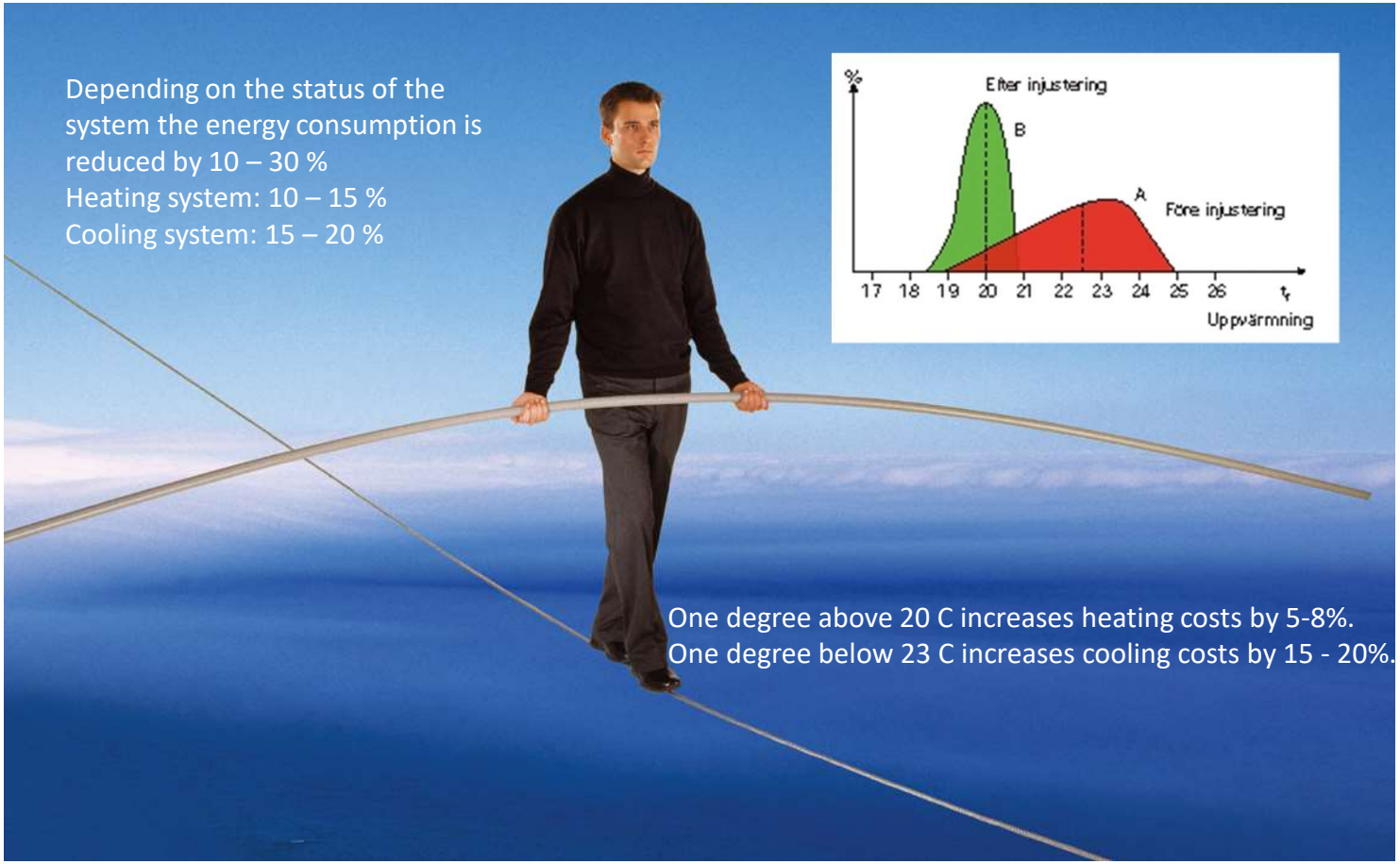
Hydronic Balancing

- Balancing Valves
- Measurement Equipment
  measurement case & terminal
- Knowledge
  software & human

Increased comfort & reduced energy consumption



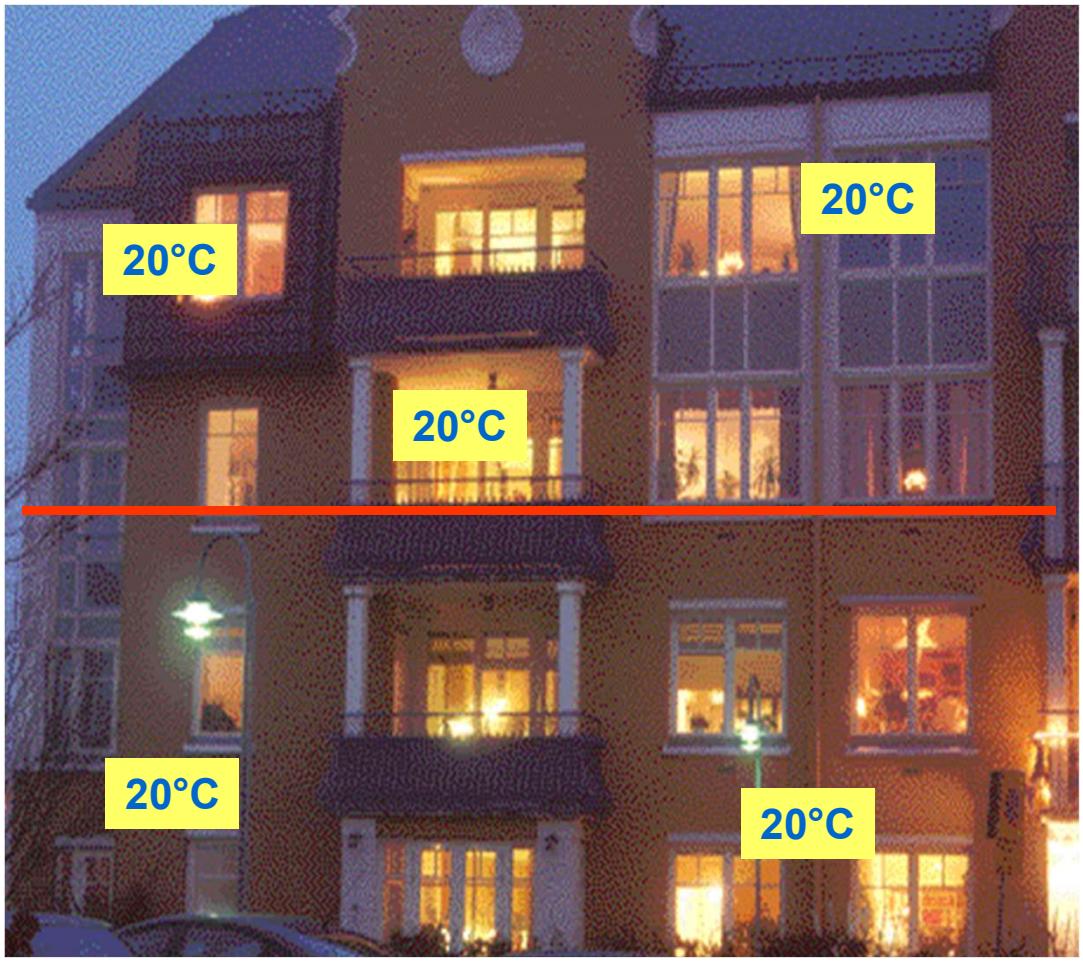
Increased comfort & reduced energy consumption

