Thermic Fluid Heater Efficiency (Direct Method)

Efficiency of a thermic fluid (hot oil) heater from the fluid flow, specific heat and temperature rise, and the fuel flow and gross calorific value.

Method: Input–output (direct) method; as for boilers

Input parameters

Unit system: SI

Parameter	Value	Unit
Thermic fluid flow	92,160	kg/h
Thermic fluid	Enter the properties below	
Specific heat of the fluid	2.6000	kJ/(kg·K)
Fluid inlet temperature	260.00	°C
Fluid outlet temperature	290.00	°C
Fuel flow	520.00	kg/h
Gross calorific value of the fuel (as fired, per kg) Per kg of fuel as fired. For gas, convert the volumetric GCV and the gas flow to a mass basis first.	18,600	kJ/kg

Calculated results

Parameter	Value	Unit
Heater efficiency (on GCV)	74.323	%
Heat to the fluid	1,996.8	kW
Heat in the fuel	2,686.7	kW

Formula and method

$$\dot{Q}_{out} = \dot{m}\, c_p\, (T_2 - T_1) \qquad \dot{Q}_{in} = \dot{m}_f GCV \qquad \eta = \frac{\dot{Q}_{out}}{\dot{Q}_{in}}$$

Variables

$\dot{m}$	thermic fluid flow	kg/s
fluid	fluid chosen, or properties entered	–
c_p	fluid specific heat at the mean temperature	J/(kg·K)
T_1	fluid inlet temperature	K
T_2	fluid outlet temperature	K
$\dot{m}_f$	fuel flow	kg/s
GCV	gross calorific value, as fired, per kg	J/kg
η	heater efficiency on GCV	–
$\dot{Q}_{out}$	heat to the fluid	W
$\dot{Q}_{in}$	heat in the fuel	W

Method and standards

Input–output (direct) efficiency, the same definition as for boilers, with the fluid specific heat at the mean 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

- Steady load; accurate fluid flow and fuel weighing; specific heat at the mean temperature.
- GCV and fuel flow on a mass, as-fired basis; convert gas from volume first.
- An efficiency above 100 % is rejected as a measurement error.

References

- Input–output (direct) method
- as for boilers

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-heater-efficiency

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Reopens the calculator with the inputs of this report.