Model 3007-LN2
Temperature Chamber

Operation and Service Manual

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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 ⚠ precedes a general CAUTION or WARNING statement.

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

Installation Safety Notices

⚠ **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.

⚠ **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 (240 V) nominal input. 208 V and 230 V (240 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 a continuous HEAT mode to ensure that the expected nominal voltage of either 208 V –5/+10% or 230 V ±10% is present.

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

⚠ **WARNING:** Liquid nitrogen is extremely cold (−190°C or −320°F). It can cause severe burns, frostbite, or eye damage. When handling liquid nitrogen containers or piping; wear goggles for eye protection, protective clothing, and thick impervious gloves (such as welder's leather).

⚠ **WARNING:** The connecting tube must include a relief valve designed for use with liquid nitrogen if a manual or automatic isolation valve is present at your source of supply or at any point between the source and the connection point on the back of the 3007-LN2 Chamber. This relief valve must be rated for at least 35 psig and less than 100 psig. It is needed to prevent excessive pressure from developing when the nitrogen in the connecting line evaporates during off cycles. Care should be exercised in sighting the relief valve to assure that should it relieve, the effluent will not discharge towards operating personnel.

⚠ **WARNING:** All liquid nitrogen connecting piping or tubing must be well insulated with appropriate vapor sealed or vacuum jacketed materials. Un-insulated nitrogen connecting lines can condense pure oxygen on their surface since liquid nitrogen is colder than liquid oxygen. Liquid oxygen can present a spontaneous fire hazard when spilled onto organic materials.

⚠ **WARNING:** Nitrogen gas is heavier than air. It makes up about 78% of the Earth's standard atmosphere, is non-toxic, colorless, odorless, and tasteless. Pure nitrogen gas in a closed area can present an asphyxiation hazard (suffocation) without warning.

Operation Safety Notices

⚠ **CAUTION:** The Watlow F4T Manuals are written by the manufacturer, Watlow, for a wide variety of applications and configurations. Not all features or functions are applicable.

⚠ **CAUTION:** The Series F4T "Alarm" functions are NOT used in the chamber's safety system and are NOT connected. TestEquity does NOT recommend using the Series F4T alarm function as the main protection device. The independent EZ-Zone Limit Controller functions as the main protection device.

⚠ **CAUTION:** The Series F4T 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 Watlow Series F4T Manuals 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:** F4T Configuration files are unique to each particular model chamber and must NEVER be transferred to a different model chamber.

⚠ **CAUTION:** NEVER select "Factory" in the "Restore Settings From" prompt in the Device Details menu in Composer Software. This will erase all controller configuration settings. The chamber will not work if you do this.

⚠ **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. 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.

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 configuration.
5. Connect to the power source.

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. 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.

The chamber must be on a solid and level floor.

⚠ **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 chamber has a condensate drain connection on the rear of the chamber. This provides a way to remove condensate that may accumulate in the chamber during low-to-high 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, the ice or frost will turn into water. The fitting accommodates a ½-inch male pipe thread. The chamber drain water is not under pressure, and is fed by gravity. Therefore, it must empty into an 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).

Input Power Configuration

This chamber can be easily configured for operation from a 208 V / 60 Hz or 230 V (240 V) / 60 Hz, 3 Phase nominal input. 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:** This chamber must be properly configured for either 208 V or 230 V (240 V) nominal input. 208 V and 230 V (240 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 a continuous HEAT mode to ensure that the expected nominal voltage of either 208 V –5/+10% or 230 V ±10% is present.

