

INSTALLING THE FAB-320/360/540 FILTERED BOX

The FAB-320/360/540 filtered air box was designed to provide an inexpensive, efficient filtered air induction system that minimizes both intake pressure loss and cowl frontal area. Testing has shown that air filtration is excellent and very little manifold pressure is lost through the filter.

The FAB-320/360/540 draws high energy ram air from outside the cowl through an intake of approximately the same area as the carburetor or fuel injection throttle body inlet. The air is then decelerated as it moves into the large filter area of the air box. This deceleration produces high-pressure turbulent airflow. The air then passes through an annular air filter. The large area of the filter helps reduce pressure losses compared to conventional flat filters. For a given flow of air, the velocity through a large filter is lower, helping reduce pressure loss in the intake. The filter not only cleans the air, it also helps filter out much of the turbulence in the airflow. In fact, our installation loses much more manifold pressure when the filter is removed than when it is installed. Some builders have even found poor engine operation (particularly with carb. equipped engines) if the air filter is not in place.

The basic FAB-320/360/540 air box is designed for use in VFR conditions only. **Vans Aircraft recommends that the FAB Bypass kit supplied with the FAB Kit, be installed so as to provide an emergency bypass system for use should any blockage of the induction air filter or flow path occur as the result of ice, bird impact, etc.**

The finished air box has two main parts. See Figure 1A for the O-320 or Figure 1B for the O-360. A flat aluminum top provides easy mounting to the carburetor or vertically oriented throttle body/servo, enables a simple alternate air gate, and allows the filter to be properly mounted. A curved fiberglass scoop at the bottom of the air box was designed to efficiently direct ram air around the filter. The flat aluminum top plate can vary on engine installation. Installations other than FAB-320-1 and FAB-360/540 will use the appropriate template for cutting out the internal cutout pattern. These templates are at the end of this document.

The FAB-320/360/540 air box must be able to accommodate numerous different airplane models and engine combinations which induces the possibility for different fuel induction methods (carburetor or fuel injection), two intake vertical positions/locations on the (I)O-320, and many cowl variations. There are so many combinations possible that a step by step installation procedure for each one is impractical. In these instructions we have tried to provide fairly detailed coverage of the most common variations and since all are very similar, these generic instructions should be able to be easily adapted to any particular installation. However, the installer should **READ ALL OF THE INSTRUCTIONS**, understand the installation **BEFORE** starting, and think ahead to integrate and adapt the different procedures to their installation. Your FAB kit will contain all the parts needed for the specific installation version you ordered (available kits listed below), but won't contain parts specific to other versions (though it may contain parts that are not needed for your installation because some kits are used for multiple installations)

Stock code	Description
FAB-320-1	FILTRD AIR BOX O-320
FAB-360/540	FLTRD A/BOX-360 FI320

The air box installation is much easier to accomplish if the exhaust system is not on the engine. Having it not in the way greatly simplifies the objective of properly aligning the air box assembly with the cowl induction air inlet.

❑ **Install the Mount Plate on the Carburetor or Fuel Injection Servo**

Install the Mount Plate using the hardware shown in Fig. 2. Do not use the large area washers or safety wire it now because it will be removed during the installation.

Note that the plate is not symmetrical. It has the center hole where it attaches to the carb. or throttle body, off-set towards the left to account for the engine being off-set to the left for torque and p-factor compensation. This gets the airbox positioned back towards the center line of the cowl.

320/360/540 WITH CARB. ONLY The Mount Plate, Fig. 1, is different for the Facet/Precision carburetor and the Ellison and fuel injection throttle bodys. You will need to cut an extra hole out of the plate if you have an O-360/540 engine with a traditional carburetor. The extra hole allows for the bowl drain to protrude through the mount plate. Use the template provided as a starting point for the cut out. The mounting plate for the O-320 carb already has the additional opening for the bowl drain and accelerator pump housing. If the carburetor on your engine has a protruding drain plug it must be replaced with the supplied Hex. Plug prior to installing the Mount Plate. (Refer to Section 5 regarding sealant use on pipe threads).

Most of the MA4-5 carburetors for the O-360/540 and some MA4SPA carburetors for the O-320 have a flashing area on the bottom at each side of the drain plug boss. You can either file this area flush (Plug the ports in the carburetor to keep it clean), or make a spacer the same thickness as the flashing that will allow the VA-131-C to lie flat on the carburetor bottom.

❑ **Trim the Filtered Air Box to length**

The air box must be trimmed to length to fit your engine and cowl. There are two carburetor locations on 4 cyl Lycoming engines. One near the rear of the sump (not very common, and not compatible with an A model nose gear) and one more near the front. The object here is to allow easy removal of the cowl by allowing you to drop it straight down and clear the spinner. Fig. 9 illustrates this and shows why the air box can't be left long so that it extends to be near the induction air inlet on the cowl, and still allow the cowl to drop down. With the lower cowl pinned in place, measure the length required. Trim both the VA-130-B or VA-131-B and the fiberglass air box to look like Fig. 9 (Leave the fiberglass portion about 3/16" longer than the VA-130/131 to allow for final adjustment later).

❑ **Fit the Top Plate to the Mount Plate**

Loosely clamp the top plate to the mount plate with the flange around the top plate equal distant from the edge of the mount plate on both sides and the rear (See PHOTO 1). Install the lower cowl. Check to make certain that the neck is laterally aligned with the cowl air scoop (Fig. 3). If not, reposition the neck of the top plate and check again. If the exhaust system is not installed, you may be able to reach inside the cowl and make the adjustments. When the top plate neck is laterally aligned (don't worry about vertical alignment right now) with the cowl scoop inlet as shown in Fig 3 to account for any offset, and the mount plate is still uniformly centered on the top plate, carefully mark the top plate by tracing around as much of the mount plate as you can access so that after the clamps are removed realignment is possible. Remove the assembly and match drill the top plate using the holes in the mount plate as a guide, and install the nutplates and the VA-131-D filter retainers (Fig. 2 & 5) to the top plate. Fabricate the retainers by cutting the material supplied into 6 equally sized pieces.

❑ **Adjust vertical alignment of the Top Plate to the top of the Induction Air Inlet.**

Vertical alignment of the top plate can now be checked in much the same manner. Bolt together the mount plate and the top plate, then install on the carburetor or throttle body. Install the cowl, and check that the top plate neck is vertically aligned with the top of the cowl air scoop (Fig. 8). During this procedure it's a good idea to also install the upper cowl to correct any potential sagging in the lower cowl. Any vertical misalignment is corrected by bending the top plate just in front of the fwd. edge of the Mount Plate. Heavily flute or notch the flanges on the top plate, in line with the intended bend position to facilitate the bend (Fig. 3 and PHOTO 2). The bend must be sharp to avoid gaps when the carburetor heat door is open (ram air position). Small wood blocks can be clamped along the bend line to help produce a sharp bend in the soft aluminum.

Note: The engine will sag slightly (about 1/8") after being put into service so you can temporarily put two washers between the mount plate and the carburetor to compensate.

❑ **Size the airbox for the filter.**

The filter must be compressed between the Mount Plate and the bottom of the air box in order to provide an air tight seal (Fig 2). To account for compressing the filter, mount the top plate 1/16 inch below the top of the filter by screwing the mount plate to the top plate with 1/16" thick spacer

washers between them at each screw location. Fit the Top Plate onto the airbox with the filter in its proper position inside. Compress the Top Plate just enough to assure the filter is captured in place with no gaps top or bottom and clamp in place around the perimeter flange. Drill and cleco the top plate to the air box using the rivet spacing specified in Fig. 4. Start at the rear and work forward around each side. **Do not drill the rivet holes forward of the bend that you made during vertical adjustment.**

❑ **Adjust the vertical dimension of the airbox inlet.**

Check that the opening of the air box inlet matches the height of the opening in the cowl air scoop. If it doesn't, make a cut on each side of the fiberglass VA-130-A or VA-131-A in line with the bend in the Top Plate. Leave about a 1 1/2" wide portion on the bottom uncut to act as a hinge and help maintain alignment. Position the forward end so the height of the opening is correct, and clamp in position. Drill the remaining holes (do not drill any holes at the fwd. most end at this time to allow for installation of a seal later. Use epoxy resin and glass cloth to close the cut. (Do NOT use polyester resin). Once the resin is fully cured, trace along the top edge of the Top Plate flange, to mark the airbox bottom for trimming off the excess/overhang. Mark the fwd. end of the fiberglass to trim it square with the end of the Top Plate. Uncleco from the Top Plate and trim at the marked lines. Some of the remaining work is easier to complete if parts can be separated so do not rivet the Top Plate to the fiberglass airbox until later. Refer to PHOTO 4.

RV-6, 7, 8, & 9, TRI-GEAR MODELS ONLY

❑ **Trim aft end of airbox for nose gear leg clearance if/as needed.**

In some configurations, there may be a minor interference between the nose gear leg and the aft bottom of the airbox. A clearance of about 1/2" minimum is necessary.

