

Ticket #930

Ticket Status: Closed

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Field of Study: Electrical Engineering

Subject: Yale

07/23/2015 2:35 pm Philip Piper

Concerning EV3.9.3(c):

We are using A123 Amp20 pouch cells, and A123 suggests using a polyurethane filler (Poron) material in their battery pack design document. Poron 4701-30 is only UL 94HBF rated and has a max constant temperature of 194 F.

In lieu of this suggested material, which clearly does not meet EV3.9.3(c), we want to use fire retardant neoprene foam that is UL 94HF1 rated and has a max constant temperature of 200 F. Note that this material still does not meet EV3.9.3(c), however it has similar properties to Poron 4701-30 and is not prohibitively expensive.

We have looked into silicone foams which have much higher temperature ratings, but they are very expensive. Additionally we noticed that it is very hard to find a thin (1/16") foam that is UL 94V0 rated.

Would the fire retardant neoprene foam or Poron foam be acceptable filler materials in our battery pack?

07/29/2015 3:56 am

Philip - we are just starting to address questions after posting the 2016 rules - apologies for the delay.

I will take your question to the pouch experts on our team and will have an answer for you shortly.

Regards -

Rob Wills

FHelecRules

08/04/2015 2:59 pm

94HF1 has a more stringent requirement than 94V0:

- **V-0:** burning stops within 10 seconds on a vertical specimen; drips of particles allowed as long as they are not inflamed.
- **HF-1:** burning stops within 2 seconds; afterglow less than 30s; no burning drips allowed

Thus we will allow the HF-1 material. Thank you -

From https://en.wikipedia.org/wiki/UL_94

08/04/2015 10:30 pm Philip Piper

If that is the case then is the HBF rating also considered more stringent than V-0? I was under the impression that the horizontal foam tests couldn't be compared to the vertical burn tests, which is why EV3.9.3(c) struck me as odd in the first place.

Thanks for the great information by the way! Its been a long summer of design and we are really looking forward to getting into fabrication once the school year starts.

08/05/2015 10:52 am

Phillip - its obviously a judgement call comparing the horizontal and vertical tests, but the fact that the burning has to stop in 2 rather than 10 seconds is indicative of a more stringent requirement. We will include the allowance of HF1 in a rules amendment.

08/05/2015 8:38 pm Philip Piper

Is the UL 94 HBF rating also acceptable for EV3.9.3(c)? The Poron 4701-30 material that A123 suggests using has the HBF rating.

Sorry if I wasn't clear in the last post!

Phil

08/07/2015 3:00 pm

Philip - HBF should be OK, but I will ask the pouch cell experts first.
Will respond shortly
FHelecRules

08/13/2015 11:30 am

Philip - still waiting a reply from our battery group. Will have an answer shortly
Thanks

08/20/2015 12:43 pm

Philip - please send us the A123 document that specifies the use of Poron 4701-30. Once we have verified this, we will issue you a waiver to use this material. HB is the lowest of the flamability requirements, so it does raise some concern. In addition, please show us the distance from exposed filler to possible ignition sources (such as a loose connection of a cell terminal). Repeating frames, interconnect boards, connectors, HV insulation, and all microelectronics along with their enclosures should all still be V-0 or better/equivalent.
Thanks -
FHelecRules

08/21/2015 12:00 pm Philip Piper

See page 34 of "A123 Amp20 Battery Pack Design.pdf". Additionally I have attached the datasheet for Poron 4701-30 verifying that it is rated UL94HBF.

Item 2 A123_AMP20_battery_Design_guide.pdf(1.9 mb) PORON-4701-30-Very-Soft.pdf(70.8 kb)

08/29/2015 4:33 pm

OK - the poron is acceptable. Please reply to our other question:

"In addition, please show us the distance from exposed filler to possible ignition sources (such as a loose connection of a cell terminal)."

What we are looking for here is some reasonable spacing between possible ignition sources and the poron pads. 10 mm would be fine, but at least 5 mm is desirable.

Thanks

FHelecRules

08/29/2015 4:33 pm

Ticket in your court..

08/29/2015 10:00 pm Philip Piper

Whoops, completely missed that question! See "Two Cell Module Transparent.pdf" for a view of the Poron foam in our two cell module. The closest ignition source is the cell tabs which are 17mm away. Additionally it is 17mm through a UL94HF1 rated foam repeating frame (which is the only transparent part in "Two Cell Module Transparent.pdf"). See "Two Cell Module.pdf" for a view with the repeating frame visible.

The repeating frame part will be made from this neoprene foam. Can this material be closer than 5mm to the cell tabs, or is that also a concern for materials that are properly UL94 rated?

Best,

Phil

Two Cell Module Transparent.pdf(104.9 kb) Two Cell Module.pdf(87.8 kb)

09/09/2015 5:45 pm

Philip - I'm comfortable that the poron and neoprene foams are far enough away from ignition sources.

The cell tab joining bars look robust - are they metal?

Are they restrained so that they can't stress the tabs, and so that torquing the fasteners does not twist the tab?

Thanks - (Sorry about the delay - very busy at work)

Rob Wills

09/10/2015 10:57 am Philip Piper

Rob,

The cell tab load spreaders are indeed aluminum. Additionally distorted thread lock nuts are used for the fasteners that hold them together.

The cell tab connections are restrained in a plastic tab cover (transparent) as shown in "Stack Closeup.pdf". The bottom of the plastic tab cover is shown in "Tab Cover.pdf". The tab cover prevents the tabs from vibrating as the car travels.

Additionally it acts as an aid in assembly such that the two nuts are placed in the cover, the first aluminum load spreader is placed over them, the tabs are folded above that, and the final assembly is torqued on above the tabs. In this manner the plastic tab cover prevents stressing of the tabs during assembly and disassembly.

Best,

Phil

Stack Closeup.pdf(339.5 kb) Tab Cover.pdf(117.5 kb)

10/02/2015 4:13 pm

Phil - I'm happy with your responses - thank you.

Closing Ticket.

Rob Wills

Please Wait!

Please wait... it will take a second!