

# Cole-Parmer®

For Version 5.2.x



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## 1 Disclaimer, Terms and Conditions

- Cole-Parmer Terms and Conditions apply.
- The intellectual property rights for this manual belong to Cole-Parmer (hereinafter referred to as “the Company”).
- The Company reserves the right to change product specifications without notice.
- The contents of this manual are subject to change without notice.
- The contents of this manual must not be copied, extracted, or modified in any form without the Company’s permission.

## 2 Safety

### DANGER! (may cause serious damage to property and or casualties)

1. No user-serviceable parts inside. Service by authorized personnel only.
2. Read this manual prior to operating FD 600 and observe and verify that all connections are properly secured.
3. Utility requirements: Ensure that the electrical connections meet the local standards and that the power supply is compatible with FD 600 nameplate. The power source must be properly grounded.
4. Do not operate FD 600 if there is any damage to the power cables.
5. The chamber and shelves may be extremely cold or hot – Check temperature before opening the chamber or touching the chamber's internal components, to avoid injury from frostbite or burns.
6. Do not force open the chamber door while the chamber is under vacuum. Doing so may cause serious injury and cause significant damage to FD 600.
7. Do not expose any body parts or entire bodies to vacuum.
8. FD 600 has been exclusively designed for freeze drying of non-flammable, non-corrosive, and non-hazardous solids or liquid containing products.
9. There is no user replaceable battery.



### WARNING! (may cause property damage or personal injury)

1. FD 600 may not be operated prior to reading this manual.
2. FD 600 must only be opened by authorized service personnel.
3. Do not place heavy objects on top of or stand on FD 600.
4. It is prohibited to install any unauthorized software onto FD 600.
5. Keep hands away from the chamber door during pump down, to prevent crushing injuries.
6. Ensure all ventilation openings are not obstructed, and air can flow freely.
7. Do not use mechanical devices or other means to accelerate the defrosting process.
8. FD 600 contains flammable refrigerating equipment. Do not damage the refrigerant circuit. While handling, moving, and operating, avoid physical damage to reduce the risk of a leak.
9. Ensure that all accessories and pumps adhere to specifications.
10. Connect and disconnect the accessories only while the machine is unplugged.



## ATTENTION! (may affect operational performance or service life)







1. The overall safe operation of FD 600 is the responsibility of the owner of FD 600 and their assigned operator(s), who in turn are responsible for ensuring the user manual guidance is applied, to ensure the safety and protection of personnel and FD 600 before, during, and after freeze drying operation.
2. FD 600 must be placed on a suitable surface of at least 77cm x 75cm (DxW), with a weight handling of a minimum 100 kg. Allow an additional 20cm space in each dimension for ventilation. Allow good access to power connections in case of emergency. Ensure FD 600 can be unplugged easily during an emergency.
3. Timely maintenance of FD 600 MUST be conducted to ensure continued safe operation and to optimize FD 600's service life.
4. Only accredited and qualified professional repair technicians can open FD 600 or conduct repairs. Persons performing repairs on FD 600 other than those selected or approved by the Company shall void any warranty for the product and are at risk of personal injury.
5. FD 600 must be used in a well-ventilated, dry environment.
6. FD 600 should be kept in a shaded area, without direct sunlight.
7. FD 600 must not be used in hazardous areas, or underground.

## FIRE HAZARD!



1. R290 - Refrigerant used in this instrument.
2. H220 - Extremely flammable gas.
3. In the case of refrigerant leak, DO NOT operate FD 600. Ensure FD 600 is disconnected from power supply and contact support immediately.

## 2.1 Panel Warnings

 Rear Panel	CAUTION – RISK OF FIRE OR EXPLOSION due to puncture of REFRIGERANT TUBING. Follow Handling Instructions Carefully. FLAMMABLE REFRIGERANT used.
 Door	WARNING – CRUSHING OF HANDS between the door and front panel, hinges, and door lock. Operate with caution.
 Chamber Wall, Shelves, and Trays	WARNING – FREEZING CONDITIONS. FROSTBITE HAZARD. Thermal gloves are required for extreme temperatures.
 Shelves and Trays	CAUTION – HOT SURFACE. Shelves and trays can be very hot. Thermal gloves are required for extreme temperatures.

## 2.2 Lifting and Moving

To ensure safety when lifting or moving FD 600, follow the below notes:

- Adjust the feet to reduce pinching hazards when positioning FD 600.
- Lift or move FD 600 on the base only.
- Keep FD 600 oriented upward.
- Lift or move FD 600 after removing the shelf stack and disconnecting all accessories.
- Avoid dropping or any severe shock and vibration. Avoid sharp objects. Avoid penetration of the housing.
- Two people are required to lift. Lift from each corner of FD 600, near the feet. Hold onto the base plate.

## 3 Sécurité

### DANGER ! (peut causer de graves dommages aux biens ou faire des victimes)



1. Aucune pièce réparable par l'utilisateur ne se trouve à l'intérieur. L'entretien doit être effectué uniquement par du personnel autorisé.
2. Lisez ce manuel avant d'utiliser le FD 600 et vérifiez que toutes les connexions sont correctement fixées.
3. Exigences utilitaires : assurez-vous que les connexions électriques sont conformes aux normes locales et que l'alimentation électrique est compatible avec la plaque signalétique du FD 600. La source d'alimentation doit être correctement mise à la terre.
4. N'utilisez pas le FD 600 si les câbles d'alimentation sont endommagés.
5. Le caisson et les étagères peuvent être extrêmement froids ou chauds. Vérifiez la température avant d'ouvrir le caisson ou de toucher ses composants internes, afin d'éviter les gelures ou les brûlures.
6. Ne forcez pas l'ouverture de la porte du caisson lorsque celle-ci est sous vide. Vous risqueriez de vous blesser gravement et d'endommager fortement le FD 600.
7. N'exposez pas des parties du corps ou des corps entiers à la machine.
8. Le FD 600 a été exclusivement conçu pour la lyophilisation de produits solides ou liquides ininflammables, non corrosifs et non dangereux.
9. Il n'y a pas de batterie remplaçable par l'utilisateur.

### AVERTISSEMENT ! (peut provoquer des dommages matériels ou corporels)



1. Lisez ce manuel avant d'utiliser le FD 600.
2. Le FD 600 ne doit être ouvert que par le personnel d'entretien autorisé.
3. Ne placez pas d'objets lourds sur le FD 600 et ne vous tenez pas debout dessus.
4. N'installez aucun logiciel non autorisé sur le FD 600.
5. N'approchez pas les mains de la porte du caisson pendant la descente de la pompe, afin d'éviter les blessures par écrasement.
6. Assurez-vous que toutes les ouvertures de ventilation ne sont pas obstruées et que l'air peut circuler librement.
7. N'utilisez pas de dispositifs mécaniques ou d'autres moyens pour accélérer le processus de dégivrage.
8. Le FD 600 contient des équipements frigorifiques inflammables. N'endommagez pas le circuit de réfrigération. Lors de la manipulation, du déplacement et de l'utilisation, évitez tout dommage physique afin de réduire le risque de fuite.
9. Veillez à ce que tous les accessoires et toutes les pompes soient conformes aux spécifications.
10. Branchez et débranchez les accessoires uniquement lorsque la machine est débranchée.

## ATTENTION ! (conséquences possibles sur les performances opérationnelles ou la durée de vie)

1. La sécurité générale du fonctionnement du FD 600 relève de la responsabilité du propriétaire du FD 600 et de son (ses) opérateur(s) attitré(s), qui doivent à leur tour s'assurer que les conseils du manuel de l'utilisateur sont appliqués, afin de garantir la sécurité et la protection du personnel et du FD 600 avant, pendant et après l'opération de lyophilisation.
2. Le FD 600 doit être placé sur une surface appropriée d'au moins 77 cm x 75 cm (DxL), avec une capacité de charge d'au moins 100 kg. Prévoyez un espace supplémentaire de 20 cm pour la ventilation. Prévoyez un bon accès aux connexions électriques en cas d'urgence. Veillez à ce que le FD 600 puisse être débranché facilement en cas d'urgence.
3. La maintenance du FD 600 DOIT être effectuée en temps utile pour garantir un fonctionnement sûr et optimiser la durée de vie du FD 600.
4. Seuls des techniciens de réparation professionnels accrédités et qualifiés peuvent ouvrir le FD 600 ou effectuer les réparations nécessaires. Les personnes effectuant des réparations sur le FD 600 autres que celles sélectionnées ou approuvées par la société annuleront toute garantie sur le produit et s'exposeront à des risques de dommages corporels.
5. Le FD 600 doit être utilisé dans un environnement sec et bien ventilé.
6. Le FD 600 doit être conservé dans un endroit ombragé, sans exposition directe au soleil.
7. Le FD 600 ne doit pas être utilisé dans les zones dangereuses ou souterraines.







## RISQUE INCENDIE !



1. R290 - Réfrigérant utilisé dans cet appareil.
2. H220 - Gaz extrêmement inflammable.
3. En cas de fuite de réfrigérant, NE faites PAS fonctionner le FD 600. Assurez-vous que le FD 600 est débranché de l'alimentation électrique et contactez immédiatement le service d'assistance.

### 3.1 Avertissements du panneau

 <p>Panneau arrière</p>	<p>ATTENTION -RISQUE D'INCENDIE OU D'EXPLOSION dû à la perforation du TUBE RÉFRIGÉRANT. Suivez attentivement les instructions de manipulation. RÉFRIGÉRANT INFLAMMABLE utilisé.</p>
 <p>Porte</p>	<p>AVERTISSEMENT -ÉCRASEMENT DES MAINS entre la porte et le panneau avant, les charnières et la serrure de la porte. Utilisez avec précaution.</p>
 <p>Mur, étagères et plateaux du caisson</p>	<p>AVERTISSEMENT -CONDITIONS DE GEL. RISQUE DE GELURES. Des gants thermiques sont nécessaires en cas de températures extrêmes.</p>
 <p>Étagères et plateaux</p>	<p>ATTENTION -SURFACE CHAUDE. Les étagères et les plateaux peuvent être très chauds. Des gants thermiques sont nécessaires pour les températures extrêmes</p>

## 3.2 Levage et déplacement

Pour garantir la sécurité lors du levage ou du déplacement du FD 600, veuillez respecter les consignes suivantes :

- Ajustez les pieds pour réduire le risque de pincement lors du positionnement du FD 600.
- Soulevez ou déplacez le FD 600 sur la base uniquement.
- Maintenez le FD 600 orienté vers le haut.
- Soulevez ou déplacez le FD 600 après avoir retiré la pile d'étagères et débranché tous les accessoires.
- Évitez les chutes, les chocs et les vibrations. Évitez les objets pointus. Évitez toute pénétration dans le boîtier.
- Deux personnes sont nécessaires pour soulever l'appareil. Soulevez chaque coin du FD 600, près des pieds. Tenez la plaque de base.

## 4 Introduction

Users are advised to carefully read this manual prior to operating FD 600 so that they are aware of all precautions outlined, and to ensure operation is in accordance with the instructions contained within this manual.

### 4.1 After Sales Support

If problems are encountered, or technical support is required when installing or operating FD 600, contact Cole-Parmer support.

The Company may provide technical assistance and information regarding FD 600, equipment, or service without charge, at its sole discretion. The buyer assumes sole responsibility for any reliance on or use of such assistance and information, and the Company makes no warranty thereon.

Upon contact, the following information is required:

- Product serial number (located on FD 600 nameplate).
- Description of issue or problem.
- Method and/or operating steps that have been undertaken towards resolution.
- Your contact details, inclusive of telephone number and email address.

### 4.2 Proper Use

FD 600 has been exclusively designed for freeze drying of non-flammable, non-corrosive and non-hazardous solids or liquid containing products. Freeze drying flammable, corrosive or hazard solids or liquids could damage the freeze dryer, void the warranty and cause accidents. FD 600 must not be used in an environment with a potentially hazardous or flammable atmosphere. FD 600 must not be used underground.

FD 600 is primarily designed for non-residential commercial use and is to be used only in conjunction with accessories recommended within this manual.

### 4.3 Product Disposal

FD 600 should not be disposed of with other household or electronics waste. To prevent possible harm to the environment or human health from uncontrolled waste disposal, recycle responsibly to promote the sustainable reuse of material resources. To return your used device, use the return and collection systems, or contact the distributor where the product was purchased. This product contains polyurethane (PU) and R290 (propane). PU is flammable and recyclable. R290 is an extremely flammable refrigerant.

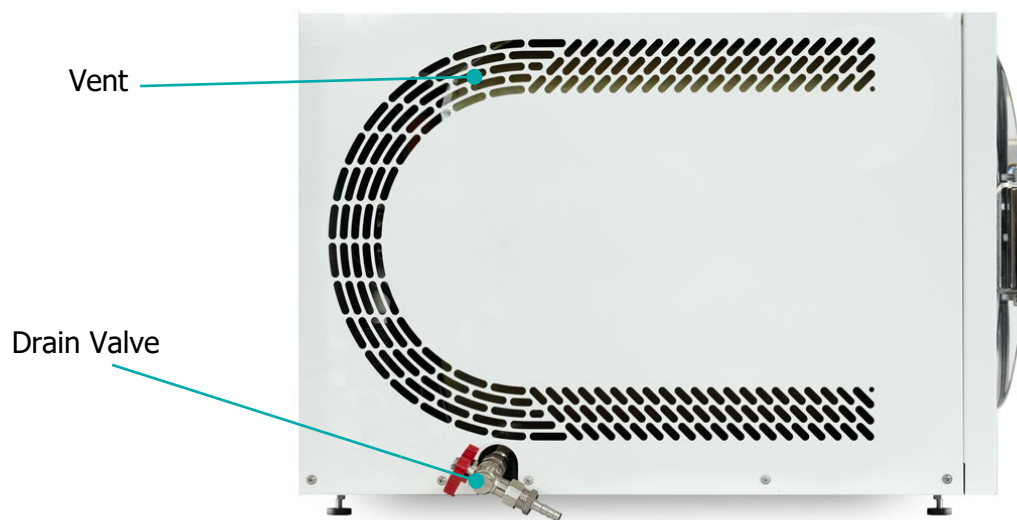
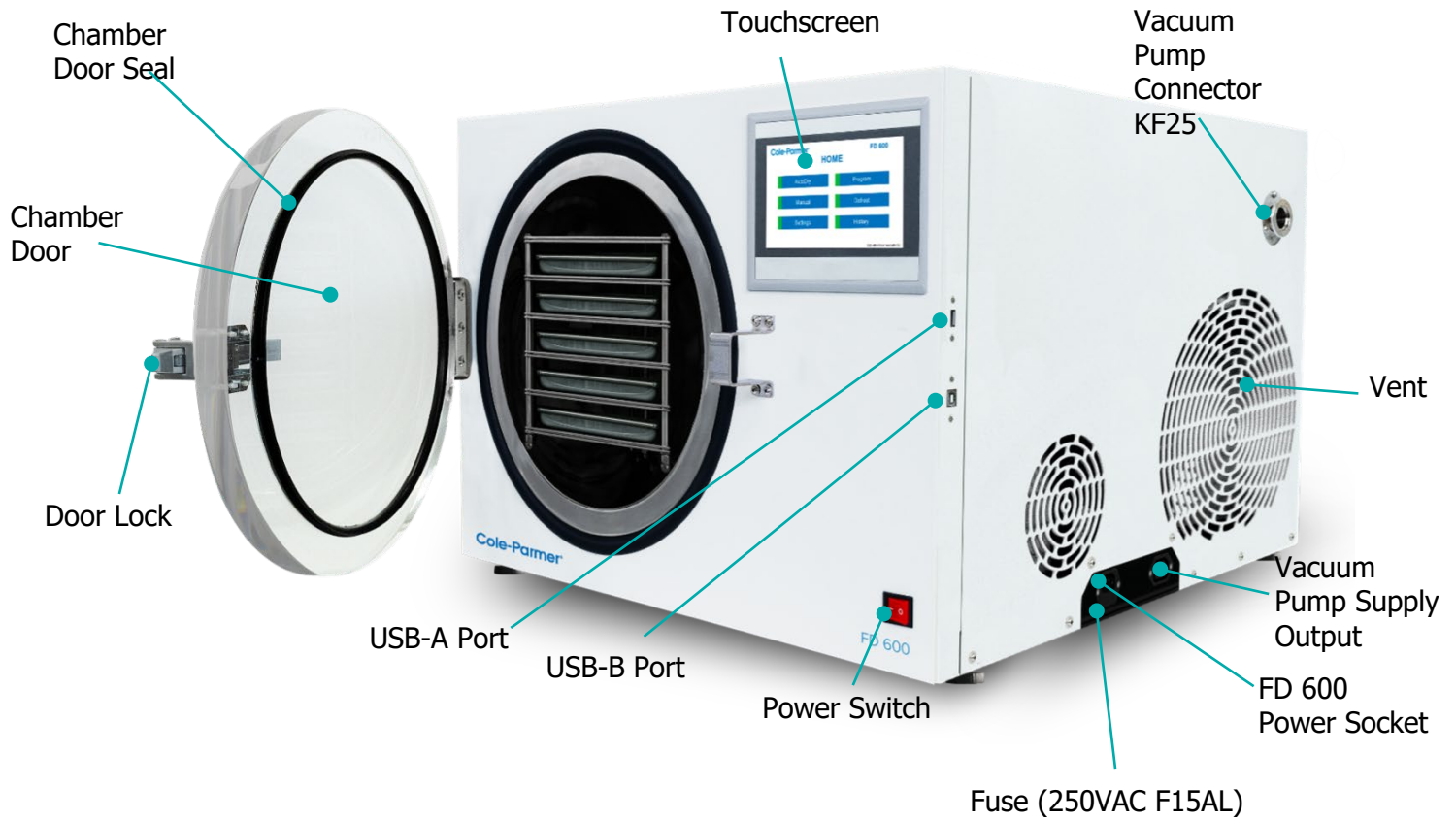
## 5 Technical Specifications

