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Chapter 1 – Safety Instructions

Introduction

Follow all CAUTION notices to prevent damage to the chamber or your test sample. Failure to follow all CAUTION notices may void your warranty. CAUTION may also indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate personal injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

The safety alert symbol \( \Delta \) precedes a general CAUTION or WARNING statement.

The electrical hazard symbol \( \Delta \) precedes an electric shock hazard CAUTION or WARNING statement.

Installation Safety Notices

\( \Delta \) CAUTION: The minimum clearance you should allow for proper ventilation around the chamber must be at least 12” from both the left and right side, and 24” from the rear.

\( \Delta \) CAUTION: This chamber is designed for operation in a conditioned laboratory environment. Operation above 30°C (85°F) or below 16°C (60°F) ambient room temperature is NOT recommended.

\( \Delta \) CAUTION: The Input Voltage label on the back of the chamber indicates the input voltage configuration as shipped from the factory. If the input voltage configuration is changed, this label must be replaced to reflect the new configuration. Replacement labels are available from TestEquity at no charge.

\( \Delta \) CAUTION: This chamber must be properly configured for either 208 V or 230 V nominal input. 208 V and 230 V are NOT the same. Do NOT guess! Do NOT assume you have “220 V”. You must verify the exact type of electrical service you have. If there is any doubt, you must consult with a qualified electrician who is familiar with industrial plant wiring. In addition, the input line voltage should be measured while the chamber is operating in the COOL mode to ensure that the expected nominal voltage of either 208 V \(-5%/+10\%\) or 230 V \(+\%10\%\) is present. Operation below 198 V or greater than 253 V requires internal transformers, which can be supplied for a nominal charge.

\( \Delta \) CAUTION: This chamber should be connected to the AC power source by a qualified electrician who is familiar with industrial plant wiring.
Operation Safety Notices

⚠️ CAUTION: This chamber has a crankcase heater to protect the high-stage compressor. The chamber must be connected to the power source AND the Main Disconnect Switch must be ON for 3 hours prior to operating the chamber. Although it may be safe to use the chamber immediately, this procedure ensures the longest possible life for the high-stage compressor if the chamber has been removed from the power source for more than 24 hours.

⚠️ CAUTION: The “Series F4 User’s Manual” is a general manual and is written by the manufacturer, Watlow, for a wide variety of applications and configurations. Not all features or functions are applicable. Only the capabilities of a model F4SH-CKA0-01, as described on page A.7 of the “Series F4 User’s Manual” are applicable. “Cascade Control” as described on page 3.6 of the “Series F4 User’s Manual” is not applicable in this configuration. The “Retransmit” function is available as an option.

⚠️ CAUTION: The Series F4 “Alarm” functions are NOT used in the chamber’s safety system and are NOT connected. TestEquity does NOT recommend using the Series F4 alarm function as the main protection device. The independent Series 97 Limit Controller functions as the main protection device.

⚠️ CAUTION: The Series F4 Temperature Controller has been properly configured by TestEquity to match the chamber’s system requirements and to perform optimally over a wide range of operating conditions. Improper modifications to these setup values can result in erratic performance and unreliable operation. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. If there is any doubt, please call TestEquity before proceeding.

⚠️ CAUTION: NEVER select “Full Defaults” in the Series F4 Controller’s Factory/Test Menu. This will erase all the correct values which are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

⚠️ CAUTION: The Series 97 Limit Controller has been properly configured by TestEquity to match the chamber’s system requirements. Improper modifications to these setup values can result in unreliable and unsafe operation. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. Setup examples in the “Series 97 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series 97 Limit Controller Setup Parameters” section of this manual.

⚠️ CAUTION: NEVER select “Default Settings” in the Series 97 Limit Controller’s Factory Page. This will erase all the correct values which are documented in the “Series 97 Limit Controller Setup Parameters” section of this manual.
**CAUTION:** Always verify that the Limit Controller’s high and low limits are set to temperatures that are appropriate for your test sample.

**CAUTION:** If your test sample is energized, it may be capable of raising the workspace temperature beyond safe limits. This could occur if your test sample exceeds the live load rating of the chamber or if the chamber’s refrigeration system fails. This chamber has a set of contacts that can be used to remove power to your test sample if the Limit Controller’s temperature limits are exceeded.

**CAUTION:** To prevent damage to your test sample and the chamber’s compressors, do not exceed the live load rating of the chamber.

**WARNING:** Do NOT put items in the chamber that could burn or explode at high temperatures. This chamber uses open wire heating elements which generate surface temperatures over 1000ºF. This is NOT an explosion-proof chamber.

**WARNING:** Do NOT put items in the chamber which can emit corrosive vapors or substances.

**WARNING:** This chamber is NOT a curing oven. There are NO provisions for venting fumes.

**WARNING:** The chamber door must remain closed while the chamber is operating. If you need to open the door while the chamber is operating, wear safety goggles to prevent the high velocity airflow from blowing particles or objects into your eyes.

**WARNING:** This chamber operates at extreme temperatures. Avoid contact with air, objects, and surfaces that are hot or cold to prevent severe burns or frostbite. Protective gloves are recommended.
Chapter 2 – Installation

Uncrating

Inspect the shipping container for any signs of visible damage. Notify the carrier and TestEquity immediately if there are signs of shipping damage.

The pallet is designed with ramps so the chamber can be rolled off without the need for a forklift or pallet jack.

1. Cut the two metal bands that hold the packaging to the pallet.
2. Remove the top cover.
3. Remove the plastic fasteners that hold the outer box together and remove the outer box.
4. Locate the retainer in the front of the pallet. Remove the two screws, then remove the retainer. Keep in mind that there is also Velcro that holds the retainer in place. Place the retainer in the front of the pallet on the floor.
5. Locate the two ramps under the chamber and remove them.
6. Attach the ramps to the front of the pallet using the Velcro straps. The retainer will be under the ramps and act as a support.
7. Carefully roll the chamber off the pallet, onto the ramps. This should be done with at least two people.

Preparation For Use

1. Inspect the chamber for signs of shipping damage.
2. Read this entire manual.
3. Select a suitable location to install the chamber.
4. Verify the input voltage and phase configuration.
5. Connect to the power source.
6. Perform following the procedures as described in the Preventive Maintenance section:
   a. Inspect the electrical compartment.
   b. Inspect the refrigeration machinery compartment.
   c. Check the low-stage refrigeration charge.
   d. Check the high-stage refrigeration charge.
   e. Verify the chamber performance.
Installation Location

The chamber will produce a significant amount of heat during normal operation. Locate the chamber in a room with adequate ventilation to prevent excessive heat build-up.

The chamber must be on a solid and level floor. Leveling legs are provided to lock the chamber securely in place if desired.

Allow enough space around the chamber to permit serviceability and the removal of the service access panels, which are located on each side and the rear.

⚠️ **CAUTION:** The minimum clearance you should allow for proper ventilation around the chamber must be at least 12" from both the left and right side, and 24" from the rear.

⚠️ **CAUTION:** This chamber is designed for operation in a conditioned laboratory environment. Operation above 30°C (85°F) or below 16°C (60°F) ambient room temperature is NOT recommended.
Input Power Configuration

Overview
This chamber is designed to be easily configured for operation from a Single Phase or Three Phase power source, and either 208 V / 60 Hz or 230 V / 60 Hz. Other input voltages and 50 Hz operation are available as special options, and are not covered in these instructions.

Your chamber was configured prior to shipment for the particular voltage that was specified at time of order. These instructions should be used to verify the input voltage configuration prior to installation, or to change the input voltage from one configuration to another.

⚠️ CAUTION: The Input Voltage label on the back of the chamber indicates the input voltage configuration as shipped from the factory. If the input voltage configuration is changed, this label must be replaced to reflect the new configuration. Replacement labels are available from TestEquity at no charge.

⚠️ CAUTION: This chamber must be properly configured for either 208 V or 230 V nominal input. 208 V and 230 V are NOT the same. Do NOT guess! Do NOT assume you have “220 V”. You must verify the exact type of electrical service you have. If there is any doubt, you must consult with a qualified electrician who is familiar with industrial plant wiring. In addition, the input line voltage should be measured while the chamber is operating in the COOL mode to ensure that the expected nominal voltage of either 208 V ±5%/±10% or 230 V ±10% is present. Operation below 198 V or greater than 253 V requires internal transformers, which can be supplied for a nominal charge.

![Figure 2-1 – Location of Input Configuration Terminals on the Electrical Sub Panel](image-url)
Voltage and Phase Configuration

NOTE: Refer to Figure 2-1 for the location of the input configuration terminals on the electrical sub panel that are described below.

230 V / 60 Hz Input Configuration
1. Turn the Main Disconnect switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Locate the Control Transformer TR1. Wire number T1 must be connected to the 230 V terminal H3 on Control Transformer TR1.
4. Locate terminal strip TB3. There must be NO jumper on TB3 terminals H3 to H4. There must be a jumper on terminals M1 to M2, and M4 to M5 (2 jumpers total).

208 V / 60 Hz Input Configuration
1. Turn the Main Disconnect switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Locate the Control Transformer TR1. Wire number T1 must be connected to the 208 V terminal H2 on Control Transformer TR1.
4. Locate terminal strip TB3. There must be a jumper across TB3 terminals H3 to H4, M1 to M2, M4 to M5 (3 jumpers total).

Single Phase Configuration
1. Turn the Main Disconnect Switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Locate terminal block TB2. There must be a jumper across TB2 terminals 1 and 3, and another jumper across TB2 terminals 2 and 4 (2 jumpers total).
4. Locate the input terminal block on the rear of the chamber. There must be NO wire on terminal L3. It should be removed and capped off.

Three Phase Configuration
1. Turn the Main Disconnect Switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Locate terminal block TB2. There must be a jumper across TB2 terminals 3 and 4 ONLY.
4. Locate the input terminal block on the rear of the chamber. There must be a wire on terminal L3. If converting from Single Phase configuration, reconnect wire L3.
Connection to the Power Source

⚠️ CAUTION: This chamber should be connected to the AC power source by a qualified electrician who is familiar with industrial plant wiring.

The Main Disconnect Switch on the front panel removes primary power to the entire chamber. All branch circuits on the load side of the Main Disconnect Switch are individually fused. However, your local electrical code may require a separate disconnect switch within sight of the chamber.

Single Phase Power Source Connection
1. Ensure that the chamber is properly configured for Single Phase input as described on the previous page.
2. Remove the Input Terminal Cover located on the rear of the chamber, left side.
3. Mount your input wires through the hole provided, using an appropriate bushing.
4. Connect the Ground wire (NOT A NEUTRAL) to the Ground terminal.
5. Connect the “Hot” input wires to terminals L1 and L2.
6. Replace the Input Terminal Cover.

Three Phase Power Source Connection
1. Ensure that the chamber is properly configured for Three Phase input as described on the previous page.
2. Remove the Input Terminal Cover located on the rear of the chamber, left side.
3. Mount your input wires through the hole provided, using an appropriate bushing.
4. Connect the Ground wire (NOT A NEUTRAL) to the Ground terminal.
5. Connect the “Hot” input wires to terminals L1, L2, and L3. Phase relationship is not important.
6. Replace the Input Terminal Cover.
Chapter 3 – Operation

Introduction

The Front Panel Switches control power to the chamber. The Front Panel Lights provide indication of heat and cool functions.

The Limit Controller is a protection device. It turns the chamber OFF if the workspace temperature exceeds either a high temperature or low temperature limit set point.

The Temperature Controller controls the temperature of the chamber. It can function as either a single set point controller or as a programmable profile controller. The Temperature Controller automatically turns the refrigeration system on or off based on the demand for cooling.

⚠️ CAUTION: This chamber has a crankcase heater to protect the high-stage compressor. The chamber must be connected to the power source AND the Main Disconnect Switch must be ON for 3 hours prior to operating the chamber. Although it may be safe to use the chamber immediately, this procedure ensures the longest possible life for the high-stage compressor if the chamber has been removed from the power source for more than 24 hours.

Summary of Chamber Operation

1. Turn the Main Disconnect Switch ON.
2. Enter the appropriate high and low temperature safety limits on the Limit Controller.
3. Enter the desired temperature set point (or program) on the Temperature Controller.
4. Load your test sample in the chamber.
5. Turn the Master Switch ON.
Front Panel Switches and Lights

Main Disconnect Switch
The Main Disconnect Switch controls power to the entire chamber and provides a mechanical safety interlock to the lower door.

In the ON position (clockwise) primary power is connected. The Temperature Controller, Limit Controller, and (optional) Chart Recorder are always functional when the Main Disconnect Switch is ON, regardless of the Master Switch position. The Main Disconnect Switch should be left ON if the chamber is usually used on a daily basis.

In the OFF position (counter clockwise) primary power is disconnected. The Main Disconnect Switch can be left OFF if the chamber is not used on a daily basis. It can also be locked in the OFF position with a padlock. The knob has a red insert that can be pushed in at the top to reveal the lock-hole.

⚠️ CAUTION: This chamber has a crankcase heater to protect the high-stage compressor. The chamber must be connected to the power source AND the Main Disconnect Switch must be ON for 3 hours prior to operating the chamber. Although it may be safe to use the chamber immediately, this procedure ensures the longest possible life for the high-stage compressor if the chamber has been removed from the power source for more than 24 hours.

Master Switch
The Master Switch enables all chamber functions. The Master Switch illuminates when it is ON.

Light Switch
The Light Switch controls the workspace light. The Light Switch illuminates when it is ON.

Silence Switch
The Limit Controller will sound an Audible Alarm in the event of an over-temperature or under-temperature condition. The Silence Switch lets you temporarily turn off the Audible Alarm.

Heat Light
The Heat Light will illuminate when the Temperature Controller turns on the heater to maintain the workspace temperature. The Heat Light will cycle on/off as the workspace temperature approaches and reaches the temperature set point.

Cool Light
The Cool Light will illuminate when the Temperature Controller turns on the cooling valve to maintain the workspace temperature. The Cool Light will cycle on/off as the workspace temperature approaches and reaches the temperature set point.
Chapter 3 – Operation

**Loading the Chamber**

⚠️ **WARNING:** Do NOT put items in the chamber that could burn or explode at high temperatures. This chamber uses open wire heating elements which generate surface temperatures over 1000°F. This is NOT an explosion-proof chamber.

⚠️ **WARNING:** Do NOT put items in the chamber which can emit corrosive vapors or substances.

⚠️ **WARNING:** This chamber is NOT a curing oven. There are NO provisions for venting fumes.