- ❑ Temporarily reinstall the Top Plate to the Carb. or Throttle Body. Fit the clecoed together Airbox assembly in place on the Top Plate to evaluate the clearance. Progressively trim the aft end if/as needed until a 1/2" clearance from the gear leg is obtained. Trim the Airbox adjacent to the trimmed area in such a way that a flat patch will have a net fit around the entire perimeter of the trimmed opening. Make a flat patch by waxing a scrap of flat aluminum sheet, and then laminating 2 layers of bi-directional fiberglass cloth (approx. 9 oz) onto it with epoxy resin. Cover the laminate with peel-ply and let cure. Once fully cured, remove the peel-ply and remove the patch from the aluminum. Trim the patch to be approx. 1/8" bigger around the entire perimeter, than the opening trimmed in the Airbox. Sand and clean the edge of the patch on the smooth side in preparation for bonding it to the Airbox. Generously wet the entire edge of the trimmed opening on the fiberglass Airbox bottom with epoxy resin. Tape the patch in place (smooth side towards the inside) and allow the resin to fully cure. Trim/sand the overhanging portion of the patch flush to the outer surface of the Airbox. Sand the outer surface of the Airbox approx. 1" beyond the perimeter edge of the patch as preparation for bonding additional fiberglass layers (it is not necessary to sand the peel-ply surface). Add an additional layer of bi-directional fiberglass cloth over the patch with it sized to allow for an overlap onto the outside of the airbox of approx. 1". See PHOTO 3 (view is after patch has been bonded and trimmed but prior to adding the additional layer

❑ **Install drain holes.**

Fit the filter into the Airbox. Drill two #30 holes through the lowest points of the air box (one inside and one outside of the filter) at the back, to allow fuel and water to drain if it were to pool at the bottom on the inside of the filter or at the very back of the Airbox.

O-320 ONLY

❑ **Modify the air filter**

To allow the filter to sit flush on the mount plate it must be trimmed to fit over the accelerator pump that is present on the MA4SPA carburetor used on the O-320. Any gaps between the filter and pump are then filled with fuel tank sealant. The sealant effectively replaces the rubber edge flange that gets cut away (Fig. 1A) and becomes a molded in place net fit seal over the accelerator pump housing. The filter is first marked to help locate the proper place to cut the clearance hole. Place the filter in the airbox and install the Mount Plate to the airbox (Make sure it is oriented with the accelerator pump opening positioned to the left side) with a couple screws to establish proper alignment on the Top Plate. The six filter retainers should hold the filter to its correct oval shape. With the filter aligned flush with the six retainers and aft edge of the drain plug cutout, mark the top of the filter through the accelerator pump cutout. Remove the mount plate from the airbox and temporarily install it to the carburetor. Remove the fiberglass from the airbox and temporarily install Top Plate to the Mount Plate with a couple of screws to assure proper alignment. g of any gap prone areas. Making certain everything is aligned correctly, install the filter and airbox on the Mount

the Top Plate to the Mount Plate with a couple of screws to assure proper alignment. 1/8" clecos can be used in the remaining holes to assure that the Top Plate is flush to the Mount Plate. Carefully trim the filter with a razor knife/blade and metal cutting snips so that it will fit over the accelerator pump with a small amount of clearance. Use the marks and protruding accelerator pump housing as a guide for how much to trim. Coat the accelerator pump housing and any areas of the Mount Plate and Top Plate that may contact the sealant, with a thin layer of parting agent. The parting agent (a coat of paste wax or grease works well) keeps the sealant from sticking to the accelerator pump housing and Mount Plate.

Apply sealant to cutaway area of the filter. Install the filter in place on the bottom of the Top Plate with it properly positioned within the 6 filter retainers and the cut-out area centered over the accelerator pump housing. Use long pieces of tape to hold the filter in place while the sealant cures. Save any leftover sealant for use in evaluating when the sealant has fully cured (store it adjacent to the filter so it is exposed to the same temp conditions). Allow at least 24 hours for drying at temps of 70 degrees. Give additional time in cooler temps. When dry, the filter can be carefully removed from the Mount Plate / carburetor. Be certain the sealant is well cured; a large mass can cure slowly. Use a knife point or screwdriver blade to help separate the sealant from the carburetor and Mount Plate. Wipe off any leftover grease or wax and trim away any excess sealant on the filter using a razor knife/blade. Make sure that all the sealant is stuck well to the filter to prevent any pieces being sucked into the carburetor. Additional sealant can be added over the cured sealant if there are voids that need to be corrected.

During final assembly fill all gaps that would allow unfiltered air to enter between the carburetor and mount plate (especially around the drain plug boss) with sealant.

□ **Modify the air filter**

Install the large area washers on the 4 Mount Plate attachment bolts and safety wire the bolts together in pairs. With the Top Plate installed on the Mount Plate, put the filter in place and mark it for any interference that exists with any of the large area washers. Trim the rubber filter material so that the filter is able to lay flush against the bottom of the Mount Plate. If the trimming results in any leakage / gaps, fuel tank sealant can be used to seal them in the same manner as the procedure detailed in the **O-320 ONLY, Modify the air filter** step.

Fuel injected engines only - When the FAB Air Box is being installed on a vertical induction fuel injected engine, the installation of the carb heat door is not required.

Refer to the VA-131Q-1 INSTALLATION supplement for installation instructions if a relief in the FAB is required to provide clearance for the mixture control arm.

Note --- When the airbox carb. heat door is being described as in the closed position, it means that the door is blocking air from entering the front of the airbox, and open position is allowing air to freely enter the front of the airbox

□ **Make Carb Heat / Inlet Block-off Door**

Use some stiff poster board or card stock to make a template for the carb. heat door. Trim it to fit the airbox opening as accurately as possible so that when it is in the closed position the top of the door is at least 1" aft of the fwd. end of the airbox, that it is about 15 degrees short of being vertical (bottom positioned a bit further aft than the top to prevent it from getting jammed closed), and when rotated to the open position and flush on the bottom of the Top Plate, it does not interfere with the fwd. most nutplate and filter retainer. An accurate fit in the closed position is important to have good carb. heat performance. Once you have a well fitting template, trace it on to the supplied material and cut it to size.

❑ **Cut a hole for the carburetor heat intake**

Clamp the carb heat door in to the airbox with it in the fully closed position. Use a pen to mark a line on the inside of the Top Plate to indicate the location of the fwd. edge of the door. Rotate the door to the full open position and clamp in place (use the previously marked line as a reference for the position of the fwd. edge of the door). Unclo the airbox bottom and mark the position of the door on the Top Plate by tracing around the entire perimeter. Unclamp the door and mark an offset line, 3/16" smaller than the actual door size, along the sides and aft edge of the door. This will make the opening slightly smaller, so the door has a surface to close against. The opening is to be cut flush to the hinge line along the front edge of the door (no 3/16" offset). Make the opening by removing the material defined by the hinge line and offset line. Deburr and smooth the edge of the cut opening.

❑ **Make the Carb. Heat Door Backing Plate**

Clamp the material provided, over the opening previously cut in the Top Plate and trace the perimeter of the opening using a pen that will make an approx. 1/16" wide line. Trim and then finish the edges of the plate so that the line just disappears. This should produce a part that is about 1/16" smaller than the opening.

❑ **Make the Carb. Heat Door flexible hinge**

Trace the outline of the carb heat door onto the fiber reenforce rubber baffle seal material. Mark an offset line along the top of the door to add an additional 9/16" of material to act as the hinge tab. Cut out the flexible hinge using the marked line as a reference.

❑ **Drill and assemble the Carb. Heat Door components**

Mark the rivet pattern (see Fig. 10) on the Backing Plate, making allowances for where the actuation arm will rivet on. Clamp the Carb. Heat Door, Flexible Hinge, and Backing Plate together with the proper offset on the Backing Plate and drill the rivet locations marked on the Door (install clecos from the Backing Plate side). With the fiberglass bowl clecoed to the Top Plate, insert the door assembly and center the backing plate within the opening cut in the Top Plate.

Make the Hinge Doubler Strip and clamp it to the hinging tab on the front of the flexible hinge with a 1/16" gap between it and the fwd. edge of the door. Operate the door between opened and closed to confirm that it seals the opening properly when closed, that it moves smoothly, and that the Backing Plate doesn't interfere with the edge of the opening cut in the top plate. Loosen the clamps and reposition as needed, and/or mark the Backing Plate for trimming if there is any interference with the Top Plate. NOTE: You will have to remove any clecos in the lower portion of the door for it to swing to the closed position)

Once satisfied with the door operation, unclo the fiberglass bowl and drill the Hinge Doubler Strip, Hinge Tab, and Top Plate for the rivets. Clamp the Arm in place as far to the right as possible but still clear the open with a 1/16" gap and drill the rivet holes. Disassemble, debur, and machine countersink the Door and the Doubler Strip for Flush rivets. Prime/paint the steel arm.

Assemble the Door and then rivet the Door and Doubler Strip to the Top Plate. NOTE – Shorter rivets than typical, should be used to avoid excessive setting pressure which will compress the rubber hinge material and distort the door and Backing Plate. Small, undersized shop heads are acceptable and desired in this very low structural load situation.

❑ **Final Assembly**

Cleco the fiberglass bowl in place and after double checking the operation of the Carb. Heat Door, rivet the bowl in place.

❑ **Making the Cowl Induction Air Inlet extension**

A molded in place extension, that reaches back almost to the air box using will be made using fiberglass laid inside of a foam mold. The gap between the extension and the inlet of the airbox is then sealed with silicone engine baffle material to isolate engine vibration. This can be a fairly time consuming procedure. However, the performance gained from a good joint makes the extra effort worthwhile.

