MAE Student Design Center

Safety Steward Responsibilities

As a Safety Steward your job is to make sure the SDC remains safe, clean, and professional. Your role is crucial to maintaining the standards expected at the SDC. Even if you are not the steward on duty for your team, you must help keep a watchful eye on everyone while at the SDC. Below is a list of responsibilities for all Safety Stewards. ***Safety Stewards found being remiss in their duties will lose their facility use privileges.***

1. **Enforce all protocols outlined in the *Rules for Facility Use* document.** This includes policies for personal safety; equipment use; facility cleanliness, organization, and respect; proper language; use of the ***Material & Tool List*** and ***Broken / Lost Tooling List;*** and all other policies.

2. **Have a strong understanding of each machine at the SDC.** You can't effectively train students in proper equipment use unless you possess a solid understanding of each machine/process. You will also be ineffective at proactively identifying and preventing mistakes that cause injury or damage. This document contains advanced equipment operation and safety protocols on each machine with which you should be familiar.

3. **Train students on machines, administer equipment SOP assessments, and sign authorization sheets**. If a student requests machine training, it is your responsibility to train him/her to the standard expected and outlined in the safety protocols. After training, administer the assessment to evaluate their understanding of the safety protocols for each machine. If the student passes the assessment, add his/her name to the approved list of users for that machine so (s)he can use the machine with steward supervision in the future.

4. **Verify students are trained and authorized on each machine they use.** Your primary responsibility is to ensure students are trained and authorized on each machine they use by referencing your team's list of authorized users. ***Students caught using machines on which they are not authorized immediately lose all facility use privileges.***

5. **Setup each approved equipment user each time (s)he works on a new part.** Never allow approved users to setup equipment on their own. For example, if a user desires to cut a piece of steel tubing using a bandsaw, check its hardness with a file to ensure it is soft enough to cut with a bandsaw, select the appropriate bandsaw based on the material being cut, check that the blade pitch matches the material type and thickness (change if necessary), and assist the student in making the first cut. At this point the student can finish their work session on their own. Even if the same student desires to cut more steel tubing another day, the same checks will need to be made by the Safety Steward.

6. **Keep watch over powered machinery as it is being used.** Accidents can happen to the best trained users. Therefore even though all users of powered machinery must be trained to be allowed to use them, Safety Stewards must still keep a watchful eye to make sure machinery is being used safely and correctly. **It is imperative you intercede if you observe a student making a mistake on one of the machines, regardless of whether or not you are on duty.**

7. **Manage access to common use facility tools.** Common use facility tools like sanders and vacuum pumps can be checked out using the ***Material & Tool Use List*** and must be returned after use each work session. During checkout, a student must ask a Safety Steward to retrieve the item from its storage location. Upon return, a Safety Steward must check that the tool has been respectfully cleaned and that it functions properly before returning it to its storage location. Users who fail to clean and return tools each session will lose use privileges.

8. **Ensure students clean machines after each use and accept responsibility for stations not up to SDC cleaning standards**. Workstations should always be left cleaner than they are found. If users cannot clean their workstation(s) properly, facility use privileges should be revoked. That said, Safety Stewards will be held accountable for dirty workstations, so ensure users properly clean up after each use (not at the end of each work session, at which time cleaning will be easily or conveniently forgotten).

9. **Ensure students keep bays neat and clean.** A clean SDC communicates professionalism and appreciation. Teams should adhere to the cleanliness policies outlined in the ***Rules for Facility Use*** document and your job is to ensure they do. This includes spills, general trash, the strict no-food policy, as well as general tidiness. Balance being respectful and being stern.

10. **Safety Stewards are never required to assist other student groups**. This might sound odd, but Safety Stewards are NOT required to assist other student groups using the facility. The first reason is accountability: if a mistake occurs it's more difficult to assign responsibility. The second reason is that each group using the facility should care enough to put forth responsible members from their team for training instead of burdening other groups' stewards. That said, please feel free to help other student groups on occasion if their Safety Steward is not present, but please don't make a habit of doing so for the reasons mentioned.