Product Name	FD 600
Product Weight	87 kg
Max Vacuum Pump Current	AC120V, 50/60Hz, 2.8A AC220-240V, 50/60Hz, 1.6A (Not for UL-mark)
Total Condenser Volume	11 litres
Ice Condenser Capacity	8 kg
Condenser Performance	4 kg per 24 hours
Ice Condenser Temperature	< -45 °C
Ultimate Vacuum	1.5 x 10 <sup>-1</sup> mbar
Minimum Shelf Temperature	-40 °C
Maximum Shelf Temperature	+60 °C
Tray Dimensions (mm)	9-shelf tray: 200 (W) x 450 (L) x 12 (H) 7-shelf tray: 200 (W) x 450 (L) x 15 (H) 5-shelf tray: 200 (W) x 450 (L) x 20 (H) 3-shelf tray: 200 (W) x 450 (L) x 20 (H) 1-shelf tray: 200 (W) x 450 (L) x 20 (H)
Number of Trays	Depends on shelf configuration
Shelf Stack Options	9, 7, 5, 3, 1 shelf
Shelf Stack Dimensions (mm)	465 (L) x 210 (W) x 240 (H)
Typical Product Capacity	9.6 kg at 80% moisture
Shelf gap	1-shelf: 188 mm 3-shelf: 59 mm 5-shelf: 33 mm 7-shelf: 22 mm 9-shelf: 16 mm
External Dimensions (mm)	770 (D) x 748 (W) x 507 (H)
Operating Altitude	< 2000m
Environmental Specification	10°C to 30°C 10% to 80%, non-condensing
Area of Operation	Indoors only
Overvoltage Category	Category II
Voltages and Frequencies	<b>For North America with UL mark</b> AC120V 50/60Hz  <b>For the rest of the world</b> AC100-120V, 50/60Hz AC220-240V, 50/60Hz
Pollution Degree	2

## 6 Precautions

- FD 600 should be connected to electrical outlets safely. Operate with dry hands to minimize the risk of electric shock.
- A suitably fused power supply (according to FD 600 nameplate) is required. An alternative supply voltage or frequency may damage FD 600 or reduce its working lifespan.
- The electrical power cord is designed to be connected to the power outlet without knots, sharp bends, or heavy materials placed on the cord.
- If the power cable is damaged, replace with same specification or contact Cole-Parmer support.
- FD 600 must be properly grounded according to local electrical codes.
- No residual water or foreign matter should be present inside the chamber prior to freeze drying.
- If an abnormal sound, excessive heat, smoke, etc. is detected, stop the process immediately, disconnect FD 600 from the power supply, and contact Cole-Parmer support. FD 600 operates with a low level of noise when running; if any significant changes occur, stop and contact support.
- If a power outage occurs when operating FD 600, open the drain valve and let the chamber pressure return to normal before opening the door to retrieve the product.
- When the freeze-drying process has finished, first turn off the vacuum pump, and then open the drain valve.
- Ensure the door seal ring and the chamber door remain clean. Only clean with soapy water and avoid using solvents or other cleaning agents.
- Do not rapidly power on/off FD 600. Wait for at least a minute after powering off FD 600 to power it on again.
- It is recommended that FD 600 be unplugged from the wall outlet, or the outlet be switched off, when not in use.
- Water may escape from FD 600 if it is operated outside of recommended operating conditions. Regularly check the vacuum pump for potential water contamination. Depending on the pump, replace the oil, and service as needed.
- Do not rapidly enable the compressor, as it may damage the component. Wait at least 30 seconds before enabling it again.
- While the compressor is running, do not directly power off FD 600. Turn it off from the software first, before turning off the power.
- When not in use, keep the drain valve and the chamber door open to prevent micro bacterial and mould growth due to residual moisture. Only seal off for storage if the chamber is entirely dry.

## 7 Components Overview





FD 600 Power Socket

Fuse (250VAC F15AL)

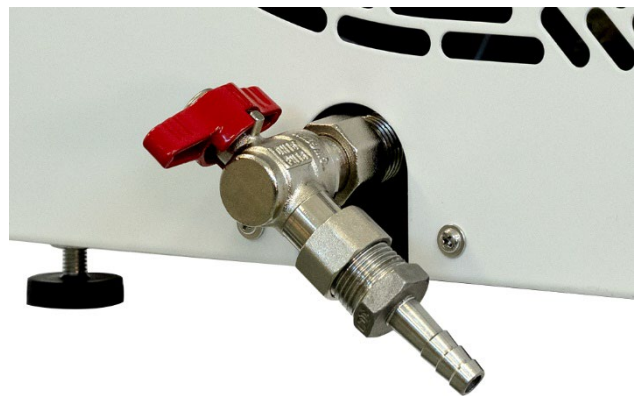
Vacuum Pump Supply Output

AC 120V, 12A, 50/60Hz  
AC 220-240V, 8A, 50/60Hz (Not for UL-mark)

AC120V, 50/60Hz, Max 2.8A  
AC220-240V, 50/60Hz, Max 1.6A (Not for UL-mark)



Drain Valve Closed



Drain Valve Open

## 8 Software Operation

Immediately after powering on FD 600, the Home screen is shown (Figure 1).

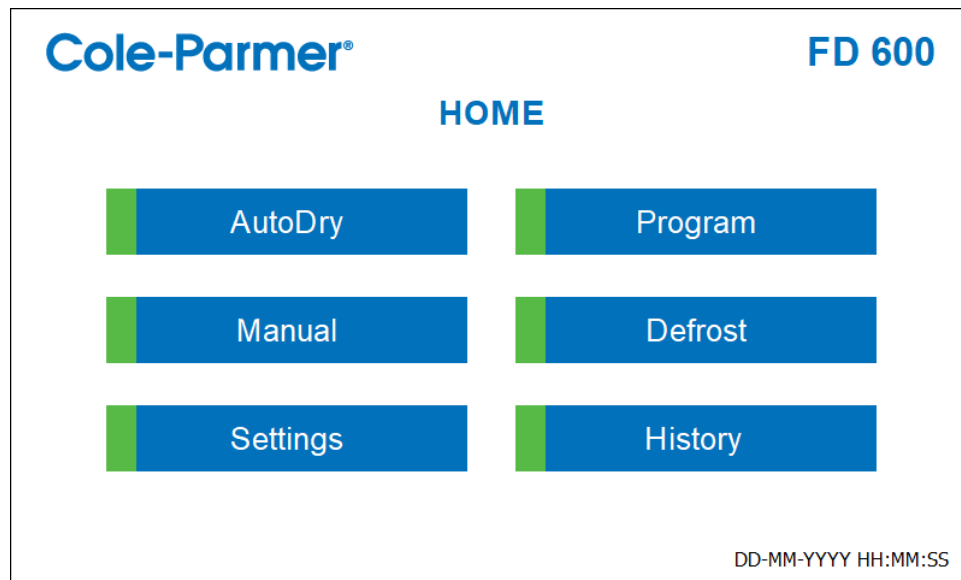


Figure 1

To go back to the Home screen, tap the "Home" icon that is present on most screens (Figure 2).

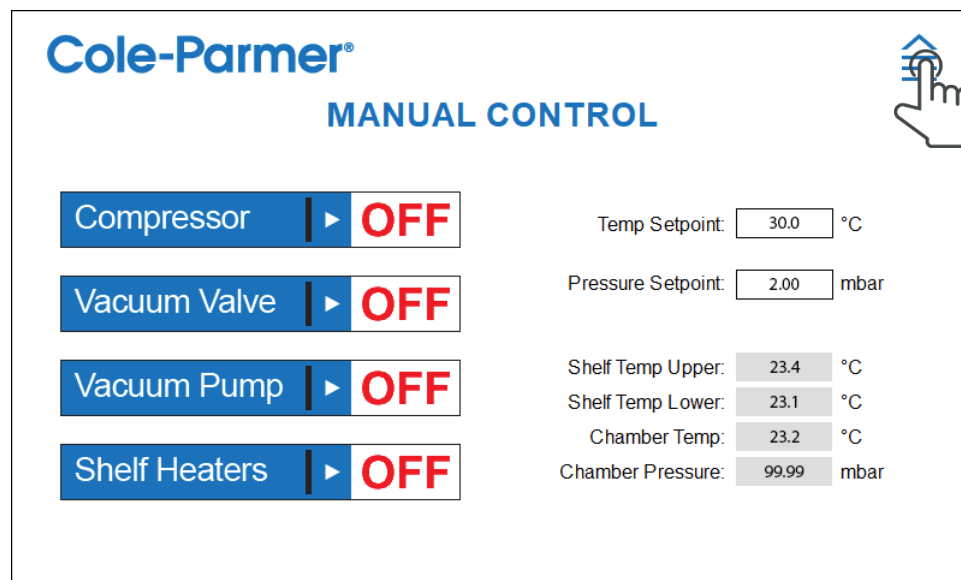


Figure 2

## 8.1 AutoDry

AutoDry automatically dries product using an intelligent dryness detection algorithm. AutoDry cannot guarantee complete product dryness for each run performed. If the dried product is found to be too moist, proceed to **"8.1.2 Editing AutoDry Parameters"**.

From the Home screen, tap on "AutoDry" (Figure 3).

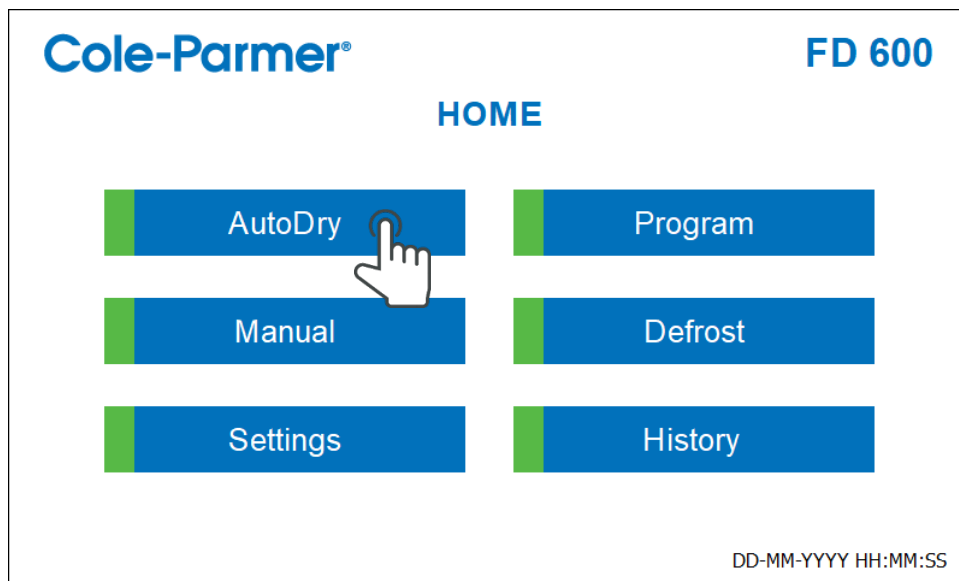


Figure 3

Figure 4 shows the AutoDry Start screen. Tap on "Start" to begin the freeze-drying process.

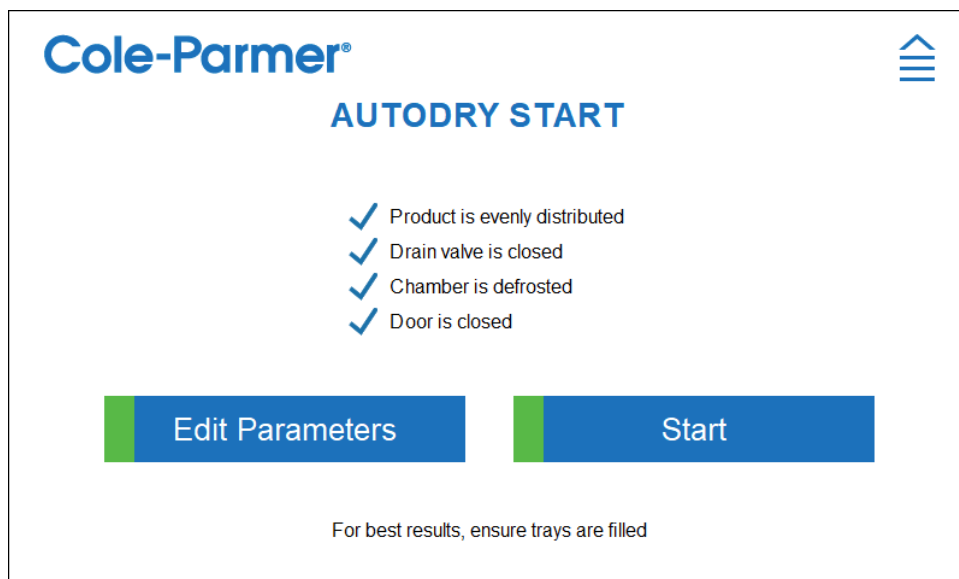


Figure 4

If in operation (i.e. Program or Defrost is running), Figure 5 shows an error message with the

"Start" button blocked.

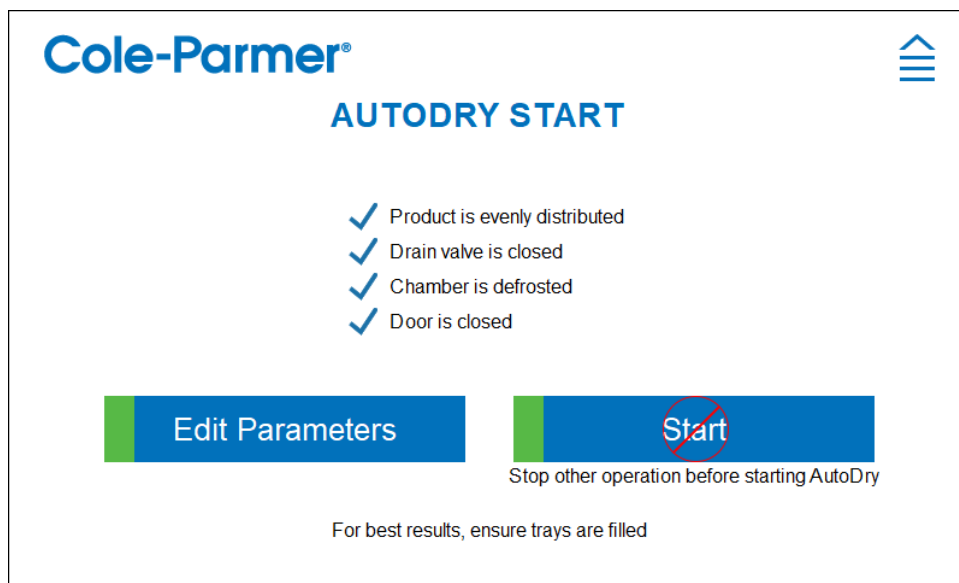


Figure 5

To proceed, stop Defrosting or the Program by navigating onto the respective screen, and tap on "Stop" or "Cancel".

## 8.1.1 AutoDry Process

AutoDry is split into 4 stages. Chronologically, they are Freezing, Evacuation, Drying, and Storage. A typical run will last for roughly 14-30 hours, depending on the moisture content of the product, and the parameters specified for the AutoDry algorithm.

Figure 6 shows the first AutoDry stage: the Freezing stage.

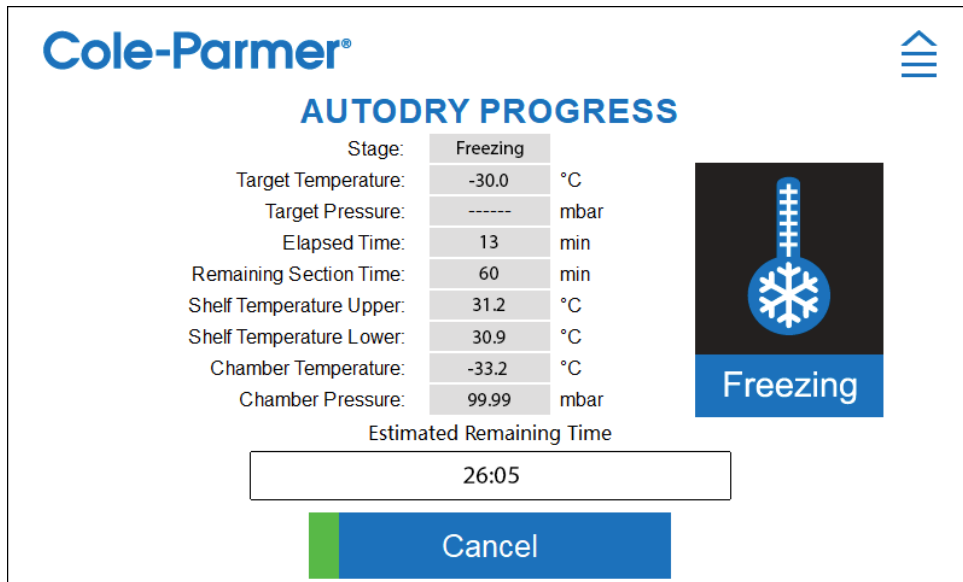


Figure 6

“Estimated Running Time” is displayed at the bottom of the screen. This time is based on the average runtime of previous successful AutoDry runs. Therefore, FD 600 first needs to almost complete a run before the displayed time is self-corrected. Adjusting any of the AutoDry parameters will reset this timer.

If there has been a power outage during a run, timing information will not be recorded for that run, and the remaining time may become inaccurate.

This timer works best using consistent product type, size and weight.

Figure 7 shows the Evacuation stage.

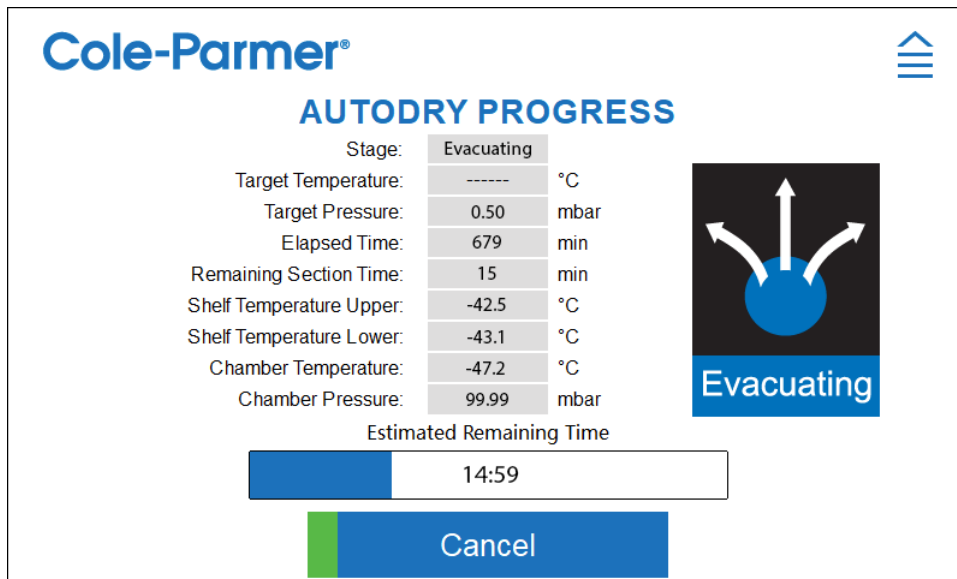


Figure 7

Figure 8 shows the Drying stage.

