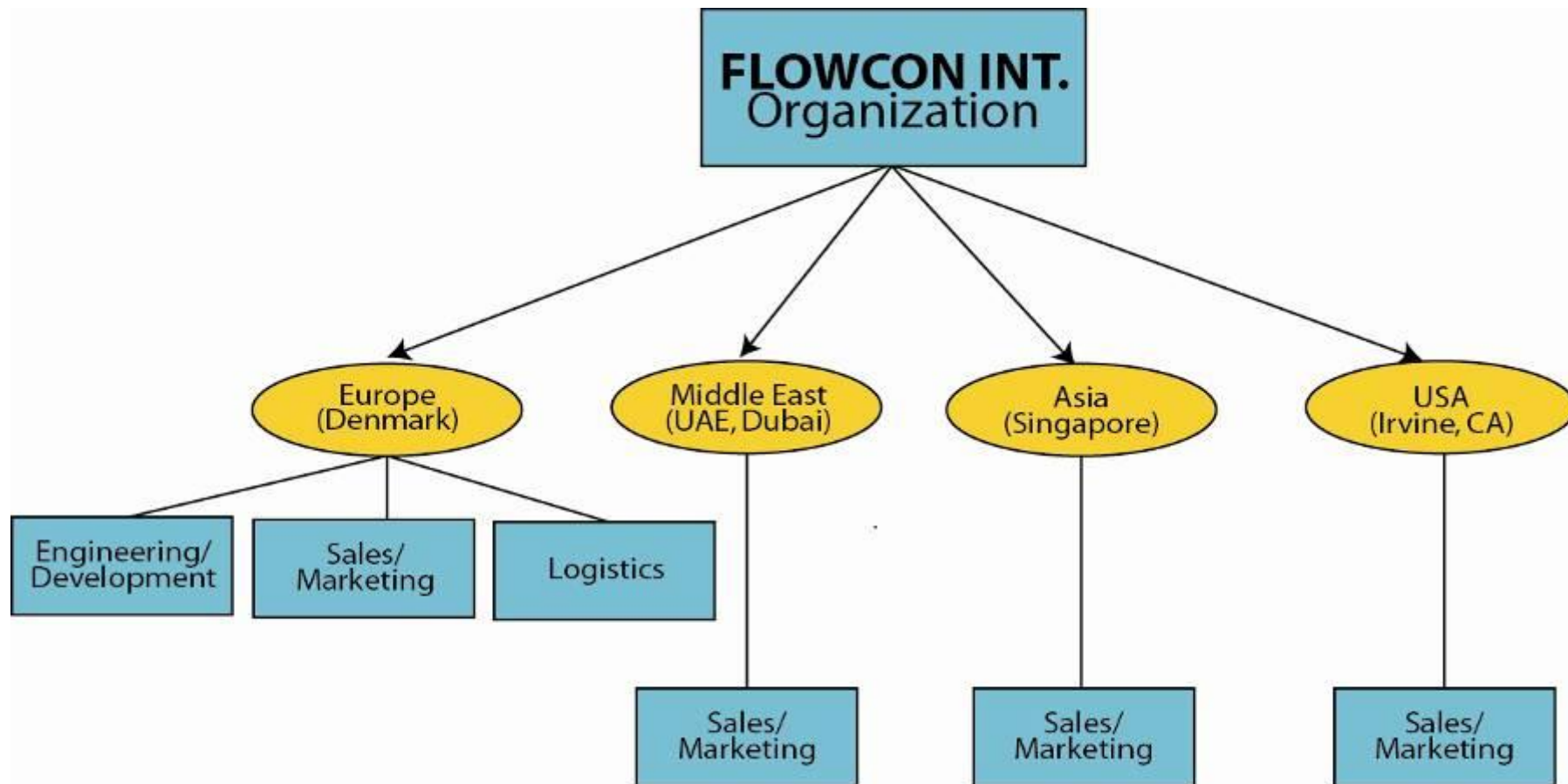


Dynamic Balancing the FlowCon way...

By Thomas Larsen,
Regional Sales Manager,
FlowCon International A/S

FlowCon Organization



ISO 9001:2000

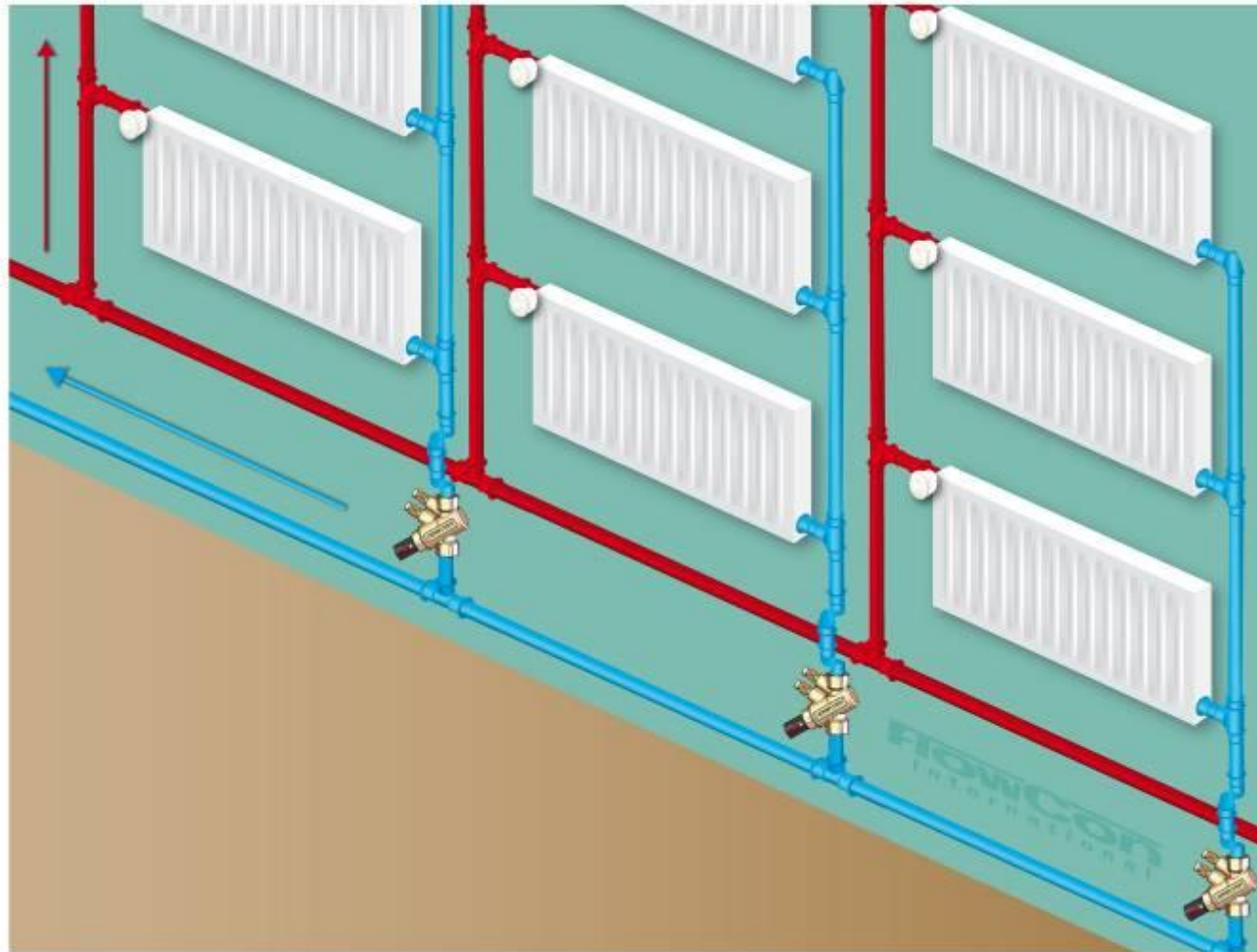


The FlowCon Objective

To provide accurate automatic flow distribution of chilled and heated water through hydronic HVAC* systems.

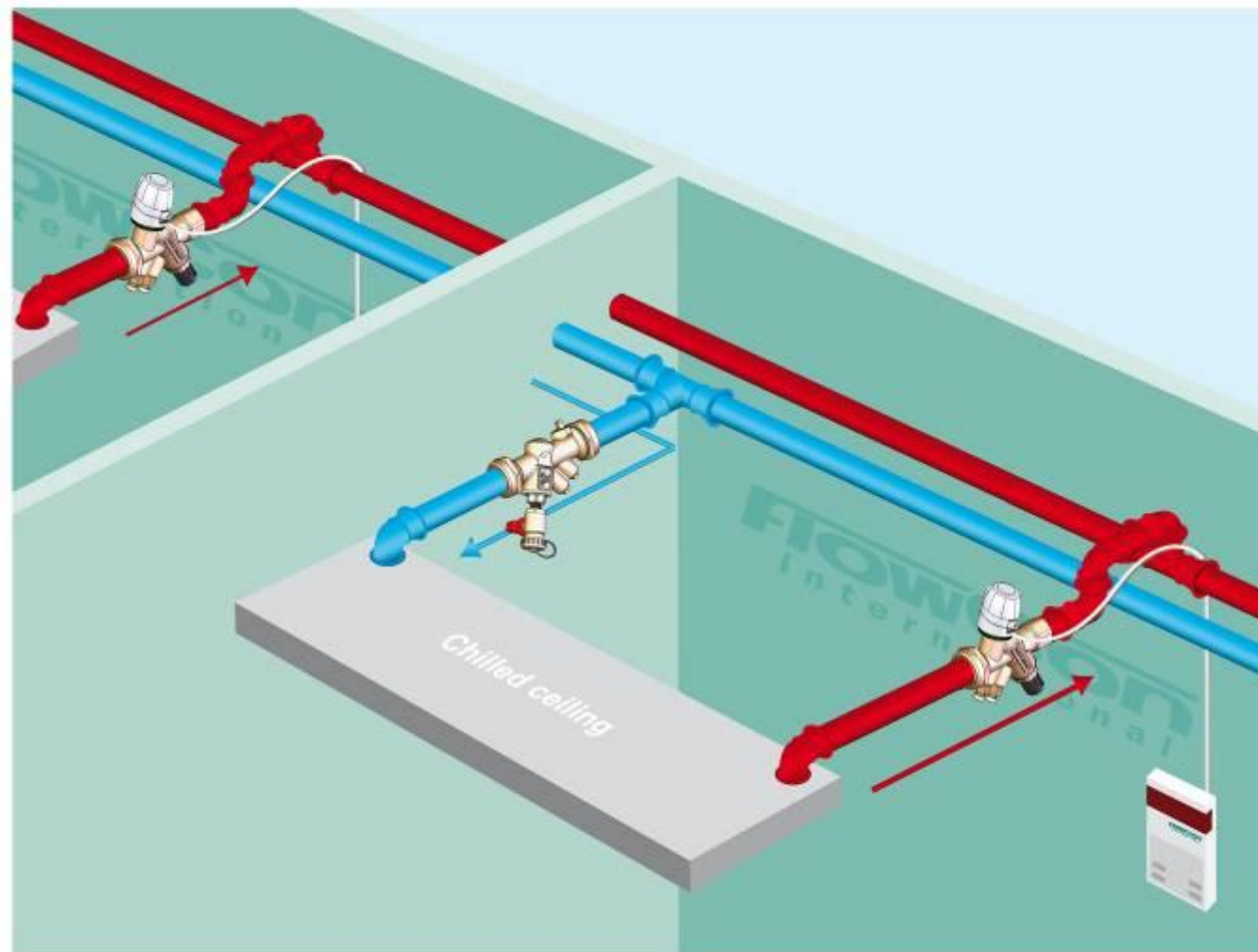
* HVAC = Heating, Ventilation & Air Conditioning

