BLACKBELT

Installation & User Manual

Original document

Version 2018- 3.5

BLACKBELT 3D Printer

Preface

This user manual has been composed for those persons assigned to work with the Blackbelt 3D Printer.
Prior to operating the Blackbelt 3D Printer, it is highly recommend to thoroughly read and understand this user manual.

The user manual consists of important instructions and information how to proceed with the printer on a safe and skilled manner.

! Please make sure a copy of this manual is available at any time near the printer !

We advise that the user manual can / shall be completed with directions and legislations with respect to national compliances concerning :
Safety / Health / Environment (SHE)

! Please read and understand the contents of this installation and user manual carefully !

Failure to read the manual may lead to personal injury, inferior results or damage to the BlackBelt 3D Printer. Always make sure that anyone who uses the Blackbelt knows and understand the contents of the manual and makes the most out of Blackbelt 3D Printer.

The conditions or methods used for assembling, handling, storage, use or disposal of the device are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, injuries, damage, or expense arising out of or in any way connected with the assembly, handling, storage, use or disposal of the product. The information in this document was obtained from sources which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness.

The Blackbelt 3D Printer is intended for use as described in Chapter 1: Technical specifications & Tolerances. Any other use of the printer is not allowed by BlackBelt 3D BV and will expose the user and its surroundings to significant danger.

Blackbelt 3D BV will assume no responsibility for direct / indirect damage resulting from improper operation / lack of maintenance and any other use of the machine as intended is this manual. Any modification on the Blackbelt 3D Printer without proper written consult and permission by BlackBelt 3D BV will automatically void any right to warranty.

Table of Contents

1: Technical specifications and tolerances

The sole intention of this machine is 3D Printing of models / parts. The Blackbelt 3D Printer is only intended to produce products and use materials as described in this user manual. A detailed description of the functionality of this machine is described in Chapter 4.2 : "Principle of operation".

⚠️ *This machine shall only be used within the specifications and tolerances as described in this manual. Blackbelt 3D BV will assume no responsibility for direct / indirect damage resulting from improper operation / lack of maintenance and any other use of the machine as intended is this manual.*

⚠️ *The sole use of the machine is only intended for the production of products as described in the general terms and conditions. These terms and conditions are provided prior to shipment and need to be countersigned for acceptance. A copy can be acquired through e-mail (info@blackbelt-3d.com) or download a copy on our website (www.blackbelt-3d.com)*

⚠️ *Do not use of the machine for any other purposes then intended by BlackBelt 3D BV. Not doing so can lead to serious damage to the machine or the machine-operator and its surroundings.*

⚠️ *The Blackbelt 3D printer generates high temperatures and has hot moving parts that can cause injury. Never reach inside of Blackbelt 3D Printer while it is in operation. Always control the printer with the jog button at the front or the power switch at the back of the electrical cabinet. Allow the Blackbelt 3D Printer to cool down for 5 minutes before reaching inside the stationary gantry.*

⚠️ *Only use this machine inside a building. Ensure the machine is positioned in a well ventilated and clean environment. Ensure a room temperature of 15C – 30C for optimal operating conditions.*

Specifications	
Voltage / Frequency	115 - 240Volt; 50 - 60Hz
Wiring machine	IEC connector
Installed Power	600W
Consumables	1.75 mm Filament / open material platform
Year of production	2018
Type of product	As agreed in order confirmation

1.1 Identification plate

The identification plate is positioned on the bottom of the electrical cabinet.

2   Safety messages

The Blackbelt 3D Printer has been designed and build using modern techniques and using appropriate safety precautions. Improper use may cause severe danger / injury to body and surroundings, as well as damage to the printer itself and peripheral appliances.

Service and maintenance of the Blackbelt 3D Printer shall only be carried out by qualified personal, taking into account the safety warnings displayed on the machine and full awareness of the user manual. Keep children and / or unqualified staff away from the machine.

1. This machine is only intended to be used for processes and ambient conditions as described in the chapter 1: "Technical specifications and tolerances" of this user manual. Any other use is prohibited and not allowed by BlackBelt 3D BV. Any other use will create direct and present danger to the user and its surroundings.
2. It is prohibited at all times, to modify the machine without prior written consent of Blackbelt 3D BV.
3. The machine shall be positioned in such as manner, that at any time there will be enough free moving space around the machine for demonstrations/ service trainings and carrying out maintenance and inspections.
4. Keep the printer location clean and well illuminated. A messy or poorly illuminated printer location can cause safety hazards and injury.
5. Keep hands, hair, loose clothing and jewelry away from the moving parts of the machine. Wear appropriate clothing. We strongly advise to wear safety glasses and gloves when working with the BlackBelt 3D Printer.
6. As long as the machine is in use and switched on, no connector or safety precautions shall be removed. Only use the machine if all safety precautions are installed and ready for use.
7. Prescribed service intervals and maintenance instructions as mentioned in this user manual must be maintained at all times.
8. Only allow qualified personnel to replace spare parts and carry out maintenance and repairs.
9. As addendum to this manual, general and local regulations with respect to Safety / Health and Environment (SHE) shall be maintained at all times, including the use of personal protection equipment.
10. Always inform the users of the Blackbelt 3D Printer in time prior to starting maintenance or repairs. Completely switch of the main power switch and remove the connector from the wall socket.
11. If a part or sub-assembly of the Blackbelt 3D Printer has been damaged or is not functioning properly, please cease all activities or print jobs immediately. Only resume activities if the part has been repaired or replaced by a spare part. Please contact or your supplier or consult with Blackbelt 3D BV, if the machine is not functioning properly.
12. Machine parts shall be disposed in accordance with local laws / regulations.

2.1   Explanation of pictograms and symbols

Pictogram	Explanation:
	Please read and understand the contents of this installation and user manual carefully. It contains important information about commissioning and maintenance of the machine.
	Warning! Important attention points / instructions concerning safety or damage prevention are highlighted with this warning sign.
	Electrical Safety E-Cabinet 110 / 230V voltage inside.
	Entrapment hazard / Mechanical safety Caution: moving parts
	Hot Surface. Burn Risk by touching the hot surface (up to 120C).

2.2   Definition of users.

Operator: Low-skilled technical staff who read this user manual. An operator can work with the Blackbelt 3D Printer, except calibration, fine-tuning and maintenance of the machine.

Maintenance: Secondary skilled technical staff who read this manual. A maintenance engineer can work and calibrate the machine, except modifying the fixed machine parameters.

Specialist: Highly educated technical staff who read this manual. A specialist can work with the machine, calibrate and fine-tune the machine and modify fixed parameters.

No users may change or temporarily overrule or disengage safety features

3   Transportation

Please follow all prescriptions as described in this manual. In particular chapter 2 : Safety messages.

The transportation box of the Blackbelt 3D Printer must carried out horizontally. The humidity in the cardboard packaging must not be allowed to reach critical levels, causing condensation of moisture in the machine.

In case of eventual damage caused by transportation, please report this damage immediately to your shipping agent or transporter and to Blackbelt 3D BV at all times. Take all necessary steps to prevent further damage to the machine.

3   Transportation

4 Description of the machine

4.1 Machine overview
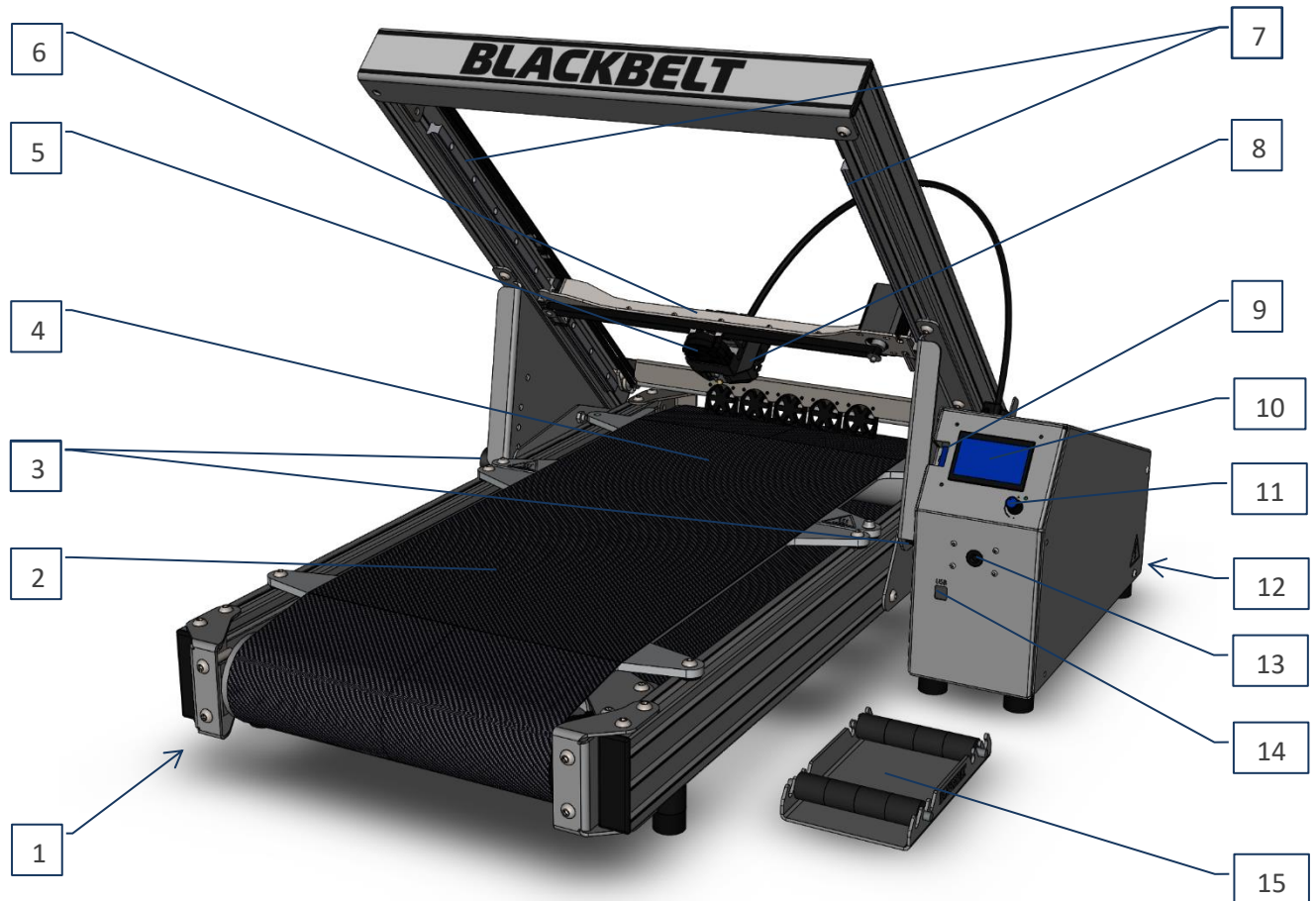
Number:	Machine part:
1	BLACKBELT 3D Printer (assembled)
2	Conveyor belt (Z Axis) cold segment
3	Angle Adjusting knob
4	Conveyor belt (Z Axis) heated segment
5	Cooling fan
6	X Axis
7	Y Axis (2x)
8	Printhead assembly
9	SD Card Slot
10	Display
11	Menu jog wheel
12	Electrical control cabinet
13	Filament inlet / entry
14	USB Port
15	Filament spool / holder

4.2   Principle of operation

Please ensure that all parts below are present, prior to commissioning the Blackbelt 3D Printer:

- All parts supplied in the packaging (picture 4.1) :
    - o   1x Printer
    - o   1x Electrical control cabinet
    - o   1x Spool holder
    - o   2x Filament spool
    - o   1x SD card
    - o   3x Printhead
    - o   2x Printhead screws
    - o   1x Hexagon key 3 mm
    - o   1x Hexagon key 5 mm
- A PC or laptop (using Windows or Mac/iOS operating system)

Standard practice:

1. Unbox / Unpack the machine and set-up on a table, wire the components
2. Install software on the PC, generate gcode, write the gcode to the SD card
3. Insert SD card into the SD card slot of the control cabinet
4. Switch on main power and select the gcode on the display
5. Pre-heat the Printer and start up a print-job
6. After the printed part has been completed, allow the machine to cool down.
7. Remove the printed part from the belt.
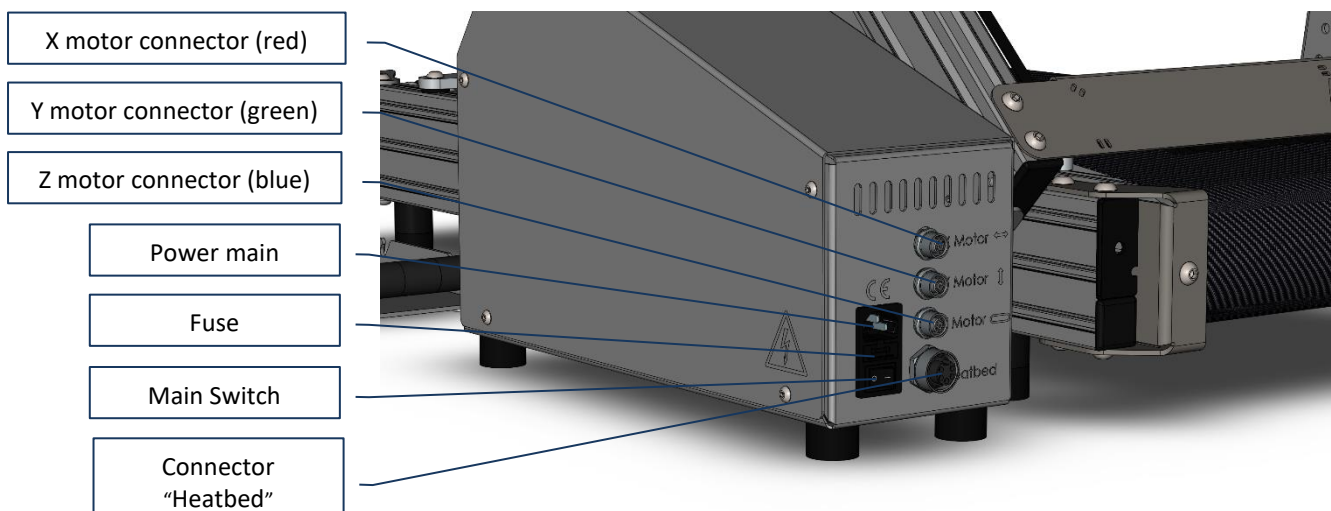
4.3   Positioning the BLACKBELT 3D Printer

Set-up the printer on a stable table in a dry and clean room with a temperature between 15-35°C.
The minimal dimensions of the table should be: 80cm x 80cm.

4.4   Control panel & electrical cabinet

Control panel / front side:

- Filament Insert lever
- SD Card slot
- Display
- Menu jog button
- Filament entrance
- USB port entrance
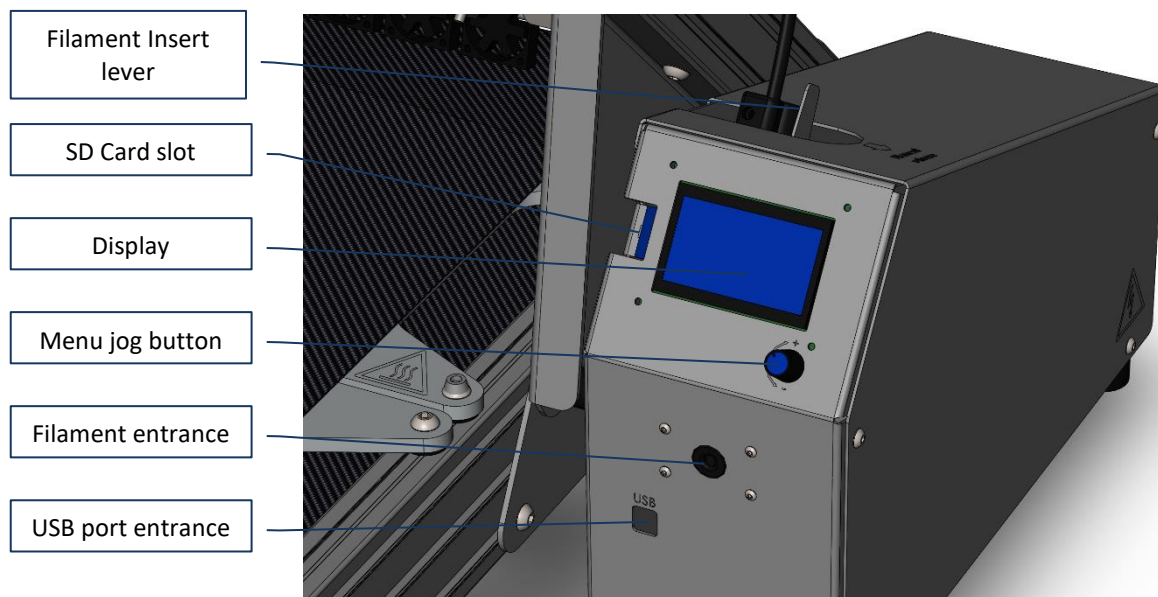
Electrical cabinet backside:

- X motor connector (red)
- Y motor connector (green)
- Z motor connector (blue)
- Power main
- Fuse
- Main Switch
- Connector "Heatbed"

5 Assembly, installation and commissioning the machine

⚠️ *Please follow all prescriptions as described in this manual. In particular chapter 2 : Safety messages.*

5.1 Positioning

The machine shall be placed on robust flat surface, rigid enough to hold the machine. The machine shall be positioned in such as manner, that at any time there will be enough free moving space around the machine for demonstrations/ service trainings and carrying out maintenance, cleaning and inspections.

5.2 Assembly / wiring

All supplied parts shall be connected onto the machine by the user as described in this manual. Once the machine assembly is completed, it can be wired and switched on by an authorized person by connecting the main power and switching on the main power.

⚠️ *As long as the machine is active and / or switched on, no connector or safety feature shall be removed. Only use the machine if all safety features are in place and functional.*

5.3   Setting up the 3D printer

1. Lift the printer from the packaging with 2 persons and place the machine on a table.
2. Remove the angle adjusting knobs (left and right), while holding the XY gantry.
3. Elevate the XY gantry to 45° (preset) and screw the adjusting knobs back in.
4. Position the control cabinet left or right beside the 3D printer.
5. Connect the cables / wires of the 3D printer with the connectors on the control cabinet:
    1. The connector with the red indicator connects with the contact labeled "X Motor".
    2. The connector with the green indicator connects with the contact labeled "Y Motor".
    3. The connector with the blue indicator connects with the contact labeled "Z Motor".
    4. The bigger connector without an indicator connects with the contact labeled "Heatbed".
    5. The main power connector connects with the supplied power adapter to the wall socket.

