



Z CORPORATION®



3DP Consumables Catalog



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Introduction

Z Corporation® offers several material systems to satisfy a variety of modeling needs. This guide is designed to give users an overview of the different types of powders, binder and infiltrants that can be used with 3D printers. The part numbers associated with each product are also listed.

These material choices allow you to tailor the properties of the finished models by selecting different infiltrants based on the application.

No matter which material you choose, you will always get the fast, high quality, and low material cost printing our machines are known for.

The affordable ZPrinter 310 Plus, the full-color Spectrum Z510 and the brand new ZPrinter 450.



Printers and Materials Compatibility Chart							
Printing System	High Performance Composite			Direct Metal Casting	Investment Casting	Elastomeric	
	zp® 130/zb® 59	zp® 131/zb® 60	zp® 140/zb 60	ZCast®/zb® 56	zp®14/zb® 51	zp® 15e/zb 51	zp 15e/zb 58
ZPrinter® 310 Plus	-	X	X	X	X	X	-
ZPrinter® 450	X	-	-	-	-	-	-
Spectrum Z™510	-	X	X	X	-	-	X
Compatible Infiltrants							
Infiltrant Name	High Performance Composite			Direct Metal Casting	Investment Casting	Elastomeric	
Z-Bond™ 101/ Apollo 5005	X	X	X	-	-	-	-
Z-Max™ Epoxy	X	X	X	-	-	-	-
Wax	X	X	X	-	X	-	-
Z-Bond 11	-	-	-	-	X	-	-
Elastomer Kit	-	-	-	-	-	X	X
Water	-	-	X	-	-	-	-

2.0 The Building Blocks of 3D Printing

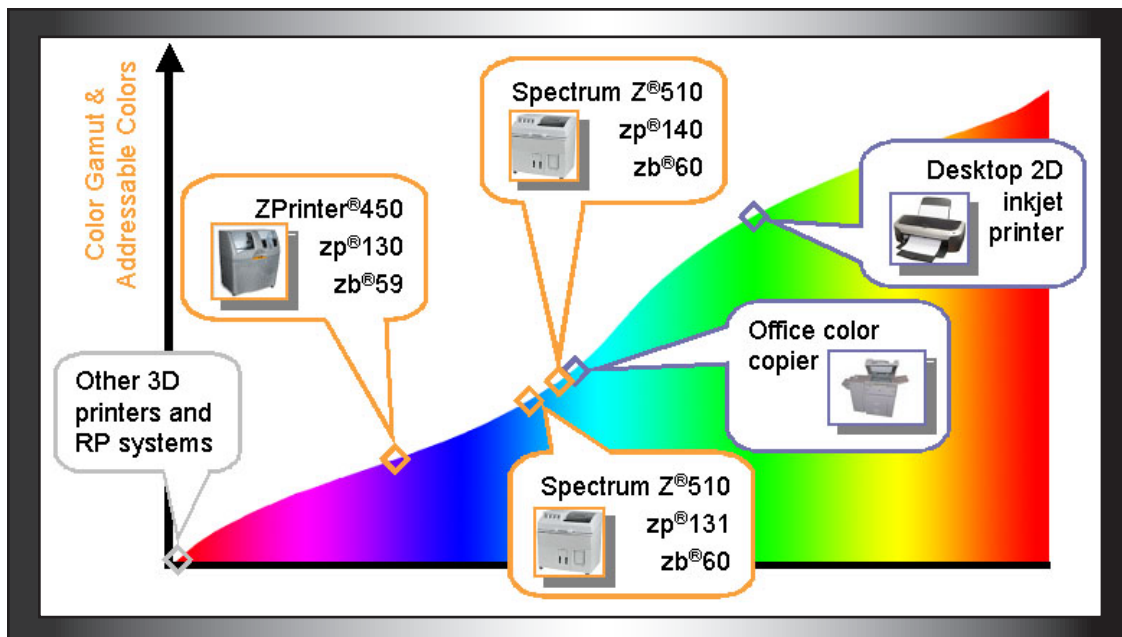
The foundation of 3DP technology is the High Performance Composite Material. It consists of a highly engineered powder with numerous additives that maximize surface finish, feature resolution, and part strength. Each material, paired with its corresponding binder, produces high-definition parts that are fit for the most demanding 3D printing application. The materials are ideal for:

- High strength requirements
- Delicate or thin-walled parts
- Color printing
- Accurate representation of design details

High Performance Composite Materials are specifically designed to take advantage of the heater modules in the current generation of printers. The final green strength (the strength of an uninfilted part) makes it easy to remove your model from the build bed and to handle it during infiltration. When your parts come out of the printer, you can expect them to be stronger than comparable parts printed with a previous generation of materials.

Refer to the color gamut chart below on our product line comparison to other 3D printers and RP systems in the market as well as desktop printers. zp 131 has a smaller color gamut than zp 140 but great for color textures and light tones. If you need the highest green strength to print fine-featured models and you use Z-Bond 101 as your main infiltrant, zp 131 is the material that is the most likely to meet your expectations. On the other hand, if what you need is an easy-to-use material, amazing color, clean whites and the Water Cure option to make 3D Printing safe and affordable, zp 140 is your material of choice. More information on each powder is addressed in the next sections of this manual.

High Performance Composite Material Comparison Chart				
		zp 131	zp 140	zp 130
Model Strength	Feature Resolution	****	***	***
	Green Strength	****	**	***
	Strength (Z-Bond)	****	**	**
Color & White	Addressable Colors	****	****	**
	Consistent Colors	***	***	**
	Whiteness	***	****	**
Ease of Use & Office Compatibility	Fast Drying	***	****	**
	Low Dustiness	****	***	*
	Water Cure	NO	YES	NO



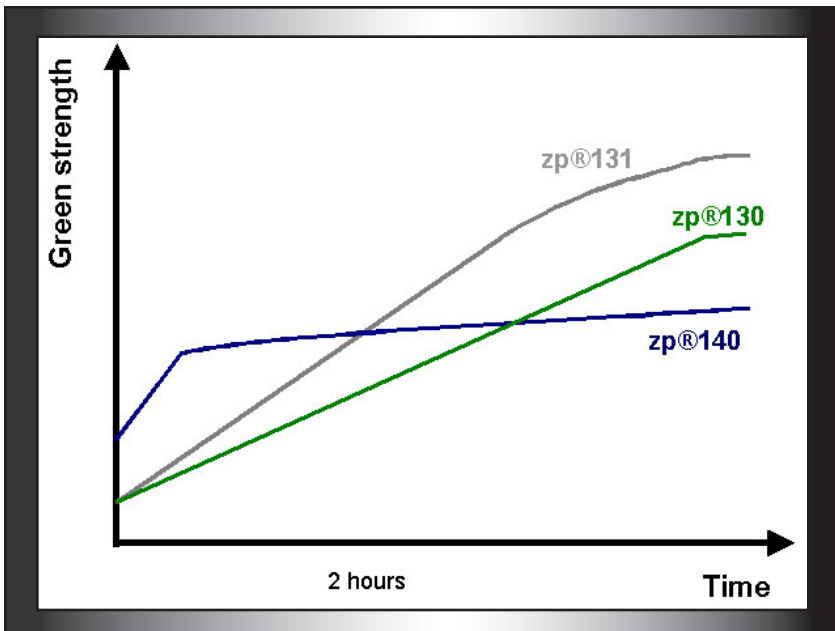
2.1 zp 130/zb 58, zp 130/ zb 59

For ZPrinter 450 users, zp 130 is the High Performance Composite powder to suit all of your applications needs. Zp130 is also the powder of choice for use in legacy printers which includes the Z406 and Z810.

Zb58 and zb59 are formulated to work specifically with zp 130.

zp 130 Key Advantages

- High feature definition
- Vibrant colors
- Good dimensional accuracy
- Great strength with infiltrated with Z-Max



Tech Tip

It is good practice to use the plastic wiper blade scraper that comes with the machine to loosen up the bottom 3 to 4 inches of powder in the feed bed since it is less used and becomes tightly packed.