11. **Report concerns, problems, or suggestions for improvement to the lab manager (mjb@ufl.edu) in an e-mail with *SDC* in the subject line.**

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SAFETY STEWARD TRAINING OUTLINES

Introduction:

The following are advanced operations and tasks you should understand as a Safety Steward. This material is not intended to replace a thorough understanding of the operating procedures outlined in the ***SDC Rules*** document, but rather to provide supplementary knowledge intended for those in supervisory positions.

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DELTA AND MSC VERTICAL BANDSAWS

Changing Blades:

Each blade is stored with a tag denoting its tooth pitch / range and appropriate machine. A higher blade pitch correlates to a lower TPI (tooth per inch) and therefore is meant for thicker materials. More teeth per inch means lower tooth pitch, which is used with thinner materials. Refer to the bandsaw chart above each bandsaw to ensure correct blade pitch.

1. **Always wear gloves because the bandsaw blades have sharp teeth.**
2. **Ensure machine is off and the power is disconnected.**
3. **Remove current blade from machine.** Open blade covers and loosen tension on the drive wheels until the blade can be pulled off and subsequently freed from the bandsaw.
4. **Coil blade for storage.** Point teeth away from you, step on bottom of blade, and twist around while lowering top half of blade. Blade should coil naturally into 3 loops.
5. **Remove tag from hook on machine and attach to coiled blade.** Ensure the correct tag stays on the correct blade, as failure to do so will result in ruined blades.
6. S**tore blade in proper location.** Ensure blades are stored coiled in the proper cabinet.
7. **Remove and hook new blade tag on machine.** This tag denotes the active blade on the machine and informs the next user if a different blade is necessary for the next part / job.
8. **Uncoil new blade.** Find an open area in the workshop, point teeth away from you, step on one of the three blade loops, and slowly uncoil bandsaw blade.
9. **Install new blade on machine.** Open covers and place blade on drive wheels and between the blade guides. Ensure teeth are pointing in the right direction (toward the user, and pointed tips down). Tension the blade until snug, and cycle the machine on and off in short bursts for a few rotations until the blade centers itself on the drive wheels. Finally, close the drive wheels and perform a test cut to ensure the new blade functions properly.

Changing Speeds:

1. **The Delta bandsaw does not have variable speed, and is therefore only suited for cutting wood or plastic.** ***NEVER CUT METALS ON THE DELTA BANDSAW.***
2. ***To change the speed on the MSC bandsaw, rotate the knob as far counterclockwise as possible, and then clockwise the correct number of turns (as shown on bandsaw chart hanging above), WHILE THE MACHINE IS RUNNING.***
3. **Reference the posted speed chart above the MSC bandsaw** to know what speeds should be used in what materials. Note that higher speeds are for softer materials.

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ROLL-IN VERTICAL GRAVITY FEED BANDSAW

Changing Blades:

Each blade is stored with a tag denoting its tooth pitch / range and appropriate machine. A higher blade pitch correlates to a lower TPI (tooth per inch) and therefore is meant for thicker materials. More teeth per inch means lower tooth pitch, which is used with thinner materials. Refer to the bandsaw chart above each bandsaw to ensure correct blade pitch.

1. **Always wear gloves because the bandsaw blades have sharp teeth.**
2. **Ensure machine is off and the power is disconnected.**
3. **Remove current blade from machine.** Retract the carriage completely using the carriage retract lever. Open blade covers and loosen tension on the drive wheels until the blade can be pulled off and subsequently freed from the bandsaw.
4. **Coil blade for storage.** Point teeth away from you, step on bottom of blade, and twist around while lowering top half of blade. Blade should coil naturally into 3 loops.
5. **Remove tag from hook on machine and attach to coiled blade.** Ensure the correct tag stays on the correct blade, as failure to do so will result in ruined blades.
6. S**tore blade in proper location.** Ensure blades are stored coiled in the proper cabinet.
7. **Remove and hook new blade tag on machine.** This tag denotes the active blade on the machine and informs the next user if a different blade is necessary for the next part / job.
8. **Uncoil new blade.** Find an open area in the workshop, point teeth away from you, step on one of the three blade loops, and slowly uncoil bandsaw blade.
9. **Install new blade on machine.** Open covers and place blade on drive wheels and between the blade guides. Ensure teeth are pointing in the right direction (toward the user, and pointed tips down). Tension the blade until snug, and cycle the machine on and off in short bursts for a few rotations until the blade centers itself on the drive wheels. Finally, close the drive wheels and perform a test cut to ensure the new blade functions properly.

