

# Draft Manufacturing Standards

## *Part I - Core Standards*

### **1. The student will understand the advantages and disadvantages of various manufacturing methods.**

- The student will be able to investigate and evaluate appropriate manufacturing methods.
- Establish an effective sequence of operations for a given design problem.
- Will use appropriate manufacturing processes to produce an actual product.

### **2. The student will understand the machinery and equipment used to manufacturing a given product.**

- Will demonstrate the application of computerized controllers to operate machinery, equipment and processes
- Will demonstrate the use and application of hydraulic, pneumatic, and mechanical controls in manufacturing processes.
- Will be able to defend/justify their selection of manufacturing machine tools to produce their product.

### **3. The student will understand the concepts of precision, accuracy, and appropriate units of measurement and their application in manufacturing processes.**

- The students will demonstrate their ability to select and utilize the proper measurement tool based on the product and required tolerance.
- The student will be able to verify proper calibration and take appropriate action to correct the measuring tools.
- The student will perform unit conversions between systems such as metric and traditional English based measurements.

### **4. Students will understand the impact and importance of environmental issues related to manufacturing processes and organizations.**

- The student will be able to describe roles and responsibilities of state and federal regulatory agencies that affect manufacturing operations.
- Students will study and report on waste stream management of selected segments of manufacturing operations.

- Students will design a plan to implement a basic recovery, disposal, recycling, or minimization system for industrial cleaning processes.

**5. The student will understand the different types of material processes.**

- Students will evaluate and contrast advantages of various mechanical processes.
- Students will evaluate and contrast advantages of various chemical processes.
- Students will evaluate and contrast advantages of various electrical processes.
- Students will evaluate and contrast advantages of various thermal processes.

**6. Students will understand the uses and the requirements those material selection places on the manufacturing method and processes.**

- The student will demonstrate the ability to select an appropriate process for a given material.
- The student will be able to select an appropriate material based upon product requirements.
- Students will be able to evaluate the cost effectiveness of the material selections for a given product.

**7. Students will understand the actual cost in time, material, and tooling expenses related to the product manufacturing cycle.**

- The student will be able to balance quality requirements verses timely product completion in the manufacturing process.
- Students will determine the appropriate processes or methods to meet cost expectations.
- The student will understand the relationship between the cost and material selection.

**8. Students will understand planning, scheduling, and time management for project completion.**

- Students will create a planning sequence for the production of a product.
- Student will develop a schedule from start to completion of the product.
- Students will demonstrate their ability to modify or adapt their schedule and plan as required.

**9. The students will understand the standard communication (Electronic Industries Association, EIA) protocols for conveying electronic information in an industrial environment.**

- The student will demonstrate the ability to read and interpret technical drawings accurately.
- The student will demonstrate the ability to interface technical information between computers, machine controllers and machinery.
- The student will demonstrate the ability to convey information electronically.

**10. The student will understand the different aspects of manufacturing management that include things such as Personal time management, Team participation/dynamics and scheduling of priorities. The student will demonstrate these by:**

- Actively participating in or on a team.
- Developing a schedule for project completion.
- Balancing multiple demands for time (i.e., several products/processes/classes).

## ***Part II - Content Standards***

### **Welding Processes**

**11. Students will understand the basic elements of proper product or project development and documentation documents used in welding design utilizing American Welding Society (AWS) standards. Students will demonstrate proficiency by:**

- Preparing a bill of materials for a given project.
- Estimating the time needed to produce a given product.
- Selecting the proper welding process to produce a given product.
- Completing the welding process required by a project in accordance with print requirements and AWS standards.

•

**12. Students will understand the chemical, physical, and mechanical properties of welding materials and how processes affect those properties. Students will demonstrate proficiency by:**

- Preparing weld joints for producing a product in accordance with print requirements and AWS standards.
- Utilizing proper fixtures and clamps to minimize undesirable defects as a result of the welding process.

**13. Students will understand the safe and efficient use of processes utilized in welding fabrication. Students will demonstrate proficiency by:**

- Using shears to cut flat metal plate material.
- Using saws to cut bar stock to size.
- Using drills to produce accurately located holes.
- Utilizes punch presses and benders for sheet metal fabrication.

