Environmental Test Chambers

Frequently Asked & Often Forgotten Questions

Mary Babitz
Cascade TEK

Hil Sybesma
Lunaire Limited

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www.cascadetek.com
Cascade TEK, Inc. 1800 NE 25th Ave #18 Hillsboro OR 97124
503-648-1818 / info@cascadetek.com

Environmental Test Chambers

Frequently Asked & Often Forgotten Questions

Here's a compilation of answers to questions you should, but may never think to consider when selecting an environmental test chamber.

This document is NOT structured to any one specific type of chamber or manufacturer. My goal is to provide **basic information** you need to make an informed decision and save you time along the way. I've included my **opinion & tips** in a few of the sections – based on experiences through the years. My opinions & tips may or may not apply to your specific application.

Special Thanks to Hil Sybesma and CSZ for their input.

I hope you find this information helpful. Contact me should you have any further questions.

Mary Babitz

Mary Babitz
Cascade TEK
206-686-2178
mary@cascadetek.com

HUMIDITY CHAMBERS

Humidity chambers require a filtered water source in order to generate humidity. You will need to provide water and a drain for the chamber. Depending on your facility, your chamber can be configured a few different ways to provide water to and a drain from the chamber.

What is the best option to supply water to your humidity system?

There are a few optional configurations available to supply water to the chamber's humidity system. Without specifying them, your chamber will generally arrive with a compression fitting for water inlet and an outlet drain tube.

Mary's Opinion: The best option is to directly plumb water to the chamber's humidity system. It maintains a consistent pressure feed to the system and once set up – is low maintenance.

What Type Of Water Should Be Used?

Most humidity chambers require demineralized or single distilled water. Do not use double or triple distilled water. RO water, single stage, is acceptable also. If you were to measure the specific resistance of the water being used, it should measure between 0.5 and 2.0 Megohm. If the water resistance is above 2.0 Megohms, corrosion of the immersion heater's copper sheath will occur and possible etching of chamber windows.

If tap water is the only source of water you have available, make sure it is fed through a demineralizer or deionizer cartridge before it is introduced to the chamber humidity system. "DI Cartridges" or "DI Filters" are sold as options.

Should you experience high levels of particulates in your local water system, consider the use of a prefilter.

REMEMBER: * Do not use Double or Triple Distilled Water! Do not supply demineralized, Deionized, Double or Triple Distilled water through a demineralizer/deionizer cartridge!

One last note, "deionization" and "demineralization" are identical processes. They are defined as a process used to remove the ions of dissolved salts from water.

What Water Pressure Is Required?

In general the water supply should be in the range from 10 to 40 PSI. This means you may have to supply a pressure regulator when connecting the plumbed water source to the chamber.

Mary's Tip: Although inexpensive and readily available, ask if the pressure regulator is included with the purchase of a Deionizer filter kit. Having it handy will save time at start-up. If you don't have access to water or a drain – See the options below:

No Water Source? No Drain? HUMIDITY CHAMBER OPTIONS

DEMINERALIZER or "DI Filter": *Strongly recommended*. The humidity water for the chamber should always be treated water. If you have city water plumbed to the lab, make sure you add the Demineralizer/Deionizer cartridge option to the chamber. The filter will change color when expired.

5 GALLON RESERVOIR (No water source): If you don't have water plumbed into the lab, consider the 5 gallon reservoir, mounted on top, or near the top of the chamber. You can keep this filled with tap water (use the DI Filter) or DI water purchased from local grocery stores or your bottled water supplier.

RESERVOIR & RETURN PUMP or "Recirculation System": (No water Source No Drain) If you have neither water plumbed into the lab, nor a way to drain off condensates, consider this option. This option drains the condensates from the chamber into a small integrated sump pump and pumps it back into the reservoir to be used again.

Mary's Opinion: The best option is to directly plumb water to the chamber's humidity system and purchase the DI Filter. It maintains a consistent pressure feed to the system and once set up – is low maintenance. The filter cartridges are easily replaceable. You'll still have to run a line to the drain or use a catch pan for a drain.

Now That You Have The Humidity Portion Configured…..

