Guide for Extrusion Problem

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.

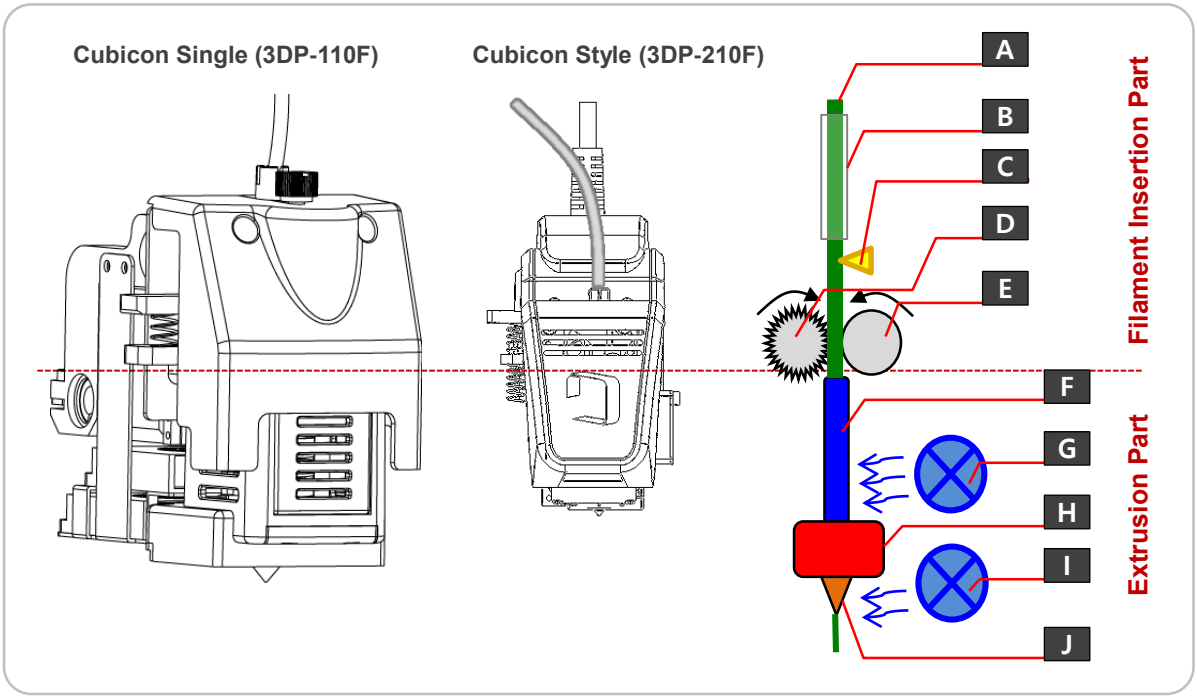
1. Extrusion Problem

Operation method of FFF (Fused Filament Fabrication) type 3d printer is the extrusion of molten plastic filament through Extruder composed of 2 types of Ends (Cold and Hot Ends).
Hot End consists of Heated Block to melt the filament and nozzle to expel the molten plastic.
In front of Hot End (Heater and nozzle) is the Cold End, which is part of an extruder driven by gear.
Through its torque, it pushes the molten filament of inner Hot End of the extruder out of the nozzle onto the exact position needed.

The gear to move the filament, the extruder to melt the filament, and the path to move the filaments are the most parts that are highly likely cause troubles.

The following explains the common extrusion problem (no material is coming out of the nozzle at all).
Once you understand below contents sufficiently and set the printing environment appropriately, it will help you increase the printing success rate.

2. Extruder Structure



Simple Layout of Cubicon Single (3DP-110F) / Cubicon Style (3DP-210F) Extruder

[A] Filament	Filament materials used for printing.
[B] Teflon tube	The passage to supply the filament into the extruder.
[C] Filament supply detection sensor	Sensor for detecting the existence of filament. (only for Cubicon Single)
[D] Drive Gear.	Gear to control the movement of filament.
[E] Idler.	To lay down filament on a drive gear.
[F] Nozzle Rod.	The passage between a drive gear and a nozzle (Cooling Zone)
[G] Cooling Fan.	A fan used to cool down the heater.

