

Model 7450 and 7470 Series

CryoMed Controlled Rate Freezer*

Operating and Maintenance Manual 7027452 Rev. 5

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Models covered in this manual"

Non-IVF Model	AC Voltage	Chamber Size (CF)	IVF Model	AC Voltage	Chamber Size (CF)
7450	120	0.6	7456	120	0.6
7451	230	0.6	7457	230	0.6
7452	120	1.2	7458	120	1.2
7453	230	1.2	7459	230	1.2
7454	120	1.7			
7455	230	1.7			
7472	100	0.6	7275	100	0.6
7473	100	1.2	7276	100	1.2
7474	100	1.7			

**from cover* - Patented liquid refrigerant injection ring optimizes uniformity and air flow. Patent # 6,044,648

MANUAL NUMBER 7027452

REV	ECR/ECN	DATE	DESCRIPTION	By
5	--	3/4/16	Added risk assessment information	ccs
4	30873/FR-2674	7/24/14	Corrected overlay part number in Parts List (Section 7) from 140296 to 140460	ccs
3	30873/FR-2674	7/22/14	RoHS overlay part number - wiring diagrams in Section 7	ccs
2	29779	5/27/14	New software V2.0	ccs
1	28702/FR-2371	8/29/12	Removed flatbed scanner references	ccs
1	28816/FR-2371	8/29/12	Added ferrite - parts list, schematics, wiring diagrams	ccs
0	28576/FR-2357	7/31/12	Original - Release 4 with new printer power supply	ccs
0	28511/FR-2371	7/31/12	Original - Release 4 with new printer power supply	ccs



Important Read this instruction manual. Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel, and poor equipment performance. ▲

Caution All internal adjustments and maintenance must be performed by qualified service personnel. ▲

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Intended Use

Thermo Scientific CryoMed controlled rate freezers are sample preparation devices used for the preparation of samples for storage at cryogenic temperatures (-130°C or below) to support medical applications. When these controlled rate freezers are used to support a medical application, they are considered an accessory to a medical device and are therefore considered a medical device in their own right by the regulatory body (e.g. FDA).

The controlled rate freezers are intended for use:

- As a sample preparation device in research use
- As a medical device for diagnostic use (For the non-IVF chambers, for preparation of samples not intended to be re-introduced into the human body such as primary cell lines or stem cells for research)
- As a medical device for targeted treatment in IVF applications (For the IVF chambers, for preparation of samples that may be re-introduced into the human body, for example: sperm or ova)

Non-intended Use

These freezers are not intended to be operated in potentially explosive environments, are not intended for storage of flammable inventory, and are not intended for use in Class II or class III applications other than those cleared by the FDA (e.g. IVF applications).

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Important operating and/or maintenance instructions. Read the accompanying text carefully.



Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.



Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.



Potential low temperature or freezing hazards. Only qualified persons exercising special precautions should operate this equipment due to the nature of liquid nitrogen.



Potential asphyxiation hazard. This equipment should be located in a well ventilated room.



Unit weighs more than 50lbs (22.7kgs). Use proper 2 person lifting techniques when handling.



WEEE Compliance: Thermo Fisher Scientific has contracted with companies for recycling/disposal in each EU Member State. For further information, send an email to weee.recycle@thermofisher.com.

- ✔ Always use the proper protective equipment (clothing, gloves, goggles, etc.)
- ✔ Always dissipate extreme cold or heat and wear protective clothing.
- ✔ Always follow good hygiene practices.
- ✔ Each individual is responsible for his or her own safety.

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When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, our professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 6:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

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Section 1 Introduction

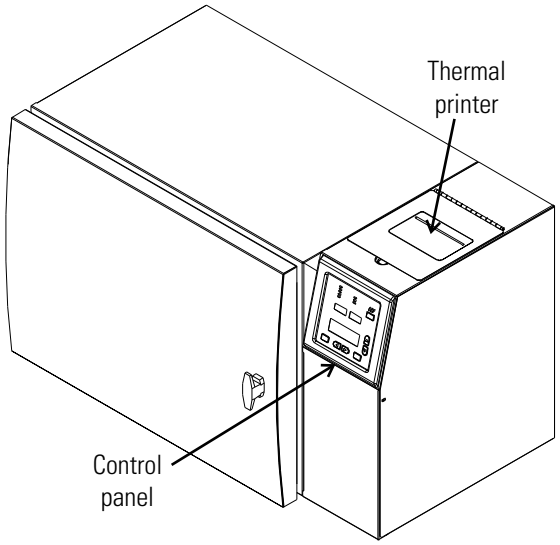


Figure 1-1. Non-IVF Controlled Rate Freezer

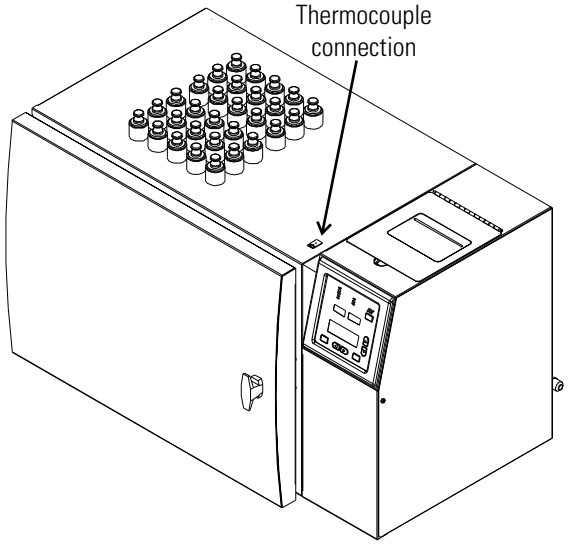


Figure 1-2. IVF Controlled Rate Freezer (FDA clearance for human research)

Remove the Shipping Brackets

Caution Use proper 2-person lifting techniques when handling the unit (refer to Specifications section for approximate unit weight). ▲

Caution Do not rest the unit on its back as it may damage the plumbing or plastic heat break. ▲

Using a 7/16" wrench or socket, remove the (4) lag screws attaching the unit to the shipping pallet. Then remove the (4) 1/4-20 bolts attaching the (2) shipping brackets to the bottom of the unit. Refer to Figure 1-3.

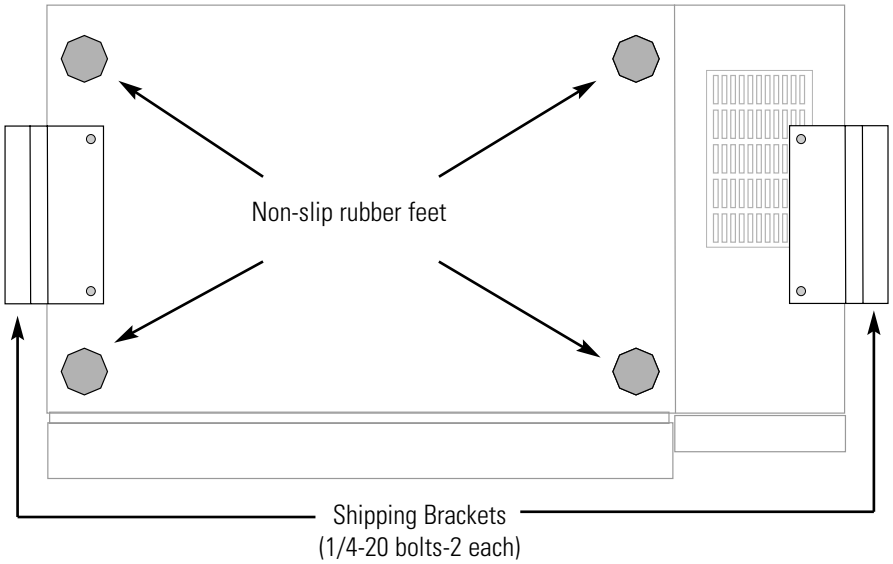


Figure 1-3. Bottom of Unit

Standard Features

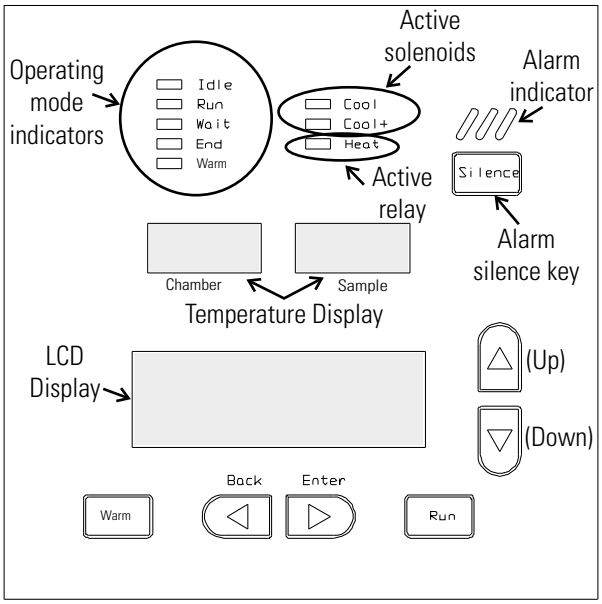


Figure 1-4. Control Panel Displays, Indicators and Keys

Door Latch

The door of the Controlled Rate Freezer is secured in the closed position with a vise-action T-handle latch. The latch maintains positive compression of the door gasket against the Teflon heatbreak to prevent leakage and ice build-up during normal operation. The latch is closed by turning the handle 180 degrees clockwise.

Note Make sure the door is properly latched during operation to prevent ice build-up. ▲

Sample 'Seeding' Access Ports (IVF)

The IVF model of the Controlled Rate Freezer has top-mounted sample access ports used to 'seed' the samples during the freezing process. Seeding should always be performed through the access ports rather than the door to reduce sample temperature fluctuations during the seeding process.

Displays

There are three displays on the Controlled Rate Freezer control panel: Chamber and Sample temperature, ranging from +54° to -199°C, the LCD Display for profile status, messages, and freezing profile editing and viewing.

Indicators

At the top of the control panel are two columns of LED Operating Mode indicators. The left indicators are:

Idle . . . . . .No profile is running
Run . . . . . .A profile is in progress
Wait . . .Profile in progress pauses until the Run key is pressed
End . . . . . .Profile is complete
Warm . . . . . .Chamber is warming to +25°C

The right column of indicators are:

Cool . . . . . .Front LN_2 Solinoid is open
Cool+ . . . . . .Rear LN_2 solenoid is open
Heat . . . . . .Heater is energized

Keys

There are seven input keys on the control panel.

Warm . . . . . .Starts the warming cycle

Run . . . . . .Starts chosen profile, or resumes after Wait.

Silence . . . . . .Turns off the audible alarm and clears the alarm messages from the display

◀ Back . . . . . .Terminates a profile in progress, returns to Program menu, or moves the cursor to the left

▶ Enter . . . . . .Starts a new line, enters a sub-menu, moves the cursor to the right, or enters View or Edit Mode

▲ (Up) . . . . . .Scrolls upward through display lines, or changes profile step and set-up parameters

▼ (Down) . . . . . .Scrolls downward through display lines, or changes profile step and set-up parameters

Alarm

Above the Silence key is the alarm indicator. In an alarm condition, the LED flashes in addition to an audible tone. See Alarms, Section 2.

Output

Graphs and cycle data, as well as additional information, are printed out at the top of the unit on a thermal printer in real-time mode.

Pre-set Profiles

The Controlled Rate Freezer has six pre-set freezing profiles. They are labeled Pre-Set Profile 1 through 6. These profiles cannot be edited.

To view the profile timing and temperature:

1. Scroll, using the up or down arrow keys, to the desired profile.

2. Press the Enter key to go into View Mode. Scroll, using the up or down keys, through steps as needed.

3. Press the Back key to return to the main menu.

Pre-set Profiles (continued)

The pre-set profiles are listed below. In addition, a Configure/Calibrate menu is available. For further information on this menu, see Section 3. User specific profiles can also be entered and saved. See Section 2.

Pre-Set Profile #1 - Commonly used for 2.0ml sample size, resulting in a 1°C rate from nucleation to -40°C and a 10°C per minute cooling rate to a -90°C end temperature.

Step 1	Wait	at 4.0C
Step 2	1.0 C/m S	to -4.0C
Step 3	25.0 C/m C	to -40C
Step 4	10.0 C/m C	to -12.0C
Step 5	1.0 C/m C	to -40C
Step 6	10.0 C/m C	to -90C
Step 7	End	

Pre-Set Profile #2 - Commonly used for very small (96 well) sample size, resulting in a 1°C rate from nucleation to -40°C and a 10°C per minute cooling rate to a -90°C end temperature.

Step 1	Wait	at 4.0C
Step 2	1.0 C/m S	to -40C
Step 3	10.0 C/m C	to -90C
Step 4	End	

Pre-Set Profile #3 - Commonly used for straw size samples, resulting in a slow rate to -7°C, a 5 minute hold for manual cell nucleation, a 0.3°C rate to -35°C, and then a 0.1°C per minute cooling rate to a -37°C end temperature.

Step 1	Wait	at 20C
Step 2	1.0 C/m C	to -4.0C
Step 3	0.5 C/m C	to -7.0C
Step 4	Hold for 5m	at -7.0C
Step 5	0.3 C/m C	to -35C
Step 6	0.1 C/m C	to -37C
Step 7	End	

Pre-set Profiles (continued)

Pre-Set Profile #4 - Commonly used for hemopoietic stem cells that are 65-100ml in size, resulting in a 1°C rate from nucleation to -45°C and a 10°C per minute cooling rate to a -90°C end temperature.

Step 1	Wait	at 20.0C
Step 2	1.0 C/m S	to -6.0C
Step 3	25.0 C/m C	to -50C
Step 4	10.0 C/m C	to -14.0C
Step 5	1.0 C/m C	to -45C
Step 6	10.0 C/m C	to -90C
Step 7	End	

Pre-Set Profile #5 - Commonly used for skin packets, resulting in a 1°C rate from nucleation to -35°C and a 10°C per minute cooling rate to a -90°C end temperature.

Step 1	Wait	at 4.0C
Step 2	1.0 C/m S	to -5.0C
Step 3	20.0 C/m C	to -40C
Step 4	10.0 C/m C	to -10.0C
Step 5	1.0 C/m C	to -35C
Step 6	10.0 C/m C	to -90C
Step 7	End	

Pre-Set Profile #6 - Commonly used for hemopoietic stem cells that are 65-100ml in size, resulting in a 0.5°C rate from nucleation to -20°C and a 1°C per minute cooling rate to a -80°C end temperature.

Step 1	Wait	at 4.0C
Step 2	1.0 C/m S	to -4.0C
Step 3	20.0 C/m C	to -45C
Step 4	10.0 C/m C	to -10.0C
Step 5	0.5 C/m C	to -20C
Step 6	1.0 C/m S	to -80C
Step 7	End	

S = Sample Temperature

C = Chamber Temperature

C/m = degrees Centigrade per Minute

Section 2 Set-Up and Operation



Warning Nitrogen gas can cause suffocation without warning. Store and use liquid nitrogen only in a well-ventilated place. As the liquid evaporates, the resulting gas displaces the normal air in the area. (The cloudy vapor that appears when liquid nitrogen is exposed to the air is condensed moisture, not the gas itself. The issuing gas is invisible.) In closed areas, excessive amounts of nitrogen gas reduces the concentration of oxygen and can result in asphyxiation. Because nitrogen gas is colorless, odorless, and tasteless, it cannot be detected by the human senses. Breathing an atmosphere that contains less than 19.5% oxygen can cause dizziness and quickly result in unconsciousness and death. Therefore, the use of oxygen monitoring equipment is strongly recommended. ▲



Warning Contact of liquid nitrogen with the skin or eyes may cause serious (freezing) injury. ▲



Caution Use proper 2-person lifting techniques when handling the unit (refer to Specifications section for approximate unit weight. ▲

Location

A six foot liquid nitrogen transfer hose with 1/2" flare fittings is supplied with the unit. The use of a transfer hose longer than six feet may degrade system performance as it may prevent liquid nitrogen from reaching the unit in the volume needed to properly control the temperature profile run.

The unit should be located within the reach of the transfer hose to the liquid nitrogen supply, allowing enough space for source tank replacement. A gauge to measure the remaining contents in the source tank should be easily viewable and read before each run to ensure that enough liquid nitrogen is available for successful temperature profile completion. A dedicated source tank is recommended for optimum performance.

This unit should be located in a well-ventilated area of the laboratory, on a table/bench capable of supporting the unit's weight (see Specifications section), with adequate workspace available. Allow clearance for the open door on the front of the unit, for the hose and power connections on the back, and the exhaust vent on the left side. Refer to Figure 2-1.

Model	W (width)
7450	29.2"
7451	29.2"
7452	35.2"
7453	35.2"
7454	41.2"
7455	41.2"
7456	29.2"
7457	29.2"
7458	35.2"
7459	35.2"
7472	29.2"
7473	35.2"
7474	41.2"
7475	29.2"
7476	35.2"

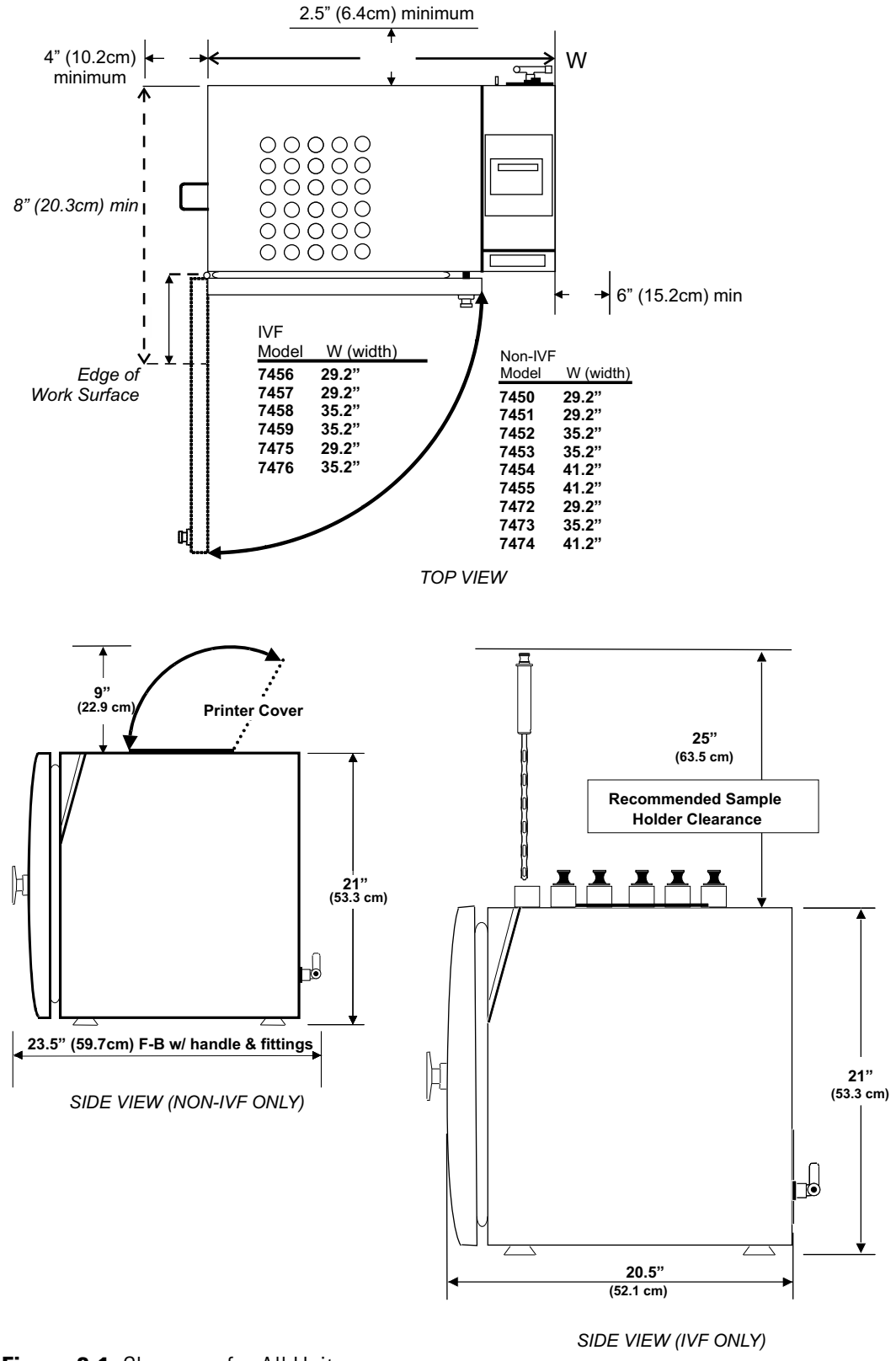


Figure 2-1. Clearance for All Units

Location (continued)

Warning Do not block nor tamper with the exhaust vent opening! Provide ample clearance around the exhaust vent to allow the gases to escape freely, otherwise an increase of gas pressure inside the chamber will forcibly open the door possibly causing damage to the unit and risking sample integrity. ▲

Also located on the back of the electronics housing is a 1/4" OD overflow drain tube from the drain pan placed under the inlet solenoids. Although most of the frost will melt and evaporate within the drain pan, it is possible that a small amount of water may drip out of the drain tube.

Caution If moisture cloud is seen exiting the drain tube, turn off the unit, shut off the liquid nitrogen supply source valve, and immediately call for service. ▲

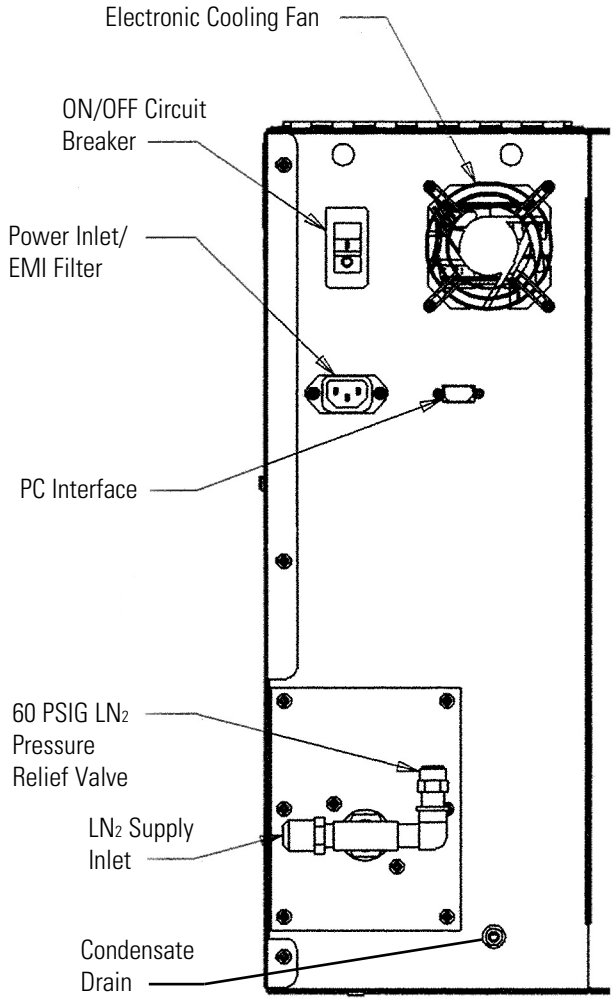


Figure 2-2. Back of Electronic Housing

LN_2 Connections



Caution The flair connections on the ends of the transfer hose do not require any sealant. Pipe dope or Teflon® tape may cause contamination of the liquid fill solenoids or leaks at the hose connections because these cannot withstand the extreme low temperatures of this application. ▲

The unit requires a user-supplied, low pressure regulated (22 PSIG) liquid nitrogen supply. Pressures higher than 22 PSIG may degrade unit performance as these could hold the fill solenoids partially open. A 60 PSIG liquid nitrogen pressure relief valve is located on the back of the unit (Figure 2-1).



Caution Do not disable or remove the pressure relief valve! ▲

Connect the transfer hose between the low pressure, liquid outlet of the nitrogen supply tank (not the gas outlet!) and the LN_2 supply inlet located on the back of the unit (Figure 2-1). The unit is shipped with a removable plastic protective cap over the LN_2 supply inlet to keep debris out of the solenoids and protect the inlet threads during shipping and handling. Do not over-tighten the fitting as it may damage the internal plumbing. Arrangements should be made to collect the water which will form on the transfer hose from melted frost, to prevent a potential slip or fall hazard.

After the transfer hose has been connected, open the supply valve and check the connections for leaks.

Electrical Connections

See the serial tag on the side of the unit for electrical specifications or refer to the electrical schematics at the end of this manual.

1. Verify the ON/OFF switch on the back of the unit is OFF.

2. Connect the appropriate line cord to the power inlet on the back of the unit.

3. Connect the unit to a grounded, dedicated circuit.



Caution The ON/OFF switch is the mains disconnect device for the unit. Position the unit so the switch is easily accessible. ▲

Sample Thermocouple Connection

Non-IVF models

1. Open the unit door.
2. Locate the thermocouple connector in the front upper right corner of the chamber.
3. Install the supplied sample thermocouple in the correct orientation.
4. Close the unit door.

IVF models

1. Locate the thermocouple connector on the top of the unit, to the left of the printer cover (refer to Figure 1-2).
2. Install the appropriate supplied sample thermocouple in the correct orientation.

Note The freezer has been calibrated at the factory with the 1.2/2.0ml sample thermocouple probe installed in the internal thermocouple connector. See Section 3 to calibrate an external thermocouple probe. ▲

Power-Up

1. Turn the freezer power switch on the back of the unit to On.
2. On the control panel, the Alarm indicator lights briefly, and the LCD display reads Controlled Rate Freezer XX (XX = software version).
3. The Idle indicator lights, then the LCD display shows the profile list.
4. To choose a profile, scroll through the selections using the up/down arrow keys. The profiles are displayed in a loop. Pressing either of the arrow keys consecutively brings the list back to the starting point.

Access Code Security

The controller will provide security for the following menus and functions, if the Access Code is enabled, by prompting for a 4-digit numeric access code:

- Configuration/Calibration Menu
- Profile Edit Menu
- Manual Override during a run
- Start of a run on second or subsequent step in a profile
- Manual change in Run profile execution to a prior or following step
- Premature termination of a profile run

Access Code Security (continued)

If access code protection is enabled (see the Configuration/Calibration section), access to the above functions is gained by entering the access code as follows:

1. Use the Enter and the Back key to select the desired digit. Use the up or down arrow keys to change the digit. When finished, use Enter to confirm entry of the code and to move into the selected protected function or menu.
2. The access code when protection is disabled is 0 0 0 0.
3. The access code can be enabled, changed, or disabled by using "Change Access Code" (see Configuration/Calibration section).

Initiate a Profile

1. Load the product into the freezing chamber. On IVF models, make sure all unused sample access ports are capped.
2. If the profile list is not on the display, press Back until the list appears.
3. Locate the item selector (è) on the left of the top line of the menu.
4. Move the required profile to this line by using the 5/6 keys. The chosen profile must be on the same line as the selector.
5. Press the Run key. If the chosen profile begins with a Wait, the Run key must be pressed again to continue, after the appropriate temperature is reached.
6. The mode indicator is lit, showing the status of the profile.

Note Any profile can be started at the second or any subsequent step by entering View Mode (press Enter), scrolling (pressing the 5/6 keys) to the desired profile step and pressing the Run key. If Access Code protection has been enabled, the unit will prompt for the access code before entering Run Mode at the selected step. ▲

Note The user can manually move to a different step in a running profile by scrolling (5/6) to the desired profile step and pressing the Run key (the move occurs when the Run key is released). If the user does not press Run within 30 seconds, or Back to abort the move, the control will automatically exit the move mode and continue profile execution without interruption. ▲

If Access Code protection has been enabled (see Configuration/ Calibration section), the unit will prompt for the access code before moving to the selected profile step.

Stop a Profile Run

A profile run can be discontinued by pressing the Back key. If Access Code protection has been enabled, the unit will prompt for the access code before terminating the profile run. However, Access Code protection is not required on an End step.

If a power outage interrupts a run, the profile will restart from the point of interruption when power is restored. See Alarms in this section.

Manual Override

The user may override a running freezing profile by manually injecting LN_2 or operating the heater to more rapidly change the chamber temperature.



Caution The manual override function is not intended for normal operation and should not be used to achieve cabinet temperatures below -180°C. It is recommended that temperature always be controlled using pre-set or user-generated programs, not manually. ▲

1. During a running profile, press the Enter key to access Manual Override Mode. If Access Code protection has been enabled, the unit will prompt for the access code before entering Manual Override Mode.

2. Select the desired function to override (Heat, Cool or Cool+) by pressing the Enter and Back keys.

   - Heat controls the heater.
   - Cool energizes the solenoid.
   - Cool+ energizes both solenoids.

3. Press and hold the up arrow key to turn On the selected function, or press and hold the down arrow key to turn it Off. The function will revert to normal profile control when the key is released.

Note The function not under manual control will still be under profile control. For example, if the Cool function is activated under manual override and the chamber drops below the programmed setpoint, the controller will activate the Heat function to compensate. ▲

Program User Specific Profiles

To program user specific profiles, enter Edit Mode. The following describes the actions and options necessary for adding or editing a profile.

Note If Access Code protection has been enabled, the unit will prompt for the code before entering Edit Mode. To enable an access code, see Access Code Security in this section. ▲

If the profile list is not displayed, press the Back key as many times as is necessary to view them.

1. Locate the arrow to the left of the option that is on the top line of the display. Move the profile (USER 1 through USER 10) that you wish to view or edit to the top line by pressing the up or down arrow keys.

Note Pre-set Profiles may not be edited. ▲

2. To enter View Mode, press the Enter key.

3. Press the up arrow key to view Step 0. This is the Name/Title step.

4. Press Enter to go into Edit Mode for Step 0 and the cursor will be blinking over the leftmost character position.

   To change this character, scroll through the available characters by pressing the up or down arrow keys. Press Enter when the chosen character is visible. The cursor will blink over the next character in the name or title. The available characters and their relative sequence is as follows: ! " # $ % & ' ( ) * + , _ . /

   0 thru 9 : ; < = > ? @

   A thru Z [ ] ^ _ ` a thru z { | } → S_P

   To delete a character, place the cursor over the chosen character and press Silence.

Note When starting with a space 'S_P', pressing the up arrow key gives you a '!', while pressing the down arrow key gives you a '→'. ▲

5. At this time, enter a unique name or title for the profile.

6. When Step 0, the name or title, is complete, move the cursor back to the leftmost position. This is View Mode.

7. Scroll, using the down arrow key, to Step 1.

8. Press Enter to go into Edit Mode.

   Step 1 contains a command with a cursor blinking just to the right of a left pointing arrow (← __). With the cursor in this position, use the up or down arrow keys to scroll through the available commands.

Program User Specific Profiles (cont.)

Listed below are the available step types.

0.0 C/m C to 0.0C - Ramp chamber temperature at the specified rate until the chamber reaches the specified temperature

0.0 C/m S to 0.0C - Ramp chamber temperature at the specified rate until the sample reaches the specified temperature

For this particular function, when the cursor is in the 'tens' position, pressing the up or down arrow keys changes the available function. The cursor must be in the 'units' position to change the rate value. See Figure 2-3 for position location.

The monitored 'trip' temperature (either S for Sample or C for chamber) can be changed by placing the cursor on the S or C and using the up or down arrow keys.



Caution Steep ramp rates may cause chamber to be much colder/warmer than the sample itself. ▲

Thermal controllers are limited to +55°C and -185°C during steep Sample ramps.

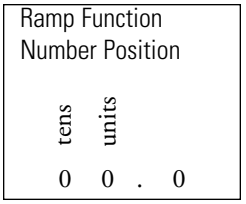


Figure 2-3. Cursor Positions

Note For chamber ramp steps, the interior set temperature will ramp 1°C beyond the programmed temperature to assure that the ramp end point condition will be reached under all operating conditions. For example, if the chamber set point is 30°C, the controller will ramp to 31°C until the setpoint is reached. Graph print-outs show this ramp setting. ▲

Wait at 0.0C: Go to specified chamber temperature and wait until the Run key is pressed

Hold for 1m at 0.0C: Hold for specified time at noted chamber temperature, then continue. A double tone sounds at the end of hold time.