- The control systems require that the heating and cooling system are properly adjusted.
- In balanced systems the facility can work optimally and deliver the right power to each room.

How to detect in-balance

- It takes a long time before all the room reaches the right temperature at start-up for night or weekend reduction.
- Energy consumption is abnormally high.
- Tenants complain that it is too hot or cold.

Balancing provides even heat throughout the house



Benefits with hydronic balancing

Clear information about the facility conditioned upon startup

Facility start-up time is shorter

Over dimensioning is avoided

Benefits with hydronic balancing

The comfort is increased and
energy consumption reduced.

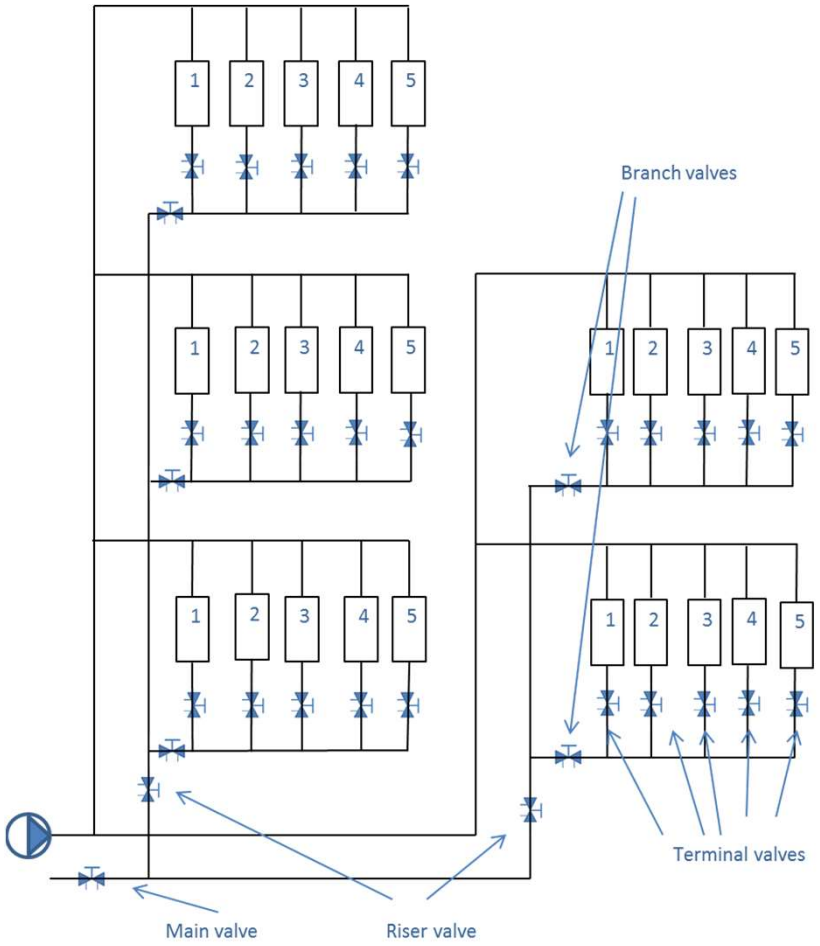
Faster right temperature
after the weekend / night lowering.

Correct flow in cooling / heating system.

System structure

Valve categories:

1. Main valve
2. Riser valves
3. Branch valves
4. Terminal valves

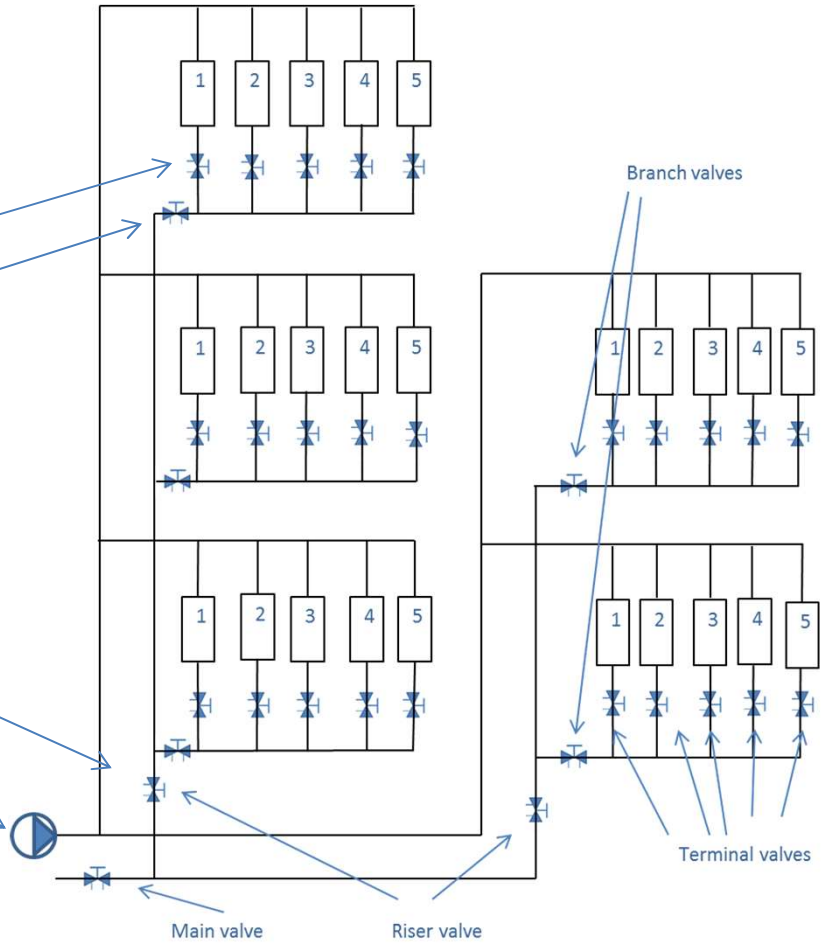


The principle of balancing

- Balancing requires ability to measure and adjust the flow in the system

- Balancing valves are mounted to each:

