Safety Manual

FIRST

Student Responsibilities

- Be familiar with any site restrictions regarding competition site locations
- Work in a safe and responsible manner
- Understand and follow established safety requirements
- Use personal protective equipment, safe guards, and other safety equipment when as required
- Identify and Report any unsafe or dangerous conditions to the Safety Captain or Mentor. This includes work practices that may cause an accident.
- Encourage safe behaviors in everyone around you

- **Mentor Responsibilities**
  - Lead by Example
  - Practice the same safety behaviors that is expected from students
  - Provide proper guidance, leadership, and encouragement to foster an environment of safety in the shop
  - Offer safety design considerations to the team so the robot is held to an acceptable level of safety
  - Familiarize yourself with relevant event safety and restrictions by reading and performing research on the appropriate information needed for the event
  - Coach the Safety Captain Captain to ensure that they understand and adequately fulfills the position's responsibilities
  - Collect and store Material Safety Data Sheets (MSDS) for any chemicals, paint, and batteries in use by the team. Become familiar with the MSDS and the related emergency procedures
  - Inform the Safety Captain of the MSDS storage location

- **Safety Captain Responsibilities**
  - Coordinate, deliver, and track safety training for the individual team members and continue to make comments about infractions and/or continuing improvements
  - Ensure safe practices are in use at the event and that each pit area remains safe
  - Provide support for any safety questions or concerns that may arise
  - Seek guidance from your team mentors
  - Know where to find, and become familiar with the MSDS and related emergency procedures
  - Perform safety inspections which will be defined later on

Injury Report

Regardless of severity, report all accidents, injuries, and near misses to a mentor and the Team Safety Captain; the safety captain will log the accident. Remember that each minor accident can be a precursor to a major accident. When at an event report all injuries to the Pit administration Supervisor. He or she will document the injury or illness on an 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. Where applicable, develop and close out corrective actions for identified deficiencies in safety. As part of the safety inspections the safety captain in conjunction with the machining captain may give out performance tests to machinists.

Safety In The Machine Shop

- Basic Safety
  - There are no earbuds or headphones allowed in the machine shop. When operating any kind of machinery, if wearing a hoodie or long sleeved shirt, tuck in the laces and roll back the sleeves to prevent being caught. When operating any machinery with moving parts (ex. Drill Press) NEVER wear gloves; gloves can be caught into the moving part of the machine and pull your hand in. When anywhere in the shop, always wear shoes that cover your entire foot. There is no gum allowed anywhere in the shop.

Safety In the Machine Shop

- Mechanical Guards
  - Mechanical guards need to be provided for power tools. 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.

Safety In the Machine Shop

- Hearing Protection
  - Use ear plugs or muffs if the situation requires them. If your not sure then ask the Safety Captain or Mentor

Safety In the Machine Shop

- Soldering
  - Always use lead free solder with electrically heated soldering iron/gun only, and only solder on a fire resistant surface.
  - When soldering, always make sure to wear eye protection and only solder in well ventilated areas. After handling solder, always wash your hands.
  - When you are finished soldering make sure to turn it off and put it back in its holder so it is not a danger to anyone or potentially cause a fire

- Tools
  - As a preface to this section if you are ever using a tool or machine and are not sure the appropriate use, way to use, or technique to be used DO NOT hesitate to ask shop personnel, machining captains, or a mentor for help. If you are unfamiliar with the use of a tool
  - <u>Tool Rules</u>
    - Before using any tool, check to see if it is in good condition. Never use defective, dull, or broken tools. Don’t put them back on the shelf; remove them from service and notify the safety captain, matching captain, or mentor so the tool can be replaced or sent for repair
    - When using handheld tools place the work on a hard surface
    - When using knives/blades, direct your cutting strokes away from your hand and body and be aware of those around you
    - Don’t leave tools on overhead work surfaces because they may fall and strike someone below

