EMERSON EXCHANGE 2025

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Crosby JDS: Revolutionizing PRV Applications with Diaphragm Technology

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Agenda

Why Do We Use Bellows?

Challenges in PRV Bellows Applications

Balanced Diaphragm Technology

Balanced Diaphragm: Performance & Lifecycle Cost-Efficiency

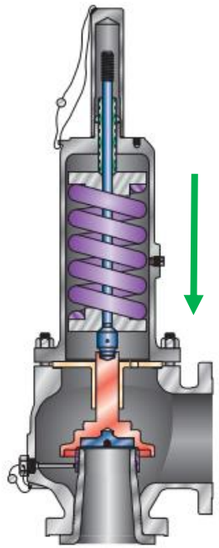
Diaphragm vs. Bellows: Balancing Technology Comparison

Balanced Diaphragm Technology: Key Benefits

Application Examples

Why Do We Use Bellows?

Constant Superimposed Back Pressure

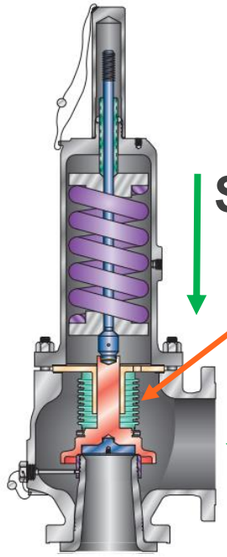


Spring Setting = 90 PSI

Constant Back Pressure = 10 PSI

Desired Set Pressure (Opening) = 100 PSI

Variable Superimposed Back Pressure



Spring Setting = 100 PSI

Bellows

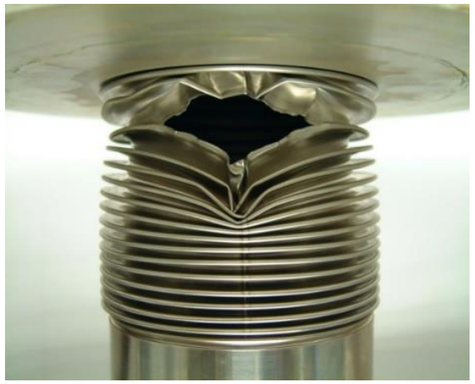
Variable Back Pressure

Desired Set Pressure (Opening) = 100 PSI

Challenges in PRV Bellows Applications

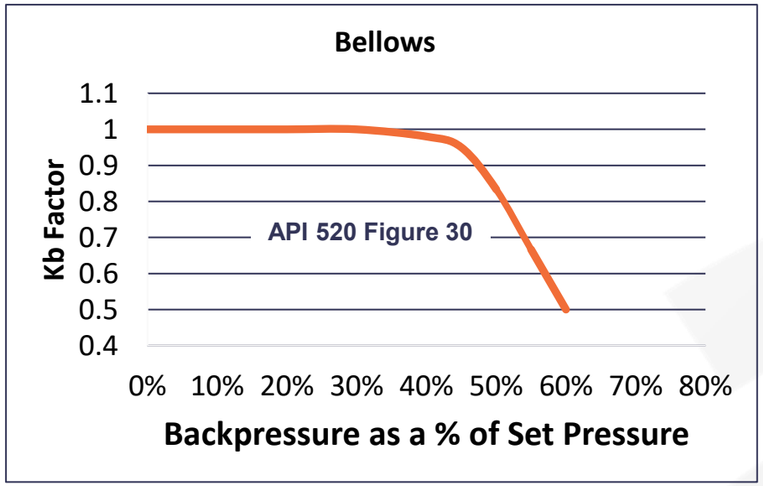
Reliability and Costs

- **2% to 6% of all bellows installed are damaged** (based on analysis of over 30K service records)
- Bellows are **costly to maintain** and may have long lead times for special sizes and materials



