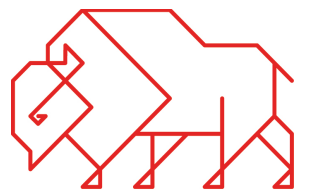




Tethonite®



TETHON 3D

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Tethonite® is an authentic ceramic powder for use in powder/binder jet 3D printers, such as the ZCorp 310 and 510. The binder-jet technology used in these printers is readily adapted to be used with the proprietary Tethonite powder and companion Tethon 3D ceramic binder. Tethonite is offered in three formulations at the same price: earthenware (terra cotta), stoneware and porcelain. All three versions have the physical properties of traditional ceramic. Stoneware powder will be shipped on all website orders, unless a different clay body is requested. Printed objects must be fired to Cone 6 (2300F). Slipped pieces may be fired together to achieve large scale objects not limited to the size of the printer build bed. Glazed pieces are food safe, microwave, dishwasher and freezer safe.



Recommended Printing Tools



Wooden board
for build plate



Fine brush to
remove loose
powder



Kitchen Strainer to
sift used Tethonite



Wear respirator
when handling
unfired Tethonite



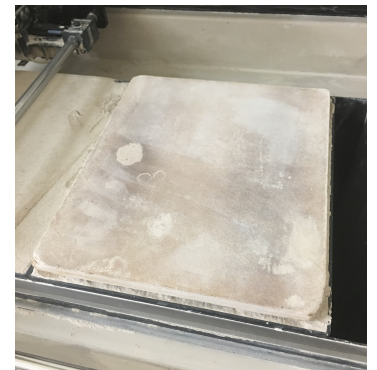
Convection oven
for drying
Tethonite



Wear safety glasses
when handling
unfired Tethonite

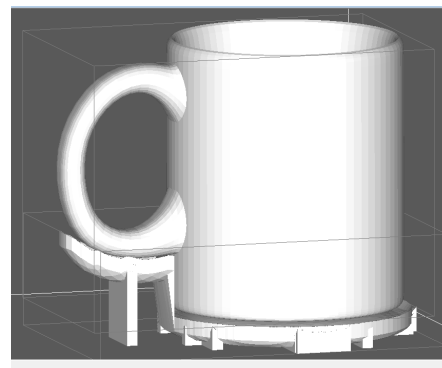
Printing Guidelines

1. Load Machine with powder and Binder as directed by manufacturer.
2. Tethonite requires an additional build plate. A build plate can be a 3/4 inch wooden board the same area as the build in the printer. The 3D print will be created on this and used later to take out the printed objects. (A ceramic kiln shelf can be used if object are too fragile to handle in green state).
3. Determine whether print needs fixture. See examples listed below to determine if you need a fixtures.
4. Make sure Tethonite binder and powder settings are selected. (see binder / powder settings bellow)



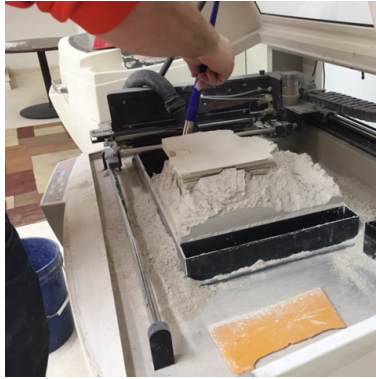
Example: Handles on mugs need to be supported with a fixture.

Fixtures are needed for unsupported areas, large flat areas, wide base, hollow interiors (with open bottom), fragile (thick to thin areas) prints, upside down pyramid (or prints that rest on a point). Bottom of print may be rough so determine best way to place print in file. - use photo from print software of fixture



Removing Part from printer

1. Lower feed bed.
2. Raise build bed to gain access to print.
3. Carefully remove excess powder using a soft brush. Do not touch the object at this point. It is better to leave excess powder around the object.
4. Remove board and print from Printer. Dry print on the board in the oven



Drying Objects



Dry in a regular or convection oven at 210 degrees F (98C) for 1-12 hours. Drying time can be the same as printing time.

