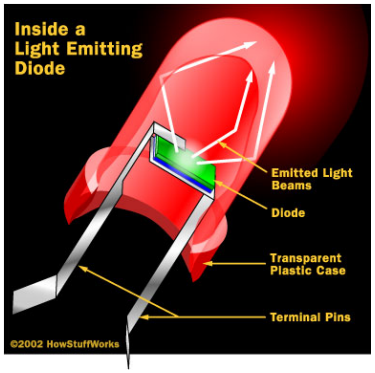
Valve Technology
Basic Introduction

Jürg Öhri
Sales Manager

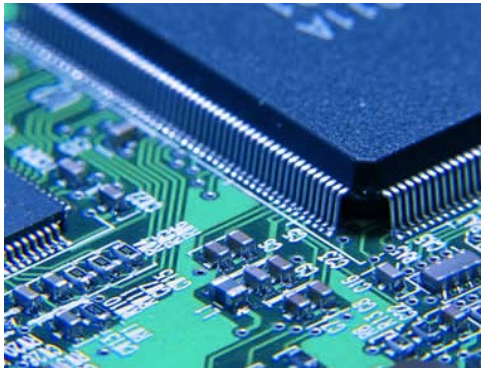
End products needing vacuum valves

Flat Panel screens

LED business



Semiconductor components



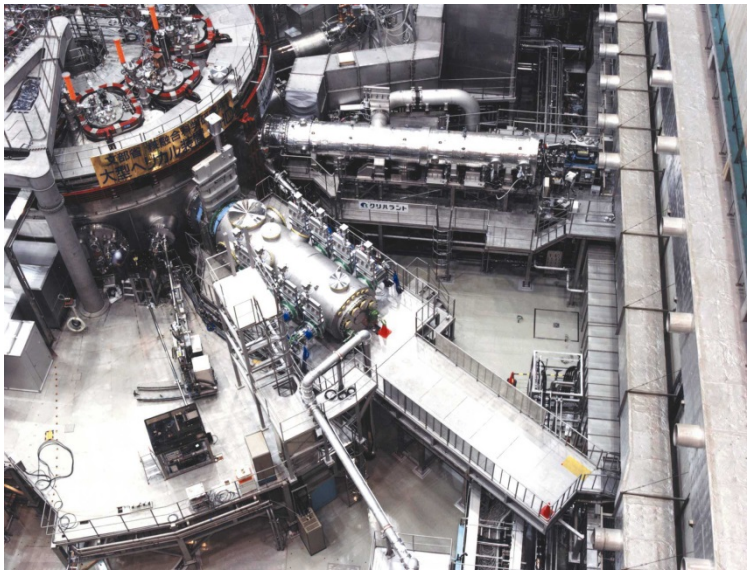
Solar Cells

Smart phones

Surface coatings

… AND MANY OTHER PRODUCTS!!

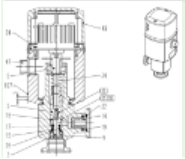
… plus many applications in R&D



Synchrotrons,
Accelerators,
Tokamaks,
Laboratories, …

Valve Categories

Type	Picture
Angle valves	
Gate valves	
Diaphragm valves	
Butterfly valves	
Pressure control valves	

Type	Picture
Leak valves	
Fast closing valves	
Beam stoppers	
Gas dosing valves	
Customized valves	

Types of gate valves

Gate valve ≠ Gate valve → there is a big variety of valves depending on vacuum level, feedthrough, actuator, material, type of flange, application, …

Series	Description	Picture
01	Mini gate valve	
08	Insertable gate valve	
09	HV gate valve “wedge valve”	
108	UHV gate valve	
110	HV gate valve	
48	All-metal gate valve	

Series	Description	Picture
121	Vacuum gate valve	
140	HV gate valve	
15	Low particle gate valve	
17	Gate valve with protective ring	
19	Large gate valves	
47	RF all-metal gate valve	

