V twin cylinder steam engine

I got inspired to make this V twin steam engine after reading R. Griffinn's build articles in ME 4396. It is based on Stuart's V-twin double-acting oscillator, but since I don't need it to be able to reverse it I could simplify the standard a bit. The double-acting cylinders were made the same way as the single cylinder oscillators I had made earlier (based on Elmer's #36).

I decided to start by making the standard and try to drill the long steam passages, if that failed I had just lost a piece of steel I got for free.

Materials

I mainly used mild steel from my scrap box and some brass I had lying around. The brass pieces were used to fabricate the cylinders. I purchased some free-cutting stainless steel and some stainless screws.

Standard

The standard was made from a piece of 16mm thick steel I found in a skip, it turned out it was easy to machine. Since I didn't intend to make any reversing gear on the engine I made the standard Y shaped.

I started by milling the top and bottom to make them parallel. Because of the size I clamped the work to an angle plate with two G-clamps and two other clamps.

After milling top and bottom the work was transferred to the lathe and mounted in the 4-jaw. The side where the steam ports will be drilled was faced.

The work was then mounted on an angle plate on the cross slide of my lathe – see photo below. The drill chuck was mounted in the lathe spindle and the long steam passages in the standard drilled. I drilled a short distance with a 2mm drill, then opened up with a 2.5mm drill. Then the 2mm drill and drill a bit deeper before opening up with the 2.5mm again. I managed to drill all the long steam passages without breaking the drill. If I wasn't able to drill the long steam passages successfully, there wouldn't be a V-twin, so I started with the standard.

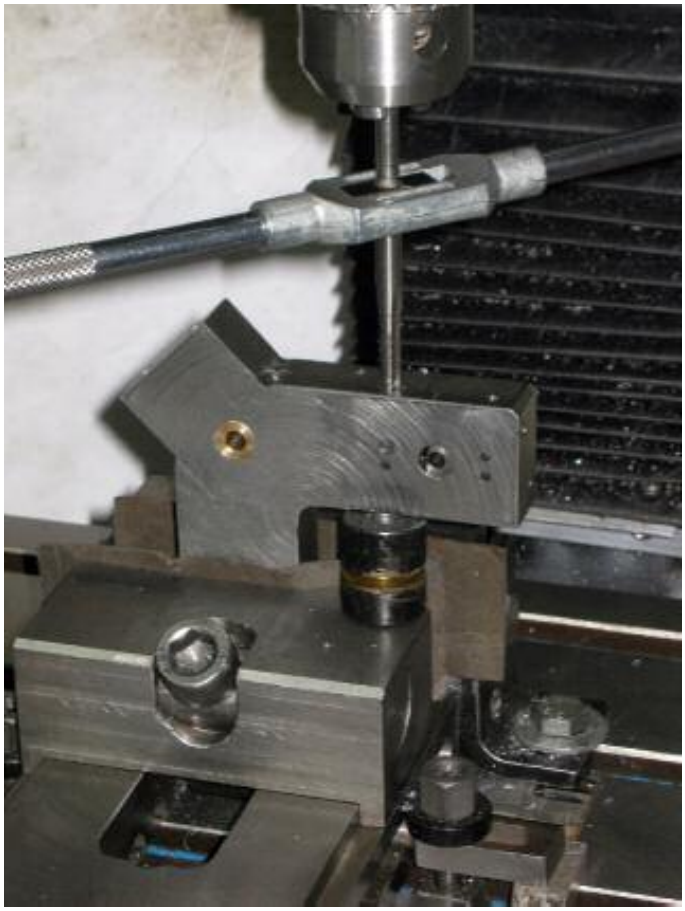
After drilling the long steam passages I used a hacksaw to cut the outline of the standard, I then milled the sides – see right photo.

I could then mark out the bearings and the short steam passages and drill them, they were drilled the same way as the long ones – left photo.

I also marked out and drilled the steam ports and the holes for the crankshaft bearing and the pivot pin bearings. I had some pieces of cast iron left over from another project, and used that to turn the pivot pin bearings and press them into the standard, the pivot pin bearings were then reamed to 4mm.

