TA HYDRONICS

Design & Commissioning : Theory to Reality

Total Balancing Solutions for the Hydronic System



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Issue 1, 02/10/2012

IMI plc in brief

- **Dynamic international engineering business**
- **17,000 employees world-wide**
- **Five platform businesses**

Merchandising Systems
Increasing impulse sales at the point of purchase





Severe Service
Leading the world in severe service valves



IMI



Beverage Dispense
Providing choice and value in beverage dispense systems

Indoor Climate
Perfecting indoor climates throughout the world



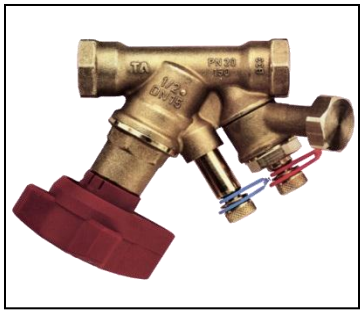
Fluid Power
Automation through fluid power

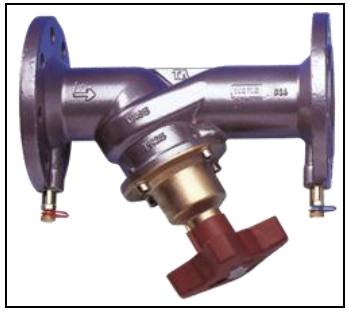
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The worlds number 1 manual balancing valves

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- The TA brand is world market leader in manual balancing valves for waterborne heating and cooling systems



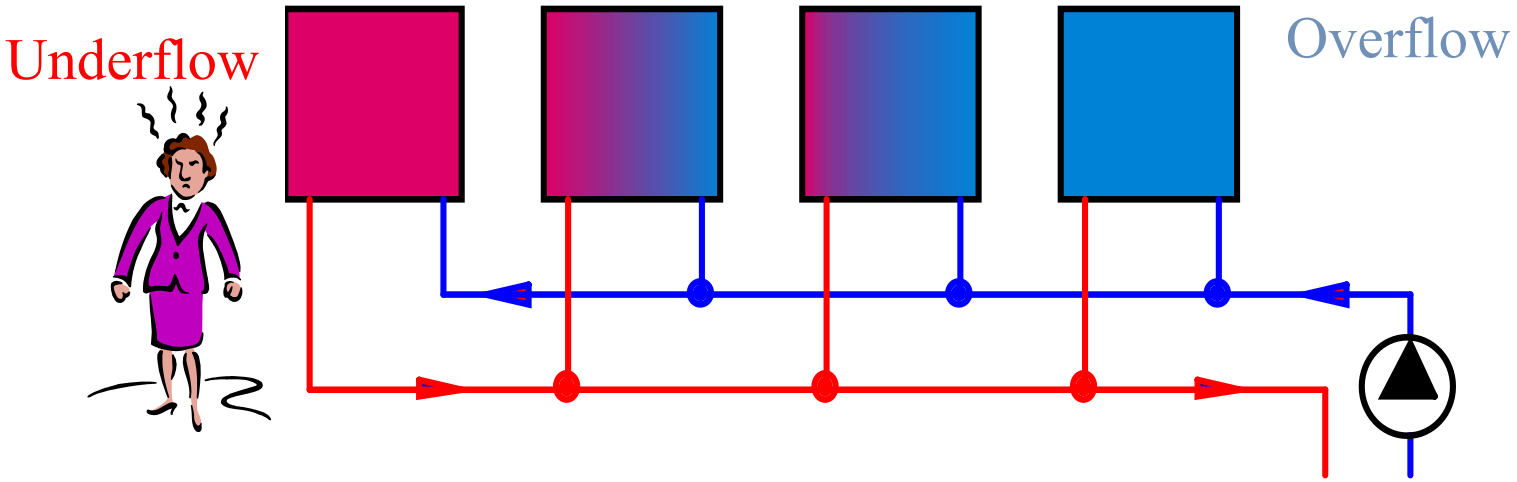




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Introduction: Hydronic Balancing

Without hydronic balancing, the first circuits are in overflow creating underflows in other circuits. 3-way and 2-way control valves cannot solve this problem.



The startup time will be longer for the last circuits. Overflows do not result in higher power output of the terminal units.

Moreover, the total flow will be higher than what is normally required !

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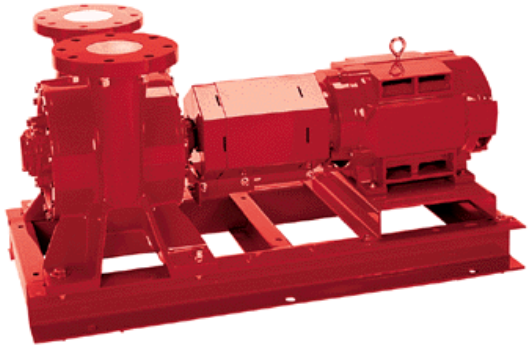
Simulator
ENGINEERING ADVANTAGE

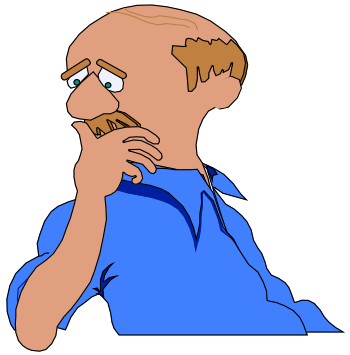
Variable speed pumps often don't deliver expected savings

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- Variable-speed pumps are selected to save energy.
- The pump accounts for up to 20 % of the total energy used.
- Most variable-speed pumps use **30% to 50%** more energy than required because of the **difficulty in finding the correct pump head set-point**.



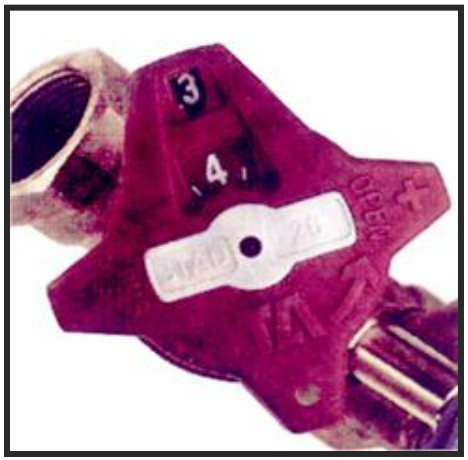




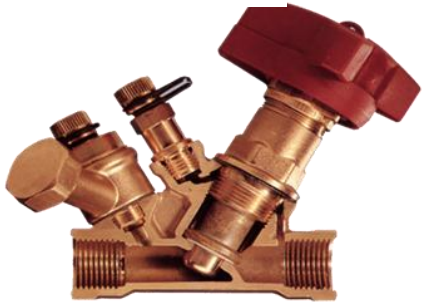
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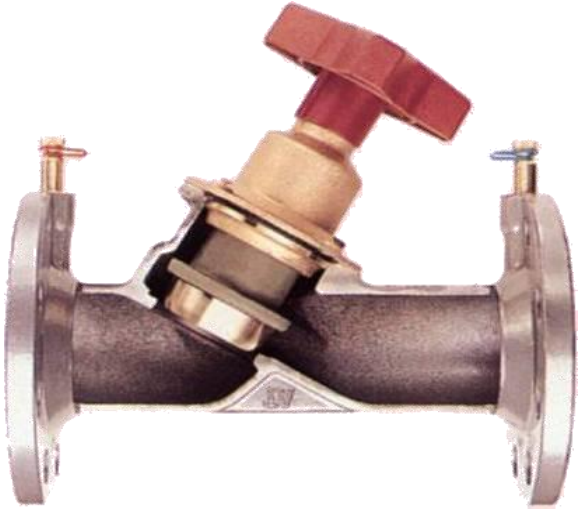
Computerized Testing & Balancing System





Handwheel with digital indication



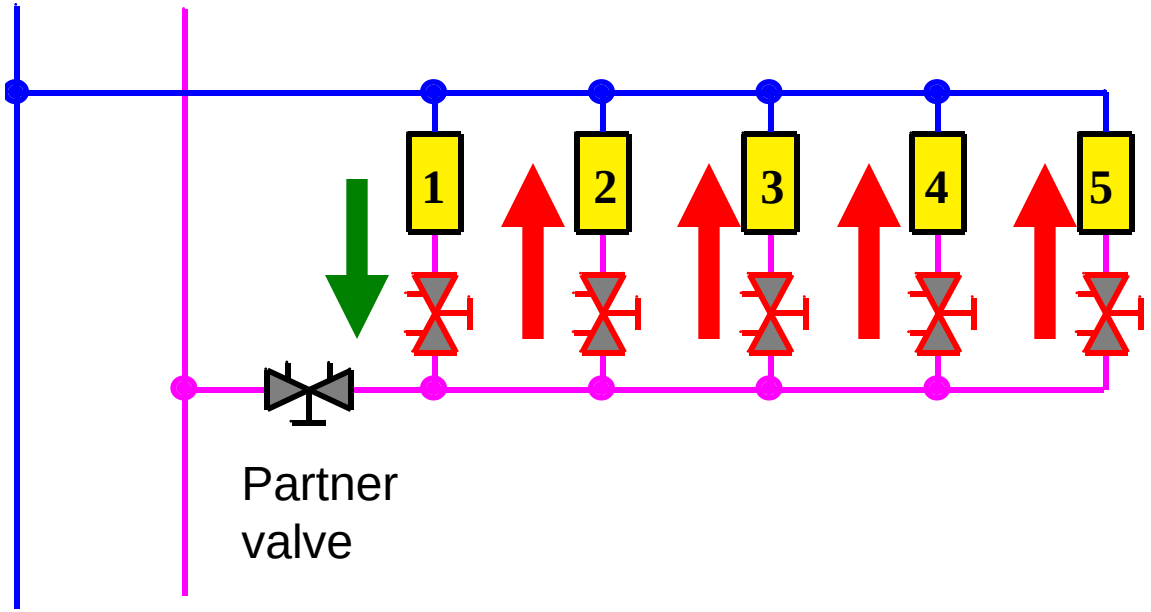


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Trial and error method impossible because of interactivity

