

## 1/2 inch Ruby Cylinders

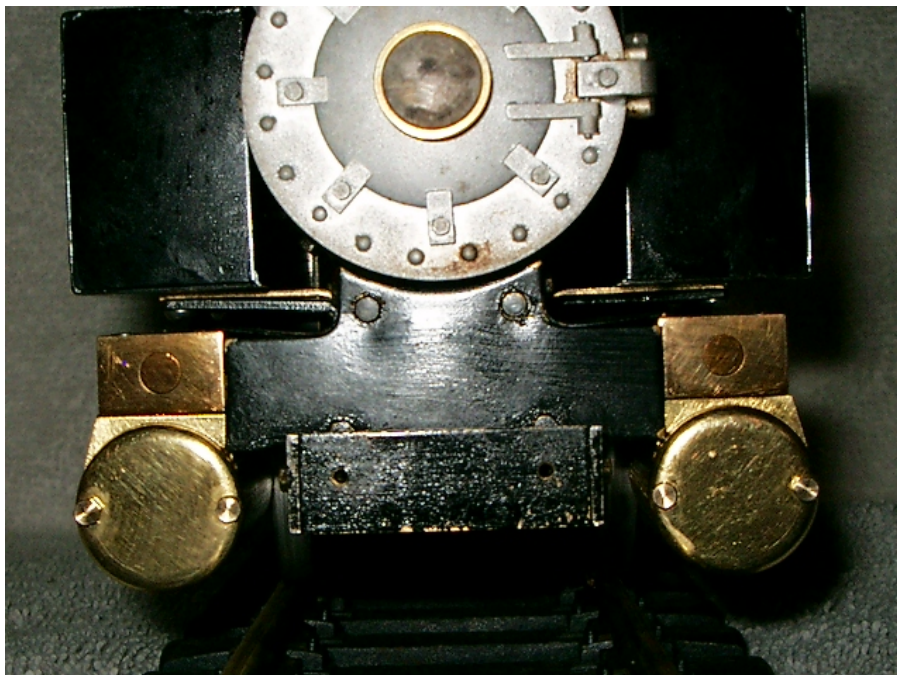
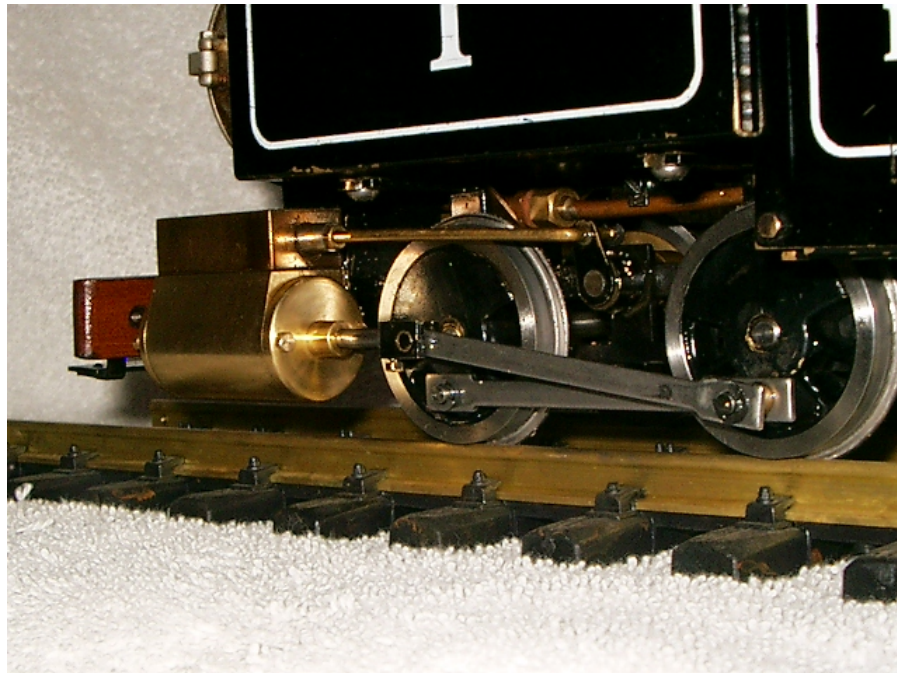
Original Topic URL: [http://www.mylargescale.com/forum/topic.asp?TOPIC\\_ID=19534](http://www.mylargescale.com/forum/topic.asp?TOPIC_ID=19534)

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**Topic author:** Dave Hottmann

**Posted on:** 04 Jan 2004 20:53:58

Here's my latest design. This time I raised the cylinders 1mm to bring the piston centerline closer to the driver centerline. Having the centerlines close makes a difference in how smooth the engine runs.



For 9/16" cylinder owners, note that the horizontal steamchest tin goes up at the valve blocks. There is enough flex in the steam pipes to keep the direction valve block in it's original position. Boiler does not need to be raised.

## Replies:

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**Reply author:** Scottychaos

**Replied on:** 08 Jan 2004 16:50:12

Dave,  
very nice!  
where did you get the new cylinders?  
did you make them yourself?  
what difference do these make over the stock cylinders?  
thanks,  
Scot

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**Reply author:** Dave Hottmann

**Replied on:** 08 Jan 2004 22:54:46

Scot,  
I machined them from round and square brass stock. I chose 1/2" bore because the Shays run so well with 1/2", and I could line up the piston and axle centerlines. Low speed performance was GREATLY improved. With 3/8" bores I couldn't pull my AMS box cars on my grades. Now I can start with cold cylinders on a 2% ascent with 2 AMS gonds, 2AMS flats, 4 AMS box cars, 5 Bachmann tanks, and an AMS brass long caboose. With this load it runs out of water in 10 minutes. With 6 Bachmann coaches it averages 17 minutes. On the treadmill it runs 35 minutes going SLOOOOOW.

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**Reply author:** Torby

**Replied on:** 09 Jan 2004 07:12:53

Going from 3/8 to 1/2 bore is going to be a huge increase in force! The results should be dramatic.

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**Reply author:** Bob Starr

**Replied on:** 10 Jan 2004 13:52:51

Dave,  
I haven't commented on your project yet, but I am impressed. It is nice to see that you are machining now it sure does increase your abilities. Yes, it is very important to keep the centerline of the pistons in line with the axles. Have you considered making an axle pump to increase run time since you have added power?

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**Reply author:** Dave Hottmann

**Replied on:** 10 Jan 2004 17:29:34

Bob,

I haven't thought about an axle pump, but my brain is working on adding to the boiler. I would like to add to the right side inside the cab. I guess this would be called an "L" boiler

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**Reply author:** John F. Mower  
**Replied on:** 10 Jan 2004 18:03:41

OK Dave H. has done it again. Dave made me a set of 1/2" cylinders for my Ruby, and today was the maiden run. You can't believe the difference in how this little engine performs 🇺🇸. I have 2 1/2% grades on my layout and it pulls the hills as slow as I want to go with twice as many cars. I now only use half of the throttle as I did with the 3/8 cylinders. Run time is almost doubled. This is now an enjoyable engine to operate. It would be nice if these cylinders were available for everyone!

I LOVE THIS LITTLE ENGINE NOW!

John M.

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**Reply author:** Dennis Paulson  
**Replied on:** 10 Jan 2004 19:08:38

Well thats two of you that have proven the larger cylinders work better , and the guy in the UK that makes the bigger cylinders that people say are such an improvement , wonder when Accucraft will take notice of the improvement of the larger bore ?

link to Super Ruby upgrades  
<http://www.sm32.co.uk/>

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**Reply author:** rmarino  
**Replied on:** 11 Jan 2004 12:40:27

Jack

I've been running the 9/16 cylinders for several months now and the improvement in power and rainge is mind boggeling.

Rick Marino

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**Reply author:** John Page  
**Replied on:** 15 Jan 2004 03:18:14

Dave,

Do you have, or can you prepare some basic shop sketches so I can learn to machine these new cylinders. If I can do so successfully, I would like to make some more pairs for the "RubyMasterClass" if it develops (at the lowest possible, non-profit cost). Do you use the OEM steam chest/valve chamber on top of the replacement cylinders?

Thank you kindly,  
John Page

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**Reply author:** slimgauge

**Replied on:** 15 Jan 2004 08:08:19

Would my poor little MicroMark 7x14 lathe and mini-mill be capable of making these replacement cylinders ? With a rank beginner like myself at the controls ?

I've run the mill a few times, but the lathe hasn't turned yet.

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**Reply author:** John Page

**Replied on:** 15 Jan 2004 12:55:02

John F.K.

A 7x14 has the size capacity for this project. I don't know how strong these motors are. Brass is a very "grabby" material. So light cuts, and non-aggressive cutting tool angles are important. Check your machining reference books for advice on grinding your bits. A separate set of drill bits is recommended, in which you have stoned the cutting lips flat for several thousandths of an inch (parallel to the drilling axis).

Start practicing ASAP on some pieces of brass. I think this is going to be fun; with small increments of frustration and large increments of learning. The actual cylinder bores will be reamed and polished, and pistons cut and grooved to fit the cylinders.

External shaping is milling machine work. I'll have to examine the Ruby's original cylinder blocks to figure out the steps involved. Help, descriptive steps, etc., from more experienced machinists is most highly welcomed.

Toot, toot to RubyMasterClass,  
John R.P.

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**Reply author:** Dave Hottmann

**Replied on:** 15 Jan 2004 12:57:42

John and John,

I don't have a computer program to post the specs. (Anyone know of a good one for Windows XP?) I'm machining with a Logan 11X24 lathe and a Grizzly knee mill. Boring the 1/2" hole is where the limits of the machines can be a problem. I am using the stock valving. I basically copy the OEM cylinders with some changes. I add 1mm to the cylinder mount, going from 2mm thick to 3mm. This is to help the centerlines line up. I lowered the bore centerline from the valve deck to .450". This makes it so you don't have to shorten the valve screws. I thickened the heads to .100" and extended the piston rod support to .200" from the back of the head. This is for better head to cylinder sealing and piston rod support. I am using silicone instead of head gaskets. This is to maintain the two bolt per head "sleeper" look. Cylinder walls are .160". The thicker cylinder walls are to prevent bore distortion from the head bolts. Cylinder head OD is .820". I am using 1/8" rods because 3mm is hard to find here in the States. The big trick is getting the piston rod to not leak. Dave at Ozark Miniatures has expressed an interest in casting cylinder blanks. We haven't tried it yet. I am using square stock for the cylinders. I started some more last night. If you are intrested I could post pictures of progress.

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**Reply author:** John Page  
**Replied on:** 15 Jan 2004 13:10:57

Dave,

Thanks much, for those initial dimensions. Progressive photo shots of machining steps and setups would be fantastic. Hi-Res broadband OK. I'll send my email addy privately, offline. I have a ready source of surplus square brass stock at \$2/lb.  
JRP

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**Reply author:** Dave Hottmann  
**Replied on:** 15 Jan 2004 14:51:50

John,

I'll post low res pictures here until someone complains. To start with you need 7/8" round, 1/2" round, and at least 1 1/8" square brass.

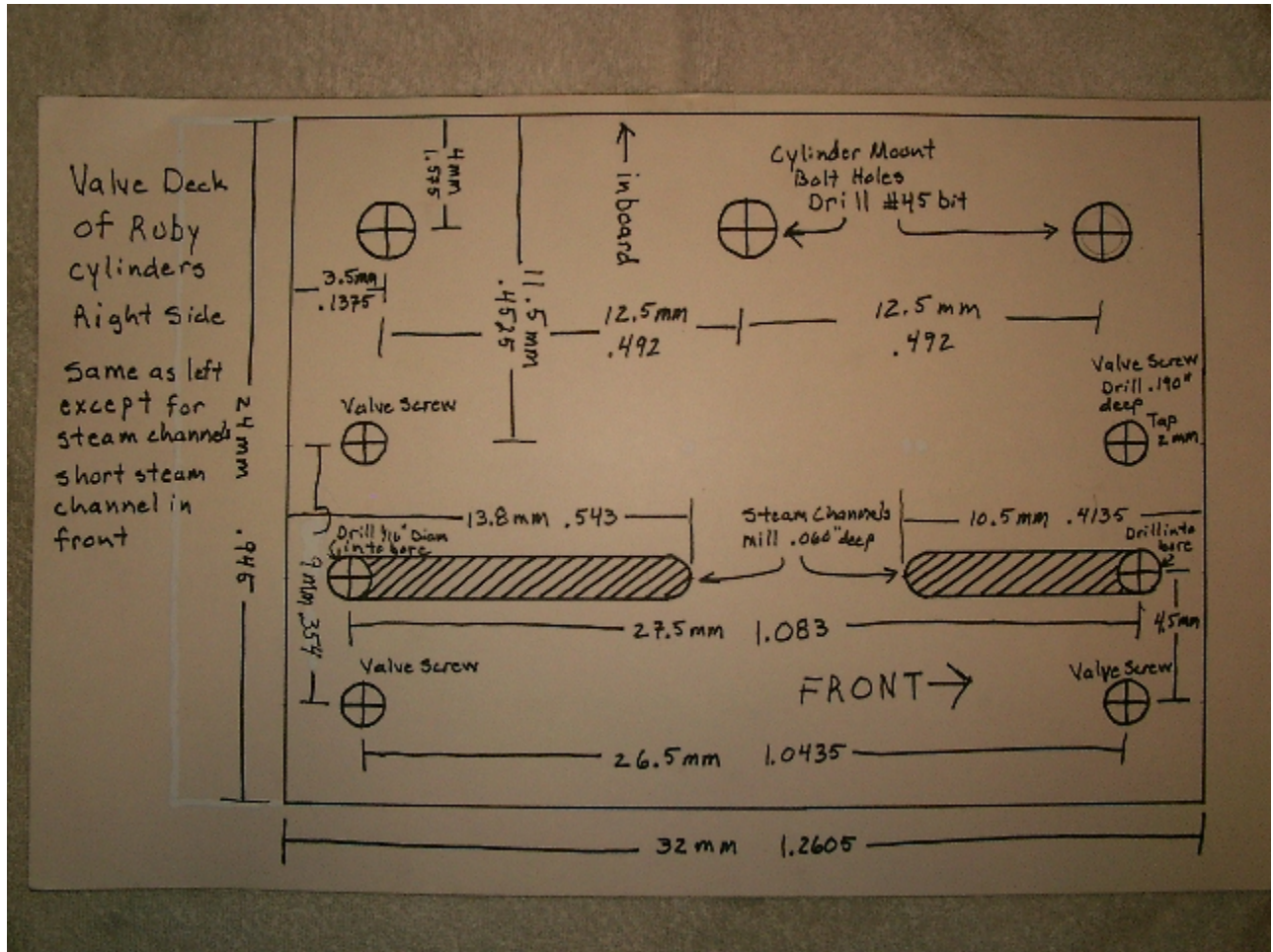
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**Reply author:** Dave Hottmann  
**Replied on:** 15 Jan 2004 18:14:24

First Step: I saw the 1 1/8" square brass to 35mm lengths. Then face them square and to 32mm long. This is the finished length of the cylinders.



Here's the specs for the valve deck. This is basically the same as an OEM cylinder. The depth of the valve screw holes is critical, .190" deep (NO MORE) and tapped 2mm with a bottoming tap. OOPS!! There is a mistake in this picture! 4mm=.1575", NOT 1.575".



sorry about the crude picture. 🙄

**Reply author:** Dave Hottmann  
**Replied on:** 16 Jan 2004 00:06:42

John,

The centerline of the bore is directly below the steam channels, .450" down from the valve deck. I'm waiting for replacement tooling to start boring. Then I'll post more pictures.

**Reply author:** samevans  
**Replied on:** 16 Jan 2004 13:59:51

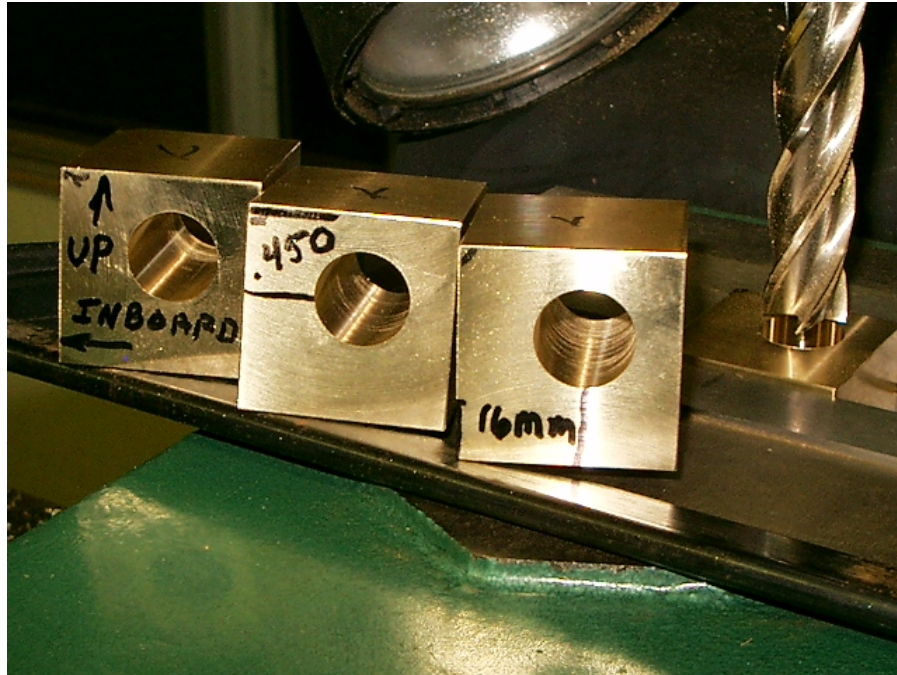
Paul Smith in the UK makes replacement cylinders for Ruby URL <http://www.sm32.co.uk/>. They use the existing valve chests. I have used these cyls and am very pleased with the difference that they make.



