



**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

PRIMARY DEVELOPERS:  
Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 1 of 11

## **Mechapacticum Outline**

### *Fabrication and Assembly*

---

#### **Topic: Mechapacticum Period 1 & 2 Fabricate and Assembly**

**Estimated completion time:** 16 hours

#### **Purpose:**

The purpose of this job is to sketch, layout and fabricate a component demonstrating the use of blueprints or specifications.

#### **Instructional Outcomes:**

The participant will demonstrate the application of their skill and knowledge in the following topical areas:

- Machining
- Blueprint Reading
- Safety

#### **Instructions to Students:**

1. The evaluator will provide you with a description of a component that you must sketch, layout and fabricate.
2. You must sketch the components as described by the evaluator.
3. Select the appropriate materials and create a bill of materials
4. Search the appropriate reference material/charts required to complete the project, and identify the equipment for the component being fabricated
5. You must correctly and accurately fabricate the component out of raw materials.
6. Assemble the component and give the final product to the evaluator.
7. Your solution must be safe, durable, functional, load appropriate, and reliable.





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

PRIMARY DEVELOPERS:  
Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 2 of 11

## **Mechapacticum Outline**

### *Fabrication and Assembly*

---

#### **Safety**

The student will demonstrate all safety practices learned previous instruction including assuring that all sharp edges are deburred.

#### **Instructions to Evaluator:**

Provide the candidate with a description of a problem situation which requires the fabrication of a bracket or support. The student must sketch, layout and fabricate the correct solution to the problem situation. Use of Manufacturing Plans

The student's solution must be safe, durable, functional, load appropriate, and reliable.

#### **Equipment and Materials**

- Computer with internet access
- Drill
- Saw
- Tap
- Measuring tools (including calipers)
- Drafting tools
- Raw material
- PPE
- Hand tools (socket wrenches, screwdrivers, layout table)

#### **Manufacturing Plans:**

Lab 1 Fabricate

Lab 2 Assembly

Lab 3 Final Lab





## MechapRACTICUM Outline

### *Fabrication and Assembly*

## Manufacturing Plan for Manual Machining

|                                   |           |                                  |                     |
|-----------------------------------|-----------|----------------------------------|---------------------|
| Part Number: Lab 1 & 2            | Quantity: | Material: Mild Steel             | Manufacturing Date: |
| Part Name: Lab 1 Assembly         | <b>1</b>  | Stock: 5/8 X 3 X 5 & 3/8 X 1 X 3 |                     |
| Part Description: Plate & Bracket |           |                                  |                     |

| Operation # | Machine Description  | Operation Description  | Tool Type                                 | Cycle Time |
|-------------|----------------------|--|---|------------|
| 1           | Band-saw             | SAW MATERIAL FOR BOTH PARTS                                    | HORIZONTAL BAND SAW                       | 30 MIN     |
| 2           | LAYOUT SURFACE PLATE | LAYOUT PART PER PRINT  | HEIGHT GAGE                               | 15 MIN     |
| 3           | Manual Mill          | CENTER DRILL AND C' SINK PER PRINT                             | ½ DIA CENTER DRILL                        | 30 MIN     |
| 4           | Drill Press          | DRILL & REAM HOLES PER PRINT<br>¼ REAMER, 3/8 REAMER, ½ REAMER | 15/64 DRILL<br>23/64 DRILL<br>15/32 DRILL | 45 MIN     |
| 5           | Drill Press          | DRILL AND HAND TAP PER PRINT                                   | F DRILL<br>5/16-18 TAP                    | 30 MIN     |
| 6           | Manual Mill          | DRILL TWO ½ DIAMETER HOLES ON BRACKET FOR THE SLOT             | ½ DRILL                                   | 15 MIN     |
| 7           | Manual Mill          | MILL FLAT AND SLOT ON BRACKET                                  | ½ & 1.0 DIA END MILL                      | 45 MIN     |
| 8           | Belt sander          | DEBURR ALL EDGES BOTH PARTS                                    | SAND PAPER                                | 15 MIN     |
| 9           | SURFACE GRINDER      | GRIND TOP & BOTTOM LAB 1 PLATE                                 | GRINDING WHEEL                            | 30 MIN     |
| 10          | ASSEMBLY TABLE       | ASSEMBLE PART 5/16 – 18 SHCS                                   |   |            |





