HOW TO BUY AN ENVIRONMENTAL TEST CHAMBER

Instructions

No matter the project, each decision you make should factor in the budget and timeline. Consider the choice between outsourcing environmental testing and purchasing a test chamber. The former might appeal to you on the surface: You gain access to experienced engineers, who can help you develop test protocols and identifyfailure reasons and fixes.
However, testing rates can run as high as $1,500/hour. That's manageable should all go to plan, but it becomesexpensive quickly if more testing is required. Take Segway. They found that purchasing chambers and a drive- or walk-in environmental chamber for $150,000 provided a break-even return within 18 months. It also provided a more time-efficient schedule, evenallowing for additional tests when needed.
The benefits go beyond time and money, too. When you're developing new-to-market items, your in-house team is likely to be the best group of experts available. Each division of the project can work together to make educated decisions and adjustments. Also, in today's fast-paced marketplace, waiting for scheduled testing timeover many iterations gives competitors a chance to beat you to market.
There's also a greater level of protection. Having the ability to test in-house as often as you like limits the chances of a costly product recall. The likelihood of one today is significantly higher than it was five years ago, with better detection tools and stricter safety rules in place. The U.S. Consumer Products Safety Commission (CPSC) averages one recall per day. Recalls.gov, a collaborative effort of seven U.S. government agencies, admitsthere are many more recalls that are not being listed.
All of the above may convince you of the benefits of purchasing a test chamber. It's still a major capital expense,though, and you have to get it right. That's where Associated Environmental Systems comes in. We put togetherthis guide to help you make the best purchasing decision and introduce customization possibilities.

Determine Your Testing Requirements

Your testing requirements may be dictated by governing boards, industry standards, or consumer expectations.

Your company has developed a new product. Now, you need to select an environmental test chamber to make sure the product will perform as expected in real-world conditions.

The product must be tested at various temperature andhumidity conditions to ensure its quality and reliability.

Where do you start? What will determine your selection criteria?

Development Testing

If you're testing in research and development (R&D for short), consider how the different elements can be tested to shorten the development time by identifying the shortcomings of components. Environmental test chambers feature precise temperature and humidity controls to createrepeatable climate conditions.

The most common tests run are for product shelflife, accelerated life testing/reliability testing (ALT/HALT testing), and stability and package testing. These tests can be run using temperature for repeated thermal cycling andhumidity to find weak points.

Identifying defects or stress limits during this process leaves room to redesign the product (if need be) and setperformance expectations.

You know when your milk will expire through the FDA's required date stamping. However, most consumer products don't have expiration dates, and companies are left to self- govern themselves.

Additionally, industries have their own test specifications. These are self-regulated through organizations or adhere to government regulations under applications like light exposure, corrosion, military standard testing, temperature evaluation studies, electronic component burn-in, plant growth, and insect rearing, to name a few.

The Automobile Industry

The automobile industry is unique. Government regulations specify the quality or safety expectations for the consumer. However, as the electric vehicle segment has grown, manufacturers created their own overseeing body to set standards based on how the battery market is changing. Therefore, they've created their own testing and performance expectations and communicated these openly to consumers.

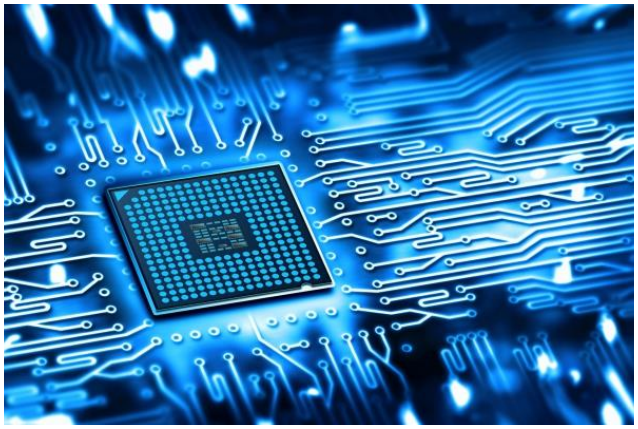
Production Testing

During production, companies either sample test products from batches or lots, or test every product that comes off the line with highly accelerated stress screening (HASS testing). This form of testing involves pushing the product to its identified stress limits determined by the HALT testingin the development phase. HASS testing is crucial because it will likely spot improper manufacturing processes. There'sa chance that the product fails during manufacturing due to unreliable components that could have been identified inHALT testing.

It's common practice to test products that contain Lithium-Ion batteries during production. Automated external defibrillators (AEDs), flight recording devices, mobile/cell phones, and many more products are tested during production. Finding defects during manufacturing is much more costly, and it's more challenging to identify where the failures are occurring. Therefore, it's beneficial to put more time and resources into development testing. Customer expectations will determine the need for batch sampling ortotal production testing, as this varies by industry.

