

27 Starting the build

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Check that all the steps have been completed and all the necessary system checks are complete. In particular pay attention to:

- Powder level via the HMI
- Pressure of gas in the argon bottle
- Regulated argon pressure
- Condition of the chiller, ensuring that fluid levels are close to the upper level marker

27.1 Process checks

Confirm each of the steps have been completed before starting the build:

- Ensure the system has been cleaned down
- Login to AM250/AM400 control interface, open door
- Confirm chamber pressure is reading zero, if not see Section 18.3 – "Checking the pressure sensor"
- Transfer powder from supplier's container to system powder bottle
- Load powder
- Install substrate
- Assemble/install wiper. Dose powder to check for even distribution
- Heat soak procedure
- Install front and rear overflow bottles
- Install safe change filter assembly OR large safe change filter assembly
- Check argon cylinder pressure greater than 25 bar, supply pressure less than 2 bar
- Check the valve positions:
 - Safe change filter/large safe change filter – 4 open (V4, V5, F1 and F2)
 - Overflow bottles – 4 open (A1, B1, V2 and V3)
 - Silo filling valve – 1 closed (V1)
- Select file and start build

27.2 Initiating the build

First of all double-check all the valve positions are correct. The system will not operate correctly unless:

- Safe change filter/large safe change filter – four valves are open (V4, V5, F1 and F2)
- Small rear overflow bottle – both bottle and pipe valves are open (A1 and V2)
- Large front overflow bottle – both bottle and pipe valves are open (B1 and V3)
- Silo – top valve is closed – even if a bottle is present (Figure 219) (V1)
- Silo – dosing valve is open (Figure 253) (IV1)



Figure 253 Silo top valve in closed position (V1)

The KF valve is open when aligned with the flow direction, and shut when the lever is 90° to the direction of flow (Figure 219).

Note: The silo dosing valve (IV1) is an exception to the rule and is open when perpendicular to flow (parallel to the ground – shown in inset of Figure 254).

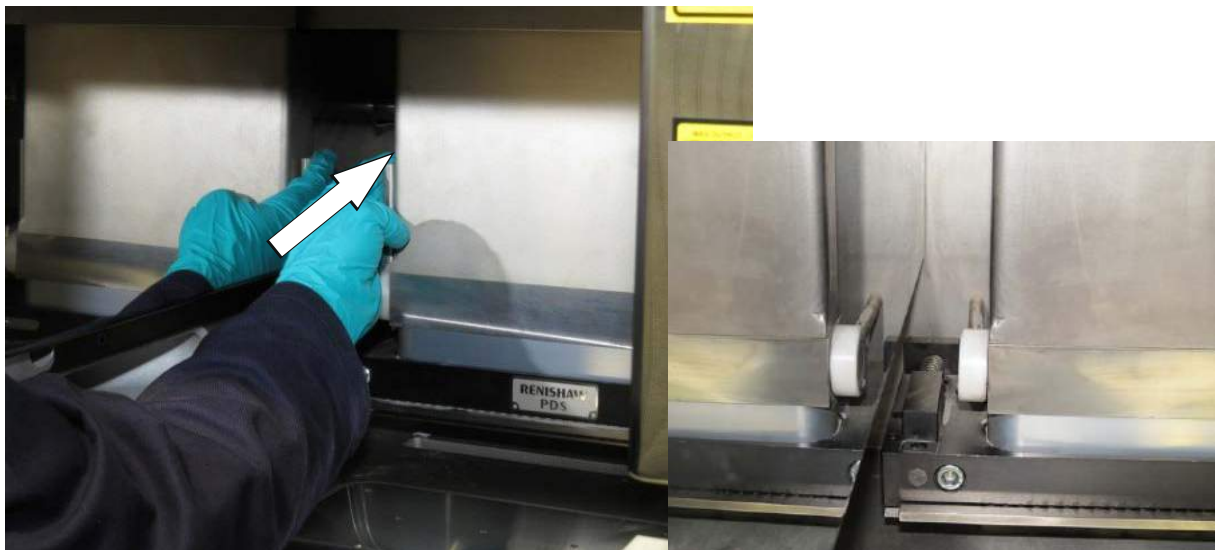


Figure 254 Open the silo dosing valve (IV1) by pushing away

Esc.

