RP TEMPERING™ TECHNOLOGY NEWS

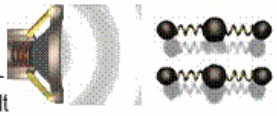
NANO-COMPOSITE TECHNOLOGY

SOLID FREEFORM ADDITIVE TECHNOLOGY & PATENT PENDING ENGINEERING TECHNIQUE

VOLUME 24

OCTOBER 2008

Acoustical Tempering



The Vibration Signature Absorption kit reduces vibration signatures and/or natural frequencies by a minimum of 70% when compared to the base material part. The material has a Durometer shore A (ASTMD2240) 70 making it a natural viscoelastic dampening material. This material will reduce the chances of connections and/or fasteners coming loose when applied properly. It will also reduce noise/sound in a wide range of frequencies exceeding the 100 dB range. This product is mildew resistant and has excellent chemical resistance. It is easy too apply and fast drying. Ask for our new Vibration Signature Absorption Kit as a cost effective way to try this product out! Contact info@RPTempering.com for more information.

Extreme Cold Temperature Resistance

Our Extreme Cold Tempering Kit comes with the choice to spray or brush-on the application. These materials are fully functional in minus 10º F temperatures. This product kit, when applied to RP/SFF parts, demonstrates excellent resistance to alkalis, moisture, water, acids and will not degrade or dry-out even when exposed to extreme environmental conditions. Other physical properties for durability are:

- Abrasion Resistance, Stone (ASTM D-3170) Excellent
- Chemical & Solvent Resistance Excellent (acids, alkaline, pollutants) Limited (petroleum)
- Appearance MIL-I-46058-C No blistering, fracturing or peeling after thermal shock & moisture soak
- Cut Resistance (D-1044) Excellent
- Permeability (ASTM-96) .03 grains/m2/hr. (3.23 grains/ m2/hr)
- Salt Spray (ASTM B-117) Pass 1,000 hrs
- Weather ability (ASTM G-53) 3-5 years

In This Issue

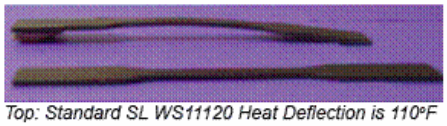
Hi-Temp Protoplass© Spray - Product Information Sheet

Hi-Temp Protoplass© Spray, when used with Proto-Reinforcement© Infiltrate Coating, will enhance the thermal properties of a SFF/RP part. This is achieved by using our base tempering formula, micro blended plasticizers, alumina, ceramic and inhibitors. Like all RP Tempering™ compounds, it is very fast drying, cost effective and easy to apply. This product comes in 12 oz cans and is available in:

Black  Clear 

The following picture shows a heat deflection test which called for this tensile bar to be cantilevered with 1.81 MPa of weight on top of the suspended end while in 80% humidity. It is important to remember that in the heat deflection test, the parts were cantilevered with weight out on the free end. In most real world applications this would be attached, which should result in a high heat deflection value.

Heat Deflection Test Result SL WS11120



Top: Standard SL WS11120 Heat Deflection is 110ºF
Bottom: Tempered SLA WS11120 Heat Deflection is 405º F

Multiple materials, including hundreds of samples, have been tested with Hi-Temp Protoplass© using the RP Tempering™ Engineered Layering Technique. Thermal Property Test Data can be found on the Hi-Temp Protoplass© Test Data Sheets. ASTM industry test standards were followed whenever possible. Test data will include: Heat Deflection (1.81 Mpa & Dwell Time), Heat Resistance, Thermal Conductivity, T/g, Coefficient of Thermal Expansion/Contraction, Melting Point, Insulation Heat, and Insulation Cold. The Hi-Temp Protoplass© will provide a smooth finish and a layered thickness of .0013". Other inherent enhancements are chemical resistance, mechanical properties and resistance to hot wax for use in casting molds.

Insultemp© Product Information Sheet

Insultemp© is a monomer blend, synthetic rubber, engineered compound that provides electrical insulation properties, including excellent dielectric resistance. Like all RP Tempering™ compounds, it is very fast drying, cost effective and easy to apply. This product is suitable for high volume, production use and can be applied by brushing, spraying (aerosol) or injecting. Brush-on and injectable compound colors are available in red and black with stock container sizes of 4 oz, 1 gallon and 5 gallon. Aerosol Spray can colors are available in red, black and clear with stock 12 oz cans.

