CONTROLLED ENVIRONMENTS

Series 5500

Standard and custom environments for testing, weighing, R&D, calibration, fabrication, conditioning, artifact display & storage. Available as uncontrolled dry boxes to fully integrated systems for precise, independent control of humidity and temperature from <5 to >98% RH and <40 to 135°F (5-55°C). Custom third parameter monitoring or control such as pressure, air velocity, ph and oxygen may also be incorporated.

GLOVE BOXES
NITROGEN DRY BOXES
DESSICATOR CABINETS
CONTROLLED HUMIDITY CHAMBERS
CONTROLLED TEMPERATURE CHAMBERS
FULL RANGE ENVIRONMENTAL CONTROL SYSTEMS

ets
electro-tech systems, inc.
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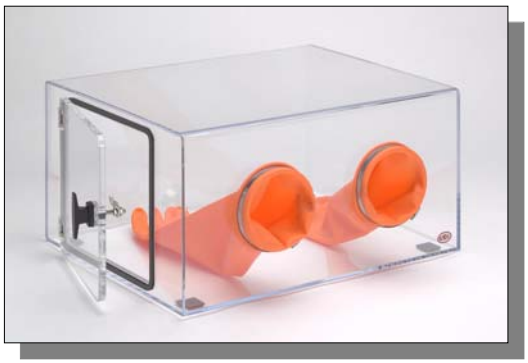
www.electrotechsystems.com

Features:

- Clear and white acrylic construction
  - Excellent visual characteristics
  - PS30 welded construction (museum quality)
  - Single and multiple access doors
  - System access ports
  - Available without or with gloves or iris ports
  - Available as metal-free working space



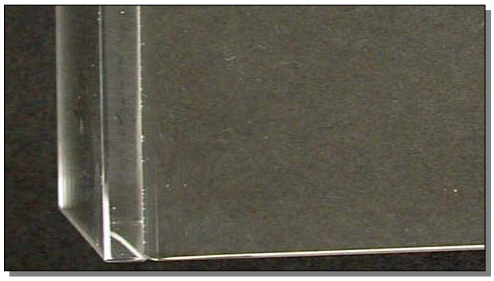
- Working volumes
  - 5503 3.75 cu. ft. (106 l)
  - 5506 9.0 cu. ft. (255 l)
  - 5518 13.0 cu. ft. (368 l)
  - 5532 13.0 cu. ft. (368 l)
  - 5538 Controlled Cabinets to 125 cu. ft. (3540 l) max

- Microprocessor PID and ON/OFF controllers
- Humidity & temperature operating systems
- Integrated Chambers include:
  - Microprocessor PID control
  - Humidity & Temp Operating Systems
  - Fluorescent Lighting
  - GFIC AC Power Outlet
  - Circulating Fan(s)
  - Thermal Protection
  - Available 3rd parameter monitoring or control

Description:

CHAMBER CONSTRUCTION - The construction method used is a function of the intended application. All seams are joined using a PS30 weld as shown below. This is the highest quality assembly method available and is commonly referred to as “museum quality” construction. Poron gaskets resistant to a permanent set when compressed are used for all door and hinged access port openings. In addition to the standard sizes listed below, custom chambers fabricated from static dissipative acrylic, polycarbonate or other material can be provided

Low cost solvent joints



ETS PS30 museum quality joints

Model 5503: The most cost effective chamber offered in the 5500 Series. The box is fabricated from .25” (6mm) clear acrylic with a 0.375” (8mm) left end cap plus a 0.5” (12mm) access door. The chamber body is wrapped and then welded to the end caps using PS30 joints and has a working volume of 3.75 cu. ft. (106 l). Clear acrylic construction provides excellent visibility from all sides. The Model 5503 includes a 12”x12” (30.5x30.5cm) opening and gasket-sealed door with ½-turn latch plus five access ports for operating systems, sensors, monitors and cables. Options include ON/OFF and PID Controls, Humidification, Dehumidification (dry nitrogen, desiccant, house air), Heating and Cooling. Dimensions are: 24”Wx15”Hx18”D (61x38x46cm). Custom widths up to 48” (122cm) can be fabricated. Chambers are available with or without 6” glove ports. Option packages are also available.

