



# Instruction Manual



## Vapor Delivery Module

Doc. no.: 9.17.079 rev. E    Date: 04-07-2019



### ATTENTION

Please read this document carefully before installing and operating the product.  
Not following the guidelines could result in personal injury and/or damage to the equipment.



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## Symbols in this document



*Important information. Disregarding this information could increase the risk of damage to the equipment, or the risk of personal injuries.*



*Helpful information. This information will facilitate the use of the instrument and/or contribute to its optimal performance.*



*Additional information available on the internet or from your Bronkhorst representative.*

## Receipt of equipment

Check the outside packaging box for damage incurred during shipment. If the box is damaged, then the local carrier must be notified at once regarding his liability, if so required. At the same time a report should be submitted to your Bronkhorst representative.

Carefully remove the equipment from the box. Verify that the contents of the package was not damaged during shipment. Should the equipment be damaged, then the local carrier must be notified at once regarding his liability, if so required. At the same time a report should be submitted to your Bronkhorst representative.



- *Check the packing list to ensure that you received all of the items included in the scope of delivery*
- *Do not discard spare or replacement parts with the packaging material*

Refer to [Removal and return instructions](#) about return shipment procedures.

## Equipment storage

The equipment should be stored in its original package in a cupboard warehouse or similar. Care should be taken not to subject the equipment to excessive temperatures or humidity.

## Warranty

Bronkhorst® products are warranted against defects in material and workmanship for a period of three years from the date of shipment, provided they are used in accordance with the ordering specifications and not subject to abuse or physical damage. Products that do not operate properly during this period may be repaired or replaced at no charge. Repairs are normally warranted for one year or the balance of the original warranty, whichever is the longer.



See also section 9 (Guarantee) of the Conditions of sales:  
[www.bronkhorst.com/about/conditions-of-sales/](http://www.bronkhorst.com/about/conditions-of-sales/)

The warranty includes all initial and latent defects, random failures, and indeterminable internal causes.

It excludes failures and damage caused by the customer, such as contamination, improper electrical hook-up, physical shock etc.

Re-conditioning of products primarily returned for warranty service that is partly or wholly judged non-warranty may be charged for.

Bronkhorst High-Tech B.V. or affiliated company prepays outgoing freight charges when any part of the service is performed under warranty, unless otherwise agreed upon beforehand, however, if the product has been returned collect to our factory or service center, these costs are added to the repair invoice. Import and/or export charges, foreign shipping methods/carriers are paid by the customer.

## General safety precautions

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Before operating, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables for cracks or breaks before each use.

The equipment and accessories must be used in accordance with their specifications and operating instructions, otherwise the safety of the equipment may be impaired.

If required, replace fuses with the same type and rating for continued protection against fire hazard.

Opening the equipment is not allowed. There are no user serviceable parts inside. In case of a defect please return the equipment to Bronkhorst High-Tech B.V.

One or more warning signs may be present on different parts of the product. These signs have the following meaning:



*Consult the instruction manual for handling instructions*



*Surface may get hot during operation*



*Shock hazard; electrical parts inside*

To maintain protection from electric shock and fire, replacement components must be obtained from Bronkhorst. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be obtained from other suppliers, as long as they are equivalent to the original component. Selected parts should be obtained only through Bronkhorst, to maintain accuracy and functionality of the product. If you are unsure about the relevance of a replacement component, contact your Bronkhorst representative for information.



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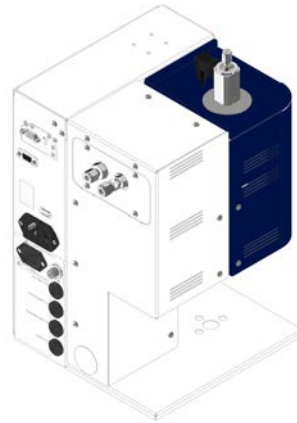
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# 1 Introduction

## 1.1 Scope of this manual

This manual contains general product information, installation and operating instructions and troubleshooting tips for the **Vapor Delivery Module (VDM)**.



## 1.2 Intended use

The VDM is a compact integrated system to realize mass flow control of a vapor. The VDM is intended to generate a predefined vapor flow, accruing from an accurately controlled liquid mass flow injected into an accurately controlled carrier gas flow with subsequent evaporation inside a temperature controlled chamber.



*The wetted materials incorporated in the VDM are compatible with media and conditions (e.g. pressure, temperature) as specified at ordering time. If you are planning to use the product (including any third party components supplied by Bronkhorst, such as pumps or valves) with other media and/or other conditions, always check the wetted materials (including seals) for compatibility. See the technical specifications of the product and consult third party documentation (if applicable) to check the incorporated materials.*

*Responsibility for the use of the equipment with regard to suitability, intended use, cleaning and corrosion resistance of the applied materials against the processed media lies solely with the end user.*

*Where appropriate, this document recommends or prescribes safety measures to be taken with respect to media usage or working with the described equipment under the specified conditions. The end user is responsible for taking the necessary safety precautions and proper use of appropriate (personal) protective equipment, even if such is not explicitly recommended or required in this document.*

*The end user is considered to be familiar with the necessary safety precautions, and to comply with the appropriate protective measures as described in the Material Safety Data Sheets of the media to be used in the system (if applicable).*

*Bronkhorst High-Tech B.V. cannot be held liable for any damage resulting from improper or unsafe use, use for other than the intended purpose or use with other media and/or under other conditions than specified on the purchase order.*

## 1.3 Other documents

Manuals and guides for digital instruments are modular. General instructions give information about the functioning and installation of instruments. Operational instructions explain the use of the digital instruments features and parameters. Fieldbus specific information explains the installation and use of the fieldbus installed on the instrument.

The following documents contain information for basic and advanced operation, more detailed product information and troubleshooting tips:

- Instruction manual **FLOW-BUS interface** (document nr. 9.17.024)
- Instruction manual **PROFIBUS-DP slave interface** (document nr. 9.17.025)
- Instruction manual **RS232 interface with FLOW-BUS protocol** (document nr. 9.17.027)
- Instruction manual **E-8000 Readout and Control System** (document nr. 9.17.076)
- Instruction manual **PROFINET interface** (document nr. 9.17.095)

For RS232 or FLOW-BUS operation the following (free) Bronkhorst® software is available:

- **FlowDDE**      *Interface between digital instruments and Windows software*
- **FlowView**    *Operating Bronkhorst digital instruments*
- **Flowfix**      *Fieldbus connection of digital instruments*
- **FlowPlot**     *Monitoring and optimizing digital instrument parameters*



Manuals and software tooling can be found at [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

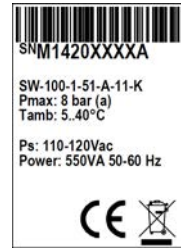


## 2 Starting up

### 2.1 Functional properties

Before installing the VDM, check if the functional properties match your requirements:

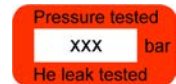
- Model key
- Pressure rate
- Temperature (ambient)
- Power supply
- Power consumption



### 2.2 Rated pressure test inspection



Bronkhorst® instruments are pressure tested to at least 1.5 times the specified working process conditions and outboard leak tested to at least  $2 * 10^{-9}$  mbar l/s Helium. The tested pressure is specified on the instrument with a red label.