- Terminal Valve
- Branch Valve
- Raiser Valve
- It should also be possible to measure and adjust the pump flow

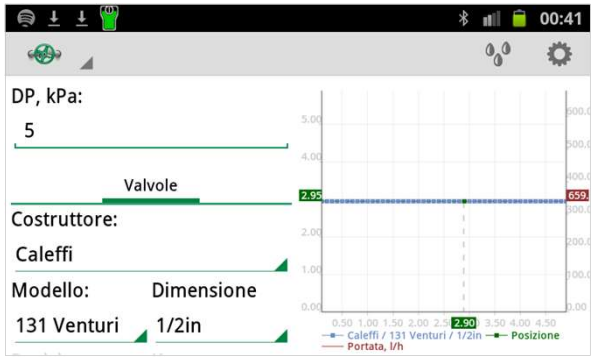


Selection of balancing valve

Use the Flow Calculator or a pressure drop chart.

When the pressure drop is not known. Select the valve which gives the calculated flow rate with a pressure drop of about 5 kPa when the valve is open to 80%.

When the flow rate and pressure drop are known. Select the valve size that provides the required capabilities when the valve is open about 80%.



Balancing Methods

All large systems enclose a certain degree of complexity, when flow is adjusted at one balancing valve, pressure drop will change in valves and pipes, which will affect differential pressure across balancing valves at other places in the system. Accordingly, when flow is adjusted on a valve in a branch, the flow in other valves that might already been adjusted will also change.

There is need for a hands on method, a working schedule.

Static Valves – Hydronic Balancing of the system

Dynamic Valves – Hydronic Balancing of the valve

Direct method [Balancing by chance]

A method to verify that the raisers containing the correct flow, used in simpler types of heat distribution systems. The installer tries to find the right setting of each valve. This approach might work at very small systems with a couple of valves, it does not work in large installations.

Pre-setting method

The installer sets the flow of the valves based on calculated pre-setting from the engineers. A few test measurements and adjustments are made. The hydraulic behavior of the system always deviates from designed values. Accordingly, this method will not give an optimal result.

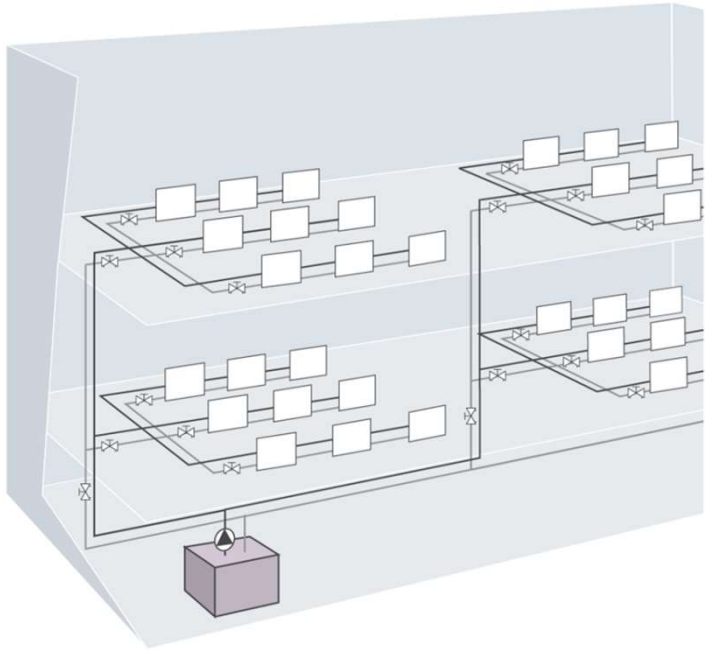
Proportional method

All correctly working methods to balancing a system are based on the Proportional Method. All terminal units, branches and risers are balanced to the same proportion, or ratio, of designed flow. When the total flow is adjusted at the pump, all units will have the correct flow.

Preparations

Before balancing the system:

- Confirm that balancing valves are correctly installed
- The system must be completely flushed, air-vented and filters/strainers cleaned
- The system should be running for a while before balancing is commenced
- Plan sketches with numbered valves and corresponding design flows should be prepared
- Check the Balancing equipment.
- The pump must be set to constant flow during the balancing procedure
- All valves and thermostatic units must be fully open.

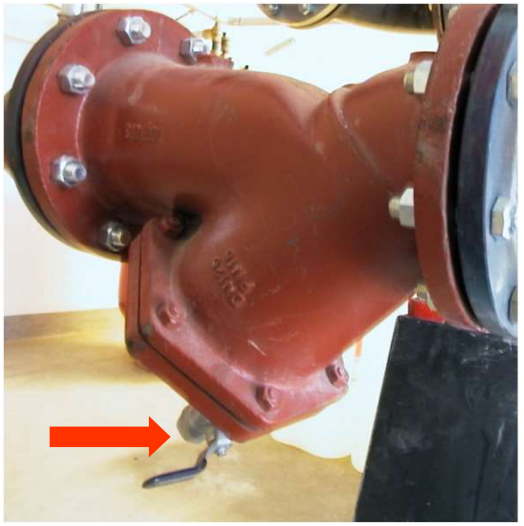


Check that all valves are in place. Make rough adjustment of the flows in the raiser, branch and distribution lines according to the documents

Preparations

Airiate the system

Check that the pump is working and has the right rotation.
If possible - set its flow 10% above of the specified value when adjusting.



Make sure that the strainers are clean.
Remove and clean the filter as needed.
Backwashing does not take away any dirt in the filter.

Check back a few times after booting.

