ANEXOS

ANEXO 1: Materiales de impresión, propiedades mecánicas

- **Verowhiteplus**

Stratasys
DIRECT MANUFACTURING

POLYJET MATERIAL SPECIFICATIONS
VeroWhitePlus

Highlights

- Opaque white
- Rigid and durable
- Produces excellent fine feature detail
- Quickly and economically produces parts
- Available in two Z resolutions
  - PolyJet: 30µm (0.00118")
  - PolyJet HD: 16µm (0.00063")
- Also known as "PolyJet White" and "SC White"

Applications

- Highly accurate presentation models
- Smaller parts with complex features
- Medical devices and components
- Electronic housings
- Suitable for a wide range of industries

TYPICAL PHYSICAL PROPERTIES

Property	Test Method	English	Metric
Color/Appearance	Visual	White	White
Tensile Strength	ASTM D638	8,350 psi	58 MPa
Elongation at Break	ASTM D638	10% - 25%	10% - 25%
Modulus of Elasticity	ASTM D638	362,500 psi	2,500 MPa
Flexural Strength	ASTM D790	13,500 psi	93 MPa
Flexural Modulus	ASTM D790	392,500 psi	2,700 MPa
Izod Notched Impact	ASTM D256	0.47 ft-lb/in	25 J/m
Shore D Hardness	-	85 D	85 D
Heat Deflection Temperature	ASTM D648 @ 264 psi	118°F	48°C
	@ 66 psi	118°F	48°C

The material properties provided herein are for reference purposes only. Actual values may vary significantly as they are dramatically affected by part geometry, process parameters and material properties changing over time. Material specifications are subject to change without notice.

PolyJet Material Datasheet VeroWhitePlus 201502-1

(888) 311-1017 | StratasysDirect.com | 28309 Avenue Crocker, Valencia CA 91355

- **ABS-M30**

ABS-M30

PRODUCTION-GRADE THERMOPLASTIC FOR FORTUS 3D PRODUCTION SYSTEMS

ABS-M30™ is up to 25 to 70 percent stronger than standard ABS and is an ideal material for conceptual modeling, functional prototyping, manufacturing tools and end-use-parts. ABS-M30 has greater tensile, impact and flexural strength than standard ABS. Layer bonding is significantly stronger than that of standard ABS, for a more durable part. This results in more realistic functional tests and higher quality parts for end use. ABS-M30 parts are stronger, smoother and have better feature detail. ABS-M30 runs the Xtend 500 Fortus Plus option, which enables more than 400 hours of unattended build time.

MECHANICAL PROPERTIES[1]	TEST METHOD	ENGLISH		METRIC	
		XZ AXIS	ZX AXIS	XZ AXIS	ZX AXIS
Tensile Strength, Yield (Type 1, 0.125", 0.2"/min)	ASTM D638	4,550 psi	3,750 psi	31 MPa	26 MPa
Tensile Strength, Ultimate (Type 1, 0.125", 0.2"/min)	ASTM D638	4,650 psi	4,050 psi	32 MPa	28 MPa
Tensile Modulus (Type 1, 0.125", 0.2"/min)	ASTM D638	320,000 psi	310,000 psi	2,230 MPa	2,180 MPa
Tensile Elongation at Break (Type 1, 0.125", 0.2"/min)	ASTM D638	7%	2%	7%	2%
Tensile Elongation at Yield (Type 1, 0.125", 0.2"/min)	ASTM D638	2%	1%	2%	1%
Flexural Strength (Method 1, 0.05"/min)	ASTM D790	8,700 psi	7,000 psi	60 MPa	48 MPa
Flexural Modulus (Method 1, 0.05"/min)	ASTM D790	300,000 psi	250,000 psi	2,060 MPa	1,760 MPa
Flexural Strain at Break (Method 1, 0.05"/min)	ASTM D790	4%	3.5%	4%	3.5%

MECHANICAL PROPERTIES	TEST METHOD	ENGLISH	
		XZ AXIS	ZX AXIS
IZOD Impact, notched (Method A, 23°C)	ASTM D256	2.4 ft-lb/n	128 J/m
IZOD Impact, un-notched (Method A, 23°C)	ASTM D256	5.6 ft-lb/in	300 J/m

