

Troubleshooting Guide for Tuning Up ShopBot PRS Gantry Tools



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Introduction to common issues

Like any mechanical device, the ShopBot PRS gantry tool needs an occasional tune up.

This document lists several problems that reveal a need to spend a few minutes adjusting and tuning your ShopBot and its consumables (i.e. collets and pinion gears). They include:

- Circles that are not round.
- Square/rectangular parts that cut correctly on 3 sides, but the 4th side is uneven.
- Parts that are not cutting all the way through, even though the correct Z depth was set in the cutting file.
- The Z axis does not seem to be holding position, or was properly zeroed before the cut, but seems to have lost its zero after the cut.
- The bits are breaking, even when machining at a feed, speed, and pass depth that are reasonable for the bit and material.
- Inconsistent moves in the Z axis: Uneven step downs or slop/slanted step downs.
- ShopBot does not seem to be “square”.

Documents on the ShopBot website (www.shopbottools.com) list the maintenance that should be performed on the ShopBot daily, weekly, monthly, and yearly.

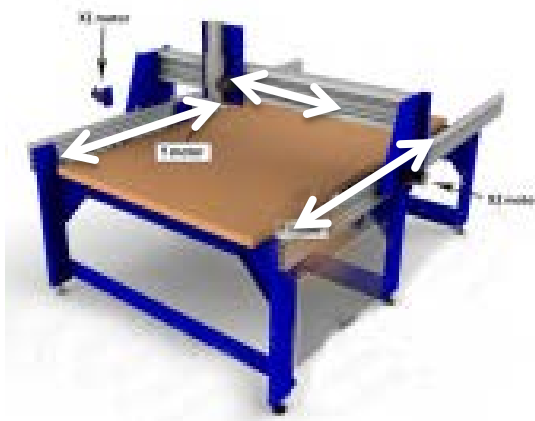
If you have additional questions, technical support is available by emailing Support@shopbottools.com.

Phone support is available at (919) 680-4800 on Monday thru Friday at 9am to 5pm EST. We also check the phone lines on nights and weekends, so leave a message and we'll get back to you.

Problem: My circles are not round

Possible causes

- The pinion gears are not engaging in the rack appropriately.
- The set screws that hold the pinion gears to the motor shaft have come loose.
- The pinion gears are worn and need to be replaced.
- The circle in the CAD file is not actually round .



First test: Are the pinion gears engaged in the rack?

With the control box on and the drivers reset, stand by each motor and try to move the gantry (X Motors) and YZ car (Y motor) side to side. There should be no play or side to side movement close to the motor where the pinion gear behind the motor meets the rack.

If there is play or side to side motion, you need to take the following steps:



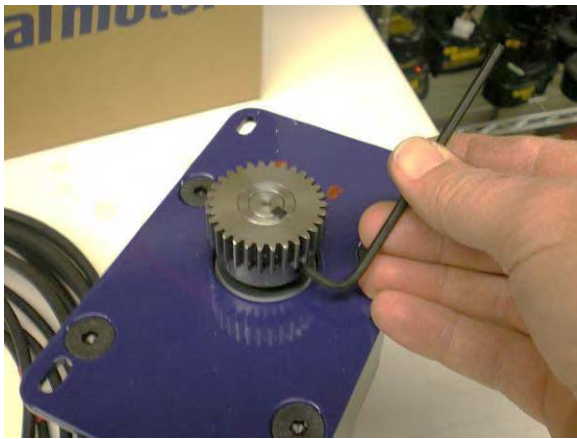
- Loosen the 4 screws holding the motor plate in place and drop the pinion gear out of the rack.
- Re-engage the pinion gear into the rack by lifting the motor in place. Wiggle it a tiny bit side to side to make sure the pinion gear is fully engaged in the rack. Apply significant pressure (15 – 20 lbs) to hold the pinion gears against the rack while you tighten the 4 screws on the motor plate.
- Test again to see if the play in the movement of the motor has been reduced/removed.
- Be sure to check both X-axis motors.
- If not completely fixed check other tests.