- The iterative method (trial and error) quickly becomes a nightmare because of **hydraulic interactivity**



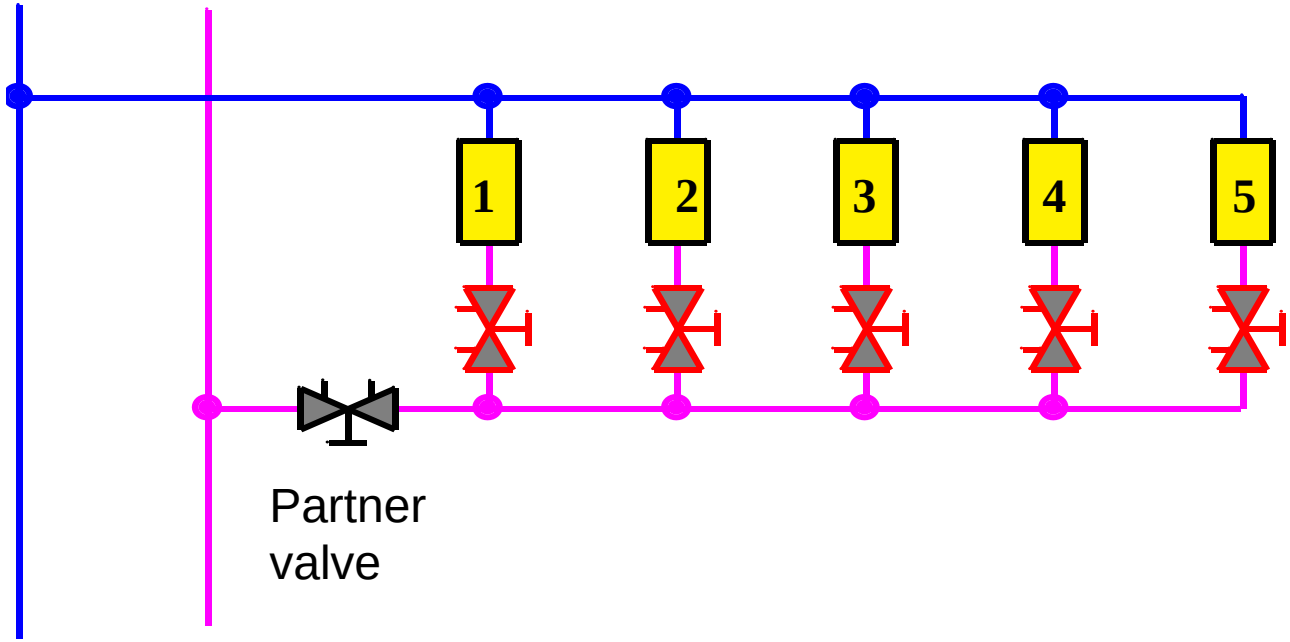


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TA Diagnostic with TA Scope - Balancing procedure

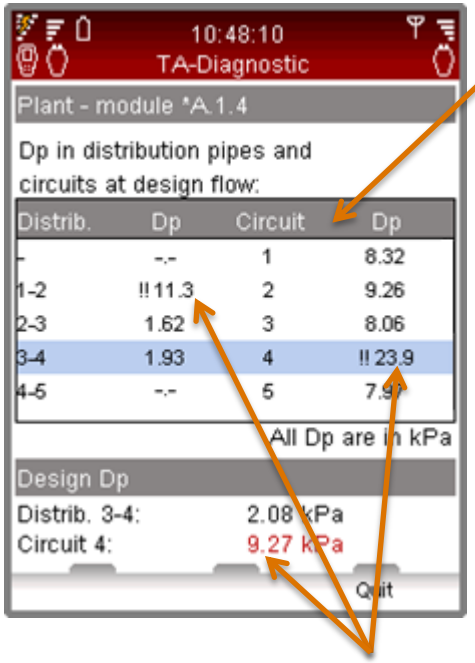
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1. Measure the pressure drop (50% open or the pre set value)
2. Shut the valve, measure the pressure drop.
3. Re-open the valve (50% open, or pre set value)
4. Enter the design Flow, then go to next valve.

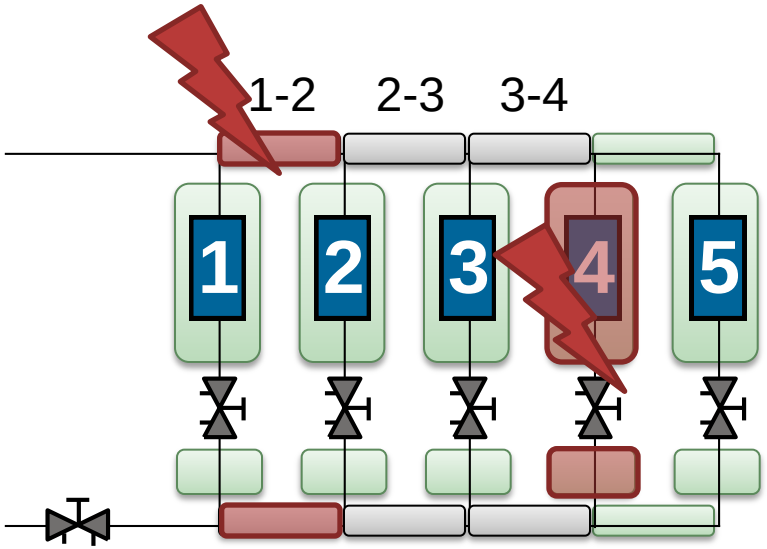


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TA-Diagnostic: viewing Dp diagnostic



Dp "map"=
Dp when/if design flows will be obtained:
- in distribution pipes (supply+return)
- in circuits (excl. bal. valve)



Double ! indicates Dp that do not match hydronic circuit calculations performed with TA Select 4
(If no calculation was performed, there is no !! marking)

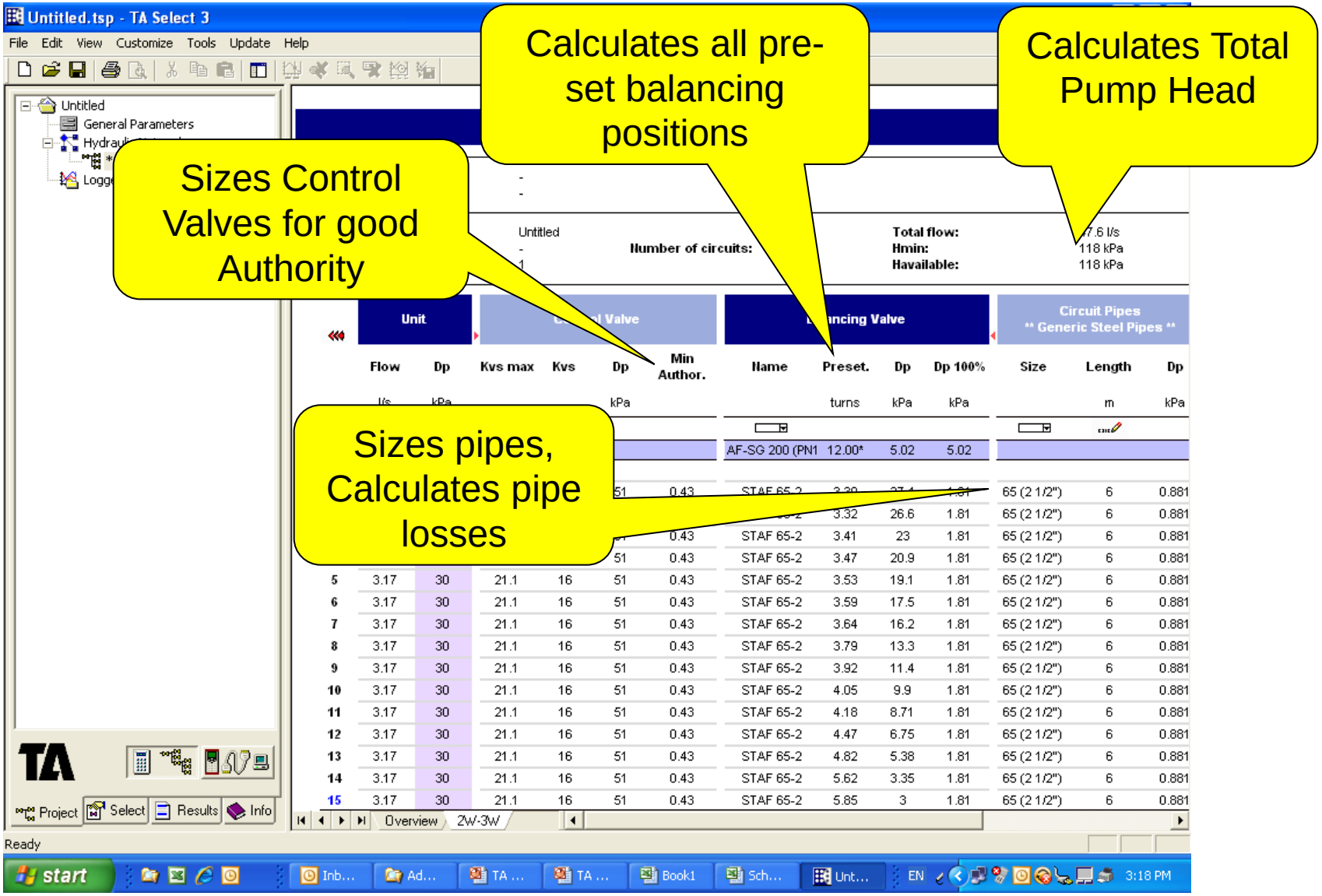
Note:
TA Diagnostic method allows obtaining flows within ±10% of the design values (due to valve, instrument and installation accuracy).