Example of where to install FlowCon valves



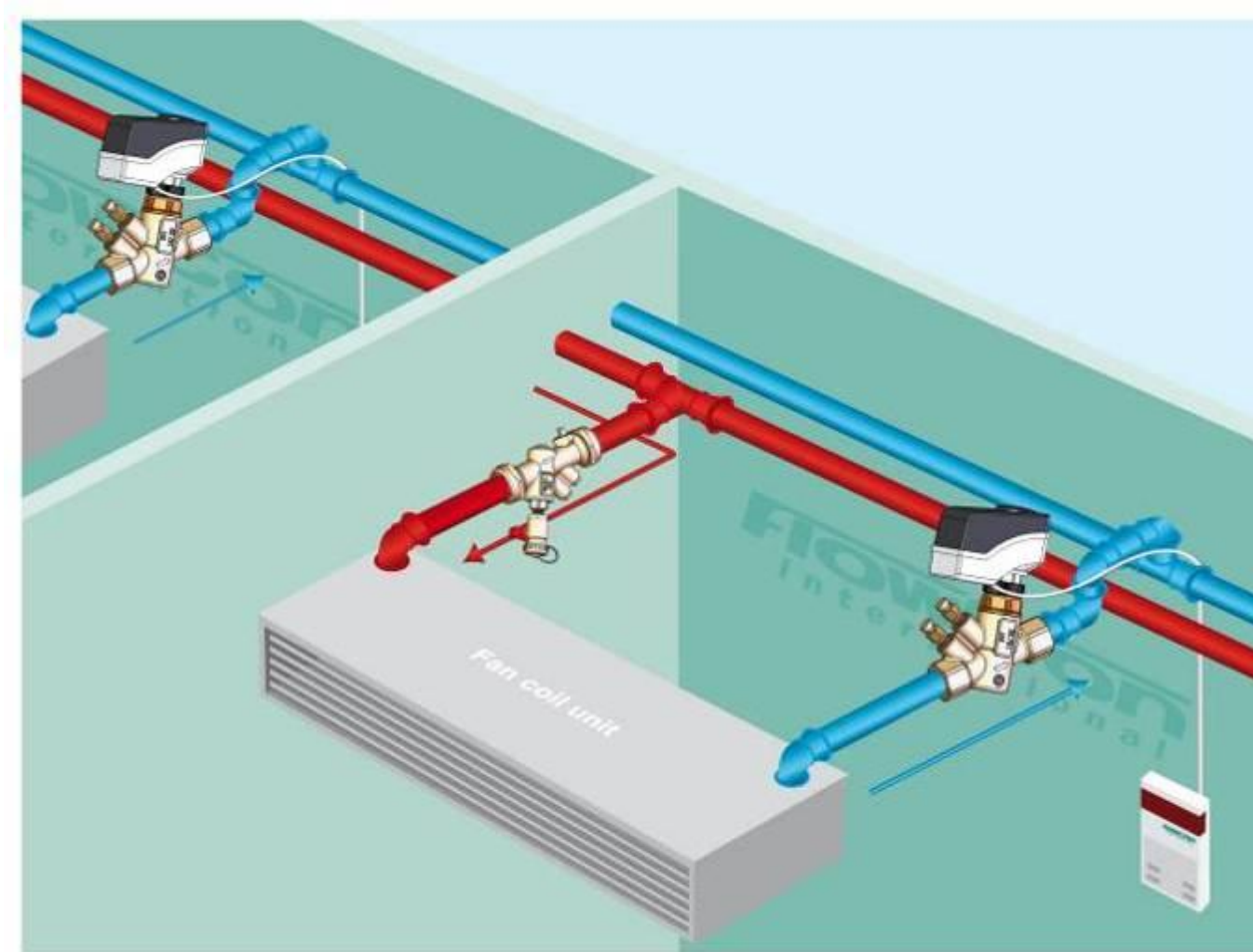
2-pipe heating system

Example of where to install FlowCon valves



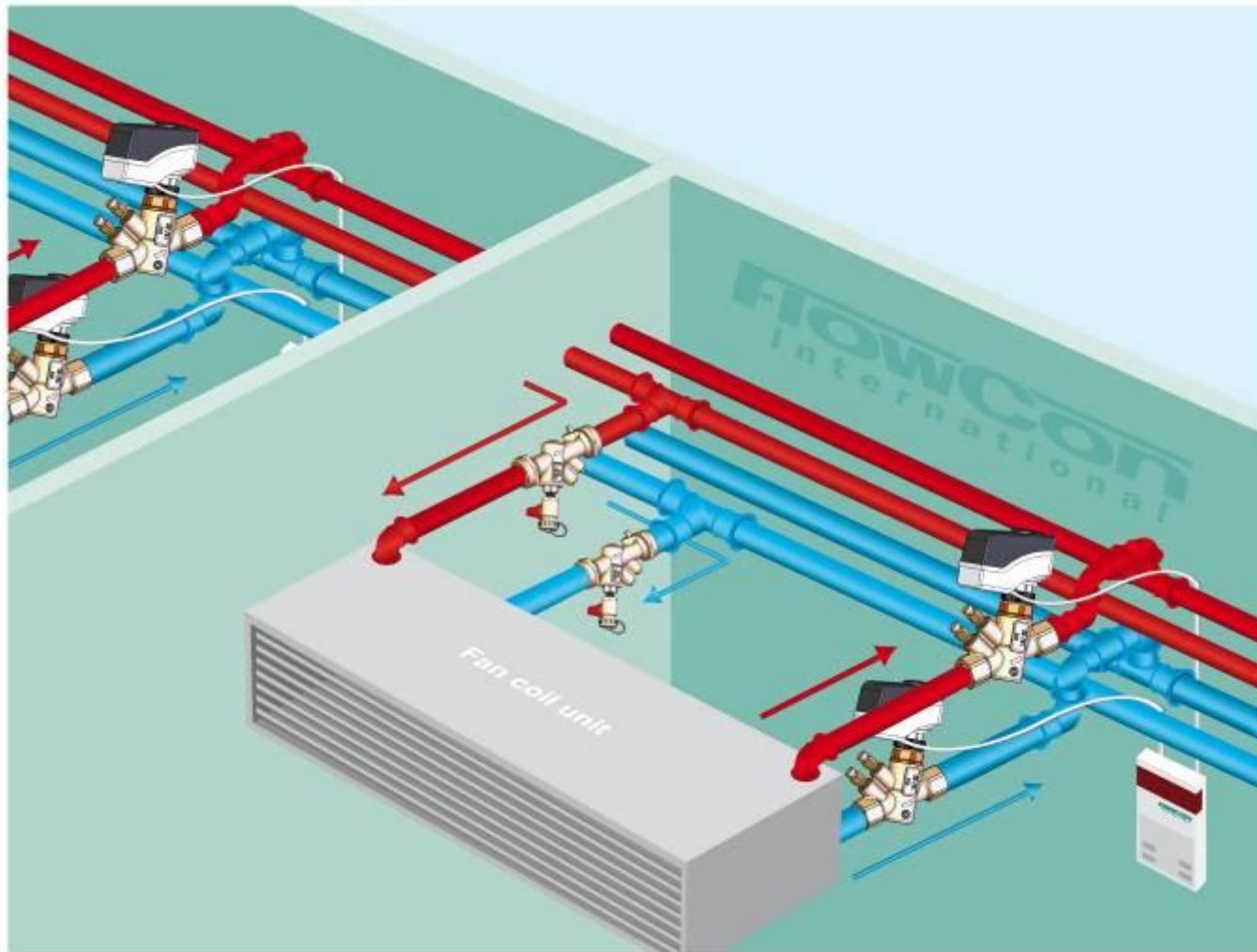
System for Chilled Ceiling

Example of where to install FlowCon valves



System for fan coil units (varme)

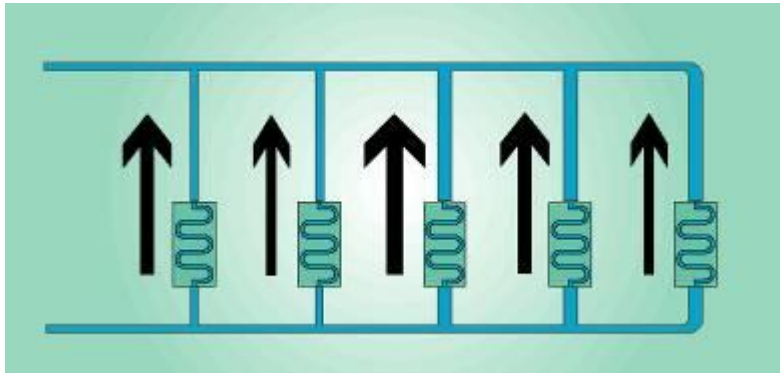
Example of where to install FlowCon valves



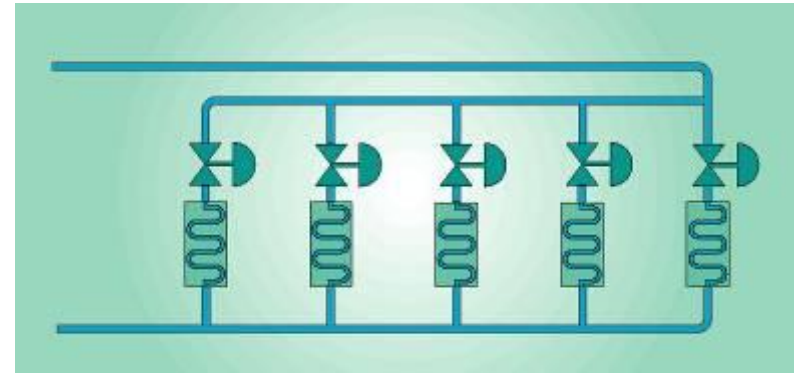
System for fan coil units (4-pipe system)

Balancing can be obtained in several different ways...

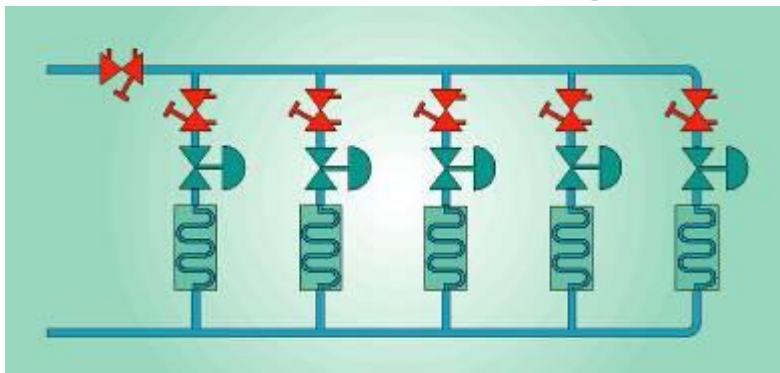
① Pipe Sizing



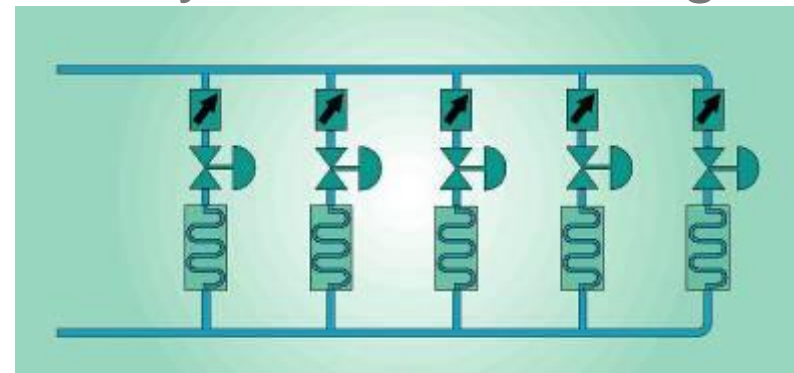
② Reversed Return



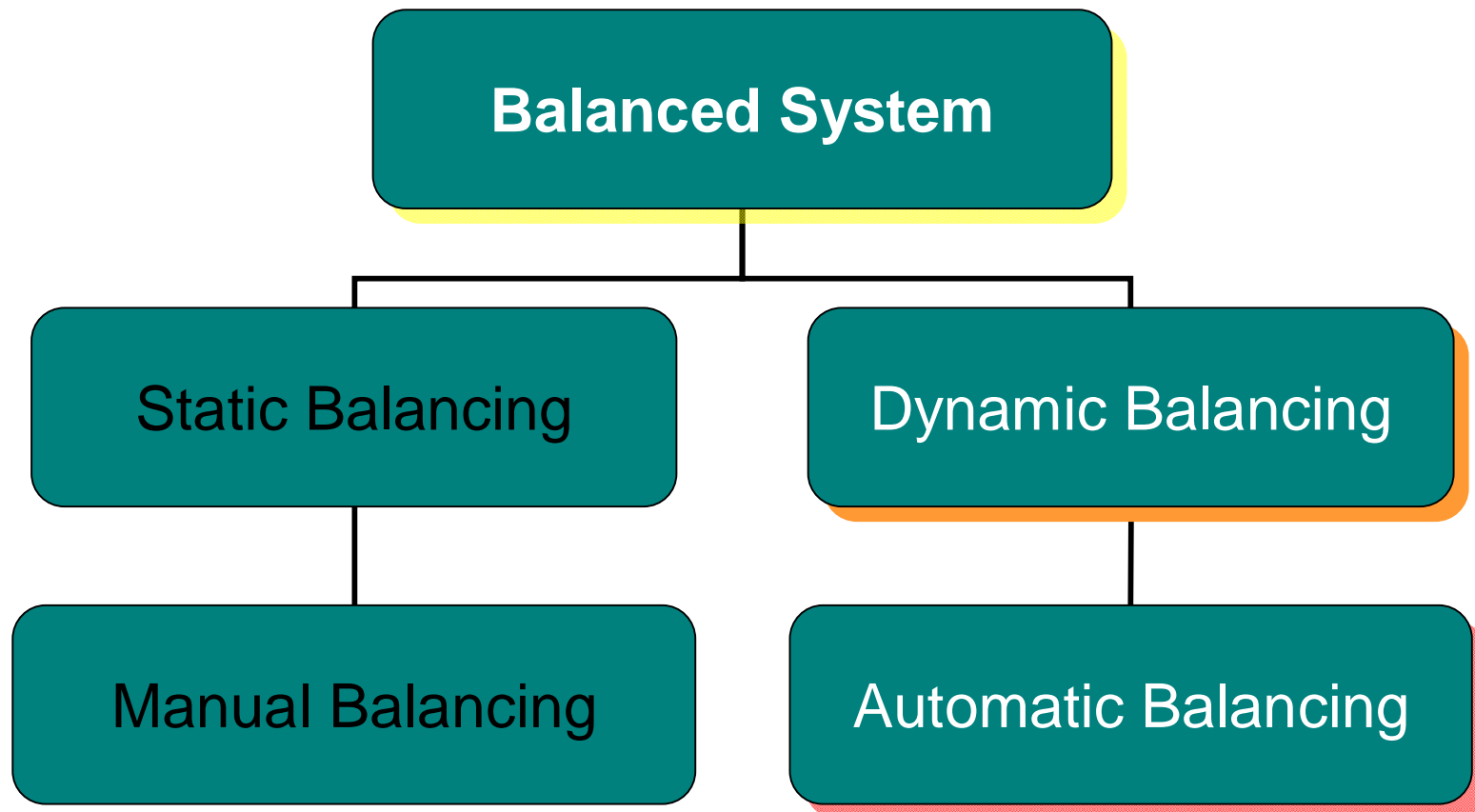
③ Static Balancing



④ Dynamic Balancing



Balanced System



Dynamic Balancing

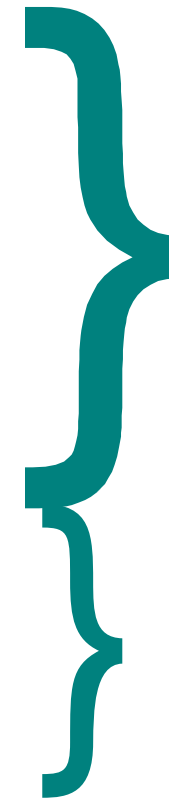
General Definition:

The **dynamic balancing valves** shall automatically control flow rates over a specified operating differential pressure range.