BLACKBELT 3D Printer

Control cabinet

Table

Spool holder
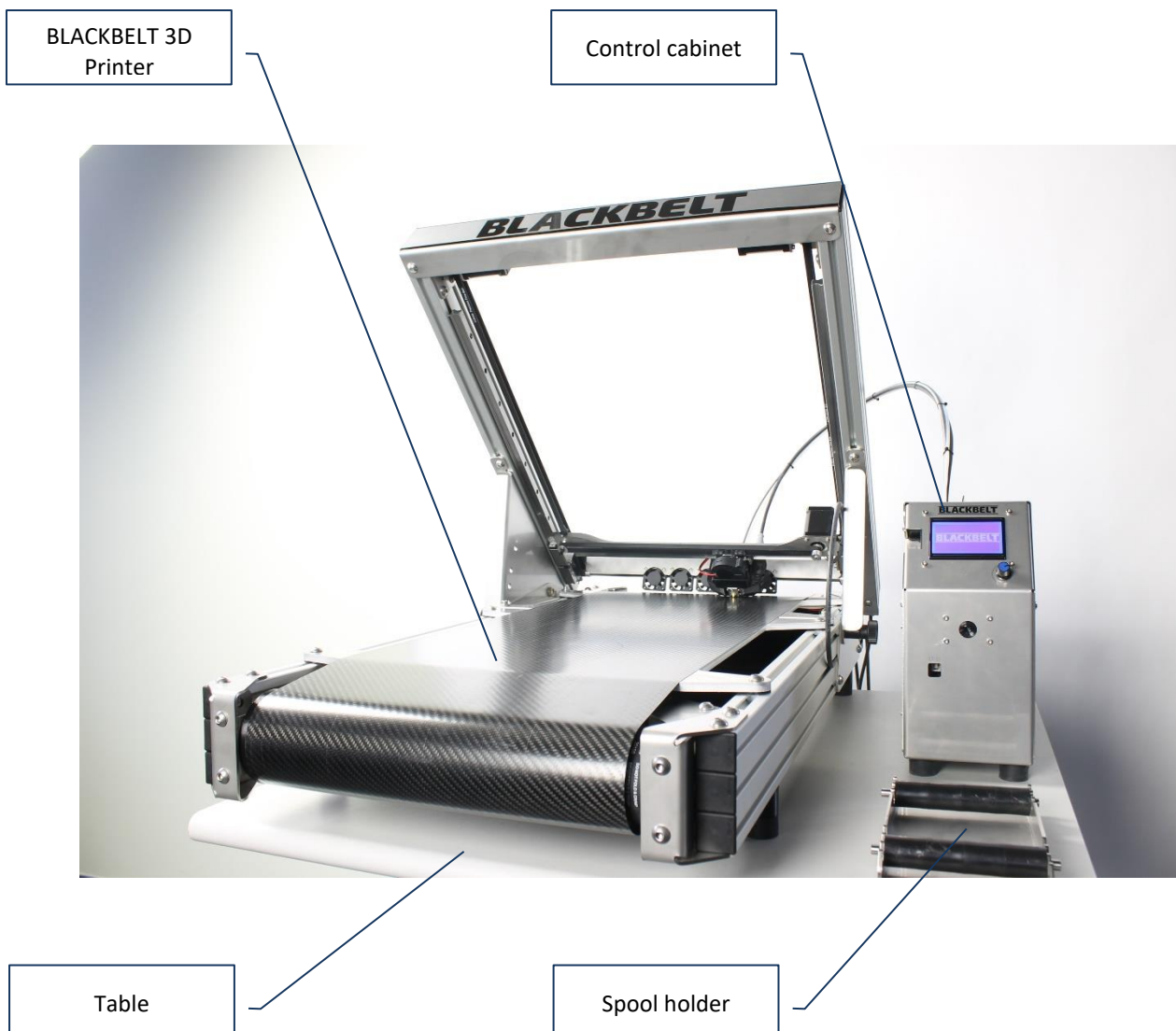
5.4   Installation of the printhead assembly.

⚠️ *Ensure the machine is switched "Off".*

⚠️ *Ensure the machine is setup secure on a robust table and can be accessed from all sides.*

Parts needed to install the printhead:

- 3D printer, assembled as described in chapter 5.3 :
- Printhead with Printhead screws
- Hexagon key 3mm.

1. Choose the printhead you wish to use.
   Printheads are available in 0.25, 0.4, 0.6, 0.8 and 1.0mm Nozzle Diameter.
   The smaller nozzle diameter you choose the more detailed prints will result. However, small nozzle diameters will also increase printing time for a big object.
2. Position the 2 printhead screws in the printhead assembly and position the printhead in front of the cooling fan assembly.
3. Move the X and Y axis of the printer to the middle of the XY gantry, providing access to the backside of the X axis.
4. Assemble the printhead on the X axis. The screws can be inserted in the 2 holes of the linear sled of the X axis.
5. Connect the wires / tubes of the control cabinet with the print head:
   a. First the spiral cable (spring) into the "spiral cable entry"
   b. Second the white PTFE Tube, into the "PTFE Tube entry".
   c. Finally connect the cable plug connector into the "Contact control cabinet".
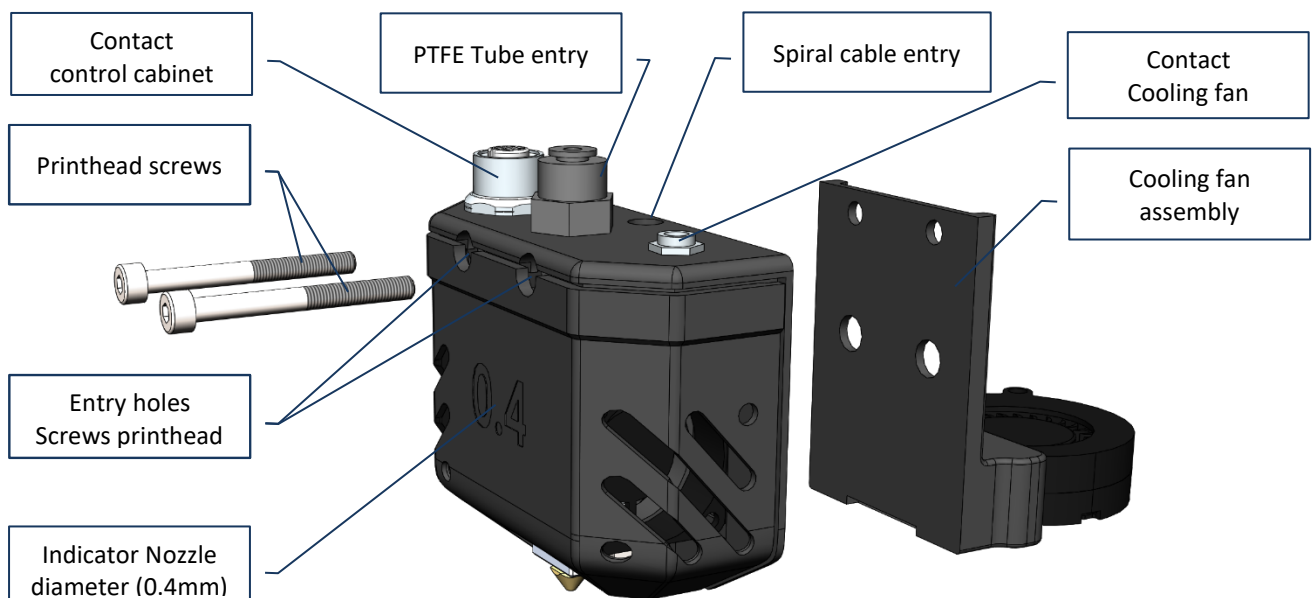
Bigger objects with less details can easily be printed with a bigger nozzle. Just changing the nozzle size will decrease printing time by a factor two if you double the size. Follow these instructions to change the nozzle size.

1. Make sure the material is removed according the steps in chapter 6.11 (Scenario 1: steps 1 + 2).
2. Unscrew the two bolts that attach the printhead tot the gantry. [1]
3. When both are loose pull the assembly back, the fan will come loose together with the printhead. Pull the cable and release the fan from the assembly. [2]
4. Detach the spring, tube and cables. [3]
5. Move the X and Y axis of the printer to the middle of the XY gantry, providing access to the backside of the X axis. [4]
6. Assemble the printhead on the X axis. The screws can be inserted in the 2 holes of the linear sled of the X axis. [5]
7. Connect the wires / tubes onto the printhead assembly:
   a. First the spiral cable (spring) into the spiral cable entry
   b. Second the PTFE Tube, into the PTFE Tube entry.
   c. Finally connect the last connector into the control cabinet.
8. Make sure you use the correct nozzle size when generating the machine code [6]
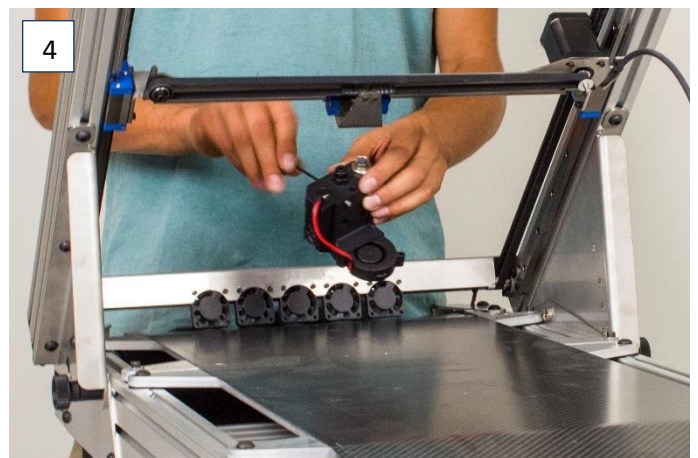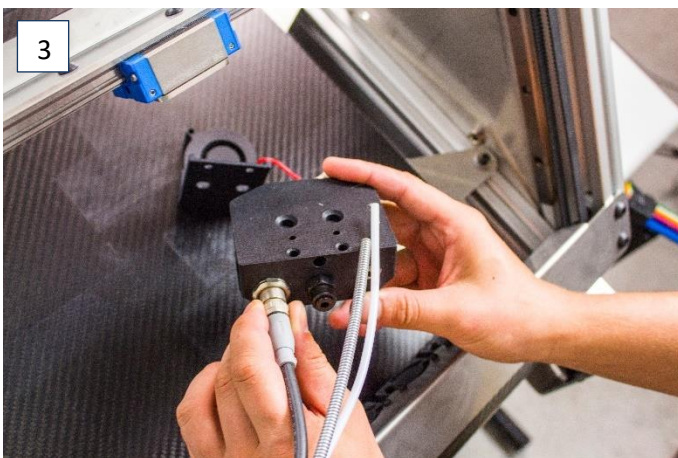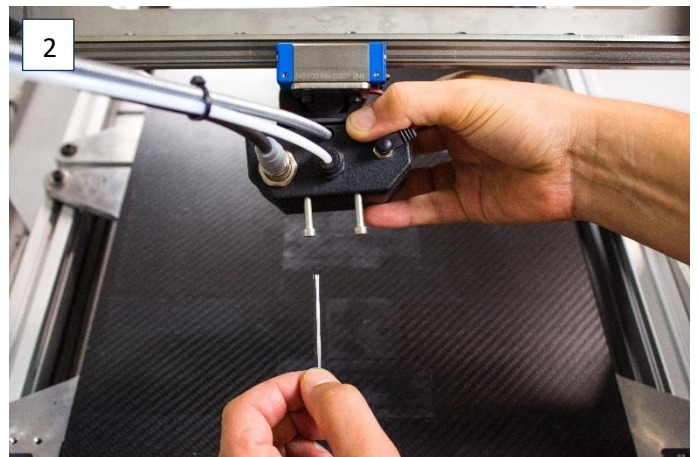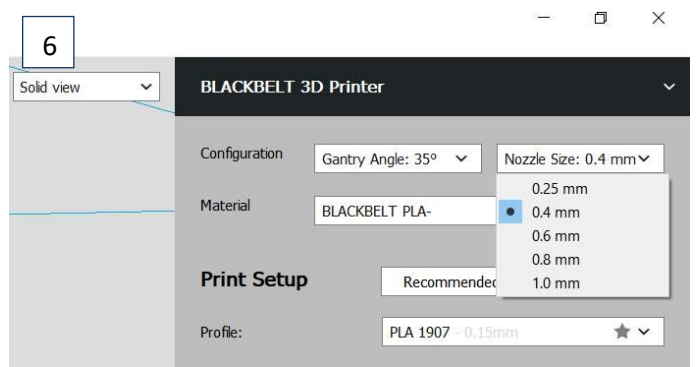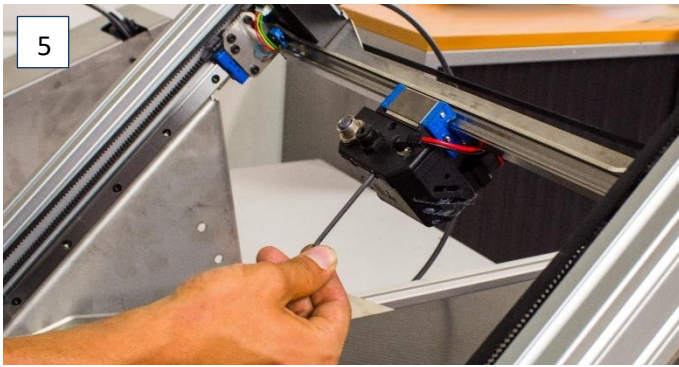
5.5 Calibration Y axis

*You'll need a 5mm and 3mm* Hexagon *key and a sheet of paper*

1. Set the gantry to 45° and mount a printhead.
2. Take a piece of paper, put it on the conveyor belt and place the printhead onto it:


3. Turn the printer on, press the jog wheel, select by rotating and pressing
   Prepare → Move axis → Move Y → Move 0.1mm
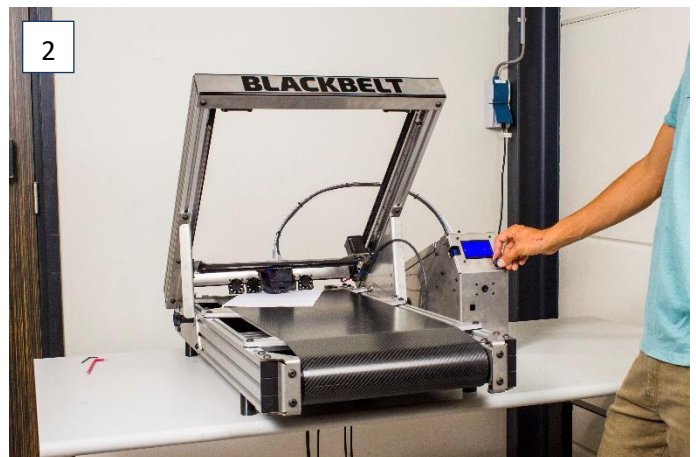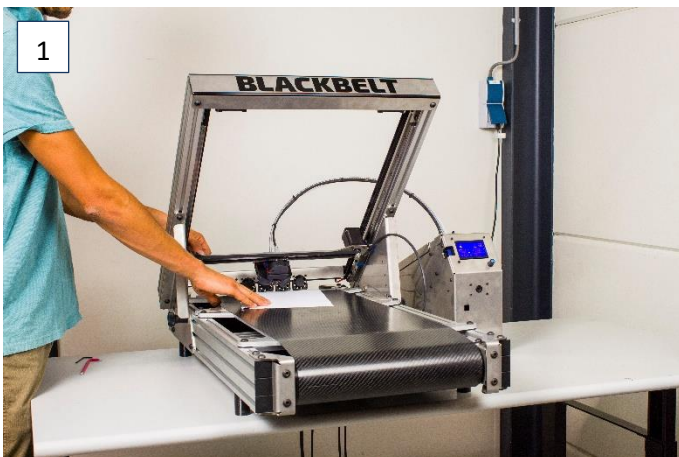
4. Turn the jog wheel to the right until you can move the paper freely
5. Now carefully move the printhead by hand to the left and right side, while constantly checking with the piece of paper if you can still move it freely. Don't move any further when you notice a resistance.   [3]
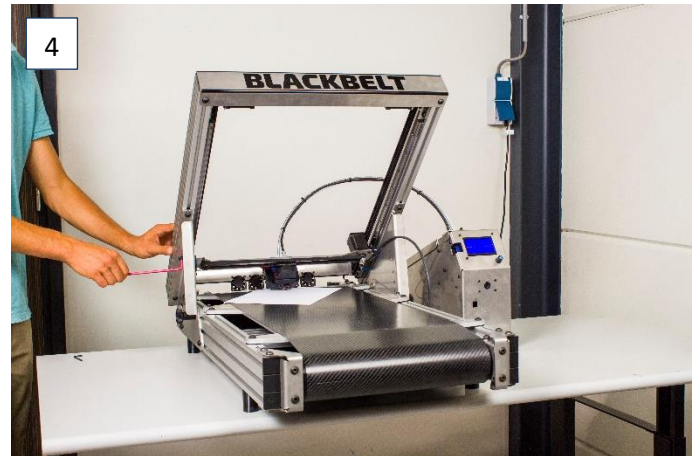
6. If you start noticing a resistant at one side, move the printhead to the opposite side.
7. Loosen the following 3 screws for ½ rotation at one side of your choice, using the 5mm Hexagon key:
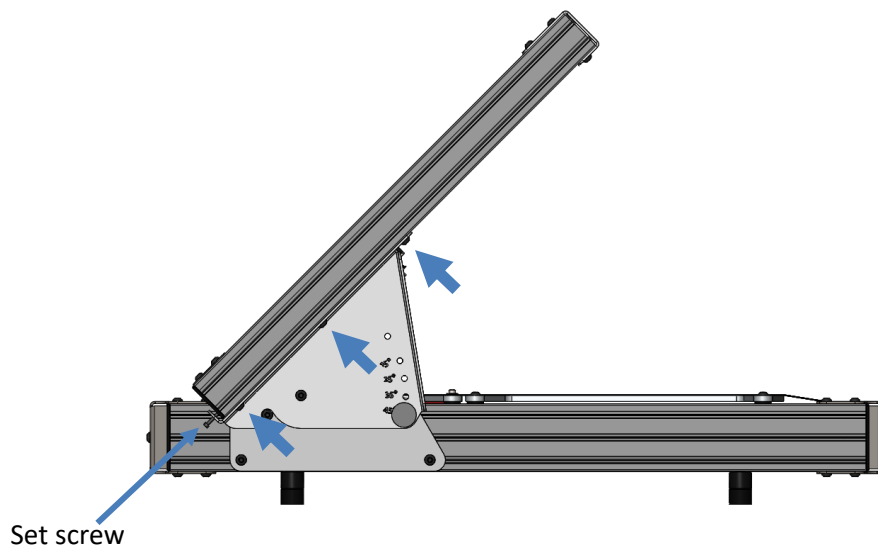
Set screw

8. Adjust the set screw to level the gantry - clockwise if the printhead is now at the same side, or counterclockwise, if the printhead is now at the other side.   [5-6]
9. Tighten the 3 screws again
10. Check calibration as described in step 5 and 6
11. Repeat step 5-9, until both sides have the same distance to the belt on both sides.