⚠️ **WARNING:** The chamber door must remain closed while the chamber is operating. If you need to open the door while the chamber is operating, wear safety goggles to prevent the high velocity airflow from blowing particles or objects into your eyes.

⚠️ **WARNING:** This chamber operates at extreme temperatures. Avoid contact with air, objects, and surfaces that are hot or cold to prevent severe burns or frostbite. Protective gloves are recommended.

⚠️ **CAUTION:** If your test sample is energized, it may be capable of raising the workspace temperature beyond safe limits. This could occur if your test sample exceeds the live load rating of the chamber or if the chamber’s refrigeration system fails. This chamber has a set of contacts that can be used to remove power to your test sample if the Limit Controller’s temperature limits are exceeded.

⚠️ **CAUTION:** To prevent damage to your test sample and the chamber’s compressors, do not exceed the live load rating of the chamber.

<table>
<thead>
<tr>
<th>Temp</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>+23°C</td>
<td>1000 W</td>
</tr>
<tr>
<td>0°C</td>
<td>800 W</td>
</tr>
<tr>
<td>-40°C</td>
<td>500 W</td>
</tr>
<tr>
<td>-55°C</td>
<td>400 W</td>
</tr>
<tr>
<td>-65°C</td>
<td>300 W</td>
</tr>
</tbody>
</table>

**Performance Considerations**

The performance of all chambers are significantly effected by the characteristics of your test sample. Factors include size, weight, material, shape, and power dissipation if energized. The test sample should be placed in the chamber in a manner that allows for air circulation. The air plenum is located on the back wall of the chamber, where air is sucked in from the bottom and exits from the top. You should not place the test sample directly on the chamber floor. It should be placed on the shelf. Multiple test samples should be distributed throughout the chamber to ensure even airflow and minimize temperature gradients. If necessary, additional shelves should be used to evenly distribute the load. Verify that the temperature gradients are within acceptable limits, by measuring the chamber temperature at strategic points using a multipoint thermocouple meter or data logger.
You may find that the temperature throughout the chamber is even, but always different from what the temperature controller indicates. The correct way to adjust what the temperature controller “displays” compared to what is measured at some point other than the controller’s sensor is with the “Calibration Offset” parameter, NOT by recalibrating the controller.

**Avoiding Moisture**  
Any time the ambient air is subjected to temperatures below the dew point, moisture will condense out of the air. The effect is ice or frost during low temperature operation, or water when maintaining over 0°C and cooling is required.

To avoid moisture condensation, make sure the port plugs are inserted at all times. Also, avoid opening the chamber door while the chamber is operating at temperatures below room ambient. When a low temperature test is completed, warm the chamber to at least room ambient before opening the chamber door and before removing your test sample.

**Internal Test Fixtures**  
Some applications require internal fixtures to support test samples and provide a convenient method of connecting wires and sensors. Fixtures must be designed to minimize their impact on chamber functionality and performance.

Fixtures should be designed for easy removal to permit maintenance and cleaning of the chamber. The chamber liner should never be drilled or screwed into. This will compromise the integrity of the liner and permit moisture migration due to condensation into the insulation, which will eventually impact performance and lead to premature rusting of the outer cabinet.

Fixtures should be constructed of stainless steel. This also applies to all screws and fasteners. All welds should be passivated. To prevent rust and corrosion, never use iron or mild steel even if it is painted or plated. Aluminum may be used. However, since the specific heat of aluminum is double that of steel, it represents a greater load and will have more impact on the chamber performance.

Make sure that all connectors, wiring, pc boards, and auxiliary components can withstand the temperature extremes that they will be subjected to. In some cases, these components may not be able to last after repeated tests and should be considered expendable.
Chapter 4 - Temperature Controller

Introduction

The Series F4 Temperature Controller can function as either a single set point controller (static mode) or as a programmable profile controller. A four-line LCD display facilitates setup and programming, and presents informative messages about status, error, and alarm conditions. Digital outputs, profiles, and alarms can be named for easy reference. An Information Key gives you quick information about the pages, menus, parameters and values, as well as error and alarm conditions if they occur. The user-interface is organized into five “pages” of menus.

⚠️ CAUTION: The Series F4 “Alarm” functions are NOT used in the chamber’s safety system and are NOT connected. TestEquity does NOT recommend using the Series F4 alarm function as the main protection device. The independent Series 97 Limit Controller functions as the main protection device.

⚠️ CAUTION: The Series F4 Temperature Controller has been properly configured by TestEquity to match the chamber’s system requirements and to perform optimally over a wide range of operating conditions. Improper modifications to these setup values can result in erratic performance and unreliable operation. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

⚠️ CAUTION: NEVER select “Full Defaults” in the Series F4 Factory/Test Menu. This will erase all the correct values which are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

Security Features

The Series F4 Controller has several levels of security to prevent unauthorized users from changing critical configuration parameters. Only the Set Point and Profile menus have “Full Access”. TestEquity has configured all other menus to “Password”, and have protected them with a password.

TestEquity does not recommend that these security levels be changed for most applications. However, there will be times when entry into these menus are necessary. For example, you may need to gain access to Setup Page in order to change from °C to °F display, or to change the time or date. You must call TestEquity at 877-512-3457 or 805-480-3697 to obtain the password.
**Temperature Controller Keys and Displays**

![Image of Temperature Controller]

**Upper Display**
Displays actual chamber temperature during operation. Displays error information if errors occur.

**Lower Display**
Displays information about the setup, operation and programming of the controller.

**Cursor**
Indicates selected parameter or present value in memory. Moves via the four navigation keys.

**Profile Indicator Light**
Lit when a ramping profile runs. Lit during an alarm state.

**Output Indicator Lights**
1A = Heat
1B = Cool

**Alarm Output Indicator Lights**
Lit (pulsates) when the controller sends or receives valid data.

**Communications Indicator Light**
Lit (pulsates) when the controller sends or receives valid data.

**Profile Key**
Summons a menu that allows you to start, hold, resume or terminate a profile.

**Information Key**
Provides information in the Lower Display about the cursor-selected parameter. Another press toggles the display back to the parameter.

**Scroll Bar**
Appears when the Up or Down Keys can reveal more information in the Lower Display.

**Up and Down Keys**
Move the cursor position in the Lower Display through the menus in the direction of the key arrow. Increase or decrease a value, or change a letter in a user-nameable field, such as events and profile names.

**Left and Right Keys**
Move right to select the choice to the right of the cursor and proceed to the next screen. Move left to exit.

**Figure 4.1 – Temperature Controller Keys and Displays**

To navigate through the menus:
1. Use the ▲ or ▼ key to move the cursor to line up with the item to be selected in a menu on the lower display.
2. Press the ► key to select the item.
3. Enter or change the value, or make a choice with the ▲ or ▼ key.
4. Press the ► key to enter the value or choice.
5. Repeat until you return to the original list.

The ► key again saves the value and proceeds to the next parameter in the series.

To edit a parameter, proceed through the series using the ► key without changing values until you find the parameter you want to change. After making the change with the with the ▲ or ▼ key, you may back using the ◄ key out or proceed using the ► key to the end of the series.
Chapter 4 – Temperature Controller

Main Page

The Main Page displays manual operating parameters, running program parameters and error messages. It also provides access to the Operations, Profiles, Setup and Factory pages. The following is a list of Main Page parameters and the description of their functions.

- **Current File**: Displayed if running a profile, the name of the profile.
- **Current Step**: Displayed if running a profile, the current step of the profile.
- **SP1**: Static (manual) temperature set point entry. If running a profile, the current set point.
- **Step Type**: Displayed if running a profile, the type of step.
- **Target SP1**: Displayed if running a profile, the target temperature during a ramp step.
- **WaitFor Status**: Displayed if running a profile, the status during a WaitFor step.
- **Time Remaining**: Displayed if running a profile, the remaining time of the current step.
- **DigitalOut**: Status of the event outputs 1 to 8. An “8” indicates when cooling system is ON.
- **Power1**: The % of throttle of the heat (positive number) or cool (negative number) output.
- **DigitalIn**: Status of the digital inputs 1 through 4.
- **Date**: Real-time clock date.
- **Time**: Real-time clock time.
- **Go to Operations**: Access to Operations Page
- **Go to Profiles**: Access to Profiles Page
- **Go to Setup**: Access to Setup Page. Not displayed if running a profile.
- **Go to Factory**: Access to Factory Page. Not displayed if running a profile.

Static Set Point Control

The Temperature Controller is in Static Mode when it is not controlling a Profile. When in a Static Mode, the Profile Indicator Light is off (see Fig. 4.1). The Upper Display shows the actual chamber workspace temperature. The Static Set Point (SP1) prompt is accessed from the Main Page.

To enter a Static Set Point:
1. Press the ▲ or ▼ key to position the Cursor next to the SP1 prompt. You may already be at this prompt.
2. Press the ► key once. You will see Static Set Point1 in the lower display with the current set point value indicated below.
3. Press the ▲ or ▼ key to change the temperature set point value.
4. Press the ► key once to enter the new temperature set point. You are now back to the Main Page.
Profile Programming

The Series F4 Temperature Controller can be programmed to store up to 256 steps into as many as 10 profiles. You do not need a computer to enter a profile – it can be easily done through the controller’s front panel keys. A Profile is a set of instructions programmed as a sequence of steps. The controller handles the profile steps automatically, in sequence. As many as 40 different profiles and a total of 256 steps can be stored in non-volatile memory. The 256 steps are grouped by profile. So, one profile could have 256 steps; or 39 profiles could have 6 steps and one could have 22; or 32 profiles could have eight steps each. The maximum number of steps is 256, and the maximum number of profiles is 40.

Step Types

Use the six available step types – Autostart, Ramp Time, Ramp Rate, Soak, Jump and End – to create simple or complex profiles involving all inputs and outputs. The Series F4 prompts you to define each step’s properties.

Autostart Step
The use of an Autostart step in a profile is optional. Autostart pauses a profile until the specified date or day, and time (of a 24-hour-clock). Define the Autostart by choosing:
- Day (of the week) or Date,
- Time

To invoke an Autostart step in a profile, you must activate the profile via the Profile Key and select the Autostart step.

Ramp Time Step
Ramp Time changes the set point to a new value in a chosen period of time. Define the Ramp Time step by choosing:
- *Wait for an event or process value
- Event outputs 1 through 7 to turn ON or OFF (For controlling the power to remote devices.)
- Time (in hours, minutes and seconds)
- Temperature Set Point
- PID set (One of five sets of heat/cool PID parameters. Normally, just leave at PID Set 1.)
- **Guaranteed Soak

Ramp Rate Step
Ramp Rate changes the set point to a new value in a chosen rate of time. Define the Ramp Rate step by choosing:
- *Wait for an event or process value
- Event outputs 1 through 7 to turn ON or OFF (For controlling the power to remote devices.)
- Rate (in degrees per minute)
- Temperature Set Point
- PID set (One of five sets of heat/cool PID parameters. Normally, just leave at PID Set 1.)
- **Guaranteed Soak
Soak Step
Soak maintains the set point from the previous step for a chosen time in hours, minutes and seconds. Define the Soak step by choosing:
• *Wait for an event or process value
• Event outputs 1 through 7 to turn ON or OFF (For controlling the power to remote devices.)
• Time
• PID set (One of five sets of heat/cool PID parameters. Normally, just leave at PID Set 1.)
• **Guaranteed Soak

Jump Step
Jump initiates another step or profile. Define the Jump step by choosing:
• Profile to jump to;
• Step to jump to; and
• Number of Repeats

NOTE: If a power-out condition occurs during a profile and more than 20 jump steps are stored in the F4’s Profile Program memory, the controller will terminate the profile and turn off all outputs if Continue, Hold or Terminate was selected as the Power Out action. If Profile Reset or Go to Idle Set Point was selected, the controller will take those actions. A pop-up message will warn of this when the 21st jump step is programmed

End Step
End terminates the profile in a chosen state. All profiles must have an End step. It cannot be deleted or changed to another step type. Define the End by choosing Hold, Control Off, All Off or Idle end state.

NOTE: TestEquity recommends having the end step type to be Hold or Idle. TestEquity does NOT recommend using an end step type of Control Off or All Off. This does not turn off the chamber fan. The chamber temperature can reach +55°C just from heat generated by the fan, and even higher if your test sample is energized.

*Wait For step option
The use of Wait For in a profile is optional. Ramp Time, Ramp Rate and Soak steps can be programmed to wait for a particular chamber temperature or event input condition. The wait conditions must be satisfied before the time clock and the step activity proceeds. Digital inputs must first be configured in the System Menu as Wait For Events, with the condition to be met also specified. Then, to wait for this digital input, you must specify On, meaning the condition as configured in the Setup Page, or Off, meaning the opposite of that condition. The digital inputs have been configured to Off by TestEquity, so this option will not show unless reconfigured.

