

# Nylon Printing Best Practices



# CubePro®

Nylon Printing Best Practices

## Introduction

Printing with CubePro Nylon (NYL) is an exciting endeavor for the 3D printing enthusiast. Nylon is a strong, flexible and durable material. It is an excellent choice for prototyping, small-run manufacturing and parts requiring secondary operations.

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## Compliance

### FCC Notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

 **NOTE:** Changes or modifications to this equipment not specifically approved by 3D Systems may void the user's authority to operate this equipment.

## KCC

이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

This equipment is home use (Class B) electromagnetic wave suitability equipment and to be used mainly at home and it can be used in all areas.

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This equipment conforms with International Electric Committee (IEC) 60950-1 and meets the requirements of the applicable EC directives.

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CAN ICES-3 (B)/NMB-3(B)

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This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.



# Important Safety Information

## Safety Symbols and Definitions



**HOT SURFACE HAZARD: A HOT SURFACE IS ACCESSIBLE IN THE VICINITY OF THIS SIGN OR AT THE PRINT JET. AVOID CONTACT WITH THESE AREAS. HOT SURFACES CAN CAUSE SEVERE BURNS.**



**Caution:** Indicates something may happen that could cause loss of data, damage to equipment, or could cause personal injury.



**Caution:** Indicates a pinch point hazard that could cause personal injury.



**SHOCK WARNING: INDICATES A POTENTIAL SHOCK HAZARD.**

## SAFETY GUIDELINES

- Follow all safety rules in this section and observe all cautions and warnings in this guide.
- Do not modify any safety features or make modifications to the CubePro. Doing so is prohibited and voids the warranty.
- Use of print materials other than genuine 3D Systems components may void the warranty.



**WARNING: HAZARDOUS MOVING PARTS. KEEP FINGERS AND OTHER BODY PARTS AWAY.**



**HOT SURFACE HAZARD: DO NOT TOUCH THE PRINT JETS DURING SETUP AND OPERATION. THE PRINT JETS BECOME VERY HOT.**



**Caution:** Read and follow all instruction prior to setting up the printer.



**SHOCK WARNING: DUE TO RISK OF SHOCK, AVOID CONTACT WITH ALL INTERNAL ELECTRONIC COMPONENTS.**



**WARNING: THE CUBEPRO SHOULD ONLY BE SERVICED BY AUTHORIZED SERVICE TECHNICIANS. PRIOR TO ANY PART REPLACEMENT PROCEDURE, THE PRINTER MUST BE POWERED OFF AND DISCONNECTED FROM UTILITY POWER.**



**HOT SURFACE HAZARD: WHEN PRINTING WITH ABS MATERIAL, THE INTERIOR (PRINT CHAMBER) OF THE PRINTER WILL HEAT TO A PREDETERMINED TEMPERATURE. THE SURFACE OF THE PRINT CHAMBER HEATER WILL BE HOT. AVOID CONTACT WITH THE PRINT CHAMBER HEATER AND NOTE THAT OTHER COMPONENTS INSIDE THE PRINT CHAMBER MAY BE HOT.**

To ensure safety, please exercise caution when operating your CubePro. Read and follow all safety precautions as outlined in this user guide. Be careful when operating your CubePro to ensure proper printing and be mindful of and avoid hot surfaces.

# Level The Print Jet Nozzle

## Verify the Print Jet Nozzle Level

Leveling the print jet nozzles is very important to ensure quality prints especially after replacing a print jet, an extruder assembly or the print pad.

The Print Jet Level Gap calibration file requires all cartridge bays to be loaded with the same material type cartridges.

 **NOTE:** Ensure the file used matches the printer model and the installed print material type. All installed cartridges must be of the same material type. (Ex. If the cartridge bays have ABS material cartridges installed, print the ABS Level Gap calibration file.)

These files are available at [www.3dsystems.com/shop/cubepro/downloads](http://www.3dsystems.com/shop/cubepro/downloads). The Level Gap Calibration files are available from the Calibration Files download link in the **Firmware and Files** section of the web page.

The file names are listed below:

### PLA:

- noz12\_PLA\_LEVELGap.cubepro (This file is for printing PLA on a CubePro Duo)
- noz123\_PLA\_LEVELGap.cubepro (This file is for printing PLA on a CubePro Trio)

### ABS:

- noz12\_ABS\_LEVELGap.cubepro (This file is for printing ABS on a CubePro Duo)
- noz123\_ABS\_LEVELGap.cubepro (This file is for printing ABS on a CubePro Trio)

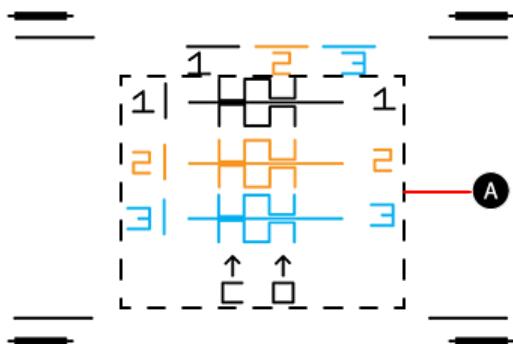
### Nylon:

- noz12\_NYL\_LEVELGap.cubepro (This file is for printing nylon on a CubePro Duo)
- noz123\_NYL\_LEVELGap.cubepro (This file is for printing nylon on a CubePro Trio)

Other files may be made available in the future.