For the crankshaft bearing I used a piece of 12mm dia. brass rod, bronze would have been better but I don't think my engines will be run for long periods of time.

I opened up the outer part of one short steam passage to 4.2mm and tapped M5, this will be used to supply the engine with compressed air (or steam). The other openings of the passages supplying compressed air to the engine was tapped M3 and will be blocked with some M3 screws and small gaskets.



Cylinders

I fabricated the cylinders from some left over pieces of 16mm dia. brass rod I had from another project. I used some 3mm x 25mm brass flat for the cylinder flanges and some thicker flats for the cylinder port block, one thicker than the other. That means the centre of the cylinders will be at different distances from the standard so the big ends of the piston rods don't foul.

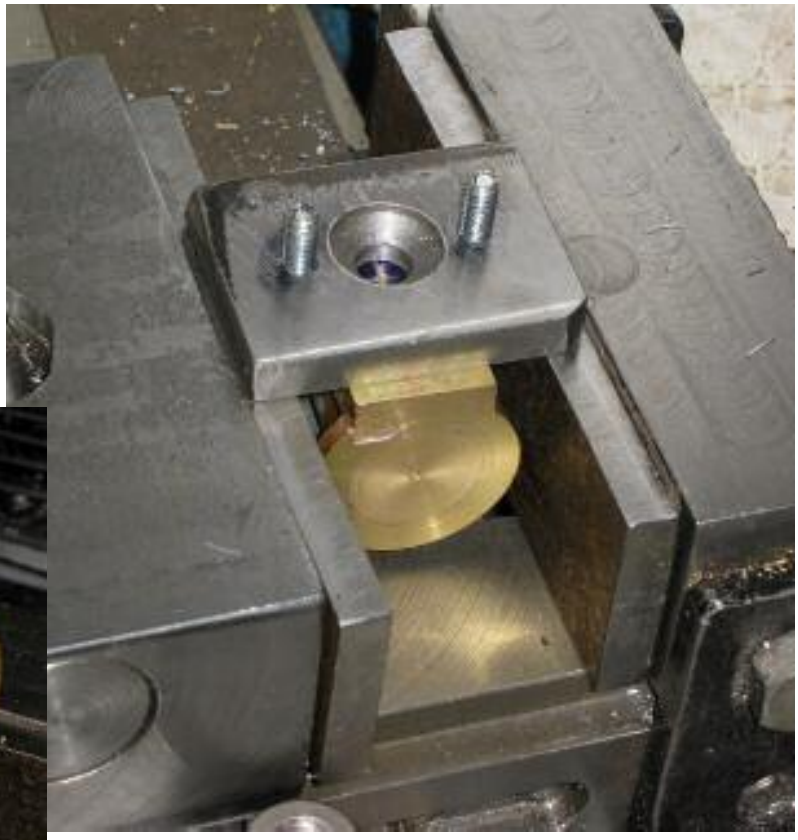
The port block was machined flat on one side and mounted in my tool vice mounted on its side – right photo. I used a 16mm slot drill to mill a depression for the 16mm brass rod. It is important that the gap between the pieces that will be silver soldered (brazed) is small, around 0.1mm. The cylinder flanges was made from 3mm x 25mm brass flat. I cut a length of just over 25mm for each flange and used a small hacksaw to cut off each corner. I drilled a hole through the centre and mounted the work on a mandrel so I could turn the outside to 25mm. The work was then mounted in my small 3-jaw and the hole opened up to 16mm. I then used a

milling cutter to mill the flange to a close fit on the port block/cylinder. After cleaning and fluxing, the parts were silver soldered together and pickled for half an hour in citric acid – left photo.

The cylinders were mounted in the 4-jaw and the flanges faced and the cylinder drilled, bored and finally reamed to 13mm.

The steam ports were marked out and drilled and the hole for the pivot pin drilled and tapped M4. There were still remains of the flux so I got my friend to sand blast them, I think that turned out well.