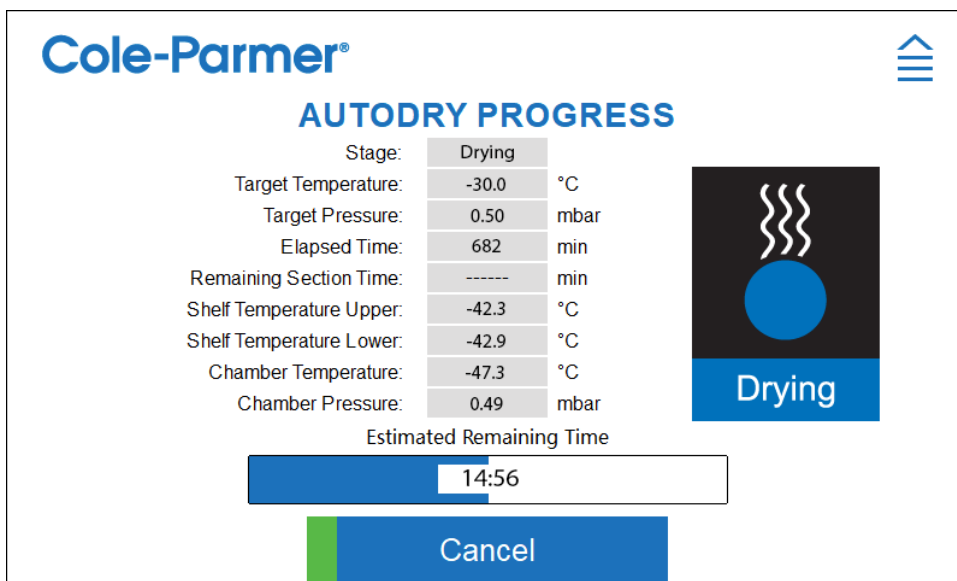


Figure 8

Figure 9 shows the Storage stage.

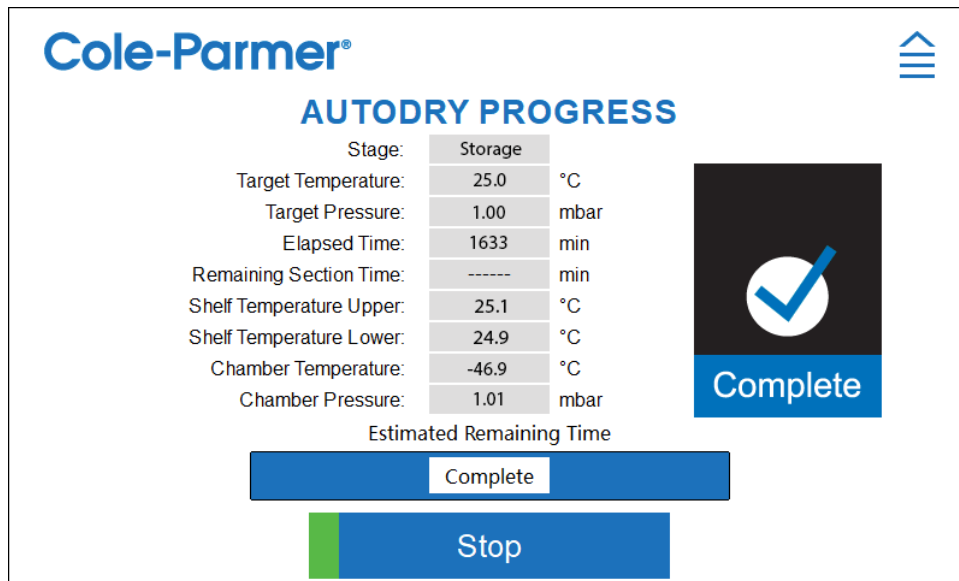


Figure 9

## 8.1.2 Editing AutoDry Parameters

To begin editing the parameters, tap on “Edit Parameters” from the AutoDry Start screen (Figure 10).

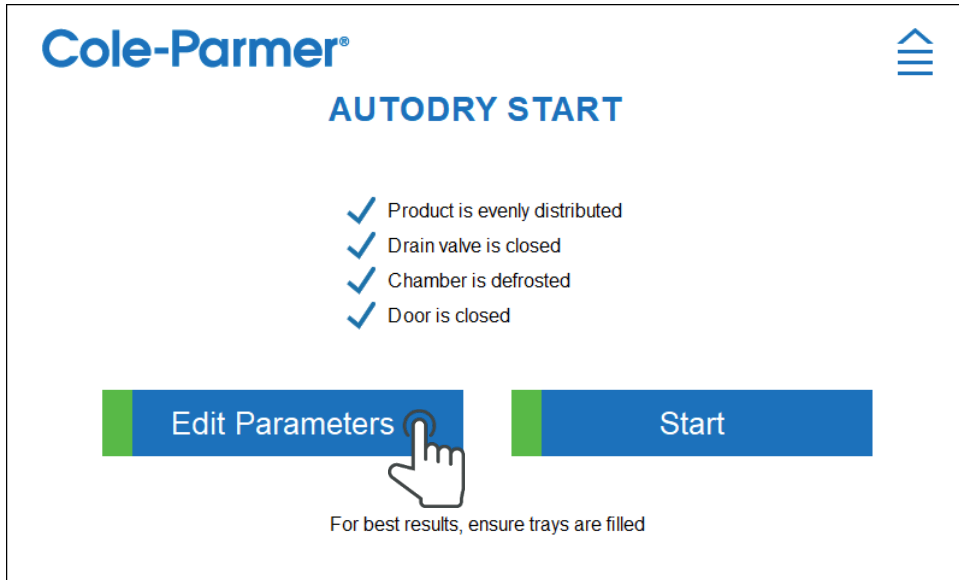


Figure 10

Figure 11 shows the Parameter Editor screen. This screen provides significant control over the behavior of the AutoDry algorithm. Only 3 of the 4 stages can be modified with AutoDry: Freezing, Drying, and Storage.

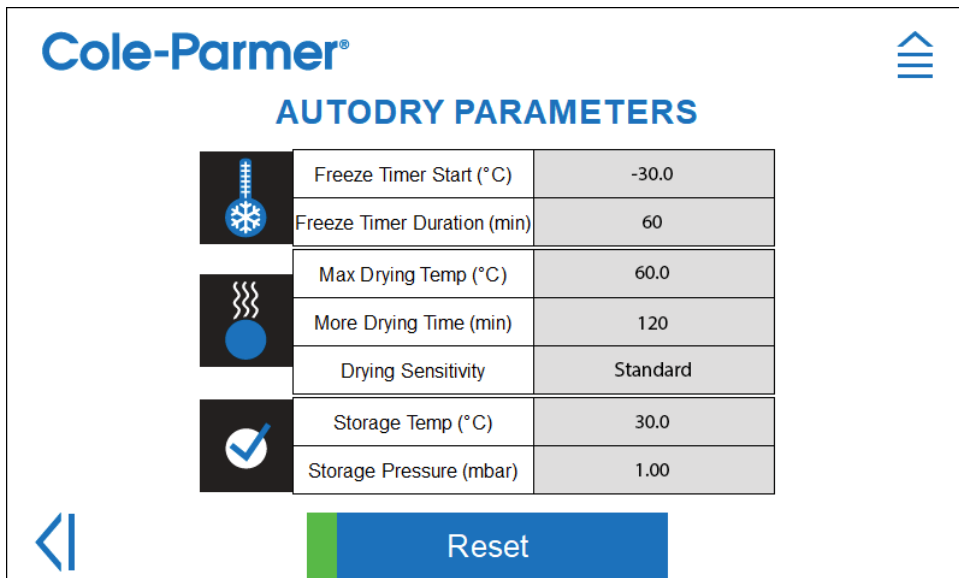


Figure 11

“Freeze Timer Start” (Figure 12) specifies the temperature the shelves must reach before the timer begins. “Freeze Timer Duration” specifies how long the shelves must be below the “Freeze Timer Start” temperature. This helps to ensure that the product is thoroughly frozen before drying starts.

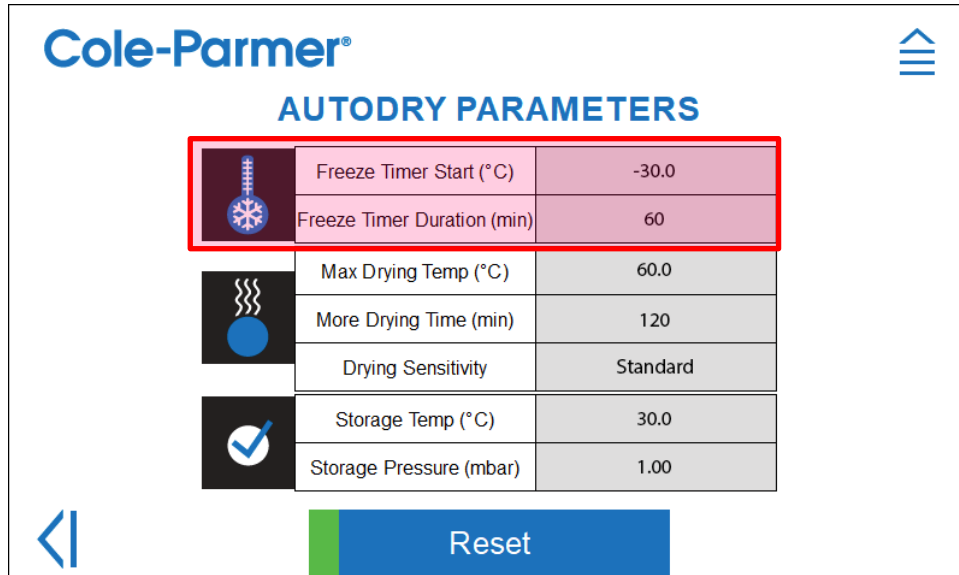


Figure 12

Figure 13 shows the Drying stage. You may increase the maximum drying temperature in conjunction with reducing sensitivity and adding more drying time. Higher temperatures and lower sensitivity will achieve shorter drying times but may have negative impacts on product quality. Reducing drying temperatures and increasing sensitivity will likely produce better quality results.

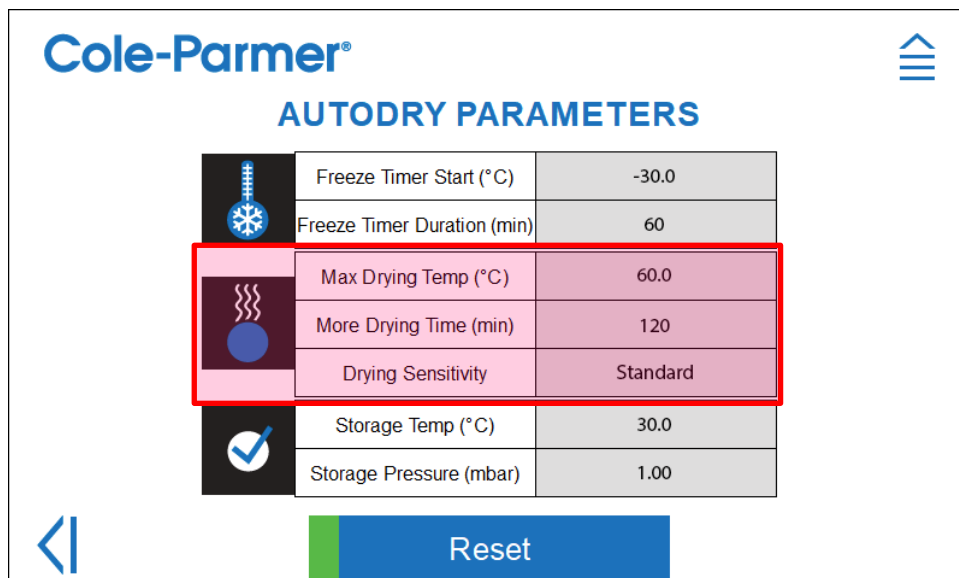


Figure 13

The Storage stage (Figure 14) specifies FD 600 operation at the conclusion of a run. We recommend storage above ambient temperature, to prevent rehydration.

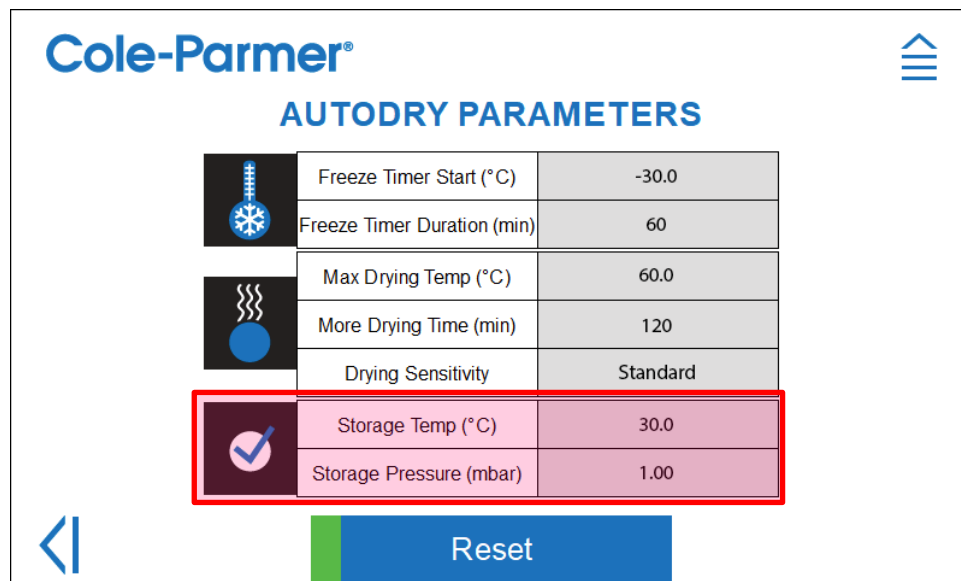


Figure 14

To restore to the default parameters for AutoDry, tap on “Reset”. The following popup will display (Figure 15):

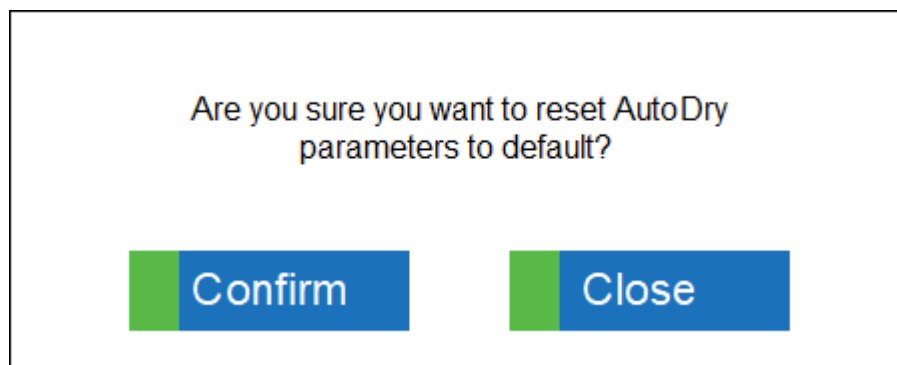


Figure 15

Tapping on “Confirm” will overwrite all previous changes to the AutoDry Parameters screen.

Note: Adjusting any parameters or resetting the values will require AutoDry to re-learn the duration of the run, and therefore will not be able to provide the duration hint until it has nearly completed a run.

## 8.2 Program

FD 600 has up to 12 customizable programs available, each with 16 steps. From the Home screen, tap on "Program" (Figure 16) to access a list of available programs (Figure 17).

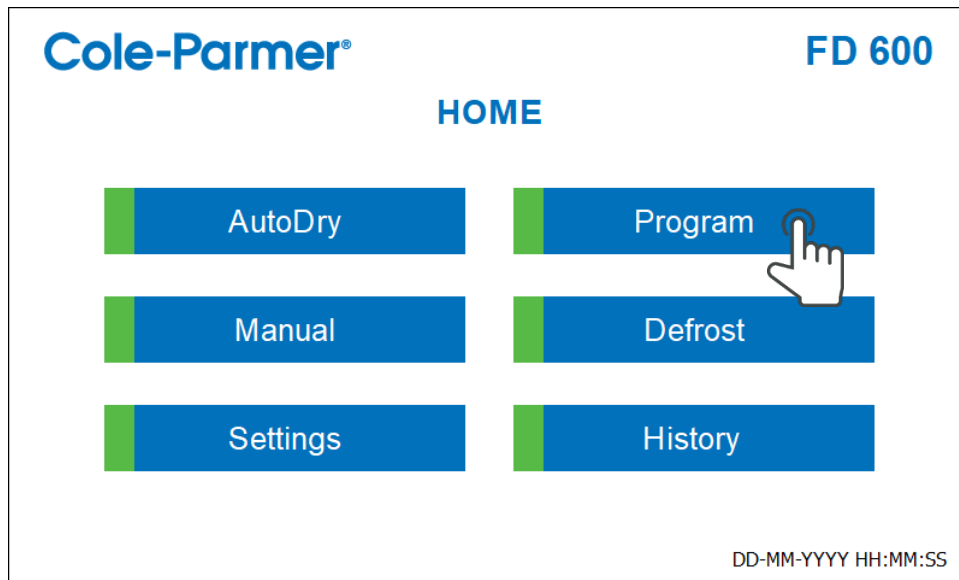


Figure 16

To review the remaining 6 available programs, tap on the right arrow (Figure 17).