Loosen up the powder by adding a scoop or two of fresh powder.

*Not applicable to ZPrinter 450



Figure 1: Powder Pails and Cartridges

High Performance Composite Materials

Category	Description	Unit of Measure	Part #
Powder	zp 130 pail	22 lbs. (10 kg)	06715
	zp 130 drum	88 lbs. (40 kg)	06716
	zp 130 powder cartridge	18 lbs. (8 kg)	06926
Binder	zb 58 clear	1 gal. (3.8 L)	06660
	zb 58 cyan	½ gal. (1.9 L)	06661
	zb 58 magenta	½ gal. (1.9 L)	06662
	zb 58 yellow	½ gal. (1.9 L)	06663
	zb 59 cartridge	2 pack (1Lx2)	Z0148



Figure 2: Millenium Tower



Figure 3: Cosmic Blob

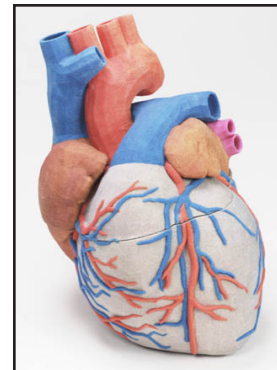


Figure 4: Heart Model



Figure 5: Architectural Model

2.2 zp 131/zb 60

zp 131 is the Premium Performance powder that will give you the toughest parts, the best resolution, and great color accuracy. It offers all the benefits of zp 130 with even more part quality and process improvements. zp 131 produces great looking color parts with extreme accuracy and has optimized infiltration characteristics making it even easier to infiltrate with Z-Bond™.

zp 131 Key Advantages

Stronger parts

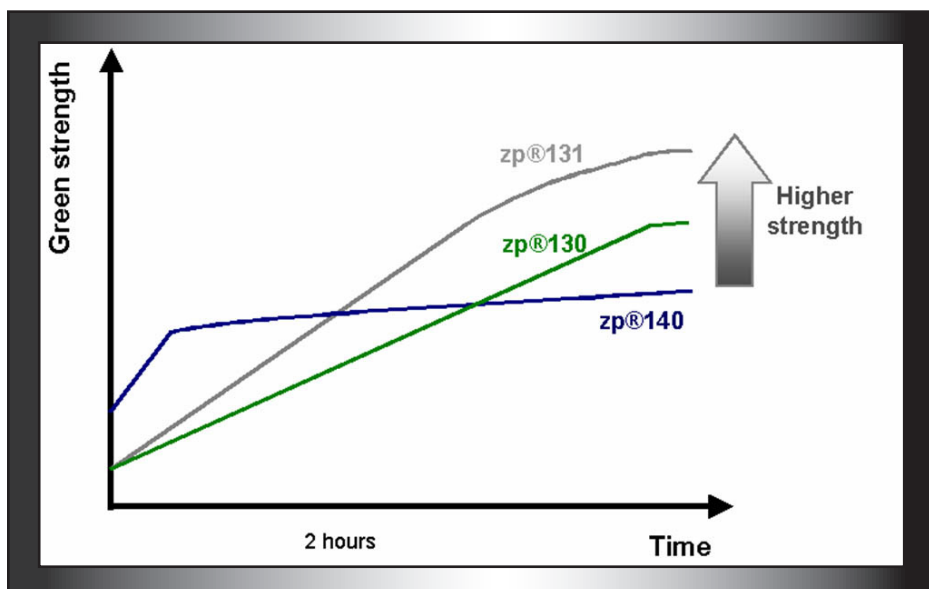
- The zp 131- Z-Bond 101 combination is on average 50% stronger than the zp 130- Z-Bond 101 combination
- Consistently stronger than zp 102
- Same great strength with Z-Max epoxy

Improved process

- Higher green strength: before infiltration, models are stronger, easier to extract from the build bed and fine-depowder
- More consistent infiltration when using Z-Bond 101 with great surface appearance every time
- Lower dust during handling and printing operations makes for a better work environment