Dp are thus diagnosed with an accuracy of about ±20%.

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Revolutionary TA Select 4 = Design & Pre-set Balancing

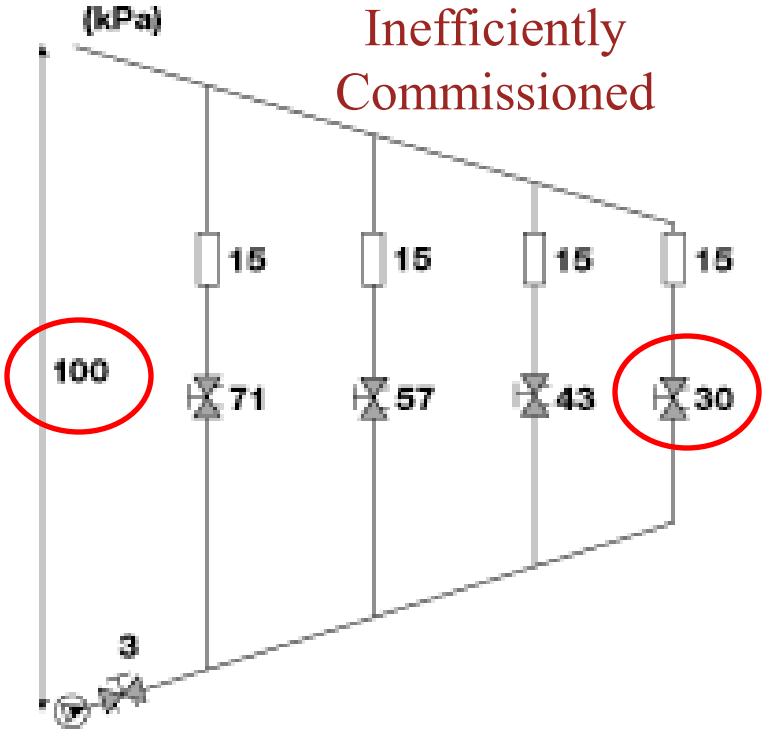
TA HYDRONICS

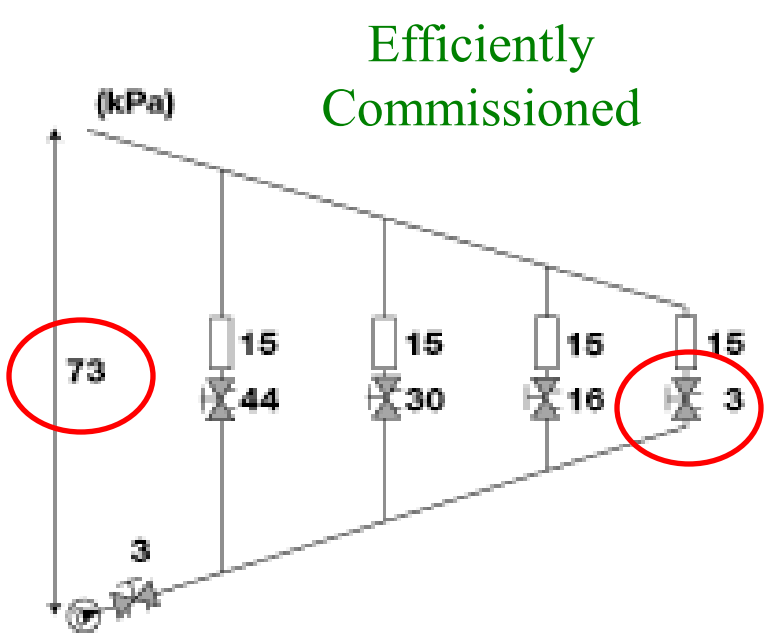


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Incorrect balancing will waste energy

- Correctly balancing, firstly determines the index (most high resistance circuit), sets that balancing valve to only 3kPaD, then balances parallel circuits relatively.
- At the last stage the VSD is manually reduced and the optimum set-point



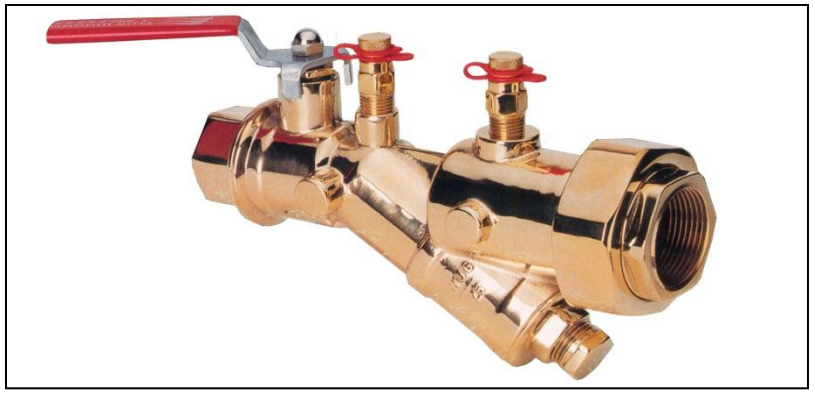


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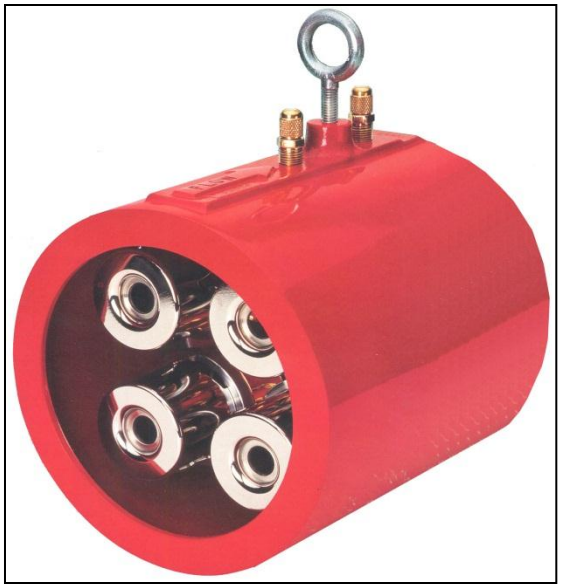
TA Autoflow Automatic Balancing Valves

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- AC & YR Models
- 15 – 50mm
- Accessible cartridge for small pipe sizes



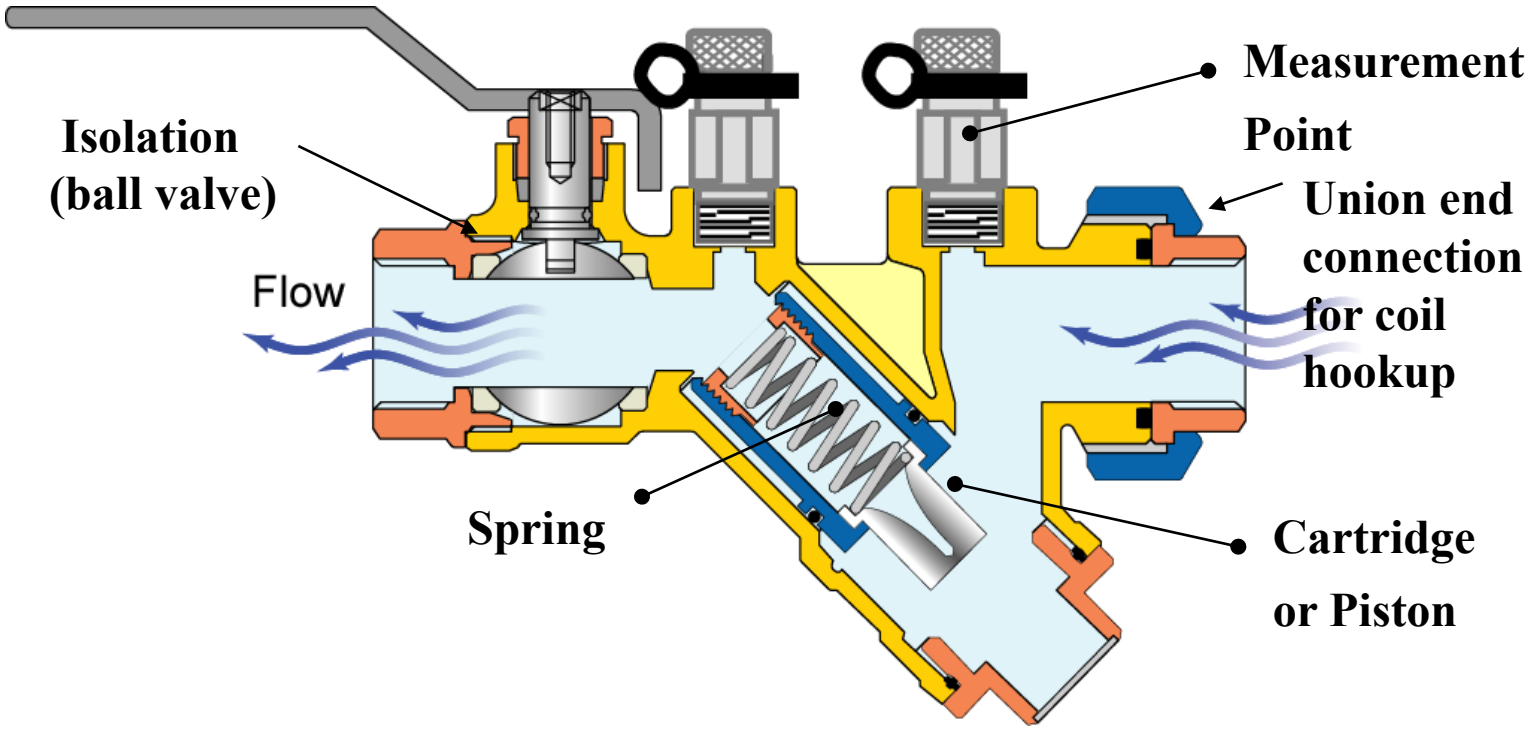
- WS Wafer
- 50 – 350mm
- Uses multiple 80mm cartridges for cost effective large pipe sizes



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TA Autoflow AC Model – 15 – 50mm

- DZR brass body with BSP threaded ends.
- Series 300 Stainless cartridge and spring



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Fully “AUTOMATIC” operation

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- The Automatic Flow Limiter Balancing Cartridge.
- Factory preset valves that require no onsite adjustment.



