

AEROVEE 2.1 TURBO

Retrofit Instructions

\$25.00

Rev. I 06/30/2023 Applies to turbo kits supplied for fitting to pre-assembled Aerovee 2.1 engines



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

AeroConVersions

A Product Line of Sonex LLC

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Disclaimer and Limited Warranty

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

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

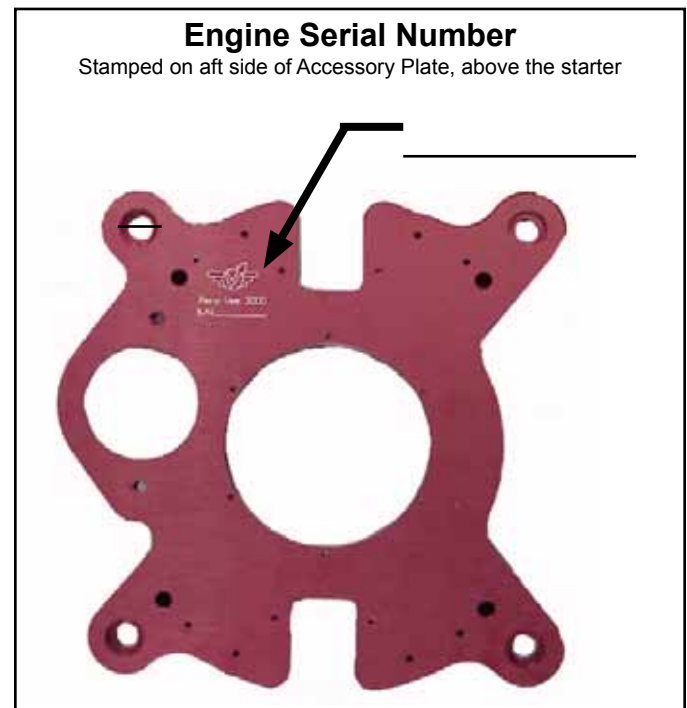
Keep Your Packing Lists

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.

Copies of (most) packing lists are archived by Sonex 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

AeroConversions Tech Support

AeroVee owners can receive individual tech support through the Sonex website: www.sonexaircraft.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 issue 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.*

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Additional Resources

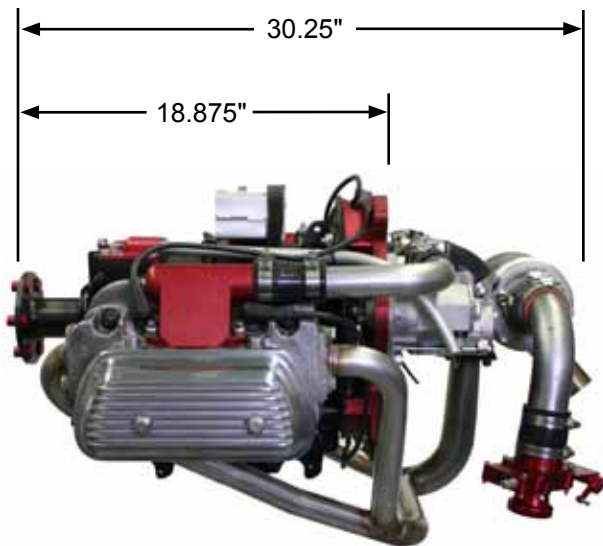
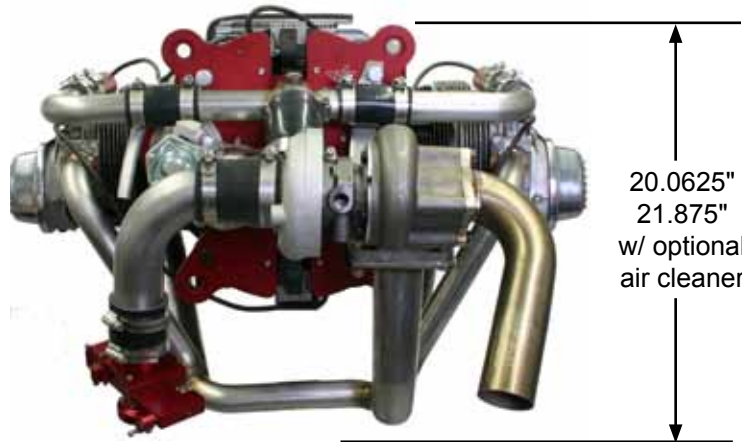
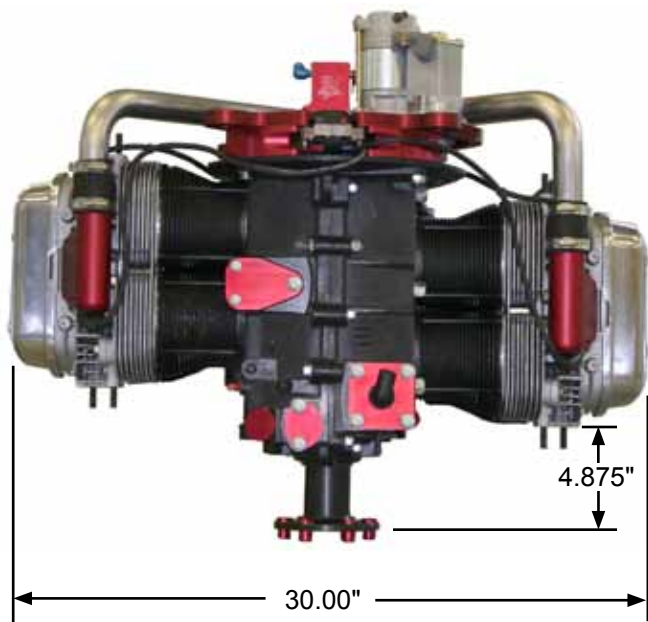
There are many books, magazines, and videos available for the assembly, maintenance, and operation of "Type 1"-based engines. We highly recommend "How to Rebuild Your Volkswagen Air-Cooled Engine" by Tom Wilson (ISBN 978-0-89586-225-9).

AeroVee 2.1 Turbo Retrofit

SPECIFICATIONS

Weights and Dimensions:

Weight (Less Oil and Exhaust):	
with Standard Pistons and Barrels.....	185 lbs.
Length.....	30.25"
Width.....	30"
Height.....	20.0625"



AeroVee 2.1 Turbo Retrofit

SPECIFICATIONS

General Specifications (Subject to change without notice)

Power and Displacement:

HP @ 3400 RPM.....	100 HP
Static RPM @ WOT (with correct propeller)	3000 RPM
Bore	92mm
Stroke	82mm
Displacement.....	2180cc
Compression Ratios (Builder configured):.....	7:1 or 8:1

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).....	18° BTDC
Ignition Module Gap (Primary Ignition).....	.010-.014"

Cooling and Lubrication:

Primary Cooling	Air
Secondary Cooling	Oil
Oil Capacity.....	3.00 US Qts.
Oil Type.....	See "Engine Oil" section for approved oils.

Fuel System:

Throttle Body	AeroInjector, ACV-C07S, 32mm
Approved Fuels:	
Aviation gasoline 91/98 minimum grade conforming to ASTM D 910.	
Automotive fuels are not recommended.	

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)	
Intake Valves008"
Exhaust Valves014"

Cylinder Identification, Engine Orientation, and Firing Order

Cylinder Identification

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

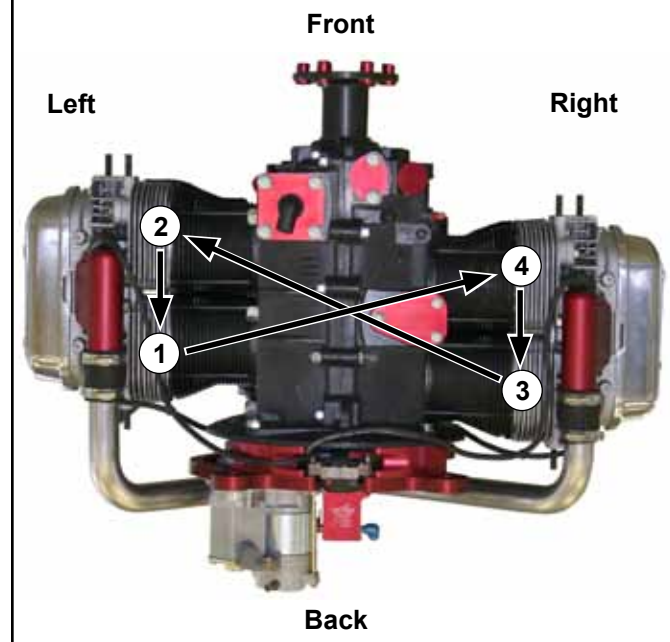
Engine Orientation

"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.

CYLINDER NUMBERING, FIRING ORDER, and ENGINE ORIENTATION



Operating Limitations (Subject to change without notice)

Idle RPM	800-900 RPM
Cruise RPM	3200 +/- 200 RPM
Maximum RPM.....	4,000 RPM
Oil Temp. - Min.	(80 degrees for take-off) 160° F
Oil Temp. - Max.	240° 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 (5 min.)	420° F
CHT Max.....	450° F
EGT Max.....	1400° F
MAP - Maximum for 2 minutes	40"
MAP - Maximum Continuous.....	35"
MAP - Minimum Take-off.....	40"
Post Flight Turbo Cool-Down	3 minutes at idle RPM



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

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 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.

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.

Important: The AeroVee engine has been sold in various kit forms since 2000. In addition to the numerous engine upgrades released by AeroConversions, builder's have made their own modifications; some small, some large.

These instructions are written for an AeroVee 2.1 engine than has been assembled correctly from AeroConversions'-provided parts. AeroConversions provide no installation support for engines that have been modified.

Your particular engine may also need additional items not included in Turbo Upgrade package. Some of these may need to be purchased from AeroConversions, others may need to be sourced from 3rd party suppliers referenced in the manual.

