

Parts

From ShapeOko

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Summary

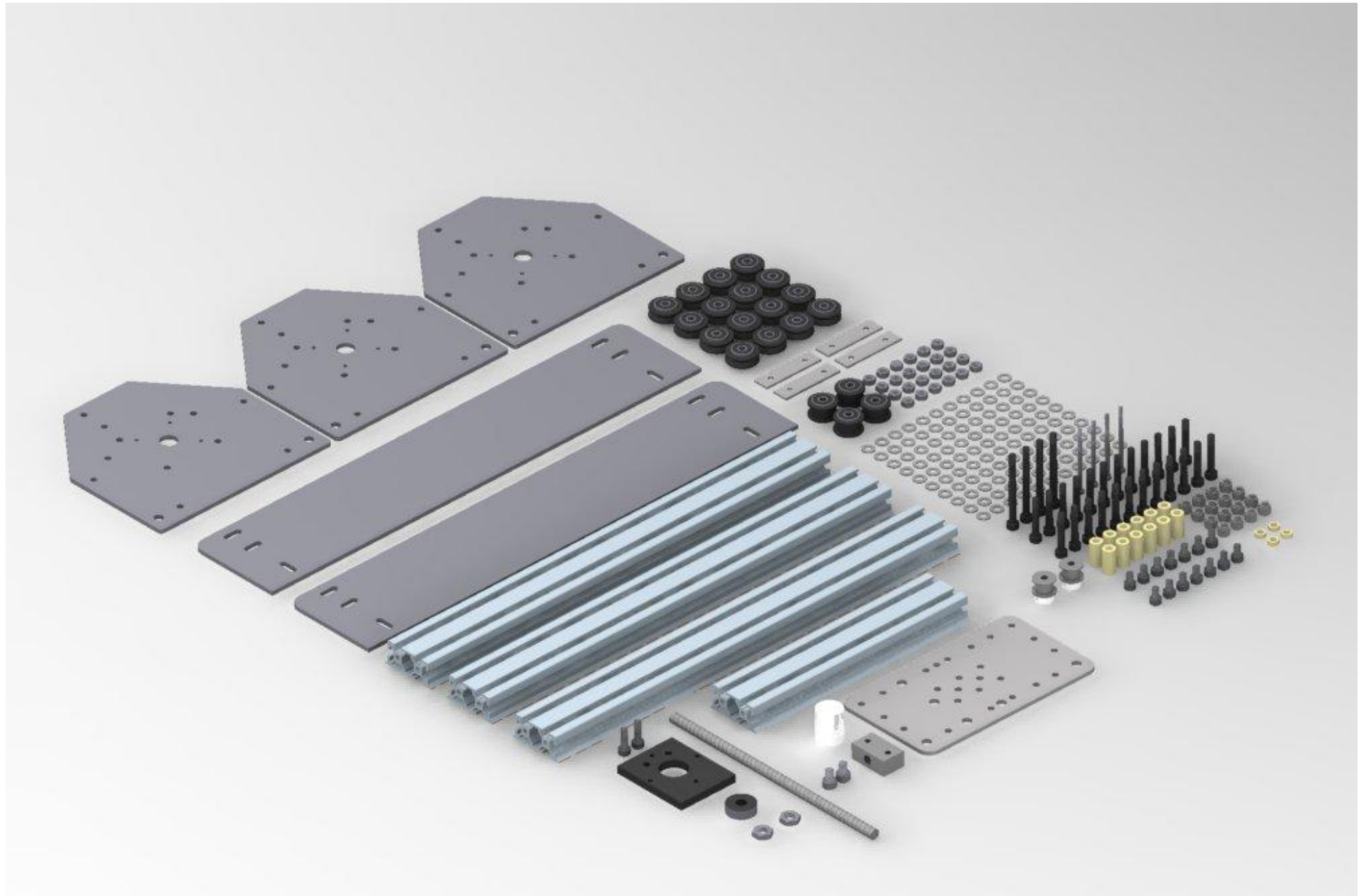
Please note that this is for the original ShapeOko and has not yet been up-dated for the new SO2. When that is done, this page should be archived under SO1 build instructions. There is a B.O.M. for the SO2 in the blog announcement (<http://blog.inventables.com/2013/10/shapeoko-2-now-available-for-preorder.html>) .