Maintenance:

The motors in the X and Y axes should be dropped and the pinion gears re-engaged at least once a month - or when play is found. This will help maintain the pinion alignment to the rack before misalignment causes problems.

Second test: Are the pinion set screws tight?

If there is still play in the ShopBot after the pinion gears have been re-engaged, check the set screws that hold the pinion gear to the shaft of the motor. The following steps will walk you through it.



- Remove the screws on the motor plate and pull the entire motor/motor plate and pinion gear away from the gantry (X motors) or YZ car (Y motor.) Be gentle and do not pull the motor assembly out too far. You could disturb the motor wire connections if you do.
- Using a 1/8" Allen wrench, tighten the set screws against the shaft of the motor. You may have a keyed shaft or a flat shaft. Make sure that the set screw is aligned over the key or flat.
- Inspect the pinion gears for wear. If you have had to tighten the set screws, now is a good time to order a new set of pinion gears as operating while loose will have accelerated the wear. Count the number of teeth or measure the diameter of all three pinion gears so you know what size to order.
- Re-engage the pinion gears in the rack as detailed in the first step.

Maintenance

Pinion gears are consumables and should be replaced every 6 months to 1 year.

The ShopBot website has a document on how to replace your pinion gears.

<http://www.shopbottools.com/ShopBotDocs/gantry.htm> > General Maintenance > Replacing Pinion Gears

To extend the life of your pinions you should keep the rack well-greased and free from any chips or debris. We recommend using heavy automotive or industrial grease, available from your local auto parts store.

More information on tool maintenance and checking for play in the pinion gears can be found on the ShopBot website (www.shopbottools.com) under ShopBot Docs.

Third test: Check the CAD file

Occasionally, the circle in a CAD file imported from a different software package is not a true circle.

You can test to see if the problem is with the CAD file or the tuning of the ShopBot by cutting a circle using the “**CC**” command from the control software.

The example below will cut a 2” (50mm) circle, .25” (6mm) deep. (The values in parentheses are not an exact conversion from inches to metric, just a close approximated value.)

If the circle cut with the “**CC**” command is round, but the circle cut from the CAD file is not, look to the CAD file for the problem.

See the “Command Reference” found under “Help” in the ShopBot control software for more details on the “Cut Circle” command.

Parameter Name:	Value:	Required
Diameter	2	<input checked="" type="checkbox"/>
Outside-Inside-True	T = true path	<input type="checkbox"/>
Direction	1 = clockwise	<input type="checkbox"/>
Begin Angle	0	<input type="checkbox"/>
End Angle	360	<input type="checkbox"/>
Plunge (per repetition)	-.25	<input type="checkbox"/>
Repetitions	1	<input type="checkbox"/>
Proportion X	1.00	<input type="checkbox"/>
Proportion Y	1.00	<input type="checkbox"/>
No Pull-Up	0 - Off	<input type="checkbox"/>
Plunge from 0	0 - Off	<input type="checkbox"/>
Special: Tabbing, Pocketing, & Spiral Plunge		
Tab, Pocket, Spiral	0 - No feature	<input type="checkbox"/>
Related Commands:		

Move the bit over to a location away from the corner where you have experienced issues, or use the location given below. For a full test, use several different locations on the ShopBot table.

- M2, 6,6 (Metric: M2, 150,150)

Use the “**CC**” command in the command prompt found in the full version of the ShopBot command software; this will not work in “EASY” mode. This will pull up the window to the left. Fill in the blanks or select the values below.