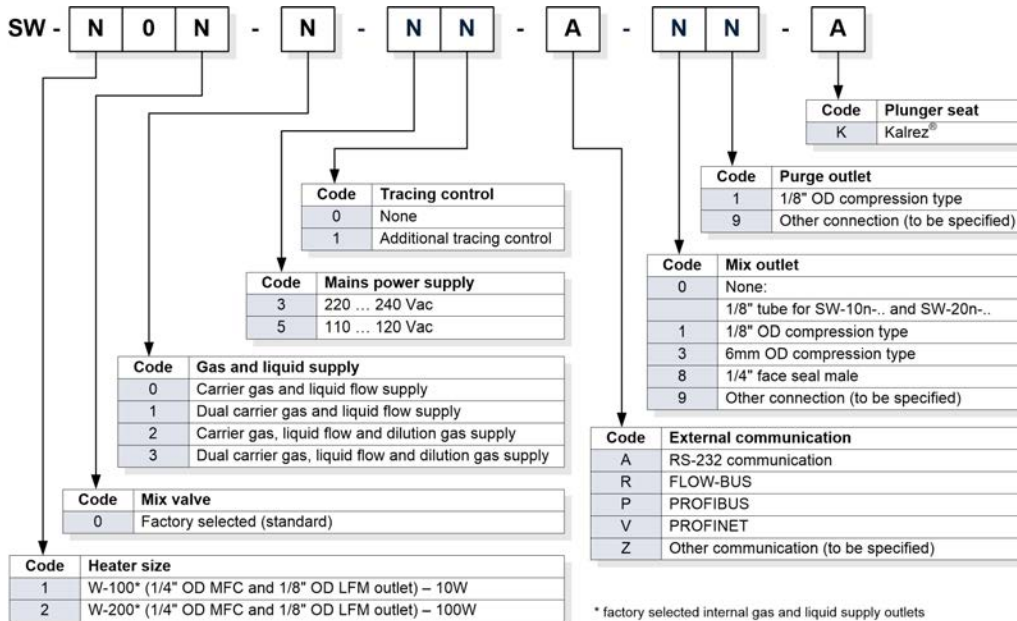
- Before installation, make sure that the tested pressure is in accordance with the safety factor of your application.
- If the pressure test label is missing or if the specified pressure is insufficient, the instrument must not be used and should be returned to the factory.
- The maximum operating pressure must never exceed the tested pressure.
- Disassembling the instrument and/or replacing parts of it will invalidate the pressure test specification.

### 2.3 Install module

See section [Installation](#) for detailed installation instructions.

Before switching on power, please check if all external electrical and communication (if necessary) connections are properly connected.

### 2.4 Model key



## 3 Technical specifications

### 3.1 Physical dimensions



For overall dimensions please consult supplied dimensional drawing 7.05.901. This document is available on [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads) or can be obtained by contacting our local sales & service representatives

### 3.2 Ambient conditions

- Ambient temperature : 5°C - 40°C.
- Relative humidity : Maximum relative humidity 80%, for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C.
- Height altitude : Up to 2000 m.

### 3.3 Ingress protection class

IP20, according IEC standard 60529.

### 3.4 Fluid connections

The VDM gas and liquid supply are equipped with compression type or face-seal-fittings. Normally these fittings are BSP parallel threads types which have to be used in combination with elastomeric O-rings to seal to the VDM. Occasionally fittings are orbital welded to the VDM.

For leak tight installation of compression type fittings be sure that the tube is inserted to the shoulder in the fitting body and that no dirt or dust is present on tube, ferrules or fittings.



For exact information on the fitting, please contact Swagelok for further instructions or documentation. Always check your system for leaks, before applying fluid pressure. Especially if toxic, explosive or other dangerous fluids are used.

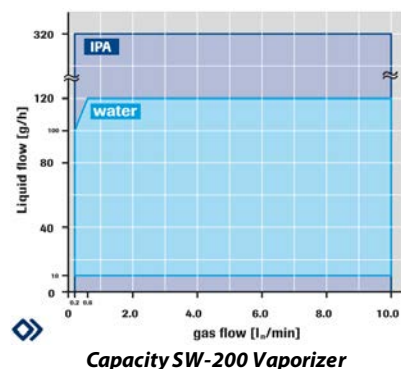
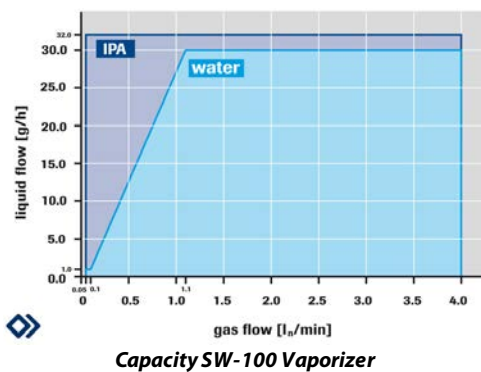
#### 3.4.1 Flow ranges of used components

Model	Heater model	Thermal power	Max. capacity*		Max temp.
SW-10n	W-100A	10 W	1...30 g/h liquid	0.05...4 l <sub>n</sub> /min gas	200°C
SW-20n	W-200A	100 W	10...120 g/h liquid	0.2...10 l <sub>n</sub> /min gas	200°C

\*) Depending on liquid and process pressure; table based on water at 1 atmosphere.

For other liquids or pressure conditions please consult the manufacturer or your local sales representative.

#### 3.4.2 Capacity



#### 3.4.3 Pressure rating

The maximum specified operating pressure is indicated on the VDM as described in section 2.2.

- To prevent liquid from flowing into the gas flow controller, make sure that the liquid pressure never exceeds the gas pressure

- Advised maximum pressure difference between inlet and outlet is 10 bar (d)

### 3.5 Piping

For optimal performance of the system it is recommend to have at least 10 pipe diameters distance between the angle and the equipment inlets. The purge is rarely used in production environments, except for installation.



*Be sure that piping is absolutely clean!*

*CAUTION - DO NOT install small diameter piping on high flow rates.*

*CAUTION - DO NOT mount abrupt angles directly to the inlet or outlet, especially for high flow rates.*

### 3.6 Electrical connections

#### 3.6.1 Mains

Model	Power supply (Vac)	Maximum power (tracing included)	Fuse primary heater	Fuse secondary heater	Fuse main
SW-10n-n-50-a-nn-a	110 ... 120	250VA 50-60 Hz	T2A I2t >30A Littelfuse 0213002.MXP*	T4A	T2A
SW-10n-n-51-a-nn-a	110 ... 120	550VA 50-60 Hz	T2A I2t >30A Littelfuse 0213002.MXP*	T4A	T2A
SW-20n-n-50-a-nn-a	110 ... 120	250VA 50-60 Hz	T2A I2t >30A Littelfuse 0213002.MXP*	T4A	T2A
SW-20n-n-51-a-nn-a	110 ... 120	550VA 50-60 Hz	T2A I2t >30A Littelfuse 0213002.MXP*	T4A	T2A
SW-10n-n-30-a-nn-a	220 ... 240	250VA 50-60 Hz	T1A I2t >10A Littelfuse 0213001.MXP*	T4A	T1A
SW-10n-n-31-a-nn-a	220 ... 240	550VA 50-60 Hz	T1A I2t >10A Littelfuse 0213001.MXP*	T4A	T1A
SW-20n-n-30-a-nn-a	220 ... 240	250VA 50-60 Hz	T1A I2t >10A Littelfuse 0213001.MXP*	T4A	T1A
SW-20n-n-31-a-nn-a	220 ... 240	550VA 50-60 Hz	T1A I2t >10A Littelfuse 0213001.MXP*	T4A	T1A

