

INT114 LAB 1.2: MILLING

Student Name: _____

Student ID: _____

LAB OUTCOMES:

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

1. Interpret a plan for a mill-machined part
2. Use an edge finder to accurately locate an origin point.
3. Mill even surfaces on a workpiece.
4. Mill surfaces of multiple heights on a workpiece.

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 2" x 2" x 1.5" steel block from the Sawing Lab 112-2.2. In this lab, you will machine the surfaces, steps, and slot.
2. Check the alignment of the vise. Does it need to be adjusted? Ensure that the vise is clean of any chips or burrs.

Part 2:

1. You will be machining the ends of the workpiece. Locate an appropriate cutting tool.

What is it?

How will this tool be mounted to the spindle?

2. Calculate the RPM and feed rate using the standard formulas. The table in the text gives the recommended cutting speed for steel as 100-235 fpm and the feed rate as 0.005 – 0.010 ftr.

3. Consult with the instructor on the appropriate spindle speed.

What speed is set?

How does this compare to your calculated values?

4. Mount the workpiece in a vise on parallels, with the top surface facing upward. One end should overhang the vise. Ensure that the work is setting flat against the vise.
5. Use an edge finder to locate your origin point. Set the dials to zero at the appropriate location.
6. Take a light cut on the overhanging end.
7. Remove the workpiece from the vise and measure it.

How much excess material will need to be removed to have this dimension accurate?

8. Remount the workpiece with the opposite end overhanging the vise. Locate your origin point and set the dials to zero.
9. Machine the overhanging end to bring the workpiece to the desired length. This may take multiple cuts.
10. Remount the workpiece with the adjacent edge overhanging the vise. Locate your origin point and set the dials to zero.
11. Take a light cut on the overhanging end.
12. Remove the workpiece from the vise and measure it.

How much excess material will need to be removed to have this dimension accurate?

13. Remount the workpiece with the opposite end overhanging the vise. Locate your origin point and set the dials to zero.
14. Machine the overhanging end to bring the workpiece to the desired length. This may take multiple cuts.

Part 3:

1. You will be machining the top and bottom surfaces of the workpiece. Locate an appropriate cutting tool.

What is it?

How will this tool be mounted to the spindle?

2. Calculate the RPM and feed rate using the standard formulas. The table in the text gives the recommended cutting speed for steel as 100-235 fpm and the feed rate as 0.005 – 0.010 ftr.

3. Consult with the instructor on the appropriate spindle speed.

What speed is set?

How does this compare to your calculated values?

4. Mount the workpiece in a vise on parallels, with the top surface facing upward. The top surface should be above the vise jaws. Ensure that the work is setting flat against the vise.
5. Use an edge finder to locate your origin point. Set the dials to zero at the appropriate location.
6. Take a light cut on the top surface.
7. Remove the workpiece from the vise and measure it.

How much excess material will need to be removed to have this dimension accurate?

8. Remount the workpiece with the opposite surface upward. Locate your origin point and set the dials to zero.
9. Machine the surface to bring the workpiece to the desired height. This may take multiple cuts.

Part 4:

1. You will be machining steps in the workpiece. Locate an appropriate cutting tool.

What is it?

How will this tool be mounted to the spindle?

2. Calculate the RPM and feed rate using the standard formulas. The table in the text gives the recommended cutting speed for steel as 100-235 fpm and the feed rate as 0.005 – 0.010 ftr.

3. Consult with the instructor on the appropriate spindle speed.

What speed is set?

How does this compare to your calculated values?

4. If needed, re-mount the workpiece in a vise on parallels, with the top surface facing upward. Ensure that the work is setting flat against the vise.
5. Use an edge finder to locate your origin point. Set the dials to zero at the appropriate location.
6. Mill the first step.
7. Mill the second step.

Part 5:

1. You will be machining the slot in the workpiece. Locate an appropriate cutting tool.

What is it?

How will this tool be mounted to the spindle?

2. Calculate the RPM and feed rate using the standard formulas. The table in the text gives the recommended cutting speed for steel as 100-235 fpm and the feed rate as 0.005 – 0.010 ftr.

3. Consult with the instructor on the appropriate spindle speed.

What speed is set?

How does this compare to your calculated values?

4. If needed, re-mount the workpiece in a vise on parallels. Ensure that the work is setting flat against the vise.
5. Use an edge finder to locate your origin point. Set the dials to zero at the appropriate location.
6. Machine the slot. Ensure that it is centered.
7. Measure all dimensions. Is the workpiece within the acceptable tolerances?

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:

This product was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.



