

**Technology Education Standards**

**Metals and Welding for Mechanics**

**Course Overview:** In this course, students will learn the materials and techniques used in welding related fields. Students will work with machinery and processes associated with the metal fabrication and welding industry such as layouts, separating, GMAW, SMAW, Oxy/Fuel and other processes. Students will use these processes to build projects that will reinforce these concepts. This course will be teaching curriculum from WITC’s Welding for Mechanics course.

**Bold standards are essential standards that all students will learn as they complete the course.**

**Advanced Credit Option:**  Any student passing this course with a grade of B or better will be eligible to receive 2 free technical college credits from WITC. Keep in mind this is a post-secondary level course and will be challenging!

**Unit 1: Safety Unit** **(4 days and ongoing)**

**Description:** Learn what we must know to insure everyone’s safety in the welding lab

**Standards**

1. The students will be able to demonstrate proper use and inspection of personal protection equipment (PPE). MnF1.a.7.h, MNF1.g.11.h
2. **The students will be able to demonstrate proper safe operation practices in the work area. MnF1.a.7.h, MNF1.g.11.h**
3. The students will be able to demonstrate proper use and inspection of ventilation equipment. MnF1.a.7.h, MNF1.g.11.h
4. The students will be able to demonstrate proper Hot Zone operation. MnF1.a.7.h
5. The students will be able to demonstrate proper use of precautionary labeling and MSDS information. MnF1.a.7.h
6. The students will be able to safely demonstrate the proper use of welding shop tools and equipment. MnF1.a.7.h, MNF1.g.11.h

**Unit 2: General Metals Unit (8 weeks)**

**Description:** The unit will cover the Metals processes of layout, separating, forming and combining metals.

**Standards**

1. **The students will learn the different physical types, shapes and properties of metals.**
2. The student will be able to safely work with sheet metals
3. The student will be able to use precision and non-precision tools to layout flat and structural metals accurately to make quality projects. MNF1.a.9.h
4. **The students will be able to use hand tools, power shears, power saws and plasma cutters to accurately separate materials. MNF1.b.5.h**
5. **The student will be able to use hand tools, non-powered brake, rollers, punches and power brake to bend metals for forming functions. MNF1.a.9.h**
6. The student will be able to use fasteners, mechanical connection and machines capable of welding metals to combine and assemble metal parts. MNF1.b.5.h
7. The student will be able to use proper finishing techniques, tools and material to finish metal projects. MNF1.b.5.h

 **Unit 3: Shielded Metal Arc Welding (SMAW) (3 weeks)**

**Description:**  This unit will begin the learning of basic SMAW techniques and focus on how a SMAW machine works to create welds?

**Standards**

1. 1. The student, having completed a general safety unit and test already, will learn and be able to pass an Arc Welding safety test with 100%. MNF1.g.9.h
2. The students will be able to categorize electrodes using numeric 4-5 digit systems. MNF1.g.8.h
3. The students will be able to describe common open circuit voltages for SMAW systems. MNF1.b.5.h
4. **The students will be able to describe common types of systems for generating an arc. (Transformer, rectifier, generator, inverter, battery, etc.) MNF1.b.5.h**
5. The students will be able to describe how duty cycles are calculated and referenced for welding machines. MNF1.b.5.h
6. The students will be able to analyze the causes and solutions for arc blow and other defects. MNF1.b.5.h
7. The students will be able to describe cable gage sizes and choose the appropriate cable diameter for different lengths welding cables. MNF1.b.5.h
8. The students will be able to explain the electrical hertz cycle and how that affects AC arcs. MNF1.b.5.h
9. **The students will demonstrate their knowledge to complete basic welder setup and operations. MNF1.b.5.h**
10. The student will be able to identify all weld types and joint designs. MNF1.g.9.h

**Unit 4: Shielded Metal Arc Welding (SMAW) out of position (2 weeks)**

**Description;** This unit will focus on how can SMAW equipment be used to weld in all positions.

**Standards**

1. The students will be able to make fillet welds, in all positions, on carbon steels. MNF1.g.9.h

2. The students will be able to make groove welds, in all positions, on carbon steel. MNF1.g.9.h

**3. The students will be able to pass a SMAW welder performance qualification test on all flat position welds (following AWS standards based on a ten point scale). MNF1.g.9.h**