LIGHT

Auto

Manual

Wiper/Elevator Control

Select Build

Open Door

Heater

Log In/Out

Alarm Sample 1

Esc.	Build Names
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Alarm Sample 1

Esc.		Wiper/Elevator Position				LIGHT	
FIND WIPER HOME		LOAD		HOME		GO TO FWD. POS.	
GO TO CENTRE		WIPER AUTO		DOSE		9 No. of Doses	
Y-Position		-999.999		mm			
FIND TABLE HOME		LOWER POS.		HOME		GO TO TOP POS.	
ABSOLUTE TOP POS		TABLE AUTO		SET DATUM		Build Height	
-999.999 mm		GO TO 40mm		GO TO 80mm		-999.999 mm	
Z-Absolute Position		-999.999		Layer No.		GO ▲ GO ▼	
Substrate Thickness		-999.999 mm		-9999		Thickness	
99999 μm		FULL AUTO		STOP ALL		RESET DRIVES	
OPEN DOOR		Alarm Sample 1		SET			

that the winner and substrate are

Wiper/Elevator Control > Find Wiper Home

Once complete, press **Set Datum** on the control interface.

Wiper/Elevator Control > Set Datum

Press Esc and select the **Auto** menu (Figure 258) and press the **Play** button (Figure 259).

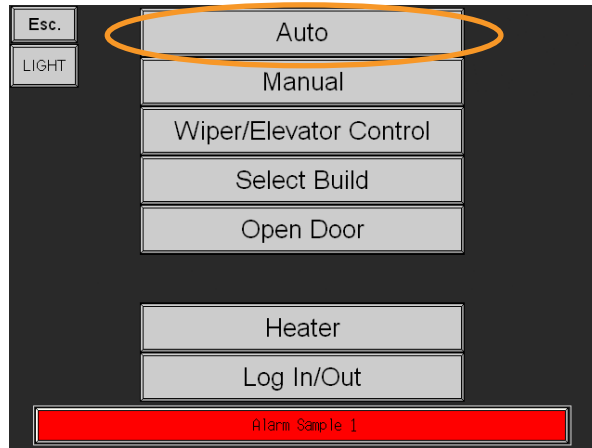


Figure 258 Select auto

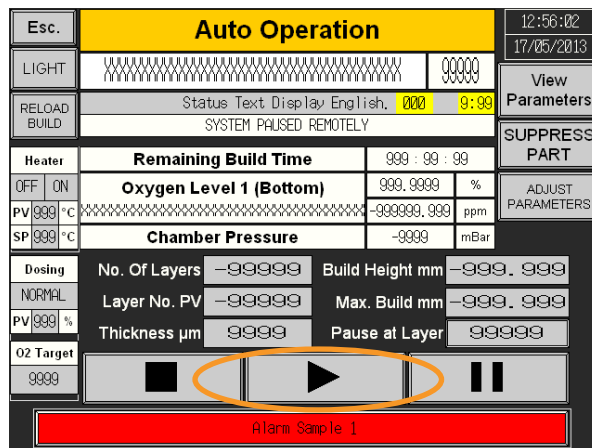


Figure 259 Press play

When prompted, ensure that the safe change filter valves (F1, F2, V4 and V5) are open and confirm this on the interface by pressing **Yes** (Figure 260).



Figure 260 Confirm by pressing Yes

27.3 Stabilising the atmosphere

At this point the system will start the process of creating the inert atmosphere. This takes between 10 and 15 minutes and throughout the process the HMI touch screen gives status updates.

Once the preset oxygen atmosphere threshold has been achieved, the system waits two minutes for the atmosphere to stabilise. If the threshold rises above the preset limit, the system will dose additional inert gas to achieve the required level and then wait a further two minutes.

27.4 Maintaining the build

WARNING: DO NOT REMOVE OR ATTEMPT TO CHANGE THE LARGE SAFE CHANGE FILTER WHILST A BUILD IS RUNNING. DO NOT OPERATE THE LARGE SAFE CHANGE FILTER VALVES (V4, V5, F1 AND F2) WHEN A BUILD IS RUNNING.

Note: Once the build has started, observe the first few minutes of the build process and check that the gas flow is correct from right to left, the quality of the part is acceptable, the powder is dosing correctly and the laser appears to be functioning correctly.

Once started, the system will then run automatically. Periodically the system operator will need to add new material and take away unused material that has been collected in the overflows.

The frequency of these activities is dictated by two factors:

- The cross sectional area of the part
- The amount of powder that is over-dosed

27.5 Setting the dosing percentage

Dosing is set via the HMI. Some degree of judgement is required for this value to be set, as it is dependent on the cross section of the part and also the layer thickness dictated by the materials file.

