

The University of New Haven
Industrial and System
Engineering Laboratory

uPrint

by dimension

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GENERAL CONCEPTS

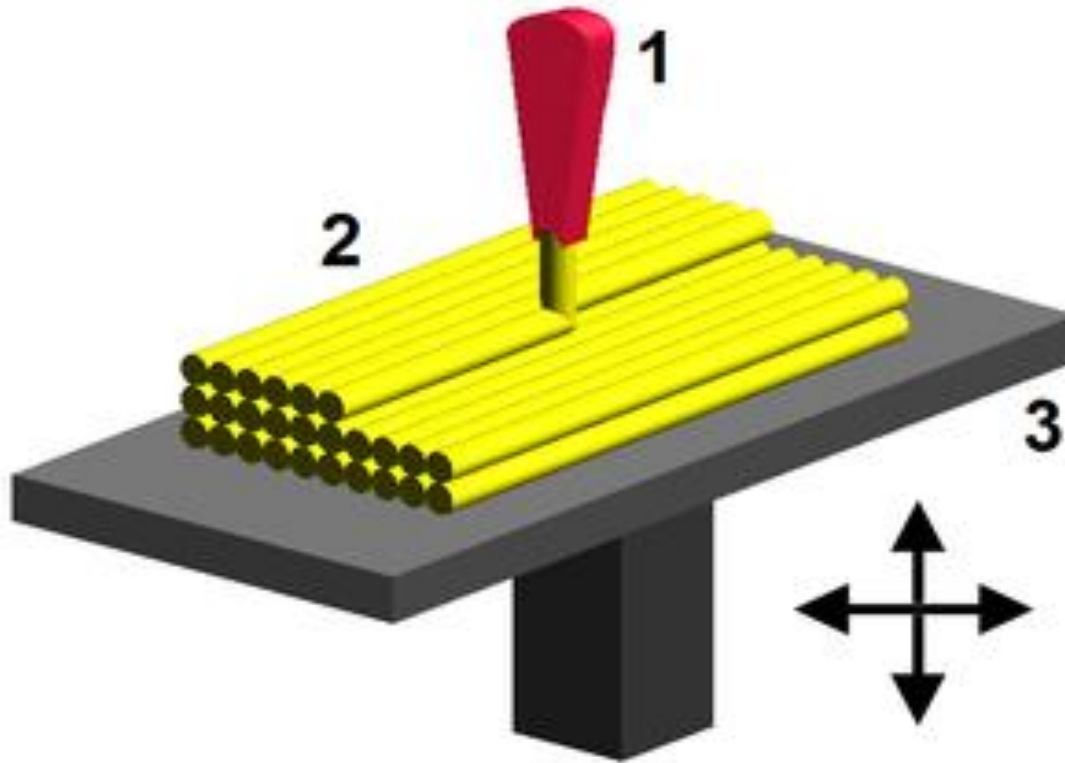
- **Rapid prototyping** is the automatic construction of physical objects using additive manufacturing technology.
- **3D printing** is a form of additive manufacturing technology where a three dimensional object is created by successive layers of material. 3D printers are generally faster, more affordable and easier to use than other additive manufacturing technologies.

GENERAL CONCEPTS

FDM technology

- Filaments of *ABSplus* modeling material and soluble support material are fed from auto-loading carriers in the material bay up to the uPrint extrusion head.
- The materials are heated to a semi-liquid state, forced through dual extrusion tips and precisely deposited onto the modeling base in extremely fine layers.
- The print head moves in X-Y coordinates and the modeling base moves down the Z-axis as the model and its support material is built from the bottom up, layer by layer.

FDM TECHNOLOGY



Fused deposition modeling (FDM), a method of rapid prototyping: 1 - nozzle ejecting molten material (plastic), 2 - deposited material (modeled part), 3 - controlled movable table

SPECIFICATIONS

Model material:

ABSpus™ in ivory

Build size:

203 x 152 x 152 mm (8 x 6 x 6 in)

Layer thickness:

0.254 mm (0.010 in) of precisely deposited model and support material

Workstation compatibility:

Windows® XP / Windows Vista®

Network connectivity:

Ethernet TCP/IP 10/100 base T

Size and weight:

uPrint printer and one material bay:

635(w) x 660(d) x 787(h) mm (25 x 26 x 31 in)

76 kg (168 lbs)

Power requirements:

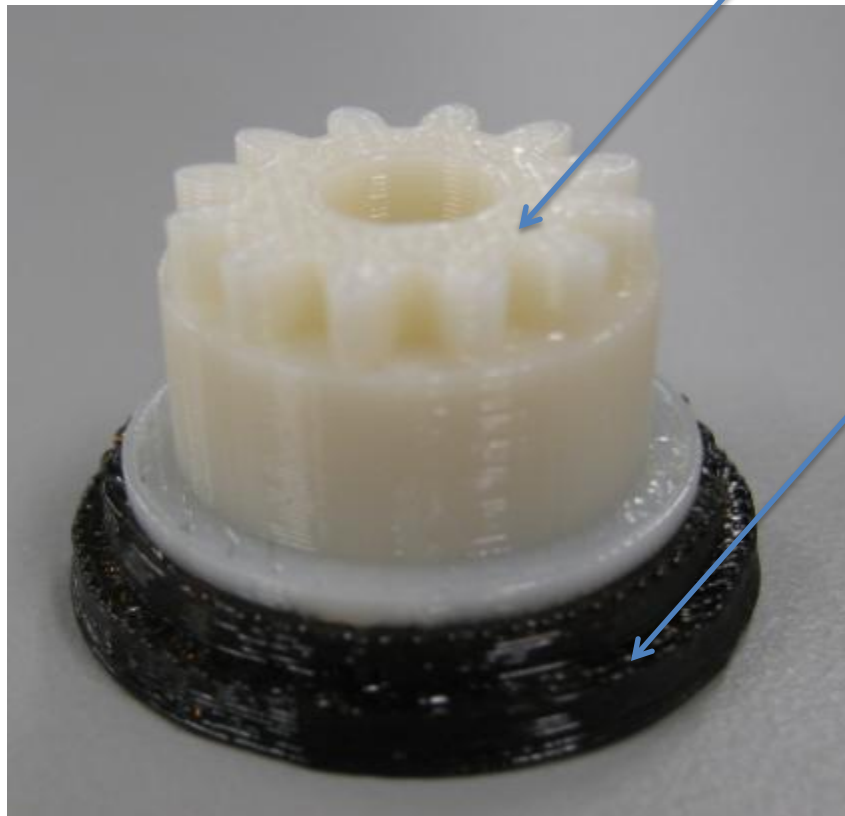
100-127 VAC 50/60 Hz, minimum 15A dedicated circuit, or

220-240 VAC 50/60 Hz, minimum 7A dedicated circuit

MATERIALS

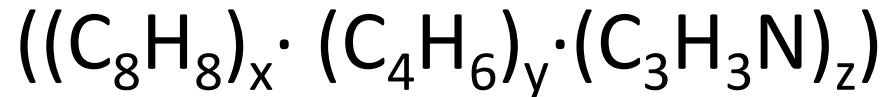
Model Material
ABS plastic

Support Material



ABS

Acrylonitrile butadiene styrene (ABS)



