District Heating Pipe Heat Capacity, Pressure Drop and Pump Power

Heat a district heating pipe can carry at a velocity and temperature difference, with the water flow, pressure drop over its length and pumping power.

Method: Hydraulic and thermal capacity of a heat main; Darcy–Weisbach with Colebrook friction

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe inside diameter	150.00	mm
Water velocity	1.5000	m/s
Supply temperature	90.000	°C
Return temperature	50.000	°C
Route length (flow and return each)	1,000.0	m
Pipe roughness	0.050000	mm
Pump efficiency	70.000	%

Calculated results

Parameter	Value	Unit
Water mass flow	94.306	t/h
Heat capacity	4.3888	MW
Pressure drop flow and return	248.61	kPa
Pump power	9.4142	kW
Pump power per heat delivered	0.21451	%

Notes for this case

• Flow at the return-side density; heat from IAPWS-IF97 enthalpies at 6 bar; Darcy–Weisbach with Colebrook friction over flow and return pipes, no fittings. Design velocities rise with pipe size (about 1 m/s small, 2–3 m/s large); a larger temperature difference carries more heat in the same pipe.

Formula and method

$$\dot{Q} = \rho v A\,(h_s - h_r), \quad \Delta p = 2f\frac{L}{D}\frac{\rho v^2}{2}, \quad P_p = \frac{\dot{V}\Delta p}{\eta_p}$$

Variables

D	Pipe inside diameter	m
v	Water velocity	m/s
T_s	Supply temperature	K
T_r	Return temperature	K
L	Route length (flow and return each)	m
ε	Pipe roughness	m
η_p	Pump efficiency	-
$\dot{m}$	Water mass flow	kg/s
$\dot{Q}$	Heat capacity	W
Δp	Pressure drop flow and return	Pa

P_p	Pump power	W
$P_p/\dot{Q}$	Pump power per heat delivered	-

Method and standards

Heat main capacity.

Assumptions and limits

- Steady flow; equal flow and return length.

References

Hydraulic and thermal capacity of a heat main, Darcy–Weisbach with Colebrook friction

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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/district-heating-pipe-capacity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.