Changing Speeds:

The Roll-In bandsaw has four speeds which are selected via the pulley ratios between the drive motor and drive wheel. The pulley ratios can be set to 1:4, 2:3, 3:2, or 4:1 (slowest to highest). Higher speeds are for softer material. To change speeds:

1. **Ensure machine is off** by hitting the red button on the front of the machine.
2. **Move carriage forward**, stopping near the end of its travel by shutting off the hydraulic feed valve. When closing the valve, make sure not to over-tighten the feed knob, as doing so will ruin the valve; ***a gentle twist is all that's ever required.***
3. **Uncover pulley set** by loosening and removing the black knob holding the orange sheet metal cover. Place cover in a safe place to ensure
4. Using the provided tool, **loosen pulley tension** by adjusting the threaded rod at the bottom of the machine.

Changing Speeds (continued):

5. **Change belt location to select desired ratio**.
6. **Re-tighten belt to proper tension** by re-adjusting the threaded rod at the bottom of the machine using the provided tool.
7. **Finally, hang appropriate speed indicator on display hook** to show others what speed the machine is set to. Put the other indicator on the storage hook on the rear of the machine.

Part Orientation:

Refer to the bandsaw chart for proper orientation of certain workpieces. **Always try to keep a consistent cross-sectional area in contact with the teeth at all times to ensure consistent cutting. Also, orient the part so it is in contact with the most teeth possible**. For example, flat stock has a consistent cross sectional area in both a vertical and horizontal orientation. However, orienting the part so that the cross section is taller than it is wide on a vertical bandsaw ensures the most teeth are in contact with the part.

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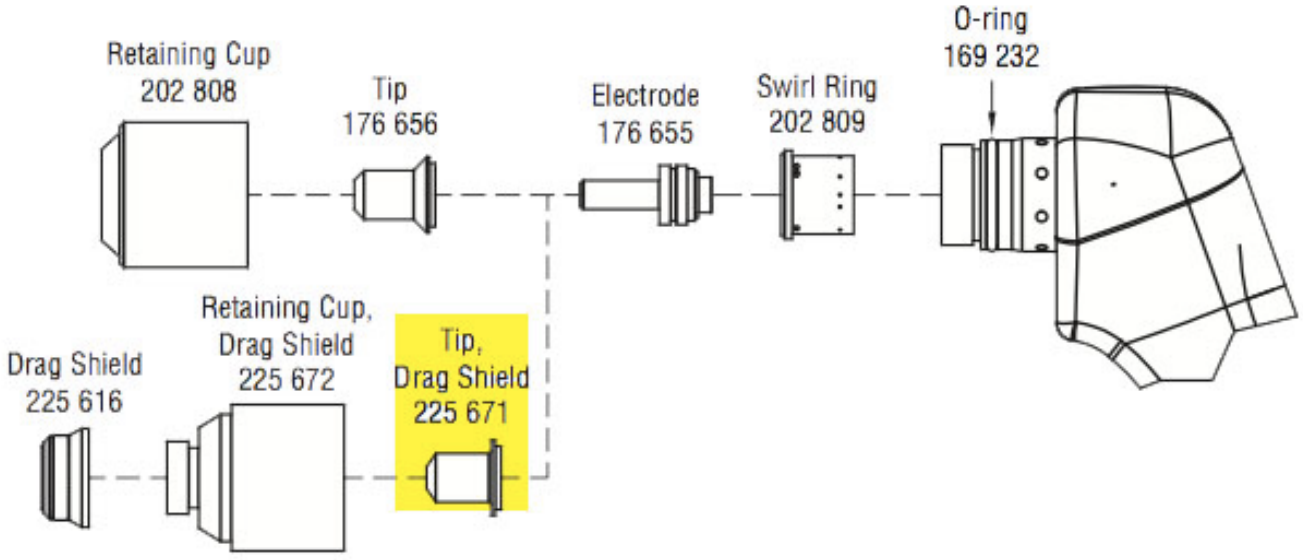
PLASMA CUTTER

