Projektovanje sistema sa promenljivim protokom

Balansiranje i regulacija termalnih jedinica

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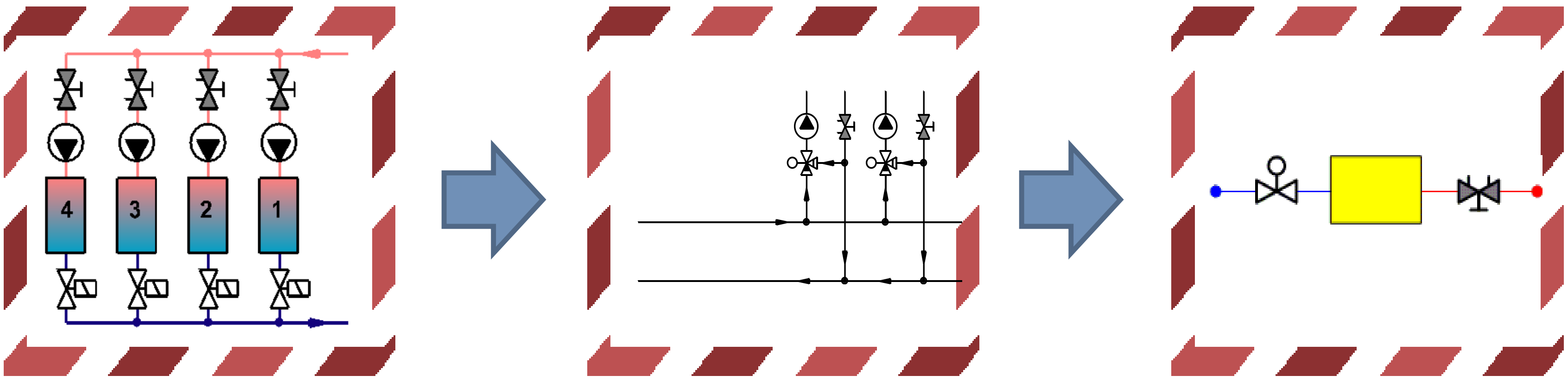
HVAC sistem

HVAC instalacije - treba postići 2 osnovna cilja:

1. Obezbediti terminalni komfor
2. Postići prvi cilj sa min. utroška energije

Proizvodnja | Distribucija | Termalna jedinica

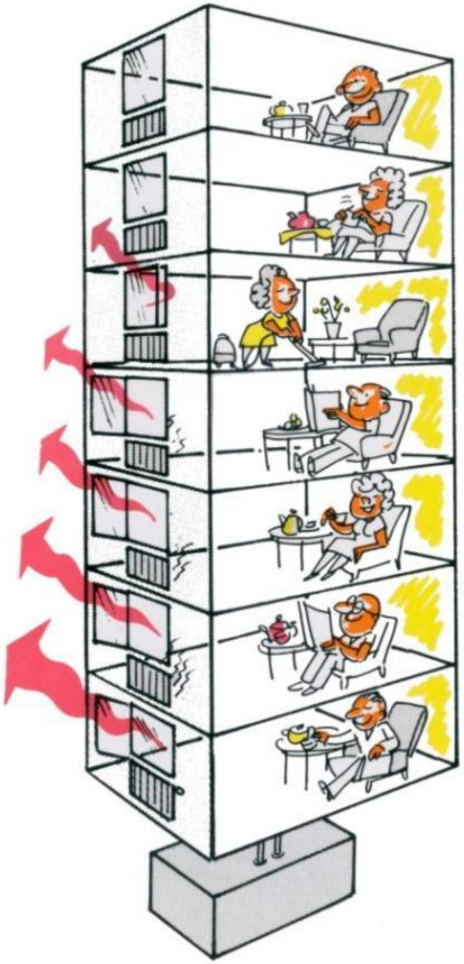


Potrošnja energije

40% od svetske energije upotrebvljava se u zgradama*
50% od te energije u HVAC sistemima zgrade*

(*) Sources: European Commission EPBD (point 6, pp1) & US Department of Energy’s “Buildings Energy Data Book”

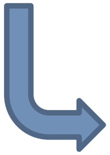
Problem hidrauličkog debalansa



Da se izbegnu primedbe stanara

Pumpe su:

- Predimenzionisane
- Rade na max. brzini
- Menjaju se sa snažnim pumpama



– Protoci su veći
– Manje poddimenz. protoci

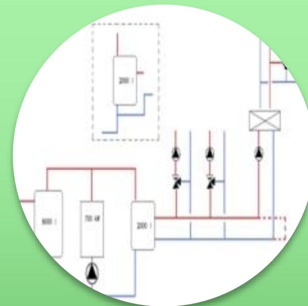
– Instalacija radi globalno sa predimenzinisanim protokom
– Napor pumpe je povećan
– Troškovi pumpe su duplirani

Kod 90% instalacija protok u distibuciji je veći za 150% od projekovanog.

Source: Investigation by Costic (French Research and Training Centre in HVAC), published in CFP Journal April-May 2002.

Ušteda energije kod HVAC sitema u zgradama

Building structure
(insulation, double glazing, …)
- Best way to save energy
- Larger energy savings
- Long pay-back times



HVAC installation
- Use of new technologies
- System approach of hydronic design
- Shorter pay-back times

Human factor
- Avoid interferences with the HVAC system
- Educate tenants and maintenance team
- Never-ending task

Modificiranje zgrade traži adaptaciju ili modernizaciju HVAC instalacije

Kada se modificiraju HVAC instalacije treba uzeti u uvid, sposobnost korisnika da koriste instalacije

Plan

Povećanje efikasnosti proizvodnih jedinica

- Faktori za smanjenje efikasnosti kond. kotla i čilera
- Efekat na DT od:
  - Varijabilnog (promenljivog) nasuprot konstantnom protoku
  - Proporcionalno nasuprot on-off kontroli

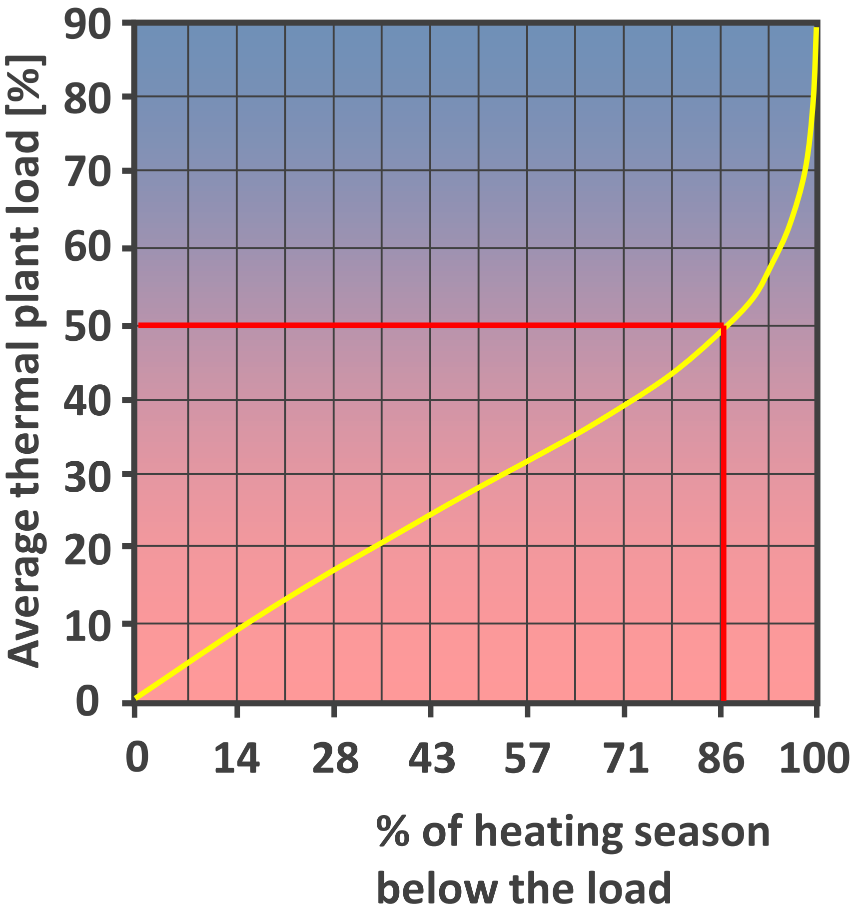
Ušteda energije kod distributivnog kruga

- Faktori smanjenja pumpnih troškova
- Optimalna upotreba VSP

Ušteda energije kroz adekvatnu kontolu sobne temp.

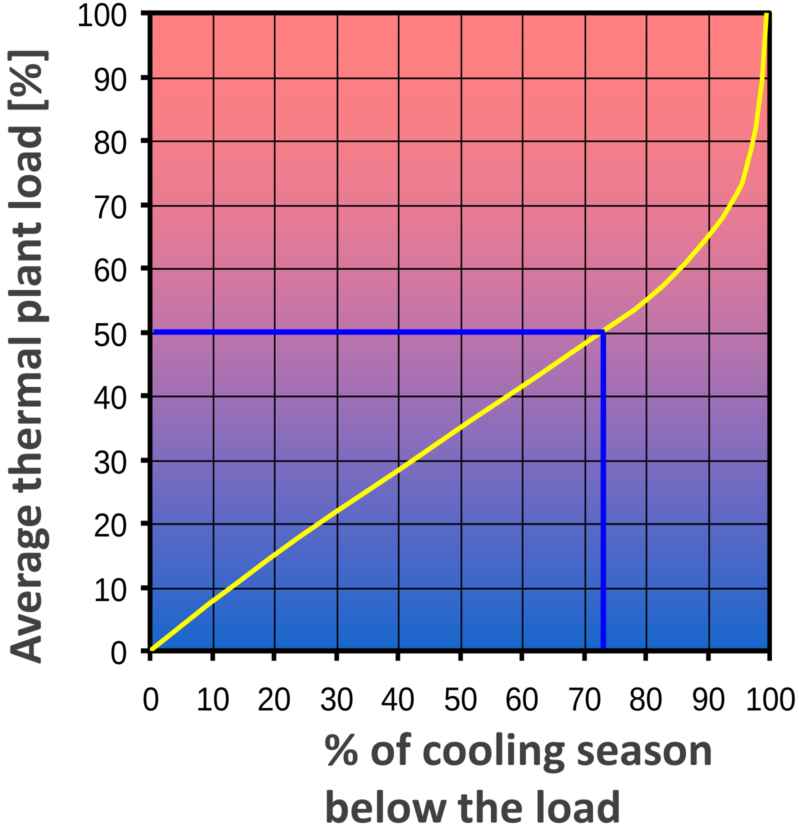
- Pitanja za predimenzionisanje
- 2-kraki ventili autoritet i dimenzionisanje

Promenljivo optrećenje kod grejanja



Više od 85% od
grejne sezone toplotno opterećenje je
manje od 50%

Promenljivo opterećenje kod hladjenja



Više od 72%
od sezona hladjenja
opterećenje je manje od 50%

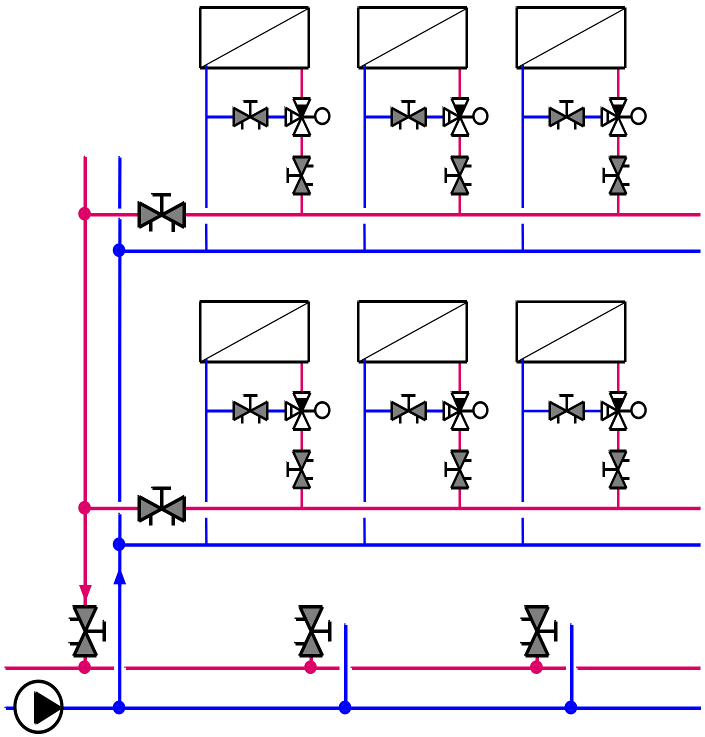
Varijacije optercénja. Najčesće su prouzrokovani od :

- Sunshine effects (up to 750 W/m² for a West façade in July around 4pm at 50° North)
- Building occupancy (1 sitting person: ±110 W, computers …)

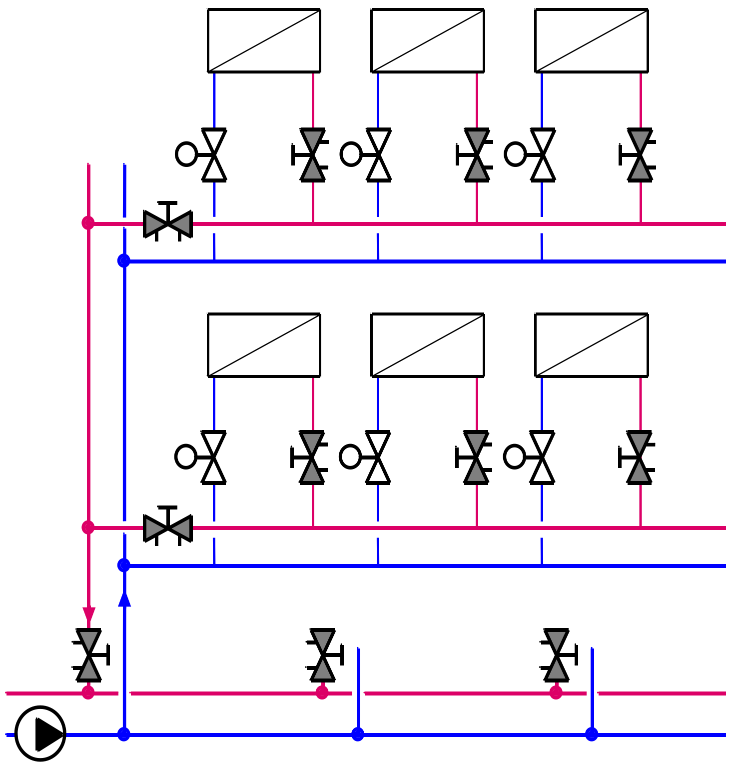
Distributivni sistem sa konstatnim ili varijabilnim (promenljivim) protokom

Varijabilni protok prati promena toplotnog the opterećenja.

Konstatni protok

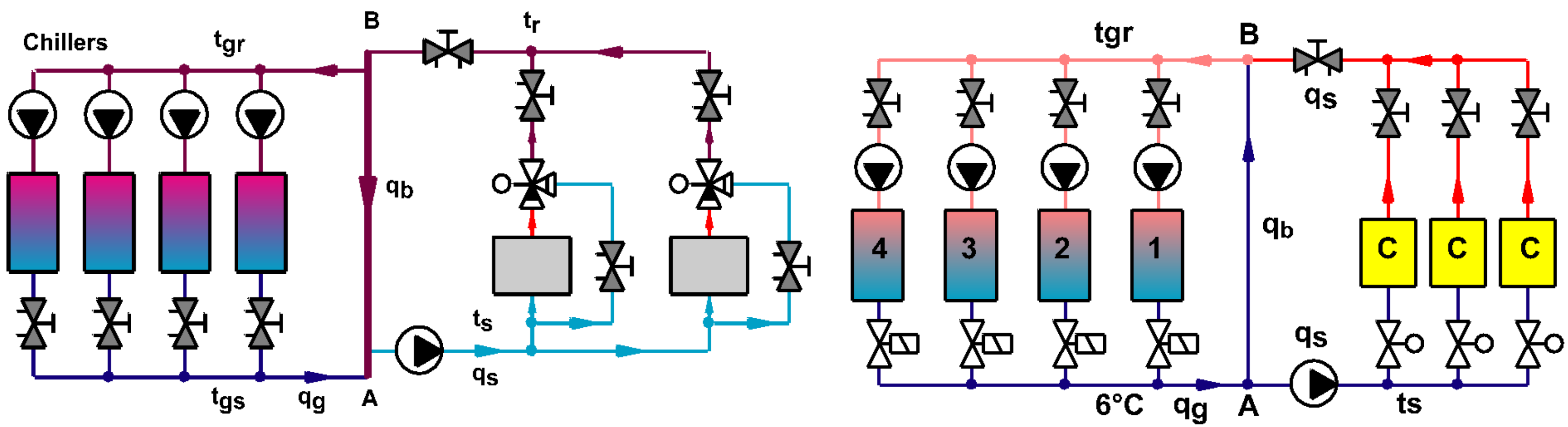


Varijabilni protok



Varijabilni protok prednosti i nedostatci

- Smanjenje potrošnja el. energ. pumpe
- Kompatibilnost izmedju proizvodnih i distributivnih protoka
- Faktor istovremenosti
- Visoki Δt (Niža povratna temp. u grejanju, viša u hladjenju

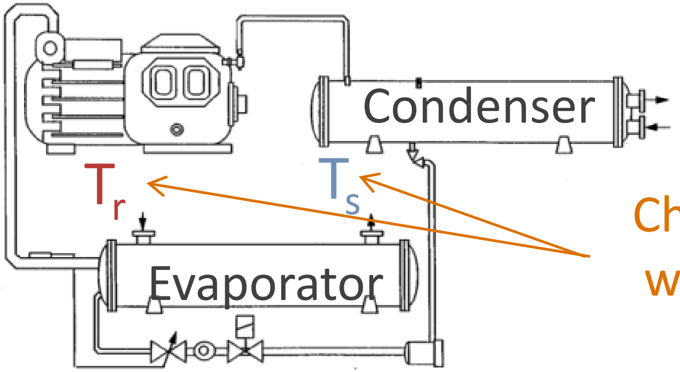


- Promenljivi autoritet kontrolnih ventila
- Potrebno je obezbediti min. protok

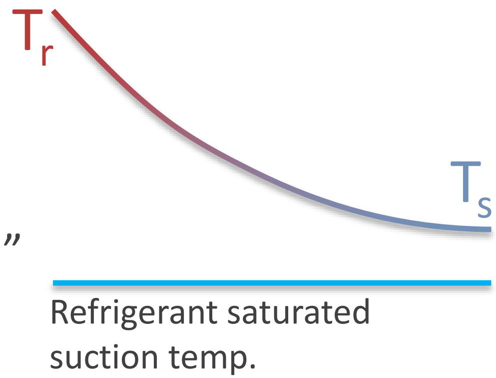
Razhladne mašine - Chillers

- Coefficient of Performance (COP) je indikator efikasnosti na čileru

$$COP = \frac{P_{evaporator}}{P_{compressor}} \approx 2.5 \ldots 4 \ldots 6$$



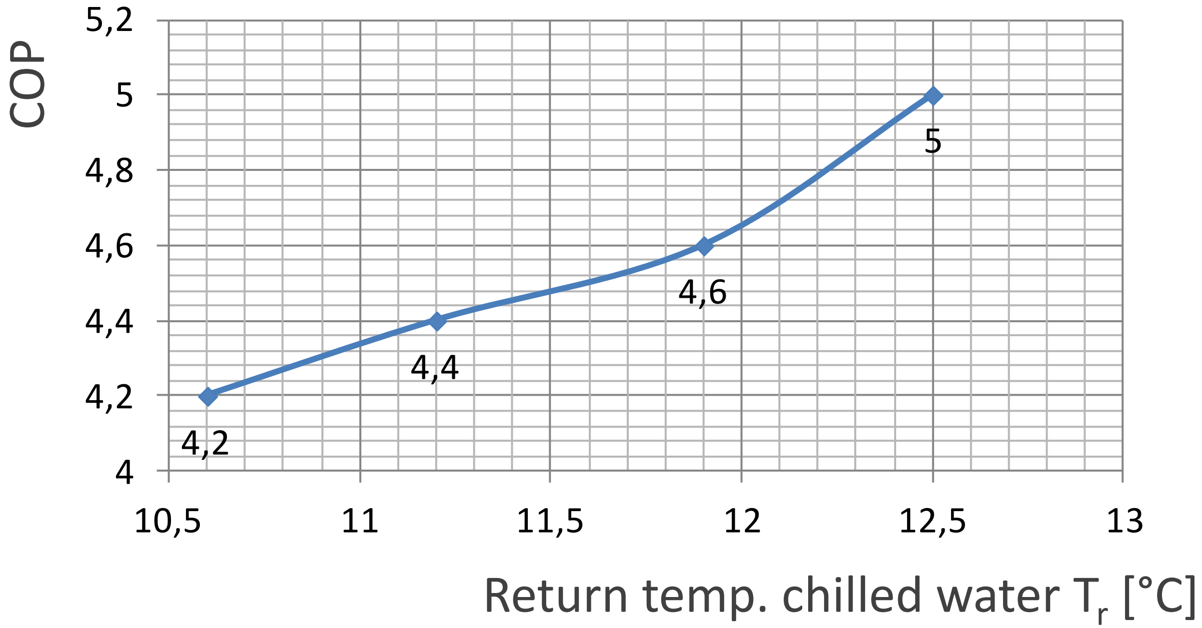
- Premin topl. (time i COP) je dobar kada LMTD izmedju vode i rashladnog sredstva je što višlji
  - Temp. isparenja ostaje const.
  - Izlazna temp. T_s uobičajeno održava se konst.
  - Zbog toga povratna temp. T_r mora da se održava „visoka„ da bi LMTD bio visok



- ***Visoka T_r (a time i visok DT = T_s-T_r) obezbedjuje visok COP pri malo topl. opterećenju.***

Uticaj od smanjenja povratne temp. vode na COP

- **Primer :**
  Chiller: 200 tons (703 kW)
  Temp. kondezaotrske vode : 29,5°/35°C
  Izlazna temp. vode iz isparivača T_s : 7°C



- Smanjenje povratne temp. vode može dovesti do 15% pad COP

Varijabilni protok – proporcionalna kontrola

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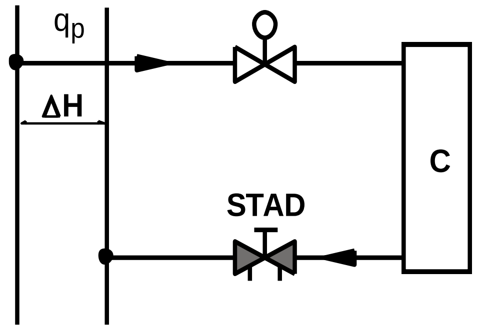
2-krak krug (promen. protok)

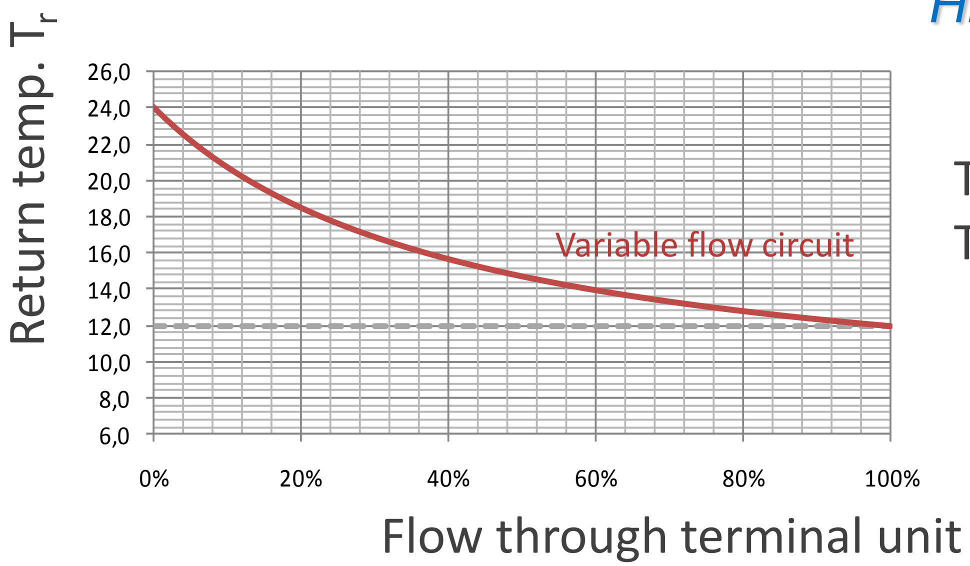


DT kroz termalne jedinice uvećava se kada se protok smanjuje.

Zbog toga **povratna temp. vode raste**

Svih beneficija za COP čilera.

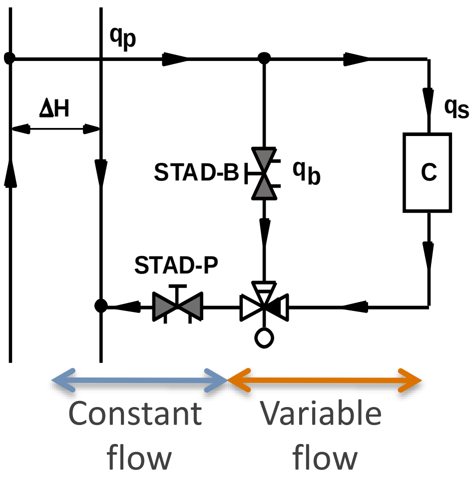
Hladjenje



Temp. režim:
Ts/Tr/Ti = 7/12/24°C

Konstantni protok – proporcionalna kontrola

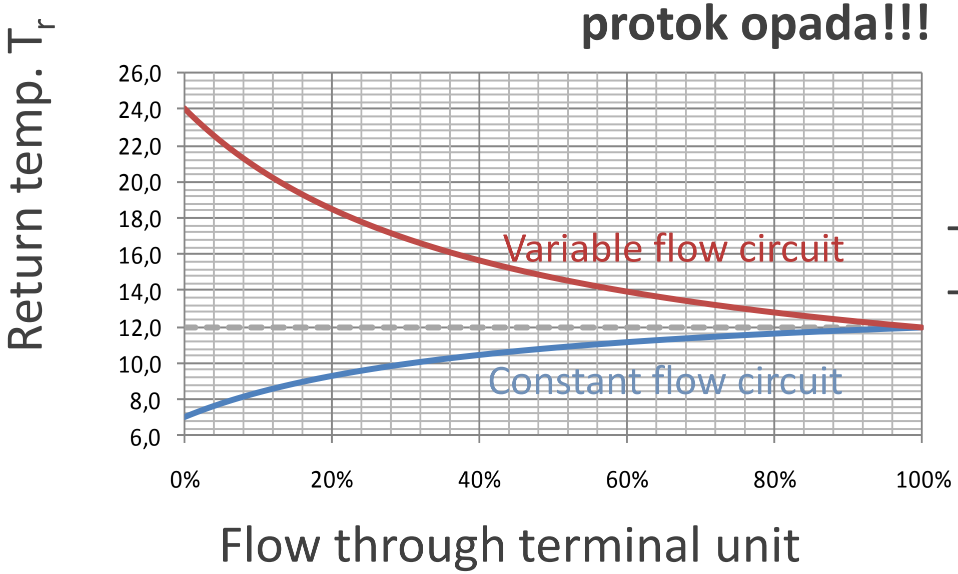
3-krak razdelni krug



ΔT kroz terminalne jedinice raste kada se protok smanjuje

Protok kroz terminalne jedinice je smanjenjen sa bajpasiranjem i povećavajući udeo primranog protoka (pri. Ts).

Zbog toga **povratna temp. smanjuje se kada protok opada!!!**



Hladjenje

Temp.režim:

Ts/Tr/Ti = 7/12/24°C

Promena diferencijalnog pritiska

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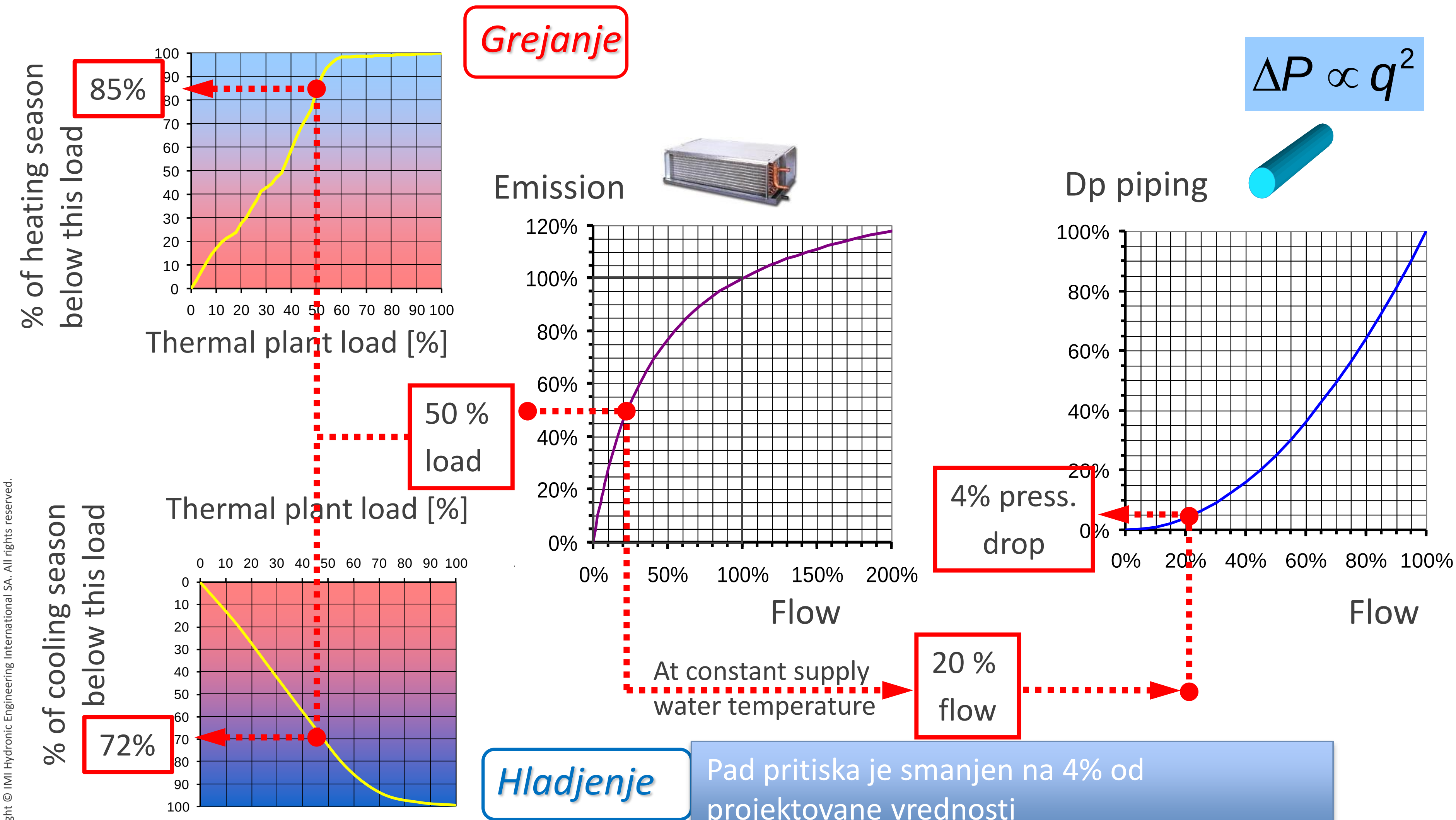

Pad pritiska je smanjen na 4% od projektovane vrednosti

Autoritet 2-krakih kontrolnih ventila

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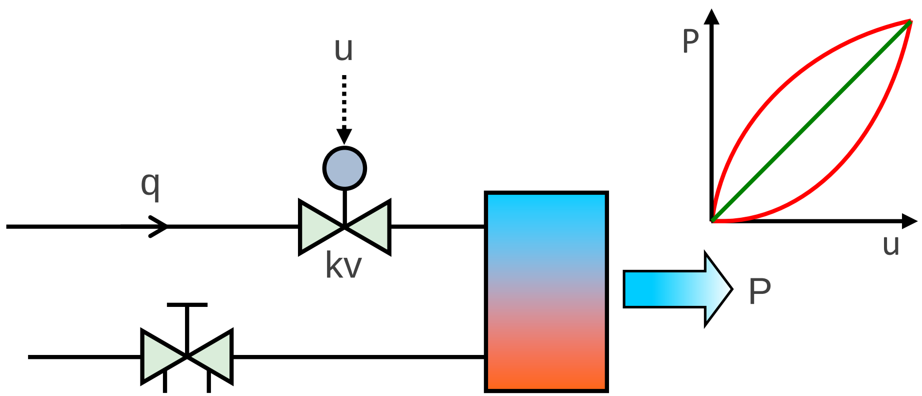
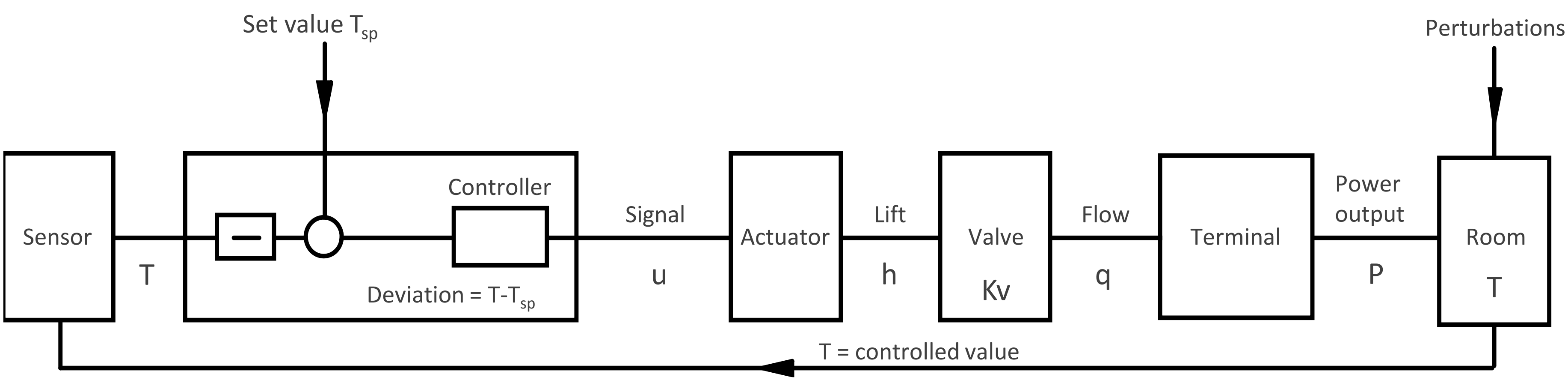
Kontrola sobne temperature



Da bi sobna temp. bila stabilna i tačna, ukupna karak. kruga treba da bude linearna

Sve ostale karak. vode do visokog rasta od nekih delova u kontrolni opseg što dovodi do oscilacije sobne temp.

Kontrolni krug sobne temp.