The following is a detailed list of specialty parts required to build the standard version of the ShapeOko cnc mill. Some parts such as nuts, socket head cap screws, washers, and wires are commodity parts found in most hardware/home improvement stores (please see the list under Additional / Commodity Items on the Purchasing page). Other parts, such as stepper motors, stepper drivers, power supplies, or microcontrollers are less likely to be found in a local store, and will probably have to order from the online suppliers. Other parts, such as the front and back frame end plates and the motor mount plates were designed specifically for this project and are custom manufactured.

Part availability and clarity are two focuses of the ShapeOko project. This page is your resource to find the descriptions and discussion links for each part you will need in order to build a ShapeOko mill. Please see the Purchasing page for a list of vendors, and where possible, direct purchase links.

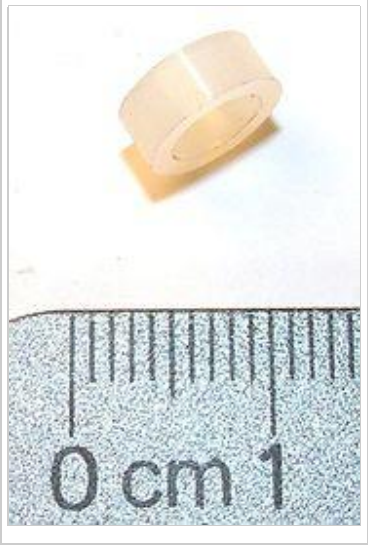
ShapeOko Assemblers Pack

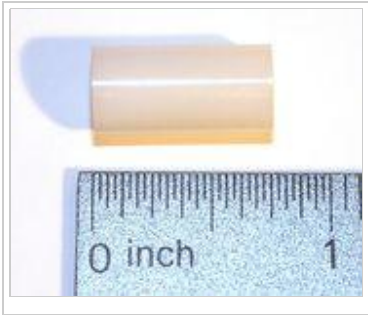
Many of the parts are available in the ShapeOko Assemblers Pack.




3D Model: GitHub (<https://github.com/shapeoko/shapeoko>)

Hardware

ShapeOko Part	Description	Dimensions	Source	Qty	Photo	Comments
Spacers						
SM-H01 (H1)	0.25" Spacer	5/16" OD, 0.192" ID	Hardware store, Specialty Hardware Store, Specialty Vendors	4		<p>The important thing is the overall dimension. In older ShapeOko kits, where 4 x 0.125" spacers were used, newer kits replace them with 2 x 0.25" spacers. An additional 4 x .25" spacers are also included for use with the smooth idlers. One can increase a machine's rigidity by using metal spacers instead. By specification, #10 bore spacers are slightly too small, but can often be used, #12 of course will fit w/ room to spare.[1] (http://www.shapeoko.com/forum/viewtopic.php?f=11&t=1569#p12354) Available from Inventables (#25312-03 or 25312-13) (https://www.inventables.com/technologies/aluminum-spacers) AluminumSpacers.com (Machinest.com) 3/8 OD x .219 ID x 1/4 Long (http://www.machinest.com/spacers/inventory_tables/sales_3_8/as38-12-16.htm)</p> <p>CAD Data</p> <ul style="list-style-type: none"> See McMaster part (http://www.mcmaster.com/#cadinlnord/94639a350/=hf9e7d) Here are some simple drawings for metric users in pdf format Spacers Metric Drawing PDF (https://www.dropbox.com/s/pb3loh99ba3jkqe/SM-H01%20og%20SM-H02%20tegning%20i%20Alu.PDF)
SM-H02 (H2)	0.75" Spacer	3/8" OD, 0.192" ID	Hardware store, Specialty Hardware Store, Specialty	10		<p>When being used with M3 screws, a 7/32" roll pin is an inexpensive alternative.</p> <p>CAD Data</p> <ul style="list-style-type: none"> See McMaster part (http://www.mcmaster.com)