**Reply author:** Dave Hottmann  
**Replied on:** 16 Jan 2004 23:59:29

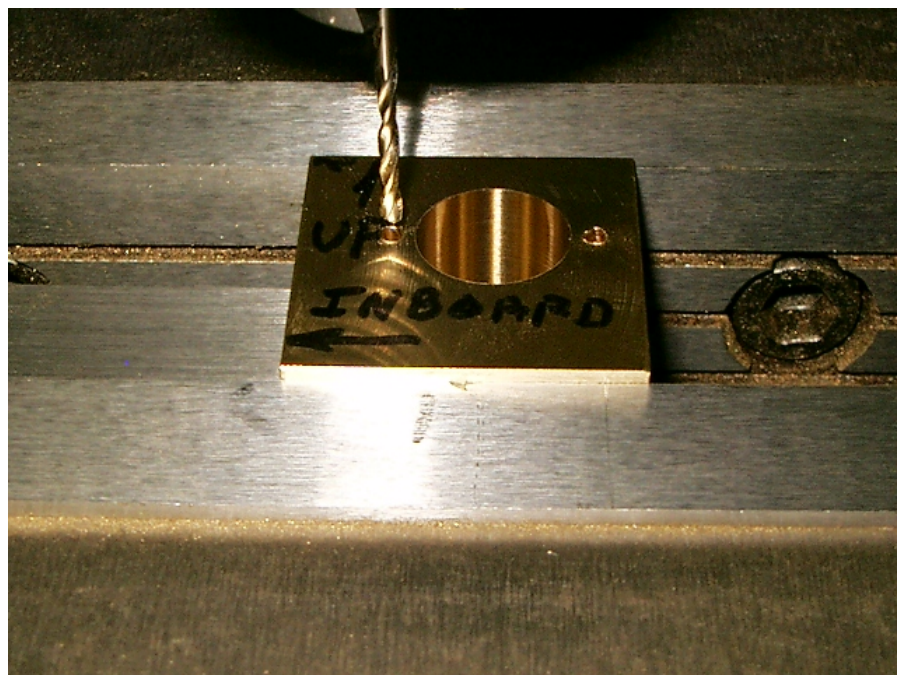
### Step 2

Pick the best surface for the valve deck and mark it. Then pick an adjacent side for the inboard. These two surfaces are where to measure from for the bore centerline. Go in 16mm from the inside and .450" from the valve deck. I bored mine with a .5 end mill, works for me.



### Step 3

Drill the head bolt holes  $.330"$  ( $.250 + .080$ ) each side of bore center  $.200"$  deep. Turn the cylinders over and drill the other head bolt holes. On the first sets I made used 2mm bolts. This time I'm using 2-56, MUCH cheaper and easier to find.



**Reply author:** TrotFox  
**Replied on:** 17 Jan 2004 04:33:50

Say Dave,

Is there any chance the cylinders could be made with a reduced wall thickness to try and maintain the small cyl look? I realize it's probably asking a lot to get the head bolts in a thinner package but it doesn't hurt to ask. ;]

One of these years I'll have a lathe and mill and will be able to do this stuff myself. :)

Trot, the dreaming, fox...

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**Reply author:** Dave Hottmann  
**Replied on:** 17 Jan 2004 08:42:38

Landon,

That is exactly what I wanted but it wouldn't work. The first set I did had .125" wall. To my horror the bore distorted when I tapped the cylinder head bolts, had to ream them again. That's why I bumped them to .160" walls. The .125" wall cylinders are still working as far as I know. Cliff has them on a Mimi.

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**Reply author:** Rick Raively  
**Replied on:** 17 Jan 2004 08:53:42

quote:

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*Originally posted by Dave Hottmann*

Landon,

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Hi Dave,

Just curious, what if you do the .125 walls and drill out the head bolts first. That way the most of the mass of the brass is still there, and hopefully won't distort when doing the 1/2 bore.

Please understand I have never done any milling, and I am just asking.

Rick R.

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**Reply author:** Dave Hottmann  
**Replied on:** 17 Jan 2004 09:29:16

Rick,

It was the tapping that stressed the piece. There is very little difference in appearance between .125 and .160 wall. Also with .160 you can use 2mm or 2-56 head bolts. 2-56 is a little larger.

Don't feel bad, I never did any milling until this project.

DARE TO FAIL!

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**Reply author:** John Page  
**Replied on:** 17 Jan 2004 12:01:01

Thanks Dave for the distortion tip. I'll plan to carefully locate and center drill for the bore, then drill and tap the holes, then finish the bore; using the thicker wall calculations to boot.

JRP

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**Reply author:** TrotFox  
**Replied on:** 17 Jan 2004 19:06:13

Dave,  
Thanks for the note. I guess it's just me wanting everything for nothing again. ;) I still want to install slide-valves and radial valve gear in my Ruby someday. };

Might it be possible to install the caps with long rods run through non-tapped holes the length of the cylinder? That sounds like a major machining chore (through-drilling the walls) but I'll never know if I don't ask!

Trot, the fox who wants it to 'notch up'..!

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**Reply author:** Dave Hottmann  
**Replied on:** 17 Jan 2004 22:00:13

Landon,

I had a similar idea a couple of years ago. Making larger heads stopped me. All I had was a drill press at the time. Instead I reamed the OEM cylinders to .388 and installed larger o-rings. This was a 50% improvement in performance coupled with raising the boiler pressure. Then I started thinking about 1/2" cylinders when I got my Shay.

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**Reply author:** TrotFox  
**Replied on:** 18 Jan 2004 04:24:27

Can the stock cyls be easily reamed with a drill press? 'Cause I've got a drill press! =D

Anything to help... don'tchaknow?

Trot, the cheep, fox... {:(

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**Reply author:** Dave Hottmann  
**Replied on:** 18 Jan 2004 08:09:38

Landon,

I used a two step reamer in a cordless drill. The reamer is self guiding. Mount the cylinder in a vise and shove the reamer through. I think most of the improvement came from true cylinders and oversize o-rings that filled the ring groove. An o-ring that is has end play can have "lost motion". Steam enters the cylinder, o-ring moves in the groove, then the piston moves.

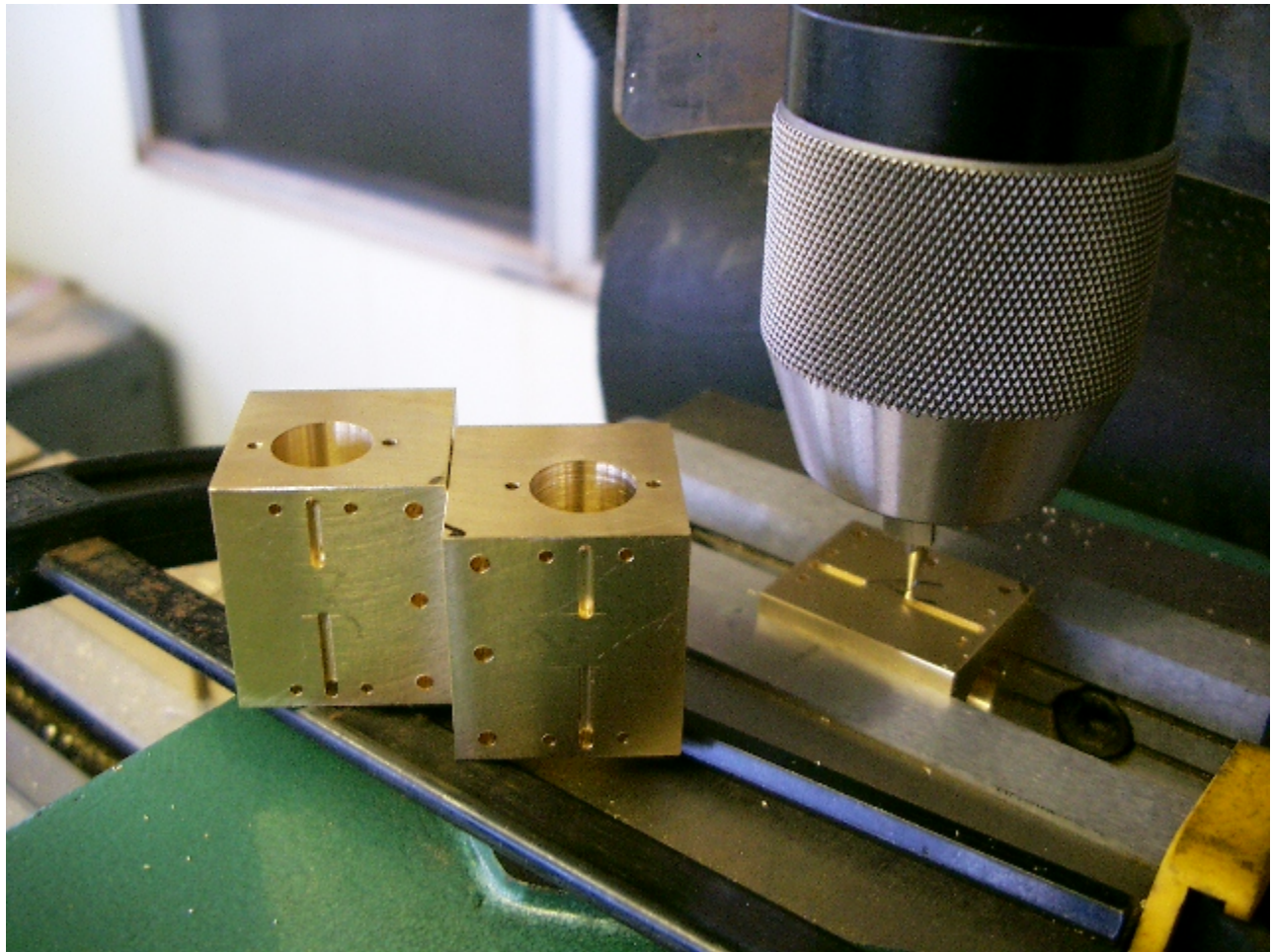
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**Reply author:** Dave Hottmann  
**Replied on:** 18 Jan 2004 17:41:33

Step 4

PLEASE NOTE that there is a mistake in the specs picture. 4mm=.1575" NOT 1.575".

Drill the mount holes with a #45 bit .200"(+or-) deep, valve screw holes with a 1/16" bit .190" deep, and the steam holes at the outer ends of the steam channels through into the bore. Cut the steam channels .060" deep with a 1/16" end mill. Note that there is a long and a short channel. Short goes in front. If you cut both blocks the same, make another pair with the channels reversed. Then you will have a second set of cylinders for your best steam buddy.



### Step 5

Cut the mount with a 1/8" end mill .280" deep. We want the mount to be 3mm(.118) thick (OEM is 2mm). To ensure that it's not cut thin, I make the depth cut .010" towards the bottom. At .280" deep I measure the mount thickness and make my finish passes until the mount measures .118" thick.

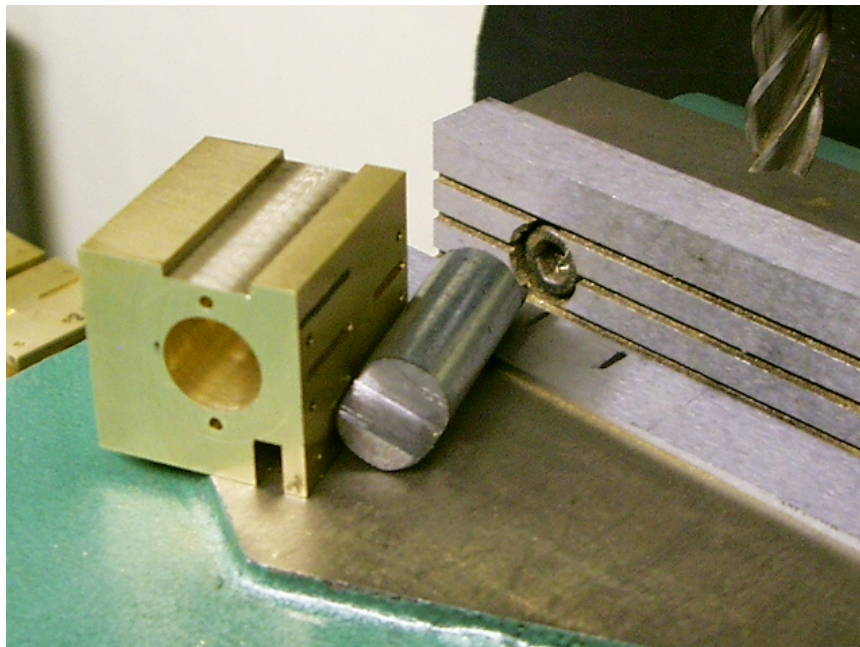


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**Reply author:** Dave Hottmann  
**Replied on:** 18 Jan 2004 23:14:04

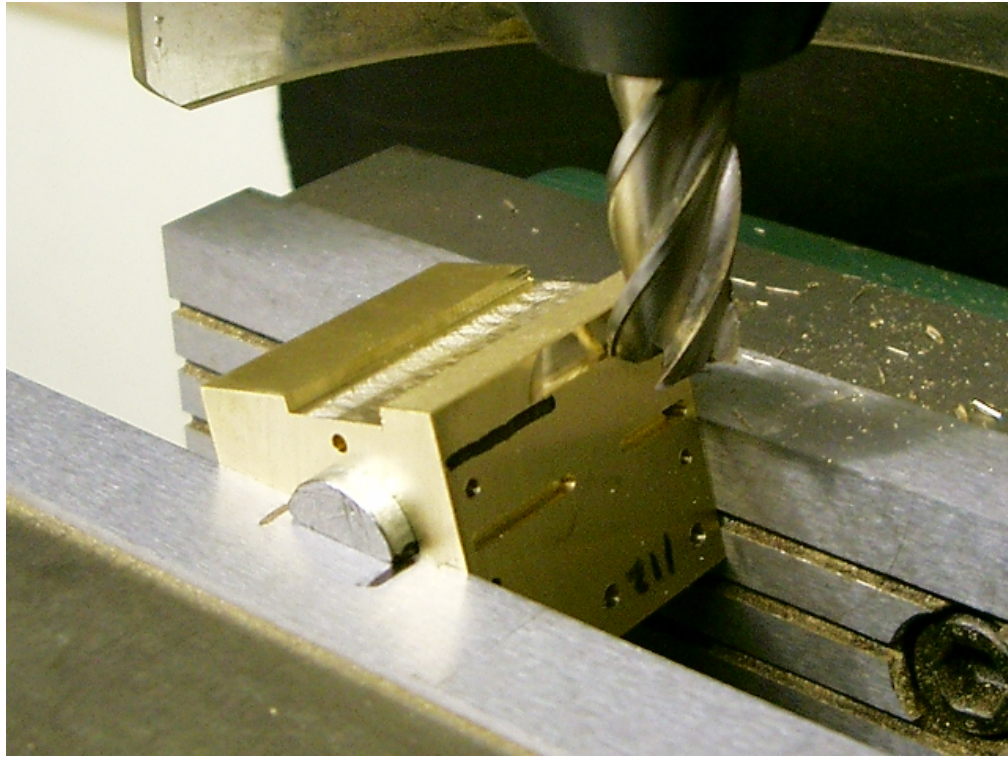
### Step 6 (step 6 is really a million steps)

For milling the outside I cut the head and threads off a 1/2" bolt, and "D" shaped each end to be a rest for the cylinders. In this picture I have already established the 3/8" end mill depth to cut the walls. I added .002" for cosmetic finishing.

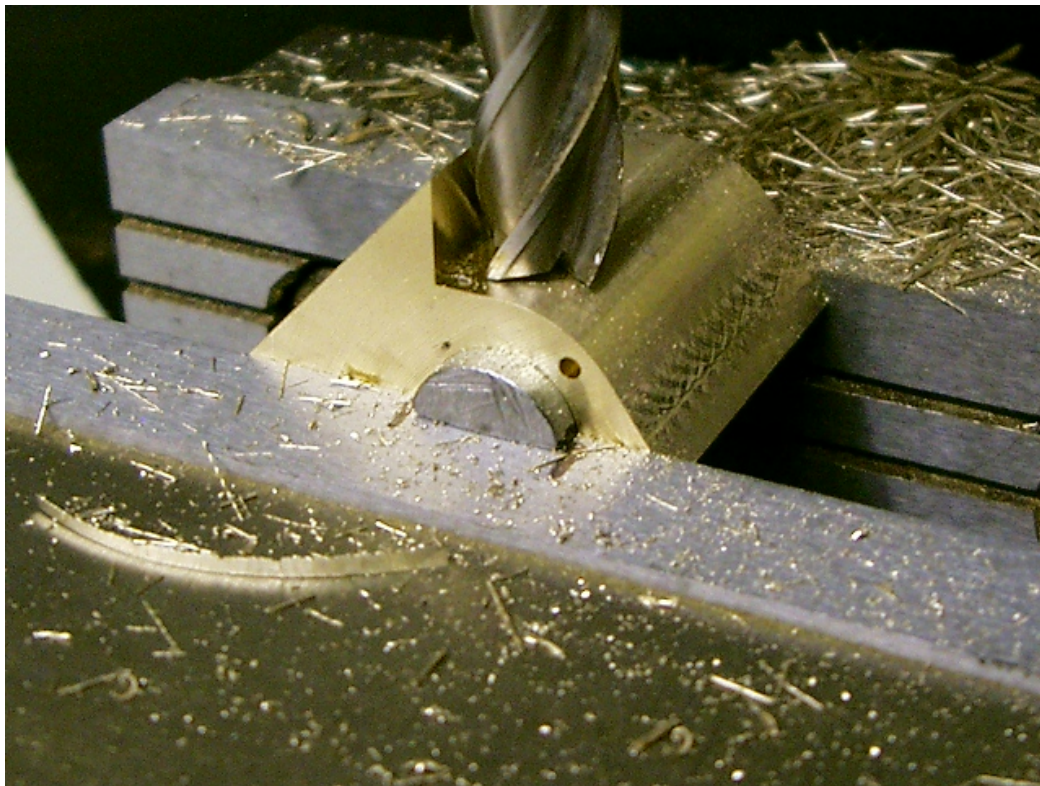




I scribed a line at 24mm from the inside edge for where the edge of valve will be. I marked it with a Sharpe for the picture. I rotated the cylinder up and test cut until I met the scribed line. Now it's time to cut the flat surface.



After the flat is cut, rotate the cylinder around a little at a time and make passes. Most of the cutting will be on the side of the end mill. Keep doing this until you play "chicken" with the cylinder mount.

