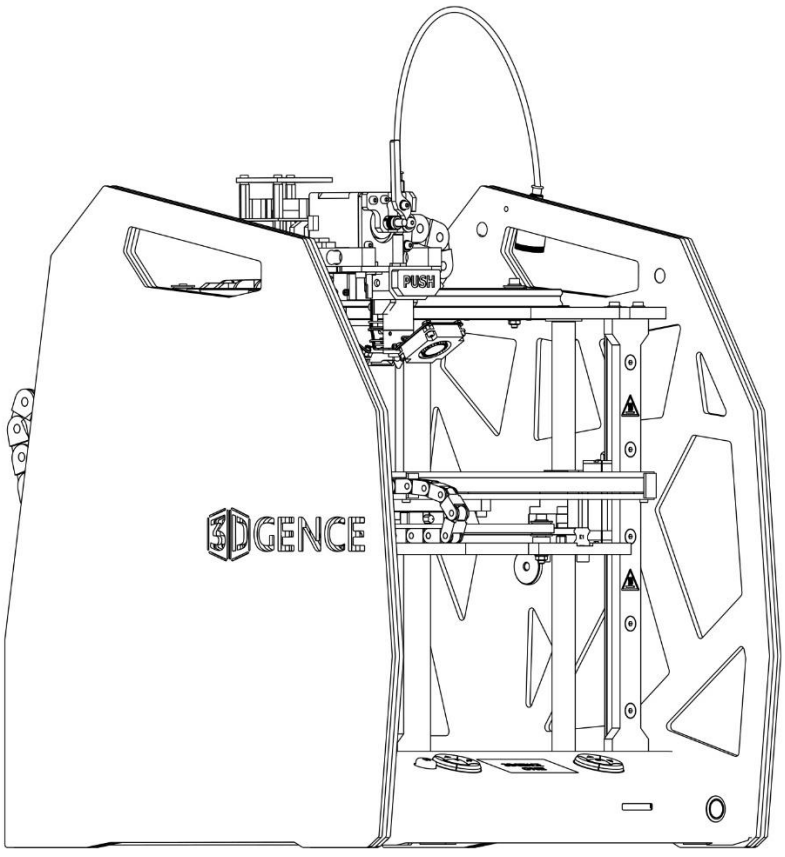
USER MANUAL

3DGence ONE



Contents

I INTRODUCTION

1. INTRODUCTORY COMMENTS

Thank you for choosing 3DGence ONE 3D printer. The following manual shall introduce you to the world of 3D printing. It enables you to work your way around it, ensures high quality working results and allows safe and effective exploitation of the device for a long time. 3DGence mission is to offer exclusively the highest class of devices that meet expectations of both professionals and amateurs.

On the last pages of this User's Manual there is the dictionary of terms and concepts connected with 3D printing. The dictionary will facilitate understanding the professional terminology and explain some terms appearing in this User's Manual.

The user manual contains information necessary for proper and safe use of the printer. Read the entire User's Manual carefully before using the printer.

The persons who have not read the User's Manual must not use the printer. Wrong use may damage the printer or cause bodily injuries or even endanger the life of the operator.

Before starting the operation of 3DGence DOUBLE printer, the user must read the entire User's Manual and accept the instructions and exceptions included in the User's Manual.

2. MATERIALS FOR PRINTING

FFF technology (Fused Filament Fabrication) used by 3DGence ONE printer consists in depositing plasticized thermoplastic material (plastic) layer by layer. This plastic is the printer's operating material. The thermoplastic material is used in the form of a filament with a precisely defined diameter, wound on a spool (fig. 1). 3DGence ONE printer uses the filament with the diameter of 1.75 mm.

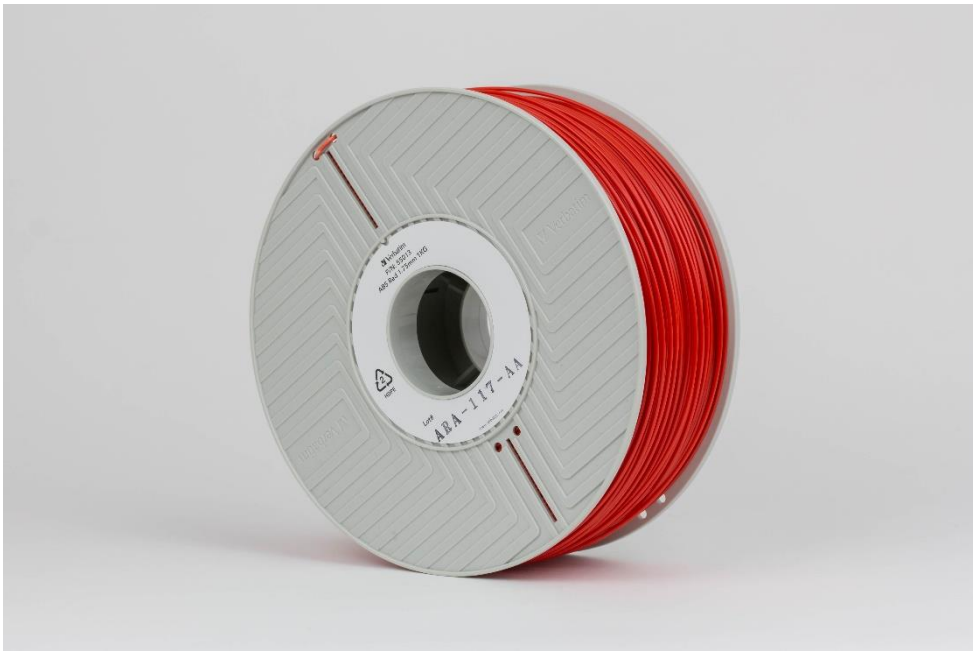


Fig. 1 Filament spool

There are many different filament materials. Consumables are usually made of substances such as: ABS, PLA, nylon with various admixtures (e.g. tribo-filaments) nylon, elastic materials, enriched with metals, wood, chalk, carbon fiber, graphite and many others. There are many types of materials such as changing colors, luminescent or made of plant fibers. The use of particular material depends primarily on individual requirements and customer expectations - filaments have a variety of properties such as esthetic, mechanical or temperature features. Any used material requires specific, precisely defined parameters for the correct printing. Growing choice of new 3D printing materials makes FFF printing one of the most universal tools on the market.

3DGence ONE printer can use a wide range of printing materials available in many colours, if the material meets the following criteria:

- the diameter of the filament should be 1.75 mm, with a tolerance of +/- 0.05mm,
- the suggested printing temperature should not exceed 265°C.

The Certified Material Base, available at www.3dgence.com, has been created for 3DGence ONE printer.

3DGence is not responsible for the quality of printouts made of the materials other than those included in the Certified Material Base and for damage caused by the use of such materials as well as it does not provide support for the quality of the printouts made of the filaments other than those included in the Certified Material Base.

3. SYMBOLS

3.1. List of symbols used in the manual

Throughout this User's Manual the following symbols are used. They identify the situations that are potentially dangerous to health or may cause damage to the printer. Always adhere to the warning symbols. Negligence may cause the printer's damage excluded from the guarantee cover as well as bodily injuries.

DANGER:
The situation or procedure described is potentially dangerous and it may result in damage to the printer or cause injury to the operator. Exercise care.

ATTENTION:
The situation or procedure described is potentially dangerous and it may result in damage to the printer. Exercise care.

PROTECTION:
Protective gloves, delivered with the printer, must be worn when performing the activities described. Put on protective gloves before performing these activities.

3.2. Indicator lights

3DGence ONE printer is equipped with LED backlight located under the printer's upper plate. The LED backlight illuminates the printout during the printer operation and is also a form of signalling device. The description of all backlight colours and their meanings is given below (table 1).

Tab. 1Meaning of backlight colours in 3DGence ONE printer

COLOUR	MEANING
Green	Safe temperature of the heatbed (below 40°C). After completed printing, the printout can be safely unloaded.
Red	Heatbed temperature exceeds 40°C. Do not touch the heatbed – there is a risk of burns. After completed printing, do not remove the printout from the heatbed until the backlight turns green.
White	The printer is working. The heatbed is hot - do not touch it. There is a serious risk of burns.
Yellow	Failure of the heating devices. If the hotend has been installed correctly, immediately disconnect the printer from power supply and contact the service department.

The backlight colour indicates the heatbed temperature not the hotend temperature! The hotend temperature is shown only on the display!

4. SAFETY MEASURES

The information below describes the correct operating conditions of 3DGence ONE printer. Failure to comply with the indications and contraindications may significantly reduce the life of the printer, violate the guarantee conditions or endanger the health of users.

4.1. General information

The printer must not be installed:

- in open space, outdoors,
- in damp places or in places at risk of flooding,
- in the vicinity of volatile and flammable substances,
- near concentrated acids, caustic vapours or corrosive substances,
- in places easily accessible to children,
- using the network without a protective earth lead (PE) and residual – current device to avoid electric shock in the event of a malfunction of the device.

Do not:

- touch the printed model, heatbed or hotend during printing,
- insert any body parts or objects into the printer's working area during printing – the printer may get damaged or the operator may get injured,
- touch the heated nozzle with your hands, even with protective gloves,
- bend over the heated hotend or the hotend area during the printer operation - there is a risk of facial burn injuries,
- touch live parts,
- touch linear guides and trapezoid bolts during the printer operation,
- operate the printer with wet hands,
- put any objects on or under the printer's table – during the printer operation or when the printer is at standstill,
- put containers with liquids on the printer,

- leave the working printer without the control of an adult who is able to take appropriate steps in the event of a failure,
- leave the working printer in a room with children or animals,
- disassemble the printer or hotends; make unauthorized repairs – the printer or hotends may get damaged.

3DGence ONE printer heats up to temperature above 250°C; the device has many elements, which make unpredictable, rapid movements during printing. It is forbidden to put any objects or parts of body inside the device when operating!

Adhere to the following instructions:

- when disconnecting the plug from the power source, pull the plug by its housing not by the cable,
- disconnect the printer from the power source before any repair or maintenance activities,
- make sure that the mains voltage corresponds with the printer's specifications,
- protect the power lead and plug against damage,
- disconnect the power plug before relocating the printer,
- disconnect the power plug if the printer will not be used for a longer period of time,
- periodically remove external contaminations from the hotend nozzles (using non-flammable material),
- always wear protective gloves when operating the printer,
- ensure the possibility of quick response in the event of a break-down/print failure,
- each time before starting the printer, carefully inspect the direct vicinity of the printer and remove all obstacles and contaminations with which the printer could collide or which could in any way hinder the free movement,
- guarantee free access to the printer for the operator, throughout the printer operation.

Heated heatbed and hotends remain hot even after completed printing. Check their temperature on the display before touching them (fig. 2) or wait at least 30 minutes after switching the printer off (e.g. in order to clean or remove the model, change the hotend, etc.)

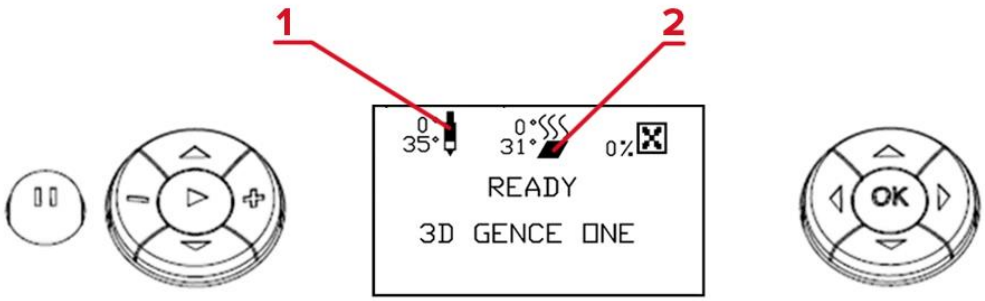


Fig. 2 Temperature indications for: 1. hotend | 2. heatbed

4.2. Relocating the printer

To ensure the safety of the user and to avoid accidental damage to the printer, the following rules must be followed when relocating the printer:

- before relocating the printer, switch it off and disconnect it from the power source,
- the printer should be cooled down, the operating material and all loose elements and accessories should be removed from the printer,
- the printer should be lifted only by the handles designated for this purpose (fig. 3); do not lift the printer by any other elements,
- the printer should not be carried by children and the elderly due to its significant weight (about 20 kg).

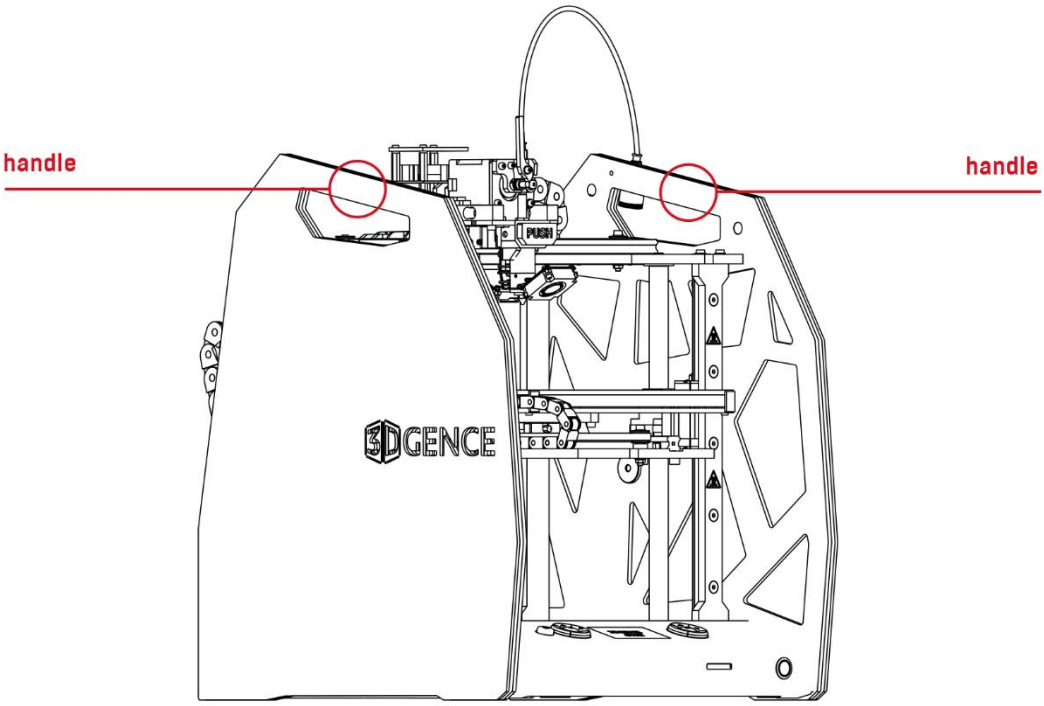


Fig. 3 Locations of handles for printer handling

4.3. Choosing proper installation place for the printer

The printer installation place should meet the following conditions:

- the printer should work at room temperature,
- the printer is not designed for work in a dusty environment,
- ventilation suitable for a room size should be ensured,
- the printer should be installed on a hard and stable ground,
- the printer should not be exposed to direct sunlight,
- ensure sufficient free space around the printer based on the printer's external dimensions and working range of the axes (fig. 4, 5),
- keep the printer away from other heat sources and draughts,
- the printer's installation place should be equipped with a 230V/50Hz mains socket (110V version for the USA market),
- the device should be connected to a mains socket with grounding to avoid electric shock in the event of a malfunction of the device,
- uninterruptible power supplies (UPS) should be used in order to ensure that the printing process is not stopped in case of instantaneous current decay.

