Photostability Test Chambers

OPERATION & MAINTENANCE MANUAL

Model No. CEO9xx - x - PH, Serial No. 3xxxx

CHAMBER TYPES

CEO9xx - 1: Heating Only
CEO9xx - 2: Heating / Cooling
CEO9xx - 3: Heating / Humidity
CEO9xx - 4: Heating / Cooling / Humidity

CONTROLLER TYPES

Temperature Controller - Watlow 96

Humidity Controller - Watlow 96 (-3 & -4 Models)

Photostability Controller(s) - Watlow 96

CHAMBER FEATURES

☐ Air Dryer
☐ Chart Recorder
☐ Photostability: Artificial Daylight Test
☐ Photostability: Near Ultraviolet Test

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570-326-1770 Fax: 570-326-7304

Rev. 10/28/05

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1.0 COMPANY INFORMATION & ASSISTANCE

Congratulations on purchasing a chamber from one of the fine divisions of TPS - Thermal Product Solutions. You probably already know us as Lunaire Limited. We've changed our name and expanded our vision with the intent to provide you with more diversified solutions to your thermal product process requirements.

We truly hope that every aspect of chamber design and quality will measure up to your strictest standards. Your chamber has been designed to operate with the reliability you expect for the demands you impose on your product and research testing.

Headquartered in Williamsport, Pennsylvania, which is located in the North-central part of the state, TPS includes the following four divisions that manufacture environmental test chambers and industrial ovens.

Tenney Environmental - - - - - - Lunaire Environmental - - - - - - Gruenberg Oven - - - - - - Blue M

Parts and service inquiries for equipment within each division should be directed to TPS by any of the following methods.

Important! Please have the **Model** and **Serial Numbers** of your unit available when contacting us.

TPS
2121 Reach Road
Williamsport, PA 17701

Phone: 570 - 326 - 1770

Fax - Parts Dept. 570 - 320 - 2160

Fax - Service Dept. 570 - 326 - 3372

Fax - Main: 570 - 326 - 7304

E - Mail Address: service@lunaire.com

Web site: www.thermalproductsolutions.com

Parts Replacement

Your equipment has been designed and manufactured to provide years of reliable service. In the event a component should fail, it is recommended that only OEM approved parts be used as replacements. Please contact the Parts Department for component replacement, or repair.

2.0 SAFETY WARNINGS & SYMBOLS

1. Read this entire Operation Manual, as well as the vendor manuals and cut-sheets provided before operating this equipment! Failure to adhere to any Safety Warning, or failure to follow the proper operating procedures listed throughout any of the information provided, could cause damage to your equipment, personal injury, or death.

2. Obey all “CAUTION”, “DANGER”, and “WARNING” signs / labels mounted on the equipment. Do not remove any of these signs / labels.

3. Do not use this equipment in any manner not specified in this manual. Improper use may impair the safety features employed and will void your warranty.

4. Operators and service personnel must be familiar with the location and function of all controls and the inherent dangers of the equipment before operating or maintaining it.

5. Only qualified service personnel should ever be permitted to perform any service-related procedure on this equipment!

6. This is not an explosion resistant chamber. Do not install test articles that may release explosive or flammable vapors in the chamber.

7. Do not place the unit near combustible materials or hazardous fumes or vapors.

8. Do not install unit in a corrosive environment. A corrosive environment may lead to poor performance and deterioration of unit.

9. Make sure the chamber and any remote equipment provided are leveled when installed. The chamber door may swing shut on personnel if unit is tilted.

10. A main power disconnect may not be provided with your unit. If not provided, we recommend that a fused disconnect switch on a separate branch circuit be installed as the power source in accordance with all National and Local Electrical Codes. If your unit is equipped with a power cord and plug, you must utilize a receptacle with the appropriate rating, which is on a branch circuit of its own.

11. Do not position the chamber in a manner that would make it difficult to operate your main power disconnect switch.

12. Your power supply line voltage may be too low or too high to properly and safely operate your equipment. Before making the power supply connection to your equipment, you must follow the specific directions stated under “Power Connection” in the Installation Instructions section. Failing to perform the directions stated may damage your equipment and void your warranty!

13. Control panels, gauge boxes, the conditioning compartment, etc., contain exposed electrical connections. Keep panels in place properly when the unit is in operation. Disconnect and Lock-Out / Tag-Out all electrical power from the unit at its source before servicing or cleaning.

14. Refrigerant under high pressure is used in the -2 and -4 units. Only qualified refrigeration mechanic personnel should ever be permitted to perform any service-related procedure on the refrigeration system.

15. Do not adjust any mechanical components such as refrigeration valves or any electrical components except as directed in this manual.

16. Human exposure to temperature extremes can cause injury. Do not open the chamber door until chamber temperature drops below 200° F (93° C), when applicable. Take appropriate precautions before opening oven doors and upon handling any chamber contents.

17. Do not modify any component on this unit. Use only original equipment manufactured (OEM) parts as replacement parts. Modifications to any component, or the use of a non-OEM replacement part could cause damage to your equipment, personal injury, or death.

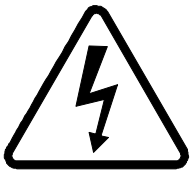
18. Do not overload the floor of the chamber workspace or load the unit unevenly.

INTERNATIONAL WARNING / SAFETY SYMBOL DEFINITIONS

Obey all "DANGER", "WARNING", and "CAUTION" labels shown in the manual and mounted on the equipment. Do not remove any labels mounted on the equipment.

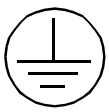
"WARNING OF HAZARDOUS AREA"

"WARNING OF DANGEROUS ELECTRIC VOLTAGE"



"WARNING OF HOT SURFACE"

"EARTH (GROUND) PROTECTIVE CONDUCTOR TERMINAL"



3.0 PRODUCT SPECIFICATIONS & OVERVIEW

Application:

This manual applies to Lunaire Photostability / Temperature - Humidity Stability Test Chambers, which are engineered to provide a diverse set of environmental operating conditions, with simultaneous **Photostability Testing**. Heating, cooling, and humidity conditioning in various combinations can be chosen to closely match your test requirements.

Two different Photostability Test Systems are available:

- Full Spectrum - Artificial Daylight
- Near UV - Ultraviolet A

The Model CEO910 chamber can employ one light system, while the larger Model CEO932 can employ two.

Model Number Designations and Specifications:

There are four basic models in the CEO series, which include Models CEO9**xx** -1, -2, -3, and -4. The dash numbers -1, -2, -3, and -4 define what environmental operating conditions the chamber provides. Chamber types and temperature and/ or humidity ranges are listed below. All model numbers will have suffix **PH** to designate the Photostability feature.

Each of the standard models are available in five different workspace sizes, which include 10, 17, 32, 41, and 58 cubic feet. Size is designated by the 9**xx** number, e.g., CEO910, CEO917, CEO932, CEO941, and CEO958. **Important Note!** Throughout this manual, the dash numbers -1, -2, -3, and -4 will reference all Lunaire chamber models.

IMPORTANT! With the light banks installed, you can only operate the chamber in the following conditions.

Temperature Range: +20° C to +35° C, with a Humidity Level Less than 50% RH

Temperature / Humidity Specifications for Chambers With Light Banks Removed

Chamber Type		**Temperature and / or Humidity Range**	
CEO9xx - 1:	Heating Only	**Temp:**	+10°C above ambient to +99°C
CEO9xx - 2:	Heating / Cooling	**Temp:**	0°C to +99°C
CEO9xx - 3:	Heating / Humidity	**Temp:**	+10°C above ambient to +99°C
		Humidity:	above ambient to 96% RH
CEO9xx - 4:	Heating / Cooling / Humidity	**Temp:**	0°C to +99°C
		Humidity:	20% to 96% RH

Control tolerance after stabilization is ±0.3°C for temperature, and ±2% for relative humidity. Temperature uniformity is maintained at ±0.5°C throughout the chamber, even with a variety of shelf loading configurations. Lower humidity levels than those listed above can be achieved with an optional air dryer.

Environmental Conditioning Functions:

- Heating of chamber air is accomplished by recirculating chamber air through electric heater elements in the conditioning plenum of all models.

- Cooling is accomplished in the -2 and -4 models by recirculating chamber air through a refrigerated cooling coil in the conditioning plenum. These chambers incorporate a single stage refrigeration system with a hermetically sealed reciprocating compressor. Non-CFC refrigerant is used.

- Humidification of chamber air in the -3 and -4 models is accomplished by water vapor injection, which is generated by a Vapor-Flo Humidity Generator. The vapor is injected into the conditioning plenum near the conditioning blower intake.

- Dehumidification of chamber air in the -3 and -4 models may be achieved with the optional heatless desiccant dryer. This dryer generates dry air using a compressed air supply and is self regenerating.

- Air circulation is generated by one or more blower conditioner motors. Air flow is in a horizontal pattern through the chamber workspace. Chamber sizes 10 thru 41 cubic feet employ one blower motor. The 58 cubic foot model employs two blower motors. Conditioner motors are externally mounted.

  Air intake and exhaust tubes with manual dampers are provided to vent moisture or undesirable vapors from the chamber workspace.

Temperature / Humidity Controller(s):

Temperature conditions are controlled by a Watlow 96 Temperature Controller, which uses an RTD sensor for temperature measurement. Humidity conditions in the -3 and -4 models are controlled by a Watlow 96 Humidity Controller, which uses a dry capacitance type humidity sensor for humidity measurement.

The Watlow 96 is a powerful one-channel non-profiling type controller that features one universal input, a second auxiliary input that can be used for a remote set point or an event input, and four outputs. Outputs are configured in several different modes. Time proportioning is used for the control of heat, and humidity (-3 & -4 models). On/Off control is used for defrost in -2 and -4 models. Alarm outputs are used for high and low limit setpoints.

Photostability Test Feature:

The photostability test feature permits photostability testing to the standards of the International Conference on Harmonization ICH. This feature is designed with interchangeable fluorescent light systems that may include Daylight lamps for Full Spectrum - Artificial Daylight stability testing, and Ultraviolet-A lamps for Near Ultraviolet stability testing. Watlow 96 Light Controllers are used to control the light level of each light system.

Additional Options:

Lunaire Steady State and Stability Test Chambers are engineered with the capability to incorporate optional features that include a humidity alarm circuit, a condensate pump, and a one or two channel circular or strip type chart recorder. And there's much more. Please contact a TPS Sales Engineer for all available options and for further details.

As you can see, Lunaire Environmental Test Chambers are diversified tools designed to encompass a wide range of operating conditions and functions. If you come upon any questions as you continue on through the manual, please contact our Service Department.

Operating Parameters and Requirements:

This equipment is designed to operate safely when the following environmental conditions are met:

- Indoor use only.
- Within a temperature range of 5°C to 30°C (max).
- Maximum relative humidity 90%.

The listed chamber specifications are based on operation at 24° C ambient temperature, altitude at sea level, and a 60 Hz power supply. Chamber operation utilizing a 50 Hz power supply may derate the listed performance specifications.

Equipment damage, personal injury, or death may result if this equipment is operated or maintained by untrained personnel. Operators and service personnel must be familiar with the location and function of all controls and the inherent dangers of the equipment before operating or maintaining it. TPS shall not be liable for any damages, including incidental and/or consequential damages, regardless of the legal theory asserted, including negligence and/or strict liability. Observe all safety warnings and operating parameters listed in this manual, as well as all Caution, Danger, and Warning signs or labels mounted on the equipment to reduce the risk of equipment damage and personal injury.

4.0 DRAWINGS, INFORMATION, and VENDOR INSTRUCTION LISTINGS

As applicable to the chamber model and serial number, the following drawings are included in the Supplemental Instructions Section of this manual.