- This regulation helps
 1. prevent an overflow condition in the circuit where it is installed and
 2. aids the overall system balance when other components are changing (modulating valves, pump staging, etc.)

Dynamic Balancing

- Benefits:
 - Fewer balancing valves
 - Quick and easy adjustment
-> better efficiency
 - 100% safe from overflow
 - Independent of errors/unreliabilities
in the calculated distribution of pressure
in the installation
 - Unproblematic re-adjustments
 - More effective adjustment
 - Great flexibility if the system is changed
after the installation



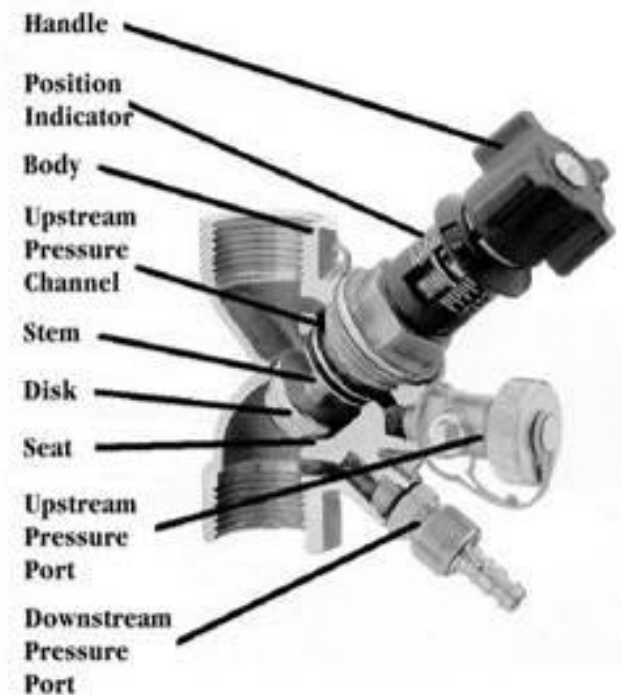
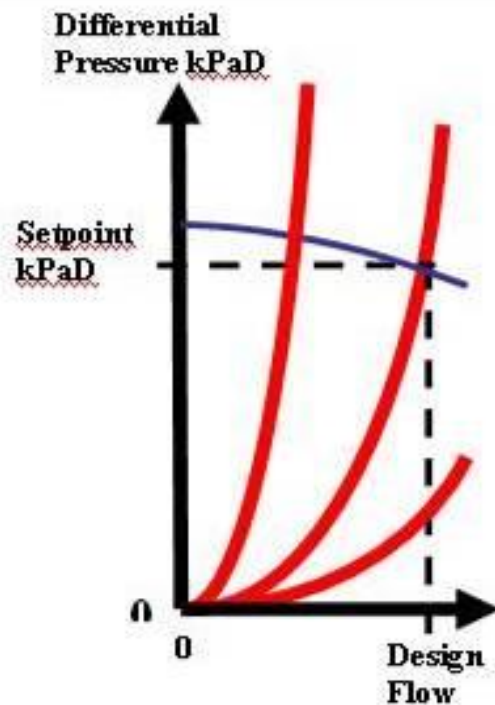
Greater flexibility
Cheaper installation and more economical operation

> **Better indoor comfort**

MANUAL BALANCING

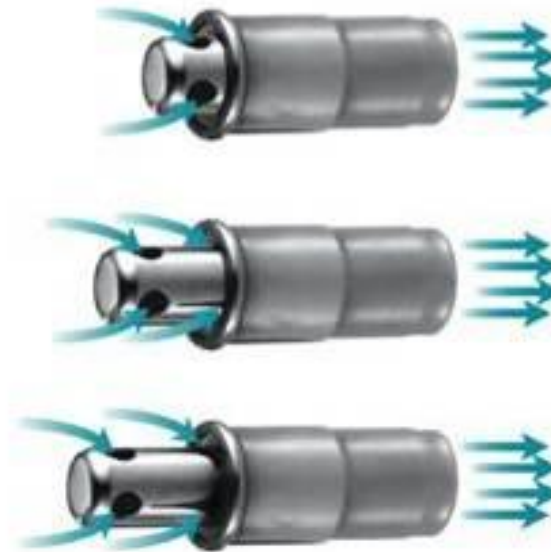
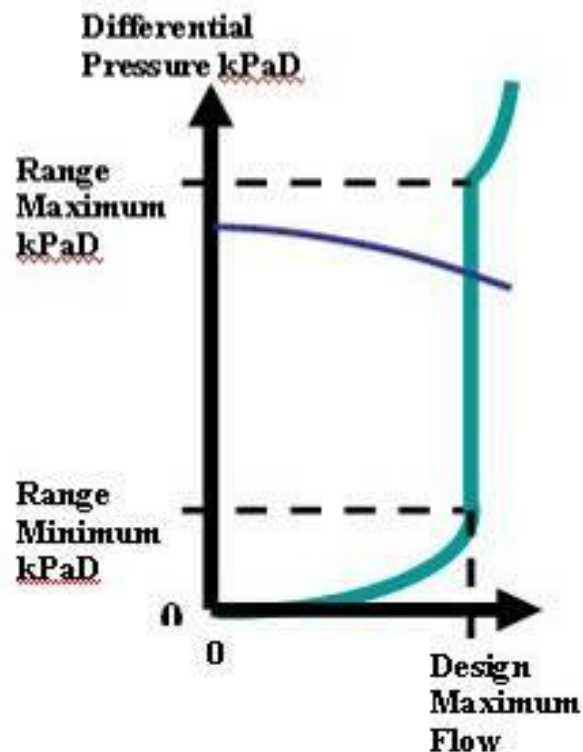
The valve must be adjusted on site after installation according to measured pressure drop.

This often introduces manual error.



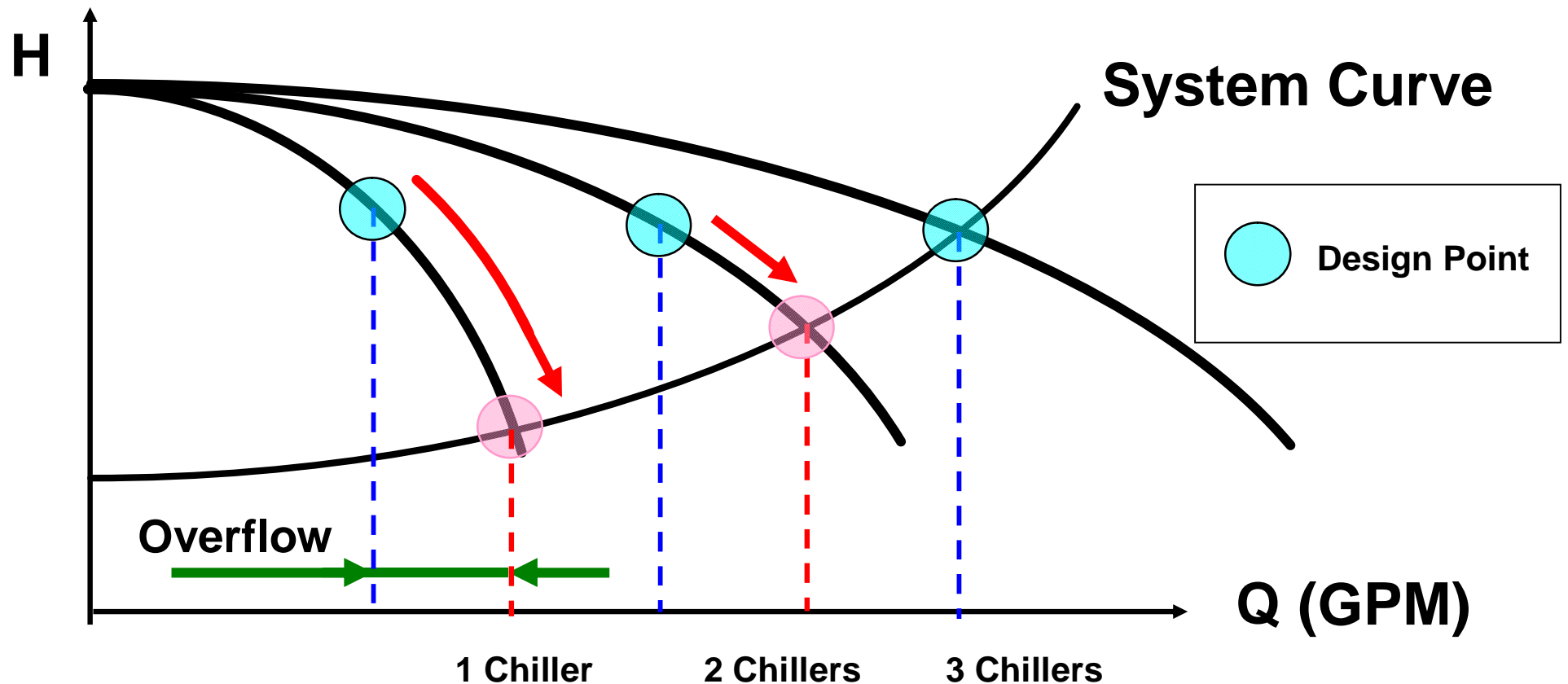
AUTOMATIC BALANCING

The valves self adjust within a broad pressure differential control range to automatically limit flow to the design maximum. When the valve is below the control range it acts as a fixed orifice and flow can be reduced by the motorized control valve.