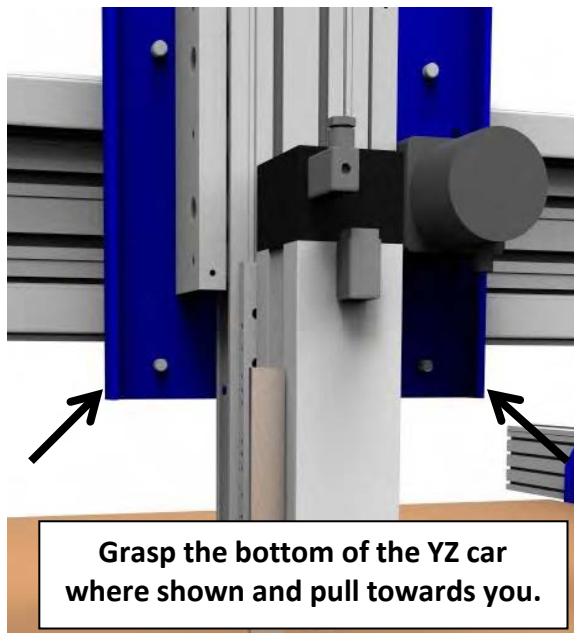
- Diameter (2” or 50mm)
- T = true path (outside-inside-true)
- 1 = clockwise (direction)
- 0 (begin angle in degrees)
- 360 (end angle in degrees)
- -.25” or -6mm (plunge)
- 1 (repetitions)
- 1 (proportion X)
- 1 (proportion Y)
- 0 – Off (no pull-up)
- 1 - On (plunge from 0)
- 0 – no feature

Problem: My square/rectangular parts cut correctly on 3 sides, but the 4th side is uneven

Possible cause

The bottom rollers on the YZ car may be not engaged correctly with the rail on the Y cross beam. This is highly likely if the direction in which the bad cut occurs is consistent.

If the cuts or step downs seem inconsistent, please refer to “Inconsistent cuts in the Z axis” below.



Test

Grasp the bottom of the YZ car with both hands and pull towards you.

There should be no motion of the YZ car away from the extruded aluminum cross beam.

If you are able to pull the YZ car towards you, the bottom rollers are not engaged properly on the rail.

The end result is that the parts will cut correctly if the force of the cut is driving the YZ car into the cross beam, but will cut incorrectly when the force of the cut is driving the YZ car away from the cross beam.

Maintenance:

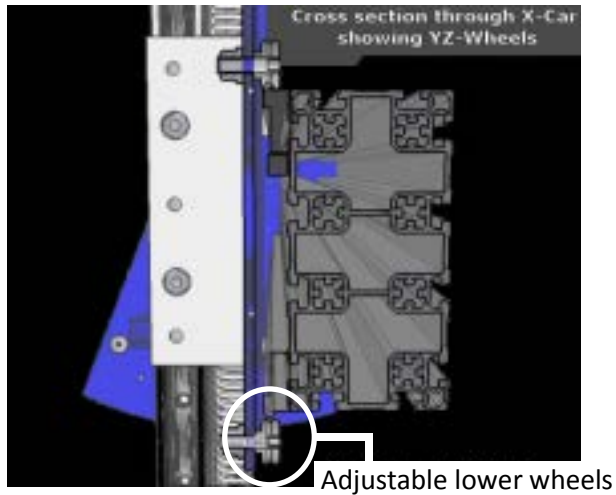
At least once a month, check that the bottom rollers on the YZ car are seated correctly.

Solution:

Refer to document “**Adjusting the Lower Wheels on the YZ car**” found on the ShopBot website for instructions on how to adjust the rollers on the rail. The directory location is described below.