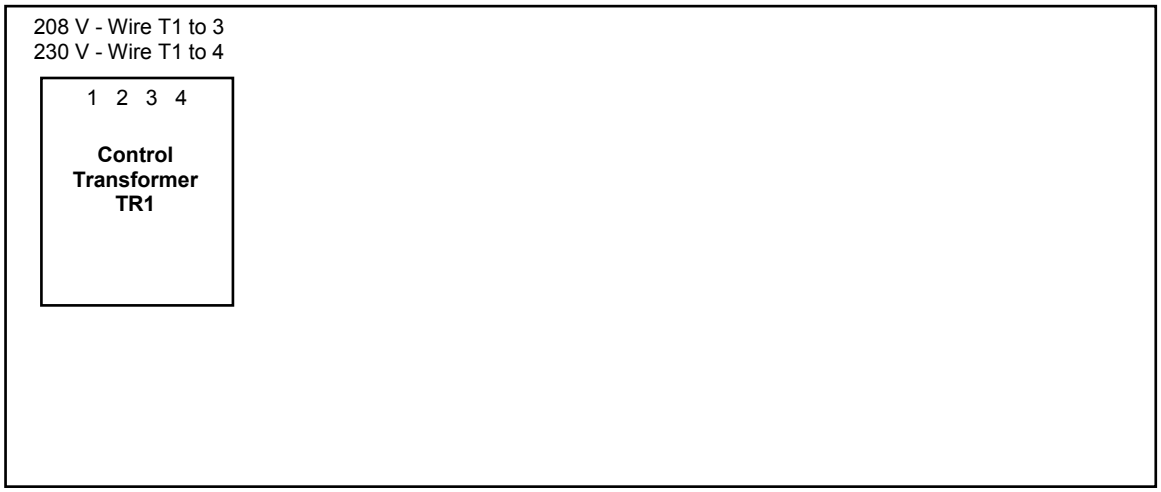


Figure 2-1 – Location of Input Configuration Terminals on the Electrical Sub Panel

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 (for 240 V lines)

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 4 on Control Transformer TR1.

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 3 on Control Transformer TR1.

The Disconnect Switch and its Selector Knob must both be in the OFF position before closing the lower door. Failure to do this will result in damage to both the switch and the knob mechanism.

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.

Power Source Connection

1. Turn the Disconnect Switch to the OFF position.
2. Remove the lower door retaining screw located on the right side. Open the lower door.
3. Remove the chamber's right side panel.
4. Mount the input wire through the hole on the rear of the chamber, using an appropriate bushing. An additional 4-feet of wire will be needed need to reach to the terminals on the electrical subpanel. The wires will need to pass through the Input Access Hole. This hole is located in the corner of the partition which separates the compressor compartment from the electrical compartment. Three tie points are provided on the side of the chamber to secure the input wiring with tie-wraps.
5. Connect the "Hot" input wires to terminals L1, L2 and L3 on the Main Disconnect Switch.
6. Connect the Ground wire (NOT A NEUTRAL) to the Ground terminal.
7. The Disconnect Switch and its Selector Knob must both be in the OFF position before closing the lower door. Failure to do this will result in damage to both the switch and the knob mechanism.

LN2 (Liquid Nitrogen) Installation

Liquid Nitrogen Safety Notices

⚠ **WARNING:** Liquid nitrogen is extremely cold (−190°C or −320°F). It can cause severe burns, frostbite, or eye damage. When handling liquid nitrogen containers or piping; wear goggles for eye protection, protective clothing, and thick impervious gloves (such as welder's leather).

⚠ **WARNING:** The connecting tube must include a relief valve designed for use with liquid nitrogen if a manual or automatic isolation valve is present at your source of supply or at any point between the source and the connection point on the back of the chamber. This relief valve must be rated for at least 35 psig and less than 100 psig. It is needed to prevent excessive pressure from developing when the nitrogen in the connecting line evaporates during off cycles. Care should be exercised in sighting the relief valve to assure that should it relieve, the effluent will not discharge towards operating personnel.

⚠ **WARNING:** All liquid nitrogen connecting piping or tubing must be well insulated with appropriate vapor sealed or vacuum jacketed materials. Un-insulated nitrogen connecting lines can condense pure oxygen on their surface since liquid nitrogen is colder than liquid oxygen. Liquid oxygen can present a spontaneous fire hazard when spilled onto organic materials.

⚠ **WARNING:** Nitrogen gas is heavier than air. It makes up about 78% of the Earth's standard atmosphere, is non-toxic, colorless, odorless, and tasteless. Pure nitrogen gas in a closed area can present an asphyxiation hazard (suffocation) without warning.

Liquid Nitrogen Installation

The LN2 system is designed to operate with a low pressure Dewar or low pressure bulk supply system. A customer-provided source of liquid nitrogen at a supply pressure between 10 psig and 75 psig is required for LN2 Boost Cooling.

A high pressure Dewar may be used but the supply must be carefully regulated to less than 75 psig to prevent venting by the chamber's LN2 pressure relief valve which is set for 100 psig. If a high pressure Dewar is used, provide a liquid nitrogen rated relief valve with a setting of not more than 100 psig in the connecting line to relieve pressure in the event that the supply hand valve on the container is manually closed.

The supply connection is on the upper back of the chamber centered between the two fan motors. This connection is a 3/8-inch JIC (Joint Industrial Council) stainless steel 37-degree flare fitting rated for very low temperature operation. The fitting is mounted on a non-metallic thermal breaker to help limit frost formation and condensation.