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

**PRIMARY DEVELOPERS:**

Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 4 of 11

## **MechapRACTICUM Outline**

### *Fabrication and Assembly*

Notes/drawings/setup sketch

**Tips:**

- Always adjust speed while machine is running
- Ream at half speed
- Edge finder is used at 1000 rpm
- Clean machines and sweep floors at end of class





## Mechapacticum Outline

### *Fabrication and Assembly*

## Manufacturing Plan for Manual Machining

|  |                       |                               |                     |
|--|-----------------------|-------------------------------|---------------------|
| Part Number:<br><b>LAB 3</b>                           | Quantity:<br><b>1</b> | Material: MILD STEEL          | Manufacturing Date: |
| Part Name:<br><b>FINAL LAB 3</b>                       |                       | Stock: 2 REQUIRED 3/8 X 1 X 3 |                     |
| Part Description: <b>TOP &amp; BOTTOM DOWEL PLATES</b> |                       |                               |                     |

| Operation # | Machine Description  | Operation Description  | Tool Type                                   | Cycle Time |
|-------------|----------------------|--|---|------------|
| 1           | Band-saw             | CHOOSE AND SAW MATERIAL TO LENGTH                                    | HORIZONTAL BAND SAW                         | 15 MIN     |
| 2           | LAYOUT SURFACE PLATE | LAYOUT BOTH UPPER AND LOWER PARTS PER PRINT                          | HEIGHT GAGE                                 | 15 MIN     |
| 3           | Manual Mill          | CENTER DRILL ALL HOLES BOTH PARTS PER PRINT                          | ½ DIA CENTER DRILL                          | 30 MIN     |
| 4           | Manual Mill          | DRILL HOLES PER PRINT BOTH PARTS                                     | .53 DIA DRILL (N .303) DRILL .425 TAP DRILL | 30 min     |
| 5           | Manual Mill          | REAM HOLES PER PRINT   | 5/16 DIA OVER/UNDER REAMERS                 | 30 MIN     |
| 6           | Drill Press          | C' SINK ALL HOLES + .030 DIA LARGER THAN HOLE SIZE HAND TAP ½-13 TPI | 82 DEGREE C' SINK BIT ½-13 TAP              | 30 MIN     |
| 7           | Belt sander          | DEBURR BOTH PARTS ALL SURFACES                                       | SAND PAPER                                  | 15 MIN     |
| 8           | ASSEMBLY TALBE       | ASSEMBLE PARTS 5/16 DOWEL PINS & ½ - 13 SHCS                         | 5/16 DOWEL PINS ½ SHCS                      | 15 MIN     |
| 9           | Choose Machine       |  |   |            |
| 10          | Choose Machine       |  |   |            |





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

**PRIMARY DEVELOPERS:**

Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 6 of 11

## **MechapRACTICUM Outline**

### *Fabrication and Assembly*

---

Notes/drawings/setup sketch

**Tips:**

- Always adjust speed while machine is running
- Ream at half speed
- Edge finder is used at 1000 rpm
- Clean machines and sweep floors at end of class