Note: For specially designed chambers, the Electrical Schematic will be designated by the number **D800**, and the Relay Pan Layout (when provided) will be designated by the number **D801**.

Electrical Schematic		LE10XX - 4
Relay Pan Layout (when provided)		L100X - 4
Refrigeration Schematic (-2 & -4 Models)		
	1/3 HP System	R - 1736 - 4
	1/2 HP System	R - 1737 - 4
	3/4 HP System	R - 1738 – 4
UVA Light / Daylight Photostability Package		LE1000 - 3
Condensate Pump & Dehumid Option (when applicable for -3 & -4)		LE1000 - 2
Humidity High / Low Alarm Option (when applicable for -3 & -4)		LE1001 - 2
Boost / Buck Transformer for Circulation Motor - Optional (when applicable)		LE1002 - 2

The following vendor manuals and information are provided:

Watlow 96 Controller Manual
Humidity Sensor (For -3 and -4 Models): Vaisala
Chart Recorder (with option)
Test Report
Heatless Dryer Manual (with dry air dehumid option)

Note: Various other vendor manuals and product information sheets may be provided, which contain important operation and maintenance instructions. Their inclusion is subject to vendor availability.

5.0 INSTALLATION INSTRUCTIONS

Read this section completely before attempting to install, or operate the equipment.

5.1 Delivery and Uncrating of Unit

Inspect equipment and shipping crate immediately upon receipt. If any damage is apparent, you should discuss it with the trucking delivery person and contact the transportation company immediately. Make notes of any damage on the Bill Of Lading. Retain all shipping materials for inspection. Any claims for damage must start at the receiving point. Check packing slip carefully and make sure all materials have been received as indicated on the packing ticket. Unless otherwise noted, YOUR ORDER HAS BEEN SHIPPED COMPLETE.

Warning! Chambers, remote control cabinets, and remote machinery skids should be handled and transported in an upright position, or as indicated on the shipping pallet. Damage to the equipment may be incurred if it is not handled properly.

Important! Do to the vibration incurred during shipping and handling, it is possible that mechanical connections could become loose. Check all connections to make sure they are secure. For -3 and -4 models with a Vapor-Flo Humidity Generator, check all water fittings to make sure they are tight. Inspect the Vapor-Flo Humidity Generator assembly as described below.

5.2 Location and Installation of Unit

Your equipment has been fully operated, tested, and balanced in our plant prior to shipment, unless notified otherwise. Follow the installation requirements below.

- Do not place the unit near combustible materials or hazardous fumes or vapors.
- Ventilation: The unit should be installed in an area where there is good air ventilation. Allow a minimum of 18 inches between any wall and any side of the unit.
- Do not locate unit in areas of wide ambient temperature variation such as near vents or outdoor entrances.
- Do not install unit in a corrosive environment. A corrosive environment may lead to poor performance and deterioration of unit.
- **Do not position the unit in a manner that would make it difficult to operate your main power disconnect switch.** See “Power Connection” below.
- Make sure the unit is leveled when set up.

5.3 Chamber Drain Connections

There are two different water drain connections for draining condensation from the chamber. The door trough drain pipe runs from the bottom front of the chamber to a ¼" O.D. plastic compression fitting on the bottom left side. The second drain line consists of a ½" copper pipe that runs out from the bottom rear of the chamber. The connection may be piped in hard line or with a flexible hose and clamp. This line drains condensation from the plenum, the chamber floor, and the door drip pan mounted on the bottom of the door.

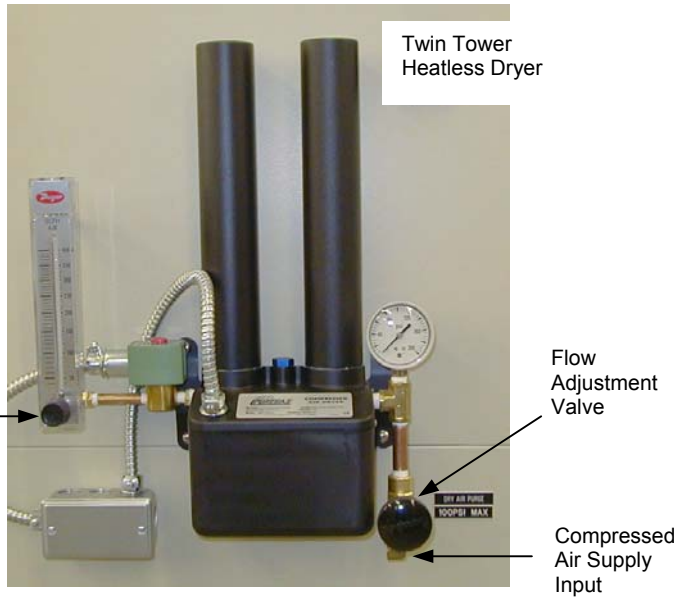
5.4 Air Supply Connection (-3 & -4 Models)

Your chamber will require a compressed air supply for the Dry Air Dehumidification / Dry Air Purge System option. The supply should be clean and dry, and range from 80 PSIG min. to 100 PSIG max. The connection type is ¼" FPT. Make sure the connection is secure. Reference the corresponding "Options" section in this manual and your chamber specifications for more details.

Flow Adjustments:

Adjust the **flow adjustment valve** at the supply connection to maintain 100 PSIG max. Adjust the flowmeter **metering valve** to approximately 300 cubic feet per hour.

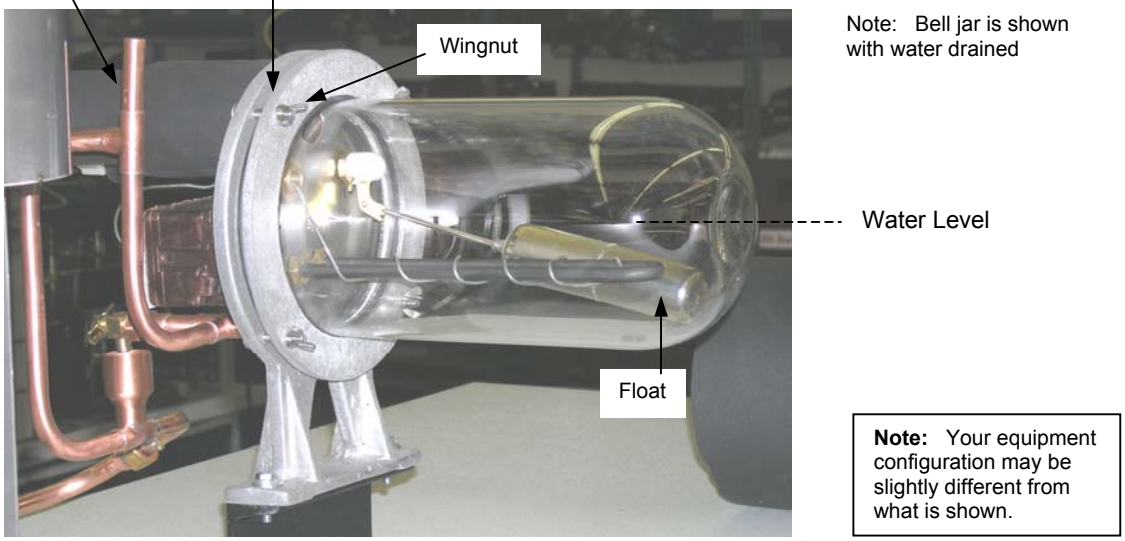
Note: Your equipment configuration may be slightly different from what is shown.



Dry Air Purge System

5.5 Vapor-Flo Humidity Generator Checks (-3 & -4 Models)

The humidity generator is installed inside the machinery section and consists mainly of a glass bell jar assembly. A thick black insulating cover is wrapped around the bell jar. Remove the cover by sliding it off. Make sure the gasket sealing the bell jar is positioned properly around its perimeter, and that the wingnuts securing the bell jar are tight. Do not replace the cover until you follow all of the instructions that follow!



Note: Bell jar is shown with water drained

Note: Your equipment configuration may be slightly different from what is shown.

VAPOR-FLO HUMIDITY GENERATOR

5.6 Vapor-Flo Water Supply Quality & Connection (-3 & -4 Models)

Water Quality

Important! Please read and adhere to the important statements below before utilizing your water supply. Also refer to the Humidity System Section in this manual for more details.

We strongly suggest that you have your water supply tested for resistivity, organic content, and inorganic content before using the humidifier.

The water supply to the generator **must** be demineralized or single distilled, and have a resistance measurement between 50,000 and 100,000 Ohm/cm (20 to 10 Microsiemens/cm). It is important that the water is very low in minerals. Otherwise, the generator's immersion heater and belljar will become encrusted with minerals and cause system failure. If your water supply can not meet the resistivity specifications, a cartridge ion exchanger (deionizer) should be obtained from TPS.

Note: Ion exchangers are discussed in detail in the Humidity System Section.

Do not use double or triple distilled (ultra-pure) water. Pure water (greater than 1.0 Megohm/cm) will attack metals such as copper, brass, etc., and will drastically reduce the life of the humidifier.

Never supply demineralized, or single distilled water to a cartridge ion exchanger. (The result is double distilled water.)

If your water supply tests show that appreciable amounts of suspended particles are present (as determined by a Certified Test Lab), either a 5 micron or 25 micron polypropylene pre-filter should be used. This filter may be needed in addition to an ion exchanger. All filter types can be obtained through TPS.

If your water supply test shows that appreciable amount of organics, free chlorine and chloramines, phosphate complexes and turbidity are present (as determined by a Certified Test Lab), a roughing filter (US Filter Model - Absorber) should be used. This filter may be needed in addition to an ion exchanger. All filter types can be obtained through TPS.

Due to periodic changes that could occur in the quality of city or well water supplies, you should check your water for resistivity and organic / inorganic content every 1 to 2 months.

Supply Connection

The water supply should be 30-40 PSIG maximum. The connection is normally made directly to the Water Pressure Regulator WPR (1/4" MPT). The regulator is adjusted at the factory for optimal performance, which is normally between 10 and 20 PSIG at the input gauge.

Water Reservoir: When the optional 5 Gallon Water Reservoir is used, fill the reservoir to just below the top hose inlet port (when provided). Water is fed by gravity to the humidifier. When operating with high humidity conditions, you may have to fill the reservoir daily.

Condensate Pump: The optional condensate pump may be used to reduce the frequency of refilling the reservoir, or to conserve water. Water is pumped back to the reservoir in response to an integral float switch.

Important! Refer to the Humidity System Section in this manual when a water reservoir, a condensate pump, or a cartridge ion exchanger is used.

Water Supply Regulator

After turning on the water supply and adjusting the pressure, make sure the water level in the belljar is approximately 1" above the immersion heater. Replace the insulating cover.

5.7 Before Running Humidity Tests - Important!

Before running high temperature with high humidity conditions, you should open the intake and exhaust port dampers at the top of the chamber. The extra heat introduced by the high volume of vapor needs to be removed.

5.8 Power Connection

Warning! Before making the power supply connection to your unit, you must perform the following procedure:

1. Verify the power supply voltage rating established for your chamber (listed above). The voltage rating is also found on the serial tag on the side of the oven. Note the rated value here: _____

2. Measure and record the intended voltage source. Note the measured value here: _____

3. Reference the "Line Voltage Min/Max Tables" below. Verify that the power supply voltage source you measured and recorded is within the minimum and maximum allowable operating voltages for your chamber rating. If it is not within this operating range, do not make the power connection! Otherwise, erratic operation and damage may occur to your equipment, which may void your warranty. If you have any questions, please call the TPS Service Department.