Preparing Your Engine

At the most basic level, your engine will need the following steps performed before you can begin the retrofit. Your particular engine / engine installation may require additional preparation work, as determined by each individual builder,

- ___ 1. Disconnect the battery
- ___ 2. Turn off the aircraft's fuel shut-off valve.
- ___ 3. Drain the oil.
- ___ 4. Remove the oil pump
- ___ 5. Remove the exhaust system
- ___ 6. Remove any oil cooler installation EXCEPT an AeroConversions' top-mounted oil cooler system.
- ___ 7. Remove the oil cooler bypass plate, if fitted.
- ___ 8. Remove the intake manifold, leaving the intake elbows in place.
- ___ 9. If your engine is equipped with Nikasil cylinders they must be replaced with steel cylinders.

Also of Special Note

The timing of the secondary ignition must be changed when the turbo is fitted The new timing is detailed in this manual.

The valve settings must be changed when the turbo is fitted The new valve settings are detailed in this manual.

If your engine is fitted to a Sonex airframe and you are fitting the top-mounted cooler as part of the turbo upgrade, the aft fence baffle needs to be modified to allow accommodate the top-mounted cooler. That modification is shown in this manual.

AeroVee 2.1 Turbo Retrofit

Parts Required:

- ___ Dual Oil Pump, ACV-T05-47
- ___ ACV-T05-69, M8x1.25 x 50mm Socket Cap Screws, (Qty. 4)
- ___ White Lithium Grease

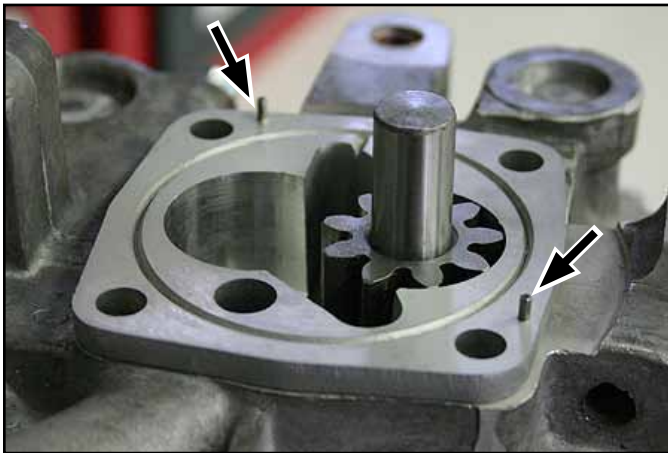
Assembly Instructions

Important: Disassemble the oil pump carefully and deliberately, paying close attention to the orientation and location of each component.

Be particularly watchful for the two small alignment pins between the two pump halves, as they can drop out.

Note: All photos were taken with the flywheel end on the workbench and the prop hub pointing up.

- ___1. Install the oil pump gasket, lightly coated with motor oil, under the oil pump housing and align pump housing with oil galley ports in the case.



The pump body is installed in the case. Pay particular attention to the two small alignment pins (identified here with arrows)

- ___2. Tap oil pump housing into place with a plastic mallet.
- ___3. Liberally grease both of the pump's gears.

- ___4. Place the secondary pump gasket, lightly coated with motor oil, on the pump.



- ___5. Make sure the two alignment pins are installed on the pump body.

DUAL OIL PUMP INSTALLATION

- ___6. Install the secondary pump. Make sure the lug of the driven gear engages the slot in the cam.

Note: Any "alignment" marks on the pump gears can be ignored.



- ___7. Confirm that the gears are liberally coated with lithium grease.

- ___8. Place the cover gasket, lightly coated with motor oil, on the secondary pump and secure the pump cover with the four mount bolts torqued to 14 ft-lbs.



Tools Required:

- ___ Feeler Gauges
- ___ 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).
- ___ 2. Insert a .008" feeler gauge between the INTAKE valve's adjusting screw and the valve.
- ___ 3. Adjust the screw until the 0.008" 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 .008 feeler gauge.
- ___ 6. Insert a .014" feeler gauge between the EXHAUST valve's adjusting screw and the valve.
- ___ 7. Adjust the screw until the 0.014" feeler gauge moves smoothly between the valve and the swivel foot.



Here an exhaust valve is being adjusted to .014".

- ___ 8. Lock the adjustment screw in place by torquing the locking nut to 14 foot pounds.
- ___ 9. Recheck the valve setting with the .014 feeler gauge.
- ___ 10. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #4, following steps 2 through 9.
- ___ 11. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #3, following steps 2 through 9.
- ___ 12. Rotate the crankshaft 180 degrees and adjust the valves of cylinder #2, following steps 2 through 9.
- ___ 13. Install the valve covers using the valve cover 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.

Assembly Instructions

The turbo installation requires the oil temperature sender to be located in the block-off plate at the front of the engine. If your engine already has the temperature sender in this location you can skip this section.

- ___ 1. Remove the Oil Temperature block-off plate.
- ___ 2. Drill and tap a hole in the center of the Oil Temperature Plate to accept the oil temperature sender. If you are using the optional temperature sender offered by Sonex you will drill a 1/2" diameter hole and tap it with a M14x1.5 tap.
- ___ 3. Re-install the temperature plate using anew gasket from the gasket kit.
- ___ 4. Install the oil temperature probe in the plate.



This oil temperature plate has been drilled for, and fitted with, an oil temperature probe. It is located on the front of the engine, below cylinder #2.

AeroVee 2.1 Turbo Retrofit

The turbo installation requires the use of the Mini Sump. If your engine already has the Mini Sump installed you can skip this section.

Parts Required:


- ___ ACV-P06-75, Mini Sump with Filter
- ___ ACV-Z01-22, 6mm Elastic Stop Nut (Qty. 6)
- ___ ACV-Z01-83, 1/4 NPT Brass Pipe Plug (Qty. 1)

Service Parts to Keep on Hand:

- ___ ACV-P01-54, Oil Change Gaskets

Assembly Instructions:

Note: Refer to the exploded photo and the instructions included with the Mini Sump (and reproduced on this page) while installing the mini sump. The following additional notes will assist you with the installation.

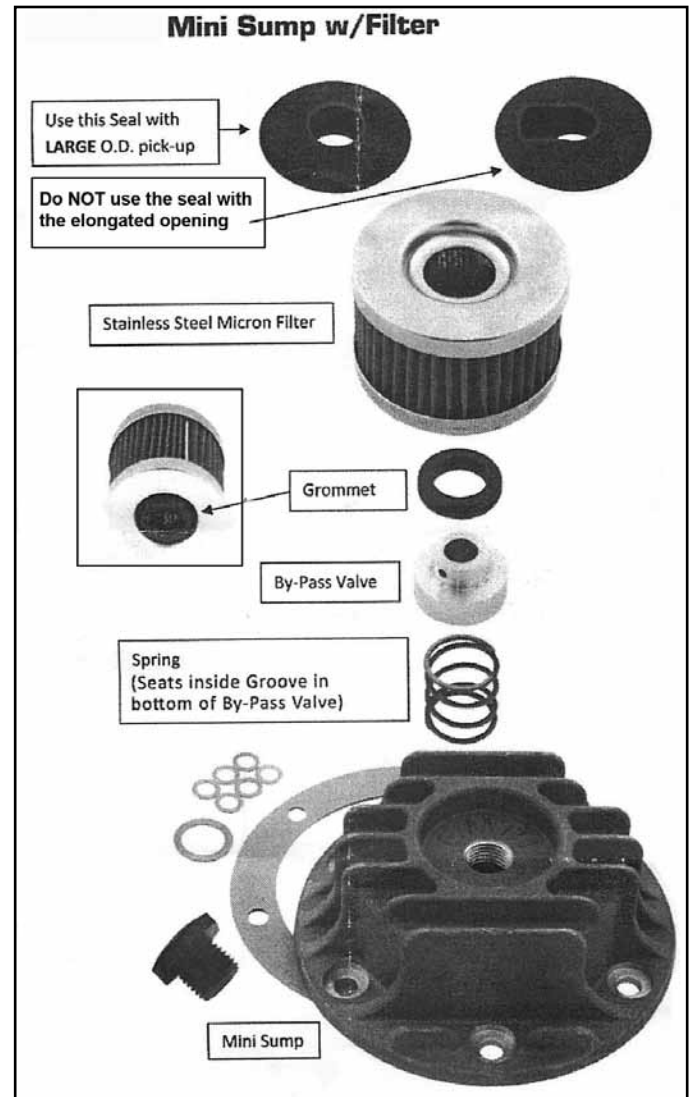
- ___ 1. Use the pick-up tube seal from the mini-sump kit that has the large hole. The curved surface goes toward the pick-up tube.

- ___ 2. Position the spring, filter and bypass valve in the sump housing and install them in the engine as a single unit.
- ___ 3. Install the sump housing with the oil return hole oriented on the *left* side of the engine. See photo below.



This installation has a return line from an oil separator. If this port is unused it must be plugged with a 1/4 NPT pipe plug.

- ___ 4. Secure the mini sump with the (six) copper washers and ACV-Z01-22 elastic stop nuts torqued to 60 in-lbs.

MINI SUMP INSTALLATION



- ___ 5. Install the drain plug and metal/copper plug washer. DO NOT install an oil temperature sender in the oil drain hole of the mini-sump.
- ___ 6. If you will NOT be using a return oil line from an oil separator, install the 1/4 NPT pipe plug in the side port of the mini sump.

Servicing Instructions:

The reusable filter of the mini sump must be cleaned with each oil change and new gasket fitted.

Oil Change Gasket kits, which include the large paper gasket and all necessary copper gaskets, are available from Sonex Aircraft (part number ACV-P01-54).

AeroVee 2.1 Turbo Retrofit

The turbo installation requires the use of the top-mounted oil cooler. If your engine already has this cooler installed you can skip this section.

Parts Required

The following items are all included as part of Sonex Aircraft part number ACV-P01-106:

- ___ Oil Cooler Mount Plate
- ___ 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

Required, 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.



