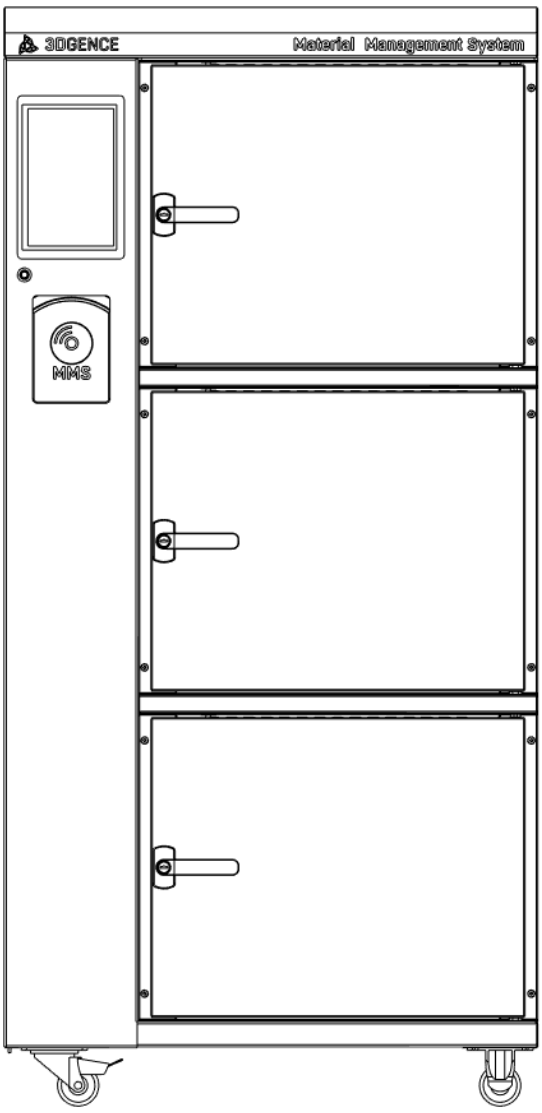
INSTRUCTION MANUAL

Original instruction

3DGence Material Management System



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DECLARATION OF LIABILITY

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I PREFACE

1. INTRODUCTION

Thank you for choosing the 3DGence Material Management System device [MMS]. The following manual will guide you through the correct preparation of materials for the printing process, guaranteeing the highest quality of printed items and allowing for repetitive and safe operation of the device over a long period of time.

This manual contains the information necessary for the correct and safe use of the device. Before starting to work, it is necessary to carefully read the entire contents of the manual below.

The MMS must not be used by anyone who has not read the manual. Improper use may damage the device, cause injury or even endanger the life of the operator.

By starting to use the 3DGence Material Management System device, you are agreeing with the full content of the user manual, you are agreeing with the guidelines contained therein and the warranty conditions available on the manufacturer's website: www.3dgence.com.

Caution must be exercised when using the device due to residual risks that exist despite the inherent safety design, safety measures and additional protective measures. Attention must be paid to markings and messages informing about hazards, i.e. stickers on mechanical parts of the device, messages on the LCD display and warning sound signals. Their meaning is described in this manual.

2. TECHNICAL SPECIFICATIONS OF THE DEVICE

The 3DGence Material Management System is an industrial device designed to:

- Store reels of printing materials.
- Carry out the process of preparing spools of material for printing.
- Carry out the recrystallisation process of printed components.

The device uses a hybrid system of hot air and industrial desiccant. The drying and recrystallisation parameters for the printed elements, developed by the 3DGence team, were prepared based on industry standards for acceptable wet weight content in the material. The technical specification of the device is shown in table 1.

Table 1 Technical specifications of the 3DGence Material Management System

DIMENSIONS AND WEIGHT	
Device dimensions (W x D x H)	- 3 chambers: 850 mm x 630 mm x 1740 mm - 6 chambers: 1560 mm x 630 mm x 1740 mm
Max. device dimensions with door open (W x D x H)	- 3 chambers: 850 mm x 1090 mm x 1740 mm - 6 chambers: 1560 mm x 1090 mm x 1740 mm
Device packaging (W x D x H)	- UE each module: 950 mm x 820 mm x 1950 mm - US each module: 1000 mm x 1200 mm x 1950 mm
Weight of the device without packaging	- 3 chambers: 190 kg - 6 chambers: 170 kg
Weight of the device with packaging	- 3 chambers: 235 kg - 6 chambers: 215 kg
ENVIRONMENT	
Operating temperature	10 – 28°C relative humidity between 30% and 60% without condensation
Storage temperature	-20 – 54°C relative humidity between 10% and 85% without condensation
POWER SUPPLY	
Required connection in European conditions	- 3 chambers: Plug 1ph 16A CEE 7/7 - 6 chambers: Plug 3ph 32A CEE 17
Required connection in US conditions	- 3 chambers: Plug NEMA L6 20A

	- 6 chambers: 2x Plug NEMA L6 20A
Length of power supply cable	2200 mm
Voltage	- 3 chambers: 230V AC (210-250V AC) - 6 chambers: 2x 230V AC (210-250V AC)
Frequency	50-60 Hz
Maximum power consumption of the device without additional accessories	- 3 chambers: 3680 W - 6 chambers: 7300 W
TEMPERATURES	
Operating temperature range	50°C - 200°C
CONNECTIVITY	
Communication	Wi-Fi, LAN, USB
TECHNOLOGY	
Working technology	Dry air (actively dried)
Device chamber space (W x D x H)	470 mm x 260 mm x 320 mm
Volume of chamber of the device	39.1 L
Number of places for materials in one chamber	4 (unlimited with CUSTOM option)
Number of chambers in the device	Depending on version (3 or 6 chambers)
Maximum diameter of the filament spool	220 mm
Maximum spool thickness	90 mm
Material tracking system	Smart Material Manager
Third-party materials	Yes, in the CUSTOM option
Process settings for material preparation	Preset / Edit in CUSTOM option
Recrystallisation process settings	Pre-defined
SOFTWARE	
Device monitoring and archive	Locally and in the 3DGence CLOUD
Software updates	Automatic, via USB
STRUCTURE	
Structure	Freestanding, equipped with castors
Frame	Steel
Door	Sealed / thermally insulated with active ventilation
Electronics	Original 3DGence
NFC TAG reader	Yes, on the front of the device
Display	10'' TFT capacitive with 1280 x 768 px resolution
SECURITY	
Door	Mechanical lock with key, door opening sensor
CERTIFICATION	
Compliance with standards	CE, FCC, IC
ACCESSORIES	
Recrystallisation set for prints	
Desiccant cartridges (one for each chamber)	
Drawers for storing materials in the device chamber (one for each chamber)	
Wi-Fi adapter	
Power adapter 1x 3ph 400V 32A / 3x 1ph 230V 32A (for connecting additional 3 chambers)	

3. DEVICE IDENTIFICATION

The MMS device can be identified by its serial number which can be found on the nameplate located on the rear cover of the device. You can also check the serial number on the printer display. By submitting a request via the 3DGence CLOUD platform, 3DGence technical support department will automatically receive the serial number of your device in your request. The serial number starts with a symbol: S/N MMS1 which should be specified when contacting 3DGence technical support.

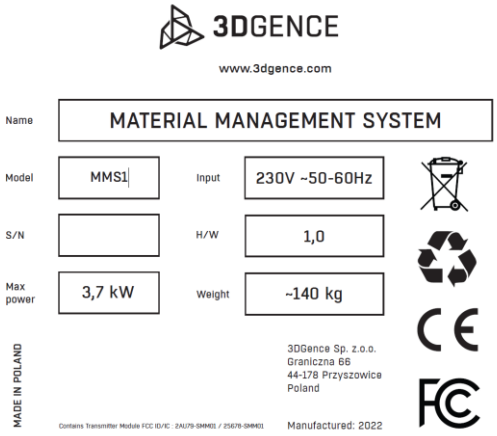

Fig. 1 Nameplate of the device

4. THE IMPORTANCE OF THE MATERIAL DRYING PROCESS FOR THE PRINTING PROCESS

Undesirable degradation processes occurring in plastics processing are well known and preventive steps are clearly defined in the technical data sheets of the base resins. One type of thermoplastic degradation is degradation by hydrolysis - the separation of a polymer chain caused by water molecules adhering to the chain. During printing, by heating the filament in the head to a high temperature, water is removed from its volume. Excess water during the printing process can cause a number of visual defects (air bubbles, cracking of elements, colour change) and a decrease in the strength properties of the print.

For 3D printing, the most important preparatory step for the printing process is to provide a build material with an optimal, low water content. In conventional plastics processing (e.g. injection), the permissible water content in the material does not exceed 0.5% of the weight of the material, and in most cases this value is below 0.08%.

A number of material conditioning methods are used to ensure a material with the correct water content. One of these is dry air drying which is able to dry the material down to as little as 0.01%. The 3DGence Material Management System uses a similar dry process air delivery technology. The air passing through the desiccant cartridge provides optimum conditions for effective material preparation, eliminating the potential risk of the print defects described above.

II INSTALLATION CONDITIONS

1. SECURITY MEASURES

The following information describes the correct operating conditions for the 3DGence Material Management System device. Failure to observe the indications and counter-indications may considerably shorten the life of the device, infringe the warranty conditions or endanger the health of users.

1.1. Symbols used in the manual

The manual is marked with the symbols specified below. They will allow you to identify potentially health- or device-threatening activities and situations. It is essential that the correct rules are followed - failure to do so may lead to damage to the device.

HAZARD:
The situation or procedure described is potentially hazardous, may result in damage to the device, or may cause injury to the operator. Be cautious.

NOTE:
The situation or procedure described is potentially hazardous and it may result in damage to the device. Be cautious.

PROTECTION:
You will need to wear the protective gloves to perform the operations described.

1.2. General safety practices

Do not install the device:

- in open space, outdoors,
- in damp areas or areas exposed to flooding,
- in the vicinity of volatile and flammable substances,
- in the vicinity of concentrated acids, caustic vapours or corrosive substances,
- in areas that are easily accessible to children,
- using the mains without a PE conductor and without a residual current circuit breaker to avoid electric shock in case of a possible device failure.

You must not:

- keep volatile and flammable substances in the device,
- touch live parts,
- operate the device with wet hands,
- climb the device,
- touch live parts,
- touch any moving parts during operation, especially the fans of the device,
- place containers with liquids or other objects on the device,
- clean the device with running water using sprinklers or other appliances,
- circumvent the security systems by modifying the device (sensors, limit switches, etc.),
- leave the running device in the room with children or animals,
- dismantle the device or carry out unauthorised repairs as this may damage the device and breach the warranty.

It is necessary to:

- use only earthed power sources (to avoid electric shocks),
- ensure sufficient free space around the device so that the door can always be fully opened,
- when disconnecting the plug from the power supply, hold it by its cover, not by the cable,
- disconnect the power supply before carrying out any repairs or maintenance,
- ensure that the mains voltage and connection parameters comply with the specifications of the device,
- protect the cable and power plug against damage,
- disconnect the power plug before moving the device,
- if the device is not used for a longer period of time, unplug the power plug,
- observe the maintenance instructions,
- always wear protective gloves when working with the MMS,
- provide easy access to the emergency switch in the event of device failure,
- If damage is evident, switch off the device and secure it against restarting.

1.3. Symbols used in the 3DGence Material Management System device

3DGence is committed to making its devices safe and reliable. The device contains a number of warning stickers about the potential hazards.

Warning of electrical voltage. The symbol means that there is high voltage in the device and special care must be taken in the areas marked with the symbol.

Warning of hot surface. The symbol informs about the occurrence of high temperature in the area. Always take extra care when handling heated parts and wear the protective gloves. Failure to observe the safety precautions may result in serious burns.

Gloves. The glove symbol means that the protective gloves supplied must be worn when working in the area marked with the symbol.

1.4. Potential areas of security hazards

Some areas in the MMS pose potential safety hazards. Special care should be taken when using and maintaining the device.

In the event of a fault, switch off the device using the main power switch at the back of the device. If there are casualties as a result of the accident, then first aid should be provided. Please report failures to 3DGence Technical Support. The device should also be protected against unauthorised start-up until the failure has been rectified.

- Always wear protective gloves when working inside the working chamber. There may be a high temperature in the chamber.
- Do not wear loose clothing, ties or dangling jewellery when working near moving parts of the device.
- Handle desiccant cartridges with care - do not shake them as dusting of the cartridge may occur.
- Pouring liquids over or immersing the desiccant cartridge in liquids is prohibited due to its reactivity in water.

1.5. Moving the device

For the user's safety and to avoid accidental damage to the device, the following rules must be observed when changing its location:

- before moving the device, switch it off and disconnect all connections,
- the device should be cooled down and the consumables and all loose parts and accessories should be removed from all chambers,
- unlock the swivel castors before moving the device.

1.6. Place of installation

Information on where to install the device:

- the device should operate at temperatures between 10 °C and 28 °C and relative humidity between 30% and 60% without condensation,
- the device should be stored at temperatures between -20 °C and 54 °C and relative humidity between 10% and 85% without condensation,
- in order to prevent spreading of vibrations and noise, the device should be placed on a stable surface with a load capacity sufficient for the weight of the device, e.g.: concrete floor; it is not recommended to install the device on e.g.: metal sheet, chipboard, wooden planking, etc.,
- the level of emission of non-ionising electromagnetic radiation generated by the device is within the limits specified by the standards: for the 3DGence Material Management System device: EN 61326-1, EN 55011, and for the built-in wireless communication device: EN 300 330, EN 55032, EN 301 489-1/-3,
- sufficient free space must be available within the MMS based on the external dimensions of the device; in addition, all sides of the printer must be accessible for, among other things, loading of the materials or maintenance work in accordance with the manufacturer's recommendations,
- the operator may occupy a position at the front of the device; it is not recommended to occupy a position at the back of the device due to the noise and/or heat generated,
- before starting the MMS for the first time, the manufacturer recommends that the device is left for minimum 2 hours before being connected to a power source in order to stabilise the temperature.
- the place of installation of the device should be adapted to the connection specifications,
- the device is not suitable for use in dusty environments,
- the room in which the device is installed must be ventilated appropriately for its size,
- the device must be placed on a firm and stable surface, suitable for its weight (Table 1),
- the device must not be exposed to direct sunlight,
- the device should stand away from other heat sources; direct, prolonged exposure to sunlight should be avoided,
- the use of an external UPS is recommended so that the device will not interrupt its operating cycle in the event of a temporary power failure,
- the height of the installation site should not exceed 2000 m above sea level.