The recommended connection method from your source of liquid nitrogen is either a length of 3/8-inch OD, ASTM A269, 0.049-inch Wall, Seamless 316 series stainless steel tube terminated on one end with a 37-degree JIC flare fitting and insulated with closed cell, vapor sealed foam; or alternately a commercially manufactured vacuum jacketed liquid nitrogen connecting tube designed for this service. For urethane and polyisocyanurate (Dow Trymer) foam, typical long-term operation liquid nitrogen insulation wall thickness is approximately 2-inches per side (4-inches OD).

If a 3/8-inch OD tube stainless steel tube is selected, the insulation should be installed flush against the non-metallic thermal breaker around the LN2 Inlet fitting on the chamber. If a vacuum jacketed tube is selected, a short adapter may be required to make the final connection to the chamber's LN2 Inlet fitting. For a vacuum jacketed connection, a short ring of closed cell, vapor sealed foam should be applied flush against the thermal breaker on one side and overlapping the vacuum jacket by approximately six inches on the other side.

Support all liquid nitrogen carrying lines with ridged hangers to prevent excessive flexing when cold.

Chamber Relief Vent Considerations with Liquid Nitrogen

For installation in enclosed areas of any size or when ventilation in the room is limited:

- The workspace vent at the top of the chamber must be piped outside of the building to atmosphere with a backpressure-free, vapor-tight, insulated tube.
- The enclosed room must be adequately ventilated to prevent the buildup of nitrogen gas due to leakage, pressure relief valve operation, or chamber door opening.
- An automatic, Low Level Oxygen Alarm must be installed to alert operators of potentially dangerous conditions within the enclosed room. These devices are available from a number of sources. An example is the Chemgard Gas Monitor from MSA (Mine Safety Appliances Company) in Pittsburgh, PA (800-672-2222, www.msanorthamerica.com).

For installation in large factory areas, with open doors and adequate ventilation certified by a qualified Mechanical Engineer:

- The vent at the top of the chamber can discharge directly into the factory. If desired, the vent can be extended upward approximately two feet with a length of insulated tubing to prevent frost buildup on the top of the chamber.

Purge

Optional GN_2 (gaseous nitrogen) Purge or optional Dry Air Purge can be used to reduce to possibility of condensation in the chamber at low temperatures.

GN2 (Gaseous Nitrogen) Installation (Option TE-0031)

Connect a supply of GN_2 with a maximum pressure of 100 psig to the 1/4-inch FPT fitting which is designated PURGE on the rear panel.

Dry Air Installation (Option TE-0034)

Option TE-0031 is a prerequisite to provide the purge inlet functionality for Option TE-0034. Connect the hose from the Dry Air system to the fitting which is designated PURGE on the rear panel. Connect a supply of compressed air to the 3/8-inch FPT shutoff valve of Dry Air system. Connect the power cord from the Dry Air system to the DRY AIR POWER socket on the rear panel. This plug must be twisted clockwise to lock it. The Dry Air system requires 8 cfm of compressed air at 100 psig (175 psig max).

Purge Operation

The Purge mode is enabled through the Purge button on the F4T Controller.

Adjusting the Purge Flow

A flowmeter is located on the front panel to adjust the flow of purge gas into the chamber. The flowmeter has a scale, calibrated in SCFM. The flow of purge gas should be adjusted to the minimum amount required to obtain the desired drying in the chamber for your particular conditions. A suggested starting setting is 4 SCFM.

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 F4T 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 F4T Temperature Controller automatically turns the refrigeration system on or off based on the demand for cooling.

NOTE: See the separate F4T Touch Screen Controller manual and F4T Touch Screen Controller Cascade Control Addendum for instructions on how to use the controller.

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. The Part Sensor must always be placed inside the chamber and mounted to the test sample (DUT). If you using Air Control, the sensor should still be placed inside the chamber workspace to prevent the possibility of thermal runaway if Air Control was inadvertently turned OFF.
6. Turn the Conditioning Switch ON. Or, put the Conditioning Switch in the Event 1 position and press Power on the F4T.

Front Panel Switches and Lights

Main Disconnect Switch

The Main Disconnect Switch (large knob on the front, right side) 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.

Conditioning Switch – ON Mode

The Conditioning Switch enables all chamber functions. When the Conditioning Switch is OFF and the Power switch is ON, only the F4T Controller and Limit Controller are operational. When the Conditioning Switch is ON, the chamber's conditioning system will function to maintain the temperature/humidity set point. The pilot light to the right of the Conditioning Switch illuminates when the chamber functions are ON.

Conditioning Switch – Event 1 Mode

When the Conditioning Switch is in the Event 1 position, you can enable and disable all chamber functions through the Power button on the F4T Controller. When the Conditioning Switch is in the Event 1 position and Power button on the F4T Controller is OFF, all chamber functions are disabled. If the Power button on the F4T controller is ON, all chamber functions are enabled. The pilot light to the right of the Conditioning Switch illuminates when the chamber functions are ON. See page 11 in the F4T manual for more information.

