

Flexible Filament Print Tip

Application Note



- The contents of this document are created taking into account a general situation. Please consider that the inserted pictures and description do not correspond with any situation.
- Please contact the designated AS centers when any breakdown in a printer occurs during some process based on this document.

1. Flexible Filament

One of greatest feature about Flexible Filament is its softness, which enables to print out different texture other than PLA and ABS filament. Also, the Filament can be used in a various application according to the print model.

However, it is difficult to output to a 3D printer in reality due to this characteristic of the Filament.

CUBICON has been supplying Flexible Filament affiliated with TPU and 3D printers to customers.

However, a 3D printer must be managed properly to print the model you want and you should follow the appropriate process and condition provided for higher success rates of output. Furthermore, Flexible Filament is generally more difficult material to print out than PLA and ABS materials, so please use the Flexible Filament after careful consideration in terms of a proper operation method for your successful printing results.

This document is as regard of Tips for printing objects successfully with Flexible Filament. You will meet with satisfying output by using Flexible Filament without great difficulty if you utilize the Cubicon 3D printer after understanding sufficiently this printing guide presented in this document.



- * The typical sort of Flexible filament for FFF(Fused Filament Fabrication) type 3D printer are TPEE(Thermoplastic polyester elastomer) of Polyester origin and TPU(Thermoplastic polyurethane) of Urethane origin.
- * It may be difficult for general users to use the Flexible TPEE Filament due to its super soft property than the Flexible TPU Filament.

2. Printing Tips for Flexible Filament

It is the successful key to fulfill the appropriate conditions for operating 3D Printer and set up the proper Printing Option through Cubicreator Software suitable to the shape of the modeling.

Flexible Filament is more soft material than typical PLA or ABS.

Operation method of FFF (Fused Filament Fabrication) type 3d printer is the extrusion of molten filament through Extruder compromised of the Cold and the Hot End.

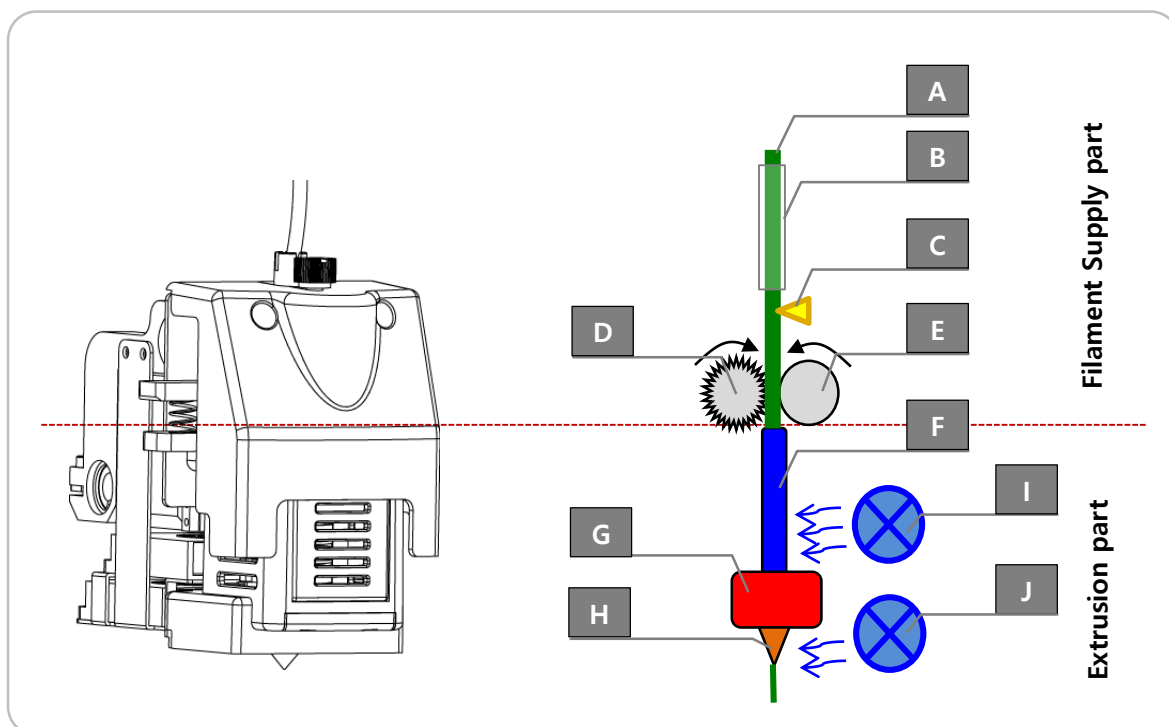
Hot End consists of Heater to melt the filament and nozzle to exit of the molten plastic.

