

STRATEGIES AND TECHNOLOGIES FOR RAPID PRODUCT DEVELOPMENT

Time-Compression TECHNOLOGIES

NOVEMBER/DECEMBER 2005

THE OFFICIAL PUBLICATION OF THE
RAPID 2006 TRADE SHOW AND CONFERENCE

WOHLERS REPORT 2005: State of the Industry

Plumbing New Depths in
Submersible Vehicle Design

Tips on Getting the Best
Product ID Graphics

Rules-driven Product
Management Threatens
The Status Quo

New Reconfigurable
Hybrid Tooling Process

New Technology Yields Better RP Parts

New process called RP Tempering speeds up build time, reduces resin cost, and produces a stronger RP part.

by jon carpenter

A SALESMAN FOR A MAJOR juvenile car seat manufacturer had to cancel a design meeting with his largest retail customer because the \$25,000 stereolithography-assembled car seat prototype he was bringing to the meeting was damaged during shipment. Luckily, Wal-Mart rescheduled the design meeting, but the manufacturer had just a week to make over most of the prototype, at a cost of \$16,000. To ensure the car seat made it to the

meeting safely this time, the company bought the car seat its own seat on the airplane. The total cost to remake the car seat components was approximately \$18,500. According to Jon Carpenter, vice president of Prototyping Services at Manufacturing by Design (Indianapolis, IN), "RP Tempering™ would have saved over \$16,000, not to mention the potential loss of business with a major retailer."

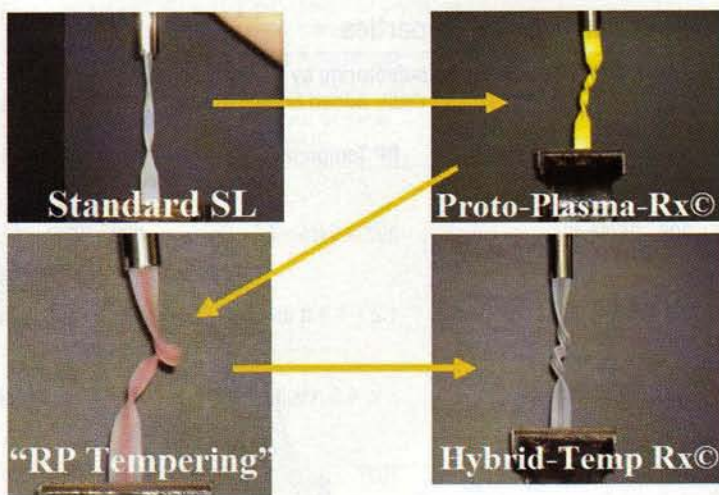
RP Tempering was invented by MBD engineer Earl Dunlap. Dunlap says it took Barnes & Thornburg, the tenth largest patent law firm in the country, two years to protect all the possible application for this technology worldwide. "The process," he says, "spans into three technologies to include Proto-Plasma-Rx® and Hybrid-Temp-Rx®, 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." (See Figure 1.) Andy Pardue, Ph.D., an expert in FEA, vibration, and CFD analysis is working with MBD researching other possible applications.

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."

Figure 1
Parts grow stronger through multi-step tempering process.

Map to Strength



Images courtesy of Manufacturing by Design, Inc.

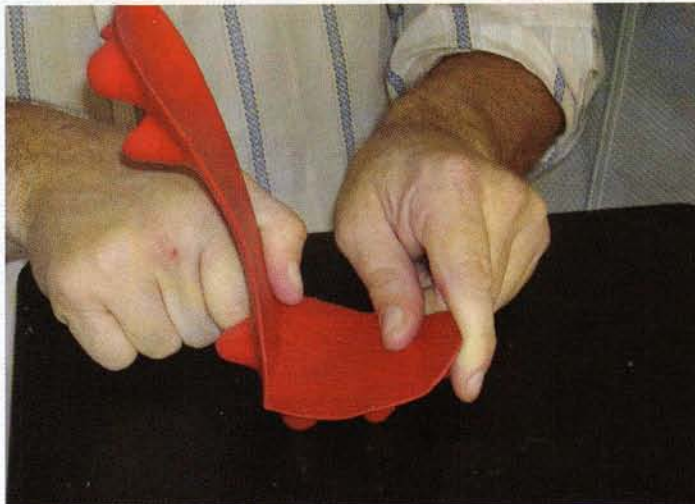


Figure 2
Specialty soccer shoe sole.

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 Proto-Plasma-Rx is used, the thermo-mechanical properties can be enhanced to include heat resistance of over 300° F.

Another example is a soccer shoe sole shown in **Figure 2**. The shoe is in production in the UK for professional players. The player's foot is digitally scanned for point cloud data. From the data, an exact SLS pattern of their feet is produced. RP Tempering technology is used to give the shoe sole flexibility in exact areas to ensure the proper toe location right before the player kicks the ball. Tempering the sole adds life to the SLS, properly positions the foot, controls

the foot and toe movements for more exact positioning and gives the sole flexibility. The shoe can be made for a player within 24 hours at a considerably lower cost than other specialty shoes.

Photo-cured resins weaken with age, (see **Figure 3**) but Carpenter claims that "parts that have undergone RP tempering can withstand drops without damage." **Figure 4** (page 20) shows a 2-year-old stereolithography part that had been RP Tempered then undergone Proto-Plasma-



Figure 3
Fresh 15" x 12" x 1" SL part with no enhancements dropped from four feet suffers damage.