Typically, a build in 25 µm (0.001 in) layers requires a dose of around 40%. Thicker layers require a larger dose. The exact dose percentage depends upon the material being used, the part density on the build plate and part placement on the build plate. Experience of builds will guide you in selecting the correct dose percentage. The operator should aim to have powder in front of the wiper for the whole sweep and a small amount of powder wiped down the overflow. Overdosing will result in extra sieving, under dosing will only partially complete the build.

To set the dose, login at level 2 and select the **Service** button (Figure 261).

Following this, select the **User settings** button (Figure 262).

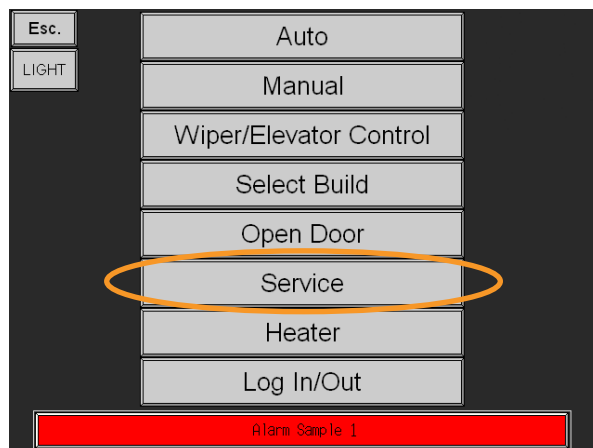


Figure 261 Select Service

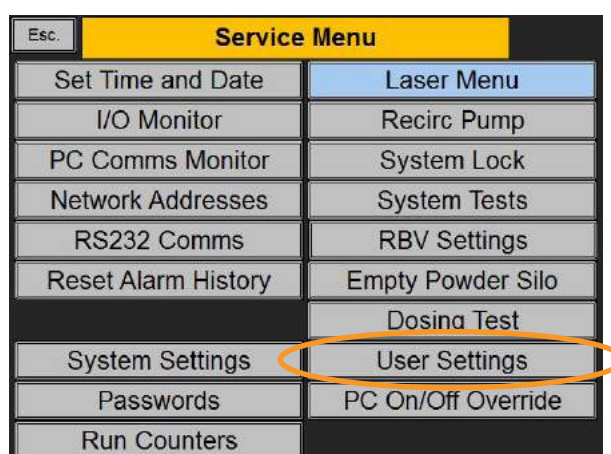


Figure 262 Select User settings

This then leads to the page that allows you to configure various settings including material, dosing, wiper speed and maximum oxygen threshold (Figure 263).

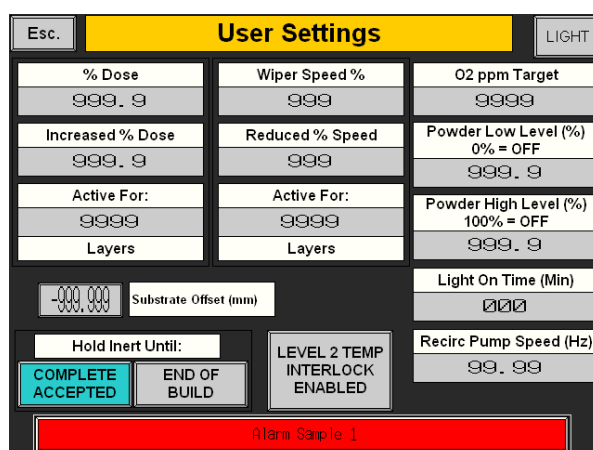


Figure 263 User-configurable settings

It is possible to amend the dosing percentage during the build.

For rapid powder delivery the dose can be setup to 300% – three fully open doses per wipe.

27.6 Restarting a build from a specific layer number

On the auto operation screen Layer No. PV (Present Value) will typically display the layer number.
Alternatively divide the build height by the layer thickness (for example 6 mm in 50 µm layers = $6 / 0.05$ = 120 layers).

If the last layer number is not known, Enter **Service Menu** (Figure 264).

Esc. Service Menu	
Set Time and Date	Laser Menu
I/O Monitor	
PC Comms Monitor	System Lock
Network Addresses	System Tests
RS232 Comms	
Reset Alarm History	Empty Powder Silo
	Dosing Test
System Settings	User Settings
Passwords	PC On/Off Override
Run Counters	UPS Settings

Figure 264 Service menu

Enter run counters menu, check the **Last layer number in previous build** value (Figure 265).





