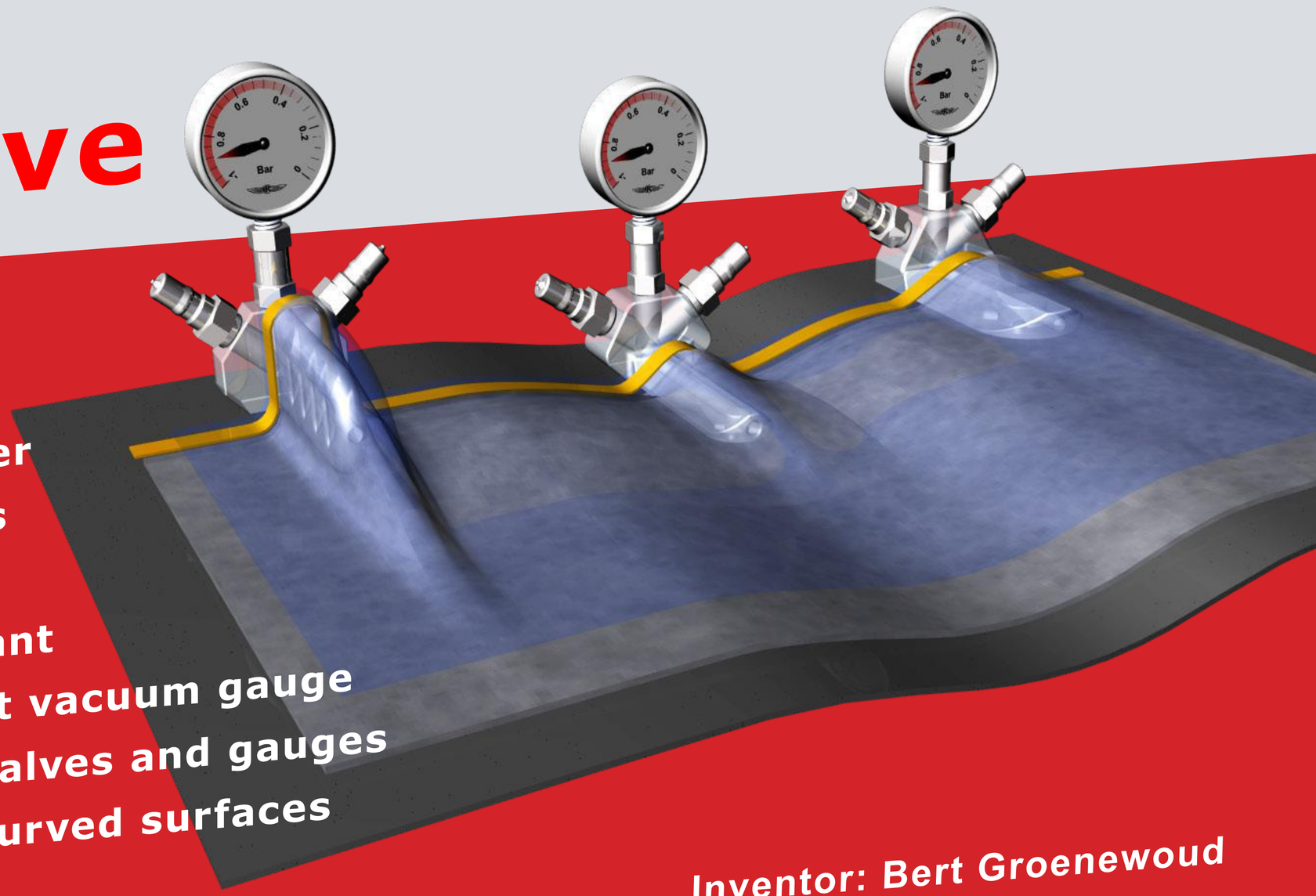
EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

Vacuum connection without failure

SmartValve



- no vacuumbag cutting
- no vacuumbag rupture
- no connectors falling over
- no loss of separate parts
- single part - no leaking
- high temperature resistant
- stable enough to support vacuum gauge
- linkable to other SmartValves and gauges
- applicable on flat and curved surfaces

Inventor: Bert Groenewoud

Rationale

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SmartValve

This presentation shows how these patented valves improve the vacuum bagging process, while saving time and cost. First I will describe the currently used, conventional process. Then I will explain the use of my invention of the SmartValve and its advantages over standard valves.

