

Thunder Scientific Corporation



Humidity Generation,
Calibration and Measurement



Model 9000
*Automated “Two-Pressure”
Humidity Generator*

Model 9000

Automated "Two-Pressure" Humidity Generator

FEATURES

- Traceable to NIST
- Accuracy $\pm 0.3\%$ RH
- High Flow Capability
- Based on NIST Proven Two-Pressure Principle
- Generate: RH, DP, FP, PPM, Multipoint Profiles
- Computerized Internal Transducer Calibration
- Computes System Uncertainties in Real Time
- Automatically Applies Enhancement Factors
- ControLog™ Automation Software

DESCRIPTION

The **Model 9000** Humidity Generator produces extremely accurate humidity values using the fundamental, NIST proven, "two-pressure" principle. The **9000** will automatically supply relative humidity, dew point, frost point, ppm, or other calculated values for instrument calibration and evaluation as well as precision environmental testing. This system will automatically generate multipoint profiles as well as manually entered humidity levels, while continuously storing and printing system data.

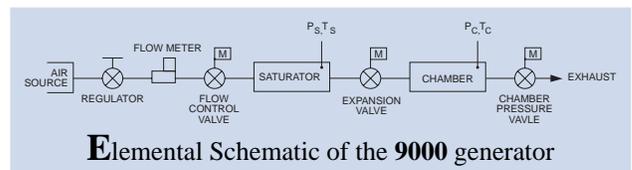
Virtually all functions of the **9000** humidity generator are computer controlled. All desired humidities, temperatures, test pressures, and time intervals may be programmed. Visual indications of system status are displayed in real time on the computer monitor. The automated features of the **9000** allow the generation of known humidity levels completely unattended for hours or even days. This frees the operating technician from the task of system monitoring and adjustment.

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 by the **9000** does not depend upon measuring the amount of water vapor in the air, but rather is dependent on the measurements of temperature and pressure alone. System precision is determined by temperature and pressure measurement accuracy, and on the

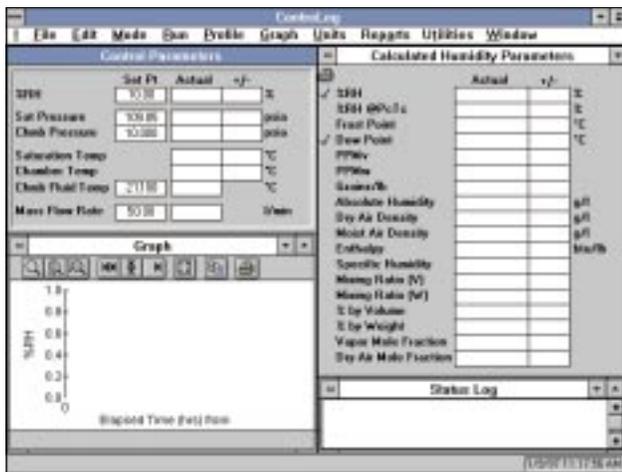


constancy of the measurements throughout. When setpoint equilibration has been reached, the indication of saturation temperature, saturation pressure, test temperature, and test pressure, may be used in the determination of all hygrometric parameters.

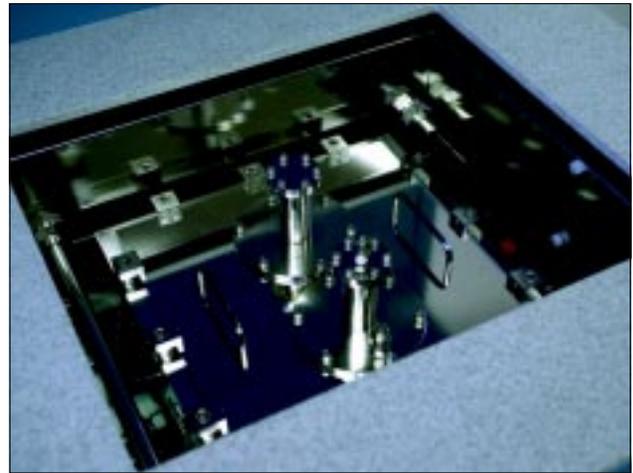


COMPUTER / CONTROL SYSTEM

The Computer/Control System performs all control functions required for humidity generation, as well as displaying, printing, and storing system parameters in real time. The computer/controller is made up of several main components, each with individual yet cooperative functions. The Computer/Control System utilizes a Windows based computer system that communicates with an HP3852A data acquisition/control system. The system consists of an integrating 5-1/2 digit volt/ohmmeter employing: multiplexed inputs to read transducers and PRT's; digital outputs for control of temperatures, pressures, and mass flow; relay outputs for control of system power, heaters, compressor and circulation pump.



9000 ControLog™ default startup screen.



APPLICATIONS FOR USE

The test chamber can accommodate various solid state sensors, chilled mirror hygrometers, psychrometers, hygrothermographs, and material samples for environmental testing. Virtually any humidity and temperature may be generated, for any length 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 printed data for analysis.

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 and you can: verify mirror temperature measurement accuracy (calibration) when the hygrometer is in thermal equilibrium with its environment; perform operational checks of the heatpump 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.

Humidity Sensors And Chart Recorders: Insert your humidity probes through a test port in the chamber or install the hygrothermograph into the chamber and you can: 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.