BLACKBELT
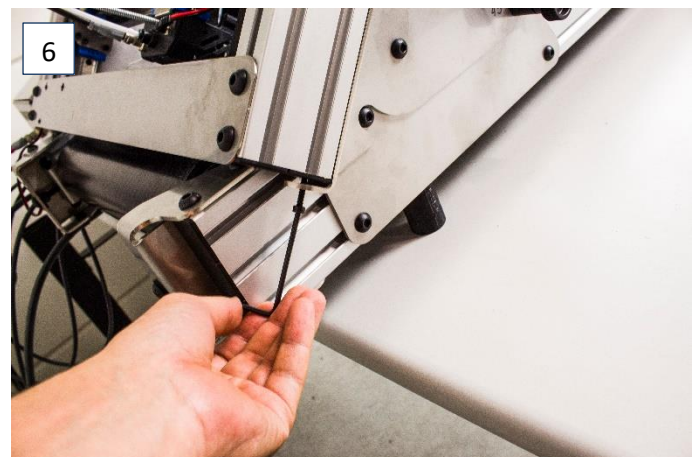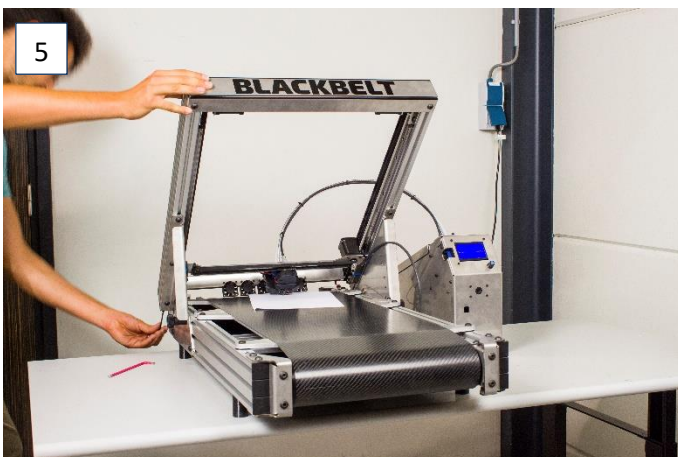
5.6 Calibrate the belt

⚠️ *In this procedure we need to touch the belt with the hands. Make sure that you have clean hands with no grease on them to keep the conveyor belt clean.*

1. Make sure that the conveyor belt is in between the limitations.   [1-2]
    a. Check the tension of the belt. Pull up the belt mid between the front roller and the front build plate.
    b. With a decent pull of your index finger you should not be able to pull it higher than the build plate. If you can pull it higher, tighten the rear screws a bit more, so its levels with the build plate.
2. Turn the belt manually by hand in the printing direction.   [3-6]
    a. If you notice the belt going towards one of the limitations, tighten that side for half a rotation and loosen the opposite side for half a rotation
3. Repeat step 2 until the belt does not move to one of the sides
4. Check the bel tension once again, make sure that you cannot lift the belt above the build plate   [2]
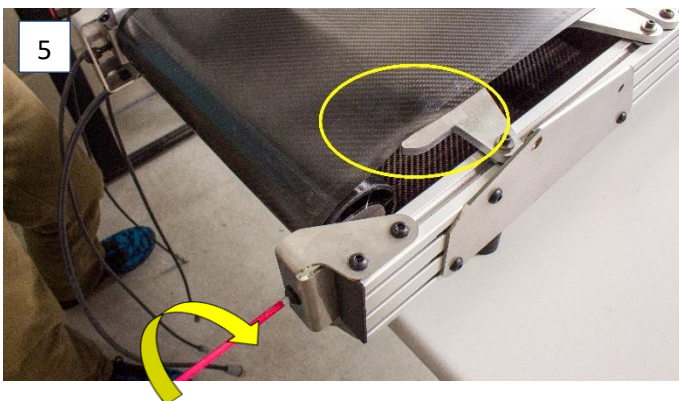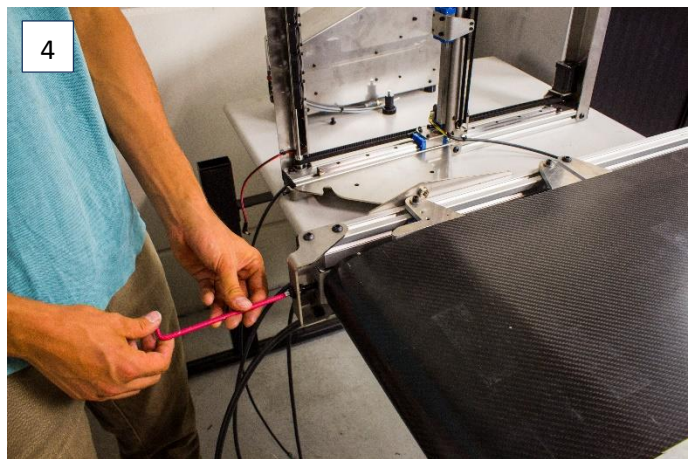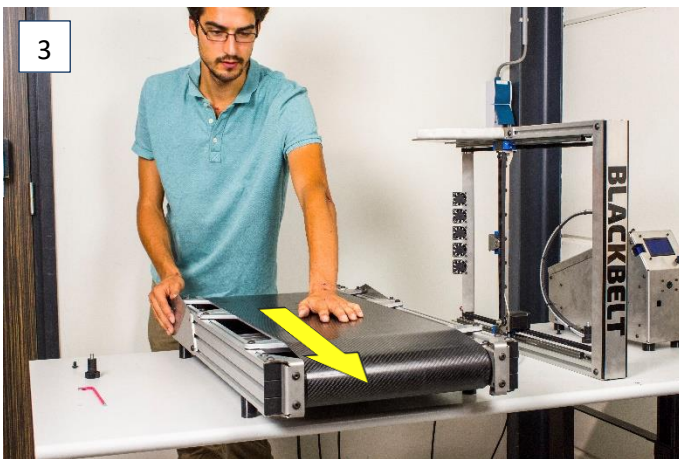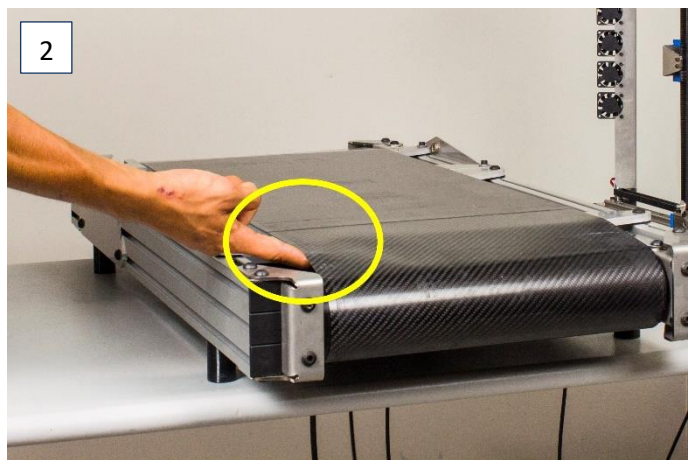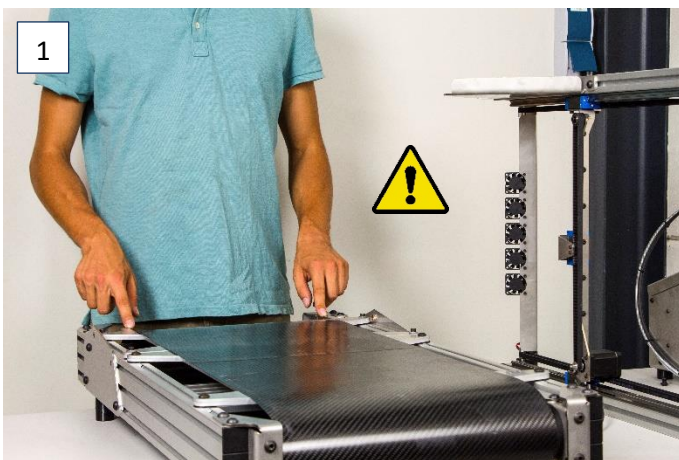
5.7   Synchronize the Y-motors

You'll need a 1,5mm Hexagon *key*

When you encounter misalignments during printing or small level shifts, a likely cause can be non-synchronized y-motors. Please follow these steps to make sure the Y motors are synchronized again.

1. Turn on the machine.   [1]
2. Position the x-axis up a bit, leave room to move up with the controller.   [2]
3. Use the jog wheel to go to *Prepare / Move axis / Move Y / 10mm*.
4. Loosen the set screws using the hexagon 3key. You might need to move the Y-axis to reach the other screw.   [3]
5. Move the X-axis up and down using the controller.
6. The motors are now synchronized again.
7. Always check the Y-alignment an recalibrate when needed before printing   [4]
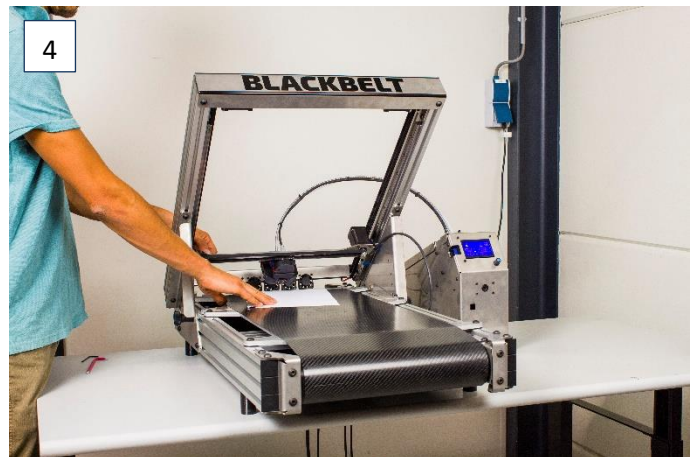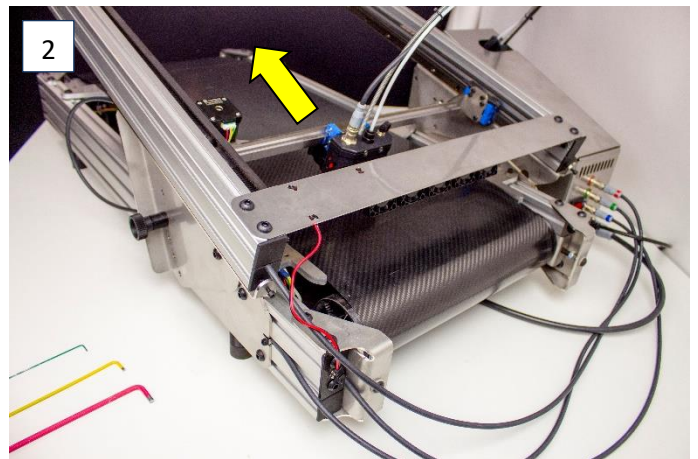
6   Operation

⚠ *Please follow all prescriptions as described in this manual. In particular chapter 2 : Safety messages.*

⚠ *As long as the machine is active and / or switched on, no connector or safety feature shall be removed. Only use the machine if all safety features are in place and functional.*

⚠ *If a machine part has been damaged or is not functioning in the prescribed way, the machine operation must be stopped immediately and can only be resumed if the damaged part has been replaced or repaired. Please inform or consult Blackbelt 3D BV if the machine is not functioning properly.*

6.1   Loading filament

⚠ *Please assure that the 3D Printer is fully assembled and wired correctly and that the printhead has been installed.*

1. Place the filament spool onto the spool holder in front of the control cabinet.
2. Take the end of the filament of the spool and assure the filament end is straight and has no thickening at its end. If not please apply a straight cut with a pair of scissors or a pair of pliers:
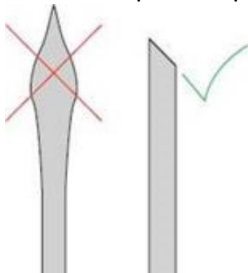
3. Please assure, the end of the filament is guided from the lower side of the spool into the control cabinet.
4. Position the filament into the filament entry and carefully push the filament up to its next touch.
5. Pull the "Filament Release" -lever in the direction of the indicated arrow:
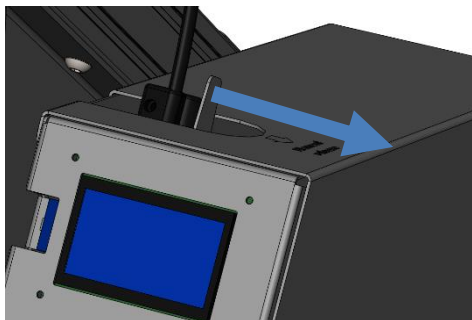
6. Push the filament further until it reaches the printhead assembly while holding the "Filament Release" - lever.
7. Release the "Filament Release" -lever.
   The filament is loaded now.

6.2 Installing software

⚠️ Software installation shall only be carried out be qualified staff.

⚠️ Only use software as made available by Blackbelt 3D BV on its website (www.blackbelt-3d.com)
Any other software may damage the machine.

⚠️ Accepted operating systems:
Windows Vista or later version, Mac OSX 10.7 of later versions
Linux Ubuntu 15.04, Fedora 23, OpenSuse 13.2, ArchLinux or later versions

⚠️ Accepted hardware:
OpenGL 2 compatible graphical chip
Intel Core 2 or AMD Athlon 64 or later versions

Installing software:
1. Browse to: https://blackbelt-3d.com/software/ and download the our software "BLACKBELT Cura"
    Select your operating system (Windows, Linux or OSX) to download the latest version of BLACKBELT Cura.
2. DoubleClick on the .exe file and follow the steps in the installation wizard.
3. Open "BLACKBELT Cura", if this does not start automatically.
4. If the next dialog window does not start automatically, then go to "Settings" – "Printer" – "Add Printer…"
5. Select "BLACKBELT 3D Printer", secondly in the submenu "BLACKBELT 3D" and click on: "Add Printer"

1: Click here

2: Click here
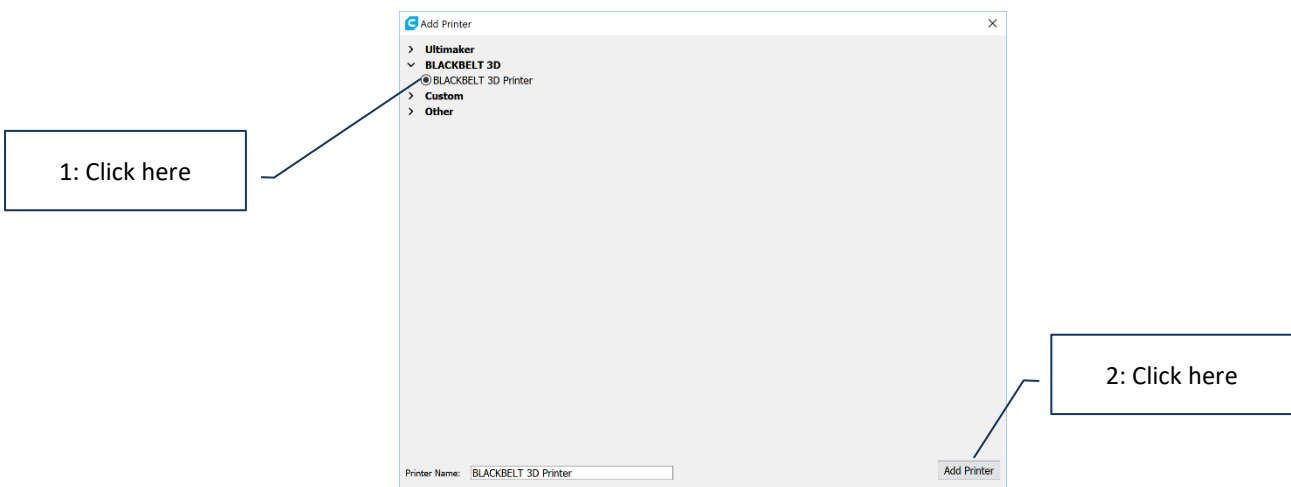
6. The Cura software for Blackbelt will now open automatically.
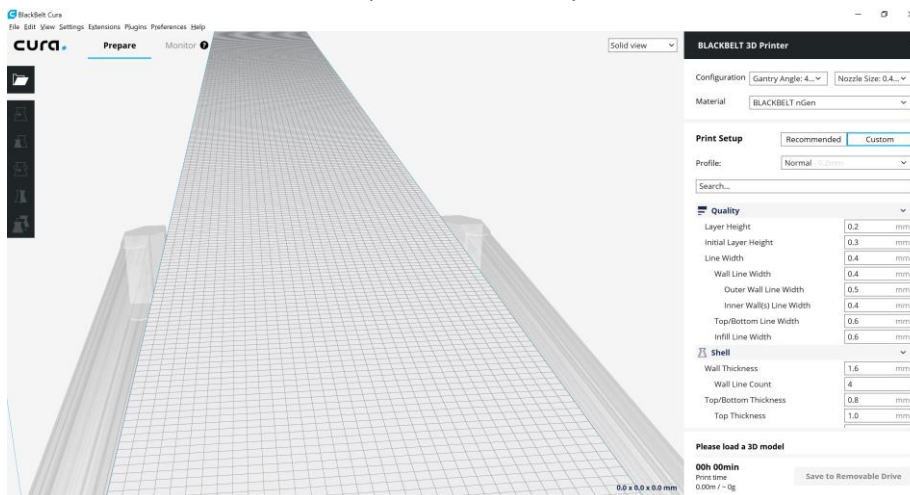
6.3 Generating Machine code / gcode

⚠ Compatible design CAD languages are: STL, OBJ or 3MF

⚠ Your hardware (PC / Laptop) must be configured to write data onto an SD card.

