Model 7452 Series

CryoMed Controlled Rate Freezer

Operating and Maintenance Manual 7007452 Rev. 9

Thermo SCIENTIFIC

Non-IVF Units

Model	Voltage
7450	120
7451	230
7452	120
7453	230
7454	120
7455	230
7472	100
7473	100
7474	100

IVF Units

Model	Voltage
7456	120
7457	230
7458	120
7459	230
7475	100
7476	100

Software Addendum

1. Installation of the National Instruments LabView Run Time Engine is required for proper operation of the PC Interface Software.
2. A PDF version of the Windows Help file for the PC Interface Software is located on the CD-ROM. The file name is "Help_PC_Interface.pdf".
3. A "Read Me" file containing the known issues with Version 1.0 of the PC Interface Software is located on the CD-ROM. The file name is ReadMe.txt.
4. The Windows Help file can be accessed in the PC Interface Software Edit, Run, Review or Options screens by depressing the F1 key on the PC keyboard.
5. If password protection is enabled, note that user names and passwords are case sensitive.

MANUAL NUMBER 7007452

REV	ECR/ECN	DATE	DESCRIPTION	By
9	24391	1/21/08	Added PC operating system specs to Section 10	ccs
8	24326/SI-9956	12/19/07	Removed all IQ/OQ kits (obsolete)	ccs
7	23738/FR-1928	10/03/06	Corrected the calibration procedure for a recorder (Pg 3-1)	ccs
6	22854/FR-1860	5/11/05	Removed registration sheet, added password and data tag info	ccs
--	21878/FR-1735	9/16/03	Replaced P/N 103113 with 195986, 195987, 195988 SRO	ccs
5	21196/FR-1670	1/20/03	Add bend to bottom of probe guide tube	ccs
--	21141/FR-1670	1/20/03	Removed 4000714 kit, added 180254 cane holder and 4000211 cane	ccs
--	21280/FR-1670	1/20/03	Changed bottom hinge block to 190612 for baseline alignment	ccs
4	21059/FR-1642	10/9/02	Changed hinge block to 1900179 for better door alignment	ccs
--	--	6/14/02	Added power disconnect warning section 4.1 per S. Neill	aks
3	--	5/15/02	Received FDA clearance for use in human research	ccs
--	--	4/12/02	Added weight chart and new declarations of conformity for IVF units	ccs
--	20558/FR-1582	3/18/02	Updated schematics and wiring diagrams for external IVF connector/probe	ccs
2	20604/FR-1592	3/12/02	Updated schematics and wiring diagrams	aks
--	--	12/21/01	Added IVF models	ccs
1	--	11/12/01	Updated profiles	ccs
--	20382/FR1555	11/13/01	Change hinge mounting screws for freezer door	aks
0	200164/SI-8280	8/23/01	Original manual	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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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.

Hot surface(s) present which may cause burns to unprotected skin, or to materials which may be damaged by elevated temperatures.

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Table of Contents

Section 1 **Introduction 1-1**
Standard Features 1-2
Door Latch 1-2
Sample 'Seeding' Access Ports (IVF) 1-2
Displays 1-2
Indicators 1-3
Keys 1-3
Alarm 1-3
Output 1-3
Pre-set Profiles 1-4
Section 2 **Set-Up and Operation 2-1**
Supplies 2-3
Electrical Connections 2-3
Environmental Conditions 2-3
Sample Thermocouple Connection 2-4
Power-Up 2-4
Access Code Security 2-5
Initiate a Profile 2-5
Stop a Profile Run 2-6
Manual Override 2-7
Program User Specific Profiles 2-7
Copy and Paste Pre-set and User Profiles 2-10
Recorder 2-11
Printer 2-11
Alarms 2-12
Chamber Thermocouple Open 2-12
Sample Thermocouple Open 2-13
Heater Malfunction 2-14
LN_2 Supply 2-14
Chamber/Sample Over/Under Limit Temp 2-15
Power Failure 2-17
Run Complete 2-17
Warm Complete 2-18
Seeding Hold 2-18
Printer Buffer Full 2-18
IVF Sample Holders 2-18
Using a Vial Holder 2-19
Using the Straw Holder 2-19
Using the Cane Holder 2-20
Holder Adjustment 2-21

Section 3 Configuration/Calibration 3-1
Menu Structure 3-1
Menu Entry Definitions 3-1
Section 4 Maintenance 4-1
Disinfect Controlled Rate Freezer Interior 4-1
Clean a Major Spill in the Chamber 4-2
Clean the Cabinet Exterior 4-3
Clean Gasket/Heat Break 4-3
Section 5 Printer Set-Up 5-1
Change the Paper 5-1
Section 6 Specifications 6-1
Section 7 Parts List 7-1
Exploded Parts Drawings 7-3
Wiring Diagrams 7-15
Section 8 Electrical Schematics 8-1
Section 9 Troubleshooting 9-1
Section 10 PC Interface Software 10-1
Installation and Set-Up 10-2
Main Menu 10-2
Edit Screen 10-3
Create a New Freezer Profile 10-7
Edit an Existing Profile 10-8
Print a Profile Listing 10-8
Display Profile Temp Graph 10-9
Error Messages 10-9
Run Screen 10-10
User Control Definitions 10-10
Status Indicators 10-13
Operating Indicators 10-13
Typical Run Procedure 10-15
Power Failure Recovery 10-16
Error Messages 10-17
Display/Control Summary 10-18
Remote Mode 10-18
Stand Alone Mode 10-19
Running a Local Profile 10-19
Review Screen 10-19
Information Fields 10-19
User Controls 10-20
Options 10-23
Plot Color Selections 10-23
Information Field Set-Up 10-24
Default Directories 10-24
User Name and Password Maintenance 10-25
Saving Changes 10-26
Sharing Host PC Resources 10-26

Section 1 Introduction

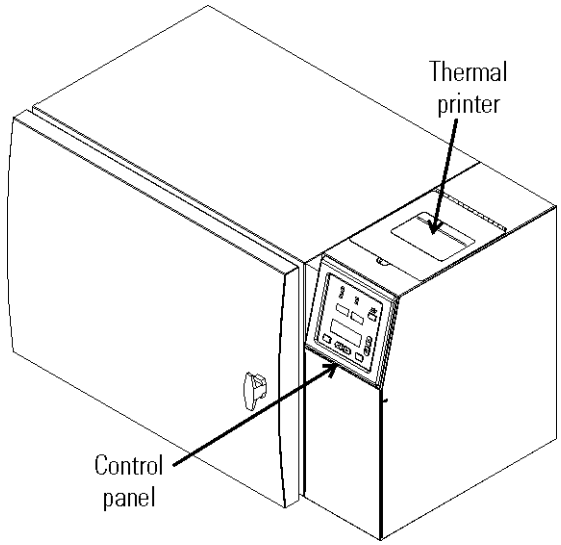


Figure 1-1. Non-IVF Controlled Rate Freezer

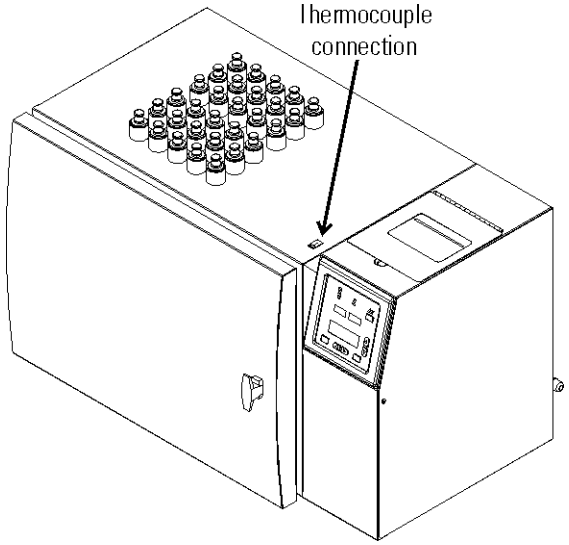


Figure 1-2. IVF Controlled Rate Freezer (FDA clearance for human research)

Standard Features

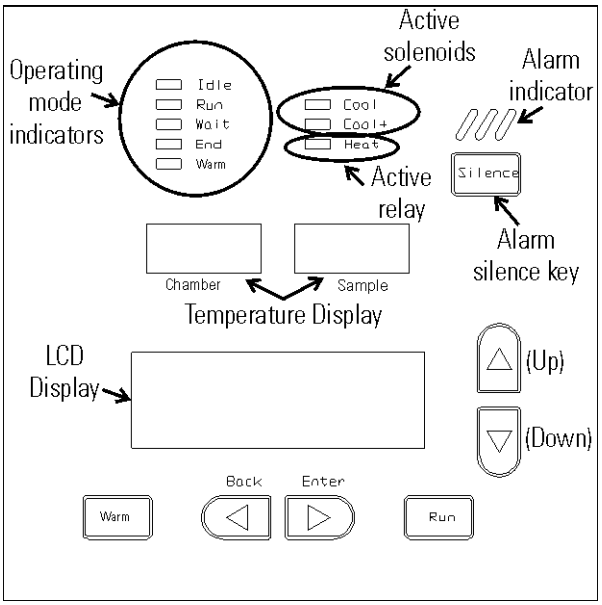


Figure 2-3. Control Panel Displays, Indicators and Keys

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 . . . . . .Single LN_2 solenoid is open

Cool+ . . . . . .Both LN_2 solenoids are open

Heat . . . . . .The 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. A connector is also available on the back of the unit for an optional strip chart temperature recorder.

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.

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 Profiles (continued)

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 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 Profiles (continued)

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. ▲

This freezer 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. (Do NOT attach anything to, or tamper with, the exhaust vent!) Locate the unit in close proximity to the LN_2 source.

Additional space for a temperature recording device may also be desired. The connector for a recorder is located on the back of the unit, next to the power connection.

When closing the freezer door, be sure to turn the handle 180° in rotation to fully seal the door.

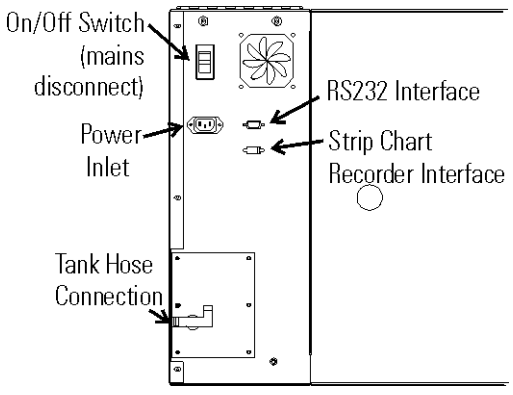
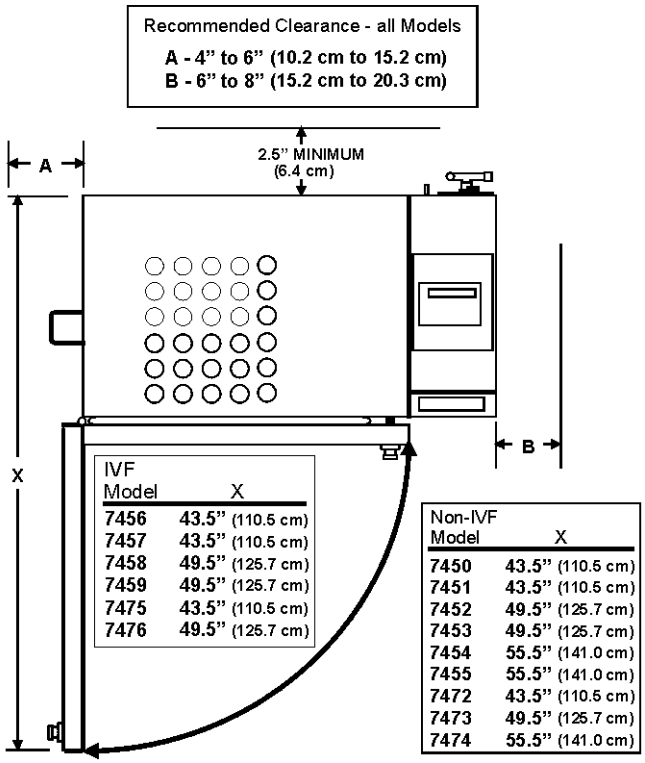
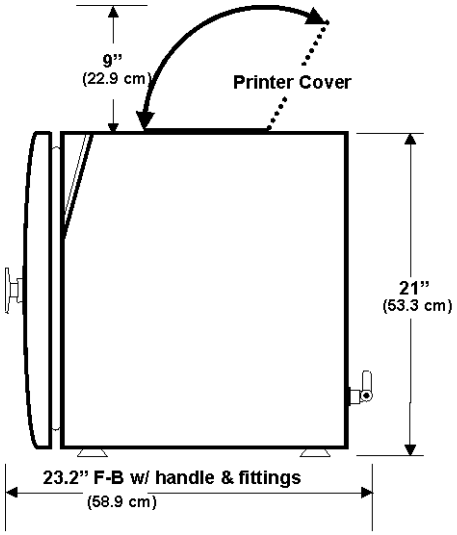


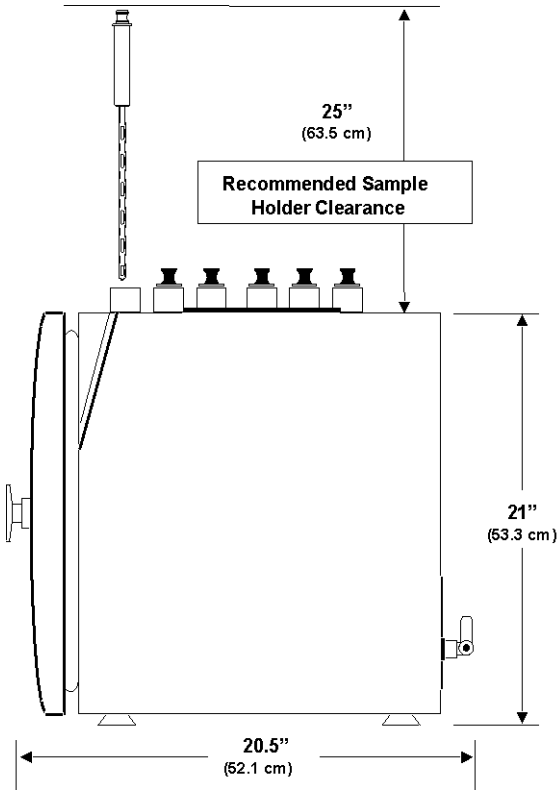
Figure 2-1. Connections on Unit Back



TOP VIEW



SIDE VIEW (NON-IVF ONLY)



SIDE VIEW (IVF ONLY)

Figure 2-2. Clearance for All Units

Supplies

The Controlled Rate Freezer requires a clean, low pressure (22 PSIG, ±30%) LIQUID nitrogen supply. Do not use the gas fitting on the supply tank! A dedicated supply tank/source is recommended for optimum operation. The tank hose connection, 1/2" flare fitting, is located on the back of the unit in the bottom left corner. Do not over-tighten when connecting. Internal plumbing could be damaged. Teflon tape is NOT recommended when installing LN_2 supply. The tape cannot withstand the low temperatures of this application. See Figure 2-1 for the connection location.

Electrical Connections

Refer to the electrical schematics or serial data tag on the unit for electrical specifications for the Controlled Rate Freezer.

1. Verify the power switch on the back of the unit is off.

2. Attach the power cord to the inlet on the back of the freezer. Connect the power cord to the appropriate power outlet.

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 I

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.

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 connector in the correct orientation.
4. Close the unit door.

IVF models

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

Note The freezer has been calibrated with the internal thermocouple connector. Refer to Section 3 for probe calibration. ▲

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

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.

Initiate a Profile (continued)

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 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.

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 5or 6 keys.

Note Pre-set Profiles may not be edited. ▲

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

Program User Specific Profiles (cont.)

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.

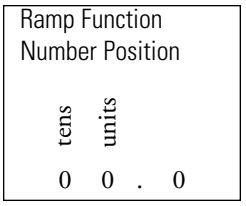


Figure 2-3. Cursor Positions

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.

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. ▲

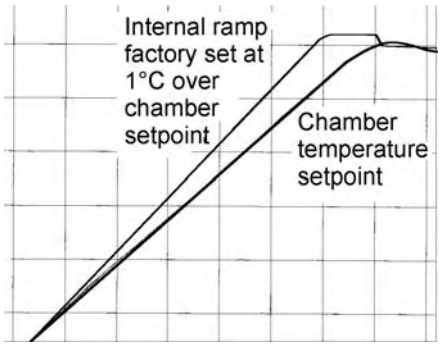


Figure 2-4. Ramp Settings

Program User Specific Profiles (cont.)

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 beep will sound at the end of the hold time.

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

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

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.

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. ▲

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.

Recorder

The recorder output connector on the back of the Controlled Rate Freezer provides an analog signal representing process temperature(s) that can be plotted on an optional strip chart recorder. The controller can be set to output Chamber or Sample temperature, a scanned combination of both, or Off. Refer to Section 3.

Note The chart recorder function is calibrated to match the non-linear scale on the chart recorder paper (P/N 197044). ▲

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. 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.

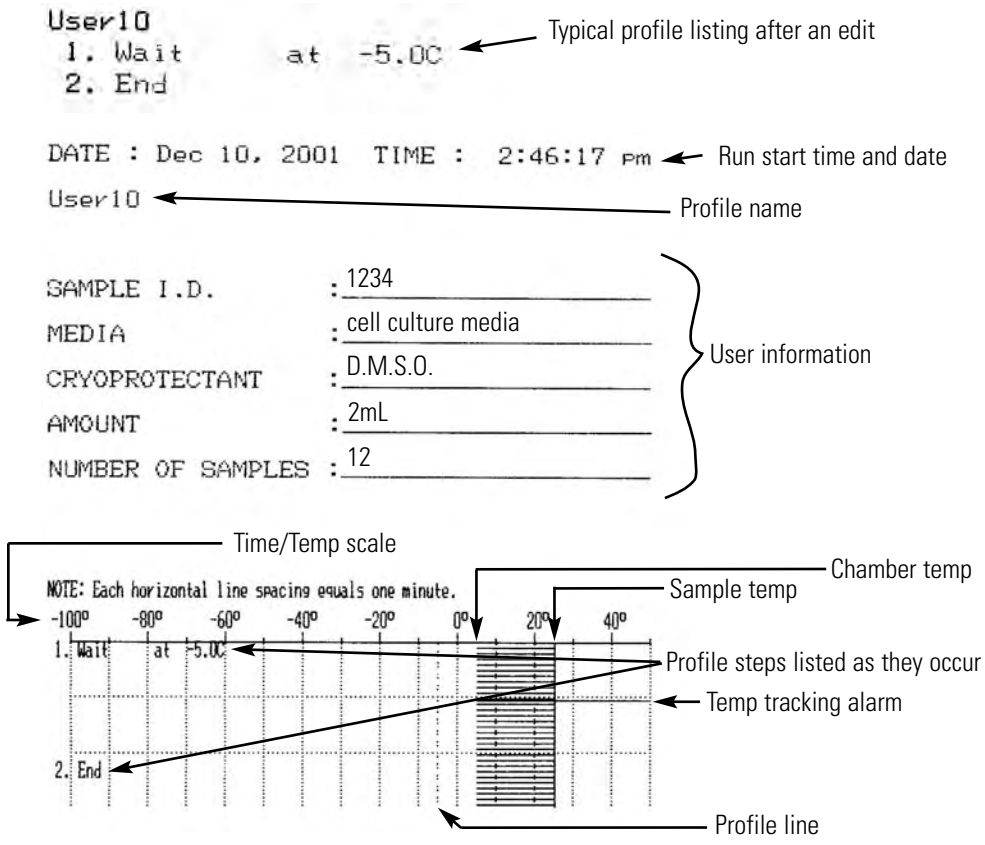


Figure 2-4. Print-outs

Alarms

- Alarm messages are shown on the fourth line of the LCD display
- Alarm messages alternate if multiple alarms are present at one time
- Alarms are cleared with the Silence key
- When an alarm message is shown, the unit will alternate between the alarm message(s) and the normal fourth line display at a rate of 2 seconds per message.
- Silence key - First depression silences the audible alarm. The second depression turns off the Alarm light and clears the message on the display if the alarm condition is resolved.

