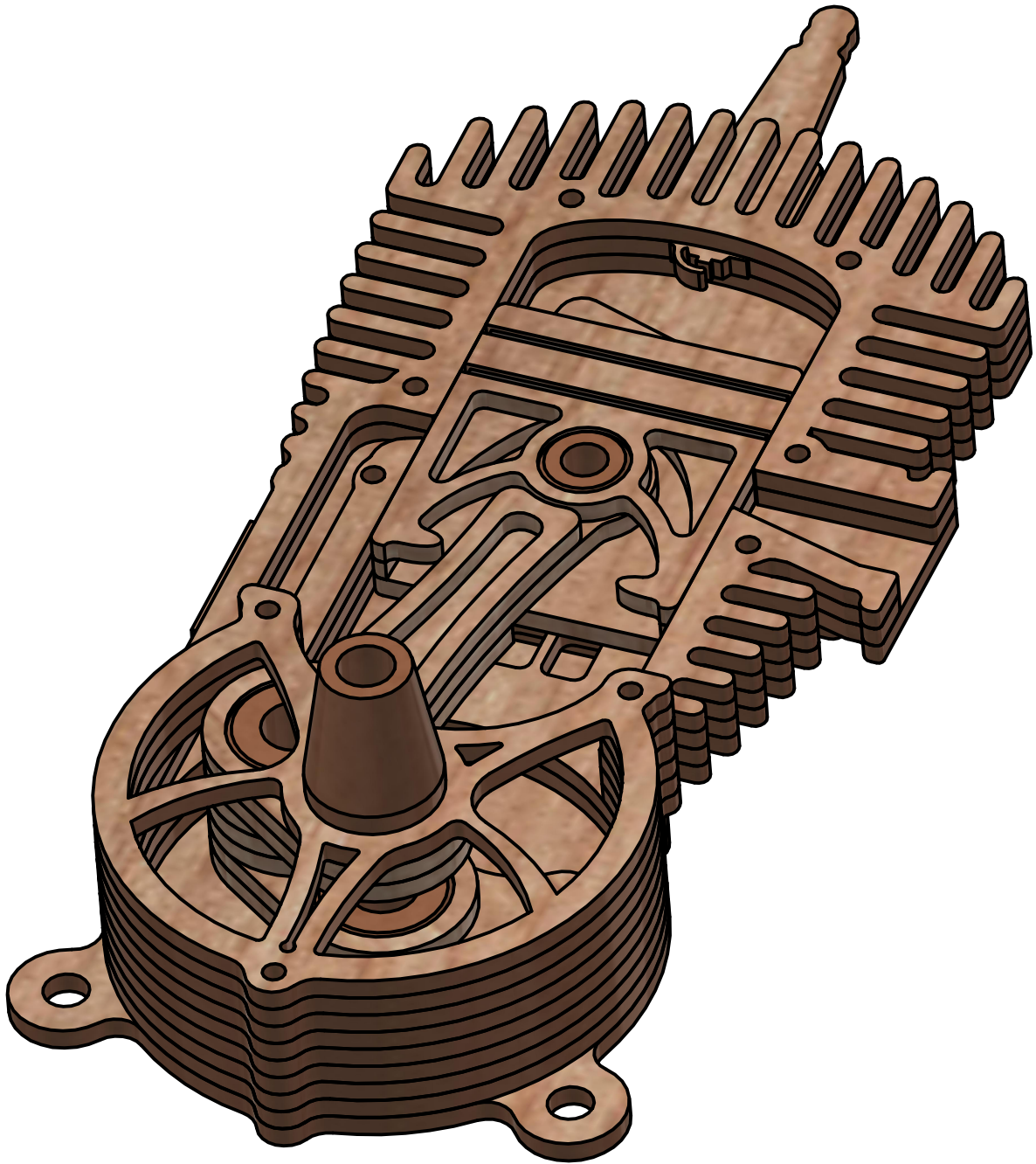


# A Scavenging 2 Stroke Engine



Our 2 Stroke model is designed to demonstrate how a 2 stroke engine works. Comparing this model to any of our 4 stroke engines, you can easily see the reduction in parts that makes small 2 stroke engines so light and compact. You can also see that the operating principles are more complicated. In order to understand the 2 stroke concept, you must pay attention to not only the space above the piston, but also the space below the piston.

# Before you Begin

Most of this kit was cut out of Baltic birch plywood on a laser cutter. Plywood is a natural product, and every piece is different. Because of this, the laser cannot cut every piece perfectly. This means that in some places, there is smoke and scorching. In other places, the wood did not cut completely and there are splinters hanging on the edges. The more time you spend preparing your parts, the better your completed model will be.

You should begin by making sure that none of the parts are missing. Look over the rest of the steps in this manual, and find all the parts for each step. Check the parts to make sure that they are in good condition. Minor damage can be repaired with glue. Splinters should be removed using an X-acto type knife and sandpaper. Scorched marks can be lightly sanded off. If any parts are badly broken or are missing, you can get replacement parts from [www.morrismodels.com](http://www.morrismodels.com).

A few of the parts for this kit are cut from maple or birch wood. These form most of the shafts. These also should be sanded for splinters. If you have access to power tools, they will look a little more realistic if you bevel the front of each shaft. The parts shown in this manual have been beveled. This step is for appearance only, and is completely optional.