Karakteristika termalne jedinice

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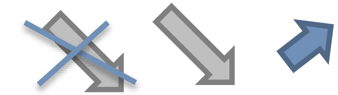
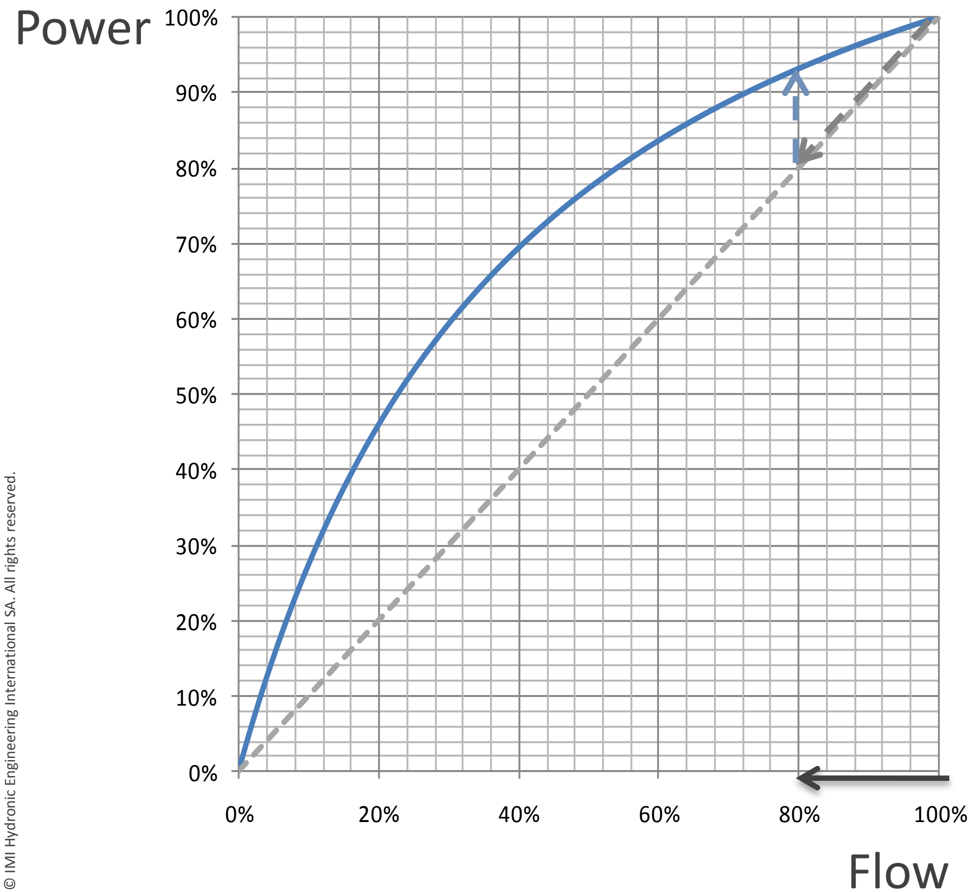


$$P \propto q \cdot \Delta T$$



- Kada protok kod term. Jedinice je smanjen,
- ΔT raste
- Nelinearna karakteristika

- Stepen nelinearnosti krive zavisi od koef. Termičke efikasnosti Φ:

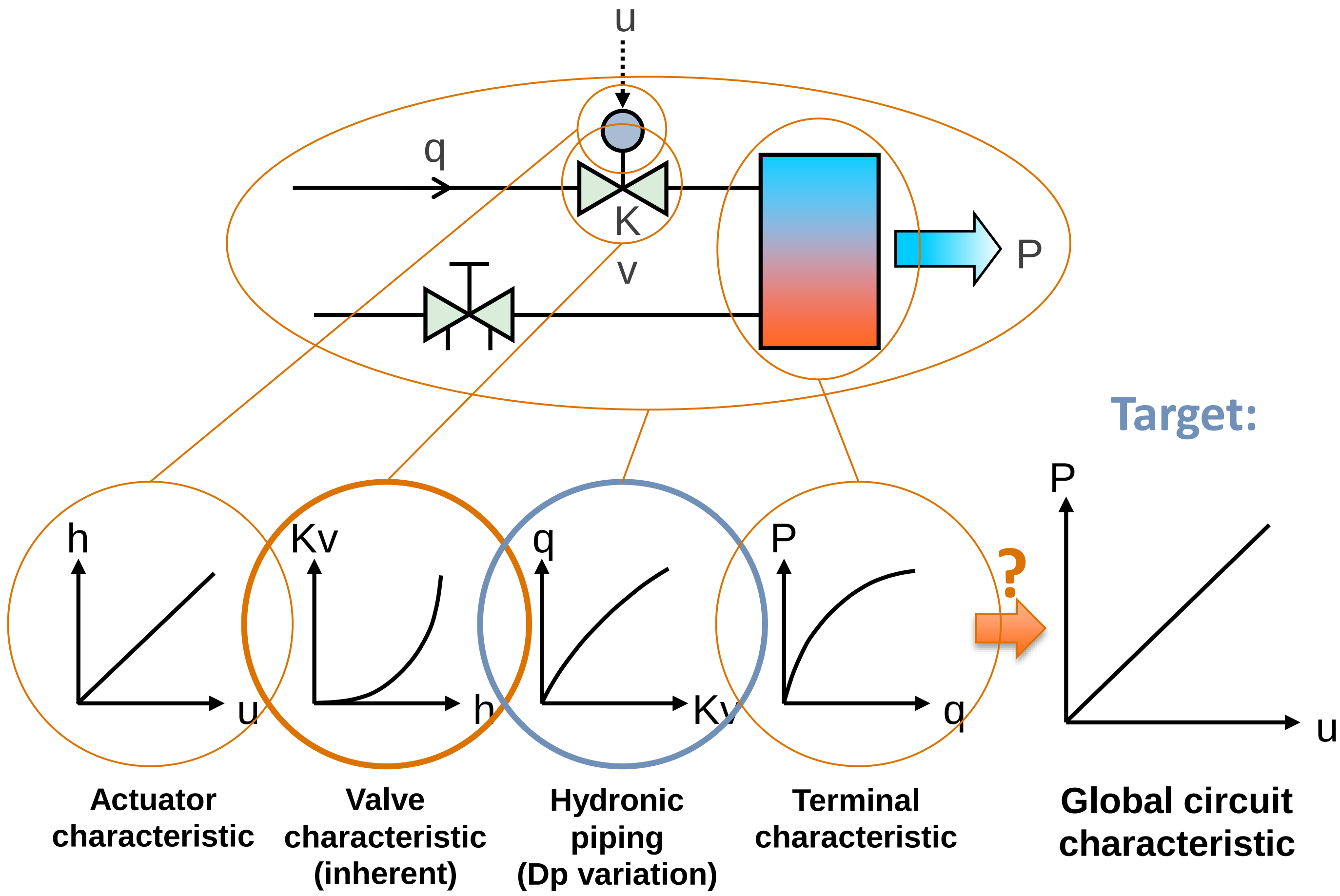
$$\Phi = \frac{T_{Return} - T_{Supply}}{T_{Indoor} - T_{Supply}}$$

Example :

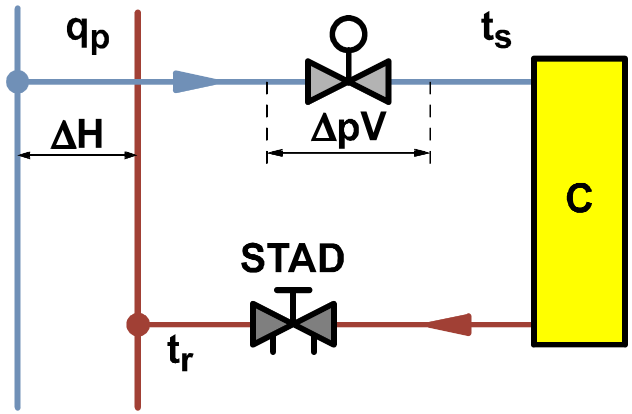
$$\Phi = \frac{12°C - 7°C}{24°C - 7°C} = 0.29$$

Ukupna karakteristika kontrolnog kruga

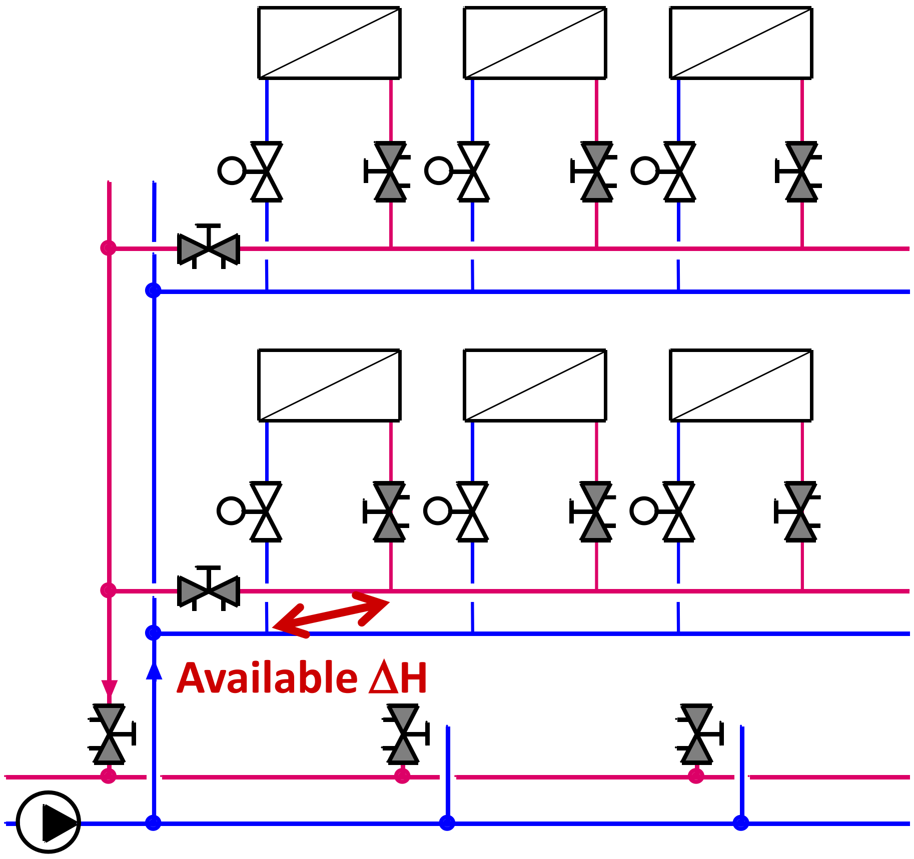
- Potrebe od **kontrolnih ventila sa istoprocentnom karak.** ciljem da se dobije dobra ukupna regulaciona karakteristika kao dobra **regulacija sobne temp**.



Autoritet 2-krakog ventila

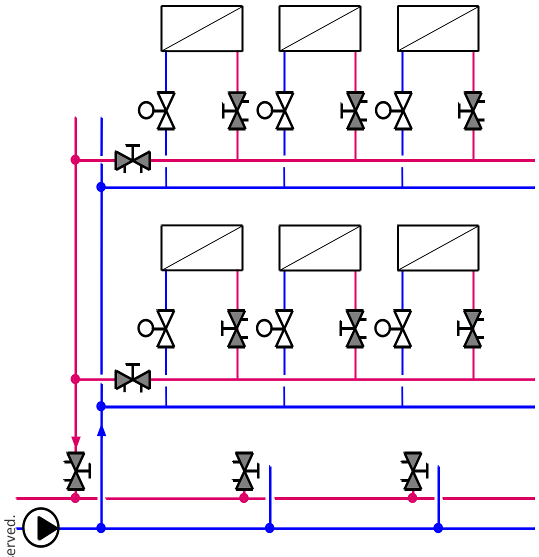


$$\beta = \frac{\Delta P_{\text{Control valve fully open and design flow}}}{\Delta P_{\text{Control valve fully shut}}}$$



Kod sistema sa varijabilnim protokom, autoritet ventila je varijabilni

Autoritet kontrolnog ventila



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

Konstantni pri odabranom Kvs

Varijabilni, zavisi od protoka u cevovodu,

Isto tako od stepen otvorenosti drugih kontrolnih ventila

Dimenzioniranje kontrolnih ventila

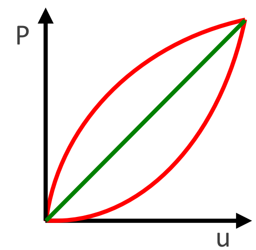
- Dimenz. = Kvs izbor
- Izbor Kvs zasniva se na:
  - Projektovani protok
  - Procena Dp (za dobre kontr. osobine)
- Dp pravila:

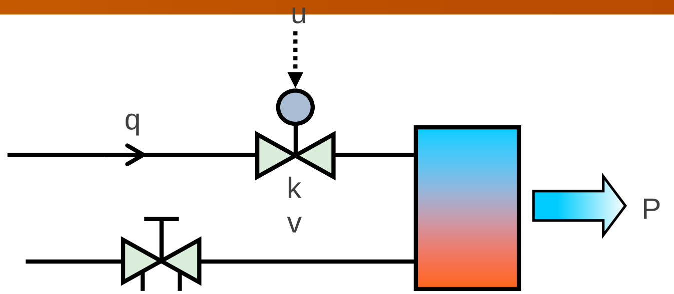
U više slučaja: prenizak Dp, preveliki Kvs

Ista dimenzija kao cev	Dimenz. cevi nije način za odredjivanje dobre kontrole
10, 15 or 20 kPa	CV mora da se dimenz. na osnovi Dp u sistemu kada se instalira
Isto Dp kao termin. Jedin.	Primena samo kod 3-краки CV u Sistemu sa konst. protok
Deo raspoložl. Dp od kruga pri projektovanim uslovima	Nije uzeta u uvid brza promena protoka pri malim topl. opterć. u sistemima sa varij. protokom

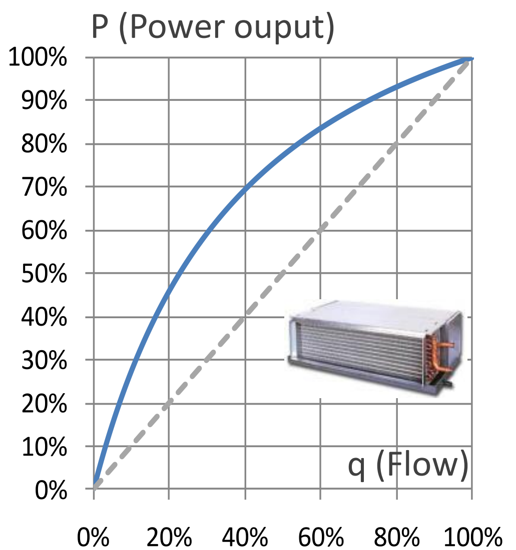
Karakteristika term. jedinice **vs**. karak CV

Da bi se dobila ukupna karak. Kruga što je moguća linearnija **nelinerana karak. termin. jedinice kompenzira se** sa istoprocentnom karak. ventila



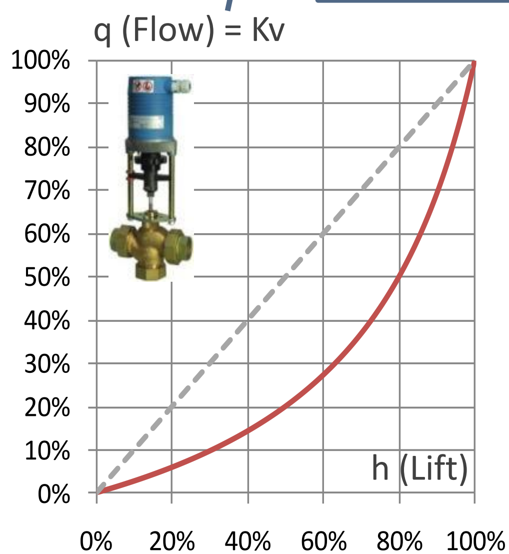


Tačno ако Δp je конст.:
$q = Kv\sqrt{(\Delta p)}$



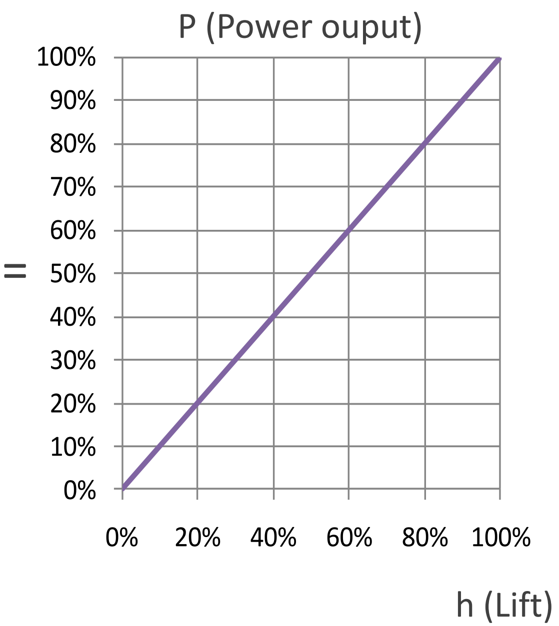
Terminal unit characteristic

+



Control valve characteristic
(Equal-percentage)

=



Promena diferencijalnog pritiska

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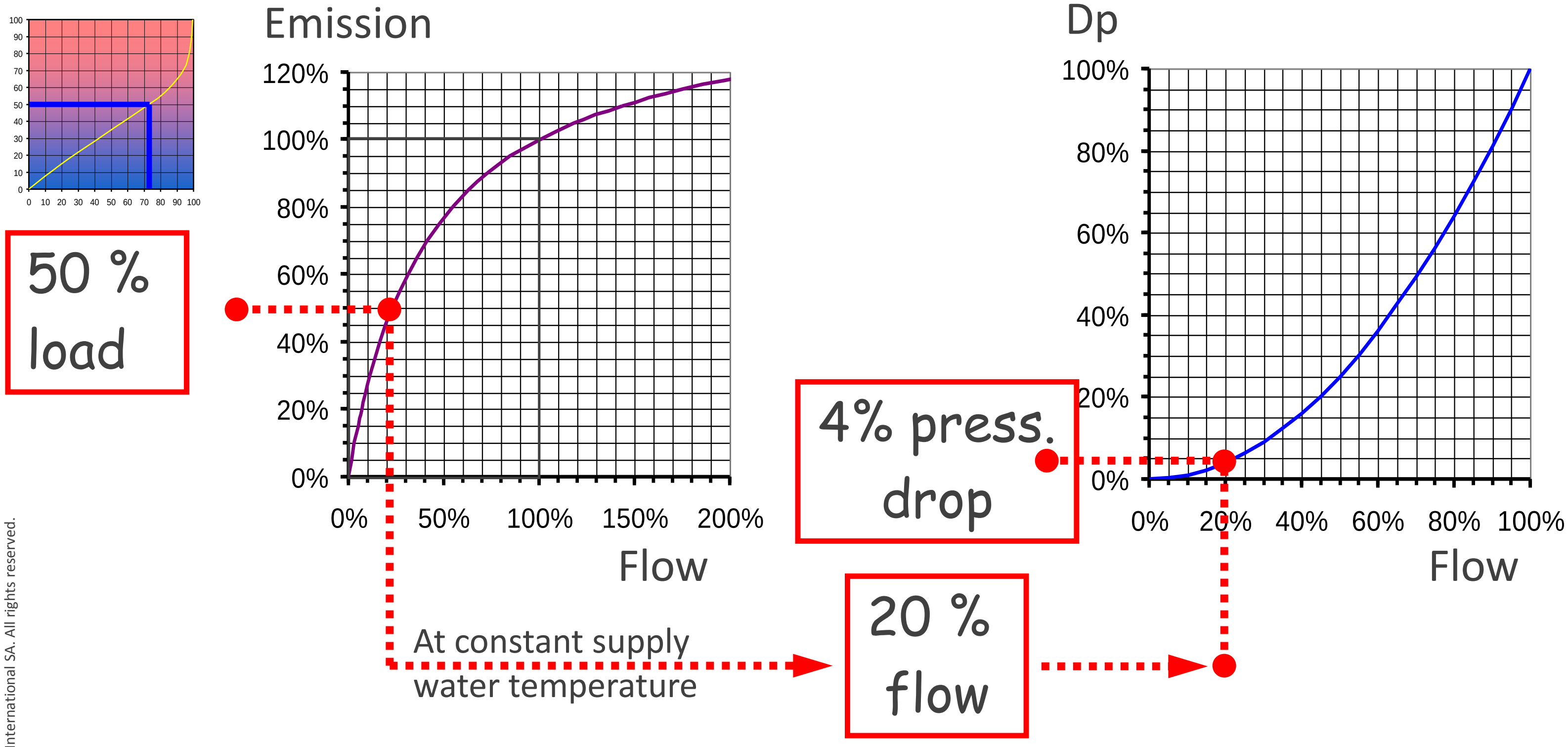
50% toplotnog optrećenja predstavlja značajni udeo od sezonskog hladjenja/grijanje



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

Pad pritiska smanjuje se na 4% od početne vrednosti.

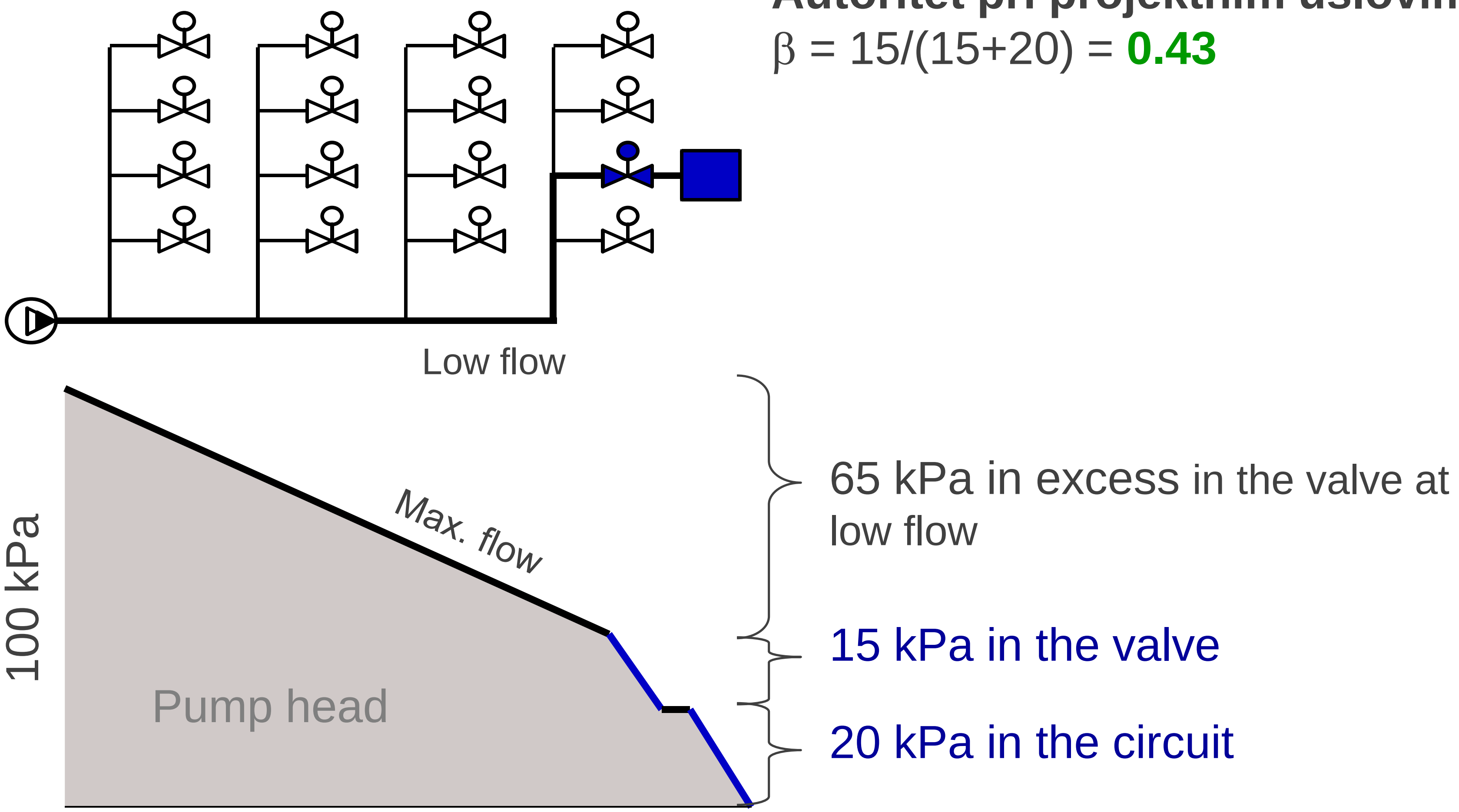
Napor pumpe u potpunost prenosi se na 2-krakog kontrolnog ventila

Promenljiv autoritet kod 2-krakih kontrolnih ventila

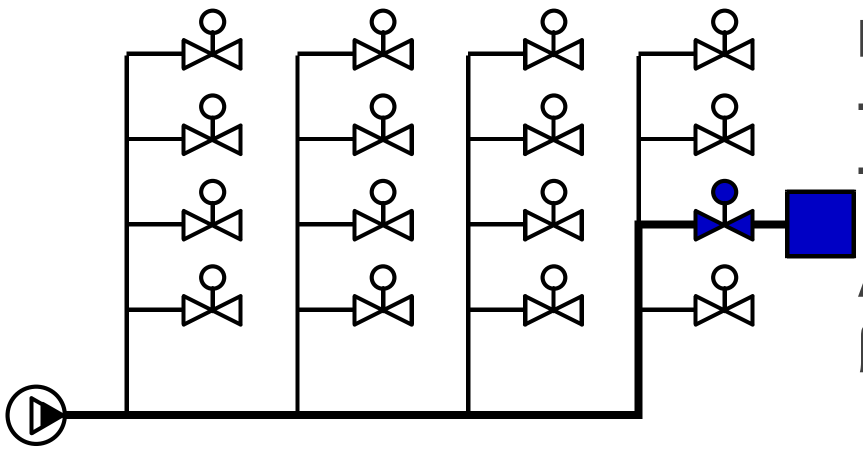
Primer:

Autoritet pri projektnim uslovima:

β = 15/(15+20) = **0.43**

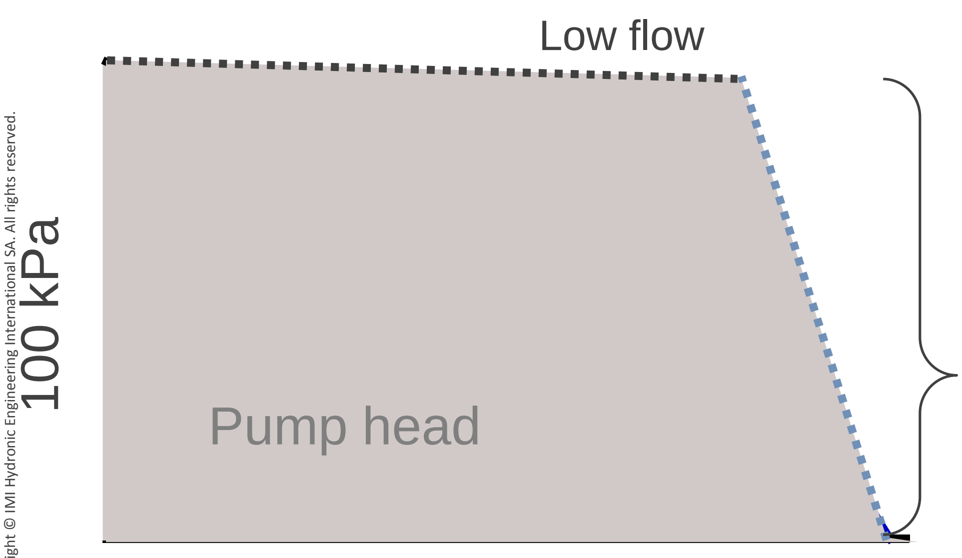


Promenljiv autoritet kod 2-krakih kontrolnih ventila



Kad se snaga smanjuje na 50 %
- Protok pada do 20%
- Pad pritiska smanjuje se na 4%

Autoritet pri 50% topl. opterč.:
β = 15/(15+20+0.96×65) = **0.15 !**



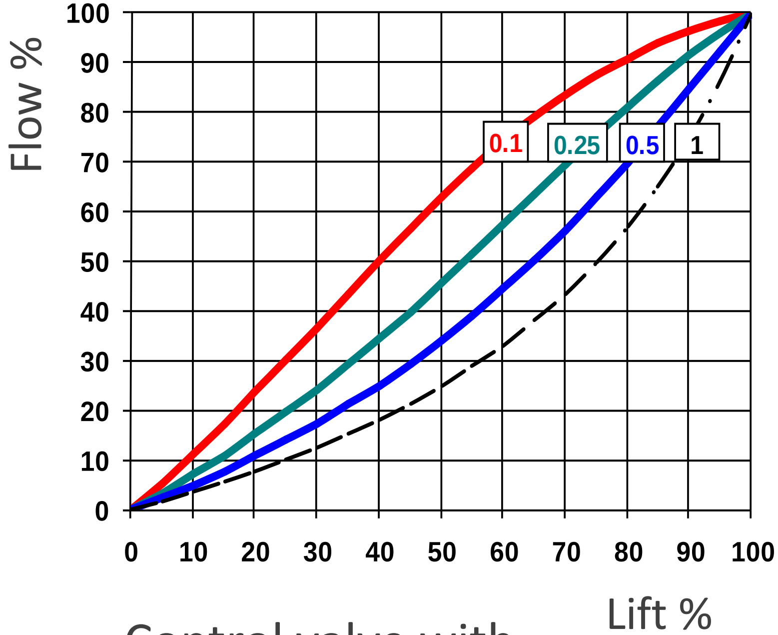
2.6 kPa left in pipes!

97.4 kPa in the valve

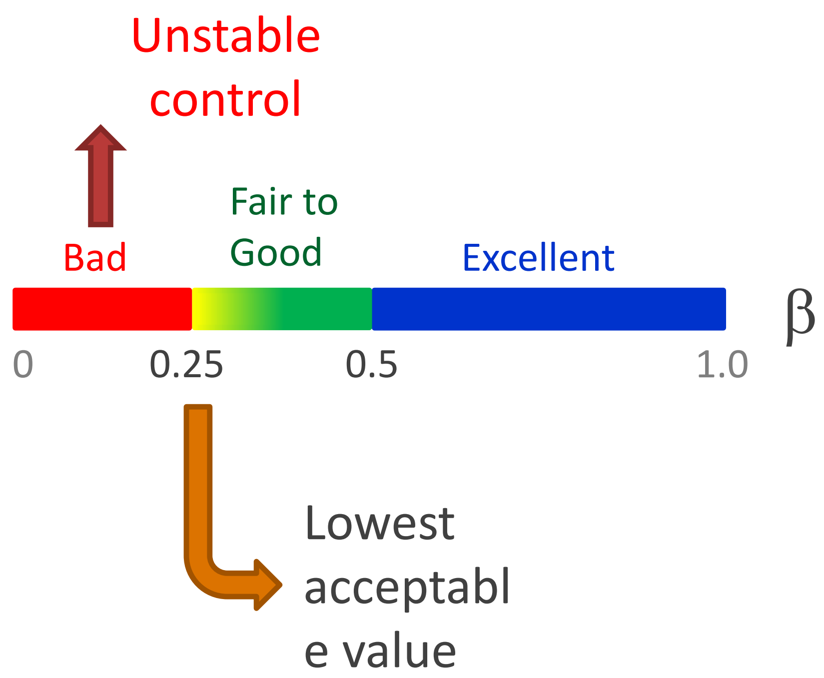
0 Δp in the circuit

Smernice za autoritet ventila

Niži autoritet,
veći Dp varijacije kontrol. ventila,
veća distorzija karak. ventila



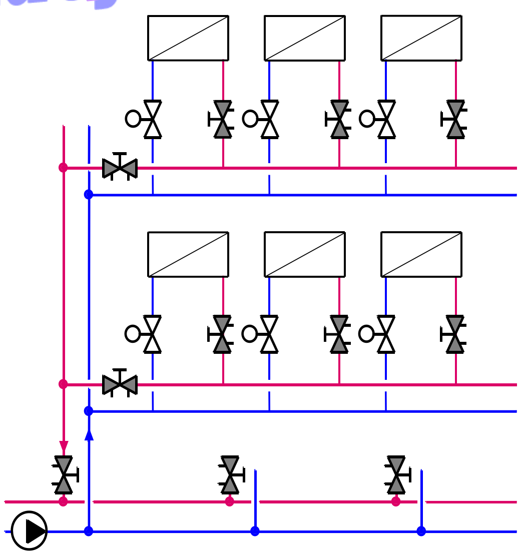
Control valve with
Equal-percentage
characteristic



2-krak CV sa MBV ?

Da se obezbedi autoritet **najmanje 0.25** za svie kontr. ventile pri najgorim uslovima

Ideja



1 Potrebni napor pumpe za ceo sistem dobija se(H_0) od proračuna pada pritiska u cevima (bez pada pritiska u CV).

2 Svi CV dimenzionisani su bez osnove **1/3 od proračuna napora pumpe**.

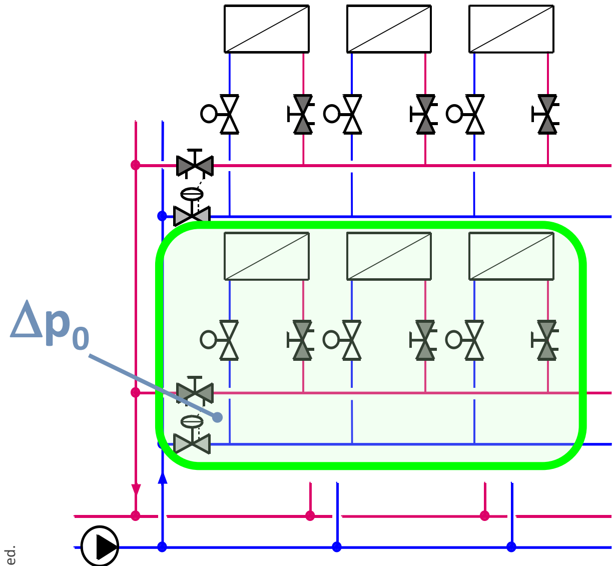
3 Konačni napor pumpe posle izbora CV (≈ **4/3 of H_0**).

- **Prednosti:** min. autoritet ventila
- **Nedostatci:** napor pumpe je uvečan za 33%

$$\frac{1/3\ Ho}{4/3\ Ho} = 0.25$$

Δp stabilizacija pojednostavljuje proračun

Δp stabilizacija na ulaz u grani → Svi proračuni odnose se na grani unutar.



