

The narrow columns on the left are for quantities or notes such as "Have" or "Buy" etc. The dimensions in these lists are rounded to make purchasing easier. They are not the final dimensions, and these lists should not be used as cut-sheets.

	LIST 1 X Axis: Parts on X Table	Used For	Count	Total
	Plywood, ½ in.	Table bed and rack boards	See Images Page 120	-
	MDF, ¾ in. Tee-Slot	Table bed	60 x 33-7/8	-
	2 x 6 Framing Lumber, Actual 1.5" x 5.5"	Rail supports Table sides Legs Table ends	2@ 60 in. rail supports 2@ 57 in. table sides 4@ ~43 in. legs 2@ 33-7/8 in. table ends	1@ 10ft. 1@ 10ft. 2@ 8ft. 68 in.
	2 x 4 Framing Lumber, Actual 1.5" x 3.5"	Table bed joists	3@ 30-7/8	1@ 8 ft.
	¾ in. ID Gas Pipe, Actual 1.03 in. OD	Rails	2@ 60 in.	1 @10 ft.
	Drywall Screws 1-5/8	Tie deck to frame	~30	~30
	Drywall Screws 2-1/2	Attach 2 x 6 stock together	56	56
	3/8-16 Threaded Rod	Tie pipe to supports	8 @ 3-1/2 in. each	28 in.
	3/8-16 Nuts	Tie pipe to supports	8@ 3 each	24
	3/8 ID washers	Tie pipe to supports	8@ 2 each	16
	1-1/8 OD Washers	Tie pipe to supports	8@ 2 each	16
	Wood Glue	Glue all wooden parts	~Small bottle	
	Loctite Thread Locker, Non-Hardening	Secure screw threads	~ Small tube	
	<b>X Axis: X Rack Version</b>			
	Plywood, ½ in.	Rack supports	2@ 48 x 4-3/4	See Images
	Lumber 2 x 2, Actual 1.5" x 1.5"	Rack support spacing	2@ 48	1@ 8 ft.
	Racks	Steel 20° Pressure Angle Spur Gear Rack 20 Pitch, 1/2" Width & Height	2@ 4 ft. Length mcmaster.com # 5174T11	2@ 4 ft.
	1 or 3/4 x 1/8 in. Al. Flat Bar	Tension Rack Board	6 @ 1.5 in.	9 in.
	#10 -24 Threaded Rod	Tension Rack Board	6 @ 2 in.	12 in.
	#10-24 Nuts	Tension Rack Board	6	6
	#10 W washers	Tension Rack Board	6	6
	#8-32 x 1-1/4 Machine Screws	Tie rack to board	14	14
	#8-32 Nuts	Tie rack to board	14	14
	#8 Washers	Tie rack to board Tie rack board to block	14 14	28
	Drywall Screws 1-5/8	Tie rack board to block	14	14
	Drywall Screws 2-1/2	Tie rack block to beam	10	10
	<b>X Axis: X Leadscrew Version</b>			
	1 x 4 Lumber, Actual 0.75" x 3.5"	X leadscrew stepper support	1@ 37 in.	37 in.
	1/4 or 1/8 in. Hardboard, Plastic etc.	X leadscrew stepper plate(s)	1 or 2 @ ~3.5 x 4.5	See Images
	5/16-18 x 3 in. Carriage bolt	Idler axle	1@ 3 in.	1
	5/16 Nuts	Idler axle	3	3
	5/16 Washer	Idler axle	1	1
	1/4-20 x 3 in. Carriage Bolts	Tie stepper plate to 1 x 4	3 for single stepper 6 for dual steppers	3 or 6
	1/4-20 Nuts	Tie stepper plate to 1 x 4	9 for single stepper 18 for dual steppers	9 or 18
	1/4 in. ID Washers	Tie stepper plate to 1 x 4	9 for single stepper 18 for dual steppers	9 or 18
	#8-32 x 3/4 in. Machine Screws	Tie stepper to plate	4 single stepper 8 dual steppers	4 or 8
	#8-32 Nuts	Tie stepper to plate	4 single stepper 8 dual steppers	4 or 8
	#8 Washers	Tie stepper to plate Tie bearing blocks to legs	4 single stepper 8 dual steppers 12 bearing blocks	16 or 20
	Plastic Kitchen Cutting Board 3/8 in.	Bearing blocks	2@ 1-1/2 x 2 4@ 1-3/8 x 1-3/8	See Images
	½ in. PVC Electrical Conduit Coupler	Idler for single long belt	1	1
	Drywall Screws 1-5/8	Tie bearing blocks to legs	12	12

