
OPERATING INSTRUCTIONS
CapaciTorr[®] HV 200 Pump



SAES ADVANCED TECHNOLOGIES S.p.A. – Italy
www.saesgetters.com

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The CapaciTorr® HV 200 is a Non Evaporable Getter (NEG) pump using the innovative ZAO® getter alloy (Ti-Zr-V-Al) in the form of highly efficient sintered disks stacked in a suitably designed cartridge.

Thanks to the sintering technology, the CapaciTorr® HV 200 combines state of the art gas sorption performances with remarkable cleanliness, not achievable by pump designs using compressed getter powder.

The pump, which has a very compact package, provides high pumping performance in the high vacuum (HV) regime (i.e. 10^{-7} - 10^{-9} Torr range) for all getterable gases like H₂, N₂, H₂O, CO/CO₂ and O₂. This is achieved operating the getter cartridge at moderate temperature (≈ 200 °C). Thanks to the extremely high gas sorption capacity, the pump can cope with large air leakages or sudden gas burst typical of high vacuum systems. Use of the pump in UHV range (Ultra High Vacuum) is also possible operating the getter cartridge at room temperature.

DESCRIPTION OF CAPACITORR® HV 200 PUMP

A picture of the CapaciTorr® HV 200 pump is shown in Fig. 1. All dimensions are in mm.

The key components are:

- The NEG cartridge, containing the sintered getter material, and the heater (1)
- The base flange with the feed-through connector (2)
- The pump body (two versions available on CF35 and CF63 flanges) (3)
- The body external shield (4)

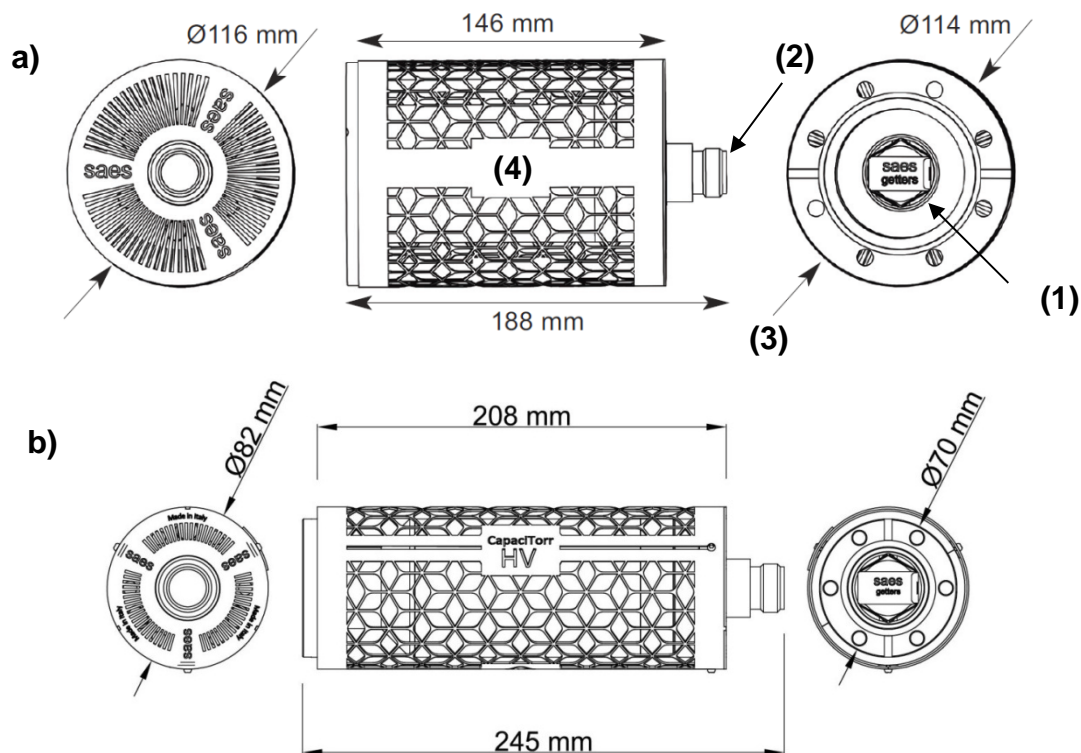


Fig. 1. Typical dimension of CapaciTorr® HV 200 on a) CF63 and b) CF35 flanges.

