

# Discovery Series

## RH Accessory for DHR



## Getting Started Guide



## Notice

The material contained in this manual, and in the online help for the software used to support this instrument, is believed adequate for the intended use of the instrument. If the instrument or procedures are used for purposes other than those specified herein, confirmation of their suitability must be obtained from TA Instruments. Otherwise, TA Instruments does not guarantee any results and assumes no obligation or liability. TA Instruments also reserves the right to revise this document and to make changes without notice.

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# Introduction

## **Important: TA Instruments Manual Supplement**

Please click the [TA Manual Supplement](#) link to access the following important information supplemental to this Getting Started Guide:

- TA Instruments Trademarks
- TA Instruments Patents
- Other Trademarks
- TA Instruments End-User License Agreement
- TA Instruments Offices

## Notes, Cautions, and Warnings

This manual uses NOTES, CAUTIONS, and WARNINGS to emphasize important and critical instructions. In the body of the manual these may be found in the shaded box on the outside of the page.

**NOTE:** A NOTE highlights important information about equipment or procedures.

**CAUTION:** A CAUTION emphasizes a procedure that may damage equipment or cause loss of data if not followed correctly.

**MISE EN GARDE:** UNE MISE EN GARDE met l'accent sur une procédure susceptible d'endommager l'équipement ou de causer la perte des données si elle n'est pas correctement suivie.

**A WARNING indicates a procedure that may be hazardous to the operator or to the environment if not followed correctly.**

**Un AVERTISSEMENT indique une procédure qui peut être dangereuse pour l'opérateur ou l'environnement si elle n'est pas correctement suivie.**

## Regulatory Compliance

### *Safety Standards*

#### **For Canada**

CAN/CSA-22.2 No. 61010-1-04 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

CAN/CSA-22.2 No. 61010-2-010-04 Particular requirements for laboratory equipment for the heating of materials + Amendments.

#### **For European Economic Area**

(In accordance with Council Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.)

EN61010-1: 2010 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General Requirements + Amendments.

EN61010-2-010: 2014 Particular requirements for laboratory equipment for the heating of materials + Amendments.

#### **For United States**

UL 61010-1: Electrical Equipment for Laboratory Use; Part 1: General Requirements.

UL 61010A-2-010 Part 2: Particular requirements for laboratory equipment for the heating of materials.

# **Electromagnetic Compatibility Standards**

## **For Australia and New Zealand**

AS/NZS CISPR11:2004 Limits and methods of measurement of electronic disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment.

## **For Canada**

ICES-001 Issue 4 June 2006 Interference-Causing Equipment Standard: Industrial, Scientific, and Medical Radio Frequency Generators.

## **For the European Economic Area**

(In accordance with Council Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility.)

EN61326-1:2013 Electrical equipment for measurement, control, and laboratory use-EMC requirements-Part 1: General Requirements. Emissions: Meets Class A requirements per CISPR 11. Immunity: Per Table 3 Protected EM environment.

## **For the United States**

CFR Title 47 Telecommunication Chapter I Federal Communications Commission, Part 15 Radio frequency devices (FCC regulation pertaining to radio frequency emissions).



## Safety

**WARNING: The operator of this instrument is advised that if the equipment is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.**

**AVERTISSEMENT: L'utilisateur de cet instrument est prévenu qu'en cas d'utilisation contraire aux indications du manuel, la protection offerte par l'équipement peut être altérée.**

### Accessory Symbols

The following labels are displayed on the RH Accessory for your protection:

Symbol	Explanation
	<p>This symbol indicates that you must unplug the accessory before doing any maintenance or repair work; AC power voltage is present in this system. High voltages are present in this accessory. If you are not trained in electrical procedures, do not remove the cabinet covers unless specifically instructed to do so in the manual. Maintenance and repair of internal parts must be performed only by TA Instruments or other qualified service personnel.</p> <p>Ce symbole indique que vous devez débrancher l'accessoire avant d'effectuer des travaux de maintenance ou de réparation ; présence d'une tension de secteur CA dans ce circuit. Présence de tensions élevées dans cet instrument/accessoire. Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par le personnel d'entretien qualifié de TA Instruments.</p>
	<p>This symbol indicates that a hot surface may be present. Take care not to touch this area or allow any material that may melt or burn come in contact with this hot surface.</p> <p>Ce symbole indique la présence possible d'une surface chaude. Prenez soin de ne pas toucher cette zone ou de laisser un matériau susceptible de fondre ou de brûler entrer en contact avec cette surface chaude.</p>

Please heed the warning labels and take the necessary precautions when dealing with those parts of the instrument. The *Discovery Series RH Accessory Getting Started Guide* contains cautions and warnings that must be followed for your own safety.

## *Electrical Safety*

You must unplug the accessory before doing any maintenance or repair work; voltages exceeding 120 VAC are present in this system.

**WARNING: High voltages are present in this accessory. If you are not trained in electrical procedures, do not remove the cabinet covers unless specifically instructed to do so in the manual. Maintenance and repair of internal parts must be performed only by TA Instruments or other qualified service personnel.**

**AVERTISSEMENT: Présence de tensions élevées dans cet accessoire. Si vous n'êtes pas formé aux procédures électriques, ne déposez pas les couvercles de l'armoire sauf indications spécifiques contenues dans le manuel. La maintenance et la réparation des pièces internes doivent être effectuées uniquement par TA Instruments ou tout autre personnel d'entretien qualifié.**

## *Thermal Safety*

**CAUTION: After completing an experiment, allow the saturator valve and fitting (located on the back panel of the RH Accessory) to cool before touching.**

**MISE EN GARDE: À la fin de l'expérience, laissez la vanne et le raccord du saturateur (situés sur le panneau arrière de l'accessoire RH) refroidir avant de les toucher.**

## *Chemical Safety*

**WARNING: Do not use hydrogen or any other explosive gas in the RH Accessory.**

**AVERTISSEMENT: N'utilisez pas d'hydrogène ou tout autre gaz explosif dans le accessoire RH.**

**WARNING: If analyzing samples that may emit harmful gases, vent the gases by placing the accessory near an exhaust.**

**AVERTISSEMENT: Si vous utilisez des échantillons qui émettent des gaz nocifs, ventilez les gaz en plaçant l'accessoire près d'un échappement.**

## *Lifting the Accessory*

**WARNING: Use two people to lift and/or carry the instrument. The instrument is too heavy for one person to handle safely.**

**AVERTISSEMENT: Demandez à deux personnes de soulever et/ou de porter l'instrument. L'instrument est trop lourd pour qu'une seule personne le manipule en toute sécurité.**

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# Chapter 1:

## Introducing the RH Accessory

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### *Overview*

The RH Accessory is used with TA Instruments Discovery Hybrid Rheometers—DHR-2 and DHR-3. This accessory allows properties of a sample to be analyzed under controlled and/or varying conditions of both relative humidity and temperature. The RH Accessory is used with specially designed and optimized geometries, consisting of parallel plate, tension (film/fiber), torsion rectangular, bulk diffusion, surface diffusion, and 3-point bending.