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Flow limiter– advantages and drawbacks



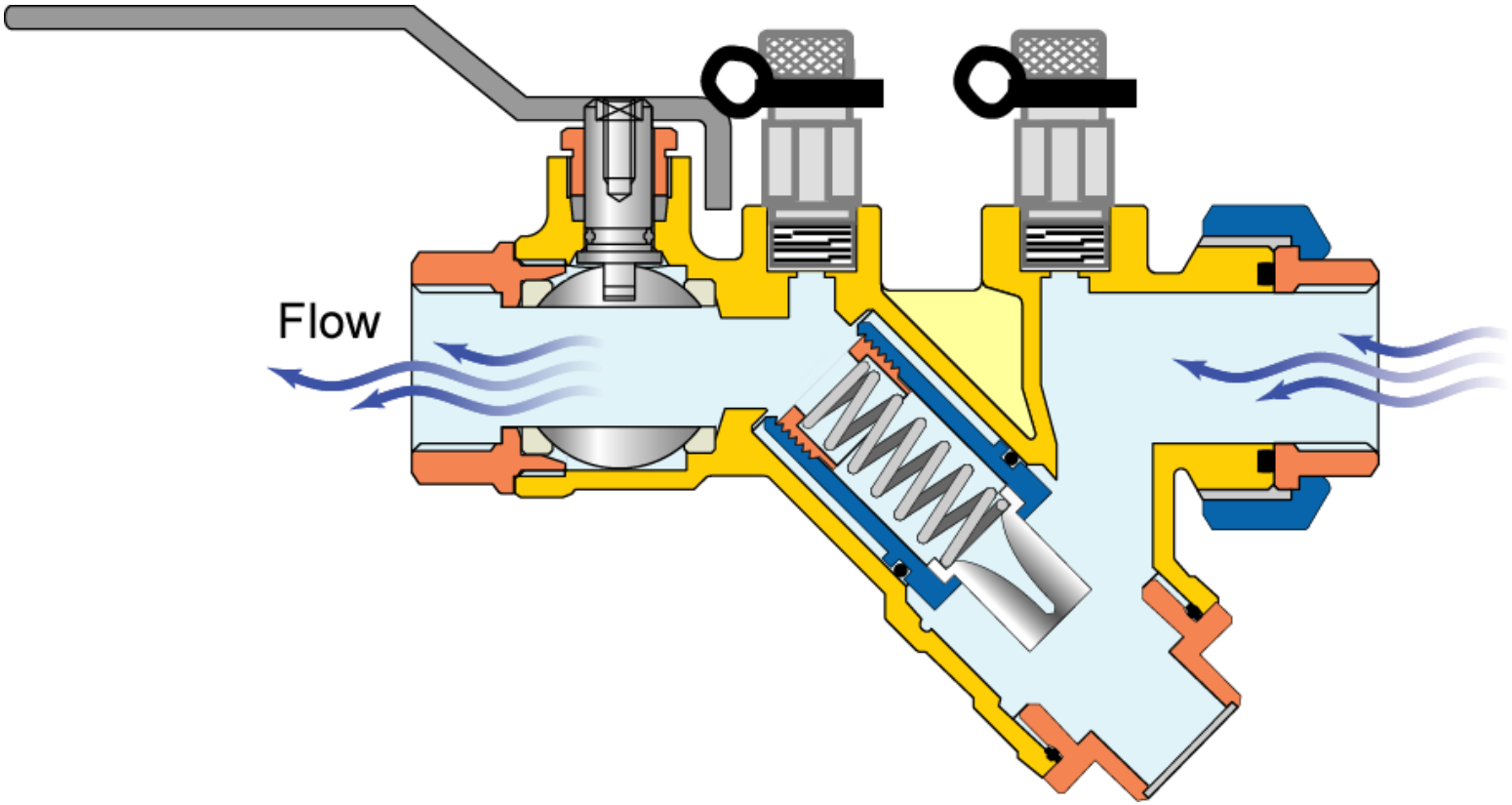
- No water balancing required



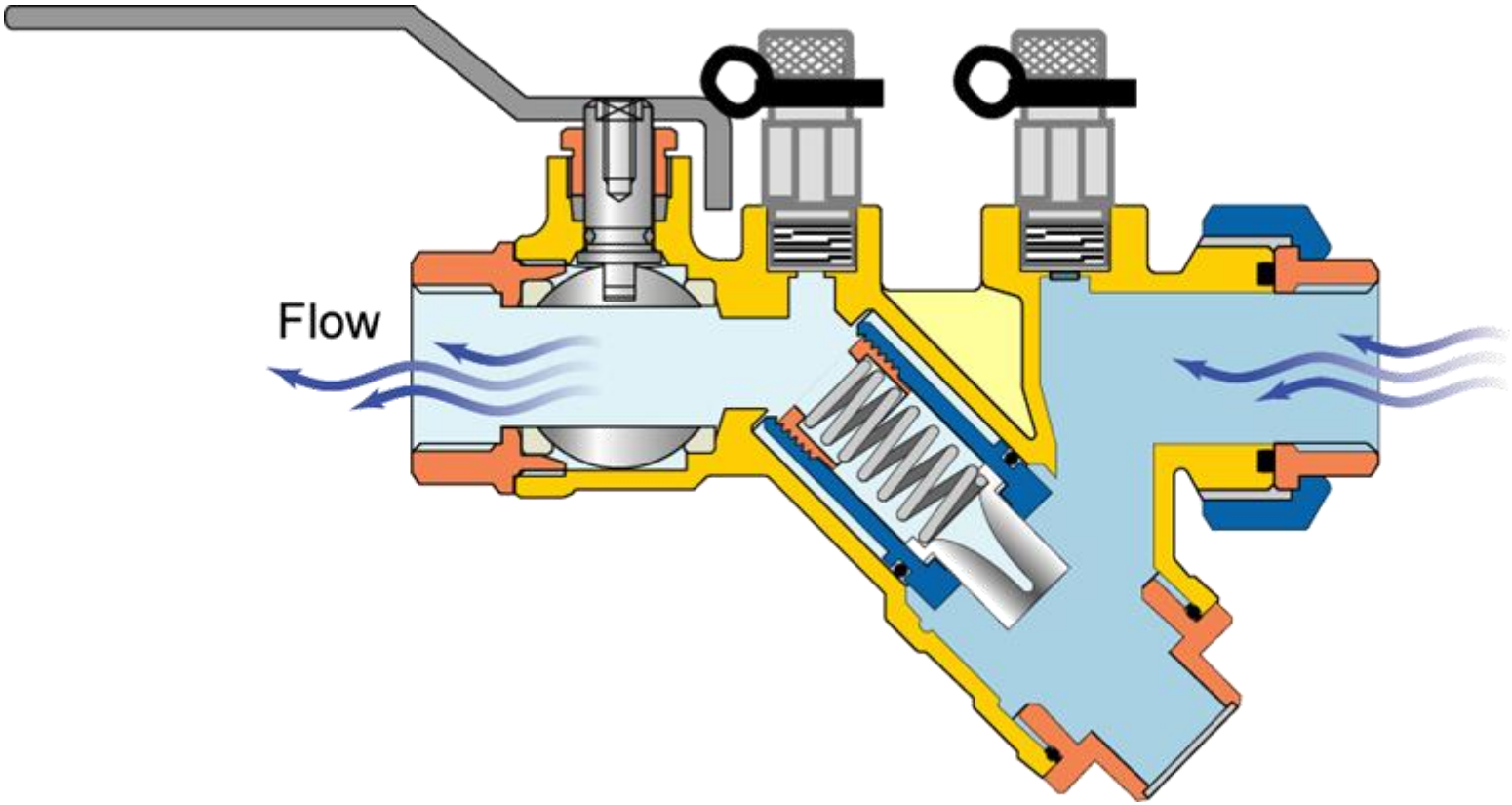


- No possibility to measure direct flow reading, only ΔP
- No troubleshooting possibility
- Conflict with modulating control valve
- Chokage
- Wrong valve installation