\* Littelfuse or equivalent

For mains connection, use appropriate cabling with IEC 60320-1/C19 connector:

- Power cable with Euro Plug (EU) – Schurter #6051.2043 (art.nr.1.15.242)
- Power cable with Switzerland Plug (CH) (art.nr.1.15.243)
- Power cable with North America Plug (USA) – Schurter #6051.2041 (art.nr.1.15.244)
- Power cable with United Kingdom Plug (UK) – Schurter #6051.2048 (art.nr.1.15.245)

#### 3.6.2 Tracing

Optionally, the VDM can be provided with a trace temperature control. In this case, the VDM Series is equipped with a tracing output IEC 60320-2-2 / C13 female connector. This connector is intended for connecting tracing tape, which is not supplied. The voltage at this tracing output is equal to the supply voltage of the VDM.

For tracing connection, use appropriate cabling with IEC 60320-2-2/C14 plug (art.nr. 1.09.594). Make sure cabling is double isolated.

The table below shows the maximum tracing power and the fuse amperage for the various models.

Model	Power supply (Vac)	Maximum tracing power	Fuse tracing heater
SW-10n-n-51-a-nn-a	110 ... 120	300 VA 50-60 Hz	T2,5A

Model	Power supply (Vac)	Maximum tracing power	Fuse tracing heater
SW-20n-n-51-a-nn-a	110 ... 120	300 VA 50-60 Hz	T2,5A
SW-10n-n-31-a-nn-a	220 ... 240	300 VA 50-60 Hz	T1,25A
SW-20n-n-31-a-nn-a	220 ... 240	300 VA 50-60 Hz	T1,25A

### 3.6.3 Pt100 tracing sensor

Optionally, the VDM can be provided with a trace temperature control. In this case, the VDM Series is equipped with a Pt100 inlet 4-pin M12 A-coded male connector. This connector is intended for connecting a two, three or four-wire Pt100. Measurement current through the sensor is 0,5 mA.

For Pt100 connection, use appropriate cabling with M12 4-pin female connector (art.nr. 1.09.593).



Make sure that the temperature sensor is properly mounted with the tracing wire, otherwise no temperature control is possible and hazardous situations may occur.

### 3.6.4 Communication

#### 3.6.4.1 RS232 / ProPar



For further instructions about the RS232 interface see manual 9.17.027 'Manual RS232 interface with FLOW-BUS protocol for digital instruments'. This manual is available at the download section of our website: [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

#### 3.6.4.2 FLOW-BUS



For further instructions about the FLOW-BUS interface see manual 9.17.024 'Manual FLOW-BUS interface for digital instruments'. This manual is available at the download section of our website: [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

#### 3.6.4.3 PROFIBUS



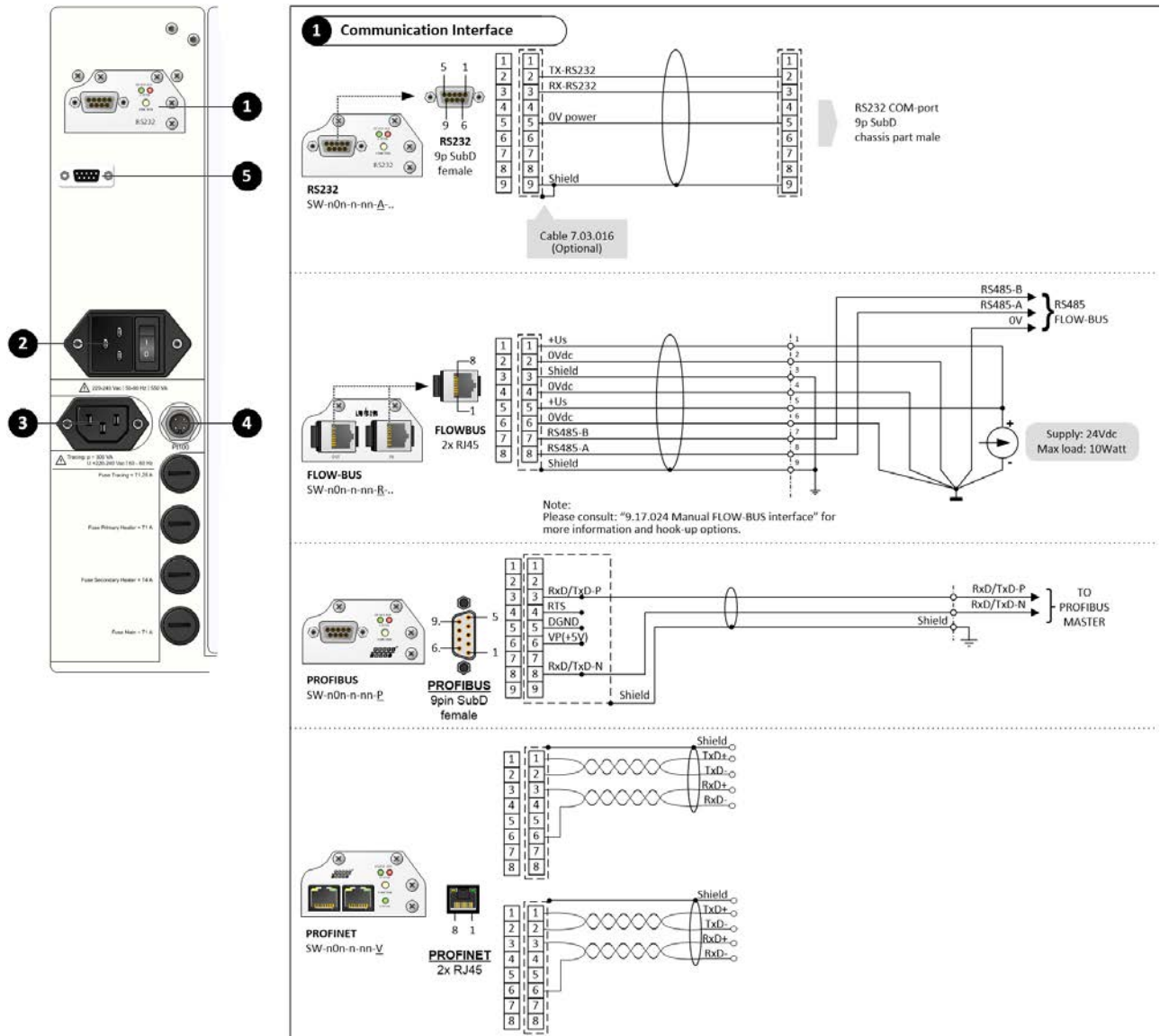
For further instructions about the PROFIBUS interface see manual 9.17.025 'Manual PROFIBUS-DP slave interface for digital instruments'. This manual is available at the download section of our website: [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

