

# MUST

## Multi Use Straightener Tool

### INSTRUCTIONS FOR FABRICATION

AUTHORS:

Leonardo Galleani, Greta Manganini, Andrea Roveroni, Silvia Torri, Chiara Tregnago

CO-AUTHORS:

**Polifactory** (Polifactory - Politecnico di Milano)

CONTACT:

Andrea Roveroni (mailto: [rove\\_95@hotmail.it](mailto:rove_95@hotmail.it))

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POLIFACTORY

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# 1. Basic Info

MUST is a new technical tool for rapid welding and joining of polymeric materials.

By taking advantage of a common hair straightener thanks to a series of add-ons, different types of welding can be carried out for different purposes, which makes it a new tool that lends itself to multiple scenarios: from the DIY world to the context linked to situations of emergency.

Everything is easily removable to allow you to return to use the hair straightener with its primary function in complete safety.

## **BILL OF MATERIALS**

The table below contains all the materials necessary for the reproduction of the product.

### **BUY**

| <b>Name and typology</b>                                    | <b>Link</b>  | <b>Qty</b> | <b>Cost</b> |
|---|--|------------|-------------|
| Hair straightener<br>Imetec Bellissima<br>Creativity B9 300 | <a href="http://bit.ly/imetec-bellissima">bit.ly/imetec-bellissima</a> | 1          | 39,90 €     |

## MAKE

| Name                    | Material and Technology     | Qty |
|-------------------------|-----------------------------|-----|
| must_arm.stl            | Flexible resin SLA printing | 2   |
| MUST_plate_01_lower.stl | Aluminium CNC milling       | 1   |
| MUST_plate_01_upper.stl | Aluminium CNC milling       | 1   |

### TECHNOLOGY AND TOOLS USED

- Form 2 by FormLabs (SLA 3D printer) to print the flexible structure.
- Roland MonoFab SRM-20 (Desktop CNC milling machine) to cut and mill the plate and its texture.

### SECURITY TOOLS AND DEVICES

Safety goggles are mandatory for the use of the milling machine, in addition, also gloves and face mask to manage the resin for the SLA printing.

## 2. Step By Step Explanation

MUST has been designed to adapt on the hair straightener Bellissima Imetec Creativity B9 300, but the files are editable to be adapted to any type of hair straightener if needed.

### 2.1.STRUCTURE (SLA / FDM 3D PRINTING)

Due to the small details and the high temperatures reached by the hair straightener, the flexible arms have been printed in SLA but, If your printer has a direct drive extruder, you can also print them in TPU (we raccomandated a 80 shore polymer).

### **Step 01 - Select and extract must\_arm.stl file from MUST\_digitalfiles.zip**

These files include the geometry that can be opened through a slicing software for 3D printing (choose the best slicing software that fits your printing needs).

Verify the printing settings, according to the printer used (SLA and/or FDM).

### **Step 02 - Proceed with the 3D printing operations**



Fig. 1. The end result of the SLA printing

### Step 03 – Wash and cure the parts

|                    |               |              |
|--------------------|---------------|--------------|
| Material           | Time          | Temperature  |
| <b>Flexible V2</b> | <b>15 min</b> | <b>60 °C</b> |

% Gain in Tensile Strength over Cure Time at 60 °C for Flexible V2

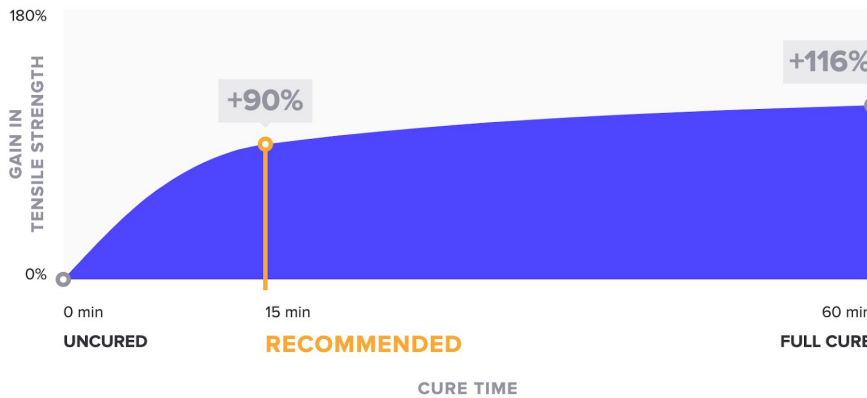


Fig. 2. Settings from the FormLabs support to cure the resin.

