InstruQuest Inc

PRODUCTS CATALOG

DENSITY MEASUREMENTS

Novel design gas (Helium pycnometers) and micro-pycnometers with additional analytical capabilities

HumiPyc™ *Gas Pycnometer/Density, Moisture, Permeation Analyzer*

Model 2

Model 1

NEVA Series
No Elutriation Volumetric Analysis

The *HumiPyc(model 1 and model2*) is a fully automatic, versatile, precise, and cost effective volumetric analyzer capable of carrying out density measurements of different samples at ambient temperature.

With ancillary equipment, it can be used for filter integrity testing, moisture analysis, permeation of gases through membranes, and calibration of RH sensors using saturated salt solutions.

Opposite to On/Off valves used in other pycnometers for pressurization / depressurization of sample chamber, the *HumiPyc* uses proportional valves to ensure continuous flow of gas in and out of the sample chamber, from vacuum to 345 kPa.

Thus, elutriation of fine powder is avoided.

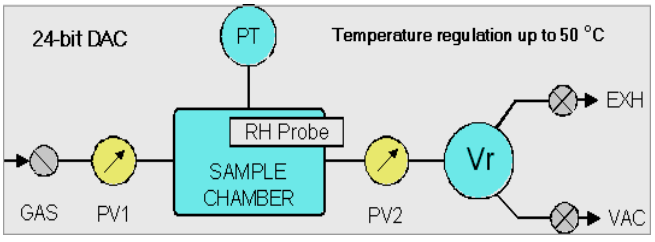
Addition of RH probe to the sample chamber allows for density determination at known conditions of RH, temperature, and pressure. A unique design of the sample chamber closure enables variety of applications.

New analytical capabilities and convenience of operation are materialized thanks to migration from classical keypad operated pycnometers to PC environment for software design and control.

A unique design of software allows the user to design experiment as a sequence of preprogrammed steps (macros), and save the created template for future use. A new experiment can be executed with just a click.

All experimental data are recorded and can be transferred to a spreadsheet.

In addition to the Auto mode, a Manual mode is also available, mainly for troubleshooting and carrying out specific R&D testing of samples.



Schematic of HumiPyc™ as a gas pycnometer

Note: Temperature regulation up to 50 C available in HumiPyc Model 1

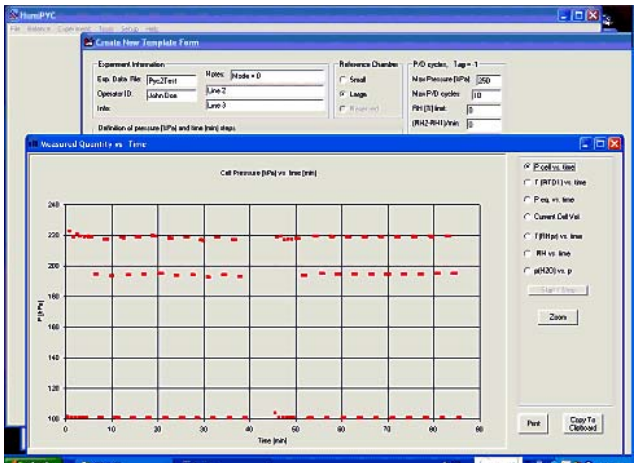
Experiment design and multi-mode control using Windows® based PC software

User-friendly software for execution of different RH steps, diagnostics, calibration, graphing, reporting, and RH calculations has been designed.

The user can conveniently define an experiment as a "sequence of steps" using the template form and save it for future use. A single step can be a complete measurement cycle, a sample treatment, or some special functionality.

Predefined routines containing user modifiable parameters are assigned a tag number, which can be introduced to the sequence of the experiment steps.

Automation of templates design, flexibility in experiment modification during run, running multiple samples using the same template, and ability to switch between Auto and Manual operation are very useful in any research work.



In addition of determination of sample volume and density of samples at defined RH, temperature, and pressure, the *HumiPyc* can be employed in further characterization of samples and other optional analytical techniques.