Model 5506: A general-purpose bench top chamber for laboratory and production use. Clear and white acrylic construction allows excellent internal visibility. The Model 5506 is large enough to accommodate testing, fabrication or storage of raw material, components, test equipment and assemblies while fitting onto a standard workbench. The chamber is fabricated from 0.25” (6mm) white acrylic (bottom, right side and rear panels), 0.375” (8mm) white acrylic (left side) and 0.375” (8mm) clear acrylic (top and front panels) using highly polished PS30 joints and has a working volume of 9 cu. ft. (255 l). The Model 5506 includes a 12”x12” (30.5x30.5cm) opening and gasket-sealed door with ½-turn latch plus five access ports for operating systems, sensors, monitors and cables. Options include Microprocessor (PID) Controlled Humidification, Dehumidification, plus Heating and Cooling operating systems. Dimensions are 36”Wx18”Hx24”D (90.5x46x61cm). Available with or without 8” glove ports. Option packages are also available.

Models 5518 and **5532:** These integrated controlled environment systems utilize the same platform, but differ in control, operating systems and performance. These are the largest standard chambers offered by ETS, having a working volume of 13 cu. ft. (368 l). The chambers are fabricated from 0.375” (12mm) clear and white acrylic using highly polished PS30 construction. A large internal work area, plus stability and versatility, make the chambers ideal for use in Biomedical, Pharmaceutical, Electrostatic, Electronic, Automotive,

EPA (filter weighting), R&D and other applications. Standard features include Equipment and Sample Doors, Fluorescent Lighting, GFIC AC Power Outlet, built-in Single (5518) and Multiple (5532) Ramping Microprocessor (PID) Controllers, Software (5532) and built-in Humidification, Dehumidification, Heating and Cooling Systems. External Dimensions are 54”W 22”Hx25.5”D (137x56x65cm). Useable working space is 39”Wx21.5”Hx21”D (99x55x53cm). Available with or without 8” glove ports.

GLOVE and IRIS PORTS – All chambers are available with or without ports. When equipped the standard gloves supplied are 6” (15cm), single piece 20 mil latex for the Model 5503 and 8” (20cm), natural rubber accordion sleeve with replaceable hands for the Models 5506, 5518 5532 and most customs. Natural rubber provides the best comfort and dexterity. Optional Hypalon gloves provide exceptional resistance to ozone, aging, oxygen, weathering and chemical products along with good mechanical and low temperature properties. Also available are Butyl, Viton and Nitrile gloves.

High quality 8” (20cm) iris ports are available where bare hand applications are required. These ports incorporate multiple overlapping layers of silicone rubber to provide excellent sealing against bare or gloved hands. Generally, iris ports will work with chamber humidity levels from 20% RH and above when ambient is around 50% RH.

OPERATING SYSTEMS – Operating systems are used to dehumidify, humidify, cool and heat the controlled environment. ETS offers a wide variety of operating systems to meet virtually all user requirements. These systems are available for use with all 5500 series Chambers. Refer to the Series 5400 Operating Systems data sheets

Dehumidification: The standard dehumidification systems use a desiccator in conjunction with a pump and desiccator column. The Models 5503, 5506 and 5518 typically utilize a 1-lb (0.45 kg) column of indicating Calcium Sulfate with a 0.6 cfm pump while the Model 5532 utilizes a 2.5-lb (1.125 kg) column in conjunction with a 1.2 cfm pump. These are closed-loop systems where the pump draws air from the chamber passes it through the desiccator for drying and then returns it back into the chamber. Desiccant based systems are capable of reducing and maintaining the humidity level in a properly sealed chamber to less than 10% RH.

A dry gas system is available for very dry and/or inert environments. This option consists of a solenoid valve and pressure regulator that is modulated by the humidity controller. Dry nitrogen, which is capable of reducing the environment to near 0% RH, is commonly used. Dry air or other gases may also be used depending upon application availability.

A self-regenerating desiccant system using molecular sieve and requiring an external 50-100 psi air supply is also available. This is an open-loop system that consists of dual molecular sieve columns that are alternately dried by pressurized air and dried air tapped off the column currently drying the chamber. This system is capable of maintaining the humidity level in a properly sealed chamber to below 10% RH.