Install the completed airbox and cowling. Measure the distance from the outside of the air scoop to the front of the air box (Fig. 9). Remove the cowling. The cowl air scoop intake lip must be filed or sanded to provide a flat bonding area for the fiberglass and to avoid decreasing the intake area when the new fiberglass is laid (Example is the light colored area around the rim of the inlet on PHOTO 6) Aggressively sand the interior surface of the cowl just inside the inlet where additional fiberglass will be applied later.

Trim and shape the supplied foam block so that it fits within the nose section of the inlet scoop and extends aft to fill the gap between the Filtered Air Box inlet and Cowl Induction Air Inlet that was measured previously. Firm pressure can be used to press the foam fwd. into the cowl to indicate where removal of foam is required. Once satisfied that the fit extends all the way to the front, bond the block in place. Hot glue gun glue or auto body filler can be used as quick cure adhesives to allow bonding while holding the foam in position. Allow the adhesive to fully cure and double check that the foam is securely held in place. See Fig. 6

❑ Shape the foam

Remove foam from the block to produce a tunnel between the Cowl Induction Air Inlet and the inlet to the Filtered Air Box. A bare hack saw blade can be forced through the foam and used to rough out the opening. Finish with sandpaper on sticks and dowls to produce a passage that transitions from the shape of the cowl inlet, to the shape of the FAB inlet. Carefully remove the cowl to avoid damaging the foam.

❑ Add Fiberglass

Cut 2 strips of general use bidirectional fiberglass cloth (as was used for canopy fairing, etc.) approx. 2.5 " wide and 11" long. Cut on the bias so that the weave is diagonal / 45 degrees to the length of the strip. Place the strips on plastic food wrap and saturate them with epoxy resin. Trim the plastic wrap close to the perimeter of the strips. Use the plastic wrap to transfer the fiberglass lay-up to the interior of the foam, and then remove the plastic wrap and reposition the cloth as needed. Trim excess to have an approx. ½" overlap. Repeat with the second layer. Position the overlap of the second layer at a different point. Allow to fully cure. Trim and sand the excess that protruded out the front of the inlet, to make a smooth radius transition to the cowl inlet (See PHOTO 6).

Trim the aft end of the layup to be flush with the aft edge of the foam. Remove as much of the foam as possible and then add two more layers of fiberglass to the inside surface of the inlet extension. Overlap the fwd. edges onto the interior area of the cowling that was sanded previously. Once fully cured, trim the second two layers to be flush on the aft edge with the first two.

❑ Install Inlet Seal

Reinstall the cowling and check for a gap between the Inlet Extension and the inlet of the FAB of ½" to 5/8". Mark and trim if/as necessary. Make a Fwd. FAB Seal with the silicone material supplied (SEAL-00009). Start with a 1.75" wide strip about 12" long. Plan for a lap joint at the top center and 5/8 deep notches to allow it to pass the flange on the Top Plate. Make a poster board template of the fiberglass inlet extension to use as a reference while fitting and drilling the seal to the FAB. Make the seal lay so that the opening is net size or just slightly less than the size of the extension so that there will be a leak free seal. (See PHOTO 7 & 8) Use clamps to temporarily hold the seal in position while progressively drilling #30 and clecoing. Rivet the seal using the specified hardware. Bond the lap joint on the top using a silicone based adhesive/sealant (Permatex Ultra Black works well)

❑ Finish installation

Install the FAB assembly to the Mount Plate. Install and connect the carb. heat control using the hardware specified. The cable housing for the control should be trimmed to be as long as possible without interfering with the Carb. Heat Door Arm when the door is in the closed position. When trimming the housing to length, be sure and remove the inner cable so that it doesn't get cut too short. Tighten the nut on the pivot bolt just enough to securely hold the cable but not distort it. The pivot bolt should move freely in the Carb. Heat Door Arm bushing. Lube the joint periodically with a drop of oil. (See PHOTO 7, 8, & 9)



