



ZPRINTER® 310 PLUS HARDWARE MANUAL

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60/558,940	08/771,009	60/612,068	60/789,758	10/999,847	11/000100
60/741,573	60/808,721	09/706,350	09/835,292	11/453,695	60/472,221
10/848,831	6,416,850	6,610,429	6,403,002	6,989,115	7,037,382
7,087,109	11/335,282	10/817,159	10/650,086		

The Equipment is designed to be used by design engineers and other professionals in the production of early-stage 3D appearance models and prototypes. The Equipment is not to be used to produce, either directly or indirectly, medical or other products that may require precise dimensions or tolerances to ensure the safe and effective operation of such products. You agree to indemnify, defend and hold Z Corporation and its officers, directors and employees harmless from and against any and all claims, losses, damages, costs and expenses resulting from any use of the Equipment other than for the production of early-stage appearance models and prototypes.

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ZPrinter® 310 Plus Hardware Manual

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1 Overview

The Overview chapter gives you a description of the principles behind the ZPrinter 310 Plus Printer, will familiarize you with the terminology we will use to describe the System, and will introduce you to some of the features of your printer.

This manual will speed you along the path towards quickly and inexpensively building parts. We recommend that you use this manual together with service training for best results. See service@zcorp.com for more information. The manual contains the following sections:

Introduction. This section provides an overview of the principles behind the System, familiarizes you with the terminology we will use to describe the System, and reviews the components of the System.

Quick Start Guide. This section provides an overview of the steps needed to print a part.

Preparing the Printer to Print. This section guides you through putting powder and binder solution in the printer, and cleaning the service station.

Material Systems. This section instructs you on how to use ZCast® process and Snap-Fit material with instructions on how to prepare your printer, print and post-process the part.

Printing a Part. This section takes you through preparing the build and checking parameters in the ZPrint Software before printing.

Post Processing. This section leads you through removing the printed parts from the build envelope, removing excess powder from the part, and infiltrating the parts to improve strength and surface finish.

Maintenance. Here we review a few preventative maintenance steps, offer some tips for troubleshooting and inform you about where to go if you experience any problems with the system.

FOR ADDITIONAL INFORMATION, PLEASE CONTACT THE Z CORPORATION SERVICE DEPARTMENT AT (781) 852-5050, TOLL-FREE AT (877) 88-ZCORP OR VIA EMAIL AT SERVICE@ZCORP.COM. YOU MAY ALSO VISIT THE USER GROUP WEBSITE AT WWW.3DPUSER.COM.

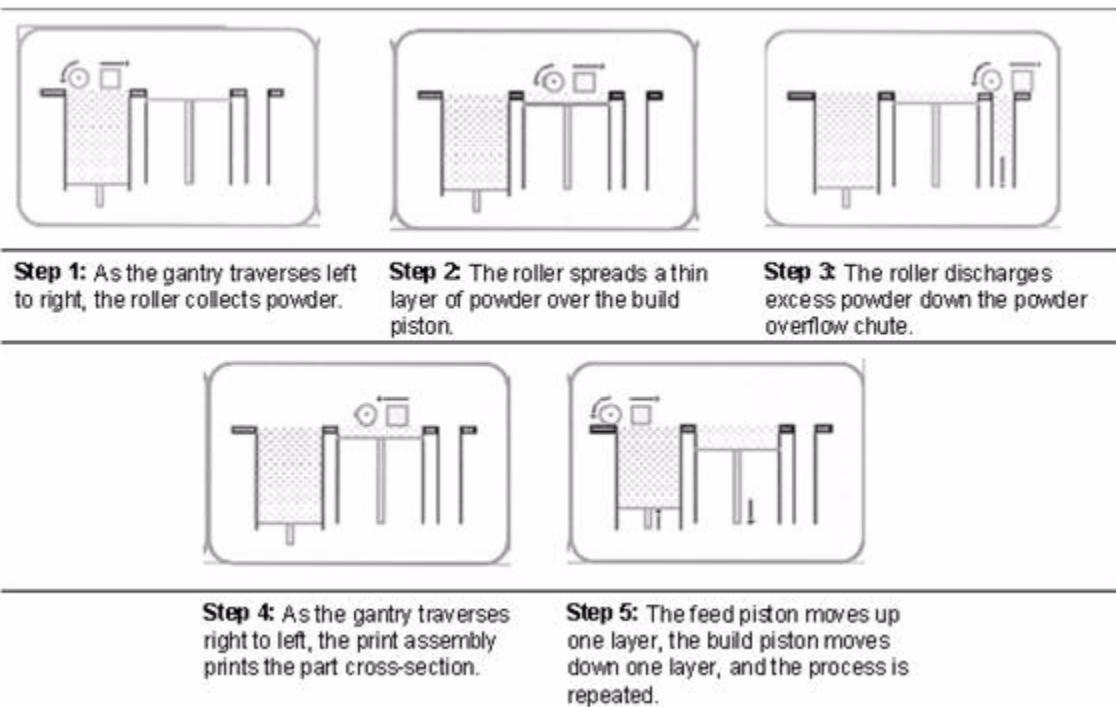
1.1 How It Works

Z Corporation 3D Printer processes are based on the Massachusetts Institute of Technology's patented 3DP™ (Three-Dimensional Printing) technology.

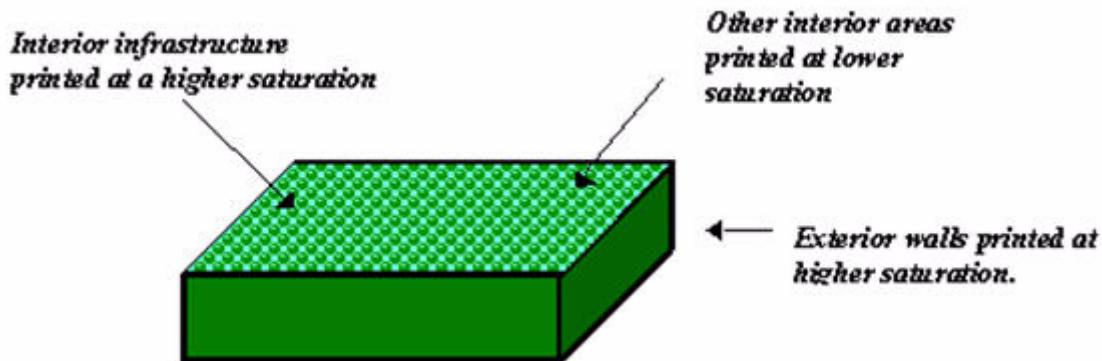
The proprietary ZPrint Software first converts a three-dimensional design built using 3D CAD into cross-sections or slices that can be between 0.003" – 009" (0.0762 - 0.2286 mm) thick.

The printer then prints these cross-sections one after another from the bottom of the design to the top. Inside the printer there are two pistons. The *feed piston* is represented in the diagrams below on the left and is shown in the 'down' position filled with powder. The *build piston* is the piston on the right, shown below in the 'up' position. Also represented in the diagrams is the *roller* (drawn as a circle) and the *print assembly* (drawn as a square.) On the printer, the roller and the print assembly are mounted together on the *gantry* which moves horizontally across the build area.

To begin the 3D printing process, the printer first spreads a layer of zp® series powder in the same thickness as the cross section to be printed. The HP print head then applies a binder solution to the powder, causing the powder particles to bind to one another and to the printed cross-section one level below. The feed piston comes up and the build piston drops one layer of the thickness. The printer then spreads a new layer of powder and repeats the process, and in a short time the entire part is printed.



The printer employs several techniques to quickly build great parts. First, binder solution is applied in a higher concentration around the edges of the part, creating a strong “shell” around the exterior of the part. Within parts, the printer builds an infrastructure by printing strong scaffolding within part walls with a higher concentration of binder solution. The remaining interior areas are printed with a lower saturation, which gives them stability, but prevents over saturation, which can lead to part distortion.



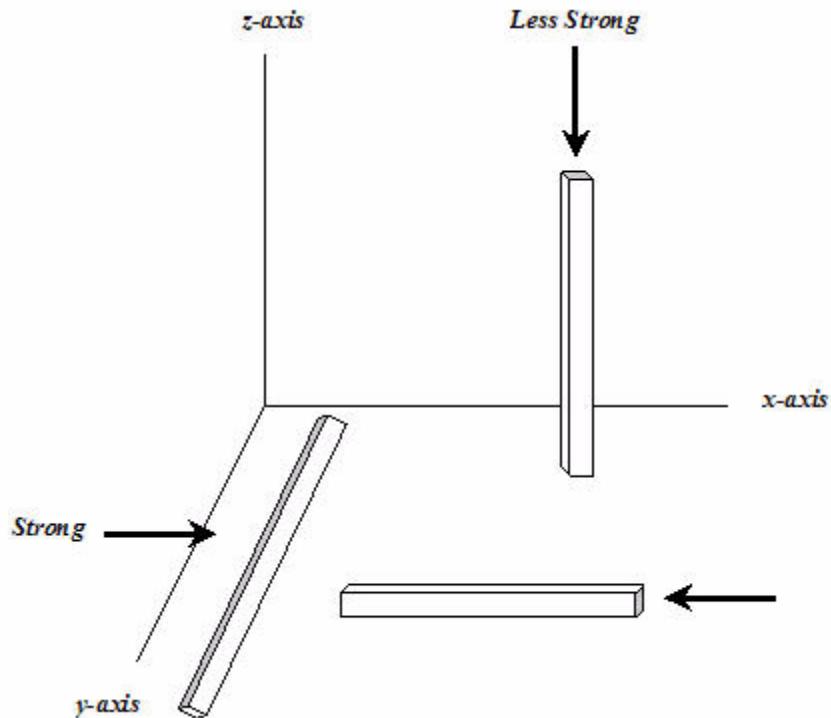
After printing, the part is removed from the powder bed, depowdered and dried. The part can then be infiltrated with wax, or other performance resins to increase strength and durability. For more information regarding infiltrants, see [Post-Processing](#).

Because the powder layers support the structures being printed above, the printer prints parts without support structures of any kind and can print parts with complex geometries that are impossible for other systems.

There are several important characteristics of the printer that will help you print the best parts for your intended purpose.

Part Placement. The software will place the parts within the build box to maximize build speed, the most important criteria for the majority of our users. The software positions the parts with the smallest dimension in the z (vertical) axis. In addition to part placement, however, the following other characteristics should be considered.

Strength. The ultimate strength of the part will be affected by its orientation within the print box. The part will be strongest along the Y-Axis and the X-Axis and less strong along the Z-Axis. This is because the cross sections are printed in continuous strips along the Y-Axis (the binder cartridge direction of travel), bands across the X-Axis (the gantry direction of travel) and laminated layers along the Z-Axis. This discussion only applies to untreated parts; once parts are infiltrated, they uniformly take on the strength characteristics of the infiltrating material.



Accuracy. The accuracy of the system depends on the materials you choose. You can employ the anisotropic scaling feature in the software to adjust for expected shrinkage and bring your parts into true scale. More information on anisotropic scaling factors is found in Chapter 3, [Preparing the 3D Printer](#).