1. Potrebni napor pumpe za modul (**Δp_0**) je proračunat bez pada pritiska u CV.
2. Svi CV dimenzionisani su na osnovi na **1/3 of Δp_0.**
3. Konačni ΔpL u modulu je ograničen na **≈ 4/3 of Δp_0.**

$$\frac{1/3\ \Delta p_o}{4/3\ \Delta p_o} = 0.25$$

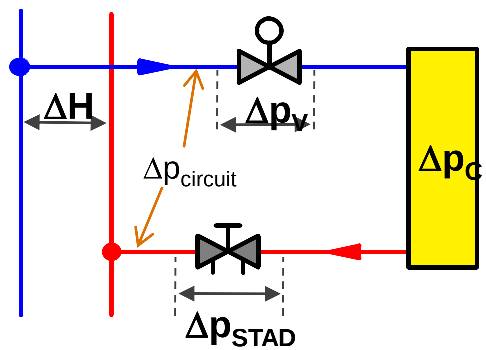
Prednosti:

- Min. autoritet za sve ventile najmanje
- Potrebni Δp u CV je drastično smanjen.
- Svi proračuni su postignuti na osnovu **hidrauličkih modula,** a ne za ceo objekat

Dimenzionisanje CV zbog autoriteta

Da bi se postigla dora kontrola, projektanti uobičajeno primenjuju sledće pravilo

1. Dimenzionisanje CV sa Kvs za $b_{design} \geq 0.5$



Pravilo бр. 1:

$\Delta p_{CV} \geq \Delta p_C + \Delta p_{circuit} + \Delta p_{STAD}$

or

$\Delta p_{CV} \geq 0.5 \times \Delta H$

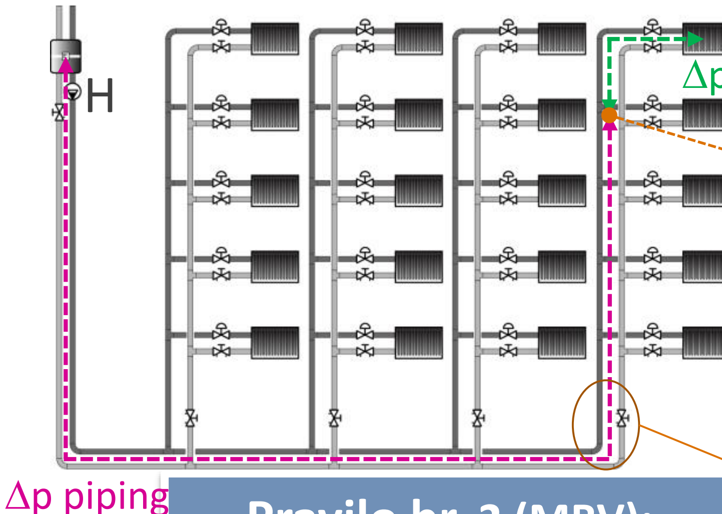
$\beta_{design} \geq 0.5$

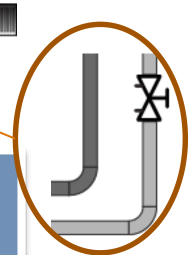
$$\beta_{design} = \frac{\Delta p_{Control valve\ fully\ open and\ design\ flow}}{\Delta H}$$

Dimenzionisanje CV zbog autoriteta

Za postizanje dobre kontrole preporučuje se da se ispune sledeća pravila autoriteta

Da se osigura $b_{min} \geq 0.25$





Pravilo br. 2 (MBV):

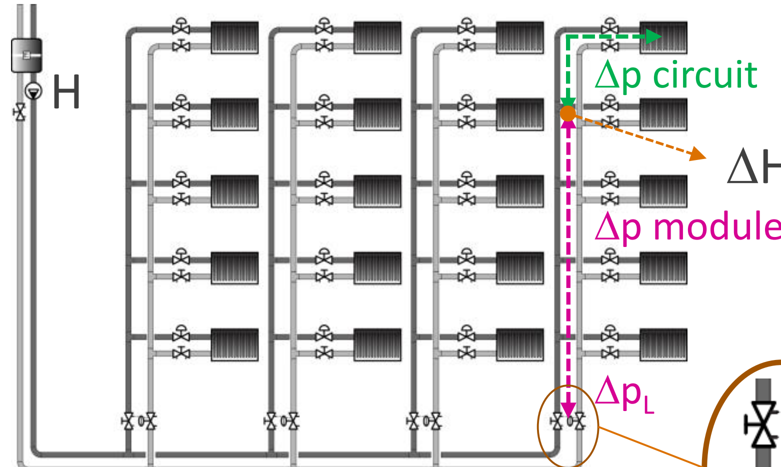
$\Delta p_{CV} \geq (\Delta p_{piping} + \Delta p_{Circuit})/3$

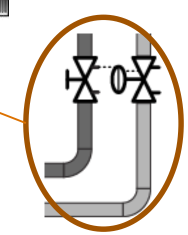
or

$\Delta p_{CV} \geq 0.25 \times H$

$\beta_{min} \geq 0.25$

$$\beta_{min} = \frac{\Delta p_{Control\ valve\ fully\ open\ and\ design\ flow}}{H}$$





Pravilo br. 2 (Dpc):

$\Delta p_{CV} \geq (\Delta p_{module} + \Delta p_{Circuit})/3$

or

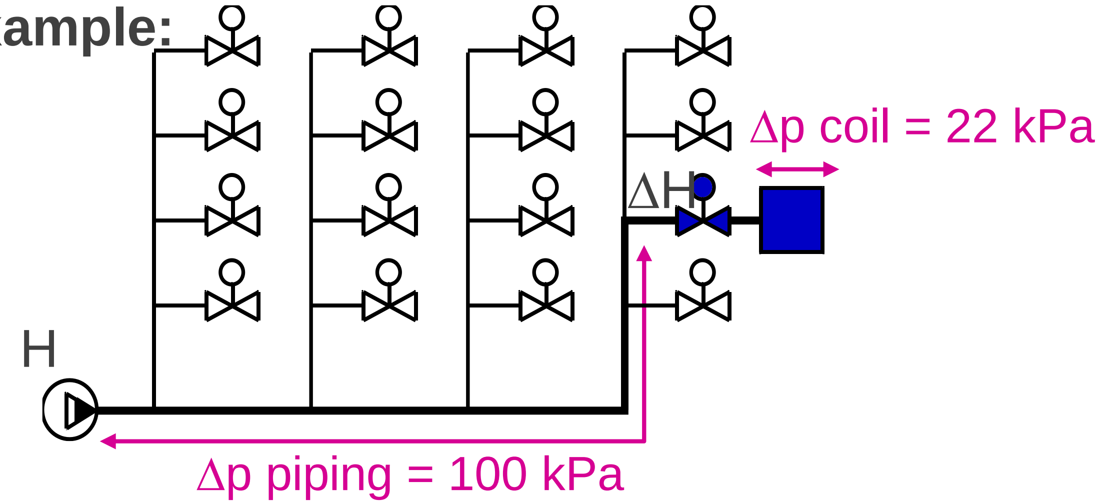
$\Delta p_{CV} \geq 0.25 \times \Delta p_L$

$\beta_{min} \geq 0.25$

$$\beta_{min} = \frac{\Delta p_{Control\ valve\ fully\ open\ and\ design\ flow}}{\Delta p_L}$$

Poboljšana kontrola za tačan proračun kontrolnog ventila

Example:



IDEA

Ensure design authority of **at least 0.5** and minimum on **0.25** in **all** control valves in the **worst** conditions.

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

$$\beta_{\min} = \frac{\Delta P_{\text{Control valve fully open and design flow}}}{H}$$

Rule no 1:

For obtaining a design authority of 0.5:

Δp in control valve must be ½ ΔH

Since Δp piping + Δp coil = 22 kPa,
Δp in control valve must be = 22 kPa

Final pump head = 122 + 22 = **144 kPa**

β_{design} **= 0.5** (22/(22+22)) **but**

β_{min} **= 0.15** (22/144)

Rule no 2:

For obtaining a minimum authority of 0.25:

Δp in control valve must be 1/3 H

Since Δp piping + Δp coil = 100 + 22 = 122 kPa,
Δp in control valve must be = 40.6 kPa

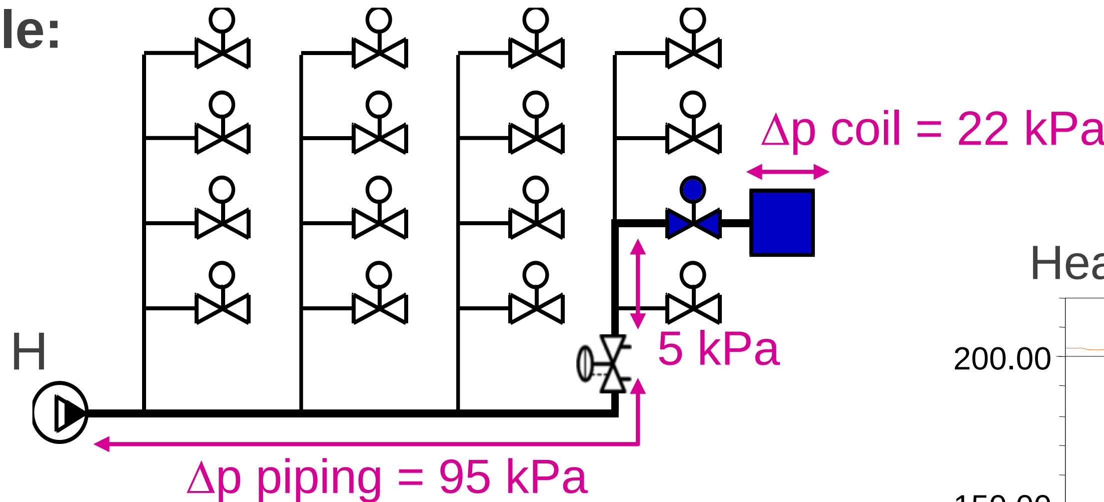
Final pump head = 122 + 40.6 = **162.6 kPa**

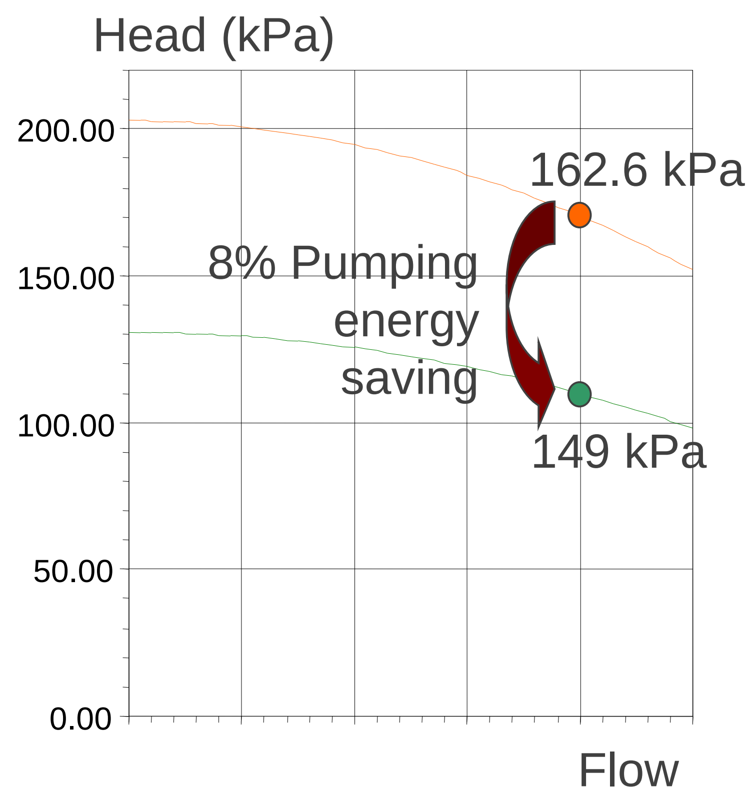
β_{design} **= 0.66** (40.6/(40.6+22)) **and**

β_{min} **= 0.25** (40.6/162.6)

Smanjenje potrošnje energije kod pumpe

Example:





Control valve sizing with Dp control:
For obtaining a design authority of 0.5 and min of 0.25:

Δp in control valve must be ½ of ΔH and ¼ of stabilized Δp

Since Δp piping + Δp coil = 22 kPa,
Δp in control valve must be = 22 kPa

Final stabilized Δp = 22 + 22 + 5 = 49 kPa
β_{design} **= 0.50** (22/(22+22)) **and**
β_{min} **= 0.45** (22/49)

Final pump head = 95 + min Δp of DpC (5 kPa) + 5 + 22 + 22 = **149 kPa**

Kako dobiti dobar (minimum) autoritet?

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

Dimezionisanje CV

Dimenzionisanje *CV* (tačan) Dp koji daje min. autoritet od 0,25

Kontrola dif. pritiska

Održavaće dif. pritiska kod *CV* dovoljno nizak

Microsoft Excel Worksheet

Dp kontroleri ili integrirani u CV

Dimenzionisanje kontrolnih ventila

Hydronic Engineering

Kontrolni ventili komrecijalno su raspoložljivi sa Kvs vrednost rasteći prema Reynard serija:

Kvs: 1.0 1.6 2.5 4.0 6.3 10 16 …

Za protok vode 4 m^3/h = 1.11 l/s, kontrolni ventil daje projektovani Δp : 16, 41 or 102 kPa, ništa izmedju

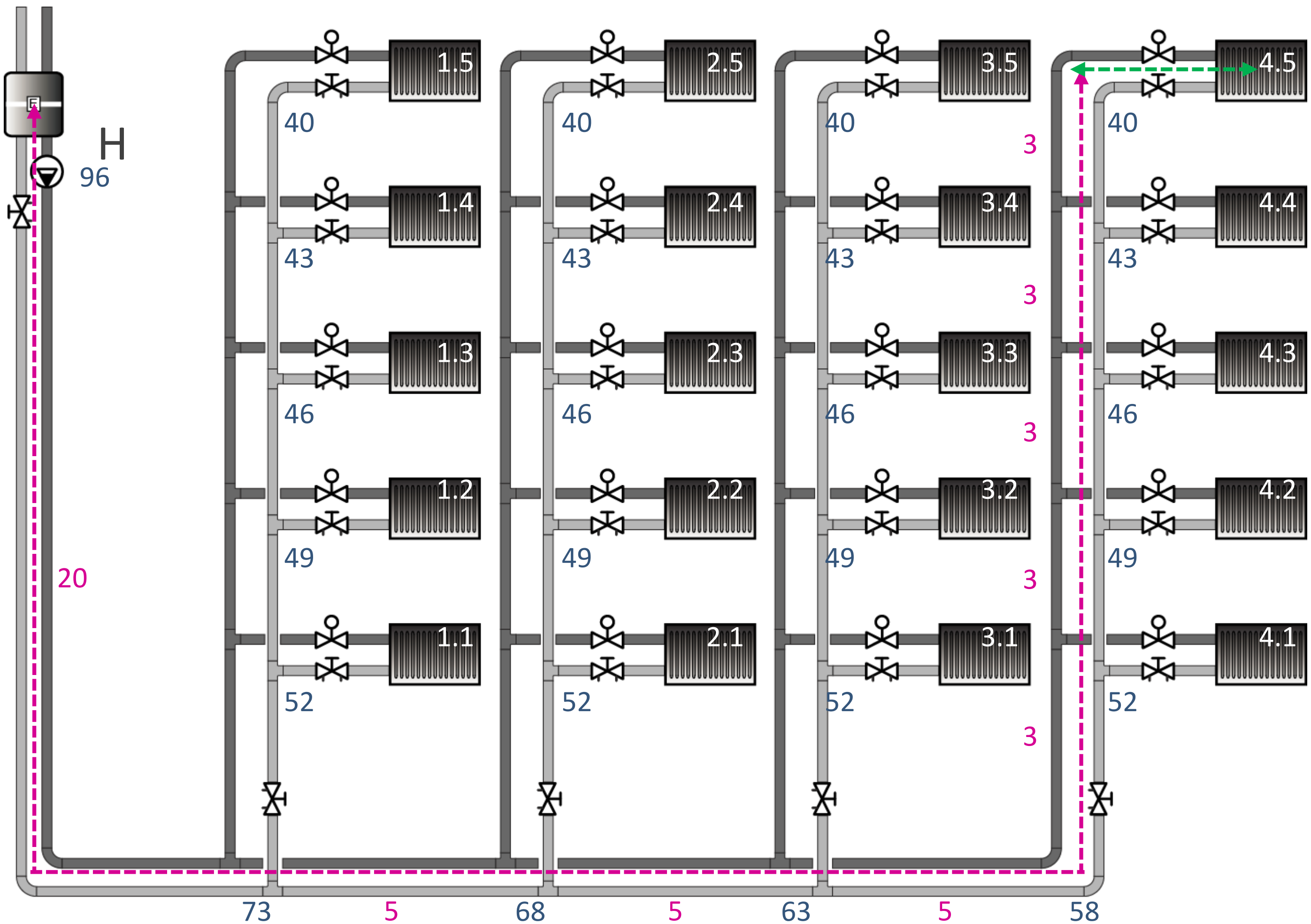
Zato kontrolni ventili su:

- ili predimenzionisani za slab autoritet,
- ili poddimenzionisani za visok Dp a time i veći napor pumpe od potrebnog

Rešenje:

Kontrolni ventili se podešava Kvs i istoprocentna karakteristika nezavisna od setiranja ventila

Proračun sistema sa standardnim ventilom + MBV



Δp circuit: 7 kPa
Δp STAD 3 kPa

Add up all Δp piping
Minimum Δp_{CV}:
66/3 = 22 kPa

Kv max:

$$0.01\frac{5500}{\sqrt{22}} = 11.7$$

Kvs: 10.0
Δp_{CV}:

$$\left(0.01\frac{5500}{10}\right)^2 = 30\ \text{kPa}$$

All ΔH can now be calculated.

All Δp_{STAD} can now be calculated like on 4.1:

$$52 - 7 - 30 = 15\ \text{kPa}$$

All β_{min} is $^{30}/_{96} = 0.31$

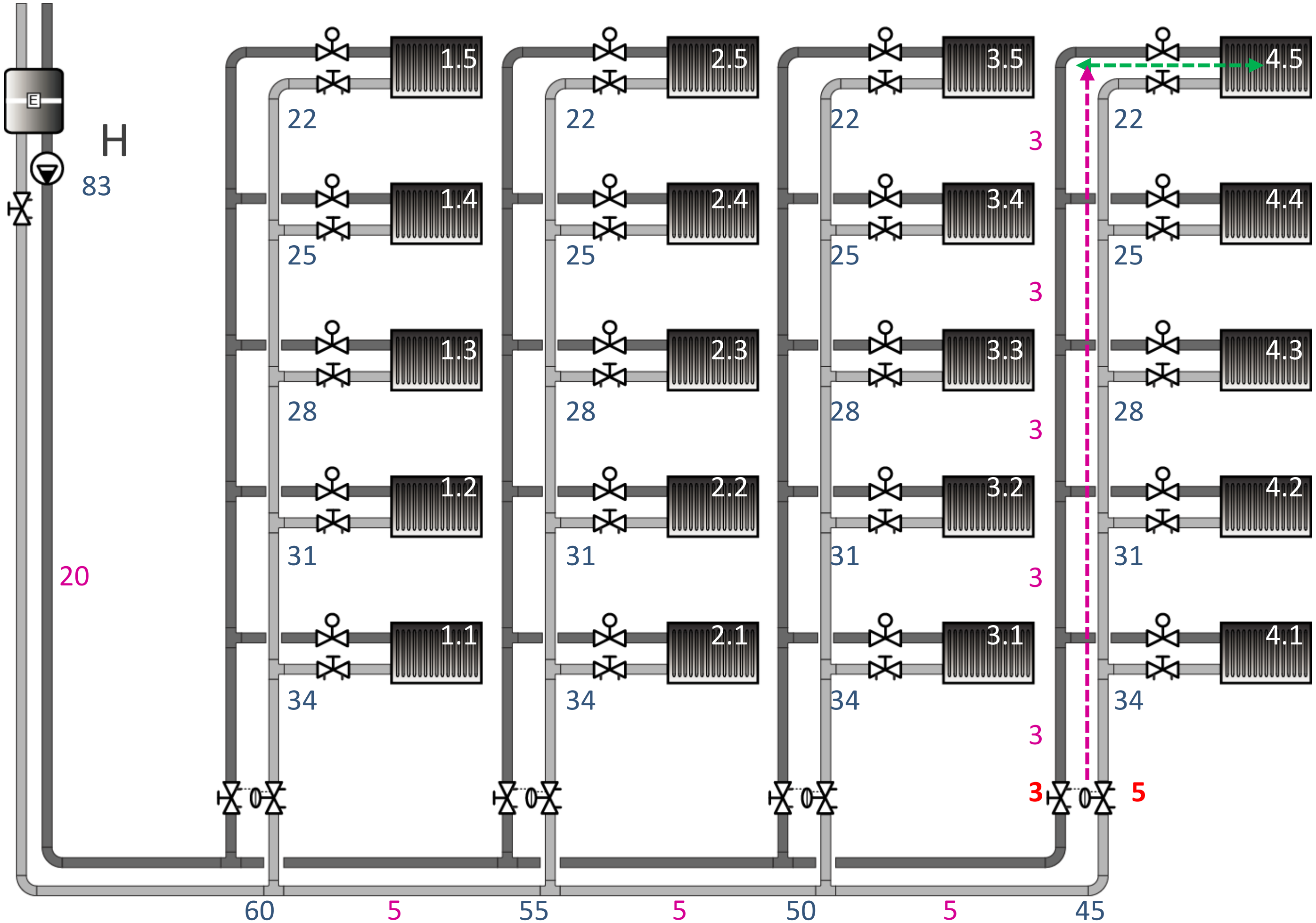
$B_{design\ [4.5]}$ is $^{30}/_{40} = 0.75$
$B_{design\ [4.1]}$ is $^{30}/_{52} = 0.58$

Δp piping: 66 kPa

ΔH

All coil flow: 5500 l/h

Proračun sistema sa standardnim ventilom + ΔpC



Δp circuit: 7 kPa
Δp STAD 3 kPa

Add up all module Δp 25 kPa
Minimum Δp_{CV}:
25/3 = 8.33 kPa

Kv max:
$$0.01\frac{5500}{\sqrt{8.33}} = 19.05$$

Kvs: 16.0
Δp_{CV}:
$$\left(0.01\frac{5500}{16}\right)^2 \approx 12 \text{ kPa}$$

ΔH can now be calculated
ΔpL can now be calculated.
22+15 = 37 kPa
ΔH_{need}: 37+3+5 = 45 kPa

All Δp_{STAD} can now be calculated like on 4.1:
$$34 - 7 - 12 = 15 \text{ kPa}$$
Final H is 45+35+3 = 83 kPa

All β_{min} is $^{12}/_{37}$=0.32
$\beta_{design\,[4.5]}$ is $^{12}/_{22}$ =0.55
$\beta_{design\,[4.1]}$ is $^{12}/_{34}$ =0.35

Δp piping: 25 kPa (41 kPa is taken out!)

ΔH

All coil flow: 5500 l/h

Proračun sistema sa BV-CM + MBV

Δp circuit: 7 kPa

Add up all Δp piping

Minimum Δp_{CV}:
63/3 = 21 kPa

All ΔH can now be calculated incl. final pump head H

Kvs [4.5]:
$$0.01\frac{5500}{\sqrt{21}} = 12.0$$
$\beta_{min\ [4.5]}$ is ${}^{21}/_{84} = 0.25$

$\Delta p_{CV\ [4.4]}$: 31-7=24
$$Kvs = 0.01\frac{5500}{\sqrt{24}} = 11.2$$
$\beta_{min\ [4.4]}$ is ${}^{24}/_{84} = 0.28$

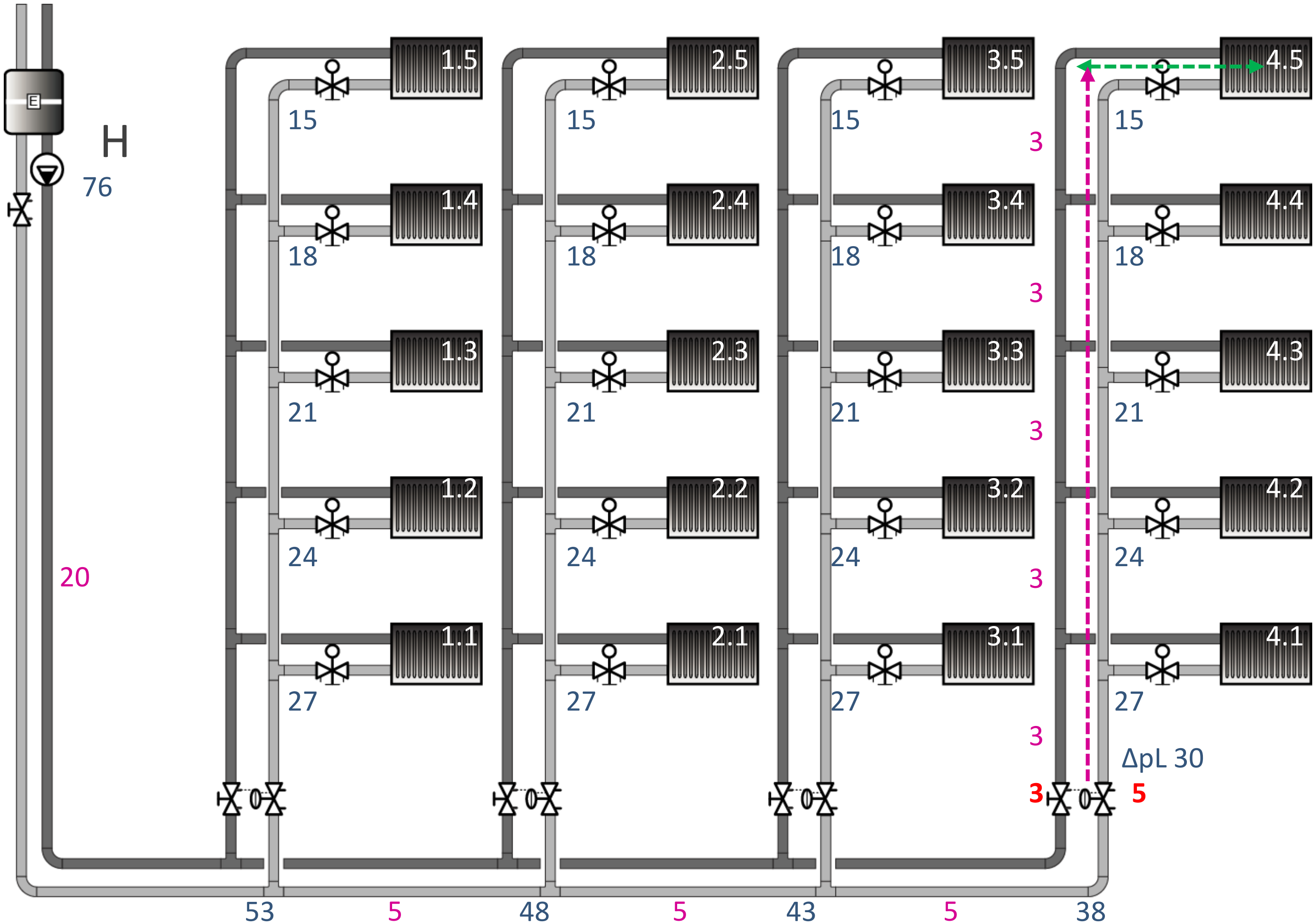
$\Delta p_{CV\ [4.1]}$: 40-7=34
$$Kvs = 0.01\frac{5500}{\sqrt{34}} = 9.4$$
$\beta_{min\ [4.5]}$ is ${}^{34}/_{84} = 0.40$

Δp piping: 63 kPa

ΔH

All coil flow: 5500 l/h

Proračun sistema sa BV-CM + ΔpC



Δp circuit: 7 kPa

Add up all module Δp 22 kPa
Minimum Δp_{CV}:
22/3 = 7.33 kPa → 8 kPa

ΔH: can now be calculated
ΔpL can now be calculated.
27+3 = 30 kPa
ΔH_{need}: 30+3+5 = 38 kPa
Final H is 45+35+3 = 76 kPa

Kvs [4.5]:
$0.01\frac{5500}{\sqrt{8}} = 19.4$
$\beta_{min\,[4.5]}$ is $^{8}/_{30} = 0.26$

$\Delta p_{CV\,[4.4]}$: 18-7=11
$Kvs = 0.01\frac{5500}{\sqrt{11}} = 16.6$
$\beta_{min\,[4.4]}$ is $^{11}/_{30} = 0.36$

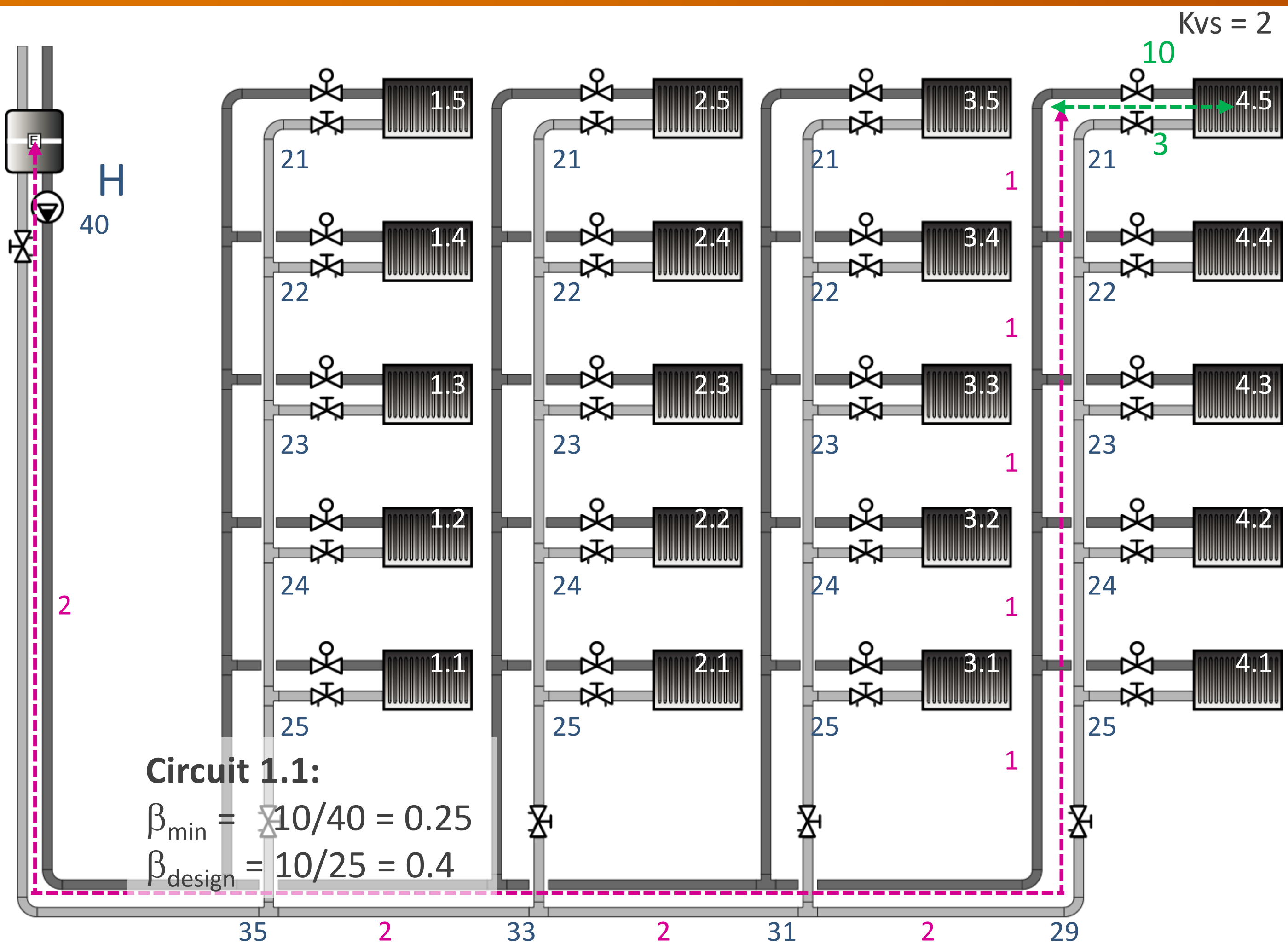
$\Delta p_{CV\,[4.1]}$: 27-7=20
$Kvs = 0.01\frac{5500}{\sqrt{20}} = 12.3$
$\beta_{min\,[4.5]}$ is $^{20}/_{30} = 0.66$

Δp piping: 22 kPa

ΔH

All coil flow: 5500 l/h

Proračun sistema sa standardnim kontrolnim ventilom + MBV



Circuit 1.1:

β_{min} = 10/40 = 0.25

β_{design} = 10/25 = 0.4

Δp circuit: 8 kPa

Circuit 4.5:

β_{min} = 10/40 = 0.25

β_{design} = 10/21 = 0.48

Circuit 4.1:

β_{min} = 10/40 = 0.25

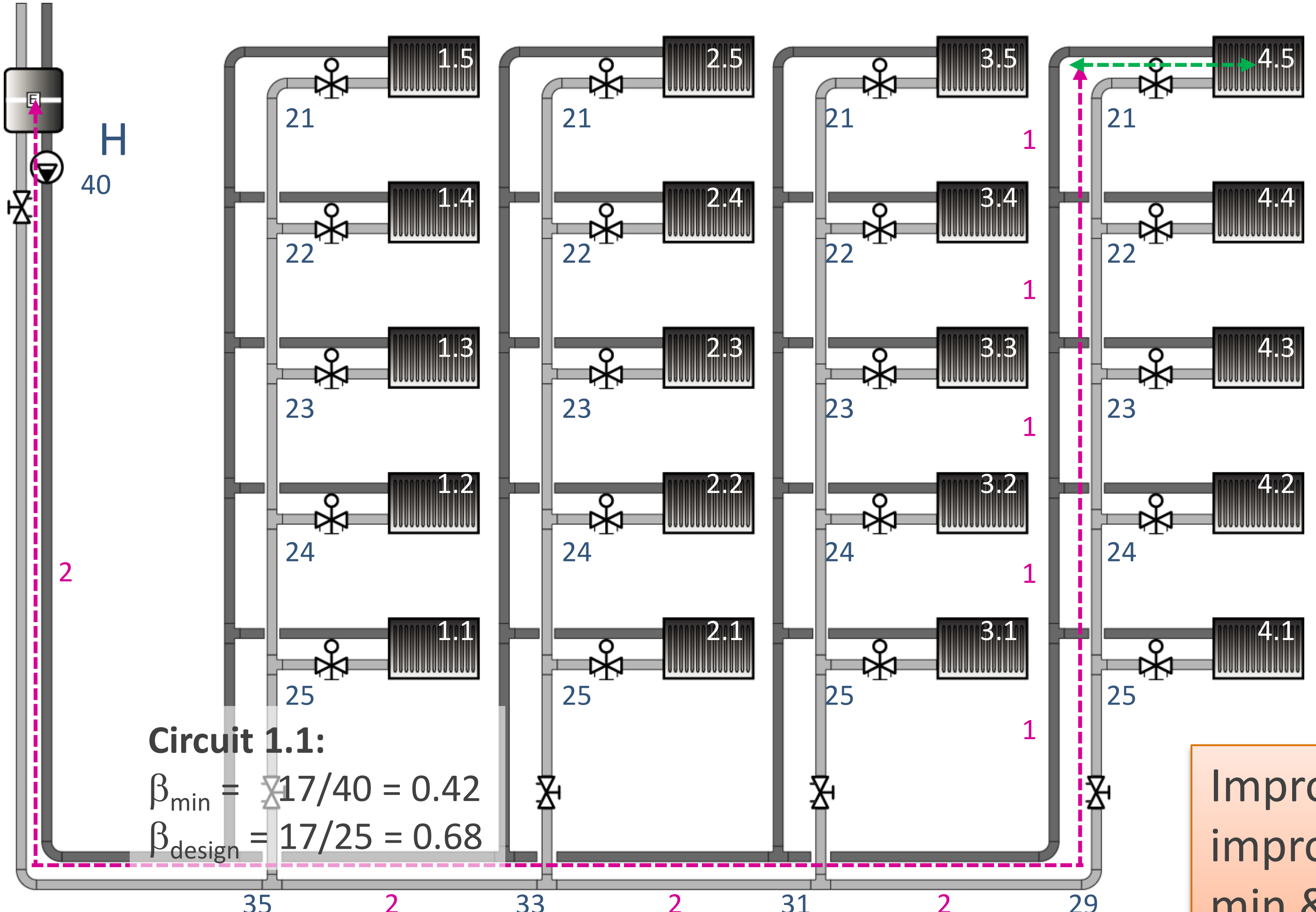
β_{design} = 10/25 = 0.4

Δp piping + BV = 22 kPa

All coil flows: 650 l/h

H_0 = 30 kPa → H = 40 kPa

Proračun sistema sa BV-CM + MBV



Circuit 4.5:

β_{min} = 13/40 = 0.32

β_{design} = 13/21 = 0.62

Circuit 4.1:

β_{min} = 17/40 = 0.42

β_{design} = 17/25 = 0.68

Circuit 1.1:

β_{min} = 17/40 = 0.42

β_{design} = 17/25 = 0.68

Hypothesis: same pump head as CV + BV

All coil flows: 650 l/h

H = 40 kPa

Improved authority and improved evolution of min & design authorities when going closer to the pump

TA FUS1ON Range

TA FUS1ON-C Range

DN32 DN40 DN50 DN65 DN80 DN100 DN125 DN150

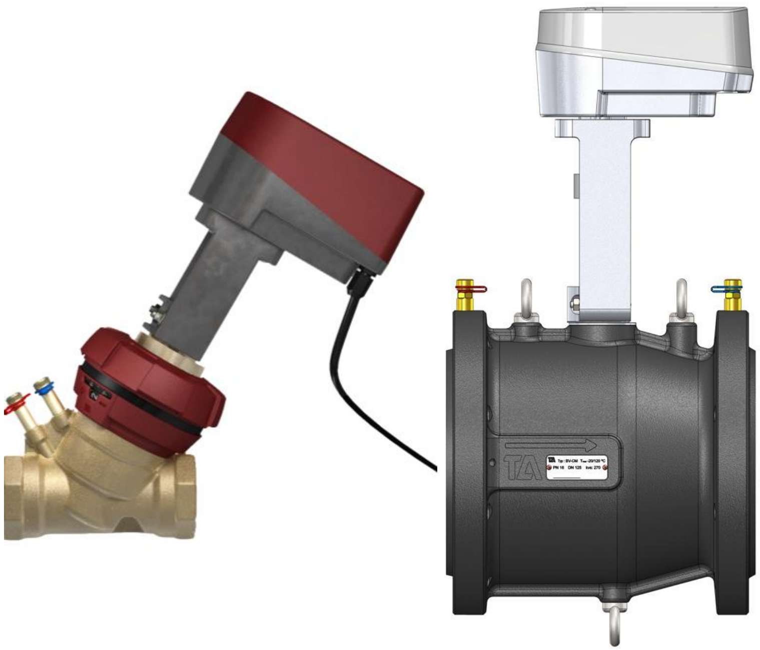
TA FUS1ON-CP Range

42

The new BV-CM

The new TA FUS1ON-C is more than a control valve ,

It's a balancing and control valve



Unique features & benefits

Manually **adjustable kvs** with independent EQM

- → correct kvs for the system (correct sizing)
- → flexibility to adapt to true system conditions

Measuring & Diagnostics

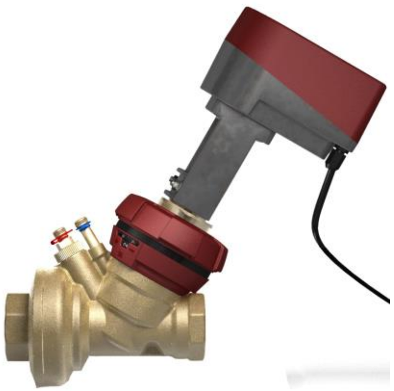
- → Easy balancing (method)
- → Confirmation system works as intend
- → Trouble shooting
- → Power measurement

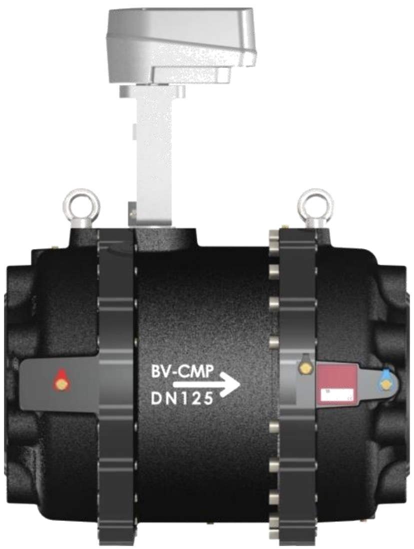
Systems that work as intended - Right first time.

