

Filament Extruding, Spooling, and Recycling Tips and Parameters

Machine: Filabot EX6

By David Florian

Last Updated: 6/10/2024



External Resources:

- [EX6 Extruder Manual](#)
- [Airpath Manual](#)
- [Filament Spooler Manual](#)
- [Filabot Extrusion Settings](#)

Important Rules:

- Never let the extruder run dry. The molten plastic keeps the screw from rubbing up against the barrel. If the extruder runs dry for any amount of time, then the mesh filter in the die must be replaced as it will be plugged with metal shavings (not good!). Fill hopper every time you check on the extruder.
- Pellets must be bone dry. Especially ABS, PETG, and other notoriously hygroscopic plastics. Do not leave pellets in the hopper overnight or they will need to be re-dried. Check pellet data sheet for drying temperatures/times, but 80C for 5 hours suitable for most resins. The pellets will off gas when dried, so only use a dedicated oven.
- The guide bearings on the Filameasure must contact the filament for an accurate measurement. The bearings should spin during spooling and the filament should have a slight bend between bearings.
- Tangled spools are caused by improper traverse speeds or misaligned gromets. When spooled incorrectly, filament will preferentially build up on one side of the spool, fall off, and become loose. Newly spooled filament can get trapped underneath this loose material resulting in a tangle.



General Observations:

- The stability of the “back” (or feed section) temperature on the EX6 strongly affects the filament diameter. If this value is fluctuating too much, then it needs to be re-tuned. Even a couple degree swings can cause the filament to go out of spec.
 - Recommended to tune this heater with the extruder running. I have had to retune if the temperature difference between plastics is >20C.

- If the filament is whipping when it is coming out of the die, then the speed is too fast. A longer die is necessary.
- Feel the filament before spooling:
 - If it is soft to the touch, then more cooling is needed.
 - If it is rough (i.e., shark skin), then slow down the extrusion speed or increase the die temperature.
- When spooling 2.85mm filament or producing 3 mm filament for recycling, the temperature at which the filament is spooled is very important. If at room temperature, then the filament will be too hard and provide too much resistance to the spooler. Even after tightening the slip-clutch mechanism, it was not possible to get “cold” filament adequately spooled. The optimal temperature is reached when the filament feels warm to the touch but cannot be deformed. To get to this filament temperature, only one airpath should be used.
- When creating filament from 100% regrind prior to pelletizing, the output is very unstable. It can easily swing +/- 0.5 mm. The pelletizer has a max input of 3.5mm, and therefore, an average filament diameter of 2.75 should be targeted.
- If the filament is sticking to the beginning of the airpath (near the die) then the metering temperature is too high, fan speed is too low, or both. It can help to tape the first fan section on the sides to concentrate the air

PLA Observations:

- 40V, 2.5A is max speed for PLA with 2 airpaths. Any higher and the filament is too soft to spool.
- All McMaster-Carr colorants are compatible with PLA except orange. Unmelt is present in the extruded fiber or some other phenomena is occurring causing there to be bumps (not bubbles) in the filament.

ABS Observations:

- Pellets must be bone dry!!! Technically 0.01% moisture before extrusion – this is very difficult if not impossible to achieve with only an oven. Make sure the pellets are dried for the full 5 hours at 80C. Also, do not leave pellets in hopper overnight, but instead put them in a sealed container.
- High barrel temperatures > 200C exacerbated vapor/bubble formation.

PETG Observations:

- PETG does not mix with other polymers. Therefore, the screw and barrel need to be cleaned completely before extruding or else the material will be inconsistent.
- The extrusion temperature affects the clarity of the material (and the bubbling). Lower metering temperatures (~185C) result in higher opacity but less bubbling. Higher temperature (>200C) the opposite was seen.
- Very difficult to get this material dry. It is recommended to **vacuum dry** pellets at 60C overnight.

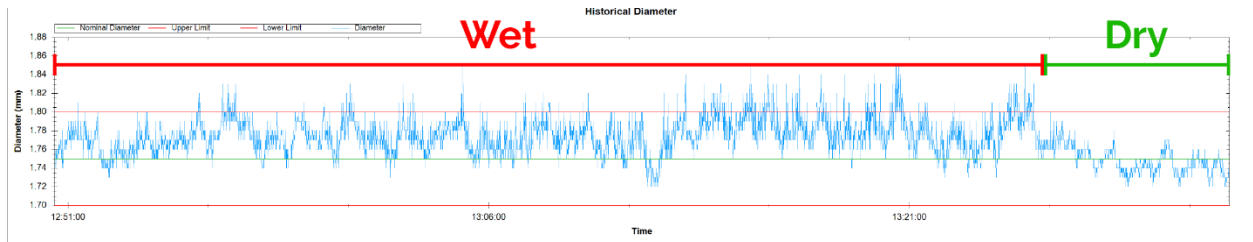
HIPS Observations:

- Low compression screw with both high temperatures (200, 190, 180) and low temperatures (190, 180, 170) resulted in unstable filament diameters. This was somewhat more manageable at low speeds (25V, 2.5A).
- Tendency to overheat need to have fans on max, especially for metering section. Retuning the metering section's PID controller is likely necessary.