Changing Cutting Torch Consumables:

Consumables are a normal wear item that should last for 5 – 8 hours of cutting. Worn consumables do not cause any damage to the plasma cutting unit; they just reduce cut quality. Therefore changing consumables prematurely wastes money. The proper procedure for changing consumables is noted below:

1. **Turn off power to the machine** (it is okay to leave the air supply turned on).
2. **Remove the retaining cup.** Do not use any tools, only your hands.
3. **Remove tip, inspect, and replace** if opening is deformed or 50% oversize.
4. **Remove electrode, inspect and replace** if center has a pit more than a 1/16" deep.
5. **Remove swirl ring, inspect and replace** if side holes are plugged.
6. **Check O-ring for cracks or worn spots,** and replace if necessary.
7. **Carefully reassemble parts in reverse order.**



Troubleshooting Tips:

1. If plasma cutter is activating but not cutting, ensure the ground clamp has been connected to the workpiece or the welding table and that the workpiece is conductive.

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MIG WELDER

General Tips for MIG Welding:

Besides understanding the safety procedures and basic operation of the MIG welding equipment, the following are a few tips and important things to know about the MIG welder to help students stay safe and prevent them from damaging the machine or their parts.

1. **Only weld material which has been cleaned thoroughly (using a sander, grinder, wire brush, wire wheel, etc.) and degreased with acetone or alcohol** to remove any residue which will contaminate the weld.
2. **Set the feedrate to ten times the voltage (3V/30ipm, 4V/40ipm, etc.).** The higher the voltage, the quicker the filler wire melts and the faster you should feed across your part. To ensure enough filler material is in your weld, proportionately increase the feedrate.
3. **Do everything you can to position yourself so you are comfortable prior to welding.**
4. **Keep electrode stick out within ½" of the gun tip** for best weld quality.
5. **Set welder one heat range higher for tack welds than for normal welding.** By definition tack welds start off cold, so the extra heat helps increase penetration. Just remember to turn the heat setting back down prior to final welding.
6. **Always run a test pass on a piece of scrap material of similar composition and thickness.** If your test passes don't turn out well, your real parts won't either.
7. **Make sure the gun nozzle remains clean and free of slag.** Periodically remove the brass nozzle on the end of the welding gun and clean the buildup from inside the nozzle with the MIG-specific needle-nose pliers. This prevents the copper contact tip from being damaged prematurely and negatively affecting the wire feed and weld quality.
8. **Use nozzle dip to help keep the nozzle clean and free from buildup** if welding for prolonged periods of time (>30 min). To apply the nozzle dip, heat up the tip of the welding gun by welding a 1" long bead on a piece of scrap metal for approximately 10 seconds, and then immediately dip the hot nozzle into the jar of nozzle dip approximately ½" deep. This will provide a protective coating that keeps slag from building up inside the nozzle.

Troubleshooting Tips:

1. If the MIG welder is on but won't weld, the heat range selector knob may have accidentally been placed between of the power settings. After reselecting the heat range try welding again.

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TIG WELDER (SEPARATE CERTIFICATION)

General Tips for TIG Welding:

Besides understanding the safety procedures and basic operation of the TIG welding equipment, the following are a few tips and important things to know about the TIG welder to help students stay safe and prevent them from damaging the machine or their parts.