THERMAL PROPERTIES[2]	TEST METHOD	ENGLISH	METRIC
ASTM D648	ASTM D648	204°F	96°C
Heat Deflection (HDT) @ 264 psi, 0.125" unannealed	ASTM D648	180°F	82°C
Vicat Softening Temperature (Rate B/50)	ASTM D1525	210°F	99°C
Glass Transition (Tg)	DMA (SSYS)	226°F	108°C
Coefficient of Thermal Expansion (flow)	ASTM E831	4.90×10^{-5} in/in/°F	8.82×10^{-5} mm/mm/°C
Coefficient of Thermal Expansion (xflow)	ASTM E831	4.70×10^{-5} in/in/°F	8.46×10^{-5} mm/mm/°C
Melting Point	.....	Not Applicable[2]	Not Applicable[2]

STRATASYS.COM

stratasys

THE 3D PRINTING SOLUTIONS COMPANY

ABS-M30

PRODUCTION-GRADE THERMOPLASTIC FOR FORTUS 3D PRODUCTION SYSTEMS

At the core: Advanced FDM Technology™

Fortus systems are based on Stratasys® FDM® (fused deposition modeling) technology. FDM is the industry's leading additive manufacturing technology, and the only one that uses productiongrade thermoplastics, enabling the most durable parts. Fortus systems use a wide range of thermoplastics with advanced mechanical properties so your parts can endure high heat, caustic chemicals,

No special facilities needed

You can install a Fortus 3D Production System just about anywhere. No special venting is required because Fortus systems don't produce noxious fumes, chemicals or waste.

No special skills needed

Fortus 3D Production Systems are easy to operate and maintain compared to other additive fabrication systems because there are no messy powders to handle and contain. They're so simple, an operator can be trained to operate a Fortus system in less than 30 minutes.

Get your benchmark on the future of manufacturing

Fine details. Smooth surface finishes. Accuracy. Strength. The best way to see the advantages of a Fortus 3D Production System is to have your own part built on a Fortus system. Get your free part at: stratasys.com.

ELECTRICAL PROPERTIES[3]	TEST METHOD	ORIENTATION	VALUE RANGE
Volume Resistivity	ASTM D257	XZ Axis	4.0x1015 - 3.3x1016 ohm-cm
Dielectric Constant	ASTM D150-98	XZ Axis	2.6 - 2.86
Dissipation Factor	ASTM D150-98	XZ Axis	0.0048 - 0.0054
Dielectric Strength	ASTM D149-09, Method A	XZ Axis	100 V/mil
Dielectric Strength	ASTM D149-09, Method A	XZ Axis	360 V/mil

OTHER[1]	TEST METHOD	VALUE
Specific Gravity	ASTM D792	1.04
Flame Classification	UL94	HB (0.09", 2.50 mm)
Rockwell Hardness	ASTM D785	109.5
UL File Number	.....	E345258

SYSTEM AVAILABILITY	LAYER THICKNESS CAPABILITY	SUPPORT STRUCTURE	AVAILABLE COLORS
Fortus® 360mc™ Fortus 380mc™ Fortus 400mc™ Fortus 450mc™ Fortus 900mc™	0.013 inch (0.330 mm) 0.010 inch (0.254 mm) 0.007 inch (0.178 mm) 0.005 inch (0.127 mm)[4]	Soluble Supports	Ivory, White, Black, Dark Grey, Red, Blue

The information presented are typical values intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes. End-use material performance can be impacted (+/-) by, but not limited to, part design, end-use conditions, test conditions, etc. Actual values will vary with build conditions. Tested parts were built on Fortus 400mc @ 0.010" (0.254 mm) slice. Product specifications are subject to change without notice.

The performance characteristics of these materials may vary according to application, operating conditions or end use. Each user is responsible for determining that the Stratasys material is safe, lawful and technically suitable for the intended application, as well as for identifying the proper disposal (or recycling) method c onsistent with applicable environmental laws and regulations. Stratasys makes no warranties of any kind, express or implied, including, but not limited to, the warranties of merchantability, fitness for a particular use, or warranty against patent infringement.

[1]Literature value unless otherwise noted.

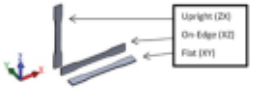
[2]Due to amorphous nature, material does not display a melting point.

[3]All Electrical Property values were generated from the average of test plaques built with default part density (solid). Test plaques were 4.0 x 4.0 x 0.1 inches (102 x 102 x 2.5 mm) and were built both in the flat and vertical orientation. The range of values is mostly the result of the difference in properties of test plaques built in the flat vs. vertical orientation.

[4]0.005 inch (0.127 mm) layer thickness not available for Fortus 900mc.

