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Low Cost 4" Comet Pumps

Figure 1: A wooden comet pump turned on a lathe.

Figure 2: 4" PVC outer sleeve and 3" PVC inner piston.

Introduction:
This project was designed around two guiding principles: 1) bigger is better and 2) pyro hobbyists have no money. Many of you have probably been wanting to make large comets, but have been denied this endeavor due to a lack of affordable tooling or the ability to make the tooling yourself. The tool shown here can be made from parts readily available in most hardware stores, with a price tag below $20 for all materials. The method of comet pump making shown here can be adjusted for any size comet you want, be they hollow core or solid. All without the need for large, expensive chunks of metal, machine tools or wood lathes.

Figure 1 shows a wooden 4" comet pump that I turned on a lathe. However, I figured that most people don't have a wood lathe and if they did, they wouldn't need me to tell them how to make something as simple as a 3-1/2" diameter cylinder with a hole through the middle! The sleeve shown in Figure one is a segment of 4" PVC that has been reduced in diameter so that the I.D. measures 3-1/2". The procedure for doing this is shown below.

Those that do have a wood lathe have the advantage of being able to turn a custom profile such as a sphereical spindle base, which is necessary when making large comets that can be attached to ball shells. The comet pump described in this article makes comets with flat surfaces on both ends, which works fine for stand alone comets and comets that can be attached to canister shells.

Making the Sleeve:
The pump shown here is made using two segments of PVC, as shown in Figure 2. The idea of using PVC sleeves to pump comets is definitely not new, but it presents a problem when the standard diameters of available PVC do not match the comet diameter that you need.

Since there is no PVC with a 3-1/2" inside diameter, it becomes necessary to shrink down a segment of 4" pipe. Start with a 9" long segment of 4" PVC that has a 1/4" wall thickness. Mark two points on the outside edge of one end that are 1-3/8" apart. This is the segment of pipe that you will need to remove. You will need to mark guide lines down the side of the pipe as shown in Figure 2. This is easily done by laying the pipe on it's side next to a thick piece of wood that runs the length of the pipe, using the wood as a guide when drawing the lines.

The tricky part is making the two cuts to remove the unwanted segment of pipe. The easiest tool to use for this is a thin kerf Japanese hand saw, as seen in Figure 3. A bench vise is really handy for holding the pipe while you are sawing. As you make the first cut, the pipe will want to close in and bind

Figure 3: Reducing the diameter of the 4" pipe to 3-1/2" I.D.

Figure 4: Pipe clamps used to close the gap prior to heating in oven.

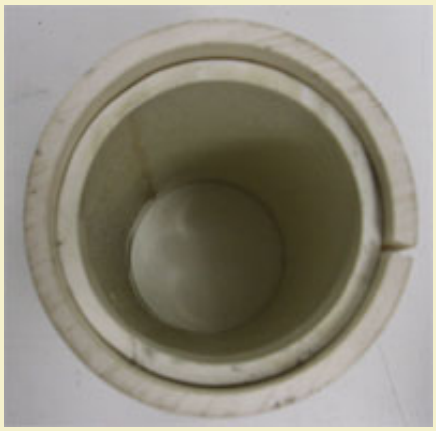

Figure 5: After heating the sleeve should fit snugly over the piston pipe.

the saw. About halfway through the cut it becomes necessary to wedge a chisel into the gap to hold it open while you cut. Making the second cut is easier and should not require this step.

Once you have cut out the thin strip, clean up the edges with sand paper or a deburring tool. Next you will want to use three pipe clamps to pull the pipe in and close the gap as much as possible. Make sure that your 3" I.D. piston pipe still fits easily inside the sleeve when the gap is closed. The piston pipe is also a 9" long segment of 3" PVC which also has a 1/4" wall thickness, making the O.D. equal to 3-1/2".

Once the sleeve gap is pulled in as close as you can get it, and it looks like the piston will fit inside with no problems, place the sleeve in an oven set to 250 deg. for about 15 minutes. This will soften the plastic and cause the pipe to maintain it's new diameter once the pipe clamps are removed. Allow the pipe to cool fully before working with it, as it will be very pliable coming out of the oven.

Figure 5 shows a perfect fit of the reduced 4" pipe with the 3-1/2" O.D. piston pipe inside of it. If there is a lot of space around the inner pipe, you can always slice off another thin strip from the pipe with your saw. However, if the sleeve is now too small to allow the piston to fit inside, you will have to start over using a narrower gap such as 1-1/4" next time.

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4" Comet Pump

Figure 6: Plywood base, 3-1/2" dia. disk and the 3/4" aluminum rod.

Figure 7: Attaching disk to base using wood glue and C clamp.

Figure 8: Perforating the piston pipe with 1/4" holes.

Building the Base:
Since this comet pump is for producing hollow core comets, it is necessary to use a base similar to a rocket spindle. The base is nothing more than a block of wood that holds a 3/4" metal which is cut to 10" long. I prefer a solid piece of aluminum bar stock, which can be found in most scrap yards for only a few dollars. Hollow tubing can be used, but the top end must be plugged to keep powder from falling into it while loading the sleeve. This is easily done by stuffing a wad of paper into the end and then filling over top of it with hot glue.

The base is made from a 6" square piece of 3/4" thick plywood and a 3-1/2" diameter disk also made from 3/4" plywood. Plywood is preferred over solid wood because it will not split under pressure.

Use a compass when marking the circle to cut for making the disk so that you will know the exact center point. You will drill a hole here later, so mark it with an X. The disk can easily be cut on a band saw or router table. If you have neither of these you can use a saber saw, saws all or similar hand held tool to try and cut the circle. Or you can just find a friend with wood tools and have him make it.

