



PHOTOVOLTAIC MODULE & SOLAR PANEL ENVIRONMENTAL TESTING GUIDE



Solar Panel Testing Chamber

CSZ provides a selection of standard & custom solar panel test chambers for testing various size photovoltaic modules and solar panels. These chambers simulate temperature and/or humidity conditions and are designed to meet all three sections of environmental solar panel test specifications for temperature cycling, damp heat and humidity freeze.

Our solar panel testing chambers aid in qualifying that modules can withstand the thermal stress caused by repeated changes in high and low temperatures along with exposure to high humidity. Unique air flow design and distribution ensures precise air flow required for solar panel testing.

All chambers include the EZT-570S Touch Screen Controller with data logging, data file access with USB compatible memory stick, Ethernet control and monitoring, alarm notification via email or phone text message, data file backup system, full system security and more. No need to worry about programming your test profile, CSZ chambers come pre-programmed with the solar test specification you request.

Below are a few examples of various CSZ chambers used for solar panel testing. Additional models and sizes are available.

Model	ZPH-32	ZPH-44	ZPH-64	ZPH-80
Workspace Dimensions	38"W x 38"D x 38"H (126cm x 97cm x 97cm)	44"W x 38"D x 46"H (112cm x 97cm x 117cm)	48"W x 48"D x 48"H (122cm x 122cm x 122cm)	48"W x 60"D x 48"H (122cm x 152cm x 122cm)
Temperature Range	Tundra®: -45°C to 190°C Cascade: -70°C to 190°C			
Humidity Range	10% to 98% RH			



Model	SPH-100
Workspace Dimensions	57.5"W x 42"D x 70"H (146cm x 107cm x 178cm)
Temperature Range	Tundra®: -45°C to 190°C Cascade: -70°C to 190°C
Humidity Range	10% to 98% RH



CSZ also provides a full range of environmental rooms and walk-in chambers for testing solar panels.

Walk-in chambers are ideal for testing larger volumes of solar panels along with a variety of different size panels. These chambers may be designed to fit your specific requirements.



WM-Series Modular Walk-In Chambers

Modular Walk-In chambers offer flexibility to meet virtually any size or configuration by using pre-fabricated panels. Modular chambers are constructed of thick polyurethane-foamed panels that lock together to form a tightly sealed chamber with stainless steel interior and aluminum or white embossed exterior. These chambers are offered in temperature ranges from -68°C to 93°C and humidity from 10% to 95% RH.

WW-Series Welded Walk-In (Solid Construction) Chambers

Welded Walk-In chambers provide wider temperature and humidity ranges. These welded walk-in chambers consist of one solid piece, simplifying installation. Welded Walk-In chambers are constructed using a zinc-coated, exterior polyurethane enamel finish and a type 304 stainless steel interior. Fiberglass insulated walls are 6" thick with seams that are continuously welded to form a hermetically sealed chamber. These chambers are available in temperature ranges from -68°C to 190°C and humidity from 10% to 95% RH.

All CSZ walk-in chambers also include CSZ's EZT-570S touch screen controller. Below are some of the features that simplify chamber control.



EZT-570S Controller

The Next Generation Controller with Smartphone Technology

Save valuable time with the ease of use of the EZT-570S featuring fewer steps to accomplish your daily testing needs while incorporating simplified operation and programming to test faster.

Communications & Connectivity

- Remotely monitor and/or Control the chamber for anytime, anywhere access from any device (PC, smartphone or tablet) using LAN/VNC.
- Alarm notification system sends email and/or text phone messages in the event of a test chamber alarm, saving valuable tests while reducing downtime.
- Multiple chambers may also be managed using VNC or CSZ's optional EZ-View PC software to monitor & control CSZ chambers and download profiles.



