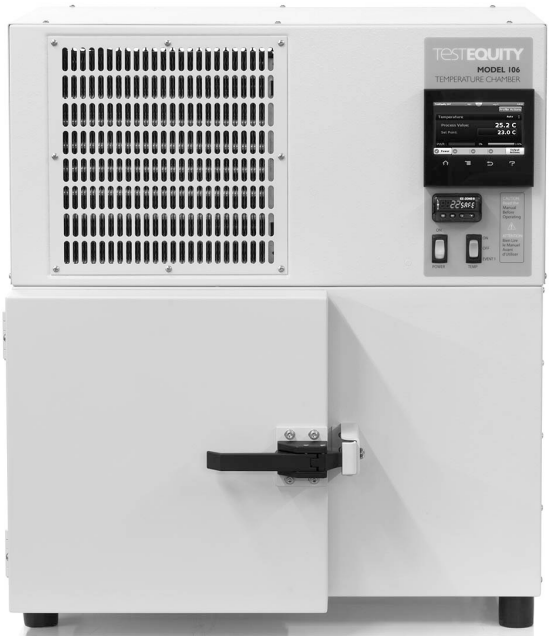
Model 106 & 107
Temperature Chamber

Operation and Service Manual

Model 107



Model 106

TestEquity LLC
6100 Condor Drive
Moorpark, CA 93021

Support: 877-512-3457 Toll Free
805-480-0636

Corporate: 800-732-3457
805-498-9933

http://www.testequity.com

Rev. 2.3 – January 15, 2019

Table of Contents

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 ⚠ precedes a general CAUTION or WARNING statement.

The electrical hazard symbol ⚠ precedes an electric shock hazard CAUTION or WARNING statement.

Installation Safety Notices

⚠ **WARNING:** The power cord is equipped with a NEMA 5-15P grounded/polarized plug. To prevent a shock hazard, DO NOT defeat the ground or polarization feature. This device MUST be plugged into a properly grounded and polarized outlet.

⚠ **CAUTION:** The minimum clearance you should allow for proper ventilation must be at least 12" from the rear of the chamber.

⚠ **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.

Operation Safety Notices

⚠ **CAUTION:** The Temperature Controller's "Alarm 1" function is NOT used in the chamber's safety system and is NOT connected. The independent EZ Zone Limit Controller functions as the main protection device.

⚠ **CAUTION:** The Temperature Controller's "Alarm 2" is configured to lock the refrigeration control system in "full cooling" mode at temperatures below –35°C. This alarm setting must NOT be changed under any circumstances!

⚠ **CAUTION:** Always verify that the EZ Zone Limit Controller settings for high and low limits are set to temperatures that are appropriate for your test sample.

⚠ **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 that 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. You are responsible for providing thermal protection devices to your test sample.

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

Chapter 2 – Installation

Unpacking

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

1. Cut the bands that hold the packaging together.
2. Remove the top cover and top foam inserts.
3. Remove the outer box.
4. Carefully lift the chamber off the pallet. 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. Hand-tighten one of the supplied barbed fittings to the drain connection on the rear of the chamber. Put a container under the condensate drain. Alternatively, attach the supplied hose to the barbed fitting and run the hose to a remote container, drain, or condensate pump. NOTE: Not all applications will result in condensate flowing through the drain.
5. Connect to a 120 VAC, 60 Hz power source with a minimum 15 Amp breaker.
6. Perform following the procedure “How to verify the chamber performance” in the Maintenance chapter of this manual to make sure that no damage has occurred in shipment.

Installation Location

The chamber will produce a moderate amount of heat during normal operation. Locate the chamber in an area with adequate ventilation to prevent excessive heat build-up. The chamber must be on a solid and level surface that is rated to hold at least 100 pounds.

⚠ **WARNING:** The power cord is equipped with a NEMA 5-15P grounded/polarized plug. To prevent a shock hazard, DO NOT defeat the ground or polarization feature. This device MUST be plugged into a properly grounded and polarized outlet.

