The Danish Society of Dairy Technology CIP Seminar – Insight and Content

Basic aspects for good cleanability for hygienic valves

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Good cleanability for hygienic valves

Basic Aspects

Agenda

- Introduction
- General design guidelines and standards for hygienic valves
- Design details of mix-proof valve under the aspect of good cleanability
- Geometry of the product wetted parts
- Surface of the product contact parts
- Product contacted seals
- Seat lifting and shaft flushing
- Comparison of CIP losses
- Cavity spraying
- Detection of the seat lifting
- Selection of mix-proof valves
- Mixed sizes

Introduction

For high quality products, hygienic valves must be used

- Every dairy is equipped with hundreds, even thousands of valves.
- Valves are installed in various process lines, units and valve manifolds.
- Valves fulfil numerous functions in process plants: shut-off and opening of flow paths, change-over, control, protection against and insufficient pressure and preventing intermixing of incompatible media at intersection points in pipes.
- To ensure high quality of the food processing and hence the food product itself, it is important to use valves conforming to hygienic requirements.

From EHEDG doc. 14 revision 3:

“The design of the valve has a considerable influence on the product safety. Hygienic deficiencies resulting from poor valve design should be regarded as a production risk in the food industry, pharma and health care or all other industries, which should ensure that only valves strictly confirming to hygienic requirements are used.”

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Use of hygienic valves to ensure high quality products

Introduction

Hygienic valves versus aseptic valves

- Hygienic valves have a dynamic shaft seal and a reciprocating shaft. This shaft travels in and out of the product zone, (small) ingress of micro-organism can happen.

- Aseptic valves have a bacteria tight seal arrangement. This arrangement seals the product hermetically from the shaft by using a flexible membrane or bellow.

Cleanability

All surfaces in contact with products should be easily cleanable with special attention to the seats and seals.

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Design guidelines & standards are applied during the design of hygienic valves

Guidelines and standards for hygienic valves

General design directives

EN ISO 12100-2010

- Safety of machinery - general principles for design - risk assessment & risk reduction

DIN EN ISO 14159:2008-07

- Safety of machinery - hygiene requirements for the design of machinery

DIN EN 1672-2:2009-07

- Food processing machinery – basic concepts – part 2 hygiene requirements

EHEDG guidelines

- Doc. 14 - Hygienic design of valve for food processing
- Doc. 20 - Hygienic design and safe use of double-seat mix-proof valves

3A Standards

- 3-A Number 53-06 - Compression-Type Valves
- 3-A Number 85-03 - Double-Seat Mix-proof Valves
- 3-A Number 18-03 Classes I and III - Rubbers

Design Requirements for Hygienic Valves

Example - SPX FLOW D4 mix-proof valve range

Use of hygienic valves to ensure high quality products

D44SL CU43

DA44SL CU43

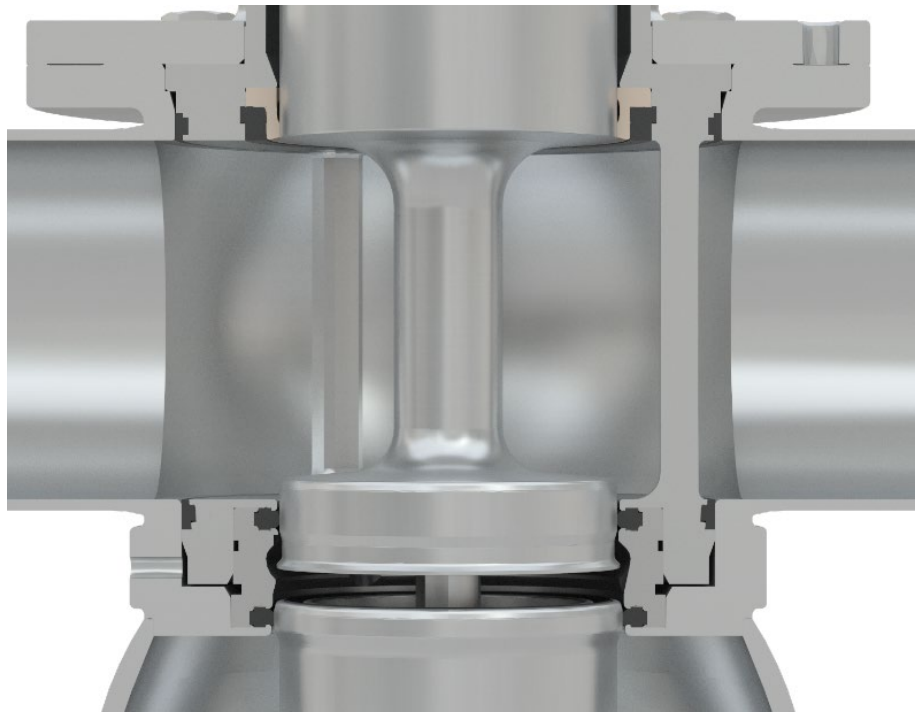
Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Geometry of the product wetted parts