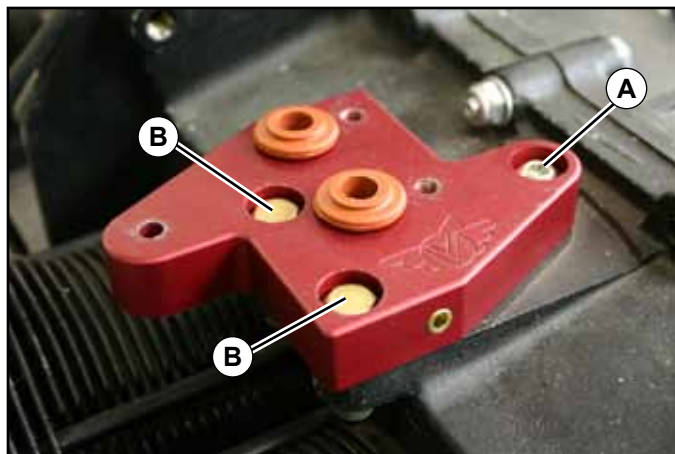
The arrow in this photo shows one of the seals before it is installed in its port.



This photo shows both seals installed in the ports.

OIL COOLER, TOP MOUNT

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.

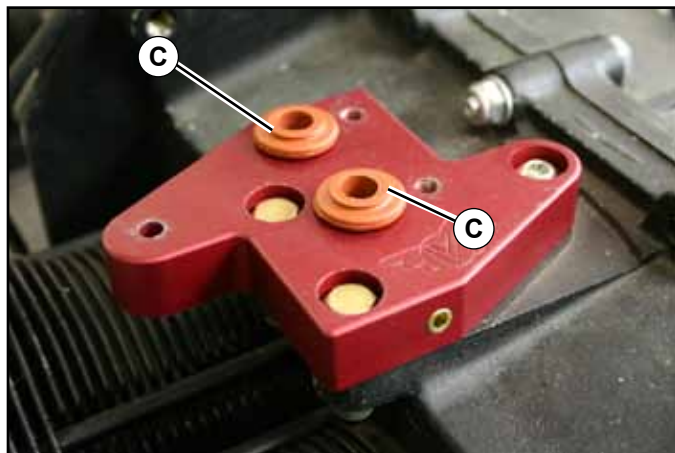


The Oil Cooler Mount Plate is attached with the following hardware:

*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.

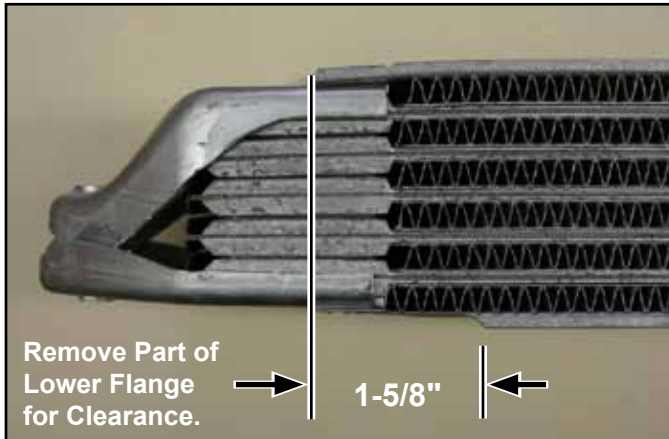


The short (thin) flanged oil seals installed in the Top Plate's oil ports (C).

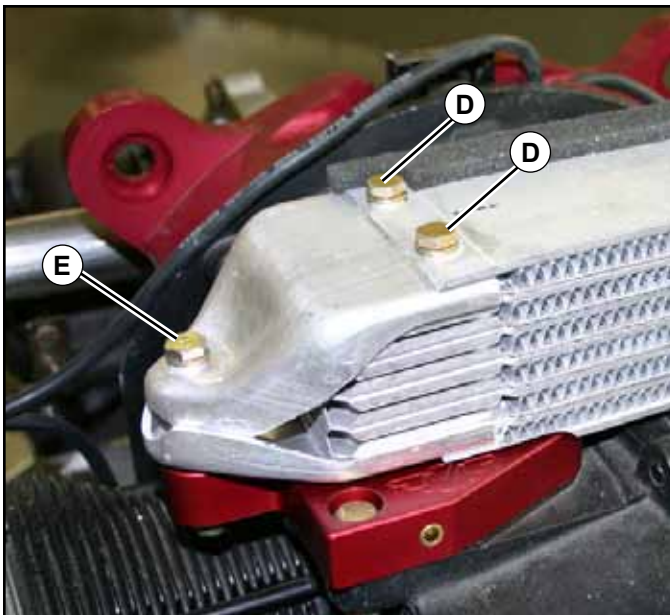
AeroVee 2.1 Turbo Retrofit

OIL COOLER, TOP MOUNT

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.

Parts Required

- ___ Turbo Exhaust Manifold (ACV-T05-20)
- ___ Exhaust Gaskets (included in ACV-P02-15)
Gasket Kit). Available separately as p/n ACV-P01-73.
- ___ ACV-Z01-39 Exhaust Mount Bolts (Qty. 8)

Installing the Exhaust Manifold

Note: If your cylinder heads have exhaust studs installed they must be removed to fit the turbo exhaust manifold.



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.

- ___ 1. Using the supplied Exhaust Attach Bolts (ACV-Z01-39), attach the exhaust manifold with an exhaust gasket at each exhaust port.

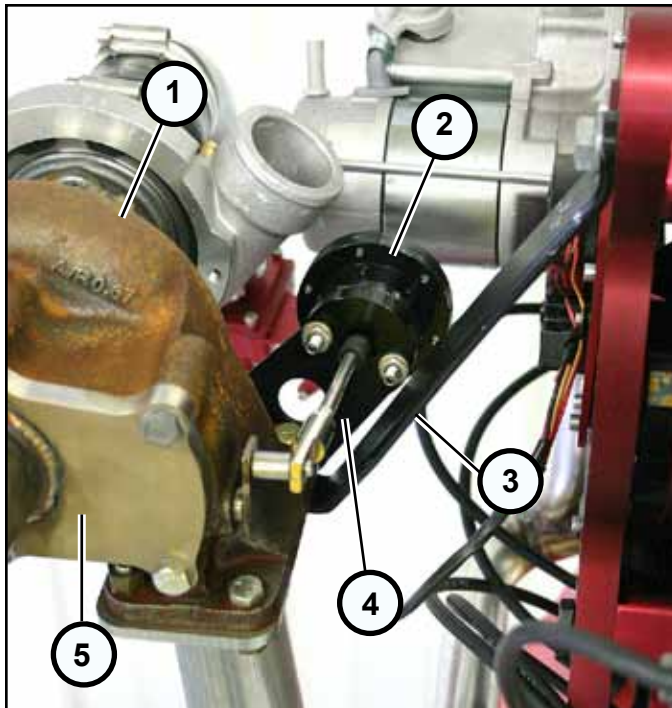


AeroVee 2.1 Turbo Retrofit

INSTALLING the TURBO

Parts Required

- ___ Turbo Support Bracket (ACV-T05-39)
- ___ Waste Gate Actuator Mount (ACV-T05-36)
- ___ Turbo 4-Hole Gasket (ACV-T05-38)
- ___ Waste Gate Actuator (ACV-T05-41)
- ___ Turbo Body (ACV-T05-40)
- ___ Turbo Top Exhaust (As provided in your kit)
- ___ 5-Hole Gasket (ACV-T05-37)
- ___ ACV-T05-42, Turbo Shroud
- ___ ACV-T05-43, Shroud Clip
- ___ ACV-Z01-89, Spring
- ___ 6000-4, Actuator Balance Line (1/4" I.D.)
- ___ 6504, Hose Clamp, Small, (Qty. 2)
- ___ ACV-T05-60, 3/8-16 x 1-1/4" Bolt, (Qty. 3)
- ___ ACV-T05-61, 3/8-16 x 1-1/2" Bolt, (Qty. 1)
- ___ ACV-T05-62, 3/8-16 Nut with Star Washer (Qty. 4)
- ___ ACV-T05-50, Waste Gate Mounting Nuts (M6 x 1), (Qty. 2)
- ___ ACV-T05-51, External Tooth Lock Washers (M6), (Qty. 2)
- ___ ACV-T05-40-01, External Retaining Ring, (Qty. 1)
- ___ ACV-Z01-39, Exhaust Attach Screws, (Qty. 5)



The major components installed in this section include:

1. Turbo Body
 2. Waste Gate Actuator
 3. Turbo Support Bracket
 4. Waste Gate Actuator Mount Bracket
 5. Top Exhaust
- (Not Shown) Turbo Shroud

Clocking the Turbo

The turbo must be "clocked" so the oil drain port and the compressed air discharge are properly positioned. **The oil drain port must be parallel to the ground when the aircraft is resting on its tires.**

Exhaust Side

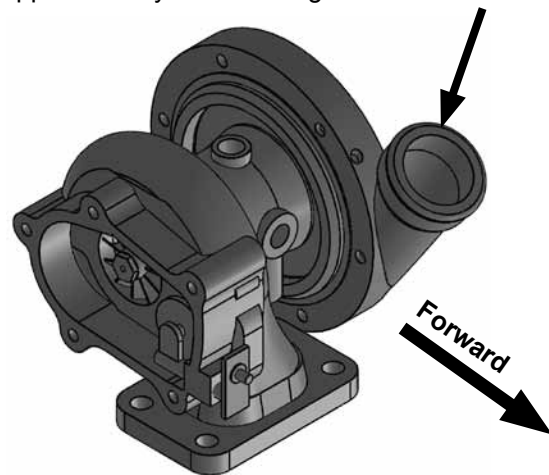
Loosen (do not remove) the four (4) bolts that hold the compressor housing to the bearing block. Retighten the bolts after completing the adjustments.