Valves in a classical vacuum system

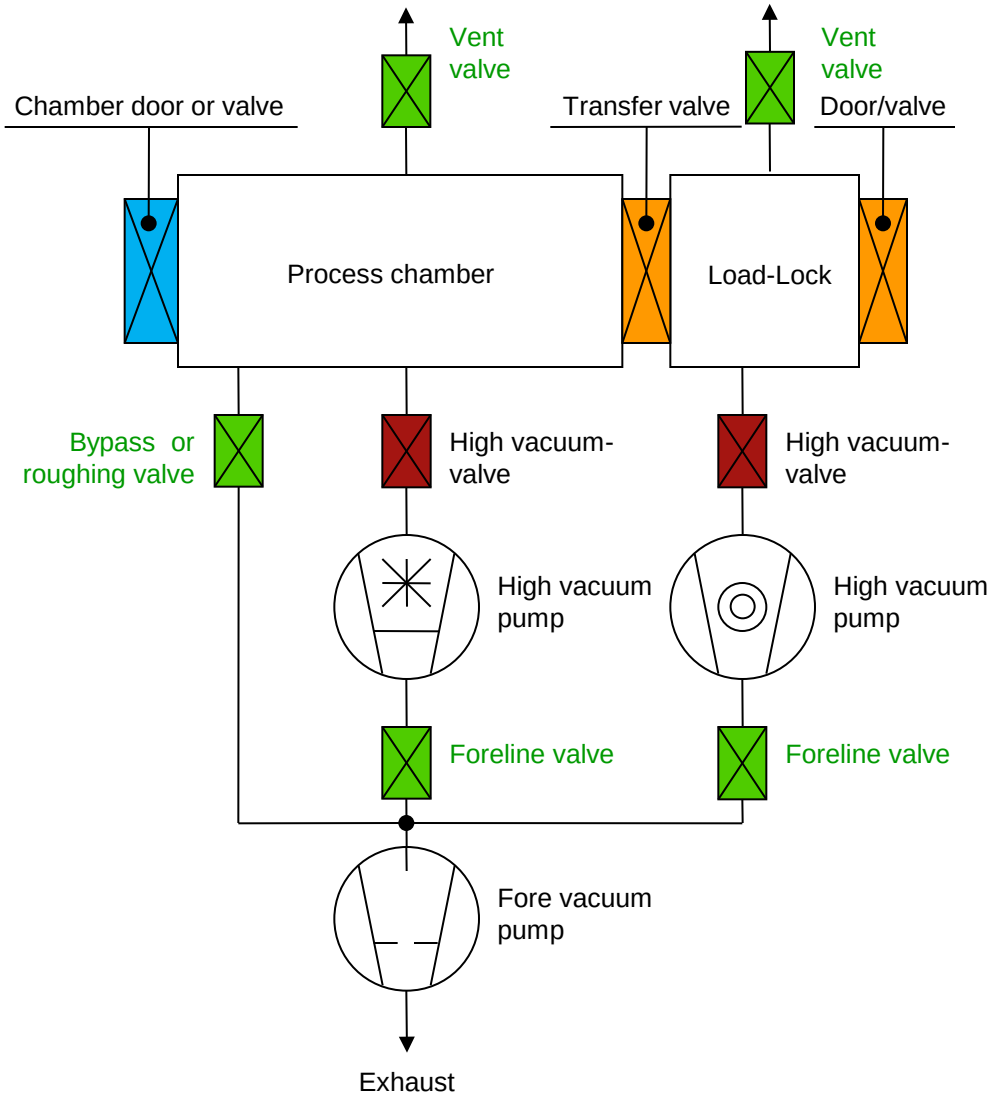
Explanation

Typical application for angle valves.
Located between fore vacuum pump and high vacuum process chamber or high vacuum pump or used as vent valve.

Typical application for gate- or pendulum valves.
Located between high vacuum pump and process chamber. In case of down stream application also control valves are used.

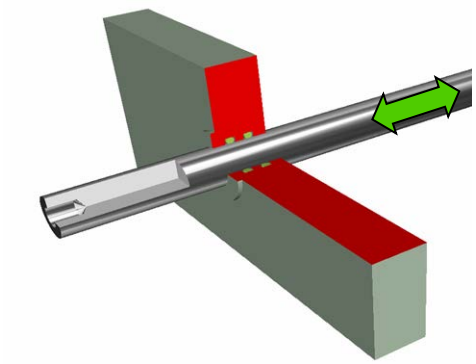
Typical application for transfer- or door valves

Typical application for door valves (usually customer tailored).



