Safety valves and their application requirements

Objective of the presentation
Show the complexity and how to handle it

The goal of this presentation is to provide an overview about the amount of different applications for Safety Valves and the complexity of certain areas.

Further it is described how this variety and complexity can be handled with a lean effective product management.
Application Areas
All fields of application for LESER safety valves

- Oil and Gas Industry
- LNG/LPG
- Petrochemical Industry
- Technical Gases
- Ship Building
- Chemical Industry
- Heating and Air Conditioning
- Energy Industry
- Food and Beverage Industry
- Pharmaceutical Industry
- Other Industries
- Heating and Air Conditioning
- Engineering and Supply Chains
- Other Industries
- Specific Concepts
- Application-based Solutions
- Objectives
- Application Examples
- How to Handle
- Product Groups
- Options
- Summary

Leser GmbH & Co. KG
Oil and Gas Industry
Upstream / Downstream
Oil and Gas Industry
Upstream / Midstream / Downstream

The Oil and Gas industry including the midstream and downstream of refining and petrochemical industry is the biggest industry in the world for pressurized applications.

<table>
<thead>
<tr>
<th>Applications</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressurized vessels</td>
<td>High valve capacity at low weight and size</td>
</tr>
<tr>
<td>Thermal expansion in piping systems</td>
<td>Corrosive environment (e.g. sea water)</td>
</tr>
<tr>
<td>Pressure-increasing stations</td>
<td>High pressures and backpressures</td>
</tr>
<tr>
<td>Christmas trees</td>
<td>Comprehensive documentation and customer-specific inspections</td>
</tr>
</tbody>
</table>
Chemical Industry
Chemical Industry

The Chemical industry has the highest demand for valves compared to the capacity in general and for overpressure protection devices as well.

### Applications

- Pressurized vessels
- Thermal expansion in piping systems
- Pressure-increasing stations
- Chemical reactors or autoclaves

### Requirements

- Wide product range for gas, steam and liquid
- Lower total costs of ownership and easy maintenance
- Suitability for aggressive and toxic media

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Photos courtesy of Chemiepark Hoechst
Chemical Industry

Urea Plants

Urea plants are in need for solutions for the highly corrosive Carbamate in the synthesis reactor and its side processes like the carbamate pumps.

Applications
- Protection of the Urea Synthesis Reactor
- CO2 – Compressor
- NH3 - Pump (liquid)
- Stripper
- Recirculations

Requirements
- Prevention of corrosion
- Prevention of crystallisation of the carbamate
- High set pressures
- High temperatures
Chemical Industry

Urea Plants

Setup of a Urea plant:
The Pharmaceutical Industry has a lot of special requirements regarding the cleanability, materials and documentation.

### Applications
- Pressurized vessels
- Piping systems
- Reaction vessels
- Filling stations

### Requirements
- Excellent cleanability
- Regulation-compliant materials
- Wide range of aseptic connections
Approach to handle the diversity

1. Different products (*Product Groups*) with specific characteristics.

2. Various standardized *options* to create a specific product for the most common demands.

3. Dedicated *concepts* to individualize the product further for specific industry requirements.

4. Complete *applications based* product *solutions* for certain areas with very specific requirements.

5. *Design* and *source to order* capabilities for requirements which cannot be covered by the first four bullet points.
### Nine product groups up to DN 400 / 16" and 850 bar / 12,000 psig