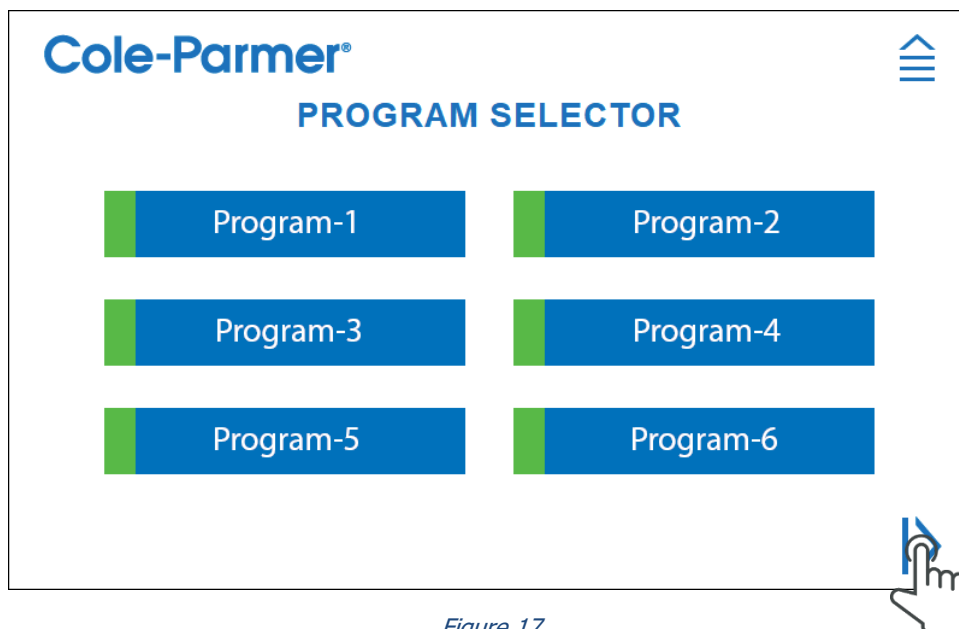


Figure 17

Figure 18 shows the remaining 6 programs. To go back, tap on the left arrow.

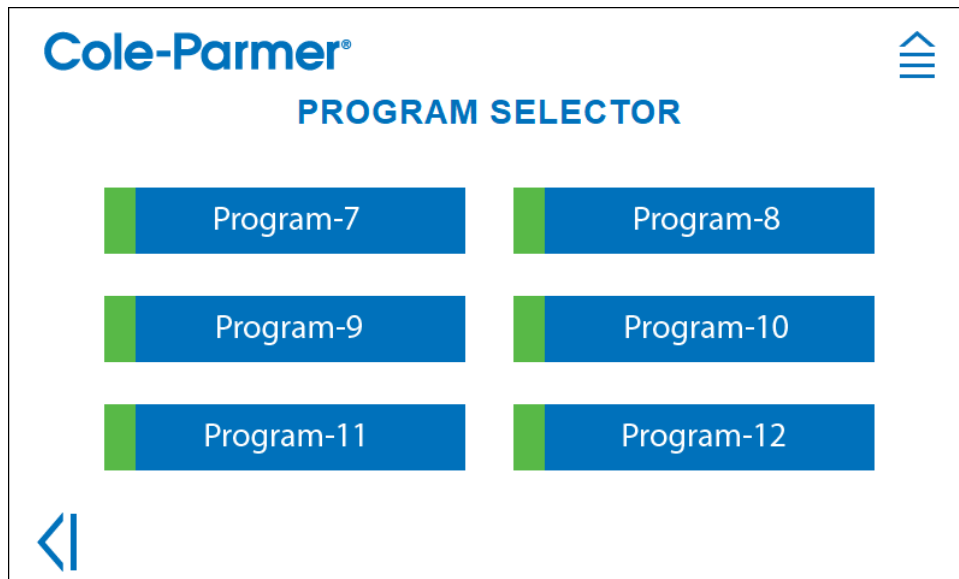


Figure 18

To edit one of these programs, tap on one of the programs (Figure 19) to enter the program editor. This will be explored in the later chapters.

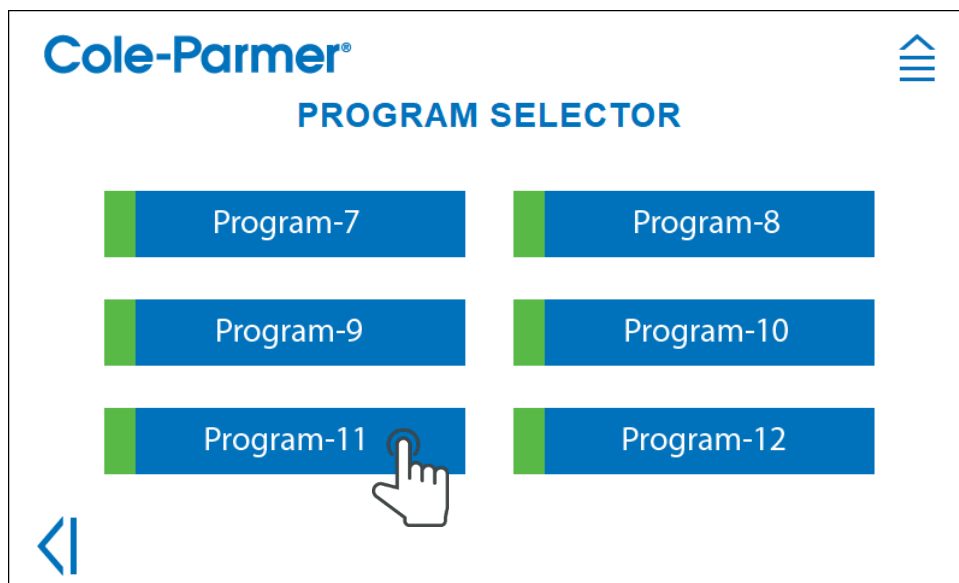


Figure 19

## 8.2.1 AutoDry/Program Stages

FD 600 Programs and AutoDry are broken down into 4 stages. Chronologically, they are as follows: Freezing, Evacuation, Drying, and Storage. See section “8.2.2 Writing a Program & Parameters Explained” for more details on each of the parameters, and how they control each stage.

- Freezing: This stage is used to cool the shelves, trays and products. This stage generally lasts for a few hours and will extend with increased load.
- Evacuation: This stage evacuates the atmosphere inside the chamber. This stage generally lasts for a few minutes.
- Drying: This stage involves the sublimation process and is where energy (heat) is transferred to the product at low chamber pressure.
- Storage: This is the final stage of the freeze-drying process, permitting a safe pressure and temperature to hold the product at until it gets removed from FD 600.

## 8.2.2 Writing a Program & Parameters Explained

From the Program Selector screen discussed in chapter 8.2, tap on “Program 1” to enter the Program Editor screen, as shown in Figure 20.

Freeze Timer Start (°C)		Freeze Timer Duration (min)		
-20.0		240		
Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 1	-30.0	120	1.00	<input type="checkbox"/>
Step 2	-20.0	120	0.80	<input type="checkbox"/>
Step 3	-10.0	120	0.60	<input type="checkbox"/>
Step 4	0.0	120	0.40	<input type="checkbox"/>
Step 5	10.0	120	0.30	<input type="checkbox"/>
Step 6	20.0	120	0.30	<input type="checkbox"/>
Step 7	30.0	120	0.30	<input type="checkbox"/>
Step 8	0.0	0	0.00	<input type="checkbox"/>

Figure 20

In Figure 20 the entries are only an example, as the parameters are dependent on the product. Program modes are explored in “8.2.6 Program Modes”.

## 8.2.2.1 Freezing Stage

The Freezing stage (Figure 21) is controlled by the “Freeze Timer Start” and “Freeze Timer Duration”. “Freeze Timer Start” specifies at what shelf temperature the timer will start, and “Freeze Timer Duration” specifies how long the shelves must stay under the specified temperature before proceeding to the Evacuation stage.

Freeze Timer Start (°C)		Freeze Timer Duration (min)		
-20.0		240		
Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 1	-30.0	120	1.00	<input type="checkbox"/>
Step 2	-20.0	120	0.80	<input type="checkbox"/>
Step 3	-10.0	120	0.60	<input type="checkbox"/>
Step 4	0.0	120	0.40	<input type="checkbox"/>
Step 5	10.0	120	0.30	<input type="checkbox"/>
Step 6	20.0	120	0.30	<input type="checkbox"/>
Step 7	30.0	120	0.30	<input type="checkbox"/>
Step 8	0.0	0	0.00	<input type="checkbox"/>

Figure 21

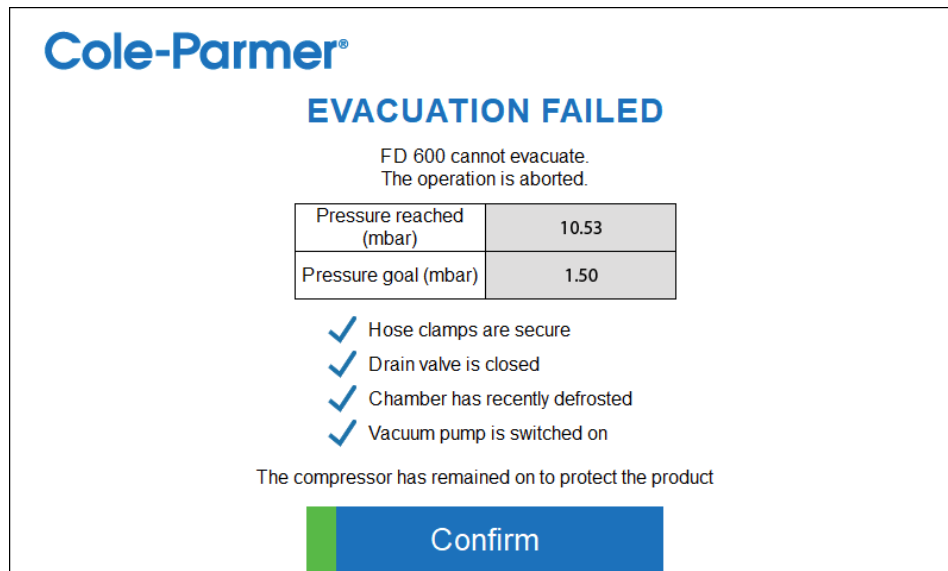
## 8.2.2.2 Evacuation Stage

The Evacuation stage (Figure 22) is controlled by Step 1’s pressure. Once the specified pressure is reached, FD 600 will proceed to the next stage.

Freeze Timer Start (°C)		Freeze Timer Duration (min)		
-20.0		240		
Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 1	-30.0	120	1.00	<input type="checkbox"/>
Step 2	-20.0	120	0.80	<input type="checkbox"/>
Step 3	-10.0	120	0.60	<input type="checkbox"/>
Step 4	0.0	120	0.40	<input type="checkbox"/>
Step 5	10.0	120	0.30	<input type="checkbox"/>
Step 6	20.0	120	0.30	<input type="checkbox"/>
Step 7	30.0	120	0.30	<input type="checkbox"/>
Step 8	0.0	0	0.00	<input type="checkbox"/>

Figure 22

The Evacuation stage will only run for up to 15 minutes. If the run has exceeded that time and the pressure is more than 0.5 mbar above from the setpoint, FD 600 will abort the run and enable the compressor in the manual page. The message below will appear, indicating that the Evacuation stage has failed (Figure 23).



*Figure 23*

If VO mode is selected (see “8.2.6.2 Vacuum Oven (VO) Mode”), then the compressor will not be enabled. Return to the Home screen by tapping on “Confirm”.

## 8.2.2.3 Drying Stage

In the Drying stage (Figure 24), up to 16 drying steps can be specified. They run sequentially, and are composed of a temperature and pressure setpoint, time, and the option of “Include Ramp Time”.

Incl. Ramp Time: This controls when the timer will start for the Drying stage. When the checkbox is checked, the timer will immediately start for the Drying stage. When all steps have this option checked, the total process time equals the sum of all drying steps (independent from how long it takes FD 600 to ‘ramp’ from step to step). When the checkbox is unchecked, the timer will only start once the shelves reach the temperature setpoint.

Freeze Timer Start (°C)		Freeze Timer Duration (min)		
-20.0		240		
Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 1	-30.0	120	1.00	<input type="checkbox"/>
Step 2	-20.0	120	0.80	<input type="checkbox"/>
Step 3	-10.0	120	0.60	<input type="checkbox"/>
Step 4	0.0	120	0.40	<input type="checkbox"/>
Step 5	10.0	120	0.30	<input type="checkbox"/>
Step 6	20.0	120	0.30	<input type="checkbox"/>
Step 7	30.0	120	0.30	<input type="checkbox"/>
Step 8	0.0	0	0.00	<input type="checkbox"/>

Figure 24

Only the first 8 steps are visible on the first page. Tap on the right arrow to navigate to the next screen, which contains the remaining 8 steps (Figure 25).

**Cole-Parmer®** Program-1

Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 9	0.0	0	0.00	<input type="checkbox"/>
Step 10	0.0	0	0.00	<input type="checkbox"/>
Step 11	0.0	0	0.00	<input type="checkbox"/>
Step 12	0.0	0	0.00	<input type="checkbox"/>
Step 13	0.0	0	0.00	<input type="checkbox"/>
Step 14	0.0	0	0.00	<input type="checkbox"/>
Step 15	0.0	0	0.00	<input type="checkbox"/>
Step 16	0.0	0	0.00	<input type="checkbox"/>

Storage Temperature (°C)	Storage Pressure (mbar)
30.0	3.00

Figure 25

### 8.2.2.4 Storage Stage

FD 600 will maintain a specified temperature and pressure that the product will be left at once the run has finished (Figure 26). Specify a pressure such as 1 mbar to avoid additional drying whilst in Storage and specify a temperature between 25-40C to prevent the product from absorbing moisture when it is reintroduced to the atmosphere.

**Cole-Parmer®** Program-1

Drying				
Drying Step	Temperature (°C)	Time (min)	Pressure (mbar)	Incl. Ramp Time
Step 9	0.0	0	0.00	<input type="checkbox"/>
Step 10	0.0	0	0.00	<input type="checkbox"/>
Step 11	0.0	0	0.00	<input type="checkbox"/>
Step 12	0.0	0	0.00	<input type="checkbox"/>
Step 13	0.0	0	0.00	<input type="checkbox"/>
Step 14	0.0	0	0.00	<input type="checkbox"/>
Step 15	0.0	0	0.00	<input type="checkbox"/>
Step 16	0.0	0	0.00	<input type="checkbox"/>

Storage Temperature (°C)	Storage Pressure (mbar)
30.0	3.00

Figure 26

For additional information about drying various products, refer to our “Freeze Drying Best Practices & Techniques” document.

## 8.2.3 Renaming a Program

FD 600 provides functionality to rename programs. On either the first or second Program Editor screen, tap on the program's name to prompt the keyboard function (Figure 27).

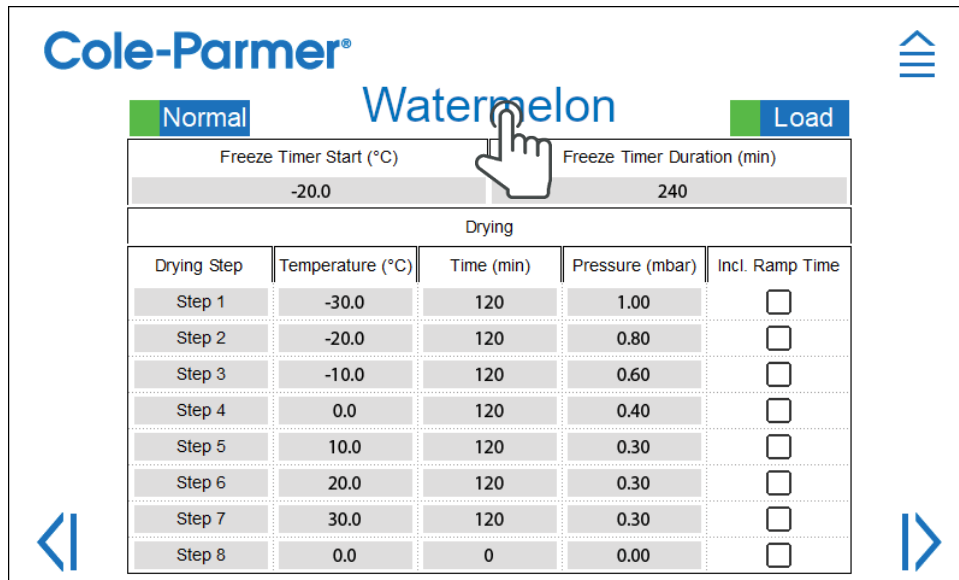


Figure 27

Type in a name, and then tap "Enter" to confirm the input. The name will be updated. The program name will be displayed on the Program Selection, Program Progress, and System Idle screens.

## 8.2.4 Loading a Preset Program

FD 600 comes with 4 preset programs as examples. To load a program, first select a program to load a preset program from the Program Selector screen. The button to load programs is located on the top-right of the Program Editor (Figure 28).

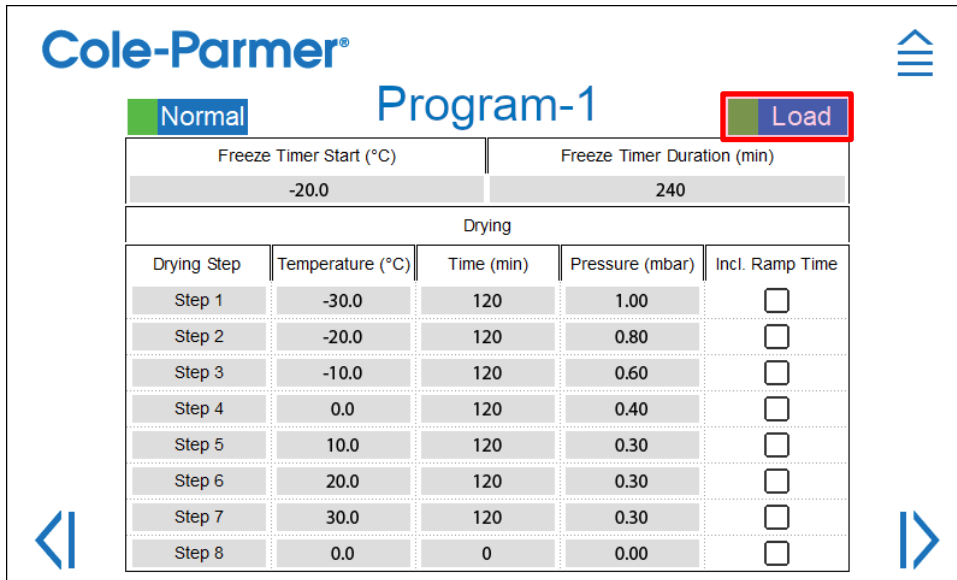


Figure 28

To prompt the UI for selecting a loadable program, tap on "Load" (Figure 29).

