UNIVERSITY OF ALBERTA

DEPARTMENT OF MECHANICAL ENGINEERING

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SAFETY PROCEDURES AND PROTOCOLS

DEPARTMENT OF MECHANICAL ENGINEERING

Prepared by André McDonald, Albert Vette, Roger Marchand, and Khurram Mahmood

Current as of 29 October 2018

PART I – OVERVIEW

Safety is of paramount importance in the Department of Mechanical Engineering. The Department has taken proactive steps to institute procedures and protocols that are geared towards ensuring that work in laboratory, office, and teaching spaces is conducted safely to avoid the occurrence of incidents. In the rare cases when incidents do occur, the Department has formal protocols that it follows in order to ensure that incidents are properly reported and that corrective actions are taken immediately. The purpose of this document is to provide information on the procedures and protocols respecting safety in the Department of Mechanical Engineering.

PART II – ORGANIZATIONAL CHART FOR SAFETY

The Department of Mechanical Engineering has a management and organizational structure in place to address issues, set policies, and create protocols, in collaboration with the Faculty of Engineering and the University of Alberta, relating to safety. Figure 1 shows a schematic of the safety organizational chart.

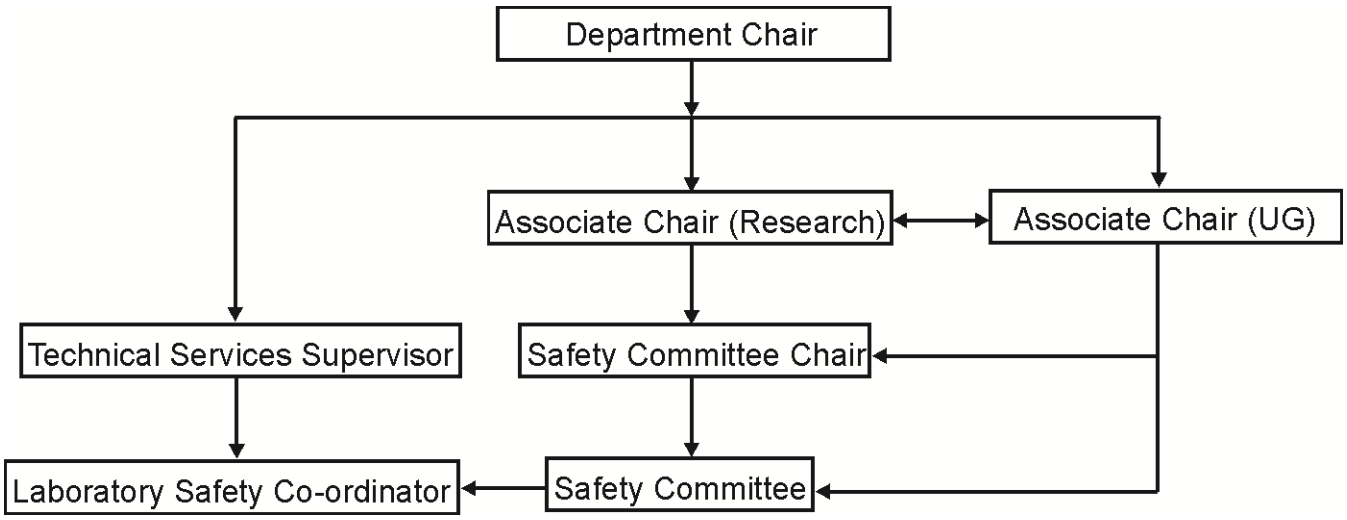


Figure 1: Schematic of the Safety Organizational Chart.

As of the current date of this document, the following individuals are participants within the management and organizational structure:

Department Chair: John Doucette, Ph.D., P.Eng.

Associate Chair (Research): André McDonald, Ph.D., B.S. Law, P.Eng.

Associate Chair (Undergraduate): Pierre Mertiny, Ph.D., P.Eng.

Technical Services Supervisor: Roger Marchand, C.E.T.

Safety Committee Chair: Albert Vette, Ph.D., P.Eng.

Laboratory Safety Coordinator: Khurram Mahmood

Safety Committee: Albert Vette, Ph.D., P.Eng. (Chair); John Doucette, Ph.D., P.Eng.; André McDonald, Ph.D., B.S. Law, P.Eng.; Kajsa Duke, Ph.D., P.Eng.; Khurram Mahmood; Roger Marchand, C.E.T.; Asha Rao, Associate Chair (Administration); Hossein Bahari (Graduate Student); Olanrewaju Bello (Graduate Student)

The *Engineering Faculty Council Appendix D* respecting Roles and Responsibilities for Dean, Associate Deans, Department Chairs, Associate Chairs, and Directors has provisioned that the Associate Chair (Research) chair the Safety Committee of the Department. With approval from the Department Chair, the duties of the Associate Chair (Research) to chair the Safety Committee may be delegated. In this case, a separate safety committee chair position was created, and the duties of managing the safety committee and issues relating to safety in the Department were delegated to the person who was chosen to serve as the safety committee chair. The Safety Committee oversees all safety matters in the Department, creates safety policy and procedures, as needed, and enforces rules and regulations that pertain to safety. The Technical Services Supervisor manages all technical services in the Department, including the Machine Shop and Maker and Design Spaces. The Technical Services Supervisor also manages the use of all equipment and technical services by students in both

the graduate and undergraduate programs. From time to time, the Associate Chair (Research), Safety Committee Chair, and Technical Services Supervisor will engage and coordinate with the Associate Chair (Undergraduate) regarding undergraduate student use of laboratory and Machine Shop space and safety issues as they relate to undergraduate course delivery and training.