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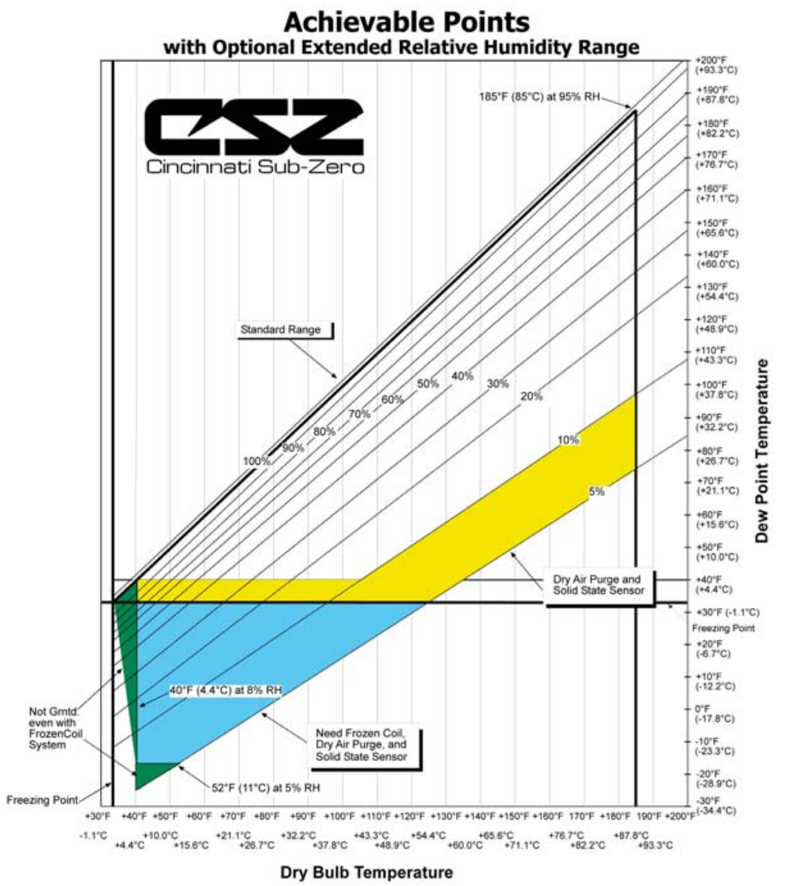
How Much Water Should Be In The Humidity Generator?

Before operating, make sure the water level in the humidity generator bell jar is between ½" to 1" above the immersion heater. Refer to the operating manual for specific instructions.

Do Your Test Requirements Fall Into An Achievable Range?

The ability to generate and control humidity under varying temperature conditions is limited. It's important to understand what humidity levels are achievable at certain temperatures.

The following chart (courtesy of CSZ) provides a good GENERAL reference. It does NOT apply to any one SPECIFIC chamber. Consult with your chamber supplier for the specific performance range of the chamber you are interested in. Also, this chart does NOT address temperature transition, or rate of change times. That's a completely different topic.



REFRIGERATION

Should I Use An Air-Cooled Or Water-Cooled System?

Good question.
Most smaller and medium size chambers, up to 64 cubic feet, use integral or local (meaning built into the chamber) air-cooled condensers. The advantage to having an integral air-cooled chamber is that they require no installation of piping and electrical lines to a condenser located outdoors on either the roof or ground level slab. With an integral air-cooled condenser, a chamber can easily be moved from lab to lab.

This changes, however when the size of the compressor increases to around 3hp to 5hp and up. The amount of heat and noise rejected increases to a point where the building air-conditioning can no longer cope with the heat load and the noise level exceeds acceptable levels for the work environment.

The primary disadvantages of air-cooled refrigeration systems are heat rejection and noise.

The heat rejected from the compressor removing the heat from the system is what you need to be concerned about. A good rule of thumb is to figure about 13,000 BTU/H per horsepower. Remember, this is an average figure. On some chambers, this will vary from 11,500 BTU/H to 15,000 BTU/H per horsepower. This is how much heat is rejected into the lab that the building's air-conditioning system has to cope with.

For example, take a chamber with a cascade (2) 1/2hp system. Specific heat rejection on this model is approx 8500 BTU/H. On 10 and 20 cubic foot models with (2) 1.5hp system, the heat rejection is generally 18,500 BTU/H. A 40 cubic foot model with (2) 3hp system tosses out 45,000 BTU/H. Remember to calculate the heat rejection based on just one compressor of a system, even though a chamber with cascade refrigeration has two compressors.

The by-product of motors, pumps and fans is the noise they produce when running. The noise level on all most chambers, with 2hp and smaller compressors characteristically fall within the acceptable limits in the lab environment. You're on the fence with a 3hp compressor system. Ask about a "quiet pack" or soundproofing options if noise is a factor.

Refrigeration systems 5hp and greater normally reject more heat and noise into the work environment then you want or can handle. A decision must be made whether to go with remote air or a water-cooled system.

Water cooled systems require additional facilities considerations and additional regular maintenance. Recirculating water cooling towers can be sized to meet the chamber's requirements. Cascade TEK can assist with this endeavor.

Finally, refer to the chamber's operating manual for the distance you need to allow between the chamber, building walls and the surrounding lab environment.