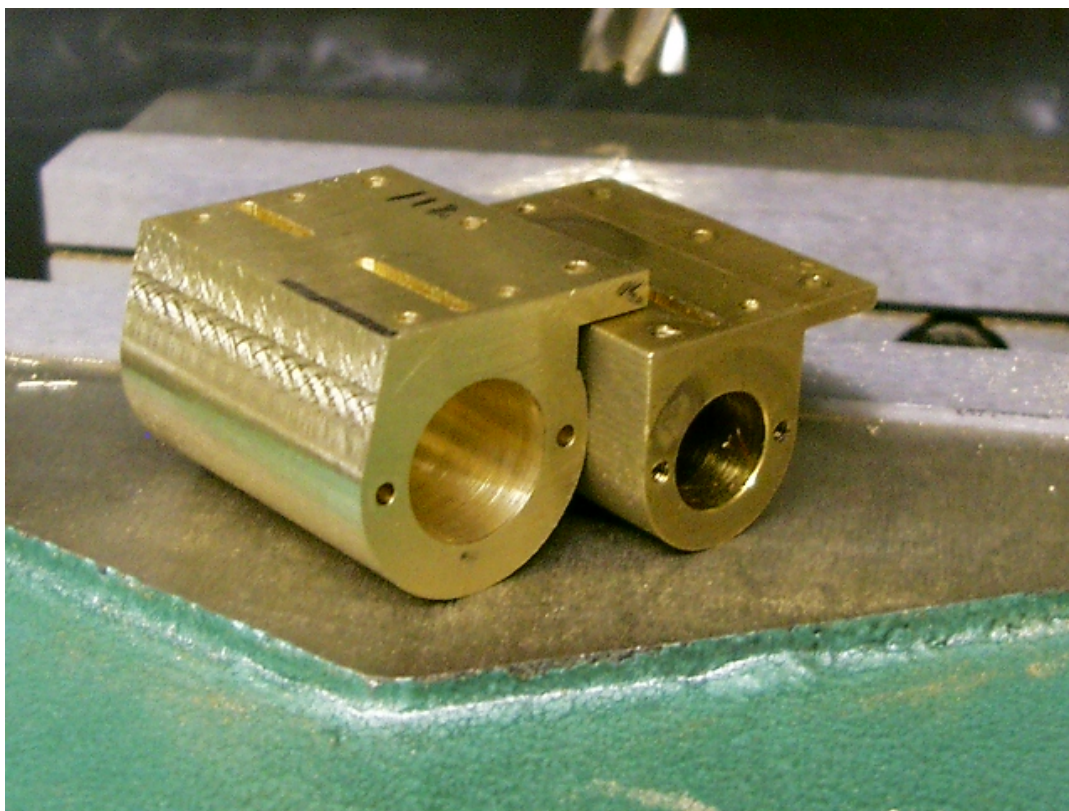




Here's where you play "chicken".



Here's the newly machined cylinder next to an OEM.



**Reply author:** John Page

**Replied on:** 19 Jan 2004 00:31:21

That is a splendid tutorial, Dave. Thank you so much. This is definitely a can-do project with my present skills.

Questions:

1) Does the idea of going to a 4-bolt cylinder head warrant consideration? I would locate the bolt hole pattern on 45 degree diagonals from the horizontal & vertical. Photos of other small steamers often show 4 bolts instead of 2. Just wondering.

2) Regarding the 1/2" bolt cylinder pivot in Step 6...

The pivot guide pin can slide sideways every time you loosen the vise to pivot the cylinder block. You have rough locating marks on the vise jaw. Are those sufficiently accurate? Is it sufficient to just center the pivot under the cutter by eyeball?

Is locating the pin with a caliper measurement sufficiently accurate?

Should we fashion a jig to keep this pin from moving sideways, and lock the X-Axis while milling the external surface in the Y-Axis?

The external shape is basically esthetic, but I want to make it look really nice. To save "production labor" this might be the point to turn the cylinders over to the individual builders for final filing and polishing of the outside surface.

NOTE to potential class members. Attendees at some of the steamups seem to agree that painted cylinders on the Ruby bashes looked much better than visible polished brass -- your choice; just another decision to ponder.

3) For builders who want the 9/16" cylinder bore, Does this require changing any other critical dimensions in your drawing?

Thanks in advance,  
John P

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**Reply author:** TrotFox

**Replied on:** 19 Jan 2004 12:39:06:

Dave,

The loose o-ring is to allow the ring to roll as the piston begins moving. This way when an engine that hasn't run in a while is being started the o-ring (which has squeezed all it's oil out and is stuck to the wall) can become oiled instead of the engine needing a push. 'Lost motion' shouldn't come into it at all as there is so very little pressure to cause it to move.

It's a good thing Dave... a technique even. : )

Trot, the fox who's gotta go looking for one of those reamers...

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**Reply author:** Bob Starr  
**Replied on:** 19 Jan 2004 17:47:23

Dave,

I certainly have been following your pictorial with a lot of interest. As a machinist myself, I understand how it is difficult to stop what you are doing between steps and click a picture! I might do some of the processes differently than you but no matter, since the results justifies the means. 🤖 So, some comments here.

Landon is correct about piston slop and o-rings. The common consensus is to have about .0005-.0010 clearance in your piston and a groove that allows the o-ring to roll. It is important for the groove to be at the manufacturers specs as to the inside diameter. A few years back, on another board, I learned about this. I had built an engine that would run perfectly on air, but refused to run on steam. After intense discussions with major players in the steam world we discovered that I had made too perfect of a fit with my piston! Once I made the proper clearance and fit for the o-ring it ran beautiful!

I have used end mills to cut bores but it is a bit tough on them. They give a fairly accurate hole, but still under size. I think that a drill and a reamer still will give you better results. And it will give you a truer run on your piston movement.

You are a brave man indeed with your jig for machining the outside of your cylinders!!!!!! My luck would be that it would move or dig in on the first pass. I guess your vice is a good one. Keep your cuts light with this one.

I see that you are not tapping your holes after you drill and so you must be tapping by hand afterwards. Of course that is all right, but it could be why you had distortion in the cylinder. Critical holes such as those I like to tap right when I am lined up. It is a hassle, but much more accurate. All in all, you are showing some great work and you have done all of us a great service by keeping us informed. Gee, I hope I get back to some machining soon, or I will be knockin' on your door one of these days and we can play hookey from our jobs and build something. 🤖

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**Reply author:** Dave Hottmann  
**Replied on:** 19 Jan 2004 18:25:03

Landon,

When you ream the cylinders to .338" there isn't an o-ring that fits and follows the rules without making a new piston. I didn't have a lathe when I did this so I cheated with good results. I use a metric o-ring that is thicker and has to be fitted to the cylinder. This way you can also set the tension. Gail Graham was telling me that he runs the o-rings looser on his high RPM boat engines.

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**Reply author:** Dave Hottmann  
**Replied on:** 19 Jan 2004 18:46:10

Hello Bob!

I used a reamer when I started this project. In my messing around I found I got a better finish with the end mill. I have dedicated Putnam end mills for boring only. I just pretend that an end mill is a spiral reamer.

I do my tapping by hand so I can feel when the tap is about to break. I learned the hard way that when a 2mm tap starts twisting to throw it away before it breaks off in a blind hole. I also learned it only takes half the time to remove a broken tap as it takes to make another cylinder.

If you ever get to see the Mimi that Cliff has with my cylinders, you will find an "oops" on the bottom where the cylinder came out of the vise. I'm getting smarter with every mistake.

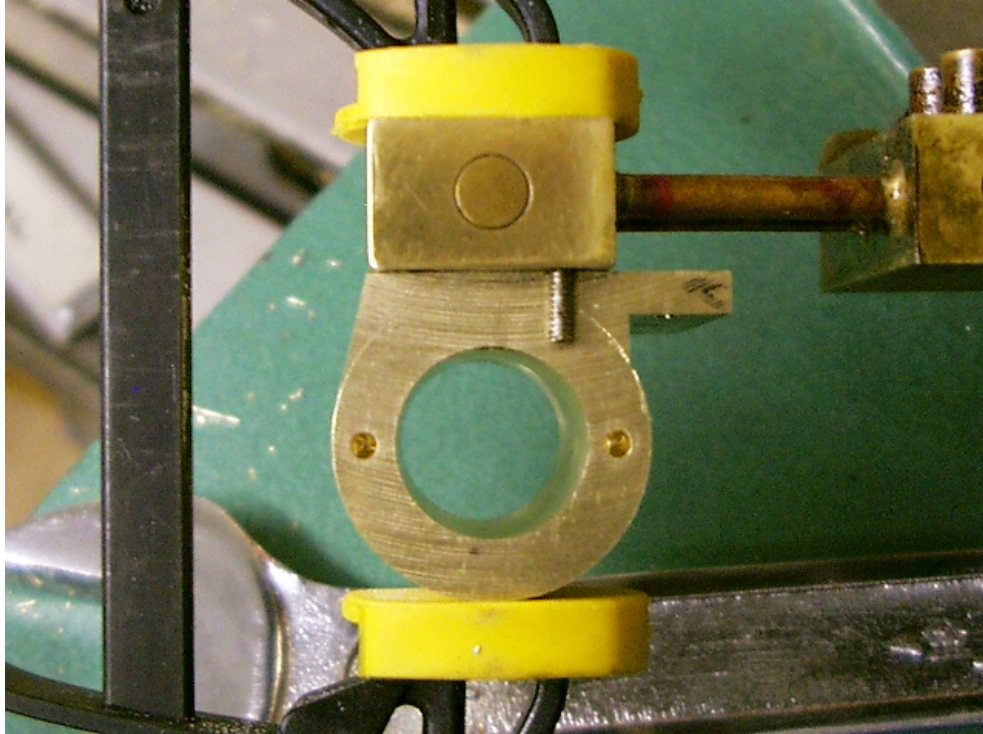
DARE TO FAIL! (and hope nobody sees you)

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**Reply author:** Dave Hottmann  
**Replied on:** 19 Jan 2004 19:10:59

John P,

1. Four bolts would be better. I stayed with two for the stock look out of the corner of your eye. I make up for weakness with thicker heads. Besides, I don't have a rotary table.
2. Where the pivot sets is far from critical until you get around to the mount. Then I move the table. Just make sure the vise is tight.
3. You could go to 9/16". To maintain the bore centerline you would need to shorten the valve screws and not drill as deep.



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**Reply author:** Bob Starr  
**Replied on:** 19 Jan 2004 19:34:08

Dave,

Truthfully, the "correct way" to do the bore is to put it into the 4-jaw chuck and do it on the lathe. Ah! But what a hassle! It would be a hassle for a one off, but in production it would be better. You could remove each piece by only moving one jaw. There are also devices for quick centering of stock on a four jaw.

I think that I have spent as much, if not more, time machining jigs to make parts. They end up lying around the shop, even forgetting what they were used to make, but ya never want to throw them away since they took so much time to make! A thought towards holding the cylinder might be one of those collet holders (I forget what they are called) that mount to the table. An indexer would work too. John asked me to comment on four bolt or two bolt on the cylinder covers. In my opinion if we can get away with two; use it. Frankly, if you turn a .031 lip that fits into the bore and use sealant you should not have a problem. I think what is more important is an o-ring at the piston rod. Even with stock covers, I had no trouble running a 3/16-40 die on the guide. It is quite easy to make the corresponding nut or Sulphur Springs Models sells them.

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**Reply author:** John Page  
**Replied on:** 19 Jan 2004 19:45:08

Dave H.

4 bolts it shall be, 2-56. That last photo 19:10:59 is most helpfull. I'll have to plot a location for the upper headbolts to avoid the valve plate holes. A friend has a rotary table to assist with this one.

John P.

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**Reply author:** Mike Reilley  
**Replied on:** 19 Jan 2004 19:46:11  
**Message:**

Live steam has always fascinated me....and this thread has done more to educate me on how the cylinders actually work. I've seen many posts about reversing this and that..and changing this and that to adjust the timing.... I just don't understand what is being discussed usually...

Is there a book anyone recommends that explains how the MODEL live steam G scale engines work?

And keep this thread going with all the photos...I just realized that the steam gets into the cylinders from tubes that run between the cylinders....

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**Reply author:** Dave Hottmann  
**Replied on:** 19 Jan 2004 22:26:50

Six million MORE steps waiting to happen.





**Reply author:** Dave Hottmann  
**Replied on:** 19 Jan 2004 22:51:52

Mike,

You're probably talking about rotating the eccentrics 180 degrees on an Accucraft Ruby and Shay to make the piston valves inside admission instead of outside admission. The purpose of this is to get the steam pressure load off the eccentrics in forward so they last longer.

As far as books go, I read old books on 1:1 scale engines. On these little guys, each manufacture does things a little different. But each one has to boil water and get the steam into the cylinders at the right time just like the big ones. If you get a chance, find a local steam up.

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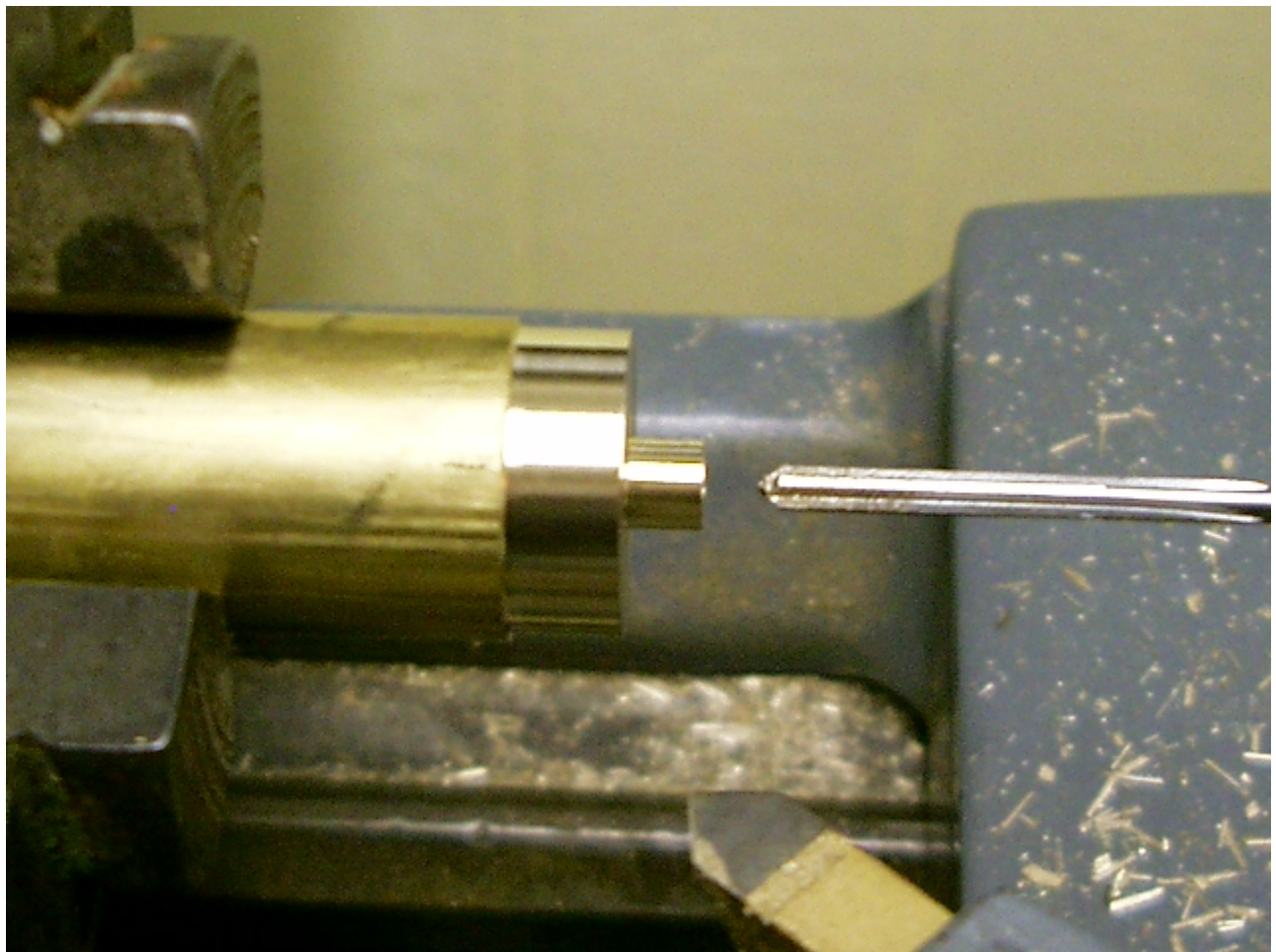
**Reply author:** Dave Hottmann  
**Replied on:** 22 Jan 2004 00:05:46

#### Step 7 The Rear Heads

This one of the fussiest parts to make. It needs to be as close to perfect as possible. Here I have turned the outside to .820"OD, and the piston rod support to .240"OD and facing it off to .200" long (fast spindle speed). I have increased the support OD and length from OEM. If you are going to use a gland nut you need to change these dimensions. (This is your cue Bob) I then drilled the piston rod hole with a #31 drill bit and finished it with a .125" reamer (slow spindle speed).

Edited 2-4-04

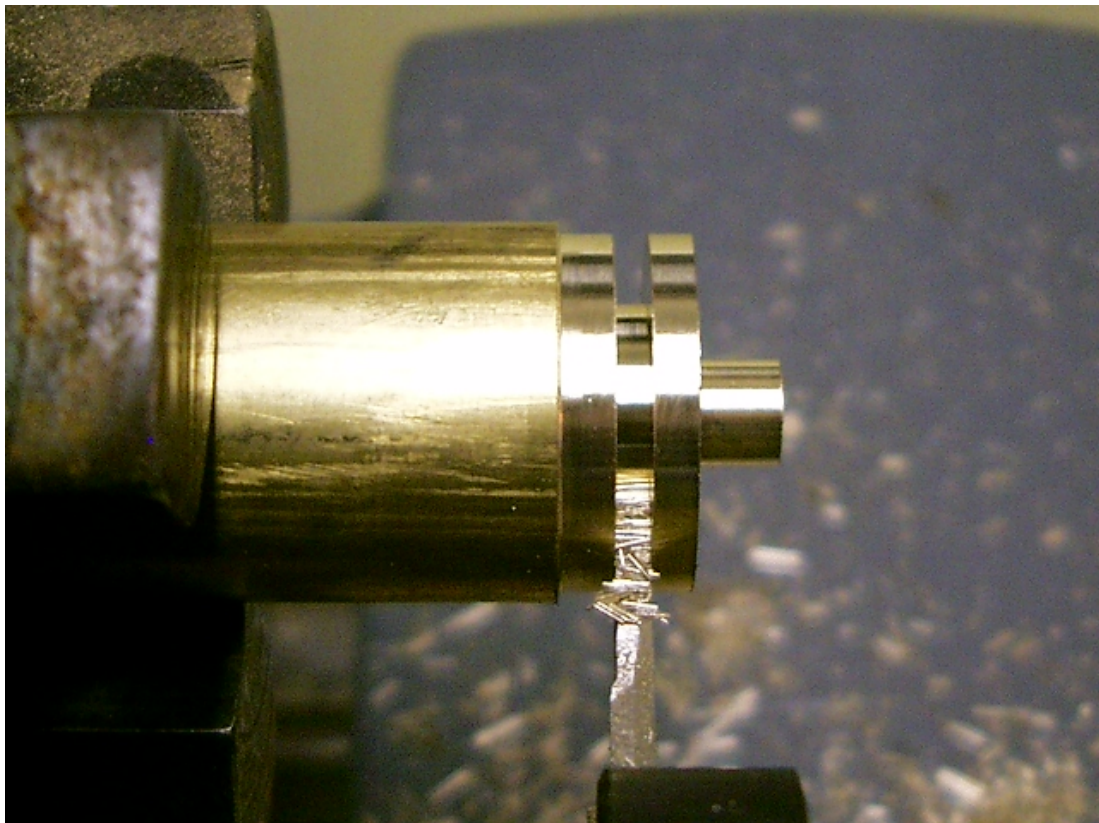
The .125" reamed hole prove to be too tight. Today I made one pass thru with a .126" reamer by hand. The hole measured .1255". After a 34 minute tread there was only weeping on water droplets, no steam hisses, no binding.



