




# RP Tempering Applications

Skill Level  Time  Cost 

## Overview

New process called RP Tempering speeds up processing time, reduces costs, and propose to produce a stronger RP part.

RP tempering was presented by MBD (PAR3 Technologies) engineer Earl Dunlap. "The process," he says, "spans into three technologies to include Proto-Plasma-Rx<sup>®</sup> and Hybrid-Temp-Rx<sup>®</sup>, depending on the mechanical property results you want to achieve. RP Tempering enhances impact strength, controls flexural modulus, improves torque and adds shelf life. Proto-Plasma-Rx will enhance temperature resistance, chemical resistance, and flexural modulus and give minor improvements in impact, torque and other mechanical properties. Hybrid-Temp-Rx is a combination of both the RP Tempering and Proto-Plasma-Rx."

The technique creates internal plumbing in the shape of a sphere, which is engineered into the part design 3D files. Directions of the internal plumbing tubes are dictated by the parts design and required specifications. Stresses within the walls of the RP part can be redirected or even controlled to achieve the desired results.

"The secondary process," Dunlap says, "is to fill the internal plumbing tubes with RP Tempering compound. When the compound fills the plumbing tubes, a chemical reaction on a nanofusion level results. Nano-sized strands create branches extending from the internal plumbing spheres, increasing the impact strength by 13 times while controlling the flex modulus."

"RP Tempering adds approximately 8 percent to the cost of producing a rapid prototype, and is completed quickly, increasing the strength of an RP part while controlling its flex modulus, which means increasing the strength of a part while keeping other mechanical properties the same, according to Dunlap. It can also give your part increased flex. When RP Tempering is used, the thermo-mechanical properties can be enhanced to include heat resistance of over 300° F.

Cured resins may weaken with age but with RP Tempering it claims that parts that have undergone RP tempering can withstand drops without damage. This technology will work on most any composite to include any RP resins and/or systems offered on the market today. To summarize, parts that have undergone RP Tempering can achieve multiple physical, mechanical and thermo characteristics within one part.



Figure 1. Appling Proto-Plasma-Rx spray



Figure 2. Nano-Carbon Fibres penetrated into Objet mold



Figure 3. Improved Flexural modulus and torque

# General Guide to RP Tempering Technologies

You have many options at your disposal when you use all the RP Tempering Technologies. You need to determine what are the critical functions of the part and it will lead you to what RP Tempering Technologies you need to use. Here are some examples:

- 1) If you have a screw boss or snap feature, then you know it needs to accept screws and not break. It would suggest that you use Hybrid-Temp-Rx™ that uses tunnelling with injected RP-Tempering™ compound, Proto-Plasma-Rx™ penetrating .003" (70 microns) thick spray coating and Proto-Seam™ reinforcement compound.
- 2) If you have a part that needs mainly heat resistance with some flexibility, increased impact strength and torque strength, we would recommend Proto-Plasma-Rx™ that does not need tunnelling. If you want extra strength on the part but without tunnelling, you can add Proto-Seam™ compound on the underside of the part.
- 3) If you have thin-walled parts made with any RP materials, then you can use "V" Groove technology which is similar to the standard RP Tempering technique only instead of tunnels you will do "V" style grooves on one side of the part. You should gain about 80% efficiency compared to the tunnelling method.
- 4) If you have parts that require strengthening on some areas only, then we suggest you use the RP Tempering™ tunnelling where you need it and then use Proto-Plasma-Rx™ for the rest of the part or sometimes nothing on the rest of the part.

## Questions and Answers for the RP Tempering Application:

- ➔ **What is RP Tempering™ compound?** Engineered compound that can be applied in many different methods.
- ➔ **Can RP Tempering™ compound be used on the outside surface of a part?** Yes, in many cases because it is 4 times stronger than Proto-Plasma-Rx™ it is brush on the core side or non-decorative side of the part.
- ➔ **Does RP Tempering™ compound come in colors?** Yes, it comes in blue, red, yellow, black, & clear.
- ➔ **Can any of the RP Tempering™ technologies help with vibration applications?** Yes
- ➔ **What is Proto-Plasma-Rx™ spray?** It is an aerosol this is very capable of putting a depth controlled penetrating compound with nano carbon fibers.
- ➔ **How is it applied?** Spraying.