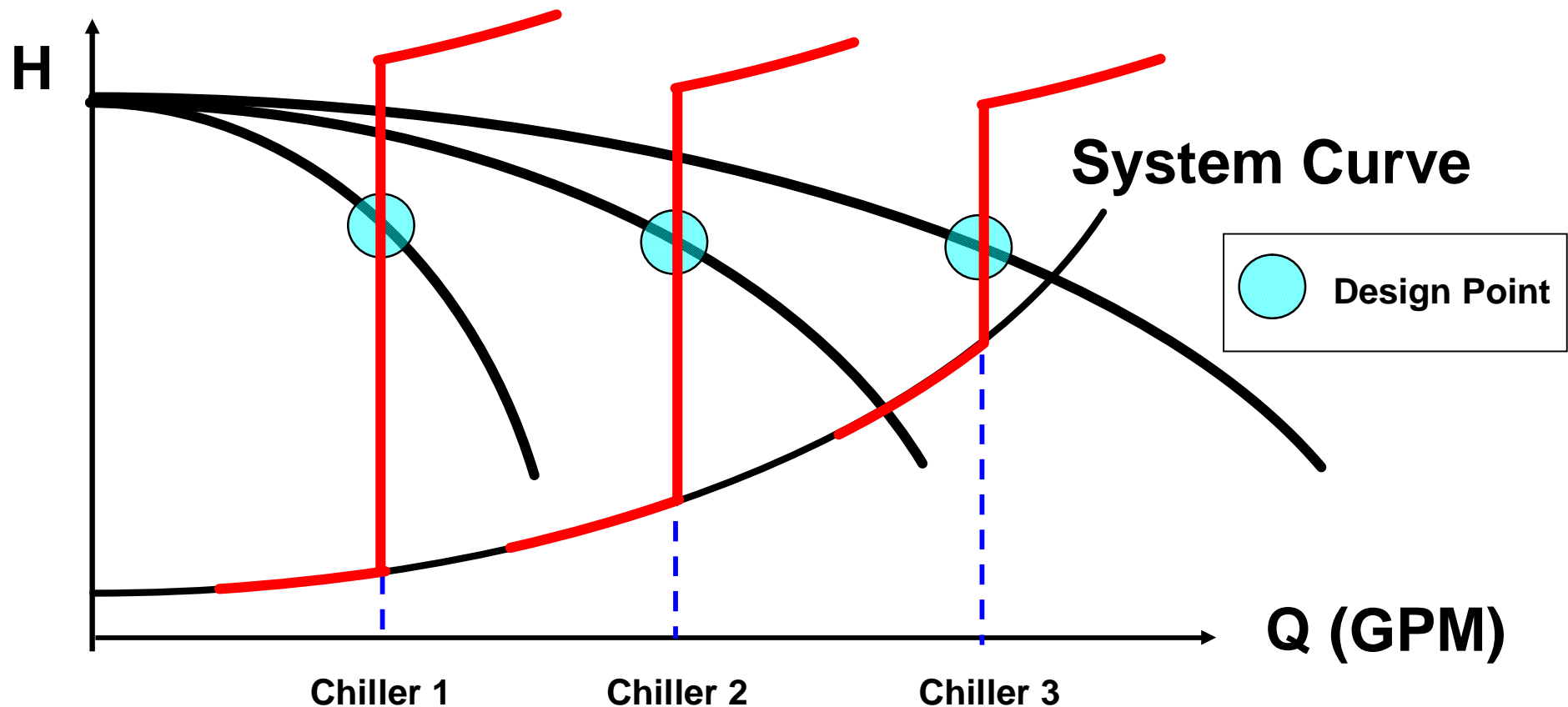
Application of Automatic Balancing Valve

- *Manual Balanced Condenser System*



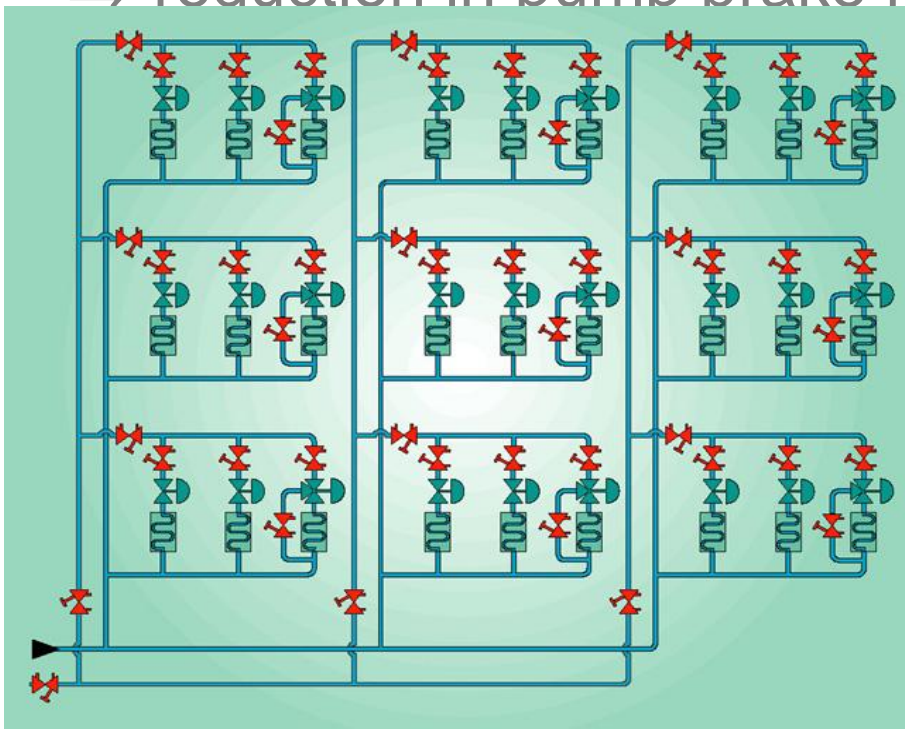
Application of Automatic Balancing Valve

- *Automatic Balanced Condenser System*

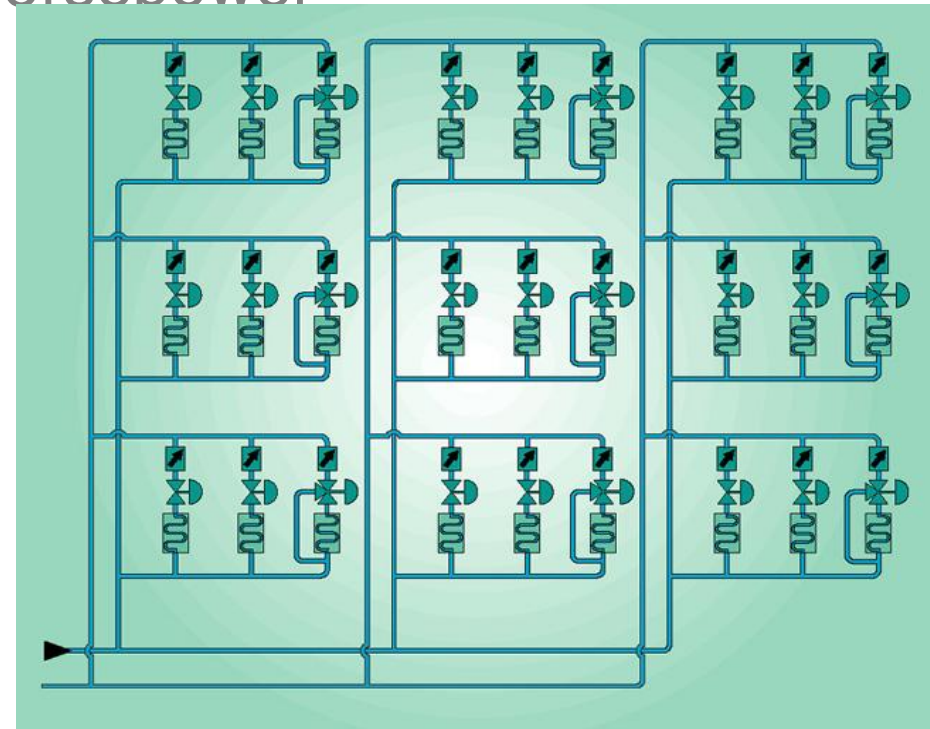


Benefits of Automatic Balancing Valve

1. *Lesser valves are required*
⇒ reduction in system head loss
⇒ reduction in pump brake horsepower