Esc. Run Counters	
Vacuum Pump	
 Hours	Reset
Recirculation Pump	
 Hours	Reset
Layer Count	
 Layers	
Last Layer Number in Previous Build	
 Layer	

Figure 265 Run counters

From the menu select **Wiper/Elevator Control** enter the required start layer into **Layer No.** Reset the datum by pressing **Set Datum** (Figure 266).

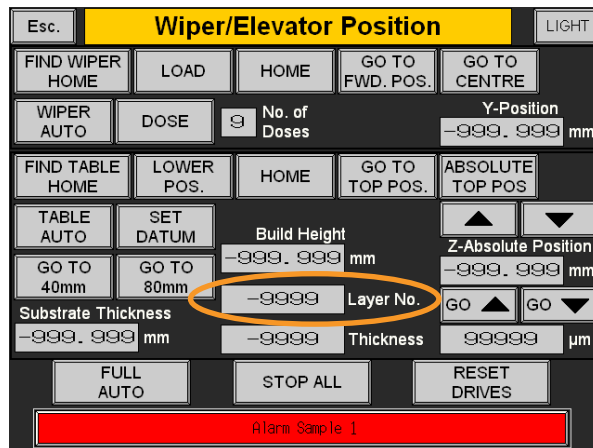


Figure 266 Enter layer number and set datum

In **Auto** press **Play**.

An on screen prompt will appear, confirm the **Start at Layer Number** figure is correct and press **Yes** (Figure 267).

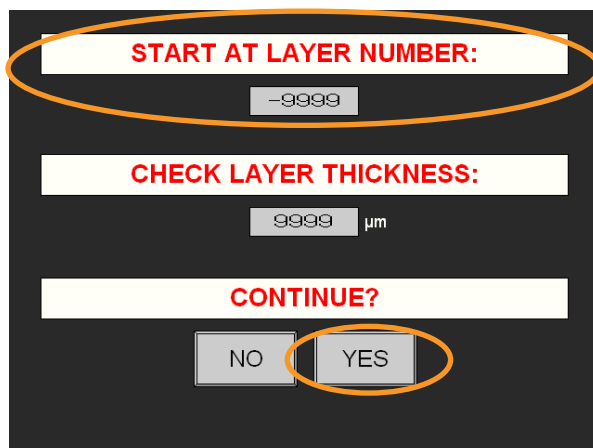


Figure 267 Check layer number and continue

Open safe change filter valves (F1, F2, V4 and V5) and proceed as a normal build.

27.7 Suppressing a part

In the **Auto** screen press **View Parameters** and then **Slice Preview** (Figure 268). Determine the number(s) of the part(s) to be suppressed (Figure 269).

Machine Status			O2 Trend
SYSTEM PAUSED REMOTELY			Slice Preview
Oxygen Level 1 (Bottom)	999.9999	%	
	999999.999	ppm	
Oxygen Level 2 (Top)	999.9999	%	
	999999.999	ppm	
Argon Pressure	9999	mBar	
Chamber Pressure	9999	mBar	
Powder Level	999.9	%	
Differential Pressure	99.99	mBar	
Vacuum Chamber Temperature	999.9	°C	
Electronics Temperature	999.9	°C	
Chilled Water Temperature	999.9	°C	
Optical Train Temperature	999.9	°C	
Elevator Temperature	999.9	°C	

Figure 268 Slice preview

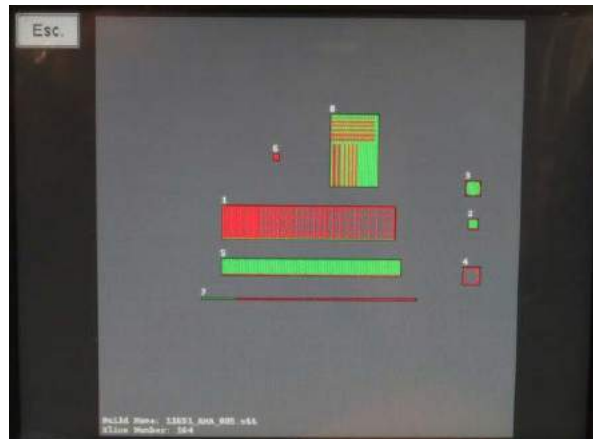


Figure 269 Check component numbers

In the **Auto** screen press **Pause**, additional functions will appear, press **Suppress part** (Figure 270).