I am in search of a licensing partner willing to produce and sell this product and I would like to ask if this invention is of interest to your company.

Index

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

SmartValve

Contained in this document:

Problems with conventional vacuum valves - 1

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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Mechanics have to fixate the vacuum hose in the correct position until full vacuum is reached. This may take up to 30 minutes when processing large parts for each vacuum valve.

The problem of standard valves is that they are tilted by the weight of the connectors and heavy vacuum hoses during de-bulks, sudden vacuum loss or venting situations in an autoclave.

When tilting occurs, the standard valves can not resume the upright position by themselves. The result is a loss of vacuum and scrapping of expensive products.

During de-bulks when fabricating parts, a mechanic has to hold the connector and hose until full vacuum is reached under the bag which is time consuming and prevents staff from performing other tasks.

Problems with conventional vacuum valves - 2

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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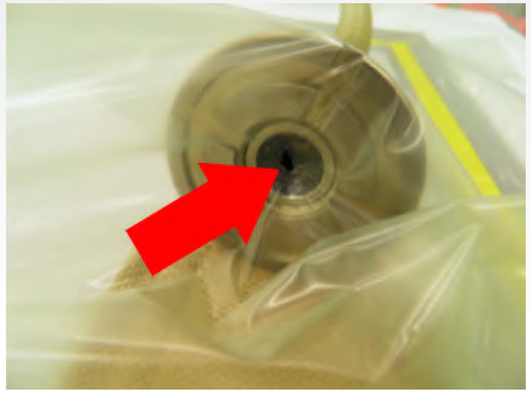

The following problems will occur:

- The vacuum bag will be sucked into the vacuum valve vent hole resulting in the bag to collapse (in and outside the autoclave)
- Expensive parts will not be cured as a result and will have to be scrapped which is a waste of a lot of time and money!

The image at the top left shows vacuum bag being sucked in the standard valve, the image at the bottom shows the hole indicated by the red arrow.

Conclusion:

- Standard vacuum valves can cause problems if not handled well
- No standard valve is fail-proof, while they are too often likely to leak

Invention

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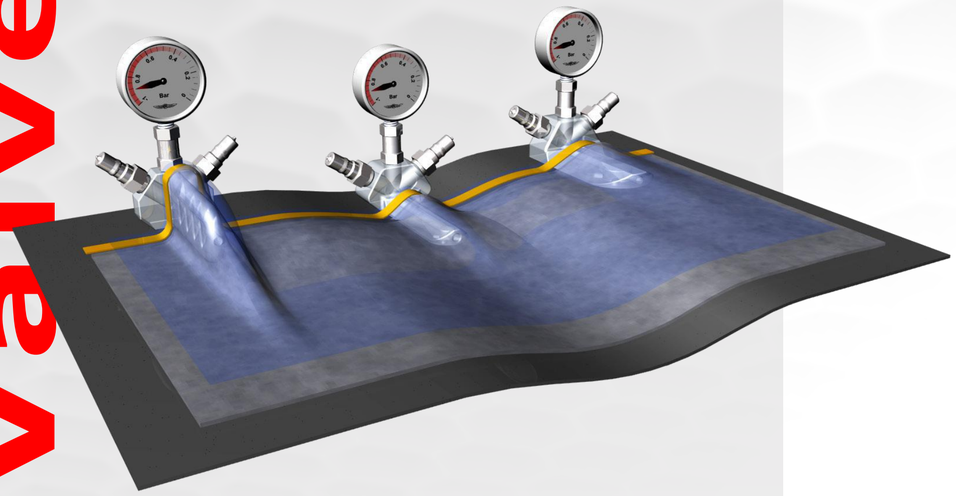
TRAINING AND CONSULTANCY

