EV Charging Time with Constant-Current and Taper Phases

Charging time of a battery in a constant-current phase to a switch-over state of charge and an exponential constant-voltage taper to a cut-off current.

Method: CC–CV charging with exponential taper

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery capacity	150.00	Ah
Starting state of charge	10.000	%
State of charge at switch to constant voltage	80.000	%
Constant-current charge current	300.00	A
Cut-off current	10.000	A

Calculated results

Parameter	Value	Unit
Constant-current time	21.000	min
Taper time constant	6.2069	min
Constant-voltage time	21.111	min
Total charging time	42.111	min
Charge rate in the CC phase	2.0000	

Notes for this case

• CC: t = Q(SOC_cv − SOC₀)/I. CV: current decays as I₀e^(−t/τ); the remaining charge Q(1 − SOC_cv) = τ(I₀ − I_end) fixes τ, and the taper ends at t = τ·ln(I₀/I_end). The taper is why the last 20 % takes as long as the first 70 % at a fast charger. Real chargers also limit power by cell temperature.

Formula and method

$$t_{cc} = \frac{Q(SOC_{cv} - SOC_0)}{I_{cc}}, \quad \tau = \frac{Q(1 - SOC_{cv})}{I_{cc} - I_{end}}, \quad t_{cv} = \tau \ln \frac{I_{cc}}{I_{end}}$$

Variables

Q	Battery capacity	C
SOC_0	Starting state of charge	-
SOC_{cv}	State of charge at switch to constant voltage	-
I_{cc}	Constant-current charge current	A
I_{end}	Cut-off current	A
t_{cc}	Constant-current time	s
τ	Taper time constant	s
t_{cv}	Constant-voltage time	s
t	Total charging time	s
C	Charge rate in the CC phase	-

Method and standards

Charge time.

Assumptions and limits

- Exponential taper; constant CC current; no thermal limits.

References

CC–CV charging with exponential taper

Report details

Report reference	FCC-5WEV-CR1M (the same inputs always give the same reference)
Generated	23 November 2026, 18:18 UTC
Calculator	EV Charging Time with Constant-Current and Taper Phases
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/automotive/electric-vehicles/ev-charge-taper-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.