PART III – GENERAL SAFETY RESOURCES AND PROCESSES

The general safety resources and processes of the Department of Mechanical Engineering are presented, in detail, on the Safety Resources website at https://www.ualberta.ca/mechanical-engineering/safety. Other actions that relate to safety take place through the Department of Mechanical Engineering Intranet site at https://www01.engineering.ualberta.ca/mece/. The Intranet is used primarily when personal information may need to be submitted. In some cases, the safety resources and other information that are available on the Department's website are linked or directed to the University of Alberta Environment Health and Safety Department at https://www.ualberta.ca/environment-health-safety/. All undergraduate students and graduate students, as well as research associates and academic visitors have access to the safety-related resources. The following are the major resources and processes that the Department has in place:

1. Department General Safety Orientation

The Department of Mechanical Engineering offers a general orientation to safety. This seminar is required for all students who have key or card access to the Mechanical Engineering (MEC E) Building or the National Institute of Nanotechnology (NINT) Building. The seminars are offered in September. Students are advised to contact the Safety Committee Chair if they were unable to attend the seminar. The presentation slides are available online at the Safety Resources webpage on the website of the Department of Mechanical Engineering under "Related Links", and under the heading, "Safety Orientation Slides (2018)".

2. Lab-Specific Safety Orientation

Lab-specific safety training and orientation is offered by the principal investigator (PI) of the research project or his or her delegate. This orientation covers general safety information, locations of safety equipment, safe operating procedures for the lab, and training on any specialized equipment that may be in use in the laboratory. Once this orientation is complete, the PI (or delegate) along with the student will sign-off on a form to document this training.

3. Planned Inspections

Monthly planned inspections of the laboratories of principal investigator faculty members are required by the Faculty of Engineering. To conduct the planned lab inspections, checklist guidelines or online inspection forms are suggested. The inspection frequency or the items on the lists can also be customized by the labs when they conduct hazard assessments.

4. WHMIS Training

WHMIS training is offered by the University of Alberta and consists of on-line modules and an on-line quiz.

5. Laboratory Safety Videos

Several laboratory safety videos are available, and they feature such topics as laboratory emergency evacuation, laboratory chemical waste, laboratory fume hoods, laboratory experimental design, laboratory personal protective equipment (PPE), and laboratory fire safety.

6. Office and Laboratory Key Requisition Process

The Department of Mechanical Engineering has a streamlined process in place for the requisition and acquisition of keys or access cards for offices and laboratory. Access to offices and laboratory spaces may strike at safety. Thus, at the time of requisition of keys or access cards on the Department's Intranet, undergraduate students and graduate students, as well as research associates and academic visitors must acknowledge that they: (i) have reviewed the employer/employee responsibilities (regarding unsafe work or conditions as per the Alberta *Occupational Health and Safety Act*, S.A. 2017, c. O-2.1 (as amended)); (ii) are aware of the

location of emergency eyewash stations and showers; (iii) are aware of the location of first aid kits and fire extinguisher, where applicable; (iv) are aware of personal protective equipment and have received training and fit requirements, if necessary; (v) are aware of the location of spill kit(s), if needed; (vi) have read the general lab rules of conduct; (vii) have reviewed any special safety instructions that apply to work in the space; and (viii) have identified the Department Safety Committee Members, for whom links are provided for contact information and their website (for general information).

The person(s) who request keys or access cards must upload the mandatory WHMIS certificate and the Laboratory and Chemical Safety certificate, if required. Students and visitors are directed to the WHMIS website at https://www.ualberta.ca/environment-health-safety/training/whmis and to the Laboratory and Chemical Safety website at https://www.ualberta.ca/environment-health-safety/training/laboratory-and-chemical-safety to take the courses and receive the certificates.

7. Incident Reporting

Although the Department of Mechanical Engineering has processes, protocols, and guidelines in place, incidents may inadvertently happen from time to time. The Government of Alberta mandates that all "near misses" and all "serious incidents" be reported immediately. Visitors to the Safety Resources webpage are directed to the incidents information and action page at https://www.ualberta.ca/environment-health-safety/report-an-incident to report incidents or “near misses”.

PART IV – INTEGRATION OF SAFETY INTO UNDERGRADUATE COURSES

Safety is an integral component of undergraduate laboratory and design courses in which work in laboratory and the Machine Shop spaces takes place or where students work with equipment or chemicals as an element of their course training.

MEC E 260 on Mechanical Design I is a second year Department of Mechanical Engineering course, and the first course in which undergraduate students in Mechanical Engineering receive training in a space or laboratory that is under the authority, control, and jurisdiction of

the Department of Mechanical Engineering. This course is part of their training in the accredited Mechanical Engineering program. Here, students: (i) complete the WHMIS training and receive a certificate; (ii) participate in the training program that is offered by the Machine Shop on the proper and safe use of equipment such as, but not limited to, drill presses, shear, rollers, spot welder, 3D printer, and laser cutter; and (iii) are mandated to bring and wear safety glasses in the Machine Shop and laboratory spaces at all times in which they are working.

