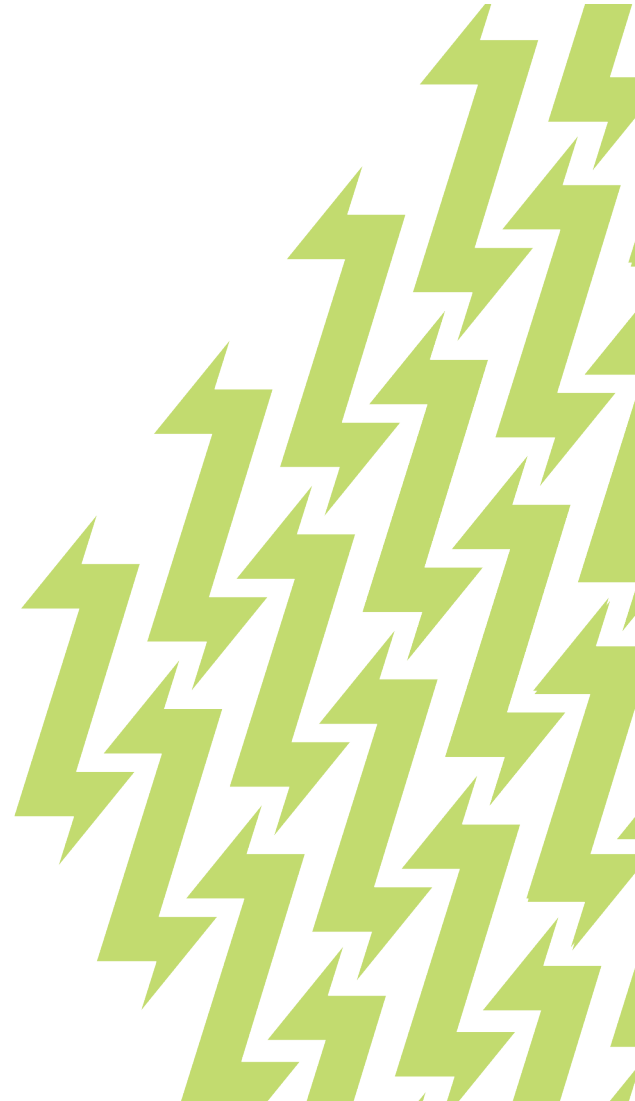




PRESENTED BY
Qualcomm



2023 *FIRST*[®] Robotics Competition and *FIRST*[®] Tech Challenge
Safety Manual



Contents

1	Safety and FIRST®	4
1.1	Culture of Safety	4
1.2	Scope.....	4
1.3	UL Solutions & FIRST Safety Learning Portal.....	4
1.4	COVID-19 Safety	4
2	Participant Responsibilities	4
2.1	All Participants	4
2.2	Mentors	5
3	General Safety Requirements	5
3.1	Stored Energy	5
3.1.1	Electrical Energy:	5
3.1.2	Pneumatic Energy (FIRST Robotics Competition Only):	5
3.1.3	Miscellaneous Energy Sources:	5
3.2	Hand Tools.....	5
3.2.1	Tool Rules	6
3.2.2	Tool Storage.....	6
3.3	Mechanical Guards	6
3.4	Respect of Electricity.....	6
3.5	Battery Safety	6
3.5.1	General Damaged Battery Information and Warnings	6
3.5.2	Necessary Safety Materials	7
3.5.3	Procedure for Handling a Leaking Lead Acid Battery	7
3.5.4	Battery Disposal	7
3.5.5	Charging and Handling	7
3.5.6	Ongoing Battery Inspection	8
3.5.7	Lithium-Ion Batteries	8
3.6	Chemical Safety	8
3.7	Soldering.....	9
4	Personal Protective Equipment (PPE)	9
4.1	Eye and Face Protection	9
4.1.1	Use and Application	9
4.1.2	Safety Glasses & Protective Eyewear	9
4.1.3	Prescription Glasses	10
4.2	Hand Protection	10
4.3	Hearing Protection	10