In order to generate the machine code (gcode) the following requirements are necessary:
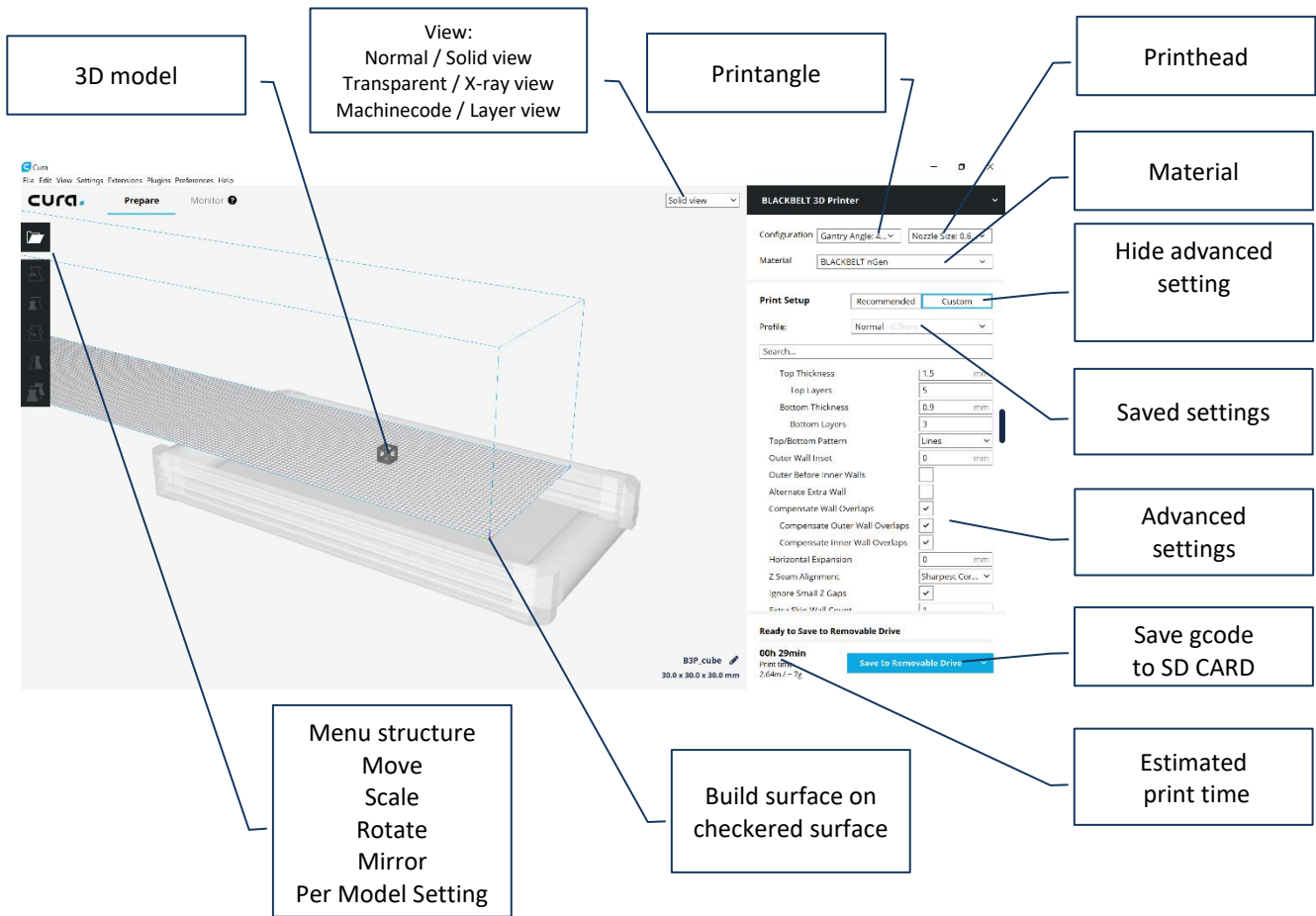
- A Mac or PC equipped with a SD card reader. The BLACKBELT Cura software needs to be installed onto the hard drive as described in chapter 6.2
- The SD card
- A 3D CAD model in STL, OBJ or 3MF format
    o A test model can be downloaded here: https://blackbelt-3d.com/downloads/cube.stl
    o More test models can be downloaded from our website to ensure your first print successes, we advise to start printing with these models and learn by doing. (warning : this is fun ☺) https://blackbelt-3d.com/downloads/test-models.zip

1. Insert the SD card into de SD card reader of your PC
   - Pay attention to using the right direction of the SD card, as specified by your computer manufacturer.
2. Open BLACKBELT Cura (version 3.4.2 or higher)
3. After loading the start screen you'll see this:
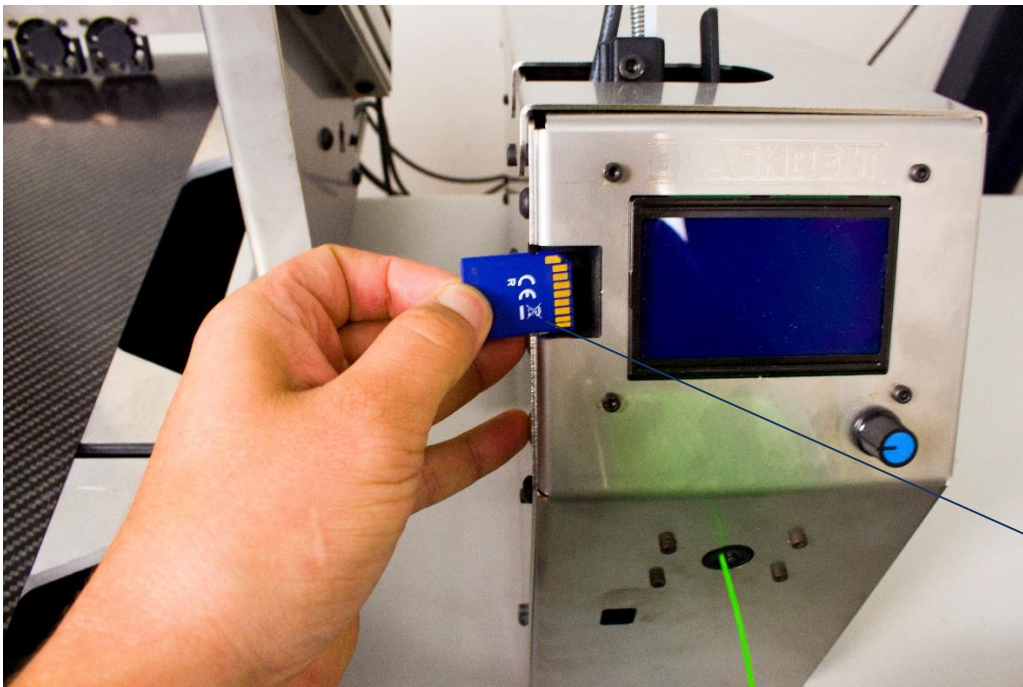
Overview BLACKBELT Cura Software:
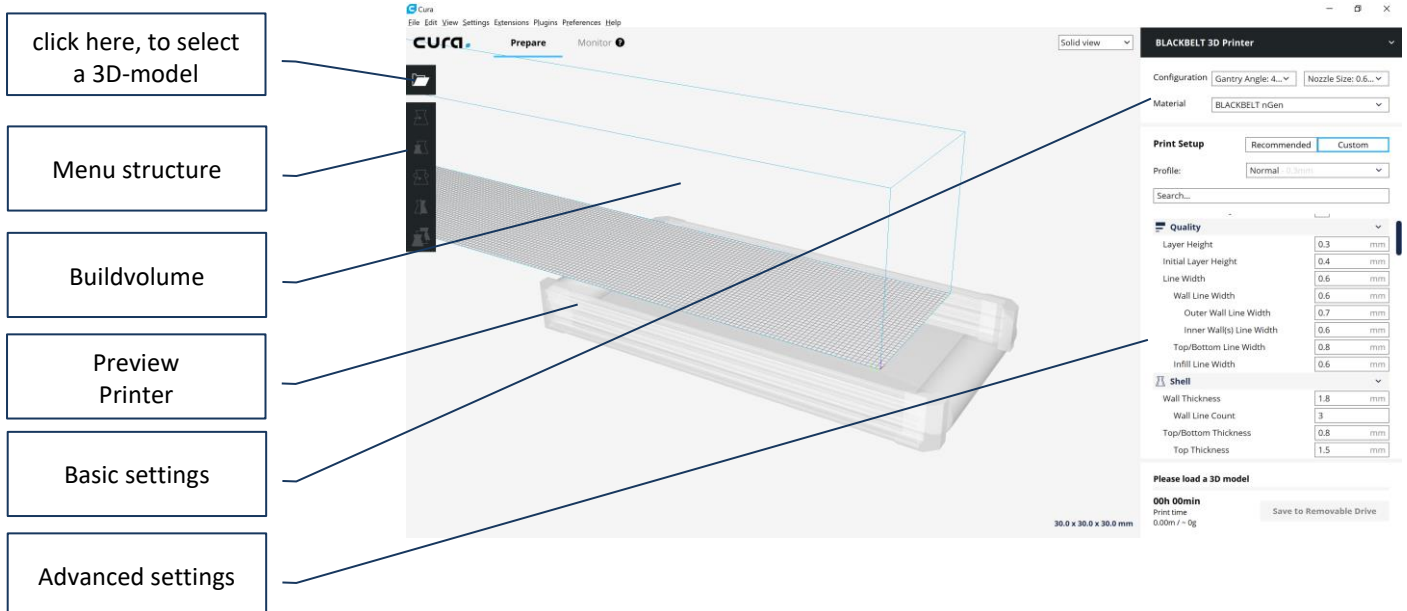
4. Import the 3D-CAD model you would like to print using the software BLACKBELT Cura.
   - Importing the model can be done in 3 ways:
     • Using "Drag & Drop"
     • Using the Menu (top left): File --> Open File(s)… Ctrl+O
     • Using the Icon on top of the left menu structure.
5. View the model from all sides.
   - Turn you scrolling wheel on your mouse to zoom.
   - Click and hold the right mouse button, move the mouse to turn the view of the part.
   - Click and hold the scrolling wheel, move the mouse to move the viewing (eye) point.

3D model

View:
Normal / Solid view
Transparent / X-ray view
Machinecode / Layer view

Printangle

Printhead

Material

Hide advanced setting

Saved settings

Advanced settings

Save gcode to SD CARD

Estimated print time

Menu structure
Move
Scale
Rotate
Mirror
Per Model Setting

Build surface on checkered surface

6. First select the desired printing angle, printhead and material in the upper right corner of the progtamme. Your selection needs to correspond with your machine set-up.
   - Print angle, using "Gantry angle" – we advise 35° (35 degrees)
   - Printhead, using "Nozzle diameter" – we advise to use a 0.4 or 0.6mm printhead, to obtain detailed results
   - Material, using "Material:" – we advise "BLACKBELT nGen" to be used for your first prints.
7. Move the model into the desired position:
   - Select the model, click on "Rotate" in the left menu structure.
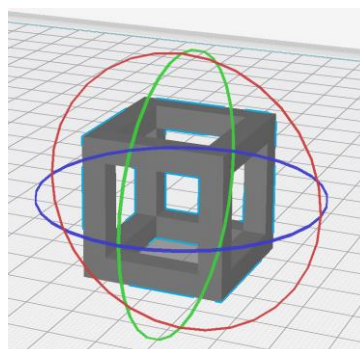
   - Click one of the circles that appear around the model, to rotate the part in steps.
   - Rotate the model to position it with a flat surface onto the checkered surface.
   - Make sure that is does not start printing in the air. Take Chapter 7 "Design Guidelines" into account if you are not sure.
8. The most important rule for a successful print is to ensure that the first line of machine code, is a flat line on the machine belt surface.
   - To verify the first line, switch the view from "Solid" to "Layer view".

Model position

Machinecode

View:
Solid View / Layer view

Color indication
Line types

Preview Slider
(2x)

Estimated
Print time

Save machine
code to SC Card

Starpoint / first
line of the
machinecode


Correct
installation of the
SD Card
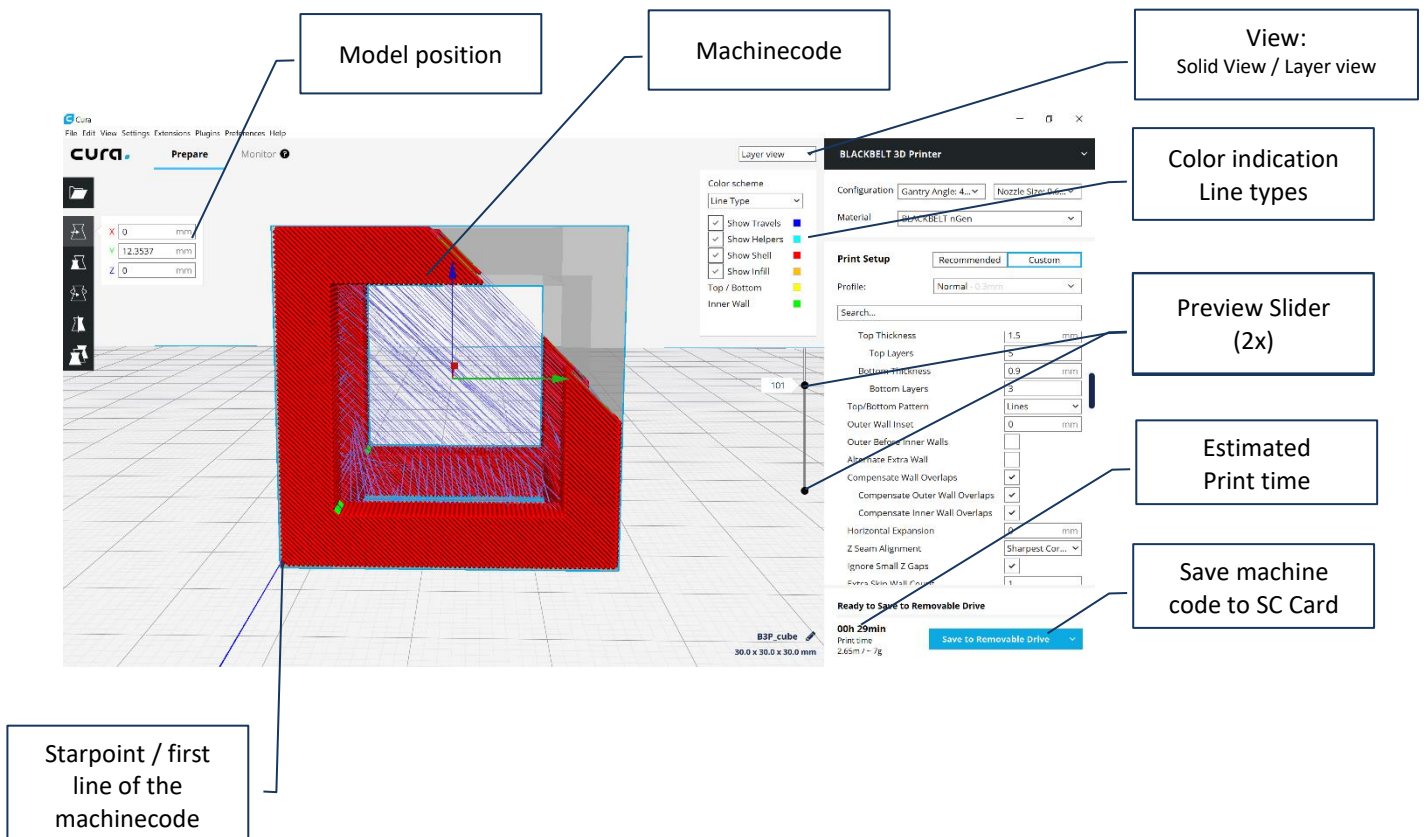
9. Have a look at the gcode / machine code and evaluate your model.
   - You can see the nozzle movements (track) the print nozzle will be following, to build the product.
   - Move the upper "Proview Slider" down, to scroll through the gcode / machinecode.
   - Please check :
     • The starting point of the first line is positioned directly onto the checkered surface.
     • A flat surface of the model is positioned onto the checkered surface.
     • Each new layer is built upon a previous layer, ensuring the print layer does not start or commence in unsupported "air"
10. Place the SD-card in your SD-card reader slot or plug the external reader in the USB (or similar) port of your PC / Mac. The filename will automatically refer to the important machine settings according to the following rule:
    - **[Gantry angle]_[Nozzle size]_[Material]_[Project name]**.gcode
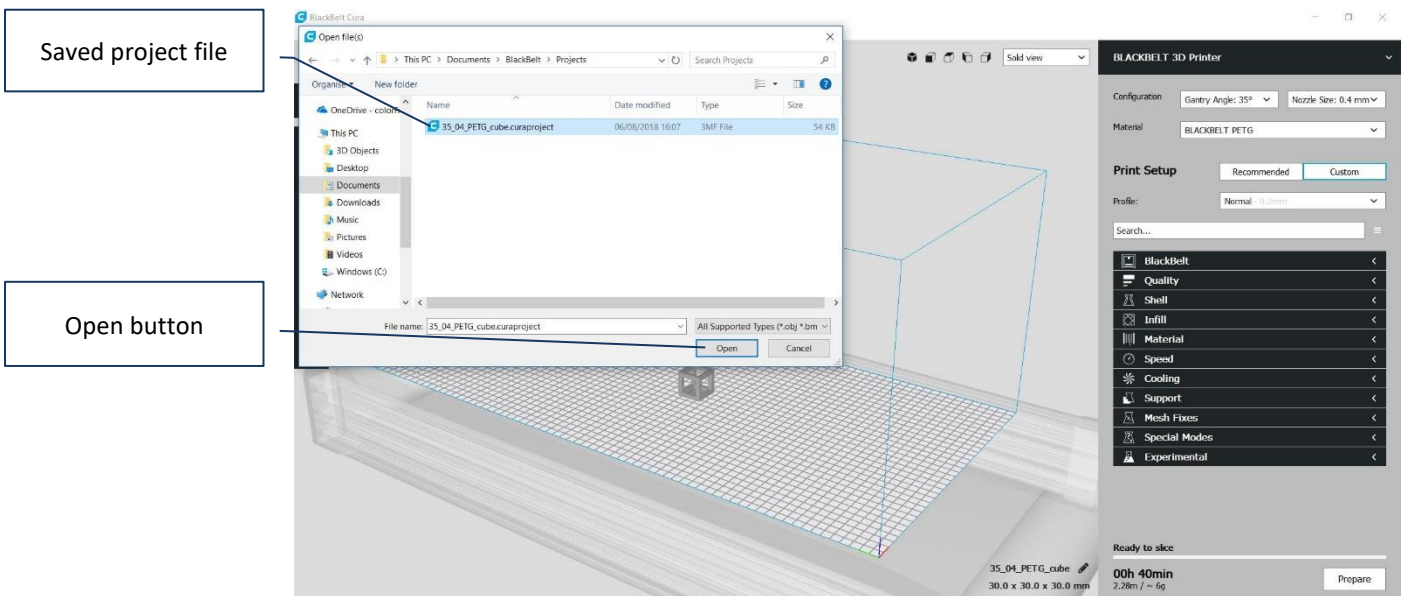   - Example: **35_08_PETG**_cube.gcode
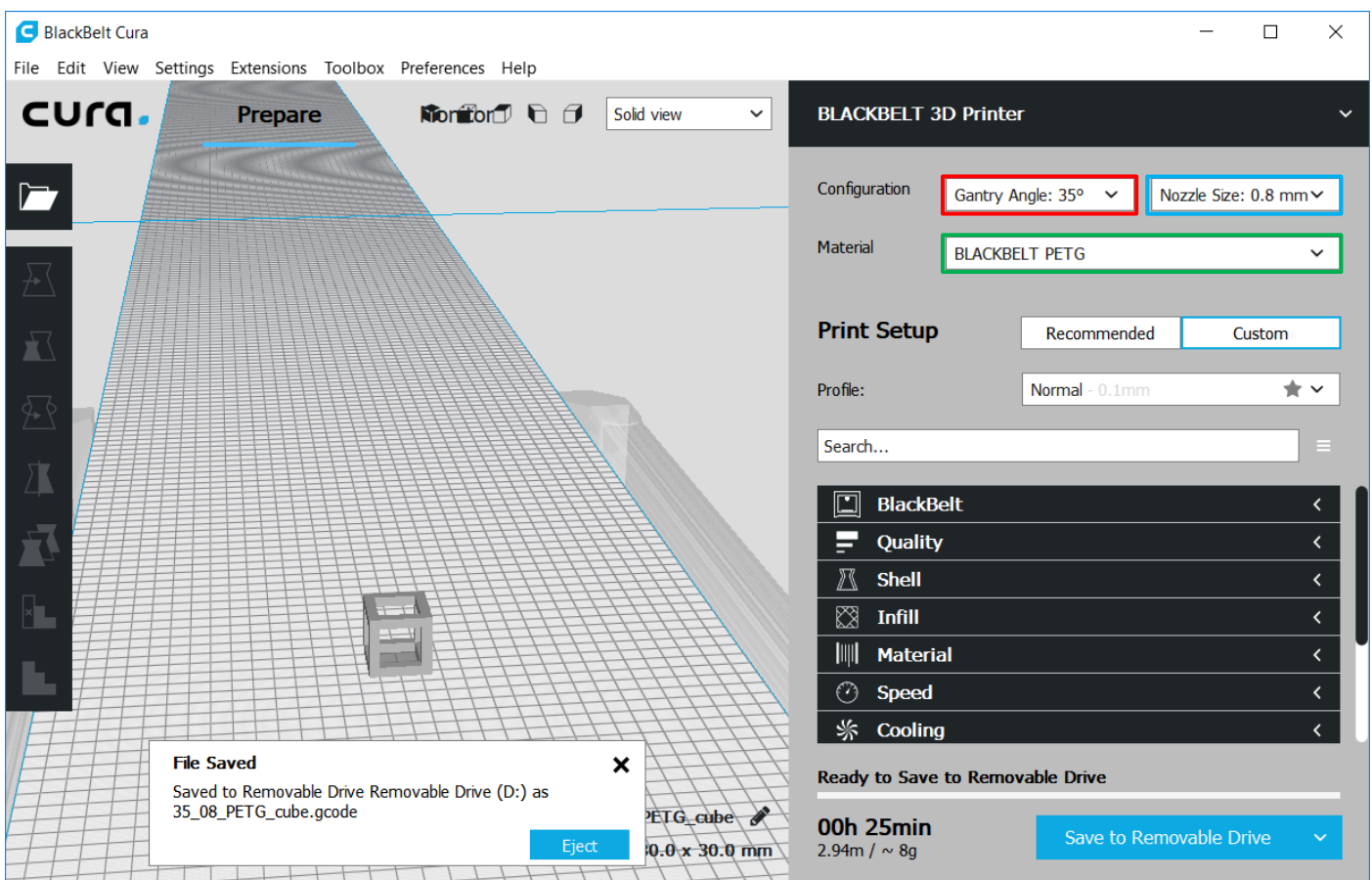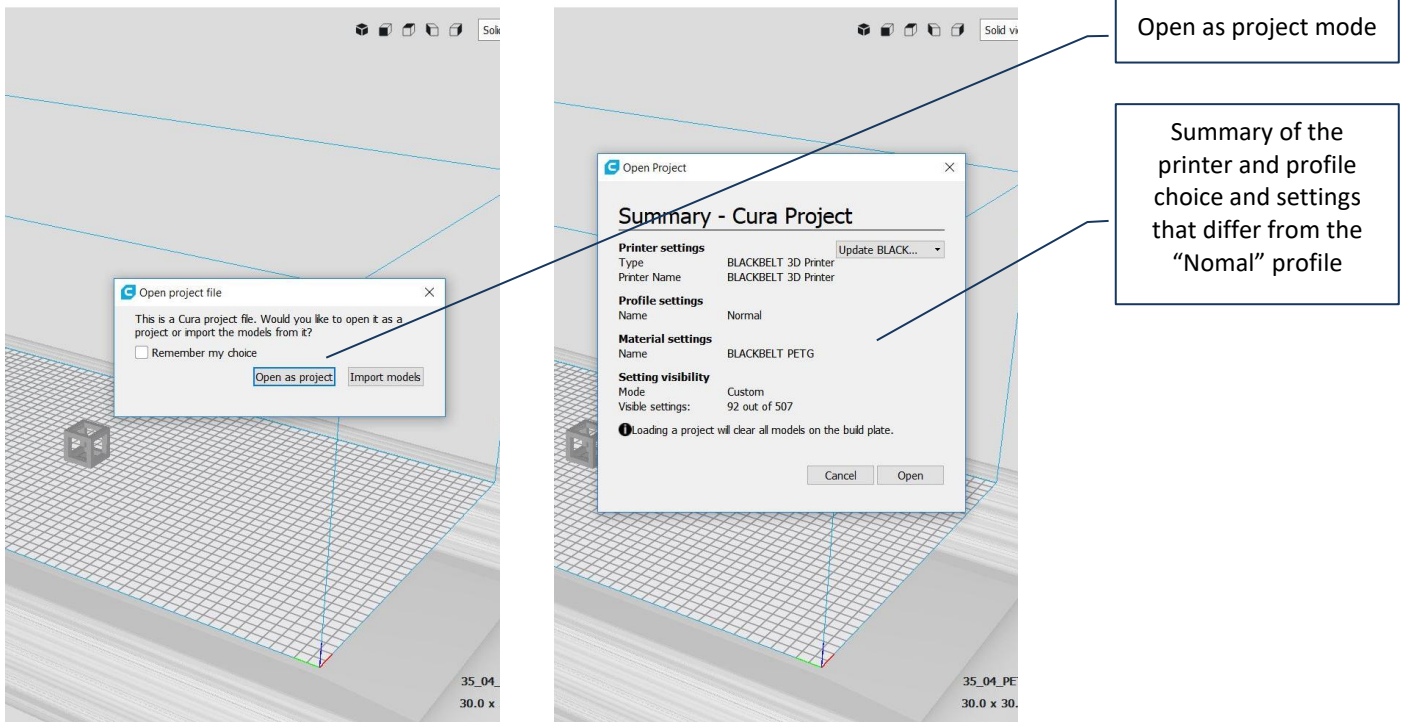
6.4   Saving a project