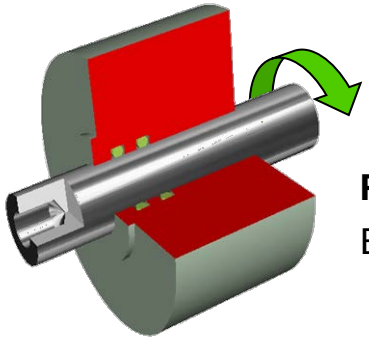
Different feed-throughs

Vacuum -10^{-7}mbar

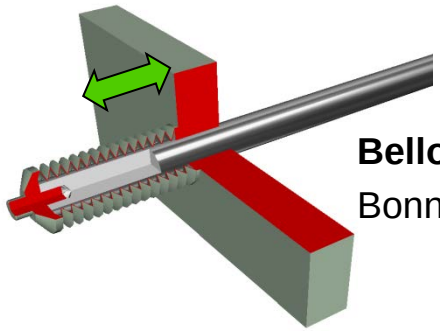


Shaft feed-through
Bonnet seal: **Viton**

High Vacuum -10^{-8}mbar

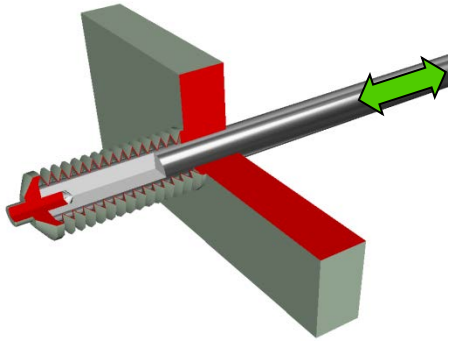


Rotary feed-through
Bonnet seal: **Viton**



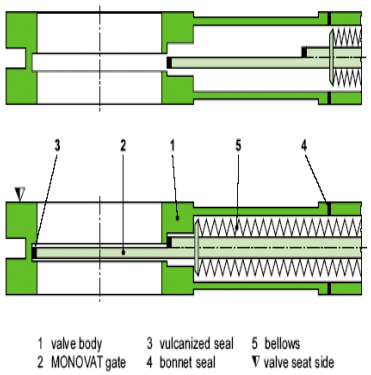
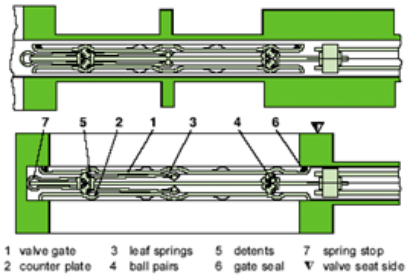
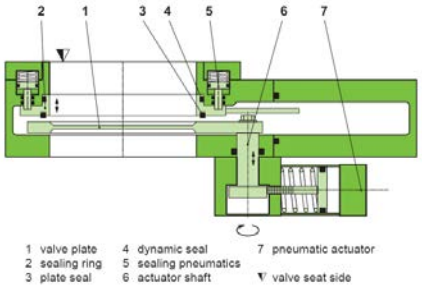
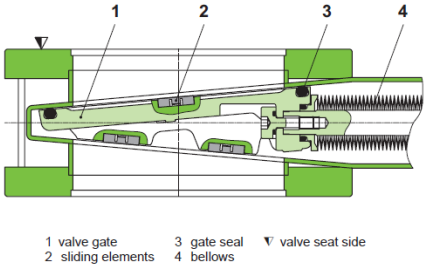
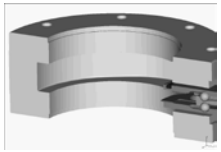
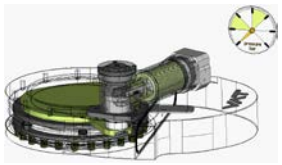
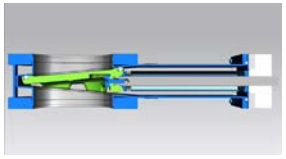
Bellows feed-through
Bonnet seal : **Viton**

UHV -10^{-10}mbar



Bellows feed-through
Bonnet seal: **Viton or Metal**

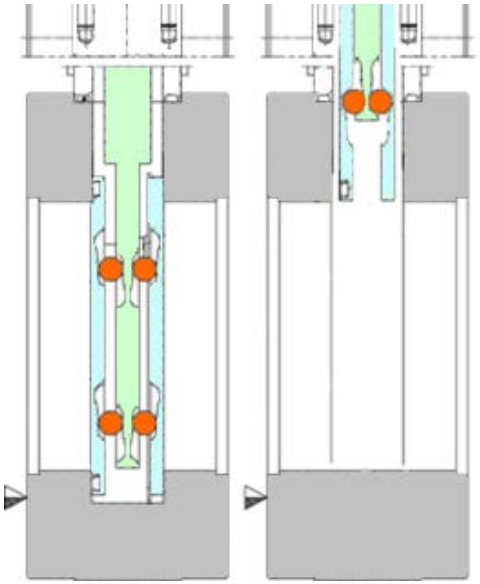
Gate Valve Comparison

Series **010/15**	**Series** **012/08/12/19/14/168/11**	**Series** **162**	**Series** **09**
MONOVAT	**VATLOCK**	**SEALING RING**	**WEDGE**
			
			
Easy maintenance, Low shock, **Best** particle performance	Gate mechanically locked without air-pressure	Easy maintenance, Low shock, good particle performance	Easy maintenance. Opening against differential pressure

Please click on 3D pictures to see the animation

VATLOCK Characteristics

Series
012/08/12/19/
14/168/11



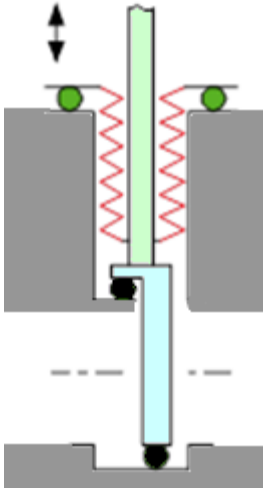
- Gate valve mechanism developed by VAT
- Gate is mechanically locked in valve closed position (remark: valve open position is not locked)
- Low shock during operation
- Differential pressure proof in both directions
- Long service lifetime

Closing sequence:

- Leaf springs hold the gate and counter plate against the carriage
- The mechanism is moved forward into closing position
- The locking starts after the leaf spring stop touches the body. The ball retainers move the ball pairs out of the detents. Gate and counter plate are spread apart.
- The gate seal is pressed against the sealing surface without scuffing.