Chamber Thermocouple Open

If a chamber thermocouple cannot be detected:

- Audible alarm sounds continuously,
- Alarm indicator lights,
- Message “C sensor fail” shows on the LCD display,
- “ILL” shows on the numeric display (chamber),
- Freezer switches to Idle Mode and operating functions are disabled.

The audible alarm is silenced by the first depression of the Silence key. When the alarm condition has cleared, another depression of the Silence key is necessary to turn off the Alarm LED and clear the alarm message from the fourth line of the display. The numeric display message will revert to a normal temperature display when the alarm condition clears.

Sample Thermocouple Open

The freezer responds to an open Sample thermocouple in different ways, depending on what the unit is doing at the time or which freezing profile has been selected.

1. Idle Mode - If the probe fails or is removed by the operator during sample loading, while unit is in Idle Mode:
    - Alarm LED lights (no audible alarm),
    - LCD Display shows “S sensor fail” on the fourth line,
    - Sample numeric display shows “ILL”.

The operator may start a run that does not reference the Sample temperature, if the Sample probe is removed or open, and the Alarm LED and the fourth line LCD message are cleared using the Silence key. The run will proceed normally.

If the operator attempts to start a run using the Sample temperature for a trip point,

- Audible alarm sounds,
- Run start prevented,
- LCD Display shows “S sensor fail” on the fourth line, alternated with “S sensor req.”

The Alarm LED and display messages remain active until the probe condition is resolved.

2. Run Mode - If the Sample probe fails during Run Mode, and the current profile uses the Sample temperature as a trip point:
    - Alarm LED lights,
    - Audible alarm sounds continuously,
    - LCD Display shows “S sensor fail” on the fourth line, alternated with “S sensor req.”,
    - Sample numeric display shows “ILL”,
    - Immediately switches to Idle Mode,
    - Disables all control functions.

Pressing the Silence key will mute the audible alarm, however, the Alarm LED and display message will remain active until the probe condition is resolved.

Sample Thermocouple Open (continued)

If the Sample probe fails during Run Mode and the current profile does not use the Sample temperature as a trip point:

- Alarm LED lights,
- Audible alarm sounds continuously,
- LCD Display shows "S sensor fail" on the fourth line,
- Sample numeric display shows "ILL",
- Continue run normally.

Depressing the Silence key will silence the audible alarm and clear the Alarm LED and display messages. The numeric display "ILL", will remain until the probe condition is resolved.

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.

LN_2 Supply

If Cool/Cool+ solenoids are energized continuously (no active temperature control) for 30 minutes, the controller will sound an LN_2 supply alarm, light the Alarm LED, sound the audible alarm continuously, show the message "Check LN2 supply" 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. A second depression of the Silence key is necessary to turn off the Alarm LED and clear the fourth line message.

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.

Caution If performing successive runs, dry the gaskets and heat breaks between each run. ▲

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 2-5.

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.

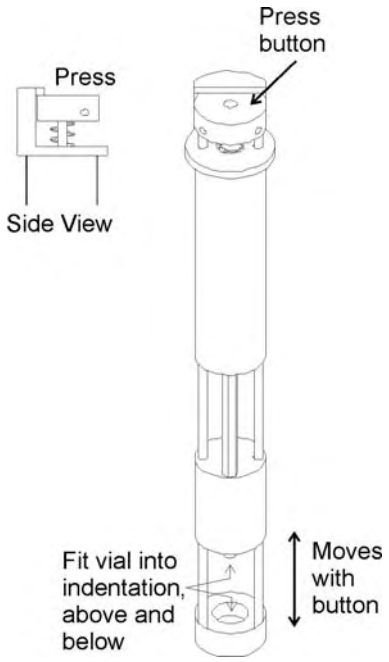


Figure 2-5. Vial Holder

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 2-6.

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.

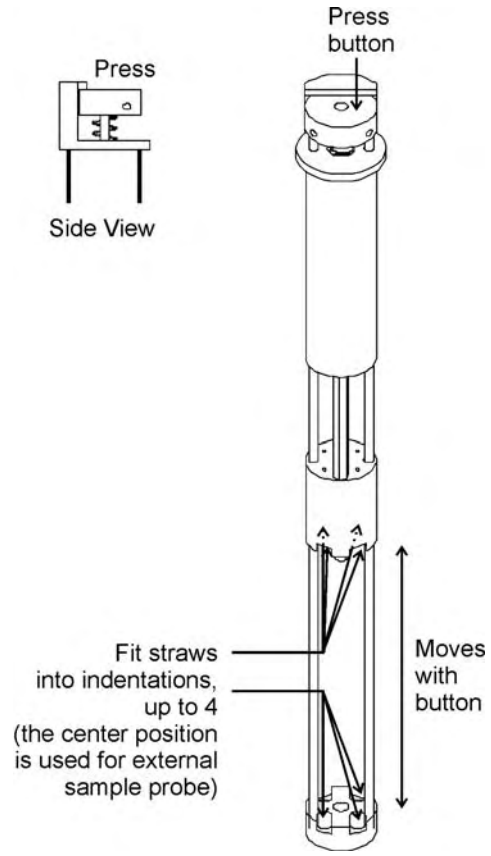


Figure 2-6. Straw Holder

Using the Cane Holder

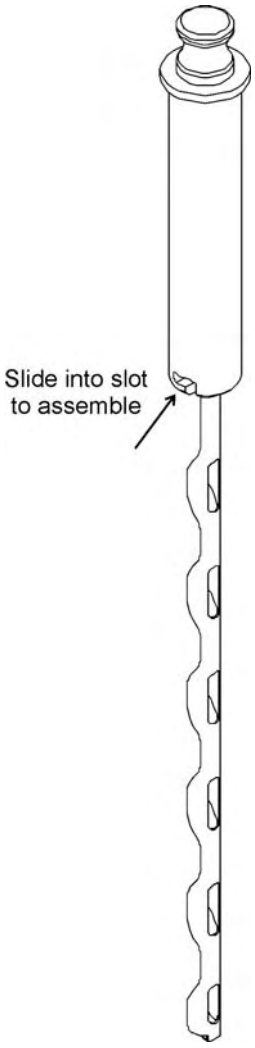


Figure 2-7. Cane Holder

The cane sample holder secures a cane for insertion through the access port on the top of the IVF freezer. See Figure 2-7. To use the cane holder, first assemble the aluminum holder to the plastic handle. Insert the cane holder assembly through the access port on the top of the unit. See 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 two sample probes at the same time. ▲

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.

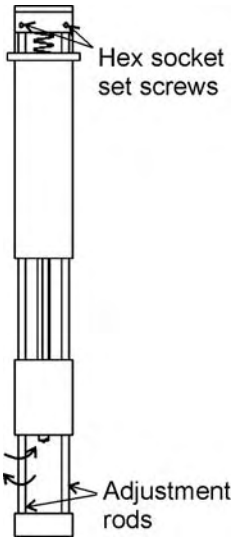


Figure 2-7. Vial Holder Adjustment

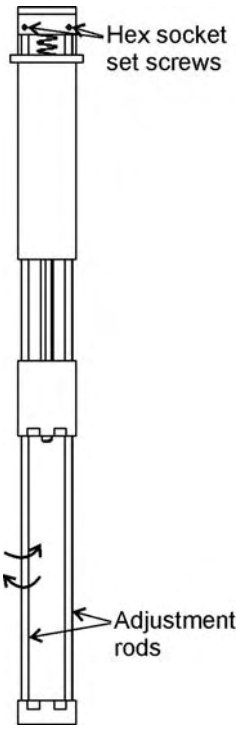


Figure 2-8. Straw Holder

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:

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 (P/N 197044). ▲

Optional Flatbed Recorder Calibration Procedure

1. Press the power switch on the flatbed recorder and allow the system to warm-up for 20 minutes.

2. Uncap and lower the pen to the graph paper.

3. From the freezer Configure-calibrate menu, select Chart Recorder. Turn the chart recorder on to Scan mode and press the Enter key.

4. Set the temperature to 0°C (zero). IMPORTANT: If the temperature is already set to 0°C, move it up or down 10°C, then back to 0°C. The recorder pen should move to 0°C. If it does not, adjust it using the zero knob on the recorder until the pen reaches 0°C.

5. Set the temperature to -180°C to simulate the low end of the scale. The recorder pen should move to -180°C. If it is out of calibration, adjust it using the small screw (accessible through the hole adjacent to the zero knob) until the pen reaches -180°C.

6. Recheck zero calibration as directed in Step 4. Repeat Steps 4 and 5 if necessary.

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.

Menu Entry Definitions (cont.)

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:

A duplicate of the print-out made during the Run. The print-out reflects the actual time and date of the run, rather than the current time and date.

Note The unit will store at least 2 hours of data. ▲

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.

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.

Menu Entry Definitions (cont.)

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. ▲

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.

Menu Entry Definitions (cont.)

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. ▲

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”.

Menu Entry Definitions (cont.)

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.

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).

Menu Entry Definitions (cont.)

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)
- 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. ▲

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

1. Turn the unit off and disconnect it from the power source.

Warning Be sure to disconnect the power source as the interior fan may start unexpectedly, under certain conditions. ▲

2. Disconnect the probe from the connector, if applicable. Remove the sample holders (IVF only).

3. Remove the two screws at the top and bottom of each side, securing the screened side ducts to the chamber. Set the ducts aside.

4. Press the top and bottom edges of the center duct toward each other and draw the duct outward to remove.

5. The chamber is now fully accessible and can be cleaned.

6. 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.

7. 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.

8. 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. ▲

9. Connect the Sample probe to the connector, if applicable.

10. All chamber parts must be re-installed for consistent uniformity and airflow. Connect the unit to the power source and turn it on.

11. 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. ▲

Clean Gasket/Heat Break

Dry any moisture from the door gasket and heat breaks between each run, using a soft cloth, to prevent ice build-up which could reduce the effectiveness of the door seal.

Section 5 Printer Set-Up

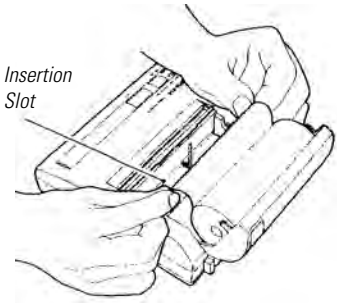
The built-in thermal printer has internal software switch settings that control how the printer interfaces with the Controlled Rate Freezer. These internal settings are pre-set at the factory for proper operation with the freezer. However, if the printer has to be replaced in the field, the settings 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

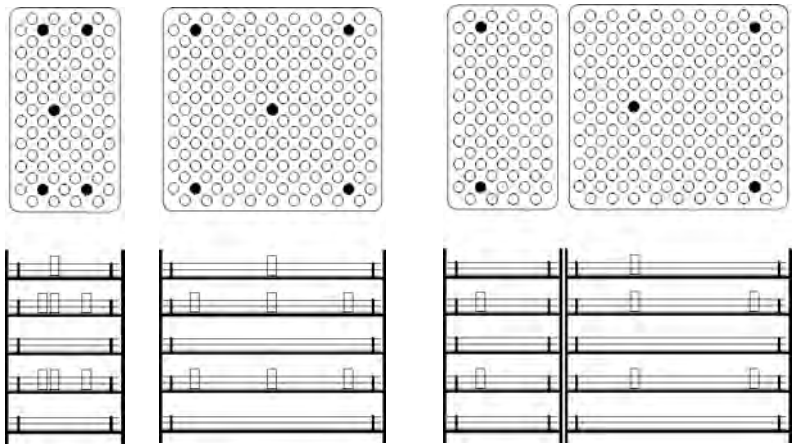
Parameter	Default from manufacturer	Required for CRF
DIP SW-1	**(switch setting)**	**(switch setting)**
1: Input	Parallel (ON)	Serial (OFF)
2: Printing Speed	High (ON)	High (ON)
3: Auto paper loading	Enabled (ON)	Enabled (ON)
4: Auto line feed	Disabled (OFF)	Disabled (OFF)
5: DIP switch setting	Enabled (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

Chamber Temperature Range

+50°C to -180°C

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 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. ▲

LN_2 Injection
Patented liquid refrigerant injection ring optimizes uniformity and air flow.

Patent # 6,044,648

Operating Environment
Ambient Temperature: 15°C to 35°C

Relative Humidity: 20% to 85% non-condensing

Insulation
Foamed-in-place polyurethane

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, a manual reset device interrupts power to the heating element.

External Connections
Power entry

Strip chart temperature recorder

PC interface port

LN2 connection 1/2” flare

External thermocouple jack (IVF models only)

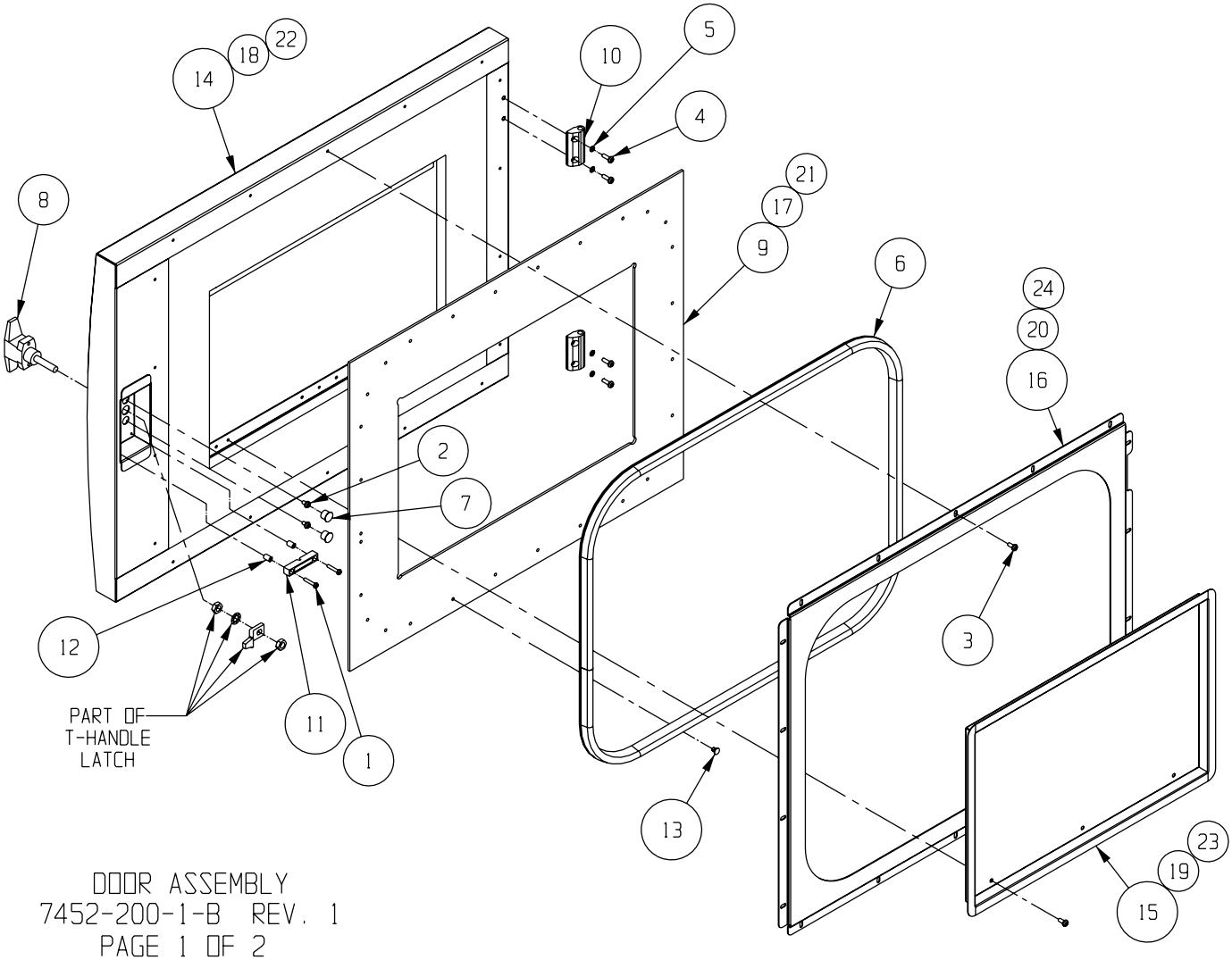
Sample access (IVF models only)

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
140296	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
201183	Thermal Data Printer
201185	120V Printer Power Supply
201186	100V Printer Power Supply
201187	230V Printer Power Supply
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
370248	T/C Plug Type T
370249	T/C Socket Type T
4000385	Internal Sample Probe 1.2 ml
4000386	Internal Sample Probe 4/5 ml

Part Number	Description
4000384	Internal Straw Probe
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
270158	DB9 Cable, 10 ft.
270159	DB25F to DB9M Adapter
8028	Flatbed Chart Recorder
4000404	PC Interface Software

IVF Models Only	
Part Number	**Description**
4000710	Straw Holder
4000711	Cane Holder
180254	Cane Holder Plug
180255	Access Port Plug
4000211	Cane
4000211	Cane, 1.2 ml, 6 ampule
180254	Cane Holder Plug
4000402	External Straw Sample Probe
4000403	External Vial Sample Probe
4000712	Sample T/C Vial with hole, 1.2 ml
4000713	Sample T/C Vial with hole, 2.0 ml
4007456	IVF CRF IQ/OQ Kit, vials
4007458	IVF CRF IQ/OQ Kit, straws

