SERIES 5500 OVERVIEW

GLOVE BOXES
NITROGEN DRY BOXES
DESSICATOR CABINETS
CONTROLLED HUMIDITY CHAMBERS
CONTROLLED TEMPERATURE CHAMBERS
HUMIDITY & TEMPERATURE CONTROLLED CHAMBERS
CONTROLLERS AND OPERATING SYSTEMS

ETS offers three standard size acrylic chambers of 3.75, 9.0 and 13.0 cu. ft. (106, 255 & 368 liters) plus custom designed chambers (shown above) up to 120 cu. ft. (3540 l). All chambers are fabricated using PS30 (a welded seam) construction for strength, visibility and years of dependable service. Chambers may be ordered with or without glove ports and are available in both 115 and 230 VAC versions. Uses include weighing, testing, storage, fabrication and conditioning for consumer product development, biomedical, pharmaceutical, automotive, electronic, electrostatic, DOD, food analysis, university research and many other applications. Uses can vary from a basic uncontrolled box to full range precision humidity and temperature control. ETS chambers offer independent control of humidity from <2 to >98% RH and temperature from <41-122°F (5-50°C). Third parameter monitoring can also be incorporated. When selecting or designing an environment please note that equipment and samples placed inside the environment may have an impact on the conditions that can be maintained and the time required to increase or decrease to the set point. Any item that adds heat or humidity to the environment will have an impact on performance. Chamber performance pertains to the ability of the chamber to reach and then hold a given level along with gradients. It is not only a function of the chamber, but the ambient humidity and temperature, operating systems and controllers used.

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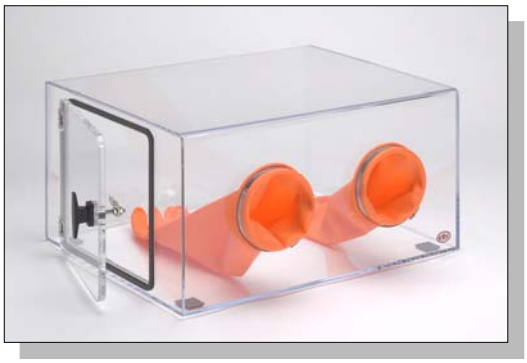
Features:

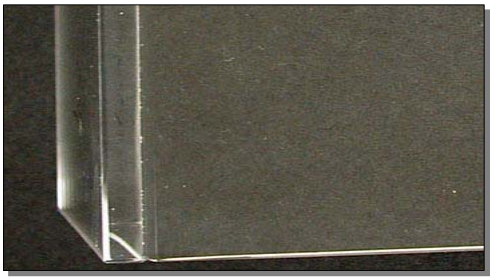
- Working volumes
  - 5503 3.75 cu. ft. (106 l)
  - 5506 9.0 cu. ft. (255 l)
  - 5518 13.0 cu. ft. (368 l)
  - 5532 13.0 cu. ft. (368 l)
  - 5500-8000 To 125 cu. ft. (3540 l) max
- Integrated chambers include
  - Microprocessor PID & On/Off control
  - Humidity & temperature control systems
  - Fluorescent lighting
  - GFIC AC power outlet (115V only)
  - Circulating fans
  - Thermal protection switch
  - Optional software
  - Optional 3rd parameter monitoring
- Humidity & temperature option packages include
  - Low humidity control
  - Elevated humidity control
  - Full range humidity control
  - Humidity control with elevated temperature
  - Full range humidity & temperature control
- 115 or 230 VAC operation
- Clear and white acrylic construction
- Excellent visual characteristics
- PS30 welded seam construction
- Single and multiple access doors
- Cable pass-thru and multiple access ports
- Available without or with glove ports
- Microprocessor, touch screen & ON/OFF controllers
- Single & multiple ramping functions
- Third parameter monitoring
- Optional antechambers
- Optional HEPA filtering
- Alternate chamber materials available



Description:

CHAMBER CONSTRUCTION - 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 doors and hinged access port openings. In addition to standard acrylic, custom chambers fabricated from static dissipative acrylic, polycarbonate or other material can be provided.

Low cost solvent joints



ETS PS30 museum quality joints

All ETS chambers are available in 115 and 230 VAC.

Series 5503: With external dimensions of 24”W x 15”H x 18”D (61x38x46cm) and a working volume of 3.75 cu. ft. (106 l) the 5503 is the smallest standard chamber offered by ETS. The chamber body is wrapped and then welded to the end caps using PS30 joints. Clear acrylic construction provides excellent visibility from all sides. The 5503 includes a 12”x12” (30.5x30.5cm) access door with gasket seal, ½-turn latch and five access ports for operating systems, sensors, monitors and cables. Options include ON/OFF and PID controllers, humidification, dehumidification, heating and cooling. Chambers may be ordered with or without 6” glove ports as freestanding enclosures, with customer selected controllers and operating systems or with option packages covering frequently requested set ups.

