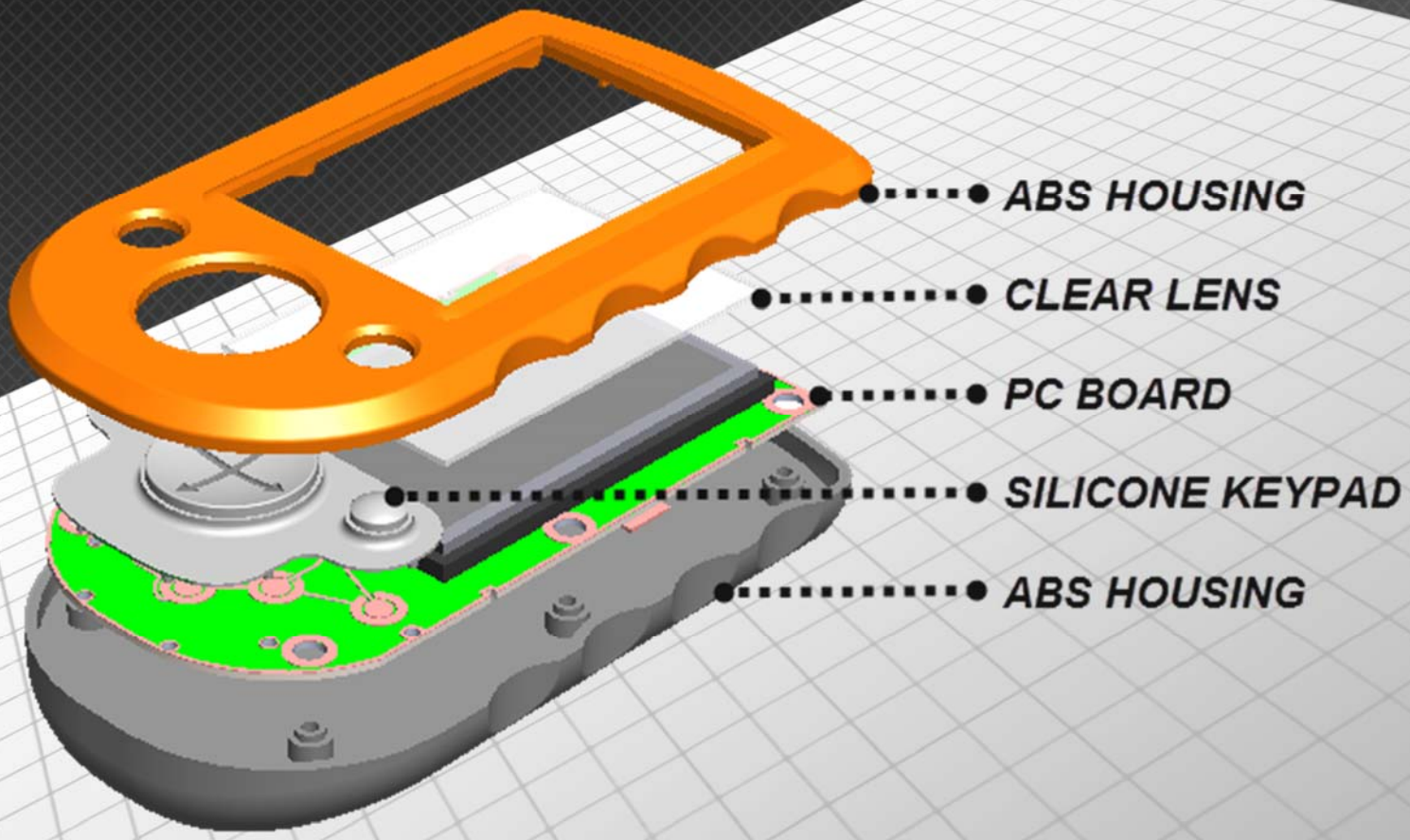
PRODUCT DEVELOPMENT INC

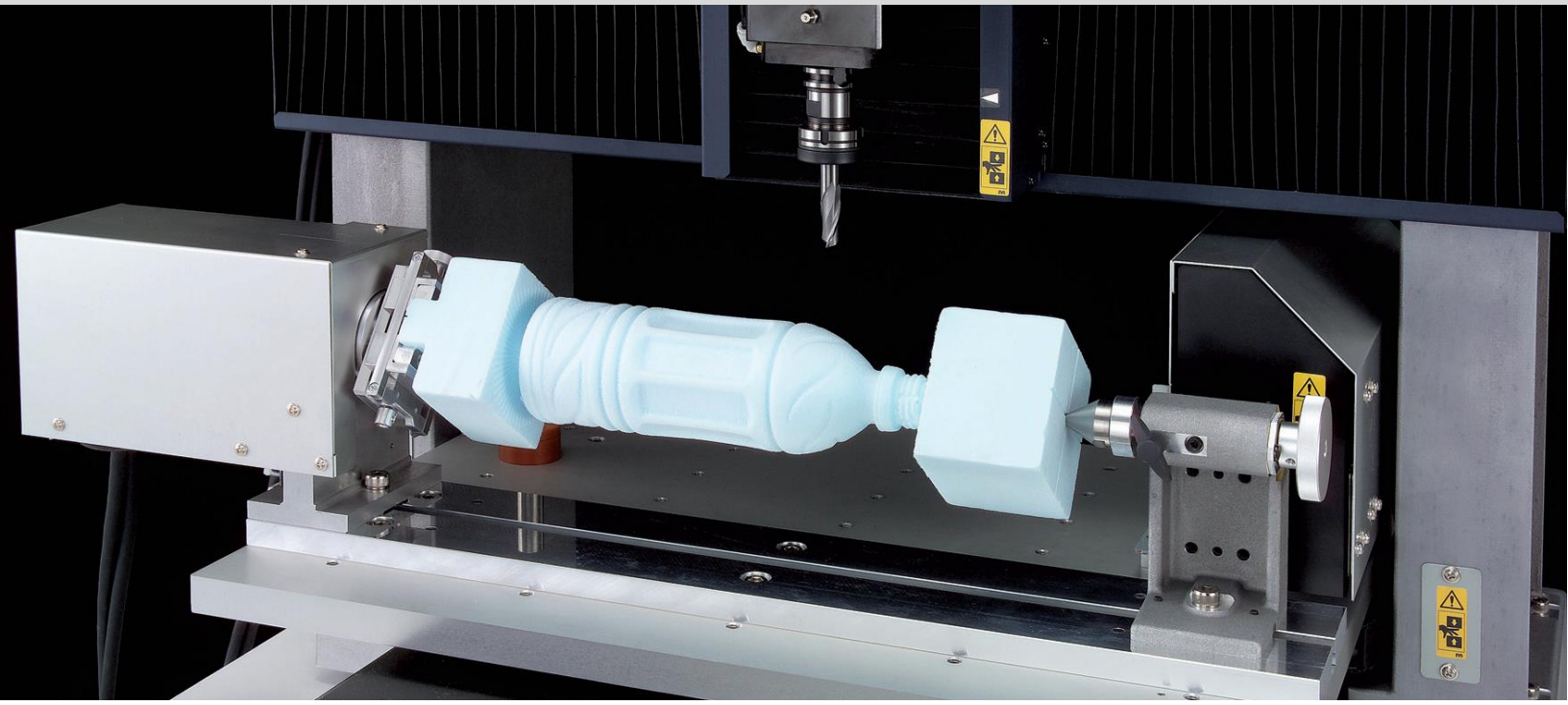
CAN YOUR 3D PRINTER DO THIS?



Guide to Roland 3D Milling & Subtractive Rapid Prototyping

448 N. CEDAR BLUFF RD. SUITE 334, KNOXVILLE, TN 37923 // T: 866.862.1184 // F: 877.485.4115 // SALES@PDI3D.COM

WWW.PDI3D.COM



Rapid Prototyping: Hype vs. Reality

Many product designers and engineers who are researching additive rapid prototyping systems as a way to test form, fit and function of their prototypes may be unaware that there is a better, cheaper, faster solution. Roland subtractive RP systems (SRP™) produce form models faster than any 3D printer on the market and easier than any other CNC mill on the market. That's because Roland offers a complete software/hardware solution that combines the ease of use of 3D printers with the benefits of CNC-machined parts. Add some of the optional accessories and the Roland SRP™ system is transformed into a 3D scanner, PC Board prototype system, engraver, jewelry wax carver, and video measurement system.