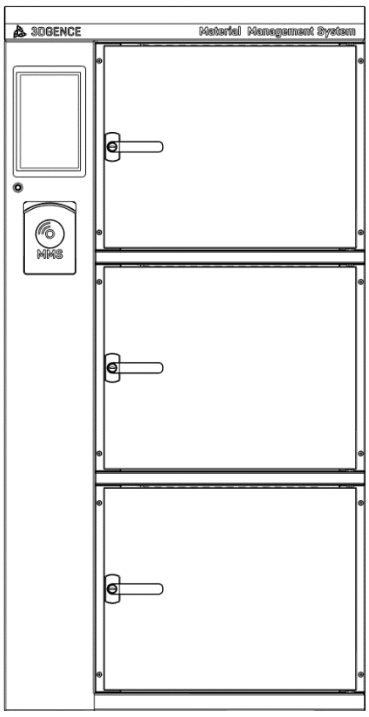

Fig. 2 Maximum size of the 3-chamber MMS (width)

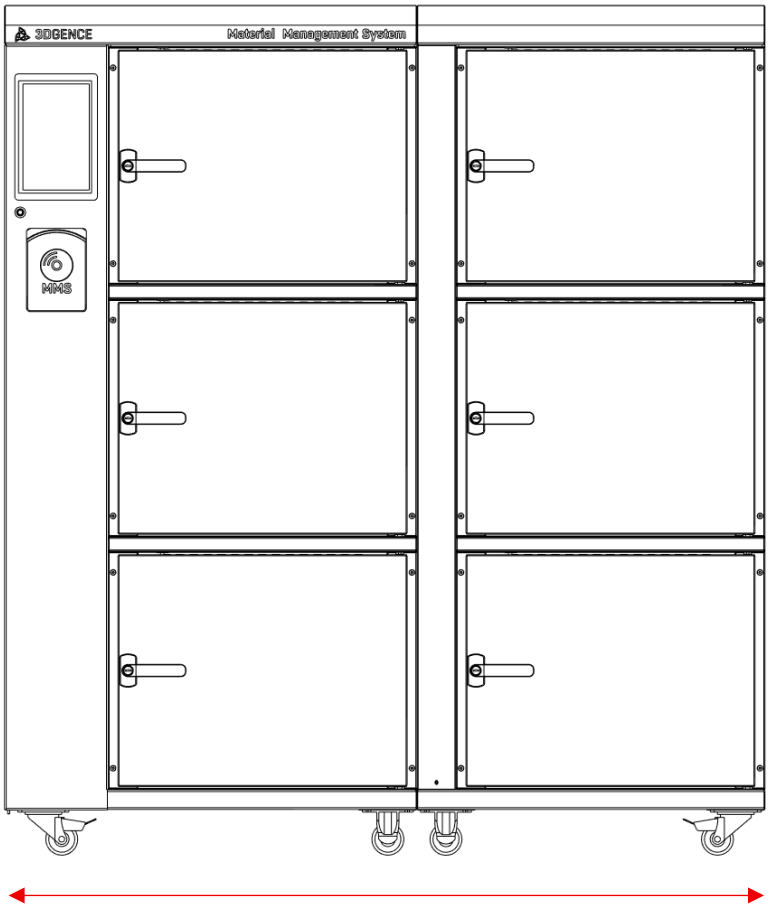

Fig. 3 Maximum size of the 6-chamber MMS (width)

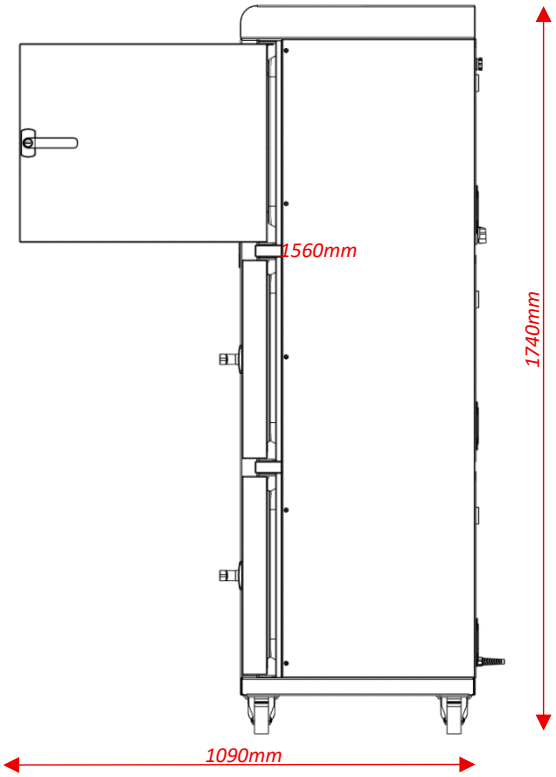

Fig. 4 Maximum size of the 3-chamber and 6-chamber MMS (depth and width)

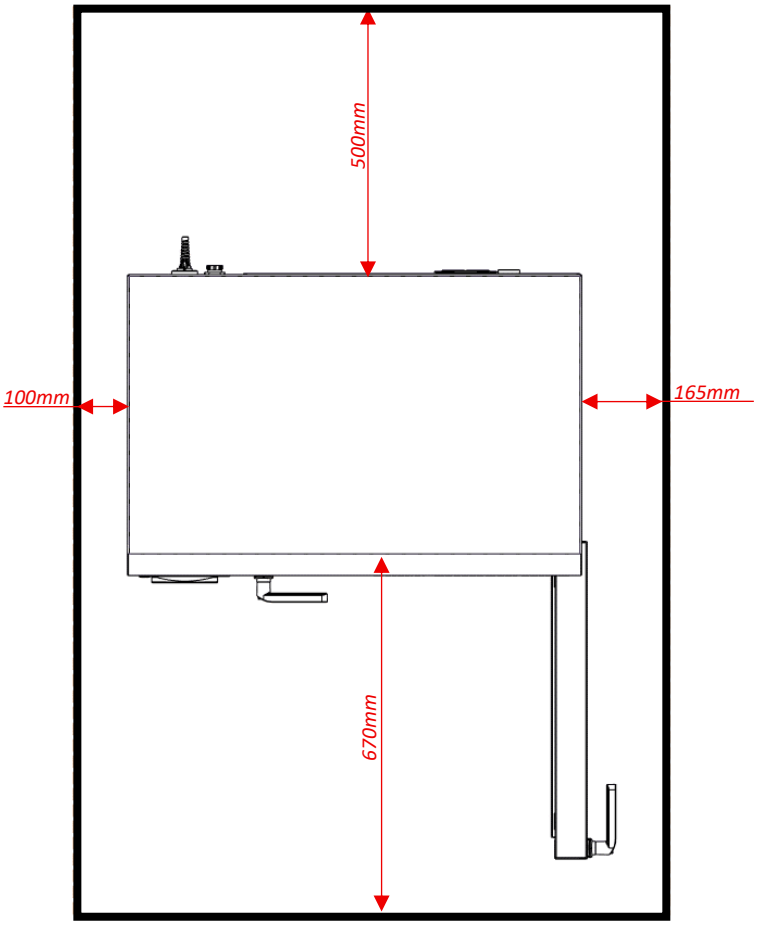

Fig. 5 Minimum distances of the MMS from walls and other objects

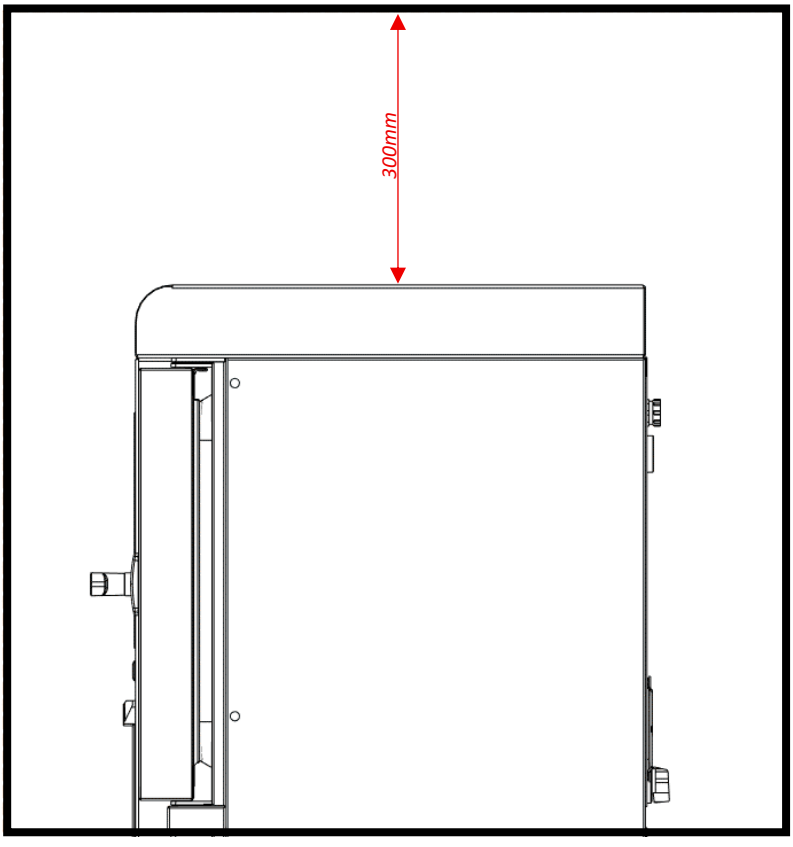

Fig. 6 Minimum distance to be kept from the top of the device

1.7. Specification of electrical connection

The electrical characteristics of the 3DGence Material Management System device are summarised below. The connection should be adjusted to the specified values.

Voltage: 230V AC (210-250V AC).
Frequency: 50-60 Hz.
Maximum current consumption by the device in the following variants:

- - 3 chambers: 16A
- - 6 chambers: 32A

In European conditions
The 3-chamber version is supplied with a 1-phase 16A plug in the CEE 7/7 standard. The 3-chamber extension module is supplied with a 16A 1-phase plug in CEE 7/7 standard and a 32A 3-phase CEE17 adapter for 3x 16A 1-phase sockets in CEE 7/7 standard.

In US conditions
All variants of the devices are supplied with a NEMA L6 20A plug. The 6 chamber versions (base device + expansion module) require two power supply lines, each in NEMA L6 20A standard.

1.8. Power requirement

The power requirement mainly depends on the type of process carried out in the device. Different temperatures are maintained in the device chamber for each process. A summary of the power requirements for the different materials is shown in Table 2.

Table 2 Power requirement characteristics for different temperatures (example for 1 device chamber)

Variant	Current consumption [A]		Power consumption [W]	
	MIN	MAX	MIN	MAX
Heating off	0.36	0.36	65	65
50°C	0.36	5.21	65	1245
60°C				
80°C				
120°C				
200°C				

2. CONTENTS OF THE SET

The 3DGence Material Management System comes with a set of necessary accessories. The set includes:

- drawers for storing materials in the device chamber (one for each chamber),
- air-drying cartridges (one for each chamber),
- 3ph 32A / 3x 1ph power adapter (only for 3-chamber expansion module),
- wireless communication module (WLAN) and RJ45 connection cable.

3. UNPACKING THE MMS

The device may be commissioned if, after installation, it complies with all recommendations contained in the manual and is free from damage and defects that may affect its safe operation. The operator of the machine must be familiar with the operating manual.

During transport, the 3DGence Material Management System is secured to the pallet with straps and protected with cardboard packaging. The pallet on which the device is placed is an euro 1 pallet with dimensions 1200 x 800 mm.

Caution: due to the considerable weight of the device (~200 kg alone), special care must be taken when unpacking.

4. STEPS BEFORE STARTING THE DEVICE

Note: Before starting the printer for the first time, the manufacturer recommends that the device is left for 2 hours before being connected to a power source in order to stabilise the temperature.

Note: before starting the device for the first time, select an appropriate installation site, observing the recommendations and requirements described in this manual.

Before starting the MMS each time:

- check the cables for chafing or other visible damage. If the cables are damaged, please inform the 3DGence technical support department immediately. It is also forbidden to connect the device to the power supply and/or undertake repairs on your own,
- check that there are no objects or loose parts in the device chambers that could cause jamming or damage to the heating elements.

5. START-UP 3DGENCE MATERIAL MANAGEMENT SYSTEM

5.1. Connecting to power source and switching on the device

Once the device is correctly positioned and the transport castors are locked, connect the device to the power source. The power cable inlet is located at the rear of the device.

5.2. Preparing the device chambers for operation

Each device is supplied with the appropriate number of drying cartridges and material storage drawers. A regeneration cycle for the desiccant cartridges must be carried out before full operation of the device. The desiccant cartridge regeneration cycle is described in Chapter V of this manual. After regenerating the desiccant cartridges, it is necessary for each chamber:

1. Make sure that there is no high temperature (below 60°C) in the chambers.
2. Open the chamber door.
3. Insert the material drawer with the notch towards the chamber door.
4. Insert the regenerated desiccant cartridge into the drawer notch.
5. Close the chamber door.

5.3 Connecting the WLAN adapter

The accessories supplied with the device include a WLAN adapter that enables wireless communication with the device.

1. Plug one end of the supplied WLAN cable into the WLAN module.
2. Plug the other end of the WLAN cable into the LAN socket on the device
3. Position the WLAN module close to the device. It will be fixed with a magnet.

