MARKES international

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Operator Manual

Regulatable Humidifier for the Micro-Chamber/Thermal Extractor

Part number: U-HUMID-REG

Contents

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1. Preface

1.1 Requirements

- High-purity air or nitrogen regulated below 22.5 psig.
- Distilled/deionised or HPLC-grade water. Ensure the correct amount of water is in the humidifier before all experiments. This should be around 350–400 mL.
- Clamp stand for holding rotameter.

1.2 Warnings

- Do not pressurise the humidifier bottle to over 22.5 psig. The bottle is not designed to withstand more than this, and over-pressurisation could cause damage to the unit.
- Do not remove the protective sleeve fitted to the humidifier bottle.
- Ensure that no water can come into contact with electricity sources.

1.3 Technical support contact details

In the first instance please contact your supplier. If they are unable to resolve your query, please contact Markes International (details below).

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2. Setup schematic

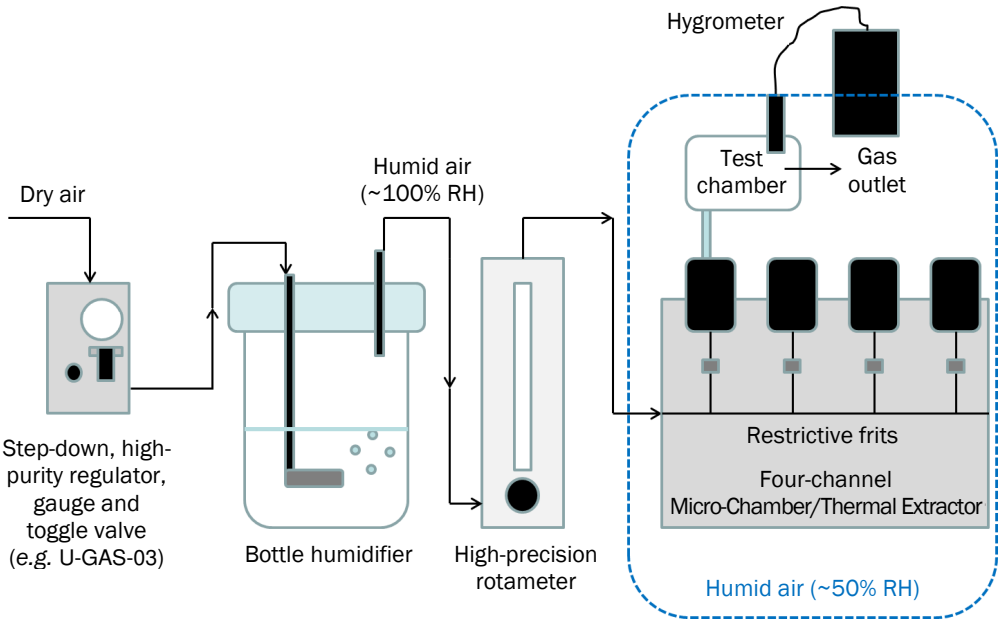

Figure 1: Setup schematic of the completed humidifier unit.

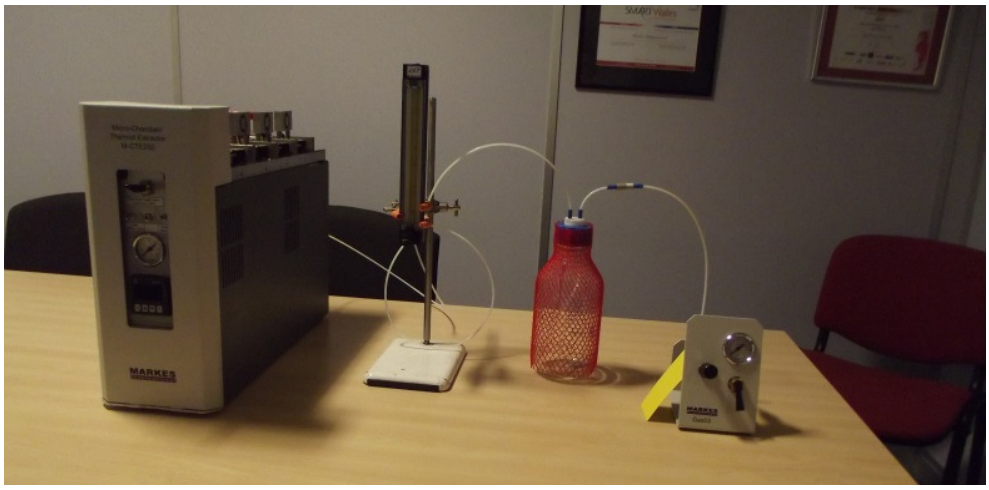

Figure 2: Photograph of the completed Regulatable Humidifier setup. The Micro-Chamber/Thermal Extractor is also shown.