## Level Nozzle Calibration Print Overview

The following illustration demonstrates what you would see when the print jet nozzles are properly leveled.



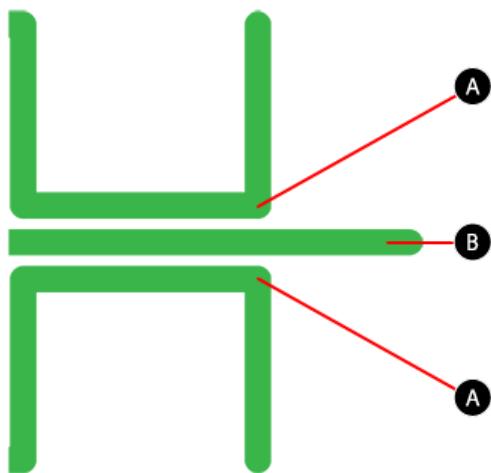
 **Z-Gap** - The Z-Gap is the distance between the print pad and the print jet nozzles. The Z-Gap should always be checked and adjusted first before the Level Gap.

## Important

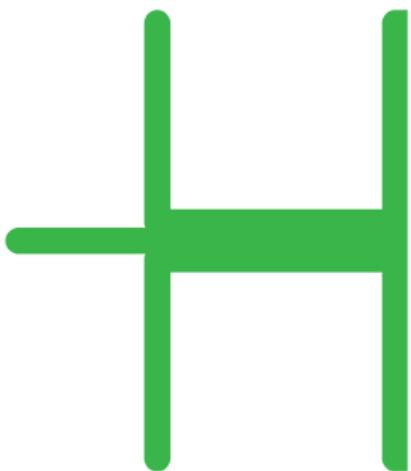
If either ABS or PLA materials are used to check nozzle level, the gap must be checked with the nylon single nozzle Level\_Gap file.

- When using NYL\_LEVEL\_GAP it is best to have the corner-plate level patterns contain a gap above and below the baseline.
- The gap for nylon is different than the gap for ABS and PLA materials. For best print results, the Z-gap for nylon should be slightly more than the Z-gap for other materials when reading the open Z-gap print. This gap is found between the measurements lines (A)

and the baseline (B).



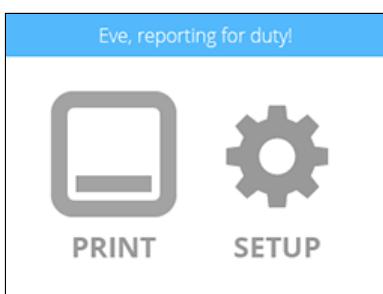
- The closed pattern should remain be closed.



## Printing the Level Gap Calibration File

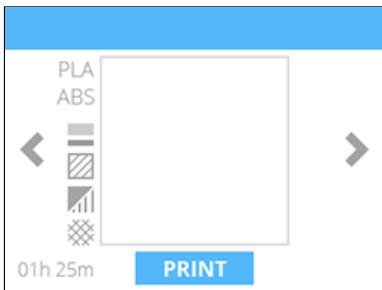
 NOTE: Ensure the print pad is completely clean from glue and printed parts before beginning this procedure.

1. Download the [CALIBRATION FILES](#) and extract them to your computer's hard drive.
2. Navigate to the file location and copy the appropriate file to your USB mass storage device.
3. Insert the USB mass storage device into the USB host port on the printer.
4. Select [PRINT](#).



5. Using the arrows, navigate to the Level Gap Calibration file and select [PRINT](#).

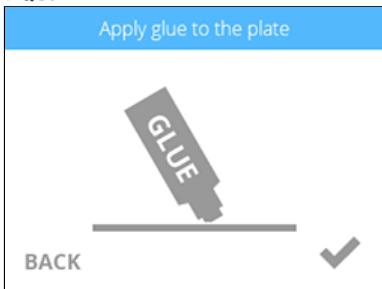
 NOTE: There are several Level Gap Calibration files as well as Nozzle Offset Calibration files. Select the Level Gap Calibration file for print material type installed in the printer.



6. Apply two thin layers of Cube Glue to the print pad in an area of 50 mm x 50 mm. Select the **checkmark** to continue.

**NOTE:** For more information, refer to the section titled [Applying Cube Glue](#).

**NOTE:** It may take several minutes to print the file.



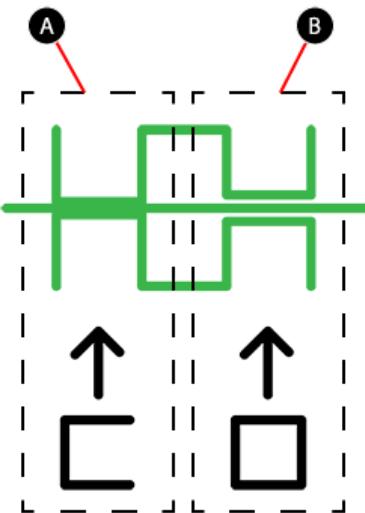
7. When finished, remove the print pad and verify the Level Gap.

**NOTE:** If any adjustments are needed, perform this procedure again after making the adjustments. Make sure all glue and plastic residues have been removed prior to performing this procedure again.