Light Switch

The Light function in the chamber does not apply.

Heat Light

The Heat Light will illuminate when the Temperature Controller turns the heater ON 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 the LN2 solenoid valve ON to maintain the workspace (or DUT if Air Control is OFF) temperature. The Cool Light will cycle ON/OFF as the workspace or DUT temperature approaches and reaches the temperature set point.

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 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.

⚠ **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.

Port Plugs

Foam port plugs are provided with a gray silicone surface on one side. The port plug must be inserted with the gray silicone surface facing the inside of the chamber. Port plugs should be considered expendable and be replaced when they no longer provide a good seal.

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, 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.

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 F4 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 F4T 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 PM6L1AJ-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. 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

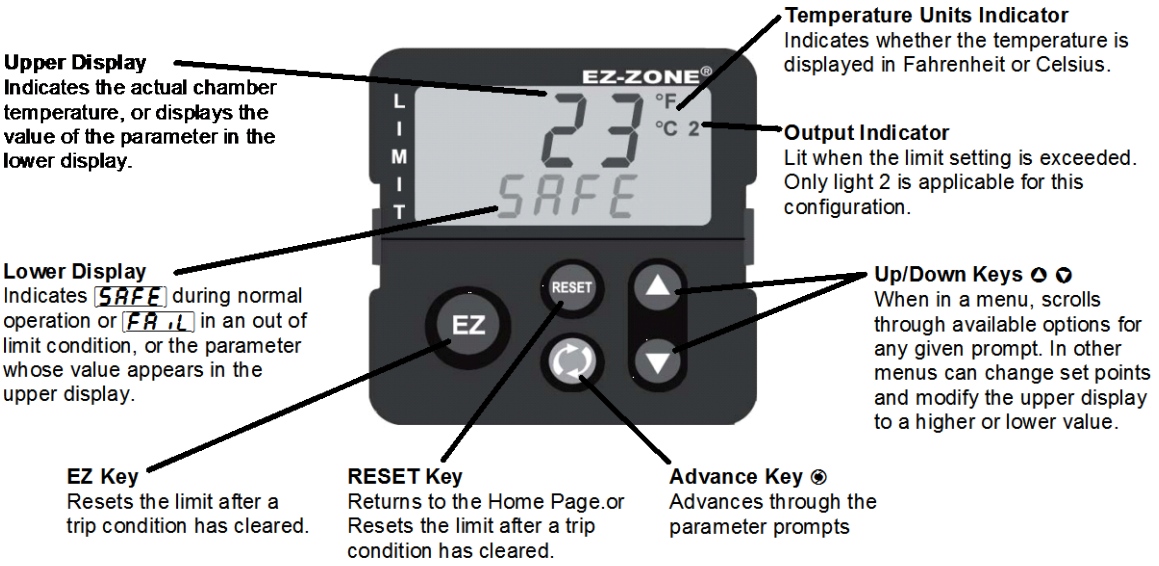


Figure 5.1 – Limit Controller Keys and Displays

How to Set the High and Low Temperature Safety Limits

1. Press the key once to get the LLS prompt in the lower display. This is the Low Limit Set Point prompt.
2. Press the ▲or ▼ key to enter the desired Low Limit Set Point in the upper 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 lower display. This is the High Limit Set Point prompt.
4. Press the ▲or ▼ key to enter the desired High Limit Set Point in the upper 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 upper display will show the actual chamber temperature while the lower 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 upper display and AtEn in the lower display, alternating with the actual chamber temperature in the upper display and FA iL in the lower 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 or EZ Key to resume normal operation.

Silencing the Audible Alarm

Turning off the Conditioning 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 cooling 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 Strip TB1 on the electrical sub panel. Connections to the safety contacts are at terminals A1 and A2.