3. System installation and setup

3.1 Unpacking the humidifier

Take care when unpacking the humidifier, as the bottle is made of glass.

3.2 Installation and setup

As with all pneumatic connections, it is important not to over-tighten the nut/ferrule assemblies and to ensure correct orientation of compression fittings. Failure to do so may cause leaks, and/or damage the components.

The completed setup for the Micro-Chamber/Thermal Extractor humidifier is shown in Figures 1 and 2. The following paragraphs highlight areas where incorrect assembly could damage components or prevent the humidifier from operating correctly.

3.2.1 Gas supply

The humidifier requires a supply of air or nitrogen at a maximum pressure of 22.5 psig, for which the supplied U-GAS03 regulator should be used. The U-GAS03 nitrogen input must not exceed 100 psig, as this could cause damage to the regulator. However, make sure that the input pressure is higher than the setting required on the U-GAS03 regulator.

3.2.2 Tools required for installation

To carry out the installation you will need the following tools:

- $^{7}/_{16}$″ spanner
- $^{9}/_{16}$″ spanner
- $^{5}/_{8}$″ spanner
- Flathead screwdriver

3.2.3 Assembling the humidifier assembly

- Remove the blue cap from the humidifier bottle.
- Fill the bottle with pure water (350–400 mL).
- Fit the bubbler (Z-1056) to either position on the underside of the cap.
- Refit the blue cap to the humidifier bottle.
- Connect the input assembly (ASX-5501) to the position on the blue cap that has the bubbler fitted on the underside.
  Please note: If the input assembly is connected to the wrong port, the rotameter and potentially the Micro-Chamber/Thermal Extractor could be flooded with water.
- Connect the output assembly (ASX-5502) to the humidifier cap on the other available port on the top side of the lid.
- Connect the free end of the input assembly (ASX-5501) to the output on the U-GAS03 regulator marked ‘OUT’.

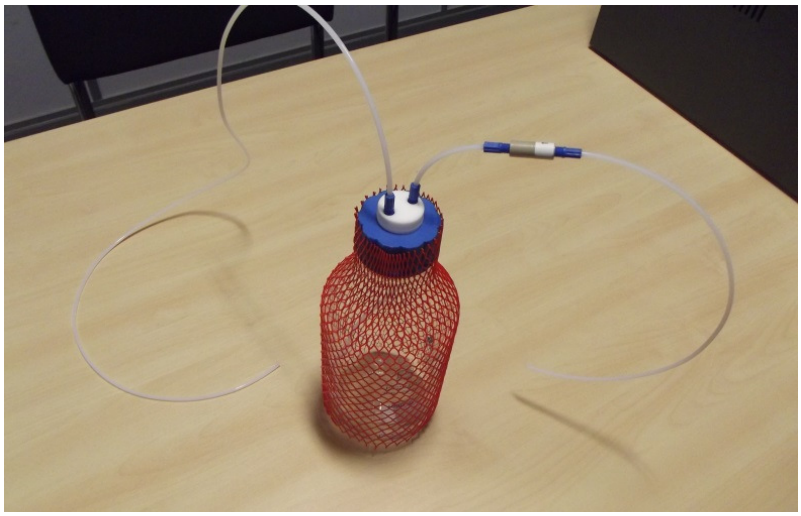

Figure 3: The completed humidifier assembly.

3.2.4 Assembling the rotameter assembly

- Remove protective covers from the rotameter (Z-1143) inputs.
- Screw the compression-fitting adapters (Z-1144) into these inputs to finger-tightness, and then further tighten with a $^{7}/_{16}$″ spanner.
- Attach one plastic ferrule (Z-1144) assembly onto the tubing leaving the humidifier bottle, and screw this onto the adapter at the bottom of the rotameter.
- Cut a length of supplied ⅛″ tubing (Z-0062) to the right size to reach the Micro-Chamber/Thermal Extractor, and attach a plastic ferrule–nut assembly to one end and a metal ferrule-nut assembly (Z-0364, Nut and Z-0365A/Z-0366A ferrules) to the other.
- Attach the plastic nut to the top input of the rotameter.
- Attach the metal nut (Z-0364) to the high-flow input of the Micro-Chamber/Thermal Extractor (if using a 6-chamber system) and to the ‘carrier in’ input (if using a 4-chamber system). If using a 4-chamber system make sure the flow mode toggle valve is set to high-flow mode (‘On’ position).
- Once assembled, use a clamp stand (not supplied) to hold the rotameter assembly in an upright position.

