Induction Heating Power for a Billet or Bar

Power induced in the workpiece and coil power to heat a cylindrical billet to temperature in a set time, from mass, mean specific heat, efficiencies and output rate.

Input parameters

Unit system: SI

Parameter	Value	Unit
Billet diameter	75.000	mm
Billet length	200.00	mm
Density of the metal	7,850.0	kg/m³
Mean specific heat over the temperature range	670.00	J/(kg·K)
Initial temperature	20.000	°C
Final temperature	1,250.0	°C
Heating time	60.000	s
Coil electrical efficiency	75.000	%
Coil thermal efficiency	80.000	%

Calculated results

Parameter	Value	Unit
Billet mass	6.9360	kg
Power induced in the workpiece	95.267	kW
Power at the coil terminals	158.78	kW
Production rate	0.41616	t/h
Heat content per tonne	228.92	kWh/t
Overall coil efficiency	60.000	%

Notes for this case

• The mean specific heat must cover the whole range; for steel it includes the peak at the Curie point (about 770 °C). Typical electrical efficiency: 0.8–0.95 for magnetic steel, 0.35–0.45 for copper or silver billets.

Formula and method

$$P_w = mc\frac{T_f - T_{in}}{t}, \quad m = \frac{\pi D^2}{4} l\gamma, \quad P_c = \frac{P_w}{\eta_{el}\eta_{th}}$$

Variables

D	Billet diameter	m
l	Billet length	m
γ	Density of the metal	kg/m³
c	Mean specific heat over the temperature range	J/(kg·K)
T_{in}	Initial temperature	K
T_f	Final temperature	K
t	Heating time	s
η_{el}	Coil electrical efficiency	-
η_{th}	Coil thermal efficiency	-
m	Billet mass	kg

P_w	Power induced in the workpiece	W
P_c	Power at the coil terminals	W
$\dot{m}$	Production rate	kg/s
HC	Heat content per tonne	J/kg
η	Overall coil efficiency	-

Method and standards

Energy balance on the workpiece.

Assumptions and limits

- Uniform through-heating; mean properties.

Report details

Report reference	FCC-MSD9-EY44 (the same inputs always give the same reference)
Generated	23 November 2026, 17:42 UTC
Calculator	Induction Heating Power for a Billet or Bar
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/materials/steelmaking-foundry/induction-heating-required-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.