

2018 Safety Manual



Sponsored by



Contents

1	Safety and <i>FIRST</i> Robotics Competition	4
1.1	Culture of Safety	4
1.2	Scope.....	4
2	Participant Responsibilities	4
2.1	All Participants	4
2.2	Mentors	4
2.3	Student Safety Captains.....	5
3	General Safety Requirements	6
3.1	Stored Energy	6
3.1.1	Electrical Energy:	6
3.1.2	Pneumatic Energy:	6
3.1.3	Miscellaneous Energy Sources:.....	7
3.2	Hand Tools.....	7
3.2.1	Tool Rules	7
3.2.2	Tool Storage.....	7
3.3	Mechanical Guards	7
3.4	Respect of Electricity.....	7
3.5	Battery Safety	8
3.5.1	General Damaged Battery Information and Warnings	8
3.5.2	Necessary Safety Materials	8
3.5.3	Procedure for Handling a Leaking Battery	8
3.5.4	Battery Disposal	9
3.5.5	Charging and Handling	9
3.5.6	Ongoing Battery Inspection	9
3.6	Chemical Safety	9
3.7	Soldering.....	10
4	Personal Protective Equipment (PPE)	10
4.1	Eye and Face Protection	10
4.1.1	Use and Application	10
4.1.2	Safety Glasses & Protective Eyewear	11
4.1.3	Prescription Glasses	11
4.2	Hand Protection	11
4.3	Hearing Protection	11

4.4	Foot Protection.....	11
4.4.1	Participants.....	11
4.4.2	Spectators	12
4.5	Other Preventatives	12
5	Safe Robot Lifting, Handling and Transportation.....	12
5.1	Robot Carts.....	12
5.2	Pre-Lift Procedures	12
5.3	During the Lift.....	13
5.4	Transporting Procedures	13
5.5	Post-Match Procedures	13
6	Safety In Your Work Spaces	14
7	Safety At <i>FIRST</i> Events	14
7.1	Safety Considerations	14
7.2	Competition Safety	15
7.3	Pit Station.....	15
7.3.1	Setting Up the Team Pit Station.....	15
7.3.2	Pit Station Safety	15
7.3.3	Pit Age Requirement	16
7.4	Using the Practice Field	16
8	Safety Awareness and Recognition Programs	16
8.1	Key Objectives	16
8.2	Safety Advisory Process	16
8.3	Safety Recognition and Awards	17
8.3.1	<i>Safety Champion Cards</i>	17
8.3.2	<i>Star of the Day</i> and <i>FIRST in Pit</i> Safety Recognition	18
8.3.3	<i>Safety Award</i> , Sponsored by Underwriters Laboratories	18
9	Appendix A: Safety Checklist	20
10	Appendix B: Corrective and Preventative Action Plan	21
11	Appendix C: Safety Data Sheets.....	22
12	Appendix D: Safety Captain's Meeting	23

1 Safety and *FIRST* Robotics Competition

1.1 Culture of Safety

Instilling a culture of safety is a value that every individual in the *FIRST* community must embrace as we pursue the mission and vision of *FIRST*. *FIRST* Robotics Competition has adopted safety as a core value and has established the framework for safety leadership in all aspects of the program.

FIRST believes that the teams that take the lead in developing safety programs and policies have a positive and lasting impact on each team member and mentor, in addition to their communities and present and future work places. *FIRST* recognizes the teams that demonstrate safety throughout their programs and are truly committed to developing a culture of safety.

1.2 Scope

This safety manual is an easy-to-use guide for important safety information and provides *FIRST* Robotics Competition participants with a basic set of requirements to maintain a safe environment during the build season and at competition events. It applies to anyone involved with the *FIRST* Robotics Competition including all student team members, mentors, volunteers and spectators.

2 Participant Responsibilities

Everyone is responsible for safety during team meetings and the design, build, travel, and event phases of the competition. Please read this entire manual for details on how to establish and maintain a culture of safety within *FIRST*. Below are the expectations for *FIRST* Robotics Competition participants.

2.1 All Participants

- Be familiar with this manual, as well as understand and follow established safety requirements applicable to your environment.
- Be familiar with any site restrictions identified in the information linked in the 'Event Info' section of the [FIRST Robotics Competition Event Search](#) page.
- Work in a safe and responsible manner.
- Use personal protective equipment (PPE), safeguards, and other safety equipment as required.
- Identify and report any unsafe or hazardous conditions to a student safety captain, mentor, and/or safety advisor. This includes work practices that may cause an accident.
- Encourage safe behaviors in everyone around you.

2.2 Mentors

- Lead by example. Practice the same safety behaviors that are expected from the students.
- Provide guidance and encouragement on a safe working environment.
- Provide leadership and guidance on matters of [general safety](#), including the use of [personal protective equipment](#) including during the [lifting, handling and transportation of robots](#) as detailed in this manual in [team work spaces](#) as well as at [events](#).
- Utilize hazard based safety engineering principles with team members to eliminate or minimize identified hazards to a suitable level.

