Induction Furnace Melting Energy and Power

Specific energy to heat, melt and superheat a metal charge, the heat into the metal and the electrical power and energy per tonne for a melt rate and efficiency.

Method: Heat balance of a melting furnace

Input parameters

Unit system: SI

Parameter	Value	Unit
Melt rate	5.0000	t/h
Mean specific heat of the solid	0.68000	kJ/(kg·K)
Charge temperature	25.000	°C
Melting temperature	1,500.0	°C
Latent heat of fusion	270.00	kJ/kg
Specific heat of the liquid	0.82000	kJ/(kg·K)
Tapping temperature	1,600.0	°C
Overall efficiency (electrical × thermal)	70.000	%

Calculated results

Parameter	Value	Unit
Heat into the metal per tonne	376.39	kWh/t
Heat rate into the metal	1,881.9	kW
Electrical power	2,688.5	kW
Electrical energy per tonne	537.70	kWh/t

Notes for this case

• The metal needs sensible heat to the melting point, the latent heat of fusion and superheat to the tapping temperature: q = c̄_s(T_m − T₀) + L_f + c_l(T_t − T_m), about 370–390 kWh/t for steel tapped at 1,600 °C and about 340 kWh/t for grey iron at 1,500 °C. Coil losses, refractory and radiation losses and holding time lower the overall efficiency to roughly 60–75 % for coreless furnaces, so plants see 520–650 kWh/t at the meter.

Formula and method

$$q = \bar{c}_s(T_m - T_0) + L_f + c_l(T_t - T_m), \quad P_e = \frac{\dot{m} q}{\eta}$$

Variables

$\dot{m}$	Melt rate	kg/s
$\bar{c}_s$	Mean specific heat of the solid	J/(kg·K)
T_0	Charge temperature	K
T_m	Melting temperature	K
L_f	Latent heat of fusion	J/kg
c_l	Specific heat of the liquid	J/(kg·K)
T_t	Tapping temperature	K
η	Overall efficiency (electrical × thermal)	-
q	Heat into the metal per tonne	J/kg
P_m	Heat rate into the metal	W
P_e	Electrical power	W

q_e	Electrical energy per tonne	J/kg

Method and standards

Melting energy.

Assumptions and limits

- Steady melt rate; mean properties; losses lumped in the efficiency.

References

Heat balance of a melting furnace

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/materials/steelmaking-foundry/induction-furnace-melting-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.