MONOVAT Characteristics

Series
010/15



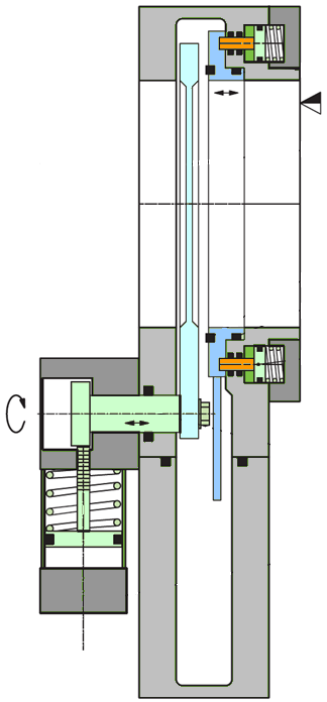
- Sealing technology developed by VAT
- Vulcanized Viton gate (or other sealing material)
- Low shock during operation
- Differential pressure proof in both directions
- Excellent particle performance
- Mechanism free of lubricants (bellows sealed versions)
- Compact design
- Minimum number of parts in vacuum
- Fast opening and closing time
- Easy maintenance procedure

Closing sequence

- The gate is moved forward into closing position
- The vulcanized seal is pressed against the seat

SEALING RING Characteristics

Series
162



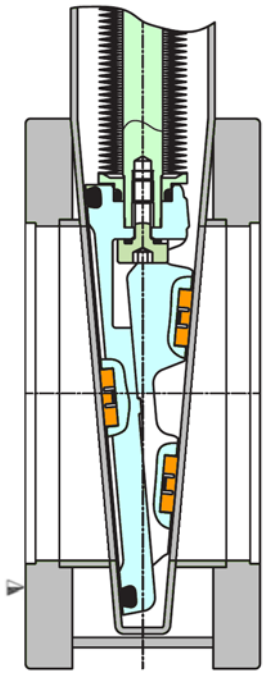
- Single plate sealing technology
- Low shock during operation
- Minimum number of parts in vacuum
- Differential pressure proof in both directions
- Easy maintenance
- NC operation

Opening sequence:

- By applying compressed air the sealing ring is pushed back to release the valve plate
- The actuator shaft releases the plate valve from the valve body
- The valve plate is rotated into the valve housing

WEDGE Characteristics

Series
09



- Special sealing technology developed by VAT
- Full 1 bar differential pressure opening possible
- Mechanism free of lubricants (bellows sealed versions)
- Compact design
- Minimum number of parts in vacuum
- Fast opening and closing time
- Easy maintenance procedure, no special tools needed
- No readjustments after cleaning
- Low cost of ownership

Closing sequence

- The gate is moved forward into closing position
- The gate o-ring is pressed against the valve body

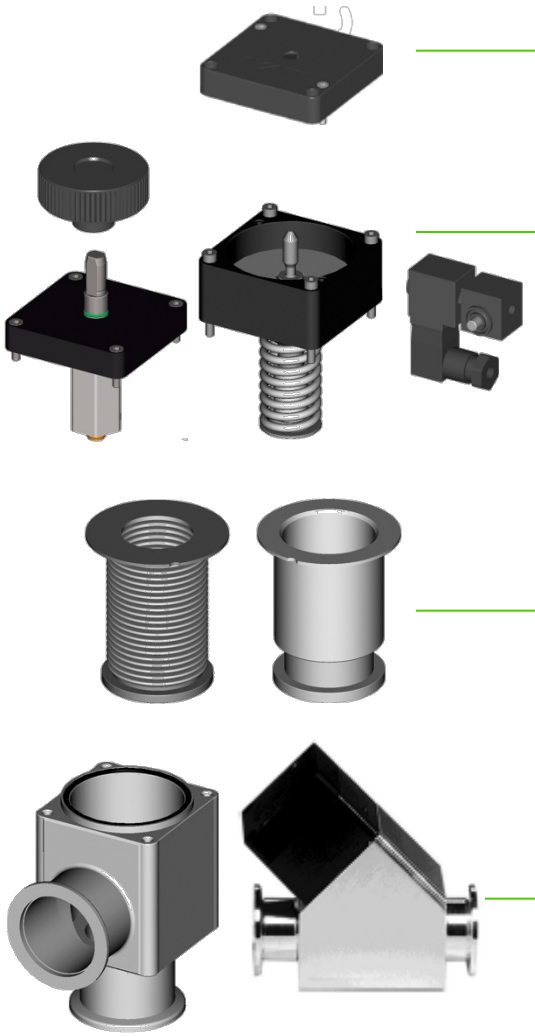
Angle Valve Characteristics

Position Indicator

Actuator
Manual -
Pneumatic -
Electro-pneumatic -

Feed through
Bellows sealed -
Shaft sealed -

Body
Stainless steal -
Aluminum -
type: inline or angle -
flanges: ISO-KF or CF -