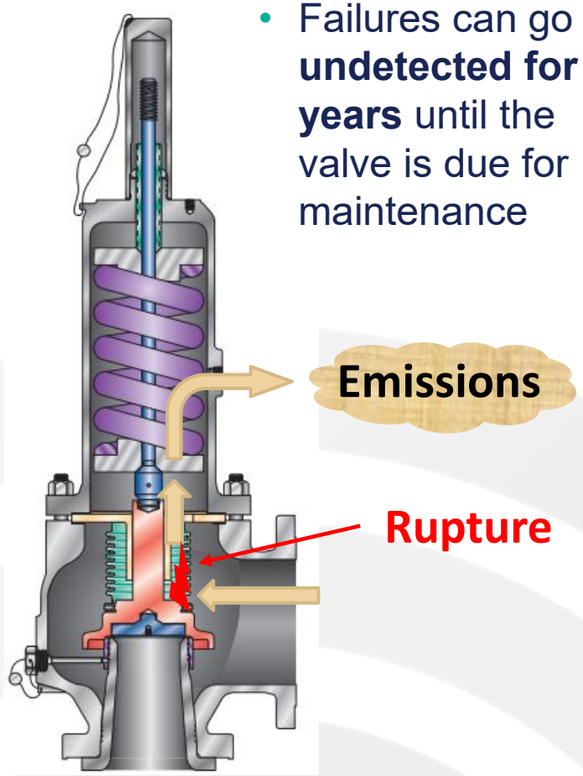
Capacity Limitations

- Flow reduction at high back pressures (may require **larger valves** in new and debottlenecking projects)