Table 1: Data Comparison of Mechanical Properties

Properties	Test Method	RP Resin	Manufacturing by Design, Inc.		
		No Enhancements	Proto-Plasma-Rx	RP Tempering	Hybrid-Temp-Rx
Flexural Modulus	ASTM D790M Popular RP Resin	296 – 344kpsi	298 – 350kpsi	292 – 240kpsi	298 – 350kpsi
Impact Strength (notched izod)	ASTM D256A Popular RP Resin	0.4 – 0.6 ft lb/in	0.5 – 0.8 ft lb/in	1.2 – 1.8 ft lb/in	1.2 – 1.9 ft lb/in
Torque	MBD Revolutions Popular RP Resin	1.25 revolutions	2 to 2.5 revolutions	3 to 4.5 revolutions	3 to 4.5 revolutions
Melting Point	ASTM/MBD Popular RP Resin	102°	240°	102°	240°
Tensile Strength	ASTM D638M Popular RP Resin	6831–7774psi	6982 – 7920psi	1258 – 10520psi	1260 – 10987psi



Figure 4

2-year-old 15" x 12" x 1" part with Hybrid-Temp Rx dropped from six feet twice and eight feet three times with no breakage.

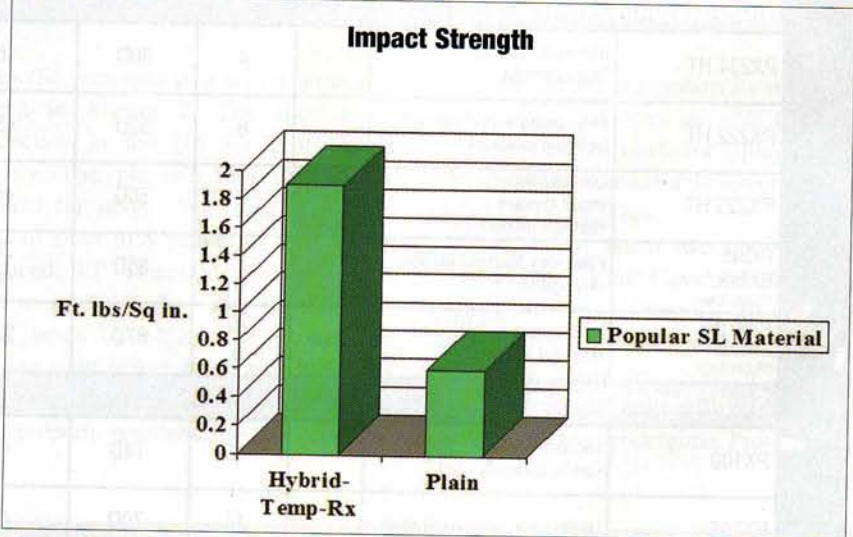
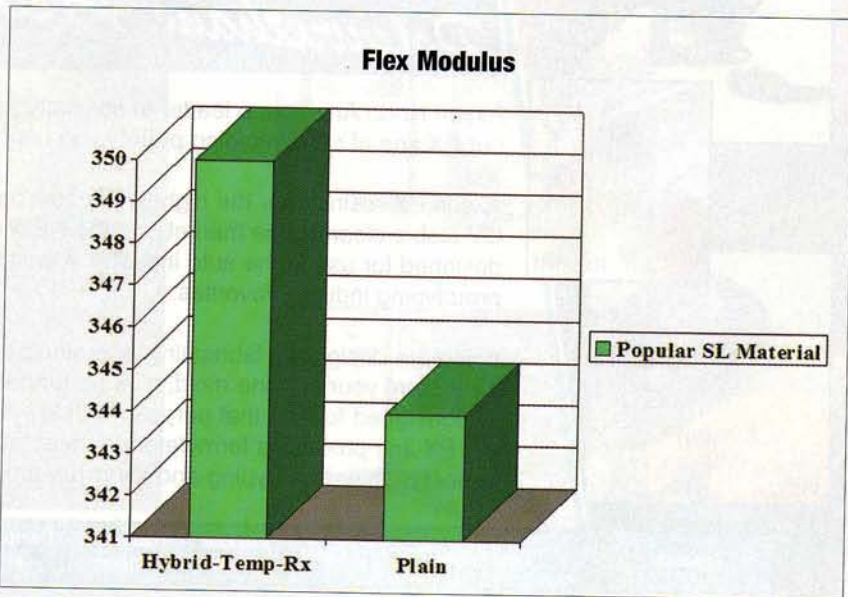


Figure 5

Rx, making it a Hybrid-Temp-Rx part. This part was dropped from six feet twice and from eight feet three times without cracking, breaking, or shattering.

Figure 5 depicts comparisons to a standard SL parts made from a popular resin, and Table 1 (page 18) provides data comparisons of mechanical properties. According to Jon Carpenter, "This technology will work on most any composite to include any RP resins and/or systems offered on the market today."

"To summarize," Carpenter says, "parts that have undergone RP

Tempering Proto-Plasma-Rx and Hybrid-Temp-Rx can achieve multiple physical, mechanical, and thermo characteristics within one part. MDB is currently investigating the use of RP tempering for use in concrete, carbon fiber, thermo-plastics, and fiberglass.

TCT

Jon Carpenter is vice president of Prototyping Services at Manufacturing by Design, Inc. (Indianapolis, IN). He can be reached at (317) 507-9030 or visit www.manufacturingbydesign.com or www.RPTempering.com.

www.timecompress.com