<http://www.shopbottools.com/ShopBotDocs/gantry.htm> > PRS Gantry Maintenance > Adjusting the Lower Wheels on the YZ car

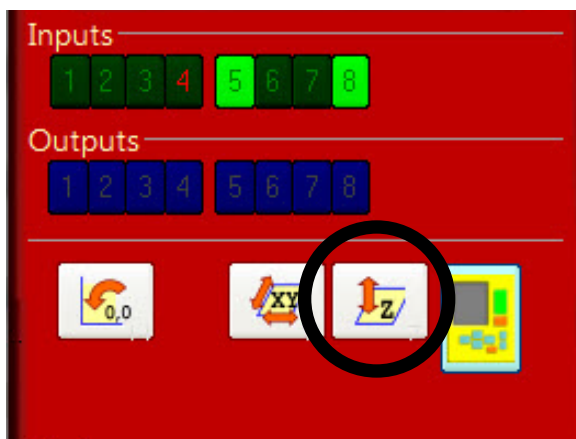
Hint: It’s a good idea to drop the pinion gear on the Y motor out of the rack before adjusting the lower wheels. This allows you to get a good idea of how easily the car rolls along the rails while still holding the car against the cross beam correctly. Don’t forget to re-tighten the pinion gear in the rack.



Problem: My parts are not cutting all the way through, even though I have set the correct Z depth in the cutting file

Possible causes

- The value of the thickness of the Z zero plate is not set correctly in the zeroing routine, which causes the Z to not zero to the correct location.
- There is an issue with the collet or the Z (see below):



First test: Is the value of plate used in the Z zero routine correct?

- Move the Z over an open area of the table.
- Run the Z zero routine using the Z zero plate. You can use the C2 command or the quick button on ShopBot 3 as shown to the left.
- Remove the alligator clip and store the plate.
- Enter the command "MZ, 0" into the command line which will plunge the bit to the top of the table.
- Test whether the bit is really sitting at the top of the table by trying to slip a piece of paper or card stock under the bit.
 - If the paper won't slide under the bit, the value of the thickness of the plate is correct.
 - If the bit is too high or low, you will need to correct the value of the thickness of the plate used in the Z-zero routine.

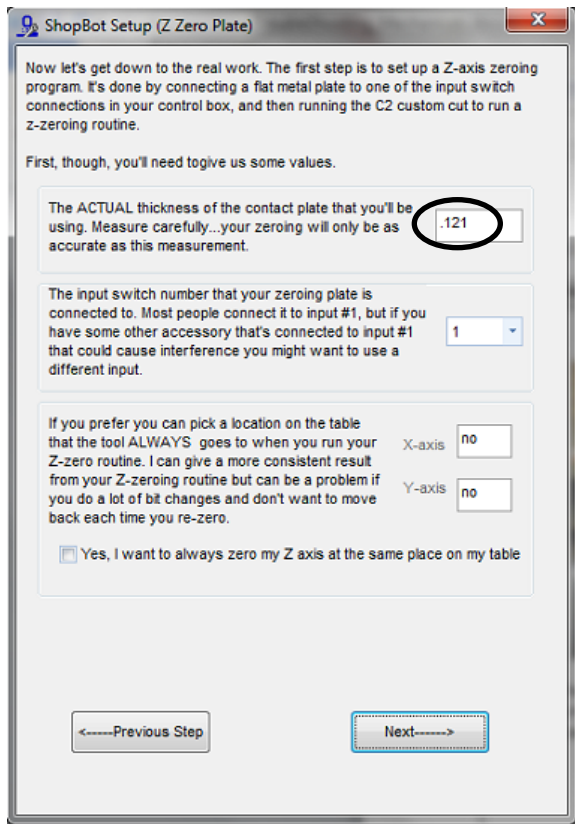


Solution

Inspect your plate to ensure it is not warped or damaged, then measure the thickness of the Z zero plate with calipers. Be as accurate as possible as this will increase the accuracy of your machine.

- With the ShopBot Control software open, go to **(T)ools: (S)hopBot Setup**
- Click through the screens
 - The second screen lets you see what model ShopBot the software thinks you are using.*
 - This screen also lets you set the display/values to inches or mm
 - The third screen (pictured) is where you enter the thickness of your Z zero plate. The default value is .121" (3.073mm). If you are using metric, enter a value (mm) that makes sense.
 - You can also set up the offsets for running the X, Y zeroing routine (C3) by clicking to the next screen.