This engine is designed to be assembled with any type of wood glue. I personally use Elmer's "Glue-All" glue. Do not use Elmer's "School Glue." It will not work. Whatever glue you use, use only enough glue to stick the parts together. Extra glue will squeeze out from between the parts and stick the engine together in places where it should not. Any glue that does squeeze out from between parts should be wiped up with a damp cloth while it is still wet. Most of the plywood parts have 1/8" holes. These holes are to help line up the layers. As you work, try to keep the glue away from these holes. When you put on a new layer, push short dowel pins into the layers to help line them up. These are called alignment pins. You should remove the alignment pins after the glue has had a few minutes to dry.

Many people ask if they can varnish, paint, or stain the engine. I do not recommend using paint or varnish, but oil-based finishes or stains are appropriate. Assemble the engine before using them. Another alternative is to use water-based markers. You can color each part before or after it is assembled. These parts absorb a lot of marker ink, so it will take quite a few markers to do the job.

Real engines use oil to keep them sliding smoothly. This wooden engine model would be ruined with oil. Most people use wax when assembling these wooden engine kits to help the parts slide smoothly. This step is optional. I have used candle wax and I have used colored crayons. Either of these will work fine. So does paraffin wax. I have also assembled quite a few of these engines without any wax. This also works. Just don't use wax on your engine before gluing the parts together, as this will interfere with the glue. It will also interfere with staining or painting the parts, so plan ahead.

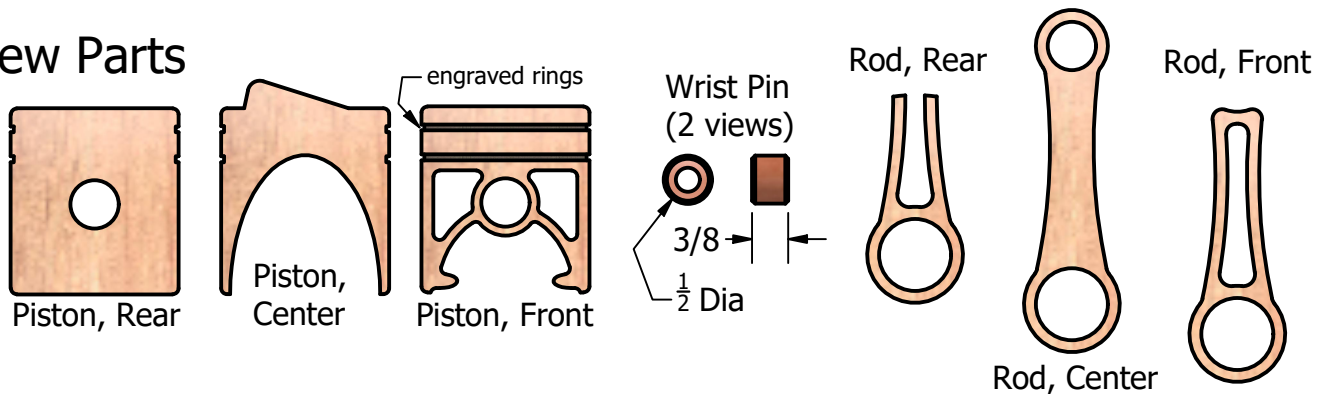
This manual shows how to build the engine step by step. Sometimes it is hard to explain things in a manual, but easy to understand it on a video. We try to shoot videos for each engine as time allows. If a video for this engine is available, it will be posted on the web site [www.morrismodels.com](http://www.morrismodels.com). Our videos show the same steps that are in the manual. Use a video if you prefer, or use the video to view any steps where you have trouble understanding the manual.

If you have access to Facebook, you can also interact with us there. We have a group that is intended to share tips, tricks, and questions with other builders. This group is entitled "Laser Cut Model Engines and Art," and we would appreciate it if you check it out and post pictures of your completed builds.

We hope you enjoy building this kit. If you do, you may want to consider building some of the other model kits. We have several more models available on the web site, and we add another model every few months - so check back.