### Step 04 – Remove the supports

Use a pair of small cutters to remove the supports. They will come off easily.

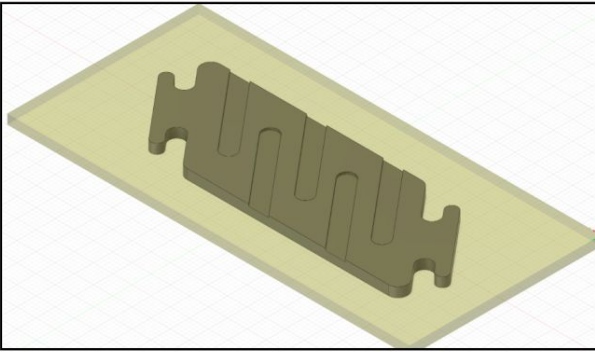
#### 2.2.PLATES (CNC MILLING)

There are two option for this components:


- A. milling the provided plates or
- B. design custom plates and then mill them.

#### Step 01A – Select and extract MUST\_plate\_01\_lower.stl and MUST\_plate\_01\_upper.stl files from MUST\_digitalfiles.zip

We use the CAM processor of Fusion 360 to generate the .nc files for our milling machine. Feel free to use whatever CAM you want. Below there are the settings used with the Roland Monofab.

| Setup                  |  |
|------------------------|--|
| WCS: #0                |  |
| STOCK:                 |  |
| DX: 105mm              |  |
| DY: 50mm               |  |
| DZ: 2.5mm              |  |
| PART:                  |  |
| DX: 83.28mm            |  |
| DY: 28mm               |  |
| DZ: 2.5mm              |  |
| STOCK LOWER IN WCS #0: |  |
| X: 0mm                 |  |
| Y: 0mm                 |  |
| Z: -2.5mm              |  |
| STOCK UPPER IN WCS #0: |  |
| X: 105mm               |  |
| Y: 50mm                |  |
| Z: 0mm                 |  |

| Total                          |
|--------------------------------|
| NUMBER OF OPERATIONS: 2        |
| NUMBER OF TOOLS: 1             |
| TOOLS: T10                     |
| MAXIMUM Z: 17mm                |
| MINIMUM Z: -2.5mm              |
| MAXIMUM FEEDRATE: 300mm/min    |
| MAXIMUM SPINDLE SPEED: 6025rpm |
| CUTTING DISTANCE: 6399.88mm    |
| RAPID DISTANCE: 454.61mm       |
| ESTIMATED CYCLE TIME: 30m:46s  |

| Tools                             |                                       |  |  |
|-----------------------------------|---------------------------------------|--|--|
| <b>T10 D10 L10</b>                |                                       |  |  |
| TYPE: flat end mill               | MINIMUM Z: -2.5mm                     | HOLDER: "TTS-JT1 Holder with 1/4" Drill Chuck" |  |
| DIAMETER: 3.17mm                  | MAXIMUM FEED: 300mm/min               | VENDOR: Tormach                                |  |
| LENGTH: 35mm                      | MAXIMUM SPINDLE SPEED: 6025rpm        | PRODUCT: 30102                                 |  |
| FLUTES: 2                         | CUTTING DISTANCE: 6399.88mm           |  |  |
| DESCRIPTION: SRM-20 flat bit 1/8" | RAPID DISTANCE: 454.61mm              |  |  |
|                                   | ESTIMATED CYCLE TIME: 30m:31s (99.2%) |  |  |