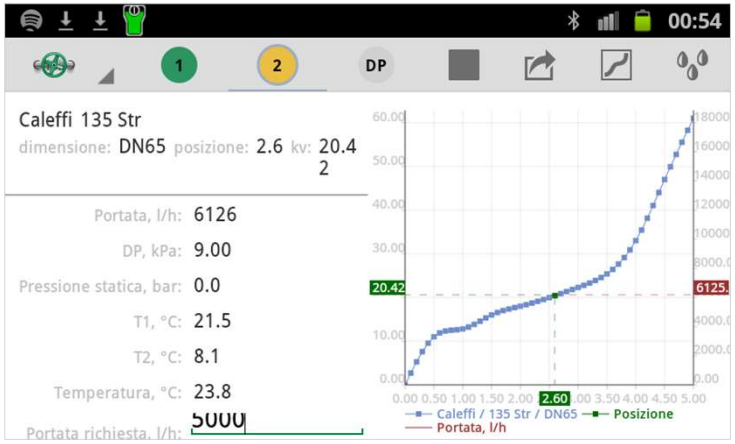
Preparations

- Check the static pressure in the system.
  If necessary fill up the system.
  Check that the pressure enough for the water to reach the upper radiator.

- Check with Balancing instrument that there is flow in all lines.
  Also check for any "short circuits".

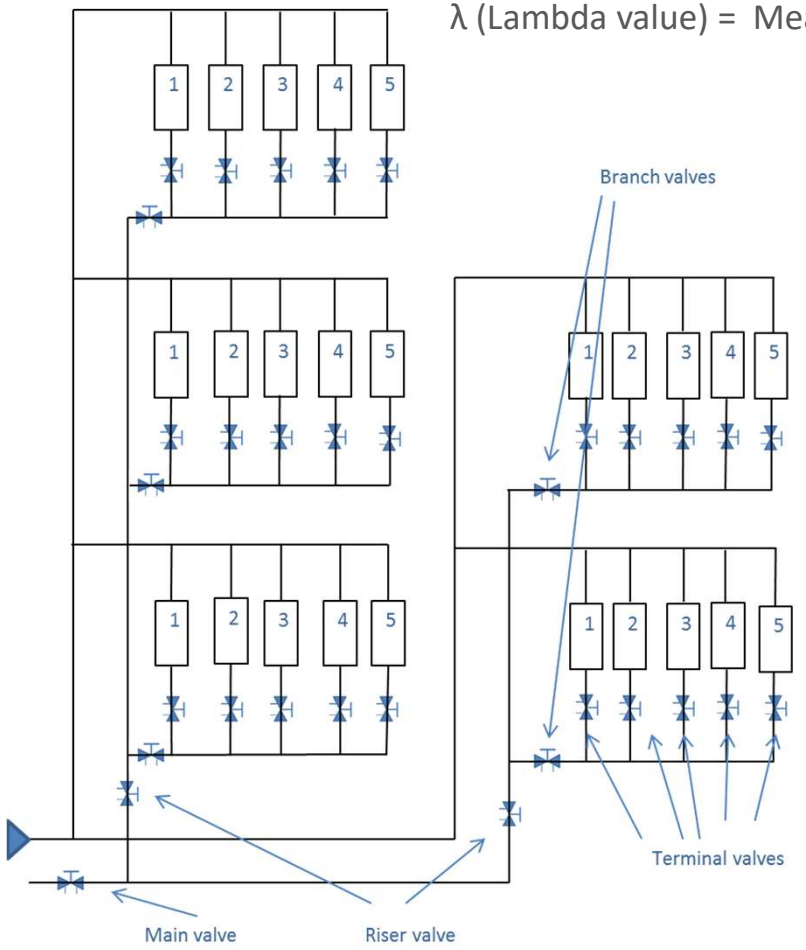
Balancing by Pre-setting method

- Calculated Design flow values are available from the blueprint and building documentation.
- Check the system according to the preparation schedule.
- Thumb rule; the least favoured valve, normally the valve farthest away from the pump, shall not be adjusted with a DP that is less than 3 kPa.
- The calculated pre-set values can never be exactly correct. Use a certain degree of common sense and basic knowledge.



Proportional Method procedure

λ (Lambda value) = Measured flow / Calculated flow

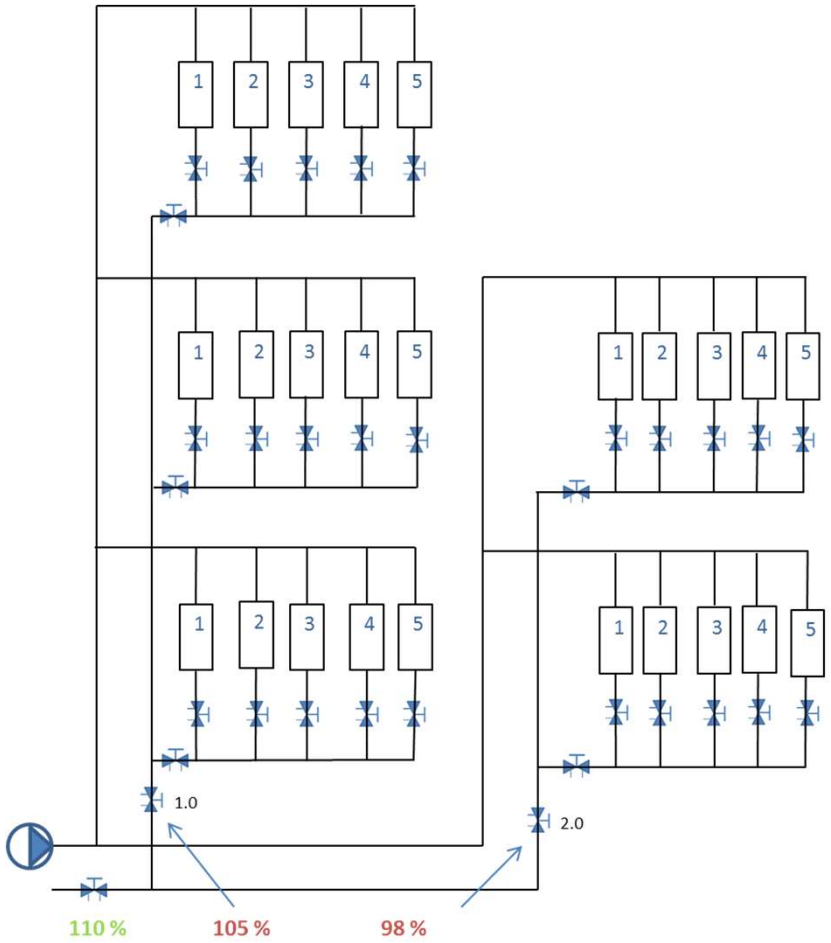


Proportional Method procedure

- Set main valve to supply approximate. 110 % of the total design flow, i.e. λ = 110 %
- Measure the λ-value on all riser valves
- Identify the riser valve that has the highest λ-value, i.e. the riser that is most oversupplied
- Proceed with the branch valves on this riser

In this example valve nr 1.0 is the most oversupplied riser valve with a λ-value of 105 %.

