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## **SAFETY AND THE *FIRST* ROBOTICS COMPETITION (FRC)**

FIRST Robotics is the, “Hardest fun you’ll ever have,” but, it is hard to have fun if you are hurt or injured. The number one element in robotics is safety. Developing a safety program is an essential part of being a FIRST robotics team. It is the belief of first that teams that emphasize safety leave a lasting impression on their community and inspire them to be safe. FIRST recognizes the teams that are true exemplars of what true safety is.

### **PURPOSE**

To inform the FIRST community about how to maintain a safe environment during build season in an easy-to-use guide.

### **SCOPE**

This manual is for anybody who gets involved in FIRST competitions. This includes, but is not limited to: student team members.

### **Responsibilities**

Everybody is responsible for reading the safety manual so they can be safe during travel, competitions and build season.

### **Participants**

An FRC participant is expected to:

- Read, understand and follow the safety manual.

- Know the restrictions listed in the “Site info”, listed on the FRC website.
- Be safe while working.
- Use personal protective equipment when needed.
- Recognize and report any dangerous conditions to the team Safety Captain and Mentors. This includes practices that may cause accidents or encourage negative behavior.

## **Mentors**

- Lead by example and practice all safety behaviors that the rest of the team would.
- Help guide the team in safety.
- Come up with design considerations to avoid hazards within the robot.
- Know the event safety rules.
- Coach the Safety Captain so they can adequately fulfill their responsibilities.
- Collect and store all Material Safety Data Sheets (MSDS) for any chemicals used.
- Become familiar with the emergency protocols.
- Inform team members of the location of the MSDS.

## **Student Safety Captains**

- Practice what you preach.
- Help the team understand the safety regulations.
- Ensure safe habits are used in the pit.
- Provide answers to any questions pertaining to safety.
- Encourage team to be safe at all times.
- Know where to find material safety data sheets.

- Know where to find a fire extinguisher.
- Make sure team members are trained and/or supervised when using power tools.
- Record days without injury.

## **Injury Reporting Requirement**

Regardless of how little, report all accidents, injuries and any near misses to the team Safety Captain and the team Mentors. Even minor injuries can become major health concerns if proper action is not taken. At events, report injuries to the Pit Administration Supervisor so they can document the injury or illness on an incident report.

## **SAFETY INSPECTIONS**

The safety captain should make sure everyone is being safe and do random safety checks.

## **Personal Protective Equipment (PPE)**

Proper use of PPE is necessary to ensure that FRC participants are protected from dangers in the work area. The following describes the PPE that will be needed when building a robot.

## **Eye and Face Protection**

There are many kinds of eye protection but only approved non-shaded safety glasses and goggles are allowed. Eye protection is necessary when:

- When there is risk of flying debris or shrapnel.
- When there is risk of chemical exposure.
- When doing any work on the robot.
- At FIRST events.
- On the playing field.
- On the practice field.
- Any area with signs requiring safety glasses.

## **Hand Protection**

Hand protection is designed to protect against heat, electrical, chemical, and mechanical dangers. Use proper gloves and mechanical tool guards.

## **Gloves**

Student team members should work with the team mentors to ensure the glove is the correct one for each project. Check for proper size, absence of cracks, holes, flexibility and grip before wearing them.

## **Mechanical Guards**

- Provide safety guards for power tools when required.
- Never use any equipment without safety guards in place.
- Tell the safety captain and a mentor if equipment is broken or defective and do not use it until it is repaired.

## **Hearing Protection**

Team mentors should evaluate noise level and provide appropriate hearing devices when necessary.

## **Foot Protection**

When engaged in FIRST activities participants must wear closed toe shoes and heels regardless of work area. Flip-flops, sandals, mules, and crocks are examples of what is not allowed. In some cases, steel toes or toe guards are required when there is a danger of objects falling on feet.

## **Other Preventatives**

Ensure team members do not wear items such as ties, loose clothing, jewelry, or hanging chains as it causes an unsafe environment.

## **Safety Requirements**

The following are a few areas where you will be judged on safety. It is the job of the safety advisors to recognize and report any unsafe behavior. Horseplay will not be tolerated.

## **General Safety**

- Follow safe work ethics and use of tools as well as maintain a healthy attitude in regards to safety.
- Always work in a controlled and thoughtful manner. No running.
- Wear approved non-shaded safety glasses the eyes must be visible to others (rose, blue, and amber are all right.).
- Wear closed toe and closed heel shoes along with the required gloves and hearing protection when necessary.
- Be certain to follow instructions with medication with regard to use of power tools.
- Keep robot in control and be sure to let people know that a robot is moving so they can get out of the way.
- Assist other teams with safety issues and display gracious professionalism at all times.
- Take very special care when working at higher than normal heights.
- Always open a ladder fully and never use an unapproved step ladder.
- Know where the Emergency Exits and Severe Weather safe areas are located.
- Know the locations and how to use the Fire Extinguishers.