The printed object should be warm to the touch when finished drying. (Cool surface = wet clay). The parts will be very soft before drying in an oven. Do not try and pick up or touch the parts before they are dry. Printed objects gain strength while drying. Once they are dried you will be able to pick up most objects.

Removing powder after drying

Use caution while removing excess powder. It is better to move slowly.
Remove dust in a hood and wear protective gear.
Use brush gently to remove large areas of powder. Soft brushes will not damage Tethonite after it dries.
When using compressed air use a large tip for larger areas of powder and a smaller tip for finer details.
40 PSI will clean Tethonite well when it is fully dried.
If after, or while you are removing powder, the print feels wet or cool to the touch, place back into oven to dry further. Removing the powder in several stages can help Tethonite dry evenly.



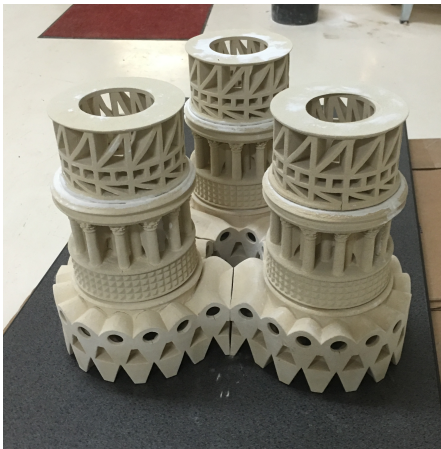
Kiln Instructions

Bisque (First firing)

Tethonite can be fired on a fast ramp cycle and does not break apart in kilns when fired too fast. Objects will shrink 10 - 12% during firing when fired to cone 6. (2250*f) When firing Tethonite it is best to support objects in the kiln with shrink slabs made from natural lay or printed supports. Use Alumina hydrate in between printed objects and their supports or fixtures.

Average Kiln Firing for Bisque

0-900 - 300*f per hour
900-2000 - 400*f per hour
2000-2269 - 270*f per hour



Ceramic bisque glue is applied in-between the printed parts. They are then fired again to make it a permanent bond.

Joining multiple pieces together

After bisque firing parts can still be attached together. This is great when assembling larger objects or simply putting a handle on a mug to avoid supporting it in the kiln. Using a ceramic bisque-fix as directed by the manufacture will allow you to make more complex objects.

Slip Firing

If you wish to add a glaze, a coat of slip is required after the bisque firing and before glazing. Add 1 - 3 coats of thin slip by dipping. There should be a slightly rough texture left on the object after slipping. If the object is entirely smooth, then too much slip has been applied. The glaze needs to grip a slightly rough surface. Fire the slipped object to 1971*f using the same bisque firing schedule.



Glazing

Glazing Tethonite is much like traditional glazing. It can be applied in a multitude of ways depending on your desired effect. Follow glaze manufacturer's instructions on how to apply glazes. Fire as directed by glaze manufacturer. Low to high fire glazes can be used with Tethonite.



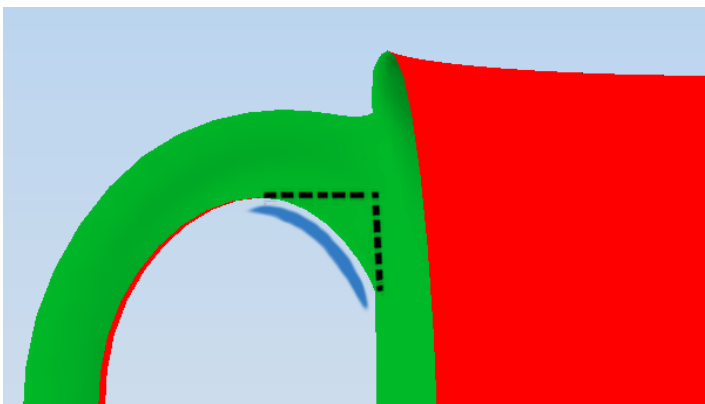
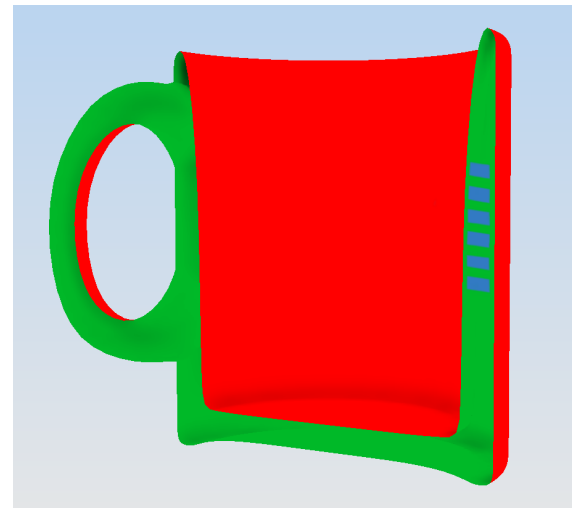
Design Guidelines