Series 5506: The 5506 is a general-purpose 9 cu. ft. (225 l) acrylic bench top chamber designed for laboratory and production applications. Clear and white acrylic construction allows excellent internal visibility. Users may select from a wide array of controllers and operating systems to meet their exact requirements. The chamber is large enough to accommodate equipment, fixtures, samples, assemblies and other items while fitting onto a standard workbench. Uses can vary from a basic uncontrolled box to full range precision humidity and temperature control. Accessories can include PID or On/Off controllers along with humidification, dehumidification, heating and cooling systems. The 5506 includes a 12”x12” access door with gasket seal, ½-turn latch plus fittings and pass through port. Dimensions are 36”W x 18”H x 24”D (90.5x46x61cm) and the chambers are available with or without 8” glove ports. Option packages are available covering frequently requested set ups.

Model 5518: The 5518 is an integrated environment with a working area of 13 cu. ft. (368l) excellent visibility and built-in humidity and temperature control. The system is designed for users that require precise control of humidification, dehumidification and heating but do not require precision, long-term cooling, multiple ramping or computer control. The Model 5518 independently maintains humidity levels from <10 to >98% RH and temperature from <32 to 122ºF (0-50ºC) when used with user supplied liquid CO_2 (with dip tube), or from ambient to 50°C at 23ºC ambient.

Model 5532: The 5532 is designed to accommodate equipment and material requiring a precise, stable environment, excellent visibility and a large internal work area (13 cu. ft., 368 l). Uses include weighing, testing, storage, fabrication and conditioning for consumer product development, biomedical, pharmaceutical, automotive, electronic, electrostatic, DOD, food product analysis, university research and other applications. Standard features include equipment and sample doors, fluorescent lighting, GFIC AC power outlet, built-in ramping microprocessor (PID) controllers, software for computer interface and control and built-in precision humidification, dehumidification,

heating and cooling systems. The system will independently maintain humidity from <10 to >98% RH and temperature from <60 to >122ºF (16-50ºC) when used in an area maintained at 23°C.

GLOVE and IRIS PORTS – All chambers are available with or without hand access ports. Standard gloves are natural rubber which provide comfort and dexterity. The 5503 Series includes 6" diameter (15cm), single piece latex gloves while the 5506 Series, Models 5518, 5532 and most customs are supplied with 8" accordion sleeves with replaceable hands. Other optional glove types are available including hypalon which provides exceptional resistance to ozone, aging, oxygen, weathering and chemical products along with good mechanical and low temperature properties. Butyl, Viton and Nitrile gloves are also available. 8" Iris Ports may be selected where bare-hand access or greater dexterity is required. Generally, iris ports are not recommended for humidity levels below 20% RH.

OPERATING SYSTEMS - ETS offers a wide variety of operating systems including humidification, dehumidification, heating and cooling. These are typically used with ETS 5000 Series Controllers and 5500 Series Chambers. Each system has its own unique benefits. Selection should be based on chamber size, conditioning requirements, desired operational range and the range of multiple systems used at the same time (what humidity level needs to be maintained at what temperature and for how long). Ultimately, the level that can be achieved within an environment depends on the systems selected, size of the environment, conditioning time, equipment or samples inside the chamber, ambient conditions and set-point. The operational range of ETS systems are always specified at ambient conditions.

Dehumidification: The standard dehumidification system used by ETS is a desiccant/pump system. The 5503, 5506 and 5518 typically utilize a 1-lb (0.45 kg) column of indicating calcium sulfate while the Model 5532 utilizes a 2.5-lb (1.125 kg) column. 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 flow regulator and is modulated by a humidity controller. Dry nitrogen, which is capable of reducing the environment to less than 1% RH, is commonly used. Dry house air or other gases may also be used depending upon application and availability. A self-regenerating system using molecular sieve and requiring an external 50-100 psi air supply is also available. This system 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 RH level in a properly sealed chamber to less than 7% RH.

Humidification: The standard ETS humidification system utilizes ultrasonic technology. The humidifier supplied with the 5503, 5506 and 5518 chambers is capable of raising the humidity level to greater than 98% at room temperature. The system incorporated into the Model 5532 is a single head, high-capacity humidifier supplied with a deionizing column allowing the use of filtered tap water for continuous operation plus a 5-gallon (19.4 l) tank for locations where tap water is not readably available. For applications requiring continuous high humidity, very large chambers or significantly reduced or elevated temperatures, an optional 3-head version is also available.

Heating: Electric heaters are used for all Series 5500 chambers. The capacity of the heaters is determined by the size of the chamber. Single or multiple heaters having a capacity of 250 or 500 Watts are typically used. The heating elements are mounted in vented enclosures with ceramic standoffs. The assembly also includes circulating fans, auxiliary AC power outlet, Power On indicator and a thermal protection switch to limit the maximum temperature to 135°F (55°C). The Model 5474 is used for the 5503 and 5506 chambers while the Model 5474L is incorporated into the Model 5518, 5532 and larger chambers. Either version is available for use with custom designed systems.

