

# INT112 LAB 3.2: BENCHWORK

Student Name: \_\_\_\_\_

Student ID: \_\_\_\_\_

## LAB OUTCOMES:

Upon completion of this lab procedure, the student should be able to:

1. Interpret a machine print.
2. Use a drill press to create through and blind holes in a workpiece.
3. Use a hand reamer to machine a hole to accurate dimensions.
4. Drill countersinks, and counterbores.
5. Use a hand tapping tool to produce internal threads.

## LAB PROCESS:

Before entering the machine shop, ensure that you have observed all required safety procedures:

- Safety glasses on
- Closed-toed shoes
- No rings or other jewelry
- No loose-fitting clothing
- Long hair pulled back
- Not under the influence of any substance that dulls reaction time or judgement

## Part 1:

1. Review the print on the last page of this lab. You will be starting with your 1" x 2" x 3" steel block from the Sawing Lab 112-2.2.
2. Consider the left-most hole on the print. What is the finished diameter of this hole?

What hand tool will you need to finish this hole in accordance with the print? What size?

What diameter drill should you use to drill this hole?

3. Consider the center hole on the print. What is the finished diameter of this hole?

What hand tool will you need to finish this hole in accordance with the print? What size?

What diameter drill should you use to drill this hole?

4. Consider the right-most hole on the print. What is the finished diameter of this hole?

What hand tool will you need to finish this hole in accordance with the print? What size?

What diameter drill should you use to drill this hole?

5. Which hole(s) are through holes?

Which hole(s) are blind holes?

Which hole(s) will require counterboring?

Which hole(s) will require countersinking?

6. Given the diameters of the holes you will need to drill, which, if any, will require a pilot hole?
7. Locate the appropriate drill(s), reamer(s), and tap(s) in the machine shop. Measure each. Are the sizes accurate?

**Part 2:**

1. Lay out the location of the holes on your workpiece.
2. Mount the work securely on the drill press bench. Be sure to allow clearance for your through holes to break through the workpiece without drilling into the vise!
3. Mount a center finder in the drill press chuck. Lower the center finder to the workpiece to check if the location of the first hole is directly under the drill spindle. Adjust the placement of the workpiece as needed to ensure that the first hole will be accurately placed.
4. Remove the center finder from the drill press chuck and mount a center drill. Always be sure to remove the chuck key!
5. Calculate the RPM using the standard formula. The table in the text gives the recommended cutting speed for mild steels as 60-100 fpm.
6. Consult with the instructor and set the appropriate RPM on the drill press. What speed is set? How does this compare with your calculated RPM?
7. Turn on the drill press. Use the center drill to drill a center hole. What is the purpose of center drilling?
8. Turn off the drill. Remove the center drill and replace it with the appropriately sized drill for your hole or pilot hole (if required).
9. Turn on the drill press. Use a steady feed to move the drill into the workpiece. For through holes, be careful when breaking through the workpiece so as not to drill into the vise.
10. Replace the drill with a counterbore or countersink, and perform that operation (if required for this hole).
11. Carefully remove chips from the workpiece. Release it from the drill press bench and reposition for drilling the second hole. Center drill and drill the second hole. Counterbore or countersink if needed.

12. Carefully remove chips from the workpiece. Release it from the drill press bench and reposition for drilling the third hole. Center drill and drill the third hole. Counterbore or countersink if needed.
13. Carefully remove all chips from the workpiece. Check all three holes.

**Part 3:**

1. Secure the workpiece to a workbench.
2. Use the appropriate reamer(s) to finish the non-threaded hole(s) to the desired size.
3. Use the appropriate tap(s) to cut internal threads in the threaded hole(s).
4. Measure all three holes. Are they within the acceptable tolerance?
5. Insert the bushing in the specified hole.

*The outcomes of this exercise (listed on page 1) specifies the skills that the Student must demonstrate to the Instructor. Once the Instructor is satisfied with the demonstration of Knowledge & Skills by the individual student, they will sign this document (for the student), then enter a 100% into the Hands-On Lab grade in Sakai.*

I verify that this student has completed all of the requirements of this Hands-On Assessment:

Student Name: \_\_\_\_\_

Faculty Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**DOL DISCLAIMER:**

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# Performance Standards

## Benchwork

### Materials

A block of cold rolled mild steel – 1.00 x 2.00 x 3.00 milled or filed to length (see *Duties and Standards for Machining Skills – Level I*, September 2001) or as specified on the print for this project. The block may be prepared for the candidate or you may choose to have the candidate cut or mill the block to length. Use a 3/8" – 16 UNC bolt for stud installation (unplated and low tensile).

### Duty

Using mildsteel, hand held drill and hand tap holes. Use hand drills, hand taps, tap wrench, files, scrapers, and coated abrasives to deburr parts. Use arbor presses to perform press fits. Use bench vises and hand tools appropriately.

### Performance Standard

Given a process plan, blueprint, access to hand tools, produce a part with two holes prepared for hand tapping, a hole prepared (reamed) for the press fit of a bushing, and a stud for one of the tapped holes. Deburr the part, hand drill and hand tap the holes, press in the bushing, and install the stud. File chamfer

### Other Evaluation Criteria

1. Free of sharp edges or burrs.
2. Go/NoGo gage for the threads.
3. Length of stud within .03 of basic dimension and square to surface.

Accuracy Level: +/- .015 unless otherwise specified on the blueprint.

### Assessment Equipment and Material

*Workstation:* Common workbench with at least a four-inch bench vise, an arbor press.