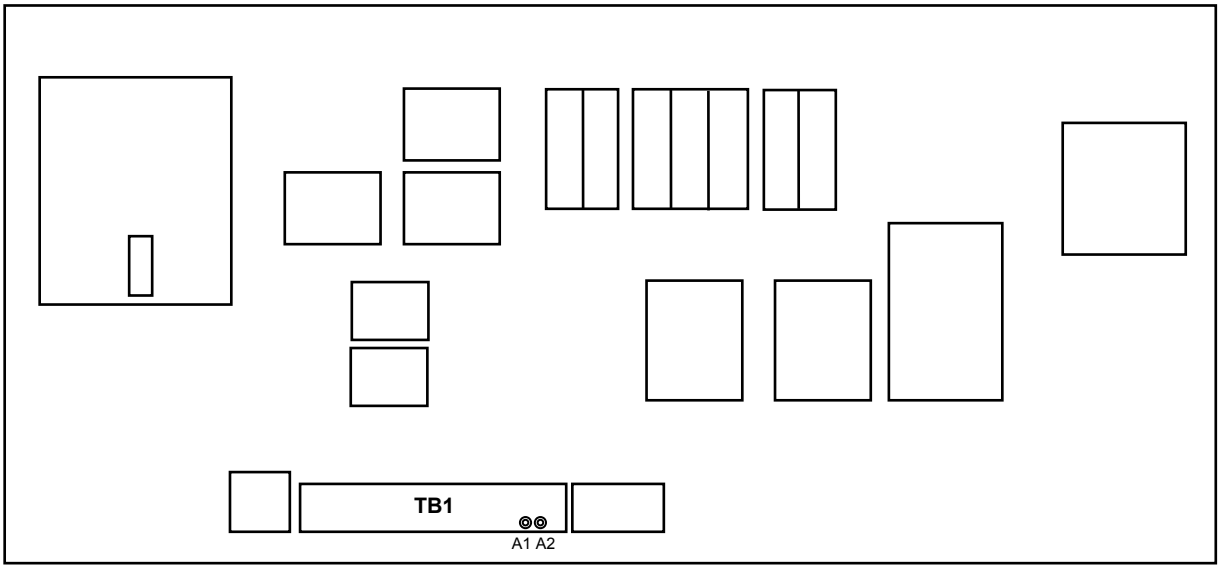


Figure 5-2 – Location of Safety Contact Connections on the Electrical Sub Panel

Chapter 5 – Frequently Asked Questions

The input voltage label says 230 (or 208) VAC. I thought I had 220 VAC. Is that ok?
220 V is a misnomer—there is no such standard as nominal 220 V in the United States. The standard line voltage in the United States is either 208 V or 240 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 a continuous HEAT 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 240 V nominal input as described in Chapter 2 - Input Power Configuration. If you have a 208 V line that measures under 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.

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 three phase voltage systems in most 50 Hz countries are typically 380 V or 400 V. Please call TestEquity for details on voltage reducing transformers 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 or heat faster?
We do not recommend any modification to achieve faster cooling or heating.

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 cooling 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 ±1.0°C, or a total of 2°C. The nominal value might be offset from the set point due to variations of control dynamics at different conditions of set point and loading. For example, the temperature set point may be –25.0°C. The actual temperature varies between –26.5°C and –24.5°C. This corresponds to a total of 2.0°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 ±1.66°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.

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.

Chapter 6 – Specifications

Model 3007-LN2 Chamber Specifications

Temperature Range	–100°C to +175°C (settable to –150°C but performance is not guaranteed)
Control Tolerance	±1.0°C (Measured at the control sensor after stabilization)
Uniformity	±1.0°C (Variations throughout the chamber after stabilization)

Cooling Rate (empty chamber)*
30°C/minute from +150°C to –100°C

Heat Up Ramp Rate (empty chamber)*
20°C/minute from –100°C to +150 °C

*** NOTE:** Ramp rates are measured at the control sensor after a 2 hour soak at the respective start temperature with an empty chamber. Measured with set point set beyond the start and end temperatures. Ramp rates do not include the effect of proportional band when approaching set point.

Input Power Requirements

230 V ±10%, 60 Hz, 3 PH	Max Current Draw 25 A; Recommended Service 30 A
208 V -5/+10%, 60 Hz, 3 PH	Max Current Draw 22.5 A; Recommended Service 30 A

Input may be configured for nominal 208 V or 230 V in the field by changing jumpers.
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 79" H x 54.25" D (nominal) Door latch adds 3" to width on right side, may be removed for move-in.
Access Ports	6" 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. This product is designed for use in a normal conditioned laboratory. Additional ports and shelves will also affect performance. Operation above 30°C (85°F) or below 16°C (60°F) ambient is not recommended. Damage that occurs due to operation below -100°C in not covered under warranty.

Chapter 7 – 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.
- Verify the chamber performance.

Every 6 Months
- Inspect the electrical compartment.

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 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 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 +150°C (+170°C would be fine), and the low limit set below –100°C (+120°C would be fine).

