MAE Student Machine Shop Handbook

NC State University

Mechanical & Aerospace Engineering

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1. INTRODUCTION

The MAE Student Machine Shop (EB III, rm 1205) is a shared departmental facility provided to give MAE students access to machine tools to fabricate parts for projects or research not related to capstone senior design projects (MAE 416, MAE 478/479). Since the shop area is used from 8 AM - 5 PM each day by senior design classes, the MAE Student Machine Shop is open in the early evening, where MAE undergraduate and/or graduate students can come and fabricate parts for department approved/related projects. A schedule will be posted on the MAE 416 lab door each semester with the evening shop operating days and times.

In order to use the shop equipment, several steps must be taken to ensure the student's eligibility and to determine the necessary training required for fabricating the part.

The first step of the process involves completing the "Training Approval Form", located in Appendix 1 (or at MyMAE (http://www.mae.ncsu.edu/mymae/)). This form should be filled out for initial training approval. It requires the student to have an engineering drawing of the part to be fabricated and approval by his/her project faculty advisor. Once completed, this form and drawing should be submitted to the MAE shop supervisor (EB III, rm 1203, between 8 AM – 5 PM, M-F) for approval. Any/all subsequent parts will require the "Subsequent Part Fabrication Approval Form" to be filled out and approved by his/her project faculty advisor and the shop supervisor (Appendix 2 or at MyMAE (http://www.mae.ncsu.edu/mymae/)).

Upon receiving approval, the shop supervisor will recommend the training required to fabricate the part. Training consists of watching a set of online videos, and completing the associated worksheets that accompany the training videos. Upon completion of the worksheets, the student will meet with the Open Shop TA during open shop hours (not between 8 AM – 5 PM, M-F) to review the worksheets, to ask you any additional questions, and to perform safety training and machine specific training. At this time, the Open Shop TA will make your shop access badge.

All students will receive the same shop safety training, and dependent on fabrication techniques required to make the part, the student will receive training for use on Shop Fabrication (Fab) Equipment (Appendix 3), Milling Machine (Appendix 4), and/or Lathe (Appendix 5). *(Note: "Shop Fab Equipment" refers to Drill Press, Bandsaw, Sheet Metal Bender, Grinder & Sander)*

At this point, the student may use the MAE Student Machine Shop during open shop hours.

a. Summary of Process for MAE Student Shop Access:

1. Training Approval Form
    a. Fill out form (Appendix 1, or MyMAE (http://www.mae.ncsu.edu/mymae/)
    b. Get faculty advisor approval (sign and date form)
    c. Get shop supervisor approval (EB III, rm 1203, between 8 AM – 5 PM, M-F)
    d. Required training is recommended by shop supervisor
2. Video training & worksheets
    a. Watch videos and fill out required worksheets
        i. Videos 1 – 3 for shop fab training
        ii. Videos 4 – 7 for milling machine training
        iii. Videos 8 – 10 for lathe training
3. In person training
    a. Shop safety overview

    b. Machine shop layout
    c. Machine introduction
4. Shop TA makes student badge
5. Student free to use shop during open hours

b. Frequently Asked Questions:

Who can use the Machine Shop?
Undergraduate and graduate students in the MAE Department, who are working on projects associated with the MAE Department. Eligible students must receive permission from an MAE faculty project advisor prior to being trained on the machines. Students enrolled in MAE 416 or MAE 478/479are not eligible to utilize the open machine shop for their senior design projects.

When can I use the Machine Shop?
The student machine shop is open in the evenings. Days and times will vary semester to semester, so look for posted hours on the MAE 416 lab door. Although the shop is open during business hours (8 AM – 5 PM, Monday – Friday), these hours are reserved solely for students in MAE 416 and MAE 478/479, working on senior design projects.

During a one week period near the end of each semester, the open shop will be closed so that senior design students can have access to the shop for extended hours. The dates of this closure will be announced and posted ahead of time.

Where do I find the training videos?
The training videos are available online and where produced by MIT. Links to the videos are included at the top of the video worksheets.

After I watch the training videos, what do I do?
As you watch the videos, fill out the associated worksheets. You may need to replay parts of the videos during this process. After watching the videos, and completing the worksheets, come to the shop during open hours (see MAE 416 door for open hours), and the Shop TA will review your worksheets, ask you additional questions to assess your understanding, give a safety overview, and provide a hands on introduction to the machine. At this time, your badge will be made and given to you to wear at all times in the shop.