- Familiarize yourself with relevant event safety and restrictions by visiting the [FIRST® POWER UP™ Game & Season](#) page as well as the 'Event Info' section of the [FIRST Robotics Competition Event Search](#) page. Go over these considerations with the team prior to an event.
- Coach the [student safety captain\(s\)](#) to ensure that he/she understands and adequately fulfills the position's responsibilities.
- Collect and store [Safety Data Sheets](#) (SDS) for any chemicals, chemical compounds or chemical mixtures (e.g. in paint, and batteries) used by the team. SDS information may include instructions for the safe use and potential hazards associated with a particular material or product. You can obtain SDS sheets from the manufacturer's web site or by calling the manufacturer directly. Become familiar with them and the related emergency procedures. Inform the safety captain of the SDS storage location.

2.3 Student Safety Captains

- Develop a team safety program manual that outlines your team's safety culture with consideration to the elements in this manual.
- Encourage your team to display positive safety behaviors at all times.
- Provide support for any safety questions or concerns that may arise. Seek guidance, as appropriate, from mentors.
- Conduct safety inspections of the general work site, especially the robot construction area. This also applies to the pit station during competition events. (See the [Safety Checklist](#) and [Corrective and Preventative Action Plan](#) Appendices for examples).
- Know where to find and become familiar with the [Safety Data Sheets](#) (SDS) and related emergency procedures.
- Coordinate, deliver, and track safety training for the individual team members as well as team wide safety procedures. It is suggested that teams bring their training log and procedures to events and continue to make comments about infractions and/or areas of continuing improvements.
- At *FIRST* events:
 - Lead the FIRST culture of safety as an event safety ambassador by maintaining [Safety At FIRST Events](#) procedures for your team, volunteers and spectators. Advise those around you of safe practices in line with these procedures and escalate to your mentor if support is required. The event safety advisor(s) will also be available for escalation as appropriate.
 - Ensure safety practices and compliance with event requirements during load in and tear down.
 - Have a safety plan for each event so that in the event of an emergency, all team members know procedures to follow to assure everyone's safety. This would include a meeting spot to gather as well as a list of participants to assure everyone is safe.
 - Participate in checkpoint safety meetings with the event safety advisor to collaborate and provide feedback on any event safety needs:
 - First full day: morning student safety captain meeting (normally 1 hour after pits open)
 - First full day: late afternoon student safety captain meeting (normally 3 hours before pits close)
 - Second full day (if applicable): afternoon student safety captain meeting (normally 2 hours after lunch)
 - Final day: morning student safety captain meeting (normally 1 hour after Opening Ceremonies)
 - Be ready to present an executive summary of your team safety program to safety advisors at the event for consideration for the Safety Award, Sponsored by UL. Please

register at the event for a presentation time as instructed by your safety advisor at the morning student safety captain meeting on day 1.

3 General Safety Requirements

The following are some areas, practices, and functions for which teams will be observed and monitored for safety practices and innovation. This list is not all-inclusive. At events, your peer student safety captains, mentors and safety advisor(s) will observe and report any positive safety practices and opportunities for improvement.

Running and horseplay is not permitted at any time.

- Follow safe work practices, including safe use of all tools and **personal protective equipment** (safety glasses, shoes, gloves, hearing protection, etc.). Maintain a healthy attitude regarding safety.
- Always walk and work in a controlled and thoughtful manner. Keep full control of robot at all times.
- Be especially careful around high-speed rotating components, both on and off the robot. If you are putting a high-speed rotating component on the robot, make sure the component is designed to be used the way you are using it.
- Take special care when working above normal height or ground level.
- Always fully open a ladder and never stand on a non-approved step.
- Be careful using tools that generate heat, such as heat guns and soldering irons. Be aware of objects that may be in the vicinity of the heat source and may catch fire. Also, be aware that these tools often retain heat after being shut off, and should be set down only on appropriate surfaces.

3.1 Stored Energy

Plan the required activities when servicing or making repairs to the robot. Make sure all team members are aware that work is being done on the robot. Address the following:

Avoid working on an energized robot during repairs unless necessary.

3.1.1 Electrical Energy:

- Disconnect the electric power source
- Best Practice: Always de-energize the robot before working on it by opening the main circuit breaker ("re-set" lever is released) and unplugging batteries

3.1.2 Pneumatic Energy:

- Always vent any compressed air to the atmosphere (this applies to all parts of the pneumatic system)
- Open the main vent valve and verify that all pressure gauges on the robot indicate zero pressure



3.1.3 Miscellaneous Energy Sources:

- Relieve any compressed or stretched springs or tubing
- Lower all raised robot arms or devices that could drop down to a lower position on the robot

3.2 Hand Tools

Constructing a robot will require the use of hand tools. Most people think of hand tools as wrenches, screwdrivers, chisels, and so forth, but the term also applies to any hand-held tool or implement used to accomplish a task. Always use the proper tool for the job.

Example: DO NOT use a wrench for a hammer or a screwdriver as a chisel.