4.4	Foot Protection	10
4.4.1	Participants.....	10
4.4.2	Spectators	10
4.5	Other Preventatives	10
5	Safe Robot Lifting, Handling and Transportation	11
5.1	Robot Carts	11
5.2	Pre-Lift Procedures	11
5.3	During the Lift	11
5.4	Transporting Procedures	12
5.5	Post-Match Procedures	12
6	Safety in Your Workspaces	12
6.1	General Safety Practices	12
7	Safety at FIRST Events	13
7.1	Safety Considerations	13
7.2	Competition Safety	13
7.3	Pit Station	14
7.3.1	Setting Up the Team Pit Station.....	14
7.3.2	Pit Station Safety.....	14
7.3.3	FIRST Robotics Competition Pit Age Requirement	14
7.4	Using the Practice Field	14
8	Appendix A: Safety Checklist	15
9	Appendix B: Corrective and Preventative Action Plan	17
10	Appendix C: Safety Data Sheets	18
11	Appendix D: Additional Components for FIRST Robotics Competition Teams	19
11.1	Key Objectives of the Safety Program	19
11.2	Student Safety Captains	19
11.3	Safety All Star	19
11.4	Event Safety Reminders:	20
11.5	Safety Managers	21
12	Appendix E: COVID-19 Safety Guidance for FIRST Teams	22
12.1	Follow Local Guidance	22
12.2	Create a Team Safety Plan for COVID-19	22
12.3	Keep Your Plan Updated	22

1 Safety and FIRST®

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. Safety is a vital part of the FIRST culture, with a framework for safety leadership established in all aspects of the programs.

FIRST believes that 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 workplaces. 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 students 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 FIRST including all student team members, mentors, volunteers, and spectators.

1.3 UL Solutions & FIRST Safety Learning Portal

FIRST® Robotics Competition & FIRST® Tech Challenge teams can access online safety training through the Safety Learning Portal. Students and mentors are strongly encouraged to expand their safety knowledge by completing UL Solutions safety-related training courses. Topics include, but are not limited to:

- Fire Extinguisher and Safety Awareness
- Hand and Power Tool Safety Awareness
- Hazard Communication – Safety Data Sheets
- Personal Protective Equipment (PPE) Awareness
- Recognizing Electrical Hazards Awareness
- Lockout/Tagout Awareness

The portal is a valuable resource to all students and mentors. Training modules can be assigned to team members to watch independently, or mentors can show the training in a group setting. Every team member who completes a training module will earn a virtual badge. Visit the FIRST Safety Page to learn more and register for the Safety Learning Portal. If you are unable to access the portal, please email either firstroboticscompetition@firstinspires.org or firsttechchallenge@firstinspires.org depending on the program you participate in.

1.4 COVID-19 Safety

Refer to Appendix E for COVID-19 safety guidance.

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 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 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 mentor. 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.
- For FIRST Robotics Competition teams, 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.

3 General Safety Requirements

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. Avoid working on an energized robot during repairs unless necessary. Address the following:

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 (FIRST Robotics Competition Only):

- 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 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. Use safety razors with retractable safety blades.
- Wear cut resistant 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 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.
- Ensure all circuits are de-energized using a voltage meter. If 50 Volts or greater are present, use rubber safety gloves with leather overprotectors rated for the voltage you are working with to ensure the circuit is de-energized before placing hands into a potential electrical hazard zone. The gloves only need to be worn to confirm that voltage is not present using the meter. Ensure any stored energy such as from capacitors has also been discharged as they can retain a charge even when power is not present.

3.5 Battery Safety

CAUTION: Batteries contain acid. This substance, H₂SO₄, is a corrosive, colorless liquid that will burn your eyes, skin, and clothing. *FIRST Robotics Competition* team mentors and/or student leads should post the Safety Data Sheet (SDS, see example in Appendix A) 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:

- It contains stored electrical energy that could cause the battery to rapidly heat up due to an internal electrical short circuit, and possibly explode.