Design details of hygienic valves to ensure high quality products

- No dome => avoid gas pockets
- No sump => full drainability
- Radii's for easy cleaning
- No crevices specially on mating parts of metal and product wetted seals
- All seals are profiled seals. A defined compression of the seal by metal to metal contact ensures a bacteria-tight seal.



Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Surface of the product contact parts

Internal surface roughness meeting or exceeding the industrial standard

- All product wetted parts have a surface roughness less than Ra = 0,8µm
- Valve housing inside e-polished as standard
- Sleek design of the actuator for easy washdown
- No external cables or proximity switches

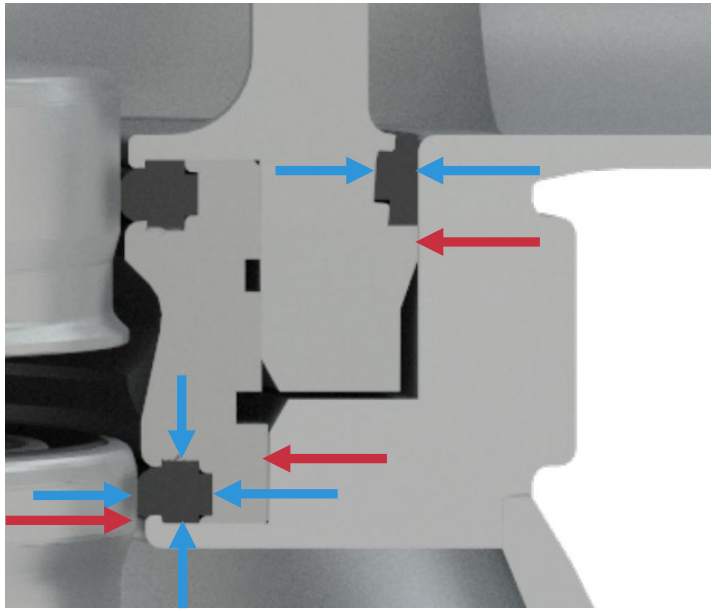
Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Seals are high functional components

Product contacted seals

- Seals ensure the function of the valves. Proper design enables a long life time of the seal, hence safe hygienic production.
- All seals and guide rings are EU FCM1935/2004 compliant, FDA conform, 3A approved, plastics acc. to FCM EU10/2011 and elastomers acc. to FCM / BfR recommendations.
- High quality elastomers EPDM, HNBR and FPM with low compression set, broad resistance against media to suit the different dairy applications.
- Only SPX FLOW profiled seals are used.
- Defined compression of the static & dynamic seals.
- Proper alignment of housing, valve seat, seat ring and shafts.
- Allowance for thermal expansion, elastomers have a 10 – 20x higher thermal expansion compared to stainless steel.
- Marking of the seal including part-number, size, material code, year of production, cavity.