Important! One of the most common causes of equipment malfunction is low line voltage as the power source to the unit. Ordinarily in this condition, the heat output would be reduced and the system's motors would operate erratically, eventually overheat, and shut down. You must be certain that your equipment is connected to a circuit with an adequate voltage and current source. An oversupply voltage would also cause erratic operation and eventual shutdown, or damage to your equipment.

- 60 HERTZ SUPPLIES - LINE VOLTAGE MIN. / MAX. TABLE		
Nominal Voltage	**Minimum Voltage**	**Maximum Voltage**
208	188	228
230	207	253
460	414	506
480	432	528
60 Hz Supply	**Operation outside these limits can result in damage to the system's motors.**	

- 50 HERTZ SUPPLIES - LINE VOLTAGE MIN. / MAX. TABLE		
Nominal Voltage	**Minimum Voltage**	**Maximum Voltage**
200	180	220
220	198	242
380	342	418
400	360	440
415	374	456
50 Hz Supply	**Operation outside these limits can result in damage to the system's motors.**	

Making the Power Supply Connection to the Chamber:

A main power disconnect switch is normally not provided with your chamber. We recommend that a fused disconnect switch on a separate branch circuit be installed as the power source to your chamber, in accordance with all national and local electrical codes. Reference your Electrical, or Power Schematic for all electrical requirements.

The power connection is made via a cord and plug for small standard units. Connect the plug to a receptacle that has the appropriate power supply on a branch circuit of its own.

For larger or special units that have the power supply hard-wired to the chamber, connect incoming lines to the main input connections provided in the control section.

Warning! High Accessible Current – An Earth connection is essential before connecting the power supply. Make sure equipment is properly grounded in accordance with all codes.

5.9 Application of Power

- Before energizing any equipment, make a visual inspection for loose components, electrical connections, fittings, etc. Shut all operating switches to the “OFF” position before energizing.
- Have trained personnel start and check out the equipment before its first cycle.

Motor Rotation Check: Units with three phase motors must be checked to insure proper motor rotation. A red arrow is located on the motor housing to show proper rotation. If it is opposite, shut down the oven and disconnect the main power supply source. Perform **Lock-Out / Tag-Out Procedures** established by your company. Reverse two of the line feeds to obtain proper operation. Failure to check motor rotation may result in **DAMAGE TO THE EQUIPMENT** due to opposite airflow, or no airflow.

6.0 AIR CIRCULATION SYSTEM

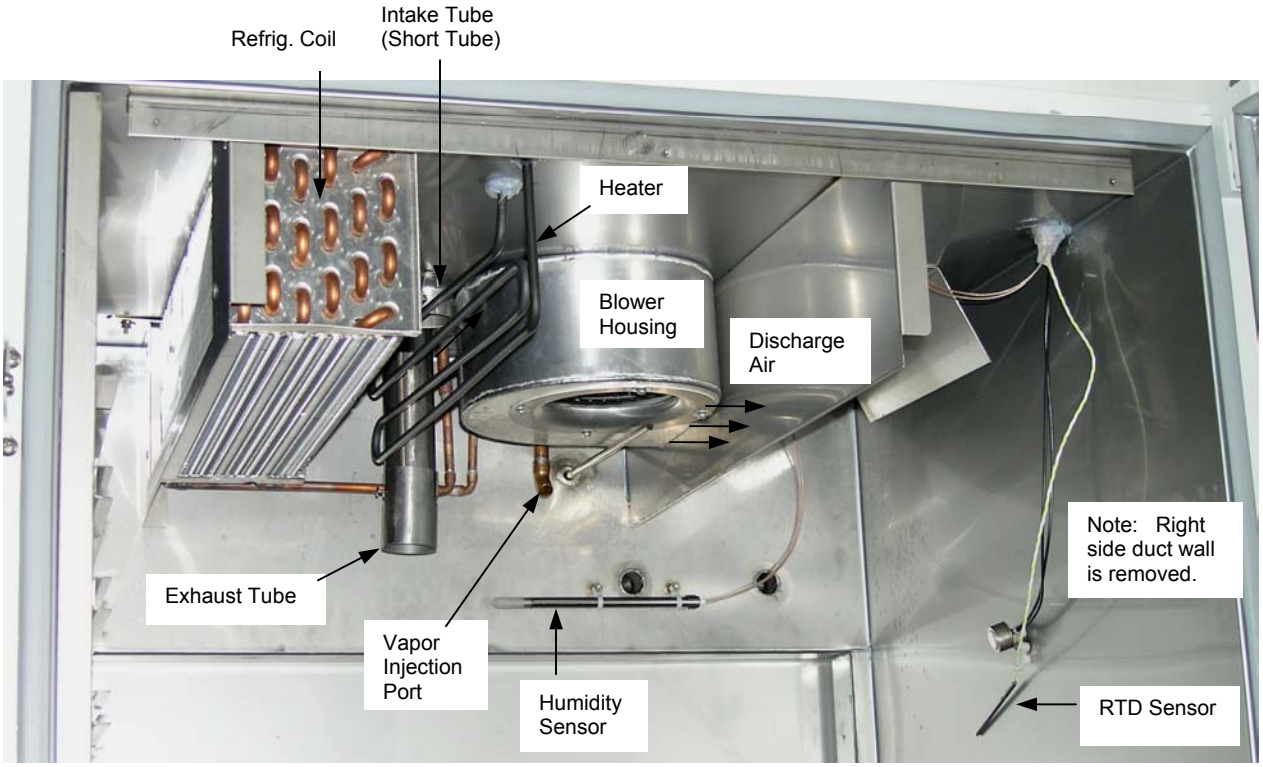
System Overview:

Lunaire chambers are engineered with a highly efficient horizontal airflow system to provide maximum temperature uniformity. The generation and conditioning of airflow occurs in the plenum conditioning section at the top of the chamber. The plenum is isolated from the workspace so that no direct radiation to the product can occur. Air circulation is generated by a blower wheel, which is driven by an externally mounted motor. Two conditioner blowers are used in the larger Model CEO958's. Conditioning equipment includes electric Incoloy sheathed heaters, a refrigeration coil (-2 & -4 Models), a humidity injection port (-3 & -4 Models), and a dry air injection port (optional).

Airflow Description:

Process air is conditioned as it is drawn through the heaters and the refrigeration coil (-2 & -4 Models) by the blower wheel. Injected humidified air or dry air (-3 & -4 Models) mixes in smoothly with the heated or cooled air. The conditioned air is discharged down into the right side duct wall and then enters the workspace through semi-pierced openings over the entire height and depth of the chamber. Air flows horizontally across the product and exits the workspace through semi-pierced openings in the left side duct wall. Processed air flows up the left side duct wall and returns to the plenum for reconditioning.

A 100 Ohm Platinum RTD sensor is used for temperature measurement. It is placed in the discharge air in the right side duct wall. A capacitive humidity sensor is used for humidity measurement (-3 & -4 Models). This sensor is placed in the chamber workspace below the plenum cover.



PLENUM CONDITIONING SECTION

Note: Your chamber configuration may be slightly different from what is shown.

PLENUM COVER INSTALLED

Air Intake Tube / Air Exhaust Tube:

An air intake tube and an air exhaust tube mounted at the top of the chamber provide a means of exchanging a portion of process air with fresh ambient air. Both tubes have manual butterfly dampers, which are factory set in the closed position. The dampers are normally closed for most operating conditions. They should be opened when running the following conditions:

- At ambient temperature conditions to remove the heat generated by the blower wheel
- At high temperature with high humidity conditions to remove the extra heat that is added by the vapor
- To remove heat generated by a live load
- To remove moisture or undesirable vapors given off by the product

Airflow Switch:

A Circulation Airflow Switch AFS is provided to monitor air circulation within the chamber. This switch is a differential air pressure type that monitors air pressure on both sides of the circulation blower. When a loss of air circulation is detected, the switch will open and remove power from the heat control circuitry, and the humidity control circuitry (-3 & -4 Models). The Circulation Failure light will illuminate and the audible alarm will sound. Loss of air circulation may result from a motor malfunction or a loose blower wheel. An airflow switch is provided for each blower in all CEO958 Models.

AIRFLOW SWITCH

Alarm Silence Switch:

The audible alarm can be silenced by pressing the Alarm Silence pushbutton. The Alarm Silence circuitry will automatically reset when the Circulation Airflow Switch AFS again closes, indicating that proper air circulation has been established.

7.0 TEMPERATURE CONTROL – Watlow 96 Controller C1

7.1 Controller Features

Temperature conditions are controlled by a microprocessor based Watlow 96 Controller **C1**. The Watlow 96 is a 1/16 DIN controller, which incorporates the following features.

- Single Channel
- Non-Profiling
- Automatic & Manual Control
- 1 Universal Input: 100 Ohm Platinum RTD is Std.
- 1 Auxiliary Input: DC Process, 4-20 ma Process, or Digital Event Input
- 2 Control Outputs: Time Proportioned, On/Off, or 4-20 ma Control (Output 2 may be an alarm)
- 1 to 3 Alarm Outputs: Optional for Outputs 2 - 4
- 1 Retransmit Output: Optional for Output 4
- Communications: Optional for Output 4, Serial w/ Modbus RTU

WATLOW 96 CONTROLLER

Keys and Displays:

The front panel of the Watlow 96 is provided with user-friendly features that aid in monitoring and setup. The upper display indicates actual process values while the lower display indicates setpoint value. Output LEDs No.'s 1, 2, 3, & 4 will light when the corresponding controller output is energized. The auto/manual mode (%) indicator light will illuminate when operating in the manual mode, and will be off when operating in the auto mode. The Advance Key advances the lower display through the configuration parameters. The Infinity / Home Key returns to the Home Page, and resets a latching alarm or a latching input sensor error. The Up and Down arrow keys raise or lower both of the display values.

Controller Configuration:

The pre-programmed controller configuration for your chamber is documented in the Test Report, which is located in the Supplemental Instructions Section. Refer to the controller manual for programming details.

Important! The configuration set-up is mainly provided for your reference. Not all of the parameters shown apply to your chamber. Changes to some of the set-up parameters may drastically affect your chamber performance and void your warranty. Contact the TPS Service Dept. before attempting any changes.

Data Communications:

As an option, your chamber may include data communications with the main controller's serial port. When employed, a Data Communications manual will be included in the Supplemental Instructions Section. As a reference, the available data types are listed and briefly described below.

RS232C / RS423A: Both interfaces are compatible and use 3 wires: a single transmit wire; a single receive wire; and a common line. The maximum wire length is 50 feet. Only a single chamber may be connected to your computer. Data signals are measured as plus and minus 12 Volts to common with RS232C, and plus and minus 5 Volts to common with RS423A.

RS422A: This interface uses 5 wires: a transmit pair; a receive pair; and a common line. Up to ten chambers may be connected to your computer on a multi-drop network up to 4,000 feet long. Data signals in each pair are measured as a plus or minus 5 Volt differential.

EIA-485: This interface uses only 2 wires. Both wires are used for transmitting and receiving data, and therefore, only one device may talk at a time. Up to 10 chambers may be connected to your computer on a multi-drop network up to 4,000 feet long. Data signals are measured as a plus or minus 5 Volt differential. An EIA-485 card must be installed for signal conversion.

IEEE-488: This is a parallel multi-drop interface with several control and data lines. Each device connected must be set to a unique address. Data from other test devices may also be collected. An IEEE-488 to serial converter card must be installed. Maximum cable length is approx. 33 ft.

