

Pressure Relief Valves Fugitive Emissions Testing



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Agenda

- Overview and importance of fugitive emissions
- Fugitive emissions standards
- Fugitive emissions for pressure relief valves
 - Testing and compliance
- Benefits of fugitive emissions compliance



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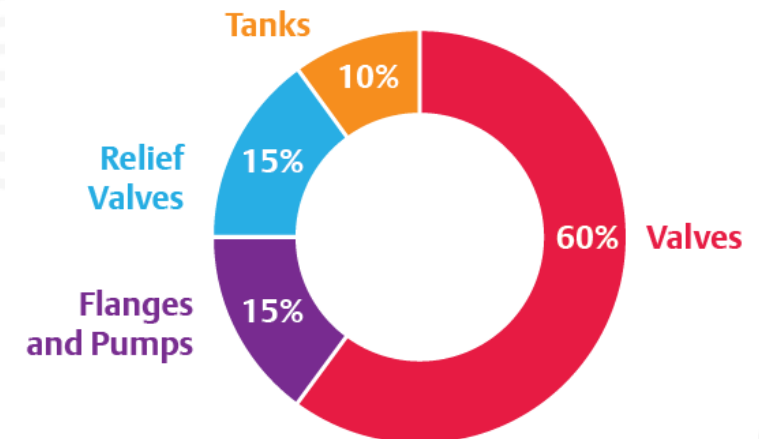


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Overview of Fugitive Emissions

- What are Fugitive Emissions?
 - **Pollutants released into air** from leaks in equipment, pipelines, seals, valves, etc., and not from the usual sources such as chimneys, stacks, and vents.
- Major **source of regulations**
 - Clean Air Act, USA
 - TA-Luft, Germany
- Importance of relief valves in controlling emissions – **15%+ is relief valves**

Industrial Fugitive Emissions Sources



Fugitive emissions in process plants: Monitoring and containment of fugitive emissions from valve stems, University of British Columbia, Vancouver

Source: EPA

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Importance of Fugitive Emissions

- Increasing traction to adopt and **enforce standards** from more countries and governments
- Rules becoming **stricter** in some countries
- Increased **Corporate Social Responsibility (CSR)** emphasis on reducing emissions and the importance of fugitive emissions in the overall process

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Fugitive Emissions Standards

- Well known standards and specifications that ensure compliance to regulations
 - ISO 15848-1 & 15848-2
Industrial valves - Measurement, Test and Qualification Procedures for Fugitive Emissions
 - API 622 and 624
Type Testing of Process Valve Packing for Fugitive Emissions
Type Testing of Rising Stem Valves Equipped with Graphite Packing for Fugitive Emissions
 - Shell MESC 77-300 and 77-312
Procedure and Technical Specification for Type Acceptance Testing of Industrial valves - Fugitive Emissions Production Testing

Standards Are Written Around Valves That Have Stems

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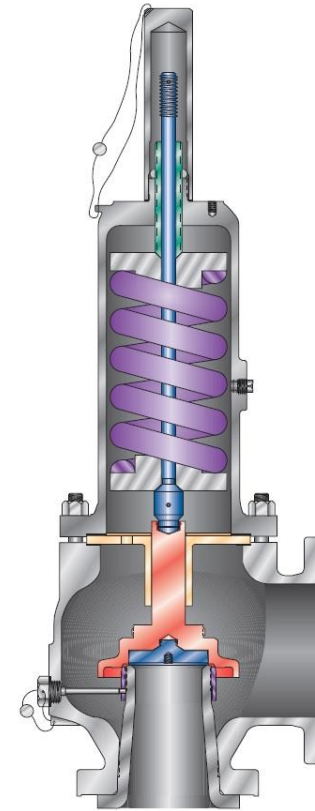
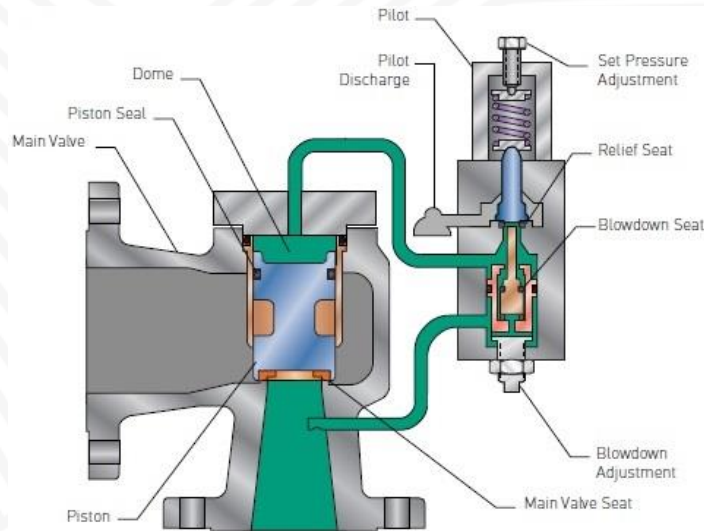
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Fugitive Emissions Compliance for Pressure Relief Valves