The new TA FUS1ON-CP

When balancing and control are not enough;

When system conditions are such that Δp control is required





Unique features & benefits

Manually **adjustable kvs** with independent EQM

- → correct kvs for the system (correct sizing)
- → flexibility to adapt to true system conditions

Measuring & Diagnostics

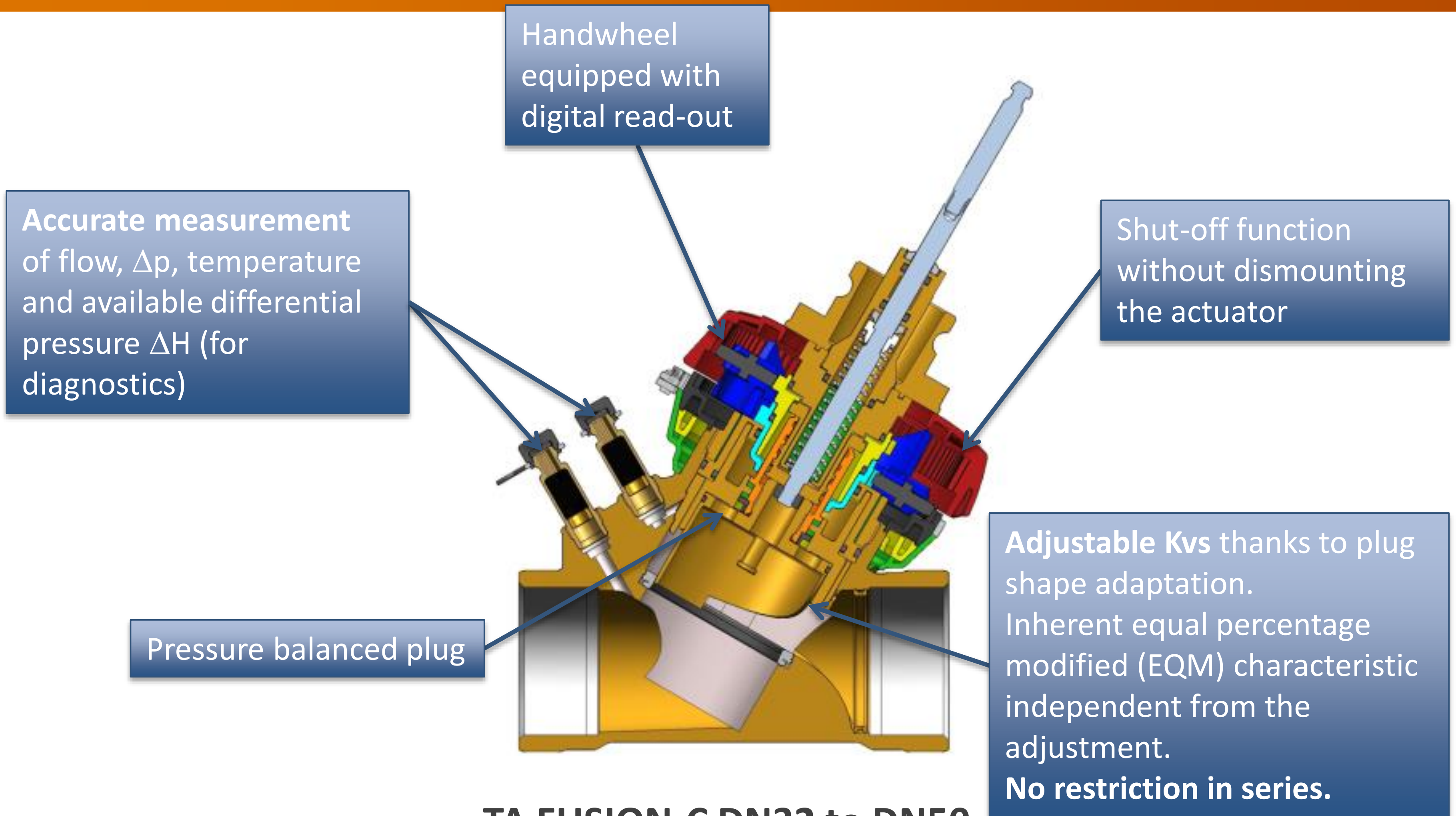
- → Easy balancing (method)
- → Confirmation system works as intended
- → Trouble shooting
- → Power measurement

Differential pressure control

- → Allowing accurate control
- → Improved control authority

Systems that work as intended - Right first time.

How does it work…



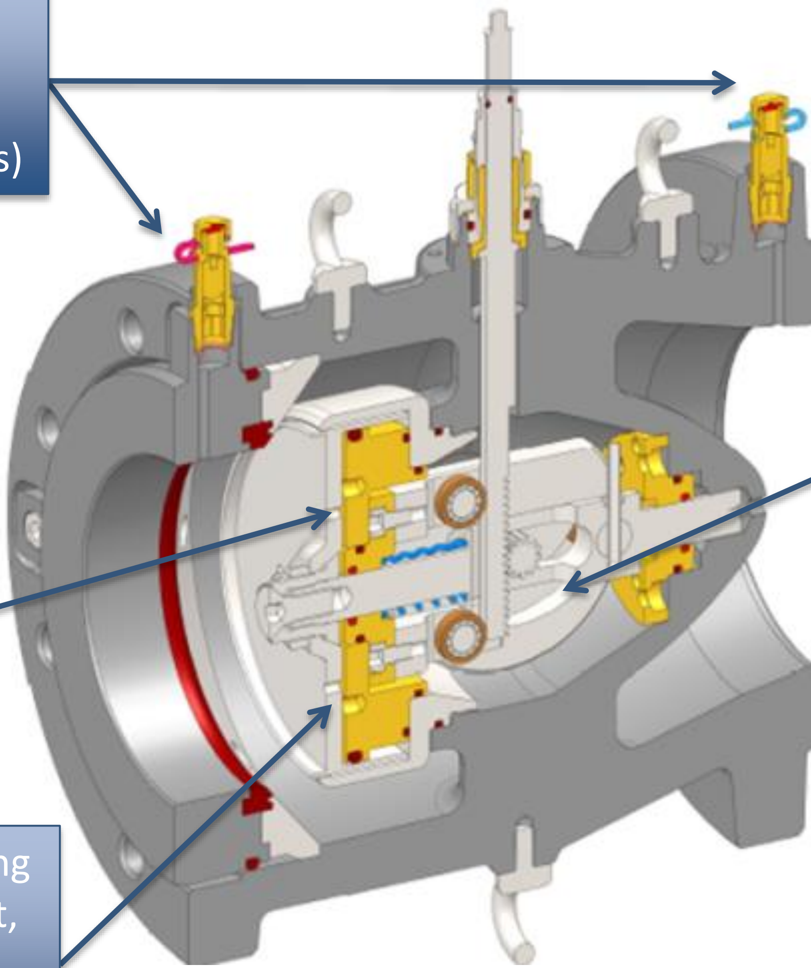
TA FUSION-C DN32 to DN50

How does it work…

Accurate measurement of flow, Δp, temperature and available differential pressure ΔH (for diagnostics)

Pressure balanced plug to enable use of low force actuators under all system conditions

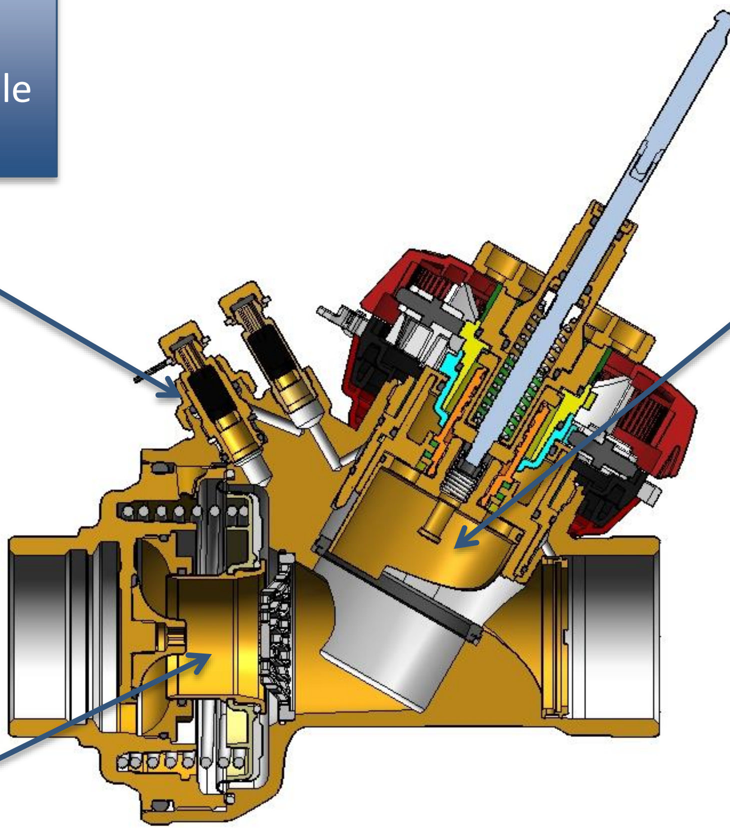
In-line technology enabling compactness, light-weight, precision control & low noise generation even at high flows



Adjustable Kvs thanks to motion translation of cam mechanism.
Inherent equal percentage modified (EQM) characteristic independent to the adjustment.
No restriction in series

TA FUS1ON-C DN65-DN150

How does it work…



TA FUS1ON-CP DN32 to DN50

Hydronic College

IMI Hydronic Engineering

Balansiranje i regulacija terminalnih jedinica

Engineering GREAT Solutions

IMI PNEUMATEX

IMI TA

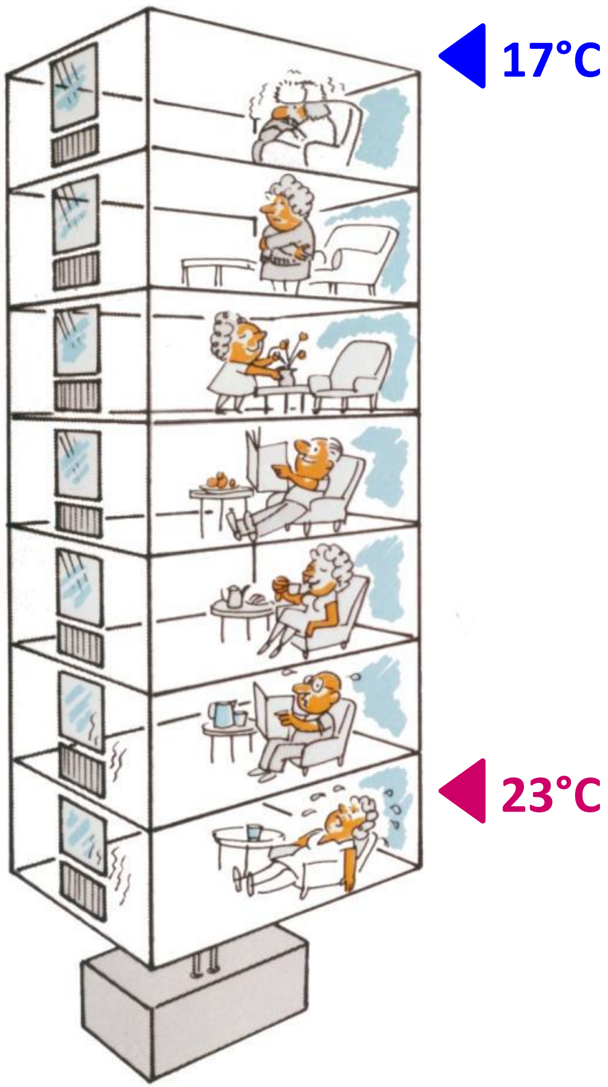
IMI HEIMEIER

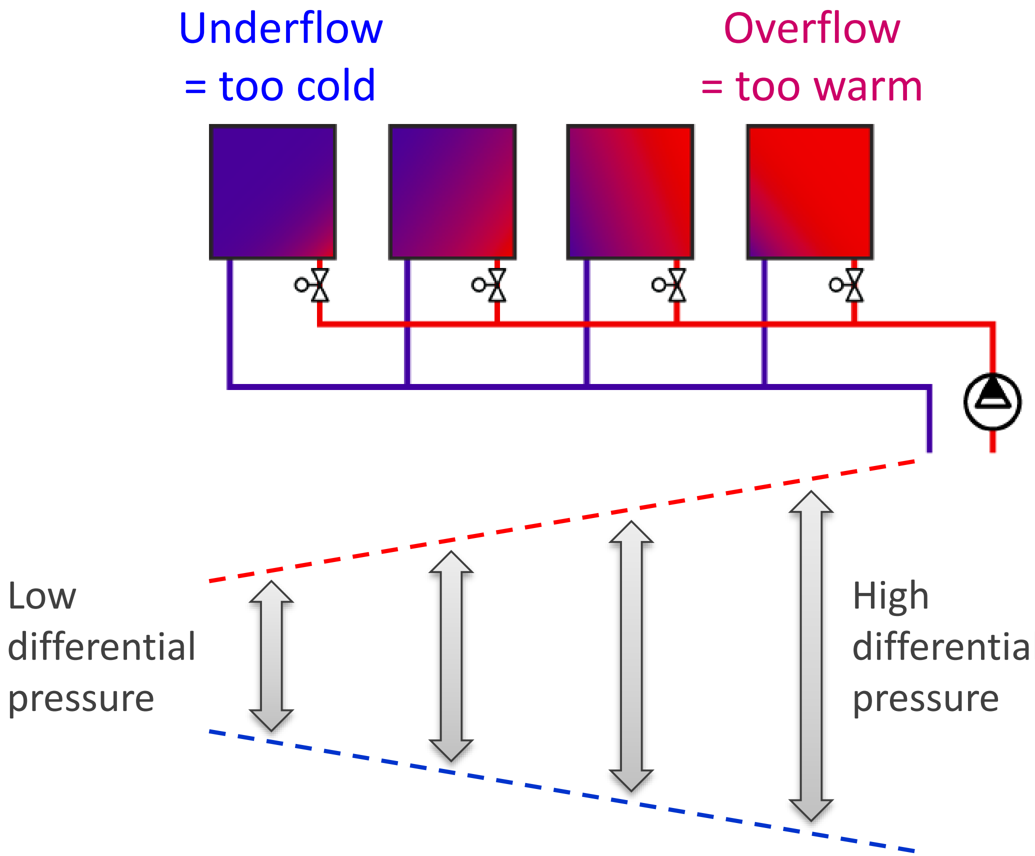
Balansiranje zbog kontrole

- Da bi se obezbedila komforna unutrašnja klima, da se smanji potrošnja energije i spreči operativne probleme hidraulički sistem mora potpuno da bude kontrolabilen.
- Da bi bio potpuno kontrolabilen mora da budu ispunjena tri hidraulička uslova:
  1. *Projektovani protok mora da bude dostupan kod svih termalnih jedinica pri potpunom opterećenju.*
  2. *Diferencijalni pritisak kroz kontrolni ventil ne sme da varira previše*
  3. *Protoci moraju da budu kompatibilni kod sistemskih priključaka.*
- Najbolji način da se ispune ovi uslovi je da bude izvršeno balansiranje

Ne izbalansirani sistem

Bez hidrauličko balansiranja, prvi krugovi imaju veći protok dok kod ostalih krugova protok je manji. Kontrolni ventili ne mogu rešiti problem.





Rešavanje problema bez balansiranje

Hydronic Engineering

- **Povećanje napor pumpe**
  - U sistemu sa 20% smanjen protok u najnepovoljnije jedinice. Protok treba povećati za 25% da bi se dobila potrebna snaga.
  - Ako se protok poveća za 25%, diferencijalni pritisak povećava se za 56%. Napor pumpe treba da se poveća za 56% to! ($1,25^2 = 1,56$)
  - Troškovi pumpe rastu za 95% ($1,25 \times 1,56$)

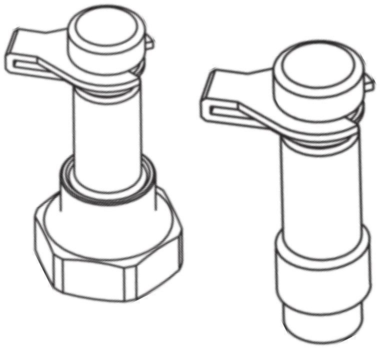
$$\Delta p \propto q^2$$

- **Da se poveća (grejanje) ili smanji (hladjenje) dovodna temperatura**
- Smanjenje izlazne temp. kod čilera približno za 4% za °C raste potrošnja energije.
- **Gubljenje energije !**
- **Povećanje emisije CO_2!**

Dijagnosticiranje sistema

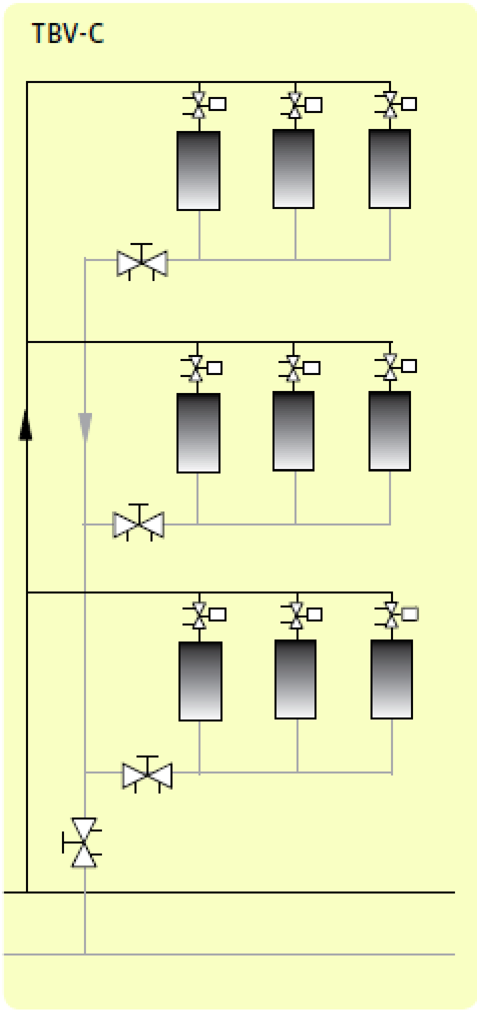
Sa balansiranje tipični defekti ili greške koji se detektiraju:

- *Zaprljani filtri, ventili i termalne jedinice*
- *Pogrešno montirane termalne jedinice, ukršteni cevi*
- *Pogrešno montirani kontrolni ventili*
- *Pogrešno montirane pumpe, nepovratni ventili*

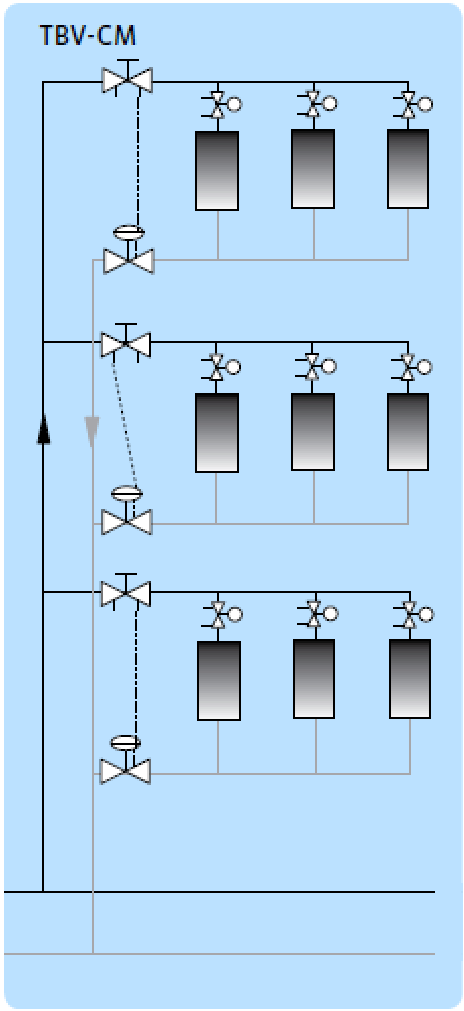


Kontrolni krugovi

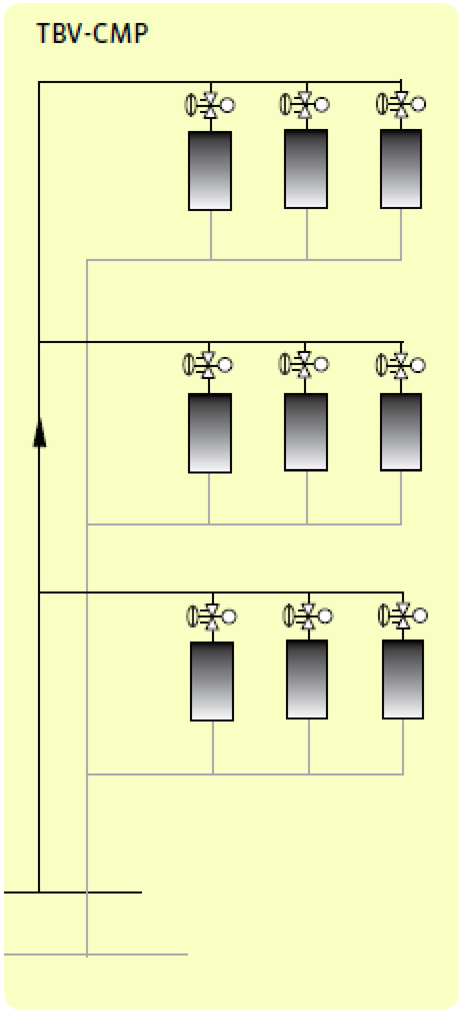
On/off



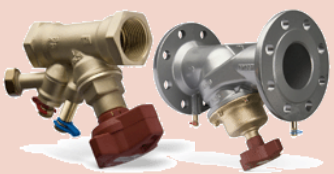
Modulating with pressure independent modules.

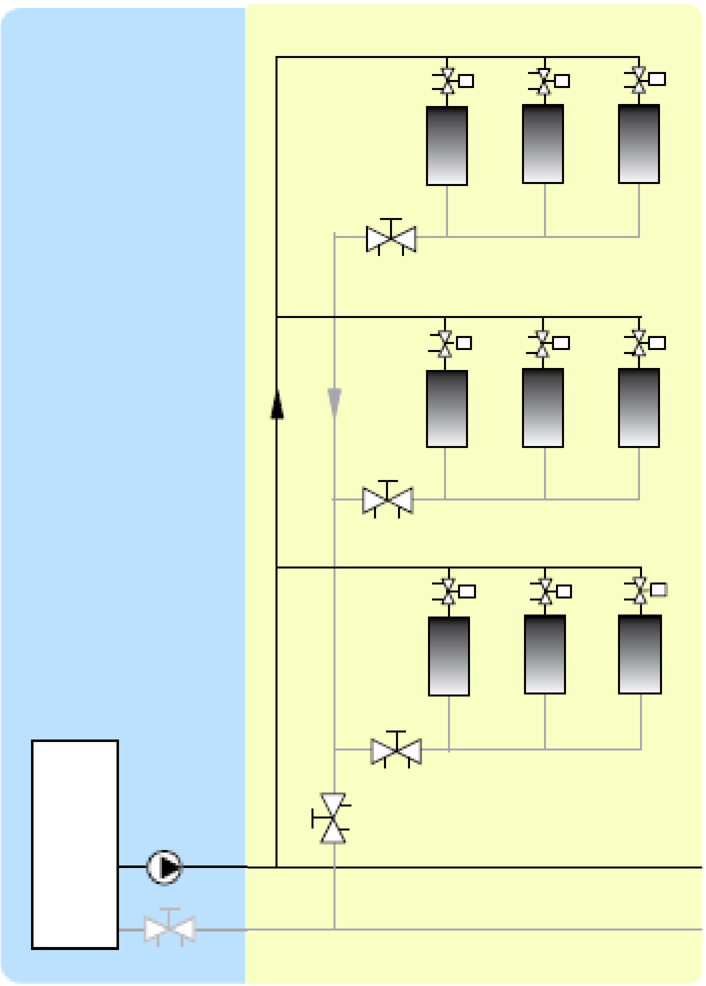


Modulating with pressure independent control valves.



Balansiranje i on/off kontrola

Solution	Remarks
TBV-C  STAD / STAF 	Most common solution for on/off systems. Total commissioning verifies that the installation is correctly executed for optimized comfort.
TBV-C  STAP  STAD/F	To simplify the balancing procedure, reduce hydraulic interactivity and minimize the risk of noise, the manual balancing valves STAD are sometimes replaced by differential pressure controllers, STAP.



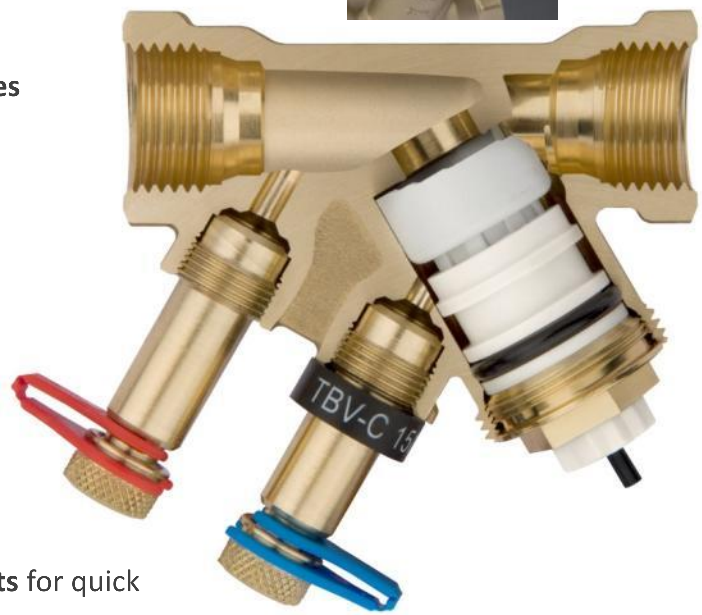
TBV-C karakteristike

TBV-C

for on/off control

Pre-setting tool for accurate and easy balancing

Multiple connection alternatives for easy installation



Stepless pre-setting, all the way from Kv min to Kv max

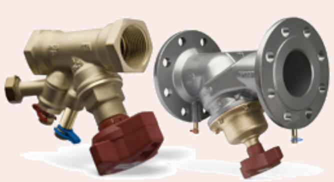
Shut off function ensures easy maintenance

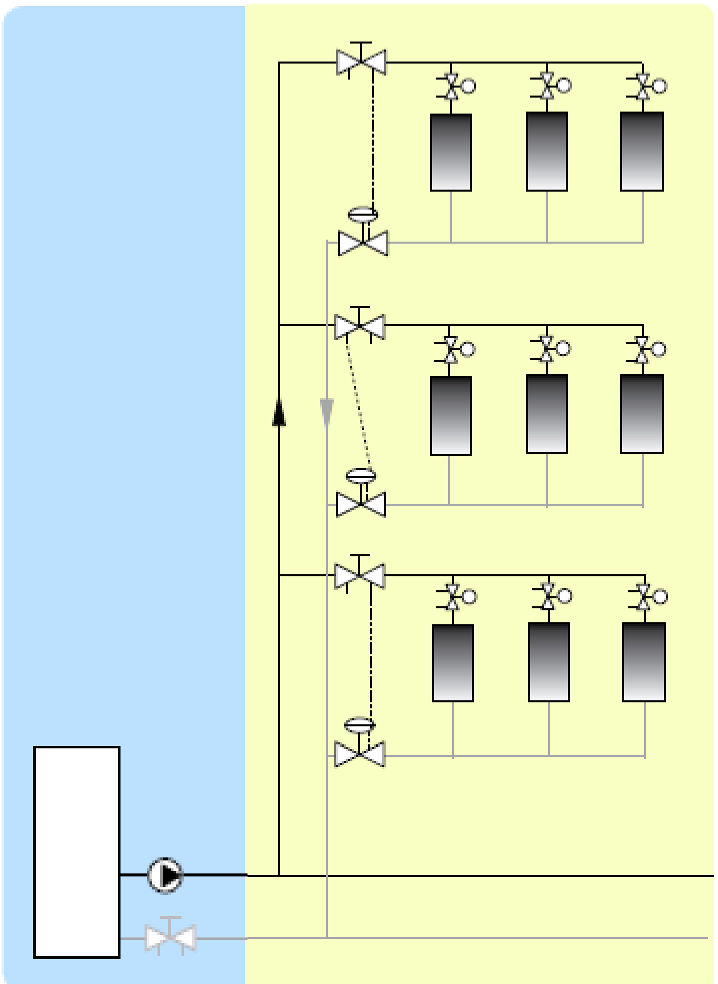
Self sealing measuring points for quick and easy measurements

TSE

Simple connection, connects with M30 x 1,5 actuator

Balansiranje i modulacijska kontrola

Solution	Remarks
TBV-CM  STAP  STAD/F	Most common solution for modulating control. This solution gives a high control valve authority, simplifies the balancing procedure and less risk of noise. ***Pressure independent modules***
TBV-CM  STAD/F 	The STAP valve can be replaced by a STAD when an acceptable control valve authority can be obtained without dp control.



TBV-CM karakteristike

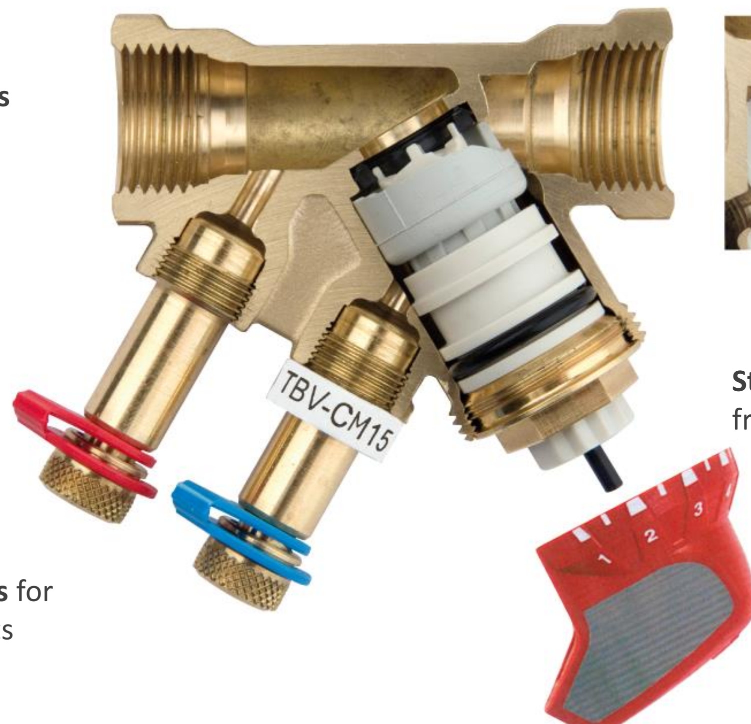
TBV-CM

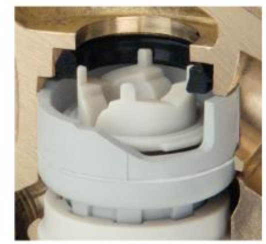
for modulating control

Pre-setting tool for accurate and easy balancing

Correct control characteristic contributes to linear-shaped circuit characteristic for optimum controllability

Multiple connection alternatives for easy installation





Shut off function ensures easy maintenance

Stepless pre-setting, all the way from Kv min to Kv max

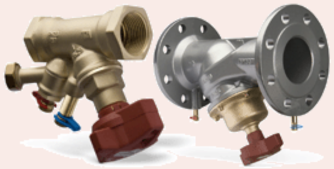
Self sealing measuring points for quick and easy measurements

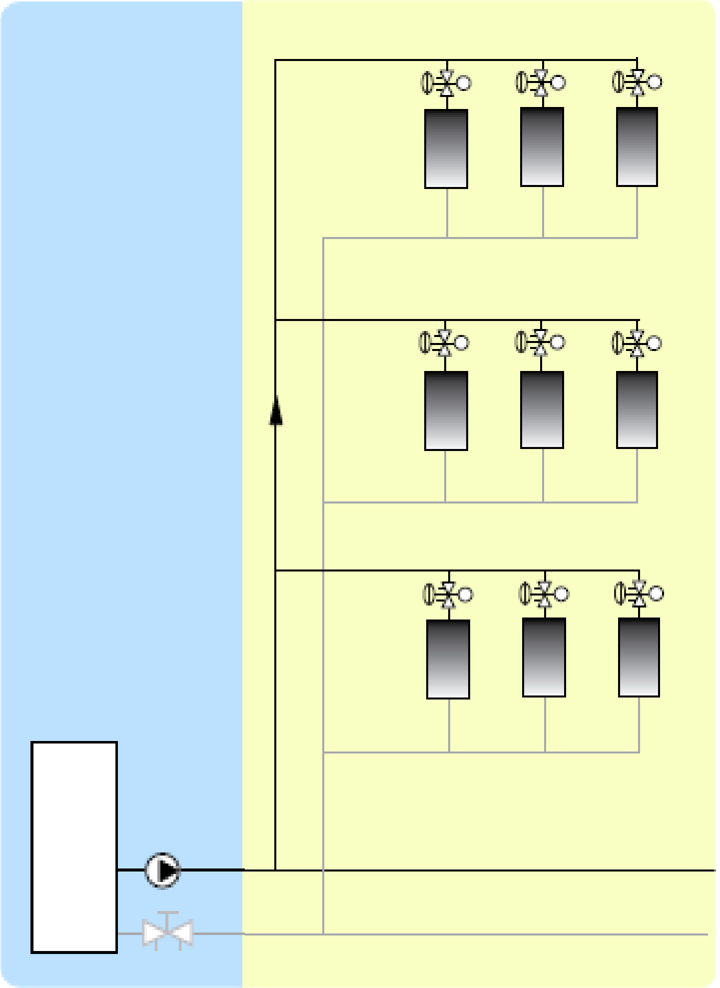
TSE-M

Simple connection, connects with M30 x 1,5 actuator

Balansiranje i modulacijska kontrola

IMI Hydronic Engineering

Solution	Remarks
TBV-CMP 	This solution is recommended when the demands in the installed system is such, that it is necessary to stabilize the Δp close to the terminal. This solution ensures correct circuit characteristic and simplifies commissioning.
STAD/F 	A central measuring valve can be placed for diagnostics and helping finding optimum set point in the pump.

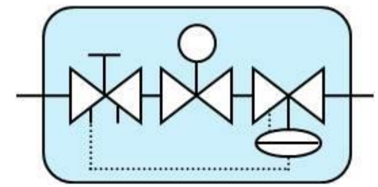


TBV-CMP karakteristika

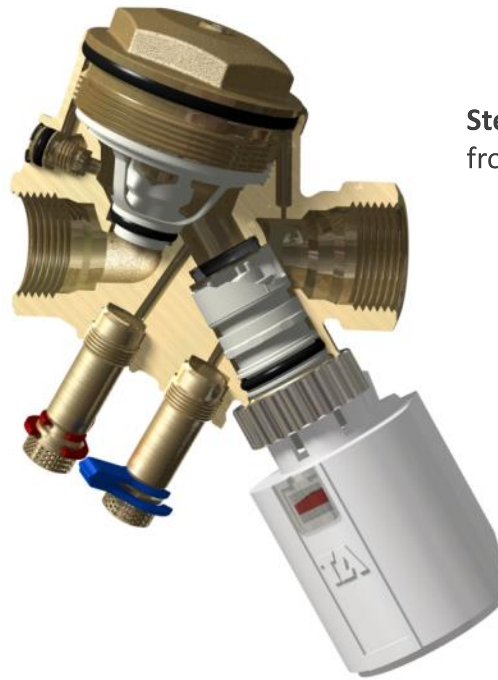
TBV-CMP

for modulating control with pressure independent control valve

Correct control characteristic contributes to linear-shaped circuit characteristic for optimum controllability



Simple flushing procedure makes maintenance procedure quick and easy.