On the following pages, you'll find a comparison of actual parts milled with a Roland milling machine and built with a 3D printer. You'll also find a Cost of Ownership comparison. Finally, we've included a testimonial by inventor and entrepreneur Joe Matteo.

Table of Contents

Key Advantages of SRP over 3D Printers:

- SRP (Subtractive Rapid Prototyping) provides a wide choice of materials, smooth surface finish, tight tolerances (MDX-40 +/- .002", MDX-540 +/- .001) and a low cost of ownership.
- All Roland products come complete with bundled CAM software (SRP Player). No G-Code programming required.
- Products include a 1 year parts/labor warranty and one way shipping.
- Roland 3D Milling Machines use industry standard tooling
- Make prototype or production parts in the materials of your choice.

Roland MDX Product Comparison

Model	Price	Build Size	Materials	Options	Notes
MDX-15	$3,495	6”x 4”x 2.4”	Foams, plastics, wax, wood		Includes probe scanner for 3D scan PC Board CAM capable
MDX-20	$4,995	8”x 6”x 2.4”	Foams, plastics, wax, wood		Includes probe scanner for 3D scan PC Board CAM capable
MDX-40A	$7,995	12”x 12” x 4.1” with 4th axis: 4.7” dia. x 10.6”	Foams, plastics, wax, wood	4th axis, 3D probe scanner, engraving, vice, curriculum	G- Code supported, but not required PC Board CAM capable
MDX-540	$20,995	19.6”x 15.7”x 6.1” with 4th axis: 7” dia. x 14”	Foams, plastics, wax, wood, light metals (brass, aluminum)	4th axis, t-slot table, safety cover, vice, high precision, automatic tool changer	G- Code supported, but not required “A”=Automatic Tool Changer (4 tools) “S”=Ultra high precision upgrade PC Board CAM capable
MDX-540A	$31,995				