Please note: The scale on the rotameter indicates relative (not absolute) flow. Therefore the rotameter should be calibrated for flow rates before use. Once calibrated, the rotameter can be used to set the same flow reliably between experiments.

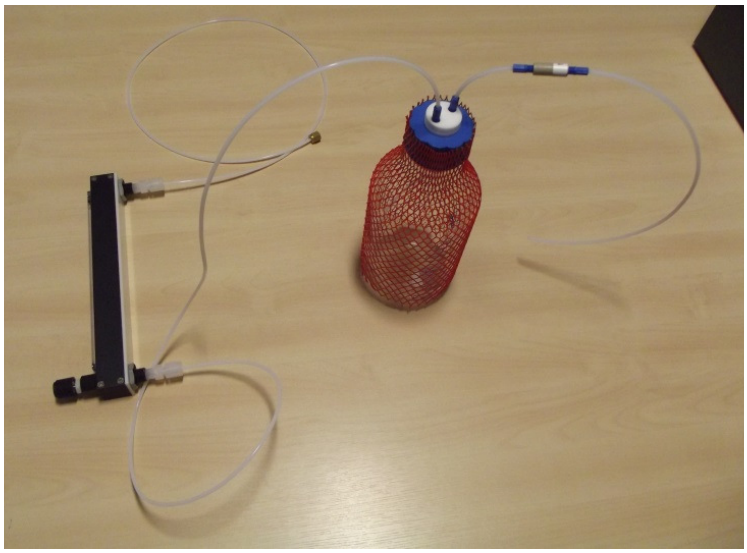

Figure 4: The completed rotameter assembly. The humidifier assembly is also shown.

3.2.5 Assembly of humidity testing chamber

- Using a flathead screwdriver, unscrew the screws holding down the lid of the chamber unit (ASX-5522) and remove the lid.
- Locate the ¼″ brass bulkhead union (Z-1147) supplied, and remove the tube nut and fixing nut from the long screw-threaded end of the union.

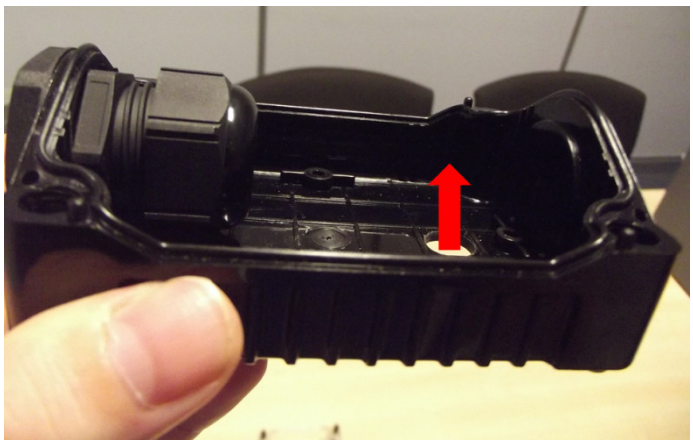

Figure 5: Bulkhead union insertion.

- Insert the bulkhead union (Z-1147) into the hole on the underside of the chamber unit.
- Screw on the fixing nut to finger-tightness against the base of the box. Further tighten the nut using two $^{5}/_{8}$″ spanners, taking care not to damage the box base.
- Screw the tube nut back on, and then replace and fasten on the lid.

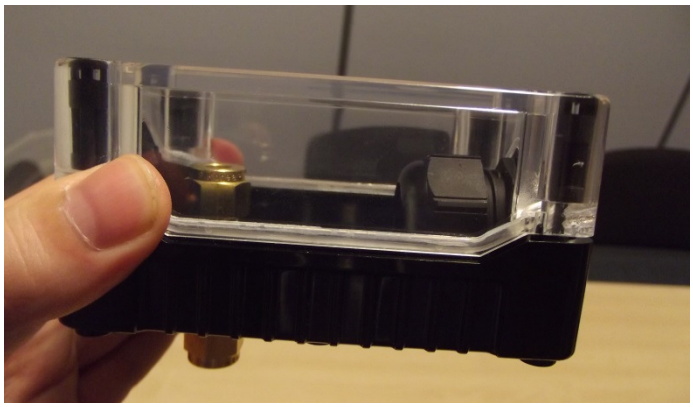

Figure 6: The completed humidity testing chamber.