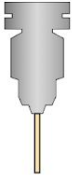
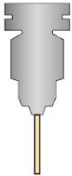
| Operations                |                                       |                                   |   |
|---------------------------|---------------------------------------|-----------------------------------|---|
| <b>Operation 1/2</b>      |                                       | <b>T10 D10 L10</b>                |   |
| DESCRIPTION: Tasca 2D2    | MAXIMUM Z: 17mm                       | TYPE: flat end mill               |  |
| STRATEGY: Pocket 2D       | MINIMUM Z: -0.5mm                     | DIAMETER: 3.17mm                  |   |
| WCS: #0                   | MAXIMUM SPINDLE SPEED: 6025rpm        | LENGTH: 35mm                      |   |
| TOLERANCE: 0.01mm         | MAXIMUM FEEDRATE: 300mm/min           | FLUTES: 2                         |   |
| STOCK TO LEAVE: 0mm       | CUTTING DISTANCE: 1921.78mm           | DESCRIPTION: SRM-20 flat bit 1/8" |   |
| MAXIMUM STEPDOWN: 0.15mm  | RAPID DISTANCE: 321.95mm              |                                   |   |
| MAXIMUM STEPOVER: 1.5mm   | ESTIMATED CYCLE TIME: 8m:20s (27.1%)  |                                   |   |
|                           | COOLANT: Off                          |                                   |   |
| <b>Operation 2/2</b>      |                                       | <b>T10 D10 L10</b>                |   |
| DESCRIPTION: Contorno 2D2 | MAXIMUM Z: 15mm                       | TYPE: flat end mill               |  |
| STRATEGY: Contour 2D      | MINIMUM Z: -2.5mm                     | DIAMETER: 3.17mm                  |   |
| WCS: #0                   | MAXIMUM SPINDLE SPEED: 6025rpm        | LENGTH: 35mm                      |   |
| TOLERANCE: 0.01mm         | MAXIMUM FEEDRATE: 300mm/min           | FLUTES: 2                         |   |
| STOCK TO LEAVE: 0mm       | CUTTING DISTANCE: 4478.1mm            | DESCRIPTION: SRM-20 flat bit 1/8" |   |
| MAXIMUM STEPDOWN: 0.15mm  | RAPID DISTANCE: 132.66mm              |                                   |   |
| MAXIMUM STEPOVER: 3.01mm  | ESTIMATED CYCLE TIME: 22m:11s (72.1%) |                                   |   |
|                           | COOLANT: Off                          |                                   |   |

Fig. 3. The settings used to manufacture the plates.

### Step 01B – Modify plates design on Fusion 360

Open the file MUST\_plate from [this link](#). That file is a “blank canvas” of the design of the plate. We also provide a .dxf with outline shape in case you want to use a different CAD program. Remember to use an aluminium sheet of 2,50mm of thickness.

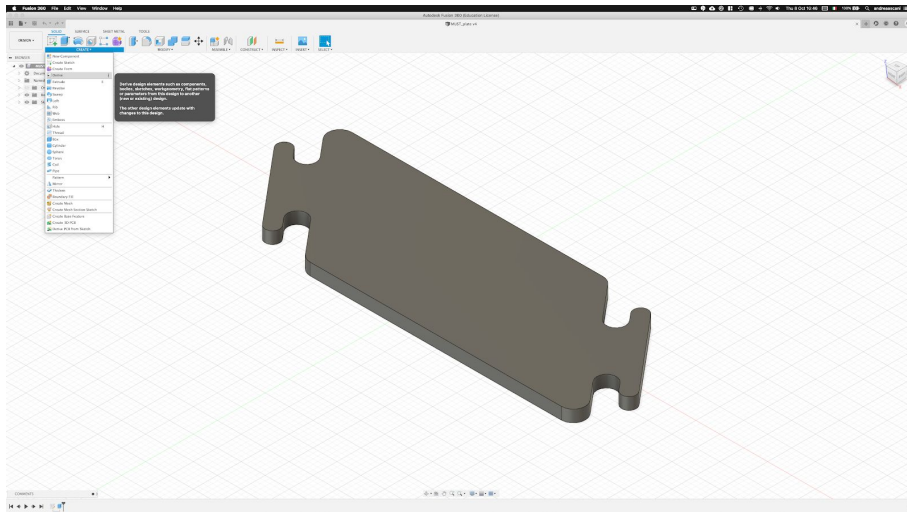


Fig. 4. Derive the design from the base profile.