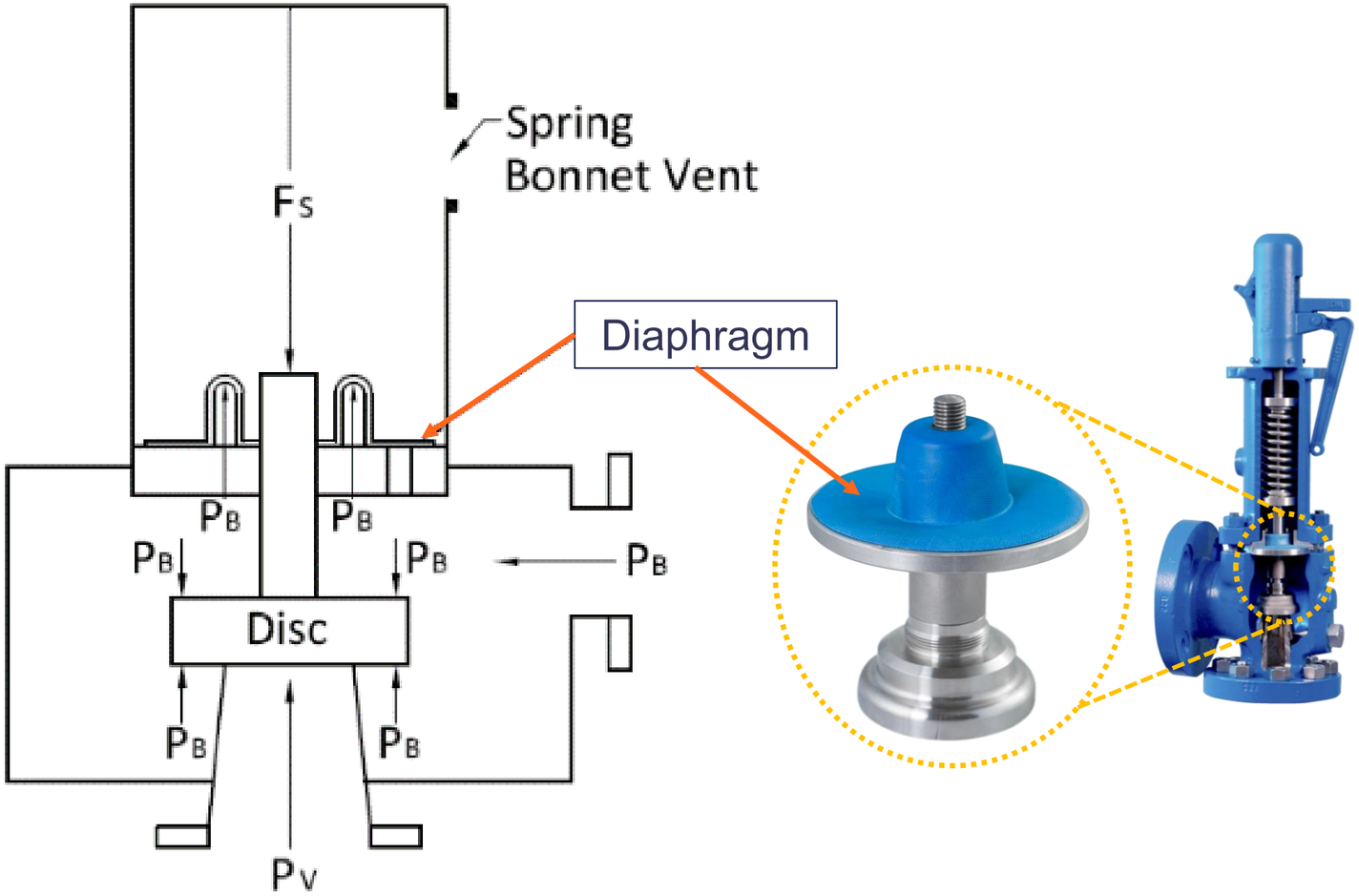


Safety and Emissions

- Failures can go **undetected for years** until the valve is due for maintenance



Balanced Diaphragm Technology



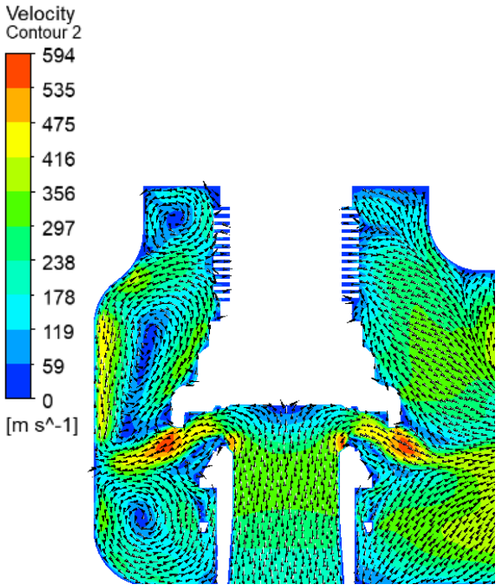
How it works

- Area subjected to backpressure has the same area as the nozzle seating area, ensuring balanced operation
- Located above the guide and not in the main flow path of the media
- No bellows spring rate effect

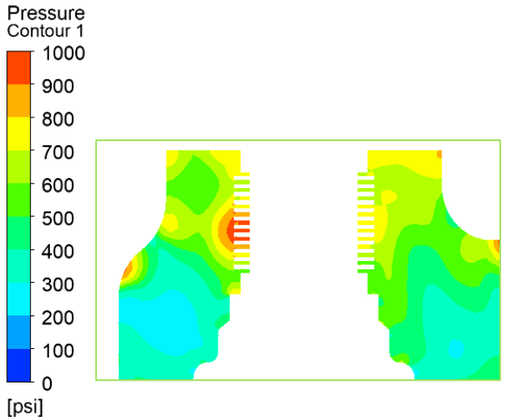
Balanced Diaphragm Technology: Velocity and Pressure Distribution Comparison