CONDENSATION

How Do I Prevent Condensation On Chamber Walls or My Parts?

This isn't always the easiest thing do. Knowing the two major causes and eliminating them will go a long way to minimizing, if not altogether doing away with condensation.

Air contracts as it cools. This phenomenon, in a chamber that is pulling down, actually causes outside lab air to be "sucked" into the chamber workspace. The moisture in the air will eventually freeze onto the cooling coil. It may very well end up as condensation dripping onto your product when heating up. This is more prevalent in the AGREE style chambers with overhead conditioning plenums. Make sure door gaskets and all access ports are properly sealed.

Gaseous Nitrogen (GN2) or Dry Air Purge can be used to minimize, if not totally eliminate, condensation occurrence. Purging the chamber with either of the two replaces the moisture laden air with dry air. On a pull down, the slight positive pressure prevents lab air from being sucked into the chamber workspace.

Perhaps the biggest contributing factor to condensation on walls and product is enabling the humidity before the walls and product stabilize, or reach equilibrium with the air temperature. Since moisture is attracted to the coldest areas of the chamber (typically the walls and product), you'll end up with condensation on the walls and possibly your product. The key is to bring up the air temperature first, let the walls and product stabilize, then enable humidity. In most cases you can run a characterization test or two first to determine how long it takes the largest mass (be it product or wall) to stabilize.

Some chamber controllers offer cascade control and guaranteed soak. A separate sensor can be used to monitor, for example, the product. The controller can be programmed to enable a certain event, only after a certain condition has been met. In this case, we're telling the controller to enable humidity only after the sensor placed on the product reaches a point within x degrees of set point.

CHAMBER/PRODUCT SAFETY

Do I Need To Add A Redundant Failsafe Device?
(Overtemp Protection – OTP)

Independent OTP is often a "High Heat Limit" device that is designed to mechanically open and disable the heat circuit in the event of a thermal rise above its designed limit. It's there to protect the chamber and keep the temperature below its design limit. It may be standard, or it may be an option.

Controllers may provide limited protection. Certain models have configurable temperature ranges. On a standard chamber with the temperature range -73°C to +200°C, the controller's range is generally the same. If your controller's range is configurable, you can reconfigure it to prevent the operator from inputting set points below your minimum and maximums. For example, information from all sources within your company and your test specifications, show that you never test outside the range of -40°C and +100°C. Reconfigure the programmable range of the controller's set points to the same range, or perhaps -45°C and +105°C. Whatever you're comfortable with.

Some controllers have adjustable alarm limits, which can be used as high/low temperature limits. Exceeding the limits the operator has programmed causes the controller to disable its outputs. No audible alarms are enabled. Once the air temperature inside the chamber has drifted back within the limits, the controller enables heating and cooling again.

There may be several reasons to add optional Over Temp Limit and Alarm Instruments. The two most important are the redundancy factor and the contacts available for turning off power to the DUT (device under test). These are explained below:

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In the event of a controller failure, you've lost your adjustable safeguard. The OTP therefore provides back up. The OTP alarm contacts can be wired into the DUT's power supply, opening on alarm condition, removing power from the DUT. Not only is the chamber turned off, but power to the DUT is interrupted as well. The primary function of the OTP is to protect the DUT, secondary is to protect the chamber.

OPTIONAL ACCESSORIES

The Most Commonly Ordered Options and Accessories

WINDOW: Windows are multi-pane, typically installed with heaters. Windows, especially in humidity chambers can fog in between panes over time. Try and keep them clean and dry after testing.

SHELVES: Frequently a forgotten item. Two things to consider: One is to make sure the weight of the product(s) doesn't exceed shelf capacity. Secondly, it's a good idea to have at least one shelf to keep your product off the floor of the chamber. It improves air circulation around the product, and with humidity chambers, the chamber floor is not level (to accommodate drainage. If you supply your own shelves make sure they are stainless

ACCESS PORTS: Each chamber typically has at least one 2" port. Additional ports, of different size and shape are available. Make sure your plugs offer a tight seal around feed-thrus.

DRY AIR PURGE: Conventional use of a dry air purge system is to minimize condensation in the chamber during operation or to augment the humidity system's low humidity capability.

BOOST COOLING: Boost cooling is available with either liquid nitrogen (LN2) or carbon dioxide (CO2). This can be used to either augment the refrigeration system, providing more rapid pull downs or be used in place of mechanical cooling. When ordering, be sure you know what working pressure your source will provide. Save Time at start-up: your safety department may be concerned about O2 displacement when venting gases into the lab area. LN2 is a more popular option than CO2.

