

# *Thunder Scientific Corporation*



## *Model 2900*

*Automated "Two-Pressure"  
Humidity Generation System*

# Model 2900

## Automated “Two-Pressure” Humidity Generation System

### FEATURES

- Traceable to SI <sup>1</sup>
- 0.5% of Reading RH Uncertainty <sup>6</sup>
- High Flow Capability of 50 L/min
- Based on the NIST “Two-Pressure” Principle
- ControLog<sup>®</sup> Embedded Automation Software
- Automatically Applies Enhancement Factors
- HumiCalc<sup>®</sup> with Uncertainty Mathematical Engine
- Generate Multipoint Profiles
- Externally Driven Chamber Fan
- Multi-point Touch LCD
- Fluid Jacketed Chamber Door
- Window Chamber Door Option (WDA)

### DESCRIPTION

The 2900 Humidity Generation System is a self-contained system capable of producing atmospheres of known humidity using the fundamental “two-pressure” principle. This system is capable of continuously supplying relative humidity, dew point, frost point, parts per million, or other calculated values for instrument calibration and evaluation as well as for precision environmental testing. This system will automatically generate manually entered humidity and temperature set points as well as user created multipoint profiles. All desired humidity’s, temperatures, flow rates, and time intervals may be programmed.

### PRINCIPLE OF OPERATION

The “two-pressure” humidity generation process involves saturating air or nitrogen with water vapor at a known temperature and pressure. The saturated high-pressure air flows from the saturator, through a pressure reducing valve, where the air is isothermally reduced to test pressure at test temperature. Humidity generation is dependent on the measurement of temperature and pressure, not on the amount of water vapor measured in the air. System uncertainty is determined by the temperature and pressure uncertainties, and on the stability and uniformity of the measurements. When setpoint equilibration has been reached, the indication of saturation temperature,



saturation pressure, test temperature, and test pressure, are used in the determination of all hygrometric parameters.

### COMPUTER/CONTROL SYSTEM

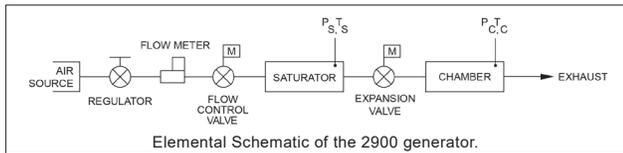
The 2900 Humidity Generation System encompasses a high-performance stand-alone Control System that performs all functions required for humidity generation and control. The Control System employs 24 bit I/O modules with integrated signal conditioning to acquire data and uses serial interfaces to transducers and stepper motors to control the operation of generating humidity. The Control System utilizes an embedded operating system in conjunction with specialty software to control and interface with the human to machine interface (HMI) computer running ControLog.

ControLog is an embedded software application that fully automates the operation of the 2900 Humidity Generation System and allows various device connections through a number of different interfaces. ControLog uses Thunder Scientific’s HumiCalc with Uncertainty as its mathematical engine for computing all humidity values and real-time uncertainties. Data from the generator and attached devices is automatically retrieved and stored for viewing in either numerical or graphical format in real time or post process. Data can be transferred off the system via a USB drive for further viewing, post processing and printing using an external Windows PC. The ControLog software also provides the primary interface to the operator

via the multi-point touch LCD which allows the user to select settings like, pressure, temperature, and flow units. Other settings are °C, °F, atm, Pa, hPa, kPa, L/min, L/hr, cfm and cfh. Humidity is calculated and displayed in percent relative humidity (%RH). The Parameter Tab is the primary interface for the user and is divided in two sections, Control and Calculated Humidity. Within each tab there are two different tiles, the Setpoint Tile is for the user to enter the desired setpoints and a Value Tile displays the Actual Value.



**Temperature Control:** The 2900 humidity generation system incorporates a water/glycol jacked test chamber for extremely stable temperature control. The system uses PID (proportional-integral-derivative) algorithms to control the temperature of the chamber fluid as it is pumped around the test chamber and through the saturator at the rate of approximately 14 gallons per minute by a magnetically coupled centrifugal pump.