3.3 Leak testing

After first assembly, a leak test should be carried out on the system as described below. This protocol is also suitable for leak testing during regular use.

Ffirst disconnect the nut from the input of the Micro-Chamber/Thermal Extractor. Using a blanking cap or your thumb, block off the end of the tube. Turn on the toggle valve on the U-GAS03 and pressurise the regulator to 3 psig. Open the rotameter fully, taking care not to over-screw the precision valve.

The humidifier bubbler will then bubble less as the system reaches pressure. Once the bubbles have slowed to a trickle, turn off the toggle valve on the U-GAS03 regulator. If the system is leak-tight the regulator should maintain its pressure reading for several minutes. If not there is a leak on the system.

4. Operating instructions

To supply 50% RH air or nitrogen to the attached Micro-Chamber/Thermal Extractor, please follow the instructions below:

- Make sure the rotameter is closed and that the U-GAS03 regulator dial is fully depressurised (turned anticlockwise sufficiently) before turning on the gas supply.
- Turn on the gas supply to the U-GAS03 regulator.
- Turn on the toggle switch on the regulator and adjust the pressure slowly from 0 psig to 14.7 psig. You should see bubbling from the humidifier bottle bubbler – if you do not, turn off the gas supply and check that the U-GAS03 regulator is connected to the correct port on the humidifier lid. You may notice that the bubbling is quite strong at first and reduces with time –this is normal and is due to the system filling with gas.
- Slowly open the high-precision valve on the rotameter until the desired flow rate is achieved (as measured on the output ports of the Micro-Chamber/Thermal Extractor).
- The humidity supplied should be close to 50% regardless of rotameter setting.

Please note: When working the rotameter valve be careful not to close it completely – doing so can damage the valve. Only close the valve enough to reduce the flow to essentially zero.

4.1 Use of humidity testing chamber

The optional hygrometer and humidity testing chamber can be used to monitor the humidity achieved in individual pots of the Micro-Chamber/Thermal Extractor. To do so, the following should be carried out before turning on the humidified gas flow.

- Firstly locate the metal tubes (ASX-1102 and ASX-1103) supplied. These are used to interface the testing chamber to the Micro-Chamber/Thermal Extractor.
- The longer length (ASX-1102) is for interfacing with the 4-chamber system and the shorter length (ASX-1103) for the 6-chamber system.
- Select the appropriate tube and unscrew the tubing nut protruding from the bottom of the chamber on the bulkhead union (Z-1147).
- Insert the metal tubing length through the ¼″ tubing nut and attach the PTFE ferrule (AAA-1011) supplied. Screw the nut to finger-tightness, and then tighten a further one-third of a turn using $^{9}/_{16}$″ and $^{5}/_{8}$″ spanners.
- The tube should now be held snugly in the union.
- Insert the chamber unit (*via* the metal tube) into one of the outlet ports of the individual pots of the Micro-Chamber/Thermal Extractor. Insert the hygrometer (Z-1149) into the side of the chamber and switch it on before introducing the gas flow.
- On 4-chamber systems, the chamber should self-support on the fan of the pot being used. On 6-chamber systems we recommend using a clamp stand to support the free end of the chamber to avoid leaks on the system.

For further operating instructions for the hygrometer, see the supplied instruction manual. Allow some time for the chamber to equilibrate to the conditions in the Micro-Chamber/Thermal Extractor, and once the hygrometer reads the desired humidity start the sampling experiment, removing the humidity testing chamber if necessary.

Please note: Be aware that the only way to change the humidity setting on this product is to change the setting on the U-GAS03, although this is not advised. See the information at end of the manual.

As a guide, following the above instructions in a laboratory with a temperature of 25–28°C provided an outputted humidity of 47.5% ± 3% RH within 10–20 minutes, with the Micro-Chamber/Thermal Extractor unit fully equilibrated to ambient conditions (*i.e.* not heated).

4.2 Maintenance

At the end of each period of use, check the internal glass tube of the rotameter for any signs of condensation build-up, as well as the connecting tubing between the humidifier bottle and the rotameter. This may happen after extended periods of use over the course of days. If this does occur, simply purge the rotameter and tubing with dry air or nitrogen until the condensate has evaporated fully. If you find the rotameter float sticks to the sides of the glass tube, this is usually indicates a need for further purge-drying.