**Guaranteed Soak step option
The use of Guaranteed Soak in a profile is optional. The Guaranteed Soak step requires the chamber temperature to be at the set point temperature, within the Guaranteed Soak Band value, before the time clock and the step activity proceeds. The Guaranteed Soak Band is configured by TestEquity for 3.0°C, and this can be changed in the System Menu.
### How to Program a New Profile

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Menu Options</th>
</tr>
</thead>
</table>
| 1.   | **Go to the Profiles Page.**  
Move the cursor down the Main Page to **Go to Profiles**, then press the ➪ key.                                                                                                    | Main Page_______                                                                                       |
|      | ▶ Go to Profiles  
Go to Setup  
Go to Factory                                                                                                                                  | ▶ Go to Profiles  
Go to Profiles  
Go to Setup  
Go to Factory                                                                                     |
| 2.   | **Create a new Profile.**  
The cursor will be on **Create Profile**. Press the ➪ key.                                                                                         | Main>Profile_______                                                                                   |
|      | ▶ Create Profile  
Edit Profile  
Delete Profile                                                                                                                                  | ▶ Create Profile  
Edit Profile  
Delete Profile                                                                                     |
| 3.   | **Name the profile.**  
You can name your profiles for easy reference if desired. Names can have up to 10 characters. You can also use one of the default profile names (ex. Profile1), and skip this step. To name a profile:  
• Press ➪ to enter the name space and the first position.  
• Press the ▲ or ▼ to scroll through the alphabet and stop at the letter or number desired.  
• Press ➪ to move to the next position.  
• Continue until the name is complete, or until you move through the name space into the next screen.  
• Press ➪ to save the name of the profile. | Choose to Name:_____  
No  
▶ Yes  
  
Enter Profile Name:___  
PROFILE1  
▲  ▼ Adjusts Char  
◄► Save Changes                                                                                     |
| 4.   | **Choose the step type.**  
• There are six step types, each of which must be defined through different parameters. (See “Step Types,” earlier in this chapter.)                                                               | Choose Step1 Type:_____  
Autostart  
  
▶ Ramp time  
Ramp Rate  
  
Choose to wait:_______  
▶ Step does not wait  
Step waits for...                                                                                   |
|      |  
Choose to wait:_______  
▶ Step does not wait  
Step waits for...                                                                                   |  
Choose to wait:_______  
▶ Step does not wait  
Step waits for...                                                                                   |
| 5.   | **Define each step type.**  
• The Series F4 prompts you to define the parameters of each step type. (See “Step Types,” earlier in this chapter.)                                                                 | Choose to wait:_______  
▶ Step does not wait  
Step waits for...                                                                                   |  
Choose to wait:_______  
▶ Step does not wait  
Step waits for...                                                                                   |
|      |  
Enter Ramp Time:_______  
00:00:01  (H:M:S)  
▲  ▼ Adjusts Digit  
◄► Save Changes                                                                                     | Enter Ramp Time:_______  
00:00:01  (H:M:S)  
▲  ▼ Adjusts Digit  
◄► Save Changes                                                                                     |
|      |  
Enter Ch1 SP:_________  
85.0 °C  
▲  ▼ Adjusts Value  
◄ Back  ► Next                                                                                      | Enter Ch1 SP:_________  
85.0 °C  
▲  ▼ Adjusts Value  
◄ Back  ► Next                                                                                      |
| 6.   | **Choose the end-state.**  
• All profiles end with an End step, which is preprogrammed into the new profile. (See “End Step,” earlier in this chapter.)                                                                 | Choose End State:_____  
Control Off  
All Off  
► Idle                                                                                               |  
Choose End State:_____  
Control Off  
All Off  
► Idle                                                                                               |
| 7.   | **Save your settings.**  
• Press ◄ to exit the Profiles Page.  
• After exiting the Profiles Page, choose ▲ to save profile data.                                                                                                                                      | Save profile data  
or restore values?  
▼ Restore  ► Save                                                                                     |  
Save profile data  
or restore values?  
▼ Restore  ► Save                                                                                     |
### Programming Hints

- The first step in a program should be an initialization step of 1-second, usually at a set point of +23°C.
- The next to last step establishes a condition to end on. For example, you may want to end the program by holding at +23°C, so this step would be to go to +23°C.
- The final step of every profile is End. You cannot delete an End step or change it to another type, but you can insert new steps before it.
- TestEquity recommends having the end step type to be Hold or Idle.
- TestEquity does NOT recommend using an end step type of All Off or Control Off. This does not turn off the chamber fan. The chamber temperature can reach +55°C just from heat generated by the fan, and even higher if your test sample is energized. See Protecting an Energized Test Sample in Chapter 5 for important information regarding energized test samples.

### Profile Key

The **Profile key:**

- Initiates the profile mode;
- Initiates the Hold-profile state;
- Initiates the Resume-profile command;
- Initiates the Terminate-profile command.

The Profile Key functions only from the Main Page.

### How to Start a Profile

To initiate the profile mode, press the **Profile key** and answer the questions that follow.

<table>
<thead>
<tr>
<th>1. Press the Profile key to enter the Profile Control menu. • The Profile Indicator will begin blinking. • Press the <strong>key for Yes.</strong></th>
<th>Start a Profile?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>▼ No ▲ Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Select the desired stored profile. • Press the <strong>or ▼</strong> to scroll through the list of stored profiles. • Press ► to select the desired profile.</th>
<th>Start Profile:__________</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Profile1</td>
</tr>
<tr>
<td></td>
<td>Profile2 ▼</td>
</tr>
<tr>
<td></td>
<td>Profile3 ▼</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Select the desired step to start on. • Press the <strong>or ▼</strong> to scroll through the list of steps. Generally you would start on Step 1, but you can also start on any other step. • Press ► to select the desired start step and the profile will begin to run. The Profile Indicator will stay lit.</th>
<th>Start:__________</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>▶ Step 1 Ramp Time</td>
</tr>
<tr>
<td></td>
<td>Step 2 Soak ▼</td>
</tr>
<tr>
<td></td>
<td>Step 3 Ramp Time ▼</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Main Page__________</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>▶ Profile 2 Running</td>
</tr>
<tr>
<td></td>
<td>Step 1</td>
</tr>
<tr>
<td></td>
<td>SP1 85.0°C ▼</td>
</tr>
</tbody>
</table>

While running a profile, the Main Page on the lower display will keep you informed about the progress of the profile. Use the **or ▼** key to scroll through the list of running profile parameters. You cannot manually change any operating condition while the profile is running.
How to Hold/Resume a Running Profile

1. **To Hold a running profile**, press the Profile key to enter the Profile Control menu.
   - Then press ▲ or ▼ to make your choice for Hold.
   - Press ► to select Hold.
   - The Main Page will appear with a profile status of Holding. The Profile Indicator will be off.

<table>
<thead>
<tr>
<th>Hold Profile:___________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t Hold</td>
</tr>
<tr>
<td>► Hold</td>
</tr>
<tr>
<td>▼ Terminate</td>
</tr>
</tbody>
</table>

   | Main Page_______________ |
   |► Profile 2 Holding     |
   | Step 2                 |
   | SP1 23.0°C             |

2. **To Resume profile on hold**, press the Profile key to enter the Resume Profile menu.
   - Then press ▲ or ▼ to make your choice for Resume.
   - Press ► to select Resume.

<table>
<thead>
<tr>
<th>Resume Profile:_________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue Holding</td>
</tr>
<tr>
<td>► Resume</td>
</tr>
<tr>
<td>▼ Terminate</td>
</tr>
</tbody>
</table>

While a profile is on Hold, the current set point can be adjusted at the SP1 prompt on the Main Page. When a profile is resumed during a Ramp step, the controller uses the Static Set Point from the Main Page to calculate the rate of change needed to get to the set point at the end of the step. When a profile is resumed in a soak step, the new set point value will be used as the soak value for the time remaining in the step.

How to Terminate a Running/Holding Profile

1. **Press the Profile key while the profile is running** to enter the Resume Control menu.
   - Then press ▲ or ▼ to make your choice for Terminate.
   - Press ► to select Terminate.

<table>
<thead>
<tr>
<th>Hold Profile:___________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t Hold</td>
</tr>
<tr>
<td>► Hold</td>
</tr>
<tr>
<td>▼ Terminate</td>
</tr>
</tbody>
</table>

If you manually terminate a running profile, the profile ends with a set point of Off. This does not turn off the chamber fan. The chamber temperature can reach +55°C just from heat generated by the fan, and even higher if your test sample is energized. See Protecting an Energized Test Sample in Chapter 5 for important information regarding energized test samples.

How to Delete or Re-Name a Profile

1. **Go to the Profiles Page**.
   - Move the cursor down the Main Page to Go to Profiles, then press the ► key.

   | Main Page______________ |
   |► Go to Profiles        |
   | Go to Setup            |
   | Go to Factory          |

2. **Choose Delete or Re-Name**.
   - Press ▲ or ▼ to scroll through your choice.
   - Press ► to select your choice.
   - The controller will prompt you to select the profile you want to delete or re-name.

   | Main>Profile___________ |
   |► Edit Profile         |
   |► Delete Profile       |
   | ► Re-Name Profile     |
## How to Edit a Profile

1. **Go to the Profiles Page.**  
   Move the cursor down the Main Page to **Go to Profiles**, then press the ► key.

2. **Choose Edit Profile.**  
   • Press the ▼ key to choose on **Edit Profile**.  
   • Then press the ► key.

3. **Select the desired stored profile to edit.**  
   • Press the ▲ or ▼ to scroll through the list of stored profiles.  
   • Press ► to select the desired profile.

4. **Choose how to edit the step.**  
   • Press the ▲ or ▼ to scroll through the list of step edit choices.  
   • Press ► to select your choice.

5. **To edit a step.**  
   • Press the ▲ or ▼ to scroll through the list of steps you want to edit.  
   • Press ► to scroll through the step parameters and make any desired changes.

6. **To insert a step.**  
   • Choose **Edit Profile** (see step 4 above)  
   • Press the ▲ or ▼ to scroll through the number of the step that the new step will precede.  
   • Press ► to enter the new step and follow the step parameter prompts.

7. **To delete a step.**  
   • Choose **Delete Step** (see step 4 above)  
   • Press the ▲ or ▼ to scroll through the number of the step you want to delete.  
   • Press ► to delete the step.

8. **Save your settings.**  
   • Press◄ successively to exit the Profiles Page.  
   • After exiting the Profiles Page, choose ▲ to save the new profile values, or ▼ to restore the old values.

- Inserting or deleting a step will renumber all steps that follow.
- A Jump Step that jumps to an End Step cannot be deleted.
- An End Step cannot be deleted.
- Inserting a new ramp step usually requires inserting an associated soak step.
- Deleting a ramp step usually requires deleting the associated soak step.
### Profile Examples

The following are examples of two typical profiles.

#### Profile Summary: -40ºC to 85ºC, no ramps, 30 minute soak time, 4 cycles. End with program hold at +23ºC.

<table>
<thead>
<tr>
<th>Step</th>
<th>Step Type</th>
<th>Day, Time</th>
<th>Choose</th>
<th>Digit Out</th>
<th>Time</th>
<th>Ch1</th>
<th>PID</th>
<th>Guar.</th>
<th>Jump to</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ramp Time</td>
<td>23/00 00:00</td>
<td></td>
<td>1</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>&lt;</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Ramp Time</td>
<td>00:00:10</td>
<td></td>
<td>1</td>
<td>-40.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Soak</td>
<td>00:30:00</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>Yes</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Ramp Time</td>
<td>00:00:10</td>
<td></td>
<td>1</td>
<td>85.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Soak</td>
<td>00:30:00</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Jump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Name 2 3 —</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>Ramp Time</td>
<td>00:00:10</td>
<td></td>
<td>1</td>
<td>23.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Step Description**

1. Establishes a recommended initialization step. Goes to +23ºC as quickly as possible.
2. Goes to -40ºC as quickly as possible.
3. Will hold for 30 minutes. Time will not start until chamber reaches -37ºC (within the 3º Guaranteed Soak Band).
4. Goes to +85ºC as quickly as possible. Time will not start until chamber reaches +79ºC (within the 3º Guaranteed Soak Band).
5. Will hold for 30 minutes. Time will not start until chamber reaches +82ºC (within the 3º Guaranteed Soak Band).
6. Jumps back to step 2. Repeats this 3-times, for a total of 4-cycles.
7. After all cycles are completed, terminates the program to an end on +23ºC at a controlled rate of 1ºC per minute. The sample is immersed OFF the Chamber.
8. End of program. Controller returns to +23ºC manual set point. The sample is immersed OFF the Chamber.

#### Notes

- Guaranteed Soak Band is set at the factory for 3.0ºC. Can be changed in the System Menu.
- Means no entry or selection is required. Just scroll through this prompt to the next prompt.
- Means prompt does not show for this step type.

#### Profile Summary: +50ºC to 0ºC, 1ºC/minute ramp, 1 hour soak time, 100 cycles. Test sample turned ON/OFF depending on step. End with return to +23ºC manual set point.

<table>
<thead>
<tr>
<th>Step</th>
<th>Step Type</th>
<th>Day, Time</th>
<th>Choose</th>
<th>Digit Out</th>
<th>Time</th>
<th>Ch1</th>
<th>PID</th>
<th>Guar.</th>
<th>Jump to</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ramp Rate</td>
<td>23/00 00:00</td>
<td>On</td>
<td>&gt;</td>
<td>23.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Ramp Rate</td>
<td>00:00:10</td>
<td>On</td>
<td>1</td>
<td>50.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Soak</td>
<td>01:00:00</td>
<td>On</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>No</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Ramp Rate</td>
<td>00:00:10</td>
<td>Off</td>
<td>1</td>
<td>0.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Soak</td>
<td>01:00:00</td>
<td>Off</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>No</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Jump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Name 99 —</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>Ramp Rate</td>
<td>00:00:10</td>
<td>Off</td>
<td>1</td>
<td>23.0</td>
<td>1</td>
<td></td>
<td></td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**Step Description**

1. Establishes a recommended initialization step. Goes to +23ºC as quickly as possible. Test sample is turned ON via Event 1.
2. Goes to +50ºC at a controlled rate of 1ºC per minute. Test sample is turned ON via Event 1.
3. Will hold for 1 hour. Test sample remains ON via Event 1.
4. Goes to 0ºC at a controlled rate of 1ºC per minute. Test sample remains ON via Event 1.
5. Will hold for 1 hour. Test sample remains ON via Event 1.
6. Jumps back to step 2. Repeats this 3-times, for a total of 4-cycles.
7. After all cycles are completed, establishes the condition to end on. Goes to +23ºC as quickly as possible. Test sample is turned OFF via Event 1.

**Notes**

- Guaranteed Soak Band is set at the factory for 3.0ºC. Can be changed in the System Menu.
- Means no entry or selection is required. Just scroll through this prompt to the next prompt.
- Means prompt does not show for this step type.
Digital Event Outputs

The Temperature Controller has digital outputs which can be configured as Event Outputs to turn remote devices on and off. There are seven Event Outputs which are available for customer use. Output number eight is configured to control the refrigeration compressors and is not available for customer use. The Event Outputs are accessed from the Main Page.

To control the Event Outputs:
1. Press the ▲ or ▼ key to position the Cursor next to the DigitalOut prompt.
2. Press the ► key once. You will see Choose Event Output prompt in the lower display.
3. Press the ▲ or ▼ key to position the Cursor next to the EventOutput prompt which you want to change. You will be able to select from EventOutput1 through EventOutput7.
4. Press the ► key once to select the desired EventOutput. Then, press the ▲ or ▼ key to select On or Off.
5. Press the ► key once to return to the Choose Event Output prompt.
6. Press the◄ key once to return back to the Main Page.

Digital Output Connections
See page 12.9 of the “Series F4 User’s Manual” for details on how to connect to the Digital Outputs.