PHOTO 1

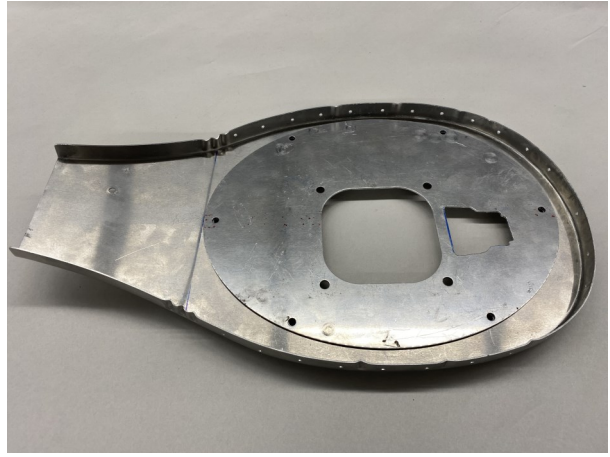


PHOTO 2



PHOTO 3

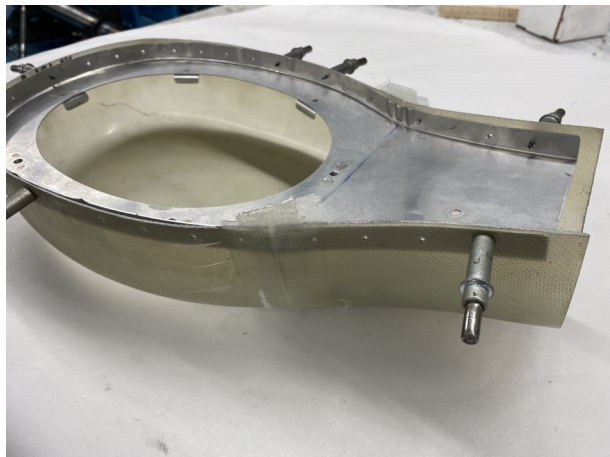


PHOTO 4



PHOTO 5

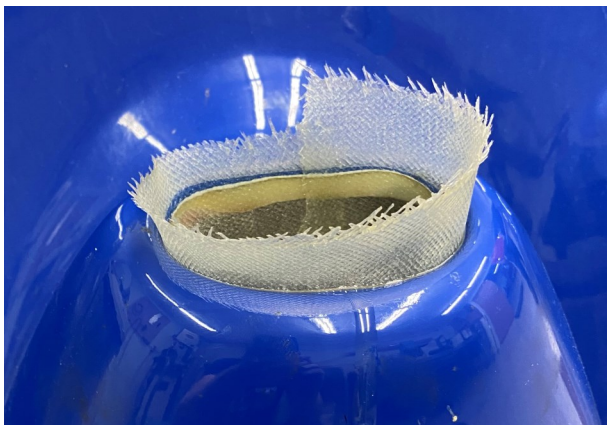


PHOTO 6



PHOTO 7



PHOTO 8

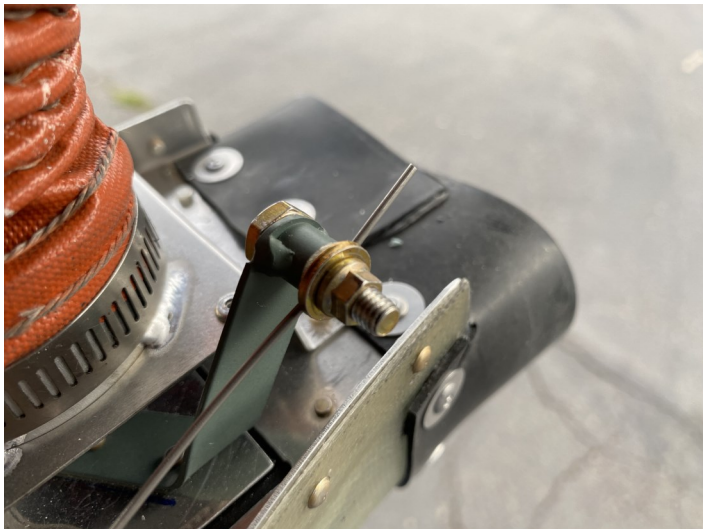


PHOTO 9

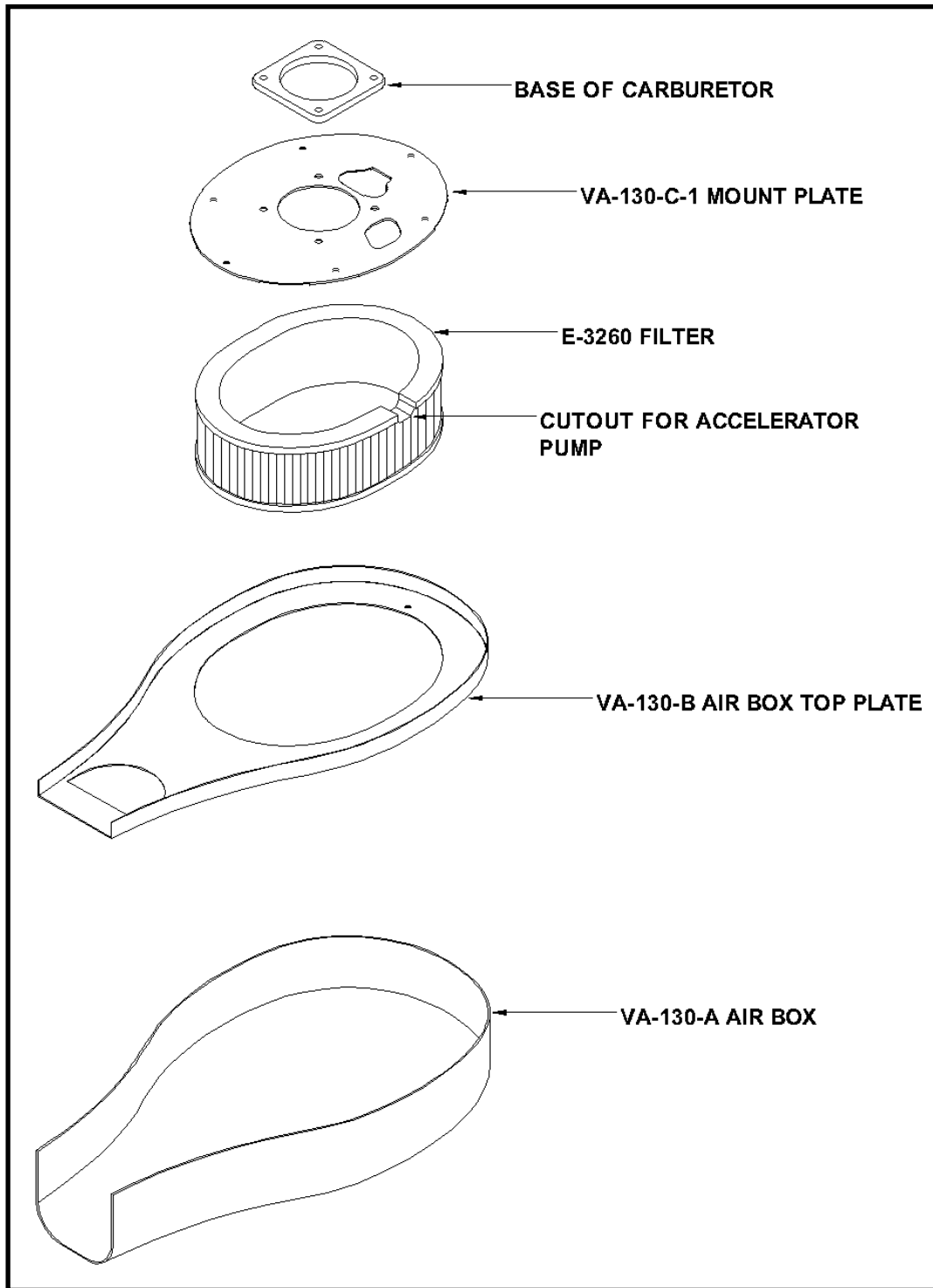


FIG. 1A
O-320

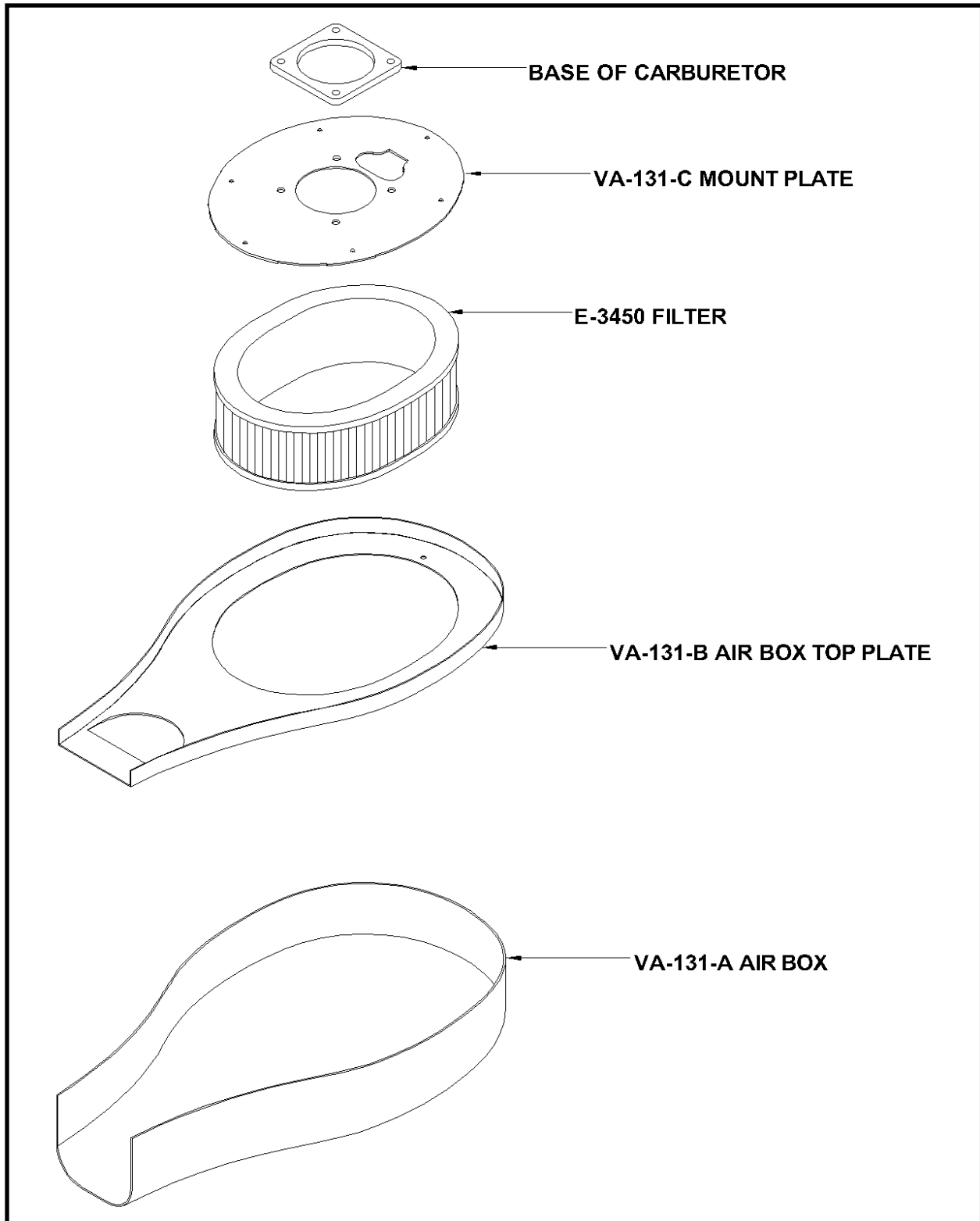