1.2 System Components

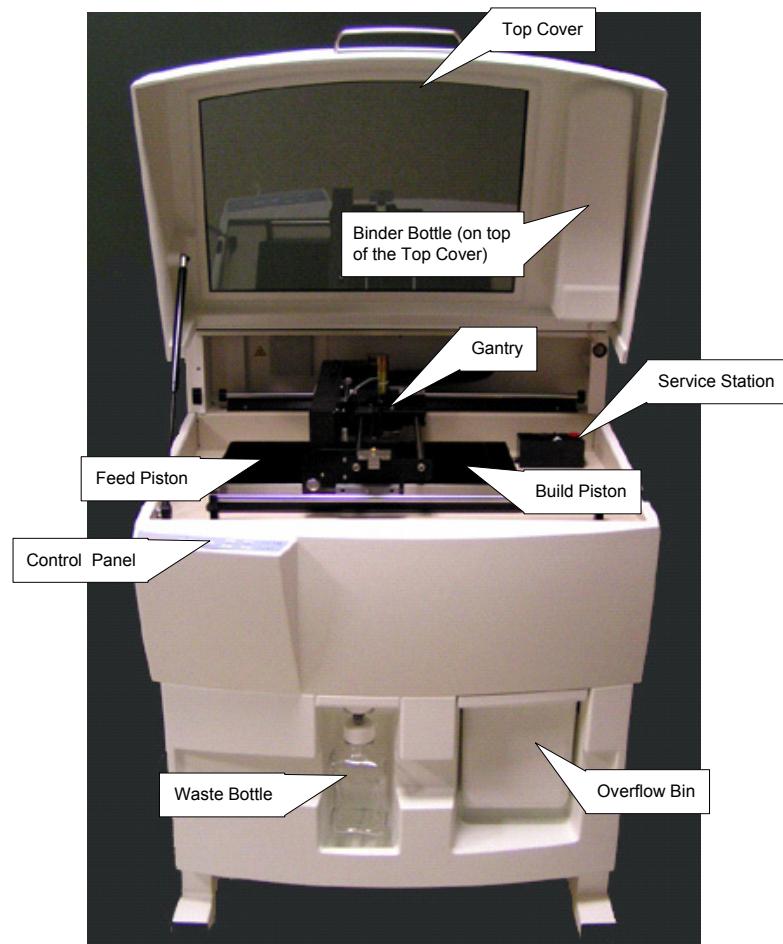


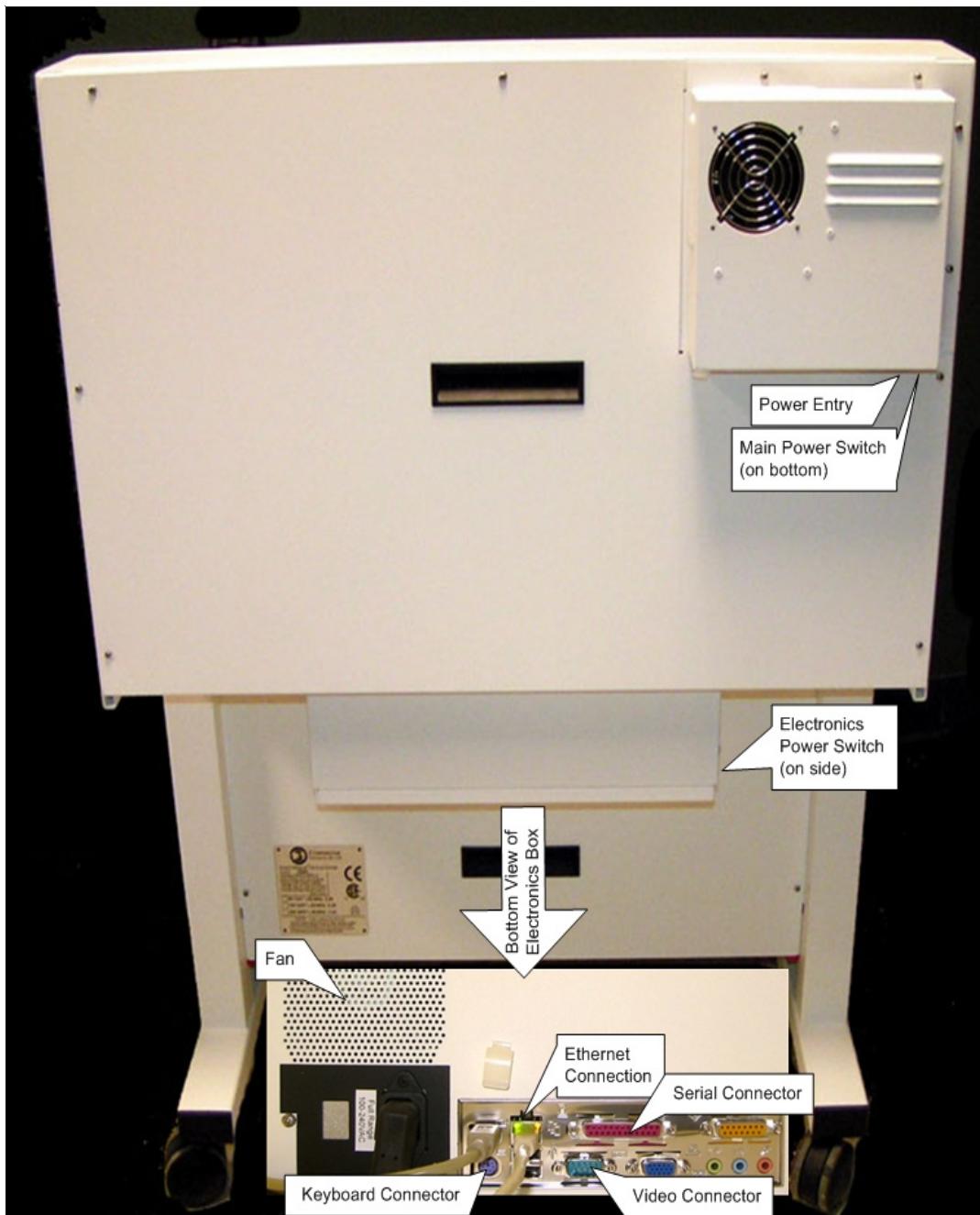
ZPrinter 310 Plus



ZD5 Powder Recycling Station

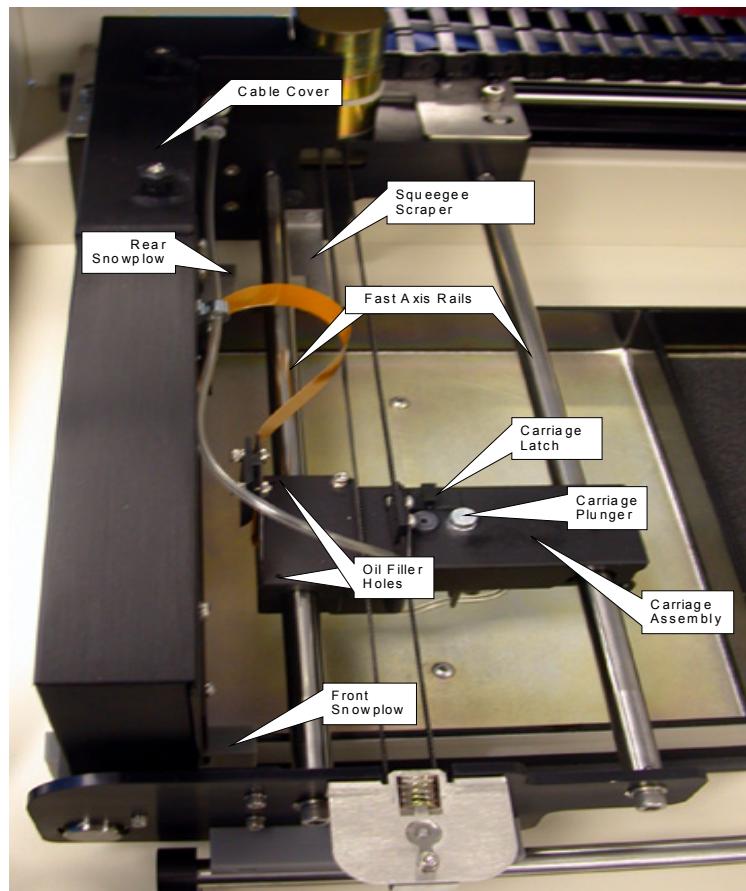
1.3 ZPrinter 310 Plus Subcomponents



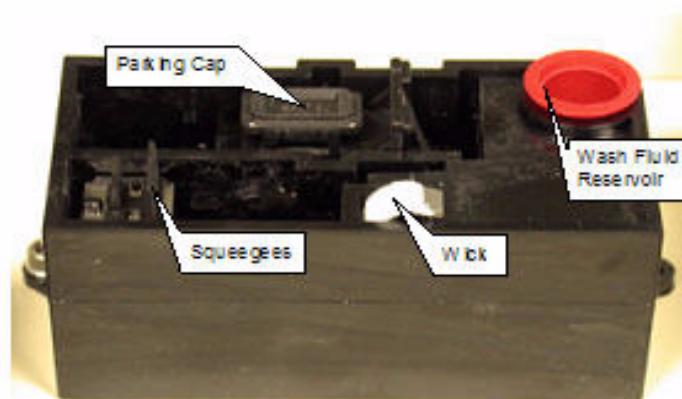


Back Panel View

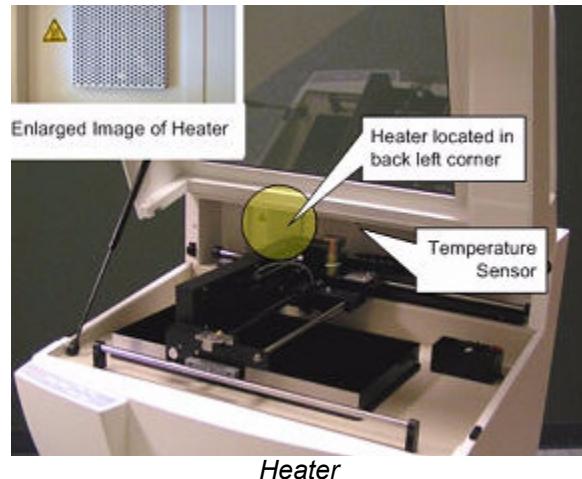
1.4 Gantry (Top View)



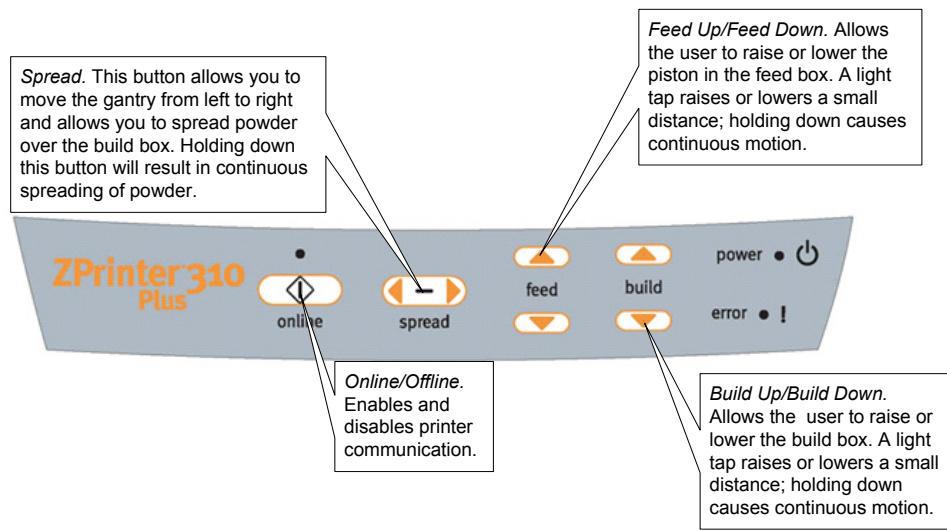
Gantry (Top View)



Service Station (Top View)



1.5 Control Panel



ZPrinter 310 Control Panel Detail



2 Quick Start Guide

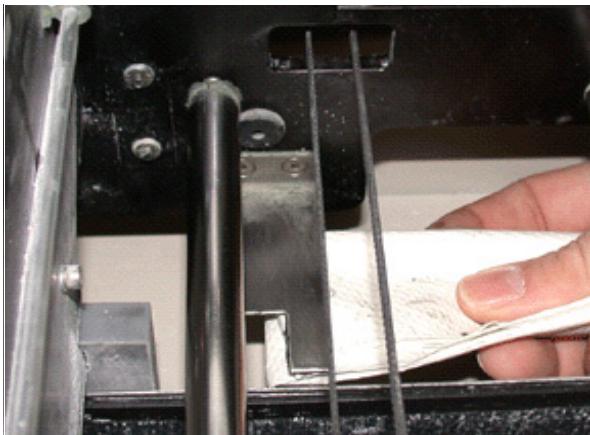
This chapter provides an overview of the setup, part removal, and part post-processing steps required to print a part. For a detailed step-by-step guide to printer setup, please refer to [Using ZPrint Software](#) and [Post-Processing](#).

For additional information on post-processing techniques visit the Z Corp. 3DP User website at www.3dpuser.com.

2.1 Printer Preparation



1. Fill the feed box with powder. Remember to use any powder in the overflow bin. Add fresh powder as needed.
2. Spread powder over build area. Vacuum any remaining powder on the top deck.
3. Clean and wipe the squeegees and parking cap on the service station with distilled water.



4. Clean the squeegee scraper with a damp paper towel.



5. Check binder level and fill if necessary. Fill the binder fluid to the neck of the tank.

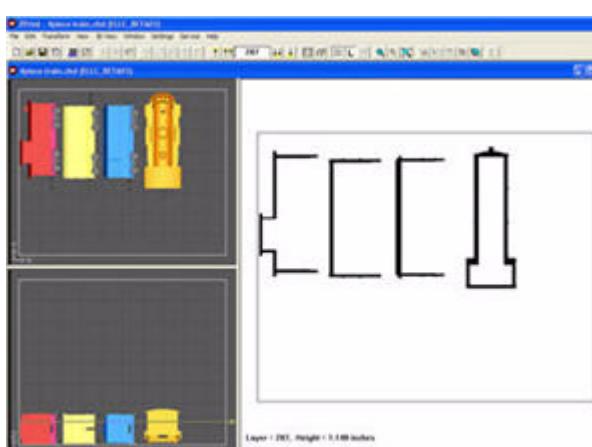
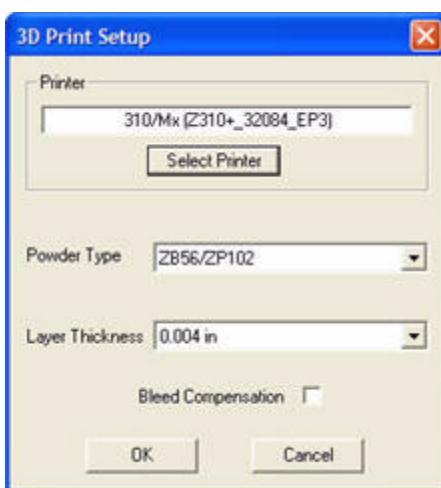
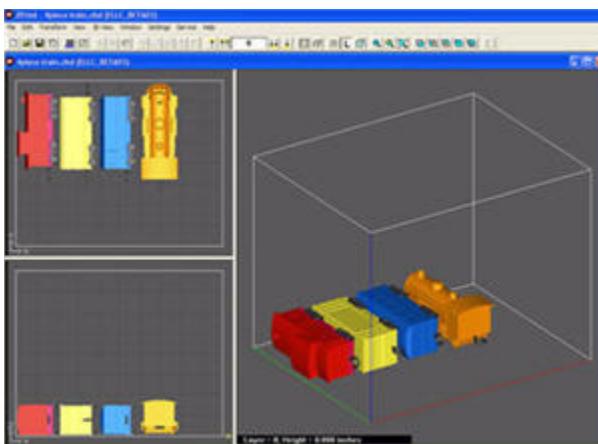


6. Check the waste bottle. Remove and dispose of liquid in accordance with local disposal regulations.



7. Put the printer Online.

2.2 Part Printing



1. Launch the ZPrint Software application. Open or import the file for the build.

2. Open the **File** menu and select **3D Print Setup** or click the **3D Print Setup** icon on the ZPrint Toolbar.



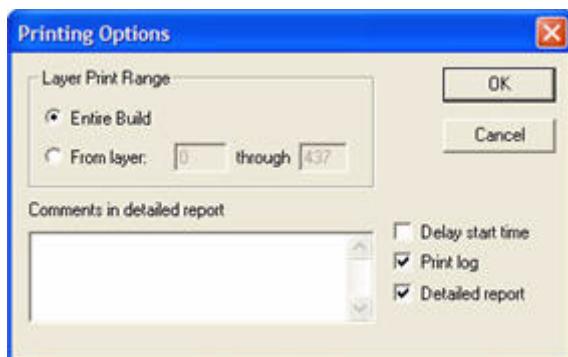
3. Check that the software is communicating with the printer by selecting **Select Printer**. Choose either **Serial Port** or **Network** depending on how the printer is connected to the computer. The printer should show up as an option if the software is properly communicating with the printer.

4. Change any powder parameters, if necessary.

5. Click the 2D icon on the Toolbar to view the build in 2D View and examine the cross-sections.



NOTE: It is recommended that you run **Collision Detection**, found on the ZPrint **View** menu if the build contains multiple parts, before beginning your build.



6. Select **3D Print** on the **File** menu or click the **3D** icon on the Toolbar to begin the build.



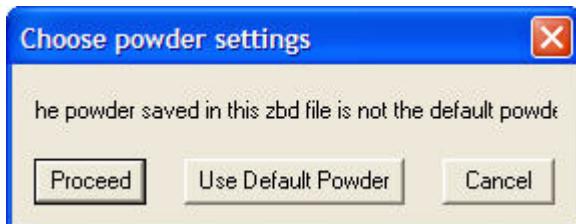
2.3 EZ Print

You may choose to print using **EZ Print** mode if you are using ZPrint version 7.2 or higher. **EZ Print** mode is useful for the inexperienced user who may need assistance in building a part. EZ Print automates some functions that eliminates the need for the user to manually set-up the part in the build. The EZ Print mode settings are on the **Settings > General Preferences > EZ Print Mode** tab in ZPrint. For more information, see *EZ Print* in the [ZPrint Software Manual](#).

PLEASE NOTE: EZ Print is **ONLY** available to those using the high composite material combinations. EZ Print will print the part using the default settings for this material set. It allows you to easily print a **SINGLE** part.



1. Launch ZPrint and choose **Open** on the **File** menu. The **Open** dialog displays. Notice the **EZ Print** checkbox at the bottom of the dialog. Check EZ Print Mode to continue in EZ Print mode. If not, you will continue in normal mode. If you are opening a **.zbd** file, the software will omit generating a fixture and show the **Ready to Print** dialog box shown in Step 7.



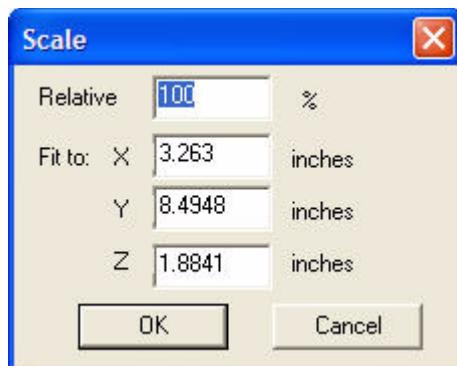
2. If you are opening a .zbd file and the powder associated with the .zbd file is not the high composite material, ZPrint will give you the option to proceed with the current powder settings, proceed with the default, or cancel out of **EZ Print** mode.