Event Board Option
Your chamber may have been ordered with the Event Board option. The event board contains solid state relays to control AC operated devices, such as power to a test sample. The solid state relays are rated for 24 to 240 VAC, 3.0 Amps. However, TestEquity recommends derating the maximum current to 2.5 Amps. The solid state relay mounting board is UL recognized/CSA certified for 120 VAC max. with the board-mounted fuses; 250 VAC max. with a #22 solid copper jumper wire instead of the fuses.

Connecting to the Event Board
1. Turn the Main Disconnect switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. The Event Board is located on the lower door. Connect to the event outputs as follows:

<table>
<thead>
<tr>
<th>Event Output</th>
<th>Event Board Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event 1</td>
<td>1, 2</td>
</tr>
<tr>
<td>Event 2</td>
<td>3, 4</td>
</tr>
<tr>
<td>Event 3</td>
<td>5, 6</td>
</tr>
<tr>
<td>Event 4</td>
<td>7, 8</td>
</tr>
<tr>
<td>Event 5</td>
<td>9, 10</td>
</tr>
<tr>
<td>Event 6</td>
<td>11, 12</td>
</tr>
<tr>
<td>Event 7</td>
<td>13, 14</td>
</tr>
</tbody>
</table>

4. The event outputs are just switches. You must provide power from an external source.
5. A 1/2-inch conduit hole is provided on the left side of the lower door to route your wires through. Use the appropriate wire/cable management fittings.
Chapter 4 – Temperature Controller

Operations Page

The Operations Page provides access to menus for control tuning (PID) and controller alarms. TestEquity has configured the security to require a password for access to all parameters in the Operations Page. You must call TestEquity at 877-512-3457 or 805-480-3697 to obtain the password.

⚠️ CAUTION: The Series F4 Temperature Controller “Alarm” functions are NOT used in the chamber’s safety system and are NOT connected. TestEquity does NOT recommend using the Series F4 alarm function as the main protection device. The independent Series 97 Limit Controller functions as the main protection device.

⚠️ CAUTION: The Series F4 Temperature Controller PID values has been properly configured by TestEquity to match the chamber’s system requirements and to perform optimally over a wide range of operating conditions. Improper modifications to these values can result in erratic performance and unreliable operation. Do not attempt to modify the PID values, unless you thoroughly understand what you are doing. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

⚠️ CAUTION: The Autotune PID function is not appropriate for use in this chamber. Using this function will result in tuning values that will not work correctly.

Setup Page

The Setup Page provides access to menus for configuring the controller hardware. TestEquity has configured the security to require a password for access to the Setup Page. However, there will be times when entry into these menus are necessary. For example, you may need to gain access to Setup Page in order to change from °C to °F display, or to change the time or date. You must call TestEquity at 877-512-3457 or 805-480-3697 to obtain the password.

⚠️ CAUTION: The Series F4 Temperature Controller setup values has been properly configured by TestEquity to match the chamber’s system requirements and to perform optimally over a wide range of operating conditions. Improper modifications to these values can result in erratic performance and unreliable operation. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.
Chapter 4 – Temperature Controller

Factory Page

The Factory Page provides access to menus for controller diagnostics and calibration. TestEquity has configured the security to require a password for access to the Setup Page. However, there will be times when entry into these menus are necessary. For example, you may need to gain access to Factory Page in order to perform a calibration, or to change the security password. You must call TestEquity at 877-512-3457 or 805-480-3697 to obtain the password.

⚠ CAUTION: NEVER select “Full Defaults” in the Factory/Test Menu. This will erase all the correct values which are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

Computer Interface

⚠ CAUTION: Every setting in the F4 Controller can be accessed via the computer interface. Do not attempt to modify any parameters associated with the Operations, Setup or Factory pages, unless you thoroughly understand what you are doing. Improper modifications to these values can result in erratic performance and unreliable operation. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series F4 Temperature Controller Setup Parameters” section of this manual.

RS-232C
The F4 Temperature Controller has an RS-232C interface. A DB-9 connector is located on the front left side. It is wired to accommodate a null-modem cable. To communicate with the controller from a PC, you need to run software that uses the Modbus RTU protocol industrial data communications. This protocol works on the principle of packet exchanges. The packet contains the address of the controller to receive the information, a command field that says what is to be done with the information and several fields of data. Reading from these registers retrieves all information in the controller. These registers are listed Chapter Seven of the “Series F4 User’s Manual”. RS-232C and Modbus programming resources can be downloaded from http://chamber.testequity.com/rs232.html.

GPIB (optional)
The optional GPIB interface consists of an internal board which converts the F4 controller’s serial interface to GPIB. Chambers with a GPIB interface have a GPIB connector in place of the RS-232C connector. GPIB programming resources can be downloaded from http://chamber.testequity.com/gpib.html.

Common Modbus Registers
- The actual chamber temperature reading is Modbus register 100 (Input 1 Value).
- The static temperature set point is Modbus register 300 (Set Point 1).
- The temperature set point during a profile is Modbus register 4122 (Set Point 1, Current Profile Status).
- The decimal points are implied. For example, 1005 is actually 100.5 and -230 is -23.0.
Chapter 5 - Limit Controller

Introduction

The Series 97 Limit Controller is a protection device. It turns the chamber OFF if the workspace temperature exceeds either a high temperature or low temperature limit. You can set these limits to correspond to the maximum and minimum temperature that your test sample can safely withstand. This provides protection against someone setting the Temperature Controller to a temperature that is unsafe for the test sample. It also provides protection in the unlikely event of a chamber system component failure. The Limit Controller has its own temperature sensor (thermocouple) and functions completely independent of the Temperature Controller.

This section provides a brief overview on how to operate the Limit Controller. For more detailed instructions, see the “Series 97 User’s Manual”.

⚠️ CAUTION: The “Series 97 User’s Manual” is a general manual and is written by the manufacturer, Watlow, for a wide variety of applications and configurations. Not all features or functions are applicable. Only the capabilities of a model 97A0-DAAA-00-RG, as described on page A.20 of the “Series 97 User’s Manual” are applicable. Please note that only the Series 97 “Limit” functions are applicable.

⚠️ CAUTION: The Series 97 Limit Controller has been properly configured by TestEquity to match the chamber’s system requirements. Improper modifications to these setup values can result in unreliable and unsafe operation. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. Setup examples in the “Series 97 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series 97 Limit Controller Setup Parameters” section of this manual.

⚠️ CAUTION: NEVER select “Default Settings” in the Factory Page. This will erase all the correct values which are documented in the “Series 97 Limit Controller Setup Parameters” section of this manual.

⚠️ CAUTION: Always verify that the Limit Controller’s high and low limits are set to temperatures that are appropriate for your test sample.

⚠️ CAUTION: If your test sample is energized, it may be capable of raising the workspace temperature beyond safe limits. This could occur if your test sample exceeds the live load rating of the chamber or if the chamber’s refrigeration system fails. This chamber has a set of contacts that can be used to remove power to your test sample if the Limit Controller’s temperature limits are exceeded.
Limit Controller Keys and Displays

Active Output Indicator Lights
Lit when the corresponding output trips. Only output 1 is applicable for this configuration.

Upper Display
Indicates actual process values during operation, the value for the parameter in the lower display, or the user programmed message.

Lower Display
Indicates factory programmed message during operation, the value for the parameter in the lower display, or the user programmed message.

Advance Key
Advances the lower display through the parameters. To reverse direction, press and hold the Advance Key while repeatedly pressing the UP Key.

Reset Key
- Returns to the Home Page (process/actual display).
- Resets the limit.
- Resets an input sensor error.

Up Key
Changes the upper display to a higher value, or up through a list of values. Moves from menu to menu in a page.

Down Key
Changes the upper display to a lower value, or down through a list of values. Moves from menu to menu in a page.

Figure 4.1 – Limit Controller Keys and Displays

How to Set the High and Low Temperature Safety Limits
1. Press the ▲ AND ▼ keys together for ONLY three seconds, until the [OPER] prompt appears in the Lower Display. The Upper Display should say [LIM].
2. Press the ◁ key once to get the [L~Lo] prompt. This is the Low Limit Set Point prompt.
3. Press the ▲ or ▼ key to enter the desired Low Limit Set Point. Make sure it is lower than your actual chamber temperature set point, and at least below room temperature to prevent nuisance tripping.
4. Press the ◁ key once to get the [L~Hi] prompt. This is the High Limit Set Point prompt.
5. Press the ▲ or ▼ key to enter the desired High Limit Set Point. Make sure it is higher than your actual chamber temperature set point to prevent nuisance tripping.
6. Press the RESET key to save these values and return to the Home Page.

If you press the ◁ key after the [L~Hi] prompt, you will get the [CAL1] prompt, which is the Calibration Offset. This is an adjustment to eliminate a difference between the indicated value and the actual process value.

Resetting a Limit Condition
If either the High or Low Limit is exceeded, the Limit Controller will indicate either [L~Hi] or [L~Lo] respectively in the lower display. It will also shut down all chamber functions and sound the Audible Alarm. The Limit Controller cannot be reset until the temperature returns to within the limit set points. Then, you must press the RESET Key to resume normal operation.

Silencing the Audible Alarm
The SILENCE switch on the chamber front panel lets you temporarily turn off the Audible Alarm, even though the High or Low Limit condition may still exist.
Protecting an Energized Test Sample

If your test sample is energized, it may be capable of raising the workspace temperature beyond safe limits. This could occur if your test sample exceeds the live load rating of the chamber or if the chamber’s refrigeration system fails.

This chamber has a set of safety contacts that can be used to remove power to your test sample if the Limit Controller’s temperature limits are exceeded.

The safety contacts are rated as follows:
Resistive: 10 A, 250 VAC or 10 A, 28 VDC
Inductive: 7 A, 250 VAC

To access the safety contacts:
1. Turn the Main Disconnect Switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Locate terminal block TB4 on the electrical sub panel. Connections to the safety contacts are at terminals A1 and A2 on terminal strip TB4.

Figure 3-1 – Location of Safety Contact Connections on the Electrical Sub Panel
Chapter 6 – Frequently Asked Questions

The input voltage label says 230 (or 208) VAC. I thought I had 220 (or 240) VAC. Is that ok?
220 V is a misnomer—there is no such standard as nominal 220 V in the United States. You must verify the exact type of electrical service you have. If there is any doubt, you must consult with a qualified electrician who is familiar with industrial plant wiring. In addition, the input line voltage should be measured while the chamber is operating in the COOL mode to ensure that the expected nominal voltage of either 208 V −5/+10% or 230 V ±10% is present. Also, make sure the chamber is properly configured for either 208 V or 230 V nominal input as described in Chapter 2 - Input Power Configuration. If you have a 208 V line that measures less than 198 V, the chamber will require boost transformers. If you have a 240 V line that measures over 252 V (a 240 V line which is 10% high could measure up to 264 V), the chamber will require bucking transformers. These transformers are available from TestEquity (part number TE-0702F) for a reasonable cost and are easy to install in the field.

Why doesn’t the chamber come with a power cord and plug?
Most local electrical codes require permanent wiring for this type of equipment. If used as a portable device, a flexible wire with a plug may be acceptable, but local codes may limit the length to 6 feet. TestEquity recommends that the appropriate method for your installation be determined by a qualified electrician who is familiar with industrial plant wiring.

I need to send the chamber outside North America. Will it work with their power?
Outside North America, most countries have 50 Hz. Standard voltages in Europe are typically 220 V to 240 V, while Japan is 200 V. Operation at 220 V to 240 V / 50 Hz requires a bucking transformer to lower the voltage at the compressor to its 50 Hz rating of 200 V. This transformer is available from TestEquity for a reasonable cost and is easy to install in the field. Note that the cooling performance will be reduced by 17% at 50 Hz. Please call TestEquity for details on reconfiguring for 50 Hz operation.

Why does my chamber heat or cool slower than the published specifications?
Performance is significantly affected by the characteristics of your test sample. Factors include size, weight, material, shape, and power dissipation if energized. The test sample should be placed in the chamber in a manner that allows for air circulation. You should not place the test sample directly on the chamber floor. It should be placed on the shelf. Multiple test samples should be distributed throughout the chamber to ensure even airflow and minimize temperature gradients. If necessary, additional shelves should be used to evenly distribute the load. You can determine if the chamber is operating properly by following the procedure in “How to verify the chamber performance”.

How can I modify the chamber to cool faster?
Unfortunately, there is little you can do to improve upon the designed-in performance. TestEquity does NOT recommend using CO2 or LN2 in this chamber to achieve faster cooling due to reliability and safety considerations, so it is NOT an available option. Modifying the chamber to add CO2 or LN2 will void the warranty.
Why is there water/ice/snow in the chamber?
Any time the ambient air is subjected to temperatures below the dew point, moisture will condense out of the air. The effect is ice or frost during low temperature operation. When the chamber is heated above 0°C, the ice or frost will turn into water. To avoid moisture condensation, make sure the port plugs are inserted at all times. Also, avoid opening the chamber door while the chamber is operating at temperatures below room ambient. When a low temperature test is completed, warm the chamber to at least room ambient before opening the chamber door and before removing your test sample.

My test specification requires convection heat only. Can I turn the circulator motor off?
NO! This will damage the heating and refrigeration systems and void the warranty. You need a “gravity convection oven” for that kind of test.

How accurate is the chamber?
That’s a loaded question! There is no “chamber accuracy” specification as such. The answer requires an understanding of several performance parameters.

Control Tolerance – The Temperature Controller uses a thermocouple control sensor, which is located in the discharge airflow. Control tolerance is a measure of how much the temperature varies after stabilization at the control sensor. It is a measure of the relative variations, NOT the absolute accuracy of the readout. The control tolerance specification for this chamber is ±0.5°C, or a total of 1°C. For example, the temperature set point may be –25.0°C. The actual temperature varies between –25.4°C and –24.5°C. This corresponds to –0.4°C and +0.5°C or a total of 0.9°C of RELATIVE variations. These specifications are for an empty chamber. The addition of a test sample may effect the control variations. In some instances, the test sample will reduce these variations.

Uniformity – Also known as Gradients. This is a measure of variations in temperature at different locations throughout the chamber interior, at the same time, after stabilization. The uniformity specification for this chamber is ±0.5°C or a total of 1°C, when measured at least 2" away from the chamber interior walls. These specifications are for an empty chamber. The addition of a test sample may effect the temperature uniformity. For example, an energized test sample will produce a higher temperature near the sample.

Controller Accuracy – This is the ability of the temperature controller to accurately display a temperature measurement when compared to a standard. The controller display accuracy is ±1.66°C. However, the total measurement accuracy in the chamber includes the thermocouple sensor wire accuracy. Thermocouple wire accuracy is ±1°C or 0.75% of reading, whichever is greater. Therefore, total system accuracy over the chamber’s operating range can be as much as ±2.66°C, although the typical accuracy is often better than ±1.0°C.

