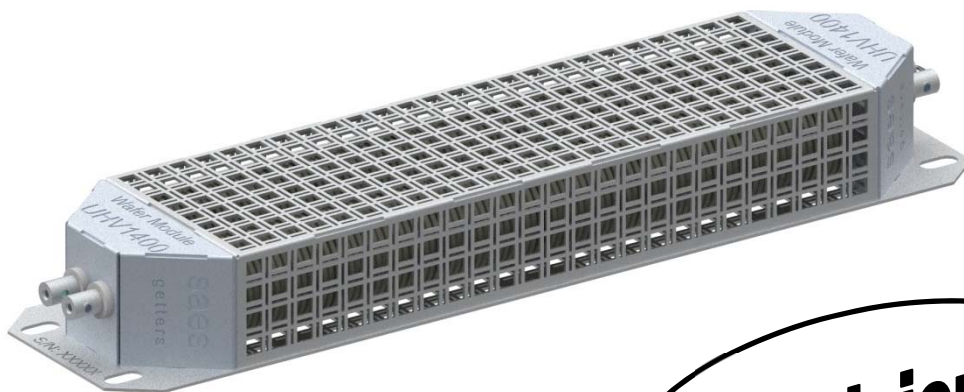
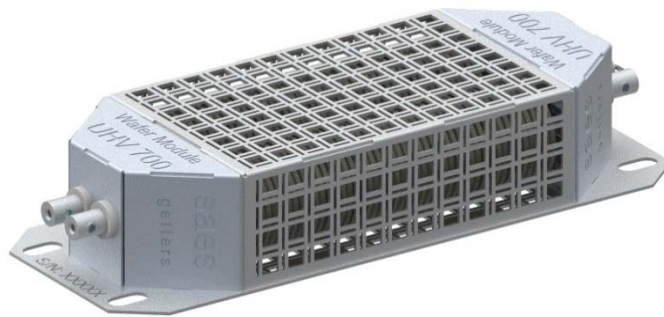

OPERATING INSTRUCTIONS
UHV 700 Wafer Module
UHV 1400 Wafer Module



Provisional



SAES Getters S.p.A. – Italy
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INDEX

1. PRODUCT GENERAL INFORMATION	2
2. UHV Wafer Modules.....	3
2.1. PUMP DIMENSIONS	4
2.2. MAIN TECHNICAL FEATURES	5
3. INSTALLATION.....	6
3.1. SAFETY SYMBOLS	6
3.2. UNPACKING	6
3.3. PRECAUTION DURING INSTALLATION	7
3.4. BAKE-OUT	7
3.5. POWERING THE PUMP.....	8
4. OPERATION OF THE PUMP.....	9
4.1. ACTIVATION OF THE NEG PUMP.....	9
4.2. REACTIVATION OF THE NEG ELEMENT	9
4.3. SPECIAL INSTRUCTIONS	10
4.3.1. Air venting.....	10
4.3.2. Vacuum failure.....	10
4.3.3. Mechanical shocks	10
5. WARRANTY CONDITIONS	11
6. INSTRUCTION FOR INSTRUMENT DISPOSAL.....	12
6.1. MEANING OF THE "WEEE" LOGO FOUND IN LABELS	12
7. SERVICE	13
7.1. SALES & SERVICE LOCATIONS:	13
APPENDIX A : UHV 700 / UHV 1400 Wafer Module typical sorption curves (as per ASTM F798-97).....	14
APPENDIX B : ZAO [®] 1 hydrogen equilibrium isotherms	15
APPENDIX C : ordering information	16

1. PRODUCT GENERAL INFORMATION

The UHV Wafer Modules are a series of very compact Non Evaporable Getter (NEG) pumps, designed to provide in-situ large pumping speed in systems where traditional pumps with an inlet flange cannot be used.

Two different pumps with different size and performances spanning from nearly 700 to 1400 l/s for H₂ are available. The getter cartridge consists of porous sintered getter disks stacked in a highly efficient gas trapping structure. The disks are made of the innovative ZAO[®]1 getter alloy (Ti-Zr-V-Al). Thanks to the flexibility of the ZAO[®]1 technology, the pumping modules combine the large pumping speed for active species with an extremely low particle release, suitable for application in particle-sensitive systems spanning from the semiconductor industry to particle accelerators.

The UHV Wafer Modules can be used alone or in combination with other vacuum pumps, taking into account that in UHV-XHV systems ungetterable gases are a very small percentage of the gas composition, generally dominated by hydrogen and carbon oxides.

This allows reducing the total weight of the pumping group, which has great value in equipment like electron microscopes, semiconductor inspection and review tools where the presence of large masses on the electro-optical columns may introduce vibrations and limit ultimate achievable performances. Moreover not all systems may have large flanges available for pumps with considerable pumping speed, so that an in-situ solution is required.

A variety of UHV systems like surface science, electron/ion spectrometers as well as high energy physics machines like synchrotrons and colliders can also benefit from the modules design. These systems are generally very crowded with instrumentation, flanges and service ports.