7.2 Conditioning Control Functions:

Temperature Control - Heating (-1 & -3 Models):

The temperature range for all -1 and -3 Models is from +10° C above ambient to +99° C. For the control of temperature, Output C1-01 of the Watlow 96 Temperature Controller **C1** is used for heat control. C1-01 is enabled as soon as the Main Power Switch is turned ON. When heating is required, C1-01 will close to energize the solid state Heater Relay 1HR. Contacts of 1HR, along with those of the High Limit Relay 1HL provide power to the heater in the conditioning section. Output C1-01 is a time proportioned PID solid state relay type that provides a temperature control tolerance of ±0.3° after stabilization.

Temperature Control - Heating & Cooling (-2 & -4 Models):

The temperature range for all -2 and -4 Models is from 0° C to +99° C. For the control of temperature, Output C1-01 of the Watlow 96 Temperature Controller **C1** is used for heat control, and a Refrigeration On/Off switch on the control panel is used for cooling. C1-01 is enabled as soon as the Main Power Switch is turned ON. When the Refrigeration Switch is turned ON, the compressor will run constantly. There is no cooling output. Please reference the Single Stage Refrigeration System section for a description of this system.

When heating the chamber to a setpoint above 37° C, the Refrigeration Switch should remain in the OFF position. Otherwise, it will take an extended period of time to reach your setpoint temperature with the refrigeration system running. For ambient temperature up to 37° C, the Refrigeration Switch can be turned ON. The heating output will now bump against the constant-running refrigeration system to attain a set temperature. Anytime you change your setpoint temperature from a high level to a lower level, the refrigeration system should be turned ON.

When heating is required, output C1-01 will close to energize the solid state Heater Relay 1HR. The contacts of 1HR, along with those of the High Limit Relay 1HL provide power to the heater in the conditioning section. Output C1-01 is a time proportioned PID solid state relay type that provides a temperature control tolerance of ±0.3° after stabilization.

8.0 TEMPERATURE ALARM and SHUTDOWN CIRCUIT

A high limit temperature shutdown circuit is provided on all models. A low limit temperature shutdown circuit is provided on -2 and -4 Models only. Both circuits sound an audible alarm when activated.

High Limit Temperature Alarm - (all Models):

Output C1-02 of the Watlow 96 Temperature Controller C1 is used as a high limit alarm output. During normal conditions, C1-02 is closed which energizes the High Limit Relay 1HL. This relay enables the heater element, and the Vapor-Flo Humidity Generator (-3 & -4 Models). When a programmed high limit setpoint is reached, output C1-02 will open to deenergize 1HL. This action removes power from the heater element, and the humidity generator (-3 & -4 Models). The High Limit Alarm light will illuminate and the audible alarm will sound.

Low Limit Temperature Alarm - (-2 & -4 Models):

Output C1-03 of the Watlow 96 Temperature Controller C1 is used as a low limit alarm output. When a programmed low limit setpoint is reached, output C1-03 will close to energize the Low Limit Control relay 1CR. Contacts of 1CR will open to deenergize and open the Refrigeration solenoid valve SV2, and the Liquid Injection solenoid valve SV3. Refrigerant flow to the cooling coil in the chamber conditioning section ceases. 1CR will also illuminate the Low Limit Alarm light and activate the audible alarm.

Alarm Silence Switch:

The audible alarm can be silenced by pressing the Alarm Silence pushbutton. The alarm silence circuitry will automatically reset when the out of limit condition returns to normal.

9.0 HEATING DESCRIPTON

Electric Incoloy sheathed heater elements are utilized for heating. The CEO910, 917, 932, and 941 series incorporate one heater element. The larger CEO958 series incorporates two elements. All heaters are mounted in the conditioning plenum. Location of the elements prevents direct heat radiation to the product. The heater ends protrude through the top of the chamber into the control panel section where the electrical connections are made. Each heater end passes through a short stainless steel alloy tube and is sealed with silicone on both ends. Retainer clips secure each heater end.

When heating is required, output C1-01 of the Watlow 96 Temperature Control C1 will close to energize Heater Relay 1HR. The contacts of 1HR along with those of the High Limit Relay 1HL, provide power to the heater element.

Please reference the Electrical Schematic for your chamber's heater bank ratings.

SHEATHED HEATER

10.0 SINGLE STAGE REFRIGERATION DESCRIPTON (-3 & -4 Models)

The basic single stage system consists of a compressor, an air-cooled condenser, an evaporator coil, and various refrigerant flow regulating devices.

Refrigerant flow is from the compressor as a hot compressed gas to the condenser. Here the refrigerant cools and condenses to liquid form and flows through various flow capacity devices to the evaporator cooling coil in the chamber conditioning section. Warm chamber air is circulated through the cooling coil and heat exchange occurs as the liquid refrigerant boils, vaporizes, and absorbs chamber heat. The vaporized refrigerant returns to the compressor through the suction line and the cycle is repeated. A Liquid Injection solenoid valve SV3 is included to inject liquid refrigerant into the suction side of the system. This action maintains a positive cool refrigerant flow to the compressor when operating at reduced capacities.

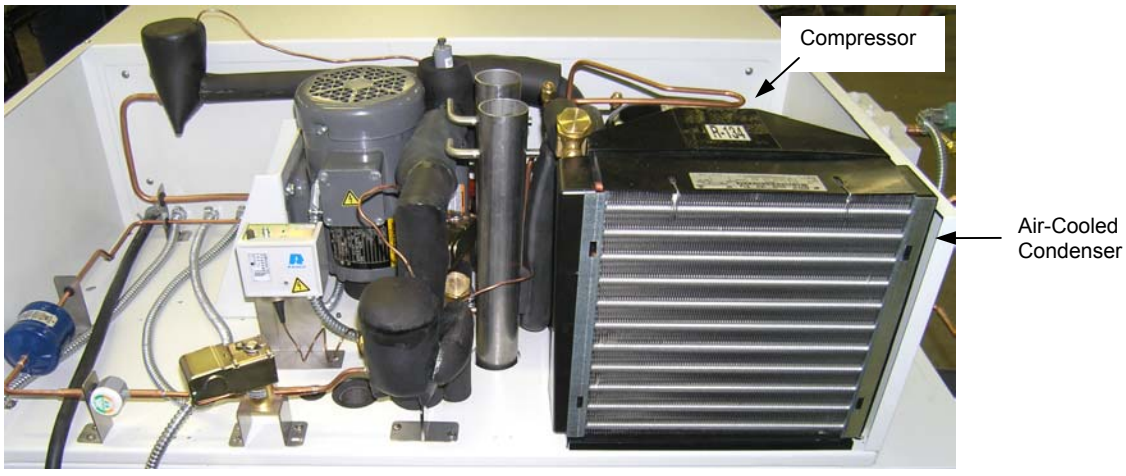
The refrigeration system is normally turned on when the chamber setpoint temperature is below 37°C, or when you wish to cool the chamber down quickly from a high setpoint. The system is energized by turning the Refrigeration Switch S3 ON. This turns on the compressor through relay **x**CR, opens the Refrigeration Valve SV2, and opens the Liquid Injection Valve SV3. The Refrigeration ON light will illuminate.

A Low Pressure Cut-out Switch PS-1 is provided in the suction line to the compressor. PS-1 will open if the compressor suction pressure falls below a preset value. Probable causes are a loss of refrigerant or restricted airflow across the evaporator.

Defrost Control:

A 24 hour digital defrost timer is provided which will **enable** the refrigeration defrost circuitry at every twelve hour interval. At this interval the timer's contacts will close for a defrost time period of ten minutes. If during this period the Defrost output C1-04 of the temperature controller closes, hot refrigerant gas will flow from the compressor, through the Hot Gas solenoid valve SV1, and to the evaporator coil. Output C1-04 closes when the temperature drops to +20° C or below for CEO9xx - 4 chambers, and to +10° C or below for CEO9xx - 2 chambers. The Defrost ON light will also illuminate. During the ten minute defrost time period, normal refrigerant flow to the evaporator coil through SV2 and SV3 will be halted, and the Refrigeration ON light will be extinguished.

The digital timer is a DIN rail type unit with a 3 digit LCD display. It is mounted in the main control enclosure. Note: Lunaire chambers manufactured before 07/2001 utilized a dial-set (mechanical) timer.



CHAMBER TOP VIEW (-2 and -4 Models)

11.0 HUMIDITY CONTROL – Watlow 96 Controller C2 (-3 & -4 Models)

Make sure the water supply is turned on to the Vapor-Flo System before operating.

Humidity conditions are controlled by a microprocessor based Watlow 96 Controller **C2**. The Watlow 96 is a 1/16 DIN controller, which incorporates the following features.

11.1 Controller Features

The Watlow 96 is a powerful 1/16 DIN controller, which incorporates the following features.

- Single Channel
- Non-Profiling
- Automatic & Manual Control
- 1 Universal Input: Dry Capacitance Type Humidity Sensor is used
- 1 Auxiliary Input: DC Process, 4-20 ma Process, or Digital Event Input
- 2 Control Outputs: Time Proportioned, On/Off, or 4-20 ma Control (Output 2 may be an alarm)
- 1 to 3 Alarm Outputs: Optional for Outputs 2 - 4
- 1 Retransmit Output: Optional for Output 4
- Communications: Optional for Output 4, Serial w/ Modbus RTU

Controller Keys and Displays:

The front panel of the Watlow 96 is provided with user-friendly features that aid in monitoring and setup. The upper display indicates actual process values, while the lower display indicates setpoint value. Output LEDs No.'s 1, 2, 3, & 4 will light when the corresponding controller output is energized. The auto/manual mode (%) indicator light will illuminate when operating in the manual mode, and will be off when operating in the auto mode. The Advance Key advances the lower display through the configuration parameters. The Infinity / Home Key returns to the Home Page, and resets a latching alarm or a latching input sensor error. The Up and Down arrow keys raise or lower both of the display values.

Data Communications - Optional:

Output No. 4 is used for this option. Data communications utilizes EIA-232 and EIA-485 serial interface with Modbus RTU protocol. Modbus RTU enables a computer or PLC to read and write directly to registers containing the controller's parameters. Both data interface types are briefly described below. Refer to the main controller manual for details.

RS232C / RS423A: Both interfaces are compatible and use 3 wires: a single transmit wire; a single receive wire; and a common line. The maximum wire length is 50 feet. Only a single chamber may be connected to your computer. Data signals are measured as plus and minus 12 volts to common with RS232C, and plus and minus 5 volts to common with RS423A.

EIA-485: This interface uses only 2 wires. Both wires are used for transmitting and receiving data, and therefore, only one device may talk at a time. Up to 10 chambers may be connected to your computer on a multi-drop network up to 4,000 feet long. Data signals are measured as a plus or minus 5 volt differential.

Controller Configuration:

The pre-programmed controller configuration for your chamber is documented in the Test Report, which is located in the Supplemental Instructions Section. Refer to the controller manual for programming details.

Important! The configuration set-up is mainly provided for your reference. Not all of the parameters shown apply to your chamber. Changes to some of the set-up parameters may drastically affect your chamber performance and void your warranty. Contact the TPS Service Dept. before attempting any changes.

11.2 Conditioning Control Functions

Humidity Control (-3 & -4 Models):

For -3 Models, humidity levels range from above ambient to 96% RH. For -4 Models, humidity levels range from 20% to 96% RH. Control tolerance is ±2% RH after stabilization. Extended dehumidification levels can be achieved with the optional dry air system.

The Humidity Switch must be turned ON to enable the humidity circuitry. When humidification is required, the time proportioned output C2-01 of the controller will energize solid state relay 2HR, which provides power to the Vapor-Flo Humidity Generator.

