Reactive Power Drawn by a Transformer

Reactive power a transformer draws from its no-load current, impedance voltage and loading, for sizing a fixed capacitor on the transformer.

Method: Q = i₀ S_r + u_k a² S_r (transformer equivalent circuit; IEC 60076 nameplate quantities)

Input parameters

Unit system: SI

Parameter	Value	Unit
Transformer rating	1,000.0	kVA
No-load (magnetising) current	1.2000	%
Impedance voltage	5.0000	%
Loading as a share of rating	70.000	%

Calculated results

Parameter	Value	Unit
No-load reactive power i₀ S_r	12.000	kvar
Reactive power of the leakage reactance u_k a² S_r	24.500	kvar
Total reactive power drawn	36.500	kvar

Notes for this case

- A fixed capacitor on a transformer is usually sized near the no-load figure so that it never over-compensates at light load.

Formula and method

$$Q = i_0 \, S_r + u_k \, a^2 \, S_r$$

Variables

S_r	Transformer rating	VA
i_0	No-load (magnetising) current	-
u_k	Impedance voltage	-
a	Loading as a share of rating	-
Q_0	No-load reactive power i₀ S_r	var
Q_L	Reactive power of the leakage reactance u_k a² S_r	var
Q	Total reactive power drawn	var

Method and standards

Magnetising branch plus series reactance.

Assumptions and limits

- Using u_k for the leakage reactance overstates Q_L by u_k/√(u_k² − u_r²): negligible for large transformers, a few per cent for small distribution transformers with a large resistive part u_r.
- Reactance taken as the impedance voltage.

References

- Q = i₀ S_r + u_k a² S_r (transformer equivalent circuit; IEC 60076 nameplate quantities)

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/electrical/transformers/transformer-reactive-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.