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POSTPRO SAFETY AND PARAMETER TRAINING (FA326)

POSTPRO SF

AUGUST 2024 // V5.0

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AGENDA

1. Safety
2. Machine Overview
3. HMI Screen
4. Pre-Processing Tips and Tricks
5. How The Process Works
6. Running a Process
7. Troubleshooting
8. Recipe and Technical Support

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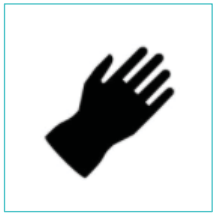
1. Safety

SAFETY

PPE

- Disposable nitrile gloves.
- Closed toe safety shoes.
- Laboratory spill resistant coat.
- Close fitting chemical eye protection.
- Half face mask with AX-P3 type filters.







UPS

- Uninterruptable Power Supply.
- Activates when the machine loses power or is powered off incorrectly.
- Approx. 5 minutes of operation before total shutdown.

EMERGENCY STOP

- Located on the front left-hand side of the machine.
- Stops all movement and power.
- Process run cannot be recovered.

FORCED DRYING CYCLE

- If the machine shuts down or an E-stop is pressed during a cycle it will enter a forced drying cycle when the machine resumes.
- Short drying cycle to extract any potential solvent from the chamber.
- If this is interrupted, it will continue to attempt the forced drying cycle until it completes.

TWO HAND START

- The door only moves when the two hand start is pressed.
- Located on both right and left side of the machine.

2. Machine Overview

MAIN COMPONENTS



1. **HMI:** With the HMI the user can set process parameters, start a process run, diagnose the machine in case of warnings or errors and communicate with AMT's support.
2. **ON/OFF Isolator:** This switch is used to power on and off as well as "lock-out" of the machine when carrying out maintenance.
3. **E-Stop:** An emergency button is placed on the front side and should be pressed in case of an emergency.
4. **Process Chamber Door:** The door lowers to give access to the processing chamber and raises again during processing.
5. **RFID Card Reader:** Holding an access card in front of the RFID reader logs the user into their respective access level.
6. **Door Movement Buttons:** To avoid getting trapped, the two buttons must be pressed simultaneously to activate the door opening and closing mechanism.
7. **Canister Drawer:** Location where the canisters are loaded into the machine.
8. **Air extraction outlet:** The outlet which is connected to the extraction unit.
9. **Extractor connection:** Start-Stop connection to the Extraction Unit.
10. **Ethernet connection:** To connect the machine to the AMT server for remote monitoring.
11. **Power connection:** Power lead to connect to the mains power supply

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1. HMI
2. ON/OFF Isolator
3. E-Stop
4. Process Chamber Door
5. RFID Card Reader
6. Door Movement Buttons
7. Canister Drawer
8. Carbon Filter Door



9 **Air extraction outlet**

10 **Extractor connection**

11 **Ethernet connection**

12 **Power connection**



CANISTER & CANISTER CONNECTIONS

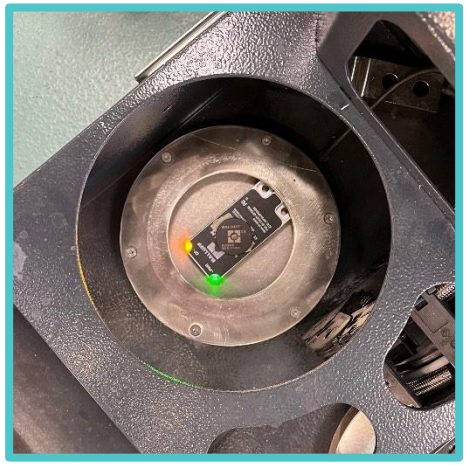


Male & Female Quick Connector





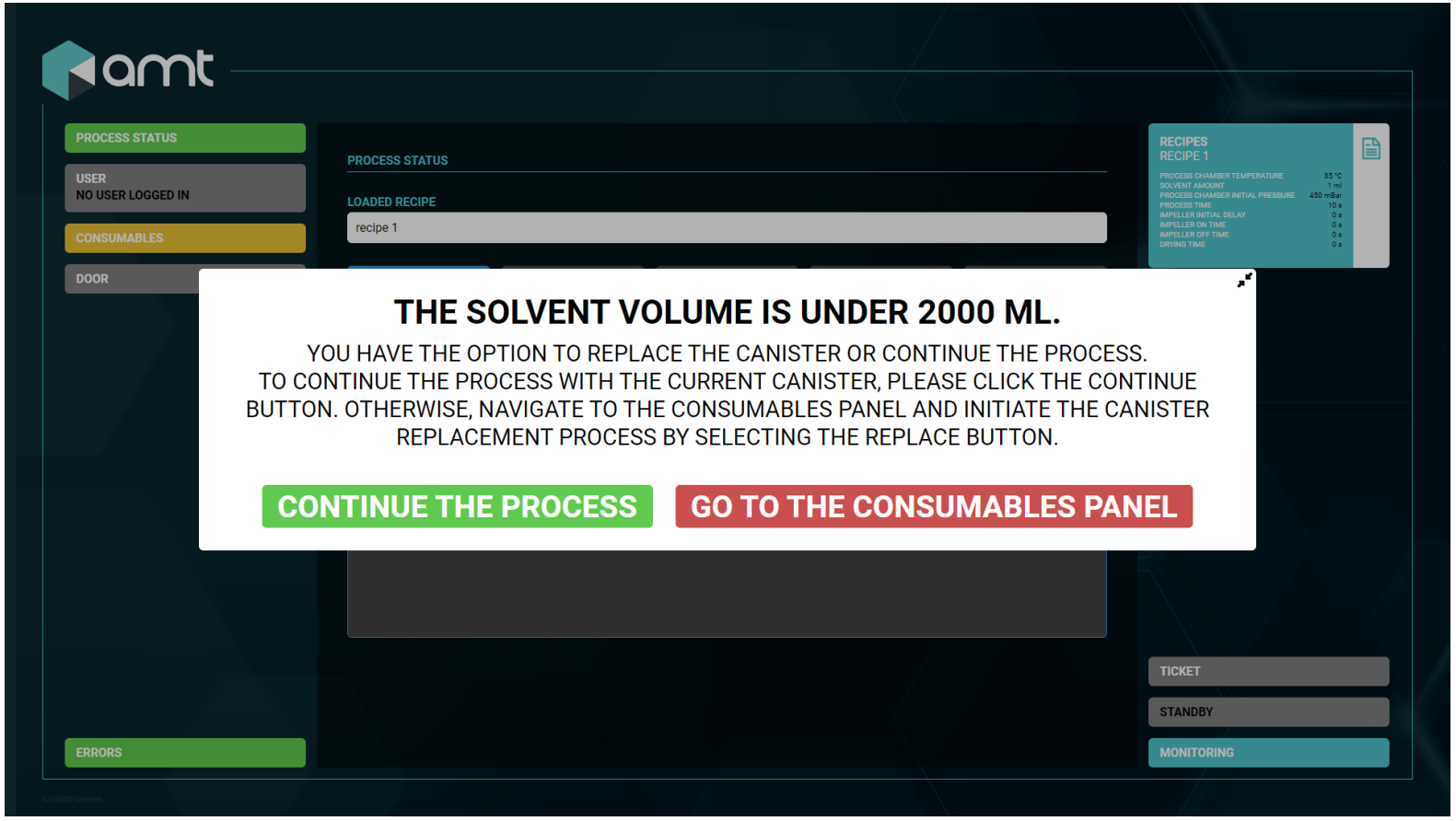
RFID Reader and Chip





CANISTER REPLACEMENT PROCESS

The canister replacement is automatic. The machine will talk you through the replacement process, please follow the instructions on the HMI screen.



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3. HMI Screen

MAIN SCREEN

Process status: Click to see the status of a current process.

User: Identifies who is logged into the machine.

Consumables: Displays information about the inserted cannisters and carbon filter.

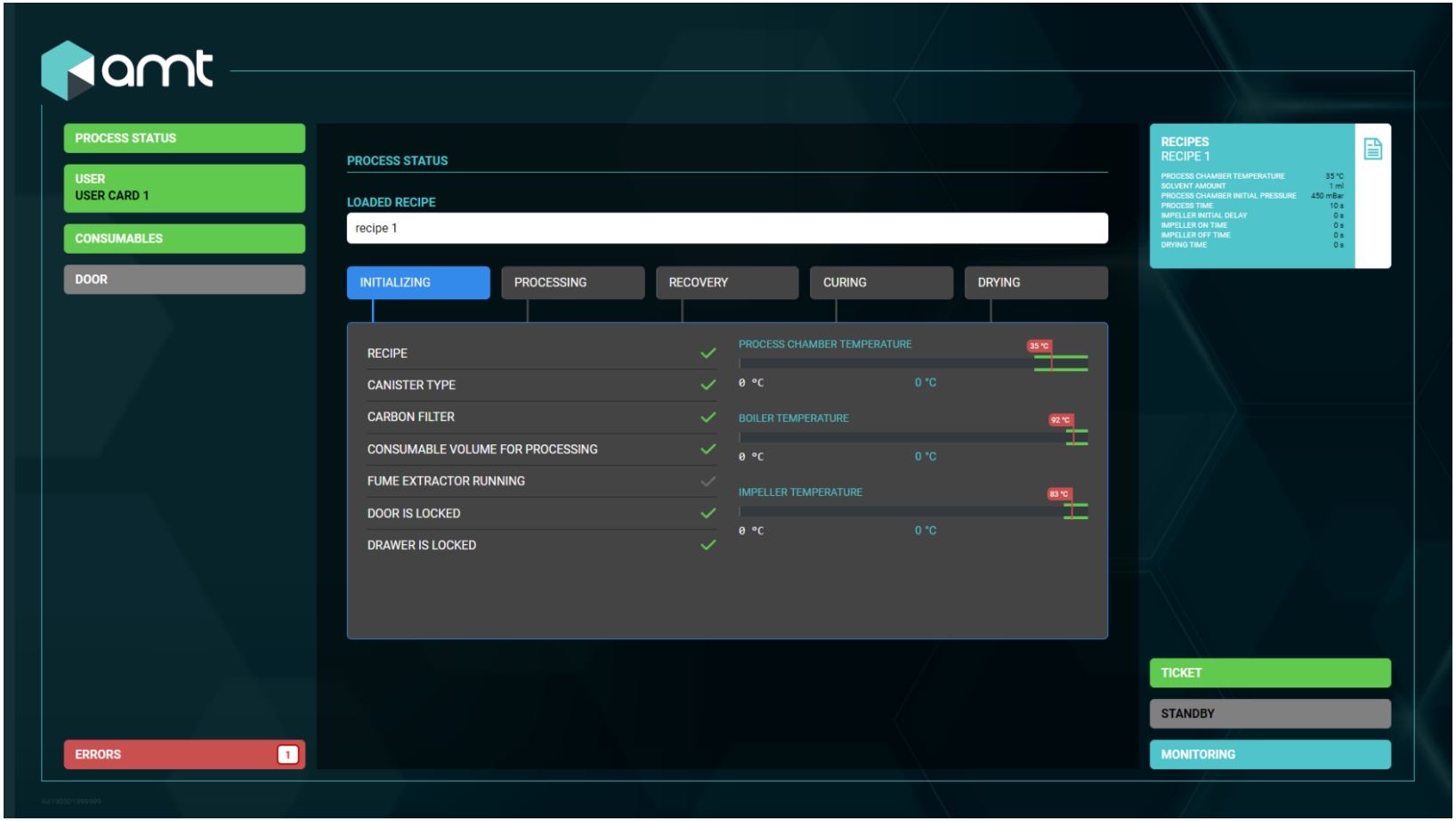
Errors: Lists the present errors.

Recipes: Lists the stored recipes on the machine.

Ticket: Allows tickets to be created and sent directly to AMT support.

Standby: Sends the machine into “Standby Mode”.

Monitoring: Allows the operator to view advanced machine parameters.



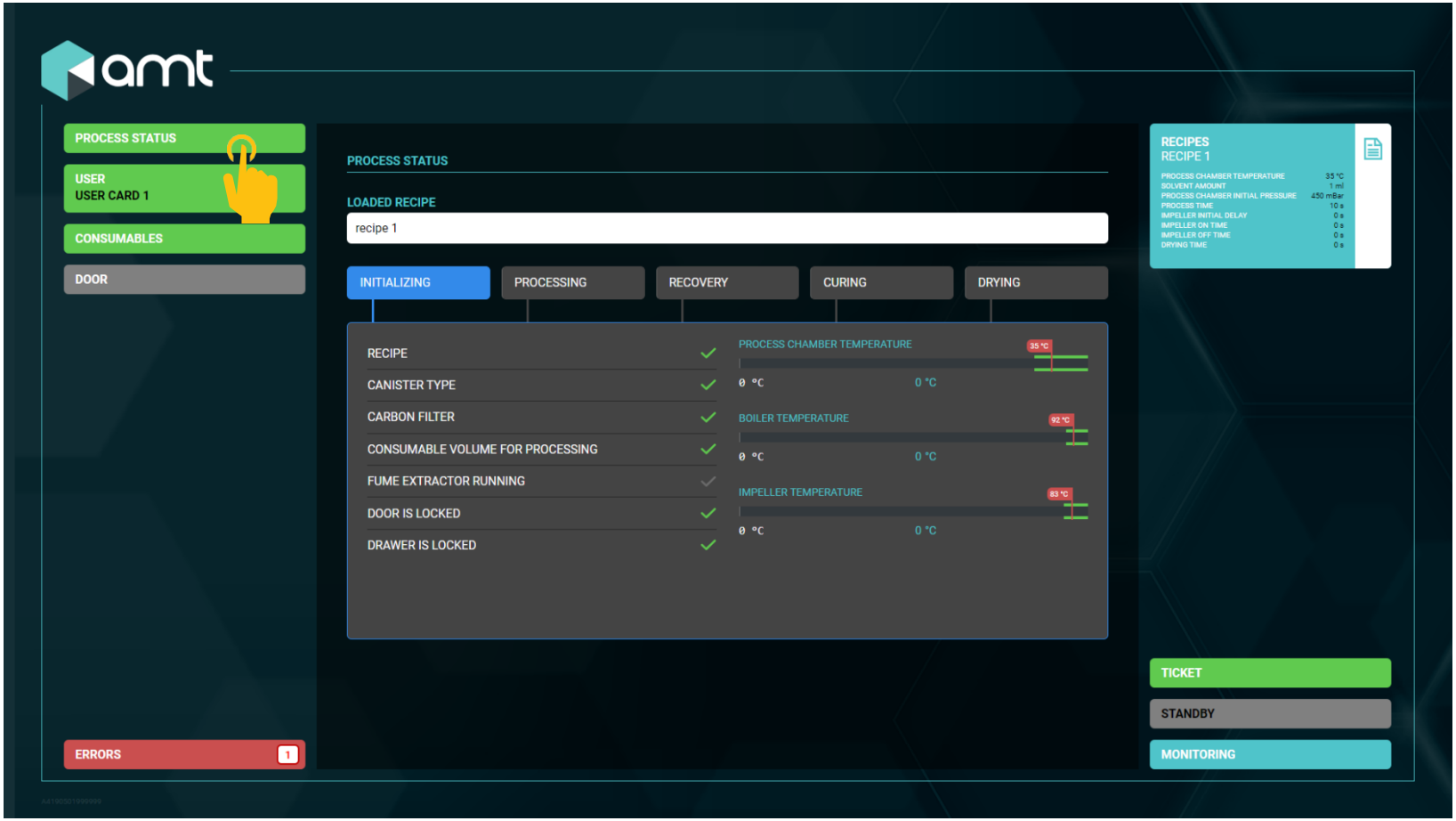
PROCESS STATUS SCREEN

The five stages of the recipe are as follows:

- Initialization
- Processing
- Recovering
- Curing
- Drying

The current stage of the process is highlighted in blue.

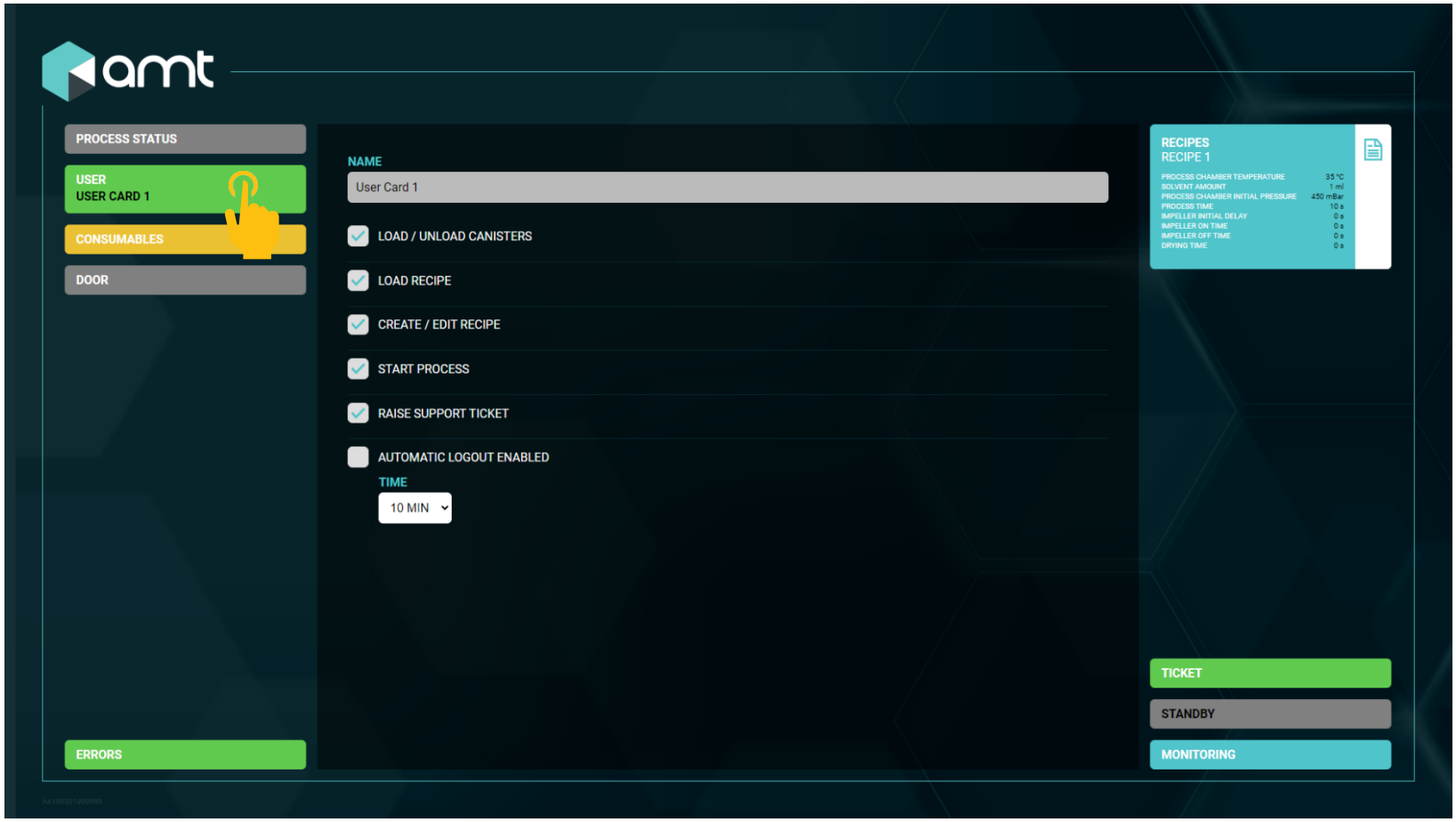
Within each stage, the main parameters, including the time remaining, can be seen.



USER

Identifies who is logged into the machine and the permissions of the selected user.

It is also possible to edit the user's permissions here, this will be discussed as follows.