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 +150°C.
3. Press the Air Control button on the F4T. Read the temperature results on the F4T Air Sensor display only.
4. Turn the Conditioning Switch to the Event 1 position. Press the Power button on the F4T Controller to turn it ON.
5. The Heat Light should be ON continuously and the Cool Light should be OFF.
6. The chamber should heat up to about +145°C and begin controlling (Heat Light cycles ON/OFF) within approximately 6 minutes.
7. The chamber temperature should slowly increase and stabilize to +150°C. It should NOT overshoot beyond +150°C by more than 2 degrees, and the LN2 should NOT be needed in order to maintain +150°C.
8. After stabilization, the chamber temperature should vary no more than ±1°C, or a total of 2°C.
9. Let the chamber stay at +150°C for one hour.
10. After two hours at +150°C, set the Temperature Controller Set Point to –100°C.
11. The Cool Light should be ON continuously and LN2 should begin to flow within a few seconds. The Heat Light should be OFF.
12. The chamber should cool down to about –95°C and begin controlling (Cool Light cycles ON/OFF) within approximately 8 minutes. It might take longer if the initial flow of nitrogen is gaseous and not liquid due to losses in the piping which connects to the chamber's LN2 inlet.
13. The chamber temperature should slowly decrease and stabilize to –100°C.
14. After stabilization, the chamber temperature should vary no more than ±1°C, or a total of 2°C.
15. Set the Temperature Controller Set Point to +23°C. The chamber should begin to heat up.
16. This concludes the chamber performance verification tests.
17. Let the chamber heat up to +23°C before turning the Conditioning Switch and the F4T's Power button 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 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.

The F4T Temperature Controller accuracy for the Air Sensor (Type-T thermocouple) is specified ±1.55°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 ±2.55°C. Additionally, there can be an error of 0.1°C for every degree above or below a 25°C ambient temperature. This can add up to a total of ±3°C accuracy at the control sensor.

The F4T Temperature Controller accuracy for the Part Sensor (RTD) is specified ±2.00°C. Total system accuracy in the chamber includes the controller plus the factory supplied RTD sensor accuracy of ±0.4°C when measuring +20°C and ±0.8°C when measuring +100°C or -100°C. This can add up to a total of ±2.8°C accuracy at +100°C or -100°C at the control sensor.

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 the errors exceed the above limits, then perform the F4T Input Calibration Procedure on the next page.

Calibration Offset

Variations in temperature throughout the chamber interior are 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.

To enter a Calibration Offset from the F4T front panel:

1. Press **Menu**, **Inputs**, and either **Air Sensor** or **Part Sensor**.
2. Enter the desired offset value in the **Calibration Offset** box.
3. Press **Done** when completed.

F4T Input Calibration Procedure

Equipment Required for Part Sensor Input:
Precision resistance of 50.00 Ohms and 350.0 Ohms. Ensure that the calibrated source is connected across R1 and both T1 and S1 inputs on F4T Module Slot 5. T1 and S1 are the two like-color wires.

Equipment Required for Air Sensor Input:
Precision millivolt source for 0.000 mV and 50.000 mV. Connect (+) to R1 and (–) to S1 on F4T Module Slot 1

To calibrate from the F4T front panel:
1. Push the **Menu**, **Service** and **Calibration** buttons, in that order.
2. Push **Actions** for the desired input (Air Sensor or Part Sensor) and then push **Perform Field Calibration**.
3. Follow instructions on the screen.

Note: At any point in time the selected module and input can be brought back to the factory calibration settings by selecting "**Restore Factory Calibration**".

Theory of Operation

Overview

The chamber is heated by an open element nichrome heater. Cooling is accomplished by a Liquid Nitrogen (LN2). The air is circulated by two blowers. The heater, LN2 injectors, and blowers are located within an air plenum which is on the back wall of the chamber interior.

The heater, and circulator fan motor operate directly from the 208 or 230 VAC input line. All line branch circuits are individually fused. A stepdown 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 F4T temperature controller's Heat Output provides a time-proportioned output to the solid state relays (SSR1, 2). Pilot light PL1 provides an indication on the front panel when the heater is on.

Nitrogen Cooling System

Cooling is accomplished by a Liquid Nitrogen (LN2) only. The F4T temperature controller's Cool Output provides a time-proportioned output to the solid state relay (SSR8). This turns the Control Solenoid Valve SV2 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.

Safety Systems

Fusible heat limiters (HL1, 2, 3) provide failsafe protection against a catastrophic failure by opening the heater circuits 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, the safety relay (CR1). CR1 is controlled by the temperature limit controller (TCR2). If either the high or low temperature safety limits are exceeded, TCR2 turns off CR1, which turns off C1.

Solenoid Valve SV1 provides a safety interlock for the LN2 system. This valve is turned off through safety relay CR1 if the low temperature safety limits in Limit Controller TCR2 are exceeded as described above.