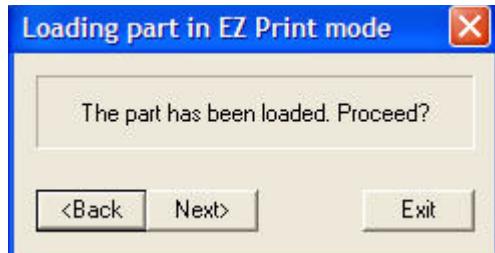
PLEASE NOTE: At any time, you may go back to the previous step to correct or respecify a part's dimensions.

3. Select the units in which the part was created.



4. If this part is too big to fit in the build box, the software will ask you to resize the part.

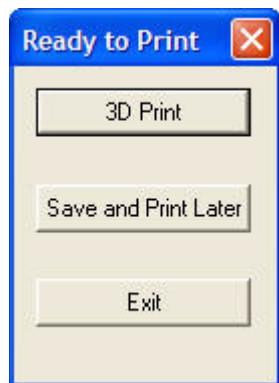




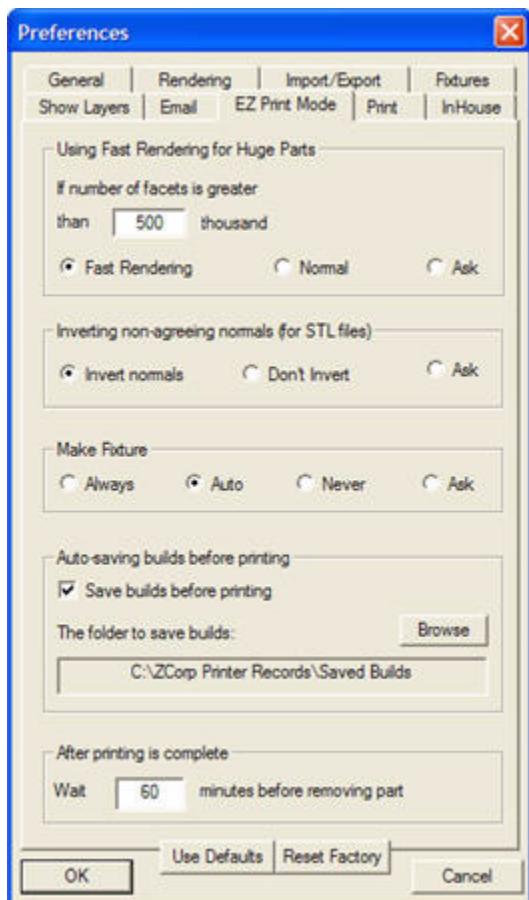
5. Once the part is loaded, ZPrint will prompt you to proceed. This allows you to confirm that the imported part and the scale are correct. Select **Next** to proceed with printing or select **Back** to open a different part or change the scale.
6. When **Next** is selected, the software will create a fixture. It will run Collision Detection to make sure the fixture and part are not touching. If there are any collisions detected, the ZPrint will regenerate the fixture with a higher accuracy level.

PLEASE NOTE: There are different options for automating fixture generation on the **Settings > General Preferences > EZ Print Mode** tab.

Select **Always**, **Auto**, **Never**, or **Ask**. If the **Auto** is selected, ZPrint will determine if the part has a non-flat bottom. In these instances, ZPrint will automatically create a fixture. For more information, consult the *ZPrint User Manual*.

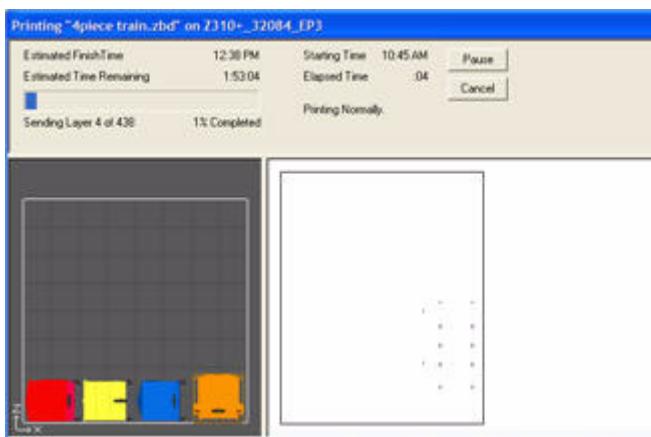


7. After a fixture is created, you may choose to print your part, save and print later, or to exit **EZ Print** mode.

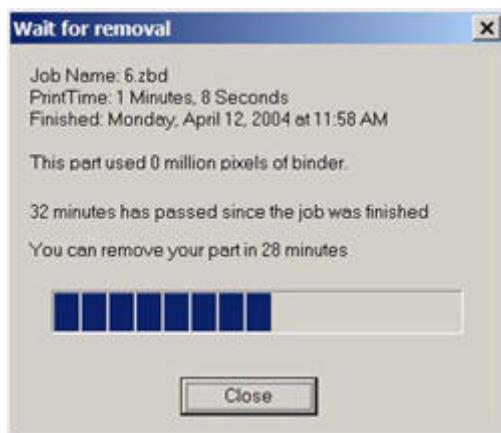


8. ZPriint takes you through four or five steps to prepare the printer. You will find pictures for each step or a video for the complete process.

9. After the steps to setup the printer have been completed, ZPrint will begin printing your part. EZ Print will automatically save your .zbd file to a specified folder if this option is selected on the **EZ Print Mode** tab. For more information, consult the [ZPrint Software Manual](#).



10. The **Printing** dialog appears when the build starts and will remain open for the duration of the build, so you can view the status of the build and see the estimated time remaining before the build is complete.

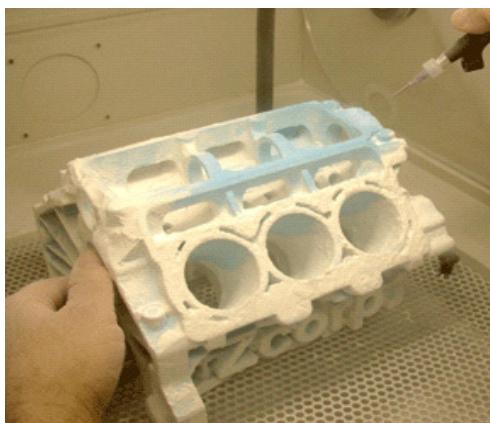


11. After the print job is completed, the software will begin a countdown before you can remove your part from the build box. For more information, consult the [ZPrint Software Manual](#).
12. When the part is ready to remove, the software will open up a dialog box informing you that the part is ready to remove. This dialog contains links to helpful video clips about how to remove, depowder, and infiltrate the part. Remove and post-process the part as instructed in the video or in the [ZPrint Software Manual](#).

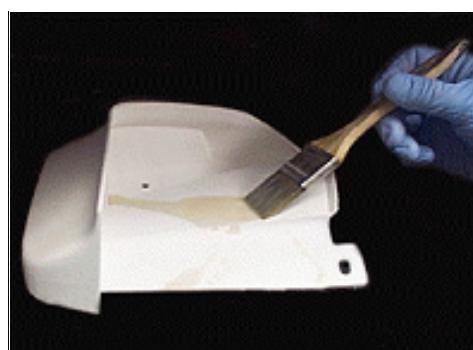
2.4 Post Processing



1. Remove excess powder from the part and *gently* remove it from the build box.



2. Depowder the part in the powder recycling station.



3. Strengthen the part with the infiltration of your choice. See *Post-Processing*.

2.5 Useful Tips

2.5.1 Part Setup, Orientation and Print Settings

- Do not tightly pack parts into the build. Keep in mind that you will need to depowder and remove them from the build box. Allow a little room around the part so you can vacuum the powder away and get your fingers around or under it.
- Orient parts so delicate features are supported in the Z-Axis, i.e. keep the attaching feature directly below the fragile features. If a delicate feature is only supported by unprinted powder the chances of breaking that small feature during depowdering is greatly increased.
- When building delicate parts use the Fixture function to cradle the part. Raising the part 0.25" (6.4 mm) from the bottom of the build and creating a fixture under the part will produce a cradle that can be handled. The part inside the cradle can easily be transported to an oven or the depowderer.
- Do not enable the bleed compensation feature if you are building a part with features under 0.050" (1.27 mm). Enabling bleed compensation may reduce the feature size.
- Parts printed with the High Performance Composite powders can be reliably printed to be within +/- 1.0% or +/- 0.007" dimensional tolerance.

- To increase the strength of thin parts, you can decrease the layer thickness to 0.0035" (0.089 mm) if you are using one of the high composite performance powders. Override the saturation values and input the saturation values used for printing at 0.004" (0.102 mm). This increases the binder to powder ratio and wets more of the resins in the powder. As you increase the strength of the part in this manner you are also increasing the amount of time to dry the part. Use of the removable build plate and oven drying the part are recommended.

2.5.2 Gross and Fine Depowdering

- Become familiar with where the parts are placed and how they are oriented in the build box so you do not accidentally bump or brush against a fragile part during the depowdering process.
- When performing the gross depowdering (removal of excess powder in the build box) do not plunge the vacuum nozzle into the powder bed. Begin at the outer perimeter of the build box, slowly work your way into the build. Hold the tip of vacuum nozzle approximately 0.25" (6.4 mm) to .375" (9.5 mm) away from the powder and allow the vacuum to pull the powder up. Slanting the vacuum nozzle will enable you to control the suction. This will decrease the chance of breaking a part that is hidden beneath the surface of the powder.
- While fine depowdering in the depowderer, always start with a low air pressure and gradually increase the pressure as the fine details and features of the part become visible. When the top and sides of the part are completely depowdered tilt the part onto one of its sides. Handle the part carefully. The part may be fragile and brittle before infiltration. If none of the sides of the part will be able to support the weight of the part you can apply a small amount of resin or epoxy to strengthen it. You want to be careful not to let any of the infiltrant come into contact with any unprinted powder that may still be on the part. Let the infiltrant dry before continuing to depowder.

2.5.3 Use of the Removable Build Plate

- The removable build plate is an excellent tool for the new user. It allows you to quickly remove the part from the build bed and begin printing again. The build plate also allows the user to easily transport the part to the oven (at temperatures below 150°F or 66°C) or the depowdering station without ever having to handle the part.

2.5.4 Oven Dry the Part

- Although the high performance composite part can be handled when it is not completely dried, the part reaches full strength when dried. Placing the part in an oven at temperatures less than 200°F (93°C) for 2-4 hours will dramatically increase the strength of the part. This is only recommended for high performance composite parts. If using the removable build plate, remove the part from the removable build plate before placing in the oven.

2.5.5 Part Infiltration

See the 3DP User website for information on [materials](#) and [applications](#).

When using Z-Bond™ Resin:

- Always infiltrate the most delicate features of the part first. Z-Bond resin gives almost immediate strength to the area of the part that has been infiltrated. As you handle the areas of the part that have been infiltrated it will be less likely to break it.
- Try to avoid infiltrating the part by applying Z-Bond resin from spot to spot. Pick a good starting place and hold that area upward relative to the rest of the part. With your free hand, place the tip of the Z-Bond bottle against the part and allow the cyanoacrylate (CA) to flow from the bottle. It is important that the CA flows at a uniform rate making it easier for you to judge how quickly it will flow from the tip of the bottle before it wicks into the part. By seeing how quickly it wicks into the part you will be able to judge where and how quickly to move the tip of the bottle while applying the CA, being sure not to apply the CA to the same place more than once.

When Using Z-Max™ or Z-Snap™ Epoxy:

- If the part has delicate features, infiltrate them last as the feature will be less strong after being infiltrated until the epoxy begins to cure. This will decrease the chance the feature will break from the part if nudged or bumped.
- If the part has multiple delicate features or it is impossible to handle the part without breaking a feature you may infiltrate these features only. Allow the Z-Max and Z-Snap epoxy to cure. Then infiltrate the rest of the part. This will add time to post-processing the part but it ensures that you have a good strong part without any fractures.

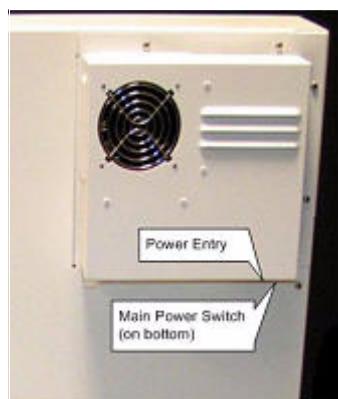
3 Preparing the 3D Printer

This chapter is a step-by-step guide on preparing the printer for printing. It covers preparing the build area, cleaning the service station, filling the binder bottle, and removing the waste bottle.

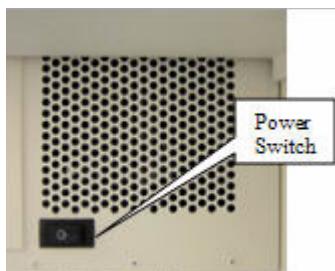
For additional assistance and information, please contact the Z Corporation Service Department at (781) 852-5050, toll-free at (877) 88-ZCORP or via email at service@zcorp.com. You may also visit the 3DP User website at www.3dpuser.com.

3.1 Start the Printer

We recommend that you leave the printer on at all times. The printer periodically exercises a print head routine for optimal operation. If the printer is off, you will need to turn it on in order to prepare the printer.



1. Press the main power switch located on the back right side of the printer.



2. Press the power switch located on the electronics box.
3. When the online light, located on the control panel, is on, the printer is ready.

3.2 Preparing the Build

3.2.1 Filling the Feed Box

Warning: Use only powder supplied by Z Corporation. Use of any other material may impact the performance and/or safety of your printer and will void warranty and service contracts.



1. Press and hold the **Feed DOWN** button until the online light begins to blink. The feed piston will lower itself until it reaches the bottom.

2. Check the overflow bin to see if there is powder to be recycled. If so, remove the powder overflow bin.

3. If you do not have any or enough powder to recycle from the overflow bin, pour fresh powder into the Feed Box.

4. Open the top cover of the printer.

5. Fill the feed box with powder.

TECHNICAL TIPS

- Keep powder containers closed when not in use to keep powder dry and free of contaminants.
- Scoop powder carefully to minimize airborne particles.
- Make sure that you carefully vacuum up excess powder. It only takes a minute, and the cleaner the machine is, the less often it will need maintenance!

3.2.2 Removing Air from Powder and Packing the Feed Box



1. Insert the powder scoop repeatedly a few inches into the loose powder to compact it. Continue for about a minute until it feels firm. Repeat for every two scoops of powder.

2. When the feed box is filled to the top, take the tamper and slowly press it into the powder surface. Be careful not to “slap” the tamper into the feed box, which will produce airborne particles. About 10-15 pounds of force will give it a smooth, flat, and compact surface. Failure to firmly pack the powder will affect part quality.

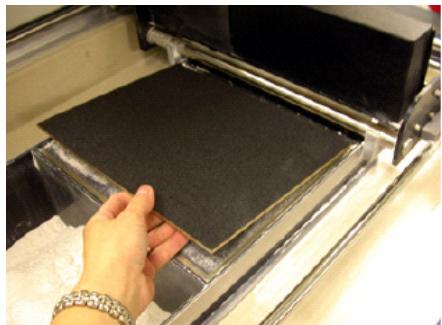
3.2.3 Preparing the Build Area



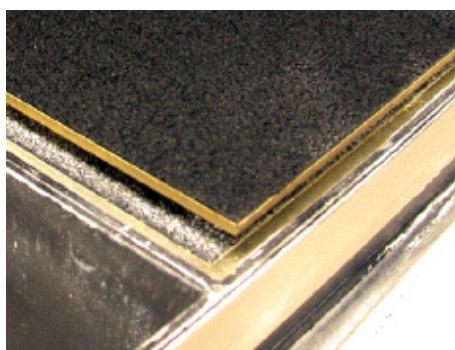
1. Press and hold the **Feed** UP button until the surface of the powder is even with the top deck.
2. Press and hold the **Build** UP button until the build piston stops.
3. Make sure the build area is clean.