USER LEVELS

USER CARD	ACCESS CARD	SERVICE CARD
• Load/Unload canisters • Load recipe • Create/Edit recipe • Start process • Automatic logout enabled • View/clear errors • Customizable access level	• This card can be used to set up the different access levels on the user cards • Cannot be used as a user card	• Full unrestricted access • Access to the “Manual mode” menu • For AMT/authorized engineers only

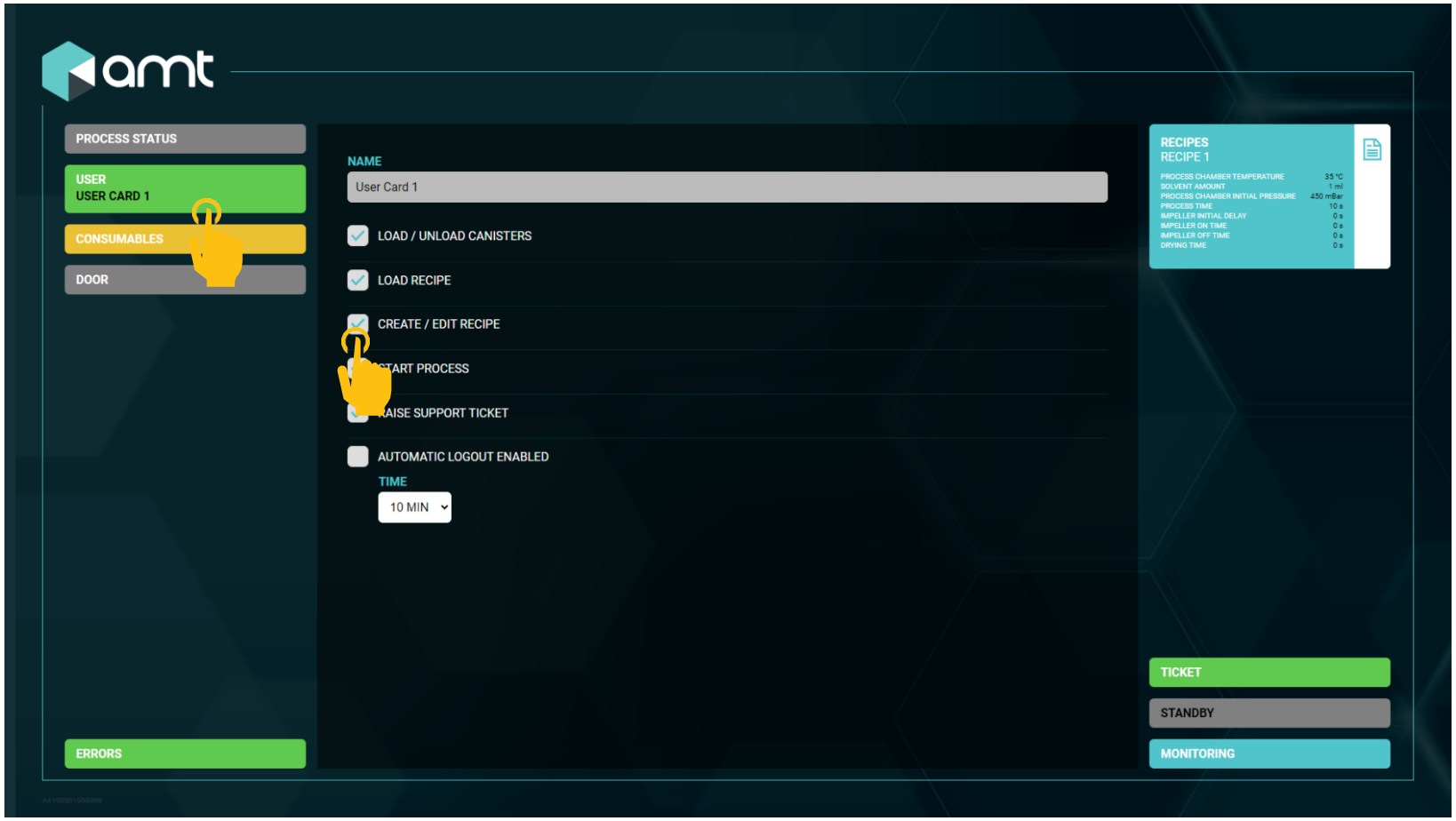






CHANGING THE USER CARD'S PERMISSIONS

1. Scan the User Card on the RFID to log in.
2. Click the "**USER**" button on the left-hand side.
3. Hold the "Access Card" in front of the RFID reader. You now have permission to edit the access of the User Card.
4. Do any modifications to the card which you require.
5. Hold the User Card in front of the RFID reader again until the following message is displayed "**PERMISSION HAS BEEN CHANGED**"
6. Use the machine as normal.



CONSUMBALES SCREEN

Provides all the important information about the cannisters and carbon filter which are loaded into the machine:

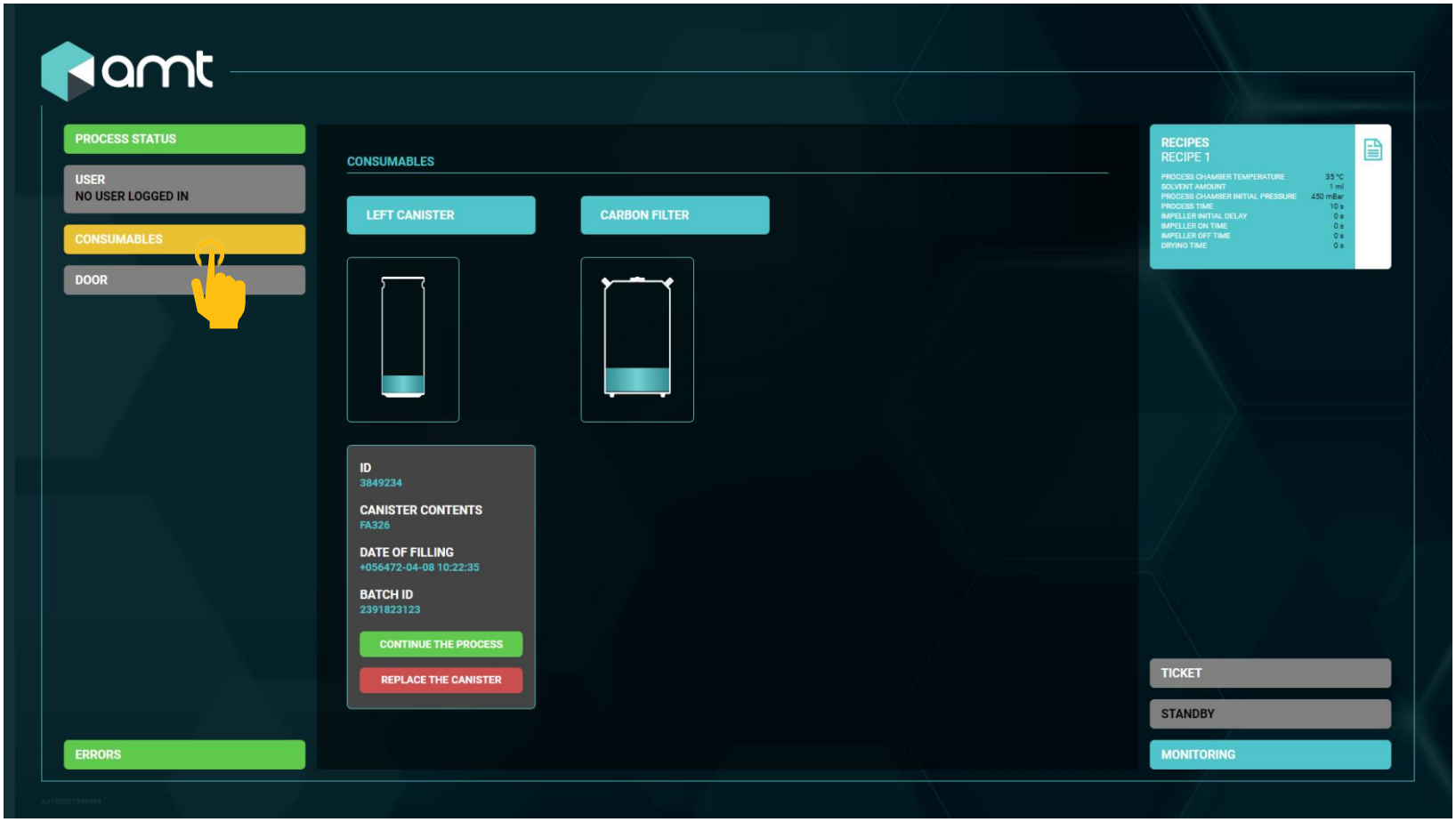
- ID Number of Cannister
- Canister Contents
- Date of filling
- Batch ID Number

When the consumable or carbon filter is nearly finished, the consumable button will go yellow and red when it is empty.

This screen is also used to initiate the canister replacement process and reset the carbon filter.

Note: The user must have permission to change consumables for this to be available.

Note: In the infographics, the canister level will go down as it is “Emptied” whereas the carbon filter level will increase as it is “Filled”.



ERRORS SCREEN

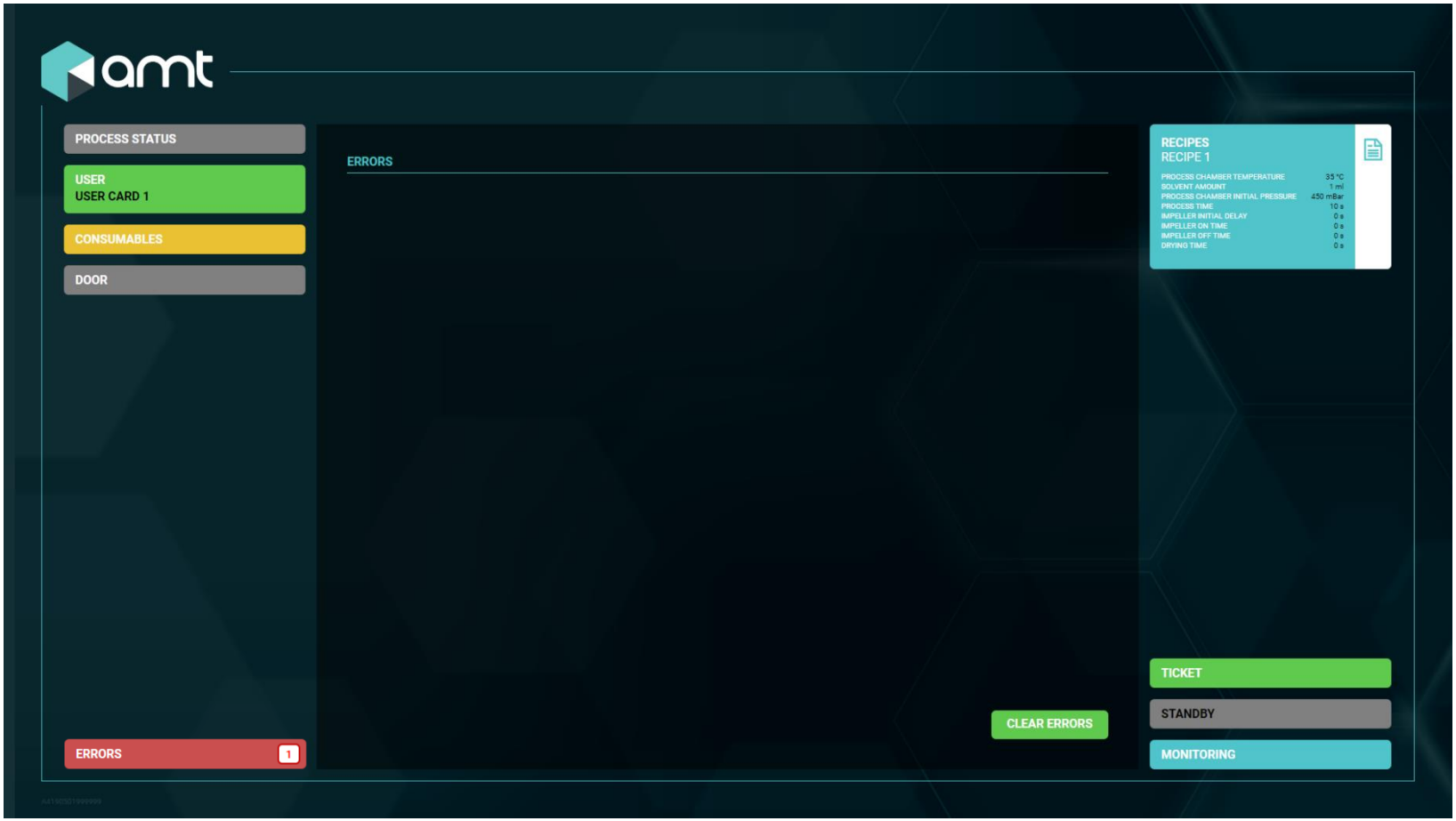
Errors can be:

I = Informative error: Provides information related to different components in the system. Can be cleared by the operator, by pressing the 'Clear Errors' button, and the machine will continue to operate as normal

S = Soft error: Informs the machine operator about a minor issue (e.g. measurement out of tolerance). If it continues to occur, it can turn into a Hard error. Soft Errors can be cleared by the operator, by pressing the 'Clear Errors' button, and the machine will continue to operate as normal.

H = Hard error: Informsthe machine operator about a major issue in the system. Can not be cleared and the machine won't start a process until it is resolved.

Note: When there is an error, the error button will turn Red and show the number of errors present.



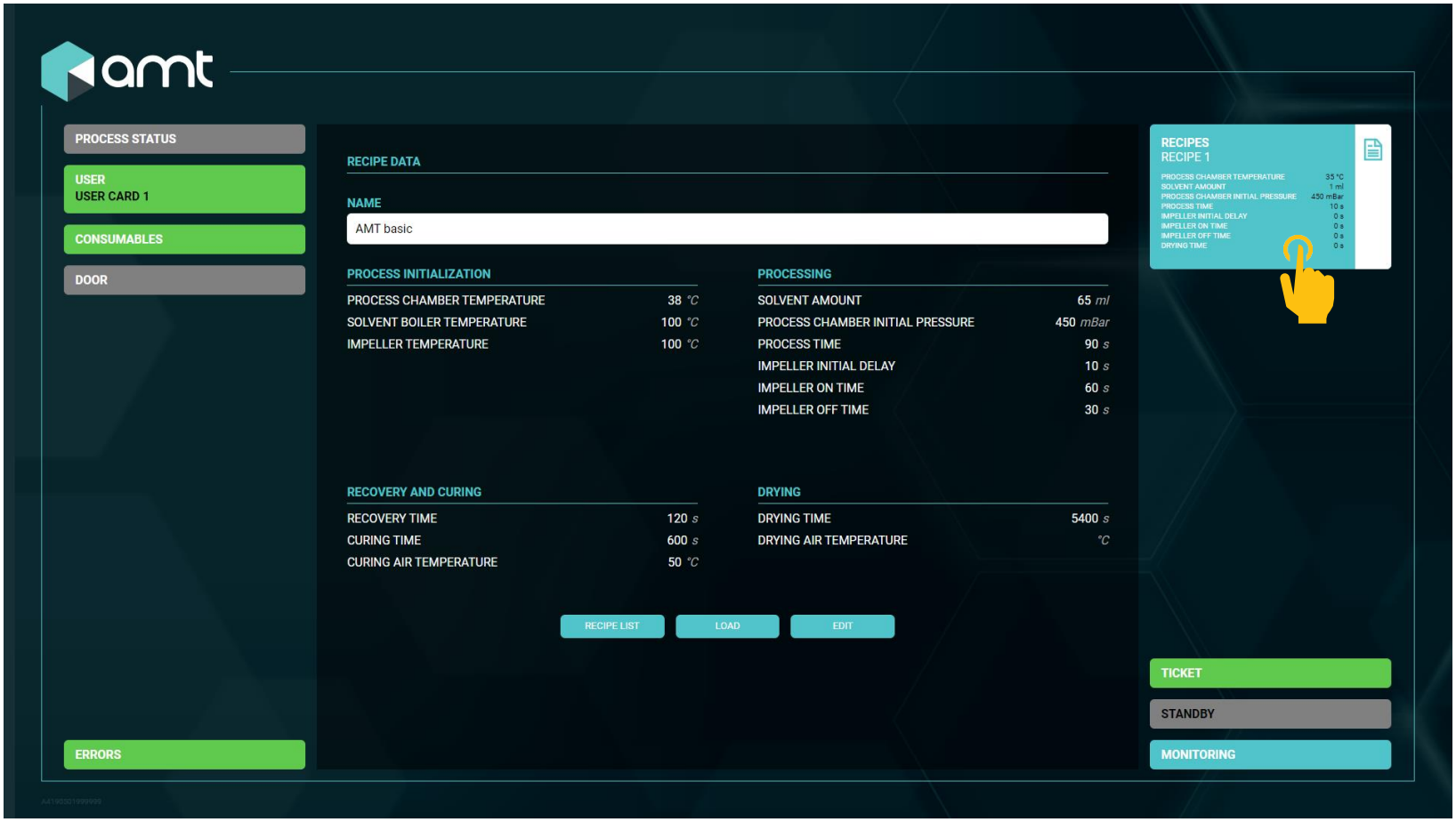
LOADED RECIPE SCREEN

When a recipe is loaded, all of the saved parameters within the recipes can be viewed.

By clicking on "**Edit**" these can then be adjusted. It is only possible to do this if logged in as a user with the required access level.

Clicking on "**Load**", will load the selected recipe so that a process can be started.

To view all the saved recipes click on "**Recipe list**".



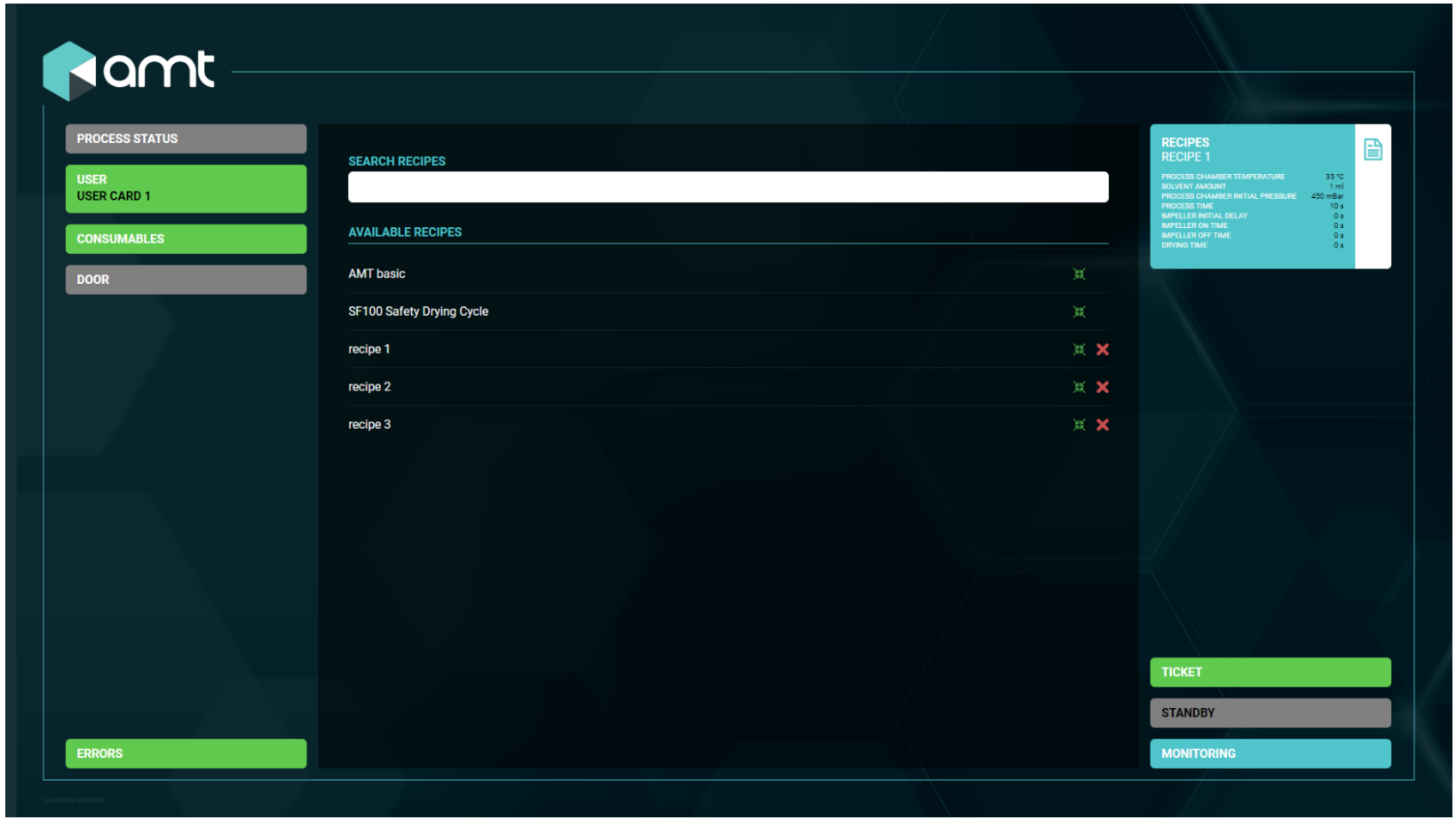
RECIPE LIST SCREEN

By clicking the "**Recipe list**" button on the previous screen the following screen is displayed.

This allows for the different recipes programmed on the machine to be loaded. This is done by clicking the green icon at the end of each recipe.

To delete a recipe, press the red icon at the end of each recipe.