The formal safety training and certificate that students receive through the MEC E 260 course are reinforced and fully utilized in other core and elective laboratory and design courses that are taught later in the undergraduate program. As of the current date of this document, these courses include: (i) MEC E 301 on Mechanical Engineering Laboratory I; (ii) MEC E 364 on Manufacturing Processes; (iii) MEC E 403 on Mechanical Engineering Laboratory II; (iv) MEC E 409 on Experimental Design Project I; (v) MEC E 460 on Capstone Design Project; (vi) MEC E 464 on Design for Manufacture; and (vii) MEC E 495 on Research Project. Safety training and assessments will be components of the MEC E 301, MEC E 364, MEC E 403, MEC E 409, MEC E 460, MEC E 464, and MEC E 495 courses, as required for proper and safe delivery of the course content as designed by the Department of Mechanical Engineering to meet the established learning objectives of the courses.

APPENDIX A:

SAFETY TRAINING DOCUMENTS FOR THE MEC E 260 COURSE AND THE MECHANICAL ENGINEERING MAKER SPACE

The Department executes its policy of providing training on safety and assessment of the knowledge transferred during such training to undergraduate students in the Mechanical Engineering undergraduate program by utilizing several documents. All mentor sign-off activities are assessments of retention of safety knowledge after training and practice. Those documents and actions include:

- Safety training checklists;
- Standard operating procedures;
- Hazard assessments;
- Mentor sign-off documents; and
- Machine usage workflow documents.

Documents that relate to these activities have been annexed to this Appendix. These documents that are annexed herein relate only to the drill press and the band saw because of the higher risk of personal harm that they pose during operation. Going forward, similar documents will be developed for lower risk equipment and tools.

The Machine shop is open for business from 8:00 AM to 4:30 PM, Monday through Friday, for drop-in, *ad hoc* activities. Please check the schedule for any variations.

The Mechanical Engineering maker workshop is available for students to use outside of normal business hours. A maker workshop orientation session and machine specific training is also required. The maker workshop is a mentor-monitored workshop and based on the nature and quality of the activity and projects, appropriate training will be provided prior to operating any equipment. Refresher sessions are also offered.

Teaching assistants of undergraduate Mechanical Engineering courses also receive special training that allow them to instruct laboratory and some design courses in which safety or safe handling of equipment or tools is a mandatory requirement. For teaching assistants whose assignment(s) involve work in a laboratory, they are required to complete online training that is available at https://www.ualberta.ca/environment-health-safety/training/supervisory-ehs-professional-development. This training is required whether or not the graduate student teaching assistant has worked in the capacity of a teaching assistant at the University of Alberta in the past.

BAND SAW SAFETY DOCUMENTS

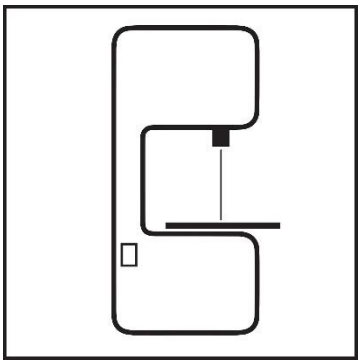
Training Checklist
Bandsaw

Name of Mentor: _____ **Date:** _____

List of Makers (Max. 4)

1. _____
2. _____
3. _____
4. _____

Training Objectives
1. Proper PPE and Standard Procedures
2. Familiarity with the ON/OFF switch
3. Blade Guard Adjustment
4. Finger Positioning and Usage of Push Sticks
5. Housekeeping Rules



The bandsaw is a very versatile machine. It can be used for a wide variety of operations. Its main use is for cutting curves or for cutting straight lines on pieces that do not have the straight edge required for any circular saw blade. It does have fences for straight cutting, however the blade cuts straight downwards into the table making freehand cuts possible. The only real drawbacks to the bandsaw are cut accuracy (which depends on the user) and the finish quality of the cuts.

Please tick relevant box after completion:

SAFETY OPERATION		✓
1	Safe Operating Procedure (PPE, etc.)	
2	Hazard Assessment discussion / location	
3	Allowed Materials (No round stock)	
4	Document locations (MEC E Makerspace Website)	

OPERATION		✓
1	Check for appropriate saw (number of teeth engaged on material)	
2	Guard blade adjustment (1/8” – 1/4” above the workpiece)	
3	Finger positioning (hazard zone on the table)	
4	Machine ON/OFF switch location and operation	
5	Making straight cuts (using push sticks for smaller workpieces)	
6	Removing workpiece from machine after cutting	
7	Using the machine fence and the miter gauge (cutting notches)	
8	Cutting a profile (changing workpiece orientation and avoiding sideways pressure on the blade)	
9	Using relief cuts for tight curves	

STANDARD OPERATING PROCEDURE
RIKON Bandsaw

PLEASE **DO NOT** USE THIS MACHINE UNLESS A LAB SUPERVISOR HAS GIVEN INSTRUCTION ON ITS SAFE USE AND OPERATION. APPROPRIATE CONSENT MUST HAVE BEEN RECEIVED.

Wear eye protection

Wear closed toe shoes

Contain loose hair and jewelry if any

Wear ear protection when necessary

Rotating Blade

Sharp Element

Flying Debris and Loud Noise

Inhalation of Potentially Toxic Particles

PRE-OPERATIONAL SAFETY CHECKS

1. Check that the bandsaw has all guards in place and in working order.
2. Use extra supports and clamps for any workpieces large enough to tip, wherever it is practical.
3. Ensure that the work area is not crowded to avoid accidents.