3.2.1 Tool Rules

- Before using any tool, check to see if it is in good condition. Don't use defective, dull, or broken tools. Don't put them back on the shelf; remove them from service and notify the safety captain and mentor so the tool can be replaced or sent for repair.
- When using a tool, place the work on a bench or hard surface rather than in the palm of your hand.
- When using knives/blades, direct your cutting strokes away from your hand and body and be aware of those around you. Wear gloves.

3.2.2 Tool Storage

- Store sharp-edged or pointed tools in a safe place. When carrying tools, cover the point or any sharp edges with shields. NEVER carry unshielded tools in your pocket. Don't leave tools on overhead work surfaces. They may fall and strike someone below. Store equipment in a location where it will not create a safety hazard or get damaged.

3.3 Mechanical Guards

Provide safety guards for power tools where required. Never use any equipment without safety guards in place. Notify your safety captain and mentor of any broken or defective equipment, and take it out of service until repairs are made.

3.4 Respect of Electricity

Proper use and respect for electricity is paramount. The following are general guidelines for ensuring basic electrical safety requirements are met:

- Inspect your equipment cords and extension cords routinely to ensure they are in good condition.
- DO NOT "daisy chain" – plug a power strip into another power strip. This could cause the potential for fire or electric shock due to overloading of the circuit.
- Avoid the following electrical power supply setups to prevent overloading:
 - Extension cord plugged into another extension cord.
 - Extension cord plugged into a power strip.
 - Multi-device receptacle plugged into a power strip or extension cord.

3.5 Battery Safety

CAUTION: Batteries contain acid. This substance, H_2SO_4 , is a corrosive, colorless liquid that will burn your eyes, skin, and clothing. The team mentor and safety captain should post the Safety Data Sheet ([SDS](#), see example in Appendix) for the battery in use and train all team members about battery safety. You can find emergency handling and first aid procedures on the SDS, along with proper protection for handling cracked or damaged batteries, and information on disposal of the battery.

3.5.1 General Damaged Battery Information and Warnings

Any battery that is visibly damaged in any way is dangerous and unusable. Don't take a chance- don't use it! Here are reasons you should not use a damaged battery:

1. It contains stored electrical energy that could cause the battery to rapidly heat up due to an internal electrical short circuit, and possibly explode.
2. The 12V batteries *FIRST* provided in your Kit of Parts contain sulfuric acid that will burn human tissue on contact.

Set aside a damaged battery and handle accordingly:

- Immediately flush any contacted skin with a large quantity of water.
- Seek medical treatment.
- Periodically inspect your batteries for any signs of damage or leaking electrolyte. Remember that a dropped battery may be cracked, but the crack may not be visible and might eventually leak electrolyte.
- Treat it as a hazardous material and process it in accordance with the battery's SDS.
- Don't take a chance- don't use it!

3.5.2 Necessary Safety Materials

FIRST recommends that teams keep the following items readily available whenever working with batteries:

- 1 A box of sodium bicarbonate (baking soda) to neutralize any exposed acid electrolyte.
- 2 A pair of acid-resistant rubber or plastic leak-proof gloves to wear when handling a leaking battery.
- 3 A suitable non-metallic leak-proof container in which to place the defective battery.

3.5.3 Procedure for Handling a Leaking Battery

When an electrolyte leak occurs:

- Neutralize it by pouring the sodium bicarbonate on all wetted surfaces. The bicarbonate of soda itself is not dangerous, and will react with the acid in the electrolyte leaving a safe residue that can be disposed of in a conventional manner such as rinsing with water.
- Follow emergency handling instructions of the SDS and notify mentor.
- Put on gloves before handling the battery.
- Place the battery in a leak-proof container for removal.
- Be sure to neutralize any acid on the gloves before removing and storing them.
- Seek medical attention if skin came into contact with any chemicals.
- Properly dispose of the battery, which is now a hazardous material.

At a *FIRST* event:

- Immediately send the person in contact with acid to the First Aid Station/EMTs.
- Report incident to the pit administration supervisor so that the individual can fill out a Medical Incident Report form. Provide team number and available information.
- Pit Administration will immediately contact Event Management for further instruction from event and venue authorities.

3.5.4 Battery Disposal

Be sure to dispose of all batteries properly and safely. Most retailers of automotive batteries will accept and properly dispose of them at no cost.

3.5.5 Charging and Handling

- Keep the battery-charging area clean and orderly.
- Place your battery charger in an area where cooling air can freely circulate around the charger. Battery chargers can fail without proper ventilation.
- Do not short out the battery terminals. If metal tools/parts contact the terminals simultaneously, it will create a direct short circuit. This may cause high heat to develop in the battery terminal/part/tool area and the battery could explode. To avoid the possibility of shorting out the battery terminals and creating a hazardous situation it is required to cover all exposed battery terminals and connections with appropriate insulating material such as electrical tape or tubing.
- Do not charge battery at greater than the manufacturer's maximum recommended rate.