Here I am checking the fit of the piston rod. This time I am using precision ground 304 stainless steel rod. K@S sort of works but I like the fit of this stuff better. This head has NO wobble play in the rod and it slides in and out. This one's a keeper. 😊



Now with a parting off tool I have gone in from head face .100" and cut in to .495"OD. I have also increased the head thickness from OEM.





After rounding the edges with a file, I moved the tool in another .050" and cut off the rear cylinder head. The front head is the same dimensions without the hole and support.



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**Reply author:** Bob Starr

**Replied on:** 22 Jan 2004 07:03:01

I shall take my cue, Dave 🤖

I find making a font cover relatively easy and I will share my thoughts here. I would turn the rod support to .250 and use a tailstock die holder to thread with a 1/4 x 40 round die. Do this BEFORE you drill your hole. For piston rod material, I have found tool steel to be the absolute best. You can get precision ground tool steel from Small Parts Inc. and believe me the results are worth it. Non hardened tool steel wears beautifully and is a joy to machine.

I find it easier to part off the piece and then reverse it in the chuck and do the rest of the machining. Generally, what I do is use a jewelers saw or a hack saw to part it off this way. I hate parting tools! When it comes time to do the other side I make a collet with a 1/4 x 40 hole in it and just thread the cover on. Then it is a simple matter to face off the piece and cut your lip. With the collet (I usually use hex stock since my next step is to make gland nuts) in your three jaw and if you have many to do; you can simply unscrew the piece and thread the next one on.

A corresponding gland nut is quite simple to make. For a 1/4 x 40 gland nut, I use 5/16 hex stock. Drill thru with an 1/8" drill and follow with a No. 1 drill 5/32 deep. Use a 1/4 x 40 tap in your tailstock and cut your thread. I like to flatten the bottom of the hole with a 7/32 mill or D-bit, but it really isn't necessary. Again, I usually use a jeweler's saw to just part it off at about 5/16" long since it is not a critical dimension. If you drill your 1/8" hole deep enough, you are ready to make your next one! I can make a bunch of these gland nuts in an evenings work.

---

**Reply author:** Dwight Ennis  
**Replied on:** 22 Jan 2004 07:15:37

Can you define a gland nut?

---

**Reply author:** Bob Starr  
**Replied on:** 22 Jan 2004 08:01:41

Dwight,  
A gland nut is the small nut with the o-ring in it to seal the piston rod from escaping steam

---

**Reply author:** Ivmosher  
**Replied on:** 22 Jan 2004 13:14:25

Well I'll be well behind in this project as I have to get the shop ready to install a mill and lathe before I even order the equipment. But I am enjoying this.

Earlier in the thread there was a comment about metric materials, rod in particular I think, and that it's hard to find. I needed some 3mm rod for a project I'm working on and wound up buying 3mm OILCRAT drill rod. Great stuff. Bought it from a place in Chicago, 2 three foot lengths at about \$2.50 each plus some minor shipping.

And the question I have is... that this project seems to be using metric measurements for one thing and inch for another...any particular reason? mm's are easier in my head than inches. Other Than machine tools, reams, taps, dies, mills etc being the more likely to be available locally.... just wondering.

Thanks,  
Larry

---

**Reply author:** Dave Hottmann  
**Replied on:** 22 Jan 2004 14:19:32

Larry,

It's a Chinese engine with a US bore. I use metric where the cylinder needs to match the engine and US on the rest. I am using 1/8 piston rods and reaming the main rod to match. Standard stuff is easier to find than metric, also cheaper.

---

**Reply author:** Dave Hottmann  
**Replied on:** 22 Jan 2004 18:46:19

Landon,

It's not a perfect seal. You hope the oil holds the steam back. Pressure and load are part of the equation. If one is marginal I squeeze the support in a three jaw chuck with the rod in it. On the OEM cylinders when they wear out, I soft solder the hole and drill it out. I wait until I can hear the leak before I will repair the hole. I think of the solder as babbitt. On these 1/2"ers I extended the support to the rear to give the rod more support and buy more time, we'll see. Best seal would be an o-ring.

---

**Reply author:** FH&PB

**Replied on:** 23 Jan 2004 15:02:21

My goodness, people! I leave you bunch alone for a week, and look what happens!

Dave, this is fabulous stuff. I am especially dazzled by your method of rounding the cylinder bodies. I had hoped to get your cylinders installed on my Ruby when I was tweaking her in preparation for Diamondhead, but then I got the front apron and side skirts off and it appeared that I was going to have to do some major surgery, including undoing some silver-soldered joints, in order to accomplish it.

So, clue me in, please. What's involved in the installation?

---

**Reply author:** Dave Hottmann

**Replied on:** 23 Jan 2004 18:50:25

Vance,

There shouldn't be any soldering involved unless something has been changed that I don't know of. I hope to have these cylinders finished soon and show installation. If you are talking about the .388" cylinders from Jim's steam up, these are MUCH better.

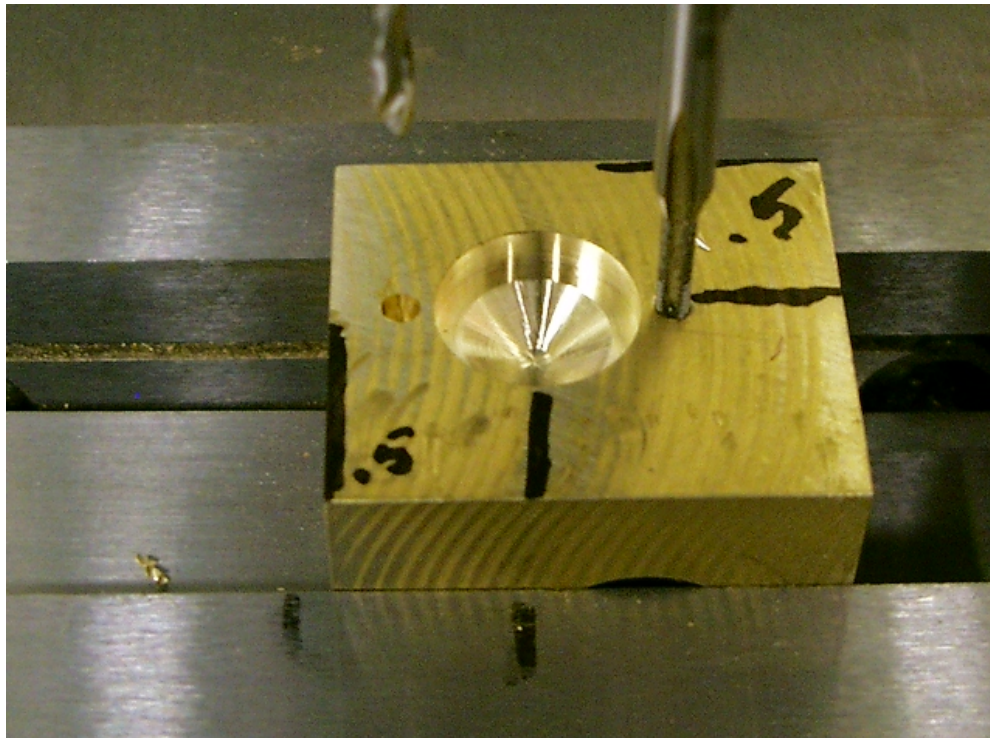
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**Reply author:** Dave Hottmann

**Replied on:** 23 Jan 2004 20:21:17

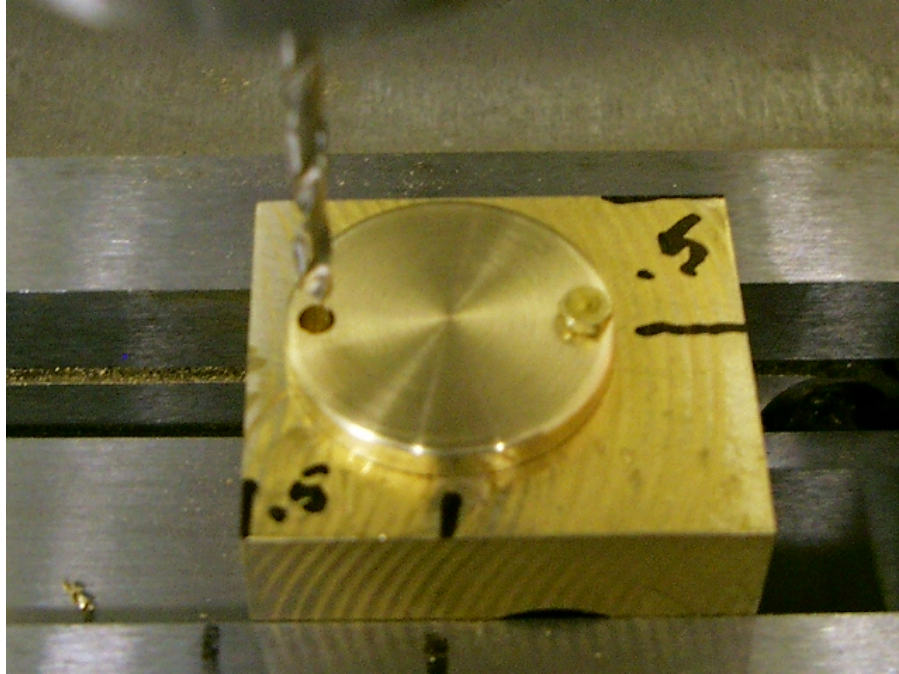
Step 8 Head Jig

This is worth making. Much better than guessing where to drill the head bolt holes. I took a squared block and picked a point in .500" from two edges. This is so I can find the center again at a later date. At the point I drilled and then end milled a .5" hole deep enough to set a head in. Then I went to the right .330" and drilled a #50 hole .3" deep and tapped 2-56. Then to the left .660" and drilled a #42 clearance hole.





Hold a head in the jig and drill a clearance hole. Rotate the head 180 degrees, install a bolt, and drill the other hole.

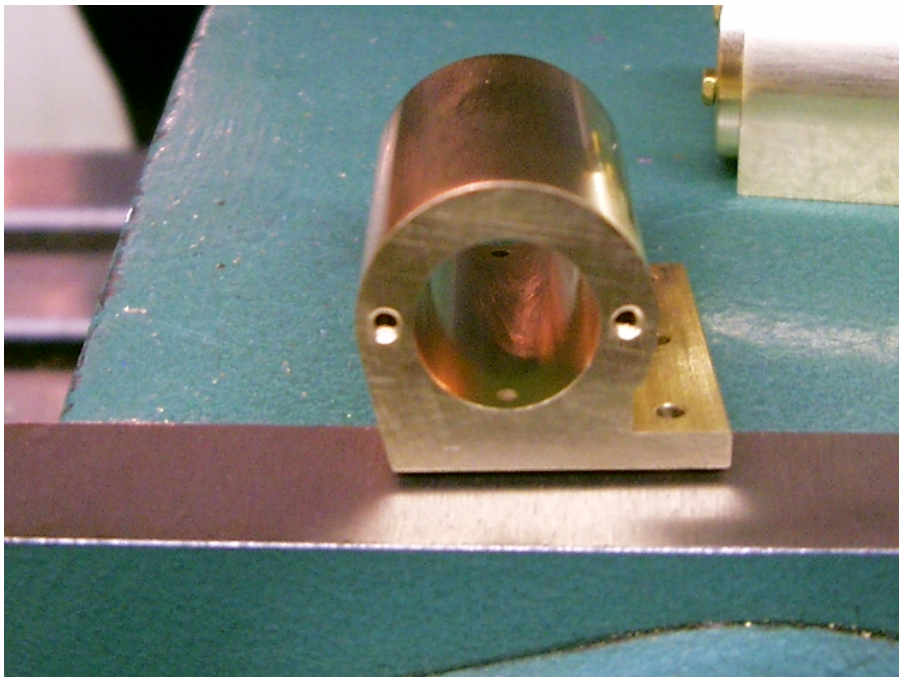


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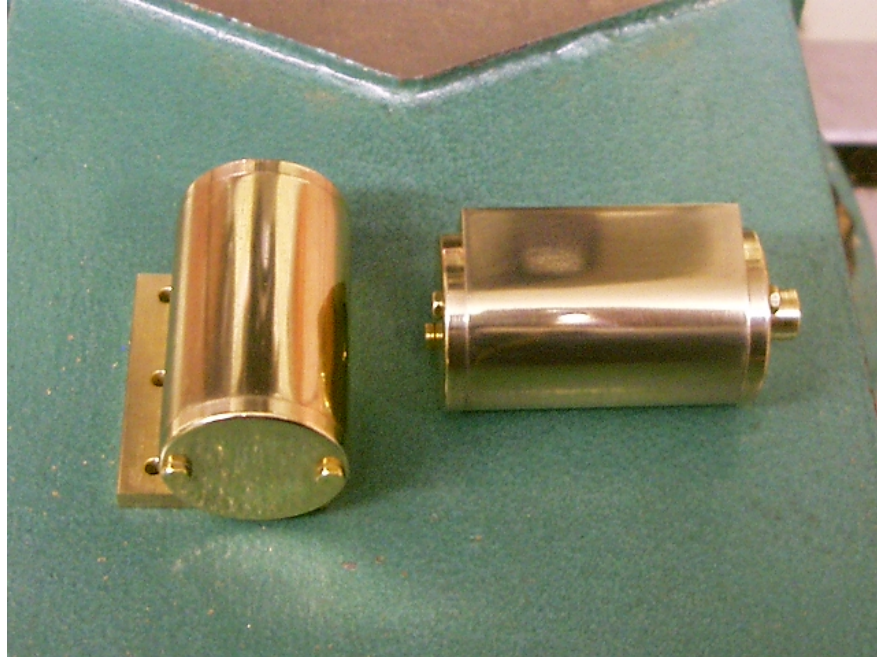
**Reply author:** Dave Hottmann  
**Replied on:** 23 Jan 2004 23:16:45

#### Step 9 Finishing the Cylinders

The holes have been tapped with tapered taps and then with bottoming taps. Not having a small enough hone I used wet/dry sandpaper wrapped around a 15/32" K&S tube in the kitchen sink with running water. No wife and a stainless steel sink make this easy. I started with 320, then 400, and finished with 0000 steel wool around an Xacto knife handle. While I had the sandpaper and steel wool out I finished the outside. It is important to finish the bores before cutting the pistons. Any oversize can be compensated for in the ring groove. These finished out at .5015"ID.



Here I have test fitted the heads. Not caring about being prototypical and taking pride in my work, I used Mother's polish to shine them up. Time for a glass of wine.

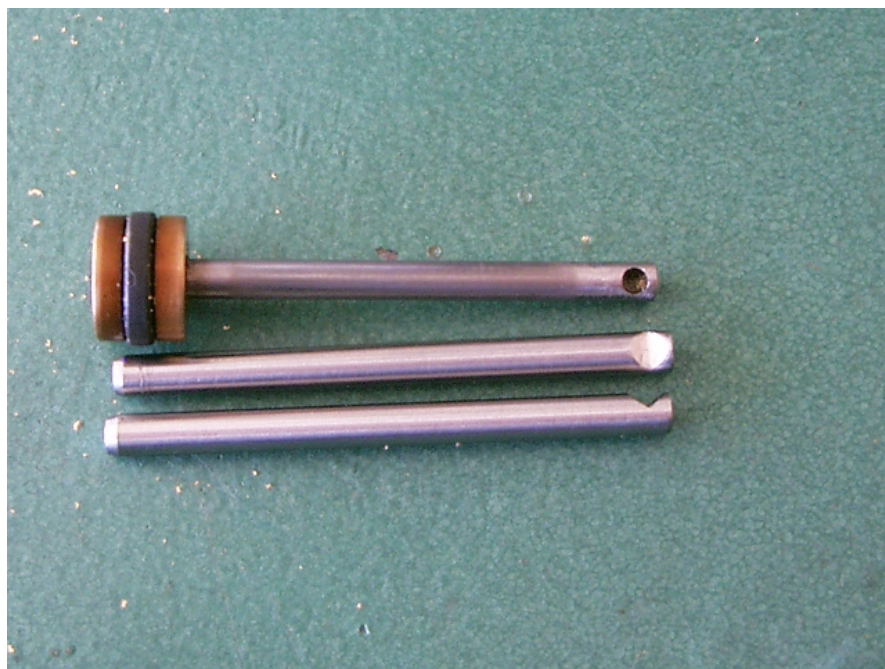


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**Reply author:** Dave Hottmann  
**Replied on:** 24 Jan 2004 10:56:16

#### Step 10 Piston Rods

I cut and ground to precision ground stainless steel rod to 41.2mm (1.622") long. Make sure you measure the length after the rod has cooled, lots of expansion. Since I don't have a way to drill the rod screw hole, I cut a "V" notch with a Dremel. The center should be 1.7mm in from the end and at least 2mm wide. I visually check with a slide caliper, aka "Precision Eyeballing". Debur the notch edges with a fine file so it won't scratch the rear head bore. Then taper the other end to help when pressing the piston on.