MDX-40A Series

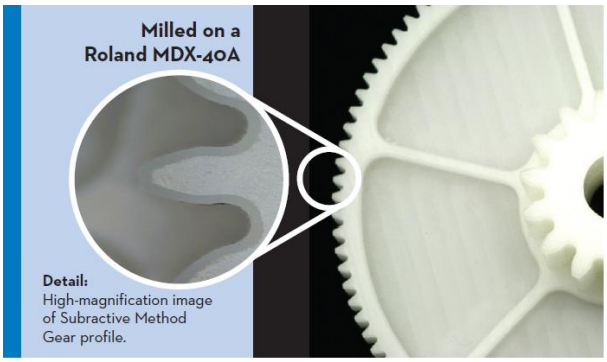
MDX-540 Series

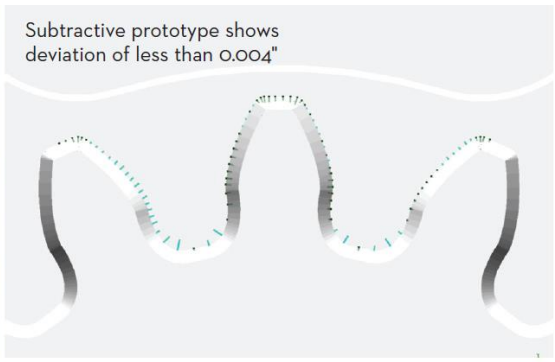
MDX-15/20 Series

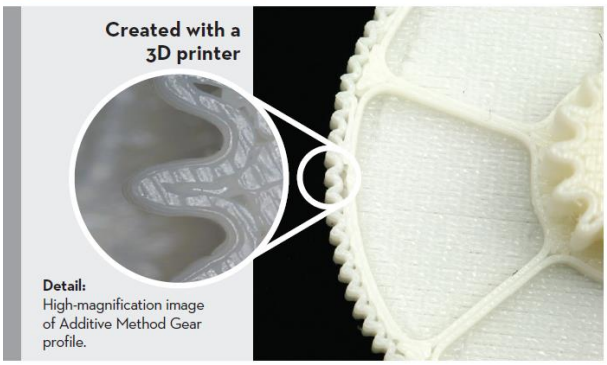
Fit, Finish and Functionality

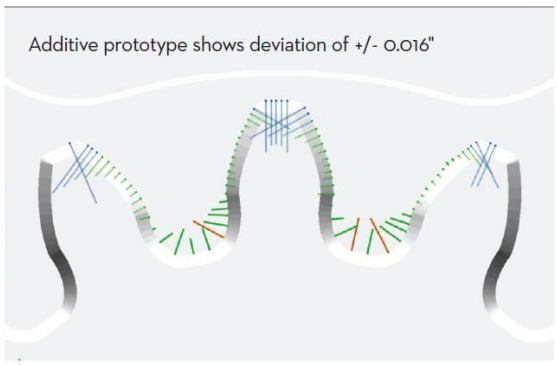
Tighter Tolerances
Roland MDX SRP Mills deliver the exact precision required. By contrast, additive systems lay down material in layers, and the tolerances are limited by the thickness of these layers.

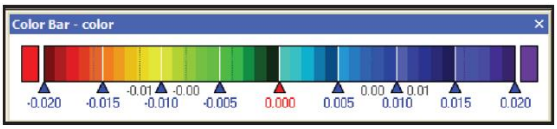
Smoother Surface Finish
When viewed side by side, the difference is clear.







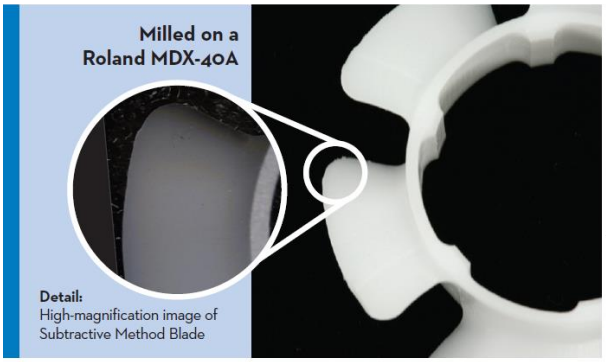


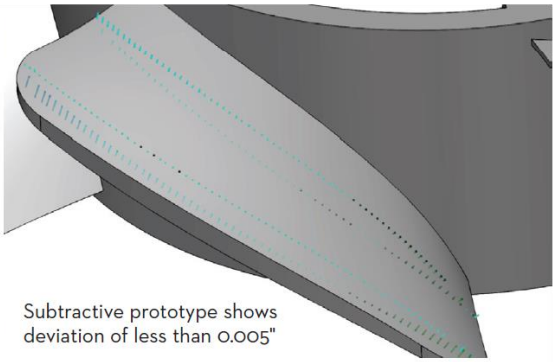


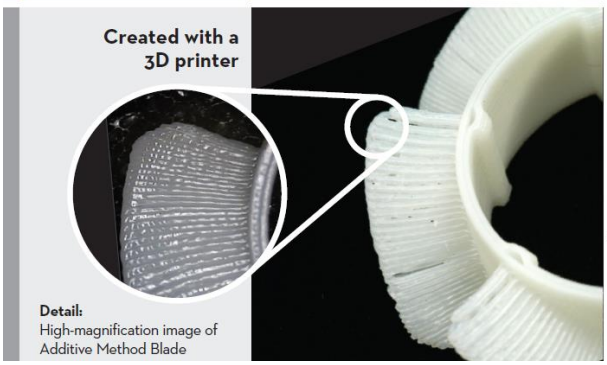
Production Quality
Subtractive parts are built to production quality standards.

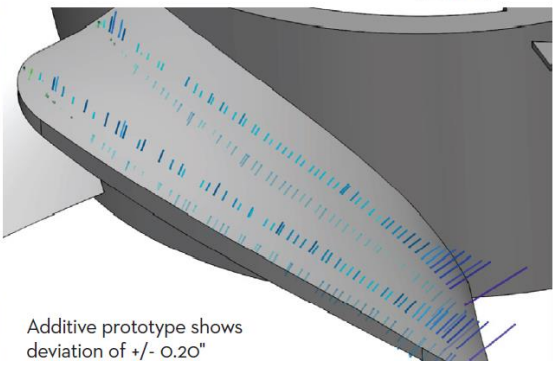
Details
Subtractive parts were milled with Acetal Copolymer on the MDX-40A.