OPERATIONAL SAFETY CHECKS

1. Never leave the bandsaw while it is running.
2. Adjust the blade guard so it just clears the material being cut.
3. Before making any adjustments or cleaning any accumulated debris, ensure that the machine is turned off and is at a complete standstill before proceeding.
4. Be aware of your clothing or hair being caught into the blade.
5. Only use the allowed materials (wood, plastic, foam) for the equipment to reduce the risk of blade breakage, fire, or other damage to the saw.
6. Never use excessive force when pushing the workpiece past the blade. Simply guide the blade to make proper cuts.
7. Use a push stick when cutting short workpieces.

HOUSEKEEPING

1. Switch off the machine after use.
2. Gather and properly dispose all the accumulated dust and debris.
3. Leave the machine in a safe and clean state.
4. Always lower the guard for the next user.

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

POTENTIAL HAZARDS

1. Entanglement in rotating blade
2. Eye injuries from flying debris
3. Cuts from sharp burrs and sharp edges
4. High noise levels
5. Inhalation of potentially dangerous dust particles and/or fumes
6. Electrocution from uninsulated cables and ungrounded equipment

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

STANDARD OPERATING PROCEDURE
LAGUNA Bandsaw

PLEASE **DO NOT** USE THIS MACHINE UNLESS A LAB SUPERVISOR HAS GIVEN INSTRUCTION ON ITS SAFE USE AND OPERATION. APPROPRIATE CONSENT MUST HAVE BEEN RECEIVED.

Wear eye protection

Wear closed toe shoes

Contain loose hair and jewelry if any

Wear ear protection when necessary

Rotating Blade

Sharp Element

Flying Debris and Loud Noise

Inhalation of Potentially Toxic Particles

PRE-OPERATIONAL SAFETY CHECKS

1. Check that the bandsaw has all guards in place and in working order.
2. Use extra supports and clamps for any workpieces large enough to tip, wherever it is practical.
3. Ensure that the work area is not crowded to avoid accidents.

OPERATIONAL SAFETY CHECKS

1. Never leave the bandsaw while it is running.
2. Adjust the blade guard so it just clears the material being cut.
3. Before making any adjustments or cleaning any accumulated debris, ensure that the machine is turned off and is at a complete standstill before proceeding.
4. Be aware of your clothing or hair being caught into the blade.
5. Only use the allowed materials (wood, plastic, foam) for the equipment to reduce the risk of blade breakage, fire, or other damage to the saw.
6. Never use excessive force when pushing the workpiece past the blade. Simply guide the blade to make proper cuts.
7. Use a push stick when cutting short workpieces.

HOUSEKEEPING

1. Switch off the machine after use.
2. Gather and properly dispose all the accumulated dust and debris.
3. Leave the machine in a safe and clean state.
4. Always lower the guard for the next user.

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

POTENTIAL HAZARDS

1. Entanglement in rotating blade
2. Eye injuries from flying debris
3. Cuts from sharp burrs and sharp edges
4. High noise levels
5. Inhalation of potentially dangerous dust particles and/or fumes
6. Electrocution from uninsulated cables and ungrounded equipment

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

STANDARD OPERATING PROCEDURE
PRM Bandsaw

PLEASE **DO NOT** USE THIS MACHINE UNLESS A LAB SUPERVISOR HAS GIVEN INSTRUCTION ON ITS SAFE USE AND OPERATION. APPROPRIATE CONSENT MUST HAVE BEEN RECEIVED.

Wear eye protection

Wear closed toe shoes

Contain loose hair and jewelry if any

Wear ear protection when necessary

Rotating Blade

Sharp Element

Flying Debris and Loud Noise

Inhalation of Potentially Toxic Particles

PRE-OPERATIONAL SAFETY CHECKS

1. Check that the bandsaw has all guards in place and in working order.
2. Use extra supports and clamps for any workpieces large enough to tip, wherever it is practical.
3. Ensure that the work area is not crowded to avoid accidents.

OPERATIONAL SAFETY CHECKS

1. Never leave the bandsaw while it is running
2. Adjust the blade guard so it just clears the material being cut.
3. Before making any adjustments or cleaning any accumulated debris, ensure that the machine is turned off and is at a complete standstill before proceeding.
4. Be aware of your clothing or hair being caught into the blade.
5. Only use the allowed materials (metal) for the equipment to reduce the risk of blade breakage, fire, or other damage to the saw.
6. Never use excessive force when pushing the workpiece past the blade. Simply guide the blade to make proper cuts.
7. Use a push stick when cutting short workpieces.
8. Ensure that the machine's blade is operating at the recommended speed for the type of sheet metal being cut.

HOUSEKEEPING

1. Switch off the machine after use.
2. Gather and properly dispose all the accumulated dust and debris.
3. Leave the machine in a safe and clean state.
4. Always lower the guard for the next user.

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

POTENTIAL HAZARDS

1. Entanglement in rotating blade
2. Eye injuries from flying debris
3. Cuts from sharp burrs and sharp edges
4. High noise levels
5. Inhalation of potentially dangerous dust particles and/or fumes

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Australia. Pictograms obtained from www.safetysign.com

Name:	Wood Band Saw Usage at MECE Machine Shop	Date Created:	May 04, 2018
Description:	An equipment with a long and sharp blade which can be used for cutting wood or wood-like products.	Last Published:	May 04, 2018