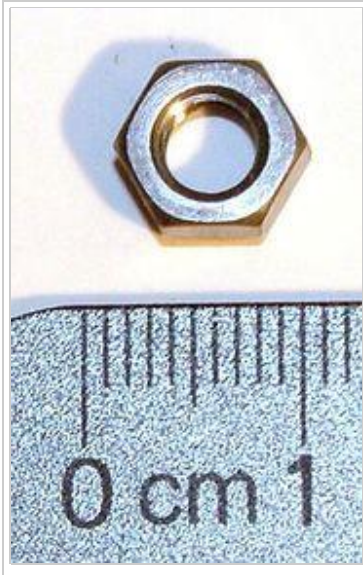
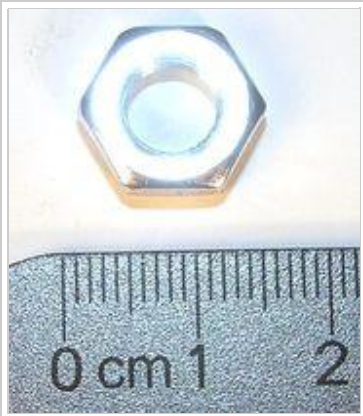
			Vendors			<p>/#cadinl nord/94639a457/=hf9ezv</p> <ul style="list-style-type: none"> Here are some simple drawings for metric users in pdf format Spacers Metric Drawing PDF (https://www.dropbox.com/s/pb3loh99ba3jkqe/SM-H01%20og%20SM-H02%20tegning%20i%20Alu.PDF)
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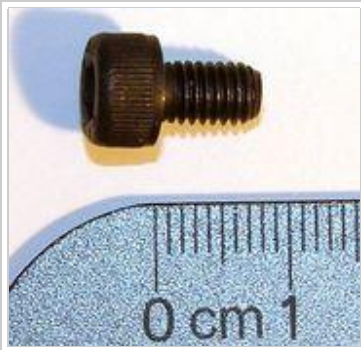
Washers


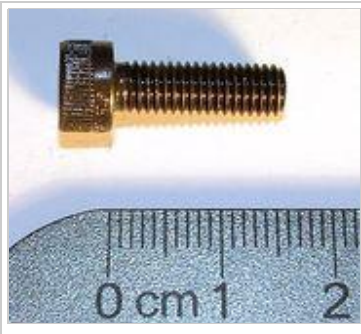

SM-H03 (H3)	5mm Washer	10mm OD, 5.3mm ID	Hardware store, Specialty Hardware Store, Specialty Vendors	103		<p>Four were used in the original method of belt anchoring, an additional eight were used to stand the motor off from the older mount plate design. Additional washers may be needed to adjust spacing (a stack is useful as a stand-in for a 1/4" spacer), to fasten the machine to the base, &c.</p>
SM-H15 (H15)	3mm Washer		Hardware store, Specialty Hardware Store, Specialty Vendors	11		

Nuts

SM-H04	5mm Nut	8mm Wrench,	Hardware store,	20		An additional four nuts were used to mount the belts in the original design. See Belt Anchors for an alternative.
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<p>(H4)</p>		<p>4mm Thick</p>	<p>Specialty Hardware Store, Specialty Vendors</p>			
<p>SM-H10 (H10)</p>	<p>8mm Jam Nut</p>	<p>13mm Wrench, 4mm Thick</p>	<p>Hardware store, Specialty Hardware Store, Specialty Vendors</p>	<p>2</p>		
<p>SM-H11 (H11)</p>	<p>Insertion Nut</p>	<p>M5 Size</p>	<p>Hardware store, Specialty Hardware</p>	<p>8</p>		<p>An additional four nuts were used to mount the belts in the original design. See Belt Anchors for an alternative.</p>