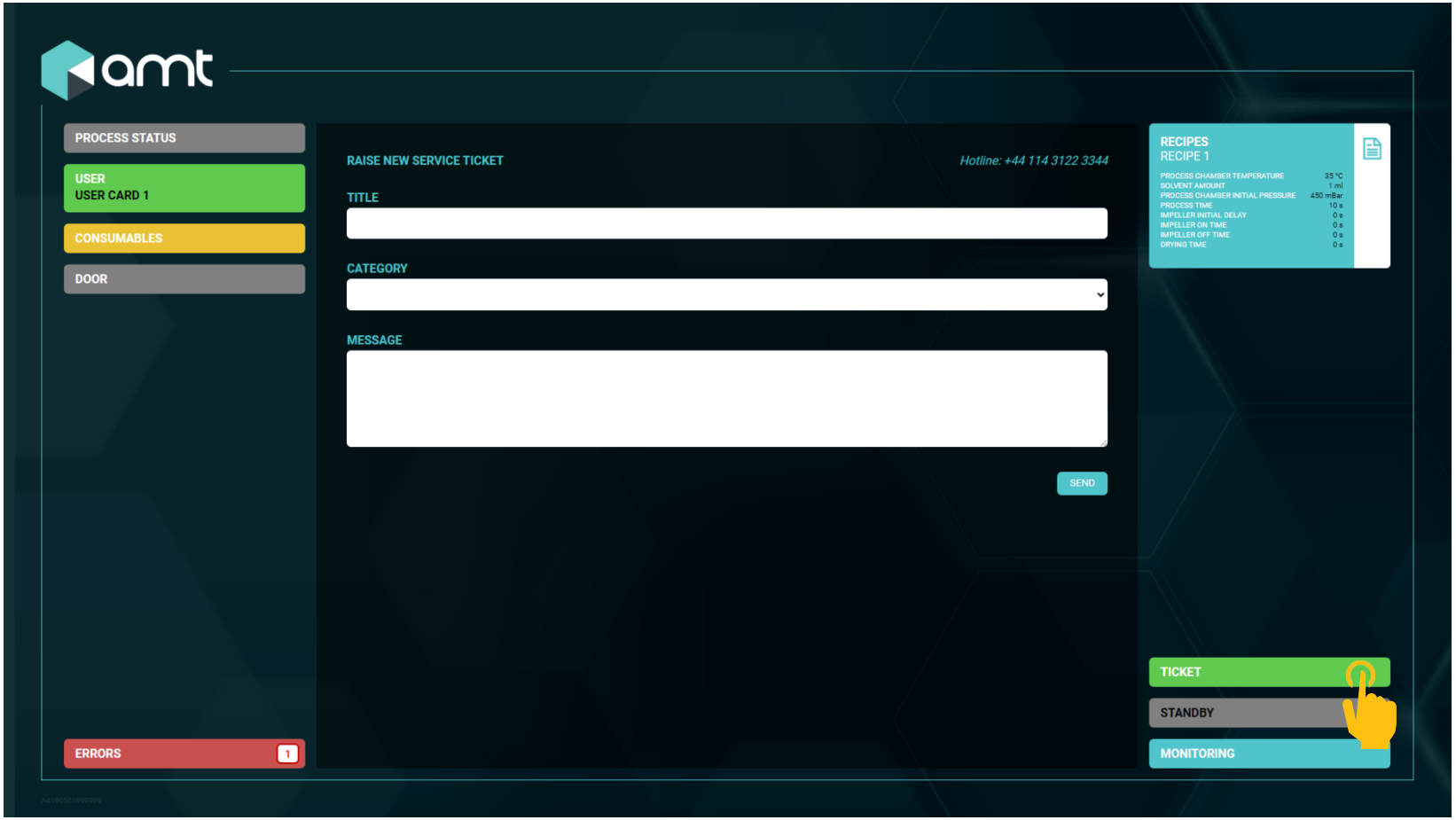
There is also a Search Recipe function to search for the desired recipe.



TICKET

By clicking the "Ticket" button, you will be able to submit a ticket through the AMT ticketing system.

Tickets can also be raised by email or on our support portal. Information regarding this can be found at the end of this training document or the user manual.



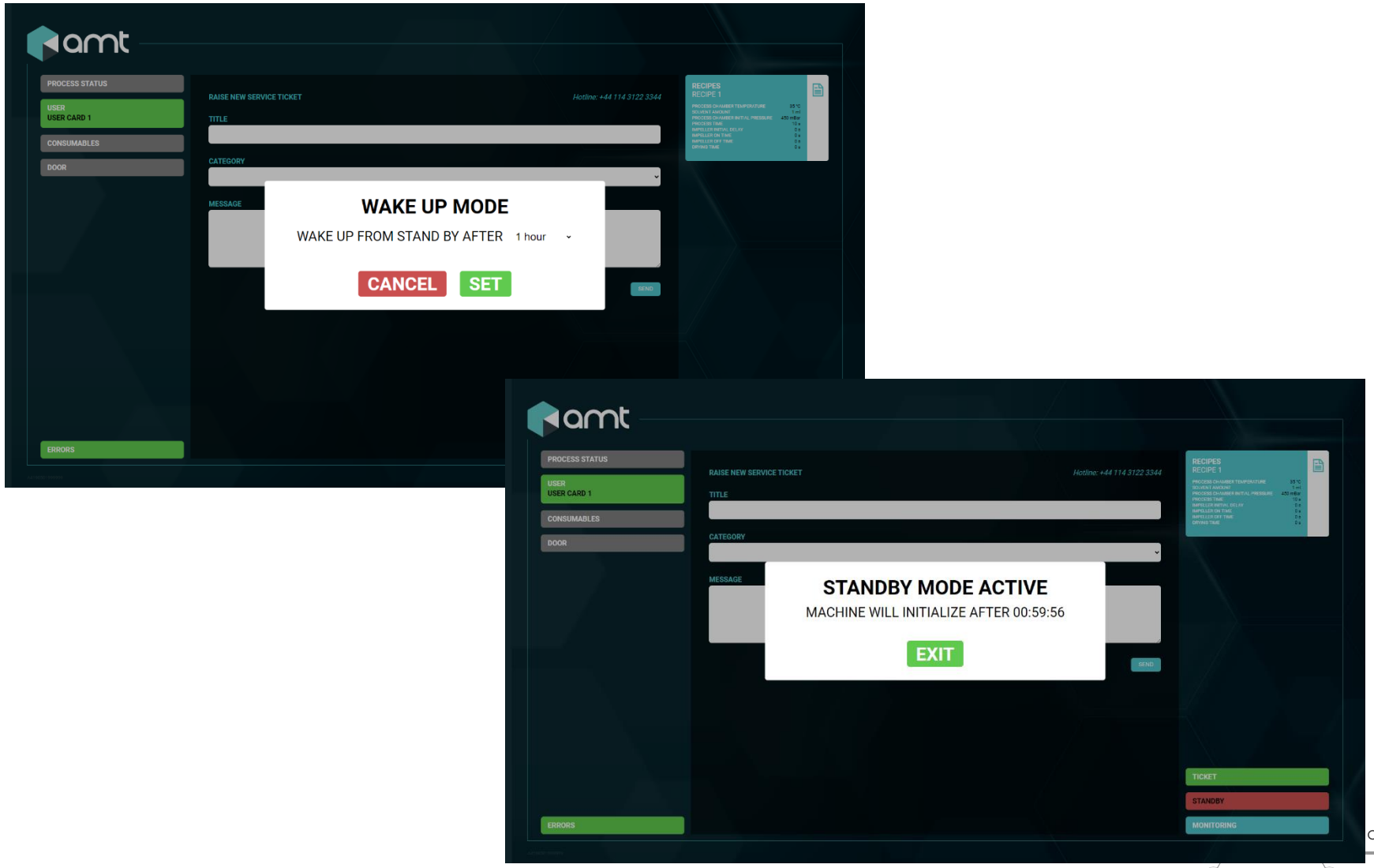
STANDBY SCREEN

If the system is not going to be used for a period of time click on "**STANDBY** " in the bottom right corner.

Once in Standby Mode, the machine can be programmed to automatically wake up after a specified period. To define this value, select the "Wake Up" time from the drop down list and press set.

To leave manual mode at any point, just press the "**EXIT**" button to start using the machine again.

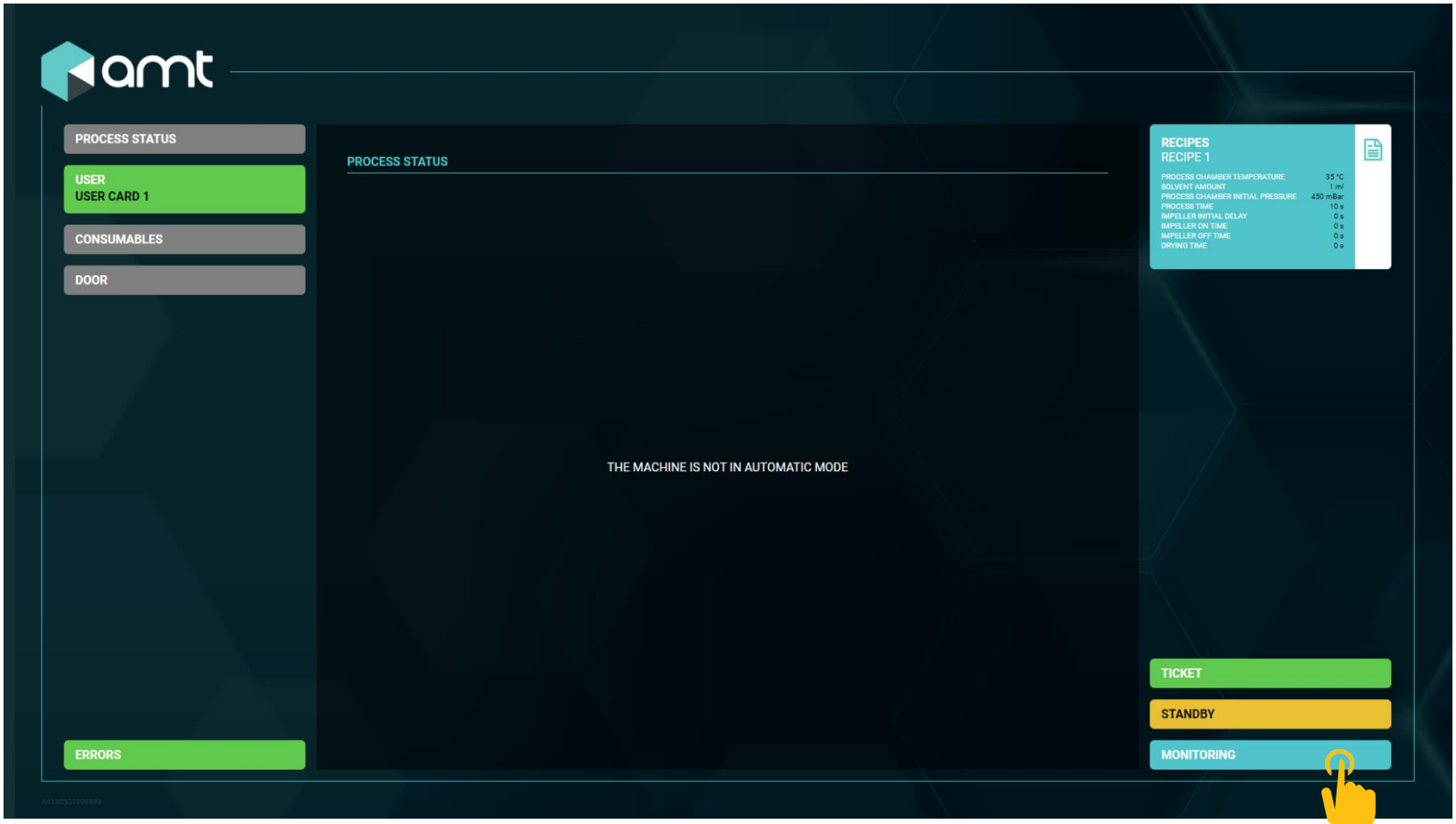
Note: Whenever leaving Standby Mode, the machine must perform a short drying recipes to ensure the chamber is clear of solvent for the safety of the operator.



MONITORING

Monitoring mode allows the user to see advanced machine settings, however, it does not allow them to be adjusted.

This mode can be useful for troubleshooting and settings adjustment.



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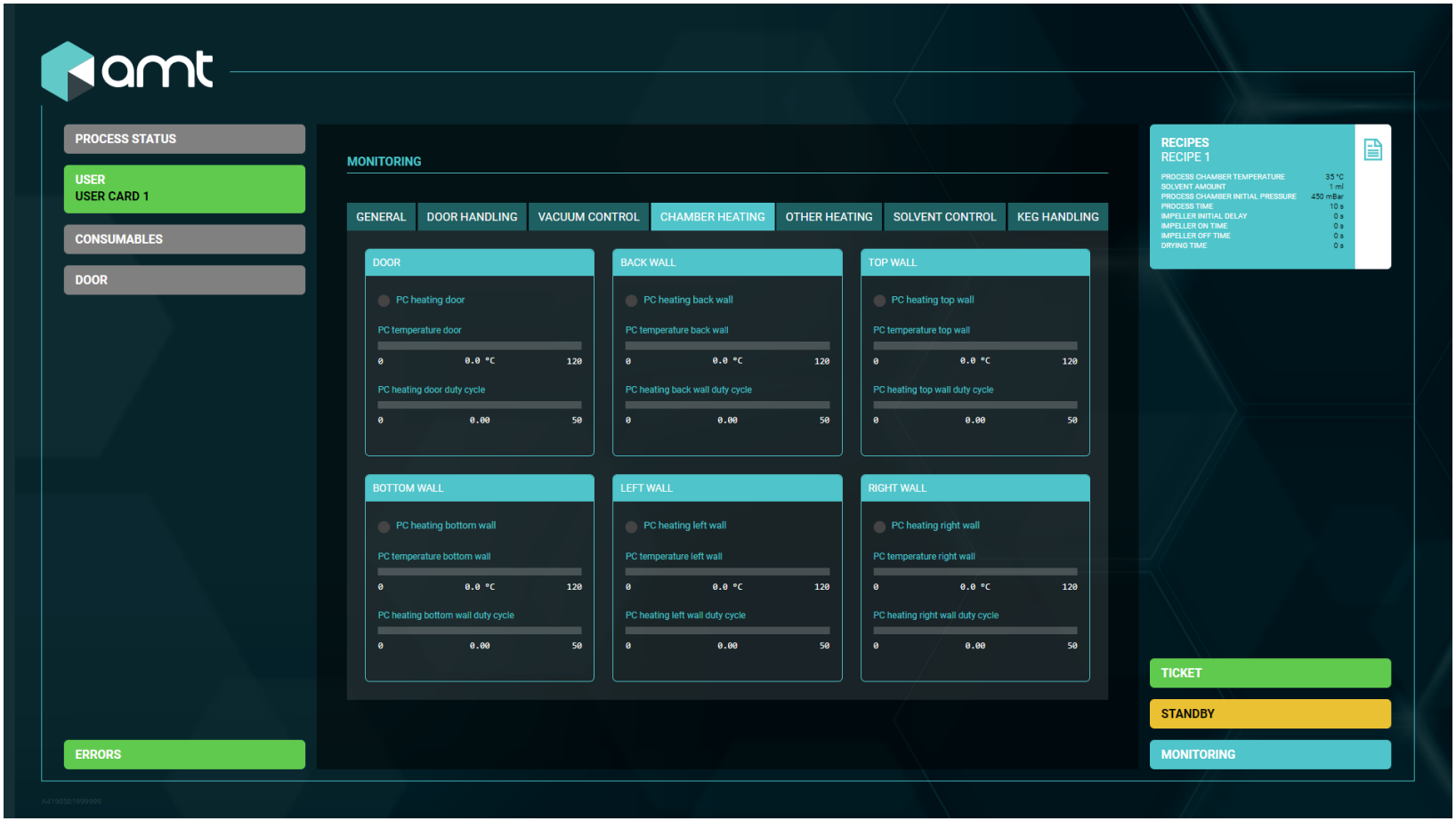


4. Pre-Processing Tips and Tricks

PRINTING

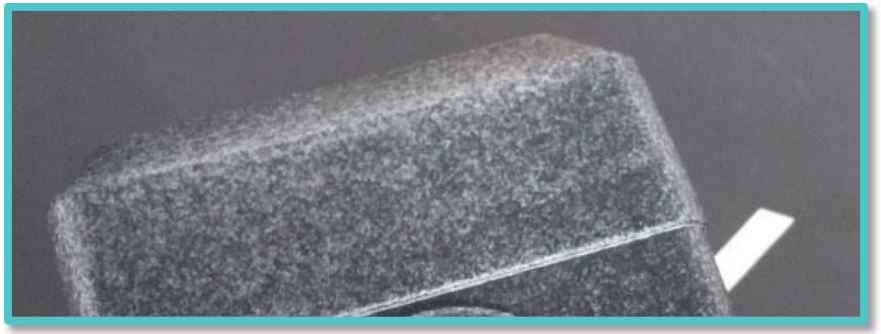
Many factors can affect the printing quality, this includes:

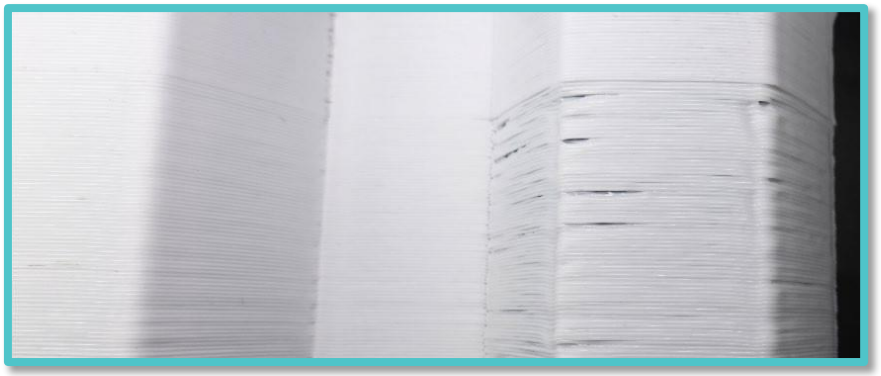
- Design and geometry of the part
- Orientation within the build
- Printing technology used
- Material
- Printing parameters

For this reason, it is important to keep each of these variables as consistent as possible to achieve repeatable smoothing results.

It is also important that the print quality of parts is good, with strong adhesion between layers and no thermal degradation/bleeding since these contribute to how well a part can smooth.

Please note that if the printing quality is poor, the post-processed surface quality will be affected.





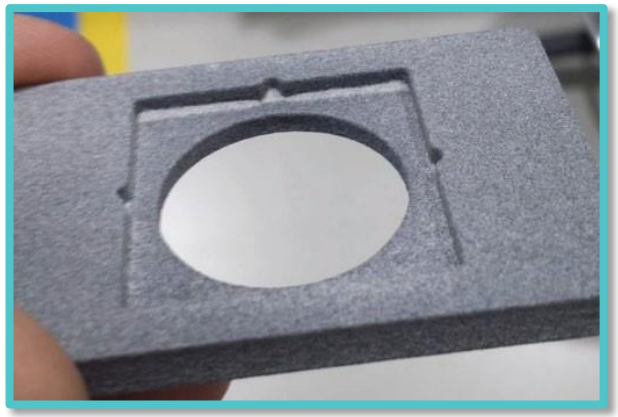


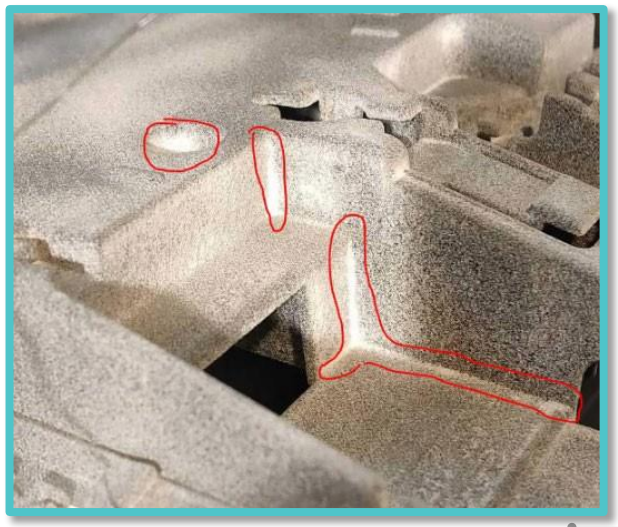
DEPOWDERING

Ensure the parts have been thoroughly depowdered!

There must be **no powder** left on the parts, especially in internal cavities and around sharp features. In general, poor depowdering leads to bad smoothing results as the powder will cause imperfections as it processes.

If necessary, do a secondary blasting step to remove all residual powder from the corners and intricate shapes.