The modules can easily fit in a small space, freeing space for additional instrumentation and experiments.

2. UHV Wafer Modules

Two different models are available, i.e. UHV 1400 and UHV 700 Wafer Module. The typical appearance of these pumps is shown schematically in figure 1.

The essential components are:

- a. NEG cartridge
- b. Heater connectors

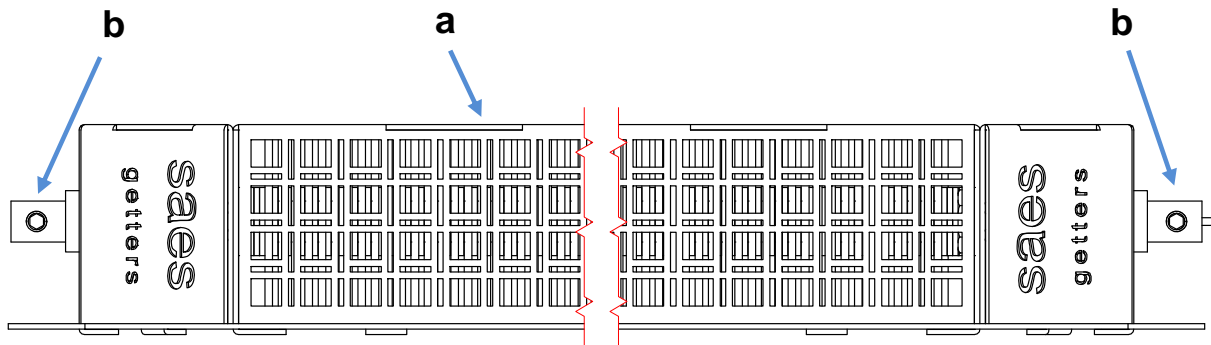


Figure 1 – Typical drawing of UHV Wafer Modules.

a. NEG cartridge

The NEG cartridge consists of a special AISI 316 L support that contains sintered porous getter material in the shape of disks suitably stacked in a high efficiency structure. A heating element is inserted inside each of the two stacks of disks to activate them. An AISI 316 L protective screen surrounds the getter material to avoid possible unwanted contact, contamination or damage of the getter disks. Composition, porosity and specific surface area of the getter disks, as well as their arrangement, have been optimized to significantly increase sorption capacity and speed. The heater consists of a tantalum wire inside an alumina insulator.

b. Heater connectors

The connectors serve to connect the heaters to the electrical feedthrough by suitable cables. Two connectors are present on each side of the module, allowing to implement different wiring schemes, in particular when using more than one module. When only one module is used, usually one side is used to connect to the feedthrough and the other is bridged. For additional details about the possible wiring schemes and recommended type of cables, see section 3.5.

IMPORTANT NOTICE: the getter cartridge and the connectors are, by design, one single piece. Replacement of the cartridge is therefore not possible. At the end of its operation life, when the getter is exhausted, the complete module must be replaced.

