Safety Manual

RESPONSIBILITIES

Everyone is responsible for safety during team meetings during the design, build, travel, and event phases of the competition. Please read this entire manual for details on how to be safe.

**As a member of Team 3142, you are expected to:**

* Be familiar with this manual as well as the safety-related requirements applicable to the work area and those that will be traveled.
* Work in a safe and responsible manner.
* Understand and follow established safety requirements.
* Use Personal Protective Equipment (PPE), safe guards, and other safety equipment when needed or as required.
* Identify and report any unsafe or hazardous conditions to the student Safety Officer. This includes work practices that may cause an accident.
* Encourage safe behaviors of everyone in work and transportation areas.

**INJURY REPORTING REQUIREMENT**

**Regardless of severity, report all accidents, injuries, and near misses to the Team Coach as well as team’s Safety Officer.** Even injuries that seem minor may become serious if proper medical attention is not provided in a timely manner. Remember, each minor event can be a precursor to a major event.

**SAFETY INSPECTIONS**

The Safety Officer will inspect the work areas on a routine basis as well as determine and document the frequency of inspections by the potential risk of the work.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The proper use of Personal Protective Equipment (PPE) is an important element to help ensure *all* team members are protected from hazards in the work area. The following describes the common PPE that are required when constructing a robot or using construction tools.

Eye and Face Protection

There are several forms of eye/face protection available to safe guard the eyes and face from hazards, including safety glasses with side shields, goggles, and face shields. Inspect equipment for damage each time items are worn. If wearing prescription glasses, which are **NOT** approved safety glasses, approved safety goggles must be worn over them to achieve adequate protection.

**Eye and face protection is required to avoid the risk of exposure to the following:**

* Flying particles.
* Sparks.
* Chemical exposure (such as splashes, splatters, and sprays).

Wear non-shaded, ANSI-approved, UL-Listed, or CSA rated eye protection.

* The use of anything other than ANSI-approved, UL-Listed, or CSA rated eye protection is prohibited.
* Lightly tinted Rose, Blue, Amber tints are *FIRST* approved, but reflective lenses are not (eyes must be clearly visible to others).
* When doing any work on the robot including, grinding, drilling, soldering, cutting, welding, or manual adjustment.

**Safety Glasses are always required:**

* In all work areas where machinery is optional.
* Anywhere in the pit area, including walk ways, and pit stations.
* On the Practice Field.
* On the Playing Field.
* Any area posted with signs requiring the use of eye protection.

Hand Protection

Hand protection is designed to protect against heat, electrical, chemical and mechanical hazards. Use proper gloves and mechanical tool guards at all times.

Gloves:

Team members should work with the Team Coach to ensure the selected glove is the correct one to use for each project. Chemical-resistant gloves afford some measure of chemical protection. Wear them when handling chemicals.

**Check gloves for:**

* Proper size.
* Absence of cracks and holes.
* Good flexibility.
* Proper grip.

*Mechanical Guards:*

It is important to always use mechanical guards in compliance with safety regulations. Team members should never tamper with or remove mechanical guards.

* Provide safety guards for power tools where required.
* Never use any equipment without safety guards in place.
* Notify the Safety Officer and Coach of any broken or defective equipment, and remove it from service until repairs are made.

Hearing Protection

Make sure hearing protection devices such as earplugs and sound guards are available where there are objectionable/questionable sound levels. The Team Coach can provide assistance in evaluating high-noise tasks and determining appropriate hearing protection devices.

* Earplugs should be worn at all times when in the pit and at competition.

Foot Protection

When at competition:

* All team members must wear shoes that completely cover the entire foot.
* Shoes must have closed-toes and closed-heels to protect against foot injuries, regardless of work location.
* Flip-Flops, Sandals, Mules, Crocs, etc. are **NOT**acceptablewhen working on or near the robot or while attendingcompetitions.
* In some cases, safety shoes or toe guards are appropriate for areas where heavy objects can fall and cause foot injuries
* Notify the Safety Officer or Coach if safety situations arise, and determine the safest way to perform the task.

Other Preventatives

There are simple things that everybody can do to keep themselves and the team safe.

* Ensure that team members and mentors are not wearing ties, dangling clothing, jewelry, lanyards or hanging key chains when near or working on moving or rotating machinery.
* Long hair must be tied back or covered.
* Be sure that all rings, watches, and bracelets are removed.
* If the ring cannot be removed, simply tape over the ring.

General Safety

• Follow all safe work practices, use tools safely, and maintain a healthy attitude regarding safety.

• Always walk and work in a controlled and thoughtful manner.

• Wear closed-toe and closed heel shoes, gloves where needed, and use hearing protection if necessary.

• Keep full control of robot at all times with no one in the robot's path at any time.