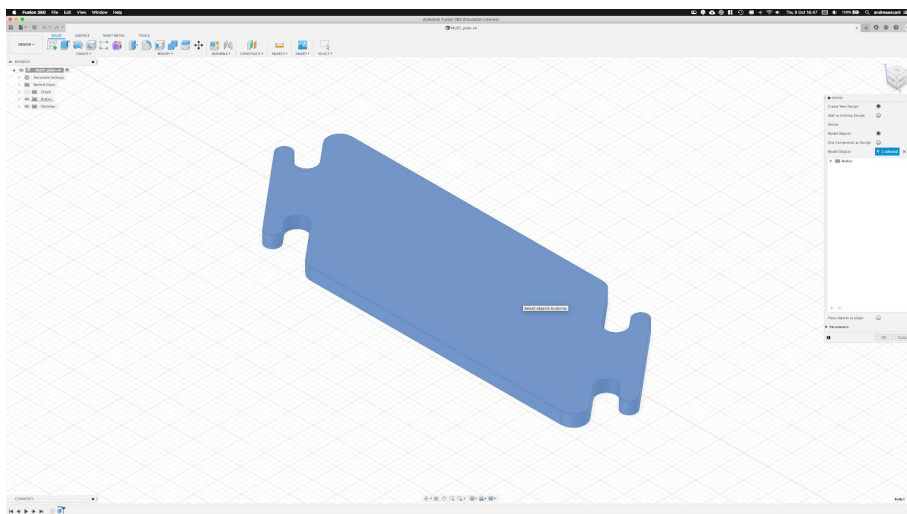


Fig. 5. Select the body and create a new design.

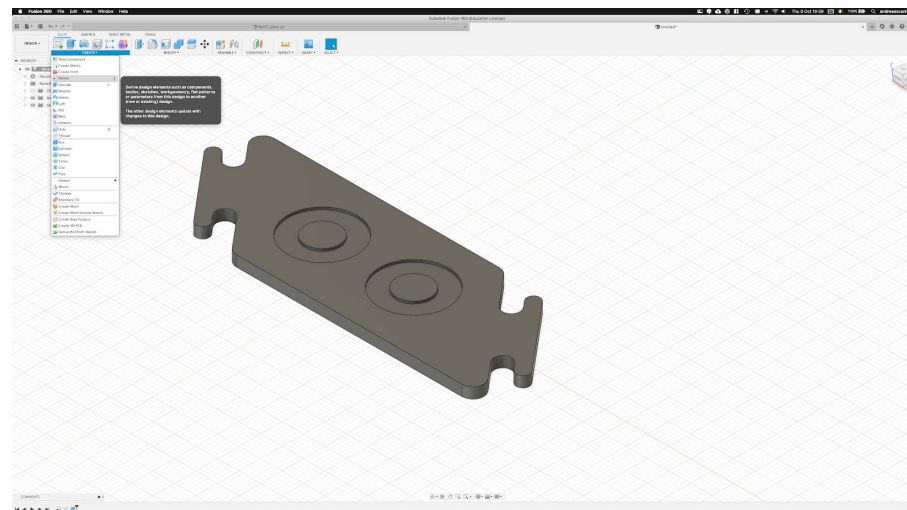


Fig. 6. Create a new feature and then create a derived design as before.