2.1. PUMP DIMENSIONS

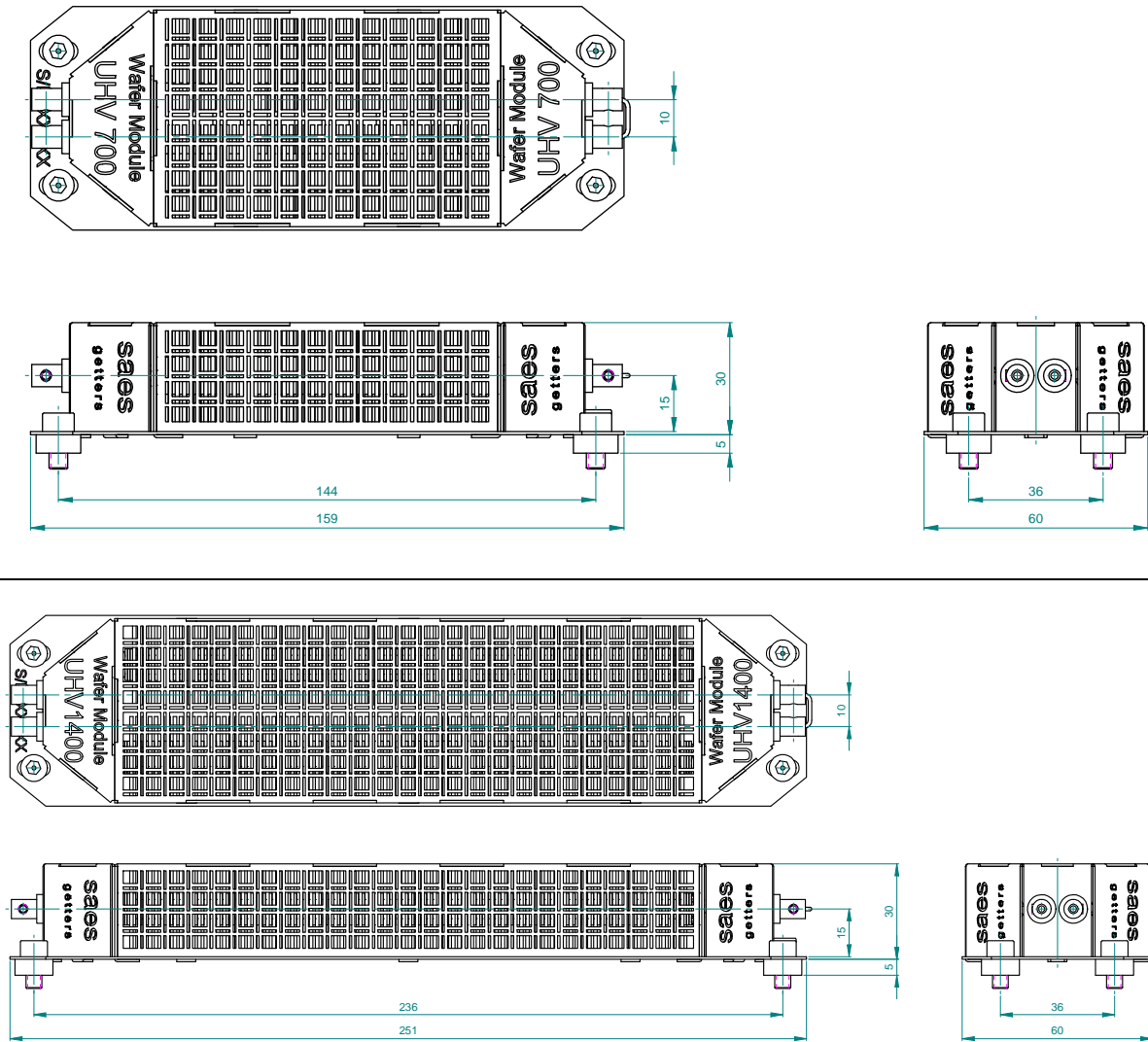


Figure 2 - 2D drawing of UHV 700 and UHV 1400 Wafer Module. All measures are in millimetres.

2.2. MAIN TECHNICAL FEATURES

Wafer Module		UHV 700	UHV 1400
Alloy Type		ZAO [®] 1	
Alloy Composition		Zr V Ti Al	
Getter Mass (g)		180	360
Getter Surface (cm ²)		950	1900
Pumping speed (l/s) ⁽¹⁾	H ₂	650	1360
	CO	260	510
	N ₂	165	330
Sorption Capacity (Torr·l)	H ₂ ⁽⁴⁾	3600	7200
	CO Single Run ⁽²⁾	1.3	2.5
	CO Total ⁽³⁾	1600	3200
	N ₂ Single Run ⁽²⁾	0.6	1.2
	N ₂ Total ⁽³⁾	300	600

⁽¹⁾ Pumping speed data refer to the initial values with the module installed on a flat surface.

⁽²⁾ Capacity values with the getter at room temperature, corresponding to a drop of the pumping speed below 25 l/s (UHV 700) and 50 l/s (UHV 1400).

⁽³⁾ Total capacity values for each single gas obtained after many reactivations (getter fully consumed). Capacity values for the various gases are not additive (a getter fully reacted with one gas specie will not sorb another gas).






⁽⁴⁾ After the getter has reached its H₂ capacity it can be "regenerated". Through the regeneration process it is possible to extract the hydrogen stored in the getter. After a full regeneration process, the pump can start pumping hydrogen again.

3. INSTALLATION

This equipment is destined for use by professionals. The user should read this instruction manual and any other additional information supplied by SAES before operating the equipment. SAES will not be held responsible for any events occurring due to non-compliance, even partial, with these instructions, improper use by untrained persons, non-authorized interference with the equipment or any action contrary to that provided for by specific national standards.

The following paragraphs contain all the information necessary to guarantee the safety of the operator when using the equipment

3.1. SAFETY SYMBOLS

SYMBOLS	SYMBOLS DESCRIPTIONS
	Access denied to active pacemaker's holders. The device is marked with this symbol to indicate that pacemaker holders must not come in contact with the device itself.
	Warning messages Attracting the attention of the operator to a particular procedure or practice which, if not followed correctly, could lead to serious injury.
	Electric hazard. The device is marked with this symbol when the operator, due to the presence of an high voltage, must refer to the user manual in order to protect himself from electrical shock risks.
	Magnetic field hazard. The device is marked with this symbol to inform the operator about the presence of a magnetic field.
	Hot surface hazard. The device is marked with this symbol when the operator must avoid the contact with potentially hot surfaces which may cause burns.

3.2. UNPACKING

Remove the module from the primary package. The pump is sealed in a can under nitrogen.



CAUTION

Do not open the package until final assembly. The getter material may be harmed by a long exposure to the environment due to the presence, for example, of high humidity levels, dust or contaminants.

3.3. PRECAUTION DURING INSTALLATION

As for all UHV type equipment, clean, lint-free gloves should be used for handling the parts of the pump exposed to vacuum. All operations should be conducted on a clean dust-free bench.