*If needed, use **"UR"** to reset the settings for your ShopBot.



Problem: The Z axis does not seem to be holding position, or the Z axis was zeroed before cutting, but seems to have lost its zero after I make a cut

Possible cause

The collet may not be holding the bit correctly, and needs to be replaced.

Collets are consumables and need to be replaced after 400 to 700 hours of use. This is necessary even if nothing traumatic has happened to the collet. Collets lose their spring and will no longer hold a bit properly after repeated use.

If something traumatic has happened, (it fell on the cement floor, it dropped a bit while cutting, the bit ran into something major while cutting) replace the collet immediately and throw the old one away. It is likely damaged and the cost of a new collet will pay for itself in prevented scrapped parts.

Test

Check that the collet is holding the bit correctly.

- Run the Z zero routine with the Z zero plate, and test (detailed in the previous section of this document) that the Z is actually zeroed (MZ, 0).
- Run a file that requires the Z to plunge into a dense material (wood recommended).
- After the file is complete, do an "MZ, 0" command and see if the bit is still zeroed correctly. If it is, the collet is holding the bit in place adequately for files cutting less aggressively. If cutting very aggressive files, keep a close eye on the bit or do a sample file that adequately simulates the aggressive cutting. Small changes in zero can be very hard to notice, but they can signify collet problems that could cause issues. If you are ever in doubt, replace the collet.

Maintenance

Each time you insert a new tool (bit) into the collet, check the following:

- Is the collet clean? Check for debris in the slots and clean as necessary.
- Is the collet the correct size for the shaft of the bit? SAE and metric collets, although close in size, are not interchangeable.
- Is the collet firmly snapped into the collet nut?
- Have you overtightened and distorted the collet into the spindle with too much force on the collet wrenches?
- Are your pass depths, plunge rates, and tool feeds and speeds appropriate for the material?

Problem: Bits are breaking, even when I am machining at feeds and speeds and pass depths that are reasonable

Possible cause

The collet needs to be replaced.

Clues that a collet needs to be replaced

- The bit moves up into the collet after plunging into solid material, thus losing the Z position.
- The bit breaks in the midst of a cut that should be fine. (i.e. feeds and speeds* and pass depth are appropriate for the material and cutter.) A bad collet can cause bit vibration or runout which results in the bit breaking.
- The bit falls out of the collet while the part is being cut out.
- It is difficult to pull a bit out of the collet. That is a sign that the collet is sprung and not holding the bit correctly.
- It has been over 400 – 700 hours of use since the collet was last replaced.

*There is a “**Chip Load Calculator**” found under the “**Tools**” menu in the ShopBot control software (TL). Click on “**Chip Load Help**” for a starting point to set reasonable feeds and speeds. For example, you can set it to a value midpoint in the chip load range, like 0.01" (0.25mm). When the feeds and speeds are correct, the bit should be comfortable to the touch (not hot) at the end of a cut.

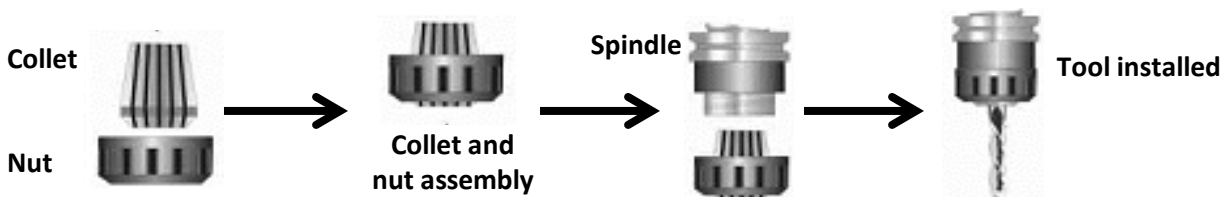
Maintenance

Bits, collets, and collet nuts should be examined for wear and cleaned before every use of the ShopBot. Checking again at the end of each session will make you more prepared for the next session.