**Rubrics:**





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 7 of 11

**PRIMARY DEVELOPERS:**

Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

**MechapRACTICUM Outline**  
*Fabrication and Assembly*

| Job 1 _____ Job 2 _____<br>(Check 1) |  |     |  |                      |   |                    |  |                 |               |                |
|--------------------------------------|--|-----|--|----------------------|---|--------------------|--|-----------------|---------------|----------------|
|                                      | SKETCHING                                    | PTS | (A) <i>Highly Proficient</i>   | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>                     | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>  | Possible points | Ratings A - E | Points Awarded |
| 1                                    | Completeness of sketch                       | 25  | All features and details are represented in at least an isometric view             |                      | Major features and details are provided; but some missing     |                    | Too many features missing to be able to produce the task                         | 25              |               |                |
| 2                                    | Clarity of sketch                            | 20  | Legible; no ambiguity in the design  |                      | Some assumptions need to be made in order to produce the part |                    | Too many assumptions need to be made; part could not be produced from the sketch | 20              |               |                |
|                                      | MATERIALS AND PROCESSES                      | PTS | (A) <i>Highly Proficient</i>   | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>                     | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>  | Possible points | Ratings A - E | Points Awarded |
| 3                                    | Selection of materials for bill of materials | 10  | Appropriate materials for load, safety, cost                                       |                      | Needed assistance or prompting to select materials            |                    | Unable to select appropriate materials   | 10              |               |                |
| 4                                    | Selection of fasteners for component         | 25  | Appropriate fasteners for load, safety, cost                                       |                      | Needed assistance or prompting to select fasteners            |                    | Unable to select appropriate fasteners   | 25              |               |                |
| 5                                    | Selection of tools                           | 10  | Appropriate drills and taps  |                      | Needed assistance or prompting                                |                    | Unable to select appropriate tools   | 10              |               |                |
| 6                                    | Resource utilization                         | 25  | Used appropriate resources for selecting materials, selecting fasteners, and tools |                      | Needed assistance or prompting                                |                    | Unable to use resources  | 25              |               |                |





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

PRIMARY DEVELOPERS:  
Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 8 of 11

## MechapRACTICUM Outline

### *Fabrication and Assembly*

---

|    | LAYOUT AND FABRICATION         | PTS | (A) <i>Highly Proficient</i>  | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>           | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>                   | Possible points | Ratings A - E | Points Awarded |
|----|--------------------------------|-----|---|----------------------|---|--------------------|---|-----------------|---------------|----------------|
| 7  | Accuracy of layout             | 10  | Correct measurements; marked center points of holes; accurately cut parts |                      | Need prompting to do correctly                      |                    | Unable to layout  | 10              |               |                |
| 8  | Use of fasteners for component | 25  | Appropriate installation of fasteners for load, safety, cost              |                      | Needed assistance or prompting to install fasteners |                    | Unable to install fasteners or incorrect fasteners used | 25              |               |                |
| 9  | Use of tools                   | 10  | Appropriate operation of drills press, taps, wrenches, etc.               |                      | Needed assistance or prompting                      |                    | Unable to use tools                                     | 10              |               |                |
| 10 | Assembly                       | 25  | Assembly was easily put together; holes appropriately located             |                      | had to alter to assemble; rework required           |                    | Was impossible- could not be assembled                  | 25              |               |                |







PRIMARY DEVELOPERS:

Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

## Mechapacticum Outline

### *Fabrication and Assembly*

|    | Safety              | PTS | (A) <i>Highly Proficient</i>  | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>                                   | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>                   | Possible points | Ratings A - E | Points Awarded |
|----|---------------------|-----|---|----------------------|---|--------------------|---|-----------------|---------------|----------------|
| 11 | Safe Work Practices | 25  | Used appropriate PPE; practiced common safety practices   |                      | Most safety practices used  |                    | Demonstrated unsafe working practices                   | 25              |               |                |
| 12 | Safety Attitude     | 25  | Work practices demonstrated safety consciousness in all procedures; looked out for safety of others |                      | Most of the time worked safely and showed some concern for safety of others |                    | Dangerous worker; did not look out for safety of others | 25              |               |                |
| 13 | Machining safety    | 25  | Guards used on drill press; secured; band saw--pusher used  |                      | Had to be prompted  |                    | Dangerous worker; did not look out for safety of others | 25              |               |                |