The Semiconductor Industry

In the semiconductor industry, manufacturers like Analog Devices HASS test every product that comes off the production line since they are used in medical systems, scientific instruments, and communication devices.



Choosing Chamber Size

Base your chamber size on these three critical factors:

1. The application test requirements
2. The load size and density
3. The test room conditions

Chambers are used in a wide variety of applications and come in many sizes. The most common sizes produced by test chamber manufacturers range in volume from a half cubic foot (14 liters) to 64 cubic feet (1,812 liters). Walk-in rooms are muchlarger, averaging 1,123 cubic feet (31,789 liters), but can be small enough for a server rack or large drive-in units that fit as many as six cars.

1. Application Test Requirements

If you haven't selected the tests you will perform, refer to our blog post on test requirements.

The suggested ratio, for many tests, is about 1:3 in terms of the product volume occupied to the total workspace volume. Generally, the proportion of product to workspace ensures adequate airflow to the test sample and makes sure you've allowed for complete conditioning throughout the entire device under test.

The 1:3 ratio doesn't always apply. For highly dense products, you might require a larger workspace. Conversely, devices thatare less dense or allow for airflow (such as a computer chassis with plenty of air vents) can take up a larger percentage of thetest volume.

The airspeed inside sand, dust, and high-altitude chambers is already very high for products and makes a 1:3 ratio unnecessary. These chambers should be just slightly bigger than your test product.

2. Live Loads

For products requiring a live-load during testing, a larger chamber may be needed to dissipate heat produced by the deviceunder test, which adversely affects the chamber's pull-down times and humidity system.

Active live-load products undergoing testing produce energy resulting in a considerably more amount of heat. Therefore, theyrequire more powerful refrigeration systems to cool-down to your specifications.

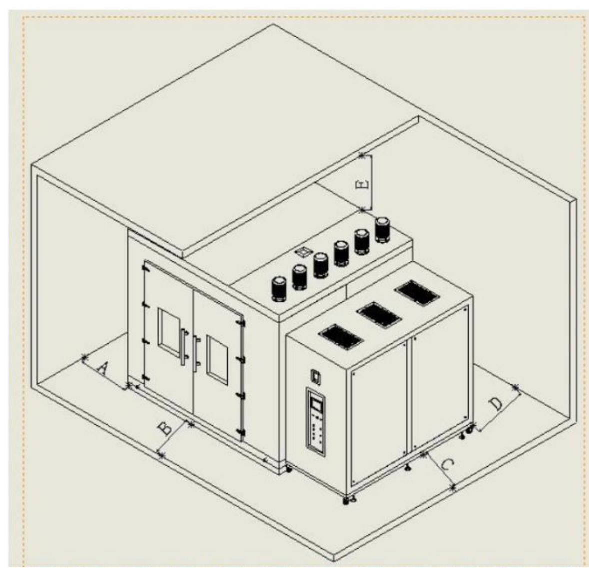
Similarly, heavier and denser products with dead loads may also require more extensive heating and refrigeration systems toachieve desired ramp and pull-down rates. It will take longer to condition the product under test all the way through

3. Test Room Conditions

Your test room conditions factor in the choice of chambers. Here are threethings to consider.

1. **Ambient Room Conditions:** External to the test chamber, the ambientcondition of the room where the test chamber will be used affects your testing. Test chambers create considerable heat, known as heat rejection, measured in BTUs, and with test cycling up and down the temperature spectrum, the test chambers themselves require good air circulation. Most units need 18-36 inches or more of clearance in all directions to work efficiently and to provide reliable data. Even more critical, test chambers should operate in rooms with an average ambient temperature of 23°C (70°F). The constant ambient room temperature will ensure that your test requirements only fluctuate when you want them to change. When the ambient temperature in the space where the test chamber is being used is continually fluctuating, the test chamber will have to work harder to reach and regulate its programmed setpoints. Work with your facilities manager to understand if the building's cooling and heating units will properly maintain adequate room temperature where the environmental test chamber will be in operation.

2. **Footprint:** You can generalize the area an environmental test chamberuses into four categories: ovens, benchtops, floor, and walk-in models. Ovens take the least amount of mechanical space because they do not have refrigeration systems and run at a steady temperature. Cycling chambers contain extensive mechanical systems, housing refrigeration (and humidity) in addition to heating systems. Let your available space control your footprint style; if you do not have floor space, can you live with a benchtop model using your desktop space? If you have minimal workspace that you can't give up, consider floor models or stackable benchtops on carts with casters for mobility. Look for where the machine and electrical packs are on a chamber: top, bottom, left, right, or rear. All of these choices will allow you to fit a test chamber into your space with easy access to the test chamber workspace. With these options available, let your laboratory space dictate the style chamber you get. Walk-in test chambers typically have panel walls that, while insulated, are highly susceptible to fluctuations due to surrounding temperature. However, heat rejection can be lowered significantly by placing machine packs outdoors and using water-cooled condensers.