Great color accuracy

- More neutral white: 115% whiter than zp 130*
- Robust color gamut with more addressable colors, particularly in the light tones and color textures
- Improved color consistency and uniformity



* per the International Commission on Illumination's Whiteness Index (WI_{CIE}), when infiltrated with Z-Bond 101

The zb 60 binder is formulated to work specifically with both zp 131 and zp 140, making it easier to swap back and forth, should your application require it.

zb 60 Key Advantages

- Brighter, truer colors
- Improved color consistency
- Better stability
- Also compatible with zp 140

High Performance Composite Materials			
Category	Description	Unit of Measure	Part #
Powder	zp 131 pail	22 lbs. (10 kg)	06930
	zp 131 drum	88 lbs. (40 kg)	06931
Binder	zb 60 clear	1 gal. (3.8 L)	06932
	zb 60 cyan	½ gal. (1.9 L)	06933
	zb 60 magenta	½ gal. (1.9 L)	06934
	zb 60 yellow	½ gal. (1.9 L)	06935

Tech Tip

Powder that is not printed on is recyclable, but fresh powder must periodically be cut in to maintain optimum part strength and printed dimensional accuracy.



Figure 6: DVD Player

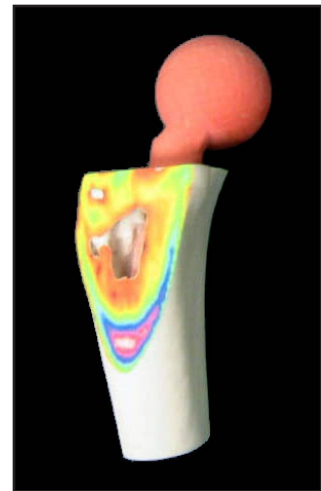


Figure 7: Femur Model



Figure 8: Valve

2.3 zp 140/zb 60

zp 140 is a High Performance Plus powder system that sets new limits to how easy it is to print in 3D. It features a new water cure process that makes it easier, faster and more affordable than ever to get from clicking “Print” to passing a model around at a meeting or in a classroom. This material produces high-definition 3D parts and is the material of choice for concept models.

A key advantage of the zp 140 is the water cure option. It has been specially engineered to allow parts to be post-processed by dipping them in water or spraying a fine mist on the surface. The reaction with water confers models additional strength and a smooth surface finish. The surface finish of a part cured with water is less smooth than with CA. There are slight surface erosions and pitting, which light sanding will eliminate.

Because this material is so white, color 3D models printed with zp 140 feature extremely vivid color. This color can be maintained by infiltrating with standard infiltrants like Z-Bond™ or Z-Max™. Colored parts printed using the zp 140 should not be infiltrated with water as the colors will bleed. Refer to the Printers & Materials Compatibility Chart on the advantages of each powder.

zb 60 binder is formulated to work specifically with both zp 131 and zp 140, making it easier to swap back and forth, should your application require it.

zp 140 Key Advantages:

- Water cure post-processing – easiest and safest option available
- Low cost per in³
- Brightest whites: 180% whiter than zp 130*
- Great for concept models

zb 60 Key Advantages:

- Better stability
- Also compatible with zp 131

High Performance Composite Materials			
Category	Description	Unit of Measure	Part #
Powder	zp 140 pail	22 lbs. (10 kg)	06936
	zp 140 drum	88 lbs. (40 kg)	06937
Binder	zb 60 clear	1 gal. (3.8 L)	06932
	zb 60 cyan	½ gal. (1.9 L)	06933
	zb 60 magenta	½ gal. (1.9 L)	06934
	zb 60 yellow	½ gal. (1.9 L)	06935

Tech Tip

Water misting before soaking the parts helps preserve your 3D model’s smallest features.

Architectural models benefit from using zp 140 infiltrated with water where true whiteness is desired.