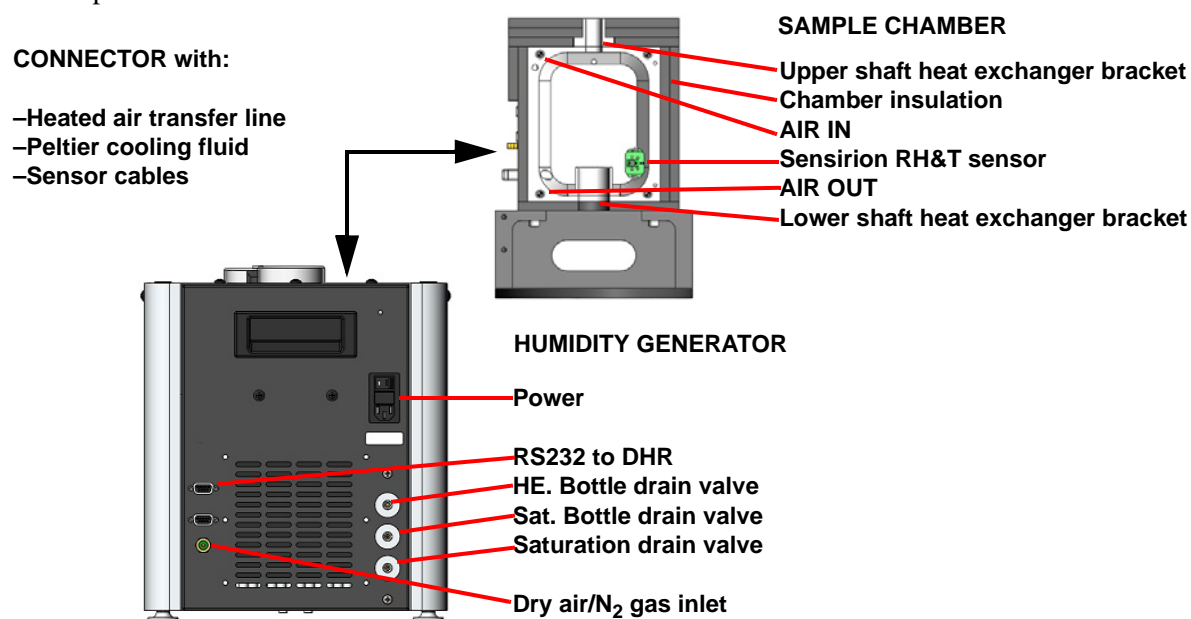


**Figure 1** RH Accessory installed on a DHR.

## System Components

The RH Accessory has the following major hardware components:

- The RH Accessory humidity generator precisely controls the temperature and humidity of the sample environment. The humidity generator is the main accessory component; it receives commands from the DHR via an RS-232 cable and controls all sub-systems that are associated with generating and maintaining both temperature and humidity.
- The heated transfer line is maintained at a temperature above the dew point temperature of the purge gas in order to avoid condensation.
- The sample chamber mounts on the DHR and encloses the sample. Its temperature and relative humidity are controlled by the humidity generator. The chamber walls are temperature-controlled to avoid condensation inside the chamber. The Sensirion sensor measures the relative humidity and the temperature in the chamber..



**Figure 2** Schematic drawing of the RH Accessory.

## Accessory Specifications

The tables below detail the RH Accessory technical specifications.

**Table 1: RH Accessory Characteristics**

<b>Dimensions of humidity generator</b>	Height: 36.8 cm (14.5 in) Width: 30.5 cm (12 in) Depth: 50.8 (20 in)
<b>Dimensions of sample chamber with attached transfer line</b>	Height: 20 cm (7.8 in) Width: 13 cm (5.11 in) Depth: 14 cm (5.5 in) Transfer line length: 2 m (6.5 feet)
<b>Weight of humidity generator (without water)</b>	27 kg (60 lbs)
<b>Weight of sample chamber with transfer line</b>	3.2 kg (7 lbs)
<b>Electrical inlet power requirements</b>	Voltage: 90–265 VAC Frequency: 45– 65Hz
<b>Energy consumption</b>	0.400 KVA

**Table 2: Accessory Gas Requirements**

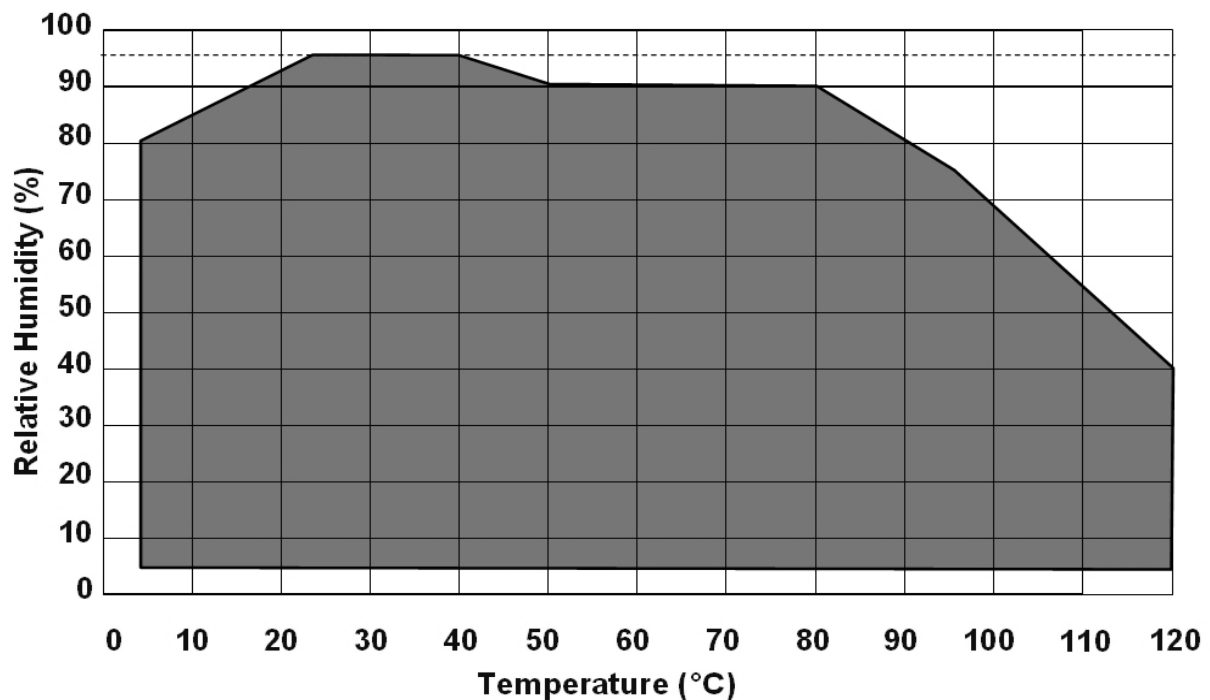
<b>Gas</b>	Filtered nitrogen with dew point of –40°C or less
<b>Pressure</b>	138 kPa gauge (20 PSI gauge)
<b>Volume</b>	3 SLPM

**Table 3: Accessory Environmental Conditions**

<b>Operating temperature range</b>	20°C to 35°C
<b>Operating altitude</b>	2000 meters maximum
<b>Relative humidity</b>	5% to 80% RH from 15°C to 31°C, decreasing to 66% RH at 35°C (non-condensing)

**Table 4: Accessory Performance Specifications**

<b>Temperature range</b>	5°C to 120°C
<b>Temperature accuracy</b>	±0.5°C
<b>Heating/Cooling rate</b>	1°C/min
<b>Humidity range</b>	See <a href="#">Figure 3</a> for the humidity range chart. Unless stated otherwise, specifications for humidity are at sea level. Units operated in higher elevations will have a reduced humidity operating range.
<b>Humidity accuracy</b>	5% to 90% RH, ±3% >90% RH, ±5%
<b>Humidity ramp rate</b>	2% RH/min (fixed), both increasing and decreasing (alternate RH pseudo-linear ramp rates can be achieved through programmed step-iso methods)



**Figure 3** RH Accessory humidity range chart.

# Chapter 2:

## Installing the RH Accessory

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### *Unpacking/Repacking the RH Accessory*

The instructions needed to unpack and repack the accessory are found as separate unpacking instructions in the shipping box and in the online documentation associated with the instrument control software. Be sure to read and perform the unpacking instructions prior to performing any procedures in this chapter.

Retain all of the shipping hardware and boxes from the accessory in the event you wish to repack and ship your accessory.

**WARNING: Have an assistant help you unpack this unit. Do not attempt to do this alone.**

**AVERTISSEMENT: Faites-vous aider par une personne pour dépoter cet appareil. N'essayez pas de le faire tout seul.**

### *Preparing the Accessory*

Before shipment, the RH Accessory is inspected both electrically and mechanically so that it is ready for operation upon proper installation. Only limited instructions are given in this manual; consult the online documentation for additional information. Installation involves the following procedures:

- Inspecting the accessory for shipping damage and missing parts
- Connecting the RH Accessory cables and lines
- Filling the reservoirs
- Priming the Temperature Control System
- Filling the saturator
- Installing the sample chamber

It is recommended that you have your RH Accessory unpacked and installed by a TA Instruments Service Representative; call for an installation appointment when you receive your accessory.