[H] Heated Block.	Heater to melt the filament.
[I] Mold Fan.	A fan used to cool down the heat of the extruded filament.
[J] Nozzle	Nozzle

- The internal components may vary according to the model types.

Above picture helps you understand each function of internal components of Extruder of the Cubic on.

In case of the printing, the movement of filament is as follows.
Filament moving path can be explained by separating the Extruder as two parts; Filament insertion and Extrusion part.
In case of the filament insertion part, the filament coming from the filament spool [A] is fed to the extruder through Teflon Tube [B].
The filament to be fed into the extruder is passed through the filament detection sensor [C] and located between Drive Gear [D] and Idler [E].
Drive Gear is connected to the Extruder motor and it enables to bite and move the filament downward by rotation of motor.
In the meantime, Idler is able to press the filament through the internal spring of Idler so that the filament is perfectly fit into the Drive Gear.

The filament in the extruder moves to the extrusion part, it passes through the nozzle nod [F] to straighten the filament, is fed into the Nozzle [J] which is inserted into the Heated Block [H].
Heated Block can heat up the nozzle so that the filament inside of the nozzle is melted.
The Cooling Fan [G] can cool down the Heated Block and the Molding Fan [I] can cool down the extruded filament out of nozzle.

As explained above, the passage for extruding filament consists of many internal components which have the various functions. If some component are in improper status to print filament, it will cause the extrusion problem.

3. Filament Extrusion problem

We will look at the general case of extrusion trouble.

3.1. Filament Moving Path Problem

If there is blockage on the filament moving path or some part being broken, the Drive Gear could pull a filament with excessive force to cause the extrusion issue.

3.1.1. Trouble on Filament insertion

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.

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 interrupting the internal filament flow.
  Since Teflon Tube is a consumable item, please replace a Teflon Tube to a new one if there is any problem with filament flow by strong 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 (only for Cubicon Single_3DP-110F)

- Cubicon Single (3DP-110F) has the Filament supply detection sensing feature, which alerts to feed the new filament when the existing filaments are used up.
  This sensor can detect filament when sensor switch inside the passage is pressed by filament inserted.
  In case the sensor is broken or contaminated, there may be the resistance in internal filament flow.
  Please exchange the switch with the new one.
- When loading the filament into the extruder, the filament detection switch can be pressed to interrupt the filament loading. Please put slight force to push the filament into the extruder.

	**When loading the 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")**

4) Drive Gear / Idler

- If the Drive Gear or Idler has the residue, it will not work properly by weakening the force of feeding filament. Please clean the Drive Gear and Idler with an antistatic brush.
- In the event that the Drive gear or Idler causes unsmooth movement of filament due to the mishandling, it is required to replace a Drive gear or Idler with new one.

	**The disassembling or repair of a Drive Gear and Idler is difficult for normal users, please contact the official AS centers.** **In case of the failure caused by being disassembled or repaired by normal users, it is would be excluded from our warranty service.**

3.1.2. Filament extrusion Part Problem.

Filament Extrusion Part consists of Nozzle rod, Heated 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 are invisible parts, it is difficult to manage them and take a proper action during its failure.

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

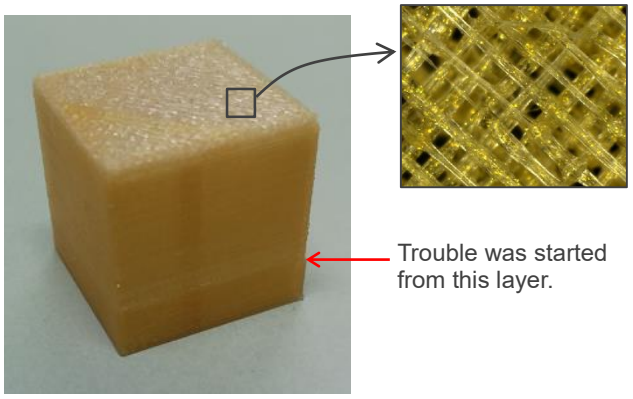
Also, it is inevitable that nozzle nod and nozzle have contaminants in FFF type printer and thus it is required to have proper maintenance skills because the life span of parts can vary according to how well you maintain them.