Precool: Cool chamber (w/ target of +4°C) and continue to next step when a sample temperature of +5°C is reached

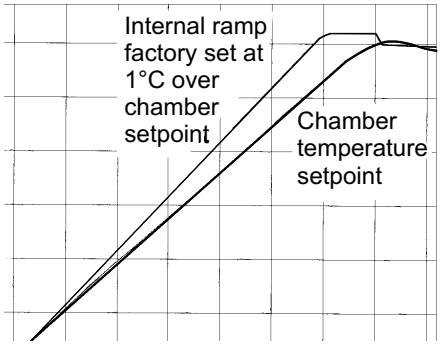


Figure 2-4. Ramp Settings

Jump to 1: Jump to a specified step

Loop to 1 for 1: Loop to step and repeat specified number of times

End: End of profile

Program User Specific Profiles (cont.)

9. After deciding on a function command, press Enter to move to the temperature, time, or step number to be set. Scroll, using the 5/6 keys to choose a number. Single clicks scroll slowly, or press and hold to scroll more quickly. Press Enter to go to the next line in the profile.

10. After all function commands are chosen, press Back until the main menu appears to save all changes.

Note After exiting Edit Mode, the edited profile is printed on the thermal printer, if printer is On and the selected output device. See Section 3. ▲

Note To edit a single line of a profile, enter View Mode, scroll to the desired profile step and go to Edit Mode by pressing Enter. ▲

Note Because so many factors affect the freezing and warming rates of a temperature profile (see Specifications section), all new user specific profiles should be verified for accuracy before applying to samples. ▲

Copy and Paste Pre-set and User Profiles

Pre-set and created user profiles can be copied, then pasted into one of the ten User Profiles as templates to create a new User Profile. To erase a User Profile already in use, a blank User Profile may be copied, then pasted over it. Use the steps below to copy and paste.

1. In the Main Menu, select the Pre-set or User Profile to be copied by using the up or down arrow keys.

2. Press and hold (approximately 3 seconds) the Back key until the message “Profile copied” appears on the second line of the display.

3. When the Back key is released, the message “Select dest with ▲ ▼” appears on the third line of the display. Select the destination for the copied profile, using the up or down arrow keys. When the desired User Profile is showing on the first line of the display, press the Enter key to complete the paste operation, or press Back to cancel.

Printer

The printer on the top of the Controlled Rate Freezer provides a visual record of a profile run, including any errors which might have occurred. Run data is captured in a printer buffer for later reprinting, even if the printer is not enabled during the Run. The printer buffer is cleared at the start of each new run.

It is recommended that a supply of printer paper be kept on hand (see Section 7 - Parts List). If paper should run out during a freezing run, first install the paper. Then when the Run is complete, the print-out may be re-started.

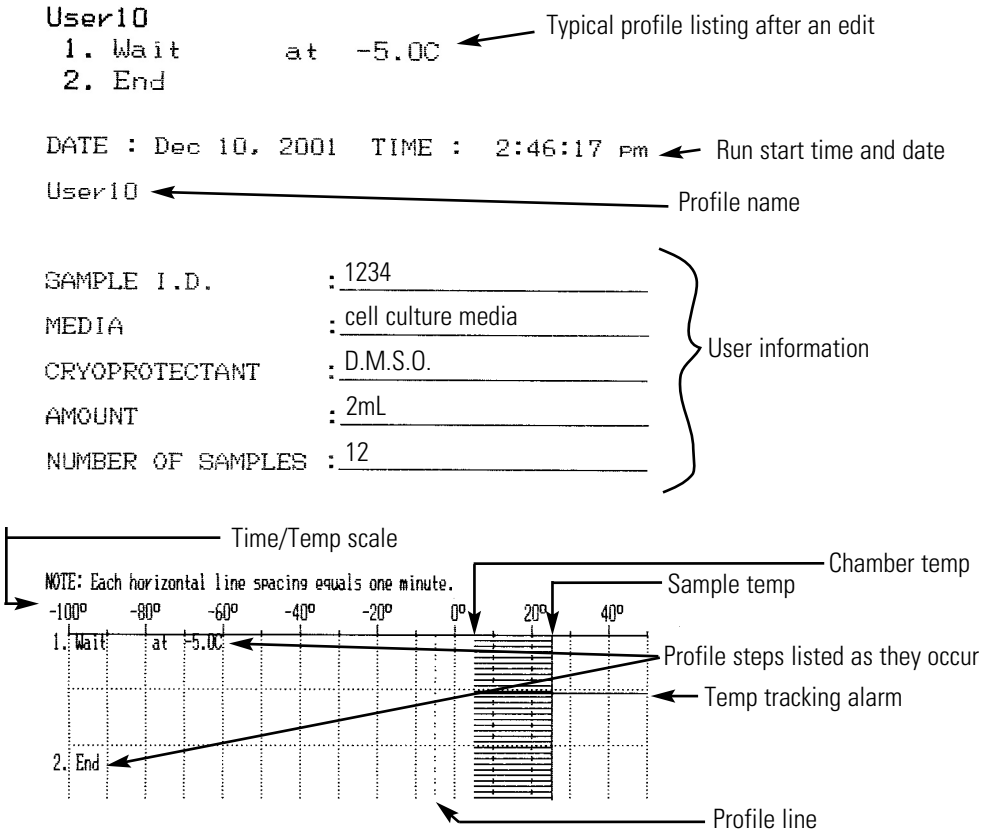


Figure 2-5. Print-outs

Alarms

- Alarm messages are shown on the fourth line of the LCD display.
- Alarm messages alternate if multiple alarms are present at one time.
- The fourth line of the LCD display will alternate at a rate of 2 seconds per screen between the alarm message(s) and the fourth line label normally displayed.
- Alarms are cleared with the Silence key. The first depression mutes the audible alarm. After the alarm condition has been resolved, the next depression turns off the alarm indicator and clears the alarm message from the fourth line of the LCD display.

Chamber Thermocouple Open

If the Chamber thermocouple cannot be detected (open):

- Audible alarm sounds continuously,
- Alarm indicator flashes,
- Fourth line of LCD display shows “Chamber sensor fail!” message,
- Chamber temperature display shows “ILL”,
- Switches to Idle mode and disables all operating functions.

The audible alarm is muted by the first depression of the Silence key. The Chamber temperature display will revert to normal when the open Chamber thermocouple is corrected. Once resolved, the second depression of the Silence key will turn off the alarm indicator, clear the alarm message from the fourth line of the LCD display, and enable all operating functions.

Sample Thermocouple Open

The freezer responds to an undetected (open) Sample thermocouple in different ways depending upon its mode and the freezing profile selected.

Idle Mode

If the probe fails or is removed by the operator during sample loading and a freezing profile which does not reference the Sample temperature is selected:

- Alarm indicator flashes (no audible alarm),
- Fourth line of LCD display shows “Sample sensor fail!” message,
- Sample temperature display shows “ILL”.

The operator may start the freezing profile and it will proceed normally. The alarm indicator can be turned off and the alarm message cleared from the fourth line of the LCD display by pressing the Silence key after the freezing profile begins. The Sample temperature display will continue to show “ILL”. After completion of the freezing profile the alarm indicator flashes and the fourth line of the LCD display shows “Sample sensor fail!” as before.

The Sample temperature display will revert to normal when the open Sample thermocouple is corrected. Once resolved, pressing the Silence key will turn off the alarm indicator and clear the fourth line of the LCD display.

If the probe fails or is removed by the operator during sample loading and a freezing profile which references the Sample temperature is selected:

- Alarm indicator flashes (no audible alarm),
- Fourth line of LCD display shows “Sample sensor fail!” message alternating with “Sample sensor requ.” message,
- Sample temperature display shows “ILL”,
- Disables Run key.

The operator may not start the freezing profile. The audible alarm is muted by the first depression of the Silence key. The Sample temperature display will revert to normal when the open Sample thermocouple is corrected. Once resolved, the second depression of the Silence key will turn off the alarm indicator, clear the alarm message from the fourth line of the LCD display, and enable the Run key.

Sample Thermocouple Open (continued)

Run Mode

If the Sample probe fails and a freezing profile which does not reference the Sample temperature is selected:

- Audible alarm sounds continuously,
- Alarm indicator flashes,
- Fourth line of LCD display shows “Sample sensor fail!” message,
- Sample temperature display shows “ILL”.

The freezing profile will proceed normally. Pressing the Silence key will mute the audible alarm, but the alarm indicator cannot be turned off and the alarm message cannot be cleared from the fourth line of the LCD display. The Sample temperature display will continue to show “ILL”.

The Sample temperature display will revert to normal when the open Sample thermocouple is corrected. Once resolved, pressing the Silence key will turn off the alarm indicator and clear the alarm message from the fourth line of the LCD display.

If the probe fails and a freezing profile which references the Sample temperature is selected:

- Audible alarm sounds continuously,
- Alarm indicator flashes,
- Fourth line of LCD display shows “Sample sensor fail!” message alternating with “Sample sensor requ.” message,
- Sample temperature display shows “ILL”,
- Switches to Idle mode and disables the Run key.

The audible alarm is muted by the first depression of the Silence key. The Sample temperature display will revert to normal when the open Sample thermocouple is corrected. Once resolved, the second depression of the Silence key will turn off the alarm indicator, clear the alarm message from the fourth line of the LCD display, and enable the Run key.

Heater Malfunction

If the heater is energized continuously (no active temperature control) for 60 minutes, the controller will sound a heater malfunction alarm, light the Alarm LED, sound the audible alarm continuously, show the message "Heater error" on the fourth line of the display and immediately switch to Idle Mode and disable all functions.

The audible alarm is silenced by pressing the Silence key. Since this alarm indicates a hard failure, the Alarm LED and fourth line message can only be cleared by turning the unit power off, then on again.

Chamber/Sample Over/Under Limit Temp



Caution Do not allow the sample probe to come into contact with the chamber interior during operation. This could cause a displayed Sample probe temperature shift. ▲

If the temperature of the Chamber or Sample probe reaches the chamber design high or low temperature limit (design temperature limits are factory pre-set at +55°C and -185°C), the controller will:

1. Sound a Temperature Limit alarm,

2. Light the Alarm LED,

3. Sound the audible alarm at a 75% on-duty cycle (2 second period),

4. Show "C temp limit" or "S temp limit" on the fourth line of the display depending on which probe is at (or exceeding) the design temperature limit (alternated with normal fourth line display contents at a 2 second rate),

5. Continue the profile run without interruption.

This is a "self clearing" alarm. While in the alarm condition, the audible alarm can be silenced by one depression of the Silence key, but the Alarm LED continues to flash and the alarm message displays as long as the alarm condition is present. When the chamber temperature returns to a value within the pre-set limits, the Alarm LED stops flashing and the audible alarm mutes (if not already muted by pressing the Silence key). However, the alarm message remains on the fourth display line until the Silence key is depressed. If the temperature of either probe continuously exceeds the pre-set limit temperatures for more than 10 minutes, the unit will immediately switch to Idle Mode and disable all functions.

Temperature Tracking Alarm

During a Run when the chamber temperature is higher or lower than the programmed temperature by a pre-determined amount for a pre-determined time period (as set in Section 3), the controller will:

- Sound a tracking alarm,
- Light the Alarm LED,
- Sound the audible alarm at a 75% On duty cycle (2 second period),
- Show “Temperature is High” or “Temperature is Low” depending on conditions, (compared to the programmed temperature) on the fourth line of the display, alternated with the normal fourth line display contents at a 2 second rate,
- Mark the strip chart recorder and thermal printer at 50°C to document on paper where the alarm occurred,
- Continue the profile run without interruption.

This is a “self clearing” alarm. When in the alarm condition, the audible alarm can be silenced by one depression of the Silence key but the Alarm LED will continue to flash and the alarm message be displayed while the alarm condition is present. When the alarm condition is resolved, the Alarm LED will stop flashing and the audible alarm will silence (if the Silence key has not already been pressed). However, the alarm message will remain on the fourth display line until the Silence key is pressed a second time.

Power Failure

The controller will detect a power failure and alert the operator under the following conditions:

1. Power failure less than 10 seconds in duration

   Continue profile run without interruption or alarm after power is restored.

2. Power failure more than 10 seconds in duration

   Flash Alarm LED and sound audible alarm at 25% On duty cycle with 2 second period

   Show duration of failure and “Power Failure Alarm” on second, third and fourth line display) display line (alternated with normal fourth line display)

   Mark strip chart recorder and thermal printer (re-print temperature scale on thermal printer)

   Continue profile run without interruption.

A single depression of the Silence key will clear the audible alarm. A second depression of the Silence key will clear the Alarm LED and the messages on the second, third and fourth display lines.

Run Complete

Five minutes after the End profile step is reached, the controller will sound the Run Complete alarm:

- Flash Alarm LED and audible tone at a 25% On duty cycle (2 second period)
- Show “End of run” on the fourth line of the display.

The controller will maintain the temperature of the final step in the profile run until the run is stopped by the operator pressing the Back key.

Warm Complete

Five minutes after the chamber reaches 25°C during a Warm cycle, the controller will sound a Warm Complete alarm:

- Flash the Alarm LED and sound an audible tone at a 25% On duty cycle (2 second period);
- Show “Warm Complete” on the fourth line of the display.

Chamber temperature is maintained at 25°C for a period of 30 minutes, then switched to Idle Mode and all functions are disabled.

Seeding Hold

When the ‘Hold’ time period has elapsed, two audible tones sound to notify the user of the completion of the ‘Hold’ step and the continuation of the profile run. This can be used to alert the user that a particular point has been reached in the profile.

When seeding, be sure to use the top access ports rather than the door.

Printer Buffer Full

This alarm message appears when the printer storage buffer is full of Run data (approximately 2 hours) and is no longer able to store data for later printing. Press Silence to mute the alarm. However, the LED will continue to flash until the Run is stopped. Press Silence to clear the alarm message. Between the time the ‘Printer Buffer Full’ messsage displays and the user stops the Run, no data is captured. The printer buffer will store the previously captured data until the next Run is started. The buffer is cleared at the start of each new Run.

Note: The printer continues to print current Run data even though the ‘Printer Buffer Full’ alarm has occurred.

IVF Sample Holders

Included with the IVF Controlled Rate Freezer are a straw holder, vial holder, cane holder and access port plugs.

Using a Vial Holder

The vial sample holder secures a vial for insertion through the access port on the top of the IVF freezer. This holder may also be used to hold the external sample probe. See Figure 2-6.

1. To secure the vial, first make sure the holder is in an upright (vertical) position.

2. Press the button on the top of the holder. This temporarily widens the opening at the bottom of the holder to install the vial.

3. Carefully let the button up on the top of the holder while making sure the vial fits into the indentation of the holder. The vial should be secure in the holder when the button is released.

4. If the holder is securing the sample probe vial (hole in vial cap), slide the probe down through the holder until it feeds through the vial cap.

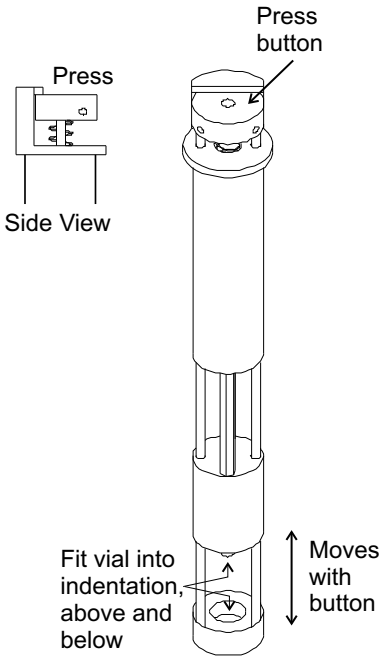


Figure 2-6. Vial Holder

5. Install the other end of the probe to the external connection on the top of the unit. See Figure 1-2.

Using the Straw Holder

The straw sample holder secures up to 4 straws for insertion through the access port on the top of the IVF freezer. The straw holder may also be used to hold the external sample probe. See Figure 2-7.

1. To secure the straws, first make sure the holder is in an upright (vertical) position.

2. Press the button on the top of the holder. This temporarily widens the opening at the bottom of the holder to install the straws.

3. Carefully let the button up on the top of the holder while making sure each straw fits into an indentation of the holder. The straws should be secure in the holder when the button is released.

4. To install the straw probe, insert the probe down the center of the button indicated below. Slide the probe down through the holder until it feeds through the center straw.

Using the Straw Holder (continued)

5. Install the other end of the probe to the external connection on the top of the unit. See Figure 1-2.

Using the Cane Holder

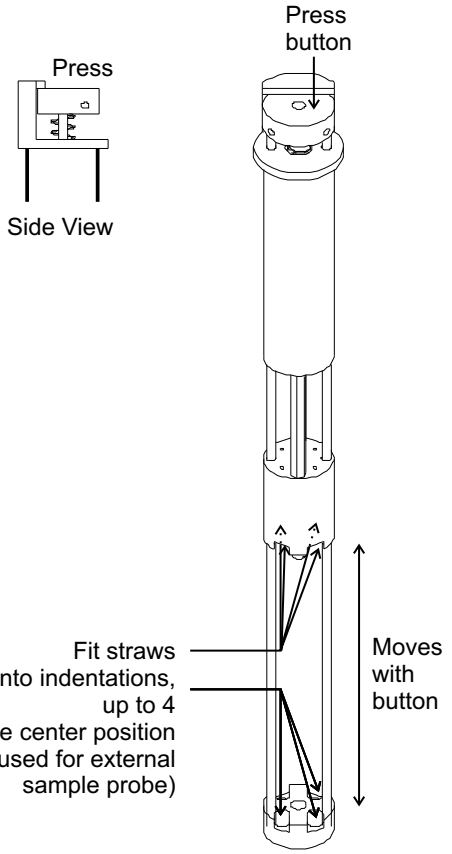


Figure 2-7. Straw Holder

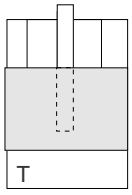


Figure 2-9. External Sample Probe with Dust Cover

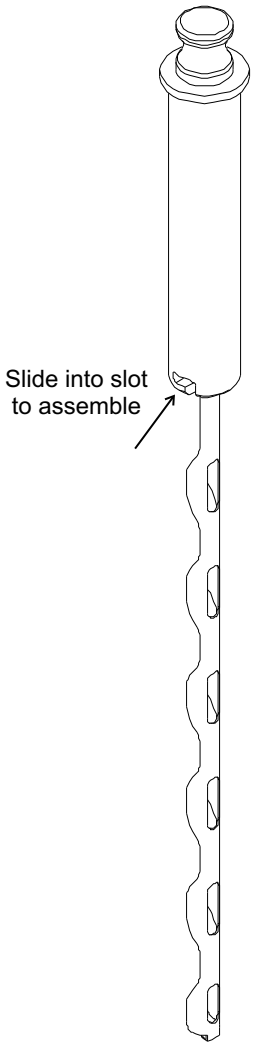


Figure 2-8. Cane Holder

The cane sample holder secures a cane for insertion through the access port on the top of the IVF freezer. See Figure 2-8. To use the cane holder, first assemble the aluminum holder to the plastic handle. Insert the cane holder assembly through access port on the top of the unit (Figure 1-2).

If the cane holder is used with a sample probe, use the standard 1.2ml vial probe. Connect the probe to the internal sample probe connection.

Caution Do not connect sample probes to both the internal and external sample probe connectors at the same time. A dust cover is shipped in the internal sample probe connector of each IVF unit which can be used as a reminder by always placing it in the unused connector. ▲

Holder Adjustment

The vial and straw holders may be adjusted to the size needed. Refer to the illustrations following.

1. *Loosen* the small hex socket set screws in the top of each holder.

2. *Rotate* each of the long adjustment rods equally, to the right to make them longer (widen the opening), or to the left to make them shorter (narrow the opening). Note the threads at the bottom of the adjustment rods.

3. *Tighten* the small hex socket set screws when the adjustment is complete, just until the screws lightly touch the rods to avoid damaging the rod threads.

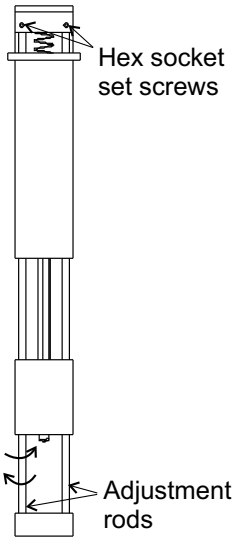


Figure 2-10. Vial Holder Adjustment

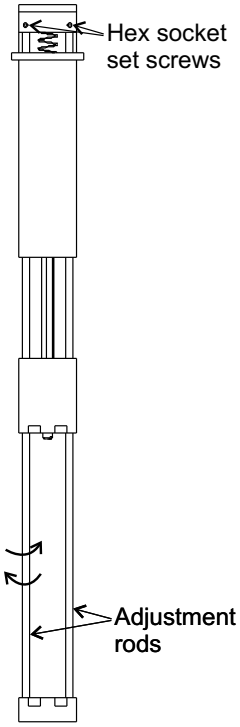


Figure 2-11. Straw Holder

Section 3 Configuration/Calibration

The Configuration/Calibration Menu is selected by pressing the Enter key with the Configure-Calibrate line selected. The software will prompt for the Access Code, if enabled, prior to entering the Configuration/ Calibration Menu.

Menu Structure

The following is the menu structure.

Configure - Calibrate
- Change Access Code
- Chart Recorder
- Printer

Probe Calibration

Service
- Manual Control
- Print Error Logs
- Reset Error Logs
- Simulation
- Software Checksum
- Test Ram
- Thermal Controller
- Use Factory Defaults

Time and Date

Tracking Alarms

Menu Entry Definitions

1. Configure-Calibrate

   A. Change Access Code:

   Change the four digit security access code by selecting each digit using the Enter and Back keys, and changing the digit using the up/down arrow keys. The default Access Code (security disabled) is 0 0 0 0. Each digit may be set over a range of 0 to 9. Exit this menu by using the Back key.

Menu Entry Definitions (cont.)

B. Chart Recorder (chart recorder output is not a standard feature):

Selects the chart recorder operating parameters and checks calibration. Exit this menu by using the Back key.

a. Select Chart Recorder Output:

Select chamber only, sample only, chamber/sample scan (2 sec. chamber, 10 sec. sample), or no chart recorder function (Off). The default setting is Off.

b. Calibration/Linearity Verification:

Verify chart recorder calibration and linearity by setting the chart recorder function over a range of -180°C (0VDC) to +50°C (approximately 10VDC) in 10° steps.

Note The chart recorder function matches the non-linear scale on the chart paper (see Section 7 - Parts List). ▲

C. Printer Menu:

Selects the thermal printer operating mode, printer scale, or initiates printing of the previous run chart. Select the desired item using the Enter and Back keys and change the selected parameter using the 5/6 keys. Exit the menu using the Back key.

a. Select Printer Output:

Select Chamber Only, Sample Only, Chamber/Sample Scan, or No Printer (Off). The default is Scan.

b. Enable/Disable Profile Set Temperature Line:

Turn On or Off a line on the thermal print-out that shows the set temperatures and ramps as the freezing profile is run and printed. The default is Off.

c. Previous Run:

Creates a duplicate of the print-out made during the previous Run from the data stored in the printer buffer. The print-out reflects the actual time and date of the run, rather than the current time and date.

d. Select Printer Temperature Scale:

Select one of two printer scales; -180C to +50C (default) or -100C to +50C.

e. Select Printer Time Scale:

Select 1, 2, or 5 minutes per division.

Menu Entry Definitions (cont.)

2. Probe Calibration:

   Allows operator to calibrate the Chamber or Sample probes by entering an offset and scale factor (scaler). Exit this menu by using the Back key. Use an appropriate reference thermometer for comparison near 0°C (offset) and -196°C (scaler).

Note The chamber/sample limit temperature alarm will sound during the scale factor adjustment at -196°C. Silence the alarm during the calibration procedure by pressing the Silence key. Clear the alarm message after the procedure is complete by pressing the Silence key one more time. ▲

Important After calibrating the temperature probe, reinstall the probe in the previous position. Make sure the tape on the probe wire is flush with the frame for consistent probe results.



Figure 3-1. Install Probe

1. Probe Offset:

   The Chamber and Sample probe offset can be adjusted over a range of -9.9°C to +9.9°C in 0.1°C increments. Adjust the probe offset for a 0.0°C temperature display reading with the probe in a standard crushed ice bath.

2. Probe Scaler:

   The Chamber and Sample probe scale factor (scaler) can be adjusted over a range of 0.5000 to 1.9995 in 0.0005 increments. Adjust the probe scaler for a -196°C temperature display reading with the probe in liquid nitrogen.



Warning Contact of liquid nitrogen with the skin or eyes may cause serious freezing (frostbite) injury. ▲

Menu Entry Definitions (cont.)

Thermocouple Probe Calibration Procedure:

Note A container of "pooled" liquid nitrogen and a container of crushed ice and water (crushed ice just covered with water) are required for this procedure. Prepare both containers before starting the procedure. ▲

1. Turn the unit on and enter the Configuration/Calibration menu. Allow the unit to warm-up for 10 minutes.

2. Remove the end of the chamber thermocouple probe from the mounting tube (near sample thermocouple connector inside the freezing chamber).

3. Dip the Chamber and Sample probes in the water/ crushed ice container and allow to stabilize for 5 minutes. The probes must be in the center of the container, well away from the container walls.

4. Observe the Chamber and Sample temperature displays. Adjust the Chamber and Sample 'Offset' parameters so that the displays each read 0.0°C. Move the cursor to the proper parameter by using the Enter/ Back keys and change the parameter using the up/down arrow keys. Each degree or tenth of a degree of Offset will result in a respective change in the corresponding temperature display.

5. Dip the Chamber and Sample probes in the liquid nitrogen container and allow to stabilize for 5 minutes. The probes must be in the center of the container, well away from the container walls.

6. Observe the Chamber and Sample temperature displays. Adjust the Chamber and Sample 'Scaler' parameters so that the displays each read -196°C. If several scaler values result in the desired reading, select a scaler value in the middle of the range.

7. Repeat Steps 3 through 6 as necessary until both temperature displays read 0.0°C and -196°C. There may be some interaction between the 'Offset' and the 'Scaler' adjustments.

3. Service

   This menu is for use by qualified service personnel. Entry into this menu has a required service access code.



Warning This area may be accessed by qualified service personnel only. ▲

Menu Entry Definitions (cont.)

A. Manual Control

Individually or in any combination, turns on fan, heater, Cool solenoid and Cool+ solenoid for diagnostic or troubleshooting purposes and displays the status of each component. Upon entering the menu, the Enter and Back keys position a cursor over the item to control. The up arrow turns On the selected item and the down arrow turns it Off. When the menu is exited (Back key), any function that has been turned On will be turned Off and the unit reverts to Idle Mode.

Note Fan will run whenever the heater is energized. The solenoid closest to the front of the unit will be energized when Cool is activated. ▲

B. Print Error Logs

This menu item prints and resets the diagnostic error logs that are stored in battery RAM. Each error log consists of the alarm message and the time/date of occurrence. A maximum of 20 alarms for each alarm type are stored in the log. Older entries are discarded when more than 20 alarms are accumulated.

The following is a list of alarm types stored.

- Chamber/Sample probe failure during a run
- Chamber/Sample over/under temperature limit
- Power failure (also stores power failure duration)
- Heater error
- Check LN2 supply
- RS-232 communication error

C. Reset Error Logs

This menu item is used to clear the Error Log entries. When the log is empty, this item reads “Error Log Empty”.

D. Simulation:

This menu item enables a thermal simulator that allows the unit to run freezing profiles in a realistic manner without actually using the chamber heater or cooling solenoids. The simulator uses separate parameters for heating and cooling effects that approximate the performance of the real chamber.

Menu Entry Definitions (cont.)

The delays supported are:

- Turn On delay (Del)
- Turn Off delay (Eff)
- Rate of temperature change per minute (C/M)

Simulation mode is enabled by changing the "sim" parameter from 0 to 1, exiting the Simulation menu and cycling the AC power Off/On. When the unit powers back up, "sim" will be appended to the software version number on the initial power-on display of the 4 X 20 LCD. The simulation mode is disabled by changing the "sim" parameter from 1 to 0, exiting the Simulation menu and cycling the AC power Off/On. "sim" will no longer be appended to the software version number on the initial power-on display.

E. Software Checksum

This menu item initiates a checksum calculation of the software in controller memory and compares it to the reference value loaded in the controller when the software was installed. In addition, the checksum value is shown in the lower right corner of the display.

F. Test RAM

This menu item initiates a non-destructive test of all RAM on the controller board (S-RAM, BAT-RAM). Any errors found would be reported on the LCD display (i.e., "Memory failure, check UXX").

G. Thermal Controller

Adjust the cycle period of the thermal controller and integral proportional, differential gain of the P.I.D. temperature controller, the minimum solenoid on time, the temperature difference from the setpoint that the Cool+ solenoid is actuated, and the difference in P.I.D. parameters for the heater vs. LN2 injection cooling. Exit this menu using the Back key.

There is a separate set of parameters for each size of chamber available ([L] 1.7 cu ft, [M] 1.2 cu ft, and [S] 0.6 cu ft).

The following is a listing of parameters with their defaults.

- Size: L, M, S (default is M)
- Cycle Time adjusted over a range of 500 to 2000mS (default is 1000mS)

Menu Entry Definitions (cont.)

- P: Proportional gain adjusted over a range of 0.0000 to 0.9999 (default 0.25)
- I: Integral gain adjusted over a range of 0.000 to 0.999 (default 0.075)
- D: Differential gain adjusted over a range of 0.00 to 9.99 (default 0.20)
- D/C: Discontinuous or Continuous operation of the controller when the probe temperature is the same as the set temperature (default C)
- PR: Cool/Cool+ solenoid precision (minimum on time) adjusted over a range of 0.01 to 0.99 (default 0.01 or 50mS minimum on time)
- CP: Cool+ differential temperature adjusted over a range of 1°C to 99°C (default 4°C)
- CM: Cool multiplier determines the cooling proportional and differential gain constants relative to the constants entered for P and D, i.e., P (cool) = P*CM, with a range of CM from 0.1 to 9.9 (default 1.0).

H. Use Factory Defaults

This menu item restores the factory-set parameters for the following items.

- Access Code (0 0 0 0, disabled)
- Probe Calibration (offset and scaler 0)
- Simulation (Off; Cool: 1S, 10S, 90C/m; Heat: 1S, 45S, 9C/m)
- Thermal Controller (Size M, 1000mS, P: 0.25, I: 0.075, D: 0.2, PR: 0.01, CP: 4, CM: 1.0, C)
- Tracking Alarms (5C, 1m)

Note User Profiles are not affected. ▲

Menu Entry Definitions (cont.)

D. Time and Date:

Select the parameter to change, using the Back and Enter keys, and change the selected parameter, using the up/down keys. Exit this menu using the Back key.

The following parameters are set.

- Day of the week (Sun, Mon, Tue, Wed, Thu, Fri, Sat)
- Month (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)
- Date (01-31)
- Year (2000 - 2098)
- Hour (12 hour format, 1 - 12)
- Minute (00 - 59)
- Second (00 - 59)
- AM/PM

E. Tracking Alarms:

Adjust the High and Low temperature tracking alarms for duration of run (Time - 1 minute increments) and temperature difference from setpoint (Delta - 1°C increments). The Time parameter can be adjusted over a range from a 1 to 99 minute range. Exit the menu using the Back key.