PLEASE NOTE: If using a build plate, see directions below (Steps 1-4), otherwise you may skip these steps and go to the [Cleaning Up](#) section.

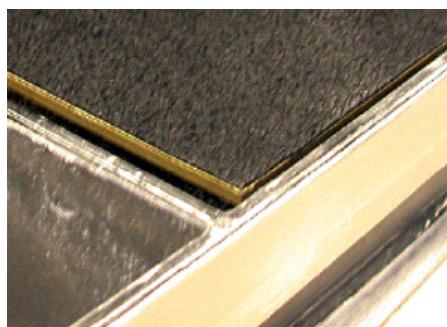
The build plate is a useful tool in making the most out of your printer. It allows you to lift delicate parts from the printer without handling them. It may allow you to safely remove parts from the machine sooner after they are printed, so that you can start another build while your parts dry outside the printer. You can use the build plate to transfer your parts to an oven to dry them quickly to their full green strength.



1. Bring build piston all the way to the top and place build plate on top of build piston.



2. The build plate will project above the top of the build box. In this position, the gantry would hit the build plate if you tried to spread powder.



3. Lower the build piston so that the top of the build plate is slightly below the top of the build box.

WARNING: If the gantry or the spread roller hits the build plate, you may damage your printer.



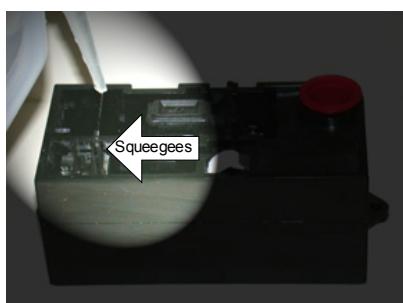
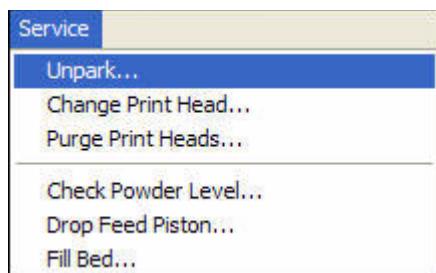
4. Press and hold the **Spread** button for four spreads, on the fifth spread, the automatic **Fill Bed** routine will take over. This will do 13 more spreads with coordinated piston movements to prepare the build area. Press **Online** to cancel this operation or press **Cancel** from the software. You may also select **Fill Bed** on the **Service** menu in ZPrint.

3.2.4 Cleaning Up

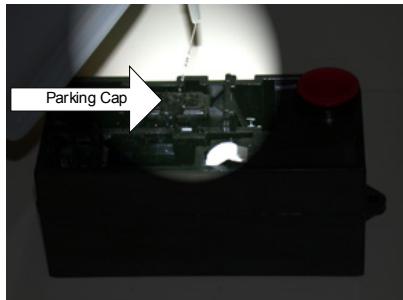


1. Vacuum off any powder on the top deck.

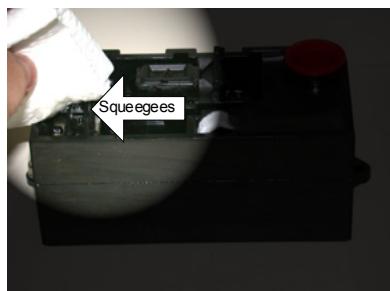
3.2.5 Cleaning the Service Station



1. Clean the Squeegees and Parking Caps.
2. Select **Unpark** on the **Service** menu. The gantry will move away from the service station exposing the squeegees and parking cap. (The printer must be online with the top cover closed).
3. Lift the top cover of the printer and manually move the gantry to the left away from the service station.
4. Fill wash bottle (supplied in the toolbox) with distilled water.
5. Rinse squeegees with water until all debris has been removed from the rubber squeegee.



6. Rinse parking cap with distilled water.

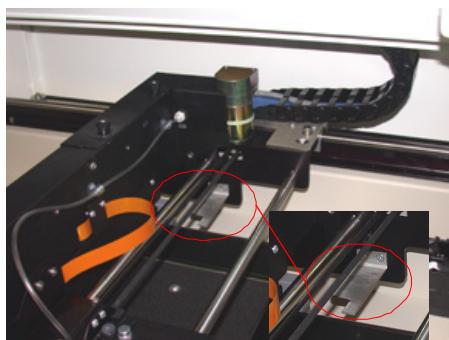


7. With a clean and dry paper towel, wipe residue off the squeegees.



8. With a clean and dry paper towel, remove standing water in the parking cap.

9. Check wash fluid reservoir and refill if needed. For more information, see *Maintenance*.



10. Locate the squeegee scraper located in the back of the printer assembly.



11. Using a damp paper towel, wipe off the top and bottom surfaces of the squeegee scraper.



12. Close the top cover.
13. Press **OK** on the software to repark the gantry.

3.2.6 Refilling the Binder Bottle



1. Unscrew the black cover of the binder bottle.



2. Fill with binder fluid until liquid reaches the neck of the bottle. Hold bottle sideways to avoid spilling binder.
3. Replace the binder bottle cover.

Warning: Use only binder supplied by Z Corporation. Use of any other material will impact the performance and/or safety of the printer and will void warranty and service contracts.

3.2.7 Changing the Print Head

Change the print head if necessary. The software will alert you if your print head is old and may not complete the build. For more information about changing print heads, please refer to *Maintenance*.

Technical Tip

If you fill the binder bottle after you change the print head, there is enough binder to last until the print head's normal life is achieved.

3.2.8 Emptying the Waste Bottle



1. Remove waste bottle by depressing the button on the waste fitting and pulling down on the waste bottle.
2. Dispose of waste liquid. Binder waste should be treated in accordance with local disposal regulations.
3. Replace waste bottle by inserting the bottle back onto the fitting.

PLEASE NOTE: Make sure the binder bottle is completely inserted against the fitting. A double clicking sound will confirm that the binder bottle is locked into place.

Warning: Do not recycle waste binder solution. The waste is contaminated with powder and use of this liquid in the printer will clog the internal plumbing system and the print head.

3.2.9 Place the Printer Online

1. Press the Online button.



2. The green online indicator light will illuminate.
3. The printer is ready to print.

4 Material Systems

This chapter provides material storage information, and instructions on how to use *ZCast®* and *Snap Fit* powder systems. It also describes the hardware and software changes required to build parts successfully with the ZCast or Snap Fit materials systems.

IMPORTANT - NEW POWDERS AVAILABLE!

NEW High Performance Composite powders are now available for the ZPrinter 310 Plus. These include zp130, zp131, and zp140. On the 3DP User Website you will find [User Guides](#) for [zp131](#) and [zp140](#), as well as other application and technical tips available for these products.

For information and guidance or additional questions, please contact the Z Corporation [Service Department](#) at (781) 852-5050, toll-free at (877) 88-ZCORP or via email at service@zcorp.com.

4.1 Material Storage Precautions

Carefully read the [Material Safety Data Sheets](#) (MSDS) before using any Z Corporation materials.

Material	Storage	Usage
Powder	Store powder on pallets in a cool, dry, ventilated area away from sources of heat, moisture, and incompatible material. Keep containers tightly closed.	Use of powder in environments with more than 30% relative humidity will affect powder performance.
Binder and Wash Fluid	Store in cool, dry place, away from sun. Keep tightly capped.	Binder is NOT recyclable.
Printhead	Store in cool, dry place, away from sun. Keep tightly capped.	
Infiltrants	Store in cool, dry place, away from sun. Keep tightly capped.	For more information, visit the 3DP User website at: www.3dpuser.com .

4.2 Using ZCast Powder

4.2.1 General Information

ZCast powder is a plaster-ceramic composition that allows you to print sand casting-like molds and/or cores with your Z Corp. printer. Once printed, depowdered and baked, you have the ability to immediately pour molten metal, yielding a cast metal part. Arguably, the ZCast process is the fastest and most direct way to obtain a metal part from digital data. ZCast has been optimized for non-ferrous materials ranging from zinc to brass, including aluminum and magnesium.

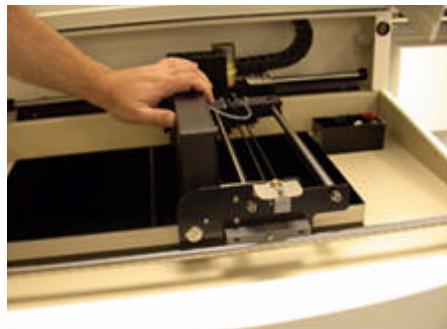
WARNING: NEVER POUR MAGNESIUM without first contacting a Z Corporation technical representative. **NEVER ATTEMPT TO POUR FERROUS METALS IN ZCAST MOLDS.**

You will find a detailed document entitled *ZCast Direct Metal Casting - Design Guide* located in the appendix of this manual for additional information. Please review the guide along with safety issues before continuing with this product. Upon review, contact Z Corporation Applications Team for information about a **free online training session** by sending an email entitled *ZCast Online Training Seminar* to applications@zcorp.com. Be sure to include preferred meeting times. The session is approximately one hour.

4.3 Using ZCast With Your ZPrinter 310 Plus

4.3.1 Temporarily Remove the Scraper Blade When Using ZCast Powder

When using ZCast powder on the printer, the scraper blade should be removed. Failure to remove the scraper blade when running ZCast powder will result in excessive wear on the scraper blade and require replacement. The entire activity should take less than ten minutes and requires two hex wrenches. Remember to reinstall the scraper blade when printing with ZCast is complete. Follow the instructions below to remove the scraper blade.

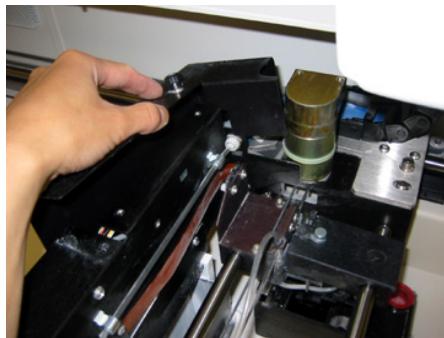


1. Turn off power and unplug the printer.
2. Slide gantry to the middle of the print area.



3. Remove the cable enclosure cover by unscrewing the two screws on the top of the enclosure.

4. Remove the cable enclosure.



5. Disconnect the ribbon cable.



6. Disconnect the head power card.

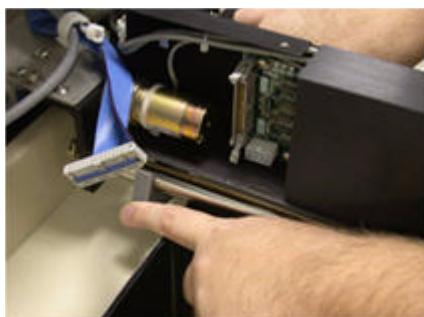


7. Twist and disconnect fluid supply fluid tubing.

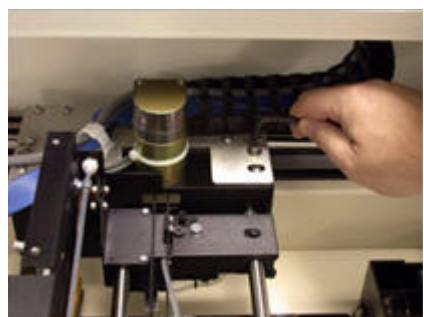




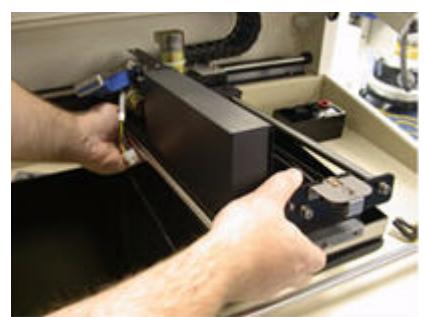
8. Remove the snowplow from the front of the printer module. Slide the snowplow away from the edge of the build box until it disengages from the retaining tab. Press on the top edge of the snowplow until it pops off the spreader roller.



9. Repeat Step 8 for the snowplow in the back of the printer module.



10. Using the 3/16 hex wrench, remove the mounting screw located on the right side of the motor assembly.



11. Pivot the front of the printer module up while lifting from the rear and remove. Place the printer module on a flat area.



12. Using the 3/32 hex wrench, remove the three hex screws holding the scraper blade retainer and scraper blade onto the printer module.

- One screw is located in the front



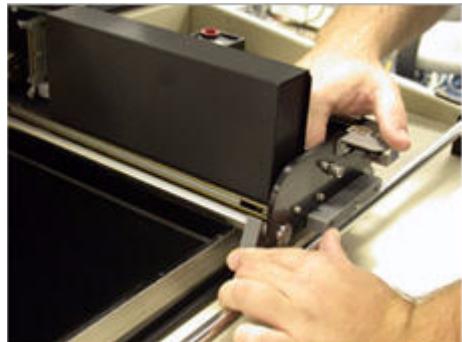
- Two are in the back (underneath the roller bearing).



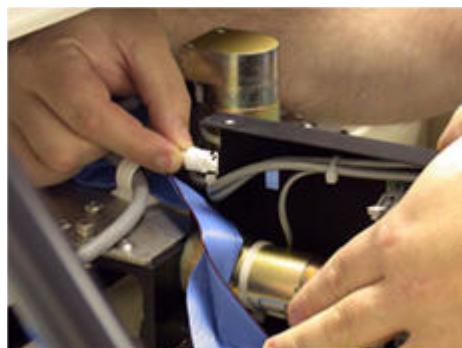
13. Replace the printer module onto the printer.



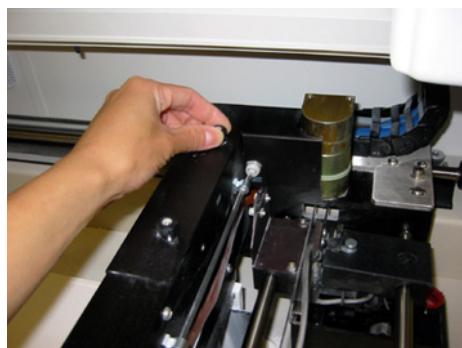
14. Tighten the mounting screws on both sides of the motor assembly.



15. Replace the snowplows in the front and back of the printer module.



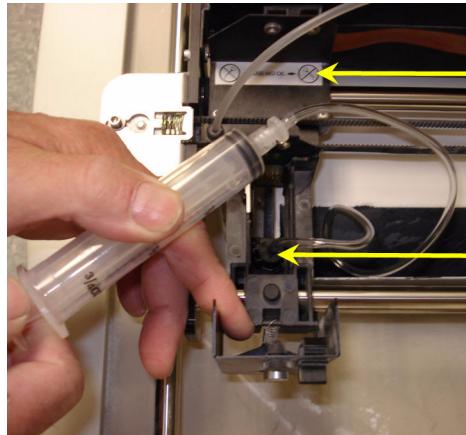
16. Reconnect the fluid line, ribbon cable, and head card power cable.



17. Replace the cable enclosure and tighten up the both screws on top of the enclosure.

18. Using the syringe provided in the Toolkit, place the tube fitting onto the septum, and slowly draw binder through the fluid system until no bubbles are present in the binder tube.

USE NO OIL Label.



Detail of syringe tube fitting over septum.