			Store, Specialty Vendors			
Screws / Bolts						
SM-H06 (H6)	M3 x 50mm socket head cap screw	2.5mm Hex Key	Hardware store, Specialty Hardware Store, Specialty Vendors	3		Note: You might need more M3 screws, depending upon the motors you purchase. NEMA 17 motors attach with M3 screws. NEMA 23 motors attach with M5 screws.
SM-H07 (H7)	M5 x 10mm socket head cap screw	4mm Hex Key	Hardware store, Specialty Hardware Store, Specialty Vendors	22		Originally, an 8mm screw was specified (and is pictured), since, this has been changed to 10mm. Larger machines may benefit from longer lengths. The eShapeOko uses 14 and 18mm by default.[2] (http://www.shapeoko.com/forum/viewtopic.php?f=10&t=1875&p=14231)




<p>SM-H08 (H8)</p>	<p>M5 x 30mm socket head cap screw</p>	<p>4mm Hex Key</p>	<p>Hardware store, Specialty Hardware Store, Specialty Vendors</p>	<p>16</p>		<p>When used w/o an eccentric spacer, this is too long --- a 22mm (or even 20mm) bolt makes up that difference.</p>
<p>SM-H09 (H9)</p>	<p>M5 x 55mm socket head cap screw</p>	<p>4mm Hex Key</p>	<p>Hardware store, Specialty Hardware Store, Specialty Vendors</p>	<p>8</p>		<p>(quantity was 4, why?)</p>
<p>SM-H13 (H13)</p>	<p>M5 x 16mm socket head cap screw</p>	<p>4mm Hex Key</p>	<p>Hardware store, Specialty Hardware Store, Specialty Vendors</p>	<p>2</p>		
<p>SM-H05 (H5)</p>	<p>8mm Threaded Rod</p>	<p>200mm Long</p>	<p>Hardware store, Specialty Hardware Store, Specialty Vendors</p>	<p>1</p>		

Specialty Parts

<p>SM-H12 (H12)</p>	<p>Z-Axis Coupler</p>	<p>5mm to 8mm Coupler</p>	<p>Specialty Vendors</p>	<p>1</p>		
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Electronics

ShapeOko Part	Description	Dimensions	Source	Qty	Photo	Comments
SM-E01 (E1)	Stepper Motors	58 oz-in, Nema 17	Specialty Vendors, Electronics Suppliers	3		<p>CAD Data</p> <ul style="list-style-type: none"> ▪ PDF (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=B10-10003) ▪ DXF (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=B10-10003&type=dx) ▪ STEP (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=B10-10003&type=step) <p>(see this page (http://www.linengineering.com/resources/wiring_connections.aspx) for information on wiring stepper motors)</p> <p>The Shapeoko can use NEMA 17 or NEMA 23 stepper motors. The 58 oz-in motors listed are sufficient to drive the Shapeoko, but larger motors can be used. Forum Discussion (http://www.shapeoko.com/forum/viewtopic.php?f=4&t=44)</p> <p>Please note that NEMA 17 motors are available w/ 1/4" shafts instead of the more typical 5mm which is assumed in these plans --- if such motors, or NEMA 23s are used, you will need to source pulleys w/ a matching i.d.</p>
E2	Power Supply	24V 4.2A	Specialty Vendors, Electronics Suppliers	1		<p>The size of the power supply should be at least 4.2A at 24V. A larger supply (for example, a 4.5A) will work fine. The size is based on the requirements of the stepper motors you choose. Power Supply (http://www.shapeoko.com/forum/viewtopic.php?f=4&t=153)</p>