3. **Mobility:** Before deciding which test chamber is right for you, consider where the unit will be located in your building. Will it be a shared unit, and need to move to different areas? Maybe your lab hasa hub-and-spoke arrangement with the testing space centralized forall users. Be sure to include discussions with R&D, manufacturing, and operations to understand better the multiple perspectives with regards to performance and facility requirements.

Choosing Temperature Characteristics

Exploring the different types of cooling systems

How Cold Do You Need Your Chamber To Be?

Across manufacturers, you will find two types of cooling systems: single-stage and cascade (two-stage) systems. A single- stage compressor refrigeration system typically supports temperatures as low as -40°C (-40°F) and conforms to many commercial and military standards for low-temperature tests. To operate with temperatures lower than -40°C, a cascade refrigeration system should be used. It can generally support temperatures as low as -75 to -80°C (-103 to -112°F). The low temperatures obtained with cascade systems occur when two separate, closed refrigerant circuits run concurrently, with each using a dedicated refrigerant. As the first stage brings temperatures to a designated low point, the second compressorkicks-in to get the first compressor's coolant down to a lower level. This process allows compressors to have a recovery perioddecreasing stress on the entire system.

The design of the mechanical refrigeration system is critical to the performance you expect. Check to see that the compressoris a self-contained system; hermetically and semi-hermetically sealed compressors are virtually maintenance-free. Cooling systems may have a scroll compressor, primarily for smaller test chamber workspaces and small temperature ranges.

Because scroll compressors do not have valves, they are significantly more efficient with precise cooling. Discus compressortechnology has changed substantially in recent years, making them more efficient. They are still necessary to overcome active live loads and large workspaces. You will find scroll and Discus compressors used in single-stage and cascade cooling systems. It's essential to communicate your low and high temperatures requirements along with the length of time your test will soak at these high and low temperatures. Staying at the extremes on either side for extended amounts of time maychange the cooling system configuration.

Choosing between an air-cooled or water-cooled condenser is easier: With water-cooled condensers, the chamber requires a dedicated conditioned waterline. All test chambers can be air- or water-cooled. However, water-cooled units will lower the temperature in the chamber workspace faster than an air-cooled test chamber. Connecting to your existing water-cooled condenseris always an option, or you can consider asking for a self-contained water-cooled condenser on-board your test chamber.

Condenser Comparison	Air-Cooled	Water-Cooled
Heat rejection	Positive heat rejection	Little to no heat rejection
Energy efficiency	Less efficient	More efficient
Footprint	Larger space requirement	Smaller space requirement
Pull-down times	Slower rate	Faster rate
Purchase price	Less costly for small units	Less costly for large units
Installation	Easy	Must supply conditioned water cooling loops

Choosing Temperature Characteristics

Continued

Cooling Systems: Liquid Nitrogen(LN2) and Carbon Dioxide (CO2) Boosts

Liquid nitrogen (LN2) and carbon dioxide (CO2) cooling systems include an attached storage vessel, called a dewar, of either liquid, which is injected into the conditioned airflowarea of the chamber, known as the plenum. These liquids evaporate into gas on-contact with the inside air of the chamber workspace.

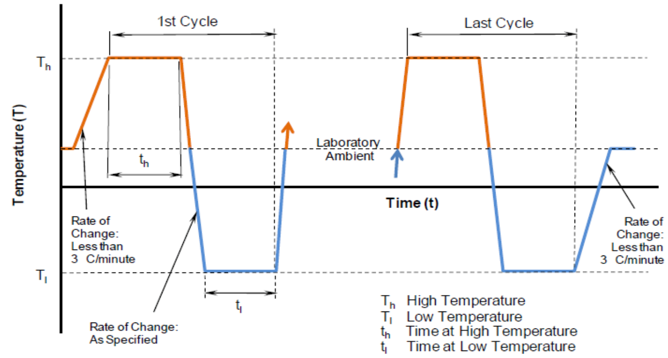
CO2 can lower the chamber's internal temperature rapidlyto -75 to -80°C (-103 to -112°F) while LN2 can quickly lower temperatures to a cryogenic temperature of -185°C (-300°F). LN2 and CO2 boost kits for mechanical refrigeration systemswill rapidly decrease the total time to cool down and are often used to cool your product under test rapidly. If you plan to use liquid gas for continuous cooling, you will want a facility line to an outside storage supply as the testchamber will consume a large amount of coolant. Liquid cooling systems can also act as back-up to the mechanicalrefrigeration system if it fails. If either LN2 or CO2 is used, make sure the test chamber is used in a well-ventilated room. Air quality is lowered to dangerous levels as liquid gases dilute the oxygen content, even though both compounds are natural components of the air you breathe. If your facility pipes the gases in, then its ventilation system most likely already vents to the outside directly. Purchasing bottled gas is an option, but consumption could be high, and again, the room must be vented to the outside to ensure the safety of personnel working in the surrounding area.