Colors: The test data was collected using ABS-M30 ivory (natural) specimens. ABS-M30 colored material will have similar properties, but can vary by up to 10%. Orientation: See Stratasys T esting white paper for more detailed description of build orientations.

- *XZ = X or "on edge"*
- *XY = Y or "flat"*
- *ZX = or "upright"*



stratasys

E info@stratasys.com / STRATASYS.COM
ISO 9001:2008 Certified

HEADQUARTERS
7665 Commerce Way, Eden Prairie, MN 55344
+1 888 480-3548 (US Toll Free)
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

2 Holtzman St., Science Park, PO Box 2496
Rehovot 76124, Israel
+972 74 745-4000
+972 74 745-5000 (Fax)

ANEXO 2: Cera Kerr

Injection Wax

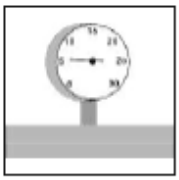
Directions for Use

Kerr

Designed for platinum, gold, silver as well as industrial and dental alloys, ACCU® Flakes™ and ACCU® Beads™ injection waxes have set the world standard in precision casting for years. With the lowest ash content available (0.003%), ACCU Flakes and Beads guarantee the cleanest burnout possible. Available in 8 application-specific colors in quick melting flake and bead form. Packaged in 50 lb / 22.67 kg cartons.

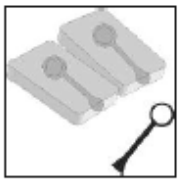
1. Fill wax pot and heat to specific injection temperature (see below). It is important not to overheat the wax.

2. Spray both sides of the rubber mold with Mold Release Spray. Open mold fully by bending it backwards in order to reach all areas with the spray. It is not necessary to spray each time before injecting mold.



3. Adjust air pressure on wax injector to between 3 and 10 pounds. Higher pressure can be used if necessary. However, for best results keep pressure under 15 pounds.

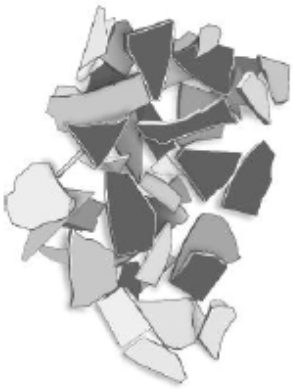
4. Put rubber mold into clamp or hold between two plates applying moderate pressure by hand. Insert nozzle into sprue opening in mold. Press mold into nozzle for 5 to 7 seconds. Make sure rubber mold is at 90 degree angle for best results.



5. Wait for 1 to 1-1/2 minutes to allow wax to solidify. Open mold carefully and remove pattern making sure that you do not force the pattern out of the mold.

6. Change wax in injection pot every 2-3 months. Use Kerr Laboratory Solitine™ for the cleaning of the wax pot and injection nozzle.

ACCU® Flakes™



ACCU® Beads™

Item	ACCU Flakes	ACCU Beads	Inj. Temp.	Application
Aqua Green	13360	33497	65°C/150°F	All purpose, best detail, highest flow, and lowest shrinkage.
Ruby Red	14079	33498	65°C/150°F	All purpose, best detail, highest flow, and lowest shrinkage.
Turquoise Blue	14293	33499	65°C/150°F	All purpose, best detail, highest flow, and lowest shrinkage.
NYC Pink	18428	33500	68°C/155°F	Highest detail, filagree, easy removal without breakage.
Flex Plast Blue	23020	33501	68°C/155°F	Longest shelf life, highest flexibility, metal molds, and stone in place.
Tuffy Green	16181	33502	73°C/165°F	Large pieces, toughest, eliminates bowing on flat surfaces.
Super Pink	12138	33503	65°C/150°F	Bezel settings, quickest solidification, will not give.
ACCU Carve Purple	32456	33504	79°C/174°F	Highly carvable, minimal gumming on files and tools.

ANEXO 3: Yeso Satín Cast 20

Satin Cast 20 / KerrCast 2000 Directions For Use

Kerr Casting Investments

Kerr's Investment products offer application specific formulations utilizing only the highest quality raw materials, to deliver a superior level of strength and accuracy. Decades of research and quality control has produced materials that deliver consistent results to meet the demands of today's changing industry. Kerr's renowned product, Satin Cast, is recognized by the world's finest jewelers as the investment that creates the finest results. KerrCast 2000 is a dependable investment that delivers consistent quality castings every time.

