Lead-Acid Battery State of Charge from Open-Circuit Voltage

Electrolyte specific gravity and state of charge of a flooded lead-acid battery from its rested open-circuit voltage, by the OCV–specific gravity relation.

Method: Open-circuit voltage and acid specific gravity relation

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery open-circuit voltage (rested)	12.500	V
Cells in series	6.0000	
OCV minus specific gravity constant	0.84500	
Specific gravity fully charged	1.2650	
Specific gravity fully discharged	1.1200	

Calculated results

Parameter	Value	Unit
Cell open-circuit voltage	2.0833	V
Estimated specific gravity	1.2383	
State of charge	81.609	%
Battery voltage when full	12.660	V

Notes for this case

• The rested cell voltage of a lead-acid cell follows its acid strength: V_oc ≈ SG + 0.84 to 0.85 V. State of charge is roughly linear in specific gravity between the discharged and charged values for the design. Let the battery rest several hours (ideally 24) after charging or discharging; surface charge makes the voltage read high. Sealed AGM and gel cells use different acid strengths, so use the maker's OCV table where available.

Formula and method

$$SG = \frac{V_{oc}}{n} - k, \quad SOC = \frac{SG - SG_{empty}}{SG_{full} - SG_{empty}}$$

Variables

V_{oc}	Battery open-circuit voltage (rested)	V
n	Cells in series	-
k	OCV minus specific gravity constant	-
SG_{full}	Specific gravity fully charged	-
SG_{empty}	Specific gravity fully discharged	-
V_{cell}	Cell open-circuit voltage	V
SG	Estimated specific gravity	-
SOC	State of charge	-
V_{full}	Battery voltage when full	V

Method and standards

State of charge.

Assumptions and limits

- Rested battery; uniform acid; linear SG–SOC.

References

Open-circuit voltage and acid specific gravity relation

Report details

Report reference	FCC-JWQH-NAJ2 (the same inputs always give the same reference)
Generated	23 November 2026, 18:08 UTC
Calculator	Lead-Acid Battery State of Charge from Open-Circuit Voltage
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/electrical/batteries-ups/lead-acid-soc-from-ocv

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.