## Compare Print Jet Z-Gaps

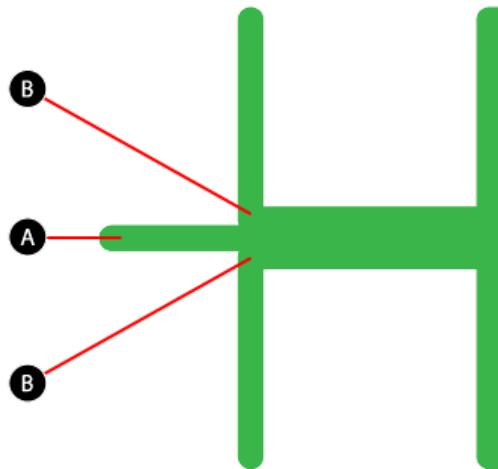
Inspect the Z-Gap readings for each print jet. If any of the print jets have an incorrect Z-gap, they will need to be leveled again.

**NOTE:** The Closed Z-Gap (A) and the Open Z-Gap (B) are two different measurements but should be read together.



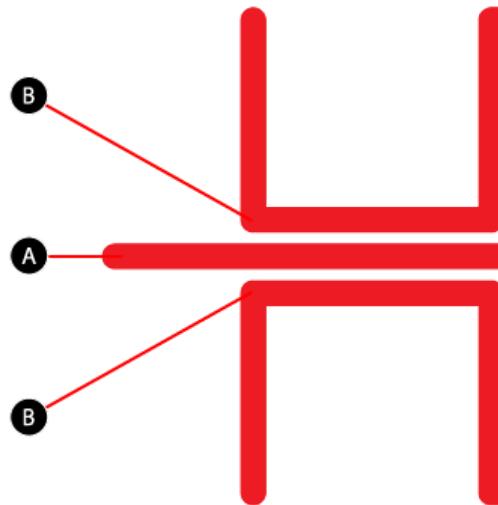
**Correct Closed Z-Gap**

The Closed Z-Gap bars (B) should touch the baseline (A). This should be consistent with the calibration print for each print jet.



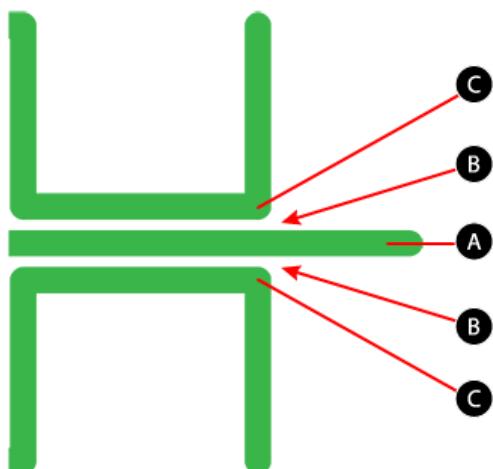
### Incorrect Closed Z-Gap

If there is a gap between the Closed Z-Gap bars (B) and the baseline (A), that print jet is too high and should be adjusted. Once it has been adjusted, print the calibration file again to verify that the print jets are level.



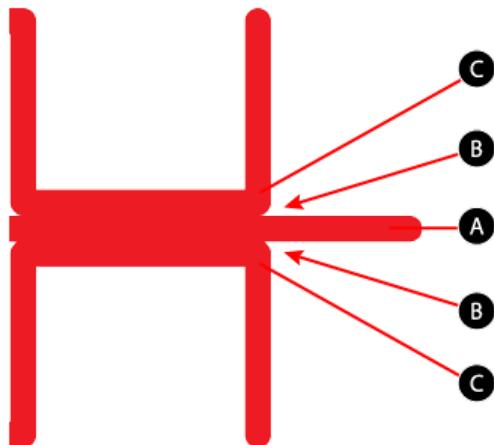
### Correct Open Z-Gap

If there is a gap (B) between the Open Z-Gap bars (C) and the baseline (A) and there is no gap between the Closed Z-Gap bars and the baseline, that print jet is level.



## Incorrect Open Z-Gap

If there is no gap (B) between the Open Z-Gap bars (C) and the baseline (A), that print jet is too low and should be adjusted. Once it has been adjusted, print the calibration file again to verify that the print jets are level.



## Leveling The Print Jet Nozzles

### Tools Needed

- T10 Torx Driver

### Level The Print Jets



**SHOCK WARNING: EXERCISE CAUTION WHENEVER YOU ARE NEAR ELECTRICAL COMPONENTS.**



**WARNING: BEFORE SERVICING THESE COMPONENTS, ENSURE YOU ARE WEARING A WELL-GROUNDED ELECTRO-STATIC DISCHARGE (ESD) STRAP. ESD PROTECTION IS REQUIRED.**



**WARNING: NEVER PULL ON WIRES TO DISCONNECT THE CONNECTORS. THIS COULD DAMAGE THE WIRES AND THE CONNECTORS AND VOID THE MANUFACTURER'S WARRANTY.**

The following procedure is intended to provide instructions about how to level print jets for printers with more than 1 print jet.

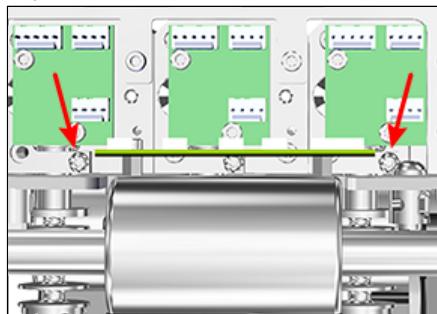
1. For printers with two (2) or three (3) print jets, loosen the T10 torx screws on extruders 1 and 3.