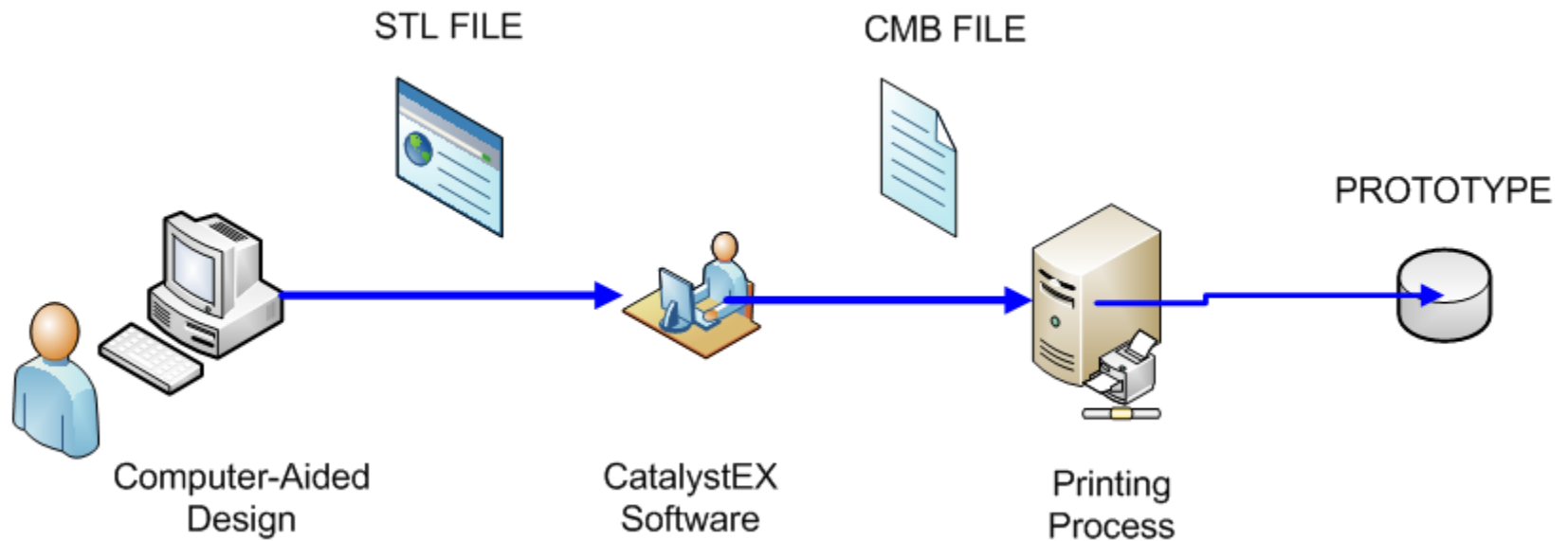
is a common thermoplastic. It is a copolymer made by polymerizing styrene and acrylonitrile in the presence of polybutadiene.

ABS

KEY CHARACTERISTICS:

- Outstanding impact resistance
- Easy to machine
- Easy to thermoform
- Easy to bond with adhesives
- Strong and stiff
- Low cost

PROCESS



APPLICATIONS AND ADVANTAGES

- Proof of Concept
- Functional Testing Dimension
- Product Cost Reduction
- Product Confidentiality
- Marketing Tools
- Product Mockups



How to print with uPrint

Making 3D models with the uPrint Personal 3D Printer is as easy as 1-2-3:



1 Prepare the file. If you can create a model in CAD software, you can print it with uPrint. The Catalyst[®]EX software that comes with your uPrint system converts the STL output from your CAD software into precise deposition paths that guide the extrusion head, printing your model layer by layer. CatalystEX automatically slices and orients your model and creates any necessary support structures. All you have to do is click "print."



2 Print your model. The uPrint 3D Printer uses patented Stratasys FDM[®] (Fused Deposition Modeling) technology to print your 3D model and its support material, layer by layer, from the bottom up. uPrint printers precisely deposit layers 0.010" (0.254mm) thick.



3 Remove the support. Remove your model from the uPrint build chamber, pop it off the modeling base and remove the soluble support material. (A support removal system is highly recommended for this process.) After it's cleaned, you can put the durable ABS^{plus}[™] plastic model through just about any post-processing you need: drilling, tapping, machining, sanding, painting, even chrome plating.

PRINTER



1 Display panel tells you at a glance the status of your uPrint printer, and lets you directly interact with its operation. Also indicates stand-by and power-down modes.

2 Extrusion head heats solid filaments of modeling and support material into a semi-liquid state. Then, the head makes extremely precise movements to deposit the materials through separate tips onto the modeling base.

3 Modeling base is the platform on which each model is printed. The modeling base moves down as the extrusion head deposits each layer of material.

4 Material bay contains two material carriers: support material on the left and modeling material on the right. An optional second material bay can be installed underneath the first bay for twice the uninterrupted print capacity.