When I need to make another part, what do I do?
To fabricate another part, please fill out the "Subsequent Part Fabrication Approval Form", located in Appendix 2.

When does my training expire?
Shop training is valid for 1 year, but extended absences (3 months or more) from the shop will result in required re-training. The extent of retraining is dependent on the student's demonstrated experience and expertise prior to the absence.

What are the consequences for safety violations?
The "3 Strike Policy" is in effect at all times. This is outline further in Section 2B on page 6. The "3 Strike Policy" is used as a warning system, and a way to ensure that multiple safety violations are addressed. A student who receives "3 strikes" (or 3 badge punches) will be barred from the machine shop for the remainder of the school year.

2. SHOP SAFETY OVERVIEW

a. General Shop Safety Rules

1. Safety glasses, cover goggles, or face shields are required when in any shop area, whether working or not!!
2. Shoes must be worn in shop area. No one wearing sandals will be allowed to enter the shop area. The minimum footwear must cover the entire foot.
3. Do not operate any item of equipment unless you are familiar with its operation and have been authorized to operate it.
4. Machine must be shut off and not moving when you are cleaning, repairing, oiling, or when you leave the area.
5. Do not wear ties, loose clothing, jewelry, gloves, etc. around moving or rotating machinery. Long hair must be tied back or covered to keep it away from moving machinery.
6. Never engage in horseplay in the shop areas.
7. All machines must be operated with all required guards and shields in place.
8. A brush, hook, or special tool is preferred for removal of chips, shavings, etc. from the work area. Never use the hands.
9. Keep fingers clear of the point of operation of machines by using special tool or devices, such as, push sticks, hooks, pliers, etc. Never use a rag near moving machinery!
10. A hard hammer should not be used to strike a hardened tool or any machine part. Use a soft-faced hammer.
11. Practice cleanliness and orderliness in the shop areas.
12. Keep the floor around the machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.
13. Before starting a machine, always check it for correct setup and always check to see if machine is clear by operating it manually, if possible.
14. Check the power cords and plugs on portable tools for damage before using them.
15. Use equipment for its intended purpose.
16. Never leave a machine running unattended.
17. Do not talk to, or permit anyone to fool around with equipment while you are operating it.
18. Get help in lifting or moving any heavy tool, attachment, or equipment.
19. Take care not to make loud and/or sudden noises.

b. 3 Strike Policies & Badge System

The 3 strike policy is in effect in the shop at all times. This policy was developed to ensure safety, and provide for safety violation consequences.

Each student will be issued a color coded badge, which states which machines they are trained to use in the shop. On each badge are 3 large X's – each providing a place for the shop TA to "punch" (or remove the X), as a result of a safety violation. After 3 punches, the student is barred from the lab.

Safety violations and consequences are outlined below (from *MAE 416 Basic Shop Rules*):

1. Wear safety glasses at <u>all</u> times. (1 Punch)
2. Closed toed shoes required. (Must leave shop)
3. Shorts <u>not</u> allowed in lab. (Must leave shop)
4. Wear protective equipment while welding. (1 Punch)
5. Certification badge required to enter machine shop. (Must leave shop)
6. Use <u>only</u> machines that you are certified to use. (1 Punch)
7. Clamp down work piece while using power equipment. (1 Punch)
8. Return all tools after use. (1 Punch)
9. Clean machines and tools after each use. (1 Punch)
10. Do not wear other students' certification badges. (2 Punches)
11. Long hair should be worn up in machine shop. (Ask student to retain hair)
12. <u>No</u> sunglasses or neck ties allowed in shop. (Ask student to remove item)
13. Do not remove guards from machines. (1 Punch)

3. Available Machinery

a. Shop Fab Equipment

The MAE Machine Shop is equipped with the following machines, used for general fabrication: drill press, vertical band saw, horizontal band saw, grinder, arbor press, sheet metal bender, sheet metal shear, and a variety of hand tools.