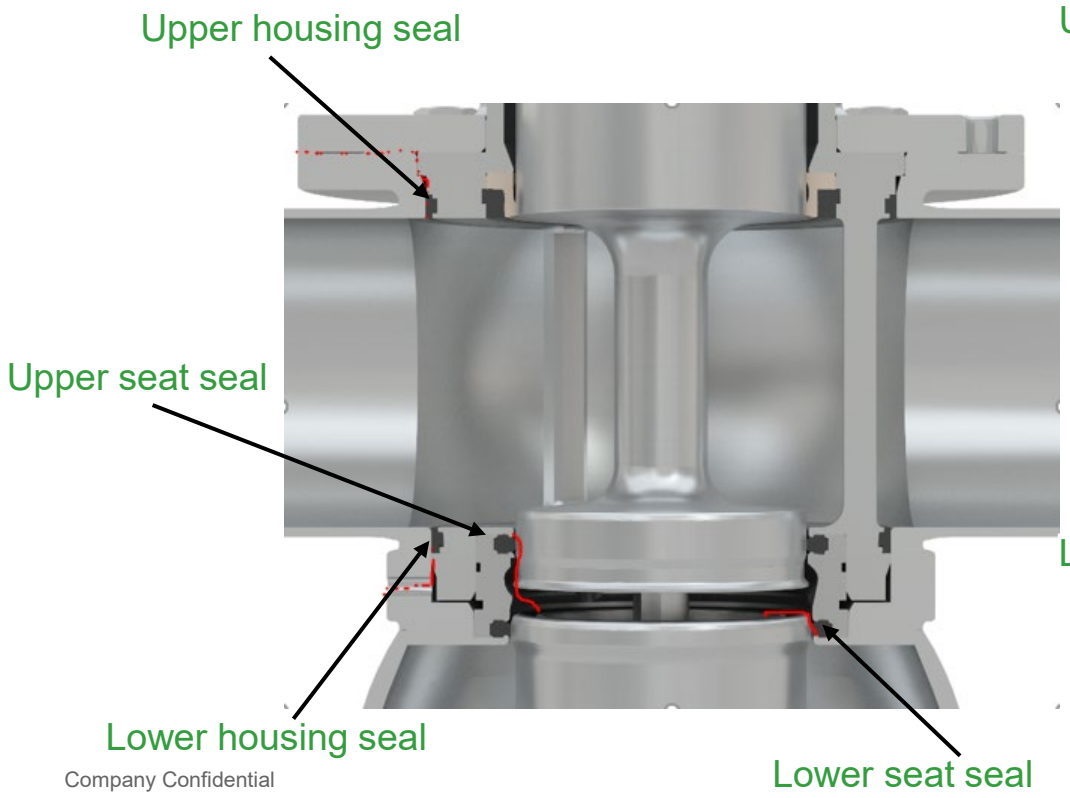
Design Requirements for Hygienic Valves

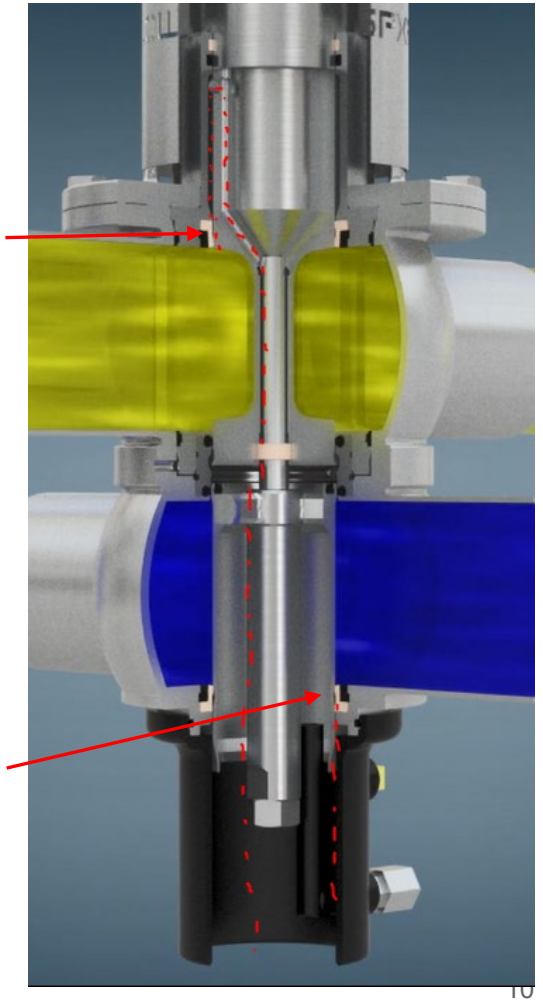
Example SPX FLOW D4 mix-proof valve range

Clear and quick identification of product leakage

Identification of leakages

- In the case of a leakage, the leakage must be quickly visible and drained to the environment.