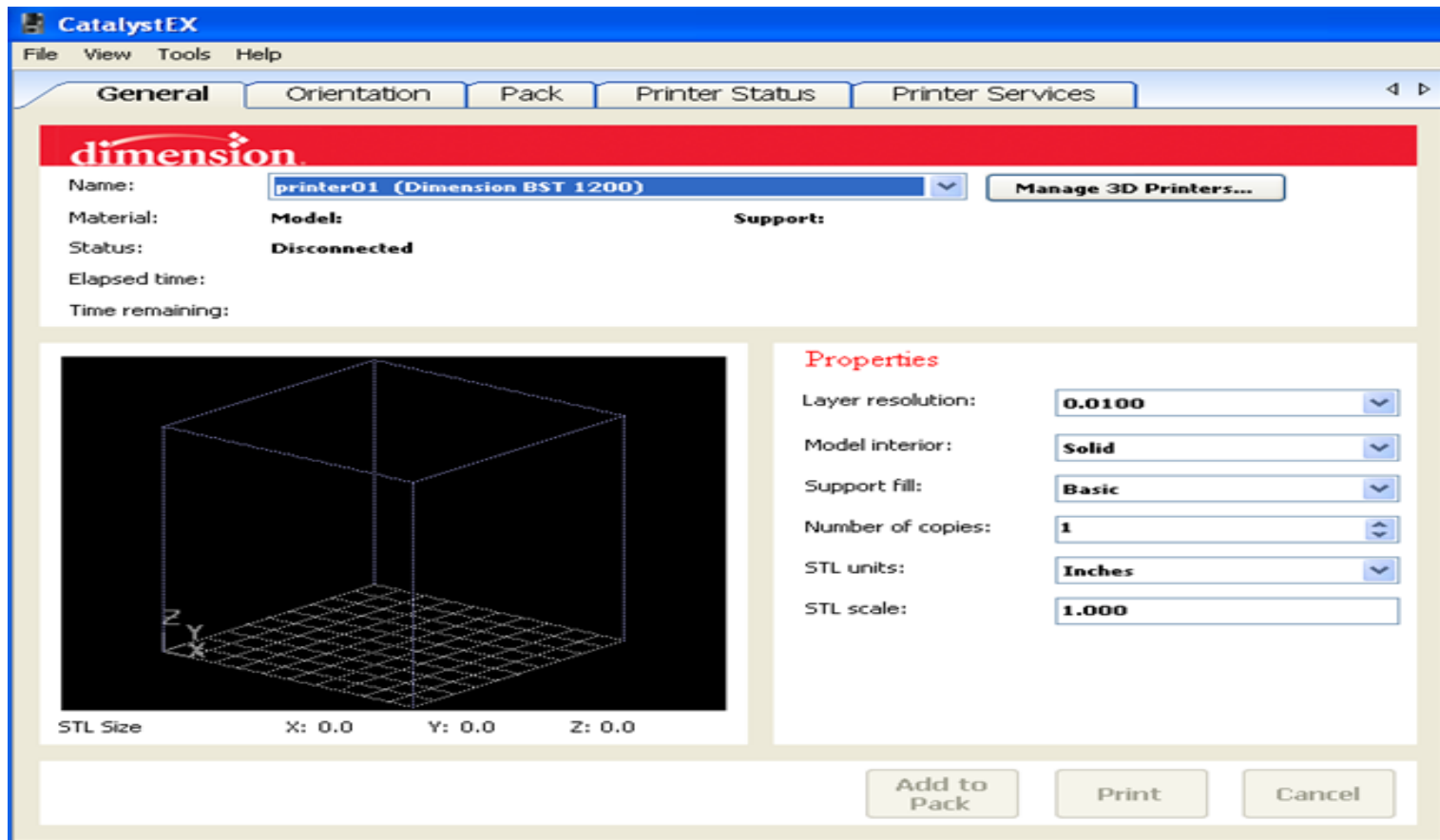
CatalystEX SOFTWARE

CatalystEX is an user-friendly application designed to interface with Dimension 3D printers. It allows you to open a 3D drawing of a part, prepare the drawing for print, and send the print command to create the part.

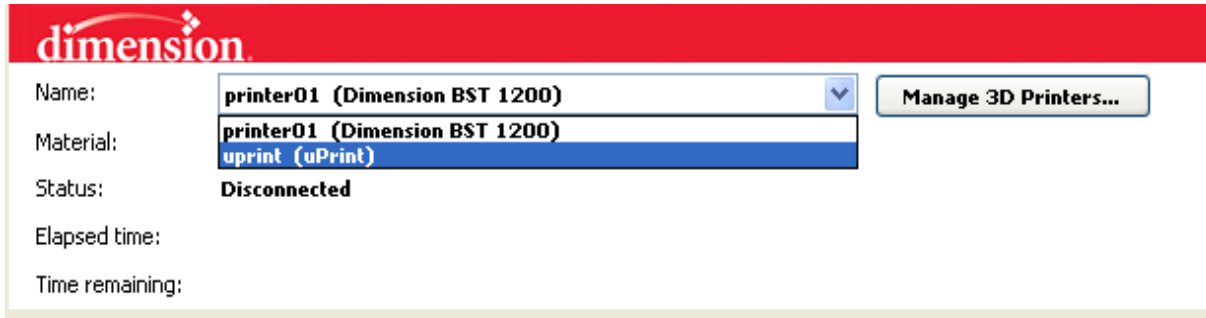


GENERAL TAB

The **General Tab** contains information relative to basic job set-up - Printer Options; Model Views; Job Properties.



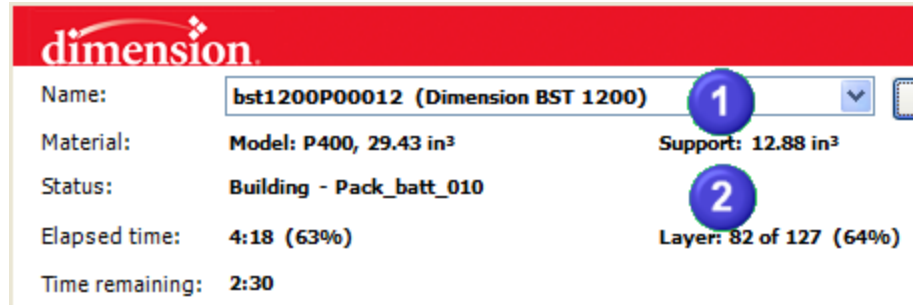
SELECT A 3D PRINTER



The screenshot shows the 'dimension.' software interface. It features a red header bar with the 'dimension.' logo. Below the header, there are several fields: 'Name:' with a dropdown menu showing 'printer01 (Dimension BST 1200)', 'Material:' with a dropdown menu showing 'printer01 (Dimension BST 1200)' and 'uprint (uPrint)' (highlighted in blue), 'Status:' with the text 'Disconnected', 'Elapsed time:', and 'Time remaining:'. To the right of these fields is a button labeled 'Manage 3D Printers...'.

- To Select an available 3D printer use the 'Name' drop-down list. This list displays the name and type of the available printers. Left-Click from the list to make a choice. A name is given to a printer during initial installation.
- Processed files must be compatible with the current printer.
- You can also change the current printer from the 'Manage 3D Printers...' button.

PRINTER INFORMATION AREA



Name:	bst1200P00012 (Dimension BST 1200)	
Material:	Model: P400, 29.43 in ³	Support: 12.88 in ³
Status:	Building - Pack_batt_010	
Elapsed time:	4:18 (63%)	Layer: 82 of 127 (64%)
Time remaining:	2:30	

Material - displays information about the material cartridges loaded on the selected printer.

Model: Model material color, type, and amount remaining.

Support: Support material amount remaining.

Status - displays the current machine state

Idle - printer has no jobs currently printing and/or in the build queue.

Building - lists the file name of the part being built.

Part Done - building of a part is complete - part is still in printer.

Pending Start - part is in queue waiting to be built.

Standby - printer has gone into a sleep mode - both head and chamber temperatures have been lowered to conserve energy.

PRINTER INFORMATION AREA

Maintenance - user is performing maintenance on the printer - the printer will be returned to "Idle" after maintenance is complete.

Upgrade - printer is ready for controller software update.

Rebooting - after an update has been completed.

Disconnected - printer is offline.

Invalid Modeler - incorrect printer definition.

Time remaining - the amount of time remaining for the part being built. (Hours: Minutes)

OPEN A FILE

Open STL file

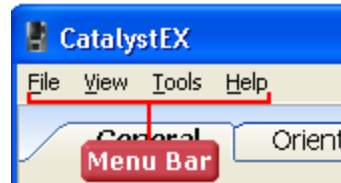
From the Menu Bar choose:

File>Open STL

Navigate to the STL file you want to open.

Double click the file or click Open.

The selected file will be added to the Model window.



Insert CMB file

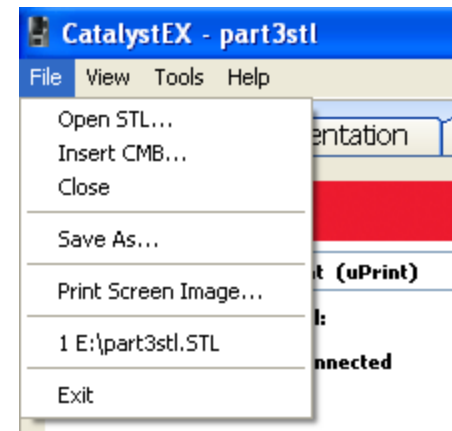
From the Menu Bar choose:

File>Insert CMB.