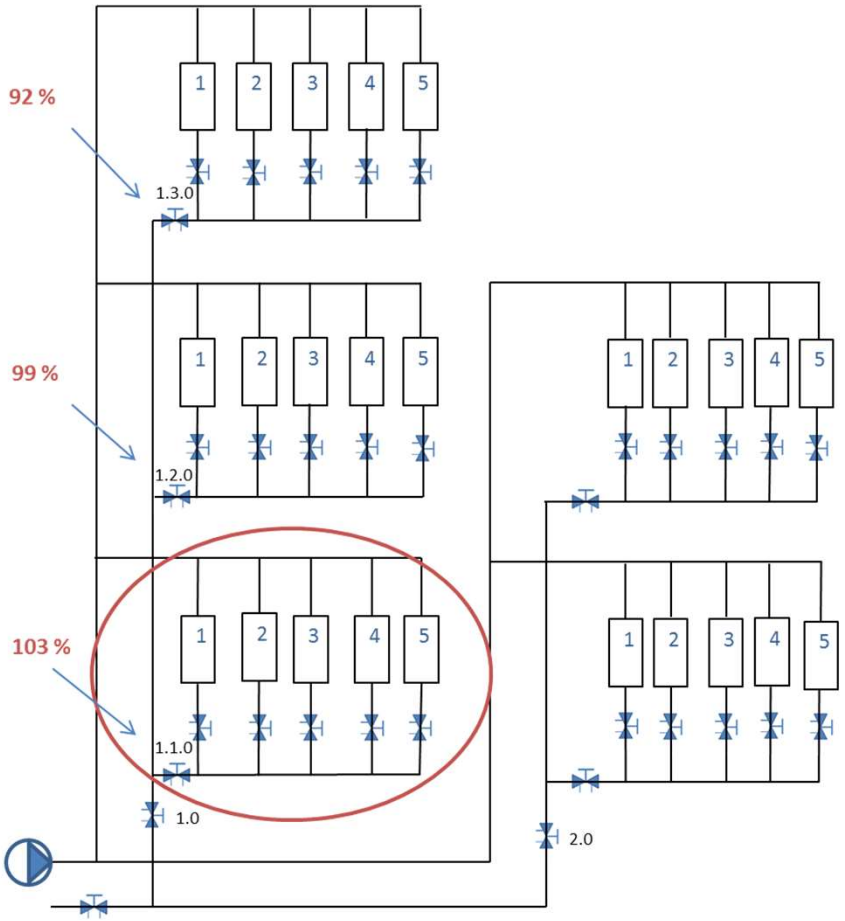
- Note:
- If the λ-value on the riser or branch exceeds 110 %, the measured value is registered and the λ-value reduced to 110 % before continuing the procedure.



Proportional Method procedure

- Measure all branch valves on the riser 1.0
- The branch with the highest λ-value is identified. This is the first branch of terminal valves to be balanced

In this example valve nr 1.1.0 is the most oversupplied riser valve with a λ-value of 103 %.

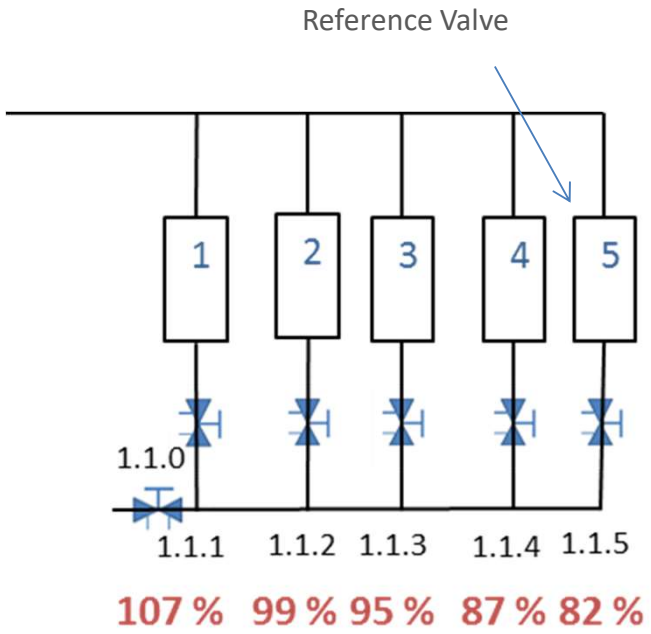


Proportional Method procedure

- Measure the λ-value on all terminal valves on the branch
- The terminal valve with the lowest λ-value is identified as the reference valve, i.e. the valve that is most undersupplied. The reference valve is normally the last valve at the branch (1.1.5 at 82 %)

If the valve on the branch with lowest λ-value is not the last valve, for instance valve1.1.3. Then it is necessary to change, redefine, the reference valve so it becomes the last valve (1.1.5) with the lowest λ-value.

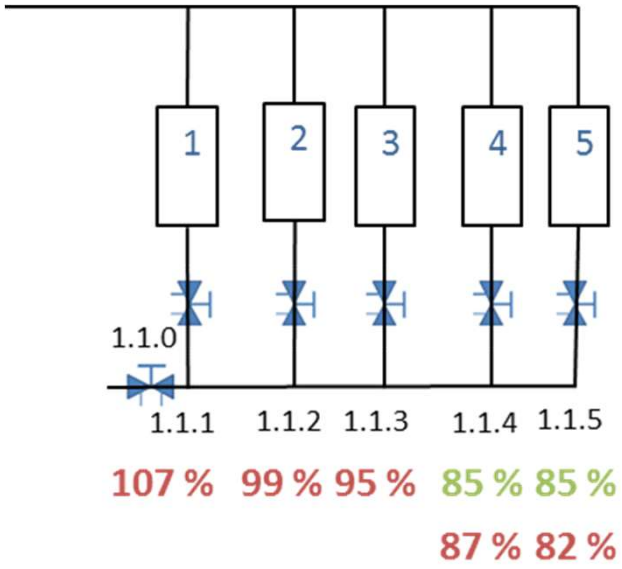
- Most efficient way to do this is by using the Balance program sensors. Place sensor 1 at valve 1.1.5 and sensor 2 at the valve with lowest λ-value, for instance 1.1.3.
- Valve 1.1.5 is adjusted until both flow meters show the same λ-value. Now both valves have the same λ-value and 1.1.5 can be used as reference valve.