12.0 HUMIDITY SYSTEM (-3 & -4 Models)

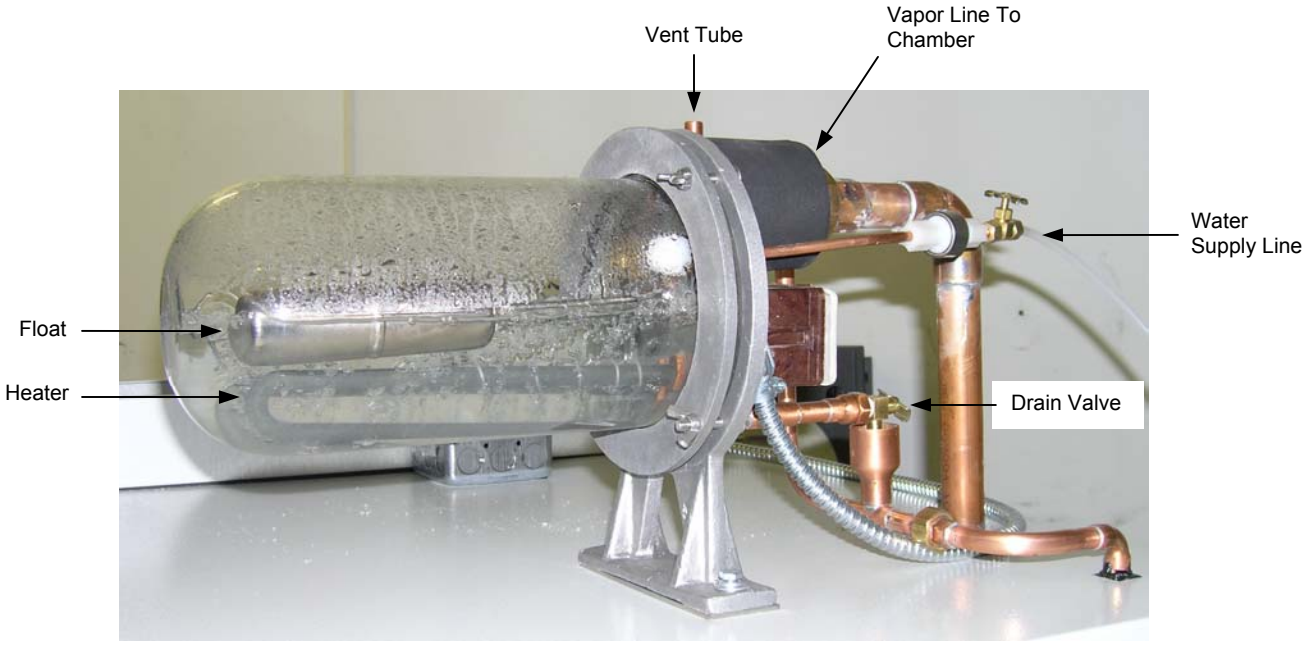
Make sure the water supply is turned on to the Vapor-Flo System before operating.

12.1 System Overview

Vapor-Flo Humidity Generators are used to generate water vapor for the humidification of test chambers. Vapor is produced by heating water with an electric immersion heater in an enclosed glass bell jar assembly. Power to the heater is time proportioned by the controller output. The build-up of vapor pressure in the bell jar causes a natural migration of vapor from the vapor port to the chamber conditioning plenum through copper or stainless steel tubing. Vapor enters the conditioning plenum through a port on the discharge side of the fan blade or blower wheel, and mixes in smoothly with the circulating air stream.

The system is very responsive, but not overpowering as you may have with a steam injection type system. An overpressure condition within the belljar can not occur because the vapor port acts like a vent port. Another important feature of the Vapor-Flo is its ability to increase chamber humidity levels with minimum effect on dry bulb temperature. This is important in small chamber designs with limited cooling capacity. Vapor generating capacities vary from 0.9 lbs./hr. (at 300 W, 115 V), to 9.0 lbs./hr. (at 3,000 W, 220 V), depending on the model used.

Note: Your equipment configuration may be slightly different from what is shown in the photo below.



VIEW DURING OPERATION

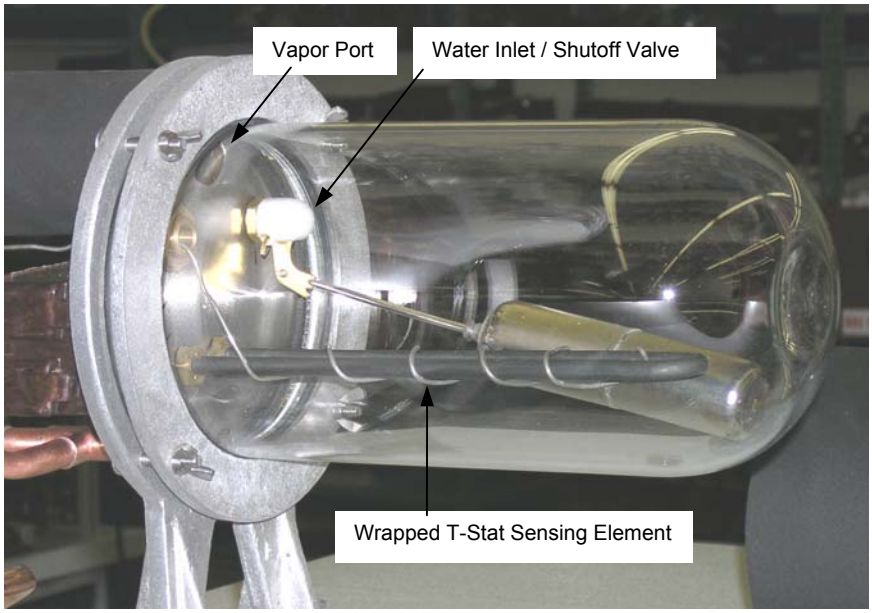
Water Supply: The water supply should be 30-40 PSIG maximum. The connection is made to either the Utility Connection Panel (1/4" MPT), or directly to the Water Pressure Regulator WPR (1/4" MPT). The regulator is adjusted at the factory for optimal performance, which is normally between 10 and 20 PSIG at the input gauge.

12.2 Design / Operational Features

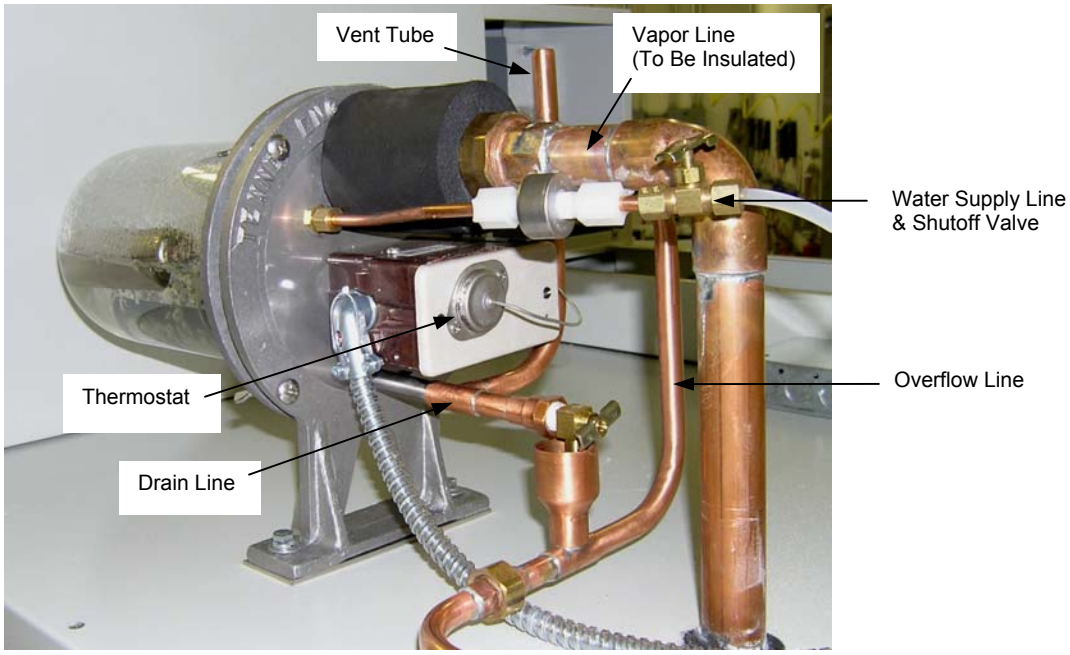
The bell jar is filled with either demineralized or single distilled water through the water inlet port. Water level is accurately controlled by a float that is connected to a shut-off valve at the water inlet port through an extension arm. The water level is kept to a minimum, about one inch above the immersion heater. This permits the water to be rapidly heated or cooled as power is cycled to the heater. There is very little system lag. A thick black insulating sleeve covers the length of the bell jar. The sleeve is removable for inspection and cleaning purposes.

An Overflow Line extends upward from the Drain Line to a point above the normal water operating level, but below the vapor port. This design prevents excess water from draining into the chamber should the float valve fail. A Vent Line extends up from the Overflow Line, which prevents a vapor-lock condition.

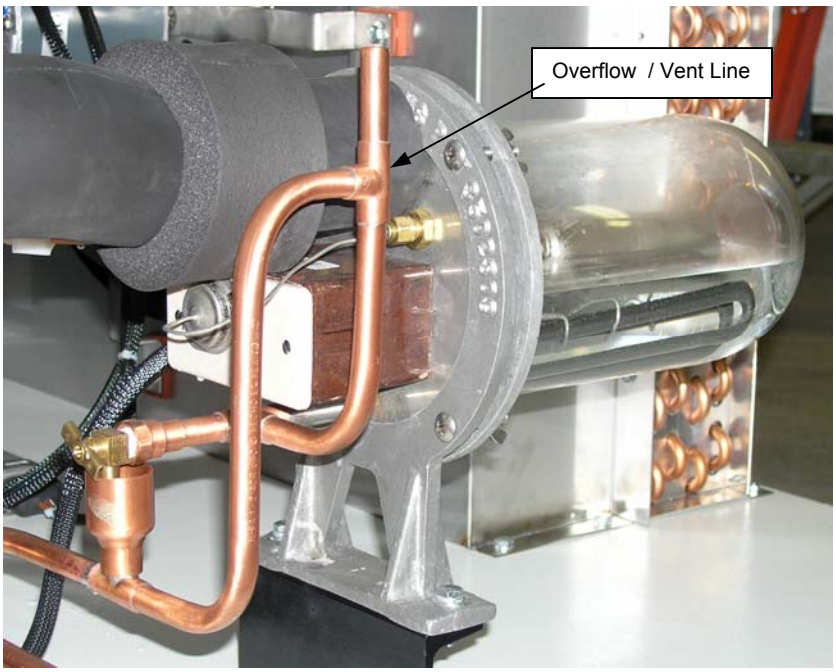
The immersion heater is protected from an overheat condition that could occur from a water supply failure by an automatic reset thermostat TS. The thermostat employs a temperature sensing element that is wrapped around the length of the immersion heater. TS contacts will open to remove power to the heater when the heater temperature rises above 168° C (334° F). The fail-safe design of the thermostat also removes power to the heater should the thermostat itself fail.



VAPOR & WATER PORTS, T-STAT ELEMENT



VAPOR-FLO REAR LEFT VIEW



VAPOR-FLO REAR RIGHT VIEW

Note: Your equipment configuration may be slightly different from what is shown.

12.3 Vapor Generating Capacity

Approximate vapor generating capacity of various models is given in the table below. This is a general guide. Please remember that the data is approximate. Variable factors such as line voltage, incoming water temperature, back pressure, and condition of the immersion heater will affect the output.

