FRC
FIRST® Robotics Competition

Team Safety Manual

FIRST

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

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 (FRC) 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.

PURPOSE

This safety manual is an easy-to-use guide for important safety information and provides FRC participants with a basic set of requirements to maintain a safe environment during the build season and at competition events.

SCOPE

This manual applies to anyone involved with the *FIRST* Robotics Competition including all student team members, Mentors, and support volunteers.

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 be safe. Below are the expectations for FRC participants.

All Participants

- Be familiar with this manual, as well as understand and follow established safety requirements applicable to your work area.
- Be familiar with any site restrictions listed in the "Site Info" listed on event entry on the FRC Regional and District Events page regarding competition site location(s).
- 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 the student Safety Captain, Mentor, and/or Safety Advisor. This includes work practices that may cause an accident. Encourage safe behaviors in everyone around you.

Mentors

- Lead by example. Practice the same safety behaviors that we expect from the students.
- Provide guidance and encouragement on a safe working environment.
- Provide leadership and guidance on a safe environment, including proper tool usage and safety as outlined in the Hand Tool section on page 6.
- Offer safety design considerations to the team so the robot itself is designed to eliminate or minimize hazards to an acceptable level.
- Familiarize yourself with relevant event safety and restrictions by reading the "At the Events" section of the FRC Manual and "Site Info" for your event(s). Go over it with the team prior to an event.
- Coach the student Safety Captain to ensure that he/she understands and adequately fulfills the position's responsibilities (see below).
- Collect and store Material Safety Data Sheets (MSDS) for any chemicals, paint, and batteries, etc. the team uses. You can obtain the MSDS 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 MSDS storage location.

Student Safety Captains

- Coordinate, deliver, and track safety training for the individual team members. It is suggested that teams bring their training log to events and continue to make comments about infractions and/or continuing improvements.
- 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. (For an example of a Safety Checklist and Corrective Action Plan, see Appendices A and B)
- Encourage your team to display positive safety behaviors at all times.
- Know where to find and become familiar with the Material Safety Data Sheets (MSDS) and related emergency procedures. (See Appendix C)
- Be ready to informally present your safety program to Safety Advisors at the event, if given the opportunity.

YOUTH PROTECTION PROGRAM

FIRST strives to create an environment in which team members can grow, learn, and have fun with minimal risk of injury. For more information about the Youth Protection Program (*FIRST* YPP) requirements and available resources, please visit http://www.usfirst.org/aboutus/youth-protection-program.
NOTE: In order to be eligible for event registration for teams in the United States and Canada, each team's Main and Alternate Contact must be successfully screened through TIMS (Team Information Management System).

INJURY REPORTING REQUIREMENT

Regardless of severity, report all accidents, injuries, and close calls to your team's Mentor and Safety Captain. Even injuries that appear minor may become serious if proper medical attention is not provided in a timely manner.

When at *FIRST* events, report all injuries to the Pit Administration Supervisor. He or she will document the injury or illness on a Medical Incident Report Form.

SAFETY INSPECTIONS

The Safety Captain should inspect the work areas on a routine basis. Determine and document the frequency of inspections by the potential risk in the work. Refer to Appendices A and B of this Manual for a sample Safety Checklist and Corrective Actions Plan (Note: these are guidelines and may be expanded upon). Where applicable, develop and close out corrective actions for identified deficiencies in a timely manner.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The proper use of personal protective equipment (PPE) is an important element to help ensure FRC 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 a robot. All PPE must be ANSI-approved, UL-Listed, or CSA rated, as applicable.

Eye and Face Protection

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

Safety Glasses Requirements

Wear ANSI-approved, UL Listed, or CSA rated non-shaded safety glasses. 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, or CSA rated eye protection is prohibited.

Prescription Glasses

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 side shields.

Wear eye protection in the following situations:

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

At *FIRST* events:

- Anywhere in the Pit Station including walk ways and Team Pits
- On the Playing Field
- On the Practice Field
- Any area posted with signs requiring the use of eye protection (such as the Machine Shop)

Hand Protection

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

FRC participants should work with their Mentor to ensure the selected glove is the correct one to use for each project. 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.

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.

Hearing Protection

Make hearing protection devices available, such as earplugs, where there are objectionable/questionable sound levels. A Mentor can provide assistance in evaluating high-noise tasks and determining appropriate hearing protection devices.

Foot Protection

When engaged in *FIRST* activities, FRC 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.