**Pressure and Flow Control:** Pressure control and mass flow control are accomplished through computer actuation of electromechanical valve assemblies. Saturation pressure and mass flow are measured continuously and controlled using PID algorithms similar to those employed in temperature control.

**Calibration:** Proper calibration of the temperature and pressure transducers ultimately determines the accuracy of the generator. The humidity generator employs an integrated software calibration scheme allowing the 2900's probes and transducers to be calibrated while they are electrically connected to the humidity generator. Coefficients for each transducer are calculated by the computer and stored to memory.

## TEST CHAMBER

The 2900 humidity generating system incorporates a test chamber, with internal dimensions of 12" x 12" x 10". Test chamber pressure range is ambient. Access is available

through two 1.875" diameter ports located on the right side. An externally driven, variable speed, chamber fan is incorporated into the rear wall of the test chamber to reduce thermal gradients. The test chamber accommodates various solid-state sensors, sensing systems, chilled mirror hygrometers, as well as material samples for environmental testing. Virtually any humidity and temperature may be generated, for long periods of time, within the operational limits of the generator. The output or recording of the device under test may then be compared with the generator's data for analysis.



## APPLICATIONS

**Humidity Sensors and Chart Recorders:** Insert humidity probes through a test port in the chamber or install the sensing systems into the chamber to: determine humidity calibration accuracy and/or characterize humidity sensitivity by subjecting the humidity sensor to a variety of humidity levels; perform operational checks such as the sensing systems capability to correctly calculate and display other humidity parameters; determine the repeatability, stability, hysteresis, and drift characteristics of various humidity sensing systems.

**Chilled Mirror Hygrometers:** Install the actual chilled mirror head into the chamber or insert a sample tube through the test port and draw a sample through the chilled mirror head to: verify mirror temperature measurement calibration when the hygrometer is in thermal equilibrium with its environment; perform operational checks of the heat pump and optical components before and after mirror cleaning and balancing; determine whether the hygrometer is controlling the mirror deposit in the liquid phase or ice phase when operating at dew and frost points below 0 °C; determine if the hygrometer is correctly calculating other humidity parameters; determine hygrometer's repeatability, stability, and drift characteristics.

**Environmental Testing:** The 2900 can serve as a test bed for evaluation and R&D of humidity sensors, humidity sensing systems, and humidity sensitive products, e.g., polymers, composites, film, magnetic medium, pharmaceuticals, soil hydrology, consumables, electronics, optics, etc.

# Model 2900 Mobile

## Automated Humidity Generation System

### SPECIFICATIONS<sup>1</sup>

Relative Humidity Range: .....	10 to 95 %RH, 10 to 40 L/min
Relative Humidity Range: .....	95 to 98 %RH, 10 to 20 L/min
Frost Point Temperature Range: .....	-33.60 to 0 °C
Dew Point Temperature Range: .....	-36.94 to 70 °C
Chamber Fluid Temperature Range: <sup>2</sup> .....	-10 to 72 °C
Chamber Fluid Temperature Control Stability: <sup>3</sup> .....	0.002 °C
Chamber Temperature Uniformity: <sup>4</sup> .....	< 0.04 °C
Chamber Fluid Temperature Heating Rate: -10 to 72 °C.....	0.5 °C per Minute (avg.)
Chamber Fluid Temperature Cooling Rate: 72 to 0 °C.....	0.5 °C per Minute (avg.)
Chamber Fluid Temperature Cooling Rate: 0 to -10 °C .....	0.2 °C per Minute (avg.)
Temperature Specification: .....	0.027 °C
Gas Type: .....	Air or Nitrogen
Gas Pressure Rating: (MAWP) .....	175 psiG
Gas Flow Rate Range: .....	10 to 50 L/min
Gas Flow Rate Specification:.....	5% of full scale
Saturation Pressure Range: .....	Ambient to 160 psiA
Saturation Pressure Specification:.....	0.02% of full scale
Test Chamber Pressure Range: .....	Ambient to 17 psiA
Test Chamber Pressure Specification:.....	0.02% of reading
Display Resolution:.....	0.001
Chamber Window Option: .....	6" x 6" (152 mm x 152 mm)
Test Chamber Dimensions: .....	12" x 12" x 10" (304.8 mm x 304.8 mm x 254 mm)
Physical Dimensions:.....	22" H x 36" W x 23" D (558.8 mm x 432 mm x 584.2 mm)