- RH analysis
- Headspace extraction
- Sample treatment
- RH sensor calibration
- Study of RH of slurries
- Permeation of gases and vapors through membranes

HumiPyc Specifications

Analytical techniques: Volume measurements from under 1cc to over 100 cc (true density) of solids (fine powder, foams), optionally at precise RH conditions.
Model 1 - built-in temperature control, from sub-ambient temperatures to 50 ˚C
Model 2 – ambient temperature
Operational mode: Fully automatic operation via PC control (Windows® based software from 95 to Windows 7 is included) and Manual Mode via front panel controls.
Sample chamber: Typical chamber volume is over 130 cc, larger volumes available, several adapters for reducing volume are supplied.
Sample containers: Several containers of different sizes are supplied, no special containers are required. Commonly available containers that can fit inside can be used.
Sample treatment: Sample treatment to specified criteria; programmable and continuous pressurization/depressurization cycles or vacuum. Optional **true purge** with gas flowing through the sample, (not around a sample container like in other pycnometers), is available.
Volume calibration Using certified metal spheres, Calibration Kit is included (Set of Large spheres (0.5" -2"), Set of micro spheres (1 – 6mm), handling tools)
Volume resolution: Better than 0.0001 cc
Typical Reproducibility: Better than ± 0.01%
Resolution of data acquisition: 24 bit
Displayed pressure resolution: 0.0001kPa
Pressure range: (transducer dependent), typically from 0 (vacuum) to 344.7 kPa (50 psia),
Transducer selection: Absolute, Gauge, Barometric, (common ranges)
Transducer accuracy: (transducer dependent), typically ±0.11%FS, ±0.073%FS optional
Temperature probe (RTD) accuracy: ±0.1 ˚C
RH probe range: 0 to 100 %
Gas Type: Helium, Nitrogen, Argon, air, etc
Gas Inlet Port: 1/8" tube compression tubing (Swagelok® type bulkhead)
Vacuum port: 1/4"NPT Female (standard), flexible vacuum hose from the instrument to a vacuum pump (e.g. small rotary vane) with KF16 flange can be supplied.
Auxiliary hardware: Specific to an optional technique or customized version.
Communication link with a PC: Serial port (RS232) or USB
Dimensions:
(W x H x D) (22 x 28 x 43cm) (8.7" x 11.4" x 19") Model 1
(W x H x D) (22 x 28 x 35cm) (8.7" x 11.4" x 13.7") Model 2
(Not including protrusions at the back)
Instrument Weight (w/o accessories): 14kg (30lb) M1, 7kg (15lb) M2
Typical power requirements:
110-240 VAC universal input, 50/60 Hz, 75VA

These specifications are subject to change at any time and dependent on specific models.

HumiPyc Accessories

The most comprehensive Gas Pycnometer Calibration Kit

Provided as a standard equipment with each HumiPyc, but also available separately at a very economical price

- Certified calibration spheres
- Micro Calibration Set included
- Two vacuum–suction tools (non-magnetic) for inserting and removal of the large spheres
- Tweezers for handling small spheres
- Special cloth for cleaning and handling
- Sturdy and lockable box

Vacuum Connecting Hose

Volume Reducing Adapters Set

A wide range of application

- True density measurements at precise condition of RH, P, and ambient T without elutriation (fine powders)
- Determination of volume (density) vs. pressure value (open-, closed-cell foam)
- Filter integrity testing (Bubble Point & Pressure Decay method)
- Permeation of gases & vapors through membranes (optional equipment needed)
- Calibration of RH sensors using saturated salt solutions
- Moisture analysis, desorption, headspace extraction, sample treatment
- Fast and easy to use for quality control

OPTIONAL TECHNIQUES:

Permeation testing using pressure gradient method, **Filter integrity testing** using Bubble Point and Pressure Decay Methods

IQIPyc™ *Gas (Helium) Pycnometer and Micro-Pycnometer In-One*

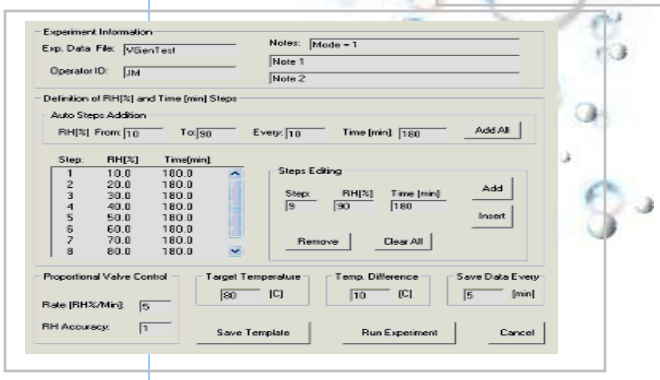
The *IQIPyc*™ combines micropycnometer and pycnometer design in one instrument. The scalable design allows selection of any or all options, 10 cc, 1 cc, or 0.1 cc range of true volume measurements. Having a very low dead volume, 24-bit data acquisition, precision pressure regulator, it offers highly accurate small sample size measurements. The embedded miniature vacuum pump enables the most effective sample treatment. Another option of dual gas supply adds convenience of switching a given gas by flipping a switch on the front panel.