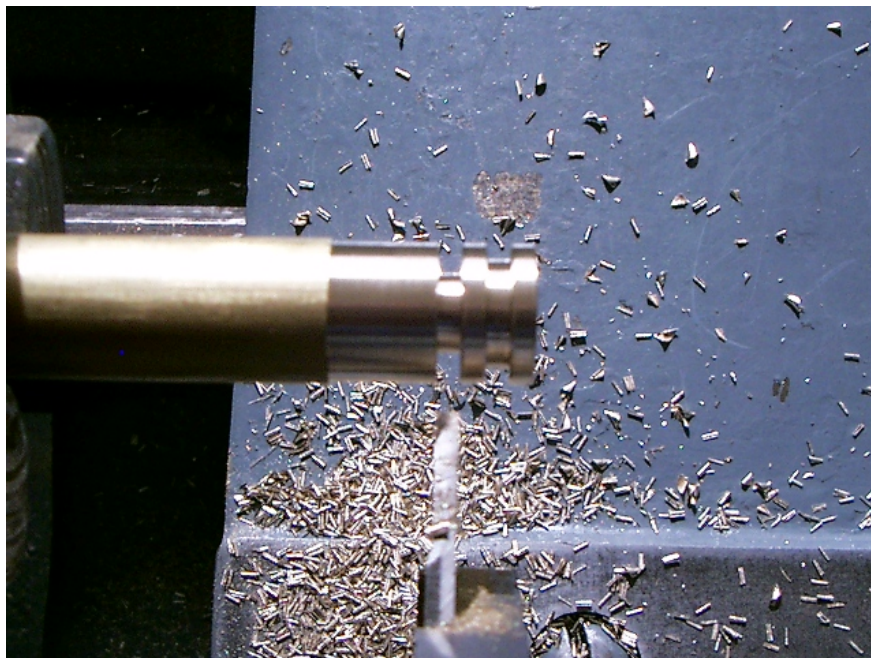
**Reply author:** Dave Hottmann  
**Replied on:** 24 Jan 2004 15:09:47

#### Step 11 The Pistons

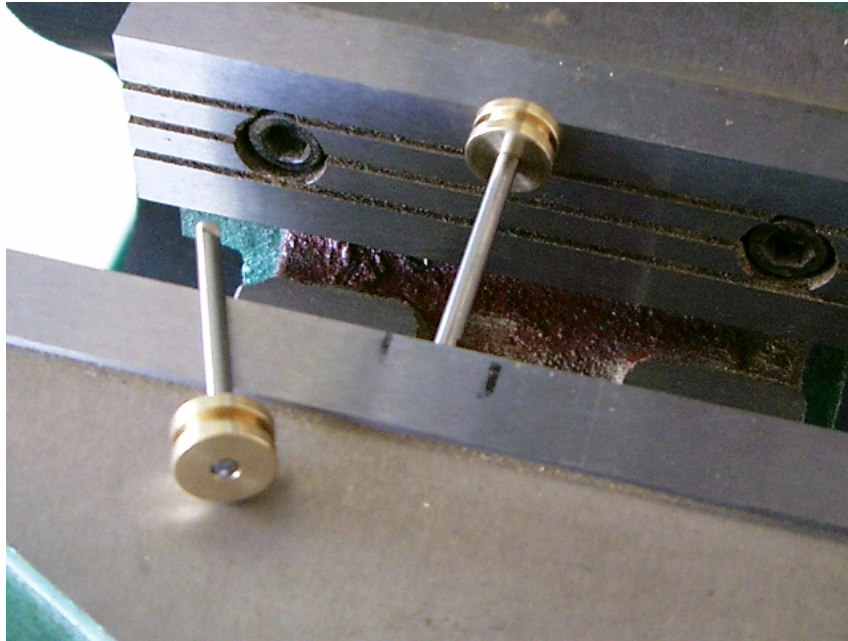
I turned some 1/2" round brass to .480"OD. Then cut the ring groove. Generic specs for a #012 o-ring are a .083" wide groove with a .055" depth from the cylinder bore. This is why it is best to finish the cylinder bores before cutting the pistons. The manufacture of your o-rings may have different specs. At this time you can do a test fit of the o-ring and slide the cylinder over it. After the groove is cut drill a #31 hole in the center and ream it with a dowel pin reamer (.1247"). You can see in the bottom of the picture that I have ground my parting off blade for the groove width as a time saver.



I have now started parting off the piston leaving it .250" thick. Just before the final parting I dressed up the rough edges with a file.



This is how I press the rods in the pistons. Start pressing the rod in, loosen the vise and rotate the assembly. Start pressing again and release and rotate again. This will help the rod self center in the piston. Be careful when you get close to the end so you don't kink the rods. The rod should end up flush with the edge of the piston.



---

**Reply author:** Dave Hottmann  
**Replied on:** 24 Jan 2004 17:07:03

#### Step 12 Assembly

The o-rings are installed and I have oiled them and the piston rods. I like to bolt down the rear head and test feel the the piston's movement. Sometimes it is smoother in one position than the other. When I have found the sweet spot I mark it. Then I remove the heads, clean with brake clean and apply a very small bead of silicone sealer on the head with a toothpick. Bolt the heads on and wipe off any excess silicone. Now it's time to play with them and go "OOH, AHH, NICE". 😊





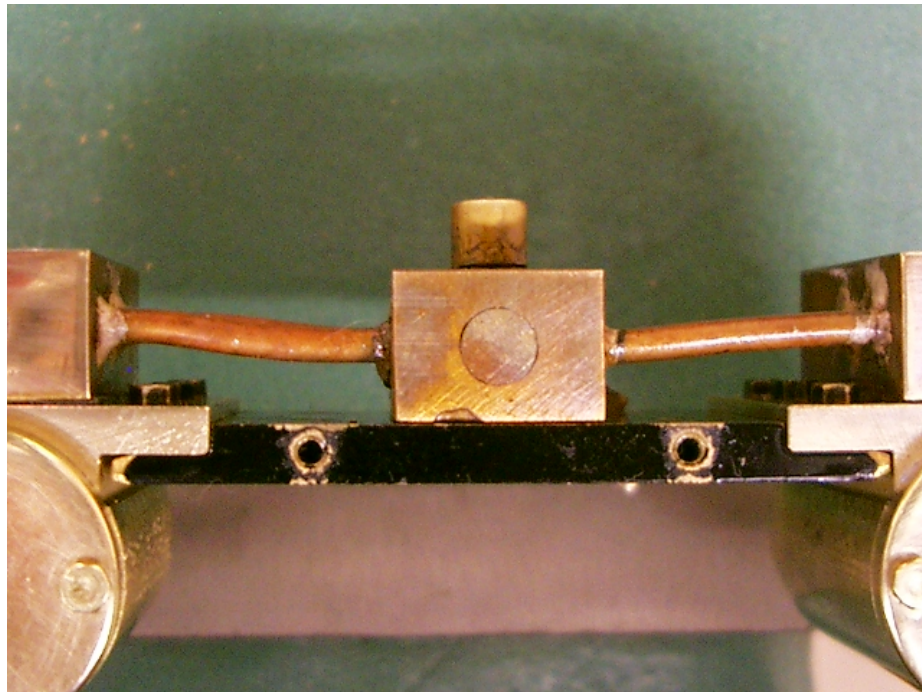
**Reply author:** Dave Hottmann  
**Replied on:** 24 Jan 2004 21:43:31

### Step 13 Installation

After removing the old cylinders, you need to remove some material from the cylinder mount to clear the new cylinders. I scribe a line .280" from the step and grind the line off. Here's an OEM next to a ground one. This also needs to be done for the 9/16 cylinders.

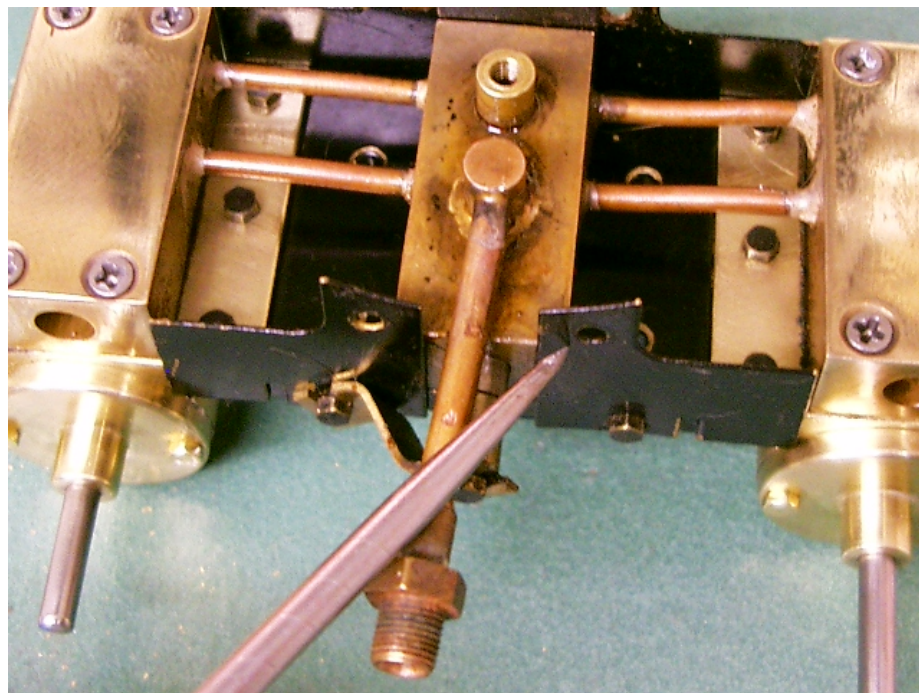


Because I raised the valve deck to raise the piston center line, the direction block also is raised. To correct this just squeeze the direction block flush to the mount with a pair of pliers. There is enough flex in the steam pipes to do this. This is so we don't raise the boiler.

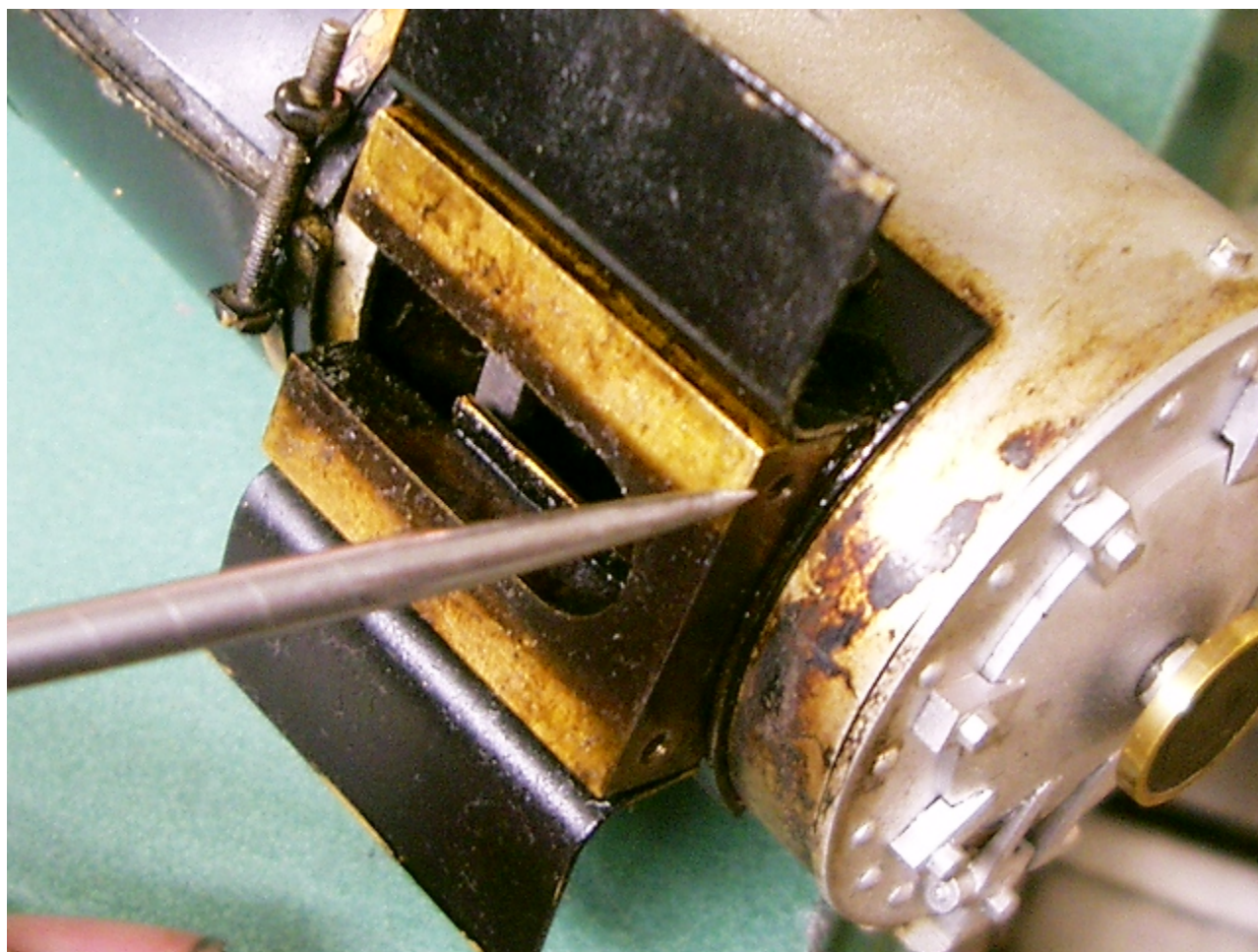




To make engine assembly easier I leave these two upper inside bolts out. I later use these bolts to replace the difficult rod screws.

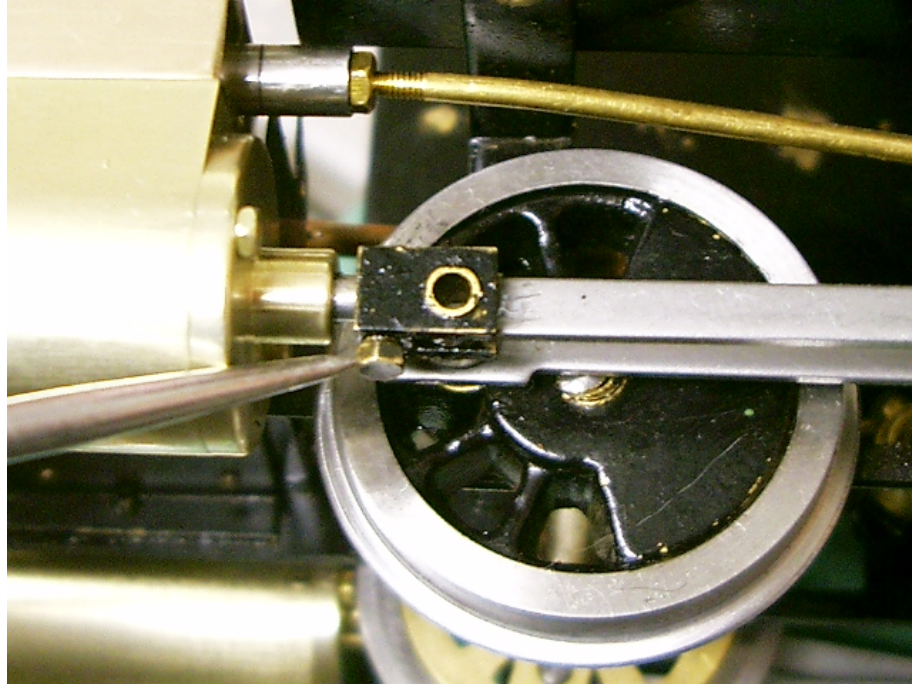


I have reassembled the lower part of the smoke box and installed the stack. These front bolt holes will be what holds the front of the boiler now.





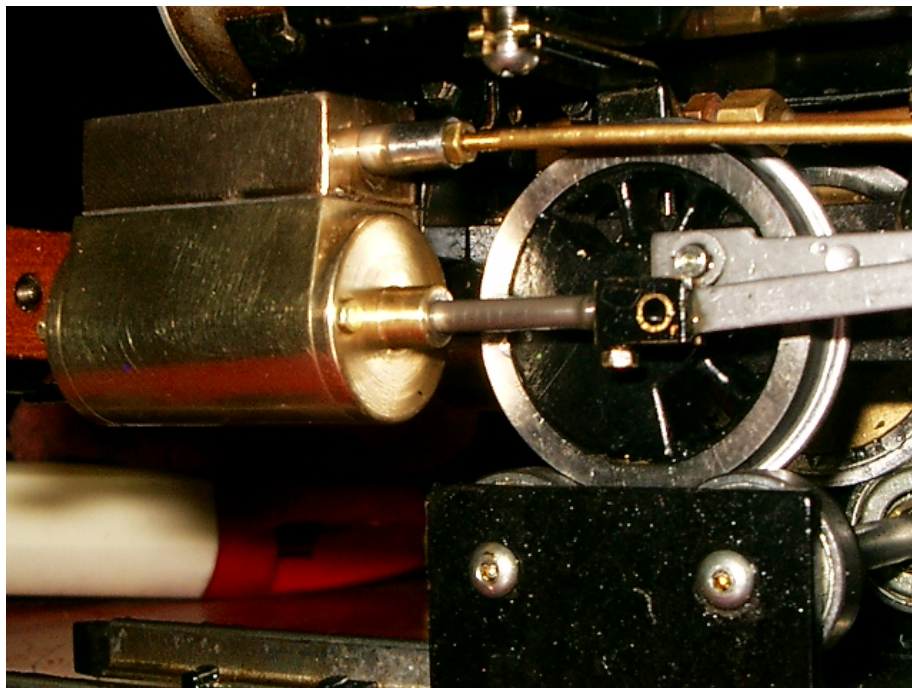
Here's the bolts I leave out holding the main rod to the piston rod. I have more patience for a hex head than for a tiny screw slot.



After a quick air tune it's time for a treadmill run. Here it is running under 40 psi, and the piston rods don't leak. I'm so relieved! 🙏

Edited 2-4-04

No leaks proved to be bad. The hole for the piston rod was too tight and would bind at higher temperatures. I passed a .126" reamer thru once by hand leaving a measured hole of .1255". After a 34 minute treadmill run there was only weeping of small water droplets, no steam hisses, no binding. Now there is much rejoicing!



I hope this has inspired some of you. It is a lot easier to buy the 9/16 cylinders, but this is a lot more fun.

---

**Reply author:** Dave Hottmann  
**Replied on:** 31 Jan 2004 18:50:33

I have an update I felt I should share. There is such a thing as "too perfect". After many runs I noticed that the engine seemed stiff at higher pressures/higher temperatures. Turns out that the piston rods expanded enough to start binding in the rear heads. I was hoping that they would break-in but I ended up removing the rear heads and running the .125" reamer thru them until I could feel a tiny wobble. A little leaking cold can be a good thing.

---

**Reply author:** Bob Starr  
**Replied on:** 31 Jan 2004 23:45:29

Dave,

This is the benifit you gain with the use of a gland nut. My general procedure is to drill the piston rod hole with a #30(.128 dia.) drill and then you rely on the o-ring seal to get rid of the steam leaks. The true gain is any leak at the gland is controlable simply by tightening the nut.

---

**Reply author:** John Page  
**Replied on:** 01 Feb 2004 23:37:05

Piston Rod Material.

Bob --

You mentioned earlier about using ground tool steel for the 1/8" piston rods. Enco has both "water hardened" and "oil hardened" rods. Which material meets your recommendation??