	<b>LIST 2 Y Axis: Parts on Gantry</b>	<b>Used For</b>	<b>Count</b>	<b>Total</b>
	Plywood, ½ in.	Gantry end plates	2@ 6 x 10-1/4	See Images
	2 x 6 Framing Lumber, Actual 1.5" x 5.5"	Y Gantry beam	33-1/4 inches	34 in.
	1 x 1 x 1/8 in. Aluminum Angle	X Bearing trucks	4@ 1-1/2	6 in.
	1 x 1/8 in. Aluminum Flat Bar	X Bearing trucks 120° angle	4@ 3-1/8	12-1/2 in.
	3/4 in. ID Gas Pipe, Actual 1.03 in.OD	Rails	2 @ 30-1/2	61 in.
	3/8-16 Threaded Rod	Tie pipe to beam	6 @ 3-1/2 in. each	21 in.
	3/8-16 Nuts	Tie pipe to beam	6@ 3 each	18
	3/8 ID Washers	Tie pipe to beam	6@ 2 each	12
	1/4-20 Threaded Rod	Tie aluminum gantry to ends	4 @ 1-1/2 in. each	6 in.
	1/4-20 Nuts	Tie aluminum gantry to ends	4	4
	1/4 in. Washers	Tie aluminum gantry to ends	4	4
	1-1/8 OD Washers	Tie pipe to beam	6@ 2 each	12
	5/16 x 2-1/2 Carriage Bolts	Tie X bearing to end plate	4@ 2 each	8
	5/16 x 1 Bolts	Tie bearings to X trucks	4@ 2 each	8
	5/16 Nuts	X Bearing trucks	4@ 11	44
	5/16 Washers	X Bearing trucks	4@~6	24
	Drywall Screws 1-5/8	Tie end plates to gantry	8	8
	#8-32 x 1 in Screws	Tie aluminum gantry to ends	4	4
	#8 Washers	Tie aluminum gantry to ends	4	4
	<b>Y Axis: X Rack Version</b>			
	Plywood, ½ inch	X Rack stepper mount	3 x 7 in.	See Images
	Metal Rod ½ x 36 in.	X Pinion axle	1@ 36 in	1
	Pinions for X Movement	Steel 20° Pressure Angle Spur Gear 20 P, 20 Teeth, 1" Pitch Dia, 1/2" Bore	mcmaster.com # 5172T12	2
	#8-32 Set Screws	Tie pinion to axle	2@ 2 each	4
	½ in. PVC Electrical Conduit Coupler	Idler for X rack and pinion	1	1
	½ in. ID x 5/8 in. OD Washer	Space pulley from bearing	See note on page 126	--
	5/16 x 1-1/2 Bolt	Idler Axle	1	1
	5/16 Nuts	Idler Axle Spacers X stepper plate	1 6	7
	5/16 Washers	Idler Axle	~3	~3
	1/4-20 x 2-1/2 Carriage Bolt	Tie X stepper plate to end	2	2
	1/4-20 Nuts	Tie X stepper plate to end	2	2
	1/4 Washers	Tie X stepper plate to end	6	6
	# 8-32 x 1 Machine Screws	Tie stepper to plate	4	4
	# 8-32 Nuts	Tie stepper to plate	4	4
	# 8 Washers	Tie stepper to plate	4	4