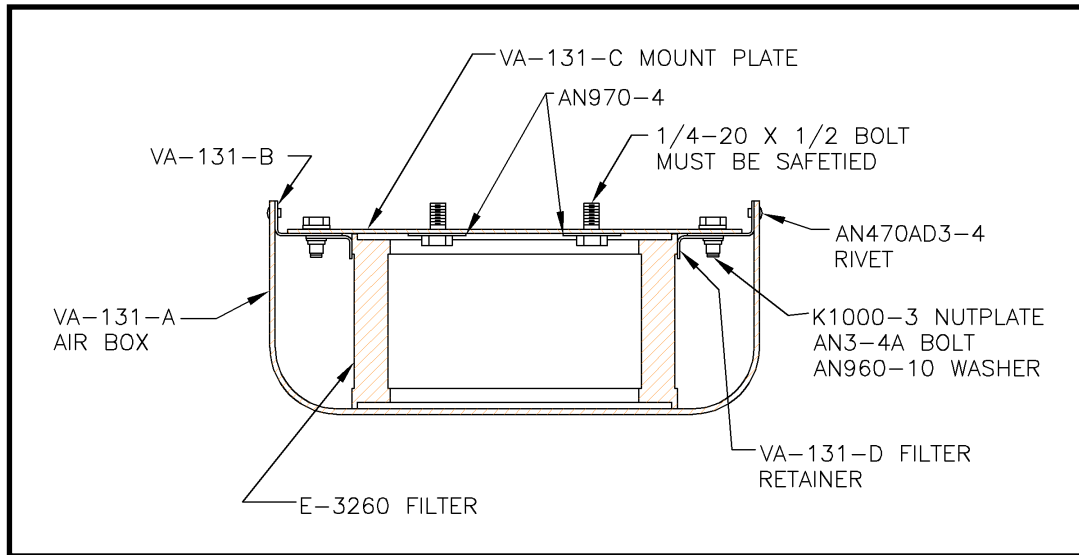
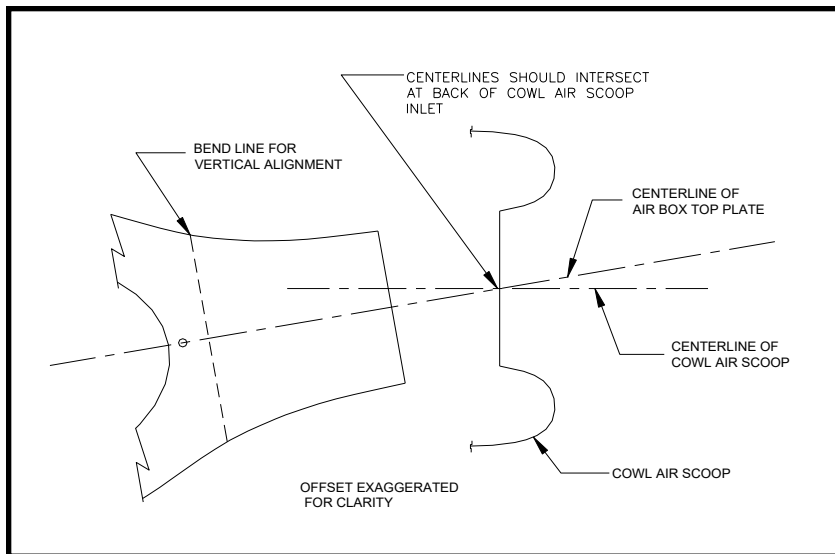
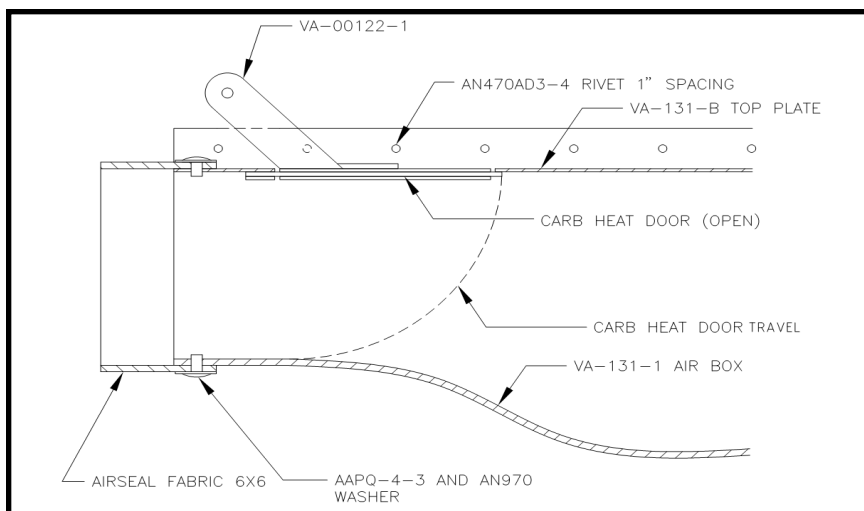
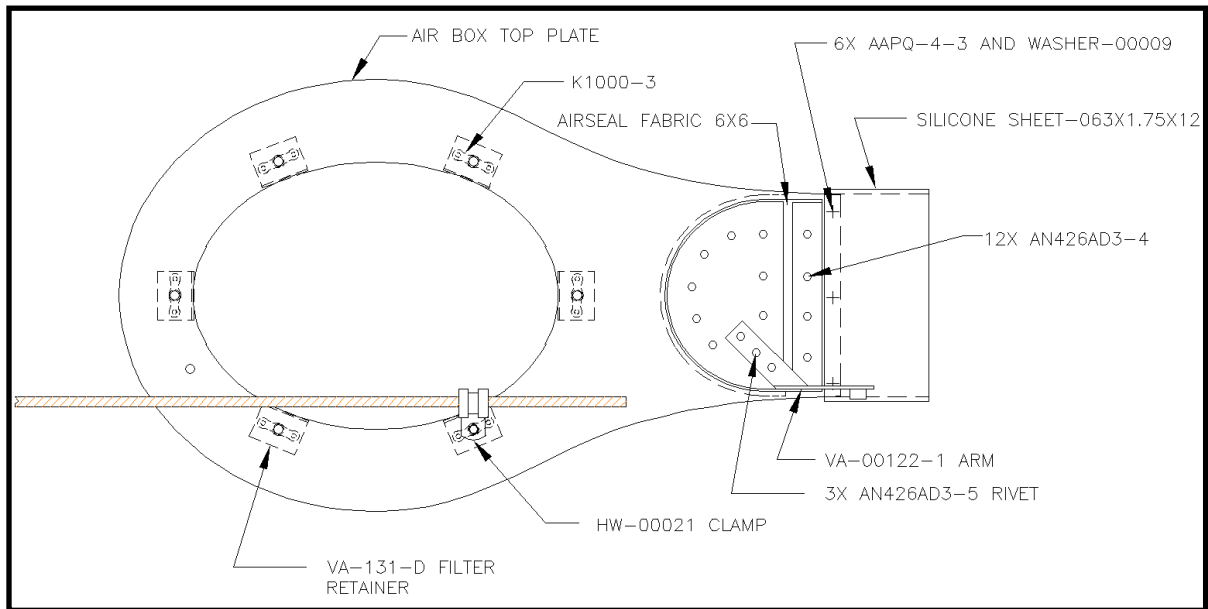
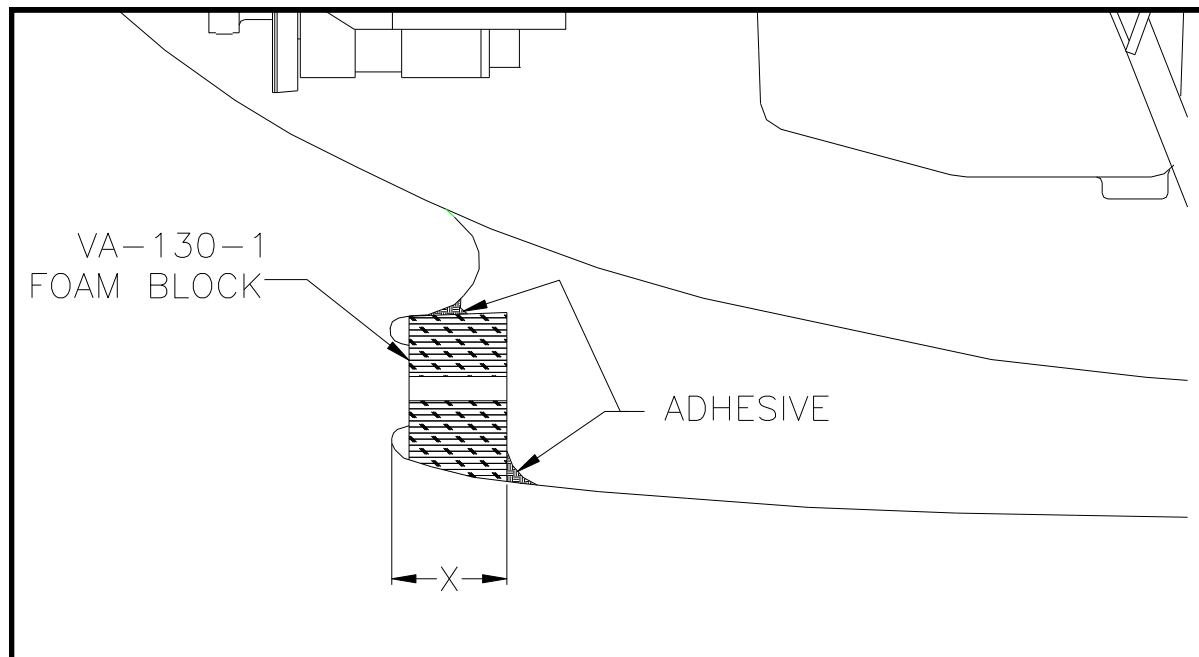
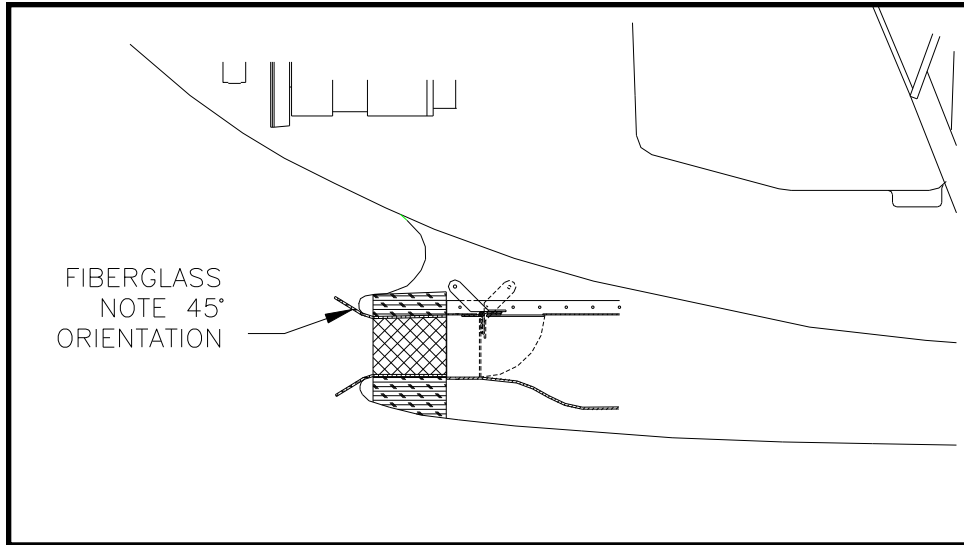
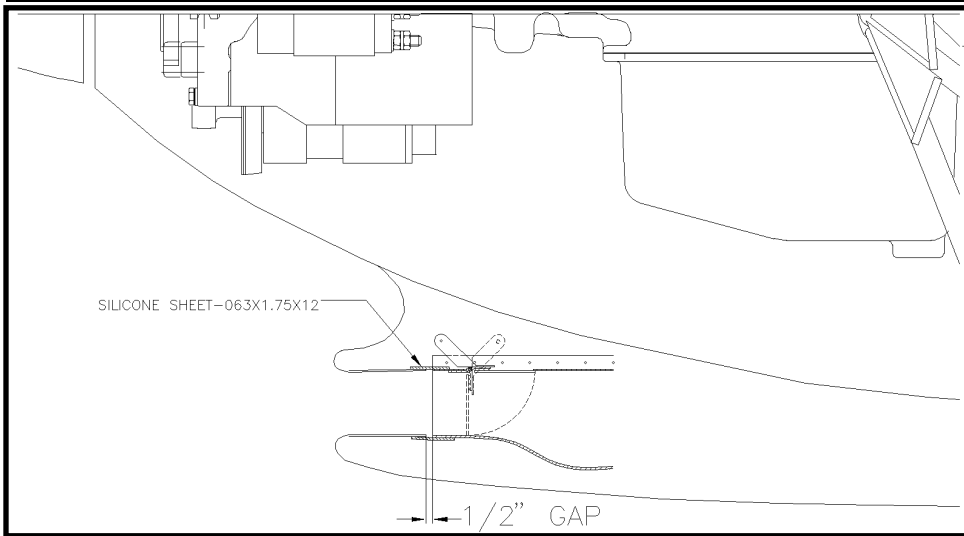
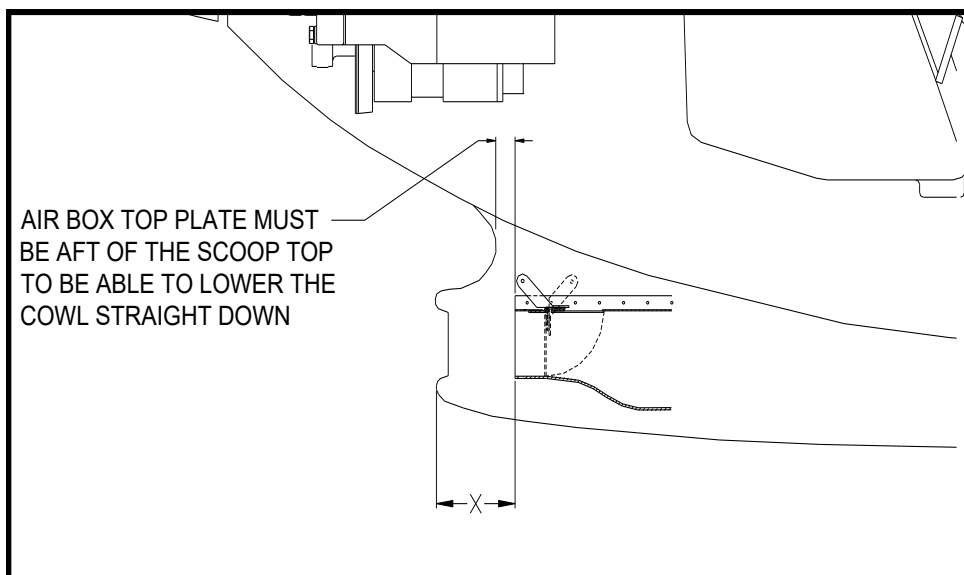