Section 4 Maintenance



Warning Be sure to disconnect the unit from the power source before beginning any service work. ▲



Caution Before using any cleaning or decontamination method except those recommended by the manufacturer, users must check with the manufacturer that the proposed method will not damage the equipment. ▲



Caution Do not use strong alkaline or caustic agents. Stainless steel is corrosion-resistant, not corrosion-proof. Do not use a solution of sodium hypochlorite (bleach) as it can cause pitting and rusting. ▲



Warning Alcohol, even a 70% solution, is volatile and flammable. Use it only in a well ventilated area that is free from open flame. If any component is cleaned with alcohol, do not expose the component to open flame or other possible hazard. Allow the alcohol to fully dry before turning power on. ▲

Dry Gaskets and Heat Breaks

Thoroughly dry the door and chamber opening gaskets and heat breaks after each run using a soft cloth to prevent ice build-up which could reduce the effectiveness of the door seal. Immediately clean up any water that may drip onto the floor in order to to prevent a potential slip or fall hazard.

Disinfect Controlled Rate Freezer Interior

Use an appropriate disinfectant. All articles and surfaces to be disinfected must be thoroughly cleaned, rinsed and roughdried.

1. Turn the freezer off and disconnect the plug from the power source.
2. Unplug and remove the Sample probe from the chamber, clean with alcohol and allow to dry.
3. Wash the cabinet interior with disinfectant starting at the top and working down. The cabinet and door must be rinsed with sterile water until the disinfectant has been removed. After the cabinet has been rinsed, spray with 70% alcohol.
4. Allow the cabinet door to remain open for the alcohol to evaporate.
5. Plug the freezer in and turn the power switch on.

Clean a Major Spill in the Chamber

Warning Be sure to turn the unit circuit breaker off and disconnect the unit from the power source to prevent the chamber fan from starting unexpectedly while the duct sheets are removed for cleaning. ▲

1. Disconnect the probe from the connector, if applicable. Remove the sample holders (IVF only).
2. Remove the two screws at the top and bottom of each side, securing the screened side ducts to the chamber. Set the ducts aside.
3. Press the top and bottom edges of the center duct toward each other and draw the duct outward to remove.
4. The chamber is now fully accessible and can be cleaned.
5. Clean the interior of the unit with an appropriate disinfectant. Clean, rinse and wipe dry, as needed. Clean the screened side ducts and center ducts before reinstalling.
6. Press the top and bottom edges of the center duct toward each other and insert the duct into the center of the chamber. The edges fit inside the door gasket.
7. Install each screened side duct. Locate the tabs on the back of each duct into the proper holes at the back of the chamber. Align the two screw holes and secure at the top and bottom of each side.



Caution Be sure all chamber components are re-installed in the proper locations to avoid compromising the chamber airflow and temperature uniformity. ▲



Caution Avoid damaging the chamber opening gasket. ▲

8. Connect the Sample probe to the connector, if applicable.
9. All chamber parts must be re-installed for consistent uniformity and airflow. Connect the unit to the power source and turn it on.
10. The freezer is ready to be returned to service.

Clean the Cabinet Exterior

Clean the freezer exterior with a damp sponge or soft, well-wrung cloth and mild detergent dissolved in water. Dry with a soft cloth.

Note On IVF models, be sure to clean between the sample access openings on the top of the unit. ▲

Solenoid Valve Maintenance

Warning These procedures must be performed by qualified service technicians. ▲



Operation

Normally closed: Valve is closed when solenoid is de-energized, valve is open when solenoid is energized.



Warning Turn OFF electrical power supply and de-pressurize valve before making repairs. It is not necessary to remove valve from pipe line for repairs. ▲

Cleaning

A periodic cleaning of all solenoid valves(s) is desirable. The time between cleanings will vary, depending upon media and service conditions. Generally, if the voltage to the coil is correct, sluggish valve operation, excessive noise, or leakage will indicate that cleaning is required.

Valve Disassembly and Reassembly

De-pressurize valve and turn OFF electrical power supply. Proceed in the following manner:

1. Remove retaining clip and slide entire solenoid enclosure from solenoid base sub-assembly.



Caution When metal retaining clip disengages, it springs upward. ▲

2. Unscrew solenoid base sub-assembly and remove body gasket, core assembly with rider ring and core spring attached.

3. Clean and assemble in reverse order of disassembly, paying careful attention to exploded view provided (Figure 4-1) for identification and placement of parts.

4. After maintenance, operate the valve a few times to ensure proper opening and closing.

Solenoid Valve Maintenance (cont.)

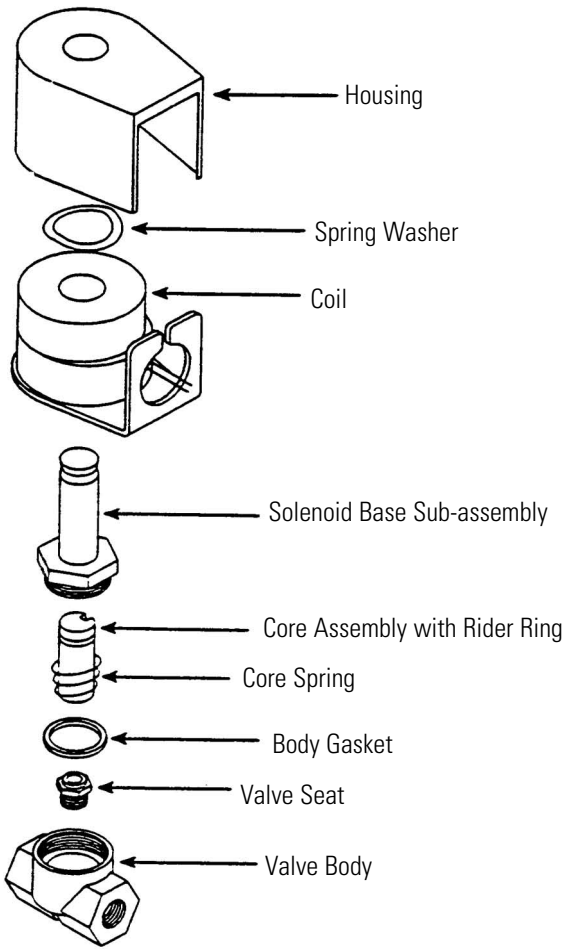


Figure 4-1. Exploded View of Valve

Reset Heater Overtemp Thermostat

Warning Only qualified service personnel or persons experienced in servicing and maintaining laboratory equipment should perform this procedure. ▲



Warning Lockout and tagout electrical power connections whenever removing cabinet panels or working on electrical components. ▲

The manual reset thermostat is located on top of the component mounting bracket above the thermal printer power supply (see Figure 4-2). The thermostat can be accessed by removing the side access panel. Press the button to reset, re-attach the side access panel, and test to verify proper operation by creating and executing the user temperature profile:

Step 1 .....Wait at 50C

Step 2 .....End

Reset Heater Thermostat (cont.)

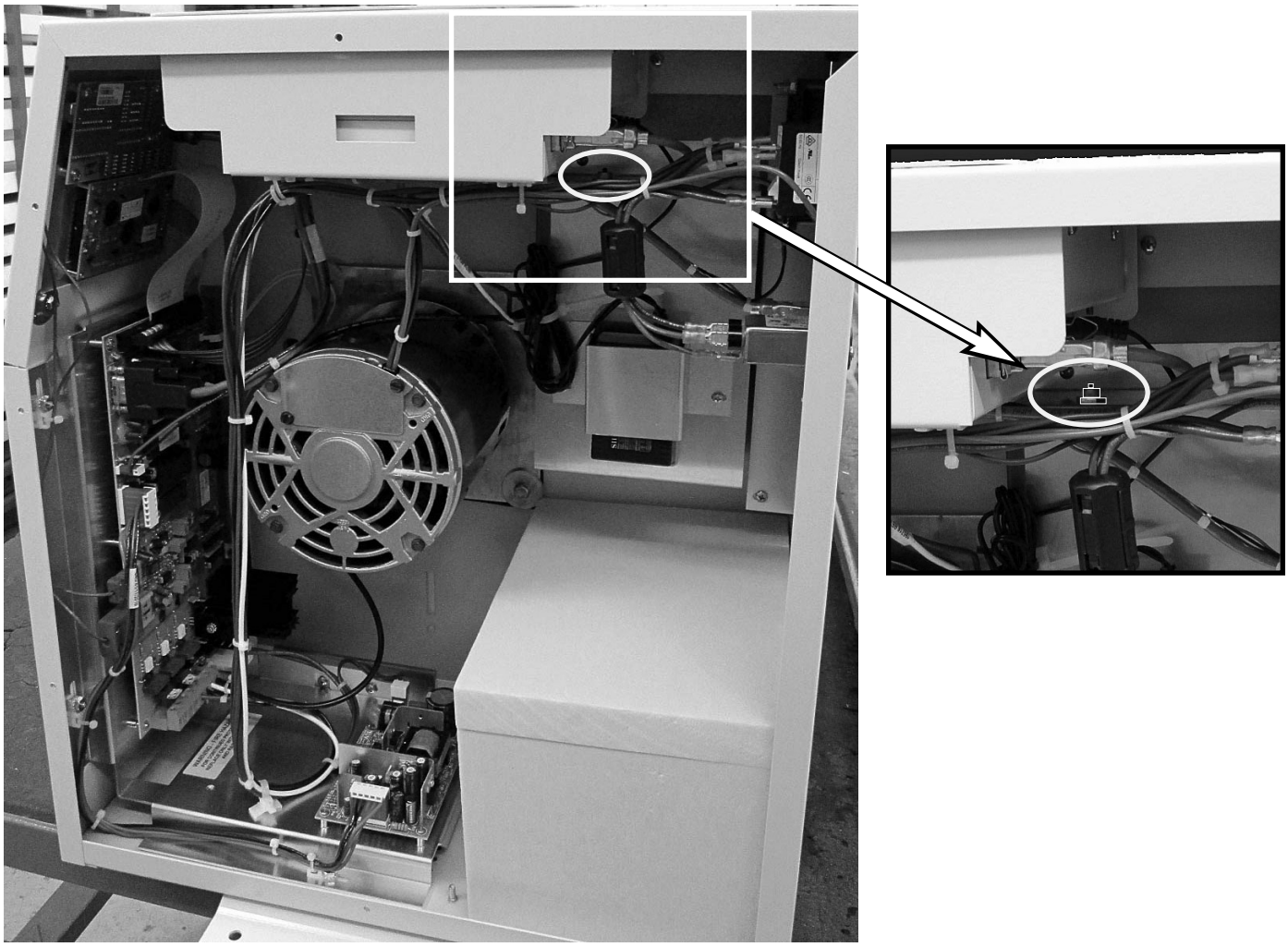


Figure 4-2. Manual Reset Heater Thermostat Location

PREVENTIVE MAINTENANCE

Your equipment has been thoroughly tested and calibrated before shipment. Regular preventive maintenance is important to keep your unit functioning properly. The operator should perform routine cleaning and maintenance on a regular basis. For maximum performance and efficiency, it is recommended that the unit be checked and calibrated periodically by a qualified service technician.

We have qualified service technicians, using NIST traceable instruments, available in many areas. For more information on Preventive Maintenance or Extended Warranties, contact Technical Services.

The following is a condensed list of preventative maintenance requirements. Refer to the operating manual for further details.

Cleaning and calibration adjustment intervals are dependent upon use, environmental conditions and accuracy required.

Action	Each Use	Daily	Weekly	Monthly	Yearly
Dry door and chamber opening gasket and heat breaks	✓				
Disinfect chamber interior		✓			
Clean cabinet exterior			✓		
Check calibration of internal and sample probes*				✓	
Review recorded alarms*				✓	
Inspect solenoid valve*					✓
**Qualified service technicians only*					

Section 5 Printer Set-Up

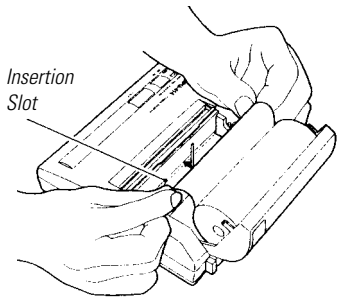
The built-in thermal printer has internal software switch settings that control how the printer interfaces with the Controlled Rate Freezer. These internal settings are pre-set at the factory for proper operation with the freezer. However, if the printer has to be replaced in the field, the settings must be changed to interface correctly with the freezer. The following chart shows the parameters which may be set, the printer manufacturer default settings and the settings required by the Controlled Rate Freezer. See the included printer manual for the software switch setting procedure.

Change the Paper

1. Turn the unit on.
2. Trim the paper as needed to make edge straight.

paper

3. Open the printer cover.
4. Feed the paper into the inlet at the bottom of the paper holder until the auto-loader begins to pull the paper in. The auto-loader will feed about 4 inches (10cm) through the paper cutter.
5. Press the paper feed switch until the paper feeds in straight and smoothly.



The printing surface is the outside of the thermal paper roll.

Table 5-1. Internal Settings

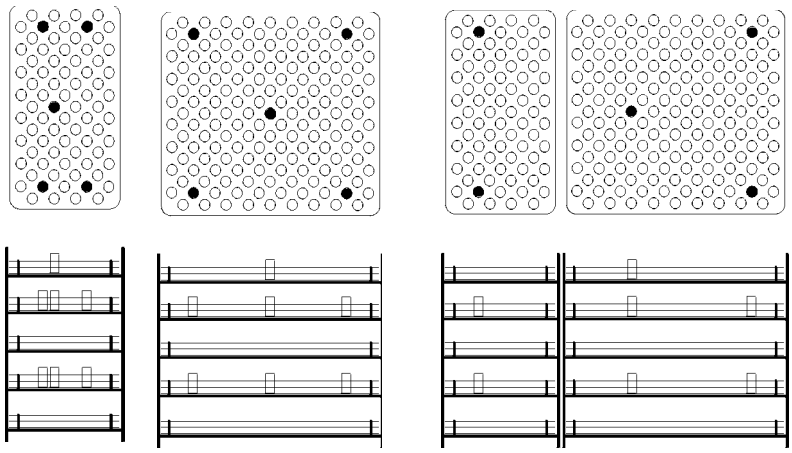
Parameter	Default from manufacturer	Required for CRF
DIP SW-1	**(switch setting)**	**(switch setting)**
1: Input	Parallel (ON)	Serial (OFF)
2: Printing Speed	High (ON)	High (ON)
3: Auto paper loading	Enabled (ON)	Enabled (ON)
4: Auto line feed	Disabled (OFF)	Disabled (OFF)
5: DIP switch setting	Enabled (ON)	Enabled (ON)
6: Print density (a)	100% (OFF)	100% (OFF)
7: Print density (b)	(ON)	(ON)
8: Print density (c)	(ON)	(ON)
DIP SW-2	**(switch setting)**	**(switch setting)**
1: Print mode	40 columns (ON)	40 columns (ON)
2: User font back-up	Enabled (ON)	Enabled (ON)
3: Character type	Normal (ON)	Normal (ON)
4: Zero style	Normal (ON)	Normal (ON)
5: Character set (a)	Japanese (ON)	USA (ON)
6: Character set (b)	(ON)	(ON)
7: Character set (c)	(ON)	(ON)
8: Character set (d)	(ON)	(OFF)
DIP SW-3	**(switch setting)**	**(switch setting)**
1: Data length	8 Bits (ON)	8 Bits (ON)
2: Parity (with/without)	Without (ON)	Without (ON)
3: Parity (odd/even)	Odd (ON)	Odd (ON)
4: Busy control	Hardware (ON)	XON/XOFF (OFF)
5: Baud rate (a)	75bps (ON)	9600bps (OFF)
6: Baud rate (b)	(ON)	(ON)
7: Baud rate (c)	(ON)	(ON)
8: Baud rate (d)	(ON)	(ON)

Section 6 Specifications

Temperature Uniformity

Temperature uniformity is specified to be less than a standard deviation of 2°C (up to the 'freeze' of the first vial) across a matrix of 10 vials (1.2/2.0ml size) containing 1.0ml (± 2%) each of distilled H_20. The temperature is to be monitored by type 'T' thermocouples placed in the center of the liquid in each vial with the vials distributed in standard racks and holders as shown below (separately for each cabinet size). Please note that there are 5 each vials in the second rack from the top, as well as the second rack up from the bottom, with the 'Sample' vial placed in the center of the top rack. Also, note that the large cabinet uses a combination of the small and mid-size rack and holder sets. Finally, a specific program sequence, listed below, must be run in order to collect the uniformity data.

Rack and Holder Vial Placement for each size chamber



0.6 cu. ft.	1.2 cu. ft.	1.7 cu. ft.
Models	Models	Models
7450/7451	7452/7453	7454/7455
7456/7457	7458/7459	7474
7472, 7475	7473, 7476	

Uniformity Profile

1) Hold 10.0min @25C
2) 2.0C/min C to 0.0C
3) 0.0C/min S to 3.0C
4) Hold 10.0min @1.0C
5) 1.0C/min C to -5.0C
6) 99C/min C to -50C
7) 99C/min C to -10.0C
8) 1.0C/min C to -2.0C
9) Hold 12.0 min @ -2.0C
10) 1.0C/min C to -20C
11) END

Weight	
Model	**lbs. (kg)**
7450	140 (63.5)
7451	140 (63.5)
7452	160 (72.6)
7453	160 (72.6)
7454	180 (81.6)
7455	180 (81.6)
7456	140 (63.5)
7457	140 (63.5)
7458	160 (72.6)
7459	160 (72.6)
7472	140 (63.5)
7473	160 (72.6)
7474	180 (81.6)
7475	140 (63.5)
7476	160 (72.6)

Chamber Temperature Range

+50°C to -180°C

Chamber Freezing Rate

Minimum 0.1°C / min

Maximum 99.9°C / min over operating temperature range

Note Rates vary based on load, LN_2 pressure, unit size, and voltage. ▲

Chamber Warming Rate

Minimum of 0.1°C / min (no load, T-couple in free air, center of chamber)

Maximum of 12.0°C / min (same conditions as above)

Average of 9.0°C / min (same conditions as above, range -40°C to -12°C)

Note Rates vary based on load, LN_2 pressure, unit size, and voltage. ▲

Automatic Restart

The microprocessor retains all programming in non-volatile memory. In the event of a power outage, the unit restarts automatically once power is restored.

Construction

Interior ..... Stainless steel with removable ductwork for ease of cleaning

Exterior ..... Stainless steel with powder coated finish

Insulation ... Foamed in place polyurethane door and cabinet

Air Flow

Horizontal from right to left, as viewed from the front

Sound Level

Unit in operation does not exceed 65 dBA.

Operational Features

Door interlock switch turns off LN_2, heater and fan motor, except during the warm-up cycle.

During the warm-up cycle, the door can be opened with heater and fan running (up to 0°C) to accelerate warming.

LN_2 pressure relief valve located adjacent to LN_2 connection.

Chamber pressure vent port located on left side-wall.

Heater overtemperature protection: At a temperature level of 93°C, an independent manual reset device interrupts power to the heating element.

External Connections

Power entry

PC interface port

LN2 connection 1/2” flare

External thermocouple jack (IVF models only)

Sample access (IVF models only)

Electrical

7450, 7452, 7454, 7456, 7458

Nominal: 120VAC, 60Hz, 1PH, 12.0 FLA

7451, 7453, 7455, 7457, 7459

Nominal: 230VAC, 50/60Hz, 1PH, 5.5FLA

7472, 7473, 7474, 7475, 7476

Nominal: 100VAC, 50/60Hz, 1PH, 10.5 FLA

Environmental Conditions

The Controlled Rate Freezer is designed to be electrically safe in the following environmental conditions:

- Indoors
- Altitude: Up to 2,000 meters
- Temperature: 5°C to 40°C
- Humidity: 80% RH at or below 31°C, decreasing linearly to 50% RH at 40°C
- Mains Supply Fluctuations: ±10% of nominal.
- Installation Category II [1]
- Pollution Degree 2 [2]
- Class of Equipment [1]

Thermo Fisher Scientific declares that the applicable CE marked models meet the provisions of the following EC directives:

2004/108/EC Electromagnetic Compatibility Directive

2006/95/EC Low Voltage Directive

2011/65/EU RoHS Directive

Declarations are available upon request.

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1 Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500V for a 230V supply and 1500V for a 120V supply.

2 Pollution Degree describes the amount of conductive pollution present in the operating environment. Pollution Degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

Section 7 Parts List

Part Number	Description
103112	Removable Bulb Gasket (chamber opening)
195986	Silicone D-Gasket (door), 0.6 cu ft units
195987	Silicone D-Gasket (door), 1.2 cu ft units
195988	Silicone D-Gasket (door), 1.7 cu ft units
121065	Vise Action T-Handle Latch
137017	Tubular Heater 945W, 115V
137018	Tubular Heater 945W, 230V
140460	Control Panel Overlay
156123	1/4 Hp Blower Motor 1725
190611	Stn Stl Hinge Pin
190612	Hinge Block Alum
191648	Display Board
191649	Control Board
201306	Thermal Data Printer
201307	100-120V Printer Power Supply
201303	230V Printer Power Supply
201305	230V Printer Power Supply Kit for units built before 01/2011
201308	120V Printer Power Supply Kit for units built before 06/2012
230184	15A DPDT Circuit Breaker/Switch
230178	8A DPDT Circuit Breaker/Switch
251008	1/4 MPT Relief Valve 60 PSIG
290170	T-Type Chamber Probe
350185	USB to Serial Adapter
370248	T/C Plug Type T
370249	T/C Socket Type T

Part Number	Description
400152	Switcher 40W 12, 5, -12 V
400148	200 F Manual Reset T-Stat
430326	Cordset, 13A/125V, 16/3, USA
430109	Cordset, 10A/250V, European
460180	Power Entry/RFI Line Filter
650012	Ext. Retaining Ring 0.250 Dia.
730036	Teflon Washer
900134	Tubeaxial Fan, 30 cfm, 12V
1890040	LN2 Inject Coil S-Asy
1890049	LN2 Inlet Plumbing
1890050	LN2 Outlet Plumbing
4000401	6 ft. Transfer Hose
4000617	120V Solenoid Valve
4000618	230V Solenoid Valve
4000619	LCD/Cable Assembly
4000621	Door Switch Assembly
130059	Ampule Stopper
130060	Straw Stopper
4000566	Thermal Printer Paper, 5 rolls per box
270158	DB9 Cable, 10 ft.
350185	USB-to-Serial Adapter
4000404	PC Interface Software V1.0 (Windows XP)
270170	Ferrite Suppressor (230V models only)
4000414	Windows 7 PC Interface Kit
4000415	Windows 7 PC Software and Unit Manual

IVF Models Only	
Part Number	**Description**
4000211	Cane
4000211	Cane, 1.2 ml, 6 ampule
4000712	Sample T/C Vial with hole, 1.2 ml
4000713	Sample T/C Vial with hole, 2.0 ml
290198	External Sample Probe Connector Replacement Kit
370650	T/C Connector Dust Cover

Accessories

Freezing Racks and Holders	
Catalog No.	**Description**
4000294	Straw Rack for .25/.5ml straws - holds 40 straws
4000303	Cane freezing rack - large
4000700	Cane freezing racks- small
4000701	1.2/2ml freezing rack - small
4000702	Rack holder for 4000701 racks - small
4000703	1.2/2ml freezing rack - large
4000704	Rack holder for 4000701 racks - large
4000705	4 or 5ml freezing rack - small
4000706	Rack holder for 4000705 racks - small
7000707	4 or 5ml freezing rack - large
4000708	Rack holder for 4000705 racks - small
4000310	Two level skin rack - holds skin packets measuring 5" x 7"
4000312	One level skin rack - holds skin packets measuring 5" x 7"
4000340	Cord blood freezing rack for 50ml canisters (4000610)
4000340	Cord blood freezing rack for 25ml canisters (1950381)
195089	Adjustable freezing rack for canisters
**These accessories can only be used when top loading cane, vial & straw holders are nto in use.*	

Accessories (continued)

Freezing Presses	
Catalog No.	**Description**
4000314	Bag press for 250ml bag (Fenwal 4R5461 or equivalent)
4000316	Bag press for 200ml bag (Gambro DF-200 or equivalent)
4000317	Bag press for Delmed 2030-2
4000318	Bag press for 250ml bag (Fenwal 4R5461 or equivalent)
4000320	Bag press for 200ml bag (Gambro DF-200 or equivalent)
4000321	Bag press for 700ml bag (Gambro DF-700 or equivalent)
4000355	Bag press for 500ml bag (Fenwal 4R5462 or equivalent)
*These accessories can only be used when top loading cane, vial and straw holderss are not in use.	

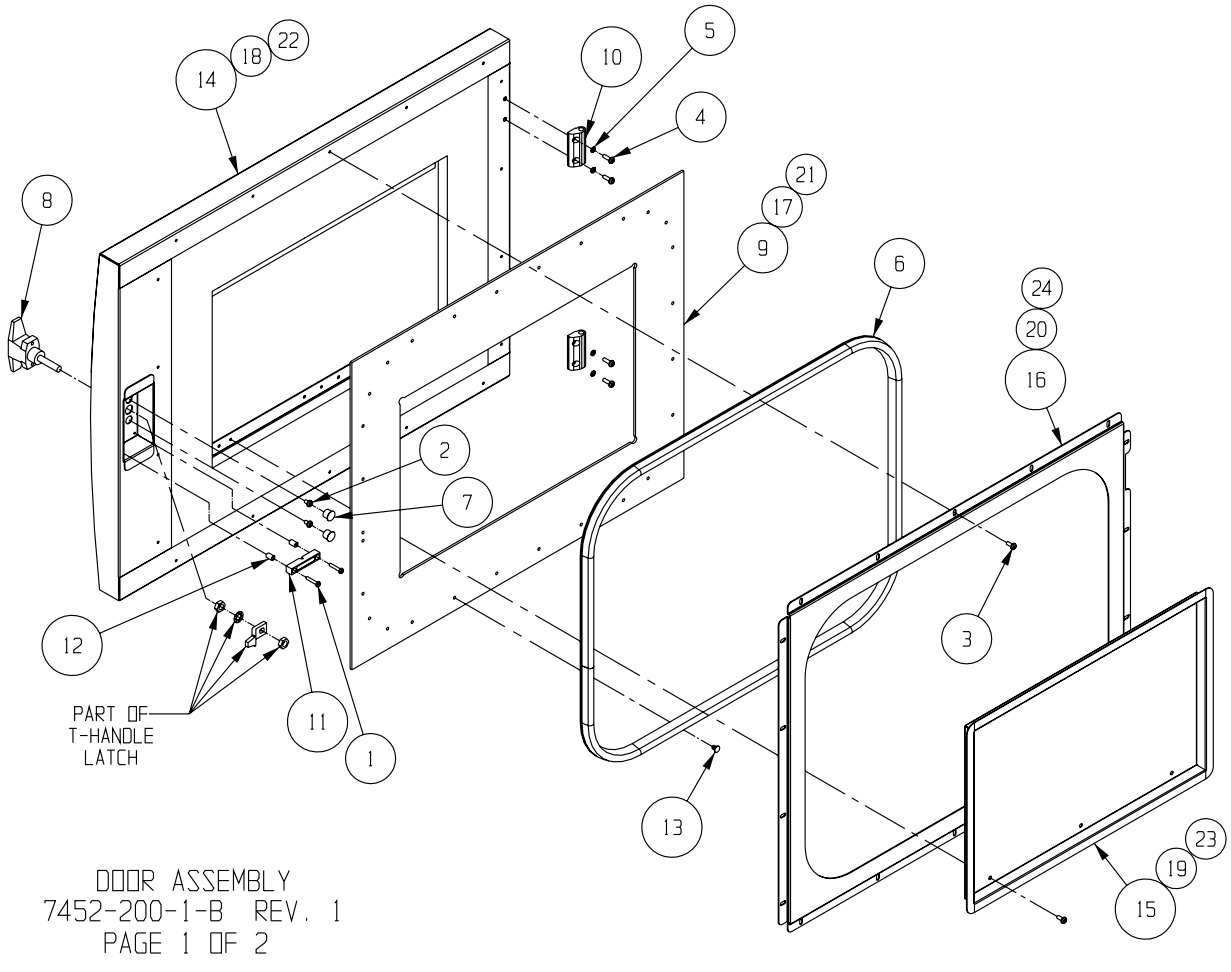
Holders and Plugs for Top Loading Chambers	
Catalog No.	**Description**
4000710	.25/.5ml Straw holder
4000711	1.2/2ml Vial holder
180254	Cane holder
180255	Sleeve plug

Sample Sensors		
Description	**Catalog No.**	
	.6, 1.2, and 1.7 cu ft units	.6 and 1.2 cu ft IVF units
Thermocouple sensor for 1.2/2ml vials	4000385	4000385*
Thermocouple sensor for 4/5ml vials	4000386	4000386*
Thermocouple sensor ribbon type for bags	4000393	4000393*
Thermocouple sensor .02 sheath for straws	N/A	4000402
Thermocouple sensor .062 sheath for vials	N/A	4000403
*These accessories can only be used when top loading cane, vial and straw holderss are not in use.		

Accessories (continued)

Printer Paper		
Description	**Catalog No.**	
	.6, 1.2, and 1.7 cu ft units	.6 and 1.2 cu ft IVF units
Thermal printer paper (5 rolls per pack)	4000566	

Canisters for Freezer Racks	
Catalog No.	**Description**
1950831	Swing arm canister for 25ml bag
4000610	Swing arm canister for 50ml bag (Fenwal 4R9951 or equivalent)
4000356	Swing arm canister for 250ml bag (Fenwal 4R5461 or equivalent)
4000357	Swing arm canister for 500ml bag (Fenwal 4R5462 or equivalent)
4000335	Swing arm canister for 200ml bag (Gambro DF-200 or equivalent)
4000336	Swing arm canister for 2 (Gambro DF-200 or equivalent)00ml bag
4000332	Swing arm canister for 700ml bag (Gambro DF-700 or equivalent)
4000333	Swing arm canister for 700ml bag (Gambro DF-700 or equivalent)
*These accessories can only be used when top loading cane, vial and straw holderss are not in use.	