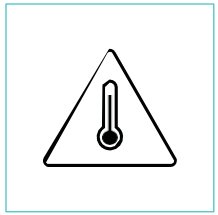


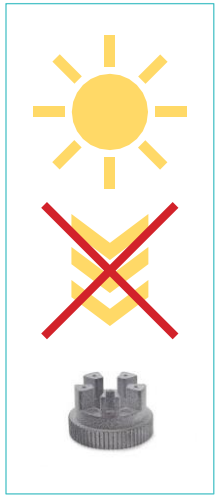
Ensure there is no contamination in the blasting media!

Poor blasting media can also result in contamination being applied to the parts, for this reason, it is important to ensure your blasting media is filtered/replaced frequently.

VAPOR SMOOTHING

Keep the part's temperature as constant as possible before the Vapor Smoothing!





Condensation of the solvent on the parts' surface is highly dependent on the difference in temperature between the parts and the solvent. The warmer the parts are when the process starts, the less condensation will take place and in turn, the less the surface will smooth.

For this reason, store parts out of direct sunlight in a temperature and humidity-controlled room which is between 18-22 degrees Celsius.

VAPOR SMOOTHING

Keep the Vapor Smoothing room clean!

Good housekeeping practices in and around the machine are crucial in preventing unwanted contamination. Parts surfaces are very sensitive to dust from the environment, and contaminated surfaces are highly visible after smoothing.

The processing chamber should be cleaned after every run using a “lint-free” wipe and IPA.





HANGING AND LOADING PARTS INTO THE CHAMBER

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Design for Post Processing

Incorporating a hanging features into the part design can save time when loading processing racks and also prevent parts from having sink marks.

The most common approach is to design sacrificial hooks on the parts which can be removed after processing.





HANGING AND LOADING PARTS INTO THE CHAMBER

HANGING AND LOADING PARTS INTO THE CHAMBER

Use Stainless Steel wires and hooks to hang parts

Some materials can react or oxidize during the process which can lead to contamination on the parts. Stainless steel is an inert material that readily available to purchase and works very well for suspending parts on to the process racks.

Make sure to use thin clips/hooks or "welding rods" to reduce the amount of condensation they attract. This will help to prevent drip marks forming on the parts.







HANGING AND LOADING PARTS INTO THE CHAMBER

Hang parts correctly

For best results:

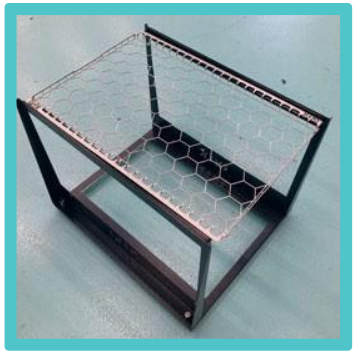
Parts should be placed at least 25 mm away from chamber walls.

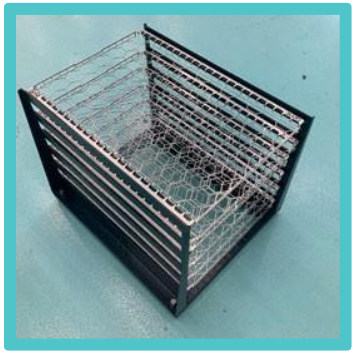
Parts should be placed at least 10 mm away from each other. Ensure parts are not touching each other.

Cupping geometries should be hung with the openings facing downwards at a 10º - 20º angle.

Minimize the contact points between the clips/wire and the part to reduce the severity of witness marks after processing.







Note: Preferably place the parts/racks in the middle of the processing chamber.

Note: Parts become soft and deform during the process, give extra time to ensure the parts are hung well and avoid weight-stress being exerted onto the weaker features.

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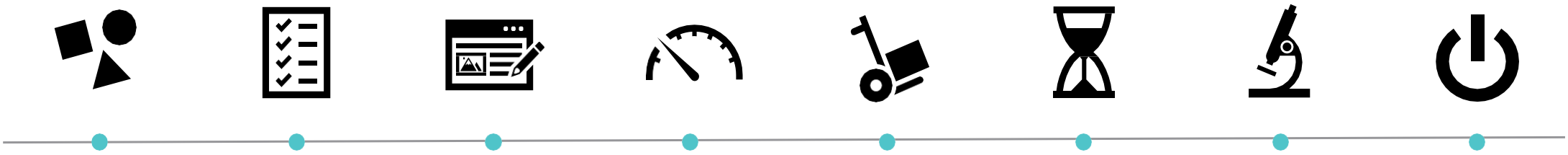
5. How The Process Works

HOW THE PROCESS WORKS

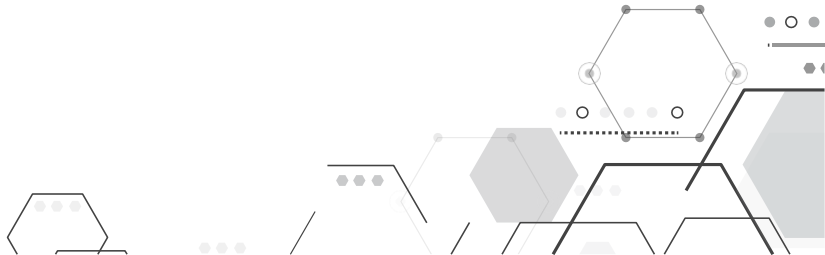


1. GROUPING THE PARTS
2. POWERING ON THE MACHINE
3. CREATING AND LOADING THE RECIPE
4. MACHINE INITIALISATION
5. HANGING AND LOADING PARTS INTO THE CHAMBER
6. MACHINE RUNNING
7. UNLOADING AND INSPECTION OF PARTS
8. POWERING DOWN THE MACHINE.

GROUPING THE PARTS

GROUPING
THE PARTS

What **Technology** was used to manufacture the parts?	SLS / MJF / FDM, etc.
What is the **Material** of the parts?	PA12 - 11 / TPU, etc.
What is the average **Wall Thickness** of the parts?	E.g. 1-2 mm / 3-4 mm / >5 mm, etc.
How **Full** is theprocessing chamber?	E.g. half full, completelyfull?



GROUPING THE PARTS

GROUPING
THE PARTS

Printing Technology

Parts of the same material, printed with different technologies, react differently to and therefore need to be processed separated. The reason for this is down to how they are formed and their properties thereafter.

Material

The same can be said for the material of the part, with each material having a different chemical resistance in relation to the consumable. As a result, more, or less aggressive parameters need to be used to overcome this.

Wall Thickness

Since the PostPro SF relies on a condensation process to deposit the consumable onto the parts, the part temperature directly impacts its effectiveness. As such, depending on the wall thickness of the part, different recipes are needed.

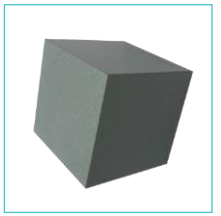
Chamber Fill Level

Unrelated to the actual parts, is how full the chamber is. The chamber fill level is important as it defines how much solvent is needed, with a higher level of fill needing more solvent. The fill level is relatively subjective since it is heavily dependent on part geometries, however, it can be estimated using the recommended hanging guidelines.

Part Colour

Finally, only process parts of the same colour together to avoid contamination. If you plan to dye the parts, it is recommended that this is done after smoothing.

THIN PARTS



THICK PARTS



WHITE PARTS



CREATING AND LOADING THE RECIPE



CREATING AND LOADING THE RECIPE

- Explanation of process parameters
- How to create a recipe

CREATING AND LOADING THE RECIPE



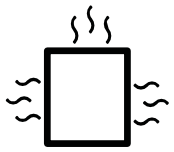
CREATING AND LOADING THE RECIPE

- Explanation of process parameters
- How to create a recipe

EXPLANATION OF PROCESS PARAMETERS

The process has 5 main stages:

1 INITIALIZATION



Processing chamber warms up

After reaching the setpoint, parts can be loaded into the chamber

2 PROCESSING



The solvent is introduced into the chamber and the condensation process takes place. This causes the surface of the parts to reflow and smooth.

3 RECOVERY



Recovery of the solvent starts

4 CURING



Parts start to harden again

5 DRYING



Any remaining trace of solvent in the parts and processing chamber is removed

- Each of these stages has their own parameters which are adjustable.
- It is necessary to change the process parameters depending on the material, geometry and quantities of the parts being processed.
- By changing the parameters, different levels of smoothing and sealing can be achieved.

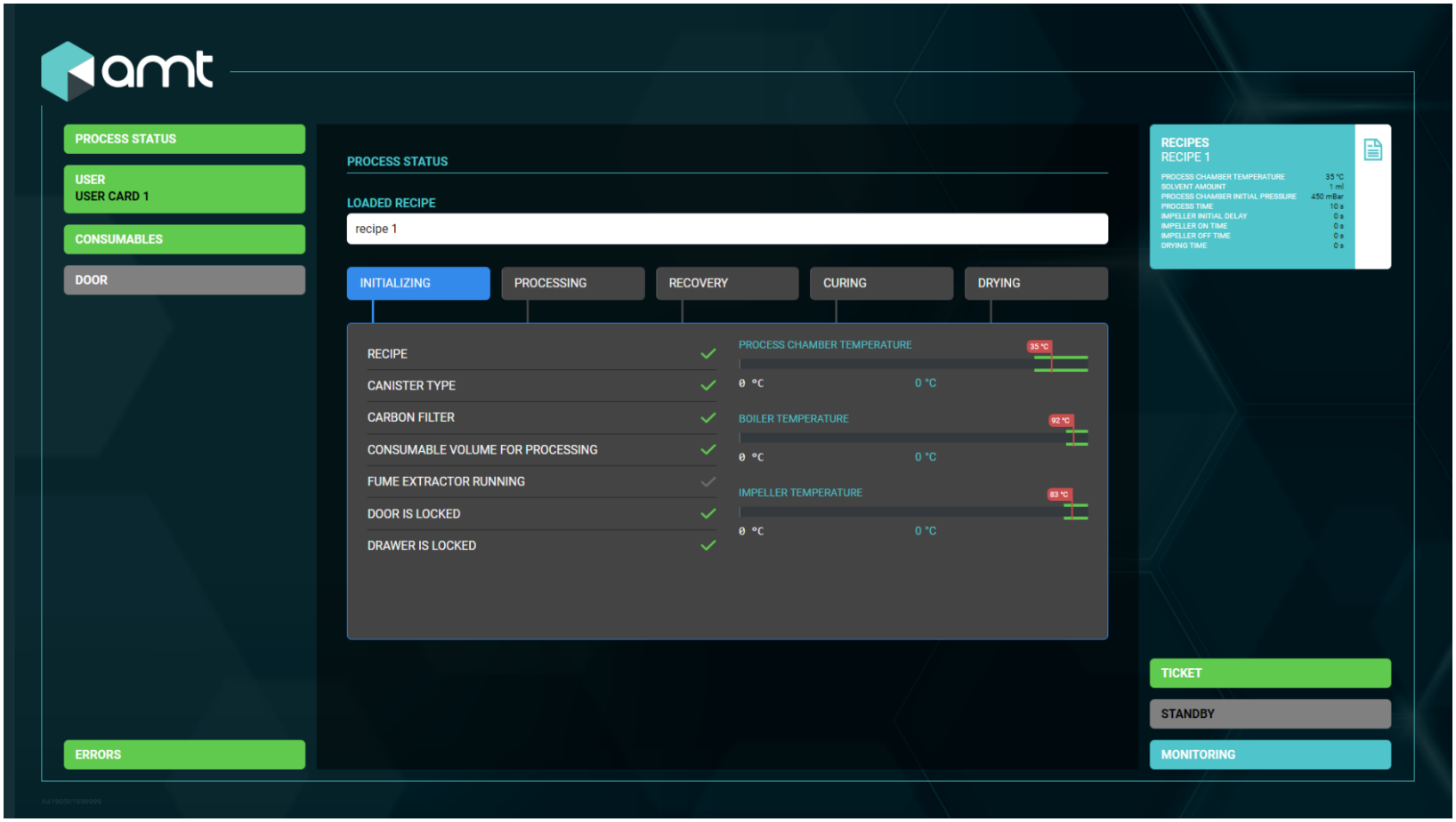
1. INITIALIZATION STAGE

The following parameters can be adjusted:

Process chamber temperature (°C): The setpoint of the walls in the processing chamber which needs to be reached before the process starts.

Solvent boiler temperature (°C): The temperature at which the boiler is set, to ensure that the solvent is heated to its boiling point.

Impeller temperature (°C): Temperature that the impeller above the processing chamber reaches before the solvent is dosed into the processing chamber.



GREEN: regular change.
ORANGE: occasional change.
RED: rarely change.

2. PROCESSING STAGE

The following parameters can be adjusted:

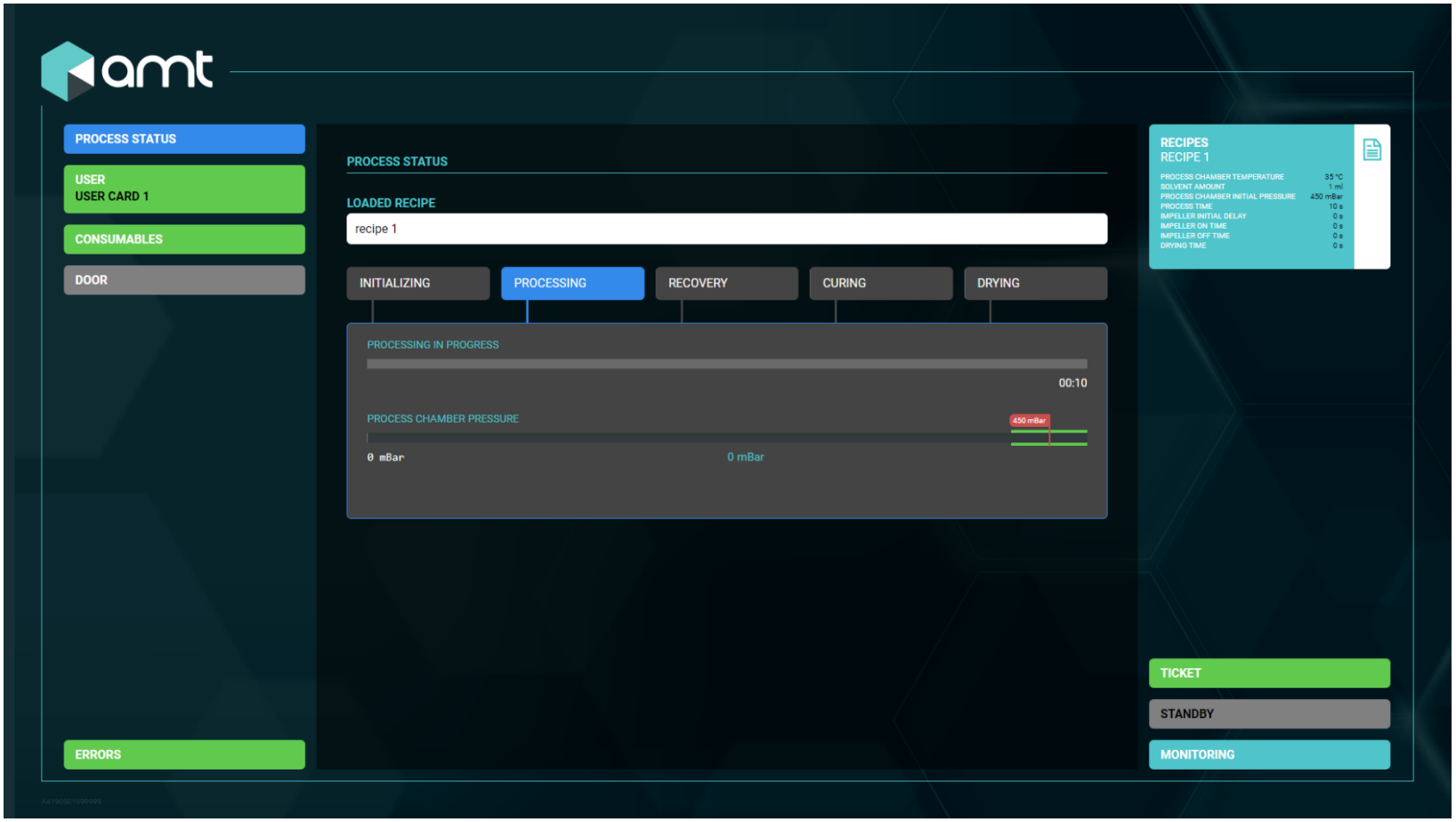
Solvent Amount (ml):
Volume of solvent which is dosed into the chamber.

Process chamber initial pressure (mbar):
Pressure that the vacuum pump pulls inside the processing chamber.

Processing time (s):
Exposure time of the solvent on the surface of the parts.

Impeller initial delay (s):
Time after which the impeller starts working.

Impeller ON/OFF time (s):
Defines whether the impeller is working constantly or in intervals.



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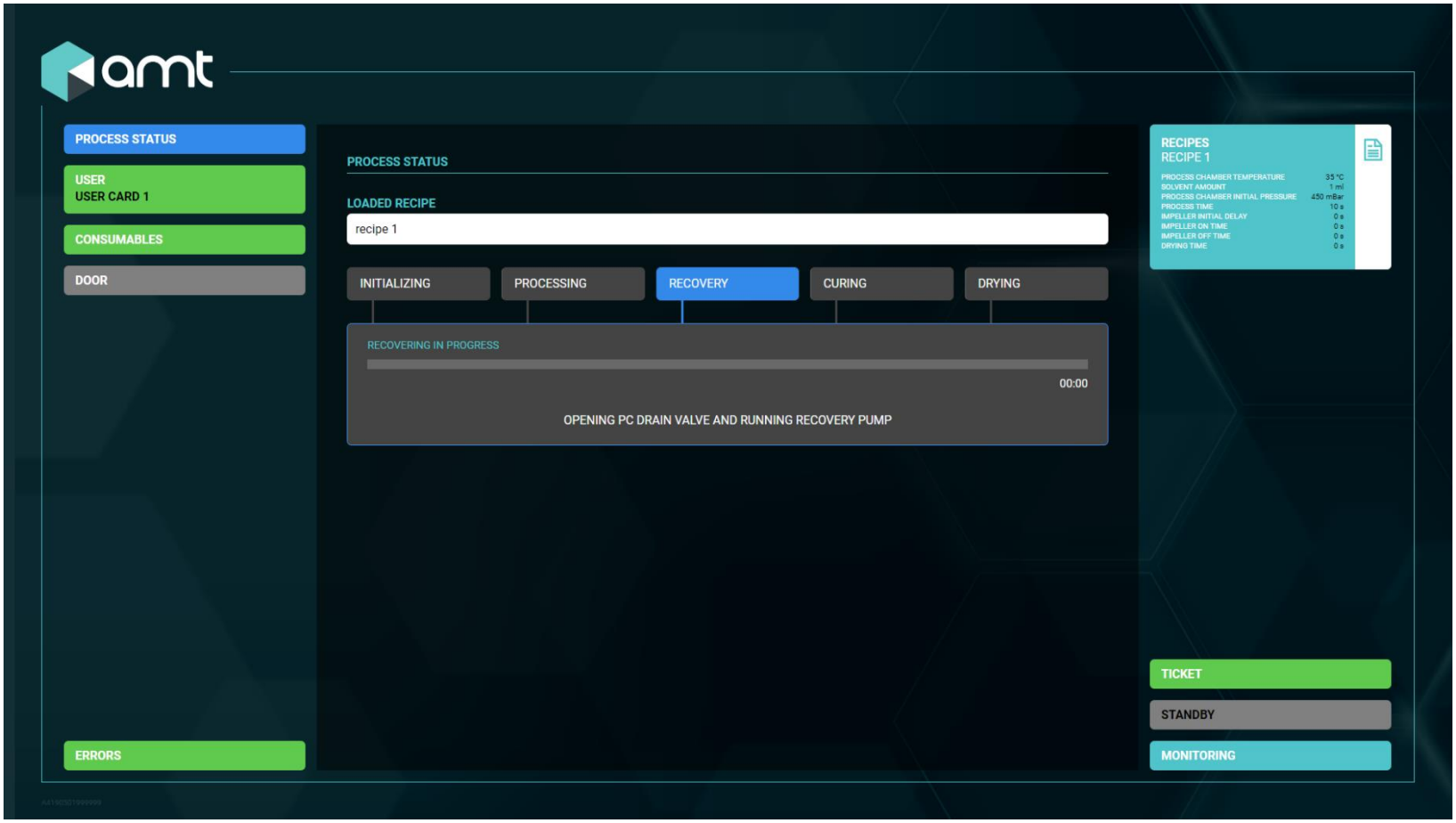
3. RECOVERY STAGE

The following parameter can be adjusted:

Recovery time (s):
Period in which the machine recovers most of the solvent.