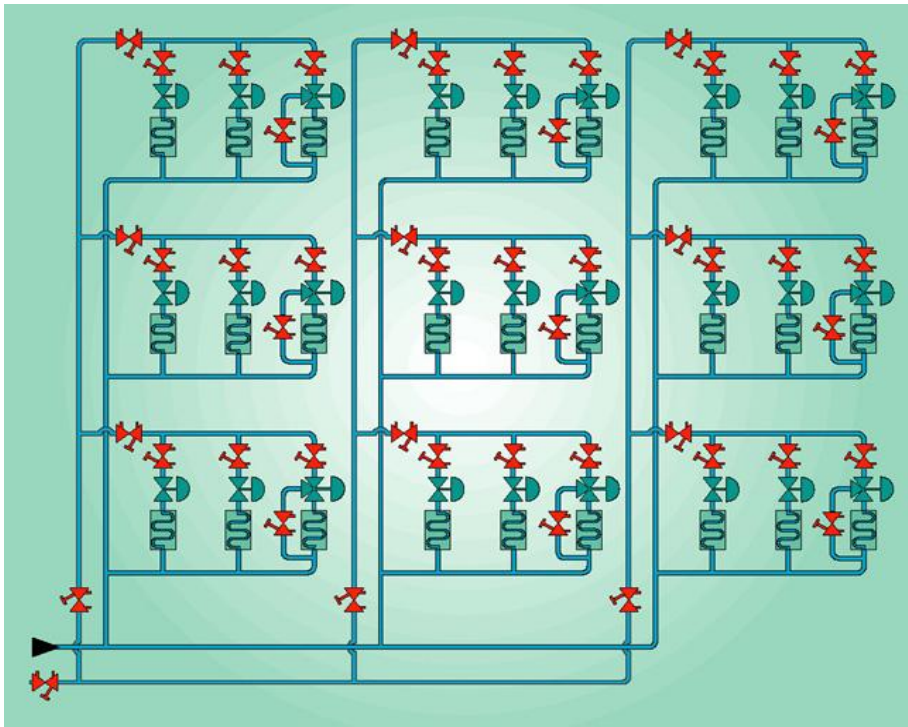
Manual Balanced System



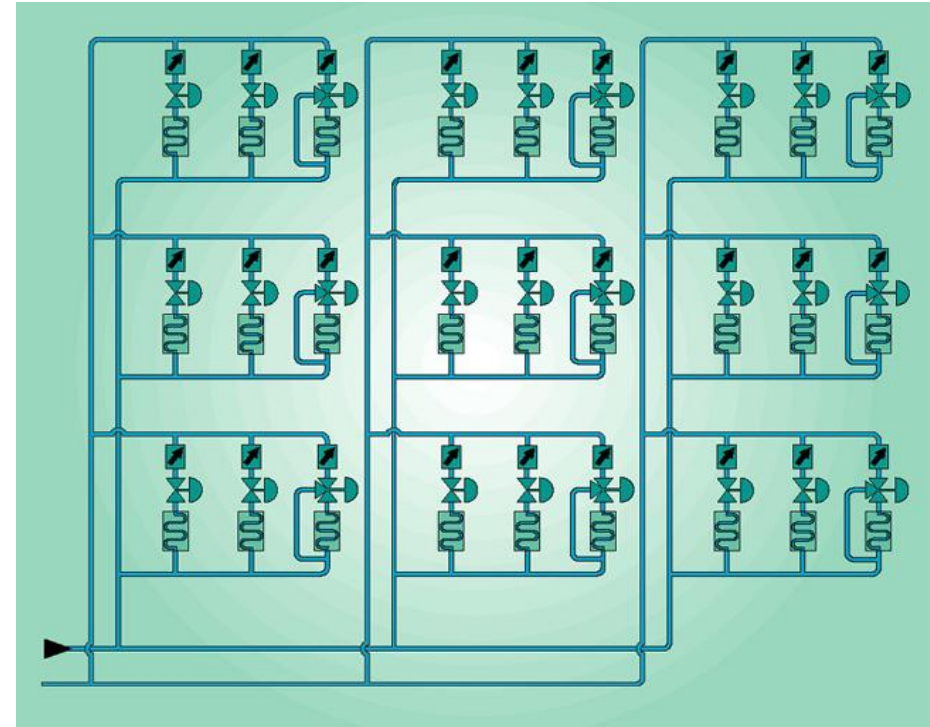
Automatic Balanced System

Benefits of Automatic Balancing Valve

2. *Less Expensive to Install.*



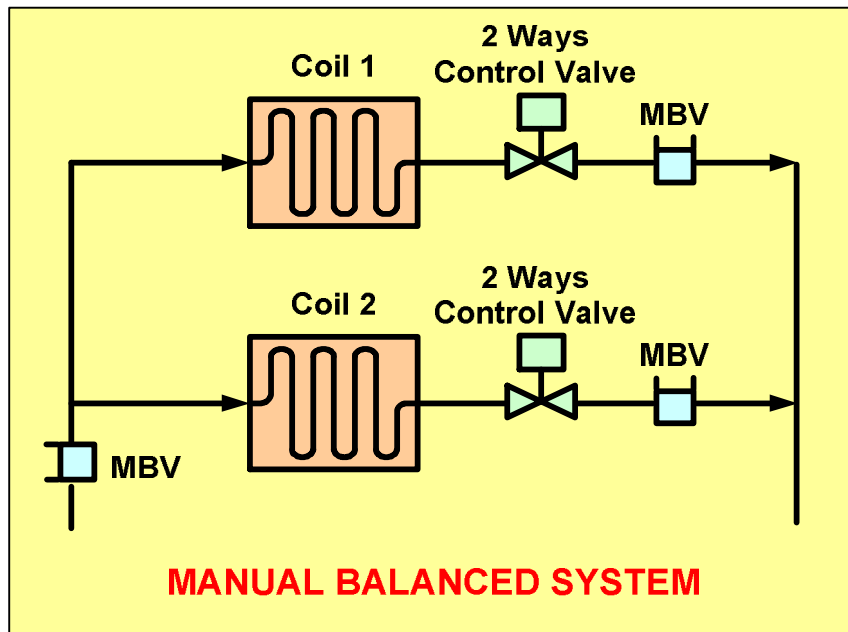
Manual Balanced System



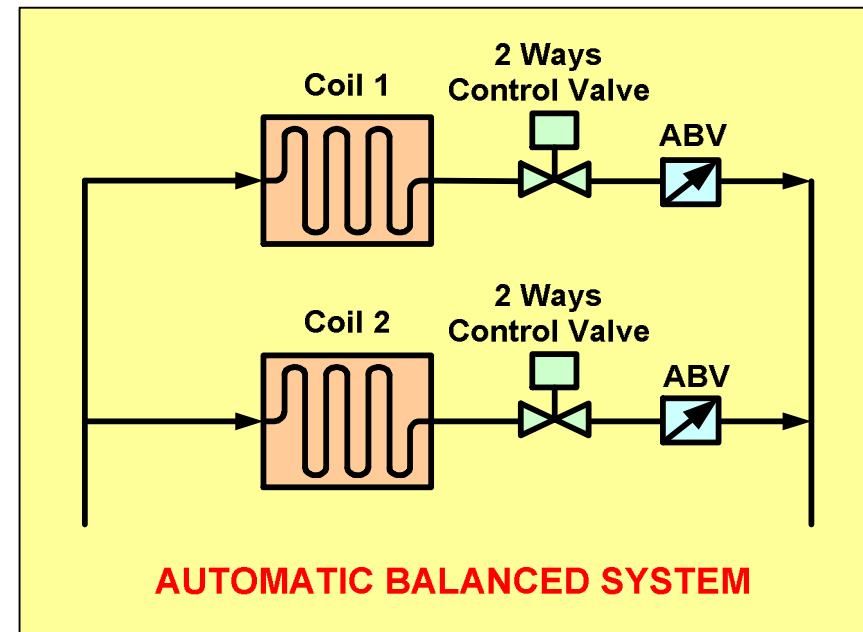
Automatic Balanced System

Benefits of Automatic Balancing Valve

3. *Retrofitting Works Require No Rebalancing.*



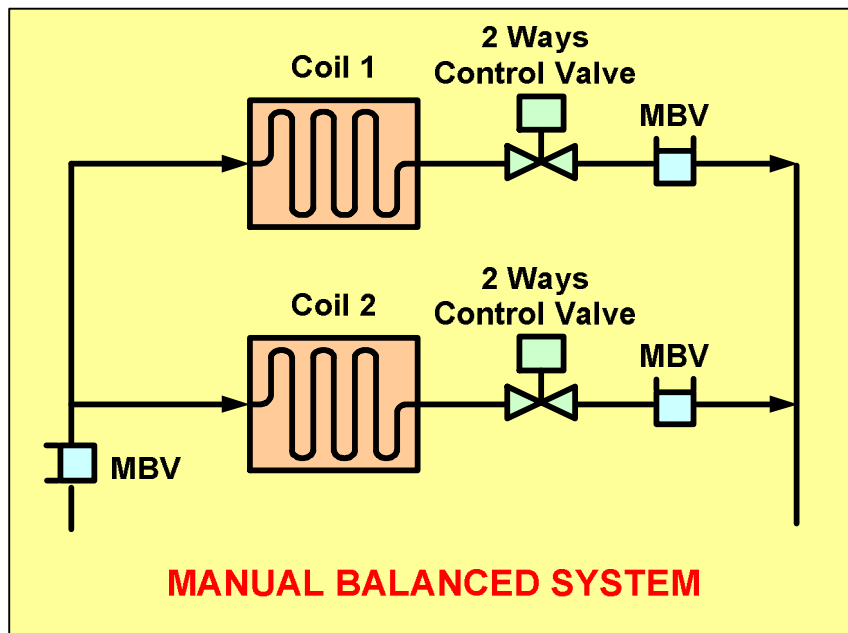
Requires rebalancing as pressure differential across other valves will differ once one manual valve is adjusted.



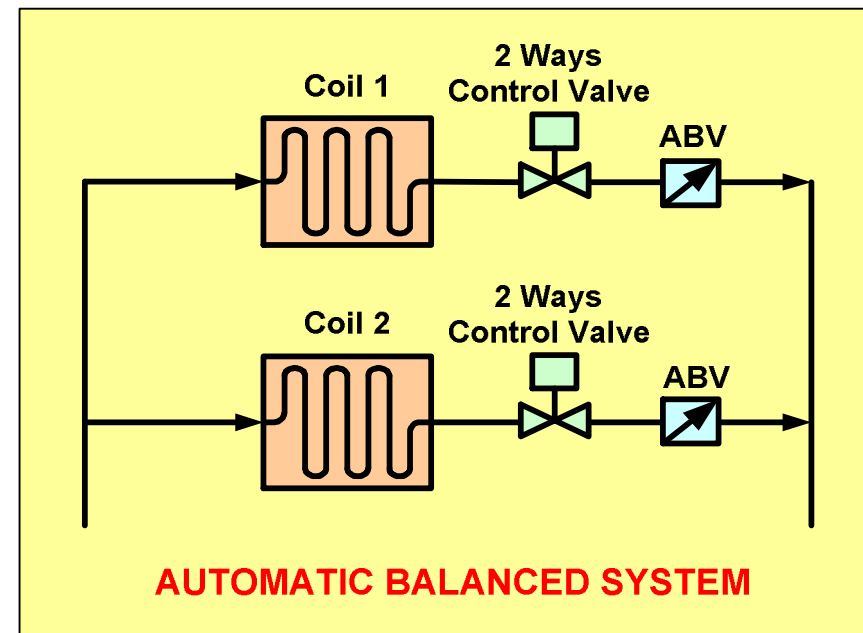
Equipment can be added without the need to rebalance as valves will adjust automatically to maintain the required flow rate.

Benefits of Automatic Balancing Valve

4. Minimum Labour Required.



Requires intensive labour for balancing.



Requires no labour for balancing. But flow verification can be done through checking pressure differential across the valve.

Benefits of Automatic Balancing Valve

5. *No Plumbing Restrictions*

Manual Balanced System

⇒ Minimum length of unrestricted straight pipe.

Automatic Balanced System

⇒ Can be plumbed anywhere in the line without affect its performance.

FLOWCON VALVES OVERVIEW

<ul style="list-style-type: none"> • CHILLER / COOLING TOWER Wafer Class 150 / Wafer Class 300 • 80 – 800 mm 	<ul style="list-style-type: none"> • AHU  <p>SM: 15 - 150 mm</p>  <p>AHU Wafer 50 - 80 mm</p>  <p>Threaded Flange 40 - 80 mm</p>	<ul style="list-style-type: none"> • FCU  <p>SME: 15 – 25 mm</p>  <p>SM: 15 – 150 mm</p>  <p>ABM: 15 – 40 mm</p>  <p>Automizer: 15 – 50 mm</p>  <p>EVS, EVC: 15 – 25 mm</p>  <p>K: 15 – 80 mm</p>  <p>ABV, AB, A: 15 – 80 mm</p>
<ul style="list-style-type: none"> • TYPES OF AUTOMATIC FLOW CARTRIDGES STAINLESS STEEL / E-JUST COMPOSITE / COMPOSITE 		

SM / SME – Dynamic Self-Balancing Modulating Control Valve

ABM / AUTOMIZER / EVS / EVC – Automatically Balanced Temperature Control Valve

Wafer Class 150 & 300 / AHU Wafer / Threaded Flange / K / ABV / AB / A – Pre-set Automatic Balancing Valve

FLOWCON VALVES OVERVIEW

Dynamic Self-Balancing Modulating Control Valves

- **SM, SME**

Automatically Balanced Temperature Control Valves

- **EVS, ABM, AUTOMIZER**

Pre-set Automatic Balancing Valves 15 - 800 mm

- **K, AHU WAFER, THREADED FLANGE, WAFER CLASS 150 & 300**

Automatically Balanced Temperature Control Valves

- **ABM, EVC**

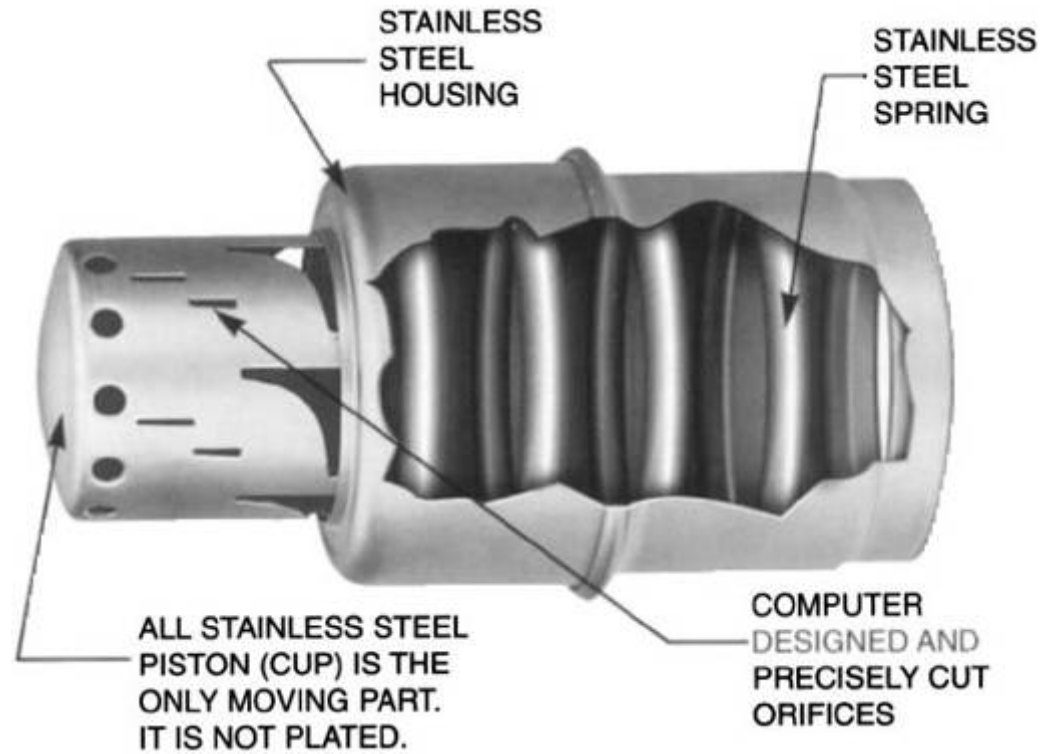
Adjustable Automatic Balancing Valves 15 - 25 mm

- **ABV, AB, A**



Cartridge Functionality:

- A standard single flow 100% stainless steel cartridge.



One flow rate per cartridge



Flow Balancing By Automatic Balancing Valve

- *Working Principle of Stainless Steel Cartridge*

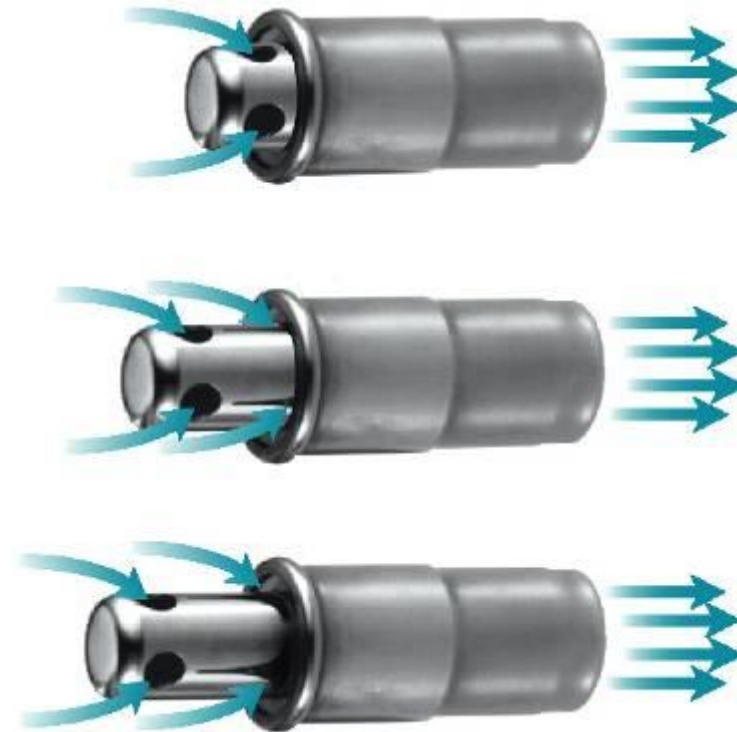
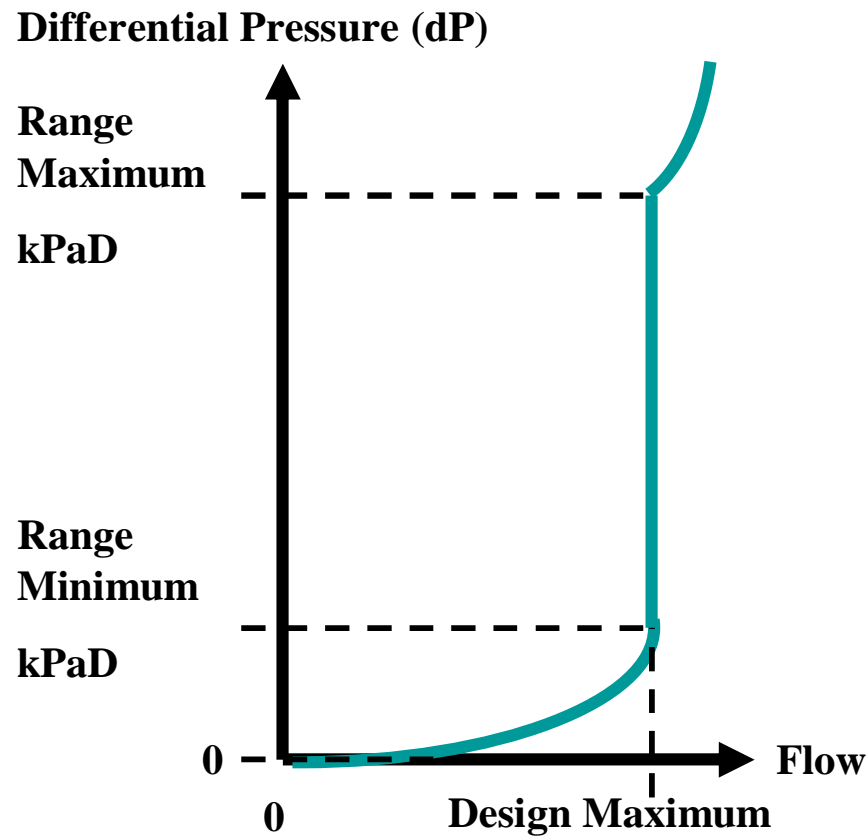
Constant = ↓ ↑
Constant = ↑ ↓