I assume that this material is a different steel from "stainless steel." So does the tool steel rod present any sort of rust or corrosion problem in a moist environment??

Dave -- Those polished cylinders are beautiful works of industrial art indeed; much too pretty to go to work on a grimy old iron horse! Thanks again for the splendid tutorial.

Making chips,  
John Page

---

**Reply author:** rwjenkins  
**Replied on:** 02 Feb 2004 11:46:20

Has anyone ever tried adding crossheads to a Ruby? I noticed that Ruby's British-outline cousin Caradoc (which has the same cylinders) has them, but Ruby doesn't. How hard would it be to fit Caradoc crossheads and crosshead guides to a Ruby?

---



**Reply author:** John Page  
**Replied on:** 03 Feb 2004 01:02:03

RW,

I was mulling the very same question around in my wee brain this afternoon; especially because the upgraded cylinders are going to have the power to run an x-6-x locomotive, if someone wants to get that adventuresome. Crosshead guides would look real sharp and would probably be desirable from a mechanical standpoint.

The Magma Arizona RR Alco No.3 (2-4-2) mining locomotive has a single upper bar crosshead guide. This loco used 33.5" drivers. Cute...

Added 2/3/04...

Paul Smith's U.K. add for 9/16" Excelsior cylinders show a photo of just such a crosshead guide. Take a look at:

<http://www.apqx23.dsl.ppipex.com/excelcylinders1.htm>

and scroll 25% down the webpage.

John P.

---

**Reply author:** John Page  
**Replied on:** 03 Feb 2004 01:07:40

Piston Rods; Step 11b.

I picked up a suggestion today which I will attempt for piston/rod assembly. The idea is to heat the pistons in the oven, chill the steel rods and hopefully drop the rods into the pistons. If the fit is correct, they will lock together with perfect concentricity and no distortion. We shall see.

John P.

---

**Reply author:** John Page  
**Replied on:** 03 Feb 2004 01:17:58

Dave H.

In machining the exterior of the 9/16" bore cylinders, are you also maintaining the same 0.16" wall thickness used for the 1/2" bore cylinders?

Thanks,  
John P.

---

**Reply author:** Dave Hottmann  
**Replied on:** 03 Feb 2004 09:10:24

John P,

I haven't done 9/16". I would stay with the .160 walls, shorten the valve screws, and go with 4 bolts per head. Maybe Rick Marino could measure the OD of his 9/16" cylinder heads for you. This would give the wall thickness that SM32 is using.

---

**Reply author:** Dave Hottmann  
**Replied on:** 04 Feb 2004 22:52:41

I have edited the rear head posts. The .125" reamed hole proved to be too tight for the .1245" rod. At higher temps the piston rod would bind in the head. Today I passed a .126" reamer thru once by hand leaving a measured .1255" hole. After a 34 minute treadmill run there was only weeping of tiny water droplets, no steam hisses, no binding. The run was at 60 psi, 2 to 3 revs per second, one boiler fill.

And there was MUCH rejoicing!

---

**Reply author:** John Page  
**Replied on:** 09 Feb 2004 17:40:51

Dave H.

When you indicated a change from 2mm bolt threads to 2-56 bolt threads on your most recent run of cylinders, I'm thinking you meant cylinder head bolt holes and threads only.

Have you thought about tapping the valve plate bolt holes with 2-56 threads? This would require that Ruby owners relieve the mounting holes in their valve bodies with a #43 drill. However, the supplier of the cylinders (and 2-56 bolts) could then shorten the bolts as required to fit the close-tolerance threaded holes in the cylinder, relieving the owner of this touchy responsibility.

Any words of wisdom on this somewhat precise matter?

Thanks,  
John P.

---

**Reply author:** Dave Hottmann  
**Replied on:** 09 Feb 2004 17:59:31

John P,

I made the mistake of drilling a valve screw holes bigger on my Ruby-Garratt for some stupid reason. Ended up with a leaking screw head. The most forward steam passage is too close to the front inboard screw hole. Had to make a seal for the screw head to stop it. I'm staying with 2mm screws for the valve block. This way the original screws can be used. I changed the head bolts to 2-56 because of availability and price.

---

**Reply author:** Slick  
**Replied on:** 09 Feb 2004 18:17:54

Dave, back a page ago it looks like you have permanently "fixed" the reversing valve in place. Seems like a small bit of angle screwed to the back of the valve. Was this to simplify testing or to simply delete the use of the push rod-johnson bar set up for reversing(forward only?) Also, in regards to inside-outside admission of steam, could the steam supply tubes be crossed over "X" or otherwise rerouted? Mimi. She Blinded me With Science!

---

**Reply author:** Dave Hottmann  
**Replied on:** 09 Feb 2004 21:16:32

Daniel,

You are very observant. I do have my Ruby fixed in forward. I never used reverse so I got rid of the Johnson bar to make more room for RC.

As far as re-routing the plumbing I think it is best to leave it alone. The temperature to silver solder the tubes back warps the piston valve bore. I have tried and made garbage. I think Accucraft bores or reams the holes after soldering. I did successfully soft solder the tubes on my Ruby-Garratt but this is far away from the smoke box heat. It is a forward only engine without the direction valve and block. Plumbing and linkage was more than I wanted to deal with. Much easier to pick it up and turn it around.

---

**Reply author:** TrotFox  
**Replied on:** 09 Feb 2004 23:08:28

I have just completed a crossing of the tubes in the smokebox... Luckily I used silver-bearing soft solder instead of the silver stuff I've got. It will be interesting to see if the bond holds up to smokebox temps but I don't think it'll be a problem. I had trouble getting enough heat into the joint with my small Radio Shack 'micronox' torch. :) Now to get the eccentrics reversed so that the J-bar does the right thing in the right place...

You know what I mean.

I had to extend the tube from the front hole to do this so i used a piece of brass just large enough to fit over the copper exhaust pipe (for alignment) and soldered to the valve block (where I had trouble getting enough heat.) So far the valves still move properly but I wish I'd seen this message before starting! I would have been more careful about my heat application!

Oh well, new valves are cheap anyway and now I won't have to worry about backpressure against the direction servo. ;]

Trot, the fox who's getting some quality shop-time in...

---

**Reply author:** East Broad Top  
**Replied on:** 10 Feb 2004 02:05:54

Okay, somehow I missed the part about crossing the tubes. I understand the part about reversing the eccentrics to go from outside to inside admission of the steam, but do we have to re-route the plumbing between the reverse block and the valve blocks to do this too, or is that simply to maintain the "Johnson Bar "forward" for forward?

I like the idea of changing the loco to inside admission, but not if it involves replumbing things. I like to keep things as mechanically simple as possible.

Later,

K

---



**Reply author:** TrotFox  
**Replied on:** 10 Feb 2004 02:28:24  
**Message:**

No, the replumbing is just some trouble I've been itching to get into for a while now. It basically should give the same effect for the reverser valve as reversing the eccentrics alone does for the cylinder valves.

Actually not an issue at all if you aren't running directional R/C (J-bar.) Not much of an issue if you're running under 40 PSI and you likely won't notice the problems I do so long as you stay in that range... :)

Trot, the experimental, fox...

---

**Reply author:** Slick  
**Replied on:** 10 Feb 2004 04:49:56

DH, Trot and all. Yes I had reversed the eccentrics as Dave H. had suggested, this was the first MAJOR IMPROVEMENT that was done to my Ruby. I no longer have reverse, no problem. (no shirt no shoes either) I will explore further crossing over the steam lines to the pistons and also the steam supply from the boiler to the what is now the exhaust port. (?? More Coffee????)

---

**Reply author:** East Broad Top  
**Replied on:** 10 Feb 2004 08:44:52

So, by going to inside admission, you're eliminating the ability to put the locomotive into reverse?

Later,

K

---

**Reply author:** Dwight Ennis  
**Replied on:** 10 Feb 2004 09:35:55

quote:

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*Originally posted by East Broad Top*

So, by going to inside admission, you're eliminating the ability to put the locomotive into reverse?

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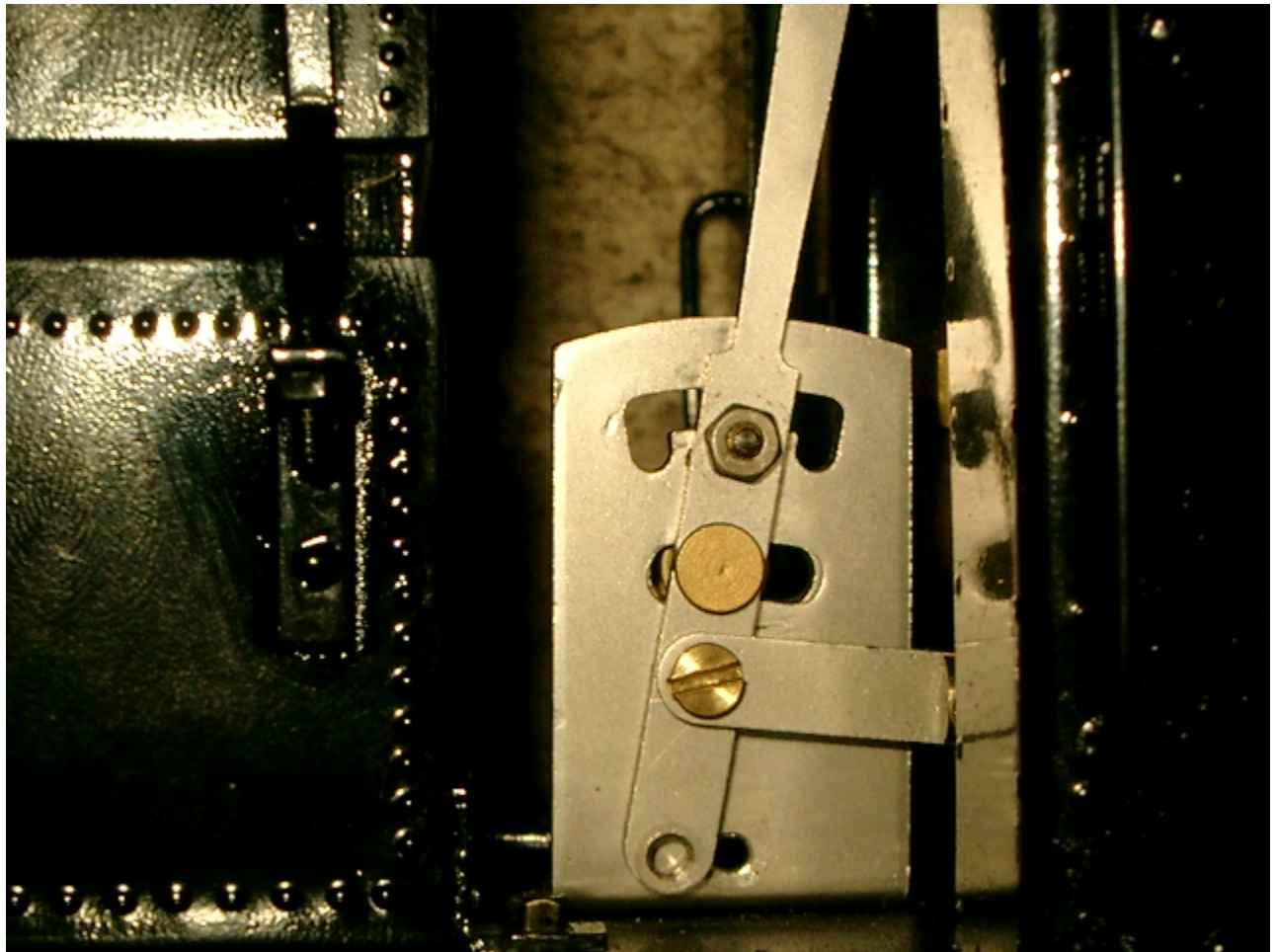
I don't believe so Kevin. It's my understanding that it essentially reverses the valve admissions so that it becomes inside admission in forward and outside admission in reverse. That's the exact opposite of the way it comes from the factory. It also reverses the action of the Johnson Bar so that it's towards the rear of the loco to run forward, and towards the front of the loco for reverse. Dave has also modified the Johnson Bar on at least one loco so that it works normally.

---

**Reply author:** Dave Hottmann  
**Replied on:** 10 Feb 2004 09:36:03

It will still have reverse, just that the Johnson bar will backwards. The pivot can be move to correct this but it can kick out or reverse from the steam pressure.

Here's what I did on my Shay.



---

**Reply author:** East Broad Top  
**Replied on:** 10 Feb 2004 12:57:00

Thanks for clarifying. I'm going to try that on my "new" Ruby project then. Since it's going to be R/C, the position of the Johnson bar is irrelevant.

Thanks for the notes about the larger cylinders, too. It's enough to make a machining novice like myself want to give it a try. trouble is, the prototype for the loco I'll be building had very small cylinders to begin with... Making larger ones will actually make them too large!

Later,

K

---

**Reply author:** Garry Paine  
**Replied on:** 18 Feb 2004 11:42:23

Accucraft lists the Ruby cylinders as: Size - D16 x 32, which I had alway assumed were the dimensions of the piston diameter and stroke in mm. This doesn't seem correct when I look at the drivers, the rod connects about 2/3 of the radius, or make sense when people talk about 1/2 or 9/16 inch pistons as larger.

What is the Ruby piston size?

Thanks, Garry

---

**Reply author:** John Page  
**Replied on:** 18 Feb 2004 14:19:41

Garry,

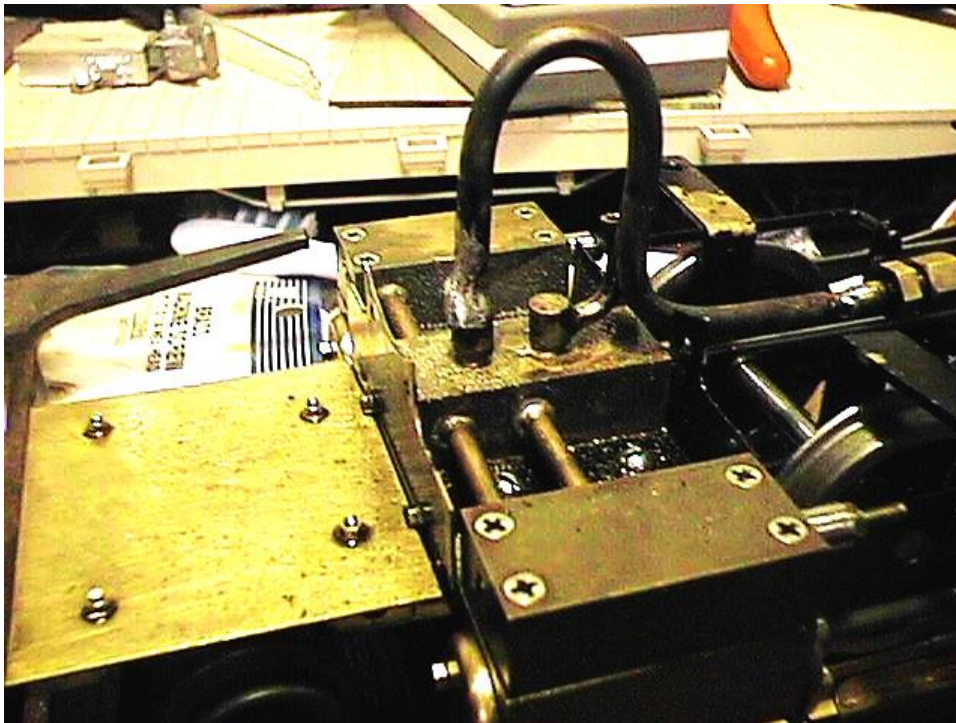
I believe the factory bore is 3/8" I.D. The 16mm dimension given by Accucraft must be the O.D. of their finished cylinder, leaving a cylinder wall thickness of 0.127".

John P

---

**Reply author:** TrotFox  
**Replied on:** 18 Feb 2004 20:48:17

Just a poor shot of the crossed pipes I mentioned earlier.



Don't make fun of my poor soldering skills!

Trot, the fox who's gettin' stuff done...

---



**Reply author:** Dave Hottmann  
**Replied on:** 18 Feb 2004 22:04:23

Landon,

Looks like it will also be a little superheater. Being in the smoke box and not in the flue, there shouldn't be any steamoil worries. Did you thread the end of the new tube and screw it in before soldering it in the directional block?

---

**Reply author:** TrotFox  
**Replied on:** 19 Feb 2004 02:13:49

Dave,

Yes, it should provide some reheating of the steam without me having to worry about oil carbonization. No, I did not thread the end of the new tube and in fact, had to drill the threads out of the inlet to the directional block. Lots of blowing and cleaning happened next to be sure I got all the shards out then the valve went in smooth and easy. However, the tube that you see is not the one that goes into the block. It's a piece of the original exhaust pipe that was cleaned and shoved in there to provide alignment for the brass tube that you see here (blackened due to the heat of the flame.) At the other end the leftover bit of the old inlet tube is still attached to its olive and has been soldered into the end of the new tube. This went well as there was enough less therman mass here to allow the solder to wick into the joint properly... I never could get that to happen at the block and am now happy it didn't with the comments about warped valve bores!

I have a piece of SS tubing I coiled up and was going to insert into the smokebox but decided to keep the saddle mods low-key. This was a compromise.

Incidentally, that ordinary piece of K&S brass tube was bent without a bender, by hand. It was annealed to red heat before the bends were made. To keep it from collapsing I shoved a handy piece of plumbing solder (no rosin core flux) into the length of it and bent away. The metal filler kept it from squishing and allowed the sharp bends you see. After the bends were made the tube was cut to length and heated again resulting in the solder flowing out like quicksilver. : ] This is a trick I picked up from the ride-on guys.

Trot, the fox who has yet to run the mod...

---

**Reply author:** TrotFox  
**Replied on:** 19 Feb 2004 19:57:34

Slick,  
Just make sure it's pure solder, not the rosin-core variety... I have a feeling that type would tend to stay in the tube after bending due to the cleaning action of the flux. :/ Without the flux it runs out like oil off water.

Trot, the noteworthy, fox...

---

**Reply author:** Bob Starr  
**Replied on:** 19 Feb 2004 21:17:52

Landon,

With my experiments with the exhaust outlet, I found that the existing hole accepted a 5-40 tap very well. I made my own fitting when I had a lathe, but it would be fairly simple to thread some heavy wall tubing to mate to the hole. That way no soldering would be required to the block.

