BATTERY SIZING GUIDELINES

for Renewable Energy and Backup Power Applications

GENERAL GUIDELINES:

- Calculate the load in Watts-hours per 24-Hr Day (Wh/d) as accurate as possible.
- Include system losses due to efficiencies of power conditioning (inverter, DC/DC converters).
- Include the appropriate factors: Temperature, autonomy, design margin, and depth of discharge (DOD).
- Consider shallow daily DOD (max 20% recommended) and occasional deeper DOD (max 80%) during cloudy days.
- Use the correct battery rating (100-Hr), or a battery rating that approximates the actual autonomy hours for the system load.
- Select highest battery capacities per unit to reduce the number of battery strings in parallel for better charge balance. The recommended maximum number of strings in parallel is 6.

LOAD CALCULATION:

The complexity of the load profile will determine the complexity of the load analysis and load calculations. For simple loads sum all the AC and DC loads as outlined in the tables below.

AC LOADS TABLE

Load Description	Quantity A	Watts * B	Duration (hrs of Operation/24-Hr Day) C	Inverter Efficiency ** D	Energy Consumption Per 24-Hr Day (Wh/d) (A x B x C) / D
				Total AC Energy Consumption	Sum 1

* This table applies for resistive loads. For motor applications, please consult with manufacturer for the applicable power factor.

** Inverter efficiency shall be the average during the day, not the maximum efficiency. If not known, please use 0.80.

DC LOADS TABLE

Load Description	Quantity A	Watts B	DC Load Voltage * C	Duration (hrs of Operation/24-Hr Day) D	DC-DC Converter Efficiency ** E	Energy Consumption Per 24-Hr Day (Wh/d) (A x B x D) / E
					Total DC Energy Consumption	Sum 2

* Common voltages: 12 Volt, 24 Volt or 48 Volt. For other voltage, consult Trojan Battery for advice.

** If & when DC-DC converter is required, please use 0.85. If not required, please use 1.00.

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TOTAL ENERGY CONSUMPTION CALCULATION

Description	Calculations Steps	Results (units)
Total AC Consumption	SUM 1	(Wh/d)
Total DC Consumption	SUM 2	(Wh/d)
Total Consumption Watt-hours Per 24-Hr Day	SUM 1 + SUM 2 = SUM 3	(Wh/d)
Battery Bank Voltage	Common Voltages: 12V, 24V or 48V	(V)
Total consumption Amp-hours Per 24-Hr Day	SUM 3 / Battery Bank Voltage =	(Ah_d)

BATTERY BANK CAPACITY (AMP-HOUR):

The battery bank capacity, B(Ah), is the capacity of the battery bank required to run the daily load under normal condition (Total consumption Amp-hours Per 24-Hr Day - see table above). This battery bank capacity shall be calculated to account for system operational parameters. The following is a list of battery bank capacity adjustment factors that will serve to calculate the adjusted and final battery capacity required to run the system appropriately.

ADJUSTMENT FACTORS

Symbol	Parameter	Range	Comments
TC	Temperature Compensation	Flooded Lead Acid	See Temperature Correction Table
DA	Days of Autonomy	2 – 10*	System Dependent *
DM	Design Margin	1 – 1.25 **	System Dependent
DOD	Depth of Discharge	0.2 – 0.8 ***	Shallow – Deep DOD

* For stand alone solar, recommended value is 5 days. For hybrid, recommended minimum value is 2 days.
** Recommended value is 1.10, and typical value is 1.
*** Recommended value is 0.2, and typical value is 0.5.

TEMPERATURE CORRECTION FACTOR

(°F)	(°C)	Flooded (FLA)	AGM	GEL
77	25.0	1.00	1.00	1.00
50	10.0	1.19	1.08	1.11
32	0	1.39	1.20	1.25
14	-10	1.70	1.35	1.42

BATTERY BANK CAPACITY B(AH)

$$Ah_a = \frac{Ah_d \times TC \times DA \times DM}{DOD}$$

Ah_a: Amp-hours adjusted
Ah_d: Amp-hours day (from chart Total Energy Consumption Calculation)
TC: from chart Temperature Correction Factor
DA: Days of Autonomy (from chart Adjustment Factors)
DM: Design Margin (from chart Adjustment Factors)
DOD: Depth of Discharge (from chart Adjustment Factors)

BATTERY CONFIGURATION

The battery bank capacity can now be used to determine the amount of batteries needed for the installation.

Description	Calculations Steps	Results
Number of Strings	Divide the B(Ah) by the battery's 100-hour rate (if 5 days autonomy selected) or a rate that approximates the actual autonomy hours for the system **A**	
Number of Batteries Cells / Monoblocks per String	Divide the battery bank voltage by the voltage of the chosen battery cell / monoblock **B**	
Total Batteries Cells / Monoblocks	**A x B**	
Battery Model	Refer to Trojan Battery's Renewable Energy Brochure or www.trojanbatteryre.com	

Trojan BATTERY COMPANY
Clean energy for life™

Trojan batteries are available worldwide.
We offer outstanding technical support, provided by full-time application engineers.
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