**CAUTION: There should be enough access to reach the torx screws using an insulated torx driver. Exercise caution when working around the PCBs.**

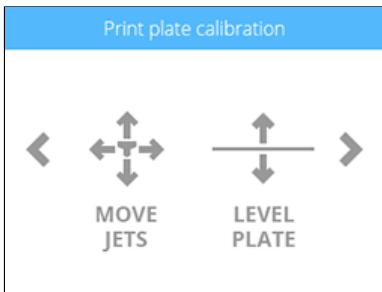


**NOTE: Print jet 2 should not need adjustments.**



2. Connect the printer to utility power, turn on the main power switch and then turn on the display.

3. Navigate to the Print Plate Calibration screen and select **MOVE JETS**.



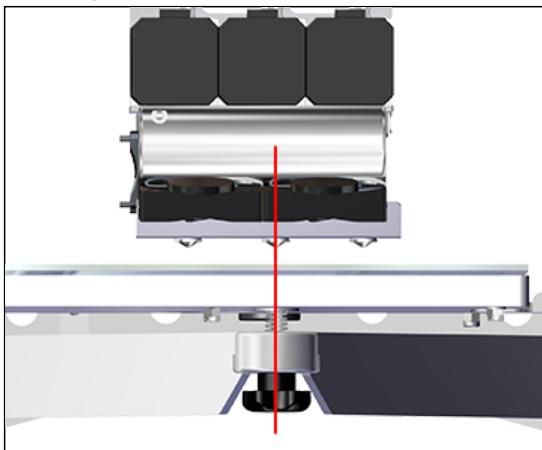
4. Select the Z: down arrow until the display reads -0.50.

**NOTE:** For printers with 2 or three print jets, visually inspect the gap between the nozzle tip of print jet 2 and the print pad. If necessary, press the Z: down arrow until there is a gap.



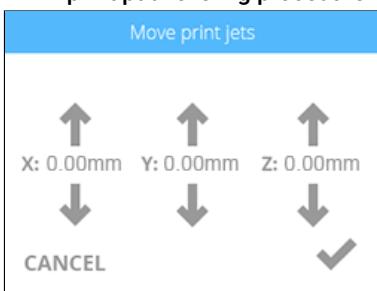
5. Press the X and Y adjustment arrows until print jet 2 is closely aligned above the front print pad adjustment knob.

**NOTE:** The red line in the illustration demonstrates an approximate alignment of print jet 2 and the front print pad adjustment knob.



6. Press the Z: up arrow until the nozzle of print jet 2 lightly touches the print pad.

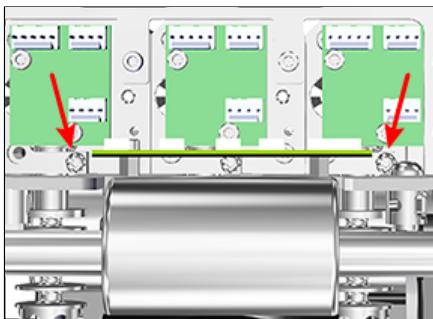
**NOTE:** If there is still a gap between the nozzle of print jet 2 and the print pad, and the Z: up arrow will not raise the print pad further, rotate the front print pad adjustment knob counter-clockwise (from the bottom side) until the nozzle lightly touches the print pad. If the adjustment knob was turned, turn it back the same amount and then be sure to perform the print pad leveling procedure.



7. Verify that the nozzles of print jet 1 and print jet 3 are also touching the print pad.

8. When all of the print jet nozzles lightly touch the print pad, power off the printer and disconnect it from utility power.

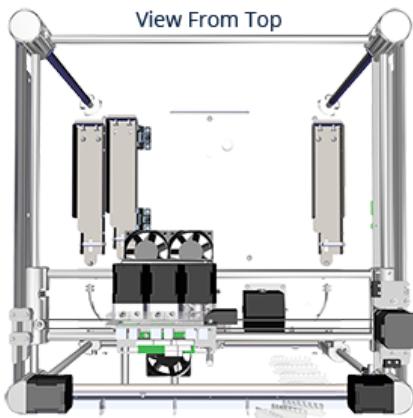
9. Tighten the left and right print jet screws using a T10 torx driver.



10. Connect the printer to utility power and power on the printer.

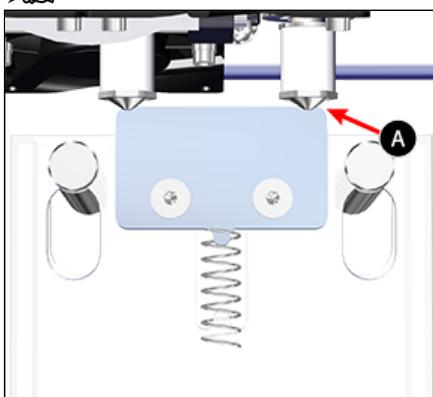
11. Ensure the print pad is at its lowest position.