### UNCERTAINTY<sup>5 & 6</sup>

RH Uncertainty: 10 to 95 %RH, 0 to 70 °C, 10 to 40 L/min.....	0.5% of reading
RH Uncertainty: 95 to 98 %RH, 0 to 70 °C, 10 to 20 L/min.....	0.5% of reading
Dew/Frost Point Uncertainty: < 0 °C, 10 to 40 L/min.....	0.05 °C
Dew Point Uncertainty: 0 to 70 °C, 10 to 40 L/min .....	0.08 °C
Temperature Uncertainty: .....	0.031 °C

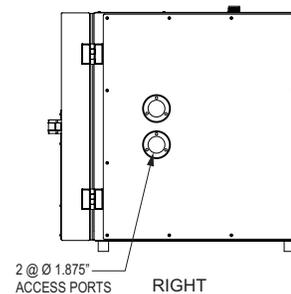
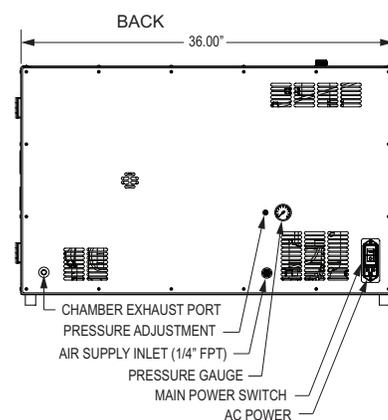
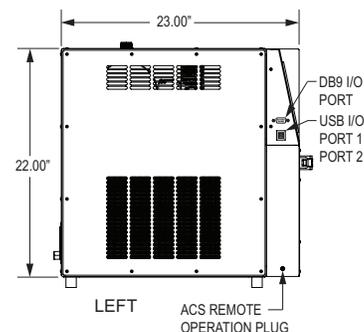
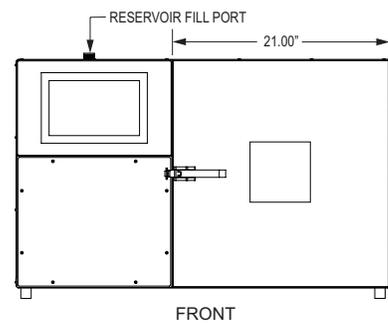
### UTILITIES

Electrical Power: .....	200-230/210-240 V~, 10 A, 1 Ø, 50/60 Hz
Gas Supply: .....	175 psiG @ 50 L/min

### ENVIRONMENTAL

Operating Temperature: .....	15 to 30 °C
Storage Temperature: .....	0 to 50 °C
Humidity: .....	5 to 95% RH Non-condensing

- Traceable to the International System of Units (SI) through a national metrology institute (NIST) recognized through a CIPM MRA.
- Only the glycol/water heat transfer fluid circulating around the chamber is controlled to setpoint via the saturation temperature probe. Chamber temperature inside the chamber may vary depending on door configuration, setup, and uniformity. Note: the 2900 can only operate for a finite amount of time at or below 0 °C.
- Temperature Control Stability is defined as the standard deviation over a 10-minute period, as measured by the saturation temperature control sensor after being at point for 60 minutes.
- Chamber Temperature Uniformity is defined as the maximum temperature difference between any two locations at a single point in time. Locations are within one inch of the chamber wall and within 2.5 inches of the chamber door. Using a minimum chamber fan speed of 25% for a temperature range of -10 °C to 72 °C when using fluid jacket door and ±10 °C from ambient when not.
- Chamber pressure at 1 atmosphere. Uncertainty values represent an expanded uncertainty using a coverage factor, k=2, at an approximate level of confidence of 95%. Uncertainty is not specified at temperatures below 0 °C or at flow rates below 10 L/min.
- Uncertainty is based on the worst-case value from the 2900 uncertainty analysis.



RIGHT  
Dimensions are excluding feet, handle, and other protrusions. Other custom options are available.

**For More Information or to Place an Order Contact:**

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[www.thunderscientific.com](http://www.thunderscientific.com)