The flexible design and **"Pycnometer to the sample concept"** allows for interfacing of the enhanced version of the IQIPyc with other equipment. The presented Versatile Materials Testing Station (VMTS) combines the IQIPyc, Test Tube Heater, test tube stand, and some other hardware. The Test Tube Heater is operated by 12 DC power and provides temperature control from ambient to 300 °C. The multi-port housing of the test tube allows for different connections and to achieve closed, open, or (flow-through) configurations. Addition of a thermocouple for measuring the sample temperature inside the test tube creates a Thermal Analyzer. In addition to phase transitions at atmospheric, vacuum, and pressurized conditions, sample degassing and metering of the evolved gas volume can be done. Using specific sensors, like RH or CO2 probes, the concentration of the vapors can be measured in the flow-through setup.

For more details and applications, please visit our www.thermopycnometer.com website.

RELATIVE HUMIDITY

Generation and Control



V-Gen™ Dew Point / Relative Humidity

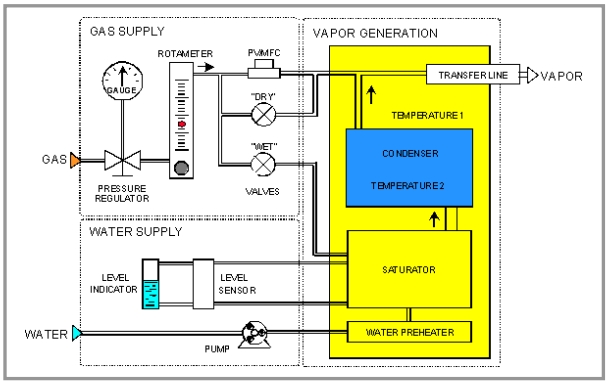
Auto / Manual operation, automatic water supply, temperature-controlled transfer line

The *V-Gen* is a novel and versatile water vapor generator and calibration system. High quality and performance, low cost, and simplicity of operation make it ideally suited for a wide variety of applications requiring an accurate and stable source of water vapor. Instruments like X-Ray Diffractometer, DMA, TGA can be easily upgraded with RH option using this generator.

The *V-Gen* employs the fundamental, Two-Temperature principle to generate stable dew points from 0 to 90 ˚C. Additional, Divided-Flow method is used to generate low values of relative humidity (RH) that are not available by the Two-Temperature method alone. However, a RH probe is needed to utilize the divided flow method. The miniature, high-temperature RH probe is normally supplied with this generator for control/verification purposes. RH values from 0 to 100% are readily available up to 85˚C with RH probe.

A precision pressure regulator isolates the selectable flow rate from fluctuations in the supply line. An automatic water supply system eliminates frequent user intervention inherent to other generators. The generated water vapor stream is delivered to the location of choice via flexible heated transfer line. To avoid condensation problems, the temperature of the transfer line is automatically maintained at a higher temperature than the current dew point value.

SYSTEM OPERATIONAL SCHEMATIC



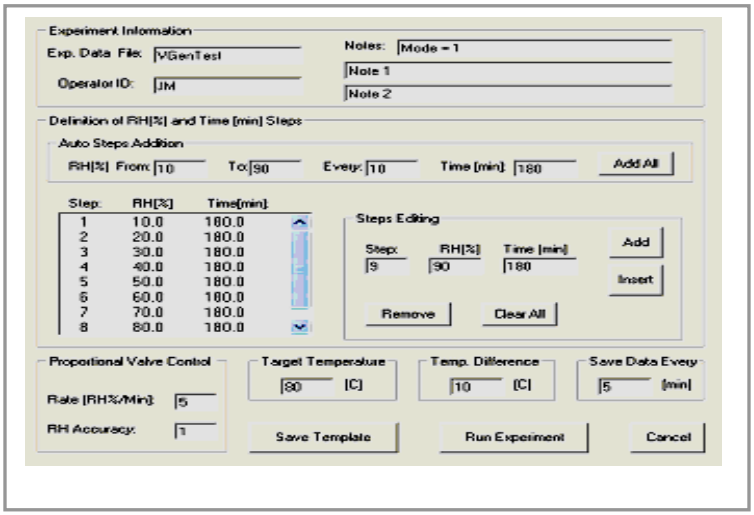
Experiment design and multi-mode control using Windows® based PC software