**CAUTION: To avoid mistakes, read this entire chapter before you begin installation.**

**MISE EN GARDE: Pour éviter de commettre des erreurs, lisez tout le chapitre avant de commencer l'installation.**

## Inspecting the System

When you receive the RH Accessory, look over the accessory and shipping container carefully for signs of shipping damage, and check the parts received against the enclosed shipping list.

- If the accessory is damaged, notify the carrier and TA Instruments immediately.
- If the accessory is intact but parts are missing, contact TA Instruments.

## Choosing a Location

Choose a location for the accessory using the following guidelines. The RH Accessory should be:

### *In*

- A temperature-controlled area. Temperatures should be in the range of 20–35°C.
- A clean environment, preferably on the ground floor in the building.
- An area with ample working and ventilation space.

### *On*

- A stable work surface.

### *Near*

- A power outlet (universal input; 90–265 VAC, 47–63 Hz, 400 VA).
- Your TA Instruments controller.
- A nitrogen gas source and purge gas supplied with suitable regulators and filters, if required.
- Your DHR, but plan to place the RH Accessory cabinet on a separate table or on the floor to the left side of the DHR.
- Be sure not to place the rear of the RH Accessory cabinet too close to a wall or other obstruction. The cooling fan is an integral part of the RH Accessory, and proper air flow is required for the operation of the system. Maintain at least 30 cm (12 in) between the rear of the cabinet and any obstruction.

### *Away from*

- Dusty environments.
- Exposure to direct sunlight.
- Direct air drafts (fans, room air ducts).
- Poorly ventilated areas.
- Noisy or mechanical vibrations.
- High traffic areas, where constant movements from passing personnel could create air currents or mechanical disturbances.

## Connecting Cables and Lines

To connect the cables and gas lines, access the RH Accessory's rear panel and follow the instructions below:

**CAUTION:** When plugging in or unplugging power cords, handle them by the plugs, not the cord.

**MISE EN GARDE:** Chaque fois que vous branchez ou débranchez les cordons d'alimentation, tenez-les par les fiches et non par les cordons.

**WARNING:** Protect power and communications cable paths. Avoid laying cables across walkways, as this can create a tripping hazard.

**AVERTISSEMENT:** Protégez les chemins de câble électriques et de câbles de télécommunication. Ne créez pas de risques de déclenchement en posant des câbles sur les voies d'accès.

- 1 A note regarding the RS232 communication cable:
  - **If this is a first-time installation**, do not yet connect the RS232 communication cable. This will be performed in subsequent steps.
  - **If this is not a first-time installation** (and you are sure there is no air in the water cooling lines), connect one end of the RS232 cable to the INSTRUMENT port on the back of the RH Accessory cabinet and the other end of the cable to the RS232 port on the DHR electronics box.
- 2 Connect your supply of nitrogen to the regulator, the regulated nitrogen (138 kPa [20 psi]) to the input of the supplied dryer, and connect the output of the dryer to the N2/DRY AIR inlet (shown in [Figure 5](#)) using the supplied 1/8" tubing.



**Figure 4** Supplied dryer and fittings.



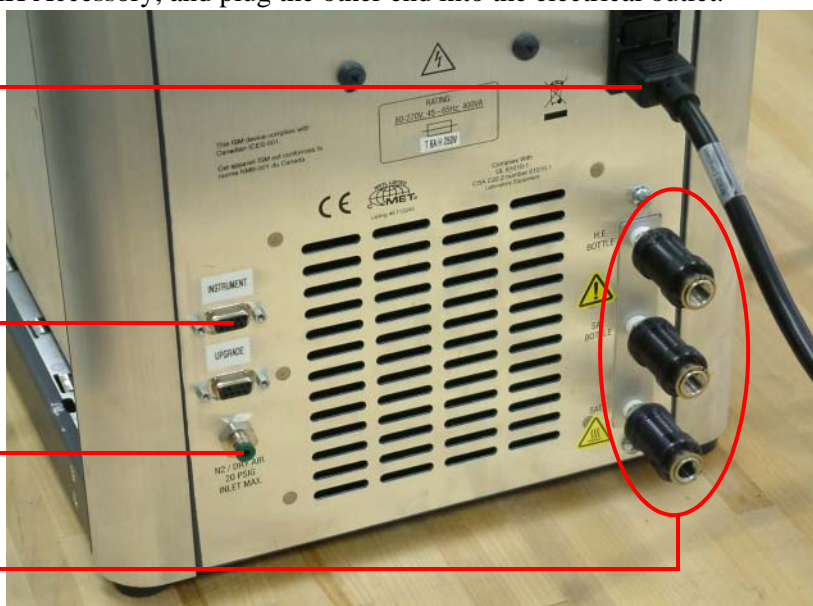
- 3 Connect the power cord to the RH Accessory, and plug the other end into the electrical outlet.

**Power cord**

**Instrument port**

**N2/DRY AIR inlet port**

**Drain valves**



**Figure 5** Connection ports and drain valves on the back of the RH Accessory.

## *Filling the RH Accessory Reservoirs*

The Saturator Reservoir holds approximately 1 L of distilled water. It can be filled at any time – even during an experiment – without adversely affecting data. The RH cabinet includes a micro-pump that automatically pumps distilled water from the Saturator Reservoir to the Saturator when it is low. It is important to maintain an adequate level of distilled water in the Saturator Reservoir to avoid an error. The Saturator Reservoir includes a liquid level sensor used to indicate a low liquid condition. If the LCD screen on the front of the RH cabinet reads “SAT RESERV LOW,” fill the Saturator Reservoir with distilled water as soon as possible. An experiment will continue for some period of time (depending on experimental temperature and requested %RH) even when a low liquid condition exists. However, once the RH Accessory determines the water level in the Saturator is too low and no water is available in the Saturator Reservoir, the experiment will be terminated and the LCD screen will display “SAT WATER LOW.”

The Heat Exchanger Reservoir also holds approximately 1 L of distilled water, and supplies this as a coolant to the temperature control system. The temperatures of the Saturator and Sample Chamber are maintained by means of Peltier elements. The Peltier elements themselves are compensated by means of circulating water. The RH cabinet includes a circulating pump that moves water from the Heat Exchanger Reservoir, through the Peltier cooling blocks on the Saturator and Sample Chamber, and finally through a heat exchanger in the rear of the RH cabinet before returning it to the reservoir. It is important to maintain an adequate level of distilled water in the Heat Exchanger Reservoir to avoid termination of an experiment. The Heat Exchanger Reservoir includes a liquid level sensor used to indicate a low liquid condition. If the LCD screen on the front of the RH cabinet reads “COOLER LOW WATER”, fill the Heat Exchanger Reservoir with distilled water as soon as possible. An experiment will continue even when a low liquid condition exists, as long as the system does not detect an over-temperature condition. If the water level in the Heat Exchanger Reservoir drops too low, it is possible to overheat the Peltier cooling blocks. An experiment will be terminated if the system detects an over-temperature condition.

- 1 Ensure that all connections in the previous section [“Connecting Cables and Lines”](#) are complete.
- 2 Ensure that all drain valves (circled in [Figure 5](#) above) are closed by pushing them in as far as allowable.
- 3 Fill the HEAT EXCHANGER RESERVOIR and the SATURATOR RESERVOIR (located on the top panel of the RH Accessory; caps shown below) with distilled water.