LIST 2 (Continued) Y Axis: X Leadscrew Version				
	1 x 1 x 1/8 in. Aluminum Angle	X Leadnut brackets	2@ 4.5 in.	9 in.
	#8-32 x 1 Machine Screws	Tie leadnut bracket to end	2@ 2each	4
	#8-32 Nuts	Tie leadnut bracket to end	2@ 2each	4
	#8 Washers	Tie leadnut bracket to end	2@ 2each	4
Y Rack Version				
	Rack for Y Movement	Steel 20° Pressure Angle Spur Gear Rack 20 Pitch, 1/2" Width & Height	2' Length mcmaster.com # 5174T1	1
	1 x 1 x 1/8 in. Aluminum Angle	Rack bracket	4@ 3/4in.	3 in.
	#8 x 1-1/2 Sheet Metal Screw	Tie rack to gantry	4	4
	#4 x 3/4 Wood Screw	Tie rack bracket to beam	4	4
	#8-32 x 3/4 Machine Screw	Rack tension screw	4	4
Y Leadscrew Version				
	Plastic Kitchen Cutting Board 3/8in.	Bearing block	1-1/2 x 2 x 3/8	See Images
	½ in. PVC Electrical Conduit Coupler	Idler	1	1
	5/16 x 1-1/2 Bolt	Idler axle	1	1
	5/16 Nut	Idler axle	1	1
	5/16 Washers	Idler axle	~3	~3
	# 8-32 x 1-1/4 Machine Screws	Tie Y bearing block to end	2	2
	# 8-32 x 1 Machine Screws	Tie Y stepper to end plate	4	4
	# 8-32 Nuts	Tie block and stepper to end	6	6
	# 8 Washers	Tie block and stepper to end	6	6

#### Washer-Spacer Note:

The pinion axles and leadscrews can require washers to space the pulleys or clamps away from the bearings. The spacers cannot have a large outside diameter or they will chafe on the seal or edge of the bearings. Therefore, standard washers often will not work at this location, and finding inexpensive washers of the proper size can be challenging.

Spacers can be made from standard spring or tooth type lock washers that are flattened; use a hammer to bend the teeth, or pliers to twist the spring type washers. Either external or internal teeth lock washers will work.

Another option is to cut sections from ½ inch copper plumbing pipe for the spacers on the ½ inch rods. Sections cut from 1/4 inch copper couplers can be used with the 3/8 inch axles. The copper spacers work well when a distance that is more or less than a lock washer's thickness is needed.

	LIST 3 Z Axis: Parts on Carriage	Used For	Count	Total
	Plywood ½ in.	Sides, top, bottom, back		See Images
	1 x 1 x 1/8 in. Aluminum Angle	Y Bearing trucks Z Cross ties Z leadscrew bearing bracket	2@ 6 trucks 3@ 3-1/8 cross ties 1-1/2 leadscrew bearing	23 in.
	1 x 1/8 in. Aluminum Flat Bar	Router mount vertical Z Cross tie Z Leadnut support Braces Tension rod brackets	2@ 5-1/4 vertical 3-1/8 cross tie 2-3/8 leadnut 6-1/2 braces 1 tension rod	24 in.
	3/4 x 3/4 x 1/8 in. Aluminum Angle	Z Bearing trucks	2@ ~10	~20
	½ in. ID Gas Pipe, Actual 0.85 in. OD	Z Rails	2@ ~18	~36 in.
	5/16-18 x 1 Bolts	Y and Z Bearing trucks	4 trucks @ 4 each	16
	5/16 Nuts	Y and Z Bearing trucks	4 trucks @ 8 each	32
	1/4-20 Threaded Rod	Tie top to back Tie bottom to back	2@ 3-3/4 2@ 2-1/4	12 in.
	1/4-20 x 2-1/2 Carriage Bolts	Tie stepper plate to top	2	2
	1/4-20 x 1-1/2 Bolts Full Thread	Router band clamp	2	2
	1/4-20 Nuts	Back to top Bottom to top Stepper plate to top Stepper plate adjust Router band clamp	2 2 2 8 2	16
	1/4 Washers	Top to back Bottom to back Stepper plate to top Stepper plate adjust Router band clamp	2 2 2 8 2	16
	#10-24 Threaded Rod	Y Tension rods Z Tension rods	2@ 13 inches 2@ 7 inches	40 in.
	#10-24 Nuts	Tension rods	10	10
	#10 Washers	Tension rods	10	10
	#8-32 x 1-1/4 Machine Screws	Z and Y bearing truck ties	4@ 2	8
	#8-32 x 1 Machine Screws	Tie stepper to mount Router mount Tension rod brackets Z Bearing block	4 4 2 2	12
	#8-32 x 3/4 Machine Screws	Z Bearing block	2	2
	#8-32 x ½ Machine Screws	Cross ties to rails Z Leadnut bar Router mount	16 4 4	24
	#8-32 Nuts	Z Leadnut bar Router mount Stepper to plate Tension rod brackets Z and Y bearing truck ties Z Bearing block	4 8 4 2 8 4	30