Make sure that the humidifier bottle is always filled with around 350–400 mL of water. Over-filling does not improve humidifier reliability or the outputted humidity, but can result in the tubing being contaminated with water due to splashing. Under-filling may reduce the humidification of the gas supply, so affecting the resulting humidity in the individual pots of the Micro-Chamber/Thermal Extractor.

To avoid build-up of contamination, it is recommended that the humidifier water is replaced every 4–6 weeks.

Please note: When working the rotameter valve be careful not to close it completely – doing so can damage the valve. Only close the valve enough to reduce the flow to essentially zero.

4.3 Humidification adjustment

It is possible to vary the humidity of gas supplied to the Micro-Chamber/Thermal Extractor, but only by varying the regulator (U-GAS03) supply pressure. A pressure of 14.7 psig should give humidity within the Micro-Chamber/Thermal Extractor of 47% + 3% RH. Different supply pressures will give different resulting humidity levels – see Figure 7 for a description of this effect.

Please note that with the current setup of this product adjusting the regulator is the only way to vary the humidity level attained. Please also remember that the gas needs to be regulated at or below 22.5 psig due to the pressure tolerance of the glass bottle supplied.

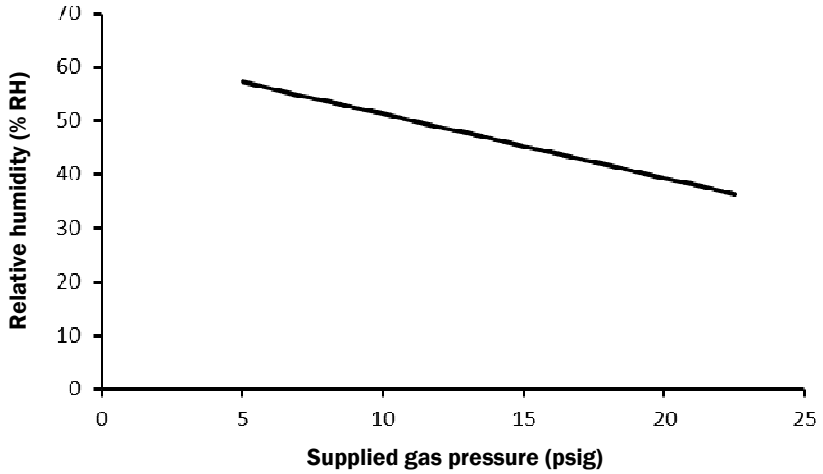

Figure 7: Effect of the regulator pressure on the humidity in the Micro-Chamber/Thermal Extractor.

4.4 Effect of temperature on humidity

Relative humidity (% RH) is highly dependent on temperature. Therefore, the value of humidification possible depends on the Micro-Chamber/Thermal Extractor temperature. Using this assembly, you can supply close to 50% RH when the chamber is not heated. When the chamber is heated the maximum possible humidity attainable will drop with increasing temperature.

As an example of this temperature effect, Figure 8 shows how the % RH changes with temperature, starting with conditions of 50% RH at 23°C.

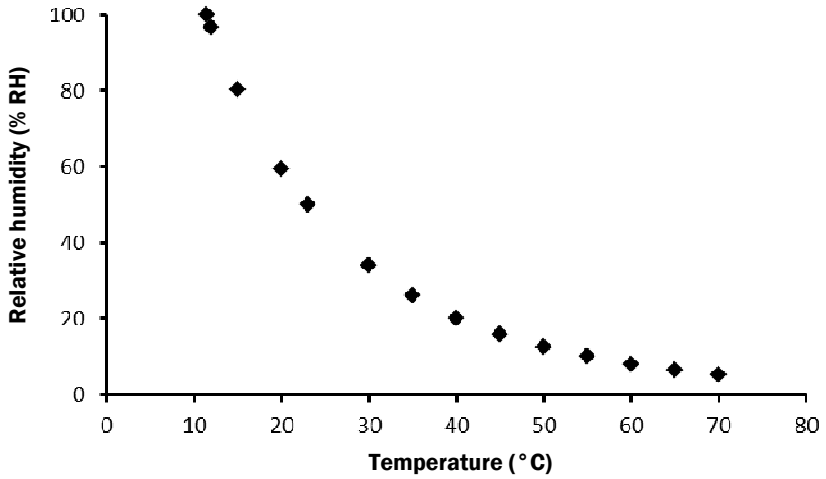

Figure 8: Effect of temperature on the relative humidity (% RH).

Please note: This is calculated data, intended as an illustrative example, and not descriptive of what is possible with the Regulatable Humidifier assembly attached to a Micro-Chamber/Thermal Extractor.