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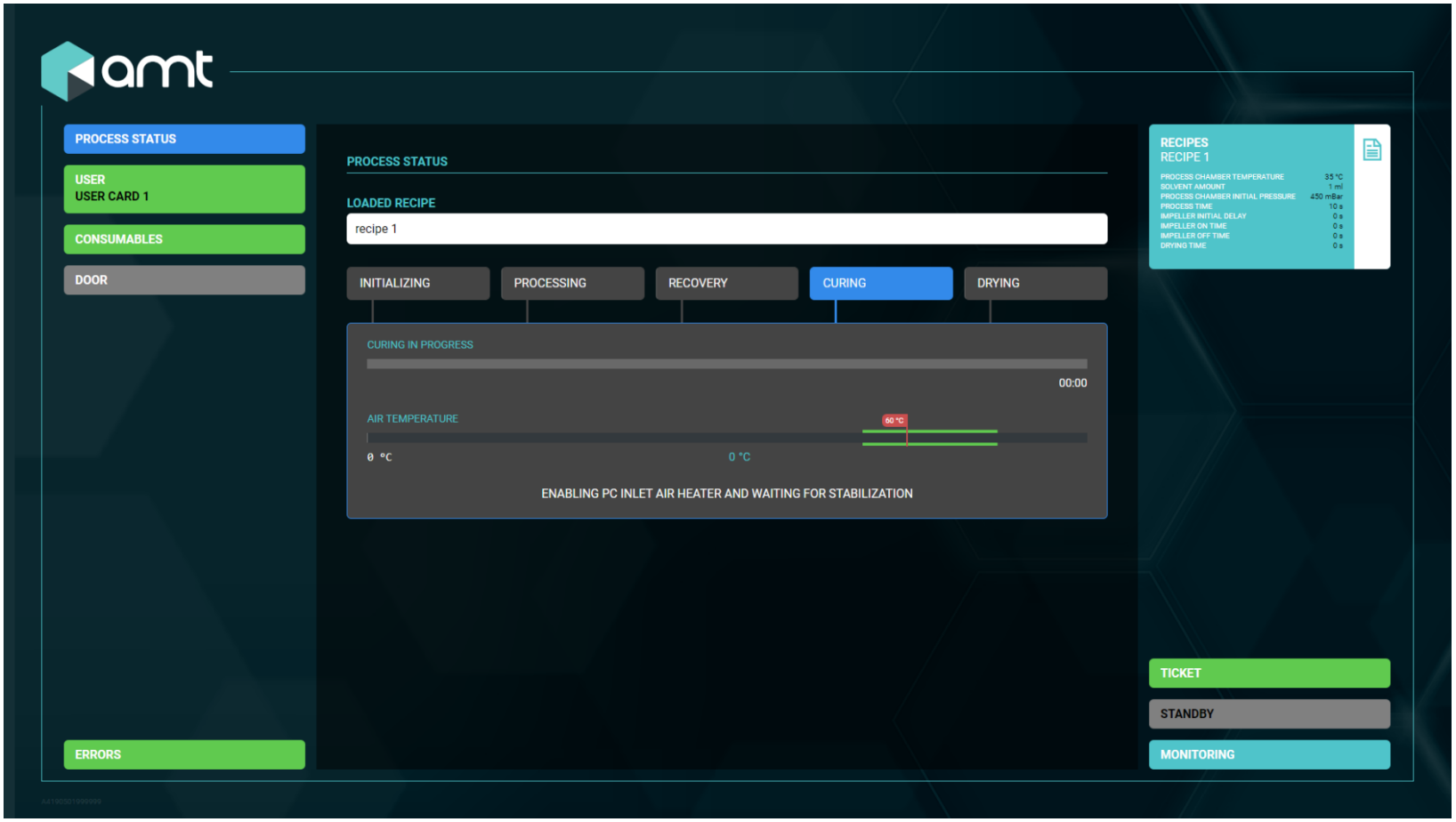
4. CURING STAGE

The following parameters can be adjusted:

Curing time (s): Duration in which the parts resolidify.

Curing air temperature (°C): Temperature of the air blown into the processing chamber.



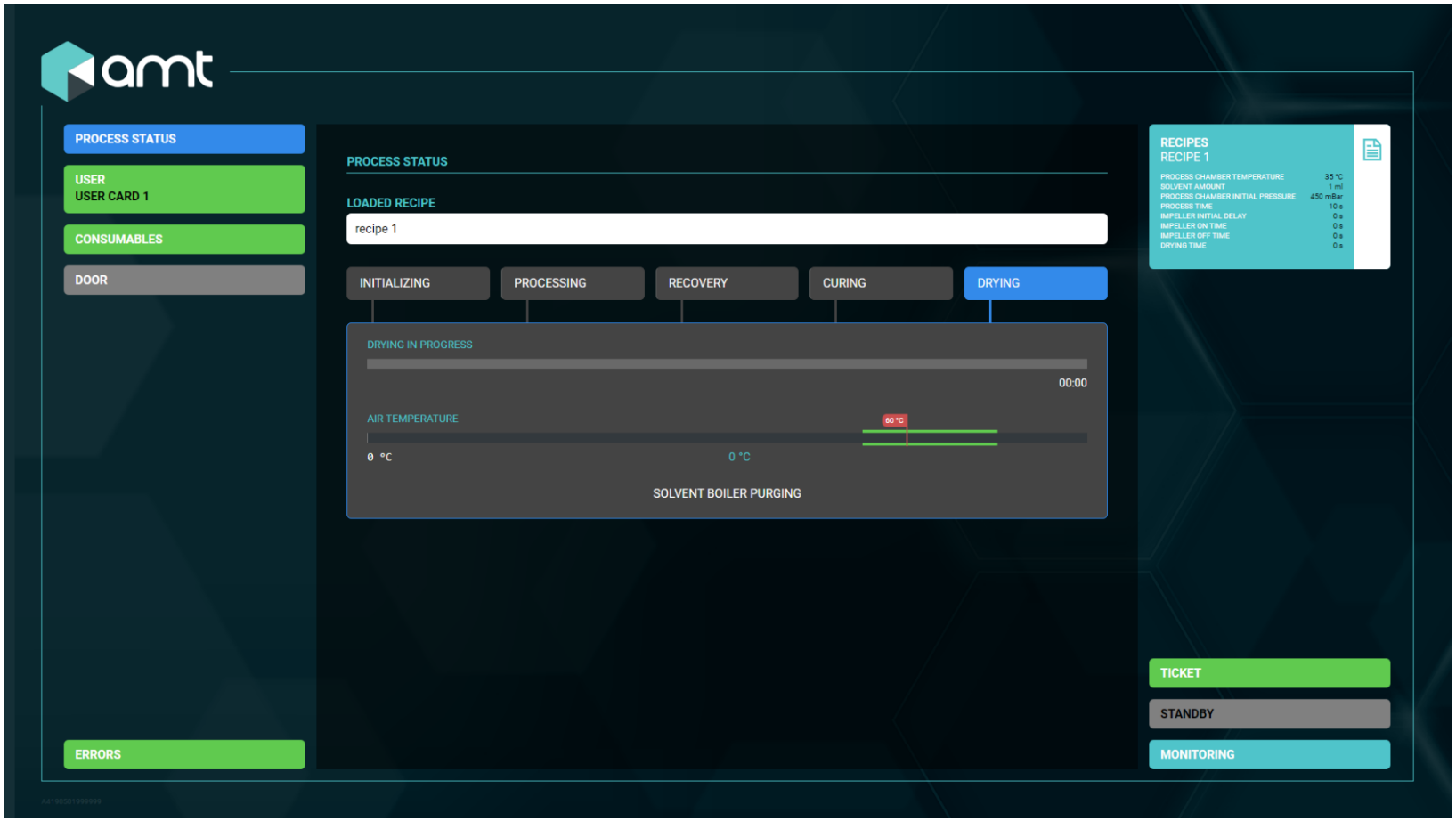
GREEN: regular change.
ORANGE: occasional change.
RED: rarely change.

5. DRYING STAGE

The following parameters can be adjusted:

Drying time (s): Duration of the drying cycle to remove any traces of the solvent.

Drying air temperature (°C): Temperature of the air blowing into processing chamber.



GREEN: regular change.
ORANGE: occasional change.
RED: rarely change.

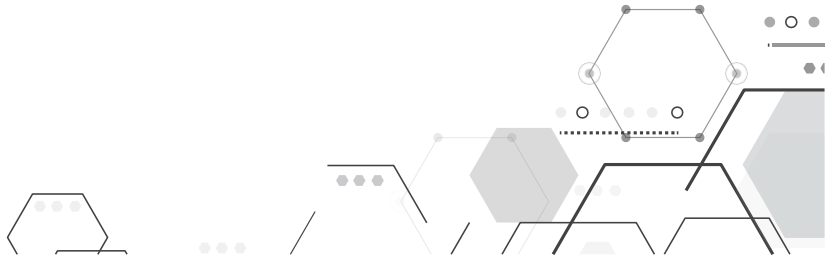
CREATING AND LOADING THE RECIPE



CREATING AND LOADING THE RECIPE

Explanation of process parameters

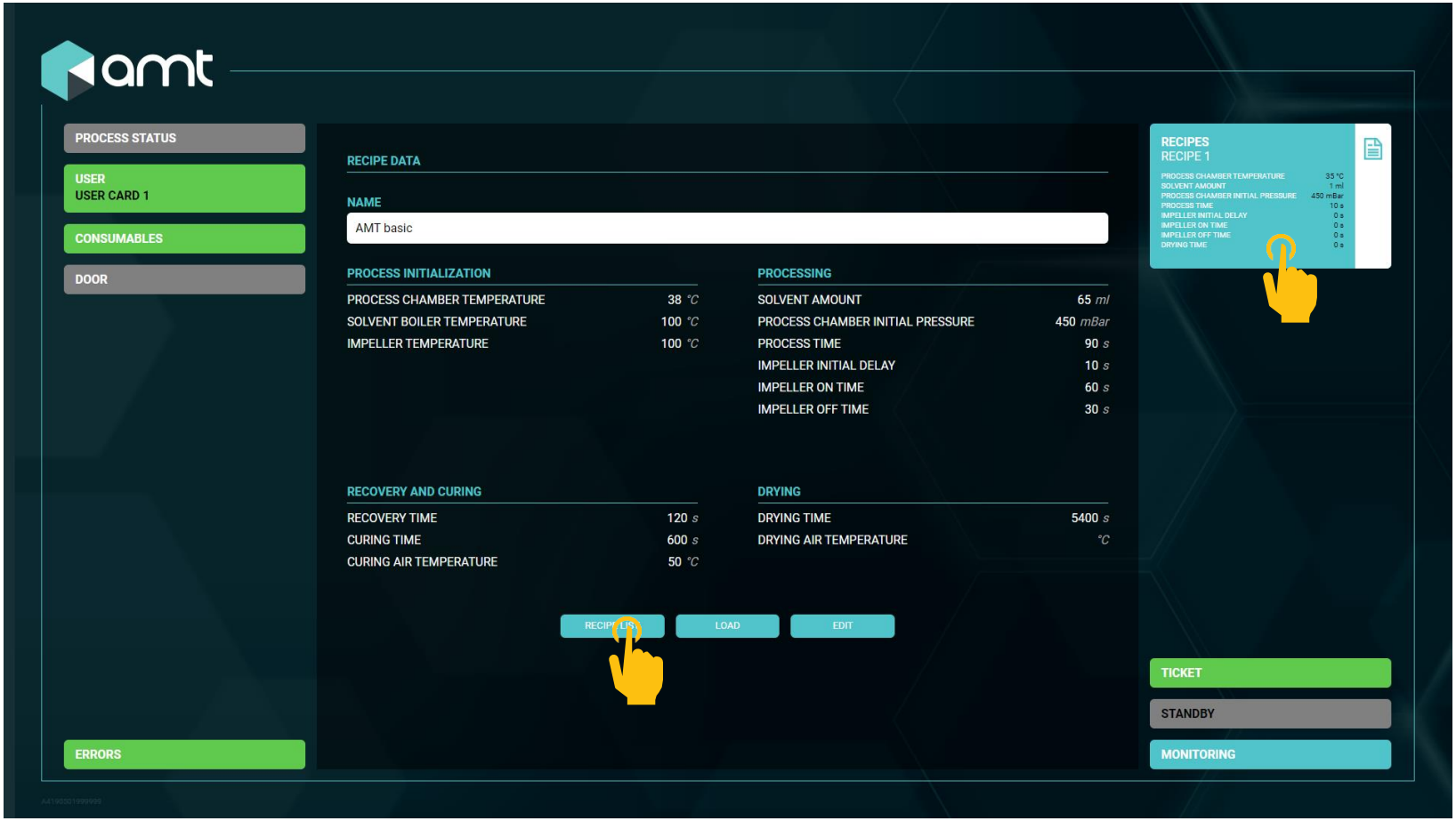
How to create a recipe



HOW TO CREATE A RECIPE

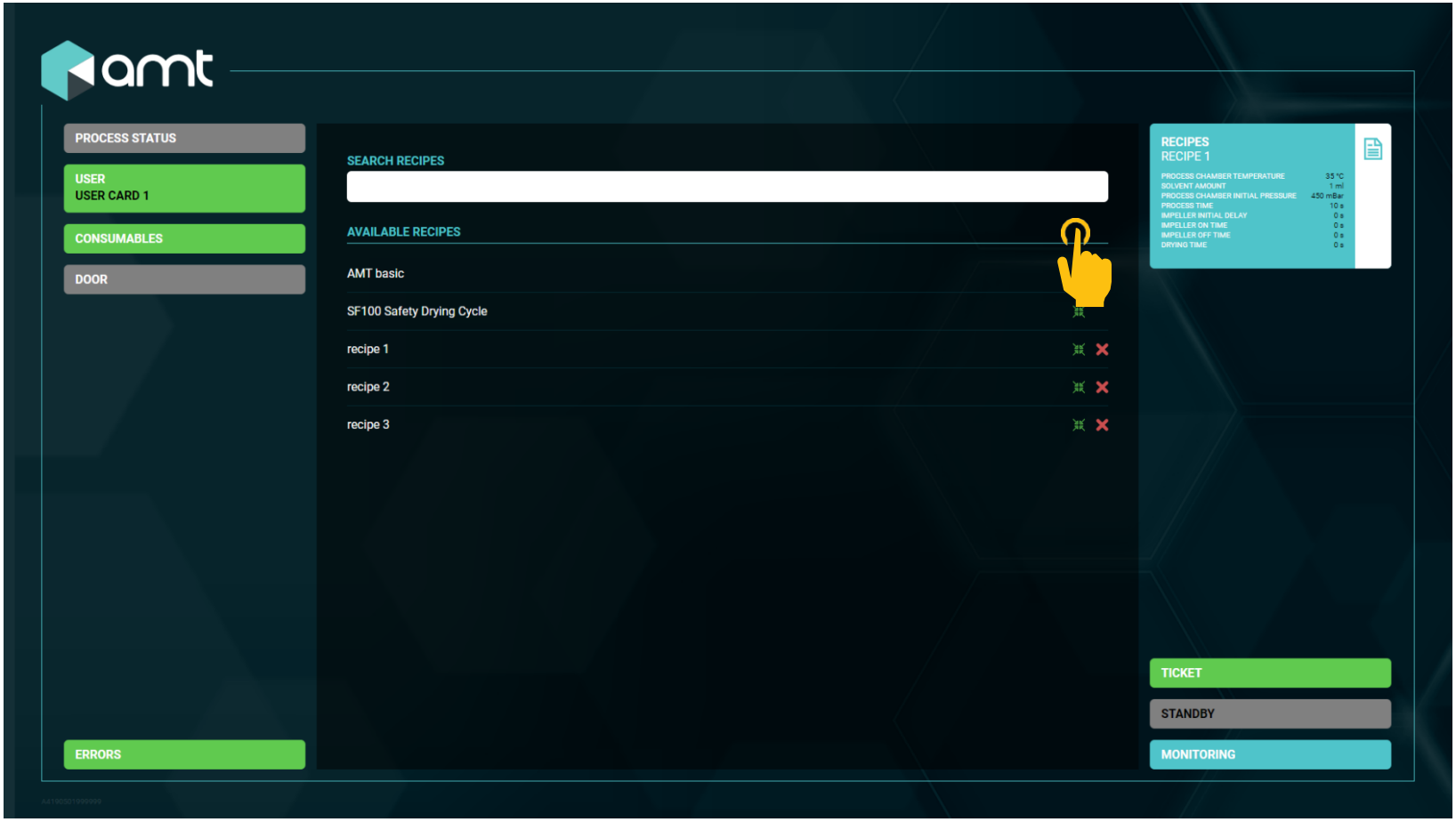
By clicking on the recipe box on the right-hand side of the screen, the last loaded recipe will be displayed.

To view all the recipes, click on the "**Recipe List**" button at the bottom of the screen.



HOW TO CREATE A RECIPE

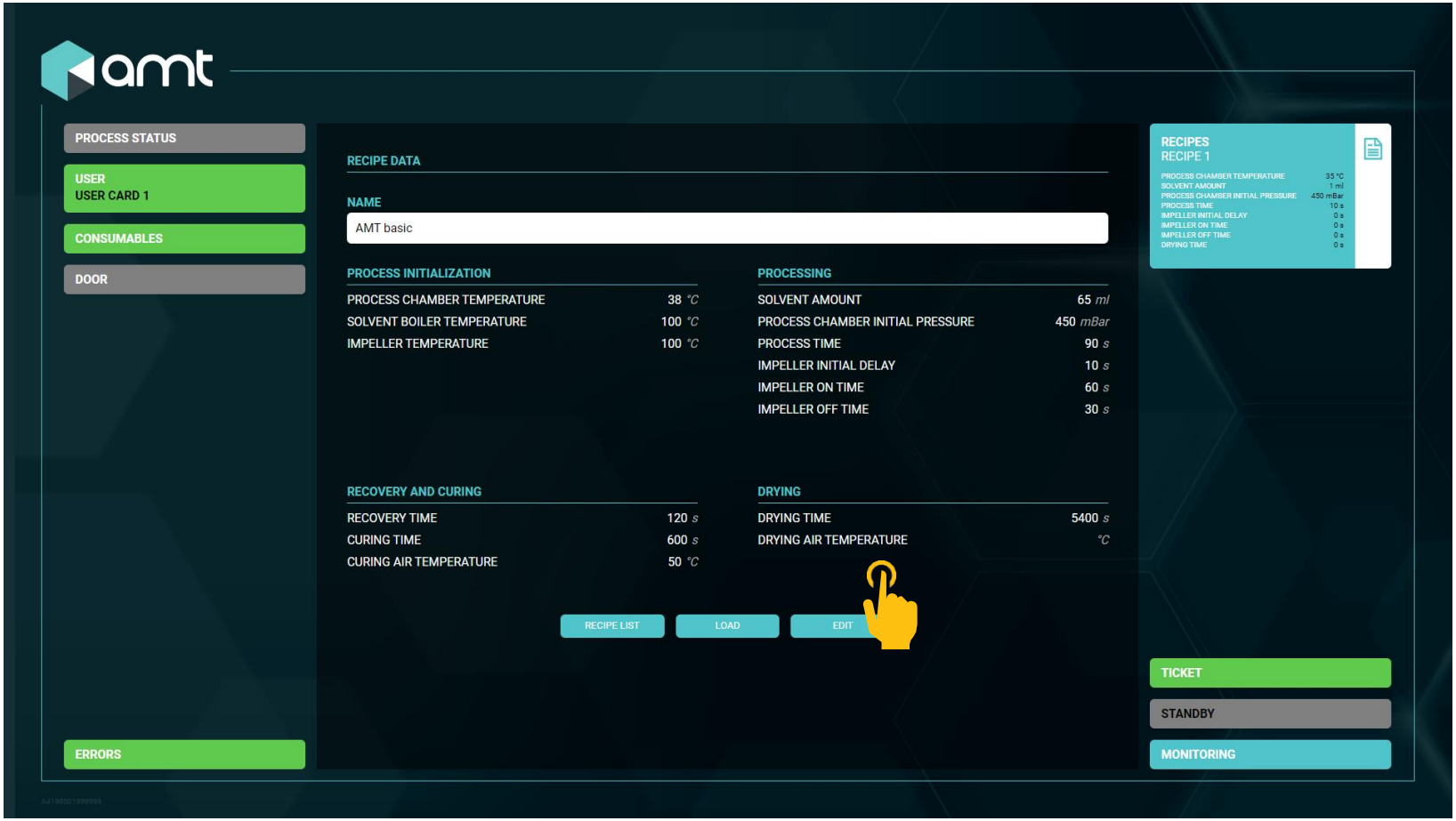
Select a recipe which you want to edit or use as the base for the new recipe. To do this, click on the green icon at the end of the recipe.



HOW TO CREATE A RECIPE

After clicking the green icon, the recipe will be displayed and all the processing parameters for the selected recipe can be seen.

Next, click on the "Edit" button.