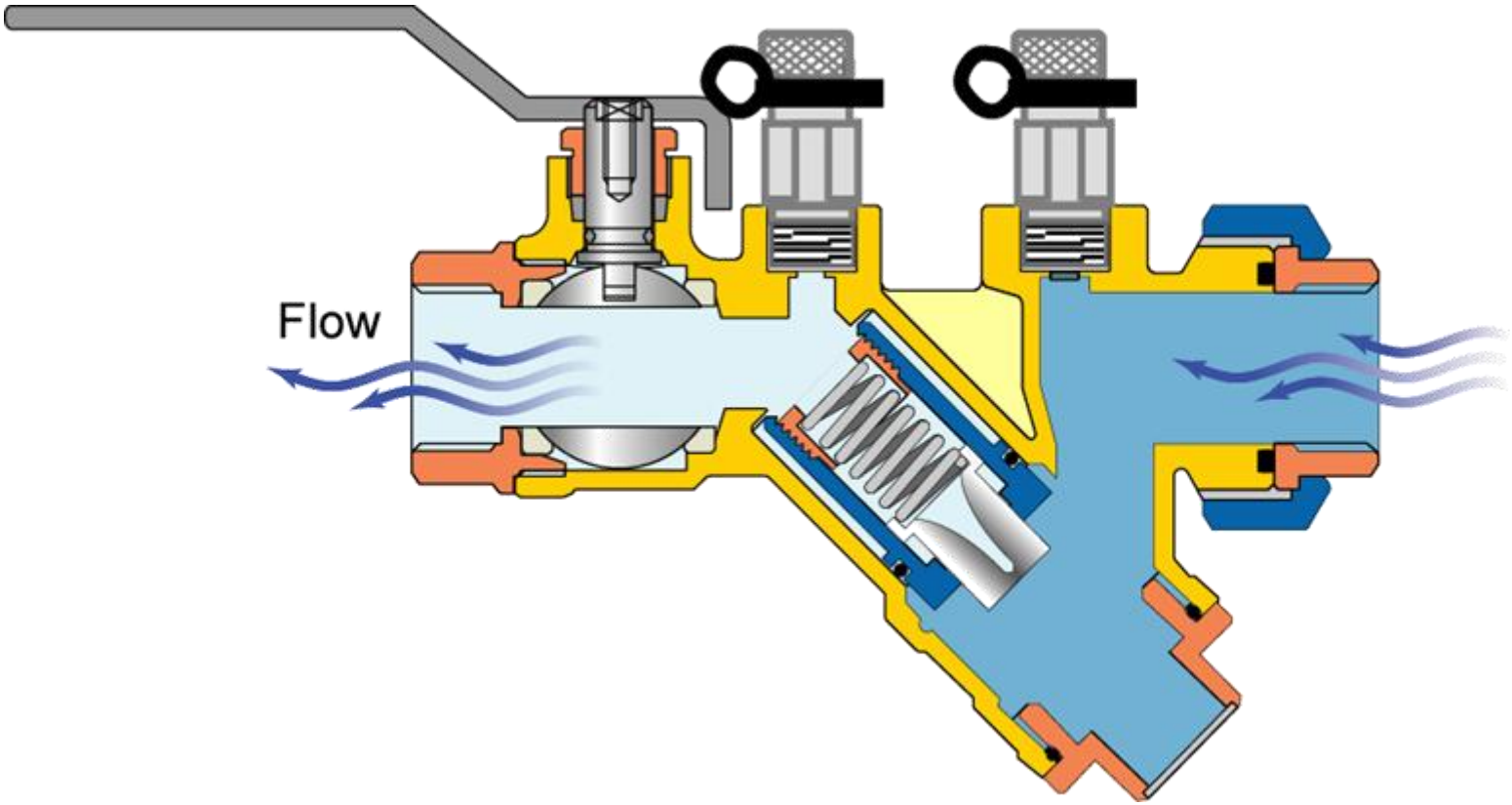
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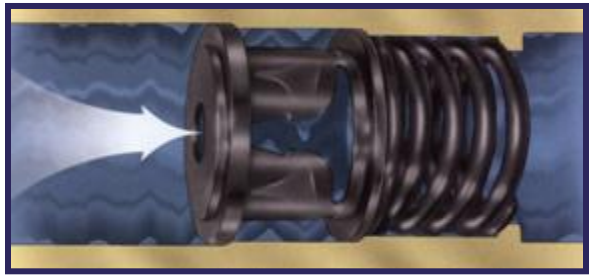


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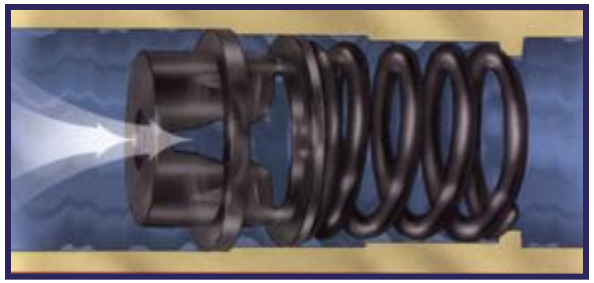
Automatic flow limiting operation

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- Example for 14 to 210kPaD range cartridge.



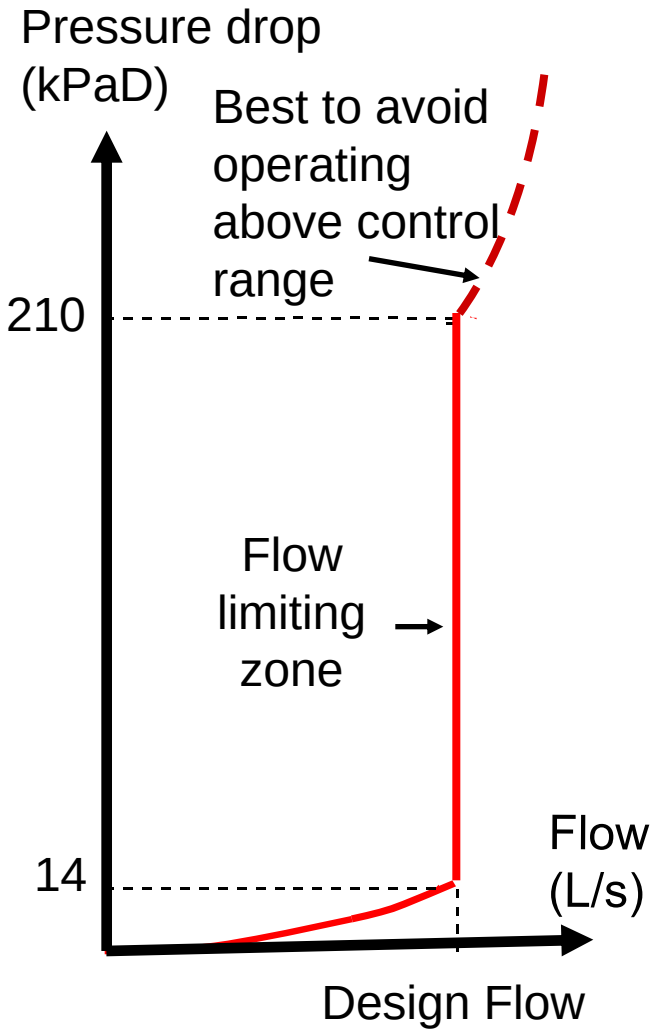
Above maximum differential pressure the piston fully compresses & acts as fixed orifice.



Within differential pressure range, piston responds limit to design flow ±5%.



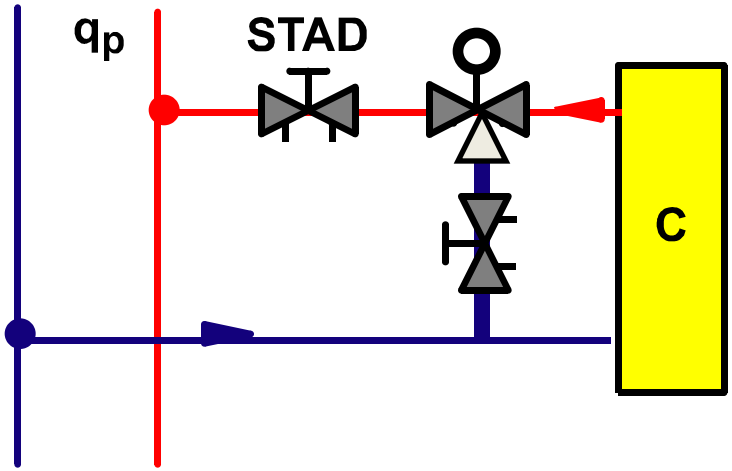
Below minimum differential pressure piston fully extends & acts as a fixed orifice.

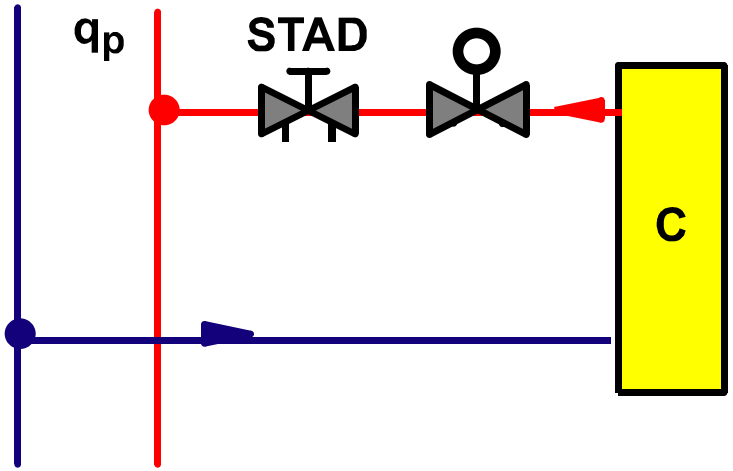


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Problems of variable flow systems