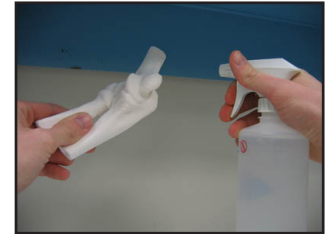


Figure 9: Water Misting



Figure 10: Water Dipping



Figure 11: Nefertiti
zp 140 vs. zp 130



Figure 12: Shoe Sole

* per the International Commission on Illumination’s Whiteness Index (W_{CIE}), when infiltrated with Z-Bond 101

3.0 Metal Casting

3.1 Direct Metal Casting

The ZCast 501 Direct Metal Casting process provides the ability to produce cast metal parts from a CAD file significantly faster and less expensively than traditional prototype casting methods. Printing molds and cores directly from digital data eliminates the pattern and core box production step used in traditional sand-casting processes. Metal is poured directly into the 3D printed molds. The technology allows engineers to prototype parts in metal that are costly and time consuming to produce using traditional methods.

Direct Casting Material can be used to create sand casting molds for non-ferrous metals. This material is a blend of foundry sand, plaster, and other additives that have been combined to provide strong molds with good surface finish. It is designed to withstand the heat required to cast non-ferrous metals.

After removal from the printer, printed molds must be baked in an oven at 375°F for 4-8 hours to remove excess moisture from the mold before metal is poured. ZCast 501 molds should never be infiltrated. Common foundry products such as core paste and refractory mold wash can be used to prepare the mold for pour as they have been designed to withstand the temperatures of the casting process. Refer to the ZCast Design Guide for more details on this process.

3.2 Investment Casting

zp 14 Investment Casting Material can be used to quickly fabricate parts that can be dipped in wax to produce investment casting patterns. The material consists of a mix of cellulose, specialty fibers, and other additives that combine to provide an accurate part while maximizing the absorption of wax and minimizing residue during the burn-out process.

For prototyping metal parts, investment casting is possible using zp 14. The process involves printing a male pattern which is then infiltrated with wax and/or Z-Bond 11. Once infiltrated, the pattern is coated with an investment slurry, creating a mold. A cycle in the oven will burn out the printed pattern.

THE ZCast PROCESS:

- Extremely fast turnaround from CAD file to prototype metal part
- Easily print complex molds and cores
- In-house mold-making capabilities for product manufacturers
- Simple metal-pouring process for foundries

Tech Tip

Investment casting: Work with your local investment casting foundry to find the proper shrinkage factor for the metal alloy used for the pour.

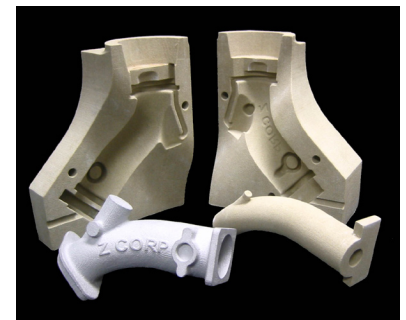


Figure 23: Metal Casting

Direct Metal Casting Materials			
Category	Description	Unit of Measure	Part #
Powder	ZCast 501 pail	33 lbs. (15 kg)	06439
	ZCast 501 drum	132 lbs. (60 kg)	06438
Binder	zb 56 clear	1 gal. (3.8 l)	06312

Investment casting materials			
Category	Description	Unit of Measure	Part #
Powder	zp 14 pail	11 lbs. (5 kg)	06127
	zp 14 drum	44 lbs. (20kg)	06128
Binder	zb 51	1 gal. (3.8 l)	05802
CA	Z-Bond 11	7.76 oz. (220 g)	15079
Wax	Paraplast X-TRA	17.6 lbs. (8 kg)	10434

4.0 Elastomeric Material

zp 15e/zb 51 – for ZPrinter 310 and ZPrinter 310 Plus

zp 15e/zb 58 – for Spectrum Z510

Elastomeric material has been optimized for infiltration with an elastomer to create parts with rubber-like properties. The material consists of a mix of cellulose, specialty fibers, and other additives that combine to provide an accurate part capable of absorbing the elastomer, which gives the parts their rubber-like properties.

zp 15e Key Advantages:

- Tough
- Flexible



Figure 13: ZCorp Football



Figure 14: Flexible Shoe

High Performance Composite Materials			
Category	Description	Unit of Measure	Part #
Powder	zp 15e pail	9.9 lbs. (4.5 kg)	06129
Binder	zb 51 clear	1 gal. (3.8 L)	05892
	zb 58 clear	1 gal. (3.8 L)	06660
	zb 58 cyan	½ gal. (1.9 L)	06661
	zb 58 magenta	½ gal. (1.9 L)	06662
	zb 58 yellow	½ gal. (1.9 L)	06663



Figure 15: ZCorp Ball

5.0 Infiltration

Infiltration is the process of applying a liquid resin to a printed part to provide strength and specific properties. Our infiltration systems have been specifically formulated to effectively penetrate the part. The lower viscosity of our infiltrants allows the resin to soak into the porous surface without leaving a thick film on the top surface.

The diagram below illustrates the open matrix of green printed Z Corp. parts. In the second drawing, the infiltrant is represented as the yellow coating applied to the surface of the matrix. Finally, the third diagram shows how the infiltrant is drawn into the part, sealing the surface area and improving the appearance and strength of the part.

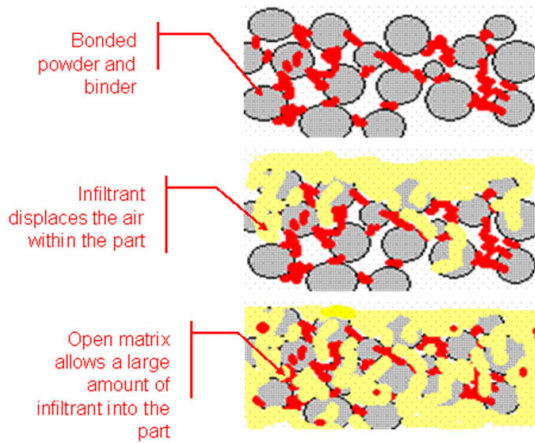
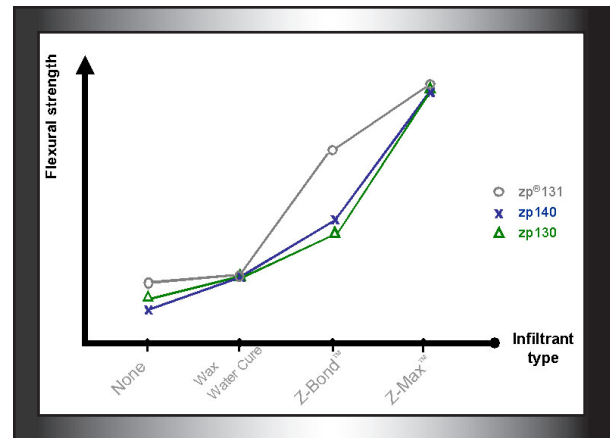


Figure 16: Infiltration Diagram

The graph below shows the flexural strength of all the powders relative to each infiltrant option. The flexural strength is how much the test specimen can bend until it breaks.



Z Corp’s infiltrant product line is divided into two categories, concept modeling and performance. Each infiltrant is designed to offer specific properties and is simple to use.

Infiltrant Guide									
Product	Description	Application Method	Color	Mix Ratio (weight)	Viscosity (cps)	Penetration Depth (mm)	Working time	Cure Time @70°F	Cure Time @160°F
Performance									
Z-Max Epoxy	Superior Strength Excellent Humidity Resistance Machinable	Spray Brush Dip	Clear to Straw	100:37	120	5-10	35 min.	24 hours	2 hours
Synair Por-A-Mold Elastomeric Urethane	Tough and Flexible	Brush	Straw	1:1	350	zp 15e 2-5	15 min.	24 hours	-
Concept Modeling									
Z-Bond 101 CyanoAcrylate Apollo 5005	Medium Strength One Part Enhances Color Vibrancy	Drip Dip	Clear	-	5	0.5-3	-	15 min.	-
Z-Bond 11 CyanoAcrylate	Medium Strength One part Enhances Color Vibrancy	Drip Dip	Clear	-	55	2-3	-	15 min.	-
Paraplast X-TRA Wax	Low Strength Improves Surface Finish Enhances Color Vibrancy	ZW4 ZW3 Dip Tank	Clear	-	15-25 Temperature Dependant	up to 100%	-	15-30 min.	-
Notes: Working time is the maximum allowable time after the resin system has been mixed to infiltrate parts and achieve best penetration depth. Cure time is the point in time when the infiltrated part is dry and has achieved its full strength.									

