Ticket #959

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Create Date:	09/07/2015 12:44 pm	**Phone:**	(713) 501-2744
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Subject: **Yale**
09/07/2015 12:44 pm Philip Piper

This question is in regards to EV3.4.1 and EV3.5.7.

Motivation:
The FSAE Lincoln rules outline how to construct an accumulator box out of steel/aluminum sheet metal. We decided to follow these rules to ease Lincoln rules compliance (rather than using composites e.g. Kevlar). Since the accumulator box will be 8kg of steel/aluminum, we figured why not use it as a heat sink for our battery stacks. The stacks are designed to have enough thermal mass to last the acceleration, autocross, and endurance events. However thermally attaching the stacks to the accumulator box would greatly reduce the thermal resistance to ambient allowing for more acceleration/autocross runs before having to let the stacks cool down.

Images:
"Stack.pdf" shows the aluminum heat spreaders inbetween pouch cells that will rest against the side of the accumulator box. "Accumulator Box.pdf" shows the accumulator box without its lid. "Accumulator.pdf" shows the stacks mechanically fastened in the accumulator box, with one side and the bottom of the heat spreaders electrically and thermally fixed to the inside of the accumulator.

Electrical Insulation Details:
Each pouch cell is electrically insulated from its respective heat sink by two means: the pouch cell's aluminum laminate and a layer of Kapton tape. Additionally the only electrically exposed parts of the pouch cell - the tabs - are contained in a fully enclosed plastic tab cover (see "Stack.pdf"). The heat spreader is directly touching the inside of the accumulator box, which is electrically connected to LV ground. The IMD would fault if a single pouch cell were to have both its aluminum laminate and Kapton tape punctured.

Question:
Does this design meet EV3.4.1 and EV3.5.7? It seems like EV3.4.1 is met because the poles of the accumulator, namely the tabs, are insulated from the inside wall of the accumulator. However EV3.5.7 is a little trickier because the insulation of each accumulator segment is within the stack (the aluminum laminate, Kapton tape, and plastic tab cover) rather than external to the stack. Note that the rest of the accumulator segment can be electrically insulated fairly easily, my main concern in this question is about the heat spreader - accumulator box interface that has to be thermally conductive.

Best,

Phil
Accumulator Box.pdf*(116.2 kb)* Accumulator.pdf*(73.7 kb)* Stack.pdf*(122.7 kb)*

09/09/2015 8:27 pm

Does this design meet EV3.4.1?

Yes - because the poles of the accumulator, namely the tabs, are insulated from the inside wall of the accumulator.

Does this design meet EV3.5.7?

Yes - the Kapton tape provides that barrier. As you point out, if the Kapton is punctured in even a single location, you will immediately ground-fault. One suggestion, as you do only have a thin layer of insulation, is to check voltage to ground for each segment (say with a 100K bleed resistor) from each segment end, before installing segment plugs. If you had two such ground faults in separate segments, you could cause a fire.

Another safety step that you could implement is to put series fuses in each segment. That would also limit catastrophic failure from a double ground fault to a single segment.

regards -

FHelecRules

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