Humidification: The standard humidification system utilizes ultrasonic technology. The humidifier supplied with the Models 5503, 5506 and 5518 chambers is a single head unit with a self-contained ½ gallon water tank capable of raising the humidity level to 100% at room temperature. The system incorporated into the Model 5532 is a single head, high-capacity humidifier supplied with a deionizing column to use with tap water for continuous operation

plus a 5-gallon (19.4 l) tank for locations where tap water is not readably available. Applications requiring high humidity, very large chambers or significantly reduced or elevated temperatures, an optional 3-head version is available.

Heating: Electric heating elements are used to provide heat for all Series 5500 chambers. The capacity of the heaters is determined by the size of the chamber. Normally, single or multiple heaters having a total capacity of 250, 500 or 800 Watts are used. The heating elements are mounted in aluminum or stainless steel vented enclosures with ceramic standoffs. The assembly also includes circulating fan(s), auxiliary GFIC AC power outlet, Power On indicator and a thermal protection switch to limit the maximum temperature to 135°F (55°C). Two sizes are available: The Model 5474 is used for the Model 5503 and 5506 chambers and the Model 5474L is incorporated into the Model 5518 and 5532 chambers. Either version is available for use with custom systems.

Cooling: To overcome fluctuations in the surrounding environment and overcome the heat load within a chamber some level of cooling may be required. Many applications require moderate levels of cooling or stability around ambient. The cooling options available with Series 5500 chambers are defined in the respective data sheets. Standard ETS chambers are not designed for use at temperatures below 40ºF for prolonged periods of time. Cooling can be achieved using several different systems including liquid-to-gas conversion, thermoelectric and refrigeration.

The most cost effective and fastest responding system is liquid CO_2. High pressure CO_2 is passed through a solenoid valve then through a small orifice. The rapid evaporation of the liquid results in a very cold gas. Low temperatures within a chamber can be achieved in this manner, but CO_2 consumption will be high. This type of system is best for short-term applications where temperatures above freezing and low humidity need to be maintained. Liquid nitrogen cooling is also available and requires a cryogenic valve and high-pressure hose.

Thermoelectric cooling (Pelletier effect) is ideal for long-term applications requiring stability. 5500 Series Chambers (non-insulated) restrict the practical cooling capacity to a maximum of approximately 27°F (15°C) below ambient without any significant internal heat load. Temperature levels can be maintained to better than 1°(F or C) by continuously operating the thermoelectric unit(s) and modulating electric heaters with a microprocessor controller. To achieve the required level of cooling multiple thermoelectric units may be cascaded and insulation added to increase efficiency. Capacities of 100, 150, 200, 300 and 400 Watts (342, 512, 684, 1026 and 1368 BTUs) are available.

Custom high-capacity cooling is available with the Series 5500 using refrigeration with a cooling capacity of 645 Watts (2200 BTUs). Like the thermoelectric system, it operates continuously with controlled heaters to maintain precise temperature. Since the non-insulated acrylic chamber precludes utilizing a defrost cycle the evaporator must be kept above freezing to minimize ice formation that can reduce both cooling efficiency and humidity stability.

Cooling is typically the costliest parameter to control, therefore, it is best to first determine the amount of actual cooling required before selecting a system. Standard ETS chambers have the following surface areas:

ETS Chamber	Surface Area – in^2
Model 5503	2124
Model 5506	3888
Model 5518/5532	4827

The following table lists the recommended cooling capacity needed for temperature differentials of 5-20°C (9-36°F) for non-insulated, acrylic chambers having a total surface area ranging from 2000-8000 in^2 (12.9-51.6 m^2) and assuming an inherent heat load of 15 Watts.

Area (in^2)	ΔT - °C			
	5	10	15	20
2000	60	125	200	275
3000	80	175	275	400
4000	100	225	375	500
5000	125	275	450	650
6000	150	325	525	750
7000	175	375	625	900
8000	200	425	700	1000

HUMIDITY/TEMPERATURE CONSIDERATIONS – When selecting a chamber for a specific controlled humidity and temperature application, the dew point, operating systems, controller interaction and humidity/temperature limitations must be taken into account. The humidity and temperature limits specified for each chamber are based on either temperature or humidity being at standard conditions (50±10%RH or 72±10°F).