Depending on the type and location of sensors involved in the RH control, several modes of operation are available. Additional modes can be implemented to address application specific requirements.

Mode 1 (minimal hardware requirements) – the temperature of the user sample chamber needs to be known and entered in the experiment definition template form.

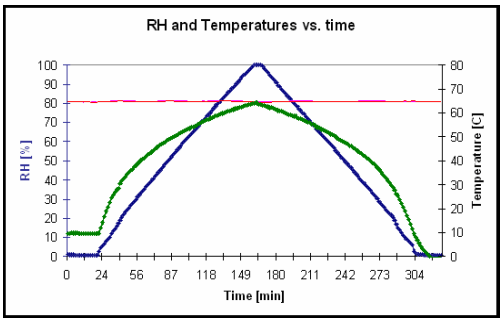
Mode 2 (the calibrated external temperature probe, RTD based, is used for temperature monitoring of the sample chamber) the Two-Temperature method is materialized and the RH is automatically adjusted based on the current temperature of the user chamber.

Mode 3 – the main mode - (RH probe is used for RH and temperature monitoring inside the user sample chamber) – the complete range of RH is materialized (two-temperature and divided flow methods).



User-friendly software features up to 1000 RH steps per run, hardware diagnostics, graphing, reporting, data recording, flexibility of experiment modifications during the run, and RH calculations. An experiment design template can be saved and a new experiment can be executed with just a few mouse clicks.

An example of a linear RH ramp using RH probe (RH - blue, temperature - red, condenser temperature of V-Gen - green)



SPECIFICATIONS

Dew Point Temperature: Range: 0 to 90 ˚C
Accuracy: ± 0.2˚C
Stability: ± 0.1˚C

RH range: 0 to 100 %

Maximum temperature of saturator: 95 ˚C

Maximum temperature of condenser: 90 ˚C

Thermal protection: Thermal cut-offs temperature limits are also set in the temperature controllers.

Flow Rate: Determined by the rotameter range,
Available ranges: 50, 100, 200, 500, 1000 cc/min.

Gas Type: Typically inert gas, air or N_2

Gas Inlet Port: 1/8" (Swagelok® type bulkhead)

Gas Inlet Pressure: Maximum: 100 psi (7 bar)
Minimum: 10 psi (0.7 bar) above set pressure

Outlet port: 0.25" (6.35 mm) OD tubing – (the fitting can be easily replaced to accommodate other sizes).

Transfer hose dimensions:
Heated length about - 1.0 m (40")
0.25" OD (6.4mm), 3/16" ID
Thickness w/ insulation: about 16-17 mm (0.65")
Other lengths and sizes available as options

Transfer hose Temperature: Maximum (Continuous) 100 ˚C
Minimum: Ambient

Dimensions: (W x H x D) (22.2 x 29 x 40.7 cm)
(8.7" x 11.4" x 16")
(Not including protrusions in front and back)

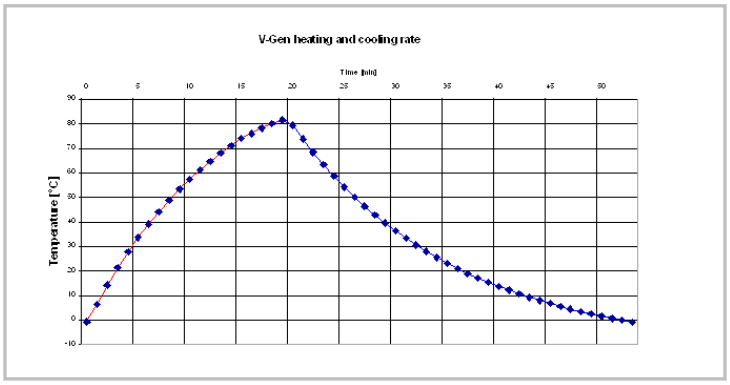
Instrument Weight: 12 kg (27 lb)