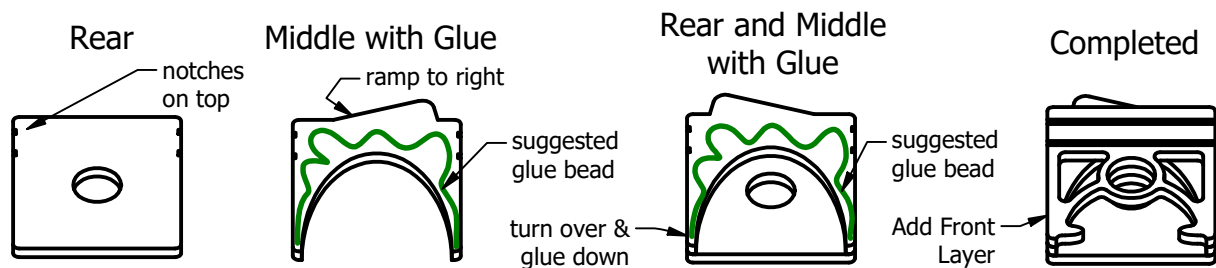
# Step 1 - Piston and Rod

## New Parts



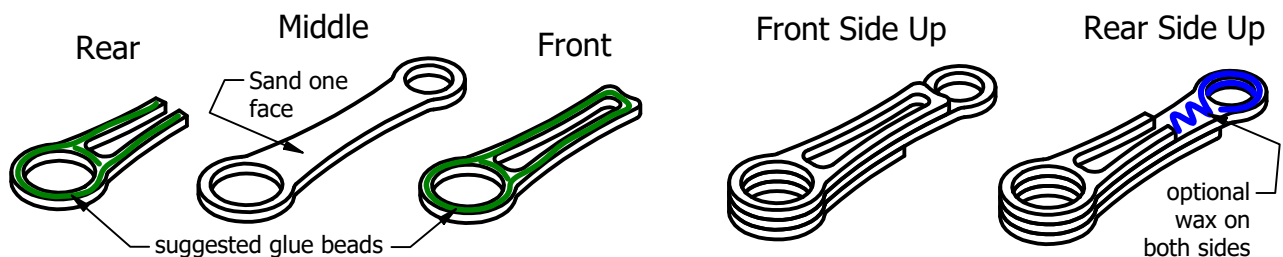
## Piston

Set the Middle and Rear Piston layers out. Gently sand and deburr the edges. Place a thin bead of glue as shown below. Turn the Middle Layer over and glue it to the Rear Layer, again as shown. Add another thin bead of glue, and add the front layer to the piston. Make sure all the edges and the wrist pin holes line up. Make sure there is no glue squeezing out of the sides. If there is glue squeezing out, clean it up before it dries and use less glue in the future. Set the piston aside to dry.



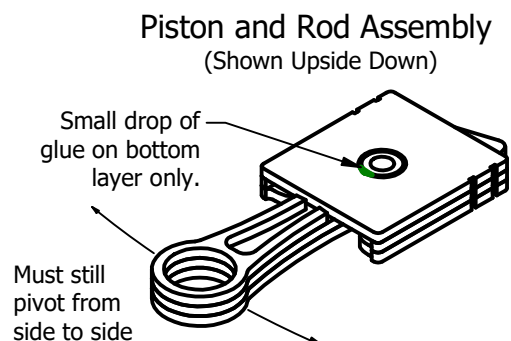
## Rod

Set all the layers of the round out in front of you, and lightly sand and deburr the edges. Then, using a sheet of approximately 80 grit sandpaper, heavily sand one face of the connecting rod. It must be a little thinner than the other layers in order fit well. Sand away about one half of one layer of wood. Next, add light glue beads to the front and rear layers of the rod as shown. Glue the front and rear of the rod to the center layer. It does not matter which side is which, but make sure that everything is lined up perfectly and no glue squeezes out around the edges or inside the hole. Set aside to dry.



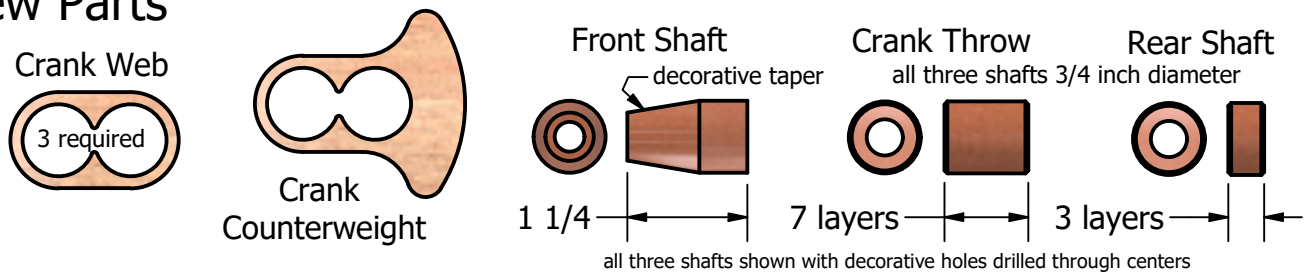
## Assembly

Gently sand and deburr the edges of the wrist pin. Wax the small end of the connecting rod if desired. After this, insert the small end of the connecting rod into the piston, and pin it in place with the wrist pin. These should fit together easily, and the piston should be able to pivot back and forth on the end of the rod. Set the rod and piston upside down, and secure the wrist pin in the piston with a small drop of glue on the edge. Make sure that the piston can still pivot.