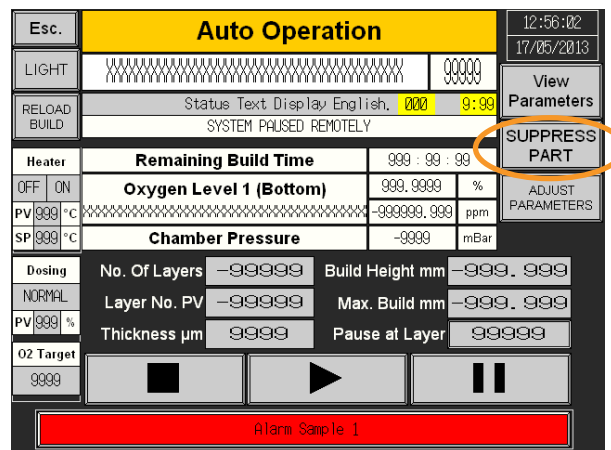


Figure 270 Suppress parts

Enter the part number into **Suppress part number** (Figure 271) follow the on screen prompts to suppress the part.

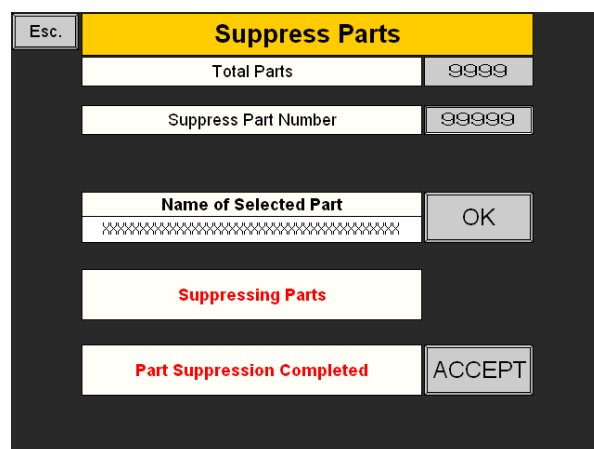


Figure 271 Suppress parts

Repeat if necessary for each part number.

Press **Escape** to exit the menu, press **Play** to re-commence the build (Figure 272).

27.8 Halting a build part way through

The Emergency Stop button should only be used to stop the build in an emergency. It will instantaneously halt the complete system, which will interfere with the software logic – it will not necessarily be possible to restart the build. The z-axis uses an incremental encoder, with a proximity sensor to provide an accurate home position. Using the Emergency Stop will require the home position of the z-axis to be re-taught.

Note: In the event of a breakdown or accident press the "Emergency Stop". Following assessment of the situation perform a restart procedure if safe, or call Renishaw AM service for support.

If a non-emergency shutdown is required, first select **Auto**, then press **Pause**, (Figure 272 and Figure 273).

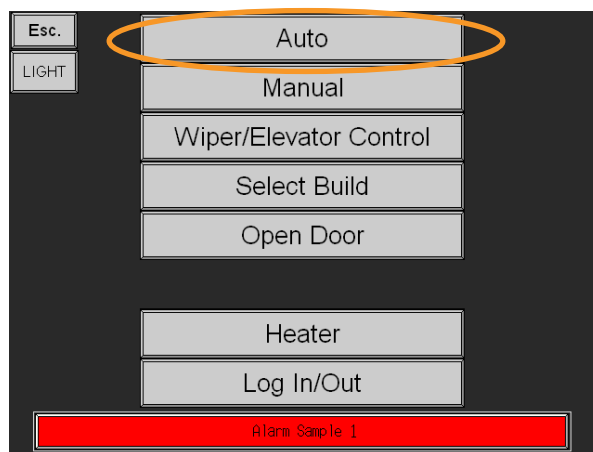


Figure 272 Select auto

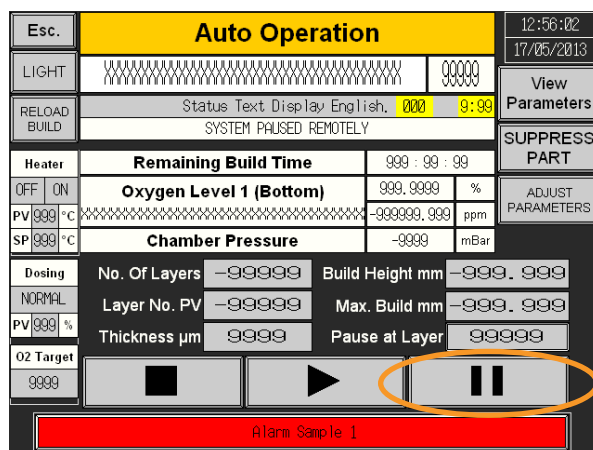


Figure 273 Press pause

28 Completing the build

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28.1 Closing the filter valves

At the end of the process, confirm the build completion when prompted on the AM control interface (Figure 274).