Table I. Typical gas sorption characteristics of the CapaciTorr® HV 200

Alloy Type		ZAO®	
Alloy Composition		Zr V Ti Al	
Getter Mass (g)		140	
Getter Surface (cm ²)		432	
Pumping speed (l/s) at 230°C			
	Gas	CF35	CF63
	H ₂	105	210
	O ₂	32	90
	CO ₂	25	65
	N ₂	30	60
Sorption Capacity (Torr l)			
	H ₂	2800	
	O ₂ Single run at 230°C	200	
	CO ₂ Single run at 230°C	40	
	N ₂ Single run at 230°C	200	
Number of runs (sorption cycles)		>20	
NOTES:			
Pumping speed data refer to the initial values measured at pump inlet.			
The "Single run" capacity is intended as the recommended absorbed quantity per run allowing to perform more than 20 sorption cycles. In case of operation under lower gas loads or at RT, the pump can be reactivated 100 times or more.			

Pump Cartridge

The pump cartridge consists of a special AISI 304 support that contains the getter material in the shape of sintered high surface area disks, and the heater. 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 tungsten wire inside an alumina insulator.

Base flange

The "base flange" is a CF35 type flange (AISI 316LN) integrating a TIG welded feed-through connector to power the getter cartridge. The base flange is leak tested to 1.0×10^{-10} mbar l/s.



The whole assembly is bakeable up to 300 °C (without powering, external shield removed). If the external shield is kept mounted, the maximum allowed temperature is 150 °C.

Feed-through connector

The flange electrical connector is designed to carry the current necessary for the activation and operation of the pump. It has 4 terminals:

- two power leads B and D (6 A max)
- two ground connections A and C



The following scheme shows the electrical connections on the feed-through (plug connector rear view):

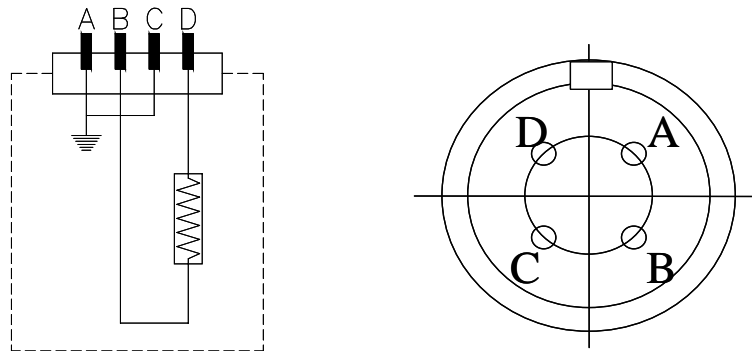


Fig. 2. Electrical connections of the feed-through.

Air side plug

The air side plug connector allows the connection of the pump to the power supply and control unit. The plug must be removed if, during a baking treatment, its temperature exceeds 200°C.



CAUTION: manipulation of the plug when the connector is above 50°C may result in damage of the feed-through connector. Connection / disconnection of the plug must be done below this temperature.

Pump body

The pump body is an integral part of the pump, and it has a thermal management function. It is a simple double flanged nipple, available in two different configurations allowing connection either to a CF35 or CF63 flange. The CF35 version is enlarged in the cartridge section to allow a higher conductance for the gases to be pumped.

The pump body is leak tested to 1.0×10^{-10} mbar l/s.

External shield

The external pump shield is designed as a safety device to prevent the user from touching the body surface, as this might achieve about 50°C during operation. Therefore, the pump should not be used without the shield.

Nevertheless, to mount the pump in the vacuum system it is necessary to remove the shield, which must be assembled again to complete the pump installation. Instructions about how to mount/dismount the shield are provided in the section “INSTALLATION OF CAPACITORR® HV 200 PUMP”.

PACKAGING OF CAPACITORR® HV 200 PUMP

The CapaciTorr® HV 200 pump is packed in a single can under pure nitrogen atmosphere. Shock absorbers are placed to prevent damage during transportation. A “can opener” can be used to open the tin.

The getter cartridge is kept in position during transportation by means of a steel holder, which must be removed before installation, as shown in Fig. 3.



CAUTION: the packing is designed to prevent possible contamination of the pump components. Even though NEG cartridges can be exposed to air without damage thanks to the stability of the getter alloy, it is advisable not to open the cartridge can until immediately before its use. Exposure of the cartridge to a dusty or smoky environment is always to be avoided to prevent possible getter contamination. Also, prolonged exposure to high levels of humidity may result in longer activation times or higher activation temperatures.