Collet info

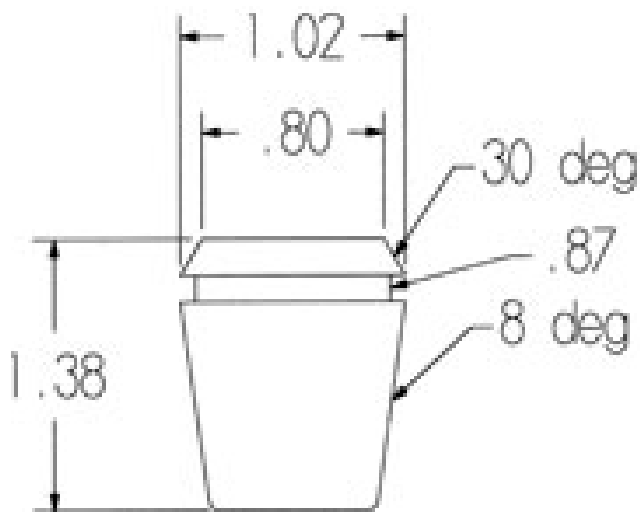
- The model of the collet (example: ER 25) is determined by the type of spindle.
- The size of the collet should match the shaft of the bit.
- Metric and inch collets are not interchangeable.
- Don't forget that the collet nut also needs to be replaced after every 400-700 hours of use. www.techniksusa.com is an alternate source of collets like those sold by ShopBot.
- The collet assemblies for spindles consist of two parts, the collet and the collet nut.

Installation of collet



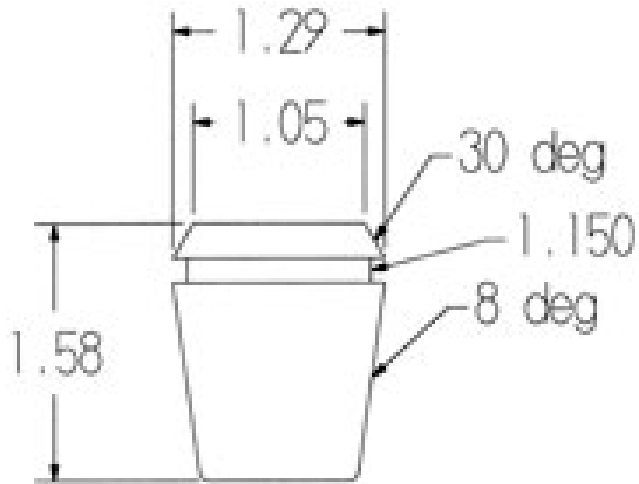
Orient the collet and nut as shown at the above left and press them together until the collet clicks into the nut. This will form the collet nut assembly. This assembly will now be inserted into the spindle in the orientation shown above. Tighten the nut a few turns onto the spindle without compressing the collet to hold the assembly in place. Now you can insert your bit and hand tighten the nut until it holds the bit securely. At this point use the provided wrenches to tighten to the appropriate specification for your spindle.

Collet types used by ShopBot and their specifications (in inches)

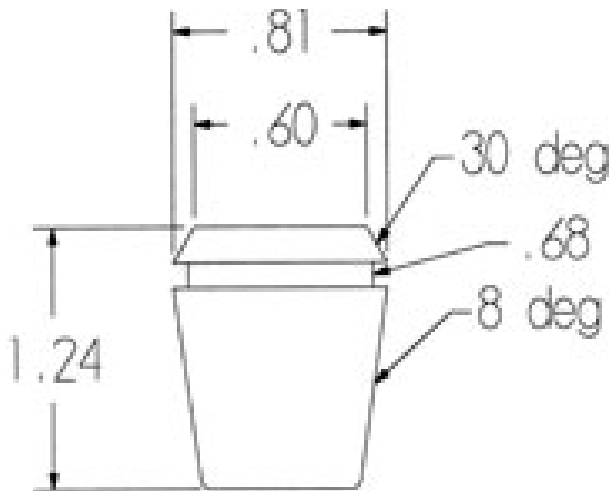


ER 25 - HSD 2.2 HP or 4 HP spindle





ER 32 - Automatic Tool Changer (ATC)