Navigate to the CMB file you want to open.

Double click the file or click Open.

The selected file will be added to the Pack Preview window.

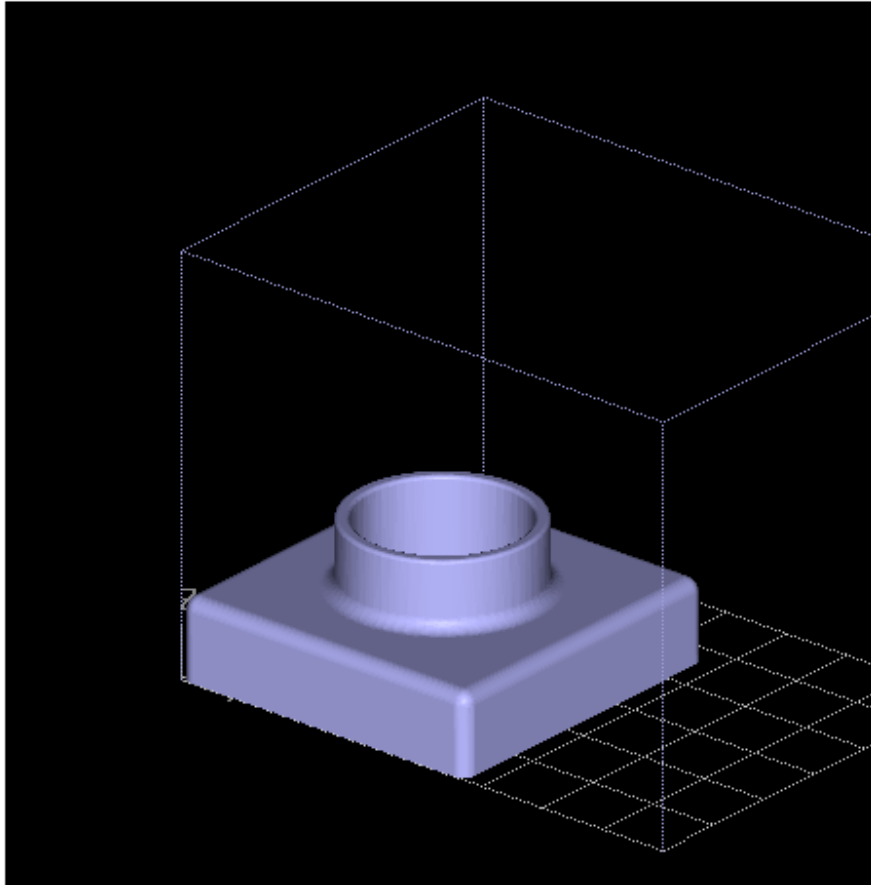


FILES TYPES

STL file - A 3D drawing of your part created by a CAD software program.

CMB file - This file is created from an STL file through a process run by the CatalystEX software. It is the CMB file that is sent to a printer.

BUILD PROPERTIES



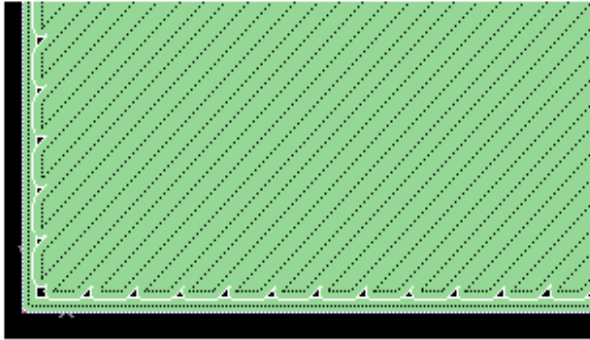
Properties

Layer resolution:	<input type="text" value="0.0100"/>
Model interior:	<input type="text" value="Sparse - high density"/>
Support fill:	<input type="text" value="Sparse"/>
Number of copies:	<input type="text" value="1"/>
STL units:	<input type="text" value="Millimeters"/>
STL scale:	<input type="text" value="1.000"/>

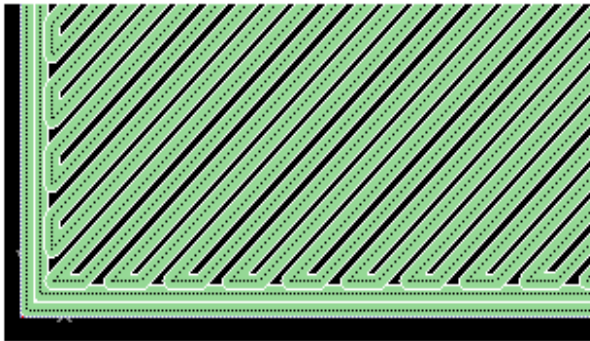
BUILD PROPERTIES

- **Layer resolution** - height of each layer of material extruded to produce a part. Resolution will effect build time and surface finish - A shorter height creates a smoother finish, but will take longer to build.
- **Model interior** - establishes type of fill used for interior, solid areas of the part. Build times will be longer and more material will be used.

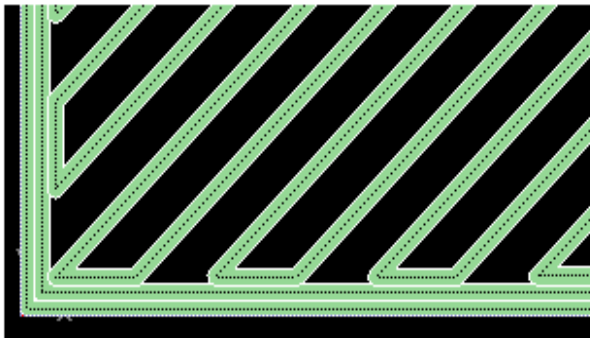
Solid - used when a stronger, more durable part is desirable. Build times will be longer and more material will be used.



Sparse - high density (Elite, 1200es, uPrint 3D Printers only) - this is the default model interior style and it is highly recommended. Build times will be shorter, less material will be used, and the possibility of part curl for geometries with large mass will be greatly reduced.



Sparse - low density - the interior will be "honeycombed/hatched". This style allows for the shortest build times and lowest material use.



BUILD PROPERTIES

Support fill - support material is used to brace the model material during the build process. It is removed when the part is complete. Support fill options will effect the support strength and build time of the print.

Basic - may be used for most parts. It uses a consistent spacing between the support raster tool paths.

Sparse - minimizes the amount of support material. Sparse uses a much larger spacing between raster tool paths than basic supports.

Minimal - is used for small parts that have small features in need of supports. It is designed to make support removal easier on these small parts. Do NOT use minimal supports on large parts or parts with tall columns of support.

Break-away - similar to Sparse supports without a closed tool path-perimeter curve. They are easier to remove than other support styles but build slower than Sparse supports (not available for all printers).