If you are happy with the settings and you want to keep these for later, you can save the entire project in Cura as a ***.curaproject.3mf** file. This can also be convenient when you want to continue a later time or share your work with others. The save project function will export the link to the models and keep all the settings. Unique profiles will be included in the workspace of a second user when accepted (see figure by step 4). You need to use the following steps to save and load a project file:

1.   Choose the "File" menu in the upper left corner and select "Save Project.."
2.   A general save window of your operating system will appear. The file name is autogenerated based on the settings, you can choose to change this, or press "Save". Make sure you choose a location where you can find the files again.
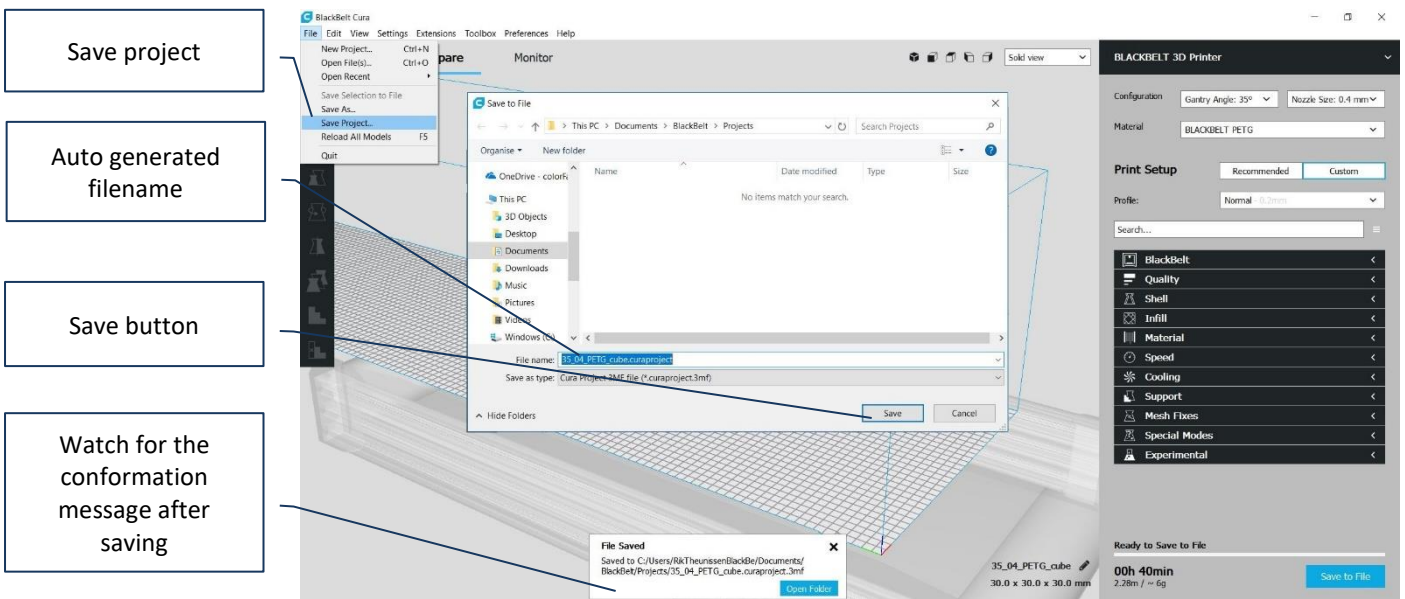
3.   Open project file by choosing "File" menu and browse to location where you saved the file.

Open as project mode

Summary of the printer and profile choice and settings that differ from the "Nomal" profile

4. After pressing the "open" button you will be ask how to load the file. Make sure you choose "Open as a project" here. Otherwise the 3D object(s) will be loaded without settings.
5. BLACKBELT Cura shows an overview of the printer, profile and material that is saved to this project. It will also overwrite the visibility settings. If you agree to overwrite the current models and settings press "open" and continue with the project.

This offers the opportunity to share your settings and files with a third party. However make sure the model files used in the project are stored in the same folder.

6.5   Upgrade machine Firmware

In order to correctly update the firmware, the following requirements are necessary:

- A Mac or PC equipped with an SD card reader. The newest version of BLACKBELT Cura software needs to be installed onto the hard drive as described in chapter 6.2
  https://blackbelt-3d.com/software
- The USB cable supplied with the BlackBelt 3D printer.

1. First turn on the BlackBelt 3d controller by flipping the main switch and make sure it powers up.
2. Hook-up the machine to the MAC or PC using the USB cable. The USB port of the printer can be found in the front side of the controller console marked USB (figure 1+2). Make sure that the orientation of the USB plug is as indicated below – the flat side pointing left:

USB port in next to the filament loading port

Orientation

USB
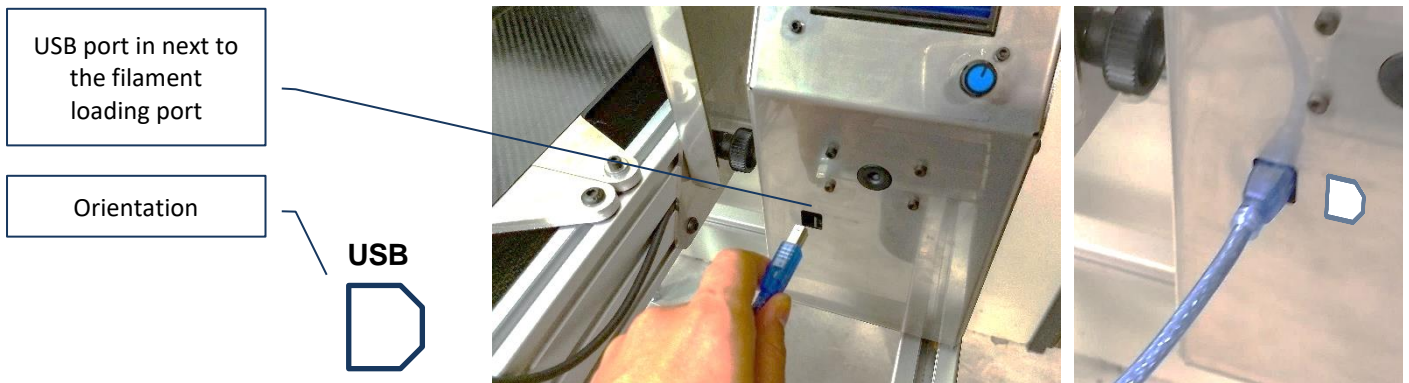
3. Open BLACKBELT Cura on the device that is just connected to the printer.
4. Open the "manage printer" menu (figure 2) under "settings / printer" or in top right corner under the slected printer.

Settings menu

Selected printer menu
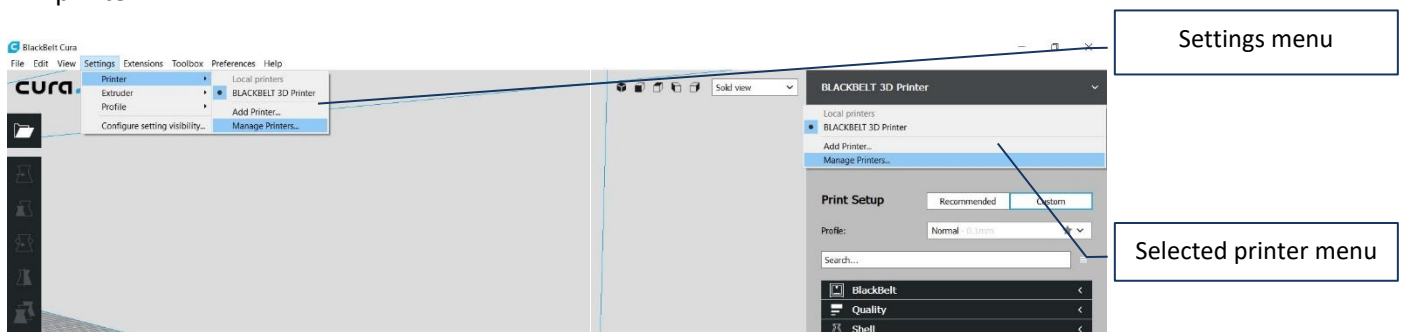
5. Now select the BlackBelt printer if this is not already the case and press "Upgrade Firmware" (figure 3).
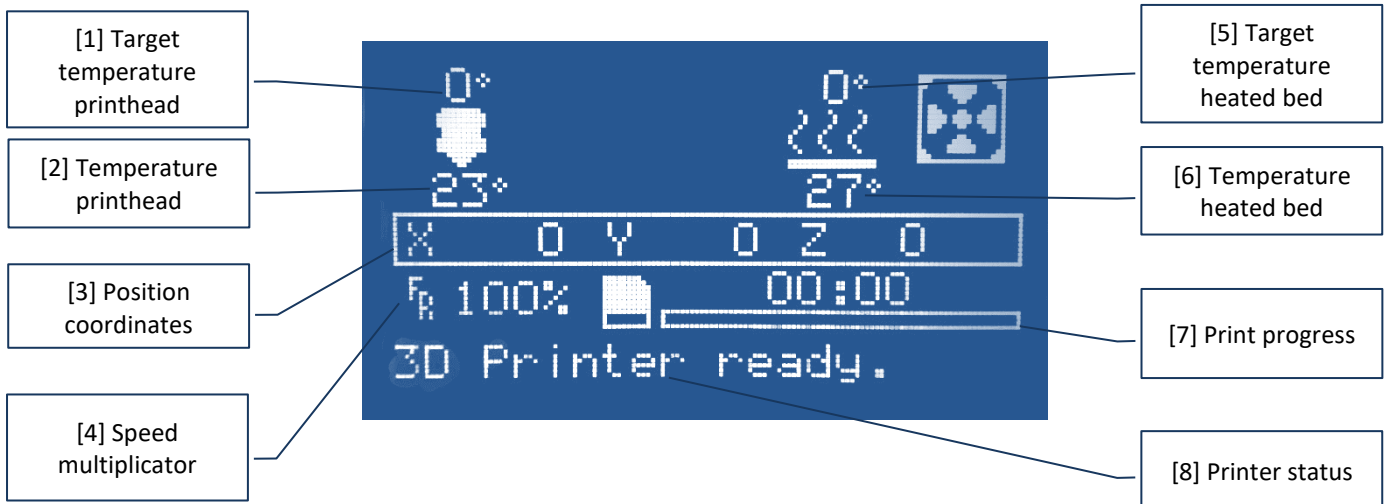
Upgrade firmware menu

6. The upgrade menu should open where you choose "Automatically upgrade Firmware". Wait for the process to complete and close all the windows until your back in the main program. Your 3D printer is now up to date with the newest version of the BlackBelt Firmware

Blue symbol for successful connection

Auto upgrade option
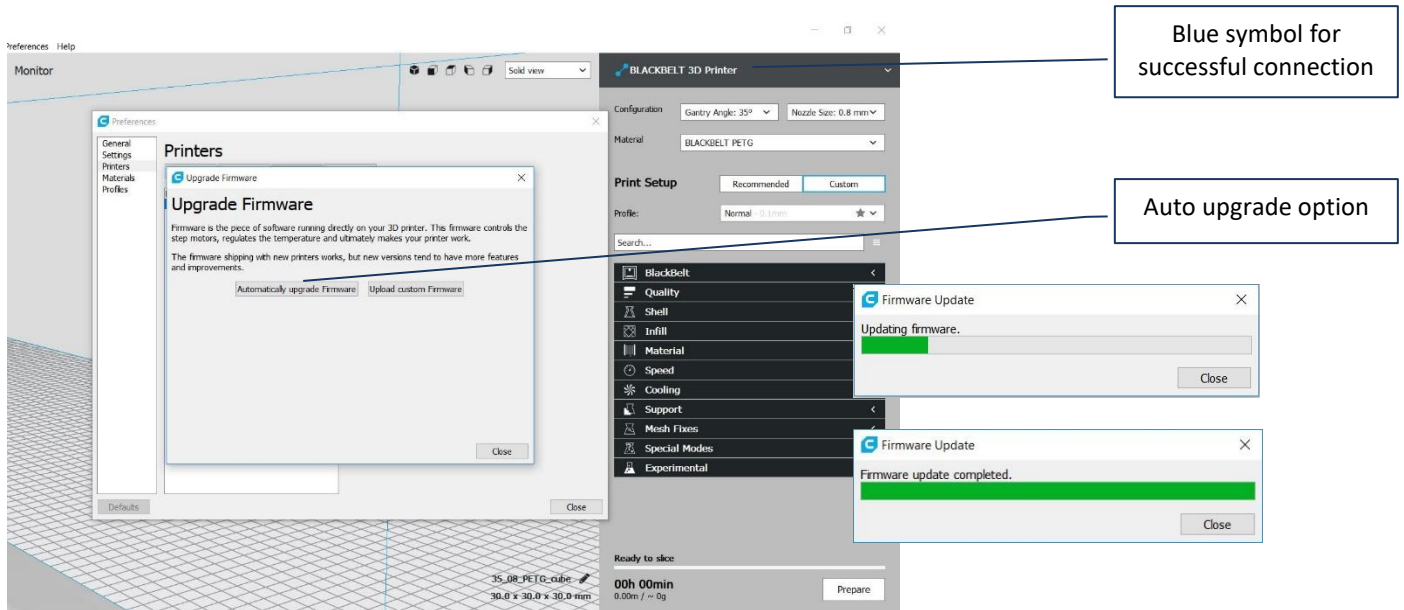
7. If it is not possible to start the update process,
   - Make sure that the 3D Printer is turned on.
   - Use a different USB port on your MAC or PC.
   - Check next to the printer name if there is a connection symbol.
     Possible solution: reconnect the USB to the device or wait for the drivers to be installed.
   - Replace the USB cable.
   - **Contact support@blackbelt-3d.com**

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6.6   Explanation Menu 3D Printer

When starting the BlackBelt 3D Printer, the following start screen will appear.