12. Holding on to the extruder carriage assembly, gently position it over the jet wiper assembly.

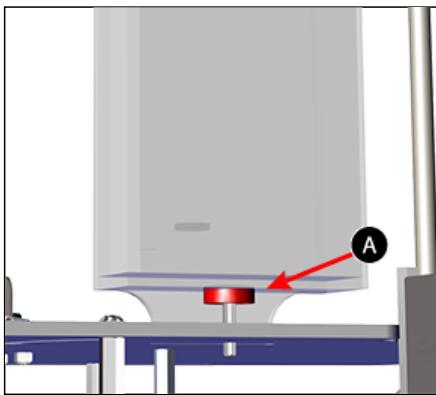


13. Verify the wiper blade meets the tapered portion (A) of the print jet nozzle. If it does, the jet wiper is properly adjusted. Proceed to step 16.

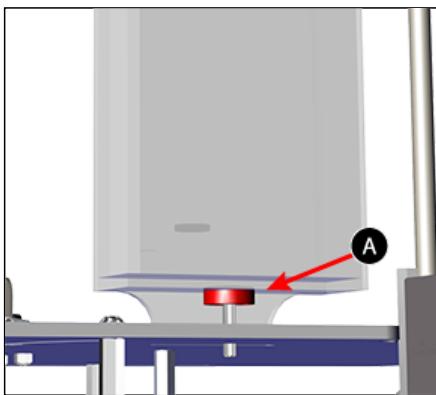
 NOTE: If the wiper tip is too high, proceed to the next step. If the wiper tip is too low, proceed to step 15.



14. If the wiper blade is too high, remove the jet wiper assembly and turn the adjustment thumbscrew (A) clockwise. Reinstall the jet wiper and return to step 13.



15. If the wiper tip is too low, remove the jet wiper assembly and turn the adjustment thumbscrew (A) counter-clockwise. Reinstall the jet wiper and return to step 13.



16. Once satisfied with the adjustment, connect your printer to utility power and power on the printer.

17. If necessary, calibrate the print pad.

18. Proceed to the Z-Gap and Level Gap procedure. Once the Z-Gap and Level Gap are correct, calibrate the offset jets.

# Loading Nylon

## Loading Nylon

Install nylon cartridges using the Change Cartridge utility in the Setup menu. Once the cartridge has been installed, it is important to purge the print jets to remove all previously used print material that may remain in the extruder assembly.

1. Navigate to the Print Jet Calibration screen and select **CONTROL JETS**.



2. Select the print jet that has been loaded with nylon print material.



3. Select the target temperature value. Select the up arrow until the target temperature value reaches 275°C.

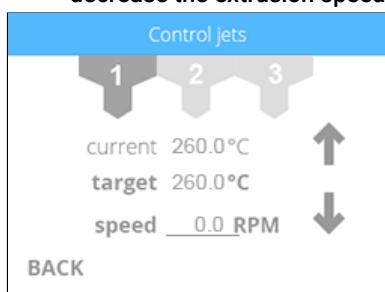
**NOTE:** To increase or decrease the temperature value, press the up or down arrow.

**NOTE:** The current temperature reading will appear above the target temperature value.



4. Once the temperature has reached 275°C, select the speed value. Use the up or down arrows to set the speed value to 3.5 RPM.

**NOTE:** Pressing the speed value twice will place the value at 4.0 RPM. Press the up or down arrows to increase or decrease the extrusion speed.



5. Allow the print jet to purge for 10 minutes.

 NOTE: Purging will clean all previous print material out of the nozzle for better print quality.

 NOTE: The amount of purged material will amount to a small bundle of material strings.

6. Once you have finished, reduce the target speed to 0.0 RPM and the target temperature to 0.0°C.

 NOTE: Pressing the values twice for target temperature and speed should change the values to 0.0.

# Printing With Supports

## Overview

Nylon is a rugged, durable material that is effective at creating fixtures, handles, levers and other parts that need to be strong. Many nylon parts require additional support and INF material works well as support material for nylon. Nylon material has four (4) options for supporting parts and some may be combined for optimal results.

 **NOTE:** Nylon material is not the preferred material for detailed parts.

Nylon parts may warp when they contain large, flat, overhanging features or long rectangular, round beams. For best printing results, add supports to your build file.

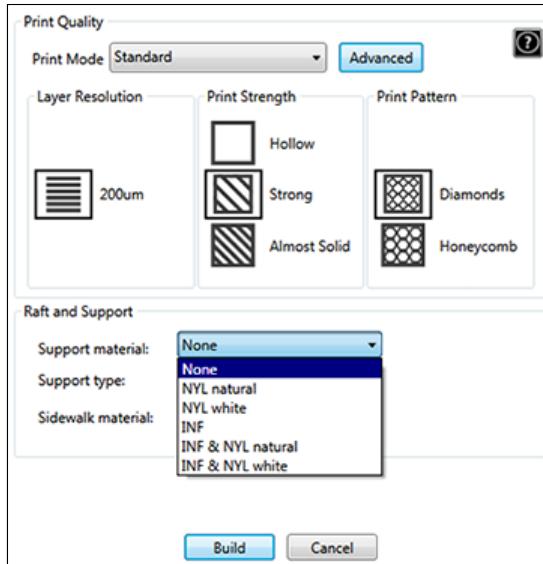
CubePro software provides four (4) options for adding supports:

- Nylon Supports
- INF Supports
- Nylon and INF (Auto-Combination Supports)
- Manual Supports - These supports can be combined with any of the other three options.

## Nylon Supports

Nylon supports are effective, general purpose supports that require post-processing to cut and clean the support attachment points. These supports provide the most support for preventing warp, and of the other options, require the most post-processing to remove them.