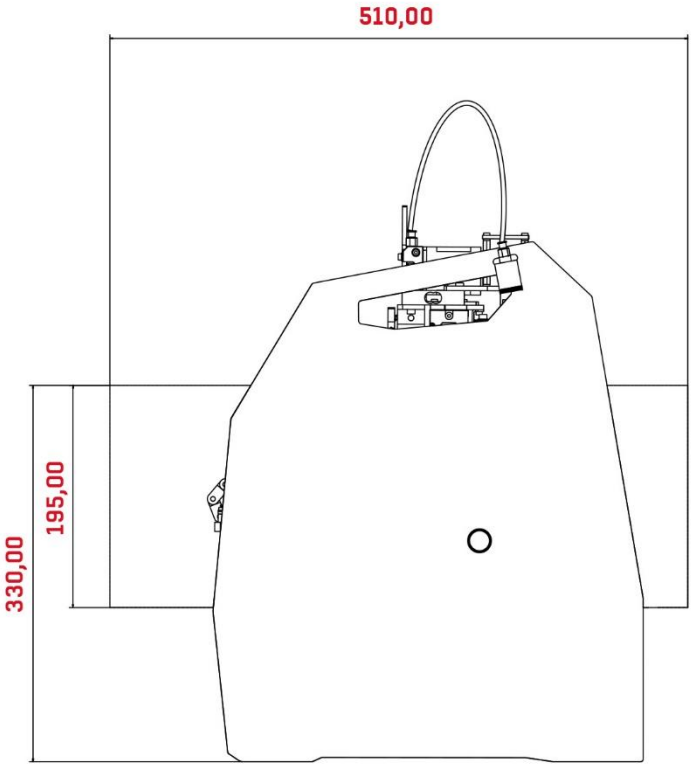


Fig. 4 The maximum dimensions of the printer taking into account the extreme positions of the heatbed – right side view

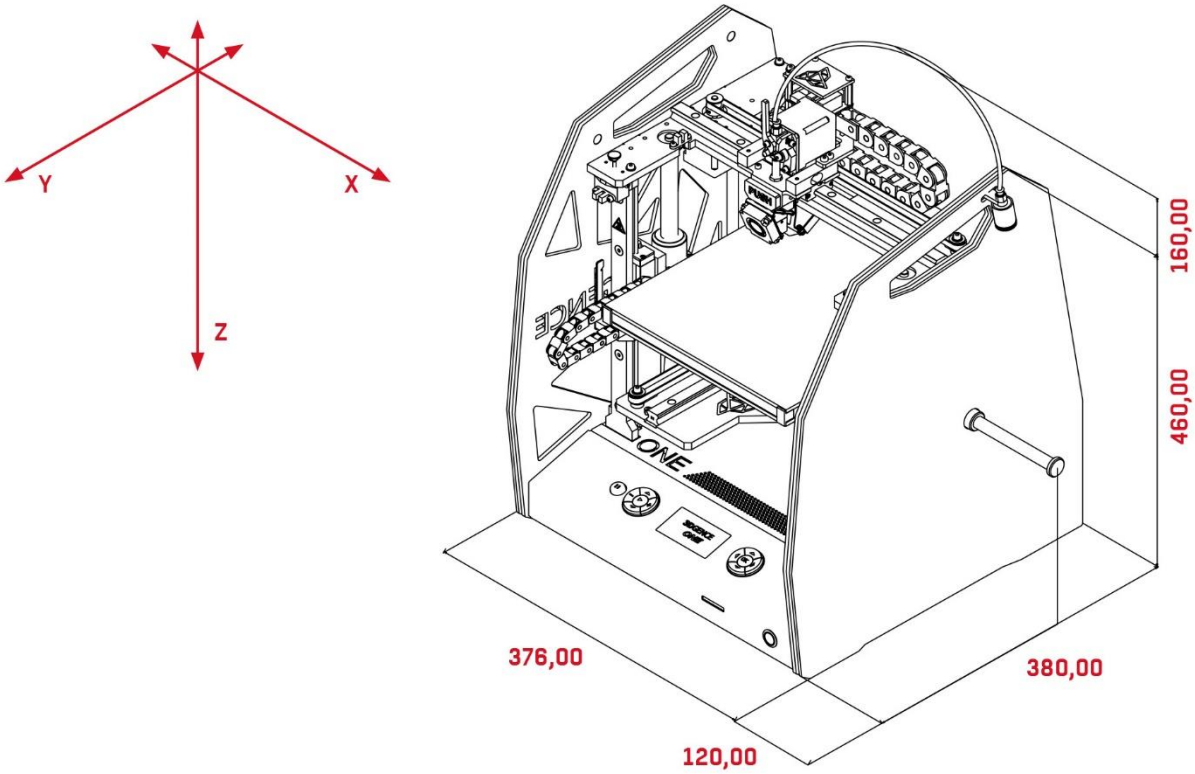


Fig. 5 The maximum external dimensions of the printer (accessories included) and markings of X, Y, Z axes

4.4. Before starting the printer

Before each use of the printer, make sure if the following conditions are met:

- check whether the cables have no visible fraying or other damage. In case of damage of cables, you should immediately notify the 3DGENCE company's technical service department. In such circumstances, the user is prohibited from connecting the device to the power supply and/or making repairs on their own,
- make sure the filament is not dirty, broken, bent or tangled on the spool,
- make sure that in the printer working area there are no items or leftover prints that could cause a jam or damage the machine,
- check the X and Y axes, and make sure that nothing is blocking their movement. Check that the toothed belts are pulled tight and have no damage,
- check whether Z-axis stopwatch (fig. 6) is not damaged, broken or bent and if it matches Z-axis limit switch (aims at the notch in limit switch),
- check the correct operation of thermistors (temperature sensors), hotend and heatbed. To do this, start the heating of the hotend and heatbed and check if temperature parameters on LCD display are rising,
- check that in the area of the printer there are no objects or persons who might be injured as a result of the printer operating.

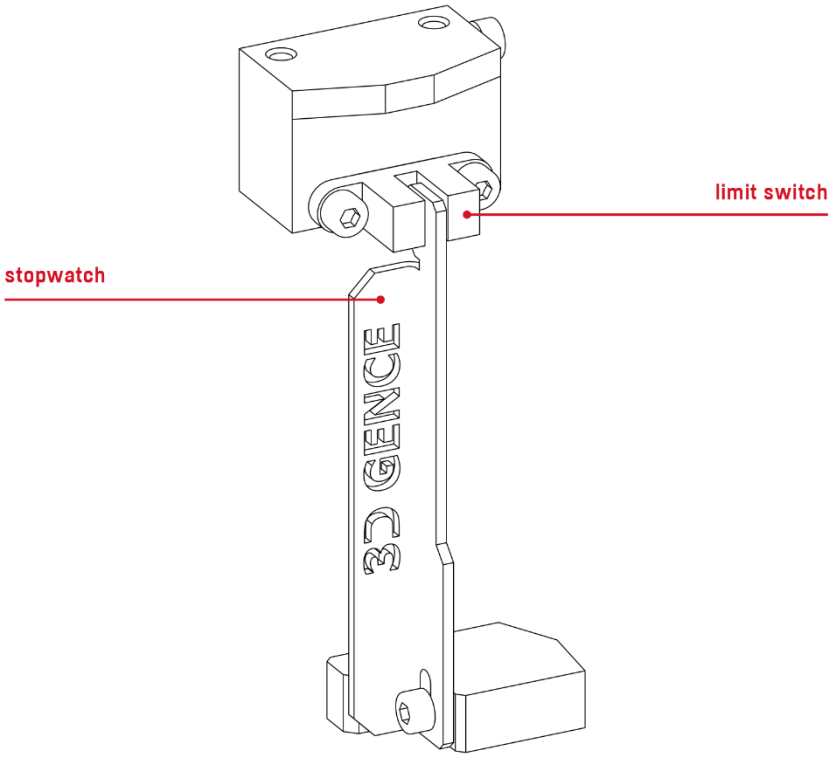


Fig. 6. Z-axis limit switch and stopwatch in their.

II DESCRIPTION OF PRINTER

1. CONSTRUCTION OF PRINTER

To facilitate learning and operating 3DGence ONE printer, the manual contains a number of figures (diagrams) (fig. 7–12) with descriptions of the most important components of the device. Reading the figures and terms can help in understanding terminology widely used in 3D printing.

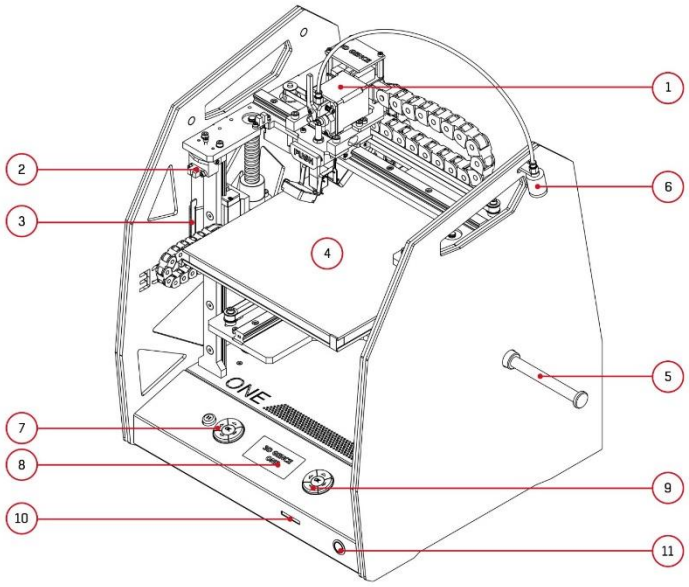


Fig. 7. 3DGence ONE printer view (left side):
1. Extruder / 2. Z-axis limit switch / 3. Z-axis timer/stopwatch / 4. Heatbed / 5. Filament spool holder
6. Filament cleaner / 7. Control buttons / 8. LCD screen / 9. MENU buttons / 10. SD card slot / 11. Power button

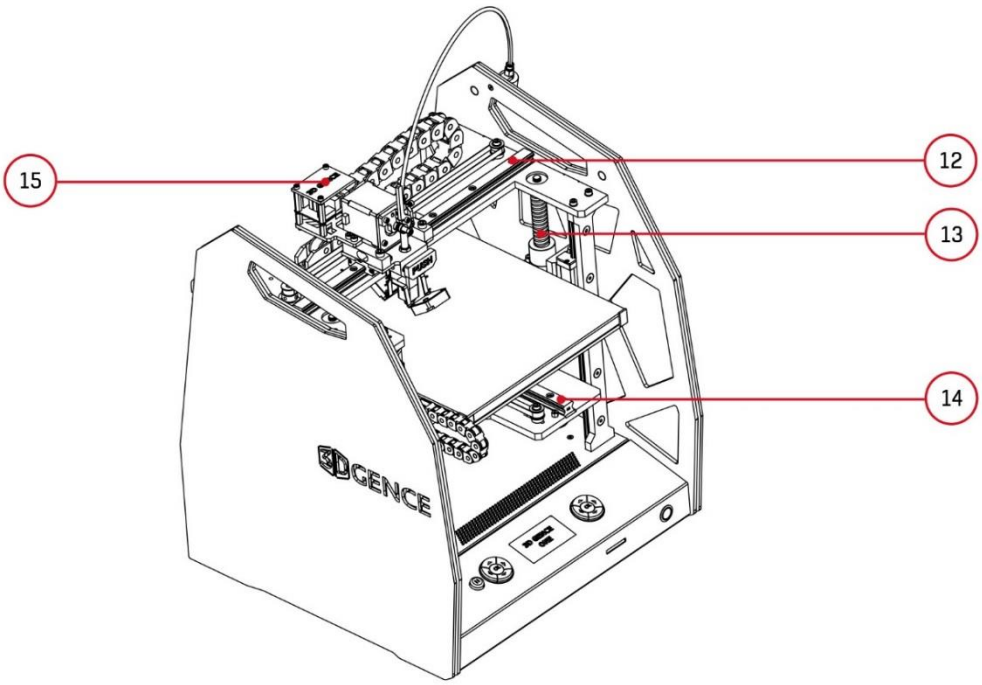


Fig. 8. 3DGence ONE printer front view (right side):
12. X-axis guide / 13. Ball screws / 14. Y-axis guide / 15. Extruder elements