Additive parts used ABS-based material.









Material Selection

Support for a wider range of materials - Choose from a wide variety of modeling materials, engineering plastics, non-ferrous metals. Basically any material with a hardness equal to or less then non - ferrous metals. Like ABS, acrylic, aluminum, brass, polyurethane, modeling boards, wood, plaster, styrene, wax, Acetal, Nylon, Peek and other FDA approved plastics.

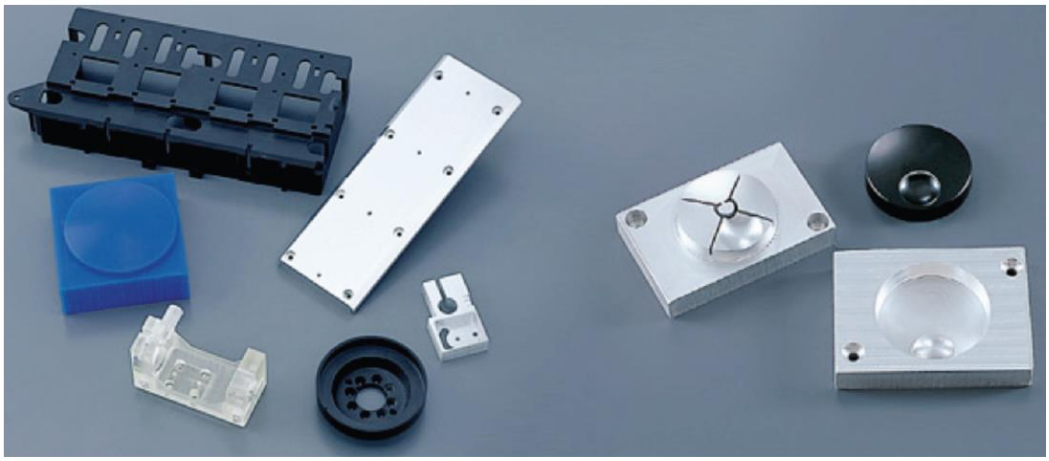
Molds
Create molds for silicones, urethanes, and injection molding.

Precision Casting
Cut models out of wax for investment casting in a variety of materials like aluminum, gold, silver, bronze, platinum, copper, stainless steel, nickel and cobalt alloys

Engraving
Using either rotary action or diamond drag engraving. You are able to engrave in a variety of materials including wood, plastics, aluminum, brass, steel and stainless steel.

Natural Materials
Use the MDX milling machines to cut materials from the natural world like, exotic woods, stones, sea shell, human and animal bone.

Acrylic, Acetal and other plastic materials are perfect for SRP.



Short-run industrial parts, prototypes and molds milled with SRP on wax, aluminum, ABS, Acetal and acrylic.

Acrylic wheel milled using Subtractive Rapid Prototyping (SRP).

Tooling board gear shift knob prototype created with the MDX-40A, shown with finished parts.

Finished phone prototype with wood, ABS and aluminum parts milled by the MDX-540.

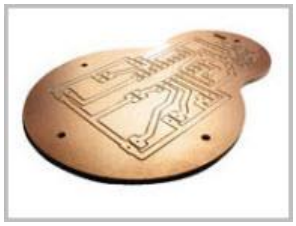
ABS iPod prototype case milled with SRP.

Advanced Applications

More than just a Rapid Prototyping System

With the Roland MDX milling machines you can do more than just make parts. By adding one of our exclusive accessories you can turn the MDX milling machine into a pc board prototyping solution, an engraver, 2d cutting device, 3d scanner, or a video measurement system. This helps you get a faster return on investment by purchasing a **single** piece of equipment for multiple uses.

PDI PC Board Prototyping Kit*
Do you ever send out pc boards to be prototyped? How long does it take you to get them back? Add our PC board prototyping kit to the MDX milling machine to turn it into a PC board prototyping solution. Then you can make single and double sided pc boards in hours instead of waiting for days.



PDI Engraving Kit*
Need to engrave serial numbers on parts? Do you need to make signage or engrave gifts? Add the engraving kit to allow the MDX milling machine to engrave in a wide variety of materials. The MDX machines are able to perform both rotary engraving and diamond drag engraving. This allows you to do engraving in house on your own schedule.