Task	Hazard	Pre-Control Risk Rating		Existing Controls	Post-Control Risk Rating	
		L x C	Total		L x C	Total
Using Wood Band Saw An equipment with a long and sharp blade which can be used for cutting wood or wood like products	Sharp/Pointed Objects ? Cuts & Punctures	3 x 3	9	Safe Work Procedures, Machine Guarding, Training/Education, Use jigs/push sticks to handle/cut small work-pieces	1 x 3	3
	Rotating or Moving Equipment	3 x 4	12	Safe Work Procedures, Training/Education, Fold long/loose sleeves, Tie up long hair	2 x 3	6
	Flying Debris	2 x 4	8	Safe Work Procedures, Eye Protection - Safety Glasses, Training/Education	2 x 2	4
	Noise Exposure	3 x 3	9	Hearing Protection - Ear Plug, Safe Work Procedures, Limit work /job time	1 x 3	3
	Electricity	3 x 5	15	Safe Work Procedures, Preventative Maintenance, Ensure no frayed/damaged electrical cables	1 x 5	5
	Ergonomics	2 x 2	4	Safe Work Procedures, Training/Education, Proper posture	3 x 1	3
	Falling Objects	3 x 2	6	Safe Work Procedures, No heavy lifting by single person	2 x 1	2

Name: Metal Band Saw usage in MECE Machine Shop

Description: An equipment with a long and sharp blade which can be used for cutting metals or similar products.

Date Created: May 04, 2018

Last Published: May 04, 2018

Task	Hazard	Pre-Control Risk Rating		Existing Controls	Post-Control Risk Rating	
		L x C	Total		L x C	Total
Using the metal band saw An equipment with a long and sharp blade which can be used for cutting metals or similar products	Sharp/Pointed Objects ? Cuts & Punctures	3 x 3	9	Safe Work Procedures, Training/Education, Machine Guarding	1 x 3	3
	Rotating or Moving Equipment	3 x 4	12	Safe Work Procedures, Training/Education, Tie up long hair, Fold loose/long sleeves	2 x 3	6
	Flying Debris	2 x 4	8	Safe Work Procedures, Training/Education, Eye Protection - Safety Glasses	2 x 2	4
	Prolonged Noise Exposure	3 x 3	9	Safe Work Procedures, Hearing Protection - Ear Plug, Frequent Breaks	1 x 3	3
	Electricity	3 x 5	15	Safe Work Procedures, Preventative Maintenance, Regular Inspection, Ensure no frayed/damaged electrical cables	1 x 5	5
	Ergonomics	2 x 2	4	Safe Work Procedures, Training/Education, Proper posture	3 x 1	3
	Falling Objects	3 x 2	6	Safe Work Procedures, Foot Protection - Closed Toe Shoe, No heavy lifting by single person	2 x 1	2

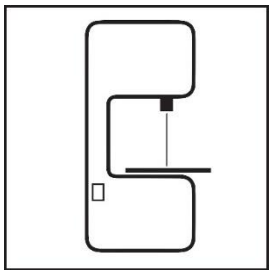
Mentor Signoff
Band Saw

Name of Mentor: _____ **Date:** _____

List of Mentors (Max. 2)

1. _____

Training Objectives
Skill Check Detailed run-through of the training checklist Standardized Training Procedures



The purpose of walking through the training checklist in detail is to familiarize the new mentor with the reasoning behind each of the steps, why we have makers try certain tasks, and the demos the mentor will provide while training new makers.
Observing training sessions and providing training with a trained partner are essential steps to allow the new mentor to provide standardized training to any new makers.

Please tick relevant box after completion:

Skill Check	✓
Adjusting blade guard height	
Finger positioning and how push sticks are used	
Cutting out notches and corner notches	
Knowing when and how to use relief cuts	
Knowing if the blade is properly adjusted (aligned and tensioned)	

	Maker Training Checklist Overview	✓
1	Safety Procedures • **INFO**: PPE, hazard discussion, allowed materials, document locations	
2	Check for appropriate saw • **DEMO**: Show thin/wide blade as well as fine/coarse blade • **INFO**: 3 or 4 teeth in the cut at all times	
3	Finger positioning • **DEMO**: Show hazard area on the table • **INFO**:Use of push sticks for smaller workpieces	
4	Machine ON/OFF location and how it operates for each band saw • **INFO**: Rikon has an ON/OFF Switch • **INFO**: Laguna has an ON/OFF Switch, E-Stop, Foot Brake • **INFO**: PRM has an ON/OFF Switch	
5	Adjusting blade guard height • **DEMO**: Show blade guard lock and adjustment knob • Lower the blade guard after use	
6	Cutting a workpiece • **DEMO**: Cut MDF in half on the RIKON • **HANDS ON**: Cut MDF, PE, and foam on the RIKON	

7	Using the fence and the miter gauge • **DEMO**: Cut a corner notch on the LAGUNA with the fence • **DEMO**: Show location of the miter gauge and how it is used • Miter gauge is used for cutting angles • Fence is helpful when cutting straight lines and resawing	
8	Cutting sheet metal • **DEMO**: Cut sheet metal on the PRM (use an acrylic block as a push stick) • **HANDS ON**: Cut sheet metal on the PRM (with or without the use of an acrylic block)	
9	Cutting a profile • **DEMO**: Cut a fillet on a corner of an MDF using relief cuts	
10	Cutting out a notch • **DEMO**: Cut a notch on an MDF	

Additional Training	✓
Changing the blade (proper storage, tensioning, adjusting blade alignment)	
Resawing	

Standardization of Training	✓	
Mentor has observed 2 training sessions		
Mentor has provided 2 training sessions with a trained partner (to other mentors/garage staff/ technicians or new makers)		