$$Q = A * \sqrt{\Delta P}$$

Variable ↑

Variable —

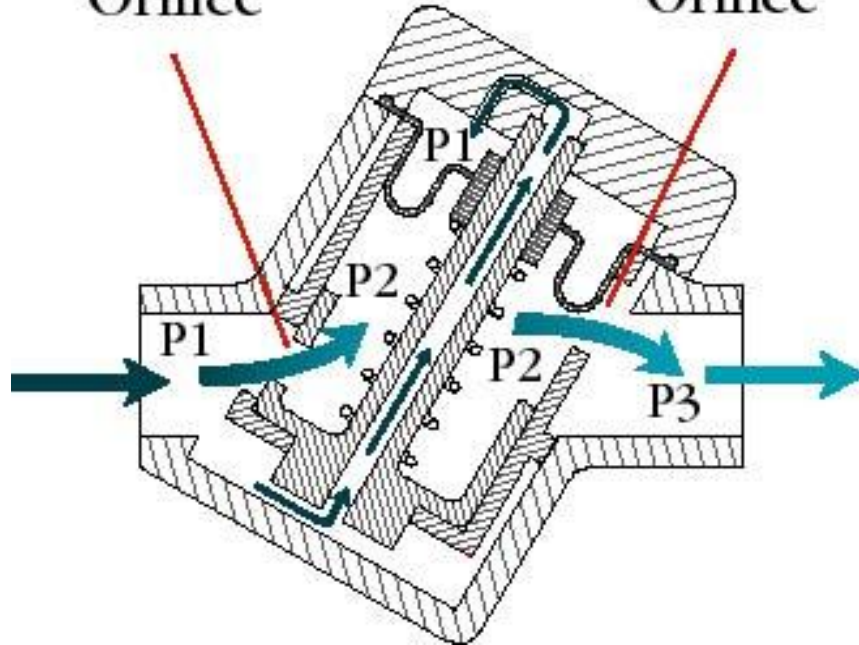
Flow Balancing By Automatic Balancing Valve



Cartridge Functionality:

Manually
Adjustable
Orifice

Diaphragm
Self Adjusting
Orifice



40 flow rates per cartridge



8 flow rates per cartridge



41 flow rates per cartridge

$$Q = A * (\sqrt{\Delta P})^{\text{constant}}$$

FlowCon composite cartridges

- The internal adjustable **composite** cartridge
- The external adjustable cartridges, **E-JUST**



Adjusted with a 6mm / 0.25in Allen Wrench



Adjusted with a special FlowCon key

FlowCon Product Program

- **FlowCon Dynamic Balancing Valves:**

Basic range: A, AB and ABV

Cartridges: Composite, E-JUST or Stainless Steel w. Adaptor

Application: Floor heating systems, heating systems / cooling system w. Separate control valves. – (used in stead of eg. STAD)



FlowCon Product Program

- **FlowCon Dynamic Balancing Valves:**
Basic range: K
Cartridge: Stainless Steel



FlowCon Product Program

- **FlowCon Dynamic Balancing Valves:**
Hi-flow range: SH
Cartridge: Built-in rolling diaphragm



FlowCon Product Program

- **FlowCon Dynamic Balancing Valves:**
Hi-flow range: AHU and Wafer
Cartridge: 1 or multiple Stainless Steel cartridges



FlowCon Product Program

- **FlowCon Control and Balancing Valves:**
Basic range: EVS / EVC
Cartridge: Stainless Steel /
Composite, E-JUST or Stainless Steel w.
Adaptor
Control: ON/OFF (NC)
Application: Cooling ceilings and Fan Coil Units.–
(used in stead of eg. STAD/TBVC/Cocon+Control.)



FlowCon Product Program

- **FlowCon Temperature and Flow Control Valves:**
Basic range: ABM
Cartridge: Composite, E-JUST or Stainless Steel w. Adaptor
Control: ON/OFF, Tri-state or modulating 2-10V or 4-20mA



FlowCon Product Program

- **FlowCon Pressure Independent Dynamic Control Valves:**

Basic range: A, AB or ABV (DN15/20)

Cartridge: SME.1 (currently only 119-1200l/h)

Control: Modulating 0-10V or Tri-state

Application: Air Handler Units, Fan Coil Units and VAV-boxes. Pressure range from 30 or 400 kPa – (used instead of eg. KTM).



FlowCon Product Program

- **FlowCon SM Valve:**

- Dynamic self-balancing modulating control valve.
Total authority, pressure independent.
Up till DN40: double union end conn. and optional p/t plugs.
Larger: flange conn. and standard p/t plugs.

Size: DN15 – DN150

Differential pressure range: 32 – 400 kPa

Flow rate range: 0.176 l/s – 29.5 l/s

Maximum pressure: 2500 kPa / 4000 kPa

Min./Max. media temp.: -20°C to +120°C



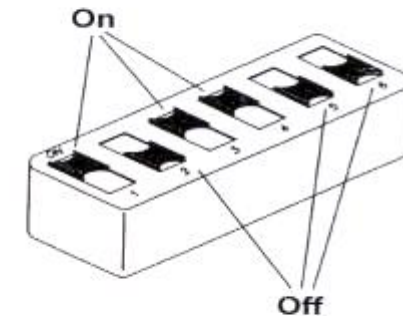
FlowCon SM Selection

- Requires only 2 parameters to select FlowCon SM.
 - Designed Flow Rate
 - Size of End Connection

DYNAMIC CONTROL VALVE 50 – 150mm 2” – 6” FLOWCON SM
MAXIMUM FLOW RATE LIMITATION DIP SWITCH SETTINGS

Valve size: DN50/65/80 2”, 2 ½”, 3”

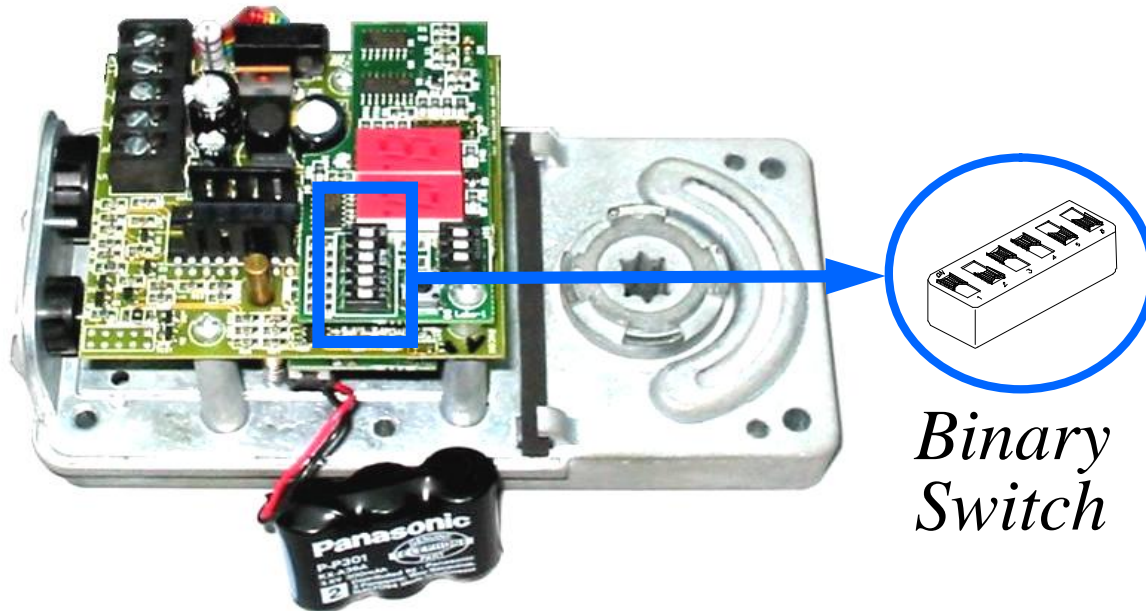
Maximum Flow Rate 50 - 80mm / 2" - 3"				Maximum Flow Rate Dip Switch Settings						Stem Rotations From Closed
35 - 400kPaD 5 - 58psid SM		80 - 400kPaD 11.6 - 58psid SMX		1	2	3	4	5	6	Rotations
L/s	GPM	L/s	GPM							
2.46	39.0	3.50	55.5	ON	ON	ON	ON	ON	ON	1.0
2.73	43.2	3.79	60.1	OFF	ON	ON	ON	ON	ON	1.1
2.99	47.4	4.08	64.7	ON	OFF	ON	ON	ON	ON	1.2
3.26	51.6	4.38	69.4	OFF	OFF	ON	ON	ON	ON	1.3
3.52	55.9	4.67	74.0	ON	ON	OFF	ON	ON	ON	1.4
3.79	60.1	4.96	78.6	OFF	ON	OFF	ON	ON	ON	1.5
3.95	62.7	5.19	82.3	ON	OFF	OFF	ON	ON	ON	1.6
4.12	65.3	5.42	86.0	OFF	OFF	OFF	ON	ON	ON	1.7



Features of FlowCon SM

Pre-setting of Maximum Flow

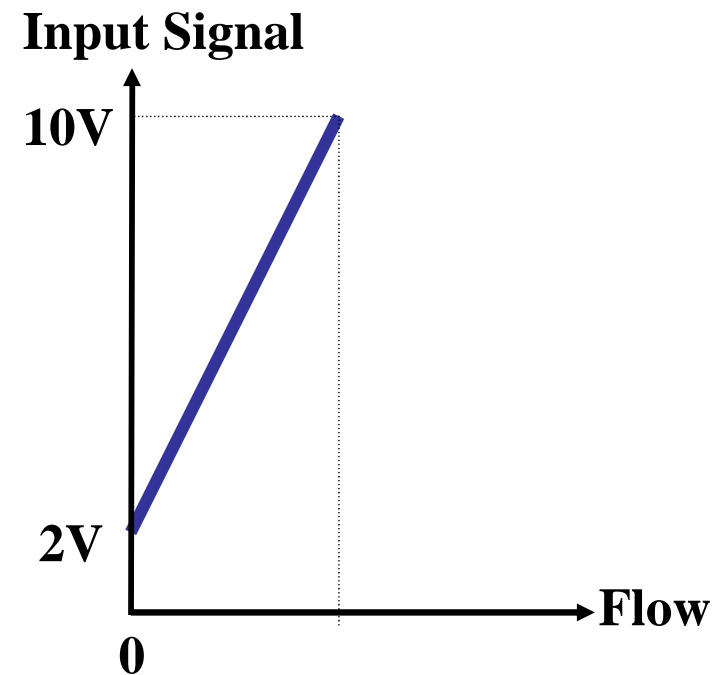
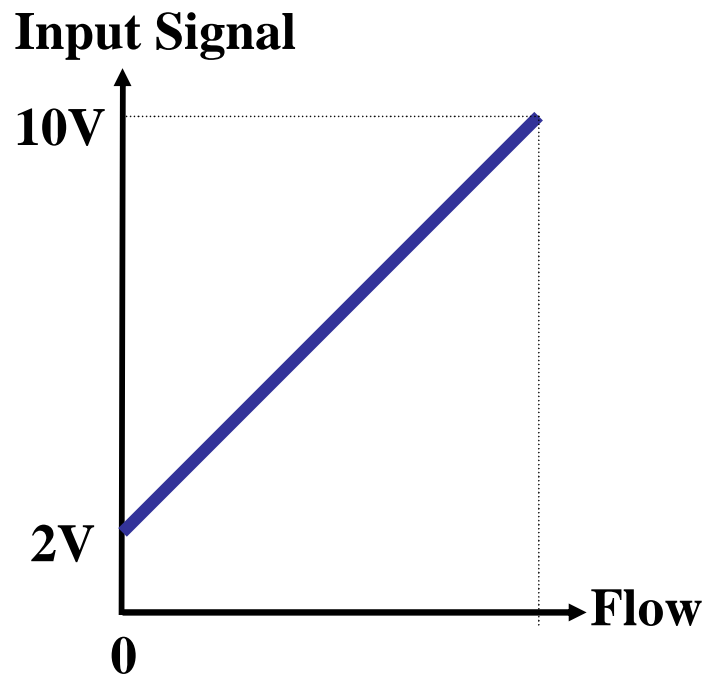
- Maximum flow can be preset by combination binary switches before installation to ensure system flow balance.