⚠ **CAUTION:** The minimum clearance you should allow for proper ventilation must be at least 12" from the rear of the chamber.

⚠ **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.

Condensate Drain

The condensate drain connection is located on the rear of the chamber. This provides a way to remove condensate that may accumulate on the evaporator (cooling coil) during temperature cycling or when the refrigeration system runs to maintain moderate temperatures.

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 or the cooling system turns off, the ice or frost will turn into water.

The drain fitting accommodates a 1/4-inch male pipe thread. Right angle and straight barbed adapters are provided so you can easily connect 3/8-inch I.D. flexible tubing to it. The chamber drain water is not under pressure and is fed by gravity. Therefore, it must empty into a container or open floor drain. Alternatively, the chamber drain can empty into a condensate pump. You can purchase a condensate pump from suppliers such as Grainger (www.grainger.com).

Under most circumstances, you will not see any water coming out of the drain.

Reversible Chamber Door (Model 107 only)

The chamber door can be mounted to open from the left or right side. The chamber cabinet has mounting holes on both sides for the hinges and door latch. If you reverse the door, see “How to inspect the door seal” in the Maintenance chapter of this manual to make sure the hinges and door latch are adjusted correctly.

Chapter 3 – Operation

Introduction

The Front Panel Switches control power to the temperature controller and all chamber functions. The Temperature Controller controls the temperature of the chamber. The Temperature Controller automatically turns the refrigeration system on or off as required based on the deviation from temperature set point.

Refer to the separate F4T or F4 Temperature Controller manual for details on how to use the Temperature Controller.

Summary of Chamber Operation

1. Turn the POWER Switch ON.
2. Enter the desired temperature set point on the Temperature Controller.
3. Load your test sample in the chamber.
4. Turn the TEMP Switch ON. Alternatively, turn the TEMP Switch to the EVENT 1 position and turn the Power button on the F4T controller or EVENT 1 on the F4 controller ON.

Front Panel Switches

POWER Switch

The POWER Switch controls power to the entire chamber. The POWER Switch illuminates when it is ON.

TEMP Switch – ON Mode

The TEMP Switch enables all chamber functions. When the TEMP Switch is OFF and the Power Switch is ON, only the Temperature Controller and Limit Controller are operational. When both the TEMP and POWER Switches are ON, the chamber's temperature conditioning system will function to maintain the temperature set point. The TEMP Switch does not illuminate.

TEMP Switch – EVENT 1 Mode

When the TEMP Switch is in the EVENT 1 position, you can enable and disable all chamber functions through the Power button on the F4T Temperature Controller or Event 1 (Digital Output 1) of the F4 Temperature Controller.

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 that generate surface temperatures over 1000ºF. This is NOT an explosion-proof chamber.

⚠ **WARNING:** Do NOT put items in the chamber that 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.

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

Live Load Rating				
Temp	**+23°C**	**0°C**	**–30°C**	**–40°C**
Watts	200 W	155 W	100 W	35 W

Performance Considerations

The performance of all chambers 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. 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, an additional shelf 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. See F4T or F4 Temperature Controller User's Manual for details.

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. 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.

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 – Limit Controller

Introduction

The EZ-Zone 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 condition 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 "EZ-Zone User's Manual".

⚠ **CAUTION:** The "EZ-Zone 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 PM3L1AJ-AAAABAA are applicable.

⚠ **CAUTION:** The EZ-Zone 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. The correct values are documented in the "EZ-Zone 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. You are responsible for providing thermal protection devices to your test sample.