VAPOR GENERATING CAPACITY		
Heater		Maximum Output
300 Watt	115 Volt	0.9 Lbs. / Hr.
750 Watt	220 Volt	2.2 Lbs. / Hr.
1,000 Watt	220 Volt	3.0 Lbs. / Hr.
1,500 Watt	220 Volt	4.5 Lbs. / Hr.
2,000 Watt	220 Volt	6.0 Lbs. / Hr.
3,000 Watt	220 Volt	9.0 Lbs. / Hr.

12.4 Humidity Control

Power to the electric immersion heater is time proportioned by the controller output. This output may be derived directly from a dedicated Humidity Controller, or from Channel 2 of a Temperature / Humidity Controller. (PLCs normally use a 4-20 ma control output signal, which may be converted to time proportioned control.) For standard Lunaire Model CEO chambers, the controller output will energize a solid state relay, which closes and provides power to the immersion heater. For Tenney chambers with a 3.0 KW or less immersion heater and a 240 VAC control circuit, the controller output will trigger a triac to conduct and supply power to the heater.

For Tenney chambers with an immersion heater greater than 3.0 KW, or a 120 VAC control circuit, the controller output will trigger a Watlow Din-a-mite SCR Power Controller to supply power to the immersion heater. The Din-a-mite incorporates a back-to-back SCR design with a fixed time base burst firing technique. Burst firing provides short bursts of alternating current to the immersion heater. This results in very short temperature swings of the heater element, which greatly extends its life. The load current is very smooth and temperature control is precise. Electrical noise is practically eliminated by the zero-cross switching of the SCRs.

12.5 Humidity Sensor

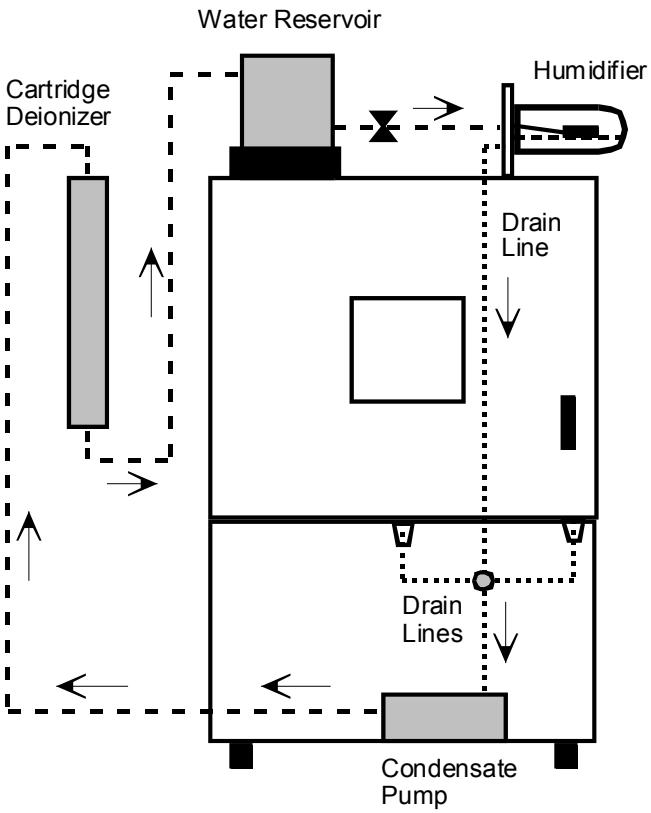
A dry capacitance type humidity sensor is used to measure chamber relative humidity. The sensor is mounted in the head of a stainless steel probe that is 8.5” long, 0.5” diameter, and is protected by a sintered filter. The probe is mounted in the downstream air of the conditioning section.

In response to humidity levels, the sensor modifies a signal from the humidity transmitter circuit board. This signal is converted by the transmitter to a 0 to 5 Volt DC signal, representing 0 to 100 percent relative humidity, and is sent to the humidity controller / channel. The humidity transmitter is powered by a small 15 Volt AC transformer.

HUMIDITY SENSOR

HUMIDITY TRANSMITTER

12.6 Optional Equipment with Water Flow Diagram



HUMIDITY SYSTEM WATER FLOW DIAGRAM

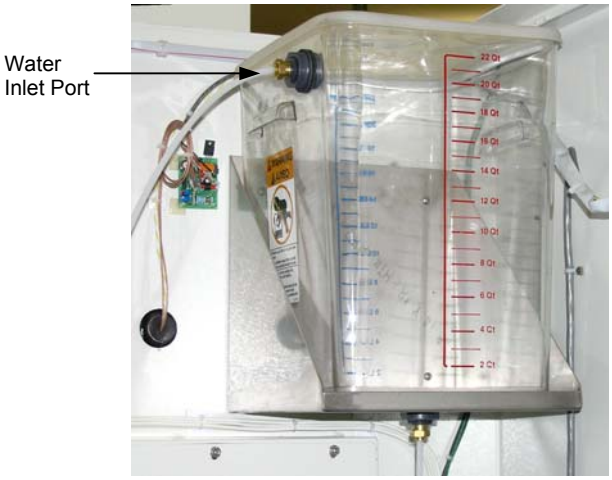
NOTE: Optional Cartridge Deionizer, Water Reservoir, and Condensate Pump Are Shown

IMPORTANT!
This drawing is for reference only. Your equipment layout may be different. All components may not be employed.

Water Reservoir:

A five gallon water reservoir may be used in place of a fixed water supply line. The gravity feed reservoir is mounted either on the top or side of the chamber. Water level in the reservoir must be maintained to just below the top hose inlet port (when provided). When operating with high humidity conditions, you may have to fill the reservoir daily. We recommend that the optional condensate pump be used with the reservoir to conserve water. Two different reservoir models are shown below. The inlet port has a ¼" compression fitting.

5 GALLON WATER RESERVOIR - ROUND



5 GALLON WATER RESERVOIR - SQUARE

Cartridge Ion Exchanger:

Ion exchangers (deionizers) should be installed in the water supply line to the humidity generator when the resistivity of your water supply is less than 50,000 Ohms/cm (20 Microsiemens/cm). Most city water supplies have a resistivity that ranges from 2,000 to 20,000 Ohms/cm (500 to 50 Microsiemens/cm). The use of water with these resistivity levels would result in encrustation of the generator's immersion heater, housing, and float assembly, and cause system failure.

Note: A prefilter may be necessary to remove an excess of suspended particles. Please refer to all water quality warnings in section (5.0).

Universal Model II Cartridge Ion Exchanger:

This unit produces an effluent with a resistivity between 50,000 and 100,000 Ohm/cm (20 to 10 Microsiemens/cm), which is equivalent to an ion concentration level obtainable by single distillation. It has a maximum capacity of 1600 grains as $CaCO_3$, at a flow of 7.2 gallons per hour. Essentially all ionizable constituents are removed with the exception of silica and free carbon dioxide.

The resin in a newly installed Model Universal II Cartridge consists of white and purple spherical shaped beads. Discoloration of the resin will occur from the top down with the resin changing to an amber color.

Important! When discoloration of the cartridge media reaches the line indicated on the cartridge (approx. 2¼" from the bottom), you must replace the cartridge. The amount of time it takes for complete exhaustion of the cartridge depends on your water resistivity and the amount of use. Typically, the cartridge should last between four and eight weeks. **However, check it weekly.** Replacement cartridges can be obtained from the TPS Parts Department.

Cartridge Deionizer

Condensate Pump:

A condensate pump may be used to pump water condensation from the chamber drain port to either a drain located away from the chamber, or back to the optional water reservoir. The pump will automatically turn on and off in response to an integral float switch. A grounded power supply cord is provided with the unit.

For Lunaire Model CEO Chambers: Place the pump underneath the drain port at the rear of the chamber to catch dripping water. Thirty feet of 1/4" PVC tubing with a 3/8" MPT X 1/4"COMP connector is provided for your pump outlet connection.

Condensate Pump

13.0 PHOTOSTABILITY TEST SYSTEM

13.1 System Overview

The photostability test feature permits photostability testing to the standards of the International Conference on Harmonization ICH. This feature is designed with interchangeable fluorescent light systems that may include Daylight lamps for Full Spectrum - Artificial Daylight stability testing, and Ultraviolet-A lamps for Near Ultraviolet stability testing.

Lunaire Model CEO910 photostability chambers employ one light bank, while the larger Model CEO932 series can employ two. Hinged reflective cover panels on the front of each bank allow chamber door openings without disruption of light testing.

Photostability testing can be combined with diverse environmental conditioning. This includes heating, cooling, and humidity conditioning in various configurations. The airflow management system consists of a horizontal airflow type that provides maximum temperature uniformity. Conditioning and air circulation systems are fully described in the corresponding sections.

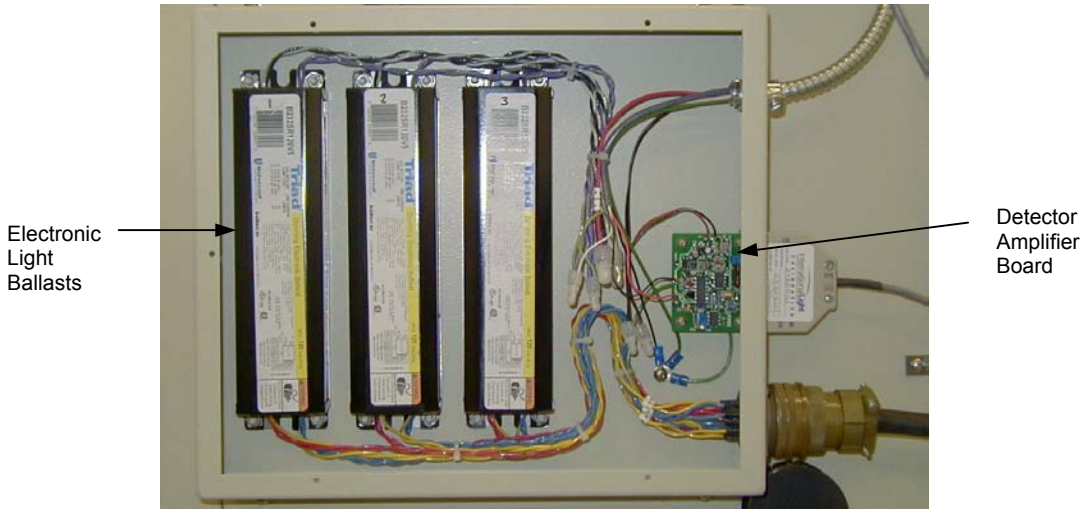
CEO932 Photostability Test Chamber

CEO932 Photostability Test Chamber - Cover Panels Removed

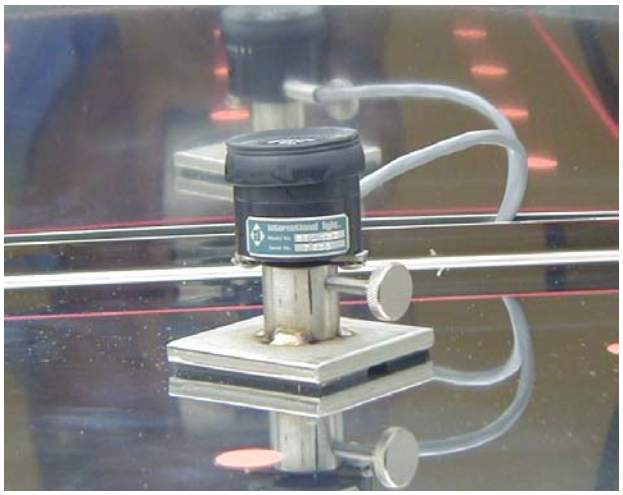
13.2 Light Control System:

The flexibility of the light control system is built around the use of a Watlow 96 Controller and a Detector Amplifier. This system can be configured to control each of the two different types of lamp systems.