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Performance Standards

Vertical Milling Level I

Material

Mild steel or low carbon steel 1.5" x 2" x 2.6"

Duty

Setup and operate vertical milling machines. Perform routine milling, and location of hole centers within $\pm .005$ ".

Performance Standard

Given raw material, print, hand, precision, and cutting tools, as well as access to an appropriate vertical milling machine and its accessories, produce a part matching the blueprint specifications using appropriate trade techniques and speeds and feeds. The part specified should require squaring up from the raw state, have at least one milled slot, require the location of at least two drilled and reamed holes within positional tolerance of .014" and have three steps controlled by tolerances of $\pm .005$ ".

Other Evaluation Criteria

1. Finishes are at least 125 Ra microinches.
2. No sharp edges.

Accuracy Level: $\pm .015$ on all fractions, $\pm .005$ on all decimals unless otherwise specified on the blueprint. Finishes Surfaces to be square within .005 over 4". Finished surfaces are to be 125 Ra microinches unless otherwise specified.

Assessment Equipment and Material

Workstation: A common workbench, a vertical mill. Table capacity of approximately 12"X36".

Material: A part matching the material requirements of the vertical milling print, material: Mild steel.

Tooling: A 6" milling vise or greater, screws, studs, nuts, washers, and clamps sufficient to secure the vise, or the part to the table. Assorted parallels, ball peen, and soft-faced hammers, assorted cutters and cutter adapters fitted to the machine spindle, files, magnetic base for indicators, soft jaws for the vise, drill chuck, drills, reamers, combination drill and countersink or spotting drill, countersink, and edge finder. Coolants and cutting oil.

Measuring Instruments: 0-3 Micrometers, combination set, dial indicator, 6" rule, a 6" vernier, dial, or electronic caliper, adjustable parallels, and depth micrometer, and surface finish comparison plates.

Pingages. .123", .124", .125", .126", .127"

Solid square

¼ - 20 UNC 2B plug gage

Telescopic gage .750

Small hole gage

Reference: Machinery's Handbook.

Performance Assessment Worksheet

Vertical Milling Level I

INSTRUCTIONS: Rate the candidate's performance for the Milling project according to the sixteen (16) criteria below. The checklist below represents a listing of the only 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/trainee must correct or redo the project.