Proportional Method procedure

- Attach flow meter 1 to the reference valve, 1.1.5 – 82%
- Attach sensor 2 to the next valve on the branch, 1.1.4 – 87%
- Adjust the valve 1.1.4, flow meter 2, until both flow meters display the same λ-value

Leave the flow meter 1 at the reference valve and proceed with number 2 to the next valve on the branch, 1.1.3 – 95%.

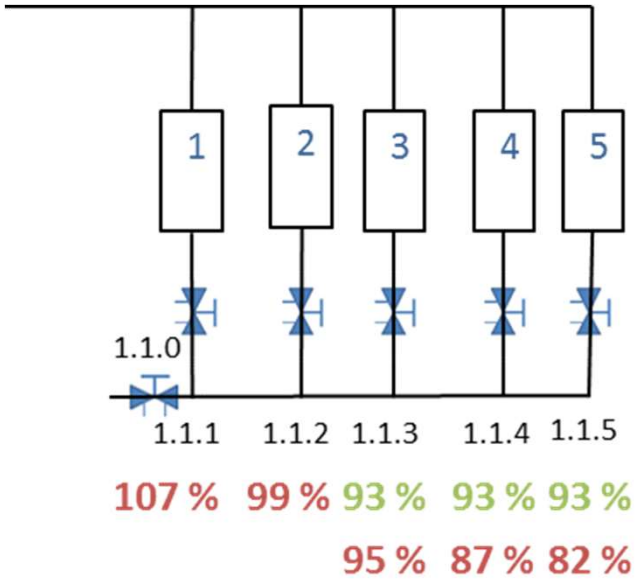


Proportional Method procedure

Adjust the 1.1.3 valve until it have the same λ-value as the reference valve

- Due to the principle of proportionality the λ-value at valve 1.1.4 changes proportionally to 1.1.3 and to 1.1.3 and 1.1.5 and will have the same λ-value.

- Leave flow meter 1 at the reference valve and proceed with number 2 to the next valve on the branch, 1.1.2 – 99%



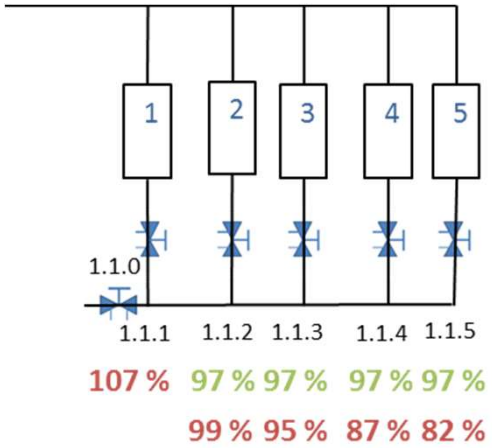
Proportional Method procedure

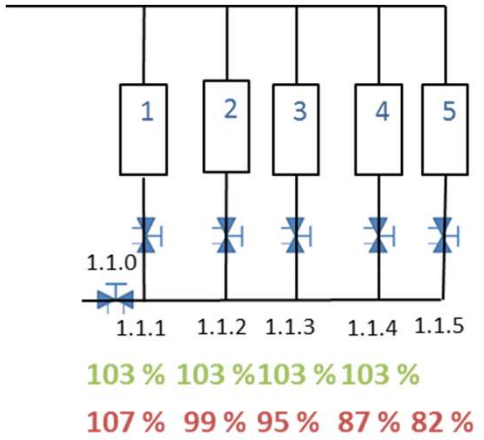
Adjust the 1.1.2 valve until it have the same λ-value as the reference valve

- Due to the principle of proportionality the λ-value at valve 1.1.3 and 1.1.4 changes proportionally to 1.1.2 and 1.1.5 and will have the same λ-values.
- Leave flow meter 1 at the reference valve and proceed with number 2 to the next valve on the branch, 1.1.1 – 107%

Adjust the 1.1.1 valve until it have the same λ-value as the reference valve

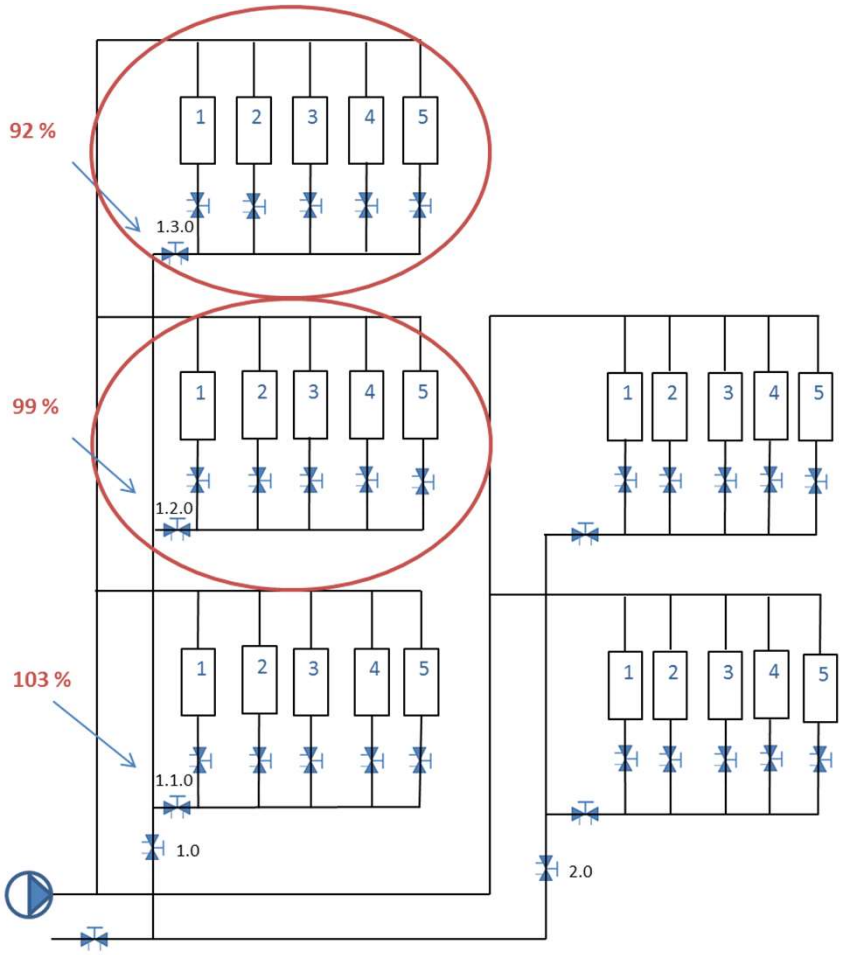
- Due to the principle of proportionality the λ-value at valve 1.1.4, 1.1.3, and 1.1.2 changes proportionally to 1.1.1 and 1.1.5 and will have the same λ-value s.
- Now all terminal valves at the branch are balanced.





