Low Loss Header (Hydraulic Separator) Sizing

Diameter of a low loss header for the larger of the primary and secondary flows, and the mixed flow temperatures it delivers to each side.

Method: Continuity at the header and mixing energy balance (hydraulic separator practice)

Input parameters

Unit system: SI

Parameter	Value	Unit
Primary (boiler or chiller) flow	20.000	m³/h
Secondary (system) flow	24.000	m³/h
Highest velocity in the header 0.1 to 0.2 m/s lets air and dirt separate and keeps the two circuits independent.	0.15000	m/s
Inside diameter of the largest connecting pipe	62.700	mm
Primary flow temperature	80.000	°C
Secondary return temperature	60.000	°C

Calculated results

Parameter	Value	Unit
Header diameter for the velocity limit	237.88	mm
Header diameter by the three-diameter rule	188.10	mm
Header diameter to use (larger of the two)	237.88	mm
Velocity in the header at that diameter	0.15000	m/s
Secondary flow temperature after mixing	76.667	°C
Primary return temperature after mixing	60.000	°C
Flow through the header (difference of the flows)	4.0000	m³/h

Notes for this case

• The header joins the primary and secondary circuits through a short, wide vessel so that neither pump drives the other. Sized for the larger flow at about 0.1–0.2 m/s (and at least three times the largest connecting pipe), its pressure drop is negligible. When the secondary flow is larger, return water mixes into the supply and the system receives a lower temperature; when the primary flow is larger, supply water short-circuits and the boiler or chiller sees a higher (or lower) return. Mixed temperatures assume equal density and specific heat on both sides.

Formula and method

$$d = \max\left(\sqrt{\frac{4\dot{V}_{max}}{\pi v_{max}}},\ 3d_c\right), \quad T_{ss} = \frac{\dot{V}_p T_{ps} + (\dot{V}_s - \dot{V}_p) T_{sr}}{\dot{V}_s}$$

Variables

$\dot{V}_p$	Primary (boiler or chiller) flow	m³/s
$\dot{V}_s$	Secondary (system) flow	m³/s
v_{max}	Highest velocity in the header	m/s
d_c	Inside diameter of the largest connecting pipe	m
T_{ps}	Primary flow temperature	K
T_{sr}	Secondary return temperature	K
d_v	Header diameter for the velocity limit	m

$3d_c$	Header diameter by the three-diameter rule	m
d	Header diameter to use (larger of the two)	m
v	Velocity in the header at that diameter	m/s
T_{ss}	Secondary flow temperature after mixing	K
T_{pr}	Primary return temperature after mixing	K
$\dot{V}_m$	Flow through the header (difference of the flows)	m³/s

Method and standards

Low loss header.

Assumptions and limits

- Equal density and specific heat; full mixing in the header.

References

Continuity at the header and mixing energy balance (hydraulic separator practice)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/hvac/chillers/low-loss-header-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.