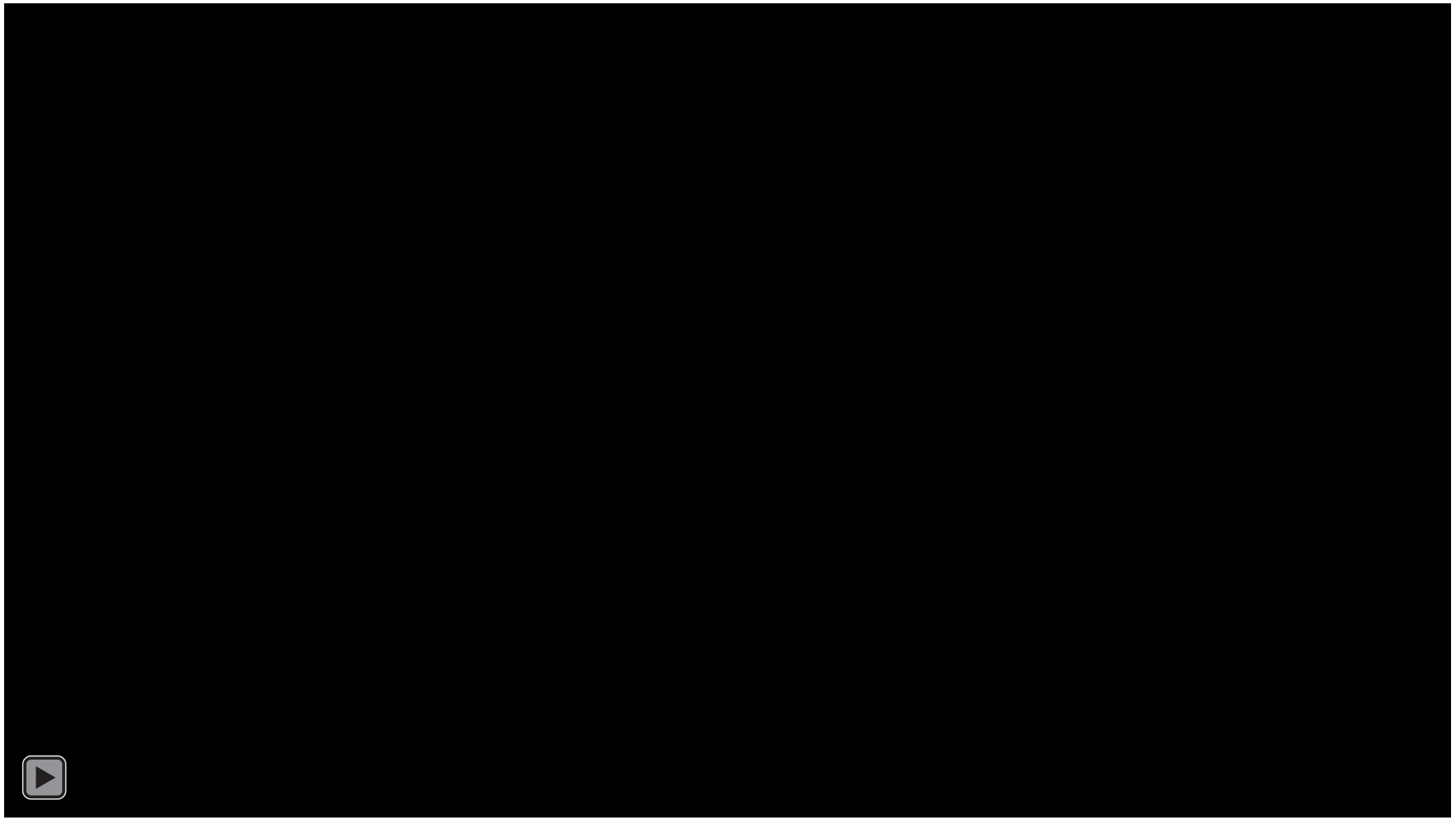


Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Comprehensive cleaning of the DA4 mix-proof valve

Seat lifting and shaft flushing of the DA4 Valve



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Design details of upper shaft lifting

Design Requirements for Hygienic Valves

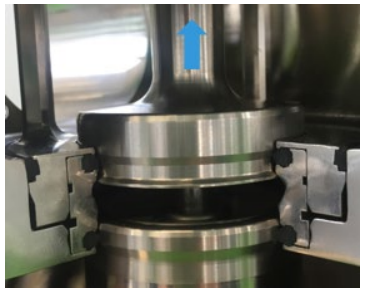
Example SPX FLOW D4 mix-proof valve range

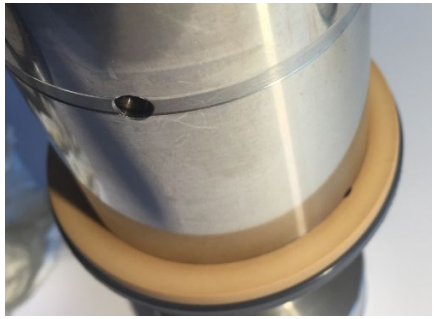
Upper seat lifting

- During the upper pipeline cleaning, the upper seat lifting is activated.
- CIP fluid flushes across the upper seat seal and the upper shaft seal.
- The seat lift stroke is controlled by a stop in the seat ring.
- Orifices in the seat ring and the shaft seal control the CIP losses.