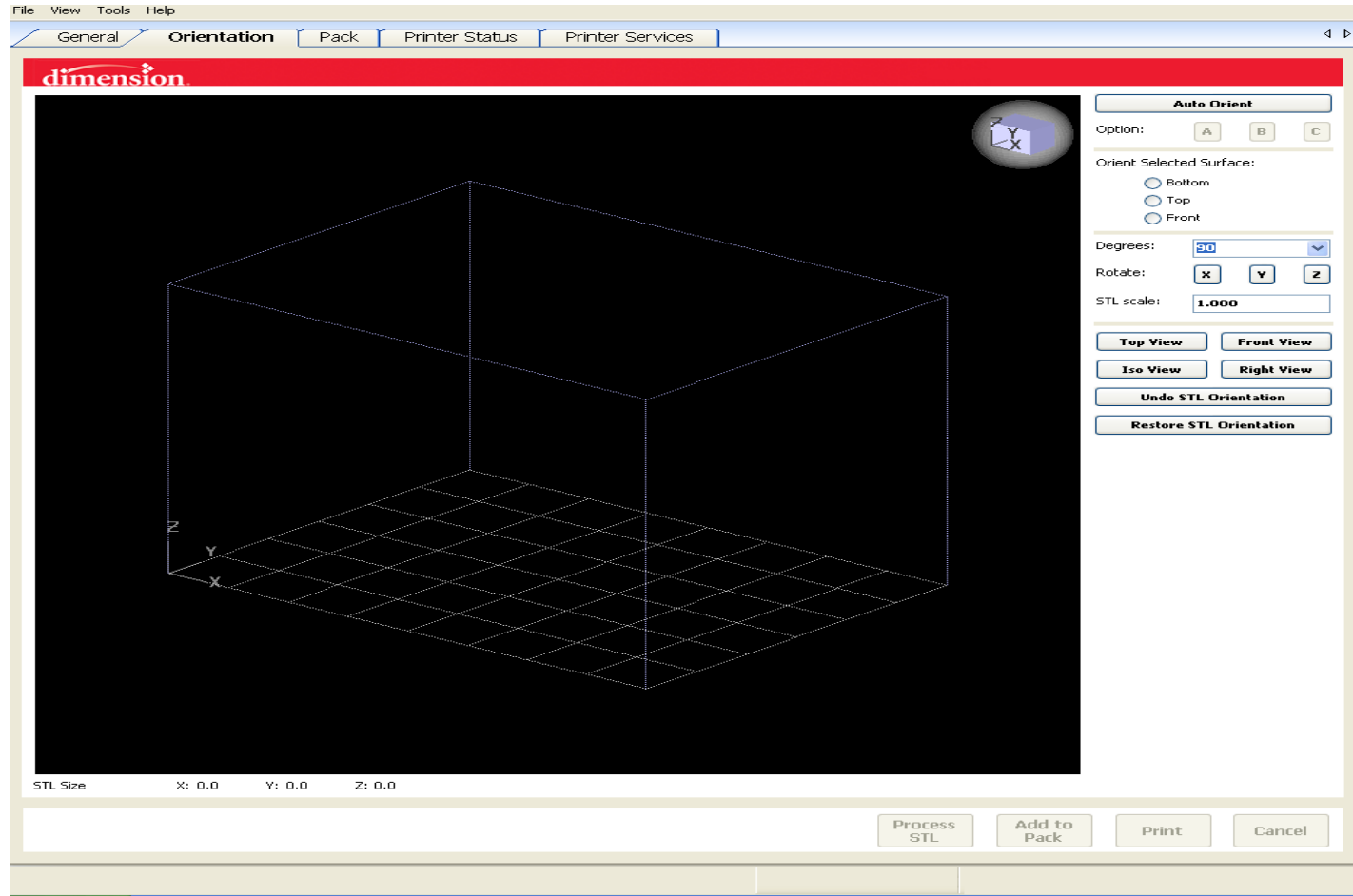
Surround - the entire model is surrounded by support material. Typically used for tall, thin (narrow) models (e.g., pencil).

BUILD PROPERTIES

- **Number of copies** - select the number of copies you want to Print or Add to Pack. The number of possible copies will be limited by the size of the modeling platform.
- **STL units - select 'inches' or 'millimeters' units of measure for your STL file.** STL files do not specify units of measure. You need to specify the units as either inches or millimeters.
- **STL scale** - before you process a part for printing, you can change the size of the part within the build envelope. Every part has a pre-defined size within the STL file. After you have opened the file you can change the size of the part produced from the STL file by changing the **scale**. The Scale always relates to the ORIGINAL (or "Save As") STL file size definition.

ORIENTATION TAB

It provides options for viewing a part, measuring a part, orienting a part, processing a part, inserting pauses, and viewing the layers of a part.



ORIENTATION TAB

Orientation Tools

- **Automated Orientation**

CatalystEX can perform an analysis of the part and provide up to 3 STL orientations that optimize build time and material usage.



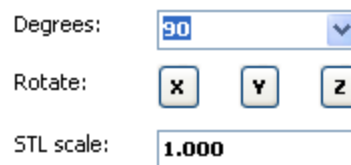
- **Orient Selected Surface**

Orient Selected Surface:

- ☐ Bottom
- ☐ Top
- ☐ Front

- **Manual Orientation**

Orient the part in one degree increments along the X, Y, and Z axes. You can also change the size of the part within the build envelope by changing the STL scale.



ORIENTATION CONSIDERATIONS

- How a part is oriented within the Model Window will determine how the part is oriented when it prints on the modeling base.
- Orientation impacts the build speed, part strength, surface finish, and material consumption.
- Orientation can also affect the ability of CatalystEX to repair problems with an STL file.

ORIENTATION CONSIDERATIONS

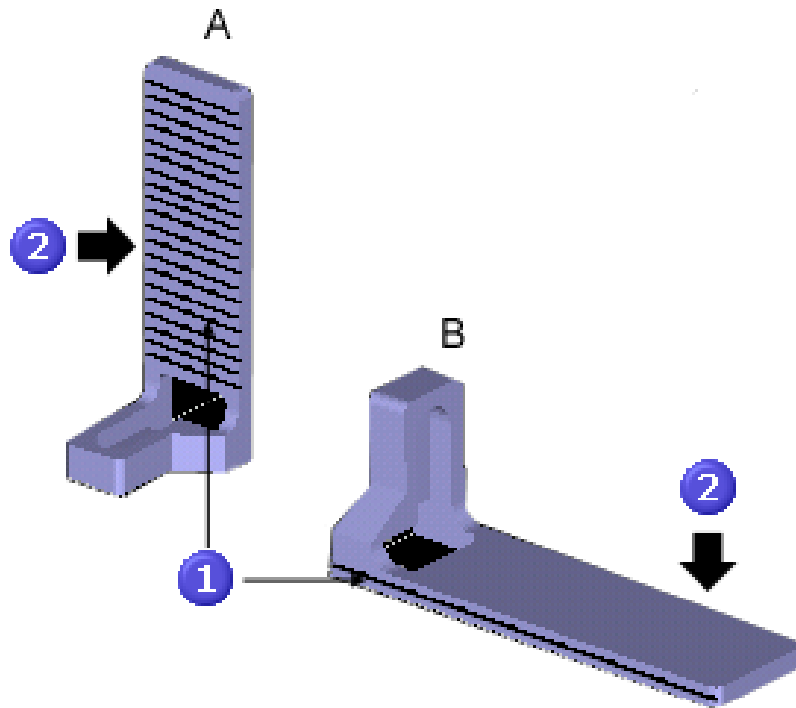
Build Speed

- Closely related to material use. In general terms, a lesser amount of supports will allow for greater build speed.
- Another factor affecting speed is the axis orientation. The printer can build faster across the X-Y plane, than it can along the Z-axis. Therefore, orienting a part so that it is 'shorter' within the modeling envelope will produce a quicker build.