- The 12V batteries *FIRST* typically provides in the 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 Safety Data Sheets (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:

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

3.5.3 Procedure for Handling a Leaking Lead Acid Battery

- When an electrolyte leak occurs:
 - Neutralize it by pouring the sodium bicarbonate on all wetted surfaces. The sodium bicarbonate 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 a 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 met 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. 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 safety. 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.
- Never attempt to disassemble batteries or battery housing to prevent accidental puncture.
- Never use tools to remove a stuck battery as they may puncture the battery.

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.

3.5.7 Lithium-Ion Batteries

Lithium-ion batteries are used in a variety of equipment and require attention to minimize hazards. Lithium-ion batteries can be forced by misuse, physical abuse or improper handling into a failure mode called thermal runaway, which can cause fires or explosions. Below are safety tips to avoid causing a lithium-ion battery to malfunction:

- Use batteries or battery packs that are UL certified for safety.
- Purchase batteries (including replacement batteries) from the original equipment manufacturer or from a reputable source. Purchasing batteries over the Internet from unknown sources at exceptionally discounted prices can be an indication the product is not authentic. Avoid products with minimal packaging, no branding, or no documentation.
- Avoid crushing, bending or severe impact to lithium-ion batteries, battery packs and battery-operated devices. Avoid excessive vibration of lithium-ion batteries.
- Do not expose lithium-ion batteries to high temperatures.
- Always use the correct, compatible charger to safely charge your batteries.
- Avoid excessive or prolonged charging. Inappropriately charging a battery can lead to irreversible changes that may reduce life or possibly lead to failure. It is best to re-charge a battery only when it has a low state of charge and then fully charge it to 100 percent.
- Do not use or charge battery operated devices if they are surrounded by materials that prevent normal air flow.
- Special care should be taken with spare batteries during storage and transport. Loose batteries or the terminals on battery packs can contact metallic items such as spiral notebook binders and cause a short circuit.
- Keep batteries out of the reach of small children. Batteries can be a choking hazard. Button or coin cells can be ingested by small children and cause serious internal injuries from chemical burns.
- Have a class "C" fire extinguisher on hand in case of lithium fires. Note that Lithium fires can include toxic smoke as a result as well and should not be attempted unless the fire is very small and the person is trained in the use of a fire extinguisher.

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 *FIRST*. Read safety precautions and instructions for use located on the chemical's label.
- Store all chemicals in an orderly way and store incompatible chemicals separately from each other. Obtain Safety Data Sheets (SDS) for the chemicals your team uses. These sheets provide information on the correct handling of a spill or injury.
- Store any flammable chemicals when not in use in a flammable cabinet.
- If you are exposed to a chemical, notify your student lead 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.
- No food or drink should be present in the specific soldering area to prevent cross-contamination.
- 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
- Dispose of solder waste appropriately, even if using lead free solder, it may contain other parts that are considered as hazardous waste.

4 Personal Protective Equipment (PPE)

The proper use of personal protective equipment (PPE) is an important element to help ensure *FIRST* 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, face shields, and face masks (see Appendix E). 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.
 - Near 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. Reflective lenses are prohibited; your eyes must be clearly visible to others. Accommodations will be made for participants that require tinted safety glasses.

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, laceration, and mechanical hazards. Use proper gloves and mechanical tool guards for the application.

FIRST 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 *FIRST* Robotics Competition 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* 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 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 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. *FIRST* Robotics Competition team carts identified as unsafe by Safety Managers 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. Stored energy can include many forms including electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other sources in machines and equipment that can be hazardous.
- 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 Workspaces

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 a Safety Checklist in the Appendix, which can serve as minimum guidelines.

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 students should constantly monitor team safety and the conditions at the work facility, so the area is secure from injury, danger, risk, or liability.

6.1 General Safety Practices

The following are some general safety practices your team should keep in mind. This list is not all-inclusive.

- 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.
 - Inspect all ladders before use for broken rungs, missing feet, and safety labels. Do not use a ladder that fails an inspection.
- 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.
- Do not use gloves when using shop equipment such as band saws and drill presses to prevent a glove from being accidentally drawn into the rotating machinery of the equipment. Participants must be behind shielding or in a marked off safety area when robots are actively operating to prevent accidental collision or contact with an active robot.