A Pressure Relief Valve is placed between SV1 and SV2 to prevent a build-up of pressure when the Control Solenoid Valve SV2 is OFF. This pressure relief valve is set to vent at 100 psig. It is spring-loaded and will re-seal itself when the pressure is below 95 psig.

Mullion Heater System

The mullion (gasket sealing surface on the chamber side) has an embedded heater (HT2) to ensure that the door gaskets remain pliable and the outer cabinet remains free of ice or condensation at low temperatures. A Type-J thermocouple senses the mullion temperature which is controlled by Door Heater Controller (TCR3). This cycles Solid State Relay SSR9 to control power to HT2 as required, maintaining the desired surface temperature on the mullion.

Troubleshooting

SYMPTOM	CONDITION	CAUSES
Chamber completely inoperative.	1. Power is applied to chamber but nothing lights up.	1. Control fuse F3 open. Likely cause is shorted solenoid coil on SV1 or SV2.
Does not heat up at all.	1. If controller light 1A is ON, circulator fan is ON, the Heat light is OFF. 2. If controller light 1A is ON, circulator fan is ON, the Heat light is ON.	1. Solid State Relay SSR1or SSR2 is defective. 2. At least two Heat Limiters HL are open.
Heats up too slow.	1. Does not meet published specifications.	1. Chamber interior is overloaded. Port plug is not in port. Verify that input voltage is within tolerance. One heat limiter HL or one heater winding is open.
Heat is on all the time.	1. If temperature controller light 1A is OFF, the Heat light is ON.	1. Solid State Relay SSR1 or SSR2 is defective. Heater is shorted to chassis.
Cools all the time.	1. When cool light is OFF.	1. Solenoid valve SV1 may be defective in open position.
Temperature varies more than ±1.0°C or 2.0°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.	1. Re-enter values as shipped from TestEquity. 2. PID parameters may need to be changed for your unique test conditions. You may need to wait longer for the temperature to stabilize.

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.

Contactors
Relays
Fuses
Heat Limiter
Circulator Motor and Fan
Switches
Solenoid Valves

Major Parts List

Description	Mfr	Mfr Part No.	Ref #	Part #	Qty	UOM
Arc Suppressor	ITW Paktron	104MACQRL150	AS1, AS2	200296	2	ea
Audible Alarm	Floyd Bell	MC-09-201-Q	AL1	200005	1	ea
Circulator Motor, 230V 1725 RPM	CUSTOM	CUSTOM	FM3, 4	222330	2	ea
Contactor, 3 P 30A	Hartland	HCC-3XT02SX	C1, 2	200245	2	ea
Control Transformer	Hammond	PH350MLI	TR1	200219	1	ea
Disconnect Switch, 3 Pole, 45A	ABB	OT63F3	DSW	200281	1	ea
F4T Temperature Controller	Watlow	F4T1L2EAA2D7030	TCR1	222514	1	ea
Fuse, 20A	Bussman	FNQ-R-20	F4-6	200242	3	ea
Fuse, 3A	Bussman	FNM-3	F3	200186	1	ea
Fuse, 4A	Bussman	FNQ-R-4	F1, 2, 7, 8	200083	4	ea
Heat Limiter	Thermodisc	G5A-01-240C	HL1-3	200070	3	ea
Heater, Air	CUSTOM	CUSTOM	HT1	222340	1	ea
High/Low Limit Controller	Watlow	PM6L1AJ-AAAABBS	TCR2	200301	1	ea
Indicator, Panel, 120V Neon	SoLiCo	S412-2-1-N1	PL2, 3	200025	2	ea
Indicator, Panel, 240V Neon	SoLiCo	S412-2-1-N2	PL1	200026	1	ea
Relay, Octal DPDT 10A 120VAC	Idec	RR2P-UCAC120	CR1	200292	1	ea
Relief Valve	Rego	SS-9432	n/a	180104	1	ea
Solenoid Valve, LN2	CUSTOM	CUSTOM	SV1, 2	180100	1	ea
Solid State Relay, 10A, 5-24V In	Omron	G3NA-D210B-DC5-24	SSR4-7 (opt.)	222425	4	ea
Solid State Relay, 20A, 5V In	Omron	G3NE-220T-US DC5	SSR3, 8	222426	2	ea
Solid State Relay, 25A, 4-32V In	Siemens	SSRT-240D25	SSR1, 2	200021	2	ea
Solid State Relay, 25A, AC Input	Carlo Gavazzi	RM1A23A25	SSR9	200268	1	ea
Switch, ON-OFF-ON	Carlingswitch	RC911-RA-B-0-N-XLR1	SW2	200275	1	ea
Switch, SPST, Rocker	Carlingswitch	LRA211-RA-B/125N	SW1	200023	1	ea
Temp Controller, Door Heater	Athena	88-A-A-03F-000	TCR3	222446	1	ea
Temp Sensor, Bolt On, Platinum	Minco	S101731PD3G120	RTD1	222445	1	ea