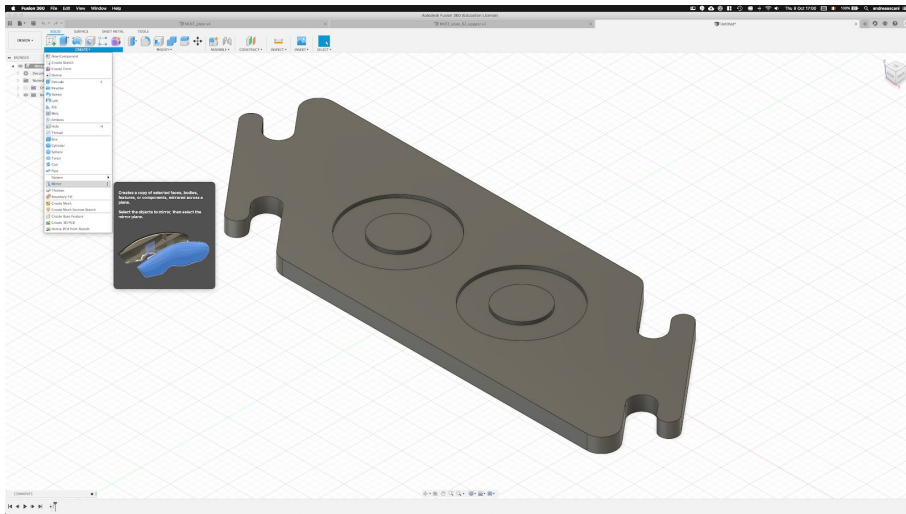


Fig. 7. With the mirror function you can create immediately the reflected second plate.

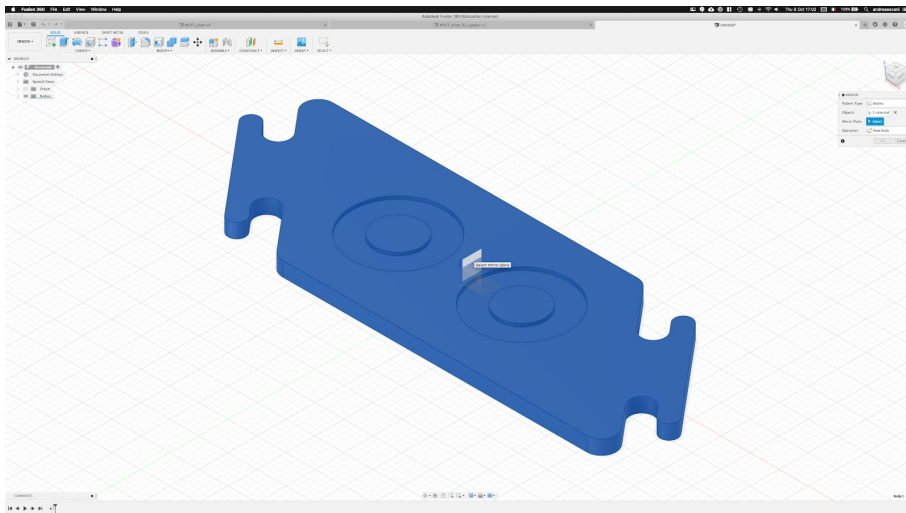


Fig. 8. Select the correct plane to mirror with.

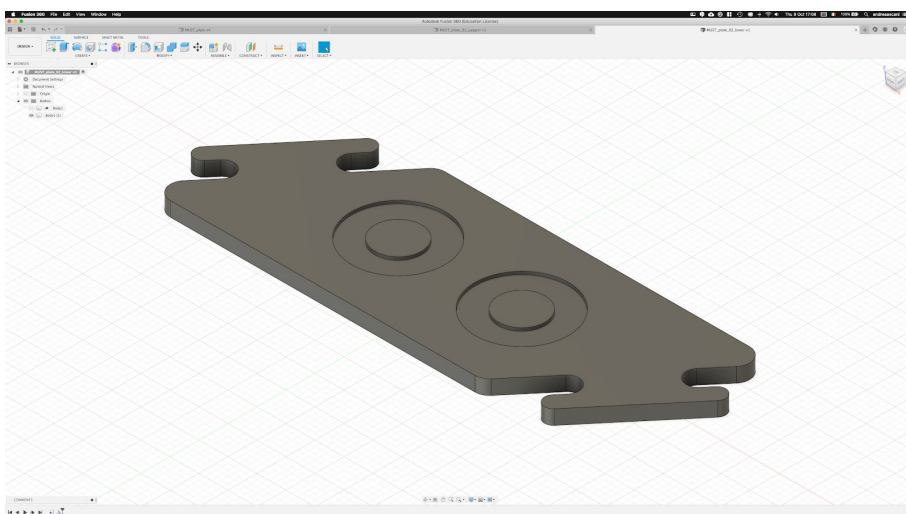


Fig. 9. The mirrored plate.



### **Step 02 - Set the plate on the machine**

Place the material on its support, secure it and set everything on the CNC machine.