[1] Target temperature printhead	[5] Target temperature heated bed
[2] Temperature printhead	[6] Temperature heated bed
[3] Position coordinates	[7] Print progress
[4] Speed multiplicator	[8] Printer status

1. Target temperature printhead: Displays the set target temperature value of the printhead. When displayed "0", the heating element is switched off.
2. Temperature printhead: displays the actual temperature of the printhead. In the screen above the display shows the room temperature of 23°C.
3. Position coordinates: displays the X, Y and Z coordinates of the printhead.
4. Speed multiplicator: By turning the jog button it is possible to increase or decrease the print speed during the printing process.
5. Target temperature heated bed: Displays the set temperature value of the heated bed (belt). When displayed "0", the heating element is switched off.
6. Temperature heated bed (belt): displays the actual temperature of the heated bed (belt). In this case : 27°C
7. Print progress: displays the progress of the part in percentage finished.
8. Printer status: displays the status of the printer or possible failure indications.

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6.7   Menu structure

By turning the jog button on the control cabinet, it is possible to change a setting or scroll through the menu structure. By pushing the jog button, is it possible to select a menu item or confirm the set value.

Menu item:	Function:
Info screen	Displays all details explained in the previous chapter 6.6. Turn the jog button, to change the feedrate / speed of the printer. Push the jog button to access the following main menu structure.
- Info Screen	Back to the Info screen
- Prepare	"Prepare" menu
- Main	Back to prepare menu
- Move Axis	Move one of the Axis
- Move X	Move X-axis (left – right)
- Move Axis	Back to the previous screen
- Move 10mm	Move X-axis 10mm
- Move 1mm	Move X-axis 1mm
- Move 0.1mm	Move X-axis 0.1mm
- Move Y	Move Y-axis (Up and down)
- Move Axis	Back to the previous screen
- Move 10mm	Move Y-axis 10mm
- Move 1mm	Move Y-axis 1mm
- Move 0.1mm	Move Y-axis 0.1mm
- Move Z	Move Z-axis (belt)
- Move Axis	Back to the previous screen
- Move 10mm	Move Z-axis 10mm
- Move 1mm	Move Z-axis 1mm
- Move 0.1mm	Move Z-axis 0.1mm
- Home X	Move the X axis to the endstop
- Disable steppers	Disable all stepper motors
- Preheat nGen	Function to preheat the printer for "nGen" Filament
- Prepare	Back to the previous screen
- Preheat nGen	Sets the printhead temperature to 230°C and the heated bed to 80°C in, to prepare for using "nGen" filament.
- Preheat nGen End	Sets the printhead temperature to 250°C
- Preheat nGen Bed	Sets the heated bed temperature to a specific temperature
- Preheat HT	Function to preheat the printer for "HT" Filament
- Prepare	Back to the previous screen
- Preheat HT	Sets the printhead temperature to 250°C and the heated bed to 100°C in, to prepare for using "HT" filament.
- Preheat HT End	Sets the printhead temperature to 250°C
- Preheat HT Bed	Sets the heated bed temperature to a specific temperature
- Control	"Control" menu
- Main	Back to the previous screen
- Temperature	"Temperature" menu

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- Control		Back to the previous screen
- Nozzle:		Set temperature printhead
- Bed:		Set temperature heated bed (belt)
- Fan Speed 1:		Set fan speed (0= off, 255=full power)
- Fan Speed 2:		Set fan speed rear fan (0= off, 255=full power)
- Autotemp:		Function, to adapt the temperature of the printhead automatically to the print speed.
- Min:		Minimal temperature for slow print moves
- Max:		Maximal temperature for fast print moves
- Fact:		Normal print temperature
- PID-P:		Set values for de heat-up speed of the printhead
- PID-I:		
- PDI-D:		
- PID Autotune:		Automatically generate values for the heat-up speed of the printhead
- Motion		Control Motion settings here (only advanced users)
- Control		Back to the previous screen
- Velocity		Allows you to change maximum Velocity Values.
- Motion		Back to the previous screen
- Vmax X:		Set max speed for the X axis in mm/s
- Vmax Y:		Set max speed for the Y axis in mm/s
- Vmax Z:		Set max speed for the Z axis (belt) mm/s
- Vmax E:		Set max speed for the Extruder in mm/s
- Acceleration		Allows you to change maximum Acceleration Values.
- Motion		Back to the previous screen
- Amax X:		Set maximum acceleration of the X axis in mm/s
- Amax Y:		Set maximum acceleration of the Y axis in mm/s
- Amax Z:		Set maximum acceleration of the Z axis (belt) in mm/s
- Amax E:		Set maximum acceleration of the Extruder in mm/s
- Jerk		Allows you to change maximum Jerk Values.
- Motion		Back to the previous screen
- Vx-jerk:		Set maximum start speed the X axis in mm/s
- Vy-jerk:		Set maximum start speed the Y axis in mm/s
- Vz-jerk:		Set maximum start speed the Z axis (belt) in mm/s
- Ve-jerk:		Set maximum acceleration of the Extruder in mm/s
- Steps/mm		Allows you to change the stepper motor steps per mm.
- Motion		Back to the previous screen
- Xsteps/mm:		Set the steps per mm for the X axis
- Ysteps/mm:		Set the steps per mm for the Y axis
- Zsteps/mm:		Set the steps per mm for the Z axis (Belt)
- Esteps/mm:		Set the steps per mm for the Extruder
- Restore Failsafe		Resets the original settings of the machine
- Print from SD		Choose a file from the SD card
- Main		Back to the previous screen

6.8   Starting up a Print

⚠️ Assure that all previous steps have been executed completely and correctly.

⚠️ Hot Surface!
Burn hazard when touching the hot surface.

⚠️ Entrapment hazard
Danger / moving parts.

1. Insert the SD Card with the gcode into SD the slot (8)
2. Doublecheck if the printhead, filament material and the printing angle are set the same as in the software as in hardware.
3. Move the printhead manually to the middle position and close to the conveyor belt.
4. Switch on the machine.
5. Insert the SD card.
6. Press in the Jog Wheel and select the option "Print from SD".
7. Select the machine code (gcode), which you wish to execute.
   - The gcode has automatically generated identifications for Gantry angle, Print head and material. Double-check that all parameters are right.
8. The printer will now automatically heat up and start the print after heating up.

6.9   Stop the print

In this chapter we will explain the most common manual ways to stop the printer.

6.9.1   Stop the print using the menu

- Push the jog button.
- Turn the button to the left and select "Stop Print" .
- Push the button again to stop printing immediately.

6.9.2   Stop the print switching of the main switch

On the rear side of the control cabinet the main switch is positioned on the left down corner. If the main switch is set to "0" the machine will stop printing immediately .

Main Switch

6.10   Unloading the filament

1. Pull the "Filament lever" on the control cabinet and hold this in position.
2. Gently pull the filament out.
   - If the filament does not release, follow the following steps.
     1. push back the filament and release the filament lever.
     2. Switch on the machine, and wait for the main screen to start.
     3. Push the jog button in
     4. Select "Preheat"
     5. Select "Preheat nGen"
     6. Select "Preheat nGen End"
3. The printhead will now heat up to 230C. The progress will be shown on the main display.
4. The set temperature value is 230C, the real temperature is shown below the set value and will reach the set value after a short time.
5. If the real temperature has reached the set temperature, it is possible to extract the filament.
6. Switch off the printer or switch off using the menu: "Prepare" –> "Cooldown"
   Or: "control" –> "Temperature" –> "Nozzle" –> Turn the Jog Wheel to set: "0"

6.11 Material change

⚠️ *Please assure that the 3D Printer is fully assembled and wired correctly and that the printhead has been installed.*

Scenario 1: NOT during a print job and when the heater is cold.

1. Preheat the nozzle with the presettings:
   - Push the button → "scroll down and select "Prepare" → scroll down and select "Preheat Ngen" of "Preheat PETG". For PLA choose "Preheat Ngen", for ABS choose "Preheat PETG"
2. Press the material leaver to the right with one hand while manually retracting the filament the filament with the other hand.
3. Push in the new material and press the leaver to the outside again. The material should be push through all the way until you see a little bit of the material leaving the nozzle.
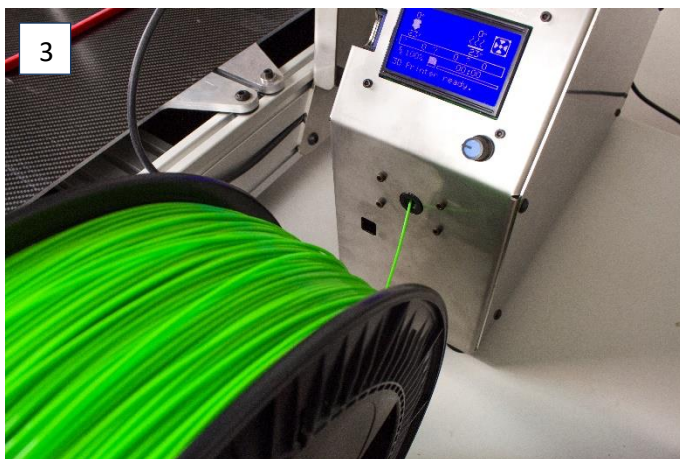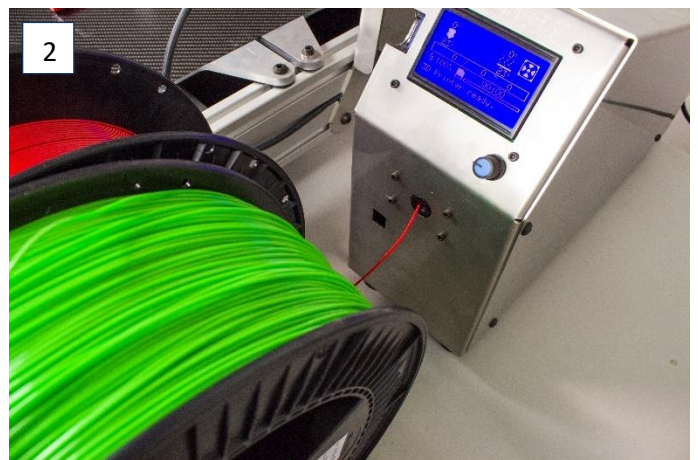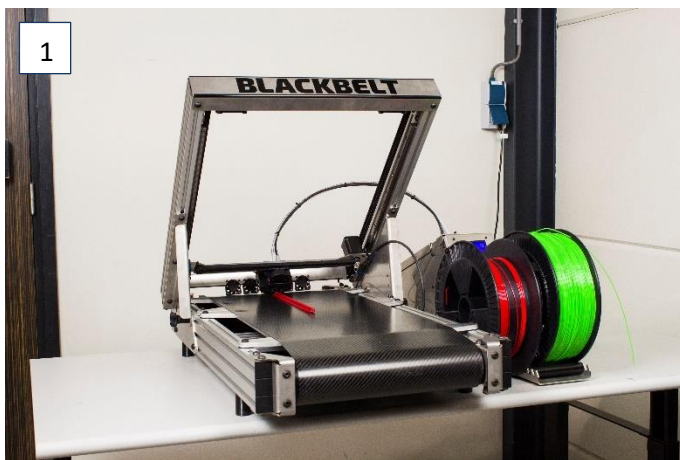
Scenario 2: DURING a print job when the heater is hot
If you notice that the spool is running towards its end you can take the following steps

1. Reduce the feed rate all the way down by rotating the jog button to the left.
2. Position the new filament on the spool roller and place the old next to it.
3. Press the material leaver to the right with one hand while manually retracting the filament the filament with the other. Place the old filament spool aside.
4. Push in the new material and press the leaver to the outside again. The material should be push through all the way until you see a little bit of the material leaving the nozzle.
5. Set the speed back up to 100%

7   Design Guide

Printing on a belt has a lot of opportunities if the design is correct. In this chapter we show the specific design rules that apply to the BlackBelt 3D printer. Not every product is directly suitable for FDM printing and some digital preparation is in order.

7.1   Design guidelines

⚠️ In order to produce successful printed parts on the BlackBelt 3D Printers, it is critical to use the correct machine parameters, but even more important is to apply to correct design rules for parts suited to be printed on the BlackBelt 3D Belt printer. If the geometry to be printed does not comply with very specific design rules the part will not print correctly and there will be a risk of damaging the machine.

The BLACKBELT 3D Printer print layers of molten polymer, in other words a viscous plastic. This polymer needs to adhere on the belt composite material or onto an existing polymer layer. In the pictures below those layers are visualized using diagonal lines.

Starting point /
First line of the
machine code
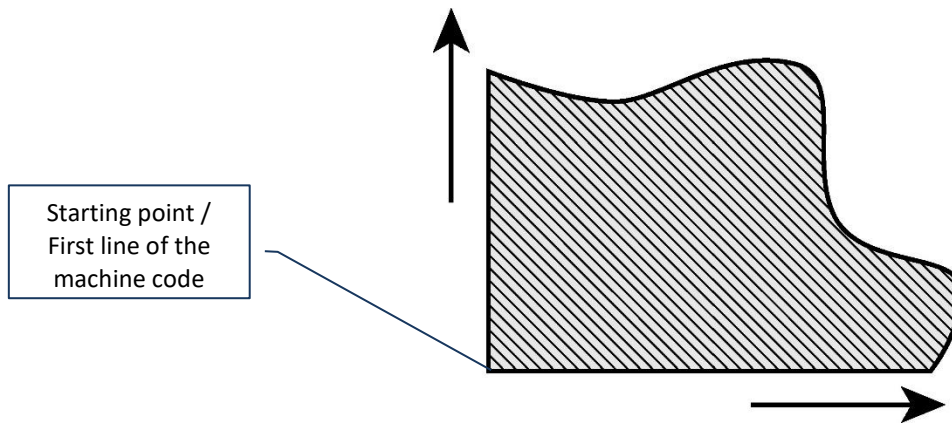
If a new product is being printed, there is no previous layer. This means that the first layer needs to start onto the conveyor belt.

Not every geometry is equally suited to be printed on the BLACKBELT 3D Printer. The model below is a cross section of a plane which does not start onto the composite belt:
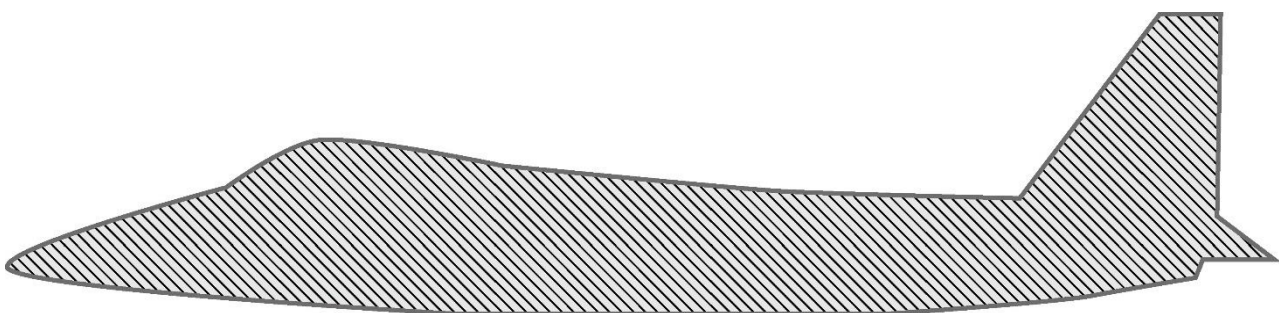
If the model starts above the belt, it is necessary to apply a support or starting geometry to the part, that can be modelled in using CAD software. Applying an offset of 0.2 mm between start geometry and the actual product will ensure easy removal of the support structure (red lines). The current version of BLACKBELT Cura (3.4) does not create support structures automatically. This needs to be done by the user in a manual design process.
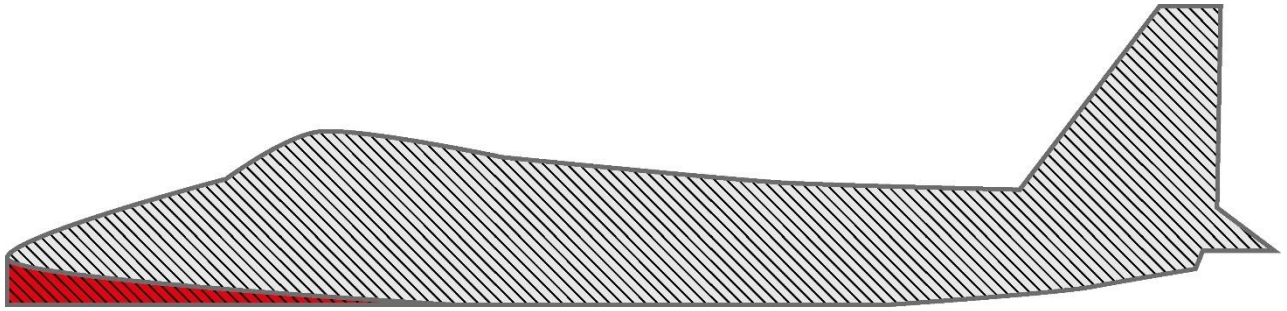
Products that are designed properly can be printed using a minimal or no support structure.

The printhead can only print onto the composite belt or on a previous layer. It is not possible to print into the air. Because of these facts, the design of the part needs to be considered carefully.

While designing products for the BlackBelt 3D Printer it is important to consider the direction the product will be printed. The cross section below can easily be printed from left to right.
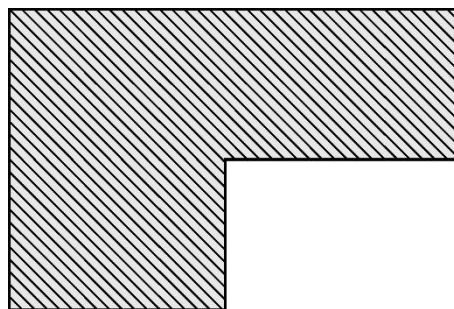
Designs and parts that need no or only little supports are very suitable for series. Printing time, material use and post processing can be reduced by applying these design rules into clever and smart designed products.

If a geometry needs to have a starting point in the air, it is possible to apply a starting / support geometry (left image).
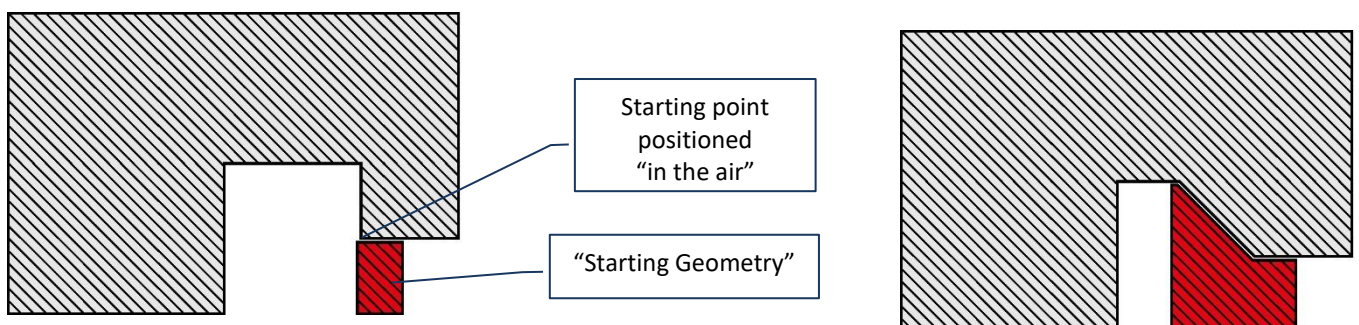
Overhangs parallel to the XY angle (printing angle) need additional support, to prevent sagging of the printed layers. (right image)

Creating those custom support geometries in CAD, Please consider creating a now volume body and using no offset to the main part. And follow the steps in the following chapter.