SmartValve



Wide, Narrow and Pleat SmartValves

Advantages of the SmartValve:

- No need to make incisions in vacuum bags
- Reduce the risk of tearing of vacuum bags
- Valves are stable - eliminate the risk of leaks
- No need for mechanics to hold vacuum hoses during vacuum build-up to prevent valves from falling over
- Reduction of material and operational cost
- Linkable system to create vacuum in large vacuum bags
- Provision to connect vacuum gauges
- Single part - no leaks, no accidental discarding of parts
- Lightweight
- Robust
- Stainless steel - endures temperatures upto 300°C
- Easy to clean
- Fits standard couplings and gauges
- Applicable on straight and curved surfaces

Intro to the SmartValve

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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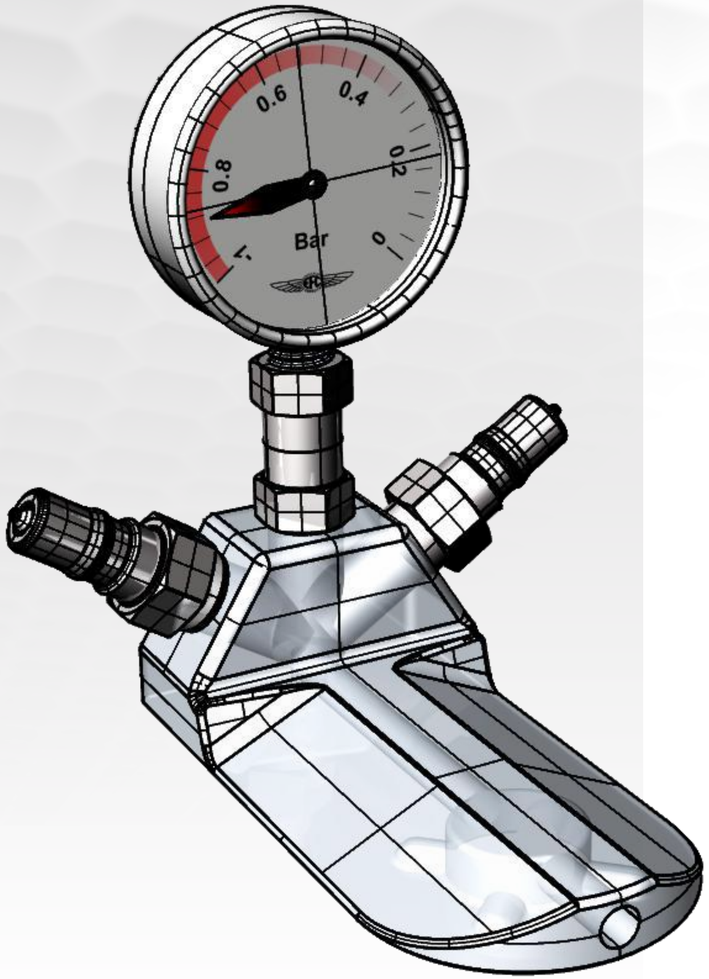


The SmartValve is invented by Bert Groenewoud. It solves the standard valve's tilting problems in the autoclave, oven and vacuum tables. Production files such as design drawings, STP / IGES files for 3D milling are created, making the SmartValve ready for production.

The new SmartValve solves all mentioned problems of standard valves and has the following additional advantages:

- **No need to cut the vacuum bag with a knife or scissors, which is necessary when using standard vacuum valves**
- **No occurrence of wrinkles and leaks as is the case when using standard valves**
- **Stable because SmartValve is taped to the surface**

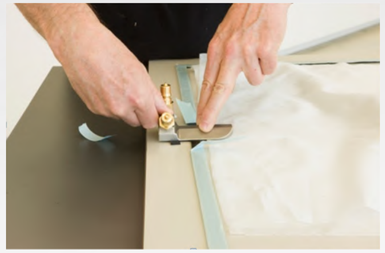
How does the SmartValve work? - 1

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

SmartValve

1

2



3

4

Every standard vacuum bag sealant tape can be used, in this case Airtech's AT200 Yellow vacuum bag sealant tape is used.