	#8 Washers	Z Leadnut bar Router mount Stepper to mount Tension rod brackets Z and Y bearing truck ties Z Bearing block Screws on carriage sides	2 8 4 2 8 6 12	42
	#6-32 x 3/4 Machine Screws	Tie Z leadnut to bar	2	2
	#6-32 Nuts	Tie Z leadnut to bar	2	2
	#6 Washers	Tie Z leadnut to bar	2	2
	Plastic Kitchen Cutting Board 3/8 in.	Z Bearing block	1-1/2 x 1-3/8	See Image
	Drywall Screws 1-5/8	Tie sides to back and top	9	9
	Drywall Screws 1-1/8	Tie braces to top plate	4	4
	Pipe Hanger Strap 16 Gauge x 3/4 in.	Router mount	1@ > 24 in. hanger strap	1
	<b>Z Axis: Y Rack Version</b>			
	Pinion for Y Movement Attached to Carriage Top	Steel 20° Pressure Angle Spur Gr. 20 Pitch, 15 Teeth, .75" Pitch Dia, 3/8" Bore	mcmaster.com # 5172T11	1
	#8-32 Set Screws	Tie pinion to axle	2	2
	3/8 x 3-3/4 Inch Rod	Pinion axle, cut from bolt	1	1
	3/8-16 Nuts	Bearing block spacers	4	4
	3/8 in. ID x 1/2 in. OD Washers	Space pulley from bearing	See note on page 126	--
	Plastic Kitchen Cutting Board 3/8 in.	Bearing block	2-1/2 x 1-3/8 x 3/8	See Image
	5/16 x 2 Carriage Bolts	Bearing block support	2	2
	5/16 x 1-1/2 Bolt	Idler axle	1	1
	5/16 Nuts	Idler axle, bearing block	3	3
	5/16 Washers	Idler axle, bearing spacers	~10	~10
	#8-32 x 1 Machine Screws	Tie Y stepper to top plate	4	4
	#8-32 Nuts	Tie Y stepper to top plate	4	4
	#8 Washers	Tie Y stepper to top plate	4	4
	#6-32 X 1 Machine Screw	Tie Y stepper to top plate	1	1
	#6-32 Nut	Tie Y stepper to top plate	1	1
	1/2 in PVC Electrical Conduit Coupler	Y Rack and pinion idler attaches to top of carriage	1	1
	<b>Z Axis: Y Leadscrew Version</b>			
	#8-32 x 1-1/4 Machine Screws	Tie leadnut block to carriage	2	2
	#8-32 x 1 Machine Screws	Tie leadnut to block	2	2
	#8-32 Nuts	Tie leadnut to block & side	4	4
	#8-32 Washers	Tie leadnut to block & side	4	4

This lists the materials by the version of machine. The versions are in the columns.  
Quantities in the far right **X Dual Stepper** column are added to the **Leadscrew X** column.