4. The students will be able to identify and use all common weld joints. MNF1.g.9.h

5. Students will be able to identify, choose and properly use the correct electrode for the application. MNF1.g.9.h

**Unit 5: Thermal Cutting Processes (3-4 days)**

**Description:** learn how thermal cutting processes can be used to prepare metal for fabrication

**Standards**

1. The students will be able to perform straight, bevel edge cutting operations, in the flat positions, on carbon steel using the manual oxy-fuel system. MNF1.h.6.h
2. The students will be able to perform straight, bevel edge cutting operations, in the flat position, on carbon steel using manual plasma system. MNF1.h.7.h
3. The students will be able to perform straight cutting operations, in the flat position, on carbon steel, aluminum and stainless using CNC Plasma table system. MNF1.h.8.h
4. The students will be able to perform scarfing and gouging operations to remove base and weld metal, in the flat and horizontal. MNF1.h.9.h

**Unit 6: Drawing and Welding Symbol Interpretation (2-4 days)**

**Description:**  Learn how information about how a part is drawn and interpreted for manufacturing

**Standards**

**1. The students will be able to interpret welding symbol information. MNF1.g.10.h**

2. The students will be able to fabricate parts from a drawing or sketch. MNF1.g.10.h

3. The students will be able to identify the different parts of a fillet and groove weld from a drawing. MNF1.g.10.h

4. The students will be able to describe how intermittent welds are referenced on a print. MNF1.g.10.h

5. The students will be able to identify the five different types of welding joints. (Tee, Butt, Corner, Lap, plug/slot, and edge) as shown on a drawing. MNF1.g.10.h

**Unit 7: Careers in welding (2 days)**

**Description:**  Student will study what career options are available that require any of the welding process skills.

**Standards**

1. The student will participate with guest speakers related to the world of welding. MNF1.g.10.h
2. **The students will be able to report on a career option that requires SMAW skills. MNF1.g.10.h**

**Unit 8: Occupational Orientation (ongoing)**

**Description:** this unit is an ongoing unit to demonstrate what are some important employability skills in the welding industry

**Standards**

1. The students will be able to prepare work reports or records. CD2.a.3.h, MNF1.c.6.h

2. The students will be able to perform housekeeping duties. CD2.b.8.h, MNF1.c.7.h

3. The students will be able to follow verbal and written instructions to complete work assignments. CD2.b.8.h, MNF1.c.7.h

4. The students will be able to use work time efficiently. CD2.b.8.h, MNF1.c.10.h, MNF1.c.9.h

**Unit 9: Metallurgy (3-5 days)**

**Description:** students will be able to answer the essential question of how to do the properties of metal change during the welding process

**Standards**

1. The students will be able to define the following physical properties: tensile strength, compressive strength, torsion, shear, fatigue, bending, hardness, elongation, ductility, brittleness, toughness, and grain size. MNF1.h.10.h
2. The students will be able to compare and contrast the physical properties of steel with differing carbon content. MNF1.h.10.h
3. The students will be able to explain how temperature, time, the rate of cooling, and the surrounding material can change the properties of the metal. MNF1.h.10.h
4. The students will be able to describe the terms: annealing, case-hardening, normalizing, tempering, and quenching. MNF1.h.10.h
5. **The students will be able to identify how common metals are formed into usable materials. MNF1.h.10.h**

**Unit 10: Gas Metal Arc Welding (GMAW) Carbon Steel (2-3 weeks)**

**Description:** This unit is going to introduce students to Gas Metal Arc Welding (GMAW)

**Standards**

1. The students will be able to perform safety inspections of GMAW equipment and accessories. MNF1.g.9.h

2. The students will be able to make minor external repairs to GMAW equipment and accessories. MNF1.g.9.h

**3. The students will be able to set up for GMAW operations on carbon steel and stainless steel. MNF1.g.12.h**

4. The students will be able to operate GMAW equipment on carbon steel and stainless steel. MNF1.g.12.h

5. The students will be able to make fillet welds in all positions on carbon steel. MNF1.g.12.h, MNF1.g.13.h

6. The students will be able to make groove welds in all positions on carbon steel. MNF1.g.13.h

7. The students will know how to pass the GMAW welder performance qualification test on carbon steel in accordance with AWS standards. MNF1.g.9.h

