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 mild steel, 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 ¼-20 plug gage, and .244-.246 pin gauges.
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.

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<table>
<thead>
<tr>
<th>Performance Project – Benchwork</th>
<th>Pass</th>
<th>Fail</th>
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<tbody>
<tr>
<td><strong>Evaluation Criteria</strong></td>
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<tr>
<td>1. Tap .250 thread .5 min depth (hole 3)</td>
<td>Pass = tapped to the minimum depth</td>
<td>Fail = not tapped to minimum depth</td>
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<tr>
<td>2. Stud within .13 surface (hole 2) ± .015</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>3. Press fit bushing check.</td>
<td>Pass = pressed correctly – tight, cannot push out with finger pressure; flush ± .03</td>
<td>Fail = not flush or loose</td>
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<tr>
<td>4. Bench chamfer .06 x 45° on top four edges</td>
<td>Pass = within tolerance .06 ± .015 45° ± 1°</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>5. Overall finish and quality</td>
<td>Pass = edges were broken .015” max. Burrs removed. Threads clean</td>
<td>Fail = burrs, excessive edge break &gt; .015, congested threads</td>
</tr>
</tbody>
</table>

END OF BENCHWORK 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 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.
NIMS PROCEDURAL REQUIREMENTS

1. PORTABLE HAND DRILL TO BE USED
2. THIS IS A BENCHWORK JOB. EXCEPT FOR PREPARATION OF THE BLOCK, ALL WORK IS TO BE DONE USING HAND TOOLS
3. SUBMIT THIS PRINT AND WORKPIECE ALONG WITH THE PERFORMANCE AFFIDAVIT FOR EVALUATION

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Performance Standards
Layout

Material
Cold rolled steel or low carbon steel .25" x 2" x 6.125" with add stock on left end.

Duty
Layout the location of hole centers and surfaces within an accuracy of +/- .015.

Performance Standard
Given a surface plate, surface gage, layout height gage, combination set, scribe, layout ink, prick punch, ball peen hammer, process plan, and part print, layout hole locations, radii, and surfaces matching the specifications.

Other Evaluation Criteria
1. Layout ink is applied to the surface appropriately.
2. Lines are struck once.
3. Intersections are clean and clear.
4. Punch marks are centered on intersections.

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

Assessment Equipment and Material
Workstation: Common workbench, a layout surface plate at least 12" X 18"
Material: A part matching the layout print, material: Cold rolled mild steel.
Tooling: A scribe, layout ink or a Magic Marker, prick punch, ball peen hammer, angle plate, C-clamps, parallel-closing clamps, magnifying glass.
Measuring Instruments: Combination set, radius gages, 6" dividers, surface gage, or layout height gage.
**Performance Assessment Worksheet**  
**Layout**

**INSTRUCTIONS:** Rate the candidate’s performance for the Layout job according to the nineteen (19) criteria below. The checklist below only represents 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/student must correct or redo the project.

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<table>
<thead>
<tr>
<th>Performance Project – Layout</th>
<th>Evaluation Criteria</th>
<th>Pass</th>
<th>Fail</th>
</tr>
</thead>
</table>
| 1. Length: 6.032/5.968       | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 2. Height: 1.765/1.735       | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 3. Height: 1.885/1.855       | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 4. Height 1.015/.985         | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 5. Radius: .38 ± .015        | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 6. Radius: .25 ± .015        | Pass = within tolerance  
Fail = out of tolerance    | ☐    | ☐    |
| 7. Location of hole #2:      | Pass = within tolerance  
3.015/2.985 x .515/.485    | ☐    | ☐    |
| 8. Location of hole #5:      | Pass = within tolerance  
3.015/2.985 x 1.515/1.485   | ☐    | ☐    |
| 9. Location of hole #1:      | Pass = within tolerance  
.515/.485 x .515/.485       | ☐    | ☐    |
### Performance Project – Layout

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Pass</th>
<th>Fail</th>
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<tbody>
<tr>
<td>10. Location at hole #3: .515/.485 x 1.515/1.485</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>11. Location at hole #4: 5.515/5.485 x .515/.485</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>12 Length to step: 1.75 1.765/1.735</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>13. Length to step: 1.00 1.765/1.735</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>15. Radius: .125 ± .015</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>16. Location of hole #2: 3.015/2.985-x .515/. 485</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>17. Location of hole #5: 3.015/2.985 x 1.515/1.485</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>18. Intersections are struck once</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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<tr>
<td>19. Location of hole #1: .515/.485 x .515/.485</td>
<td>Pass = within tolerance</td>
<td>Fail = out of tolerance</td>
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Notes:
BREAK ALL SHARP EDGES

NIMS PROCEDURAL REQUIREMENTS
1. THIS IS A LAYOUT ONLY, DO NOT CUT PART PROFILE
2. CONSTRUCTION LINES FOR LAYOUT ARE PERMISSIBLE
3. LINES ARE STRUCK ONCE
4. INTERSECTIONS ARE CLEAN AND CLEAR
5. PUNCH MARKS ARE CENTERED ON INTERSECTIONS: ± .015
6. SUBMIT THIS PRINT AND WORKPIECE ALONG WITH THE PERFORMANCE AFFIDAVIT FOR EVALUATION

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