|    | PRODUCT EVALUATION                           | PTS | (A) <i>Highly Proficient</i>  | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>              | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>   | Possible points | Ratings A - E | Points Awarded |
|----|--|-----|---|----------------------|--|--------------------|---|-----------------|---------------|----------------|
| 14 | Safe product                                 | 10  | Product was deburred so could be handled safely   |                      | Minor deburring problems; but overall safe             |                    | Ouch                                    | 10              |               |                |
| 15 | Durability, reliability and load appropriate | 25  | Appropriate materials, fasteners and design made the product durable for use in an industrial environment |                      | Minor design issues could have improved the durability |                    | Not at all durable                      | 25              |               |                |
| 16 | Function                                     | 25  | Product met the needs of the problem presented  |                      | Will basically work                                    |                    | Will not serve the needs of the problem | 25              |               |                |





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 10 of 11

PRIMARY DEVELOPERS:

Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

## MechapRACTICUM Outline

### *Fabrication and Assembly*

|    | WORK HABITS      | PTS | (A) <i>Highly Proficient</i>   | (B) <i>Competent</i> | (C) <i>Partially Competent/Developing</i>                                       | (D) <i>Limited</i> | (E) <i>Major Improvement Required</i>                                  | Possible points | Ratings A - E | Points Awarded |
|----|------------------|-----|--|----------------------|---|--------------------|--|-----------------|---------------|----------------|
| 17 | Work Attitude    | 15  | Alert to finding and correcting problem  |                      | Honestly attempted to find and correct problems                                 |                    | Showed frustration in finding and correctly problem                    | 15              |               |                |
| 18 | Work Procedure   | 25  | Always followed standard procedures; demonstrated planning and organization skills in correcting the problem |                      | Complied with standard procedures; Showed some plan and organization in working |                    | Did not follow standard procedures; Disorganized and slipshod methods; | 25              |               |                |
| 19 | Professionalism  | 20  | Work showed pride in accomplishment  |                      | Tried hard and shows promise  |                    | Work lacks praiseworthy factors  | 20              |               |                |
| 20 | Self-confidence  | 15  | Appeared comfortable and posed when performing tasks   |                      | Fairly self-confident; occasionally disconnected                                |                    | Hesitant, timid, uncertainty   | 15              |               |                |
| 21 | Knowledge of job | 25  | Has an exceptionally thorough knowledge of the job   |                      | Has good knowledge but needed coaching  |                    | Has inadequate knowledge of job  | 25              |               |                |

Total  
Points





**Multi-State  
Advanced Manufacturing  
Consortium**

US DOL SPONSORED TAACCCT GRANT: TC23767

PRIMARY DEVELOPERS:  
Glenn Wisniewski – Corporate Trainer, Henry Ford College  
Wes Bye – Mechatronics SME, Pontiac Coil

RELEASE DATE 12/17/2014

VERSION v 001

PAGE 11 of 11

## **Mechapacticum Outline**

### *Fabrication and Assembly*

---

#### **SAFETY DISCLAIMER:**

M-SAMC educational resources are in no way meant to be a substitute for occupational safety and health standards. No guarantee is made to resource thoroughness, statutory or regulatory compliance, and related media may depict situations that are not in compliance with OSHA and other safety requirements. It is the responsibility of educators/employers and their students/employees, or anybody using our resources, to comply fully with all pertinent OSHA, and any other, rules and regulations in any jurisdiction in which they learn/work. M-SAMC will not be liable for any damages or other claims and demands arising out of the use of these educational resources. By using these resources, the user releases the Multi-State Advanced Manufacturing Consortium and participating educational institutions and their respective Boards, individual trustees, employees, contractors, and sub-contractors from any liability for injuries resulting from the use of the educational resources.

#### **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.

#### **RELEVANCY REMINDER:**

M-SAMC resources reflect a shared understanding of grant partners at the time of development. In keeping with our industry and college partner requirements, our products are continuously improved. Updated versions of our work can be found here: <http://www.msamc.org/resources.html>.