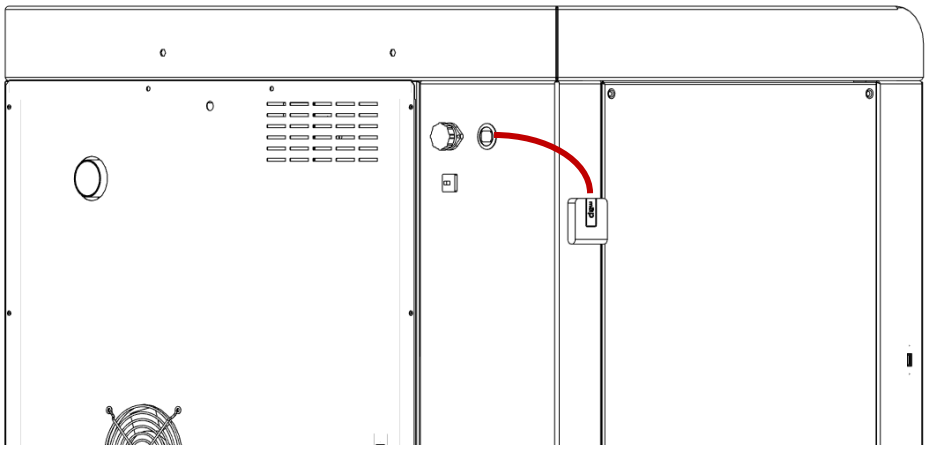

Fig. 8 Proposed position of the WLAN adapter on the device

5.3. Network configuration

On the display of the device after selecting: network settings button in the "network type" record, you can select the type of connection. The possible states are:

- disabled - disabled network options,
- wired - connected to the LAN through a cable with an RJ45 plug,
- Wi-Fi - wireless connection using a WLAN adapter.

When a WLAN adapter is connected and a connection via Wi-Fi is selected in the "network type" record, the "Wi-Fi" record below becomes active and takes you to the list of available networks. Once a network is selected, the MMS attempts to connect to it and an on-screen keyboard appears with the option to enter a password if required. Connection to the network is indicated by the "connected" status at the bottom of the screen.

If connection via "wired" cable is selected in the "network type" record, remove the WLAN adapter from the MMS and plug the LAN cable into the LAN/ WLAN adapter socket on the device. Connection to the network is indicated by the "connected" status at the bottom of the screen.

III CONSTRUCTION OF THE 3DGENCE MATERIAL MANAGEMENT SYSTEM DEVICE

1. GENERAL

In order to make working with the 3DGence Material Management System easier and to make the rest of the manual easy to understand, below you will find a series of drawings with descriptions of the most important components comprising the device.

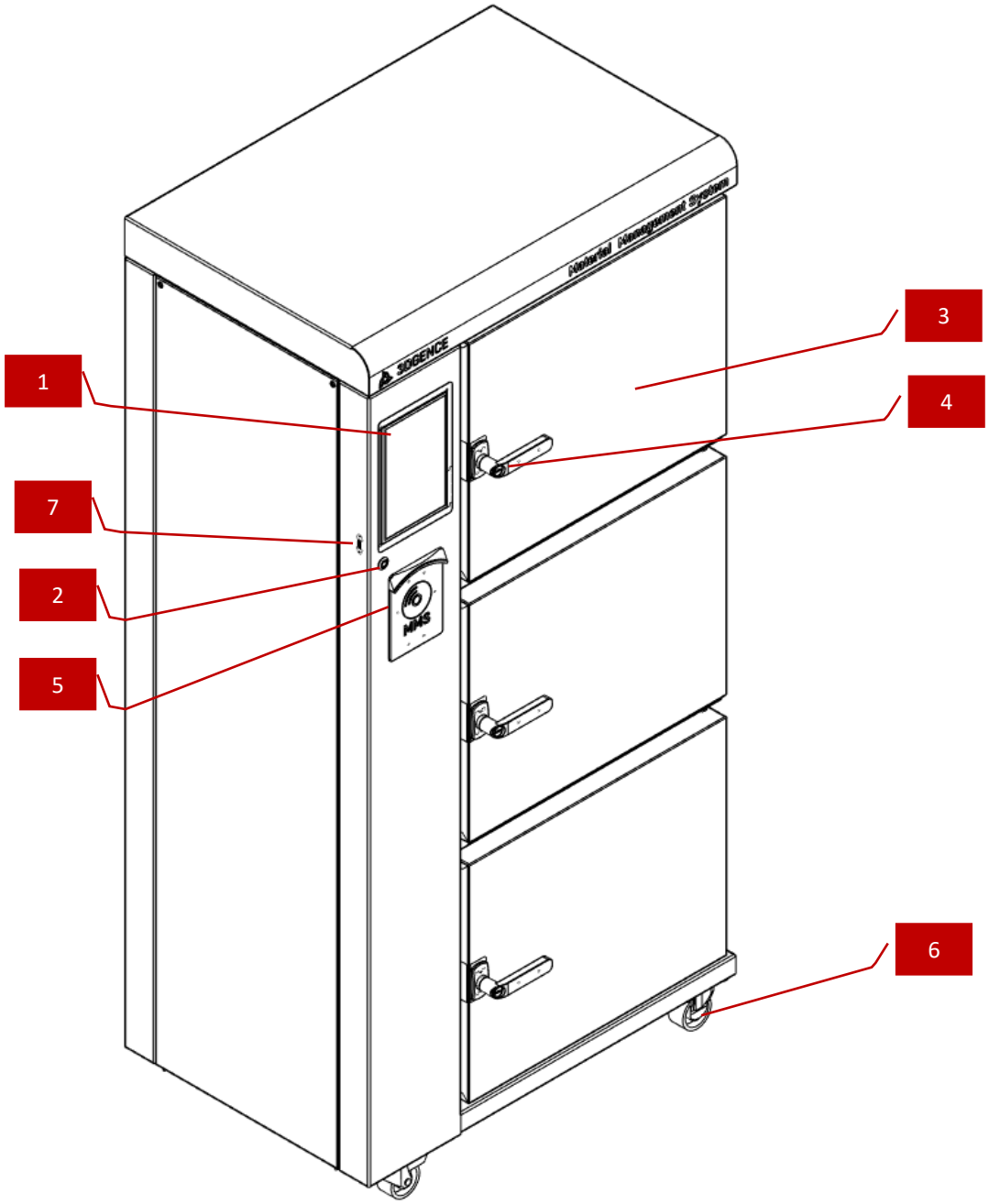

Fig. 7 3DGence Material Management System – isometric view
1. Display | 2. Power switch | 3. Chamber door/ 4. Chamber door lock | 5. SMM TAG reader | 6. Castors | 7. USB connector

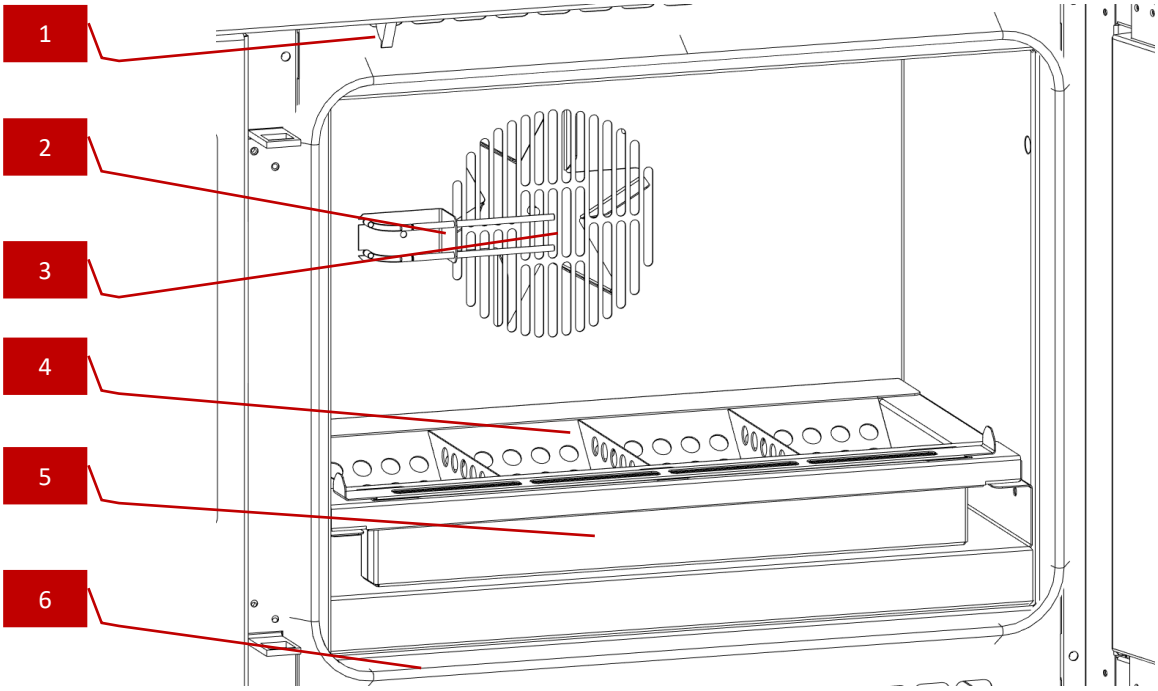

Fig. 10 3DGence Material Management System – inside of the chamber:
1. Door opening sensor | 2. Chamber temperature sensors | 3. Chamber fan | 4. Material storage drawer | 5. Desiccant cartridge | 6. Seal of *the chamber door.*

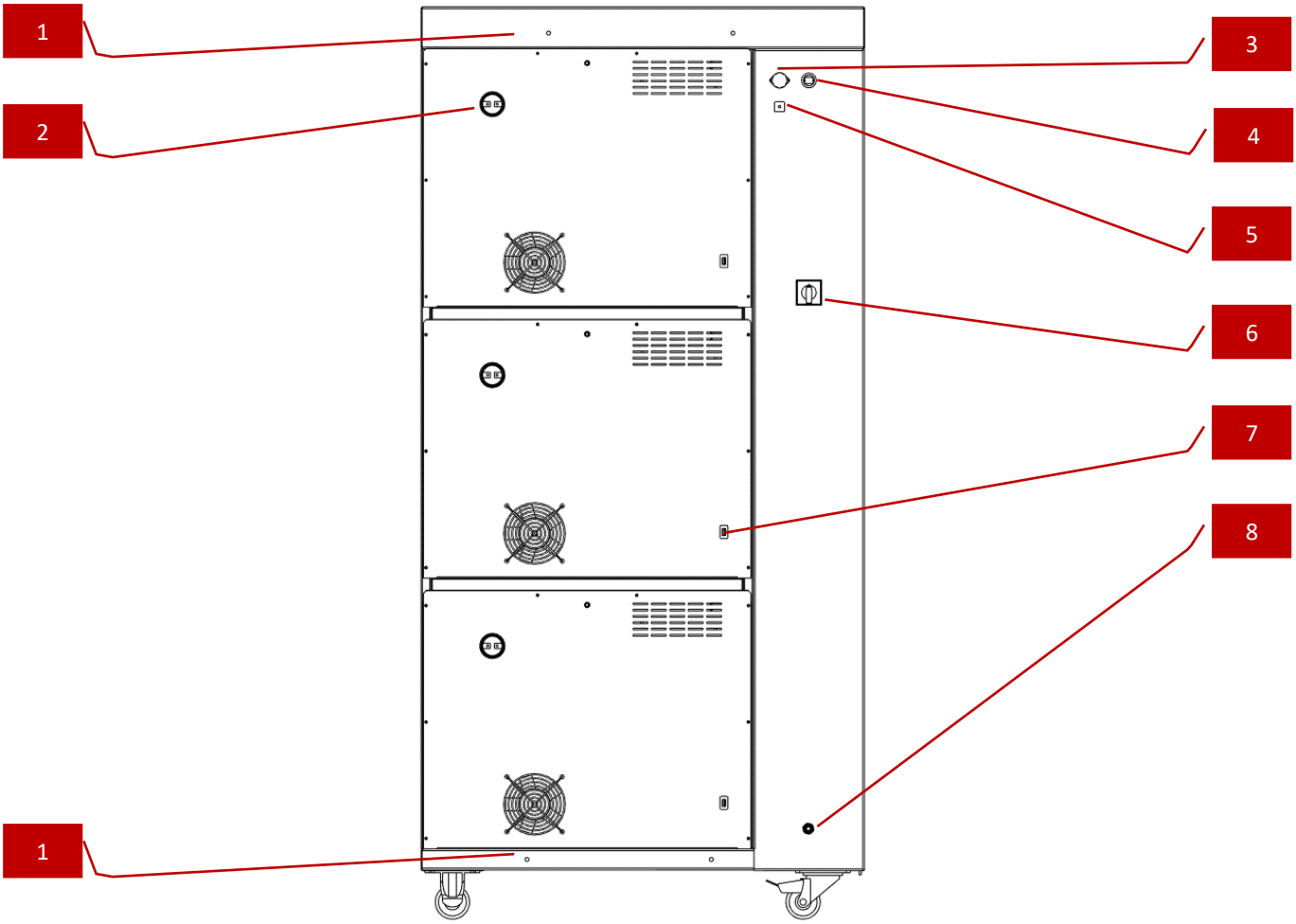

Fig. 11 3DGence Material Management System – rear view:
1. Mounting points for the 3-chamber extension
2. Air outlet from the chamber | 3. Multi-connector socket for communication connection for the 3-chamber extension | 4. LAN/WLAN adapter socket | 5. Overcurrent protection | 6. Main switch | 7. Service USB connectors for the chamber | 8. Power cable input

3. USER INTERFACE PANEL

3.1. Display:

The 10.1” touch and colour display is located on the left side of the front panel of the device. It provides an interface for communication with the device via a transparent graphical menu. It allows the user to control the operation of the MMS and displays the operating status of the device.

3.2. Power switch

The power button is located on the left side of the front panel of the device under the display. It allows you to switch the MMS on and off. The button switches off the power supply to the machine main controller only. To completely turn off the power to the device, set the main switch to the "off" position.