Can I tilt the chamber to move it?
You should be able to tilt the chamber 45 degrees to move it. After tilting it and moving it into place, perform the steps as outlined in “How to inspect the refrigeration machinery compartment” and “How to check the refrigerant charge” before placing the chamber back into service to make sure that no damage has occurred.
Chapter 6 – Frequently Asked Questions

I’m not going to use the chamber for a while. Is there anything I should do to prepare it for storage?
Perform ALL the steps in the Preventive Maintenance Schedule before placing the chamber into storage. This will ensure that the chamber will be ready to operate when it is taken out of storage. If the chamber has a problem and is still under warranty, these problems should be resolved before being placed into storage, since the warranty period starts from the date of shipment. The chamber should be stored in a conditioned environment. Do not store it outside or where it will be subjected to dirt or excessive moisture.

I haven’t used the chamber for a while. Is there anything I should do to prepare it for operation?
Perform ALL the steps in the Preventive Maintenance Schedule before placing the chamber back into service. This will ensure that nothing has been damaged and that a leak has not developed.

This chamber has a crankcase heater to protect the high-stage compressor. The chamber must be connected to the power source AND the Main Disconnect Switch must be ON for 3 hours prior to operating the chamber. Although it may be safe to use the chamber immediately, this procedure ensures the longest possible life for the high-stage compressor if the chamber has been removed from the power source for more than 24 hours.

Can the person who services our air conditioning also service the chamber?
Probably not. Most air conditioning mechanics are not familiar with low-temperature cascade refrigeration systems. While this chamber is relatively easy to maintain and repair, most air conditioning mechanics do not have the necessary refrigerants and may not be familiar with the microprocessor-based controls. This chamber should only be serviced by a qualified mechanic that is familiar with low-temperature cascade refrigeration systems. Call TestEquity to recommend one in your area, or to check if the one you would like to use is qualified.

Can/Should I put a filter in front of the condenser air inlet?
No, TestEquity does not recommend this. Just follow the maintenance procedures and clean the condenser fins periodically.

How often should I charge the refrigeration system?
This chamber uses a closed-loop refrigeration system. Just like your refrigerator at home, it does not need periodic charging. If the charge is low, this means that there is a leak. Leaks should be repaired before recharging.

What kind of Freon does the chamber use?
The word Freon® is a DuPont registered trade name for their CFC-based refrigerants and is incorrectly used as a generic term for refrigerants. TestEquity chambers do not use CFC-based refrigerants. The high-stage system uses R-404A, which is also known as DuPont Suva® HP62. The low-stage system uses R-508B, which is also known as DuPont Suva® 95.
Chapter 7 – Specifications

Model 1007C Chamber Specifications

Temperature Range
-75°C to +175°C

Control Tolerance
±0.5°C (±0.2°C Typical) (Measured at the control sensor after stabilization)

Uniformity
±0.5°C (Variations throughout the chamber after stabilization)

Live Load Capacity @

<table>
<thead>
<tr>
<th>Temperature</th>
<th>1000 W</th>
<th>800 W</th>
<th>500 W</th>
<th>400 W</th>
<th>300 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>+23°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-40°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-55°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-65°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cool Down Transition Time*

<table>
<thead>
<tr>
<th>Start Temp to</th>
<th>+23°C</th>
<th>0°C</th>
<th>-40°C</th>
<th>-55°C</th>
<th>-65°C</th>
<th>-75°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>+23°C</td>
<td>----</td>
<td>4 min</td>
<td>18 min</td>
<td>25 min</td>
<td>33 min</td>
<td>ultimate</td>
</tr>
<tr>
<td>+50°C</td>
<td>5 min</td>
<td>11 min</td>
<td>27 min</td>
<td>36 min</td>
<td>45 min</td>
<td>ultimate</td>
</tr>
<tr>
<td>+85°C</td>
<td>13 min</td>
<td>20 min</td>
<td>37 min</td>
<td>47 min</td>
<td>55 min</td>
<td>ultimate</td>
</tr>
<tr>
<td>+150°C</td>
<td>32 min</td>
<td>39 min</td>
<td>58 min</td>
<td>65 min</td>
<td>76 min</td>
<td>ultimate</td>
</tr>
</tbody>
</table>

Heat Up Transition Time*

<table>
<thead>
<tr>
<th>Start Temp to</th>
<th>+23°C</th>
<th>0°C</th>
<th>-40°C</th>
<th>-55°C</th>
<th>-65°C</th>
<th>-75°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>+23°C</td>
<td>----</td>
<td>1.5 min</td>
<td>7 min</td>
<td>14 min</td>
<td>20 min</td>
<td>25 min</td>
</tr>
<tr>
<td>0°C</td>
<td>1.5 min</td>
<td>3.5 min</td>
<td>13 min</td>
<td>20 min</td>
<td>23 min</td>
<td>31 min</td>
</tr>
<tr>
<td>-40°C</td>
<td>6 min</td>
<td>11 min</td>
<td>17 min</td>
<td>24 min</td>
<td>30 min</td>
<td>35 min</td>
</tr>
<tr>
<td>-55°C</td>
<td>8 min</td>
<td>13 min</td>
<td>19 min</td>
<td>26 min</td>
<td>32 min</td>
<td>37 min</td>
</tr>
<tr>
<td>-65°C</td>
<td>10 min</td>
<td>14 min</td>
<td>21 min</td>
<td>28 min</td>
<td>34 min</td>
<td>39 min</td>
</tr>
</tbody>
</table>

*Note: Transition times are measured after a 2-hour soak at the start temperature with an empty chamber.

Input Power Requirements

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Phase</th>
<th>Current Draw</th>
<th>Minimum Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>230 V ±10%, 60 Hz</td>
<td>1 PH</td>
<td>25 A</td>
<td>30 A</td>
</tr>
<tr>
<td></td>
<td>3 PH</td>
<td>19 A</td>
<td>25 A</td>
</tr>
<tr>
<td>208 V -5/+10%, 60 Hz</td>
<td>1 PH</td>
<td>28 A</td>
<td>35 A</td>
</tr>
<tr>
<td></td>
<td>3 PH</td>
<td>21 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

Input may be configured for single or three phase in the field by changing jumpers. Three phase load is semi-balanced. Operation below 198 V requires internal boost transformers, which can be supplied for a nominal charge. Call for other voltages or 50 Hz operation.

Workspace Dimensions
24" W x 21" H x 24" D (7 cubic feet)

Outside Dimensions
33" W x 68.75" H x 50" D (nominal)

Door latch adds 3" to width on right side (may be removed to permit move-in through a 36" doorway). Circulator motor housing adds 6" to height.

Min. Installed Clearance
12" from the left and right side, 24" from the rear

Access Ports
4" Port on left and right side (two total), Supplied with foam plugs

Weight
850 pounds

NOTE: Performance is typical and based on operation at 23°C (73°F) ambient and nominal input voltage. Designed for use in a normal conditioned laboratory. Operation at higher ambient temperatures may result in decreased cooling performance. Additional ports and shelves will also affect performance. Operation above 30°C (85°F) or below 16°C (60°F) ambient is not recommended.
Model 1007C Safety and EMC

ETL Listing

ETL Listed, File No. 9901813
Conforms to UL STD 3101-1
Certified to CAN/CSA STD C22.2 No. 1010.1

CE Declaration of Conformity

Declaration of Conformity

TestEquity Inc.
2450 Turquoise Circle
Thousand Oaks, CA 91320

Declares that the following product:
Model Number: 1007C, including all standard options
Designation: Temperature Chamber

Meets the essential requirements of the following European Union Directive(s) using the relevant section(s) of the normalized standards and related documents shown:

89/336/EEC Electromagnetic Compatibility Directive
EN 50081-2 EMC Generic emission standard, Part 2: Industrial environment
EN 55011 Conducted Emissions, Class A
EN 55011 Radiated Emissions, Class A

EN 50082-2 EMC Generic immunity standard, Part 2: Industrial environment
EN 61000-4-2 Electrostatic discharge
EN 61000-4-3 Radiated immunity (AM)
ENV 50204 Radiated Immunity (Pulse)
EN 61000-4-4 Electrical fast transients
EN 61000-4-5 Surges
EN 61000-4-6 Conducted immunity

73/23/EEC Low-Voltage Directive
EN 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General requirements

Name of Authorized Representative: Peter Kesselman
Title of Authorized Representative: Vice President, Product Marketing
Place of Issue: Thousand Oaks, CA
Date of Issue: September 28, 1999

Signature of Authorized Representative

Peter Kesselman
Chapter 7 – Specifications

F4 Temperature Controller Specifications

Specifications as configured for the TestEquity 1007C Chamber

Accuracy & Sensor Conformity*  
±1.55°C (above −50°C)  
±1.66°C (below −50°C)

Stability  
±0.1°C/°C rise in ambient

Digital Inputs  
(Four) Contact closure or dc voltage, 10 kΩ impedance

Retransmit Outputs (Optional)  
(Two) User-selectable ranges:  
0 to 10 VDC, 0 to 5 VDC, 1 to 5 VDC  
0 to 20 mA, 4 to 20 mA

Alarm Outputs  
(Two) Electromechanical relay;  
Form C, 2 A @ 20 VDC or 240 VAC max.

Digital Outputs  
(7 available for customer use) Open collector output  
OFF: 42 VDC @ 10 µA max.  
ON: 0.2 VDC @ 50 mA sink max.  
Internal supply: 5 VDC @ 80 mA

Communications  
EIA-232 and EIA-485 serial communications with  
Modbus™ RTU protocol

Safety & Agency Approvals  
UL/c-UL 916-listed, File #E185611  
CE to EN61010  
NEMA 4X and IP65  
CE EMC to EN50082-2  
CE EMC to EN55011

Displays  
Process: 5, seven-segment red LED.  
Interface Display: 4-line high-definition green LCD;  
selectable °C or °F

Data Retention  
Retention upon power failure via nonvolatile memory  
(seven years for battery-backed RAM)

*Note: Total system accuracy in the chamber includes thermocouple wire accuracy.  
Thermocouple wire accuracy is ±1°C or 0.75% of reading, whichever is greater.  
Therefore, total system accuracy over the chamber’s operating range can be as much as ±2.66°C,  
although the typical accuracy is often better than ±1.0°C.
Chapter 8 – Maintenance

⚠️ WARNING: Maintenance must be performed by properly trained personnel only.

Preventive Maintenance Intervals

Daily or As Needed
- Clean chamber interior and exterior.
- Listen for abnormal noise or vibration.

Every 3 Months
- Inspect the door seal.
- Inspect the refrigeration machinery compartment.
- Check the low-stage refrigeration charge.
- Check the high-stage refrigeration charge.
- Verify the chamber performance.

Every 6 Months
- Inspect the electrical compartment.
- Clean the condenser.

Every 12 Months
- Verify the calibration.
**Maintenance Procedures**

**How to clean the chamber interior and exterior.**
- Wipe or vacuum out all debris.
- Clean surfaces with a damp cloth, mild detergent, or stainless-steel cleaner. Avoid cleaners that are abrasive or leave a residue. Do NOT use steel wool.
- If you clean the interior with something other than water, you may want to operate the chamber at high temperature (approximately +125°C) after cleaning. This helps to “bake out” any residue. Remove the port plugs to permit the residual vapors to escape.
- Clean the silicone door gaskets with a damp cloth or mild detergent.
- Clean the exterior painted surfaces with a damp cloth or mild detergent. If you are using a detergent, test a small inconspicuous area to make sure it does not damage the finish.

**How to listen for abnormal noise or vibration.**
You should become familiar with normal operating noises. Being able to recognize changes from normal operating noises can be a valuable way to identify problems and prevent further damage. Examples of noises to be aware of include:
- Circulator motor and fan noises (with compressors off).
- Compressor start-up and running noises, sequential starting of compressors.
- Condenser and desuperheater fan noises.
- Relay and valve cycling noises when cool light is cycling.

**How to inspect the door seal.**
The door has two silicone gaskets to minimize thermal losses and moisture migration.
- Inspect the gaskets for dirt and tears.
- Repair minor tears with a high quality RTV silicone such as GE RTV167.
- Check the integrity of the door seal by closing the door on a sheet of paper. With the door closed, slowly pull the paper. You should feel the resistance getting lighter as the paper goes past the inner gasket. Repeat this all around the door at several places.
- If the seal is not tight, adjust the door latch. The stainless-steel catch (on the bracket that is mounted to the chamber) has slotted holes to permit adjustment.
- If the seal is still loose on the hinge side, adjust the door hinge. The hinges have slotted holes (on the door side) to permit adjustment.
How to inspect the refrigeration machinery compartment.

⚠️ WARNING: Wear safety goggles when inspecting the machinery compartment to protect against a refrigerant line which could break.

1. Turn the Main Disconnect Switch OFF.
2. Remove the side and rear panels.
3. Inspect for signs of refrigeration tubing abrasion.
4. Inspect for oil around refrigeration valves, fittings and joints. This may be a sign of leaks.
5. Inspect for loose hardware and tighten as required.
6. Inspect for signs of insect or rodent infestation. Yes, it does happen!

How to check the low-stage refrigerant charge.
The low-stage refrigerant charge is checked by observing the “standby pressure” (also known as static or balance pressure).

1. Make sure the chamber has been off for at least 8 hours.
2. Locate the two low-stage gauges marked R-508B on the left side of the rear of the chamber.
3. The two gauges have different scales. However, they should read the same value of pressure. This indicates that the system is equalized and an accurate reading can be taken.
4. Both R-508B gauges should read between 85 and 100 PSI.
5. If the pressure is low, this indicates that there is probably a leak.
6. If one gauge is low and the other is high, then the system is not equalized yet and an accurate reading cannot be made. Wait until both gauges read the same pressure.

NOTE: If the low-stage has been evacuated and recharged after a repair, the standby pressure should be rechecked after 24 hours to make sure it is between 85 and 100 PSI. This is because the R-508B refrigerant mixes with the oil in the compressor, causing a lower standby pressure. Do not mistake this initial loss of pressure with a leak. After verifying that there is no leak, you may need to top-off the charge if the pressure is too low. This note only applies to systems that have been evacuated and recharged.

How to check the high-stage refrigerant charge.
The high-stage refrigerant charge is checked by observing the sightglass.