Profiling

- Profiling includes up to 99 steps and 1000 cycles.
- Program ramp steps entering time or °C/min.
- Easily review profile using trend chart or list of steps
- Profile status view displays current step, estimated start/stop date and time.
- Profiles may be transferred to different chambers via USB or optional EZ-View software.



Data Logging

- Configurable log interval, data file length, filename, operator entered batch & lot information as well as an unlimited number of operator notes saved to the data file.
- Easily download profiles, alarm files, audit trail files and data files using USB or email from controller in a compatible .csv file format. Files may automatically be backed up using FTP.
- Email built-in to send data, alarm, audit trail files directly from controller. Also create and send new emails.
- Open and plot historical data files.



User Convenience & Flexibility

- Controller may be configured in any of one of 28 languages - one setting updates icons, menus and help screen.
- Selectable power failure/recovery options.
- Full system security allows up to 30 different users with four different levels of security.
- Audit trail files track changes in settings by each user.
- Import/export configuration settings to other controllers saving time. (Personalized to your use)
- Configurable alarms and maintenance alerts.

With the ever increasing concern of global warming and lower energy costs, there is a growing need for alternative energy that is both clean and affordable.

Overview of Solar Panel Specifications for Environmental Testing

Solar Energy is one alternative that uses Photovoltaic (PV) modules to generate energy. These modules are exposed to severe environmental temperature and humidity extremes throughout the life of the product.

Listed below is a general overview of common solar panel test specifications that require the use of environmental testing. Outlined are the test conditions related to our test chambers. For more information on IEC, UL or ASTM standards or to purchase a copy of the full specification, visit the following web sites www.iec.ch, www.ul.com, or www.astm.com.

Test Specification	Test Specification Description
IEC 61215	Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification Temperature Cycling: -40°C to +85°C for 50 and/or 200 cycles *Humidity Freeze: -40°C to +85°C & 85% RH for 10 cycles Damp Heat: +85°C & 85% RH for 1,000 hours *Current test chart shows humidity control during the ramp
IEC 61646	Thin-film terrestrial photovoltaic (PV) modules - Design qualification Temperature Cycling: -40°C to +85°C for 50 and/or 200 cycles *Humidity Freeze: -40°C to +85°C & 85% RH for 10 cycles Damp Heat: +85°C & 85% RH for 1,000 hours *Current test chart does not show humidity control during the ramp
IEC 61730	Photovoltaic module safety qualification Part 2: Requirements for testing
IEC 62108	Concentrator photovoltaic (CPV) modules and assemblies - Design qualification
UL 1703	Flat Plate Photovoltaic Modules and Panels
ASTM E1171	Test methods for photovoltaic modules in cyclic temperature and humidity environments

The above list is not intended to be inclusive of all test standards related to solar panel testing. If you have a test requirement for other standards that are not listed above, contact us to see how we can meet your needs.

Energy Savings

CSZ Solar Panel Test Chambers Provide Up To 65% Energy Savings

Using CSZ's patented Tundra® refrigeration system provides the ability to test product down to -40 °C with a load and a single compressor where traditional test chambers for solar panel testing require a cascade refrigeration system. Documented energy savings of 47-65% were obtained by following the test specifications below with CSZ test chambers and a Fluke power monitoring system.

Test Spec	Energy Savings	No. of Cycles/ No. of Days	Cost Savings
Temperature Cycling Test			
IEC 61646	47%	50 or 200 cycles 6 or 25 days*	Up to \$14.80 per day
IEC 61215			
Humidity Freeze Test			
IEC 61646	65%	10 cycles 10 days	Up to \$11.64 per day
IEC 61215	62%		Up to \$9.92 per day

*Time based upon a chamber that meets that max ramp rate requirements.
Data compares the energy savings of operating at 15HP cascade compared to a 10HP Tundra in an empty chamber.
Cost savings calculations based upon 13 cents per Kwh.

A total of \$560 - \$860 dollars can be saved completing each of the above tests in a CSZ chamber with Tundra system.