ER 20 - Desktop HSD 1 HP spindle



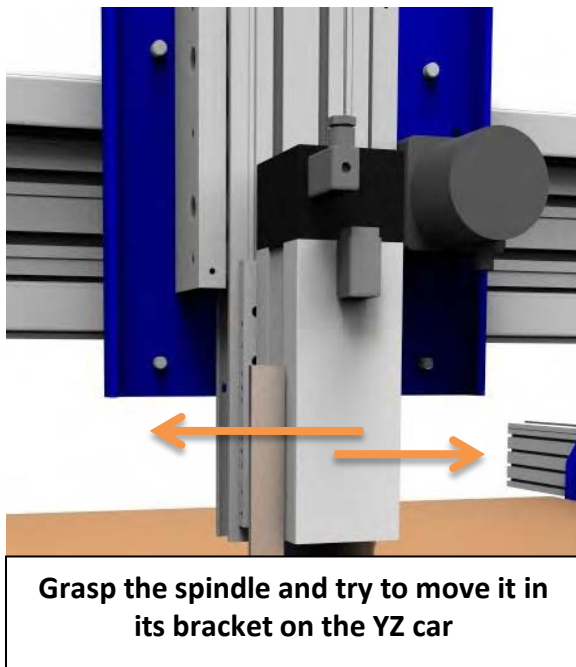
Porter Cable collets are only sold in one piece and must be replaced in their entirety.

Problem: Inconsistent moves in the Z axis: Uneven step downs or slop/slanted step downs

Possible causes

- The spindle is not tight in its bracket.
- The Z axis bearings need to be re-adjusted.

Checking spindle bracket



Test

Check to see if spindle is tightened correctly in its bracket.

- Grasp the spindle itself and try to move it in its bracket.
- There should be no motion of the spindle from side to side or front to back.
- If you are able to move the spindle independently of the YZ car, it may not be firmly attached to its bracket.
- The end result is that the parts will cut incorrectly whenever the force of the cut is pushing the spindle away from square.

Maintenance

At least once a month, check that the spindle is still firmly attached to its bracket.

Solution

Tighten the spindle in its bracket. Refer to the "PRS Assembly Manual" for instructions on how to square up and tighten the spindle.

<http://www.shopbottools.com/ShopBotDocs/gantry.htm> > PRS Assembly and Setup
> PRS Assembly Manual

Adjusting the Z car bearings



Refer to the document on the website for information if you need to adjust the bearings on the Z axis.

Signs bearings are too loose:

- Top and/or lower bearings spin freely and are not in contact with inner part of the captured rail.
- There are lateral inconsistencies in Z axis, commonly called "slop".

If bearings are too tight :

- Z axis loses steps/position, binds or even stops abruptly.
- There is premature wear to the inner part of the captured rail.

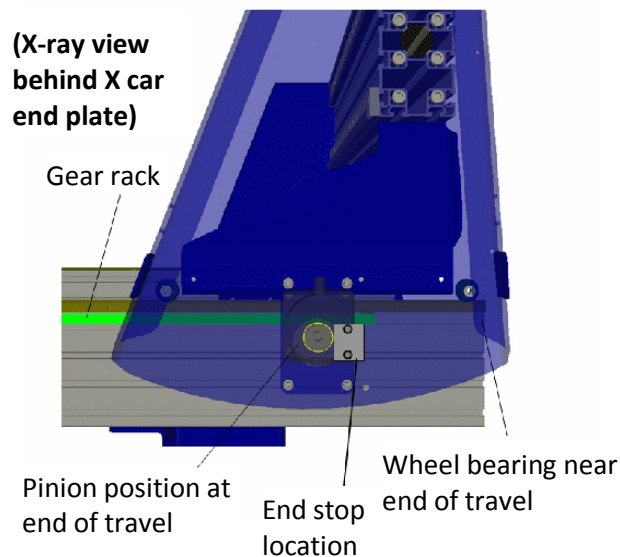
<http://www.shopbottools.com/ShopBotDocs/gantry.htm> > PRS Gantry Maintenance
> Adjust PRS Z Car Bearings