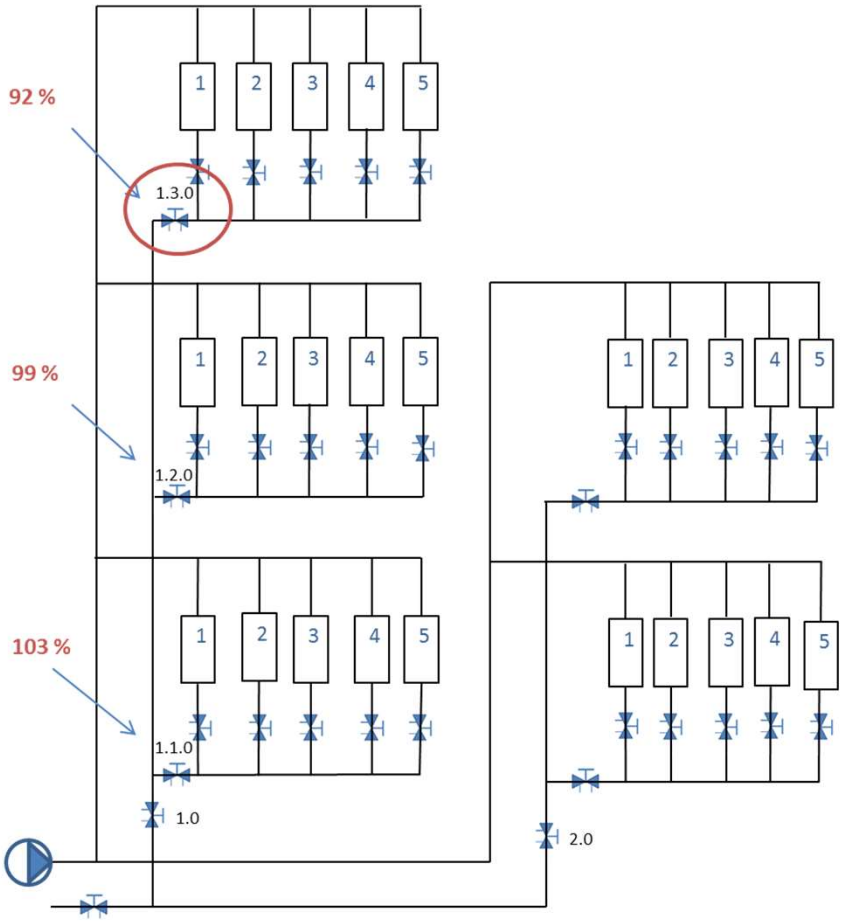
Proportional Method procedure

- The balancing procedure continue on the next branch on the riser, i.e. the one with the second highest λ-value, 1.2.0-99%
- The terminal valves at branch 1.2 are balanced in the same way as on branch 1.1 and then the procedure is repeated on branch 1.3 with the lowest branch λ-value, 1.3.0-92%.



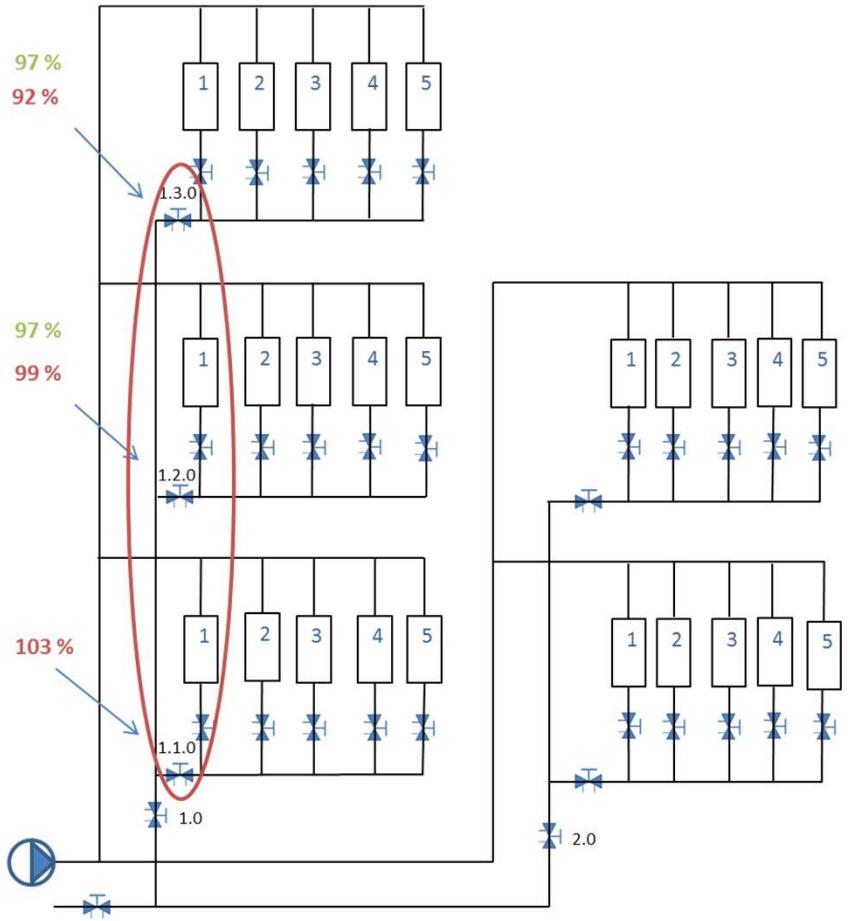
Proportional Method procedure

- Balancing branch valves
- All terminal valves on riser 1 are balanced. Continue balancing the branch valves. The procedure is the same as for terminal valves since the branch valves among themselves are now regarded as terminal valves.
- Start at the reference valve which is the most undersupplied branch on the riser 1.1.3.0-92%.