What we need to know to provide you with the right test chamber for your application.

- How many panels/modules are being tested? What are the dimensions and weight of the panels/racks?
- Which test specifications are you testing your product to meet?
- Do you want to test to the maximum rate the specification allows or the minimum? Test time can be significantly reduced with a chamber that can meet the maximum ramp rate. However a chamber that meets the minimum requirements will be less expensive.



Options to consider

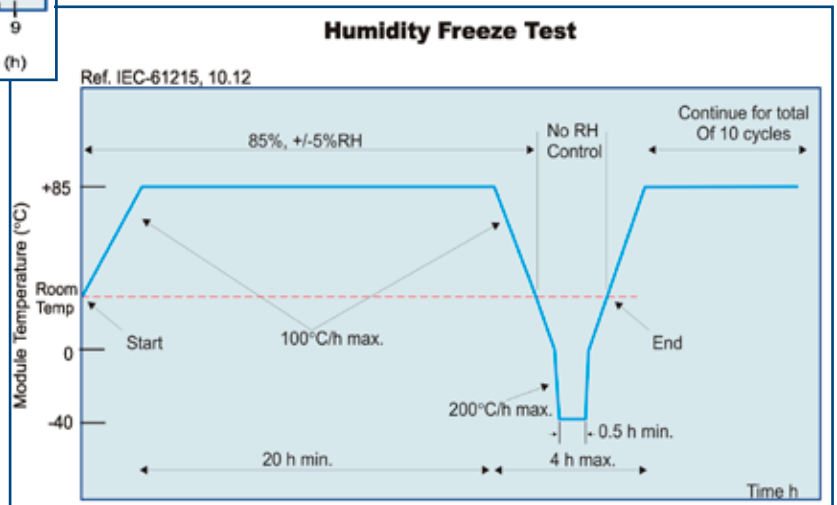
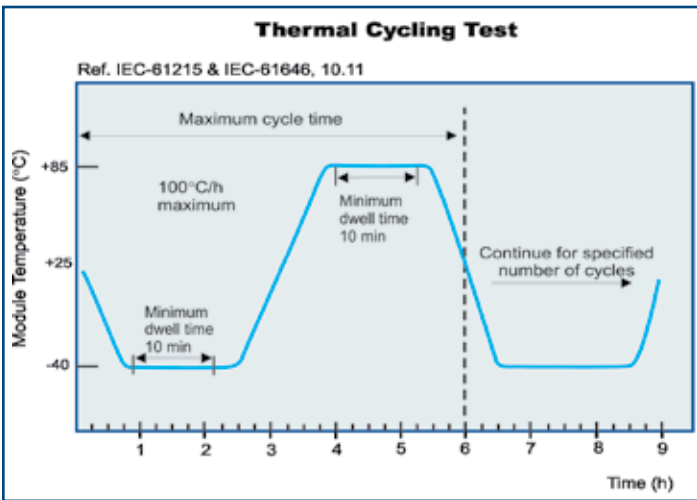
- Damp Heat tests take approximately 42 days to complete based upon 1,000 hrs. If speed of testing is important to you consider purchasing a separate chamber since this test takes the longest to complete.

If you do not have capital available to purchase another chamber or do not have the time to complete the test, consider sending your products to us and we can provide testing through our A2LA Accredited test laboratory, CSZ Testing Services.