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 deformed and it will interrupt the flow of filament. Please do not let the deformed residue of filament inside of nozzle piled up by cleaning using a Nozzle cleaning Pin.
- If you insert a nozzle cleaning pin into the heated nozzle, the melting filament can be stuck around the nozzle cleaning pin and also inside of nozzle rod Please remove the contamination as soon as it occurs.
  Please be careful to prevent any contamination, and remove the residue immediately.

2) Nozzle

- A nozzle is the component, which is heated constantly at each filament temperature settings, and constantly has contaminants or abrasions by filaments as it has direct contact to the printed products 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 the nozzle rod and nozzle periodically to prevent any accumulation of carbonized filaments or contaminants inside of the nozzle.
- Please do not repeat heating/ cooling processes as the carbonization of filaments gets worse when the nozzle is continuously heated up, having un-extruded filament remain inside of internal nozzle.



Inaccurate printing case: Shifted layer

Charred residue inside of nozzle

Above figures show the bad quality issues.
Left image is a case of abnormal printing which is improperly printed 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 cleaning Pin.

⚠	*** Please use a nozzle management pin with smoothly forcing it to prevent damage on the part inside excruder.** *** 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. A breakdown or a damage caused by improper use of the nozzle cleaning pin is not covered by the warranty since they are regarded as a damage caused by misuse of the user.**

3) Heated Block (Heater, Temperature Sensor)

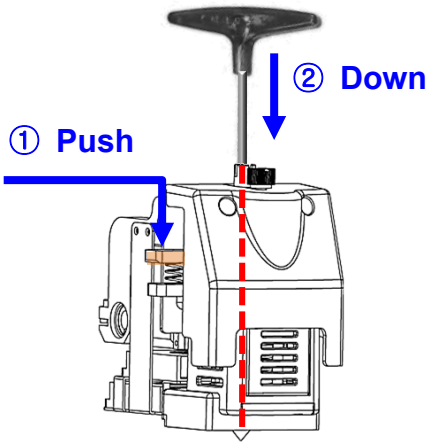
- Heated Block is consists of heater and temperature sensor.
  If there is some problem on temperature sensor, it will be heating up the nozzle at the higher or lower temperature than the set point, making the filament carbonized or clogged not to be extruded.
  If the temperature on display considerably differs from the set point, please contact authorized CS center for checkup.

4) FAN

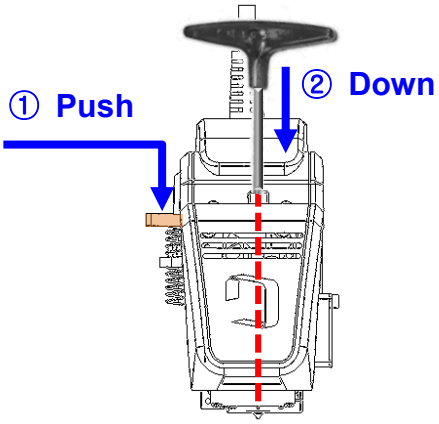
- The Cooling Fan is relevant to the extrusion problem. The Cooling Fan enables to cool down the heats of Heated Block so as to avoid heating up the upper extruder part.
  With the problem of cooling fan, heats of Heated Block affects the nozzle nod and damages the upper structure.
  In this case, it may cause the extrusion problem or failure of Extruder due to the transformation of Extruder. If the Cooling Fan is not working well, please contact the authorized CS Center for checkup.

3.1.3. 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, it may cause interrupt the movement of filament flow and extrusion problem of the filament.