**14. Students will understand the safe and efficient use of tools and equipment used in welding processes. Students will demonstrate proficiency by:**

- Flame cutting a half-inch steel plate producing a straight, slag free edge.
- Brazing a cast iron part-requiring repair.
- Welding steel parts in accordance with specification in all positions, utilizing proper gas settings, tip sizes and filler rod.

**15. Students will understand the functions of shielded metal arc welding (SMAW) machines and consumable supplies required for proper operation. Students will demonstrate proficiency by:**

- Welding steel parts in accordance with specification in all positions, utilizing proper gas settings, tip sizes and filler rod.
- Identifying welding rod codes according to AWS standards for the given application.

**16. Students will understand the functions of gas metal arc welding (GMAW) machines and consumable supplies required for proper operation. Students will demonstrate proficiency by:**

- Identifying the various gases used for shielding and the proper selection for various applications.
- Welding steel plate according to given specifications in all positions utilizing proper polarity, wire size, gas type and flow, and machine settings.
- Welding stainless steel according to given specifications in all positions utilizing the proper polarity, wire size, gas type and flow, and machine settings.
- Welding aluminum according to the given specifications in all positions utilizing proper polarity, wire size, gas type and flow, and machine settings.

**17. Students will understand the functions of tungsten metal arc welding (TMAW) machines and consumable supplies required for proper operation. Students will demonstrate proficiency by:**

- Welding mild steel sheet metal according to given specification in all positions utilizing proper polarity settings, tungsten type, tungsten size, tip preparation, and gas flow appropriate to the work material.
- Welding stainless steel sheet metal according to given specification in all positions utilizing proper polarity settings, tungsten type, tungsten size, tip preparation, and gas flow appropriate to the work material.
- Welding aluminum sheet metal according to given specification in all positions utilizing proper polarity settings, tungsten type, tungsten size, tip preparation, and gas flow appropriate to the work material.

**18. Students will understand the principles of electric resistance and methods used in resistance welding. Students will demonstrate proficiency by:**

- Selecting the appropriate electrode type, electrode force, squeeze time, and current setting to weld various materials.
- Welding various materials in accordance with AWS standards.

**19. Students will understand some of the special processes used for welding or cutting unusual materials.**

- Explaining several processes used for welding or cutting extremely thick or extremely thin materials.
- Explaining several processes used for welding or cutting to increase productivity.
- Describing processes used in unusable conditions or locations to complete welding requirements and evaluate the relative merits of each.

**20. Students will understand welding methods used to joint pipe and tubing. They will demonstrate proficiency by:**

- Laying out, fitting, and butt welding pipe or tubing using the shielded metal arc welding process.
- Preparing pipe for welding in 90 and 45 degree branch configurations.

**21. Students will understand common types of weld tests, how to identify a flaw, and what constitutes a defect. They will demonstrate proficiency by:**

- Visually inspecting welds they have completed.
- Identify drop through, undercut, overlap, and porosity on actual welds.

- Describing tensile strength, shear strength, hardness, and the methods of testing these parameters.
- All evaluations of student performance will be based on the standards of the American Society of Mechanical Engineers (ASME) and the AWS.

## **Machine Tool Processes**

### **22. Students will understand concepts of dimensioning systems including industry-approved standards (i.e., American National Standards Institute, ANSI) for geometric tolerancing.**

- The student will identify dimensions necessary to produce a product.
- The student will calculate the minimum and maximum allowable dimensions within the specified tolerance.
- The student will demonstrate knowledge and proficiency in the selection of measurement tool necessary to achieve required accuracy.

### **23. Students will understand how to use machine-tooling holding devices, fixtures, vices, rotary devices, and hold-down clamps to secure work in a machine tool operation.**

- Students will identify and utilize the proper holding device secure a part for machining.
- Students will demonstrate proficiency in working with angular indexing devices for layout and machining.