Closed valve

Upper seat lifting activated





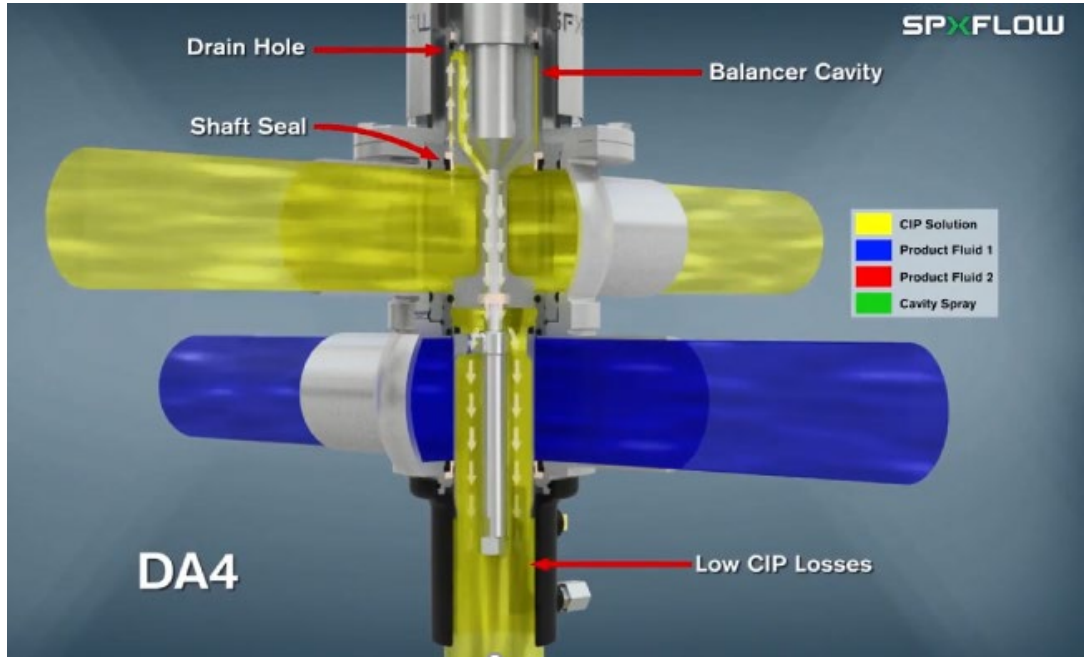
Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Most comprehensive cleaning during upper seat lifting

Areas cleaned during upper seat lifting

- Upper seat seal & sealing surface of disc of upper shaft
- Sealing surface of the upper shaft seal
- OD of balancer of upper shaft to avoid elevator effect
- The leakage chamber is flushed simultaneously. The cleaning liquid drains off to the bottom in depressurized state.



Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Most comprehensive cleaning during upper seat lifting

Upper shaft flushing

Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Detailed pictures of lower shaft movement

Lower seat lifting

- During lower pipeline cleaning, the lower seat lifting is activated.
- By lifting the lower valve shaft CIP fluid flushes across the lower seat seal and the lower shaft seal.
- The seat lift stroke is controlled by a stop in the seat ring.
- Notches in the seat ring and the shaft seal reduce the CIP losses.