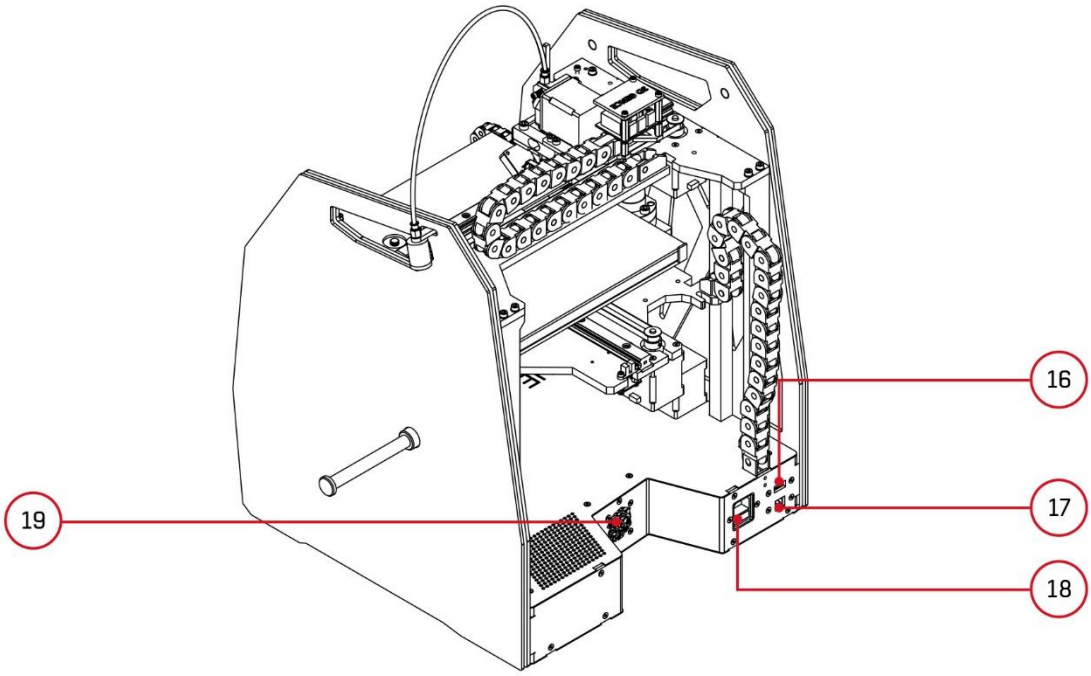


Fig. 9. 3DGence ONE printer view (left side):

16. USB port A (flash drive) / 17. USB port B (computer) / 18. Power inlet socket
19. Fan (warning: do not obstruct)

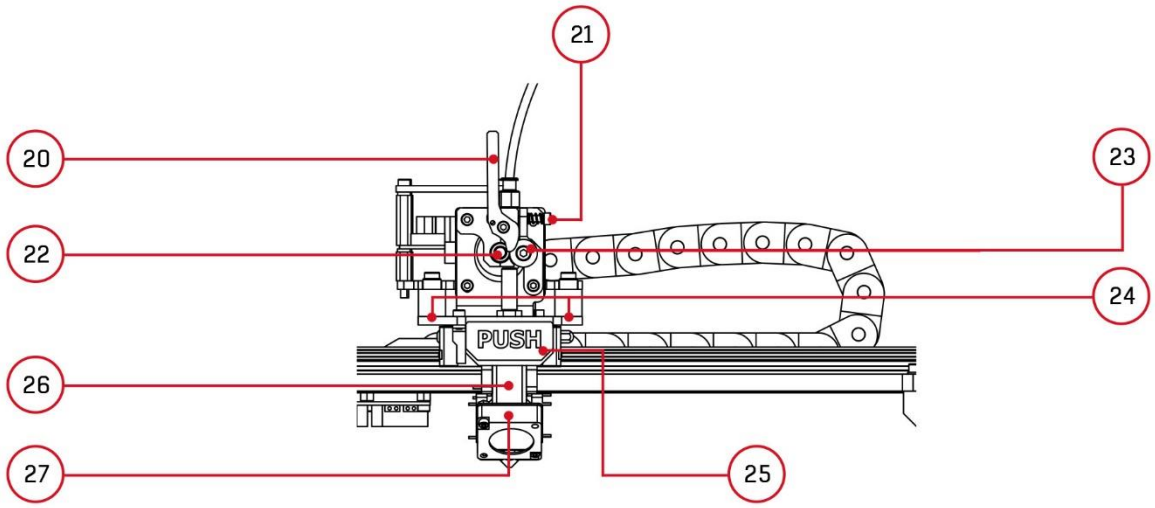


Fig. 10. Extruder and head module (front view)

20. Extruder (open/close) lever / 21. Clamp adjustment screw / 22. Knurl
23. Extruder clamp / 24. Tensometers / 25. Button releasing the hotend / 26. Hotend
27. Printout cooling fan

NOTE:
After removing printer from the package, make sure that the extruder lever (element 20) is in correct position (as shown in fig. 10) and if there is a 7-8 mm space between clamp adjustment screw (element 21) and extruder clamp (element 23).

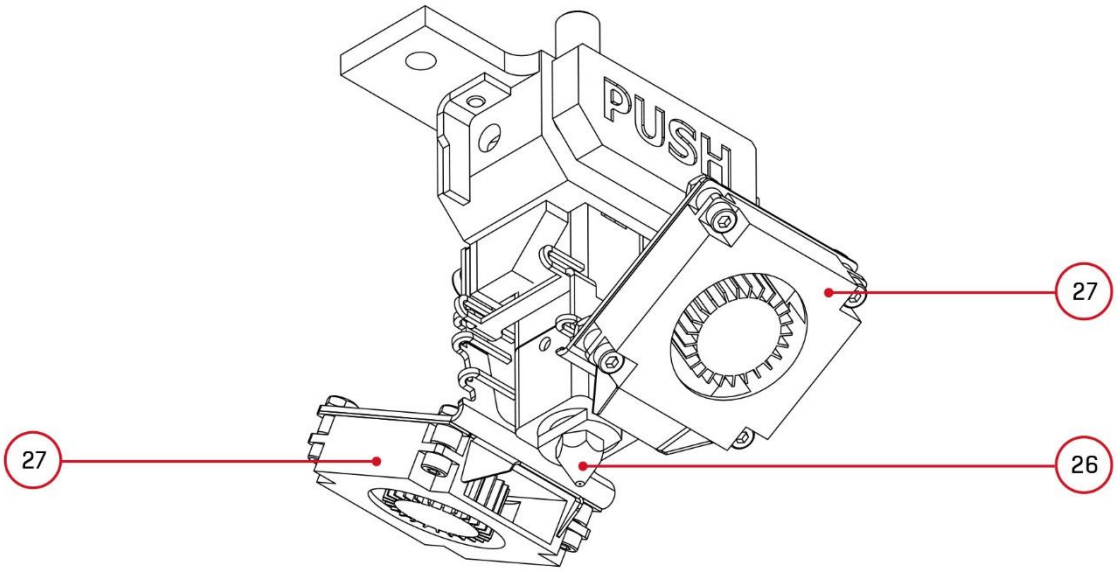


Fig. 11. 26. Hotend / 27. Cooling fans

NOTE:
Figure 11 presents the print head. The nozzle (element 26), accumulates contaminations in the process the printing. Deposits accumulated on the nozzle should be regularly removed with the use of non-combustible cleaning substance. For more information on cleaning the nozzle see chapter „Post-printing operations", section 2.1.

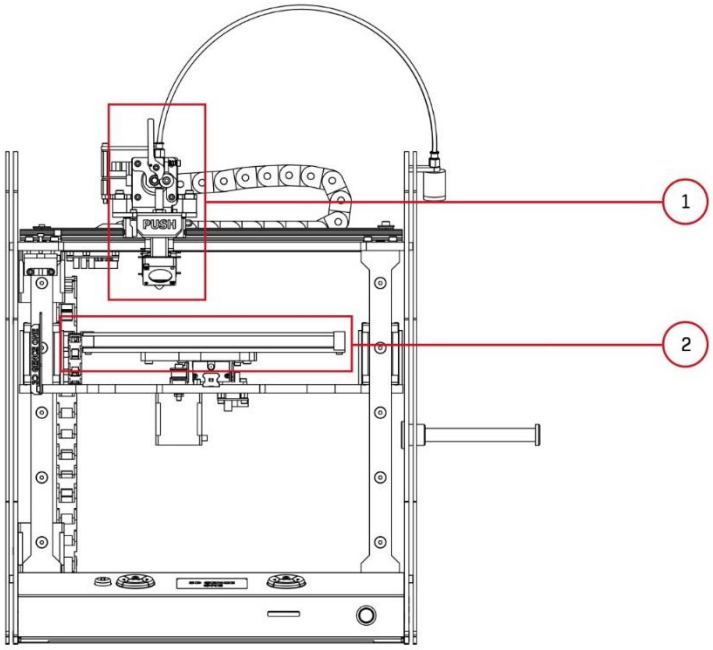


Fig. 12. 1. Extruder / 2. Heatbed

Figure 12 shows locations of hot zones marked in red, where the operating machine reaches a high temperature. Touching any elements placed in hot zones before their complete cooling may result in burns!

Zone 1: hotend and extruder zone. Working temperature to 265°C.
Zone 2: heatbed zone; working temperature to 160°C.

2. CONTENTS OF EQUIPMENT

The 3DGence ONE printer is supplied with material spool and a set of necessary accessories. The kit includes (Figures 13, 14):

- spatula for removing printouts (1),
- USB cable (2),
- filament spool holder (Note: left-hand thread!) (3),
- tweezers (4),
- SD memory card (5),
- cleaner with handle and teflon wire (6),
- power cable (7),
- protective gloves (8),
- filament spool,
- hotend with nozzle with a diameter of 0.4 mm (already installed),
- additional hotends (optional) (10),
- panels made of polycarbonate (sides, depending on the color version: red, blue or orange) (10),

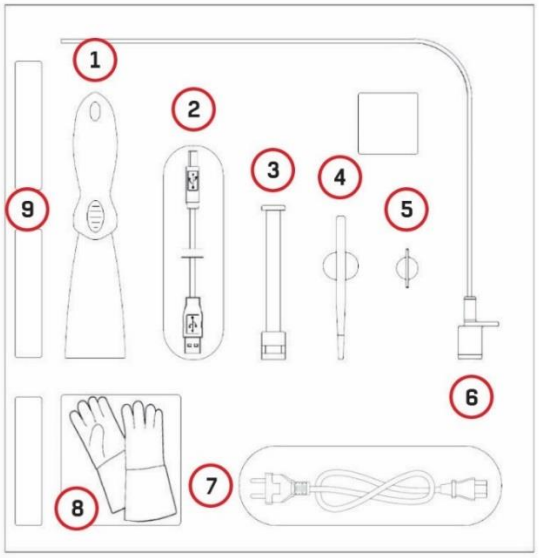


Fig. 13. Distibution of accessories in the package.

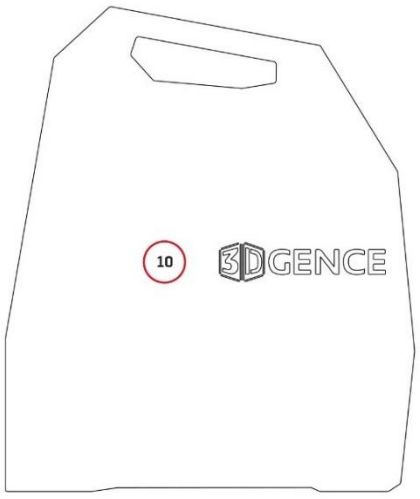


Fig. 14. Panels made of polycarbonate (sides, depending on the color version: red, blue or orange).

3. USER INTERFACE

3.1. Main panel

Below is shown the main panel of 3DGence ONE. It consists of 11 buttons, divided into two functional groups. The functions of two of them (Pause/Start) are discussed in the next subsection.

Right panel is shown in Figure 15.

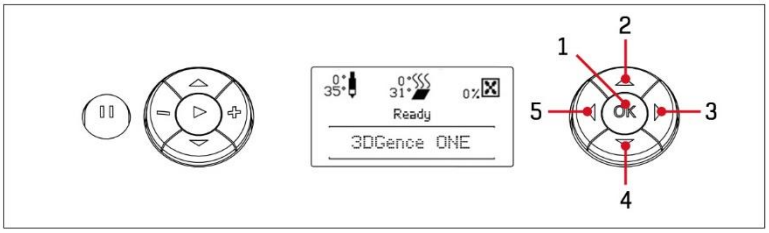


Fig. 15. 3DGence ONE navigation panel: 1st group of buttons.

Buttons in this group are for navigating MENU. They provide access to all parameters in the menu and allow adjusting their values.

Function of buttons (fig. 15):

1. Navigation key OK - entering MENU and confirming selection.
2. Upwards Menu navigation button (and values changer).
3. Instant file preview on SD card.
4. Key down navigation menu (and values changer).
5. Menu Navigation button and menu return.

Left panel is shown in Figure 16.

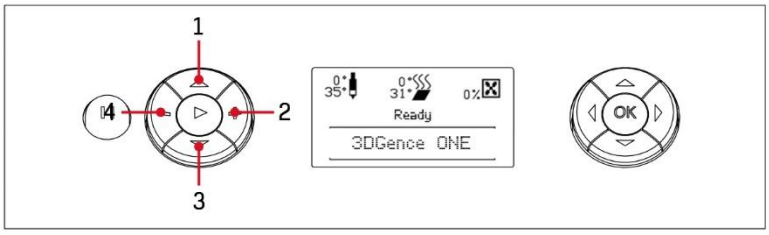


Fig. 16. 3DGence ONE navigation panel: 2nd group of buttons.

WARNING:
Left control panel operates outside of traffic restrictions (by micro switches), damage caused by improper use is not covered by the warranty (buttons from 1 to 4).

Function of buttons (fig. 16):

1. Upwards heatbed adjustment button, one click moves the heatbed by 0,025mm, which enables adjusting the height of the heatbed during printing (the button is active after referencing Z axis).
2. Add filament button (active after the hotend reaches 185°C). Allows control of feeding the material during printing. The button allows to fill the unfinished spaces/losses on individual layers or fill up the hotend before the commencement of printing.

3. Downwards heatbed adjustment button, one click moves the heatbed by 0,025mm, which enables adjusting the height of the heatbed during printing (the button works after referencing Z axis).
4. Filament recognition button (active from 185°C). Allows removing material from the hotend.

Applies to PLA material, in the case of ABS, set hotend temperature to 240°C to use quick access keys.

WARNING:
Buttons in point 2 and 4 are to be used after the head has warmed up to the temperature recommended by the manufacturer of the material. If not used properly, it may cause damage to the hotend.