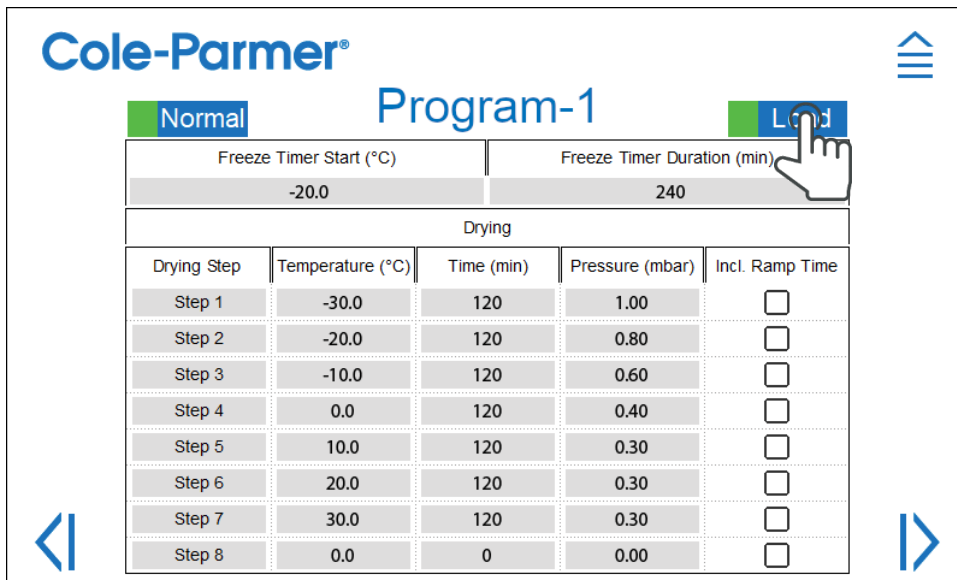


Figure 29

The following popup displays all the available programs to load (Figure 30). SafeDry, Liquid 2L, Candy, and Botanical example programs are available. Tapping on one of them will show a popup with product preparation instructions.

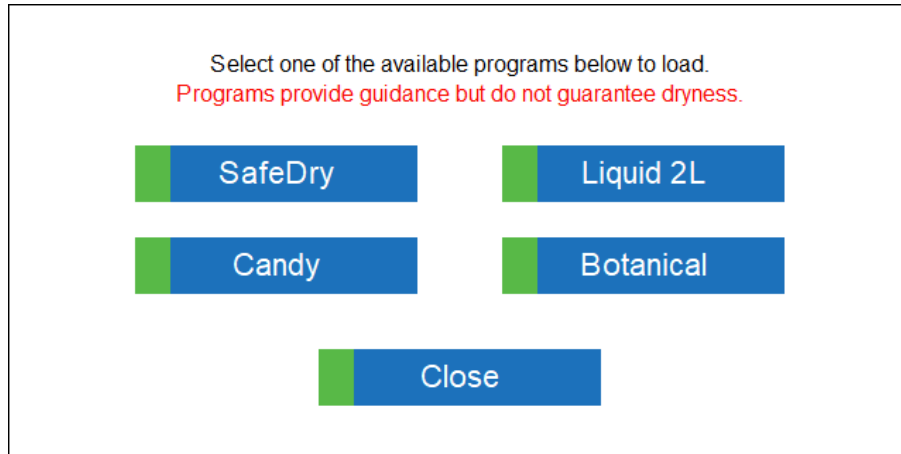


Figure 30

Tap on "SafeDry". Figure 31 is the popup that appears. Tapping on "Load" will close the popup and write the SafeDry program onto the selected program.

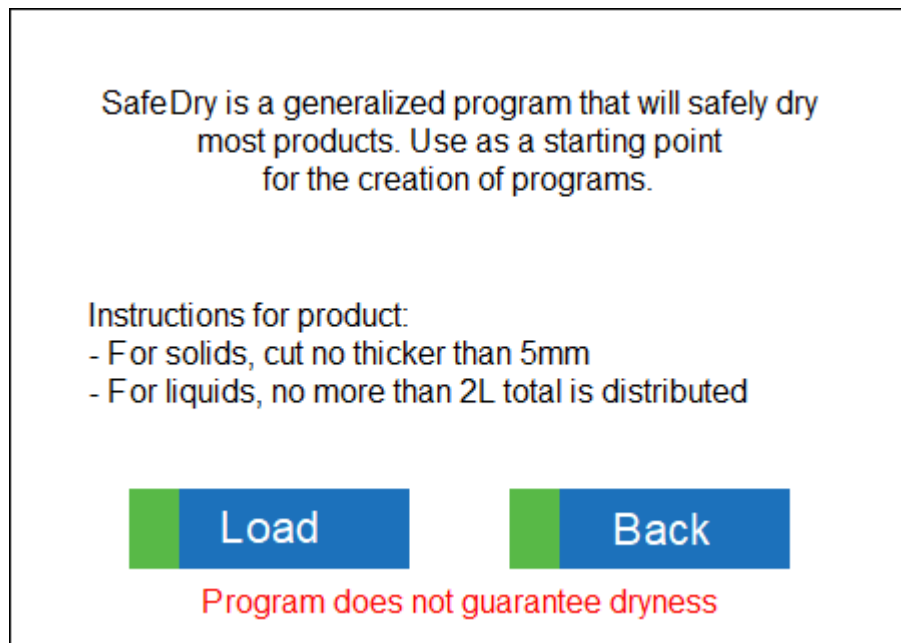


Figure 31

## 8.2.5 Starting a Program

Before starting the program, ensure the following:

- Product is evenly distributed between each tray for optimal drying.
- Drain valve is closed.
- Chamber is defrosted.
- Chamber door contact surface is clear of ice, and the door is closed.

It is important to defrost FD 600 before conducting a run. In addition, occasionally opening the ballast valve on the pump to release moisture buildup is recommended.

To run a program, while in the program editor, tap on the right arrow (Figure 32) to navigate to the Program Start screen (Figure 33).

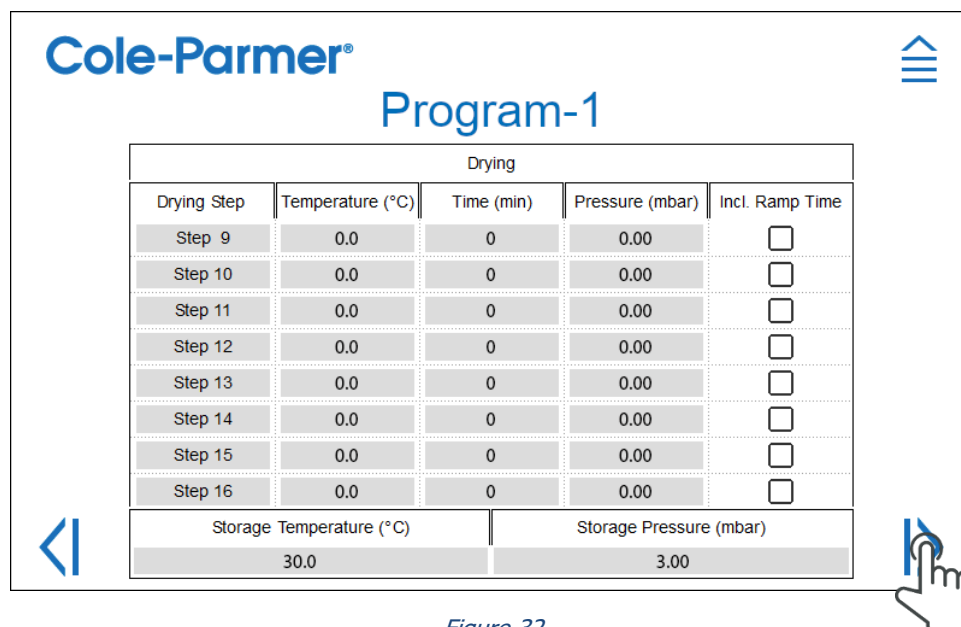


Figure 32

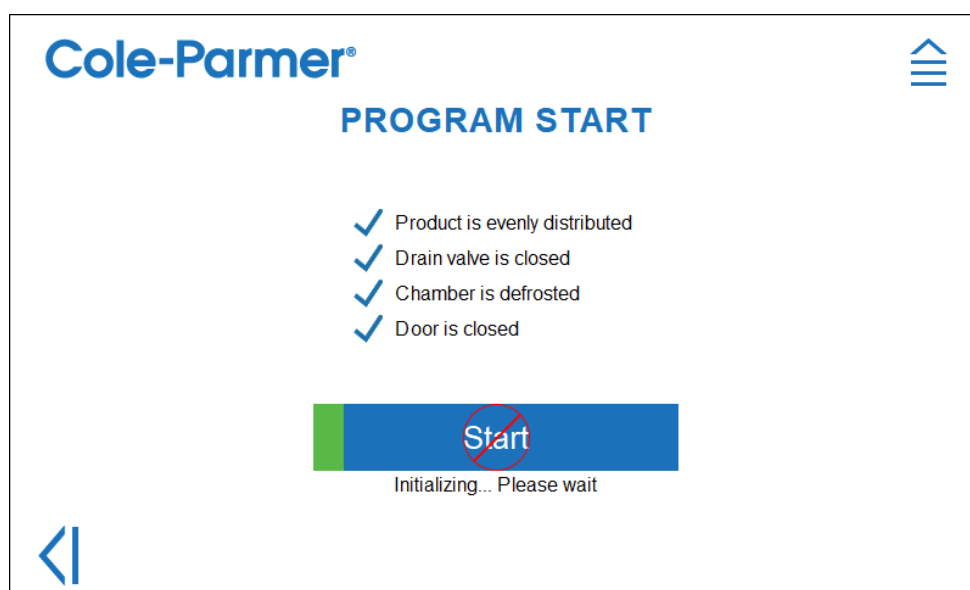


Figure 33

When you navigate to the Program Start page, it may take a few seconds to initialize. Wait until it initializes before attempting to start. If under an operation (e.g. Defrosting or AutoDry), you will get the following screen (Figure 34).

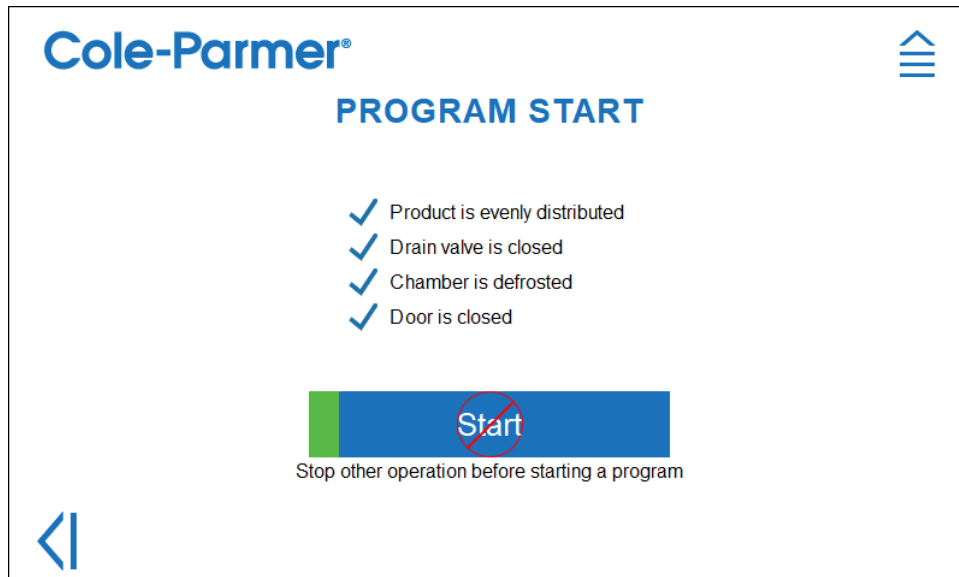


Figure 34

You will need to stop the other mode (such as Defrost) to start a program. If no other mode is running, and it has successfully initialized, you may tap on "Start" to begin the program (Figure 35).

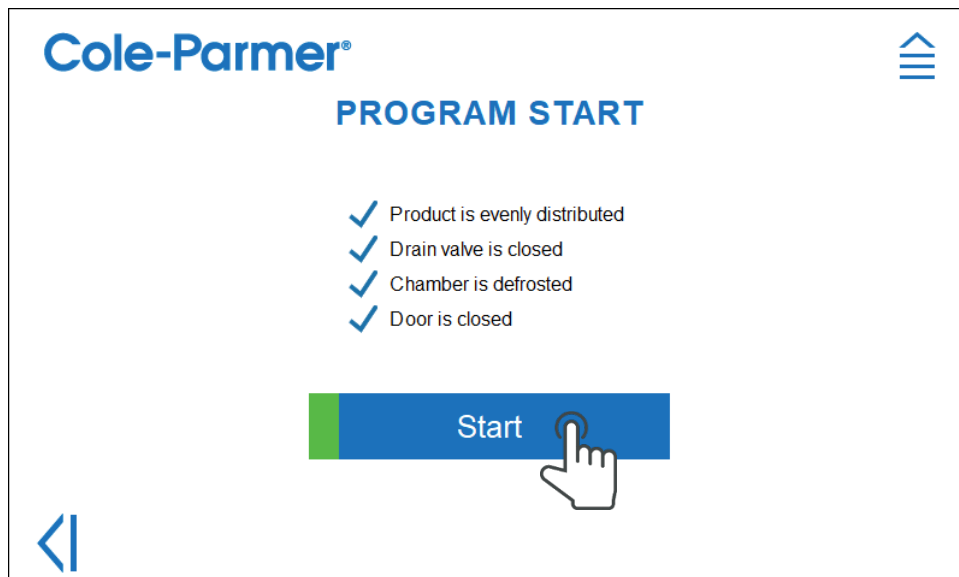


Figure 35

Verify the program is running by the sound of the compressor starting and the Program Progress screen appearing (Figure 36).

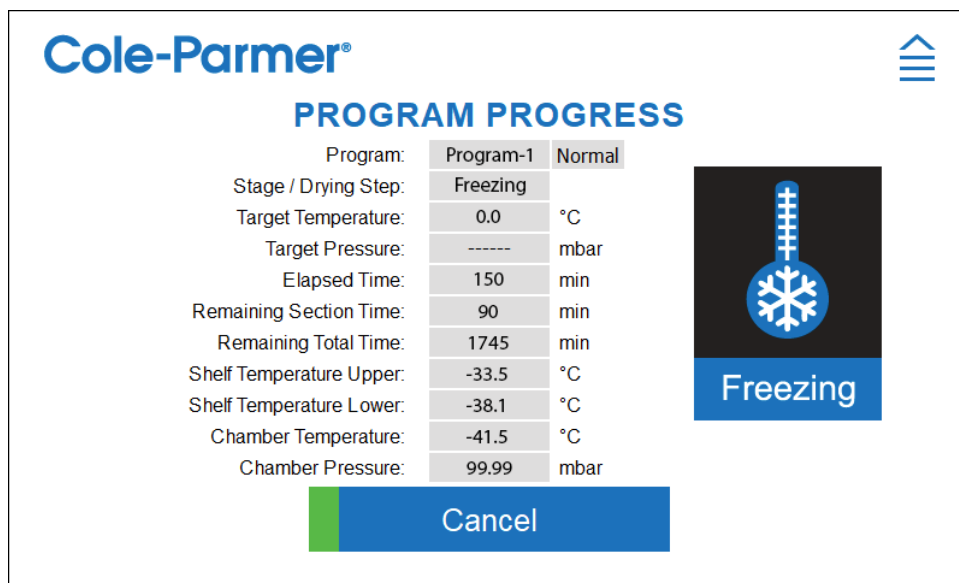


Figure 36

The Program Progress screen displays real-time values of the operation of the current program (Figure 36). Some of the readings are as follows:

**Elapsed Time:** The number of minutes that have passed since the program started.

**Remaining Section Time:** The timer for how much time is left on the current stage/drying step.

**Remaining Total Time:** The cumulative total of all the times from each stage and drying steps. This is not the estimated remaining time, but rather the remaining timer time.

**Note:** Most timers don't start unless the preconditions are met. For example, if the "Incl. Ramp Time" is unchecked, the drying step timer starts once the shelf temperatures are reached. This is indicated with a message under the "Cancel" button.

The Program Progress screen also displays the current stage. There are four stages in a Program “Freezing” (Figure 36), “Evacuating” (Figure 37), “Drying” (Figure 38) and “Storage” (Figure 39).

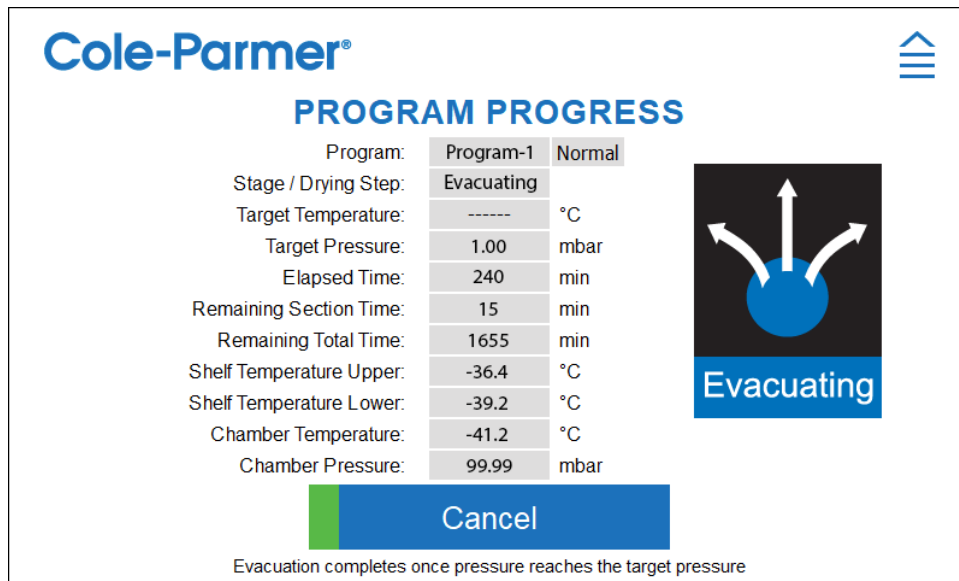


Figure 37

Note: If the pressure isn’t reached within a certain amount of time, the evacuation stage is aborted. This is explored in “8.2.2.2 Evacuation Stage”.