Cooling: To overcome fluctuations in the surrounding environment and the heat load within a chamber some level of cooling may be required. Many applications require moderate levels of cooling or stability at or near ambient. Standard ETS chambers are not designed for use at temperatures below 45ºF for prolonged periods of time. Cooling can be achieved using different systems including thermoelectric and liquid-to-gas conversion. Thermoelectric cooling (Pelletier effect) is ideal for long-term applications requiring stability and precision. 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

ETS chambers are not insulated restricting the practical cooling capacity to a maximum of approximately 45°F (7°C) when using thermoelectric cooling and 0°F when using liquid CO_2. 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.

Temperature levels can be maintained to better than 1°C by continuously operating the thermoelectric units and modulating the heating system with an ETS microprocessor controller. To achieve the required level of cooling multiple thermoelectric units may be cascaded to increase efficiency. Capacities of 150, 200, 300 and 400 Watts (512, 684, 1020 and 1368 BTUs) are available. 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 AND TEMPERATURE CONSIDERATIONS – When selecting a chamber for a specific controlled humidity and temperature application, the dew point, operating systems, controller 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±5%RH and 72 ±5°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 following dew point chart 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 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. Humidification is even more difficult to achieve at temperature extremes.

TEMPERATURE Deg C

RELATIVE HUMIDITY	0	5	10	15	20	25	30	35	40	45	50	55	60
RH													
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

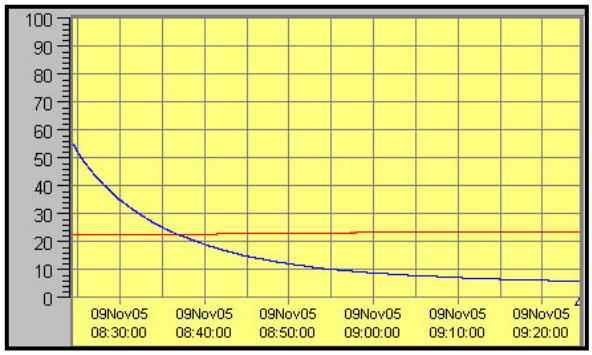
CONTROLLERS - The type of controller selected and how it is programmed will determine how precisely the desired humidity and temperature levels can be maintained. All ETS microprocessor controllers can be set to provide either ON/OFF or PID control. The only dedicated ON/OFF controllers are the Model 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). Microprocessor controllers are capable of automatically learning the process and then pulsing 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 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.

ON/OFF controllers can provide reasonably good dehumidification and cooling control because these parameters are slow reacting. Ultrasonic humidification and heating tend to overshoot the set point limiting the ability of ON/OFF controllers to provide stability.

PERFORMANCE:

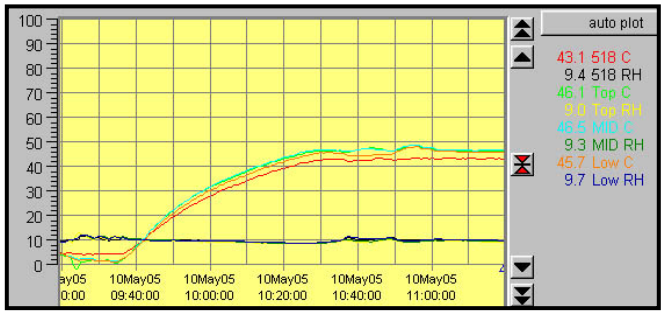
The time required for a chamber to reach and then stabilize around the set point is a function of many factors including, but not limited to, the following: Control of required humidity, temperature or both level(s) above or below ambient; humidity and/or temperature load; stability of the outside environment;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

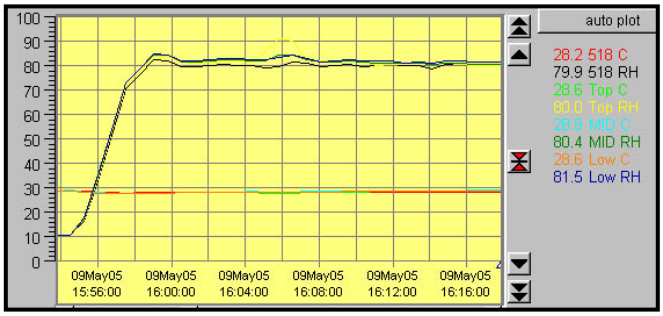


Rate of decrease

Rate of increase



Increase RH, constant temperature



Increase temperature, constant RH

SPECIFICATIONS - For additional information on ETS chambers, controllers and operating system performance and specifications please see the respective data sheets which are available on our Web Site at www.electrotechsystems.com

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