4.3.2 Loading ZCast Powder

1. Remove any non-ZCast powder from the feed piston, build piston, and overflow bucket.
2. Fill the piston completely with ZCast powder being sure to keep the casting powder “fluffy”. Use the tamper to level off the top of the feed piston but **do not compress** the powder.

4.3.3 Spread Over The Build Bed and Print.

Packing the casting powder into the feed piston increases the density of the powder at the feed piston plate and increases the gripping force that ZCast powder has on the sidewalls of the feed piston. **DO NOT** pack the casting powder.

4.3.4 Setting Up ZCast Builds

Follow best practices for setting up a build in the printers found in the ZPrint Software User Manual. Take into consideration part orientation verses strength tradeoffs and use fixtures when applicable to control the reduced effects of ‘squash’. For more information, please refer to the [ZCast Direct Metal Casting – Design Guide](#).

4.3.5 Post Processing

Unlike other Z Corp. parts, ZCast parts require no infiltration. However, ZCast molds must be thoroughly baked in a vented oven at sufficient temperatures to burn out organic materials. Additionally, the user may apply a core wash solution to improve the surface finish of the casting. See the [ZCast Direct Metal Casting – Design Guide](#) for bake temperatures, times and additional information.

WARNING: *If using a build plate, remove the part from the build plate before placing in the oven. Failure to do so will damage the build plate.*

4.3.6 Recycling

Similar to plaster and starch, ZCast can be recycled. Recycle only powder that is unprinted and free of moisture as bonded or printed material will degrade printing performance.

4.3.7 Storage

ZCast powder should be stored in a cool, dry environment. See container labels for additional information.

4.3.8 Disposal

ZCast powder is a non-toxic substance. Please consult the [Material Safety Data Sheet](#) for product details. Dispose of ZCast powder according to local and state regulations.

4.3.9 Questions and Support

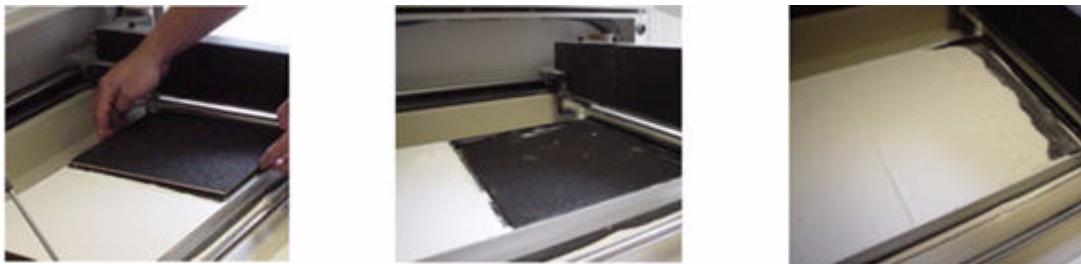
If you have any questions regarding this product, contact the Z Corporation Applications Team for technical support at (781) 852-5050 or via email at applications@zcorp.com.

4.4 Using Snap-Fit Material

zp250 powder is formulated for Z Corporation 3D Printers utilizing the Hewlett Packard print head technology - printers. Specifically formulated to have an open matrix to absorb infiltration resins, zp250 is an extremely versatile, composite-based powder used to fabricate models with plastic flexural properties which are ideal for snap-fit applications. It can be used as your sole powder to fulfill a number of application needs. zp250 powder is best suited for monochrome parts. It is also recommended for parts that have a wall thickness that is greater than 0.06" (1.5 mm).

4.4.1 Machine Setup

- Remove all of the powder currently in the printer (feed piston, build piston, overflow bin).
- Remove all powder in the depowdering unit and install a new vacuum bag in the vacuum unit.
- Check to see if the binder solution currently being used is compatible with zp250 powder. If you are not currently using zb56 binder, replace the current binder with zb56 binder then flush and purge the fluids system in accordance with your respective printer's user manual. zb56 binder is the required binder system for zp250 powder.
- Fill the feed piston with zp250 powder. ZPrinter 310 users may use the removable build plate (Z Corp. part number 06302) to aid in the removal of the 3D printed part after the build is completed. Place the build plate onto the build piston and lower the build piston until the top surface of the removable build plate is slightly below the surface of the top deck of the 3D printer to make certain that the spread roller does not hit the build plate.

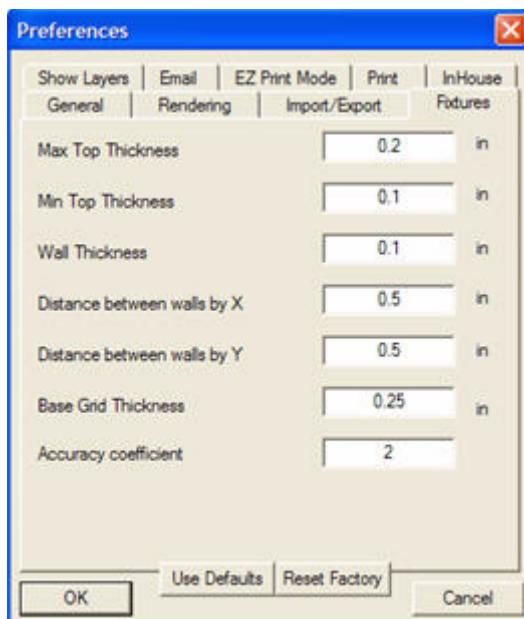


4.4.2 Software Setup

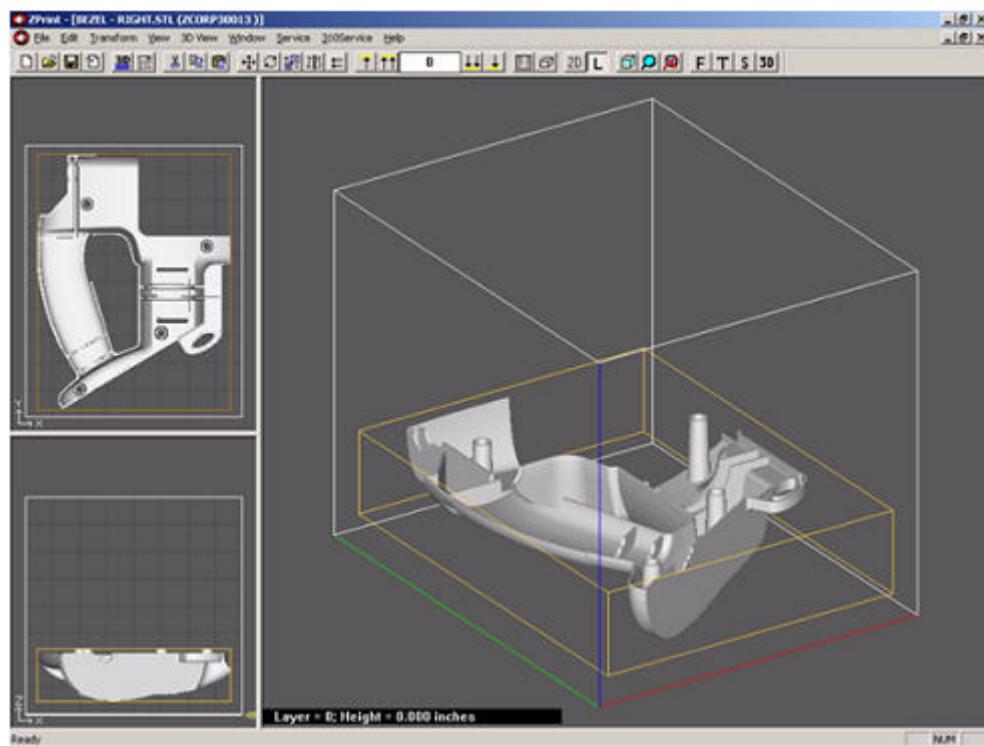
Due to the nature of the open powder matrix of zp250 powder, and its capacity to absorb Z-Snap or Z-Max epoxy infiltrant, the use of a Fixture is recommended for parts with a wall thickness less than 0.25" (6.35mm) on the printer. For a complete explanation of how to use the **Make Fixture** feature, refer to the [ZPrint Software Manual](#). Fixtures for parts made with zp250 powder should be built with the following parameters:

Clearance	0.125" – 0.25" (3.175 – 6.35 mm)
Top Surface Thickness	0.1" – 0.25" (2.54 – 6.35 mm)
Wall Thickness	0.1" – 0.25" (2.54 – 6.35 mm)
Distance Between Wall by X	0.5" – 1.0" (12.7 – 25.4 mm)
Distance Between Wall by Y	0.5" – 1.0" (12.7 – 25.4 mm)
Accuracy Coefficient	High enough to avoid collisions between the part and the Fixture (e.g. 8)

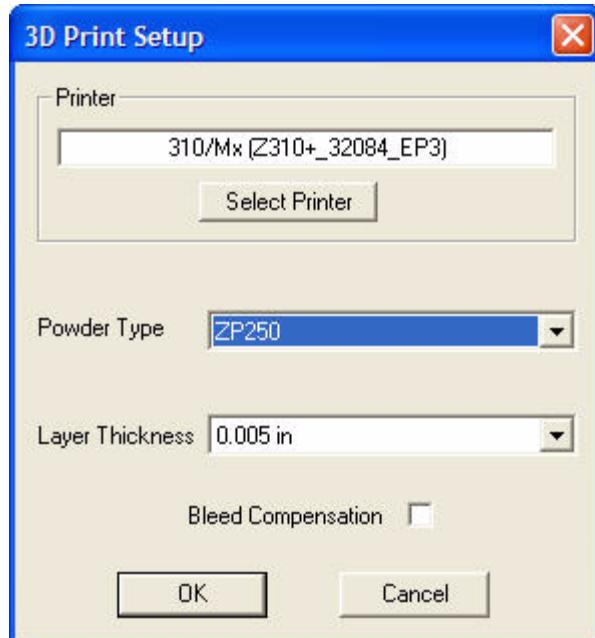
To change the default values in the **Make Fixture** dialog, select **Settings > General Preferences > Fixture** tab. Enter new values, and click **OK**.



To create a Fixture, first raise the part in ZPrint on the Z-Axis to at least 0.5" (12.7 mm) from the bottom of the build plate. If the part is not raised enough, it may not be fully supported by the Fixture after depowdering.



Select **File > 3D Print Setup** and choose **zp250** as the powder type.



4.4.3 Part Removal and Post Processing

1. When printing parts that can be manually handled, allow the part and Fixture to dry in the build bed for 2 hours before removing. If printing parts that cannot be manually handled, please refer to the *Infiltration Addendum* at the end of these instructions.

Parts built deeper than 2 inches (50.8 mm) into the build box may require longer drying time before handling. If the removable build plate was used, the part can be gross depowdered and removed prior to two hours and placed in an oven at 150°F (66°C) for at least 2 hours or longer depending on the mass/volume of the part.

2. If a Fixture was used during the printing process it should also be used during the infiltration and curing steps as well.
3. Depowder the part and the Fixture.
4. Remove part and Fixture from the build plate and place it on a clean surface. Now separate the part from the Fixture.



5. Apply a silicone mold release (such as IMS Paintable Neutral Oil Mold Release – www.imscompany.com or Hapco GREASE-IT FDG - www.hapcoweb.com) liberally onto the top surface of the Fixture where the part will make contact with the Fixture. Doing this prevents the infiltrated part from adhering to the Fixture during the infiltration process.
6. Gently apply Z-Snap or Z-Max epoxy to the bottom surface of the part and carefully place the part back onto the Fixture.



7. Apply Z-Snap or Z-Max epoxy to the rest of the part. Do not apply excess epoxy as pooling will occur. Several thin coats are better than one thick coat. Use a paper towel to remove excess epoxy that may have pooled on the surface of the part.



8. Let the part sit for 30 minutes at room temperature to allow excess Z-Snap epoxy to drain or wick into the Fixture. Z-Max parts should sit at room temperature for one hour prior to the oven cure.
9. If using Z-Snap epoxy, place the part with its Fixture into an oven for 30 minutes at 120°F (49°C). This step reduces the occurrence of bubbling or pooling of the resin. If using Z-Max, parts should be oven cured for an additional two hours at 160°F (71°C).
10. Parts infiltrated with Z-Snap epoxy should then be cured for an additional two hours in the oven at 165°F (74°C). **Do not place on the build plate.**
11. Let the part sit for 30 minutes at room temperature to cool before handling.

4.4.4 Infiltration Addendum

Parts with large unsupported overhangs that are difficult to manually handle without breaking should be left on the Fixture. Remove as much powder as possible from the top and side surfaces while the part is on the Fixture. Lightly infiltrate the exposed top surfaces of the part with Z-Snap or Z-Max epoxy. **DO NOT** apply too much infiltrant to prevent the infiltrant from wicking through to the bottom side of the part. Cure the part for one hour at 165°F (74°C). **Do not place on the build plate.**

For more information, please contact one of our applications engineers at applications@zcorp.com.

5 Using ZPrint Software

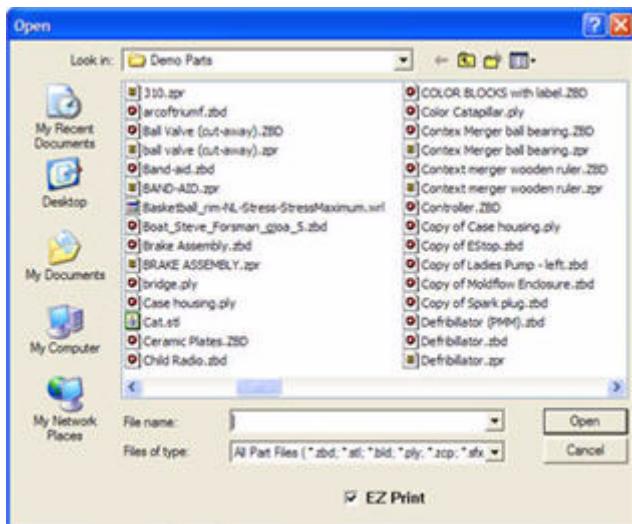
This chapter will explain how to set up the build, check the 3D Print Settings, and print. For more information about the features in the software, please refer to the [ZPrint Software Manual](#).

For information and guidance on software features, please contact the Z Corporation [Service Department](#) at (781) 852-5050, toll-free at (877) 88-ZCORP or via email at service@zcorp.com.

PLEASE NOTE: Verify that the software has been installed. Installation instructions are located in the [ZPrint Software Manual](#).

5.1 Opening or Importing a File

1. Launch the ZPrint application. The **Open** dialog box appears. Choose the file you wish to open. Click **Open** or double-click the file.

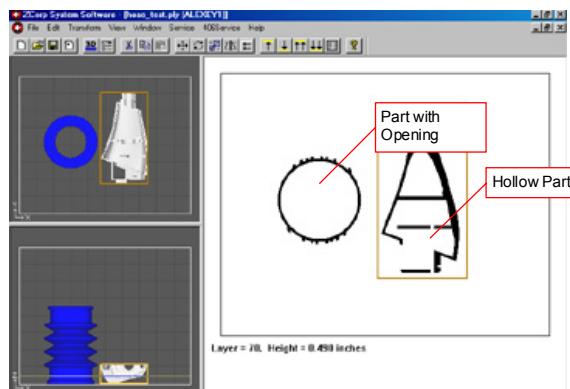


2. Choose the dimensions and powder type you will be using and click **OK**.
3. The file will be brought into ZPrint and sliced. If you would like to open additional files, choose **Import** on the **File** menu.