It reduces vibration with its viscoelastic dampening properties and reduces the chances of terminals and other connections coming loose. Insultemp© also demonstrates excellent resistance to alkalis, moisture, water, acids and will not degrade or dry-out even when exposed to extreme environmental conditions. RP Tempering™ Technologies and Patented Engineering Techniques were developed to enhance Rapid Manufacture parts made from SFF systems. SFF technology presents OEM's with an opportunity to create and design geometric pre-engineered shapes within the wall of the physical part. RP Tempering™ internal wall geometry technology and additive materials science will enhance SFF parts either in combination or individually to include: Mechanical Properties, Electrical Properties, Thermal Properties and Chemical & Environmental Resistance Properties.

Please see the Insultemp© Technical Data Sheet for test result details on all Electrical Properties, Physical & Typical Properties. The dielectric strength is 1400 v/mil (volts per 1/mil).

Electrical Insulation Enhancement:

- Dimensionally thinner coats of Insultemp© can be applied when compared to competitive coatings with the same 50kv results.
- RP Tempering™ patented engineering technique, if used, can reduce your part thickness by over 70% when compared to applying the Insultemp© on the outside of the part geometry. This engineering technique teaches us to create supported cylindrical voids at 40 to 55% of the total wall thickness and core out most of the internal wall area in the SFF part. Next Insultemp© is injected into the voids backfilling the internal geometry. Insultemp© will achieve the same insulating properties as applying the materials to the outside wall geometry.

Benefits:

- o NO thickness will be added to the physical part design.
- o Part will weigh less
- o By doing this tempering technique we can reduce the size of a part
- o Natural protection of the insulating material from abrasion
- o Increase impact strength
- o Increase flex strength
- o Enhance part torque durability.

Electrical Properties

Insulation Resistance, Ohms 3 mils
Initial @25° C – 50% R.H less than 2.2 x 1013 power
24 hrs after 10th cycle @ 25° C – 50% R.H 5.0 x 1012 pwr
Dielectric with standing voltage, 150 volts, 60 Hz None
Dielectric Constant @ 25° C, 100Hz 3.8
1 KHz 3.52
1 MHz 3.36
Dielectric Strength 1400 volts per 1/mil
Surface Resistivity @ 25° C, ohms 5.66 x 1014 power
Volume Resistivity @ 25° C, ohms 1.18 x 1016 power

Technical Data Sheet

Typical Properties
Color Clear
Solids (wt.) 40%
Viscosity Range, cps 7,000 to 22,000
Specific Gravity (H20=1) .067
Flash Point, F, Seta Flash 62
Shelf Life @ 25° °C° 1 year
Physical Properties
Hardness Durometer shore A (ASTMD2240) 70
Tensile (ASTM D638) 2,500 psi
Elongation (ASTM D-638) 500%
Cut Resistance (D-1044) Very Good
Permeability (ASTM-96) .03 grains/m2/hr.(3.23 grains/m2/hr)
Salt Spray (ASTM B-117) Passes 1,000 hours
Weather ability (ASTM G-53) 10 years minimum
Temperature Range 83° degrees °C° to 110° degrees °C°
Cure Time 40 minutes to touch 24 hrs. full cure
Thermal Fame Resistance UL94 V-0 Vertical, UL94 H-B Horizontal, UL94 5VA Surface &
MVSS302 US Automotive. (Note: all application need to be certified by end user)

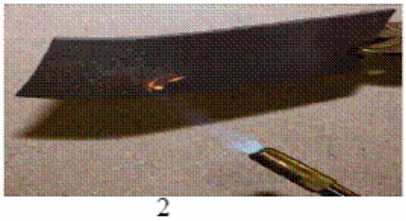
Fire Retardant Protoplass© Spray - Product Information Sheet

Fire Retardant Protoplass© Spray, when used with Proto-Reinforcement© Infiltrate Coating, will enhance the Fire Retardancy and Thermal Properties of your SFF/RP part. This is achieved by using our base tempering formula, micro blended plasticizers, alumina, ceramic and inhibitors. Like all RP Tempering™ compounds it is very fast drying, cost effective and easy to apply. Colors are available in Black & Gray 12 oz. cans:

Black Gray

The following picture is a 1200° F open flame on a piece of Duraform™ SLS that does not burn. SLS (PA & GF) and FDM (PC & PPSF) will pass all the UL94 Burn Test Criteria at the highest level, including: Vertical Burn Test V-0, Horizontal Burn Test H-B and Surface Burn 5V-A. Several other SFF materials will pass the MVSS302 Automotive Burn Test Code.

Multiple materials, resulting in hundreds of samples, have been tested with Fire Retardant Protoplass© using the RP Tempering™ Engineered Layering Technique. Thermal Property Test Data can be found on Test Data Sheets. ASTM industry test standards were followed whenever possible.