1. **Only weld material which has been cleaned thoroughly (using a sander, grinder, wire brush, wire wheel, etc.) and degreased with acetone or alcohol** to remove any residue which will contaminate the weld.
2. **Generally, adjust the current setting to 1 amp per 0.001" of material thickness.**
3. **Use only ceriated tungsten on the SDC inverter-style TIG welder** (never pure tungsten).
4. **Match the tungsten diameter (0.040", 1/16", 3/32", or 1/8") to the workpiece thickness.**
5. **Use the smallest filler wire size that won't melt prematurely before dipping into the puddle.**
6. **Keep electrode stick out within one radius of the TIG torch nozzle's end** for best weld quality.
7. **Keep the tip of the tungsten within 1/8" of the molten pool at all times when welding.**
8. **Do everything you can to position yourself so you are comfortable prior to welding.**
9. **Keep the filler wire in the shielding gas stream when not dipping into the puddle.**
10. **Upon completing each weld keep the shielding gas aimed at the solidifying weld pool for the entire duration of the post-flow timer setting (typically 7 – 10 seconds).** Pulling the torch away prematurely can cause contamination by surrounding oxygen.
11. **Minimize the torch angle to prevent shielding gas vortices from drawing in surrounding oxygen and contaminating the molted weld pool.**
12. **Be careful when setting the TIG torch down**, as the cup on the end of the torch is made of ceramic and is therefore very brittle.
13. **Always run a few test passes (welds) on scrap material of similar composition and thickness.** If your test passes don't turn out well, your real parts won't either.
14. **Spend time on WeldingTipsandTricks.com website for more training tips.**

Learning to TIG Weld:

The following strategy seems to work best for new students desiring to learn how to TIG weld:

15. **Purchase 1/16" diameter ceriated tungsten** from a vendor like Tig Depot, Cyber Weld, Airgas, or McMaster-Carr. We pay for the shielding gas and electricity, but students must provide their own Tungsten electrodes when using the TIG welder.
16. **Sharpen the tungsten on the dedicated tungsten grinder so it has a profile similar to the shape of a pencil tip** (see figure 1 below).

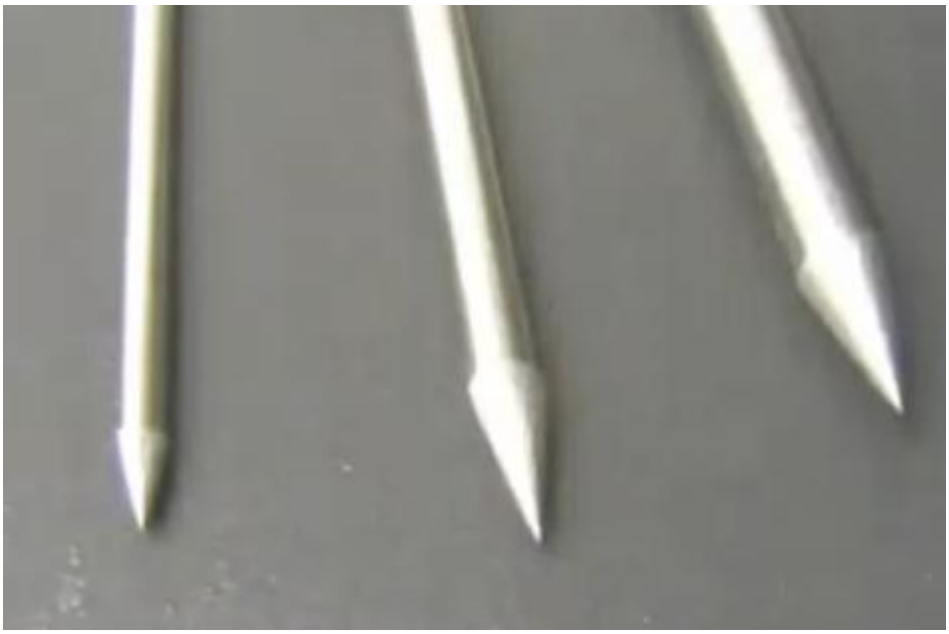

Figure 1: Properly sharpened tungsten electrodes

17. **Begin by making small welds without adding filler across a piece of 1/16" to 1/8" scrap steel** paying attention to weld visibility, speed, torch angle (< 20 degrees from vertical), electrode distance (within 1/8" of the molten pool), arc starting and stopping (slowly). Start with your dominant hand and then practice with your other hand. The torch velocity should be very consistent. Every 10 – 15 minutes dip the piece in water to prevent from overheating the welds. Keep the torch over the puddle for at least 5 seconds at the end of each weld.