Intake Side:

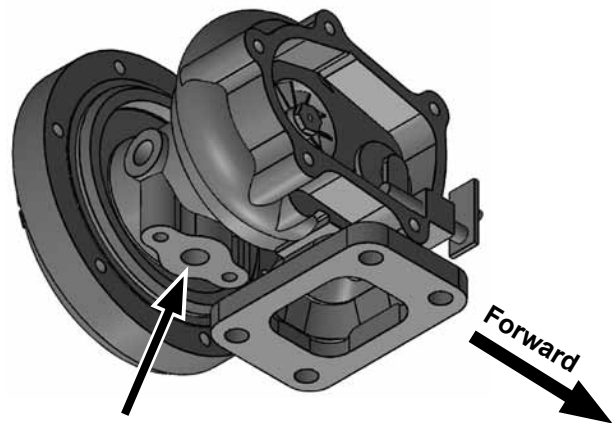
A large snap ring holds the compressor housing to the bearing block. The compressor housing may rotate by hand (it will be tight). If not, use a large snap ring pliers to take some tension off the snap ring. **Do not remove the snap ring.**

Top View Looking Aft

The **Compressed Air Discharge** must face "forward" approximately 40 to 45 degrees from vertical.



Bottom View Looking Forward



The **oil drain port must** be parallel to the ground when the aircraft is resting on its tires.

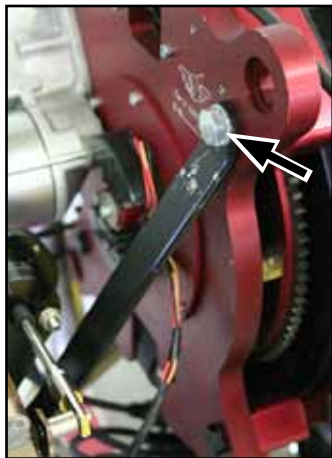
AeroVee 2.1 Turbo Retrofit

INSTALLING the TURBO

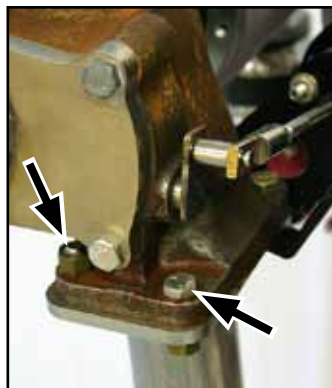
Assembly Instructions

Note: The turbo charger body is cast iron and will oxidize.

- ___ 1. Attach the Turbo Support Bracket to the back of the Accessory Plate with the existing Accessory Plate attach bolt. You may wish to leave this bolt slightly loose until the other components are in place.
- ___ 2. Place the Turbo 4-Hole Gasket on the exhaust manifold.



- ___ 3. Position the Turbo Body on the exhaust manifold and secure it with an ACV-T05-60 Bolt and ACV-T05-62 Nut through ONLY the two outboard mounting holes. Leave these bolts slightly loose until the other components are in place.



- ___ 4. Position the Waste Gate Actuator Mount *under* the exhaust manifold and secure it with an ACV-T05-60 Bolt and ACV-T05-62 Nut through ONLY the aft, inboard mounting hole. Leave this bolt slightly loose until the other components are in place.



- ___ 5. Position the lower end of the Turbo Support Bracket *under* the Waste Gate Actuator Mount and secure it with the ACV-T05-61 Bolt and an ACV-T05-62 Nut.



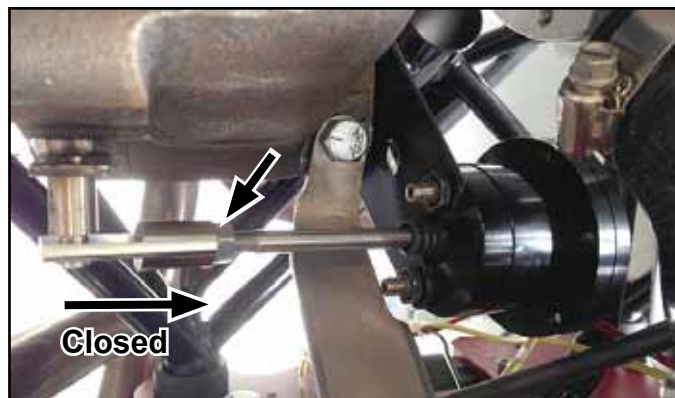
- ___ 6. Tighten all of the hardware.

- ___ 7. Attach the Waste Gate Actuator to the bracket with two ACV-T05-51 Lock washers and ACV-T05-50 Nuts.

Note: The actuator's hose nipple must point down.



- ___ 8. Adjust the actuator's pushrod (see photo, below) so it holds the wastegate in the closed position, but also has no end play. Do not allow any "preload" on the actuator.



The locknut on the actuator arm (arrow) locks the pushrod's length. Once the length is set a retaining ring is installed to hold the pushrod on the waste gate lever (See next page).

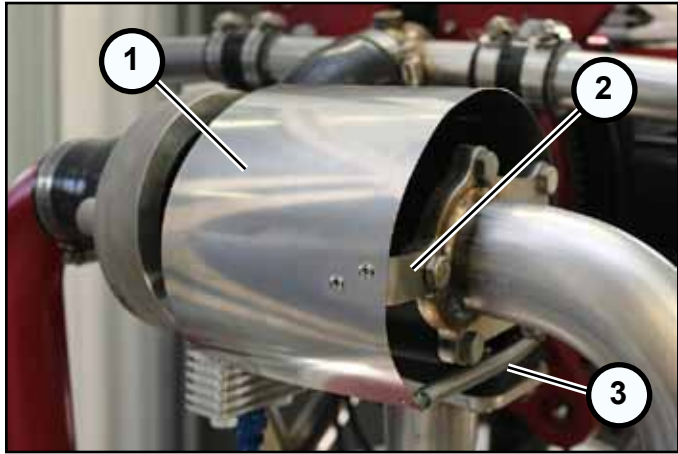
- ___ 9. Bolt the Turbo Top Exhaust to the turbo body using ACV-Z01-39 Bolts. Make sure you install the 5-Hole Gasket, ACV-T05-37, between the turbo body and the exhaust plate.

Note: The aft bolt (identified by the arrow in the photo, right) should be left out until the Turbo Shroud is installed in step 12.



AeroVee 2.1 Turbo Retrofit

- __10. Form the turbo shroud into an open cylinder. This is easily accomplished by hand using the edge of a worktable.



A completed Turbo Shield installation is shown here.

1. Hand-formed shield (ACV-T05-42)
2. Mounting tab (ACV-T05-43) riveted in place
3. Mounting spring (one on each end) (ACV-Z01-89)

- __11. Bend the turbo shroud mounting tab 90-degrees and rivet it to the shroud.
- __12. Secure the turbo shroud to the turbo exhaust with the remaining ACV-Z01-39 bolt.
- __13. Install the two springs, one on each end of the shroud. Holes are provided in the shroud for attaching the springs.
- __14. Secure the actuator's arm to the waste gate lever with the ACV-T05-40-01 Retaining Ring.



Turbo Shield mounting tab and spring(s).



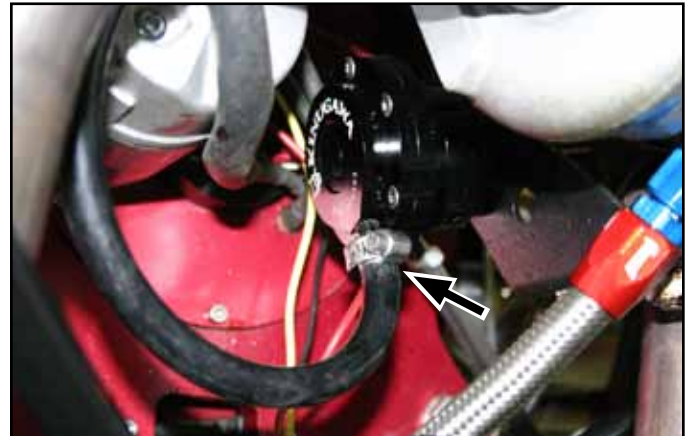
Secure the actuator arm with the snap ring provided.

INSTALLING the TURBO BODY

- __15. Secure the Actuator Air Balance Line (p/n 6000-4) to the nipple in the bottom of the Actuator and to the nipple on the turbo using small hose clamps (p/n 6504).



One end of the Actuator Air Balance line is secured to the nipple on the compressor portion of the turbo.



The other end of the Actuator Air Balance line is secured to the nipple on the bottom of the Actuator.

Parts Required

- ___ Turbo Exhaust Bottom Tube (as provided in your kit)
- ___ Exhaust Springs, Qty. 2, (ACV-E01-23)
- ___ Exhaust Wrap (ACV-T05-59)

Supplies Required (not supplied by Sonex Aircraft)

- ___ Stainless Steel Tie-wraps or hose clamps

EGT Probe Installation

If you are installing EGT probes (recommended, not provided by Sonex Aircraft), it is recommended that the holes for each probe be drilled in the exhaust manifold prior to wrapping the manifold. Sonex Aircraft suggests these guidelines for locating the probes:

- a. The probe should enter the pipe at a location that is 4" from the exhaust flange along an imaginary line through the center of the pipe.
- b. All probes should be the same distance from the exhaust flange.
- c. The hole for the probe should be drilled in a location that prevents the installed probe from contacting other items under the cowl, or being contacted by the cowl-ing.

Assembly Instructions

- ___ 1. Install the lower exhaust tube by securing it to the exhaust manifold with two ACV-E01-23 springs.
- ___ 2. Wrap the exhaust. Use stainless steel tie-wraps and/or stainless steel hose clamps to secure the exhaust wrap.



Stainless steel tie-wraps and/or hose clamps are used as needed to hold the exhaust wrap in place. The wrap can be pierced for the installation of an EGT probe. The probe's hose clamp will also help secure the exhaust wrap.

AeroVee 2.1 Turbo Retrofit

If your engine was previously fitted with a top-mounted oil cooler this section may not apply to you.

Please look at the photos and determine if your fence baffle has been fitted with a similar exit baffling for the top-mounted oil cooler. If not, complete this section.