Dew point: The humidity and temperature level where condensation occurs is known as the dew point. Hence, the actual humidity that can be maintained at a given temperature is first and foremost determined by the dew point. The dew point chart below covers the humidity and temperature range of the Series 5500 chambers.

To read the chart select the temperature and relative humidity required. The number in the box where the temperature column and relative humidity intersect is the temperature where condensation will start to occur (dew point).

Humidity & Temperature Systems: Operating system capacity available with the Series 5500 chambers is the second limiting factor. A desiccant based dehumidification system can ideally reduce humidity to less than 10% RH while a dry gas system is capable of reducing the humidity to close to 0% in a tightly sealed chamber. If the chamber is also being heated the heat will assist in the drying process. However, when cooling, condensation almost always occurs and this small amount of moisture can overwhelm the drying capacity of a desiccant dehumidification system. For low humidity applications where maximum cooling is required a dry gas system is the most appropriate choice.

TEMPERATURE Deg C

RELATIVE HUMIDITY RH	0	5	10	15	20	25	30	35	40	45	50	55	60
1	-50.42	-47.26	-44.13	-41.03	-37.96	-34.93	-31.92	-28.94	-25.99	-23.07	-20.19	-17.33	-14.49
5	-35.30	-31.64	-28.00	-24.40	-20.82	-17.26	-13.73	-10.22	-6.74	-3.29	0.14	3.55	6.93
10	-28.06	-24.14	-20.25	-16.38	-12.54	-8.71	-4.91	-1.13	2.63	6.37	10.09	13.78	17.45
15	-23.59	-19.51	-15.46	-11.42	-7.40	-3.41	0.57	4.53	8.47	12.39	16.29	20.17	24.04
20	-20.31	-16.11	-11.93	-7.77	-3.62	0.50	4.61	8.71	12.78	16.84	20.88	24.91	28.91
25	-17.69	-13.40	-9.12	-4.85	-0.61	3.63	7.85	12.05	16.23	20.41	24.56	28.70	32.83
30	-15.51	-11.14	-6.77	-2.42	1.92	6.24	10.55	14.84	19.13	23.39	27.65	31.89	36.11
35	-13.64	-9.19	-4.75	-0.32	4.09	8.49	12.88	17.26	21.62	25.97	30.31	34.64	38.95
40	-11.99	-7.47	-2.97	1.52	6.01	10.48	14.94	19.38	23.82	28.25	32.66	37.07	41.46
45	-10.51	-5.94	-1.38	3.18	7.72	12.25	16.78	21.29	25.79	30.29	34.77	39.25	43.71
50	-9.18	-4.55	0.06	4.67	9.27	13.86	18.45	23.02	27.59	32.14	36.69	41.23	45.75
55	-7.96	-3.28	1.38	6.04	10.70	15.34	19.98	24.60	29.23	33.84	38.44	43.04	47.63
60	-6.83	-2.11	2.60	7.31	12.01	16.70	21.39	26.07	30.74	35.41	40.07	44.72	49.37
65	-5.79	-1.02	3.73	8.48	13.23	17.97	22.70	27.43	32.15	36.87	41.58	46.28	50.98
70	-4.81	-0.01	4.79	9.58	14.37	19.15	23.93	28.70	33.47	38.23	42.99	47.74	52.49
75	-3.90	0.94	5.78	10.61	15.44	20.26	25.08	29.90	34.71	39.52	44.32	49.12	53.91
80	-3.03	1.84	6.71	11.58	16.45	21.31	26.17	31.02	35.88	40.73	45.57	50.42	55.26
85	-2.22	2.69	7.60	12.50	17.40	22.30	27.20	39.02	36.99	41.87	46.76	51.65	56.53
90	-1.44	3.50	8.44	13.37	18.31	23.24	28.18	33.11	38.04	42.97	47.89	52.82	57.74
95	-0.70	4.27	9.24	14.21	19.17	24.14	29.11	34.08	39.04	44.01	48.97	53.93	58.90
100	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00

Humidification is even more difficult to achieve at the temperature extremes. Cooling naturally tries to reduce humidity. Injecting high levels of moisture causes ice to build up which in turn reduces the cooling capacity. Conversely, elevated temperatures dry the environment. Increasing humidifier capacity can add several percent, but as temperatures increase above 100°F (38°C) the maximum humidity that can be achieved approaches 85-90%.