In front of Hot End (Heater and nozzle), there is the Cold End which is part of an extruder driven by gear. Through its torque, it enables to force the raw filament into the Hot End and pushes the molten filament of inner Hot End of extruder out of the nozzle, falling the extruded filament onto

the exact position needed.

However, in case of the Flexible Filament, it is difficult to be extruded by torque of a due to its softness property. Therefore, **the Flexible Filament should be printed by not the typical extrusion method like pushing a molten Filament into the nozzle, but the way to flow over a molten Filament.**

The following introduces some difficult situations during flowing over a Flexible Filament and how to resolve it. Once you understand below contents sufficiently and set the printing environment appropriately, it enables to increase the printing success rate.



Extruder of Cubicon Single (3DP-110F) and internal structure of Extruder

[A] Filament	Filament materials used for printing.
[B] Teflon tube	The path to supply the filament into the extruder.
[C] Filament supply detection sensor	Sensor for detecting the existence of filament.
[D] Drive Gear	Gear to control the movement of filament.
[E] Idler	To lay down filament on a drive gear.
[F] Nozzle Rod	The path between a drive gear and a nozzle (Cooling Zone)
[G] Heating Block	To melt Filament by heating.
[H] Nozzle	Nozzle to extrude the melted filament.
[I] Cooling Fan	Used to cool down the heater.
[J] Mold Fan	Used to cool down the heat of the extruded filament.

Above picture helps you understand each function of internal components of Extruder of the Cubicon Single (3DP-110F). You can also refer this information when using our other 3D printers, which can be printed with the Flexible Filament, because there are many common components to be used. (There might be some differences depending on the printer).

Based on the picture, let's take a look at check list for extruding a Flexible Filament.

As the above figure, the path for extruding filament consists of many internal components which have the various functions. If some component has the improper status to print filament, it will affect the quality of printed objects. The typical features of ABS and PLA filament such as strength, Melting temperature and flowing temperature cannot be less affected by the change of internal parts, but Flexible Filament are seriously affected by changed status of components. It can cause a failure of printing.

As mentioned in the beginning, the most important thing to be considered for printing Flexible Filament is that it should be printed by flowing over a filament into a nozzle, not pushing it.

2.1 Improving the load of filament moving path

As shown in the above figure, filament moving path can be explained by separating the Extruder as two parts; Filament insertion and Extrusion part.

2.1.1 Improving the load of Filament Insertion Part

Filament Insertion Part consists of Filament spool (not specified on the above picture), Teflon tube, Filament supply detection sensor (Cubicon Single), Drive gear and Idler.

In case of the poor filament flow issue with high resistance, it may cause the unsmooth supply of filament.

1) Filament Spool

- Please check if a filament gets tangled or a spool is smoothly rotated.
- As for the flexible filament, considerable adhesion may occur among filaments, being mounted in the spool. In this case using optional spool holder improves the rotation of spool to help it feed in the direction of being pulled.

2) Teflon Tube

- Continuous use of Teflon tube causes abrasion on a Teflon tube, which is the path from spool to Extruder. Especially using rough-surfaced filament will cause considerable abrasion into the

Teflon tube affecting interrupt of the internal filament flow.

Since Teflon Tube is a consumable item, please replace a Teflon Tube to the new one if there is any problem with filament flow like resistance inside of Teflon tube.

- In the event of any bending or the tangle issue of Teflon Tube, filament flow will not be as smooth as usual.

Please re-print after resolving those bending or twisting issue.

If the bending or a tangle issue continues, please replace a Teflon Tube with the new one.

3) Filament supply detection sensor


- Cubicon Single has the Filament supply detection feature which alerts to feed the new filament when the existing filaments are used up.

This sensor can detect filament by a pinch system; pressing the filament with switch.

In case the switch is broken or contaminated, there may be the resistance in internal filament flow.

Please exchange the switch with the new one.


- When loading the flexible filament into the extruder, the filament detection switch can be pressed to interrupt the filament loading. Please slightly force to push the filament into the extruder.