Limit Controller Keys and Displays

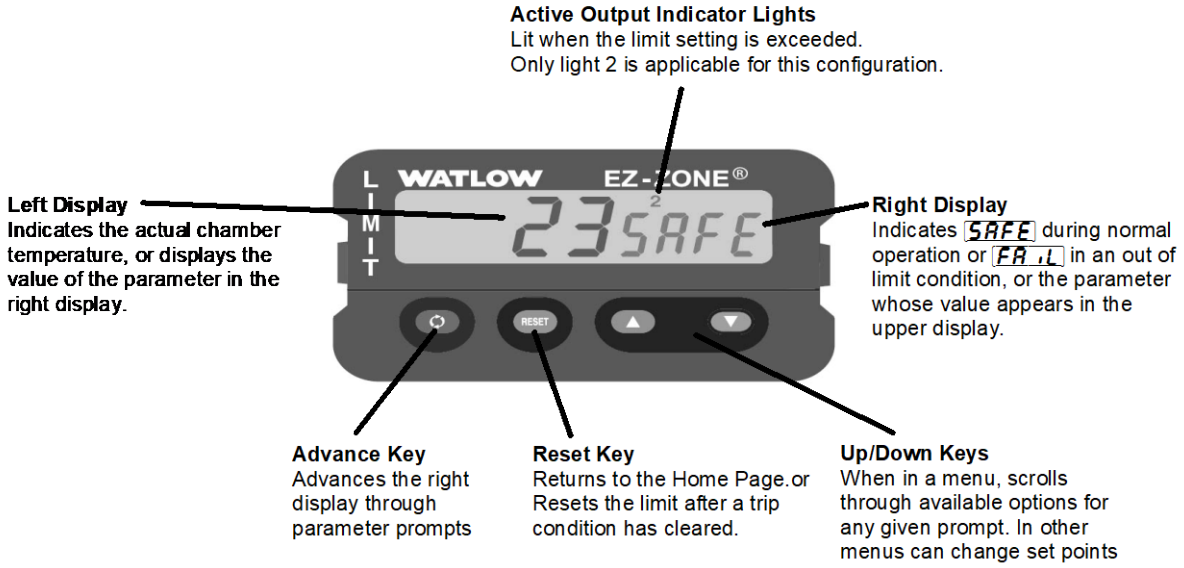


Figure 4.1 – Limit Controller Keys and Displays

How to Set the High and Low Temperature Safety Limits

1. Press the ⟲ key once to get the LLS prompt in the right display. This is the Low Limit Set Point prompt.
2. Press the ▲or ▼ key to enter the desired Low Limit Set Point in the left display. Make sure it is lower than your actual chamber temperature set point, and at least below room temperature to prevent nuisance tripping.
3. Press the ⟲ key once again to get the LhS prompt in the right display. This is the High Limit Set Point prompt.
4. Press the ▲or ▼ key to enter the desired High Limit Set Point in the right display. Make sure it is higher than your actual chamber temperature set point to prevent nuisance tripping.
5. Press the RESET Key to return to the Home Page.
6. The left display will show the actual chamber temperature while the right display will show SAFE as long as the limits are not exceeded.

Resetting an Out of Limit Condition

If the limit is exceeded, the Limit Controller will flash L iH 1 (high limit) or L iL 1 (low limit) in the right display and AtEn in the left display, alternating with the actual chamber temperature in the upper display and FA iL in the right display. It will also shut down all chamber functions. 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.

Chapter 5 – Frequently Asked Questions

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, an additional shelf 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 or colder?
Unfortunately, there is nothing you can do to improve upon the designed-in performance. TestEquity does NOT recommend using CO_2 or LN_2 in this chamber to achieve colder or faster cooling due to reliability and safety considerations, so it is NOT an available option. Modifying the chamber to add CO_2 or LN_2 will permanently damage the chamber and void the warranty.

Why is there water/ice/snow in the chamber?
Any time the ambient air is subjected to temperatures below the dewpoint, 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. A condensate drain is provided to remove condensate from the chamber.

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 intake airflow within the air plenum. 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 –10.0°C. The actual temperature varies between –9.9°C and –10.6°C. This corresponds to –0.6°C and +0.1°C or a total of 0.7°C of RELATIVE variations. These specifications are for an empty chamber. The addition of a test sample may affect 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 ±1.0°C or a total of 2°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 affect 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 ±1.55°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 ±2.55°C, although the typical accuracy is often better than ±1.0°C.