**Figure 6** HEAT EXCHANGER RESERVOIR (left); SATURATOR RESERVOIR (right).

**CAUTION:** Do not put any liquid other than distilled water into any of the RH Accessory's reservoirs.

**MISE EN GARDE:** Ne versez aucun liquide autre que de l'eau distillée dans les réservoirs de l'accessoire RH.

4. Power on the RH Accessory using the **On/Off** switch on the back panel of the accessory.

## *Priming the Temperature Control System*

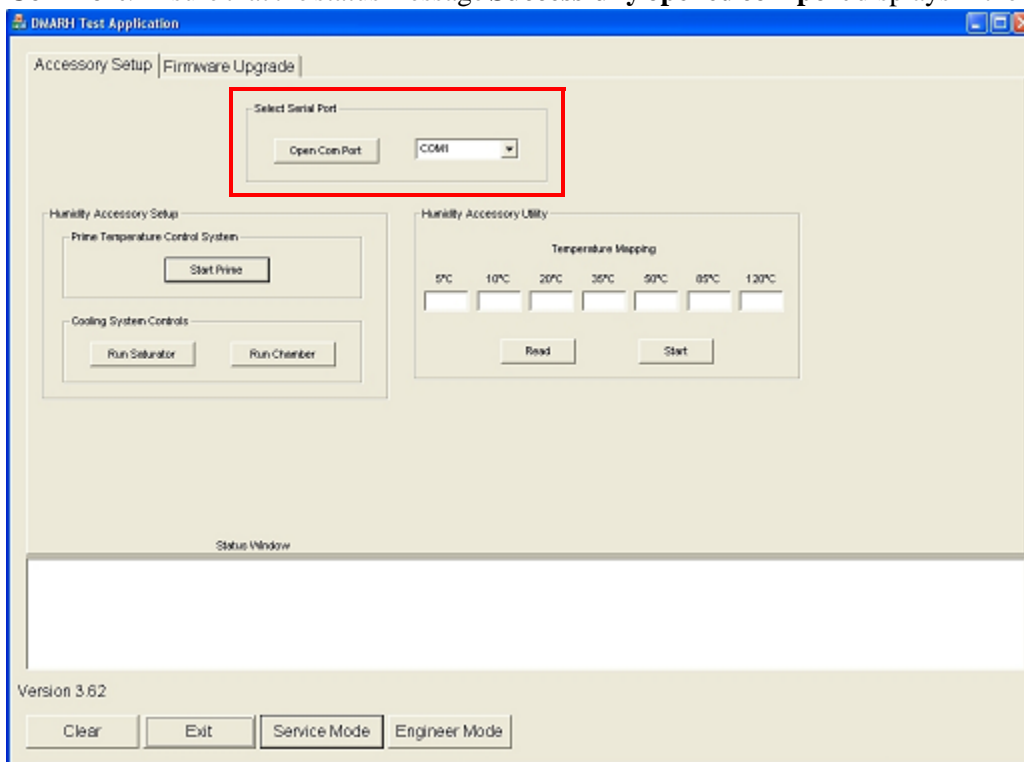
The Temperature Control System must be purged of all air to ensure maximum efficiency of cooling and heating. This is accomplished using the Accessory Setup screen of the Humidity Accessory Test Application.

Prime the temperature control system upon initial installation, or if you suspect air has gotten into the lines.

- 1 Connect one end of the RS232 communication cable to COM1 (or available serial port) on the PC. Connect the other end of the communication cable to the UPGRADE port on the RH Accessory.

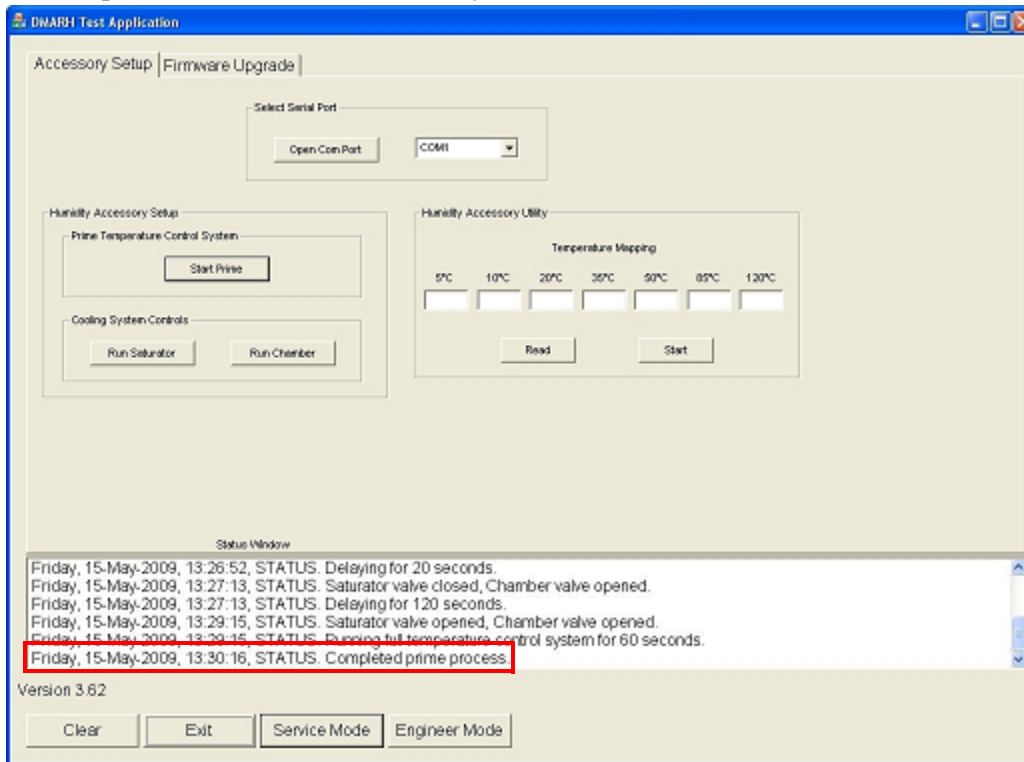
**NOTE:** A USB Serial Adapter is provided should a COM port not be available.

- 2 Navigate to **C:\Program Files (x86)\TA Instruments\TRIOS\Tools** and then double-click the executable **DMARH.exe** to run the Humidity Accessory Application.
- 3 Click the **Accessory Setup** tab.
- 4 In the **Select Serial Port** section, select the proper **COM** port from the drop-down list and click **Open Com Port**. Ensure that the status message **Successfully opened com port** displays in the **Status** window.



**Figure 7** Open COM port.

- 5 Click **Start Prime** in the **Prime Temperature Control System** section. The RH Accessory begins the automated priming process, displaying each step in the **Status** window. At this time, the saturator pump will begin to click about two times per second, indicating that the pump is filling the saturator.
- 6 When the process is complete, **Completed prime process** displays in the **Status** window, and water flow stops (a small amount of water may continue to flow).



**Figure 8** STATUS Completed prime process.

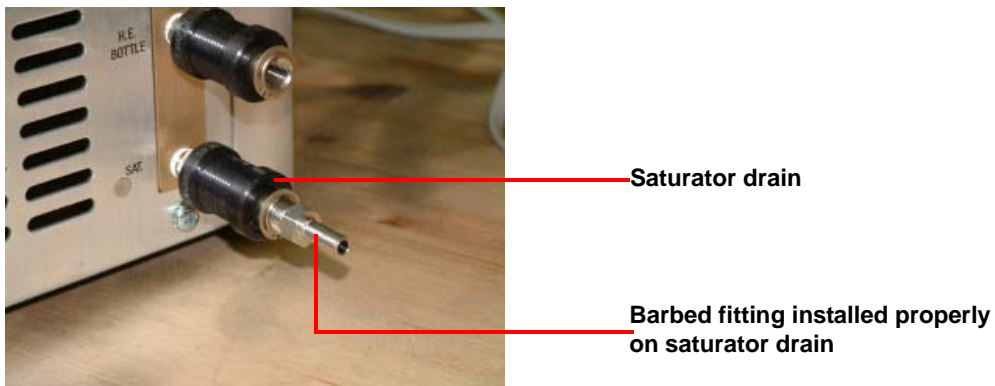
- 7 To ensure that the temperature control systems are properly primed, click **Run Saturator** in the **Cooling System Controls** section. Remove the lid from the Heat Exchanger bottle and verify water is flowing from the upper fitting into bottle. Click **Stop Saturator**.
- 8 Click **Run Chamber** and verify that water is flowing from upper fitting into Heat Exchanger bottle. Click **Stop Chamber**.

## *Filling the Saturator*

- 1 Install the barbed fitting (included in accessory kit and shown below in [Figure 9](#)) in the SAT (saturator drain) valve (see [Figure 10](#)). Hand-tighten the fitting.