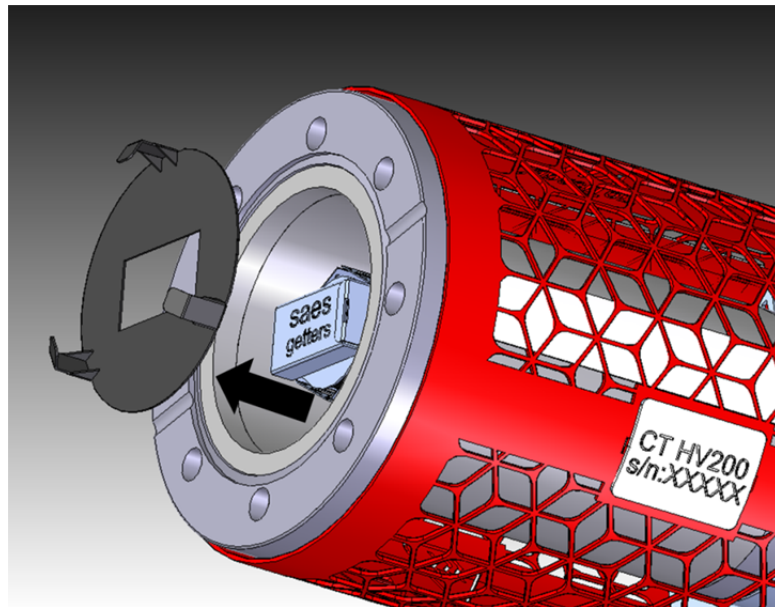


Fig. 3. Cartridge steel holder.

PRECAUTIONS BEFORE AND DURING INSTALLATION OF CAPACITORR® HV 200 PUMP

UHV standards have to be followed when handling/using the pump components. As for all UHV type of equipment, clean plastic or rubber, lint free gloves or finger cots should be used for handling the parts of the pump exposed to vacuum. Never handle the pump with bare hands. All handling operations should be conducted on a clean dust-free table. All tools used for the assembly should be cleaned before use.

INSTALLATION OF CAPACITORR® HV 200 PUMP

MOUNTING

The CapaciTorr® HV 200 is ready to be mounted to the vacuum system directly connecting the body flange to the port of the vessel. To this aim the external shield must be removed, and mounted again before operation. To dismount the shield on the CF63 version remove the three screws and simply extract the shield (Fig. 4a). To slide the shield on the CF35 version partially loosen the three screws and slide the shield (Fig. 4b). In case of need to completely remove the shield, further loosen the screws till complete extraction.

IMPORTANT NOTICE: The pump operation is **not affected** by the mounting orientation



CAUTION: the external shield is a safety device, which prevents the user from touching the body hot surface during getter activation and operation. It is recommended not to remove **the external shield during operation.**