Can I operate or transport the chamber on its side?
No, the chamber can only be operated or transported in the upright position. Operating or transporting the chamber on its side will cause permanent damage to the refrigeration system and void the warranty.

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.

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 system uses R-410A, which is also known as DuPont Suva® 410A.

Chapter 6 – Specifications

Model 106 & 107 Chamber Specifications

Temperature Range –42°C to +130°C
Control Tolerance ±0.5°C, ±0.2°C Typical (Measured at the control sensor after stabilization)
Uniformity ±1.0°C, ±0.5°C Typical (Variations throughout the chamber after stabilization)

Live Load Capacity @	**+23°C**	**0°C**	**–30°C**	**–40°C**
(Watts)	200 W	155 W	100 W	35 W

Heat Up Transition Time 8.5°C/minute (empty chamber, typical)

Cool Down Transition Time (empty chamber, typical)

		End Temp					
Start Temp to →	**+23°C**	**0°C**	**–10°C**	**–20°C**	**–30°C**	**–35°C**	**–40°C**
+23°C	-----	7 min	11 min	15 min	19 min	23 min	30 min
+85°C	13 min	20 min	24 min	28 min	32 min	36 min	45 min

***Note:** Transition times are measured after a 30 minute soak at the start temperature. To calculate rate of change for a particular condition, take the difference between the Start Temp and End Temp and divide by the Transition Time.
Cool Down Example (empty): From +85°C to –20°C = 105°C / 28 min = 3.75°C/min.

Power Requirements
Input Voltage 120 VAC nominal (110 to 126 VAC), Single Phase, 60 Hz
Current Draw 10 A maximum; Recommended Service 15 A
Heat of Rejection 3,000 BTUH
(maximum rated chamber load at maximum cooling rate from high temperature soak)

Workspace Dimensions **Model 106:** 9" W x 9" H x 13.25" D (0.62 cubic feet)
Model 107: 12" W x 9" H x 11.25" D (0.7 cubic feet)
Outside Dimensions **Model 106:** 23" W x 26" H x 16" D (nominal)
Model 107: 16.5" W x 26" H x 23" D (nominal), Door latch adds 2" to width.
Min. Installed Clearance 12" from the rear
Access Ports **Model 106:** 4" (2.83" ID) Port on left side, Supplied with foam plug
Model 107: 3" (3.83" ID) Port on left and right side (two total), Supplied with foam plugs
Weight 124 pounds
Sound Level 52 dBA in cooling mode
(A-weighted, measured 36" from the front surface, 63" from the floor, in a free-standing environment)

NOTE: Performance is typical and based on operation at 23°C (73°F) ambient and nominal input voltage. This product is designed for use in a normal conditioned laboratory. Operation at higher ambient temperatures will result in decreased cooling performance. Low end limit derates to -38°C when operating above 27°C (80°F) ambient. Operation above 30°C (85°F) or below 16°C (60°F) ambient is not recommended.

Chapter 7 – Maintenance

Preventive Maintenance Schedule

Daily or As Needed

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

Every 6 Months

- Inspect the door seal.
- Clean the condenser.
- Inspect the electrical/refrigeration compartment.
- Verify the chamber performance.

Every 12 Months

- Verify the calibration.

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. NEVER use steel wool.
- If you clean the interior with something other than water, you may want to operate the chamber at high temperature (approximately +85°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 noise (with compressor off).
- Compressor start-up and running noise.
- Condenser fan noise.
- Valve cycling noise.

How to inspect the door seal

The door and chamber opening have 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. Repeat this all around the door at several places.
- If the seal is not tight on the latch side, adjust the latch bracket. The latch bracket is mounted to the chamber, and has slotted holes to permit adjustment.
- If the seal is not tight on the hinge side, adjust the door hinge. The hinges have a slotted hole on the door side to permit adjustment.