Environmental Safety

Today, environmentally friendly hydrofluorocarbons (HFC) refrigerant and chlorofluorocarbon-free (CFC-free) insulation are utilized by most reputable test chamber manufacturers. Check with your manufacturer, though, as the use of environmentally-friendly chemicals is not a requirement, andmoving toward these refrigerants aligns with the UNFCCC Paris Agreement to address climate change. Occasionally, compressors will need to be "recharged." If your facility is located in a rural area, check that the refrigerants you will need are available.

Temperature Change Rate

Temperature cycling is a method used for accelerated life and stress testing, and HALT and HASS tests. Therefore, the temperature change rate of an environmental test chamber will be significant when determining which test chamber to purchase.



Typically, the larger the chamber, and the more extreme the temperature range, the longer it will take the workspace to reach the maximum (ramp-up) or minimum (pull-down) temperature.

Usually, more powerful heating and refrigeration systemswill be used for larger chambers to keep these larger chambers' change rates consistent with smaller test chambers within the same series.

Another factor that can affect the pull-down rate is whetherthe refrigeration system is water- or air-cooled. Water- cooled systems typically will lower temperatures faster when compared to air-cooled systems of the same size.

Depending on the temperature range and workspace size, some chambers will take up to two hours to reach the maximum temperature. For example, eight-cubic-foot test chambers can take up to two hours to get to 538°C (1000°F),while workspaces smaller will take about one hour.

Likewise, chambers can take up to an hour to reach their lower limits. With CO2 or LN2 boosts, workspaces will reach -75°C (-103°F) in 15-60 minutes. The time savings add up toaround 10 hours based on a 40-cycle testing period.

Usually, chamber manufacturers have options to increase ramp-up and pull-down rates in the form of more powerful heating and refrigeration units.

Finally, how air moves around the product and workspace is crucial in environmental testing. As discussed in the "Choosing Chamber Size" section, the general rule of thumbis only to fill one-third of the internal space with products. Always ensure that the product under test is centered in the workspace so that air can circulate freely around all sides. Airflow that moves freely through the workspace ensures that the conditioned air can flow evenly through theworkspace for accurate and speedy heating and cooling of the products.

If multiple or many smaller products are in the workspace, it's best to spread the products evenly throughout the chamber to maximize airflow circulation. When selecting a test chamber, order fully adjustable shelves, so you can freely arrange products throughout the workspace with aircirculation in mind.

Choosing Humidity Systems

Exploring the different types of humidity systems

Vapor Generator

The vapor generator is a closed steam generator sized tofit any chamber. Humidity control is optimized and more precise when multiple smaller generators are installed instead of one large steam generator.

When highly-active live loads are being tested, vapor generators may create problems with icing on the refrigeration coils. Increasing the workspace ratio of product-to-working-volume by using a larger chamber is recommended. Share your live load requirements with themanufacturer so you can ensure performance for live loadtesting.

Immersion Water Pan

The water pan system consists of an open-water pan with an immersed heater that generates steam. The heating mechanism must be completely submerged at all times to prevent the heater from burning out. It's a simple system that produces steam slower than vapor generator systems.

Atomizing

Mainly used in salt spray chambers, an atomizing nozzle creates fog inside the workspace and requires a direct and constant facility water supply.

Any system using water requires diligent preventative maintenance.

Humidity Range

The humidity range for most chambers is 20% to 95%, ±2% Relative Humidity (RH). The RH ranges can extend lower and higher by adding optional features. To achieve dryer conditions, as low as 5% RH, adding an external system is needed.

Obtaining relative humidity above 95% requires an electronic high humidity sensor, which is virtually maintenance-free with calibration accuracy. Dry-bulb/wet- bulb or wet psychrometer systems will increase humidity but require continuous monitoring to maintain proper conditioning of the muslin covers, called wicks. The wick needs regular changing, sometimes even when tests are in process. You can monitor, control, and collect data from bothextended RH options using a digital controller.

Whenever you are introducing water to a mechanical system, regular preventative maintenance is required. Across the test chamber industry, you will find that environmental test chambers need conditioned water: waterwithin a specific resistivity or total dissolved solids (TDS) range. You can purchase demineralized or deionized water, but not all bottled water is equal. Not all manufacturers are equivalent when building humidity-enabled test equipment,so know your facility water quality, and compare that to themaker's recommendations to prevent deteriorated systems later on.

Your facility's tap water supply is likely either too clean or too rich in chemicals and mineral content. Therefore, facilitywater will need conditioning, or you will need to purchase water from an outside source. It's recommended that you send a facility water sample to a qualified independent laboratory to determine the chemical and mineral content inthe water supply. City or town water reports only measure at the utility water station, not the water into your building.Choose the filtration system to achieve the water quality recommended by your manufacturer.