Troubleshooting Filament Diameter Issues

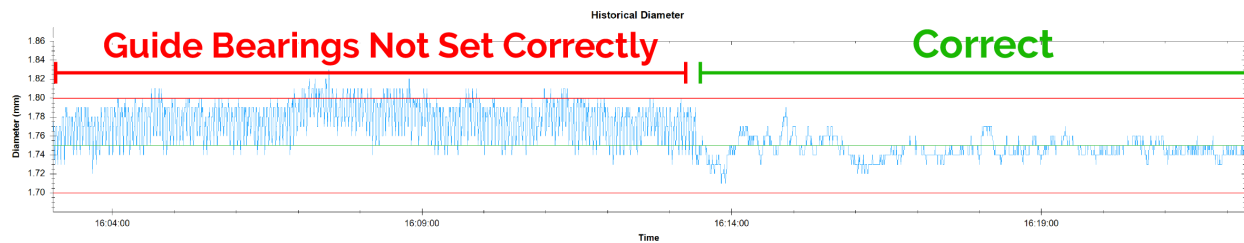
Problem: Random out of tolerance peaks.

Cause: Wet pellets. Vapor escapes from the filament or out of the die causing craters and bubbles.



Problem: Oscillatory filament diameter measurements.

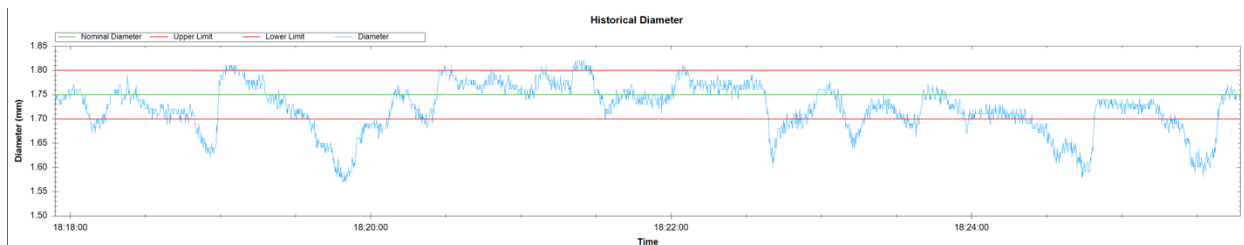
Cause: Guide bearings not set properly.



Problem: Output randomly decreases rapidly but then recovers.

Causes:

1. Feeding issues. Adjust feed temperature, change screw (usually higher compression is needed) and check material shape if processing regrind.
2. Temperature readings are fluctuating on PID controllers and require a re-tune.



Material Parameters: PLA Luminy® LX175

Reseller: [Filabot](#)

Process time for 1kg spool: 44 minutes

Nozzle: 2x Length Melt Filter Nozzle – Style X – with 60 mesh

Screw: Standard Compression

Airpath Spacing: The first airpath should be directly underneath the EX6 die.

Temperatures:

- Front: 165
- Middle: 170
- Back: 160
- Feed: 40

Fans:

- Front: Full
- Middle: 2/3
- Feed: full
- Motor: full

Number of air paths:

- 2

Approximate motor power:

- 35V
- 2.25A

Speed Knob position:

- 12

Traverse Knob Position:

- 12

Colorants Tested:

- **Good:** McMaster-Carr White: Cat# [5174N33](#)
- **Good:** McMaster-Carr Black: Cat# [5174N32](#)
- **Good:** McMaster-Carr Dark Red: Cat# [5174N35](#)
- **Questionable (Easy to produce filament but blue spools were most likely to plug FFF extruders):** McMaster-Carr Blue: Cat# [5174N38](#)
- **BAD:** McMaster-Carr Orange: Cat# [5174N42](#)

Notes:

- Some skin formation (a bit rough to the touch at this speed).



Material Parameters: 3DXTech ABS

Reseller: [3DXTech](#)

Process time for 1kg spool: 45 minutes

Nozzle: Standard Melt Filter Nozzle – Style X – with 60 mesh

Screw: Standard Compression

Airpath Spacing: The first airpath should be directly underneath the EX6 die.