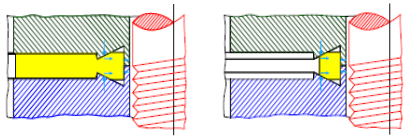
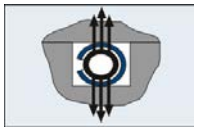
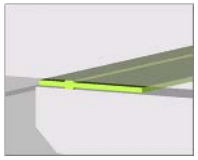
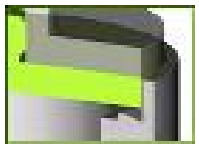
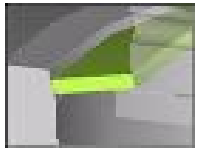


The modular system with low part count ensures reliable operation

All Metal Sealing Technology

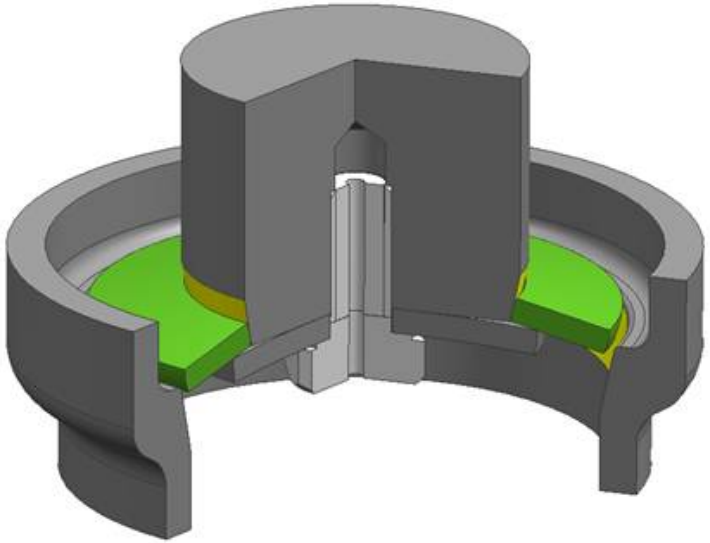
Is there any standard?

There are solutions for a wide range of UHV and XHV applications.

	For static seals: main standard it's the Conflat Flange (CF) system (proven and reliable sealing method up to DN 250).
	Partly, where chain clamps are used (radiation environment) we find Helicoflex seals as a static seal.
	In synchrotrons we see more and more the VATSEAL as static seal for specific RF apertures.
 	For dynamic seals we find the combination of copper pad and knife edge ("soft-on-hard") or the VATRING system ("hard-on-hard") in the field.

Comparison of two different all metal sealing technologies

- **„Soft-on-hard“ sealing method**
  - At least one sealing partner is plastically deformed to a considerable degree
    Classical example: ss knife edge into copper pad



- **„Hard-on-hard“ sealing method**
  - All sealing partners are mainly deformed in the elastic area.
    Example: silver coated ss ring into ss seat

VATRING

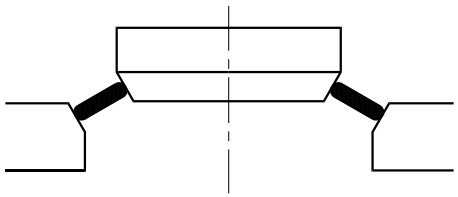
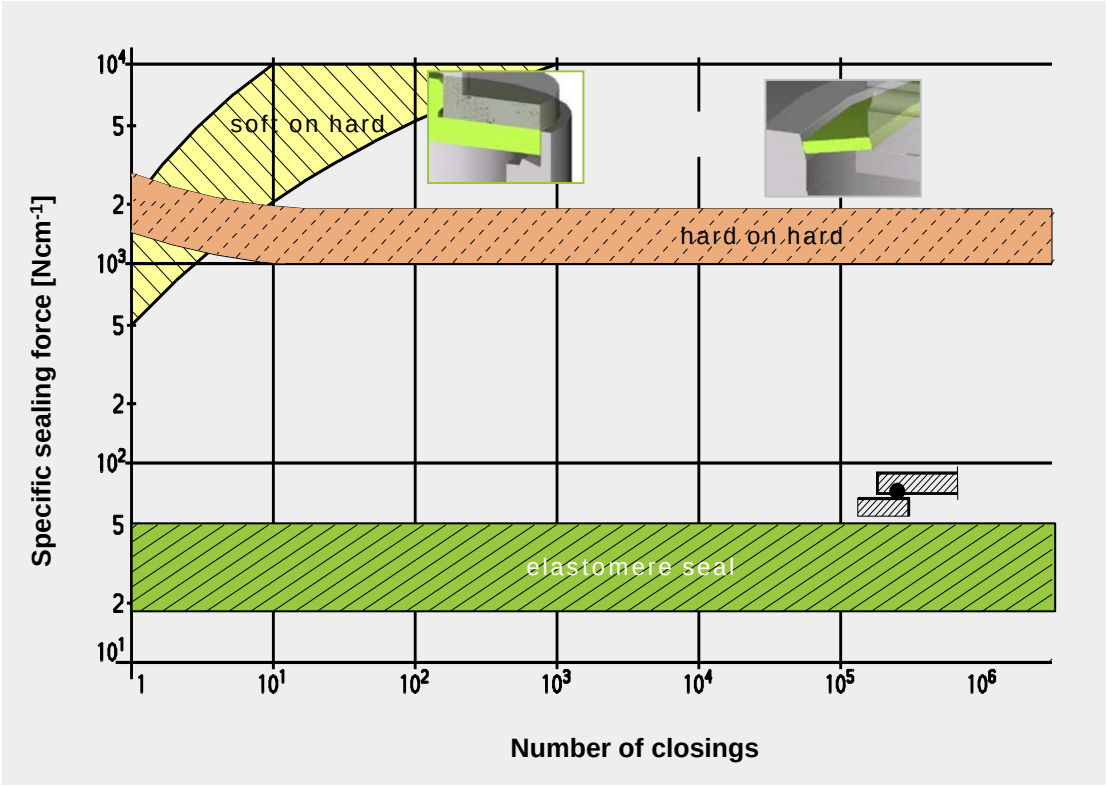