Parts Required (provided in turbo upgrade kit)

___ ONX-P01-45 or SNB-P30-40, Upper Oil Cooler Baffle

If you do not have a fence baffle kit for your Sonex Aircraft airframe, laser-cut baffle kits are available separately. These kits include the required Upper Oil Cooler Baffle.

___ SNX-P30-10, For a Sonex, Waix, or Xenos airframe.

___ ONX-P01-10, For a Onex airframe.



These two photos show the required baffling when a top-mounted oil cooler is installed.



OIL COOLER FENCE BAFFLE

Assembly Instructions:

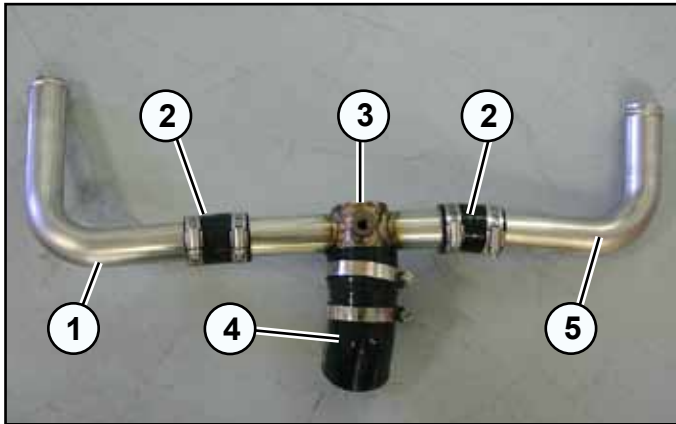
- ___ 1. Modify the aft fence baffle as needed to fit the Upper Oil Cooler Baffle.
- ___ 2. Make sure the Upper Oil Cooler Baffle is sealed against the oil cooler as well as the cowling.

AeroVee 2.1 Turbo Retrofit

INSTALLING the INTAKE MANIFOLD

Parts Required

- ___ Turbo Intake Manifold Collector (ACV-T05-10)
- ___ Turbo Right Hand Intake Manifold Tube (ACV-T05-11)
- ___ Turbo Left Hand Intake Manifold Tube (ACV-T05-12)
- ___ Straight Silicone Coupler, Qty. 4 (ACV-M01-21)
- ___ 45-Degree Silicone Elbow, Qty. 1 (ACV-M01-22)
- ___ Hose Clamps, Qty. 8 (ACV-Z01-10)



The components of the intake manifold assembly (as viewed from above):

1. Turbo Left Hand Intake Manifold Tube
2. Straight Coupler
3. Turbo Intake Manifold Collector
4. 45-degree Elbow
5. Turbo Right Hand Intake Manifold Tube

Assembly Instructions:

- ___ 1. Trim 1.125" (28mm) of *each* end of the 45-degree silicone elbow.
- ___ 2. Remove any debris that may be in the intake tubes and couplers.
- ___ 3. Assemble the manifold as shown in the photo above. The tubes will generally butt in the center of each coupler.
 - a. Keep the hose clamps somewhat loose until the manifold is fitted to the engine.
 - b. Position the tightening screws of each clamp for easy access after installation.
 - c. Trim the tail of each hose clamp if desired.

Installation Instructions:

- ___ 1. Slide a straight silicone coupler on to each intake elbow and secure them with a hose clamp.



- ___ 2. Slide the LEFT intake tube into the silicone reducer already installed on the left intake elbow.
- ___ 3. Slide the Right intake tube into the silicone reducer already installed on the right intake elbow.
- ___ 4. Slide the silicone elbow onto the turbo unit.
- ___ 5. Adjust the tubes and couplers as needed.
- ___ 6. Position and tighten the hose clamps.



These images show the intake manifold installed.



Parts Required

- ___ Elbow, 1/8 NPT to 1/4 Hose Barb, AN842-4D, (Qty. 1)
- ___ Clear Pulse Line, 05-01063
- ___ Small Hose Clamp, 6504, (Qty. 2)



The manifold pressure line is a simple connection at the top of the Turbo Intake Manifold. The opposite end of the tube (not shown) connects to your manifold pressure gauge.

Installation Instructions

Important. Do not use teflon tape on this installation as it may impede air flow. Use teflon paste.

- ___ 1. Install the 1/8 NPT Elbow in the port in the turbo intake manifold.
- ___ 2. Attach the hose to the elbow and secure it with a hose clamp.
- ___ 3. Route the hose as needed for attachment to your manifold pressure gauge.

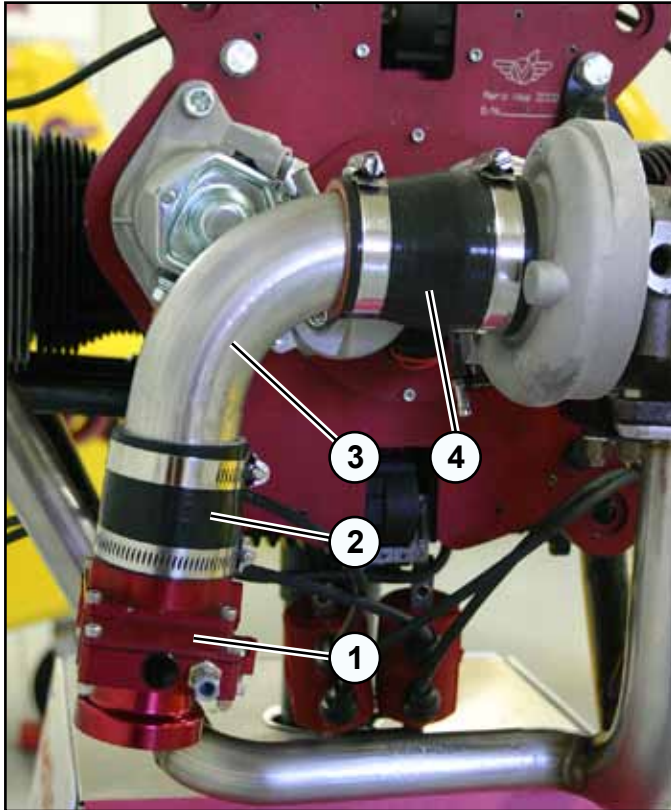
AeroVee 2.1 Turbo Retrofit

Parts Required

- ___ Turbo Intake Tube (ACV-T05-16 or ACV-T05-17)
- ___ Silicone Reducer, Qty. 1, (ACV-M01-23)
- ___ Silicone Reducer, Qty. 1, (ACV-M01-24)
- ___ Hose Clamp, ACV-Z01-10-68 (Qty. 4)

Installation Instructions:

Note: Rotate the tube and AeroInjector as necessary to eliminate interference with other engine, motormount, and firewall-mounted components.



The components of the AeroInjector intake manifold:

1. AeroInjector
2. Silicone Reducer (ACV-M01-24)
3. Down Tube
4. Silicone Reducer (ACV-M01-23)

INSTALLING the AEROINJECTOR

Note: Rotate each hose clamp for easy access to the tightening screw.

- ___ 1. Secure the ACV-M01-23 Reducer to the intake port of the turbo body with a hose clamp.
- ___ 2. Secure the Intake Tube to the Reducer with a hose clamp.
- ___ 3. Secure the ACV-M01-24 Reducer to the Intake Tube a hose clamp.
- ___ 4. Secure the AeroInjector's the Reducer with a hose clamp.

Refer to the AeroInjector's Owner's Manual, provided with the AeroInjector, for additional AeroInjector-specific installation instructions.

AeroVee 2.1 Turbo Retrofit

Parts Required

- ___ Coupling Nut, AN818-6D, (Qty. 2)
- ___ Coupling Sleeve, AN819-6D (Qty. 2)
- ___ Elbow, 90-degree, 1/4 NPT to 37-degree Flare, AN822-6D, Qty. 1
- ___ Aluminum Tubing, 3/8 OD x .035 3003-O, approx. 24"
- ___ ACV-T05-44, -6 AN Flare to 16mm x 1.5 Fitting Adapter, Qty. 1
- ___ ACV-T05-45, Crush Washer, Qty. 1

Installation Instructions:

Important. Never use teflon tape on any oil system connection as it may block oil flow. Use teflon paste on all NPT pipe threads. No paste should be used on the threads of a flared tubing connector.

- ___ 1. **IMPORTANT: If you are performing this step on an assembled engine care must be taken to prevent debris from entering the crankcase.**

Drill and tap a 1/4 NPT hole centered approximately 1.5" below the oil filler port. The 90-elbow will be installed in this hole in step 2. See photo below.



Oil line from the right port of the secondary oil pump to a hole tapped in the engine case approximately 1.5" below the oil fill cap.

OIL LINE: PUMP to CASE

- ___ 2. Install the 90-degree elbow / flare fitting in the engine case.
- ___ 3. Install the ACV-T05-44 -6 AN to 16mm Fitting Adapter with an ACV-T05-45 Crush Washer in the right hand port of the Secondary Oil Pump.



- ___ 4. Place a Coupling Nut and Coupling Sleeve one end of the aluminum tube and flare that end of the tube with a 37-degree flaring tool. This end be attached to the oil pump.
- ___ 5. Form the tubing so it is routed near the case and as directly as possible to the 90-degree elbow. When the cooling baffles are installed this tube will need to pass through a hole in the baffle and be protected by a grommet.
- ___ 6. Place a Coupling Nut and Coupling Sleeve on the free end of the aluminum tube.
- ___ 7. Confirm the tube is correctly formed and trimmed and flare the end of the tube with a 37-degree flaring tool.
- ___ 8. Secure the tube assembly to the 90-degree elbow on the engine.