Figure 4. Enhance stresses within RP part



Figure 5. Improvement in impact and other mechanical Properties



Figure 6. Extra Strength on a Part with Proto-Seam™

Continued on next page »

## Questions and Answers for the RP Tempering Application (Continue)

- **How does it adhere to the surface of Objet's parts?** Excellent when the nano carbon fibers penetrate into the imperfections of the wall they cling on like adhesive.
- **How fast does it dry?** Within minutes the parts dry and can be handled and shipped but, takes 12 hours to cure.
- **How thick of a surface does it add to the part?**  
.003" to .004" thick +/- .001"
- **Does it bridge like paint?** No! it will attached and follow any shape even sharp corners.
- **Do we have colors?** Yes, it comes in Black, Blue, Red, Yellow and clear.
- **RP Tempering™ Process:** Before the part build apply the patented 3D CAD engineering technique. Mapping of location of the required tunneling or other geometries may be required if the CAD person is not trained. After build apply the appropriate compounds suggested. Other options are available in detail but, will only be supplied to RP Tempering™ licensees.
- **Proto-Plasma-Rx™ Process:** After the part is built where applicable an aerosol spray is applied to any or all of a specified surface area. No 3D CAD file manipulation is needed unless the .003" thick +/- .001" penetrating depth coating needs to be allowed for in a specific application. Four to Six coats are usually needed to achieve recommended specifications.
- **Hybrid-Temp-Rx™ Process:** This process combines any or all of the RP Tempering™ process, Proto-Plasma-Rx™ process and the use of Proto-Reinforcement© compound in specified cross-sectional areas applied in a any number of ways to include: brush, spray, wipe, inject etc...
- **Tunneling or "V" Groove™ Process:** Either spherical shapes, cylindrical tunnels are placed strategically within the walls of a part design at 40% to 50% of the wall thickness. This engineering process is almost non-apparent to the end user. "V"Grooves™ are place on the core or non-decorative side of the part.  
These geometries usually get filled back in with RP Tempering™ material.

# Resistance to Tunneling and Alternatives Explained

The RP Tempering™ Technologies include a tool chest of engineering techniques, additive and subtractive methods. Tunneling is the method that gives you the maximum strength in any type RP part and/or composite. There has been a reluctance to tunnel parts so the Proto-Plasma-Rx™ spray coating and RP Tempering™ compound put on the out side of a part has become the most popular tempering methodology. These are very good methods to cost effectively increase part durability but tunneling, “V”Grooves, “U” wall technique and others can give you an even more dramatic improvement while still being cost effective and fast. The learning curve is minimal with a 400% improvement in overall part durability.

Early in the evolution of the RP industry, honeycomb interior structures were introduced. While a honeycomb shape within the walls of a composite part increase your impact in one dimension the other 2 dimensions can actually get weaker. When tunneling a part, you work under the same principle of reducing mass, except with a tunnel you achieve a 3D dimensional result. This means you increase your impact in all 3 dimensions. Not only do you increase impact strength, you get benefits from the 3D engineering technique. The benefits include an increased 3 Point Flex by 800%(8x), torsion by 300%(3x) and while maintaining tensile or flexural modulus. The part will stay the same stiffness. Some RP Tempering™ license bureaus say they cannot get the tunnels to drain especially in LS parts. The tunneling technique can be altered to add drain portal slots and then filled back in with RP Tempering™ Nano-Carbon Compound. You will achieve the same results within a 3% range.

Other alternatives to the tunneling technique are “V”Grooves and “U” wall engineered geometries. These techniques do not need drainage or portals. They are easily applied in an STL file before the part is built, thanks to 3Matic Materialise software for RP Tempering™. When using this technique, you will still achieve impressive improvements but it will be approximately 15% less than if the part was tunneled with the exception of torsion. Torsion will increase by 200%(2x). Upholding dramatic improvement in mechanical properties and

Information is delivered for reference only. For more information, one may contact PAR3 Technologies, Inc., Mr. Earl Dunlap/P.E. Engineer Inc. [endunlap@manufacturingbydesign.com](mailto:endunlap@manufacturingbydesign.com), [www.RPTempering.com](http://www.RPTempering.com)

Objet Geometries Ltd.  
2 Holzman St., Science Park,  
P.O. Box 2496, Rehovot 76124, Israel  
Tel +972-8-9314314, Fax +972-8-9314315  
E-mail: [info@2objet.com](mailto:info@2objet.com)  
Web: [www.2objet.com](http://www.2objet.com)