Diagram showing sealing force requirements



For dynamic vacuum seals VAT uses the “hard-on-hard“ sealing method because of numerous advantages against the “soft-on-hard“ sealing method.

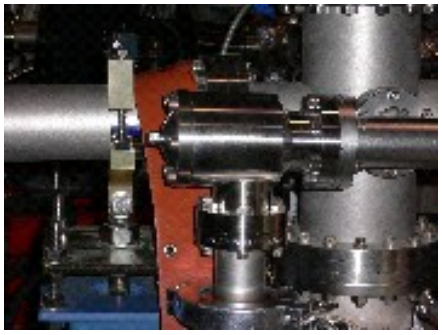
All metal valves - Applications

LINACs

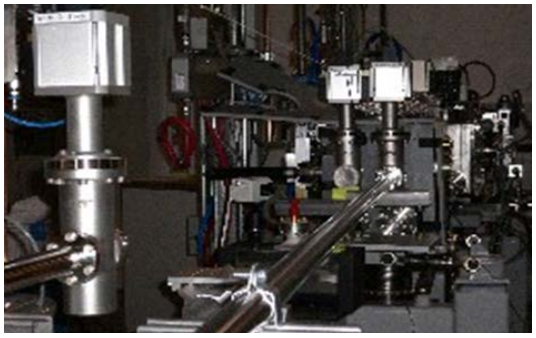
Storage rings

Front ends

Pumping stations



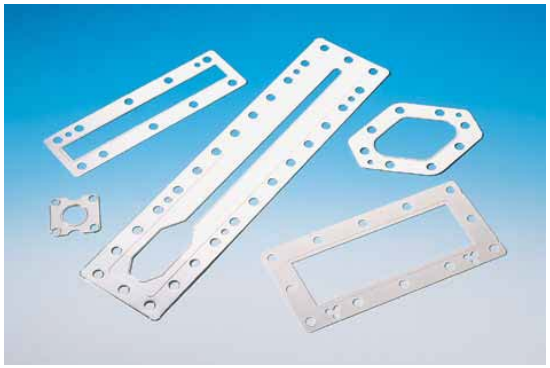
Beam lines



Applications requiring …

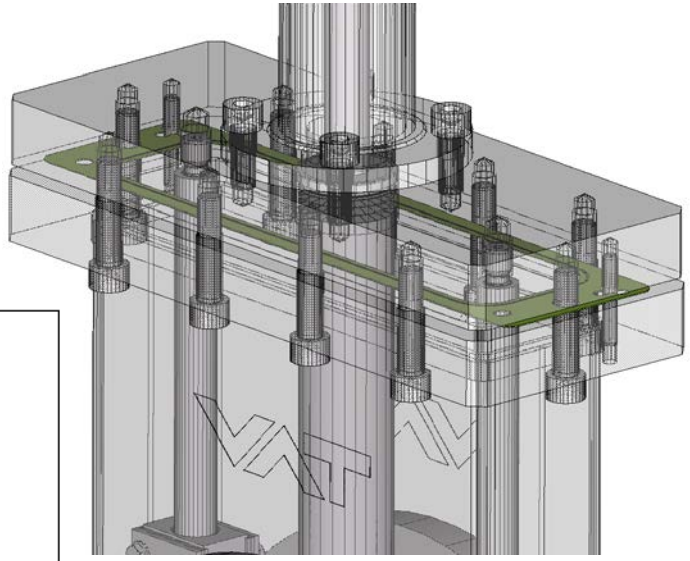
- low outgassing
- high temperatures
- XHV conditions
- radiation resistance