IEC 61215

Crystalline Silicon Terrestrial Photovoltaic (PV)

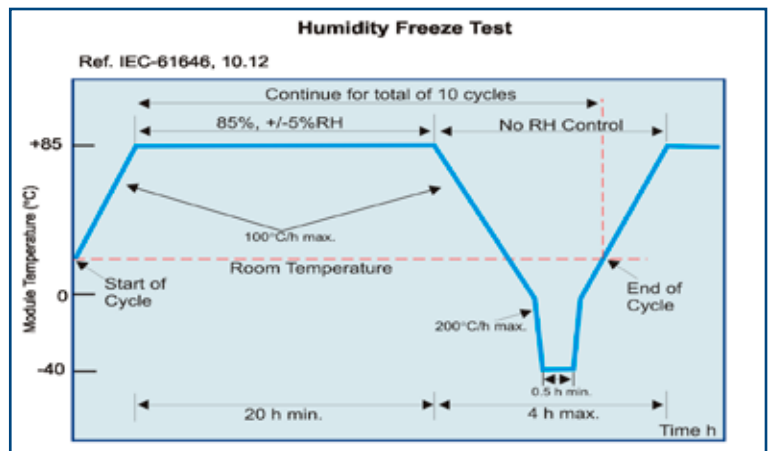
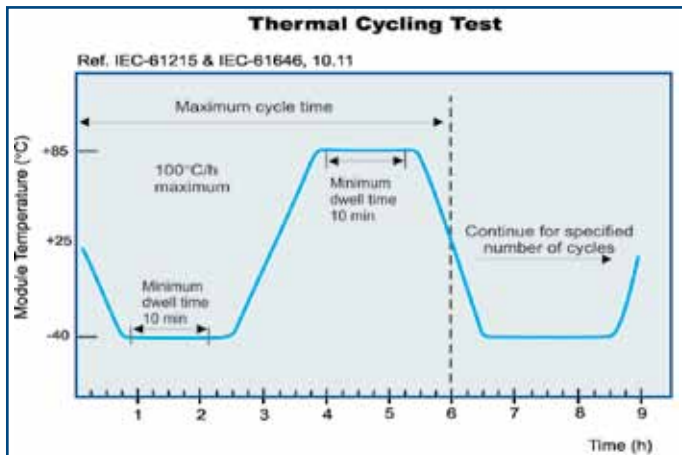
Section	Title	Description
10.11	Thermal Cycling	Ramp down from 25°C to -40°C at 100°C/h max., soak for a of 10 minutes. Ramp up to 85°C at 100°C/h or less. Soak a minimum of 10 minutes. Then return to 25°C, 6 hour maximum cycle time. Repeat for specified number of cycles per figure 1 “Qualification Test Sequence” of the IEC-61215 test specification (50 and/ or 200 cycles). Current test profile chart is based upon module temperature
10.12	Humidity Freeze	Ramp from room temperature with 85%RH to 85°C/ 85%RH at 100°C/h max. Soak for 20 hours minimum. Ramp down to ambient with 85% RH at 100°C/h max. Ramp down to 0°C at 100°C/h max then to -40°C at 200°C/h max. Soak for 30 minute minimum. Ramp from -40°C to 0°C at 200°C/h max and from 0°C to 25°C at 100°C/h max. Humidity must be maintained at 85% ±5% whenever temperature is 25°C or higher. No. of Cycles: 10 cycles Current test profile chart is based upon module temperature
10.13	Damp Heat	85°C, ±2°C, 85%, ±5% RH No of Cycles/Time: 1,000 hours