5.2 Orienting the Part

5.2.1 Part Containing an Opening or Hollow Area

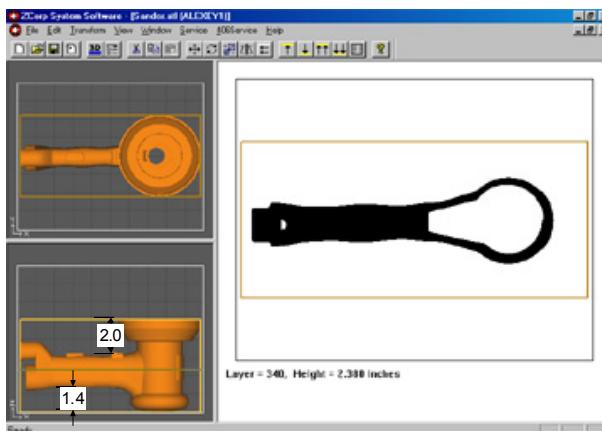
If the part has an opening or is hollow, place the opening or hollow side of the part in position so that it is facing upward. This will allow for the removal of powder during the depowdering process.



5.2.2 Part Containing Overhangs

Unsupported overhangs should be placed on the left hand-side of the build. The plaster powder, being extremely fine, is more fluid in the build box. Placing a fixture underneath overhanging surfaces will reduce the movement of the overhang. For information on generating fixtures, refer to the software manual.

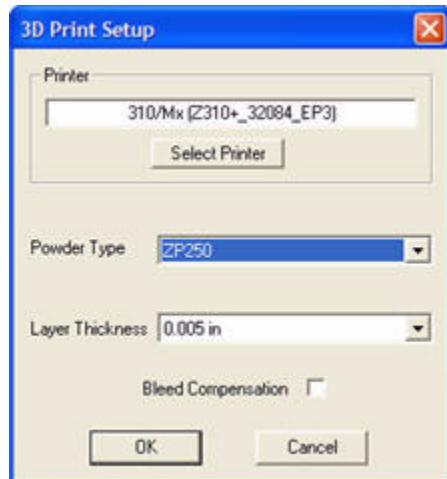
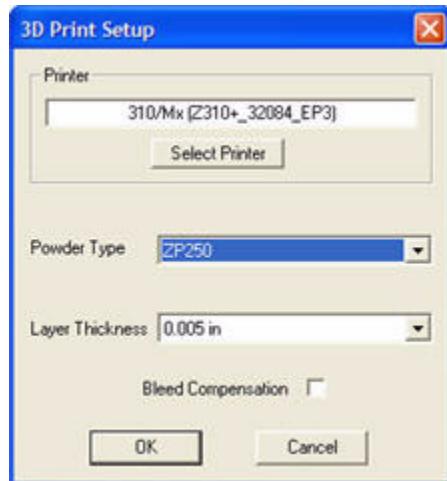
Cylindrical features will be more accurate when their axis is parallel to the z-axis. For example, if you were to print a bottle, the bottle would best be printed standing up, with the mouth of the bottle facing the top of the printer.



5.3 Checking Build Settings

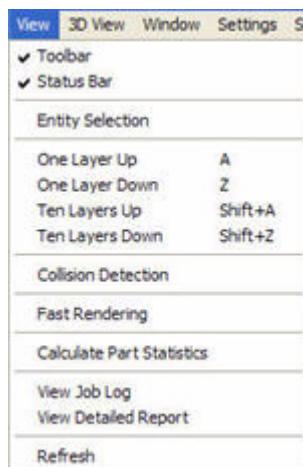
ALWAYS check build settings before printing. For more information on how to change the settings, please refer to the [ZPrint Software Manual](#).

1. Select **3D Print Setup** on the **File** menu (or Toolbar). 
2. Check that the printer, powder type, and powder settings for the build are correct in the **3D Print Setup** dialog.



3. It is also strongly recommended that you run **Collision Detection** (if more than one part is being printed) before starting the build. This feature is found on the **View** menu.

 - **Collision Detection** will scan through the slices and report the layer in which part overlapping is found.

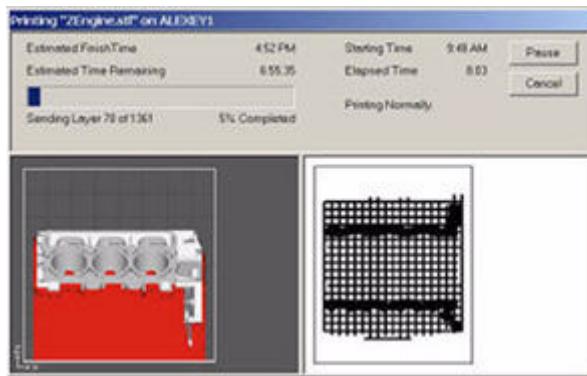


5.3.1 Printing the Build

It is strongly recommended that the build settings be confirmed before printing. To check build settings, choose **3D Print Setup** on the **File** menu, or click on the **3D Print Setup** icon located on the Toolbar. 

After all build settings have been confirmed:

1. Choose **3D Print** on the **File** menu, or click the **3D** icon on the Toolbar. 
2. A dialog appears prompting you to check the powder and fluid levels.
3. Press **OK** to confirm that these have been checked to begin the build.
4. Once the build has begun, the **Printing** dialog will appear reporting the status of the build.



6 Post-Processing

This chapter will explain how to remove a part from the printer, remove excess powder by depowdering, and introduce the use of infiltration materials.

For information and guidance on Infiltration materials, please contact the Z Corporation [Service Department](#) at (781) 852-5050, toll-free at (877) 88-ZCORP or via email at service@zcorp.com.

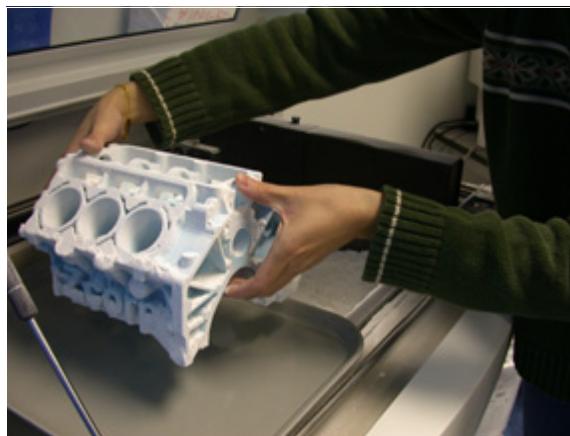


1. Allow the part to dry in the machine using one of these recommended times.
 - With specialty material parts (unless otherwise specified), wait approximately ten to fifteen minutes to ensure that the uppermost layers of the part have had a chance to dry.
 - With high performance composite parts, leave the part in the bed for approximately 30-60 minutes. Keeping the top cover closed with the heater running will help in drying the parts.
2. Take the machine Offline by pressing the **Online** button.
3. Lift the top cover.
4. Press the **Feed** DOWN button to lower the feed piston.
5. Place a tray on the top of the feed area.
6. Take a moment to look at the computer screen and determine exactly where parts lie in the build box. To do this, select **3D View** in the [ZPrint Software](#).

WARNING: When performing any vacuuming operation, use the vacuum provided as part of the printer. Vacuuming powder can generate static electricity, and use of a non-grounded vacuum hose will create static charges, which may affect the operation of the printer and harm the operator.



7. Without raising the build piston, begin vacuuming powder out of the build box. Hold the end of the hose on a 20° to 30° degree angle over the powder so the hose inlet is 1/4" to 3/8" above the surface of the powder. This generates enough of a draft to lift loose powder without damaging the parts.



8. Vacuum powder away from the buried parts, and clean powder out of the margins against the walls of the build box.
9. To gain access to the sides of the parts, raise the build piston by holding the **Build UP** button.
10. Remove the part or build plate and place on the tray. The part is now ready to be fine depowdered.
11. Vacuum off any remaining powder on the deck.

6.1 Depowdering the Part



1. Place parts inside the powder recycling unit.

Technical Tip

The air pressure on your depowdering station is adjustable. For bulky parts, turn the air pressure up. For more delicate parts, turn the air pressure down.



2. Turn on the vacuum cleaner.



3. Turn on the air compressor.



4. Change the air pressure as needed and check the pressure with your hand before applying air to the part.



5. Remove the excess powder from the part.

6.2 Using the External Vacuum Bag Liner

Z Corporation has developed an accessory to the vacuum cleaner to assist the user with the removal of the vacuum bag from the canister. The vacuum cleaner liner is easy to use and will prevent ripping and tearing of the blue vacuum bag once it is full of powder. The vacuum cleaner liner is placed in the vacuum canister prior to the bag, and once the bag is full the liner handles are used to lift the bag out of the canister.





1. Start with the empty vacuum canister.



2. Place the vacuum cleaner liner into the empty canister, being sure the cutout in the liner goes around the vacuum inlet.



3. Install the vacuum bag inside the vacuum cleaner liner.



4. Fold the handles of the vacuum cleaner liner up onto the top of the empty vacuum bag.



5. Install the vacuum filter.



6. Install the vacuum motor.



7. Once the vacuum bag is full, remove the motor and filter. Remove the vacuum bag from the canister by lifting the vacuum cleaner liner handles straight up.



8. Rotate the vacuum canister, in the direction of the inlet, from under the vacuum bag.



9. Once the vacuum cleaner inlet tube is disengaged from the vacuum bag, you can lift and remove the bag and liner.

6.3 Drying the Part

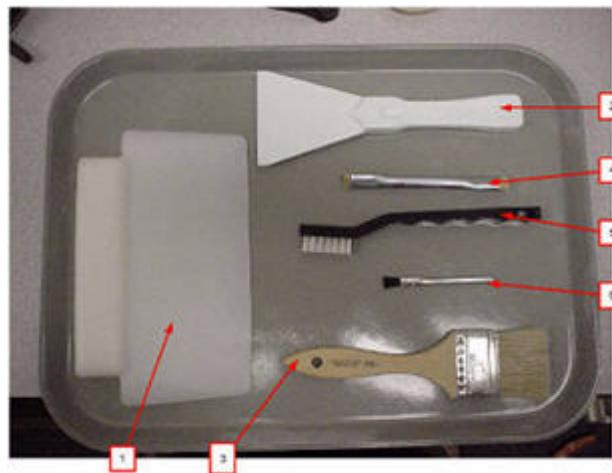
To infiltrate parts with wax, the parts must be hot and dry. Preheat part at 165°F (or 74°C) in a Z Corp. waxing system or in a drying oven. Remember that drying time and part wall thickness are directly related. If the average wall thickness is $\frac{1}{4}$ " (6.35 mm), then the part should be in the drying oven for 30 minutes. If average wall thickness is $\frac{1}{2}$ " (12.7 mm) inch, the part should be in the drying oven for 45 minutes. Use the chart below as a guide.

Average Wall Thickness	Drying Time
1/8 inch (3.175 mm)	15 minutes
1/4 inch (6.35 mm)	30 minute
1/2 inch (12.7 mm)	45 minutes
1 inch or greater (25.4 mm)	90 minutes

For instructions on how to use the [ZW4 or ZW3 Waxing Systems](#), please refer to the respective product's user manual.

6.4 Post Processing Tools

There are six tools included in the accessories kit that are used to assist the user with gross depowdering and cleaning of the part.



Wide Blade Utility Scraper: This part is extremely useful in moving powder from the build chamber or deck surface back into the feed chamber.



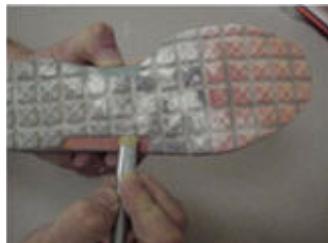
Polypropylene Scraper: When gross depowdering a bulky part, such as the engine block, the user may choose to carve powder away from the part instead of moving it away with either the vacuum or their hands.



Soft Horsehair Brush: This brush has very soft bristles and assists the user with the gross depowdering process. Brushing powder away from the part is a useful technique prior to the vacuuming step.



Stiff Detailing Brush: This brush has very stiff bristles, which are useful for scrubbing caked powder out of tight areas of a part. The brush is also very helpful when removing fringing from color part surfaces.



Stiff Handle Brush: This tool serves the same purpose as the Stiff Detailing Brush but is slightly larger and is more useful when working with a larger surface area.



Soft Acid Brush: This part can also be used to remove caked powder from hard to reach areas and the soft bristles make this brush perfect for delicate features.



6.5 Infiltrating the Part

All parts can be infiltrated with a variety of Z Corp. resins to produce a range of material properties. As an early stage design tool, it may not be necessary to infiltrate the parts at all. However, the true versatility of the Z Corp. System is derived from the spectrum of material properties that can be achieved by applying one of our infiltration materials to parts. For additional information on how Z Corp. customers are utilizing our line of infiltration products, call us at Z Corporation, or visit our 3DP User Group website at www.3dpuser.com. Here you will find a variety of application and technical tips that describe the many ways that our infiltration products can benefit your operation.

6.6 Using Z-Max™ Epoxy

Z-Max epoxy is a high strength epoxy infiltration system specifically formulated for Z Corporation. Z-Max epoxy is a low viscosity, high strength, infiltration system designed to work on all of Z Corporation's printers. Z Corp. parts infiltrated with Z-Max epoxy are easily sanded and are surface machinable. For best results always oven dry high performance series parts at temperatures no greater than 65°C (170°F). Oven drying will yield consistently strong parts and deeper penetration.

6.6.1 Safety Precautions

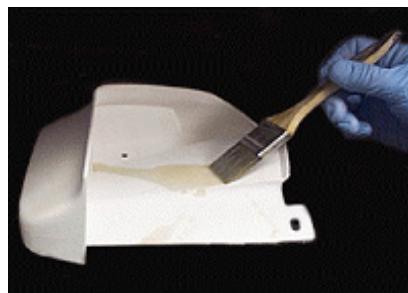
- Wear lab coat, gloves (we recommend PVC Examination Gloves), face shield or goggles. Face shield is required if spraying. Apply in ventilated hood.
- Specialized containers recommended for dispensing and application. Use a system for avoiding spills: catch pan, waxed paper, or plastic drop cloth.
- Label disposal materials.
- Wear dust mask when sanding finished parts.
- Please read the [Material Safety Data Sheet](#) for Z-Max™ epoxy prior to the use of this material.

6.6.2 Mixing Instructions

Mix 100 parts Z-Max Resin to 37 parts Z-Max Hardener by weight or 100 parts Z-Max Resin to 41 parts Z-Max Hardener by volume. Mix the two parts thoroughly for two minutes before application. The material has a working time of 35 minutes in a 425 gram mass. Please be aware of the gel time while preparing quantities of material as the gel time decreases as the quantity of material increases. It is recommended not to mix quantities over 425 grams.

6.6.3 General Application

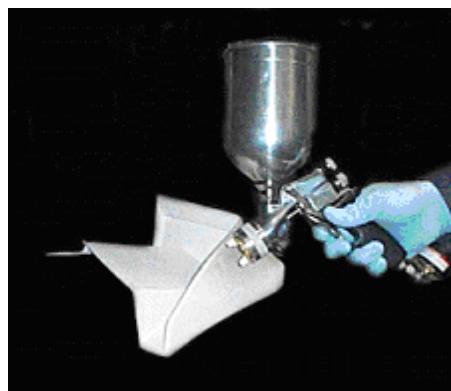
- Material can be brushed or sprayed.
- Material will penetrate between 0.079- 0.28 (2 – 7 mm).
- Do not over apply the material, as it will pool off the part during curing.
- Better penetration depth is achieved by applying several light coats of material.
- Allow all mixed materials to cure prior to disposal.