Part Strength

A 3D part is stronger within a layer than it is across layers. Depending upon what you want your part to demonstrate, you may need to orient a part to have its greatest strength across a specific area - i.e., a tab that needs to be squeezed would be weakest if you are squeezing across layers.

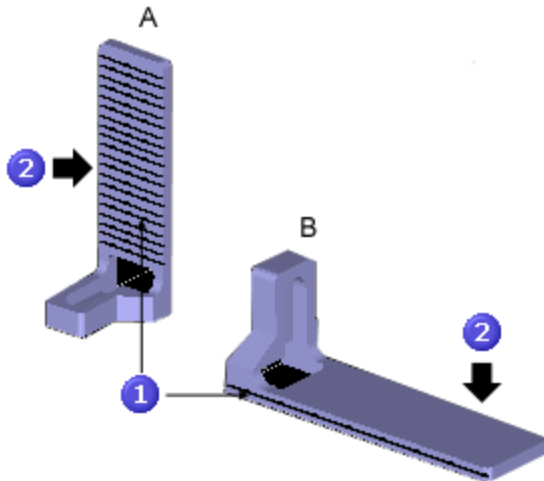
ORIENTATION CONSIDERATIONS



- | | |
|---|------------------------------------------------------------------------------------------------------|
| 1 | Layer direction |
| 2 | Force applied to the part.
Orientation B produces the strongest part against the indicated force. |

ORIENTATION CONSIDERATIONS

- **Surface Finish** - Much like orienting for strength, orienting a part for finish will allow the printer to provide the smoothest finish for a specific area.



1 Layer direction

2 Appearance of long surface.
The long surface of orientation B will be smoother than the long surface created by orientation A.

ORIENTATION CONSIDERATIONS

- **STL File Repair** - It is possible for an STL file to have errors and appear to be trouble free. If the STL file contains errors, CatalystEX may have problems processing the file. CatalystEX has the ability to automatically correct some STL file errors. Part orientation can impact this automated repair function.

PROCESSING AND PRINTING

There are 4 buttons in CatalystEX that control the processing, packing, and printing of STL files.



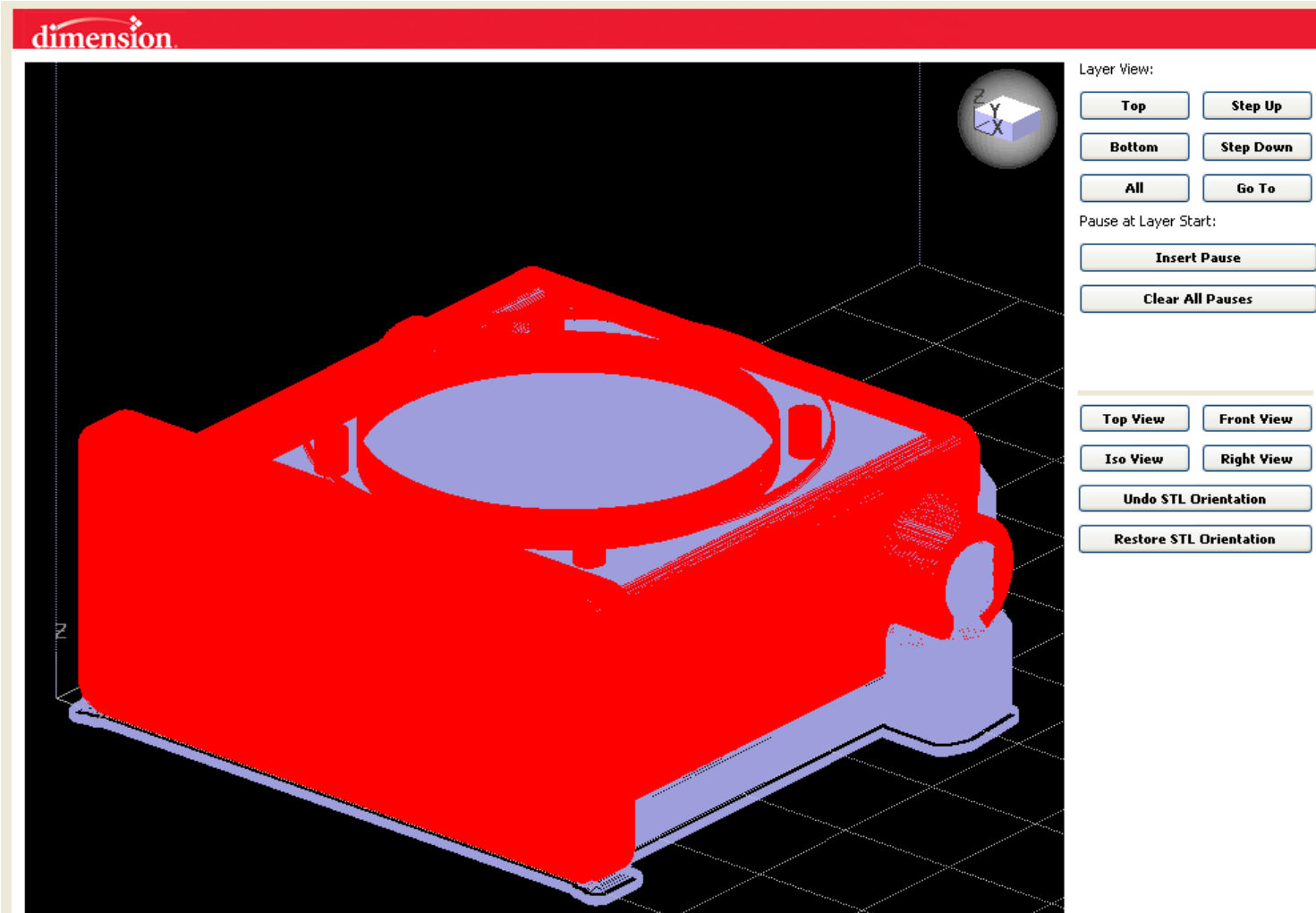
Process STL Button

- The Process STL button is only found on the Orientation Tab. Clicking this button allows you to process an STL file without sending the file to a Pack or to Print.
- When CatalystEX processes an STL file, it automatically saves the process result as a CMB file.

Add to Pack Button

- The Add to Pack button is found on the General Tab, Orientation Tab, and Pack Tab.
- When you click the Add to Pack button, CatalystEX will add the file that is currently in the Model Window (General Tab or Orientation Tab) to the Pack Preview window (Pack Tab).
- If the file in the Model window has NOT been processed for print, processing will occur before the file is added to the pack.