4. CHAMBER OF THE 3DGENCE MATERIAL MANAGEMENT SYSTEM

4.1. MMS chamber door and door opening sensor

The device's chamber door with a door-opening sensor ensures efficient and safe operation of the device. In addition, the chamber door is actively cooled by the air flow, maintaining a safe temperature of the outer surface of the door. The door opening sensor located in the upper part of the chamber frame controls the operation of the device. When the door is opened, the heating system and the thermal circuit are switched off and the currently running programme goes into a pause mode.

4.2. Material drawer and drying cartridge

Each chamber of the device has one drawer for storing materials. The drawer has removable dividers which are used to differentiate between the individual material spool locations. The dividers can be removed to collectively dry more materials, for a device in the CUSTOM mode. In the front part of the drawer there is an elongated notch into which the desiccant cartridge should be inserted. The notch position guarantees an adequate air flow through the desiccant cartridge and at the same time the best quality of the material preparation process.

4.3. Temperature sensors

Each chamber is equipped with two chamber air temperature sensors: the main one and a safety one. A redundant temperature measurement system protects the materials inside the chamber against overheating and protects the entire device against damage due to a failure of the heating elements. In addition, the device is protected by a sensor that tests the temperature within the electronic circuits. If the permissible temperature is exceeded, the device will automatically switch off the faulty chamber.

4.4. Chamber fans

A fan located in the rear of the chamber is responsible for maintaining the correct direction and speed of air flow. It directs the air to the desiccant cartridge for the pre-press process.

5. ECOSYSTEM SMART MATERIAL MANAGER

Smart Material Manager is a system developed by 3DGence that provides simplicity of device operation by using the SMM (Smart Material Manager) tag system on dedicated print materials.

The system allows, among other things:

- automatic upload of the net material weight, material type and manufacturer, working parameters for the material preparation process,
- monitoring the suitability of the material for the printing process,
- monitoring the amount of material remaining on the spool,
- communicating possible problems to the user, e.g. use of inappropriate material for a given .3dg file,
- quality control of the material flow during operation,
- detection of the end of material.

The SMM system in the Material Management System device consists of three key elements:

1. An SMM TAG reader, located on the front of the device, under the display;
2. SMM system stickers containing the material data, affixed to the material spool coming from the Certified Material Base;
3. 3DGence CLOUD system, which allows you the traceability of a spool of material and the tracking of material status within the 3DGence CLOUD account.

6. REAR PANEL

6.1. LAN

The LAN socket allows the device to be connected to a network infrastructure via a cable with an RJ45 standard plug. The network can be connected to the Internet, in which case it is possible to use the 3DGence CLOUD system and automatic MMS software updates.

The socket can also be used to connect a WLAN adapter, due to the PoE (Power over Ethernet) technology applied. If the manufacturer's supplied adapter is used, no additional power supply is required. The manufacturer provides a pre-configured device, and the selection of the appropriate Wi-Fi network and security is done through the operator panel. It is possible to use LAN/WLAN adapters from external suppliers, but then it will be necessary to configure the device outside the device software and the PoE function will be inactive.

It is recommended to use cables with RJ45 Cat 5 plugs with a maximum length of 10 metres.

6.2. Overcurrent protection

The device's overcurrent protection (AC fuse) is located on the rear housing of the device. It provides protection of the device against the effects of short circuits and low voltage AC and DC overloads. When high current surges occur, the AC fuse activates, protecting the electrical and electronic components of the MMS. Before restarting, ensure that all malfunctions have been corrected and that the start-up of the device does not cause any hazard. To reconnect the power supply, push the protruding part of the fuse inside its housing.

6.3. Main switch

The main switch is located at the rear of the device and power is supplied to all systems inside the MMS through this switch. The switch is provided with 2 current circuits. It is recommended to switch off the device using the main switch after completing the safe shutdown procedure from the operator panel (the power button on the front panel of the device).

6.4. Power cable input

The power cable input is located on the rear housing of the device. It is fitted with a cable gland to prevent the supply cable from being kinked. Use power cables that comply with the specifications and check the condition of the power cable. Do not use the device with a damaged cable or cable gland.

7. ADDITIONAL ACCESSORIES

7.1. Recrystallisation set for prints

7.2. 3-chamber extension

The 3DGence Material Management System can optionally be provided with a 3-chamber expansion module that doubles the capacity of the device. Each base MMS device (fitted with a display) can be provided with a single expansion module and installation is easy and can be done by the user himself. A minimum of two people is recommended to unpack the expansion module due to the size and weight of the device.

7.2.1. Methods of connecting the expansion module to the mains

NOTE: The expansion module has the same electrical connection requirements as the base unit. For this reason, the extension module can be connected via:

- A 32A 3-phase adapter (included with the expansion module) that allows the 3-phase output to be split into three individual phases. In this arrangement, the base unit and expansion module are connected to two of the three 1-phase sockets, and the 3-phase plug is connected to the 3-phase mains with 32A overcurrent protection.
- Directly connect the device to a separate 1-phase installation provided with 16A overcurrent protection.
- In US conditions, the device must be connected to a power source equipped with separate 20A protection.

7.2.2. Contents of the 3-chamber extension set

- Expansion module
- Assembly parts of the extension module to the base unit.
- Set of drawers and desiccant cartridges.
- 32A 3 phase to 3x 1 phase power supply adapter.

7.2.3. Preparation of devices for installation of the 3-chamber extension

The base unit to which the expansion module will be connected should be disconnected from the power supply and all its chambers emptied and cooled.

1. Remove the 5 mounting point plugs on the right-hand wall of the base unit (highlighted in red in the figure below).

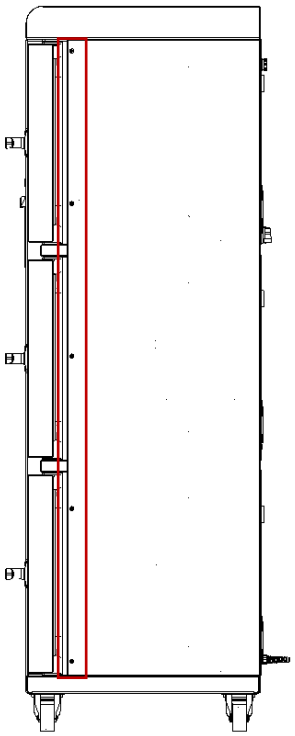

Fig. 12 Location of the mounting point plugs in the base unit

2. Using the screws from the set, install the angle bracket into the expansion module (highlighted in blue) as indicated in the figure below. The second mounting plane should face to the left (towards the outer edge of the module).

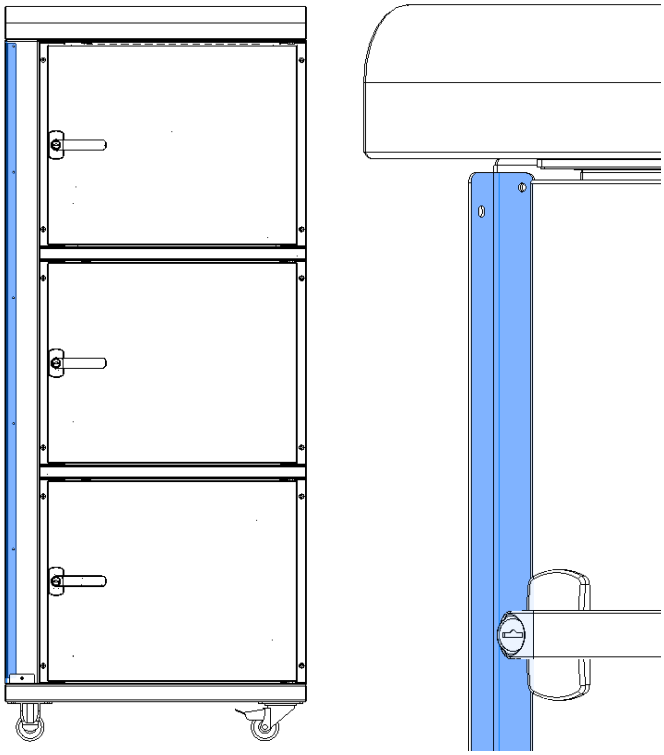

Fig. 13 Location of the bracket and zoom on its mounting in the expansion module

3. Position the extension module with its left side parallel to the right side of the base unit and slide them together so that the openings in the base unit align with the openings in the angle bracket of the extension module. Then use the screws provided to connect the two devices together at five points. The doors of the expansion module chambers can be opened to facilitate installation.

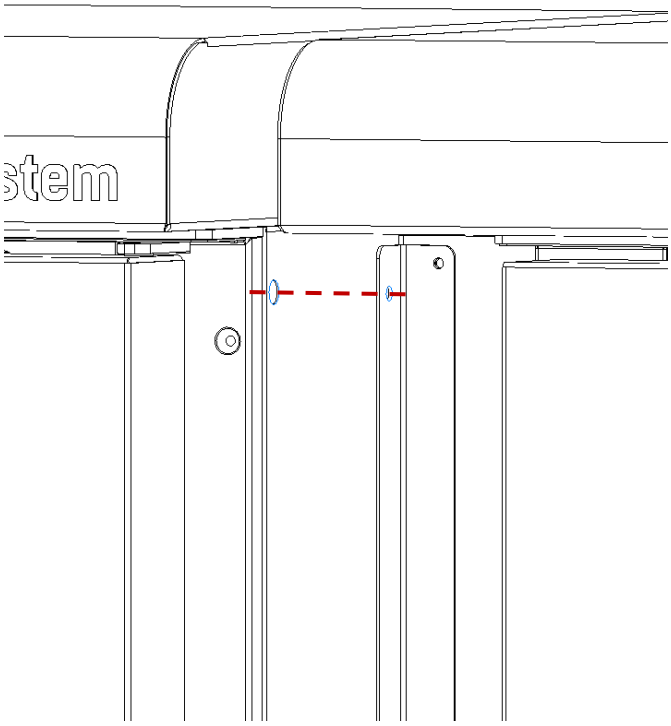

Fig. 14 Positioning of the extension module in relation to the base unit

4. On the back of the unit, remove the clamp that holds the expansion module communication cable, then connect the communication cable to the communication socket on the back of the base unit. The cable and the communication socket are highlighted in blue in the figure below.

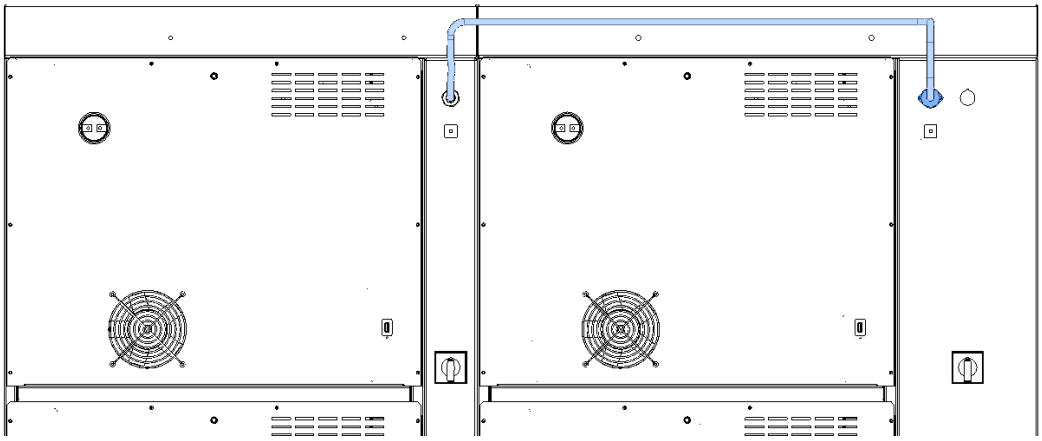

Fig. 15 Rear of the device - how to install the communication cable

5. Screw the bottom beam (highlighted in blue in the figure below) at 4 points, connecting the two devices.

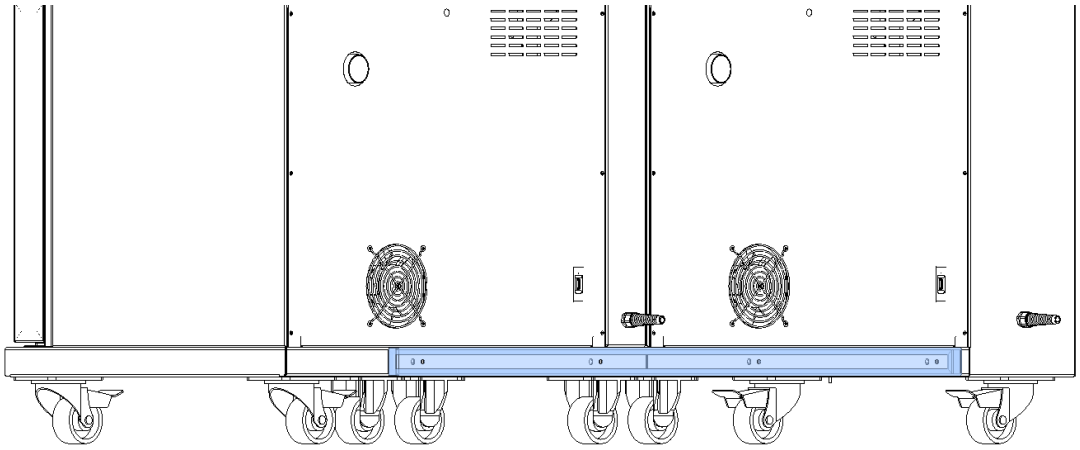

Fig. 16 Rear of the device - how to install the bottom beam

6. Screw the top beam (highlighted in blue in the figure below) at 4 points, at the same time laying the communication cable so that it runs in the centre of the top beam. The top beam has special notches which allow the communication cable to be led out on both sides.