**General industrial applications (chemical, petrochemical, oil & gas, technical gases, LNG / LPG, marine)**

<table>
<thead>
<tr>
<th>Product Group</th>
<th>High Performance</th>
<th>API</th>
<th>Compact Performance</th>
<th>High Efficiency Pilot-operated safety valve</th>
<th>Modulate Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short description</td>
<td>Flanged safety valves with especially high capacity for their size</td>
<td>Flanged safety valves that meet all the requirements of API 526</td>
<td>Threaded and flanged safety valves with compact dimensions</td>
<td>Pilot-operated safety valves for optimal tightness right up to set pressure.</td>
<td>Flanged valves with a standard or proportional opening characteristic.</td>
</tr>
<tr>
<td>Nominal Diameter at Inlet</td>
<td>DN 20 - DN 400 3/4&quot; - 16&quot;</td>
<td>DN 25 - DN 200 1&quot; - 8&quot;</td>
<td>DN 15 - DN 40 3/8&quot; - 2&quot;</td>
<td>DN 25 - DN 200 1&quot; - 8&quot;</td>
<td>DN 15 - DN 150 1/2&quot; - 6&quot;</td>
</tr>
<tr>
<td>Pressure</td>
<td>0.1 - 300 bar 1.5 - 4,350 psig</td>
<td>0.12 - 413.8 bar 2 - 6,000 psig</td>
<td>0.1 - 850 bar 1.5 - 12,328 psig</td>
<td>2.5 - 426 bar 36 - 6,170 psig</td>
<td>0.2 - 160 bar 2.9 - 2,320 psig</td>
</tr>
</tbody>
</table>

**Special industrial applications**

<table>
<thead>
<tr>
<th>Product Group</th>
<th>Clean Service</th>
<th>Critical Service</th>
<th>High Efficiency Suppl. loading</th>
<th>Best Availability Change-over v.</th>
<th>Best Availability Bursting discs</th>
<th>S&amp;R</th>
</tr>
</thead>
</table>

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**Options**

**Application-Based Solutions**

**Engineering and Supply Chains**

**Summary**

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**Objectives**

**Application Overview**

**Application Examples**

**How to Handle**

**Product Groups**
Valve Finder ASME for spring loaded safety valves

Finding the right Safety Valve Product Group

Clean Service Application?

YES

Critical Service Application?

YES

NO

Critical-/ High Corrosive Service?

NO

API

Compact Performance

High Performance

API specified Application?

NO

Required Orifice letter?

Orifice < F

Orifice > F

Clean Service

Critical Service

API

Compact Performance

High Performance

Clean Service

Critical Service
Over 2 Million different configurations are possible.
Specific concepts for critical applications

1. Alloy concept

2. Corrosion protection

3. NACE

4. Emission concepts
Alloy concept application examples

Oil and Gas Industry Onshore / Offshore:
- Corrosive marine environment
- Corrosive media: sea water
- Corrosive media: Hydrocarbons with H₂S (NACE) and sea water
- Platforms, FPSOs, OEMs, e.g. pumps, compressors for above mentioned applications

Industrial Gas Industry, Air separation:
- Oxygen service at higher pressure
- Nozzle & disc in Monel 400
Alloy concept design
Type 526 Alloy Level Concept

Level system for economic solutions according to application requirements

- Level 1: Inlet wetted
- Level 2: Inlet wetted & trim
- Level 3: Inlet & outlet wetted
- Level 4: Valve external
- Level 5: Complete valve
Alloy concept benefits

- Economic solutions in Duplex and high-alloyed materials according to application requirements
- Defined material specifications in accordance with relevant codes and standards
- Short delivery time
- Easy configuration & ordering

<table>
<thead>
<tr>
<th>Part</th>
<th>Materials</th>
<th>Delivery time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>CF3M</td>
<td>24 weeks</td>
</tr>
<tr>
<td></td>
<td>22Cr Duplex - CD3MN</td>
<td>15 weeks</td>
</tr>
<tr>
<td></td>
<td>25CR Super Duplex - CD3MWCuN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monel – M35-1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hastelloy C22 - CX2MW</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inconel 625 - CW-6MC</td>
<td></td>
</tr>
<tr>
<td>Nozzle</td>
<td>22Cr Duplex - F51, S31803</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Disc</td>
<td>25CR Super Duplex - F55, S32760</td>
<td></td>
</tr>
<tr>
<td>Guide</td>
<td>Monel 400 - SB-164, N04400</td>
<td></td>
</tr>
<tr>
<td>Spindle</td>
<td>Hastelloy C4 - SB-574, N06455</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inconel 625 - SB-446, N06625</td>
<td></td>
</tr>
<tr>
<td>Bellows</td>
<td>Inconel 625 / 316L</td>
<td>4 weeks</td>
</tr>
<tr>
<td></td>
<td>Hastelloy C276 / Hastelloy C4</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Spring</td>
<td>Inconel X-750</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>
Specific solutions for critical applications

1. Urea
2. Solar
3. Tank farms
4. Refrigeration
5. FPSO
Application Examples Urea

Protecting corrosive media with a tendency for crystallization (e.g. in the synthesis section of a urea plant).