3.5.6 Ongoing Battery Inspection

- Periodically inspect your battery for any evidence of damage, such as a cracked case or leaking electrolyte.
- Bent terminals can also be a potential leak source.
- Inspect the battery before and after each round of competition.

3.6 Chemical Safety

- Keep chemical containers in good condition.
- Make sure all chemical containers have labels placed by the manufacturer.
- Ensure all labels are legible.
- Become familiar with the chemicals you may use as part of the *FIRST* Robotics Competition. Read safety precautions and instructions for use located on the chemical's label.
- Store all chemicals in an orderly way. Obtain Safety Data Sheets (SDS) for the chemicals your team uses. These sheets provide information on the correct handling of a spill or injury.
- If you are exposed to a chemical, notify your safety captain and mentor immediately and consult the SDS if necessary.
- Don't use any highly flammable materials, such as cleaning solutions, at *FIRST* events.

3.7 Soldering

Soldering can be dangerous because of the heat from the iron and the chemical fumes and vapors released from the solder and flux. When soldering, observe the following points:

- Use lead-free solder only and solder with electrically heated soldering iron/gun only.
- No torches or open flames of any kind are allowed in event venues, except by authorized personnel in specified areas (such as the event machine shop).
- Wear eye and face protection.
- Solder in well-ventilated areas.
- Never touch the iron/gun. It heats to extreme temperatures that will cause severe burns.
- Prevent burns by wearing cotton clothing that covers your arms and legs.
- Always wash your hands with soap and water after handling solder.
- Work on a fire resistant surface.
- Keep your soldering iron in its protective holder when not actually being used.
- Do not leave any hot tools where someone can accidentally contact the hot element.

4 Personal Protective Equipment (PPE)

The proper use of personal protective equipment (PPE) is an important element to help ensure *FIRST* Robotics Competition participants are protected from hazards in the work area. The following describes the common PPE that you are required to wear as part of constructing, use, maintenance and transport of a robot. All PPE must be ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated, as applicable.

4.1 Eye and Face Protection

There are several forms of eye/face protection available to provide protection from related hazards, including safety glasses with side shields, goggles, and face shields. Inspect equipment for damage each time it is worn.

4.1.1 Use and Application

Wear eye protection in the following situations:

- When performing any work on the robot including grinding, drilling, soldering, cutting, welding, etc.
- When there is a risk of exposure to flying particles or chemical exposure (such as splashes, splatters, and sprays).

At *FIRST* events, wear eye protection:

- Anywhere in the pit station including walkways and team pits.
- In the vicinity of the arena, including the playing field.
- On the practice field.
- Any area posted with signs requiring the use of eye protection (such as the machine shop).



4.1.2 Safety Glasses & Protective Eyewear

Safety glasses and protective eyewear are designed to provide a shield around the entire eye to protect against hazards such as splashes of liquids, burns from steam, compressed air, and flying wood or metal debris.

To prevent injury, all individuals in the pit area, the practice field area and the arena must wear safety glasses or protective eyewear that is ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated. Only lightly tinted yellow, rose, blue, and amber tints are *FIRST* approved. Reflective lenses are prohibited; your eyes must be clearly visible to others.

The use of anything other than ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated eye protection is prohibited.

4.1.3 Prescription Glasses

If you wear prescription glasses that do not have a marked safety rating, you must wear rated safety goggles over them to achieve adequate protection.

If you wear marked safety rated glasses, you may use ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated side shields.

Safety rated glasses, side shields and frames can be identified by markings stating the standard that they are rated to (ex. Z87.1).

4.2 Hand Protection

Hand protection is designed to protect against heat, electrical, chemical and mechanical hazards. Use proper gloves and mechanical tool guards for the application.

FIRST Robotics Competition participants should work with their mentor to ensure the selected glove is the correct one to use for each activity. For example, wear chemical-resistant gloves when handling chemicals. Check your gloves for proper size, absence of cracks and holes, and good flexibility and grip before you wear them.

4.3 Hearing Protection

Make hearing protection devices available, such as earplugs, where there are objectionable/questionable sound levels. At events, hearing protection is often available at pit administration. A mentor can provide assistance in evaluating high-noise tasks and determining appropriate hearing protection devices.

4.4 Foot Protection

4.4.1 Participants

When engaged in *FIRST* activities, *FIRST* Robotics Competition participants must wear shoes that completely cover the entire foot. Shoes must be substantial and have closed-toes and heels to protect against foot injuries, regardless of work location. Flip-flops, sandals, mules, lightweight slippers, etc. are not acceptable when working on or near the robot.

In some cases, safety shoes or toe guards are appropriate for areas where heavy objects can fall on your foot. Notify your team mentor if you encounter such situations, and determine the safest way to perform the task.



4.4.2 Spectators

Spectators attending *FIRST* competitions should follow the same footwear rules as participants. If substantial close-toed shoes are not available, they may enter the pit area as long as they remain in the pit aisles. Spectators that do not meet the footwear requirement for participants, as described above, are not allowed inside individual team pits or in any locations where robots are being worked on.

Please note that loose sandals (like flip-flops) or bare feet are not permitted in the pit area under any circumstances.