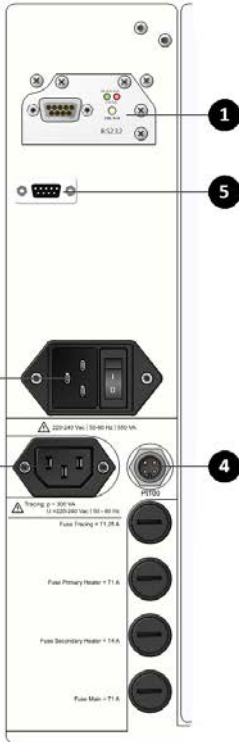
#### 3.6.4.4 PROFINET



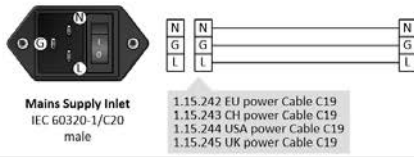
For further instructions about the PROFINET interface see manual 9.17.095 'Manual PROFINET interface for digital instruments'. This manual is available at the download section of our website: [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

### 3.7 Connectors (hook-up diagram)

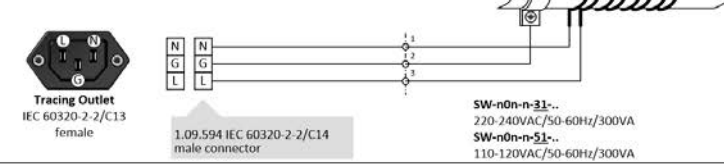




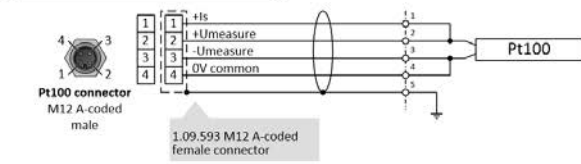
**2 Mains Supply**



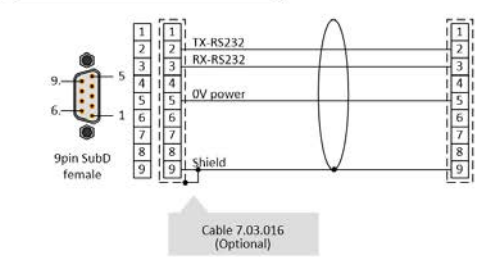
**3 Heater Outlet (for tracing only)**



**4 Pt100 Inlet (for tracing only)**



**5 Service connection (RS232)**



## 4 Installation

### 4.1 Mounting

The mounting position of the equipment is upright. Please take attention:

- Avoid installation in close proximity of mechanic vibration and/or heat sources.
- Avoid contact between hot surfaces of the enclosure with electrical cables and fluid hoses/pipes.
- Ventilation requires a minimum distance of 100 mm space from each side to a wall.
- Make use of the protective earth pin (see [Connectors \(hook-up diagram\)](#), connector 3) for grounding the connected tubing. Use an appropriate cable.
- Mount the equipment in such a way, that cables and mains switches can easily be reached and disconnected.



### 4.2 Fluid connections

For exact information on the fittings, please contact Swagelok for further instructions or documentation.



Please be aware when using Oxygen ( $O_2$ ) that the fittings mounted in the gas line should be absolutely oxygen clean.

### 4.3 Supply pressure

Do not apply pressure until electrical connections are made. When applying pressure to the system, make sure that the pressure is increased gradually and avoid pressure shocks in the system.

### 4.4 Leak check



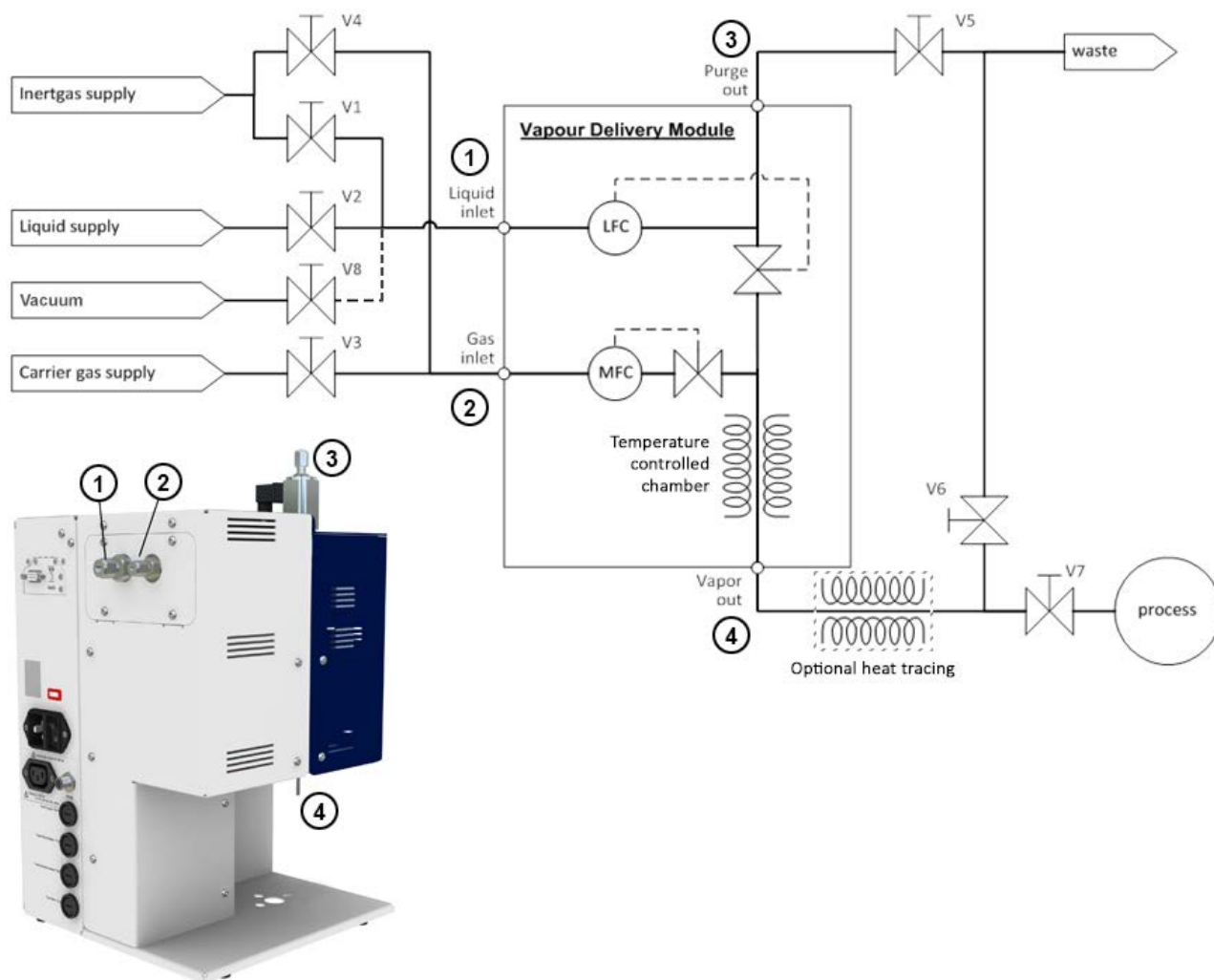
Check the fluid system for leaks before applying pressure, especially when using hazardous media (e.g. toxic or flammable).

### 4.5 Seals



Bronkhorst has gathered a material compatibility chart from a number of sources believed to be reliable. However, it is a general guide only. Operating conditions may substantially change the accuracy of this guide. Therefore there is no liability for damages accruing from the use of this guide. The customer's application will demand its own specific design or test evaluation for optimum reliability. So check order documentation if the used seals are correct for the process.

