Installing and Adjusting Cooling Baffles

Like most air-cooled engines, Jabiru engines rely on ram air moving through a properly-constructed air duct for adequate cooling. While other traditional aircraft engines often require a tedious installation of cowling baffle systems, Jabiru engineers have simplified this crucial task for the homebuilder. Each engine comes with a pair of fiberglass plenum ducts that bolt to the upper portion of the cylinder heads. Fiberglass air dams are installed by the builder to the inner surface of each plenum duct to direct air onto each cylinder and head. During flight testing, these air dams are gradually trimmed as necessary so that each individual cylinder receives optimum cooling.

Duct and Air Dam Construction

1. Remove forward upper valve cover cap screw of the front cylinder and rear upper valve cover cap screw of rear cylinder as shown. Remove forward upper cap screw on center cylinder for the 3300.

Figure 1

2. Sand or trim duct to fit on top of all of the cylinders on one side of the engine as shown in Figure 1. Notches are pre-cut to clear valve cover cap screws not used to attach the duct. Make sure the duct does not rub on these bolts or any oil lines leading to the heads. Remove material from the rear baffle as shown in Figure 2 so the baffle clears the rear head by about ¼". Set inboard edge of duct between the cylinder cooling fins as shown in Figure 3. Duct should fit down onto all cylinders evenly and solidly.

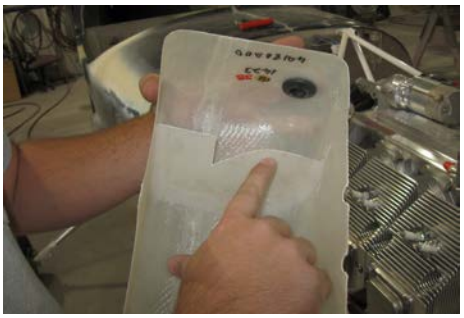

Figure 2

3. With the duct set in place, mark the locations for the ¼" holes for the valve cover/duct mounting cap screws. You should be able to see the location through the translucent fiberglass. Remove the duct from the engine and drill the holes.

Figure 3

4. Set the duct in place on the engine. Place one stainless reinforcing tab over each screw hole. Insert and tighten the valve cover/duct cap screws so the tabs are held upright as shown in Figure 4. Drill the holes for the 3/32" blind rivets and install the rivets with the manufactured heads INSIDE the ducts. The shop end of the rivet must point outboard as shown in Figure 4 to avoid chafing on the spark plug wires.

Figure 4

5. With the duct in place on the engine, draw a mark above the centerline of the forward valve cover (and center cover in the 3300). Extend the marks up over the top of the duct. This will be the location of the air dams.

Figure 5

6. Using the flat pieces of fiberglass included with the engine, fabricate air dams as shown in Figure 5. (It may be best to make a template from cardboard first.) The dams should be about ½" tall and fit the ducts at a 90 degree angle to the upper surface. It is important that no air is allowed to flow between the dam and the surface of the duct, so make it fit the duct contour as close as you can.

Figure 6

7. Use 80-220 grit sandpaper to take the shine off the inner surface of the duct at the air dam locations. Be careful not to sand into the glass fibers. Epoxy the dams in place using 30-minute two-part epoxy. Fillet the epoxy with flock if necessary to fill in any spaces between the duct and the dam. Let the epoxy cure fully.

8. Make the front baffle from the same fiberglass material as the air dams. It should be flush with the bottom surface of the front duct opening and perpendicular to the thrustline. Make it tall enough to cover ½ of the height of the cylinder. Epoxy in place with 30-minute epoxy and cotton flock. See Figure 7.

Figure 7

9. Drill a 3/32” hole in the duct, centered over the middle cylinder (or front cylinder of the 2200), in the position shown in Figure 8. Attach the angle bracket to the duct using a blind rivet, with the manufactured head inside the duct. Run a loop of safety wire around the cylinder barrel between the fins as shown, twist and form into a loop as shown. Hook the spring onto the bracket and the loop with a fair amount of tension. This will hold the inboard side of the duct tight to the engine.

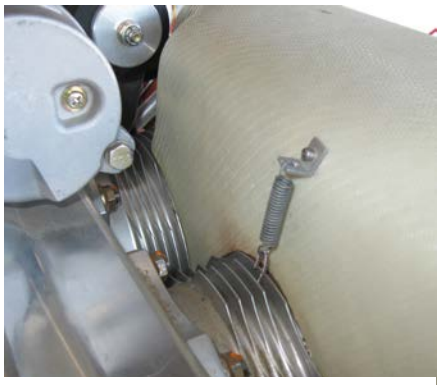

Figure 8

10. Repeat steps 1-9 for the other duct.

Coil Blast Tube Installation

Blast tubes must be installed to keep the ignition coils cool during flight. The directions below are for making them from simple ½” PVC pipe. They gather ram air from inside the duct and direct it onto the ignition coils as shown in Figures 9 and 10. Blast tubes may also be made of bent aluminum tubing for a show-plane look. The pipe lengths are approximate only. Cut and fit to your specific installation.

