Battery Run Time with Peukert's Law

Run time of a battery at a discharge current by Peukert's law from its rated capacity, rated discharge time and Peukert exponent, with the capacity delivered.

Method: W. Peukert; Elektrotechnische Zeitschrift 20 (1897); form t = H (C / (I H))^k

Input parameters

Unit system: SI

Parameter	Value	Unit
Rated capacity	100.00	Ah
Rated discharge time (the rate the capacity is quoted at)	20.000	h
Discharge current	10.000	A
Peukert exponent From the battery maker, or from two discharge tests; 1 means no loss of capacity with rate.	1.2000	
Depth of discharge allowed	100.00	%

Calculated results

Parameter	Value	Unit
Run time to the allowed depth of discharge	8.7055	h
Run time ignoring the Peukert effect	10.000	h
Capacity delivered at this current (to full discharge)	87.055	Ah

Notes for this case

- Peukert's law was fitted to lead–acid batteries at constant current and temperature; lithium cells lose much less capacity with rate.

Formula and method

$$t = DoD \cdot H \left(\frac{C}{I\,H} \right)^{k}$$

$$t_0 = DoD \cdot \frac{C}{I}, \qquad C_{eff} = I\,H \left(\frac{C}{I\,H} \right)^{k}$$

Variables

C	Rated capacity	C
H	Rated discharge time (the rate the capacity is quoted at)	s
I	Discharge current	A
k	Peukert exponent	-
DoD	Depth of discharge allowed	-
t	Run time to the allowed depth of discharge	s
t_0	Run time ignoring the Peukert effect	s
C_{eff}	Capacity delivered at this current (to full discharge)	C

Method and standards

Peukert's empirical law referred to the rated discharge time.

Assumptions and limits

- Constant current and temperature.
- Below the rated rate (I < C/H) the law extrapolates above the rated capacity; real batteries rarely deliver it.

References

- W. Peukert
- Elektrotechnische Zeitschrift 20 (1897); form t = H (C / (I H))^k

Report details

Report reference	FCC-NA3W-VQEA (the same inputs always give the same reference)
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Calculator	Battery Run Time with Peukert's Law
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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/batteries-ups/battery-runtime-peukert

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.