RENSSELAER MOTORSPORT

Electrical Safety

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Goal

- Gain basic knowledge of electrical safety including:
  a. Battery cells
  b. Powertrain
  c. HV System
  d. LV System
  e. Shutdown system
  f. Equipment

Battery Cells

- **Damaged cells should be reported and handled with extreme care**
  - Cell wrapping is not just used to change how the cell looks
    - It insulates the positive and negative terminal
    - Even a slight nick in the wrapping will increase the chances of an accidental short between the terminals
- **Individual cells are capable of high current output**
  - Misuse or a short between terminals can cause fire or an explosion
- **The cells will be hot**
  - Thermal runaway is when a cell overheats and domino effects the accumulator (why EV fires are BAD)
- If handling **cells**, contact **ESO**

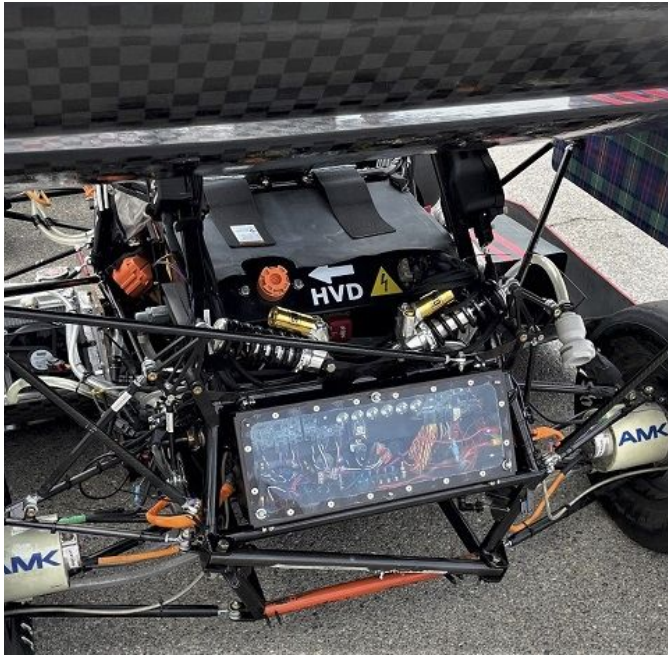
https://www.osha.gov/sites/default/files/publications/shib011819.pdf

Powertrain

- In addition to being connected to 400V, the motor is heavy and moving (and EXPENSIVE)
  - **The entire motor casing spins FAST**
- Even if the motor has stopped moving:
  - Ensure power is cut off from the tractive system
  - **Motor will be hot**
- The ESC handles many volts and amps
  - **ESC will be hot**
- If handling **motor or ESC**, contact **PT Lead or ESO**

HV System

- There are many built in safety mechanisms within the accumulator
- If something does go wrong
  - **High Voltage Disconnect (HVD)**
    - There will be an HVD on the car
    - HVD labeled “HVD” and in rear of car
    - **PULL MAIN HVD IF DRIVER IN DANGER**
  - **Isolation**
    - The battery segments will be isolated from the other components in the accumulator
    - Added layer of protection
    - **Will make an LED light up colors depending on status**

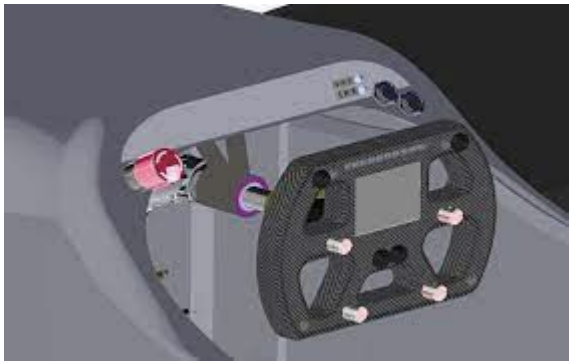


LV System

- **Biggest safety concern is the LV Battery**
  - Relatively **low voltage**, but extremely **high current**
  - Ask LV lead or ESO before handeling
  - Store in a **dry and cool** location
  - Most common mistake: **Shorting cell terminals**
    - **Overheats and will cause fire**
    - THIS HAS HAPPENED TO US BEFORE!!!
- 12V and 5V systems
  - Can short if **loose pwr and gnds**
    - Cover with E-tape
  - Has indicator lights

EV Indicator Lights

- TSAL
  - Located at **top of main roll hoop**
  - **Flashes RED** when HV is **active** outside accumulator
  - **Solid GREEN** when HV is **inactive** outside accumulator
- AMS Light
  - BMS controlled
  - Located on **dash**
  - **Solid RED** if there is any **AMS issue**
- IMD Light
  - Located on **dash**
  - **Solid RED** if there is any **IMD issue**



Shutdown System

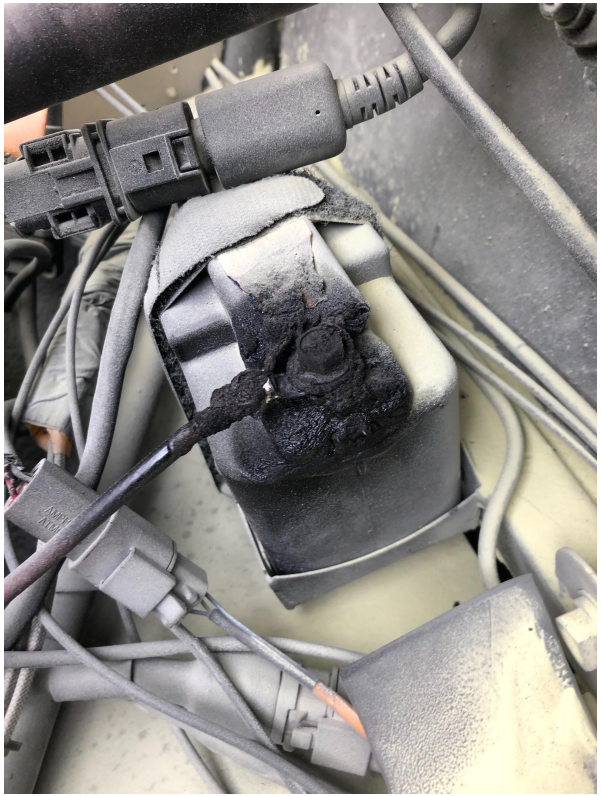
- **The shutdown circuit controls the the accumulators connection to the tractive system**
  - What happens when the shutdown circuit opens?
- **5 separate buttons to open the circuit (turn off the car)**
  - LV Master Switch
  - Tractive System Master Switch
  - Cockpit/Left/ Right Shutdown button
- If any of the monitoring systems open the shutdown circuit they must be reset manually by someone outside of the cockpit

Equipment

- HV safety blanket
  - Orange Rubber mat
  - Reduces chance for short to table
  - **Use to put accumulator on when working**
- HV gloves
  - Very thick black rubber gloves
  - **Use when handling accumulator internals**
- HV tools
  - Tools with more insulation to protect from higher voltage
  - **Use when working on accumulator**

Most Common Emergencies

- Accumulator/Car fire
  - Due to thermal runaway of overtemp cells
  - Ensure **driver gets out of car** then **distance yourself from car**
- Isolation error
  - **Remove HVD**
  - Put on HV equipment
  - Disconnect parts if possible to isolate segments
- Crash/dropped accumulator
  - Notify ESO and HV Lead
  - Look from afar to **ensure no smoke or fire or sparks**
  - CAREFULLY open and **inspect internals for damage**



Questions?