Environmental Testing: The 9000 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.

Temperature Controlled Bath: The 9000 humidity generating system incorporates a computer controlled temperature bath. Bath temperature is digitally controlled by the computer at any value between 0°C and 70°C using PID (proportional-integral-derivative) algorithms. The test chamber, saturators, heat exchangers, and connecting tubing are immersed in approximately 20 gallons of distilled water that is circulated at the rate of 50 gallons per minute by a magnetically coupled centrifugal pump. Fast fluid circulation provides the temperature conditioning of these components, resulting in long term bath stability and uniformity. This allows a very stable humidity to be generated.

Pressure And Flow Control: Pressure control and mass flow control are accomplished through computer actuation of electromechanical valve assemblies. Saturation pressure, chamber 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 9000 employs an integral programmatic calibration scheme allowing the 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

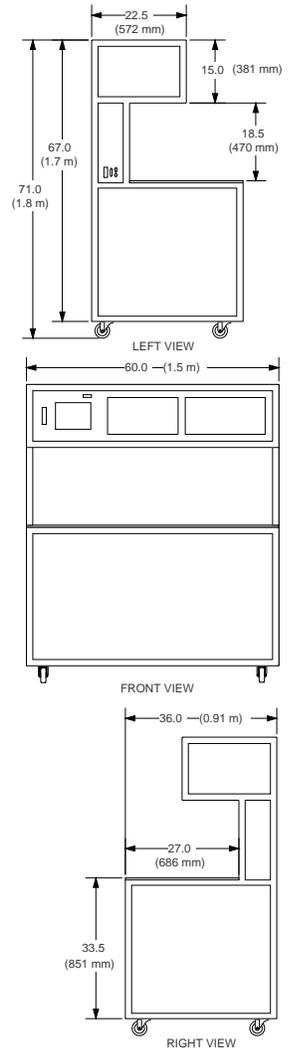
The 9000 humidity generating system incorporates a completely immersed test chamber, with internal dimensions of 12" x 12" x 12". Test chamber pressure range is ambient to 20 PSIA. The main chamber cover is removable utilizing quick release hold downs. Removal of the chamber cover allows a full 12 inch by 12 inch access to the test space. Access is also available through two 3.65" diameter ports in the chamber cover or two 1.125" inside diameter port cover adapters.

Model 9000

Automated "Two-Pressure" Humidity Generator

SPECIFICATIONS

Relative Humidity Range:	5 to 99%
Relative Humidity Resolution:	0.01%
Relative Humidity Accuracy*:	±0.3%
Frost Point Temperature Range:	-32 to 0°C
Dew Point Temperature Range:	-35 to 69.7°C
Parts Per Million By Volume Range:	300 to 440000 PPMv
Bath Temperature Range:	0 to 70°C
Bath Temperature Measurement Resolution:	0.005°C
Bath Temperature Control Stability:	±0.02°C
Bath Temperature Uniformity:	0.04°C
Bath Temperature Measurement Accuracy:	±0.038°C
Bath Temperature Heating/Cooling Rate:	1.5 Minutes Per °C Average
Gas Type:	Air or Nitrogen
Gas Pressure Rating (MAWP):	300 psiG
Gas Flow Rate Range:	5 to 150 slpm
Gas Flow Rate Resolution:	0.1 slpm
Gas Flow Rate Accuracy:	±3 slpm
Saturation Pressure - Low Range:	Ambient to 45 psiA
Saturation Pressure Accuracy - Low Range:	±0.0045 psiA
Saturation Pressure Resolution - Low Range:	0.001 psiA
Saturation Pressure - High Range:	45 to 300 psiA
Saturation Pressure Accuracy - High Range:	±0.03 psiA
Saturation Pressure Resolution - High Range:	0.01 psiA
Saturation To Chamber Temp Intercomparison Accuracy**:	0.038°C
Test Chamber Pressure Range:	Ambient to 20 psiA
Test Chamber Pressure Resolution:	0.001 psiA
Test Chamber Pressure Accuracy:	±0.0023 psiA
Test Chamber Dimensions:	12" x 12" x 12" (305 mm x 305 mm x 305 mm)
Physical Dimensions:	60" x 36" x 71" (1.5 m x 0.91 m x 1.8 m)



UTILITIES

Electrical Power:	200/230 V~, 20 A, 3 Ø, 50/60 Hz, 4 Wire
Gas Supply:	350 psiG @ 5 scfm
Cooling Water:	2 gpm (8 l/m) Maximum @ 21°C

ENVIRONMENTAL

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

* Allowing for necessary corrections of temperature and pressure over the relative humidity range of 5% to 95%, at fluid temperatures from 0°C to 70°C, at a mass flow rate of 20 to 100 slpm, while using air as the carrier gas.

** Saturation to Chamber Temperature Intercomparison Accuracy is defined as the maximum temperature difference existing between the saturation temperature and chamber temperature measurements when intercompared in a homogeneous medium.

For More Information or to Place an Order Contact:

Thunder Scientific

623 Wyoming S.E. • Albuquerque, New Mexico 87123-3198
Ordering: 800.872.7728 • Tel: 505.265.8701 • FAX: 505.266.6203

www.thunderscientific.com