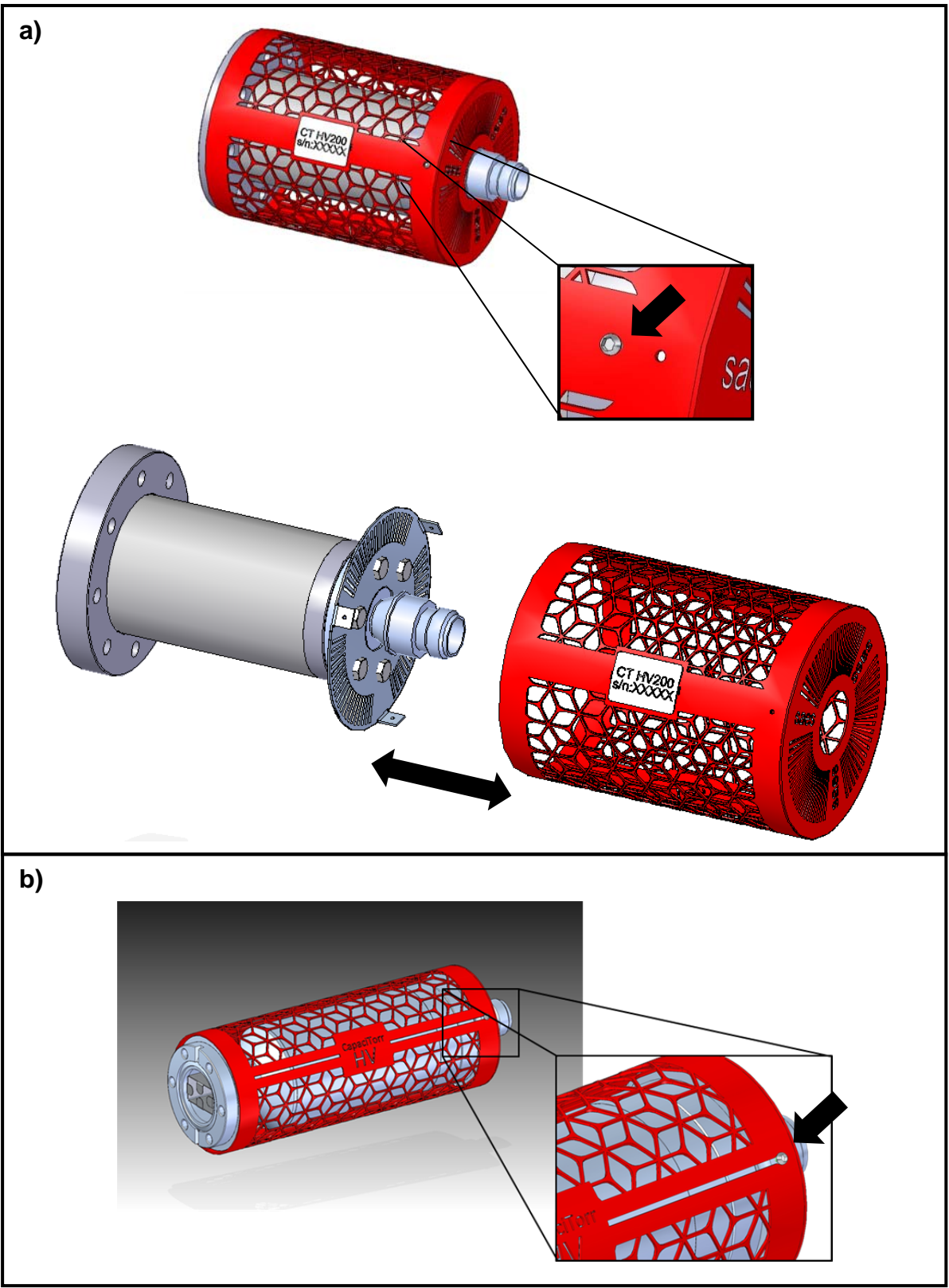


Fig. 4. Dismount of the CapaciTorr® HV 200 on a) CF63 and b) CF35 flanges.

POWERING THE PUMP

The CapaciTorr® HV 200 Power Supply provides the correct heating parameters in a compact and robust unit. For an optimal thermal management of the pump it is highly advisable to use SAES dedicated power supply. The pump can also be powered using alternative suitable AC or DC power sources, provided that the correct voltage is applied. Special instructions to power the pump with a different power supply are available on request.

ACTIVATION OF CAPACITORR® HV 200 PUMP

The non-evaporable getter material used in the CapaciTorr® HV 200 pump develops its pumping characteristics after an **activation** process, i.e., after being heated to a suitable temperature for an appropriate time under vacuum.

The power consumed by the CapaciTorr® HV 200 Power Supply to achieve full (100%) activation for the CapaciTorr® HV 200 pump is:

54 W for 60 minutes (both CF35 and CF63 body)

With this power the getter temperature is in the range 530 - 570°C.

Even though there are no strict rules, as conditions may change from one situation to another, the activation process should be preferably carried out only after the vacuum system has been pumped down by Turbo molecular pumps or other pumps to less than 10^{-6} Torr. When the system is below 10^{-6} Torr, the heater can be powered.

The time needed to reach the activation temperature is about 20 min. During activation the temperature of the base flange and the inlet flange are about 60°C and 40°C respectively. The external shield is at room temperature.



CAUTION: if possible avoid simultaneous baking & pump activation as this may cause an overheating of the pump and of the air plug. If this is not possible, limit the baking temperature to 150°C during the activation.

OPERATION OF CAPACITORR® HV 200 PUMP

Once activated, the CapaciTorr® HV 200 pump is designed to operate at about 200°C. At this temperature the ZAO® getter capacity for active gases is compatible with operation in the 10^{-8} – 10^{-7} Torr range. Under these conditions, time between reactivations (“sorption cycle”) can be long, from several months to one year or more depending on the actual atmosphere composition and gas flux in the vacuum system.