CONTROLLERS - The type of controller and how it is programmed determines how precise the desired humidity and temperature can be maintained. Due to the nature of the operating systems ON/OFF controllers can provide reasonably good dehumidification and cooling control because these parameters are generally slow reacting and do not tend to significantly overshoot the set point, On the other hand, ultrasonic humidification and heating do tend to overshoot the set point limiting the ability of ON/OFF controllers to provide stable control. Ultrasonic humidifiers are fast reacting while electric heaters retain heat after being turned off.

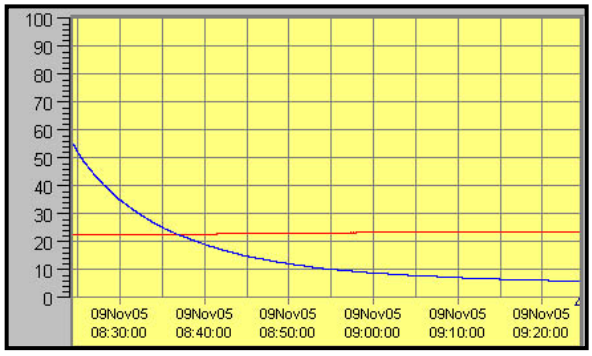
Microprocessor controllers are capable of automatically learning the process and then pulse the AC power to the respective operating system to achieve precise control of the process. With integrated systems such as the Models 5518 and 5532 the microprocessor controllers are preprogrammed at the factory to provide optimum chamber performance for typical applications. Chambers with individual operating systems and controllers are also preprogrammed. All controllers can be fine tuned at the factory to fit the user's specific application. The user may also fine-tune each parameter for optimal performance.

All ETS microprocessor controllers can be set to provide either ON/OFF or PID control. The only dedicated ON/OFF controllers offered are the Model 5311 single point dry gas system and the Model 5112 Dehumidifier Controller. With proper air circulation, ETS chambers are capable of independently maintaining humidity and temperature to better than 1% RH and 1° (F or C). Refer to the Series 5000 Controller data sheets for specifications

Performance:

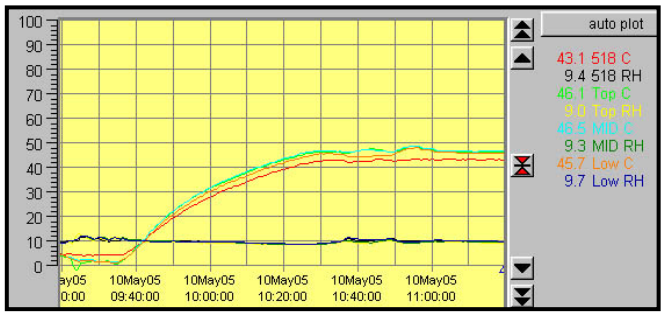
The time required for a chamber to reach and then stabilize around the set point is a function of many factors including, but not limited to, the following: Control of required humidity, temperature or both level(s) above or below ambient; humidity and/or temperature load; stability of the outside environment; chamber integrity (air leaks); glove movement, door openings; air circulation etc.

The following charts are examples of the time typically required to reach set point, stability and humidity/temperature gradients of an ETS Model 5518 Controlled Environment Chamber using the optional CALCOMMS software package. For individual chamber performance refer to the respective chamber data sheets.

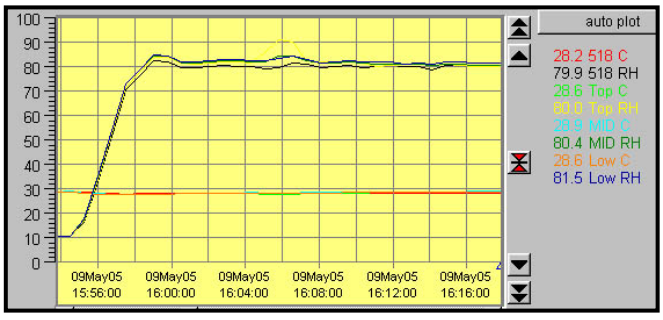


Rate of decrease

Rate of increase



Increase RH, constant temperature



Increase temperature, constant RH

Specifications:

For chamber or integrated controlled environment system specifications and performance refer to the respective data sheets.

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