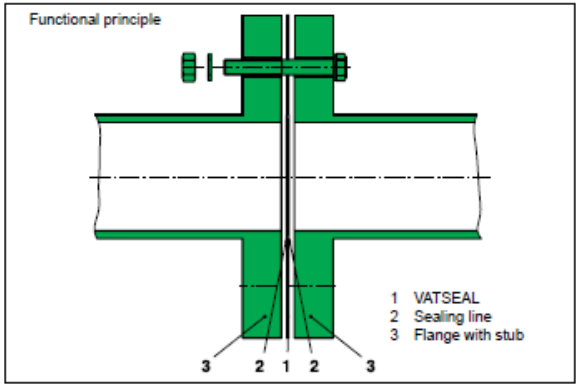
VATSEAL's



Requirements for an all-metal seal besides leaktightness:

- at least one-time or multiple use
- bakeable (often to high temperatures)
- low permeation
- low outgassing
- no hydrocarbons
- radiation resistance





Series 35 VATSEAL as static metal vacuum seals
Leak rate < $1x10^{-10}$ $mbarls^{-1}$
shaped according to customer's needs

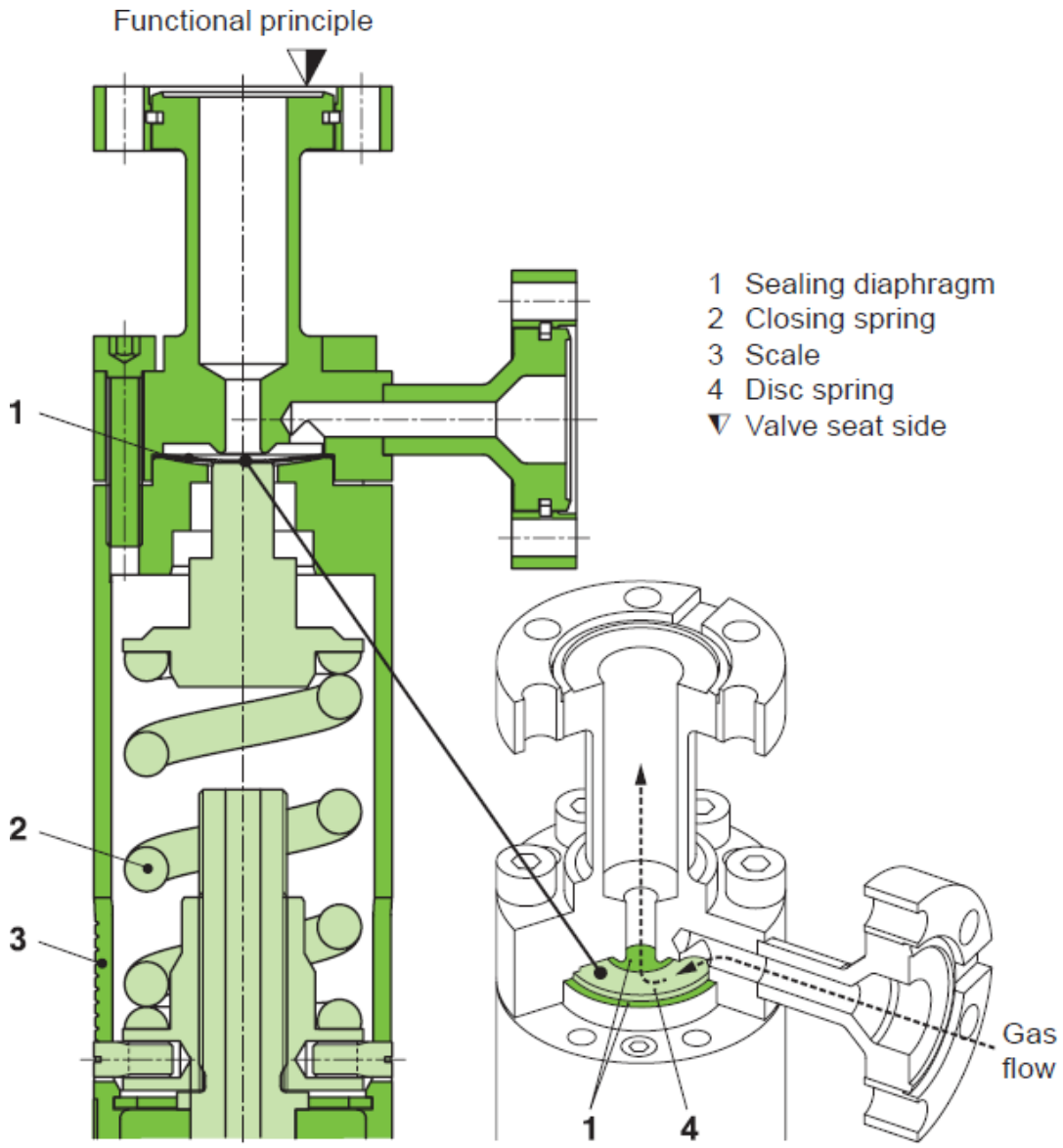
Products - All metal variable leak valve