## 4.6 Purging and filling





### 4.6.1 Starting up without using vacuum

#### 4.6.1.1 Filling system


Procedure		Actions
A1	Purge all lines	<ul style="list-style-type: none"> <li>• Close V2, V3 and V7</li> <li>• Open V1, V4, V5 and V6</li> <li>• Give setpoint 100% to MFC</li> <li>• Give setpoint 0% to LFC</li> <li>• Purge for a long time.</li> </ul>
A2	Setup carrier gas supply	<ul style="list-style-type: none"> <li>• Close V4</li> <li>• Open V3</li> </ul>
A3	Fill the system with liquid. <i>Make sure that the carrier gas is always flowing when the liquid flow is on. It is preferred to always have gas flowing in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>• Close V1</li> <li>• Open V2 briefly; allow mixing valve VDM to fill.</li> <li>• Wait until all gas bubbles left the system via Purge out and V5, then close V5.</li> </ul>
A4	The system is now ready for use.	



#### 4.6.1.2 Starting process

Procedure		Actions
B1	Set the heater at right temperature	<ul style="list-style-type: none"> <li>Give set point to the heater; wait until the temperature is stabilized</li> </ul>
B2	Start gas flow  <i>Make sure that the carrier gas is always flowing when the liquid flow is on. Preferably, let always gas flow in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>Give setpoint to MFC</li> </ul>
B3	Start liquid flow  <i>Close supply pressure of the liquid vessel during the process. The pressure controller of the inert gas supply can influence the stability of the liquid flow controller.</i>	<ul style="list-style-type: none"> <li>Give setpoint LFC, wait until stabilization</li> </ul>
B4	Connect process	<ul style="list-style-type: none"> <li>Open V7, close V6</li> </ul>

#### 4.6.1.3 Stopping process

Procedure		Actions
C1	Disconnect process	<ul style="list-style-type: none"> <li>Open V6, close V7</li> </ul>
C2	Stop liquid flow	<ul style="list-style-type: none"> <li>Give setpoint = 0 to LFC</li> </ul>
C3	Optional: Stop gas flow  <i>Make sure that the carrier gas is always flowing when the liquid flow is on. Preferably, let always gas flow in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>Give setpoint = 0 to MFC</li> </ul>

#### 4.6.1.4 Leaving system overnight

Procedure		Actions
D1	Relieve the supply pressure from the liquid- and carrier gas lines	<ul style="list-style-type: none"> <li>Close V2 and V3</li> </ul>

#### 4.6.1.5 Emptying and purging system

Procedure <sup>(1,2)</sup>		Actions
E1	Relieve the supply pressure from the liquid- and carrier gas lines	<ul style="list-style-type: none"> <li>Close V2 and V3</li> </ul>
E2	Purge liquid out of lines	<ul style="list-style-type: none"> <li>Open V1 and V5</li> </ul>
E3	Purge lines with inert gas	<ul style="list-style-type: none"> <li>Open V4, V6</li> <li>Close V7</li> <li>Give setpoint to MFC</li> </ul>
E4	Optional: purge with inert liquid	Connect inert liquid to inert gas supply, proceed from E2
E5	Optional: alter E3 and E4 for a few times	



<sup>(1)</sup> If the liquid is reactive or aggressive, be sure to remove air (and water vapor) carefully, before introducing liquid in the system.


<sup>(2)</sup> If the liquid is reactive, aggressive, poisonous, toxic, or flammable, beware that the system is purged fully (preferably with inert liquid, E3, E4, E5) before opening the system.





- In case of non-pure liquids, place a filter upstream the liquid flow controller.
- Mount the VDM upright.

## 4.6.2 Starting up using vacuum


### 4.6.2.1 Filling system

Procedure		Actions
A1	Evacuate the lines "Vacuum"	<ul style="list-style-type: none"> <li>Start pumps</li> </ul>
A2	Evacuate all lines	<ul style="list-style-type: none"> <li>Close: V1, V2, V3, V4, and V6</li> <li>Make sure that "waste" and "process" are vacuum</li> <li>Connect inert gas on carrier gas inle.</li> <li>Open : V5 and V8</li> <li>Give setpoint to gas and liquid control (the control valves of the LFC and MFC open)</li> <li>Pump for a long time</li> <li>Remark: if the system is not completely dry follow procedure of E3, E4, (E5)</li> </ul>
A3	Purge line between inert gas source and valve V1	<ul style="list-style-type: none"> <li>Open valve V1 briefly for some seconds.</li> </ul>
A4	Purge line between process gas source and gas MFC	<ul style="list-style-type: none"> <li>Give setpoint = 0 to LFM (mix valve closes)</li> <li>Open valve V3 briefly for some seconds</li> </ul>
A5	Pump down liquid supply	<ul style="list-style-type: none"> <li>Open V2 for some time</li> <li>Close V2</li> </ul>
A6	Setup carrier gas	<ul style="list-style-type: none"> <li>Close V8</li> <li>Open V3</li> </ul>
A7	Fill the system with liquid  <i>Make sure that the carrier gas is always flowing when the liquid flow is on. Preferably, let always gas flow in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>Close V1</li> <li>Open B2 briefly; allow mixing valve VDM to fill</li> <li>Close V5</li> </ul>
A8	Optional: degassing mixing valve	<ul style="list-style-type: none"> <li>Open V5, a needle valve will be best, to avoid too much liquid be pumped away</li> </ul>
A9	The system is now ready for use	

### 4.6.2.2 Starting process

Procedure		Actions
B1	Set the heater at right temperature	<ul style="list-style-type: none"> <li>Give setpoint to the heater, wait until temperature is reached</li> </ul>
B2	Start gas flow  <i>Make sure that the carrier gas is always flowing when the liquid flow is on. Preferably, let always gas flow in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>Give setpoint to MFC</li> </ul>
B3	Start liquid flow  <i>Close supply pressure of the liquid vessel during the process. The pressure controller of the inert gas supply can influence the stability of the liquid flow controller.</i>	<ul style="list-style-type: none"> <li>Give setpoint LFC, wait until stabilization</li> </ul>
B4	Connect process	<ul style="list-style-type: none"> <li>Open V7, close V6</li> </ul>

### 4.6.2.3 Stopping process

Procedure		Actions
C1	Disconnect process	<ul style="list-style-type: none"> <li>Open V6, close V7</li> </ul>
C2	Stop liquid flow	<ul style="list-style-type: none"> <li>Give setpoint = 0 to LFC</li> </ul>
C3	Optional: Stop gas flow   <i>Make sure that the carrier gas is always flowing when the liquid flow is on. Preferably, let always gas flow in the carrier gas line when the system is filled with liquid.</i>	<ul style="list-style-type: none"> <li>Give setpoint = 0 to MFC</li> </ul>

### 4.6.2.4 Leaving system overnight

Procedure		Actions
D1	Relieve the supply pressure from the liquid- and carrier gas lines	<ul style="list-style-type: none"> <li>Close V2</li> <li>Open V8 for some seconds</li> </ul>

### 4.6.2.5 Emptying and purging system

Procedure <sup>(1,2)</sup>		Actions
E1	Relieve the supply pressure from the liquid- and carrier gas lines	<ul style="list-style-type: none"> <li>Close V2 and V3</li> </ul>
E2	Purge liquid out of lines	<ul style="list-style-type: none"> <li>Open V1 and V4</li> </ul>
E3	Purge lines with inert gas	<ul style="list-style-type: none"> <li>Open V4 and V6</li> <li>Close V7</li> <li>Give setpoint to MFC</li> </ul>
E4	Evacuate liquid lines (cont.)	<ul style="list-style-type: none"> <li>Close V1</li> <li>Open V8</li> </ul>
E5	Optional: repeat last two steps for a few times	



<sup>(1)</sup> If the liquid is reactive or aggressive, be sure to remove air (and water vapor) carefully, before introducing liquid in the system.