Satin Cast 20 is recognized by the global jewelry casting industry as the benchmark for casting the highest quality gold and silver.

Satin Cast 20
07960 45kg Drum
31009 15 kg Carton

KerrCast 2000 is a very forgiving and dependable jewelry investment for all of your gold, silver and brass casting needs.

KerrCast 2000
27746 45kg Drum
35361 15 kg Carton

Investment Mixing Instructions

1. Weigh investment.

2. Measure water.

3. Add investment to water.

4. Mix 3 to 3-1/2 minutes.

5. Vacuum 20 seconds after boil.

6. Pour into flask.

7. Vacuum up to 90 seconds.

8. Let flasks sit still for 2 hours.

9. Preheat furnace 300ºF / 149ºC. (for multiple flasks do not preheat)

10. Remove sprue base.

11. Load into furnace.

12. Follow appropriate burnout cycle.

Kerr

Investment Recommended Water / Powder Ratios

To determine the number of pounds of investment needed to fill any particular flask, divide the cubic inch content of the flask by 20.
(1 lb = 454 grams).

To determine flask content in cubic inches:

Round Flask:
0.7854 x dia.² x height

Square Flask:
width x length x height

Weight / lbs.	grams		Heavy Castings: Heavy Ladies Rings, Men's Rings & School Rings — 38 ml water to 100 g powder: Water av. oz	ml	Yields cubic inch	Yields cubic cent.		Regular Castings: Ladies Rings, Pendants, Filigree & Intricate Wax Patterns — 40 ml water to 100 g powder: Water av. oz.	ml	Yields cubic inch	Yields cubic cent.
1/2	227		3.0	86	10.5	174		3.2	91	11	179
1	454		6.1	172	21	349		6.4	182	22	359
5	2268		31	862	107	1745		32	908	110	1794
10	4535		61	1724	213	3490		64	1816	219	3589
15	6803		92	2586	320	5235		96	2724	329	5383
20	9070		122	3448	426	6980		128	3632	438	7178
25	11338		153	4310	533	8725		160	4540	548	8972

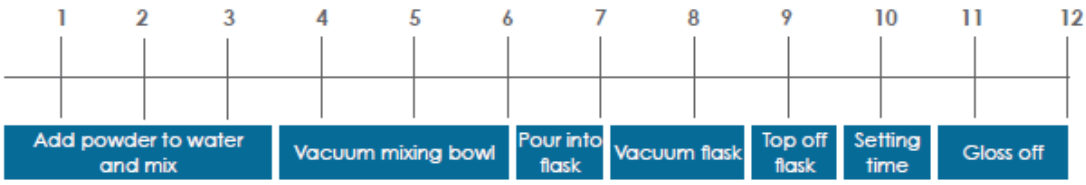
Investment Powder & Water Requirements for Flask Sizes

Top Figure - Investment Powder (oz), Bottom Figure - Water (ml)

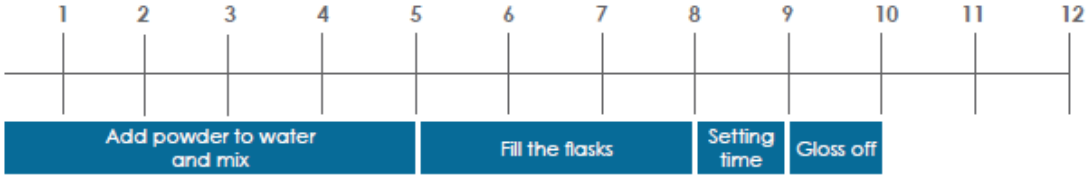
Flask Diameter	Height 2"	2.5"	3"	3.5"	4"	5"	6"		Regular Castings: Ladies Rings, Pendants, Filigree & Intricate Wax Patterns — 40 ml water to 100 g powder: 2"	2.5"	3"	3.5"	4"	5"	6"
2"	5 oz 57 ml	6 oz 68 ml	7.5 oz 85 ml	9 oz 102 ml	10 oz 114 ml				5 oz 53.9 ml	6 oz 64.6 ml	7.5 oz 80.8 ml	9 oz 97 ml	10 oz 107.8 ml		
2.5"	8 oz 91 ml	10 oz 114 ml	12 oz 136 ml	14 oz 160 ml	16 oz 183 ml	20 oz 228 ml			8 oz 86.2 ml	10 oz 107.8 ml	12 oz 129 ml	14 oz 150.9 ml	16 oz 172.5 ml	20 oz 215.6 ml	
3"	12 oz 136 ml	15 oz 170 ml	18 oz 205 ml	21 oz 240 ml	1.5 lb 274 ml	30 oz 340 ml	32 oz 410 ml		12 oz 129.3 ml	15 oz 161.7 ml	18 oz 194 ml	21 oz 226.4ml	1.5 lb 258 ml	30 oz 323 ml	32 oz 345 ml
3.5"	1 lb 182 ml	1.25 lb 228 ml	1.5 lb 274 ml	1.75 lb 320 ml	2 lb 364 ml	2.5 lb 456 ml	3 lb 548 ml		1 lb 172 ml	1.25 lb 215 ml	1.5 lb 258 ml	1.75 lb 301 ml	2 lb 344 ml	2.5 lb 430 ml	3 lb 516 ml
4"	18 oz 205 ml	23 oz 262 ml	27 oz 308 ml	2 lb 364 ml	2.25 lb 410 ml	3 lb 546 ml	3.5 lb 637 ml		18 oz 194 ml	23 oz 247.9 ml	27 oz 291 ml	2 lb 344 ml	2.25 lb 387 ml	3 lb 516 ml	3.5 lb 602 ml
5"					3.75 lb 682 ml	4.75 lb 864 ml	5.5 lb 1000 ml						3.75 lb 645 ml	4.75 lb 817 ml	5.5 lb 946 ml