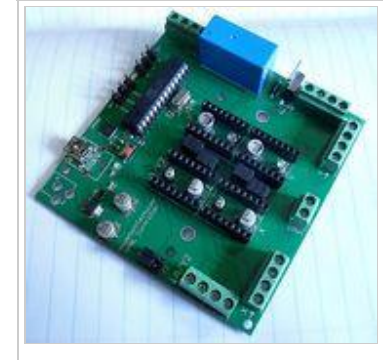
						
E3	Stepper Driver	Pololu A4988 compatible	Specialty Vendors	3		The stepper drivers that the Shapeoko is designed to use is the Pololu A4988. There are other drivers that are compatible, including the Pololu-compatible open source Stepstick (http://reprap.org/wiki/StepStick) .
E4	Arduino (328P Compatible)		Specialty Vendors	1		Any Arduino 328P compatible board should work. Multiple vendors sell these boards, and price varies by vendor and features. Alternately the machine can be directly controlled by a computer, see Alternative Electronics.
E5	Arduino stepper shield	2.7 in x 2.1 in (standard Uno shield)	Electronics Suppliers	1		The Shapeoko was designed to use the Pololu stepper drivers, and this Arduino shield makes assembly and wiring very easy and straight forward. Another option is to create your own board. A good example of this is User:DrRob, who

size)



Revision 3.0 board on an Uno


has made his own shield using perfboard. Alternately, one could use a custom board which incorporates both an Arduino and a stepper shield such as the AtomCNC (97.8mm x 95.5mm (inches: 3.85" x 3.76")), which was available at <http://atomssofttech.com/AtomWiki> (Revision 1 board shown). Using an all-in-one board makes the whole wiring and usage of the Shapeoko fairly simple. A single board makes further features such as an optional 50mm fan mount, or a 10A @ 240VAC relay for rotary tool ON/OFF control, or a Homing/Limit I/O and GPIO for future use more affordable.



Alternate controller: Arduino grblShield (<https://www.synthetos.com/webstore/index.php/assembled-electronics/grblshield-grbl-arduino-diy-cnc-shield.html>)



Discussion in the forums: Buildlog.net Arduino Compatible Stepper Shields available (<http://www.shapeoko.com/forum/viewtopic.php?f=12&t=169>) Full Controller (<http://www.shapeoko.com/forum/viewtopic.php?f=12&t=215>) Buildlog Stepper Shields (<http://www.shapeoko.com/forum/viewtopic.php?f=12&t=80>)

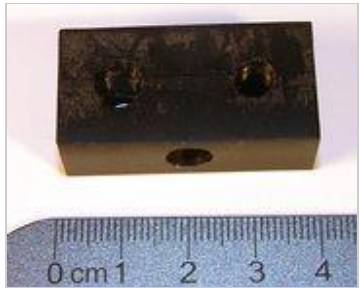
Motion

ShapeOko Part	Description	Source	Qty	Photo	Comments
MSK01-05 (M1)	Dual Bearing V Wheel	Specialty Vendors	16		<p>CAD Data</p> <ul style="list-style-type: none"> ■ Dual Bearing V Wheel (Part) PDF (http://www.makerslide.com/drawings/b17021_rev_1.pdf) DXF (http://www.makerslide.com/drawings/b17021_rev_1.dxf) STEP (http://www.makerslide.com/drawings/b17021.stp) ■ Google SketchUp 3D Warehouse - Buildlog.net MakerSlide Delrin Wheel (http://sketchup.google.com/3dwarehouse/details?mid=1c4a0d47ed568b4052f05c121726c97c&prevstart=0) <p>Note that there is a 1mm precision washer which goes in-between the two bearings. The specification for this part allows a bit of variance in the sizing. Forum discussions: Re: ACME screw upgrade for Shapeoko Z-Axis (http://www.shapeoko.com/forum/viewtopic.php?f=12&t=850&start=20#p7307) , and also see V-Wheel Precision Washer upgrade for your exacting CNC setup (http://www.shapeoko.com/forum/viewtopic.php?f=12&t=909) which includes a link to purchase them: Reactive Substance Storefront (http://www.reactive-substance.com/shop.html)</p>
MSK01-04 (M2)	Eccentric Spacer	Specialty Vendors	8		<p>CAD Data</p> <ul style="list-style-type: none"> ■ Eccentric spacer - PDF (http://www.buildlog.net/sm_laser/drawings/b18001_rev_3.pdf) STEP (http://www.makerslide.com/drawings/b18001-001.stp) ■ Google SketchUp 3D Warehouse - Buildlog.net Makerslide Eccentric Spacer (http://sketchup.google.com/3dwarehouse/details?mid=b2e3cd28afd4890f41171a49c6f158d5&prevstart=0)