Urea plant example:

- Protected medium: Carbamate gas
- Typical pressure / temperature: Up to 170 bar / up to 190° C (depending on licensor)
- Typical safety valve: API 526 3x4 with heating jacket, necessity for an individual check is dependent on plant capacity.
- Typical materials: Carbamate corrosion resistant materials (e.g. 316L UG, 1.4462, 1.4466, SAFUREX®)
- Typical challenges for safety valve: danger of carbamate crystallization and corrosion requires e.g. steam purging
- Further process optimization: Supplementary Loading System
**Design**

Safety Valve Technology for Urea Synthesis Section

<table>
<thead>
<tr>
<th>Closed position</th>
<th>Open position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected medium – Carbamate gas</td>
<td>Protected medium – Carbamate gas</td>
</tr>
</tbody>
</table>

**Material**
- 316L Urea Grade
- 1.4466 – UNS 31050
- 1.4462 – UNS 31803
- SAFUREX – UNS 32906

*Continuous steam flow prevents medium crystallization in case of small valve leakage.*

*Continuous steam flow covers medium.*

*Continuous steam purging.*
Design

High-end LESER Safety Valve technology with a Supplementary Loading System for the Urea Synthesis Section

- Main components are: Safety valve, actuator, control unit
- Improves the opening and closing characteristics of a safety valve
- Customer-optimized Supplementary Loading System uses pressure transmitters located directly on the protected system.
- Approved by TUV Nord authorities in Germany and PED / ISO 4126-5.
## Benefits

### Urea Synthesis Design

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special stainless steel grades</td>
<td>Longer (2-3x) service intervals</td>
</tr>
<tr>
<td>Minimized steam requirement</td>
<td>Reduced operating costs</td>
</tr>
<tr>
<td>Only one injection point</td>
<td>Less piping needed</td>
</tr>
</tbody>
</table>
| Continuous steam purging    | ▪ Prevents crevice corrosion and crystallization in outlet body  
                                ▪ Ensures media temperatures stay above critical 142° C. |

Source: LESER
### Engineering capacities and Supply Chains

<table>
<thead>
<tr>
<th>Order value in %</th>
<th>Customer need</th>
<th>LESER supply chain</th>
<th>Engineering capacities</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>Standard delivery in 2-4 weeks ex works, convenient and comfortable ordering</td>
<td>Eco line</td>
<td>Low Engineering capacities only sizing and choosing of right product plus options or application solution</td>
</tr>
<tr>
<td>30%</td>
<td>Quick delivery from local stock</td>
<td>Project line</td>
<td>Engineering capacities needed during offer (Technical Sales) and order process (Design Center)</td>
</tr>
<tr>
<td>1%</td>
<td>Quickest delivery (Emergency)</td>
<td>Fast Track Order</td>
<td>Standard products plus options only</td>
</tr>
</tbody>
</table>

**Customer need**
- **60%**: Standard delivery in 2-4 weeks ex works, convenient and comfortable ordering
- **30%**: Quick delivery from local stock
- **1%**: Quickest delivery (Emergency)

**LESER supply chain**
- Eco line
- Project line
- Fast Track Order

**Engineering capacities**
- Low Engineering capacities only sizing and choosing of right product plus options or application solution
- Engineering capacities needed during offer (Technical Sales) and order process (Design Center)
- Standard products plus options only
Summary

- The amount of pressurized applications and industries is quite extensive.
- The requirements and demands to fulfill the main task of overpressure protection are differing.
- With a certain product structure it is possible to handle the requirements reliable, repeatable and economically.