PDI Video Measurement Kit*
Do you do reverse engineering? Do you ever need to take multiple measurements on parts with really fine details? The video measurement kit allows you to measure, inspect and reverse engineer parts using your MDX machine.

PDI 2D Kit*
Do you need to cut items out of flat materials like acrylic or wood? Add the 2D kit and the MDX machines can be used to cut 2d nested objects out of flat materials. This allows you cut out parts just like you would on a laser cutter.

3D Scanning Probe
Do you ever need to 3d model items that are hard to measure with a pair of calipers? Items that have flowing curves and features that are hard to define? Add the 3D touch probe scanner and set the scanner to automatically scan the entire surface of model and bring it into your cad software to complete your design.

***PDI Exclusive**
These items are exclusive items integrated and offered by Product Development Inc for the Roland MDX milling machines.

How much will SRP save you?

Making parts in-house vs. using an outside machine shop.

The following examples are real world parts that were used for a variety of applications from visual concept models to prototypes and functional production parts, all created using Roland SRP technology. SRP gives you a greater choice of materials so you can select the optimum material for your design instead of being limited to proprietary materials from 3D print vendors. The tight tolerances and smooth surface finish of SRP ensure you won't compromise a thing.

Fan Part

This functional model is used on our machines to blow chips out of the cutting area when milling acrylic, wood or aluminum. Once the model was created it was put to work immediately after being removed from the machine. Visit our website to see a video of this part being created.
Part dimensions: 40mm x 40mm x 10mm | Part build time: 1.1 hour

R.O.I	
Acetal Material	$9.50
Labor (1/2 hr.)	$17.32
Total Cost	$26.82
Value	$199.00
Savings	**$172.82**

Hair Dryer Prototype

When the designers wanted to test the fit and finish of a new travel sized hair dryer, they used Roland SRP technology to produce a prototype that would go beyond concept. Accurate materials, smooth surface finish and tight tolerances gave them an assembly that could stand up to thermal and impact testing.
Part dimensions: 135mm x 175mm x 60mm | Part build time: 12 hours

R.O.I	
Acetal Material	$65.00
Labor (2 hrs.)	$69.30
Total Cost	$134.30
Value	$1,768.00
Savings	**$1,633.70**

Gear Prototype

This gear was used as a prototype to test real world functionality. This is a fully operational gear, cut in the exact material that the final product would be produced in. It's fit, finish, and structural integrity mimic the final product allowing for accurate component testing.
Part dimensions: 51mm x 51mm x 15mm | Part build time: 3.7 hours

R.O.I	
Nylon Material	$5.00
Labor (1/2 hr.)	$17.32
Total Cost	$22.32
Value	$199.00
Savings	**$176.68**

Bearing Block Prototype

Medium density tooling board provides extremely fast concept models that are dimensionally accurate. This material allows users to create concept models at a fraction of the time of plastics or non-ferrous metals giving you a dimensionally accurate, smooth surfaced model that will hold up to design reviews.
Part dimensions: 165mm x 67mm x 40mm | Part build time: 3.2 hours

R.O.I	
Model Material	$25.00
Labor (1 hr.)	$34.00
Total Cost	$59.00
Value	$950.00
Savings	**$891.00**

Rocker Arm Prototype

This aluminum rocker arm prototype was an early design model used to test the overall shape and function of a mountain bike part. This prototype was created in production grade material to match the production part and confirm fit, finish and functionality.
Part dimensions: 140mm x 45mm x 7.5mm | Part build time: 2.1 hours

R.O.I	
Alum Material	$10.00
Labor (1 hr.)	$34.00
Total Cost	$44.00
Value	$349.00
Savings	**$305.00**

Fixturing Prototype

This assembly is composed of several close tolerance parts. The jig required a special fixture clamp that was not commercially available and was quickly created on the Roland SRP milling machine. The Acetal copolymer material will maintain tolerances over the entire production run.
Part dimensions: 28mm x 98mm x 48mm | Part build time: 4.2 hours

R.O.I	
Acetal Material	$20.00
Labor (1 hr.)	$34.00
Total Cost	$54.00
Value	$375.00
Savings	**$321.00**

Note: Parts featured here were sent to an outside service bureau whose price was average for machine shops.