To be able to drill the hole for the pivot pin square with respect to the cylinder port face, I made a simple jig (right and lower photo) consisting of a flat piece of steel with 3 holes. The centre hole was drilled 5mm and countersunk, the other two holes were drilled 3.3mm and tapped M4. The M4 holes are used to clamp the cylinder to the jig with a small clamp. The jig is then placed on two (home made) parallels and the pivot hole



drilled and tapped.

The top cylinder covers were made from a piece of 25mm dia. brass rod. The spigot was turned to a close sliding fit in the cylinder and it protrudes about 1mm, then the cover was parted off to a total length of 3mm. The covers were mounted in a 3-jaw on the rotary table and the three 3mm holes drilled. The top covers were used to spot the holes in the upper cylinder flanges.

The bottom covers were fabricated from a piece of 10mm brass rod and the same size brass flat that were used for the cylinder flanges. The brass rod was faced and then the end turned slightly hollow to fit the depression in the brass flat that I milled with a 10mm slot drill. This way the pieces stayed in position while silver soldering.

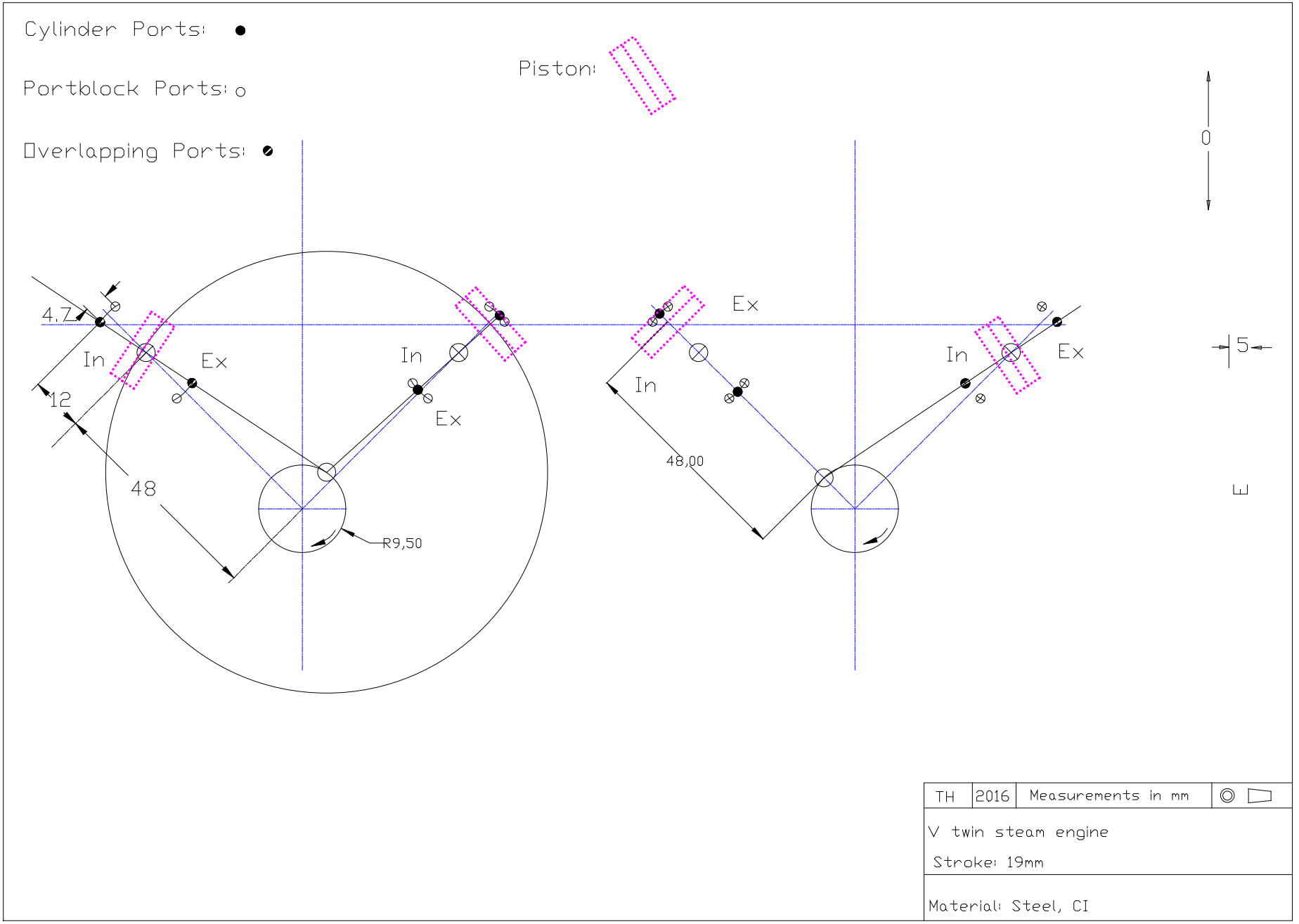
Pistons

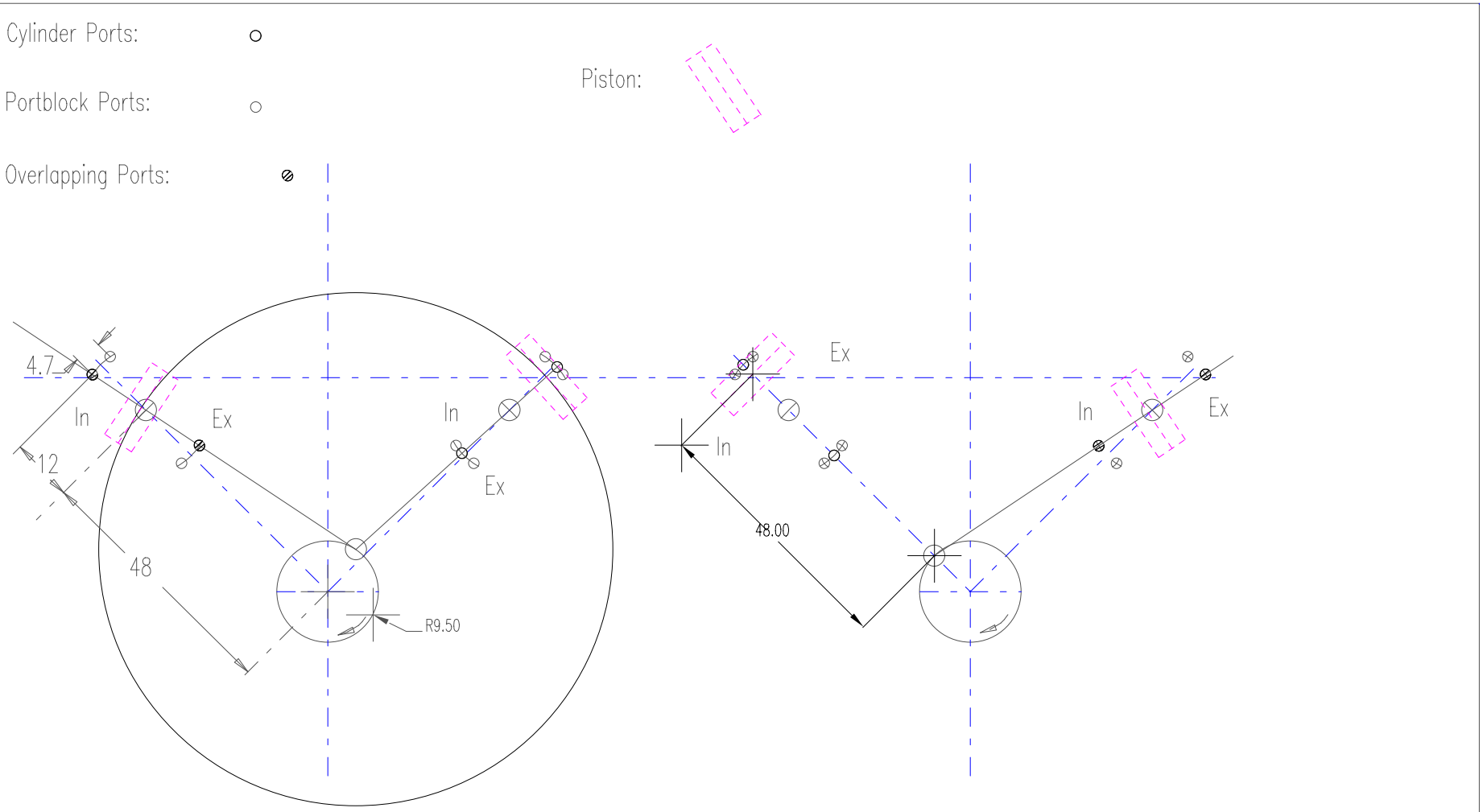
The pistons and piston rods were made from stainless steel. I happened to have some $^1/_8$ in. 303 free cutting stainless steel and used that to make the piston rods. The ends were turned down to 3mm and then threaded M3 at each end. I also had a piece of $^1/_8$ in. silver steel and used that to make a D-bit that I used to ream the $^1/_8$ in. holes in the bottom covers and in the pistons.