*Material:* A part machined to the benchwork blueprint, A stud matching the requirements of the blueprint, and a selection of sleeve bushings for the desired fit, cutting oil, and appropriate lubricants.

*Tooling:* Taps, tap wrenches, assorted files with handles, assorted scrapers, reamer, hacksaw frame with an assortment of blades.

*Measuring Instruments:* Combination set, height gage or depth micrometer, a 1/4-20 plug gage, and .244-.246 pin gauges.

*Reference:* Machinery's Handbook.

## Performance Assessment Worksheet Benchwork

**INSTRUCTIONS:** Rate the candidate's performance for the Benchwork job according to the criteria below. The checklist below represents only a listing of criteria to be evaluated. It is not a sequence of process steps or a process plan for making the part. For each item, check the box under Pass or Fail accordingly.

Remember, NIMS requires that all specifications must be met within the allowable tolerance limits. If the part does not meet all specifications, the candidate must correct or redo the project.

Candidate Name \_\_\_\_\_

Evaluation Date \_\_\_\_\_

<b>Performance Project – Benchwork</b>			
<b>Evaluation Criteria</b>		<b>Pass</b>	<b>Fail</b>
1. Tap .250 thread .5 min depth (hole 3)	Pass = tapped to the minimum depth Fail = not tapped to minimum depth	<input type="checkbox"/>	<input type="checkbox"/>
2. Stud within .13 surface (hole 2) $\pm .015$	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
3. Press fit bushing check.	Pass = pressed correctly – tight, cannot push out with finger pressure; flush $\pm .03$ Fail = not flush or loose	<input type="checkbox"/>	<input type="checkbox"/>
4. Bench chamfer .06 x 45° on top four edges	Pass = within tolerance .06 $\pm .015$ 45° $\pm 1^\circ$ Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
5. Overall finish and quality	Pass = edges were broken .015" max. Burrs removed. Threads clean Fail = burrs, excessive edge break $> .015$ , congested threads	<input type="checkbox"/>	<input type="checkbox"/>
<b>END OF BENCHWORK EVALUATION</b>			

*It is important to note that the part must be 100% within the tolerances listed on the print. The criteria listed here are a guide for instructors and supervisors. Not every dimension is included in this guide. Nonetheless, the completed part must be 100% within the specifications of the print. The print takes precedence over this guide when the parts are inspected by the MET-TEC committee. The candidate must also complete the performance in layout to be eligible for the related theory exam for the NIMS Credential in Job Planning, Benchwork, and Layout. When both performances have been successfully met, the sponsor should complete and send to NIMS only the completed signed Performance Affidavit*

Technical drawing of a stepped cylindrical part. The drawing shows a side view with three steps and a cross-sectional view. Dimensions are given in inches.

Dimensions:

- Overall length: 3.00
- Overall diameter: 2.00
- Step 1 (left): Diameter  $\phi .3750$  (IN ITEM 1), length .75
- Step 2 (middle): Diameter  $\phi .307/.321$ , length 1.50
- Step 3 (right): Diameter  $\phi .196/.207$ , length .50

Feature Callouts:

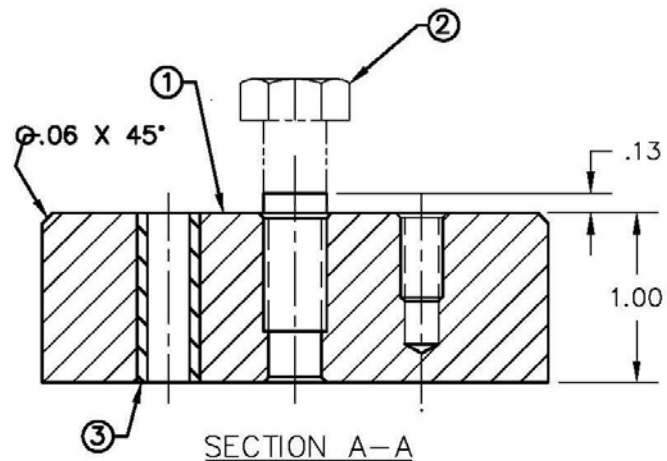
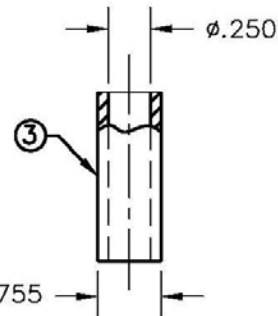
- Top surface of Step 1:  $\sqrt{\phi .43 \times 90^\circ}$
- Top surface of Step 2:  $\sqrt{\phi .28 \times 90^\circ}$
- Bottom surface of Step 2:  $\sqrt{\phi .28 \times 90^\circ}$
- Bottom surface of Step 3:  $\sqrt{\phi .28 \times 90^\circ}$

Surface Finish:

- Top surface of Step 1:  $\sqrt{\phi .43 \times 90^\circ}$
- Top surface of Step 2:  $\sqrt{\phi .28 \times 90^\circ}$
- Bottom surface of Step 2:  $\sqrt{\phi .28 \times 90^\circ}$
- Bottom surface of Step 3:  $\sqrt{\phi .28 \times 90^\circ}$

Section Line A-A is shown across the part.

**3. BROKEN EDGES .015" MAX**



## NIMS PROCEDURAL REQUIREMENTS

- 3. SUBMIT THIS PRINT AND WORKPIECE ALONG WITH THE PERFORMANCE AFFIDAVIT FOR EVALUATION**