Workflow
Band Saw

Using the Band Saw

1. Be familiar on how to turn on and off the machine. Ensure that you are wearing the proper PPE before using the band saw.
2. Prepare the workpiece by drawing the lines on the surface that you would want to cut.
3. Ensure that there are three to four teeth engaged on the material and that you are using the appropriate machine for the material that you are cutting.
    a. Laguna and Rikon: Wood, Foam, Plastic (polyethylene, etc.)
    b. PRM: Metal
4. Adjust the blade guard so that it just clears the workpiece (a little less than 1 cm above the material).
5. Turn on the band saw using the switch.
6. Push the workpiece through the blade while making sure that your fingers do not fall within the hazard zone (marked on the table). If the workpiece becomes too small, **ALWAYS** use a push stick to guide it through the blade (or one of the acrylic blocks if you are using the PRM for sheet metal).
7. If you need to use any of the accessories, position them at the appropriate spot on the machine. These accessories include:
    a. Miter gauge (for cutting angles on the workpiece)
    b. Fence (useful for making straight cuts and resawing procedures)
8. Turn off the machine once you are done using it.
9. Always lower the blade guard for the next user.
10. Always clear the table of any residual sawdust using the brush (can be found hung on the wall).

DRILL PRESS SAFETY DOCUMENTS

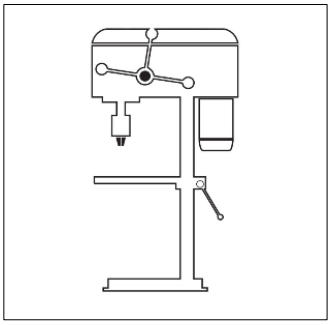
Training Checklist
Drill Press

Name of Mentor: _____ **Date:** _____

List of Makers (Max. 4)

1. _____
2. _____
3. _____
4. _____

Training Objectives
1. Clamp it down
2. Avoid hair/hoody string entanglement
3. One-person Machine
4. Emergency Stop if mishap
5. Don't drill into table



Drill Press: A drill press can be used for a variety of drilling/cutting operations with different types of drills. The type/size of the drill and the work piece material are major factors to determine the RPM and FEEDING SPEED. Different drills will offer varied drilling accuracy and production efficiency.

Please tick relevant box after completion:

SAFETY OPERATION		✓
1	Safe Operating Procedure (PPE, etc.)	
2	Hazard Assessment discussion / location	
3	Allowed Materials	
4	Document locations (MEC E Makerspace Website/ Office Binder)	

OPERATION		✓
1	Machine ON/OFF switch location, know both the turning and pressing actions	
2	Speed dial is off before turning on the drill press	
3	Adjustable drill press guard use and adjustment (if applicable)	
4	Gear-drive (stop the machine to change RPM) or belt-drive (change RPM while operating)	
5	Scrap hardwood (or other suitable materials) as a backer underneath the work piece	
6	Finger positioning / Hazard Zone around the drill (always use the clamp/vise to hold the work piece)	
7	Drill type and size correctly selected	
8	Drill condition check (forward-drilling drill/cracks/nicks/unsymmetrical shape}	
9	Tighten drill onto chuck with the chuck key on all 3 jaws holes till snug (for equal pressures from 3 jaws and for true drill positioning	
10	Chuck key placed on the magnet before turning the drill press on	
11	Table and drill head are tightly secured in place	
12	RPM correctly calculated or checked; Maintain steady pressure on feed lever while drilling and reduce feeding rate near the end	
13	Wait for the drill to come to a halt after shutting it down and be aware of the heat due to friction	

STANDARD OPERATING PROCEDURE
Drill Press

PLEASE **DO NOT** USE THIS MACHINE UNLESS A LAB SUPERVISOR HAS GIVEN INSTRUCTION ON ITS SAFE USE AND OPERATION. APPROPRIATE CONSENT MUST HAVE BEEN RECEIVED.

Wear eye protection

Wear close-toe foot protection

Tie back loose hair and tuck in loose clothing; No jewelry/gloves

Wear ear protection when necessary

Rotating Blade

Sharp Element

Flying Debris and Loud Noise

Inhalation of Potentially Toxic Particles

PRE-OPERATIONAL SAFETY CHECKS

1. Ensure only one person is operating the drill press with enough space to move around the machine
2. Check workplace and walkways to ensure no slip-hazards are present.
3. Ensure familiarity with the operation of the machine's ON/OFF switch and its Emergency Stop Button.
4. Ensure the key has been removed from the drill chuck before turning the machine on
5. Always use a clamp or vise to secure the work piece.

OPERATIONAL SAFETY CHECKS

1. Never leave the drill press while it is running
2. Use a backer wood underneath the material to avoid drilling into the table
3. Only use the correct RPM and a steady feeding pressure for drilling to reduce the risk of cutting edge breakage, pre-mature wear, or other damage to the equipment
4. Use a safe work posture when feeding and beware of hair/clothing entanglement
5. Use peck-drilling motion if necessary to avoid long chips with sharp edges
6. Never touch anything on the table while the drill is spinning (may or may not be in operation), and use the Emergency Stop Button if applicable
7. Wait for the drill to halt before reaching for the work piece and be aware of the heat produced by friction
8. Before cleaning off swarfs on the table or making adjustment, bring the machine to a complete standstill

HOUSEKEEPING

1. Switch off the machine after use
2. Clean off the accumulated metal swarfs, dust or debris with a brush
3. Leave the machine in a safe and clean state.