7.1.1 Using custom support

The custom support mentioned in the previous chapter can be designed in your CAD program [1-2].
Make sure that the support geometry is an apart volume body that has no offset to the product geometry. It may interfere however.

1. Save both files to a folder on your system on which BlackBelt Cura is installed. Make sure both files share a common origin. If the models don't align in the next steps this is the most common issue.
2. Open both models in the same BlackBelt Cura window.
3. Before further positioning, Merge the models by selecting both via ctrl + "A" or holding *Shift* key down and clicking on the models [3]. Then right click and select "Merge Models" in the pop-up screen [4].
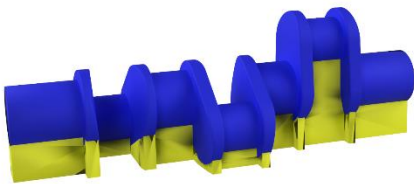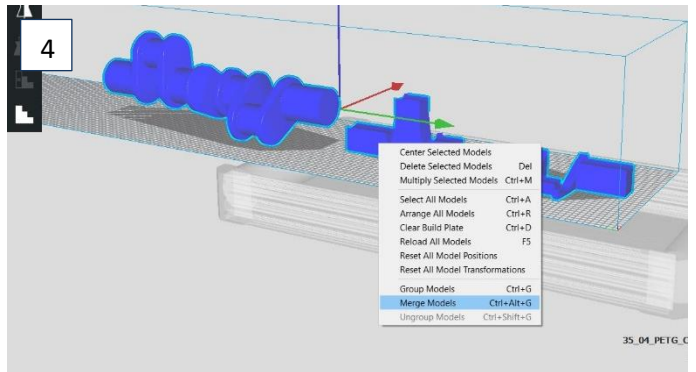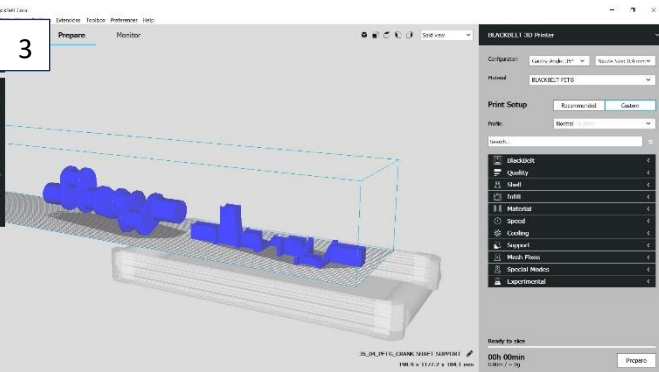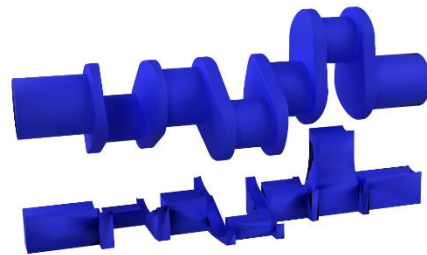
4. When both files are merged they should be aligned and positioned as drawn in your CAD software [5].
5. Select the support structure by holding *Ctrl* and clicking on the model. The *"Per model Settings"* are now available. Choose in this menu to *"Print as Support".* When applied correctly the model get a chequered texture. [6]
6. Slice the model and use the "layer view" to see if the support is generated as imagined [7-8].
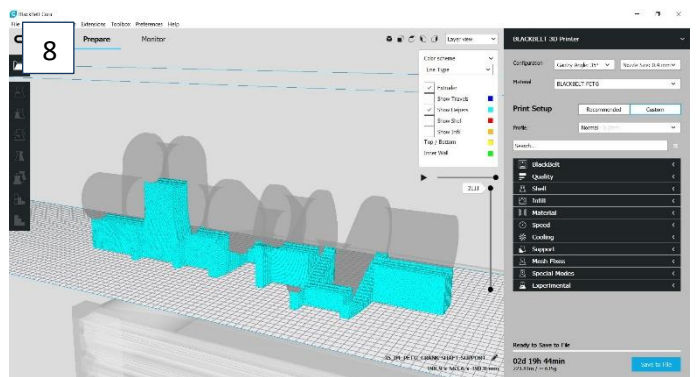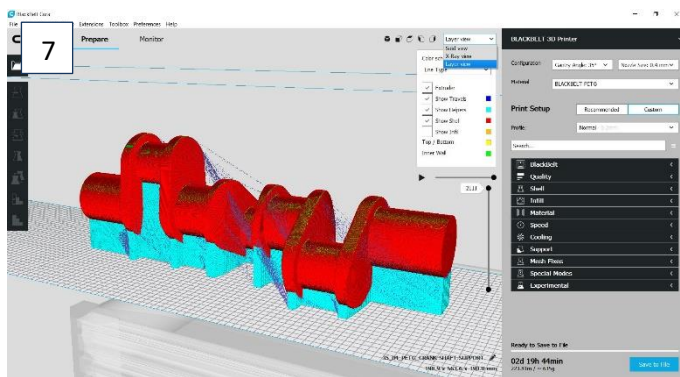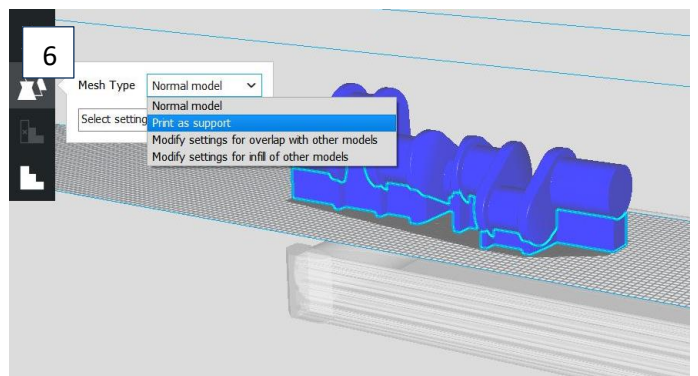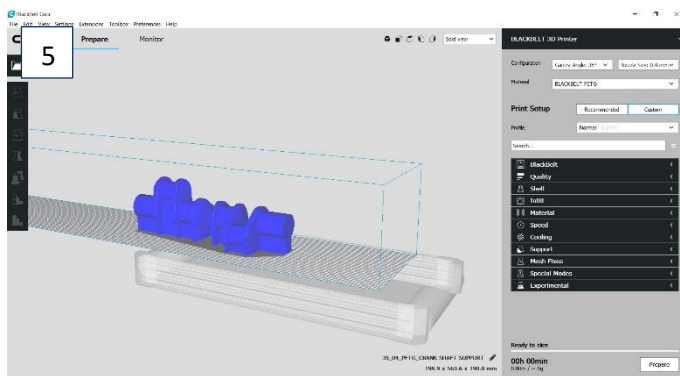
BlackBelt 3D BV is at your disposal to help optimize designs for printability.

7.2   Materials

Economy PLA	Economy PLA is a bio based material, perfectly suited for:
	- Visual parts
	- Interior parts
	- Very low warp, perfect for e.g. extrusion profiles.
	Note: low adhesion to the conveyor belt. Part needs a big footprint.
NGen	nGen copolyester is a multipurpose material most reliable easy to print with.
	- Provides Smooth surfaces
	- Visual or Functional parts
	- Easy to post-process
	Note: Suits many application, the BLACKBELT comes with 2 big spools of nGen.
Economy PETG	Economy PETG is a Technical material with high impact resistance
	- Functional Parts
	- Mechanical applications like jigs and fixtures
	- Very affordable engineering plastic

Material comparison

Property	PLA	NGen	PETG	ABS
Typical printing temperature [°C]	180 – 220C	220 – 235C	230 – 260C	240 – 260C
Typical belt temperature [°C]	65C	80C	75C	90C
Temperature resistance	45C	70C	70C	80C
Strength	*	**	***	***
Printability	***	***	***	*
UV stability	Yes	Only in black color		

We are constantly expanding our material portfolio For more info or data sheets please check our website: https://blackbelt-3d.com/filament

7.2.1 Custom Materials

Best way to keep track of all the different material settings is to make use of the Material library integrated in BlackBelt Cura. Use the following instructions to add custom materials to the library.

To add new materials, go to the *Manage Materials* menu [1] under materials tab. In the materials Menu you can use Create to generate a new material template. Use the print settings listed above and fill in the information to be able to find the material in the library.

8   Maintenance

⚠️ *Please follow all prescriptions as described in this manual. In particular chapter 2 : Safety messages.*

⚠️ *Maintenance of this machine shall only be carried out by qualified staff following the warning signs on the machine and taking into account the recommendations in this user manual. To re-assure the functionality of the machine we advise in case of accidents to consult Blackbelt 3D BV immediately. Please doublecheck if the instructions in this manual have been executed properly. If the machine is still not functioning properly, please consult the Blackbelt 3D BV service desk. (mail : support@blackbelt-3d.com)*

⚠️ *Keep hands / hairs / loose clothing / jewelry away from moving parts in the machine. Wear appropriate clothes preventing loose hanging clothing parts.*

⚠️ *As long as the machine is active and / or switched on, no connector or safety feature shall be removed. Only use the machine if all safety features are in place and functional.*

⚠️ *Inform your staff or users prior to starting maintenance or repairs. Switch of the main power switch.*

8.1   Preventive maintenance

For regular use of the machine the maintenance schedule below can be used in regular intervals. In case of intensified use or use in extreme circumstances the maintenance schedule intervals need to be doubled.

Item	Frequency	Remarks
Machine	Continuously	Keep the conveyor belt clean. Remove materials that can disrupt the functionality of the machine
Machine	Continuously	Assure there is enough filament on the spool to print a part
Machine	Daily	Doublecheck if all moving parts do not jam and move correctly. Broken or damaged parts shall be removed and replaced upon repair. Printing using damaged parts will shorten the lifetime of other components.
Bearings / linear bearings	Every 6 months	Apply grease type LG2 (bearing grease) Use a grease gun.

8.2 Belt adhesion maintenance

To increase the adhesion between the 3D printed part and the conveyor belt, the belt surface can be roughened by using sanding paper.
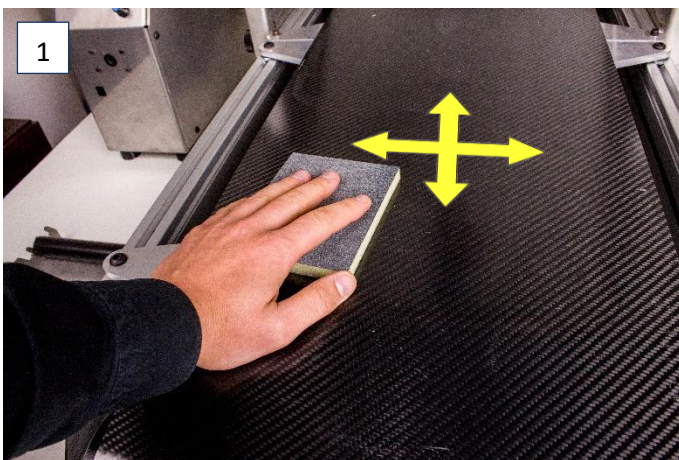
⚠️ *In order to prevent permanent damage to the conveyor belt or the machine. Please follow all steps as described.*

In order to correctly roughen the belt, the following requirements are necessary:

- Disposable Silicone Rubber Gloves
- Softback Sanding Sponge (MEDIUM | 200 – 300 grid)
  https://www.amazon.ca/3M-Medium-Softback-Sanding-Sponge/dp/B001EM4DRY
- Isopropyl Alcohol or similar cleaning agency without additives
- Paper tissue or clean cloth

1. Make sure that the conveyor belt is free from objects or material residue.
   Move the belt once around by hand to check that all spots are clean.
2. Sand the belt until there is an even dull shine to the belt. Move in the direction of the belt or perpendicular to it to minimize the scratch visibility. Also prevent to much force to keep an even look.   [1]
3. After sanding the entire belt surface, apply the Isopropyl alcohol directly to the cloth and wipe the belt clean of dust.   [2]
4. When the alcohol vaporizes, and the belt looks clean you can start you prints again.

8.3   Possible failure mode

Problem	Possible cause	Action / solution
3D printed part detaches from the belt	Too fast belt wall or belt Temperature too low	Enable the feature "Belt Wall" In BLACKBELT Cura and set it between 10 and 15 mm/s. Slice the part and see the result in Layer View option "Feedrate". The slos wall will turn blue. Increase the temperature of the heated bed (Control -> Temperature -> Bed)
3D printed parts adheres too strong to the belt	Temperature too high or "Belt wall" too slow	Lower the temperature of the heated bed: (Control -> Temperature -> Bed) Disable the feature "Belt Wall" in BLACKBELT Cura
3D printed parts leaves marks on the belt	Belt Offset too small	Increase the belt offset (set between 0.3 and 1mm in BLACKBELT Cura)
Bad surface quality of the print	Not enough cooling	Make sure, the part cooling fan is mounted and connected to the print head. Increase the speed of the cooling fan (Control -> Temperature -> Fan speed) during a print. Or in BLACKBELT Cura, setting "Fan Speed".
Conveyor belt is running curling against the wall	Belt Calibration needed	The belt needs to be calibrated (chapter 5.6)
One side prints closer to the belt than the other side	Y calibration needed	The Y axis needs to be calibrated (chapter 5.5)

8.4   Spare parts

Only original spare parts and machine parts of BlackBelt 3D BV can be used in the machine.
All consumer and spare parts can be found in the web shop of Blackbelt-3d.com or by direct inquiries at sales@blackbelt-3d.com. When sending inquiries always remark the number of parts and specifications.

In the following sub chapters we will explain some of the handling steps of replacing the most common spare parts.

8.4.1 Changing the belt

⚠️ *Please make sure all the material is removed from the printer. The material removal steps are explained in chapter 6.11.*

1. Turn off the machine and disconnect the controller box   [1-3]
2. Remove the printhead, please make sure all the cables are removed   [4-6]
3. Remove the controller box, make sure that there is enough space to the right of the machine [7]
4. Set the machine to 45°   [8]
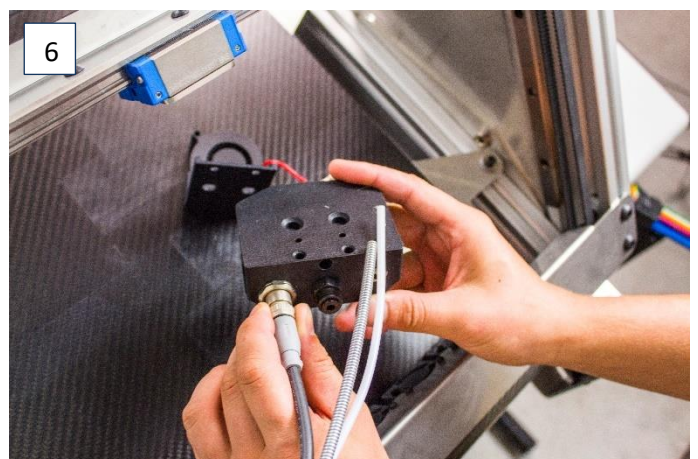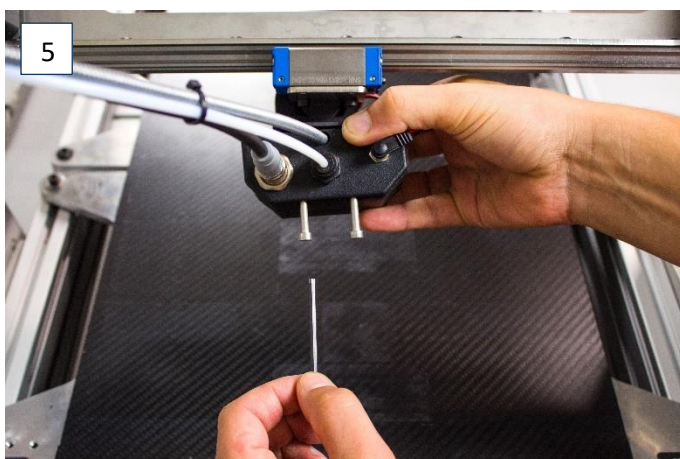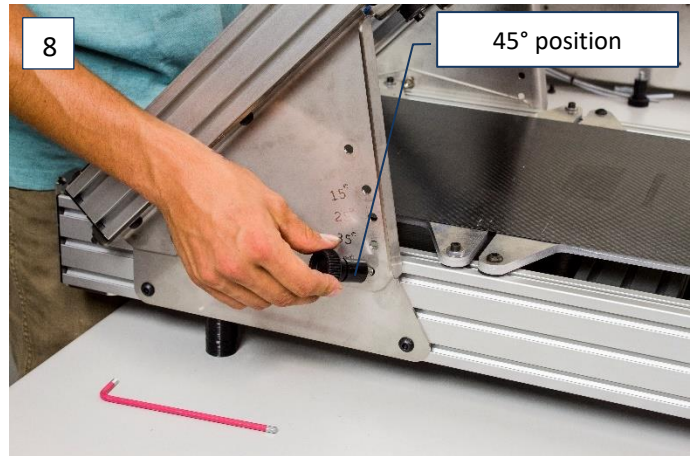
45° position