FIG. 1B
O-360/540

**FIG. 2****FIG. 3****FIG. 4**

**FIG. 5****FIG. 6**

**FIG. 7****FIG. 8****FIG. 9**

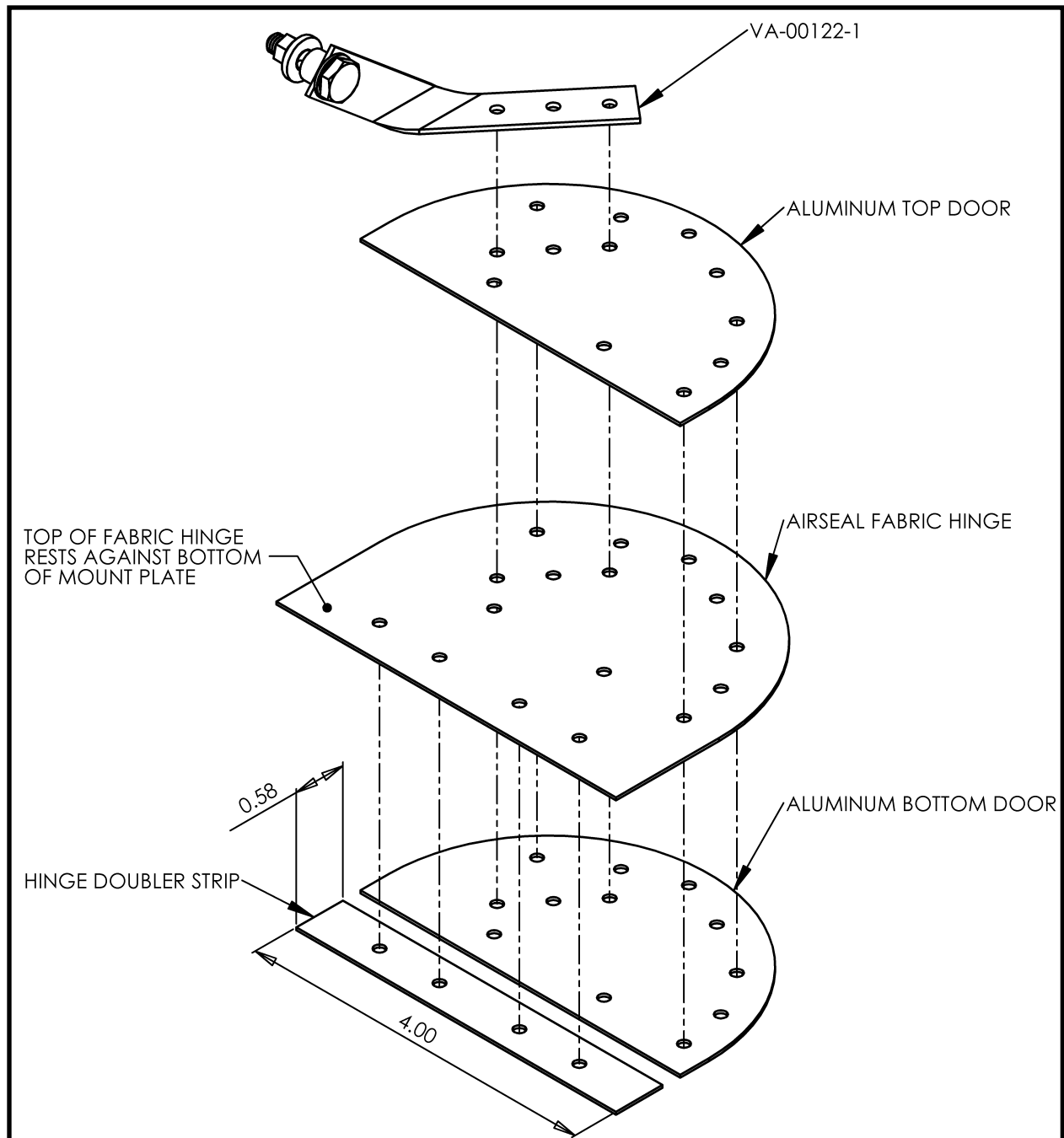


FIG. 10
CARB HEAT DOOR ASSEMBLY

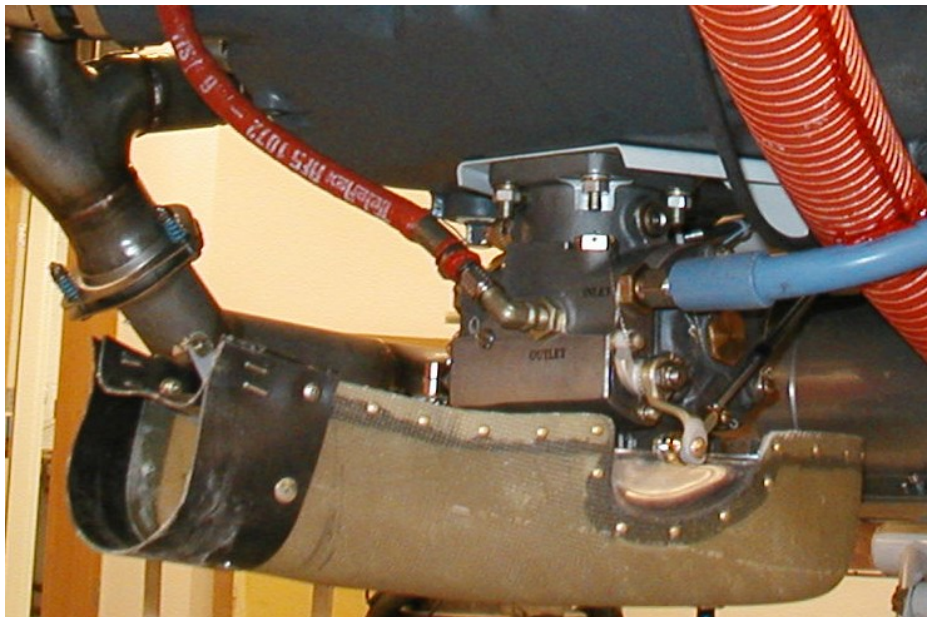
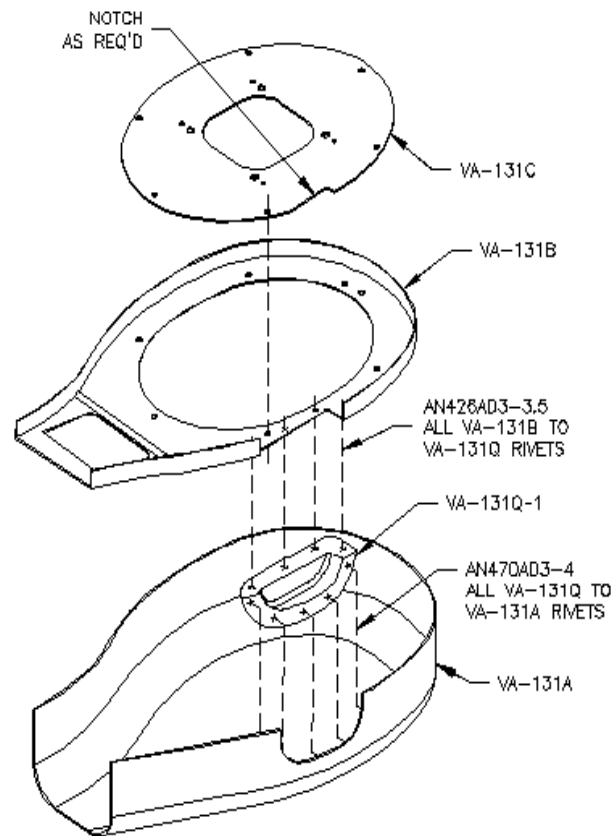
VA-131Q-1 INSTALLATION