Drill Press & Vertical Band Saw

Horizontal Band Saw

Arbor Press & Grinder

Sheet Metal Bending Brake

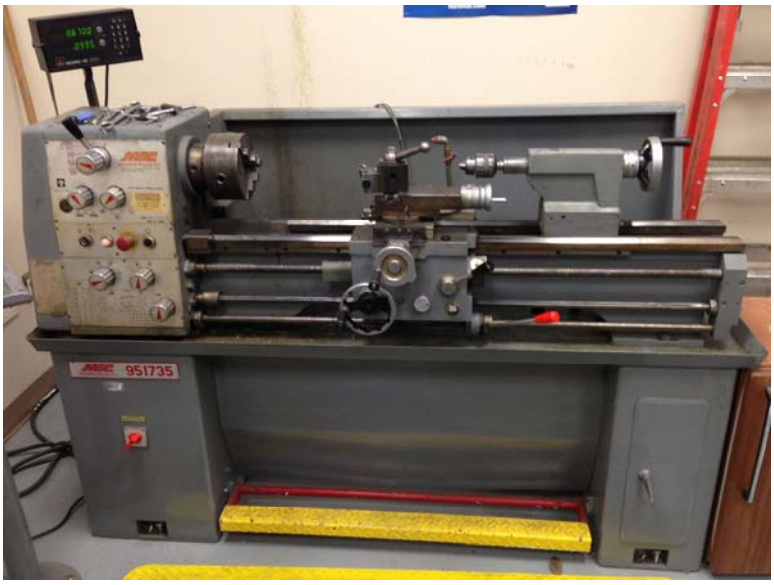
b. Milling Machine

The MAE Machine Shop is also equipped with several milling machines, and a wide assortment of necessary machining accessories (drill bits, end mills, parallels, center finders, etc…)

Milling Machine

c. Lathe

The MAE Machine Shop is also equipped with several lathes and associated accessories, for turning parts with cylindrical features.



Lathe

d. Specialty Fabrication (Hydraulic Shear, Welding, Waterjet,)

Additionally, the Shop TA is able to assist with specialty fabrication needs – including, but not limited to, the use of a hydraulic sheet metal sheer, welding, and the waterjet cutter. Use of specialty fabrication machines/equipment will be decided at the discretion of the Shop TA.

Parts requiring high precision, complex machining or involve specialty fabrication techniques should be directed to the Departmental machinist (EB III, rm 1228).

4. TOOL SPECIFIC SAFETY RULES

a. Drill Press

1. Run drill at correct RPM for diameter of drill bit and material.
2. Always hold work in vise or clamp it to the drill table.
3. Use a correct ground drill bit for the material being drilled.
4. Use the proper cutting fluid for the material being drilled.
5. Remove chips with a brush. Never by hand or with a rag.
6. Ease up on drilling as the drill starts to break through the bottom of the material.
7. Do not use a dull or cracked drill. Inspect the drill before using it.
8. Do not drill with excessive pressure.
9. Always try to support part on parallels or a backing board when drilling through material.
10. Never place a taper shank tool, such as large diameter drill or tapered shank reamers in drill chuck. Only straight shank tool such as standard drills can be clamped in chucks.
11. Always clean drill shank and/or drill sleeve, and spindle bore before mounting.
12. Never try to loosen the drill chuck while the power is on.
13. Lower the drill spindle close to the table when releasing the drill chuck or taper shank drill to reduce the risk of damage to the drill and/or machine in the event of a fall. If the drill is large place a piece of wood on the table for the drill to drop on to.
14. Never clean the machine while in motion!
15. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
16. When drilling a deep hole withdraw the drill bit frequent to clear chips. If a chip sticks to the drill use an acid brush to remove them.
17. Always remove the drill chuck key or the drill drift from the spindle immediately after using.
18. Wear safety eye protection while drilling.
19. Let the spindle stop of it's own accord after turning the power off. Never try to stop the spindle with your hands.

b. Band Saw

1 If the blade breaks, immediately shut off the power and stand clear until the machine has come to a complete stop.

2. Examine the blade for excessive wear or cracks. Do not install a cracked blade. If blade is cracked or has excessive wear notify a supervisor immediately.