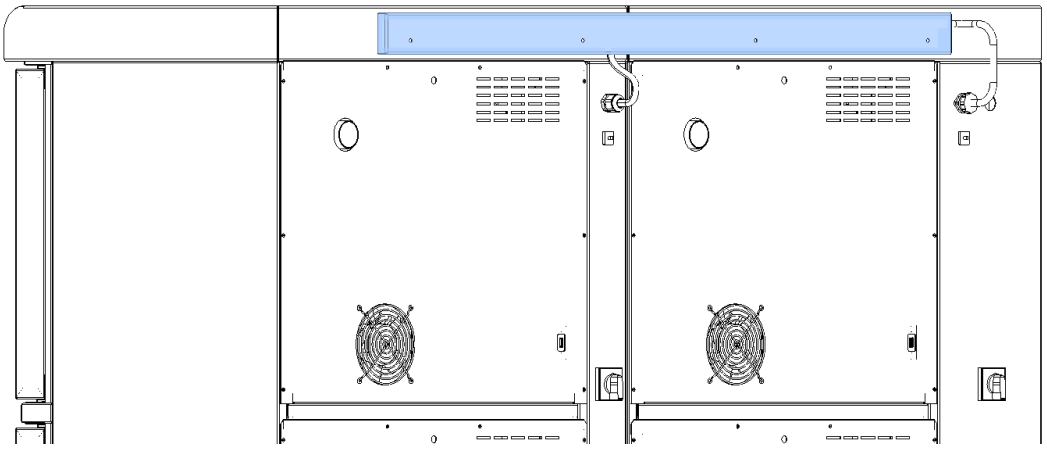

Fig. 17 Rear of the device - how to install the top beam

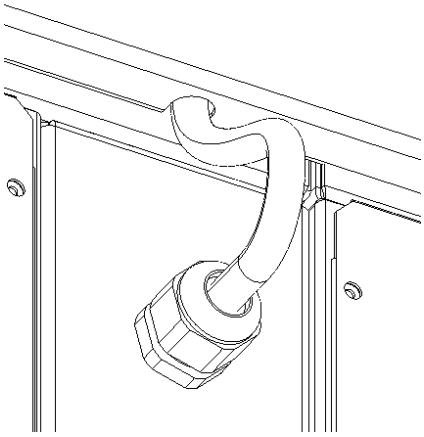

Fig. 18 Example of routing the communication cable out of the top beam

7. Install the front cover of the connection between the two devices. To do this, insert the upper part of the cover into the notch in the upper housing of the device (marked with an arrow in red in the figure below). Then, at the bottom of the device, fasten the cover with the screw from the set (highlighted in red in the figure below).

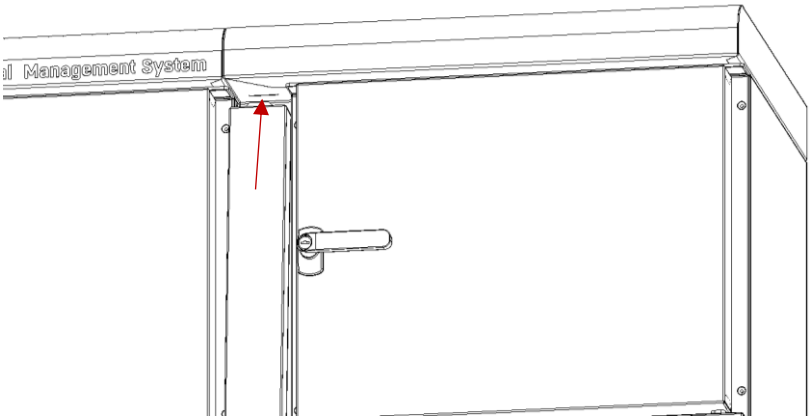

Fig. 19 Place where the front cover is inserted into the upper casing of the device

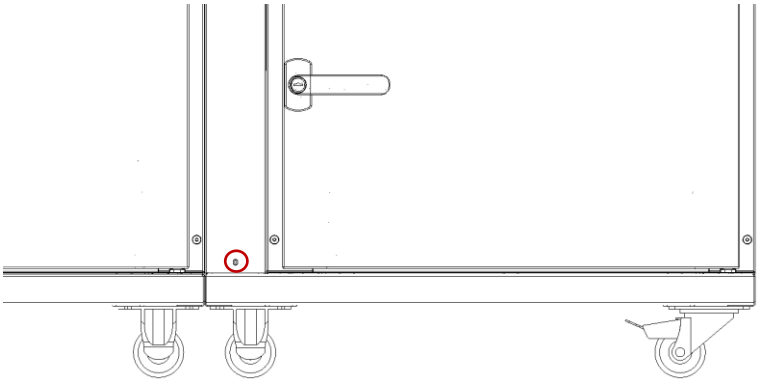

Fig. 20 Screwing place for the front cover

8. Connect the devices to the power supply according to the preferred method.
9. Set the main switches of both devices to the ON position.
10. Start the device using the switch on the front panel
11. After the device has started up, check that the system has correctly detected the additional column of chambers by moving the screen to the right. When the screen is moved, a screen should appear with active chambers numbered 4, 5 and 6.
12. Perform the first regeneration cycle of the desiccant cartridges for the newly installed chambers.
13. Once the desiccant cartridge regeneration cycle is complete, install the material drawers and desiccant cartridges.

IV USER INTERFACE

The 3DGence Material Management System features a 10.1-inch colour touchscreen display on the left side of the front panel of the device. It provides an interface for communication with the device via a transparent graphical menu.

1. MENU AT REST

After connecting the device to the power supply and starting it up, the start-up screen is displayed, indicating that the device has started to prepare for operation

Fig. 21 Start-up screen

The display then shows the device's main menu at rest.

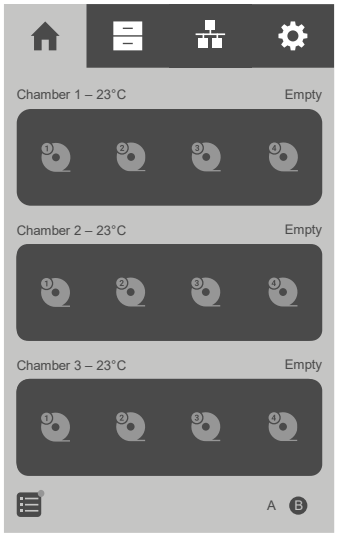

Fig. 22 Main menu of the device at rest 1. Main screen | 2. Archive switch | 3. Network settings button | 4. Network device button | 5. Current chamber temperature | 6. Current chamber status | 7. Chamber operating mode selection button | 8. Notification centre button | 9. Indicator of active device column (for 4 and 6-chamber versions)

1. **Main screen button** - after navigating to other tabs, selecting this button returns you to the device's main screen.
2. **Archive button** - takes you to the material archive screen.
3. **Network settings button** - takes you to a screen related to network functionalities.
4. **Settings button** - takes you to a screen related to settings.
5. **Current chamber temperature** - the current temperature in the selected chamber of the device is displayed here.
6. **Current chamber status** - the current status of the chamber is displayed here, informing the user about the progress of the selected process.

7. **Message button** - takes you to a screen related to messages.
8. **Active device column indicator** - informs the user of the currently displayed device chamber column (visible for 4 and 6-chamber versions).

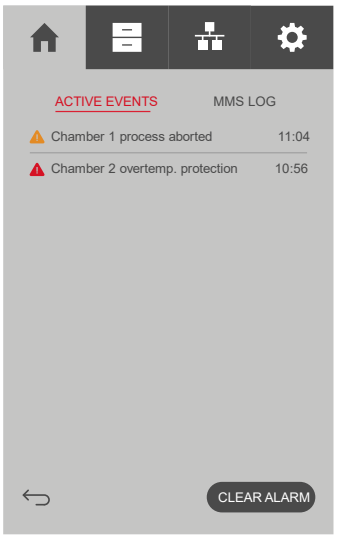

Fig. 23 Message screen - active events

Active events – this tab displays all active events such as information or warnings together with the time of occurrence. If an event changes its status to inactive, it will be moved to the "printer log" tab.

Clear alarm – allows the event to be acknowledged and, if possible, the error to be cancelled and the acoustic alarm to be switched off.

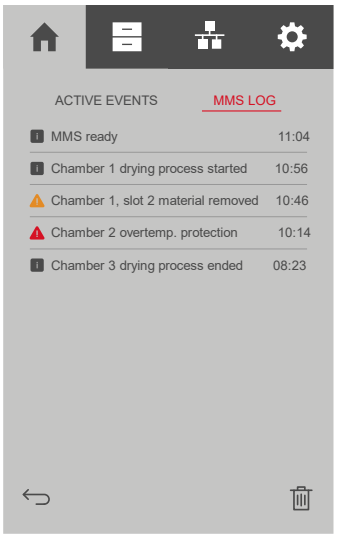

Fig. 24 Message screen - MMS log

MMS log – this tab displays all events that are no longer active. This allows the user to see all information, warnings and errors that the device has sent. Using the bin icon, it is possible to delete all events stored here.

1.1. Network settings screen

When the “network settings” button is selected, the user will be taken to a screen related to network functionalities.

Fig. 25 Network settings screen

Network type – use the arrows to select the type of MMS connection. The possible states are:

- “disabled” - disabled network options,
- “wired” - connected to the LAN through a cable with an RJ45 plug,
- “Wi-Fi” - wireless connection using a WLAN adapter.

Wi-Fi networks – transfers to the list of available networks.

Network details – transfers to the screen related to network connection details.

3DGence CLOUD – transfers you to the screen related to the connection with 3DGence CLOUD.

Connection status – informs about the status of the connection.

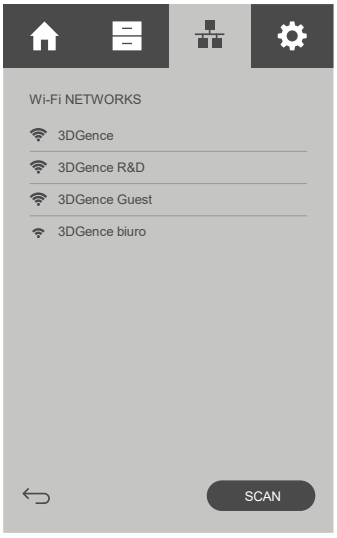

Fig. 26 Screen with available Wi-Fi networks

Scan – selecting this button allows you to search for available networks.

To enable connection to one of the available Wi-Fi networks, select it. The device will then attempt to connect to the network and an on-screen keyboard will appear with the option to enter a password if required. Connection to the network is indicated by the "connected" status at the bottom of the screen.

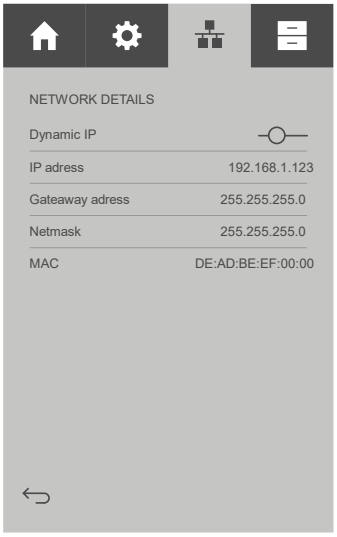

Fig. 27 Network details screen.

Dynamic IP – choice of static or dynamic IP address.

ID address – network address of the device.

Gateway address – IP address of the default gateway.

Netmask – sub-net mask.

MAC – physical address of the device.

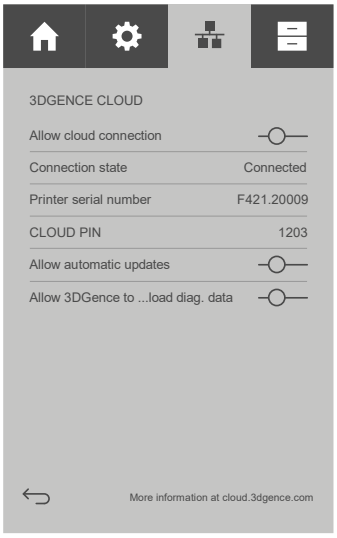

Fig. 28 3DGence CLOUD screen

Allow cloud connection – the default setting of "on" allows the MMS to connect to the 3DGence CLOUD platform. This option can be disabled by moving the slider to the "off" position.

Connection state – status indicating whether the device has been connected to the 3DGence CLOUD platform.

Printer serial number – MMS serial number to be entered when adding the device to the 3DGence CLOUD web platform.

CLOUD PIN – the code to be entered when adding the device to the 3DGence CLOUD web platform.

Allow automatic updates – the default setting of "on" allows automatic updates of the device software. This option can be disabled by moving the slider to the "off" position. The manufacturer recommends enabling automatic software updates.

Allow 3DGence to download diagnostic data – the default setting of "off" allows the manufacturer to automatically download diagnostic data from the device. Data is collected in case of maintenance and/or after-sales support needs.

1.2. Settings screen

The settings screen is designed for basic device configuration.

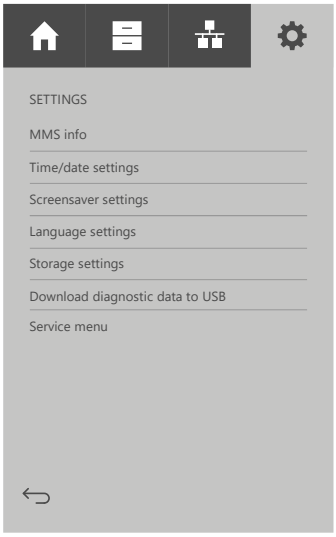

Fig. 29 Device settings screen

MMS info – transfers to a screen related to device information.

Time/date settings – transfers to the screen related to date and time settings.

Screensaver settings – transfers to the screen saver settings screen.

Language settings – transfers to the screen where the language on the device can be changed.

Storage settings – transfers to the screen enabling configuration of the material storage mode

Download diagnostic data to USB – If a USB mass storage device is installed in the device, a file with the device diagnostic data will be downloaded when this button is pressed.

1.2.1 MMS info screen

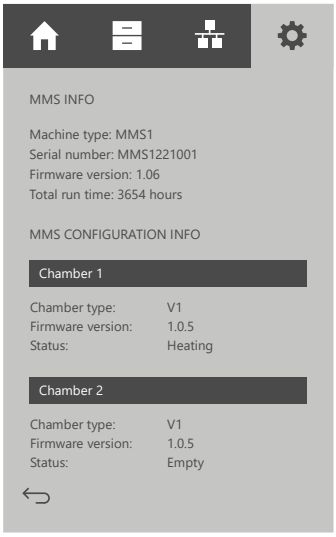

Fig. 30 Screen with device configuration information

MMS INFO SECTION

Machine type - device model.