<sup>(2)</sup> If the liquid is reactive, aggressive, poisonous, toxic, or flammable, beware that the system is purged fully (preferably with inert liquid, E3, E4, E5) before opening the system.



- In case of non-pure liquids, place a filter upstream the liquid flow controller.
- Mount the VDM upright.

## 5 Operation

### 5.1 Powering up

Before switching on the power, be sure that:

- System is checked for leakage of gases and liquids
- All connections have been made
- Flow-set points are zero
- No liquid has been spilled into the equipment

Switch on and then:

- Allow 30 minutes (from switching on) to warm up (common for thermal flow controllers)
- Wait until temperatures setpoints are reached. When the LED indicators turn blue, temperature setpoints are reached.
- Make sure that the carrier gas is always flowing before the liquid flow setpoint is applied.

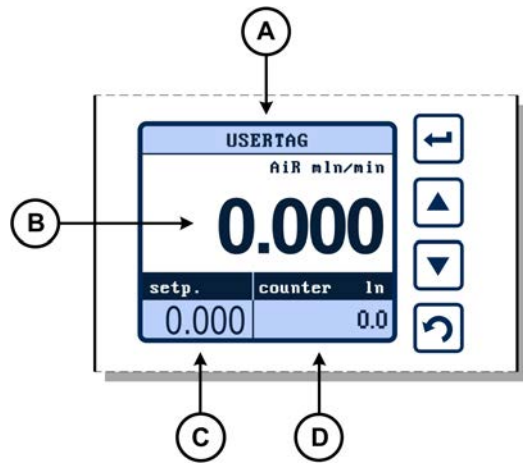


### 5.2 User interface

#### 5.2.1 Buttons

The buttons have the following functions:

- Enter selected menu  
- Enter edit mode  
- Confirm selection/changes
- Menu selection up  
- Select information field  
- Next character in edit mode  
- Up in table
- Menu selection down  
- Select information field  
- Previous character in edit mode  
- Down in table
- Return to previous screen  
- Undo, cancel and exit edit mode  
- Switch content in the 'Custom readout 2' field



- A** Top line
- B** Measure readout
- C** Custom readout 1
- D** Custom readout 2

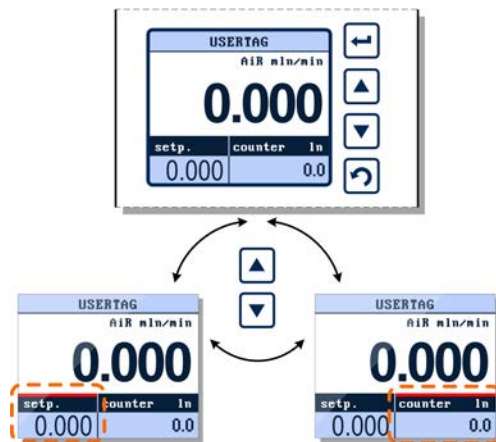
#### 5.2.2 Display

The display is divided into 4 areas, 'Measure readout', 'Custom readout 1', 'Custom readout 2' and the 'Top line'. The information in these areas can be configured by the user.

If an area contains a parameter which can be set or reset by the operator, you can press or to select this parameter. Press to enter the edit mode or press to return to the 'Measure readout' screen **B**.



If 'Custom readout 1' is disabled, you can only switch between 'Measure readout' and 'Custom readout 2'.



### 5.2.3 Select instrument

The Vapor Delivery Modules contains liquid and gas flow controllers. Also a temperature controller for evaporation and optional trace heating is provided. These integrated instruments have unique node addresses. Factory default node addresses are:

Node address	Instrument
2	Readout and control (Display)
3	Temp. controlled evaporation device
4*	Trace heating temperature control
5	Liquid flow supply
6	Carrier gas supply
7*	Second carrier gas supply
8*	Dilution gas supply

\* = if applicable

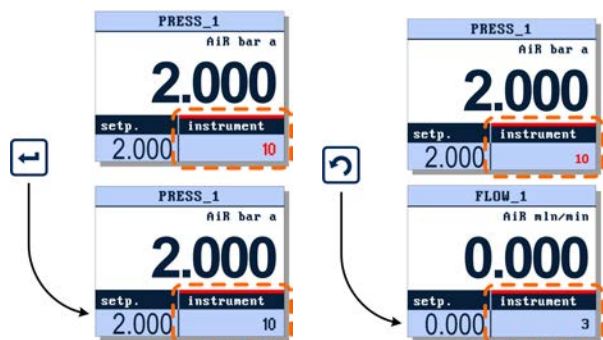
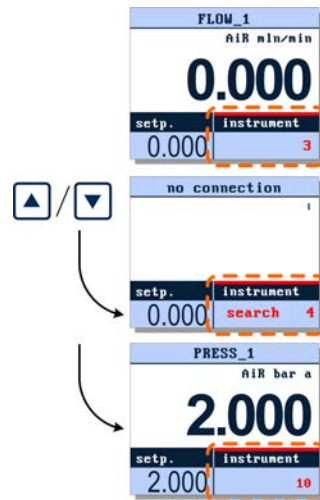
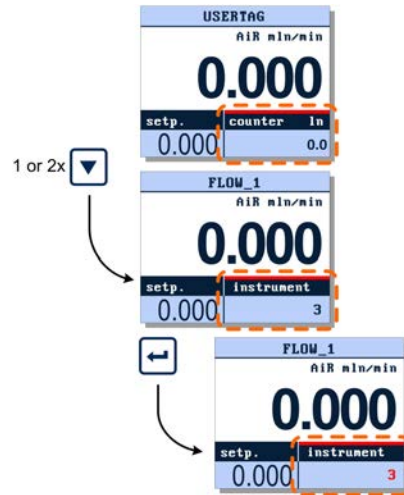
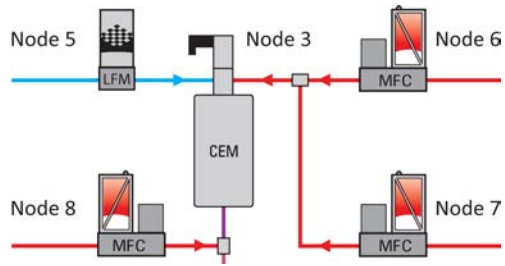
To enter the 'instrument' mode, press the button until the red line appears above 'Custom readout 2' than press to activate this field.

- Security settings can be set to avoid unauthorised access to this option.
- The number of displays that have the same instrument selected must not exceed 3.

The integrated Instruments will be indicated with their node addresses. Press or to search for an instrument on the bus. While the message "search" is displayed, the VDM is searching for a valid node address and it will not show any specific instrument info until an active node is found.