The pistons were turned from a piece of 16mm dia. stainless steel. I first drilled a 2.5mm hole to a depth a little more than the length of the piston. The outer part was opened up to 3.1mm for a depth of 2/3 of the length of the piston, and a D-bit used to ream that part of the hole to $^1/_8$ in. The inner part was threaded M3.

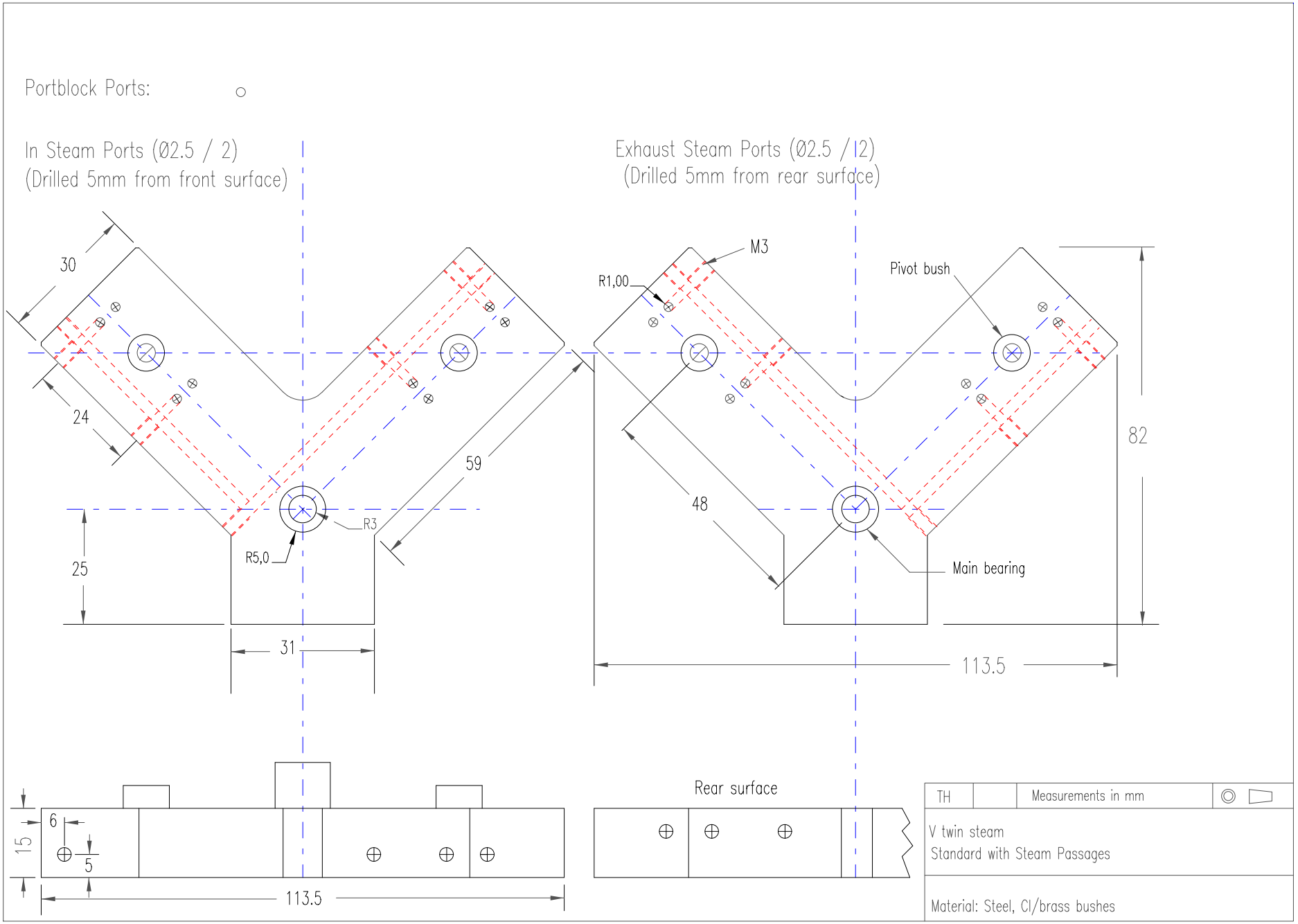
I used a parting off tool to make a packing groove in the piston – right photo – before parting off.
The piston rod big end bearing was made from some left over pieces of square brass. The brass was mounted in the 4-jaw and turned to a little over 6mm diameter for a length of nearly 6mm. The work was then transferred to the milling machine and the hole for the crankpin drilled.