3.2. PAUSE and START buttons

To increase functionality and facilitate the use of the printer, 3DGence ONE unit has been equipped with PAUSE button (fig. 17) (1) that has the following functions:

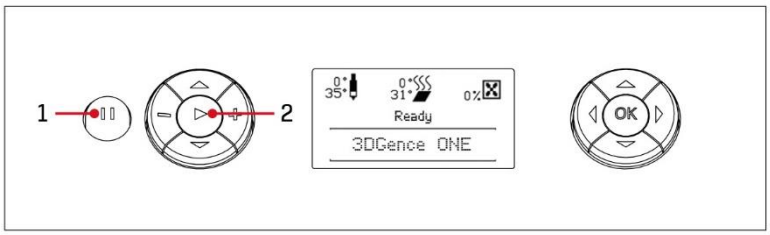


Fig. 17. 3DGence ONE navigation panel: PAUSE (1) i START (2).

- a single-press will stop the printing process,
- a double-press will hold the printing process and the departure of the nozzle to X and Y axes base position.

This function allows modifying the printed object e.g.: inserting a cap (or other object) to a specially prepared socket and further printing on the surface of the inserted object, changing the color of the filament, or, if the printing material runs out, replacing an empty spool. However, for the replacement of printing material it is recommended to use filament replacement guide „Filament change" from the MENU. Note that the added objects cannot protrude beyond the currently existing printing surface; otherwise the hotend can collide with the added object and be damaged.

When changing the printing material, it is recommended to hold the printing process at the stage of printing the filling, which reduces the risk of possible defects on the surface of printing model.

WARNING:
Always wear protective gloves for any manual operations within the working area.

To resume the printing process press START button (button 2, fig. 17), regardless of whether PAUSE button was pressed once or twice.

3.3. LCD display

LCD display enables accessing all MENU functions and direct control of important parameters of 3DGence ONE printer such as hotend and heatbed temperature. Location of particular parameters on LCD panel is presented below.
After starting the printer it displays the following information (fig. 18):

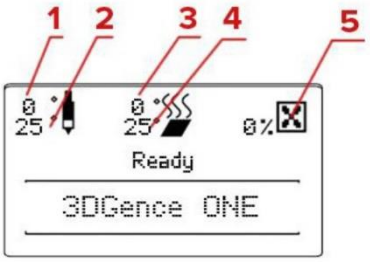


Fig. 18. 3DGence LCD display after turning on.

3DGence ONE printer displays the following information:

1. Preset hotend temperature,
2. Current temperature of hotend (as indicated by temperature sensor),
3. Preset heatbed temperature,
4. Current temperature of heatbed (as indicated by temperature sensor).
5. Percentage of current power of printout cooling fans.

After starting printing, LCD panel displays the following information (fig. 19):

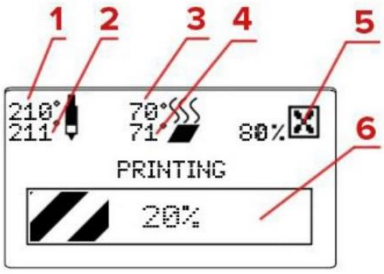


Fig. 19. 3DGence LCD display while printing.

Information currently displayed:

1. Preset hotend temperature,
2. Current temperature of hotend (as indicated by temperature sensor)
3. Preset introduced heatbed temperature,
4. Current temperature of heatbed (as indicated by temperature sensor)
5. Percentage of current power of printout cooling fans.
6. Printing progress panel (graphic presentation and percentage).

Temperature parameters and fan power can be changed during the printing process. Parameters can be manually adjusted for the purpose of printing process optimization. For example, strong airflow should not be used during printing the first layer, for this reason the obtained read may be 0%. Machine code automatically starts the cooling fan at the appropriate stage of printing. Fan settings can be changed from the MENU - Fan Speed.
LCD panel can also display information on total printing time and the amount of printed material from the initial starting of the printer. To access this data press the arrow down button (4, Fig. 14) on the right side of the panel from the main MENU.

3.4. MENU

3DGence ONE has an extensive user interface allowing full control of the printer without connecting it to a computer. For accessing MENU press OK button on the main panel (button 1, Fig. 14). To navigate MENU use navigation buttons on the right side of the panel (see chapter “Main Panel” - buttons 2, 3, 4, 5, Fig. 14).

Diagram of the Menu and description of available functions are presented below. The displayed functions of menu can change depending on the printer’s current operation mode (active or idle). Here is an example of menu in idle mode:

The symbol shown stands for choosing the option for up and down parameter regulation after pressing OK button.

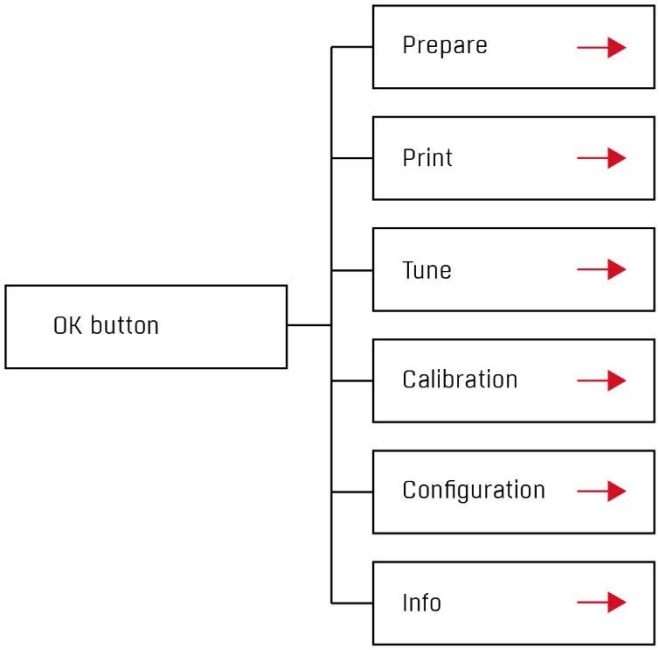


Fig. 20. Main menu in idle mode.

From this level you can enter a given selection settings:

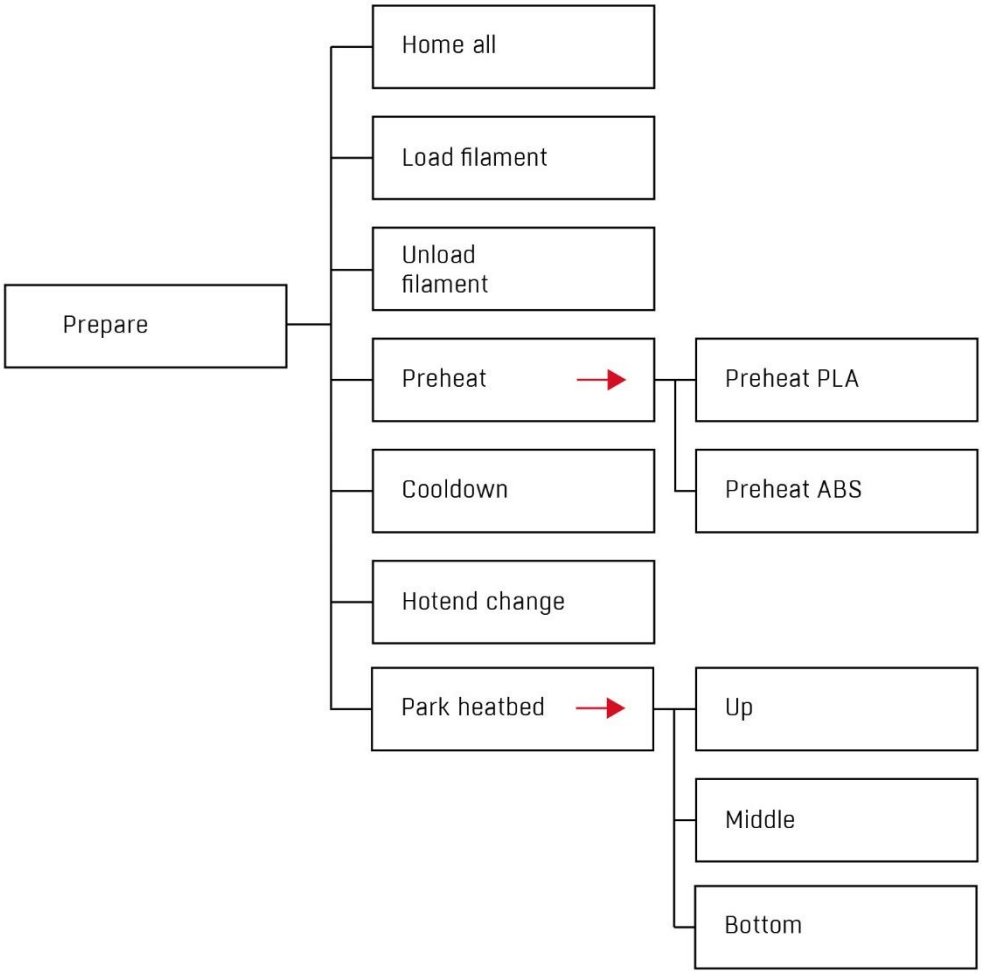


Fig. 21. PREPARE menu

Fig. 22. PRINT menu

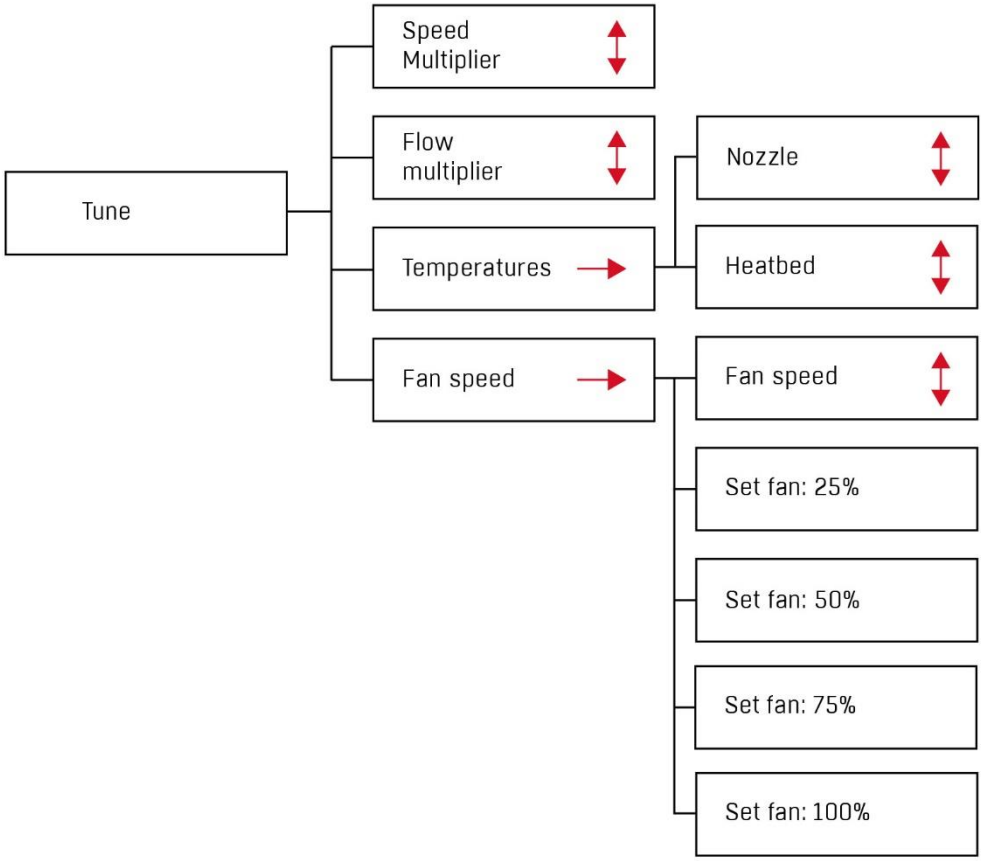


Fig. 23. TUNE menu

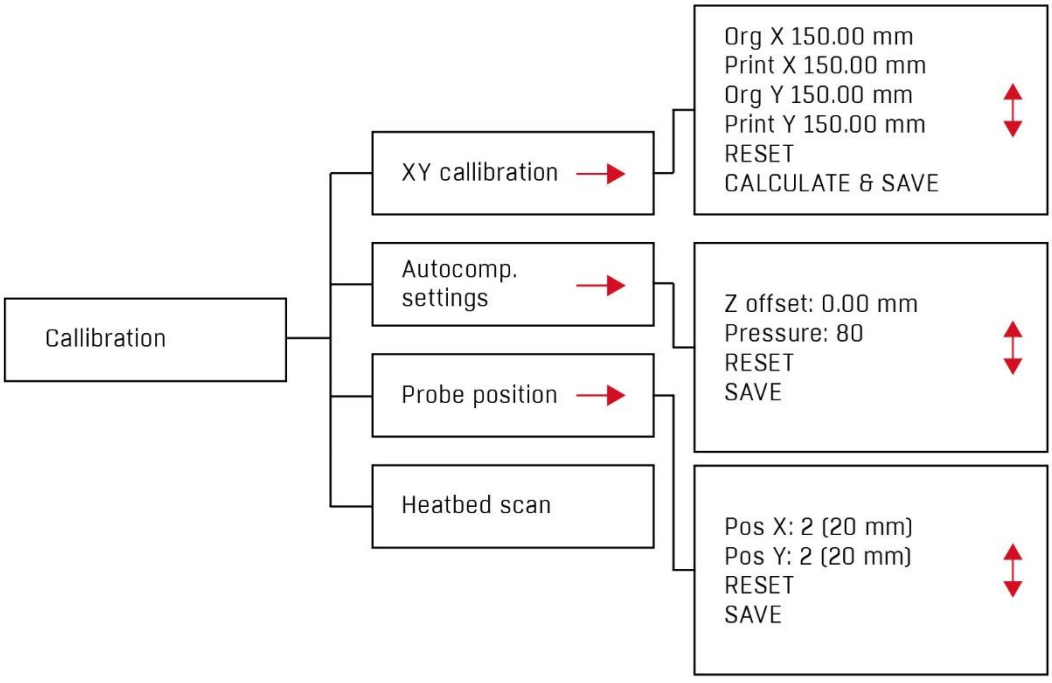


Fig. 24. CALLIBRATION menu

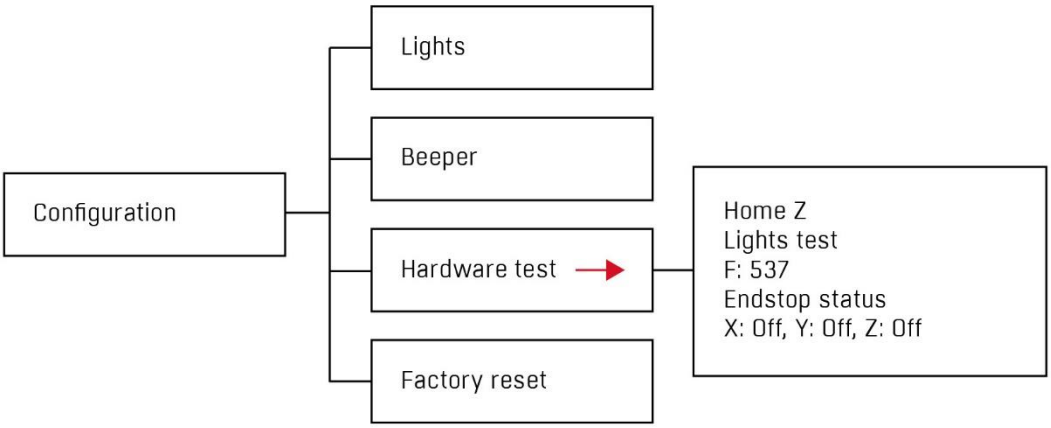


Fig. 25. CONFIGURATION menu

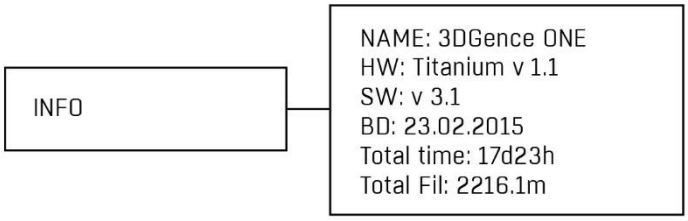


Fig. 26. INFO menu

In active mode, the printer's menu displays different information. A printed model can be instantly modified by changing parameter settings during printing. Instant parameter correction may be necessary when the amount of material fed is too small or the cooling is not effective.

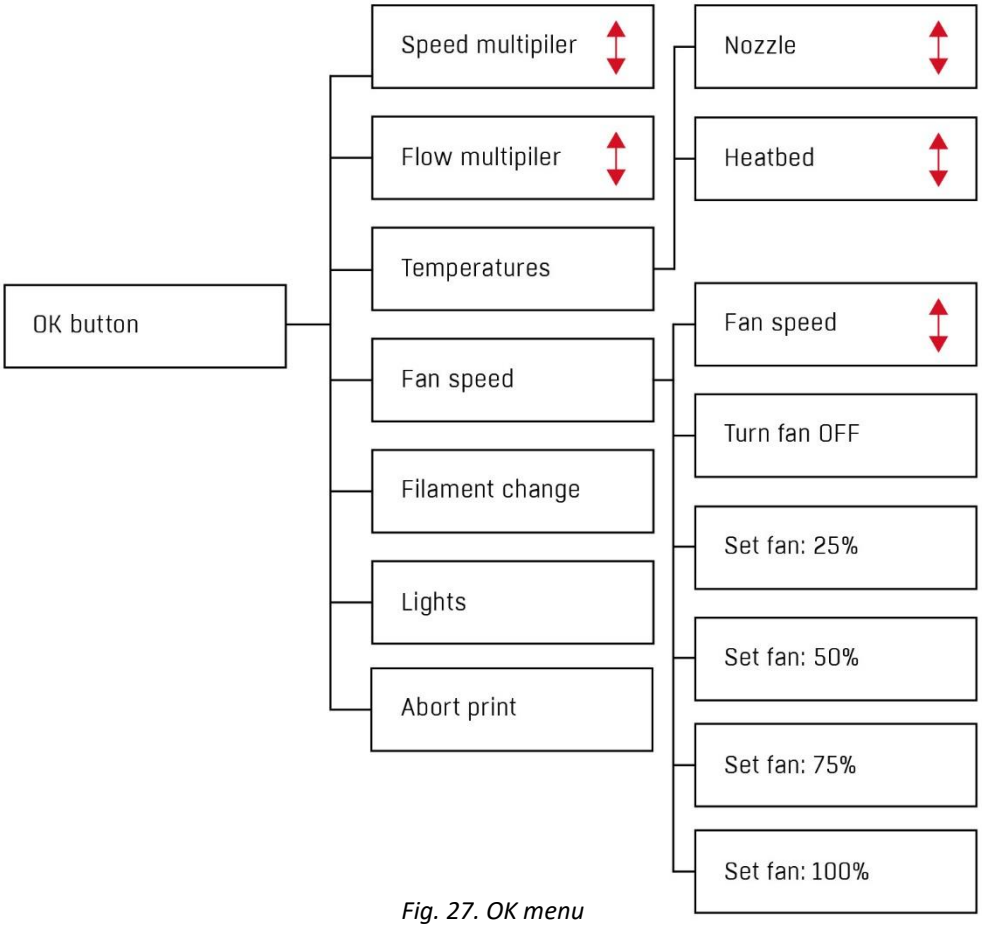


Fig. 27. OK menu

III PREPARATION FOR WORK

1. FIRMWARE UPDATE

The 3DGence ONE printer does not require any additional drivers. The only program required to operate the device is the 3DGence Slicer software that generates a machine code. For more information on 3DGence Slicer refer to the SOFTWARE chapter.
Printer firmware are subject to periodic update. It is important that drivers are always updated to the latest version.
The latest printer driver is available at: www.3dgence.com/support in Firmware category (the Firmware category is available after creating an account and registering the device).

The procedure of firmware update proceeds as follows:

1. Download the firmware file from the website mentioned above (the folder contains the firmware with .hex extension, free Xloader program that allows you to upload the firmware to the printer's controllers, the manual and init.g file).
2. Plug in an USB cable to printer USB port.
3. Plug in an USB cable to computer USB port.
4. Switch on the printer
5. Wait until new hardware installer operation is completed, if it has been started automatically.
6. In Xloader program in Hex file box mark the newly downloaded firmware file.
7. In COM port field, indicate the port assigned to the printer. In order to check Port COM enter: Windows Control Panel -> System and Security -> System -> Device Manager -> Ports (COM and LPT) -> USB Serial Port (Com…).
8. In Device field set the Mega(ATMEGA2560) option. Remaining information should be left unchanged.
9. Press the Upload key. Loading the new firmware may take a few minutes. During the loading process, printer display can show colorful artifacts (graphical noise), this is however completely normal. Update success will be confirmed by an appropriate message displayed on the computer screen: '… bites uploaded'.
10. Now you can remove the USB cable from the printer and turn off the printer.
11. Load the init.g file into memory card and insert it into the SD card slot of the printer.
12. Turn on the printer and wait for the sound signal. It informes that the configuration has been succesfully loaded.

2. CONNECTING AND STARTING PRINTER

1. If the printer is started for the first time follow instructions from „Quickstart" chart included in the package set.
2. Place the device on a flat and stable surface and connect it to the power source with the use of power cable. Power inlet socket is located at the rear of the device (fig. 28).

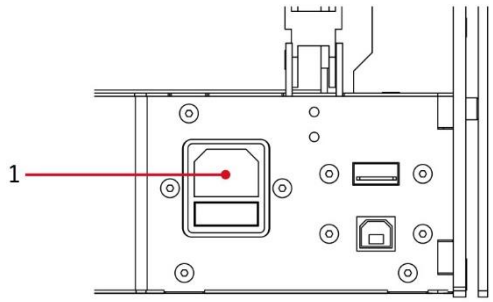


Fig. 28. Location of power inlet socket (1)

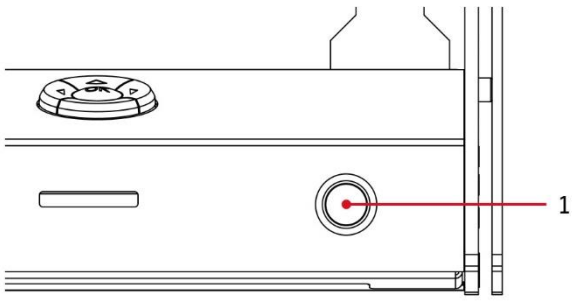


Fig. 29. POWER buton location (1)

3. To start the device press POWER button on the right side of the main panel (fig. 29).
4. After starting the printer, set all axes to their initial positions. To do this, select Home All option from the submenu

Prepare - go to main menu level and press OK button three times. At this point, all axes go to their base position.
5. After that, the unit is ready for further preparatory steps.

3. CALIBRATION OF HEATBED

3.1. Indication for calibration of heatbed

Heatbed calibration is not required each time you run the printer - it should be done approximately once a few dozen to a few hundred hours of printing. Other indications for heatbed calibration are enumerated below.

Heatbed should be calibrated when:

- the printer is started for the first time,
- one or more corners or edges of printed model peels off or does not adhere to the working table,
- one or more corners or edges of printed model are squeezed into the surface of heatbed (the printed layer seems transparent or too thin, printing mechanism skips layers, extruder engine makes a clicking noise or printing material excessively accumulates in transitions between layers),
- table surface was unintentionally lifted,
- too much force was used during removal of the printout, which might have caused heatbed displacement,
- the first printing layer is not even - one edge is printed correctly, whereas the other edge is too flat or does not adhere to the surface of the heatbed.

3.2. Heatbed calibration procedure

1. Check if X and Y axes can move without any obstructions. Make sure if any cables are not frayed or damaged. Check if the toothed belts are not frayed or damaged. Check if Z-axis stopwatch is not damaged, broken or bent, and if it matches Z-axis limit switch (if it aims at the notch of Z axis limit switch).
2. Any filament leftovers should be removed (see „Removing filament”) and the hotend should be cooled down to temperature below 50°C.
3. Remove all dirt and leftover material from the nozzle of hotend and clean the table with a spatula (not required when starting the device for the first time).
4. From the submenu „Prepare” select „Home All” and confirm by pressing „OK” button. At this point, all axes will go to their base position.

WARNING:
Carefully observe the movement of all axes. When Z axis reaches its limit switch, check the distance between the end of hotend and the heatbed. It should be about 0.8 - 1 mm (no more than 1 mm), greater distance may interrupt scanning the heatbed, which is displayed as an error „Heat bed scan aborted!” If the distance between the hotend end and heatbed is more than 1 mm, adjust it manually to 0.8 - 1 mm. To do this, release the screw (1) (fig. 30.) and adjust the distance using the knurled screw (2). Turning the knurled screw clockwise will increase the distance between the table and the head. Counter-clockwise turn will decrease the distance. A single full turn increases or decreases the distance by 0.5 mm. Once you have finished knurled screw adjustment, check the position of the nozzle with the command HOME Z and tighten the screw (1) again.

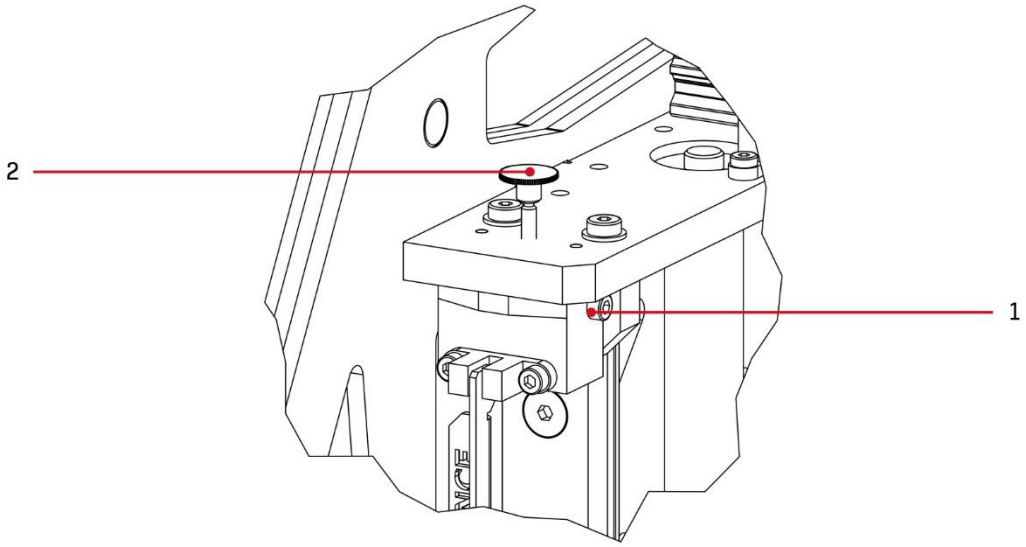


Fig. 30. Hotend height adjustment screws.

5. Select Calibration and Heatbed Scan. At this point, the device starts the heatbed calibration process.
6. During calibration, do not touch the hotend or the extruder – the calibration process can take up to 25 minutes. After the scanning is completed, the display shows information HEATBED SCAN COMPLETED. The printer was calibrated successfully.

WARNING:
During calibration, do not touch the hotend or the extruder. It may disrupt calibration, which is displayed as an error „HEATBED SCAN ABORTED". This message may also appear if the instruction from point 3 was not followed. The calibration process can take up to 25 minutes. In the event of hearing a loud „clicking" sound coming from the engine, or if one of axes did not stop, immediately turn off the device and contact 3DGence technical service department using report problem form on www.3dgence.com/support page.

4. PRINTING MATERIAL APPLICATION PROCEDURE

All further steps require opening and closing the extruder with the use of extruder lever marked red in the fig. 31 below:

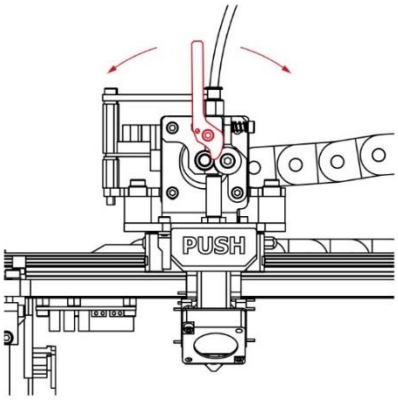


Fig. 31. Extruder lever position.