How to clean the condenser

1. Unplug the chamber from the power source.
2. Remove the condenser grille from the front of the chamber.
3. Clean the condenser 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 inspect the electrical/refrigeration compartment

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

1. Unplug the power cord.
2. Remove the top cover.
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. Check for loose wires and burned insulation near terminals.
7. Inspect for signs of insect or rodent infestation. Yes, it does happen!

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 below –42°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. Plug the chamber into a 120 VAC outlet. Turn the POWER Switch ON and the TEMP Switch OFF.
3. Set the Temperature Controller Set Point to +85.0°C and turn the TEMP Switch ON.
4. With F4T Controller: Left PWR bar should show 100%, Right PWR bar 0%. With F4 Controller: The 1A light should be ON continuously and the Controller's 1B light should be OFF;
5. The chamber should heat up to about +82°C and begin controlling (F4T Left PWR bar should show less than 100%) or (F4: 1A light cycles ON/OFF;) within approximately 8 minutes.
6. The chamber temperature should slowly increase and stabilize to +85°C. It should NOT overshoot beyond +85°C by more than 0.5°C, and the compressor should NOT need to turn ON to maintain +85°C.
7. After stabilization, the chamber should vary no more than ±0.2°C, or a total of 0.4°C.
8. Let the chamber stay at +85°C for 30 minutes.
9. After 30 minutes at +85°C, set the Temperature Controller Set Point to +23.0°C.
10. The compressor should turn ON. The chamber should cool down to about +26°C and begin controlling (F4T: right PWR bar shows less than 100%; F4: 1B light cycles ON/OFF) within approximately 13 minutes.
11. The chamber temperature should slowly decrease and stabilize to +23°C. It should NOT undershoot beyond +23°C by more than 1.0°C, and the compressor should NOT need to turn OFF in order to maintain +23°C.
12. After stabilization, the chamber should vary no more than ±0.5°C, or a total of 1.0°C.
13. Set the Temperature Controller Set Point to –40.0°C.
14. The F4 Alarm 2 light (looks like a bell with the number 2) should turn on when the chamber reaches –35.0°C. This is an internal chamber system function, not a "fault". There is no similar indication on the F4T Home display.
15. The chamber should cool down from +23.0°C to –40°C within approximately 30 minutes.
16. F4T: Right PWR bar will ultimately show 0% and Left PWR bar should show a few %; F4: 1B light will ultimately remain OFF and the 1A light should eventually cycle ON/OFF while maintaining –40°C. The temperature should NOT undershoot beyond –40°C by more than 1.0°C, and the compressor should NOT need to turn OFF to maintain –40°C.
17. After stabilization, the chamber should vary no more than ±0.2°C, or a total of 0.4°C.
18. Set the Temperature Controller Set Point to +23°C. The chamber should begin to heat up. The compressor should turn off in 30 seconds.
19. This concludes the chamber performance verification tests.
20. Let the chamber heat up to +23°C before turning the TEMP Switch OFF.

How to verify the calibration

⚠ **CAUTION:** TestEquity does not recommend performing the controller calibration procedures unless you have verified that the controller is actually out of calibration.

TestEquity recommends verifying the calibration before attempting to actually perform a calibration. The microprocessor-based instrumentation used in TestEquity chambers 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 are NOT a measurement of controller 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 common practice of measuring multiple points in the chamber and adjusting the temperature controller's calibration to correct for these errors is incorrect! 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. The F4T or F4 Temperature Controller User's Manual for details. Calibration verification should be performed with the Calibration Offset set to 0.0 (zero).

Total system accuracy in the chamber includes the controller plus the thermocouple wire accuracy. Total system accuracy over the chamber's operating range is typically ±1.55°C, ±1 LSD or a theoretical total of ±2.55°C. The easiest way to verify the instrumentation accuracy is with an independent calibrated temperature sensor and display. Place the sensor inside the chamber, near the chamber's conditioner fan grille. If the readings agree within the specified limits, then no calibration adjustments are necessary.