## **Competition Safety**

- Travel with a buddy and make sure another team member knows your whereabouts at all time.

- Travel carefully and politely between pits and playing field.
- Demonstrate safe behavior in the heat of battle.
- Use safe lifting procedure for the robot and equipment.
- Make sure the robot is secured in a safe manner while being worked on.
- Help other teams with safety issues.

## **Pit Station Safety**

- Control access to your pit.
- Visitors are required to comply with PPE rules.
- Keep aisles clear for pedestrians and robot transport.
- When transporting the robot make it clear to the pedestrians that you are moving one by yelling “Robot”.
- Adhere to the specifics of the FRC administrative manual “At the Event”.
- Be gracious to your neighbors and warn them of hazards in your pit area.
- Keep the pit area in a orderly manner and remember to clean the floor in your pit station.
- Store tools properly and take proper care of battery chargers.
- Tidy up personal belongings and equipment.
- Complete Pit Safety Checklist.

## **Soldering**

Soldering is used to join to ends of wire together. Due to the heat and chemical vapors produced in this process the following guidelines are to be followed.

- Use only lead free solder with an electric solder gun.

- No open flames allowed in the building or machine shop.
- Wear PPE to protect your body from burns.
- Never touch the tip of the soldering gun. It can heat to extreme temperatures.
- Solder in a well ventilated area.
- Clean your hands well after soldering.
- Work on heat resistant surfaces.
- Keep soldering gun in its case when not being used.
- Do not leave hot tools where a person could touch them and get burned.

## **Hand Tools**

Hand tools are used when building a robot. Always use the proper tool to accomplish the task. Example, never use a screwdriver as a chisel.

## **Tool Rules**

- Check to make sure tools are in good condition before using.
- Do not use defective, dull, or broken tools.
- Remove damaged tools and tell the Safety Captain and Mentor.
- When using knives or blades, always cut away from you.
- Always be aware of those around you. Create a safety circle.

## **Tool Storage**

The proper storage of tools will keep them in working and safe condition.

- Store sharp or pointed tools in a safe place.
- When transporting tools, make sure the edges are shielded.
- Never run with tools.
- Never put unshielded tools in your pocket.
- Don't put tools on surfaces above the workplace. They may fall, harming someone.
- Store equipment where it will not become a hazard.

## **Stored Energy**

Plan out what you intend to do to the robot before working on it and ensure that no one will be working when it is plugged into the battery.

- Always unplug the battery to de-energize the robot before working on it.
- Open the main circuit breaker. ( Hit the red button on the circuit breaker )

## **Pneumatic Energy**

- Always release any compressed air to the atmosphere. This is necessary for any pneumatic parts on the robot.
- Make sure that pressure relief valves are functional.
- Open the main valve and make sure all pressure gauges read zero.

## **Miscellaneous Energy Sources**

- Relieve any compressed springs and tubing.

- Lower all raised devices that could drop to a downward position.

## **Battery Safety**

**Caution:** Batteries contain acid. This substance, H<sub>2</sub>SO<sub>4</sub>, is a corrosive, colorless liquid that will burn your eyes, skin and clothing. The team Mentor and Safety Captain should post the MSDS for the battery in use. Train all team members about battery safety. You can find emergency handling, first aid, proper protection for handling cracked or damage batteries and battery disposal in the MSDS.

- [http://www.mkbattery.com/images/MSDS\\_smallsealed\\_line](http://www.mkbattery.com/images/MSDS_smallsealed_line).

## **General Damaged Battery Information/Warnings**

Any battery that is visibly damaged in any way, shape, or form is considered dangerous and unusable. The damaged battery should be set aside and handled accordingly. The battery contains stored energy that could cause heat to build up due to an internal short circuit causing an explosion.

- The battery contains sulfuric acid and if contact is made flush any contacted skin with large amounts of water and seek medical treatment.
- Periodically inspect batteries for damage.
- If damage is noticed, don't use the battery and treat as a hazardous material.
- Consult MSDS for handling damaged batteries.
- Make sure all power connections are properly insulated.

## **Procedure for Handling a Leaking Battery When an Electrolyte Leak Occurs:**

- Neutralize by pouring Sodium Bicarbonate on the spill.
- PPE before handling the battery.
- Place battery in a leak proof container for removal.
- Neutralize any acid on your gloves before removing and storing them.
- Clean up and dispose of the battery, which is now a hazardous material.
- Follow the MSDS handling instructions and notify a Mentor.
- Seek medical attention if necessary.