5.1 Concept Modeling

For the purpose of concept modeling, Z Corporation offers infiltrants in 2 categories, Paraplast X-TRA and Z-Bond 101.

5.1.1 Paraplast X-TRA (Wax)

The fastest and most cost-effective infiltrant option for concept models is Paraplast X-TRA Wax. Dipping the printed models in melted wax quickly enhances colors and seals the part while improving surface finish. Paraplast X-TRA is a low viscosity, general purpose, infiltration wax formulated to melt at very low temperatures (122°F or 50°C), and to strengthen parts. This material cures rapidly and enhances the vibrancy of color parts.

5.1.2 Z-Bond 101

Z-Bond 101 CyanoAcrylate (CA) is an extremely fast-setting, low-viscosity, general-purpose infiltration resin designed to rapidly strengthen parts. Z-Bond 101 shares the infiltrant characteristics of Paraplast X-TRA Wax with the addition of considerably greater strength benefits. The resin was specifically designed to be user friendly, low odor, and non-blooming when used with the High Performance Composite material system. The resin cures quickly (within a period of minutes) when applied by either the dipping or drizzle method. Z-Bond has a working time of 50 seconds. Full cure will occur within 15-20 minutes.

5.1.3 Apollo 5005

Apollo 5005 is a CA that has many of the same features of Z-Bond. The larger packaging size of Apollo 5005 makes it perfect for infiltrating large parts and is ideal for dipping those parts.

The clarity of both these concept modeling infiltrants allows light to pass into the surface of the part. The colors of the part will appear much more vibrant and full after infiltration, perfect for great looking concept models. Parts can be infiltrated first with CA to add strength and then waxed to further enhance the vibrancy of the color and to improve the surface finish.

Concept Modeling Infiltrants			
Category	Description	Unit of Measure	Part #
CA	Z-Bond 101, small	3.53 oz. (100 g)	15078
	Z-Bond 101, large	16 oz. (454 g)	15077
	Apollo 5005	22 lbs. (10 kg)	14428
Wax	Paraplast X-TRA	17.6 lbs. (8 kg)	10434

CONCEPT MODELING INFILTRANT CHARACTERISTICS:

- Easy and cost effective to use
- Seal and smooth part surface
- Enhances color vibrancy
- Strengthens part for handling

Tech Tip

A little sanding goes along way in improving the appearance of your models.

Before infiltration, take a minute to lightly sand away unevenness in the color of the part.

Once infiltrated the colors of the parts will be brighter and more uniform in appearance.



Figure 17: Paraplast X-Tra



Figure 18: Z-Bond=101



Figure 19: Waxed Ball

5.2 Performance

5.2.1 Z-Max

Z-Max epoxy is the infiltrant of choice for the user that needs prototyping functionality from their parts. A part infiltrated with Z-Max allows engineers and designers to quickly test design iterations without the cost and time associated with waiting for molded plastic parts. Once infiltrated, parts can easily be machined, tapped, sanded, and painted. Z-Max will give you a very hard, very rigid, and very strong part.

Z-Max is really a unique epoxy system. This product was formulated to support needs not met by any epoxy currently on the market. The primary factors are low viscosity and full cure at room temperature. Z-Max has an extremely low viscosity for a two-part epoxy, about 120cps. The low viscosity, in combination with a 35 minute working time, allows the user to apply a large amount of infiltrant to the part. Unlike Z-Bond, where you can only apply one coat, with Z-Max you can keep applying the infiltrant to the printed part surface, as it wicks in until it begins to gel before the cure. Typical infiltration depth can reach 0.25" and even more is possible with the assistance of a vacuum chamber.