---

**Reply author:** Slick

**Replied on:** 20 Feb 2004 04:44:30

TrotFox, this past summer I bit the bullet and opened the cylinders to inspect the pistons. When I reassembled them there seemed to be too much play. (why I opened them to begin with) Took some teflon tape, put a wrap of it in the O-Ring channel and replaced the O-Ring. I got a good seal and easy enough motion of the piston, perhaps this method will rehab your pistons or valves.....Next time I go out to purchase Automotive Snake-Oil I am going to get some Teflon Spray to dress the surfaces of these parts.....

---

**Reply author:** John Page

**Replied on:** 20 Feb 2004 17:24:27

Re: Piston Rod O-ring Seal.

Attn: Casey Sterbenz and others contemplating adding a gland nut to their rear cylinder heads. Before you invest in a 1/4-40 tap & die set, hold off for another couple of months until I can test another very simple idea for holding an O-ring in that cylinder head. If it works, you will hear about it right here; and all of my cylinders will be equipped with it.

Update: The same solution has been suggested to me by three local machinists, including a present Ruby owner (C&OCRY.com). The idea is to turn two disks for the rear cylinder head with an O-ring recess in one of them. The O-ring is sandwiched in between the two disks when they are bolted up together to the cylinder. His lathe is in temporary storage, or we would have tried it this afternoon. C&OCRY also provided me with several more pressure gauges; and ball-bearing roller sets to make a test stand for the Ruby.

Downside: This system does not provide any take-up adjustment for wear. Should the O-ring ever give out, it has to be replaced by disassembling the rear cylinder head. <no free lunch, I guess>

JRP

---

**Reply author:** TrotFox

**Replied on:** 22 Feb 2004 07:38:05

John,

Sounds like a very good and sound idea! Any thoughts on someone making a bunch to sell? I have no lathe and unless the parts can be made up of K&S brass stock I'll not likely be able to pull it off. :]

My thought was to slice off the protrusion at the back of the cyl-cover and tap two tiny holes for bolts. Using an elliptical cup to hold the o-ring (ellipse ends for the bolts) would produce a very nearly prototypical device for holding the gland rings.

As an added benifit, I might actually be able to make them. };] I have a spare pair of piston/covers to play with. These were the first set that wore out on my engine. (Never EVER throw anything away...)

Trot, the fox who's got too much junque...

---

**Reply author:** John Page  
**Replied on:** 22 Feb 2004 15:08:06

Dave,

The British cylinders are 9/16" and seem to be enjoying great operating characteristics. 1/2" cylinders make a substantial improvement in operating and performance characteristics according to those who are using them. Check with David Hottmann. 1/2" may be enough.

For those in the Steam Class who are most interested in scale modeling of prototype engines, any of these upgrades are considerably OVER-sized in comparison to prototype external diameters. The upgrade cylinders are 0.8"(+) in O.D.

From some of the exciting photos Tom Farin has posted, I'd guess that even the Accucraft original 3/8" cylinders are well oversized as far as the external visual appearance is concerned.

So those who are upgrading to larger steam cylinders already have a scale compromise to deal with. Me -- I'm going for performance and handling characteristics before scale appearance...  
[Standing by to be scolded by somebody <g>. I'll be faking plenty of rivets, but don't bother trying to count them!!!]

John

---

**Reply author:** Dave Brown  
**Replied on:** 22 Feb 2004 15:45:15

John,

Do the 9/16 and 1/2 cylinders share the same OD cylinder block?

Dave

---

**Reply author:** Dave Hottmann  
**Replied on:** 22 Feb 2004 16:02:35

I'm more than pleased with my 1/2" cylinders. Last weekend my Ruby walked 3 coaches up and down 2.5% grades for 24 minutes on the initial boiler fill. Sometimes I had to speed up so I wouldn't get rearended by a C-16. Don't know how 9/16" compare to 1/2".

---

**Reply author:** John Page  
**Replied on:** 22 Feb 2004 18:58:31

To begin with, I plan to follow Dave Hottmann's lead and maintain a wall thickness of 0.16". Those walls receive the holes and threads for the cylinder head bolts. To do this, the O.D. on the 9/16" cylinders is going to end up at 0.8825", figure 0.883". The 1/2" bore cylinders end up at 0.82" O.D.

I don't have original cylinders yet to make any measurements. But if the original wall thickness was say 0.14" Then the original O.D. would  $0.28" + 0.375" \text{ bore} = 0.65"$  measured horizontally. If the OEM walls are 0.15", the the O.D. would be 0.68". So the upgrades, like waistlines and budgets, are getting fatter. Can anyone post the width of an OEM Accucraft Ruby cylinder?

JRP

P.S. Rick Marino with the 9/16" Ruby cylinders. Would you be so kind as to post the O.D. on your cylinders? Much appreciated.

---



**Reply author:** TrotFox

**Replied on:** 22 Feb 2004 22:49:58

John,

I suspect there will be a difference in outer diameter, correct? I think the 1/2" will be the size for me. Let us know when you get them going as I am certainly interested!

Uummm, I won't be buying a kit though... can I still purchase a pair?

Trot, the fox who's already got a Ruby... {:]

---

**Reply author:** Dave Hottmann

**Replied on:** 22 Feb 2004 22:55:12

John Page,

OEM cylinder walls measure .125". OEM bore .375". Outside measures .625-.630". The outside varies a little but doesn't matter that much.

---

**Reply author:** Dave Hottmann

**Replied on:** 24 Feb 2004 19:15:09

John P,

On the 2mm taps I make my own bottoming taps by cutting off the taper with a Dremel and a cut-off disc. As the taper taps wear their ends get cut off to become bottoming taps. When the taps start to get a twist in them I throw them away. It's a BIG bummer when they break off in a blind hole. Usually flush and in the second to the last hole to be tapped. Buy lots of taps and have fun!

By definition I'm not a machinist but I do make some nice garbage. Besides, junk parts can make good jigs.

---

**Reply author:** John Page

**Replied on:** 24 Feb 2004 19:31:54

Dave H.

I really appreciate the 2 mm encouragement. Yes, I was thinking about grinding the tips off to make ever-fresh bottom taps. I'll watch carefully for any twisting that takes a set in the tap.

As a teenager, I broke a head bolt in the block of a Ford flat-head V-8 engine. Naturally it was the lower row at the extreme rear of the block; engine still in the vehicle! (argh).

More shop excuses: "Junk parts are not junk parts at all. They are being held in reserve for the next smaller project." <g>.

JRP

---

**Reply author:** Dwight Ennis  
**Replied on:** 24 Feb 2004 21:05:54

quote:

---

*Originally posted by Dave Hottmann*

---

It's a BIG bummer when they break off in a blind hole. Usually flush and in the second to the last hole to be tapped.

---

1/2 turn in and 1/4 turn out... and cutting oil. 🤖 Leastways, that's what they taught me in metal shop those many years ago. 😊

---

**Reply author:** Dave Hottmann  
**Replied on:** 24 Feb 2004 21:23:00:

Dwight,

I wish I was that patient. I did learn it only takes half the time to get the tap out as it takes to make another cylinder, and that taps are cheap!

---

**Reply author:** Bob Starr  
**Replied on:** 24 Feb 2004 22:48:22

Dwight is, of course, right about the proper method to tap and it really is not hard to get into that habit as does clear the chips away. But another thing to consider is that in most instances we do not require the full holding power of threads. When a tap hole size is given, it is for a full depth thread, so going up at least one size bigger will not destroy your holding power. This is often done for small blind holes in production line work where broken taps is costly affair.

---

**Reply author:** Dwight Ennis  
**Replied on:** 24 Feb 2004 22:58:44

You mean I'm actually right? 🤖 Miracles never cease! 😊

---

**Reply author:** TrotFox  
**Replied on:** 25 Feb 2004 23:27:43

Alright mister... uh... right-y-pants.

What do you use for cutting fluid? I've been using 3-in-1 oil as it's cheap and readily available (sitting in front of me when I grab the tap) but I don't know if it's up to snuff. I mean, I'm only cutting very tiny threads and I'm using phunky three-sided taps. They don't even look like they have actual cutting faces but they get the job done. \*shrug\*

Trot, the fox who has yet to break a tap...

---

**Reply author:** John Page  
**Replied on:** 25 Feb 2004 23:51:08

Trot haven't-broken-one-yet Fox...

Oh dear. Now you've gone and done it. Why do I get the feeling you shouldn't have said that.... These tiny little taps sure take on that twisty-twirly set awful easy. I've been trying the heavy sulphured cutting oil (smelly and messy) and also the thin Tap-Magic. I can't tell yet which is better.

For the experts: Is there any preference between carbon steel and HSS taps for doing these small holes in brass? Thank you in advance.

John P.

---

**Reply author:** Dwight Ennis  
**Replied on:** 26 Feb 2004 00:12:11

Actually, I've used steam oil a couple of times. Seemed to work good. 😊

---

**Reply author:** SteveJ  
**Replied on:** 26 Feb 2004 08:46:35

Trot, 3-in-1 oil is all that lives on the workbench here, but it's a vast improvement on not using anything.  
SteveJ

---

**Reply author:** John Page  
**Replied on:** 07 Mar 2004 14:39:42

Dave,

I used a 0.1247 reamer in a 1" dia x 1/2" thick steel disk to make a "dial indicator accessory" for dialing in cylinder blocks. The intention was to press the disk on 1/8" (0.125) steel rod. But I ended up with a close slip fit instead of a press fit...a little disconcerting. Reaming was done at 70 rpm, with the reamer in the lathe tail stock, and cutting oil. Locktite saved the day, and the centering device works as intended.

However, I'm concerned that the same procedure, used on brass rod for pistons, is going to also result in an undesirable slip fit for the piston rods. I have not tried this procedure on the brass rod as yet. Any suggestions?

Thanks,  
JRP

Cylinder boring is progressing slowly but without problems.

---



**Reply author:** Dave Hottmann  
**Replied on:** 07 Mar 2004 16:33:18

John P,

I run the .1247 reamer through the piston once by hand only one way. This has worked for the precision ground ss steel rod I'm using for the piston rods. I tried the next size down numbered drill. With this rod that is too tight and the rods kink close to the end of pressing.

I had a couple bad bores. Instead of scrapping them I hand reamed them out .006 and cut pistons to fit. To finish the cylinders I used a 240 grit ball hone with cutting oil, and 0000 steel wool with water. Wouldn't you know it, they have been the best ones yet.

---

**Reply author:** linuxhost  
**Replied on:** 08 Mar 2004 10:14:36

Does any one have any thoughts on casting the cly., instead of machining them? I've done some playing around with "Lost Wax Casting", and have had very good luck with it. True, you will still have to mill down the head and valve surfaces along with the cly. bore, but you would not have to worry about machining the outer part.

Heck, you could even cast in surface details.

Doug

---

**Reply author:** Dave Hottmann  
**Replied on:** 08 Mar 2004 12:29:11

Doug,

Dave Rhoton of Ozark Miniatures has offered to do lost wax castings if I would give him some finished cylinders. Unfortunately I haven't had time to even talk to him so I have dropped the ball. I have also delayed because of figuring out how to hold them for machining. I'm a novice machinist. The 9/16" cylinders are CNCed from bars. They are about \$140 for a finished set.

This raises the question, what would people be willing to pay for a set of castings?

---

**Reply author:** John Page  
**Replied on:** 08 Mar 2004 13:28:32

Since square brass bar is available so cheaply, and the drilling and reaming of the cylinder block is about the easiest of all the procedures so far, I don't see any advantage personally, in paying the costs for cylinder castings...merely a personal opinion. I certainly do not wish to discourage anyone from trying out alternate ideas.

The machining of the exterior of the cylinders, using a mandrel in a rotary table, does not appear to be any more difficult.

This first batch of cylinders is very time consuming at the moment, primary because I am starting with 1 1/4" square stock, instead of 1 1/8" stock. I grab what the salvage metal yard has available. After initial facing and boring, there is still a hunk of brass remaining to machine away. Next time, I may also bandsaw some of the excess material away, once I get the saw assembled...another project!!

Then again, my practice pair of cylinders has provided lots of margin for errors and setup mistakes. I may spoil the practice set before I am finished. But so far, they are as serviceable as the pieces that

follow. The practice set just involves four times the amount of time that the production pieces require.

It is certainly true that lost wax cylinder castings give the opportunity for some impressive detailing. So there is every reason for Dave Rhoton to investigate the possibility of producing nice castings. As Dave Hottmann has just noted, setting up castings for machining becomes more complicated compared to working with solid bar stock. In drilling the cylinder bores, I'm indicating in each individual block in a 4-jaw chuck; takes 2 to 3 minutes using a home-made centering rod with a sharp point. I'm using a shim to protect the top surface from jaw marks. The marks on the other three sides will be machined away. On future batch runs, I think I will finish-mill that top surface after the blocks are drilled out in the lathe.

There are dozens of castings kits on the market for stationary, RR, and marine steam engines of all sizes. So I would think that there are some standardized setup procedures for machining cast cylinders that are already round. That might be a good question to post on the numerous metal machining clubs and forums on the Internet.

Learning a lot,  
JRP

---

**Reply author:** linuxhost  
**Replied on:** 08 Mar 2004 17:11:26

I'm by no means an expert machinist, but as John has pointed out, using a rotary table is by far the best way to machine the exterior of the cyl.. The problem is that most folks don't have a rotary table. Especially the ones, like myself, that only have a "Mini Mill" at home. Heck a small rotary table is as big as the mill !

With a raw casting, the rest of the machining can be done on even the small mills.  
Also, brass ingots are really cheap.

There are drawbacks with casting, one is shrinkage. The master for the mold has to be approx. 2%-3% oversized for brass castings.

The other, as Dave has pointed out, is holding the cast piece while machining. Although I think that the mounting problem can be overcome with the addition of a second flange, opposite of the cly. to frame, mount flange. With this second flange the piece can be dropped into a vertical vise for the cly. and head bolt-holes boring and then put into a horz. vice for the valve body face, boring & milling. Once the machining is done, either cut the extra flange off or mill it off.

However, a better machinist than myself, can probably turn out, two or three pairs of completed cly. faster than one pair can be cast.

As far as cost, I'm game for any price, as long as it doesn't exceed the cost of the "Ruby". I can't see putting a \$500 set of cly, on a \$250 engine. I don't care how much better it runs.

Doug

---

**Reply author:** Dave Hottmann  
**Replied on:** 08 Mar 2004 18:19:33

I have an update on castings. My friend John Mower is taking one non-perfect cylinder to Dave Rhoton tomorrow to practice with. Dave R. stays busy with the business so it might be a while.

---

**Reply author:** ozmin

**Replied on:** 12 Mar 2004 16:48:07

I have taken a look at the cylinder and can cast that puppy up. John is getting Dave to get me a perfect cylinder set And I will make the molds and start production. If there are any other parts you folks want cast if you have 1 piece I can take it from there BUT remember shrinkage can range from 3% up to 9%. The larger the mass the more shrinkage. This occurs during the wax process of the lost wax castings.]

Ozrk Miniatures Dave

---

**Reply author:** FH&PB

**Replied on:** 12 Mar 2004 17:15:52

Listen, if you're going to be casting replacement cylinders, why not take an extra half hour and make a pattern that looks like a locomotive cylinder, rather than just a chunk of milled brass?

The bug-ugly, unpainted cylinders are the Ruby's biggest cosmetic flaw, so if we could fix that at the same time, it would be a huge improvement!

---

**Reply author:** TrotFox

**Replied on:** 12 Mar 2004 20:11:23

I have to agree with Vance. Those cylinders really stand out unless you do something creative to hide them!

Now if only there was a way to make shorter piston-valves that would fit a valve block that's about 1/2 the length of the current ones... \*wink wink nudge NUDGE!\*

Trot, the fox who'd really like some slide-valves with real valve-gear...

---

**Reply author:** Dave Hottmann

**Replied on:** 12 Mar 2004 21:14:05

Would shaping the outside of the cylinders like the Shays be OK? I have one set of cylinders that the outside hasn't been cut.

---

**Reply author:** Bob Starr

**Replied on:** 12 Mar 2004 21:47:16

Well, how about one better. Why not just make them slide valve instead. Really would not be very hard.

My other suggestion is to use caruba wax to make the model that will be cast. This is what is commonly used by jewelers and other cast modelers use. The wax can be turned on a lathe and can also be carved with a hot knife or wax carving tool. If the original were to be this way it could be made oversize to allow for shrinkage and machining; something, I hope, you all have taken into consideration.

The wax can be obtained from any jewelry supply and comes in different colors to identify its properties. For general use I prefer the green.

---



**Reply author:** TrotFox  
**Replied on:** 13 Mar 2004 02:22:37

Bob,

Slide valve would require fabrication of full valve gear which Ruby doesn't come with. Stock it is a simple single-eccentric engine which uses a piston valve reverser which changes steam-flow direction. That's really the only thing keeping it from happening. I think it could be done reasonably easily with Walchearts. Especially if a simplified version was used like that in the Roundhouse engines which is what I'm pondering for my Ruby. I don't know if I'm up for the calculations involved in the design of a full setup. { : }

Trot, the simple, fox...

---

**Reply author:** FH&PB  
**Replied on:** 13 Mar 2004 10:21:13  
**Message:**

Dave, I don't know what the Shay's cylinders look like. Got a pic we could see?

---

**Reply author:** Pat  
**Replied on:** 13 Mar 2004 12:29:35

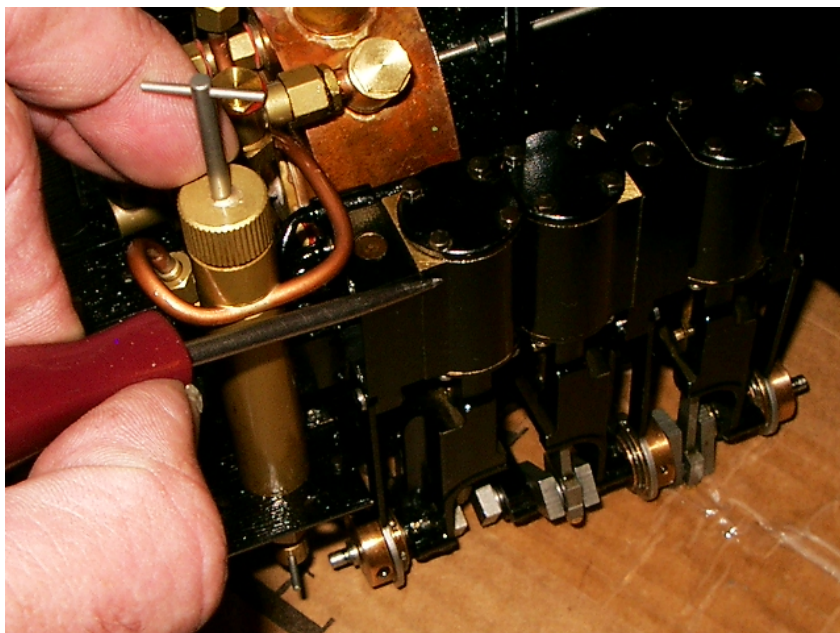
Or how about a dummy casting that just slips or screws onto the original casting and/or one of the new 1/2 or 9/16 cylinders?