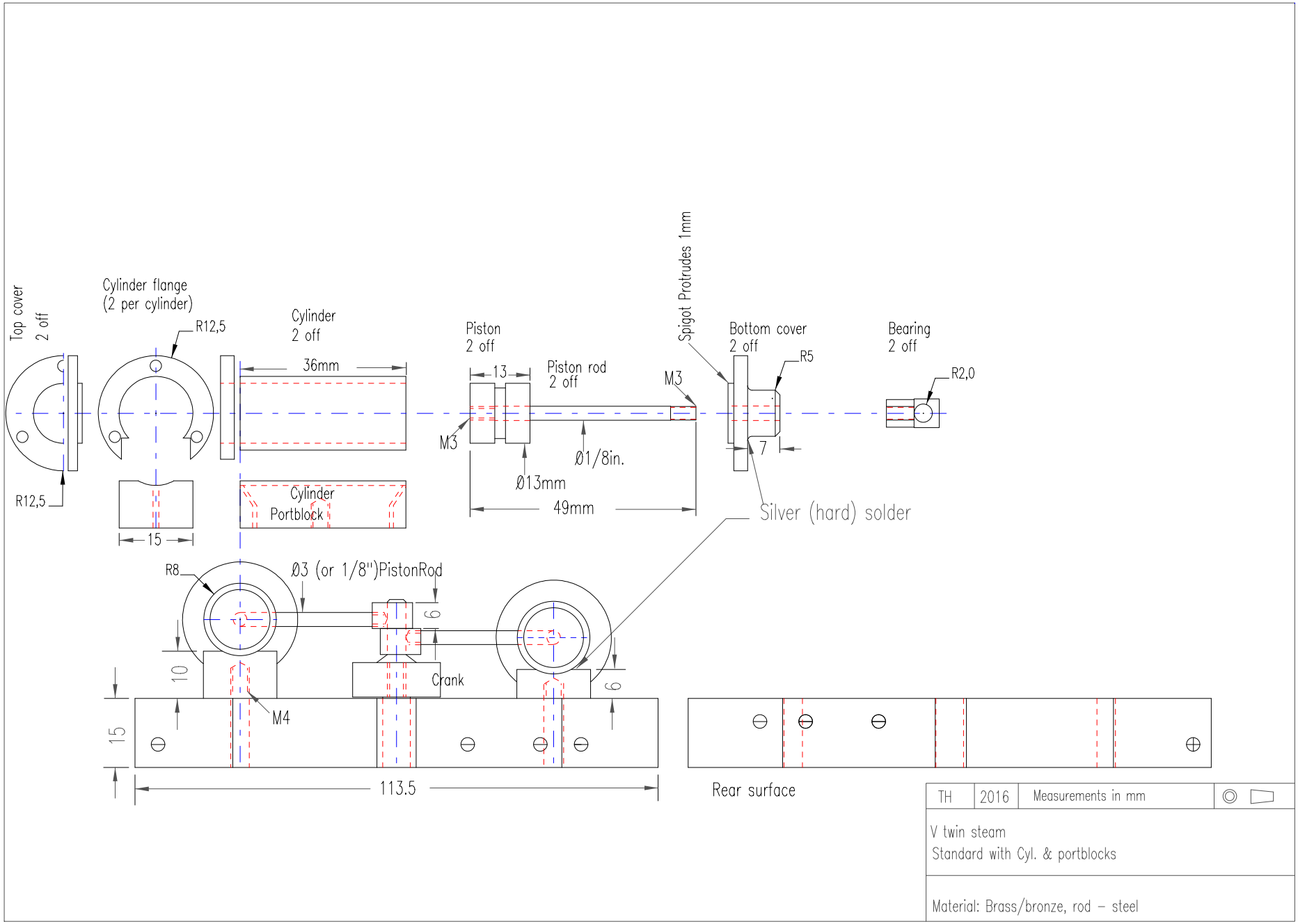
The parts were mounted and the engine was connected to my friends air compressor. It was a bit stiff to begin with, but after running at around 3 bar for some time it was possible to get the engine running as low as 1 bar, even if there were no packing in the piston groove or gaskets or gland packing. It seems that a proper gland might not be necessary at all. A bit more work is needed on some details and a coat of paint. I had some green paint and used that, see right photo.