### **At a FIRST Event**

- If a person comes in contact with acid, send them to the First Aid Station or EMT.
- Report incidents to the Pit Administration Supervisor. Provide team number and available information.
- Use Sodium Bicarbonate and sprinkle it on the spill. Then clean it up and dispose of the neutralized material in the trash.
- Dispose of the battery properly.

### **Battery Disposal**

The Interstate Battery Company has volunteered to accept and properly dispose of any FRC team's batteries and you can find a location near you by going to this website:  
<http://www.interstatebatteries.com>

## **Charging and Handling of Batteries**

- When the battery is not connected to the robot or charger, use the battery protector safety plugs provide by FIRST.
- Keep the battery charging area clean and orderly.
- Place the battery charger in an area with good ventilation.
- Do not short out the battery terminals.
- Do not put metal parts on both terminals simultaneously. This could cause an explosion.
- If you must use tools to remove a battery, make sure that metal does not come in contact with both terminals.

## **Ongoing Battery Inspection**

- Occasionally check batteries for damage.
- Bent terminals can also be a potential leak source.
- Check your battery before competing in each round.

## **Chemical Safety**

- Keep chemical containers in good condition.

- Make sure all chemicals have legible labels placed by the manufacturer.
- Be familiar with the chemicals and their safety precautions.
- Store all containers neatly in an organized fashion.
- Obtain an MSDS to provide information on handling spills and injuries.
- If you are exposed to a chemical, notify your Safety Captain and Mentor immediately and consult the MSDS.
- Do not use any flammable materials at FIRST events.
- MSDS are kept in the Safety Manual.

## Respect of Electricity

Proper care of electricity is paramount. The following are guidelines for being safe around electricity;

- Inspect cords to make sure they are in good condition.
- Do not overload electrical fixtures and/or receptacles.
- Do not “Daisy Chain “, power strips.
- Do not plug in extension cords into power strips.

## At the Event

**Registration:** An adult will register your team and may be asked to sign a safety statement.

- Safety glasses are required **everywhere** in the pits.
- Don't ship glasses or goggles in the crate or you will not be able to enter the pit area.
- Use safe lifting techniques.

**Age Requirement:** Children 12 and under must have a person of 18 or older with them at all times. There will be child size safety glasses to borrow and return.

## **Setting up the Team Pit Station**

- Bring and use work gloves for uncrating and re-crating.
- Design your pit area beforehand and do not climb on tables, desks, chairs, etc. Use ladders.
- Keep in mind the ten foot height limit.
- Small bench top band saws and drill presses with appropriate safeguards are allowed in the team pit station.
- Use proper tools to hang team banners. Adhere to the 10 foot height limit.

## **Working in the Pit**

- Proper use of power strips. Do not “Daisy Chain “.
- Keep work area neat and orderly.
- Participants should be wearing PPE in the pits at all times.
- Safety goggles over prescription glasses, or prescription safety glasses that are agency approved.
- Wear shoes that completely cover the foot.

## **Using the Practice Area**

If there is a practice area, obey the rules for maintaining an “Exclusion Zone “to ensure that robots and parts will not exceed the practice area. This will help prevent accidents and injuries. Wear safety glasses, use safe lifting procedures and make sure the area is clear of debris.

# Safe Robot Lifting, Handling and Transporting

## Pre Lift

- Make sure your team knows how to lift the robot.
- Practice lifting the robot.
- Lift with your legs, not your back.
- Ensure all transporters are wearing PPE.
- Make sure the robot is safe to move.
- Make sure all robot parts are secure.
- Make sure the power is off.
- Make sure that no team members are working on the robot.

## During the Lift

- Have someone supervise the lift.
- Lifters should put feet close to the robot and stand in a balanced position.
- Lift with the legs and keep the back straight.
- Do not twist the body.
- Use proper hand holds.
- Tighten your stomach when lifting the robot.
- Keep the robot close to the body and coordinate the lift speed with others.
- Make sure the cart is stable and will not roll.
- Coordinate correct placement on the cart.

## Post Match

- Release all stored energy and open up the main circuit breaker on the robot.

- Ensure that the robot is safe prior to lifting it off the playing field, no dangling parts, everything secure, battery off, release pneumatic pressure, etc.
- Use proper lifting procedure.
- Remove debris from the playing field.
- Use the gate opening to exit the playing field.

## **Transporting**

- Make sure the robot is secure to the cart.
- Keep control of the cart at all times.
- Use courteous behavior around others.
- Use the gate opening when entering and exiting the playing field.
- Do not include music on the cart.

## **Safety Awareness and Recognition Program**

With the safety check-list, the Twisted Devil Safety Team monitors the team during all phases of robot construction and recognizes and awards the students and Mentors that are promoting and following safety protocols. The Safety Team also reviews areas where safety improvements can be made or updated.