	<p>When loading Flexible Filament, it may cause the malfunction due to the pressure on the filament pressed by filament supply detection sensor. In this case, please deactivate the function of filament supply detection function. (Menu> Configuration> Filament Check "Off")</p>
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4) Drive Gear / Idler

- If a Drive Gear or Idler has the residue, it will not work properly to weaken the force of feeding filament. Please clean a Drive Gear and an Idler with an antistatic brush.

- In the event of damage of a Drive gear or Idler causing unsmooth movement of filament due to the mishandling, it is required to replace a Drive gear or Idler with new one.

	<p>The disassembling or repair of a Drive Gear and Idler is difficult for general users, please contact the official AS centers. In case of the failure caused by disassembled or repaired by users, it is exceptional to provide the warranty service.</p>
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2.1.2 Improving the load of Filament extrusion Part

Filament Extrusion Part consists of Nozzle rod, Heating Block and Nozzle. As per Heating Block,

we do not explain the details in this document as it is not directly contacted to the filament to heat up the nozzle temperature.

As Nozzle rod and the internal Nozzle is invisible parts, it is difficult to manage them and take a proper action while its failure.

However, the most of extrusion issue is caused by the nozzle part and it is difficult to fix it when failure, so it needs to be properly managed prior to the actual outbreak of failure related to the extrusion.

Also, nozzle rod and nozzle has inevitably contaminants in FFF type and thus it is required to have a substantial and proper management because the life of parts can be determined according to the user's maintenance.

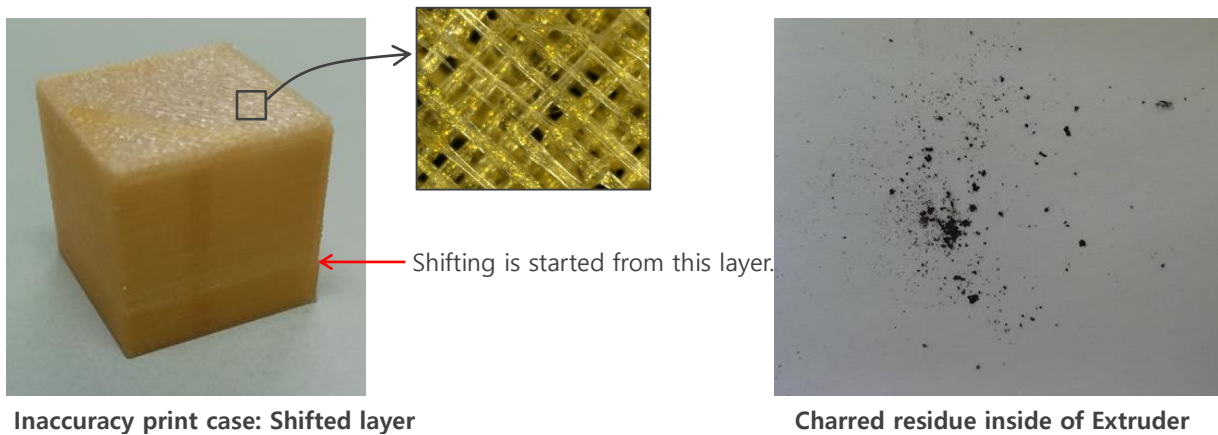
1) Nozzle rod

- The moving path of filament from a drive gear to a nozzle for extruding the filament.
- Please remove any contaminants like filament residue on the entrance of nozzle rod. They interrupt the filament movement.
- In case you use a filament with an inappropriate temperature condition, the filament will be transformed and it will interrupt the flow of filament. Please prevent to pile up the transformed the residue of filament inside of nozzle, cleaning by using a Nozzle Management Pin.
- If inserting a nozzle management pin into the heated nozzle, the melting filament will be stuck around the nozzle management pin and it will also be stuck inside of nozzle rod while moving the unclogging pin.
Please be careful to prevent any contamination, and remove the residue immediately.

2) Nozzle

- A nozzle is the component, which is heated constantly with the filament temperature setting condition having contaminants or abrasions by filaments as it is contacted to the final directly. Thus, on the internal and external nozzle, filament is carbonized continuously and the contaminants are piled up. It brings blockage as well as the breakdown of a printer due to malfunction on the internal component of the Extruder.
- Please clean a nozzle rod and a nozzle periodically to prevent to accumulate carbonized filaments or contaminants inside of the nozzle.