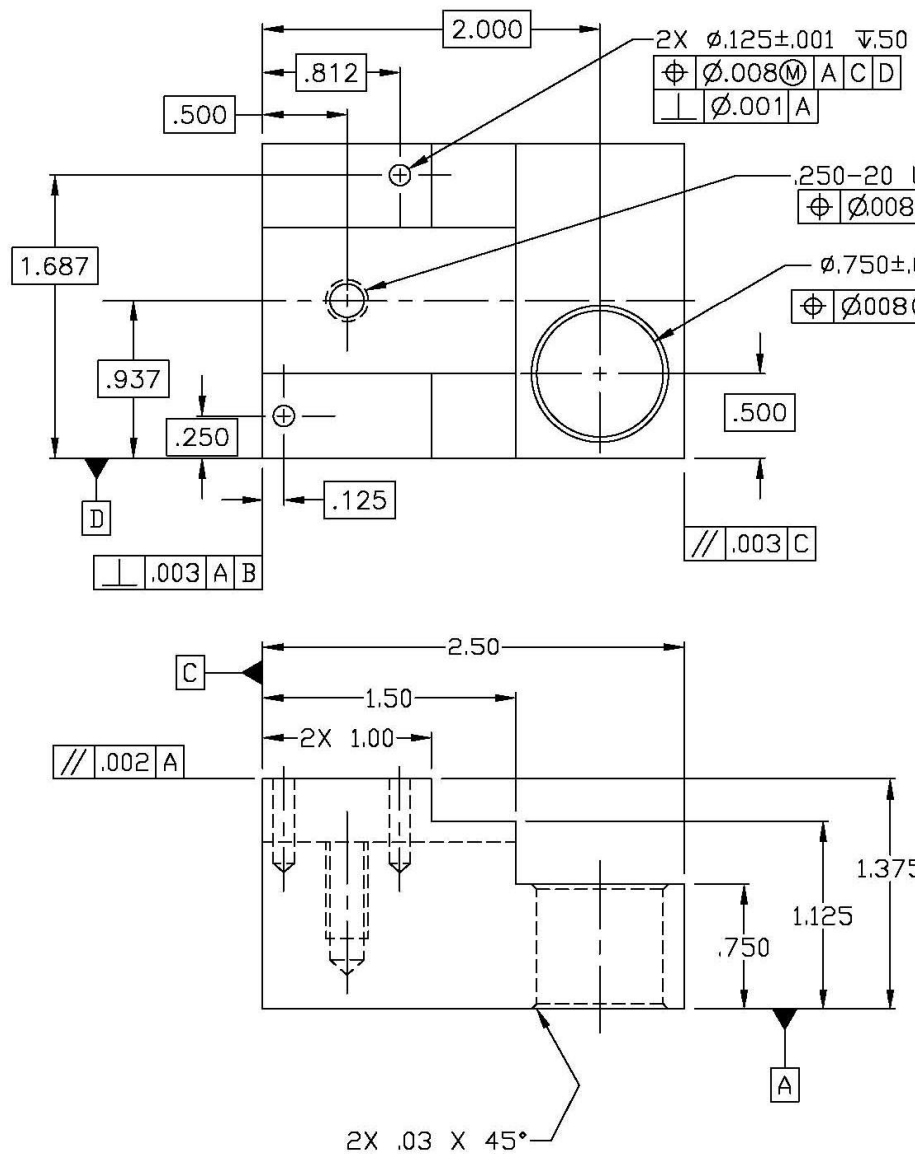
Candidate Name _____

Evaluation Date _____

Performance Project – Milling			
Evaluation Criteria		Pass	Fail
1. Lengths $2.50 \pm .015$, $1.50 \pm .015$, $1.00 \pm .015$	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
2. Heights $1.375 \pm .005$, $1.125 \pm .005$, $.750 \pm .005$, $1.000 \pm .005$	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
3. Width $1.875 \pm .005$	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
4. All surfaces are \square or $//$ within specified tolerance zones in the feature control symbols to their respective datums	Pass = within tolerance zones Fail = exceeds tolerance zones	<input type="checkbox"/>	<input type="checkbox"/>
5. $\varnothing .750 \pm .005$ bore	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
6. True position of $\varnothing .750$ bore $.014$ tolerance zone to datums A, C and D	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
7. $\varnothing .25$ - 20 UNC-2B Thread True position tolerance zone of $.014$ to datums A, C and D (base true position from tap drill diameter.	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>


Performance Project – Milling			
Evaluation Criteria		Pass	Fail
8. $.875 \pm .005$ position to datum B with a $.005$ tolerance zone.	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
9. 2 x $.125$ ” holes positioned within $.812 \pm .005$ datums A, C, & D	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
10. $.125$ hole diameter $\pm .001$ (both holes)	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
11. Tap for $.25 - 20 \times .50$ deep min. (No break out at the bottom of the hole)	Pass = within tolerance zones Fail = exceeds tolerance zones	<input type="checkbox"/>	<input type="checkbox"/>
12. $.031$ deep $\times 45^\circ$ chamfers	Pass = within tolerance Fail = out of tolerance	<input type="checkbox"/>	<input type="checkbox"/>
13. Surface finish, no ground surfaces	Pass = 125 Ra microinches or better Fail = over 125 Ra microinches	<input type="checkbox"/>	<input type="checkbox"/>
14. Sharp edges $.015$ max. and holes countersunk $.031$ max.	Pass = no sharp edges, within maximum allowance Fail = sharp edges	<input type="checkbox"/>	<input type="checkbox"/>
END OF MILLING EVALUATION			

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 part print and the Performance Affidavit should be sent along with the part to the MET-TEC for evaluation. Send to NIMS only the completed Performance Affidavit, signed by the MET-TEC members. A copy of the Performance Affidavit should be retained in the candidate's file documenting completed performance for this credential.



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	UPDATED DRAWING AND TITLE BLOCK	3/7/05	LW

- Notes:
1. FINISH ALL OVER 125 MICROINCHES MAX
 2. BREAK ALL SHARP EDGES .015" MAX
 3. COUNTERSINK ALL HOLES .03" MAX UNLESS SHOWN

				MACHINING SKILLS LEVEL I			
				Job Duty 2.5 & 2.6 Vertical Milling Operation			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994		DESIGNER	DK	8/1/01	MATERIAL COLD ROLL STEEL OR MILD STEEL		
TOLERANCES .X $\pm .032$.XXX $\pm .005$.XX $\pm .015$ ANGLES ± 1 DEG. FRACTIONS $\pm 1/64$		DWG CHK					
		DWG APPD					
		SCALE FULL		DWG.#98301 I		SHEET 1 OF 1	

DO NOT SCALE DRAWING

NIMS PROCEDURAL REQUIREMENTS

1. SUBMIT THIS PRINT AND WORKPIECE ALONG WITH THE PERFORMANCE AFFIDAVIT FOR EVALUATION