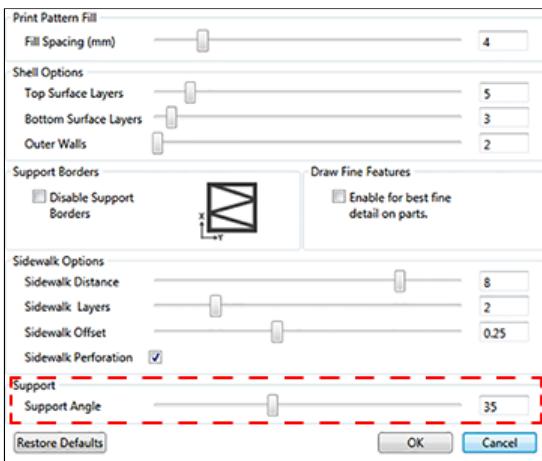
Select a NYL option from the Support Material drop down menu in the Build Settings utility.



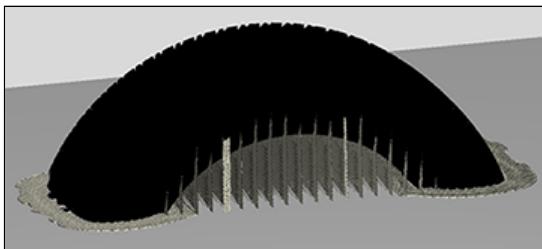
## Printing A Large Flat Radius Feature

Parts with large radius features need more supports than flat angles. Because of nylon printing properties, it requires more support than PLA and ABS. If not properly supported, the nozzle can break if the print begins to curl and warp.

Use the Advanced menu in the Build Settings utility to set the Support Angle to 75° or the appropriate angle for supporting your part.



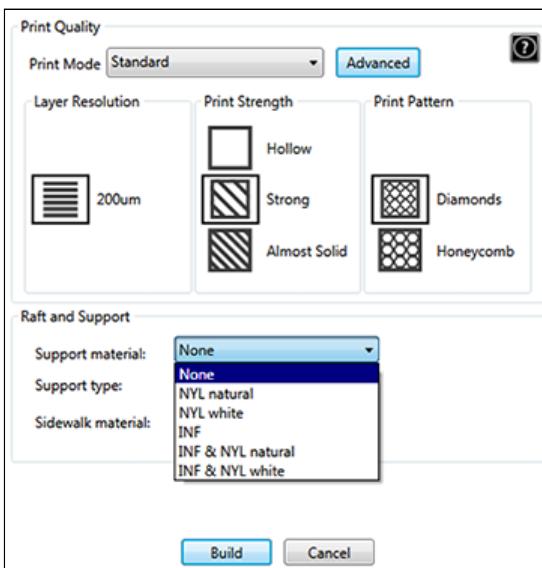
Verify the part in the software after it has been built to confirm that the support angle is correct.

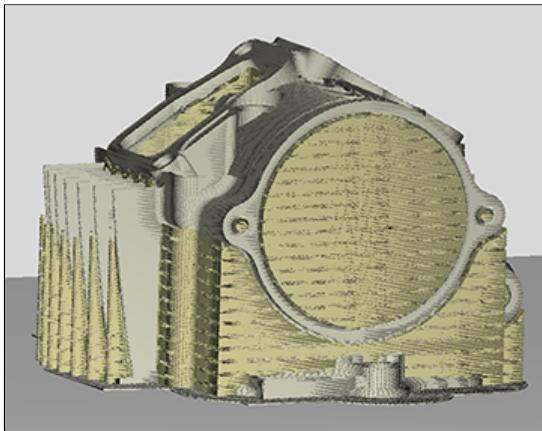


## INF Supports

INF material is effective for supporting nylon parts containing inner chambers, moving parts and multiple small overhanging features. For larger overhanging features or other parts that are subject to becoming warped, Manual Supports should be used to help anchor corners. In addition, Manual Supports should be used with INF Supports to maintain the smooth down-facing surfaces of parts as well as detailed and intricate features of parts requiring support. In addition, INF supports provide smoother bottom surfaces than standard nylon supports.

Select INF from the Support Material drop down menu in the Build Settings utility.



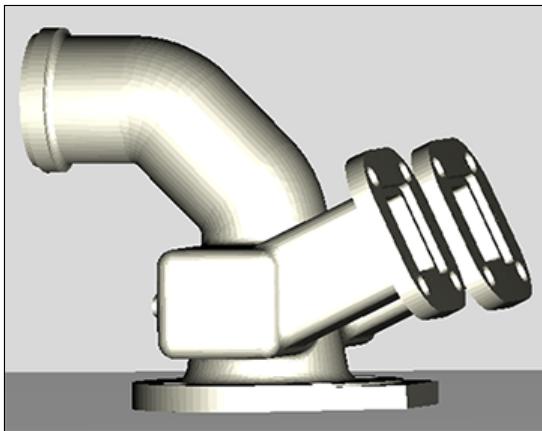


## Combination Supports

### Introduction

When printing nylon parts while using INF support material, the CubePro software provides an option to automatically add nylon supports to the INF supports. This reduces warpage when printing parts with large overhangs and is also effective when printing thin parts. This auto-combination support creates nylon anchors to prevent warping while providing support for down-facing surfaces using INF support material.