6.6.4 Spraying Instructions

Use a **Gravity Feed High Volume/Low Pressure or HVLP Sprayer**. We recommend a DeVilbiss Sprayer with 14 – 18 mm tip. The DeVilbiss Sprayer is available from Z Corp. with disposable canister liners and will minimize the amount of cleanup.

1. Have the sprayer, parts and materials ready before mixing the resin.
2. Mix resin and pour into the disposable liner in the canister.
3. **Always spray in a vented hood.** Spray resin between 15 – 20 psi (1-1.4 bar).
4. When finished, remove the disposable liner and clean the sprayer with a mild solvent, such as isopropyl alcohol or acetone.
5. Remove the tip and thoroughly clean by hand to avoid resin build up. (Cleanup takes approximately 15 minutes).



6.6.5 Curing Information

- The resin can be cured at an accelerated rate in an oven. **The oven must be vented.** Ventilation designs need to meet each customer's respective governmental health and safety requirements. A reference frequently used by U.S. firms to comply with OSHA regulations is the *American Conference of Governmental Industrial Hygienists Industrial Ventilation Manual*. At 160°F (71°C) your part will reach full strength in 2 hours.
- Allow the part to cure for 1 hour at ambient temperature prior to placing in the oven for accelerated cure to avoid discoloration due to exothermic reaction.
- The part should be placed on a non-stick, (wax paper, Teflon, etc.) material or it will adhere to the surface it is sitting on while curing.
- Wear gloves when handling the parts when they are still at an elevated temperature. Parts will attain full strength and be safe to handle once they cool to room temperature.
- The resin will cure at room temperature after 24 hours.

6.6.6 Painting Parts

Parts can be painted to enhance surface finish and appearance. Z Corp recommends coating all surfaces with Dupont Fill 'N Sand Acrylic Primer-Surfacer #131S, a lacquer-based primer ideal for improving the adhesion of most paints. This material can be purchased at most auto body supply stores.

6.7 Using ZBond™ Cyanoacrylate

Z-Bond cyanoacrylate is an extremely fast setting, low viscosity, general-purpose infiltration resin. This resin is designed to rapidly strengthen parts. Z-Bond is a one part, user friendly, no-odor, non-blooming resin that may eliminate the need for special ventilation. This resin is easily sanded and enhances the vibrancy of color parts. Z-Bond 11 (which can be used with the specialty materials) is available in 0.5 lb bottles and Z-Bond 101 (which can be used with high performance composite material) is available in 3.5 ounce bottles and 24 ounce spray bottles.



6.7.1 Safety Precautions

- Do not use or handle this product until the [Material Safety Data Sheet](#) has been read and understood.
- Wear lab coat, gloves (we recommend Nitrile Examination Gloves), face shield or goggles. Face shield is required if spraying. Apply in ventilated hood.
- Specialized containers recommended for dispensing and application. System for avoiding spills: Catch pan, waxed paper, or plastic drop cloth.
- Label disposal materials.
- Wear dust mask when sanding finished parts.

6.7.2 General Application Notes

- Part should be fully dried before applying resin. Resin reacts with water and produces heat. If the part is not dried, it will heat up the part and produce gas that may be an irritant to the mucous membranes.
- Material can be brushed, dripped or sprayed.
- Material will penetrate between 0.08 - 0.12 inches (2–3 mm).
- Do not over apply the material, as it will pool off the part during cure cycle.

6.7.3 Spraying Instructions

- Always spray in a vented hood.
- While wearing all protective equipment, insert the spray trigger nozzle into bottle.
- Use cardboard or wax paper to protect the spraying area from overspray.
- Spray Z-Bond only onto parts that have been oven dried and are free from moisture (this ensures deepest available penetration and decreases smoking from reaction with water).
- Keeping the tip of the spray bottle 4 – 6 inches (10 -15 cm) away from top of the part begin squeezing the trigger.
- Adjust the tip of the sprayer until the desired spray pattern is reached.
- Apply Z-Bond to all upward facing surfaces and sides of the part. Be sure not to spray the base of the part, as it will stick to the surface it is sitting on.
- Wait for the top of the part to cure or speed up the process by using an approved Z-Bond accelerator.

6.7.4 Curing Information

- The part should be placed on a non-stick material (wax paper, Teflon, etc.) or it will adhere to the surface it is sitting on while curing.
- Wear gloves when handling the parts to avoid contact with uncured resin.
- Parts will attain full strength in fifteen minutes.

6.8 Using Z-Snap™ Epoxy

Z-Snap epoxy is a flexible, toughened epoxy infiltration system specifically formulated for Z Corporation for use with zp®250 powder. Parts made from zp250 powder and infiltrated with Z-Snap epoxy exhibit the appearance and snap fit characteristics of plastic. These parts can be easily sanded and finished. For detailed instructions on how to use Z-Snap epoxy with zp250 parts see [Material Systems](#).

6.8.1 General Application Notes

- All part surfaces should be clean, dry and free of contaminants prior to applying Z-Snap epoxy.
- The part should be oven dried for 2 - 4 hours at 150°F - 200°F (65°C - 85°C), depending on part volume and wall thickness, to drive off any excess moisture that remains in the part after depowdering.
- Z-Snap epoxy can be sprayed, brushed or drizzled onto parts. Multiple thin coats applied liberally during the resin's working time will produce maximum infiltration depth.

6.8.2 Mixing Instructions

- In a clean, plastic, non-porous, container mix Z-Snap Resin to Hardener in a 2:1 ratio by volume, 100:47 by weight. Mix the two parts thoroughly for 2 minutes, stirring in a figure eight pattern, being sure to scrape the sides and bottom of the container.
- The material has a working time of 85 minutes in a 450 gram mass at room temperature. Mix only what you need. Please be aware that the mixed solution will increase to a maximum temperature of 122°F (50°C) after 40 minutes.

PLEASE NOTE: *The gel time decreases when preparing quantities of material greater than 450 grams.*

6.8.3 Curing Information

- Infiltrated parts should be pre-cured at ambient temperature for 30 minutes.
- Cure the infiltrated part for 30 minutes at (120°F) 50°C then 2 hours at (165°F) 74°C on a non-stick (wax paper, Teflon, polyethylene, etc.) material or it will adhere to the surface it is sitting on while curing.

PLEASE NOTE: Z-Snap epoxy should not be cured at temperatures greater than (165°F) 74°C and longer than 3 hours because flexibility may decrease, making the parts more brittle.

6.8.4 Clean Up

Any remaining mixed infiltrant beyond the working time should be kept in a well-ventilated area to avoid fumes. Clean up of the spraying apparatus is simple with solvents found at a local hardware store such as acetone or denatured alcohol.

For more information on the uses of Z-Snap epoxy, please refer to the technical data sheet that can be found on the 3DP User website at www.3dpuser.com.

6.9 Using Paroplast X-TRA Wax

Paroplast X-Tra is a low viscosity, general purpose, infiltration wax formulated to melt at very low temperatures (122°F or 50°C) and strengthen both starch and plaster powder parts. This material cures rapidly and enhances the vibrancy of color parts. Paroplast is available in a case of eight 2.2 lb. (1 kilogram) bag of chips.

6.9.1 Safety Precautions

- Liquid wax is hot and may cause burns. Follow all recommended safety precautions for your Z Corp. Waxter.
- Wear gloves when handling hot parts.

6.9.2 General Application Notes

- Parts should be dried in an oven at 100°F (38°C) prior to infiltrating with wax for deeper wax penetration.
- If the part is bulky, you may preheat it at 150°F (66°C) for up to 30 minutes.
- Soak part in liquid wax tank (follow all tank manufacturer's instructions).
- Remove infiltrated part from waxter.
- Place part in an oven at 150°F (66°C) until the wax has penetrated or melted off your part (usually around 15 minutes).
- Be aware that these are simple guidelines. Your specific applications may require additional steps.

6.9.3 Curing Information

Allow your parts to cool after removal from the oven until the part is no longer warm to the touch.

7 Maintenance and the Service Menu

This chapter covers routine maintenance steps and procedures that are recommended to keep the printer operating in optimal condition. It includes procedures on changing the print head, when to oil/not oil the Fast Axis, filling the wash fluid reservoir, and greasing the Slow Axis and piston screws. It will also explain the process of changing binder fluid, and bleeding air from the fluid system.

The ZPrint **Service** menu is the user's primary interface from the desktop when performing routine maintenance functions on the printer. On the ZPrint **Settings > General Preferences > General** tab, be sure to enable the **Activate Maintenance Reminder** option to have ZPrint prompt you to perform occasional maintenance on certain printer components.

For information and guidance on additional maintenance steps, please contact the Z Corporation [Service Department](#) at (781) 852-5050, toll-free at (877) 88-ZCORP or via email at service@zcorp.com.

7.1 Unpark

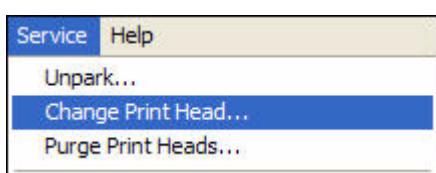
Unpark moves the carriage from its parked position, in the service station, allowing the user to freely move the gantry and carriage in order to perform routine cleaning.

7.2 Change Print Head

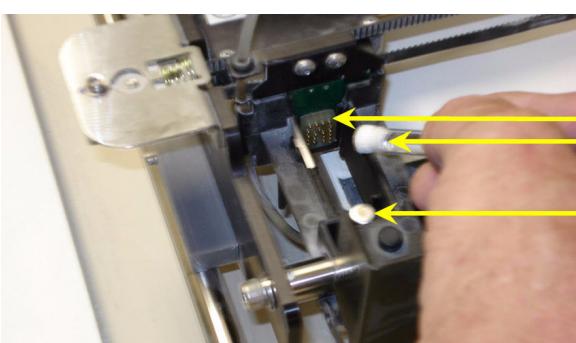
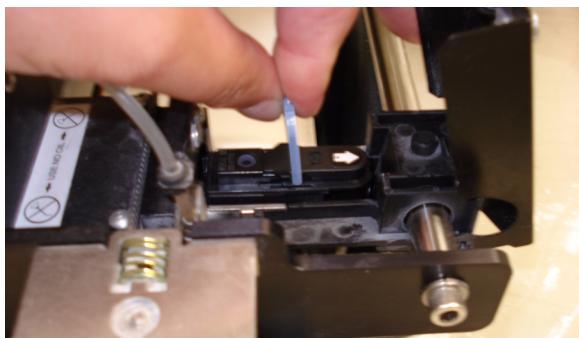
The print head will need to be changed when the print becomes uneven. A print head should be able to print at least 1.2 liters of binder (about 30 Billion pixels, equivalent to about 2500 cubic centimeters of parts). Print head life can depend upon the geometry of the parts printed, so some print heads may last longer. Signs of a worn print head are weak parts, rough surface finish, or visibly uneven printing in the build. The software will display a warning when the print head will be exceeding the expected print head life during the build. To ensure that the build will be completed and you have good print quality, replace the print heads as follows:

Technical Tip

If you fill the binder tank when you change the print head, you will not have to fill it again until you change the print head again.



1. Select **Service > Change Print Head** in ZPrint. Press **Start** to begin the process.



2. Wait for Carriage to stop moving, then lift the top cover of the print head cover.

3. Lift the Carriage cover to expose the print head. Slide the latch back to disengage and open the cover.

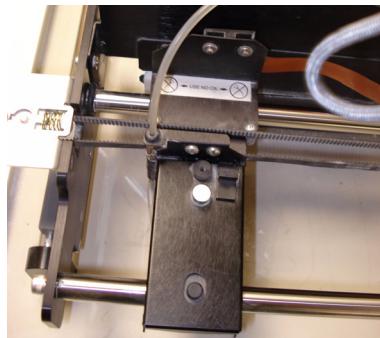
4. Remove the print head by lifting the handle and pulling directly up.

5. Take an alcohol crush tube swab and thoroughly wipe the pogo pins clean.

**Pogo Pins
Alcohol Crush Tube Swab**

Septum

6. Place the new print head in the Carriage and push down to secure the print head. The print head should seat firmly in the Carriage.



7. Close the Carriage cover and press on the Carriage cover lock until it clicks to ensure the cover is properly latched.
8. Close the top cover of the printer.
9. Press **Online** on the control panel or **Done** in ZPrint.
10. Select **Purge Print Head** on the **Service** menu.

7.3 Purge Print Heads

New print heads must be purged to remove the black ink.

1. Fill up the Binder bottle.
2. Make sure the Waste bottle is empty.
3. To purge the print head, choose **Service > Purge Print Head**. When the purge cycle is completed, the printer stops beeping.
4. Press the **Online** button on the printer.

Tip

You may continue purging the print head if you need to work in another dialogue box. Click the **X** located on the upper right-hand corner of the dialog box and close the dialog. *DO NOT* click the **Done** or **Cancel** button.

7.4 Check Powder Level

Select **Check Powder Level** to check if the printer has enough powder in the feed piston to complete the current build in ZPrint.

7.5 Drop Feed Piston

Select **Drop Feed Piston** to drop the feed piston to its lowest position from the desktop enabling the user to easily add additional powder, or to begin gross depowdering.

7.6 Fill Bed

Select to fill the build bed with powder. This is the equivalent of selecting the **Fill Bed** on the Control Panel.

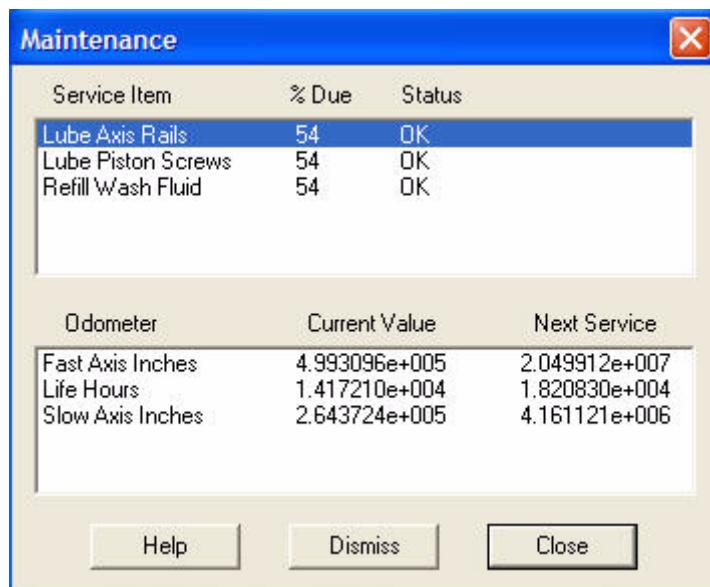
7.7 Preheat Printer

Select to heat the Printer to the proper temperature before printing. This may add some time to your overall print time.

7.8 Maintenance

Select to have the system remind you to lube the Fast/Slow axes rails, lube the piston screws, and refill the wash fluid. See *Section 7.8.2 - When to Oil/Not Oil the Fast Axis* for important information when you are prompted in ZPrint to Lube Axis Rails.

Sections 7.8.1 - 7.8.9 describes each maintenance procedure for the printer. Please follow the instructions in these section to properly perform maintenance on your printer.



7.8.1 Clean Pogo Pins

In general, clean the pogo pins whenever you replace or remove the print head. Doing this will reduce errors in communication between the print head and the printer (such as *Head ROM* errors).