Closed Valve

Lower seat lifting activated

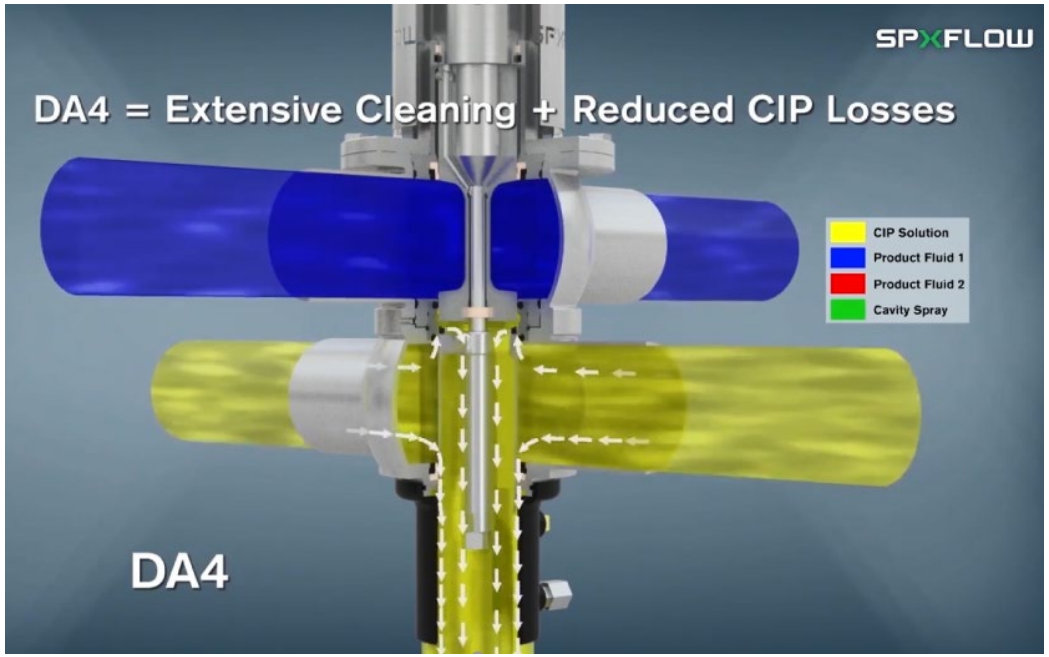
Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Most comprehensive cleaning during lower seat lifting

Areas cleaned during lower seat lifting

- Lower seat seal & sealing surface on the lower shaft
- Sealing surface of the lower shaft seal
- Outside of the lower shaft which is below the shaft seal
- The leakage chamber is flushed simultaneously. The cleaning liquid drains off to the bottom in depressurized state.



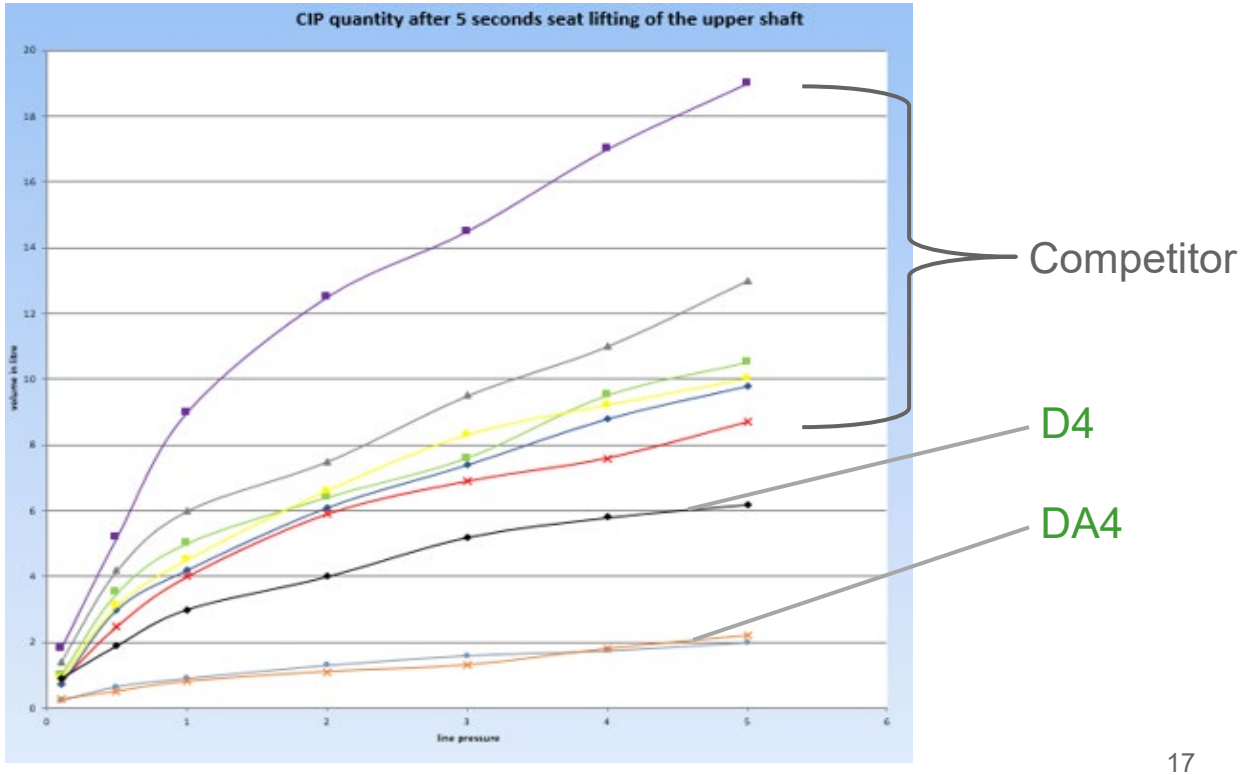
Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