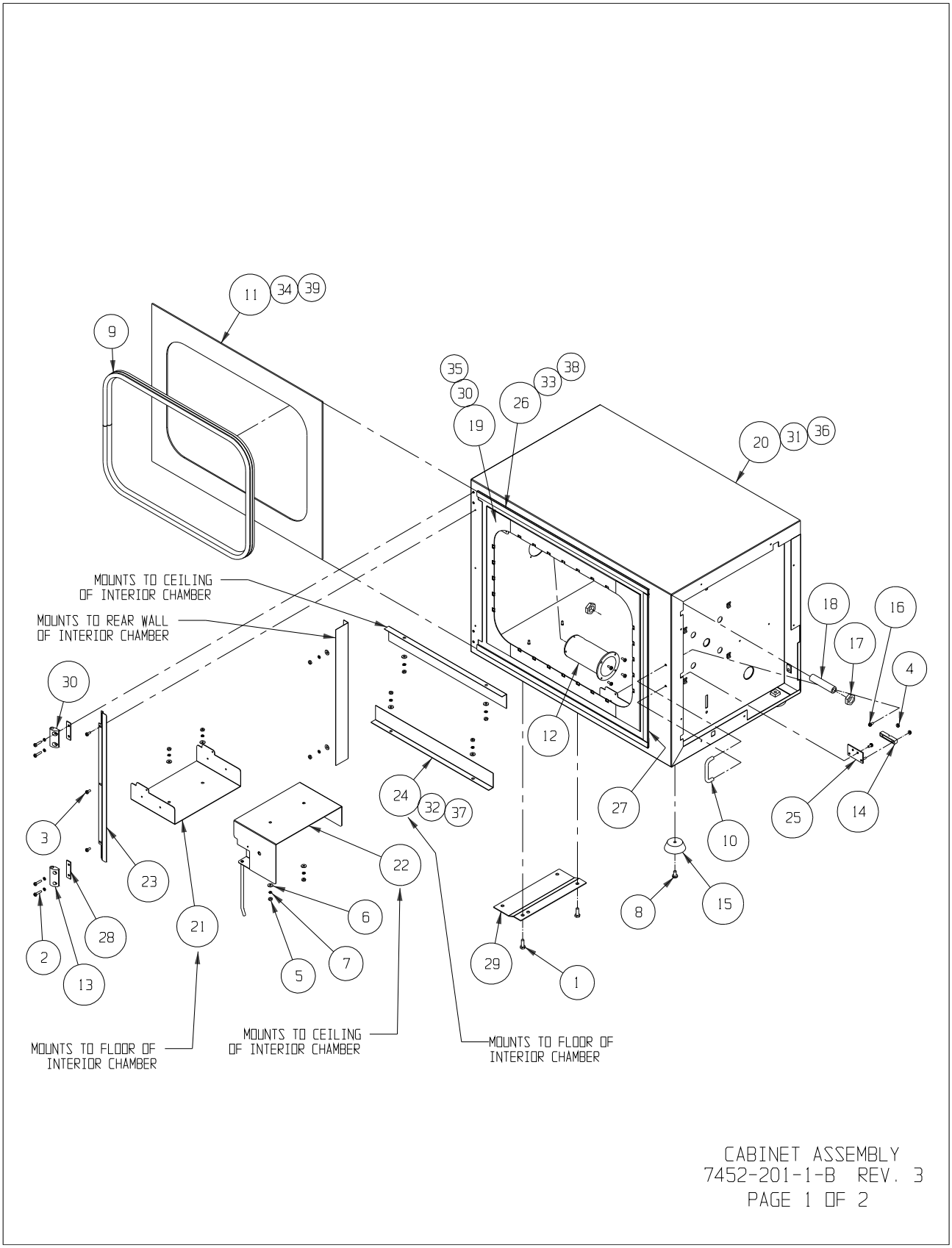


DOOR ASSEMBLY
7452-200-1-B REV. 1
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BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	22008	#6-32 X 3/4 SS PHP SCREW	2
2	22051	#8-32 X 1/4 SS PHP SCREW	2
3	22052	#8-32 X 3/8 SS PHP SCREW	24
4	22053	#8-32 X 1/2 SS PHP SCREW	4
5	23080	#8 SS SPRING LOCKWASHER	4
6	103113	SILICONE "D" GASKET	1
7	117018	7/16" DIA. BLACK HOLE PLUG	2
8	121065	VICE-ACTION T-HANDLE LATCH	1
9	180223	1.2CF CRF DOOR HEAT BREAK FRAME	1
10	190612	ALUMINUM HINGE BLOCK	2
11	360235	SURFACE MOUNT MAGNETIC SWITCH MAGNET	1
12	515084	1/4 DIA. X 3/8L SS SPACER	2
13	670015	NYLON PUSH-IN RIVET	29
14	1890002	DOOR ASSEMBLY	1
15	1890018	DOOR INNER PAN SUB-ASSEMBLY	1
16	1890020	SECONDARY SEAL RETAINER FRAME	1
17	180222	0.6CF CRF DOOR HEAT BREAK FRAME	1
18	1890034	0.6CF DOOR ASSEMBLY	1
19	1890036	0.6CF DOOR INNER PAN SUB-ASSEMBLY	1
20	1890038	0.6CF SECONDARY SEAL RETAINER FRAME	1
21	180224	1.7CF CRF DOOR HEAT BREAK FRAME	1
22	1890043	1.7CF. DOOR ASSEMBLY	1
23	1890045	1.7CF DOOR INNER PAN SUB-ASSEMBLY	1
24	1890047	1.7CF SECONDARY SEAL RETAINER FRAME	1

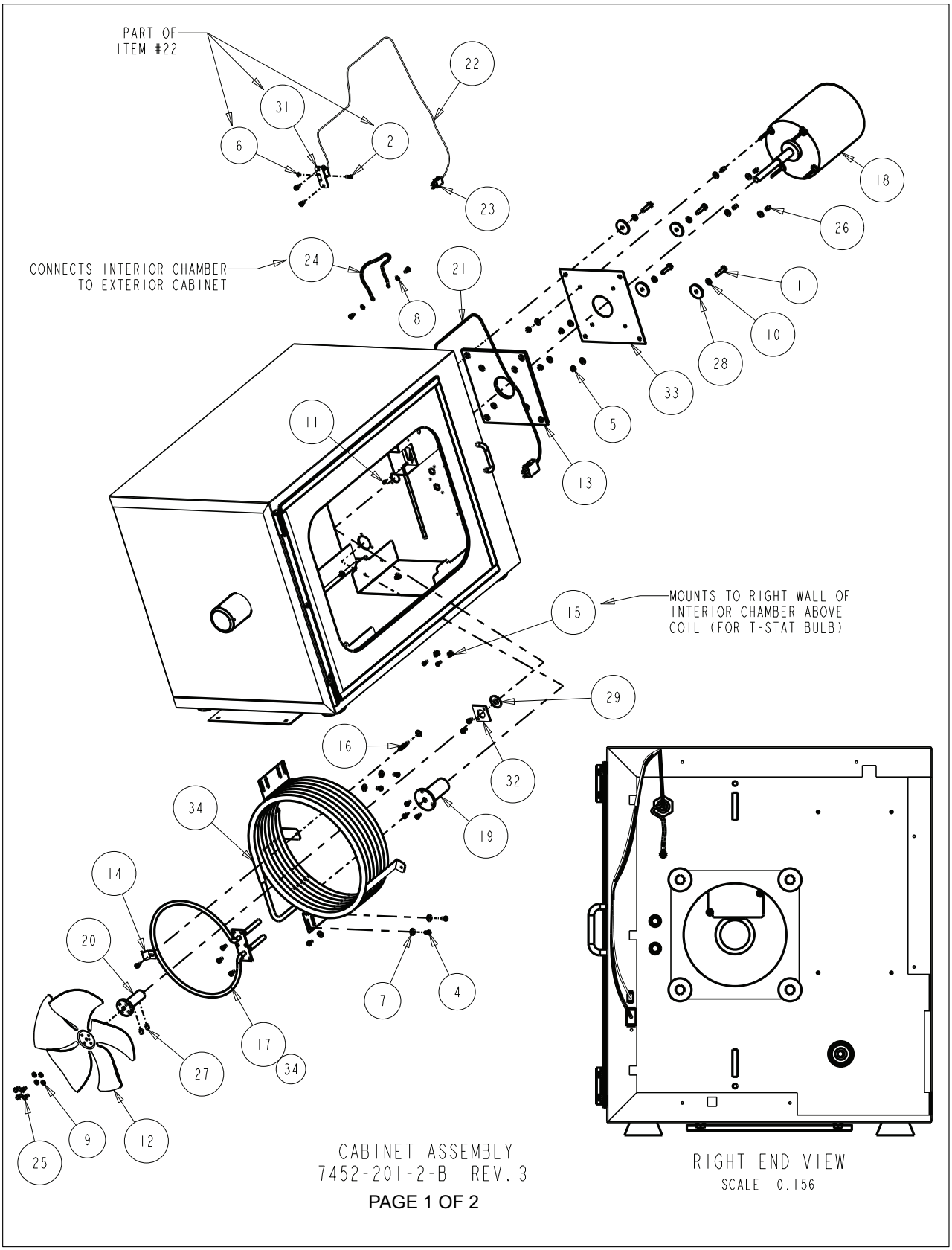
NOTE: SOME FASTENER QUANTITIES WILL VARY BASED ON DIFFERENT SIZE UNITS.

DOOR ASSEMBLY
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11
34
39
9
35
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26
33
38
20
31
36
MOUNTS TO CEILING
OF INTERIOR CHAMBER
MOUNTS TO REAR WALL
OF INTERIOR CHAMBER
18
16
17
4
30
12
24
32
37
27
25
14
3
10
22
23
8
15
6
21
28
2
7
29
1
5
13
MOUNTS TO FLOOR OF
INTERIOR CHAMBER
MOUNTS TO CEILING
OF INTERIOR CHAMBER
MOUNTS TO FLOOR OF
INTERIOR CHAMBER
CABINET ASSEMBLY
7452-201-1-B REV. 3
PAGE 1 OF 2

BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	20017	1/4-20 X 3/4 ZP HH CAP SCREW	2
2	22015	#8-32 X 3/4 SS PHP SCREW	4
3	22052	#8-32 X 3/8 SS PHP SCREW	7
4	23001	#6-32 ZP LKWASH HEX NUT	2
5	23010	#8-32 SS HEX NUT	14
6	23021	#8 SS FLAT WASHER	14
7	23080	#8 SS SPRING LOCKWASHER	18
8	59000	1/4-20 X 1/2 ZP PHP SCREW	4
9	103112	REMOVABLE BULB GASKET	1
10	115027	5/16" DIA. S.S. HANDLE	1
11	180226	1.2CF CRF CABINET HEAT BREAK FRAME	1
12	180231	CONTROLLED RATE FREEZER EXHAUST VENT	1
13	190612	ALUMINUM HINGE BLOCK	1
14	360235	SURFACE MOUNT MAGNETIC SWITCH	1
15	505180	2" DIA. BLACK RUBBER FOOT	4
16	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW	2
17	610073	3/8-18 NPT NYLON JAM NUT	2
18	860032	3/8 MPT CPVC X 3" LONG NIPPLE	1
19	1890000	INTERIOR CHAMBER SUB-ASSEMBLY	1
20	1890001	1.2CF EXTERIOR CABINET	1
21	1890003	INTERIOR CHAMBER SUPPORT	3
22	1890004	UPPER RIGHT CHAMBER SUPPORT	1
23	1890010	CABINET HEAT BREAK END RETAINER	1
24	1890019	RETURN AIR BLOCK	3
25	1890021	DOOR SWITCH MOUNTING PLATE SUB-ASSEMBLY	1
26	1890029	TOP AND BOTTOM HEAT BREAK RETAINER	2
27	1890030	SIDE HEAT BREAK RETAINER	1
28	1890052	HINGE SHIM	2
29	1890053	SHIPPING BRACKET	1
30	1900179	ALUMINUM HINGE BLOCK	1
30	1890032	0.6CF INTERIOR CHAMBER SUB-ASSEMBLY	1
31	1890033	0.6CF EXTERIOR CABINET	1
32	1890037	0.6CF RETURN AIR BLOCK	2
33	1890039	0.6CF TOP AND BOTTOM HEAT BREAK RETAINER	2
34	180225	0.6CF CRF CABINET HEAT BREAK FRAME	1
35	1890041	1.7CF INTERIOR CHAMBER SUB-ASSEMBLY	1
36	1890042	1.7CF EXTERIOR CABINET	1
37	1890046	1.7CF RETURN AIR BLOCK	2
38	1890048	1.7CF TOP AND BOTTOM HEAT BREAK RETAINER	2
39	180227	1.7CF CRF CABINET HEAT BREAK FRAME	1

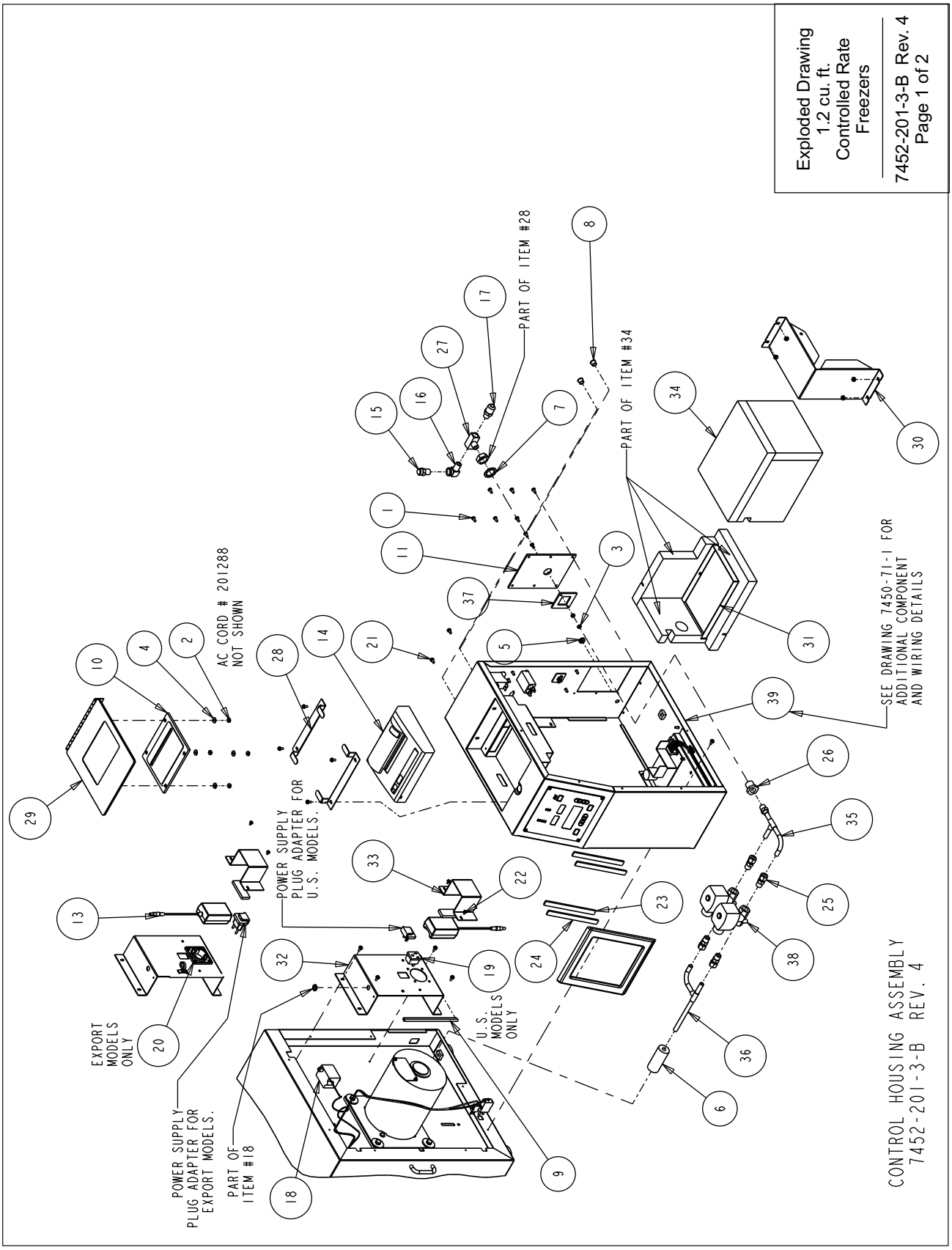
CABINET ASSEMBLY
7452-201-1-B REV. 3
PAGE 2 OF 2


PART OF
ITEM #22
CONNECTS INTERIOR CHAMBER
TO EXTERIOR CABINET
MOUNTS TO RIGHT WALL OF
INTERIOR CHAMBER ABOVE
COIL (FOR T-STAT BULB)
CABINET ASSEMBLY
7452-201-2-B REV. 3
PAGE 1 OF 2
RIGHT END VIEW
SCALE 0.156

BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	20004	1/4-20 X 1 SS HH CAP SCREW	4
2	22002	#4-40 X 1/2 SS PHP SCREW	1
3	22049	#6-32 X 3/8 SS PHP SCREW	2
4	22052	#8-32 X 3/8 SS PHP SCREW	18
5	23002	#8-32 ZP LKWASH HEX NUT	4
6	23005	#4-40 SS HEX NUT	1
7	23021	#8 SS FLAT WASHER	14
8	23059	#8 SS EXT TOOTH LOCKWASHER	2
9	23082	#10 SS SPRING LOCKWASHER	4
10	23084	1/4 SS SPRING LOCKWASHER	4
11	30092	3/16" SHORTY SNAP BUSHING	1
12	100116	10" CW FAN BLADE 40° PITCH	1
13	100117	MOTOR FACE MOUNTING PLATE GASKET	1
14	111002	3/8" PROBE CLIP	1
15	111022	1/4 DIA. BRASS FUSE CLIP	2
16	127075	#8-32 X .813 LONG M-F STANDOFF	1
17	137017	945 WATT 115V TUBULAR HEATER	1
18	156123	1/4 HP BLOWER MOTOR 1725 RPM	1
19	180217	INJECT LINE COLLAR	1
20	195715	FAN BLADE/MOTOR HUB	1
21	290170	CRF T-TYPE CHAMBER PROBE	1
22	290171	CRF T-TYPE EXTENSION CABLE	1
23	370248	THERMOCOUPLE PLUG TYPE T	1
24	430240	FLAT BRAID GROUND STRAP	1
25	510033	#10-32 X 3/8 SS HH MACH. SCREW	4
26	515084	1/4 DIA. X 3/8L SS SPACER	4
27	700036	1/4-28 X 3/8 LG S.S. HEX SOCKET SET SCREW	2
28	730059	11 GA. SS 2B FLAT WASHER	4
29	730071	.450 ID TEFLON FLAT WASHER	1
30	1890004	UPPER RIGHT CHAMBER SUPPORT	1
31	1890008	SAMPLE PROBE CONNECTOR MOUNT	1
32	1890009	SHAFT SEAL PLATE	1
33	1890012	MOTOR MOUNTING PLATE	1
34	1890040	LN2 INJECT COIL SUB-ASSEMBLY	1
34	137018	945 WATT 230V TUBULAR HEATER (EXPORT ONLY)	1

CABINET ASSEMBLY
7452-201-2-B REV. 3

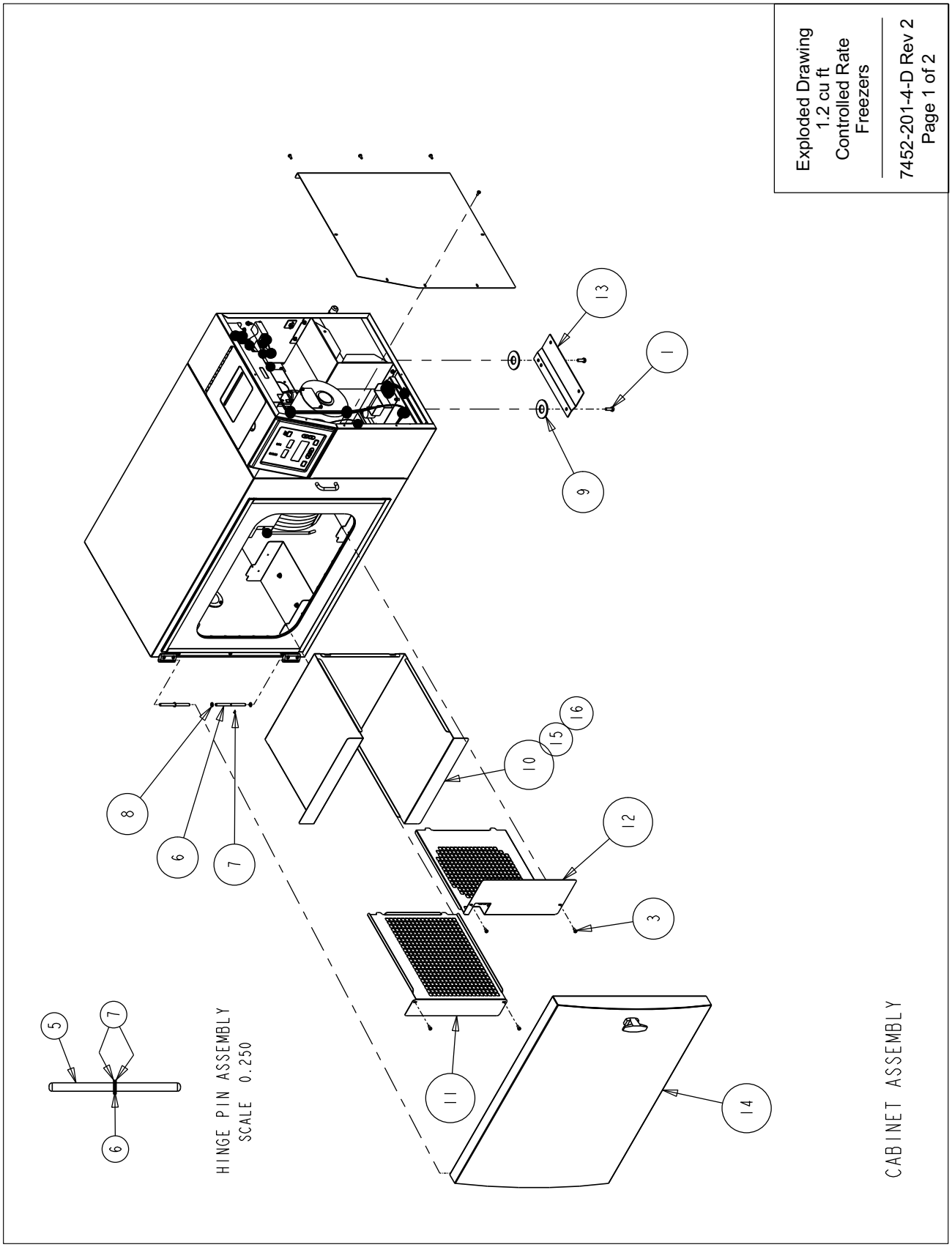
PAGE 2 OF 2


Exploded Drawing
1.2 cu. ft.
Controlled Rate
Freezers
7452-201-3-B Rev. 4
Page 1 of 2
CONTROL HOUSING ASSEMBLY
7452-201-3-B REV. 4
AC CORD # 201288
NOT SHOWN
POWER SUPPLY
PLUG ADAPTER FOR
U.S. MODELS.
POWER SUPPLY
PLUG ADAPTER FOR
EXPORT MODELS.
EXPORT
MODELS
ONLY
U.S.
MODELS
ONLY
PART OF
ITEM #18
PART OF ITEM #28
PART OF ITEM #34
SEE DRAWING 7450-71-1 FOR
ADDITIONAL COMPONENT
AND WIRING DETAILS

BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	22052	#8-32 X 3/8 SS PHP SCREW	16
2	23002	#8-32 ZP LKWASH HEX NUT	8
3	23010	#8-32 SS HEX NUT	2
4	23021	#8 SS FLAT WASHER	4
5	30004	3/8" X 1/4" ID GROMMET	1
6	35021	3/8" ID X 3/8" WALL ARMAFLEX TUBE	1
7	73135	3/4 SS INT TOOTH LOCK WASHER	1
8	117018	7/16" DIA. BLACK HOLE PLUG	2
9	123020	NYLON EDGE PROTECTOR	2
10	180216	PRINTER WINDOW/PAPER CUTTER	1
11	180230	BULKHEAD HEATBREAK	1
12	201303	-	3
13	201303	PRINTER POWER SUPPLY W/PLUGS	1
14	201306	THERMAL DATA PRINTER	1
15	251008	1/4 MPT 60 PSI RELIEF VALVE	1
16	380181	1/4 X 90 BRASS STREET ELBOW	1
17	380260	1/2 FLARE X 1/4 MPT CONNECTOR	1
18	400148	200F MANUAL RESET T-STAT	1
19	460024	SNAP-IN OUTLET, WHITE	1
20	460203	250V 16AMP SCHUKO RECEPTACLE	1
21	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW	10
22	590027	#6-32 X 1/4 SS PHP EXT SEMS SCREW	8
23	640037	DUAL LOCK FASTENER TYPE 400	2
24	640038	DUAL LOCK FASTENER TYPE 170	2
25	790008	3/8 COMP X 1/4 MPT BRASS CONNECTOR	4
26	800031	1/4 FPT ANCHOR COUPLING	1
27	800032	1/4 PIPE MALE BRANCH TEE	1
28	1890014	PRINTER CLAMP	2
29	1890015	PRINTER COVER SUB-ASSEMBLY	1
30	1890022	VALVE BOX BRACKET	1
31	1890023	DRIP PAN SUB-ASSEMBLY	1
32	1890024	COMPONENT MOUNTING BRACKET	2
33	1890025	DOMESTIC POWER SUPPLY HOLD-DOWN	2
34	1890031	PLUMBING INSULATION SUB-ASSEMBLY	1
35	1890049	LN2 INLET PLUMBING SUB-ASSEMBLY	1
36	1890050	LN2 OUTLET PLUMBING SUB-ASSEMBLY	1
37	1890054	BULKHEAD RETAINING PLATE	1
38	4000617	120V BRASS SOLENOID VALVE	2
39		CONTROL HOUSING ASSEMBLY	1
44	201186	100V 50/60HZ PRINTER POWER SUPPLY (JAPAN ONLY)	1
45	4000618	220V BRASS SOLENOID VALVE (EXPORT ONLY)	2

Exploded Drawing
1.2 cu. ft.
Controlled Rate
Freezers

7452-201-3-B Rev. 4
Page 2 of 2


Exploded Drawing
1.2 cu ft
Controlled Rate
Freezers
7452-201-4-D Rev 2
Page 1 of 2
HINGE PIN ASSEMBLY
SCALE 0.250
CABINET ASSEMBLY
1
3
5
6
7
8
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10
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12
13
14
15
16

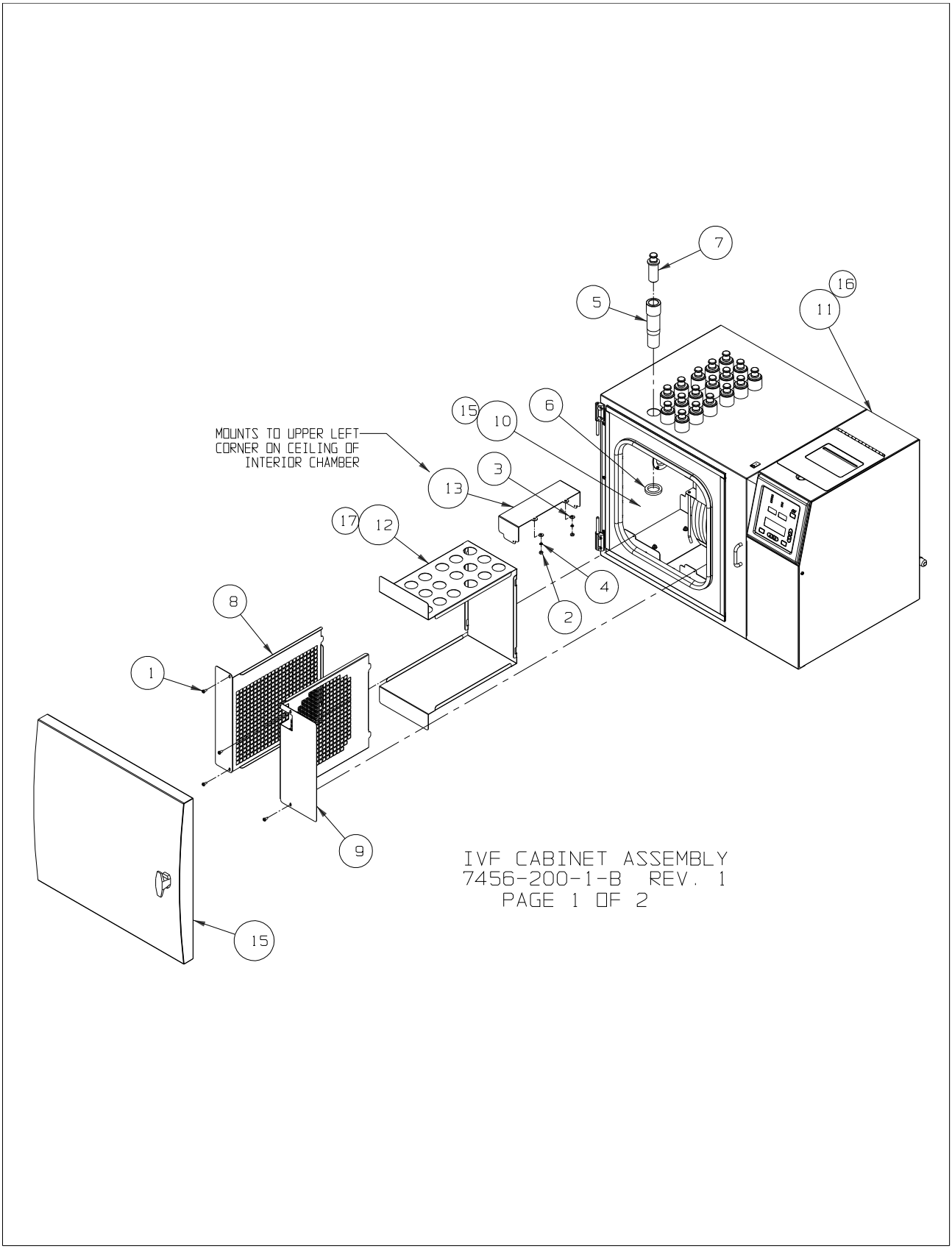
BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	20017	1/4-20 X 3/4 ZP HH CAP SCREW	2
2	22049	#6-32 X 3/8 SS PHP SCREW	2
3	22052	#8-32 X 3/8 SS PHP SCREW	8
4	23001	#6-32 ZP LKWASH HEX NUT	4
5	180228	CRF CONTROL PANEL BEZEL	1
6	190611	STAINLESS STEEL HINGE PIN	2
7	650012	.250 DIA. EXTERNAL RETAINING RING	2
8	730036	.247 ID TEFLON FLAT WASHER	4
9	730063	FLAT WASHER SHIM	2
10	1890005	INTERIOR DUCT WRAP	1
11	1890006	INTERIOR LEFT SIDE GRILLE	1
12	1890007	INTERIOR RIGHT SIDE GRILLE	1
13	1890053	SHIPPING BRACKET	1
14		DOOR ASSEMBLY	1
15	1890016-31-1	SIDE ACCESS PANEL	1
15	1890035	0.6CF INTERIOR DUCT WRAP	1
16	1890044	1.7CF INTERIOR DUCT WRAP	1

NOT SHOWN:

130059	STANDARD AMPULE STOPPER (2)
130060	STRAW STOPPER (2)
430326	CORDSET, 13A/125V, 16/3, USA (DOMESTIC MODELS)
430109	CORDSET, 10A/250V, EUROPEAN (EXPORT MODELS)
290200	2ML SAMPLE THERMOCOUPLE SENSOR
4000401	6 FT. TRANSFER HOSE
4000566	THERMAL PRINTER PAPER (5 ROLLS)
7007452	CONTROLLED RATE FREEZER MANUAL
	THERMAL PRINTER MANUAL