4.1. Mounting filament

1. Install in the spool holder on the right side of the device (turn counterclockwise) (fig. 32).

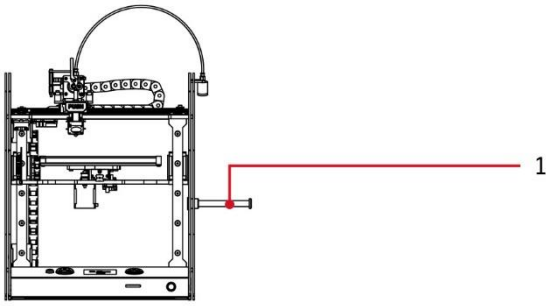


Fig. 32. Location of the spool holder.

NOTE:
The nut on the handle has a left hand thread! For loosening, spin the nut clockwise, for tightening counterclockwise!

2. Unpack the spool with the filament attached to the device.

3. Release the sealed end of the material and cut the ending with scissors or pliers. The ending cannot be crushed or deformed.

4. Place the spool on the handle.

5. Place the filament in the cleaning tool (see fig. 33). Follow the instruction below:

- remove the Bowden (tube) from the cleaner by pressing and holding the clamping ring of pneumatic connector (2) and pull the tube out (1),
- unscrew the cleaner's nut (4) and remove the sponge inlay,
- pass the filament through the hole of the cleaner's nut (4) and pierce the sponge located in the cleaning tool with the tip of filament,
- pass the filament through the sponge (3), insert the filament and the sponge to the cleaning tool and tighten all with the cleaner's nut (4),
- push the filament wire through a tube (Bowden) (1), straighten the end of it and insert it into the cleaner's pneumatic connector (2).

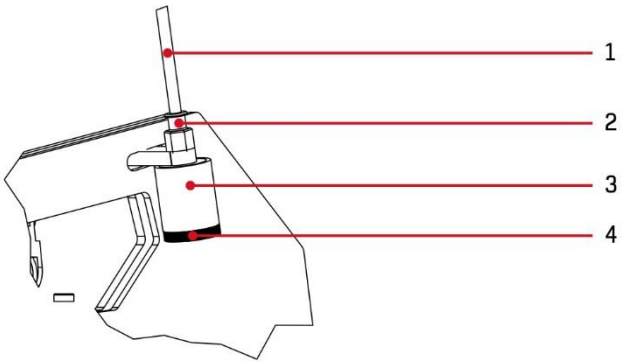


Fig. 33. Constructing of the cleaning tool.

6. Select „Load Filament” in Prepare menu and follow instructions on LCD panel:
The device will heat up the hotend to 240°C and start extruding the printing material. Next:

- open the extruder by moving its lever to the left (counter clockwise),
- straighten the end of filament and insert it to the hotend (min. 5 cm from the inlet of extruder),
- close the filament inside the extruder by moving the lever right (clockwise),
- after the hotend is sufficiently filled with the new material (approx. 5 cm of filament should be pushed through when changing the color of the filament), press „OK” button to stop loading filament;
- remove the material leak from the hotend with the use of tweezers.

7. LCD panel should display information that loading filament was completed successfully. Press “OK” button to confirm.

4.2. Filament removal

To remove filament from the extruder (to replace it or to clean the hotend):
1. Select Unload Filament from Prepare menu and follow instructions on printer’s LCD panel.

WARNING:
The hotend is heated up to 240°C and then the device starts extruding a few millimeters of material. This prevents a possible clogging of the material in the hotend.

- open the extruder by moving the lever to the left (counterclockwise),
- firmly grasp the filament on the hotend, pull it out with one vigorous stroke and press OK button to confirm cleaning the hotend.

Always store the filament in a dry and dark place. The filament may absorb humidity or be deformed when exposed to sunlight. In both cases, the use of such a filament may cause difficulties or faults such as not adhering to the heatbed.

WARNING:
Do not remove the filament from the inside of the hotend without heating the hotend and opening extruder lever! It may damage the hotend. Hotend should not remain heated, regardless of whether it is full of printing material or empty. The hotend can be heated for a long time only in the process of print – material flow.

4.3. Changing filament during printing

The material on the spool may run out before the printout is finished. For quick replacement of filament spool or changing the color of filament (in two color or multicolor prints), use filament change assistant. The current printing will be paused without cancelling printing operation. Printing is restored after confirming and closing filament change assistant.

Before starting printing the system displays the amount of material required to complete a particular printing object.
Make sure that you have enough printing material.

1. Go to the printer’s menu (menu is recalled by pressing „OK” button during printing). Choose “Filament Change” and press ”OK” to confirm. Printing will be paused and all mechanisms will go to their safe points.
2. Open the extruder by moving its lever to the left.
3. Pull out the filament with one vigorous upstroke.
4. Place the new filament spool on the handle and pass its loose end through the cleaner and the tube (Bowden). Straighten the tip of filament. Make an even cut on the tip if necessary
5. Insert at least 5 centimeters of filament wire to the extruder.
6. Close the extruder by moving the lever to the right and press „OK” to confirm.

7. Remove the material leak from the hotend with the use of tweezers. Confirm completing the procedure by pressing “OK” button.

3DGence ONE printer will continue printing with the new material from the point, where the process was stopped for changing filament. It is recommended that the filament should be replaced at the stage of printing the filling (for the purpose of masking the transitions between different materials).

IV FIRST PRINTOUT

1. LAUNCHING SD CARD CODE

First printing can be started under the following conditions:

- location of the device meets all conditions stated in chapter 4.3.,
- the device is properly connected to power supply,
- all axes and limit switches move without any obstructions,
- heatbed is properly calibrated,
- SD memory card is properly inserted,
- filament is mounted properly,
- all readings of the printer are correct.

WARNING:
Starting the first print without meeting the conditions specified in this user manual (chapters DESCRIPTION OF PRINTER, PREPARATION FOR WORK) can result in equipment damage or cause injury to the operator. Always follow instructions for safe operation – even if you are an experienced operator.

Use 3DGence print testing file from the included SD memory card. For more information on file preparation, format of files and method of conversion, see chapter SOFTWARE. The initial print will help determine if the printer is functioning properly.

For making the first printout:
1. Turn on the device with POWER button.
2. Go to main menu by pressing “OK” button. Select the option “Print” using navigation buttons up - down on the right panel. Confirm again by pressing ”OK” button.
3. Select „Print File” and press „OK” to confirm.
4. Now you have access to all G-code files and subfolders on SD card.
G-code files are instructions for the printer – only these files can be used for starting printing.
5. Confirm selection of one of the files by pressing „OK” button.

The printer starts heating the hotend and heatbed. After reaching the exact temperature, the device will measure the parameter of height for the hotend. Do not press the heatbed surface or touch the hotend during the measurement - it may cause interruption or incorrect readings. Next, the device will extrude a sample strap of printing material near the edge of heatbed. This is to ensure that the hotend is properly filled with the material before starting printing.

Depending on the selected file, the printing can take from one to three and a half hours:

- 3D_keychain – 1 hour,
- calibration XY – 1 hour 45 minutes (printing calibration solid – see chapter „Calibration of axes”),
- phonestand – 3 hours 30 minutes.

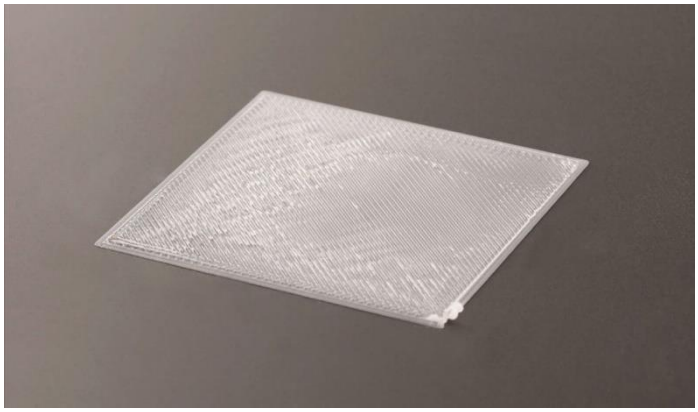
After the completion of printing the hotend returns to a safe position and the printout is cooled. Wait until progress bar for cooling reaches 100%. When the printout is cooled, you can safely remove it from the heatbed. For more information see chapter „Post-printing operations”.
For starting any next printing, the device must be cooled down. All printing leftovers and material contaminations (pieces of plastic, lumps in the hotend) must be removed.

2. EVALUATION OF OPERATIONAL QUALITY OF PRINTER

After the first printout, the printer operation quality can be preliminarily assessed. Pay attention to the following elements:

1. shape of model base (elephant foot),
2. seam,
3. general geometry,
4. quality of side walls and top wall.

Another factor to be considered is the heatbed position when printing the first layer. Examples with descriptions are shown in figures 34, 35, 36.

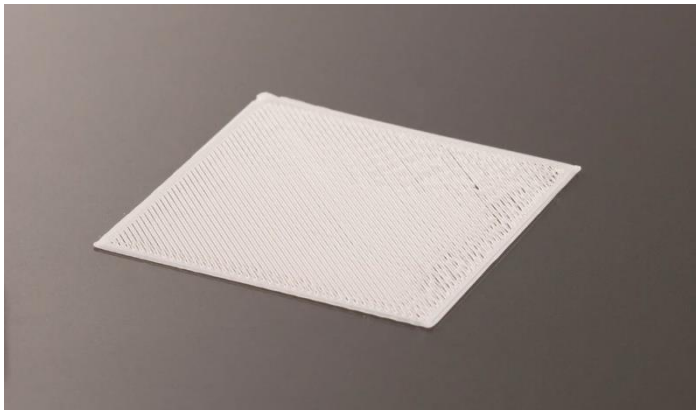


Too high position of the heatbed
The distance between the heatbed and the nozzle is too small. The material is pushed outside the nozzle when printing the first layer. This leads to deformation of the printed model base. This indicates that the heatbed recalibration is required. The distance between the nozzle and the heatbed can be adjusted also during printing. To do this, lower the heatbed using down arrow on the left panel (one click moves the heatbed by 0.025mm along Z axis).

Fig. 34 Example of too high setting of the heatbed

The heatbed in proper position
The material is laid regularly. The entire surface of the model base is covered with material and the upper surface of the first layer is a regular, flat and solid surface.

Fig. 35 Example of the correct setting of the heatbed



Too low position of the heatbed

The distance between the heatbed and the nozzle is too large. Consequently, the adhesion of material to the heatbed is weak and there is a threat that the model may get unstuck during printing. This indicates that the heatbed recalibration is required. The distance between the nozzle and the heatbed can be adjusted also during printing. To do this, rise the heatbed by using the up arrow on the left panel (one click moves the heatbed by 0.025 mm along Z axis).

Fig. 36 Example of too low setting of the heatbed

V SOFTWARE

1. INTRODUCTION

The dedicated 3DGence Slicer software containing the ready-made print settings for dedicated materials has been prepared for 3DGence printers. The software is used for preparing machine codes - .gcode - from files describing spatial geometry in STL format. The manufacturer ensures full support concerning the use of the prepared printing profiles in the software and recommended printing materials. The option for changing the print settings is available for advanced users. Due to the character of parameter modifications, the manufacturer does not guarantee the quality and repeatability of printouts prepared in this way.

1.1. Quality guarantee

The manufacturer guarantees the highest possible quality of models printed using dedicated software and materials. However, if you find imperfections in the printed model or errors while using the software, please contact us using the problem notification form at www.3dgence.com/support and attach a photo and description of the defect and, if possible, .gcode and .stl files (the notification form is available after creating an account and registering the device). Each model sent in this way to the manufacturer will be assessed and/or printed at the manufacturer's premises. The manufacturer will suggest how to solve the problem - by advising, starting service actions (if necessary), preparing the .gcode executable file or updating the printout profiles.

2. INSTALLATION

The software together with the user manual should be downloaded from the manufacturer's website: www.3dgence.com/support. The recommended system requirements to run the program are as follows:

- Windows 7 or higher,
- screen resolution: 1920×1080 pixels,
- 4 GB of RAM,
- Intel Core i3 dual core processor or a newer one.

It is possible to run the software on hardware that does not meet these requirements, however, the comfort of work and the speed of processing of the models may deteriorate. The manufacturer does not provide support for equipment that does not meet the system requirements, especially older versions of operating systems.

At the first start of the program, the user will be asked for permission to automatically update the printing profiles. We recommend that this option should be enabled to get the best possible model quality. This option can be enabled or disabled at any time. Updates take place every time the program is started. The profiles can also be updated manually.

VI POST PRINTING OPERATIONS

1. REMOVING THE PRINTOUT FROM THE DEVICE

The cooling sequence starts immediately after finishing the printing process. The heatbed of the printer remains highlighted in red until the temperature is safe for removing the printout from the heatbed. Except the color of highlighting while the device cools down, information on cooling progress is displayed on the printer's panel. When the temperature of printer is safe, the device lighting turns green and the panel displays message Remove Model.

Always wear protective gloves when removing the printed object from the heatbed!

NOTE: The cooling sequence can be skipped after finishing printing. To do this select, the option Skip Cooling from the printer's menu. However, only experienced operators are allowed to use this option. To prevent accidental burns, make sure that the hotend is cooled down and withdrawn to zero position of X-axis (maximum left).

To remove the printout from the heatbed, use the attached spatula to gently pry the object up from several sides. Never use sharp corners of spatula – use only the flat edge of the tool (fig. 34). Never remove the printout by force, as this may damage the heatbed. In case of problems with separating the printout from the heatbed, it is recommended to reheat the heatbed and cool it down again. Reheating the heatbed can be repeated several times and may prove necessary for solids with large surface base, the base of printout should be constantly pried up with a spatula when the device is cooled.

Fig. 37. Printout removal procedure.

WARNING:
Do not touch the heatbed surface with bare hands! Any undesired substance spread on the surface of heatbed may affect its adhesive/adherent properties necessary for the correct printing process. Always use CLEAN protective gloves to ensure that printed objects shall properly adhere to the heatbed.