Problem: My ShopBot does not seem to be “square”

There are a number of good ways to evaluate whether your tool is “square”.

- The first is to just cut a large rectangle, the bigger the better, and measure the diagonals. They should be equal.
- Short of cutting something out, you can use a V Bit to inscribe a shallow, large square or rectangle (e.g. 30”x 50” or 750mm x 1250mm) on your table surface (or put a pencil into the spindle and draw one) and measure the diagonals.
- Alternatively, drill 4 holes at the corners of a square and measure the diagonals.
- In all cases, if the diagonals are equal your tool is cutting square.
- If your tool is not cutting square (the diagonals are not equal), the problem can be as easy as pulling the gantry into square using your end stops, or as involved as making adjustments to your gantry or table.

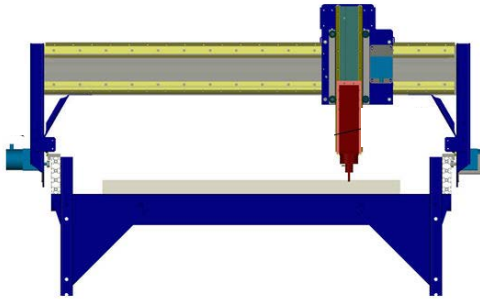
Squaring your tool using end stops



If the end stops were properly set up during tool installation, then they will be squared to each other. In this case you can then use them to pull the gantry into square before you engage the motors/drivers. The motors will hold the gantry in place as long as they are engaged and powered. This misalignment typically occurs when someone moves one side of the gantry while the tool is powered off by leaning or bumping into it. It is recommended to align the motors to each other before every start-up.

See <http://shopbottools.com/ShopBotDocs/gantry.htm> > PRS Maintenance > Squaring the PRS Gantry and Table for further information.

Check to see if gantry is out of square

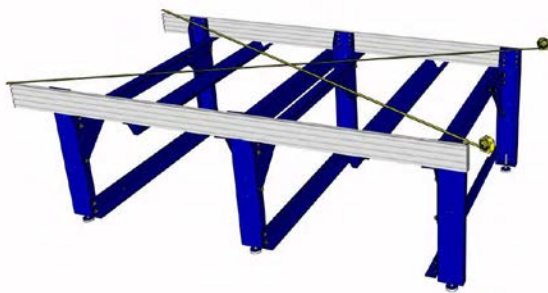


If squaring using the end stops does not work, your end stops are not in the proper location or the gantry itself may be out of square.

Try dropping the pinion gears out of the rack and rolling the gantry along the rails. Do all the wheels roll smoothly all along the rail? Do both sides of the gantry sit at the same location near the end of the rails? If they do not, see

<http://shopbottools.com/ShopBotDocs/gantry.htm> > PRS Maintenance > Squaring the PRS Gantry and Table for further information.

Check to see if table is out of square



It is possible that the table is no longer square. To check this, measure the diagonals on the table as shown in the image. They should be equal, but if they are not refer to the original PRS Assembly Manual <http://shopbottools.com/ShopBotDocs/gantry.htm> > PRS Assembly Manual for information on how to square your table.

Please note that if a ShopBot is cutting square, but fails this test (typically because rails are parallel even if not exactly identical) then you may not need to take any corrective action.