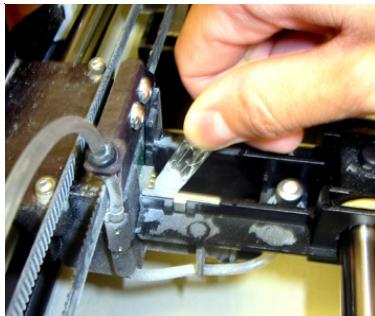
To clean the pogo pins, follow these instructions:



1. Use an alcohol swab, which can be ordered from Z Corporation.
2. Remove the alcohol swab from the packaging.



3. Crush the plastic casing to release alcohol into the swab.
4. Open the Carriage cover.
5. Remove the print head.



6. Wipe the pogo pins with the swab.
7. Reinsert the print head and close the Carriage cover.

7.8.2 When To Oil/Not Oil 310 Fast Axis Assemblies

ZPrinter 310's manufactured after September 2006 and the Fast Axis Assemblies rebuilt/manufactured after this same date, **DO NOT** require oiling of the Fast Axis rails or bearings. This is the result of changing the bearings on the Fast Axis to those that *do not* require oil.

The carriage of these new units and assemblies carries a prominent **USE NO OIL** label on the Carriage assembly. Oiling units with this label may cause them to malfunction. If oil is applied by accident, you should wipe it off completely with a paper towel before operating the printer.



If your carriage has the **USE NO OIL** label, ZPrint will still prompt you to lubricate your printer axis rails. Grease the Slow Axis in the usual way (see Section 7.9), but **DO NOT** oil the Fast Axis. To close the dialog, click **Dismiss**. When the prompt “Did you lube Axis Rails?” appears, click **Yes** to close the prompt and reset the maintenance counters.

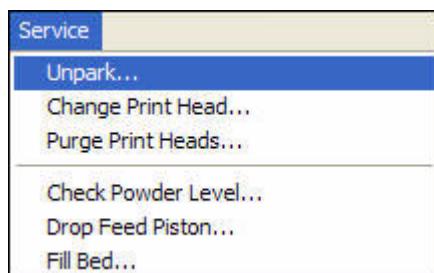
IMPORTANT!

If your ZPrinter 310 was manufactured prior to September 2006, the ZPrint Software will prompt you when it is time to *oil* the Fast Axis, provided the maintenance reminder feature is enabled on the ZPrint **Settings > General Preferences > General** tab. *Do not oil the Fast Axis unless prompted to in ZPrint.*

Fast Axis lubrication is required only for ZPrinter 310 machines with the old Fast Axis assemblies like the one shown below, (no label is covering the bearings). If your machine has an older Fast Axis assembly, follow the instructions in *Section 7.8.3* when ZPrint prompts you to lubricate the Fast Axis.



7.8.3 Fast Axis Rails and Bearings Lubrication



1. Select **Unpark** on the **Service** menu.
2. Take the printer offline by pressing the **Online** button on the 310 control panel and lift the top cover.
3. Manually move the gantry to the middle of the printer.





4. Apply a very small amount of oil on a paper towel.



5. Locate any residue buildup on the fast axis rails.



6. Wipe both of the fast axis rails with the paper towel to remove the residue. Make sure to move the carriage and wipe the back of the rail.

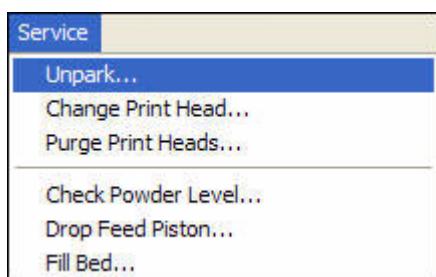


7. To oil the bearings, place the tip of the oil bottle into a fitting. Apply oil for **1 (one) second** to the bearing. Repeat for the second bearing. **DO NOT OVER OIL!** If any excess oil flows out of either fitting, wipe up the excess with a dry paper towel.



7.8.4 Refill the Wash Fluid Reservoir

Refill the wash fluid reservoir with zc10 wash fluid when alerted by the software, or refill if the wick on the service station has dried out. One bottle of wash fluid will fill up the entire reservoir. Zprint will prompt you when it is time to refill the wash fluid when the maintenance reminder feature is enabled on the ZPrint **Settings > General Preferences > General** tab. Do not refill the reservoir unless prompted to by ZPrint.



1. Select **Unpark** on the **Service** menu.
2. Take the printer Offline.
3. Lift the printer top cover and manually move the gantry to expose the Service Station.
4. Remove the red wash fluid reservoir cap.
5. Refill the reservoir using the wash fluid supplied in the Toolbox. One bottle will fill up the reservoir. Remember to reorder zc10 Wash Fluid.
6. Close the printer top cover.
7. Place the printer Online.





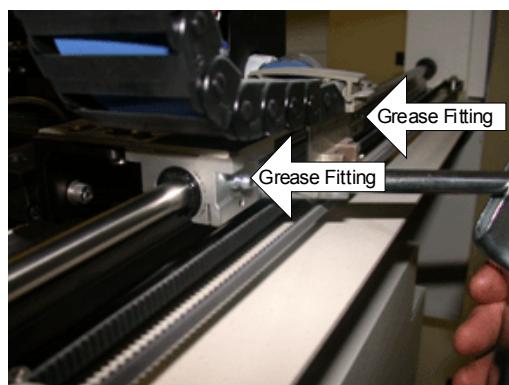
8. Click **OK** in the ZPrint **Unpark** dialog to repark the gantry.

7.8.5 Slow Axis Lubrication

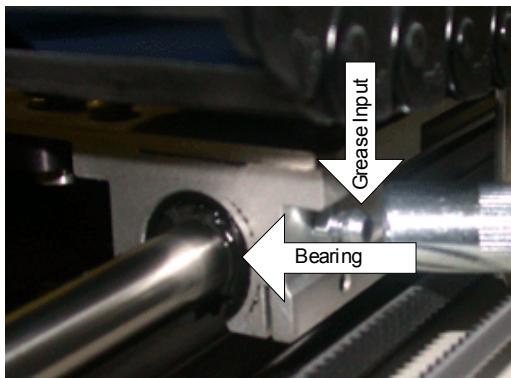
The Slow Axis will need to be greased occasionally to prevent slow axis errors. When the maintenance reminder feature is enabled on the ZPrint **Settings > General Preferences > General** tab, ZPrint will prompt you when it is time to grease the Slow Axis. Do not grease the Slow Axis unless prompted to in ZPrint.



1. If this is the first time greasing the Slow Axis, assemble the grease gun. Follow the instructions on the packaging.
2. Release the power cord from the cord clip at the bottom of the printer back cover. Remove the printer back cover by removing the seven screws.



3. Locate the two grease fittings.
4. Snap the grease coupler onto the fittings.



5. Add grease until it begins to come out the side of the bearing (typically two pulls on the trigger).
6. Clean any powder that has been deposited on the back of the top deck.
7. Replace the printer back cover.
8. Store grease gun for future use.

7.8.6 Piston Screws Lubrication

ZPrint will prompt you when the build and feed pistons need to be greased provided the maintenance reminder feature is enabled on the ZPrint **Settings > General Preferences > General** tab. Do not grease the pistons unless prompted to by ZPrint.



1. Lower both the feed and build pistons all the way down.
2. Turn Off and unplug the printer.
3. Remove the overflow bucket and locate the two piston screws.
4. Take the grease tube supplied in the Toolkit and apply grease to the entire length of both feed and build piston screws.



5. Take a paper towel and lightly wipe the feed and build piston screws in order to distribute grease.
6. Replace the overflow bucket.
7. Plug in the printer and then turn the printer On. Raise and lower the feed and build pistons a couple of times to work in the grease and then leave both pistons raised back to their proper position.

7.8.7 Change the Binder Tank

At times, you may choose to change material systems in your printer. You can use a second binder tank to facilitate the changeover procedure.



1. Carefully lift and move the binder bottle towards the front of the printer.



2. Press the release latch and pull the tubing out.



3. Insert the tubing into the latch from the new binder bottle and secure the binder bottle in place on top cover.
4. Perform the bleed air procedure to remove old binder and air from the tubing. See *Section 7.14* for instructions.
5. Purge or change the print head to flush the remaining old binder from the fluid system.

7.8.8 Change the Binder Color

Add the following mixtures of color binder to the printer feed bottle (3/4 full with clear binder) to achieve your desired color. These ratios are based on the 1.5 liters of clear binder in the feed bottle prior to adding any color. Please review the following chart for quantities.

Desired Color	Quantity of Color Binder Added to Feed Bottle with Clear Binder			
	Cyan	Magenta	Yellow	Black
Red	-	18 Squirts	9 Squirts	-
Magenta	-	18 Squirts	-	-
Orange	-	3 Squirts	12 Squirts	-
Yellow	-	-	18 Squirts	-
Green	3 Squirts	-	12 Squirts	-
Blue	18 Squirts	3 Squirts	-	-
Violet	9 Squirts	18 Squirts	-	-
Gray	-	-	-	6-12 Squirts

Hold the color binder bottle, with pump attached, up to the opening of the printer feed bottle and add the desired amount of color binder. Each squirt is approximately one ounce of binder.

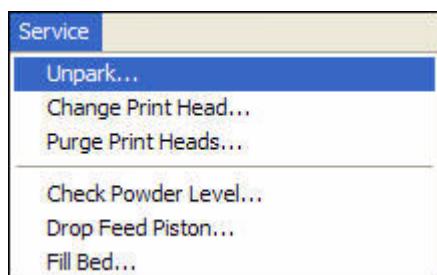
Darker or lighter shades of colors can be achieved by adding more or less of the corresponding desired color ratio (pink can be achieved by cutting the quantity of total color binder added by two). The part will appear more vibrant after infiltration.



IMPORTANT: Higher concentrations of color binder than those stated above will reduce print head life (less than 30 billion pixels). The reduction of print head life will lead to premature head over temp errors and striping during print jobs.

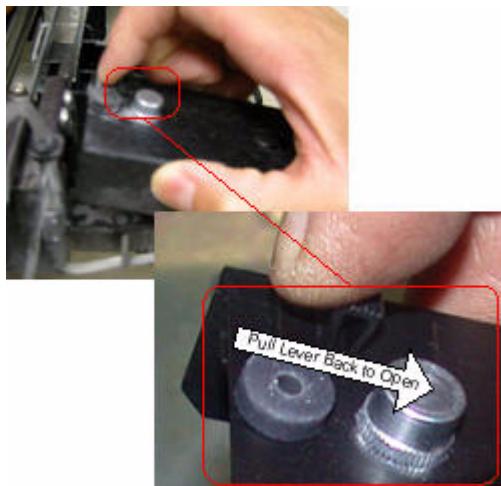
7.8.9 Bleed Air from the Fluid Lines

If air gets into the tubing due to inadequate supply of binder, or through removing the binder bottle, then bleed out the air to prevent damage to the print head.



1. Select **Service > Unpark**.

2. Lift the printer top cover.

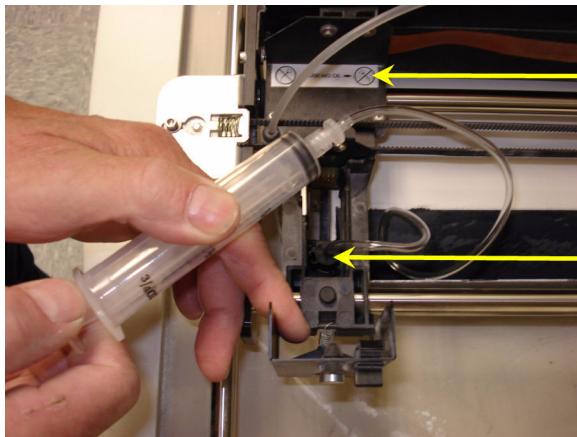


3. Open the Carriage cover to expose the print head.



4. Remove the print head.

5. Insert syringe tube fitting into the septum and remove the air and 10 cc's of liquid.



USE NO OIL Label.

Detail of syringe tube fitting over septum.

6. When completed, re-insert the print head, close the Carriage cover, close the printer top cover, and click **OK** on the **Unpark** dialog to repark the gantry.

7.9 Service Print Head

(Shortcut Key: F3) Select to service the print head if it is not printing well.

7.10 Stripe Test

Select to print a stripe test to check the functionality of the print heads.

7.11 Toggle Roller On/Off

(Shortcut Key: F4) Select to access the roller independently for easy cleaning.

7.12 Check Status

(Shortcut Key: F1) Select to check the status of how much powder is in the Feed Piston, of how much room is remaining in the Build Box, and to see which version of the ZPrint Firmware you are running.

7.13 Print Head Report

Select to view a report of the number of pixels printed, temperature levels, and flow rates for the current print heads.

7.14 View Printer Log

Select to view a report of the number of pixels printed, temperature levels, and flow rates for the current print heads.

7.15 Upload New Firmware

Select to upgrade the Firmware for your 3D Printer. The Service Department will provide you with the required upgrades and instructions for installing. You can also check our user Website at www.3dpuser.com.

7.16 Upload New Printer Configuration

This feature is used during diagnosis. It should only be modified under the instruction of the Z Corporation Service Department or an authorized Service representative.

7.17 Edit .INI File, Send File and Receive File

This feature is used during diagnosis. It should only be modified under the instruction of the Z Corporation Service Department or an authorized Service representative.

7.18 Machine Status

State	Power LED	Online LED	Error LED	Beep
Off	off	off	off	off
Booting	solid	off	off	off
Online	solid	solid	off	off
Offline	solid	off	off	off
Printing	solid	solid	off	off
Sleeping	solid	slow flash	off	off
Error ¹	solid	off	solid	off
Booted, can't find network ²	solid	off	solid	off
Cover open – close to continue	solid	fast flash	fast flash	solid
Cover open – print head not parked	solid	on or off	off	once every 30 seconds
Auto parking	solid	on or off	off	3 fast beeps
Piston auto dropping	solid	medium flash	off	off
Filling bed	solid	medium flash	off	off
Changing the print head	solid	medium flash	off	off
Purging the print head	solid	medium flash	off	slow

¹ Press the online button to recover from an error. If the error is unrecoverable, the printer will reboot.

² Press the online button to revert to serial port communication.

8 System Details

This chapter covers the system details and material storage precautions. For more information, please contact the Z Corporation [Service Department](#) at (781)852-5050 or Toll-Free at (877)88-ZCorp. Or, visit the 3DP User Website at www.3dpuser.com.

8.1 Symbols Used

The following symbols are used on the ZPrinter 310 Plus System:

This is the international symbol for **Standby Power**. It is used on the printer power switch. The printer is partially powered as soon as you plug it in. The power switch is momentary contact and toggles the machine from idle mode to full power on mode.



This is the international symbol for **Warning** or **Caution**. When it appears on the exterior of the equipment, it indicates the need to consult your manual for further information.



This is the international symbol for **Hot Surface**. When it appears on the exterior of the equipment, it indicates caution when around the area.



8.2 System Specifications

System Dimensions 32.0" x 29.8" x 43.2" (81 x 76 x 110 cm)

Operating Conditions 68 to 85°F (20-29°C), 20 to 60% Relative Humidity, non-condensing.

Lithium Battery

Internal to the printer is a lithium coin cell type battery. This may be any one of the following: Type: CR2032, either Maxell, Panasonic, Renata, Sanyo, or Sony.

PLEASE NOTE: This battery is **not** in a user accessible area and is *not user replaceable*. The expected lifetime of the battery is in excess of five years. Replacement will be handled by your authorized service representative.

FCC Notice

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CENELEC Class A Warning

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to EN 55022. Class A devices are for office and light industrial environments, and are not generally suitable for home use.

WARNING

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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