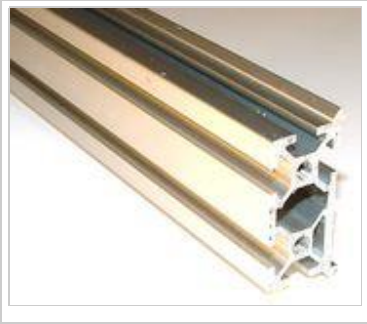
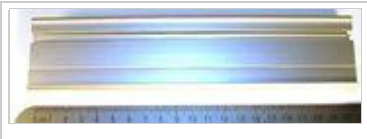
					
MSK01-06 (M3)	Smooth Idler Drum	Specialty Vendors	4		CAD Data <ul style="list-style-type: none">■ Google SketchUp 3D Warehouse - Buildlog.net Smooth Idler Pulley (http://sketchup.google.com/3dwarehouse/details?mid=635927d7f0b2e7bb6c0700fd717b4867&prevstart=0)■ Thingiverse - Shapeoko Idler (http://www.thingiverse.com/thing:42470)■ PDF (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=B30041)

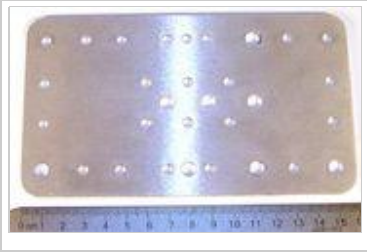

SM-M04 (M4)	MXL Belt	Specialty Hardware Stores, Specialty Vendors	4 ft		0.08" MXL, Width: .25" - Spec Sheet (PDF) (https://sdp-si.com/ss/PDF/80502007.PDF)
SM-M05 (M5)	Belt anchor	Hardware Stores, Specialty Hardware Stores, Specialty Vendors	4		Mending brackets / plates usually sold in packs of 2 --- a Stanley Hardware Mending Bracket (http://www.stanleyhardware.com/default.asp?TYPE=CATEGORY&CATEGORY=HDW+MENDING+PLATE)
MSK01-09 (M9)	18 Tooth MXL Timing Pulley w/ 5mm bore	Specialty Hardware Stores, Specialty Vendors	2		Pulley has 18 teeth


					
<p>SM-M07 (M7)</p>	<p>Z-Axis Bearing: 608ZZ Bearing 8x22x7 Shielded Miniature Ball Bearing</p>	<p>Specialty Hardware Stores, Specialty Vendors</p>	<p>1</p>		

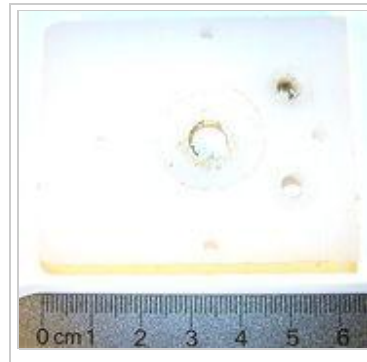
SM-M08 (M8)	Z-Axis Delrin Lead Nut	Specialty Vendors	1		<p>CAD file on github (https://raw.githubusercontent.com/shapeoko/ShapeOko/master/drawings_pdf/SM-M08.pdf)</p> <p>There have been a number of machines which have had issues w/ the Z-axis nut. One solution is of course an ACME Z-axis. Forum user ejs decided on directly addressing the part itself in A new Z-axis nut - metal on metal w/ built in anti-backlash (http://www.shapeoko.com/forum/viewtopic.php?f=11&t=1720&p=12964) .</p>
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Structural