2. CLEANING

2.1. Cleaning the hotend

Cleaning the hotend is recommended each time after finishing printing for the purpose of removing any remains of molten/burned material stuck to the outer surface of the nozzle (Figure 11, element 26).

For this purpose:

1. Set the heatbed to a position that allows good access to the hotend with the option: Prepare → Park Heatbed → Bottom.
2. Warm up the hotend with the option: Preheat PLA/Preheat ABS- depending on the material used in the hotend. Heatbed also heats up within this option.
3. Wear protective gloves.
4. Gently remove any molten/burnt material from the nozzle with non-combustible material or tweezers.

After cleaning the hotends, turn off the heating (to do this, use e.g. Cooldown function from printer's menu).

2.2. Cleaning heatbed

A dirty or greasy surface of heatbed can seriously impair or make impossible the printing process. It is recommended to clean the heatbed before each new printing.
The heatbed should be cleaned according to the instruction below:.

1. Set the heatbed to a position that makes it possible to clean it with the option: Prepare → Park Heatbed → Middle or Bottom.
2. Switch off all heating elements of the printer. Allow to cool completely and reach the ambient temperature. Use "Cooldown" option from the menu.
3. Turn the printer off by pressing the power button and unplug the printer from the power source.
4. Wear protective gloves.
5. Clean the heatbed surface of any plastic residue with a spatula.
6. Clean the heatbed with a damp cloth and then wipe dry with a paper towel.
7. Degrease the heatbed with a cloth soaked in ethyl alcohol or isopropyl alcohol and wait for the alcohol to evaporate.

3. SWITCHING THE PRINTER OFF

To turn off the printer, press POWER button on the right side of the front main panel of the printer (fig. 35).

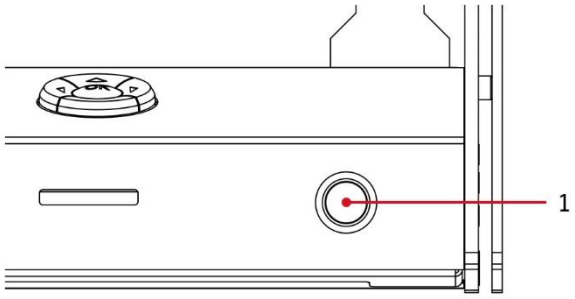


Fig. 38. Location of POWER (1).

After switching off the device the filament should be protected against humidity, dust and other soilings. When not using the printer for a long of time it is recommended to secure all axis guides and ball screws against dust and other soiling.

When the device is switched off:

- never leave the printer in a humid room,
- never leave the printer in a dusty room,
- never place the printer on high shelves,
- never place the printer in a cardboard box, bag or closet before the device heaters are completely cooled down,
- place the printer out of reach of children,
- protect the filament and the device against humidity, dust and other soiling,
- when storing, disconnect power cable from the device.

WARNING:
never turn off 3DGence ONE printer by pulling the power cable from the socket. This can damage the device.

VII HOTEND REPLACEMENT

3DGence ONE printer is equipped with a quick, patented system of hotend replacement - Push-System. It enables high-speed printing with the use of large diameter nozzle or high precision printing requiring nozzles with smaller diameter. As a standard, the printer is equipped with the nozzle with 0.4 mm diameter. Other nozzles available for the printer have the diameter of 0.5 and 0.3 mm.

To replace the hotend:

1. Complete the full procedure for filament removal. Hotend must be clean (see p. Removing filament).
2. Got to Prepare menu, select Hotend Change and follow the instructions on printer's LCD panel:

a) wait until the hotend cools down.

b) turn the printer off using power button.

3. Wear protective gloves.
4. Move the hotend along X axis to the maximum left to immobilize it for the time of replacement. Fully press down and hold the red PUSH button (fig. 36). Slide the hotend out with the other hand. Pay special attention not to drop the hotend on the heatbed.

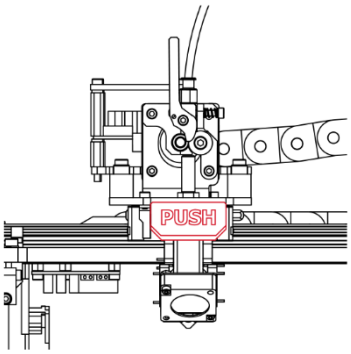


Fig. 39. Location of PUSH button.

5. At the exact place of the old one, insert the new, clean hotend. The cavity marked on the drawing must face your direction (towards the front of the printer) (fig. 37). The PUSH key must remain pressed - otherwise the hotend can be inserted incorrectly.

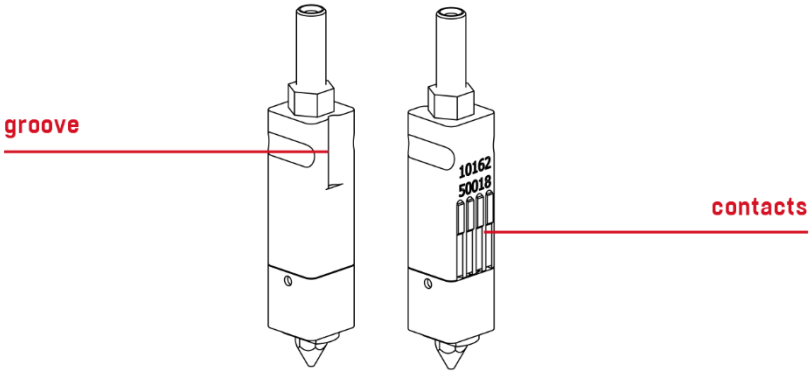


Fig. 40. Location of the cavity.

NOTE:
Pay special attention while mounting hotend. To avoid bending contact pins, hold the hotend in an upright position. In the event of damaging contact pins or incorrect insertion of hotend, the switched on printer displays an error message „def (see - ADD)" in temperature parameters window.

6. When the hotend is properly mounted in the blocking mechanism, release PUSH button to lock it.
7. Hotend replacement is finished. Press POWER button to run the printer. Always remember to define the nozzle type in the program.

VIII CALIBRATION OF AXES

3DGence ONE printer has a unique system for precise adjustment of size parameters of the printed object. The printer is pre-calibrated for 3DGence PLA material with an accuracy of 0.1 mm. Printing with the use of materials with different thermal contraction may require size correction of a printed object. For most printers, such correction can be very difficult or even impossible. With its innovative system, 3DGence ONE allows quick, easy and accurate size correction. The new system performs only one printout calibration session and a simple measurement to acquire the accuracy of 0.02 mm.

NOTE: Each type of material used as filament has its own thermal contraction. To maximize the precision of the results, the calibration should be made for the exact material that is to be used for printing.

To be able to start the precise calibration of the XY axis, it will be necessary to print a special block (fig. 41). The Dimmension_Calibration.stl model is on the www.3dgence / support website in the files tab (the tab is available after creating an account and registering the device). The model should be prepared for printing in the 3DGence Slicer software for the selected material. The printout will take approximately 45 minutes.

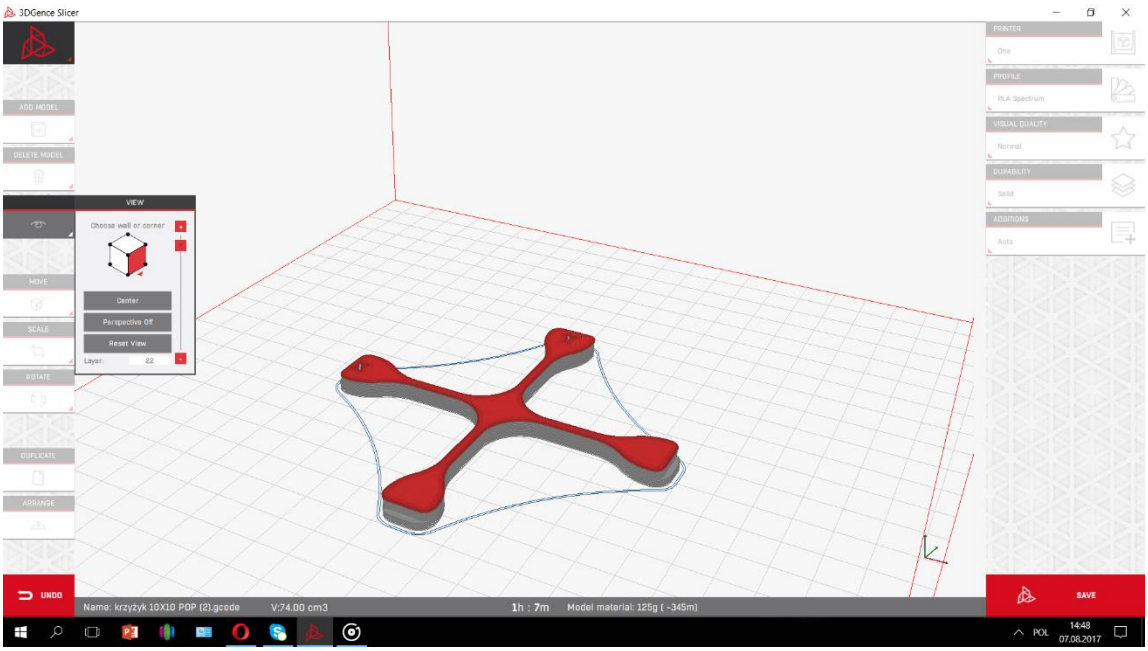


Fig. 41 Visualization of the Dimmension_Calibration.stl model

After printing, cooling and careful removal of calibration object (the cross), take measures of X and Y axes of the printed model. Several measuring tools can be used, provided that their accuracy cannot be worse than 0.05mm:

- caliper,
- micrometer,
- coordinate-measuring machine,
- optical devices.

The printout should be measured along X and Y axis. For reliable measurement, use the following guidelines:

- the measuring point should be in the middle of the height of the printed object, both points at the height of the same layer,
- repeat the measurement for X and Y axis 5 times. Discard the highest and lowest results from each group. Average the results for both axes:

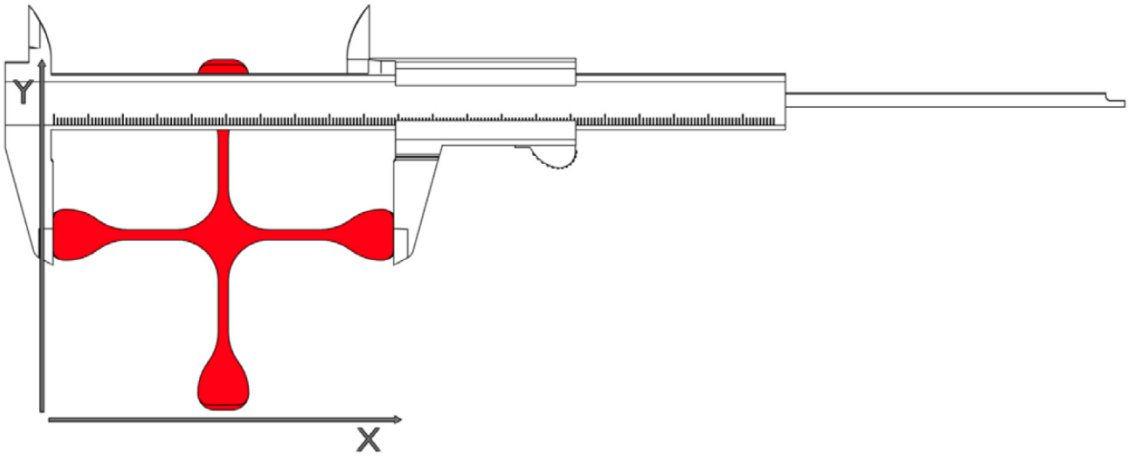


Fig. 42 Visualization of the measurement

MEASUREMENT:	X:	Y:
	100,08	100,07
	100,06	100,06
	100,05	100,08
	100,04	100,06
	100,05	100,05
AVERAGE:	100,05	100,06

Fig. 43 Table of measurements for the X axis and the Y axis

The result of this formula will be the basis for further operations:

1. Go to Calibration menu and select XY Calibration. Confirm selection by pressing OK button.
2. Use up and down buttons from the right panel to select Print X value and press OK. Use up and down buttons to introduce the value obtained from X axis measurements.
3. Use up and down buttons from the right panel to select Print Y value and press OK. Use up and down buttons to introduce the value obtained from Y axis measurements.
4. After entering all values, confirm changes by selecting „CALCULATE & SAVE". The algorithm will calculate printing parameters according to the measurements made.

Additionally, to verify the correct axis calibration, you can print the Dimmension_Calibration.stl model downloaded from the website and perform the measurement. Thanks to this procedure, the next printout from the material for which the calibration was performed will be printed with compensation of material shrinkage in the X and Y axes.

IX ADDITIONAL INFORMATION

1. AUTOCOMPENSATION

Each device undergoes manufacturer's default scan of the heatbed. For ensuring optimal printing quality, it is recommended to repeat the scan procedure every several hundred working hours of the printer. It is also recommended to repeat the scan procedure in case of adhesion problems or uneven application of material while printing first layers.

3DGence ONE printer is equipped with advanced algorithms for autocalibration and autocompensation of the heatbed. Scanning the heatbed is required for proper autocompensation of printing process.
Autocalibration of heatbed is based on measurements of extruder's pressure sensor examining the surface of heatbed in approx. 300 points. Based on the obtained measures, the program creates a virtual map of heatbed curvature, which is the basis for autocalibration and autocompensation of printing process (fig. 38). Table curvature map is stored in the printer's memory and can be changed only after the next scanning of the heatbed.

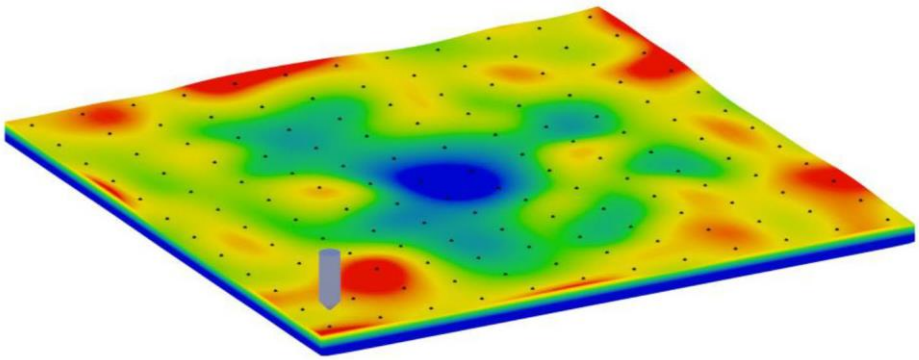


Fig. 44. Virtual map of heatbed curvature.