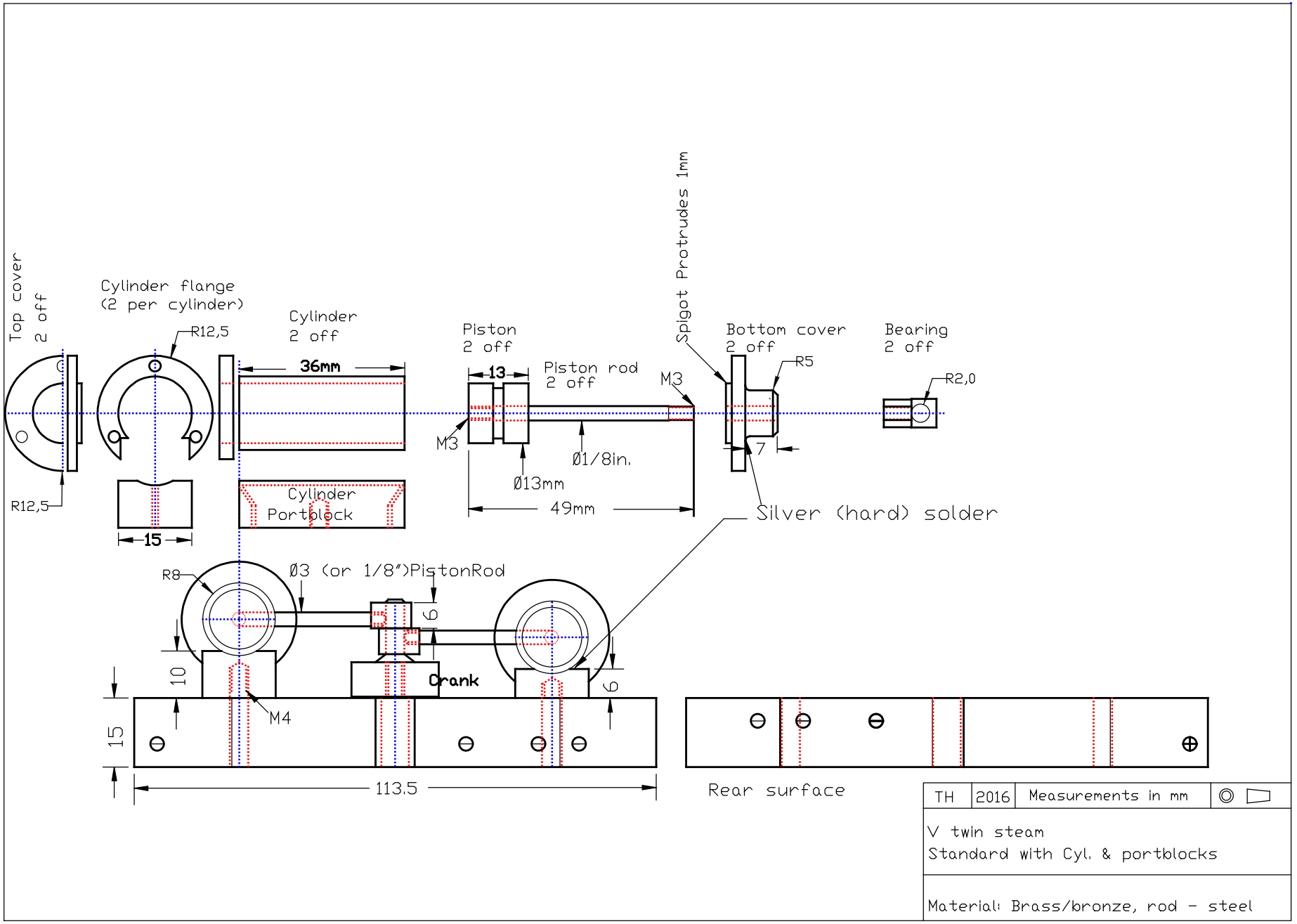

Cylinder Ports:
Portblock Ports:
Overlapping Ports:
Piston:
0
4,7
In
Ex
12
48
In
Ex
R9,50
Ex
In
48,00
In
Ex
5
E
TH
2016
Measurements in mm
V twin steam engine
Stroke: 19mm
Material: Steel, CI



TH	2016	Measurements in mm	
V twin steam engine Stroke: 19mm			
Material: Steel, CI			


Portblock Ports:
In Steam Ports (Ø2.5 / 2)
(Drilled 5mm from front surface)
Exhaust Steam Ports (Ø2.5 / 2)
(Drilled 5mm from rear surface)
30
24
25
31
59
R3
R5,0
M3
R1,00
Pivot bush
48
82
Main bearing
113.5
Rear surface
6
5
15
113.5
TH
Measurements in mm
V twin steam
Standard with Steam Passages
Material: Steel, CI/brass bushes


Top cover
2 off
R12,5
Cylinder flange
(2 per cylinder)
R12,5
Cylinder
2 off
36mm
Cylinder
Portblock
15
Piston
2 off
13
Piston rod
2 off
M3
M3
Ø13mm
Ø1/8in.
49mm
Spigot Protrudes 1mm
Bottom cover
2 off
R5
7
Bearing
2 off
R2,0
Silver (hard) solder
R8
Ø3 (or 1/8")PistonRod
6
10
Crank
6
M4
15
113.5
Rear surface
TH
2016
Measurements in mm
V twin steam
Standard with Cyl. & portblocks
Material: Brass/bronze, rod – steel


Top cover
2 off
Cylinder flange
(2 per cylinder)
R12,5
Cylinder
2 off
36mm
Piston
2 off
13
Piston rod
2 off
M3
Spigot Protrudes 1mm
Bottom cover
2 off
R5
Bearing
2 off
R2,0
M3
Ø1/8in.
Ø13mm
49mm
7
Silver (hard) solder
R12,5
Cylinder
Portblock
15
R8
Ø3 (or 1/8")PistonRod
9
10
Crank
M4
9
15
113,5
Rear surface
TH
2016
Measurements in mm
V twin steam
Standard with Cyl. & portblocks
Material: Brass/bronze, rod - steel