- Please do not repeat heating/ cooling process as the carbonization of filaments gets worse when the nozzle is continuously heated up having un-extruded filament remain inside of internal nozzle.
- The temperature of Extruder nozzle for printing Flexible Filament (Indicated on the filament spool) is higher than the actual melting temperature and it aims to smoothly flow the filament. However, Flexible filament can be much worse carbonized than PLA or ABS filament. Please extrude the flexible filament in a short time and do not continuously heat up the temperature while the filament is fed into the nozzle.. Please clean not only a nozzle rod, but also a nozzle periodically when printing flexible filament.



The final object on above figures has the bad quality issue.

Left image is a case of abnormal printing which is improperly printed shifting from the particular layer. This problem is caused by different amount of filament extrusion.

In addition, if checking the nozzle of defective Extruder, residue (in the right figure) will be generated due to considerable carbonization of internal nozzle. Such residue remaining inside of nozzle has disrupted filament extrusion.

Please replace it with new nozzle if you still have this problem despite of cleaning nozzle sufficiently by using Nozzle Management Pin.

3) Temperature Condition during replacement of filament.

- When using diverse types of filament with one Extruder, you should clean a nozzle sufficiently and consider the nozzle temperatures not only before but also after exchanging the filament. If you don't perfectly remove the filament residue remaining after previous printing work, the residue will be carbonized or it will cause the nozzle blockage.
- As for Flexible Filaments, it should be printed like flowing over and thus the residue of other filaments leads to critical printing problem increasing the load.

- Please follow the cleaning steps when replacing to other filaments. The recommended nozzle temperature is as following; ABS: 240C, PLA: 210C, and Flexible: 230C.

The below table explains the proper nozzle temperature when replacing the filament from '(A) Previous filament inside of nozzle' to '(B) the new filament'.

	(A) PLA → (B) Flexible	(A) ABS → (B) Flexible	(A) Flexible → (B) PLA	(A) Flexible → (B) ABS
Unloading Temperature of heating nozzle(UT)	210	240	230	230
Loading Temperature of heating nozzle (LT)	230	240	230	240

- ① Remove '(A) Filament' from Extruder.

Unload '(A) Filament' after heating up the nozzle temperature according to Unloading temperature (UT).

- ② Insert '(B)Filament' into Extruder.

Load '(B) Filament' after heating up the nozzle temperature according to Unloading temperature.

Please be aware the following simple things.


- Choose the higher loading temperature of filaments before and after exchanging filament.
- Please insert about above 30 cm of '(B) Filament', wait for 10 seconds and repeat to load the filament.
- At each step, pushing residual filament in a nozzle by using a nozzle management pin is also a good way.
- Depending on the types of filament before and after the replacement, Filament inside of the nozzle can be seriously carbonized at the Unloading Temperature/ Loading Temperature. Please replace the filament (Cleaning) as soon as possible because residuary filament in a nozzle can be carbonized seriously at the Unloading Temperature /Loading Temperature depending on which filament is replaced into.

Please do not leave the melted filament in the nozzle at high temperature.

- As melting PLA or Flexible filament is sticky, when the PLA or Flexible filament remains before changing to other filament, please extrude a lot of filaments when loading it.
- If you cannot aware which type of filament is remained in a nozzle before a replacement, please choose the highest temperature of filament and clean the nozzle.
- Please clean a nozzle in case of replacing other color of the same type of filament or loading the new filament spool.

The setting values presented at the above table is for your reference. Thus, please set the optimal printing condition acquired through sufficient user-experience.

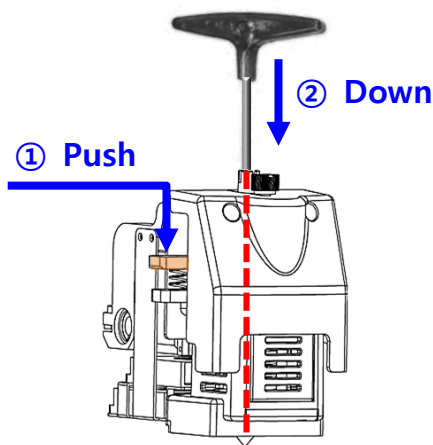
Cleaning a nozzle frequently is a good way to lengthen the printer's life, except in the case the printer is damaged due to immoderate cleaning.