3. Use the proper pitch blade for the thickness of the material to be cut. There should be two teeth in the material when cutting aluminum. Use three teeth when cutting steel.
4. Do not run the band saw at a higher speed than recommended for the material being cut. Always refer to speed chart.
5. If the saw stalls in the work piece, turn the power off and reverse the blade by hand (use the drive wheel to do this) to free the blade from the work piece.

c. Grinding

1. Abrasive wheel machinery shall not be operated without the appropriate guards in place.
2. Tool rests on bench or pedestal grinders shall be set no more than 1/8 inch from the wheel.
3. Never use a wheel that has been dropped or has received a heavy blow, even through there may be no apparent damage. Such wheels may have internal fractures and will explode upon startup.
4. Stand to one side when starting machine.
5. Do not grind on the side of the wheel unless wheel is specifically designed for such use.
6. Do not use excessive pressure while grinding. Do not exceed .0005 inch down-feed at any time on the surface grinder.
7. Report to the area supervisor immediately any cracked, broken or otherwise defected wheels.
8. Have the area supervisor mount and balance new wheels.
9. Hold work securely while grinding, use the tool rest to support the work when off-hand grinding on a bench or pedestal grinders.
10. Do not grind aluminum or magnesium. Aluminum will compact into the wheel's pores and cause it to explode and magnesium is extremely flammable.
11. Wear goggles or face shield over safety glasses when grinding on bench or pedestal grinders

d. Milling Machine

1. Work must be clamped securely in a vise and the vise clamped tightly to the table or the work piece must be clamped securely to the table.
2. Never use a rag to clean the machine or part when it is in motion!
3. Do not perform down milling on the milling equipment unless instructed to do so.
4. Make sure cutter is rotating in the proper direction before cutting material.

5. Before running machine, the spindle should be rotated by hand to make sure it is clear for cutting.
6. Make sure the power is off before changing cutters.
7. Always use the proper cutting fluid for the material being cut.
8. Never run the machine faster than the correct cutting speed.
9. Make sure that the machine is fully stopped before taking any measurements.
10. Always use cutters which are sharp and in good condition.
11. Don't place anything on the milling machine table such as wrenches, hammers, or other tools.
12. Always stay at the machine while it's running.
13. Don't take too heavy of a cut or use rapid feed for cutting. Always refer to speed and feed charts.
14. Remove the Collet tightening wrench immediately after using it.
15. Rig a guard or shield to prevent chips from hitting you or other people.
16. Use the milling machine spindle brake to stop the spindle after the power has been turned off.
17. Before cleaning the mill, remove cutting tools from spindle to avoid cutting yourself.

e. Lathe

1. Make sure that the chuck or faceplate is securely tightened onto the lathe spindle.
2. Move the tool bit a safe distance from the Collet or chuck when inserting or removing work.
3. Don't run the machine faster than the proper cutting speed
4. In setting up the tool holder, place it to the left side of the compound slide to prevent the compound slide from running into the chuck or spindle attachments.
5. Always clamp the tool bit as short as possible in the tool holder to prevent it from breaking or chattering.
6. Always make sure that the tool bit is sharp and has the proper clearance. Ask for assistance making adjustment.
7. If any filing is done on work revolving in the lathe, file left handed to prevent slipping into the chuck. Never use a file without a handle.
8. If work is turned between centers, make sure that the proper adjustments are made between centers and that the tailstock is locked in place.
9. If work is being turned between centers and expands due to heat generated from cutting, readjust centers to avoid excessive fraction.

10. Do not grasp or touch chips or turnings with your fingers, but get rid of them using a blunt instrument. It is safer to turn off the lathe before clearing chips then to leave it running.
11. Set the tool bit on the centerline of work to prevent work from climbing over tool or cutting above center and dragging.
12. Don’t cut work completely through when turning between centers.
13. Remove chuck key from chuck immediately after using.
14. Turn chuck or face plate through by hand before turning on the power to be sure there is no binding or clearance problem.
15. Stop the machine before taking measurements.
16. Before cleaning the lathe remove tools from the tool post and tailstock.
17. Never use a rag to clean the machine or part when it is in motion!

APPENDICES

1: Training Approval Form

MAE Student Machine Shop
Training Approval Form and Log

Name:_____ Date: _____

Project: _____ Advisor/Sponsor:_____

Email: _____ Phone:_____

Description of **initial** part to be fabricated: (also, attach engineering drawing of part)

Professor Approval: _____

Shop Supervisor Approval: _____

Training Log

Upon receiving shop supervisor's approval for training, he/she will recommend specific training categories, and instruct the student on how to watch the videos and complete the associated worksheets.