EMI-Temp© Shielding - Technical Data Sheet

EMI-Temp© offers our customers easy to follow application techniques for EMI Shielding applications. EMI-Temp© is easy to apply, dries fast and is cost effective verses sending the part out to an EMI Shielding House at a premium price along with long lead times and extra setup costs for fixtures.

The most common electrical property applications are for EMI/RFI shielding. The initials "EMI" stands for Electro Magnetic Interference. Electro Magnetic Frequency Interference shielding can be achieved by using highly conductive materials, such as 1 to 3 micron sized copper particles. EMI Shielding is done for two primary reasons:

- To keep electronic devices from interfering with others
- To keep other devices from interfering with yours.

EMI-Temp© Shielding was developed for low volume rapid prototypes (all RP/SFF materials & systems), injection molded plastics and many other materials. This particular shielding product has copper/aluminum/nickel combined. Some of our conductive coatings can even reflect the interfering radiation light waves. Typical applications for EMI shielding are enclosures for Mobile Phones, Laptop PCs, PDAs, Digital Cameras, Scanners, and MP3 players to mention a few.

Shielding against magnetic fields is difficult. Our EMI/RFI products should be effective as energy is reflected. Then the rest of the energy is transmitted across the surface boundary and absorption further attenuates it. This way we can meet certain applications by inhibiting electro-magnetic waves and impeding the field. Most metals have low impedance. Low impedance energy is more likely to be absorbed. If the electrical field wave impedance is high most of the energy is likely to be reflected. At higher frequencies our EMI shielding is governed mostly by absorption.

Our standard EMI shielding data is detailed in the chart below. The data presented is only to be used for guideline purposes and actual results should be tested 100% by customers and their electrical engineers. The results may also vary depending on the person applying the materials. Upon requests, we can mix any of our conductive particles in combination or individually. Our EMI shielding should be adequate for standard shielding per our data +/-25%.

Hz	Current EMI Shielding used in combination
30MHZ	43dB
100MHZ	61dB
200MHZ	60dB
500MHZ	66dB
700MHZ	64dB
900MHZ	63dB

EMI Blocked Decibels	Percentages Blocked
20dB	85%
40dB	90%
60dB	95%
80dB	98%

Microwave Post Processing of RP/SFF Parts – Initial Results

Microwaves are being tested and initially show promise for use in post processing parts made from FDM, Digitally Printed Resin, SL and LS materials. This idea for potentially using microwaves came up during our monthly "new concept ideation" session with our RP Tempering™ team. This monthly business development exercise is to evaluate the following:

A] Current RP Tempering™ developmental products and processes.

B] Review any outside comments or suggested for applications, processes, and/or products.

C] Brainstorm any new ideas that may fit and/or compliment RP Tempering™ Technologies as a business unit and brand.

At each session we will choose one idea to move forward with and create an initial fact finding plan to see if there is any potential for development. This initial plan was to see if sample parts (tensile bars) from each of the prototyping technologies would benefit mechanically after being post processed with an everyday, in home, microwave verses a non-microwaved part made during the same build (as a base line). We performed mechanical property ASTM standard tests for 3 point flex and ultimate tensile test. We visually evaluated multiple samples to include cross sections using a lab microscope (100x). Our initial test specimens for each of the four RP materials and systems (SL, LS, Digitally Printed Resin, FDM) included

- 6 non-microwaved test parts
- 6 microwaved test parts - high power (10) for 3 one minute blasts
- 6 microwaved test parts - high power (10) for 3 two minute blasts
- 6 microwaved test parts - high power (10) for 5 two minute blasts

Round One Experiments & Test

The results from the mechanical property 3 point flex and tensile tests where interesting but inconclusive with one exception. The digitally printed resin test specimens, when tested for 3 point flex consistently improved by an average of 8%. Another interesting observation was during the 3 point flex tests, 100% of all the other materials were at least as good as the baseline, at any length of time being microwaved. The tensile testing revealed similar results. Note: When we are finished with our testing, we will disclose all the RP material types/grades with a compete summary of all the actual test data.

The other observation that we made is by visually inspecting the all the part surfaces x,y & z views, as well as cross-section views. There were very interesting surface changes at a microscopic level in multiple materials especially in the cross sectional views.