Spectators attending *FIRST* competitions should follow these footwear rules. If substantial close-toed shoes are not available, they may enter the pit area as long as they remain in the pit aisles. Please note that loose sandals (like flip-flops) or bare feet are not permitted in the pit area under any circumstances. Spectators that do not meet the footwear requirement for participants, as described above, are not allowed inside individual team pit areas or where robots are being worked on.

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.

Other Preventives

Ensure that team members or Mentors are not wearing ties, loose clothing, jewelry, or hanging key chains when near or working on moving or rotating machinery. Tie hair back or cover it.

GENERAL SAFETY REQUIREMENTS

The following are some areas, practices, and functions for which teams will be observed and monitored for safety conformity and innovation. This list is not all-inclusive. At events, Safety Advisors and your peers will observe and report any positive and negative safety practices. Running and horseplay is not permitted at any time.

- Follow safe work practices, including safe use of all tools and 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.

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

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.

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.

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.

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.

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

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

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 Material Safety Data Sheet (MSDS, see example in Appendix C) for the battery in use and train all team members about battery safety. You can find emergency handling and first aid procedures on the MSDS, along with proper protection for handling cracked or damaged batteries, and information on disposal of the battery.

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 MSDS.
- Don't take a chance- don't use it!

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.

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 MSDS and notify Mentor.
- Put on the 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.

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.

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.
- Do not charge battery at greater than the manufacturer's maximum recommended rate.

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

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 FRC. Read safety precautions and instructions for use located on the chemical's label.
- Store all chemicals in an orderly way. Obtain Material Safety Data Sheets (MSDS) 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 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 basic electrical safety requirements are met:

- Inspect your equipment cords and extension cords routinely to ensure they are in good condition.
- DO NOT overload electrical fixtures and/or receptacles.
- DO NOT "daisy chain" – plug a power strip into another power strip.
- 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.

AT THE EVENTS:

Follow the following safety considerations at FRC Event(s):

- Safety glasses are required *everywhere* in the Pit.
- To gain entrance to the Pit, every person will have to wear a pair of safety glasses or or safety rated prescription glasses with side shields.
- Don't ship all safety glasses or side shields in the crate. 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 techniques.

Setting Up the Team Pit Station

- Bring and use work gloves for uncrating and re-crating
- 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 Staion

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.

Pit Age Requirement

Children twelve and under must have a person eighteen or older with them at all times. There will be child safety glasses available to borrow and return. Child strollers and baby carriages are not allowed within the individual Pit Stations.

Pit Station Safety

Control access to your Pit Station; visitors are required to comply with PPE rules. Keep the aisle immediately outside your Pit Station clear for pedestrians and robot transit. When transporting your robot, politely keep pedestrians alert to your movement. Adhere to the specifics in the FRC Competition Manual, "At the Events" section:

- 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. Remember, 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

Working in the Pit

- Properly use power strips (do not "daisy chain" – plug a power strip into another power strip)
- Keep the work area neat and orderly
- Participants should be wearing approved personal protective equipment, PPE, in the Pit at all times, including:
- ANSI-approved, UL Listed, or CSA rated, non-shaded safety glasses or safety rated prescription glasses with approved side shields must be worn at all times in the Pit area
- Wear substantial shoes that completely cover the entire foot are required inside the Pit area. Lightweight shoes should not be worn to a competition.

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 not exceed 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 protective equipment 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.

SAFE ROBOT LIFTING, HANDLING, AND TRANSPORTING

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.

Pre-Lift Procedures:

- Ensure all transporters are wearing PPE (safety glasses, gloves, etc.)
- 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.

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 the 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

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

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.
- 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

SAFETY AWARENESS AND RECOGNITION PROGRAMS

Key Objectives

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

a. Ensure participants, staff and the public 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 Industrial Safety Award sponsored by Underwriters Laboratories
d. Publically recognize other Teams for safe practices

The Safety Advisors and FRC participants will rate safe performance in three key areas:

1. Safe Behavior
2. Physical Conditions
3. Personal Protective Equipment (PPE) Usage

The program uses coaching, positive reinforcement and public recognition to meet its objectives. The Safety Advisors with input from FRC participants will select the teams that best meet the program objectives. Please read below for a description of the expected "safe" activities that Safety Advisors and participants will assess over the course of a typical FRC event.

Safety Advisory Process

Prior to the competition, Mentors should coach participants on working together and show the students how to use equipment and construct, operate, repair, and move the robot safely.

Throughout the competition, the easily recognizable, green-shirted Safety Advisors will observe activities in the Pit, practice field, queue line, and playing fields to identify the safety habits of the teams. This includes observing the uncrating/un-bagging of robots and transporting them between the Pit and playing fields. Teams should not hesitate to talk with the Safety Advisors and ask questions.