Maximum length in longest direction

76 - 101mm or 3 - 4in -
101 - 127mm or 4 - 5in -
127 - 152mm or 5 - 6 in -
152 - 178mm or 6 - 7 in -
178 - 203mm or 7 - 8 in -

Required wall thickness

3mm or 0.11in
4mm or 0.16in
5mm or 0.2in
6mm or 0.24in
7mm or 0.28in

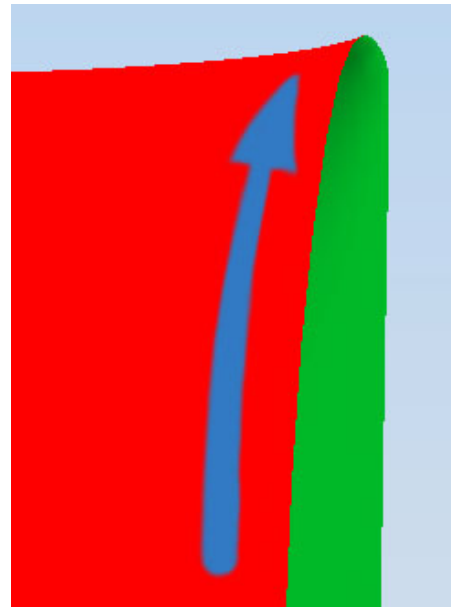


Bevel

For prints where shapes of the piece connect with each other it helps the print to have a beveled edge instead of a harsh angle. Beveling all right angles will decrease chances of cracking during firing.

Minimum wall thickness can vary +/- 1 mm from the above suggested wall thickness throughout the object. Tapering the wall thickness from thicker at the bottom to thinner at the top will increase the overall strength and stability of the object

(Thicker sections should not be on top of thinner sections. The wall thickness should vary from thicker at the bottom to thinner at the top. Larger forms may use this technique to to give the appearance of a thinner wall.)



Concave Base

For prints that are containers or container like it is best if bottom of the piece is concave.

Minimum embossed detail
1.5mm min width and height

Minimum engraved detail
2mm mm width and depth

Loose powder escape holes 10 - 15 mm or 0.39 - 0.59 inches.

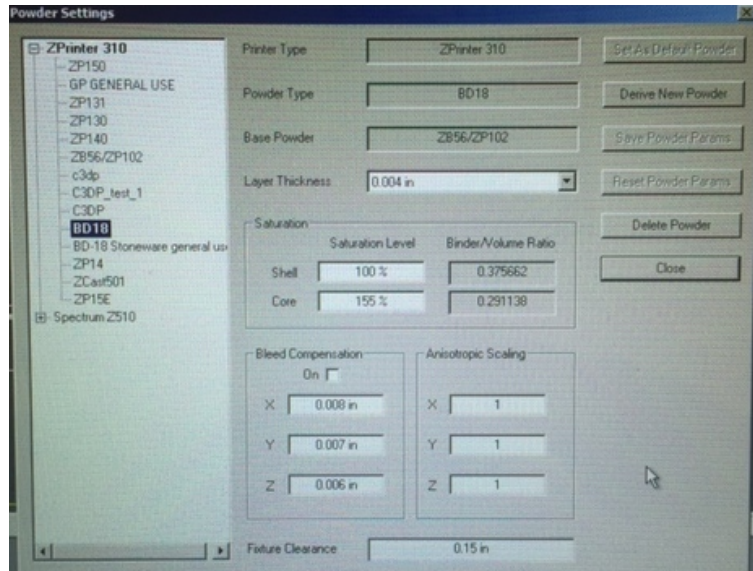
Making a model hollow instead of solid can help reduce the cost of a print. When doing this you may need to make a hole in the object to remove the excess powder from the piece. Unlike plastic materials, ceramics allow you to print a plug separately and seal the hole after printing.