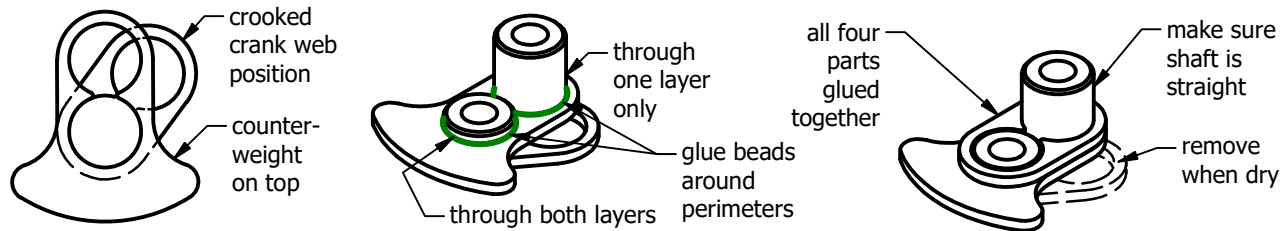
# Step 2 - Crankshaft

## New Parts



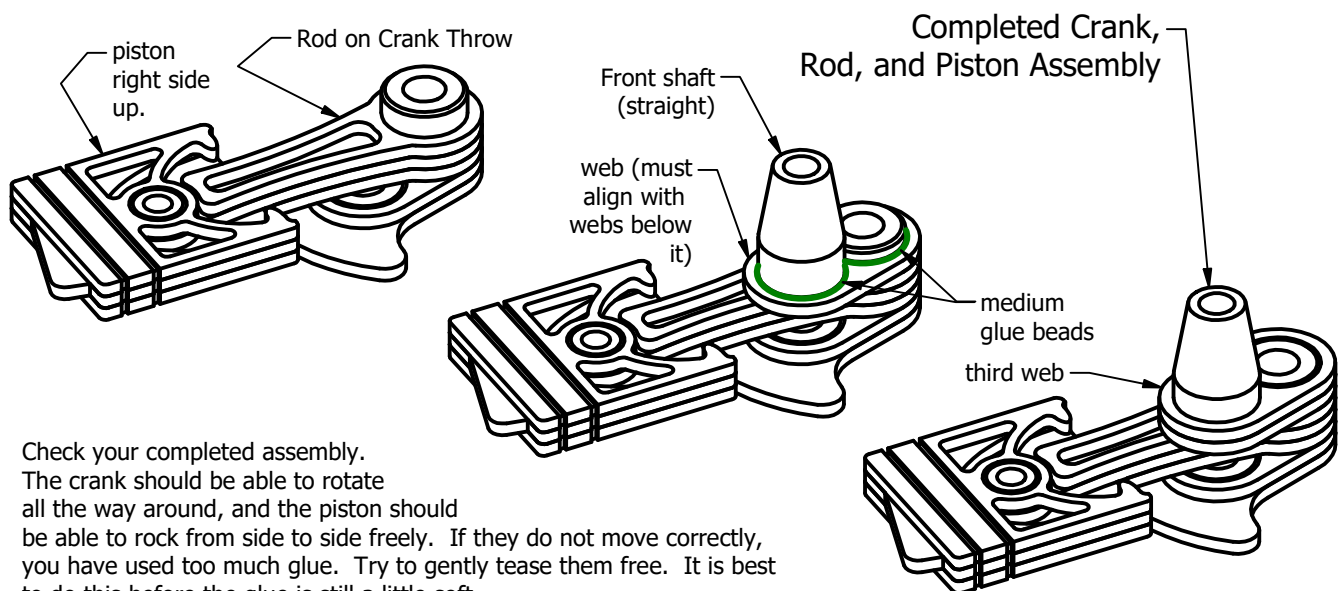
## Rear of Crank

Gently sand and deburr all parts. Set the crank counterweight on top of one of your crank webs, and place the rear shaft in the center hole as shown. It should extend through both parts. Place the crank throw in the other hole. It should only extend through the crank counterweight part. Lay out two medium circles of glue around the edges of both shafts where they meet the crank counterweight. Add another crank web over the top of both shafts, pressing it down firmly and gluing all the parts except the bottom crank web together. Allow to dry, and then remove the crooked crank web from the bottom.



## Completing the Crank

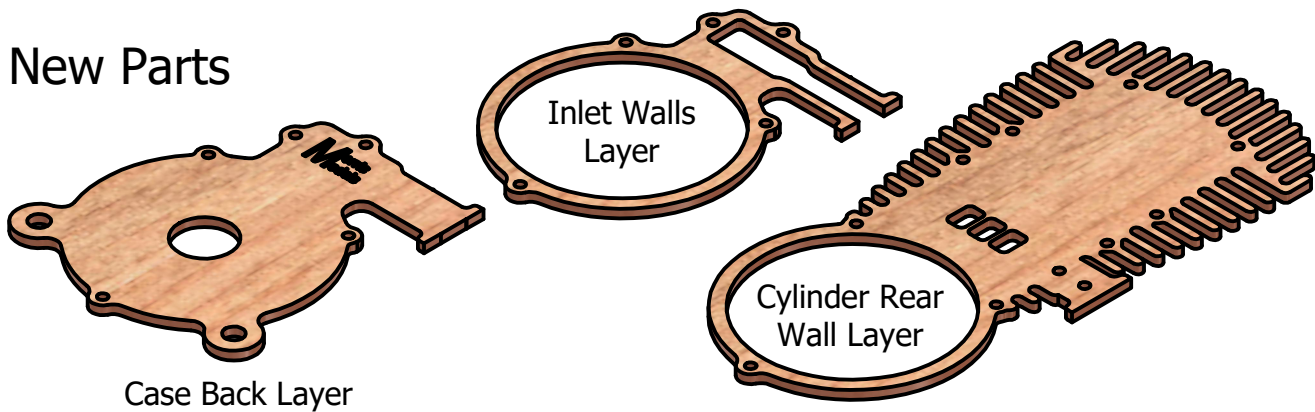
Heavily sand one surface of one of the remaining crank webs much like you sanded the center of the connecting rod. Wax the inside of the hole and the edges of the hole on the connecting rod (from the last page) if desired. Place the rod over the top of the crank throw as shown, making sure that the piston is face up. Place the sanded crank web over the top of the connecting rod and crank throw, and set the front shaft into the remaining hole. Lay a medium bead of glue around the perimeters of the throw and front shafts, and then add the third crank web to the top. Make sure that the glue does not get on the connecting rod, that the crank webs are aligned with each other, and that front shaft is straight. Set aside to partially dry before checking movement below.



