

Mini-guide

# 3D printing from PET bottles

A step-by-step tutorial



## **Key learning outcomes:**

- *Learn a new way to recycle PET bottle at a local scale*
- *Get the 9 easy steps to make your customized product*



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The contents of this guide are proposed in **open source**

Contributions to this mini-guide are welcome → please send an e-mail to [jean-baptiste@plasticodyssey.org](mailto:jean-baptiste@plasticodyssey.org)

# Introduction

PET bottles (water bottles) are a really common type of high-value “waste” that can quite easily be recycled with an access to industrial facilities to make new PET bottles mainly. When this option is available, this is the most circular solution to go for. However, it happens that this option is neither technically available nor economically viable (too far from a recycling center or no sufficient economic incentive etc).

In this case, recycling PET becomes trickier as it is more complicated to recycle it at a sub-industrial scale because of its properties when extruding (contrary to polyolefins like PE or PP).

That's why, finding other ways to reuse, recycle or downcycle PET is necessary to avoid leaving these precious materials to landfills, open burning or Ocean pollution.

One of the solutions proposed by a member of the Plastic Odyssey community of recycling entrepreneurs is to transform these PET bottles into objects through 3D printing. Although this is a niche approach with very specific applications and limited production capacity, we found it interesting to inform you of this method. This guide shows you how to proceed, step by step.

We will explore through other guides, other methods to transform PET bottles at a sub-industrial scale (micro or semi-industrial scale).

**Many thanks to Yerry Batista (Dominican Republic) for his valuable contribution!**




PET bottle that has leaked in the Ocean - Gili islands, Indonesia

# 1. PET bottles' selection

Let's start from the beginning: selection of the feedstock! Selected bottles must meet cleanliness criteria. Any bottles that have been in contact with leachate or other toxic substances are rejected. Additionally, bottles containing oils or substances that require excessive water consumption for cleaning are also generally discarded.



 **Tools:** none

 **Optional:** Selected bottles can be already crushed, but the mouth with the thread must remain intact so that the cap with the air valve can be used to inflate the bottles (see next section)

# 2. Blowing

The bottles are fitted with a special cap with a valve and inflated until they have 20 pounds of internal pressure, the air pressure helps in the smoothing process. If the bottle cannot be inflated, it is discarded. If the bottle has no relief and is completely cylindrical, this step is not necessary.



### Tools:

- Valve Cap:

Example:

[Aoerzn 8Pcs Premium TR413 Tubeless Tire Valve Stems, Black Rubber Snap-in Tire Valve Stem, Universal for Tubeless 0.453 inches 11.5mm Rim Holes](#)

- Air Pump:

Example:

[Amazon.com: AVID POWER Tire Inflator Air Compressor, 20V Cordless Car Tire Pump with Rechargeable Li-ion Battery, 12V Car Power Adapter, Digital Pressure Gauge](#)

 **Video:** [Master the Techniques for Expanding and Smoothing PET#1 Bottles for The Recreator 3D Pultrusion Unit](#)

Note: Don't heat the bottle using the method of this video

## 3. Smoothing

The still-inflated bottles are placed in a rotary device and with one or more heat guns (depending on the size), all the reliefs are removed, and the label is removed, which easily yields when heated, leaving the glue exposed.

 **Video:** [Green PET bottle complete process #3dprinting #3dprint #creality #ender...](#)

### Alternatives:

- Submerging the inflated bottle in hot water
- Using a heat gun to apply heat only to the desired area, while rotating the bottle using an electric drill (the method I use)

### Tools:

- Electric drill:

Example:

[https://www.amazon.com/LDX120C-20-Volt-Lithium-Ion-Cordless-Standard/dp/B01MoTPUYC/ref=sr\\_1\\_4?keywords=BLACK-DECKER-LDX120C-Lithium&qid=1700209452&sr=8-4](https://www.amazon.com/LDX120C-20-Volt-Lithium-Ion-Cordless-Standard/dp/B01MoTPUYC/ref=sr_1_4?keywords=BLACK-DECKER-LDX120C-Lithium&qid=1700209452&sr=8-4)

- Heat gun:

Example:

[https://www.amazon.com/Black-Decker-1800-Watt-Temperature-Orange/dp/BooCIIXRE/ref=sr\\_1\\_2?keywords=BLACK-DECKER-HG1300-Dual&qid=1700209402&sr=8-2](https://www.amazon.com/Black-Decker-1800-Watt-Temperature-Orange/dp/BooCIIXRE/ref=sr_1_2?keywords=BLACK-DECKER-HG1300-Dual&qid=1700209402&sr=8-2)

## 4. Glue removal

The glue is removed using acetone or paint solvent and a small towel, before passing the bottle to the next stage it is checked again that it has no trace of glue.