For the F4T Controller: If calibration of the temperature controller is necessary, refer to the "F4T Touch Screen Controller User's Guide".

For the F4 Controller: If calibration of the temperature controller is necessary, refer to the "F4 Temperature Controller User's Manual".

Theory of Operation

Overview
The chamber is heated by a nichrome heater. Cooling is accomplished by a single-stage refrigeration system. The air is circulated by a propeller fan. The heater, evaporator, and fan are located within an air plenum, which is on the back wall of the chamber interior.

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

A fusible heat limiter (HL) provides failsafe protection against a catastrophic failure by opening the heater circuit at +192°C.

Refrigeration System
Cooling is accomplished by a single-stage refrigeration system. The refrigeration system provides cooling to the chamber interior through a finned evaporator coil, which is located in the air plenum.

The system uses refrigerant R-410A. High pressure liquid refrigerant is fed from the condenser through the filter-drier, then solenoid valve, to the capillary tube. The capillary tube feeds the finned evaporator coil, which is located in the air plenum where heat is absorbed to provide cooling within the chamber. The reduction of pressure on the liquid refrigerant causes it to boil or vaporize, absorbing heat which provides a cooling effect. The refrigerant vapor travels through the suction line accumulator 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 exits 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 temperature controller's cool output cycles the liquid-line solenoid valve (SV1) ON/OFF to control the chamber temperature. When SV1 is ON, liquid refrigerant flows through the capillary tube to the evaporator, providing full-capacity cooling. When SV1 is OFF, liquid refrigerant flow is stopped, causing cooling to stop while the compressor remains ON. In this mode, the hot gas regulator (HGR1) keeps the suction pressure above 5 PSIG.

During a high temperature cool-down or when SV1 is cycled OFF, it is possible for excessive hot gas to return to the compressor. The suction line cooling thermostatic expansion valve (TEV1) senses the suction line temperature and injects liquid refrigerant to cool the hot gas within safe limits.

At chamber temperatures below –35°C, the temperature controller's Alarm 2 disables the suction cooling expansion valve and hot-gas bypass valve through SV2, while locking SV1 ON regardless of the controller's cool output status.

Troubleshooting

SYMPTOM	CONDITION	POSSIBLE CAUSES
Chamber does not function.	If POWER switch is ON and TEMP switch is in EVENT 1 position.	a) F4T Power button (F4 Event 1) needs to be turned ON, or put TEMP switch in ON position.
	If POWER and TEMP switches are ON, Limit Controller "2" light is ON.	a) Chamber temperature has exceeded the Alarm limits.
Does not heat up at all.	If F4 controller light 1A is ON (F4T left PWR bar is 100%), circulator fan is ON.	a) Heat Limiter HL is open. b) Heater HT1 is open. c) Solid State Relay SSR1 is defective. d) Temperature controller is defective.
Heats up too slow.	If F4T left PWR bar is 100% (F4 controller light 1A is ON). Compressor is not running.	a) Chamber interior is overloaded. b) Port plug is not in port. c) Verify that input line voltage measures no less than 110 VAC.
Heat is on all the time.	If F4T left PWR bar is 0% (F4 controller light 1A is OFF).	a) Solid State Relay SSR1 is defective. b) Temperature controller's heat output is defective.
Does not cool at all.	If F4T Cool & Compressor outputs are ON (F4 controller light 1B and DigitalOut 8 are ON). Compressor is running.	a) Refrigerant leak. b) Plugged capillary tube.
	If F4T Cool & Compressor outputs are ON (F4 controller light 1B and DigitalOut 8 are ON). Compressor is not running.	a) Solid State Relay SSR2 is defective. b) Relay C2 is defective. c) Compressor is defective. d) Compressor start components are defective.
	If F4T Cool output is ON (F4 controller light 1B is ON). F4T Compressor output is OFF (F4 DigitalOut 8 is OFF). Compressor is not running.	a) Compressor Output parameters have been changed. Re-enter values as shipped from TestEquity.
Cools too slowly or does not cool down to –40°C.	If F4T Cool & Compressor outputs are ON (F4 controller lights 1B and DigitalOut 8 are ON). Compressor is running.	a) Chamber interior is overloaded. b) Test sample is energized, giving off heat. c) Port plug is not in port. d) Refrigerant leak. e) Capillary tube is plugged. f) Controller Alarm 2 is set too high.
Temperature varies more than ±0.5°C or 1°C total.	If tuning PID control parameters in temperature controller were changed.	a) Re-enter values as shipped from TestEquity.
	If tuning PID control parameters in temperature controller are as shipped from TestEquity.	a) Control parameters may need to be changed for your unique test conditions.
	If tuning PID control parameters in temperature controller are as shipped from TestEquity and only occurs in cool mode.	a) Control parameters may need to be changed for your unique test conditions. b) Solenoid valve SV1 may be defective.
Compressor turns on and off too frequently.	If controller Compressor Output parameters were changed.	a) Re-enter values as shipped from TestEquity.
	If controller Compressor Output parameters are as shipped from TestEquity.	a) Control parameters may need to be changed for your unique test conditions.