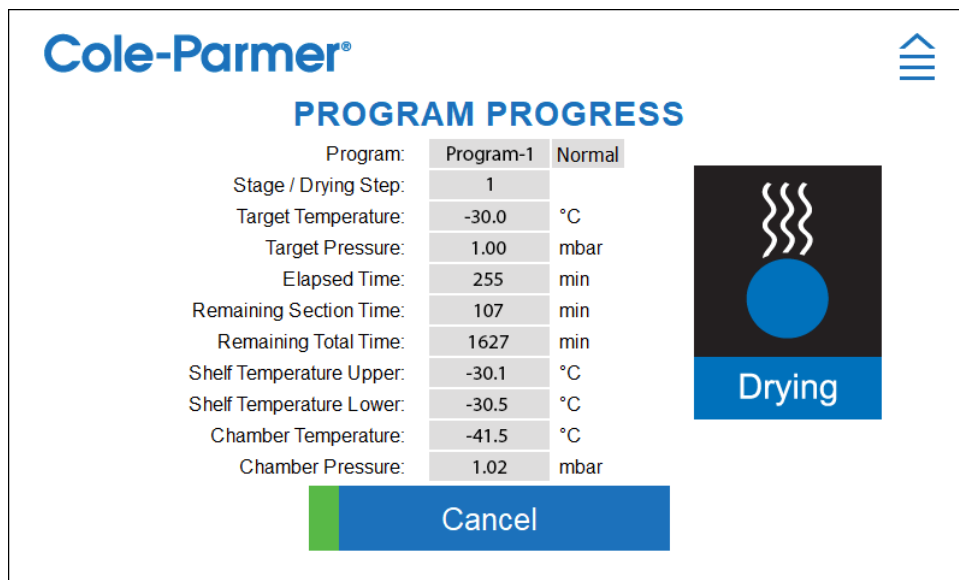


Figure 38

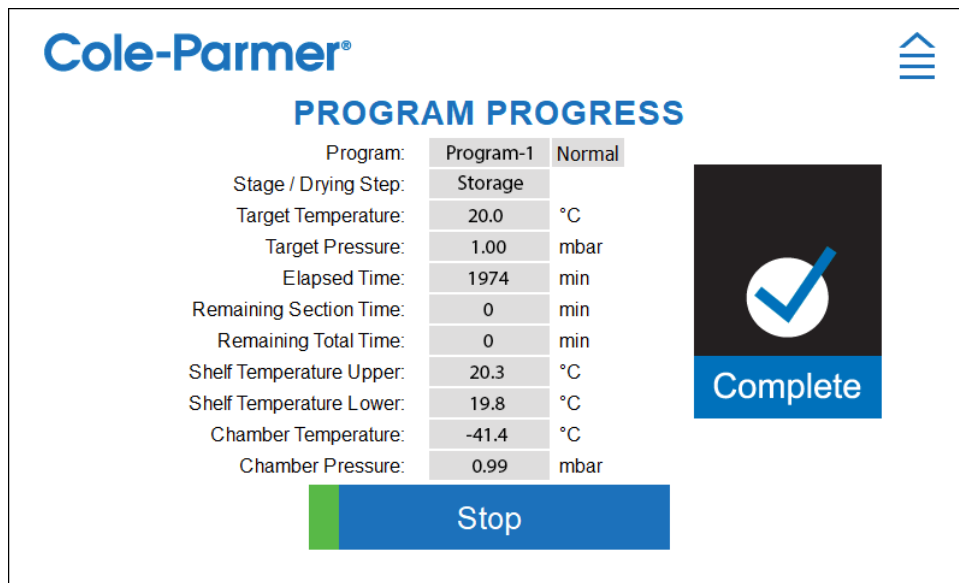


Figure 39

When the Stage/Drying step displays "Storage" (Figure 39), the Program is finished and will maintain temperatures and pressure based on the storage parameters. Stopping a program is explored in "8.3 Extra Drying".

## 8.2.6 Program Modes

The FD 600 includes 3 modes for programs. Normal, Vacuum Oven (VO), and Candy. Each mode affects how the program cycle operates. Modes can be selected by tapping on the button on the top-left on the program editor screen (Figure 40), and will cycle to VO, Candy, and back to Normal. More details are in the following chapters.

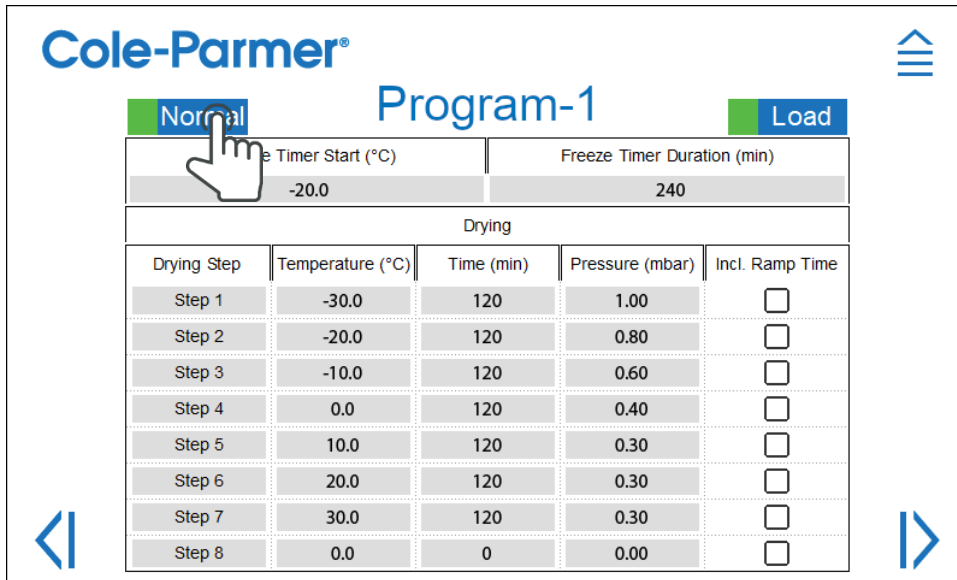


Figure 40

### 8.2.6.1 Normal Mode

Normal Mode is used for freeze-drying and is recommended for most use cases. It is the default mode for a program.

### 8.2.6.2 Vacuum Oven (VO) Mode

VO mode (Figure 41) provides the ability for FD 600 to serve as a vacuum oven. Enabling VO skips the Freezing stage, and the compressor remains off throughout the run. VO mode requires working knowledge of how to manage vapor load within the vacuum pump and is an advanced feature. In VO mode, the Freezing stage is no longer editable and is skipped (Figure 41).

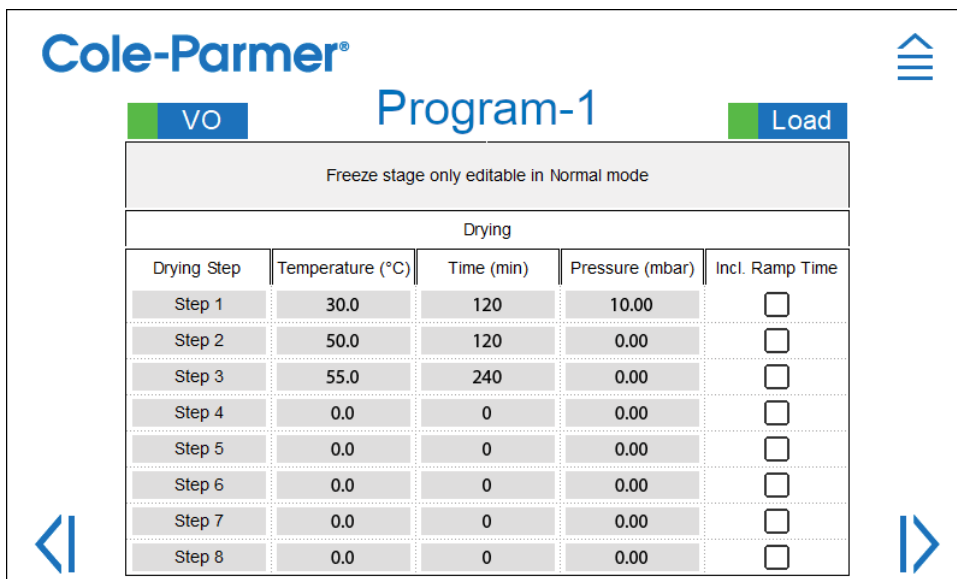


Figure 41

## 8.2.6.3 Candy Mode

Candy Mode (Figure 42) is a feature that allows more efficient program cycles that are specifically tailored for candy. For the freezing stage, the chamber must reach -20°C for at least 10 minutes before it proceeds into evacuation. During freezing, the trays can be optionally kept warm during the freezing stage. Once the Candy cycle is complete, the product will maintain 20°C with the vacuum valve remaining closed.

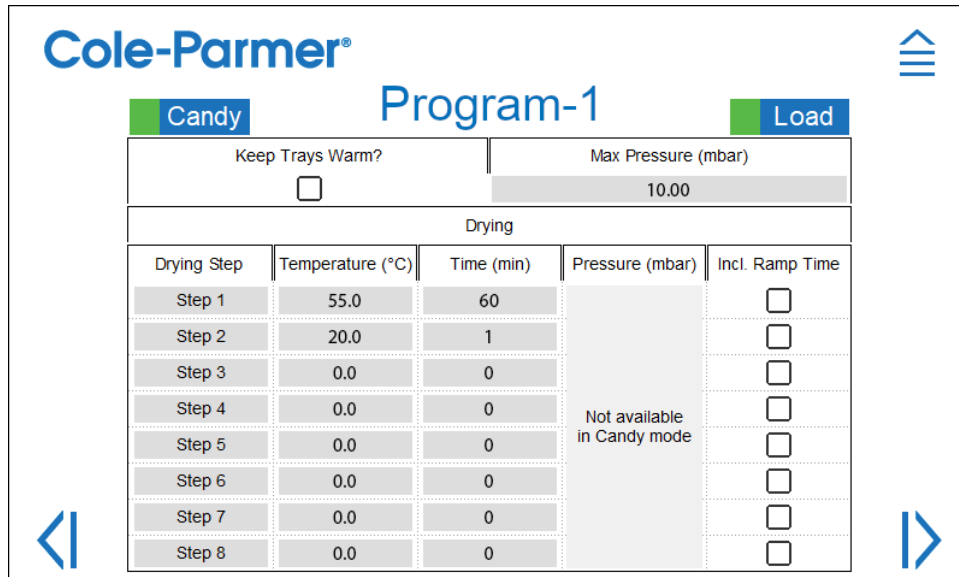


Figure 42

Fine pressure control is not supported in candy mode. On the next page (Figure 43), the storage stage is disabled for editing. By default, the storage stage will maintain shelves at 20°C and the vacuum valve remains closed.

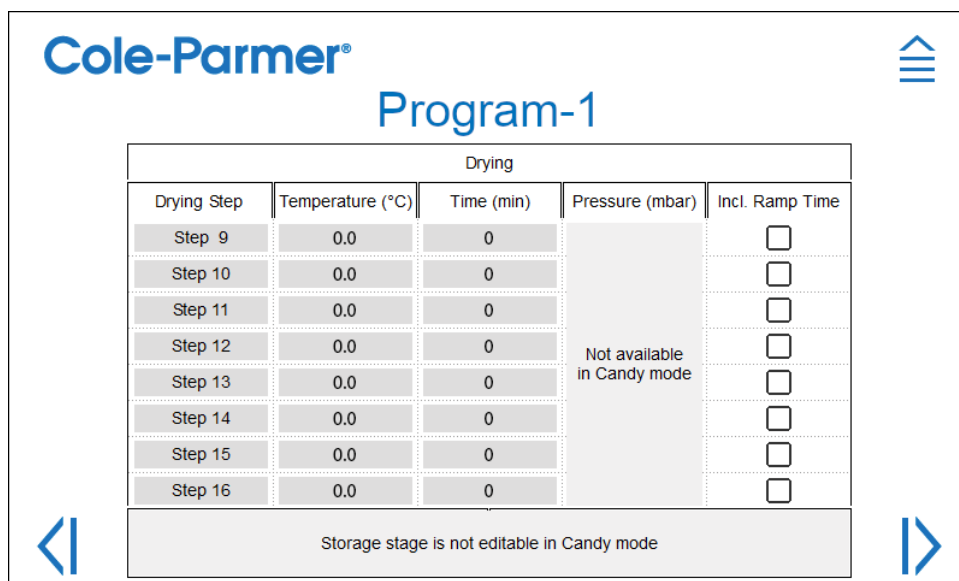


Figure 43

## 8.3 Extra Drying

Once a program or AutoDry run is in storage, the operator will have the ability to verify that their product is dry before ending the program. After tapping "Stop" on the Program Progress screen, a popup will appear (Figure 44).

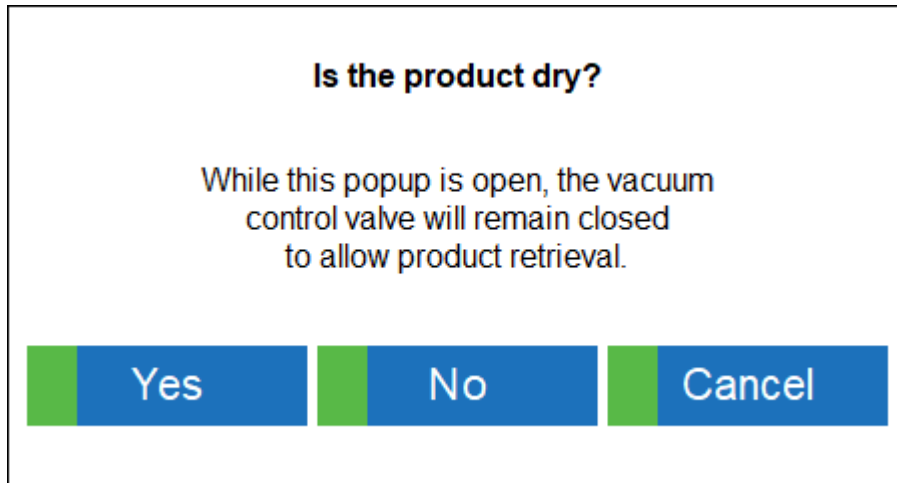


Figure 44

While this popup is shown, the vacuum control valve will remain closed. This allows the operator to open the drain valve, retrieve the product and test it, while the shelves and compressor remain on. Tapping on "Yes" will stop the run, while tapping on "Cancel" will close the popup and re-enable the opening of the vacuum control valve.

To start the extra drying, tap on "No", and the following popup will appear (Figure 45):

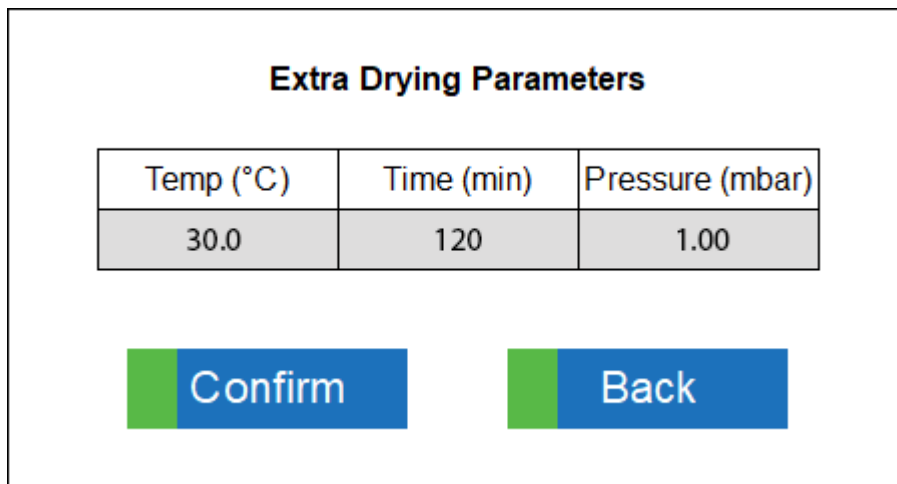


Figure 45

Figure 45 shows the Extra Drying Parameters popup. This popup will allow you to specify an extra drying step for your Program. Specifying pressure is not available in AutoDry (Figure 46).

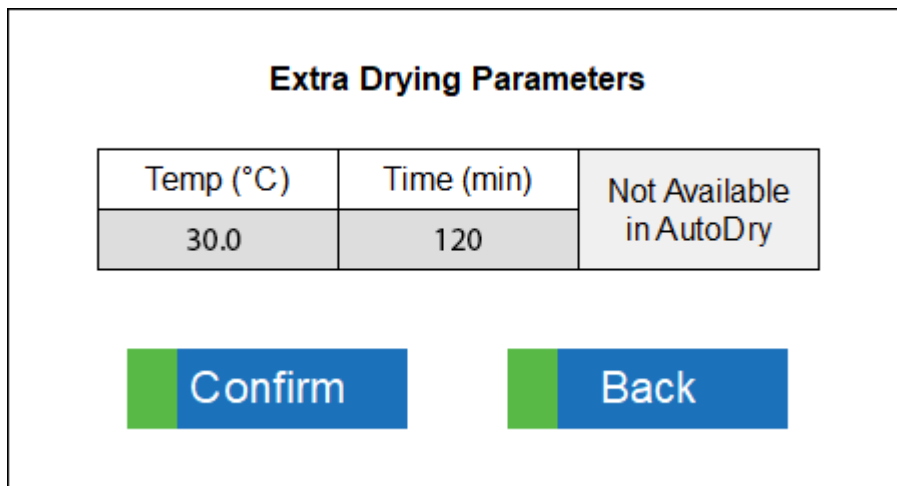


Figure 46

The parameters for the extra drying will default, depending on whether the extra drying is being applied to AutoDry or Program Mode. If AutoDry, the Temp and Time parameters will be based on "Max Drying Temp" and "More Drying Time" respectively, while for Program, the parameters will be based on the last step for the Program.

After tapping on "Confirm", the popup will disappear, and "Extra Drying" will be visible on the Drying Stage section of the Program Progress screen (Figure 47).