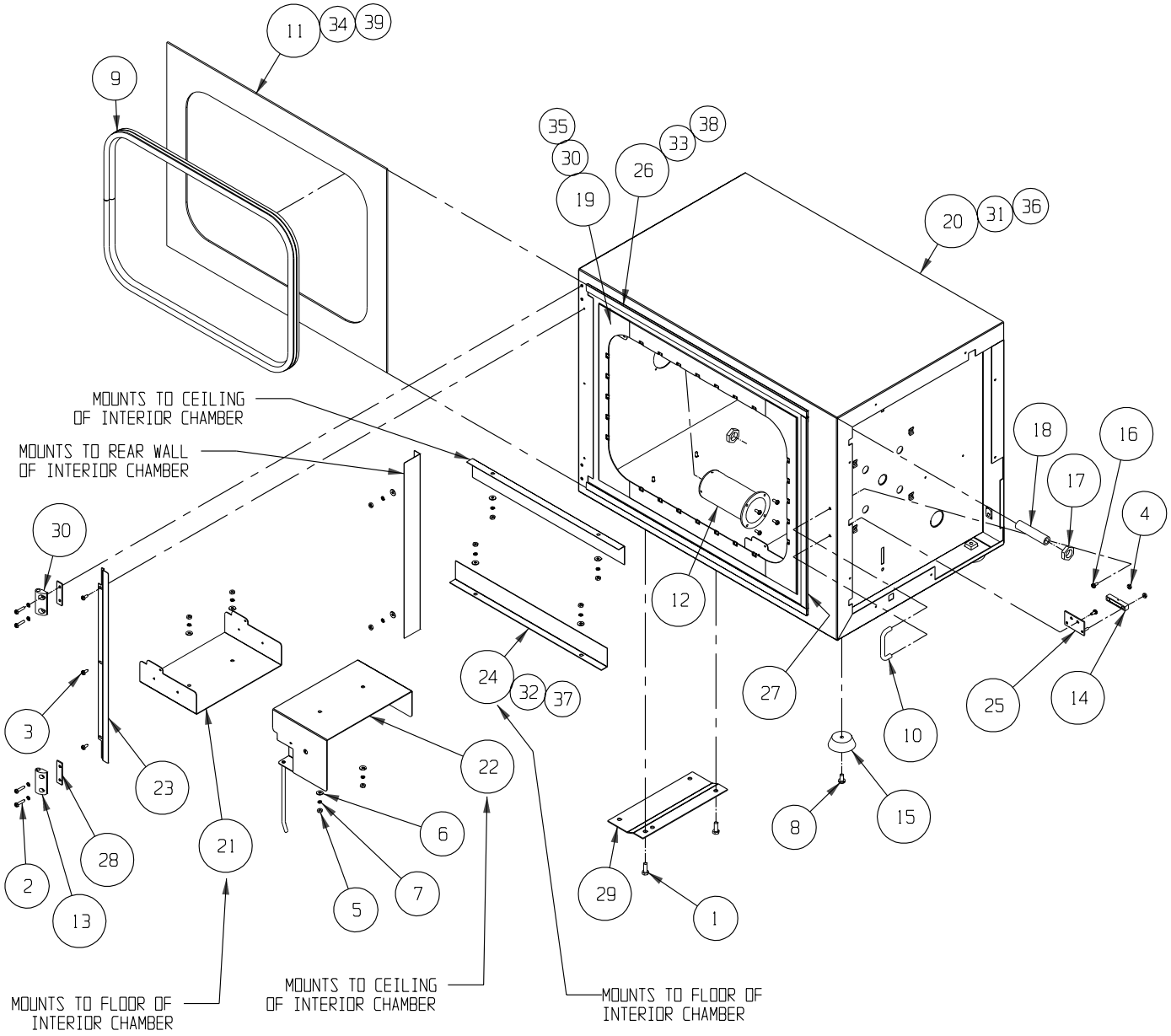


DOOR ASSEMBLY
7452-200-1-B REV. 1
PAGE 1 OF 2

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.

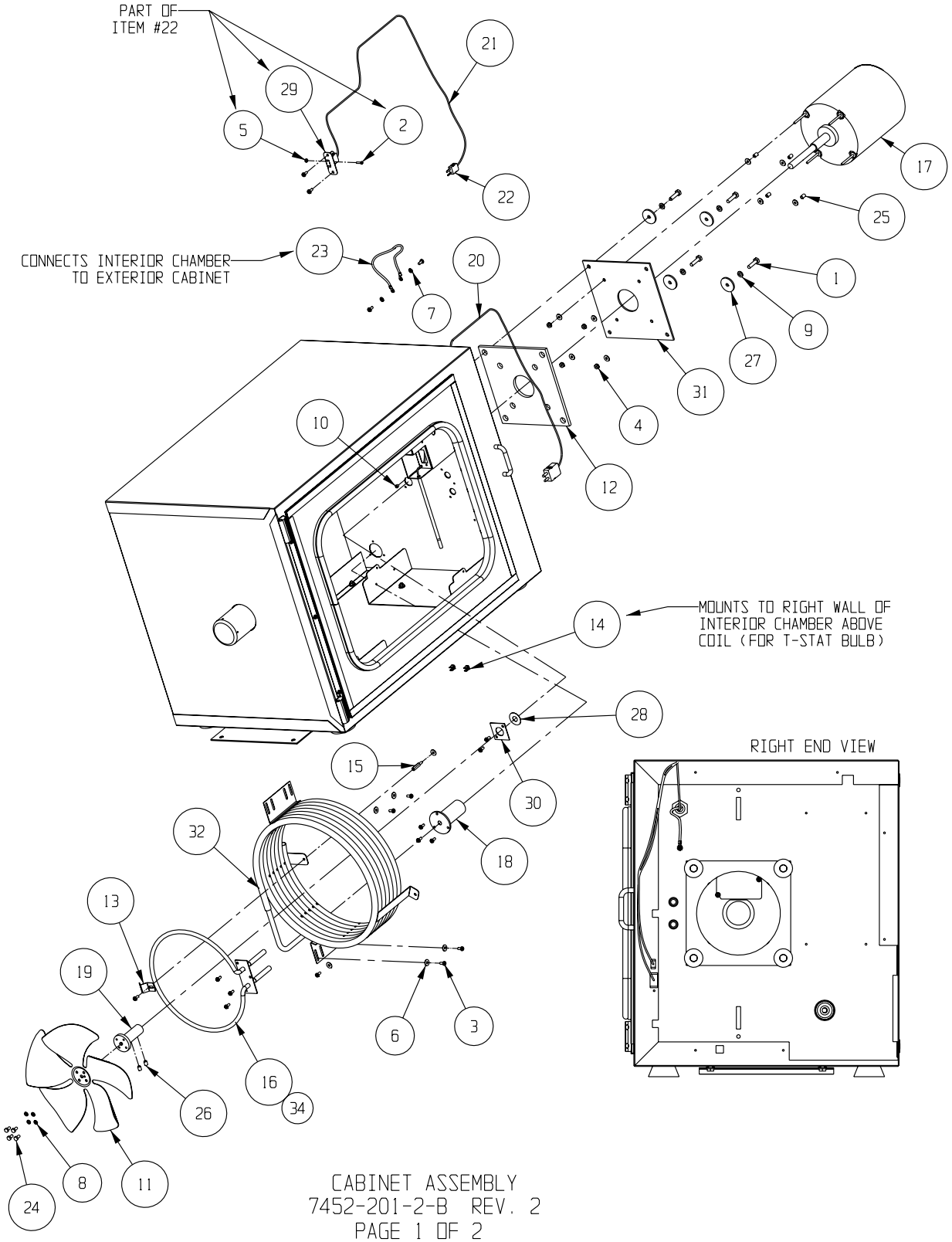
DOOR ASSEMBLY
7452-200-1-B REV. 1
PAGE 2 OF 2



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

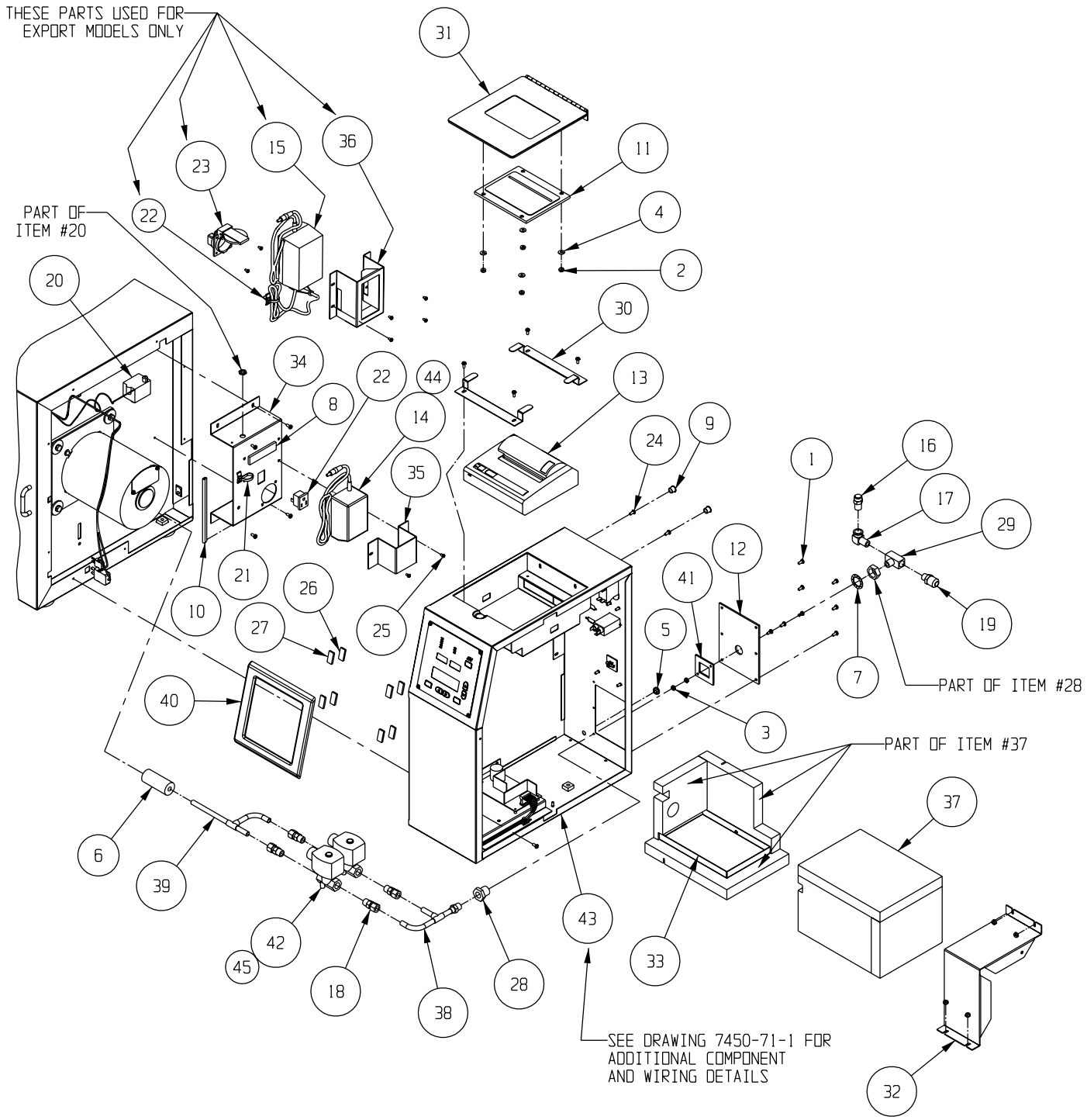
BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	20017	1/4-20 X 3/4 ZP HH CAP SCREW	2
2	22015	#8-32 X 3/4 SS PHP SCREW	4
3	22052	#8-32 X 3/8 SS PHP SCREW	7
4	23001	#6-32 ZP LKWASH HEX NUT	2
5	23010	#8-32 SS HEX NUT	14
6	23021	#8 SS FLAT WASHER	14
7	23080	#8 SS SPRING LOCKWASHER	18
8	59000	1/4-20 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)
RIGHT END VIEW
CABINET ASSEMBLY
7452-201-2-B REV. 2
PAGE 1 OF 2

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	22052	#8-32 X 3/8 SS PHP SCREW	18
4	23002	#8-32 ZP LKWASH HEX NUT	4
5	23005	#4-40 SS HEX NUT	1
6	23021	#8 SS FLAT WASHER	14
7	23059	#8 SS EXT TOOTH LOCKWASHER	2
8	23082	#10 SS SPRING LOCKWASHER	4
9	23084	1/4 SS SPRING LOCKWASHER	4
10	30092	3/16" SHORTY SNAP BUSHING	1
11	100116	10" CW FAN BLADE 40° PITCH	1
12	100117	MOTOR FACE MOUNTING PLATE GASKET	1
13	111002	3/8" PROBE CLIP	1
14	111022	1/4 DIA. BRASS FUSE CLIP	2
15	127075	#8-32 X .813 LONG M-F STANDOFF	1
16	137017	945 WATT 115V TUBULAR HEATER	1
17	156123	1/4 HP BLOWER MOTOR 1725 RPM	1
18	180217	INJECT LINE COLLAR	1
19	195715	FAN BLADE/MOTOR HUB	1
20	290170	CRF T-TYPE CHAMBER PROBE	1
21	290171	CRF T-TYPE EXTENSION CABLE	1
22	370248	THERMOCOUPLE PLUG TYPE T	1
23	430240	FLAT BRAID GROUND STRAP	1
24	510033	#10-32 X 3/8 SS HH MACH. SCREW	4
25	515084	1/4 DIA. X 3/8L SS SPACER	4
26	700036	1/4-28 X 3/8 LG S.S. HEX SOCKET SET SCREW	2
27	730059	11 GA. SS 2B FLAT WASHER	4
28	730071	.450 ID TEFLON FLAT WASHER	1
29	1890008	SAMPLE PROBE CONNECTOR MOUNT	1
30	1890009	SHAFT SEAL PLATE	1
31	1890012	MOTOR MOUNTING PLATE	1
32	1890040	LN2 INJECT COIL SUB-ASSEMBLY	1
34	137018	945 WATT 230V TUBULAR HEATER (EXPORT ONLY)	1

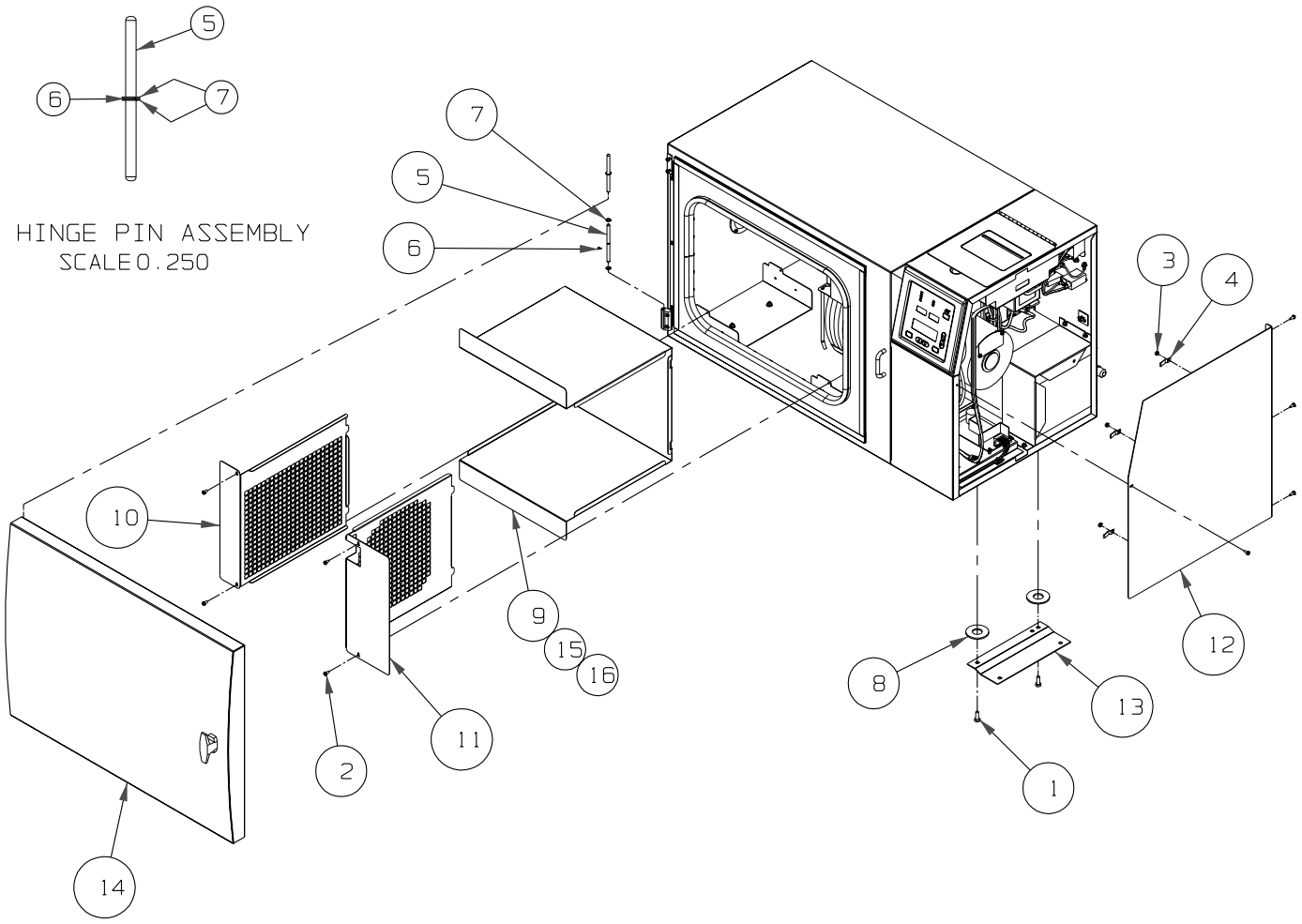
CABINET ASSEMBLY
7452-201-2-B REV. 2
PAGE 2 OF 2



CONTROL HOUSING ASSEMBLY
7452-201-3-B REV. 0
PAGE 1 OF 2

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	100057	3/16 X 3/4 BLACK TAPE GASKET	1
9	117018	7/16" DIA. BLACK HOLE PLUG	2
10	123020	NYLON EDGE PROTECTOR	1
11	180216	PRINTER WINDOW/PAPER CUTTER	1
12	180230	BULKHEAD HEATBREAK	1
13	201183	THERMAL DATA PRINTER	1
14	201185	120V 60HZ PRINTER POWER SUPPLY	1
15	201187	230V 50HZ PRINTER POWER SUPPLY	1
16	251008	1/4 MPT 60 PSI RELIEF VALVE	1
17	380181	1/4 X 90 BRASS STREET ELBOW	1
18	380224	3/8 COMP X 1/4 MPT BRASS CONNECTOR	4
19	380260	1/2 FLARE X 1/4 MPT CONNECTOR	1
20	400148	200F MANUAL RESET T-STAT	1
21	440022	PUSH MOUNT TIE AND ANCHOR	1
22	460024	SNAP-IN OUTLET, WHITE	1
23	460128	220V EUROPEAN RECEPT. W/COVER	1
24	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW	10
25	590027	#6-32 X 1/4 SS PHP EXT SEMS SCREW	8
26	640037	DUAL LOCK FASTENER TYPE 400	4
27	640038	DUAL LOCK FASTENER TYPE 170	4
28	800031	1/4 FPT ANCHOR COUPLING	1
29	800032	1/4 PIPE MALE BRANCH TEE	1
30	1890014	PRINTER CLAMP	2
31	1890015	PRINTER COVER SUB-ASSEMBLY	1
32	1890022	VALVE BOX BRACKET	1
33	1890023	DRIP PAN SUB-ASSEMBLY	1
34	1890024	COMPONENT MOUNTING BRACKET SUB-ASSEMBLY	1
35	1890025	DOMESTIC POWER SUPPLY HOLD-DOWN	1
36	1890026	EXPORT POWER SUPPLY HOLD-DOWN	1
37	1890031	PLUMBING INSULATION SUB-ASSEMBLY	1
38	1890049	LN2 INLET PLUMBING SUB-ASSEMBLY	1
39	1890050	LN2 OUTLET PLUMBING SUB-ASSEMBLY	1
40	1890051	PAINTED CONTROL PANEL BEZEL	1
41	1890054	BULKHEAD RETAINING PLATE	1
42	4000617	120V BRASS SOLENOID VALVE	2
43		CONTROL HOUSING ASSEMBLY	1
44	201186	100V 50/60HZ PRINTER POWER SUPPLY (JAPAN ONLY)	1
45	4000618	220V BRASS SOLENOID VALVE (EXPORT ONLY)	2