Demineralizer systems, coupled with filtration, are often options offered by a manufacturer to protect chambers internally. Semi-annual, in-house water testing can measuremost chemicals, and a meter can calculate the total dissolvedsolids in your facility water, in between formal laboratory testing of your water. Will corrode and eventually destroy the internal workings of a chamber. The damage begins inside the pipes that transport the water, so by the time the naked eye can see a leak, the damage to the water lines is beyond repair and the lines must be reconstructed.

Cycle Times

Humidity systems have factors that influence cycle times: the type of humidity system; ambient climate conditions (room temperature and relative humidity) where the test chamber is in use; temperature within the workspace; and humidity setpoint. All of these conditions affect the time it takes for a test chamber to reach its setpoint. When contacting manufacturers, ask for more details on humidity cycle times and share your typical ambient conditions to understand actual performance once the test chamber arrives at your desired location.

Percent Relative Humidity (RH%)Vs. Temperature

Electronic Sensor Measurement

Chambers made today are typically equipped with electronic, relative humidity sensors as a standard feature. Take time to discuss with manufacturers your product andneeds to monitor humidity and temperature levels.

There are many electronic sensors on the market today, andthe technology is changing fast. Although there's no perfectelectronic sensor for all needs, several are available on the market to suit your needs. As humidity moves close to 100%, sensors can have a difficult time with accuracy.

The same goes for scenarios where test products release gases when exposed to heat and moisture. When the gases come in contact with typical electronic sensors, the gases stick to the sensor surface, blocking the probe's ability to get an accurate reading. Special sensors can replace standard probes that separate the residues from the gases released inthe chamber.

When chambers cycle from high to low temperatures while humidity remains constant, ask for "warmed sensors" to stop condensation from building up on the sensor and giving inaccurate readings. In some cases, you may choose to resort to old school methods: Dry-bulb/wet-bulbtemperature readings.

Dry-Bulb/Wet-Bulb Measurement

Before electronic sensors were available, engineers and scientists used this method to determine relative humidityand temperature. Dry-bulb measurement is how most people measure temperature—holding a thermometer tip (aka the bulb) and allowing air to pass by.

Wet-bulb measurement is a process in which you wrap the tip of the bulb in wet muslin, called a wick. This temperature reading will be lower than the dry measurement. The evaporation of the wick and the dry-bulb and wet-bulb readings combined in an equation will determine the humidity in the workspace air. You know humidity is 100% when the dry-bulb and wet-bulb are the same temperatures: achieving complete saturation. Applying the dry-bulb/wet- bulb temperatures on a psychrometric chart will indicate the humidity level. Of course, using a manual calculation and a psychrometric graph is no longer necessary. Today, bulbs have probes to collect temperature readings and the relative humidity displays on your digital controller. A more in-depth controller discussion can be found in the "Controls and Sensors" section.

Few manufacturers and users still choose to use this method because they consistently run environmental tests at high humidity levels. The controller cannot monitor the conditionof the muslin wick wrapped around the wet bulb. This is still a manual visual and tactile task that is performed even while test profiles are operating. It's worth mentioning that some users believe dry-bulb/wet-bulb measurements lose accuracy during low-humidity testing conditions. Frequent calibration of the dry and wet bulbs is required. When test chambers are not in use for an extended period, the dry- andwet-bulbs will most likely need replacement.

Achieving Low Relative Humidity

Dehumidification systems enable you to operate a chamber at low humidity levels, beyond the ability of the refrigeration system evaporators. If you require low-temperature/ low-humidity conditioning in your workspace, take time to understand the facility requirements and maintenanceneeded to operate the dehumidifiers. Each has pros and cons, and the offerings are diverse across chambermanufacturers.