- Tape around the part (image 1)
- Apply a short 6 cm (2 $^{23}/_{64}$ inch) piece of sealant tape $^{1}/_{2}$ inch away from the earlier placed sealant tape (image 2)
- Place the SmartValve over the sealant tape (image 3)
- Cover the valve with an 8 cm (3 $^{5}/_{32}$ inch) long piece of tape (image 4)

How does the SmartValve work? - 2

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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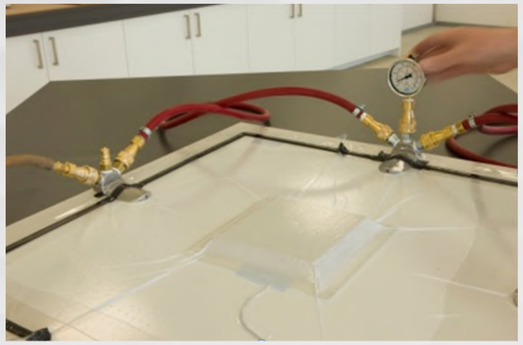


5

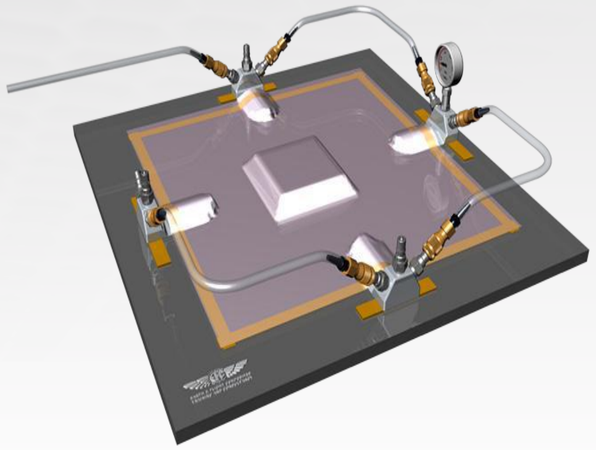
6

- Place a second valve in the same way as the previous one (image 5)
- The SmartValves can easily be connected to each other to create a faster and more evenly distributed vacuum in the bag
- Connecting a pressure gauge and 2 vacuum hoses do not cause the SmartValve to tilt (image 6)
- The firm fixture cause the valves to remain in place; they are unaffected by heavy vacuum gauge, connectors and hoses as shown in image 6

Sumary of SmartValve properties - 1

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

SmartValve



- The SmartValve is installed quickly compared to existing standard vacuum valves - a time saver, no risky vacuum bag cutting and use of many parts
- No need for mechanics / laminators to hold connectors and hoses during vacuum build-up - this saves considerable time and money!
- No danger of creeping and leaking of a vacuum bag between connector - faster an flawless vacuum build-up
- The SmartValve has 3 points that can be connected to vacuum hoses, stops or gauges - no T-coupling required
- The SmartValve does not fall over / tilt in the autoclave or oven - get things right the first time, every time!
- The SmartValve can be connected to other SmartValves to create a faster and safer vacuum system without using T-couplings - create perfect vacuum for large and complex parts
- The Narrow type SmartValve can be used on convex and concave curved surfaces - tailored for every type of vacuum job