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 that 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 when working on the robot or machinery 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* 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.
 - *FIRST* Robotics Competition ONLY: Teams are able to enter the pits without safety glasses for the first ten minutes of a team's load in and the first ten minutes of pits opening each day, UNTIL they start working on the robot or setting up their pit.
- 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.
- Stay aware of your surroundings.
- Always demonstrate safe behaviors, 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 (this varies for (FIRST Tech Challenge – depending on the venue and event).

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. Before your team leaves 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 FIRST Robotics Competition Pit Age Requirement

- Children twelve (12) and under must have a person eighteen (18) or older with them at all times. There may 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 Appendix A: Safety Checklist

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).

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

ITEM	Y	N	NA	LOCATION/NOTES
HAND & PORTABLE TOOLS				
Are powered tools in good condition with no evidence of damage?				
Are tools properly stored when not in use?				
Are guards and safety devices in place and operational?				
CHEMICALS				
Are chemical containers properly labeled and in good condition with no sign of damage?				
Are SDSs posted/readily available and team members aware?				
ELECTRICAL				
Are cords and plugs free of broken insulation, exposed wiring, and provided with grounded connections, or double insulated?				
Are electrical outlets overloaded? (1 power strip used per outlet)				
Is the battery charger situated so there is air circulating around it?				
Are the batteries visibly ok, terminals not bent, and no cracks in case?				
TEAM PIT				
Is team equipment within the designated space? Aisle clear?				
Is the area free of slipping and tripping hazards?				
Is storage of materials orderly?				
Does the area conform to the 10' height restriction? This includes banners, signs, and all construction.				
Are the work surfaces neat and uncluttered?				

ITEM	Y	N	NA	LOCATION/NOTES
APPROVED PERSONAL PROTECTIVE EQUIPMENT (PPE)				
Is PPE available for <i>FIRST</i> participants and their visitors?				
Is PPE worn by team members where required/posted?				
Is PPE properly maintained and stored?				
RESPECT OF STORED ENERGY DANGERS				
After competing: Does the team relieve electrical, pneumatic, and miscellaneous energy before moving the robot off the field?				
In the pit: Does the team ensure no one is working on the robot while it is energized?				

9 Appendix B: Corrective and Preventative Action Plan

Use this Preventative and Corrective Action Plan to monitor changes your mentor, or the event Safety Manager (*FIRST* Robotics Competition Only) 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:

10 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](#))

11 Appendix D: Additional Components for *FIRST* Robotics Competition Teams

The following section contains information that is applicable to only *FIRST* Robotics Competition Teams

11.1 Key Objectives of the Safety Program

The key objectives of the *Safety Program* are:

- Help ensure participants, volunteers and spectators have injury-free competitions
- Motivate participants to learn and follow safe individual and group practices as a life skill using a positive coaching approach
- Implement safety in all aspects of *FIRST* Robotics Competition participation
- Publicly recognize teams and individuals for safe practices

To be eligible for any award, teams will now be required to show how they espouse [FIRST Core Values](#) and a culture of safety in addition to demonstrating *Gracious Professionalism*®.

11.2 Student Safety Captains

FIRST Robotics Competition requires teams designate a student safety captain for events. Teams are also encouraged to identify the safety captain in advance so they can help oversee safety in your shop.

- The mentor should coach the student safety captain(s) to ensure that they understand the position's responsibilities.
- Develop a team safety program 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](#) 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 Manager(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.

11.3 Safety All Star

Creating a culture of safety is exemplified by the work and dedication of Safety Captains. Throughout the competition teams are encouraged to spend time talking to other team's Safety Captains to learn what

they are doing to create and build a culture of safety. In order to recognize those individuals who are going above and beyond to drive a culture of safety each team will be provided with *Safety All Star Cards*. The *Safety All Star Cards* are used to vote for the safety captain they believe exemplifies leadership, possesses extensive safety knowledge, and demonstrates excellence.

This information will be used to assess candidates for safety recognition and awards. Safety Managers, with input from *FIRST* Robotics Competition participants, will select the Safety All Star on the primary competition day(s) at each event. Each day's Safety All Star will be presented with a small token of appreciation.

