Since 2001

HIGH QUALITY PRODUCTS BASED ON INNOVATION AND SUCCESS

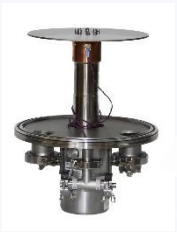
WHO WE ARE

Our company started 2001 with development and manufacturing of a brand new, **patented generation of cryo pumps** which succeeded on the market due to their special innovations

Cryogenic Products

VCP Cryo Pumps

SINCO Cryo Pumps



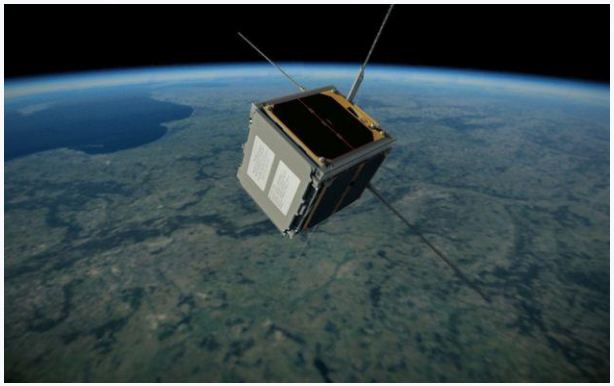
VELCO Cryo Pumps

VELCO H2 Pumps

Cryostats

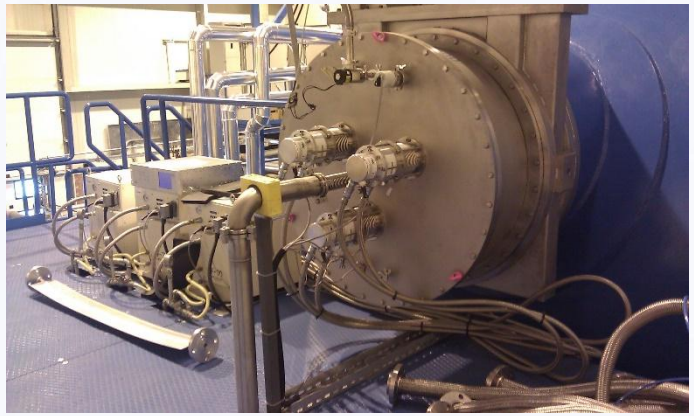
Customized Devices

Space simulation



- **Thermal vacuum testing**
- **Satellite thruster testing**
- **Customized applications**

Thermal vacuum testing



Thermal vacuum chamber (TVC) using
2 sets VELCO 1000

Thermal vacuum testing

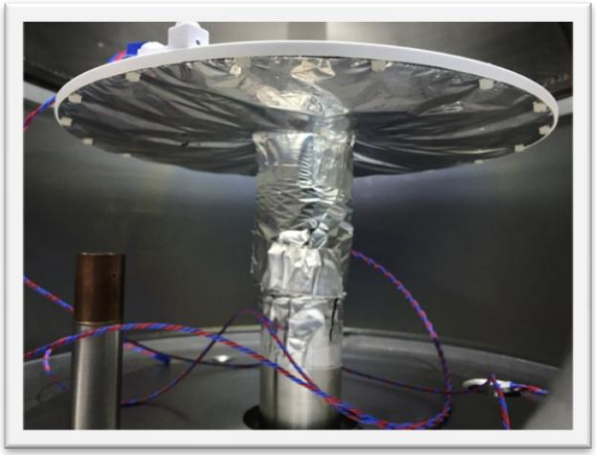
VELCO 1250

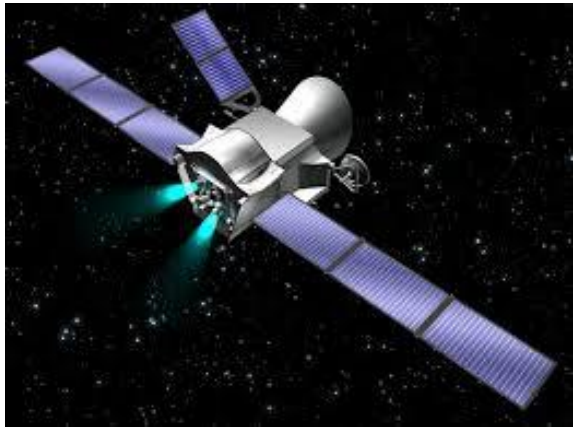
VELCO 800 LN2

Recommended type of cryo pumps:

- **VELCO standard pumps**
- **VELCO LN2 pumps**

Testing of Xe / Kr thrusters





Thruster testing using SINCO or VELCO Xe or Kr pumps

Testing of Xe / Kr thrusters

VELCO 400 Kr

SINCO 250 P70

Recommended type of cryo pumps:

- **VELCO Xe pumps**
- **VELCO Kr pumps**
- **SINCO pumps for Xe and Kr**
- **VELCO LN2 pumps**

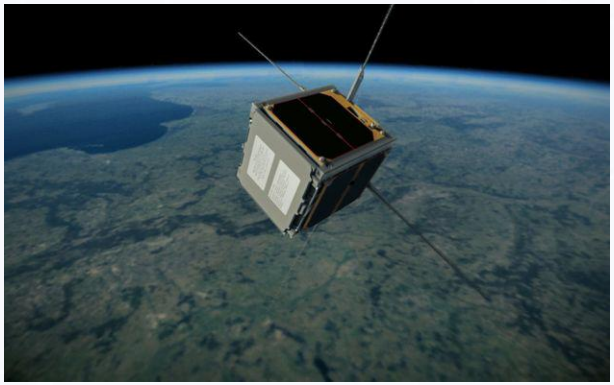
VELCO 2000 Xe

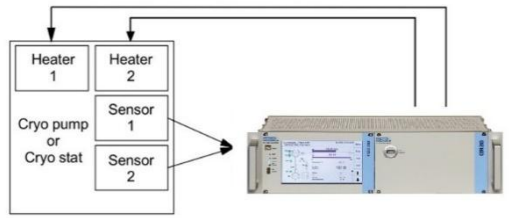
Customized applications

VELCO 1250 LV

Recommended type of cryo pumps:

- **VELCO low vibration pumps**
- **Customized pumps**





Temperatur control application

- Can be used for **VELCO** and **SINCO** cryo pumps
- Control accuracy **+/- 1K**

Testing of Xe / Kr Thruster

Requirements for pumping Xenon / Krypton gas

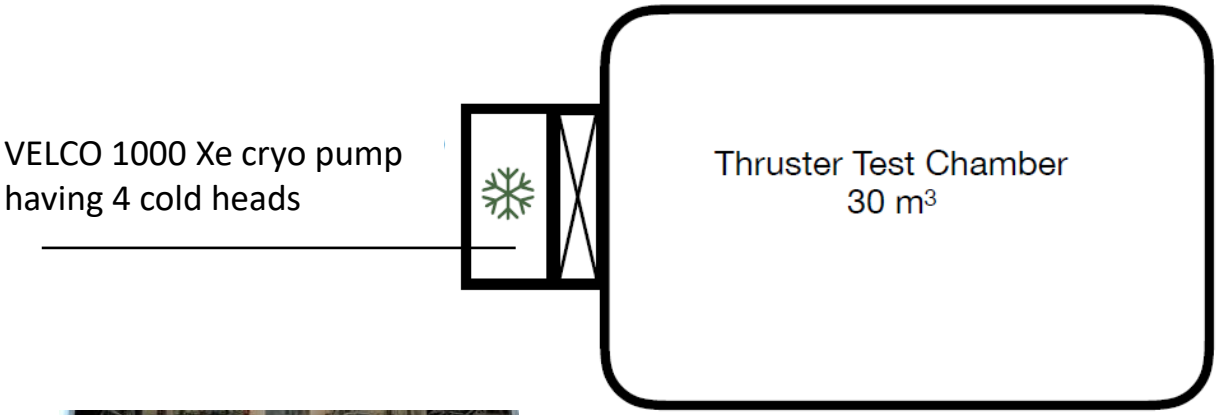
- The vapor pressure curve for Xe and Kr shows, that a certain minimum temperature is required for optimal condensation on available surfaces

- In order to meet the increasing Xe or Kr gas flow, another important requirement for the cooling system is the available cooling capacity at needed process temperature and pressure

Testing of Xe / Kr Thruster

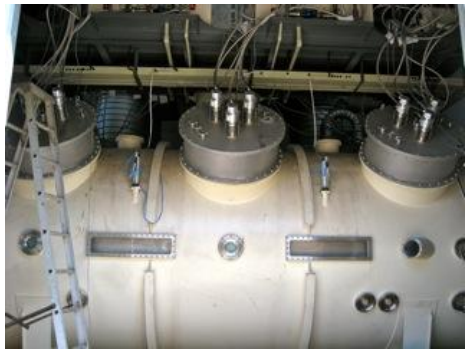
Comparison of available HSR pump systems