Exploded Drawing
1.2 cu ft
Controlled Rate
Freezers

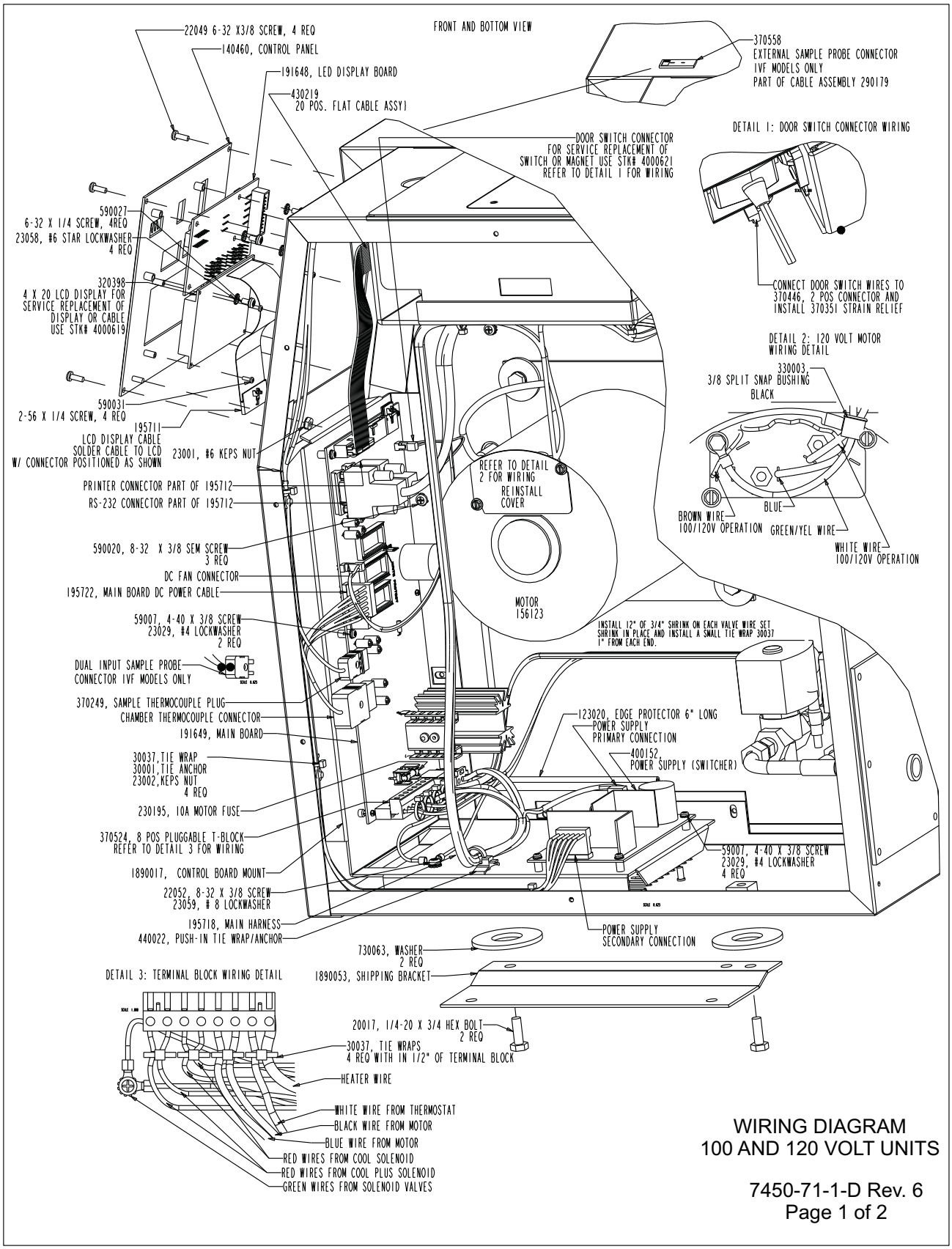
7452-201-4-D Rev 2
Page 2 of 2


7
5
16
11
15
10
6
MOUNTS TO UPPER LEFT
CORNER ON CEILING OF
INTERIOR CHAMBER
3
13
17
12
4
2
8
1
9
15
IVF CABINET ASSEMBLY
7456-200-1-B REV. 1
PAGE 1 OF 2

BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	22052	#8-32 X 3/8 SS PHP SCREW	4
2	23010	#8-32 SS HEX NUT	2
3	23021	#8 SS FLAT WASHER	2
4	23080	#8 SS SPRING LOCKWASHER	2
5	180250	HOLDER SLEEVE	18
6	180251	SLEEVE RETAINING NUT	18
7	180255	SLEEVE PLUG	18
8	1890006	INTERIOR LEFT SIDE GRILLE	1
9	1890007	INTERIOR RIGHT SIDE GRILLE	1
10	1890055	INTERIOR CHAMBER SUB-ASSEMBLY	1
11	1890056	0.6CF IVF EXTERIOR CABINET	1
12	1890057	INTERIOR DUCT WRAP	1
13	1890058	INTERIOR CHAMBER SUPPORT	1
14	1900179	ALUMINUM HINGE BLOCK	1
15		DOOR ASSEMBLY	1
16	1890004_BENT	UPPER RIGHT CHAMBER SUPPORT	1
15	1890059	1.2CF INTERIOR CHAMBER SUB-ASSEMBLY	1
16	1890060	1.2CF IVF EXTERIOR CABINET	1
17	1890061	1.2CF INTERIOR DUCT WRAP	1

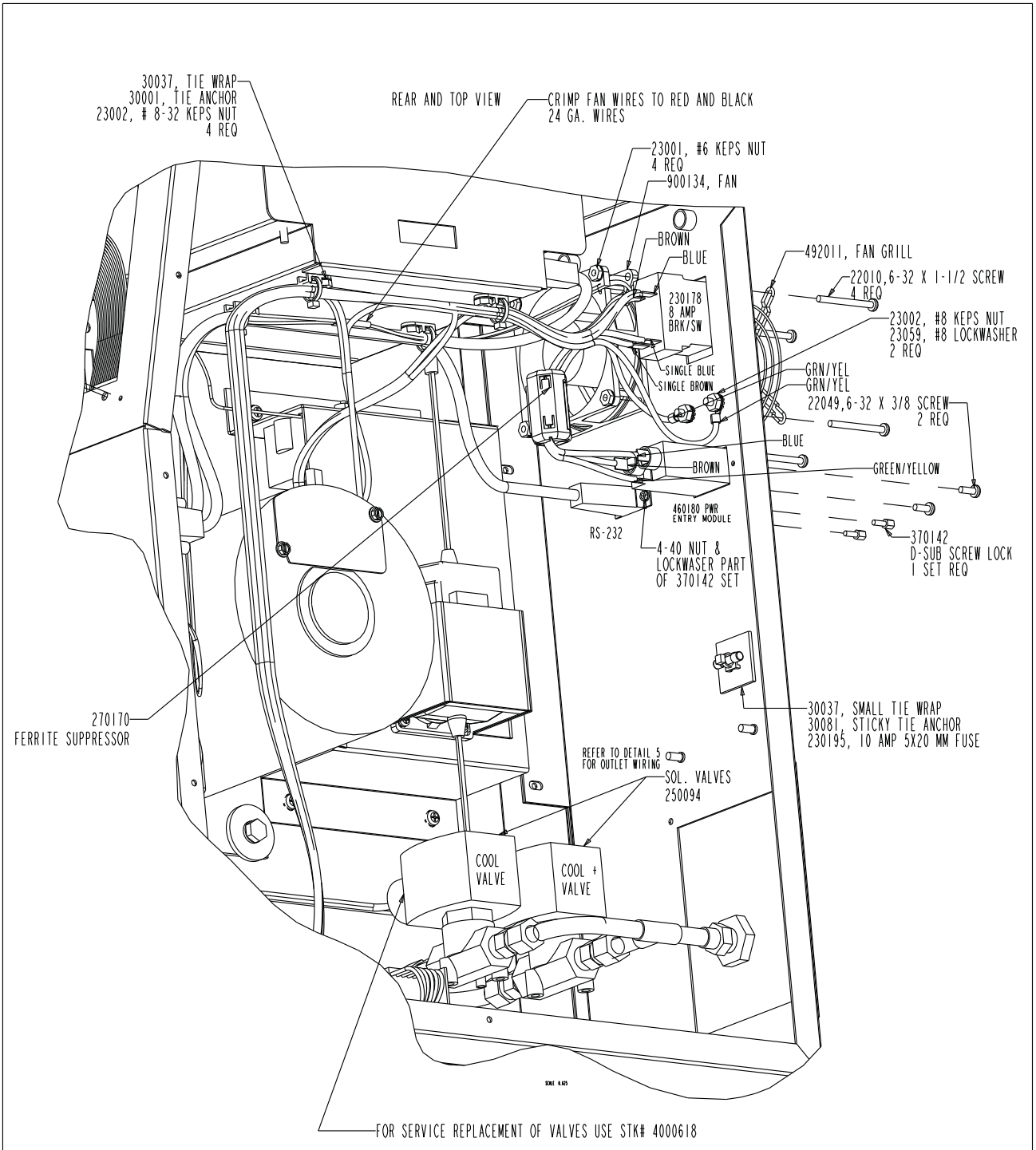
NOTE: QUANTITY IS (30) FOR 1.2CF UNIT

IVF CABINET ASSEMBLY
7456-200-1-B REV. 1
PAGE 2 OF 2



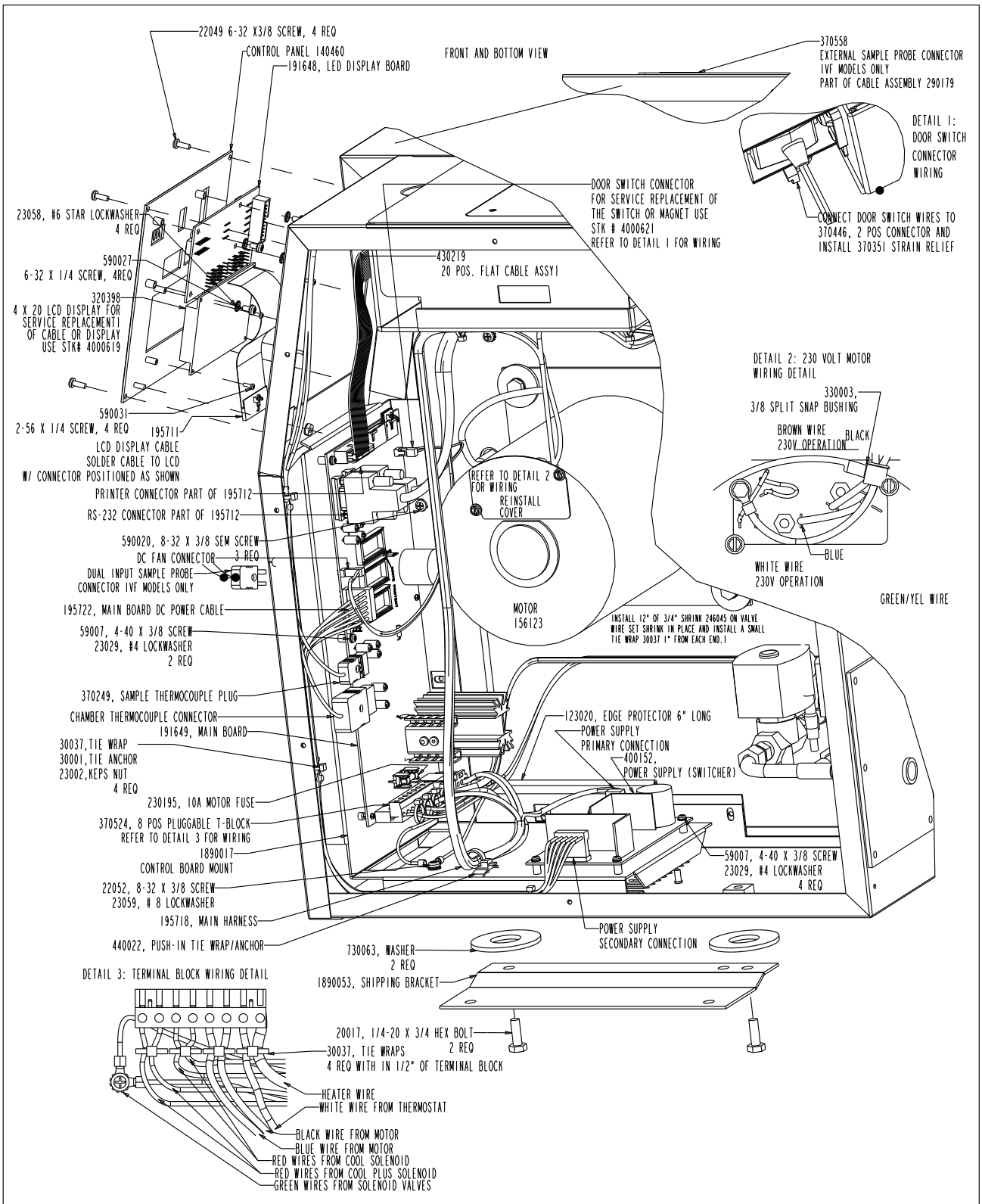
WIRING DIAGRAM
100 AND 120 VOLT UNITS

7450-71-1-D Rev. 6
Page 1 of 2



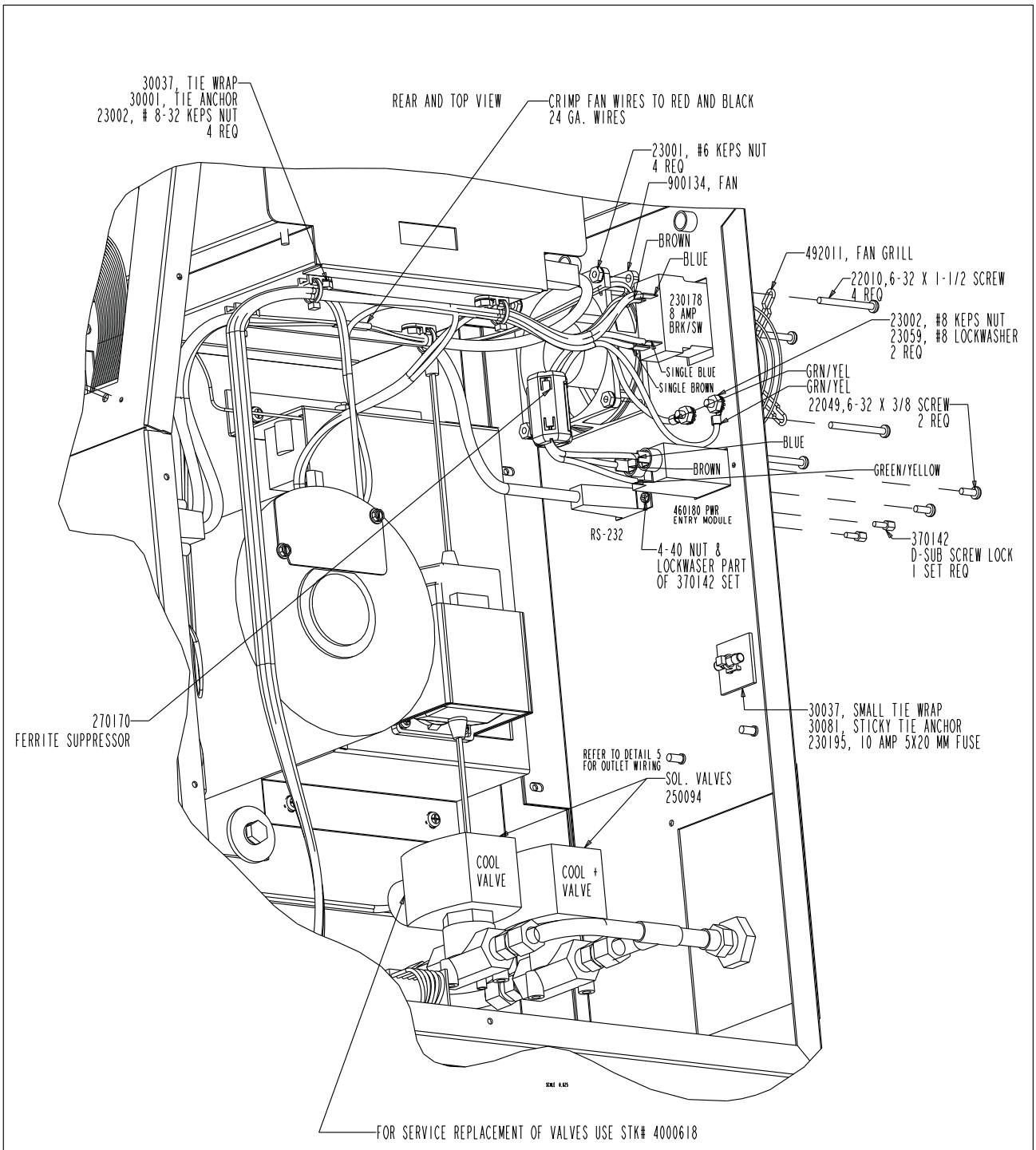
WIRING DIAGRAM
230 VOLT EXPORT

7451-71-1-D
PAGE 2 OF 2



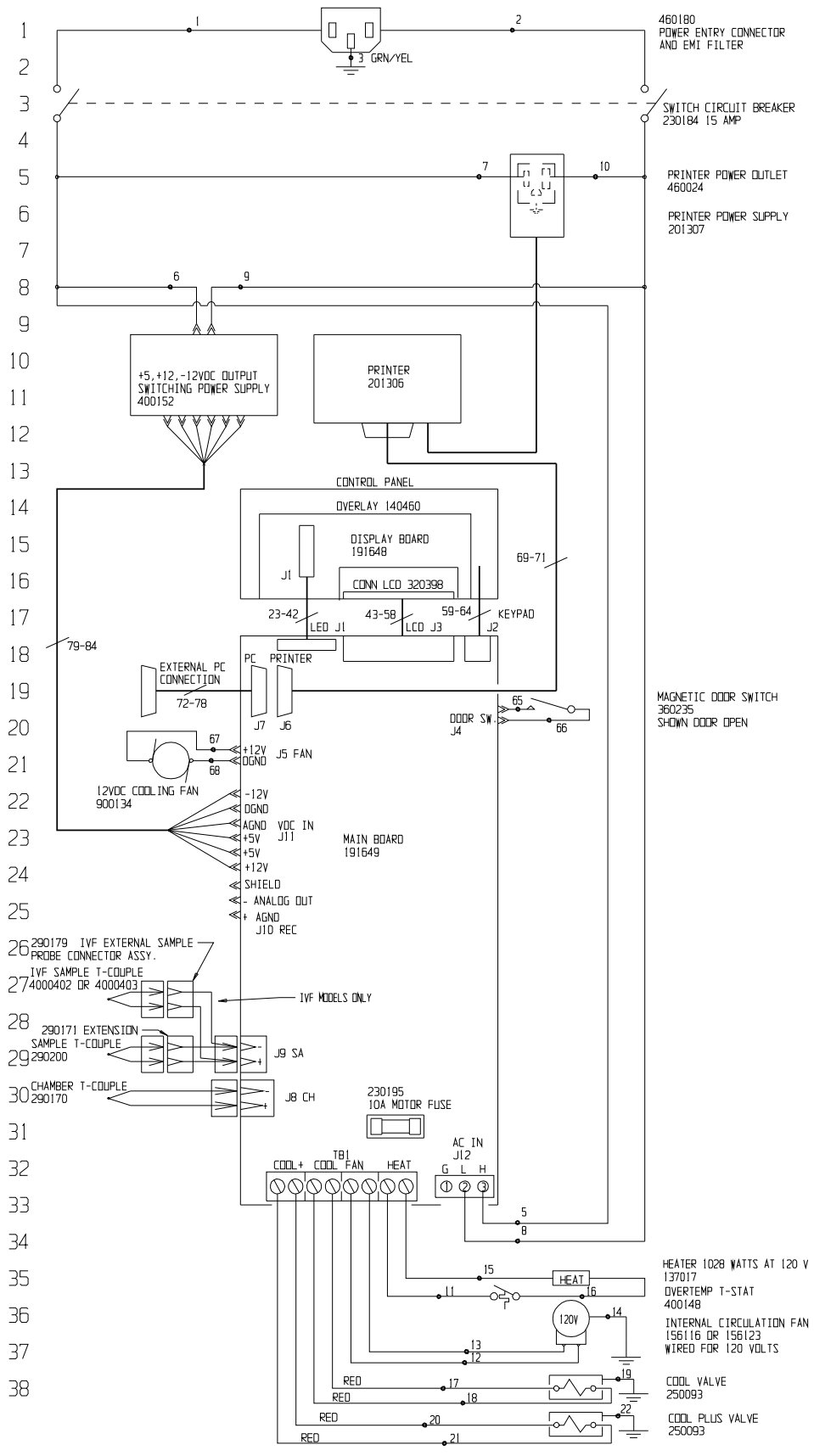
WIRING DIAGRAM
230 VOLT EXPORT

7451-71-1-D
PAGE 1 OF 2



WIRING DIAGRAM
230 VOLT EXPORT

7451-71-1-D
PAGE 2 OF 2



Electrical Schematic
Models:
7450, 7452, 7454,
7456 and 7458
Control Rate Freezer

7450-70-1-D REV.11
Page 1 of 2

EXTERNAL P.C. CONNECTION

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 TRANSMIT DATA
PIN 3 RECEIVE DATA
PIN 5 SIGNAL GROUND

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR	WIRE #	GAUGE	COLOR
1	16	BROWN	65	22	WHITE
2	16	BLUE	66	22	WHITE
3	16	GRN/YEL	67	22	RED
4			68	22	BLACK
5	16	BROWN	69	24	BLACK
6	18	BROWN	70	24	WHITE
7	16	BROWN	71	24	RED
8	16	BLUE	72	24	BLACK
9	18	BLUE	73	24	RED
10	16	BLUE	74	24	GREEN
11	16	WHITE	75	24	BROWN
12	16	BLUE	76	24	BLUE
13	16	BLACK	77	24	ORANGE
14	16	GRN/YEL	78	24	YELLOW
15	16	BLACK	79	18	ORANGE
16	16	BLACK	80	18	RED
17	18	RED	81	18	RED
18	18	RED	82	18	BLACK
19	18	GRN/YEL	83	18	BLACK
20	18	RED	84	18	BROWN
21	18	RED			
22	18	GRN/YEL			
23-42	28	RIBBON CABLE			
43-58	28	RIBBON CABLE			
59-64	28	RIBBON CABLE			

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
11	FR-2674	07-22-14	MAM	KDG	CCS	CHANGED 140296 TO 140460, ROHS
10	FR-2371	06-08-12	GSW	SAG	MSB	CHANGED PRINTER POWER SUPPLY
9	FR-2371	06-08-12	GSW	SAG	MSB	DEL. FLT REC. OUT, WIRE # CORRECT.
8	FR-2357	04-27-12	DRP	KDG	DRP	CORRECTED PRINTER POWER SUPPLY
7	SI-10486	09-15-11	GSW	SAG	DRP	201306 WAS 201183
6	SI-10817	8-31-11	MLS	MLS	DRP	REVISED PER ECR# 26310
5	FR-1582	03-08-02	RTT	PDK	LDN	ADD IVF PROBE CONNECTIONS
4	FR-1592	2/21/02	RTT	PDK	LDN	ADDED MOTOR FUSE TO DRAWING
3	SI-8280	6/19/01	RTT	RTT	BH	CHANGED WATTAGE FROM 1000
2	FR-1499	5/9/01	RTT	RTT	BH	ADD MOTOR 156123, REV J5 & J10 PLACE
1	FR-1497	3/19/01	RTT	RTT	RTT	REV. POWER CONNECTION, P. S. STK #

ATTENTION
OBSERVE PRECAUTIONS
ELECTROSTATIC
SENSITIVE DEVICES

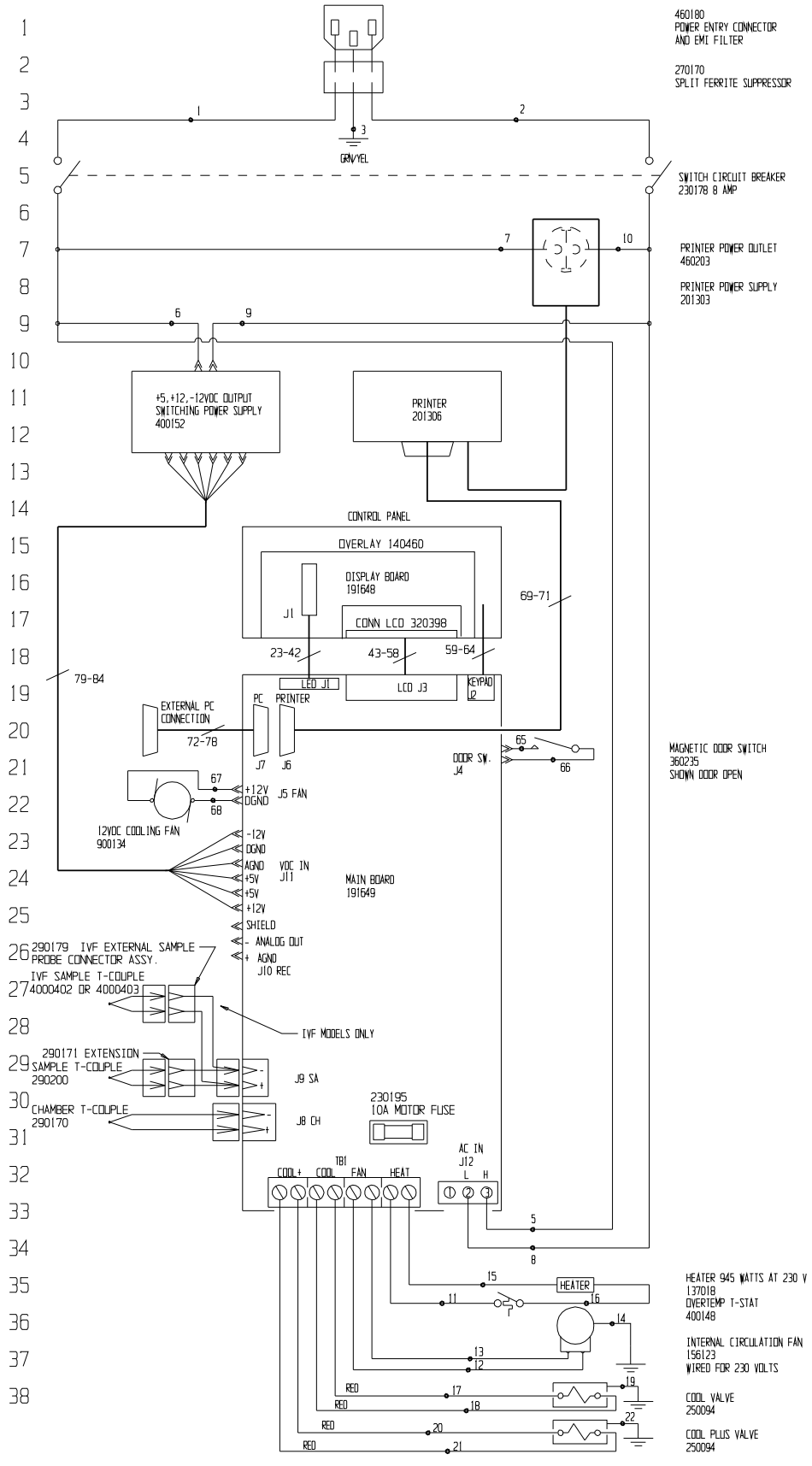
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ThermoFisher SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: CONT. RATE FREEZER 7450, 52, 54, 56 & 58
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: RTT | CAD: RTT | APPD: BH | DATE: 10/6/00 | SCALE: NONE
MATERIAL:
PAINT COLOR:
DRAWING NUMBER 7450-70-1 | SIZE D

Electrical Schematic
Models:
7450, 7452, 7454,
7456 and 7458
Control Rate Freezer

7450-70-1-D REV.11
Page 2 of 2



Electrical Schematic
Models:
7451, 7453, 7455,
7457 and 7459
Control Rate Freezer

7451-70-1-D REV. 8
Page 1 of 2

EXTERNAL P.C. CONNECTION

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 TRANSMIT DATA
PIN 3 RECEIVE DATA
PIN 5 SIGNAL GROUND

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR	WIRE #	GAUGE	COLOR
1	16	BROWN	65	22	WHITE
2	16	BLUE	66	22	WHITE
3	16	GRN/YEL	67	22	RED
4			68	22	BLACK
5	16	BROWN	69	24	BLACK
6	18	BROWN	70	24	WHITE
7	16	BROWN	71	24	RED
8	16	BLUE	72	24	BLACK
9	18	BLUE	73	24	RED
10	16	BLUE	74	24	GREEN
11	16	WHITE	75	24	BROWN
12	16	BLUE	76	24	BLUE
13	16	BLACK	77	24	ORANGE
14	16	GRN/YEL	78	24	YELLOW
15	16	BLACK	79	18	ORANGE
16	16	BLACK	80	18	RED
17	18	RED	81	18	RED
18	18	RED	82	18	BLACK
19	18	GRN/YEL	83	18	BLACK
20	18	RED	84	18	BROWN
21	18	RED			
22	18	GRN/YEL			
23-42	28	RIBBON CABLE			
43-58	28	RIBBON CABLE			
59-64	28	RIBBON CABLE			

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
8	FR-2674	07-22-14	MAM	KDG	CCS	CHANGED 140296 TO 140460, ROHS
7	FR-2371	7-25-12	GSW	KDG	MSB	ADDED 270170 SPLIT FERRITE SUPPRESSOR
6	FR-2371	6-11-12	GSW	KDG	DRP	DEL. FLATBED RECORDER OUTPUT
5	FR-2357	04-27-12	DRP	KDG	DRP	CORRECTED PRINTER POWER SUPPLY
4	SI-10486	09-15-11	GSW	SAG	DRP	201306 WAS 201183
3	SI-10817	8-31-11	MLS	MLS	DRP	REVISED PER ECR# 26310
2	FR-1582	03-08-02	RTT	PDK	LDN	ADD IVF PROBE CONNECTIONS
1	SI-8280	6/19/01	RTT	RTT	BH	CHANGED WATTAGE FROM 1000
0	N/A	5/29/01	RTT	RTT	BH	RELEASED FOR PRODUCTION

ATTENTION
OBSERVE PRECAUTIONS
ELECTROSTATIC
SENSITIVE DEVICES

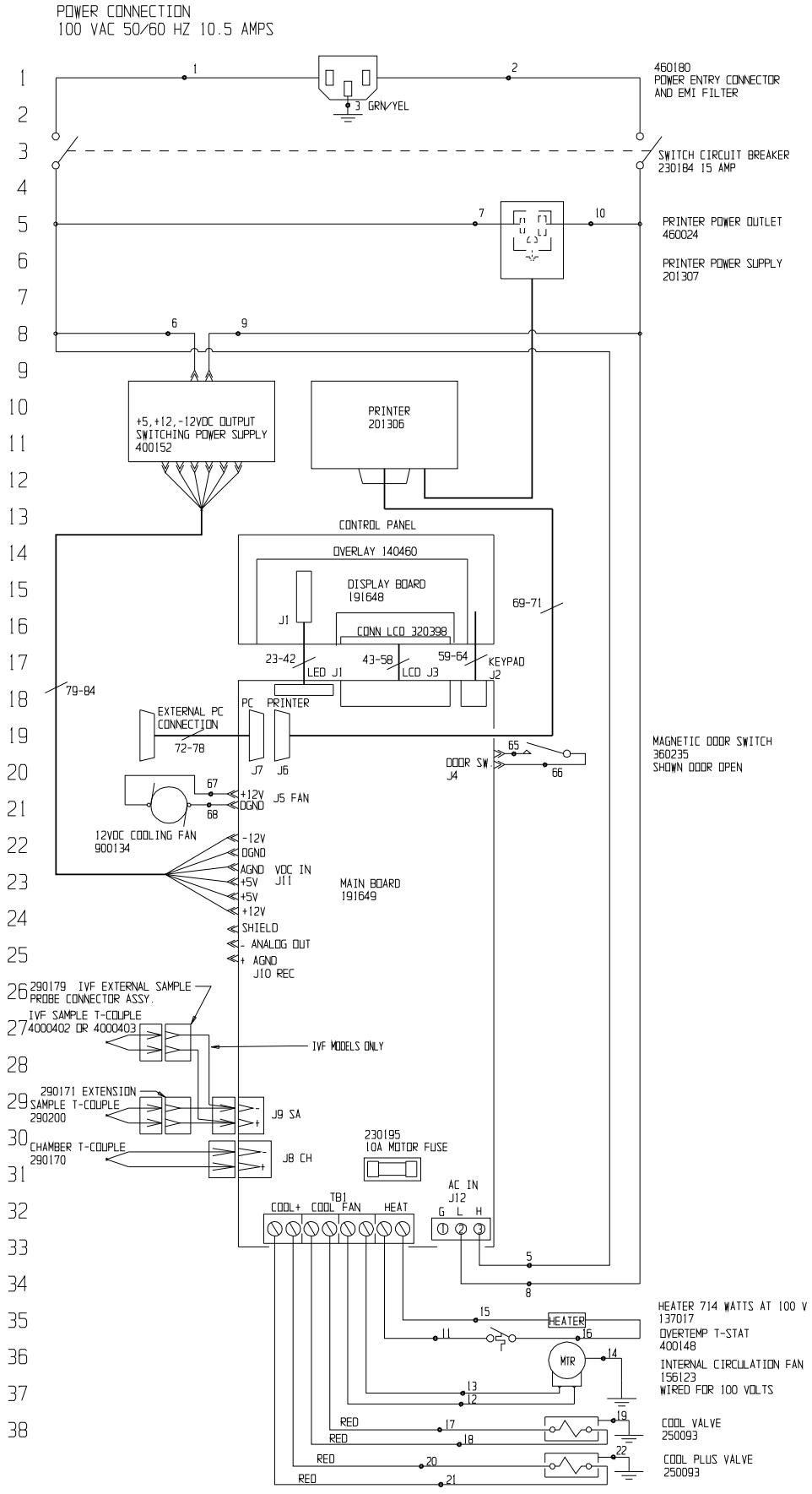
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Thermo Fisher SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: CONT. RATE FREEZER 7451,53,55,57 & 59
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: RTT | CAD: RTT | APPD: BH | DATE: 01/02/01 | SCALE: NONE
MATERIAL:
PAINT COLOR:
DRAWING NUMBER 7451-70-1 | SIZE D