Balanced Bellows Technology

Velocity Profile

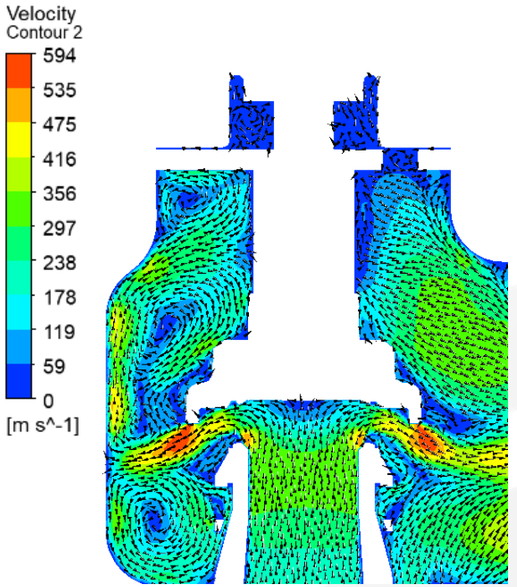


Pressure Profile

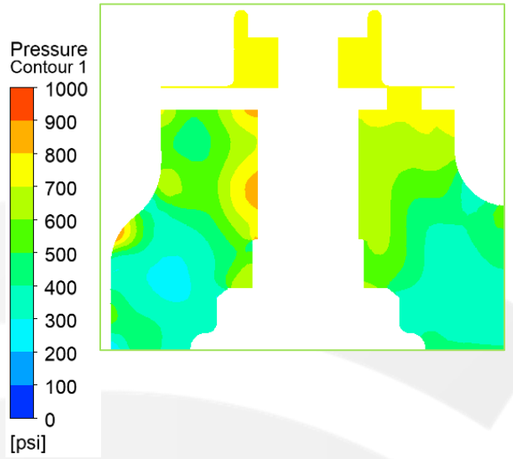


Balanced Diaphragm Technology

Velocity Profile



Pressure Profile



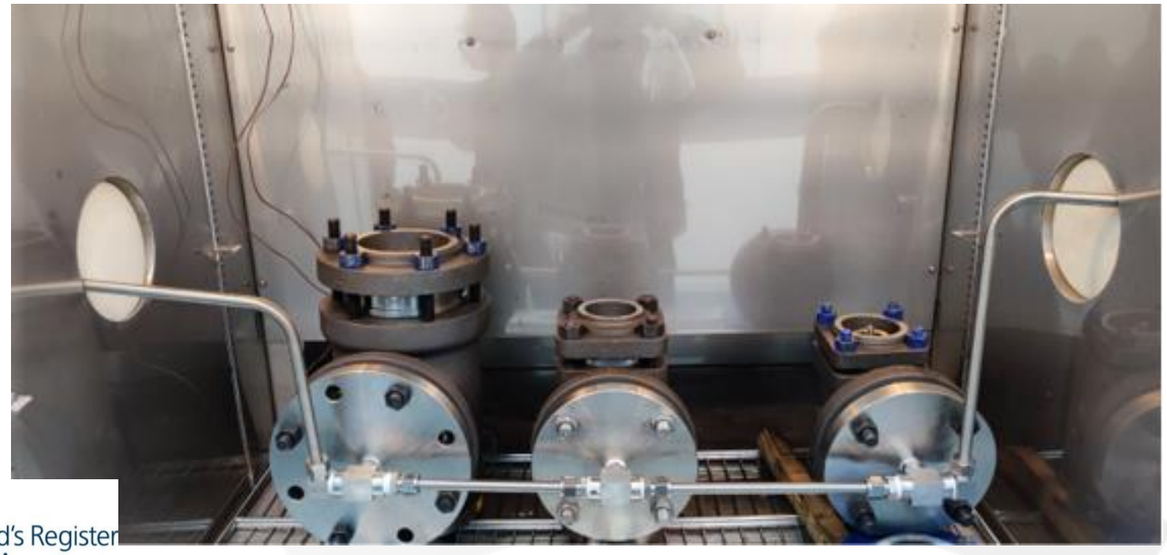
Bellows are exposed to high turbulence, while diaphragms are outside the flow path and experience significantly less turbulence