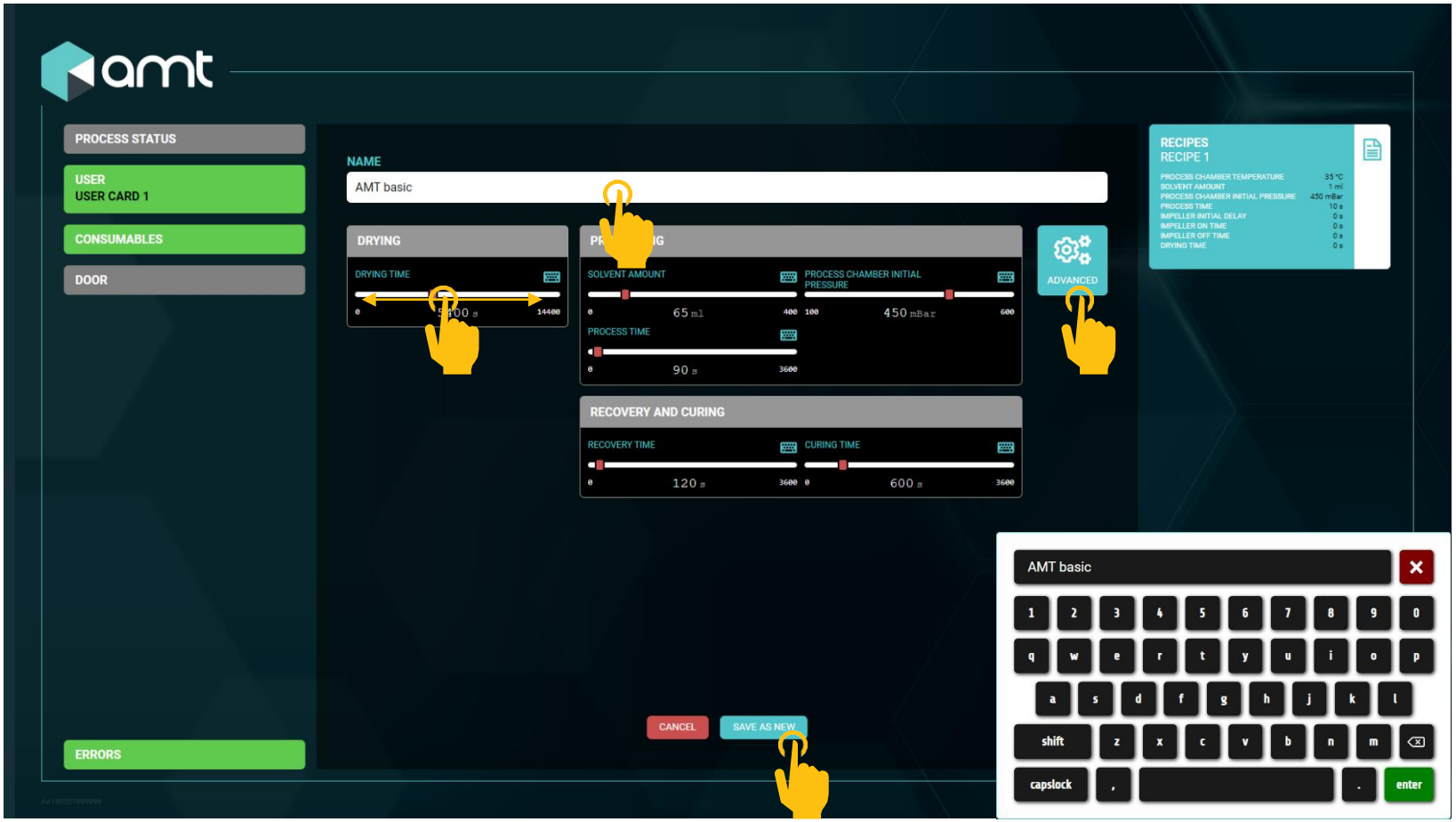


HOW TO CREATE A RECIPE

The different parameters can be adjusted either by moving the red indicator along the bar or by clicking on the small keyboard and entering the value manually.

If a new recipe is being created, it is important to rename the recipe using the text box at the top.

To edit the advanced parameters click on "Advanced".

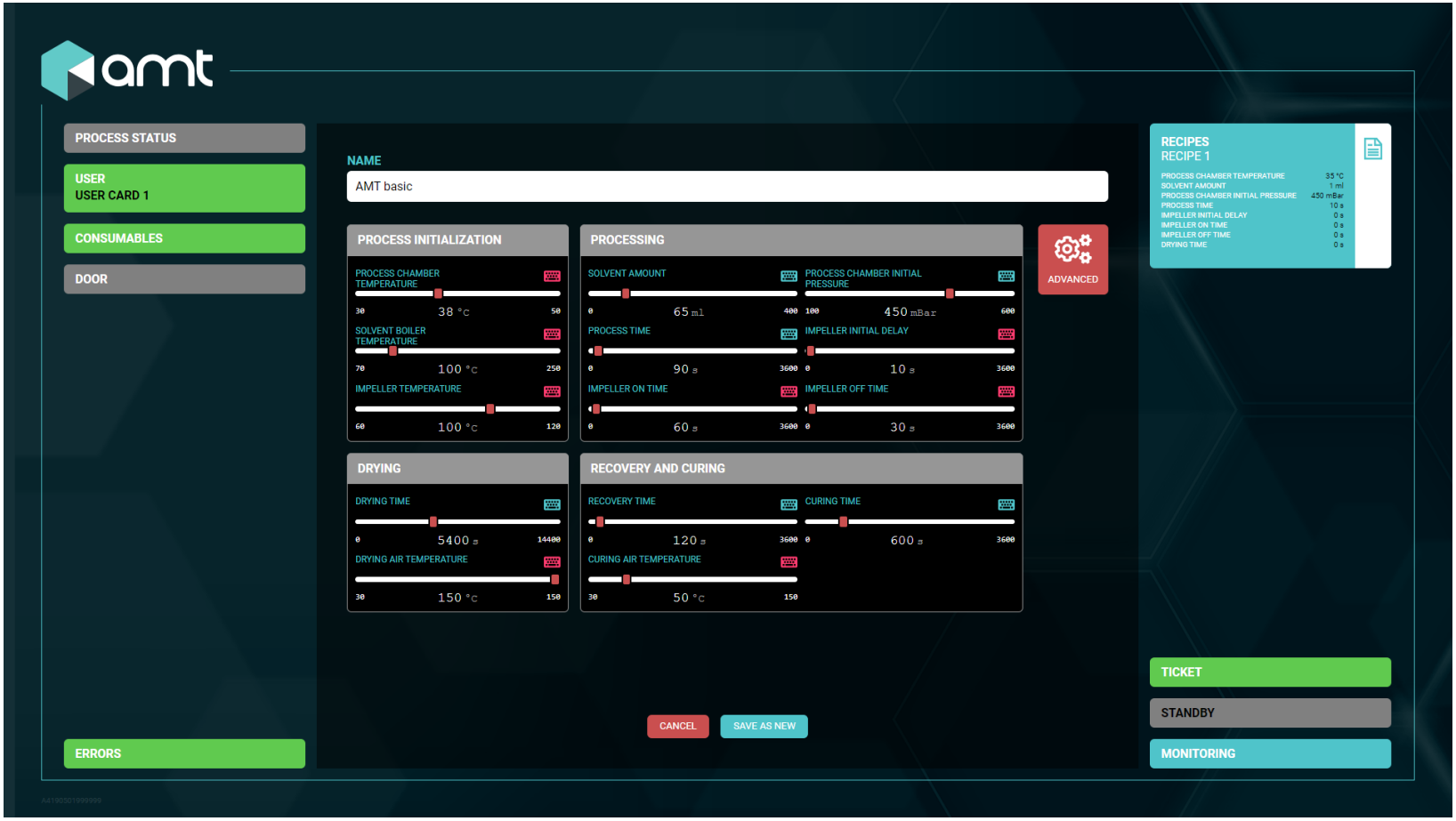


HOW TO CREATE A RECIPE

The advanced parameters can also be adjusted by either moving the red indicator on the bar, or by clicking on the small keyboard and entering the value manually.

Once finished, click on "**Save as new**" to save the recipe.

The new recipe can be found under the list of Recipes.



If modifying a global AMT recipe, the user can only "SAVE AS NEW." The user can use the "SAVE" button with their own recipe.

amt postpro®

6. Running a Process

POWERING ON THE MACHINE

POWERING ON THE MACHINE

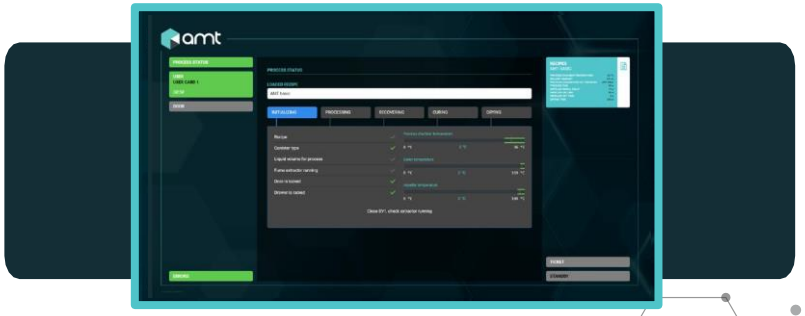
Turn on the BOFA extractor using the standby button on the front (where applicable).



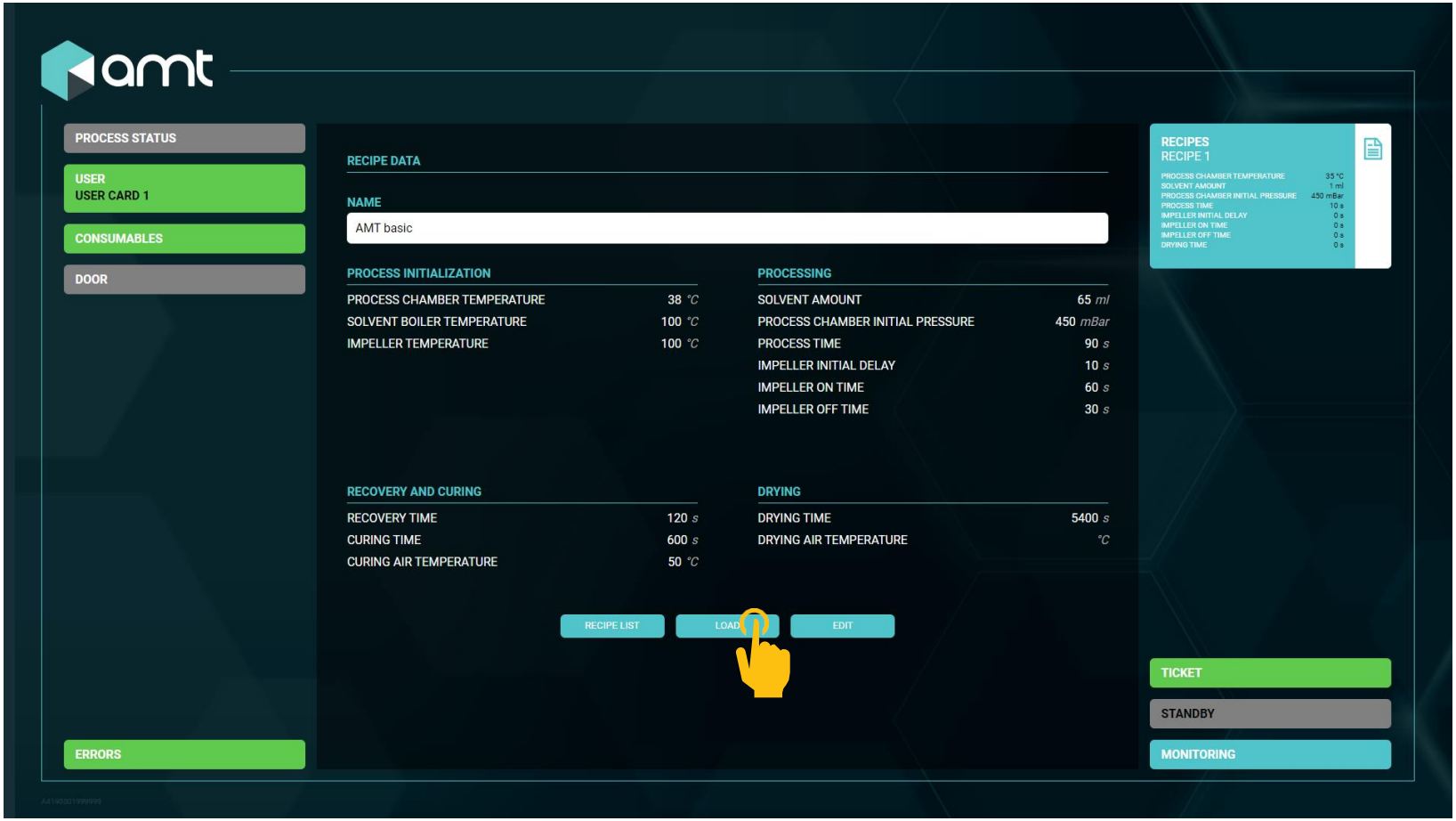
Turn the Isolator to the ON position (on the left side of the screen) to power on the SF machine.



After a few minutes, the SF screen will then display the Main Screen



MACHINE INITIALISATION

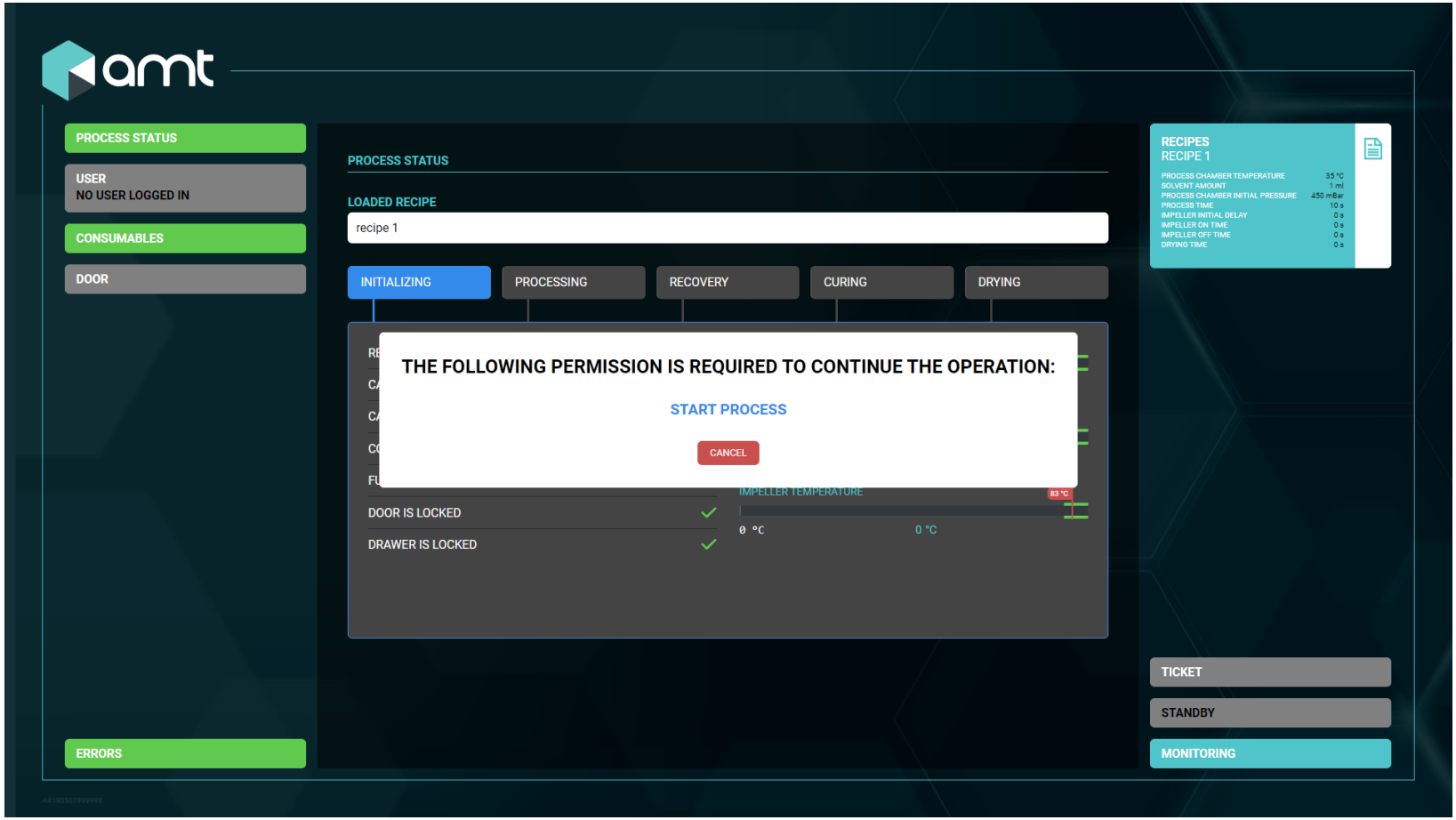


To load the chosen recipe, press the "**load**" button. Make sure the upper right recipe has changed to the recipe you want to run.

The machine will begin to initialize, this can take some time depending on the current condition of the machine (first process run etc).

MACHINE INITIALISATION

MACHINE INITIALISATION

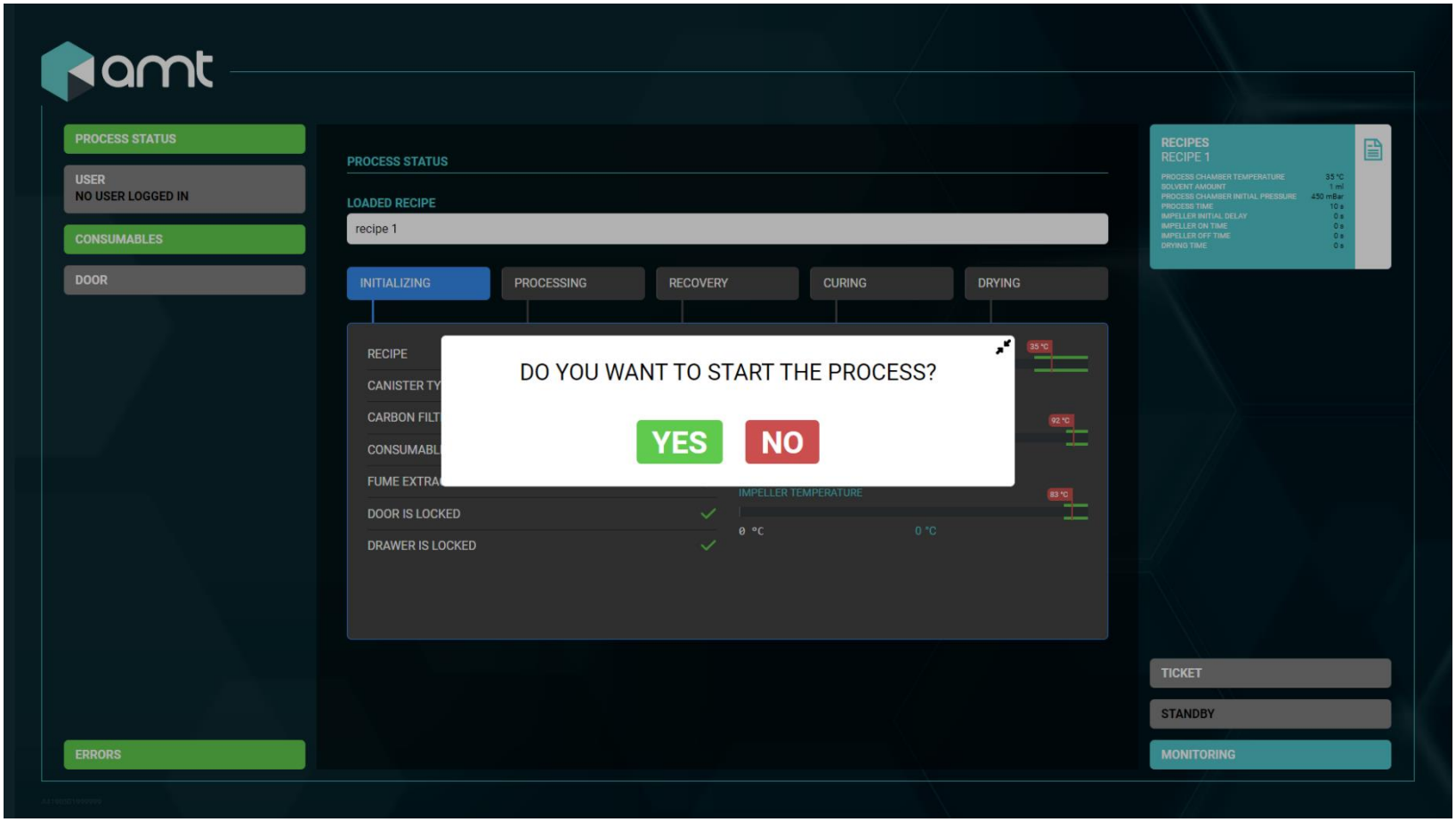


When the machine has fully initialized, you will need to log in with your user card to give it permission to start the process (you will not see this screen if you're already logged in).