Cost of Ownership

Affordable pricing, no annual maintenance fees and low material costs will save you thousands over alternative RP systems.

Comparable 3D Printer vs. Roland MDX-540A	Comparable 3D Printer[2]	Roland MDX-540
Build Area	10x10x12	15x15x6
Warranty	90 days	1 year
Machine Purchase Price	$29,900.00	$20,995.00
Accessories/options/support removal bath[3]	$3,000.00	$7,326.00
Purchase Price Subtotal	**$32,900.00**	**$28,321.00**
Annual Maintenance	$3,000.00	$0.00
Annual Material Cost[1] - Finishing costs (binders, fillers, support removal solution, support removal tools, etc.)	$2,592.00	$432.00
Annual Cost Subtotal	$5,592.00	$432.00
5 year maintenance & material cost	**$27,960.00**	**$2,160.00**
Total 5 year cost of ownership	**$60,860.00**	**$30,481.00**

5 year savings over comparable 3D printer	**$30,379.00**

Comparable 3D Printer vs. Roland MDX-40A	Comparable 3D Printer[2]	Roland MDX-40A
Build Area	8x6x6	12x12x4
Warranty	1 year	1 year
Machine Purchase Price	$14,900.00	$11,694.00
Accessories/options/support removal bath[4]	$3,000.00	$524.00
Purchase Price Subtotal	**$17,900.00**	**$12,218.00**
Annual Maintenance	$1,500.00	$0.00
Annual Material Cost[1] - Finishing costs (binders, fillers, support removal solution, support removal tools, etc.)	$2,592.00	$432.00
Annual Cost Subtotal	$4,092.00	$432.00
5 year maintenance & material cost	**$20,460.00**	**$2,160.00**
Total 5 year cost of ownership	**$38,360.00**	**$14,378.00**

5 year savings over comparable 3D printer	**$23,982.00**

[1]Material Cost Calculator	Comparable 3D Printer[2]	Roland MDX-40A
Estimated cost/cubic inch	$6.00	$1.00
Average cubic/inch per part	12	12
Average cost per part	$72.00	$12.00
Parts per year	36	36
Total Annual material cost	**$2,592.00**	**$432.00**

[2]Information correct at time of printing

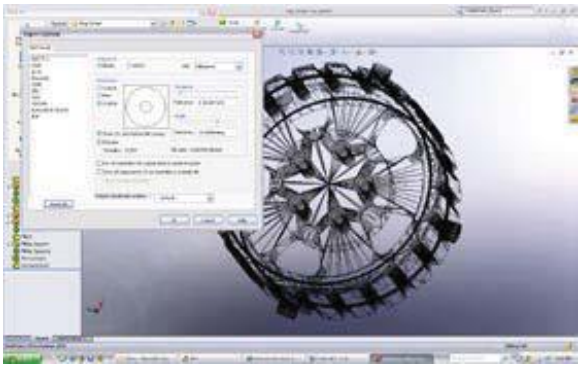
[3]MDX-540 accessories include: safety cover, rotary 4th axis unit, starter tool kit, collet kit

[4]MDX-40A accessories include: rotary 4th axis, starter tool kit

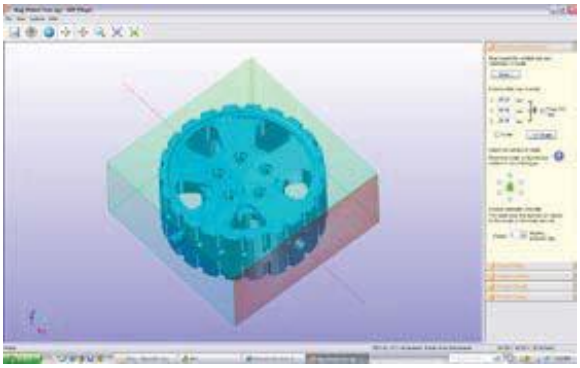
SRP Player Workflow

Roland MDX SRP Mills come complete with SRP Player Software to prepare your CAD model for SRP prototyping with no programming skills required.