- Function, geometry, and inherent design of pressure relief valves (PRV) are different from in-line valves
 - PRVs are self-contained (no stem) and self-actuated
 - Challenge: How to apply FE concepts



No Widely Adopted Standards Exist

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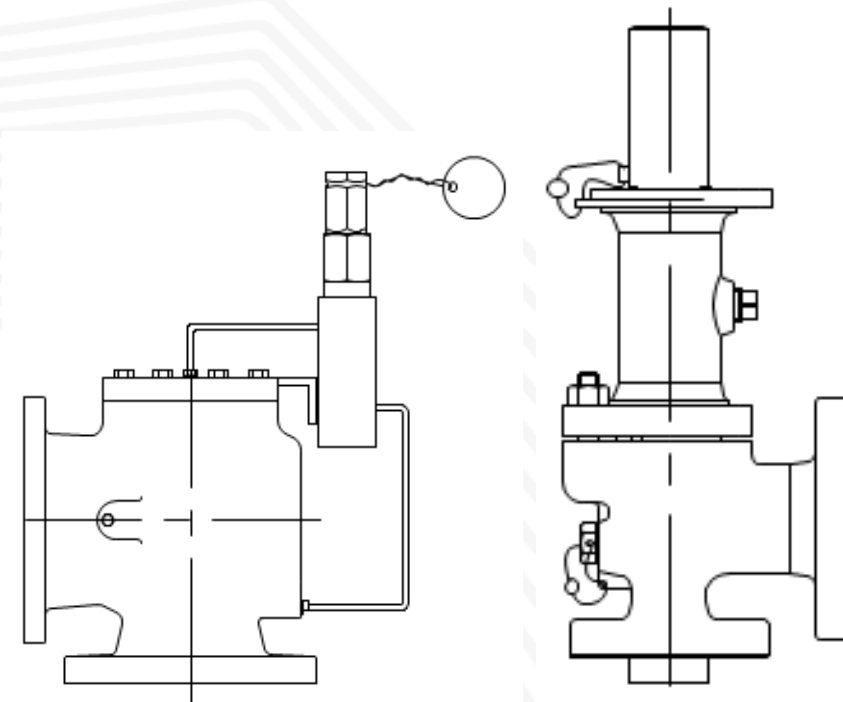
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Pressure Relief Valves Fugitive Emissions Testing

- Initiative:
 - Working from customer's standard for manual valves, adapting it to suit the unique nature of pressure relief valves
- Create New Emerson Test Procedure
- Scope: Direct Spring Valves (Conventional and Thermal Relief) and Pilot Operated Valves
- 1" to 10", up to CL2500, -320°F (-200°C) to 1000°F (540°C)