MACHINE INITAILISATION

MACHINE INITIALISATION

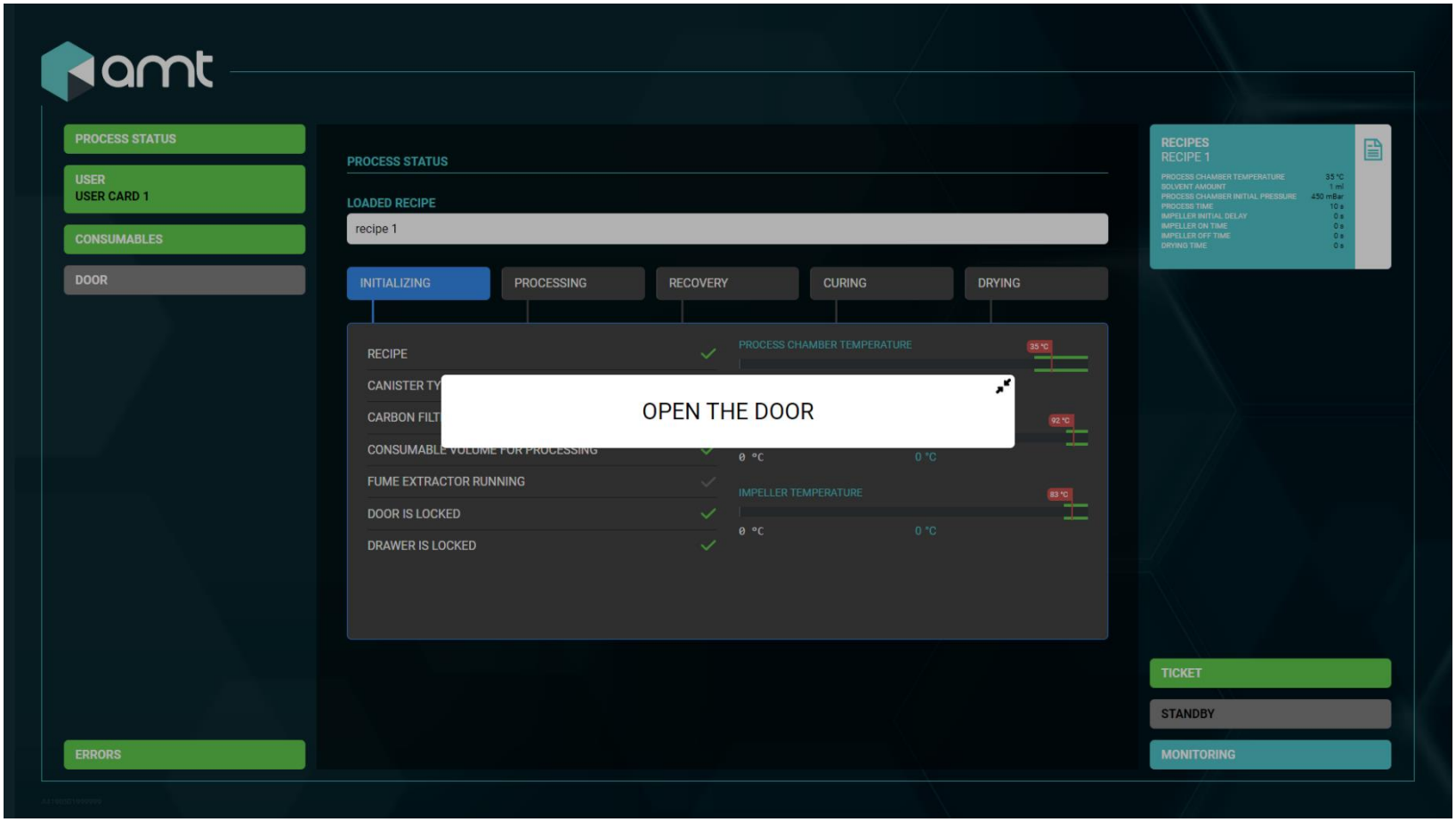
MACHINE INITAILISATION



When logged in, press the “**Yes**” button and the machine will prepare the door ready for you to load the parts, this will take around 10 - 30 seconds.

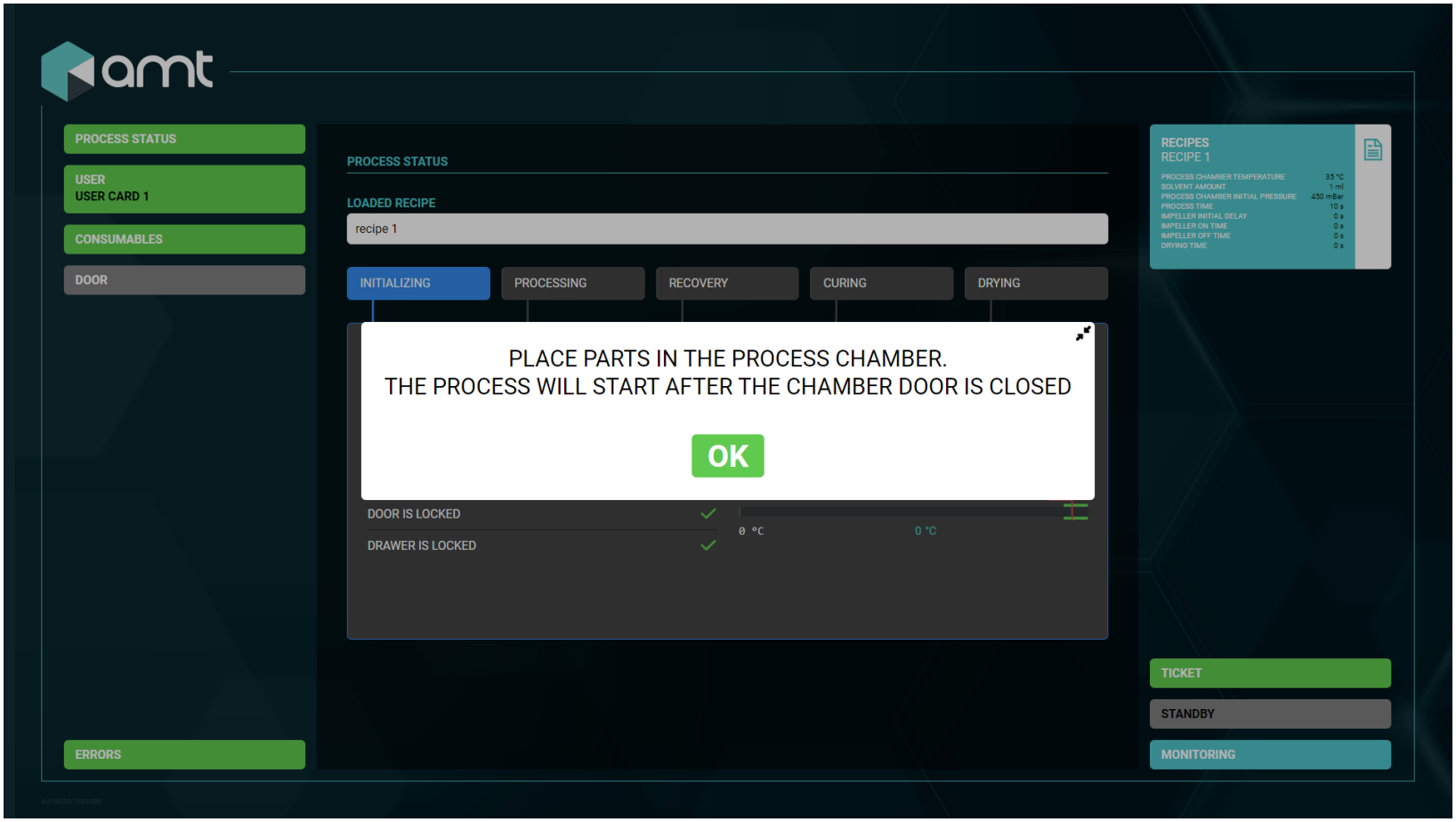
LOADING THE PARTS

HANGING AND LOADING PARTS INTO THE CHAMBER



When the machine is ready, press the two-hand buttons on each side of the door until the screen changes. To avoid getting trapped, only one person should operate the door, and they should be at full arms length.

LOADING THE PARTS

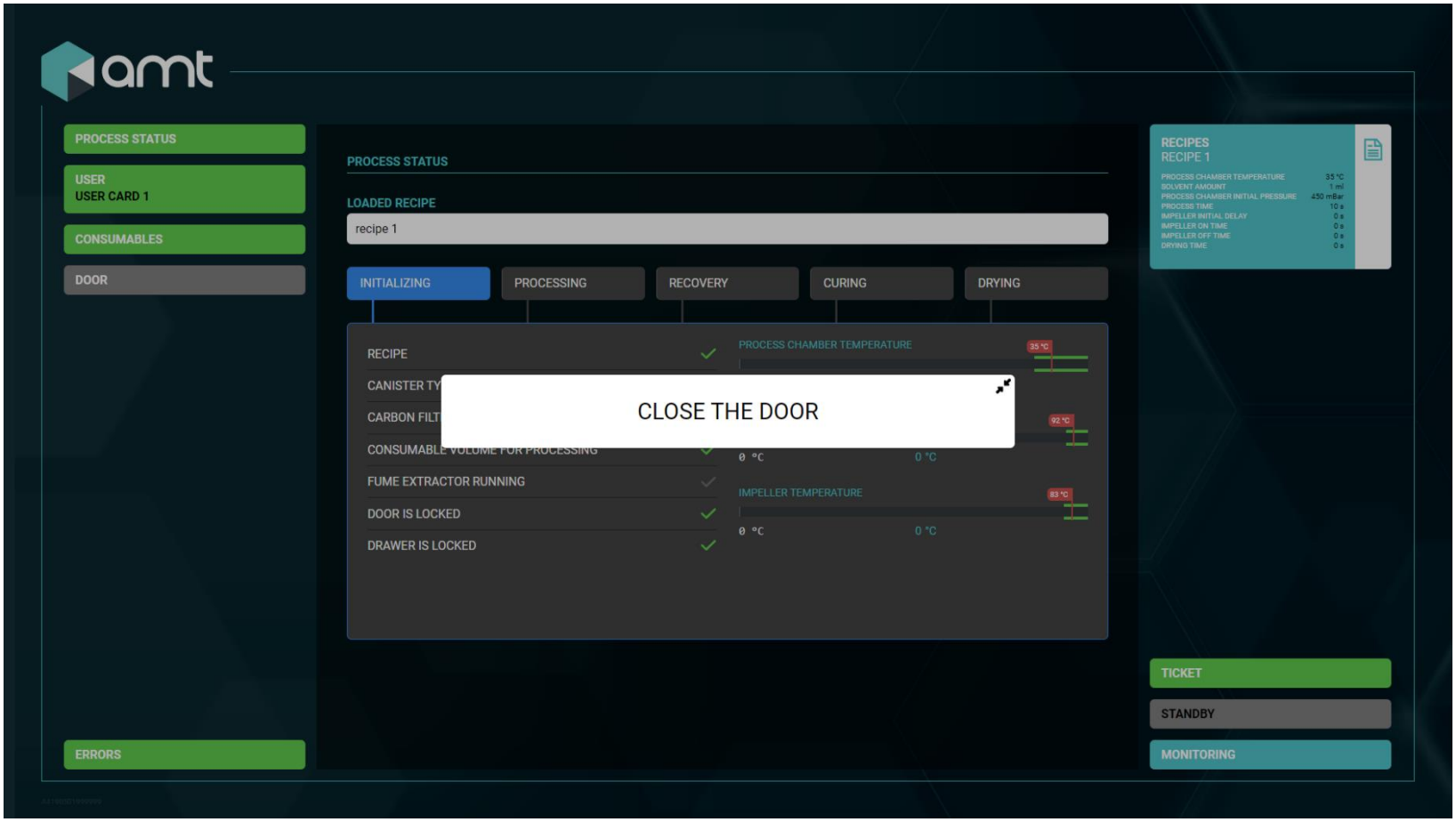


HANGING AND LOADING PARTS INTO THE CHAMBER

Slide the racks into the chamber carefully, keeping the correct clearances between the parts/walls and ensure the parts are securely fastened. Press “**OK**” when the parts all the racks have been loaded

LOADING THE PARTS

HANGING AND LOADING PARTS INTO THE CHAMBER



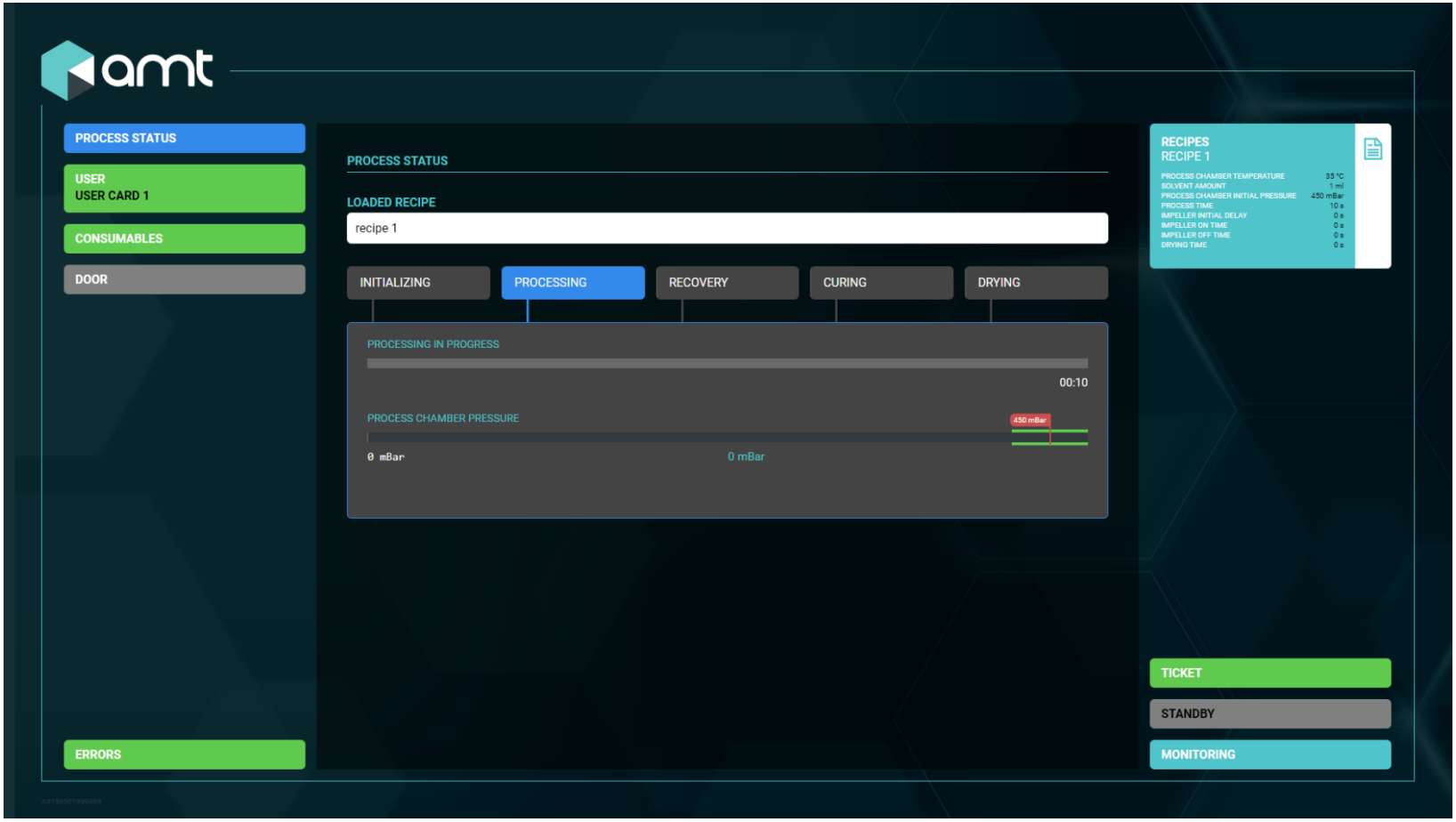
Press two-hand door buttons again simultaneously to close the door.

Note: Do not release the buttons until the machine starts the process to allow the locks to be applied correctly.

MACHINE RUNNING

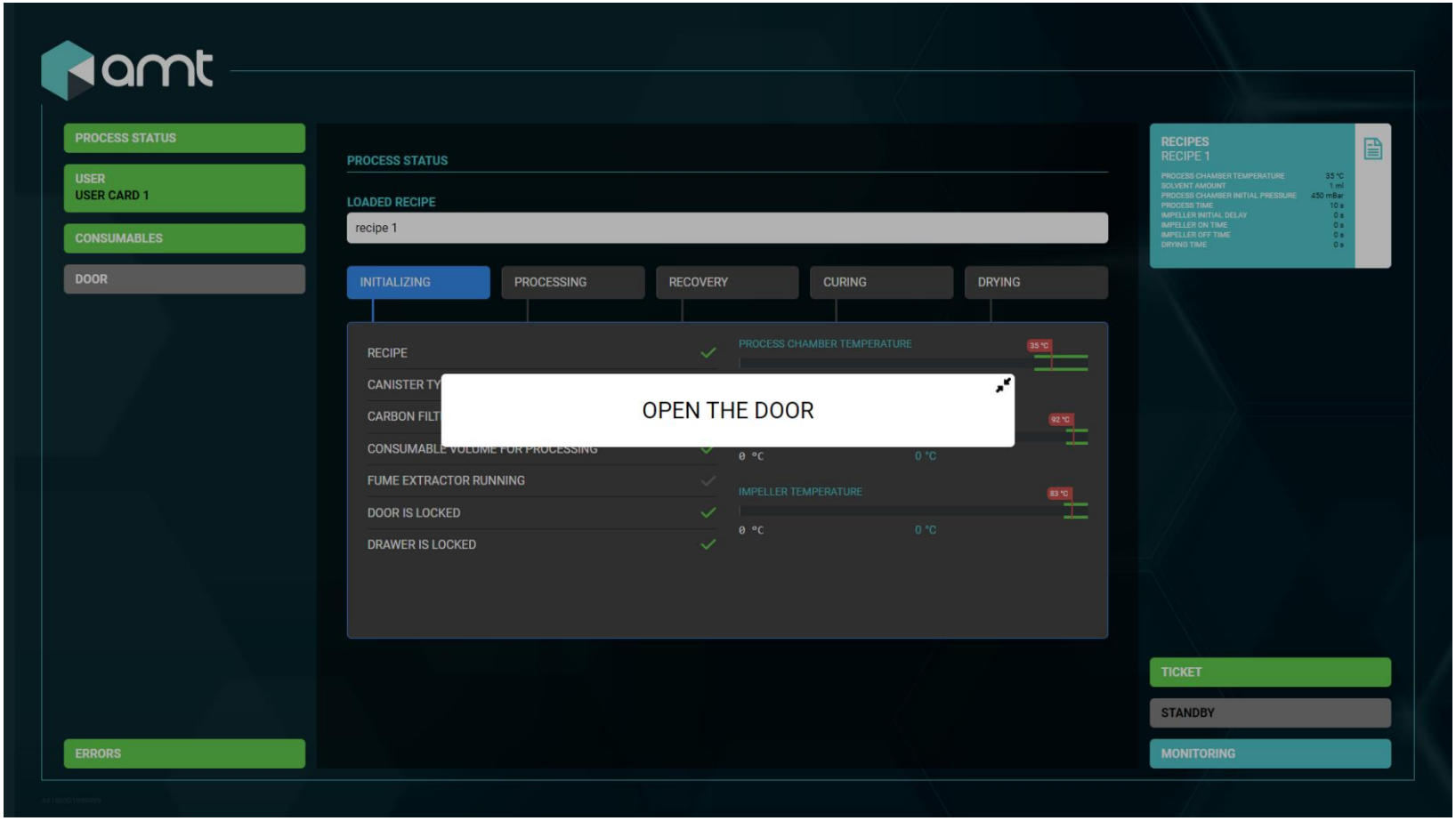


MACHINE RUNNING



The machine will run the process.