	Suggested Training	Completed Date
General Safety	*Required*	
Shop Fab		
Mill		
Lathe		

Incident Log

Date Incident Actions Taken

2: Subsequent Part Fabrication Approval Form

MAE Student Machine Shop
Subsequent Part Fabrication Approval Form

Name:_____ Project:_____

Date	Description of Part	Advisor Approval	Shop Supervisor Approval	New Training Required

3: Shop Fab Training Video Worksheets

Video # 1: Machine Shop 1 – Basic (40:32)

http://techtv.mit.edu/genres/24-how-to/videos/142-machine-shop-1

- Basic Tour:
  - Lathes are for machining _____ parts with _____ features.
  - Tool used to smooth down sharp edges from a band saw? _____
- Layout Techniques:
  - To scribe lines parallel or perpendicular to lines already on a part use what two tools? _____ & _____
  - How thick is a scribed line? _____
  - Is the ruler on the square particularly accurate? _____
  - What is a more accurate way? _____
  - What tool is used to mark the location for a hole? _____
  - What is another way to scribe lines? _____
  - What is a quick way to transfer relative hole locations? _____
- Basic Tools: Drill Press
  - What is the benefit of using a drill press over a hand drill? _____
    _____
- Locating and Drilling Holes
  - What tool is used to align the spindle of the drill press with your hole? _____
    _____
  - Does the drill press need to be running for this operation? _____
  - What tool is used to start drilling the hole? _____
  - What is special about this tool? _____
    _____
  - How far down should you drill with this tool? _____
  - What tool is used for to clean the hole, and edge of the part? _____
    _____
- Tapping Holes

- What tool is used to thread holes? _____
- What are two ways to tap a hole? _____
- With the second method, is the machine running? _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 2: Machine Shop 2 – Machining Skills for Prototype Development (57:33)

http://techtv.mit.edu/genres/24-how-to/videos/130-machine-shop-2

- Drilling Holes
  - For drilling a hole with a large aspect ratio, what should be used? _____
    _____
  - Define in your own words what "aspect ratio means": _____
    _____
  - What does cutting fluid do? _____
    _____
  - What is the purpose of "stepping up" when drilling large holes? How big should the steps be (nominally)? _____
    _____
  - What does chattering indicate? How should it be fixed? _____
    _____
  - *Note: drill press transmission in video is different than our lab, and automatic feed rates not available.*
  - What 3 types of drill bits are there? _____
    _____
  - *Note: Sensitive drilling capabilities not present in lab.*
  - What is different for drilling holes in brass or plastics? _____
    _____
- Drill Press Limitations
  - The drill press is not meant to be used as what, even though the functionality can appear similar? _____

- Band Saw:
    - What feature/characteristic of the saw allows the user to cut curves? _____

      _____
    - What is the danger of cutting thin materials? _____
    - *Note: Hydraulic shear available for TA assist in cutting thin materials*
- Suitable Speeds, Feeds, Materials
    - How does one prevent blade wandering? _____

      _____
    - Which cuts faster, aluminum or steel?_____
    - Describe proper use of the blade guard/guide? _____

      _____
    - Describe your body position relative to the bandsaw? _____

      _____

      _____

      _____
    - *Note: Video instructor is seen sitting on stools. NEVER sit down while operating the machinery in the lab. Sitting encourages complacency, and bad places your face closer to the cutting area – an obvious danger.*
    - What tool do you use to grip round stock when cutting? _____

      _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 3: Machine Shop 3 – Machining Skills for Prototype Development (30:02)

http://techtv.mit.edu/genres/24-how-to/videos/181-machine-shop-3

- Belt Sander
    - How should hot spots on belt be eliminated? _____

      _____

- Describe precautions in holding parts? _____

  _____

  _____

- *Note: Small belt sander not available in lab.*

- Grinder
  - What is the primary purpose of the grinder? _____

    _____

  - *Note: Consult TA prior.*
  - What happens when you grind aluminum? _____

    _____

- Deburring and Buffing & Finishing
  - The deburring wheel is similar to what kitchen tool? _____
  - Can this be used on hard materials? _____
  - What does the buffing wheel need to operate? _____