To achieve the working temperature, the CapaciTorr® HV 200 Power Supply delivers:

7.5 W for CF35 body

8.6 W for CF63 body

The time needed to reach the working temperature starting from room temperature is about 40 min. When the operation temperature has to be reached immediately after the activation, it is recommended to power the pump 20 min after the end of the activation process to minimize the required time.

During operation the temperature of the base flange and the inlet flange are about 40°C and 30°C respectively. The external shield is at room temperature.

The use of the pump in UHV is also possible operating the pump at room temperature (power off).

The typical pumping speed curves of the CapaciTorr® HV 200 at standard working temperature and at room temperature are shown in **APPENDIX B**.

REACTIVATION OF CAPACITORR® HV 200 PUMP

When the pump sorption speed falls below acceptable limits due to surface saturation (typically at the end of each sorption cycle) a re-activation is required to start a new sorption cycle. A re-activation is also required every time the pump is vented to air.

After sorption of significant gas loads at high temperature, for example after several sorption cycles in the 10^{-8} – 10^{-7} Torr range, it is advisable to increase the re-activation duration to up to **4 hours**. This will allow a more efficient getter recovery.

The entire capacity of the getter material will be used up only after many successive sorption cycles. The total number of reactivations can vary depending on the gas load. Under operation at 200°C in the mid 10^{-8} Torr range, it is advisable to reactivate the pump at least once a year. Under these conditions tens of reactivations are possible as indicated in Table I. In case of operation under lower gas loads or at RT, the pump can be reactivated more than 100 times.

CARTRIDGE REPLACEMENT

At the end of its usable life, when the getter material is exhausted, the cartridge has to be replaced. The cartridge must be handled as per the relevant Material Safety Data Sheets (MSDS) and disposed according to local regulations.

Special instructions are available on request.

SPECIAL INSTRUCTIONS

Air venting

It is advisable to open the vacuum chamber where CapaciTorr® HV 200 pumps 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 operation pump lifetime. After turning off the heater, time needed to cool the getter cartridge down to 80°C is about 70 min.

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

Vacuum failure

Even though the ZAO alloy is an improved getter, it is a good practice to avoid air to suddenly enter the vacuum system when the pump is hot (i.e. during pump activation, regeneration, operation or baking of the system).

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

In the worse cases, i.e. getter exposed hot to atmospheric pressure for a long time, 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.

- the user must switch off the pump heater and any other heating source, and try to recover a suitable vacuum level

Do not to touch or remove the pump during/after a vacuum failure till the getter cartridge cools down.

Mechanical shocks

The pump is mechanically robust and suitably engineered. It is however advisable to handle it with care during mounting and assembling/disassembling, due to the presence of the insulating elements of the heater and connector (ceramic components). Also, accidental dropping and similar mechanical shock could result in damages of the getter disks or the heating/connecting elements.

PART NUMBERS / ORDERING INFORMATION

Product	Description	Code
CapaciTorr HV 200 pump on CF63	CapaciTorr HV 200	5H0156
CapaciTorr HV 200 pump on CF35	CapaciTorr HV 200 CF35	5H0159
power supply+output cables 5 mt	CapaciTorr HV200 Power Supply	3B0455
Input cable EU plug	Cable Mains Input CF35 3Mt	3B0338

Note: replaceable cartridges, flanges and bodies are available on request

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.

SERVICE

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

Sales & Service Locations:

Europe, Middle East and Africa:

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Viale Italia 77
20020 Lainate (Milan) - Italy
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European Customer Relations:

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North and South America:

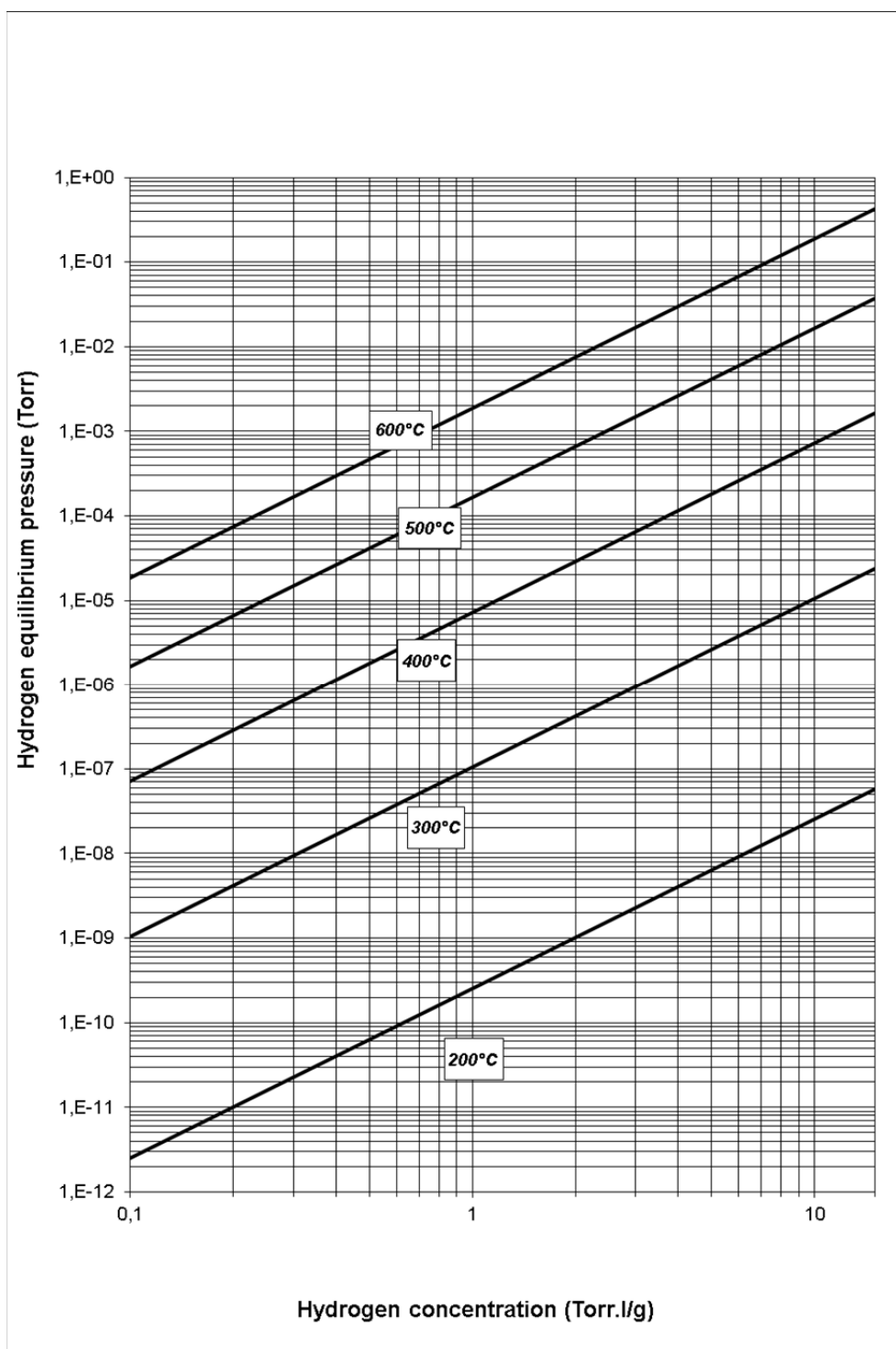
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Colorado Springs, CO 80906 - USA
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Remember that SAES cannot accept any pump which contains biological or chemical hazards or radioactive substances. Please clearly inform SAES Customer Service should this have happened during pump use, so to discuss adequate solutions.