1. The sight glass is located behind the rear bottom panel, on the right side.
2. Set the Temperature Controller to a low-temperature Set Point. The Cool Light should be on continuously.
3. After about 5 minutes of operation in this mode, inspect the sightglass.
4. If you see bubbles or it appears partially full, then this indicates that there is probably a leak.
5. When the Temperature Controller is cycling (Cool Light cycles on/off), the sightglass may appear 1/2 to 2/3 full. This is normal.
**How to verify the chamber performance.**

These tests verify the performance of the heating, refrigeration, electrical controls, temperature controller, and air circulation systems. The chamber should meet all published performance specifications if all of these tests are successfully passed.

These tests assume that the Temperature Controller’s setup and tuning values have not been changed from the values as shipped from TestEquity. Also, the Limit Controller high limit must be set to over +85°C (+88°C would be fine), and the low limit set to –75°C.

If the chamber fails any of these tests, it should be removed from service to prevent further damage until the cause of the problem is determined and resolved.

1. The chamber interior should be empty and at ambient temperature, approximately +23°C.
2. Set the Temperature Controller Set Point to +85°C and turn the Master Switch ON.
3. The Heat Light should be ON continuously and the Cool Light should be OFF.
4. The chamber should heat up to about +80°C and begin controlling (Heat Light cycles ON/OFF) within 7 minutes.
5. The chamber temperature should slowly increase and stabilize to +85°C. It should NOT overshoot beyond +85°C by more than a few tenths of a degree, and the compressors should NOT need to turn ON in order to maintain +85°C.
6. After stabilization, the chamber temperature should vary no more than ±0.5°C, or a total of 1°C.
7. Let the chamber stay at +85°C for two hours.
8. After two hours at +85°C, set the Temperature Controller Set Point to –65°C.
9. The high-stage compressor should turn ON within a few seconds. Then, the low-stage compressor should turn ON within approximately 30 seconds, and the Cool Light should be ON continuously and the Heat Light should be OFF.
10. The chamber should cool down to about –60°C and begin controlling (Cool Light cycles ON/OFF) within 55 minutes.
11. The chamber temperature should slowly decrease and stabilize to –65°C. It should NOT undershoot beyond –65°C by more than a few tenths of a degree, and the compressors should NOT need to turn OFF in order to maintain –65°C.
12. After stabilization, the chamber temperature should vary no more than ±0.5°C, or a total of 1°C.
13. Set the Temperature Controller Set Point to –73°C.
14. The chamber should approach –73°C and control (Cool Light cycles ON/OFF) within approximately 5 minutes.
15. Set the Temperature Controller Set Point to +23°C. The chamber should begin to heat up. The compressors should turn off within approximately 1 minute.
16. This concludes the chamber performance verification tests.
17. Let the chamber heat up to +23°C before turning the Master Switch OFF.
How to inspect the electrical compartment.
1. Disconnect the chamber from the power source.
2. Turn the Main Disconnect Switch to the OFF position.
3. Remove the lower door retaining screw located on the right side. Open the lower door.
4. Check for loose components, loose wires, burned insulation near terminals, and burned or excessively pitted contacts on contactors.

How to clean the condenser.
1. Disconnect the chamber from the power source.
2. Turn the Main Disconnect Switch to the OFF position.
3. Remove the lower door retaining screw located on the right side. Open the lower door.
4. Clean the condenser and desuperheater fins with a vacuum cleaner.

NOTE: You may need to clean the condenser more frequently if the chamber is in a dusty environment. You may be able to clean the condenser less frequently if the chamber is in a very clean environment.

How to verify the calibration.
TestEquity recommends verifying the calibration before attempting to actually perform a calibration. The state-of-the-art instrumentation used in TestEquity chambers is of the highest quality and seldom goes out of calibration. If you try to calibrate the instrumentation before determining that calibration is necessary, you may make it worse if done incorrectly.

Variations in temperature throughout the chamber interior is NOT a measurement of accuracy. These variations, called “gradients”, are a function of the physical design of the chamber and its airflow, the characteristics of the test sample, and how it is oriented in the chamber. You cannot “calibrate” to improve gradients. The correct way to adjust what the temperature controller “displays” compared to what is measured at some point other than the controller’s sensor, is with the “Calibration Offset” parameter. See page 6.2 of the “Series F4 User’s Manual” for details. Calibration verification should be performed with the Calibration Offset set to 0.0 (zero).

The F4 Temperature Controller accuracy is specified ±1.55°C (above −50°C) and ±1.66°C (below −50°C). Total system accuracy in the chamber includes the controller plus the thermocouple wire accuracy of ±1.0°C. Total system accuracy over the chamber’s operating range is can be as much as ±2.66°C, although it is typically better than ±1.0°C.

The easiest way to verify the instrumentation accuracy is with an independent calibrated temperature sensor and display. Place the sensor near the chamber’s sensors, which are located towards the right side of the conditioner fan grille. If the readings agree within the specified limits above, then no calibration adjustments are necessary.

If calibration of the temperature controller is necessary, refer to page 9.2 of the “Series F4 User’s Manual” and follow the instructions for “Thermocouple Input Procedure”. If calibration of the limit controller is necessary, refer to page A.11 of the “Series 97 User’s Manual” and follow the instructions for “Thermocouple Input Procedure”.
Theory of Operation

Overview
The chamber is heated by an open element nichrome heater. Cooling is accomplished by a cascade refrigeration system, which consists of two compressors. The air is circulated by a propeller fan. The heater, evaporator (cooling coil), and fan are located within an air plenum which is on the back wall of the chamber interior.

The heater, compressors, and circulator fan motor operate directly from the 208 or 230 VAC input line. All line branch circuits are individually fused. A step-down transformer provides 115 VAC for all instrumentation and control elements.

Refer to the electrical and refrigeration drawings to identify the referenced items described below.

Heating System
The chamber is heated by an open-element nichrome heater (HT1). The heater is located in the air plenum. The temperature controller provides a time-proportioned output to a solid state relay (SSR1). This turns the heater on/off as required to maintain the temperature set point. Pilot light PL1 provides an indication on the front panel when the heater is on.

A fusible heat limiter (HL) provides failsafe protection against a catastrophic failure by opening the heater circuit at +240°C. The master heat contactor C1 provides a power interlock for the heaters, circulator fan motor, and the control system. C1 is controlled by both the Master Switch and safety relay (CR3). CR3 is controlled by the temperature limit controller (TCR2). If either the high or low temperature safety limits are exceeded, TCR2 turns off CR3, which turns off C1.

Refrigeration System
Cooling is accomplished by a cascade refrigeration system. A cascade refrigeration system consists of two interdependent refrigeration systems. The low-stage provides cooling to the chamber interior through a finned evaporator coil, which is located in the air plenum. The high-stage provides cooling to the cascade condenser. The cascade condenser is a heat exchanger that has one circuit which is the evaporator of the high-stage, and another circuit which is the condenser of the low-stage.

The high-stage uses refrigerant R-404A. High pressure liquid refrigerant is fed from the condenser through the liquid line, filter-drier, and sight glass to the thermostatic expansion valve. The thermostatic expansion valve controls the feed of liquid refrigerant to the evaporator circuit of the cascade condenser and, by means of an orifice, reduces the pressure of the refrigerant to the evaporating or low side pressure. The reduction of pressure on the liquid refrigerant causes it to boil or vaporize, absorbing heat which provides a cooling effect. The expansion valve regulates the flow as necessary to maintain a preset temperature difference or superheat between the evaporating refrigerant and the vapor leaving the evaporator circuit of the cascade condenser. The refrigerant vapor travels through the suction line to the compressor suction inlet. The compressor takes the low pressure vapor and compresses it, increasing both the pressure and the temperature. The hot, high pressure vapor is forced out of the compressor discharge valve and into the condenser. As the high pressure vapor passes through the condenser, it is cooled by a
fan, which blows ambient air across the finned condenser surface. The vapor condenses into a liquid and the cycle is repeated.

The Low-Stage uses refrigerant R-508B. High pressure liquid refrigerant is fed from the condenser circuit of the cascade condenser, through the filter-drier and liquid-line solenoid valve to the thermostatic expansion valve. The thermostatic expansion valve feeds the finned evaporator coil, which is located in the air plenum where heat is absorbed to provide a cooling effect within the chamber. The refrigerant vapor travels through the suction line to the compressor suction inlet. The compressor takes the low pressure vapor and compresses it, increasing both the pressure and the temperature. The hot, high pressure vapor is forced out the compressor discharge valve and into the desuperheater. As the high pressure vapor passes through the desuperheater, it is cooled by a fan, which blows ambient air across the finned surface to remove the heat of compression. Next, the vapor goes through the oil separator, which returns any entrained oil back to the compressor’s crankcase. The vapor flows through the condenser circuit of the cascade condenser, where it is condensed back into a liquid.

The temperature controller cycles the low-stage liquid-line solenoid valve (SV1) ON/OFF to control the chamber temperature. When SV1 is ON, liquid refrigerant flows through the thermostatic expansion valve and evaporator to cool the chamber. When SV1 is OFF, the flow stops. The hot gas bypass solenoid valve (SV2) is ON whenever SV1 is OFF. SV2 feeds high pressure vapor to the hot gas regulator, which meters a precise amount into the suction line to maintain a minimum load on the system and keep it out of a vacuum. The hot gas regulator is adjusted to keep the suction pressure at 8 PSIG when SV1 is OFF. This is also called “bypass mode”. The temperature controller alternately cycles SV2 and SV1 through cool relay CR1. Pilot Light PL2 provides an indication on the front panel when SV1 is ON.

During a high temperature pull down or a continuous bypass condition, it is possible for excessive hot gas to return to the compressor. The suction line cooling thermostatic expansion valve senses the suction line temperature and injects liquid refrigerant to cool the hot gas within safe limits.

The low-stage discharge pressure is kept within safe limits with the discharge pressure regulator valve. If the discharge pressure exceeds 225 PSIG, the discharge pressure regulator valve will “dump” refrigerant into the expansion tank. This refrigerant is slowly returned from the expansion tank to the suction line through a capillary tube. The expansion tank also provides sufficient volume in the system to keep the “standby pressure” (also known as static or balance pressure), when the system is off, within safe limits.

Both the high- and low-stages each have a fusible plug which opens in the event of a fire. Both the high- and low-stages each have a high/low pressure switch which turns off the entire refrigeration system in the event of an out of limit condition. The high-stage compressor has a crankcase heater to prevent refrigerant from condensing in the oil when the compressor is off.

The temperature controller has internal logic to turn the compressors on if cooling is required to maintain the temperature set point. The low-stage compressor turns on 30 seconds after the high-stage turns on through Timing Module TM1. This reduces the system’s starting current, while allowing the cascade condenser to get cool before the low-stage turns on.
## Troubleshooting

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>CONDITION</th>
<th>CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber completely inoperative.</td>
<td>1. Power is applied to chamber but the controllers do not light up.</td>
<td>1. Control fuse F9 open. Likely cause is solenoid coil SV1 or SV2 is shorted.</td>
</tr>
<tr>
<td></td>
<td>2. If controller light 1A is ON, circulator fan is ON, the Heat light is OFF.</td>
<td>2. The Heat Limiter HL is open. The Heater HT1 is open.</td>
</tr>
<tr>
<td>Does not heat up at all.</td>
<td>1. If controller light 1A is ON, circulator fan is ON, the Heat light is OFF.</td>
<td>1. Solid State Relay SSR1 is defective (open).</td>
</tr>
<tr>
<td></td>
<td>2. If controller light 1A is ON, circulator fan is ON, the Heat light is ON.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Does not meet published specifications.</td>
<td>1. Chamber interior is overloaded. Circulator motor is not turning. Port plug is not in port. Verify that input voltage is within tolerance and matches the input power configuration (see Chapter 2, Input Power Configuration).</td>
</tr>
<tr>
<td>Heats up too slow.</td>
<td>1. If temperature controller light 1A is OFF, the Heat light is ON.</td>
<td>1. Solid State Relay SSR1 is defective (shorted). Heater is shorted to chassis.</td>
</tr>
<tr>
<td></td>
<td>1. If temperature controller light 1B is ON, the Cool light is OFF, both compressors are OFF.</td>
<td>1. Pressure switch DPS1 or DPS2 is tripped.</td>
</tr>
<tr>
<td></td>
<td>2. If temperature controller light 1B is ON, the Cool light is ON, both compressors are ON.</td>
<td>2. Solenoid valve SV1 may be defective in closed position.</td>
</tr>
<tr>
<td>Heat is on all the time.</td>
<td>1. If temperature controller light 1A is OFF, the Heat light is ON.</td>
<td>1. Solid State Relay SSR1 is defective (shorted). Heater is shorted to chassis.</td>
</tr>
<tr>
<td>Does not cool at all.</td>
<td>1. If temperature controller light 1B is ON, the Cool light is OFF, both compressors are OFF.</td>
<td>1. Pressure switch DPS1 or DPS2 is tripped.</td>
</tr>
<tr>
<td></td>
<td>2. If temperature controller light 1B is ON, the Cool light is ON, both compressors are ON.</td>
<td>2. Solenoid valve SV1 may be defective in closed position.</td>
</tr>
<tr>
<td>R-404A pressure switch DPS1 trips.</td>
<td>1. Trips after operating for a while.</td>
<td>1. Ambient temperature may be too high (over 90°F). Dirty condenser, inadequate clearance from back of chamber to the wall.</td>
</tr>
<tr>
<td></td>
<td>2. Trips immediately after turn on.</td>
<td>2. Low charge (leak).</td>
</tr>
<tr>
<td>R-508B pressure switch DPS2 trips.</td>
<td>1. Trips shortly after cool light turns OFF.</td>
<td>1. Solenoid valve SV1 may be defective.</td>
</tr>
<tr>
<td></td>
<td>2. Trips during a high temp pull down.</td>
<td>2. R-508B discharge pressure regulator may be defective.</td>
</tr>
<tr>
<td></td>
<td>3. Trips when the cool light cycles to OFF.</td>
<td>3. Solenoid valve SV2 may be defective. Hot gas bypass regulator may be defective or set too low.</td>
</tr>
<tr>
<td>SYMPTOM</td>
<td>CONDITION</td>
<td>CAUSES</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>R-508B standby pressure is less than 85 PSIG</strong></td>
<td>1. When unit is off and system is equalized.</td>
<td>1. Low charge (leak).</td>
</tr>
</tbody>
</table>
| **R-404A sightglass has bubbles or does not look full.** | 1. During all running conditions.  
2. Only when cool light is cycling.                                                                                                                                              | 1. Low charge (leak).  
2. No problem. This is normal.                                                                                                                                                                        |
| **Cools too slowly or does not reach −75°C.**     | 1. R-508B standby is ok, no bubbles in R-404A sightglass.                                                                                                                                                 | 1. Chamber interior is overloaded. Test sample is energized, giving off heat. Circulator motor is not turning. Port plug is not in port. Door is not sealing completely. Ice on evaporator. |
| **Temperature varies more than ±0.5°C or 1°C total.** | 1. If tuning PID control parameters in temperature controller were changed.  
2. If tuning PID control parameters in temperature controller are as shipped from TestEquity.  
3. If tuning PID control parameters in temperature controller are as shipped from TestEquity and only occurs in cool mode. | 1. Re-enter values as shipped from TestEquity.  
2. Control parameters may need to be changed for your unique test conditions.  
3. Control parameters may need to be changed for your unique test conditions. R-508B hot gas bypass regulator may be defective or set too high. R-508B expansion valve may be defective. |
| **Compressors turn on and off too frequently.**   | 1. If compressor control parameters in temperature controller were changed.  
2. If compressor control parameters in temperature controller are as shipped from TestEquity.                                                                 | 1. Re-enter values as shipped from TestEquity.  
2. Solenoid valve SV1 may be defective in the open position.                                                                                                                                              |
| **Excessive noise and vibration when the high-stage compressor starts.** | 1. Chamber has been off for several hours or more and is not connected to source of power, or main disconnect switch is off during that time.  
2. Chamber has been off for several hours or more, and is connected to source of power and main disconnect switch is on during that time. | 1. The chamber must be connected to the power source AND the main disconnect switch must be on for 3 hours prior to operating the chamber.  
2. R-404A crankcase heater defective (open).                                                                                                                                                           |
**Refrigeration System Charging Instructions**

⚠️ **WARNING:** Repair of the refrigeration system must be performed only by a properly trained mechanic who is experienced in repairing cascade refrigeration systems. Do NOT substitute any component. Do NOT substitute refrigerants. Improper repairs will void the warranty.

