Chilled Water Pipe Heat Gain and Surface Condensation

Heat gain of an insulated chilled water pipe by the ISO 12241 method, the outer surface temperature against the dew point, and the water temperature rise.

Method: ISO 12241 insulated pipe method (engine InsulatedPipe); dew point over water or ice from IAPWS; water rise with the c_p entered

Input parameters

Unit system: SI

Parameter	Value	Unit
Pipe outer diameter	168.30	mm
Insulation thickness	40.000	mm
Insulation conductivity	0.035000	W/(m·K)
Chilled water or brine temperature	7.0000	°C
Ambient air temperature	35.000	°C
Ambient relative humidity	70.000	%
Surface emissivity	90.000	%
Pipe length	200.00	m
Water flow	72,000	kg/h
Specific heat of the water or brine 4186 J/(kg·K) for water; about 3 600 for 30 % glycol and lower for strong brines: from the maker's data.	4.1860	kJ/(kg·K)

Calculated results

Parameter	Value	Unit
Heat gain per metre	14.531	W/m
Total heat gain	2.9062	kW
Outer surface temperature	32.697	°C
Ambient dew point	28.701	°C
Margin (negative: condensation)	3.9961	K
Water temperature rise	0.034714	K

Formula and method

$$q' = \frac{T_a - T_w}{\frac{\ln(D/D_o)}{2\pi\lambda} + \frac{1}{h_{se}\pi D}}, \quad \Delta T_w = \frac{q' L}{\dot{m} c_p}$$

Variables

D_o	Pipe outer diameter	m
s	Insulation thickness	m
λ	Insulation conductivity	W/(m·K)
T_w	Chilled water or brine temperature	K
T_a	Ambient air temperature	K
φ	Ambient relative humidity	-
ε	Surface emissivity	-
L	Pipe length	m
$\dot{m}$	Water flow	kg/s

c_p	Specific heat of the water or brine	J/(kg·K)
q'	Heat gain per metre	W/m
$\dot{Q}$	Total heat gain	W
T_s	Outer surface temperature	K
T_{dp}	Ambient dew point	K
$T_s - T_{dp}$	Margin (negative: condensation)	K
ΔT_w	Water temperature rise	K

Method and standards

ISO 12241 conduction and surface coefficient.

Assumptions and limits

- Still air, steady state.
- The water temperature rise uses the specific heat entered (4186 J/(kg·K) for water; lower for glycol and brine).

References

• ISO 12241 insulated pipe method (engine InsulatedPipe); dew point over water or ice from IAPWS; water rise with the c_p entered

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/chilled-water-pipe-heat-gain

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.