ShapeOko Part	Description	Source	Qty	Photo	Comments
MSK01-02 (S1)	Makerslide Extrusion - 375mm	Inventables kit (http://www.shapeoko.com/mechanical-details)	3		<p>Note: Tap for M5 screw, in 10mm and 16mm (or longer) lengths. See assembly instructions for details.</p> <p>CAD Data</p> <ul style="list-style-type: none"> ■ Extrusion Profile - DXF (http://www.makerslide.com/drawings/makerslide.dxf) PDF (http://www.buildlog.net/documents/b17022_rev_1.pdf) ■ Extrusion (100mm lg) - STEP (http://www.makerslide.com/drawings/maker_slide_100.stp) ■ Extrusion (200mm lg) - STEP (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=B14022&type=step) ■ Google 3D Warehouse - Buildlog.net Makerslide 20x40mm extrusion profile (http://sketchup.google.com/3dwarehouse/details?mid=4ad0abbbc50c99936c0700fd717b4867&prevstart=0) , Sketchup Warehouse (http://sketchup.google.com/3dwarehouse/cldetails?mid=de15ed1810bca07352f05c121726c97c) ■ Thingiverse CAD data (http://www.thingiverse.com/thing:8992)
MSK01-03 (S2)	Makerslide Extrusion - 200mm	Inventables kit (http://www.shapeoko.com/mechanical-details)	1		<p>Note: Tap for 16mm M5 screw, accounting for thickness of Z-axis motor mount plate. See assembly instructions for details.</p>

MSK01-01 (S3)	Standard Carriage Plate	Inventables kit (http://www.shapeoko.com/mechanical-details)	1		<p>CAD Data</p> <ul style="list-style-type: none"> Standard plate - DXF (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=C14005&type=dx) STEP (http://www.buildlog.net/cnc_laser/erp/get_doc.php?docNumber=C14005&type=step) PDF (http://www.buildlog.net/documents/c14005_rev_2.pdf) Google 3D Warehouse - Buildlog.net Makerslide bearing plate / Standard Wheel Carriage Plate (http://sketchup.google.com/3dwarehouse/details?mid=61f182dd611c5ee741171a49c6f158d5&prevstart=0) Github - CAD file at Github (https://raw.githubusercontent.com/shapeoko/ShapeOko/master/drawings_pdf/MSK01-01.pdf)
SM-S01 (S4)	Mount Plate	Inventables kit (http://www.shapeoko.com/mechanical-details)	3		<p>Needs to be a minimum of .0747" (~2mm) thick if made of steel [3] (http://groups.google.com/group/shapeoko/msg/81e551625636ea4e?dmode=source) . Further discussion (http://www.shapeoko.com/forum/viewtopic.php?f=11&t=1086&p=8756) . 1/4" noted as being "overkill"[4] (http://www.shapeoko.com/forum/viewtopic.php?t=900&p=7309#p7303) . The eShapeOko uses 2mm stainless steel (forum post on this and theorization about 3.175mm aluminum being enough in Re: New new end plates (http://www.shapeoko.com/forum/viewtopic.php?f=11&t=815#p12272)) . Please note that these are now available (see the Purchasing page).</p> <p>CAD Data</p> <ul style="list-style-type: none"> Motor Mount Plates (14ga) - DXF (http://www.shapeoko.com/wp-content/uploads)