Electrical Schematic
Models:
7451, 7453, 7455,
7457 and 7459
Control Rate Freezer

7451-70-1-D REV. 8
Page 2 of 2



Electrical Schematic
Model:
7472, 7473, 7474,
7475 and 7476
Control Rate Freezer

7472-70-1-D REV. 8
Page 1 of 2

EXTERNAL P.C. CONNECTION

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 TRANSMIT DATA
PIN 3 RECEIVE DATA
PIN 5 SIGNAL GROUND

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR	WIRE #	GAUGE	COLOR
1	16	BROWN	65	22	WHITE
2	16	BLUE	66	22	WHITE
3	16	GRN/YEL	67	22	RED
4			68	22	BLACK
5	16	BROWN	69	24	BLACK
6	18	BROWN	70	24	WHITE
7	16	BROWN	71	24	RED
8	16	BLUE	72	24	BLACK
9	18	BLUE	73	24	RED
10	16	BLUE	74	24	GREEN
11	16	WHITE	75	24	BROWN
12	16	BLUE	76	24	BLUE
13	16	BLACK	77	24	ORANGE
14	16	GRN/YEL	78	24	YELLOW
15	16	BLACK	79	18	ORANGE
16	16	BLACK	80	18	RED
17	18	RED	81	18	RED
18	18	RED	82	18	BLACK
19	18	GRN/YEL	83	18	BLACK
20	18	RED	84	18	BROWN
21	18	RED			
22	18	GRN/YEL			
23-42	28	RIBBON CABLE			
43-58	28	RIBBON CABLE			
59-64	28	RIBBON CABLE			

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
8	FR-2674	07-22-14	MAM	KDG	CCS	CHANGED 140296 TO 140460, ROHS
7	FR-2371	06-12-12	GSW	SAG	MSB	DEL. FLATBED REC. OUT, CORR. WIRE #'S
6	FR-2371	06-08-12	GSW	SAG	MSB	CHANGED PRINTER POWER SUPPLY
5	FR-2357	04-27-12	DRP	KDG	DRP	CORRECTED PRINTER POWER SUPPLY
4	SI-10486	09-15-11	GSW	SAG	DRP	201306 WAS 201183
3	SI-10817	8-31-11	MLS	MLS	DRP	REVISED PER ECR# 26310
2	FR-1582	03-08-02	RTT	PDK	LDN	ADD IVF PROBE CONNECTIONS
1	SI-8280	6/19/01	RTT	RTT	BH	CHANGED WATTAGE FROM 1000
0	N/A	5/29/01	RTT	RTT	BH	RELEASED FOR PRODUCTION

ATTENTION
OBSERVE PRECAUTIONS
ELECTROSTATIC
SENSITIVE DEVICES

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ThermoFisher SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: CONT. RATE FREEZER 7472, 73, 74, 75 & 76
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: RTT | CAD: RTT | APPD: BH | DATE: 5/29/01 | SCALE: NONE
MATERIAL:
PAINT COLOR:
DRAWING NUMBER 7472-70-1 | SIZE D

Electrical Schematic
Model:
7472, 7473, 7474,
7475 and 7476
Control Rate Freezer

7472-70-1-D REV. 8
Page 2 of 2

Troubleshooting Guide

Symptom	Possible Cause	Verification	Solution
LED's and displays not lighted	1). Power at AC outlet	1). Measure less than 90/207VAC at outlet?	1). Correct problem
	2). Power cord	2). Measure less than 90/207VAC at AC inlet?	2). Replace power cord
	3). Circuit Breaker	3). Measure less than 90/207VAC at power supply input	3). Replace circuit breaker
	4). Power supply	4). DC outputs (5/12/-12VDC) not present when power harness disconnected from controller board?	4). Replace power supply
	5). Control Board	5). DC outputs (5/12/-12VDC) not present when power harness connected to controller board?	5). Replace controller board (may also be power supply).
No Power-up "Splash" screen	1). LCD display contrast	1). If temperature displays and LED's appear normal, verify adjustment of R8 LCD contrast	1). Adjust R8 for optimum contrast.
	2). Power supply	2). If +5V DC less than 4.75V when power harness connected to controller board?	2). Replace power supply (may be controller board if components seem hot to the touch)
	3). LCD display	3). LED's and temperature display appear normal and Pre-set profile #1 starts when the Run key is pressed.	3). Replace LCD display (may also be controller board)
	4). Controller board	4). Multiple LED's lit (Idle/Run/Warm) and/or unchanging misc. numbers in temperature displays.	4). Replace controller board
Heater Error Alarm	1). Heater Thermal Cutout	1). Check thermal cutout.	1). Reset thermal cutout
		1a). Examine Error Logs for "Chamber over limit temperature" and/or sensor failure alarms. If none:	1a). Replace thermal cutout
	1b). Controller board	1b). If over limit or sensor failure logs present, measure heater voltage on/off in manual mode. If on but no off:	1b). Replace controller board
	2). Heater	2). Measure more than 90/207VAC across heater in manual mode with heater on and no chamber temperature rise:	2). Replace heater

Troubleshooting Guide

Symptom	Possible Cause	Verification	Solution
Check LN_2 Supply Alarm	1). LN_2 supply tank empty	1). Verify supply tank contents adequate?	1). Replace/fill tank
	2). LN_2 supply pressure too low	2). Verify tank pressure (regulator: 22# nominal)	2). Replace tank/regulator
	3). LN_2 supply hose too long	3). 4'/6' flex line to tank or vacuum insulated plumbing?	3). Replace/upgrade hose/plumbing.
	4). LN_2 solenoids bad	4). Check solenoid operation (sound & gas flow) in manual mode and chamber temperature drop. If more than 90/207VAC across solenoids and no sound or temperature drop:	4). Replace solenoids
	5). Controller board bad	5). If less than 90/207VAC across solenoid (and AC supply is adequate):	5). Replace controller board
Fan will not run	1). Fuse on controller board	1). Check fuse/value	1). Replace fuse
		1a). Check for unobstructed rotation of fan	1a). Move/adjust to eliminate obstruction.
		1b). Check for free rotation of motor shaft.	1b). Replace motor
		1c). Check for excessive motor current vs. name plate. 120/230VAC strapping incorrect? If not:	1c). Correct 120/230VAC strapping.
		1d). Check for excessive motor current and 120/230VAC strapping correct?	1d). Replace motor
	2). Thermal cut-out in motor (motor overheating)	2). Check if less than 90/207VAC across motor in manual mode with fan on.	2). Correct AC supply problem
		2a). 120/230VAC strapping in motor vs. AC supply	2a). Correct motor strapping
	3). Controller board	3). Measure more than 90/207VAC across motor in manual mode with motor on. If not:	3). Replace controller board

Troubleshooting Guide

Symptom	Possible Cause	Verification	Solution
No temperature display (other displays normal)	1). Chamber under/over limit temperature	1). Display showing "+ _ _" or "-_ _" and chamber appears to be beyond normal temperatures. Confirm voltage on heater or solenoids (120/230VAC) can be turned on/off by controller in manual mode. If not:	1). Replace controller board
		1a). If solenoid voltage turned on/off in manual mode but chamber still cold/cooling, confirm solenoid valves stopping flow of LN2. If not:	1a). Replace solenoid valves
	2). Power supply	2). Verify 12/-12VDC at controller board power connector. If not:	2). Replace power supply (may also be controller board)
	3). Display Board	3). Confirm controller regulates at 25C by pressing Warm key.	3). Replace display board (may also be controller board)
	4). Controller board	4). If controller overshoots 25C in Warm mode or won't initiate Warm mode:	4). Replace controller board
"ILL" on temperature display	1). Chamber or Sample probe, connector screw, connector.	1). Measure resistance between pins on probe harness in sidecar for Chamber or Sample. If more than a few ohms:	1). Tighten connector screws, replace probe, harness or connector.
	2). Power supply	2). Verify 5/12/-12VDC at controller board power connector. If not:	2). Replace power supply
	3). Controller board	3). Short thermocouple inputs on controller board with jumper wire or bent paper clip. If "ILL" display still present:	3). Replace controller board
Will not run selected profile	1). Chamber/Sample probe	1). "ILL" on Chamber or Sample temperature 1a). Confirm profile does not use Sample temperature	1). See "ILL" troubleshooting 1a). Remove sample temperature from profile or add sample probe.
	2). Door open/ajar	2). Confirm door is fully closed/latched (Run lit but no fan)	2). Close/latch door
	3). Door switch	3). Confirm resistance of door switch with door closed is less than 10 ohms. If not:	3). Replace door switch and/or magnet
	4). Controller board	4). Run Test and Software Checksum tests in Configuration/Calibration–Service menu. If failures presented:	4). Replace controller board

Troubleshooting Guide

Symptom	Possible Cause	Verification	Solution
No printer output	1). Printer not "on line"	1). Confirm green Online light lighted on printer	1). Press Online button on printer
		1a). Offline light flashing. Check paper.	1a). Replace thermal paper
		1b). Online and Offline lights lighted on printer. Check for paper jam. Do test print (power up while holding feed button).	1b). Clear jam or replace printer
	2). Printer menu setup	2). Check Configuration/Calibration – Printer menu, set for "Off"?	2). Select Chamber, Sample or Scan
	3). Printer power	3). Check "power" LED on front of printer. Confirm power switch on left side of printer is on.	3). Turn power switch on (toward rear of machine)
		3a). Check voltage at printer power connector (6.17-6.83 or 6.65-7.35 VDC per power supply nameplate).	3a). Remove side access panel and check that the printer power supply is fully inserted into the printer power outlet.
	4). Internal printer setup	3b) Measure voltage at printer power outlet to be within 100-240VAC range.	
	5). Printer harness	3c) Repair wiring to printer power outlet or replace printer power supply.	
	6). Controller board	4). Confirm printer DIP SW-1, -2, and -3 correct (power up while holding Online button).	4). Reset printer DIP switches
Chamber temperature erratic	1). High LN_2 pressure	1). Verify tank pressure (regulator: 22# nominal)	1). Replace tank/regulator
	2). Chamber thermocouple mounting	2). Verify thermocouple head out of mounting tube ¾ inch	2). Adjust thermocouple head position.
	3). Customer adjusted PID parameters	3). Verify correct PID values in Service – Thermal Controller menu	3). Set correct PID values or reset to factory defaults in the Service menu (Make note of probe calibration values prior to reset to factory defaults or re-calibrate probes as necessary)
	4). T/C shorted or incorrectly positioned.	4). Test for short and verify position.	

Section 10 PC Interface Software

The CryoMed Controlled Rate Freezer (CRF) includes the option for PC interface. The PC based software enables the user to create and download freezer profiles. It initiates a profile run, monitors its progress, detects and responds to error conditions. It also enables a user to print a report summary of the run data.

The interface requires one of the following operating systems: Microsoft Windows XP, 7 or 8.

During the time that the freezer is running a PC-initiated profile (Remote Run), the control panel keypad is disabled with the exception of the Silence key.

The PC software communicates with the CRF through the RS-232 serial connection (included with the freezer is a 10' male-female DB9 cable and a USB to Serial Adapter). Data information is routed with a check byte for transmission integrity. The software communicates with the freezer to collect information, such as run data and any alarms.

The Controlled Rate Freezer companion PC software is optimized to work with Windows 7. Using a PC with Windows 7, a PC with software installed can communicate with up to four CRF units. However, our recommendation is to use a dedicated PC for each CRF.

If multiple instances of the software are open and connected to different CRF units through the same PC, it is recommended to minimize the inactive windows or instances of open software not being used. This reduces the load on the CPU and improves the efficiency/productivity of the software.

Installation

A Java Run Time Engine is installed with the PC interface software.

Ensure that both the RS232 extension cable and USB to serial adapter are connected properly between the freezer and the PC. Download and install the USB to serial adapter driver software appropriate for the PC operating system.

Note When using the USB to serial adapter driver software, if installation does not begin when cable is connected to unit, visit cable manufacturer website (cable manufacturer can be found on cable/cable box). ▲

Follow these steps to install and set-up the software on the PC:

1. CD/DVD drive is required to install the PC Interface application.

2. Non-admin users can install the PC interface software. However, admin access rights are required to install the Java Runtime Environment (Java). The interface software will run on Java 1.7.0 and later versions. Figure 10-1 shows the error which will occur if admin rights are assumed but not allowed. Non-admin users who see the Figure 10-1 pop-up, should contact their IT department for software download assistance. While in admin mode, run (download) software as administrator, and continue walking through the following steps.

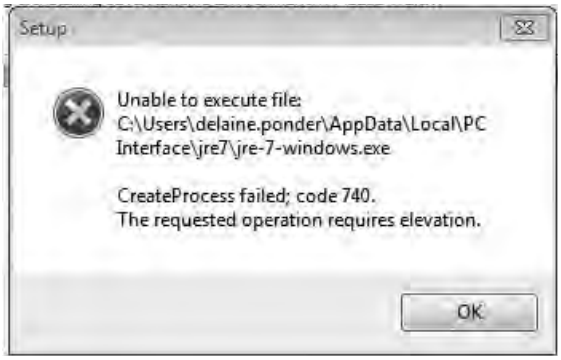


Figure 10-1. Admin Rights Error

3. When the user inserts the CD into the CD/DVD drive, Figure 10-2 will appear. Select 'Open Folder to view files'. Select PC Interface.exe. Your view may vary slightly.

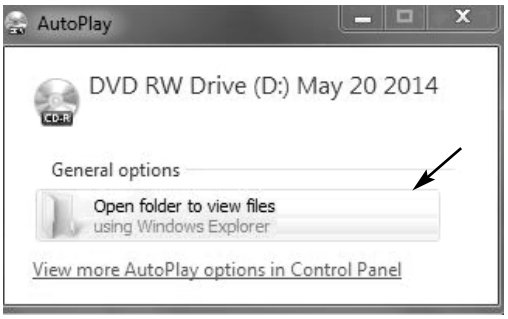


Figure 10-2. Window on CD Insertion

Installation (continued)



Figure 10-3. Next Step

4. The dialog box in Figure 10-3 will appear, select **Next** and continue through the installation screens.

5. A prompt window appears to verify installation location. The default location is indicated in Figure 10-4, or the user can **Browse** to a more desirable location.

6. Make sure you have enough disk space to install the software (Figure 10-4). If not, you will see an error message. Select **Next**.

7. Check the little window if a desktop icon is required. See Figure 10-5. Select **Next**.

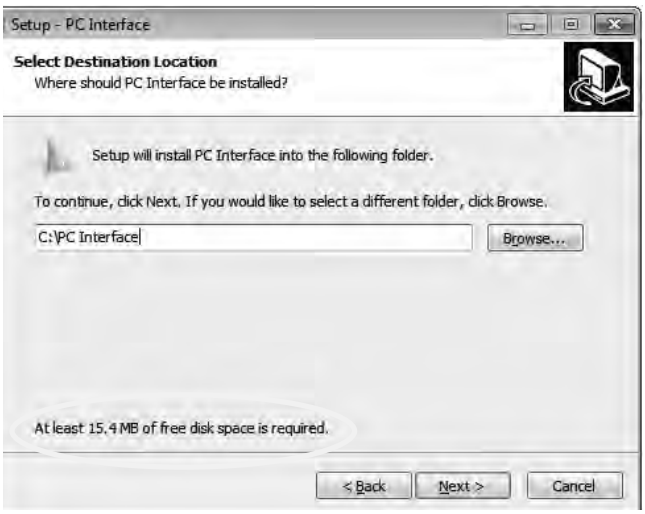


Figure 10-4. Installation Location

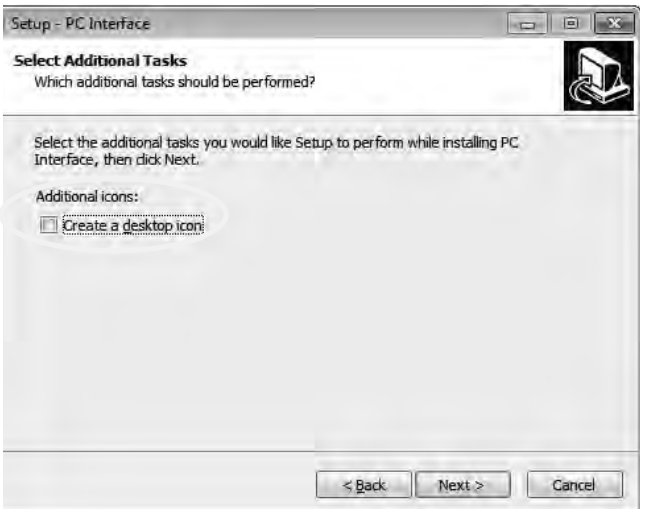


Figure 10-5. Desktop Icon

Installation (continued)

8. Verify the installation set-up as shown in Figure 10-6. Select **Install**.



Figure 10-6. Verify and Install

9. Allow the installation to complete. The next window will open automatically.

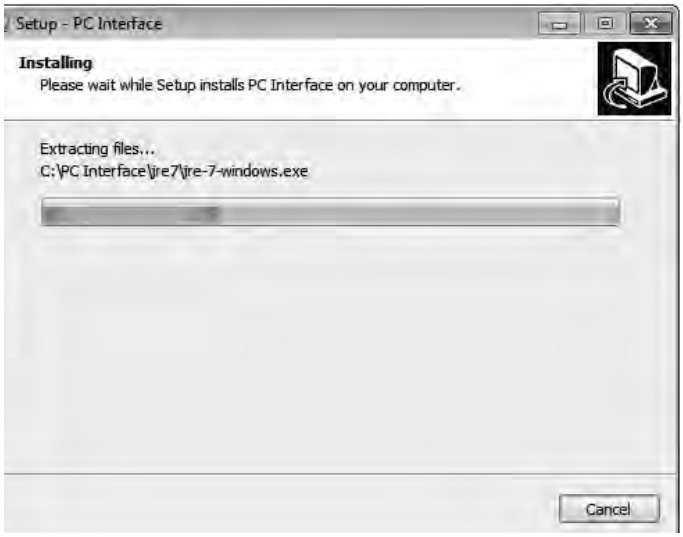


Figure 10-7. Installation Progress

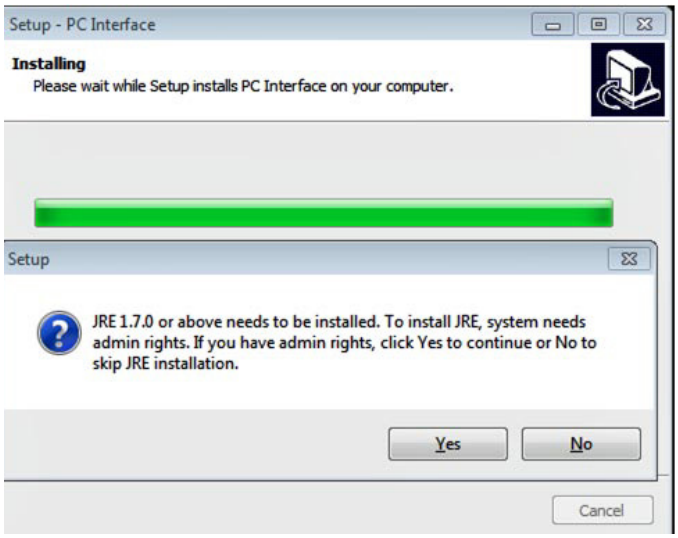


Figure 10-8. Java Installation Choices

10. If Java Runtime Environment is either not installed or is an older version, then the window shown in Figure 10-8 will display. Select **Yes** to install a new or newer version of Java, or **No** to cancel for lack of admin access rights.

Installation (continued)

11. If Yes, the Java installation window displays as shown below. To verify installation location, check the **Change the Destination Folder** box. Then select **Install** to install Java.



Figure 10-9. Java Installation

12. Allow the Java installation process to complete. It may take a few minutes. The next window will open automatically.



Figure 10-10. Java Installation Progress



Figure 10-11. Installation Completion

13. After installation is complete (Figure 10-11), select **Close** to finish.

Installation (continued)

14. To complete the PC software installation, first check the Launch PC Interface window. Then select **Finish**.



Figure 10-12. Completed PC Software Installation

15. If Java is not installed or the version is too old, the error below will display and the PC software will not open.



Figure 10-13. Java Not Installed Error

Login

The icon at right appears in the default directory after the application is successfully installed.



Login (continued)

As the PC interface program begins, a splash screen (Figure 10-14) appears with user access to the application.



Figure 10-14. Splash Screen

Login can occur in three ways:

- Enter Username and Password. If at least one user identity has already been set up, the user can login with username and password.
- Anonymous Login: Access to the software is allowed without providing a username and password, but with limited functionality. A user can login using “Anonymous” when there are no user identities created.
- Common Login: A user can login to the PC software with the identity of the user in the Username field and the static recovery password “ThermoCRF”.

Note Username will be supplied with the security module of the software. 'Anonymous' is used if password security is not enabled. This will be displayed on the bottom right corner. ▲

Requirements for username and password are described below:

Username Requirements:

- Username length must be between 7 to 12 characters.
- Username can only start with “$”, “_” or an alphabet. However, digits and special characters (‘@’ ‘$’ and ‘_’ only) can be added after the first character.
- Password must be alphanumeric from third character onwards.
- Username cannot have spaces or linefeed.
- "Please enter Username” message displays if Username field is blank.

Login Error Messages

Table 10-1. Login Error

	This message appears when the username length is not between 7 to 12 characters.
	This message appears when the username field is blank.
	This message appears when the password length is not between 7 to 12 characters.
	This message appears when the password field is blank.
	This message appears when the user enters incorrect username and password.

Setup

The Home Page screen opens as shown below:

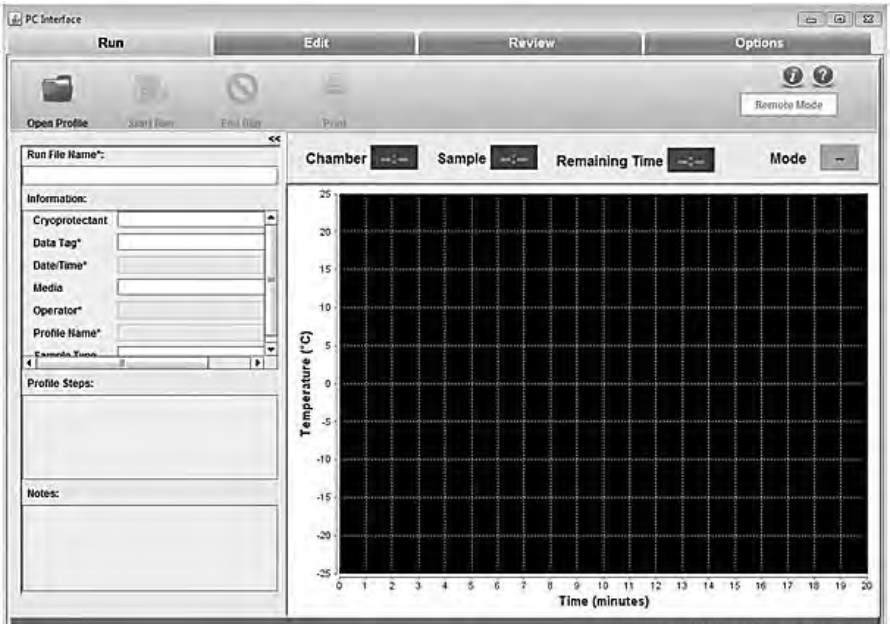


Figure 10-2. Home Page of PC Software

Setup (continued)

Password Requirements:

- Password length must be between 7 to 12 characters.
- The Password can contain any combination of alphanumeric and special characters.
- The message "Please enter Password" displays if Password field is blank.
- If login information is not valid, a message displays "Your login information is not valid. Please verify your information and try again".

If the validation fails, corresponding error messages will be displayed.

The user can perform the following functions as described.



Figure 10-3. Function Selections

Run Operation

Run: The Run command opens communication with the freezer through the COM port. Profile commands are downloaded and the program executed.

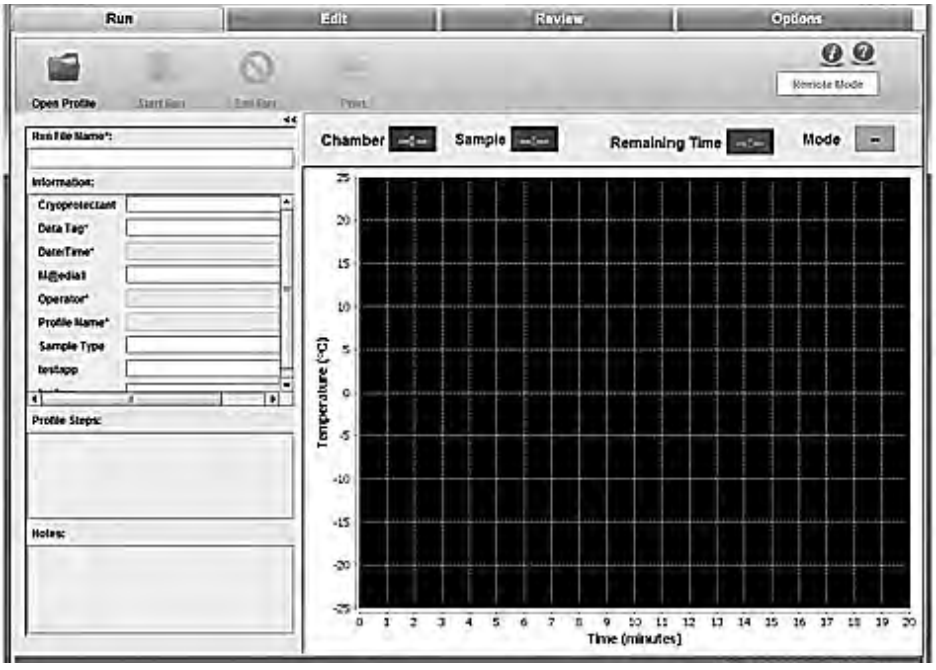


Figure 10-4. Run Screen

Run Operation (continued)

Edit: The Edit screen enables the user to create and edit a freezing profile. Users can also print a profile listing. An approximate representation of the freezing profile will be displayed in the Edit window graph.

Review: The Review screen allows a user to review the existing Run file data, or compare existing Run data. Information on alerts occurring during run are also shown.

Options: Select plot colors for a graph, set-up default directories, manage users and information fields are available user options.

The PC software continually communicates with the freezer, displaying the sample temperature and chamber temperature. Freezing Profiles are displayed in a graph. Press Ctrl + Mouse Left/Right button to pan around graph.

The Run screen enables the user to perform the following commands:

- Open profile: Displays the predefined and user-created freezer profiles.
- Start Run: Enables the user to run the freezing profile.
- End Run: Allows the user to end the run command.
- Print: Allows the user to print a freezing profile.
- Move To: Allows the user to move from one profile command to another. This command can be used only when the profile is running. The current step is shown in green and the moved step in yellow.
- Manual Override: Allows the user to change the temperature time cycle by increasing or decreasing the temperatures using cool, cool+ and warm functions.

Run File Name

Initially, the Run file name field will be empty. The user must enter a Run file name that begins with a letter. Special characters will not be allowed. The length of the name cannot exceed 30 characters.

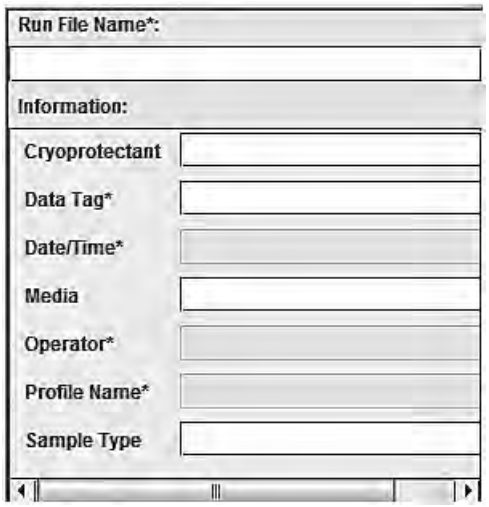


Figure 10-5. Run File Name

Information Fields

The Information menu contains default fields as follows:

Note Mandatory fields are marked as *. ▲

- Cryoprotectant – Enter the anem of the cryoprotectant being used with the samples. The name cannot exceed 30 characters and is an optional field.
- Data tag*- Data tag is a mandatory data field. Information entered is used as a prefix for the file name where the run data is stored.
    - o Must be alphanumeric values.
    - o Special characters such as /,\,:, *,?,<,> and |are not allowed
    - o Length must not exceed 20 characters.
- Date/Time* - Date/Time will be taken from the computer clock when the user initiates a run and stores run data. If the date/time changes when a profile is running, it will not affect the date/time that is stored in the run data. It will save the timestamp when the user runs the profile.
- Media- Enter information on the media being used with the samples. It is an optional field.
- Operator*- Enter the user login username.
- Profile Name*- Indicates the profile selected (.prg file) by the user for the run.
- Sample type - Enter the type of sample being frozen. The description cannot exceed 30 characters.

Note Profile Name, Date/Time, and Operator fields are not editable by user. ▲

Profile Steps

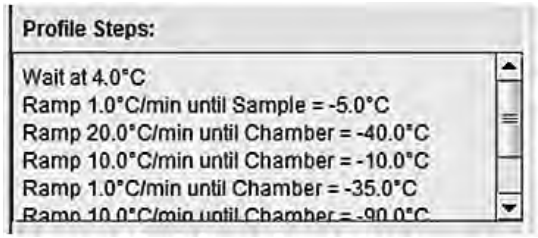


Figure 10-6. Profile Steps

Profile steps display all the profile commands of a freezing profile.

Notes

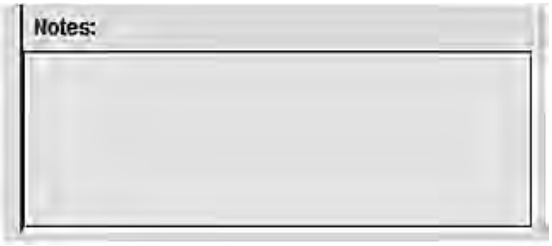


Figure 10-7. Notes

The Notes field is for additional pertinent information to be saved with the profile run date. It is an optional field and cannot exceed 50 characters.

Chamber/Sample Temperature



Figure 10-8. Temperature Display

- Shows temperature of Chamber and Sample in °C.
- Data begins to populate once the Run has initiated.

Remaining Time



Figure 10-9. Remaining Time

- Populates remaining time every 3 seconds once Run is initiated by the user, and when the profile achieves temperature.
- Calculates the remaining time from the second profile step, after the WAIT step.
- Calculates the time only for profiles having ramp and hold steps.
- Does not calculate during manual override, move to, loop and jump functions.
- Displays time in minutes and seconds.

Mode



Figure 10-10. Remaining Time

- Mode displays the current state of the freezer, displays if unit is warm.
- Indicates the unit is in Idle state.
- Indicates unit is in Wait state.
- Changes to Run after run is initiated.
- Shows End if program is complete.

Remote Mode



Figure 10-11. Remote Mode

- Remote Mode is used to indicate if the CRF is under control of the PC software
- Initially, the remote mode is displayed in a white color.
- This field turns green when successful connection to the freezer has occurred, and the freezer is remotely controlled.