When an active node address is found, the VDM will show the corresponding USERTAG or Serial Number in the 'Top line'. It will also show the actual measure and, if applicable, the actual setpoint.

Press to select this instrument to be operated by the VDM or press to return to the previous selected instrument.



### 5.2.4 Temperature and flow setpoints

Setpoint can only be edited when the setpoint parameter is displayed in 'Custom readout 1' or 'Custom readout 2'.

To edit the setpoint press to select the readout area in which this parameter is displayed. Press to enter the edit mode, the first digit will lighten.

Security settings can be set to avoid unauthorised access to the setpoint parameter.

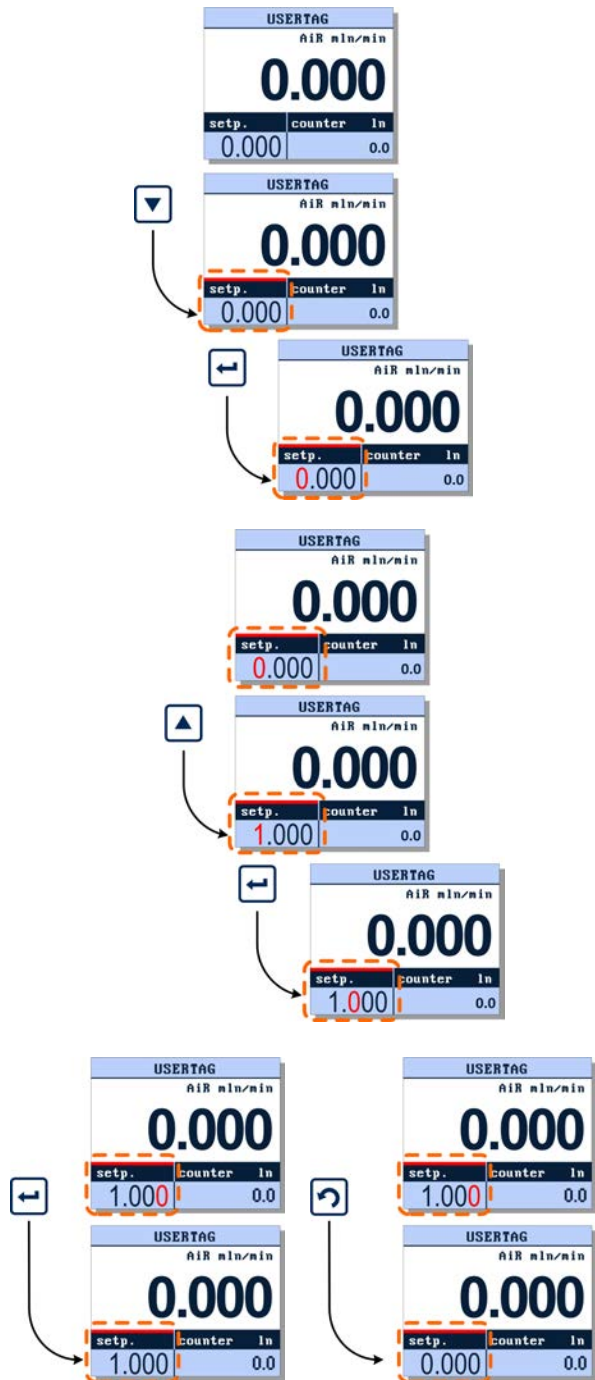
Use or to change the digits, press to confirm and select the next digit.

You can change the setpoint edit mode into 'step'. This enables you to change the setpoint using fixed steps. See section 'Customize display info' in the E-8000 manual (9.17.076) for more detailed information.

After the last digit is confirmed by pressing , the setpoint will be sent to the instrument.

If the entered setpoint is ignored, check controller mode. See section 'Controller mode' in the E-8000 manual (9.17.076) for more detailed information.

The button can be used to exit the edit mode and cancel the changes.



This chapter explains the most important user interface options. For more information please check the E-8000 manual (document no 9.17.076) at [www.bronkhorst.com/downloads](http://www.bronkhorst.com/downloads)

### 5.3 Operational settings

Make sure that the tracing and heating temperatures are well above the dew point of the desired vapor flow at the process conditions.



Especially for tracing, the temperature is only controlled at a single location, while inadequate insulation may introduce cold-spots at which condensation may occur.

Be aware that both heater and tracing temperature depend on the location of the sensor. Therefore, it is advised to set the heater temperature approximately 20°C above the theoretical temperature. In addition, it is advised to set the tracing temperature another 10°C higher.

### 5.3.1 Operation example

#### Application

The VDM can be used for generating certain humidity in a gas stream. Carrier gas and liquid (water) are controlled to regulate the humidity. The water is mixed with the gas and consequently evaporated. The humidity at a certain temperature corresponds with a certain ratio of gas and water, this ratio can be set by the flow controllers which are part of the VDM.

#### Calculation example for setting of relative humidity

At atmospheric pressure, at 80°C, 2 l<sub>n</sub>/min Air has to be moistened. Which water flow is needed for a r.h. of 50%. The vapor pressure of water at 80°C is 473.3 mbar according to FLUIDAT®.



FLUIDAT® on the Net: Bronkhorst's interactive Flow Calculations and routines generating Physical Properties. Visit [www.fluidat.com](http://www.fluidat.com)



#### Assumptions:

- consider water vapor as an ideal gas
- 1 mole of ideal gas at normal conditions = 22.4 l
- 1 mole of water is 18 g and 1 hour is 60 min.
- 1 atm. = 1013.25 mbar.

#### At 100% r.h., the (Mole)Ratio between gas and water is:

The mole ratio:

$$X = \frac{473.3}{(1013.25 - 473.3)} = 0.876$$

So in a gas flow of 2 l<sub>n</sub>/min, the saturated vapor flow (100% r.h.) is:

$$\Phi_{water} = X \cdot \Phi_{gas} = 0.876 \cdot 2 = 1.752$$

and in [g/h]:

$$\frac{1.752 \left[ \frac{\text{ln}}{\text{min}} \right] \cdot 18 \left[ \frac{\text{g}}{\text{mol}} \right] \cdot 60 \left[ \frac{\text{min}}{\text{h}} \right]}{22.4 \left[ \frac{\text{ln}}{\text{mol}} \right]} = 83.5$$

