CRANE BS&U supporting the Building Services Industry

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Crane Co founded in 1855 by Richard Teller Crane who made the following resolution -

“\textit{I am resolved to conduct my business in the strictest honesty and fairness; to avoid all deception and trickery; to deal fairly with both customers and competitors; to be liberal and just towards employees; and to put my whole mind upon the business}”

Crane Limited founded in Ipswich in 1919
Crane Building Services & Utilities created 2009
CRANE BS&U 2010 sales £110m
industry organisations

- CIBSE
- SoHPE
- BSRIA
- CSA
Introduction to Safety Valves

CIBSE approved CPD

Andy Lucas
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An introduction to Safety Valves

To give an understanding of Safety Valves used in Building Services including

- sizing
- installation
- maintenance
What are they?

**Definition (PED)**
‘a valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges a quantity of the fluid so as to prevent a predetermined safe pressure being exceeded, and which is designed to reclose and prevent further flow of fluid after normal pressure conditions of service have been restored’

**PED**
Pressure Equipment Directive 97/23/EC
- the regulation covering safety valves in Europe
- safety valves are classified PED category IV

**Standard**
EN ISO 4126 - joint European & ISO standard
BS6759 – valve manufactured to BS6759 are deemed to comply with EN ISO 4126 if no design changes
What are they?

Safety valves, as the name implies, have a specific function

*to protect equipment & personnel*

EN ISO 4126 only refers to **safety valves** & covers

- safety valves
- relief valves
- pressure relief valves
- safety relief valves
Why we need one?

4 main reasons

• blocked discharge
• external heat
• thermal expansion
• failure of pipeline component, ie control valve
Why we need one?

4 main reasons

- blocked discharge
Safety Valves

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Safety Valves

Why we need one?

4 main reasons

- blocked discharge
- external heat
- thermal expansion
- failure of pipeline component, ie control valve
Terminology

Set pressure: the pressure at which the valves starts to open, measured at valve inlet. Normally 1.1 x working pressure or working pressure + 0.7 bar for water, whichever is the greater.

Overpressure: pressure at which valve has to achieve its full discharge capacity, normally set pressure +10%.

Accumulation: pressure increase over the maximum working pressure of the system during discharge through the safety valve.
Operating states

there are 3 operating states for safety valves

1. Equilibrium
2. Fully open
3. Fully closed
Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Blowdown</td>
<td>the pressure difference between set pressure and pressure at which the valve reseats expressed as a % of the set pressure</td>
</tr>
<tr>
<td>Reseat Pressure</td>
<td>pressure at which valve is fully closed</td>
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<tr>
<td>Working Pressure</td>
<td>pressure at which the system being protected normally operates</td>
</tr>
<tr>
<td>Discharge Capacity</td>
<td>the amount of water / gas/ vapour the valve will pass at a given pressure</td>
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Equilibrium

forces acting to close are in equilibrium (balance) with the forces acting to open and the seat & disc are just in contact

defined in EN ISO 4126 as the Set Pressure

this is the point when flow is about to start

in practice flow commences as the equilibrium point is reached

P system = P spring
Fully open

the position the valve must achieve to pass its *rated capacity* at its specified overpressure

note - this is not the *Set Pressure*

different designs of valve have different relationship between flow & pressure

some designs have a rapid increase in flow for a small increase in pressure - others offer a gradual increase

\[ \text{P system} + \text{overpressure} = \text{P spring} \]
Safety Valves

Fully closed

the position when the valve has re-seated ie fully closed - *nil leakage*

the difference between the re-seat pressure & set pressure is often referred to as the **Blowdown Pressure**

the blowdown pressure will depend on valve design, the faster the flow increases on opening the lower the blowdown pressure is

\[
P_{\text{re-seat}} = P_{\text{system}} - \text{blowdown}
\]
Direct Spring Safety Valve

within Building Services the Direct Spring Safety valve is generally used

the spring is pre-compressed to apply force downwards on the disc holding it onto the seat to maintain a pressure seal

if the system pressure increases the spring force is exceeded & flow commences
Safety Valves

Direct Spring Safety Valve

adjuster
easing lever
spring
stem
bonnet
disc
seat
body

Direct Spring with easing lever
Safety Valves

Direct Spring Safety Valve

- topworks enclosure
- spring
- body
- disc
- seat
- adjuster
- lock nut
- stem
- bonnet

Direct Spring with topworks enclosure
Combined Pressure & Temperature

Direct Spring Safety Valve with temperature function

the spring is pre-compressed to apply force downwards on the disc holding it onto the seat to maintain a pressure seal

if the system *pressure* or *temperature* increases the spring force is exceeded & flow commences
Combined Pressure & Temperature

Direct Spring Combined Pressure & Temperature with easing lever

- adjuster
- stem
- disc
- seat
- body
- spring
- bonnet
- easing lever
- temperature sensor
correct sizing of Safety Valves is important

- undersize valves may not relieve sufficient quantity of system media to prevent pressure build-up
- oversized valves will partially lift at set pressure & then re-seat so could cause ‘chattering’ of the disc damaging the seat / disc surfaces

sizing affects how a Safety Valve performs
Sizing requirements for sizing Safety Valves are:

- What is the application
- What is the set pressure
- What is the discharge capacity required
Sizing requirements for sizing Safety Valves are

What is the application

• system media, ie water / steam etc
• operating temperature
• operating pressure
Sizing requirements for sizing Safety Valves are

What is the application

What is the set pressure

• the pressure at which the valves starts to open measured at valve inlet
  
  normally 1.1 x working pressure
  
  or
  
  working pressure + 0.7 bar for water whichever is the greater
Sizing requirements for sizing Safety Valves are

What is the application
What is the set pressure
What is the discharge capacity required

• the amount of water / gas / vapour required to discharge at a given pressure
Installation

installed position of the Safety Valve affects how the Safety Valve performs

*mount vertically*

- avoiding
  - long pipework runs to Safety Valves
  - valves between system & Safety Valve
  - fittings / bend between Safety Valve and system
  - installation near to pipework lateral connections
  - inverted outlet
Installation

- long pipework runs to Safety Valves

pipework losses between protected system & Safety Valve should not be greater than 3% of maximum discharged capacity pressure
Installation

• long pipework runs
• valves between system & Safety Valve

under no circumstances should valves be installed between safety Valve & protected system
Installation

• long pipework runs
• valves between system & Safety Valve
• fittings / bend between Safety Valve and system

fitting etc between Safety Valve & system affect discharge capacity & should be avoided
Installation

- long pipework runs
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Installation

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System media trapped in outlet creates a back pressure on the Safety Valve disc affecting set pressure.
Safety Valves

Maintenance

regular maintenance ensures

• Safety Valve will work when required
• life of valve
• system is correctly protected from over pressure
• compliance with insurance company requirements
Maintenance

maintenance regime should include

• the mechanical operation should be checked at **three monthly intervals** by manually operating the easing lever

  *see installation instructions supplied with valve*

• to avoid unnecessary strain on the easing gear, the valve should be under a pressure of not less than 75% of its set pressure

• where arduous conditions of service exist, more frequent testing may be required

*It is the responsibility of the user to establish the frequency of manual testing*
Safety Valves

Maintenance

the set pressure of Safety Valves should be checked every **twelve months**

- this can be carried out in situ
  - usually difficult on site as gauges need to be calibrated and system pressure needs to be varied to check set pressure
- by removal of the Safety Valve to a test facility

*before removing the valve, steps should be taken to ensure that the system has been de-pressured*
Introduction to Safety Valves

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