Figure 9 (duct painted black)

1. For the right-side duct, cut a length of tubing with a 45-degree angle on one end and 90-degree cut on the other approx. 4” long. Cut another piece about 5” long, square on each end. Join the two together with a 45-degree elbow and PVC cement as shown in Figure 9, with the open end of the 45- degree cut facing forward to gather the ram air as it moves through the duct. Position the tube as shown in Figure 9, with the end of the tube about ¼” from the ignition coil. Epoxy and flock in place.

2. For the left-side duct, cut two pieces of PVC at 90-degree angles, one 2” long and the other about 3 ½” long. Join together with a 90-degree elbow and PVC cement. Epoxy in place as shown in Figure 10.

Figure 10

Finishing of Cooling Duct Plenums

The ducts may be left in their natural fiberglass state or finished on the exterior with any type of spray paint. Common finishes include silver paint, speckle paint, flat black, or a color that matches the aircraft exterior. After trimming the front of the ducts to fit behind the cowling, a piece of rubber about 1/2" wide and 1/16" thick may be glued with contact cement around the front edges to act as a gasket between the cowling and the duct.

Jabiru Engine Cooling 101: Adjusting Your Installation

Optimal CHTs in stable, level cruise flight (about 2850 rpm) are between 270 and 300°F. Spreads of 20-30°F between cylinders and sides are normal. If you can tune your CHTs to within 20° of each other, you are a rock star. This section will help you troubleshoot high temps and fine-tune your installation for perfect engine cooling.

(Keep in mind that high EGTs indicate carburetion and/or propeller issues, and usually not cowling adjustment.)

Adjusting the Lower Cowling

If, during cruise flight, all or most of the cylinders run hotter than expected beyond the normal range for an engine in its break-in period, you may need to adjust the lower opening in the bottom cowl and/or the oil cooler inlet. Proper cooling depends on the balance of air pressures within the cowling and baffle system. There must be a low pressure area under the outlet of the bottom cowl to draw the cooling air through the system in an organized flow. This low pressure area draws air in through the duct inlets across the air dams, and pulls it down through all of the engine cooling fins, across the exhaust pipes, and out the bottom of the cowl. If the low pressure area is not strong enough, the ram air will swirl aimlessly through the cowl and will not pull engine heat away efficiently. This can lead to overheating.

All modern Jabiru USA engine cowls have a 1-2" lip on the lower cowl outlet. This lip hangs down into the slipstream and creates the low-pressure area that draws the air through the system. Some older or custom-designed cowlings may not have a lip, or it may not be big enough. If this lip is insufficient for your installation, you may add material to it in the form of sheets of aluminum riveted in place or fiberglass bonded with epoxy and flock. This flap acts like a cowl flap on a larger airplane, drawing the air through the system and lowering all of the CHTs. (This is one advantage of leaving the cowl unpainted during flight testing.)

A good seal around the oil cooler is also critical to proper engine cooling. Air rushing in around the edges of a poorly-sealed chin-mounted oil cooler may

create a high pressure area underneath the engine that spoils the pressure differential and causes inefficient heat removal. Seal the oil cooler opening area with a rubber strip around the edge of the opening in the cowl, similar to the one used on the duct inlets.

Adjusting the Air Dams

Because each engine installation is unique, the air dams usually have to be adjusted in size for optimum cooling. As long as the engine temperatures are within limits, there is no need to worry about wide temperature spreads on the first flights. Fine tuning of cylinder head temperatures is desired, however, for smooth running and long engine life. Each side is treated as a group; that is, cylinder head temperatures within one plenum duct must be adjusted in relation to each other. Any adjustment made to affect the front or middle cylinder will affect the cylinders behind it; therefore, we recommend a CHT probe on EVERY cylinder head, not just the one guessed to be the "hottest."

Use these guidelines to adjust individual cylinder head cooling:

1. To raise the temperature of a cylinder head, shave the air dam above it. This allows more air to flow above and bypass the cylinder. This will also help to cool the cylinders downstream.
2. To lower the temperature of a cylinder head, you may need to add material to the air dam above it. This forces more cooling air down through the fins. It will also raise the temperatures of cylinders downstream.
3. Work in small increments. Do not add or subtract more than 1/8" to or from any air dam in one sitting.
4. Do not work on more than one air dam per side between test flights. Remember, an adjustment to one air dam will affect all the others on that side.

Example: CHT on the middle cylinder of one side of a 3300 is running 50°F hotter than the front and 15°F hotter than the rear cylinder.
To even the temperatures out:

1. Start by shaving a little bit off of the air dam above the front cylinder. This will increase air volume moving over the top of it the front cylinder, allowing it to run a bit warmer and the other cylinders to receive more cooling air.
2. Test fly airplane. If the middle cylinder is still too hot:
3. Add a slight amount of material to the dam above the middle cylinder. This will force more air down onto its cooling fins.