

# Course Outline

Manufacturing and Product Development

REVISED: July/2021

**Job Title**

Welder

**77-95-50**

**Career Pathway:**

Welding and Materials Joining

**Welding/1**

**Industry Sector:**

Manufacturing and Product Development

**Credits:** 15

**Hours:** 180

**O\*NET-SOC CODE:**

51-4121.00

**Course Description:**

This competency-based course is the first in a sequence of three designed for welding. Instruction includes orientation and safety, resource management, trade mathematics 1, welding symbols and codes, welding metallurgy, tools and equipment, surface welds, shielded metal arc welding, oxyacetylene cutting, brazing, welding tubing: all positions, and employability skills. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

**CBEDS Title:**

Welding Technology

**Prerequisites:**

Enrollment requires a reading level of 8.0 as measured by the CASAS GOALS test.

**CBEDS No.:**

5619

**NOTE:** For Perkins purposes this course has been designated as an **introductory** course.

This course cannot be repeated once a student receives a Certificate of Completion.



## **COURSE OUTLINE COMPETENCY-BASED COMPONENTS**

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

### **COURSE OUTLINE COMPONENTS**

### **LOCATION**

#### **GOALS AND PURPOSES**

Cover

The educational goals or purposes of every course are clearly stated and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course, and are written to be understandable by a prospective student.

#### **PERFORMANCE OBJECTIVES OR COMPETENCIES**

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Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction, which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and In competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction and assessment in competency-based education are: explicit, known, agreed upon, integrated, performance oriented, and adaptive.

**COURSE OUTLINE COMPETENCY-BASED COMPONENTS**  
**(continued)**

**COURSE OUTLINE COMPONENTS**

**LOCATION**

**INSTRUCTIONAL STRATEGIES**

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Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.

Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.

**UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT**

Cover

The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.

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Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.

**EVALUATION PROCEDURES**

p. 16-17

The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.

Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.

**REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT**

Cover

After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.

## ***ACKNOWLEDGMENTS***

Thanks to PEDRO CERDA, FRANCO GARCIA, MILTON MARTINEZ and MAURICIO REYES for developing and editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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**CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS**  
**Manufacturing and Product Development Industry Sector**  
**Knowledge and Performance Anchor Standards**

**1.0 Academics**

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Manufacturing and Product Development academic alignment matrix for identification of standards.

**2.0 Communications**

Acquire and accurately use Manufacturing and Product Design sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

**3.0 Career Planning and Management**

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

**4.0 Technology**

Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the Manufacturing and Product Design sector workplace environment.

**5.0 Problem Solving and Critical Thinking**

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Manufacturing and Product Design sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

**6.0 Health and Safety**

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Manufacturing and Product Design sector workplace environment.

**7.0 Responsibility and Flexibility**

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Manufacturing and Product Design sector workplace environment and community settings.

**8.0 Ethics and Legal Responsibilities**

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

**9.0 Leadership and Teamwork**

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organizations.

**10.0 Technical Knowledge and Skills**

Apply essential technical knowledge and skills common to all pathways in the Manufacturing and Product Design sector, following procedures when carrying out experiments or performing technical tasks.

**11.0 Demonstration and Application**

Demonstrate and apply the knowledge and skills contained in the Manufacturing and Product Design anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organizations.

## ***Manufacturing and Product Development Pathway Standards***

### **C. Welding and Materials Joining Pathway**

The Welding and Materials Joining pathway provides students with an understanding of manufacturing processes and systems common to careers in welding and related industries. The following pathway standards are based on, but not limited to, well established American Welding Society (AWS) EG2.0 Guidelines for the Entry Level Welder. Representative topics include the interpretation and layout of welded and assembled-part prints, cutting, mechanical bonding, joining, cohesive bonding, adhesive bonding, and mechanical fastening.