Refrigeration System Charging Instructions

⚠ **WARNING:** Repair of the refrigeration system must be performed only by a properly trained mechanic. 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-410A Charge

The proper charging procedure is as follows:

1. Repair any leaks before recharging. Replace the filter/drier.
2. Evacuate the system to 100 microns. DO NOT GUESS! You must use a micron gauge.
3. Use a charging scale to weigh in 7.0 ounces of R-410A. DO NOT GUESS! You must use an accurate charging scale.
4. Verify the cooling performance as outlined in “How to verify the chamber performance”.

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

Electrical Parts
Temperature Controller
Relays, Fuse
Heat Limiter
Circulator Motor, Fan
Switch

Refrigeration Parts
Solenoid Valve
Capillary Tube
Expansion Valve
Condensing Unit

Major Electrical Parts

Description	Mfr	Mfr Part No.	Ref #	Part #	Qty	UOM
Arc Suppressor	ITW Paktron	104MACQRL150	AS1, 2, 3	200296	3	ea
Circulator Motor Kit	CUSTOM	100579	FM1	100579	1	ea
Contactor, 1P, 30A	Hartland Controls	HCC-1XT02AA	C1-2	200237	2	ea
Fuse, 3/10A	Bussman	MDL-3/10	F1	200130	1	ea
Heater, Air	CUSTOM	200132	HT1	200132	1	ea
Limit Controller	Watlow	PM3L1AJ-AAAABBT	TCR2	200300	1	ea
Line Cord, 14/3, SJT	Carol	W1950.70.01		200135	1	ea
Relay, SPDT	Omron	G2R-1-T-AC120	CR1	200160	1	ea
Solid State Relay, 10A, 24VDC In	Omron	G3NE-210T-US DC24	SSR1	200177	1	ea
Solid State Relay, 10A, 5VDC In	Omron	G3NE-210T-US DC5	SSR2, 3	200129	2	ea
Switch, SPST, Rocker	Carlingswitch	LRA211-RA-B/125N	SW1	200023	1	ea
Switch, SPDT, On-Off-On, Rocker	Carlingswitch	RC911-RA-B-O-N-XLR1	SW2	200275	1	ea
F4 Temperature Controller	Watlow	F4SH-CKA0-01AE	TCR1	200001	1	ea
F4T Temperature Controller	Watlow	F4T1L2EAA2E1017	TCR1	222510	1	ea