Proportional Method procedure

- Attach flow meter 1 to the reference valve, 1.3.0
- Attach flow meter 2 to the next valve on the branch, 1.2.0-99%
- Adjust valve 1.2.0, flow meter 2, until both flow meters display the same λ-value.

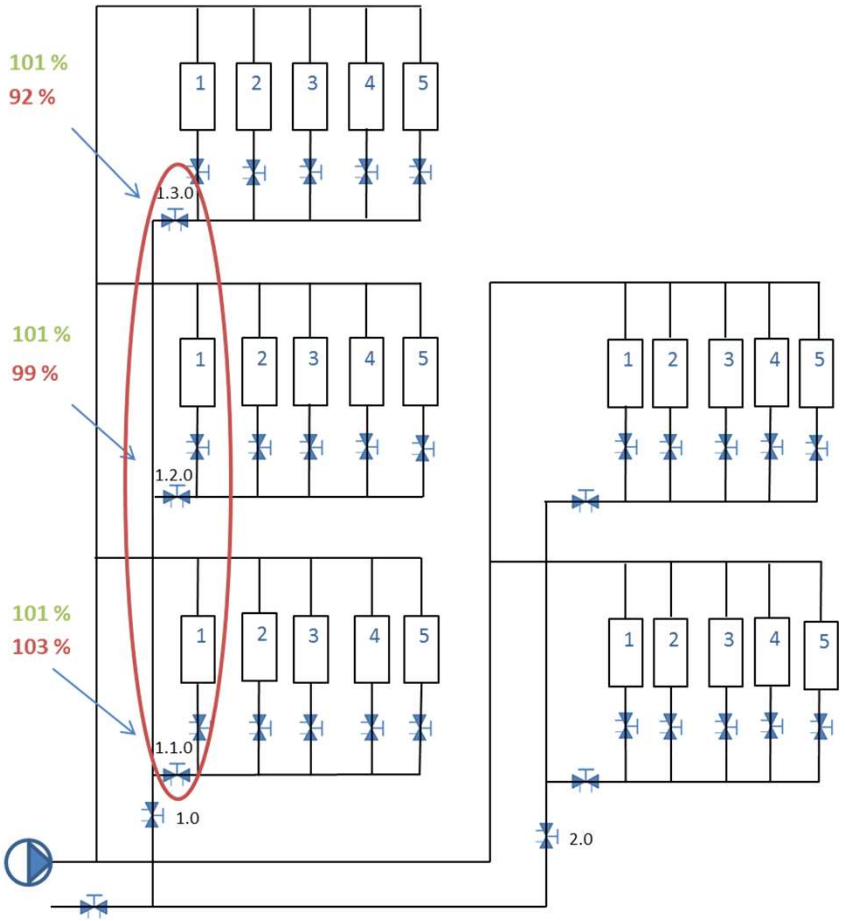


Proportional Method procedure

- Leave flow meter 1 attached to the reference valve, 1.3.0
- Attach flow meter 2 to the next valve on the branch, 1.1.0-103%
- Adjust valve 1.1.0, flow meter 2, until both flow meters display the same λ-value.

- Due to the principle of proportionality the λ-value at valve 1.2.0 changes proportionally to 1.3.0 and 1.1.0 and will have the same λ-value s.

- The branch valves on riser 1 are now balanced. Continue with the same procedure on the riser valve that has the second highest λ-value, 2.0.Once both terminal and branch valves are balanced the riser valves can be balanced.

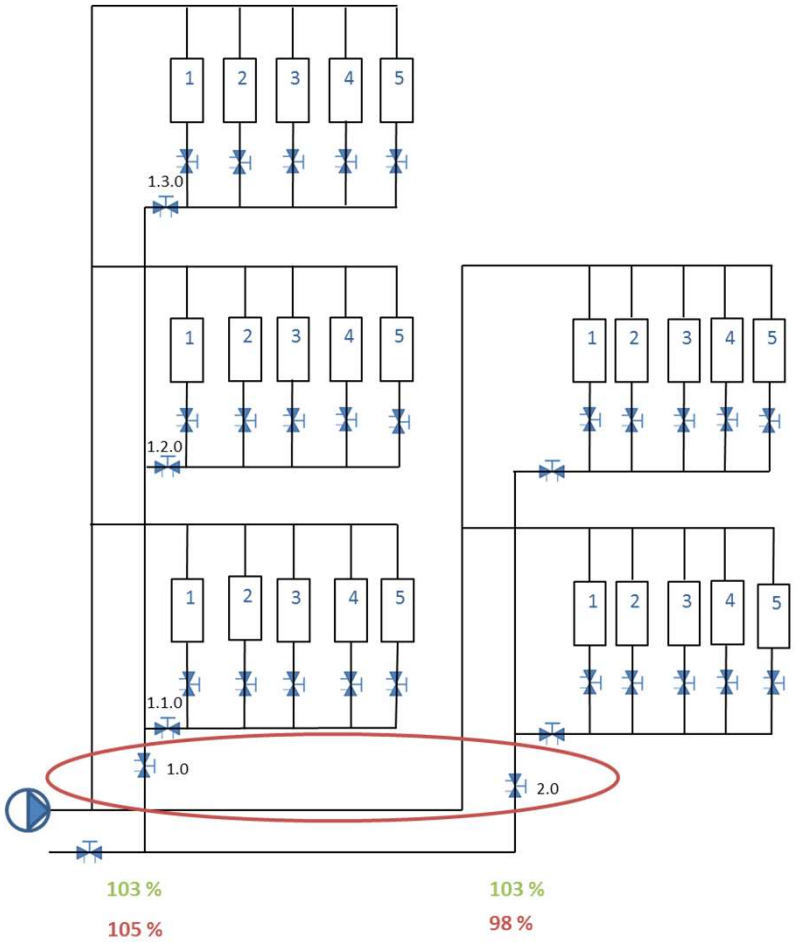


Proportional Method procedure

The riser valves are now considered as terminal valves. The reference valve with the lowest λ-value is identified .

- Attach flow meter 1 to valve 2.0 -98%.
- Attach flow meter 2 to the next valve, 1.0-105%.
- Adjust valve 1.0, flow meter 2, until both flow meters display the same λ-value.

The system is now balanced meaning that all balancing valves in the system have the same λ-value.



Proportional Method procedure

All that remains is to adjust the main valve/pump to provided maximum 100 % of the design flow.

Commissioning report

Measured values are transferred to a PC or laptop and the PC program then automatically create the commissioning report.