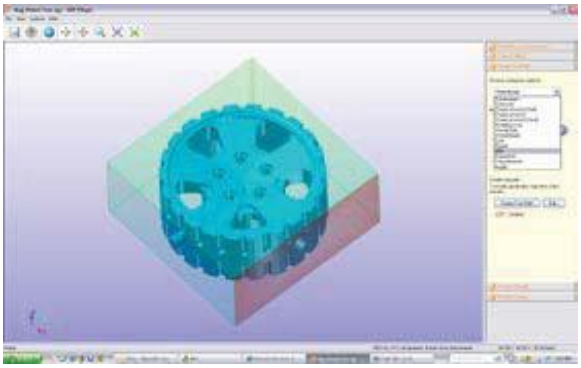
1. Create your design in your favorite 3D design software.



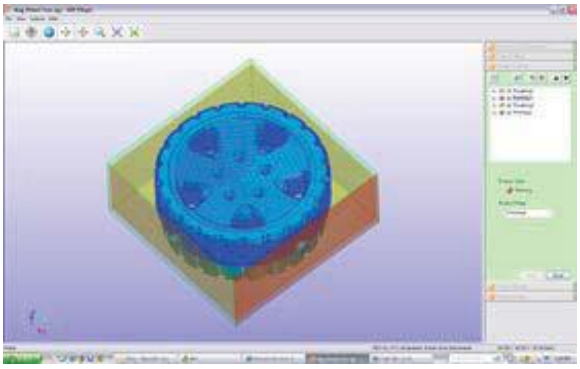
2. Export from your CAD as .STL or DXF, .3DM, .IGS/.IGES



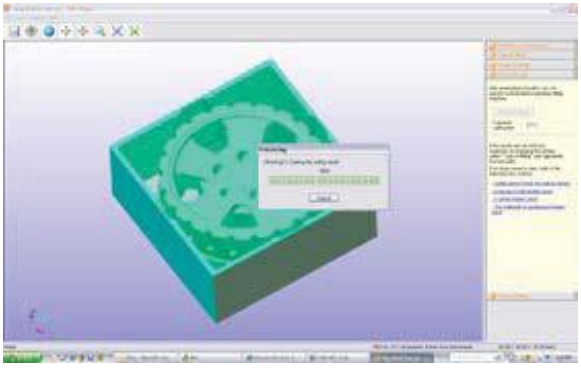
3. Open the .STL file in Roland SRP Player Software (Included with machine)



4. Follow the Steps on the right side to orient model, select material, and tool options.



5. SRP Player automatically generates machine instructions (Tool Paths)



6. Preview results, then click “Send to Machine” to make your model!

Customer Testimonial

Subtractive Rapid Prototyping for Micro scale Medical Applications

"The process of product development is really accelerated by having the Roland MDX-540. It has allowed me to cost effectively make parts I wouldn't previously consider attainable."

Joe Matteo, founder MicroTypes, LLC

Ask MicroTypes, LLC founder Joe Matteo why he chose Roland's MDX-540 Subtractive Rapid Prototyping milling machine and he'll start by naming the many substances the MDX-540 can process. "The driver for me was the broad choice of materials. I wanted to use the parts produced as actual prototypes, so I was looking beyond fit and finish," said Matteo. "With the MDX, I can machine our devices in, for example, aluminum, Delrin, Teflon, and PEEK to test the best material for our applications."

Matteo relies on the Roland MDX-540 to produce precision components for high-tech instruments used in medicine and science. The instruments contain micro-scale parts with features as small as 75 microns, approximately the thickness of a human hair. Maintaining pressures as high as 100 psi (pounds per square inch) requires that the prototype parts have extremely accurate fit and finish to create tight seals. "The machine's precision is incredible," said Matteo. "I can create a slip fit or press fit without hesitation."

"Reducing costs and increasing the number of iteration cycles in the development process is critical for high technology products to be successful. The process of product development is really accelerated by having this machine. It has allowed me to cost effectively make parts I wouldn't previously consider attainable," said Matteo. "I rely on the MDX-540 to get our products to market quickly."

Have more questions about the Roland 3D Milling and Subtractive Rapid Prototyping systems contact us and one of our dedicated applications engineers will help answer your questions.

866-862-1184 sales@pdi3d.com www.pdi3d.com