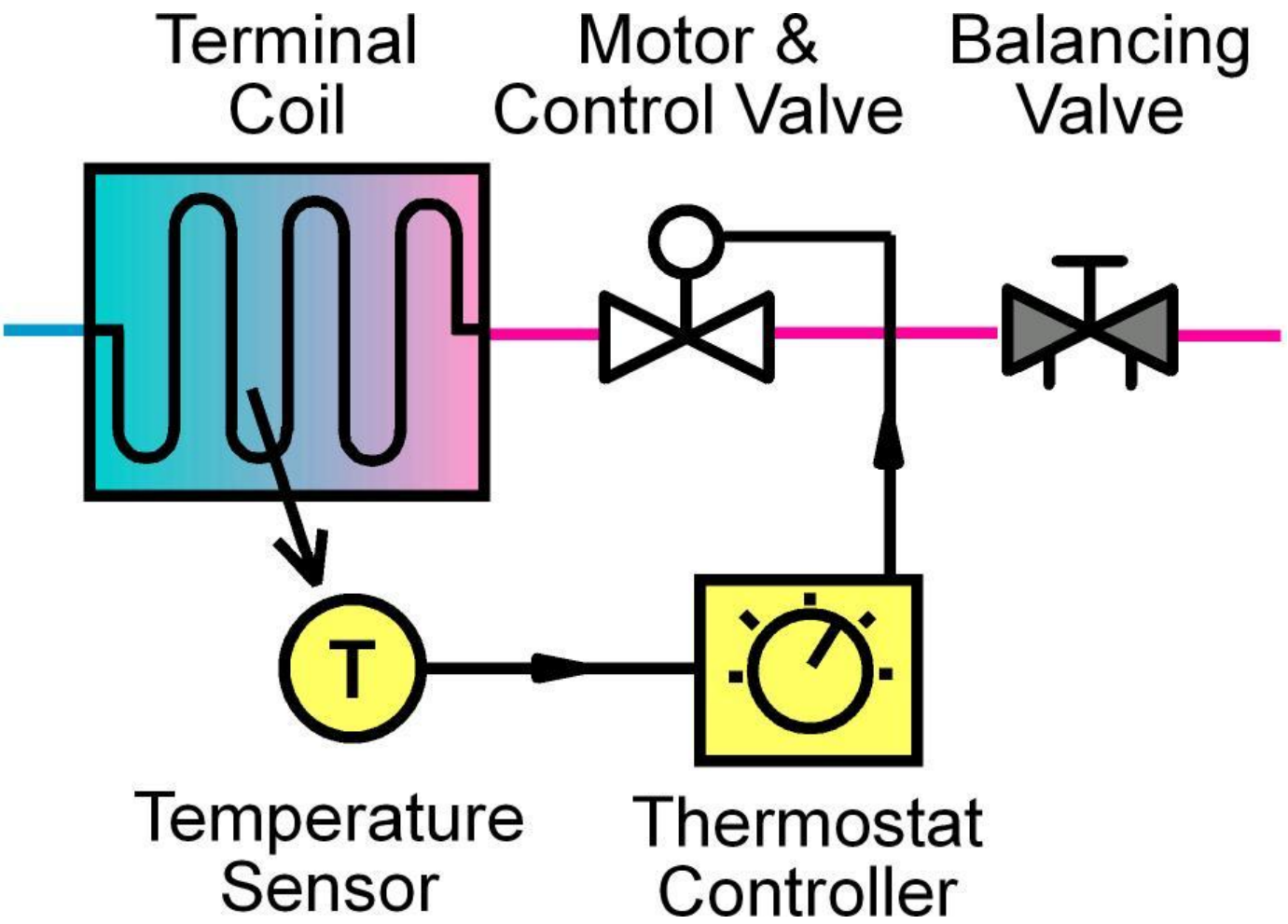
- There is a move to 2-way control valve variable flow systems instead of 3-way constant flow systems for the following reasons.
  - Lower pumping costs & Lower capital costs because of diversity factor
- However it introduces performance disadvantages :
  - Variable system pressure differentials due to changing pipe flows
  - Difficulty maintaining stable temperatures
  - Control valves cannot shut against high pressure differentials
  - Actuators burnt out after only a few months
  - Noise for hotels, hospitals and apartments





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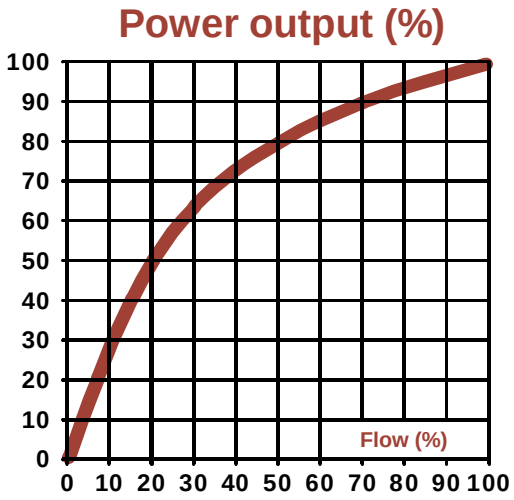
The Total Control Loop



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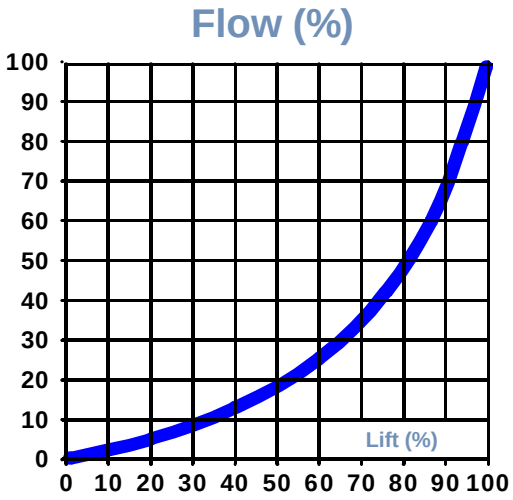
Theory of Modulating 2-way control for variable flow

- In THEORY, the characteristics of the coil and the control valve combine to provide a linear relationship between thermostat signal and power output of the coil.
- This theory is based on ***assumption of constant pressure differential on control valve*** – ie 100% control valve authority.



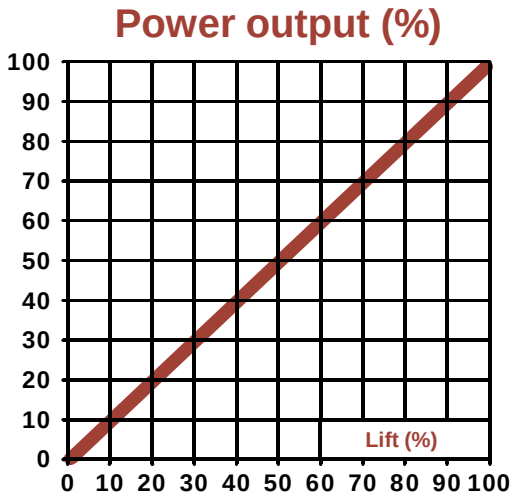
Typical cooling coil characteristic

+



EQM 2-way valve characteristic

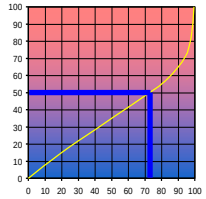
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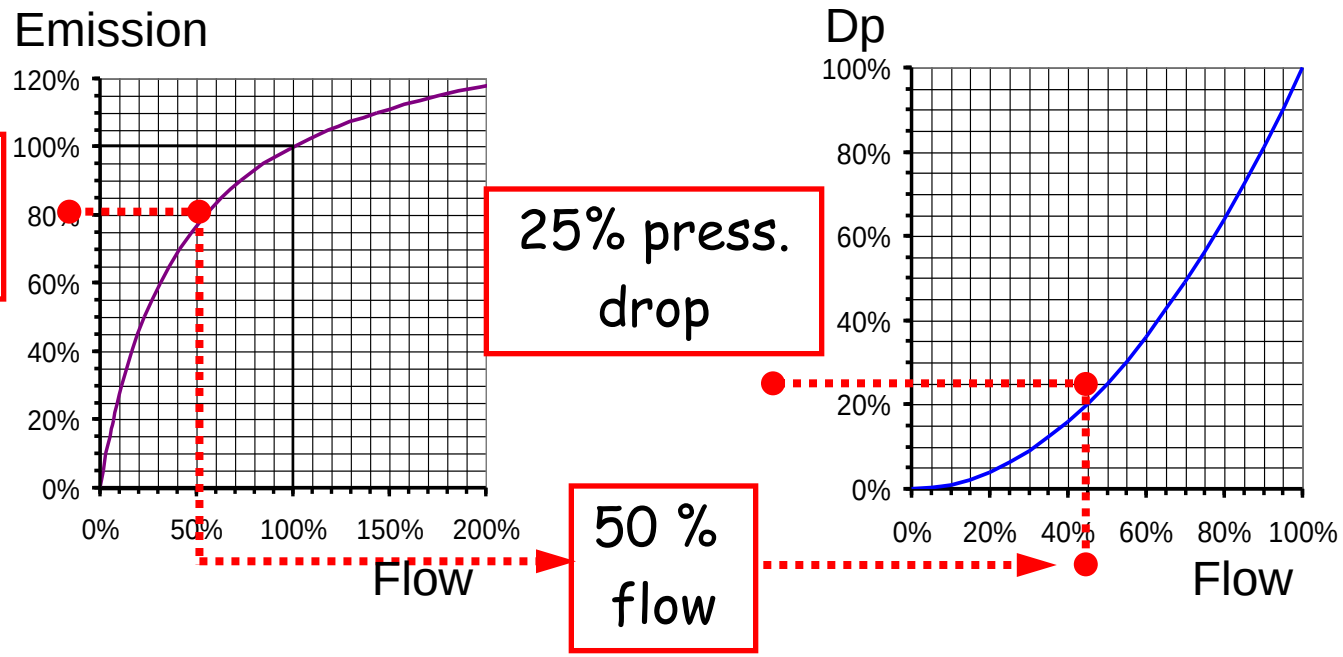
Combination of both characteristics

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Differential pressure variations



Half-load and below represents a considerable fraction of the cooling/heating season



80 % load

25% press. drop

50 % flow

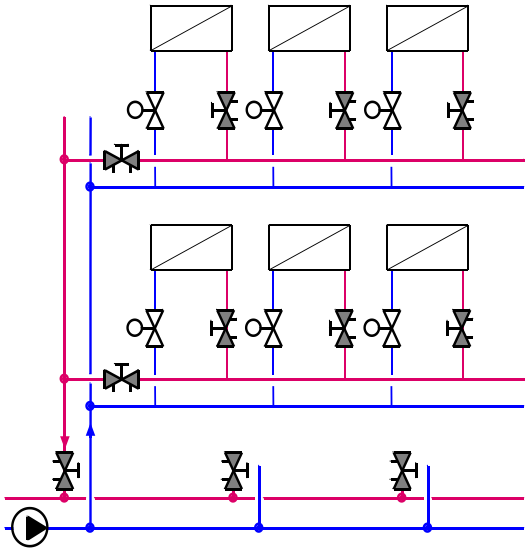
$$\Delta P \propto q^2$$

Pressure drops reduced to 25% of their initial value.

