Thermic Fluid Circulation Flow and Velocity

Circulation flow of a thermic fluid (hot oil) heater from its duty and temperature difference, in kg/s and m³/h, with the velocity in the main pipe.

Method: First law of thermodynamics (Q = m c_p ΔT); continuity

Input parameters

Unit system: SI

Parameter	Value	Unit
Heater duty	2,000.0	kW
Fluid return temperature (heater inlet)	260.00	°C
Fluid supply temperature (heater outlet)	290.00	°C
Thermic fluid	Enter the properties below	
Specific heat of the fluid	2.6000	kJ/(kg·K)
Density of the fluid	760.00	kg/m³
Main pipe inside diameter	102.30	mm

Calculated results

Parameter	Value	Unit
Fluid mass flow	92,308	kg/h
Fluid volume flow	121.46	m³/h
Velocity in the main pipe	4.1047	m/s
Temperature difference across the heater	30.000	K

Formula and method

$$\dot{m} = \frac{\dot{Q}}{c_p\,(T_2 - T_1)} \qquad \dot{V} = \frac{\dot{m}}{\rho} \qquad v = \frac{\dot{V}}{\pi D^2/4} \qquad \Delta T = T_2 - T_1$$

Variables

$\dot{Q}$	heater duty	W
T_1	return temperature	K
T_2	supply temperature	K
fluid	fluid chosen, or properties entered	–
c_p	fluid specific heat at the mean temperature	J/(kg·K)
ρ	fluid density	kg/m³
D	main pipe inside diameter	m
$\dot{m}$	mass flow	kg/s
$\dot{V}$	volume flow	m³/s
v	velocity	m/s
ΔT	temperature difference	K

Method and standards

Energy balance of the heater and continuity in the pipe, with properties at the mean of supply and return temperature. Fluid properties: either typed in, or taken from the makers' published liquid tables for Therminol 55 (Eastman bulletin TF8994), Therminol VP-1 (Eastman bulletin TF9141), DOWTHERM A (Dow technical data sheet; no kinematic viscosity tabulated) and Therminol 66 (Eastman bulletin SFE-HTF-19853), interpolated linearly between the published points (viscosity linearly in its logarithm) and never extrapolated. More fluids will be added as their makers' tables are captured.

Assumptions and limits

- Properties at the mean temperature; steady duty. With "enter the properties", type c_p and ρ at the mean of supply and return temperatures.
- The pipe velocity is not checked against limits; compare it with your piping design rules.

References

- First law of thermodynamics (Q = m c_p ΔT)
- continuity

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/boilers-power-plant/thermic-fluid-heaters/thermic-fluid-flow

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Reopens the calculator with the inputs of this report.