Check your completed assembly. The crank should be able to rotate all the way around, and the piston should be able to rock from side to side freely. If they do not move correctly, you have used too much glue. Try to gently tease them free. It is best to do this before the glue is still a little soft.

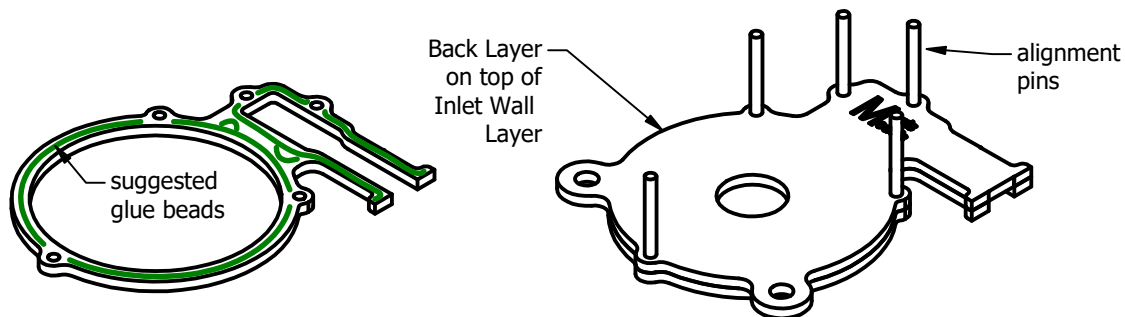
## Step 3 - Back of Case

### New Parts



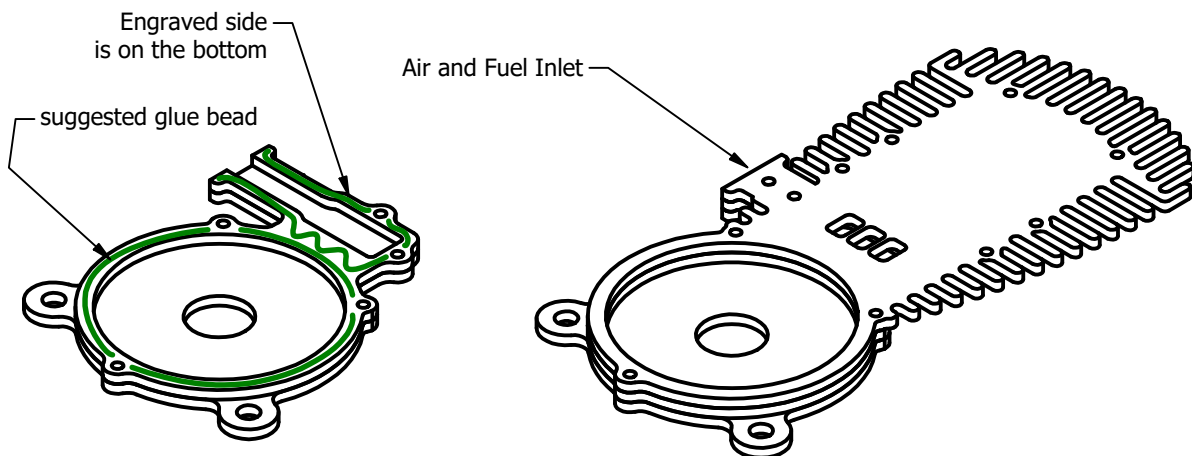
### Rear of Case

As always, begin by gently sanding and deburring all new parts. Set the inlet wall layer on the table in front of you as shown with the opening on top of the circle and facing to the right. Spread a thin bead of glue as shown. Glue the back layer in place over the top of the inlet walls. Insert short lengths of 1/8 inch dowel rod into the small holes to help you align the edges. These pieces of dowel rods are called "alignment pins" and will be used in most steps for the rest of this process. They will only be shown in this step. Make sure they don't get glued into the model. It is best to remove them before the glue completely dries. You should also be aware that they do not guarantee correct alignment - they are just an aid.



### Rear Cylinder Wall

Invert the rear case parts you just glued together, and spread another thin glue bead on the inlet wall layer. This bead is a mirror image of the last glue bead. Use three alignment pins (not shown) around the perimeter of the big hole to help you align the cylinder rear wall layer with the assembly. Glue it down, and check for any glue squeeze-out. If there is any, clean it up before the glue dries. Don't forget to remove the alignment pins before the glue dries completely.