The whole pump head applies itself on the 2-way control valves.

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2-way control valve authority



$$\beta = \frac{\Delta P_{\text{Control valve fully open and design flow}}}{\Delta P_{\text{Control valve fully shut}}}$$

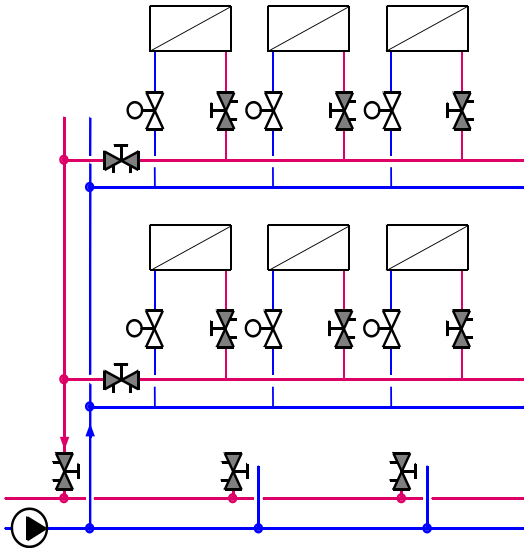
Constant as soon as the valve Kvs is chosen.

Variable, depends on the flow, thus also on the opening of all the other control valves.

In a *variable* flow distribution, the authority of a control valve is *variable.*

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2-way control valve authority



$$\beta = \frac{\Delta P_{\text{Control valve fully open and design flow}}}{\Delta P_{\text{Control valve fully shut}}}$$

The **available ΔH** in a given location is:

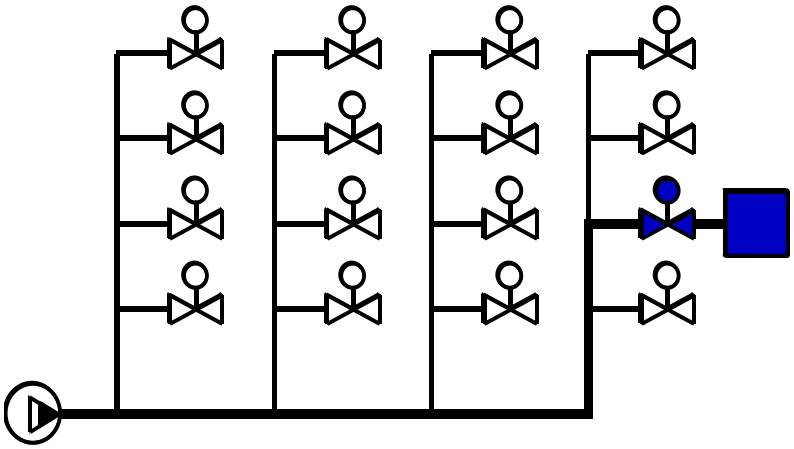
- minimum under design conditions,
- maximum at min. flow of the plant
  ≈ Pump head

The **authority of 2-way control valves** is thus:

- maximum under design conditions,
- minimum at min. flow of the plant

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Example:

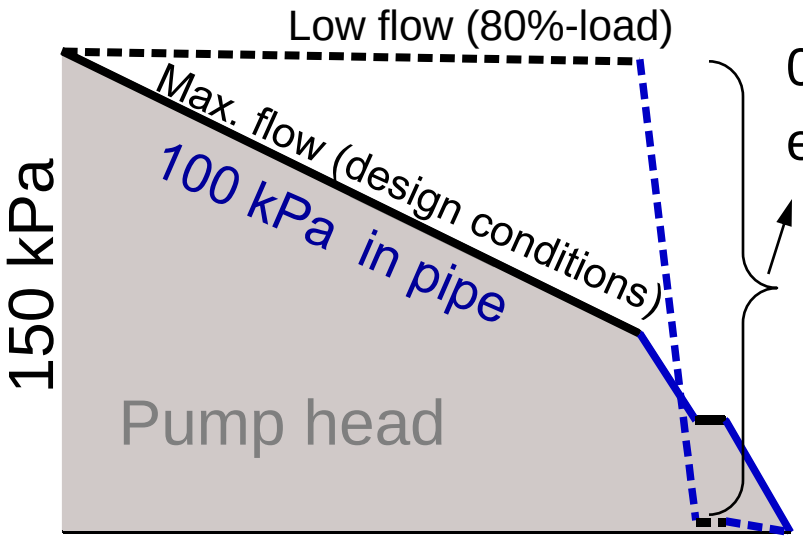


Authority in design conditions:

$\beta \approx 20/(20+30) = 0.4$

Authority at 80% load:

$\beta = 20/(20+30+0.75*100) = 0.16$!



0.75*100 Kpa +0.75*30 kPa ≈ 97.5 kPa in excess in the valve at 80% load

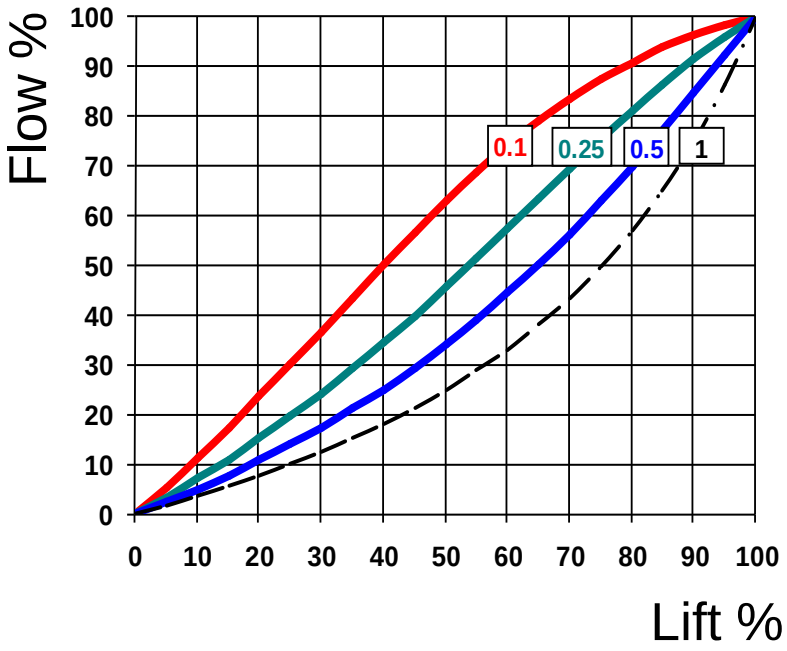
20 kPa in the valve

30 kPa in the coil

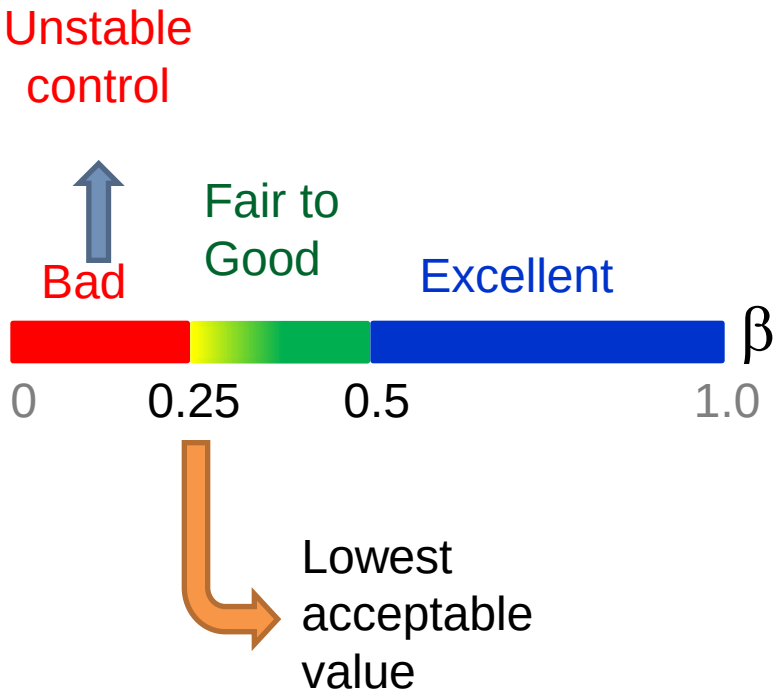
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Distortion of valve characteristic

The lower the authority,
the larger the Dp variations on the control valve,
the larger distortion of the valve characteristic



