3D Printer Features

AHG 2015 Preconference Session

## What is a 3D Printer?

Essentially a 3D printer is a robot. It is a machine that creates three dimensional objects through additive manufacturing in which successive layers of a material are laid down under computer control.

Technically there are all types of processes that fit the bill, including use of inkjet printers with plaster powder laid down sequentially or laser melting or sintering of metal or ceramic powders. Sintering refers to the process by which a solid mass is made by compacting and forming material using heatand/or pressure but without melting it to the point of liquefaction.

For the purpose of this session, we are focusing on extrusion. We are looking at 3D printers that use thermoplastics such as PLA, ABS, or other filaments to create models one layer at a time.

## What are some of the key differences in printers of this type?

There are many printers on the market, and many more coming out every month. Prices shift and features evolve. Below are descriptions of some of the key features to keep in mind when evaluating options.

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| **Key Features** | **What it means** |
| Bed Features | * Smaller bed sizes mean needing to print pieces one at a time (or in pieces) * Larger bed sizes allows for printing larger pieces or multiple pieces at once * Self-leveling are easier to use * Heated beds help with adhesion (making sure filament sticks to glass in printing) |
| Filament Spool Load | * Closed holders are more common with manufacturer specific cartridges * Open designs allow for more flexibility and easier access for cleaning |
| Printing Speed | * Faster print speeds require higher temperatures (melt filament more quickly) * Corners and edges are slower than curves - high res takes longer than low res |
| Resolution (layer height) | * Thinner layers render prints with more detail (.1mm or smaller) * Thicker layers print faster (.5mm is considered thick) |
| Extruders | * The extruder is the combination of the nozzle that melts the filament, the motor that pushes the filament, and the temperature sensor and fan that maintain an appropriate temperature * Some systems have a single extruder – others offer multiple extruders * The max temperature of the nozzle dictates which filaments can be used |
| Control of Unit | * SD Cards or USB Drives with control panels or dials and on screen displays * USB for direct computer connection * Wireless computer connection and/or use of Mobile Apps * On board storage allows jobs to be saved to and run straight from device |
| Display | * Text display allows for file navigation * Full display allows for visualization prior to print |

## A Side-by-Side Comparison of Selected Models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Flashforge Dreamer | LulzBot Mini | Ultimaker 2 | MakerBot 5th Gen |
| Image of the Unit  with alt text descriptions | Flashforge Dreamer is fully enclosed with a gray plastic exterior and removable lid. The door in the front opens. The LCD display is in the front right bottom corner. | [LulzBot Mini is an open frame in black metal with side vents and a large red power button and USB slot in front. There is a green rocktopus on the bed.](http://www.tomsguide.com/us/slideshow/LulzBot-Mini_product-photo,0101-490440-0-2-9-1-jpg-.html) | [Ultimaker has an enclosed sides with an open front and top in white. The SD card slot, LCD display, and illuminated dial are centered on the front bottom of the unit. The bed is empty but raised.](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0CAcQjRw&url=http://www.engadget.com/2013/09/20/ultimaker-2/&ei=QtWWVeraN8GxsAWTno6oBQ&bvm=bv.96952980,d.b2w&psig=AFQjCNEmJJnwGpsQfvO0unwTcWDV_ZCmQA&ust=1436034750430909) | The MakerBot has open front and sides and is a dark grayish black exterior with a control panel located on the top front toward the right side of the unit and the filament compartment is raised in the loading position. There is a red plasatic bunny rabbit on the bed. |
| Bed Dimensions and Features | Bed size – 9.1 x 5.9 x 5.5  295 cubic inch build area  Heated alloy  Assisted-leveling | Bed size – 6 x 6 x 6  223 cubic inch build area  Heated glass  Self-leveling | Bed size – 9 x 8.7 x 8  626 cubic inch build area  heated glass  Assisted-leveling | Bed size – 9.9 x 5.9 x 7.8  456 cubic inch build area  Unheated acrylic  Assisted-leveling |
| Extruder Details | Dual extruders that feed from internally housed left and right side filaments | Single extruder that feeds at head with open design and arm that holds spool | Single extruder that feeds from the back through bowden tube | Smart Extruder cartridge with spool stored in compartment - up to load |
| Best Resolution | Layer height to .1mm | Layer height 0.05 mm | Layer height .02 mm | Layer height to .1 mm |
| Max Temperature | Nozzle temp to 240 C  Bed temp to 120 C | Nozzle temp to 300 C  Bed temp to 120 C | Nozzle temp to 260 C  Bed temp to 100 C | Nozzle temp to 240 C  Bed temp N/A |
| Filament Options | PLA, ABS, PVA – 1.75mm | Range of filaments – 3mm | PLA, ABS, CPE – 3mm | MakerBot’s PLA – 1.75 mm |
| Display/Connection | SD card with LCD display  USB or WiFi connection | No display or SD card  USB to computer | SD card with LCD display  USB to computer | USB drive with LCD display  USB or WiFi connection |
| Software | Flashprint Software with options for slicing engine | Choice of Open Source (comes with Cura) | Cura (Open Source) | MakerBot Software |
| Features | 4GB Internal Storage | Cleaning pad for nozzle | Room for dual extruders | Camera and mobile app |