The UHV Wafer Module can be mounted inside the vacuum system on any support with suitable holes for the four fixing screws (see Figure 2).

The pump can operate in any mounting orientation, but horizontal position is preferred.

As shown in Figure 3, installation of the UHV Wafer Module with spacers included in the supply is recommended.

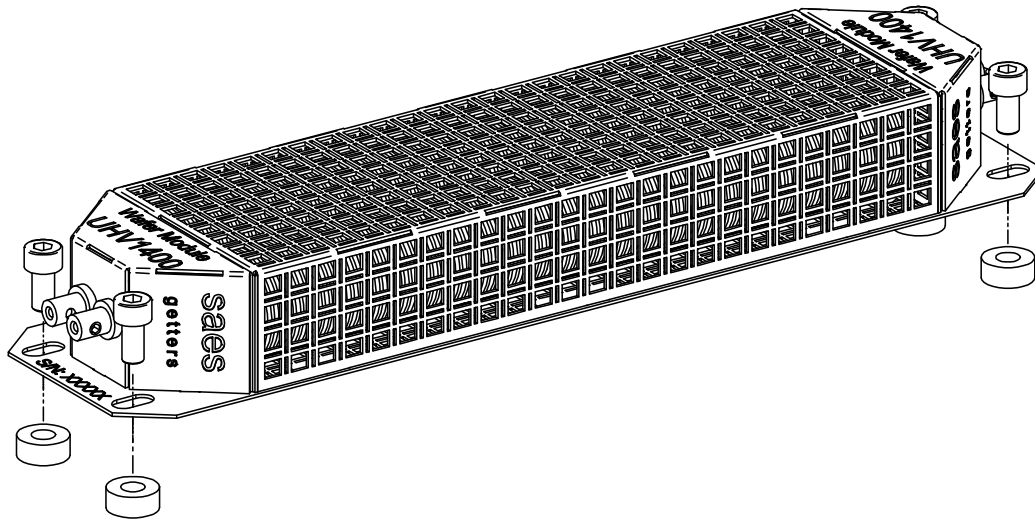


Figure 3 – UHV Wafer Module installation scheme (valid for all models).

3.4. BAKE-OUT

The pump is compatible with bake-out up to 400°C, Please ensure that the cables used to power the module are compatible with the desired bake-out temperature.

3.5. POWERING THE PUMP

As reported in Section 2, the UHV Wafer Module is provided with two resistive heaters. Two connectors are present on each side of the module, one for each end of the heaters, as shown in Figure 4a. The module is shipped bridged on one side as in Figure 4b. Depending on the user's needs and the number of modules to be powered, the bridge can be removed to allow connecting them with a suitable wiring scheme. Thanks to the flexibility of the modules, the proper combination of parallel and series connection can be used to choose the best voltage/current settings.

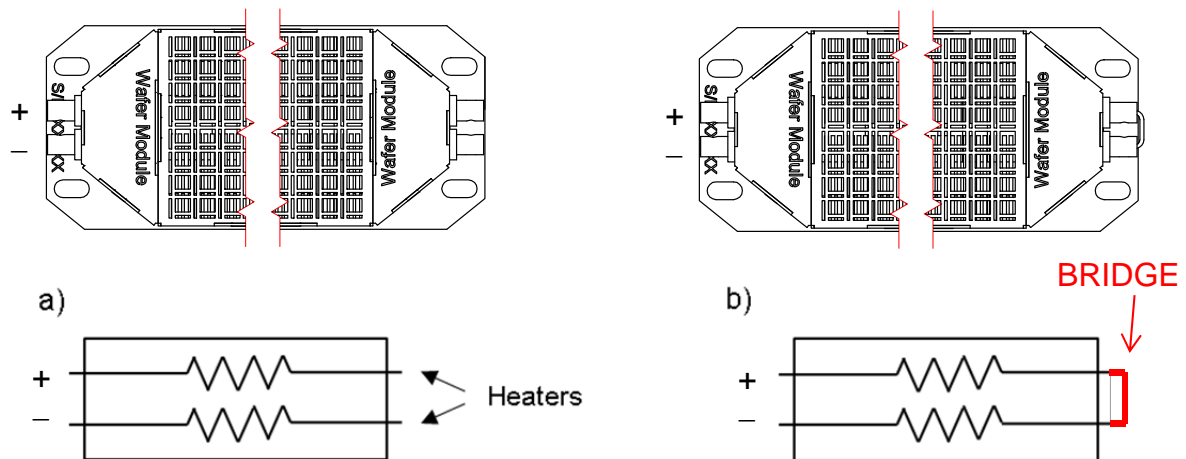


Figure 4 – Scheme of the module's resistive heaters

The cables connecting one module to another and to the feedthrough should fulfil the requirements defined by the voltage/current values and the operation temperature, as well as compatibility with UHV environment. Cables with Kapton[®], Peek[®] or ceramic insulation are suggested. The minimum recommended conductor section is 1.5 mm².