These instructions are intended as guidelines for repairing TestEquity chambers. Details such as how to attach a gauge manifold are not covered. These are NOT do-it-yourself instructions!

**R-404A High-Stage Charge**
TestEquity does NOT recommend charging the system by relying on a clear sight glass only. Although a clear sight glass generally means the system is fully charged, it can be misleading. For example, if the system is charged on a cool day or with an empty chamber, it could be undercharged for hot days or with a heavy load. The proper charging procedure is as follows:

1. Repair any leaks before recharging.
2. Attach a vacuum pump and manifold gauge to the suction and discharge ports.
3. Evacuate the system to at least 100 microns. **DO NOT GUESS!** You must use a micron gauge.
4. Use a charging scale to weigh in 24 ounces of R-404A.
5. Verify the cooling performance as outlined in “How to verify the chamber performance”.

**NOTE:** If the Temperature Controller is cycling (Cool Light cycles on/off), the sightglass may appear 1/2 to 2/3 full. This is normal.

**R-508B Low-Stage Charge**

1. Repair any leaks before recharging.
2. Attach a vacuum pump and manifold gauge to the suction, discharge, and expansion tank ports. Attaching to the expansion tank is very important because it is otherwise very difficult to evacuate the tank through the pressure regulator or capillary tube that is connects it to the system.
3. Evacuate the system to at least 100 microns. **Do NOT guess!** You must use a micron gauge.
4. **Do NOT** put any additives in the system. Pentane is **NOT** necessary or desirable.
5. Charge the system until the standby pressure is 100 PSIG. Allow time for the charge to equalize as read on the suction and discharge gauges. This is 10 PSIG higher than the target amount of 90 PSIG. This corresponds to about 12 ounces. See **NOTE** below.
6. Verify the cooling performance as outlined in “How to verify the chamber performance”.

**NOTE:** If the low-stage has been evacuated and recharged, the standby pressure should be rechecked after 24 hours to make sure it is 90 PSIG. This is because the refrigerant mixes with the POE oil in the compressor, causing a lower standby pressure than was initially observed. Do not mistake this initial loss of pressure with a leak. After verifying that there is no leak, you may need to top-off the charge if the pressure is too low.
**Recommended Spare Parts**

Replacement parts are available from TestEquity. Parts are generally in-stock and ready for immediate shipment. Next-day delivery is always available. If you cannot risk being out of service for even one day, then you should purchase critical spare parts in advance. Although most parts are standard and available from a variety of local distributors, some parts are either harder to find or custom.

The following is a list of the kinds of parts that you may want to purchase in advance.

**Electrical Parts**
- Contactors
- Relays
- Fuses
- Heat Limiter
- Circulator Motor and Fan
- Switches

**Refrigeration Parts**
- Solenoid Valves
- Expansion Valves
- Regulator Valves
### Major Electrical Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Mfr</th>
<th>Mfr Part No.</th>
<th>Ref #</th>
<th>Part #</th>
<th>Qty</th>
<th>UOM</th>
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</thead>
<tbody>
<tr>
<td>Audible Alarm</td>
<td>Floyd Bell</td>
<td>MC-09-201-Q</td>
<td>AL1</td>
<td>200005</td>
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<td>Arc Suppressor</td>
<td>ITW Paktron</td>
<td>104M06QC100</td>
<td>AS1, 2</td>
<td>200115</td>
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<td>Contactor, 2 P 25A</td>
<td>Furnas</td>
<td>42AF15AF</td>
<td>C1-3</td>
<td>200004</td>
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<td>Relay, Octal DPDT 5A 120VAC</td>
<td>Omron</td>
<td>MK2PSAC120</td>
<td>CR1-3</td>
<td>200031</td>
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<td>Disconnect Switch, 3 Pole, 45A</td>
<td>ABB</td>
<td>OT45E3</td>
<td>DSW</td>
<td>200014</td>
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<td>Fuse, 12A</td>
<td>Bussman</td>
<td>FNW-12</td>
<td>F3-6</td>
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<td>Fuse, 15A</td>
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<td>FNW-15</td>
<td>F7, 8</td>
<td>200011</td>
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<td>Fuse, 2A</td>
<td>Bussman</td>
<td>FNW-2</td>
<td>F1, 2, 9</td>
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<td>Fan, 112 CFM 230V Ball Bearing</td>
<td>U.S. Toyo Fan</td>
<td>USTF120382305T</td>
<td>FM2</td>
<td>200027</td>
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<td>Circulator Motor, 230V 3000 RPM</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>FM3</td>
<td>200022</td>
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<td>Heater, Air</td>
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<td>CUSTOM</td>
<td>HT1</td>
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<td>Heat Limiter</td>
<td>ThermoDisc</td>
<td>G5A-01-240C</td>
<td>HL</td>
<td>200070</td>
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<td>Appliance Light, 40W, 120V</td>
<td>Generic</td>
<td>Generic</td>
<td>LT1</td>
<td>300096</td>
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<td>Indicator, Panel, 240V Neon</td>
<td>SoLiCo</td>
<td>S412-2-1-N2</td>
<td>PL1</td>
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<td>Indicator, Panel, 120V Neon</td>
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<td>Resistor, 470k, 1/2W</td>
<td>Generic</td>
<td>470KH-ND</td>
<td>R1</td>
<td>200037</td>
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<td>Solid State Relay, 25A</td>
<td>Siemens</td>
<td>SSRT-240D25</td>
<td>SSR1</td>
<td>200021</td>
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<td>Solid State Relay, 5A</td>
<td>Omron</td>
<td>G3NA-205B-DC5-24</td>
<td>SSR2</td>
<td>200032</td>
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<td>Switch, SPST, Rocker</td>
<td>Carlingswitch</td>
<td>LRA211-RA-B/125N</td>
<td>SW1, 2</td>
<td>200023</td>
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<td>Switch, SPST, Momentary ON</td>
<td>Carlingswitch</td>
<td>RD221-MR-B-0-N</td>
<td>SW3</td>
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<td>Temperature Controller</td>
<td>Watlow</td>
<td>F4SH-CKA0-01AE</td>
<td>TCR1</td>
<td>200001</td>
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<td>High/Low Limit Controller</td>
<td>Watlow</td>
<td>97A0-DAAA-AEAG</td>
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<td>Timing Module</td>
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<td>TS1423</td>
<td>TM1</td>
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<td>Transformer, Control</td>
<td>Acme Electric</td>
<td>TA-2-69303</td>
<td>TR1</td>
<td>200006</td>
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</tbody>
</table>

#### 60 Hz Low or High Line Option

| Transformer                      | Acme Electric | T-1-81050 | TR2, 3 | 200060 | 2   | ea  |

#### 50 Hz Option

| Transformer                      | Acme Electric | T-1-81058 | TR2, 3 | 200124 | 2   | ea  |

#### Chart Recorder Option

| Recorder, 1 Pen, 10"             | Honeywell    | DR4301-0000-G0100 | RCD1 | 200094 | 1   | ea  |
| Chart paper, -90 to 210 C        | Honeywell    | 24001660-034      |      | 200095 | 1   | ea  |
| Chart paper, -130 to 410 F, Alternate | Honeywell | 24001660-033      |      | 200096 | 1   | ea  |
| Pen, Purple, Six Pack            | Honeywell    | 30735489-007      |      | 200097 | 1   | ea  |
## Major Refrigeration Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Mfr</th>
<th>Mfr Part No.</th>
<th>Ref #</th>
<th>Part #</th>
<th>Qty</th>
<th>UOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor</td>
<td>Copeland</td>
<td>RS97C1E-CAV-221</td>
<td>1, p/o 7</td>
<td>100002</td>
<td>2</td>
<td>ea</td>
</tr>
<tr>
<td>Evaporator Coil</td>
<td>CUSTOM</td>
<td>9X18-4R-38/96</td>
<td>24</td>
<td>100004</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Desuperheater Coil</td>
<td>CUSTOM</td>
<td>5X10-1R-38/96</td>
<td>2</td>
<td>100005</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Expansion Valve, Low-Stage</td>
<td>Sporlan</td>
<td>CUSTOM</td>
<td>22</td>
<td>100006</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Expansion Valve, Suction Cooling</td>
<td>Sporlan</td>
<td>EMC-10-JC, 3/8 x 1/2 ODF</td>
<td>25</td>
<td>100007</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Expansion Valve, High-Stage</td>
<td>Sporlan</td>
<td>SBFS-AA-ZP, 3/8 x 5/8 ODF</td>
<td>18</td>
<td>100052</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Distributor</td>
<td>Sporlan</td>
<td>1620-2-3/16-3/4-J</td>
<td>23</td>
<td>100009</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Solenoid Valve</td>
<td>Sporlan</td>
<td>E3S130, 3/8 x 3/8 ODF</td>
<td>21, 27</td>
<td>100010</td>
<td>2</td>
<td>ea</td>
</tr>
<tr>
<td>Solenoid Valve Coil</td>
<td>Sporlan</td>
<td>MKC-1-120/50-60</td>
<td>SV1, 2</td>
<td>100011</td>
<td>2</td>
<td>ea</td>
</tr>
<tr>
<td>Hot Gas Bypass Regulator</td>
<td>Sporlan</td>
<td>ADRI-1-0/55 strt 3/8x3/8 ODF</td>
<td>26</td>
<td>100012</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Discharge Pressure Regulator</td>
<td>Sporlan</td>
<td>ORI-6-65/225-II, 5/8 ODS set225</td>
<td>28</td>
<td>100013</td>
<td>1</td>
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</tr>
<tr>
<td>Fusible Plug, 3/8&quot; MPT</td>
<td>Superior</td>
<td>FPC275</td>
<td>5, 9</td>
<td>100014</td>
<td>2</td>
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<tr>
<td>Dual Pressure Control</td>
<td>Johnson Controls</td>
<td>P70NA-1C</td>
<td>15, 32</td>
<td>100015</td>
<td>2</td>
<td>ea</td>
</tr>
<tr>
<td>Filter Drier</td>
<td>Sporlan</td>
<td>CW-033-S</td>
<td>11</td>
<td>100016</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Filter Drier</td>
<td>Danfoss</td>
<td>023Z0053</td>
<td>20</td>
<td>100318</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Sight Glass</td>
<td>Henry</td>
<td>MI-30-3/8-S</td>
<td>12</td>
<td>100018</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Capillary Tube, 0.050 x 3 ft.</td>
<td>Suppcoc</td>
<td>BC3100</td>
<td>30</td>
<td>100019</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Capillary Tube, 0.036 x 3 ft.</td>
<td>Watsco</td>
<td>7801</td>
<td>13, 17, 34, 35</td>
<td>100043</td>
<td>4</td>
<td>ea</td>
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<tr>
<td>Cascade Condenser</td>
<td>Flatplate</td>
<td>CH1-1/2 A</td>
<td>19</td>
<td>100020</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Oil Separator</td>
<td>A. C. &amp; R.</td>
<td>S-5581</td>
<td>4</td>
<td>100051</td>
<td>1</td>
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<tr>
<td>Strainer</td>
<td>Watsco</td>
<td>S-218</td>
<td>29</td>
<td>100050</td>
<td>1</td>
<td>ea</td>
</tr>
<tr>
<td>Gauge, 30&quot; x 200 PSIG Compound</td>
<td>Versa</td>
<td>CUSTOM</td>
<td>17, 34</td>
<td>100024</td>
<td>2</td>
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<tr>
<td>Gauge, 0 x 400 PSIG Pressure</td>
<td>Versa</td>
<td>CUSTOM</td>
<td>13, 35</td>
<td>100025</td>
<td>2</td>
<td>ea</td>
</tr>
<tr>
<td>Crankcase Heater, 45 W, 120 V</td>
<td>Copeland</td>
<td>018-0038-00</td>
<td>8</td>
<td>100030</td>
<td>1</td>
<td>ea</td>
</tr>
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</table>

## General Parts

<table>
<thead>
<tr>
<th>Description</th>
<th>Mfr</th>
<th>Mfr Part No.</th>
<th>Ref #</th>
<th>Part #</th>
<th>Qty</th>
<th>UOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Plug, Foam, 4&quot;</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>300001</td>
<td>2</td>
<td>ea</td>
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<tr>
<td>Viewing Window</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>300002</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Door Gasket, Inner</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>300003</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Door Gasket, Outer</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>300004</td>
<td>1</td>
<td>ea</td>
<td></td>
</tr>
<tr>
<td>Fan, Alum, 7&quot; D, 5/16&quot; Bore, CW</td>
<td>Revcor</td>
<td>0705-31 R 0.3125 DANN</td>
<td>300006</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Door Latch, Chamber Workspace</td>
<td>Southco</td>
<td>A2-10-501-21</td>
<td>300009</td>
<td>1</td>
<td>ea</td>
<td></td>
</tr>
<tr>
<td>Caster, Swivel</td>
<td>RollMaster</td>
<td>35-15-11</td>
<td>300011</td>
<td>2</td>
<td>ea</td>
<td></td>
</tr>
<tr>
<td>Caster, Rigid</td>
<td>RollMaster</td>
<td>35-16-11</td>
<td>300012</td>
<td>2</td>
<td>ea</td>
<td></td>
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<tr>
<td>Leveler</td>
<td>J.W. Winco</td>
<td>6T2LMB</td>
<td>300018</td>
<td>4</td>
<td>ea</td>
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<tr>
<td>Shelf</td>
<td>CUSTOM</td>
<td>CUSTOM</td>
<td>300013</td>
<td>1</td>
<td>ea</td>
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<tr>
<td>Shelf Retainer Clip</td>
<td>Kason</td>
<td>Style 66, #0066000008</td>
<td>300015</td>
<td>4</td>
<td>ea</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 8 – Maintenance

Series F4 Temperature Controller Setup Parameters

⚠️ CAUTION: The “Series F4 User’s Manual” is a general manual and is written by the manufacturer, Watlow, for a wide variety of applications and configurations. Not all features or functions are applicable. Only the capabilities of a model F4SH-CKA0-01, as described on page A.7 of the “Series F4 User’s Manual” are applicable. “Cascade Control” as described on page 3.6 of the “Series F4 User’s Manual” is not applicable in this configuration. The “Retransmit” function is available as an option.