-Pat Rolland

---

**Reply author:** Dave Hottmann  
**Replied on:** 13 Mar 2004 22:00:40

Vance, on the others I went straight from the OD radius to the base of the valve block for the sleeper look. It was also easier. The 9/16 cylinders are rounded here and I could do a sharp line like here.



**Reply author:** TrotFox  
**Replied on:** 18 Mar 2004 00:53:35

Dave,

Went looking for .12" reemers to use with my 3mm piston rods but no joy! No one local seems to have them. I just re-read through these pages and you mention drilling the solder out of your repaired heads... Is drilling alone sufficient? If not, where can I order the proper sized reemers? How much clearance is needed? I can get a 1/8" reemer but that's 50 thou over and I don't have enough machining to know if it's small enough. : (

Trot, the careful, fox...

---

**Reply author:** John Page  
**Replied on:** 18 Mar 2004 10:18:04

Landon,

Some of your additional choices include:  
1/8" dowel pin reamer: 0.1247"  
Under and Over reamers: 0.124 and 0.126 (I think)  
The next drill size: 0.128 if I recall.

As indicated by Dave, any of these will give you differing final hole sizes depending on how you use them: manually, one or several turns; machine driven (many turns of the reamer even at slow speed = larger hole). The last method, using the dowel pin reamer, gave me a beautiful sliding fit on a ground 1/8" steel rod -- not the mild press fit I was expecting.

Learning something new every day,  
John P.

---

**Reply author:** Dave Hottmann  
**Replied on:** 18 Mar 2004 10:52:10

Landon,

For the 3mm rods I drilled the soft solder out with a #32 or 31 bit. I would shave solder out with the bit until the rod would go threw and then use the rod to "form" the solder until the rod moves freely. Sometimes the rods are worn so there might be tight spots. After a few runs the tight spots go away. Oh the things we do to keep our Rubys running.

---

**Reply author:** TrotFox  
**Replied on:** 18 Mar 2004 18:58:21

How long will this fix last Dave? I measured the rods and one is dead on 3mm with the other slightly under. : / I'm more than half tempted to just go on with my O-ring idea and see if it can be made to work. : ]

Any ideas on fitting working crossheads? I've got a couple but they're more work than I'm currently interested in performing.

Trot, the fox who's getting lazy again!

---

**Reply author:** Dave Hottmann  
**Replied on:** 18 Mar 2004 21:32:09

Landon,

The soft solder will work a little less longer than a brass cylinder head. The solder is easier on piston rods. On the cylinders I built I extended the rear cylinder head for more support and longer life. I also figured that with bigger cylinders I would pull even bigger trains. (I went from 10 to 14 cars on grades. Poor Ruby, I'm so mean.)

I decided against a crosshead because it would cause more friction for a poor little Ruby to overcome. I was also too lazy to do it.

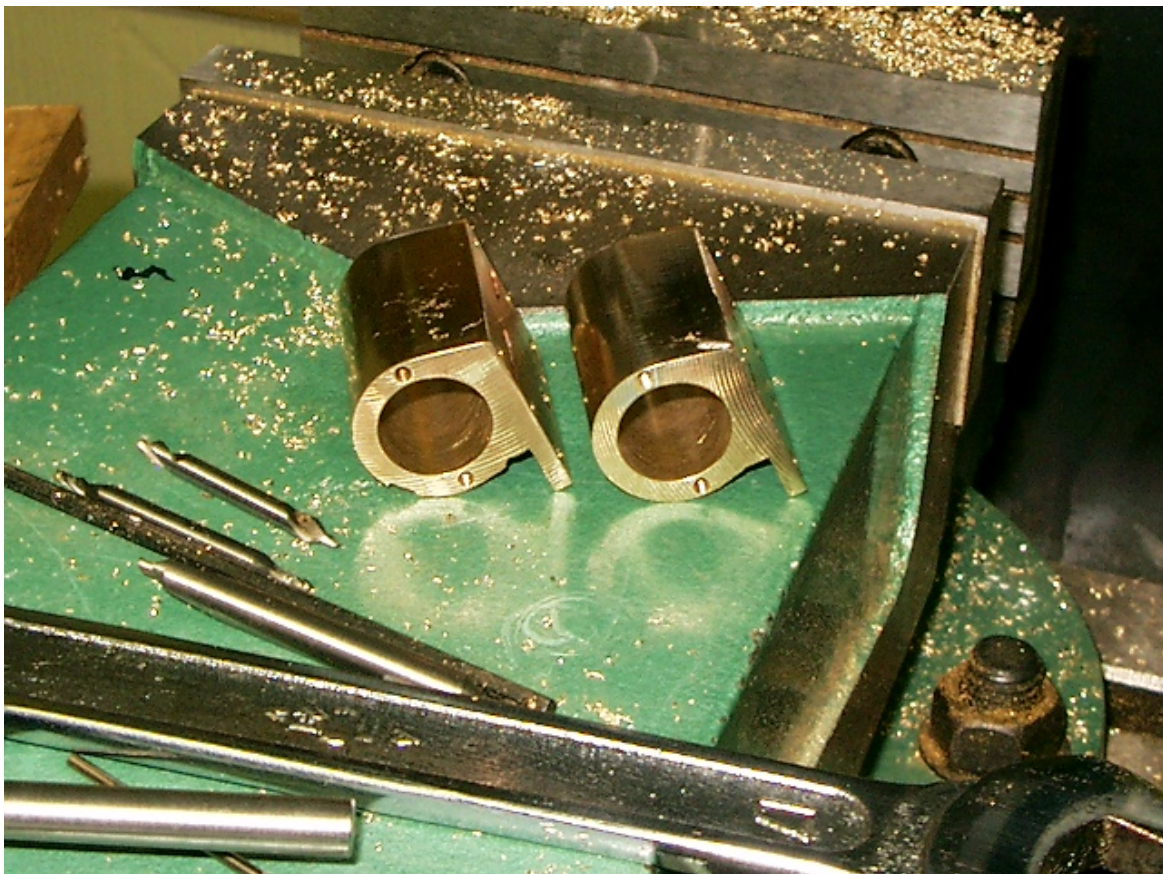
I haven't tried o-rings or seen one so I don't know how well they work or last.

---

**Reply author:** Dave Hottmann  
**Replied on:** 17 Jun 2004 21:57:18

I received the first cylinder castings last night from Dave Rhoton of Ozark Miniatures. The patterns were near perfect machined cylinders without compensation for shrinkage. When they 17% they aren't kidding. Basically the finished product is 1mm too small in all directions. This was just trial run anyway.

Here's what I salvaged after 9 hours.





**Reply author:** John Page

**Replied on:** 17 Jun 2004 23:07:44

Thanks for that update, Dave. When you say 9 hours, I believe it. No strenuous convincing needed here at all.

My salvage brass bar stock starts out 1 1/2" square, so machining to size makes a LOT of chips!

My lathe and mill now sport compressed air lines with drop hoses from the ceiling; and multiple 50-Watt halogen spot lights suspended from the ceiling from adjustable conduit mounts. What a difference, being able to see while operating these machines!!

John in Medford

---

**Reply author:** Dwight Ennis

**Replied on:** 18 Jun 2004 05:01:17

Wow! Nine hours! How does that compare with the time it takes to make a set from scratch?

---

**Reply author:** Dave Hottmann

**Replied on:** 18 Jun 2004 09:56:22

I don't remember the time for cutting a brass block. All the same cuts had to be made but some of them were much faster because there was less material to remove. The biggest battle was moving bolt holes. With the shrinkage three holes were a half a hole off. I had to drill and tap, plug the holes and re-drill and tap in the correct place. We should of melted them back down but finishing them taught me a lot.

---

**Reply author:** Steve Shyvers

**Replied on:** 18 Jun 2004 10:58:23

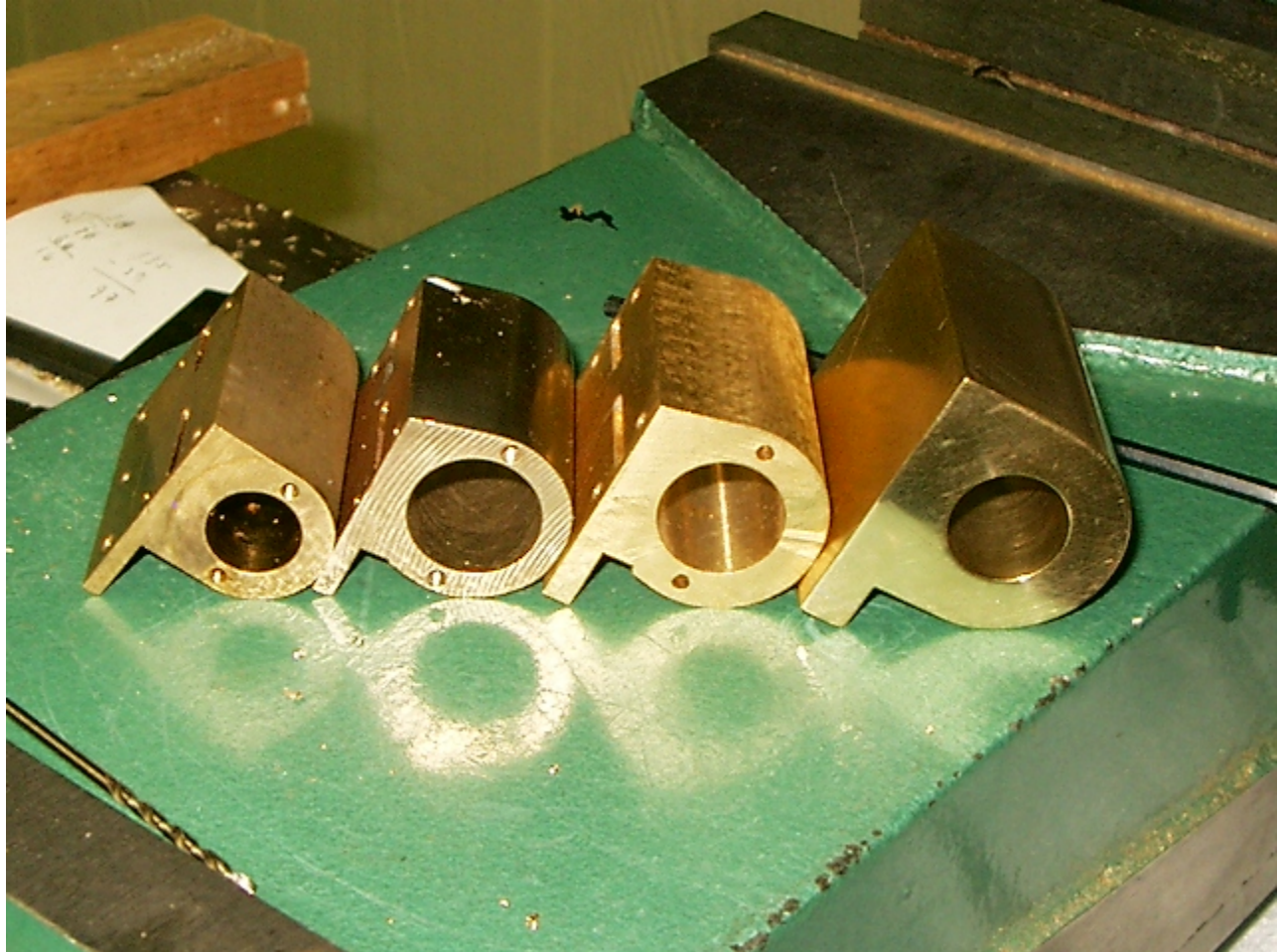
Dave,

Thanks again and again for the lessons about the realities of machining. It sure helps me to understand the true scope of projects.

---

**Reply author:** Dave Hottmann  
**Replied on:** 18 Jun 2004 22:36:02

Tonight I made an enlarged cylinder for the second try at casting. In the picture below the cylinder on the far left is a stock cylinder. Next one is machined from a casting of the right of center cylinder (too thin to use). The cylinder on the far right is the model for the next mold. Hopefully the next castings will machine into the right of center cylinder.



---

**Reply author:** Dwight Ennis  
**Replied on:** 19 Jun 2004 07:51:51

Dave - just curious as to why the one is too thin to use. It's can't be the pressure so I assume (there's that word again) that the heat may distort it, taking the bore out of round?

---

**Reply author:** Dave Hottmann  
**Replied on:** 19 Jun 2004 14:03:01

Dwight,

The head bolts and valve screws distort the bore. They are close to tissue paper thin in places. I tried to save them but learned a lot from the failure. Every time I plugged and soldered a hole I had to ream the bores to make them true. The finished bores measure .522". The cylinders are also 2mm too short. If I get really bored I might make special pistons and heads someday and hope they don't leak and stay together.

---

**Reply author:** John Page  
**Replied on:** 28 Jul 2004 12:37:05

Dave,

In your opening post to this thread, you mention raising the height of the cylinder bore to achieve better alignment of the piston rod on centerline with the drivers.

In my recently arrived Ruby kit, the piston rod of the OEM cylinder is nicely aligned with the driver axles. Did Accucraft adjust their dimensions before making this run of kits? If so, is there a possibility that cylinders machined to fit the kit frames may be slightly off-center for pre-existing Rubys already in the hands of our membership?

John P.

---

**Reply author:** Dave Hottmann  
**Replied on:** 28 Jul 2004 13:08:02

John,

The factory cylinders have always been lined up with the axles. In increasing the bore the cylinder center line was lowered to make room for the valve block screws. I have noticed that the new Rubys have shorter screws. Instead of running the cylinder centerline low, I raised the deck for the valve blocks.

---

**Reply author:** John Page  
**Replied on:** 30 Sep 2004 02:17:29

Well, I had to return the rotary table I was going to use to machine the outside of the cylinders. I'm now contemplating purchasing my own rotary table unit (ouch).

Last week I got to run Clark Lord's stock Ruby (3/8" cylinders), which is will broken in. Many thanks to Clark for all of the personal instruction. I got the impression that 1/2" cylinders would probably be a sufficient upgrade, as per Dave Hottmann's wisdom. However, since the majority of builders who have written me were interested in the 9/16" cylinder bore, I will continue with that size as my objective. Since I have some pairs of blocks already bored for 1/2", I'll plan to finish them in that size. I'll just have to machine two separate arbors for the rotary table when I get it.

John in Southern Oregon

---

**Reply author:** wchasr  
**Replied on:** 19 Nov 2004 08:11:48

Dave &/or John,

I have translated all the dimensions & sketches from this thread to Solidworks which is a solid modeling software that I use at work. I can transfer this to 2D drawings in Solidworks or in AutoCAD or in \*.DXF files to those that are interested. I believe I got all the inforamtion correct but not being totally familiar with Live steam I'd like to forward copies to one of you or both to check my work or someone else perhaps? I thought of you two as I know you've made these cylinders already.

Chas Ronolder

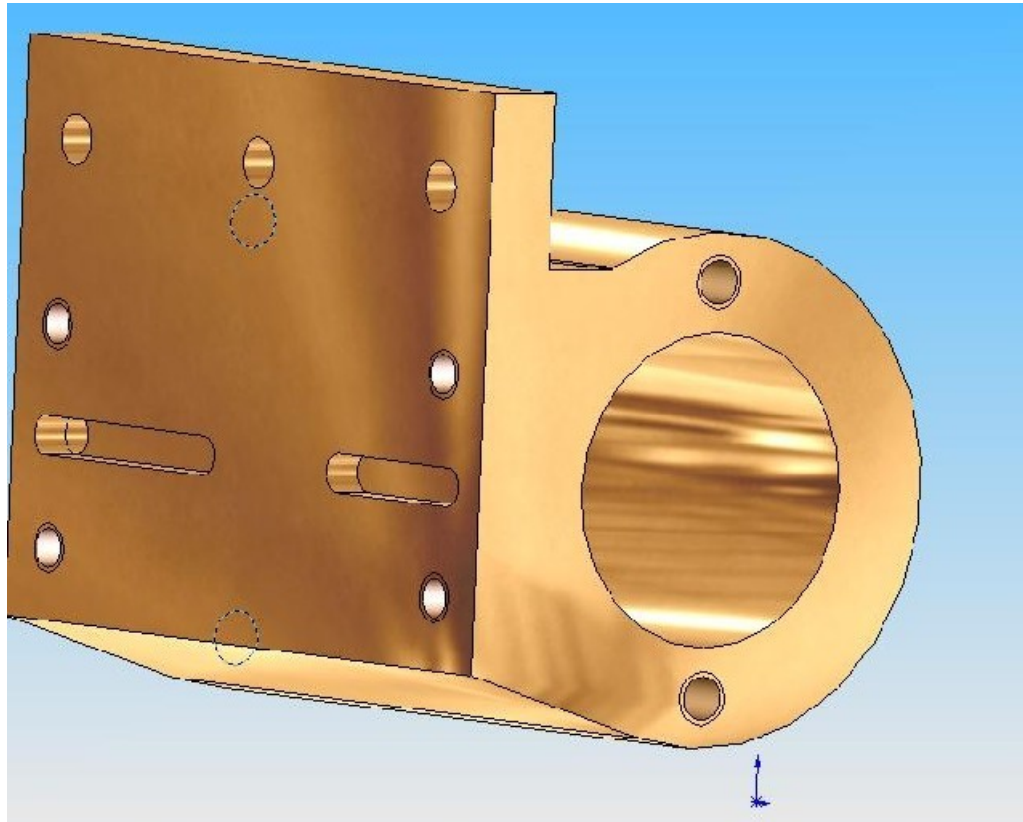
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**Reply author:** wchasr

**Replied on:** 19 Nov 2004 13:32:08

Heres a screen shot of one of the cylinders before it is dropped to a 2D drawing. I even changed the material to Brass!



Chas

---

**Reply author:** John Page

**Replied on:** 19 Nov 2004 14:20:34

Very cool graphic, Chas. Wouldn't it be nice to have an additional keystroke in SolidWorks which would drop a finished machined cylinder right out on your desk????

If you would care for forward the file of your 2D drawing, I'd like to take a look. My drawing is a hand draft scaled up by a factor of 10, in order to check hole clearances. I'm going to try for four cylinder head bolts instead of two. But they will not be symmetrically spaced at 45 degrees around the bolthole circle because of interference with the valve block mounting holes.

John

---

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