The 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 FRC participants, will select the three (3) teams to win the Hard Hat Pin Award and designate the "Star of the Day" person to a Mentor or Student.

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 Safety Captain will have an opportunity to give a five minute informal presentation of their team's safety program to a designated Safety Advisor. The Safety

Advisor team will use the information presented to evaluate each FRC team and provide coaching and mentoring throughout the competition.

Top 3 Safe Teams (Hard Hat Pin Award)

FRC participants will use the input card below to provide feedback to the Safety Advisors.

The Safety Advisors will use this information, as well as the following criteria, to determine the Hard Hat Pin Award winners:

1. Community Outreach
2. Safety Initiatives (at the event)
3. Program Presentations (Safety Program Development)

Teams will be provided with these input cards at the event. After practice day, one Highlighting Safety recommendation input card will be turned in by each team to Pit Administration each morning.

NOTE: The winner of the UL Industrial Safety Award is not eligible to receive these pins because that team will receive a separate pin during the closing awards ceremony.

Also, a '#1 in Pit Safety' poster may be awarded to a team during the two primary competition days at each event.

Star of the Day Award

The Safety Advisors, with input from FRC participants, will select the "Star of the Day" winners on the two primary competition days at each event. On the following day(s), you will be able to see the winner's name and team affiliation on a poster near Pit Administration. This will be visible 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 Advisors and FRC 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.

Industrial 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. The winning team consistently demonstrates excellence in industrial safety performance that shines throughout the competition from load-in to load-out.

Safety Advisors are volunteers who will observe all the teams and with input from FRC participants, select the Team that best meets the criteria for the UL Industrial Safety Award.

SAFETY IN YOUR WORK SPACES

We recommend that teams implement a safety program. You will find an inspection sheet in the Appendix, which will be a guideline at the 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 situations. 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 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.

GOOD LUCK AND BE SAFE!

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APPENDIX A: SAFETY CHECKLIST

Date: _____ **Location/Area:** _____ **Inspector(s):** _____

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	**HAND & PORTABLE TOOLS**				
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	**CHEMICALS**				
1	Are chemical containers properly labeled and in good condition with no sign of damage?				
2	Are MSDSs posted/readily available and team members aware?				
C	**ELECTRICAL**				
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?				
4	Are the batteries visibly ok, terminals not bent, and no cracks in case?				
D	**THE TEAM PIT STATION**				
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	**APPROVED PERSONAL PROTECTIVE EQUIPMENT (PPE)**				
1	Is PPE available for FRC Participants and their visitors?				
2	Is PPE worn by team members where required/posted?				
3	Is PPE properly maintained and stored?				
F	**RESPECT OF STORED ENERGY DANGERS**				
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?				

APPENDIX B: CORRECTIVE ACTION PLAN

Use this Corrective Action Plan to monitor changes your Mentor, Safety Captain, or the event Safety Advisor recommends.

ITEM NO.	DESCRIPTION AND CORRECTIVE ACTION	TARGET TIME	COMPLETION TIME	PERSON(S) RESPONSIBLE

Positive Findings:

Comments:

Appendix C

MATERIAL SAFETY DATA SHEET

Revision Date:Oct. 2008

Section I : Product and Manufacturer Identity

Product Name : Sealed Lead-Acid Battery

Manufacturer's Name and Address :

MK Batteries
8997-C YELLOWBRICK ROAD.
BALTIMORE, MD 21237 U.S.A.

Telephone :

410-238-1526
Fax: 410-238-1047
Web-site : http://www.mkbattery.com/

Section II : Composition/Information On Ingredients

Identification of single or mixed substance product : Mixed substance product.

※PBB spices or PBDE spices is not involved

Components	CAS #	Hazard Category	OSHA PEL	ACGIH TLV	% (By weight)
Lead	7439-92-1	Acute-Chronic	0.05 mg/m^3	0.15 mg/m^3	45 ~ 60%
Lead Dioxide	1309-60-0	Acute-Chronic	0.05 mg/m^3	0.15 mg/m^3	15 ~ 25%
Sulfuric Acid Electrolyte	7664-93-9	Acute-Chronic Reactive -Oxidizer	1.00 mg/m^3	1.00 mg/m^3	15 ~ 20%
Non-Hazardous Materials	N/A	Not applicable	N/A	N/A	5 ~ 10%

Section III : Physical / Chemical Properties

Boiling Point :	110℃ ~ 112℃
Vapor Pressure :	21 mm Hg. at 25℃
Vapor Density (AIR = 1) :	Electrolyte 3.4
Specific Gravity (H_2O = 1) :	1.270 ~ 1.335
Solubility in Water :	Sulfuric Acid is 100% soluble in water.
Appearance and Odor :	A battery is a solid article consisting of an opaque plastic case with two lead terminals; no apparent odor. Electrolyte is a liquid absorbed in glass mat material, a little pungent odor.