Cubicon Single (3DP-110F)



Cubicon Style (3DP-210F)

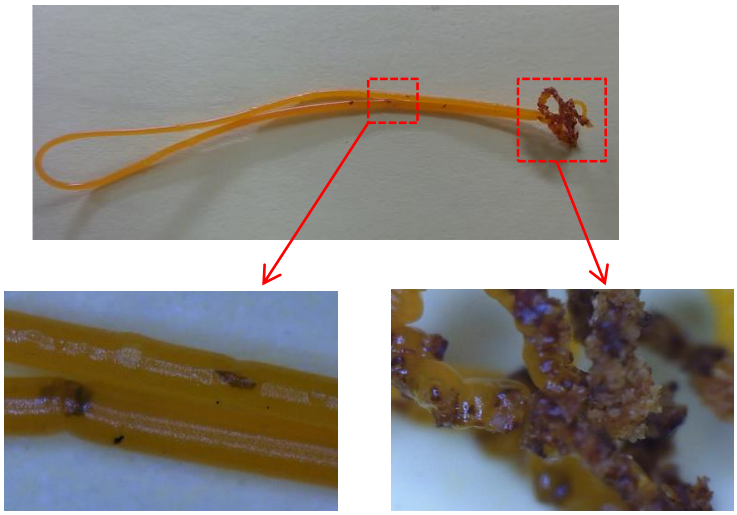
To check the straightness of filament :
Please keep pushing the Filament Handle like above figure '① Push'.
② Please insert a nozzle cleaning pin into the Extruder and check status of internal extruder.
In case of the Extruder of Cubicon Single, due to its internal parts like filament detection Sensor, Drive Gear/Idler and detachable part, there could be some blockage when inserting the nozzle cleaning Pin. However, please check an alignment of inside components of the extruder when detecting any severe internal barrier when inserting the nozzle cleaning 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.

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

When starting the print, the filament extrudes from the nozzle.
If the distance between the nozzle and print bed is too close to extrude the filament, this filament may be twisted or separated inside of the extruder.
Thanks to the Auto Leveling function of the Cubicon Single and Cubicon Style, 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 separated as the extrusion of filament will be blocked by the print bed. In this case, please re-start the Cubicon after turning off, wait for 10 Sec and turn it on to re-operate the printing.
If this issue continues, please ask for the check-up from official AS center

3.2. The problem when switching from different filament

In case of printing with various filaments in a printer, please be careful to clean up the internal nozzle or consider the proper extrusion condition.
The same type of filament can have the different property according to the color or Batch to be produced. In worst case, it may have different property in the same filament spool.
This slight difference could not be recognized by most of users, but it is highly recommended to regularly clean up the nozzle before switching from the previous filament, and ensure to set the proper temperature before Loading/ Unloading process.



The filament residue in the above picture comes from the nozzle when using different color or type of filament. As you can see, it is the previous filament residue being carbonized, and it may cause the considerable blockage of nozzle.
Please do clean up the nozzle to manage it properly.

- 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.

- Please follow the cleaning steps when replacing to other filaments. We will consider the nozzle temperature 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 Loading temperature.

Please be aware of the following simple but important precautions.
- 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 cleaning 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 / 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 it is replaced into. Please do not leave the melted filament in the nozzle at high temperature.
- Generally speaking, in case of melting PLA or Flexible filament, it can get sticky, so when you have PLA or Flexible filament inside the nozzle before changing to other filament, please extrude a lot of filaments when loading it.
- If you are not aware which type of filament remains in a nozzle before a replacement, please choose the highest temperature of filament type and clean the nozzle.
- Please clean a nozzle in case of replacing with other color of the same type of filament or loading a 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.

⚠	*** Please use a nozzle cleaning pin with smoothly forcing it to prevent damage on the part inside extruder.** *** Improper use of the nozzle cleaning pin can cause damages to the internal extruder, even though proper use of the nozzle cleaning pin can greatly help managing nozzle.** **A breakdown or a damge by improper use of the nozzle cleaning pin is not covered by the free warrany service since they are regarded as a damage caused by manufacturer.**

3.3. Filament Issue

Filament is one of the important factors in FFF-Type 3D Printer, also.