Balancing Diaphragm – Testing and Approvals

Burst Test

Fire Test

Cycle Test

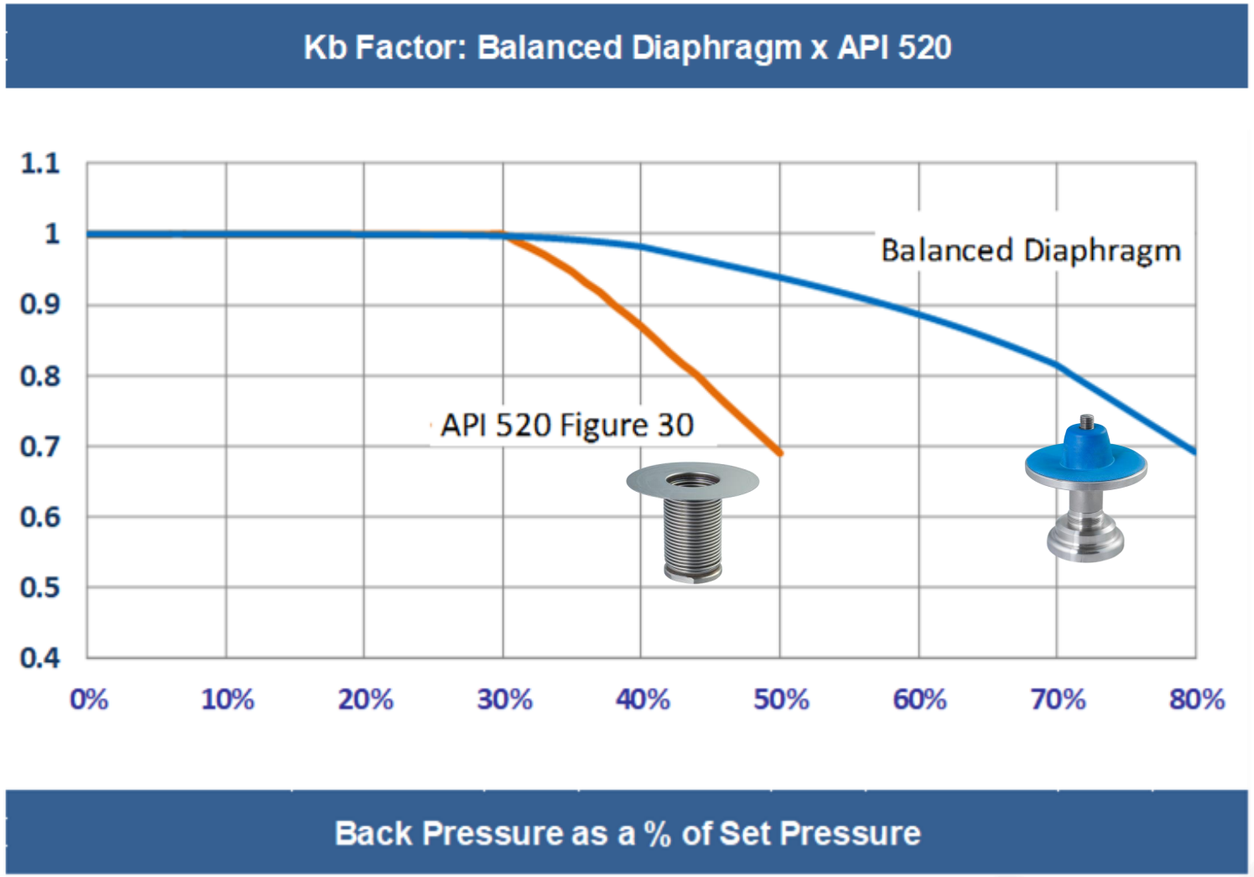


Approvals

NBBI SINCE 1919 THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

JLT/JLT-JDS (Liquids)	15095
JLT-JOS/JLT-JBS/JLT-JDS, 8500, ACL/ABL	15512
JLT-JOS-RL/JLT-JBS-RL/JLT-JDS-RL (Liquids) (Restricted lift version of Certification 15095)	01393
JLT-JOS-RL/JLT-JBS-RL/JLT-JDS-RL (Restricted Lift version of Certification 15512)	01382
JOS-E/JBS-E/JOS-H-E/JBS-H-E/JOS-JDS-E, 8400, AC/AB	15208
JOS-E-RL/JBS-E-RL/JDS-E-RL (Restricted Lift version of cert 15208)	01045

Balanced Diaphragm - Performance



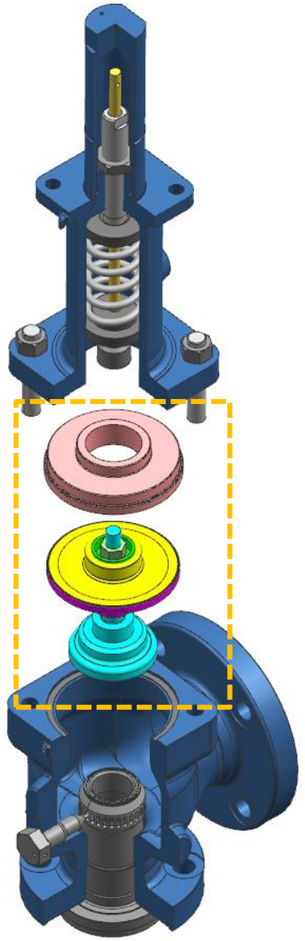
Performance Improvements

- **No spring effect from bellows** enhances valve stability and set pressure performance.
- Improved backpressure limit and flow capacity expand the use of spring-loaded PRVs:
  - 20% greater back pressure handling
  - 15% improvement in flow capacity (Kb factor)