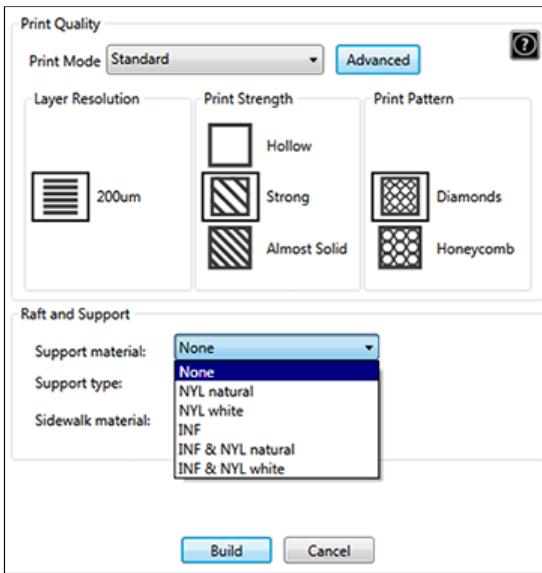
- Warping of curved and angled parts can also be prevented by using both manual supports and INF supports together.
- Combination supports anchor parts very well while still providing good bottom surfaces.
- These supports are not recommended for moving part assemblies.



### Procedure

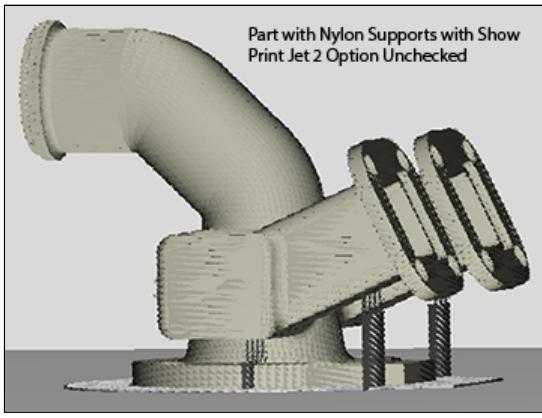
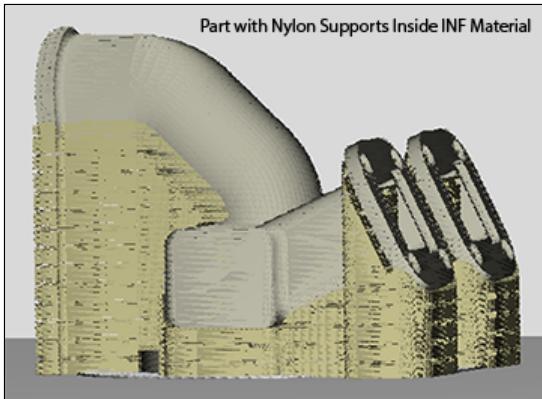
1. To use the combination of automatic nylon support with INF supports, select [Settings > Build Settings](#).
2. Select the Support Material drop down menu.
3. Select one of the [INF & NYL](#) combination options that is currently installed in your printer.
4. Select [Build](#).

The software will automatically place structured nylon supports within the INF supports.



## Confirm the Build Before Printing

The preview of the print file will be generated which will allow you to review the file prior to printing. Use the slider on the right side of the interface to view a cutaway of the print file. You can also uncheck the Show Print Jet 2 option in the View tab menu to view the part without INF material.

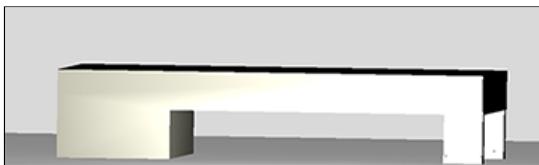


## Adding Manual Supports

Parts with large, flat overhangs may benefit from using the nylon/INF auto-combination support as well as manual supports.

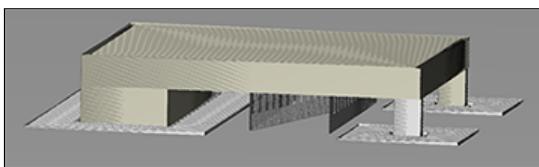
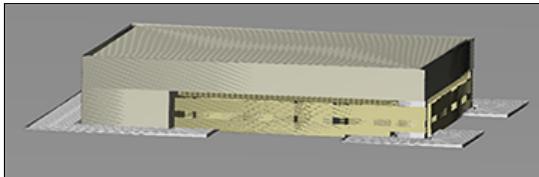


1. Open the appropriate manual supports and move them into position.



2. Build your part after choosing the appropriate INF & Nylon combination.

3. View your part in its build stages by selecting and deselecting the Show Print Jet 2 option.

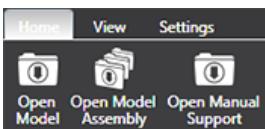


## Nylon Manual Supports

When printing with nylon, parts with large, flat overhanging features may warp. CubePro software provides readily-accessible nylon supports for your nylon-printed parts.

**NOTE:** The use of nylon manual supports requires INF support material to also be installed in the printer and used as a support material type when setting the build settings. INF support material should be used in addition to the nylon supports you will add to the part.