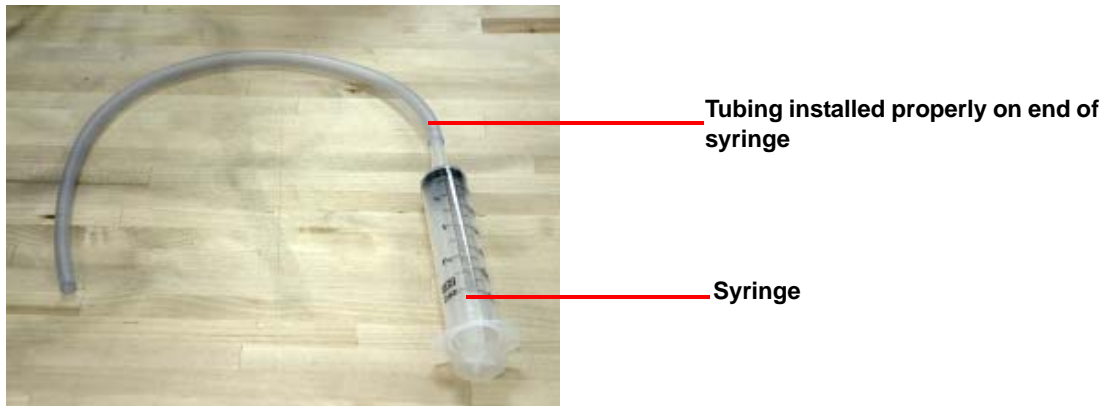


**Figure 9** Saturator drain barbed fitting.



**Figure 10** Fitting installed properly in saturator drain.

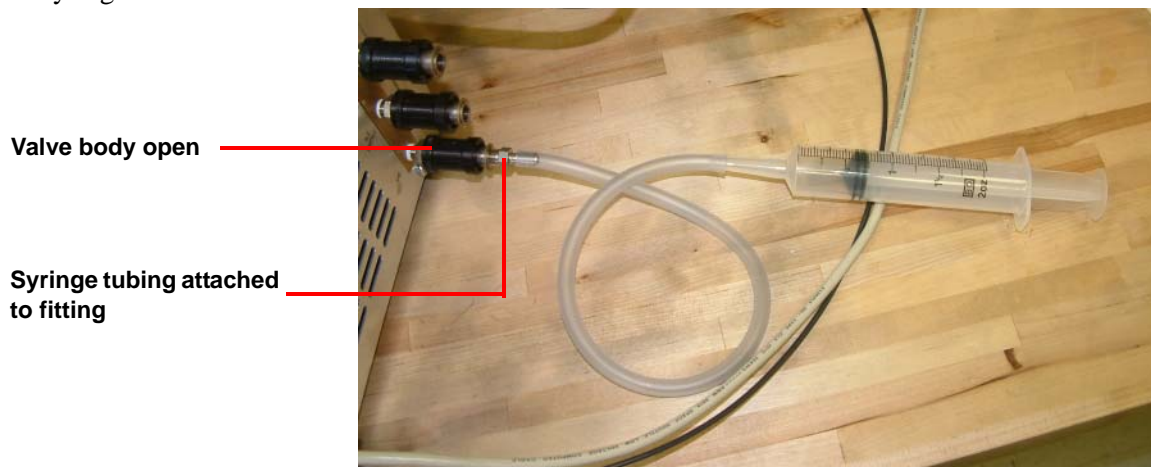
- 2 Obtain the tubing and syringe from the accessory kit. Install the tubing onto the end of the syringe, as shown below.



**Figure 11** Proper syringe and tubing connections.

- 3 Fill the syringe with 60 cc of distilled water.
- 4 Connect the open end of the syringe tubing to the barbed fitting on the RH Accessory SAT valve.

- 5 Pull the valve body to open the valve and **slowly** dispense water into the RH Accessory by pushing in on the syringe.



**Figure 12** Filling the saturator through the saturator valve.

- 6 Close the saturator valve when the syringe empties and disconnect the syringe tubing from the barbed fitting.
- 7 Repeat step 4 through step 7 two to three more times until the pump clicking stops. This indicates that the saturator is full.

If necessary, disconnect the communication cable from the UPGRADE port on the RH Accessory and connect it to the INSTRUMENT port. Disconnect the other end from the PC and connect it to RS232 on the DHR electronics.

**CAUTION: Do not add more than 240 mL (4 filled syringes) or continue to add water if the pump stops clicking. It is possible to over-fill the saturator and push water into the sample chamber, potentially damaging the DHR.**

**MISE EN GARDE: Ne pas ajouter plus de 240 ml (4 seringues remplies) ou continuer à ajouter de l'eau si la pompe cesse de cliquer. Il est possible de trop remplir le saturateur et pousser l'eau dans la chambre de l'échantillon, ce qui pourrait endommager la DHR.**

- 8 Remove the syringe tubing from the barbed fitting and, if desired, remove the fitting from the saturator valve. Again ensure that the saturator fitting valve is closed (pushed in).

**CAUTION: If it becomes necessary to move the RH Accessory, it is necessary to drain some of the water out of the saturator. Failure to drain water from the saturator will result in water being pushed into the transfer line and then into the sample chamber when the purge gas is turned back on, potentially causing damage to the DHR. Follow the instructions given in [“Moving the RH Accessory” on page 29](#).**

**MISE EN GARDE: S'il s'avère nécessaire de déplacer l'accessoire RH, il faut évacuer une partie de l'eau hors du tampon de saturation. Si vous n'évacuez pas l'eau du tampon de saturation, l'eau risque d'être poussée dans la conduite de transfert et ensuite dans la chambre à échantillon lorsque le gaz de drainage est remis en marche, ce qui pourrait endommager le DHR. Suivez les instructions fournies dans la section « Déplacement de l'accessoire RH » en page 29.**



## *Installing the RH Sample Chamber*

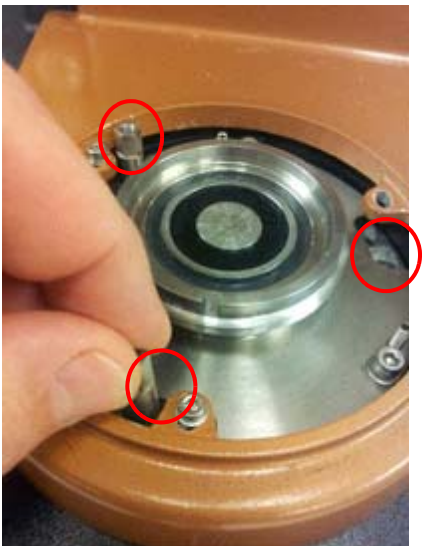
To install the RH Accessory sample chamber onto the DHR, follow the instructions below:

- 1 Raise the rheometer head to the top-most position.
- 2 Rotate the protection cover at the Smart Swap™ base in counterclockwise direction and remove it.



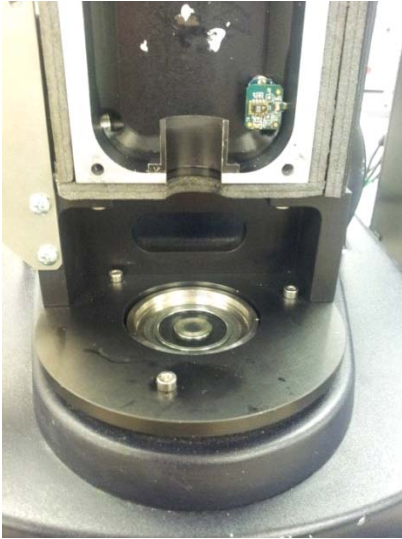
**Figure 13** Remove protection cover.

- 3 Remove the screws in the base using an allen wrench, if present.
- 4 Insert the 3 standoff studs (see installation kit) to the base of the Smart Swap flange plate.



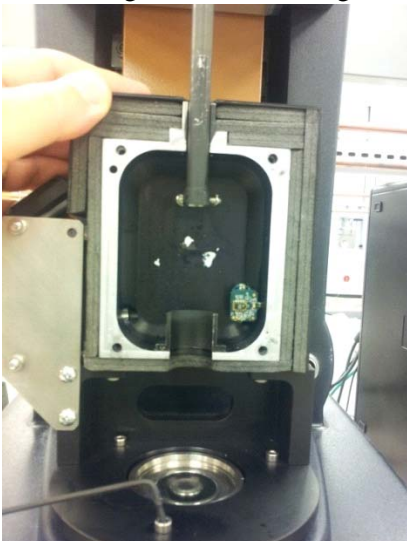
**Figure 14** Install the 3 standoff studs.