Example 1: Xenon cryo pump with increased number of coldheads



Pumping speed for different gases:

Water vapor:	110000 l/s
Xenon:	**45000 l/s**
Nitrogen:	45000 l/s
Argon:	38000 l/s
Hydrogen:	42000 l/s



Testing of Xe / Kr Thruster

Comparison of pump systems:

Example 1: Xenon cryo pump with increased number of coldheads

Main advantages	Main disadvantages
The high pumping speed of Xe / Kr pumps are generated on shielding surface of 1st stage and as well on 2nd stage	The operating temperatur on pump shieldings during Xe or Kr pumping must remain below a ceratin temperature on complete surface aerea. ➢ there for high cooling power and additional cooled shieldings in front of gas entrance may be required
Using HSR Xe / Kr pumps, number of needed pumps and gate valves can be reduced to appr 50%	Additional acceptable heat load is limited by cooling power capacity of coldheads.
The pump can also be used for background pumping, therefore no additional pumps for generating of the background pressure are necessary.	Higher investment cost version
If a gate valve is installed between pump and chamber, batch changes are possible without warming up the pump.	
Xe / Kr cryo pumps equipped with gate valve allows regeneration of specific single Xe / Kr cryo pumps during test operation	

Testing of Xe / Kr Thruster

HSR cryo controllers for VELCO LN2 pumps

Pump controller
HCC 200

Generally said:

- Each cryo pump requires one controller
- HCC 200 controller can serve up multiple cold heads / compressors in one cryo pump
- Multiple HCC 200 controllers can be controlled by system control via Ethernet

Testing of Xe / Kr Thruster

Comparison of available HSR pump systems

Example 2: SINCO pumps

Pumping speed 3 x single stage Xenon pump:

Water vapor: 122000 l/s
Xenon: 45000 l/s

no pumping speed for N_2 ; Ar; H_2; etc.

Testing of Xe / Kr Thruster

Comparison of pump systems:

Main advantages	Main disadvantages
Low cost version of Xe and Kr pump	For pumping of Xe / Kr gas only
High pump speeds for Xe and Kr gas can be realized without a need for big sized connecting flanges	At least one additional standard cryopump or a big number of turbomolecular pumps are necessary to compensate the required pumping speed for generating the base pressure of <10E-6 mbar
SINCO pumps can be placed near the source of process gas flow. ➔ Less loss of conductance for Xe / Kr gas	Warming up of Xe / Kr pumps is necessary for each batch change.
Connections on main chamber can be realized using smaller flanges.	No individual regeneration of single SINCO pumps possible during process operation
	0peration is also limited by additional heat radiation or hot gas loading

Testing of Xe / Kr Thruster

HSR SINCO pumps

High capacity version

- Optimized for highest capacity
- Long term application

Available types:

- SINCO 160 P50
- SINCO 200 P50
- SINCO 250 P50

	Capacity	Pump Speed
SINCO 160 P50	3000 bar l @ 1200 sccm	18 000 l/s
SINCO 250 P50	3000 bar l @ 1200 sccm	18 000 l/s