Maximum Flow Rate						Maximum Flow Rate Dip Switch Settings Combination						Position In Stem Rotations From Closed
15 - 25mm 1/2" - 1"			25 - 40mm 1" - 1 1/2"			1	2	3	4	5	6	
L/s	L/hr	GPM	L/s	L/hr	GPM							
0.18	635	2.8	0.53	1900	8.4	ON	ON	ON	ON	ON	ON	1.0
0.19	700	3.1	0.58	2089	9.2	OFF	ON	ON	ON	ON	ON	1.1
0.21	765	3.4	0.63	2278	10.0	ON	OFF	ON	ON	ON	ON	1.2
0.23	831	3.7	0.69	2468	10.9	OFF	OFF	ON	ON	ON	ON	1.3
0.25	896	3.9	0.74	2657	11.7	ON	ON	OFF	ON	ON	ON	1.4
0.27	961	4.2	0.79	2846	12.5	OFF	ON	OFF	ON	ON	ON	1.5
0.28	1023	4.5	0.85	3043	13.4	ON	OFF	OFF	ON	ON	ON	1.6
0.30	1085	4.8	0.90	3239	14.3	OFF	OFF	OFF	ON	ON	ON	1.7
0.32	1146	5.0	0.95	3436	15.1	ON	ON	ON	OFF	ON	ON	1.8
0.34	1208	5.3	1.01	3632	16.0	OFF	ON	ON	OFF	ON	ON	1.9
0.35	1270	5.6	1.06	3829	16.9	ON	OFF	ON	OFF	ON	ON	2.0
0.37	1317	5.8	1.11	4000	17.8	OFF	OFF	ON	OFF	ON	ON	2.1
0.38	1363	6.0	1.16	4171	18.4	ON	ON	OFF	OFF	ON	ON	2.2
0.39	1410	6.2	1.21	4343	19.1	OFF	ON	OFF	OFF	ON	ON	2.3
0.40	1456	6.4	1.25	4514	19.9	ON	OFF	OFF	OFF	ON	ON	2.4
0.42	1503	6.6	1.30	4685	20.6	OFF	OFF	OFF	OFF	ON	ON	2.5
0.43	1545	6.8	1.34	4831	21.3	ON	ON	ON	ON	OFF	ON	2.6
0.44	1587	7.0	1.38	4976	21.9	OFF	ON	ON	ON	OFF	ON	2.7
0.45	1628	7.2	1.42	5122	22.6	ON	OFF	ON	ON	OFF	ON	2.8
0.46	1670	7.4	1.46	5267	23.2	OFF	OFF	ON	ON	OFF	ON	2.9
0.48	1712	7.5	1.50	5413	23.8	ON	ON	OFF	ON	OFF	ON	3.0
0.48	1745	7.7	1.54	5548	24.4	OFF	ON	OFF	ON	OFF	ON	3.1
0.49	1778	7.8	1.58	5683	25.0	ON	OFF	OFF	ON	OFF	ON	3.2
0.50	1810	8.0	1.62	5817	25.6	OFF	OFF	OFF	ON	OFF	ON	3.3
0.51	1843	8.1	1.65	5952	26.2	ON	ON	ON	OFF	OFF	ON	3.4
0.52	1876	8.3	1.69	6087	26.8	OFF	ON	ON	OFF	OFF	ON	3.5
0.53	1908	8.4	1.72	6204	27.3	ON	OFF	ON	OFF	OFF	ON	3.6
0.54	1939	8.5	1.76	6321	27.8	OFF	OFF	ON	OFF	OFF	ON	3.7
0.55	1971	8.7	1.79	6439	28.3	ON	ON	OFF	OFF	OFF	ON	3.8
0.56	2002	8.8	1.82	6556	28.9	OFF	ON	OFF	OFF	OFF	ON	3.9
0.57	2034	9.0	1.85	6673	29.4	ON	OFF	OFF	OFF	OFF	ON	4.0
0.57	2060	9.1	1.88	6770	29.8	OFF	OFF	OFF	OFF	OFF	ON	4.1
0.58	2086	9.2	1.91	6867	30.2	ON	ON	ON	ON	ON	OFF	4.2
0.59	2112	9.3	1.93	6964	30.7	OFF	ON	OFF	ON	ON	OFF	4.3
0.59	2138	9.4	1.96	7061	31.1	ON	OFF	ON	ON	ON	OFF	4.4
0.60	2164	9.5	1.99	7159	31.5	OFF	OFF	ON	ON	ON	OFF	4.5
0.61	2189	9.6	2.02	7256	31.9	ON	ON	OFF	ON	ON	OFF	4.6
0.62	2215	9.8	2.04	7353	32.4	OFF	ON	OFF	ON	ON	OFF	4.7
0.62	2241	9.9	2.07	7450	32.8	ON	OFF	OFF	ON	ON	OFF	4.8
0.63	2267	10.0	2.10	7547	33.2	OFF	OFF	OFF	ON	ON	OFF	4.9
0.64	2293	10.1	2.12	7644	33.7	ON	ON	ON	OFF	ON	OFF	5.0
0.64	2308	10.2	2.15	7723	34.0	OFF	ON	ON	OFF	ON	OFF	5.1
0.65	2323	10.2	2.17	7802	34.4	ON	OFF	ON	OFF	ON	OFF	5.2
0.65	2339	10.3	2.19	7881	34.7	OFF	OFF	ON	OFF	ON	OFF	5.3
0.65	2354	10.4	2.21	7960	35.0	ON	ON	OFF	OFF	ON	OFF	5.4
0.66	2369	10.4	2.23	8039	35.4	OFF	ON	OFF	OFF	ON	OFF	5.5
0.66	2384	10.5	2.26	8118	35.7	ON	OFF	OFF	OFF	ON	OFF	5.6
0.67	2399	10.6	2.28	8197	36.1	OFF	OFF	OFF	OFF	ON	OFF	5.7
0.67	2415	10.6	2.30	8276	36.4	ON	ON	ON	ON	OFF	OFF	5.8
0.68	2430	10.7	2.32	8355	36.8	OFF	ON	ON	ON	OFF	OFF	5.9
0.68	2445	10.8	2.34	8434	37.1	ON	OFF	ON	ON	OFF	OFF	6.0

100% Control Signal Usage

- When the dip switches are adjusted the actuator self re-calibrates so that maximum signal (i.e. 10V) = maximum design flow requirement
=> full 2-10Volt signal used



FlowCon Product Program

- **FlowCon T-JUST:**

- Thermostatic balancing valve for use in hot potable water. Available for either manual or actuated by-pass function for "Legionella flushing"

Size: DN15 – DN25
Temperature range: +35°C - +65°C
Max. differential pressure: 100 kPa
Max. media temp.: +100°C

Basic range: A, AB, ABV or FF-unit



Choice of Product

1. Flow Rate

1. At constant flow, choose the flow closest to the design flow.
2. At varying flow (e.g. in series with a modulating control valve) choose the flow closest to design maximum flow for the circuit.

2. Differential Pressure Rate

1. Determine the minimum and maximum pressure-loss which the valve will experience. Maximum pressure loss is typically when the other circuits are closed and minimum is when they are open.
2. Hereafter choose a control range wider than the calculated dP.

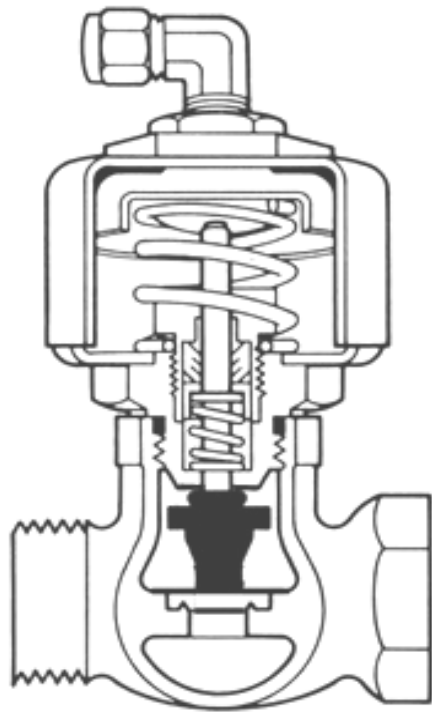
3. Size

1. Choose the required size according to pipe dimension.

Thank you for your attention!



COMPARISON – SUMMARY



VS.

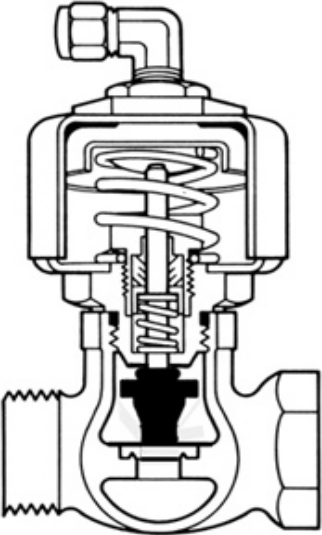
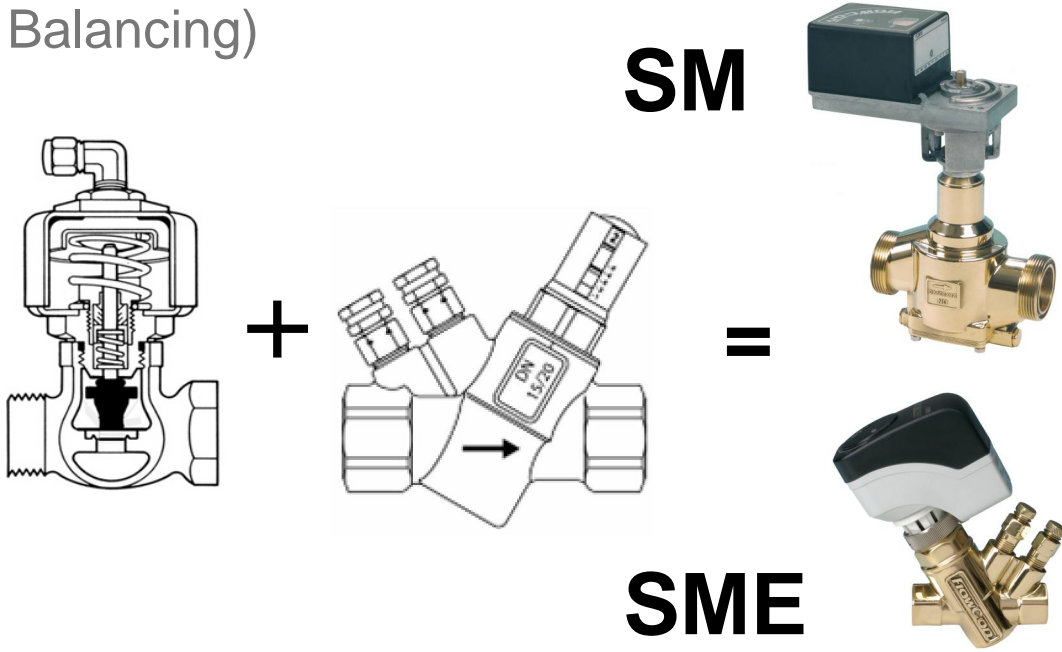
SM