4.5 Other Preventatives

Ensure that team members or mentors are not wearing ties, loose clothing, jewelry, hanging key chains or similar when near or working on moving or rotating machinery so as to avoid the potential risk of draw in to rotating parts. In the case of individuals with long hair, this risk should be mitigated by tying back or covering long hair.

5 Safe Robot Lifting, Handling and Transportation

Take a few moments to ensure your team knows how to lift your robot properly and safely. Practice the procedures prior to beginning the season so everyone has the same method and goals at the events.

5.1 Robot Carts

To protect team members from muscle strains and other injuries as they transport the robot between the pits and the competition area, we strongly recommend team members use a cart. Please keep the following in mind:

- Carts must remain in the team pit area when not in use for robot transportation;
- All carts should fit through a standard 30-inch door;
- Wheels on the cart must not damage site flooring;
- Do not add music or other sound-generating devices to the cart, with the exception of devices of reasonable volume intended to be activated occasionally to make others in the direct vicinity aware that a robot is on the move for safety purposes; and
- Put your team number on your cart so it can be identified by field personnel.

NOTE: Carts must be safe. They must be easy to control and maneuver, and pose no risk to bystanders. Carts identified as unsafe by safety advisors must be made safe before they will be allowed to be used.

Always follow recommended practices for lifting, handling and transportation of robots. By practicing these safety techniques, your team members will also develop a quick, fluid routine.

5.2 Pre-Lift Procedures

- Ensure all transporters are wearing appropriate PPE (safety glasses at a minimum are required.)
- Make sure the robot is safe to move:
 - Are all parts of the robot secured?



- Is the robot powered off?
 - Is anyone still working on the robot?
 - Are there enough people to perform the lift safely? Two to four people are preferred.
- Before lifting, hold a short discussion to determine the direction and path you will be lifting.
- Ensure that the areas and paths are clear of debris and hazards.

5.3 During the Lift

- Appoint someone to coordinate the lift to make sure you are all ready to begin.
- Each lifter should place his/her feet close to the robot and adopt a balanced position.
- All persons should lift at the same time using proper body mechanics, these include:
 - Lift with your legs, keeping your back straight.
 - Do not twist your body- use your feet to turn your entire frame if you need to turn.
 - Use proper hand holds to grasp the robot and make sure you have a safe, secure lift point before starting the lift.
 - Bend your knees to a comfortable degree and get a good handhold. Maintain normal spinal curves.
 - Tighten your stomach muscles and commence lifting the robot, using your leg muscles if you are lifting the robot up from the floor.
 - Keep the robot close to your body, and coordinate lift speed with the others.
- Make sure the cart is stable and will not roll, coordinate correct placement of robot on the cart.
- Use the gate opening to enter the playing field. Climbing over the railing is prohibited.

5.4 Transporting Procedures

- Make sure the robot is stable on the cart before transporting.
- Keep the cart under control at all times, especially when removing or placing the robot.
- Lead the cart with a team member who can ensure the safety of those in the path of the travel area.
- Use patience and control when moving the robot, especially in crowded areas (do not run).
- Ensure that the cart will not roll away or pose a hazard, especially upon robot removal (use a chock block if necessary).
- Use the gate opening when entering/exiting the playing field. Climbing over the railing is prohibited.

5.5 Post-Match Procedures

- Relieve all stored energy and open the main circuit breaker on the robot.
- Ensure that the robot is made safe prior to lifting it off the playing field, no dangling parts, etc.
- Remove debris from the playing field.
- Use the above "Pre-lift" and "During the lift" procedures.
- Use the gate opening to exit the playing field. Climbing over the railing is prohibited.

6 Safety In Your Work Spaces

We recommend that teams implement a safety program to deliver on ensuring a culture of safety for the team throughout the season covering all aspects of the program. You will find an [Inspection Sheet](#) in the Appendix, which will serve as a minimum guideline at your events. Safety advisors will be on site to mentor and coach teams on proper safety practices.

We recommend that teams implement a checklist of their own to monitor their unique work facility safety considerations. Check for items such as:

- Are stacked items at least 18" below sprinkler heads?
- Are stacks stable and secure against sliding and collapse?
- Are heavy or bulky items stored below shoulder level?
- Are floors free of slipping and tripping hazards?
- Are all light fixtures functional?
- Is illumination level sufficient for the detail of work performed?

Review your workspace, take notes, and make any improvements to the safety of the environment and those working there. The mentors and student safety captain should constantly monitor team safety and the conditions at the work facility so the area is secure from injury, danger, risk, or liability.

7 Safety At *FIRST* Events

7.1 Safety Considerations

At events, the pure anticipation and excitement can sometimes overshadow common sense and safety fundamentals. One safety area teams sometimes overlook is the need to wear appropriate clothing when working on or being around robots. In addition to the ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated safety glasses required for [eye protection](#), *FIRST* highly recommends that team members and mentors:

- Refrain from wearing dangling jewelry or loose, baggy clothing near the robots;
- Tie back long hair so that it will not get caught in the robot or other machinery; and
- Wear gloves to protect hands and fingers when handling the robot or the robot crate; finger injuries are one of the most common injuries at events.