#### At 50% r.h., the (Mole)Ratio between gas and water is:

$$r.h.\% = \frac{e}{e_{sat}} \cdot 100$$

$$e = \frac{50 \cdot 473.3}{100} = 236.6$$

The mole ratio:

$$X = \frac{236.6}{(1013.25 - 236.6)} = 0.305$$

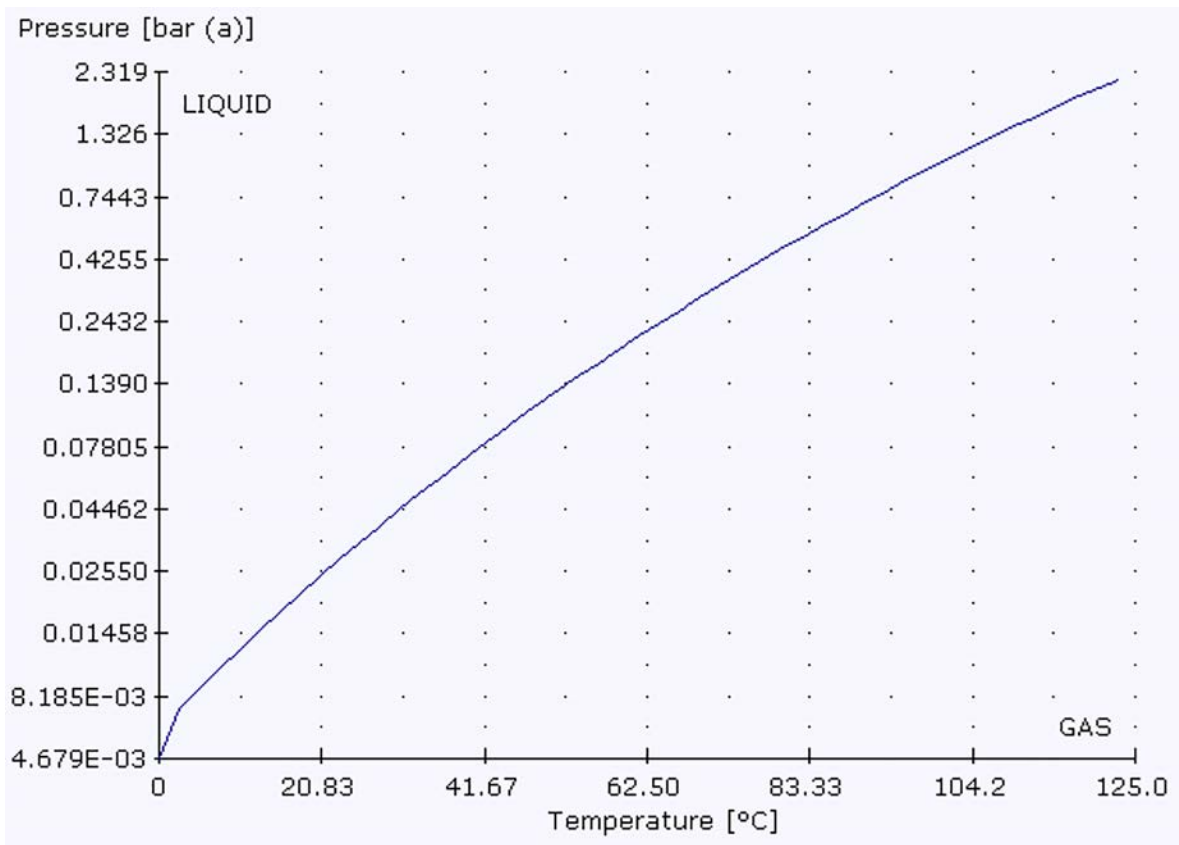
So in a gas flow of 2 l<sub>n</sub>/min, the saturated vapor flow (50% r.h.) is:

$$\Phi_{water} = X \cdot \Phi_{gas} = 0.305 \cdot 2 = 0.61$$

and in [g/h]:

$$\frac{0.61 \left[ \frac{\text{ln}}{\text{min}} \right] \cdot 18 \left[ \frac{\text{g}}{\text{mol}} \right] \cdot 60 \left[ \frac{\text{min}}{\text{h}} \right]}{22.4 \left[ \frac{\text{ln}}{\text{mol}} \right]} = 29.41$$

### 5.3.2 Vapor pressure of water





## 6 Troubleshooting and service

### 6.1 Common issues

Symptom	Possible cause	Action
No heating of heater, everything else works (no ready heater LED after 10 minutes)	1. Mains switch turned off	Turn on mains switch
	2. Fuse may be blown	Replace fuse (check mains and heater fuse)
	3. Defective temperature sensor	Return equipment
	4. Heater defective	Return equipment
No heating of tracing, everything else works (no ready heater LED after 30 minutes)	1. Fuse blown	Replace fuse (check mains and tracing fuse)
	2. Defective temperature sensor	Replace sensor
	3. Defective tracing	Replace tracing
	4. Inadequate insulation resulting in thermal power loss	Improve insulation
No Liquid flow	1. Wrong controller mode LFC	Check controller mode LFC
	2. No setpoint	Give Setpoint
No Gas flow	1. Wrong controller mode MFC	Check controller mode MFC
	2. No Setpoint	Give Setpoint
No vapor stream	1. No gas supply	Check gas supply
	2. No liquid supply	Check liquid supply
Liquid in process chamber	1. Mixture saturated, condensation	1. Increase setpoint Heater 2. Increase setpoint Tracing 3. Increase carrier gas flow 4. Decrease liquid flow 5. Any combination of the actions 1 – 4
	2. No proper insulation of the outlet piping	Improve insulation of piping
Irregular vapor stream	Significant pressure variations on inlets	Reduce pressure variations by e.g. adding pressure regulators or buffers



- In case of equipment malfunctioning, de-installation and returning of the equipment is recommended. See [Removal and return instructions](#) for relevant details.
- Do not open or disassemble the equipment.

## 6.2 Maintenance

### Maintenance

No routine maintenance is required. In case of (other) maintenance which requires de-installation of the equipment, purge the system first as specified in section [Purging and filling](#).

### Cleaning

For cleaning the exterior use a soft damp cloth.

## 6.3 Service

For current information on Bronkhorst® and service addresses, please visit our website:



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

Do you have any questions about our products? Our Sales Department will gladly assist you selecting the right product for your application. Contact sales by e-mail:



[sales@bronkhorst.com](mailto:sales@bronkhorst.com)

For after-sales questions, our Customer Service Department is available with help and guidance.

To contact CSD by e-mail:



[support@bronkhorst.com](mailto:support@bronkhorst.com)

No matter the time zone, our experts within the Support Group are available to answer your request immediately or ensure appropriate further action. Our experts can be reached at:



[+31 859 02 18 66](tel:+31859021866)

Bronkhorst High-Tech B.V.  
Nijverheidsstraat 1A  
NL-7261 AK Ruurlo  
The Netherlands

## 7 Removal and return instructions

When returning materials, always clearly describe the problem, and, if possible, the work to be done, in a covering letter.

### Instrument handling:

1. Purge all fluid lines (if applicable)
2. If toxic or dangerous fluids have been used, the instrument must be cleaned before shipping
3. Disconnect all external cabling and tubing and remove the instrument from the process line
4. If applicable, secure movable parts with appropriate transport safety materials, to prevent damage during transportation
5. The instrument must be at ambient temperature before packaging
6. Insert the instrument into a plastic bag and seal the bag
7. Place the bag in an appropriate shipping container; if possible, use the original packaging box

### Add documentation:

- Reason of return
- Failure symptoms
- Contaminated condition
- Declaration on decontamination



**It is absolutely required to notify the factory if toxic or dangerous fluids have been in contact with the device!**  
*This is to enable the factory to take sufficient precautionary measures to safeguard the staff in their repair department.*

*All instruments must be dispatched with a completely filled in 'Declaration on decontamination'. Instruments without this declaration will not be accepted.*



*A safety information document containing a 'Declaration on decontamination' form (document no 9.17.032) can be downloaded from the **Service & Support** section of the Bronkhorst website ([www.bronkhorst.com](http://www.bronkhorst.com)).*

### Important:

Clearly note, on top of the package, the customs clearance number of Bronkhorst High-Tech B.V.:

**NL801989978B01**

(only if applicable, otherwise contact your Bronkhorst representative for local arrangements.)