Distribution Line I²R Loss and Energy Lost

Power lost in a feeder or distribution line from current, resistance per km and length, as a share of the power carried, with the energy lost in a year.

Method: Joule's law: 3 I² R (three phase); 2 I² R (single phase, go and return)

Input parameters

Unit system: SI

Parameter	Value	Unit
Line current	200.00	A
Resistance of one conductor per unit length	0.10000	Ω/km
Route length	500.00	m
Supply	Three phase	
Voltage (line to line for three phase)	415.00	V
Power factor	0.90000	
Running time in the year	6,000.0	h

Calculated results

Parameter	Value	Unit
Power lost in the line	6.0000	kW
Power carried	129.38	kW
Loss as a share of the power carried	4.6374	%
Energy lost in the year	36,000	kWh

Formula and method

$$P_{loss} = 3\,I^2\,r\,L\ (3\phi), \quad 2\,I^2\,r\,L\ (1\phi)$$

$$E_{loss} = P_{loss}\,t$$

Variables

I	Line current	A
r	Resistance of one conductor per unit length	Ω/m
L	Route length	m
phases	Supply	-
V	Voltage (line to line for three phase)	V
$\cos\varphi$	Power factor	-
t	Running time in the year	s
P_{loss}	Power lost in the line	W
P	Power carried	W
p_{loss}	Loss as a share of the power carried	-
E_{loss}	Energy lost in the year	J

Method and standards

Joule heating in each loaded conductor.

Assumptions and limits

- Balanced load; neutral unloaded.
- The annual energy assumes the same current for all the running hours; for a varying load multiply by the loss-load factor (mean of I² over peak I²) instead.

References

- Joule's law: 3 I^2 R (three phase)
- 2 I^2 R (single phase, go and return)

Report details

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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/electrical/power/line-loss-i2r

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.