HIGH VOLUME **CELL SCREENING**

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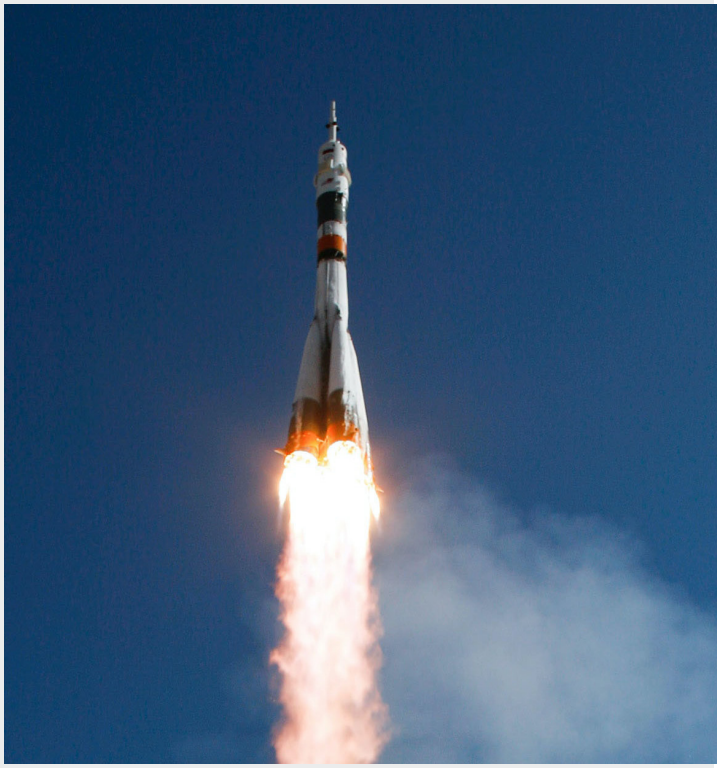
OVERVIEW

Is your organization tasked with managing a large volume of cells or batteries for mission critical applications?

Perhaps due to supply chain constraints, your designs are now having to utilize less mature lithium-ion options? These are examples of situations where both safety and performance risks must be proactively mitigated to prevent future problems in the field. In addition to working with suppliers to ensure robust quality management practices are being utilized, periodic screening on a sampling or full-lot basis offers added confidence that defective units are being culled out and contained. Read our latest white paper to see how this may apply to your needs.



With the increasing strain on lithium-ion cell availability driven by increased market demand and a supply chain left still trying to catch up, concerns over quality and longer-term reliability have many looking for mitigation options. The reality is that in the past, most major industries had access to high quality "tier 1" cells. This is no longer the case as electric vehicles are becoming more abundant and are monopolizing those limited resources. The reality for most other industries that lack that procurement power is they are now left with utilizing less mature suppliers that they might not have considered in the past.

The spectrum of these lower tier cell suppliers varies dramatically. Some have embraced quality in their operations and produce reliable, consistent products that perform well in terms of both safety and performance. At the other end are those that are still finding their way. Their processes are neither mature nor optimized. Their personnel may not have the benefit of experience in the industry. Their component supply chains may be suffering from the same lack of know-how which compounds manufacturing problems. The result is products that have increased (undesirable) variation. At a minimum, this may result in substandard field performance in terms of characteristics like cycle life, rate capability, mechanical durability, and non-ambient temperature operation. In the worst-case scenario, such variation leads to thermal runaway which can result in death, injury, or property damage, not to mention loss of brand reputation and market share. The reality is that such problems tend to have a low frequency of occurrence, which is certainly a positive. On balance, these situations involve a range of possible effects that range from the minimal to the very severe as noted above. The open question is what can and should be done.

One recommended mitigation effort is screening.

THERE ARE TWO GENERAL APPROACHES

1. **The first is just to test to the specifications.**
This is a compliance test. A given cell or battery is either within the specifications ("accept") or outside them ("reject"). This is a simple approach and is most valuable when production test equipment is available that provides a pass or fail result. This could be attribute go/no-go gauges or electrical function test equipment. The limitation is that this method has relatively low power as it does not offer any discrimination between resultant values, provided they are within the specification range.

2. **The second option test lots to find and remove outliers.**
This process involves recording actual parametric data for each sample. This data for the lot is statistically analyzed to discern its distribution and establish control limits. These limits do not discern good versus bad, but rather expected versus not expected. Put another way, values are evaluated as likely to have occurred due to random variation (common cause) or more likely to have a unique problem (special cause), the latter of which is generally removed from the lot.

As an example comparing the two methods, imagine that the acceptable specification range for a given parameter is between 2.0 and 3.0 Volts. 100 cells are tested for voltage and all fall within the acceptable specification range. By this measure, all are considered "good". But what if you could look at the underlying data and see that 99 of the cells were clustered around 2.8V and only a single cell was at 2.1V? Does that mean that the 2.1V cell is bad? Not necessarily, but it is certainly suspect and worthy of further evaluation or removal if evaluation is not feasible. In practice, the distribution of the lot data would be statistically evaluated to see if it sufficiently approximates a Normal (aka Gaussian) distribution. If so, the average (arithmetic mean) and standard deviation would be calculated. The control limits might be set at the mean ± 3 standard deviations. Depending upon the situation, other multiples of the standard deviation besides 3 can be used.

It should be noted that a typical cell or battery screening can involve more than one parameter.

In fact, using multiple factors that are not tightly correlated can result in a much more powerful screening program. This can be a mix of electrical, mechanical, or visual factors. Not having correlated parameters is simply a matter of screening efficiency. If you already know two measurements are correlated, testing both will most likely be unnecessary.

Should you sample or test everything? This is a difficult question.

Lot acceptance sampling has been around for decades, but for this case it will need to be setup to detect very low probability occurrences, which means higher sample sizes.

IN THE END, THE DECISION COMES DOWN TO A FEW CONSIDERATIONS:

1. How much risk are you willing to accept?

The answer to this question is informed by what is the net impact of a bad unit escaping to the field?

2. How much time to you have?

If you have the time, clearly a full check of every unit is better.

3. What is the project's budget?

More screening equals better confidence, but it comes at additional expense.

A FINAL CONSIDERATION IS WHETHER THIS SCREENING SHOULD BE CONDUCTED IN HOUSE OR OUTSOURCED.

In house screening permits tighter control, but also means that internal resources will be dedicated to the setup, management, and execution of the screening program. Perhaps if the quantities are small or the screening tests are quick or involve specialized expertise, this is the most efficient option. For other situations, most companies tend to prefer to outsource the work. It allows them to stay focused on their core competencies while one or more qualified sources handle the "step and repeat" screening activity.

If you are considering outsourcing, make sure that your provider has the relevant experience and expertise to run the program correctly and efficiently. Clearly it is not in your best interest for your provider to be learning what to do on your project. Their facilities should be neat, clean, and have the necessary equipment and processes to support the work. Environmental factors that might impact the testing, most commonly temperature, should be reasonably controlled such that such negative impacts are avoided. Finally, do they demonstrate the customer focus to make sure your needs are being addressed promptly and properly.

Energy Assurance/Element has a history of conducting multiple high-volume screening cell and battery screening projects for multiple customers in the aerospace, military, medical, and consumer electronics industries.

Our combined facilities have over 3,500 cycler channels and a wide range of other electrical, mechanical, and visual evaluation capabilities suitable for inclusion in your custom cell or battery screening operation.

Contact us to discuss your needs.

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