Major Refrigeration Parts

Description	Mfr	Mfr Part No.	Ref #	Part #	Qty	UOM
Accumulator	CUSTOM	CUSTOM	9	100313	1	ea
Capillary Tube, 0.031	JB	TC-31	5	100320	108	in
Condensing Unit	Copeland	M6JL-H030-1AA-XXX	1	180625	1	ea
Evaporator Coil	CUSTOM	CUSTOM	7	100502	1	ea
Expansion Valve, Suction Cooling	Danfoss	068U2027	8 (TEV1)	100314	1	ea
Filter Drier	Danfoss	023Z5048	2	100524	1	ea
Hot Gas Regulator	Sporlan	ADRI-1/4-0/55	12 (HGR1)	100497	1	Ea
Solenoid Valve	Sporlan	E3S120, 1/4 x 1/4 ODM	3 (SV1,2, 3)	100310	3	ea
Solenoid Valve Coil	Sporlan	MKC-1-120/50-60	4 (SV1,2, 3)	100011	3	ea

General Parts

Description	Mfr	Mfr Part No.	Ref #	Part #	Qty	UOM
Door Latch, Chamber Workspace	Southco	A7-10-301-20		300216	1	ea
Gasket, Door Side	CUSTOM	300220		300220	1	ea
Port Plug, Silicone Foam, 4"	CUSTOM	300914	For Model 106	300914	1	ea
Port Plug, Silicone Foam, 3"	CUSTOM	300374	For Model 107	300374	2	ea
Shelf for Model 106	CUSTOM	1061	For Model 106	TE-1061	1	ea
Shelf for Model 107	CUSTOM	1071	For Model 107	TE-1071	1	ea

EZ-Zone Limit Controller Setup Parameters

⚠ **CAUTION:** The EZ-Zone Limit Controller has been properly configured by TestEquity to match the chamber's system requirements. 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. If there is any doubt, please call TestEquity before proceeding.

Setup Menu

Prompt	Function	Setting	Alternate Setting
LoC	Lockout Menu	2	See NOTE 1 below
SEn	Sensor Type	tC	Do Not Change
L in	Linearization	t	Do Not Change
dEC	Decimal	0	Alt. "0.0"
C_F	°C or °F	C	Alt. "F"
r.Lo	Range Low	-44	Do not make any lower
r.h i	Range High	130	Do not make any higher
Fn2	Output 2 Function	L inT	Do Not Change
L.Sd	Limit Sides	both	Alt. "high" (High only) or "LoW" (Low only)
L.hY	Limit Hysteresis	2	Change not recommended
A.tY	Alarm Type	oFF	Do Not Change
PAr 1	Upper Display	ACPu	Alt. "none"
PAr2	Lower Display	LSt	Alt. "Lh.s" (High Set Point) or "LL.S" (Low Set Point)
Ad.S	Zone Address	1	Not functional for this application

NOTE 1: The Lockout Menu LoC sets the security clearance level as follows:

- 1 Operations Menu, read only
- 2 Operations Menu, set point read/write
- 3 Operations Menu, set point read or write (same as level 2)
- 4 Operations Menu, full access read/write (required to access Calibration Offset below)
- 5 Operations Menu and Setup Menu full access (required to access Setup Menu and Calibration Offset below)

Operations Menu

Prompt	Function	Setting	Alternate Setting
LLS	Low Set Point	-44	Appropriate Low Limit Set Point
LhS	High Set Point	130	Appropriate High Limit Set Point
iCA	Calibration Offset	0	Calibration Offset as required (see NOTE 2 below)

NOTE 2: LoC parameter in Setup Menu must be set for 4 or 5 to access the Calibration Offset parameter.

Chapter 8 – Warranty

TestEquity LLC Limited Warranty

TestEquity LLC (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.

TestEquity must initiate field service for in-warranty claims. Purchaser will not be reimbursed for labor if they initiate service on their own without prior approval from TestEquity. Replacement parts must be supplied by TestEquity for in-warranty claims. Purchaser will not be reimbursed for parts they buy on their own without prior approval from TestEquity.

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, port plugs, and refrigerant.

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 LLC THE FORGOING LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. TestEquity LLC 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.

Chapter 9 – Drawings

Electrical Subpanel Component Location