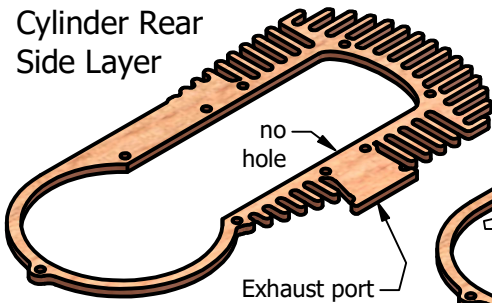
# Step 4 - Finish Cylinders

## New Parts

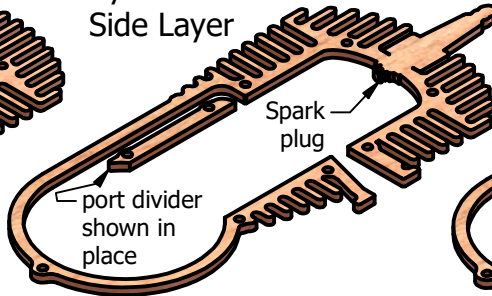


Port Divider  
(2 needed - shown full sized)

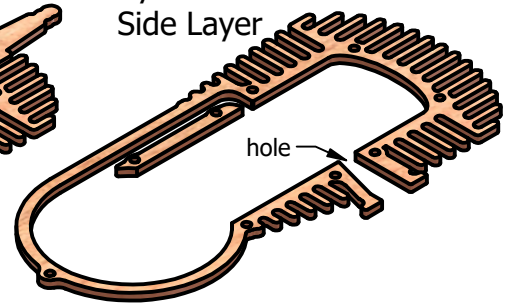
Cylinder Rear  
Side Layer



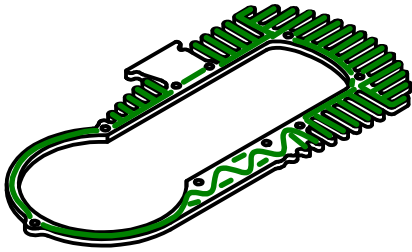
Cylinder Mid  
Side Layer



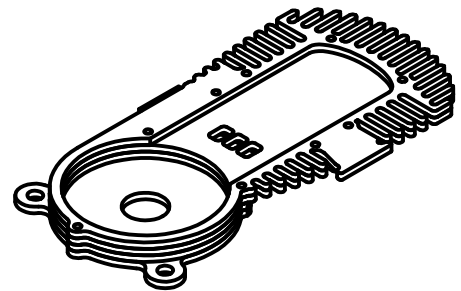
Cylinder Front  
Side Layer



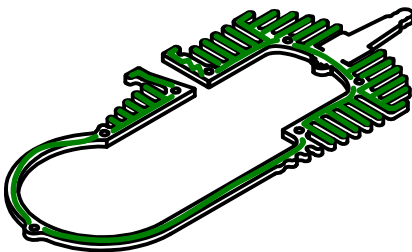
## Rear Side Layer



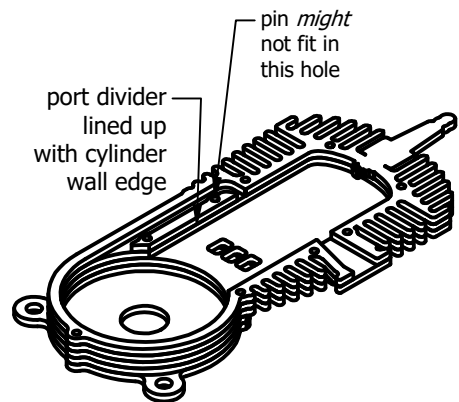
Again, sand and deburr the new parts. Set the rear cylinder layer so that the exhaust port is up and to the left as shown on the left. Add a thin glue bead as shown, taking time to include all the fins. Turn this layer over, and glue it on top of the rear cylinder wall on the assembly you built on the last page. Use alignment pins to help you. Assembly is on the right.



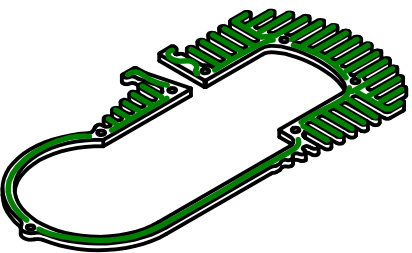
## Mid Side Layer



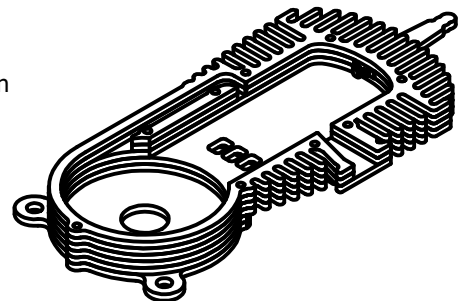
Set the mid cylinder layer so that the exhaust port is up and to the left as shown. Add a thin glue bead as shown, taking time to include all the fins. Turn this layer over, and glue it on top of the assembly. Next, add one of the port dividers. Use pins to help alignment. (Some early models have an error, and you can only use the bottom pin.)