Sumary of SmartValve properties - 2

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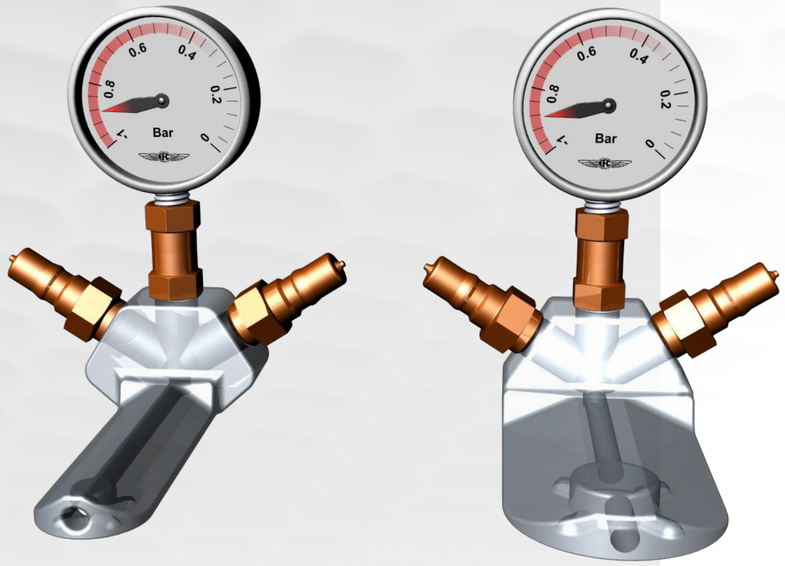
TRAINING AND CONSULTANCY

SmartValve



- Removal of a cured part from the vacuum bag is easy and fast without the need to separate the hose connector from the valve's base plate that is under vacuum bag - less time consuming procedure!
- The SmartValve consists of a single part so it can't accidentally thrown away after use (which often happens to the base of traditional vacuum valves) - buy once, use forever
- The SmartValve establishes better and faster vacuum transportation on a mold or vacuum table in combination with other Smart-Valves placed on the perimeters of the vacuum bag - risk of flawed vacuum is history
- The SmartValve can replace a standard AQD 500TF - continue to use the products you already have
- There is less scrap due to elimination of vacuum rapture and loss of expensive composite assemblies - no failures, less waste, lower costs!
- The SmartValve prevents incorrect mounting - fail-proof concept
- The SmartValve is made of stainless steel - rugged construction that withstands high autoclave temperatures

SmartValve fabrication advantages

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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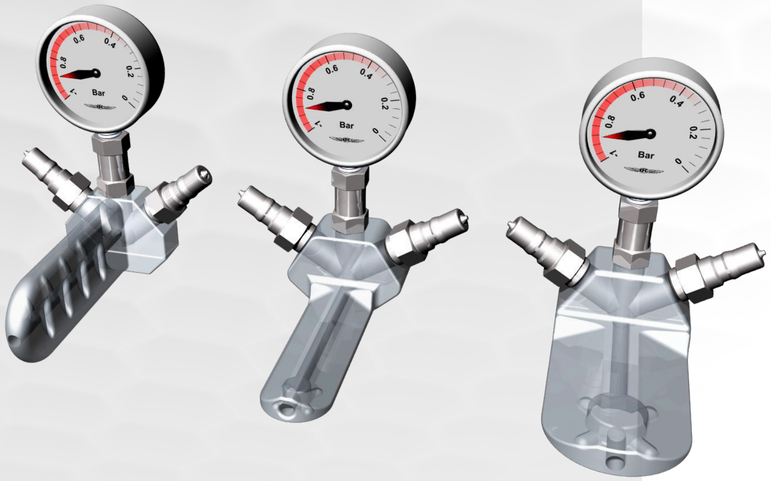

From left to right are shown:

- SmartValve for use in pleats
- Narrow type SmartValve for use on curved surfaces
- Standard SmartValve for use on flat surfaces

- The SmartValve can easily be cast in simple molds
- The Smart valve/ports are produced by the Lost wax casting (lost wax casting / investment casting
- Casting lost wax is very well suited for mass production. Multiple wax models can be linked for a wax tree
- Casting lost wax can be done in various degrees of quality, investment casting (highest quality) and precision casting. The casting tolerances (based on the casting norm NEN EN ISO 8062-3) vary between the DCTG 6 (investment casting and DCTG 8 (precision casting)
- The SmartValve consists of a single part and needs no assembly
- Production cost is lower even in small numbers than standard vacuum valves