CONTROL HOUSING ASSEMBLY
7452-201-3-B REV. 0
PAGE 2 OF 2



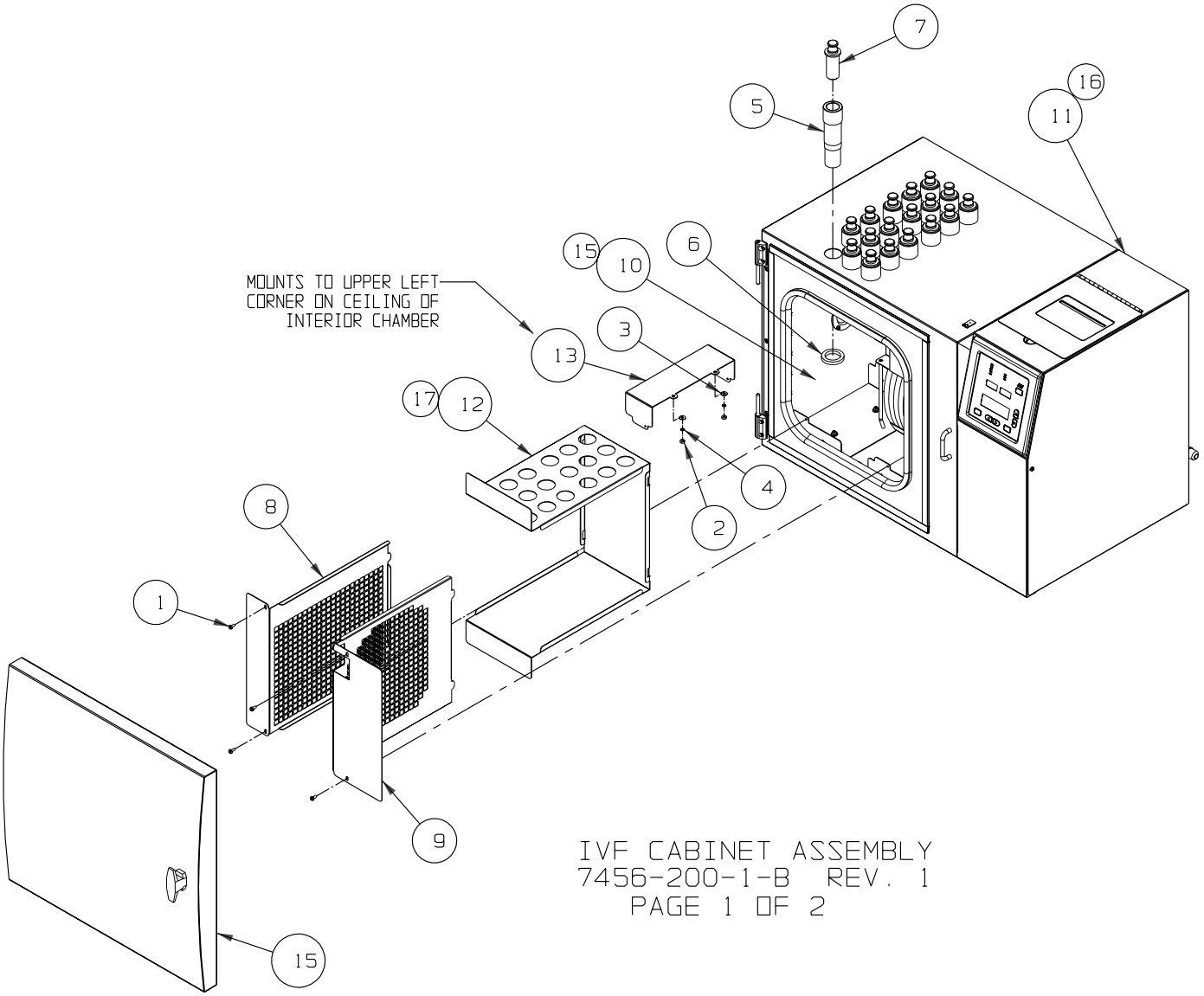
CABINET ASSEMBLY
7452-201-4 REV. 1
PAGE 1 OF 2

BILL OF MATERIALS			
ITEM	PART NO.	PART DESCRIPTION	QTY
1	20017	1/4-20 X 3/4 ZP HH CAP SCREW	2
2	22052	#8-32 X 3/8 SS PHP SCREW	8
3	23001	#6-32 ZP LKWASH HEX NUT	4
4	111035	FLAT SPRING CLAMP	4
5	190611	STAINLESS STEEL HINGE PIN	2
6	650012	.250 DIA. EXTERNAL RETAINING RING	2
7	730036	.247 ID TEFLON FLAT WASHER	4
8	730063	FLAT WASHER SHIM	2
9	1890005	INTERIOR DUCT WRAP	1
10	1890006	INTERIOR LEFT SIDE GRILLE	1
11	1890007	INTERIOR RIGHT SIDE GRILLE	1
12	1890016	SIDE ACCESS PANEL SUB-ASSEMBLY	1
13	1890053	SHIPPING BRACKET	1
14		DOOR ASSEMBLY	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)
4000385 2ML SAMPLE THERMOCOUPLE SENSOR
4000401 6 FT. TRANSFER HOSE
4000566 THERMAL PRINTER PAPER (5 ROLLS)
7007452 CONTROLLED RATE FREEZER MANUAL
THERMAL PRINTER MANUAL

CABINET ASSEMBLY
7452-201-4 REV. 1
PAGE 2 OF 2

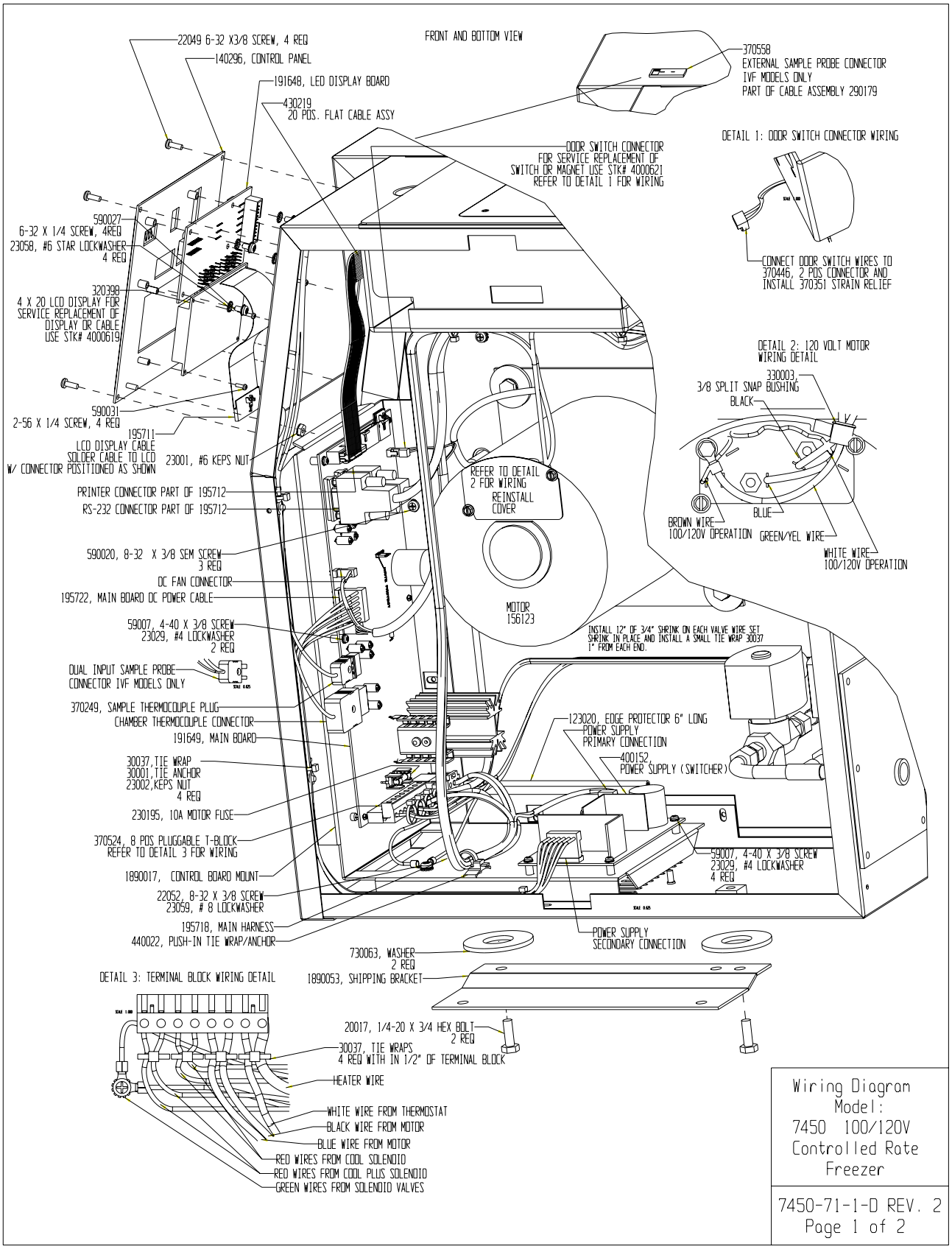


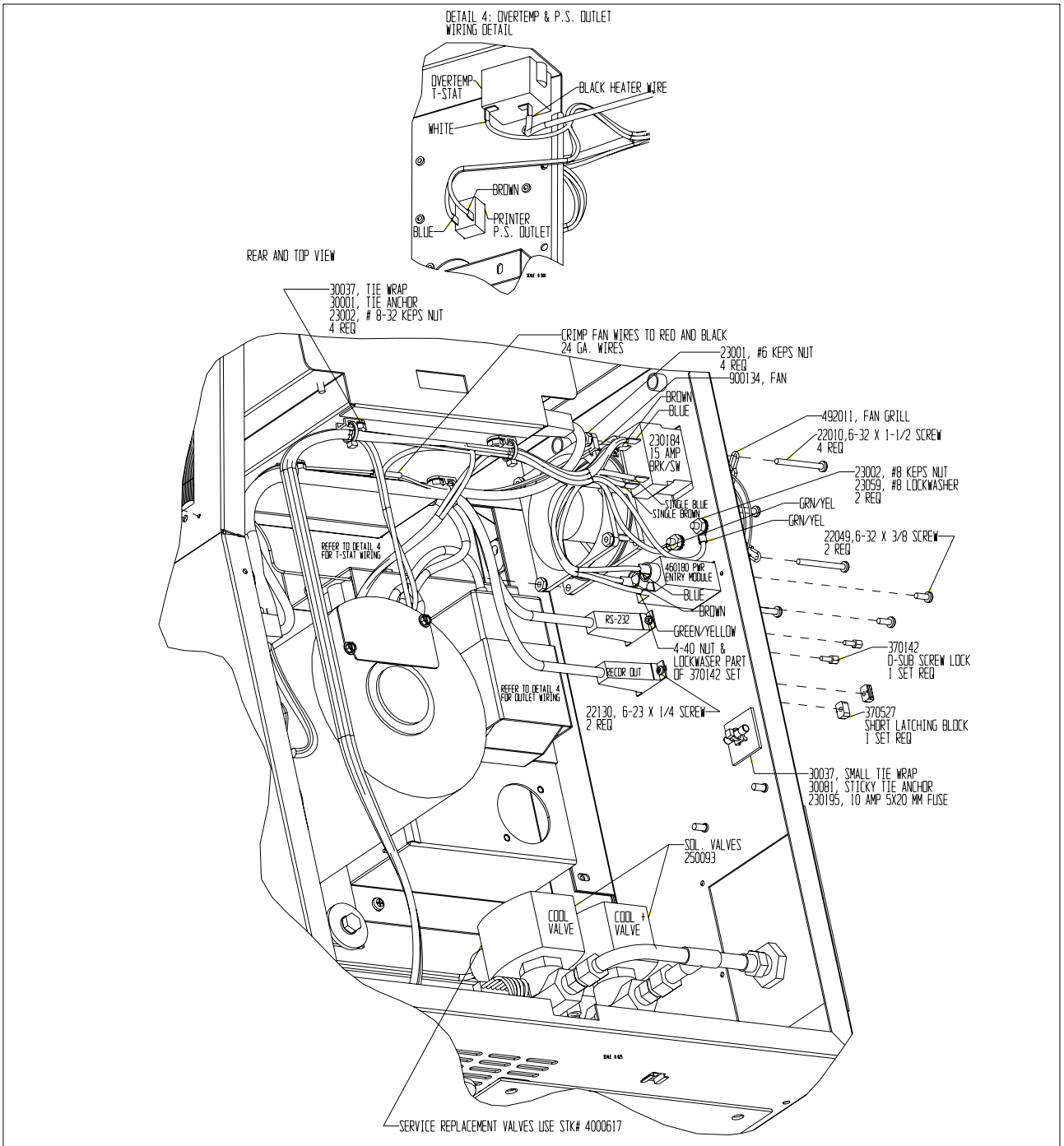
IVF CABINET ASSEMBLY
7456-200-1-B REV. 1
PAGE 1 OF 2

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


FRONT AND BOTTOM VIEW
22049 6-32 X3/8 SCREW, 4 REQ
140296, CONTROL PANEL
191648, LED DISPLAY BOARD
430219
20 POS. FLAT CABLE ASSY
370558
EXTERNAL SAMPLE PROBE CONNECTOR
IVF MODELS ONLY
PART OF CABLE ASSEMBLY 290179
DOOR SWITCH CONNECTOR
FOR SERVICE REPLACEMENT OF
SWITCH OR MAGNET USE STK# 4000621
REFER TO DETAIL 1 FOR WIRING
DETAIL 1: DOOR SWITCH CONNECTOR WIRING
CONNECT DOOR SWITCH WIRES TO
370446, 2 POS CONNECTOR AND
INSTALL 370351 STRAIN RELIEF
590027
6-32 X 1/4 SCREW, 4REQ
23058, #6 STAR LOCKWASHER
4 REQ
320398
4 X 20 LCD DISPLAY FOR
SERVICE REPLACEMENT OF
DISPLAY OR CABLE
USE STK# 4000619
590031
2-56 X 1/4 SCREW, 4 REQ
195711
LCD DISPLAY CABLE
SOLDER CABLE TO LCD
W/ CONNECTOR POSITIONED AS SHOWN
23001, #6 KEPS NUT
DETAIL 2: 120 VOLT MOTOR
WIRING DETAIL
330003,
3/8 SPLIT SNAP BUSHING
BLACK
BLUE
BROWN WIRE
100/120V OPERATION
GREEN/YEL WIRE
WHITE WIRE
100/120V OPERATION
REFER TO DETAIL
2 FOR WIRING
REINSTALL
COVER
PRINTER CONNECTOR PART OF 195712
RS-232 CONNECTOR PART OF 195712
590020, 8-32 X 3/8 SEM SCREW
3 REQ
DC FAN CONNECTOR
195722, MAIN BOARD DC POWER CABLE
MOTOR
156123
59007, 4-40 X 3/8 SCREW
23029, #4 LOCKWASHER
2 REQ
INSTALL 12" OF 3/4" SHRINK ON EACH VALVE WIRE SET
SHRINK IN PLACE AND INSTALL A SMALL TIE WRAP 30037
1" FROM EACH END.
DUAL INPUT SAMPLE PROBE
CONNECTOR IVF MODELS ONLY
370249, SAMPLE THERMOCOUPLE PLUG
CHAMBER THERMOCOUPLE CONNECTOR
191649, MAIN BOARD
123020, EDGE PROTECTOR 6" LONG
POWER SUPPLY
PRIMARY CONNECTION
400152,
POWER SUPPLY (SWITCHER)
30037,TIE WRAP
30001,TIE ANCHOR
23002,KEPS NUT
4 REQ
230195, 10A MOTOR FUSE
370524, 8 POS PLUGGABLE T-BLOCK
REFER TO DETAIL 3 FOR WIRING
59007, 4-40 X 3/8 SCREW
23029, #4 LOCKWASHER
4 REQ
1890017, CONTROL BOARD MOUNT
22052, 8-32 X 3/8 SCREW
23059, # 8 LOCKWASHER
195718, MAIN HARNESS
440022, PUSH-IN TIE WRAP/ANCHOR
POWER SUPPLY
SECONDARY CONNECTION
730063, WASHER
2 REQ
1890053, SHIPPING BRACKET
DETAIL 3: TERMINAL BLOCK WIRING DETAIL
20017, 1/4-20 X 3/4 HEX BOLT
2 REQ
30037, TIE WRAPS
4 REQ WITH IN 1/2" OF TERMINAL BLOCK
HEATER WIRE
WHITE WIRE FROM THERMOSTAT
BLACK WIRE FROM MOTOR
BLUE WIRE FROM MOTOR
RED WIRES FROM COOL SOLENOID
RED WIRES FROM COOL PLUS SOLENOID
GREEN WIRES FROM SOLENOID VALVES
Wiring Diagram
Model:
7450 100/120V
Controlled Rate
Freezer
7450-71-1-D REV. 2
Page 1 of 2



REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
2	FR-1582	03-08-02	RTT	RTT	AKS	ADD EXTERNAL IVE PROBE CONNECTION
1	FR-1592	02-21-02	RTT	PDK	LDN	ADDED MOTOR FUSE TO DRAWING
0	N/A	8/16/01	RTT	RTT	BH	RELEASED FOR PRODUCTION