## Front Side Layer

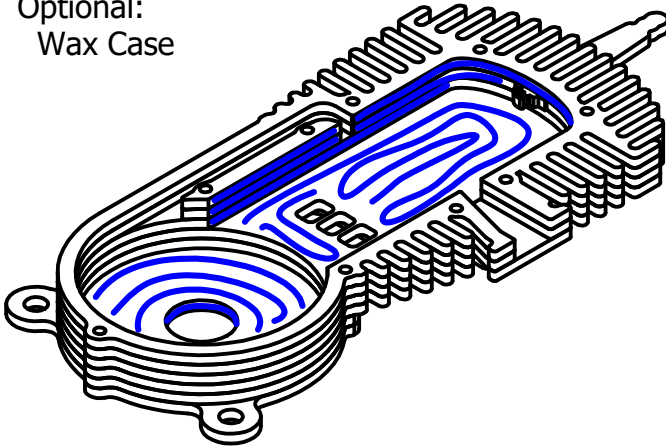


Set out the front side layer as shown, and add the suggested glue bead. Turn over the front layer, and glue it and its port divider down onto the assembly. Allow assembly to dry before continuing.



# Step 5 - Fit the Rotating Assembly

Optional:  
Wax Case

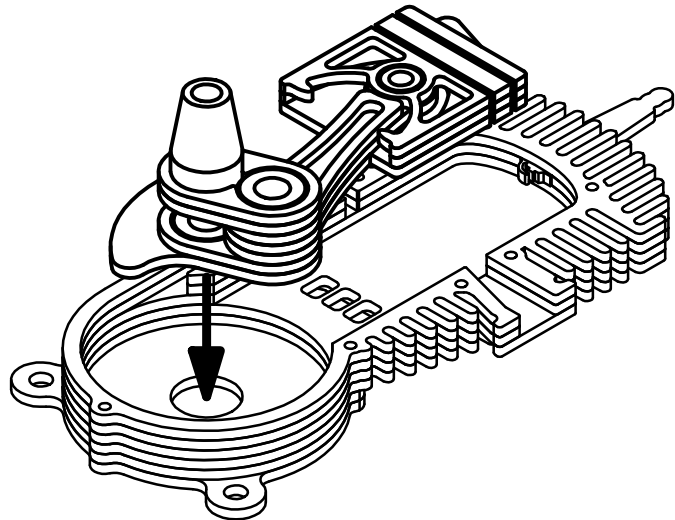


If desired, wax the back of the case, the rear cylinder wall, the side cylinder walls, and the sides of the crank hole. This will make the engine spin a little more smoothly.

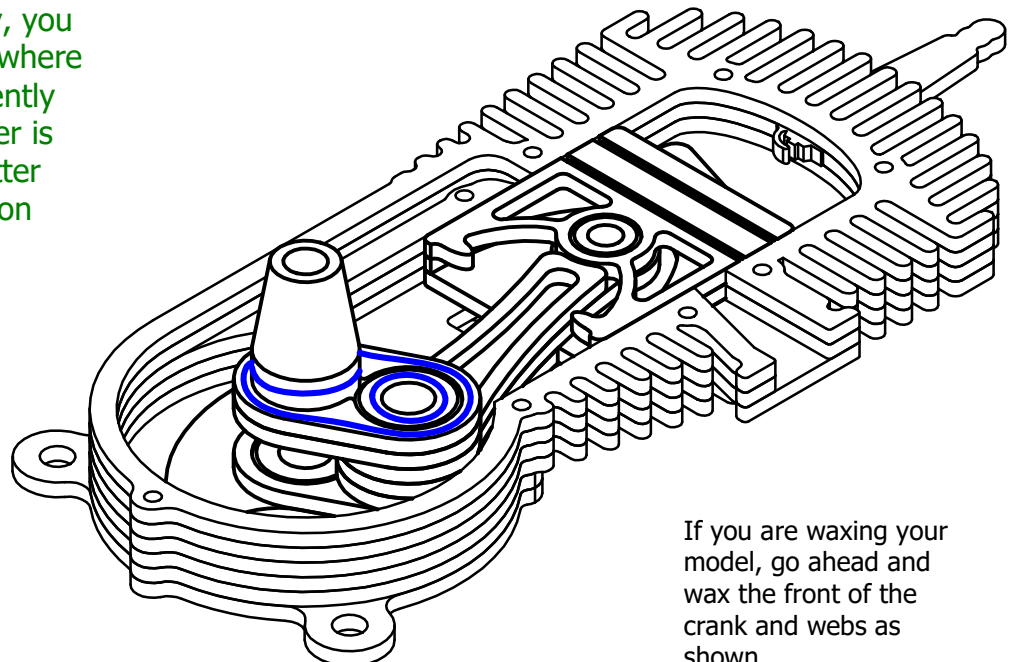
Suggested waxing locations are shown in blue.

## Add Rotating Assembly

Gently line up the piston and crankshaft with the open space in the case and cylinder assembly. Fit the crankshaft into the round part of the case, with the rear shaft fit into the center hole.



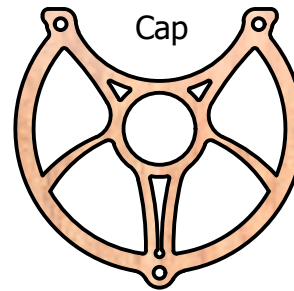
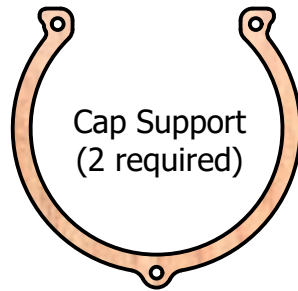
At this point, you should be able to spin the crank and the piston should go up and down easily. If it cannot move easily, you need to figure out where it is sticking and gently sand away whatever is binding it. It is better to sand on the piston sides than on the cylinder walls.