Sample occupations associated with this pathway:

- ◆ Metal Fabricator
- ◆ Sales
- ◆ Welders, Cutters, and Fitters
- ◆ Welding Inspector
- ◆ Welding Engineer

- C1.0 Interpret and demonstrate the planning and layout operations used in the welding processes.
- C2.0 Understand and demonstrate how materials can be processed through the use of welding tools and equipment.
- C3.0 Differentiate and apply various types of welding assembly processes.
- C4.0 Understand finishing processes and the differences between various types of finishing materials used in the manufacture of welded parts and products.
- C5.0 Understand and defend the purposes and processes of inspection and quality control in welding manufacturing processes.
- C6.0 Explore and understand various welding systems that require standard hand and machine tools.
- C7.0 Understand various automated welding systems, welding design for manufacturing, flexible manufacturing systems, and materials resource planning.
- C8.0 Understand various joining or combining processes, including welding processes used in manufacturing, maintenance, and repair.
- C9.0 Understand how a manufacturing company is organized and the elements of welding production management.

**CBE**  
**Competency-Based Education**

**COMPETENCY-BASED COMPONENTS**  
**for the Welding/1 Course**

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. ORIENTATION AND SAFETY</p> <p>Understand, apply, and evaluate classroom and workplace policies and techniques used in accordance with federal, state, and local safety and environmental regulations.</p> <p>(4 hours)</p>	<ol style="list-style-type: none"> <li>1. Describe the scope and purpose of the course.</li> <li>2. Describe classroom policies and procedures.</li> <li>3. Describe the different occupations in the Manufacturing Industry Sector, which have an impact on the role of welders.</li> <li>4. Describe the opportunities available for promoting gender equity and the representation of non-traditional populations in the welding industry.</li> <li>5. Describe the purpose of the California Occupational Safety and Health Administration (Cal/OSHA) and its laws governing welders.</li> <li>6. Explain the impact of Environmental Protection Agency (EPA) legislation on Manufacturing and Product Development Industry Sector practices in protecting and preserving the environment.</li> <li>7. Describe and demonstrate techniques for contacting the proper authorities for the removal of hazardous materials based on EPA standards.</li> <li>8. Describe and demonstrate the use of the Safety Data Sheet (SDS) as it applies to the welding industry.</li> <li>9. Describe classroom and workplace first aid and emergency procedures according to American Red Cross (ARC) standards.</li> <li>10. Describe how each of the following insures a safe workplace:               <ol style="list-style-type: none"> <li>a. employees' rights as they apply to job safety</li> <li>b. employers' obligations as they apply to job safety</li> <li>c. role of the Division of Workers' Compensation (DWC)</li> <li>d. safe use and storage of flammable liquids and gases, materials, and safety supplies</li> <li>e. wearing of eye protection</li> <li>f. removal of jewelry</li> <li>g. wearing properly fitted clothing</li> <li>h. never leaving an operating machine unattended</li> <li>i. not stopping and starting a machine for someone else</li> </ol> </li> <li>11. Pass the safety exam with 100% accuracy.