* Assist other teams with safety issues.
* Take special care when working above normal height.
* Always fully open a ladder and never stand on a non-approved step.
* When using a ladder always have someone there as a spotter.
* Never distract someone using a hand or power tool.

Competition Safety

• Use the buddy system when traveling and while at events.

• Travel safely and carefully between the Pit, the Practice Field, and the Playing Field.

• Demonstrate safe behaviors in the heat of competition.

• Exhibit a planned, safe lifting procedure of the robot, including cart removal after the lift.

• Make sure the robot is properly secured when working around or underneath it.

* Never set the robot on an unstable, un-stationary surface.
* Power off the robot entirely when working on it.

• Assist and mentor other teams with safety issues.

* Use the buddy system when working on the robot and using power tools
* Be aware of maintaining a safe work environment at all times.

Pit Station Safety

* Control access to the Pit area to prevent distraction to the construction crew.
* Visitors are required to comply with PPE rules.
* Keep the aisle clear for pedestrians and robot transit.
* When transporting the robot, politely keep pedestrians alert to its movement.
* Always adhere to the safety specifics in the “At the Events” section of the FRC Manual.
* ***No*** Team Pit Station structures, signs, banners, or displays may be higher than 10 feet above the floor.
* Be considerate of pit station boundaries.

Setting up the Team Pit Station

* Securely mount team pit station signs, banners, and displays to the structure
* Bring glasses and use work gloves for uncrating and re-crating.
* Design and set up Pit Station safely.
* Properly 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.
* Small, bench-top band saws and drill presses, with appropriate guards, are allowed in team Pit Stations.
* Use proper tools to safely hang banners. Banners must also adhere to the ten-foot height limit.

Working in the Pit Station

* Properly use and secure power strips; do not daisy chain
* Keep the work area neat and orderly.

**Participants should be wearing approved personal protective equipment, PPE, in the Pit at all times, including:**

* Safety goggles over prescription glasses, or prescription safety glasses that are agency approved

**Appropriate footwear:**

* No open-toe or open heel shoes or sandals.

Using the Practice Area/Field

* If the 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 not exceed the practice area.
* It will 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 safety glasses and use safe lifting practices.
* Make sure the 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 and should be cooperated with at all times.

Hotel Safety

* When a mentor comes to do room check, Team Members are expected to be in their room and stay there until morning.
* No boys in girls rooms and vice versa unless a chaperone is around.
* Never go anywhere alone, always use the buddy system.

SAFE ROBOT LIFTING, HANDLING, AND TRANSPORTING

Proper lifting technique is just as important as any other part of competition. By knowing and practicing proper lifting technique injury can be prevented.

Pre-Lift Checklist:

* Are all transporters wearing PPE devices?
* Is the robot stable and safe to move?
* Are all parts of the robot secured?
* Is the robot powered off?
* Is anyone still working on the robot?
* Has the robot been disconnected from the tethered point?
* Has a pre-lift briefing to determine direction and path taken place?
* Is the area and path clear of debris and hazards?
* Are there enough team members to perform the lift safely?

During the Lift

* Appoint team members to coordinate the lift to make sure everyone is ready to begin.
* Appoint one team member to be in charge of the lift.
* Each lifter should place his/her feet close to the robot and adopt a balanced, bent knee position.
* All persons should lift at the same time using proper body mechanics.

**Which includes:**

* Lift with the legs, keeping back straight.
* Do not twist body. Use feet if there is a need to turn.
* Use proper hand holds to grasp the robot and ensure a safe, secure lift point before starting the lift.
* Bend knees to a comfortable degree and get a good handhold. Maintain normal spinal curves.
* Tighten stomach muscles and commence lifting the robot, using leg muscles if lifting the robot up from the floor.
* Keep the robot close to the body, and coordinate lift speed with other team mates.
* Make sure the cart is stable and will not roll.
* Coordinate correct placement on the cart and ensure robot is secure.

Post Match

* 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 or Practice Field, no dangling parts, loose hardware, etc.
* Remove debris from the Playing Field or Practice 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.

Transporting

* Make sure the robot is secured to the cart.
* Make sure that the robot is disconnected from the tethered point.
* Keep the cart under control at all times, especially in transit, removing or placing the robot.
* Use Gracious Professionalism around others to prevent damage or injury.
* Do not include music on the robot cart.
* 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.

GENERAL TOOL SAFETY

SOLDERING

Soldering can be dangerous because of heat from the soldering iron and the chemical fumes as well released from the solder and flux.

**When soldering, observe the following points:**

* Use lead-free solder only.
* Solder with electrically heated soldering iron/gun only.
* No torches or open flames of any kind are allowed indoors.
* Wear eye and face protection as per PPE regulation.
* Solder in well-ventilated areas.
* Never touch the iron which heats to extreme temperatures as it will cause severe burns.