5. Remove the 2 screws at the hinge – the gantry will now hold its position   [9-10]
6. **Detach the rear fan cable!**   [11]
7. Remove the 2 angle adjusting knobs (3) while holding the gantry up with one hand   [12]
8. Take off the gantry and put it to the left besides the printer   [13]
9. Set the base unit upright   [14]
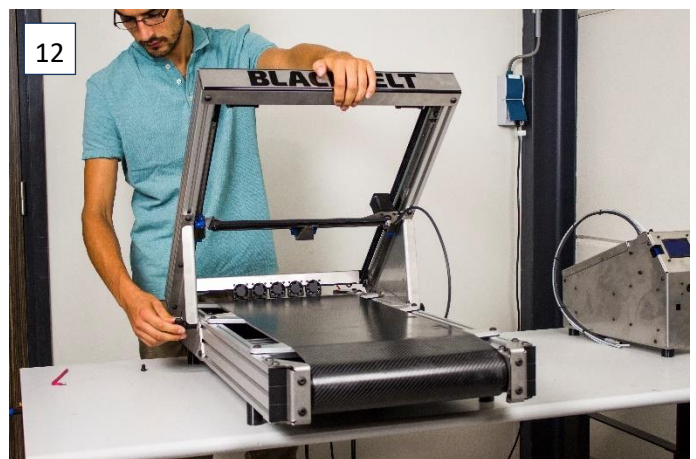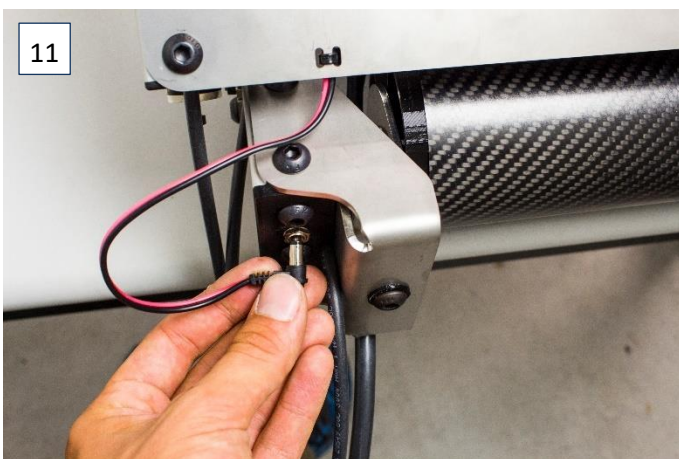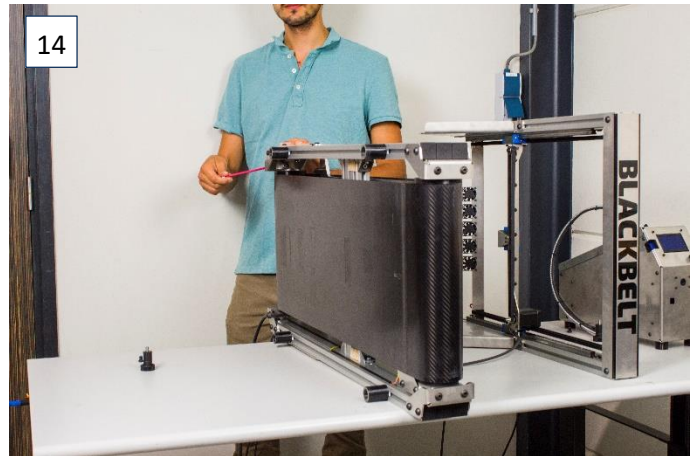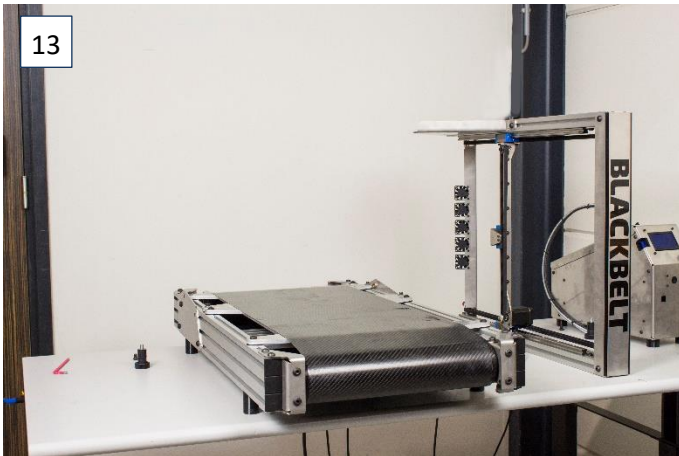
10. Loosen the rear roller with the rear 2 screws [14]
11. Unmount the rear roller while **holding it with the other hand** [15]
12. Remove the rear roller [16]
13. Remove the conveyor belt [17-18]
    a. Move it carefully to the front, between the limitations
    b. Now lift the front side of the belt above the mount of the front roller
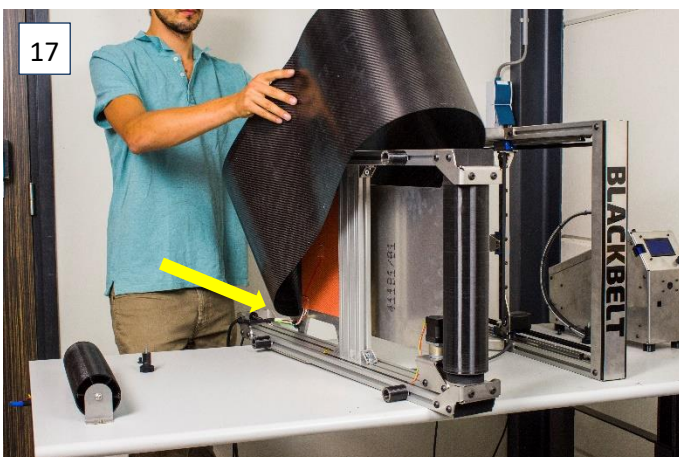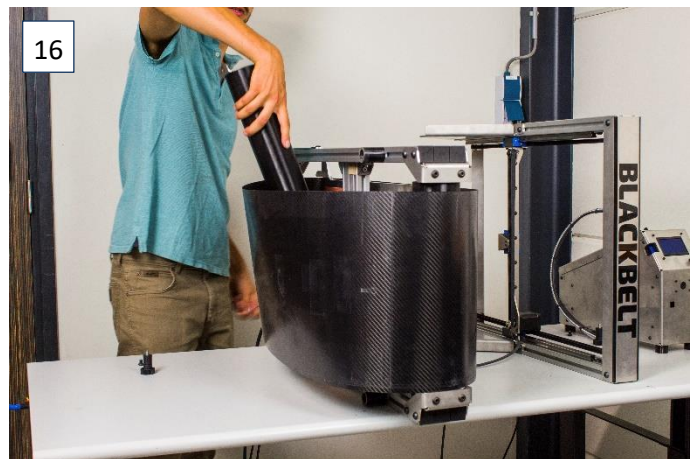
14. Mount the new belt [19-20]
    a. Check the belt direction
    b. **Carefully position the belt to the rear of the printer**
    c. Then put it over the front roller
15. Put back the rear roller inside the conveyor belt [20-21]
16. Mount the rear roller with the 2 rear screws. Turn at the short side of the Hexagon key to not overtighten the belt. [22-23]
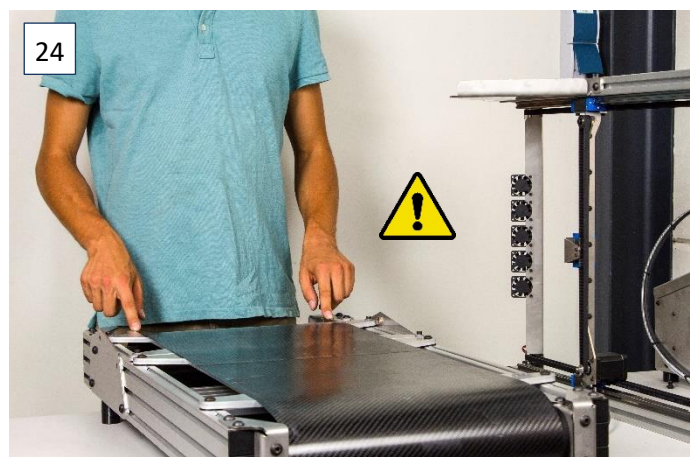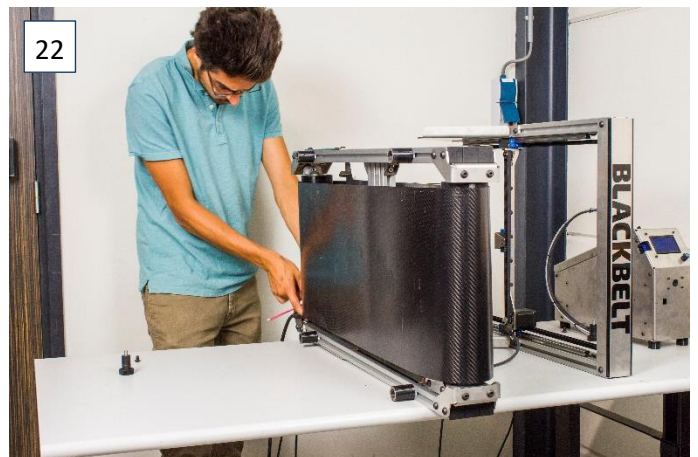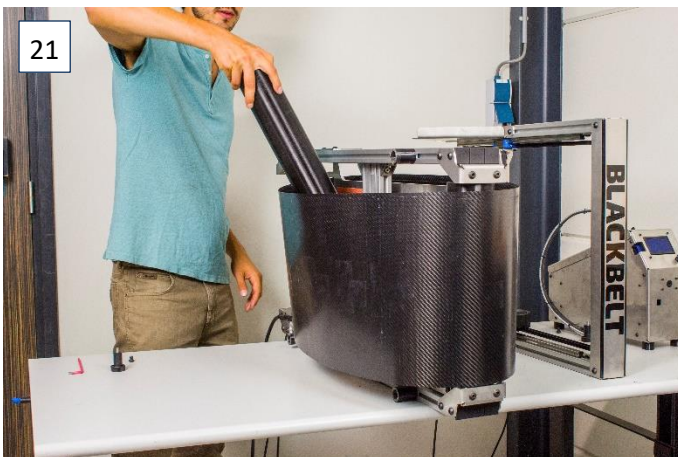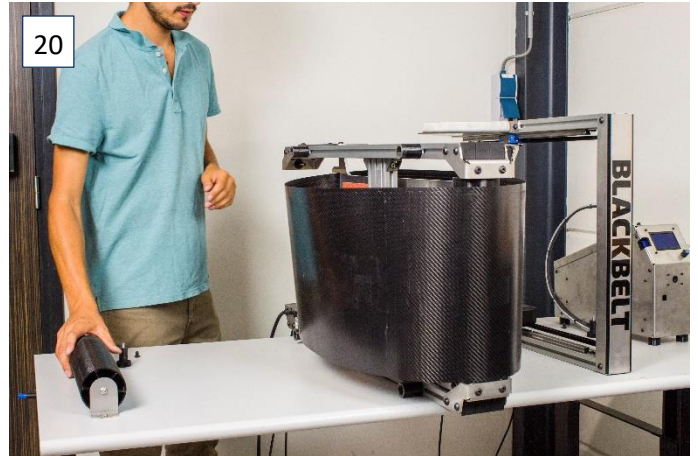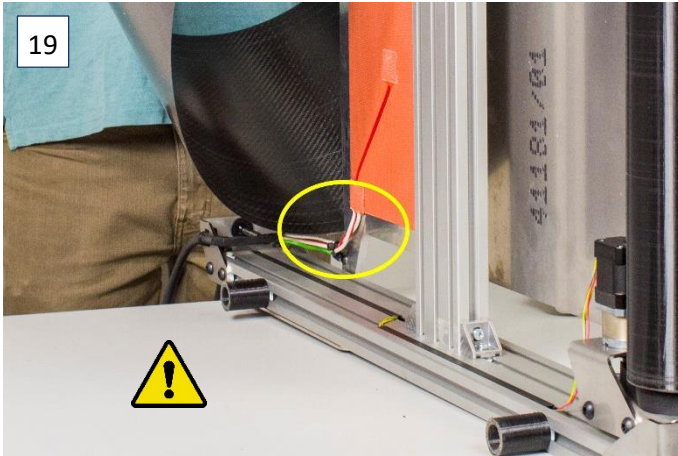
17. Turn the base unit back on its feet [24]
    a. **Make sure the belt is between the guiders!**

⚠️ *Follow instructions in Chapter 5.6 for the belt calibration before continuing this guide.*
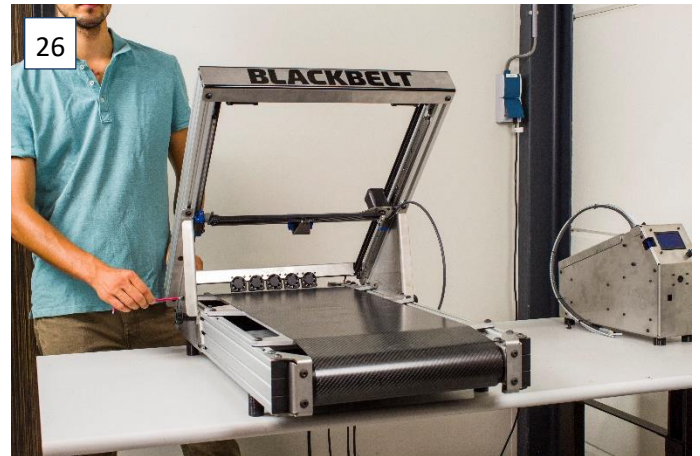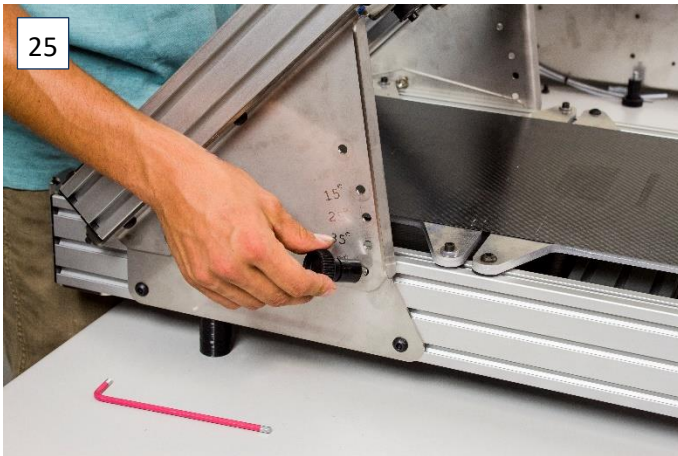

18. Put the gantry back on the base unit and mount it in 45° position with the 2 angle adjusting knobs [25]
19. Mount the 2 screws at the hinge back again. [26]
20. After a belt change you'll need to calibrate the Y axis as explained in chapter 5.5.

8.5 Heated bed modification

⚠️ *Before taking these steps make sure the printer is turned off, the power cable is unplugged, and the bed is cooled down to room temperature < 30 °C*

For parts that extend the heated area during printing, we recommend doing a onetime modification to the printer. This will not affect the printing performance for the other materials. To extend the heated zone for long adhesion to the belt.

1. Take a number 5 Hexagon key
2. Loosen the 4 bolts indicated with the arrows in [1].
3. Push the front plate backward until it's aligned with the hot plate. This will increase the hot zone of the printer.
4. Fix the bolts before plugging the power cable back in and turning the printer back on.
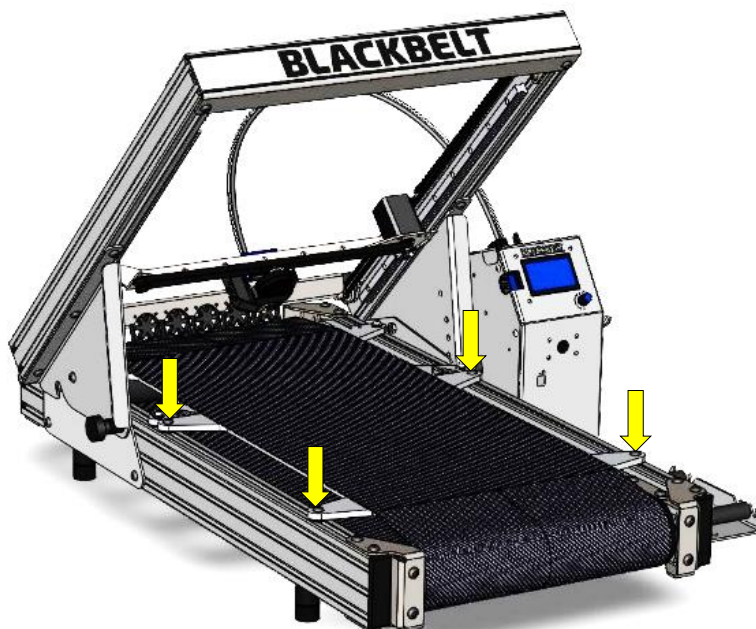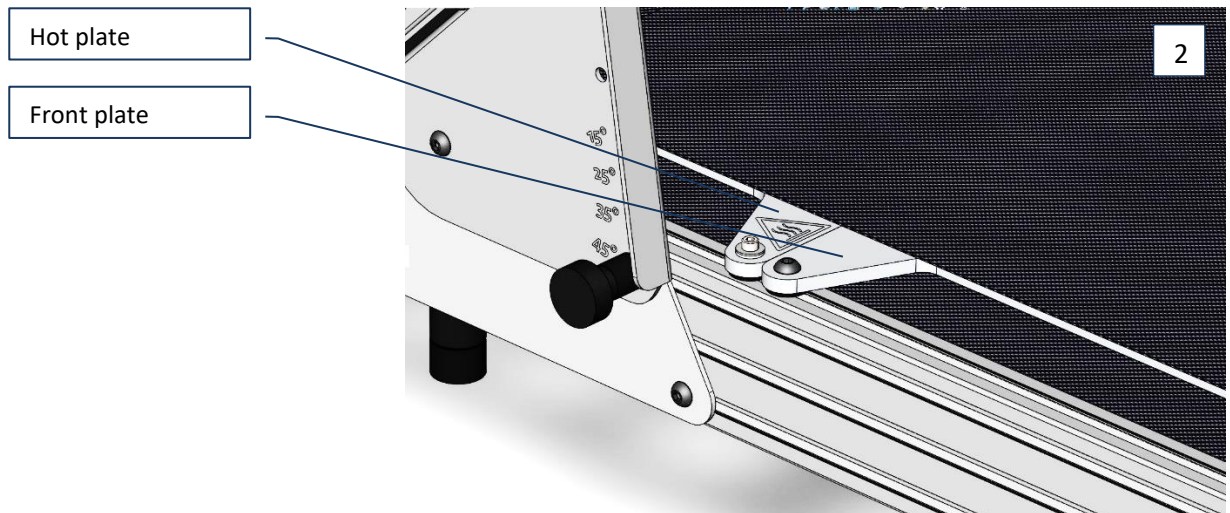

Figure 1 Loosen these screws to move the front plate

8.6   Customer service and support

Our technical and support department will answer all your questions about repair and maintenance of your machine and spare parts. Team BLACKBELT 3D is happy to advise you regarding your purchase, use of the machine and setting up the products, as well as applying the correct design guidelines. Please contact us at support@blackbelt-3d.com.

9   Disposing the machine or machine parts

⚠️ *Please follow all prescriptions as described in this manual. In particular chapter 2 : Safety messages*

Carry out the following steps while disposing the machine:
1. Put the machine out of order and detach all electrical connections.
2. Remove all consumables.
3. Scrap / dispose all machine parts separately conform local regulations.

10 EG-declaration of compliance

EG-declaration of compliance for machinery (directive 2006/42/EG, Addendum II, section A.)

$C\epsilon$

Blackbelt 3D BV
Bremweg 7
5951 DK Belfeld
Netherlands

Declares that:

> ### *Machine: BLACKBELT 3D-Printer*
> ### *Type: BLACKBELT 3D-Printer Desktop version*

complies with **Machinery directive 2006/42/EG** and complies to the provisions of the **EMC-directive 2014/30/EG**

complies with harmonized European standards:

Harmonised European standard	Description	Harmonised European standard	Description
NEN-EN-ISO 12100:2010	Safety of machinery - General principles for design – part 1: Basic principles, methodology	NPR-ISO/TR 14121-2:2010	Safety of machinery – Risk assessment – Part 2: Practical guidance and examples of methods
NEN-EN-IEC 60204-1	Safety of machinery - Electrical equipment of machines – part 1: General requirements		

Belfeld, The Netherlands   Stephan Schürmann
August 2018   CEO