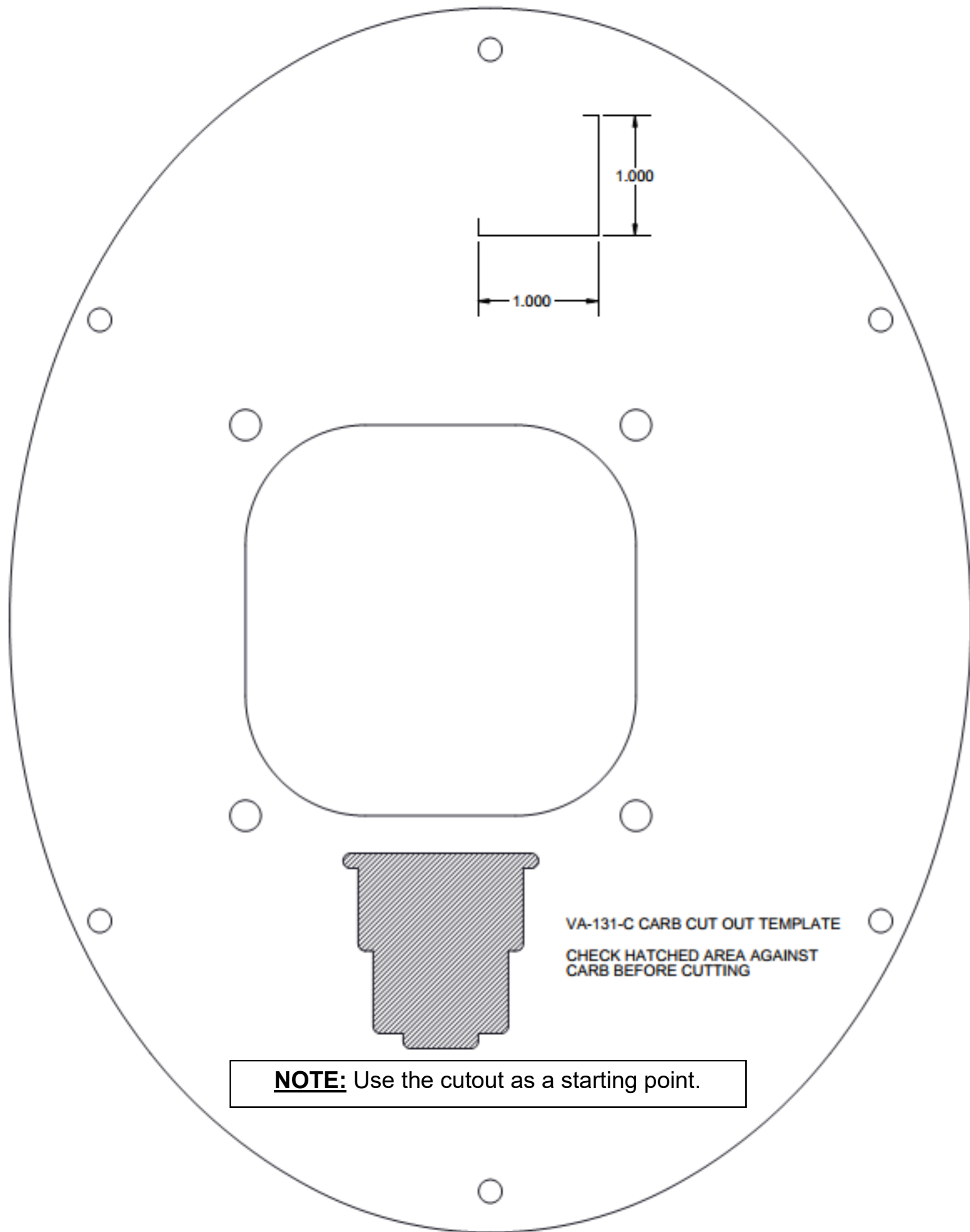
On engines with a vertical induction fuel injection system the mixture control arm will aim downwards for the correct throw direction and may interfere with the left side of the Filtered Airbox Assembly. This interference can be removed by using the VA-131Q-1 Recess.

Trim the flanges of the VA-131Q-1 Recess. Flute the flanges of the recess as needed to make the recess match the shape of the Filtered Airbox. Position the recess on the filtered airbox to match the throw of the mixture arm. Mark the recess contour on VA-131A. Cut this area away from the side of VA-131A. With the filtered airbox reassembled mark the recess contour on VA-131B. Cut away this area from VA-131B. Test fit VA-131B to VA-131C and notch VA-131C as required.

Drill #40 the VA-131Q-1 Recess to VA-131A in five places. Drill #40 the recess to VA-131B in four locations (note the fastener that attaches VA-131B to VA-131C). Disassemble and deburr all parts.

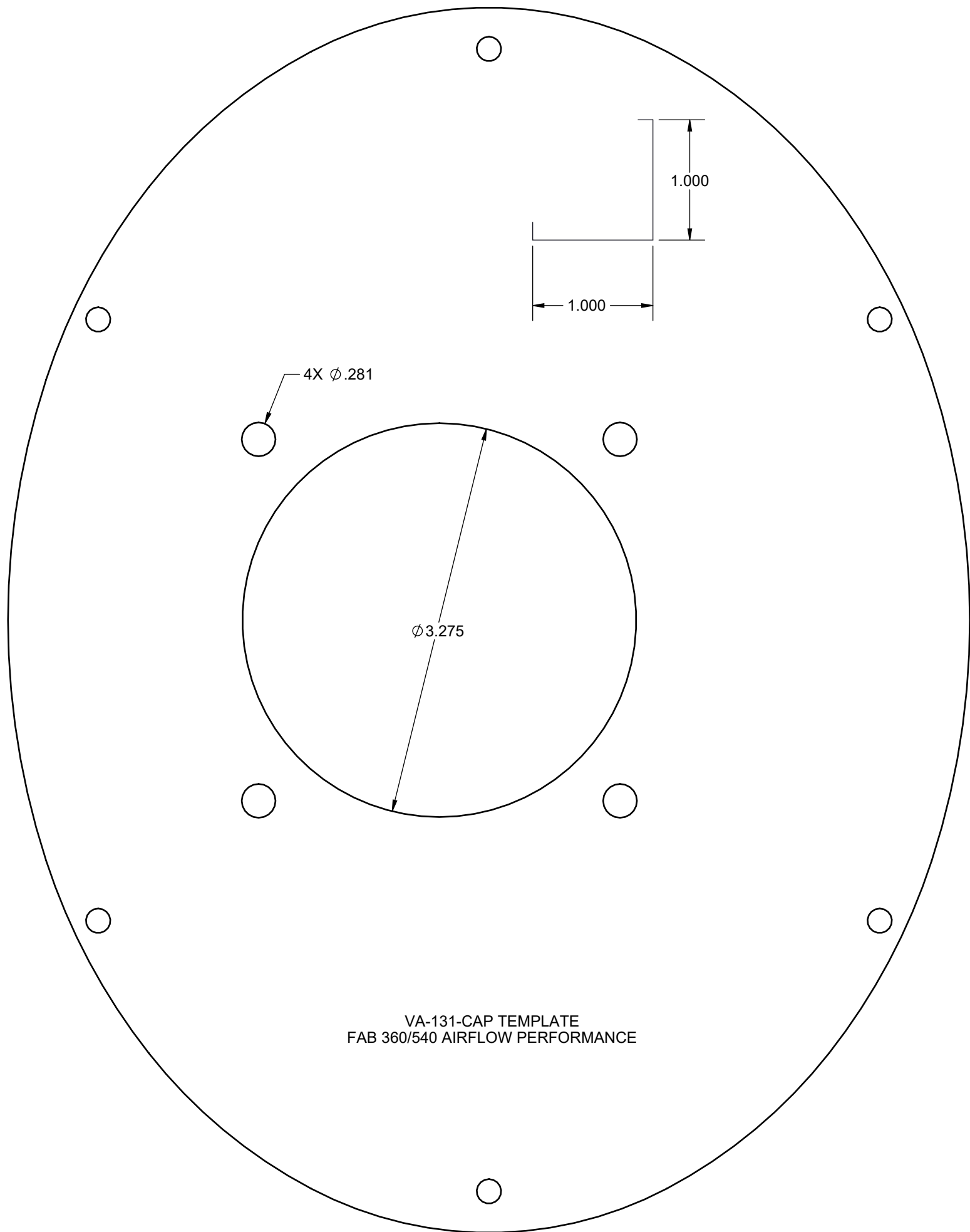
Rivet on VA-131Q-1 at the same time VA-131A and B are riveted together.



