

## 10 Things You Should Know About Designing with Batteries

	<i>Things That Matter</i>	<i>Why</i>
1	Battery Chemistry	The various battery chemistries can have different: <ul style="list-style-type: none"> <li>• Voltages – Open Cell and Operating</li> <li>• Operating temperature ranges</li> <li>• Self discharge rates, i.e. Shelf Life</li> </ul>
2	Size	In general, larger batteries have; <ul style="list-style-type: none"> <li>• Greater available energy (Capacity)</li> <li>• Higher discharge rates</li> <li>• Longer run times</li> </ul>
3	Construction	Batteries are made in Cylindrical, Flat, and Coin/Button form factors <ul style="list-style-type: none"> <li>• Cylindrical batteries are able to discharge at higher rates than flat, or coin/button cells.</li> <li>• Batteries made with wound electrodes have the highest discharge rate capability</li> <li>• Coin/Button cells have small form factors, but also low discharge rates.</li> </ul>
4	Depth of Discharge	<ul style="list-style-type: none"> <li>• Battery capacity is specified to end of life voltage</li> <li>• Over discharge leads to cell damage and leakage</li> <li>• Circuit designs must have voltage cut offs</li> </ul>
5	Safety	<ul style="list-style-type: none"> <li>• Primary batteries are not to be charged.</li> <li>• Battery cavities should be isolated from the circuits</li> <li>• Battery cavities should be designed with battery polarity control.</li> </ul>
6	Temperature	<ul style="list-style-type: none"> <li>• Battery performance declines at low temperatures</li> <li>• High temperatures increase self discharge and reduce shelf life</li> </ul>
7	Environmental Conditions	<ul style="list-style-type: none"> <li>• Temperature, humidity, shock and vibration all can reduce battery performance and damage the battery.</li> <li>• Please consult Duracell for safety and handling guidelines</li> </ul>
8	Batteries are not AC Power Supplies	<ul style="list-style-type: none"> <li>• Batteries are dynamic sources of power</li> <li>• The battery's internal resistance rises with the depth of discharge</li> <li>• Power declines internal resistance increases</li> <li>• Batteries are impacted by environmental conditions</li> </ul>
9	Batteries have Shelf Life or "Freshness" limits	<ul style="list-style-type: none"> <li>• Shelf life refers to the ability of the battery to retain capacity under specified storage conditions.</li> <li>• Different battery chemistries have different shelf life limits, ranging from 3 – 15 years depending upon the chemistry.</li> </ul>

	<i>Things That Matter</i>	<i>Why</i>
		<ul style="list-style-type: none"> <li>Rechargeable batteries lose energy at a high rate and need to be recharged weeks or months after the last charge.</li> </ul>
10	Intermittent vs. Continuous Discharge Affects Run Time	<ul style="list-style-type: none"> <li>Discharging batteries intermittently results in longer run times than with a continuous discharge.</li> <li>Designing discharge with an optimized pulse drain and duty cycle will result in the best run time</li> </ul>
	For more design help, contact Duracell's Global OEM Sales and Consulting Group	<a href="http://www.duracell.com/OEM">www.duracell.com/OEM</a>