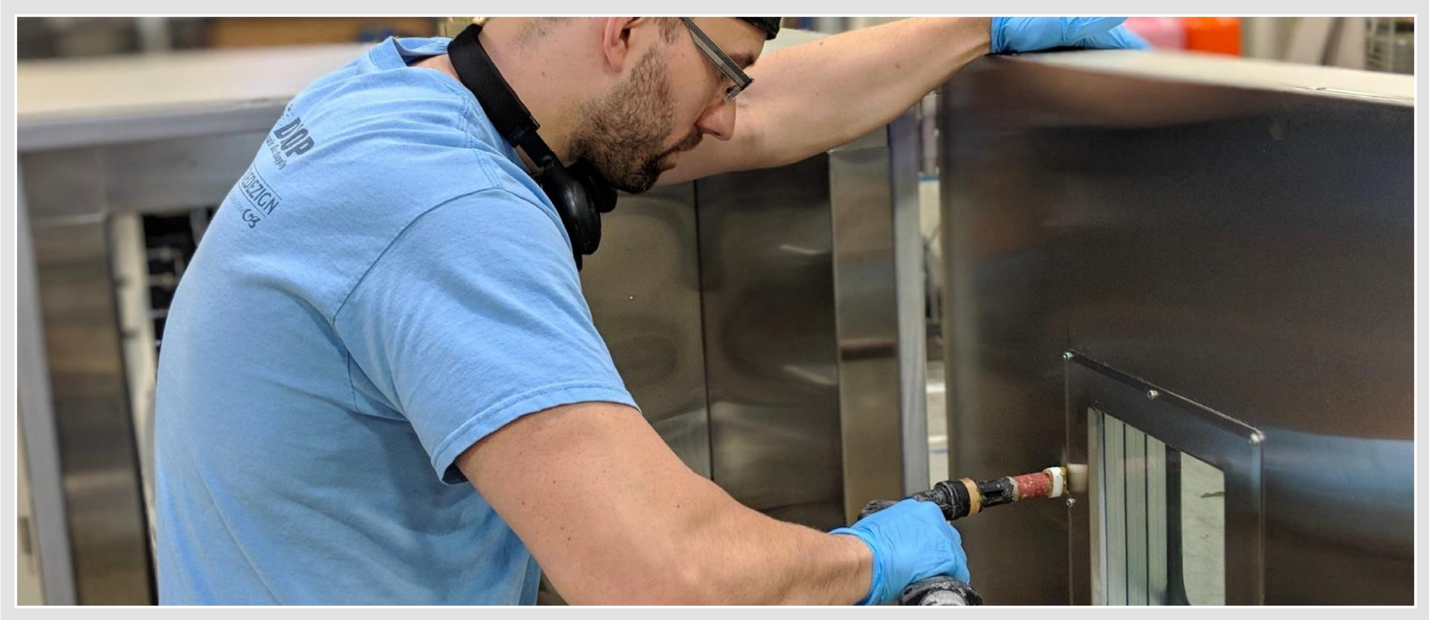
Desiccant air dryers circulate wet air through a series of drying agents or a drying wheel, recirculating the clean, dryair into the plenum for temperature conditioning.

Another option is a dry-air purge, where compressed air from an outside supply line is added into the workspace until the RH setpoint is reached. Both desiccant air dryers and dry-air purge options can be managed through the test chamber's digital controller.

Most modern test chambers feature programmable, microprocessor-based controllers with:

- Computer communications
- Autotune
- Solid-state RH sensing
- Stainless steel temperature probe inputs
- LED, LCD, or full-color, touchscreen displays showingboth process values and setpoint values.

Components and Materials



Construction Materials

When purchasing an environmental test chamber, it's crucial to select one whose value will remain intact as your company grows and changes. It's not unusual for a well-maintained test chamber to last for 15 years or more. Ensure the materials usedin construction are high-quality and durable to extend your test chamber's life. For smaller test chambers, less than eight cubic feet in volume, confirm the interior workspace walls have at least 304-grade stainless steel with a thickness of at least18-gauge stainless steel. Larger chambers need a minimum of 18-gauge, sometimes 16 gauge stainless steel with a reinforcedfloor, to ensure adequate durability.

Construction Method

- **Internal Workspace:** The interior walls of a chamber should be seam-welded. Heli Arc or tungsten inert gas (TIG) welding ispreferred to reduce the chance of leaks from inside the workspace to the electrical and mechanical components. Some chambers use riveted wall assembly, which will leak heat and humidity into the insulation and machine compartments.
- **Door:** The door to the chamber workspace should be fitted with a silicone-type gasket to ensure chamber conditions and preventleaks. Silicone gaskets can sustain its structure in high and low-temperature conditions. Gasket quality becomes especially essential when CO2 or LN2 is in-use because other materials quickly disintegrate when exposed to low temperatures.
- **Exterior:** The outer body of the test chamber should be welded, heavy-gauge, cold-rolled steel. Cold-rolled steel is 20% harder than regular steel and is more durable and has a low tolerance, offering a more accurate shape when bent and abetter-sealed workspace as a result. These qualities are all critical factors when subjecting machines to high and low temperatures and various humidity levels. Applying powder-coated finishes adds long-term protection against rust andcorrosion, and bumps as compared to wet-painted finishes.
- **Machine Components:** Ensure quality craft by applying national standards organizations' requirements to the wiring, whichshould conform to the National Electrical Code (NEC). Refrigeration systems should follow the American Society of Heat- ing, Refrigerating, and Air-Conditioning Engineers (ASHRAE) guidelines.
- **Insulation:** Good insulation will maintain thermal integrity. Placed between the inner and outer walls and inside doors, lookfor high-density, low "K" factor, non-settling fiberglass or mineral wool insulation. These products are fire retardant, non-corrosive. These materials appear to be in sealed areas, but because of the forced air circulation, check that the insulation materials are thoroughly health- and safety-tested for people that regularly work around test chambers.

Controls and Sensors

Environmental test chambers come standard with digital control systems, maximizedfor user-friendliness.