PROCESS STL



ADDING TO PACK

- A Pack can consist of one model or many models.
- A pack contains information about the location of single or multiple CMB files within the build envelope.
- A pack can be sent directly to a printer ... or it can be saved to allow printing at a later time. When a Pack is sent to a printer, the models in the pack are created simultaneously by the printer.
- To be included in a Pack the STL file for a part must first be processed into a CMB file.

ADDING TO PACK

GeneralOrientationPackPrinter StatusPrinter Services

dimension

Name:printer01 (Dimension BST 1200)Manage 3D Printers...

Material:Model:Support:

Status:Disconnected

Preview

Insert CMB

Copy

Remove

Repack

Rotate

Clear Pack

Save As

Pack Details

Name:housing_03

Model Material:17.20 in³

Support Material:6.65 in³

Time:15:10

Notes:

ID	Name
1	housing_03

PRINTING PACK

- **Insert CMB** - Click to select a CMB file to add to the Pack.
- **Copy** - Allows you to copy the 'selected' model within the Pack Preview window.
- **Remove** - Deletes the 'selected' model within the Pack Preview window.
- **Repack** - Automatically consolidates parts on the Pack. The parts are arranged to maintain minimum spacing between parts. By default, parts repack to the center of the platen.
- **Rotate** - Rotates the 'selected' model 90 degrees counterclockwise.
- **Clear Pack** - The entire contents of the Pack Preview window will be emptied. If the Pack has not been saved, the grouping will be lost.
- **Save As** - Allows you to save and name a Pack. When a Pack is saved, the CMB file data and modeling platform location information are saved as a single CMB file. The individual CMB files will still exist, but now there will also be a single CMB file for the Pack.

PRINTING PACK

- The build estimates displayed show the estimated material amounts required for the pack and the approximate build time of the pack.
- You can also add your own notes, which will get saved when the CMB file is saved.
- The numbered list shows all the CMB files that are included in the Pack. Selecting a file name in the list will select the file in the Pack Preview window (indicated by a box around the part).

Pack Details

Name:

Model Material: **17.20 in³**

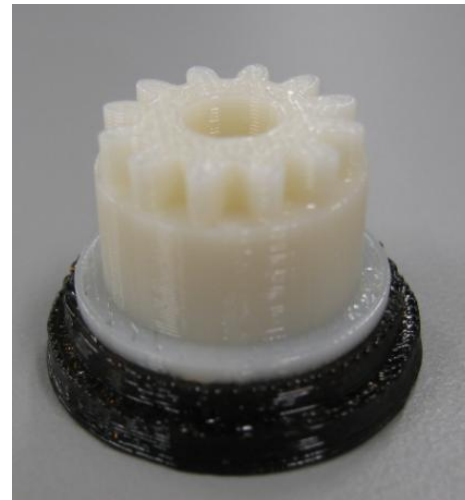
Support Material: **6.65 in³**

Time: **15:10**

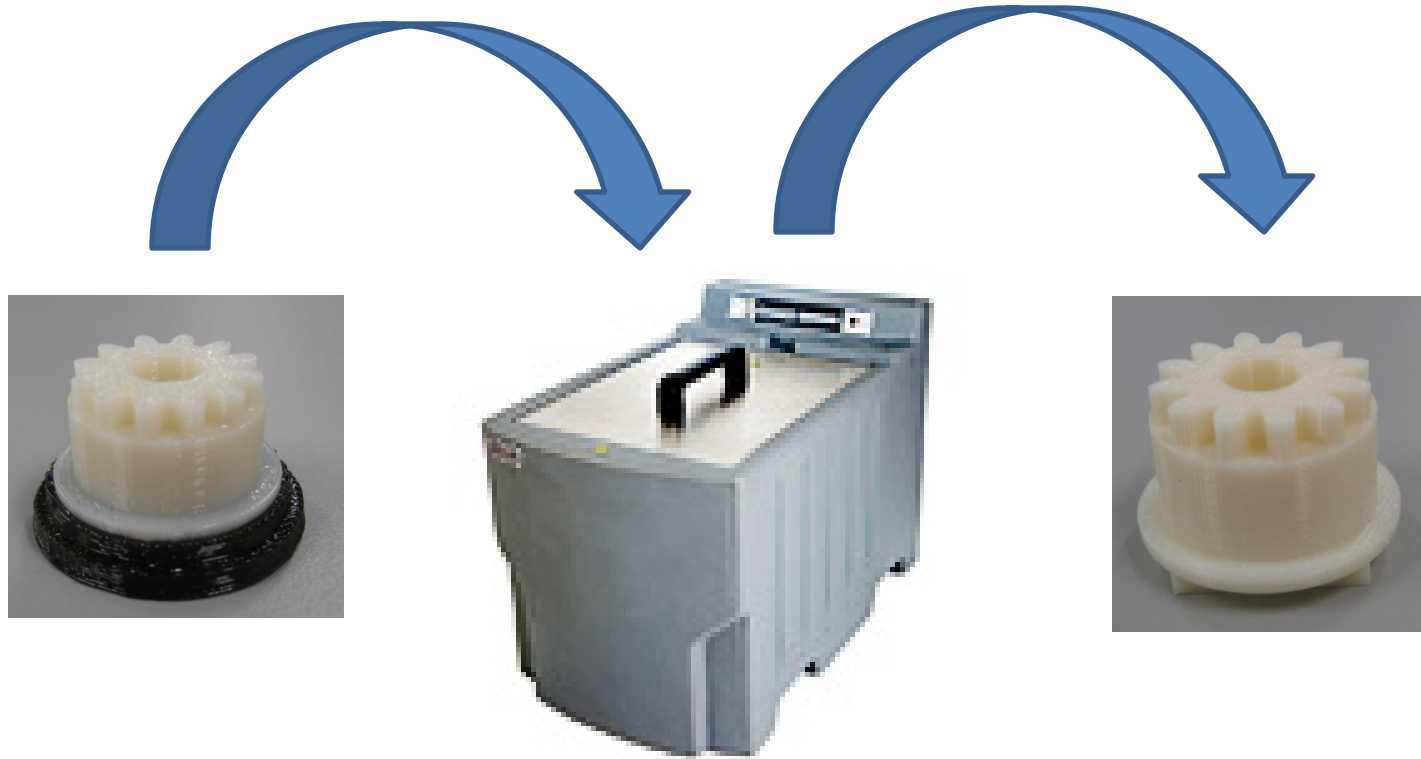
Notes: ...

ID	Name
1	housing_03

PRINT



AFTER PRINTING



RINSE TANK



Support removal

uPrint uses Soluble Support Technology (SST) with a model support material that dissolves away in a soluble solution, providing a hands-free process.

We highly recommend the purchase of a uPrint support removal system to handle this process. You just pop your completed model off the modeling base and place it in the support removal tank. The support removal system maintains the right solution temperature and agitation for efficient support removal.