The maximum cable diameter fitting the module's connector is 2 mm; anyway, the use of crimp pins is recommended.

The NEG POWER is a power controller able to drive up to four pumps at a time, including the UHV Wafer Modules in activation mode or conditioning mode. The user can also set the desired current and voltage to be delivered to the pump depending on the needs. The NEG POWER can be configured locally through a user-friendly touch screen or remotely through RS232/RS485 or Ethernet communication ports. Specific information can be found in the document "*User's Manual NEG POWER*".

The most suited choice of the wiring and power supply configuration can be supported by SAES representatives.

4. OPERATION OF THE PUMP

During normal operation in UHV-XHV environments, the pump sorbs gases at room temperature and does not need power to operate. After having pumped a significant amount of gases, the surface of the getter will become saturated. When the pumping speed drops below an acceptable value (generally set at 10% of the initial pump speed), the NEG element needs to be reactivated. The reactivation, like the first activation, restores the initial pumping speed of the pump (see Sect. 4.1 for more details).

During a long bake-out it may be useful to keep the temperature of the getter at 200÷300°C. Doing so, the gases trapped on the surface and chemically reacted will progressively diffuse from the surface to the bulk of the getter material freeing a significant fraction of the surface sites for additional chemisorption. As a result, the pumping speed will stay high for a longer time. This is helpful to improve the achievable base pressure during the pump down or to reduce the bake-out duration.

4.1. ACTIVATION OF THE NEG PUMP

The non-evaporable getter material used in the UHV Wafer Modules (Zr-V-Ti-Al, ZAO^{®1}) develops its pumping characteristics after an **activation** process, i.e. a heating treatment carried out at a suitable temperature under vacuum for a sufficiently long time.

The power delivered during the activation of the UHV Wafer Modules is about:

125 W - 27 V for 60 minutes (UHV 700)
225 W – 50 V for 60 minutes (UHV 1400)

With this power, the getter temperature for the pump in “nude” configuration (i.e. the module far from the chamber walls except for the bottom¹) is about 550°C.

When the module is surrounded by walls and/or close to other modules, the getter material will reach higher activation temperature. Lower current values might therefore be sufficient to activate the pump.



CAUTION: the maximum current applicable to each module is 5 Ampere.

Thanks to the ZAO^{®1} properties, the activation process can be carried out after the system has been pumped down to a pressure of 10⁻⁴ Torr or lower.

The typical pumping speed curves of the UHV Wafer Modules at room temperature are reported in **APPENDIX A**.

4.2. REACTIVATION OF THE NEG ELEMENT

When the pump sorption speed falls below acceptable limits due to surface saturation (typically at the end of each sorption cycle), a reactivation of the getter material of the is necessary to recover the initial pumping performances. A reactivation is also required every time the pump is vented to air. If the pump is used in UHV conditions at room temperature, more than 100 reactivations are possible. The entire capacity of the getter material will be fully exploited only after many successive sorption cycles.

¹ Installation of UHV Wafer Modules with spacers included in the supply is always recommended.

4.3. SPECIAL INSTRUCTIONS

4.3.1. Air venting

It is recommended to open the vacuum chamber where the UHV Wafer Modules are mounted when the getter temperature is below 80°C or, preferably, at room temperature. This will reduce the surface oxidation and ensure a prolonged pump lifetime. After turning off the heater, the time needed to cool down to 80°C the getter in nude configuration is about 100 minutes. This value may change depending on the distance from other surfaces and their temperature.

Venting with dry nitrogen instead of air is the best option to preserve the pump performances after repeated venting/reactivation cycles. A further improvement is obtained when pure Argon is used as a protective gas during maintenance operations.

4.3.2. Vacuum failure

Even though the ZAO[®]1 alloy is an improved getter, it is a good practice to avoid air to suddenly enter the vacuum system when the NEG element is hot (i.e. during pump activation/reactivation or conditioning).

Should this happen, due to a significant air exposure, the getter material may get oxidized.

In the worst cases, i.e. the getter exposed hot to atmospheric pressure, the oxidation reaction may become self-sustained leading to an exothermic reaction. The temperature increase and the degree of oxidation will depend on the actual conditions. The reaction will be in any case progressive, without any burning.

Should this unlucky event occur, then:

- 1) The user must switch off the power supplied to the heater of the NEG element and any other heating source, and try to recover a suitable vacuum level
- 2) Do not touch or remove the pump during/after a vacuum failure till the getter cartridge cools down.

4.3.3. Mechanical shocks

Due to the mechanical characteristics of the getter disks on the pump and of the insulating elements of the heater (ceramic components) care must be observed in handling the pump cartridge during mounting (and removal) of the pump. Accidental dropping and similar mechanical shock could result in permanent damage of the getter disks or the heating elements.

5. WARRANTY CONDITIONS

SAES guarantees that the Products delivered shall be free from operational and material defects and shall comply with the construction and functional data and specifications indicated in the Contractual Documents.