The following safety considerations apply at all *FIRST* Robotics Competition Event(s):

- To gain entrance to the pit, every person will have to wear a pair of [safety glasses](#) or safety rated prescription glasses with side shields.
 - Don't leave all safety glasses or side shields in the pit. Be sure to bring a few pairs with you, so someone from your team can enter the pit and get the safety glasses for all other members.
- Use safe lifting, handling and transportation techniques around the robots at all times.



- Do not use skateboards, 'hoverboards', or drones at events.
- Do not bring bottled gas tanks (e.g. helium) to events.
- Do not throw objects (such as paper airplanes) from the stands/bleachers.

7.2 Competition Safety

- Use the buddy system when traveling and while at the event.
- Note that *FIRST* staff and volunteers are distinguished by their name badges.
- Travel safely and carefully between the pit and the playing field.
- Demonstrate safe behaviors at all times, even in the heat of competition.
- Establish a planned, safe lifting procedure of the robot, including cart removal after the lift.
- Make sure the robot is properly secured if you must work underneath it. Never work on the robot on an unstable surface.
- Assist and mentor other teams with safety issues.

7.3 Pit Station

7.3.1 Setting Up the Team Pit Station

- Bring and use work gloves for uncrating and re-crating, if a crate is in use.
- Design and set up your pit station safely and use proper tools to construct any components (displays, shelves, banners, etc.)
- Use ladders; don't climb on items not meant for the task, such as tables and chairs.
- Observe the ten-foot height limit for all portions of your pit station, including banners.
- Small, bench-top band saws and drill presses, with appropriate guards, are allowed in team pit station.

7.3.2 Pit Station Safety

- Control access to your pit station.
- Keep the work area neat and orderly.
- Properly use power strips. Do not 'daisy chain' (plugging power strips into one another) or overload the rated capacity of the power strip.
- Keep the aisle immediately outside your pit station clear for pedestrians and robot transit.
- Participants and spectators should be wearing approved personal protective equipment, PPE, in the pit at all times.
- Teams may not build any structure to support people or items for storage over the top of the work area in their team pit station.
- Team structures, signs, banners, or displays cannot be higher than 10 feet above the floor.
 - Securely mount team pit station signs, banners, and displays.
- Be aware of your neighbors. Alert them if there is a hazard in your pit or near theirs. Maintain a clean, neat, and orderly pit station at all times. There are inspections after teams leave so be sure to do the following:

- Clean floor in and around your pit station
- Proper tool storage
- Proper care of batteries and battery chargers
- Tidy storage of personal belongings and equipment
- When transporting your robot, politely keep pedestrians alert to your movement.

7.3.3 Pit Age Requirement

Children twelve (12) and under must have a person eighteen (18) or older with them at all times. There will be child safety glasses available to borrow and return at the safety glass station.

Child strollers and baby carriages are not allowed within the individual pit stations.

7.4 Using the Practice Field

If your event has a practice field/area, be sure to obey the rules for maintaining an “exclusion zone” around the area. This zone will help ensure that robots and moving parts will remain within the practice area. It will also help prevent accidents to those persons viewing the sessions or traveling nearby who may not be aware of the movement of the robots.

Be sure to wear proper [personal protective equipment \(PPE\)](#) and use [safe lifting practices](#). Make sure the practice field is clear of debris, and be gracious by picking up any foreign materials. The designated volunteers are there to help maintain a safe area. Please cooperate with them.

8 Safety Awareness and Recognition Programs

8.1 Key Objectives

The key objectives of the *Safety Awareness and Recognition Program* are:

- a. Ensure participants, volunteers and spectators have injury-free competitions
- b. Motivate participants to learn and follow safe individual and group practices as a life skill using a positive coaching approach
- c. Select the winning team for the *Safety Award* sponsored by Underwriters Laboratories
- d. Publicly recognize other teams and individuals for safe practices

8.2 Safety Advisory Process

Throughout the event, the easily recognizable, red-shirted safety advisors with the support of student safety captains, will continuously tour the event to observe activities in the pit, practice field, queue line, and playing fields to observe the safety habits of the teams. This includes observing the un-crating/un-bagging of robots and transporting them between the pit and playing fields. Safety advisor(s) will assess the culture of safety at the event and that demonstrated by individual teams and rate overall safety performance programs in the following areas in determining opportunities for award recognition:

1. Safe Behavior
 - a. [Personal Protective Equipment \(PPE\)](#) Usage
2. Physical Conditions



3. Safety Innovation
4. Safety Program presentations

The program uses coaching, positive reinforcement and public recognition to meet its objectives. The safety advisor(s) with input from *FIRST* Robotics Competition participants will select the teams that best meet the program objectives. Safety advisors will:

1. Provide positive verbal feedback for safe behavior and conditions.
2. Indicate unsafe behavior and coach to correct unsafe behavior.
3. With input from the *FIRST* Robotics Competition participants and student safety captains, will select:
 - i. “*Star of the Day*”: a mentor, volunteer or student
 - ii. *FIRST* in Pit Safety
 - iii. *Hard Hat Pin Award: Safety Award Finalists*
 - iv. *Safety Award*, Sponsored by UL

Teams should not hesitate to talk with the safety advisors and ask questions.