Serial number - device serial number.

Firmware version – the software version of the device.

Total run time – total number of operating hours of the device.

MMS CONFIGURATION INFO SECTION

Chamber type – the type of chamber installed in the device.

Firmware version – the software version of the chamber.

Status – current status of the chamber.

1.2.2 Time/date settings screen

Fig. 31 Screen related to setting the time (set time)

The top of the screen shows the current time and the current date.

Time zone – allows you to set the time zone.

Adjust automatically – The default setting "on" allows the date and time to be set automatically on the device. The only requirement is that the device is connected to the internet. The option can be deactivated by moving the slider to the "off" position and then the "adjust manually" option becomes active.

Adjust manually – allows you to set the time and date manually.

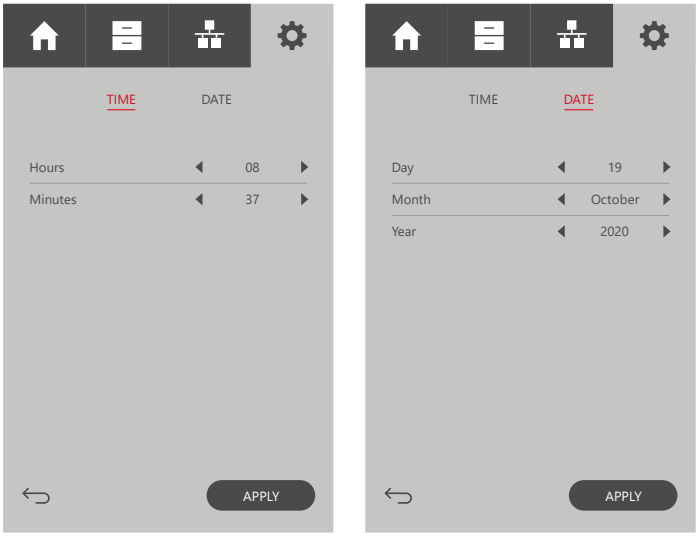

Fig. 32 Screens related to manual date and time setting

1.2.3 Language screen

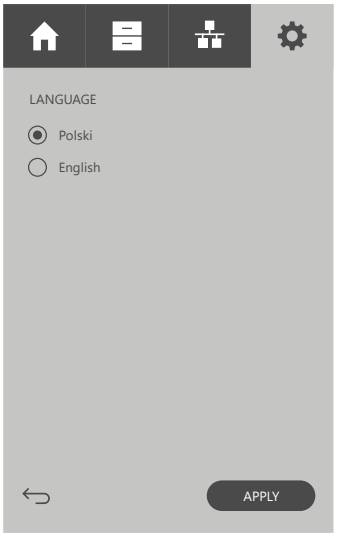

Fig. 33 Screen related to language change on the device (language)

1.2.4 Storage settings

Storage control – By default the option is in the "off" position which results in automatic control of temperature and time parameters for the storage mode. To activate manual control of the storage mode parameters, move the indicator to the "on" position.

Temperature – The option allows you to set your own temperature setting for storing materials after the process is complete. The temperature can be set between 50°C and 80°C.

Time limit – The option allows you to set a time limit that will apply to the changed material storage temperature. The time limit can be set from 1 minute to 99 hours and 59 minutes.

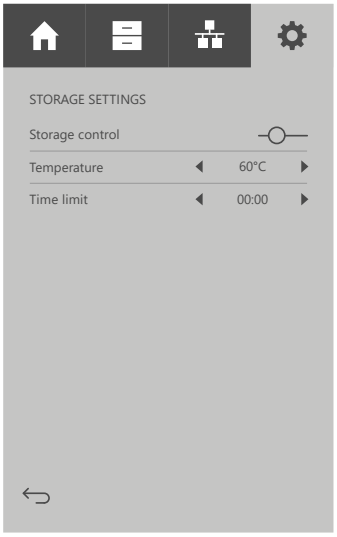

Fig. 34 Screen enabling the configuration of the material storage mode

2. Work with the 3DGence Material Management System device

When the device is running, the main screen is the main source of information about the running processes. Depending on the device's hardware configuration (number of chambers), on the main screen each chamber has its own information section where the chamber number, its status and the current temperature in the chamber can be listed. The following figure shows the main screen of the MMS device in the idle state - without any heating processes running.

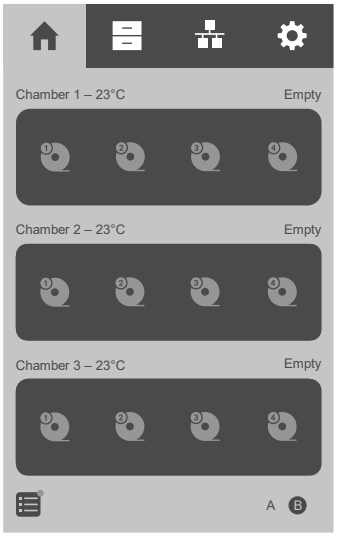

Fig. 35 MMS main screen in idle mode

In the 3DGence Material Management System there are four operating modes:

- **Preparation of materials for printing** - the basic mode of operation of the device in which the spool of material is blown with dried air at an elevated temperature for a preset time. Process parameters are automatically selected after scanning the TAG of the SMM and placing a spool of material in the machine chamber.
- **Recrystallisation of prints** - a process involving thermal treatment of prints to enable the recrystallisation process of their microstructure. The print recrystallization process settings can only be accessed when no other processes are running in the selected chamber.
- **Desiccant cartridge regeneration process** - this process enables the removal of water accumulated in desiccant cartridges.
- **User-defined process** - In this option, the user has the possibility of defining his/her own temperature and time parameters in the full range (option additionally payable). Access to the user-defined process settings is only possible when no other processes are running in the selected chamber.

2.1. Material statuses in the 3DGence Material Management System device

Both the main menu screen and the individual screens will show different colours indicating a change in the status of the material in the chamber. The meaning of the different colours that may appear in the MMS menu is shown below.

-  Grey - means that a given space in the chamber is available and can be allocated if compatible material is loaded.
-  White - indicates that the material is currently in the prepress cycle. Below the symbol there is a countdown indicator of the time remaining for the material to complete the process.
-  Green - indicates that the material has completed the full preparation cycle and is ready to be removed from the device chamber.
-  Blue indicates that the material requires a prepress process.
-  Red - symbolises an error caused by the interruption of the material preparation process and requires the user to manually remove the materials from the MMS system.

V OPERATION OF THE DEVICE

1. FIRMWARE UPDATE

Due to continuous development, the device's Firmware is periodically updated. It is important that the Firmware is always updated to the latest available version. To enable automatic Firmware updates for the device, you must have the option "on" in the Network settings menu → *3DGence CLOUD* → *allow automatic updates.* If the automatic update option is enabled, the new Firmware will be downloaded and automatically updated when the device is restarted. It is required that the MMS be connected to the network.

If "off" is set to "*allow automatic updates*", automatic Firmware updates will not be possible.

2. SWITCHING THE DEVICE ON AND OFF

2.1. Activating the 3DGence Material Management System

1. Set the main switch located on the back of the device to ON (in the case of the 6-chamber version, also set the switch to ON the 3-chamber unit).
2. Press the power button on the left side of the front panel.
3. The device will start up and the touch screen will be activated. During start-up, the MMS will begin to prepare for operation, the start-up screen will appear followed by the device home screen.

2.2. Deactivating the 3DGence Material Management System

1. Make sure that no processes are currently running on the device.
2. Press the power button on the left side of the front panel.
3. Confirm the message on the screen that you wish to switch off the device. If the message is not acknowledged, the device will return to the main menu and will not be switched off.
4. When the message is acknowledged, the device will automatically switch off.

Note: once the power button has been selected, the power must not be disconnected before the unit has cooled down and switched off.

Note: this procedure only switches off the power supply to the electronics. To completely turn off the power to the MMS, set the main switch to the OFF position.

3. PROCESS OF PREPARING MATERIALS FOR PRINTING

The 3DGence Material Management System device has been verified for its effectiveness in preparing materials from the 3DGence material range. Information about the preparation process parameters is stored on the SMM TAG and on the device itself. Thanks to this combination, the material is properly prepared for the printing process, and degradation of the material is avoided. Every spool of material purchased as part of the 3DGence material database has an SMM TAG:

Fig. 36 Material spool with an SMM TAG in the centre

To upload a material to the MMS system, place the spool of material against the TAG reader on the device, with the SMM sticker towards the reader. Hold the spool on the reader for a few seconds (usually 3-4 seconds) until the data for the material being read appears on the display.

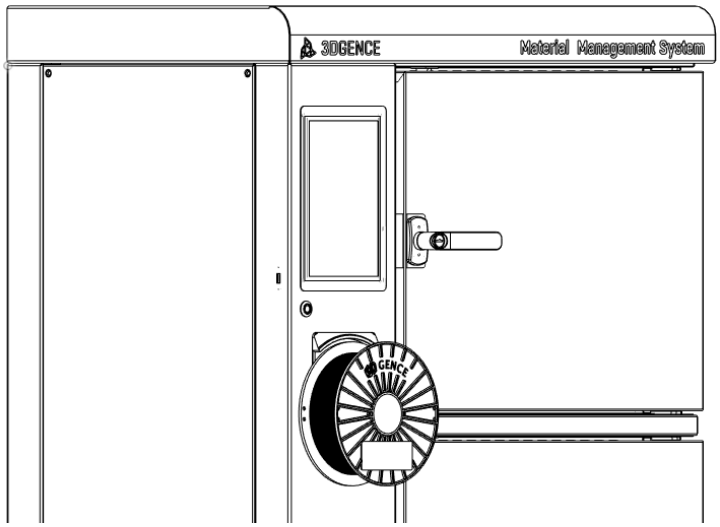

Fig. 37 Correct way to position the material spool on the SMM TAG reader

Once the material has been correctly uploaded to the MMS device, the device screen will display information about the material.

- **Current status** – The current status of the material as it is uploaded to the device. The status informs the user whether the material preparation process needs to be carried out again.
- **Drying time** – Cycle time for material preparation.
- **Manufacturer** – Material manufacturer.
- **Color –** Colour of the material.
- **Material available** – Quantity of material remaining on the spool.
- **UID** – A unique material spool identifier that enables the Smart Material Manager ecosystem to track the material lifecycle in the 3DGence printer, CLOUD system and Material Management System device.
- **STORAGE** – a button allowing material to be added to the machine chamber without starting the actual material preparation cycle.

- **DRYING –** a button which allows to add material to the device chamber and subsequently to start the material preparation cycle.

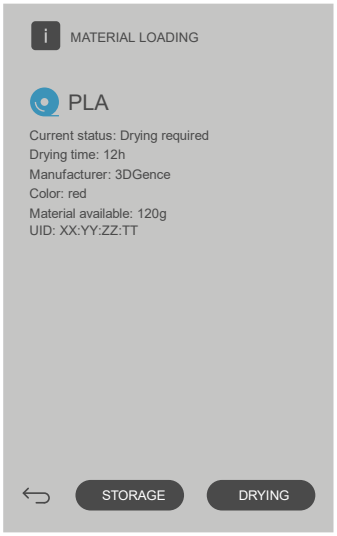

Fig. 38 Screen for loading material into the MMS device

Regardless of the option selected on the loading screen, the device will first verify the availability of the chambers in terms of temperature and space and then indicate the best fit to the user. If the device does not find suitable space for the material and the selected programme, it will inform the user when space for the material becomes available. When the material to be loaded has a lower process temperature than the one currently prevailing in the chamber, the device will inform the user to wait until the chamber cools down below the process temperature for the preparation of the material.

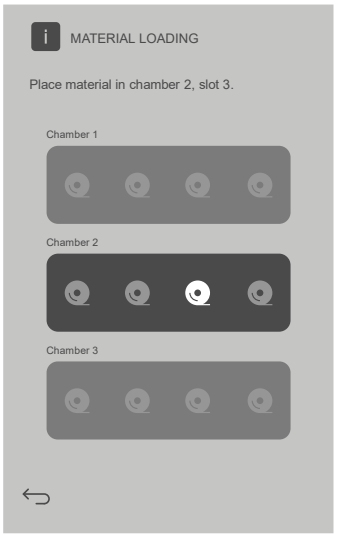

Fig. 39 Material loading screen. The device indicates the place where the selected material is to be inserted

Once the material has been loaded into the indicated place and the chamber door is closed, the device will automatically start the selected process. The screen below shows the 3DGence Material Management System device at work, presenting:

- Empty chamber 1.
- Process of storing materials in the chamber 2.
- Process of material preparation in the chamber 3.

Fig. 40 Screen demonstrating the operating scenario

To unload the material, select the appropriate material from the main screen by clicking on its icon on the screen. After clicking on the material icon, the details screen for the selected item will appear. Pressing the REMOVE button will start the procedure of unloading the material from the device chamber.

NOTE: The status of ready-to-print material will be assigned to a spool of material that:

- has successfully passed the preparation cycle,
- once the process was complete, it was scanned with the SMM TAG reader on the front of the device for the status update.