Pilot Operated Valve

Direct Spring Valve

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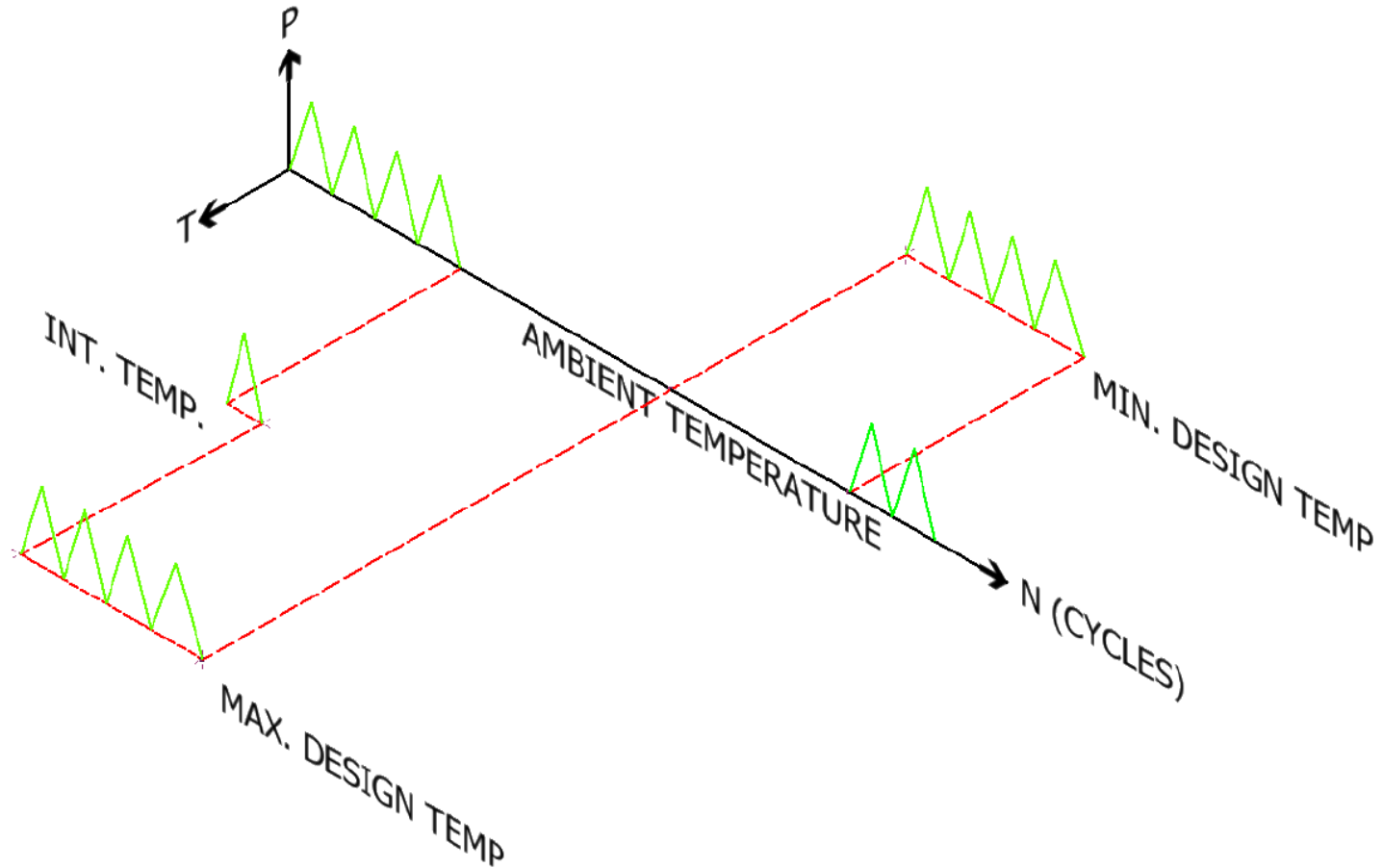
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Pressure Relief Valves Fugitive Emissions Testing

- Original Procedure (For In-Line Valves)