OTP: The OTP is a High/Low Temperature Limit and Alarm

RECORDERS: Chart recorders are available to provide hard copy documentation of the chamber's performance. Recorders are available in circular form or strip chart. Single channel for temperature recording, two channel for temperature and humidity recording.

COMMUNICATIONS Computer interfaces are standard on some controllers, optional on others. Current available IO's are RS232, RS423, RS422, RS485 and IEEE-488. But, by the time you read this, I'm sure there will be new technologies emerging. These interfaces allow for chamber programming and control from a remote PC.

Mary's tip - Make sure you have support available from both the software and hardware suppliers. When questions arise, hardware people know hardware, software people know software. You are in the middle.

INSTALLATION & CHAMBER OPERATING ENVIRONMENT

What Must I Provide For The Chamber?

You must provide an adequate power source. The serial tag at the rear of the chamber will tell you specifically the operating voltage and FLA (or minimum circuit size) of your chamber.

For local air-cooled chambers, do not let the temperature of the lab in which the chamber is used exceed 85°F (29.4°C). Temperatures above 85°F reduce the ability of the condenser to provide liquid refrigerant to the system, thereby reducing the capacity of the system to remove heat from the chamber workspace. The compressors may overheat and trip out, eventually causing damage to the refrigeration system.

Provide a well ventilated area for your chamber(s). In an air-conditioned room, there must be enough capacity to remove the heat rejected by the system.

Humidity chambers require a water source and a method of draining condensates from the chamber. Condensates can be allowed to drain off into an open drain or into an optional 5 Gallon Reservoir and Condensate Return Pump system. This water recirculation system takes condensate drain water from the chamber into a small reservoir with sump pump and pumps it back into the 5 gallon reservoir, to be used again.

What Can I Do To Make Installation Painless?

You can avoid potential embarrassment by answering the questions:

1. Getting it off the truck. When that truck pulls up with your chamber, how are you going to get if off? With the exception of a few of the small ovens, they're too heavy to lift by hand. If there's no dock available for the trucker to back up to, you want to consider requesting delivery by truck with a "lift gate". A pallet jack may be useful to have. Not all delivery trucks have one. Those that do, won't necessarily part with them. Larger chambers will require a forklift.

2. Moving it into the building. Be sure you know what the outside dimensions of the chamber are before it is ordered. Know what the dimensions are of your building's doorways, hallways and the lowest points between Shipping and Receiving area and your lab. Will you be using a freight elevator?

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3. Facilities. What voltage is available in the building, specifically, the location being considered for the chamber? 115 volt, 208, 230 or 460? Single or three phase? Is there enough power for the chamber's needs? Save time at start-up – Will the chamber have to be hardwired by an electrician or simply plugged into an existing power source?

   For humidity chambers, water and in some cases, air must be considered. If the water recirculating option is not considered, you must then provide a drain for the condensate water. Air must be supplied to the chamber if the optional Dry Air Purge is added. Air from the plant's air system is typically adequate. This air supply should be between 80 to 110 psig, moisture free and clean.

   If the chamber is air-cooled, with an integral condenser, make sure the air-conditioning system in the area has enough capacity to remove that heat.

SHIPPING

What Do I Need To Know About Shipping?

Most companies' terms always state FOB (or point of origin). Simply put, this means once it leaves the dock, the title of ownership is transferred to the customer.

Mary's Opinion – most chambers should ship "air-ride – padded" van. More expensive, but the best way to prevent jarring and refrigeration leaks during transit. If you are shipping the unit yourself, don't forget to insure the unit for replacement value of the chamber.

If the equipment is damaged while in FOB transit, it is the responsibility of the customer to note those damages, notify the responsible trucking company and file claim.

On delivery, make a thorough inspection of the crate or box for apparent damage. Make a note of any visible damage you find on the receipt/shipper you sign from the trucker. It's wise to take pictures of the damaged area and to keep the damaged packing material.

You've accepted delivery of your chamber, signed the shipper, and unpack it only to find hidden damage. Notify the trucking company immediately and

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take pictures. The longer you wait to notify them, the less plausible your claim, the more difficult it becomes to collect damages.

You will eventually be asked to contact the supplier for an estimate of repairs (if you haven't already). Contact the service department and they'll schedule the service technician to stop in and assess the damage (you may be asked for a PO to cover time and travel expenses).

CALIBRATION

Is NIST Traceable Calibration Available?

Yes. This is an optional service available from most chamber manufacturers and independent service companies. It can that can be added as a line item to the purchase order of the chamber(s) being considered for purchase. A Certificate of Calibration, traceable to NIST Standards, will be supplied.

Calibration and Preventative Maintenance – How Often?

Most people have their chambers calibrated and serviced once per year. Cascade TEK can perform this service, or recommend a local resource.

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