PIBCV
application and benefits

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3 years
Payback time
Case studies prove that investing in PIBCV’s pays itself back in less than 3 years.

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Agenda

• AB-QM PIBCV
  • Actuators
  • What is a good PICV
• ΔT in the system
  • Chiller lift
  • VFD sensor placement
  • ΔT issues
• Danfoss DSC
• Conclusion
What is a PIBCV?

**Pressure Independent Balancing and Control Valve (PIBCV):**

- Control valve
- Automatic balancing function
Applications

- AHU, Heating/Cooling
Applications

- Fancoil unit, Heating/Cooling
How does a PIBCV work

Schematic overview

Pressure controller
Control valve + Setting
How does a PIBCV work

- The top part is a control valve
How does a PIBCV work

- The bottom part is a differential pressure controller that keeps a constant differential pressure across the control valve independent of pressure fluctuations in the system.
How does a PIBCV work

- The pressure controller keeps a constant differential pressure across the control valve
- \( Q = K_v \times \sqrt{\Delta P} \)
- Constant differential pressure means:
  - Constant flow
  - Full authority
What is a good PIBCV?

- Membrane driven hollow cone type
- Stroke limitation
- Calibrating actuator
- Precise and predictable characteristic
Membrane driven hollow cone

- Hollow cone ensures easy passage of dirt
Cartridge type

- Often plastic-on-plastic or metal-on-plastic movement. Not robust.
- Small openings (easy to clog)
- Low presettings will increase clogging problems (beware of overspecified valves)
Stroke limitation
(and why you want it)

“Full stroke valves”

What they say it is

What it actually is

Calculation example:
P1-P3 kept constant by K at 15 kPa

Without presetting:
P1-P2=0
P2-P3=15

With presetting 50%:
P1-P2=7,5
P2-P3=7,5

This means, by definition: Authority ≠ 1!!
BSRIA report – Full stroke valve

Ramp 0-10-0V with fixed differential pressure and various valve % opening
Stroke limitation
(and why you want it)

• AB-QM uses the same device (control valve) to both control and limit the flow
• This is the only way you can have authority of 1
• We are using the calibration function of our actuators to compensate for the shortened stroke
• We have proven ability to control small flows (demo panel)
BSRIA report – Stroke limitation
Conclusion

A good PICV has:

• Authority 1 (so stroke limitation)
• Hollow cone membrane driven pressure controller
• Is equipped with a calibrating actuator
• Has a precise and predictable characteristic for stable control
In HVAC installations the Chiller, Fans and Pumps consume the majority of the energy needed for cooling the building.
Chiller efficiency

The COP is not constant! It depends on Load & Lift. Lift changes COP at same system load!
Preparation of chilled water

\[ T_{\text{con}} = f(T_{\text{air}}) = f(\text{weather conditions}) \]

\[ T_{\text{evap}} = f(T_{\text{cw}}), \quad T_{\text{cw}} = \frac{T_{\text{cw, sup}} + T_{\text{cw, ret}}}{2} = f(\text{cooling system}) \]
Preparation of chilled water

Low $\Delta T$ syndrome causes a LIFT increase (more work for the compressor)
When the LIFT increases, COP decreases!!!
DEN Temperature requirements - Design

6°C

T_{\text{exchange}} = 1°C

7°C

ΔT = 6°C

12°C

HEAT EXCHANGER

13°C
Traditional Control strategies

Increase pump speed for more flow
Low $\Delta T$ Syndrome!
Undercapacity for coils!

example: velocity 1m/s

$6^\circ C$  $\rightarrow$ $7^\circ C$

$9^\circ C$  $\rightarrow$ $10^\circ C$

$\Delta T = 3^\circ C$
Flow rate

0%
25%
50%
75%
100%

Cooling coil character

Overflows means lower output

100% Overflow = 10% power output

Wasted pumping range

\( \Delta T = 2^\circ C \)
\( \Delta T = 9^\circ C \)
\( \Delta T = 20^\circ C \)
Solution: Use Danfoss Pressure independent Balancing and Control Valve
ΔT: Conclusions

The Chiller is the biggest energy consumer in the system and it’s efficiency is dependent on the lift

- weather conditions (uncontrollable)
- ΔTcw
- Low ΔTcw will also cause low ΔT syndrome

- In DC systems proper flows will ensure proper temperatures
- Proper ΔT in the system will prevent fines and reduce energy bills

The efficiency is therefore heavily dependent on providing the correct ΔTcw which can only be achieved with proper hydronic balance

Increased energy consumption when $T_{cw}$ drops for 1ºK
Future developments of PIBCV
4 system components combined in 1 actuator

**Actuator**
NovoCon® is a highly accurate multi-functional actuator

**Flow indicator**
NovoCon® indicates flow through the AB-QM valve

**Bus communication device**
NovoCon® enables more than flow control via Fieldbus

**Data logger**
NovoCon® stores data to compare building performance
Direct bus communication

OLD vs NEW

BMS → Controller → Servomotor

Direct 2-way

BMS → Bus actuator
Benefits of integrated bus communication

- Conventional
- Bus actuator
Benefit: Remote setting of design flow
Benefit: Remote features

- Flushing program
- De-air program
Time to close ceiling: Conventional

- Install PIBCV
- Fill the system
- Flush
- De-air
- Pre-set
- Install actuator
- Close the ceiling
Time to close ceiling: Bus actuators

- Install bus actuator +PIBCV
- Close the ceiling

Afterwards by BMS
- Flush
- De-air
- Flow setting
Spread the workload

- NovoCon®
- Conventional
Remote status feedback

- Error: No signal
- Error: Calibration
- Warning high temperature electronics
- Warning abnormal supply voltage
- Closing error due to obstruction
- No 0-10V control signal
Conclusion

• PIBCV = Pressure Independent Balancing and Control Valve
• PIBCV ensure proper balancing and control
• Both chiller installations and District Cooling systems benefit from PIBCV’s because of precise ΔT
• In the future installations will be more connected
• Bus connected actuators will be the next trend