Analog Controllers

Very few modern chambers are sold with only an on/off control and dial knobs. These are included because there are still many labs that have 20-year-old-plus chambers running. These companies have maintained impeccable preventative maintenance on their test chambers, and the machines continue to operate effectively. Upgrading an analog control systemrequires an entire electrical overhaul and would, more than likely, not be cost-effective.

There are test chamber manufacturers that will retrofit your environmental test chamber with today's technology. The onlycaveat is that the controller you currently use must be digital.

Digital Controllers

Digital controllers have been standard in test chambers for more than 20 years, and there are many choices in the marketplace. Watlow is a recognized leader in the industry for accuracy and reliability, and the following is based on their product line.

In their simplest form, digital controllers allow you to manually create setpoints and adjust the settings for one control loop.Errors and disruptions are managed using soft buttons from the controller. This controller allows for three basic operations:on/off, setpoint value, and present value readings, along with two alarms. This product is ideal for new users and useful for straight-forward testing applications, known as a single-loop test. Think of this model as the "set-it-and-forget-it" of controllers. These controllers are typically operated at the test chamber. A segmented LCD-display, soft buttons, and up/down/enter allows you to change the setpoint and two alarm functions.

Digital Proportional-Integral-Derivative (PID):

SCROLLING MENUS. The next generation of digital controllers is a backlit, LED-segmented character display controller, whichadds complexity to various control options.

There are multiple control loop options, either as a single-channel or dual-channel, with a set number of inputs and outputs.Watlow offers the F4, which has guided set-up, easy access to alarms and setpoint values, and an onboard user manual.

Programming a test profile is all accomplished at the chamber on a panel-mount, four-by-four-inch controller on a four-linedisplay screen with 40 characters per line, and soft-button, menu-driven scrolling. You can code your profiles at your desk then upload them using a thumb drive or any of the following communication methods: RS-232, RS-485, or ethernet port with Modbus or TCP Ethernet, IEEE-488, or GPIB.

TOUCHSCREEN MENUS. The most recent advances in controllers include high-resolution, graphical, and touch-screen displaysthat are menu-driven and come with software that allows you to create profiles using code or bricks. The tabbed screen makes for easy navigation, but the multiple forms of inputs to build control loops add complexity to the system. When you're ready to purchase an environmental test chamber, you can share your test profile with the manufacturer, and they can set-up and tune the chamber to that particular profile.

Sensors

Quality matters, so consider having digital setpoint controllers with displays that allow for linearization and tracking betweenthe display and sensor temperature. These sensors should be resistance temperature detectors (RTD), 100-ohm platinum sensors because of their accuracy and ability to provide excellent stability and repeatability.

Data Collection

The methods for data collection have changed over time, but some of the oldest techniques still apply.

Window:

Looking through a window is the most basic of data collection but is sometimes the only option. Don't forget the value of seeing your product in action as it moves through test cycles.

Internal Light With External Switch:

If you ordered the window, you should also request an interior light to go with it. Larger chambers typically have internal lights included, so test engineers can see their work without rigging their own lighting system. It beats using a flashlight, and it frees up their two hands to work safely.

IEEE-488 Computer Interface:

A general-purpose interface bus (GPIB) allows for 1 Mbyte/ second maximum data transfer rate. Data is transferred digitally, one byte at a time. The method provides for the transfer of data between a PID controller and a computer. This protocol, as a method of communication, is dated compared with modern communication methods.

Circular Chart Recording:

Digital chart recorders offer real-time data collection by documenting the test process using multi-color pens. The chart recorder connects directly to the PID controller or independent sensors. Examples of the recorders are chosen from Honeywell, a reputable instrumentation provider.

Honeywell's Truline products allow up to four channels that monitor process variables, up to two PIDs to allow for configuration to the exact control action needed, and Modbus communications to allow for an external interface.

Electronic Data Recorder:

These recorders typically collect data from up to 12 inputs in continuous and batch data in a digital format, for download into your favorite analysis tool. Newer technology also offers similar data collection with a touchscreen option for quicker visualization of the data. The Honeywell EZ Trend controller allows you to go paperless, replacing the 100mm paper strips and circular chart recorders. The secure digital format eliminates transposing errors. The data is encrypted and can only be read using proprietary Honeywell software to ensure data integrity. The touchscreen version is the Honeywell Minitrend controller Touch Panel Control.

Controller & Data Management Merge:

The technology that controls chambers has simplified programming, operating, and analyzing data anywhere you are. Whether in the lab, at your desk, or home. There are many third-party software products to help manage data and make it available to you. AESONE CONNECT, a software and hardware suite, is designed to work hand-in-hand with your environmental test chamber and today's workstyle.

Here's a quick view into what AESONE CONNECT can do for you. AESONE CONNECT, developed by Associated Environmental Systems, allows you to operate and monitor your test chamber, manage your data, and create test profiles.