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 7, 10, 11, 12</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Career Planning and Management: 3.1, 3.2 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Health and Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 Responsibility and Flexibility: 7.2, 7.3 Ethics and Legal Responsibilities: 8.4 Leadership and Teamwork: 9.6 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.2</p> <p><b>CTE Pathway:</b> C1.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>B. RESOURCE MANAGEMENT</p> <p>Understand, apply, and evaluate the resource management principles and techniques in the welding industry field.</p> <p>(1 hour)</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. resources</li> <li>b. management</li> <li>c. sustainability</li> <li>d. Critical Path Method (CPM) – different pathways within industry sector</li> </ol> </li> <li>2. List and describe examples of effective management of the following resources in the welding business:               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials</li> <li>c. personnel</li> </ol> </li> <li>3. Describe the following components of CPM and how they impact project management:               <ol style="list-style-type: none"> <li>a. work breakdown structure</li> <li>b. duration</li> <li>c. dependencies</li> </ol> </li> <li>4. Describe the benefits of effective resource management in the welding business:               <ol style="list-style-type: none"> <li>a. profitability</li> <li>b. sustainability</li> <li>c. company growth</li> </ol> </li> <li>5. Describe the economic benefits and liabilities of managing resources in an environmentally responsible way.               <ol style="list-style-type: none"> <li>a. time</li> <li>b. materials and supplies</li> <li>c. personnel</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Responsibility and Flexibility: 7.2, 7.3, 7.4, 7.6 Ethics and Responsibilities: 8.4 Leadership and Teamwork: 9.6</p> <p><b>CTE Pathway:</b> C1.1</p>
<p>C. TRADE MATHEMATICS I</p> <p>Understand, apply, and evaluate the mathematical requirements used in the welding industry.</p> <p>(15 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify the practical applications of math in the welding industry.</li> <li>2. Describe and demonstrate problem-solving techniques involving whole number problems, using addition, subtraction, multiplication, and division.</li> <li>3. Describe and demonstrate problem-solving techniques involving various fraction problems, using arithmetic operations (addition, subtraction, multiplication, and division).</li> <li>4. Describe and demonstrate problem-solving techniques involving various decimal problems, using arithmetic operations.</li> <li>5. Describe and demonstrate techniques for changing fractions to decimals.</li> <li>6. Describe and demonstrate techniques for changing decimals to fractions.</li> <li>7. Describe the English system of measuring length.</li> <li>8. Describe the English system of measuring weight.</li> <li>9. Describe the English system of measuring volume or capacity.</li> <li>10. Describe and demonstrate problem-solving techniques for various English system measuring problems, using arithmetic operations.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.5 Problem Solving and Critical Thinking: 5.1, 5.4 Technical Knowledge and Skills: 10.1, 10.2, 10.4</p> <p><b>CTE Pathway:</b> C1.2, 1.3</p>



COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>D. WELDING SYMBOLS AND CODES</p> <p>Understand, apply, and evaluate the welding symbols and codes.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Identify and describe the following:               <ol style="list-style-type: none"> <li>a. welding symbols</li> <li>b. welding codes</li> <li>c. welding abbreviations</li> </ol> </li> <li>2. Discuss how to read a measuring tape.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.3, 2.4, 2.5 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.3 Technical Knowledge and Skills: 10.1, 10.2, 10.4</p> <p><b>CTE Pathway:</b> C1.1, C1.2, C1.3, C1.4</p>
<p>E. WELDING METALLURGY</p> <p>Understand, apply, and evaluate the principles of welding metallurgy.</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. ferrous and non-ferrous metals</li> <li>b. base metal</li> <li>c. metallurgy</li> <li>d. law of expansion</li> <li>e. law of contraction</li> <li>f. law of distortion</li> <li>g. preheat treatment</li> <li>h. post-heating</li> <li>i. post-heat treatment</li> <li>j. material defects</li> <li>k. welding</li> <li>l. welding tests</li> <li>m. fabrication</li> <li>n. jigs</li> <li>o. fixtures</li> <li>p. stresses</li> <li>q. stress relief</li> <li>r. annealing</li> </ol> </li> <li>2. Identify and describe the features and functions of the following:               <ol style="list-style-type: none"> <li>a. types of metals</li> <li>b. types of iron                   <ol style="list-style-type: none"> <li>i. carbon steel</li> <li>ii. alloy steel</li> </ol> </li> <li>c. nickel alloys</li> <li>d. copper</li> <li>e. brass</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.2, 5.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C1.1, C1.3, C2.2, C2.3, C3.1, C3.2, C5.1, C5.3, C5.4, C7.1 9.1</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(10 hours)	<ul style="list-style-type: none"> <li>f. filler metals</li> <li>g. chemical and physical properties of metals               <ul style="list-style-type: none"> <li>i. strength</li> <li>ii. tensile strength</li> <li>iii. compressive strength</li> <li>iv. ductility</li> <li>v. brittleness</li> <li>vi. toughness</li> <li>vii. hardness</li> <li>viii. grain size</li> </ul> </li> <li>h. crystal lattice structures of metals</li> <li>i. methods of heat treating metals</li> <li>j. effect of grain changes on metal properties</li> <li>k. types of welding procedures               <ul style="list-style-type: none"> <li>i. fusion</li> <li>ii. non-fusion</li> <li>iii. oxy fuel</li> </ul> </li> <li>3. Describe the following:               <ul style="list-style-type: none"> <li>a. methods by which a weld is achieved</li> <li>b. differences between the chemical and mechanical properties of metals</li> <li>c. effects of welding on metals</li> <li>d. processes used to heat-treat metals</li> <li>e. causes of major weld defects</li> <li>f. preventive techniques for major weld defects</li> <li>g. methods and processes of welding</li> <li>h. uses of jigs and fixtures to prevent metal distortion</li> <li>i. reasons for preheating and post heating</li> <li>j. carbon steel welding</li> <li>k. alloy steel welding</li> <li>l. dimensions used of fillet welds</li> <li>m. dimensions used in groove welds</li> <li>n. complete joint penetration groove welds</li> <li>o. partial joint penetration groove welds</li> </ul> </li> </ul>	
<p>F. TOOLS AND EQUIPMENT</p> <p>Understand, apply, and evaluate the tools, equipment, and safety issues in welding.</p>	<ul style="list-style-type: none"> <li>1. Describe the following in relation to welding:               <ul style="list-style-type: none"> <li>a. fire hazards</li> <li>b. electrical hazards</li> <li>c. machinery hazards</li> <li>d. hazardous fumes</li> <li>e. compressed gas cylinder hazards</li> <li>f. hazardous obstacles</li> <li>g. suffocation hazards</li> </ul> </li> <li>2. Identify and demonstrate proper use of personal protective equipment (PPE) for welders.