- 5 Remove the front face of the RH Accessory sample chamber by unscrewing the 4xM3 socket head cap screws using the T-handle hex wrench.
- 6 Locate the RH Accessory sample chamber on the 3 standoff studs and lightly fix in place using the 3xM4 socket head cap screws. Do not fully tighten the screws.



**Figure 15** Mount the RH chamber to the DHR base.

- 7 Attach the upper geometry to the motor shaft using the draw rod. It will be necessary to adjust the head position using the instrument keypad so that the clamp /plate is within the sample chamber, but not touching the roof of the chamber.
- 8 Adjust the base of the sample chamber so that there is an even gap around the upper geometry shaft, and then tighten the mounting screws.




**Figure 16** Adjust and align the chamber with the upper geometry shaft installed.



- 9 Fit the front half of the sample chamber and make sure the gap around the upper geometry shaft is still even. If not, loosen the screws and realign. When properly aligned, the upper geometry should spin freely.
- 10 Remove the front half of the sample chamber.

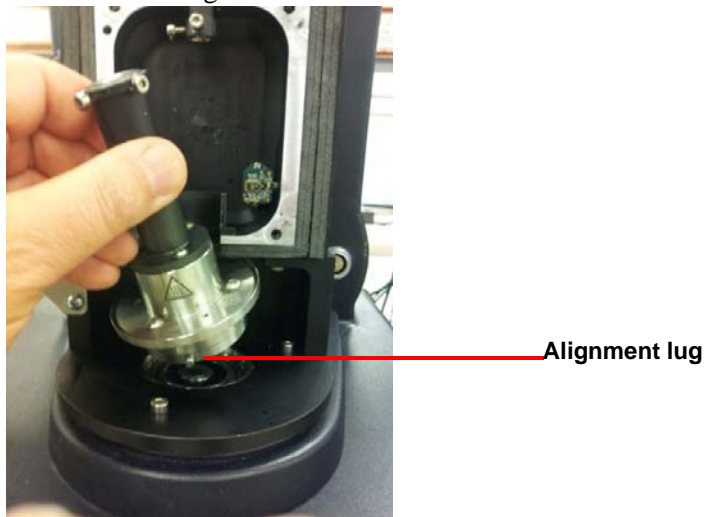
## *Fitting the Lower and Upper Geometry Assembly*

There are a number of RH lower assemblies, but they are all attached in the same way.

- 1 Press the Release button  on the instrument keypad. A continuous green light indicates that the assembly can be fitted.

**NOTE:** The release state will only stay active for 10 seconds.

- 2 Fit the assembly as shown in the figure below, making sure it is correctly aligned. The alignment lug on the lower stage should locate in the slot on the Smart Swap™ base.



**Figure 17** Fit the lower assembly.

- 3 When the green status light turns off, the lower assembly will be locked in place.
- 4 Attach the upper geometry to the motor shaft using the draw rod. It will be necessary to adjust the head position using the instrument keypad so that the clamp/plate is within the sample chamber. Some geometries such as film/fiber and 3-point bending test fixtures must be operated at a fixed angular position. Lock the upper shaft in the alignment position from the Instrument Motor panel. Refer to TRIOS online help for instructions on calibrating the alignment position for these geometries.
- 5 Zero the gap and map the geometry. Refer to the TRIOS online help topic “Operating the RH Accessory” for details.

# Chapter 3:

## Use, Maintenance, & Diagnostics

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### *Using the RH Accessory*

All of your RH Accessory experiments will follow the same general outline. In some cases, not all of these steps will be performed. The majority of these steps are performed using the instrument control software. See the instrument control online help for instructions on performing these actions.

- Creating or choosing a test procedure and entering experiment information through TRIOS software
- Loading the sample
- Starting the experiment

### **Before You Begin**

Before using the RH Accessory, make sure that the DHR is installed properly. Also make sure you have:

- Connected the RS232 cable between the DHR and the RH Accessory
- Connected enclosure power line and gas line
- Powered on each unit.

**NOTE:** If the RH Accessory is detached from the DHR it will still be the active temperature system until it is switched off, even if another Environmental system is plugged in. Therefore, it is good practice to turn off the power to the RH Accessory before detaching it from the DHR.

- Filled the reservoirs as necessary
- Become familiar with controller operations

# *Running an RH Experiment*

## Setting up a Geometry

See online help for details on setting up a geometry. Make sure that **Humidity** is selected as the Temperature System in the Geometry template.

## Loading the Sample

See online help for details concerning sample preparation and loading. The same general guidelines are applicable as a standard experiment.

## Creating an Experimental Procedure

TRIOS has a Conditioning Humidity procedure step. See online help for details on controlling humidity during a procedure.

## *Maintaining the Accessory*

The primary maintenance procedures described in this section are the customer's responsibility. Any further maintenance should be performed by a representative of TA Instruments or other qualified service personnel. Consult the online documentation installed with the instrument control software for further information.

**WARNING: Because of the high voltages in this accessory, untrained personnel must not attempt to test or repair any electrical circuits.**

**DANGER: À cause de la présence de tensions élevées dans cet accessoire, le personnel non formé ne doit pas essayer de tester ou de réparer les circuits électriques.**

## Draining the RH Accessory Reservoirs

The procedure below explains how to properly drain the RH Accessory reservoirs.

- 1 Turn off the power switch on the accessory and unplug the power cord from the power inlet. Remove the power supply side panel (the right side panel if facing the drain valves).
- 2 Remove both the Heat Exchange Reservoir and Saturator Reservoir caps.
- 3 Install the barbed fitting (included in accessory kit and shown in [Figure 9](#)) in the SAT (saturator drain) valve (refer to [Figure 10](#)).
- 4 Obtain the tubing from the accessory kit. Install the tubing onto the end of the barbed fitting, and pull the SAT valve open to drain. Use a bucket or a similar apparatus to catch the draining liquid.
- 5 Once the draining is complete, remove the barbed fitting and tubing from the SAT drain valve.
- 6 Attach the fitting and tubing to the SAT BOTTLE drain valve, and pull the SAT BOTTLE valve open to drain. Again, use a bucket or a similar apparatus to catch the draining liquid.
- 7 Once the draining is complete, remove the barbed fitting and tubing from the SAT BOTTLE drain valve.

- 8 Attach the fitting and tubing to the H.E. BOTTLE drain valve. Pull the H.E. BOTTLE drain valve open to drain, using a bucket or similar apparatus to catch the draining liquid.
- 9 Pinch off the supply line from the Heat Exchange reservoir above the “tee” fitting using the hemostat pliers supplied in the accessory kit. Refer to the figure below.

Pliers pinching  
supply line

Tee fitting



**Figure 18** Hemostat pliers pinching off supply line, just above “tee” fitting.

- 10 Obtain the syringe from the accessory kit and retract the plunger. Attach the syringe to the tubing.
- 11 Push the plunger into the syringe, forcing water from the cooling system back into the Heat Exchange reservoir.
- 12 Close the drain valve, remove the tubing (with syringe still attached) from the fitting, and retract the plunger.
- 13 Reattach the tubing and syringe to the fitting and open the drain valve. Push the plunger into the syringe.
- 14 Repeat step 12 and step 13 (approximately 15 times) until all water is forced from the cooling system.
- 15 When all water is forced from the cooling system, close the drain valve, remove the hemostat pliers pinching off the supply line, and remove the syringe from the tubing. Then open the H.E. BOTTLE drain valve to drain the remaining water from the H.E. Reservoir, using a bucket or similar apparatus to catch the draining liquid.
- 16 When finished, replace the reservoir caps and reattach the power supply side panel.

## Cleaning the Accessory

To clean the RH Accessory, wipe down the control cabinet with a damp, soft cloth.

**CAUTION: Do not use harsh chemicals, abrasive cleansers, steel wool, or any rough materials to clean the cabinet, as you may scratch the surface and degrade its properties.**

**MISE EN GARDE: N'utilisez pas de produits chimiques agressifs, de nettoyants abrasifs, de la laine d'acier ou tout autre matériau rugueux pour nettoyer l'armoire, car vous pourriez égratigner sa surface et dégrader ses propriétés.**

## Moving the RH Accessory

**CAUTION:** If it becomes necessary to move the RH Accessory, it is important to drain some of the water out of the saturator. Failure to drain water from the saturator will result in water being pushed into the transfer line and then into the sample chamber when the purge gas is turned back on, causing potential damage to the DHR.