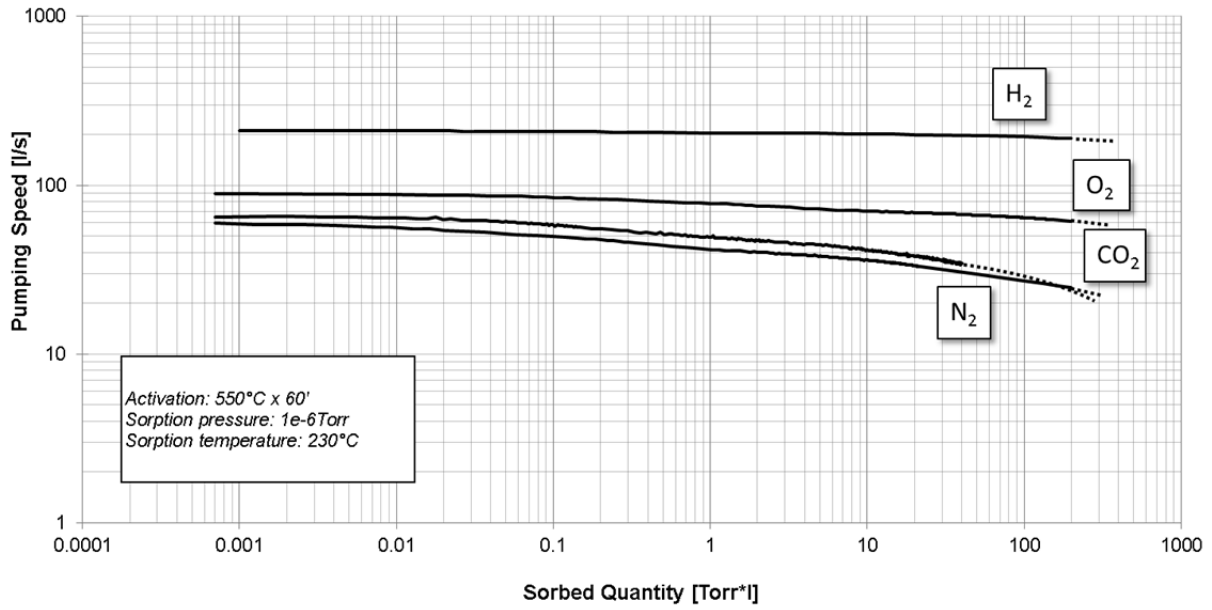
APPENDIX A

Typical hydrogen equilibrium pressure curves for ZAO[®] alloy

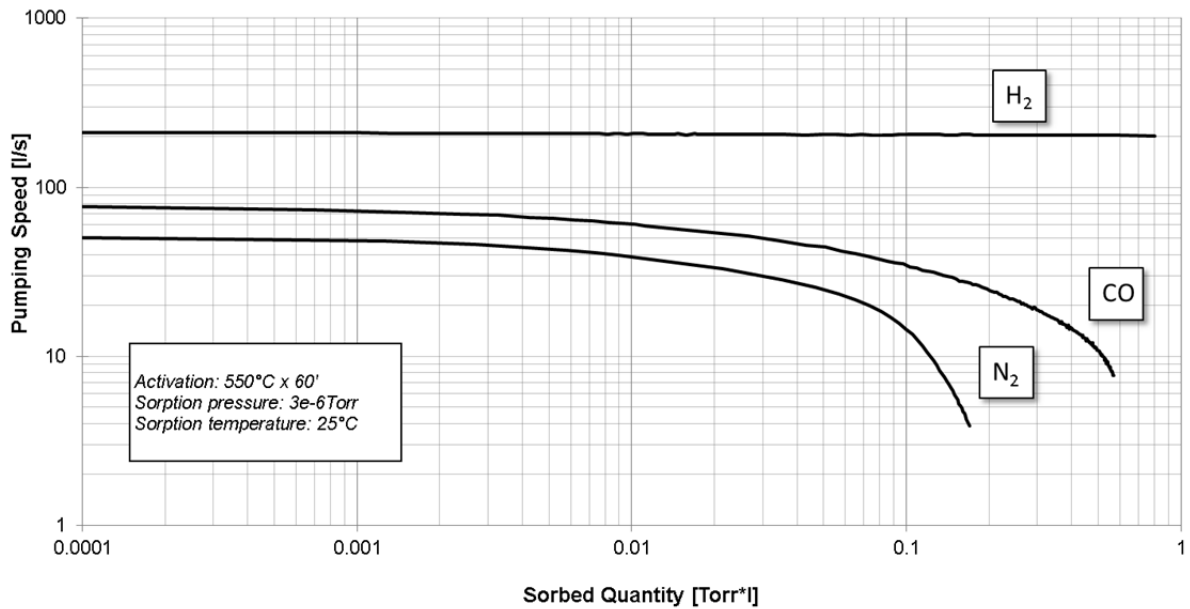


APPENDIX B

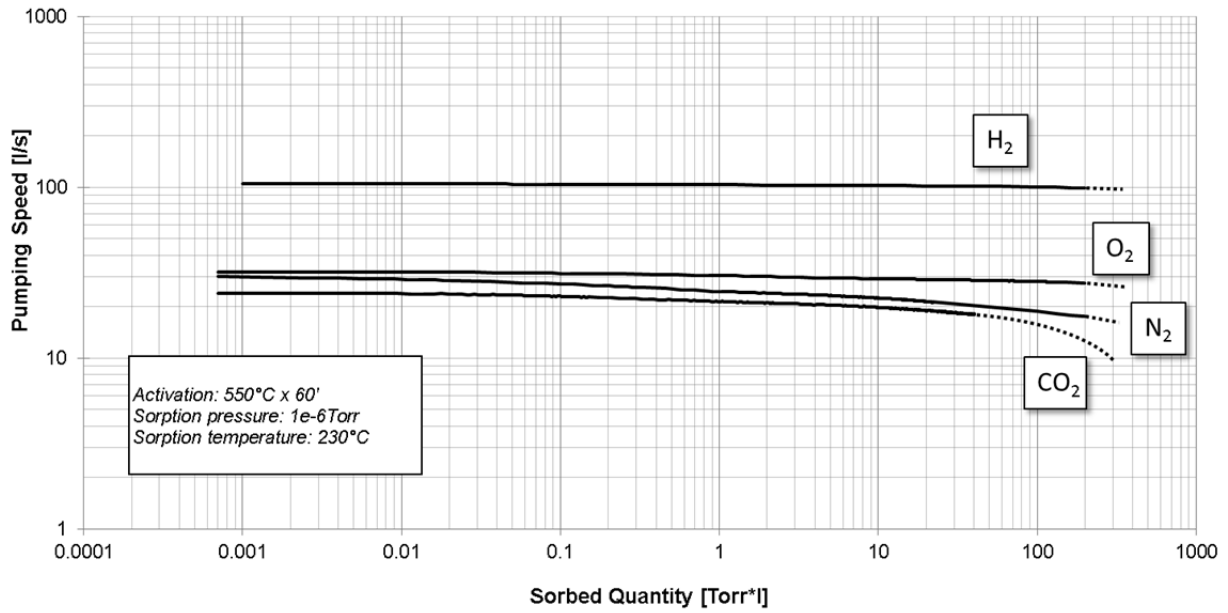
CapaciTorr HV200 - body CF63
Typical sorption curves (according to ASTM F798-97)



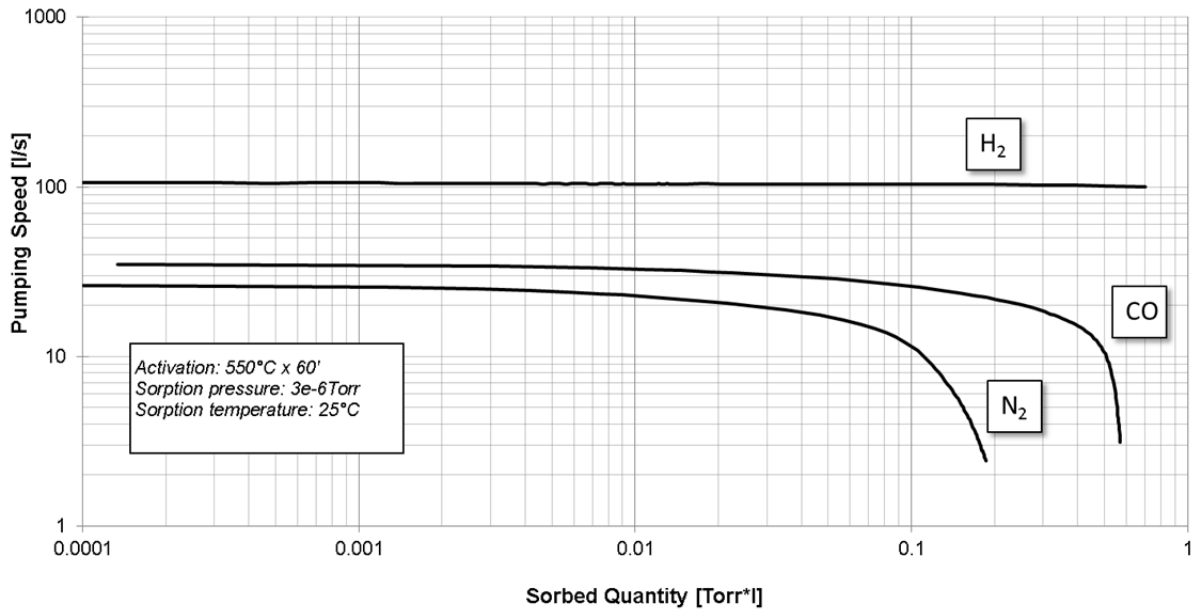
CapaciTorr HV 200 - body CF63
Typical sorption curves (according to ASTM F798-97)



CapaciTorr HV200 - body CF35
 Typical sorption curves (according to ASTM F798-97)



CapaciTorr HV 200 - body CF35
 Typical sorption curves (according to ASTM F798-97)





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