**Video:** [Green PET bottle complete process #3dprinting #3dprint #creality #ender5s1](#)

**Note:** if the bottle contains water and is clean, no washing is required, jumping to the cutting stage.



## 5. Washing

Finally, the bottle is washed inside and out with water. If the bottle contains detergents, it is filled, shaken, and emptied as many times as necessary until it is free of detergents and it is checked that it does not foam when filled. To save water, the last wash of the previous bottle becomes the first fill of the next one, and for washing the bottles, they are not completely filled with water. If the processed bottle contains water and is clean, this step is not necessary.

**Note:** it is not necessary to dry the bottles before cutting the strips (in our experience), you can also cut the bottom of the bottle to dry it faster.



## 6. Ribbon cutting

After cutting the bottom, the bottle is inserted into the ribbon cutter. The width of the ribbon is determined by the thickness of the bottle walls, according to the application's indication. The width of the ribbon is checked with a caliper before proceeding. At the end of the pull, the width of the ribbon is checked, and the beginning and end are cut where it is irregular or has defects. The bottom and neck of the bottle are thrown into a special container that, when filled, is taken to a recycling center.





**Note:** Some Pull-Truding machines include the ribbon cutter in their function, in our case we process large batches of bottles and cut them separately, to reduce space, ensure the quality and reduce time.

**Tools:**

- Scissors
- Bottom Cutter (DIY) (optional):

Example:

<https://www.printables.com/model/446660-pet-bottom-cutter>

- Ribbon Cutter (optional for batch cutting):

Example: [Plastic Bottle and Can Cutter](#)

Filament cutter settings according to the height of the PET strip to the bottle wall thickness:

4mm	--> 0,45mm
5mm	--> 0,40mm
6mm	--> 0,35mm
7mm	--> 0,30mm
8mm	--> 0,25mm
9mm	--> 0,20mm
10mm	--> 0,15mm
12mm	--> 0,1mm

## 7. Pull-trusion

A long tip is cut at the end of the ribbon and inserted into the nozzle, the machine is heated to 220-230 degrees Celsius, the first end of the ribbon is inserted and pulled until it reaches the other end where the reel and holder are. Then the two filaments are tied, and the machine is started until the ribbon is completely pulled and converted into filament.

If it is not possible to pull the ribbon through the nozzle or too much force must be applied when pulling, it means that the ribbon is too wide. And on the contrary, if we observe that the filament is not completely closed, it means that the ribbon is too thin.



### Recommended Machines:

- Recreator 3D: Needs to repurpose an old printer, DIY and expensive
- PETmachine: DIY, the kit is sold with all non 3D printed parts, guide instructions are detailed
- PETALOT: fully operational <https://function3d.xyz/en/> (Best option)

## 8. Final filament winding

After the extrusion pulling is completed, the irregular ends of the filament are cut and wound onto a reel or inserted into a box.

**Note:** PET filaments (PETG or PET) must be stored in a dry container to avoid stringing and imperfections while printing.

## 9. 3D printing

It is recommended that all 3D printers used for this method have a filament runout sensor, speed is not taken into account because PET can't be printed at speeds over 60 mm/s in most models. A printer with multiple materials system or (AMS) is recommended to avoid manually and constantly changing filaments. Also the recommended printers are fully enclosed machines, and have functions to dry the filaments when needed.

**Recommended printers:** Bambu Labs P1S with AMS or X1 Carbon with AMS.

<https://store.bambulab.com/collections/3d-printer?skr=yes>

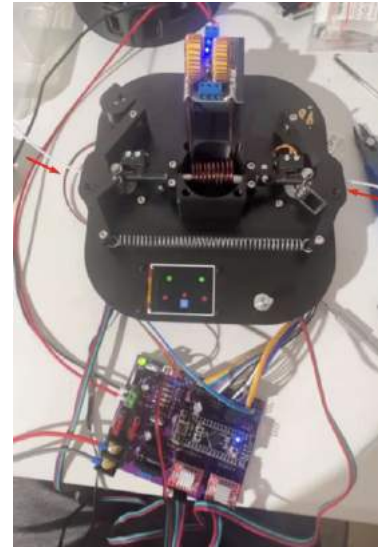




## 10. Research & Development

The community is working on making the process easier and solving some problems like:

- Heating the whole bottle at one time, reducing electricity consumption.
- Filament welding: see picture on the right



## Conclusion: example of a final result

Check out an example of outcome in the video below and test your own ideas!

 **Video:** [De botella abandonada a Camión de Juguete con impresora 3D #reciclajecreativo - YouTube](#) (in spanish but self explanatory)



*It's now up to you to take this knowledge and apply it to the environment around you.*