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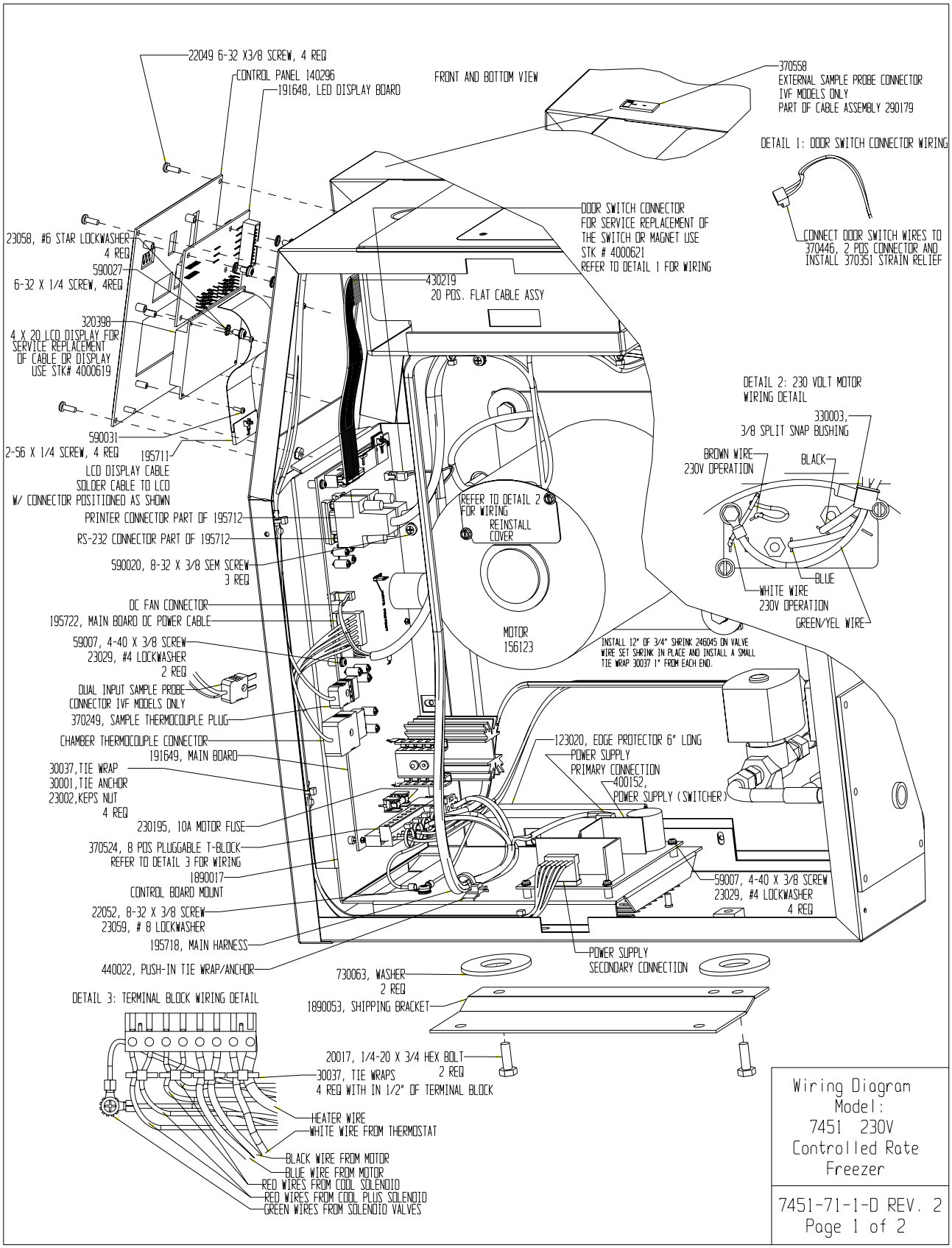
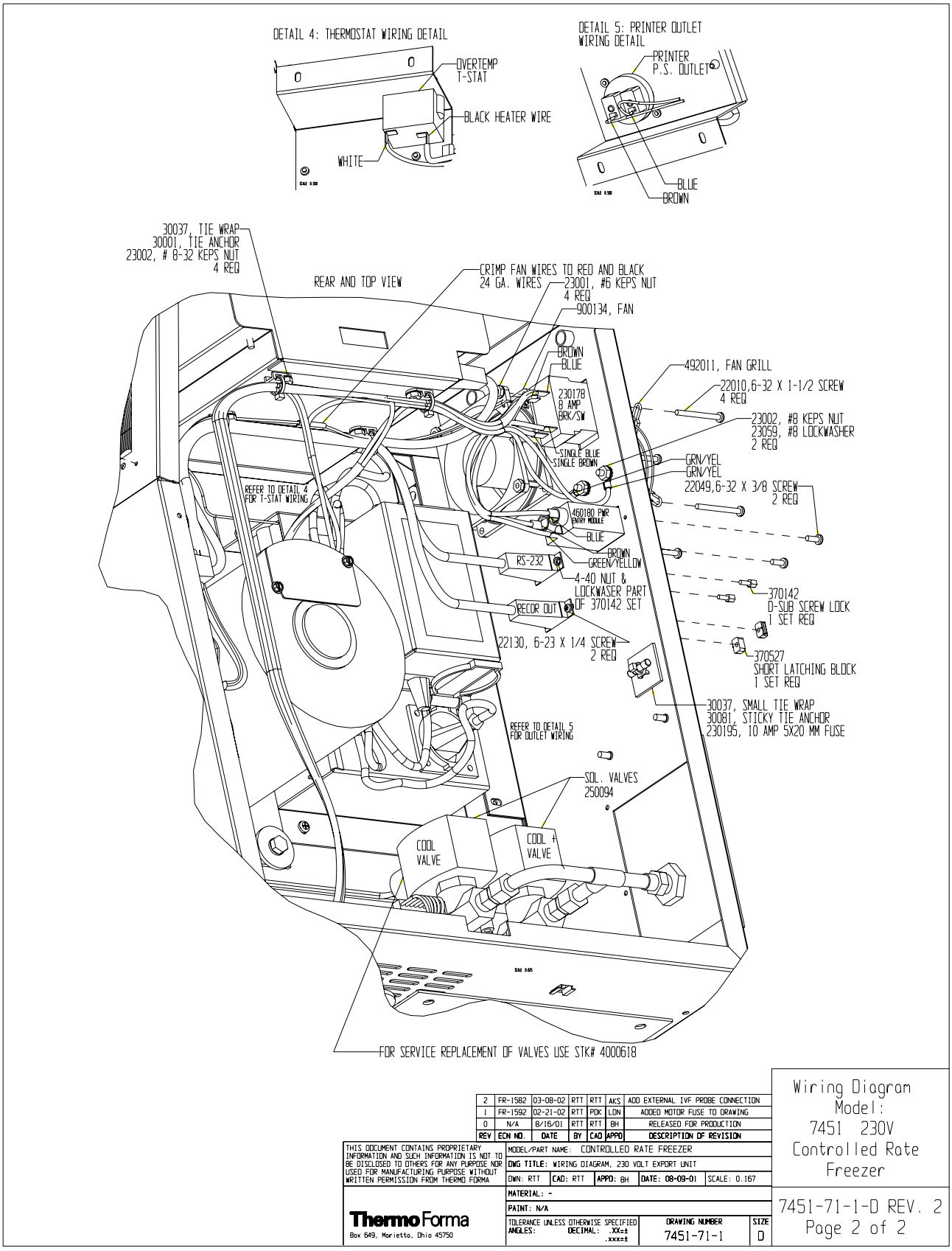
MODEL/PART NAME: CONTROLLED RATE FREEZER
DWG TITLE: WIRING DIAGRAM, 100 AND 120 VOLT UNITS
DWN: RTT | CAD: RTT | APPD: LDN | DATE: 08-09-01 | SCALE: 0.167
MATERIAL: -
PAINT: N/A
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX±
.XXX±
DRAWING NUMBER 7450-71-1
SIZE D

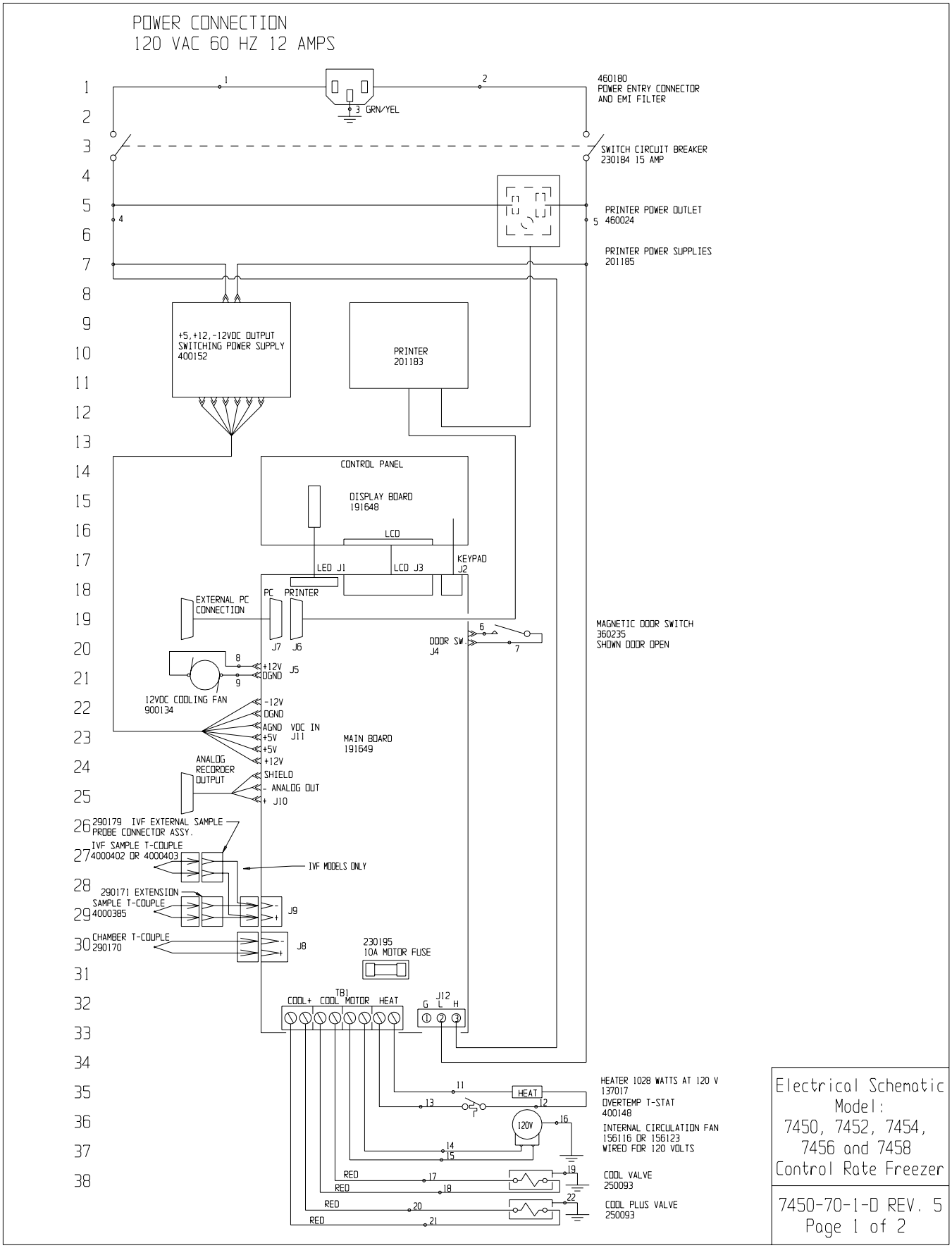
Thermo Forma
Box 649, Marietta, Ohio 45750

Wiring Diagram
Model:
7450 100/120V
Controlled Rate
Freezer

7450-71-1-D REV. 2
Page 2 of 2


22049 6-32 X3/8 SCREW, 4 REQ
CONTROL PANEL 140296
191648, LED DISPLAY BOARD
FRONT AND BOTTOM VIEW
370558
EXTERNAL SAMPLE PROBE CONNECTOR
IVF MODELS ONLY
PART OF CABLE ASSEMBLY 290179
DETAIL 1: DOOR SWITCH CONNECTOR WIRING
CONNECT DOOR SWITCH WIRES TO
370446, 2 POS CONNECTOR AND
INSTALL 370351 STRAIN RELIEF
DOOR SWITCH CONNECTOR
FOR SERVICE REPLACEMENT OF
THE SWITCH OR MAGNET USE
STK # 4000621
REFER TO DETAIL 1 FOR WIRING
23058, #6 STAR LOCKWASHER
4 REQ
590027
6-32 X 1/4 SCREW, 4REQ
430219
20 POS. FLAT CABLE ASSY
320398
4 X 20 LCD DISPLAY FOR
SERVICE REPLACEMENT
OF CABLE OR DISPLAY
USE STK# 4000619
DETAIL 2: 230 VOLT MOTOR
WIRING DETAIL
330003,
3/8 SPLIT SNAP BUSHING
BROWN WIRE
230V OPERATION
BLACK
BLUE
WHITE WIRE
230V OPERATION
GREEN/YEL WIRE
590031
2-56 X 1/4 SCREW, 4 REQ
195711
LCD DISPLAY CABLE
SOLDER CABLE TO LCD
W/ CONNECTOR POSITIONED AS SHOWN
PRINTER CONNECTOR PART OF 195712
RS-232 CONNECTOR PART OF 195712
REFER TO DETAIL 2
FOR WIRING
REINSTALL
COVER
590020, 8-32 X 3/8 SEM SCREW
3 REQ
DC FAN CONNECTOR
195722, MAIN BOARD DC POWER CABLE
MOTOR
156123
INSTALL 12" OF 3/4" SHRINK 246045 ON VALVE
WIRE SET SHRINK IN PLACE AND INSTALL A SMALL
TIE WRAP 30037 1" FROM EACH END.
59007, 4-40 X 3/8 SCREW
23029, #4 LOCKWASHER
2 REQ
DUAL INPUT SAMPLE PROBE
CONNECTOR IVF MODELS ONLY
370249, SAMPLE THERMOCOUPLE PLUG
CHAMBER THERMOCOUPLE CONNECTOR
191649, MAIN BOARD
123020, EDGE PROTECTOR 6" LONG
POWER SUPPLY
PRIMARY CONNECTION
400152,
POWER SUPPLY (SWITCHER)
30037,TIE WRAP
30001,TIE ANCHOR
23002,KEPS NUT
4 REQ
230195, 10A MOTOR FUSE
370524, 8 POS PLUGGABLE T-BLOCK
REFER TO DETAIL 3 FOR WIRING
1890017
CONTROL BOARD MOUNT
59007, 4-40 X 3/8 SCREW
23029, #4 LOCKWASHER
4 REQ
22052, 8-32 X 3/8 SCREW
23059, # 8 LOCKWASHER
195718, MAIN HARNESS
440022, PUSH-IN TIE WRAP/ANCHOR
POWER SUPPLY
SECONDARY CONNECTION
730063, WASHER
2 REQ
1890053, SHIPPING BRACKET
DETAIL 3: TERMINAL BLOCK WIRING DETAIL
20017, 1/4-20 X 3/4 HEX BOLT
2 REQ
30037, TIE WRAPS
4 REQ WITH IN 1/2" OF TERMINAL BLOCK
HEATER WIRE
WHITE WIRE FROM THERMOSTAT
BLACK WIRE FROM MOTOR
BLUE WIRE FROM MOTOR
RED WIRES FROM COOL SOLENOID
RED WIRES FROM COOL PLUS SOLENOID
GREEN WIRES FROM SOLENOID VALVES
Wiring Diagram
Model:
7451 230V
Controlled Rate
Freezer
7451-71-1-D REV. 2
Page 1 of 2


DETAIL 4: THERMOSTAT WIRING DETAIL
OVERTEMP T-STAT
BLACK HEATER WIRE
WHITE
DETAIL 5: PRINTER OUTLET WIRING DETAIL
PRINTER P.S. OUTLET
BLUE
BROWN
30037, TIE WRAP
30001, TIE ANCHOR
23002, # 8-32 KEPS NUT
4 REQ
REAR AND TOP VIEW
CRIMP FAN WIRES TO RED AND BLACK 24 GA. WIRES
23001, #6 KEPS NUT
4 REQ
900134, FAN
BROWN
BLUE
492011, FAN GRILL
22010, 6-32 X 1-1/2 SCREW
4 REQ
23002, #8 KEPS NUT
23059, #8 LOCKWASHER
2 REQ
230178
8 AMP
BRK/SW
SINGLE BLUE
SINGLE BROWN
GRN/YEL
GRN/YEL
22049, 6-32 X 3/8 SCREW
2 REQ
REFER TO DETAIL 4 FOR T-STAT WIRING
460180 PWR ENTRY MODULE
BLUE
BROWN
GREEN/YELLOW
RS-232
4-40 NUT & LOCKWASER PART OF 370142 SET
RECOR OUT
370142
D-SUB SCREW LOCK
1 SET REQ
22130, 6-23 X 1/4 SCREW
2 REQ
370527
SHORT LATCHING BLOCK
1 SET REQ
30037, SMALL TIE WRAP
30081, STICKY TIE ANCHOR
230195, 10 AMP 5X20 MM FUSE
REFER TO DETAIL 5 FOR OUTLET WIRING
SOL. VALVES
250094
COOL VALVE
COOL + VALVE
FOR SERVICE REPLACEMENT OF VALVES USE STK# 4000618
2 FR-1582 03-08-02 RTT RTT AKS ADD EXTERNAL IVF PROBE CONNECTION
1 FR-1592 02-21-02 RTT PDK LDN ADDED MOTOR FUSE TO DRAWING
0 N/A 8/16/01 RTT RTT BH RELEASED FOR PRODUCTION
REV ECN NO. DATE BY CAD APPD DESCRIPTION OF REVISION
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSE WITHOUT WRITTEN PERMISSION FROM THERMO FORMA
MODEL/PART NAME: CONTROLLED RATE FREEZER
DWG TITLE: WIRING DIAGRAM, 230 VOLT EXPORT UNIT
DWN: RTT CAD: RTT APPD: BH DATE: 08-09-01 SCALE: 0.167
MATERIAL: -
PAINT: N/A
TOLERANCE UNLESS OTHERWISE SPECIFIED ANGLES: DECIMAL: .XX±± .XXX±±
DRAWING NUMBER 7451-71-1
SIZE D
ThermoForma
Box 649, Marietta, Ohio 45750
Wiring Diagram
Model:
7451 230V
Controlled Rate
Freezer
7451-71-1-D REV. 2
Page 2 of 2


POWER CONNECTION
120 VAC 60 HZ 12 AMPS
460180
POWER ENTRY CONNECTOR
AND EMI FILTER
3 GRN/YEL
SWITCH CIRCUIT BREAKER
230184 15 AMP
PRINTER POWER OUTLET
460024
PRINTER POWER SUPPLIES
201185
+5,+12,-12VDC OUTPUT
SWITCHING POWER SUPPLY
400152
PRINTER
201183
CONTROL PANEL
DISPLAY BOARD
191648
LCD
LED J1
LCD J3
KEYPAD
J2
EXTERNAL PC
CONNECTION
PC
PRINTER
J7
J6
MAGNETIC DOOR SWITCH
360235
SHOWN DOOR OPEN
DOOR SW
J4
+12V
DGND
J5
12VDC COOLING FAN
900134
-12V
DGND
AGND
+5V
+5V
+12V
VDC IN
J11
MAIN BOARD
191649
ANALOG
RECORDER
OUTPUT
SHIELD
- ANALOG OUT
+ J10
290179 IVF EXTERNAL SAMPLE
PROBE CONNECTOR ASSY.
IVF SAMPLE T-COUPLE
4000402 OR 4000403
IVF MODELS ONLY
290171 EXTENSION
SAMPLE T-COUPLE
4000385
J9
CHAMBER T-COUPLE
290170
J8
230195
10A MOTOR FUSE
TB1
COOL+
COOL MOTOR
HEAT
J12
G L H
HEATER 1028 WATTS AT 120 V
137017
HEAT
OVERTEMP T-STAT
400148
120V
INTERNAL CIRCULATION FAN
156116 OR 156123
WIRED FOR 120 VOLTS
RED
COOL VALVE
250093
COOL PLUS VALVE
250093
Electrical Schematic
Model:
7450, 7452, 7454,
7456 and 7458
Control Rate Freezer
7450-70-1-D REV. 5
Page 1 of 2