This warranty shall have a term of TWELVE (12) MONTHS. For Products which require installation at BUYER's facility by SAES personnel, the warranty shall have a term of TWELVE (12) MONTHS from the date of installation or FOURTEEN (14) MONTHS from the date of delivery, whichever term is shorter. Subject to the remainder of this Article 14, any action by BUYER for any alleged breach of this warranty shall be brought in writing by BUYER within thirty (30) days of BUYER's discovery of the breach. This warranty shall only apply to the BUYER and may not be assigned.

During the term of the warranty set forth above, SAES will promptly repair the Products which for their features can be repaired and which do not conform to the specifications and which BUYER returns to SAES at the address provided. Unless otherwise agreed and specified, BUYER shall be responsible for all transportation charges incurred in returning Products to SAES for repair; BUYER shall have obtained a Returned Material Authorization ("RMA") number and specific shipping instructions from SAES prior to its shipping of the Products to SAES. SAES shall not unreasonably deny BUYER authorization to ship Products to SAES. SAES shall return repaired Products to BUYER, with transportation charges prepaid by SAES, unless otherwise agreed. Additional information is available on the General conditions of sales.

6. INSTRUCTION FOR INSTRUMENT DISPOSAL

The instrument disposal should be carried out in compliance with the user's country applicable regulations.

The instrument contains materials which may endanger the environment. When disposing of the instrument, separate disassembly by material is to be arranged for and the different materials shall be collected separately for disposal. Neither the collection nor the transport of thus collected and separated materials is subject to any special requirements.

6.1. MEANING OF THE "WEEE" LOGO FOUND IN LABELS

The following symbol is applied in accordance with the EC WEEE (Waste Electrical and Electronic Equipment)

Directive. This symbol (valid only in countries of the European Community) indicates that the product it applies to must NOT be disposed of together with ordinary domestic or industrial waste but must be sent to a differentiated waste collection system.

The end user is therefore invited to contact the supplier of the device, whether the Parent Company or a retailer, to initiate the collection and disposal process after checking the contractual terms and conditions of sale.



7. SERVICE

For a request of return of the pump please contact SAES Customer Service.

7.1. SALES & SERVICE LOCATIONS:

Europe, Middle East and Africa:

SAES Getters S.p.A.

Viale Italia, 77
20020 Lainate (Milan) – Italy
Ph. +39 02 93178 1 - Fax +39 02 93178 320

European Customer Relations:

Ph. +39 02 9317 8402 - Fax +39 02 93178320
E-mail: CRM_SALES@saes-group.com

Asia and Oceania:

SAES Getters S.p.A. - Japan Technical Service

Branch Office

2nd Gotanda Fujikoshi Bldg.
23-1 Higashi Gotanda 5-Chome
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Ph. +81 3 542 00431 - Fax +81 3 542 00438

SAES Getters (Nanjing) Co.,Ltd.

56 Xingangdadao, Xinchengwei
Nanjing Economic & Technical Development Zone
Nanjing 210038, Jiangsu Province, P.R. of China
Ph. +86 25 8580 2335 - Fax +86 25 8580 1639

SAES Getters Korea Corporation

7th Fl. Dongwon Bldg. 143-28
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Seoul 135-877, Korea
Ph. +82 2 3404 2400 - Fax +82 2 3452 4510/11