AeroVee 2.1 Turbo Retrofit

Parts Required

- ___ Fitting, Hose End, -06 Straight, SUM-220690 (Qty. 1)
- ___ Fitting, Hose End, -06 Elbow, SUM-220687 (Qty. 1)
- ___ ACV-T05-44, -6 AN Flare to 16mm x 1.5 Fitting Adapter, (Qty. 1)
- ___ ACV-T05-45, Crush Washer, Qty. 1
- ___ Elbow, 45-Degree, 1/4 NPT to 37-Degree Flare, AN823-6D (Qty. 1)
- ___ Braided Hose, -06, SUM-230606 (Approx 26" needed)
- ___ Turbo Oil Drain Sump, (ACV-T05-48)
- ___ ACV-Z01-42 Bolts, 8-1.25 x 70mm, (Qty. 2)
- ___ ACV-Z01-26 Washers, M8, (Qty. 2)

Installation Instructions:

Important. Never use teflon tape on any oil system connection as it may block oil flow. Use teflon paste on all NPT pipe threads. No paste should be used on the threads of a flared tubing connector.

- ___ 1. Apply Red High-Temp RTV to the mating surface of the Oil Drain Sump and bolt it to the underside of the turbo body with ACV-Z01-42 bolts and ACV-Z01-26 washers.
- ___ 2. Install a straight or a 45-Degree 1/4 NPT to Flare Elbow in the port in the Oil Drain Sump.



The oil drain sump is bolted (1) to the bottom of the turbo body. A 1/4 NPT to -06 hose fitting (2) is installed in the drain. The fitting may be straight or a 45-degree elbow.

- ___ 3. Install the ACV-T05-44, -6 AN to 16mm Fitting Adapter, with a crush washer in the left hand port of the Secondary Oil Pump.



OIL LINE: TURBO DRAIN to PUMP

- ___ 4. Attach the straight hose end fitting to a 30" (approx.) length of -06 hose.
- ___ 5. Loosely attach the hose to the fitting in the oil drain sump.
- ___ 6. Determine the best hose routing to the secondary oil pump. The accompanying photo (below) shows the line routed along the lower, left side of the oil sump and secured to the engine case.
- ___ 7. Trim the hose as needed.
- ___ 8. Attach the 90-Degree Hose End Fitting to the -06 hose.



The oil line secured under the engine case. The oil line runs from the bottom of the Turbo Oil Drain Sump to the left port of the secondary oil pump (right photo).

- ___ 9. Install the hose assembly on the engine.
- ___ 10. Secure the hose as needed to prevent movement and chafing.

AeroVee 2.1 Turbo Retrofit

Parts Required (Supplied)

- ___ 1/8 NPT Brass Street Fitting, 16775NOS, (Qty. 1)
- ___ Nipple, 1/8 NPT to -4 Flare, AN816-4D (Qty. 1)
- ___ Coupling Nut ("B" Nut), AN818-4D (Qty. 2)
- ___ Coupling Sleeve, AN819-4D (Qty. 2)
- ___ Bulkhead Fitting, -4 Flare, AN832-4D, (Qty. 1)
- ___ Nut for Bulkhead Fitting, AN924-4D, (Qty. 1)
- ___ 1/2-20 to -AN4 Adapter, 592047ERL, (Qty. 1)
- ___ 3003-O Aluminum Tubing, 1/4" OD x .032 Wall, (1 Foot)
- ___ 45-degree -4 AN Hose to Female -4 AN (610080) (Qty. 1)
- ___ Straight Adapter, -4 AN Male to 1/4 NPT Male (SUM-220447) (Qty. 2)
- ___ Straight Hose End Fitting, -4 AN Hose to Female -4 AN (SUM-220490) (Qty. 3)
- ___ -4 Braided Hose, (SUM-230436) (Qty. 6 feet)

Parts Required (Not Supplied)

- ___ Remote Oil Filter Mount Bracket, Derafe 25044, available from Summit Racing, JEGS, etc.
- ___ Oil Filter, FRAM PH8172 or equivalent.
- ___ Hardware to mount oil filter bracket (determined on installation)

Installation Overview

Important. The installation of the oil line must be done after the cooling fence baffle has been installed.



This overview photo shows the items installed in steps 1 through 11 of this section. These items are all forward of the flange on the back of the engine case.

OIL LINE: SUPPLY LINE to TURBO

Installation Instructions

Important. Never use teflon tape on any oil system connection as it may block oil flow. Use teflon paste on all NPT pipe threads. No paste should be used on the threads of a flared tubing connector.

- ___ 1. Install the 1/8 NPT Brass Street Fitting in the oil port on the upper, right-hand side of the engine block. **Do not over-tighten this fitting as the tapered thread can crack the engine case.** The tapered thread does the sealing, not excessive tightening of the fitting.



- ___ 2. Install the 1/8 NPT to -4 Nipple in the street fitting.
- ___ 3. Drill a 1/2" diameter hole through the baffle *and* the rear flange of the engine case for the bulkhead fitting.



The bulkhead fitting installed through the engine case flange (fence baffle not shown in this photo).

- ___ 4. Install the bulkhead fitting.
- ___ 5. Place a Coupling Nut and Coupling Sleeve one end of the aluminum tube and flare that end of the tube with a 37-degree flaring tool.
- ___ 6. Temporarily install the tube on the bulkhead fitting (see photos).



Looking down on the bulkhead fitting installed through the engine case flange and rear fence baffle.

AeroVee 2.1 Turbo Retrofit

- ___ 7. Route the tubing forward to nipple and trim it to length, allowing material for flaring. If you leave the tube slightly long the extra length can be taken up with gentle bends in the pipe.
- ___ 8. Place a Coupling Nut and Coupling Sleeve on the free end of the aluminum pipe.
- ___ 9. Confirm the tube is correctly formed and trimmed and flare the end of the tube with a 37-degree flaring tool.
- ___ 10. Install the tube assembly on the nipple.
- ___ 11. Install an oil pressure sender (ACV-P01-76) in the brass street fitting. Use teflon paste on the threads.

Note: To assure a reliable signal, attach a ground wire to the body of the sender.



Oil Filter Installation

Important. Never use teflon tape on any oil system connection as it may block oil flow. Use teflon paste on all NPT pipe threads. No paste should be used on the threads of a flared tubing connector.

- ___ 1. Mount the oil filter bracket to the firewall or motor-mount.
- ___ 2. Install straight adapters (SUM-220447) in the oil filter mounting bracket.



The bulkhead fitting installed through the engine case flange (fence baffle not shown in this photo).

OIL LINE: SUPPLY LINE to TURBO

- ___ 3. Install the oil filter.

Note: The oil filter can be safety-wired by attaching a hose clamp to the filter and installing safety wire between the hose clamp and a small hole drilled in the oil filter mounting bracket.

Oil Line Installation - Oil Filter to Turbo Body

Important. Never use teflon tape on any oil system connection as it may block oil flow. Use teflon paste on all NPT pipe threads. No paste should be used on the threads of a flared tubing connector.

- ___ 1. Install the 45-degree -4 AN Hose to Female -4 AN fitting to the bulkhead fitting in the engine case flange.
- ___ 2. Install a straight adapter (592047ERL) in the oil port at the top of the turbo body. See photo below.



The oil supply port in the top of the turbo body and oil line fittings are shown here.

- ___ 3. Assemble a hose to connect the oil port in the top of the turbo (see photo above) to the "OUT" port of the oil filter mounting bracket.
- ___ 4. Attach the 45-degree -4 AN Hose to Female -4 AN elbow to the bulkhead fitting in the flange of the engine case.
- ___ 5. Assemble a hose to connect the 45-degree elbow installed in step 4, above (see photo, right) to the "IN" port of the oil filter mounting bracket.



Parts Required

___ 4 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)

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

Approved break-in oils are:

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 are incompatible with 100LL fuel and must not be used.

Approved post break-in oils are:

Brad Penn Penn-Grade 1 Racing 20w50

Priming the Engine and Setting Oil Level

The following method should be used to achieve the proper oil level for your engine:

- ___ 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.

AeroVee 2.1 Turbo Retrofit

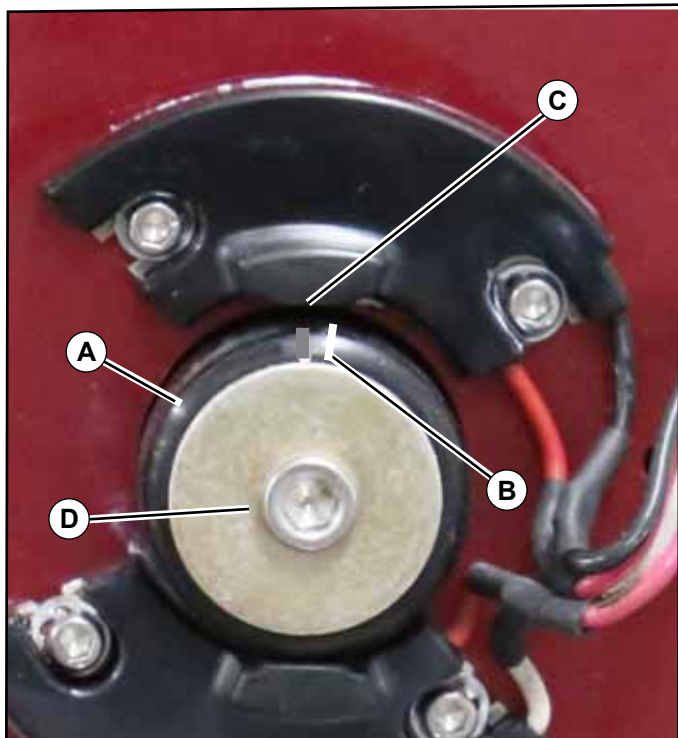
Tools Required

— 5/32" hex wrench

Timing Basics

The electronic (secondary) ignition on a turbo-equipped AeroVee is timed to 18 degrees BTDC, unlike 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).