STL REPORT

Stl Report

STL Information

STL name:

E:\housing_03.STL

STL comment:

solid housing_03

STL size (inches):

(5.53, 4.72, 2.36)

STL scale:

1

Facet count:

11616

Vertex count:

5786

Edge count:

17424

Memory (KB):

8651

Unjoined edge count:

0

Automated Slice Curve Repair

Small curves discarded:

0

Open curves closed:

0

Neighboring curves merged:

0

Error Conditions

Misoriented curves:

0

Self-intersecting curves:

0

Open curves:

0

Save As

OK

STL REPORT

- Before an STL file is processed the STL Report will provide general information about the file in the 'STL Information' section of the screen.
- After the file is processed, the information provided varies dependent upon the STL file and the processing result.
- If an STL file contains no issues to affect processing, the resulting STL Report will not change from the report generated prior to processing.

STL REPORT

Automated Repair

- CatalystEX has the ability to automatically repair some STL file errors. The success of automatically repairing an STL file is dependent upon several factors - the type of error, the location of the error, the STL scale, and the orientation of the part.
- All Repairs are listed in the 'Automated Slice Curve Repair' section of the Report

Unresolved Errors

- CatalystEX cannot Repair all STL file errors. If the errors cannot be corrected the Status Line of the CatalystEX window will show the message, 'Done slicing, with problems. See STL Report for more information'.
- Errors that caused a processing failure are listed in the 'Error Conditions' section of the report. Errors that cause processing to fail are also highlighted by a Red Exclamation Point.

STL REPORT

How to Fix Unresolved Errors

- Change the part orientation or STL scale and re-process the part - some errors may automatically repair.
- Use a CAD program to edit the STL file to remove Unjoined edges.
- Use an STL repair software package.

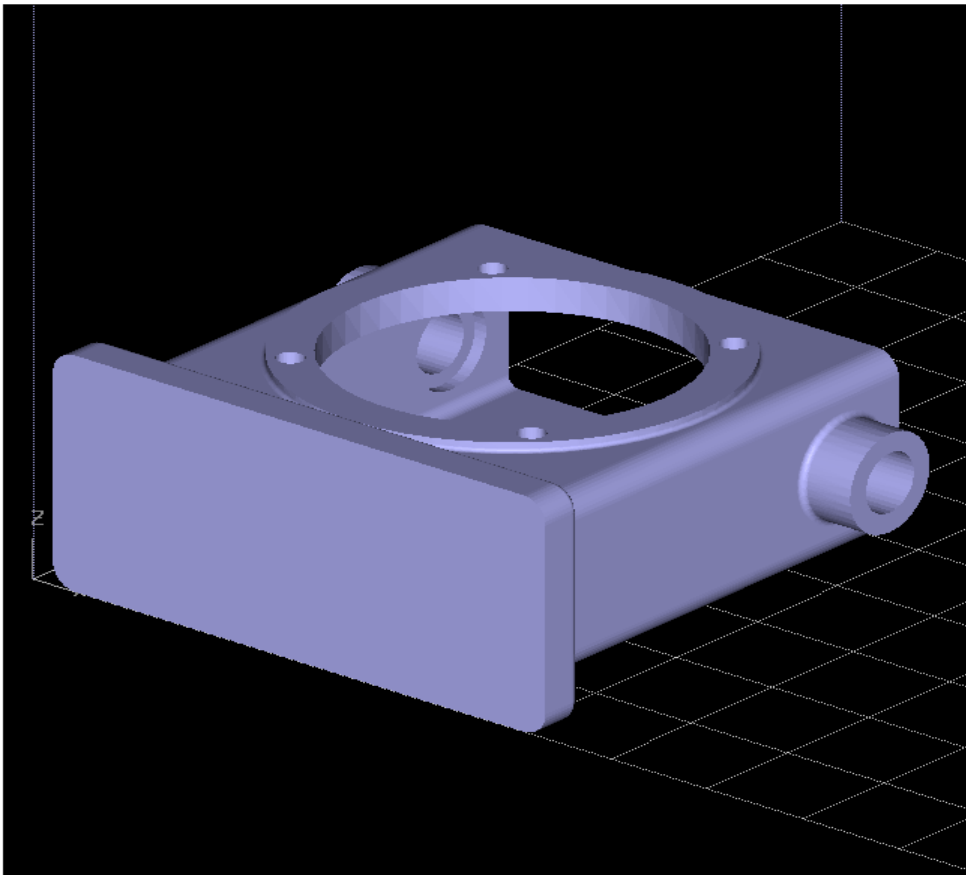
PART SUMMARY

Part Summary

dimension.

STL path: E:\housing_03.STL

CMB path: E:\housing_03.cmb.gz



Printer type:	Dimension BST 1200
Build time estimate:	15:10
Model material:	17.204 in³
Support material:	6.650 in³
Layer resolution:	0.010 Inches
Model interior:	Solid
Support fill:	Basic
Version:	Version 4.0.1 Build 3818

PART SUMMARY

- The Part Summary opens within the main window of CatalystEX and displays the part in its non-processed state - all path and slice information is removed from the Summary. You can access the Menu Bar to print a screen image (File>Print Screen Image...); change the View of the part; access file options (Tools>Options).
- The 'Save As' button gives you a choice of saving the Part Summary as a JPEG or as a TXT file.
- When saved as a JPEG, the entire screen image is captured
- When saved as a TXT file, the pertinent file data is saved as text and can be opened by any text editing application (Notepad, WordPad, Word, etc):

PRINTER STATUS TAB

Build Queue

- The Build Queue window displays current or pending jobs by order in which the jobs were sent to the printer - the last job sent is at the bottom of the list.
- The Queue displays the following for each Job: Job Name, Owner Name, Submit Time, Estimated Build Time, Estimated Finish Time, Model Material, Support Material (Model Material and Support Material indicate predicted amount of material required for job), Model Cartridge, and Support Cartridge (Model Cartridge and Support Cartridge indicate approximate amount of material remaining in the cartridge AFTER the part is complete).

Building Indicator

- Indicates that the job has started building. The job will remain in the queue until the job is complete and removed from the printer.

PRINTER SERVICES TAB

Administration

- **Printer Password** - Allows you to change or create a printer password. When a password is enabled Print Queue manipulation, Software Upgrades, and changes to the Printer Clock cannot be accomplished without the correct password.

Maintenance

- **Printer Info** - Displays valuable printer information - In addition to the printer name, type, status, serial number, and software version, the pop-up provides:
- **Material Amounts** - The amount of Model and Support material remaining in the cartridges.
- **Current Temperatures** - The current Build Envelope, Model Head, and Support Head temperatures are displayed.
- **Update Software** - The controller software for the printer can be updated from your PC.

UPDATING SOFTWARE

- The controller software for the printer can be updated from your PC.
 1. From the printer, enter 'Maintenance', then select 'Load Upgrade'.
 2. From CatalystEX, select the printer you wish to upgrade, then click the 'Update Software' button.
 3. Navigate to the location of the controller software upgrade file (.upg file). Select the file specific to your printer and Open the file.
 4. The update will be automatically loaded to the printer.
 5. After load, the printer will display Verifying update.
 6. At completion of verification process, the printer will display, Reboot to Complete. Select Yes.

REFERENCES

- uPrint User guide
- <http://www.dimensionprinting.com>

END