Recommended Work Time - In Minutes

Conventional Mixing



Vacuum Mixing



Work Time: Work time is the time that has elapsed between adding the powder to the water, and when the investment thickens.
Water Temperature: Water should be 70ºF / 21ºC to 75ºF / 24ºC. Colder water extends work time, warmer water shortens work time.

Recommended Burnout Cycles

Casting Temperatures

Ladies Rings,
filigree or intricate designs
900º - 1000ºF (482º - 538ºC)

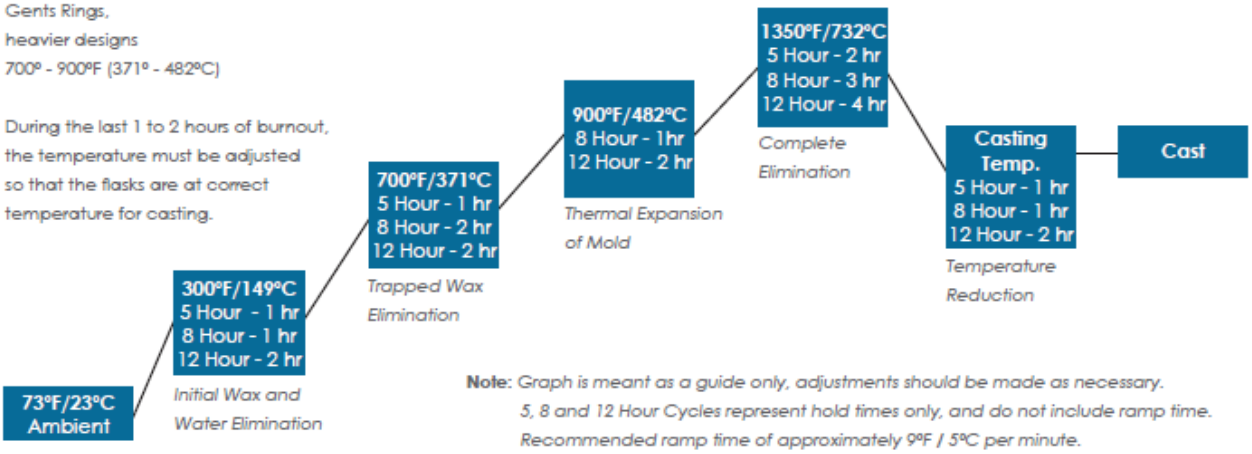
Gents Rings,
heavier designs
700º - 900ºF (371º - 482ºC)

During the last 1 to 2 hours of burnout, the temperature must be adjusted so that the flasks are at correct temperature for casting.

5 Hour Cycle
2 - 1/2" x 2-1/2"
(63 x 63 mm)

8 Hour Cycle
3-1/2" x 4"
(89 x 100 mm)

12 Hour Cycle
4" x 8"
(100 x 200 mm)



Note: *Graph is meant as a guide only, adjustments should be made as necessary. 5, 8 and 12 Hour Cycles represent hold times only, and do not include ramp time. Recommended ramp time of approximately 9ºF / 5ºC per minute.*

Cast with Kerr™ Kerr