Stepless pre-setting, all the way from Kv min to Kv max

Multiple connection alternatives for easy installation

Shut off function ensures easy maintenance

Measuring of flow, dpL and dH ensures optimal control and easy trouble shooting.

TSE-M

Simple connection, connects with M30 x 1,5 actuator

Balansiranje i kontrola

Koje rešenje primeniti?

- Rešenje zavisi od sistemskih zahteva

Balancing procedure	On/off control		Modulating control	
	No dp control desired	Dp control desired	No dp control required	Dp control required
Normal	STAD + TBV-C		STAD + TBV-CM	
Simplified		STAP + TBV-C		STAP + TBV-CM
Pre-setting				TBV-CMP

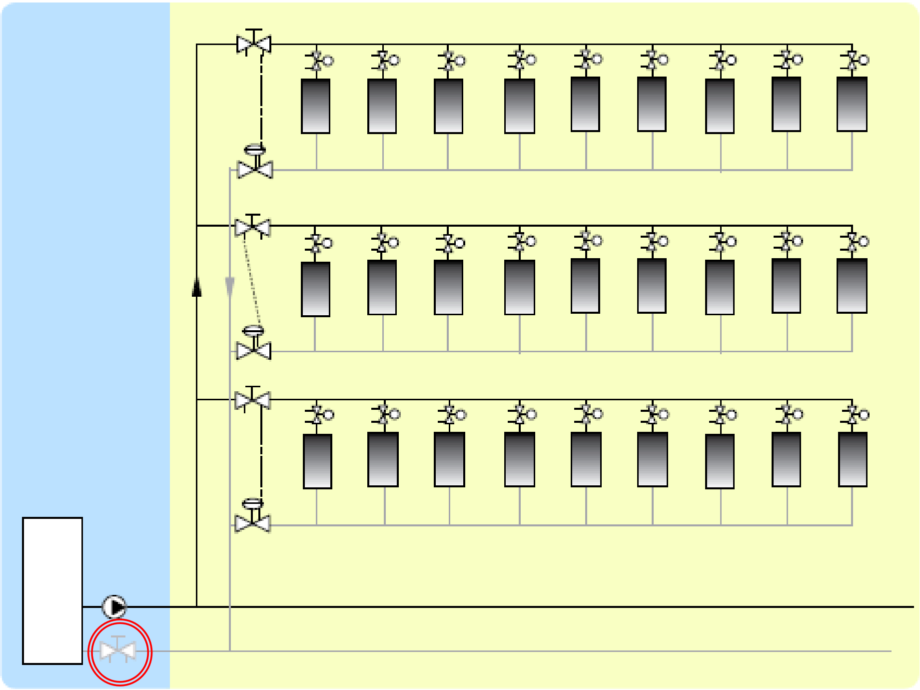
- Merenje je potrebno zbog:
  - Verifikacije protoka
  - Tehnički protokol
  - Dijagnosticiranje sistema

Pritisno nezavisni krugovi

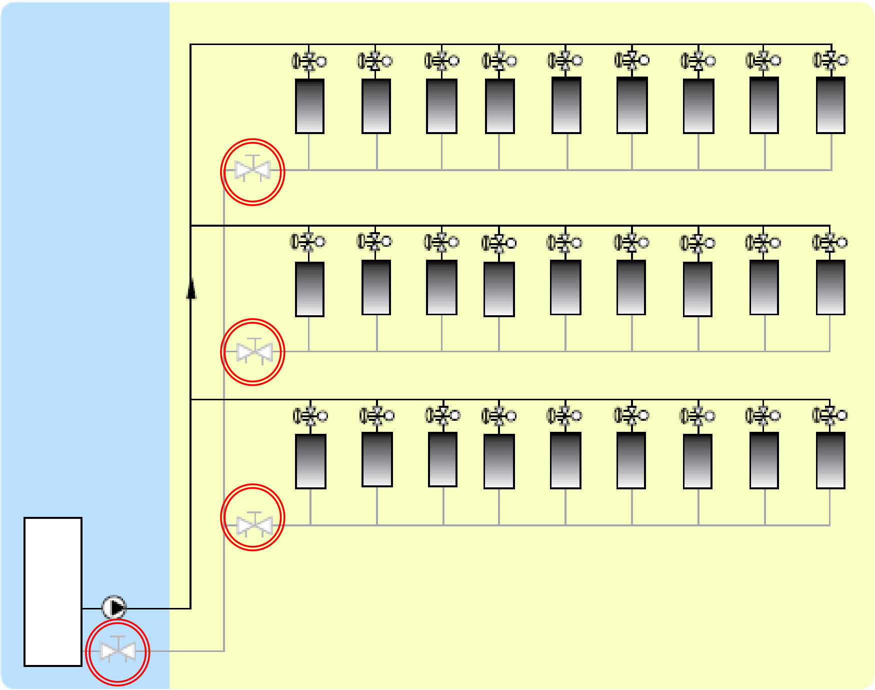
Kada je upotrebljena Δp-kontrola (STAP or TBV-CMP), nisu potrebni dopunski ventili po granama sve dok terminalne jedinice ili krugovi su hidraulički nezavisni

U razgranjenim mrežama poželjno je postaviti balansne ventile na strateškim tačkama zbog lakog otkrivanja grešaka u sistemu.

TBV-CM



TBV-CMP



TA-COMPACT-P

Pritisno nezavisni kontrolni i balansni ventil za On-Off kontrolu

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IMI PNEUMATEX
IMI TA
IMI HEIMEIER

Moguća rešenja za On-Off kontrolu

Δp control on branch, manual balancing on units	STAP on branch (with TBV-C)	
Δp control on each valve	TA-COMPACT-P	
Return water temperature limitation	TA-COMPACT-T	

TA-COMPACT-P

- Kompaktni
- On-Off kontrola
- Dinamičko balansiranje kroz Dp kontrolu
- Dijagnosticiranje
- Shut-off
- Lak izbor
- Lako setiranje
- Za hladjenje i grejanje

Funkicije

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IMI Hydronic Engineering

Measuring points

Shut-off "X"

Setting 1-10

Kompaktnost

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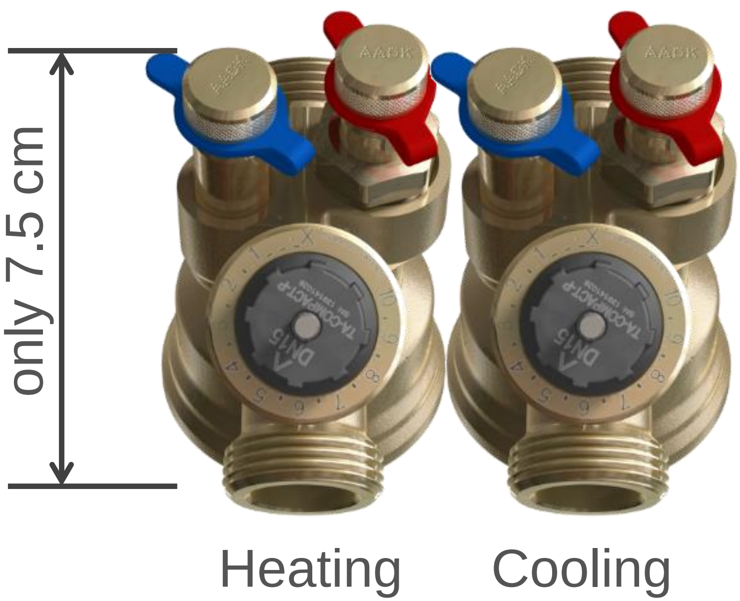
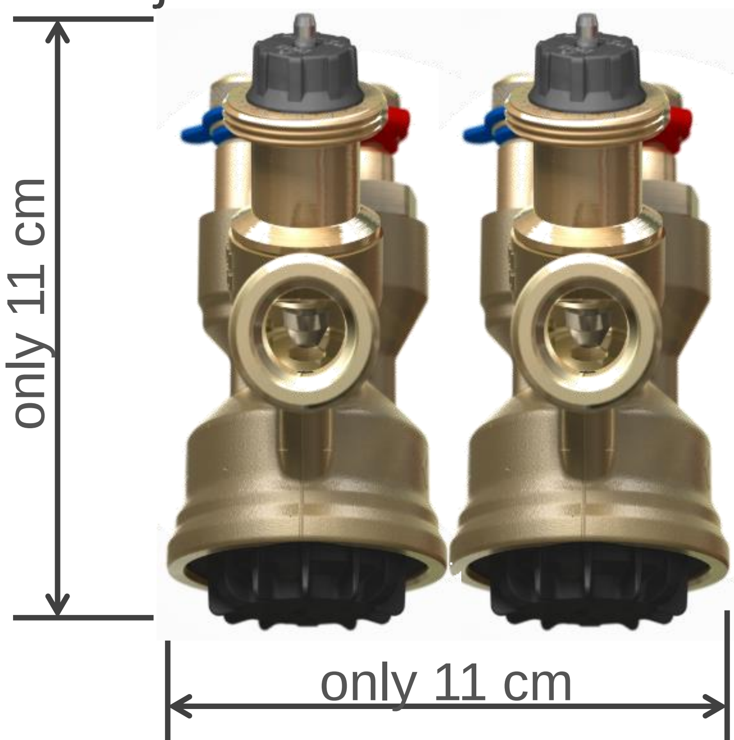
IMI Hydronic Engineering

- Projektovan za upotrebu u malim kućištima ventilatorski konvektori
- Tanko telo omogućuje paralelno instaliranje
- Pristup do svih funkcija





TA-Compact-P DN 15

Primeri instaliranja

Fan-coil (floor-standing)

2 TA-COMPACT-P DN 15
with actuator EMO T

Short valve body…
always above condensing container

Tehničkih podatci

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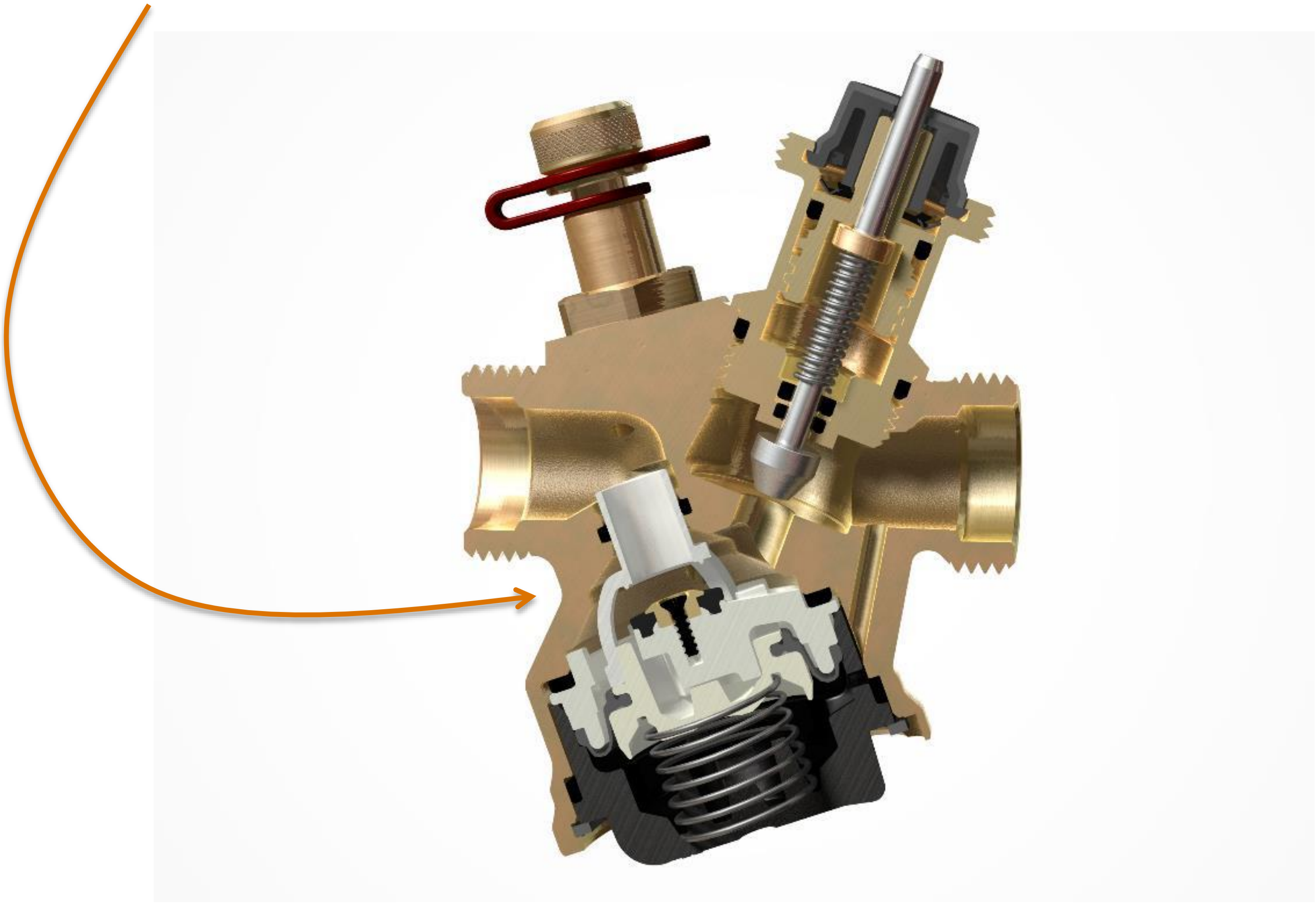
IMI Hydronic Engineering

- DN 10, 15, 20, 25, 32
- PN 16
- Spoljašni navoj
- Linearna karakteristika
- 4mm hod
- Priključak za aktuator: M30x1.5
- Max. dif. pritisak ΔpV_{max} = 4 bar
- Min. . dif. pritisak
  ΔpV_{min} ≤ 15 kPa (DN10-20); ≤ 25 kPa (DN25-32)
- Temperaturni opseg: 0 to 80°C

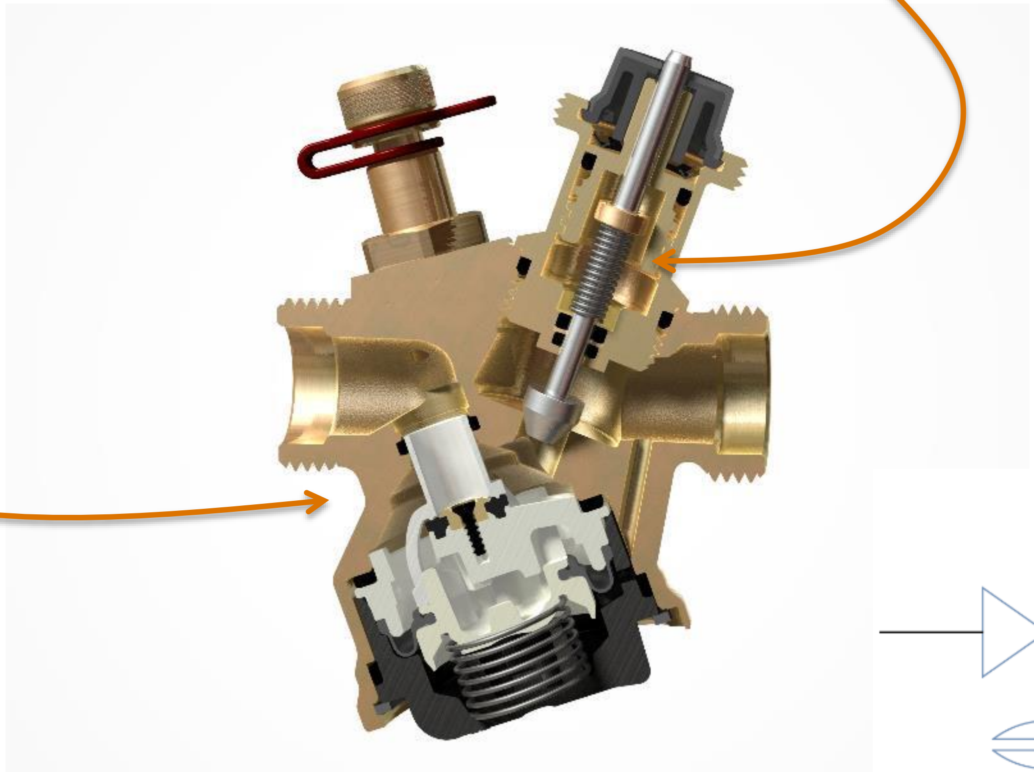
Princip rada

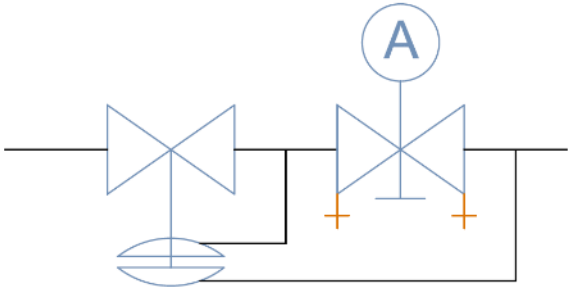
- Dp kontroler kompenzuje varijacije Δp



Princip rada

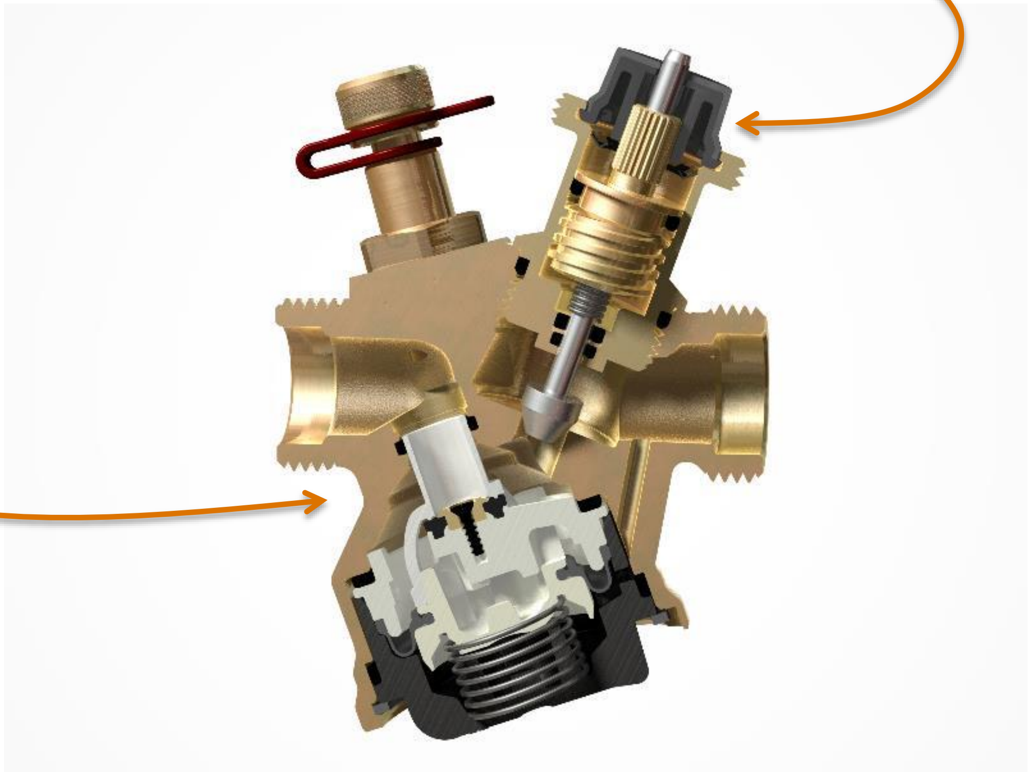
- Dp kontroler podešava otvor da bi održao const. Dp kod pokretnog kontrolnog dela.





Princip rada

- Dp kontroler podešava otvor da bi održao const Dp kod pokretnog kontrolnog dela koj je podešen



Lako dimenzionisanje

Heating/cooling output of terminal unit [kW]											
TA-COMPACT-P	Flow [l/h]		Cooling		Heating						
			DT=6K		DT=10K		DT=15K		DT=20K		
	min	max	min	max	min	max	min	max	min	max	
DN 10	21.5	120	0.15	0.84	0.25	1.4	0.38	2.1	0.5	2.8	
DN 15	88	470	0.61	3.3	1	5.5	1.5	8.2	2	10.9	
DN 20	210	1150	1.5	8	2.4	13.4	3.7	20.1	4.9	26.7	
DN 25	400	2000	2.8	14	4.7	23.3	7	34.9	9.3	46.5	
DN 32	800	4000	5.6	27.9	9.3	46.5	14	69.8	18.6	93	

ΔpV_{min} ≤ 15 kPa (DN10-20); ≤ 25 kPa (DN25-32)

Aktuatori

IMI Hydronic Engineering

OVERVIEW	TA-COMPACT-P	TBV-CMP	TBV-C	TBV-CM
Characteristics	linear	EQM	linear	EQM
Pressure independent	yes	yes	no	no
On-Off control	EMO-T	EMO-T (use TA-COMPACT-P)	EMO-T	not recommended
Modulating control	not recommended	EMO-TM or MC15/24-C	not recommended	EMO-TM or MC15/24-C
3-point control	EMO-3 or MC15/24-C or MC15/230-C	EMO-3 or MC15/24-C or MC15/230-C	EMO-3 or MC15/24-C or MC15/230-C	EMO-3 or MC15/24-C or MC15/230-C




TA-COMPACT-T

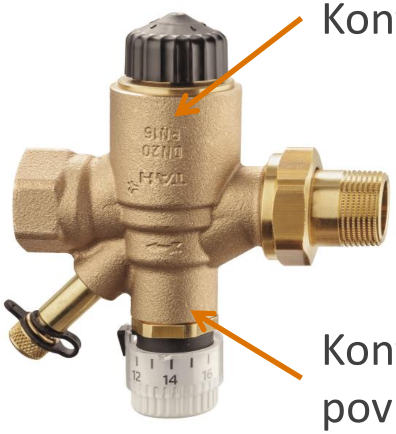
On-Off kontrolni ventil integrisan sa kontrolerom povratne temp.

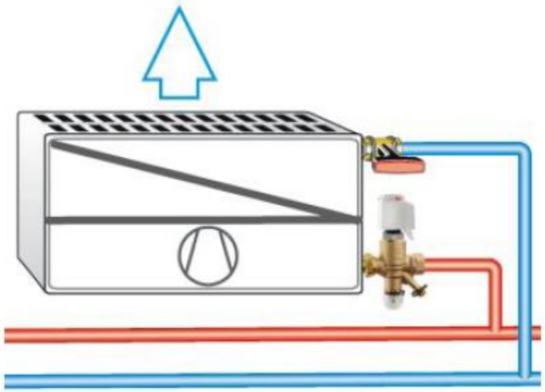
IMI Hydronic Engineering

Unikatni način da se poboljša preniža povratna temp.(a time i enreg. efikasnost) kod (postojeći) rashladnih sistema, upotrebljavajući **On-Off** kontrola.

Prednosti pri kontroli povratne temp. Vode kod sistema sa On-Off kontrola:

- Protok modulira u zavisnost sa aktuelnom isporučrnom rashladnom snagom iako je upotrebljen On-Off actuator
- Smanjuje se kondezacija u cevnoj mreži
  → ušteda energije
- Veća izlazna temp. Vazduha u fenkojlerima pri nižim obrtajima smanjuje promaja u sobi
- → veća klasa komfora





Prednosti za rashladnog sistema

- Pomaže da zaštiti čiler od niže povrtane temp.
- Obezbedjeno hidrauličko balansiranje sa ograničavanje protoka i hidraulička interaktivnost izmedju terminalnih jedinica
- Smanjuje troškove pumpe do 40%
- Veća povratna temperatura smanjuje gubitke toplote u cevima i štiti izolaciju od pojave kondezacije u područja sa većom vlažnošću

Tehnički podatci

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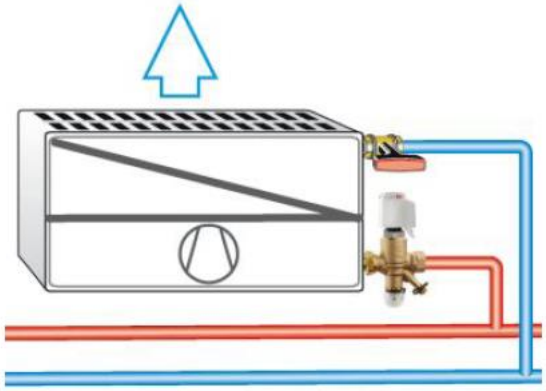
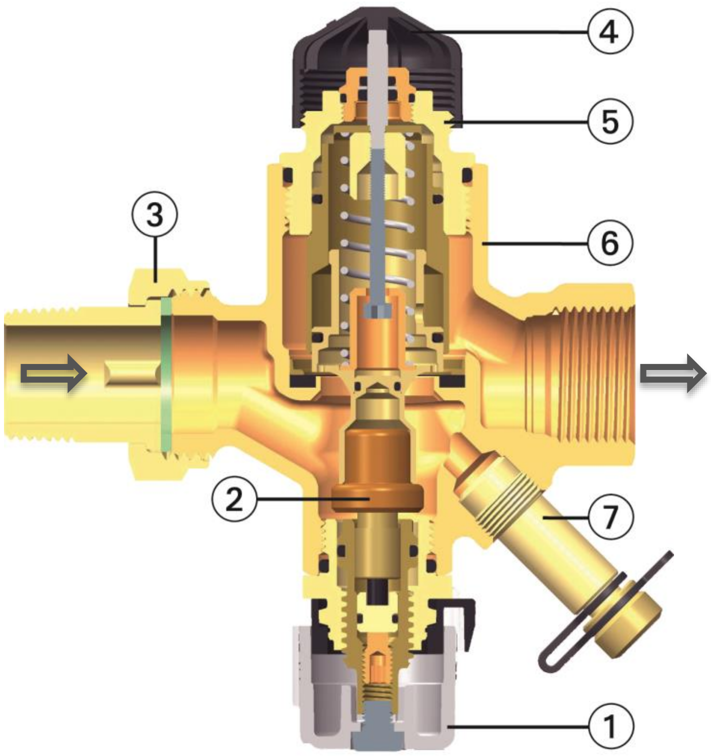
- Direct temperature setting with lock ring
- Self-sealing measuring point for temperature measurement
- Dimensions: DN 15-25 (1/2" – 1")
- Actuator connection M30x1.5
- Setting range: 8-18°C (46 – 64°F)
- Delivery setting: 12°C (54°F)
- Max. working temp: 50°C (122°F)
- Min. working temp: -10°C (14°F)
- Pressure class: PN16 (230 psi)
- Max. differential pressure 2 bar (29 psi)
- Lift 4 mm (0.157 in)

Princip rada

1. Ručica za setiranje povratne temp.
2. Temperaturni senzor
3. Navojni priljučak
4. Zaštitna kapa
5. Priključak za aktuator M30x1.5
6. Telo ventila je otporno na koroziju
7. Merno mesto za merenje temp.



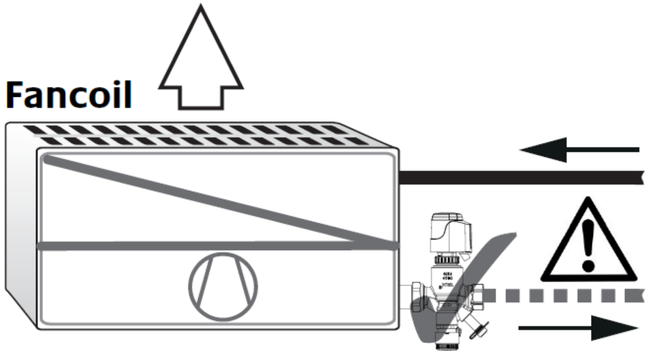


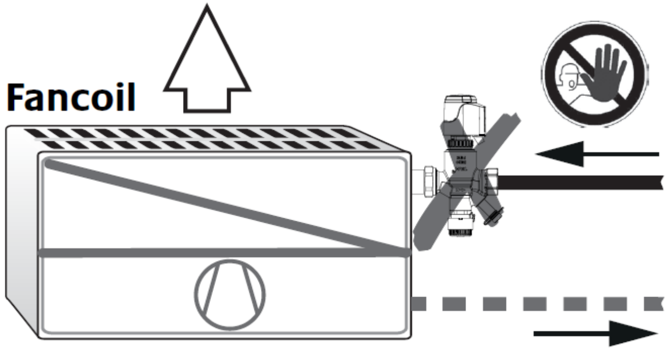
Setiranje

- Temperaturno područje 8-18°C (46 – 64°F)
- Fabričko podešeno 12°C (54°F)
- Prsten za zaključavanje pozicije
- Lako podešavanje
- Dobra preglednost setirane temperature

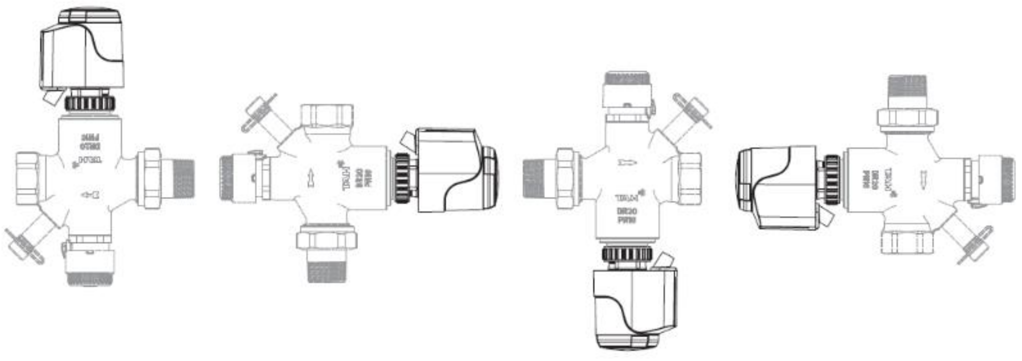
Sealable ring

Aktuator & pozicija za montažu





TA-COMPACT-T + EMO T
Max. Δp 200 kPa (29 psi) → EMO T = 125 N (28 lbf)



Primer montaže

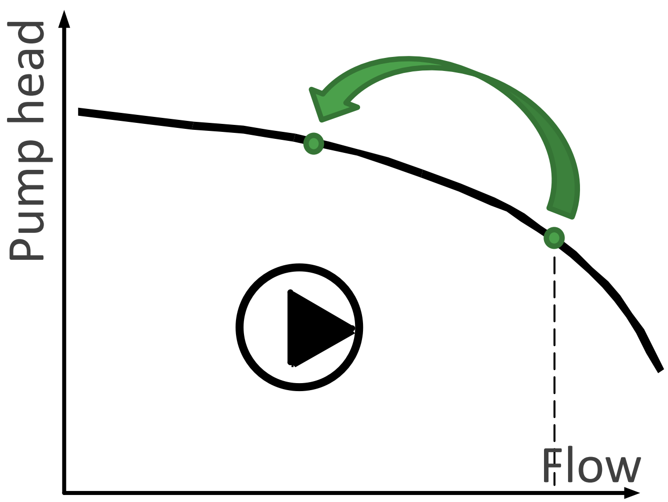
Pumpni troškovi

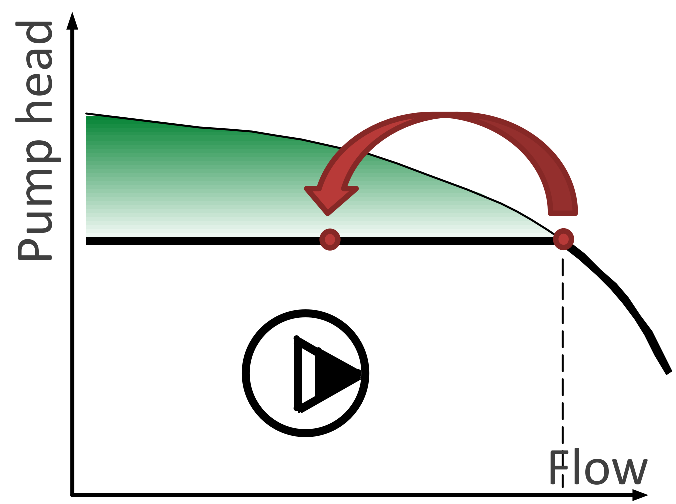
x 0.7 (x 1.4 · x 0.5)

$$\text{Pumping costs} \approx C_0 + \frac{\text{Pump head} \times \text{Flow}}{\text{Pump efficiency}}$$

x 0.5 (= · x 0.5)

$$\text{Pumping costs} \approx C_0 + \frac{\text{Pump head} \times \text{Flow}}{\text{Pump efficiency}}$$





- Sitemi sa varijabilni protok smanjuju pumpne troškove pri manji topl. opterećenja.
- VSP dopunski smanjuju pumpne troškove bez da se poveća napor pumpe kada se protok smanjuje

Pumpa sa promenljivim brojem okretaja (VSP)

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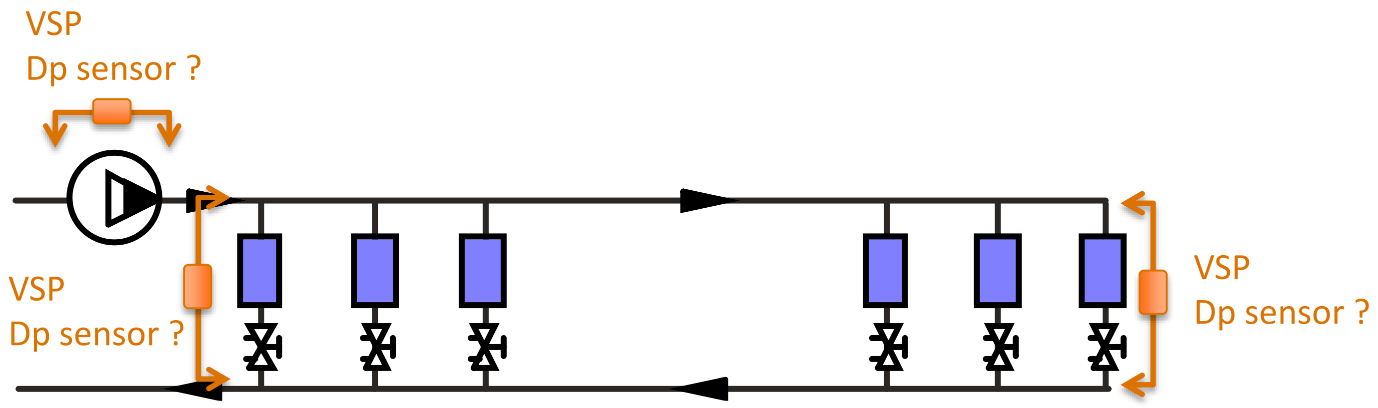
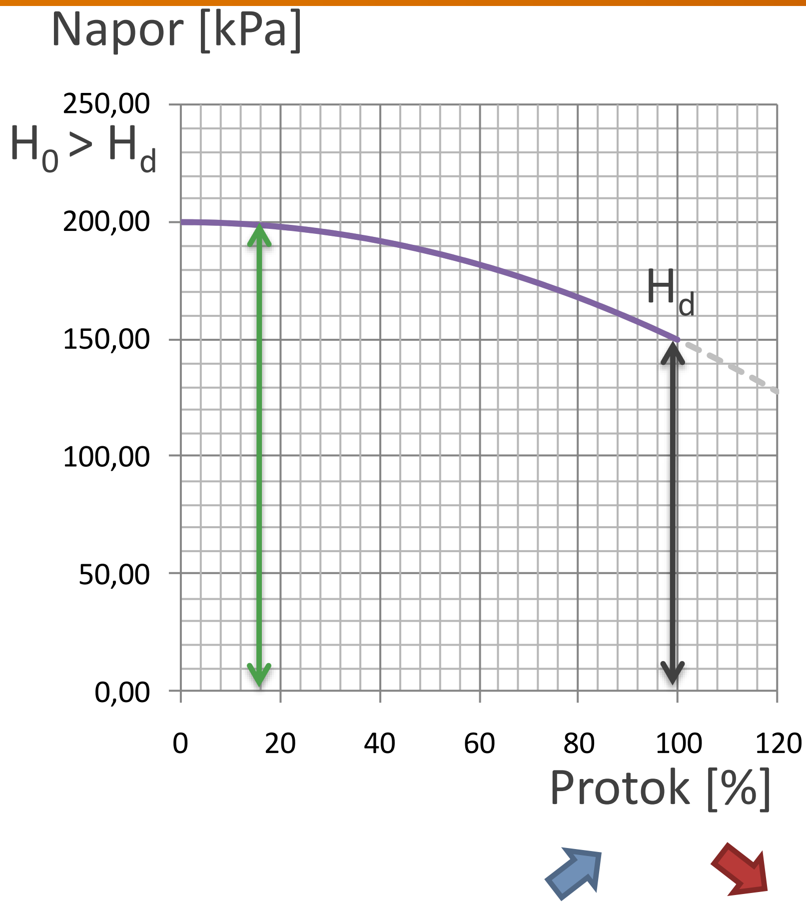
Cilj:

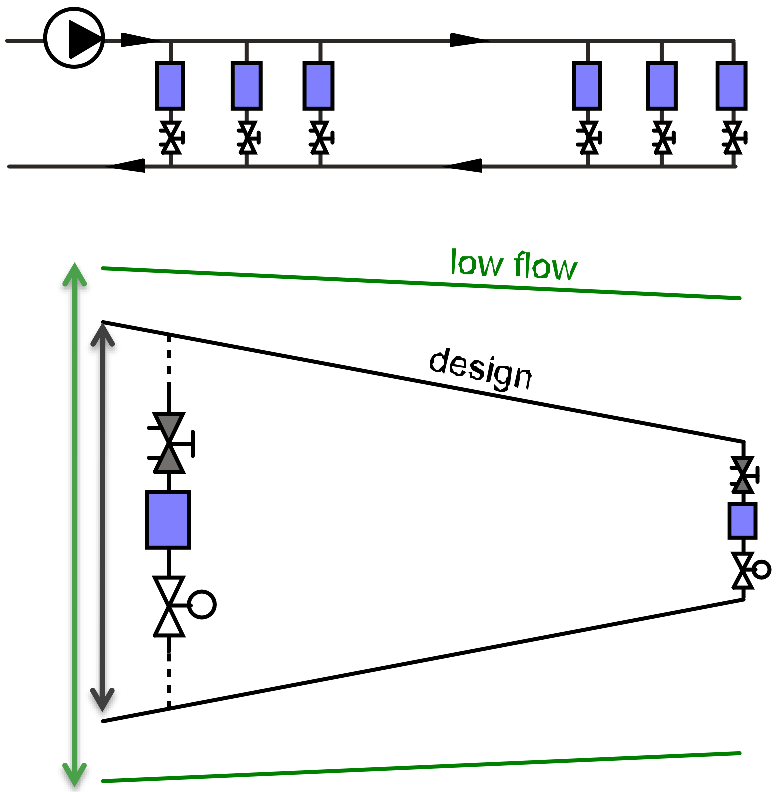
- **Povećanje uštede energije kod pumpe**
- pri održavanju **100% operativnost** sistema za grejanje/hladjenje

- Koji kontroleni mod da bude odabran za VSP?
- Ako se upotrebljava daljinski Dp senzor za VSP, gde da se postavi?