    _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

4: Milling Machine Training Video Worksheets

Video # 1: Machine Shop 4 – Milling Machine 1 (50:33)

http://techtv.mit.edu/genres/24-how-to/videos/127-machine-shop-4

- Mill Parts
    - Which direction does the knee move? _____
    - Which direction does the saddle move? _____

      _____
    - Which direction does the bed move? _____

      _____
    - What two purposes is the brake used for? _____

      _____

      _____
    - List the steps to remove a tool:
        - _____
        - _____
        - _____
        - _____
        - _____
    - What do you do if you cannot change from high to low gear? _____

      _____
- Quill Feed
    - Note: *Power feed no available in lab*
- Axis Handfeed
    - *Note: Digital readout available on mills for X, Y, Z locating*
- Gib Locks
    - What is this device used for? _____
- Power Feed
    - *Note: Power feeds not available on mills in lab.*
- Digital Readouts
    - Do we need to worry about backlash with a digital readout? _____

- *Note: Head and vise are routinely squared by TA. This does not need to be performed by students.*
- Accessories and workholding techniques:
    - What is the "most common tool"? _____
    - To make precise holes, use what tool? _____
    - To square up stock material, use which tool? _____
    - What is an end mill held in place with? _____
    - After you drill a hole, what tool is used to refine a drilled hole? _____
    - What tool is used to find the edge of a part? _____
    - To drill large holes, what tool is used? _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 2: Machine Shop 5 – Milling Machine 2 (1:03:33)

http://techtv.mit.edu/genres/24-how-to/videos/84-machine-shop-5

- Clamping Stock material
    - How is the hex collet block different than the square one? _____
      _____
    - What is the V-block used for? _____
      _____
    - For large parts that don't fit in the vise, how should they be secured? _____
      _____
    - In this operation, how are parallels used? _____
      _____
    - Should the hold down clamp be exactly horizontal when clamping? _____
      _____
    - To cut material at an angle, without readjusting the vise, what tool should be used? _____
    - What are a few method to securely clamp awkward positions? _____
      _____

- For clamping up thin material, what should be used? _____

- Squaring high aspect ratio parts
  - Name some problems of vibrations resulting from cantilevered parts?
    - _____
    - _____
  - How can one increase the stiffness of the part? _____

    _____
- *Note: Right Angle Attachment not available for use in lab*
  - To make high aspect ratio slots, what tool should be used? _____

    _____
  - Should coolant be used in this operation? How much? _____
- Rotary Table
  - How do you reference the center of the rotary table to the center of the quill?

    _____
  - What tool can be used to quickly indicate commonly spaced holes? _____

    _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 3: Machine Shop 6 – Milling Machine 3 (42:36)

http://techtv.mit.edu/genres/24-how-to/videos/143-machine-shop-6

- Squaring Stock
  - What does squaring the stock mean? _____

    _____

    _____
  - Why is a concave surface desired? _____

    _____
  - What is a good depth to cut for initial squaring? _____
  - For a finishing pass, what is a good depth? _____
- Squaring a Plate

- List steps to mill the edge of a part:
  - _____
  - _____
  - _____
  - _____
  - _____
  - _____
  - _____
  - _____
  - _____
  - _____
- When milling the edge of a horizontal part, what is a good pass depth for accurate dimensions? _____
- Why can one not go deeper per pass? _____

  _____
- When roughing out stock, or removing large amounts of material, what is a good pass depth? _____

- Edge-finder
  - To locate the part relative to the spindle of the machine, what tool is used?___

    _____
  - Does the machine need to be spinning for this tool to be used? _____
  - *Note: The electronic edge finders should not be spun*
  - When you have located the edge of the part, is the center of the spindle located over the edge of the part? _____

    _____

    _____

- Drilling Holes
  - What tool is used to start drilling a hole? _____
  - What is special about this tool? _____

    _____

- How deep should this first hole be drilled? _____

  _____

- When should cutting fluid be used? _____

  _____

- What precaution should be taken when drilling all the way through a part? ___

  _____

  _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 4: Machine Shop 7 – Milling Machine 4 (23:07)

http://techtv.mit.edu/genres/24-how-to/videos/183-machine-shop-7

- Reaming Holes
  - How close can one expect a hole diameter to be to the state drill size? _____