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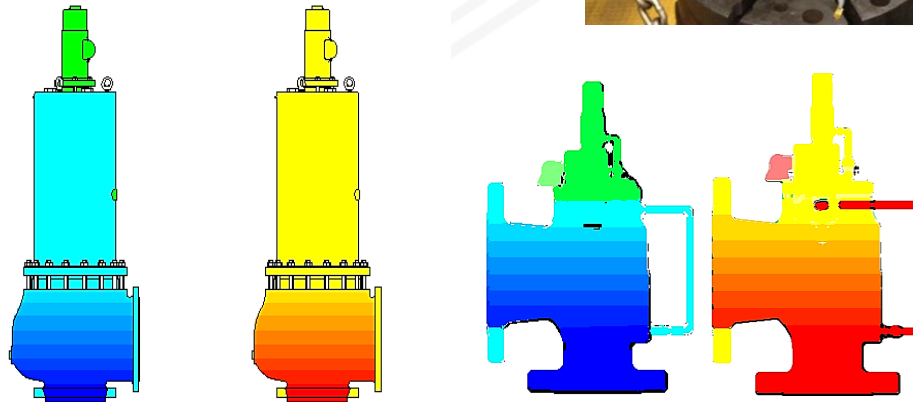
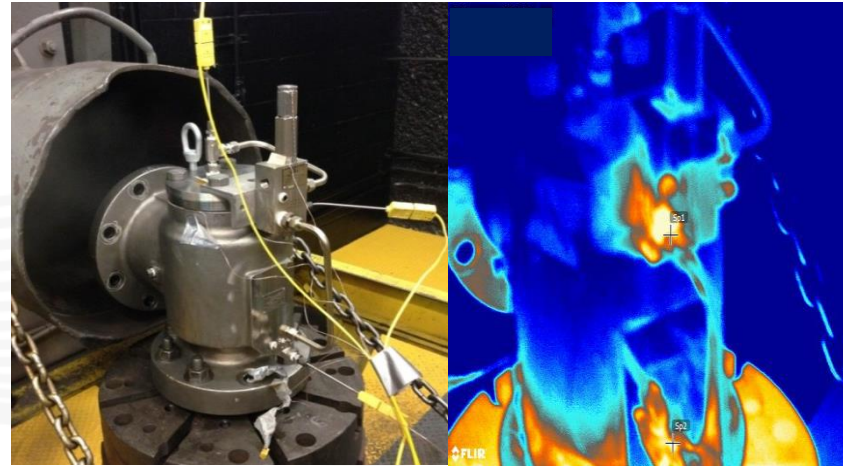


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Pressure Relief Valves Thermal Signature

- Thermal imaging testing proved that **not the whole valve** is subject to the same temperature

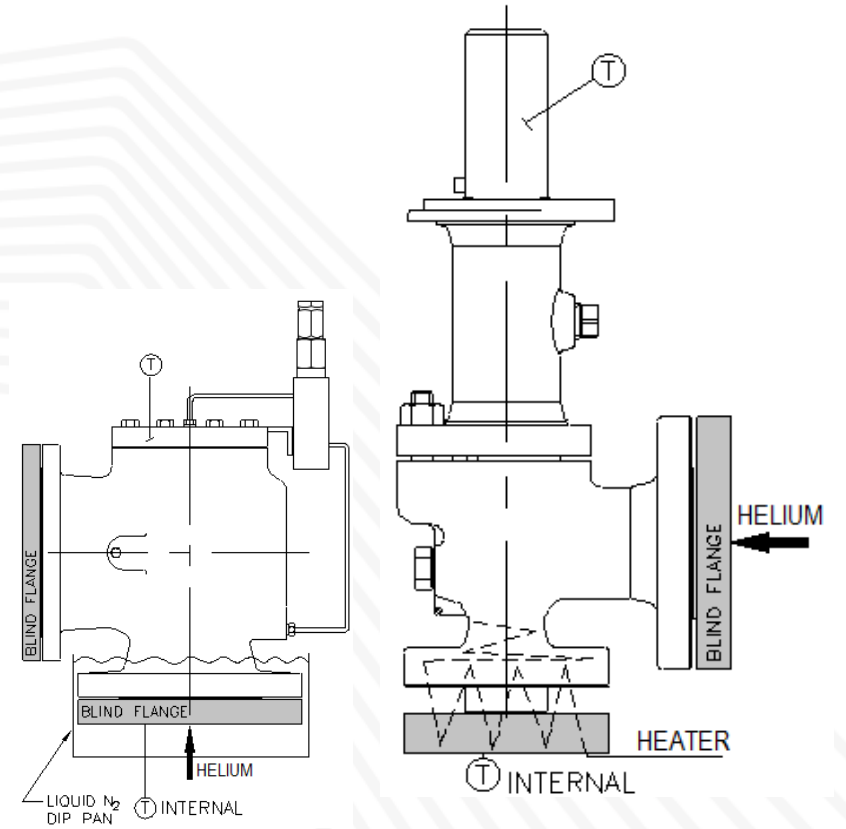
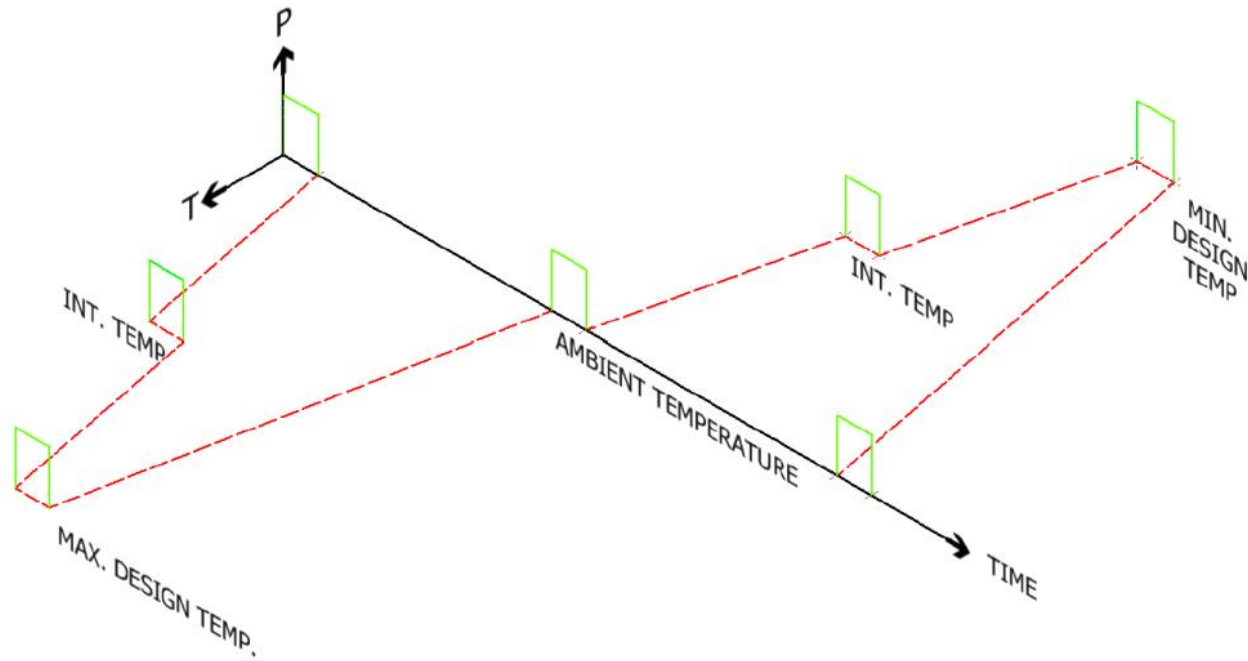