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR
1	16	BROWN
2	16	BLUE
3	16	GRN/YEL
4	16	BROWN
5	16	BLUE
6	24	WHITE
7	24	WHITE
8	22	RED
9	22	BLACK
11	16	BLACK
12	16	BLACK
13	16	WHITE
14	16	BLACK
15	16	BLUE
16	16	GRN/YEL
17	18	RED
18	18	RED
19	18	GRN/YEL
20	18	RED
21	18	RED
22	18	GRN/YEL

EXTERNAL CONNECTIONS

EXTERNAL P.C. CONNECTION

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

ANALOG RECORDER OUPUT 0-10VDC NONLINEAR

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 PLUS
PIN 4 MINUS

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
5	FR-1582	03-08-02	RTT	PDK	AKS	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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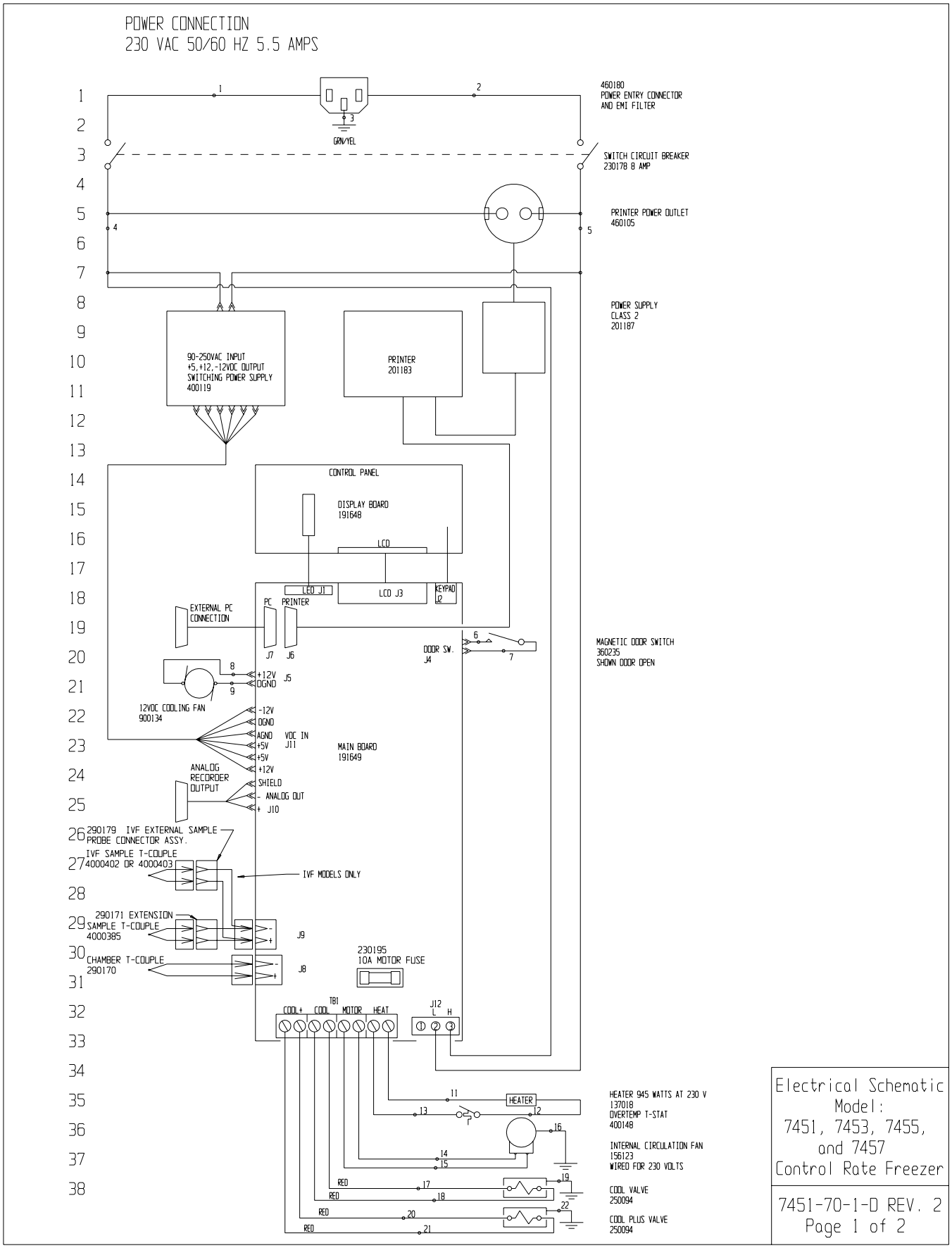
ThermoForma
BOX 649, MARIETTA, OHIO 45750

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
Model:
7450, 7452, 7454,
7456 and 7458
Control Rate Freezer

7450-70-1-D REV. 5
Page 2 of 2


POWER CONNECTION
230 VAC 50/60 HZ 5.5 AMPS
460180
POWER ENTRY CONNECTOR
AND EMI FILTER
GRN/YEL
SWITCH CIRCUIT BREAKER
230178 8 AMP
PRINTER POWER OUTLET
460105
POWER SUPPLY
CLASS 2
201187
90-250VAC INPUT
+5,+12,-12VDC OUTPUT
SWITCHING POWER SUPPLY
400119
PRINTER
201183
CONTROL PANEL
DISPLAY BOARD
191648
LCD
LCD J1
LCD J3
KEYPAD
J2
EXTERNAL PC
CONNECTION
PC
PRINTER
J7
J6
DOOR SW.
J4
MAGNETIC DOOR SWITCH
360235
SHOWN DOOR OPEN
+12V
DGND
J5
12VDC COOLING FAN
900134
-12V
DGND
AGND
+5V
+5V
+12V
VDC IN
J11
MAIN BOARD
191649
ANALOG
RECORDER
OUTPUT
SHIELD
- ANALOG OUT
+ J10
290179 IVF EXTERNAL SAMPLE
PROBE CONNECTOR ASSY.
IVF SAMPLE T-COUPLE
4000402 OR 4000403
IVF MODELS ONLY
290171 EXTENSION
SAMPLE T-COUPLE
4000385
J9
CHAMBER T-COUPLE
290170
J8
230195
10A MOTOR FUSE
TB1
COOL+
COOL
MOTOR
HEAT
J12
L
H
HEATER
HEATER 945 WATTS AT 230 V
137018
OVERTEMP T-STAT
400148
INTERNAL CIRCULATION FAN
156123
WIRED FOR 230 VOLTS
RED
COOL VALVE
250094
COOL PLUS VALVE
250094
Electrical Schematic
Model:
7451, 7453, 7455,
and 7457
Control Rate Freezer
7451-70-1-D REV. 2
Page 1 of 2

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR
1	16	BROWN
2	16	BLUE
3	16	GRN/YEL
4	16	BROWN
5	16	BLUE
6	24	WHITE
7	24	WHITE
8	22	RED
9	22	BLACK
11	16	BLACK
12	16	BLACK
13	16	WHITE
14	16	BLACK
15	16	BLUE
16	16	GRN/YEL
17	18	RED
18	18	RED
19	18	GRN/YEL
20	18	RED
21	18	RED
22	18	GRN/YEL

EXTERNAL CONNECTIONS

EXTERNAL P.C. CONNECTION

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

ANALOG RECORDER OUPUT 0-10VDC NONLINEAR

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 PLUS
PIN 4 MINUS

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
2	FR-1582	03-08-02	RTT	POK	AKS	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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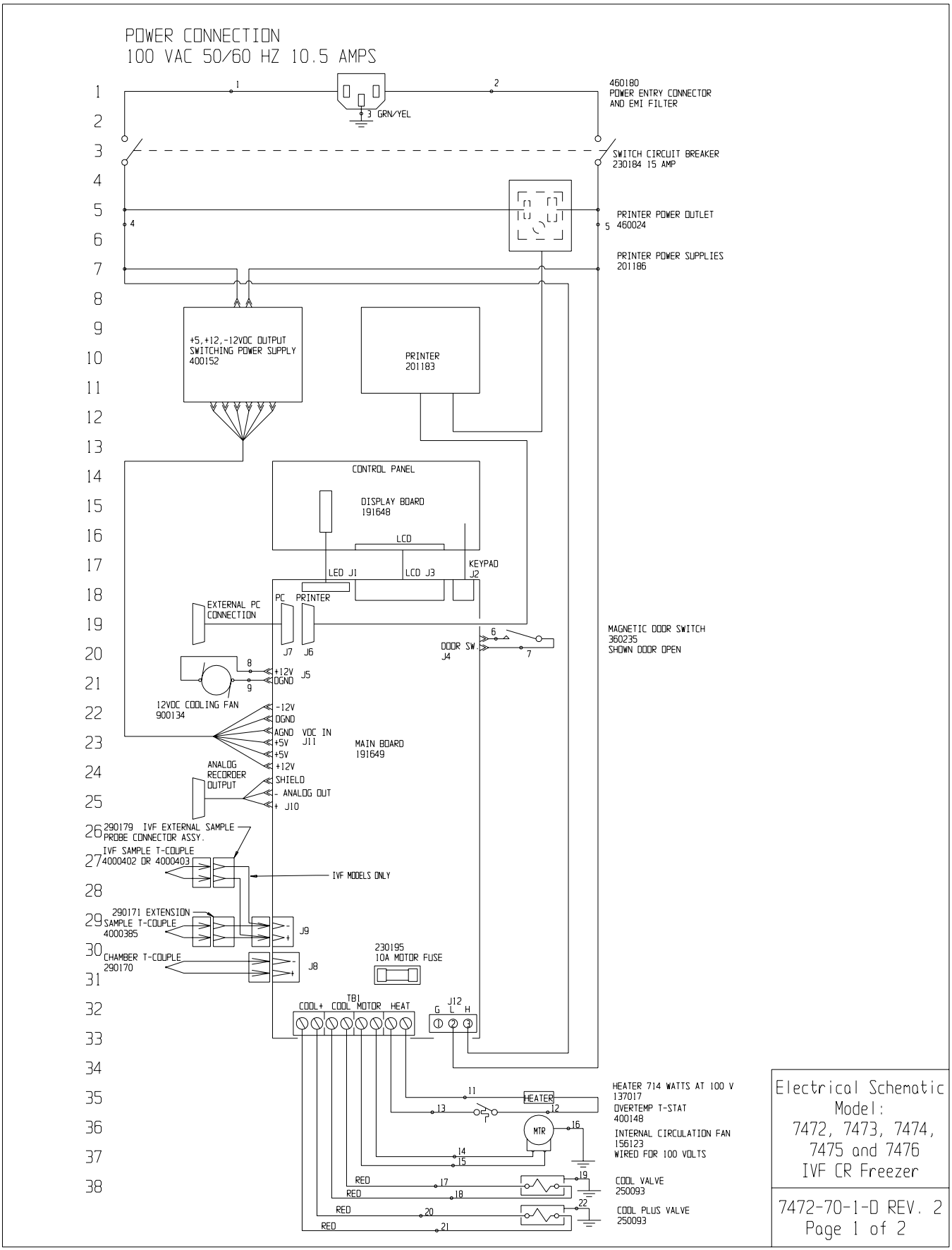
MODEL/PART NAME: CONT. RATE FREEZER 7451,53,55,57 & 59
DWG TITLE: ELECTRICAL SCHEMATIC
DWN: RTT | CAD: RTT | APPD: BH | DATE: 01/02/01 | SCALE: NONE
MATERIAL:
PAINT COLOR:

Thermo Forma
BOX 649, MARIETTA, OHIO 45750

DRAWING NUMBER 7451-70-1 | SIZE D

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

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



Electrical Schematic
Model:
7472, 7473, 7474,
7475 and 7476
IVF CR Freezer

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

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR
1	16	BROWN
2	16	BLUE
3	16	GRN/YEL
4	16	BROWN
5	16	BLUE
6	24	WHITE
7	24	WHITE
8	22	RED
9	22	BLACK
11	16	BLACK
12	16	BLACK
13	16	WHITE
14	16	BLACK
15	16	BLUE
16	16	GRN/YEL
17	18	RED
18	18	RED
19	18	GRN/YEL
20	18	RED
21	18	RED
22	18	GRN/YEL

EXTERNAL CONNECTIONS

EXTERNAL P.C. CONNECTION

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

ANALOG RECORDER OUPUT 0-10VDC NONLINEAR

FEMALE SUBMINIATURE D CONNECTOR
PIN 2 PLUS
PIN 4 MINUS

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
2	FR-1582	03-08-02	RTT	PDK	AKS	ADD IVF PROBE CONNECTIONS
1	S1-8280	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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ThermoForma
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
IVF CR Freezer

7472-70-1-D REV. 2
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	1). See "ILL" troubleshooting
		1a). Confirm profile does not use Sample temperature	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
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

Chamber temperature erratic	1). High LN_2 pressure 2). Chamber thermocouple mounting 3). Customer adjusted PID parameters 4). T/C shorted or incorrectly positioned.	1). Verify tank pressure (regulator: 22# nominal) 2). Verify thermocouple head out of mounting tube ¾ inch 3). Verify correct PID values in Service – Thermal Controller menu 4). Test for short and verify position.	1). Replace tank/regulator 2). Adjust thermocouple head position. 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)

Section 10 PC Interface Software

Figure 10-1. Opening Screen

The CryoMed Controlled Rate Freezer (CRF) includes the option for PC interface. The interface requires one of the following operating systems: MS Windows 95, 98, ME, NT, XP, or 2000.

The PC software can create and download freezer profiles. It can initiate a profile run, monitor its progress, then create a printed report summary of the run data. 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 DB25F to DB9M adapter). Data information is routed with a check byte for transmission integrity. The software stays in continual touch with the freezer to detect any communication breakdown.

A single PC can communicate with up to four Controlled Rate Freezers, using separate Run windows. To connect a PC to more than one CRF, install a multiple port serial interface card in the PC. Interface cards should meet the following specifications.

- 9-pin RS232 ports (1 communication port for each freezer)
- Support baud rates up to 9600K baud minimum
- 16550 UARTS (suggested)
- 128 byte transmit and receive buffers (FIFOs, suggested)
- Automatic assignment of ports (suggested)

Installation and Set-Up

Make sure the cable between the Controlled Rate Freezer and the PC is connected properly.

To install and set-up the PC software, locate and execute the Set-Up.exe file on the software CD by selecting Start, then Run. The software is installed in the default directory. Additional directories are created for the freezer profiles (Programs) and run data (Run Files).

The PC software must be registered. If, after 30 days, the software has not been registered, an alert screen will display on start-up. The registration passcode is T2YRPW9PWFXD28GJ

When installation is complete, click the Option button to set default directories, information fields and add user names and passwords, if password protection of all Main Menu features is desired.

System software (Lab View Run Time Engine) is installed along with the PC interface software.

Note This system software is required for proper operation of the PC interface with the freezer. ▲

Main Menu

As the PC interface program begins, a splash screen (Figure 10-1) appears just before the registration screen. The splash screen contains the company logo, contact information and a picture of the Controlled Rate Freezer.

The Main Menu buttons are displayed; Edit, Run, Review, Options, and About. Selected button turns dark when activated.

- The About screen displays the Thermo family of laboratory equipment plus the company Mission statement. Click anywhere on this screen to close it.

- The Exit button closes the PC interface application software. All other windows must be closed before exiting to avoid error messages.

Edit Screen

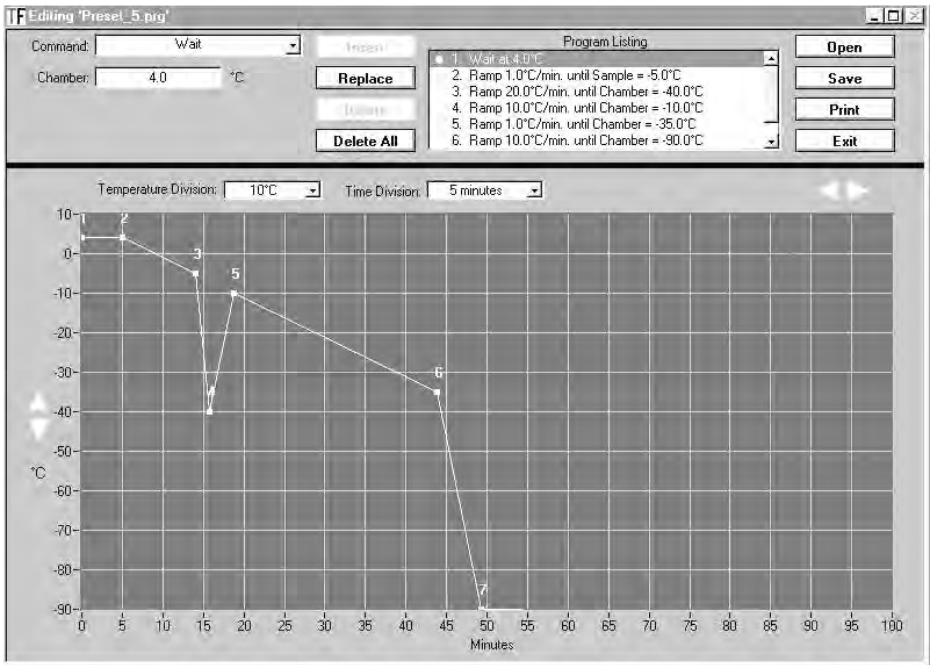


Figure 10-2. Freezing Profile

On the Edit screen, a freezing profile can be created and saved by the operator. An existing profile may be edited, if required. A profile listing can be printed. An approximate representation of the freezing profile will be displayed in the Edit window graph.

These are the profile steps available in the pull-down menu with definitions following.

Step Name with Menu Format	**Step Parameters with Definitions**
Wait - **Wait At X.X°C**	where X.X is the chamber set temperature 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 a range of -180°C to +50°C with a setting resolution of 0.1°C.

Edit Screen (continued)

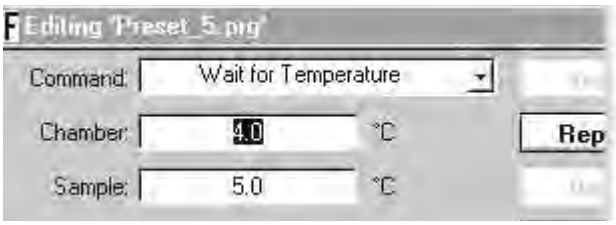


Figure 10-3. Wait for Temp

Step Name with Menu Format	Step Parameters with Definitions
Wait for temperature - **WAIT AT CHAMBER=X.X°C UNTIL SAMPLE=Y.Y°C**	where X.X is Chamber set temp and Y.Y is the Sample trip temp. The default Sample trip temp is1°C above Chamber temp. Step maintains specified Chamber temp and moves to next step in profile when Sample temp cools to the specified temp. This step can only be used when the starting Sample temp is greater than the specified Sample temp (the Sample is cooling).