### **24. Students will understand the safe and proper operation of a conventional lathe to produce a part or product.**

- The student will demonstrate the ability to select the proper cutting speed for different materials and cutting tools.
- The students will demonstrate the ability to calculate correct turning speed for different materials and tooling operations.
- Students will demonstrate the ability to select the proper feed rates and depth of cut for required machining.
- Students will demonstrate to grind lathe tools for turning, facing, threading, and cutting off of materials.
- Students demonstrate the correct lathe setup for performing facing, threading, and cutting off of materials.

**25. Students will understand the safe and proper operation of a conventional milling machine to produce a part or product.**

- Students will demonstrate the ability to select correct cutting speed and turning speed for different materials and required machining operations.
- Students will demonstrate the ability to determine the depth of cut and chip load for various feed rates in order to complete a machine task.
- The student will demonstrate the correct setup of vertical and horizontal milling machines for safe and proper machining operations.

**26. Students will understand the safe and proper operation of grinders and demonstrate the selection of appropriate grinding wheels for specific applications.**

- The student will be able to dress a grinding wheel and adjust work-rests for proper operation.
- The student will demonstrate the ability to identify various types of grinding wheels to process differing materials.
- The student will be able to utilize a grinder to sharpen various cutting tools, including twist drill bits.
- The student will finish a part to specified flatness and finish requirements on a surface grinder.

**27. Students will understand how precision instruments are used in the manufacture of parts or products and to insure compliance with dimensional tolerances and standards of accuracy.**

- Students will demonstrate proficiency by using instruments which include micrometer, vernier calipers, vernier height gauge, and assemble gauge blocks to an accuracy of .001 inch or metric equivalent.
- The student will utilize a vernier bevel protractor to accurately measure plus or minus 15 minutes angle.
- Students will compare a part with a known standard part using a dial indicator to insure accuracy.

**28. Students will understand layout work using industry-approved standards. They will lay out, machine, and inspect manufactured parts. Students will demonstrate proficiency by performing the following:**

- Layout dimensions according to print specifications to an accuracy of .001 inch or metric equivalent using a vernier height gauge.
- Layout dimensions according to print specifications to an accuracy of 1/64 of an inch or metric equivalent using a combination square.

- Layout dimensions according to print specifications to an accuracy of plus or minus 15 minutes or metric equivalent using a protractor.
- Locate centers of holes accurately using prick and center punches.
- Identify symbols used in for geometric tolerancing and dimensioning.
- Inspect a finished part to verify dimensional accuracy according to print tolerances.

## **Forming Processes**

### **29. Students will understand foundry and casting practices in relation to manufacturing processes. They will demonstrate proficiency by:**

- Identifying tools used in foundry practices (copes, drags, patterns, crucibles, and ladles).
- Identifying components of a casting process (gates, runners, spruces, and vents).
- Preparing a flask for producing a cast part.
- Operating the crucible furnace for preparation of molten metal.
- Identify proper temperature and safety requirements for different material to be used in the casting process.
- Pour a crucible of molten metal into a prepared flask to produce a cast part.

### **30. Students will understand the use of hand tools and machines for fabricating and forming sheet metal. They will demonstrate proficiency by:**

- Laying out a sheet metal project which includes calculation and the incorporation bending allowances for different gage materials.
- Creating a pattern to be used for manufacturing a product.
- Creating a completed project using sheet metal forming equipment.

## **Enterprise**

### **31. Students will understand workplace functions in all aspects of a manufacturing organization. They will demonstrate proficiency by:**

- Creating an actual or fictional manufacturing enterprise.
- Perform at least one of the functions in a manufacturing enterprise, site management, finance operations, marketing, community relations and labor relations.
- Explaining the purpose of all functions listed above.

**32. Students will understand that manufacturing is an integrated system. They will demonstrate proficiency by:**

- Working on a project team creating an integrated manufacturing system that carries a product from its inception to sale.

**33. Students will understand the elements of production management. They will demonstrate proficiency by:**

- Working on a project team to create a management system that includes planning, engineering, organizing, producing, and controlling resources and manufacturing processes.