Temperature Gradients

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Pressure and Temperature for Pressure Relief Valves Testing

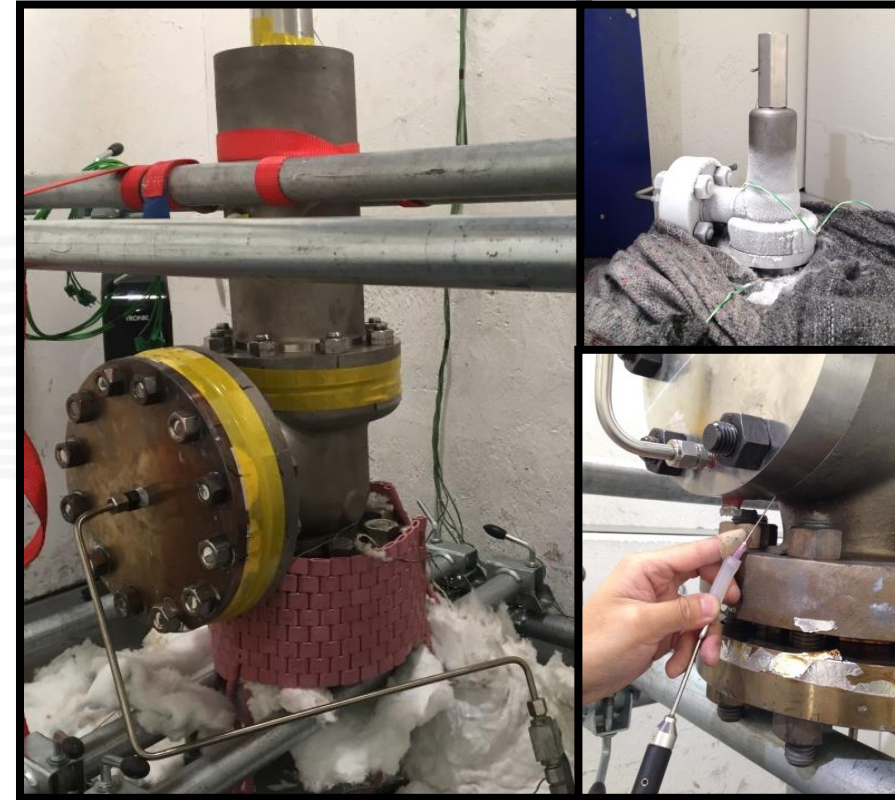


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Test Rig

- Testing done at experienced independent laboratory
- Test gas: helium
- Pressure is applied at outlet for spring valves
- Valves are not actuated
- One mechanical adjustment at room temperature and pressure is allowed (same as in-line valves)