</li> <li>3. Describe and demonstrate the following:               <ul style="list-style-type: none"> <li>a. the proper use of fire extinguishers</li> <li>b. first aid procedures for first, second, and third degree burns</li> <li>c. procedures for tool use, maintenance, and repair</li> <li>d. procedures for handling compressed gas cylinders</li> </ul> </li> </ul>	<p><b>Career Ready Practice:</b> 1, 2, 5, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2 Problem Solving and Critical Thinking: 5.1 Health and Safety: 6.1, 6.3, 6.5, 6.6, 6.7, 6.8</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(15 hours)	<ol style="list-style-type: none"> <li>4. Define the following:               <ol style="list-style-type: none"> <li>a. alternating current (AC)</li> <li>b. direct current (DC)</li> <li>c. amperes</li> <li>d. ohms</li> <li>e. volts</li> <li>f. electrodes</li> <li>g. wattage</li> </ol> </li> <li>5. Identify each of the following and describe its use in welding:               <ol style="list-style-type: none"> <li>a. AC and DC power supplies and their operation</li> <li>b. electrode classification and sizes</li> <li>c. gases and their cylinder identifications</li> <li>d. gases used on specific metals and jobs</li> <li>e. torches and tips</li> </ol> </li> <li>6. Define/identify and describe the following and their welding applications:               <ol style="list-style-type: none"> <li>a. relationship between voltage and current</li> <li>b. direct current straight polarity (DCSP) aka as direct current electrode negative (DCEN)</li> <li>c. direct current reverse polarity (DCRP) aka as direct current electrode positive (DCEP)</li> <li>d. hoses</li> <li>e. gauges</li> <li>f. regulators</li> <li>g. welding benches</li> </ol> </li> <li>7. Describe and evaluate the following:               <ol style="list-style-type: none"> <li>a. identification and selection of correct electrodes for various metals</li> <li>b. selection and use of various torches, tips, and hoses</li> <li>c. selection and use of various helmet filter lenses</li> <li>d. use of various types of gases in welding</li> <li>e. use of various types of gas cylinders in welding</li> <li>f. use of various gauges and regulators</li> <li>g. set up various types of regulators, welding tips, and working pressures (PSI)</li> <li>h. use of work bench and hand tools</li> <li>i. use of portable and stationary grinders</li> <li>j. use of various types of power-activated machinery</li> </ol> </li> <li>8. Describe and demonstrate inspection and maintenance procedures.</li> </ol>	<p>Ethics and Legal Responsibilities: 8.1, 8.2 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C3.1, C5.3, C5.5, C6.1</p>
<p>G. SURFACE WELDS</p> <p>Understand, apply, and evaluate the tools and techniques used for welding in various positions.</p>	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. surface welds</li> <li>b. flat position</li> <li>c. horizontal position</li> <li>d. vertical position</li> <li>e. overhead position</li> </ol> </li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(25 hours)		Problem Solving and Critical Thinking: 5.1 Technical Knowledge and Skills: 10.1  <b>CTE Pathway:</b> C1.1, C1.3, C2.2, C2.3, C3.1, C3.2
H. SHIELDED METAL ARC WELDING (SMAW)  Understand, apply, and evaluate the tools and techniques used in basic shielded metal arc welding.	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. shielded metal arc welding</li> <li>b. arc length</li> <li>c. stringer beads</li> <li>d. electrode angle</li> </ol> </li> <li>2. Describe and demonstrate the following:               <ol style="list-style-type: none"> <li>a. setting up the different types of arc welding machines</li> <li>b. operation of the different types of arc welding machines</li> <li>c. selection of electrodes</li> <li>d. striking and maintaining an arc</li> <li>e. producing the appropriate electrode angle</li> <li>f. producing the appropriate arc length</li> <li>g. selection of current and polarity</li> <li>h. stopping and restarting a continuous bead</li> </ol> </li> </ol>	<b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11  <b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Technical Knowledge and skills: 10.1  <b>CTE Pathway:</b> C1.1, C1.3, C2.2, C2.3, C3.1, C3.2
I. OXYACETYLENE CUTTING  Understand, apply, and evaluate the tools and techniques used for oxyacetylene cutting.	<ol style="list-style-type: none"> <li>1. Define the following:               <ol style="list-style-type: none"> <li>a. acetylene</li> <li>b. oxygen</li> <li>c. oxyacetylene cutting</li> </ol> </li> <li>2. Identify each of the following and describe its use:               <ol style="list-style-type: none"> <li>a. fuel gases</li> <li>b. characteristics of acetylene</li> <li>c. characteristics of oxygen</li> <li>d. types of cylinders</li> <li>e. types of regulators</li> <li>f. oxyacetylene cutting equipment</li> <li>g. working pressure</li> </ol> </li> <li>3. Review and demonstrate the following:               <ol style="list-style-type: none"> <li>a. techniques for handling/transporting cylinders and regulators</li> <li>b. selection of flame adjustment of tips and pressure</li> <li>c. use of layout procedures</li> </ol> </li> </ol>	<b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11  <b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Technical Knowledge and Skills: 10.1