SME

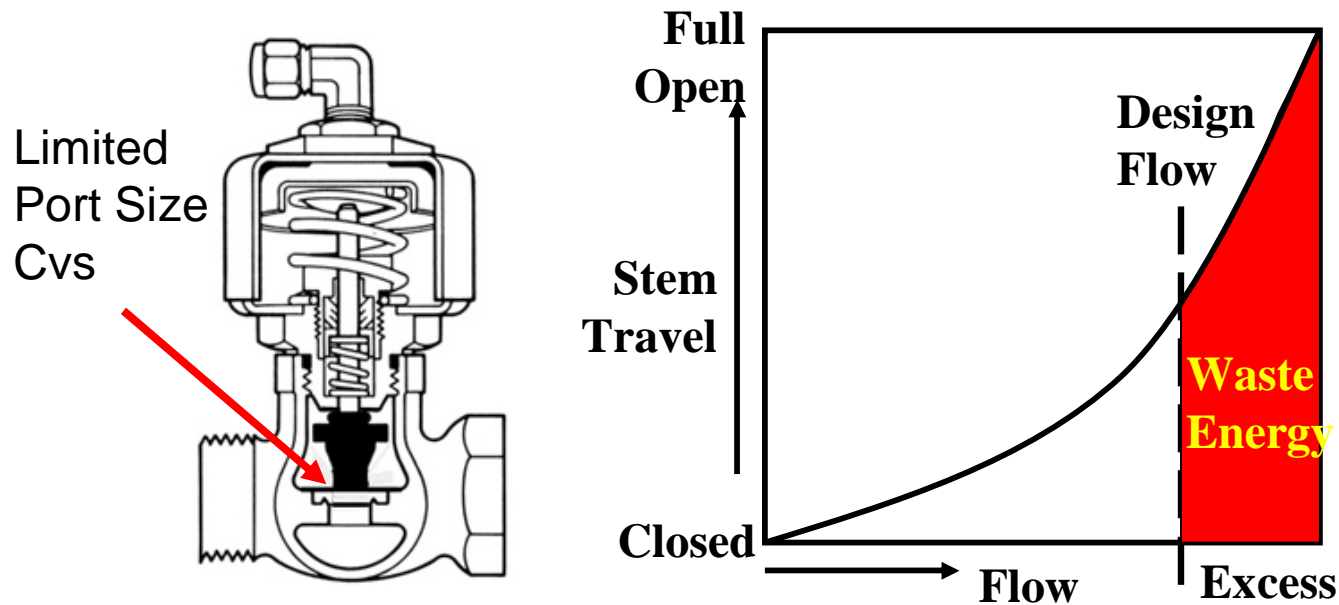


Conventional Control Valve vs. FlowCon SM / SME

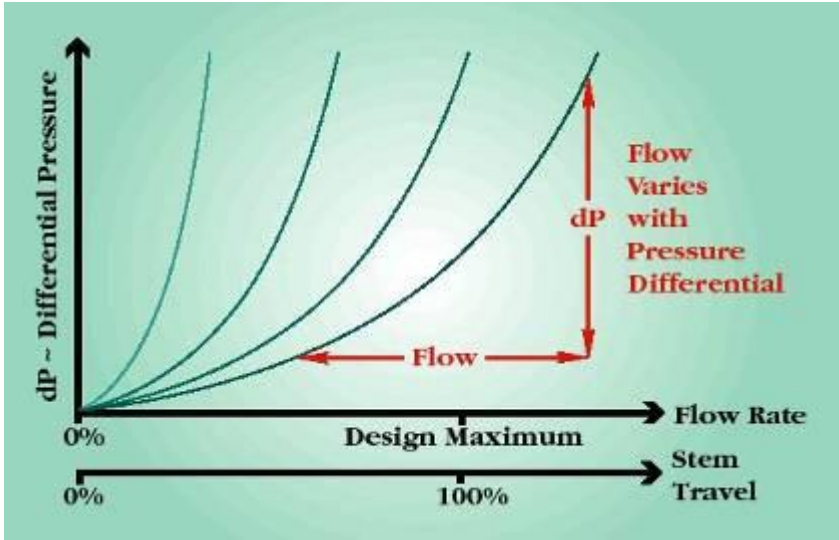
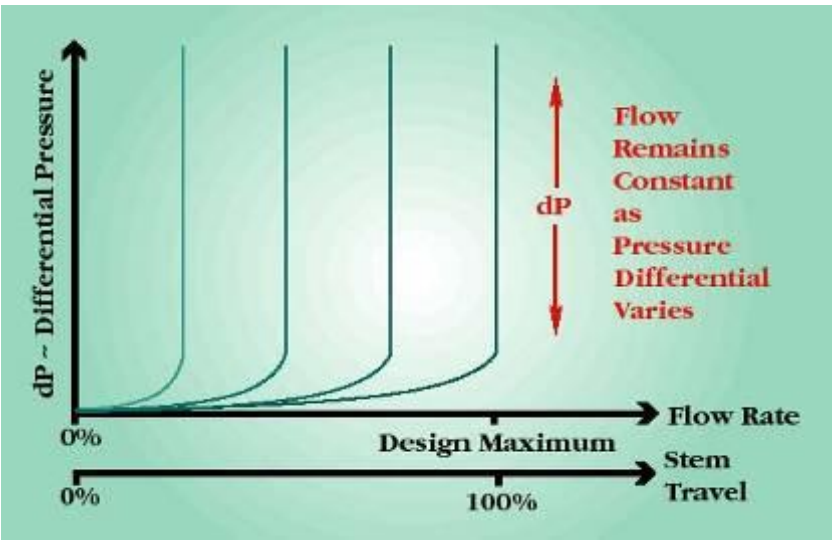
Conventional Control Valve	FlowCon SM / SME
<ul style="list-style-type: none"> • Just a Control Valve 	<ul style="list-style-type: none"> • 2-in-1 (Dynamic Control + Automatic Balancing)  <p>SM</p> <p>SME</p>

The 2 Control Valve Sizes

- Under-sized and over-sized !
- Logic dictates it is better to over-size than under-size.
- Overflow to one valve steals flow from another.
- Overflow through a coil causes poor heat transfer efficiency.



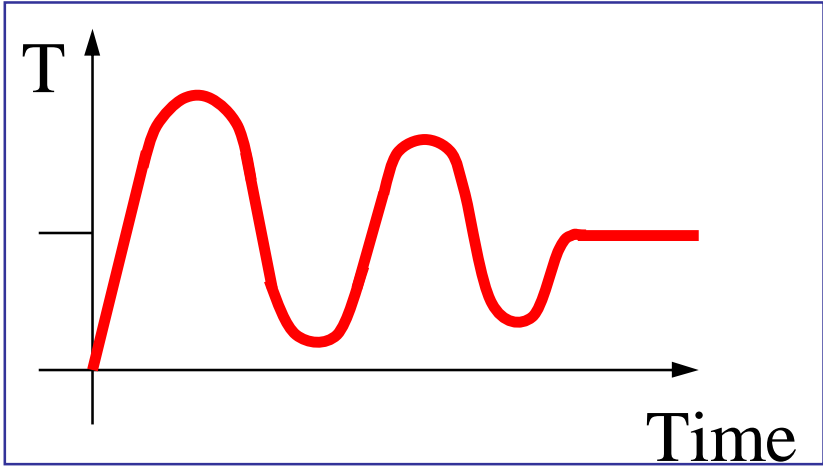
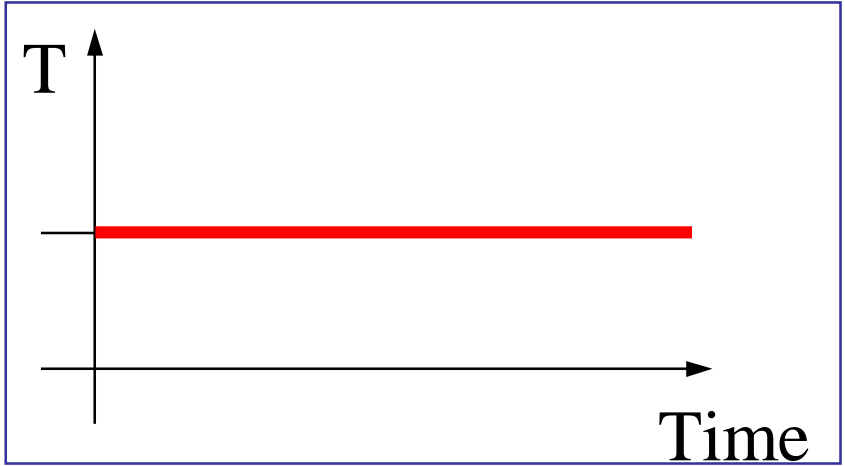
Conventional Control Valve vs FlowCon SM/SME

Conventional Control Valve	FlowCon SM/SME
<p>•Pressure Dependent</p>  $Q = \sqrt{dP} * \text{Orifice constant}$	<p>•Pressure Independent</p>  <p style="text-align: center;">↓ ↓</p> $Q = \sqrt{DP} * A_o$

* For the case of a conventional control valve, Q varies according to the change in dP

* But for SM valve, even when differential pressure varies, Q remains constant;

Conventional Control Valve vs FlowCon SM/SME

Conventional Control Valve	FlowCon SM/SME
<p>•Temperature Unstable</p>  <p style="text-align: center;"> Fluctuating dP ↓ Fluctuating Q ↓ Fluctuating T </p>	<p>•Temperature Stable</p>  <p style="text-align: center;"> Constant dP ↓ Constant Q ↓ Constant T </p>

* Due to the change in dP, Q varies, which causes T for conventional control valve to be Unstable!

* dP is kept constant by SM valve, hence Q remains constant; thus maintaining T to be Stable!

Conventional Control Valve vs FlowCon SM/SME

Conventional Control Valve	FlowCon SM/SME
<ul style="list-style-type: none"> • Tedious Cv calculations • Often over-sized due to design & analysis process of control valve sizing ≤ 50% Valve Authority • Hunting of actuator • ↑ chances of actuators being burnt out • ↑ Time Spent (Installing 2 valves) • ↑ Labour Cost (Installing 2 valves) • ↑ Maintenance Cost (For 2 valves) • ↑ Head Lost (Summation of 2 valves) • ↑ Utility Bills (↑ Head Lost for 2 valves) 	<ul style="list-style-type: none"> • No Cv calculations required • No Cv calculations, hence will not be oversized. Selections based on Q and \varnothing • 100% Valve Authority • No Hunting of actuator • ↓ chances of actuators being burnt out • ↓ Time Spent (Installing 1 valve only!) • ↓ Labour cost (Installing 1 valve only!) • ↓ Maintenance Cost (1 valve only!) • ↓ Head Lost (1 valve only!) • ↓ Utility Bills (↓ Head Lost for 1 valve!)

Manual vs Automatic

(Fideco Project, Vietnam)

Items	Manual Valves	Automatic Balancing Valves	Estimated Savings/Differences
Total Investments on valves only	USD65,000	Equal to Manual Valve	N/A
Total Investments for pumping system		Smaller overall pump capacity and pump head	10%
Number of Valves	190	171	Less 19 pcs branch 65mm valves
Installation cost	Cost + Time for installing 19 pcs 65mm valves	Nil	Cost + Time for installing 19 pcs 65mm valves
Accuracy	+/-15%	+/-5%	10% increased in accuracy
Balancing cost	3 persons, 2 months	No	Approx USD5,000
Warranty period	1 year	1 1/2 years	1/2 yrs more warranty
Energy saving	No	Yes, as no overflow, reduce the pressure loss	About USD10,000/ Year
System protection	No	Yes, as no overflow	N/A
Re-balancing after 2 years of operation	3 persons, 2 months	No	Approx USD5,000
System expansion	Re-Balancing	No re-balancing is necessary	Labour Cost saving
Maintenance cost	Trouble	Simple and easy	

Advantages of Pressure Independent Flow Control (SM/SME)

- Returns authority to the coil and control valve and thermostat, eliminates “hunting” by valve
- Allows for maximum efficiency of the coil’s performance
- Replaces the need for a Pressure Regulator
- Equalizes pressure which reduces Pump Head in addition to that provided by the flow control feature
- Extends equipment life span, reduces maintenance
- Compensates for irregular piping design or installation
- Eliminates the need to compensate for variable pressure
- Lowest operating cost of any type of balancing

The Results

Controlling Pressure

establishes

Valve & Thermostat Authority

which can allow for

higher ΔT , the real savings

The ΔT Difference:

- Valves selected for the coil design flow only
Detrimental design or installation conditions do not affect the valve performance
- Valve stem travels the full stroke, regardless of flow rate and pressure
Very accurate resolution
 - **99.8% accuracy verified by field tests, i.e. 1 GPM loss in 500**
- Each time the stroke position changes, the pressure is equalized across the valve, the result.....

TOTAL VALVE AUTHORITY

Total Authority Valves

Substantially reduce:

- Flow per ton of cooling
- Pump Head
- Energy consumption at the production point

Allow capacity expansion by:

- Lowering flow rate as ΔT increases
- Increasing chiller capacity for:
 - Plant
 - Thermal Storage
 - Distribution System
 - Cooling Coils

NEW ADDITIONS TO SYSTEM WITHOUT NEW INSTALLED CAPACITY

Features & Benefits

Design

- Less time needed to define the necessary equipment for a hydraulic balanced system
- No need to calculate valve authority (if SM or SME is used)
- Certainty that the specified flow is equal to the actual flow
- Flexibility if the system is modified after the initial installation
- Fewer balancing valves needed - no further balancing required in the system when FlowCon balancing valves are installed at terminals.

Installation

- Minimized commissioning time due to automatic balancing of the system
- Removable cartridge solution simplifies flushing procedure
- No minimum straight pipe lengths required before or after the valve.

Operation

- High comfort for the end-users due to high precision temperature control (SM & SME balanced control valves)
- Less energy consumption due to faster response and increased system stability

Features & Benefits (FlowCon SM & SME)

Advantages

- The pre-setting function has no impact on the stroke; Full stroke modulation at all times, guarantees real 100% authority
- High quality electrical actuators; modulating or 3-point floating
- Automatic balancing eliminates overflows regardless of fluctuating pressure conditions in the system
- Flushing through the valve is possible due to the removable cartridge feature
- Possibility to change the cartridge to obtain different flow rate range
- Differential pressure operating range from 30-400 kPa (but still covering 2 valves in 1).
- Field adjustable; flow rate can be changed on demand without removing the cartridge from the valve body
- up to 51 different settings in one single cartridge with a very accurate positioning of each individual setting.
- Accuracy: greatest of either +/-10% of controlled flow rate or +/-2% of maximum flow rate.
- Optimal indoor climate

Thank you for your attention!