Series 59

DN16

All Metal Variable Leak Valve

- **High reproducibility of small gas flow for constant system pressure**
- **Reliable and repeatable leaktight closing**
- **Easy to handle and maintenance free**
- **Bakeable to 300°C in open and closed position**

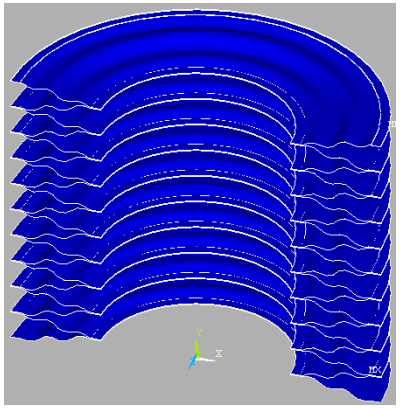


What is an edge welded bellows?

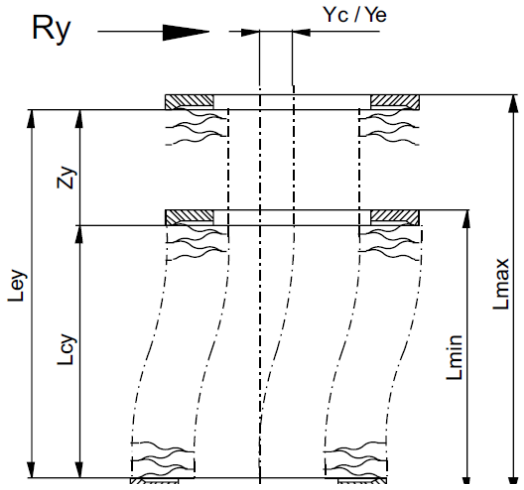
A Bellows

- is a **sealing** (gasket) for separation of media;
- is a **flexible** connection (axial, lateral or angular displacement); and
- consists of **membranes, welded** at their edges (alternating at ID and OD)

Convolutions =
pair of membranes



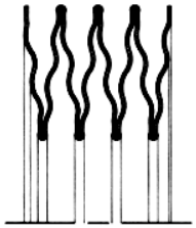
Bellows package (Capsule)
= a set of convolutions



Bellows unit (Assembly)
always has two endpieces

Comparison of different types of bellows

Edge welded



Strength

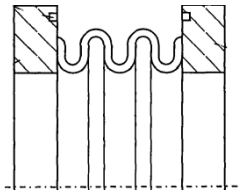
- Best elasticity
- Lowest possible installed length
- Low Spring rate
- Variety of materials (only little deformation necessary)

Weakness

- Cost-intensive production
- Sensitive to mounting stress and contamination w/ particles
- Limited pressure capabilities

VAT

Hydroformed flexible tubing



Strength

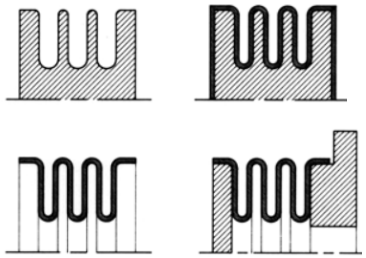
- Low cost
- High pressure capability
- Suitable for rough environment

Weakness

- Low elasticity
- Only high ductile materials
- Mounting length 2-3 times higher than EWB

not VAT

Electro deposited



Strength

- Micro-Dimensions
- Corrosion resistance

Weakness

- Low elasticity
- Costly (single-use Al-mandrel)
- Limited choice of materials

not VAT

Bellows – a few application examples

Flexible Compensator (non-dynamic)

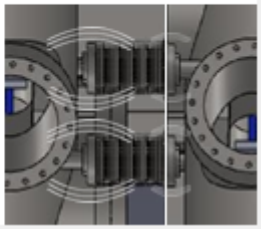
- Compensates installation misalignments
- Multiple degrees of freedom possible

Feedthrough

- Axial displacement only
- Variety of operating requirements
- Low or High Cycle Life

Vibration Decoupler

- To reduce transduction between two appliances
- Large installation length needed, because damping effect is low
- Critical, if vibration frequency is close to natural frequency of the required bellows



X-Y-Z Translator

- Axial and/or Lateral displacement
- Actuated manually, pneumatically, or by servo motor
- Low or High Cycle Life

Sputter Gun Adjustment

MBE/IBE Source Isolator

MBE:
Molecular Beam Epitaxy

IBE:
Ion Beam Etching

Thank you !

This presentation has been prepared

for the CERN CAS 2017 by

VAT Vakuumventile AG of Switzerland

being the global leader in vacuum valve technology

and offering the widest variety of vacuum valves worldwide.

Please contact us in case of any questions:

www.vatvalve.com