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Section IV : Fire - Fighting Measures

Flash Point :	Not Applicable
Flammable Limits :	Lower limit 4.10% (Hydrogen gas in air) Upper limit 74.20%
Extinguishing Media :	Class ABC, Dry chemical, CO2 or halon, or water spray
Auto – Ignition Temperature :	357℃(polypropylene), 245℃(ABS)

Special Fire Fighting Procedures : If batteries are on charge, turn off power. Use positive pressure, self-contained breathing apparatus in fighting fire. Water applied to electrolyte generates heat and causes it to spatter. Wear acid resistant clothing. Ventilate area well.

Unusual Fire and Explosion Hazards : Hydrogen gas may be produced and may explode if ignited. Remove all sources of ignition. Sulfuric acid vapors are generated upon overcharge and case failure. Avoid open flames/sparks/other sources of ignition near battery.

Section V : Stability and Reactivity

Stability :	Stable under normal conditions
Conditions to Avoid :	Avoid shorting circuit or sparks near battery. Avoid prolonged over-charging. Use only approved charging methods. Do not charge in gas tight containers. Sparks, open flames, keep battery away from strong oxidizers.

Section VI : First - Aid Measures

Battery Electrolyte :

Inhalation :	Remove to fresh air. Give oxygen or artificial respiration if needed. Get immediate medical attention.
Eye Contact :	Flush with plenty of water for at least 15 minutes. Get immediate medical attention.
Skin Contact :	Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes.
Ingestion :	Do not induce vomiting. Dilute by giving large quantities of water. If available give several glass of milk. Do not give anything by mouth to an unconscious person. Give CPR if breathing has stopped. Get immediate medical attention.

Routes of Entry :

Electrolyte: Harmful by all routes of entry.

Inhalation :

Electrolyte: Breathing of sulfuric acid vapors or mists may cause severe respiratory irritation.

Ingestion :

Electrolyte: May cause severe irritation of mouth, throat, esophagus, and stomach.

Skin Contact :

Electrolyte: Severe irritation, burns, and ulceration.

Eye Contact :

Electrolyte: Severe irritation, burns, cornea damage, and blindness.

Effects of Overexposure – Acute :

Electrolyte: Severe skin irritation, damage to cornea may cause blindness, upper respiratory irritation.

Effects of Overexposure – Chronic :

Electrolyte: Possible erosion of tooth enamel; inflammation of nose, throat, and bronchial tubes.

Carcinogenic :

Electrolyte: The International Agency for Research on Cancer (IARC) has classified " strong inorganic acid mist containing sulfuric acid" as a Category 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid or sulfuric acid solutions contained within the battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product, such as overcharging, may result in the generation of sulfuric acid mist.

Medical Conditions Generally Aggravated by Exposure :

Overexposure to sulfuric acid mist may cause lung damage and aggravate pulmonary conditions. Contact of electrolyte with skin may aggravate skin diseases such as eczema and contact dermatitis. Contact of electrolyte with eyes may damage cornea and/or cause blindness. Lead and its compounds can aggravate some forms of kidney, liver, and neurological and diseases.

Section VII : Accidental Release Measures

Steps to be Taken in Case of Broken Battery Case or Electrolyte Leakage : Avoid contact with acid materials. Use soda ash or lime to neutralize. Flush with water. Dispose of clean-up materials as a hazardous waste.

Waste Disposal Method : Dispose of in accordance with Federal, State and Local Regulations. Do not incinerate. Batteries should be shipped to a reclamation facility for recovery of the metal and plastic components as the proper method of waste management. Contact distributors for appropriate product return procedures.

Other Precautions : Do not charge in unventilated areas. Do not use organic solvents or other than recommended chemical cleaners on battery.

Procedures for cleanup. Avoid contact with any spilled material. Contain spill, isolate hazard area, and deny entry. Limit site access to emergency responders. Neutralize with sodium bicarbonate, soda ash, lime or other neutralizing agent. Place battery in suitable container for disposal. Dispose of contaminated material in accordance with applicable local, state and federal regulations. Sodium bicarbonate, soda ash, sand, lime or other neutralizing agent should be kept on-site for spill remediation.
Personal Precautions: Acid resistant aprons, boots and protective clothing. ANSI approved safety glasses with side shields/face shield recommended.