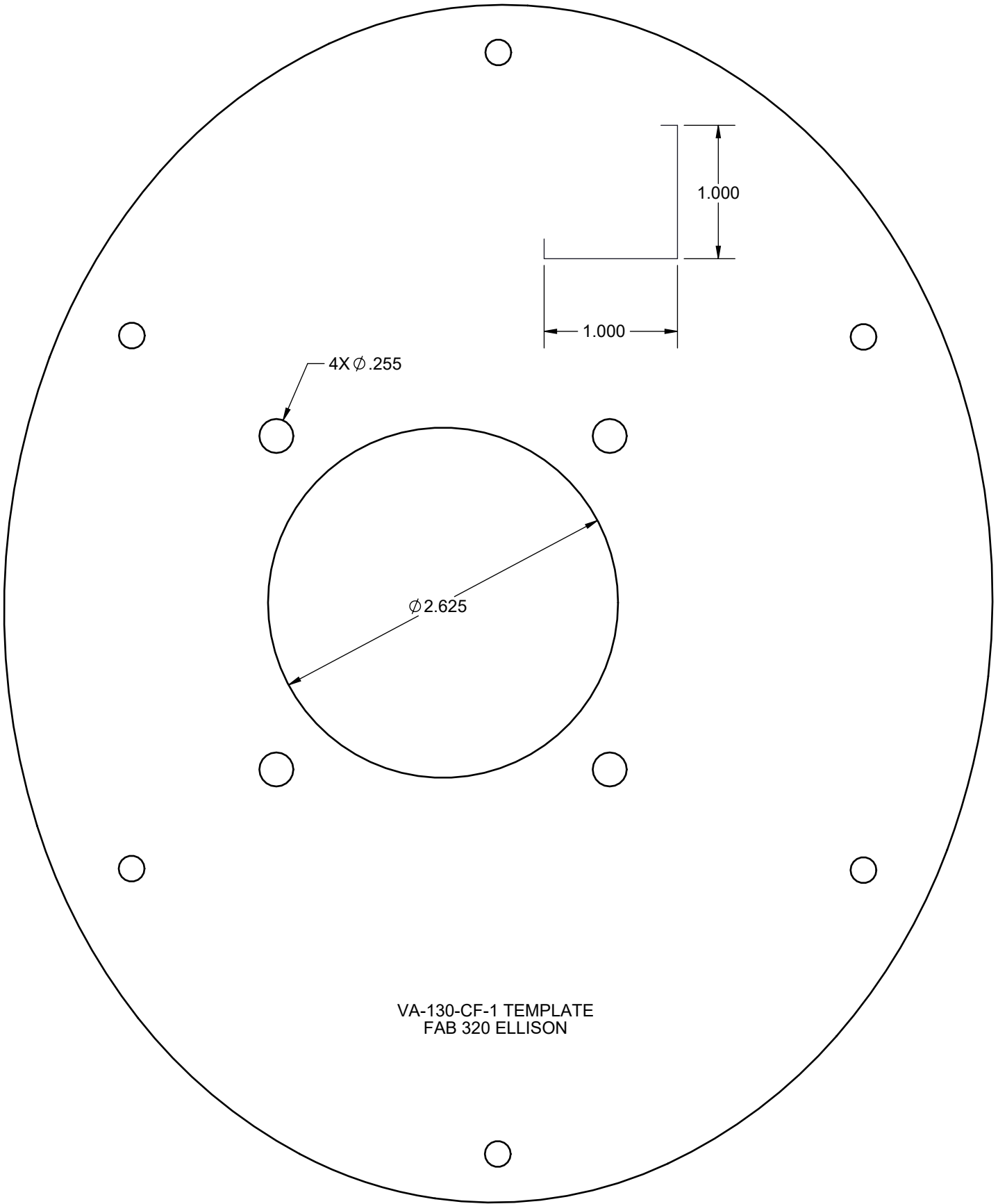


VA-131-C CARB CUT OUT TEMPLATE
CHECK HATCHED AREA AGAINST
CARB BEFORE CUTTING

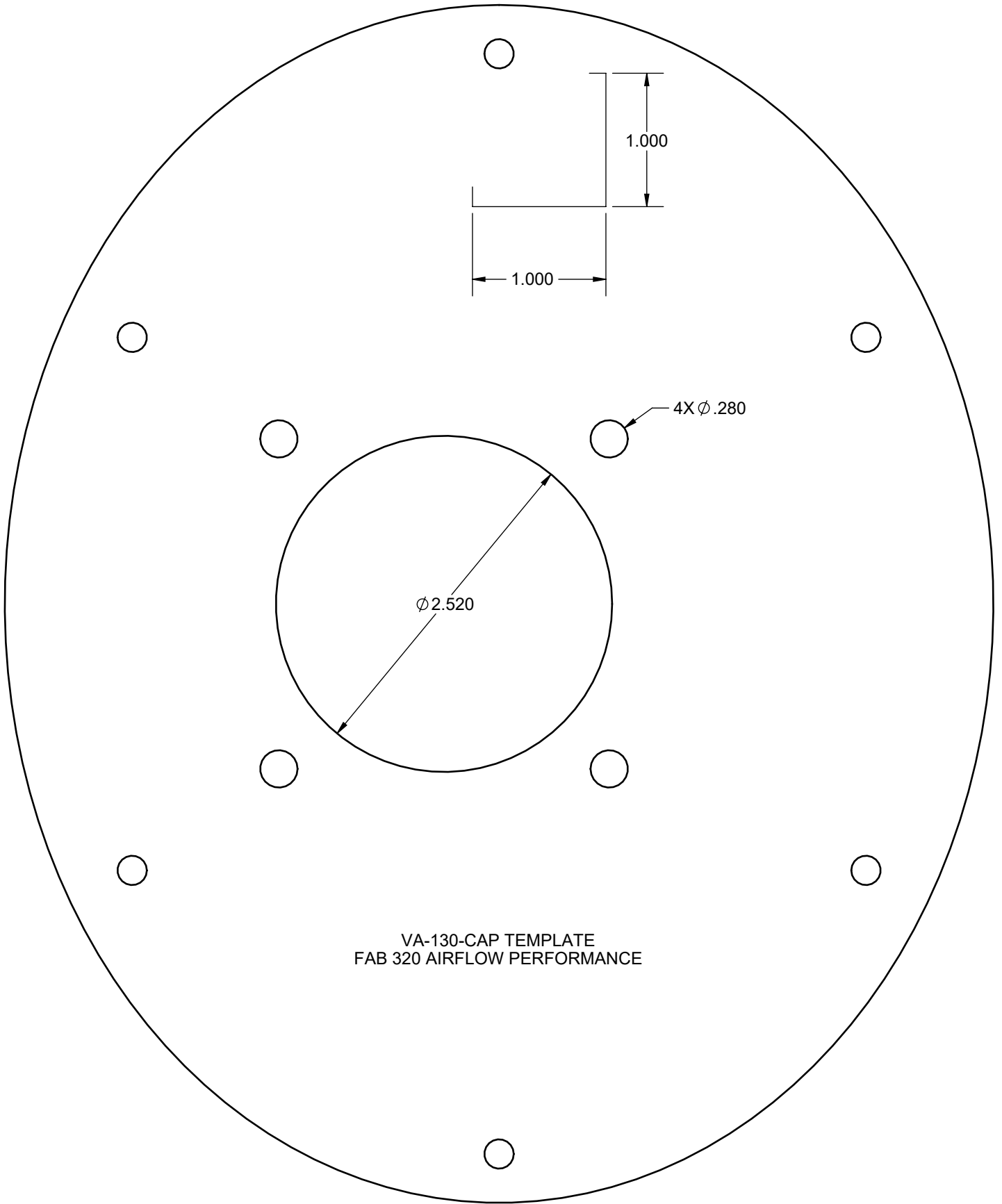
NOTE: Use the cutout as a starting point.



VA-131-CAP TEMPLATE
FAB 360/540 AIRFLOW PERFORMANCE



VA-130-CF-1 TEMPLATE
FAB 320 ELLISON



VA-130-CAP TEMPLATE
FAB 320 AIRFLOW PERFORMANCE