8.3 Safety Recognition and Awards

The *Safety Awareness and Recognition Program* rewards teams and individuals for their exceptional dedication to safe working methods and considerations by providing the awards below.

At events, each team student safety captain will have an opportunity to sign up for a 10 minute informal presentation of their team's safety program to a designated safety advisor. The safety advisor(s) will use the information presented to evaluate each *FIRST* Robotics Competition team and provide coaching and mentoring throughout the competition.

8.3.1 Safety Champion Cards

The culture of safety at *FIRST* is exemplified directly by its participants. In order to have a better view and understanding of the culture of safety at each *FIRST* events, *FIRST* Robotics Competition teams are provided with *Safety Champion Cards* to provide feedback to submit to safety advisor(s) and recognize the contributions of peers to the enhancement of the culture of safety at *FIRST*.

Figure 8.3.1: Safety Champion Card

Safety Champions

My Team Name: _____ **Team #:** _____

Directions: Select the team that exemplifies the principles stated. Cards are to be handed in 1 hour before close of competition each day.

Best Team Safety Culture _____ **Team #:** _____

(Team that exhibited safe practices at all times, wearing safety glasses, proper use of tools, use of PPE.) Set an example for others to follow.

Best Pit Safety _____ **Team #:** _____

(Clean, organized, smart design using the Safety manual.) Maintain a healthy attitude regarding safety.

Star of the Day Name: _____ **Team #:** _____

(Student or Mentor who went out of their way to assure you or others were safe today)

Working for a Safer World

UL promotes safe living and working environments for people by the application of Safety Science and Hazard-based Safety Engineering.

UL supports the production and use of products which are physically and environmentally safe and to apply our efforts to prevent or reduce loss of life and property.

We advance safety science through research, standards development and education.

We concentrate our efforts and resources on public safety in those areas where we can make valuable contributions.

UL works with integrity and a focus on quality to enhance the trust conveyed by our certification marks and services.

The safety advisor(s) will use this information, as well as the following criteria, to assess candidates for safety recognition and awards:

1. Program Presentations (Team Safety Program)
2. Safety Initiatives (at the event)
3. Community Outreach
4. Safety Innovation

Safety Champion Cards will be provided to teams to be completed on non-playoff round days of each event. The cards should be completed and submitted to pit administration prior to the end of the day received.

8.3.2 *Star of the Day* and *FIRST in Pit Safety* Recognition

The safety advisor(s), with input from *FIRST* Robotics Competition participants, will select the *Star of the Day* and *FIRST in Pit Safety* winners on the primary competition day(s) at each event.

- For *Star of the Day*, the winner's name and team affiliation will be displayed on a poster near pit administration for the duration of the competition. This individual is presented with a small token of appreciation. This award can go to any student, mentor or volunteer who, in the opinion of the safety advisor(s) and *FIRST* Robotics Competition participants, has made a noteworthy contribution to promoting a culture of safety and is a person that the rest of the *FIRST* community should emulate for their safety practices.
- For *FIRST in Pit Safety*, the winning team(s) will receive a display sign for their pit to promote their recognition as a token of appreciation. This award goes to a team who, in the opinion of the safety advisor(s) and *FIRST* Robotics Competition participants, has made a noteworthy contribution to exemplify the culture of safety through their pit management at events.

8.3.3 *Safety Award, Sponsored by Underwriters Laboratories*

This award celebrates the team that progresses beyond safety fundamentals by using innovative ways to eliminate or protect against hazards and spread the principles and culture of safety throughout and beyond their team to enhance the understanding and recognition of safety principles to the larger community. The winning team consistently demonstrates excellence within their safety program that shines throughout the season as well as at competitions from load-in to load-out.

9 Appendix A: Safety Checklist

Date:

Location/Area:

Inspected by:

Teams should review the condition of the inspected area per the criteria in the checklist below. Assess each item and answer the question by placing a “√” in the appropriate column. For any questions answered “no” below, complete a Corrective Action Plan (see next page).

Safety advisors will use a similar checklist when they inspect the pit and individual pit stations during competition events.

Key: Y = Yes N = No NA = Not applicable

NO.	ITEM	Y	N	NA	LOCATION/NOTES
A	<u>HAND & PORTABLE TOOLS</u>				
1	Are powered tools in good condition with no evidence of damage?				
2	Are tools properly stored when not in use?				
3	Are guards and safety devices in place and operational?				
B	<u>CHEMICALS</u>				
1	Are chemical containers properly labeled and in good condition with no sign of damage?				
2	Are SDSs posted/readily available and team members aware?				
C	<u>ELECTRICAL</u>				
1	Are cords and plugs free of broken insulation, exposed wiring, and provided with grounded connections, or double insulated?				
2	Are electrical outlets overloaded? (1 power strip used per outlet)				
3	Is the battery charger situated so there is air circulating around it?				