### **Step 03 - Proceed with the CNC milling operations**

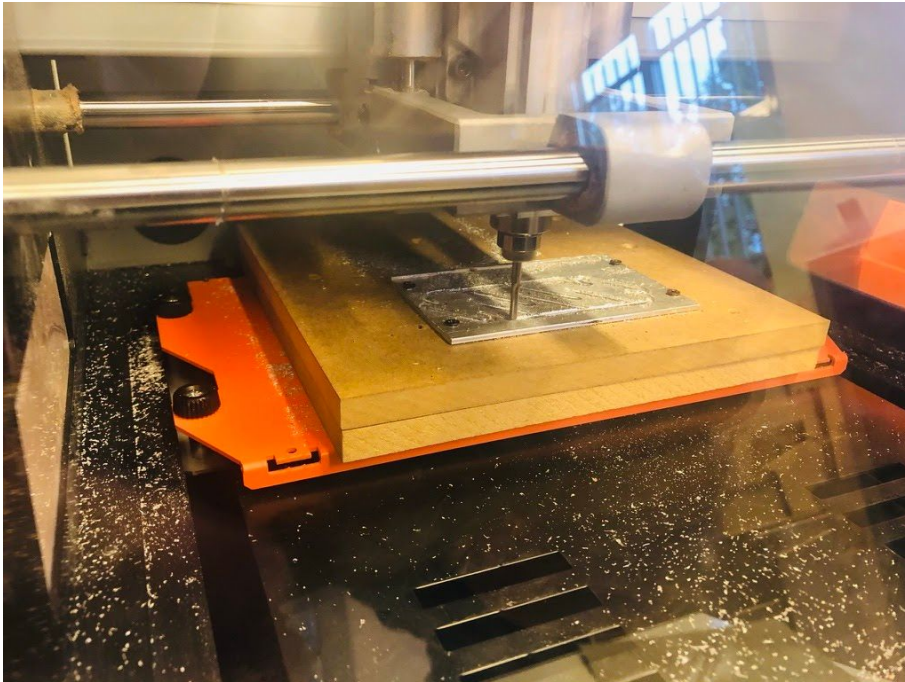


Fig. 10. The milling machine in process.

### **Step 04 - Remove the plate from the support and then the excess material from the plate**



Fig. 11. The final result.

### 2.3.ASSEMBLY

To assemble MUST no fasteners are needed! Just elastic deformation: insert one side of the aluminium plate to the structure and then fix it on your hair straightener. We recommend downloading the User Guide for more details. Be careful and have fun!

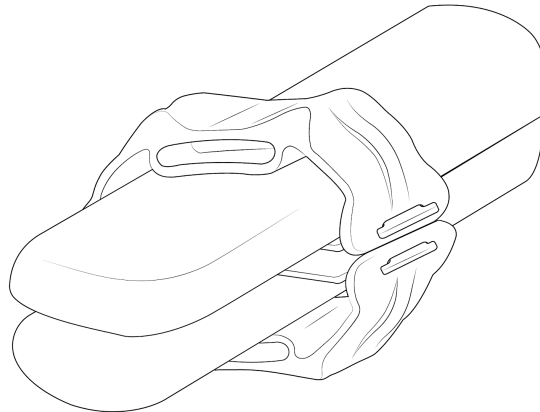


Fig. 12. MUST on the hair straightener.

## 3. Credits

MUST is a project publicly released and made available in open source mode according to the **Creative Common License (CC-BY)** and promoted by Distributed Design with the related documentation.

The authors of MUST are Leonardo Galleani, Greta Manganini, Andrea Roveroni, Silvia Torri, Chiara Tregnago. MUST is a project developed with the collaboration of Polifactory within the Distributed Design project co-funded by the Creative Europe Programme of the European Union. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

\* POLIFACTORY and DD logos have to be inserted (a .svg file with the two logos is included in the .zip folder named MUST\_digitalfiles.zip)

## 4. Downloadable Files

MUST files can be download at:

\*\*\*[www.polifactory.polimi.it/en/polifactory/delice](http://www.polifactory.polimi.it/en/polifactory/delice)

CONTACT: Andrea Roveroni (mailto:[rove\\_95@hotmail.it](mailto:rove_95@hotmail.it))