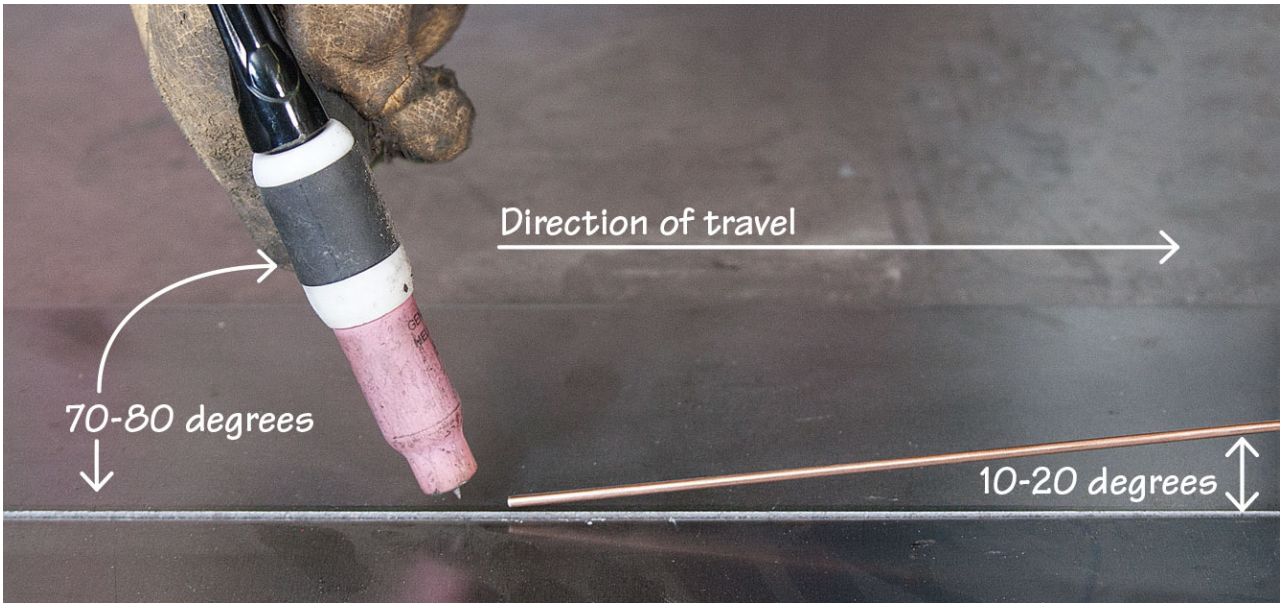

Figure 2: Proper torch angle, filler rod angle, and electrode distance

18. **Add filler wire into the molten pool.** Keep the filler rod angle < 20 degrees (as shown in figure 2) and keep the filler rod in the shielding gas in between dips. Remember to keep the torch over the puddle for at least 5 seconds at the end of each weld. Use consistent torch velocity, proper torch angle and electrode distance, and taper the heat off gradually at the end of each weld to avoid creating a crater (stress riser). Start with your dominant hand and then practice with your other hand. Every 10 – 15 minutes dip the piece in water to prevent from overheating the welds. Keep the torch over the puddle for at least 5 seconds at the end of each weld.
19. **Perform some lap and fillet welds on multiple pieces.**
20. **Practice, practice, practice.** This typically takes 15 – 30 hours. ***Do not even think about trying to TIG welding aluminum until you can TIG weld steel very well.***
21. **Section and inspect welds for penetration.** After a little practice anyone can run TIG welds that look nice but are of low quality. To know whether your welds are penetrating into the two base materials, you must cut a cross section through the weld, sand (180, 240, 320 grit discs), polish (red and then blue Scotchbrite disc), and etch the material to reveal the weld nugget for inspection. ***Etch steel test coupons with Naval Jelly (phosphoric acid) and aluminum coupons with Easy-Off Oven Cleaner.***