**MISE EN GARDE:** S'il s'avère nécessaire de déplacer l'accessoire RH, il faut évacuer une partie de l'eau hors du tampon de saturation. Si vous n'évacuez pas l'eau du tampon de saturation, l'eau risque d'être poussée dans la conduite de transfert et ensuite dans la chambre à échantillon lorsque le gaz de drainage est remis en marche, ce qui pourrait endommager le DHR.

Follow these steps to drain a small amount of water from the saturator:

- 1 Turn off the power switch on the accessory and unplug the power cord from the power inlet.
- 2 Obtain a bucket or small container to collect the water that will be drained from the saturator.
- 3 Locate the saturator drain fitting (shown in [Figure 9](#)) and pull the valve body to open the valve and allow water to flow into the container. Drain at least 100 mL of water from the saturator prior to moving the RH Accessory.
- 4 Move the RH Accessory to a new location, following the guidelines found in [“Choosing a Location” on page 15](#) in this manual.
- 5 Reattach all cables and lines per [“Connecting Cables and Lines” on page 16](#) found in this guide.

## Downloading Firmware to the RH Accessory

Upon delivery, the latest firmware is already installed on the RH. However, in the event that you need to update the firmware, follow the procedure below.

- 1 Attach an RS232 cable to the serial port on the controller and to the serial port labeled UPGRADE on the rear of the RH Accessory.
- 2 Navigate to the directory **C:\Program Files (86)\TA Instruments\TRIOS\Tools\RH**.
- 3 Double-click on the executable file **DMARH.exe** to open the RH Accessory application.
- 4 When the application opens, select the **Firmware Upgrade** tab.



**Figure 19** Firmware Upgrade tab.

- 5 Verify that the **Flash Program File Selector** is set to the following path: **C:\Program Files (x86)\TA Instruments\TRIOS\Tools\RH**
- 6 If the **Flash Program File Selector** is set to a different path, click **Select Program File** and navigate to the path listed in step 5.

- 7 Under **Firmware Program Control**, click the drop-down menu to the right of **Open Com Port**. Select the RS232 Com Port that the cable is connected to on the controller. Then click **Open Com Port**.

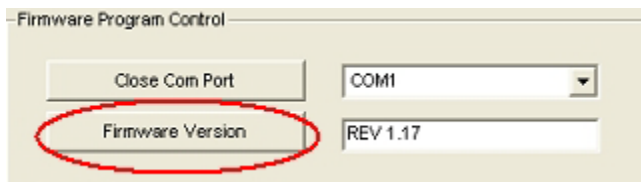


A message similar to the one below displays.

Tuesday, 12-May-2009, 14:10:36, STATUS. Open serial port successfully

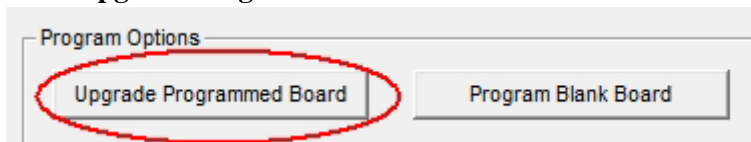
**Figure 20** Status message.

- 8 Click **Firmware Version** to obtain the current version of firmware installed on the RH Accessory.



**Figure 21** Firmware Version.

- 9 Click **Upgrade Programmed Board** to start the firmware download process.



**Figure 22** Upgrade Programmed Board.

A message similar to the one below displays.

Tuesday, 12-May-2009, 14:16:37, STATUS. Starting firmware download process.  
Tuesday, 12-May-2009, 14:16:39, STATUS. Downloading firmware to Accessory.

**Figure 23** Status message.

- 10 When the firmware download completes, a status message similar to the one below displays within the RH Accessory application.

Tuesday, 12-May-2009, 15:01:44, STATUS. Firmware Download: .....  
Tuesday, 12-May-2009, 15:01:44, STATUS. Firmware Download: Loaded 0x00F24C bytes.  
Tuesday, 12-May-2009, 15:01:44, STATUS. Waiting for final response.  
Tuesday, 12-May-2009, 15:01:56, STATUS. Successfully downloaded firmware to Accessory.  
Tuesday, 12-May-2009, 15:01:56, STATUS. Serial port is closed  
Tuesday, 12-May-2009, 15:01:56, STATUS. Open serial port successfully

**Figure 24** Status message.

- 11 After receiving the message that the firmware was successfully downloaded to the RH Accessory, click **Exit** to close the application.
- 12 As part of the download process, the RH Accessory automatically reboots.
- 13 Disconnect the RS232 communication cable between the controller and UPGRADE port on the rear of the RH Accessory.

## *Mapping Temperature on the RH Accessory*

If the RH sensor is replaced, it is necessary to map the new sensor's response to the sample chamber. Additionally, if the measured temperature drifts away from the requested temperature by an unacceptable amount, perform the temperature mapping process as a means to reconcile the values. Note that this procedure should be completed with tools properly installed, otherwise mapping may not be accurate.

Follow the procedure below to map the temperature sensor:

- 1 Attach an RS232 cable to the serial port on the controller and to the serial port labeled INSTRUMENT on the rear of the RH Accessory.
- 2 Navigate to the directory **C:\Program Files (x86)\TA Instruments\TRIOS\Tools\RH**.
- 3 Double-click on the executable file **DMARH.exe** to open the RH Accessory application.
- 4 When the application opens, click the **Accessory Setup** tab.



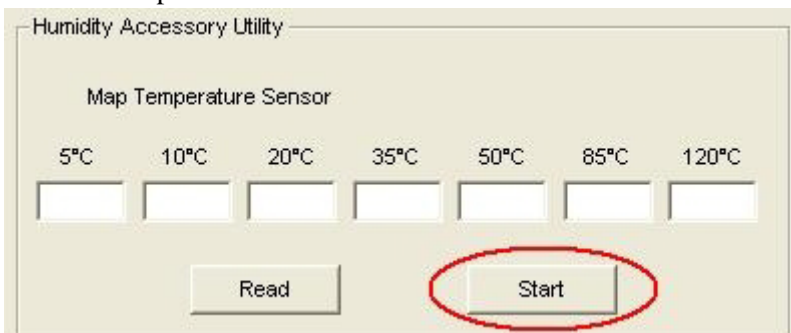
**Figure 25** Accessory Setup tab.

- 5 Click the drop-down menu to the right of **Open Com Port**. Select the RS232 COM Port that the cable is connected to on the controller. Then click **Open Com Port**.



**Figure 26** Select Serial Port.

- 6 Click **Start** to begin the temperature mapping process. Note that this process will take approximately 8 hours to complete.



**Figure 27** Humidity Accessory Utility.



- 7 Upon completion of the temperature mapping, the values appear in the boxes, and the RH Accessory automatically stores the values in flash memory.

## *Monitoring the Humidity Chamber*

The water reservoir within the RH Accessory cabinet will require periodic refills with distilled water. When the reservoir is low, a message will appear in the status line. Follow the instructions on page 16 to fill the reservoir again.

**NOTE:** The “SAT RESERV LOW” indicator initially triggers when approximately 250 mL are left in the reservoir.

The water reservoir in the RH Accessory holds approximately 1 L of water when full. The rate of consumption of that water during experiments is dependent on temperature, %RH requested, and time. The dominant factor, however, is temperature. At 25°C, the rate of consumption is low, even if high humidities are used. At 25°C it takes more than 30 days for the reservoir to be depleted. On the other hand, at extreme conditions (for example, isothermal at 85°C and 85% RH), the rate of water consumption is much higher.

**NOTE:** It is good practice to always fill the water reservoir prior to starting an experiment. Water can be added in the middle of an experiment with no adverse affects to the data.

## *Replacing Fuses*

**WARNING: Always unplug the instrument before you examine or replace the fuses.**

**AVERTISSEMENT: Débranchez toujours l'instrument avant d'examiner ou de remplacer les fusibles.**

The RH Accessory contains internal fuses that are not user serviceable. If any of the internal fuses blow, a hazard may exist. Call your TA Instruments service representative.