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(25 hours)	<ul style="list-style-type: none"> <li>d. free hand cutting techniques</li> <li>e. machine cutting techniques</li> <li>f. assembly of oxyacetylene cutting equipment</li> <li>g. adjusting oxyacetylene work pressure</li> <li>h. tip cleaning procedures</li> <li>i. burning slits, scarfing, and piercing holes</li> <li>j. beveling a 30 degree bevel on various thickness plates</li> </ul>	<p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C3.1, C3.3</p>
<p>J. BRAZING</p> <p>Understand, apply, and evaluate the tools and techniques used in joining metals by brazing.</p> <p>(10 hours)</p>	<ul style="list-style-type: none"> <li>1. Define brazing.</li> <li>2. Identify the following: <ul style="list-style-type: none"> <li>a. oxyacetylene equipment</li> <li>b. brazing process</li> <li>c. filler rod</li> <li>d. brazing flux</li> <li>e. sheet metal butt joints</li> <li>f. sheet metal lap joints</li> <li>g. sheet metal tee joints</li> </ul> </li> <li>3. Describe and demonstrate the following: <ul style="list-style-type: none"> <li>a. setting up the oxyacetylene equipment</li> <li>b. use of the brazing process</li> <li>c. process and selection of filler rod and brazing flux</li> <li>d. proper metal preparation for brazing</li> <li>e. brazing of sheet metal</li> <li>f. brazing on dissimilar metals</li> <li>g. adjust flame correctly for brazing</li> <li>h. brazing of sheet metal butt, lap, and tee joints</li> <li>i. brazing on tubing in butt, horizontal, vertical and overhead positions</li> </ul> </li> </ul>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C3.1, C3.2, C3.3</p>
<p>K. WELDING TUBING: ALL POSITIONS</p> <p>Understand, apply, and evaluate the tools and techniques used in welding tubing in all positions.</p> <p>(25 hours)</p>	<ul style="list-style-type: none"> <li>1. Describe and demonstrate the following: <ul style="list-style-type: none"> <li>a. flat butt joint rolled</li> <li>b. horizontal butt joint-fixed-position</li> <li>c. vertical butt joint fixed position</li> <li>d. Tee joints in all positions</li> </ul> </li> </ul>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 10, 11</p> <p><b>CTE Anchor:</b> Communications: 2.1, 2.2, 2.4 Technology: 4.3 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3 Technical Knowledge and Skills: 10.1</p> <p><b>CTE Pathway:</b> C2.1, C2.2, C2.3, C3.1, C3.2, C3.3</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>L. EMPLOYABILITY SKILLS</p> <p>Understand, apply, and evaluate the employability skills required in the welding industry.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> <li>1. Summarize employer requirements for the following:               <ol style="list-style-type: none"> <li>a. punctuality</li> <li>b. attendance</li> <li>c. attitude toward work</li> <li>d. quality of work</li> <li>e. teamwork</li> <li>f. responsibility</li> <li>g. timeliness</li> <li>h. communication skills</li> </ol> </li> <li>2. Identify potential employers through traditional and internet sources.</li> <li>3. Describe the role of electronic social networking in job search.</li> <li>4. Design sample résumés and cover letters.</li> <li>5. Explain the importance of filling out a job application legibly, with accurate and complete information.</li> <li>6. Describe the common mistakes that are made on job applications.</li> <li>7. Complete sample job application forms correctly.</li> <li>8. State the importance of enthusiasm in the interview and on a job.</li> <li>9. State the importance of appropriate appearance in the interview and on a job.</li> <li>10. Explain the importance of the continuous upgrading of job skills through lifelong learning.</li> <li>11. Describe customer service as a method of building permanent relationships between the organization and the client.</li> <li>12. Describe and demonstrate appropriate interviewing techniques.</li> <li>13. Identify the informational materials, resources, and test knowledge needed to be successful in an interview.</li> <li>14. Design sample follow-up letters.</li> <li>15. Describe and demonstrate appropriate follow-up procedures.</li> </ol>	<p><b>Career Ready Practice:</b> 1, 2, 4, 5, 8, 9, 10, 11, 12</p> <p><b>CTE Anchor:</b> Communications: 2.3, 2.4, 2.5, 2.6 Career Planning and Management: 3.2, 3.3, 3.5, 3.6, 3.7 Technology: 4.5 Responsibility and Flexibility: 7.3, 7.4 Leadership and Teamwork: 9.3 Technical Knowledge and Skills: 10.4</p> <p><b>CTE Pathway:</b> C9.1, C9.2, C9.3</p>