1. After loading your part to the print pad, select [Open Manual Support](#).

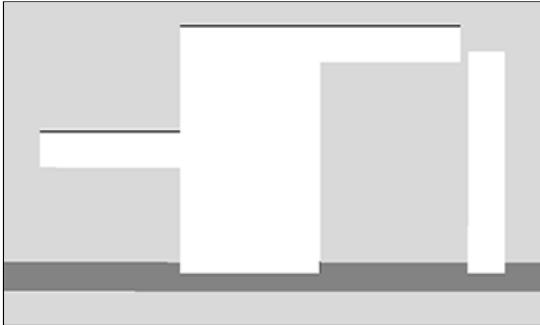


2. Select the supports you will need by their height value.

**NOTE:** The height is noted by the variables after the last X in the file name. You may have to keep trying different support sizes until you find the one that contacts the bottom surface of the part needing support. It is okay for the support to be taller than the bottom surface but it should not extrude above the part.

Name	Type
<input type="checkbox"/> 2.5x5x150	STL File
<input type="checkbox"/> 2.5x5x145	STL File
<input type="checkbox"/> 2.5x5x140	STL File
<input type="checkbox"/> 2.5x5x135	STL File
<input type="checkbox"/> 2.5x5x130	STL File
<input type="checkbox"/> 2.5x5x125	STL File
<input checked="" type="checkbox"/> 2.5x5x120	STL File
<input type="checkbox"/> 2.5x5x115	STL File
<input type="checkbox"/> 2.5x5x110	STL File
<input type="checkbox"/> 2.5x5x105	STL File

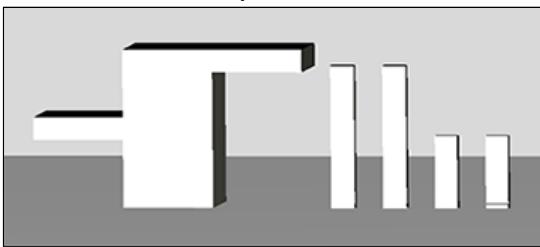
**NOTE:** It is okay for the support to be taller than the bottom surface but the support should not extrude above the part.



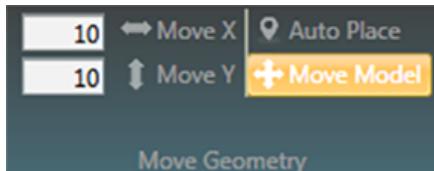
3. Add as many supports as you will need knowing that INF material will be printed around the supports providing additional stability.

**NOTE:** For best results, place supports under the corners of overhanging features.

**NOTE:** Once you move the supports into position, adding additional manual supports will reset all of them and each one will have to be repositioned.



4. Select **Move Model**.

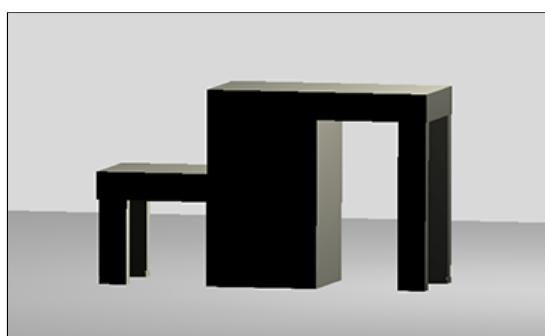


5. Select the support you would like to move and drag it into position.

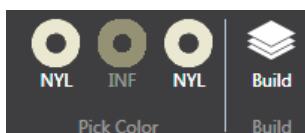
**NOTE:** It may be helpful to zoom in to the image before positioning the supports.



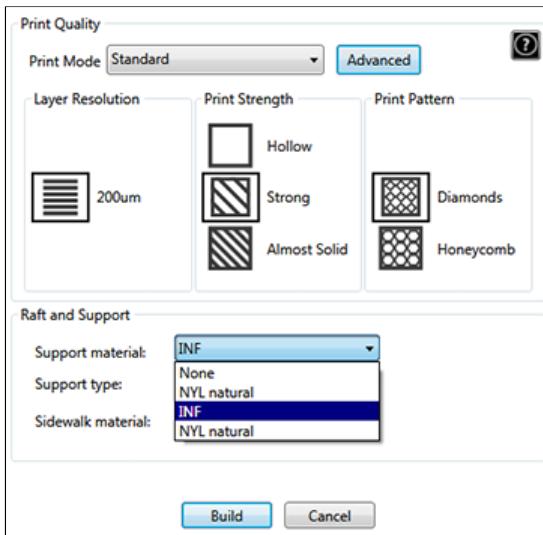
6. Move each support into position. When finished, select **Move Model** to deselect it.



7. Ensure your color has been assigned and select **Build**.



8. Select **INF** from the Support Material drop down menu. Then, select **Build**.

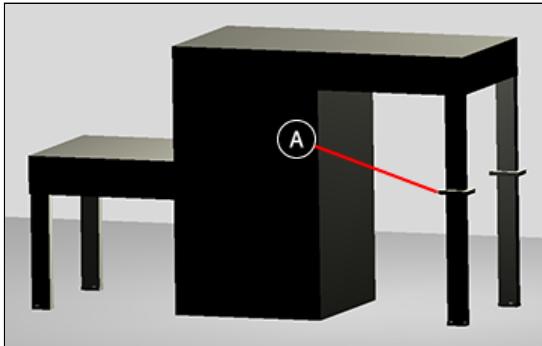


9. Save the file to your desired location.

**NOTE:** INF material will surround manual supports that are inset under an overhanging feature.



**NOTE:** Taller manual supports feature a band (A) that enables INF material to print around it for added support.



**NOTE:** You can place manual supports at the edge of your part and INF material will print to the band for additional support.