SAES Getters S.p.A. - Taiwan Branch Office

6F-1, No. 1071, Zhongzheng Road,
Taoyuan City, Taoyuan County 330
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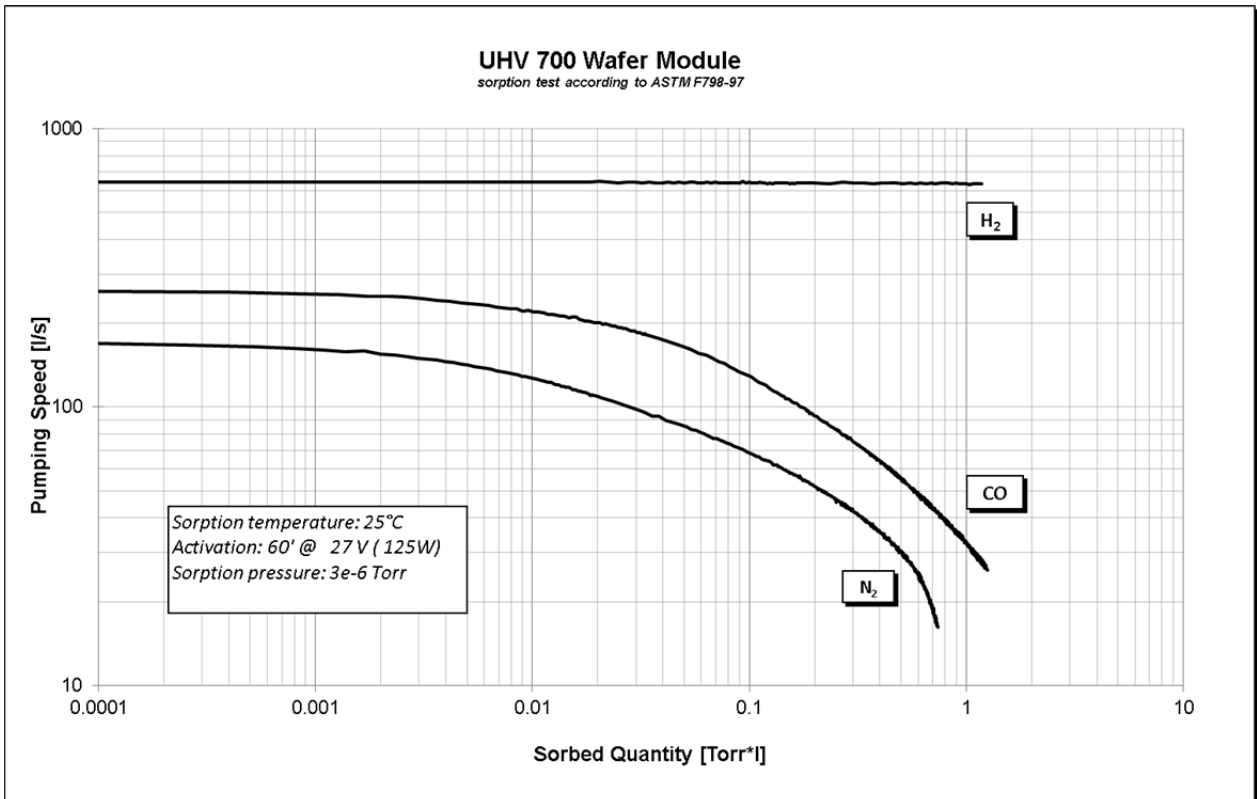
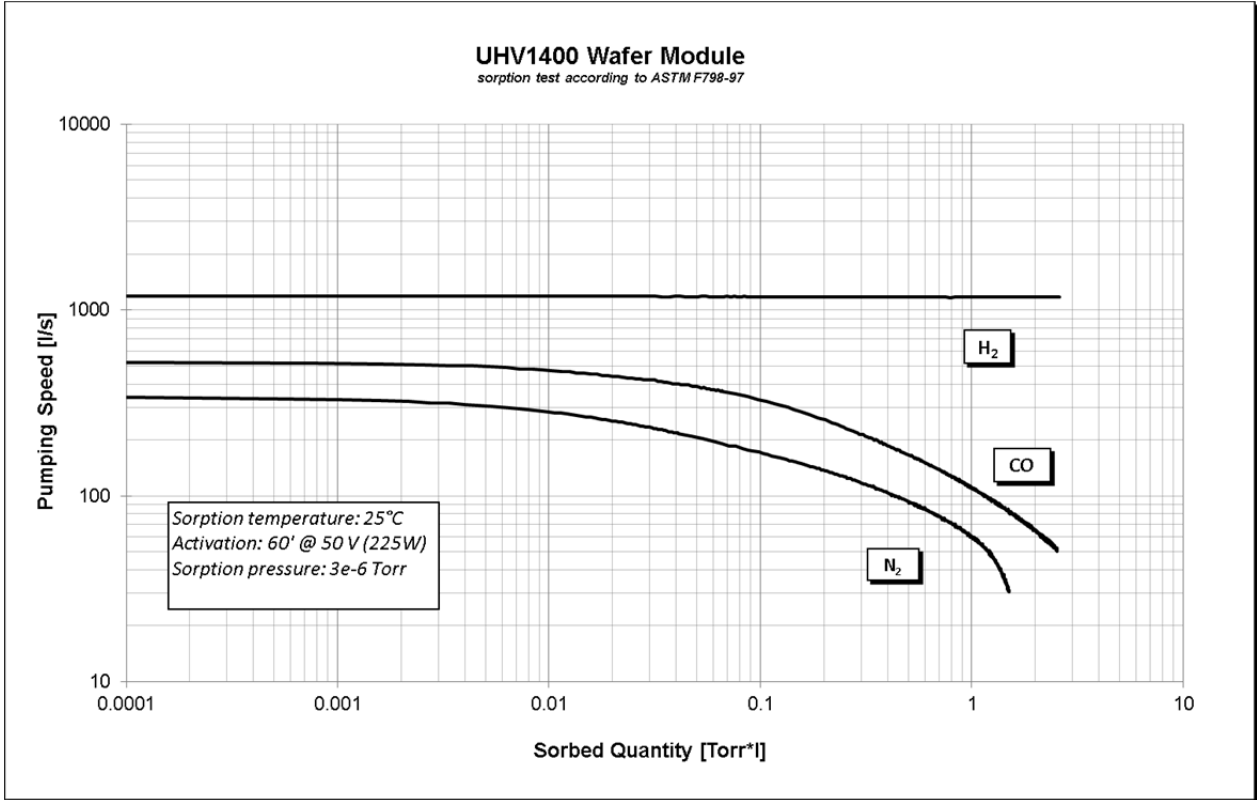
North and South America:

SAES Getters USA, Inc.