Note The sample temp must be greater than the chamber temp. ▲

Edit Screen (continued)

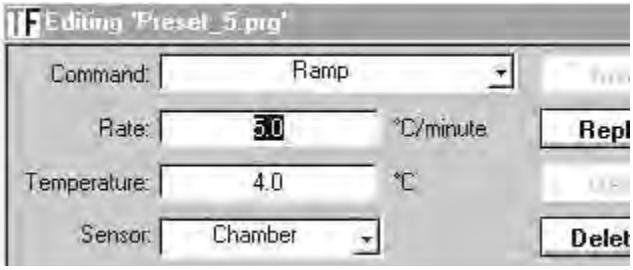


Figure 10-4. Ramp Rate

Step Name with Menu Format	Step Parameters with Definitions
Ramp - **RAMP X.X°C/MIN UNTIL CHAMBER=Y.Y°C** or **RAMP X.X°C/MIN UNTIL SAMPLE=Y.Y°C**	where X.X is the ramp rate and Y.Y is the chamber (or sample) endpoint temperature. Changes Chamber temp from its current value to specified temp (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 temp can be set over a range of -180°C to +50°C(±0.1°C). When the Chamber reaches specified temp, the control moves to the next step in the profile. If Sample sensor is selected, Chamber temp changes at a specified rate until Sample temp reaches specified temperature.

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

Edit Screen (continued)

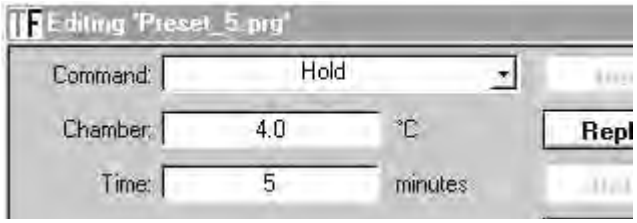


Figure 10-5. Hold at Temperature

Step Name with Menu Format	Step Parameters with Definitions
Hold - **HOLD X.X°C FOR Y.Y MINUTES**	where X.X is the chamber set temperature and Y.Y is the minutes 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.

Figure 10-6. Jump to Specified Step

Jump - **JUMP TO STEP X**	where X is the step number Automatic advance to a subsequent step or return to a previous step in a freezing profile. The Jump function can be programmed over a range of Step 1 to Step 20.

Edit Screen (continued)

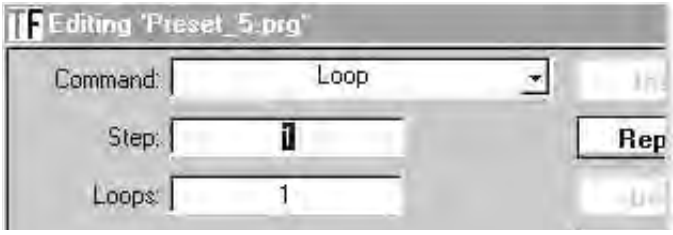


Figure 10-7. Repetitions From Specified Step

Step Name with Menu Format	Step Parameters with Definitions
Loop - **LOOP X TIMES STARTING AT STEP Y**	where X is number of repetitions and Y is the step number to begin Automatic advance to a subsequent step or return to a previous step in a freezing profile for a programmable number of repetitions. The Loop function can be programmed over a range of Step 1 to Step 20, and over a range of repetitions from 1 to 99.
End	Last step in profile Maintains the last Chamber temperature from the previous step indefinitely until the user terminates the Run with the Stop button or from the freezer keypad.

Create a New Freezer Profile

Follow the procedure below to create a new freezing profile.

1. Select the desired first step type from the Step pull down menu. WAIT or WAIT FOR TEMPERATURE is the mandatory first step. It is required to purge the warm LN2 plumbing prior to initiating controlled rate freezing. This step cannot be deleted or changed to a different step type.

2. Select subsequent steps. Use Insert to add a step. The new step is added on the line that is highlighted. Use Replace to modify an existing step's parameters or change to a different step type.

3. 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.

Create a New Freezer Profile (continued)

4. Save the profile by selecting the Save button. Enter a profile name and Save. A comment may be saved with the profile. Comments are printed with the Run data. Saved profiles are given the extension .prg.

5. Select the Delete All button to clear the program listing window.

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

Edit an Existing Profile

A saved or already existing profile may be changed as needed.

1. Open a freezing profile by selecting the Open button. The steps appear in the program listing window.

2. Select the step to edit. Change the step type or modify the step parameters and click Replace.

3. Choose the point at which to insert a new step.

4. New steps are inserted at the position highlighted in the program listing window.

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

6. Select the step type and enter the desired parameters.

7. Press the Insert button to insert the new step. Use the Replace button to modify or edit a step. Use the Delete button to delete a step or the Delete All button to delete all the steps in the profile.

8. Save the edited profile. The same file name may be used or a new profile name can be entered. An optional comment may be saved with the profile. Comments are printed with the Run data.

Print a Profile Listing

A listing of the open freezing profiles may be printed at any time by selecting the Print button. Print requests are sent to the Windows default printer. To choose a different default printer, first exit the interface software. Choose the printer, then restart the PC interface software. The printer selection will not be changed if the software application is still open at the time of the change.

Display Profile Temp Graph

A representation of the freezing profile is displayed on the Edit window graph. Refer to the illustration following. The starting point of each Step is indicated on the graph line by a small square. The graph can be moved horizontally and vertically by using the scroll buttons. Scale adjustments can be made using the time and temperature pull-down menus.

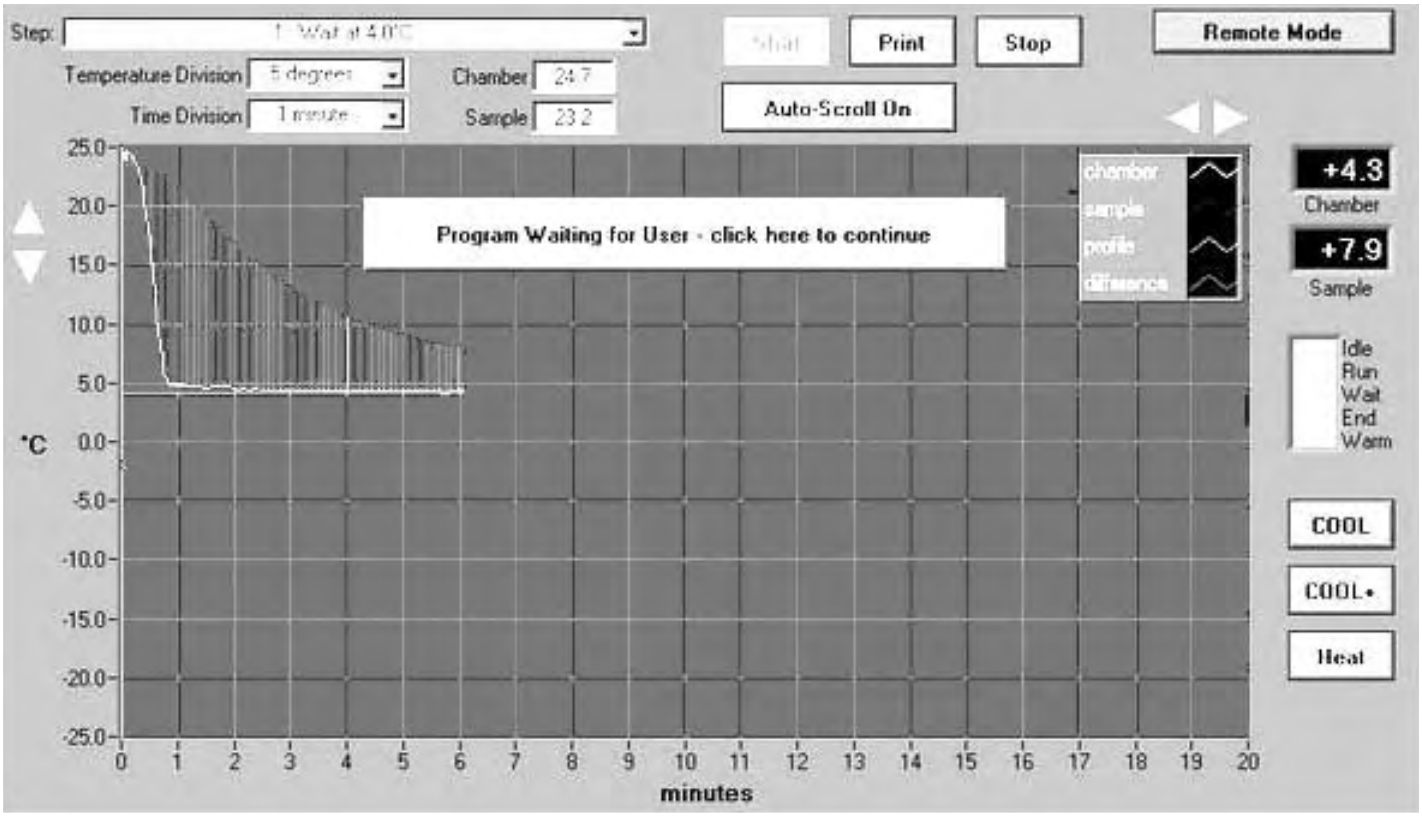


Figure 10-8. Edit Window Graph

Error Messages

If selected step parameters are out of range, an error message will appear when the Enter or Replace button is pressed. Press OK and correct the parameters.

When saving a profile which has the same name as one already existing, a file overwrite error message will appear. Choose YES to overwrite (replace) or NO to enter a new file name.

Run Screen

- Data Tag is mandatory information entered by the user which is used as a prefix for the file name in which the run data is stored. Note: If illegal characters (/ \ : * ? < > |, all lower case word “run”) are used in the data tag, the program runs normally but no data file is created.
- Date/Time is information taken from the PC system clock and stored with the run data.
- User Name is supplied by the security module of the software. ‘Anonymous’ is used if password security is not enabled.
- Run window status bar, prior to the start of a run, shows the communication port, the profile file name, and the path of the profile selected. After the start of a run, the bar shows the communication port, the profile name, and the run data storage file name.

User Control Definitions

- The Start button initiates a Run. This button changes to 'Move to' during a Run when a different step is selected in the Step pull-down menu.
- The Print button initiates a print-out during a Run or after a Run is complete, using the Windows default printer. Color or monochrome output may be selected.

  a. If default printer is monochrome, select 'Monochrome'.

  b. If the default is color, select 'Monochrome' or 'Color'.

  Choosing 'Monochrome' on a color printer uses marker/line patterns to identify different lines on the graph (i.e. Sample temperature, Chamber temperature, Profile, etc).

  If 'Color' is selected with a monochrome printer, colors are represented by shades of gray so some colors may not be clearly visible.

  c. Selecting 'Single page report' prints the current Run screen.

User Control Definitions (continued)

d. Selecting 'Two page report' prints an information sheet first, which includes the following;

- Profile name and path
- Run data file and path
- User name
- Date/time
- User Information Field name/contents
- Run start/stop "comments"
- Profile listing
- Alarm listing with time of occurrence

The second page printed is the current screen graph display.

e. Selecting 'Multi-page report' prints the information sheet described above as the first page.

The pages following are the entire Run graph, printed vertically for best presentation. Horizontal scale may be selected on the Run screen. The number of pages to be printed in horizontal scale is indicated on the print-out selection window.

- Stop/Exit button stops a Run in progress, or exits the Run screen after a Run has ended. The Run screen may be exited during Warm. However, the Controlled Rate Freezer will maintain Warm Mode until terminated by the user at the keypad.
- Auto-Scroll button is an On/Off button with the default being On. This button has an automatic adjustment of the graph scale so that it is always visible in the window. In addition, the most recent data is automatically displayed.
- The Warm button appears when a Run is terminated. It allows the user to initiate a Chamber Warm from the PC. This button has an On or Off option. Click once to turn On; click again to turn Off.
- Manual override buttons are activated by pressing and holding the mouse button. When the mouse button is released, the function is deactivated. This button is only available during a profile Run.

a. The override Heat button turns the heater on.

b. The override Cool button turns the Cool solenoid on.

c. The override Cool+ button turns the Cool and Cool+ solenoids on.

User Control Definitions (continued)

- Time/Temperature Division pull-down menus are as follows:

  a. Temperature divisions may be chosen by clicking the down arrow to select 20/10/5/2/1°C per division.

  b. Time divisions may be chosen by clicking the down arrow to select 20/10/5/2/1/0.5/0.1 minutes per division.

- The Program Listing pull-down menu shows all the steps in the current profile. A check mark indicates the step that is currently running. This menu can be used to manually move the freezer to a different step (forward or backward). Select the step destination. It turns yellow to indicate the change is not yet complete. When a different step is selected, the 'Start' button changes to 'Move to'. Select it to execute the move. The selected step turns white to show the move is complete and the new step is running.

  To start a Run at any step after the first step, choose the step to begin. Then select the 'Start' button to begin the run. The step turns white to show the change is complete. The Run starts at the chosen step.

- Chamber/Sample temperature window indicates these temperatures at a chosen point on the graph. To choose a point on the graph, first place the mouse pointer on the default cursor position (left side of the on-screen graph /yellow vertical line). Press and hold the left mouse button and drag the curser to the desired point on the graph.

- Graph legend selection box includes the legend which shows the colors/plot styles of the on-screen plot lines. A variety of colors/styles may be selected for the current window only. The default colors are listed in the Options/Plot Colors window. Any changes made are in effect for the current window only.

  To change the color/pattern, click the plot line to be changed within the graph legend box. Select the Color, Line Style or Line Width from the pull-down menu. An on screen plot line may be rendered invisible by selecting a color that matches the on-screen background color. A white color will make the plot line invisible on color print-out.

- Scroll the Graph from side-to-side, using the right/left arrow buttons. Use the up/down arrow buttons to scroll the graph top-to-bottom. Turn Auto-Scroll off to view a portion of the graph off-screen from the current plot position.

Status Indicators

The Controlled Rate Freezer remote status indicator messages are listed and defined below. The indicator status is valid 1-5 seconds after the Run screen opens.

- CRF Idle: Freezer is in the Idle state
- CRF Warming: Freezer is in the Warm mode
- CRF Busy: Run screen was opened for a freezer currently running a stand-alone profile
- Remote Mode: Freezer is running under control of the PC
- CRF Running Stand-alone: Freezer started a Remote Run under PC control but is now running the remote profile off-line. This is caused by a PC-to-CRF communication interruption of more than 20 seconds.

The current Chamber/Sample temperature indicators show the present temperatures at the freezer.

- ILL: Indicates an open Sample or Chamber thermocouple probe

Operating Indicators

The Operating Status indicators are as follows:

- Idle: CRF is in idle mode; fan solenoids and heater turned off
- Run: Running a profile
- Wait: Running a profile but waiting for user intervention
- End: Running a profile but at the End (last) step in the profile
- Warm: Warming the chamber to 25C

Pop-up status windows display a message requiring user intervention. During a profile 'Wait' step, a message will appear 'Program waiting for user -- Click here to continue'. Click on the message box to continue to the next step in the profile.

Alarm messages may also appear before or during a run. These 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.

Operating Indicators (continued)

For more information on the alarms listed below, see the Controlled Rate Freezer manual.

- Temperature High (tracking)
- Temperature Low (tracking)
- Power Fail and failure duration
- Chamber Sensor Failure
- Sample Sensor Failure
- Chamber Limit Temperature
- Sample Limit Temperature
- Heater Malfunction
- LN_2 Supply
- Run Complete
- Warm Complete
- CRF Printer Buffer Full

When an alarm condition occurs, sudible 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'. 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 up to three most recent alarm and the message 'Click Here To Clear'. Click anywhere on the alarm window to clear all alarms whose conditions have been resolved.

The alarm window reappears if any alarms are still active. Correct these conditions and click anywhere on the alarm window to clear these alarms.

If the message 'Profile Stopped At Freezer' displays, the run has been stopped by a component failure in the freezer, or by the user pressing the Back button at the freezer while the profile is in the End step. Click on the message to acknowledge that the run was stopped. This action has the same effect as clicking the Stop button.

Typical Run Procedure

1. Click the Run button on the Main screen.

2. Select the PC commmunication port. Available ports are shown on a pull-down menu. If a port is in use by another freezer, the port will not appear on the menu. Click 'Continue', or 'Cancel' to abort start.

3. Select a freezing profile. The File Select window opens at the default directory chosen in the Options screen. Choose a file, or change directories, then choose a file. Click 'Open' to continue or 'Cancel' to abort the start of the Run. As the Controlled Rate Freezer goes into 'Remote Mode' and profile is downloaded and validated, then the freezer keypad is disabled except for the Silence key.

4. Enter the mandatory 'Data Tag'. Select a word or abbreviation to identify the Run. The Data Tag is used as Run data file name prefix, followed by a sequential number generated by the application. The Data Tag information must be entered before the Run can be started. Note: If illegal characters (/ \ : * ? < > |) are used in the data tag, the program runs normally but no data file is created.

5. Enter any optional data in previously enabled 'Information Fields'. Up to 12 fields can be enabled and named in the Options screen. The information entered is captured in the Run file and displayed on the Review screen and information page print-outs.

6. Select the starting step of the profile. Default is the first step in the profile. Any step can be chosen to begin the profile.

7. Initiate the profile Run by clicking the Start button.

8. Enter optional comments. The text entry window opens for the option of adding, for example, notes pertaining to the Run or samples. Click 'Continue' to begin capturing temperature data from the Controlled Rate Freezer. Run data will not be captured until the comment window is closed.

9. Stop the freezer after the completion of the run and removal of the samples. The freezer holds the last chamber temperature indefinitely at the End step. The Run may be stopped by clicking on the Stop button or pressing the Back key on the freezer keypad.

10. Enter any additional comments when the text entry window opens again. This window appears regardless of the Run stop method.

Typical Run Procedure (cont.)

11. Initiate Warm Mode. The Warm button appears after the Run stops and the comment window is closed. Click the Warm button, or press the Warm key on the freezer keypad. The PC monitors the freezer's warming status.

12. Terminate Warm Mode and close the Run screen with Exit button. Warm Mode can be terminated by clicking the Warm button, or by pressing the Back key on the freezer keypad. The PC monitors the Warm status regardless of the method of termination.

    The Run screen may be closed without terminating the Warm mode by clicking the 'Exit' button. The freezer continues to warm until it is either stopped by the user at the freezer keypad, or automatically 30 minutes after the Warm Complete alarm occurs.

Power Failure Recovery

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

When power is restored, the freezer will continue the Run at the point of failure. 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 freezer's keypad 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 will then resume control of the freezer. Pressing 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 was longer than 10 seconds. The graph on the Run screen will show a temperature occurrence of zero to indicate a freezer power failure, rather than a PC-only power failure. A communication error message will display on the Run screen during the freezer power failure.

Power Failure Recovery (continued)

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

The freezer switches to 'Stand-alone' mode if there is no communication from the PC for more than 20 seconds. When power is restored to the PC and Windows reboots, restart the freezer application. Select Run from the Main Menu. Choose the COM port for the freezer that is running. The PC will recover the Run data captured prior to its power failure, then continue the 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. It could be as much as 1 minute of Run data, as the application saves data to disk approximately once per minute. Up to four 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.

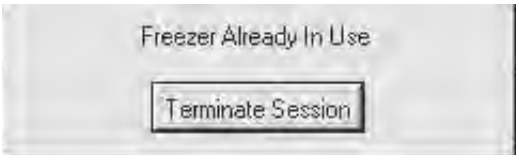
If both the freezer and the PC have power failures, see the previous paragraph. The behavior and recovery are the same as above.