Power Requirements:
110 VAC, 400VA, 60 Hz nominal
(Optional): 220 VAC, 400VA, 50 Hz nominal

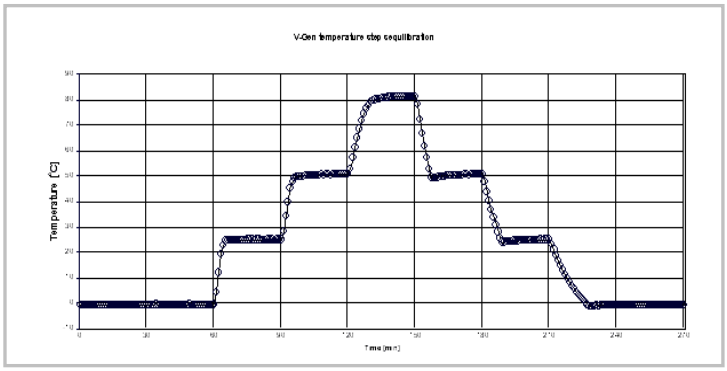
These specifications are subject to change at any time

SYSTEM DYNAMICS

One of the objectives of *V-Gen* design was to improve the two-temperature system dynamics while assuring accuracy and stability.



The figure shows the heating and cooling rate of the condenser chamber. The whole cycle of heating the chamber and cooling it back takes less than an hour for the 80˚C temperature span.



This figure shows equilibration dynamics for several large temperature steps in the increasing and decreasing direction versus time

APPLICATIONS

Stable Dew Point / RH source suitable for:

- X-Ray Diffractometer, DMA, TGA, etc.
- Gravimetric sorption systems
- Permeation measurement instruments
- Relative humidity sensors calibration
- Sample conditioning in specialized instrumentation

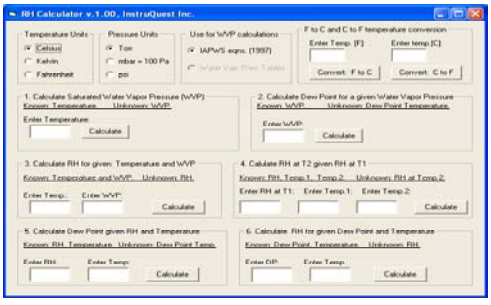
HumiSys LF™

Low Flow Versatile Relative Humidity Generation and Multi –Sensor System

The *HumiSys LF (Low Flow)* is a versatile water vapor generator designed for variety of custom applications requiring flow rates up to 0.5 L/min. The modular design of the system, ability to work in different sensors and hardware configurations, and versatile PC software allow for easy integration with other analytical setups.

The *HumiSys* employs divided (split) flow technique for generation of requested level of relative humidity. A pair of mass flow controllers (MFC) is used to divide the flow into the so-called WET branch that passes through the saturator and the DRY branch that bypasses the saturator. The branches are combined in the mixing manifold. While maintaining the selectable total amount of flow rate constant, the ratio of the WET and DRY flow is varied to achieve the desired level of relative humidity (RH) at the user defined location. The factory set maximum flow range of mass flow controllers defines the highest flow rate. The ability of MFC to quickly change its flow rate allows for generating sharp steps of RH.
The *HumiSys* is equipped with a serial port for communicating with a master controller, normally a PC. A serial to USB converter can easily add additional serial port to allow for serial communication in newer computers. Since the generator uses a set of simple commands for hardware control and reporting its state, users can also control the generator directly by writing their own software. The generator also has the capability to remotely start and stop the operating PC software for some custom applications.

The Windows based PC software allows for defining, saving, and reusing templates for carrying out and experiment. Up to 1000 RH steps of practically infinite duration time are allowed. Diagnostics, graphing, reporting, viewing previous data, and RH calculator form are some of the features. During a run any parameter declared in the template can be modified at any stage of the experiment.