The Detector Amplifier is a current-to-voltage converter / amplifier that is compatible with all International Light, Inc. SEL type detectors. It can be easily calibrated against a standard detector or light level in the field or laboratory. Light intensity measured by the detector is sent as a current signal to the Detector Amplifier, which amplifies it and converts it to a 0-5 VDC signal. The Watlow 96 (configured as a UV Controller, or a Daylight Controller) processes this signal and displays actual light intensity in the corresponding units. Light intensity is controlled with a 0-10 VDC output from the controller to the electronic dimming ballasts. Setpoint and actual light intensity are simultaneously displayed on the controller. Each light system is equipped with an On/Off switch and an ON indicating light.



Light Ballast Enclosure



SEL Light Detector

W96 Light Controllers

13.3 Light Bank Types

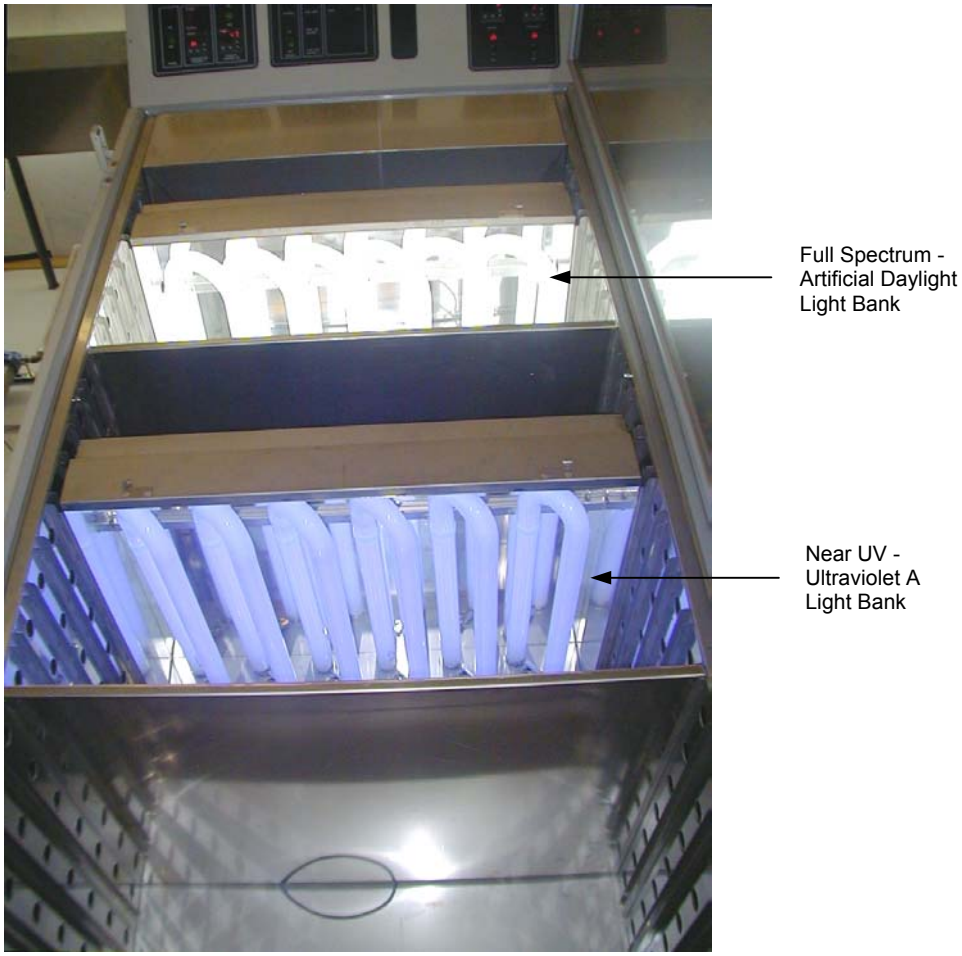
Full Spectrum - Artificial Daylight:

Fluorescent Daylight Lamp Type FB40DX/6, (Type 12), with light source at 400 - 700 nm
Ballast Model RZT-2S32
Light Intensity Range: 300 to 800 footcandles
Light Detector: International Light Model SEL033/Y/W

Near UV - Ultraviolet A:

UVA Source Blacklight Lamp Type F40BL/U/3, with light source at 300 - 400 nm
Ballast Model RZT-2S32
Light Intensity Range: 7 to 19 W/m^2
Light Detector: International Light Model SEL033/UVA/W

Lamp Replacement - Important! After replacing a lamp and before attempting any dimming control, the lamp must be burned-in at 100% output for a minimum of 100 hours.



CEO932 - Bottom View of Light Banks

13.4 Light Bank & Detector Installation Procedures

13.4.1 Model CEO932 Light Bank Types & Locations

Note: Your chamber may only be equipped with the Full Spectrum - Artificial Daylight Unit.

Full Spectrum - Artificial Daylight Unit: This light bank is the top mounted unit and must slide into shelf slot No. 17, as counted up from the bottom of the chamber. The product tray must go into shelf slot No. 13.

Near UV - Ultraviolet A Unit: This light bank is the bottom mounted unit and must slide into shelf slot No. 9, as counted up from the bottom of the chamber. The product tray must go into shelf slot No. 5.

For both light bank types and locations, uniformity validation is performed with the product tray twelve inches from the bottom of the light bank assembly.

13.4.2 Model CEO910 Light Bank Types & Location

Full Spectrum, or Near UV Units: For Model CEO910 chambers the light bank must slide into shelf slot No. 4, which is the middle shelf slot. The product tray should be placed into the bottom slot.

For both light bank types, uniformity validation is performed with the product tray twelve inches from the bottom of the light bank assembly.

13.4.3 Installation:

Important! Installation of a light bank must be done by two people. Extreme care must be taken in each of the steps described below. Read the entire procedure before attempting the removal.

1. Install the product tray into the proper slot about three fourths of the way in.

2. **Make sure you have the correct light detector that is designated for the lamp you are installing!** Place the light detector on the product tray.Insert the detector connector and cord through the 2½" rear port from the inside of the chamber. Leave ample cord inside the chamber for final positioning of the detector.

3. For installation of the light bank, the unit should ideally be **placed on a cart with an outside dimension larger than that of the light bank.** Move the cart within two feet of the chamber opening. Insert the light bank power cord and plug through the 2½" rear port from inside the chamber. With a person on each side of the light bank, gently slide the unit into the chamber about two thirds of the way. One person must go to the rear of the chamber and pull the light bank power cord through the rear port until no slack remains. At this time the other person can push the light bank the rest of the way into the chamber. The cord should be pulled the rest of the way through the rear port. Connect the Amphenol connector to the corresponding socket on the ballast box.

4. Finnish pulling the detector cord through the rear port by the amount necessary that will allow proper placement of the detector on the product tray. Connect the detector connector to the corresponding socket on the ballast box.

Important Note: Uniformity testing with each light bank type provided is done with the sensor at its lowest height. Increased sensor height will affect uniformity.

Continued on next page!

5. Install the split port plug.

6. Remove the light bank transport protector plate by sliding it out from the bottom of the light bank.

7. Install the front hinged reflective cover panel to the light bank assembly.

Important! Never operate the chamber with the light bank transport protector plate installed into the bottom slot of the light bank. This plate is only provided for protection of the lamps when removing and installing the light bank.

Note: For full operating instructions on the Watlow 96 Controller, please refer to the Watlow 96 User's Manual located in the Supplemental Instructions Section.

13.5 Light Bank & Detector Removal Procedure

Important! Removal of a light bank must be done by two people. Extreme care must be taken in each of the steps described below. Please read the entire procedure before attempting the removal.

1. Remove all power from the chamber.

2. Remove all test products from the product tray.

3. Disconnect the light bank power cord / plug from the ballast box at the rear of the chamber by unplugging the round Amphenol connector. Let it hang for the moment.

4. Disconnect the detector cord / plug from the ballast box at the rear of the chamber by unplugging the rectangular connector. Let it hang for the moment.

5. Remove the split port plug at rear of chamber.

6. Remove the front hinged reflective cover panel from the light bank.

7. Install the light bank transport protector plate (provided) into the bottom slot of the light bank assembly by sliding it in. This plate protects the exposed lamps when the light banks are taken out of the chamber. **It must by used whenever the light banks are removed!**

8. With one person on either side of the chamber door opening, gently slide out the light bank about a third of the way. At this point have one person pull the light bank power cord and Amphenol connector through the 2½" rear port. Lay the cord and connector on top of the light bank. With one person on either side of the light bank, slide the unit out of the chamber the rest of the way, and **place it on a flat sturdy surface larger than the outside dimension of the light bank assembly.**

9. Pull the detector cord and plug through the 2½" rear port to the inside of the chamber and remove with detector.

10. Slide out product tray.

14.0 HUMIDITY ALARM CIRCUITS (Optional for -3 & -4 Models)

As an option, outputs from the Watlow 96 Humidity Controller C2 may be used as high and low humidity alarm outputs. Output C2-03 will close and energize the High Humidity Alarm Relay 8CR when the programmed high limit humidity level is reached. Output C2-04 will close and energize the Low Humidity Alarm Relay 9CR when the programmed low limit humidity level is reached. Corresponding Low Humidity and High Humidity lights will illuminate and an audio alarm will sound.

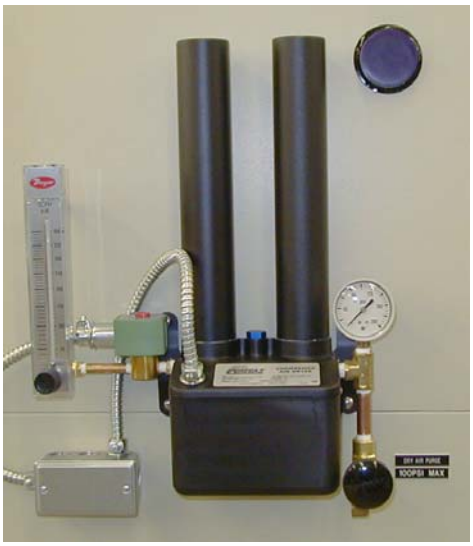
When either the high or low limit alarm circuit triggers the audio alarm, the audio alarm can be silenced by pressing the Alarm Silence pushbutton. The Alarm Silence circuitry will automatically reset when the out of limit condition returns to normal.

15.0 DRY AIR SYSTEM FOR DEHUMIDIFICATION (Optional for -3 & -4 Models)

Note: Refer to the Installation Instructions Section for supply and connection type specifications.

As an option, your chamber may be equipped with a dry air system, which permits dehumidification to dew point levels below those attainable with a refrigerated dehumidification coil. The system uses a heatless desiccant dryer that is operated by a compressed air supply to generate the dry air. This system is described below.

The dryer is a twin tower heatless desiccant type that is self-regenerating. Each desiccant tower (chamber) contains a compression packed molecular sieve. As the compressed air passes through the sieve, moisture is picked up by the desiccant. The dried air is released through an outlet port and injected into the test chamber's conditioning airflow through solenoid valve SV4. A small portion of the dried air is passed through a sized orifice to the other tower to purge the desiccant of moisture collected during the previous cycle. There are four distinct phases of the heatless dryer where the compressed air is alternately cycled and dried in each of the two desiccant towers. Integral timers and solenoid valves within the dryer control this operation.