					<p>/2012/04/SMS001.dxf)</p> <ul style="list-style-type: none"> ▪ Github CAD files on Github (https://raw.githubusercontent.com/shapeoko/ShapeOko/master/drawings_pdf/SM-S01.pdf) ▪ Sketchup Warehouse Sketchup Warehouse (http://sketchup.google.com/3dwarehouse/details?mid=2a3754dc14ae1ffddb8f267ad6945df) ▪ Upgrade plates v3 - shapeoko_upgrade_parts_v3.zip (http://www.shapeoko.com/forum/download/file.php?id=1085)
SM-S02 (S5)	End Plates (Front/Back Plate)	Inventables kit (http://www.shapeoko.com/mechanical-details)	2		<p>SMS002 - Needs to be a minimum of .1345" (~3.5mm) thick if made of steel [5] (http://groups.google.com/group/shapeoko/msg/81e551625636ea4e?dmode=source) . Further discussion (http://www.shapeoko.com/forum/viewtopic.php?f=11&t=1086&p=8756) . An alternative is to use the new Open End Plates and a rectangular aluminum extrusion. Please note that the new open end plates are now available (see the Purchasing page).</p> <p>CAD Data</p> <ul style="list-style-type: none"> ▪ End Plates (10ga) - DXF (http://www.shapeoko.com/wp-content/uploads/2012/04/SMS002.dxf) ▪ Github CAD files on Github (https://raw.githubusercontent.com/shapeoko/ShapeOko/master/drawings_pdf/SM-S02.pdf)
SM-S06 (S6)	Z-Axis Mount Plate	Inventables kit (http://www.shapeoko.com/mechanical-details)	1		<p>CAD files on Github (https://raw.githubusercontent.com/shapeoko/ShapeOko/master/drawings_pdf/SM-S06.pdf)</p> <p>Thingiverse - Makerslide Shapeoko Nema 17 Mount Plate Z axis (http://www.thingiverse.com/thing:39555)</p>



Tooling

ShapeOko Part	Description	Source	Qty	Photo	Comments
SM-TM3 (T1)	Spindle	Amazon (http://www.amazon.com/gp/product/B000LRJZ8U/ref=oh_o05_s00_i00_details)	1		<p>Edward R. Ford made some notes on spindle options[6] (http://www.shapeoko.com/forum/viewtopic.php?f=23&t=1555&p=12466#p12466) .</p> <p>Vote for your favorite ShapeOko spindle solution! (http://www.shapeoko.com/forum/viewtopic.php?f=7&t=258)</p>
SM-TM1 and SM-TM2 (T2)	Spindle Mount (top)	Inventables kit (http://www.shapeoko.com/mechanical-details) or McMaster (http://www.mcmaster.com/#cadinlnord/3042t76/=giuo42)	1		<p>In newer kits, the spindle mounts are milled blocks of aluminum, see Re: Insertion nut screw shaft too large for makerslide (http://www.shapeoko.com/forum/viewtopic.php?f=10&t=1697&p=12799#p12797) .</p>  <ul style="list-style-type: none"> ▪ SM-TM1.pdf on Github (https://github.com/shapeoko/ShapeOko/blob/master/drawings_pdf/SM-TM1.pdf) ▪ SM-TM2.pdf on Github (https://github.com/shapeoko/ShapeOko/blob/master/drawings_pdf/SM-TM2.pdf) <p>Alternately, see Spindle Mount or Dewalt DW660. CAD Data</p> <ul style="list-style-type: none"> ▪ See McMaster part

					(http://www.mcmaster.com/#cadinl nord/3042t76/=hf9c49)
T3 (T3)	Spindle Mount (bottom)	Inventables kit (http://www.shapeoko.com/mechanical-details) or McMaster (http://www.mcmaster.com/#cadinl nord/3042t75/=giuo8f)	1		In newer kits, the spindle mounts are milled blocks of aluminum. CAD Data <ul style="list-style-type: none"> See  McMaster part (http://www.mcmaster.com/#cadinl nord/3042t75/=hf9d61)

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