General Parts

Description	Mfr	Mfr Part No.	Ref #	Part #	Qty	UOM
Port Plug, Silicone Foam, 4"	CUSTOM	CUSTOM		300534	2	ea
Door Gasket	CUSTOM	CUSTOM		380032	1	ea
Door Latch, Chamber Workspace	Southco	A2-10-501-21		300009	1	ea
Caster, Swivel	RollMaster	35-15-11		300011	2	ea
Caster, Rigid	RollMaster	35-16-11		300012	2	ea
Shelf with 4 Clips	CUSTOM	CUSTOM		TE-0701	1	ea
Shelf Retainer Clip	Kason	Style 66, #0066000008		300015	4	ea
Blower Wheel, CW	CUSTOM	Required when replacing circulator motor		382498	1	ea
Blower Wheel, CCW	CUSTOM	Required when replacing circulator motor		382499	1	ea
Fan Motor Face Gasket	CUSTOM	Required when replacing circulator motor		382809	2	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	-175	Do not make any lower
r.h i	Range High	180	Do not make any higher
Fn2	Output 2 Function	L inA	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	-175	Appropriate Low Limit Set Point
LhS	High Set Point	180	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.

Damage that occurs due to operation below -100°C is not covered under warranty.

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; (4) Damage that occurs due to operation below -100°C.

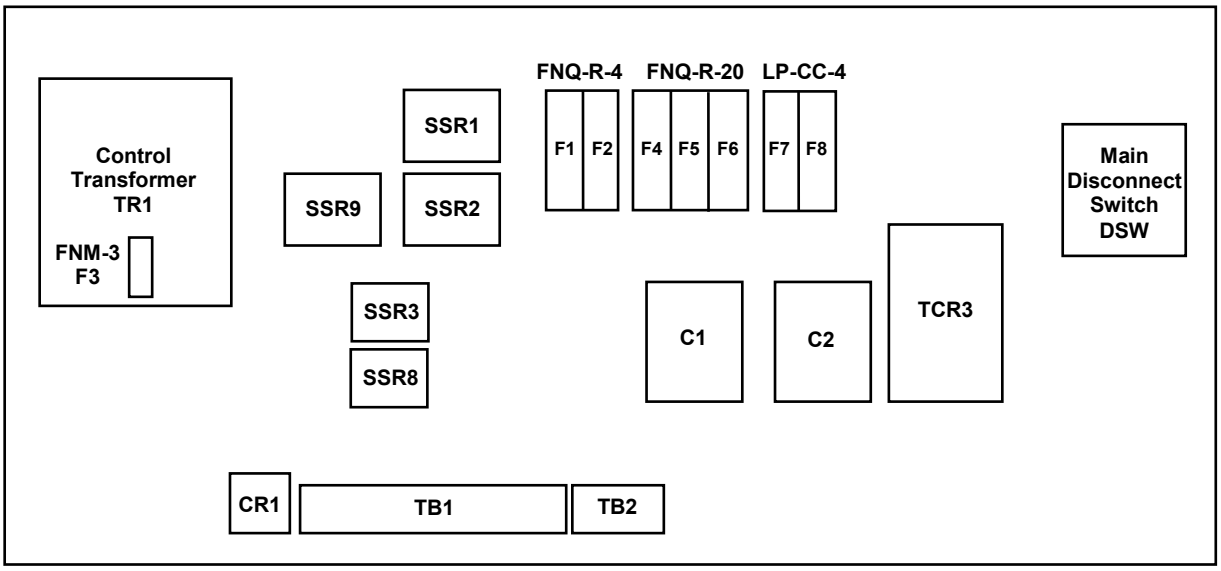
This warranty as to Equipment is LIMITED to repair or replacement of parts or Equipment in the determination of TestEquity LLC THE FORGOING LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES INCLUDING THE IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. TestEquity LLC DISCLAIMS 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.

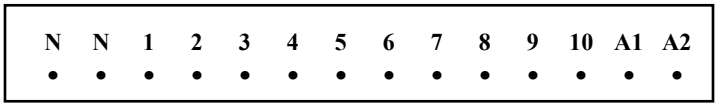
This limited warranty shall be extended only to the first Purchaser of this Equipment and is not transferable.

Chapter 9 – Drawings

Electrical Subpanel Component Location



TB1 Terminals (115V Control Circuit)



TB2 Terminals (208V Circuits)