NO.	ITEM	Y	N	NA	LOCATION/NOTES
4	Are the batteries visibly ok, terminals not bent, and no cracks in case?				
D	<u>THE TEAM PIT STATION</u>				
1	Is team equipment within the designated space? Aisle clear?				
2	Is the area free of slipping and tripping hazards?				
3	Is storage of materials orderly?				
4	Does the area conform to the 10' height restriction? This includes banners, signs, and all construction.				
5	Are the work surfaces neat and uncluttered?				
E	<u>APPROVED PERSONAL PROTECTIVE EQUIPMENT (PPE)</u>				
1	Is PPE available for <i>FIRST</i> Robotics Competition participants and their visitors?				
2	Is PPE worn by team members where required/posted?				
3	Is PPE properly maintained and stored?				
F	<u>RESPECT OF STORED ENERGY DANGERS</u>				
1.	After competing: Does the team relieve electrical, pneumatic, and miscellaneous energy before moving the robot off the field?				
2	In the pit: Does the team ensure no one is working on the robot while it is energized?				

10 Appendix B: Corrective and Preventative Action Plan

Use this Preventative and Corrective Action Plan to monitor changes your mentor, safety captain, or the event safety advisor recommends.

ID	DESCRIPTION AND ACTION	INITIATED	CLOSED	RESPONSIBLE
0.1	(Example) Unsafe placement of shelf in pit Shelf placed while standing on stacked crates to be able to reach mount area. Action: Team implemented procedure to use small ladder when assembling and dismantling pit.	01/15/20xx	03/01/20xx	Joan Builder

Comments:



11 Appendix C: Safety Data Sheets

Each team is responsible to collect and store Safety Data Sheets (SDS) for any chemicals, chemical compounds or chemical mixtures used by the team. SDS information may include instructions for the safe use and potential hazards associated with a particular material or product. You can obtain SDS sheets from the manufacturer's web site or by calling the manufacturer directly.

Please note the following links to sample SDS Sheets.

1. Battery Non-Spillable 49 CFR 173.159a ([SDS](#))
2. Scotch-Weld Plastic & Rubber Instant Adhesive (Gel) (Clear) ([SDS](#))

Examples of other common materials:

3. Loctite ([Various](#))
4. WD 40 ([SDS](#))

12 Appendix D: Safety Captain's Meeting

The following information will be reviewed at the first safety captain's meeting at each event.

- Safety captain event meeting schedule

Considerations:

- Be Safe, Be Kind, Be Gracious. Instilling a culture of safety throughout the build season, including at *FIRST* events, is a fundamental goal of *FIRST*.
- The safety advisor(s) (red shirts) are here to help promote safety with you during these events and in the heat of competition. We'd love to hear about your team's approach to safety!
- Serve as a safety ambassador for *FIRST* at the event and be a proponent for the *FIRST* culture of safety. Escalation of safety matters should be made through your mentor or, as appropriate, with the event safety advisor(s).
- **Pit station** = Includes your individual pit and all adjacent aisles. The pit area begins when you enter the designated area, usually near the pit administration desk or safety glasses station.
 - Safety glasses are required at all times in the pit area and on the competition field. *FIRST* needs your help to enforce this rule. Please ask your team members and spectators to wear their safety glasses. Wear ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated safety glasses. Lightly tinted yellow, rose, blue, and amber tints are allowed for *FIRST* events, but reflective lenses are not (your eyes must be clearly visible to others). If you wear non-safety rated prescription glasses, you must wear approved safety goggles over them to achieve adequate protection. If you wear safety rated glasses, you may use ANSI-approved, UL-Listed, CE EN166 rated, AS/NZS certified or CSA rated side shields.
 - Wear shoes that completely cover the entire foot. Shoes must be substantial and have closed-toes and heels to protect against foot injuries, regardless of work location. Flip-flops, sandals, mules, Crocs, lightweight slippers, etc. are not acceptable.
 - 10-foot height limit for equipment and displays in the pits will be enforced.
 - Children twelve (12) and under must have a person eighteen (18) or older with them at all times.
- Practice safe robot transportation principles.
- No open flames in the arena venue, except by authorized personnel and in approved locations (such as the machine shop).
- Report all injuries and illness to the EMT stationed near the pit administration desk.

Safety Awareness and Recognition:

- Gracious Professionalism® + Demonstrated Safety = Safety Award. One winner of the Safety Award Sponsored by UL will be selected by the safety advisors based on their safety observations throughout the event and through the demonstration of their safety program during interviews.
- *Safety Champion* input cards are to be filled out by each team and turned in each day after practice day to pit administration.
- Safety advisors will be reviewing the safe condition/design of pits after closing each night. A '#1 in Pit Safety' poster may be awarded to a team during the two primary competition days at each event. **The team pit station should demonstrate safety at all times.**

