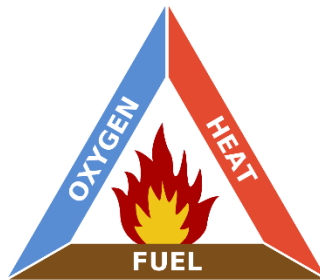


HIGH VOLTAGE SAFETY

INTRODUCTION

High voltage is defined as electrical potential substantial enough to cause injury or damage. According to Formula Society of Automotive Engineers (FSAE) standards, high voltage safety protocols must be in place when dealing with electrical systems exceeding 60 Volts.

Lithium batteries, particularly, can be dangerous if they are not handled with care. Misuse of the batteries may lead to hazards such as shorts, arc flashes, and thermal events. A thermal event may occur in the presence of the three elements shown in the figure.



Because of the ubiquity of these three elements within high voltage applications, it is important to understand how to operate properly to avoid thermal events in hopes that they do not occur as well as how to handle them in case they do.

PRECAUTIONARY MEASURES

SETUP

High voltage work must NEVER be conducted alone. For any high voltage work, students should work with at least one peer and *must* be under the supervision of Dr. Yann Staelens, Dr. Emma Singer, Mr. Will Rollins, or Mr. William Colvin. Alerting one of the aforementioned persons of high voltage work will grant students access to the necessary personal protective equipment (PPE) and materials to continue. To setup the space,

1. Clear a working space outdoors of any Foreign Object Debris (FOD), such as leaves. Do not conduct high voltage work if it is raining.
2. Roll the high voltage table into the outdoor working space.
3. Place rubber mats on both sides of the table.
4. Set up the safety perimeter around the table.



5. Ensure that there is 20 ft between you and anything that could catch on fire.
6. Put on the flame resistant black lab coat.
7. Put on the set of white inner gloves.



8. Check the black rubber gloves for holes.
 - a. Fill the gloves with air.
 - b. Close the opening of the gloves.
 - c. Begin to roll the gloves going from the opening to the fingertips.
 - d. Ensure that the glove inflates.
 - e. Inspect the glove for any potential holes.



9. If there are no faults, put the black rubber gloves on.
10. Put on the white leather gloves.



11. Put on the face shield.



ATTIRE

To ensure safety, proper attire must be worn when conducting high voltage work. The following table details proper dress.

DO WEAR	DO NOT WEAR
<ul style="list-style-type: none">• Flame resistant black lab coat *• Face Shield *• Closed toe shoes *• White inner gloves• Black rubber gloves• White leather outer gloves• Long sleeves (recommended)• Long hair tied back• Safety glasses when around the outside perimeter	<ul style="list-style-type: none">• Any kind of synthetic fabrics Common synthetic fabrics include but are not limited to:<ul style="list-style-type: none">○ Polyester○ Nylon○ Acrylic○ Spandex○ Rayon○ Olefin○ Microfiber○ Fleece• Jewelry, watches, or other similar accessories

Note: Starred (*) items should be considered for low voltage work as well

EQUIPMENT CHECKS

To ensure safety, the status of the [fire extinguishers](#) should be checked regularly. The indicator must be within the green region, indicating a full tank, before high voltage work is conducted.



The status of the [black leather gloves](#) must additionally be checked. After the gloves have been opened, if it has been over 6 months since the gloves were last certified, the gloves must be sent in for recertification, and high voltage work cannot be conducted.

All batteries should be stored in the blue lithium battery cabinet inside of the maker space. The charge of the batteries should not exceed 30% to ensure safety.

The functionality of the **voltmeter** should be confirmed. This test can be performed using the proving unit.



The proving unit should be set to the appropriate power type (AC or DC). The probes should be inserted into the 1000 V CAT III port and the COM port. The probes should also be set to CAT III to mirror the voltmeter. Upon the insertion of the other end of the probes into the proving unit, a green light should illuminate and the voltmeter should read 240 Volts. After the high voltage work is completed, the process should be repeated to verify functionality.

For high voltage work, the **insulated tools** found in the large orange tool chest should be used.

IN THE CASE OF A THERMAL EVENT

- Use the landline on the makerspace wall to call DPS.
- Avoid smelling the fumes.
- Use the LiCell fire extinguisher on batteries.
- Use the ABC fire extinguisher for surroundings.



LiCell Fire Extinguisher



ABC Fire Extinguisher

- Put on heat gloves.
- Roll the high voltage table as far away from the building as possible.