**Unit 11: Gas Tungsten Arc Welding (GTAW) Stainless Steel (2-3 weeks)**

**Description:** This unit will focus on the use of GMAW and GTAW or TIG)

**Standards**

1. The students will be able to set up for GTAW and GMAW operations stainless steel. MNF1.g.12.h

2. The students will be able to operate GTAW equipment on stainless steel. MNF1.g.9.h

3. The students will be able to make fillet welds in the stainless steel. MNF1.g.9.h

4. The students will be able to make groove welds on stainless steel. MNF1.g.9.h

5. The students will be able to understand proficiency on a GTAW welder performance qualification test on stainless steel in accordance with AWS standards. MNF1.g.12.h, MNF1.g.9.h

**Unit 12: Gas Tungsten Arc Welding (GTAW) Aluminum (2-3 weeks)**

**Description:** This unit will focus on how to weld nonferrous metals using the different processes of welding.

**Standards**

1. The students will be able to set up for GTAW and GMAW operations on aluminum. MNF1.g.9.h

2. The students will be able to operate GTAW equipment on aluminum. MNF1.G.13.h

3. The students will be able to make fillet welds in the 1F and 2F positions on aluminum. MNF1.G.13.h

4. The students will be able to make groove welds in the 1G position on aluminum. MNF1.G.13.h

5. The students will be able to understand tungsten electrodes uses, composition and uses. MNF1.G.13.h

6. The students will be able to explain the reason for pre and post flow shielding gas. MNF1.G.13.h

7. The students will be able to describe the proper tip preparation for different welding applications. MNF1.G.13.h, MNF1.g.9.h

8. The students will be able to describe the purpose of high-frequency current for AC welding. MNF1.g.9.h

9. The students will be able to compare and contrast AC, DCEP, and DCEN. MNF1.g.9.h

10. The students will be able to choose the proper nozzle or cup size for different welding applications. MNF1.G.13.h

**11. The students will be able to describe the different techniques used for welding on stainless steel and aluminum. MNF1.g.9.h**

12. The students will be able to identify common shielding gases used for GTAW. MNF1.G.13.h

13. The students will be able to describe the importance of cleaning base metals prior to welding. MNF1.G.13.h

14. The students will be able to categorize filler metals using the AWS classification system. MNF1.g.9.h

15. The students will be able to describe the techniques used when welding out of out of position with GTAW. MNF1.G.13.h

**Unit 13: Gas Metal Arc Welding (GMAW-S, GMAW spray transfer) (2-3 weeks)**

**Description**: Students will learn how the GMAW process can be used for welding a variety of different metals

**Standards**

1. The students will be able to describe how amperage and resistance are controlled in a constant voltage system. MNF1.g.12.h

2. The students will be able to explain how electricity is transferred to the wire through the contact tip. MNF1.g.12.h

3. The students will be able to categorize electrode wire using the AWS system. MNF1.g.9.h

4. The students will be able to compare and contrast different welding gasses and their uses. MNF1.g.13.h

5. The students will be able to compare and contrast the different transfer methods (short circuit, globular, spray, pulse, and surface tension). MNF1.g.13.h

6. The students will be able to make fillet welds, in all positions, on carbon steel using short-circuiting transfer. MNF1.g.13.h

7. The students will be able to make groove welds, in all positions, on carbon steel using short-circuiting transfer. MNF1.g.13.h

8. The students will be able to make fillet welds in the 1F and 2F positions on carbon steel using spray transfer. MNF1.g.13.h

9. The students will be able to make groove welds in the 1G position on carbon steel using spray transfer. MNF1.g.13.h

**Unit 14: Weld Inspection SENSE test**

**Description:** Students will learn how welds are rated and evaluated.

**Standards**

1. The students will be able to examine tacks, root passes, intermediate layers, and completed welds. ENG4.a.5.h

2. The students will be able to setup and perform transverse root and face bend tests. ENG5.a.7.h

3. The students will be able to compare and contrast successful vs. failed bend tests. ENG5.b.9.h

**4. The students will be able to visually evaluate welds in a nondestructive manner. ENG5.b.9.h**