Team508: Structural and Thermal Management of an Automotive Battery  
Customer Needs

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The customer needs were acquired through general question brainstorming with our project sponsor and interpretation of the SAE Formula Hybrid competition rule book. The SAE Formula Hybrid rules dictate certain limitations and numerical constraints on many components.

# Question, Answers, and Interpretations

Questions regarding general design, testing, constraints, etc. were asked, and the associated answers were then interpreted into solvable requests. The SAE Formula Hybrid competition rule book was also reviewed, in understanding the necessary requirements and needs. Table 1 shows the questions asked to Dr. Hays, his answer, and the interpreted need. The interpretation of the SAE Formula Hybrid rules and restrictions are discussed below.

## SAE Formula Hybrid Rules

The rulebook of the SAE Formula Hybrid Competition provides additional needs that the system must adhere to. The following rules are interpreted as customer needs.

The rulebook outlines many safety requirements and technical constraints that need to be met. Firewall(s) must separate the driver compartment from the accumulator (EV.2.2.2. & T.4.5.1.).  Housings and/or covers must prevent inadvertent human contact with any part of the tractive system circuitry. (EV.3.1.1.) These covers must be adequately rigid and secured. Tractive systems and containers must be protected from moisture in the form of rain or puddles. (EV.3.1.10)

Regulations call for the addition of an accumulator monitoring system (AMS) and test where cell voltage will be measured and compared to ESF values for AMS trip points (EV10.4.1).  To enable this test, a break-out connector must be provided within the accumulator container (EV10.4.2). The connector must be Anderson 1327G8FP (EV10.10.4.4) and be in a location where it can be readily accessed during technical inspection (EV10.4.3).

The accumulators may be charged inside the vehicle or outside, if fitted with a removable accumulator container (EV12.2.4).

# Conclusion

Through accumulating the needs of our sponsor Dr. Hays and the SAE Formula Hybrid competition, the optimal design of the battery system can be accomplished. The interpreted needs state what the functional requirements are in designing a safe and efficient product. Additional rules are implemented for technical components and list numerical constraints that will be used to form metrics and constraints for the system’s design.

# References

*2019 Formula Hybrid Rules.* (2018). SAE Formula Hybrid.

Tables

Table 1

Customer Needs Question and Answer

|  |  |  |
| --- | --- | --- |
| T508 Questions | Customer Statement | Interpreted Need |
| Will a vehicle be provided or is there an existing/theoretical vehicle that we are implementing the battery into? | You can use your student chapter of SAE’s vehicle. | Design battery housing dimensions for application in the existing FAMU-FSU SAE vehicle. |
| Where will our battery be tested and applied? | Act as though the battery will be used in the SAE Formula Hybrid competition, in New Hampshire | Base thermal constraints off of ambient temperatures in New Hampshire in April. |
| Will we need to consider a charging unit within the battery? | It’s up to you, but charging has extra thermal considerations. | The battery dissipates excess thermal load from charging. |
| Last year’s senior design has a 4 cell module in the battery pack, will we need more? | Yes, and race power requirements will help decide how many. | The battery pack provides adequate power for race requirements, while conforming to SAE Formula Hybrid race specifications |
| What kind of force does the battery pack need to withstand? | The car will experience G-force in turns and acceleration as well as impacts and vibration. | The battery pack safely withstands impacts from all directions and structural vibration from driving. |