Safety All Star Cards will be provided to teams 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.

11.4 Event Safety Reminders:

The following information will be reviewed at the first safety captain's meeting at each event, but all team members should be aware of these event safety reminders:

- Be Safe, Be Kind, Be Gracious. Instilling a culture of safety throughout the season, including at *FIRST* events, is a fundamental goal of *FIRST*.
- The Safety Manager(s) 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 Manager(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. If glasses are tinted, only lightly tinted yellow, rose, blue, and amber tints are *FIRST* approved, 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.
 - Accommodations can be made for those that require darker tinted glasses, however glasses should not hinder a person's ability to see.
 - 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.
- Teams should remember to review the [Event Rules](#) prior to the event.
- Safety All Star input cards are to be filled out by each team and turned in each day to pit administration. Safety Managers with input from *FIRST* Robotics Competition participants, will select the Safety All Star on the primary competition day(s) at each event.

11.5 Safety Managers

FIRST Robotics Competition Safety Managers are volunteers who work with teams to ensure they understand, comply with, and practice the fundamentals of safety to ensure the safety of all *FIRST* event participants. Throughout the event, the safety practices of teams will be observed in the pit, practice field, queue line, and playing field. This includes observing the transporting of robots between the pit and playing fields. The culture of safety at the event and that demonstrated by individual teams will be assessed.

- The program uses coaching, positive reinforcement, and public recognition to meet its objectives.
- Positive verbal feedback for safe behavior and conditions.
- Identification of unsafe behavior and coaching to correct unsafe behavior.
- Teams should not hesitate to talk with the Safety Manager(s) and ask questions.

12 Appendix E: COVID-19 Safety Guidance for FIRST Teams

12.1 Follow Local Guidance

Teams are responsible for following all local guidelines. Prior to creating a Safety Plan for COVID-19, teams must understand all national and local guidelines published by health offices. Safety is always the number one priority for teams. Any team looking for the appropriate local guidance should contact their local health office for more information.

12.2 Create a Team Safety Plan for COVID-19

Instilling a culture of safety is a value that every individual in the *FIRST* community must embrace as we pursue *FIRST*'s mission and vision. As teams plan to have a safe season, a Safety Plan must consider the implications of infectious disease and incorporate elements that help minimize the risk of spreading COVID-19. Elements of this plan can include use of collaboration tools, identifying precautions, social distancing measures, and establishing policies around sharing materials and tools, plus any other guidelines required by local health offices. This information is in addition to the team's current Safety Plan.

Prior to putting your team's Safety Plan for COVID-19 in place, teams must contact your managing organization as well as local health offices to determine the guidance for your area.

The following are examples of resources you can use as you assemble your plan.

- [How to Protect Yourself and Others \(US CDC\)](#)
- [How to Protect Yourself and Others \(World Health Organization\)](#)
- [Guidance for Cleaning and Disinfecting Public Spaces, Workplaces, Businesses, Schools and Homes \(US CDC\)](#)
- [Cleaning and disinfecting environmental surfaces \(World Health Organization\)](#)
- Safety plans from your managing organization (school or school district, 4-H chapter, Boys & Girls Club, etc.) and other sources of policies for your area.
- [Youth Protection policy](#)

Examples of Information to Include in a Safety Plan

Examples of the type of information about how to limit the spread of infectious diseases that could be included in a Safety Plan are below. This list is not exhaustive and should be considered an addition to a team's typical Safety Plan. All teams should consult with their local health offices prior to implementing a Safety Plan.

1. Expectations that team members follow safety guidelines created by your team
2. Use of personal protective equipment (PPE), such as safety glasses and masks
3. The importance of handwashing and use of hand sanitizer
4. Space and distance guidelines
5. Knowing when to stay home
6. How to handle shared materials and tools

12.3 Keep Your Plan Updated

Be sure to keep your Safety Plan for COVID-19 updated. As local conditions and team needs change, your plan should change with them. Be sure to communicate those changes with your team.