High pump speed version

- Optimized for highest pump speed
- Short term application

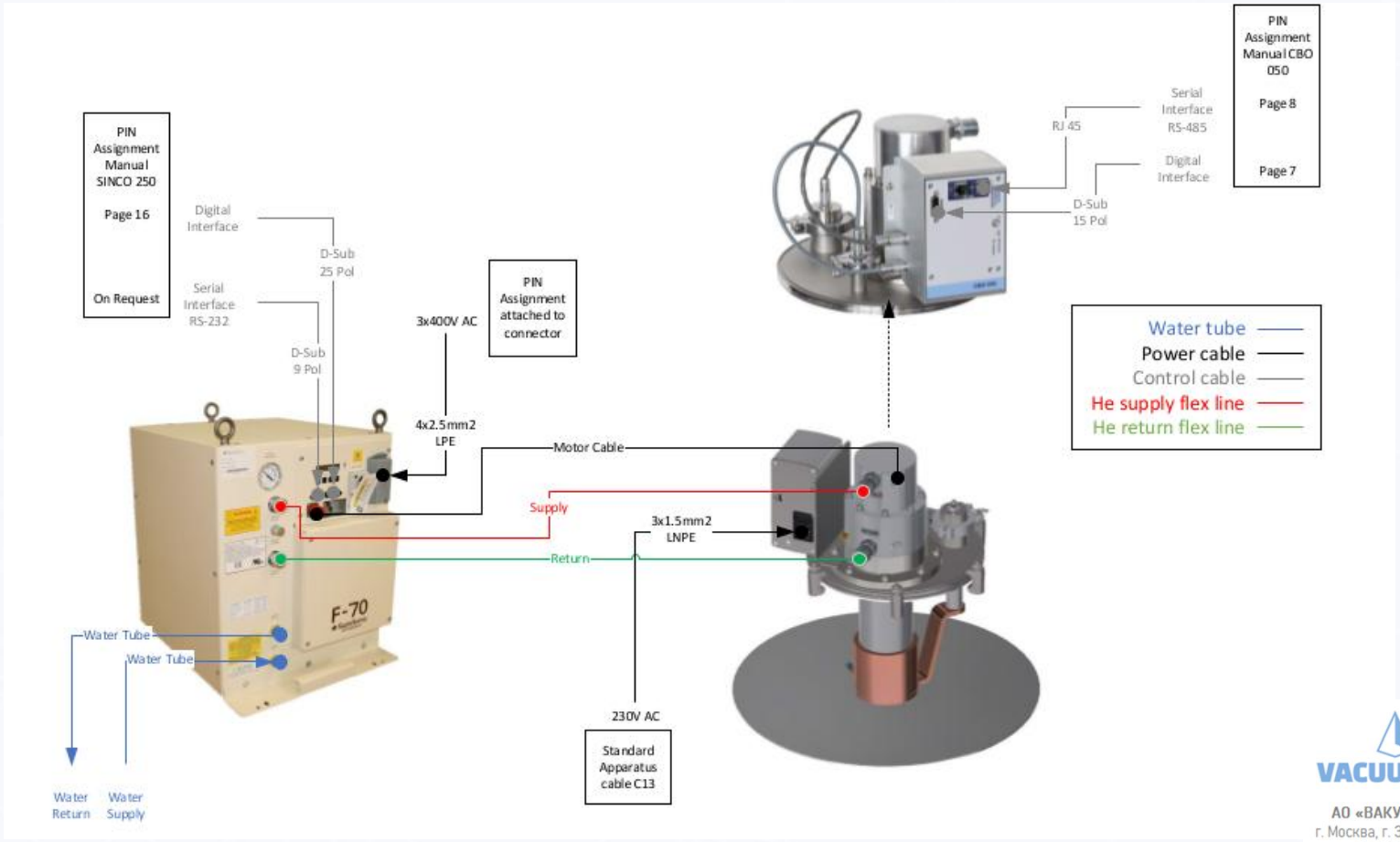
Available types:

- SINCO 100 P30
- SINCO 160 P70
- SINCO 250 P70

	Capacity	Pump Speed
SINCO 160 P70	570 bar l @ 600 sccm	32 000 l/s
SINCO 250 P70	740 bar l @ 200 sccm	32 000 l/sec
	300 bar l @ 1200 sccm	