OTHER POTENTIAL HAZARDS

1. Heat on material produced from drilling friction
2. Chuck with keys on it
3. Sharp edges/ Burs/ Splinters

Acknowledgement: Information contained in this document is based on the material published by the Department of Education and Training, Queensland Government, Technology of Machine Tools, 2nd ed. by McGraw-Hill Ryerson Limited, 1976. Pictograms obtained from www.safetysign.com

Reviewed: May 24th, 2018

Speed in revolutions per minute (RPM) for high-speed steel drills (reduce RPM one-half for carbon steel drills)								
Diameter Size Visualization	Diameter of Drill (inches)	Diameter of Drill (millimeters)	**Polyethylene/ Acrylic**		**Low-Carbon Steel**		**Brass/ Aluminum**	
			145-195 FPM		80-100 FPM		150-300 FPM	
			Calculated/Textbook Suggested RPM	Shop Recommended RPM	Calculated/Textbook Suggested RPM	Shop Recommended RPM	Calculated/Textbook Suggested RPM	Shop Recommended RPM
	1/16 0.0625	1.588	8862-11918	**1070**	4889-6112	**1745**	9167-18335	**3480**
	1/8 0.125	3.175	4431-5959	**840**	2445-3056	**1070**	4584-9167	**1745**
	**1/4** 0.250	6.350	2215-2979	**840**	1222-1528	**1070**	2292-4584	**1070**
	**3/8** 0.375	9.525	1477-1986	**535**	815-1019	**840**	1528-3056	**840**
	**1/2** 0.500	12.700	1108-1490	**420**	611-764	**535**	1146-2292	**535**

Drilling Speeds (RPM) Chart [MEC E 260]

For Use with High-Speed Steel Drills

Name:	GENERAL DRILL PRESS USAGE IN MACHINE SHOP	Date Created:	Dec 12, 2017
Description:	An equipment used to drill holes in wood/metals by utilizing a rotating drill bit through a levered action.	Last Published:	Dec 12, 2017

Task	Hazard	Pre-Control Risk Rating		Existing Controls	Post-Control Risk Rating	
		L x C	Total		L x C	Total
Securing Work-piece on Table This tasks involves the securing of the work-piece (piece of metal/wood on which hole is to be drilled) on the drill press table	Falling Objects	2 x 2	4	Safe Work Procedures, Safe work porcedures, foot protection (closed toe shoe, proper clamping)	1 x 1	1
	Sharp/Pointed Objects ? Cuts & Punctures	3 x 2	6	Use gloves while handling sharp objects; use a brush to clean off the table with metal/wood swarfs on it	2 x 1	2
	Toxic chemicals from the drilled material	2 x 4	8	Determine whether the material is permitted on the drill press	1 x 3	3
Drilling Hole on the Work-piece This task involves the actual drilling process, in which rotating drill bit is used to make a hole. Vertical motion of the drill bit is achieved through a manual lever	Sharp/Pointed Objects ? Cuts & Punctures	3 x 3	9	Eye Protection - Safety Goggle, Foot Protection - Closed Toe Shoe	2 x 1	2
	Flying Debris	3 x 2	6	Eye Protection - Safety Goggle, Safe Work Procedures	2 x 1	2
	Entanglement	3 x 3	9	Long Hair Tied Up, No Contact with Rotating Drill Bit, No loose clothing, gloves, or jewelries , Do not touch the material when it is being drilled or anything on the table. Never attempt to grab work which may have caught in the drill. Stop the machine	2 x 3	6
	Rotating or Moving Equipment	3 x 3	9	Eye Protection, Long Hair Tied Up, Do not change the speed setting while the machine is running if it is a gear driven drill press. Do change the quill speed while in operation if the machine is belt-driven, Clamp down the work piece, Table and drill head are tightly secured in place, Have chuck guard set up if applicable, Keep operating fingers away from the clamped-down work piece. Do not touch the drill while it is in operation. Ensure to remove the chuck key before turning on the machine, Wait for the drill to fully stop before retrieving the work piece	2 x 2	4

Name: GENERAL DRILL PRESS USAGE IN MACHINE SHOP

Description: An equipment used to drill holes in wood/metals by utilizing a rotating drill bit through a levered action.

Date Created: Dec 12, 2017

Last Published: Dec 12, 2017

Task	Hazard	Pre-Control Risk Rating		Existing Controls	Post-Control Risk Rating	
		L x C	Total		L x C	Total
	Dusty Cutting Operation	2	2	Dust Mask / Face Mask	2 x 1	2
	Long material swirl pieces with sharp edges	4 x 2	8	Lower and raise the drill (peck-drill) frequently while drilling to ensure the material swirl/swarf have manageable sizes	1 x 1	1
	Awkward posture	5 x 2	10	Do not lean over the machine, safe working posture., Do not lean over the machine, safe working posture., Do not lean over the machine, safe working posture.	1 x 1	1
	Loose drill in chuck	2 x 3	6	Tighten drill onto chuck with the chuck key on all 3 jaw holes till snug	1 x 1	1
Work-piece Orientation Change / Finishing the Job This task is performed while drilling multiple holes on the same work-piece. Also similar hazards can be encountered if the drilling job is finished and the work-piece is to be removed from the drill press table	Hot Surfaces	3 x 3	9	Safe Work Procedures, Let the Drill Bit Stop, Do not Touch Hot Surfaces, Allow the work-piece to cool down	2 x 2	4
	Spinning chuck/drill	4 x 3	12	Wait for the drill to fully stop before retrieving the work piece	1 x 1	1

Name: GENERAL DRILL PRESS USAGE IN MACHINE SHOP

Description: An equipment used to drill holes in wood/metals by utilizing a rotating drill bit through a levered action.