Drill Press

- Run drill at correct RPM for diameter of drill bit and material
- Always hold work in a vise or clamp to the drill table
- Use a correctly ground drill bit for the material being drilled
- Use the proper cutting fluid for the material being drilled
- Remove chips with a brush and never with your hand
- Ease up on drilling pressure as the drill starts to break through the bottom of the material
- Don’t use a dull or cracked rill
- Always inspect drill before use
- Always try to support part on parallels or a backing board when drilling thru material
- Never place taper shank tools such as large diameter drills or tapered shank reamers in a drill chuck
    - Only straight shank tools such as standard drills can be clamped in chucks
- Always clean drill shank and/or drill sleeve and spindle hole before mounting
- Remove taper shank tools from spindle or sleeve with a drill drift and hammer
- Never try to loosen the drill chuck while the power is on

Drill Press Continued…

- Never clean a machine while it is in motion
- If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit
- When drilling a deep hole withdraw the drill bit frequently clear chips and lubricate the bit
- Always remove the drill chuck key or the drill drift from the spindle immediately after using it
- Let the spindle stop on its own after turning off the power

Lathe Safety

- Ensure stock is properly secured and the chuck is reasonably tight
- Always remember to remove the key from the chuck
- Check to make sure the cutter is sharp
- Ensure tooling is properly secured
- Before running machine make sure the spindle is engaged and the lathe bed is clear of obstructions
- Make sure the spindle is rotating in the proper direction
- Use the proper speed and feed to the best of the ability of the machine
- Take cuts of reasonable depth
- To remove chips from the stock or bits use proper tooling (brush, rag, pliers)
- Always make sure power is off before putting the key in the chuck
- Remember to remove the key before applying power to the spindle
- When you are done clean the table, return the cutters to their designated locations, and return extra stock to the proper location
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Mill Safety

- Ensure stock is properly secured
- Check to make sure the cutter is sharp
- Ensure tooling is properly secured
- Before running machine make sure the spindle is engaged and the table is clear of obstructions
- Make sure the spindle is rotating in the proper direction
- Use the proper speed and feed to the best of the ability of the machine
- Take cuts of reasonable depth
- To remove chips from the stock or bits use proper tooling (brush, rag, pliers)
- Always make sure power is off before putting a wrench on the spindle
- Remember to remove the wrench before applying power to the spindle
- When you are done clean the table, return the cutters to their designated locations, and return extra stock to the proper location

Band Saw

- The upper guide and guard should be set as close to the work as possible
  - At least within ¼”
- If the band breaks, immediately shut off the power and stand clear until the machine has stopped
- Examine the blade before installing to see if it is cracked, do not install a cracked blade
- Use the proper pitch blade for the thickness of the material to be cut. There should be at least 2 teeth in the material when cutting aluminum, and three teeth when cutting steel
- If you run the saw blade too fast the blade will wear out quickly
- If the saw stalls in a cut turn the power off and reverse the blade by hand to free it

Grinding Machine

- Special training is required before using the surface grinder
- Abrasive wheel machinery shall not be operated without the appropriate guards in place
- Tool Rests on bench or pedestal grinders shall be set no more than 1/16” from the wheel
- Never use a wheel that has been dropped or received a heavy blow, even though there may be no apparent damage. Such wheels may be weakened or unbalanced enough to fly apart on startup
- Stand to one side when starting a grinding machine
    - This is done because damaged wheels are most likely to fall apart when the machine is being started
- Do not grind on side of wheel unless wheel is specifically designed for such use
- Do not use excessive pressure while grinding
- Report to the area supervisor immediately any cracked, broken , or defective wheels
- Have the area supervisor mount balance new wheels

Grinding Machine Continued…

- Keep the grinding wheel dressed dressing a small amount frequently is better than having to dress a lot later and will allow the wheel to cut faster, cooler, and with a better surface finish
- Dressing is cleaning and smoothing the surface of the grinding wheel
  - Hold the work securely while grinding use the tool rest to support the work when off-hand grinding on bench or pedestal grinders
- Do not grind aluminum. If aluminum must be ground check with a supervisor
  - Aluminum dust is explosive
- If a magnetic chuck is being used, on the surface grinder, make sure it is holding the work securely before starting to grind