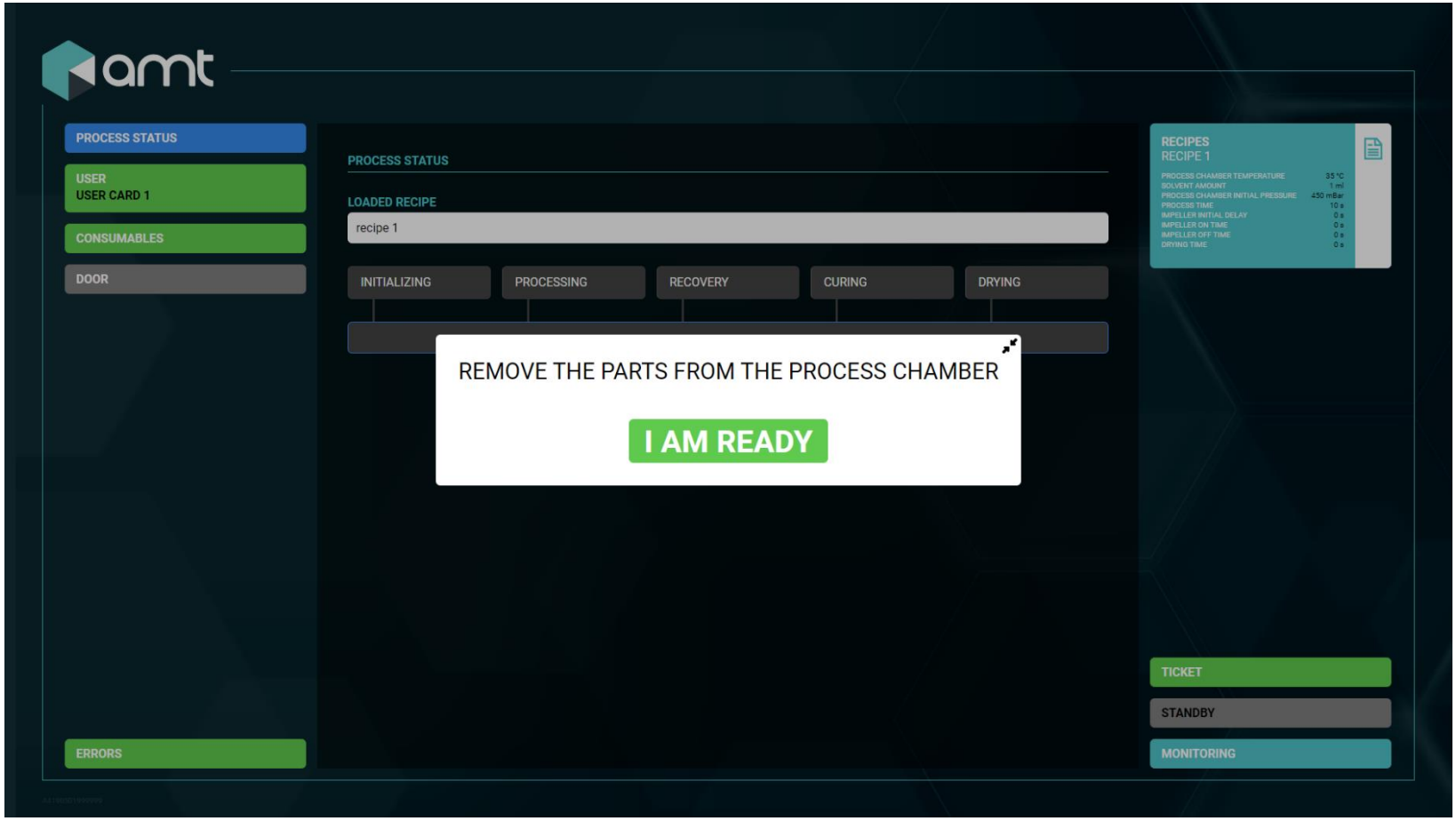
UNLOADING AND INSPECTION OF PARTS



When the machine finished the process, press the two-hand door buttons simultaneously to open the door.

Please make sure you wear all the PPE before opening the door.

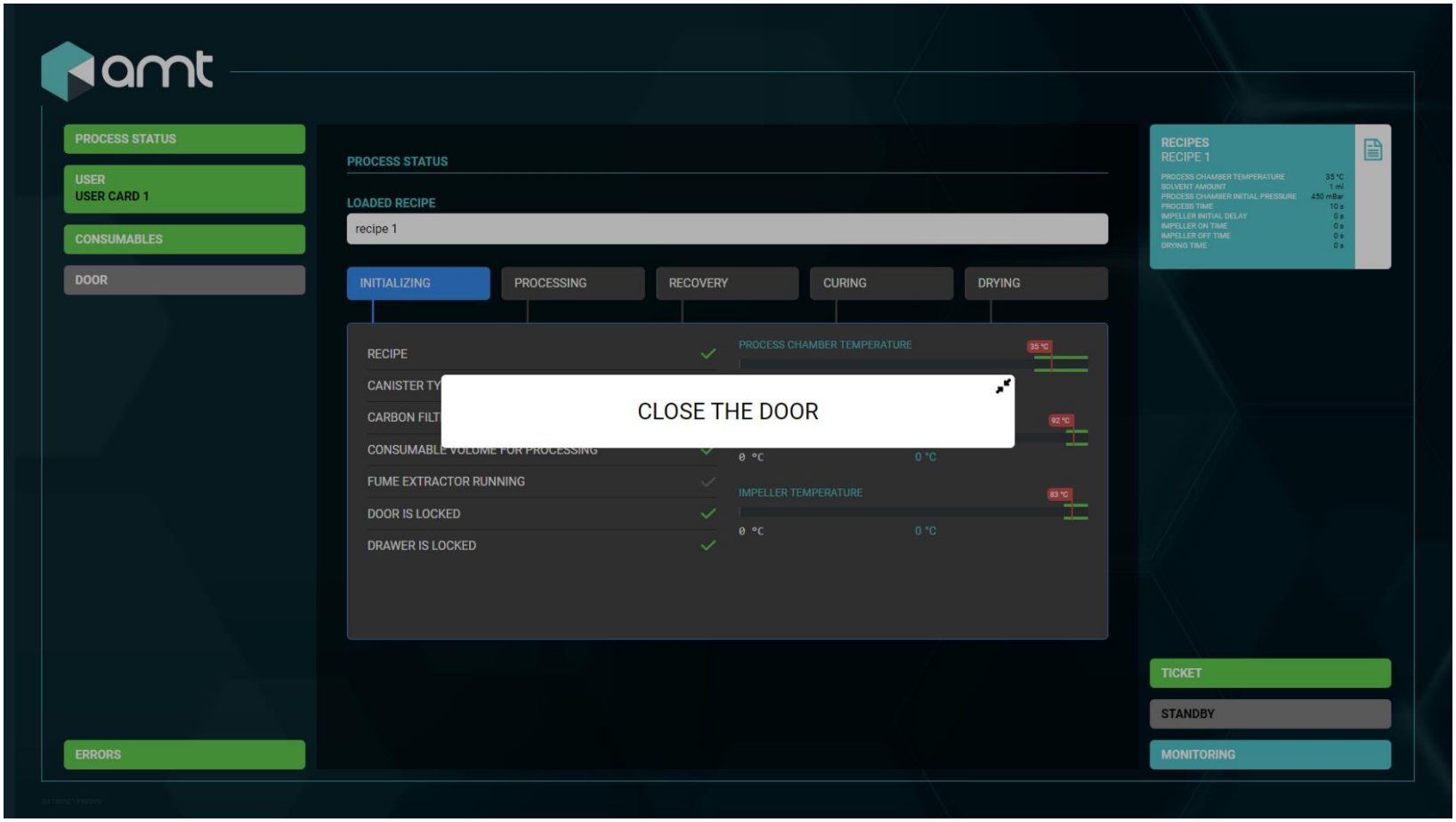
UNLOADING AND INSPECTION OF PARTS



Remove the finished parts from the process chamber and press “**I AM READY**” after taking out all the parts.

UNLOADING AND INSPECTION OF PARTS

UNLOADING AND INSPECTION OF PARTS



Press two-hand door buttons again simultaneously to close the door properly.

POWERING DOWN THE MACHINE

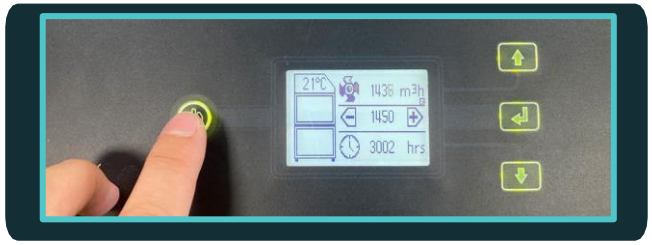
To power down the system, turn the isolator switch to the OFF position (on the left side of the screen).



The system will then fully shut down. Due to the UPS (internal battery), it can take a 5 – 10 minutes to fully power down.



Make sure to switch OFF the extractor connected to the machine separately (where applicable).



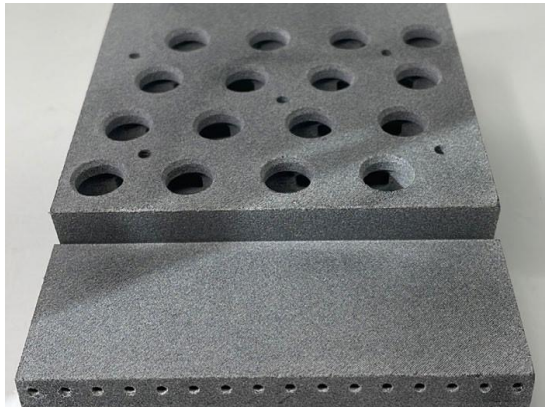
7. Troubleshooting

UNPROCESSED

Parts look the same as when they went in.

What can cause this issue?

1. The material is not approved for use with the AMT Vapor Smoothing technology and is not listed in the “Compatible Material List”.
2. The recipe used is not aggressive enough to smooth the parts.
3. Part temperature exceeds the recommended range.



How to fix it?

1. Check the material is listed in the “AMT PostPro Compatible Material List”.
2. Ensure the processing chamber pressure, processing time and consumable volume are within the recommended range. If not, increase these accordingly.
3. Store parts in a climate-controlled environment where temperature and humidity can be monitored.

UNDER-PROCESSED

The part has partially smoothed, more smoothing is needed.

What can cause this issue?

1. The recipe used was not aggressive enough to smooth the parts:
   - Pressure during processing was too low.
   - Not enough solvent was used.
   - Processing time was too short.
2. Part temperature exceeds the recommended range.



How to fix it?

1. Ensure the processing chamber pressure, processing time and consumable volume are within the recommended range. If not, increase these accordingly. This can vary but typically ranges between 10-40 ml/s/mbar (Depending on the initial recipe).
2. Store parts in a climate-controlled environment where temperature and humidity can be monitored.

SLIGHTLY OVER-PROCESSED

Sharp edges have started to round and small blisters have formed.

What can cause this issue?

1. The recipe used was slightly too aggressive to smooth the parts:
   - Pressure during processing was too high.
   - Too much solvent was used.
   - Processing time was too long.
2. Part temperature is below the recommended range.



How to fix it?

1. Ensure the processing chamber pressure, processing time and consumable volume are within the recommended range. If not, decrease these accordingly. This can vary but typically range between 10-40 ml/s/mbar (Depending on the initial recipe).
2. Store parts in a climate-controlled environment where temperature and humidity can be monitored.

OVER-PROCESSED

Sharp edges are rounded and large blisters are present.

What can cause this issue?

1. The recipe used was too aggressive to smooth the parts:
    - Pressure during processing was too high.
    - Too much solvent was used.
    - Processing time was too long.
2. Hanging orientation was not correct.
3. Depowdering was not completed effectively.
4. The chamber was overfilled and caused solvent to drip onto the parts' surface (vapour dripping from the parts or racks)
5. Part temperature is below the recommended range.



How to fix it?

1. Ensure the processing chamber pressure, processing time and consumable volume are within the recommended range. If not, decrease these accordingly.
2. Adjust the hanging orientation.
3. Ensure the parts have been thoroughly de-powdered.
4. Hang parts well to avoid dripping from parts or racks.
5. Store parts in a climate-controlled environment where temperature and humidity can be monitored.

BUBBLES

There are bubbles on the surface of the part.

What can cause this issue?

During the curing cycle, the solvent is extracted slowly from the surface.

If the curing time is too short the part could be damaged as the solvent is extracted too fast. Especially in FDM parts.



How to fix it?

1. Increase curing time using the recipe book for guidance. (e.g. 600sec > 1200sec)
2. Reduce the amount of solvent.
3. Reduce drying temperature.

CONTAMINATION

Dust and/or dots of contamination are stuck to the surface of the part.



What can cause this issue? / How to fix it?

1. **Bad Printing Quality**
    - There were impurities before processing (not visible to the naked eye).
    - The quality of the printing powder is not good enough (It is contaminated or has been reused too many times).

2. **Poorly Controlled Preparation**
    - The quality of the blasting media or poor cleanliness in your depowdering process.
    - Clean gloves and lab coat were not worn when handling parts.
    - Parts were mixed with parts of a different colour.
    - Storage boxes were not cleaned between use.
    - Different colour parts were smoothed in the same process run.

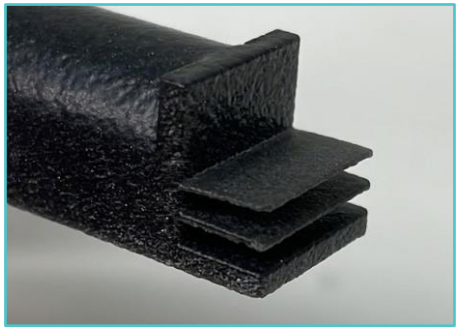
3. **Dusty environment and Insufficient Cleaning Process**
    1. The environment varies from the recommendation outlined in the AMT Site Preparation Document.
    2. Contamination inside the SF machine.
    3. Chamber and racks were not cleaned as per AMT recommendation. If running different colour parts, consider increasing the frequency of cleaning.
    4. If you smooth previously dyed parts, some contamination could be left in the chamber.

THIN PARTS

Parts with a wall thickness (<1mm) are not processing well.

What can cause this issue?

Very thin parts tend to warm up quickly inside the processing chamber.



How to fix it?

Freeze or chill the parts. The condensation of the solvent can be improved by increasing the difference in temperatures between the parts and the chamber walls.

We recommend freezing thin parts (<1mm) for at least 30 minutes in a blast freezer to achieve this.



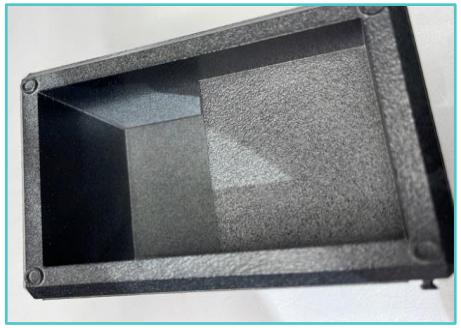
As standard, we do not recommend freezing/chilling parts as this can lead to other problems.

UN-PROCESSED INTERNAL SURFACES

There is a variation in smoothing between internal/external surfaces

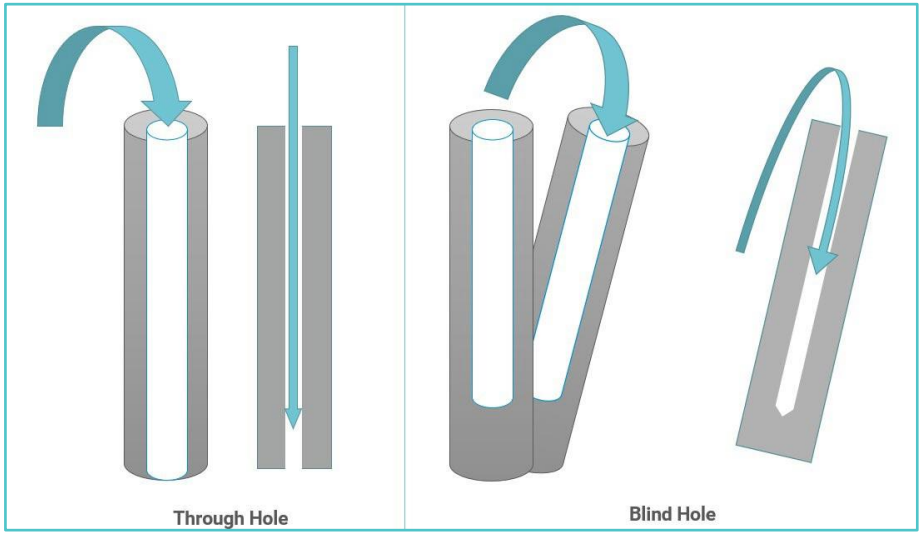
What can cause this issue?

The vapour cannot enter the internal surfaces easily.



How to fix it?

1. Make sure the opening is facing up.
2. A slightly inclined angle improves the vapour flow through the hole.
3. The through-hole can be placed vertically, but it depends on the length, geometry, and material.
4. How deep the vapor can go through depends on the length, geometry, and material. In some cases, it may not be possible to smooth the entire internal surface.

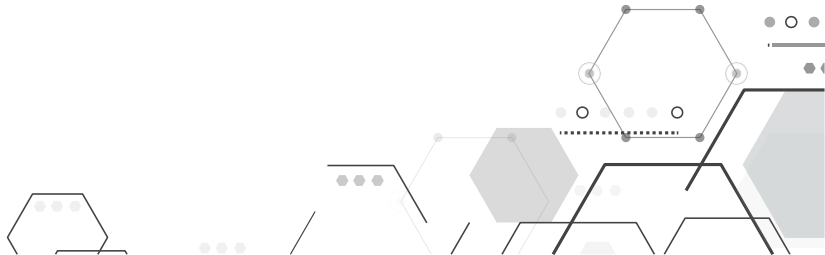


8. Recipe and Technical Support

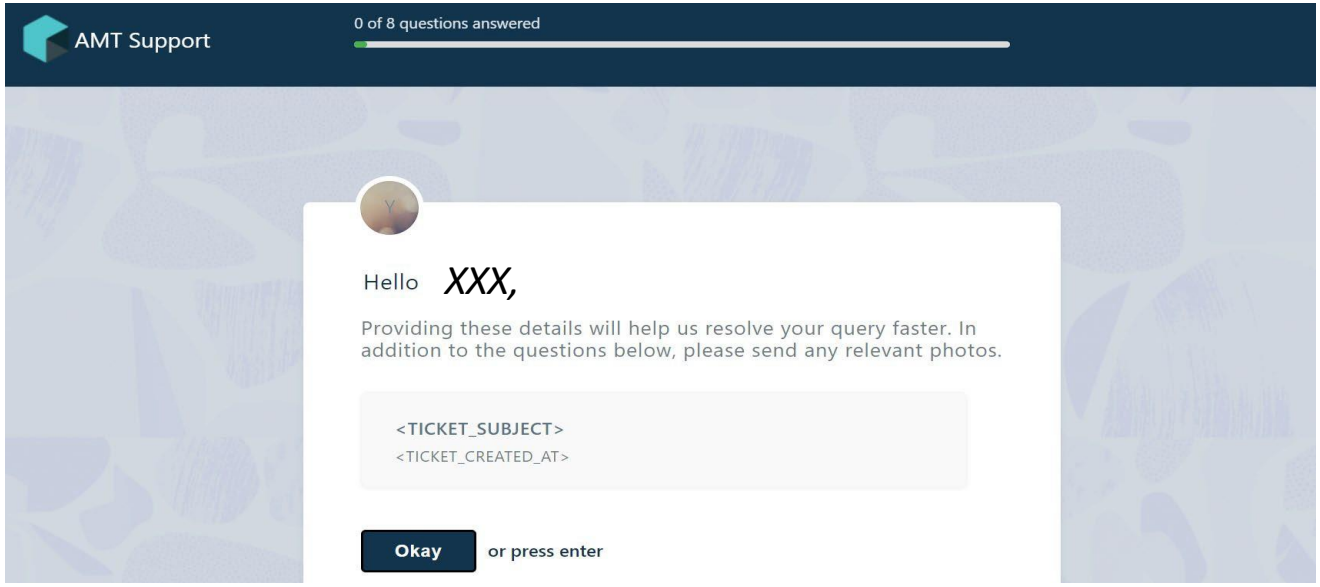
BEFORE THE PROCESS, PLEASE NOTE

Recipes are tested and defined in a controlled AMT process facility. The recommended recipes may need to be adjusted depending on your specific environment and parts. This includes room temperature, humidity, printers, materials grade/mix ratio, part geometry and quantity, hanging orientation, etc.

For this reason, it is important to note that the recipes suggested may require some fine-tuning to achieve optimal results in your facility. AMT will support you as needed.



FOR RECIPE SUPPORT



Please send an email to **SUPPORT@AMTECHNOLOGIES.COM** for any recipe support/queries. We will request the following information so please make sure this is available.

- Printing Technology
- Material grade
- The average wall thickness of part(s)
- Part size/geometry
- Have the parts been dyed?
- Number of parts to be processed
- Have you tried processing these parts previously? If so, what recipe did you use? What was the outcome?



THANK YOU!

FOR MORE INFORMATION:
SUPPORT@AMTECHNOLOGIES.COM