Raspored pritiska kod CSP

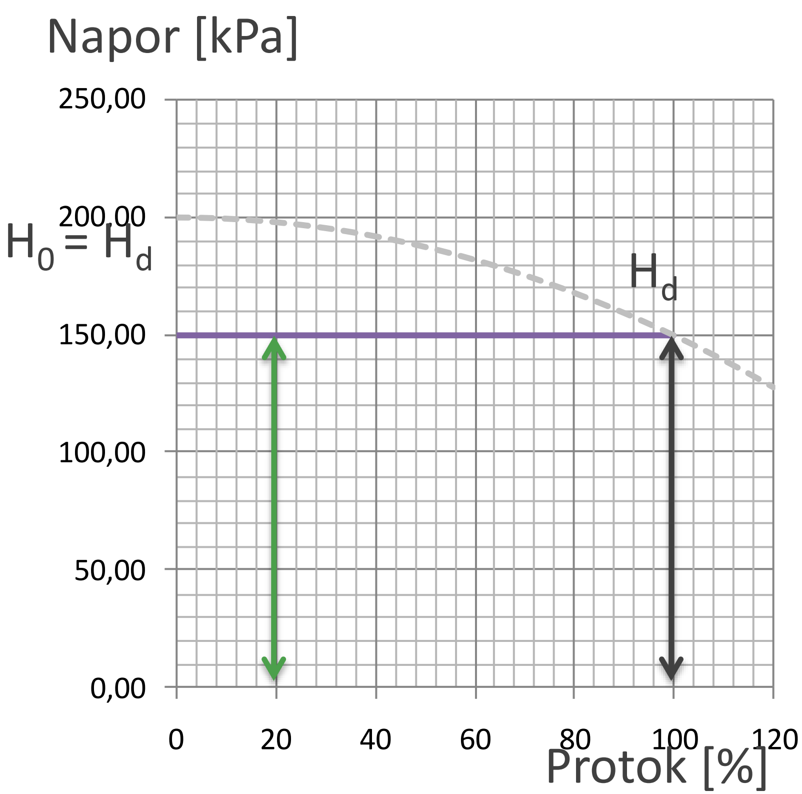


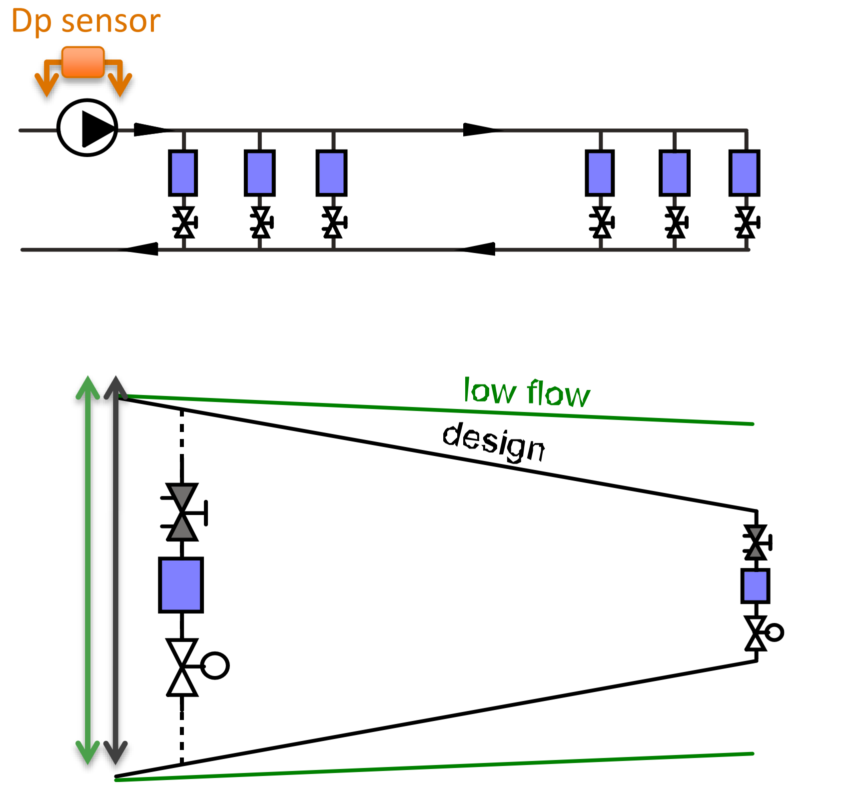


$$\text{Pumping costs} \approx C_0 + \frac{\text{Pump head} \times \text{Flow}}{\text{Pump efficiency}}$$

Diferencijalni pritisak povećava se kod svih krugova pri malom topl. opterećenjem.

Raspored pritiska
VSP – Constant head

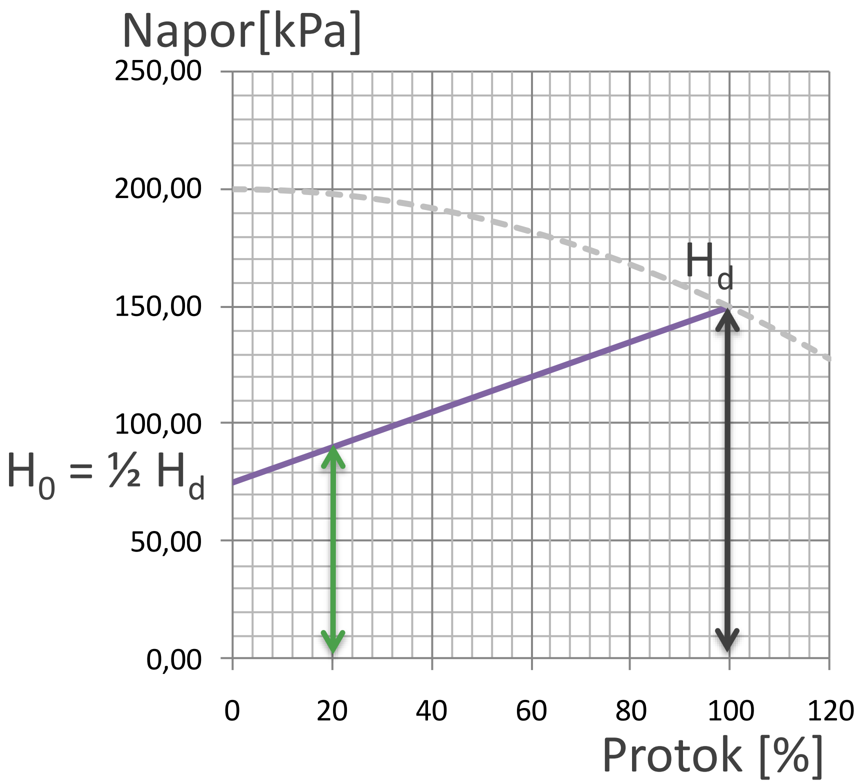


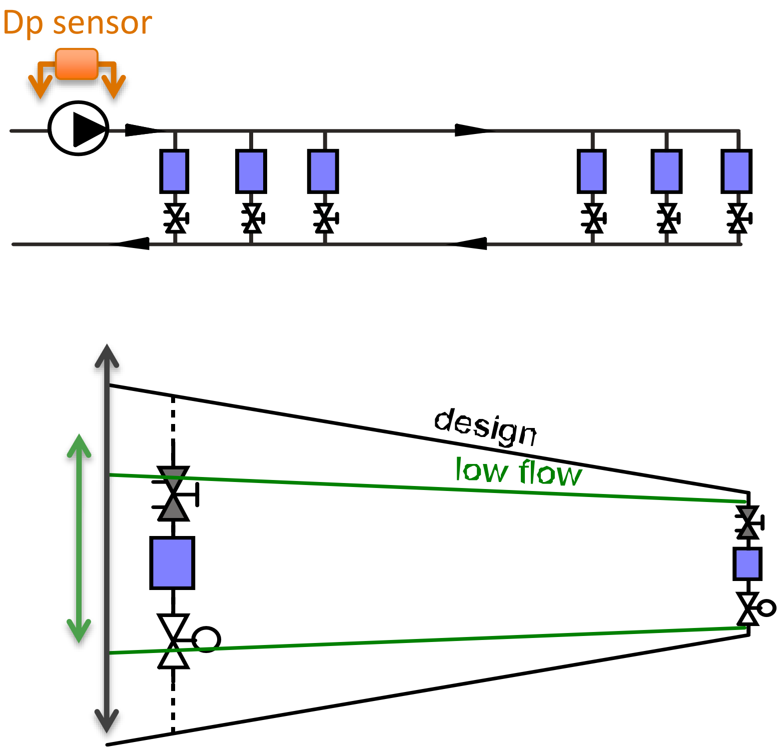


$$\text{Pumping costs} \approx C_0 + \frac{\text{Pump head} \times \text{Flow}}{\text{Pump efficiency}}$$

Diferencijalni pritisak povećava se uglavnom na zadnjom krugu pri malom topl. opterećenjem.

Raspored pritiska
VSP – Proportional head

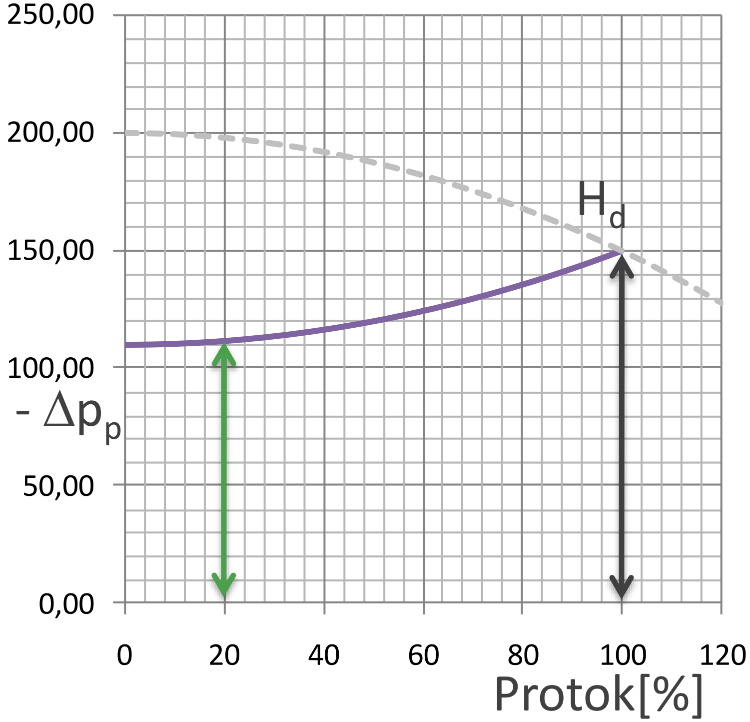




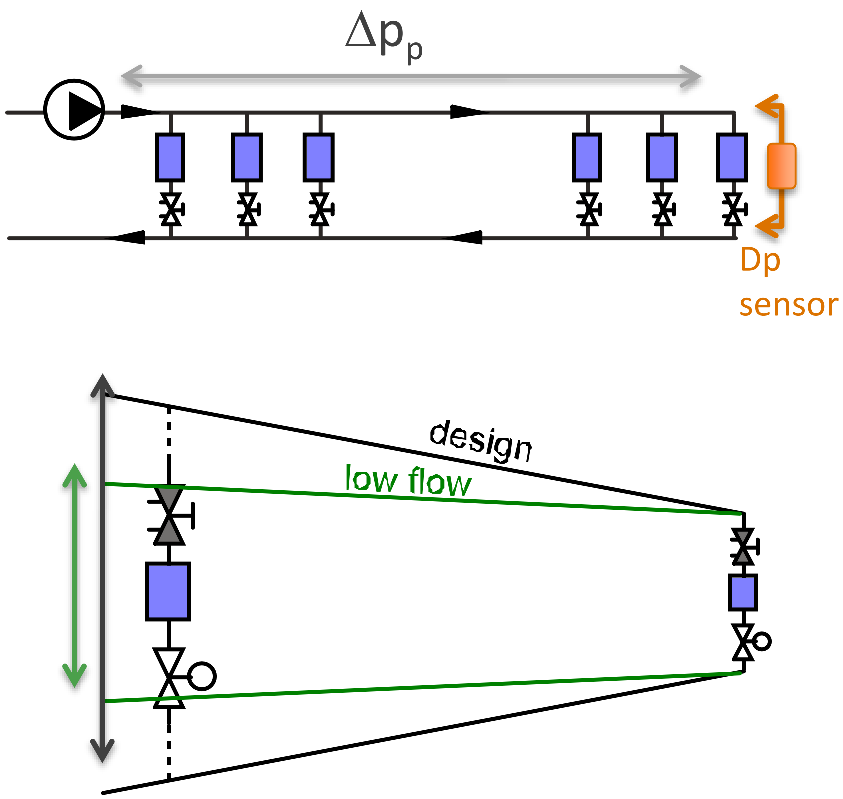
$$\text{Pumping costs} \approx C_0 + \frac{\text{Pump head} \times \text{Flow}}{\text{Pump efficiency}}$$

Diferencijalni pritisak smanjuje se uglavno kod prvok kruga pri malom othopereć. Dovodeći do pada protoka kod krugova koji još traže dopunski protok

Raspored pritiska
VSP – Remote sensor at cst head



$H_0 = H_d - \Delta p_p$



$$\text{Pumpingcosts} \approx C_0 + \frac{\text{Pumphead} \times \text{Flow}}{\text{Pumpefficiency}}$$

Diferencijalni pritisak smanjuje se uglavno kod prvog kruga pri malom opterećenju. Dovodeći do pada protoka kod krugova koji još traže dopunski protok

Zaključak

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- Velika količina energije troši se pri proizvodnji toplotne energije (čileri, kotlovi, gde može značajno da se utiče
- Obezbedjivanje dobre kontrole sistema je krucijalno za izbegavanje nestabilnog sistema, a time i do degradacija na ΔT i do povećanje potrošnje energije
- Pumpe sa frekfentnom regulacijom je osnovni alat za minimizaciju pumpnih troškova.
- No VSP ne mogu obezbediti dobar autoritet kontrolnih ventila za sve krugove pri sva topl. Opterećenja pa zato su Dp kontroleri neophodni.
- Senzor za VSP može da se postavi na indeksnoj grani. Ako je Dp kontrola obezbedjena za sve grane (sve jedinice) to vodi do optimalnih ušteda energije.

Hydronic College

IMI Hydronic Engineering

Hvala na pažnji

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Projektovanje sistema podnog i zidnog grejanja sa sistemom Dynacon

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IMI PNEUMATEX

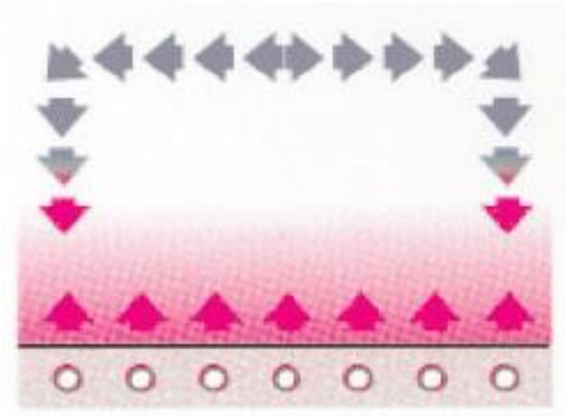
IMI TA

IMI HEIMEIER

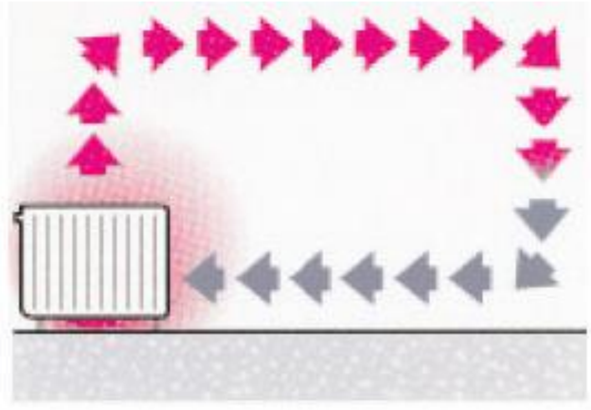
Podno grejanje

Podno grejanje u odnosu na radijatorsko

- ***U poređenju sa radijatorskim grejanjem, podno grejanje ima nekoliko prednsoti***
- ***Obezbeđuje takvu emisiju toplote da se po visini prostorije održava konstantan profil temperature***
- ***Smanjenje količine prašine u vazduhu usled blagog strujanja vazduha***
- ***Veću relativnu vlažnost vazduha***
- ***Uštedu energije***
- ***Veću udobnost***

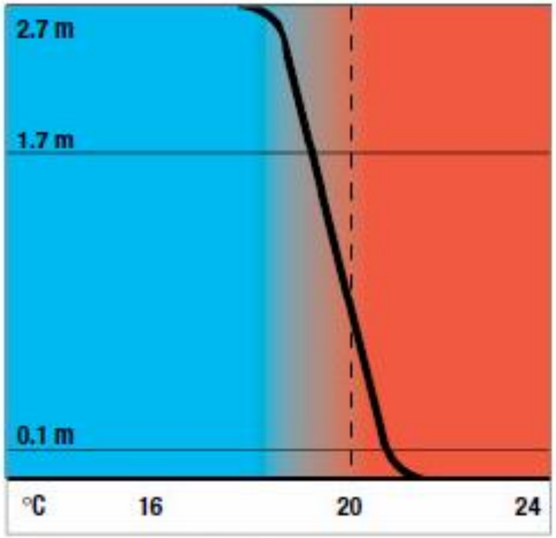


Podno grejanje

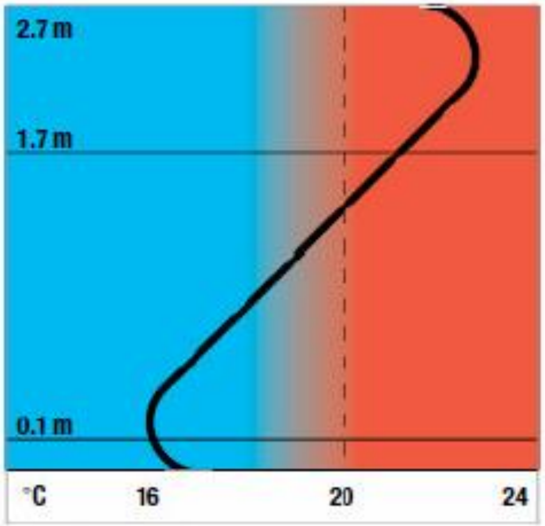


Radijatorsko grejanje

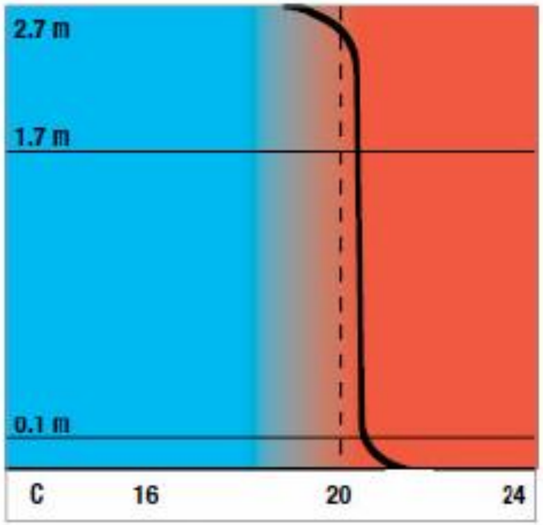
Primer raspodele temperature u zagrejanim prostorijama



Idealna raspodela toplote



Raspodela toplote radijatorskim grejanjem



Raspodela toplote podnim grejanjem

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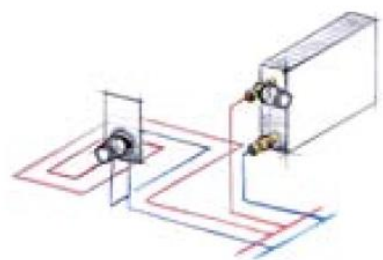
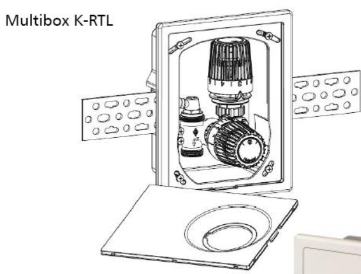
Podno grejanje pravila

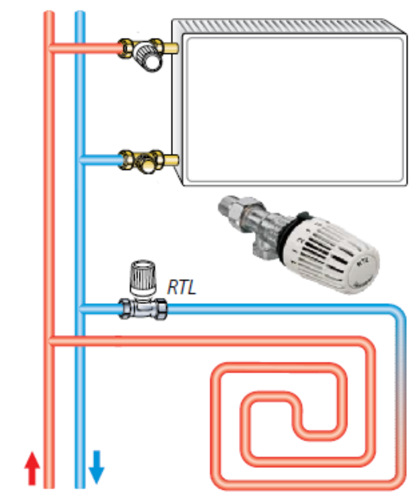
- ***Temperatura vode koja cirkuliše u cevima za podno grejanje je 35-45°C***
- ***Temperatura poda je najviše i veoma retko 29°C (u kupatilima 32°C)***
- ***Temperatura vazduha u visini glave 18-20°C(u kupatilima 22°C)***

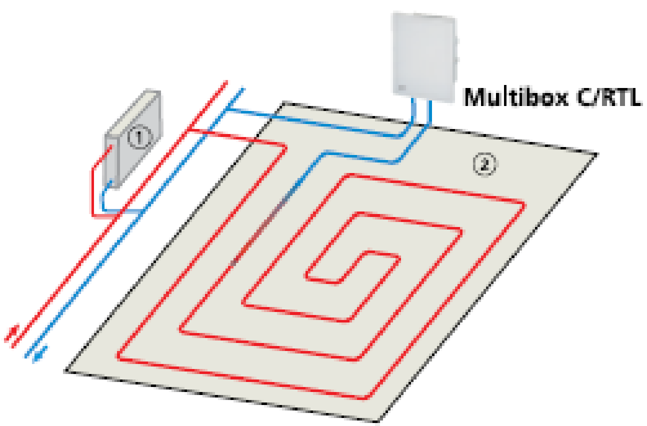
Podno grejanje manje površine

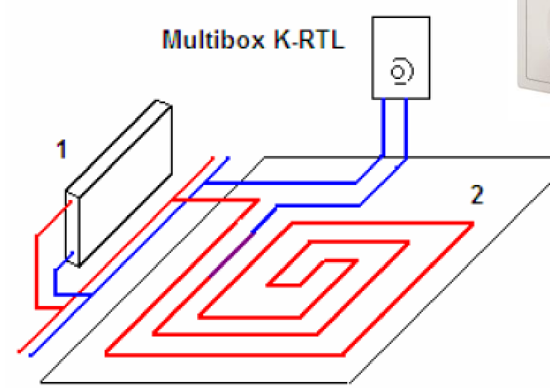
- *Sa radijatorskim grejanjem gde imamo radnu temperaturu 80-60°C , 70-50°C za jedan prostor, za podno grejanje na malim površinama je potreban niskotemperaturni režim na.pr kupatilo, kuhinja, hodnik.*
- *Za manje površine podnog grejanja gde na osnovu stambenog objekta imamo jednu ili dve prostorije do 15-20m² ili 100 m razvučenih cevi tj. Jedan krug podnog grejanja koristimo uređaj Multibox C/RTL ili RTL*







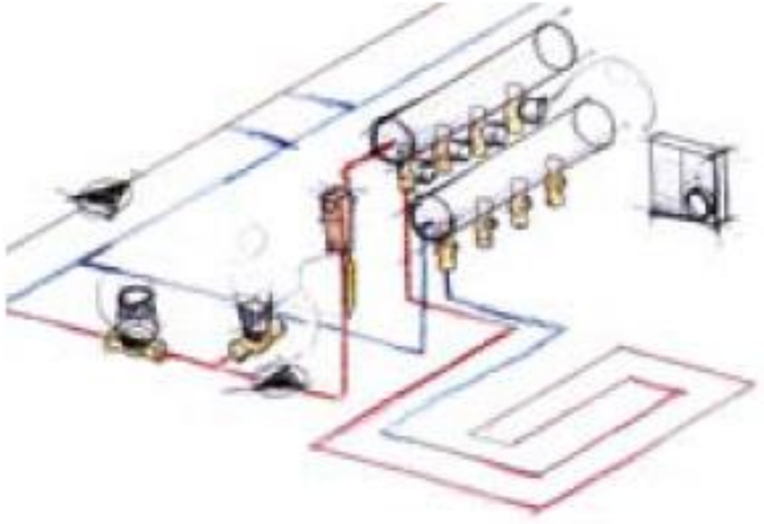




Podno grejanje veće površine

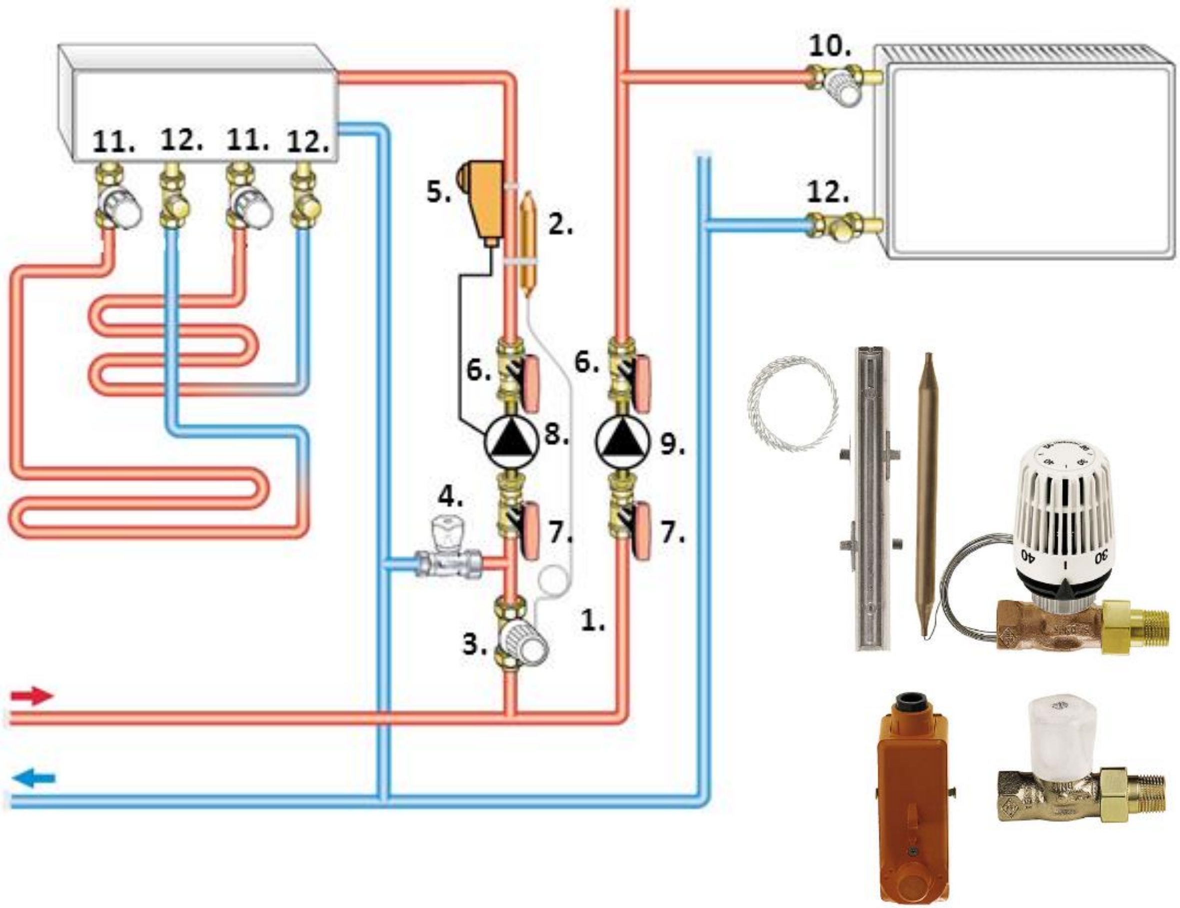
- *Sa radijatorskim grejanjem gde imamo radnu temperaturu 80-60°C , 70-50°C i sistem podnog grejanja 45-35°C gde je podnim grejanjem potrebno grejati veće površine.*

- *Za veće površine podnog grejanja potrebna nam je priprema vode na projektovanu temperaturu*
- *Postoji više načina:*
- ** Setovi za podno grejanje*
- ** Trokraki mešni ventil sa termoglavom i nalegajućim senzorom*
- ** Trokraki razdelni ventil sa termoglavom i nalegajućim senzorom*



PODNO GREJANJE :

- Setovi za podno grejanje do 45m², do 85m², do 120m², do 160m² i radijatorsko grejanje



1. **Termostatska glava sa nalegajućim termostatom, opseg temerature od 20-50°C opseg za podno grejanje.**
2. **Nalegajući senzor.**
3. **Termostatski ventil.**
4. **Ručni relgulacioni radijatorski ventil.**
5. **Elektronski cevni nalegajući termostat 10-90°C.**
6. **Heimeier Globo P-S kugla za pumpu (direktno kačenje) sa nepovratnom klapnom.**
7. **Heimeier Globo P kugla za pumpu (direktno kačenje) sa termometrom.**
8. **Pumpa za podno grejanje.**
9. **Pumpa za radijatorsko grejanje.**
10. **Termostatski ventil.**
11. **Termostatki ventil na sabirniku i razdelniku sa aktuatorom.**

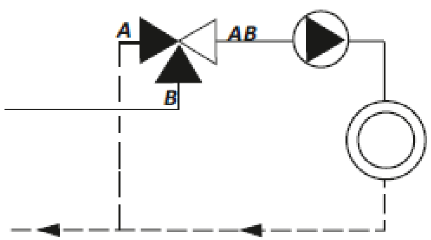
Trokraki mešni ventil u funkciji podnog grejanja

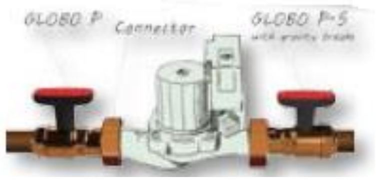
Mešna funkcija (najčešće za podno grejanje)

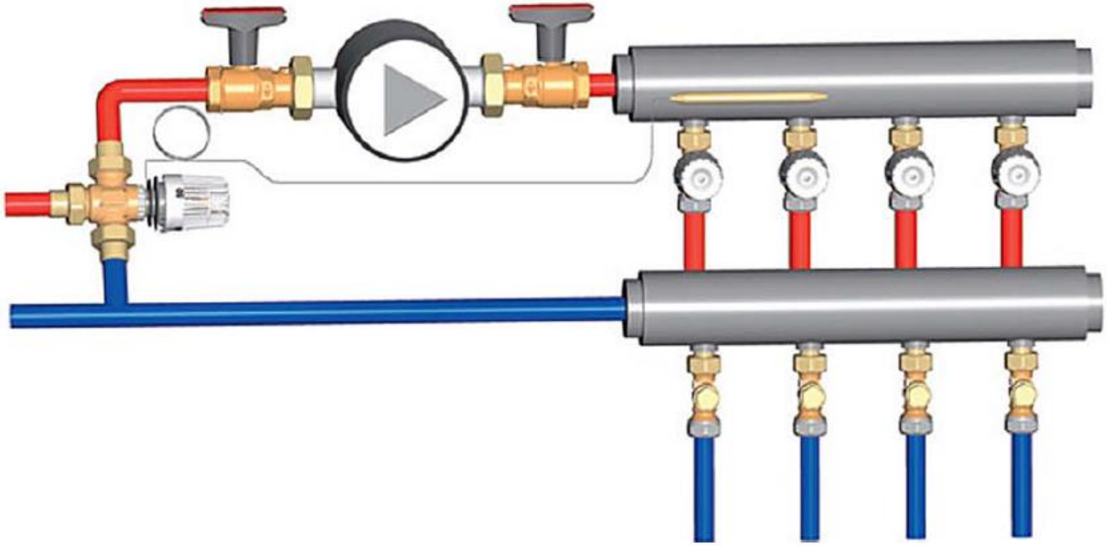
A - dovod povratne vode

B - dovod tople vode

AB - mešana voda







Trokraki mešni ventil u funkciji podnog grejanja

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Diagram – Three-way mixing valve, kvs values

		kv value with thermostatic head [1]	Kvs [2]	Permitted operating temperature TB [°C]	Permitted operating over-pressure PB [bar]	Permitted differential pressure under which the valve still closes Δp [bar]
DN 15		1,40	2,50	120	10	1,20
DN 15	with T-piece	1,40	2,50	120	10	1,20
DN 20		1,90	3,50	120	10	0,75
DN 20	with T-piece	1,90	3,50	120	10	0,75
DN 25		2,60	4,60	120	10	0,50
DN 32		3,50	6,40	120	10	0,25

[1] The kv value corresponds with the flow in angular direction B-AB or in straight direction A-AB when the valve cone is in the middle respectively. The mixing ratio is then 50 %.