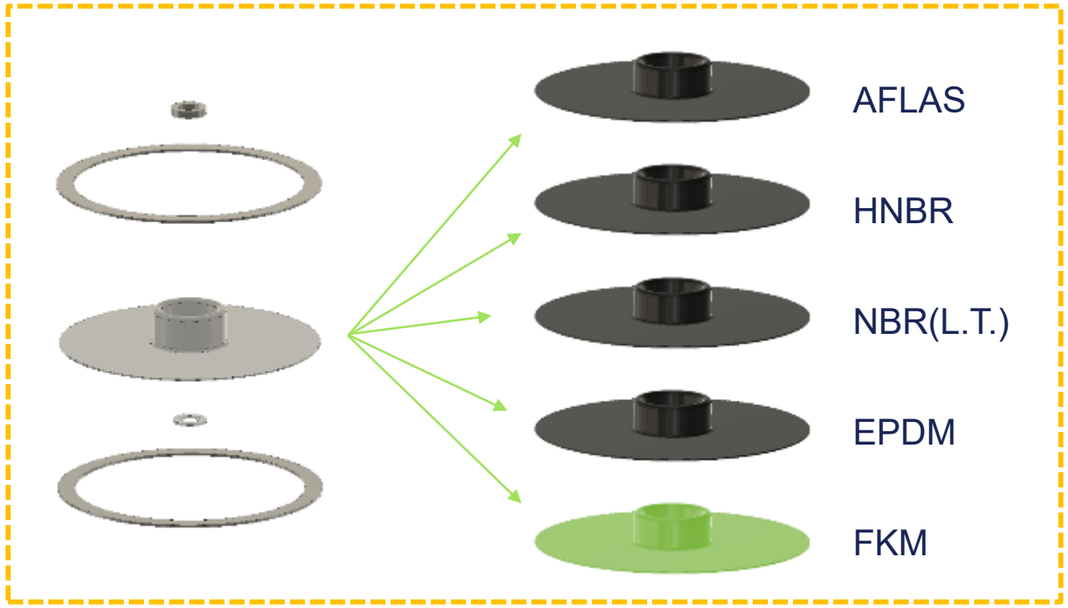
Lifecycle Cost-Efficiency
Upgrade Kits and Serviceability

Upgrade Kit Includes:

- Diaphragm*
- Adaptor
- Guide
- Disc Holder
- Gaskets
- Hardware



Soft Goods Kit
(Includes Diaphragm)



Balanced Diaphragm Technology - Comparison

Balanced Diaphragm

Advantages

- Greater backpressure limits
- Improved Kb factor
- Resilience to fatigue
- Protected from relief flow pass
- Less prone to instability
- Low cost of ownership

Disadvantages

- Temperature limits
- Chemical compatibility
- Valve trim not isolated from media

Bellows

Advantages

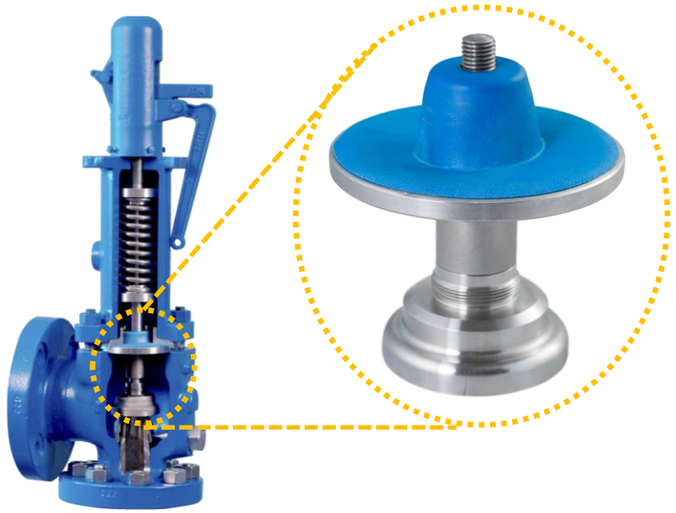
- Temperature limits
- Chemical compatibility
- Valve trim isolation from media