Control valve with Equal-percentage characteristic

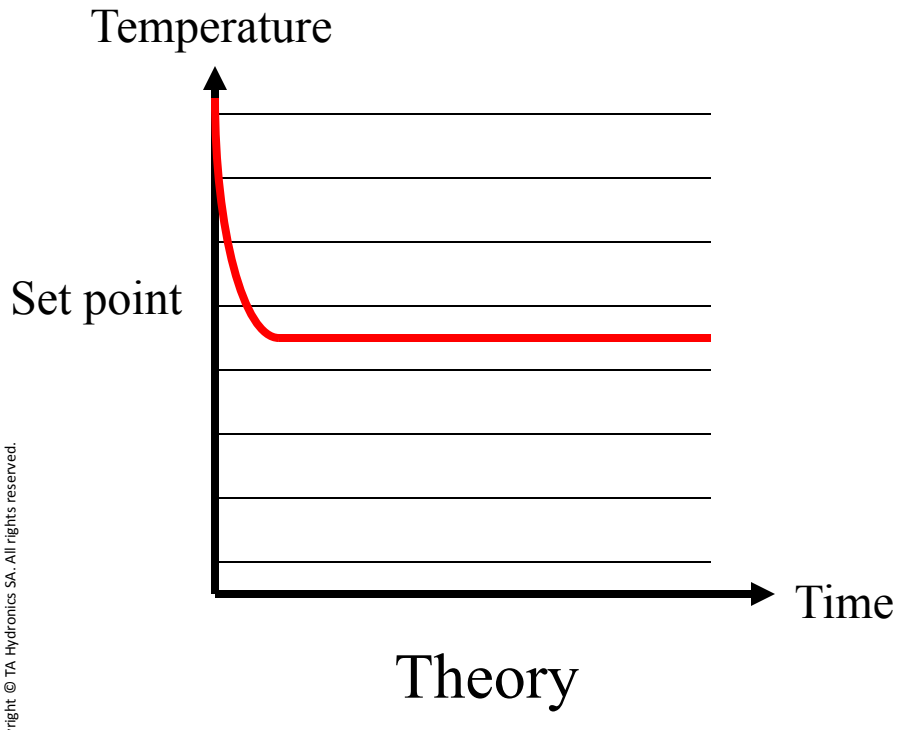


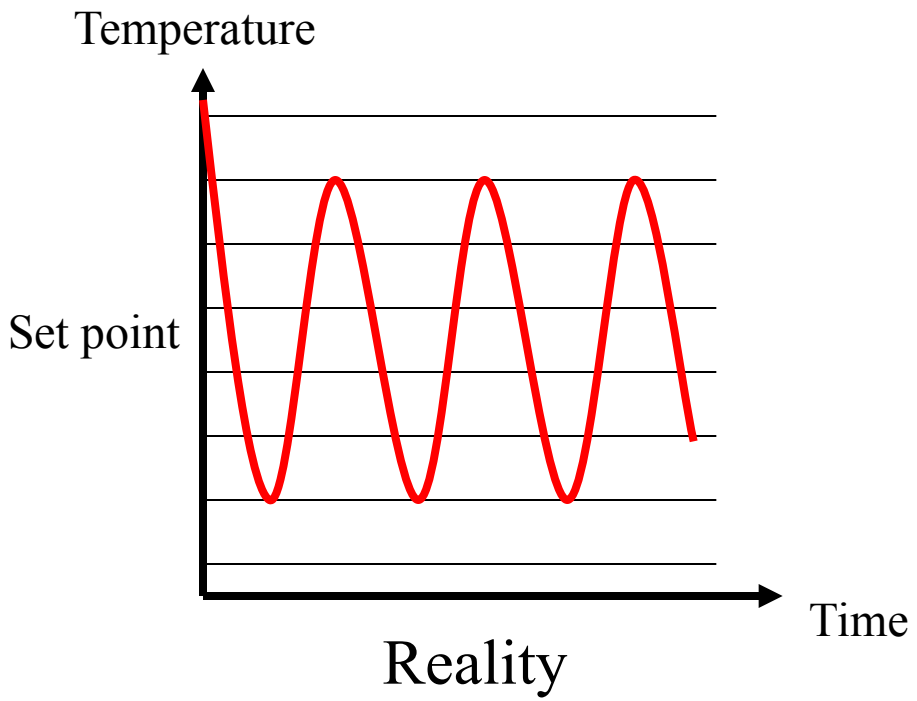
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Poor Authority variable control has unstable temperature!

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- Poor authority due to variable pressure differential causes expensive modulating 2-way valves to act like cheap on/off valves.
- Result : temperature is fluctuating up and down.





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Applications

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How does a differential Pressure control valve work ?

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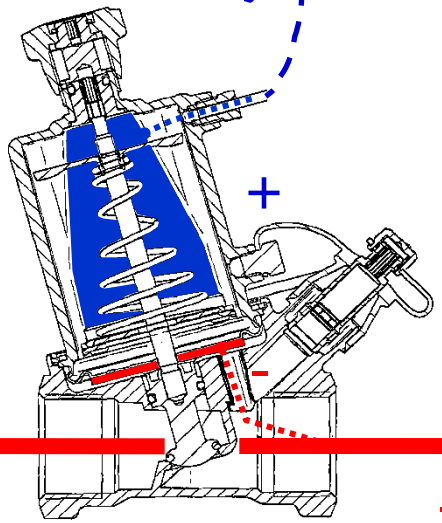


Pressure connection, dP & flow testing, verification & isolation

DH

Varies for example between 8~25mH2O

\+



\+

\-

DP Stabilized : example : 6mH2O

Differential Pressure controller

\-

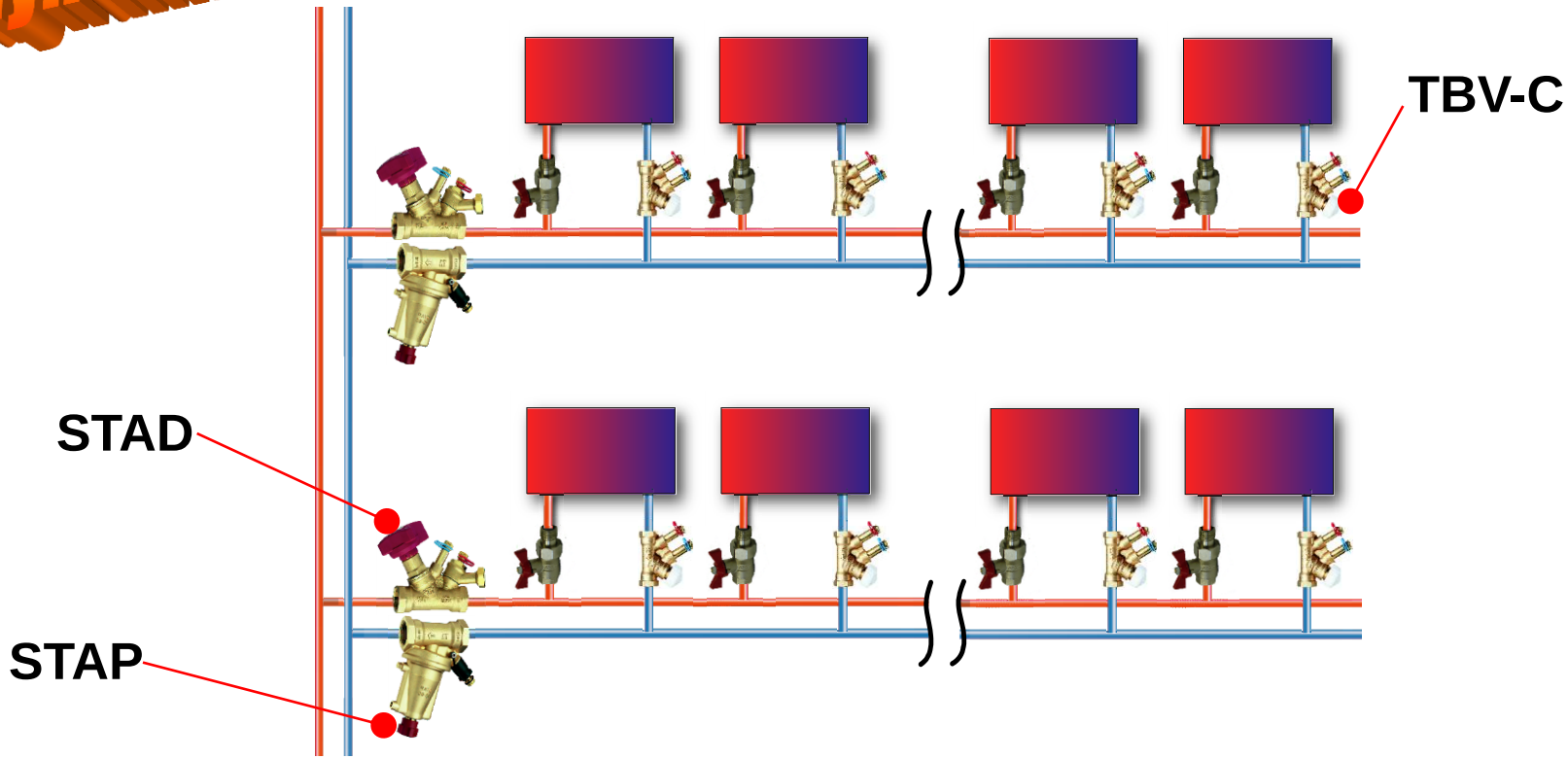
All excess differential pressure automatically dissipated with durable dP Controller to balance dP & system flow

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Dp control on branches of terminal units

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The dynamic branch



Excellent performance/cost ratio.

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For large expensive critical Air Handling Units

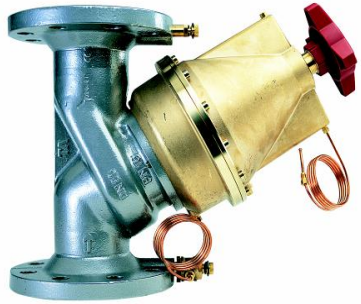


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Conclusion

Differential pressure controllers will be used:

- To give guaranteed good minimum authority to control valves
  - with a lower required pump head (pumping cost)
  - without expensive discomfort (chiller energy cost)
- To minimize the risk of noise generation
- To allow close-off of control valves with standard ranges of actuators
- In evolutive plants or for plants that are balanced in stages



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Conclusion

With TA Solution for variable flow distributions, energy savings will be obtained:

- By optimizing the VSP set-point through a systematic TAB procedure
- By minimizing the design required pump head
- By sizing control valves for good controllability
- By locating the ΔP sensor to the index location for lower VSP set-point at part load conditions with ΔP control valves

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