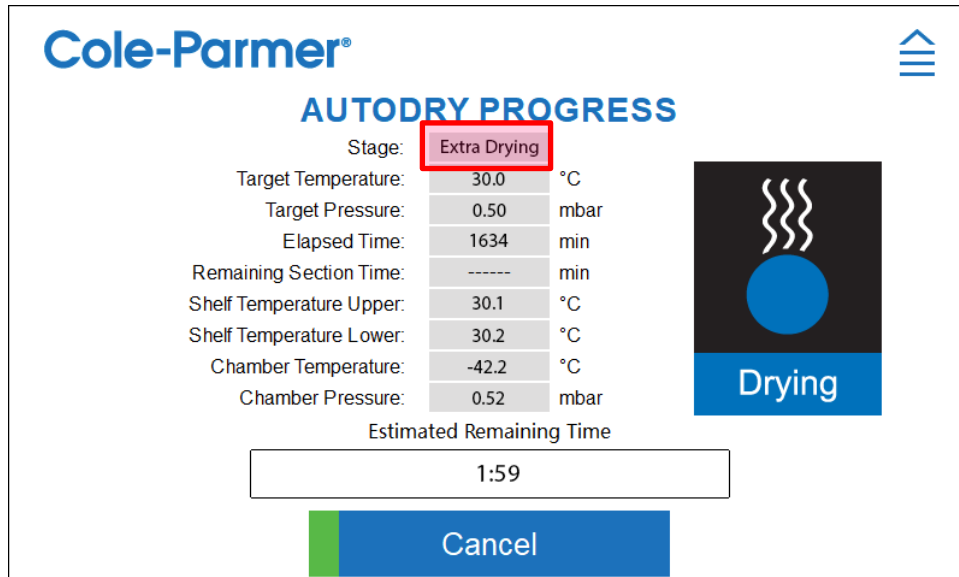
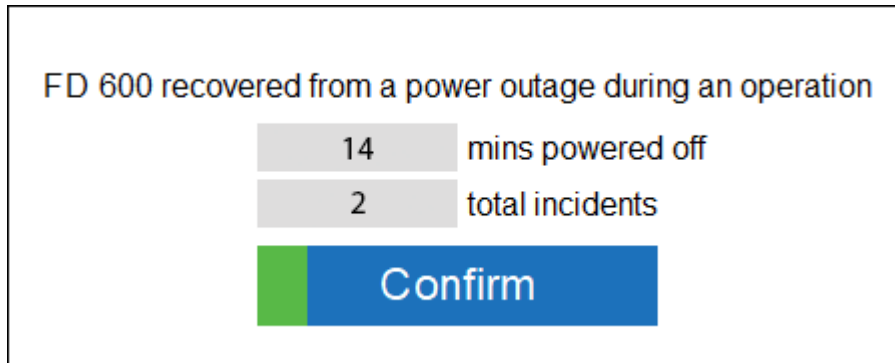


Figure 47

## 8.4 Power Recovery

If a transient power outage occurs during a Program or AutoDry run, FD 600 will automatically recover back to the last state before FD 600 lost power. A popup will appear as soon as power is restored to FD 600 (Figure 48).



*Figure 48*

This is designed to be completely autonomous. FD 600 will continue the drying process irrespective of the duration or frequency of the power outages. It is up to the operator to determine the health of the product.

During an AutoDry run, recovering from power loss will prevent timing information from being recorded for that run, and the remaining time may become inaccurate.

## 8.5 Manual Control

To enter the Manual Control screen, tap on the "Manual" button (Figure 49).

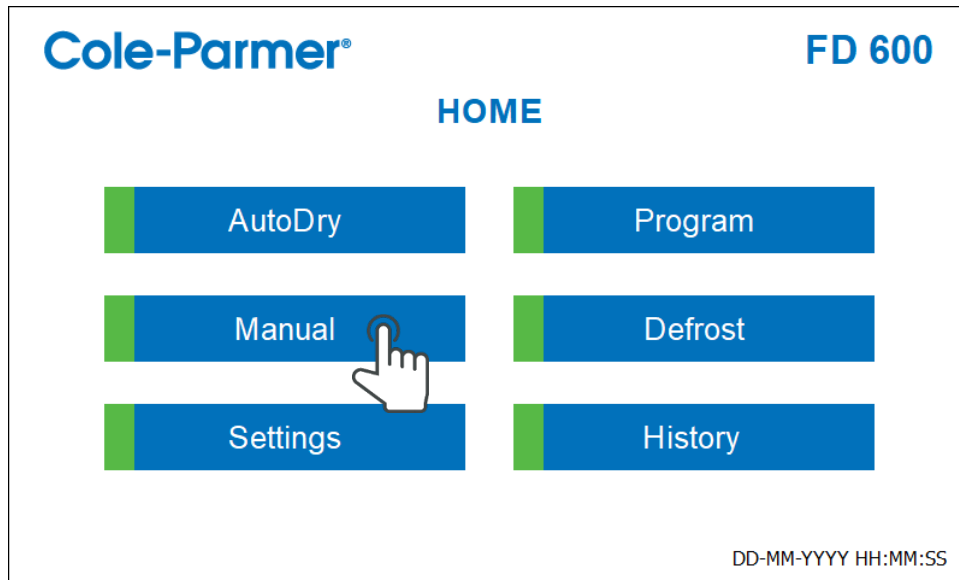


Figure 49

Figure 50 shows the Manual Control screen.

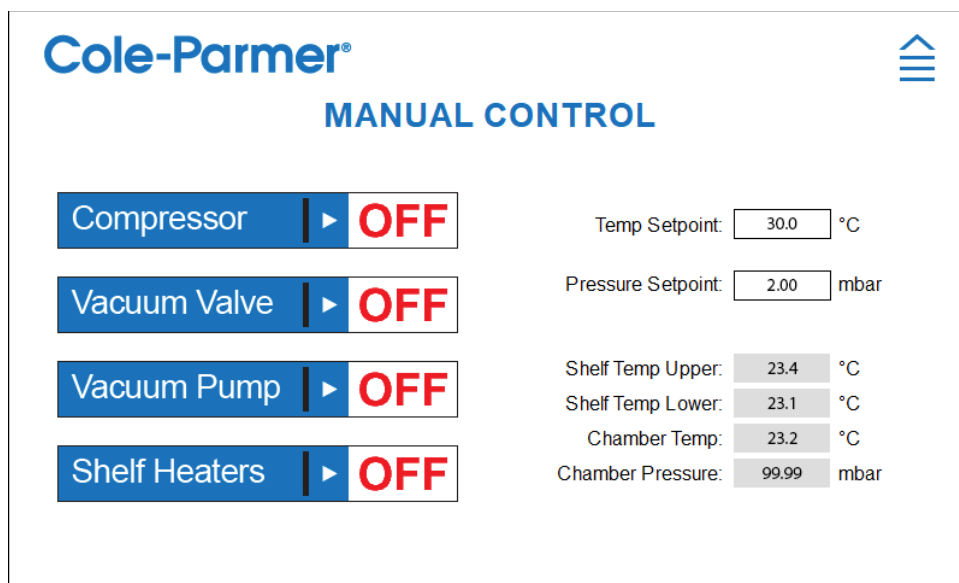


Figure 50

On the right-hand side (Figure 51), temperature and pressure setpoints can be specified for FD 600 to maintain (if enabled).

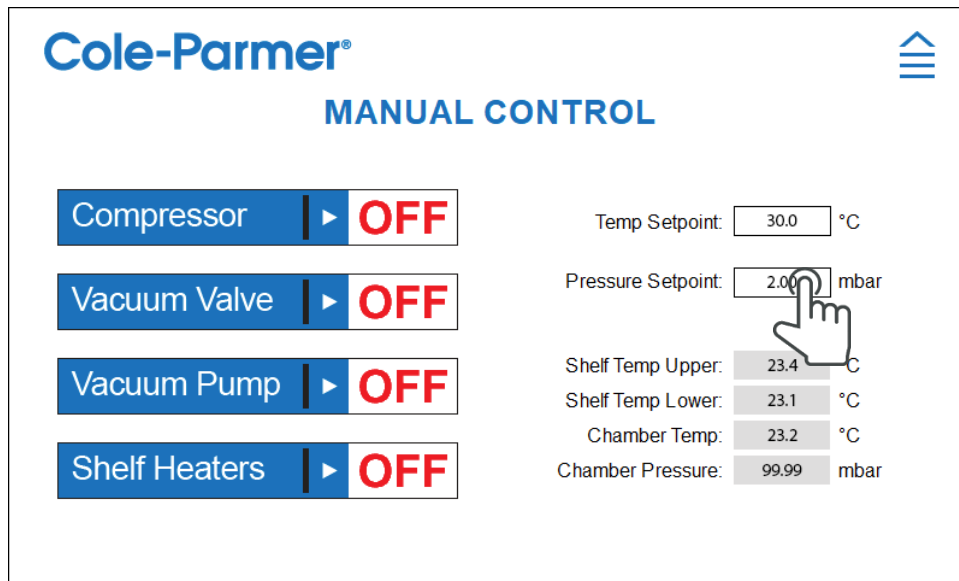


Figure 51

The left-hand side provides relay control of FD 600. They are as follows:

- Compressor
- Vacuum Valve
- Vacuum Pump
- Shelf Heaters (upper & lower)

Tap on those relays (Figure 52) to enable them.

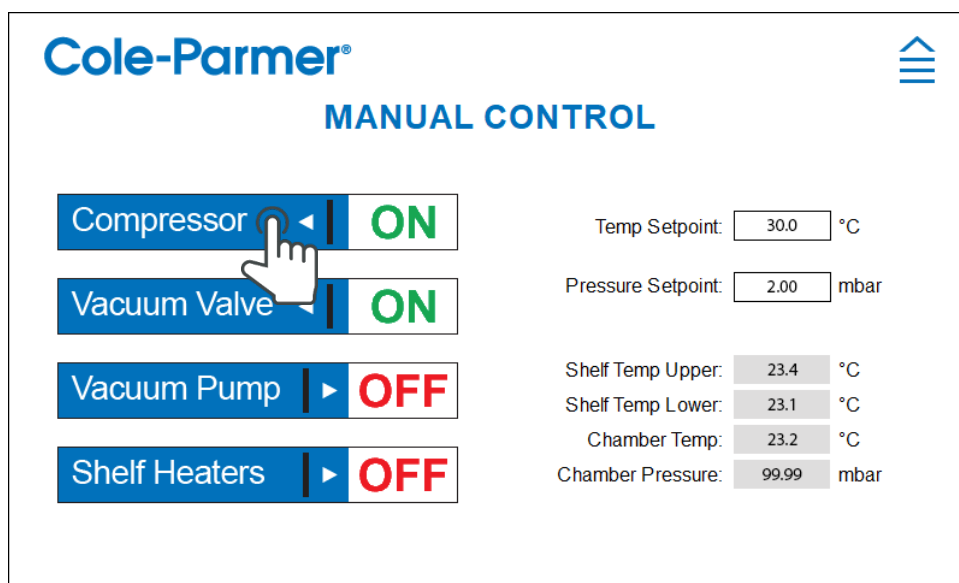
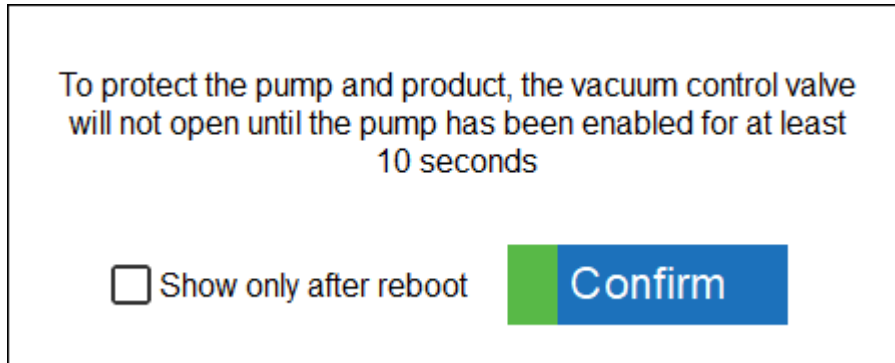


Figure 52

Note: For FD 600 to maintain the pressure setpoint, enable both the Vacuum Pump and Vacuum Valve. The Vacuum Valve will not open if the pump isn't enabled, and a warning will display (Figure 53). This is to prevent back flow contamination from the pump.



*Figure 53*

Ensure that there are no liquids, and your product is fully frozen, before evacuating. Evacuating while there is still liquid in the chamber may damage or cause premature wear to the vacuum pump.

## 8.6 Defrost Mode

While FD 600 is in an idle state, tap on "Defrost" from the Home screen to enter the Defrost screen (Figure 54).

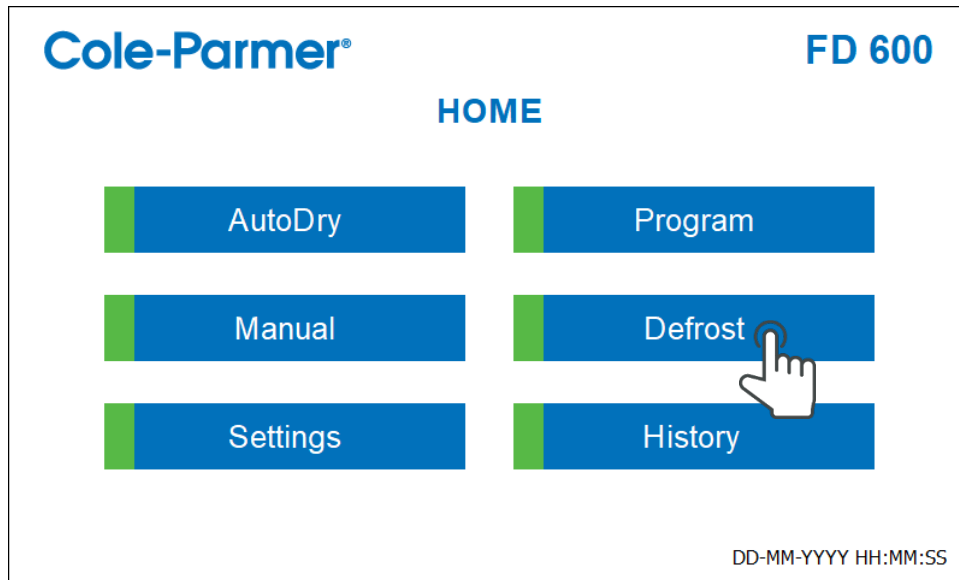


Figure 54

Figure 55: The Defrost screen prior to starting.

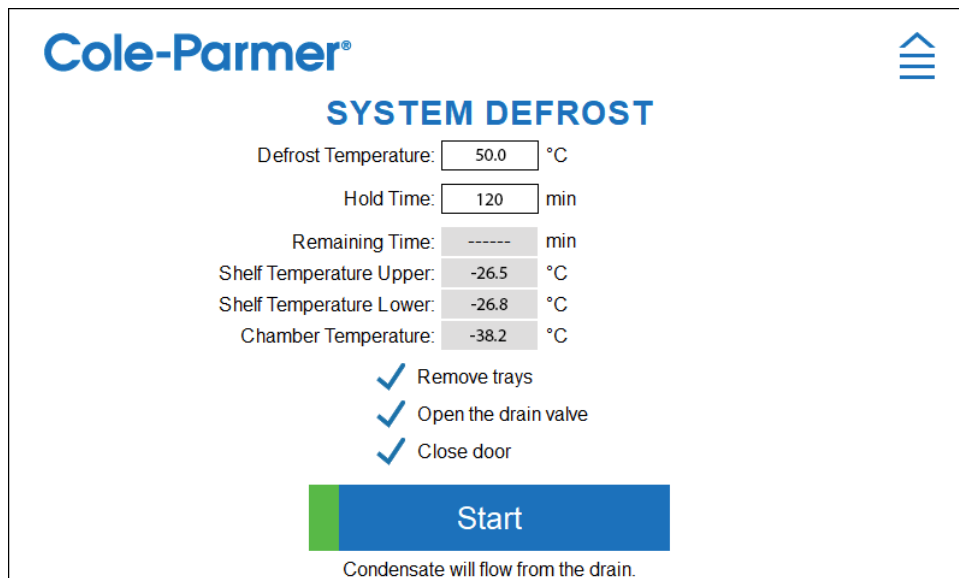


Figure 55

Before starting the Defrost process, confirm:

- Product has been taken out.
- Drain valve is open.
- Chamber door is closed.

Set the Defrost Temperature and Defrost Time as desired (Figure 56). A 50°C defrost temperature and 2 hours hold time are generally adequate.

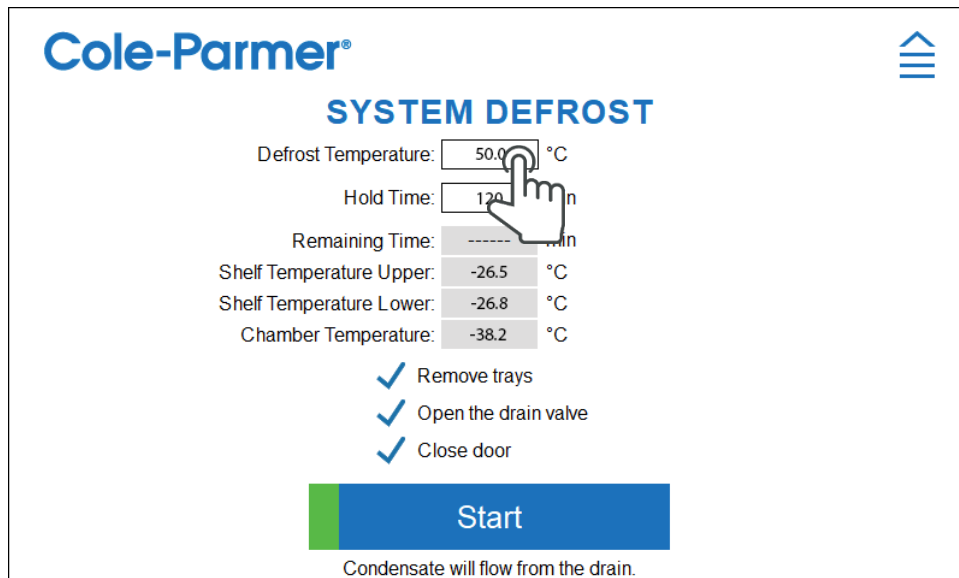


Figure 56

Tap on "Start" (Figure 57).