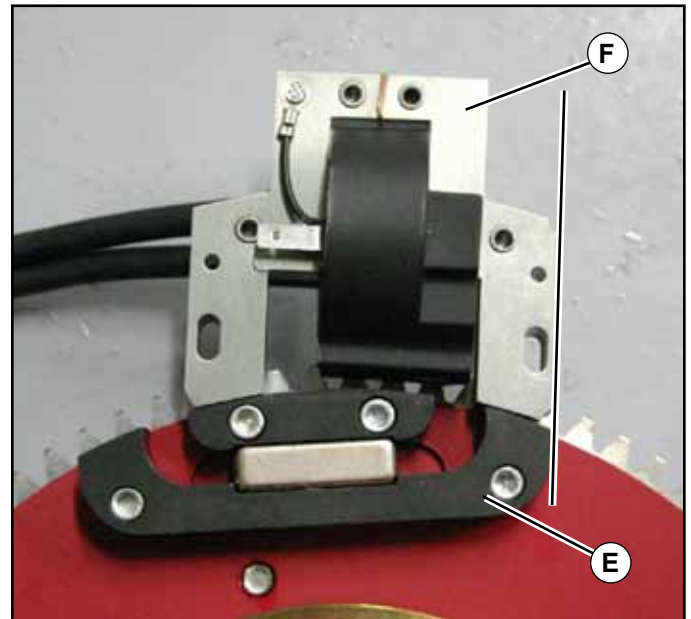
The trigger cap (A) is locked in position by a socket head cap screw (D). A mark (B) on the trigger cap corresponds with the location of the trigger magnet. When this magnet passes by a sensor (C) in the upper and lower triggers, the spark plugs fire.

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.

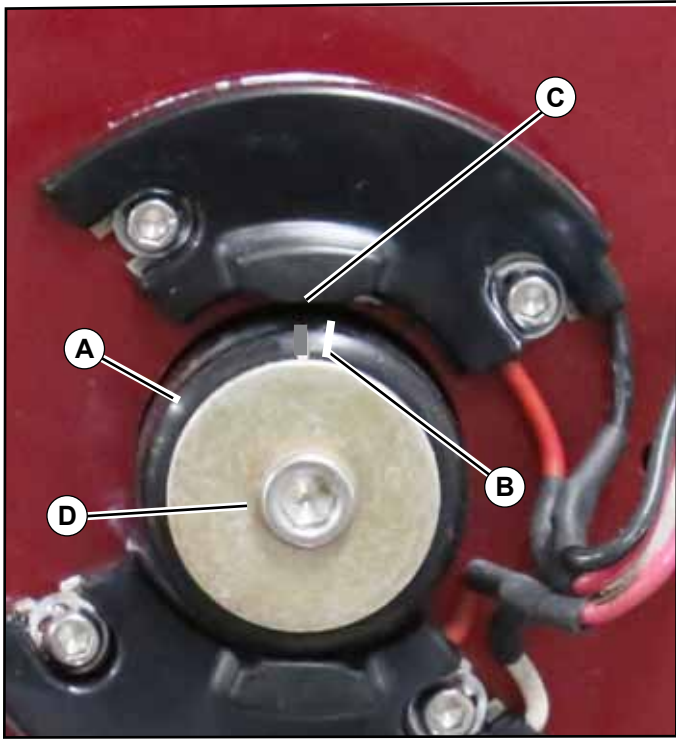


The black / white line on the right shows how the top Magnatron and magnet shoe on the flywheel align prior to setting the secondary ignition timing. For clarity these parts are shown removed from the engine.

- 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.

AeroVee 2.1 Turbo Retrofit

- ___ 4. Loosen the socket head cap screw (D) and rotate the magnet cap (A) until the mark on the magnet cap (B) is in the approximate position shown in the photo, below, relative to the sensor (C) of the upper trigger.



When the crankshaft is in the proper position (See steps 1 through 4) static timing is achieved by loosening the cap screw (D) and rotating the trigger cap (A) until the mark on the trigger cap (B) is in the approximate position shown.

- ___ 5. Tighten the socket head cap screw.

ELECTRONIC IGNITION TIMING

Timing Check

The nominal figure for proper timing of the secondary ignition is 18-degrees BTDC.

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 a slight change in RPM when the Primary (magnatron) ignition is turned off. No change will be noted when the Secondary (electronic) ignition is turned off.

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 needs adjustment. Advance or retard the secondary ignition, as needed, by turning the magnet cap slightly.

AeroVee 2.1 Turbo Retrofit

The AeroConversions' AeroVee Turbo Radiator is a self-contained turbo cooling system intended to greatly reduce or eliminate “turbo coking” and turbo seizing caused by extreme temperature soaking of the bearing block after engine shutdown.

Installation Guidelines

Each installation will need to be adapted to the particular airframe it is being installed on. These guidelines, together with the following resources, will help you achieve a functional installation. These resources can be downloaded from:

www.aeroconversions.com/support/manuals.html

- ☐ ACV-T06 Bill of Materials / Shopping List
- ☐ Drawing ACV-T06, Turbo Cooling System (Schematic)
- ☐ Drawing ACV-T06-07, Radiator Plenum Drawing

An over-view photo of that installation on a Waix airframe is included on page 68.

Radiator

Cushioned clamps (AN 742) can be used to secure the radiator to the motormount.

B-Model Airframe

Mount the radiator/fan assembly horizontally on the left side of the firewall. See photo, page 68.

Legacy Airframe

Mount the radiator/fan assembly vertically on the left side of the motor mount.

Catch Can

Mount the catch can as high as possible. The filler neck must be above the radiator.

Coolant Hoses

Route the coolant hoses in a manner that prevents trapping air.

Vent Tube

A vent tube must be installed on the barbed fitting of the catch can's filler neck. The end of the vent tube must be routed out the bottom of the cowl. The vent tube allows the release of excessive pressure from the system. When the coolant is hot avoid the vent tubes's outlet to avoid serious burns.

Water Pump

Mount the pump lower on the firewall than the radiator. It should be positioned to facilitate hose installation and minimize hose length.

TURBO COOLANT SYSTEM

Cowl Vents

Top cowl vents are highly recommended.

Two 4” dia. vents cut in the top of the cowl provide outlets for ambient and forced cooling air after shutdown. 4” diameter louvered aluminum soffit vents work well.

Switch / System Wiring

Wire the system to the “hot” side of the Master switch to allow operation when the Master switch is turned off. This is particularly important for automatic operation with the thermostat.

A 3-position switch installed in the panel allows these pump/fan operation modes:

Off - Pump and fan will not run

Automatic - The thermostat controls the operation of the pump and fan. The system turns on/off at approximately the thermostat's rated temperature

On - Pump and fan will run until the switch is manually turned off.

An indicator light wired to the switch and placed next to the switch in the panel indicates when the system is running.

Bearing Block Temperature Sender

Install a temperature sender under the thermostat to monitor the turbo bearing temperature. Unused CHT or EGT inputs on most EFIS systems will work for this purpose. Our prototype installation uses a large diameter CHT probe held in place by the thermostat.

Coolant

High-temperature waterless coolants (Evans Coolant EC10064 or equivalent) are recommended due to their high boiling point which reduces pressure in the system.

The capacity of the system is approximately 1.5 pints (24 fl. oz., .75 liters)

Filling the Coolant System

1. Add coolant until the catch can no longer accepts more coolant.
2. Leave the filler cap off and run the pump to purge air from the system.
3. Add more coolant as described in step 1.
4. Repeat steps 2 and 3 until the catch can remains full.
5. Install the filler cap.
6. Operate the pump and inspect for leaks.

Ground Testing the Installation

Perform the initial post-installation tests with the cowl removed.

IMPORTANT: Keep the CHT within limits while ground running the engine.

1. Tie down the aircraft.
2. Have someone watch for coolant leaks.
3. Run the engine until the bearing block reaches approximately 230°F or its temperature stabilizes below 230°F.
Note: Oil flow through the bearing block may prevent the temperature from getting to 230°F.
4. Turn the pump/fan switch to "On."
5. Shut down the engine.
6. Listen for both the pump and fan running. Positive operation will also be indicated by air being forced through the radiator.
7. Observe the bearing block temperature for a marked decrease in the indicated temperature of the bearing block.
8. If there are coolant leaks or the fan or pump do not operate, allow the engine to cool before investigating and correcting the problem. Repeat the test.
9. Repeat the test with the switch turned to the "Automatic" position.
10. Listen for both the pump and fan running. Operation will also be indicated by air being forced through the radiator and a marked decrease in the indicated temperature of the bearing block.
11. Confirm the fan and pump shut off automatically when the bearing block temperature falls near, or below, 160°F.
12. If the fan or pump do not operate properly, allow the engine to cool before investigating and correcting the problem. Repeat the test.

Operational Notes

The bearing block temperature is typically under 230°F while the engine is running. The purpose of the cooler is to prevent oil coking by maintaining the temperature below 250°F after shut down.

Prior to Takeoff

There is no benefit to operating the pump prior to take-off or during flight.

Always check turbo operation with a proper engine run-up prior to takeoff. **DO NOT take off if a power loss is indicated.**

Post Landing / Pre-Shut-Down Pump Operation

The pump should be switched to "On" or "Automatic" after landing or immediately before shut down.

Automatic pump/fan shut down occurs near the thermostat's rated temperature when the switch is placed to "Automatic."

Manual shut-down is required when the switch is placed to "On."

Maintain Battery Health

When possible, connect a battery maintainer after shutdown. Normally, battery drain is not significant during the automatic cool-down cycle but poor battery condition due to battery age or other factors could prevent engine restart.

AeroVee 2.1 Turbo Retrofit



AeroVee 2.1 Turbo Retrofit START-UP and BREAK IN and OPERATION

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."
- ___ 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.

If the engine does start, exhibits oil pressure and runs well enough, let it idle for 3 minutes to assure the oil system is well primed.
- ___ 4. If the engine does not start, investigate the cause (see Troubleshooting section) and repeat steps 2 and 3, above.
- ___ 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.

Operation

It is important to follow these operational notes.

Pre Take Off

Abort the take-off if the engine does not develop 40" of manifold pressure during the take-off roll.

Pre Shut Down

Allow the engine to idle for 3 minutes prior to shutting the engine off. This idle period helps cool the turbo.

See also "Operating Limitations" on page 6.

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.