Graph

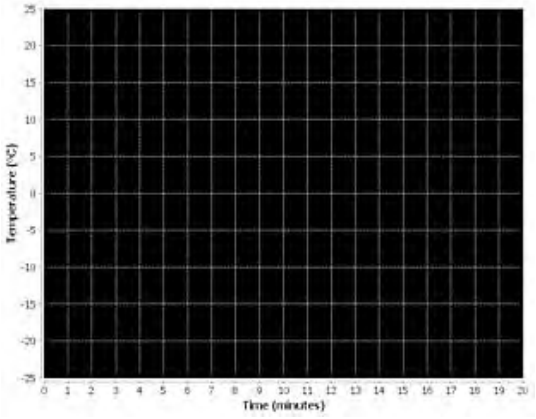


Figure 10-12. Graph

- A graph displays the run profile as it progresses
- X-axis displays time in Minutes. Default setting for X-axis is 1 minute.
- Y-axis displays temperature in degrees Celsius (°C). Default setting for Y-axis is 5°C.
- Allows the user to zoom in and out. Graph is adjusted based on the temperature selected. Press Ctrl + Mouse Left/Right button to pan around graph.

Graph Legend

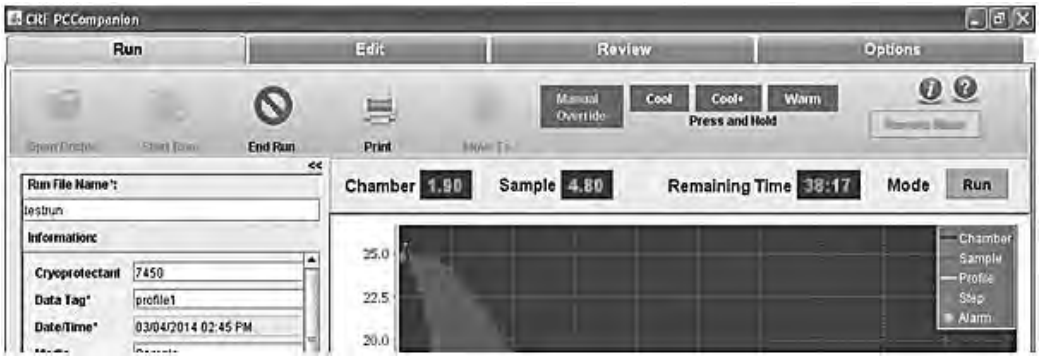


Figure 10-13. Graph Legend

The Graph Legend displays the different plot colors at upper right side of the Graph as shown above.

The legend shows the key colors and symbols used to represent:

- Chamber Plot
- Sample Plot
- Profile Temperature Plot
- Step Marker
- Alarm Marker

Typical Run Procedure

1. Click Open Profile. The Open window appears.
2. Select the required profile.
3. Click Open. The freezer profile is displayed.
4. Enter the Run File Name and Data Tag field.
5. The sample temperature, chamber temperature, and the profile temperature are received from the CRF unit every second.
6. Before the profile run begins, the user will be prompted to select the COM port, from a list of available COM ports, to which the CRF has to be connected. The ports which are not available at that time will be inactive (hidden). The COM port Selection window is shown at right.



Figure 10-14. Select Port

Typical Run Procedure (cont.)

7. Click OK. A window appears displaying "Downloading Profile. Please wait."



Figure 10-15. Downloading

8. Click OK. A window appears displaying "Profile is downloaded."



Figure 10-16. Downloaded

9. Click OK. A Save window appears.

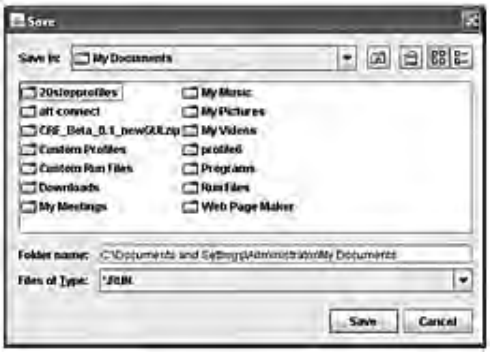


Figure 10-17. Save

10. Select the path of the directory and ensure that the file type is .RUN.
When "Save" dialogue box pops up, it is recommended to browse to your desired directory or type in the full path (case sensitive).
Network drives are prone to connection failure which could cause data loss during profile Run data storage. It is recommended to use a local drive to store profile Run data.

11. Click Save. The profile is saved in the directory selected.

12. Program waiting for user- click here to continue will appear on the graph. This message will be displayed to the user when the freezer is in wait step while in the remote mode. Select this message in order to begin profile run. The message will not pop-up when freezer is in the standalone or normal mode. When the user clicks "Click here to continue" the application will send a run (22 decimal) command to the freezer that causes the freezer to move to the next step in the profile.

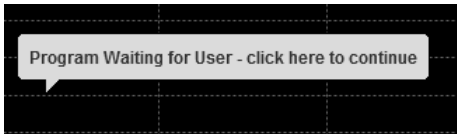


Figure 10-18. Continue

Typical Run Procedure (cont.)

13. Remote Mode button will turn green color once Profile run is started.



Figure 10-19. Green Remote Profile Button

14. Remaining time will display in green color once Profile run starts.

15. Current run step will be highlighted in the Profile steps in green color.

16. While running profile - Run file name will be displayed at left corner of the status bar.

17. The **Print** option allows the user to preview and print a profile. It will use Windows default print dialog.

18. Click **Move To** to change from one profile step to another.

19. The following are the errors that may occur while running a profile:

    a. **Error Messages** –

        i. **Communication Failure, Freezer not responding**: The freezer is not sending status updates to the PC on request. Verify that the communication cable is connected and working properly, the freezer has power and is turned on, and that there is not a hardware failure in the PC or freezer. If communication is interrupted for more than 20 seconds, the freezer will go into 'Off-line' mode.



Figure 10-20. Failure Error

        ii. **Freezer Already In Use**: This message appears when a communication port is selected for a freezer that is running a profile initiated from the freezer keypad. In this case, the PC cannot take control. Select the 'Terminate Session' button to close the Run window.

        iii. **Cannot Stop Freezer in Stand-alone Mode**: This message displays if the Stop button is clicked while the freezer is running a Remote profile in 'Stand-alone' mode. Clicking the Stop button at this time stops only the data capture. Choose 'Continue capturing data' or 'Stop capturing data'. No other commands can be sent from the PC.

Typical Run Procedure (cont.)



Figure 10-21. Already In Use Error



Figure 10-22. Cannot Stop Error

iv. **Program loading error:**
The download program cannot be validated: This message appears after the download profile fails to validate (initial validation and three re-tries) .The user must open a profile again and initiate the run.

v. **Communication error-** A CRF was not found: This message appears when the user opens a run screen and selects a COM port that is not connected to a freezer. The user has to select the other COM port to start/initiate the run.

vi. **Serial Port error** - COM port is busy or unavailable: This message appears when the user opens a run screen and selects a COM port that is in use with another application.

This message will be displayed when the user attempts to open a Run screen when all available COM ports are already communicating with freezers and/or when the maximum of two Run screens are already open.

Manual Override Procedure

Manual Override allows the user to change the temperature time cycle while running a freezer profile defined in the profile Steps. Manual Override prompts the user for a password. Manual override buttons are activated by pressing and holding the mouse button. When the mouse button is released, the function is deactivated. Manual Override is only available during a profile Run.



Figure 10-23. Override Password

The manual override displays three modes of temperature variation:

Cool: The override Cool button energizes one solenoid.

Cool+: The override Cool+ button energizes both solenoids.

Warm: The override Warm button turns the heater ON.

End Run

End run allows the user to end the run of a freezer profile. This option is enabled only while profile is in Run mode. User will be prompted to enter a correct password to end the profile. Note that these pop-up windows may appear behind the software screen if user is running multiple programs at one time. Minimize software, and pop-up will appear.

1. Click End Run. A window appears to confirm the end of run.
2. Click OK. A window appears to enter a password. The user must enter a password to confirm end run.



Figure 10-24. Stop Run



Figure 10-25. Password to End Run

3. Displays a pop-up window if an incorrect password is entered.
4. Click OK and enter the correct password to terminate a profile run. A window appears showing "Profile run terminated". Click OK to close.



Figure 10-26. Password Invalid



Figure 10-27. Run Terminated

   i. Remote Mode button will turn white after profile run is terminated.
   ii. Unit Connection status will turn to Unit Not connected in footer panel.
   iii. Manual Override button will be disabled.
   iv. CRF will stop running the profile.

5. After the profile run is complete, the profile Run Completed window will appear as shown in Figure 10-28. Press Ok in pop-up window.

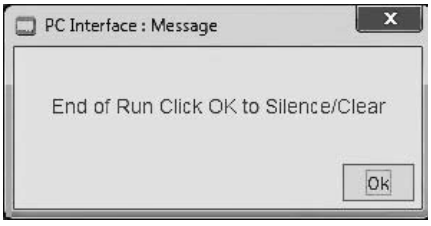


Figure 10-28. Completed

6. Press the End Run button from the window bar. This will terminate the profile.
7. To warm the chamber to room temperature, select and run preset profile #7 (preset_warming). This profile will return the chamber to a temperature of 25°C.

Print

Print allows the user to print a freezing profile in three categories: Profile Header, Profile Data and Graph Data

Profile Header contains:

- CryoMed Model 74xx Controlled Rate Freeze Run Data Report.

Profile Data contains:

- "Program" profile name with directory details
- "Author" Thermo Scientific
- "User" operator name
- "Edited" profile created date as edited date
- "Printed" date and time of profile printout taken
- "Description" entered notes as description
- "Profile:" as header
- "XXXXXXXX" as sub header
- Profile commands with numbering
- "Alarm Listing" as header
- " XXXXXXXX" as sub header
- "Occurrence "Alarm Profile Time(min) as header
  - o Alarms occurrence details with alarm type and time of occurrence
- Page numbers at bottom left corner of print document
- "Thermo Scientific" logo at bottom right corner of print document.

Profile Graph contains:

- "Data file" profile name with directory details
- "User" operator name
- "Printed" date and time of profile printout taken
- Current view of the profile run graph
- Page numbers at bottom left corner of print document
- "Thermo Scientific" logo at bottom right corner of print document.

Alarms

When an alarm condition occurs, audible and visual alarms are presented at the freezer, and an alarm window appears on the PC screen. The window contains a list of up to three of the most recent alarms and the message 'Click Here To Silence' displays. Note that these pop-up windows may appear behind the software screen if user is running multiple programs at one time. Minimize software, and pop-up will appear.



Figure 10-29. Click to Silence

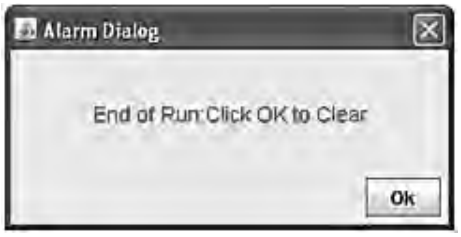


Figure 10-30. Clear Alarm

Click anywhere on the alarm window to silence the audible alarm at the freezer. After the audible alarm is silenced, another alarm window appears showing the list of three most recent alarms and the message 'Click Here To Clear'. Click anywhere on the alarm window to clear all alarms that have been resolved. The alarm window reappears if any alarms are still active.

If the message 'Profile Stopped At Freezer' displays, the run has been stopped due to a component failure in the freezer **or** when a user selects the Back button at the freezer during the end run of the profile. Click the message to acknowledge that the run has stopped. This action has the same effect as the Stop button.

Alarm messages alert the user to the alarm status of the freezer. The user must clear the message on the screen even though the alarm condition may have already corrected itself. Alarm messages may also appear before or during a run. Alarm messages alternate if multiple alarms are present one at a time.

Alarms are cleared with the Silence key.

The following are the alarm messages that could appear:

- "**Temperature is High: Click OK to Silence**" message appears when chamber temperature is greater than programmed temperature by a pre-determined amount (5°C).
- "**Temperature is Low: Click OK to Silence**" message appears when chamber temperature is less than programmed temperature by a pre-determined amount (5°C).

Alarms (continued)

- "**Chamber Sensor fail!**" message appears when chamber temp >75.0°C.
- "**Sample Sensor fail!**" message appears when sample temp >75.0°C.
- "**Chamber temp limit**" message appears when chamber temperature is in between 55°C to 75°C or less than -185°C.
- "**Sample temp limit**" message appears when sample temperature is in between 55°C to 75°C or less than -185°C.
- "**Warm Complete**" message occurs five minutes after the chamber reaches 25°C during a warm cycle.
- "**End of run: Click OK to Clear**" message appears five minutes after the end profile step is reached.
- "**Check LN2 Supply!**" message appears when LN2 is ON for 30 minutes.
- "**Heater Error**" message appears if the heater is energized continuously (no active temperature control) for 60minutes.
- "**Printer Buffer Full!**" message appears when the printer storage buffer is full of run data(approximately 2 hours)and no longer able to store the data for later printing.
- **Power failure at CRF! –**
  - "Power Failure" message appears when there is a power failure in freezer.
  - The computer reports a Power Fail alarm and the failure duration, if the failure duration is longer than 10 seconds.
  - The graph on the Run screen stops plotting when there is a power failure and user will be prompted if failure duration is more than 10 seconds.

Power Failure Recovery

If the Controlled Rate Freezer experiences a power failure and the PC continues to operate:

The freezer continues to run the profile from the point of failure when the power is restored. However, the freezer runs in 'Stand-alone' mode. All commands from the PC are ignored except for profile status requests. The temperature data is continually captured and plotted. The PC cannot clear alarms or stop the Run. The keypad of the freezer remains disabled except for the Silence key, which may be used to mute or clear any alarms.

The Run can be aborted at the freezer by pressing and holding the Back key for 3 seconds. The PC resumes control of the freezer.

The Stop button on the Run screen ends data capture only. The PC will report a Power Fail alarm including the failure duration, if the failure duration is longer than 10 seconds. A communication error message will display on the Run screen during the freezer power failure.

If the PC experiences a power failure and the Controlled Rate Freezer continues to operate:

When power is restored to the PC and Windows reboots, restart the freezer application.

Select Run from Main Menu. Select any profile, fill mandatory fields(Data Tag and Run file name) and press Start Run. Choose the COM port for the freezer that is running. The PC will recover the Run data captured prior to its power failure, continue Run in 'Stand-alone' mode. The graph on the Run screen will show the gap when the PC was not communicating. Data not saved prior to the power failure cannot be recovered as the application saves data to disk approximately once every minute.

Two Run screens can be restored for freezers that were running during the PC power failure. As the freezer did not experience the power failure, no alarm will be recorded.

Display/Control Summary

Controlled Rate Freezer and PC configuration has three types of modes: Remote Mode, Stand Alone Mode, and Running a Local Profile.

Remote Mode

The PC can initiate all actions at the freezer such as Run, Stop, Warm, Manual Over-ride, Alarm Silence, and Alarm Clear. The PC displays the current freezer operation status (Idle, Run, Wait, End, and Warm) for the chamber and sample temperatures. Time and temperature details are captured every 6 seconds.

The CRF keypad is disabled except for the Silence key which can be used to silence the audible alarm and clear alarm messages at the freezer. Alarm messages on the PC must be cleared by the user. The other freezer keypad keys are disabled to prevent persons near the freezer from taking control of a freezing run without the knowledge of the user/initiator of the run. All freezer status and temperature displays operate normally. The message 'Under Remote Control' displays on the freezer as well as the current profile step being executed. Alarm messages alternate with the current step information if an alarm condition occurs.

Stand Alone Mode

The PC can only capture time/temperature and alarm data in this mode. No action commands are permitted. Current operating status and chamber/sample temperatures will be updated and displayed normally.

The freezer keypad is still disabled in this mode except for the Silence key. However, a run may be aborted by pressing and holding the Back key on the freezer for 3 seconds. All freezer status and temperature displays operate normally. The message 'Running Remote Profile' is displayed at the freezer, as well as the current step information alternated with any alarm messages.

Edit Screen

The edit screen enables the user to create a freezing profile or edit an existing freezing profile. The user can also print a freezing profile.

Edit Policy:

Wait command range: Temperature values must be between 50°C to -180°C.

Wait For Temperature Command Range: Temperature values must be between 50°C to -180°C.

Wait For Temperature Command: Sample Temperature value must be min 1°C greater than Chamber Temperature value.

Ramp Command Range: The rate of freezing must be between +0.00°C to +99.9°C and temperature values must be between -180°C to +50°C.

Hold Command: Allows the user to enter a temperature range between 50°C to -180°C.

The edit screen is shown below. Press Ctrl + Mouse Left/Right button to pan around graph.

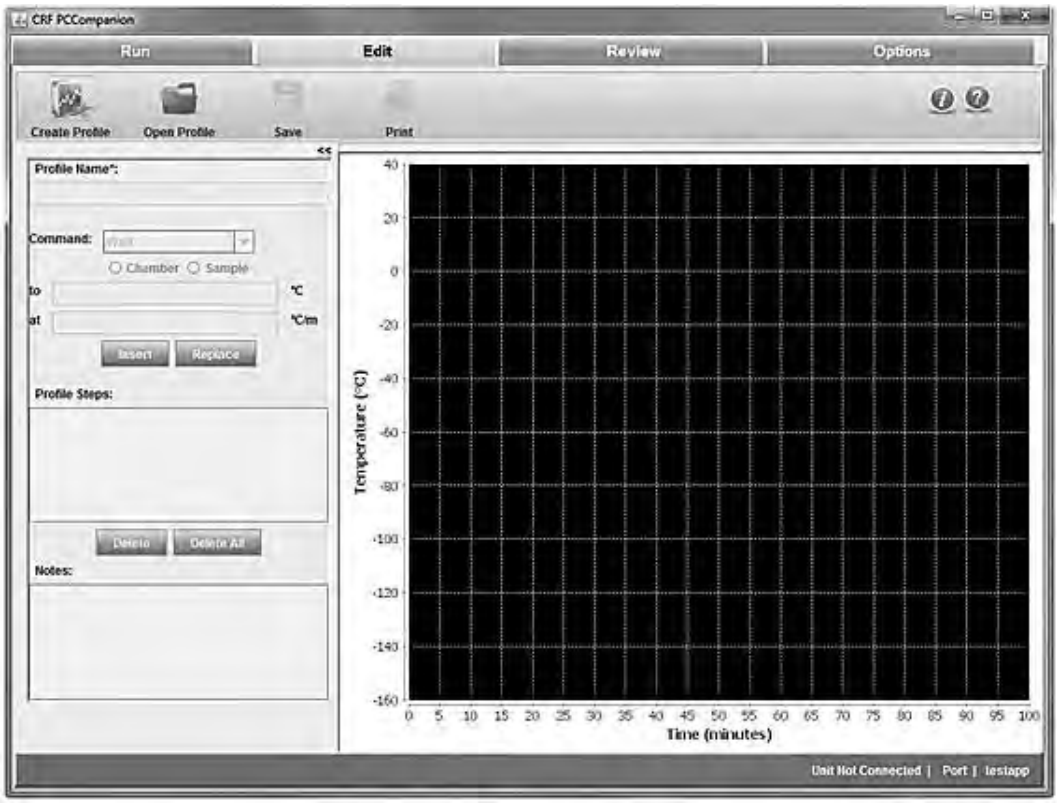


Figure 10-31. Edit Screen

Startup

- Create Profile enables the user to create a freezer profile. The user must enter the profile name, select the command from the drop down menu and insert the profile steps.
- Open Profile enables the user to edit an existing profile. The information fields are auto populated when the user opens an existing profile and enables the user to modify the required fields.
- Save enables the user to save the profile created or save any modifications performed on a profile and save it as a new file. User is prompted to save with a different file name.
- Print enables the user to preview and print a freezer profile. It also allows the user to select a printer, set printer properties, select a preview function, specify the no. of copies, print style, etc.
- The graph is plotted based on the steps added/edited in the profile.

The following profile steps will be available in the drop-down menu

Wait - Wait At X.X°C where X.X is the chamber set temperature.

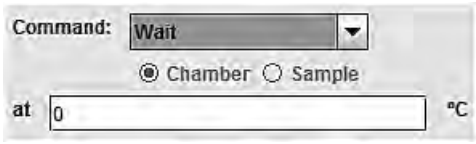


Figure 10-32. Wait Screen

Maintains specified chamber temperature indefinitely until the user clicks the "**Program waiting for user -- Click here to continue**" button on the Run screen. The temperature can be set over the -180°C to +50°C range, with a setting resolution of 0.1°C.

Note Chamber and Sample selection are deactivated. ▲

Wait For temperature

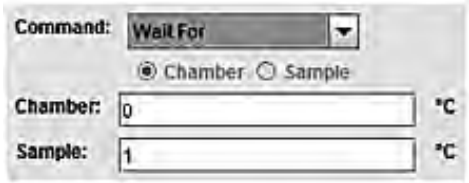


Figure 10-33. Wait For Screen

WAIT AT CHAMBER=X.X°C UNTIL SAMPLE=Y.Y°C. X.X is Chamber set temperature and Y.Y is the Sample trip temperature. The default Sample trip temperature is 1°C above Chamber temperature.

Startup (continued)

Step maintains specified Chamber temperature and moves to next step in profile when Sample temp cools to the specified temperature. This step can only be used when the starting Sample temperature is greater than the specified Sample temperature (the Sample is cooling).

Note Sample temperature must be greater than Chamber temperature. Chamber and Sample selection are deactivated here. ▲

Ramp

RAMP X.X°C/MIN UNTIL CHAMBER=Y.Y°C (or) RAMP X.X°C/MIN UNTIL SAMPLE=Y.Y°C. X.X is the ramp rate and Y.Y is the chamber (or sample) endpoint temperature.



Figure 10-34. Ramp

This step changes Chamber temperature from its current value to specified temperature (chamber sensor trip point) at the selected rate (°C/minute). The rate can be set over a range of 0.1°C/ minute to 99.9°C/minute. The temperature can be set over a range of -180°C to +50°C (±0.1°C). When the chamber reaches specified temperature, the control moves to the next step in the profile. If Sample is selected, chamber temperature changes at a specified rate until sample reaches specified temperature.

Note The slope of the temperature ramp is determined automatically, based on the temperature defined and the chamber temperature at the beginning of the step. Entry of a sign for the rate term is not required/allowed. ▲

Hold

HOLD X.X°C FOR Y.Y MINUTES where X.X is the chamber set temperature and Y.Y is the minutes.

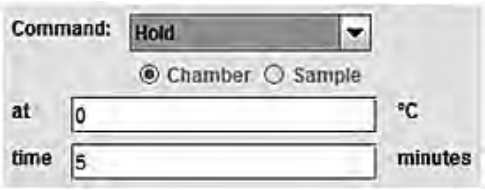


Figure 10-35. Hold

Maintains a specified Chamber temperature for the specified hold duration before proceeding to the next step. The time can be set over a range of 1 to 99 minutes, and the temperature can be set over a range of -180°C to +50°C with a setting resolution of 0.1°C.

Note Chamber and Sample selection are deactivated here. ▲

Startup (continued)

Jump - JUMP TO STEP X where X is the step number.



Figure 10-36. Jump

Automatically advances to a subsequent step or returns to a previous step in a freezing profile. The Jump function can be programmed over a range of Step 1 to Step 20.

Note Chamber and Sample selection are deactivated here.

Loop - LOOP X TIMES STARTING AT STEP Y. X is number of repetitions and Y is the step number to begin. Automatically advances to a subsequent step or returns to a previous step in a freezing profile for a programmable number of repetitions. The Loop function can be programmed from Step 1 to Step 20, and over a range of repetitions from 1 to 99.

1. Click Insert. The temperature of the chamber is defined.
2. Click Replace to replace the temperature of the step.
3. The defined commands and temperatures are displayed in Profile Steps.
4. Click Delete if the user wants to delete a profile step.

Note The user can add notes in the Notes section, if desired. ▲

Create Profile

Create Profile enables the user to create a freezer profile to preserve the test samples in the CRF based on the user's requirement. The following image shows the Create Profile screen:

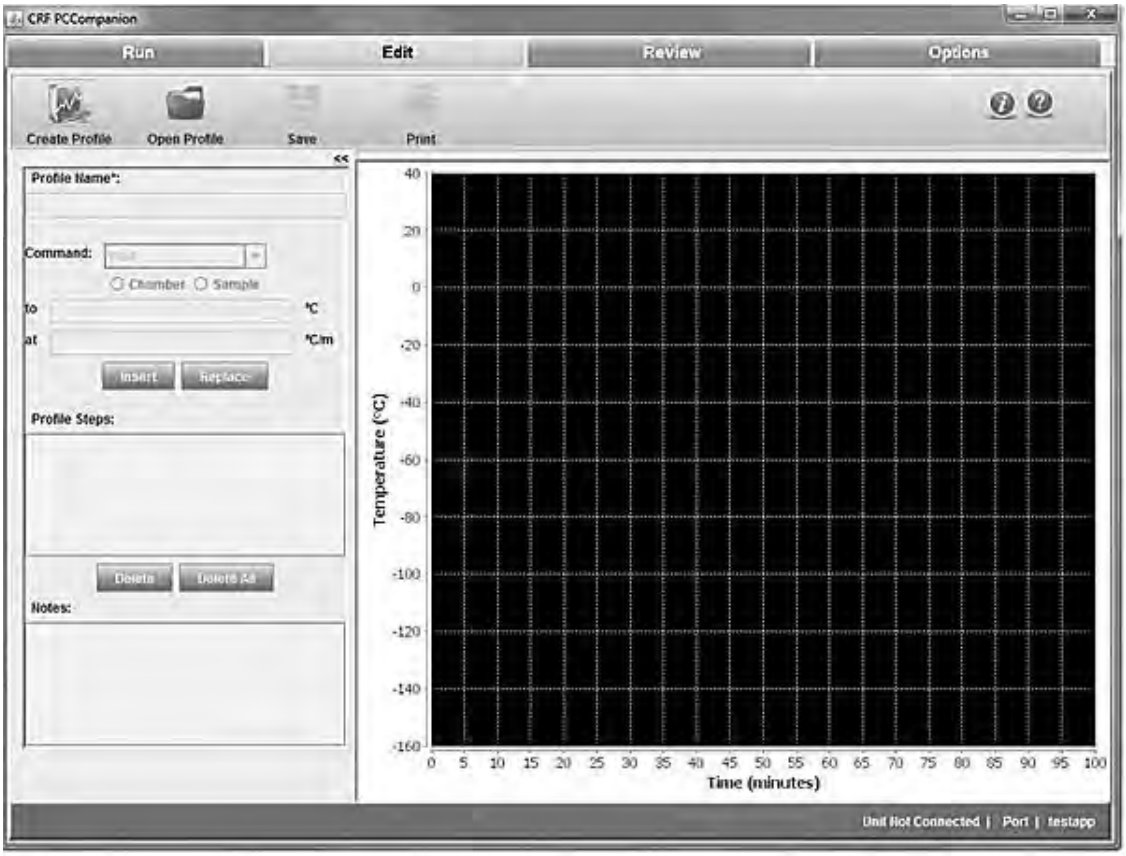


Figure 10-37. Create Profile Screen

To create a freezing profile, follow these steps:

1. Enter the Profile Name.

2. Select WAIT or WAIT FOR from the Command drop down. As first step can be either wait/wait for, hence it cannot be created automatically for every run.

   Wait or wait for command increases the TEMPERATURE of LN2 and is the mandatory first step. It is required to purge the warm LN2 plumbing prior to initiating controlled rate freezing. This step is not available for deleting or changing to a different step type.

3. If the user selects WAIT command, the CRF (chamber) waits at 0°C or at user defined temperature. If the user selects WAIT FOR command, the chamber temperature waits at 0°C until sample temperature is 1°C.

Create Profile (continued)

4. Select the desired profile steps from the command drop down. The commands selected are displayed in the profile steps.

5. **Insert** is used to add a step. The new step will be added on the line that is highlighted. **Replace** is used to modify an existing step's parameters or change to a different step type and **Delete** is used to delete a step and **Delete All** is used to delete all steps at a time.

6. **END** is the mandatory last step. It alerts the freezer that the profile steps are completed. This step is automatically added during the profile creation. It cannot be deleted or replaced.

7. Click **Save** to save the freezer profile created. Notes are saved with the profile and are printed with the run data. Saved profiles are given the extension ".prg". If the profile already exists, then the software prompts the user to confirm whether to replace the profile or not.

Note There can be a maximum of 20 steps, including the End step. ▲

8. The temperature range for all the profile steps while creating a profile is -180°C to 50°C. Ramp rate has a range of 0°C/minute to 99.9°C/minute i.e. 0<=Ramp Rate<=99.9°C/minute.

9. Ramp rate field can take fractional values but temperature, if set in fractions, will be rounded off to nearest integer.

10. The graph is plotted based on the steps created.

Edit Profile

The edit profile enables the user to modify a freezer profile. The user can insert a new step, change the step type, modify the step parameters or delete one or more steps. Press Ctrl + Mouse Left/Right button to pan around graph.

To edit a profile, follow these steps:

1. Click **Open Profile**. A dialog box with title "CRF PC Companion: Open" is displayed which allows only .prg file to be selected. The steps appear in the program listing window and the graph is also displayed.

Edit Profile (continued)



Figure 10-38. Open Profile

2. Select the profile and click Open. The freezing profile opens.

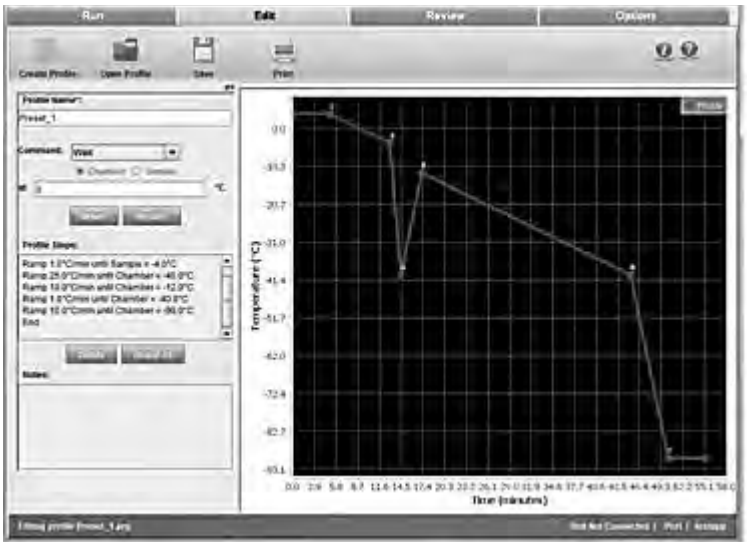


Figure 10-39. Freezer Profile

3. **Replace** button is used to select the step to edit, change the step type, or modify the step parameters.
4. **Insert** button is used to insert the new step. Initially it is non-operational.
5. **Replace** button is used to modify or edit a step. Initially replace is non-operational.
6. **Delete** button is used to delete a step.
7. **Delete All** button is used to delete all steps at a time. When the user clicks the Delete All button, a confirmation window is displayed as shown below.

Edit Profile (continued)

8. New steps will be inserted at the position highlighted in the program listing window.

9. Subsequent steps will move down one position as new ones are added.

10. Selecting the step type and entering the desired parameter option will be available for the user.

11. The graph will be modified accordingly with the changes in the steps.

12. The user can save the profile edited. The same file name may be used or a new profile name can be entered. Optional notes may be saved with the profile. Notes will be printed with the Run data.