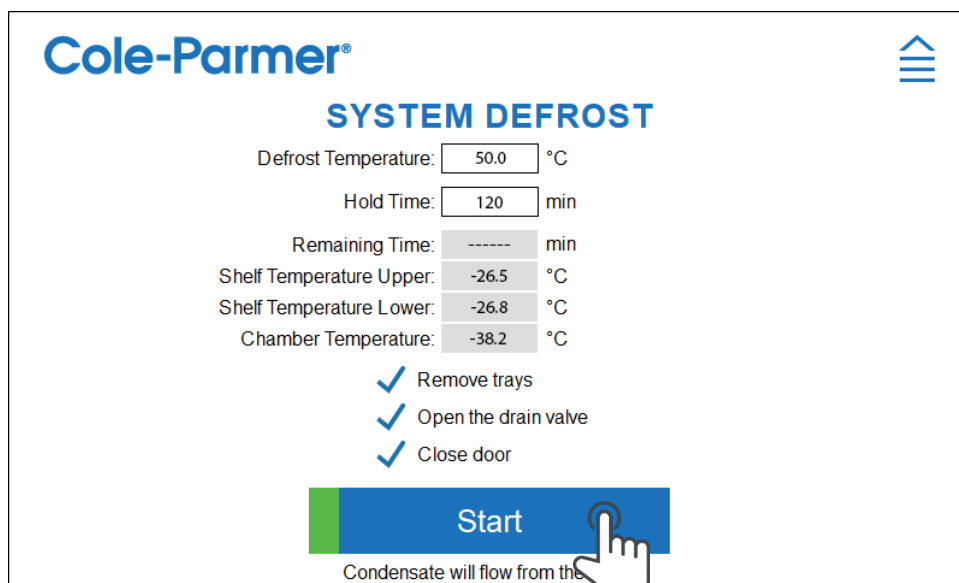


Figure 57

The “Defrosting” icon will appear (Figure 58).

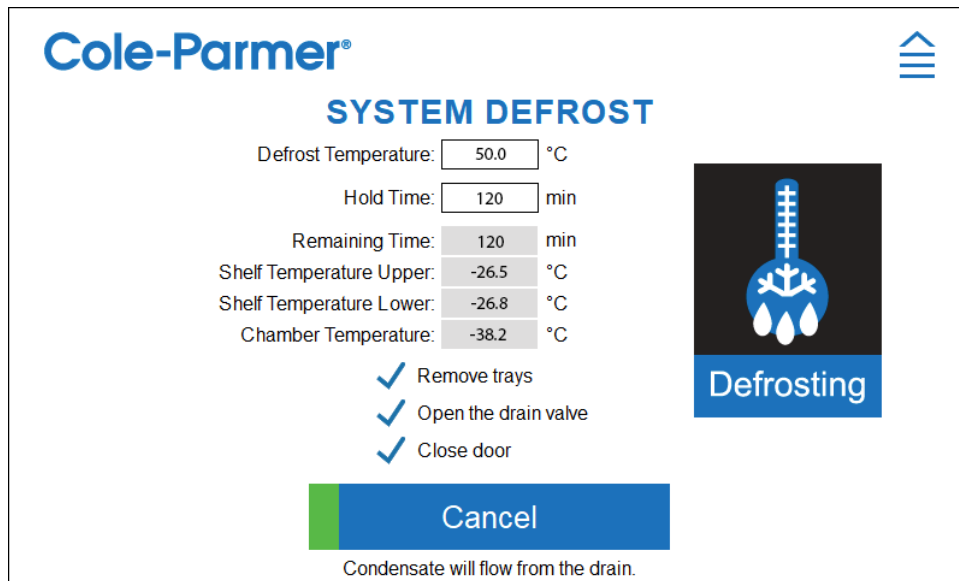


Figure 58

The System Defrost screen will display the real-time values for the lower and upper shelf temperature and chamber temperature.

Tap “Cancel” to stop the defrosting process (Figure 59).

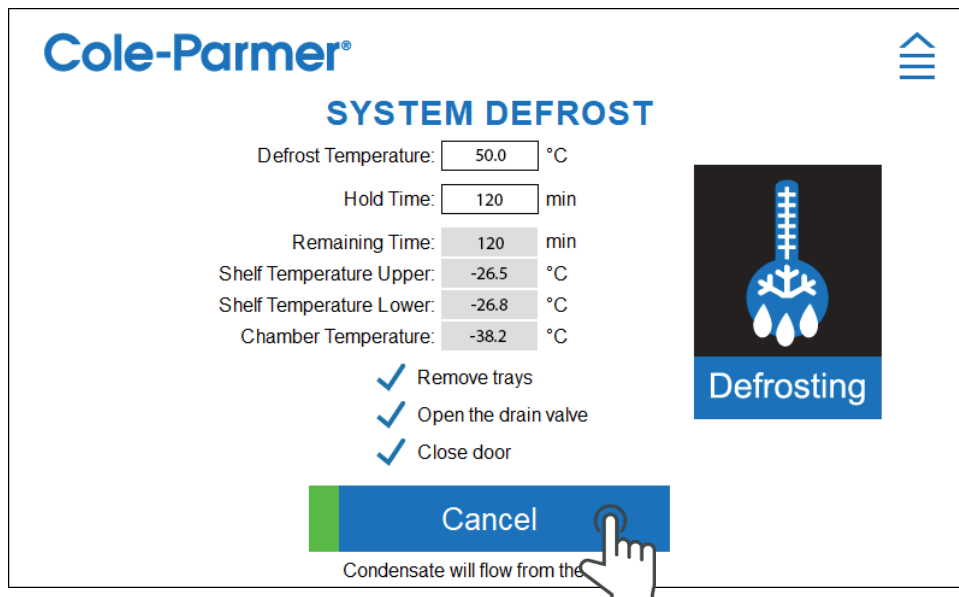


Figure 59

## 8.7 System Settings

Tap "Settings" on the Home screen (Figure 60).

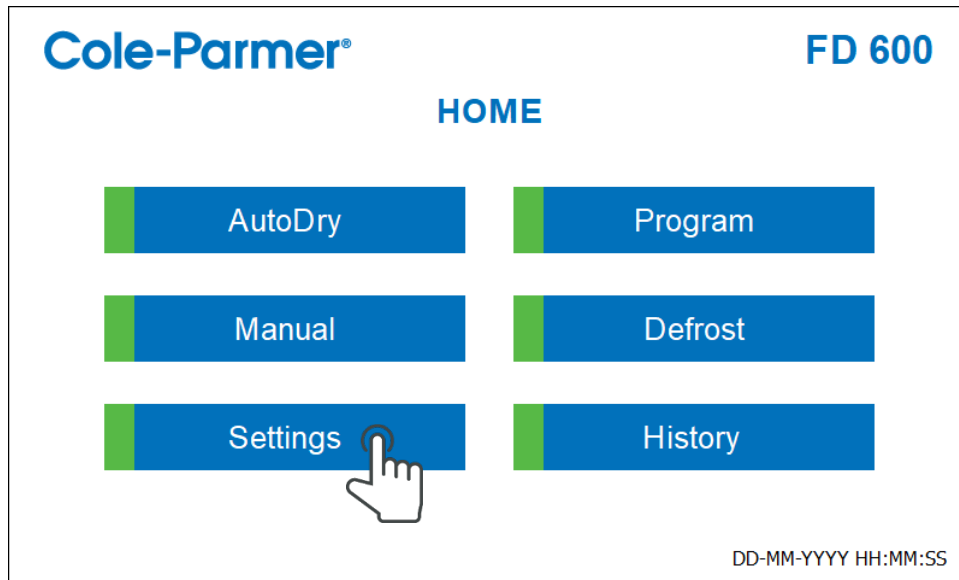


Figure 60

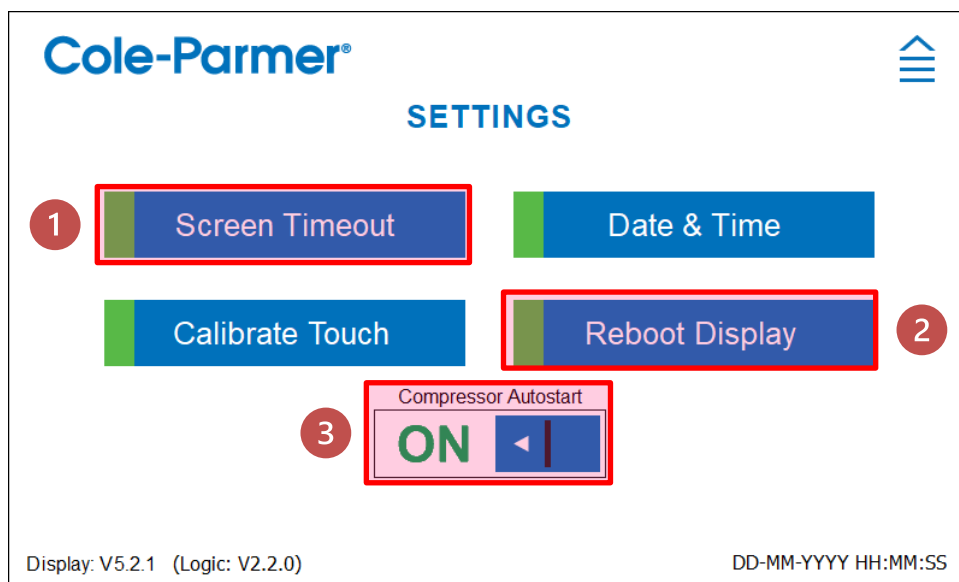


Figure 61

1. The screen timeout specifies the time it takes to display the System State since the last touch interaction. Setting it for 0 minutes will disable it. The System State Screen (Figure 62) shows a general overview of the current state of FD 600.

Cole-Parmer®		FD 600
<b>SYSTEM STATE</b>		
Active Program:	Program-1	Normal
Stage / Mode:	Freezing	
Drying Step:	-----	
Target Temperature:	-----	°C
Target Pressure:	-----	mbar
Elapsed Time:	0	min
Remaining Section Time:	240	min
Remaining Total Time:	1240	min
Shelf Temperature Upper:	13.3	°C
Shelf Temperature Lower:	8.9	°C
Chamber Temperature:	-37.8	°C
Chamber Pressure:	99.99	mbar

Figure 62

2. Rebooting the display is not the same as power cycling. After updating, perform a power cycle using the main power switch located under the display.
3. Compressor Autostart when enabled, the compressor automatically starts when FD 600 is powered on. The compressor can be turned off on the manual screen.

## 8.8 History Screen

The History screen shows data from FD 600 over time, in 15 second intervals. To access this screen, tap on "History" from the Home screen (Figure 63).

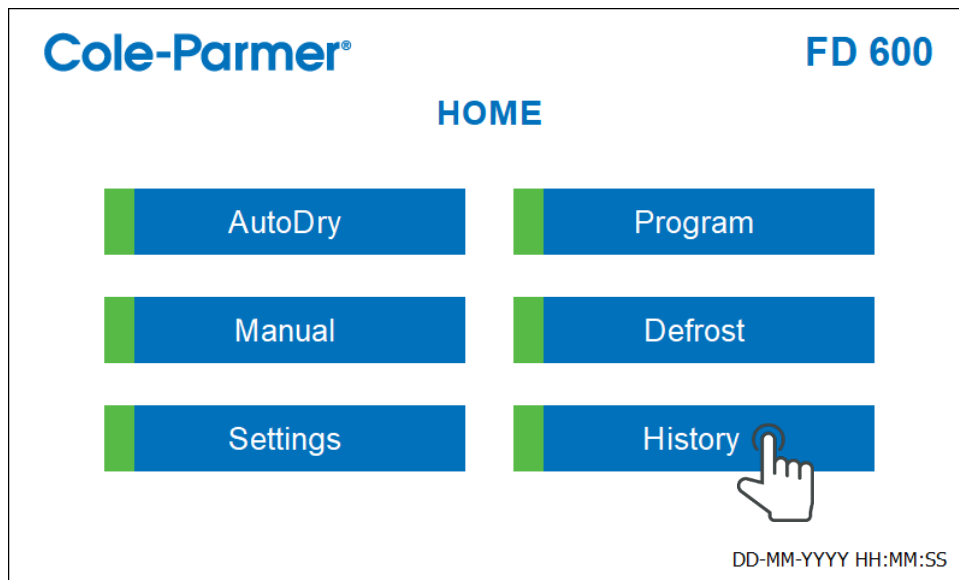


Figure 63

Figure 64 is the History screen. Tap on "Page Up" and "Page Down" to navigate through the history of the temperature/pressure sensors with the associated time stamps.

Time	Date	Upper Shelf Temp (°C)	Lower Shelf Temp (°C)	Condenser Temp (°C)	Pressure (mbar)
17:02:51	2023/06/21	16.6	16.3	16.5	99.99
17:03:06	2023/06/21	16.7	16.3	16.5	99.99
17:03:21	2023/06/21	16.6	16.2	16.5	99.99
17:03:36	2023/06/21	16.6	16.2	16.5	99.99
17:03:51	2023/06/21	16.5	16.3	16.6	99.99
17:04:06	2023/06/21	16.6	16.3	16.6	99.99
17:04:21	2023/06/21	16.6	16.3	16.5	99.99
17:04:36	2023/06/21	16.5	16.3	16.5	99.99
17:04:51	2023/06/21	16.5	16.3	16.5	99.99
17:05:06	2023/06/22	16.4	16.2	16.5	99.99

Figure 64

## 8.8.1 History Export

To export the History of FD 600, insert a USB formatted as FAT32 into the USB-A port of FD 600. After inserting the USB, navigate to the History screen and tap on "Export" (Figure 65).

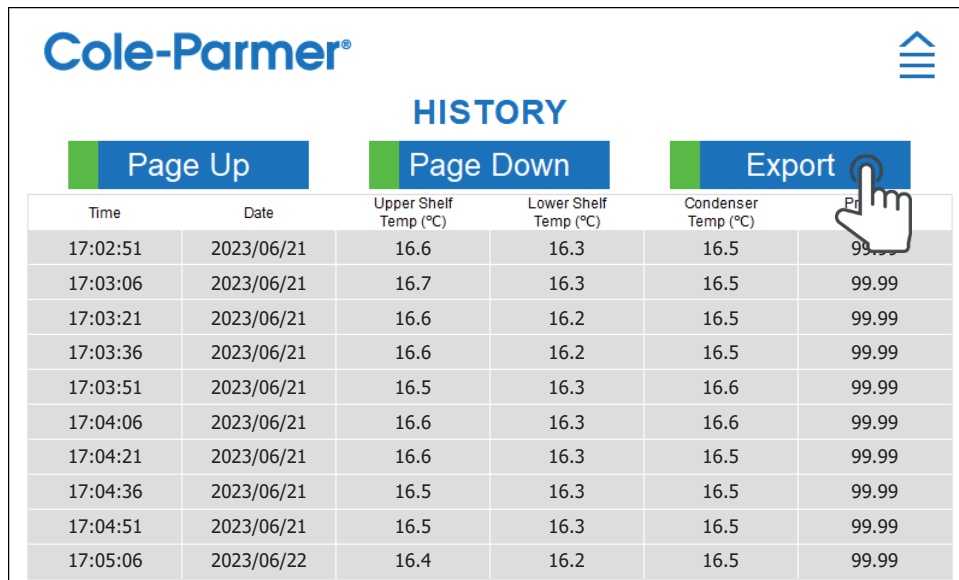


Figure 65

After tapping on "Export", a dialogue box will appear showing "Exporting Data...". Wait until "Exporting Complete" is shown and then disappears, then remove the USB.

Insert the USB into a computer. The exported file will be called "History-YYYY-MM-DD-HH-mm-SS.xls", located onto the root directory of the USB. The filename specifies the timestamp of when the history was exported.

## 9 Fault Diagnosis

Before conducting a diagnosis, verify that the chamber is clean, dry, and empty of product.

Error	Solutions
Ultimate Vacuum of 0.15 mbar not reached.	Check that the vacuum pump is correctly connected to the main unit with the clamp (tightly).
	Check that the drain valve has the rubber gasket installed and is installed hand tight. Close the gasket valve
	Check that the vacuum hose and rings are installed correctly. Verify that there is no damage on the rubber rings, and that it is clear from particles.
	Check that the vacuum pump functions correctly and that the vacuum pump oil is clear (if oil sealed vacuum pumps are used).
	Verify that the ballast valve is in a closed position on the pump (if fitted).
	Verify that FD 600 is defrosted and that the inner door ring contacts a clean surface.
	Check that the compressor is enabled and has been running for at least 1 hour.
	If the error remains, contact support.
The chamber temperature is not cooling to specification.	Let the compressor run for at least 1 hour.
	Verify that no significant sounds are coming from the compressor. FD 600 should operate quietly. Contact support if FD 600 makes significant or unfamiliar noises.
	Check that shelves are not enabled in the Manual screen.
	Make sure the compressor is running by listening for sound.
	If compressor is "ON" but the temperature inside the chamber is still high, check the housing vents for blockage and dust. Remove blocking items and clean as required. If substantial dust is visible on the condenser inside the housing, contact support.
	Ensure that there is enough clearance around the vents and that the ambient temperature of the room is below 25°C.
The unit is making a strange sound.	Turn off the machine and contact support immediately.
The clock resets after each power cycle.	Contact support.

## 10 Cleaning and Maintenance

### 10.1 Cleaning

- Water from the product will collect inside of the chamber during drying. Be sure to defrost after each run and clean the inside of the chamber periodically by wiping down the chamber walls with washing detergent.
- Clean the trays after every freeze-drying process with mild, non-corrosive detergent. Wipe dry afterwards.
- Periodically check the chamber door seal ring and contact surface is clean from contaminants, to ensure performant evacuation.

### 10.2 Maintenance

- Check the chamber door seal ring regularly to make sure it is not damaged or worn.
- If an oil vacuum pump is used, check the vacuum oil after every 100 hours of operation, and replace the vacuum pump oil if the level is low or if the oil is dirty.
- If a dry pump is used, refer to its User's Manual.
- Clean instrument vents regularly to prevent dust build up.

## 11 Declaration of Conformity

We, Cole-Parmer, located at 625 East Bunker Court, Vernon Hills, IL, 60061, United States, under our sole responsibility that the product:

**Product Name:** Freeze Dryer

**Model/Type:** Cole-Parmer FD 600

to which this declaration relates, is in conformity with the following directives and

### Directives

- 2014/30/EU (EMC Directive)
- 2014/35/EU (Low Voltage Directive)

### Standards

- EN IEC 61326-1:2021
- EN 61010-1:2010 + A1:2019
- EN 61010-1:2010, AMD1:2016
- EN IEC 61010-2-012:2022/A11:2022
- UL 61010-1
- CAN/CSA-C22.2 No. 61010-1-12
- UL 61010-2-010
- CSA C22.2 No. 61010-2-010:19
- UL 61010-2-011
- CSA C22.2 No. 61010-2-011:19
- CFR 47 FCC Part 15 subpart B
- ANSI C63.4-2014

The product has been independently assessed and found to comply with the applicable directives and standards.

This declaration is issued under the sole responsibility of the manufacturer.

**Place of Issue:** Vernon Hills, IL

**Date of Issue:** 21 February 2025

Cole-Parmer

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