Turbo Charger-specific Maintenance

The turbo charger unit requires no specific maintenance beyond the oil change interval recommended below for the AeroVee engine.

Minimum Maintenance Interval

1 Hour Accumulated

___ Change the oil and clean the oil filter.

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.....	13mm	10	120
Small Case Nuts.....	13mm	14	168
Cylinder Head Nuts.....	15mm	18	216
Rocker Arm Nuts	13mm	14	168
Prop Hub Nut	30mm	70-80.....	840-960
Flywheel Gland Nut.....	36mm	227	2724
Connecting Rod Nuts.....	14mm	30	360
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.

AeroVee 2.1 Turbo Retrofit APPENDIX A - SONEX COWL OPENINGS

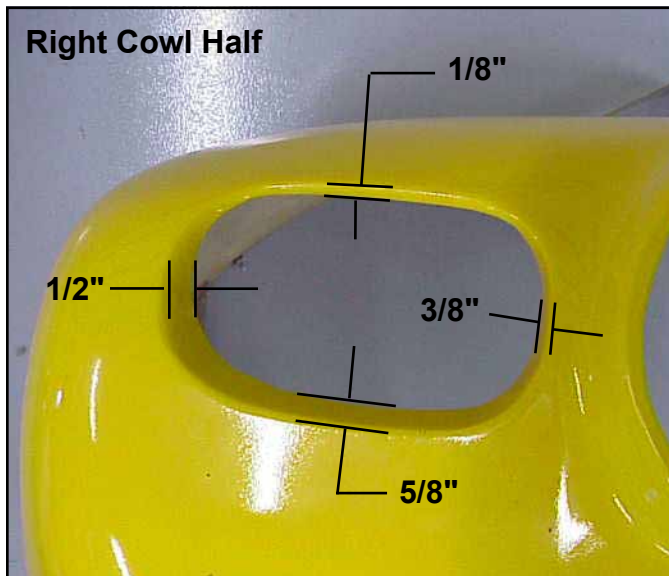
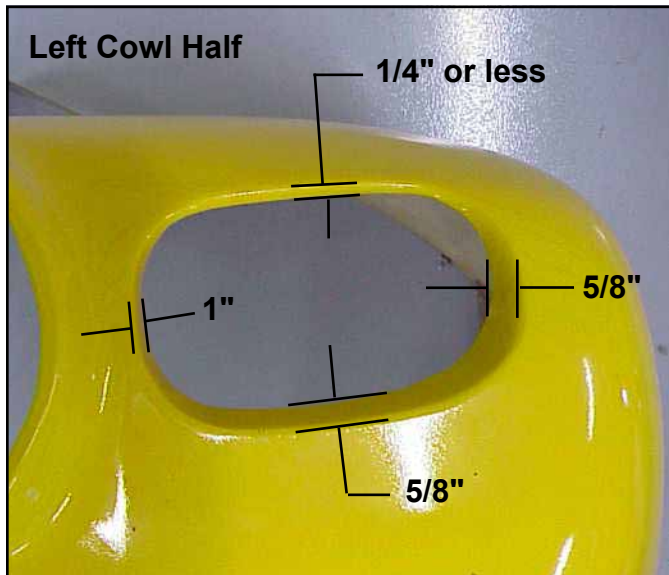
Proper cooling inlets and exhaust outlets are critical to proper engine cooling. Arbitrarily changing any of the defined openings can have a negative affect on cooling.

This Appendix details the cowling inlets and outlets of a Sonex cowl fitted to a Sonex, Waixex, 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.



AeroVee 2.1 Turbo Retrofit APPENDIX A - SONEX COWL OPENINGS

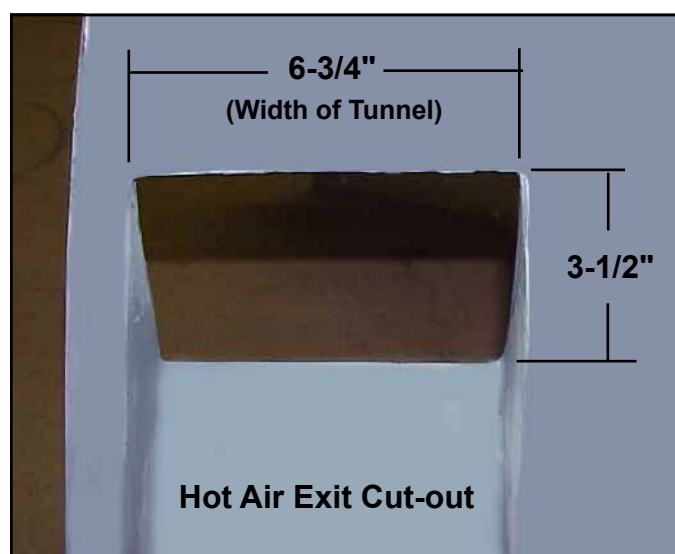
Hot Air Exit Cut-outs

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.

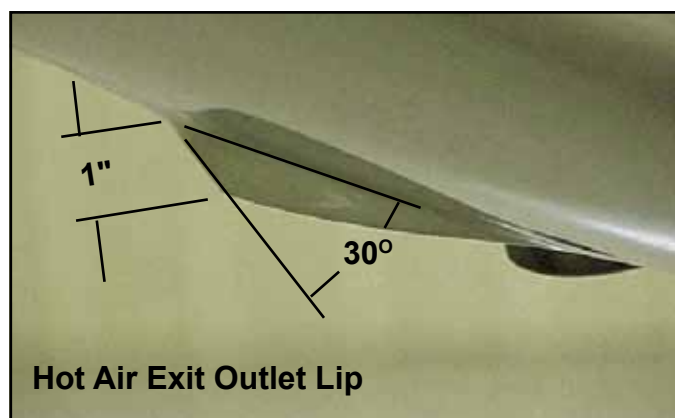
VW Cowl with Pre-molded Exhaust Tunnel

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 hot air outlet cut-out before the lips are added.



The hot air outlet 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.



This view of a completed cowl clearly shows the air deflector lips which are added to the front of the hot air exit 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 a non-turbo exhaust. A turbo installation will require a hole be cut large enough to allow the turbo exhaust to exit the cowl without contacting the cowl (see photo next page).

AeroVee 2.1 Turbo Retrofit APPENDIX A - SONEX COWL OPENINGS

Legacy Sonex Universal Cowl without Exhaust Tunnels

A 4" x 12.5" cut-out is made on the lower aft edge of the cowl-ing, where it attaches to the bottom of the firewall. This open-ing provides 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 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.



*This photo shows the hot air exit for a legacy Sonex cowl **without** pre-molded tunnels. The cut-out measures 4" x 12.5". No additional cowl outlets are needed for cooling air; however the turbo installtion requires a hole be cut large enough to allow the turbo exhaust to exit the cowl without contacting the cowl (photo below).*



This photo shows the cut-out to allow the turbo exhaust to exit the cowl without contacting the cowl. The opening can be en-circled by an aluminium or stainless steel heat sheild to protect the fiberglass cowl.

B-Model Cowl Side Vents

Note: The side vents introduced on the B-Model airframes are not intedned for use on legacy airframes.

The B-Model side vents should be positionned in accordance with the B-Model airframe plans.

Supplementing Cooling when using B-Model Side Vents

While a factory prototype has been flying succesfully with only the side vents for hot air exits, some customer aircraft have experienced insufficient cooling. There can be many reasons for individual, handbuilt aircraft to run hot and each aircraft must be diagnosed individually, however, some have benefit-ted from adding the standard cooling air outlet described in the previous column.



This B-Model Side vents should only be fitted to B-Model cowlings. They may need to be supplemented with an additio-anl exit air opening on the bottom of the cowl.

Rev. I 6/30/23

Removed tech support email address.
Added Appendix A, Sonex cowl vent details

Rev. H 12/21/22

Pages 33-35, Added Turbo Coolant System instructions, which were previously a free-standing document.
Page 3, Removed email address
Page 4, Added mention of Tech Support email form

Rev. G 03/24/22

Changed Sonex Aircraft LLC to Sonex LLC.
Updated Secondary Ignition Instructions and schematics for ACV-A01-23 triggers that require user-installed ground wire.

Rev. F 04/26/21

Page 16, Corrected Parts List Errors: (None of these changes altered the assembly or the contents of the kit):
-ACV-T05-43 Shroud Clip WAS Waste Gate Mount Nuts.
-ACV-T05-50 Waste Gate Mount Nuts WAS Actuator Mount Nuts.
-Deleted ACV-T05-72 Turbo Shroud Group Part number and replaced with individual part numbers: ACV-T05-42, Turbo Shroud; ACV-Z01-89, Spring; ACV-T05-43, Shroud Clip.
Page 18, Added Part Numbers to caption for Turbo Shroud installation.

Rev. E 04/06/21

Page 16, Added Turbo Clocking instructions.

Rev. D 06/30/17

Part number call-out corrected.
Page 27, "Oil Line Installation - Oil Filter to Turbo Body," step 2, part number SUM-220447 changed to 592047ERL.

Rev. C 12/21/16

Revised manual to include changes to reduce coking of the turbo. Specific changes include:
3 minute turbo cool-down at idle RPM added.
Added note that turbo drain must be parallel to the ground when the aircraft is resting on its tires.
Turbo blanket replaced with turbo shroud.
Added Turbo Drain Sump.
Added remote oil filter.
Added Turbo Operation notes to page 66.
Removed Valvoline VR-1, 20W50 non-synthetic as a recommended oil.

Other changes:

Timing specification for secondary ignition changed to 18 BTDC (was 10).
Removed synthetic oils as oil options.
Moved oil return line from valve cover to engine case by oil filler.

Rev. B 08/05/15

Bolts used to attach oil cooler top plate and oil cooler lengthened +1. Shorter bolts previously used are still acceptable

Rev. A 01/06/15

Changed the step sequence for installing the actuator's retaining ring and turbo blanket.

Rev. NC 11/24/14

Original Publication of AeroVee 2.1 Turbo Assembly Manual