13. Make the required changes and Click Save. A Save window opens.

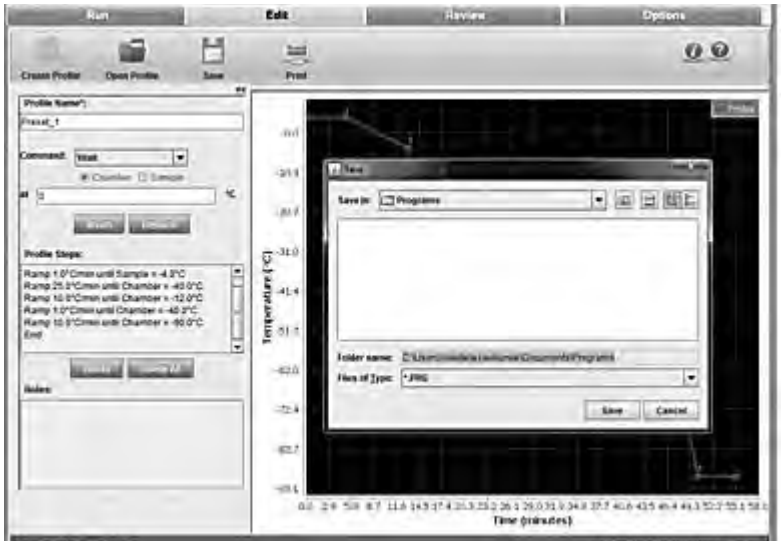


Figure 10-40. Save

14. Click Save. The modified changes of the profile step are saved.

Print a Profile Listing

Print profile listing enables the user to preview and print the freezing profiles. The user can select the printer, set printer properties, specify the number of copies, and print style. Print policies are as below:

- Profile Header is bold in print.
- Print contains "Program:" and Profile name with Directory details.
- Print contains the "Author:" and Operator name.
- Print contains "Edited:" and Profile created date as Edited date.
- Print contains "Printed:" and Date and Time of Printed as Printed.
- Print contains "Description" and entered notes as description.
- Print contains " ----------" as sub header.
- Print contains "Program Listing:" as header.
- Print contains Profile commands with numbering.

Display Profile Temperature Graph

A representation of the freezing profile is displayed on the Edit window graph. Refer to the following illustration.

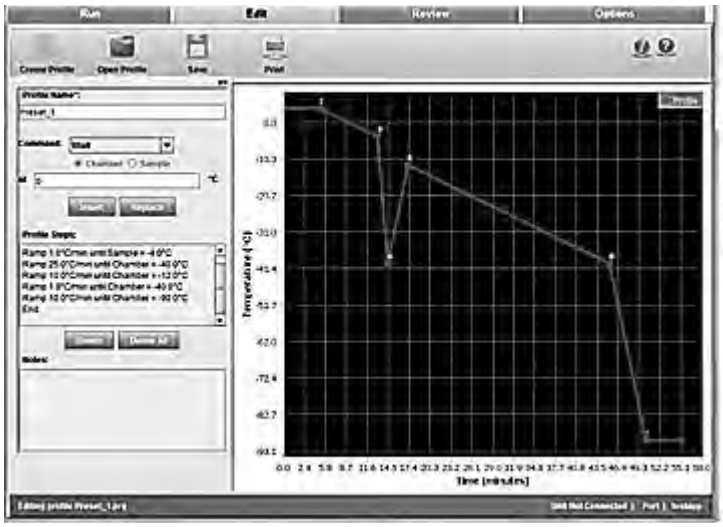


Figure 10-41. Graph of Freezing Profile

The starting point of each Step is indicated on the graph line by a small shaded square.

To view a specific location on the graph, point at cursor, press and hold the left mouse button, and drag the cursor to the desired graph position.

1. Axis:
    i. X-Axis will be displayed as Minutes
    ii. Y- Axis will be displayed as temperature (°C)

Error Messages

Description of error messages that occur during an edit profile follow:

Note All the fields that are not relevant to current running step will be disabled.For example, if a loop operation is running, then the steps related to Wait, Wait for etc. will be disabled. ▲

Error Message	Description
When the user tries to replace the first step	
"Can't replace first step" 	This message appears if the user tries to replace the first step in the profile with a Ramp, Hold, Jump, or Loop Step.
"Graph step transition capacity exceeded"	This message appears when the step transition capacity of the graph is exceeded. This will alert the user of an unintentional infinite loop, but allows the user to continue the edit/save process normally if the infinite loop is intentional.
The user selects Enter or Replace when the selected step parameters are out of range	
"Invalid Chamber/Sample value entered. Value must be between +50°C and -180°C 	This message appears when the temperature is outside range of -180°C to +50°C (Wait, Wait For, Hold, Ramp).
"Invalid Ramp value entered. Ramp rate must be between 0 and 99.9°C/m" 	This message appears when the temperature rate is outside the range of +0.0°C/min to +99.9°C/m (Ramp).
"Invalid Sample temperature value entered. Value must be greater than the Chamber temperature" 	This message appears when the sample temperature is not greater than the chamber temperature (Wait for).

(continued)

Error Messages (continued)

Error Message	Description
The user selects Enter or Replace when the selected step parameters are out of range (continued)	
"Invalid Step Number" 	This message appears when the user enters the invalid step number or greater than the current number of steps (Jump, Loop).
"Number of repetitions outside the range of 1 to 99 (Loop)"	This message appears when the number of repetitions is outside the range of 1 to 99.
When the user tries to save a profile with an already existing name	
"File already exists" 	This message appears when the user is trying to save a profile with an already existing name.

Review Screen

Review enables the user to perform the following functions:

- Review a run profile
- Compare two run profiles
- Export the file in a .CSV format.
- Print a profile

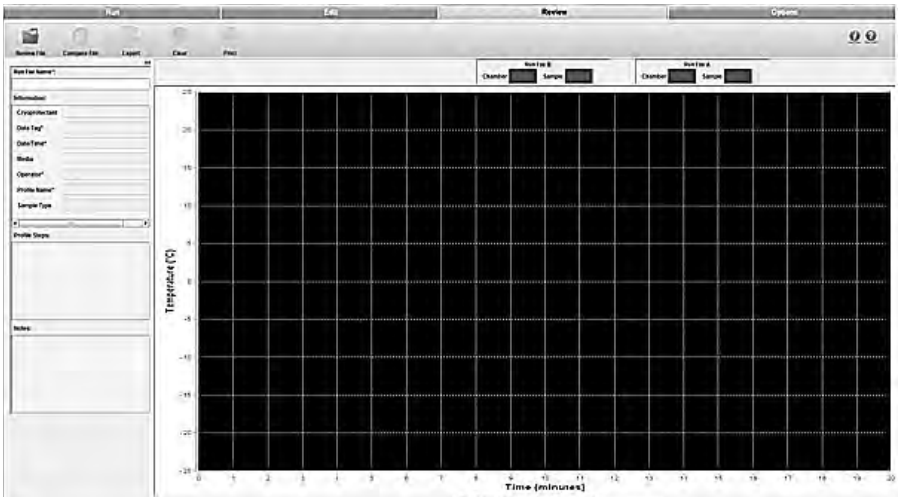


Figure 10-43. Review Screen

Review Screen (continued)

In **Review**, a user can review, analyse, and compare run data from ".run" files. A user can also open ".run" files from the previous software version. Review will not change run data in any way, i.e. it will not make any changes in ".run" files. Hence, all the fields will be greyed indicating that they are not editable. Review allows a user to open and plot run data i.e. Chamber, Sample (actual performance of the unit), and profile plot.

A user can review .run files from the previous version software as well. Review will be able to provide plot chamber/sample/profile data Review File. The graph fits automatically irrespective of the scale of the graph plot.

The screen shown in the figure below will appear once the user clicks Open and selects the required run file. Press Ctrl + Mouse Left/Right button to pan around graph.

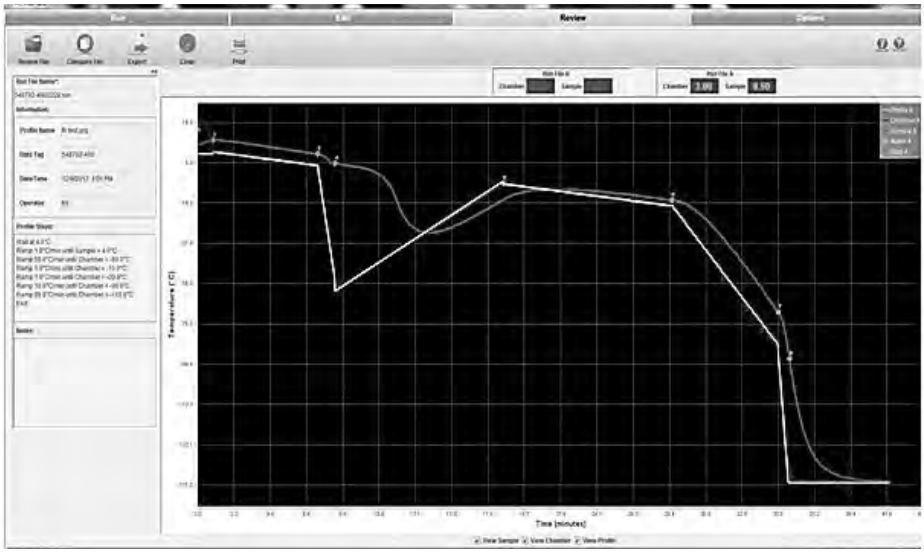


Figure 10-43. Review Profile Screen

User Controls

- **Review:** This screen enables the user to review a freezer profile. When the user opens a run file to review, the properties of a freezer profile are populated automatically.

Note A current running profile cannot be used for comparison until it has ended. A run file will be reviewed or compared only after its corresponding run has completed. ▲

- **Compare:** This screen allows the user to compare two run profiles. The profiles are named as Run File A and Run File B. The user can compare information fields, profile steps, analyse the graph plots of two profiles and the chamber and sample temperatures respectively.

User Controls (continued)

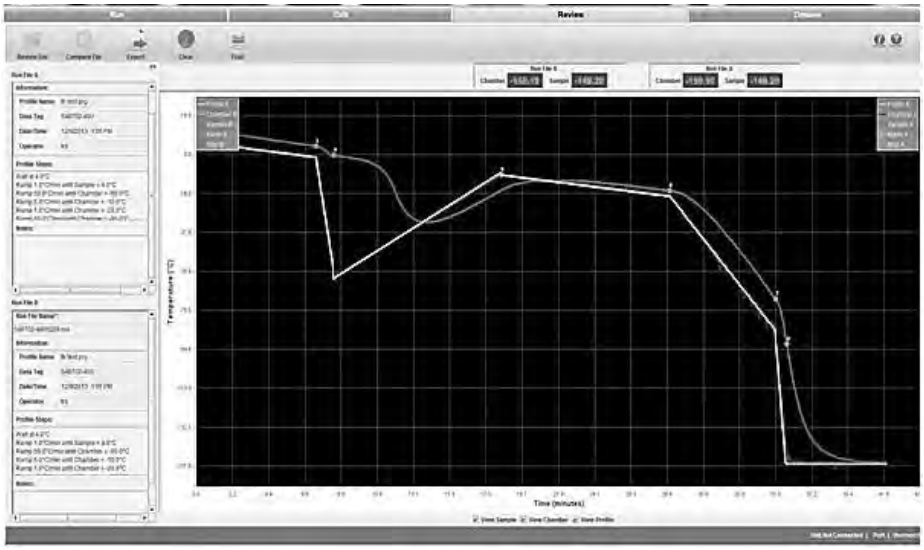


Figure 10-44. Compare Profiles

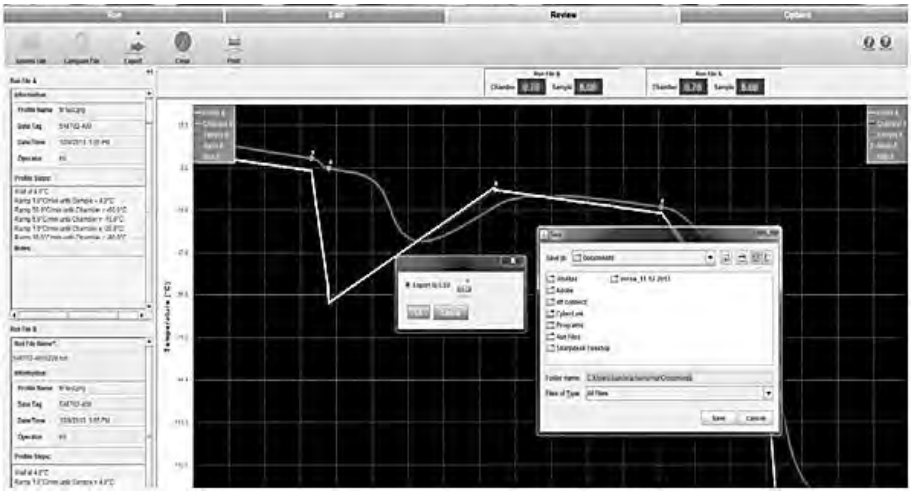


Figure 10-45. Export

- **Export:** The export icon allows the user to export the file into the local system in the .CSV format.

User Controls (continued)

The user must select the destination folder to export the file. A ".csv" file contains the following information:

- Company name
- Data tag entered by the user
- Date and time of profile run
- User name
- Notes entered by the user
- Run file name
- Profile name
- Profile steps
- Elapsed time, chamber temperature, sample temperature and profile temperature
- Occurrence of alarm time with alarm information

- **Clear:** Clear allows the user to clear all the information fields of a run profile.

- **Print:** The user can preview and print the review run file information and the run files compared using the print icon. It allows the user to select a printer, set printer properties, select a preview function, specify the no. of copies, print style, etc.

  'Single Page Report' may be selected to print the current review screen. A 'Two Page Report' may be chosen to print, in addition to the current view of the graph, one or two information sheets. The first sheet printed on a two page report is the open Review file information.

Information Fields

Information fields on the Review screen will appear as they were created for the Run data file that has been opened. The following information fields will be supported.

1. Profile name:
   a. Initially will be blank and not editable
   b. Populates the profile name once the Run file is loaded
2. Date/ Time:
   a. Initially will be blank and not editable
   b. Populates the Date/Time once the Run file is loaded

User Controls (continued)

Information Fields (continued)

3. Operator:
    a. Initially will be blank and not editable
    b. Populates the Operator name once the Run file is loaded
4. Cryoprotectant:
    a. Initially will be blank
    b. Populates the Cryoprotectant once the Run file is loaded if the data is available in run file
5. Media:
    a. Initially will be blank
    b. Populates the media value once the Run file is loaded if the data is available in run file
6. Sample Type:
    a. Initially will be blank
    b. Populates the sample once the Run file is loaded if the data is available in run file
7. Data Tag:
    a. Initially will be blank
    b. Populates the Data Tag once the Run file is loaded
8. Profile Steps:
    a. Initially will be blank
    b. Populates Profile steps once the Run file is loaded
9. Notes:
    a. Initially will be blank
    b. Populates notes once the Run file is loaded if data is available in run file.

Options Screen

Options enable the user to perform the following functions:

- Set or change the plot colors
- Set or change default directories
- Add users
- Define information fields

Plot Colors

The Plot Colors screen allows a user to set the colors of the graph.

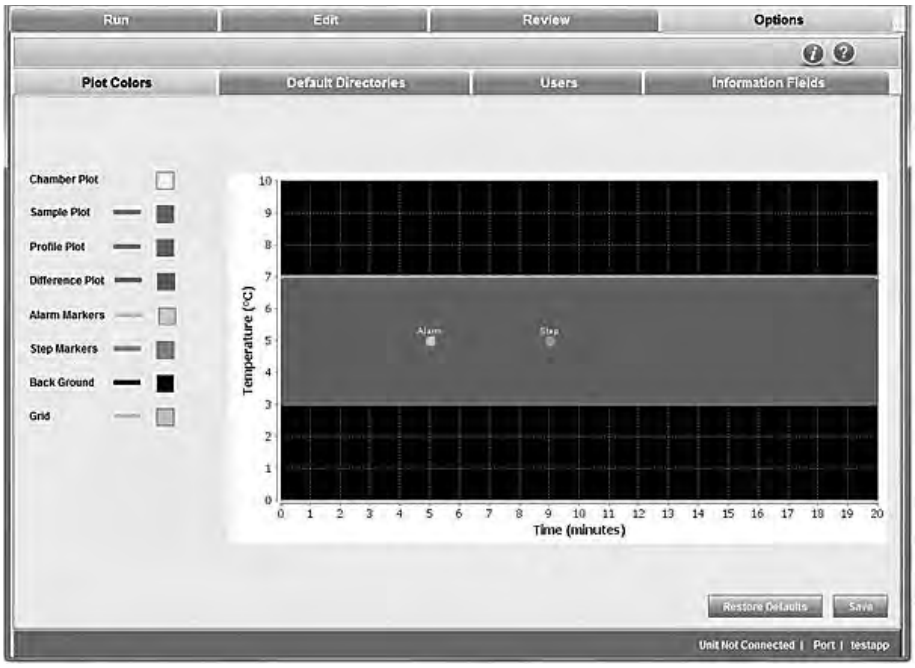


Figure 10-47. Plot Colors

The Plot Colors window indicates the graph color choices.

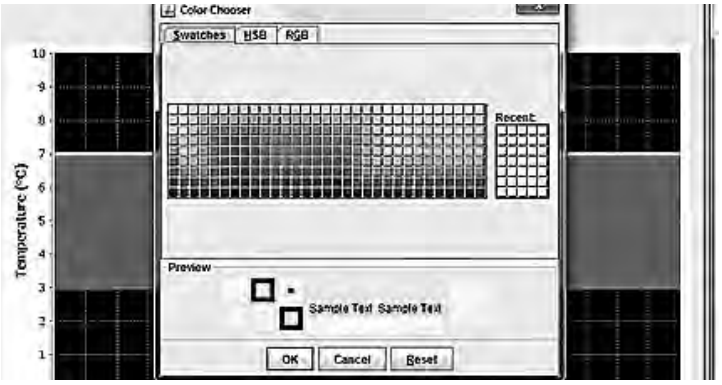


Figure 10-48. Plot Color Choices

Description

1. Plot Items are displayed as follows:
   a. Sample Plot: Red
   b. Chamber Plot: Yellow
   c. Profile Plot: Magenta
   d Difference Plot: Pink
   e. Alarm Markers: Green
   f. Step Markers: Orange
   g. Background: Black
   h. Grid Color: Gray
2. Procedure
   a. To choose colors, user can select the color box corresponding to the desired plot item. The color palette shows the different colors available.
   b. Select “Save” to keep changes.
   c. To return to previously saved colors, select “Restore Defaults”.

Default Directories

This screen enables the user to change the default directory settings. The user can define the default profile directory and default run directory to store the program profiles and run profiles.



Figure 10-49. Default Directories

Default Directories (continued)

To set default directories,

1. Click Default profile Directory folder icon. The Open window dialog box appears.
2. Select the path of the directory and click Open.
3. Click Default Run Directory. The Open window dialog box appears.
4. Select the path and click Open. When selecting the file path, it is recommended to browse to your desired directory or type in the full path (case sensitive).
5. Click **Save**. The default directories path is now saved.
6. Click **Restore Defaults** to restore the previous path.

Note Network drives might not be supported if user's computer is not registered to the network. ▲

Users

This section enables a user to add new users, modify passwords and delete existing users.

The following image shows the "add new user" screen.



Figure 10-49. Add New User

Users (continued)

A user can also delete other users. The following image shows edit password and delete user screen



Figure 10-51. Edit Password/Delete User

Note When all the users are deleted, the PC software can be accessed as an anonymous user. ▲

Username Policies

- To access the application in user's mode, a new user will have to be set up. Users cannot be imported from other applications or previous versions of Thermo Scientific CRF software.
- All existing users will be displayed in a list/scrollbar.
- The new user account will be created when the "**Add**" button is clicked.
- To add a user, provide Password and Confirm Password field data. If they match, only then will new user details will be added.
- The created user will be reflected in the existing user list box.
- If user selects a name already taken, selected user name will be populated.
- Username length must be between 7 to 12 characters.
- First character in username can be '$' or '_' or alphabet.
- Second character can be '$'or '_' or '@' or alphabet.
- From third character onwards, username can contain digits or special characters.
- Username must not contain spaces or the new line character.
- To delete a user name, select the user name form the pull-down list (or type name in User Name window) and click the "**Delete**" button. Any user can delete another user. An unlimited number of users can be created.
- No user can delete the anonymous user account.
- A user can also delete his account, but only if the run initiated by that user has completed.
- If all the user accounts are deleted, then Anonymous mode will be activated automatically.

Password Policies

- Password length must be between 7 to 12 characters.
- Password can contain any combination of digits, alphabets and special characters.
- Changing a user's password will require confirmation.
- To change a password, select the user name from the pull-down list (or type the name in User Name window), enter and confirm the new password, and lastly click the "**Add**" button.
- Save the changes to ".properties" file.
- One user will not be able to change another's password, as changing a user's password will require his old password.

Anonymous User Policies

- Anonymous can create other users.
- Anonymous does not exist once the users are added.
- Anonymous cannot delete any users.
- Anonymous cannot change other user's password.

Information Fields

This section enables the user to add or delete information fields of a freezer profile. There are seven information fields that are predefined such as, Cryoprotectent, Data Tag, Date/Time, Media, Operator, profile Name and Sample Type. The information fields that are added are available in subsequent runs.

The user can add 5 additional fields. The total number of information fields that can be defined is 12.



Figure 10-52. Add Information Fields

Information Fields (continued)

- The new fields that are added cannot have the same name as a default predefined field.
- Information Field name length must be a minimum 5 characters.
- Information Field name must not start with any special character or numerical value. It must start with a letter only.
- Information Field name can contain a special character as the second character or thereafter.
- Default information fields are Profile Name, Data Tag, Date/Time, Operator, Cryoprotectant, Media, and Sample Type.
- The additional fields are stored in ".properties" file.
- All fields including default Information fields are maximum of 20 characters only.

To remove a field,

1. Select the “delete” field. A dialog box appears.
2. Select the field and click “OK.”

Note Mandatory fields are not removable. Mandatory fields are denoted with an “*.” ▲

Status Bar

The status bar displays the commands or the actions to perform in the bottom left corner of the window and status of connection between the unit and the PC software (unit connected or unit not connected), the port connected and the username in the bottom right corner of the window.

Figure 10-53 shows the status bar.



Figure 10-53. Status Bar

Help

The Help section assists the user in navigating through the PC Software.

Contact Information:

Australia +61 39757 4300	**India toll free** 1800 22 8374
Austria +43 1 801 40 0	**India** +91 22 6716 2200
Belgium +32 53 73 42 41	**Italy** +32 02 95 05 92 52
China +86 21 6865 4588 or +86 10 8419 3588	**Japan** +81 45 453 9220
Netherlands +31 76 579 55 55	**France** +33 2 2803 2180
New Zealand +64 9 980 6700	**Germany national toll free** +0800 1 536 376
Nordic/Baltic/CIS countries +358 9 329 10200	**Germany international** +49 6184 90 6000
Russia +7 812 703 42 15	**USA/Canada** +1 866 984 3766
Spain/Portugal +34 93 223 09 18	**Switzerland** +41 870 609 9203
Other Asian Countries +852 2885 4613	**Countries not listed** +46 6184 90 600

www.thermoscientific.com/cold

OS Compatibility: Windows

Software Version: FDA Compliant

Figure 10-54. Information

About

This section provides information for Thermo Fisher, the OS compatibility, and the software version of the application.

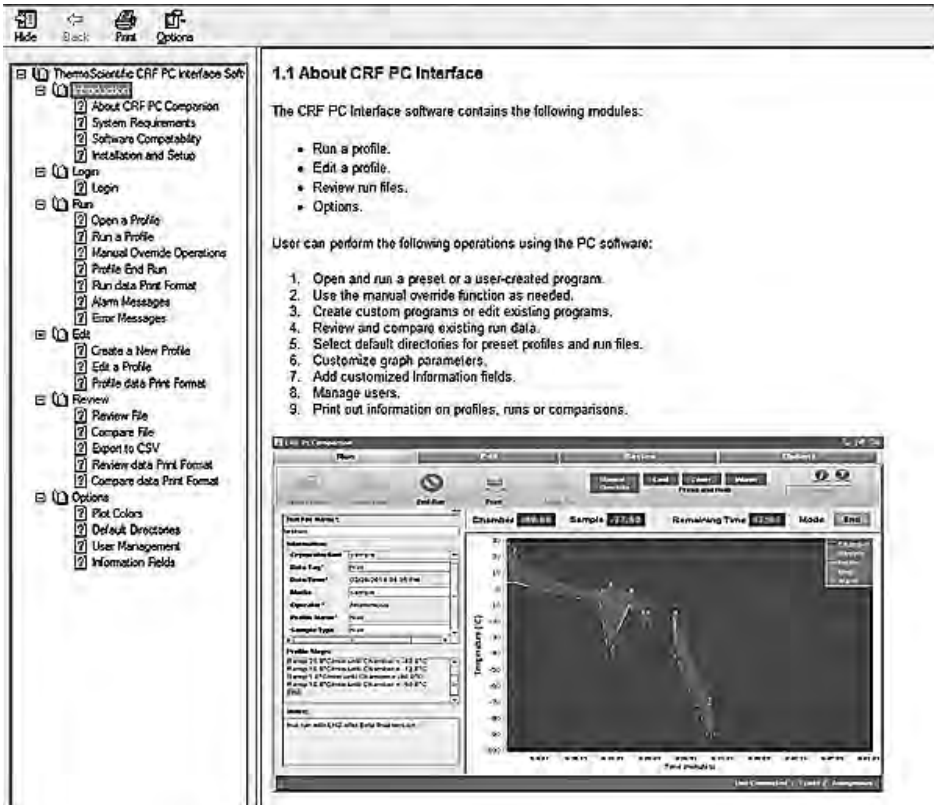


Figure 10-55. Help File

THERMO FISHER SCIENTIFIC PC AND PERIPHERAL WARRANTY

The warranty on any of the computer components must be referred to the component manufacturer. Please contact them as needed.

The Technical Services Department may be contacted for set-up and operational questions on the Controlled Rate Freezer and PC interface, 1-888-213-1790. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

If equipment service is required, please call your Technical Services Department at 1-800-438-4851 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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THERMO FISHER SCIENTIFIC INTERNATIONAL DEALER PC AND PERIPHERALS WARRANTY

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Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Thermo Services Department at 1-800-438-4851 (USA or Canada), or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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THERMO FISHER SCIENTIFIC CONTROLLED RATE FREEZER WARRANTY

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters, gaskets, personal computers, monitors and inkjet printers are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all defective parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed operating manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-800-438-4851 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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THERMO FISHER SCIENTIFIC INTERNATIONAL
CONTROLLED RATE FREEZER DEALER WARRANTY

The Warranty Period starts two months from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the first year warranty period. Dealers who stock our equipment are allowed an additional six months for delivery and installation, provided the warranty card is completed and returned to the Technical Services Department.

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor excluded. Installation and calibration are not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters, gaskets, personal computers, monitors & inkjet printers are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all defective parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

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Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-800-438-4851 (USA or Canada), or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special application. Outside the USA, contact your local distributor for warranty information.

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Handling Liquid Nitrogen

Warning Contact of liquid nitrogen or cold gas with the skin or eyes may cause serious freezing (frostbite) injury. ▲



Handle liquid nitrogen carefully.

The extremely low temperature can freeze human flesh very rapidly. When spilled on a surface, the liquid tends to cover it completely and intimately, cooling a large area. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as that of the eyes, can be damaged by an exposure to the cold gas which would be too brief to affect the skin of the hands or face.

Never allow any unprotected part of your body to touch objects cooled by liquid nitrogen.

Such objects may stick fast to the skin and tear the flesh when you attempt to free yourself. Use tongs to withdraw objects immersed in the liquid, and handle the object carefully.

Wear protective clothing.

Protect your eyes with a face shield or safety goggles (safety glasses without side shields do not give adequate protection). Always wear gloves when handling anything that is, or may have been, in immediate contact with liquid nitrogen. Insulated gloves are recommended, but heavy leather gloves may also be used. The gloves should fit loosely, so that they can be thrown off quickly if liquid should splash into them. When handling liquid in open containers, it is advisable to wear high-top shoes. Trousers (which should be cuffless if possible) should be worn outside the shoes.

Introduction

The safe handling and use of liquid nitrogen in cryogenic refrigerators and dewar flasks is largely a matter of knowing the potential hazards and using common-sense procedures based on that knowledge. There are two important properties of liquid nitrogen that present potential hazards:

1. It is extremely cold. At atmospheric pressure, liquid nitrogen boils at -320° F (-196°C).
2. Very small amounts of liquid vaporize into large amounts of gas. One liter of liquid nitrogen becomes 24.6 cu. ft. (0.7 m3) of gas.

The safety precautions in this manual must be followed to avoid potential injury or damage which could result from these two characteristics. Do not attempt to handle liquid nitrogen until you read and fully understand the potential hazards, their consequences, and the related safety precautions. Keep this information handy for ready reference and review.

Note Because argon is an inert gas whose physical properties are very similar to those of nitrogen, the precautions and safe practices for handling and use of liquid argon are the same as those for liquid nitrogen. ▲

Use containers designed for low temperature liquids.

Cryogenic containers are specifically designed and made of materials that can withstand the rapid changes and extreme temperature differences encountered in working with liquid nitrogen. Even these special containers should be filled SLOWLY to minimize the internal stresses that occur when any material is cooled. Excessive internal stresses can damage the container.

Do not cover or plug the entrance opening of any liquid nitrogen refrigerator or dewar. Do not use any stopper or other device that would interfere with venting of gas.

These cryogenic liquid containers are generally designed to operate with little or no internal pressure. Inadequate venting can result in excessive gas pressure which could damage or burst the container. Use only the loose-fitting necktube core supplied or one of the approved accessories for closing the necktube. Check the unit periodically to be sure that venting is not restricted by accumulated ice or frost.

Use proper transfer equipment.

Use a phase separator or special filling funnel to prevent splashing and spilling when transferring liquid nitrogen into or from a dewar or refrigerator. The top of the funnel should be partly covered to reduce splashing. Use only small, easily-handled dewars for pouring liquid. For the larger, heavier containers, use a cryogenic liquid withdrawal device to transfer liquid from one container to another. Be sure to follow instructions supplied with the withdrawal device. When liquid cylinders or other large storage containers are used for filling, follow the instructions supplied with those units and their accessories.

Do not overfill containers.

Filling above the bottom of the necktube (or specified maximum level) can result in overflow and spillage of liquid when the necktube core or cover is placed in the opening.

Never use hollow rods or tubes as dipsticks.

When a warm tube is inserted into liquid nitrogen, liquid will spout from the top of the tube due to gasification and rapid expansion of liquid inside the tube.



Warning Nitrogen gas can cause suffocation without warning! ▲

Store and use liquid nitrogen only in a well-ventilated place.

As the liquid evaporates, the resulting gas tends to displace the normal air from the area. In closed areas, excessive amounts of nitrogen gas reduce the concentration of oxygen and can result in asphyxiation. Because nitrogen gas is colorless, odorless and tasteless, it cannot be detected by the human senses and will be breathed as if it were air. Breathing an atmosphere that contains less than 18% oxygen can cause dizziness and quickly result in unconsciousness and death.

Note The cloudy vapor that appears when liquid nitrogen is exposed to the air is condensed moisture; not the gas itself. The issuing gas is invisible. ▲

Never dispose of liquid nitrogen in confined areas or places where others may enter.

Disposal of liquid nitrogen should be done outdoors in a safe place. Pour the liquid slowly on gravel or bare earth where it can evaporate without causing damage. Do not pour the liquid on pavement.

First Aid

If a person seems to become dizzy or loses consciousness while working with liquid nitrogen, move to a well-ventilated area immediately. If breathing has stopped, apply artificial respiration. If breathing is difficult, give oxygen. Call a physician. Keep warm and at rest.

If exposed to liquid or cold gas, restore tissue to normal body temperature (98.6°F) as rapidly as possible, followed by protection of the injured tissue from further damage and infection.

Remove or loosen clothing that may constrict blood circulation to the frozen area. Call a physician. Rapid warming of the affected part is best achieved by using water at 108°F. Under no circumstance should the water be over 112°F, nor should the frozen part be rubbed either before or after rewarming. The patient should neither smoke nor drink alcohol.

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