    _____
  - If one requires a more accurate hole than this, what tool should be used? ____

    _____
  - How precise can this tool be? _____
- Boring Holes
  - *Should* this tool be used to take out a lot of material at once? _____
  - *Can* this tool be used to take out a lot of material at once? _____
  - Can absolute hole sizes be bored, or relative? _____

    _____
- Milling a Slot
  - What is the most common tool used for milling? _____
  - What is the depth of cut that can be taken? _____

    _____
  - How does one produce a very flat surface, with a good surface finish? _____

    _____
- Milling a Shoulder

- What is climb milling? _____

  _____

- What is conventional milling? _____

  _____

- Which is more dangerous? _____
- Which is better for finish cuts? _____
- Which is better for rough cuts? _____

- Cleaning the machine
  - Should compressed air be used to clean a machine? _____
  - What is the risk? _____

    _____

  - When should the cutting tool be removed? _____
  - When should the machine be cleaned? _____

    _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

5: Lathe Training Video Worksheets

Video # 1: Machine Shop 8 – Lathe 1 (42:37)

http://techtv.mit.edu/genres/24-how-to/videos/144-machine-shop-8

- Components & Setup
    - List the components of the lathe: _____
    - What component supplies power to the machine? _____
    - To support long pieces, which component is used? _____
    - What rides on the bed of the lathe? _____
    - *Note: Power feed systems different on lab lathes*
- Turning Tools
    - How are lathe tools held? _____
    - What does knurling do? _____
    - What tool has a long thin blade to cut off pieces from stock? _____
- Turning and facing
    - Before removing chips, always do what? _____
    - After a roughing pass, what is performed? _____
    - What does breaking an edge mean? _____
    - Which produces a smoother finish: Rough pass or finishing pass? _____
    - Which produces a smoother finish: Manual or automatic feed? _____
- Cutting off a part:

- What tool is used for this operation? _____
- At what angle does this tool need to be? _____
- Where should the tip of the tool be? _____

  _____
- Can deep cuts be performed 'dry'? _____

- Drilling
  - What should be checked before drilling? _____

    _____
  - Where is the drill chuck inserted? _____
  - How do you start drilling a hole? _____
  - How much material should be removed at once? _____

    _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 2: Machine Shop 9 – Lathe 2 (47:02)

http://techtv.mit.edu/genres/24-how-to/videos/134-machine-shop-9

- Tapping
  - What does tapping a hole do? _____

    _____
  - What tool can be used to support the back of the tap handle? _____

    _____
  - Can most materials be tapped dry? _____
- Boring
  - What tool is used for this operation? _____
  - Should manual feed be used for boring holes? _____

    _____
- Knurling
  - Does this setup need to be precise? _____

- Should the face of the knurler be square to the part? _____
- Do both wheels need to come in contact with the part? _____
- Should you come in fast or slow to the part? _____

_____

- Cutting Tapers
  - Is the same tool used for turning as for this operation? _____
  - What component of the lathe is used? _____
- Turning shafts
  - Why is turning shafts special? _____

    _____
  - What tool is used to alleviate this problem? _____
  - How should the hole for this be milled? _____

    _____
- Single Point Thread Turning
  - What is the angle on this tool? _____
  - Should this tool be perpendicular to the material? _____
  - *Note: Thread controls differ per machine*
  - At what angle should the compound be set? _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____

Video # 3: Machine Shop 10 – Lathe 3 (29:31)

http://techtv.mit.edu/genres/24-how-to/videos/172-machine-shop-10

- Lathe Chuck
  - Is it easy to hold a piece with a large hole in the chuck? _____
  - If it doesn't have a hole and the piece is too big to fit in the chuck, how can the piece be held? _____
- Lathe Arbors

- What does allow for? _____

  _____

- Describe a lathe arbor: _____

  _____

- For low aspect ratio parts, what should be made? _____

  _____

- Turning between centers
  - What is used to react to the cutting torque? _____

    _____

  - Should a dead or live –center be used on the tailstock? _____

    _____

- Face plates
  - What is put in the T-slots to mount the part to the face plate? _____

    _____

  - Is this safe? _____

    _____

  - For thin materials, how should the material be affixed to the face plate? _____

    _____

Honor Pledge: *I watched this video fully focused and without distraction. No answers were dishonestly obtained. Signed:* _____*Date:*_____