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Task	Hazard	Pre-Control Risk Rating		Existing Controls	Post-Control Risk Rating	
		L x C	Total		L x C	Total
Replacement of Drill Bit This task is performed whenever the size of the drill bit is to be changed or a new drill bit is to be used	Hot Surfaces	3 x 3	9	Allow the Drill Bit to Cool Down, Do not Touch Hot Drill Bit, Let the Drill Bit Stop, Safe Work Procedures	2 x 2	4
	Rotating or Moving Equipment	3 x 3	9	Eye Protection, Let the Drill Bit Stop before replacement of the Drill Bit, Safe Work Procedures	2 x 2	4
House Keeping	Running Machine	2 x 2	4	Ensure you leave the machine in the OFF position before leaving the machine or doing maintenance. Never leave the machine running unattended	1 x 1	1
	Improper or dirty environment	5 x 1	5	Adequate housekeeping, remove all chips and debris from the machine and thoroughly clean all surfaces	1 x 1	1
	Machine housekeeping	5 x 1	5	Always remove cutting tools, and store them in a safe place. Drills should be dry and free of debris or damage before use	1 x 1	1

Mentor Signoff
DRILL PRESS

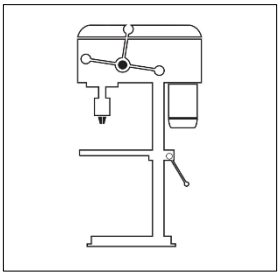
NAME OF TRAINER: _____ **Date:** _____

LIST OF MENTORS: (Max. 2)

1. _____

Training Objectives

1. Skill Check
2. Detailed run-through of the training checklist
3. Emphasis on key points
4. Standardized Training Procedures



The purpose of walking through the training checklist in detail is to familiarize the new mentor with the reasoning behind each of the steps, why we have markers try certain tasks, and the demos the mentor will provide while training new makers. Observing training sessions and providing training with a trained partner are essential steps to allow the new mentor to provide standardized training to any new makers.

PLEASE TICK RELEVANT BOXES AFTER COMPLETION:

	CHECKLIST OVERVIEW (Training given by trainer will cover the following)	✓
1	PPE: Safety goggles, close toed shoes, long pants, no loose hair/clothes (hoody strap, belt, etc.) or jewelries	
2	Show ON/OFF switches for all machines and E-stop buttons for the ones that have them	
3	Demo the difference in turning off the IMA and what happens if the speed 1-2 dial is left open	
4	Demo speed changing with chuck for gear driven drill press	
5	Demo technique for clamping down material (eg. with the drill chisel head's support)	
6	Forward and reverse drilling drill difference and usage on the drill press	
7	Demo Peck Drilling, and how the technique breaks chips/ clear build-up chips	
8	RPM correctly calculated or checked, explain relationship between the RPM and the drill diameter	
9	Pay attention to the heat on work piece after drilling due to friction	
10	Hands on the drill while taking it off the chuck	
11	The drill guards advantage and disadvantage; the inaccuracy of the laser pointer	
12	Show speed changing differences between variable speed drill press and the set speed drill press	

	SKILL CHECK (Trainee will show his/her ability to do the following)	✓
1	Locate drilling position on the work piece (eg. usage of center punch)	
2	Secure machine components	
3	Secure work piece with sacrificial material underneath	
4	Chuck key usage	
5	Drill speed selection	
6	Drill wood, polyethylene, low-carbon-steel in 1/8'' & 3/8'' sizes	
7	E-stop usage test	
8	Metal bur/ wood splinter clean-off	

	STANDARDIZATION OF TRAINING (Trainee will complete the following tasks)	✓	
1	Mentor observed at least 2 training sessions		
2	Mentor provided at least 2 training sessions with a trained partner (other mentors/staff/ technicians/new makers) within time limit and with all user training checklist points covered		
3	Device a comprehensive script that covers all the steps of the user training checklist		
4	Reasoning behind the steps in the user training checklist		
5	Emphasis on all key learning objectives		
6	Demonstrate necessary steps on the machine or with the tools		
7	Instruct the trainer/new users to practice on materials provided with different sized drill bits (eg, step drills, hole saws, twist drills with brad or chisel point)		

Workflow
Drill Press

Using the Drill Press

1. Wear all necessary PPE and contain loose clothes part/hair
2. Locate the drilling point on the material, then use a center punch to make an indent at the same location.
3. Find the optimal drill for the material and the drilling finish
4. Make sure you have ample room to move around the drill press
5. Make sure the machine is off
6. Clear any swarfs on the table with a brush
7. Check the ground for tripping hazard.
8. Set the drill press to the correct revolution per minute
9. Place the drill into the drill chuck and secure the drill with a chuck key
10. REMOVE THE KEY FROM THE CHUCK.
11. Place a piece of sacrificial/backer materials on the table
12. Adjust the height of the drill head or the table if needed.
13. Set the drilling depth stop to the correct height if needed
14. Clamp down the work piece onto the backer material
15. Align the drill center to the drilling location, re-adjust the position of work piece and backer material if necessary
16. Start the drill press
17. Feed the drill through the material by maintain a steady pressure and peck-drill if necessary
18. Stop the drill press after the hole is drilled.
19. Release the clamp to retrieve the work piece
20. Remove the drill with a chuck key
21. Remove the backer material from the table if needed
22. Clear the swarfs on table and the ground if needed