Heatless Desiccant Dryer

Operation:

The Dehumidify Switch S6 must be closed to energize the air dryer and to enable the controller dehumidification output. During operation, the time-proportioned output C2-02 of the Watlow 96 Controller will energize and open the Dehumidify solenoid valve SV4 to permit the injection of dry air into the chamber. The Dehumidify ON light will also illuminate.

Note: Your equipment configuration may be slightly different from what is shown.

16.0 CHART RECORDER (Optional for all models)

As an option, your chamber may be provided with either a circular or strip type chart recorder to record temperature versus time. This recorder is typically a one pen type which also digitally displays the process value. A 100 ohm Platinum RTD sensor is used for temperature measurement. The sensor is normally placed in the right side duct wall.

The recorder configuration is documented in the Test Report, which is located in the Supplemental Instructions Section. For complete details on the operation of the recorder, please reference the recorder's user's manual, which is located in the same section.

17.0 SEQUENCE OF OPERATION

IMPORTANT! Make sure the Installation Instructions have been properly followed before operating the chamber. Make sure all external switches are in the OFF position before performing the sequence below.

IMPORTANT! **With the light banks installed, you can only operate the chamber in the following conditions.**

Temperature Range: +20° C to +35° C, with a Humidity Level Less than 50% RH

1. Turn on the power source to the chamber and close the Main Power Switch. The display of the main controller(s) and the Main Power On light should be illuminated. The circulation blower(s) should be running.

2. Load product and make sure the chamber door is securely closed.

3. For **heating control**, enter the desired temperature setpoint into the Temperature Controller C1. Enter your high limit and low limit (-2 & -4 Models) alarm setpoints into C1.

4. For **cooling control** with all -2 and -4 Models, close the Refrigeration Switch when your temperature setpoint is below 37° C, or when pulling the chamber temperature down from a high level.

   The Refrigeration ON light should illuminate. If this light does not illuminate, the cooling system is in the defrost cycle. Cooling will resume when the defrost cycle ends.

5. For **humidity control** with the -3 and -4 Models, close the Humidity Switch and enter the desired humidity setpoint into the Humidity Controller C2. If your chamber employs the Humidity Alarm option, enter your high limit and low limit alarm setpoints into C2.

6. **Photostability Feature:** To enable each Photostability Test System provided, close the appropriate Light Switch on the control panel. Enter the light intensity setpoint into the Watlow 96 Photostability Controller.

7. If your chamber includes any options, please reference the appropriate “Optional” section for further details.

Important Note! For **complete** programming and/or operating instructions on any of the controllers, electrical / mechanical components, or optional equipment, you must refer to their operating manuals included with your Lunaire Environmental manual.

CONTROL PANEL

18.0 PREVENTATIVE MAINTENANCE

Only qualified service personnel should ever be permitted to perform any service related procedure on this chamber!

Disconnect and Lock-Out / Tag-Out all electrical power from the facility at its source before servicing or cleaning.

Frequency of preventive maintenance procedures depends upon how the facility is used and upon other circumstances. Because of this, a hard and fast schedule of maintenance operations is difficult to present. Indeed, an inflexible schedule might be suitable for one user, but completely inadequate for another. Therefore, we have provided periodic figures when to perform maintenance procedures, based on the average chamber use.

We suggest that you maintain a preventive maintenance log. In this log you will record operating notes, pressures, temperatures, and electric readings. The log is valuable because it will help maintenance and service people by documenting long term trends and by showing parameter levels when the chamber is operating properly.

Since the refrigeration system is sealed and the instruments are solid state, little maintenance is required on the temperature chamber. However, the following preventive maintenance steps are suggested.

18.1 Maintenance Checks / Procedures

All interlocks and safety features should be tested periodically for proper operation.

Door Gaskets:

Inspect the door gaskets for wear (cracks, tears, etc.). Replace gasket if significant wear is evident.
Inspection Period: 30 Days

Door Sealing Quality:

Check that the door seals evenly around its perimeter to negate thermal loss. Adjust door latch if necessary.
Inspection Period: 30 Days

Air-Cooled Condenser Coil / Fan:

 Remove All Power From Chamber!

Inspect the condenser coil for dust or dirt accumulation that would impede the flow of air (-2 and -4 Models). A dirty condenser will decrease system efficiency and drive up compressor head pressure, causing it to trip out. If necessary, clean with a brush or vacuum cleaner. Frequency of cleaning depends upon the air quality at the chamber. The condenser fan should also be checked for cleanliness. Make sure the fan spins freely.
Inspection Period: 30 Days

Conditioner Blower Wheel:

 Remove All Power From Chamber!

Inspect and clean the conditioner fan in the conditioning plenum. Make sure the fan spins freely and that it is tight on its shaft.
Inspection Period: 6 Months

Evaporator Cooling Coil:

 Remove All Power From Chamber!

Clean the evaporator cooling coil in the conditioning plenum.
Inspection Period: 6 Months

General Electrical Connections:

 Remove All Power From Chamber!

Inspect inside the control panel and the machinery compartment for loose electrical connections, frayed wires, loose components, or other potential problems.
Inspection Period: 6 Months

Electric Heater(s):

 Remove All Power From Chamber!

Inspect the electric heater(s) inside the chamber conditioning plenum and look for defects.
Inspection Period: 6 Months

Electrical Supply Voltage:

Measure the power supply voltage to your oven and verify that it is within the ±10% tolerance established for the nameplate rating of your oven.
Inspection Period: 6 Months

Controller Calibration:

The main temperature and high limit controllers should be checked for temperature indicating accuracy, and for the proper activation of limit or alarm outputs. Please reference the controller user manual for more information.
Inspection Period: 1 Year

Cleaning The Unit:

 Remove All Power From Chamber!

We recommend cleaning with soap and water or alcohol. After cleaning, a laboratory disinfectant should be used to finish. Removal of shelves, and side panels is typical.

Plenum (Conditioning Section): When all the shelves have been removed, the plenum may be taken out. First extract the three screws in front of and just below the gasket. Then disconnect the plenum drain hose (if provided). Finish this step by sliding the plenum toward the front of the unit until it is completely out.

Side Panels: The side panels are held in place by four stainless steel nuts. To remove the panels, remove the four nuts on each side panel. Swing the bottom of panels toward the center of the unit and remove.

Important Note: For **complete** preventative maintenance instructions or equipment maintenance instructions on any of the instruments, electrical or mechanical components, or electrical / mechanical machinery and motors, you must refer to their operating manuals included with your Tenney, or Lunaire Environmental manual. The smaller manuals and vendor cut-sheets are located in the Supplemental Instructions Section. Any large manuals that could not fit into this 3-ring blue binder are sent alongside of it.

Notes:

- The refrigeration system is permanently sealed and a periodic oil change is NOT required.
- If a loss of cooling performance is noted, immediately check the condenser for restricted air flow.
- All motors are permanently lubricated; therefore, greasing or oiling is not required.

18.2 Vapor-Flo Humidifier Maintenance & Troubleshooting

Only qualified service personnel should ever be permitted to perform any service related procedure on this chamber!

Maintenance:

- Pull back the bell jar insulation and inspect the float, heater and jar. When they appear encrusted with salts and scale, clean the assembly (described below). **Inspection Period: Every 2 weeks**
- Drain the bell jar assembly completely to remove any concentrated impurities. This is achieved by opening the drain valve at the rear of the Vapo-Flo. **Inspection Period: Every 2 to 4 weeks**

Cleaning:

Disconnect all power from the chamber. Shut off the water supply. Drain the bell jar. Remove the bell jar as described below and gently wipe the inside of the glass with a mild cleaner. Carefully clean any water deposits from the heater assembly. Rinse the glass thoroughly and replace as described below.

Removing the Bell Jar:

Remove the Armaflex insulating sleeve by sliding it over the end of the bell jar. Spin off the four wing nuts - **top one last**. Slip off the outer ring flange and then remove the glass jar. The immersion heater, thermostat element, float, and float valve are now exposed. Usually, the bell jar flange will adhere to the humidifier bracket. **LOOSEN IT GENTLY.** Prying with a screwdriver may chip or break the glass.

Reassembling the Bell Jar:

When reassembling, smear a thin coat of silicone grease on the bell jar's ground flange to prevent its sticking to the gasket. Tighten the four wing nuts finger tight only: Do not use pliers.

Trouble Shooting:

Generator will not deliver vapor: Make sure the water level in the bell jar is approximately 1” above the immersion heater. Measure voltage on immersion heater. Heater terminals can be accessed in the electrical box on the rear of the Vapor-Flo.

Immersion heater cycles on and off: This is usually an indication of low water level. Be sure water supply is adequate. Clean the water inlet valve and washer of contamination. Flush and clean the bell jar. Finally, adjust the float so that water level is about 1" above the immersion heater. You may have to bend the float arm slightly. Careful! Do not damage the float. If the element still cycles, replace the thermostat assembly. Wind the sensing element on the immersion heater approximately as the original was wound.

Water continually runs or dribbles from over-flow: The float valve is leaking. Shut off water. Remove the bell jar insulating sleeve and bell jar. Remove and disassemble the float valve. Shake the float. If it is water-logged, replace it. Clean the valve and reassemble. If the valve still leaks after cleaning, replace the Viton seal.

Humidifier operates but vapor volume is low: Examine the humidity feed line and remove any obstruction. Thoroughly clean the immersion heater. Be sure the water level is approximately 1" above the immersion heater.

Check the optional reservoir water level, which should be just below the top inlet port. The Viton seal may need replaced if the water level is too far above this level.

Measure the immersion heater's resistance. Unusually high resistance would indicate lack of heating power. With the Vapor-Flo unit operating, measure voltage at the immersion heater terminals. The voltage should be no lower than 10% below nominal. (Chief cause of low immersion heater voltage is an inadequate power cord.)

Immersion Heater Resistance:

The Heater Resistance Table is provided to identify shorted or open elements and to identify heater size. Resistance values are those at 75 degrees Fahrenheit and may vary by 15% or more without falling out of tolerance. Heater terminals can be accessed in the electrical box on the rear of the Vapor-Flo.

Important! The Vapor-Flo Generator should be drained before checking heater resistance. This prevents erroneous readings that may occur from a shorted element.

HEATER RESISTANCE		
Heater		NOMINAL RESISTANCE
300 Watt	115 Volt	43 Ohm
750 Watt	220 Volt	63 Ohm
1,000 Watt	220 Volt	47 Ohm
1,500 Watt	220 Volt	31 Ohm
2,000 Watt	220 Volt	24 Ohm
3,000 Watt	220 Volt	16 Ohm

Spare Parts:

Complete spare parts are available from the TPS Service Department. When you order, please specify the model and serial number of the equipment served by your Vapor-Flo Humidity Generator.

18.3 Preventative Maintenance Schedule / Log

Important: For each of the items to be inspected, refer to item description sections for details on maintenance and service.

PREVENTATIVE MAINTENANCE SCHEDULE / LOG					
ITEM TO BE INSPECTED	**Inspection Period**	**Actual Date Inspected / Serviced**	**Actual Date Inspected / Serviced**	**Actual Date Inspected / Serviced**	**Actual Date Inspected / Serviced**
Door Gaskets	30 Days				
Door Sealing Quality	30 Days				
Condenser Coil / Fan	30 Days				
Conditioner Blower Wheel	6 Months				
Evaporator Cooling Coil	6 Months				
General Electrical Connections	6 Months				
Electric Heaters	6 Months				
Electrical Supply Voltage	6 Months				
Main Temperature Controller Calibration	1 Year				
Vapor-Flo Bell Jar	2 Weeks				
Drain Vapor-Flo Bell Jar	2 to 4 Weeks				

SUPPLEMENTAL INSTRUCTIONS