Testing of Xe / Kr Thruster

HSR cryo controllers for SINCO pumps

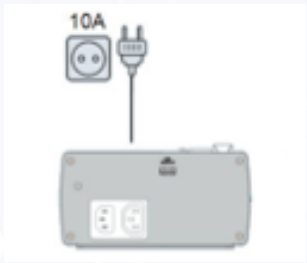


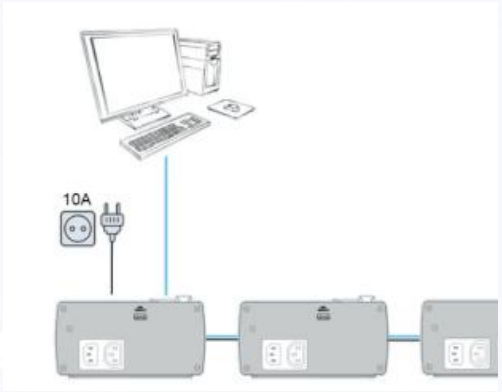
System overview **CBO 050 / SINCO**

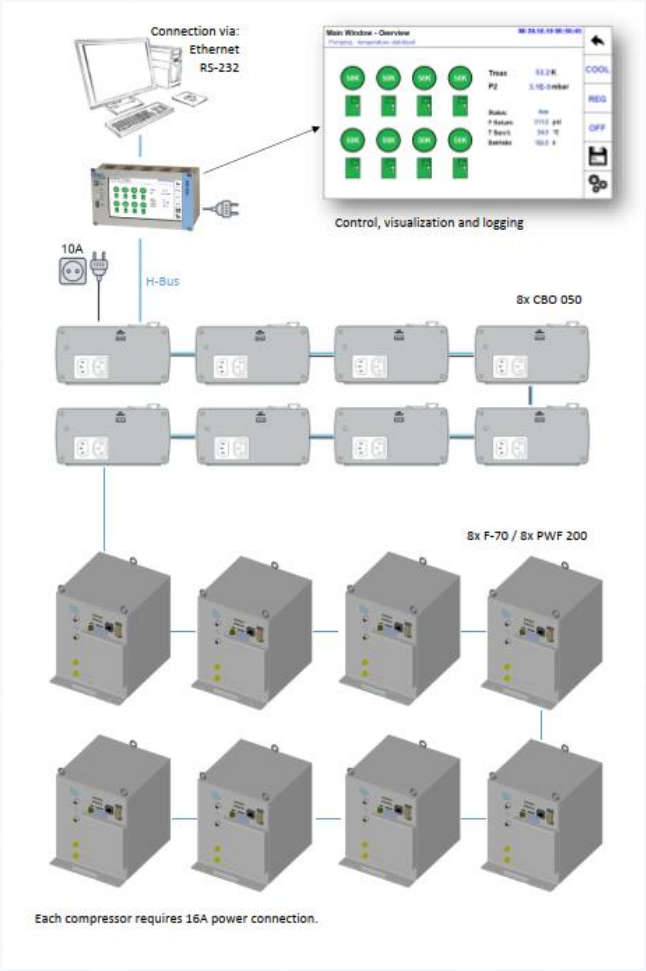
Testing of Xe / Kr Thruster

HSR cryo controllers for SINCO pumps

System integration
CBO 050





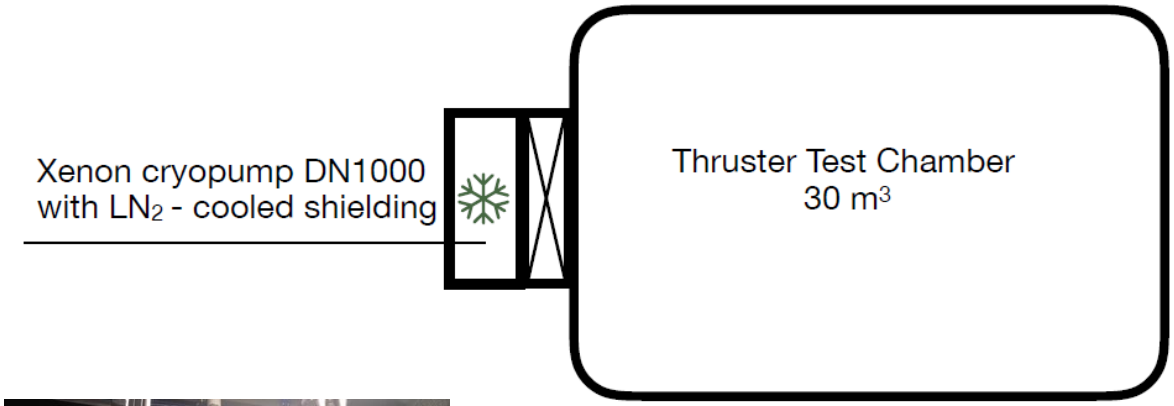


Testing of Xe / Kr Thruster

Testing of Xe / Kr Thruster

Comparison of available HSR pump systems

Example 3: Xenon cryo pumps with LN_2 cooled 1st stage



Pumping speed for different gases:

Water vapor:	110000 l/s
Xenon:	**27500** l/s
Nitrogen:	45000 l/s
Argon:	38000 l/s
Hydrogen:	42000 l/s

Testing of Xe / Kr Thruster

Comparison of pump systems:

Example 3: Xenon cryo pumps with LN_2 cooled 1st stage

Main advantages	Main disadvantages
Unlimited cooling power on shielding due to LN_2 - cooling, therefore independent of heat load of process gas and heat radiation.	LN_2 temperature is not sufficient for condensation of Xe nor Kr, therefore pumping speed is generated on second stage of cold head only.
The pump can also be used for background pumping, there fore no additional pumps for generating of the background pressure are necessary.	Low pumping speed for Xe and Kr gas
If a gate valve is installed between pump and chamber is installed, batch changes are possible without warming up of the pump.	Due to its high consumption of LN2, operation costs of this type of pumps are very high

Testing of Xe / Kr thrusters

Remark:

- Xenon and Krypton gases have special properties compared to the usual gas types to be pumped. Those must be taken into account when pumping by condensation and also when designing pumping systems

- The required condensation temperatures are depending on the desired operating pressures

- Available capacity of Xe / Kr VELCO and SINCO pumps are strongly depending on working pressures and condensing temperatures, e.g. resulting growing rate of the gases

Testing of Xe / Kr Thruster

HSR cryo controllers for VELCO LN2 pumps

Pump controller
HCC 200

Generally said:

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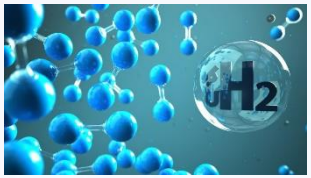
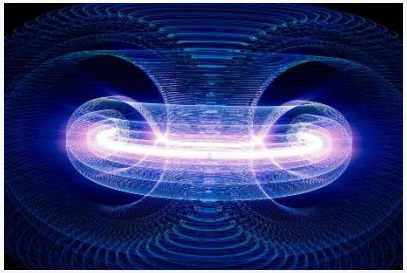
- Multiple HCC 200 controllers can be controlled by system control via Ethernet

Hydrogen application



- Rocket engine testing
- Fusion technology
- Customized applications



Hydrogen applications

Requirements for pumping H2 gas

- H2 gas is not condensed on surfaces as other gases, it is adsorbed by using active charcoal. This requires an appropriate aerea and volume of activated charcoal, optimized designs of corresponding panels and an available high cooling power at low temperatures

- Another important topic is, depending on gas loads and application, an optimized concept regarding safety during all stages of operation and regeneration

Hydrogen applications

Requirements for pumping H2 gas

- Sufficient surface of active charcoal
- Optimized design of H2 panels
- High cooling power at low temperatures to secure high capacities and long operation times
- Avoiding of ignition sources as critical gas mixtures or use of standard measurement gauges during operation and regeneration
- An appropriate safety concept covering operation, regeneration and unexpected loss of main power

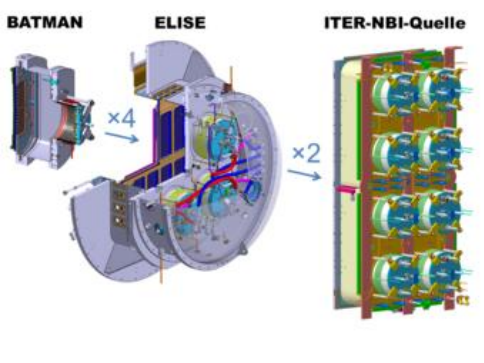
VELCO 1000 H2

Example 1:

=>optimized for H2 regarding

- highest pump speed
- maximal flow
- maximized capacity

- **Fusion project** (part of ITER)
- Provides long operation times according to customer specification



VELCO 900 H2

Example 2:

=>optimized for H2 application

- **VELCO 900 H2:**
  - optimized for maximal pump speed

- **VELCO 900 H2 CL:**
  - optimized for high pump speed and high gas flow

- **VELCO 900 H2 DL:**
  - optimized for maximized pump speed and highest gas flow

VELCO H2 customized

Example 3:

=>optimized for gas mix of H2/D2/He regarding

- highest intrensic pump speed
- maximal flow

- **Fusion project**
- Customized pump version, optimized on specific application

SINCO 250 (H2)

Example 4:

=> No H2 pumping!

- Manufacturing of high precision optics for lithography within an H2 athmosphere
- Pumping all gases except hydrogen

Testing of Xe / Kr Thruster

HSR cryo controllers for VELCO H2 pumps

Pump controller
HCC 200 for H2 application

Generally said:

- Each VELCO H2 cryo pump requires one controller
- HCC 200 controller for H2 application provides optimized regeneration cycles for H2 application

Extract of space customers

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