IEC 61646

Thin-Film Terrestrial Photovoltaic (PV) Modules

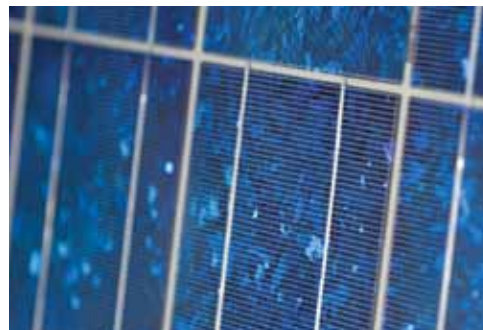
Section	Title	Description
10.11	Thermal Cycling Test	Ramp down from 25°C to -40°C at 100°C/h max, soak for a minimum of 10 minutes. Ramp up to 85°C at 100°C/h or less. Soak for a minimum of 10 minutes. Then return to 25°C, 6 hour total cycle. Repeat for specified number of cycles per figure 1 “Qualification Test Sequence” of the IEC-61646 test specification (50 and/or 200 cycles. Current test profile chart is based upon module temperature
10.12	Humidity-Freeze Test	Ramp from room temperature to 85°C at 100°C/h max. Soak at 85°C/85%RH for 20 hours minimum. Ramp temperature down to 0°C at 100°C/h max then to -40°C at 200°C/h max. Soak for 30 minute minimum. Ramp from -40°C to 0°C at 200°C/h max and from 0°C to 25°C at 100°C/h max. Humidity control is not required during temperature transitions. No. of Cycles: 10 cycles Current test profile chart is based upon module temperature
10.13	Damp Heat Test	85°C, ±2°C 85%, ±5% RH for 1000 hours



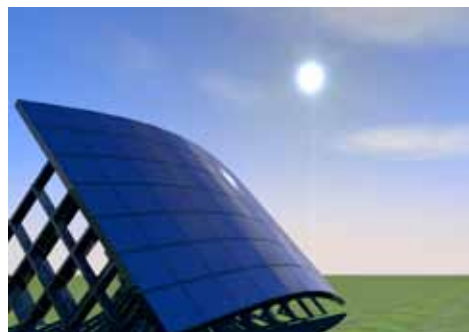
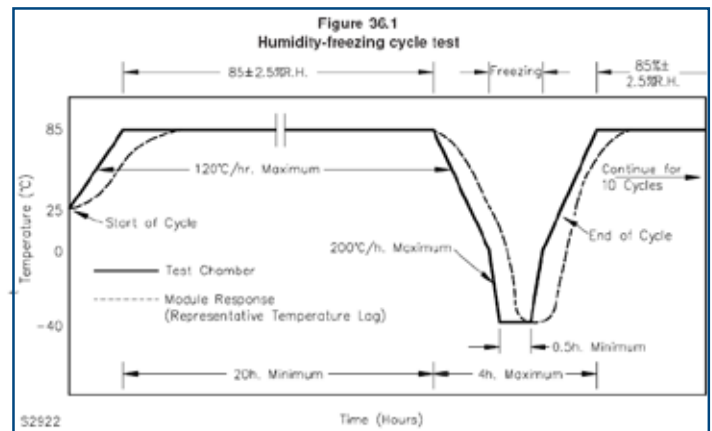
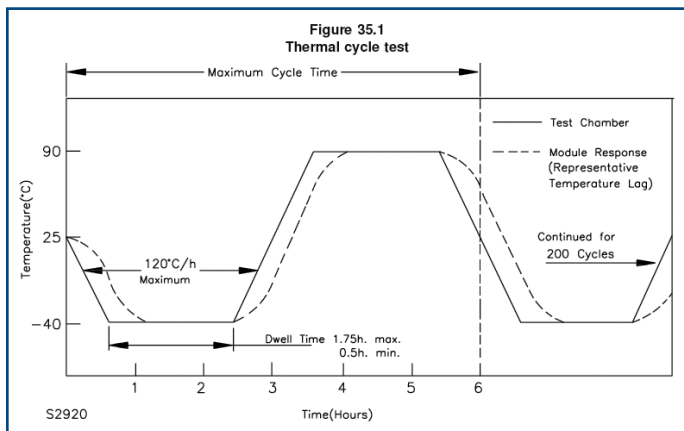
IEC 62108