APPLICATION

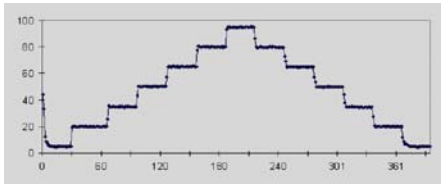
Programmable RH source suitable for:

- Evaluation of variety of processes towards water vapor presence
- Evaluation of distribution of RH and temperature gradients in chambers
- Gravimetric sorption systems
- Permeation measurement instruments
- Relative humidity sensors calibration
- Sample conditioning in specialized instrumentation
- Maintenance of precise RH in variety of industrial chambers

SPECIFICATIONS

Flow Rate: Maximum flow rate is determined by the Mass Flow Controllers range,
Typical ranges of MFC: 10, 20, 50, 100, 200,
or 500 mL/min (cc/min), N2.
Maximum temperature of saturator: 90 ˚C (220 VAC), 95˚C (110VAC)
RH range: 0 to 100 %, may depend on the flow rate and the target temperature
RTD Accuracy: ± 0.1 ˚C.
Thermal protection: Programmed limits and thermal cut-offs for the saturator heater.
Gas Type: Inert gas, typically air or N_2
Gas Inlet Port: 1/8" compression tubing (Swagelok® type bulkhead)
Gas Inlet Pressure (pressure regulator dependent):
Maximum: 20 bar, (300 psi)
Minimum: 0.7 bar (10 psi) above the working pressure
Outlet port: 1/4" compression fitting (the fitting can be easily replaced to accommodate other sizes).
Transfer hose dimensions:
Heated length – at least 1m (40")
Inner Teflon tubing, (6mm OD, 4mm ID),
or (.25" OD, 3/16" ID or 5/32"), typically
Thickness w/ insulation: about 20 mm, (0.8")
Other lengths and sizes available as options
Transfer Hose Temperature:
Maximum (Continuous) 100 ˚C
Minimum: Ambient
Dimensions: (W x H x D)
(22.3 x 29.2 x 40.6 cm)
(8.75" x 11.5" x 16")
(Not including protrusions in front and back)
Instrument Weight (w/o accessories):
18kg (40 lb) approximately
Typical power requirements: (Dependent on specific model) 110 VAC, 300VA, 60 Hz nominal
(Optional): 220/240 VAC, 300VA, 50 Hz nominal

These specifications are subject to change at any time and are dependent on specific models.



RH [%] vs. Time [min.]

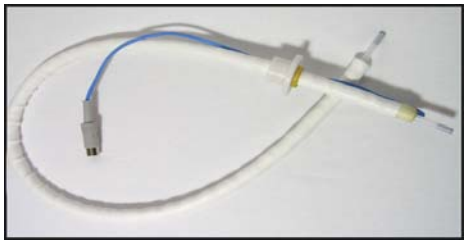
HumiSys HF™

High Flow Versatile Relative Humidity Generation and Multi –Sensor System

The *HumiSys HF* is a higher flow version of the previous HumiSys water vapor generation system. Fast response, wide flow range, ability to collect data from variety of sensors, fully automatic and manual operation make it ideally suited for a wide variety of applications requiring an accurate and stable source of water vapor. Its modular design, ability of control using a simple command language, and versatility of PC software allow easy integration into a larger analytical setup or interfacing with other devices.

The *HumiSys HF* uses two mass flow controllers to generate fast, stable, and repeatable RH values from 0 to 100% at temperatures up to 95 ˚C (extended temperature models) and flow rates up to 50 L/min. Typically, temperature probe (RTD1) and a HygroClip® digital RH probe (RH and temperature data, 16-bit resolution) are used for control of RH. Additional temperature probe (RTD2) and RH probe, as well as other sensors can be used for monitoring temperatures and RH at other locations in the process chamber.

A precision pressure regulator isolates the selectable flow rate from fluctuations in the supply line. An automatic water supply and control system eliminates frequent user intervention typical to other generators. The generated water vapor stream is delivered to the location of choice via a flexible heated transfer line.