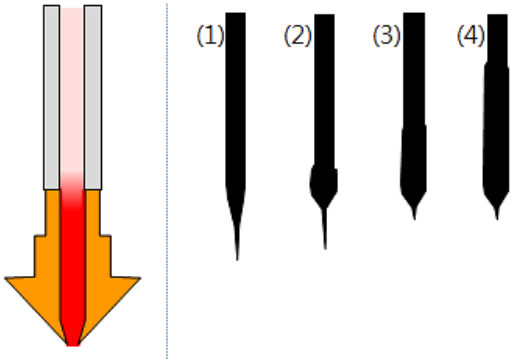
3.3.1. Use of faulty filament

- If the filament has rough surface or is contaminated, it may cause the problem to move or extrude the filament due to the clogging issue in nozzle.
  Please keep filament in an air-tight package, and consume all filament spools after opening.
- Do not use the recycled filament or re-wound spool.
- The Cubicon is designed to use 1.75mm diameter filament. If using too thick or thin filament, it may cause the extrusion problem or failure of printer.
  Do use the 1.75mm diameter filament (For ABS or PLA material, it ranges from 1.6mm to 1.9mm).

3.3.2. Use of considerably transformed filament.

If the filament is heated up, it starts to be deformed. In particular, it is getting much softer and swollen up.

- As it is getting placed between the Drive Gear and Idler, the filaments get softer and it becomes harder to move through due to being physically bitten and jammed inside gear.
- In case of swollen filament, its diameter could be thicker which increase the load and blockage on the filament movement inside the Extruder.



The above picture shows the deformed filament in the nozzle/ nozzle nod.
(You can figure out the shape deformation of the filament during Unloading process, it may differ according to the type of filament, extrusion condition or internal/external air temperature).

If the state of heating the nozzle lasts when the filament remains inside of nozzle/nozzle nod, it will cause the filament deformation by the heat.
At the picture above,
the filament is excessively swollen and deformed in sequence of (4) > (3) > (2) > (1).
The filament could be thickened and elongated through thermal deformation to increase the blockage of filament movement.
In general, the filament is extruded downward before getting critically thermal-transformed. But some of filament is not suitable as it has the considerable thermal deformation.

Severely deformed filament

The above filament in the picture has thermal transformation and removed from the extruder with extrusion problem.
The diameter of the filament is getting thicker over 2mm due to the thermal deformation and it is getting softer and pressed by the Gear

In this case,

1) It can be worse in printing with PLA material which has much lower melting temperature than ABS material.

2) It could be improved if one opens the printer door in order to lower the ambient temperature while printing.

3) We recommend using our approved filaments which cause less thermal deformation.

In case the filament is jammed inside the internal extruder due to the thermal deformation, do heat up the nozzle temperature and remove the deformed filament from the nozzle.
If it is difficult to pick out the sandwiched filament in the extruder, insert the nozzle cleaning pin into the extruder and push it toward the nozzle.

⚠	**In below cases, the thermal deformation will happen.** **1) In case that you keep the filament inside of the nozzle and constantly heat up the nozzle. (While the Gear is rotating, the filament is not moving through).** **2) In case of the low printing speed of lower melton temperature filament like PLA(It differs according to the model).** **3) In case the high ambient temperature affects the thermal transformation of filament.** **In those cases, it will be difficult to pull out the swollen filament from Extruder.** **Please heat up the nozzle temperature and push down the filament toward the nozzle through nozzle cleaning pin.**

3.4. Setting Filament Printing Option.

- 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 your nozzle at too low temperature, 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, it will lead the bad movement of filament causing the extrusion problem.
  If this temperature is higher than the suggestion, it will lead to the excessive supply of filament or to carbonization of filament.
  In general, the proper temperature ranges 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 printed 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 the object is rough, please lower or higher temperature to improve the quality of the surface.
  When using Flexible Filament, if the printing temperature is higher than it is required normal, the extruded filament material can be so melted watery before being laid down on the desired position.
  In this case, it leads to the lack of filament for the actual extrusion and generates bubbles on the surface and thus the surface of object will be 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 normal temperature while printing Raft.