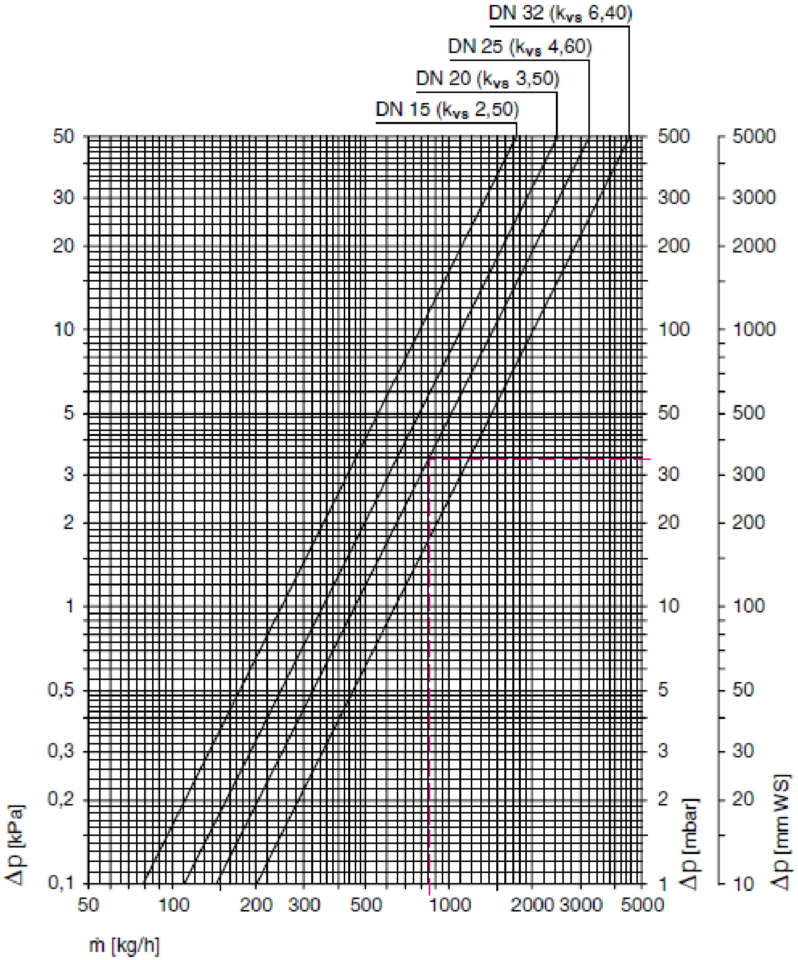
[2] The Kvs value corresponds with the flow in angular direction B-AB when the valve is fully open, or with the flow in straight direction A-AB when the valve is closed.

Calculation example

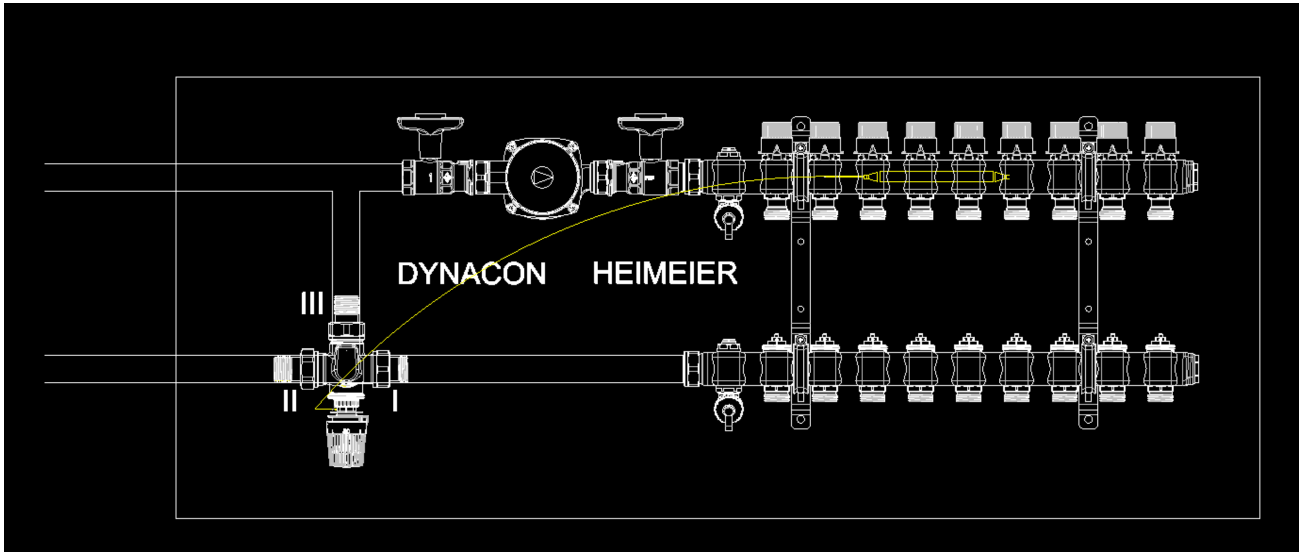
Required: Pressure loss Δp_V

Given: Three-way mixing valve DN 25 with actuator (add-mixing control)
Heat flow $\dot{Q}$ = 14830 W
Supply temperature primary circuit t_v = 70 °C
Return temperature secondary circuit t_r = 55 °C

Solution: Mass flow $\dot{m} = \dot{Q} / (c \cdot \Delta t) = 14830 / (1{,}163 \cdot 15)$ = 850 kg/h
Pressure loss from diagram Δp_V = 34 mbar



Trokraki razdelni ventil u funkciji podnog grejanja



Distributivna funkcija

I – dovod tople vode
II – izlaz (željena temperatura)
III – izlaz (kada postigne željenu temperaturu preusmerava protok vode iz ulaza I u izlaz III). Na osnovu temperaturnog senzora regulišemo temperaturu izlaza.

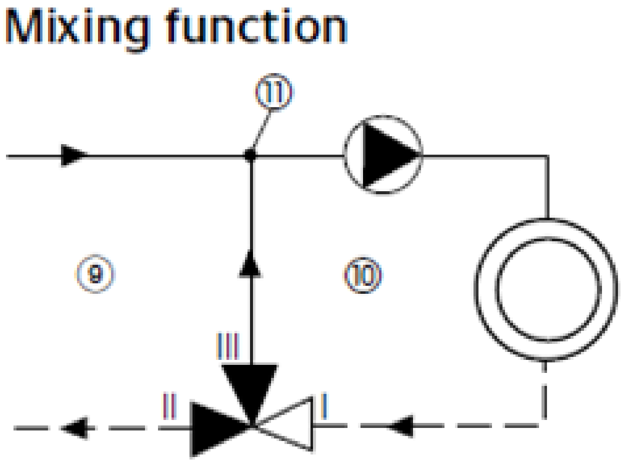


Diagram – Three-way reversing valve with actuator

Three-way reversing valve with Thermostatic head K*)

Three-way reversing valve with immersion/contact sensor		kv-value [m³/h] P-band [K]				Kvs [m³/h]
		2,0	**4,0**	**6,0**	**8,0**	
DN 15		0,60	1,20	1,71	2,10	2,47
DN 15	with T-piece	0,57	1,11	1,58	2,00	2,25
DN 20		0,70	1,50	2,39	3,10	3,48
DN 25		1,08	2,28	3,48	4,62	5,12

*) The kv values correspond to the flow in the direction of passage I-II at the given system deviations.
With the models without T-piece the kvs-values corresponds to the flow in the direction I-II with a completely opened valve and in the direction I-III with a closed valve.
With the models with T-piece the kv/kvs-values corresponds to the flow in the direction I-II.

Sample calculation

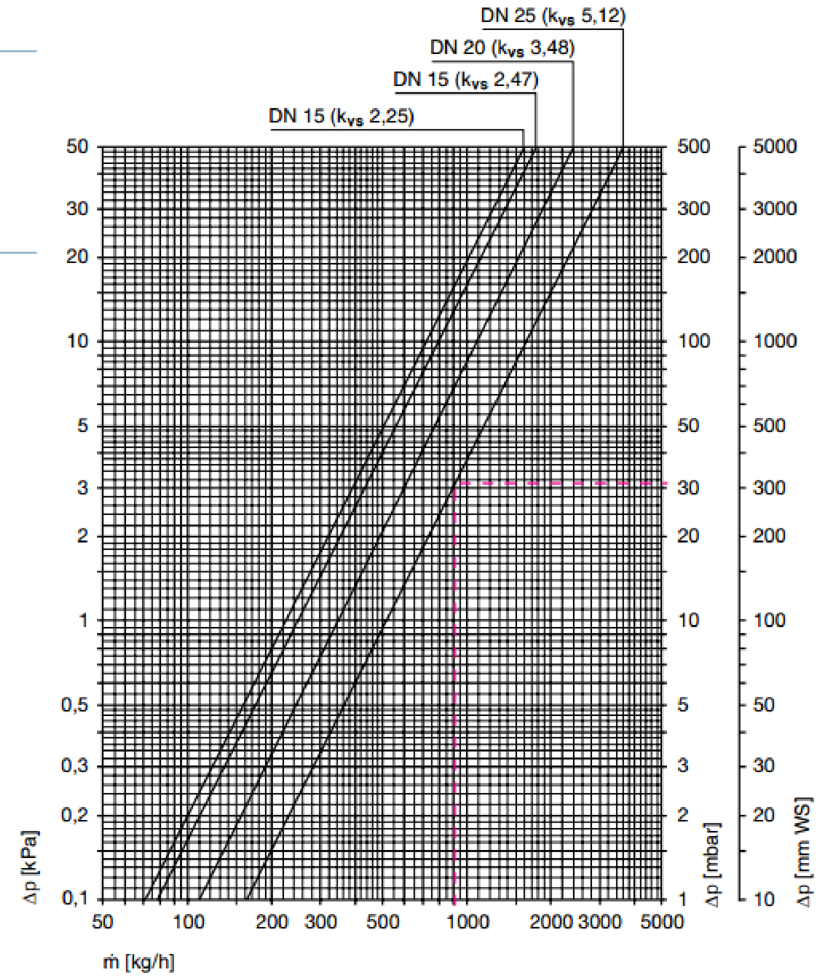
Goal: Pressure loss Δp_v

Given: Three-way reversing valve DN 25 with thermal actuator
Heat flow $\dot{Q}$ = 21000 W
Temperature adjustment Δt = 20 K (70/50°C)

$c_v = \frac{k_v}{0,86}$

$k_v = c_v \cdot 0,86$

Solution: Mass flow $\dot{m} = \dot{Q} / (c \cdot \Delta t)$ = 21000 / (1,163 · 20) = 903 kg/h
Pressure loss from diagram Δp_v = 31 mbar



Dynacon

IMI Hydronic Engineering

Dynacon

Jednim lakim predpodešavanjem...
300
110
250
250
220
250
80
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Dynacon


DYNACON
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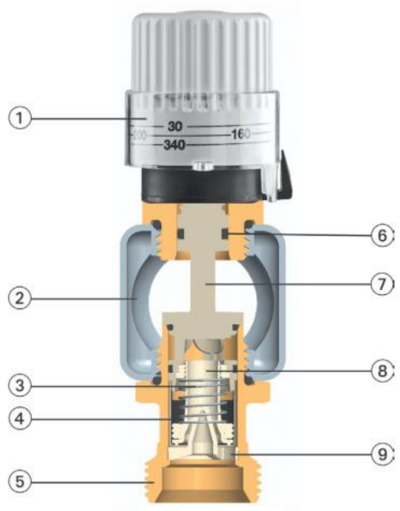
U čemu je tajna?

Dynacon

- **Dynacon** sabirnik i razdelnik za podno grejanje sa atomatskim regulatorom protoka za svaki induvidualni krug. Omogućava nam hidraulički izbalansiran sistem u jednom potezu.

- Sa Dynacon obezbeđujemo konstantni protok a samim tim obezbeđujemo optimalnu distribuciju temperature, štedimo energiju i povećavamo komfor.



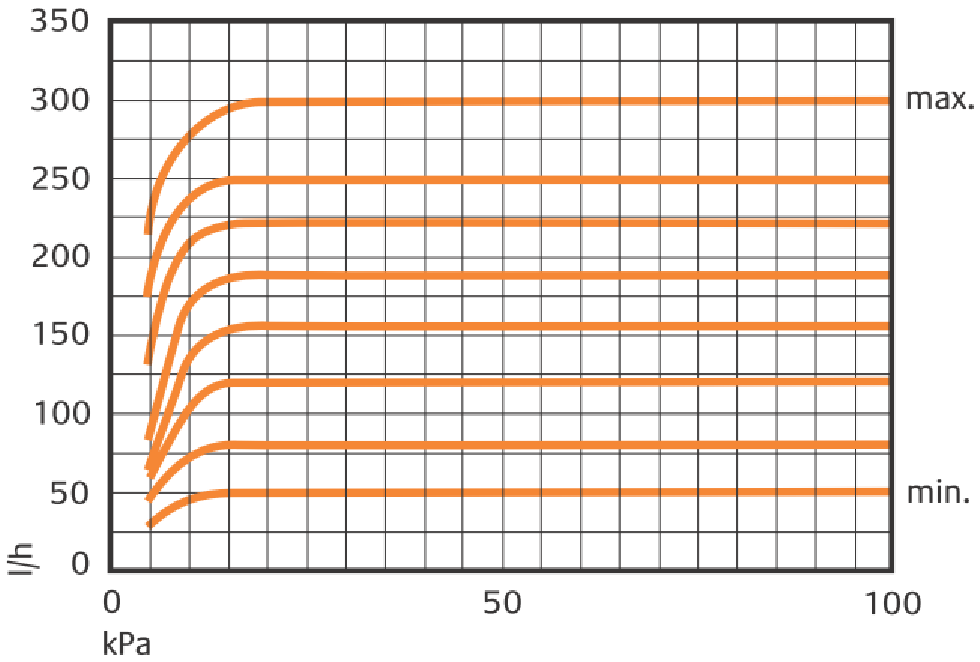
1. Prsten - blokira ventil da ne može da se promeni njegov položaj
2. Kolektor
3. Pritisna opruga
4 .Ketridz
5. Priključni nipl za krug grejanja
6. O-ring prsten
7. Podešavanje vretena ventila
8. Čaura ventila
9. Kontrolni element

Dynacon

IMI Hydronic Engineering

Prednosti

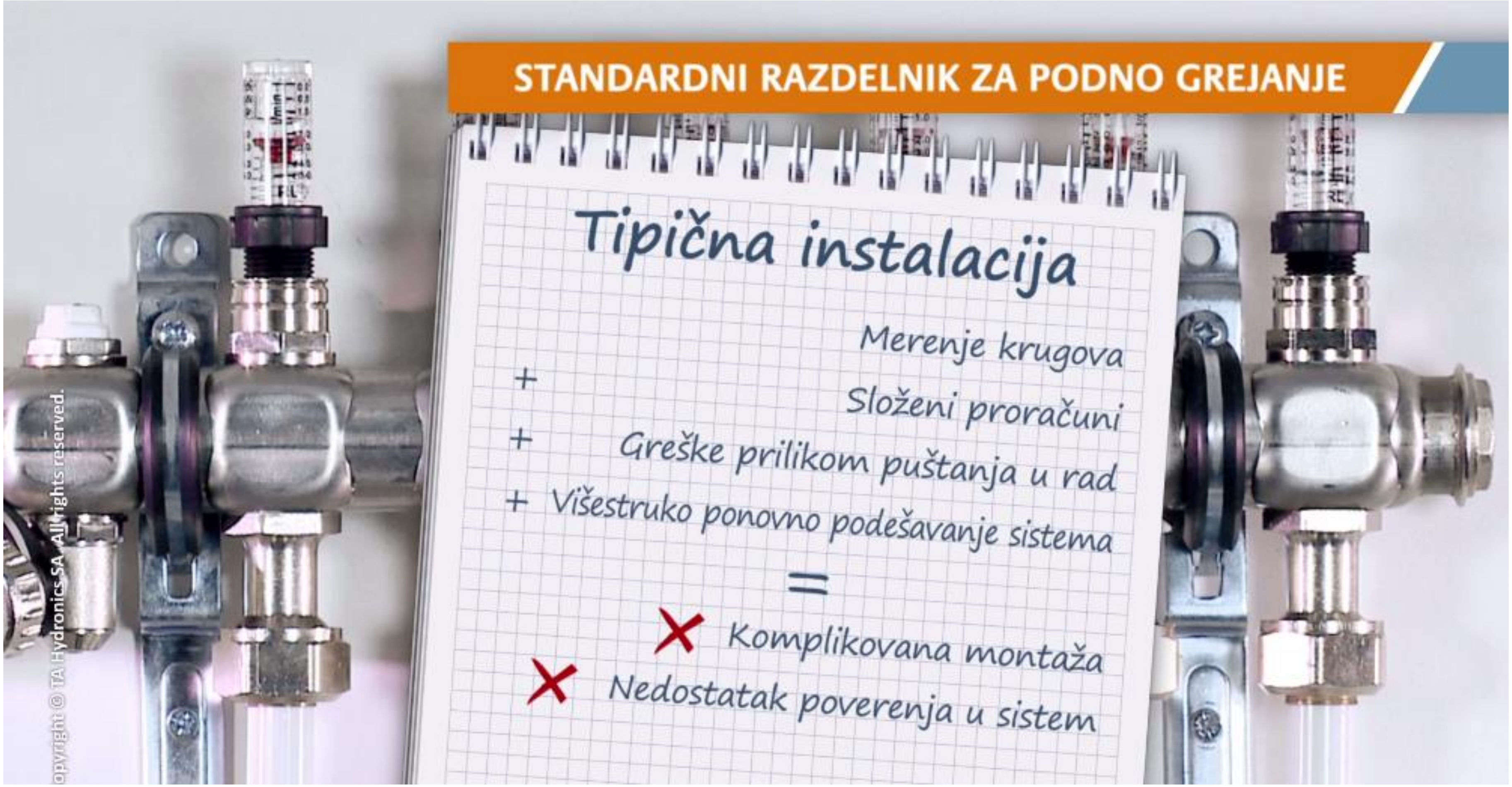
- Automatsko hidrauličko balansiranje preko direktnog postavljanja potrebnog protoka
- Vreme ugradnje i troškovi svedeni na minimum
- Zaboravite na ponovno podešavanje



USP

- Protok direktno podešavamo 50 – 300 l/h

Dynacon


STANDARDNI RAZDELNIK ZA PODNO GREJANJE
Tipična instalacija
Merenje krugova
+
Složeni proračuni
+
Greške prilikom puštanja u rad
+
Višestruko ponovno podešavanje sistema
=
Komplikovana montaža
Nedostatak poverenja u sistem
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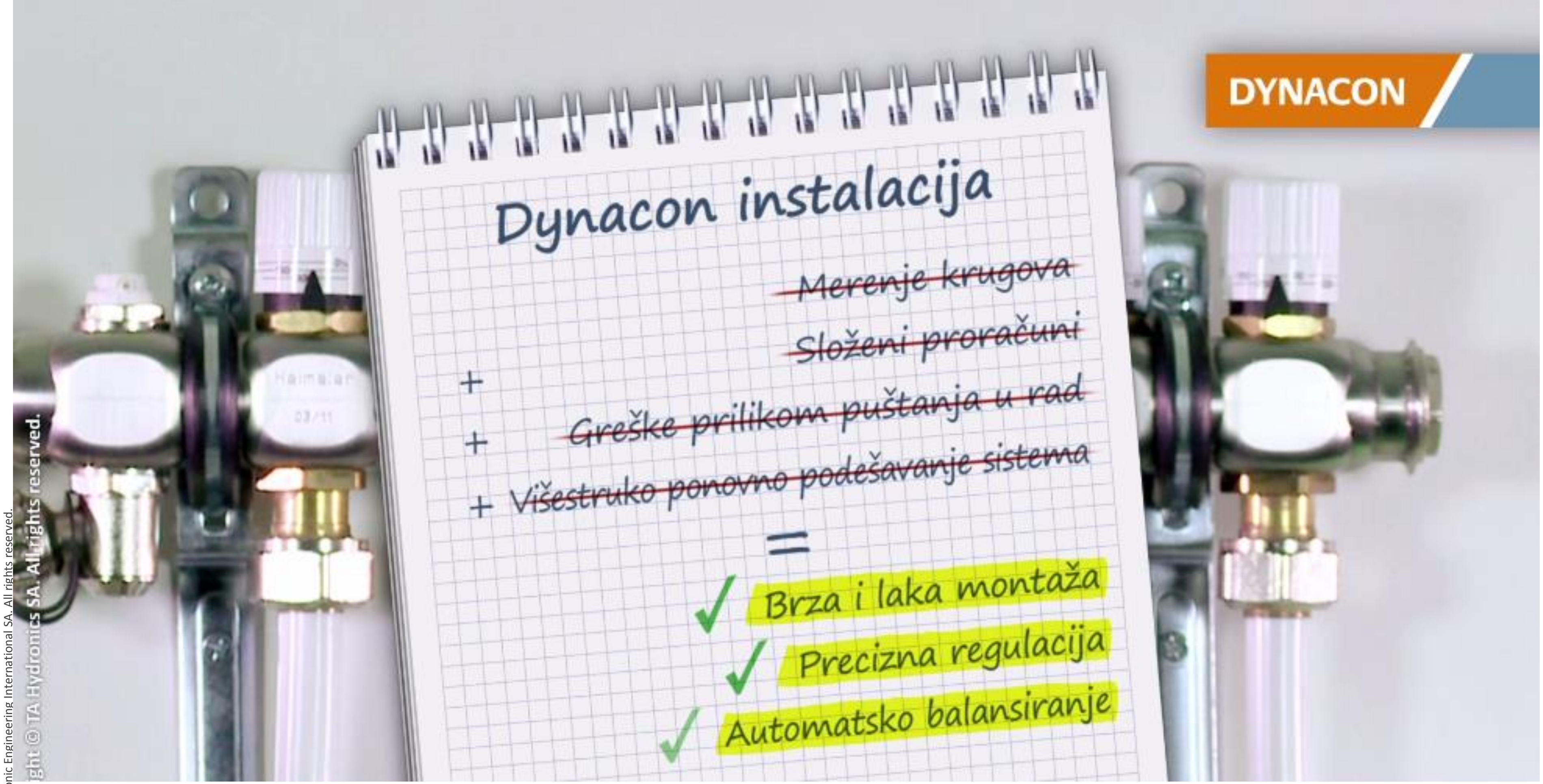
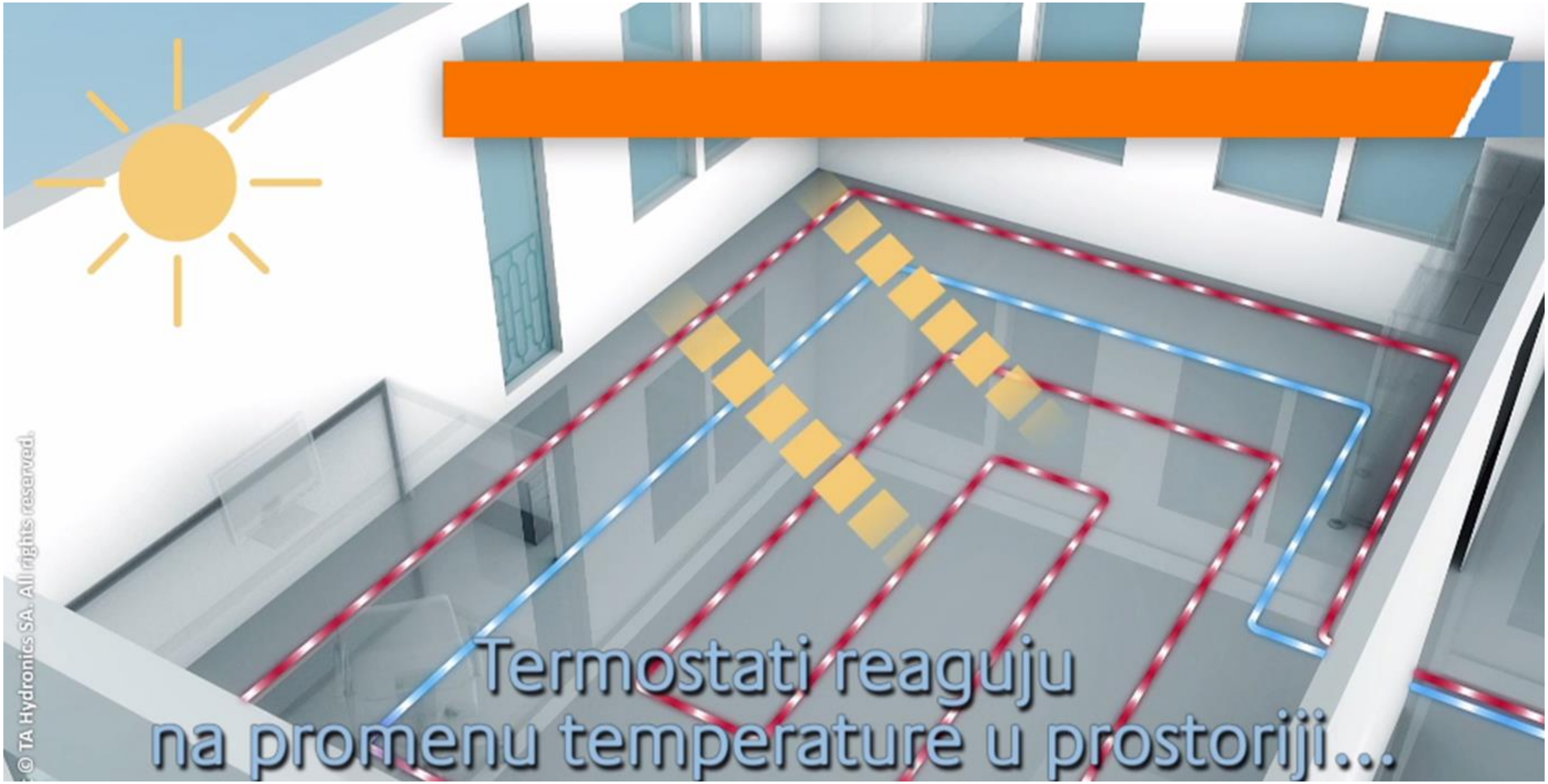
Dynacon



DYNACON
Dynacon instalacija
Merenje krugova
Složeni proračuni
+
+ Greške prilikom puštanja u rad
+ Višestruko ponovno podešavanje sistema
=
Brza i laka montaža
Precizna regulacija
Automatsko balansiranje

Dynacon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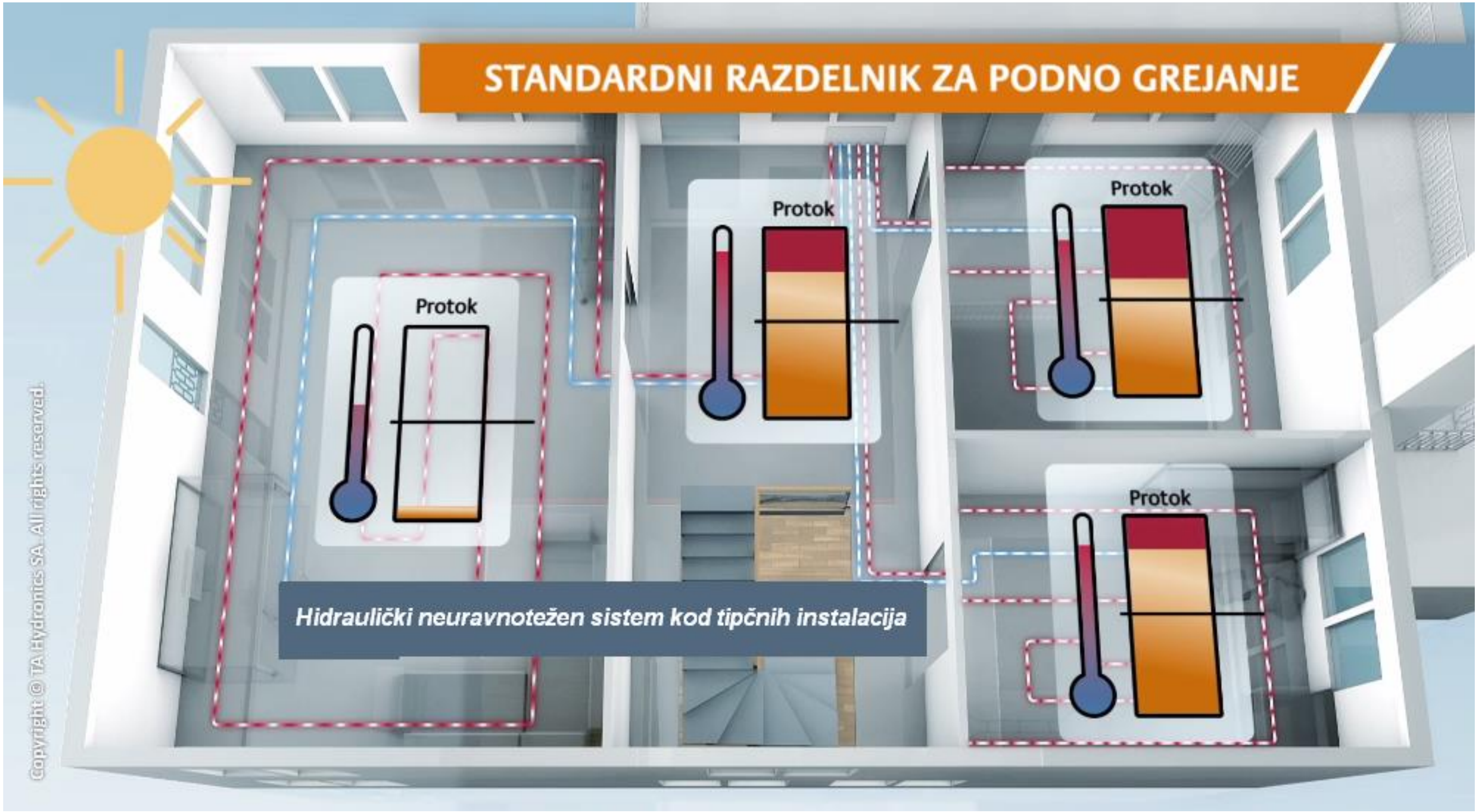
Termostati reaguju
na promenu temperature u prostoriji...

Dynacon



STANDARDNI RAZDELNIK ZA PODNO GREJANJE
Protok
Protok
Protok
Protok
Hidraulički neuravnotežen sistem kod tipčnih instalacija
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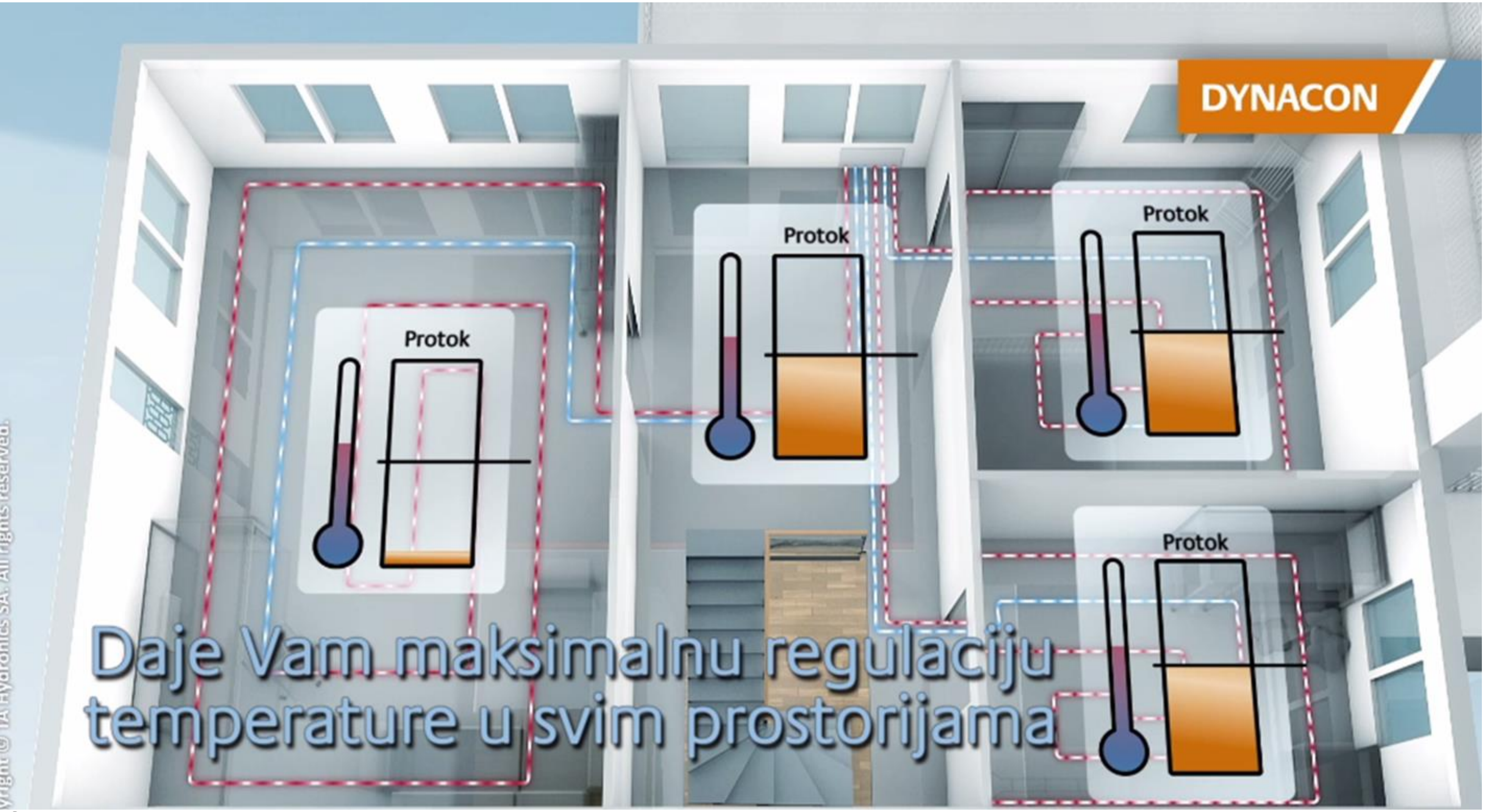
Dynacon