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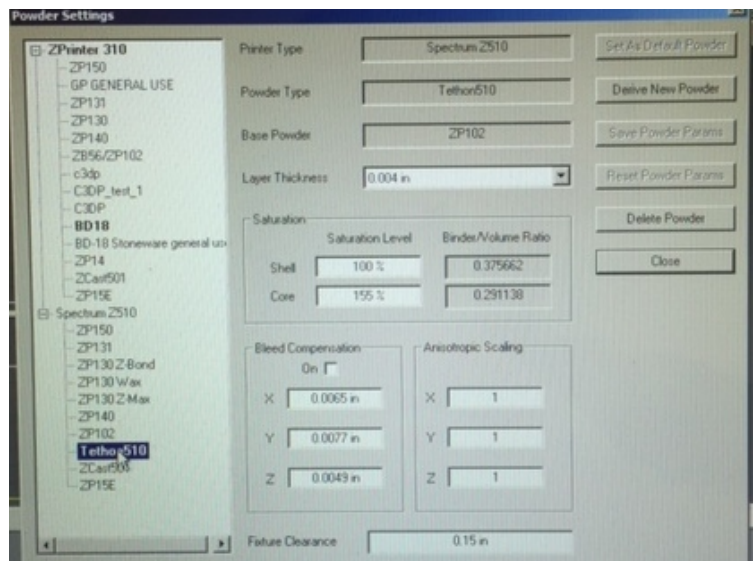
Binder and Powder Settings

Binder: For Tethonite to properly work it needs its own specific binder settings. The most important part about the binder settings is to have it fully saturated in the core and the shell of the print. The more binder that is saturated into the print the stronger the object will be. These settings are examples on the Zcorp 310 and 510.



Zcorp 310 Binder Settings - Derived from ZP56/ZP102
Shell 100% Core 155%

Powder: Tethonite can be printed in very fine layers. This results in very little visible print layers. The most common print layer is just .004 inches thick.



Zcorp 510 Binder Settings - Derived from ZP102
Shell 100% Core 155%

Troubleshooting

If binder laid down by the printhead is looking streaky or missing spots.

- Check Printhead for powder buildup.
- Check binder lines for blockage. Clear with bleach to remove possible bacteria buildup.
- Check to make sure the printhead has enough binder in it. Refill if necessary. Use this tool for refilling printheads <http://www.inkowl.com/index.php?S=19&B=8&product=5668&p=product>
- Inspect the 3D file for non-manifold geometry.

If printed object is weak and breaks in the green state.

- Allow print to dry longer in over after printing.
- Increase wall thickness of the object.
- Check Binder Saturation settings in your 3D printing software.

If cracks form during firing.

- Make sure your following the print guidelines.
- Increase wall thickness.
- Add additional supports to your object.
- Use bisque repair medium to fill in any cracks formed during firing.

Uses of Tethonite



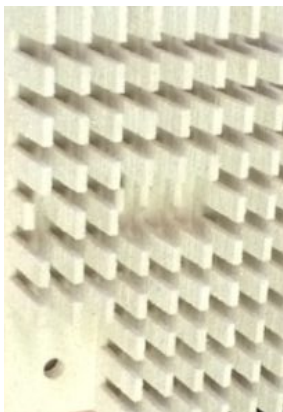
Medical Prototypes



Tile Reproduction



Aquatic life preservation



Thermal Prototypes



Archeology Models



Functional Prototyping