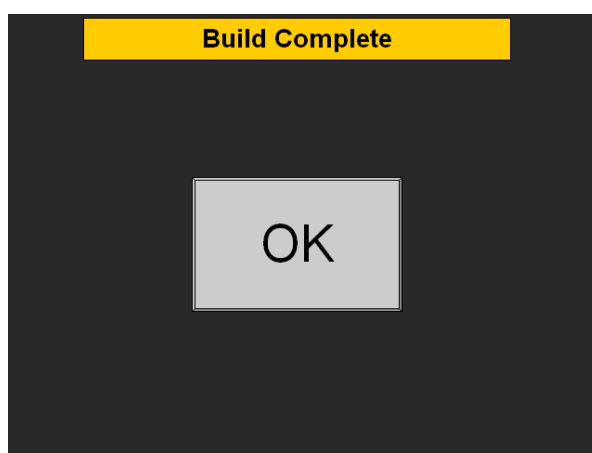


Figure 274 Build complete prompt in the control interface

You will then be prompted to close the safe change filter/large safe change filter valves, (V4, V5, F1 and F2) (Figure 275).



Figure 275 Isolate safe change filter

WARNING: THE FILTER WETTING (INERTING) PROCEDURE MUST BE FOLLOWED FOR ALL POWDER TYPES AND AFTER EVERY BUILD, SEE SECTION 22.

To close the four valves (V4, V5, F1 and F2), open the side door on the system to locate the safe change filter/large safe change filter and turn the levers so that they are at 90° to the direction of flow, (Figure 276).



Figure 276 Close safe change filter/large safe change filter upper and lower valves, (V4, V5, F1 and F2)

Confirm the filter valves (V4, V5, F1 and F2) have been closed (Figure 276) by selecting the following in the AM control interface.

> CONFIRM

The filter valves (V4, V5, F1 and F2) must remain closed until it is ready to be wet inerted. See Section 22 – "Safe change filter and large safe change filter", for details of the inerting and filter replacement process.

WARNING: THE SAFE CHANGE FILTER/LARGE SAFE CHANGE FILTER MUST BE REPLACED AFTER EVERY BUILD. SEE SECTION 22 "SAFE CHANGE FILTER AND LARGE SAFE CHANGE FILTER" FOR DETAILS.

28.2 Cool down

Wait for the heater temperature PV (Present Value) to reach room temperature before opening the door (Figure 277 and Figure 278).

Esc.	Auto Operation		12:56:02
LIGHT	00000		17/05/2013
RELOAD BUILD	Status Text Display English: 000 9:09		View Parameters
	SYSTEM PAUSED REMOTELY		SUPPRESS PART
Heater	Remaining Build Time 999 : 99 : 99		
OFF ON	Oxygen Level 1 (Bottom) 999.9999 %		ADJUST PARAMETERS
PV 999 °C	-999999.999 ppm		
SP 999 °C	Chamber Pressure -9999 mBar		
Dosing	No. Of Layers -99999	Build Height mm -9999.999	
NORMAL	Layer No. PV -99999	Max. Build mm -9999.999	
PV 999 %	Thickness µm 9999	Pause at Layer 999999	
O2 Target 9999			
<div>Alarm Sample 1</div>			

Figure 277 Allow PV to drop to < 40°C

Esc.	Auto Operation		15:25:42
LIGHT	00000		23/04/2013
	Upper Role Required.		View Parameters
Heater	Remaining Build Time 000 : 00 : 00		
OFF ON	Oxygen Level 1 (Bottom) 7.3250 %		
PV 26 °C	73250.000 ppm		
SP 1000 °C	Chamber Pressure 0 mBar		
Dosing	No. Of Layers 0	Build Height mm 0.000	
NORMAL	Layer No. SP 0	Layer No. PV 0	
PV 100 %	Thickness µm 50	Pause at Layer 0	
O2 Target 1000			
<div>EMERGENCY STOP OPERATED</div>			

Figure 278 PV at 26°C