Z-Max is a two-part, epoxy-based resin. In the packages, both parts of the resin are supplied simply requiring mixture before use. It is compatible with zp 130, zp 131, zp 140, and zp 14. It also comes in two sizes, a 250 gram, pre-measured kit and a bulk .7 gallon kit where the user needs to measure out the components.

After infiltration, Z-Max infiltrated parts will cure at room temperature in 12-24 hours. The use of an oven for the cure cycle significantly reduces this cure time to 2 hours, producing consistently strong parts quickly.

An average strength comparison of infiltrating with Z-Max as compared to Z-Bond demonstrates the following:

- With zp 130 – about 66% stronger than Z-Bond
- With zp 131 – about 34% stronger than Z-Bond
- This is based on a part that has been fully oven dried and infiltrated with Z-Max. Note here that zp 131 is optimized to be 50% stronger when infiltrated with Z-Bond 101, as compared to a zp 130/Z-Bond101 combination.

PERFORMANCE SERIES INFILTRANT CHARACTERISTICS:

- Easy and cost effective to use
- Seals part surface
- Strengthens part
- Resistant to temperature and humidity

Tech Tip

When applying Z-Max, a heat gun is a good tool to use to retain fine feature detail.

When heat is applied to an area of the part the viscosity of the epoxy drops locally, allowing it to more easily wick in. This helps to preserve the quality of the part.



Figure 20: Z-Max

5.2.2 Z-Bond and Apollo 5005

The CA infiltrant systems, while not nearly as strong as an epoxy, should also be considered for use with functional prototypes. Objects such as cases for small electronic devices can quickly and successfully be prototyped and fit together with these infiltrants.

5.2.3 Elastomeric Urethane

POR-A-MOLD elastomer is used to give zp 15e parts their elastomeric properties. This two part urethane is mixed and then brushed onto the part. The part must then cure at room temperature for 24 hours. This will produce a very flexible part, yielding a Shore A Hardness.

Functional Prototype Infiltrants			
Category	Description	Unit of Measure	Part #
Epoxy	Z-Max Epoxy, small	8.8 oz. (250 g)	14516
	Z-Max Epoxy, large	0.7 gal. (2.86 kg)	14505
CA	Z-Bond 101, small	3.53 oz. (100 g)	15078
	Z-Bond 101, large	16 oz. (454 g)	15077
	Apollo 5005	22 lbs. (10 kg)	14428
Synair POR-A-MOLD Elastomeric Urethane	Elastomer Kit	2 qts.	20093

Tech Tip for Elastomeric Urethane

1. Mix the material in small batches
2. Apply the first coat very liberally
3. Additional coats should be lighter
4. Be ready to dab off excess material
5. Once a part has been infiltrated, be careful not to leave the part sitting in a puddle of material, as it will be difficult to cut off afterwards.



Figure 21: POR-A-MOLD



Figure 22: Applying POR-A-MOLD

6.0 Resources

All consumable items can be ordered online through our Z Shop site found in the ZCorp User site, www.3dpuser.com. If you are not a North American customer, you should contact your authorized sales representative for ordering information.

Ordering inquiries can also be directed to our Customer Development team at: custdev@zcorp.com

Technical application inquiries can be directed to our Applications team at: applications@zcorp.com

Z Corp's annual User Group Meeting is another valuable resource to learn and share new applications with other 3DP users and our applications team. This conference is an invaluable networking tool for users at every level. 2007 User Group Meeting conference is scheduled from September 9-12, 2007 in Hyannis, MA. Visit the User site for more information.

More information in our ZCorp User Site:

- Latest Updates and Information
- Technical Applications Note
- Design Guides
- Best Practices
- User Training
- Knowledge Base
- Software Help
- 3DP User Group
- Message Board
- Software, Firmware, Patches Downloads
- Product information including our line of printers and consumables
- MSDS, and User Guides
- Z Shop
- And many more