Error Messages

- 'Communication Failure -- CRF Not Responding'

  This message indicates that the freezer is not sending status updates to the PC when requested. Verify that the communication cable is connected and working correctly, the freezer has power and is turned on, and that there has not hardware failure in the PC or freezer. If communication is interrupted for more than 20 seconds, the freezer will go into 'Off-line' mode.

- '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.

Error Messages (continued)

- '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.

Display/Control Summary

Three modes are available when using a Controlled Rate Freezer and PC configuration: 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, Warm) and 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 at the PC as an added assurance that the PC user will be aware of the alarm condition. 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.

Running a Local Profile

Any attempt to open a Run screen for a freezer already running a local profile will result in an error message ‘Freezer Already In Use’. The Run screen cannot be opened.

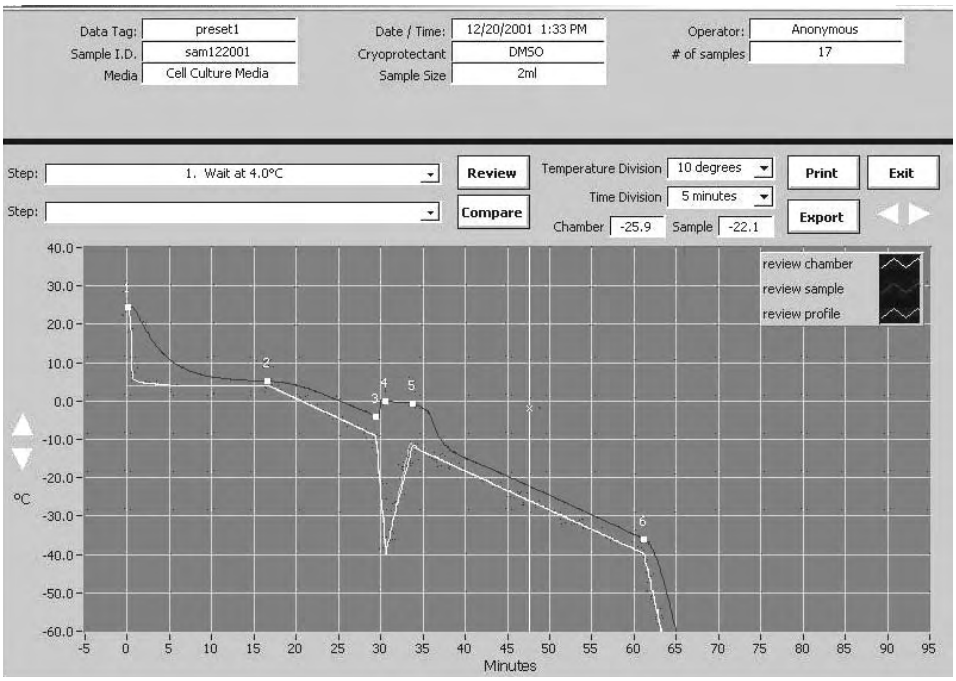
Review Screen

Refer to the details below concerning the information fields and user controls for the review screen.

Information Fields

- Data Tag: Shows mandatory information entered by the user for the open Run file
- Date/Time: Shows the start time/date of the open Run file
- Operator: Shows user name, or "Anonymous" if no users are set up in Options screen
- Review window status bar: Shows the name and path of open Run file
- Review step select pull-down menu: Displays the steps of the profile in the open ‘Review’ Run file
- Compare step select pull-down menu: Displays the steps of the profile in the open ‘Compare’ Run file

Review Screen (continued)



User Controls

- Review Button

  This button opens an existing Run profile for on-screen review and print-out. The Chamber and Sample temperatures can be examined over the time, or the actual Chamber temperature may be compared with the programmed temperature. Click the Review button again to open a different file.

- Compare Button

  This button opens a second file for comparison. Both files are plotted on the graph. Click the Compare button again to remove the comparison data.

- Print Button

  This button is used to initiate a print-out of the Review and Compare data, using the Windows default printer. Select color or monochrome (black & white) output. If the printer is monochrome, select 'monochrome'. If color, select either. Monochrome uses marker/line patterns to identify specific lines on the graph. If 'Color' is selected with a monochrome printer, colors are represented by shades of grey (some colors may not be clearly visible).

User Controls (continued)

'Single Page Report' may be selected to print the current Review screen. 'Two Page Report' may 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.

1) Review file profile name and path

2) Review Run data file and path

3) User name

4) Date/time

5) User Information Field name/contents

6) Run start/stop "comments"

7) Profile listing

8) Alarm listing with time of occurrence

If a Compare file is open, a second information sheet is printed.

'Multi-page Report' prints information pages on the Review profile, and the Compare profile, if open. Subsequent pages are the entire Run graph. Horizontal scale is as selected on the Review screen. This also determines the number of pages, as indicated in the print-out selection window. Vertical scale may be automatically selected for best presentation.

1) Compare file Profile name and path

2) Compare Run data file and path

3) User name

4) Date/time

5) User Information Field name/contents

6) Run start/stop "comments"

7) Profile listing

8) Alarm listing with time of occurrence

User Controls (continued)

- Exit Button

  This button may be used to exit the Review screen. It is not necessary to close any files before exiting.

- Export Button

  This button may be used to export the open Run profile data into a 'comma-separated variable' format. The data can then be imported into standard spreadsheet or database programs.

  The data includes the data tag, date/time, user name, information field name and contents, source data file name, profile steps, elapsed time, profile temp, Chamber Temp, Sample temp (run data), and any alarm with occurance time.

- Scale Select Pull-down Menus

  Temperature division: Click down arrow to select 20/10/5/2/1°C per division

  Time division: Click down arrow to select 20/10/5/2/1/.5/.1 minutes per division

  Graph cursor and Chamber/Sample temperature windows used to indicate the Chamber/Sample temperature at a selected point on the graph. The default cursor position is the left side of the on-screen graph (yellow vertical line). Point at cursor, press and hold the left mouse button and drag the cursor to the desired graph position.

- Graph color selection box

  This box includes a graph legend showing the colors/plot styles of on-screen plot lines. Select from a variety of colors/styles for the current window only. Default colors are as specified in the Options/Plot Colors window. Any color/pattern changes are in effect for the current window.

  To choose colors/patterns, left-click the plot line to be changed within the legend box. Select the color, line style or line width from the pull-down menu. Selection of an on-screen background color can make the plot line invisible on the graph. White can be selected to make the plot line invisible on print-out (color print-out).

- Graph Scroll Buttons

  The left/right scroll arrow buttons move the graph right or left in the display window. The up/down scroll arrow buttons move the graph up or down in the display window.

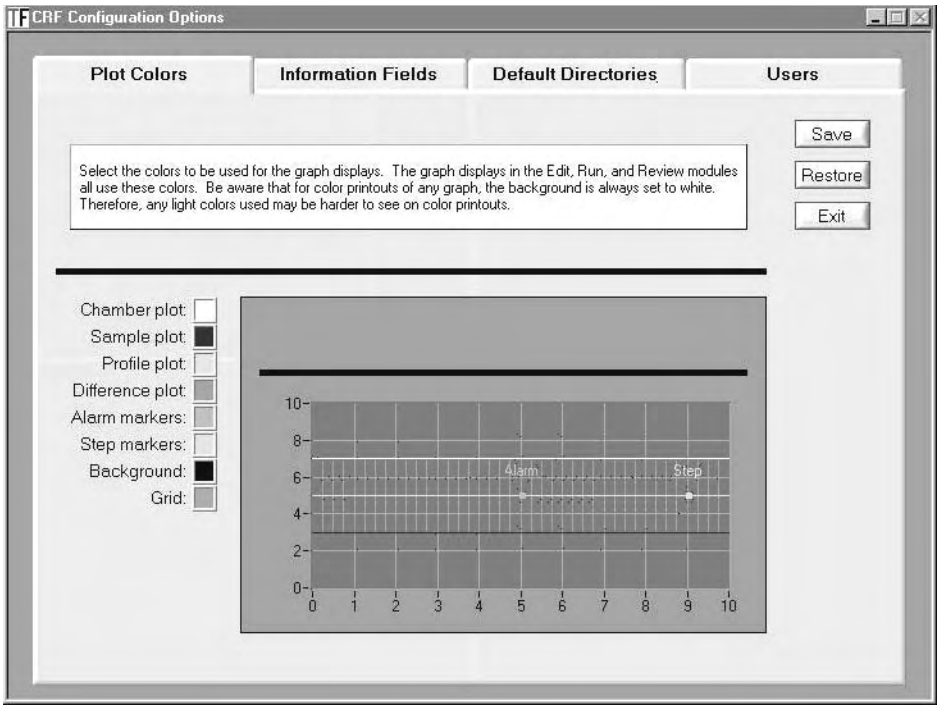
Options

Several options are available. See the tabs in the illustration below.

Plot Color Selections

The plot colors must be chosen so as to be distinguishable from each other on the screen and in the print-outs. Make sure there is a noticeable difference between the Chamber and Sample colors. Choose plot colors for the Chamber temp, Sample temp, Profile, Alarm, steps, background and grid. Save before leaving the Options screen.

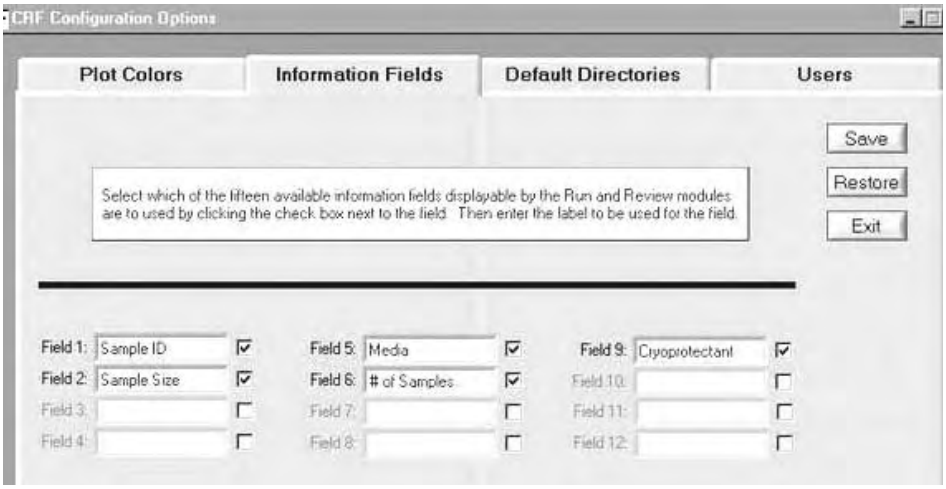
To choose colors, click on the color box corresponding to the desired plot item. Move the cursor over the desired color (observe the changes in the sample graph). Click the palette button to create custom colors. When the cursor is over the desired color, click the left mouse button. Click Save to keep changes. Click Restore to return to previously saved colors. Click Exit to exit Options menu.



Information Field Set-Up

Select the number of information fields to be displayed on the Run screen. Information field names and contents are saved with the Run data file for each enabled field. Be sure to save choices before leaving the Information Fields screen.

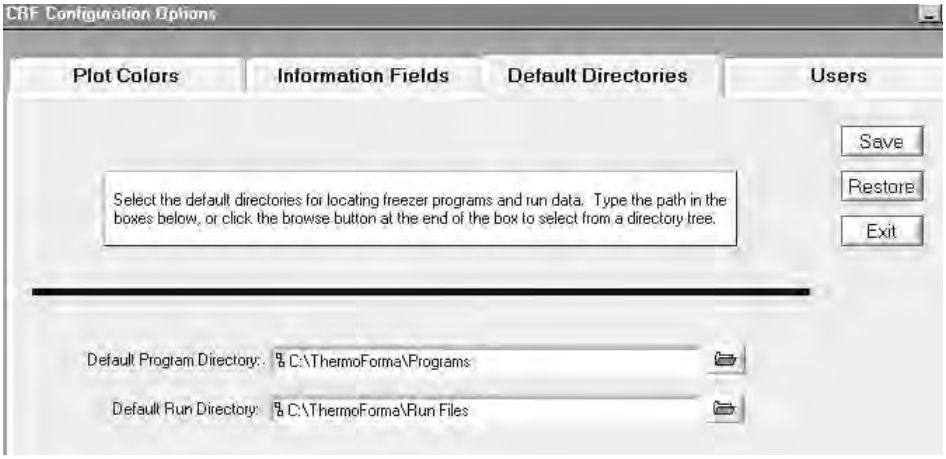
Click the check box next to a field to enable it. Enter a name for each enabled information field. Click Save to keep the changes. Click Restore to return to previously saved changes. Click Exit to exit the Options screen.



Default Directories

Directories may be set up to store program (profiles) and run files. Save before leaving the Default Directories screen.

Enter the desired path and file name in the window for the default program directory and run data directory. A Windows directory browse button may also be selected. Click Save to keep changes. Click Restore to return to previously saved changes. Click Exit to exit Options screen.

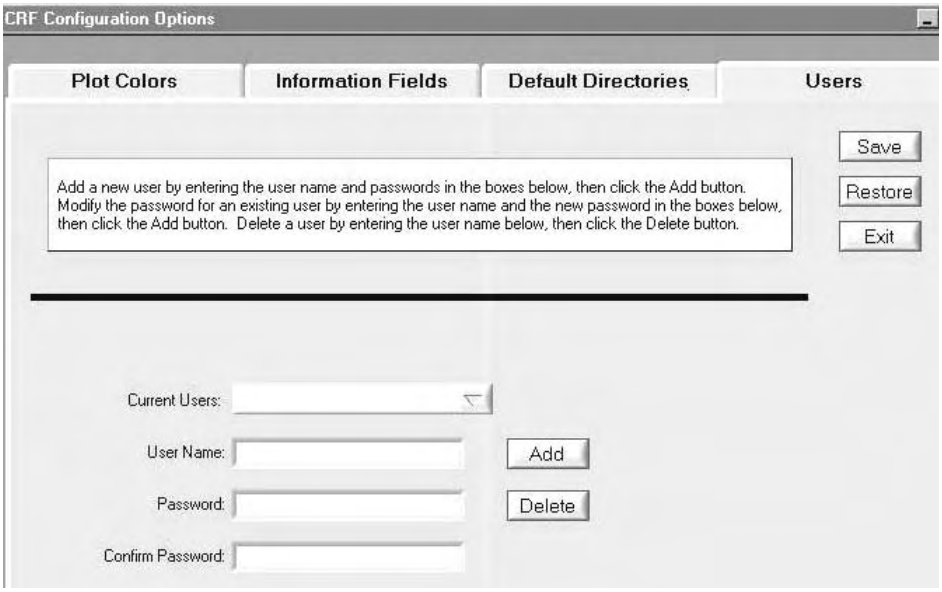


User Name and Password Maintenance

User names and passwords may be set up to protect all entries into the Edit, Run, Review and Options menus. Save before leaving the Users screen.

1. Type a name into the User Name window.
2. Type the desired password in the Password window.
3. Confirm the password in the Confirm Password window.
4. Click Add button to add the user name and password to the list.
5. Repeat for any additional user names.
6. To change a password, select the user name from the pull-down list (or type the name in User Name window), enter the new password and click the Modify button.
7. 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.
8. Click Save to keep changes.
9. Click Restore to return to previously saved changes.
10. Click Exit to exit Options screen.

If no user names are defined, all menus can be accessed without password protection. Anonymous is listed as the user name if no users are set up. If password protection is no longer desired, simply delete all user names.



Saving Changes

Each of the four screens described above must be saved individually. The application will prompt to Save if unsaved changes are present when the Exit button is clicked.

Sharing Host PC Resources

When using the same PC for several freezers, potential problems could occur during printing. There could be a loss of Run data points. Chart data is updated every 6 seconds. Run data is captured every 6 seconds with updates to hard disk every minute. Serial port communication may stop for a short time during printing. The loss of a small number of data points during slow ramps or holds will not cause a problem (chart lines are interpolated across the gaps). Loss of data during fast ramps may be more critical. Experiment with test runs before trying to print during a critical part of a critical freeze. If in doubt, don't print during a critical run.

If, because of printing, the freezer loses communication for more than 20 seconds, the freezer will go in 'Stand Alone' mode. A very slow PC (<166MHz) with limited resources (<32MB RAM) may stop serial communication for more than 20 sec during printing. In 'Stand Alone' mode, PC control is disabled and there may be loss of run data for the duration of the serial communication interruption. Experiment with test runs, or if in doubt, don't print during a critical run.

Using other applications on the same PC with a Run in progress may cause the loss of Run data points. Serial port communication may stop for a short time if PC resources are consumed by other applications. Chart lines continue across the communication gaps. Slow ramps or holds will lose very little data. However, steep ramps may be more critical. Experiment with test runs, or if in doubt, don't run other applications during a critical profile run.

If there is a loss of communication between the PC and the freezer for more than 20 seconds, the freezer may go into 'Stand- Alone' mode. A slow PC (<166MHz) with limited resources (<32MB RAM) may stop serial communication for more than 20 sec if multi-tasking. PC control would be disabled for the duration of the current Run. Run data is lost during the time of the communication interruption. Experiment with test runs, or if in doubt, don't run other applications during a critical profile run.

A Windows crash may stop serial communication for more than 20 seconds. The freezer will go into 'Stand Alone' mode and PC control will be disabled for the duration of the current Run. Run data will be lost during the time of the communication interruption. Experiment with test runs, or if in doubt, don't run other applications during a critical profile run.

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 1-888-213-1790 (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.

Rev. 2 5/07

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THERMO FISHER SCIENTIFIC INTERNATIONAL DEALER PC AND PERIPHERALS WARRANTY

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

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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 1-888-213-1790 (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.

ISO 9001 REGISTERED

Rev. 2 5/07

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.

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Rev. 2 2/07

ISO 9001 REGISTERED

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.

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 Forma 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 instruction manuals carefully detail equipment installation, operation and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-888-213-1790 (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.

Rev. 2 2/07

ISO 9001 REGISTERED

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7450**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1
	UL 61010A-1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7451**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7452**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1
	UL 61010A-1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7453**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7454**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1
	UL 61010A-1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7455**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7456**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1
	UL 61010A-1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7457**

Year of Initial Marking (CE): 2002

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7458**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1
	UL 61010A-1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Fisher Scientific (Asheville) LLC

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7459**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

ThermoFisher
SCIENTIFIC

15 November 2007

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7472**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7473**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® Controlled Rate Freezer

Product Designations: **7474**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**LVD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7475**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Declaration of Conformity

Manufacturer's Name: Thermo Electron Corp.

Manufacturer's Address: 401 Millcreek Road
Marietta, Ohio 45750
U.S.A.

Product Description: Forma® IVF Controlled Rate Freezer

Product Designations: **7476**

Year of Initial Marking (CE): 2001

Affected Units: Release 2
(Release Level [REL#] shown on Serial Tag)

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
MDD: 93/42/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	**MDD:**
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	Amendments 1 and 2
EN 50082-1:97	CSA C22.2 No. 1010.1

Richard L. Miller, CQE
Regulatory Compliance Manager

Thermo
ELECTRON CORPORATION

19 December 2003

Appendix A

a. Handling Liquid Nitrogen

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.

b. 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 booklet 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 the 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.

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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