

**FreedomCAR Energy Storage System Performance Goals for Power-Assist
Hybrid Electric Vehicles (November 2002)**

Characteristics	Units	Power-Assist (Minimum)	Power-Assist (Maximum)
Pulse discharge power (10s)	kW	25	40
Peak regenerative pulse power (10s)	kW	20 (55-Wh pulse)	35 (97-Wh pulse)
Total available energy (over DOD range where power goals are met)	KWh	0.3(atC ₁ /1rate)	0.5 (at C ₁ /1 rate)
Minimum round-trip energy efficiency	%	90 (25-Wh cycle)	90 (50-Wh cycle)
Cold cranking power at -30°C (three 2-s pulses, 10-rests between)	kW	5	7
Cycle life for specified SOC increments	cycles	300,000 (25-Wh cycles (7.5MWh))	300,000 (50-Wh cycles (15 MWh))
Calendar Life	years	15	15
maximum weight	kg	40	60
Maximum volume	l	32	45
Operating Voltage limits	Vdc	max≤400 min≥(0.55 x Vmax)	max<400 min>(0.55 x Vmax)
Maximum allowable self-discharge rate	Wh/day	50	50
Temperature range: Equipment operation Equipment survival	°C	-30 to +52 46 to +66	-30 to +52 46 to +66
Production Price @ 1000,000 units/year	\$	500	800

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