Disadvantages

- Backpressure limits
- Standard Kb factor
- Prone to metal fatigue
- Exposure to fluid relief flow pass
- Prone to instability
- High cost of ownership

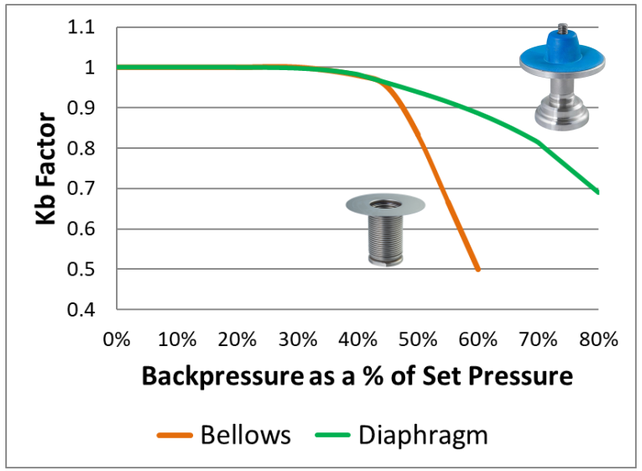
Beyond Bellows: JDS Balanced Diaphragm Technology

Reliability and Cost



- 100x more resilient than bellows
- Cycle, Burst, and Fire Tested and independently witnessed by Lloyd's Register (LRQA)
- Upgrade Kits and Soft Goods

Capacity Performance



- 20% greater back pressure handling
- 15% improvement in Kb factor
- No Spring effect from Bellows enhances stability

Key Benefits

- **Safety -** Reliable and longer life ensuring balanced operation
- **Reliability -** Improved durability of diaphragm backed by extensive testing
- **Productivity -** Improvement in Kb factor enables sizing of smaller and/or fewer valves
- **Environmental -** Durable and robust design maintaining protection against fugitive emissions

Application Examples

Refinery: Large Capacity Requirement

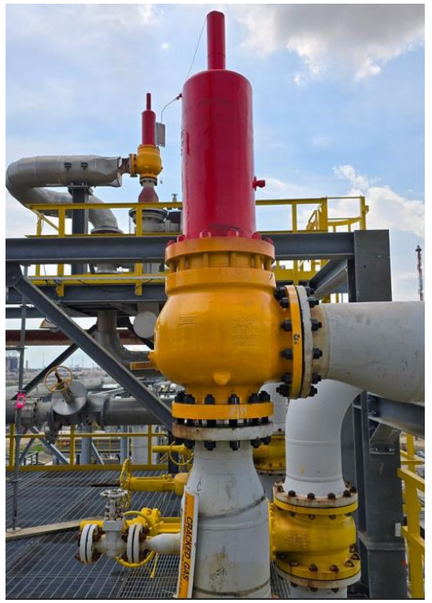
Quench Tower, Total Power Failure Safety Scenario

User Pain

- Increased throughput led to higher backpressure, reducing the effective capacity of the existing relief system.
- Twelve JBS valves (T orifice, Kb = 0.758) were no longer sufficient to meet the required relief capacity, risking non-compliance and safety issues.

Solution

- Replaced with twelve 8-T2-10 JDS valves, specifically engineered for this application.
- The JDS valves (T orifice, Kb = 0.886) provided a 17% increase in capacity under backpressure conditions.
- The T2 JDS solution was custom-developed for this plant's needs—and is now available for broader application.



Benefit to User

- Achieved compliance with relief capacity requirements during critical events like total power failure.
- Enhanced safety and operational reliability in a high-risk system.
- Demonstrated the superior performance and scalability of JDS in high-backpressure environments.

Safety Sustainability Productivity

Oil & Gas: High Back Pressure Application

Oil and Gas: Offshore Upstream

User Pain

- After Process Changes, the amount of backpressure on the existing PRV downstream increased to a higher value, which couldn't be met with Bellows
- A solution with the same face to face dimensions to match existing piping required
- Process media may contain impurities, causing Pilot Operated Valve to not be a good solution

Solution

- 2 x 4P6JDS-E15XXJ-SPL - Duplex Construction
- With the Balanced Diaphragm capabilities of handling higher backpressure and having a better Kb Factor, we were able to match the existing orifice and face to face dimensions of the existing Leser valve and replace with a JDS solution.