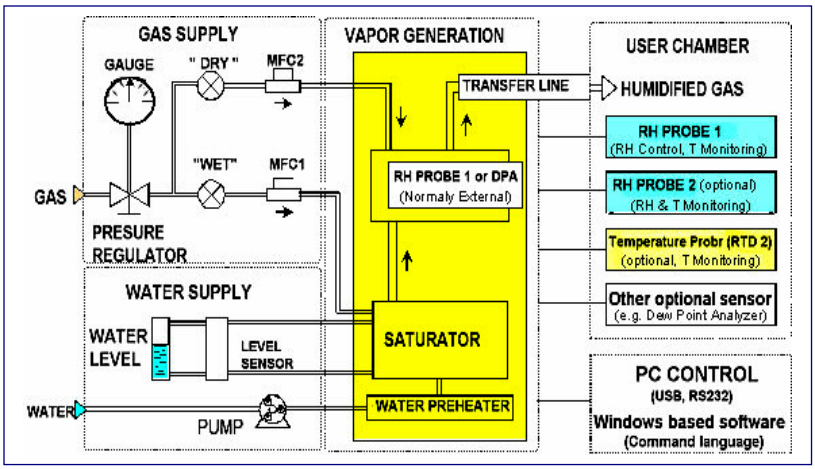
Heated Transfer Hose

SPECIFICATIONS

RH range: 0 to 100 %
RH and temperature resolution: 16-bit (RH probe)
RH accuracy: sensor dependent (±1% RH probe, ± 0.2 ˚C DPA
Maximum temperature of saturator: 75 ˚C standard, (95 ˚C for extended temperature units)
Thermal protection: Thermal cut-off for the saturator heater. Temperature limit is also set in the temperature controller.
Flow Rate: typically: 1, 2 ,5, 10, 20,, 30, or 50 L/min.
Gas Type: Normally inert gases, typically air or N_2
Gas Inlet Port: 1/4" (Swagelok® type bulkhead)
Gas Inlet Pressure:
Maximum: 150 psi (10.3 bar)
Minimum: 20 psi (1.4 bar) above set pressure
Outlet port: 0.375" (9.5 mm) OD tubing or 1/2" (12.7mm) hose for 50 L/min
Transfer hose dimensions 0.375" OD, 0.25" (6.4mm) ID
Sizes and lengths of inner tube can be customizing. Typically: 0.375" OD, 0.25" ID, about 4.5ft. L
Transfer Hose Temperature:
Maximum (Continuous) - 100 ˚C,
Minimum: Ambient
Power Requirements:
110 VAC, 600VA, 60 Hz nominal
(Optional): 220 VAC, 600VA, 50 Hz nominal
Dimensions: (W x H x D) (28.5 x 36.3 x 48.2 cm) 11.25" x 14.3" x 19"
(Not including protrusions in front and back)
Instrument Weight: about 23 kg (50 lb)

These specifications are subject to change at any time

SYSTEM SCHEMATIC



Relative Humidity Generation and Multi –Sensor System

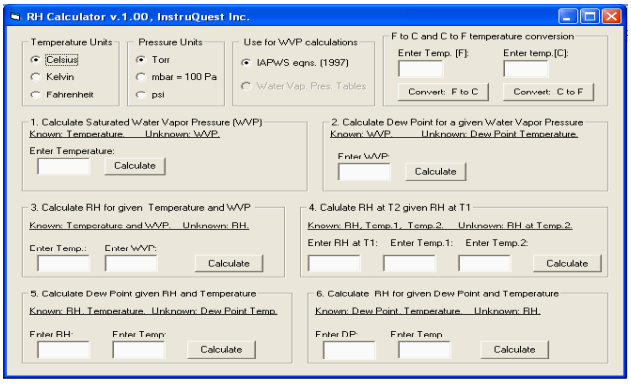
Experiment design and control using Windows® based PC software

User-friendly software for execution of up to 1000 of different RH steps per run of practically infinite duration. Diagnostics, calibration, graphing, reporting, and RH calculations are some of the features. Automation of experiment templates design, flexibility in experiment modification during run, and ability to switch between Auto and Manual operation are very useful in any research work. The amount of total flow rate is selectable.

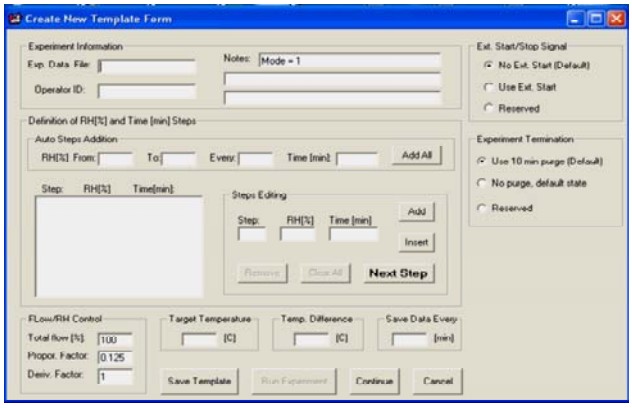
The instrument can be equipped with different hardware configurations and it can be used as a calibrator or generator. Depending on which sensor is currently used for determining the final RH, one of several modes of operation could be implemented. The system can be easily accommodated to address different RH needs.