	<ul style="list-style-type: none">* Please use a nozzle management pin with smoothly forcing it to prevent damage on the part inside extruder.* Improper use of the nozzle management pin can cause any damages to the internal extruder, even though proper use of the nozzle management pin can greatly help management of nozzle. <p>A breakdown or a damage by improper use of the nozzle management pin is not be covered by the warranty since they are regarded as a damage caused by user.</p>
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2.1.3. Filaments movement inside the Extruder

Please check the status of filament's moving path inside extruder; whether the path maintains the straightness, if there is no any problem with Loading of Filament Insertion/Extrusion Part.

If the filament cannot maintain the straightness inside of the Extruder, unlike PLA and ABS which are solid property, Flexible Filament has the smooth property to cause the tangle interrupting the movement of filament flow and it may cause the extrusion problem of the filament.



To check the straightness of filament:

- ① Please keep pushing the Filament Handle like above figure '① Push'.
- ② Please insert a nozzle management pin into the Extruder and check status of internal extruder.

In case of the Extruder of Cubicon Single, due to its internal parts like filament detection Sensor, Drive Gear/Idler and detachable part, there will be some load when inserting the nozzle management Pin.

However, please check an alignment of inside components of the extruder when detecting any severe internal barrier when inserting the nozzle management pin into the Extruder.

Also, after detaching and mounting the extruder again this internal barrier maintains, please contact AS center to adjust the align of parts inside of the Extruder.

2.1.4. Distance between a Nozzle and a Print Bed at the beginning of Printing.

Thanks to the Auto Leveling function of the Cubicon Single, the distance between a nozzle and a print bed is automatically adjusted. However, if the nozzle is too close to the print bed due to any malfunction, filament can be twisted or grounded as the extrusion of filament will be blocked by the close print bed to the nozzle. In this case, please re-start a Cubicon single after turning off, waiting 10 Sec and turn on to re-operate the printing.

If this issue continues, please ask for the check-up from official AS center.

2.2. Setting Filament Printing Option

Printing with Flexible Filament needs to be flowed over the molten filament, but not by pushing a molten filament into a nozzle. To fulfill this process, it is important to checkup the printer and set up the proper printing option.

- The recommend temperatures for Flexible filament print are 65C for Bed platform and 230C for Nozzle. However, the optimum temperature should be adjusted after sufficient experience since the optimum temperature will differ according to the type of filaments or a printing model.

- The nozzle temperature of Extruder is closely related to printing speed. For instance, if you want to print an object at high speed, the melting process should be quickly done at a high temperature to extrude the filament at high speed.

If you set improper low nozzle temperature, filament cannot be twisted to block the extrusion as the filament is continuously fed through torque of Gear, but it cannot be melted enough to be extruded from the nozzle end.

Please set the proper temperature according to the printing speed.

- Please set a Nozzle Temperature within the temperature range indicated on the Spool sticker. If this temperature is lower than the suggestion, there will lead the bad movement of filament causing the extrusion problem.

If this temperature is higher than the suggestion, it will lead the excessive supply of filament or to carbonization of filament.

In general, the proper temperature range for printing Flexible filament is narrower than PLA and ABS print. In addition, when the temperature is out of the suggested range, the probability of printing failure for Flexible Filament will be increased.

- Printing speed per each section can differ according to the print model. It is because

deceleration or acceleration of the straight and curved section affects the printing speed. Thus, please set the print speed and temperature properly depending on a print model.

- If the surface of object is rough, please lower temperature to improve the quality of the surface. When using Flexible Filament, if the printing temperature is higher than the proper one, the extruded filament material can be so watery melted that flowed over before being laid down on the desired position. In this case, it leads the lack of filament for the actual extrusion and generates bubble on the surface and thus the surface of object will be poorly rough.
- Please take a close attention to set temperature when generating Raft as a base structure. Raft is one of the base structures to improve the bad bottom surface such as unevenness or scratch. Also, when printing with Raft, the speed is faster and the amount of extruded filament is larger than printing without Raft. In that, the amount of filament supplied to nozzle is so larger than usual that higher temperature is required to melt the filament. For printing Raft base structure, it will be helpful to set 5-10 degrees higher nozzle temperature than printing without Raft.

2.3. Cautions for Transformation of Filament

Please remind that the bending property of filament will be changed if the filament is unwound from the filament spool. In particular, due to the softness of Flexible Filament, it is difficult be fed into the Extruder when forcing the unspooled filament which cannot have straightness. For this reason, please print Flexible Filament while winding it on the spool. Also, please take attention to prevent any transformation of filament by external force, temperature and humidity.