Table Saw

- Stand to one side-never directly in line with-of work being fed through the saw
- Use proper blade for the material and type of cut. Don't use a rip blade for cross cutting or a crosscut blade for rip sawing. Do not use a plywood blade for anything but plywood
- Inspect the blade before using it, to make sure it is the proper blade and is sharp and free from cracks
- Never allow your fingers to get near the blade when sawing. Use a pusher stick to rip narrow pieces of stock. Don't use pusher stick to remove scrap. For scrap removal, shut off machine and wait until blade stops, then remove scraps
- Appropriate guards must be in place at all times. Never remove the guard. Ask one of the shop personnel for help if you think the guard is in the wrong way
- If the piece of material you are cutting is large, get someone to assist in tailing off for you. Never try to do it alone tailing off refers to supporting a large workpiece by supporting it underneath with your hands

Table Saw Continued…

- If you are tailing off for someone else let them guide the work through the saw. You should just support the work without influencing the cut
- Never reach over the saw to obtain something from the other side
- When shutting off power, never attempt to stop the saw quickly by shoving anything against the blade. Make sure the saw has stopped before leaving it
- Never make any adjustments to the saw while it is running. Turn off the power and make sure the saw is completely stopped before attempting to adjust it
- Do not allow material to collect on or around the saw table. Sweep up sawdust and material scraps regularly while working to minimize chances of slipping or stumbling
- Make sure that you clean up thoroughly around the saw before leaving the area. If you don’t you culd be the cause of someone else have an accident
- The circular blade of the table saw should be set to ⅛” above the work

Disc and Belt Sander

- Do not operate sanders without guards in place
- On the disc sander always use the downward motion side of the disc to sand. Never the upward motion side as this can throw your part upwards with great force
- Always attempt to place your work against the rest on the disc and belt sanders
- On the horizontal belt sander, always sand, so that the belt motion is away from you
- DO NOT operate machines with torn or ripped belts or disks
- Do not sand any material that will give off a dangerous dust

- Power Hand (Skil) Saw
  - Unplug the tool before making any adjustments
  - Before using any power tool, inspect it to make sure the cord is not damaged in any way, that the ground pin is intact and that the blade is sharp or undamaged
  - Do not use the saw in a wet area
  - Do not run the extension cord across walkways where people might trip over it or where the cord may be run over and damaged
  - Keep you head out of the path of particles thrown out by the blade
  - Disconnect the power cord before cleaning changing blades, or making any adjustments to the saw
  - When it is necessary to raise the guard for certain types of cuts, use the guard lever
  - Never wedge wire or jam the guard to prevent it from working
    - Doing this will have your privilege of working in the machine shop revoked immediately

Power Hand (skil) Saw

- Wait until the saw stops before lifting it from a cut
- Before setting the saw down make sure the guard is closed as the blade may still be turning
- Don’t carry the saw with your fingers on the switch trigger
- Don’t pull the saw backwards in a cut if you can avoid it
- Use the proper blade for the type of cut to be made
- Do not use the cord to move or drag the saw
- Do not use the power hand saw for cuts if you cannot keep a firm and secure grip on the saw and the material being cut
    - A hand saw would be best for this kind of work
- Before cutting small workpieces shop personnel must be consulted
- Adjust the depth of cut ⅛” greater than the material thickness

- Guidelines for cleaning
  - Turn off power to the machine before cleaning
  - Remove cutting tools, take out drill bits, mills and remove lathe tools to reduce the chances of getting cut
  - When cleaning the table saw lower the blade completely
  - Put away all hand tools and other items around the tool so that you don't make make them dirtier
  - Clean chips from the tool with the chip pans. Recycle clean where possible
  - Put a light coat of oil on the machine ways. Ask staff to show where this oil is kept
  - Sweep the floor in the area where you have been working
  - Do not over use compressed air. Do not blow air into the bearing surfaces, and do not scatter chips all over the shop
  - Sometimes a vacuum works better than an air gun
  - Report missing, broken or damaged tools to the shop supervisor, Machine Captain, and Safety Captain
  - Clean up after yourself
  - Always remember that clean machines and tools are safer afer ones too

Handling of 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. Do not work on an energized robot unless absolutely necessary.