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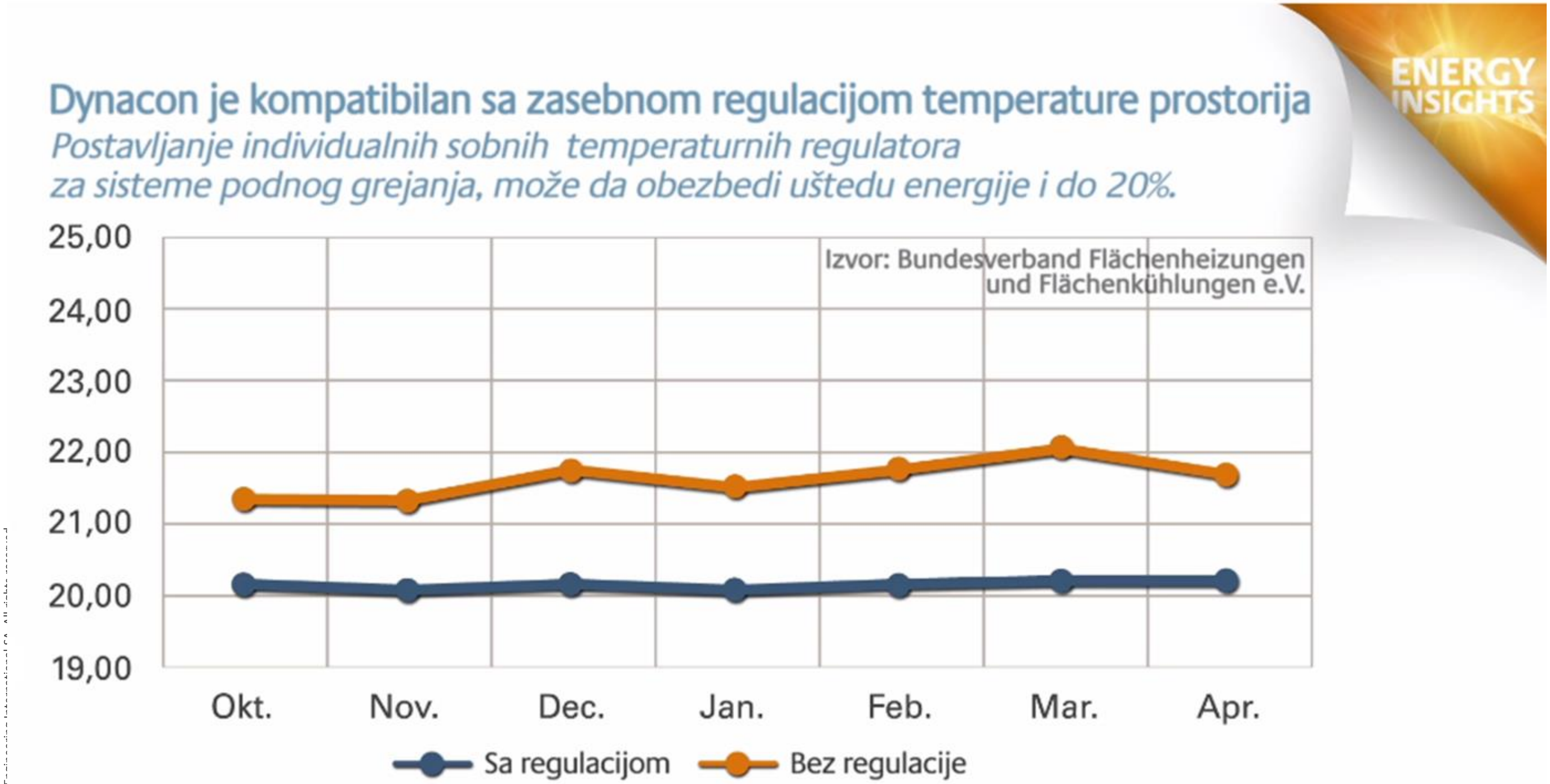
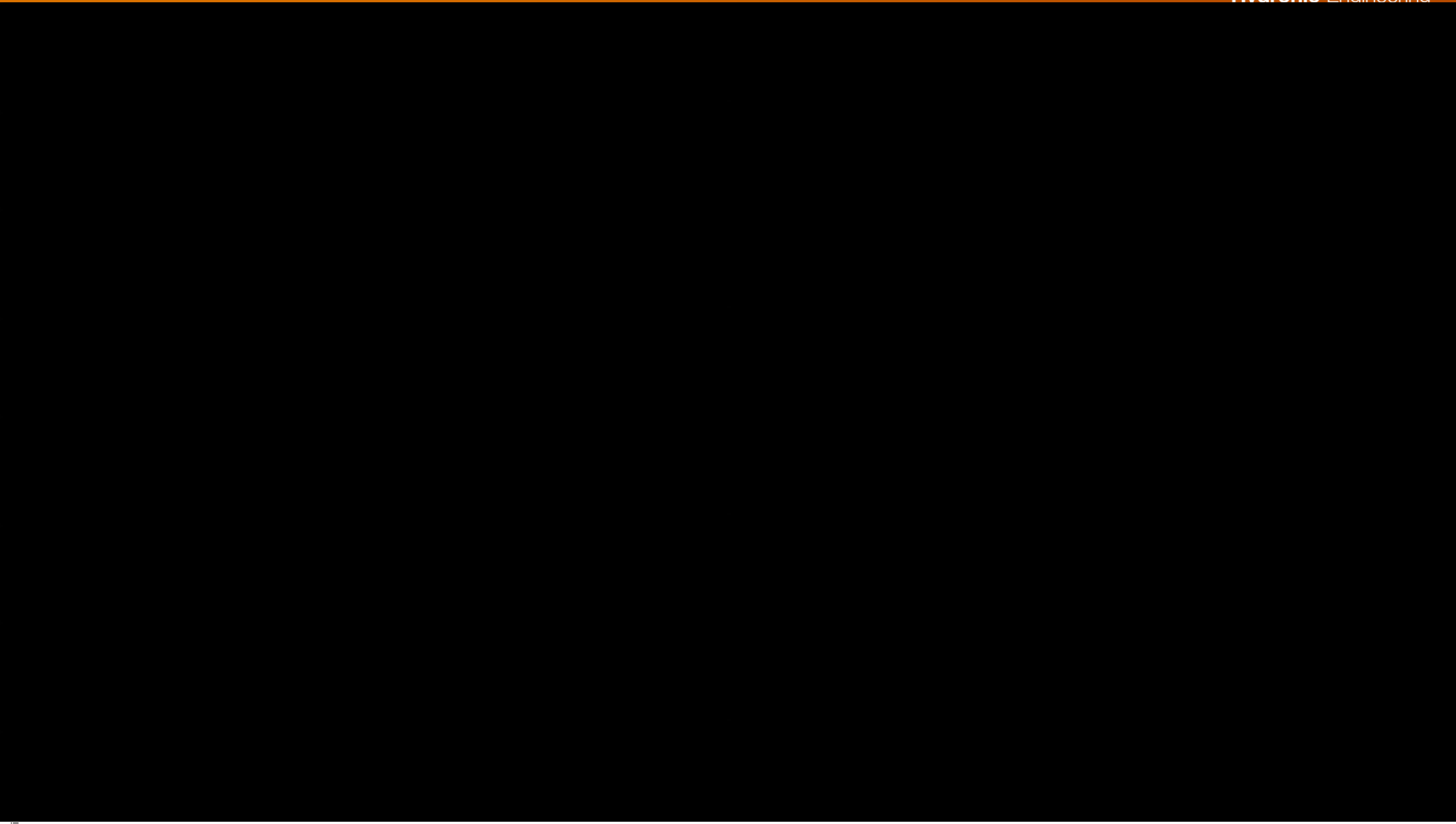

Dynacon je kompatibilan sa zasebnom regulacijom temperature prostorija
Postavljanje individualnih sobnih temperaturnih regulatora
za sisteme podnog grejanja, može da obezbedi uštedu energije i do 20%.
ENERGY INSIGHTS
Izvor: Bundesverband Flächenheizungen und Flächenkühlungen e.V.
25,00
24,00
23,00
22,00
21,00
20,00
19,00
Okt.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
Sa regulacijom
Bez regulacije

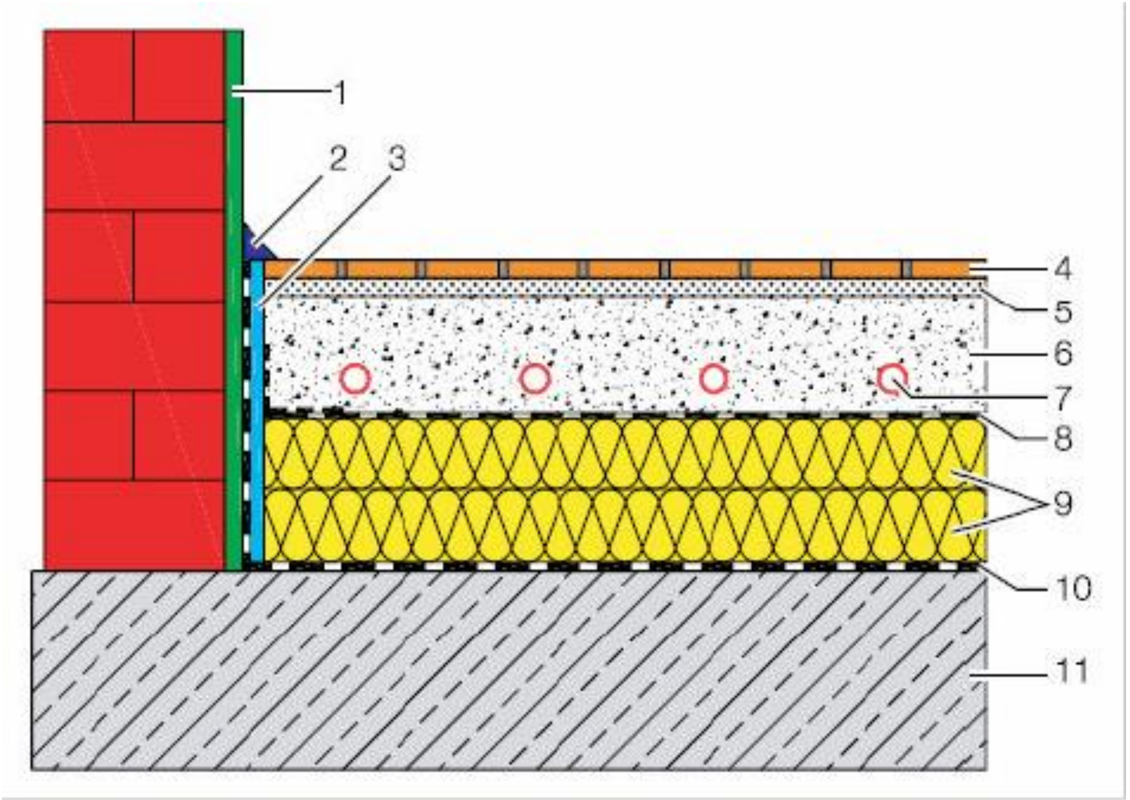
Dynacon

Pogodnosti za korisnika
Povećana udobnost
Ušteda energije i do 20%
Ušteda vremena i novca

Dynacon



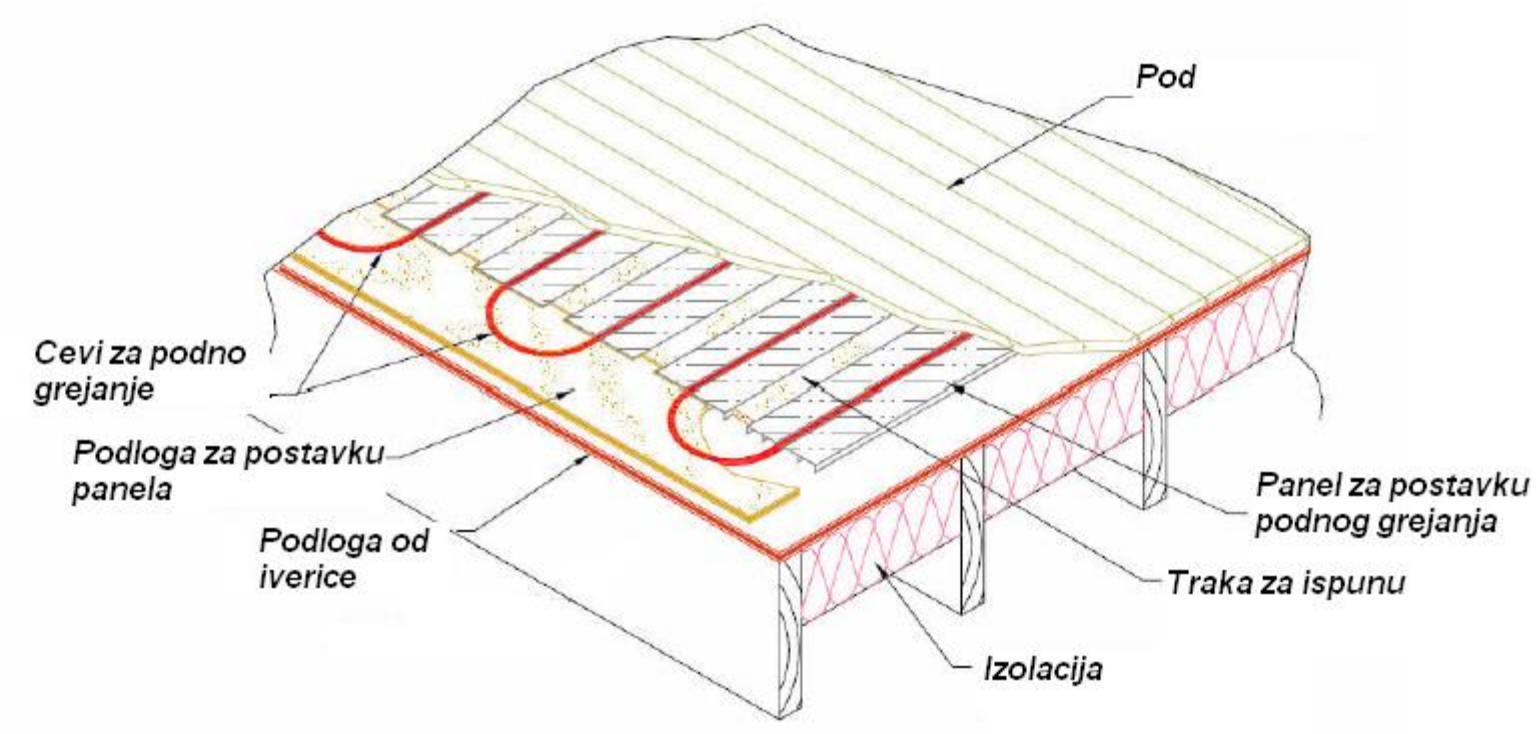
Vlažan sistem podnog grejanja



1.Omalterisan zid – završna obrada
2. Lajsna
3.Izolacioni panel – traka
4. Pod
5. Podna obloga
6. Estrih – cementna košuljica
7. Cevi za podno grejanje
8. Membrana
9. Termo izolacija
10.Membrana
11. Betonska ploča

Suvi sistem podnog grejanja

- Idealan za instalacije gde je pod urađen

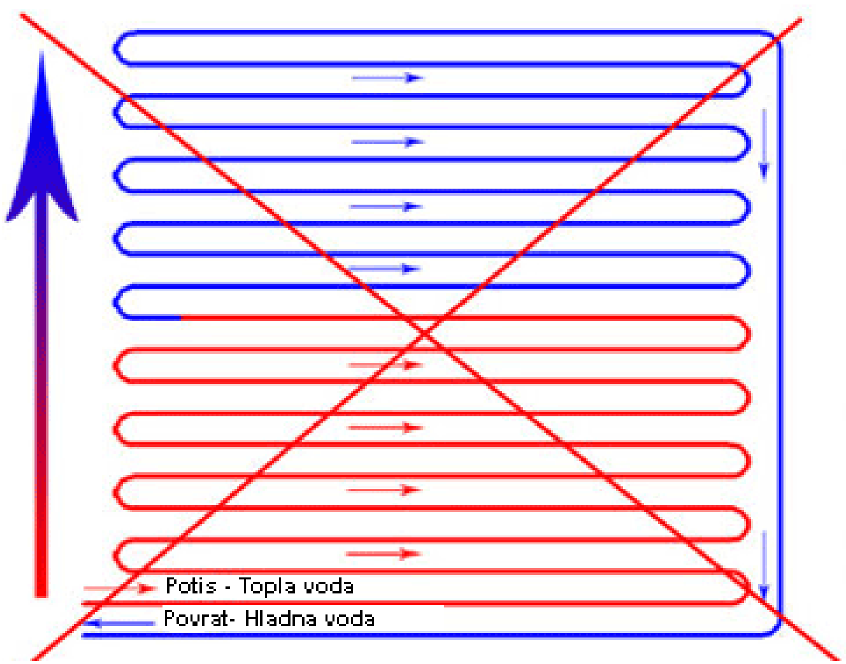


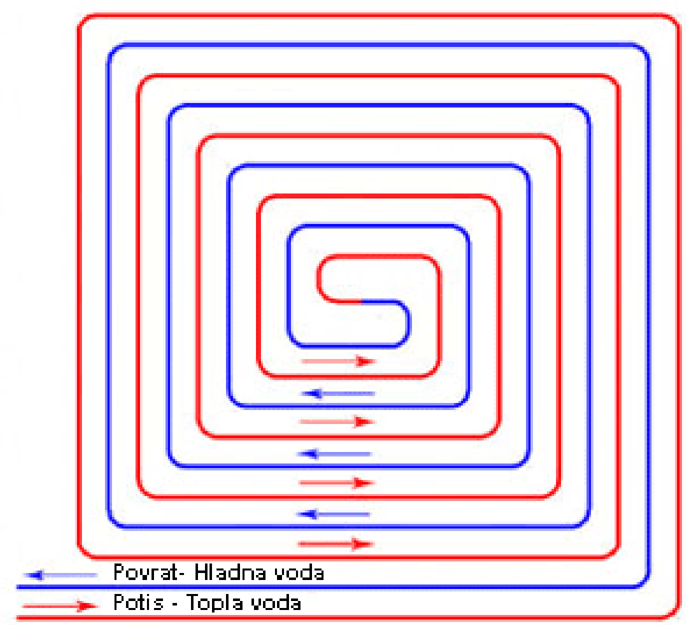
Predlog:

Tipična rastojanja cevi u instalaciji

VA 5	50 mm
VA 10	100 mm
VA 15*	150 mm
VA 20	200 mm
VA 30	300 mm

***Najčešće korišćen tip instalacije**





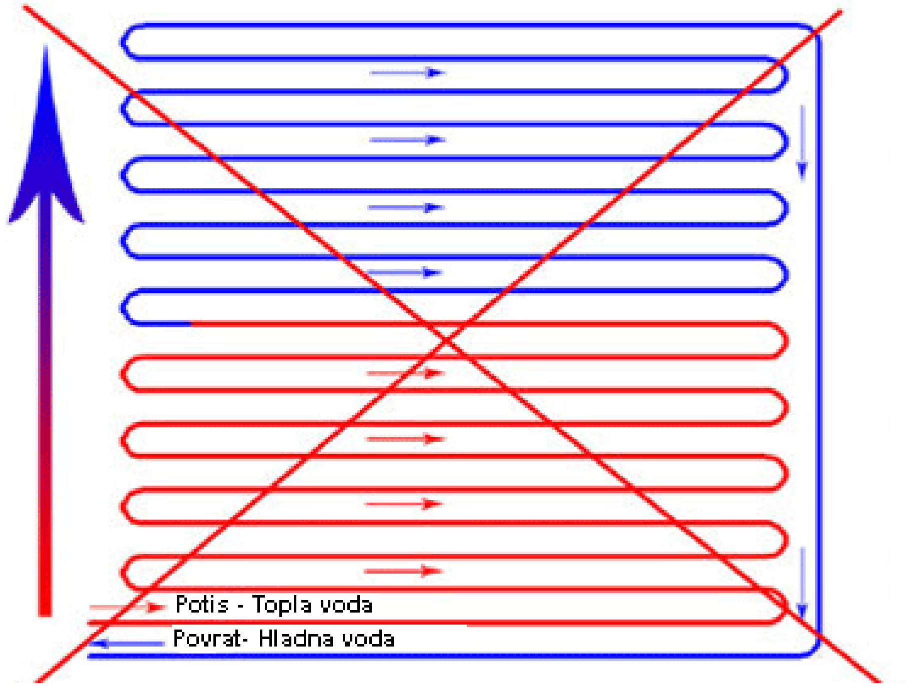
Predlog:

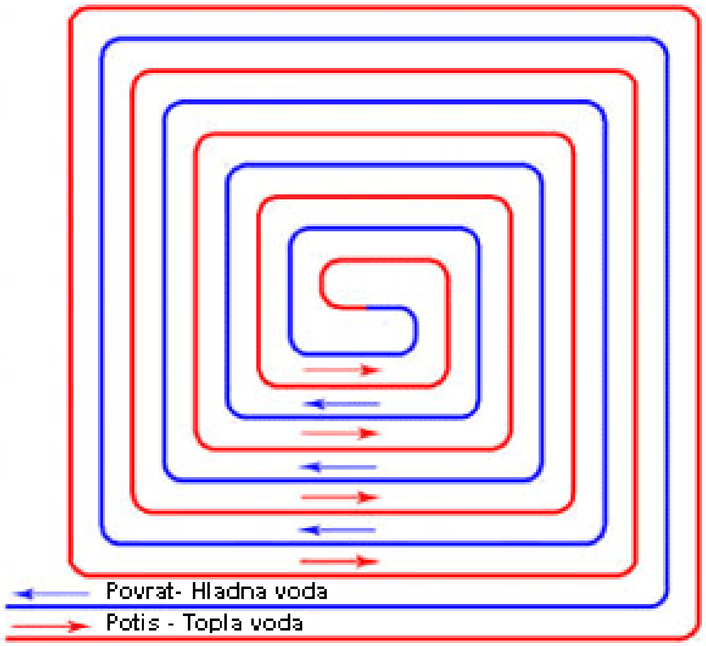
Dužina cevi u 1 m^2 poda

Dimenzija cevi 17x2

VA 10	10 m/m^2	1,33 l/m^2
VA 15	6,7 m/m^2	0,89 l/m^2
VA 20	5 m/m^2	0,67 l/m^2
VA 30	3,3 m/m^2	0,44 l/m^2

Preporučena maksimalna dužiina cevi u jednom krugu podnog grejanja : 120m





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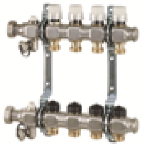
Proračun sistema Dynacon

PE-Xa 17 x 2
wet installation

BACK to HOME



90 l/h

Installation distance between the pipes	3	
VA 100 mm -1		
VA 150 mm - 2		
VA 200 mm - 3		
VA 300 mm - 4		
Flooring	2	
Marble, floor tile 0,011 W/m² K - 1		
Parquet 0,05 W/m² K - 2		
Carpet 0,12 W/m² K - 3		
Specific heat loss of the circuit:	30 W/m2	
Surface of the circuit:	15 m2	
Room temperature:	23 °C	
Connecting pipe length from Dynacon to the circ. and back	10 m	*max. 10 m*
Supply water temperature	34.0 °C	

Results		***Suggested values***
Total heat loss of the circuit	450 W	
Specific heat power of the floor heating circuit	30 W/m2	*30-100 W/m²*
Temperature of the surface of the circuit	26.2 °C	*max. 29 °C; bathroom max. 33 °C*
Return water temperature	29.1 °C	
dt of water	4.9 K	*4-10 K*
Flow rate	**84.13 l/h**	*30 - 300 l/h*
Total pipe length	85 m	*max. 140 m*
Linear pressure drop	52 Pa/m	*max. 200 Pa/m*
dp of the circuit w/o Dynacon	4.62 kPa	*max. 20 kPa*
dp of the Dynacon via the flow regulator	12.24 kPa	
Total dp	**17.70 kPa**	
Flow velocity	0.18 m/s	*max. 0.3 m/s*

Proračun sistema Dynacon

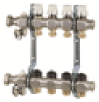
IMI Hydronic Engineering

PE-Xa 16x2.2
wet installation

BACK to HOME

Design supply water temperature

38.5 °C



FLOORHEATING

The yellow cells are the ones that have to be filled !

TA DYNACON V.1.00.04

Description	Circuit															DYNACON
	Room temp.	Surf.	Spec. heat (30-100 W/m²)	Load	Connecting pipe length from Dynacon to the circ. and back; max. 10	Installation dist. VA [1]	Flooring [2]	Surface temp.	Return water temp.	dt of water	Flow	Total dp	Linear pressure drop	Velocity	Total pipe length	Pesetting
	°C	m²	W/m²	W	m			°C	°C	K	l/h	kPa	Pa/m	m/s	m	l/h
Circuit 1	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 2	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 3	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 4	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 5	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 6	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 7	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 8	18	12	75	900	10	150	M	25.2	29.1	9.4	87	22			90	90
Circuit 9				0		200	C	0.0	0.0	0.0	0	0			0	0
Circuit 10				0		150	P	0.0	0.0	0.0	0	0			0	0
Circuit 11				0		100	P	0.0	0.0	0.0	0	0			0	0
Circuit 12				0		100	M	0.0	0.0	0.0	0	0			0	0

1) Installation distance

VA 100 mm
VA 150 mm
VA 200 mm
VA 300 mm

2) Flooring

Marble, floor tile 0,011 W/m² K - M
Parquet 0,05 W/m² K - P
Carpet 0,12 W/m² K - C

Notes:

Surface temperature: max. 29 °C; bathroom 33 °C
dt of water: 4-10 K
Flow: 30-300 l/h
Summa dp: max. 35 kPa
Summa pipe length: max. 140 m
Max. linear pressure drop: 200 Pa/m
Max. velocity: 0,3 m/s

Project:	
Date:	
Made by:	

Radiocontrol F bežična regulacija temperature

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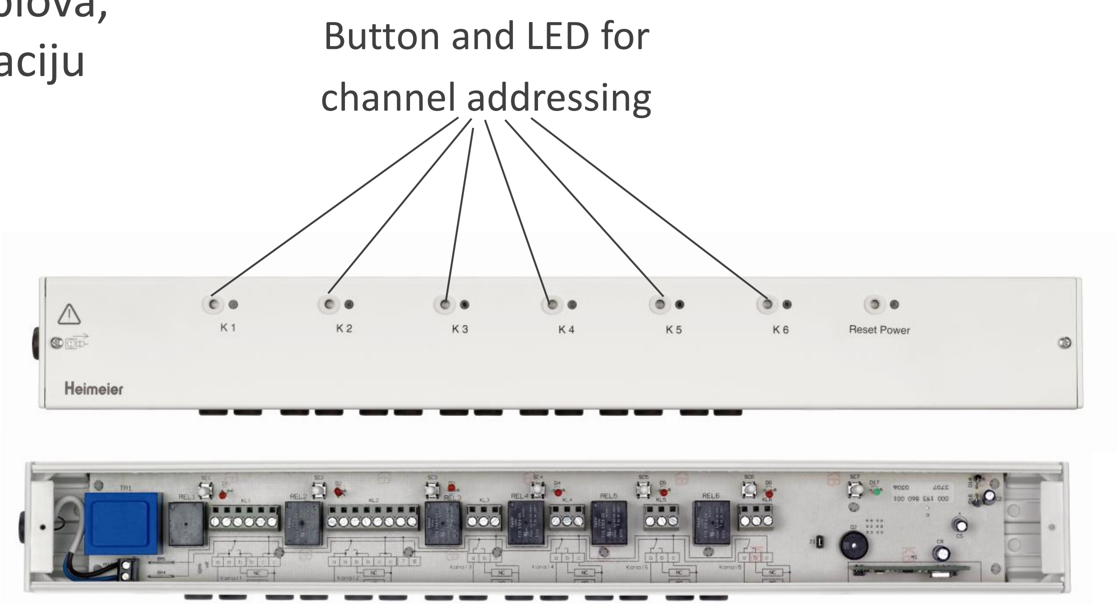
Centralna jedinica sa 6 kanala

Posebne funkcije

- Regulacija podnog grejanja bez kablova, bežična kontrola. Idealan za adaptaciju postojećih sistema.
- Priključak je jednostavan. Utikač na 220V.
- Cenralna jedinica se postavlja u razvodnu kutiju ili u blizini razvodne kutije.
- Jednostavno puštanje u rad. Raspodela kanala na svaku prostoriju.
- Maksimalno 10 aktuatora po kanalu je moguće. Maksimalno 60 aktuatora po centralnoj jedinici.



- Pogoni (aktuatori) na 230V direktno povezati sa sabirnikom i razdelnikom Dynacon, i priključiti ih na centralnu jedinicu. Aktuatori mogu biti normalno otvoreni i/ili normalno zatvoreni.

- Chanel 6 optional for direct connection of the pump.

8- kanalna Centralna jedinca sa tajmerom

IMI Hydronic Engineering

Posebne funkcije

- Regulacija podnog grejanja bez kablova, bežična kontrola. Idealan za adaptaciju postojećih sistema.
- Laka ugradnja
- Priključak je jednostavan. Utikač na 220V.
- Do 10 aktuatora po kanalu je moguće. Maksimalno aktuatora po kanulu 15.

- Kanal 7 opcija za kotlovsku kontrolu; kanal 8 opcija za kontrolu pumpe.
- Tajmer za 6 individualnih vremenskih profila. Za svaki kanal različito vreme profila.
- Promene za grejanje i hlađenje preko spoljnjeg impulsa, čak i za pojedinačne prostorije.

Sobni bežični termostat

Posebne funkcije

- Kontrola temperature podnog grajanja u odnosu na sobnu temperaturu bežičnom komunikacijom bez žice; idealan za savremene sisteme kao i za adaptaciju postojećihunder floor heating control without costly cabling; ideal to retrofit existing systems

- Sobni termostat može se nositi ne mora biti fiksiran za jednu poziciju

- Operativna distanca: 100 m kad je otvoren prostor ili 1 plafon odnosno signal može da prođe kroz tri zida.

Bežični sobni termostat sa digitalnim tajmerom

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Hydronic Engineering

- Elektronska radiokontrola sa digitalnim displejom prikazuje vreme i temperaturu.
- Za grejanje i hlađenje
- Podešavanje od 5°C do 32°C
- Maksimalno 6 isprogramiranih temeratura za jedan dan.
- Radni režim: automatski, manuelni radi, odmor, dan režim.
- 2 baterije LR 6 (AA)

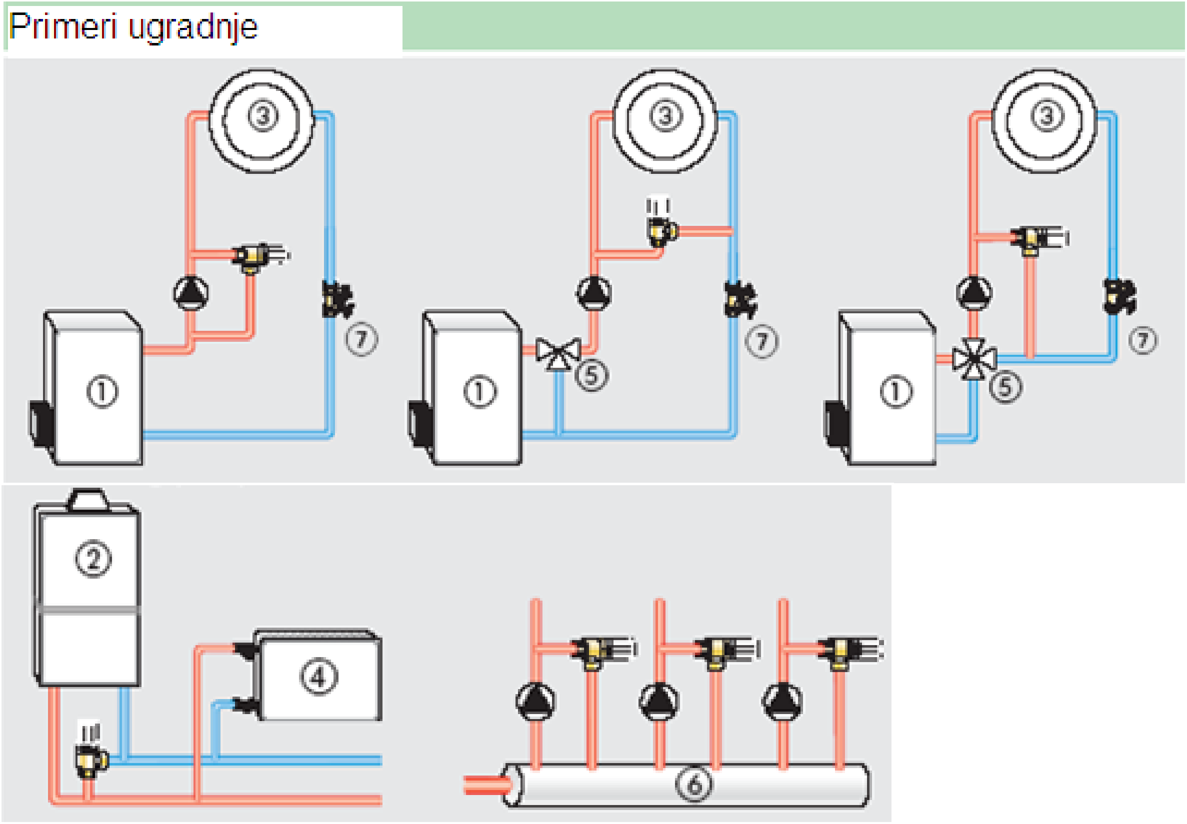
Podno grejanje sa Radiocontrol F

IMI Hydronic Engineering

Heimeier rešenje za podno grejanje sa bežičnom regulacijom temperature i automatskom regulacijom protoka za svaki krug podnog grejanja sa sabirnikom i razdelnikom Dynacon.

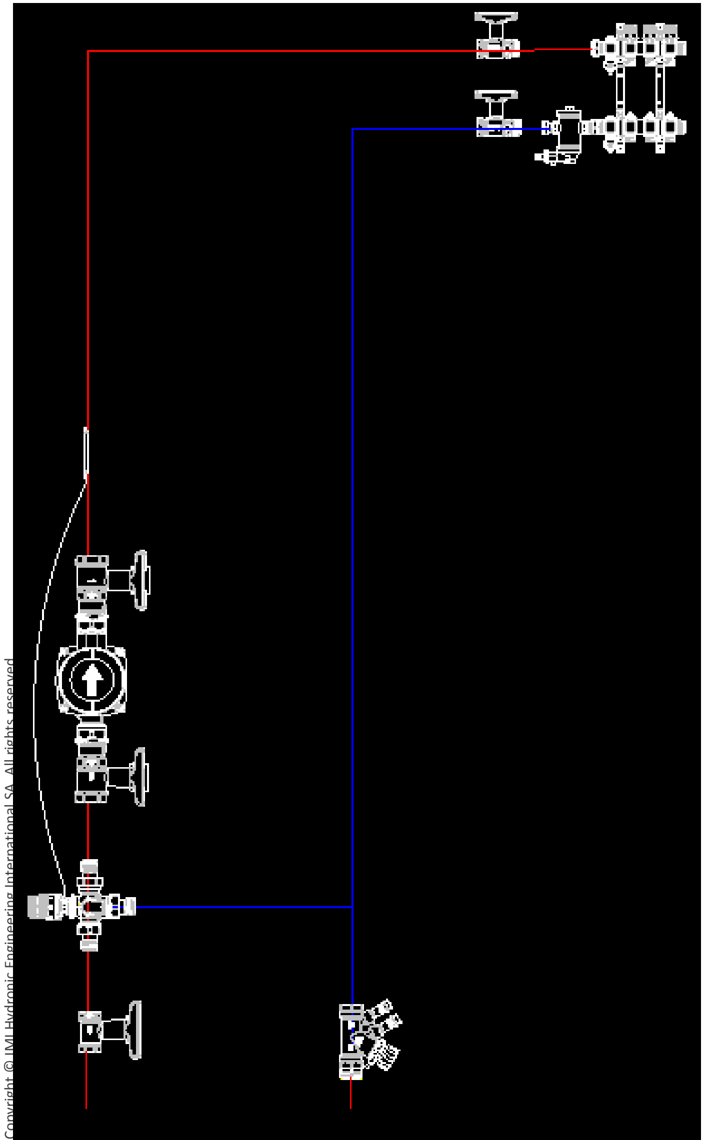
1. Sobni bežični termostat
2. Radiocnotrol F i aktuatori EMO T ili EMO Tec
3. Sabirnik i razdelnik sa automatskim regulatorom protoka Dynacon
4. Kotao

HYDROLUX – zaštiti pumpu

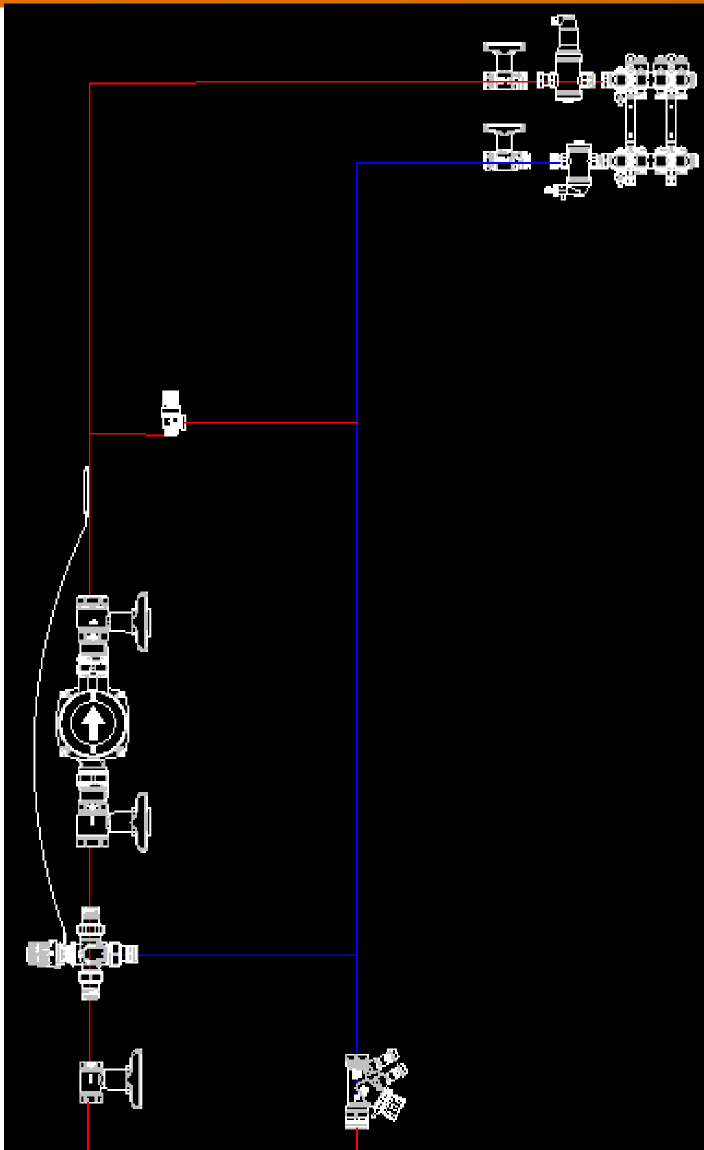


Prestrujni ventil za diferencijlni pritisak sa direktnim prikazivanjem na skali za podešavanje

Zaključak



Zaključak



ZAHVALJUJEM SE NA PAŽNJI

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