FEATURES AND BENEFITS

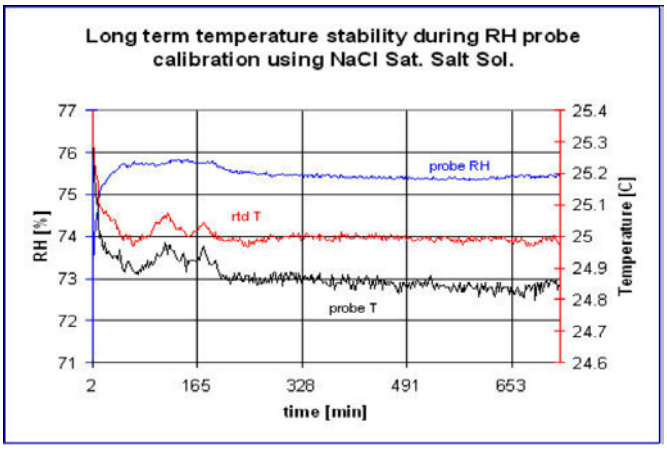
- Two mass flow controllers design – fast response
- Large range of flow rates, up to 50 L/min (Humisys HF)
- RH from 0 to 100%
- Saturator temperature up to 95C (ext. temperature models)
- Auto / Manual operation
- Complete experiment design and control software
- Open design for OEM applications
- Easy integration with other equipment
- Can accept external sensors: RTD's, RH probe, DPA
- Automatic water supply system
- Heated transfer line
- Digital RH probe(s) (RH and T, 16-bit resolution)
- Pressurized applications, typically up to 1.5 Bar (25 psi) above the atmospheric pressure (HumiSys HF)



RH Calculator Form



Experiment Template Form



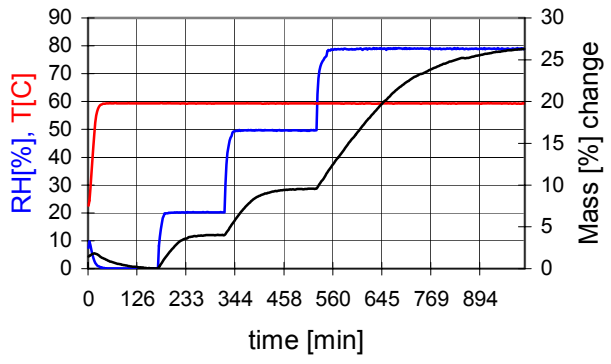
Dynamic Vapor Sorption

VGA-2 Versatile Gravimetric Analyzer

The *VGA-2* is designed for carrying out dynamic water vapor sorption experiments at various RH and temperature levels. The system consists of RH generator, isothermal chamber housing the balance, semi-microbalance with weighing under feature, and a computer. Each of the modules can be used separately for other purposes. Due to large sample chamber size and balance of high capacity, much larger sample sizes can be analyzed then in other instruments. Permeation cells of special construction can be used for determination of vapor transfer rates of water and organic materials through membranes at various levels of RH and temperatures.

Depending on the flow rates requirements, one of the HumiSys RH generators can be used. Since separate software for it is also provided, the RH generator can be used for other applications.

Silica gel, dried and run at 59 C



Typically a sample is subjected first to a relatively high temperature and dry gas is flown to establish the dry mass. Next, the sample is subjected to various levels of RH at the user-selected temperature. The sample responds to the various RH levels by uptake or loss of water vapors and the mass changes are recorded. An example of such experiment is presented on the chart.

InstruQuest Inc. is dedicated to R&D and manufacturing of complex analytical Scientific Instruments (systems), especially in the area of relative humidity generation and density analysis.

We specialize in modular and open-architecture design of novel and versatile research tools to address variety of application specific problems. Our products offer unparallel combination of performance, quality, value, and are backed up by lifetime support and service.

InstruQuest Inc., Scientific Instruments R&D

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