## ***SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES***

### **TEXTBOOKS**

Bowditch, William A., Kevin E. Bowditch, and Mark A. Bowditch. Welding Fundamentals, 5<sup>th</sup> Edition. Goodheart-Wilcox Publisher, 2016.

Jeffus, Larry. Welding: Principles and Applications, 8<sup>th</sup> Edition. Cengage Learning, 2020.

Kou, Sindo. Welding Metallurgy, 2<sup>nd</sup> Edition. Wiley, John & Sons, Incorporated, 2002.

Ruck, James. Welding Projects, 2<sup>nd</sup> Edition. Goodheart-Willcox Publisher, 2005

American Welding Society. AWS D 1.1 Structural Steel Code, 2015 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.2 Aluminum Code, 2014 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.3 Sheet Steel Code, 2018 Edition. American National Institute, 2017.

American Welding Society. AWS D 1.4 Structural Steel Code, 2018 Edition. American National Institute, 2018.

American Welding Society. AWS D 1.5 Bridge Code, 2015 Edition. American National Institute, 2015.

American Welding Society. AWS D 1.6 Stainless Steel Code, 2017 Edition. American National Institute, 2017.

American Welding Society. AWS D 1.8 Structural Steel Seismic Code, 2016 Edition. American National Institute, 2016.

American Society for Mechanical Engineers SEC IX Boiler and High Pressure Vessels Code, 2015 Edition. ASME International, 2015.

American Institute of Steel Construction, AISC Steel Construction Manual, 14<sup>th</sup> Edition. AISC, 2015.

### **RESOURCES**

Employer Advisory Board members

CTE Model Curriculum Standards for Manufacturing and Product Development:

<http://www.cde.ca.gov/ci/ct/sf/documents/manproddev.pdf>

American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126; Phone: 800-443-9353,

<http://www.aws.org>

[American Society for Mechanical Engineers, 2 Park Avenue, New York, NY 10016](http://www.asme.org)

<http://www.asme.org>

[America Institute of Steel and Construction, 130 EAST RANDOLPH, SUITE 2000, CHICAGO, IL, 60601: 312-670-2400](http://www.aisc.org)

[Aisc.org](http://www.aisc.org)

### **COMPETENCY CHECKLIST**

## **TEACHING STRATEGIES and EVALUATION**

### **METHODS AND PROCEDURES**

- A. Lecture and discussions
- B. Demonstrations and participation
- C. Multimedia presentations
- D. Individualized instruction
- E. Role-playing
- F. Guest speakers
- G. Fieldtrips and field study experiences
- H. Projects

### **EVALUATION**

SECTION A – Orientation and Safety – Pass the safety test with 100% accuracy.

SECTION B – Resource Management – Pass all assignments and exams on principles of resource management with a minimum score of 80% or higher.

SECTION C – Trade Mathematics I – Pass all assignments and exams on trade mathematics I with a minimum score of 80% or higher.

SECTION D – Welding Symbols and Codes – Pass all assignments and exams on welding symbols and codes with a minimum score of 80% or higher.

SECTION E – Welding Metallurgy – Pass all assignments and exams on welding metallurgy with a minimum score of 80% or higher.

SECTION F – Tools and Equipment – Pass all assignments and exams on tools and equipment with a minimum score of 80% or higher.

SECTION G – Surface Welds – Pass all assignments and exams on surface welds with a minimum score of 80% or higher.

SECTION H – Shielded Metal Arc Welding (SMAW) – Pass all assignments and exams on shielded metal arc welding (SMAW) control with a minimum score of 80% or higher.

SECTION I – Oxyacetylene Cutting – Pass all assignments and exams on oxyacetylene cutting with a minimum score of 80% or higher.



SECTION J – Brazing – Pass all assignments and exams on brazing with a minimum score of 80% or higher.

SECTION K – Welding Tubing: All Positions – Pass all assignments and exams on welding tubing: all positions with a minimum score of 80% or higher.

SECTION L – Employability Skills – Pass all assignments and exams on employability skills with a minimum score of 80% or higher.

## ***Standards for Career Ready Practice***

### **1. Apply appropriate technical skills and academic knowledge.**

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

### **2. Communicate clearly, effectively, and with reason.**

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

### **3. Develop an education and career plan aligned with personal goals.**

Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

### **4. Apply technology to enhance productivity.**

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

### **5. Utilize critical thinking to make sense of problems and persevere in solving them**

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

### **6. Practice personal health and understand financial literacy.**

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

### **7. Act as a responsible citizen in the workplace and the community.**

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

**8. Model integrity, ethical leadership, and effective management.**

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

**9. Work productively in teams while integrating cultural and global competence.**

Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

**10. Demonstrate creativity and innovation.**

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

**11. Employ valid and reliable research strategies.**

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

**12. Understand the environmental, societal, and economic impacts of decisions.**

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

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## Statement for Civil Rights

All educational and vocational opportunities are offered without regard to race, color, national origin, gender, or physical disability.

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