The DA4 valve has the lowest CIP consumption

Comparison of the CIP losses during seat lifting

- CIP losses comparison for mix-proof valves in size DN65
- CIP losses measured at different line pressures for 5 seconds
- Competitor valves have far higher CIP losses
- Similar results for the lower seat lifting
- The DA4 valve has the lowest CIP consumption



Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Individual cleaning of the leakage cavity

Cavity spraying

- The leakage cavity including the seat area is cleaned via direct spraying of CIP liquid. The CIP flows from the cleaning connection up through a vertical pipe. The cleaning liquid drains off to the bottom in depressurized state.
- The cavity spraying can be done independently of the valve position and products in the pipelines.
- For viscous and sticky products, it is recommended to flush the seat area directly after valve closure.

Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

The CU4plus does raise the level of valve position control

Detection of the seat lifting via the new CU4plus

- The CU4plus continuously monitors the upper and lower shafts via 2 linear sensors. During the teach routine, the open & close positions and the seat lifting positions of the upper and lower shafts are permanently saved in the CU4plus electronic.
- During operation, the actual valve shaft positions are compared with the saved valve shaft positions.
- The CU4plus returns feedback to the PLC that seat lifting of the mix-proof valves has been operated. With this CU4plus, the level of information / control to ensure a proper cleaned valve is raised.
- Additionally, the seat lift pulsation can be activated. Different pulse times can be set to reduce the CIP quantity.

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Use of hygienic valves to ensure high quality products

Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Selection of mix-proof valves

	D4 NSL	D4 SL	DA4	D4PMO
General	• When full cleanability of seats is NOT required • CIP return line in valve manifold • CIP plants • Non-hygienic applications requiring safe separation	• When seat lifting is required • **Cost of Investment** is a key decision factor • When minimal switching leakage is a preferred • Products with fibres or solids	• When seat lifting is required • When CIP is done 1x per day or more often • **Cost of Operation** is key decision factor due to the minimized CIP losses • When the customer requires the highest hygienic level due to the most comprehensive cleaning	• Grade A Dairies in USA • When plants are exporting dairy products into USA and require PMO compliance
Dairy	• Unpasteurized products • Water supply	• Unpasteurized products, if seat lifting is required • Pasteurized “non-critical“ products	• Pasteurized “critical“ applications • Extended shelf-life products	• Unpasteurized & Pasteurized products • Fluid milk • Whey • Cheese • Yogurts

- The main factors for sizing mix-proof valves are the product flow velocity and the CIP flow velocity.
- Recommended product velocity depends on the product, max. up to 1,5 m/s. Recommend CIP flow velocity is between 1,5 – 2 m/s.

Design Requirements for Hygienic Valves

Example SPX FLOW D4 mix-proof valve range

Mixed sized valves are available to ensure high quality products

Mixed size D4 mix-proof valves

- The process plant, different pipe sizes are used to maintain the proper product and CIP flow velocity.
- At the intersection points of the pipes mix-proof valves are used.
- To keep the identical pipe size, hence keep the flow velocity, mixed size mix-proof valves are selected. Reductions, hence sump and/or dome are avoided.
- Due to the modular design of the D4 mix-proof valve, mixed size valves can be build easily. The size for the upper or lower line can vary between the sizes DN40/DN150 and 1,5“/6“. The upper or lower line can be of smaller size.
- The standard seal kit is used, the kit for the smaller size is used.

Thank you

Q&A

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