Linking several SmartValves

EARTH & FLIGHT COMPOSITES
TRAINING AND CONSULTANCY

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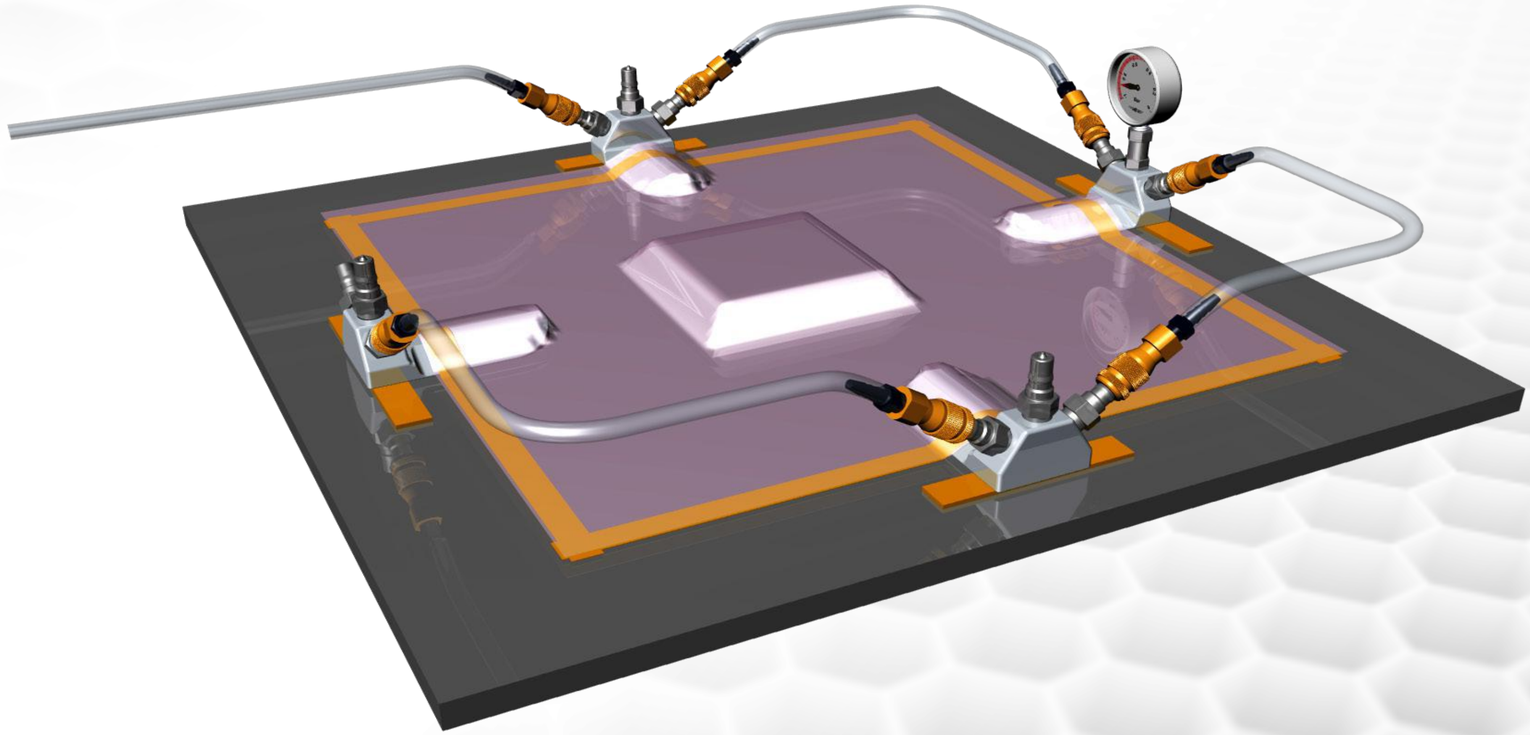
The SmartValve can be placed in the beginning, in the middle and at the end of a vacuum system.



Narrow SmartValves on a curved surface

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TRAINING AND CONSULTANCY

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The narrow type SmartValve, due to its small footprint, is suited to be used on curved surfaces.