Benefit to User

The user was able to have a solution to meet their application with the higher backpressure, without needing to modify piping and ensure a more reliable and durable solution.

Ultimately, the user will get improved personnel safety, while reducing downtime, product losses and constant needs of bellows replacement.

Safety Sustainability Productivity

Oil & Gas: High Pressure Flare Header

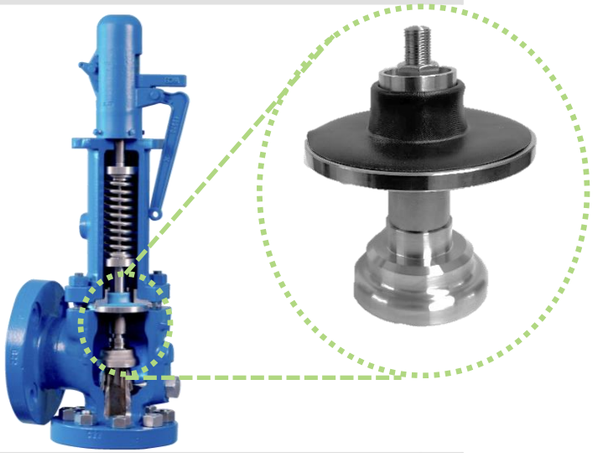
Fuel Gas System at Low Temperatures

User Pain

- Concerns about diaphragm reliability in low-temperature fuel gas service.
- Need for a PRV solution that could handle temperatures as low as -40°C while maintaining performance and safety.

Solution

- Supplied model 1.5G3JLTJDS-E35J-N2 from the J-Series Diaphragm Solution (JDS) line.
- Engineered with low-temperature-rated materials to meet the service conditions: Fuel Gas Relief to High-Pressure Flare Header, operating between -40°C to 37°C, installed indoors.



GENERAL	2	Service		Fuel Gas Relief to High Pressure Flare Header	
	3	P & ID Number		781110-M-PID-01-713-01	
	4	Line Number / Vessel Number		2-EG-BB-71503 / 3-HPF-AS-71504	
	5	NACE MR-01-75 (2002)		Yes	
	6	CRN		Required	
	7	Instrument Location		(-40 °C to 37 °C) (Located inside building)	
VALVE	8	Safety or Relief		Relief	
	9	Style		Conventional	
	10	Bonnet		Closed	
	11	Design Pressure	Temperature	4500 kPag	100 °C
	12	Size & Rating: Inlet x Outlet		1-1/2" 300# RF x 3" 150# RF	
MATERIALS	13	Body and Bonnet		WCB/WCC	
	14	Nozzle and Disc		316 SST	
	15	Seat		Metal	
	16	Guide and Rings		SS A297 Gr. HE	
	17	Spring		Chr. Steel - Alum. Metallized	
	18	Bellows		-	
	19	Body Stud and Nuts		-	
OPTIONS	20	Cap: Screwed or Bolted		Screwed	
	21	Lever: Plain or Packed		None	
	22	Test Gag		None	
BASIS	23	Code		ASME Section VIII	
	24	Sizing Case		Control Valve Failure	
SERVICE	25	Fluid		Fuel Gas	
	26	State		Gas	
	27	Required Capacity	(Sm3/hr)	9,282.92	
	28	Mol. Wt.	Oper. SG	17.94	0.9
	29	Operating Pressure	Set Pressure	3,132.9 kPag	3481 kPag
	30	Operating Temp.	Relieving Temp.	80°C	100°C
	31	Design Pressure	Temperature	4500 kPag	100 deg C
	32	Backpressure	Constant	0 kPag	
	33		Variable(buildup)	100 kPag	
	34		Total	100 kPag	
	35	Allowable Overpressure		10%	
	36	Compressibility Factor		0.94	

Benefit to User

- Reliable performance in cold climate conditions, ensuring safe pressure relief.
- Successful adoption of JDS technology built confidence for future applications.
- Reduced risk of failure and minimized maintenance concerns in a critical safety system.

Safety Sustainability Productivity

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Booth 300 – Regulators and Pressure Relief Valves

Find More Information

Crosby J: Balanced Diaphragm (emersonautomation.com)

Contacts

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Thank You