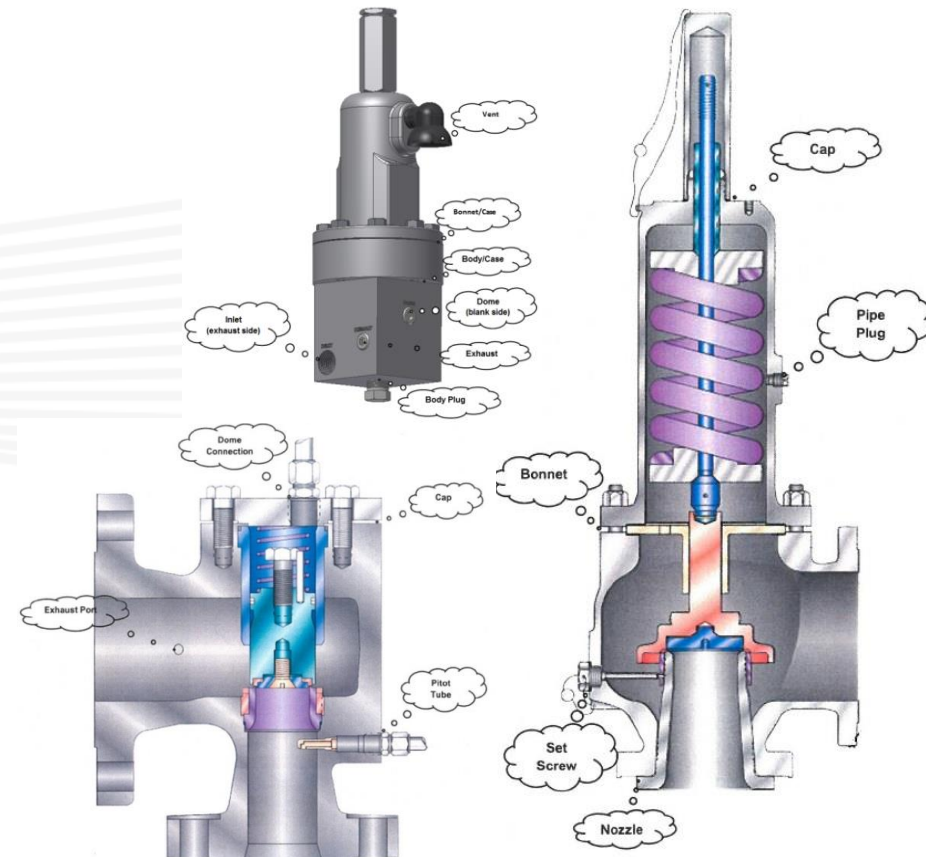
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Measurement Locations

- Measurement:
 - Leak paths identified
 - Mass spectrometer leak detector with sample probe ('sniffing' method)
 - Sensitivity of at least 1.0×10^{-10} Pa- m^3/s

- Acceptance Criteria:
 - Class A: 1.78 E^{-9} x gasket OD (mm)
 - Class B: 1.78 E^{-8} x gasket OD (mm)
 - Leakage above Class B is unacceptable



Emissions From All Mechanical Connections

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What Makes a PRV FE-Compliant?

- **Design**
 - Proper O-ring/groove design
 - Bolt torqueing
 - Gasket seals
 - Area affects bolt torque
 - Material porosity and density
- **Process**
 - Workmanship
 - Threaded connections: proper cleaning and taping (NPT)
 - Control / Repeatability



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Benefits of Fugitive Emissions Compliance

- Safety: limits employees' direct exposure to **harmful products**
- Economic advantages: **save more of the process fluids** and assure shareholders that production processes are conducted efficiently
- Environmental: **minimizes the greenhouse effect** on the environment and curtails global warming
- Legal: **avoid fines** from local and federal regulators

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Thank You

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Questions?

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