If you are waxing your model, go ahead and wax the front of the crank and webs as shown.

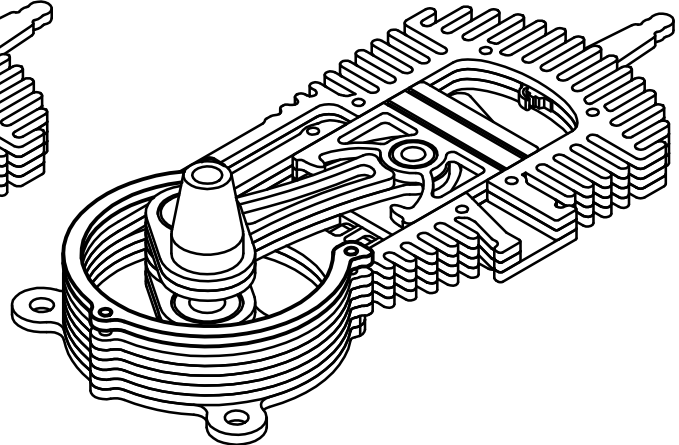
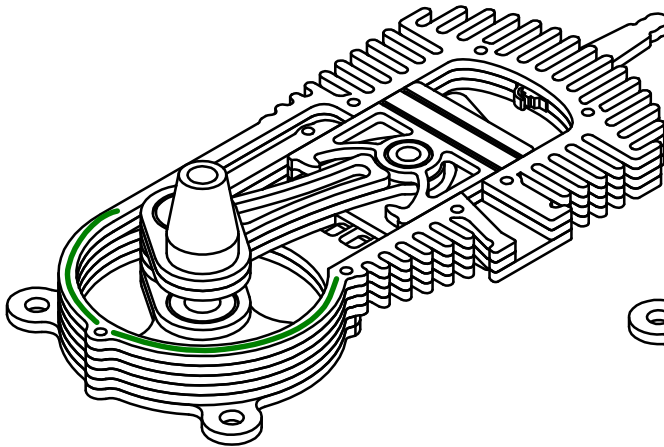
# Step 6 - Finish the Model

## New Parts



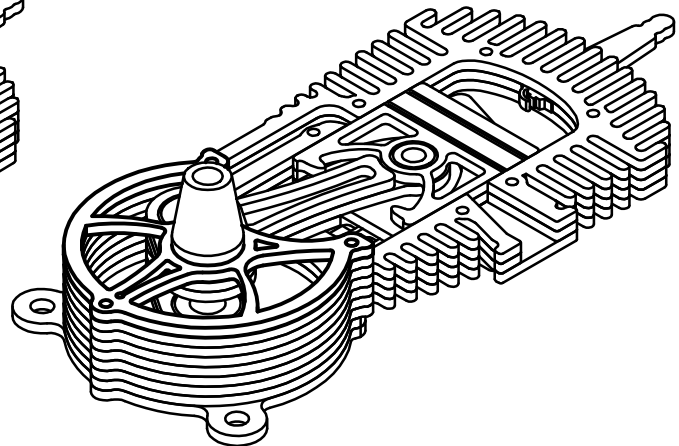
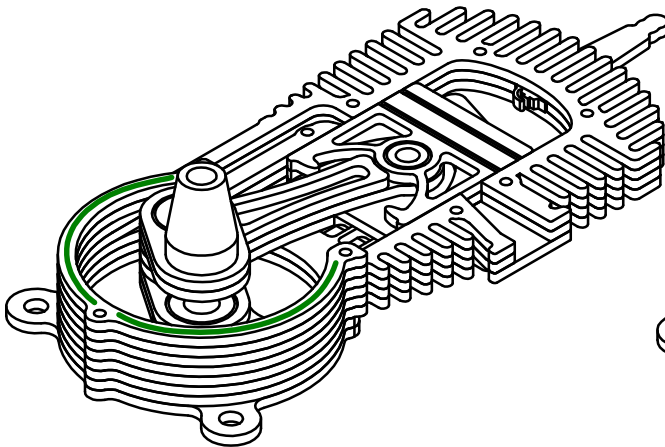
## Add Cap Supports

Gently sand and deburr the edges of the new parts. Spread a thin bead of glue around the crankcase circle as shown below. Use alignment pins and add one of the cap supports. Spread a similar bead of glue on it, and add the second cap support directly on top of the first.



## Finish the Model

Dry fit the top cap in place on the model, and verify that you will be able to glue it in place. If you have thinned your parts as in the instructions, it should fit in place without squeezing down so tightly on the parts below it that it is hard to turn the crankshaft. If the crank is squeezed too tightly, you will need to space the cap forward with part of the extra cap support that is included with your model. If you need to do this, you should sand the support down until it is the minimum thickness needed to allow the crank to spin easily. Glue it down like the two previous supports in the last step. Spread your last light beads of glue on the cap support and glue the cap down. Allow the glue to dry.



We hope you enjoyed putting together this model. If you did, you may enjoy some of our more complicated models. Please visit [www.morrismodels.com](http://www.morrismodels.com) to see our other offerings.