Temperatures:

- Front: 200
- Middle: 195
- Back: 190
- Feed: 60

Fans:

- Front: 1/2
- Middle: Full
- Feed: full
- Motor: full



Number of air paths:

- 2

Approximate motor power:

- 45V
- 2.25A

Speed Knob position:

- 14



Traverse Knob Position:

- 9

Colorants Tested:

- **Good:** McMaster-Carr Orange: Cat# [5174N42](#)
- **Good:** McMaster-Carr Dark Red: Cat# [5174N35](#)

Notes:

- ABS pellets must be absolutely dry! Do not leave them in the hopper overnight.
- High barrel temperatures > 200C exacerbated the vapor/bubble formation

Material Parameters: 3DXTech CF+ABS

Reseller: [3DXTech](#)

Process time for 1kg spool: 45 minutes

Nozzle: Standard Melt Nozzle – Style X – No mesh

Screw: Standard Compression

Airpath Spacing: The first airpath should be 1-2in away from the EX6 die.

Temperatures:

- Front: 190
- Middle: 185
- Back: 165
- Feed: 60

Fans:

- Front: Full
- Middle: 1/2
- Feed: Full
- Motor: Full

Number of air paths:

- 2

Approximate motor power:

-
- 2.25A

Speed Knob position:

- 9

Traverse Knob Position:

- 9

Colorants Tested:

- No colorants

Notes:

- Even at low screw speeds the filament comes out very fast. So fast, that the spooler maxed out at slightly higher extrusion speeds.
- High die swell – significant pulldown required.
- Having issues with buildup of carbon fiber on the nozzle. After about 20-30 minutes, the buildup sticks to the extrudate, which causes the filament to clump and break.
 - Attempted solutions:

- PTFE non-stick coating on the nozzle (didn't work)
- Chamfered the rough exit bore (didn't work)

Material Parameters: Recycled PETG (rPETG)

Reseller: Filabot

Process time for 1kg spool: 1:30 min

Nozzle: 3X Extended-length Melt Filter Nozzle – Style X – with 60 mesh

Screw: High Compression

Airpath Spacing: The first airpath should be 50 mm (2”) away from the EX6 die.

Temperatures:

- Front: 220
- Middle: 210
- Back: 190
- Feed: 50

Fans:

- Front: 1/2
- Middle: Full
- Feed: full
- Motor: full

Number of air paths:

- 2 (but 1 would suffice)

Approximate motor power:

- 30V
- 5A+

Speed Knob position:

-

Traverse Knob Position:

- 4

Colorants Tested:

- Clear only so far

Notes:

- Vacuum dry pellets.

Material Parameters: HIPS

Reseller: [3DXTech](#)

Process time for 1kg spool: 35 min

Nozzle: Standard Melt Filter Nozzle – Style X – with 60 mesh

Screw: Standard Compression

Airpath Spacing: The first airpath should be directly underneath the EX6 die.

Temperatures:

- Front: 210
- Middle: 190
- Back: 180
- Feed: 40

Fans:

- Front: Full
- Middle: Full
- Feed: full
- Motor: full



Number of air paths:

- 2 (but 1 would suffice for lower speeds)

Approximate motor power:

- 45V
- 2.25 A

Speed Knob position:

- 15



Traverse Knob Position:

- 13

Colorants Tested:

- **Good:** McMaster-Carr Dark Red: Cat# [5174N35](#)

Notes:

- All pellets are vacuum dried overnight at 80C.
- Extruder temperature retuning may be needed. Temperature often overshoots set value in metering section even with full fan speed.

Recycling

PLA

- PLA regrind has half the bulk density of pellets.
- 50% volume of regrind to 50% volume of pellets (1:3 ratio of weight) resulted in filament that was largely in spec. It was not necessary to extrude the regrind then pelletize, which saves a lot of time. However, the material that was reground were print failures (i.e., they went right from the printer to the recycling bin), and the only degradation they likely experienced was thermal.
- Temperatures: Front: 180, Middle: 175, Back: 170, Feed: 40.
 - I believe that the lower front or metering temperature is result of a decreased melt viscosity for recycled material. At 190C, the filament would stick to the airpath.
- Speed Knob Position: 15
- Motor Power Draw: 50 V, 2A
- Traverse: 5

PET

- PET could be extruded with a moisture content below 0.02 wt%.
 - Recommended drying: 100C at Vacuum
 - Within only 15 min, the material absorbs enough moisture to reach a content of 0.02 wt.% - KEEP Enclosed
 - PET degrades in the presence of water at high temperatures.
- Resources:
 - <https://www.mdpi.com/2313-4321/7/5/69>