Environmental Precautions: Lead and its compounds and sulfuric acid can pose a severe threat to the environment. Contamination of water, soil and air should be prevented.

Section VIII : Exposure Controls/ Personal Protection

General :

Normal room ventilation is sufficient during normal use and handling.

Personal Protective Equipment (in the Event of Battery Case Breakage) :

Always wear safety glasses with side shields or full-face shield.
Use rubber or neoprene glove.
Wear acid resistant boots, apron or clothing.

Work / Hygienic Practices :

Remove jewelry, rings, watcher and any other metallic objects while working on batteries. All tools should be adequately insulated to avoid the possibility of shorting connections. Do not lay tools on top of battery. Be sure to discharge static electricity from tools and individual person by touching a grounded surface in the vicinity of the batteries, but away from cells. Batteries are heavy. Serious injury can result from improper lifting or installation. Do not lift, carry, install or remove cells by lifting or pulling the terminal posts for safety reasons and because terminal posts and post seals may be damaged. Do not wear nylon clothes or overalls as they can create static electricity. Do keep a fire extinguisher and emergency communications device in the work area.

Hazardous Decomposition Products	Combustion can produce carbon dioxide and carbon monoxide.

Hazardous Polymerization — Hazardous Polymerization has not been reported.

Section IX : Transport Information

NFPA Hazard Rating for Sulfuric Acid :

Flammability (Red) = 0 Health (Blue) = 3 Reactivity (Yellow) = 2

Transportation Information

Proper shipping name:
"Batteries, Wet, Non-Spillable, Electric Storage."

U.S. DOT :

DOT-Unregulated, meets the requirements of 49 CFR 173.159(d). They do not have an assigned UN number nor do they require additional DOT hazard labeling.

IATA / ICAO :

IATA/ICAO-Unregulated, meets the requirements of Special Provision A67. They are exempt from hazardous goods unregulations, and classified as a "Non-Spillable battery". The batteries have been tested according to packing instruction no. 806

The MK batteries are securely packaged, protected from short circuits and labled 'Non-Spillable". MK 's sealed lead-acid batteries are exempt from DOT Hazardous Material Regulation and IATA Dangerous Goods Regulations

For all modes of transportation, each battery and outer package must be labeled :

"Non-Spillable" or "Non-Spillable Battery". This label must be visible during transportation.

IMDG: Our batteries are authorized for transportation on deck or under deck storage on either a passenger or cargo vessel by passing the Vibration and Pressure Differential Tests as described in the International Maritime Dangerous Goods Regulations (IMDG).

Applied Standard : JIS C8702-1、8702-2、8702-3
IEC61056-1、61056-2、61056-3

Section X : Additional Information

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The Material Safety Data Sheet is supplied for informational purposes only. The information and recommendations contained herein have been compiled from sources believed to be reliable and represent current opinion on the subject. No warranty, guarantee, or representation is made by MK Battery as to the absolute correctness or sufficiency of any representation contained herein and MK Battery assumes no responsibility in connection therewith, nor can it be assumed that all acceptable safety measures are contained herein, or that additional measures may not be required under particular or exceptional conditions or circumstances.

APPENDIX D: SAFETY CAPTAIN MEETING

This information will be reviewed at the Safety Captain Meeting at each event.

- Be Safe, Be Kind, Be Gracious. Instilling a culture of safety throughout the build season, at Regional and District events, and the *FIRST* Championship is a fundamental goal of *FIRST*. The UL Safety Advisors are here to help promote safety during these events and in the heat of competition. You'll recognize us by our green shirts, and we'd love to hear about your team.

- Report all injuries and illness to the EMT stationed near the Pit Administration Desk.

- Gracious Professionalism® + Demonstrated Safety = Industrial Safety Award. One winner of the Industrial Safety Award sponsored by Underwriters Laboratories will be selected by the Safety
  Advisors based on their safety observations throughout the contest.

- **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 required at all times in the Pit Area and on the competition field. *FIRST* needs your help to enforce this rule. Please ask your guests and visitors to wear their safety glasses. Wear ANSI-approved, UL Listed, or CSA rated non-shaded safety glasses. 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 side shields.

- Children twelve (12) and under must have a person eighteen (18) or older with them at all times.

- 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.*

- No open flames in arena venue, except by authorized personnel and in approved locations (such as the Machine Shop).

- 10-foot height limit for equipment and displays in the Pits will be enforced.

- Highlighting Safety 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.**