Concentrator Photovoltaic (CPV) Modules and Assemblies

Section	Title	Description
10.6	Thermal Cycling Test	<p>Ramp from room temperature to -40°C within $\pm 3^{\circ}\text{C}$. Dwell 10 minutes. Ramp up to one of three options below within $\pm 3^{\circ}\text{C}$.</p> <p><u>Three Options for high temp:</u></p> <ol style="list-style-type: none"> 1. 85°C for 1,000 cycles 2. 110°C for 500 cycles 3. 65°C for 2,000 cycles <p>Dwell minimum of 10 minutes. 10-18 cycles per day.</p>
10.7	Damp Heat	<p>85°C, $\pm 2^{\circ}\text{C}$ 85%, $\pm 5\%$ RH for 1000 hours</p>
10.8	Humidity-Freeze Test	<p>Pre-Thermal Cycle Test Ramp from room temperature to -40°C within $\pm 3^{\circ}\text{C}$. Dwell 10 minutes. Ramp up to one of three options below within $\pm 3^{\circ}\text{C}$.</p> <p><u>Three Options for high temp:</u></p> <ol style="list-style-type: none"> 1. 85°C for 200 cycles 2. 110°C for 100 cycles 3. 65°C for 400 cycles <p>Ramp from room temp to one of the options below:</p> <p>Two Options for humidity/temp.</p> <ol style="list-style-type: none"> 1. 85°C / 85%RH for 20 cycles 2. 65°C / 85% for 40 cycles <p>Ramp from room temperature to maximum test time / 85%RH at $100^{\circ}\text{C}/\text{h}$ max. Soak for 20 hours minimum. Ramp down to 0°C at $100^{\circ}\text{C}/\text{h}$ max then to -40°C at $200^{\circ}\text{C}/\text{h}$ max. Soak for 30 minute minimum. Ramp from -40°C to 0°C at $200^{\circ}\text{C}/\text{h}$ max and from 0°C to 25°C at $100^{\circ}\text{C}/\text{h}$ max. Ramp back up to room temperature and repeat cycle accordingly. Humidity controlled at 85% when temperature is above 25°C.</p>



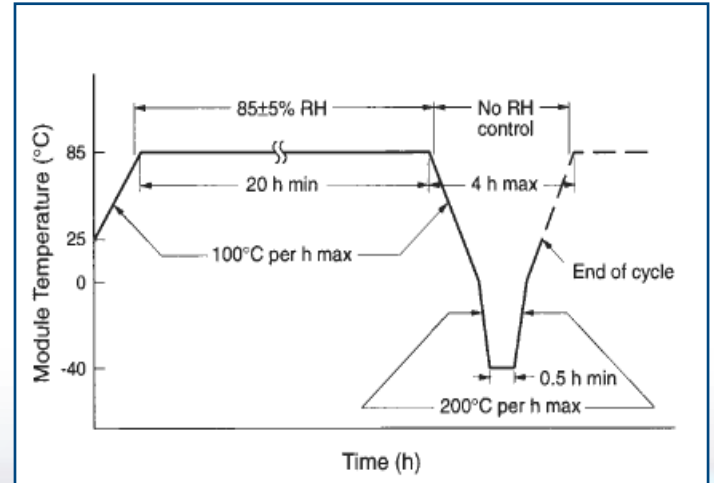
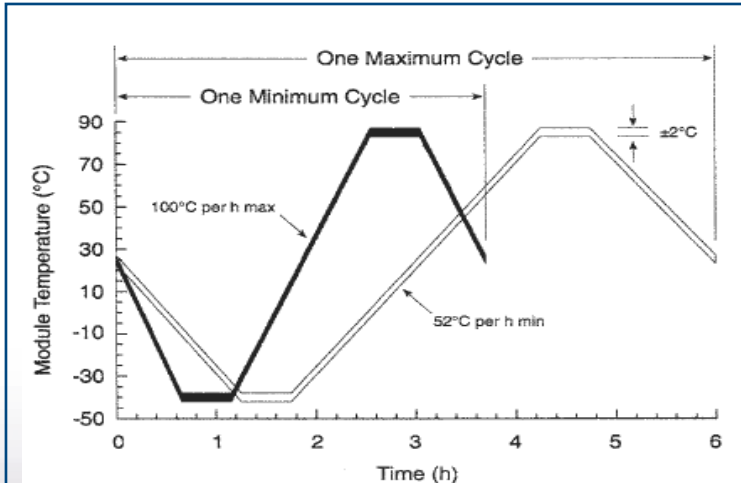
Section	Title	Description
35	Temperature Cycling Test	<p>Ramp from 25°C to -40°C. Dwell at -40°C for 30 min or until module temperature is within 2°C of chamber temperature. Soak can last no longer than 1 hr 45 min. Ramp from -40°C to 90°C. Dwell for 30 minutes or until temperature is within 2°C of chamber temperature. Soak can last no longer than 1 hr 45 min. Ramp from 90°C to 25°C. Total cycle not to exceed 6 hrs.</p> <p>All transitions not to exceed 120°C/hr.</p>
36	Humidity Test	<p>Ramp from room temperature to 85°C/ 85%RH at 120°C/h max. Soak for 20 hours minimum. Ramp down to 0°C at 100°C/h max then to -40°C at 200°C/h max. Soak for 30 minute minimum. Ramp from -40°C to 0°C at 200°C/h max and from 0°C to 25°C at 120°C/h max. Repeat the entire cycle for 10 cycles. Humidity control is not required during temperature transitions.</p>