The only fuses that you can replace yourself are the fuses located in the power entry module located at the rear of the accessory. To check or change these fuses:

- 1 Turn the accessory off and remove the power cord.
- 2 Remove the fuse drawer from the accessory by using your finger to pry out the edge of the drawer, then removing the entire fuse drawer (see [Figure 28](#)).

**CAUTION: Do not use a metal tool to remove the fuse drawer from the RH Accessory, as it could result to damage to the fuse and/or fuse drawer.**

**MISE EN GARDE: N'utilisez pas un outil métallique pour retirer le tiroir à fusible de l'accessoire RH, car cela pourrait endommager le fusible et/ou le tiroir à fusibles.**





**Figure 28** Fuses on the RH Accessory.

- 3 Remove old fuses and replace the fuses only with the type and rating indicated on the accessory's rear panel.
- 4 Place fuse holder back into opening and push until it sits securely in the slot.

## *Replacement Parts*

**Table 5: Replacement Parts for the RH Accessory**

Part Number	Description
985606.901	Mass flow control assembly
985670.901	RH sensor PC board
985680.901	RH control PC board

## *Error Messages and Troubleshooting*

The following are error codes that display in the software and on the DHR touch screen; included in this list are possible troubleshooting solutions for each error code.

<b>LCD Display Text</b>	<b>Additional Information</b>	<b>Try the Following</b>
Bad Press Sensor	Bad pressure sensor. Call TA Instruments.	Reboot the RH Accessory box. If problem persists, call TA Instruments.
Encl Over Temp	RH Accessory enclosure temperature too high. Call TA Instruments.	Turn the RH Accessory off, and let sit for several minutes. Try powering it back on and running another experiment. If problem persists, call TA Instruments.
No Instrum Comm	Communication time out with the RH Accessory.	Check the RS232 cable connections at both the instrument and the RH Accessory. The cable should be connected to the RS232 port on the instrument, and the INSTRUMENT port on the RH Accessory.
Low 24V Power	Power Supply. Low 24V. Call TA Instruments.	Call TA Instruments.
No Mass Flow Cal	No calibration parameters found for Mass Flow Controllers.	Power cycle the RH Accessory. If the error persists, call TA Instruments.
MFC Checksum Err	Error reading calibration parameters for Mass Flow Controllers.	Turn off the power to the RH Accessory. Wait several minutes, then turn the power back on. If the error persists, call TA Instruments.
MFC 100% Sensor	Unable to attain purge gas flow. Call TA Instruments.	Ensure a dry gas purge line is connected to the rear of the RH Accessory. If problem persists, call TA Instruments.
MFC 0% Sensor	Unable to attain purge gas flow. Call TA Instruments.	Ensure a dry gas purge line is connected to the rear of the RH Accessory. If problem persists, call TA Instruments.
MFC 100% Balance	Problem controlling humidity to proper level. Damage to DHR could be possible. Call TA Instruments as soon as possible.	Call TA Instruments.
MFC 0% Balance	Problem controlling humidity to proper level. Damage to DHR could be possible. Call TA Instruments as soon as possible.	Call TA Instruments.

Sat Water Low	Saturator water level is too low, and saturator reservoir bottle is empty. Refill saturator reservoir bottle.	Fill the saturator reservoir bottle near the front of the RH Accessory with distilled water. See <a href="#">“Filling the RH Accessory Reservoirs” on page 18</a> in this manual for help. To clear the fault, cycle the power on the RH Accessory. A clicking sound will be heard as the system refills the saturator to its proper level.
Sat Refill Error	Error refilling saturator. Call TA Instruments.	Call TA Instruments.
Sat Heat Sink OT	Saturator heat sink temperature too high. Call TA Instruments.	In this fault state, the RH Accessory should continue to cool itself and bring the temperature down to a safe level. Leave the RH Accessory alone for several minutes to allow it to cool sufficiently. The LCD screen will continue to post this message, even if the system is able to cool the heat sink sufficiently. After cooling down, a new experiment can be started. If the system is able to run, it will clear the message and enter operational mode. If the system cannot run, and continues to post this error message, call TA Instruments.
Sat Wall Temper	Saturator temperature too high. Call TA Instruments.	In this fault state, the RH Accessory should continue to cool itself and bring the temperature down to a safe level. Leave the RH Accessory alone for several minutes to allow it to cool sufficiently. The LCD screen will continue to post this message, even if the system is able to cool the saturator sufficiently. After cooling down, a new experiment can be started. If the system is able to run, it will clear the message and enter operational mode. If the system cannot run, and continues to post this error message, call TA Instruments.
No Humidity Cal	No calibration parameters found for humidity.	Turn off the power to the RH Accessory. Wait several minutes, then turn the power back on. If the error persists, call TA Instruments.
Sat Cal Wrt Err	Error writing humidity calibration values to memory.	Turn off the power to the RH Accessory. Wait several minutes, then turn the power back on. If the error persists, call TA Instruments.
Sat Cal Read Err	Error reading humidity calibration values from memory.	Turn off the power to the RH Accessory. Wait several minutes, then turn the power back on. If the error persists, call TA Instruments.

Sat Reserv Low	Saturator reservoir water level is low. Refill the saturator reservoir as soon as possible.	Refill the saturator reservoir bottle toward the front of the RH Accessory with distilled water. See <a href="#">“Filling the RH Accessory Reservoirs” on page 18</a> in this manual for assistance.
Cham Sensor Open	Error reading Sample Chamber humidity and temperature sensor. Call TA Instruments.	Turn off the power to the RH Accessory. Wait several minutes, then turn the power back on. If the error persists, call TA Instruments.
Cham High Dew Pt	Dew Point Temperature in Sample Chamber is too high. Run ended.	In this state, the system has detected a dew point temperature that could cause condensation to form within the sample chamber. As a safety feature, the system stops the run and purges the sample chamber with dry gas. Allow the RH Accessory to remain in standby mode for several minutes to allow the system to purge the sample chamber. After several minutes it is safe to begin the experiment again.
Cham Heat SNK OT	Sample Chamber heat sink temperature too high. Call TA Instruments.	In this fault state, the RH Accessory should continue to cool itself and to bring the temperature down to a safe level. Leave the RH Accessory alone for several minutes to allow it to cool sufficiently. The LCD screen will continue to post this message, even if the system is able to cool the heat sink sufficiently. After cooling down, a new experiment can be started. If the system is able to run, it will clear the message and enter operational mode. If the system cannot run, and continues to post this message, call TA Instruments.
Chamb Over Temp	Sample Chamber temperature too high. Call TA Instruments.	Call TA Instruments.
Xfer High Temp	Transfer line temperature too high. Call TA Instruments.	Call TA Instruments.
Xfer High Dew Pt	Dew Point temperature of purge gas is higher than transfer line temperature. Restart run.	The system detected a low temperature condition in the transfer line and entered into standby mode. Allow the system to remain in standby mode for a few minutes to allow dry gas to purge through the line. Restart run.
Cooler Low Water	Heat Exchanger reservoir water level is low. Refill the heat exchanger reservoir as soon as possible.	Refill the heat exchanger reservoir bottle toward the back of the RH Accessory with distilled water. See <a href="#">“Filling the RH Accessory Reservoirs” on page 18</a> in this manual for assistance.

Setting Truncate	A temperature or humidity request is outside of the operational range of the RH Accessory. The setting was truncated to the closest valid setting.	This typically occurs when the RH Accessory receives a humidity setpoint higher than its established operational range. In this case, the RH Accessory will control the humidity to the highest valid setting within its operational range. The run will continue normally, and all data will be saved.
Chamb Temp Delta	Temperature delta between the Sample Temperature sensor and the Sample Chamber wall is too high. Run ended.	This typically occurs if the RH Accessory begins a run without the front half of the sample chamber fitted, or if the front half of the sample is removed during an experiment. Ensure the front half of the sample chamber is installed properly, and then restart the run. If the problem persists, call TA Instruments.
Humidity Backoff	The humidity level in the Sample Chamber was reduced slightly to avoid condensation on the chamber wall.	This condition occurs if the system detects the temperature of the sample chamber wall has fallen below the dew point temperature of the environment within the sample chamber. The system will dynamically control the humidity level down slightly to ensure no condensation occurs within the sample chamber. The run will continue normally, and all data will be saved.