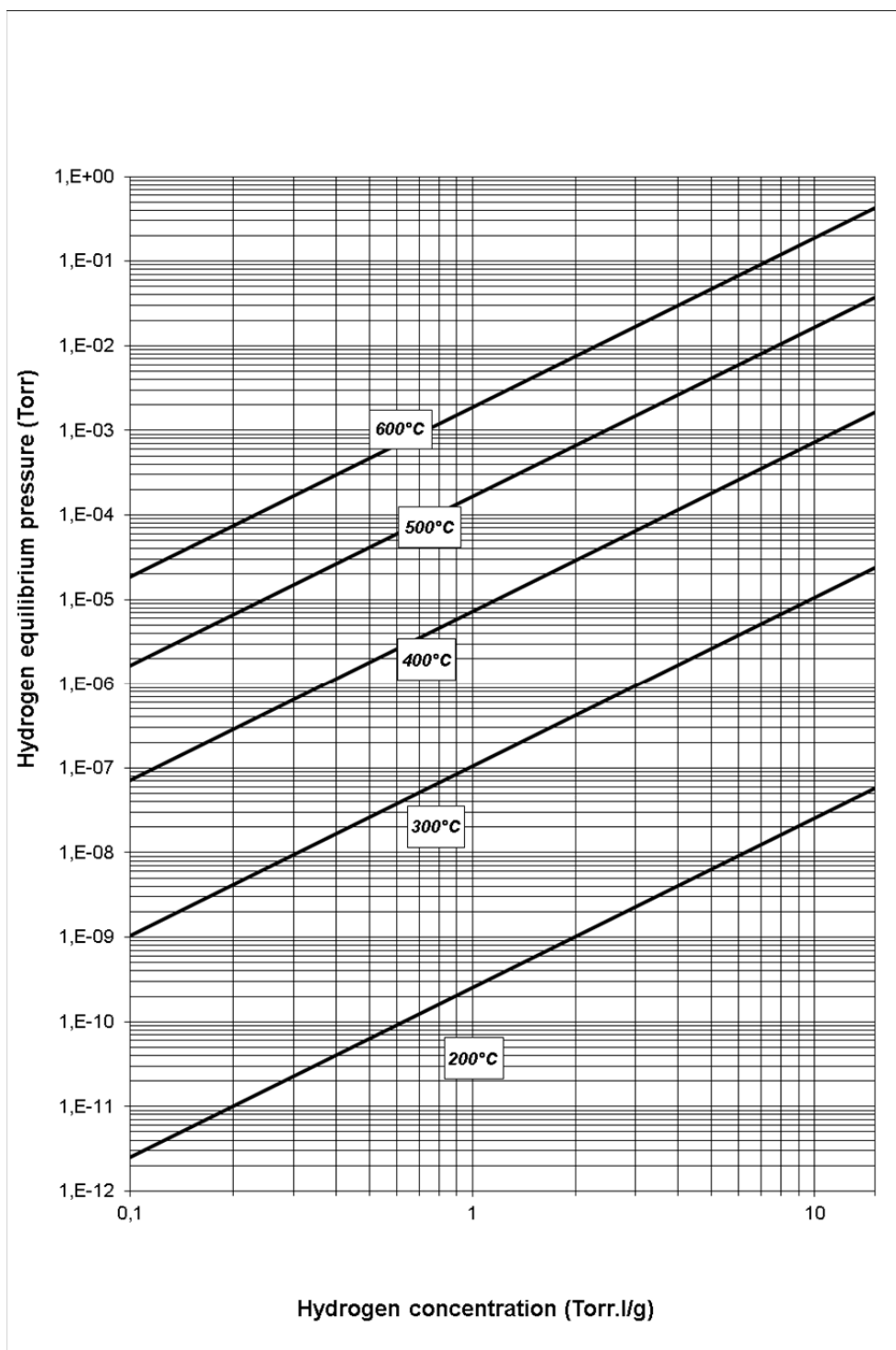
1122 East Cheyenne Mountain Blvd.
Colorado Springs, CO 80906 – USA
Ph. +1 719 576 3200 - Fax +1 719 576 5025

Remember that SAES cannot accept any pump which contains biological or chemical hazards or radioactive substances. Please clearly inform SAES Customer Service should this have happened during pump use, so to discuss adequate solutions.

APPENDIX A : UHV 700 / UHV 1400 Wafer Module typical sorption curves (as per ASTM F798-97)



APPENDIX B : ZAO[®]1 Hydrogen equilibrium isotherms



APPENDIX C : ordering information

Part numbers and product description of the UHV Wafer Modules and the power supply are provided in the following table.

Product	Product description	Code
NEG Module	UHV 1400 Wafer Module	5H0701
NEG Module	UHV 700 Wafer Module	5H0703
NEG power supply	NEG POWER C1 (*) (**)	3B0501
NEG power supply	NEG POWER LP C1 (*) (**)	3B0521

(*) Power supply includes input cable;

(**) Other models, able to simultaneously drive up to four pumps, are available.



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