- Electrical Energy
  - Always disconnect the electric power source(taking the battery out)
  - Open the main circuit breaker
- Pneumatic Energy
  - Open the main vent valve and verify that all pressure gauges on the robot indicate that there is no pressure
- Miscellaneous Energy Sources
  - Relieve any compressed or stretched springs, bands, or tubing
  - Lower all raised robot arms or devices that could drop down to a lower position on the robot

Battery Safety

- Basic Battery Safety
  - Always carry batteries properly
    - Use both hands and never carry on shoulder
- Necessary Safety materials
  - Sodium bicarbonate to neutralize exposed electrolyte
  - A pair of acid resistant rubber or plastic leaf 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
  - 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
  - Put on the gloves before handling the battery
  - Place the battery in the leak proof container for removal

- Procedure for Handling a leaking battery
  - Be sure to neutralize any acid on the gloves before removing and storing them
  - Follow emergency handling instructions of the MSDS; notify mentor and safety captain
  - Seek medical attention
  - Properly dispose of the battery, which is now a hazardous material, treat it as such
- 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 and the battery could fail and or explode
  - If a quick disconnect is not available and you must use tools to disconnect the battery, make sure metal tools don’t contact both terminals at the same time
  - Do not charge battery at greater than the manufacturer’s maximum recommended rate

- Never have open drinks near batteries or battery chargers

- <u>Ongoing Battery Inspection</u>
  - Periodically inspect you batter 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 the battery before competing as well

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 chemical you use in the shop. Read safety precautions and instructions for use located on the chemical's label
- Store all chemicals in an orderly way
- If you are exposed to a chemical, notify your safety captain and team mentor immediately and consult the MSDS if necessary
- Don’t use any highly flammable materials at FIRST events

Electrical Safety

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

- Inspect equipment cords and extension cords often to make sure everything is in good condition
- Do not overload electrical fixtures and/or receptacles
- NEVER daisy chain surge protectors/power strips

Handling of Robot

Take a minute to make sure everybody on your team knows how to lift the robot properly and safely. Make sure before the season that everyone knows the procedures involved in lifting the robot not only safely but efficiently

<u>Pre Lift</u>

- Make sure you have a clear path to carry the robot
- Before lifting as yourself these questions
  - Are all parts of the robot secure?
  - Is the robot properly powered off and de-energized?
  - Is anyone still working on the Robot?
  - Are there enough people to perform the lift safely?
  - Are said people strong enough to perform the task at hand?
    - Remember that everybody, even you, has their limits

During the Lift

- Be properly balanced
- Communicate that everyone is ready to start the lift
- Adopt proper lifting techniques
    - Lift with your legs keeping your back straight throughout
    - Do not twist your body, use your feet 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 grip on the robot with your hands
- Make sure during before and after the lift that you are actively communicating with your teammates
- Remember to Always lift the robot by the frame and never by the bumper or drive train

Pit Safety

Setting Up the Pit Station

- Have the pit designed and set up properly to promote a safer environment for people to work in
- Be aware that there is a ten foot height limit for everywhere inside of the pit station
- Use the correct tools to hang the banner (if one is being used) and don’t let the banner cross the ten foot barrier either

Working in the pit

- Practice proper electrical safety
- Keep the work are clean and free from trash
- Eliminate all trip hazards
- Keep the pits as uncrowded as possible
    - There is not a lot of room to maneuver and cannot fit many people so if you are not needed in the pits stand outside of them
    - When the pits become to crowded accidents or people getting hurt is more likely to happen
- When running a systems check on the robot make sure to announce what you are doing and clear everyone away from danger and form the robot
    - Make sure to also say enabling to ensure that everyone knows what you are doing
- There is absolutely no open food or drink allowed in the pits

Questions?