Autocompensation of the heatbed consists of single point measurement of the distance to heatbed and setting the correct distance for starting printing operation. Autocompensation process is performed each time before printing. After setting the correct height over the chosen single point, the printing operation is performed pursuant to table curvature coordinates (curvature map) stored in printer's memory for the purpose of real time adjustment of nozzle height in Z axis to maintain the exact same height of the nozzle over any chosen point on the surface of heatbed.

Autocompensation settings can be changed from „Calibration" menu by selecting „Autocomp. settings"(Fig.45).

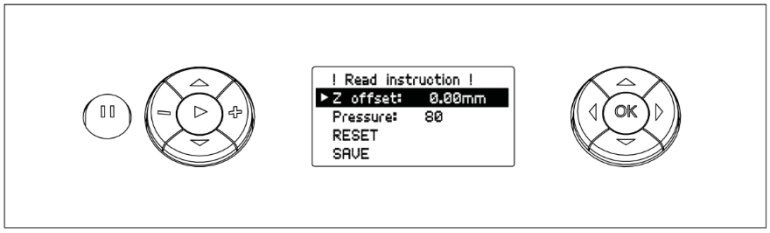


Fig. 45 Menu Autocomp. Settings

Z offset: manual correction of Z-axis measurement allows adding (or subtracting) a given value to Z axis single point measure (autocompensation). If Z offset is set to 0.1mm, the initial height of printing will be lifted by this value:
height of the first layer 0.2 mm + Z-offset: 0.1 mm = actual printing height: 0.3 mm.
This option can be useful when using adhesive tapes or pads. In such a case, Z-offset should be set to correspond to the thickness of the applied tape or pad. This parameter can be also set to negative values and as a result, the starting point for the printout will be placed at a lower height (closer to the table).

NOTE:
Negative values of Z offset should never exceed the thickness of first printing layer!

Pressure: sensitivity of autocompensation measurement on Z-axis allows determining the value of contact force for hotend measuring the height between the hotend and the heatbed. Measurement sensitivity can be adjusted in the range between 20 (0.5g) and 120 (4g). When using materials with higher fluidity, it may be necessary to increase the contact force to reduce the risk of incorrect measurement caused by leaning of the hotend against the extruding material.
When starting the print, these incorrect readings may cause lifting up of the hotend as a result of adding the thickness of material leaking under the hotend (holding the head up) in the process of height calculation.

An additional parameter related to auto-compensation is the place of measurement. This setting can be changed in MENU → Calibration → Probe position (Fig. 46).

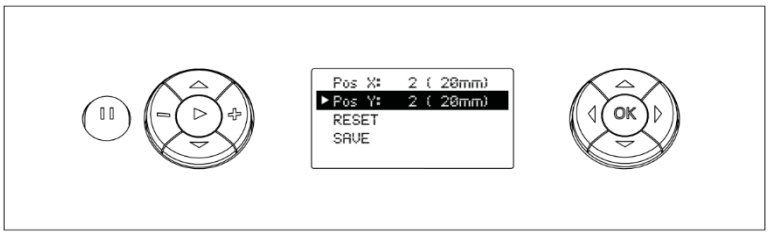


Fig. 46 Menu Probe position

By editing values in Pos X and Pos Y, the point of autocompensation can be changed - respectively for X and Y axes of the printer.

X DICTIONARY

ABS (poly acrylonitrile butadiene styrene) – apart from PLA one of the main materials for 3D printers. Features a high impact strength, hardness and resistance to scratching. It is not resistant to UV radiation. Soluble in acetone, which allows for post-processing of prints by using the acetone vaporizing method. ABS prints can also be glued together with ABS solved in acetone. ABS features a fairly significant thermal shrinkage (up to 0.7%). The typical operating temperature for ABS is 220 to 250 degrees Celsius and about 100 degrees for the bed. The heated working space is necessary to maintain dimensional compatibility for printed items.

Adhesion – in the 3D print context it means the adhesion to the device bed. Insufficient print adhesion can result in partial or complete tear of the print from the table during printer operation. The ceramic table of the 3DGence ONE provides a good adhesion for the certified materials, however for hard to print plastics there is a lot of commercial solutions available for improving adhesion of the print to the bed. Grease or soiling on the table has a negative impact on adhesion.

Autocalibration – a printer capacity to perform an automated bed calibration. This process is designed to generate curve and irregularity maps for the working table and by introducing dynamic corrections it provides a constant height of the nozzle over the bed. It usually takes from a few to several dozen minutes, and necessary user operations are reduced to starting the process by using an appropriate command.

Autocompensation – consists in a single-point measurement of the distance to bed and determining a correct distance to start a job. This process takes place each time before printing. After setting a correct height over a single point, further part of the print will be performed by taking into account the table curve pattern stored in the printer memory – thanks to this, the distance between the nozzle and working table is always the same and corrected in Z axis on a continuous basis.

Bridge – a part of model printed in the air, suspended between two parts of the print. It is subject to special calculations while preparing the file for printing, If the bridge is too long, it may be subject to deformation. In such cases this component should be supported with support structures.

Brim – one of the methods of improving print adhesion to the bed. It consists in increasing the adhesion surface to the bed by generating additional, external brims of the solid at the level of the first layer of the print. The more brim lines will be added, the larger will be the adhesion surface. Typically, from 5 to 20 brim lines are used. The brim should be used, in case of problems with detaching prints from the bed.

CAD (Computer Aided Design) – collective term for various computer aided design processes. The CAD methodology is used in mechanical, electrical, medical and architectural engineering. The base for CAD methodology is geometrical modeling aimed at creating two or three-dimensional representation of the planned component. There are various CAD software packages available, adjusted to users' needs and requirements. From those programs models in STL or OBJ formats are exported for use in 3D printing. The most popular CAD packages include: SolidWorks, Inventor, PTC Creo, CATIA, Rhino, SolidEdge – however there many others.

Curling – a negative phenomenon that occurs during 3D print using FFF technique. Curling can be observed while printing overhangs or sharp edges between faces of a solid. It manifests as curling of the print edges upwards. In extreme situations it may lead to print failure, and always have a negative impact on visual effect, especially at the bottom parts of the print. It leads also to collisions of the printing head with the print during operation. The basis method of fighting against curling is the active print cooling. If turning on the fans does not help, it is good to lower the speed of printing.

Slicing – the process aimed at generating paths and instructions for the printer (machine code, G code) from a 3D model. At the level of slicer we can choose such settings as layer thickness, print speed, filling density, thickness of solid walls or nozzle and printing bed temperature. In addition, it is also possible to select the use and the density of supports and one of the few ways of improving the print adhesion to the bed (e.g. raft or brim). The 3DGence ONE printer uses the 3DGence Slicer program with predefined settings from various materials and resolutions. The final effect of slicer operation results in obtaining a machine code representing a specific 3D model in the form of G code (g-code, *.GCODE) that is subject to interpretation by the printer electronics.

Nozzle – a head component coming into direct contact with the print. The nozzle heated to temperature specific for a material makes it flow and forms a thread of plastic with a rated nozzle diameter. The 3DGence ONE printer as standard is equipped with a 0.4 mm nozzle. The nozzle outlet diameter affects the available resolutions, print speed and accuracy.

Extruder – a part of the 3D printer working in the FFF technology. It is designed to feed the filament at a strictly defined rate, and consequently – quantity. The 3DGence ONE printer is fitted with a Bowden type extruder. It means that extruder motors are located beyond the moving printer parts, leading material to the head via the PTFE tubing. It makes the design lighter and has a positive impact on the print quality.

Endstop – an optoelectronic switch that limits a 3D printer movement beyond the maximum range. The device is fitted with 3 optical endstops – one for each axis. The optical endstop does not require any physical contact with the corresponding interrupter, which provides its long life, however one should notice that it is sensitive to the sources of bright light which may result in triggering its false operation.

Filament – popular description for material used to print in fused deposition modeling (FFF) technology. The filament is a thermoplastic wire (PLA, ABS, PVA, HIPS, PC, Nylon or other) generated with specific tolerances The filament is wound on a spool. The relevant parameters when selecting a filament include: dimensional tolerance and the method for protection against moisture (optimally the filament should be vacuum packed with a moisture absorber.) A high diameter of the spool hub provides an opportunity to use its entire length – an excessive bending of the filament (e.g. on a small spool hub) can cause problems with its application. The filament after opening the package should be stored in a dark, dry place with a moisture absorber.

G-Code – is a normalized programming language adjusted to control CAM machines. In simple words, the G code string includes machine instructions – in what direction, how fast and along which axis to move. The code for printers is generated by slicing software (slicers). It stores all the data on subassembly temperatures and the revs of motors in a precision sequence that results in moving the head and defines the extruder behavior. The code commands are sent line by line to the printer controller processor during the printing process. The processor interprets the code based on its software and sends specific signals to particular components.

Skipping steps – under abnormal motor and controller operating conditions (e.g. too high temperature, mechanical resistance) the motor can skip operation steps. This can be noticed after moving the printing plane in the axis in which the motor skipped steps. The visual effects of this failure depend on the path the head moves along in relation to the table. To make it better imaginable let's assume that the print is a cube and the printer skipped steps in the middle of the print. The printed solid would look as if it was cut in two in XY plane and glued with a certain displacement.

HIPS (High-Impact Polystyrene) – a styrene polymer. It is used mainly in 3D printing as a material for printing support structures for ABS plastic. It is soluble in d – limonene It features a high impact resistance and a low flexibility.

Normal – a colloquial term used in 3D modeling to name a vector normal to a plane. The normal vector is a vector perpendicular to a plane or in the case of other planes perpendicular to the plane, tangential to the surface in a specific point. In 3D modeling

its orientation defines the solid interior and exterior In a majority of cases it is assumed that a correct normal is oriented outwards the solid.

Nylon – a group of polyamide materials developed by DuPont company. Currently, these are used also for producing resistant filaments for 3D prints. Its main advantage includes its high mechanical and chemical strength, possibility of further processing and coloring with textile dyes. Prints feature also some flexibility and resistance to rupture.

OBJ – a popular format of 3D files. It may contain an additional MTL (Material Template Library) file irrelevant for FFF print, containing information on material libraries defined for the model. OBJ files apart from the geometry description, apex layout and normal orientations includes information on UV coordinates for textures. It is read by the 3DGence Slicer program.

PLA (polylactide – a lactic acid polymer) – produced in industrial quantities with use of eco-friendly methods. The main sources for initial materials include grains, e.g. cornflour or bacterial cultures. This is a basic material for FFF technology 3D printing. Low costs, no thermal shrinkage, good adhesion to the bed and multiple filler and color variants make the PLA the most versatile and most commonly used filament. During printing it gives off a weak, neutral odor, does not emit harmful substances and is fully biodegradable. It is more fragile and susceptible to mechanical damage than ABS, that's why its use to manufacture the prototypes of mechanical devices is limited.

Overhang – a shape of the part of a model with special significance from the point of FFF printing. An overhang can be found where a model plane forms an overhang over the working table or other model part. The 3DGence Slicer software identifies those areas and analyzes the overhang angle in relation to the working table. If the angle exceeds the value of limit angle predefined in the software, the 3DGence Slicer program automatically generates support structures for such a surface.

PVA (polivinyl alcohol) – a water soluble vinyl alcohol polymer. It is used to produce water-soluble filaments, perfectly suitable for printing support structures in dual-material printing. The model itself is printed with an insoluble plastic (the most commonly with PLA), which allows for its accurate cleaning in water bath. Using an ultrasound washer results in significant acceleration of the process.

Raft – one of the methods of enhancing print adhesion to the working table. The raft is the base (bed) with a thickness of a few alternately applied layers that is generated by the slicer under the model. The raft is larger than model outline, which increases print adhesion to the table and prevents from thermal shrinkage effects (plastic to plastic connection). Another advantage of the raft is its capacity to smooth minor uneven areas of the working table. The raft makes it also easier to print models without a flat surface that could make a base. Brim, as previously described, and the raft should not be used simultaneously.

Stepper motor – is an electric motor that can move in steps by a specific angle. This is made possible by a special setting of electric A and B electromagnets grouped around a metal gear linked with the motor shaft. Stepper motors make up the main drive of the 3DGence ONE printer because of their high precision of position control.

Skirt – additional material printed around the model at a distance of a few millimeters from it at the very beginning of the print. The Skirt does not make an integral part of a model. Its function is to initialize and stabilize the flow of plastics through the head. By observing the way the printer lays skirt on the table we can assess if the table is correctly leveled and if the print adheres to it.

Support – is a support added by a model designer or a slicing software (3DGence Slicer) in order to form a supporting frame for the parts of the model suspended in the air. A correctly made support is not a part of a model and can be easily removed once the print is completed. 3DGence Slicer automatically generates supports, providing the user with an opportunity to add or subtract supports at user's own discretion. The support generated by 3DGence Slicer consists of two parts – a loose laid material and the so-called dense support layers, directly supporting the model itself.

STL (Surface Tessellation Language) – one of the basic formats of 3D files. It describes only the layout of triangle apexes that make up the solid and the orientation of normal for those triangles. It does not include any information on color, materials, textures or other graphical elements being part of other more extensive 3D file formats. Originally implemented by 3D Systems company for the use of stereographic printing.

Knurl – is an extruder part, driven by a stepper motor. It makes it possible to accurately feed the plastic wire to the printer nozzle thanks to its concave, “toothed/knurled” recess that “bites” into the plastic wire. An element that strictly cooperates with the knurl is the clamp providing a correct contact between the knurl and the filament..

Warping – a negative phenomenon that occurs in FFF prints affecting mainly the materials with a high thermal shrinkage. It consists in tearing the most external print elements, most commonly the corners, from the printing bed. It is prevented by using a heated table and working chamber of the device.

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