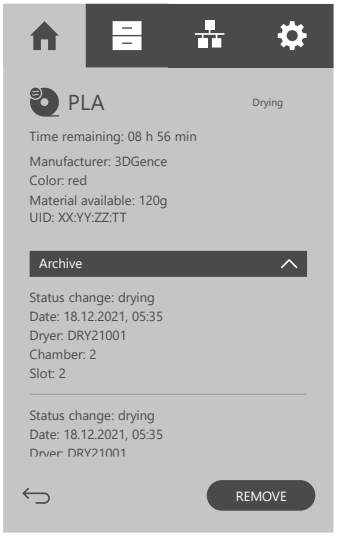

Fig. 41 Screen for unloading material from the device chamber

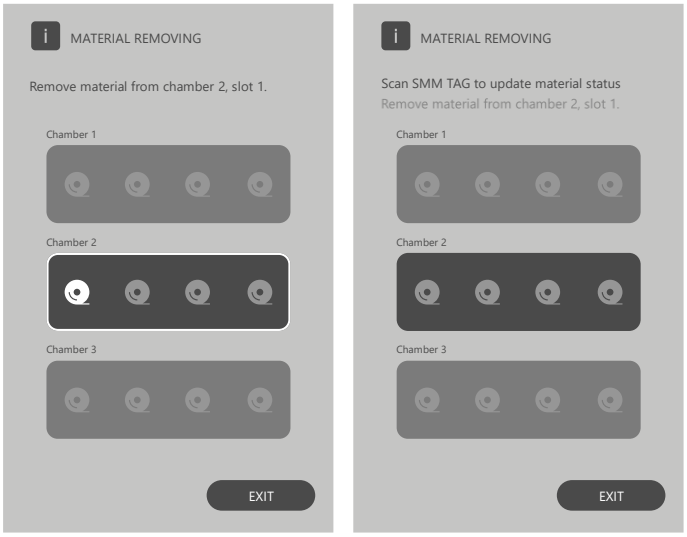

Fig. 42 Screens showing the steps in the process of extracting material from the device chamber

4. RECRYSTALLISATION PROCESS OF PRINTOUTS

The 3DGence Material Management System device is provided with a heating system that allows for a free recrystallisation process of printouts which usually requires a much higher process temperature than material preparation processes. Preparation of the charge for the recrystallisation process is described in a separate document, available by logging on to support.3dgence.com.

In order to start the process of print recrystallisation, at least one chamber of the machine must be completely empty and no other processes may be carried out in it. To start the recrystallisation process wizard, press on the area of the empty chamber (highlighted in red in Figure 35).

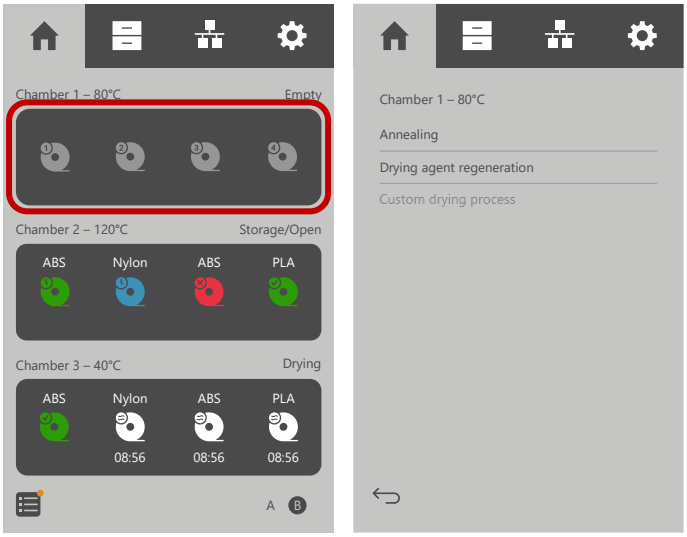

Fig. 43 Screen indicating an empty device chamber and process wizard screen

After pressing the area of the empty chamber, the process wizard will start, where the ANNEALING option is to be selected.

Next, select an appropriate programme depending on the material from which the printouts are made and press the NEXT button - a screen will appear with a summary of the selected programme and information on how to prepare the device chamber for the process. After pressing the START button, the device will start the preset programme and display the relevant information on the main screen.

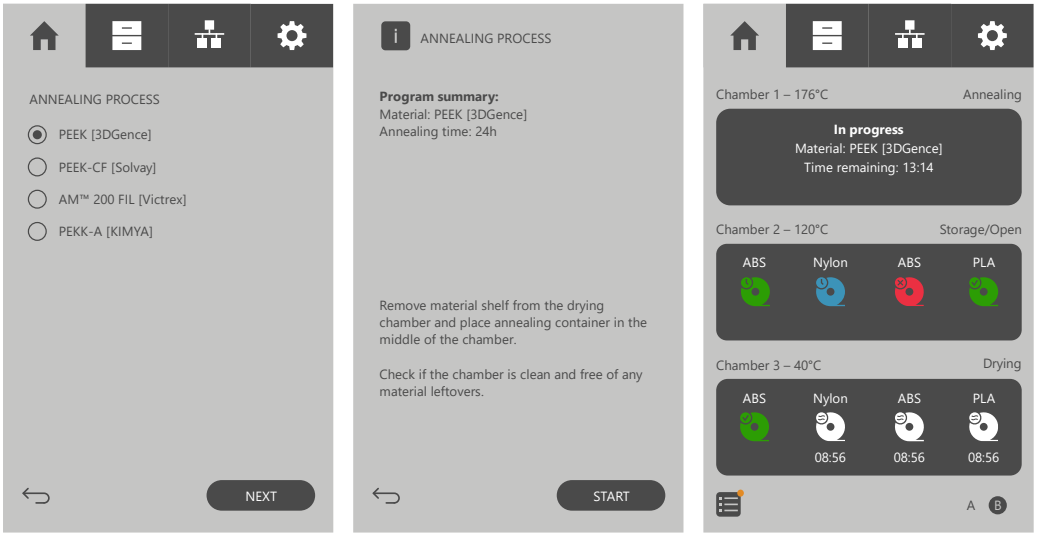

Fig. 44 Screens demonstrating steps to start the recrystallisation process of printouts

Once the recrystallisation process is complete, the chamber will automatically cool down to a safe temperature and assume the DONE status. To reset the chamber status to empty, press the chamber area.

To cancel the recrystallisation process, press on the chamber area during the process. After pressing the chamber area, confirm your intention to cancel the process by pressing the ABORT button. To reset the chamber status to empty, press the chamber area.

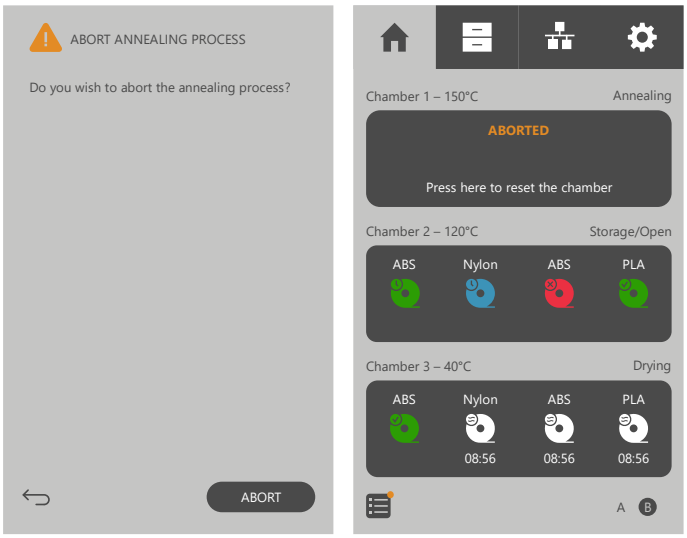

Fig. 45 Screens demonstrating the process of cancelling the recrystallisation of printouts

5. REGENERATION PROCESS OF DESICCANT CARTRIDGES

The 3DGence Material Management System device features an active air drying system, using granules used for drying thermoplastics in conventional industry (e.g. injection moulding, extrusion). Thanks to a special cartridge in the device chamber, the air penetrating the material spools is dried and the collected water particles are stored in the desiccant cartridge. In order to remove the stored water, a special cartridge regeneration cycle has been implemented, during which the cartridges are heated to a high temperature and the evaporated water is discharged through a vent at the back of the device.

It is recommended that a regeneration cycle is carried out every 21 days to maintain the best performance of the print preparation process. In case the device operates in an environment with high humidity or has been out of use for more than 14 days, it is recommended to carry out a cartridge regeneration cycle every 14 days.

Each chamber in the device is capable of carrying out a regeneration cycle; however, to reduce energy consumption it is recommended that the process be carried out for all cartridges in the same chamber.

To start the desiccant cartridge regeneration cycle, go to the process wizard screen and select DRYING AGENT REGENERATION, follow the on-screen instructions, and then press the START button.

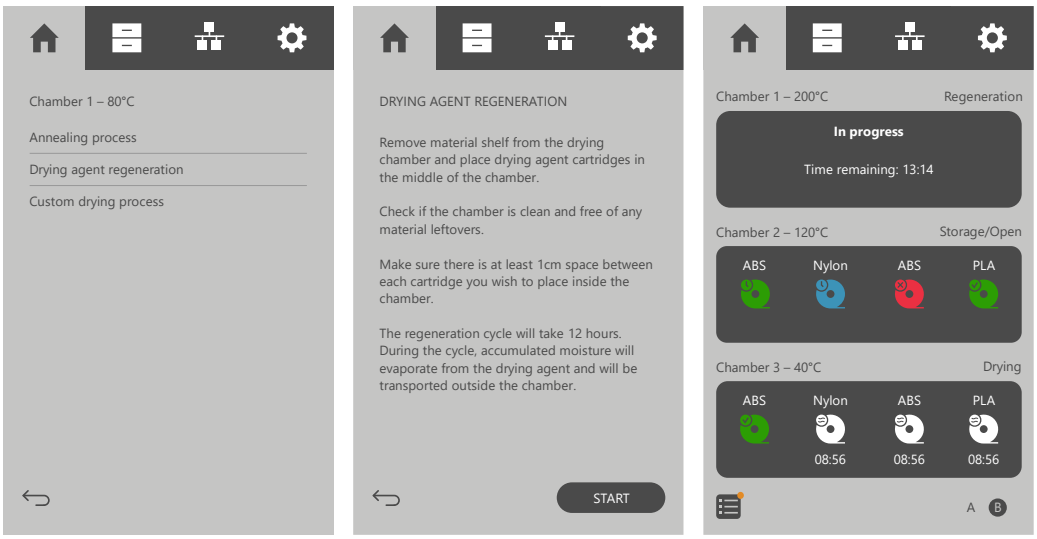

Fig. 46 Screens demonstrating the activation of the regeneration process of desiccant cartridges

To cancel the regeneration process of desiccant cartridges, press on the chamber area during the process. After pressing the chamber area, confirm your intention to cancel the process by pressing the ABORT button. To reset the chamber status to empty, press the chamber area.

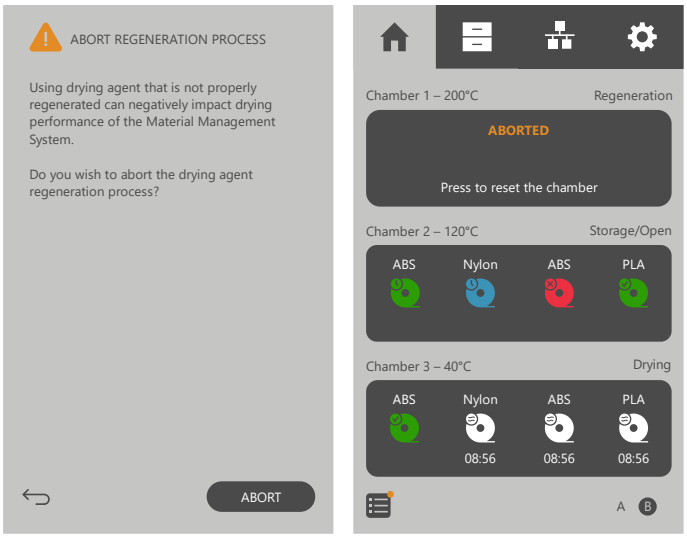

Fig. 47 Screens demonstrating the process of cancelling the regeneration of desiccant cartridges

6. USER DEFINED PROCESS (optional)

In the extended version of the 3DGence Material Management System, which is configured accordingly at the production stage, it is possible for the user to define the basic parameters of the device cycle himself. The parameters that the user can define are as follows:

- Cycle temperature: between 50°C and 200°C.
- Cycle time: from 1 minute to 99 hours and 59 minutes.
- Storage temperature after the process: between 50°C and 80°C

To start your own process, enter the process wizard screen and then select CUSTOM DRYING. When CUSTOM DRYING is selected, a set of parameters will appear on the screen for you to define. When the START button is pressed, the cycle will start automatically. At the end of the set cycle, the chamber will automatically switch to material storage mode.

NOTE: In the user-defined process mode, all functions for tracking material status (including the SMM TAG factor) are disabled.

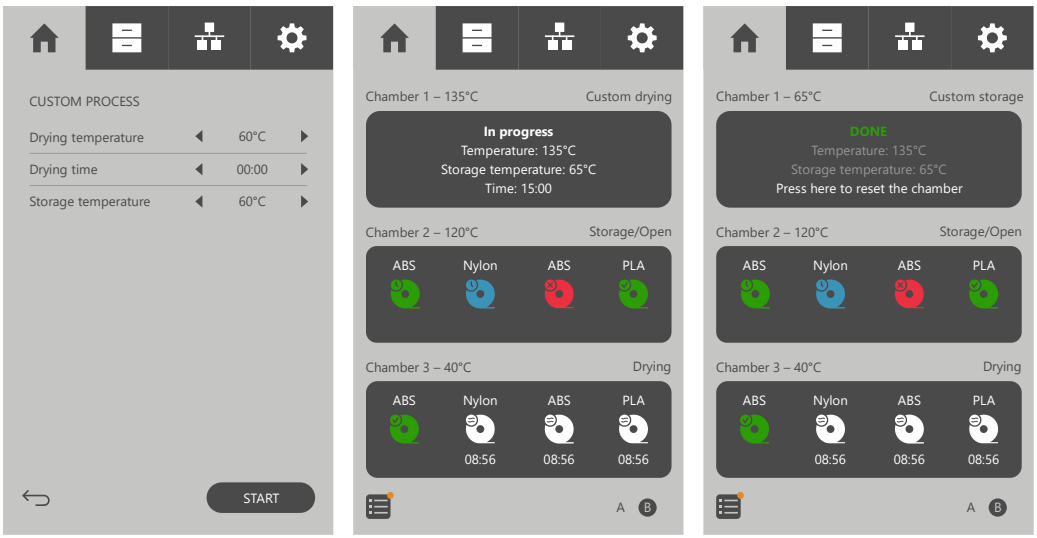

Fig. 48 Screens demonstrating the activation of the user-defined process

To cancel the user-defined process, press on the chamber area during the process. After pressing the chamber area, confirm your intention to cancel the process by pressing the ABORT button. To reset the chamber status to empty, press the chamber area.