**To prevent burns due to chemical:**

* Wear cotton clothing that covers entire body
* Always wash hands with soap and water after handling solder.
* Work on a fire resistant surface.
* Keep the soldering iron in its protective holder when not in hand.
* Do not leave any hot tools, where they can accidentally come into contact with a person or flammable items.

HAND TOOLS

Constructing a robot will sometimes 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 handheld tool or implement used to accomplish a task.

 **This includes all sorts of things used to:**

* Grasp
* Lift
* Push
* Pull
* Carry
* Clean
* Always use the proper tool for the job.
* **DO NOT** use a wrench for a hammer or a screwdriver as a chisel.

Tool Rules

Hand tools are essential to building a robot. It is important to know how to use them properly.

* Check the tool to see if it is in good condition. Don’t use defective, dull, or broken tools.
* Do not put damaged tools back on the shelf; remove the tools from service and notify the Safety Officer and mentor so the tools can be replaced or sent for repair.
* When using a screwdriver or other tools, place the work on a bench or a hard, stable surface rather than holding the item to be worked on
* When using knives/blades, direct cutting strokes away from hands and body, and be aware of those surrounding the work area.
* Wear proper PPE.

*Tool Storage*

* Store sharp-edged or pointed tools in a safe place.
* When carrying hand tools, cover the point or edges with shields. **NEVER** carry unshielded tools in a pocket.
* Do not leave tools on overhead work surfaces which could fall and strike someone below.
* Store equipment in a location where it will not create a safety hazard or get damaged.

ENERGY

It is always important to be aware of different types of energy which can be encountered when building a robot.

STORED ENERGY

* Plan out the required activities when servicing or making repairs to the robot. Make sure all teammates are aware that work is being done on the robot.
* Ensure no one is working on the robot when it will be energized during repairs.

Electrical Energy

* Disconnect the electric power source
* Always de-energize the robot before working on it by unplugging batteries.
* Remember to open the main circuit breaker which releases the re-set lever.

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.

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.

BATTERY SAFETY

Batteries contain acid. This substance, H2SO4, is a corrosive, colorless liquid that will burn your eyes, skin, and clothing.

* The Safety Officer will post the Material Safety Data Sheet for the battery in use in the pit area and train all team members about battery safety.

General Damaged Battery Information/Warnings

Any battery that is visibly damaged in any way is dangerous and unusable, and should be put aside and handled accordingly.

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

Treatment

* Immediately flush any contacted skin with a large quantity of water.
* Seek immediate 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. **\*\*\***
* When in doubt, don't take a chance. Don’t use it!
* Treat a damaged battery as a hazardous material and process it in accordance with the battery's MSDS.

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.

Procedure for Handling a Leaking Battery

When an electrolyte leak occurs:

* Neutralize battery acid 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.
* Put on the gloves before handling the battery.
* Place the battery in the leak-proof container for removal.
* Be sure to neutralize any acid on the gloves before removing and storing them.
* Follow emergency handling instructions of the MSDS, and notify mentor.
* Seek medical attention if necessary.
* Properly dispose of the battery, which is now a hazardous material.

Charging and Handling

* When a battery is neither connected to the robot nor the battery charger, use the battery protector safety plugs *FIRST* provides in the Kit of Parts.
* Keep the batteries charging area clean and orderly.
* Place the 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.
* If a quick disconnect is not available and tools are needed to disconnect the battery, make sure metal tools don’t contact both terminals at the same time.
* Do not charge at greater than the manufacturer’s maximum recommended rate.

Ongoing Battery Inspection

* Periodically inspect batteries for any evidence of damage, such as a cracked case or leaking electrolyte.
* Bent terminals can also be a potential leak source.
* After each competition round, inspect the battery.
* Check battery again prior to competing in each round.

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 that maybe used as part of the FRC. Read safety precautions and usage instructions located on the chemical’s label.
* Store all chemicals in an orderly way.
* Obtain Material Safety Data Sheets (MSDS) for the chemicals to be used. These sheets provide information on the correct handling of a spill or injury.
* If exposed to a chemical, notify the Safety Officer and Team Coach immediately and consult the MSDS if necessary.
* Don’t use any highly flammable materials, such as cleaning solutions, at *FIRST* events.

RESPECT OF ELECTRICITY

Proper use and respect for electricity is paramount. The following are general guidelines for

ensuring that basic electrical safety requirements are met.

* Inspect your equipment cords and extension cords routinely to ensure that they are in good condition.
* DO NOT overload electrical fixtures and/or receptacles.
* Avoid the following electrical power supply setups to prevent overloading.
* Power strip plugged into another power strip also known as ‘Daisy Chaining’, is strictly prohibited.
* Extension cord plugged into another extension cord also known as ‘Daisy Chaining’, is strictly prohibited.
* Multi-device receptacle plugged into a power strip or extension cord is strictly prohibited.

**Remember to have fun and stay safe!**