Round Two Experiments & Test

For round two we repeated all the tests as in round one with identical test specimens. The difference this round was that we tempered the parts and put them through the same process and tests as listed above. The tempered parts were prepared as follows:

- Applied Proto-Reinforcement(c) Infiltrate Coating (2 coats)
- Applied Proto-Reinforcement(c) Infiltrate Coating (2 coats) & Proto-Plasma-Rx(tm) (3 coats)

The results from the mechanical property 3 point flex and tensile tests on the same materials and specimen types as round one testing were consistent with round one results, meaning:

- The digitally printed resin test specimens when tested for 3 point flex consistently improved by an average of 7% or more.
- We witnessed the same consistency in results with the 3 point flex tests. Again 100%

Microwave Processing Results continued

of all the other materials, at any length of time in the microwave, were at least as good as the base line parts. All the other materials did yield a marginal increases in test results.

• During the tensile testing, again, we only saw one test result that was worse and the rest tested slightly higher in tensile strength, when comparing microwave processed verses base line parts.

The test results from the mechanical property 3 point flex and tensile tests on the tempered parts versed non-tempered and, microwave and non-microwaved parts were surprising to say the least. Tensile strength tested consistently the same no matter the process or tempering technique with the exception of the digitally printed resin parts. These parts test over 5% higher in tensile strength. We are assuming that if we were to test these same parts for elongation we would see a slight improvement here as well. The 3 point flex tests yielded 100% higher test results with the microwave processed tempered part verses the non-microwave processed tempered part. The percentage improvement depended on the base material, the tempering technique and time in the microwave. Here are summaries of the results:

1] FDM specimens that where microwave processed at the power of 10 for five, 2 minute blasts tested on average 5% higher/better in 3 point flex verses a standard tempered part. It was a dramatic improvement verses a non-tempered part.

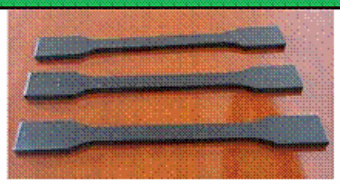
2] GF LS specimens that where microwave processed at the power of 10 for five, 2 minute blasts tested on average 3% higher in the 3 point flex verses a standard tempered part. It was dramatic improvement verses a non-tempered part.

3] SL specimens that where microwave processed at the power of 10 for three and five, 2 minute blasts tested on average 3% higher in the 3 point flex verses a standard tempered part. It was dramatic improvement verses a non-tempered part.

4] Digitally Printed Resin specimens that where microwave processed at the power of 10 for five, 2 minute blasts tested on average 7% higher in the 3 point flex verses a standard tempered part. It was dramatic improvement verses a non-tempered part.

Round two visual inspections where completed on all the part surfaces x,y & z views as well as cross-section views. This time after tempering the parts we are seeing changes ranging from slight surface changes to drastic changes to the material surfaces, especially in the cross sectional views. The Proto-Reinforcement© Infiltrate Coating seems to be going deeper and/or forming to more imperfections within the part and filling pours within the part structure. This is really hard to explain so next time we will do our visual inspection with an electron microscope to witness better details. With the Proto-Plasma-Rx™ we are seeing smoother surface finishes than normal. We are even asking ourselves, are we thinning/evening out the coating and increasing the surface hardness to some degree? We have decided to investigate this further with the proper test equipment for answers these questions.

Proto-Reinforcement(c) Infiltrate Coating Top part:1 minute blast, Middle: 3 – 2 minute blasts, Bottom: 5 – 2 minute blasts.



Proto-Reinforcement(c) Infiltrate Coating & & Proto-Plasma-Rx(tm) Coating applied. Bottom: 1 minute blast, Middle: 3 -2 minute blasts, Top: 5 – 2 minute blasts.

Next we are enhancing a microwave to achieve higher power intensity to repeat these tests with standard materials, the same RP Tempering™ formulas along with some different ones. The higher microwave power with or without tempering coating applied may help us in many different ways to include:

• Give a window to soften and/or create paths to allow tempering materials or other plasticizers to penetrate, absorb and/or attach to more surface area and enhance the part mechanical properties, thermal properties and/or environmental resistant capabilities.

• Actually fuse/crosslink some of the RP Materials better by themselves or mix with applied coatings/powders etc.... and create enhancements as we mentioned above or maybe increase surface hardness too.

These are only a few of our thoughts. If we are seeing better results out of longer microwave exposure times, changes in the original material surface area with or without tempering materials applied, and potential enhancements over the standard part and a tempered part, there might be something to this. Only time will tell! We will report these results in a future RP Tempering™ Technology News letter.

We welcome anyone who wants to get involved with these experiments, either through comments and advice or even actually helping with the to test plan going forward. You can contact us by emailing Info@RPTempering.com or call 931-528-8578.

Contact Us:

PAR3 Technology

www.RPTempering.com

info@rptempering.com

www.par3technology.com

info@par3technology.com

931-528-8578