⚠️ CAUTION: The Series F4 Temperature Controller has been properly configured by TestEquity to match the chamber’s system requirements and to perform optimally over a wide range of operating conditions. Improper modifications to these setup values can result in erratic performance and unreliable operation. Setup examples in the “Series F4 User’s Manual” are NOT applicable to this chamber. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. If there is any doubt, please call TestEquity before proceeding.

⚠️ CAUTION: The alarm outputs of the Temperature Controller are NOT connected to the chamber’s safety system. TestEquity does NOT recommend using the Temperature Controller’s alarm function as the main protection device.

⚠️ CAUTION: NEVER select “Full Defaults” in the Factory/Test Menu. “Full Defaults” are NOT the TestEquity configuration parameters for this chamber. If you select “Full Defaults”, you must reconfigure all System and Operation Parameters as documented in the TestEquity manual, NOT the “Series F4 User’s Manual”.

TestEquity has configured the Temperature Controller with the parameters as documented on the following pages.
Chapter 8 – Maintenance

Series F4 System Parameters

### System Menu
Main Page\Go to Setup\System

- Guaranteed Soak Band 1: 3.0 °C (9.0 if °F)
- PID Units: US
- F or C: C
- Show F or C: Yes
- Ch1 Autotune SP: 90%
- Input 1 Fail: 0%
- Open Loop Ch1: No
- Power Out Time: 10 Sec
- Power-Out Action: Cont

### Analog Input Menu
Main Page\Go to Setup\System\Analog Input 1

- Analog Input 1
- Choose Sensor: T/C
- Type: T
- Choose Decimal: 0.0
- SP Low Limit: -75.0 °C (-103.0 if °F)
- SP High Limit: 175.0 °C (347.0 if °F)
- Cal Offset: 0.0
- Filter Time: 1.0 sec
- Error Latch: Self-Clear

### Digital Input Menu
Main Page\Go to Setup\System\Digital Input (1-4)

- Name: DIGIT IN (1-4)
- Function: Off

### Control Output Menu
Main Page\Go to Setup\System\Control Output (1A-1B)

- Control Output 1A
  - Function: Heat
  - Process Type: Fixed Time
  - Cycle Time: 3.0 sec
  - Hi Power Limit: 100%
  - Low Power Limit: 0%

- Control Output 1B
  - Function: Cool
  - Process Type: Fixed Time
  - Cycle Time: 5.0 sec
  - Hi Power Limit: 100%
  - Low Power Limit: 0%

### Alarm Output Menu
Main Page\Go to Setup\System\Alarm Output (1, 2)

- Alarm Output 1 and Alarm Output 2
  - Name: No
  - Type: Process
  - Source: Input 1
  - Latches: Self-Clears
  - Silencing: Yes
  - Hysteresis: 1.7 °C (3.0 if °F)
  - Sides: Both
  - Logic: Open
  - Show Message: Yes

**NOTE:** The alarm outputs of the Temperature Controller are NOT connected to the chamber’s safety system. TestEquity does NOT recommend using the Temperature Controller’s alarm function as the main protection device.

### Retransmit Output Menu
(Main page only if retransmit option is ordered)

- Retransmit Output 1
  - Retransmit Source: Set point 1
  - Analog Range: 0-5V
  - Low Scale: -75.0°C (-103.0 if °F)
  - High Scale: 175.0°C (347.0 if °F)
  - Scale Offset: 0.0

- Retransmit Output 2
  - Retransmit Source: Input 1
  - Analog Range: 0-5V
  - Low Scale: -75.0°C (-103.0 if °F)
  - High Scale: 175.0°C (347.0 if °F)
  - Scale Offset: 0.0

### Digital Output Menu
Main Page\Go to Setup\System\Digital Output (1-8)

- Digital Output 1 through 7
  - Name: No
  - Function: Event Output

### Digital Output 8
Function: Compressor
- Comp. On % Pwr.: -2%
- Comp. Off % Pwr.: 2%
- Comp. Off Delay: 60 sec
- Comp. On Delay: 10 sec

### Communications Menu
Main Page\Go to Setup\System\Communications

- Baud Rate: 19200 (9600 w/GPIB)
- Address: 1

### Custom Main Page Menu
Main Page\Go to Setup\System\Custom Main Page

- P1: Current File
- P2: Current Step
- P3: Set Point 1
- P4: Step Type
- P5: Target SP1
- P6: Wait For Status
- P7: Jump Count
- P8: Time Remaining
- P9: Digital Outs
- P10: % Power 1
- P11: Time
- P12: Date
- P13: None
- P14: None
- P15: None
- P16: None
Series F4 Operations Parameters

### PID Set Channel 1 Menu
Main Page\Go to Operations\Edit PID\PID Set Channel 1

<table>
<thead>
<tr>
<th>PID Set 1-5</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prop. Band A</td>
<td>5.0 °C (9.0 if °F)</td>
<td></td>
</tr>
<tr>
<td>Reset A</td>
<td>0.05 min</td>
<td></td>
</tr>
<tr>
<td>Rate A</td>
<td>0.00 min</td>
<td></td>
</tr>
<tr>
<td>Dead Band A</td>
<td>0.0 °C</td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Prop. Band B</td>
<td>5.0 °C (9.0 if °F)</td>
<td></td>
</tr>
<tr>
<td>Reset B</td>
<td>0.05 min</td>
<td></td>
</tr>
<tr>
<td>Rate B</td>
<td>0.00 min</td>
<td></td>
</tr>
<tr>
<td>Dead Band B</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm Setpoints Menu
Main Page\Go to Operations\Alarm Setpoints

<table>
<thead>
<tr>
<th>Alarm1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm1 Low SP</td>
<td>-75.0°C (-103.0° if °F)</td>
<td></td>
</tr>
<tr>
<td>Alarm1 High SP</td>
<td>175.0 °C (347.0 if °F)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alarm2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm2 Low SP</td>
<td>-75.0°C (-103.0° if °F)</td>
<td></td>
</tr>
<tr>
<td>Alarm2 High SP</td>
<td>175.0 °C (347.0 if °F)</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** The alarm outputs of the Temperature Controller are NOT connected to the chamber’s safety system. TestEquity does NOT recommend using the Temperature Controller’s alarm function as the main protection device.

### Series F4 Set Lockout Parameters
The Series F4 Controller has several levels of security to prevent unauthorized users from changing critical configuration parameters. Only the Set Point and Profile menus have “Full Access”. TestEquity has configured all other menus to “Password”, and have protected them with a password.

TestEquity does not recommend that these security levels be changed for most applications. However, there will be times when “Full Access” is necessary. For example, you may need to gain access to Setup Page in order to change from °C to °F display, or to change the time or date. You must call TestEquity at 877-512-3457 or 805-480-3697 to obtain the password.

### Set Lockout Menu
Main Page\Go to Factory\Set Lockout

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Point</td>
<td>Full Access</td>
</tr>
<tr>
<td>Oper. Autotune PID</td>
<td>Password</td>
</tr>
<tr>
<td>Oper. Edit PID</td>
<td>Password</td>
</tr>
<tr>
<td>Oper. Alarm SP</td>
<td>Password</td>
</tr>
<tr>
<td>Profile</td>
<td>Full Access</td>
</tr>
<tr>
<td>Setup</td>
<td>Password</td>
</tr>
<tr>
<td>Factory</td>
<td>Password</td>
</tr>
</tbody>
</table>
Series 97 Limit Controller Setup Parameters

For more detailed instructions, see the “Series 97 User’s Manual”.

⚠️ CAUTION: The “Series 97 User’s Manual” is a general manual and is written by the manufacturer, Watlow, for a wide variety of applications and configurations. Not all features or functions are applicable. Only the capabilities of a model 97A0-DAAA-00-RG, as described on page A.20 of the “Series 97 User’s Manual” are applicable. Please note that only the Series 97 “Limit” functions are applicable.

Home Page

- **97** Process Value
- **SAFE** Limit Status

Operations Page

- **LIM** Limit Menu
  - **OPR** Operations Page
  - **LO** Low Limit Set Point
  - **HI** High Limit Set Point
  - **CAL** Calibration Offset

- **MON** Monitor Menu
  - **OPR** Operations Page
  - **PR1** Process 1
  - **SAFE** Limit Status

Setup Page

- **INP** Input 1 Menu
  - **SET** Setup Page
  - **SET1** Sensor Type 1
  - **R1** Input 1
  - **RL1** Range Low 1
  - **RH1** Range High 1
  - **DEC1** Decimal 1
  - **F1** Input Software Filter 1

- **OUT** Output 1 Menu
  - **SET** Setup Page
  - **LS1** Limit Active Sides
  - **LHY1** Limit Hysteresis

- **DIS** Display Menu
  - **SET** Setup Page
  - **UCL** Upper Display
  - **ULS** User Limit Message
  - **LCL** Lower Display
  - **LSS** User Safe Message

- **GLB** Global Menu
  - **SET** Setup Page
  - **C-F** C or F
  - **ER** Input Error Latching

Factory Page

- **LOC** Lockout Menu
  - **FCT** Factory Page
  - **OPR** Operations Page Mode
  - **SEL** Setup Page Lock
  - **CAL** Calibration Menu Lock

TestEquity 1007C Temperature Chamber
Chapter 9 - Warranty

TestEquity Inc. Limited Warranty

TestEquity Inc. (TestEquity) warrants Environmental Chambers (Equipment) manufactured by TestEquity and supplied under this contract to be free from defects in materials and workmanship under normal use and proper maintenance.

TestEquity will repair or replace any defective part for a period of THREE YEARS from the date of invoice. TestEquity reserves the right to require any defective part be returned, freight prepaid, to TestEquity’s factory or to inspect any defective part at the Purchaser’s site. TestEquity shall have sole discretion to determine whether any part is defective and whether any defective part will be repaired or replaced. This limited warranty shall extend to any standard chamber accessory and component part which is normally sold by TestEquity. Non-standard accessories and component parts specified by the Purchaser shall be warranted only to the extent of the original manufacturer’s warranty, if any exists.

If the repair or replacement is performed in the FIRST YEAR from the date of invoice, TestEquity will also pay for the labor associated with the repair at the Purchaser’s site, subject to TestEquity’s prior approval. During the SECOND and THIRD YEAR of the warranty period, Purchaser will be responsible for the installation and cost of installation of replacement or repaired parts. Purchaser shall notify TestEquity in writing of any alleged defect within 10 days after its discovery within the warranty period. TestEquity reserves the right to satisfy the labor portion of this limited warranty either through its own service personnel or an authorized agent. In order to provide expeditious service, TestEquity reserves the right to satisfy its limited warranty obligation by sending replacement parts to be installed by the Purchaser if they can be installed easily without special tools or training. TestEquity reserves the right to satisfy this limited warranty by requiring the Purchaser to return the Equipment to TestEquity when such return is feasible.

The following parts are excluded from this limited warranty and are sold as-is or are considered expendable: interior light bulb, viewing window, paint and cosmetic surface finishes and treatments, and port plugs.

This limited warranty shall extend in full to Equipment installed within continental United States and Canada. For all other locations, Purchaser is responsible for all labor costs for repairs or parts installation, and for all shipping costs associated with providing replacement parts.

This limited warranty does not cover: (1) Defects or damages arising as the result of shipment by common carriers or private transportation, unless TestEquity undertakes shipment and transportation of the Equipment to Purchaser’s site or contractually assumes the risk of damage to the Equipment in shipment; (2) Defects or damages arising out of, or as the result, of mishandling, modification, or improper start up, installation or maintenance of the Equipment (including start up, installation or maintenance not in accordance with TestEquity’s written procedures); (3) Defects or damages resulting from, or arising out of, abuse, misuse, neglect, intentional damage, accident, fire, flood, earthquake, or any other act of God.

This warranty as to Equipment is LIMITED to repair or replacement of parts or Equipment in the determination of TestEquity Inc. THE FORGOING LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. TestEquity Inc. DISCLAIMS ANY LIABILITY FOR ANY DAMAGES RESULTING FROM DELAY OR LOSS OF USE IN SERVICE OR REPAIR, OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE EQUIPMENT, EXCEPT AS STATED IN THIS PARAGRAPH.

This limited warranty cannot be modified in any way except in writing by both TestEquity and Purchaser. Invalidation of any one or more of the provisions of this limited warranty shall in no way affect any of the other provisions hereof, which remain in full force and effect.

This limited warranty shall be extended only to the first Purchaser of this Equipment and is not transferable.
Electrical Subpanel Component Location

TB2 Terminals

1 •
2 •
3 •
4 •

TB3 Terminals

H1 H2 H3 H4 M1 M2 M3 M4 M5 M6 G G G

TB4 Terminals

N N 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 A1 A2