ASTM E1171

Test Methods for Photovoltaic Modules in Cyclic Temperature and Humidity Environments

Section	Title	Description
6.5	Temperature Cycling Procedure	Ramp down from 25°C to -40°C at a change rate of between 100°C/h max and 52°C/h soak for a minimum of 30 minutes. Ramp from -40°C to 85°C at a change rate of between 100°C/h max and 52°C/h minimum. The cycle time is not-to-exceed 6 hours. Repeat cycle for 50 cycles. Perform Visual and Electrical Retest. Re-run cycle for 150 cycles
6.6	Humidity Freeze Cycle Procedure	Ramp from room temperature with 85%RH to 85°C/ 85%RH at 100°C/h max. Soak for 20 hours minimum. Ramp down to 0°C at 100°C/h max then to -40°C at 200°C/h max. Soak for 30 minute minimum. Ramp from -40°C to 0°C at 200°C/h max and from 0°C to 25°C at 100°C/h max. Repeat the entire cycle for 10 cycles.
6.7	Damp Heat Exposure Procedure	85°C, ±2°C 85%, ±5% RH for 1000 hours



CSZ is committed to your satisfaction every step of the way.

We are dedicated to our customers from the initial point of contact, fully understanding your unique needs, developing the right solution and delivering outstanding products and post-sale support.



CSZ has two manufacturing facilities in Cincinnati, OH with world-wide sales and service.

Your one stop solution for Environmental Chambers

- Temperature Cycling
- Humidity
- Stability Cabinets & Rooms
- Thermal Shock
- Stress-Screening
- Altitude
- AGREE Vibration
- HALT/HASS
- Freezers
- Liquid Chillers
- Wind & Rain
- Sand & Dust
- Other Temperature Management Solutions

Sizes range from benchtop to full walk-in/drive-in chambers.

Services

- Refrigeration Retrofits
- Controller Upgrades
- Preventative Maintenance
- Calibration Services

Testing Services

CSZ Testing Services is an A2LA Accredited Test Laboratory utilizing the latest test technology. We are your one stop source for all of your environmental simulation testing needs. Our testing laboratory is here to help with your product qualification testing, overflow testing and /or third party product validation. Testing capabilities include Temperature, Humidity, and/or Vibration, Thermal Shock, Burn-in, Radiator Testing, Altitude, Vibration, HALT/HASS, Shock, Salt Spray, and Cyclic Corrosion test. Serving you from two locations in Cincinnati, OH and Sterling Heights, MI.

FOR MORE INFORMATION please call CSZ Testing headquarters at 513-793-7774 or visit www.csztesting.com.



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