	LIST 4 Parts By Machine	Rack X Rack Y	Rack X Leadscrew Y	Leadscrew X Leadscrew Y	X Dual Steppers
	2 x 6	3@ 10', 2@ 8'	3@ 10', 2@ 8'	3@ 10', 2@ 8'	
	2 x 4	8'	8'	8'	
	2 x 2	8'	8'	--	
	1 x 4	--	--	37"	
	Plywood ½ in.	24" x 24", 10" x 48"	24" x 24", 10" x 48"	24" x 24"	
	MDF Tee Slot, 3/4 in.	60 x 33-7/8	60 x 33-7/8	60 x 33-7/8	
	3/4 in ID Gas Pipe	2@ 5', 2@ 3'	2@ 5', 2@ 3'	2@ 5', 2@ 3'	
	½ in. ID Gas Pipe	~36"	~36"	~36"	
	1 x 1 x 1/8 Aluminum Angle	32"	29"	38"	
	1 x 1/8 Aluminum Flat Bar	45.5"	45.5"	36.5"	
	3/4 x 3/4 x 1/8 Aluminum Angle	~21"	~21"	~21"	
	½ x 36 in. Solid Metal Rod	1	1	--	
	3/8 x 3-5/8 Rod (Cut from Bolt)	1	--	--	
	3/8-16 Threaded Rod	49"	49"	49"	
	3/8-16 Nuts	46	42	42	
	3/8 ID Washers	28	28	28	
	1-1/8 OD Washers	28	28	28	
	5/16-18 x 3 Carriage Bolt	--	--	1 w / One Belt	
	5/16-18 x 2-1/2 Carriage Bolts	8	8	8	
	5/16-18 x 2 Carriage Bolts	2	--	--	
	5/16-18 x 1-1/2 Inch Bolts	2	2	--	
	5/16-18 x 1 Bolts	24	24	24	
	5/16-18 Nuts	86	84	79	
	5/16 Washers	37	30	25	
	1/4-20 Threaded Rod	12"(+6" Al. Gantry)	12" (+6")	12"(+6")	
	1/4-20 x 3 Carriage Bolts	--	--	3	+3
	1/4-20 x 2-1/2 Carriage Bolts	4	2	2	
	1/4-20 x 1-1/2 Bolts Full Thread	2	2	2	
	1/4-20 Nuts	18 (+4 Al. Gantry)	18 (+4)	25 (+4)	+9
	1/4 Washers	22 (+4)	22 (+4)	25 (+4)	+9
	#10 Threaded Rod	52"	52"	40"	
	#10 Nuts	16	16	10	
	#10 Washers	16	16	10	
	#8-32 x 1-1/4 Machine Screws	22	26	8	
	#8-32 x 1 Machine Screws	20 (+4)	22 (+4)	16 (+4)	
	#8-32 x 3/4 Machine Screws	6	2	6	+4
	#8-32 x 1/2 Machine Screws	24	24	24	
	#8-32 Nuts	52	58	38	+4
	#8 Washers	78 (+4)	84 (+4)	62 (+4)	+4

	LIST 4 (Continued) Parts By Machine	Rack X Rack Y	Rack X Leadscrew Y	Leadscrew X Leadscrew Y	Dual Steppers
	#6-32 x 1 Machine Screws	1	--	--	
	#6-32 x 3/4 Machine Screws	2	2	2	
	#6-32 Nuts	3	2	2	
	#6 Washers	2	2	2	
	2-1/2 Drywall Screws	66	66	56	
	1-5/8 Drywall Screws	61	61	59	
	1-1/8 Drywall Screws	4	4	4	
	#8 x 1-1/2 Sheet Metal Screw	4	--	--	
	#4 x 3/4 Wood Screw	4	--	--	
	1/2 in PVC Electrical Conduit Coupler	2	2	1 + 1 w/ Long Belt	
	Pipe Hanger Strap > 24 x 3/4 in.	1	1	1	
	1/2 x 5/8 Washer, See note p. 126	1	1	--	
	3/8 x 1/2 Washers See note p. 126	2	--	--	
	Plastic Kitchen Cutting Board 3/8"	Y & Z Blocks	Y & Z Blocks	X, Y & Z Blocks	
	Plastic Kitchen Cutting Board 1/4"	~ Z Stepper Plate	~ Z Stepper Plate	X & ~ Z Stepper Plate	+1 Plate
	1/8 in. Thick Plastic or Hardboard	~ Z Stepper Plate	~ Z Stepper Plate	~ Z Stepper Plate, X Stepper Plate for 1 Stepper w/ 2 Belts	
	1in. Pitch Diameter Pinions	2	2	--	
	3/4 in Pitch Diameter Pinion	1	--	--	
	#8-32 Set Screws for Pinions	6	4	--	
	Racks	4' + 4' +2' or 4' + 6'	4' + 4'	--	
	X Leadscrews	--	--	2@ 1/2" x ~64" *	
	Y Leadscrew	--	3/8" x 36"+ *	3/8" x 36"+ *	
	Z Leadscrew	3/8" x 12"+ *	3/8" x 12"+ *	3/8" x 12"+ *	
	Wood Glue	✓	✓	✓	
	Epoxy Glue	✓	✓	✓	
	Loctite Thread-Locker Non Hardening	✓	✓	✓	
	608 22 x 8 mm Bearings	32	32	30, 32 w/ Long Belt	
	R6 7/8 x 3/8 Bearings	4 *	4 *	4 *	
	R8 1-1/8 x 1/2 Bearings	3 *	3 *	8 *	

\* Leadscrews and Bearings. These sizes will vary and the leadscrews must match the bearings. The diameters listed are the ones preferred on the prototypes, but other sizes will work. The lengths will also vary, the ones given are minimums and they will not work on all machines. Order extra, or measure the actual machine before ordering.