The wooden disk is simply glued to the middle of the square base using wood glue and a C clamp, as seen in Figure 7.

Once the glue is dry, you will need to drill a 3/4" hole about 1" deep into the base using a spade bit. Use of a drill press is the best way to insure that the hole is exactly perpendicular. Drill presses come in handy for all sorts of pyro applications, so if you've been thinking about buying one then now you have one more reason!

The spindle rod should fit snugly into this hole, but there is no need to permanently secure it in place. Just press fitting the rod in place allows you the ability to interchange it with shorter rods for making cavity comets, which are comets where the core does not go all the way through the comet.

Making the Rammer:
While the glue is drying on your base, take your 3" PVC piston pipe and drill a bunch of 1/4" holes through the sides as shown in Figure 8. The purpose of these holes is to allow the plaster that will be poured inside to have a firm grip on the walls, insuring that there is no chance the core could ever break loose from the outer pipe. Do not worry about precision spacing with the holes, just randomly perforate the pipe with them.

Once your base is completed, you will use it for the mold when pouring the rammer. You will need to prepare the spindle rod by rolling two turns of kraft around it to increase it's diameter slightly. Be sure to leave 1" exposed from the end so that you can insert it back into the base. Next you will need to roll

Figure 9: Base and rod are protected with wax paper.

Figure 10: All pieces in place and ready for pouring the core.

another two turns of wax paper around the kraft paper so that the spindle and paper can be removed from the mold when it dries. Since nothing sticks to wax paper, you will have to secure the two turns in place using heat to melt the wax together. I do this by heating a chisel with a blowtorch and then rubbing the hot metal over the seam to seal it down.

Place a piece of wax paper over the base and then press the spindle back into the hole through the wax paper. You will also need to roll a few turns of kraft around your perforated rammer pipe in order to minimize liquid plaster from running down the sides. Figure 9 shows the base and rammer prepared for pouring.

First slide the sleeve onto the base over top of the wax paper. Next you will need to wedge the rammer into place. The two turns of kraft will increase the diameter so that it no longer easily fits into the sleeve, so you will need to use a screwdriver to pry open the sleeve until you can push it down into place. Figure 10 shows all components ready for the pour. Be sure that the spindle sticks up higher than the rammer and sleeve, otherwise it will get buried under plaster.

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4" Comet Pump

Figure 11: Mixing Durham's Rock Hard Putty in a cutoff milk jug.

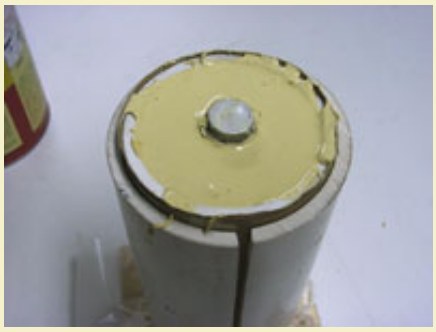
Figure 12: Piston is filled to the top with water putty.


Figure 13: Complete 4" hollow core comet pump for under $20!

Pouring the Plaster:
While there are a couple of fillers that could be used to pour this mold, the easiest one to work with by far is Durham's Rock Hard Water Putty, shown in Figure 11. This yellow powder is simply mixed with water like plaster of Paris, but unlike plaster of Paris it dries so hard that it is difficult to even sand it. This stuff is so strong I have even heard of people using it to plug the bottoms of mortars! It dries fast and is easy to wipe from places where it is not supposed to be.

Another substance that can be used, and will also never crack under pressure, is fiberglass resin diluted heavily with sand. This is a bigger pain to work with and also requires more skill to properly prepare. It must be diluted at least 50% by volume with sand, which conserves resin and also helps prevent excessive heating as the resin dries. The mess, fumes and difficulty of cleanup makes this method unattractive.

You will need the 4 lb can of Durham's to make enough to fill this mold. I prefer to mix this putty in a modified milk jug, shown in Figure 11. The thin, flexible jug allows you to easily crack off the dried leftovers and remix a new batch between applications. It will take two batches of the size shown in Figure 11 to fill the mold. If you work fast enough you can mix the second batch without cleaning the jug from the first batch.

Simply add water and stir with a spoon until a creamy consistency is reached. It should not be thin enough to be poured, rather you should have to scoop it into the mold. You don't want it too thick either or it will not settle into the holes and air may get trapped between lumps.

Fill all the way to the top of the pipe, then clean off the end of the spindle so that it is not buried in putty. Figure 12 shows the finished pour.

After about 20 minutes the putty will reach a semi-dried state where it is still soft enough to scrape but solid enough not to deform or run. At this point you want to remove the sleeve and pull the rammer off the spindle. Unwrap the kraft wrapper and use a thin metal blade to shave off any putty that squirted out the holes. Also clean up the ends of the rammer as much as possible, because it is much easier to trim off the putty now than when it dries. The paper tube left inside the rammer should slide out, leaving only the wax paper. Try and pull out as much of the wax paper as you can. If some wax paper gets stuck inside the cavity wall then don't worry about it.

Figure 13 shows the completed comet pump set. The exposed wood on the base should be protected with varnish, krylon or other sealer so that the pump can be hosed off after use. It is a good idea to seal the exposed plaster on both ends as well, since it will absorb water.

Listen to what Rocky sez!

The end of the rammer that is very flat should be the end that gets pressed from above when pressing comets. Ideally both sides of the rammer will be flush and flat so that you don't have to worry about which side to press against.

Note that both top and bottom of this pump must be sandwiched between at least 5" square metal plates, which will distribute the pressure evenly so that the pump does not get damaged. For more information on how to use this pump, see the 4" comet article in this month's issue.

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