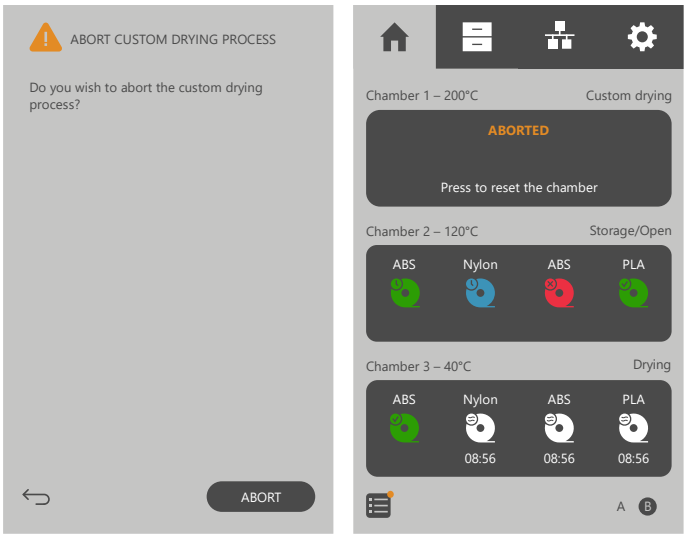

Fig. 49 Screens demonstrating the process of cancelling the user-defined process

VII SOFTWARE

1. 3DGENCE CLOUD

3DGence CLOUD is a software designed to remotely support a set of printers in a fleet of machines. The software has been developed to meet Industry 4.0 requirements for 3DGence devices and allows remote communication with the 3DGence INDUSTRY F350 printer. Communication in the system is encrypted. User .stl files are split into multiple elements and encrypted as .3dg files. 3DGence has no access to files uploaded to the system by Customers. 3DGence CLOUD allows full control of the 3D printing process, including starting and queuing prints, collecting statistics and accessing service functions. It is a solution that streamlines workflow and enables remote control of printing.

Main functions of the system:

- remote control of 3D printers,
- print queuing,
- monitoring of printed models by means of a camera placed in the printer,
- remote monitoring of the operation of the MMS device including viewing the inventory of available materials,
- problem reporting - service support,
- managing the 3DGence machine park: adding and deleting machines in the system, making machines available to appropriate users with specific rights,
- giving different privileges to different users,
- access to files made available by the manufacturer,
- collection of statistics.

Creation of a Customer account in the 3DGence CLOUD system is done by 3DGence engineers during installation of the device or after an e-mail contact at support@3dgence.com. The only requirements to use the system are Internet access and consent to the processing of personal data.

VIII MAINTENANCE

To ensure a high level of safety, the manufacturer recommends the use of spare parts with numbers that correspond to the factory numbers. If such parts are not available, it is recommended to contact the 3DGence technical support department.

1. **Once the process is completed in the chamber**
    - Make sure that there are no loose parts in the device chamber that could damage the chamber fan.
2. **Once a week or more frequently**

    2.1. Housing of the device

    - Clean the device housing door with a soft damp cloth.
    - The cleaning can be done with mild cleaning agents.
    - Exposed electrical components may not be left in contact with water or detergent.
    - Clean the operator panel with a microfibre cloth designed for cleaning screens. In addition, a specialist LCD cleaner can be used.
    - The communication sockets (USB, LAN) should be cleaned with a hoover.

    2.2. Cleaning the inside of the chamber

    - Empty the chamber before cleaning it.
    - Wait for the chamber to cool down if necessary.
    - Use water or water with a mild detergent for cleaning.
    - After cleaning, dry the cleaned surfaces and install the drawer.
    - When cleaning, pay attention to the temperature sensors so as not to damage them accidentally.

IX TECHNICAL SUPPORT

If you experience a problem with the device or software that is not addressed in the manual, please contact the 3DGence technical support department.

When contacting the technical support, in addition to a detailed description of the problem, please provide the serial number of the device.

Forms of contact:

- report form at www.3dgence.com/support,
- e-mail: support@3dgence.com,
- telephone: +48 32 438 98 64,
- reporting form on the 3DGence CLOUD platform (www.cloud.3dgence.com).

X GLOSSARY

ABS (polyacrylonitrile-butadiene-styrene) - one of the main consumables of 3D printers, next to PLA. It is characterised by high impact strength, hardness and scratch resistance. It is not resistant to UV radiation. Soluble in acetone, which allows post-production of prints by acetone vaporisation. ABS prints can also be glued together with an ABS solution in acetone. ABS has a fairly significant thermal shrinkage (up to 0.7%). The typical operating temperature for ABS printing is 220 - 250°C and about 100°C for the work platform. A heated workspace is necessary to maintain the dimensional consistency of the printed elements.

Adhesion – in the context of 3D printing, the adhesion of the print to the working platform of the device. Insufficient adhesion of the printout may result in partial or complete detachment of the printout from the table during printer operation. Grease or dirt on the table adversely affects adhesion.

Bridge – a part of the model printed in the air, suspended between two parts of the print. It is subject to special recalculation when preparing the file for printing. If the bridge is too long, it may become deformed. In such cases, the printing element must be supported by supporting structures.

Brim – a way to improve the adhesion of prints to the working platform. It consists in increasing the area of adhesion to the platform by generating additional, external contours of the actual solid at the level of the first print layer. The more contour lines are added, the greater the area of adhesion. Usually between 5 and 20 additional contours (brim lines) are used. The brim should be used if there are problems with the print peeling off the working platform.

CAD (Computer Aided Design) – a collective term for various computer-aided design processes. The CAD methodology is used in mechanical, electrical, medical and architectural engineering, among others. The CAD methodology is based on geometric modelling to create a two- or three-dimensional representation of the component being designed. Multiple CAD software packages are available to suit your needs and requirements. Models in STL or OBJ formats are exported from these programs for 3D printing. The most popular are: SolidWorks, Inventor, PTC Creo, CATIA, Rhino, SolidEdge - however, there are many others.

Curling – a negative phenomenon occurring during 3D printing with the FFF technique. Curling can most often be seen when printing overhangs or sharply folded elements of solids. It consists of curling up the edges of the print. In extreme cases it can lead to print failure. However, it always adversely affects the visual aspect, especially of the bottom surfaces of the print. It also leads to the print head colliding with the print during operation. The primary method to combat curling is to actively cool the print. If running the fans does not help, it is worth reducing the print speed.

Model slicing – a process to generate paths and instructions for the printer (machine code) from a 3D model. At the slicer level, settings such as layer height, print speed, fill density, solid wall thickness or temperatures for the nozzle and working platform are selected. In addition, you can choose the use and density of supports and one of several ways to improve the adhesion of the print to the working platform (e.g. raft or brim). The 3DGence INDUSTRY F350 printer uses the 3DGence SLICER 4.0 software, where settings for different modules and resolutions have been defined. The final result of the slicers is a machine code representing the given 3D model in the form of a G-code which is interpreted by the printer's electronics.

Nozzle - the part of the print head that is in direct contact with the printout. When heated to the correct temperature, it liquefies the material and forms a plastic thread with the nominal diameter of the nozzle. The nozzle output diameter affects the available resolutions, speed and accuracy of the print.

Extruder – a part of the 3D printer working in the FFF technology. Its task is to feed the filament at a precisely defined rate and thus quantity. The 3DGence INDUSTRY F350 is fitted with a Direct type of extruder. This means that the extruder motors are located directly above the printing module, feeding the material to the print heads via sleeves.

Endstop / limit switch / end position sensor – an optoelectronic switch that limits the movement of the 3D printer beyond the maximum allowed movement. The optical endstop does not require physical contact with the corresponding cutter which guarantees a long service life. However, attention should be paid to its sensitivity to bright light sources which may cause false activation.

Filament – a common term for FFF printing material. Filament is a wire made of a thermoplastic material (PLA, ABS, HIPS, PC, Nylon and others) within a certain tolerance. The filament is wound on a spool. Important parameters when choosing a filament are the manufacturing tolerance and the way it is protected from moisture (preferably the filament is vacuum-packed with a moisture absorber). The large diameter of the spool hub will ensure that the entire length can be used - excessive bending of

the filament (e.g. on a small hub) can make it difficult to use. Once opened, the filament is best stored in a dark, dry place with a moisture absorber.
NOTE: Using materials outside of the 3DGence Certified Materials Database prevents you from using the SMM system.

Firmware – the 3D printer's internal software. It is responsible for interpreting commands contained in machine code (G code). Its effect is the basic signals for heaters, motors and fans. It is responsible for the interpretation of accelerations, temperature adjustment tables and many other factors. Well-tuned firmware is an essential part of a machine's calibration as it is responsible for adjusting breakaways, acceleration and other key parameters for good performance.

Loss of steps – in abnormal operating conditions of the motor and the printer driver (e.g. too high temperature, mechanical resistance) the motor steps may be lost. The symptoms can be seen by moving the print plane in the axis where the motor has lost steps. The visual effects of this fault depend on the path in which the head moves relative to the table. To visualise this better, let's assume that the printout is a cube and the printer has lost its steps halfway through the printout. The printed solid would look as if it had been cut in half in the XY plane and glued together with a displacement.

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

Normal – a common name in 3D modelling for a vector normal to a plane. A normal vector is a vector perpendicular to a plane or, in the case of other surfaces, perpendicular to a plane tangent to the surface at a given point. In 3D modelling, its turn defines the interior and exterior of a solid. In most cases it is assumed that the normal correctly faces the outside of the solid.

Nylon (PA) – a group of polyamides developed by DuPont. Nowadays, they are also used to produce robust 3D printing filaments. The main advantage of such prints is the high mechanical and chemical resistance, the possibility of processing and colouring with knitting dyes. The prints are also characterised by a certain flexibility and resistance to tearing.

OBJ – a popular format of 3D files. It may contain an additional MTL (Material Template Library) file, which is irrelevant to FFF printing, containing information about the material libraries defined for the model. OBJ files, in addition to geometry description, vertex placement and normal turns, contain information about UV coordinates for textures. It is read by the 3DGence SLICER 4.0 software.

PLA (polylactide, a polymer of lactic acid) - produced in industrial quantities using ecological methods. Cereals, e.g. maize meal or bacterial cultures are the main sources of starting materials. It is the basic material for 3D printing in FFF technology. Low cost, no thermal shrinkage, good adhesion to the work platform and a multitude of fill and colour variations make PLA the most versatile and widely used filament. It gives off a faint, neutral odour during printing, emits no harmful substances and is fully biodegradable. More fragile and susceptible to mechanical failure than ABS, making its use for functional prototypes of mechanical devices limited.

Overhang – the characteristic shape in the printed model from the point of view of FFF printing. An overhang occurs where the plane of the model forms an overhang above the work table or other part of the model. The 3DGence SLICER 4.0 software recognises these surfaces and analyses the overhang angle relative to the work table. If the angle exceeds a limit angle defined in the software, 3DGence SLICER 4.0 will automatically generate support structures under such a surface.

PVA (polyvinyl alcohol) – water-soluble vinyl alcohol polymer. Water-soluble filaments are produced from it, making it ideal for printing support structures in two-material printing. The actual model is printed from an insoluble material (usually PLA), which allows it to be thoroughly cleaned in a water bath. Using an ultrasonic cleaner speeds up the process considerably.

Raft – a method to increase the adhesion of the print to the work table. A raft is a base (platform) thick in several alternating layers that is generated by the slicer under the model. The raft is larger than the outline of the model which increases the adhesion of the print to the table and also prevents the effects of thermal shrinkage (plastic-plastic bonding). The advantage of the raft is its ability to level out any unevenness of the table. Raft also makes it easier to print models that do not contain a flat surface to serve as a base. Brim, described earlier, and raft should not be used simultaneously.

Stepper motor – is an electric motor that has the ability to move by a strictly defined angle. This is made possible by the specific positioning of pairs of electromagnets A and B around a metal pinion connected to the motor shaft. Stepper motors, due to their ability to control the position very precisely, are the main drive of the 3DGence INDUSTRY F350 printer.

Skirt – an additional material printed at the very beginning of the print around the model at a distance of a few millimetres from it. The skirt is not an integral part of the model. A function designed to initiate and stabilise the flow of plastic through

the head. By observing how the printer places the skirt on the table, we can also assess whether the table is correctly levelled and whether the printout will adhere to it correctly.

Support – it is a "support" added by the model designer or cutting software, on which the parts of the model hanging in the air are supported. A properly executed support is not part of the model and can easily be detached after printing. 3DGence SLICER 4.0 generates the supports automatically. The support generated by 3DGence SLICER 4.0 has two parts - loose material and so-called dense support layers, directly supporting the actual model.

STL (Surface Tessellation Language) – one of the primary 3D file formats. It describes only the position of the vertices of the triangles forming the solid and the turn of the normal of those triangles. It does not include information about colour, materials, textures and other graphical elements included in other, more extensive 3D file formats. Originally implemented by 3D Systems for stereolithography printing.

Spindle – is a part of the extruder, directly driven by a stepper motor. It enables precise dosing of the filament into the printer nozzle thanks to a concave, sharply serrated recess that "bites" into the plastic wire. The element which closely cooperates with the spindle is a pressing tool, ensuring proper contact between the spindle and the filament.

Warping – a negative phenomenon occurring in FFF printing, mainly involving materials with high thermal shrinkage. It consists in tearing off the outermost parts of the printout, usually the corners, from the working platform. This is counteracted by the device's heated table and working chamber.

.3dg – precise instructions to the machine, e.g. in which direction, how fast and in which axis to move. The code for the printers is generated by the slicing software (slicer). It stores all the data on component temperatures and motor rotation in a precise sequence that amounts to head movement and extruder behaviour. Code commands are sent line by line to the printer driver processor during printing. The processor interprets the code based on its Firmware and sends the appropriate signals to the relevant components.

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