AESONE XCHANGE hardware enables any test chamber to expand its accessibility to data by creating a networked system. Never lose your test results with expanded storage that saves up to eight years of data. Even if you have a test chamber made by a different manufacturer, there is a retrofit package for any manufacturers' brand of test chambers.

Decide how you want to use your test chamber:

Operational control. How will you control the chamber—at the chamber, at your desk, or outside the office? Would you like to be able to turn the test chamber on/off? Do you want to run/pause/stop/start over at any time, even if you're not in the building? Do you need to view the operational setpoints and present values while testing is in progress? How are test profiles built? One person controls all profile building, or is it a shared responsibility? Do multiple test chambers share the same test profile? Do you need to store and move different profiles on and off chamber controllers?

Viewing and managing data. Do you need to view your data and historical data during testing to make real-time decisions? Do multiple team members need access to view operational settings, test progress, and data? Do you need notifications and alarms to signal when test processes begin or end? Would you like to add notes and comments at specific datapoints anytime during or after testing?

Do you need to do all or most of this work remotely? Are team members working separate shifts on the same project? Are they spread out over different locations and need access to operational test monitoring and access to data for analysis?

Security. How will your chamber access your network to share data? How secure is login authorization? Will you need to limit the amount and type of access various team members and users have to chamber operation and data?

Before investing in a test chamber or purchasing third-party software, ask the right questions to meet your needs.

Safety

Environmental test chambers come standard with multiple failsafes to protect theproduct and you.

High-Temperature Failsafe Controls:

There are multiple types of temperature failsafes available. The most common failsafethat is generally standard with all manufacturers is the mechanical failsafe. The mechanical failsafe ensures that a product will stay within the setpoint in case of a malfunction of the primary controller.

Mechanical Failsafe Heat Fuse:

This is a safety mechanism used in heating devices to provide failsafe overheating protection. This should be a last resort protection and not a standalone protection. A heatfuse or thermal fuse will interrupt the flow of electricity to the heaters and shut it down if it reaches a certain temperature.

Digital High Temp Limit Failsafe:

Most manufacturers will factory set a digital high temp limit failsafe, preventing the heaters from running out of control. As the user, you may dial this down to create your own high-temperature limit: a digital set temperature safety that will shut down the testchamber if it goes over a certain temperature.

Programmable High and Low Temp Safety Indicator:

Once you know your product's fail points, you can set the chamber to test up to that setpoint and set a safety indicator, so the chamber does not exceed the high and lowpoints. This will ensure you're not causing product failures during production testing.

Noise Reduction Package:

If employees will be working nearby, you can add a sound-deadening foam to the unit'smechanical portion to lower the chamber's noise output.

Alternative Power and Other Requirements:

Power. When you look for chambers on manufacturers' websites, you may find one power option or multiple power options to choose from. Power requirements are determined by your facility's electrical supply or output. Check with your facilities teamto ensure the chamber can be placed in the desired location or a better-suited spot inthe building to meet the chamber's power needs. If multiple chambers or other power- draining units are in use simultaneously, the load on the facility might be too high. Check with a qualified electrical engineer to determine your capacity.

Water. If you have ordered humidity or have internal water-cooled refrigeration, you will need a dedicated water supply and a drain. Be diligent when choosing the right testchamber; it needs to fit your test requirements and facility.

Service

Once you've purchased a test chamber, you need to make the investment last. The best way to do that is to practiceregular maintenance and coupling your purchase with a service plan. Work with your manufacturer if possible as they know your test chamber inside and out.

A service plan ensures you address issues as soon as they arise, spot any defects before they become expensive fixes, and establish a testing schedule with maintenance built into the calendar. The goal is to keep your test cham-ber operational for as long as possible (upwards of 15 years) while preventing any costly delays.

When considering a service partner, value these qualities:

Availability

Prioritize a service provider that communicates effectively and can accessyour test chamber promptly. Ongoing testing often runs outside of 'normal' work hours, so work with a company that can accommodate yourschedule. The other side of availability has to do with parts in stock. If youneed to replace a defective piece of your test chamber, you'd like to be able to do so quickly and at a low cost.

Expertise

The best test chamber service companies provide general expertise as well as demonstrate strong technical skills. They also work on all test chambers, regardless of manufacturers. Think about it. You may have testchambers in your lab that are 10, 15, or even 20 years old from differentbrands. Calling one service company instead of one for each is ideal.

Customer Service

You rely on your service company to give you honest feedback. What exactly is the problem? How much will it cost to fix? When should I purchase a new chamber rather than continuing upkeep on an older one?A company that talks you through your options and sets expectations willstand out from one that's inflexible.

For more information, we encourage you to read our Guide to TestChamber Service.

Conclusion

Test chambers come with many features, both standard and optional. Planning ahead of time will make the capital expenditure process easier and free up your valuable time.Best of luck with your testing.