

Welding Technology Program Elements
 January 2023

Career Cluster: Advanced Manufacturing - Pathway: Welding Technology							
Principles		CTE Concentrator A		CTE Concentrator B		Pathway Capstone	
7110	Principles of Welding Technology	7111	Shielded Metal Arc Welding	7101	Gas Welding Processes	7226	Welding Technology Capstone

7110 Principles of Welding Technology	
Course Description	<i>Principles of Welding Technology includes classroom and laboratory experiences that develop a variety of skills in oxy-fuel cutting and basic welding. This course is designed for individuals who intend to make a career as a Welder, Technician, Designer, Researcher, or Engineer. Emphasis is placed on safety at all times. OSHA standards and guidelines endorsed by the American Welding Society (AWS) are used. Instructional activities emphasize properties of metals, safety issues, blueprint reading, electrical principles, welding symbols, and mechanical drawing through projects and exercises that teach students how to weld and be prepared for postsecondary and career success.</i>
Pre/Co Req	None
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas
ITCC Courses	WELD 100: Welding Fundamentals
Promoted Certifications	AWS Sense Core

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Welding Fundamentals</i>
7110.D1.1	Understand and identify welding symbols and blueprints.
7110.D1.2	Discuss the need for workplace safety and workplace safety training programs as covered by the OSHA 10 hour program
7110.D1.3	Demonstrate basic welding techniques using a virtual welding simulator.
7110.D1.4	Learn proper AWS Standard Welding Terms and Definitions.
7110.D1.5	Effectively analyze and apply Metallurgy fundamentals to welding processes.

7110.D1.6	Identify the five basic welding joints.
7110.D1.7	Understand and identify welding defects and discontinuities.
7110.D1.8	Understand how to interpret Weld Procedure Specifications (WPSs) and their purpose.
7110.D1.9	Demonstrate the use of oxy fuel welding and cutting.
7110.D1.10	Demonstrate the use of plasma arc cutting.
7110.D1.11	Discuss the current trends and opportunities in the welding field.
7110.D1.12	Attain readiness to take OSHA 10 Hour General Industry Certification exam
7110.D1.13	Demonstrate ability to read and interpret technical documents. Apply that knowledge to steel fabrication.
7110.D1.14	Utilize welding symbols to make appropriate welds according to code.
7110.D1.15	Understand the basic concepts of sketching and drawing blueprints.
7110.D1.16	Understand and apply welding symbol terminology and theory to industry applications
7110.D1.17	Demonstrate ability to use various types of software applicable to the course.
Domain	Plasma Arc Cutting
7110.D2.1	Understand and apply learned skills to be able to operate CNC plasma cutting equipment
7110.D2.2	Use CAD software to design parts
7110.D2.3	Perform basic maintenance on all required equipment
7110.D2.4	Utilize equipment to its full capability
7110.D2.5	Use proper terminology as it applies to Plasma Arc Cutting
7110.D2.6	Show they understand safe work practices
7110.D2.7	Apply learned skills to cut and fabricate a project

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Welding Fundamentals	<ul style="list-style-type: none"> • Student reads and understands basic measurements on a ruler (Standard and Metric). • Student reads a blueprint and works from that print to complete a project. • Students reads and understands standard AWS welding symbols. 	<ul style="list-style-type: none"> • Reading a ruler classroom activities. • Using a tape measure/ Ruler students will measure, layout, and Tack certification tests according to the provided AWS blueprint. • Students create Flashcards (paper or digital) of each weld symbol. Students quiz each other over Identifying each symbol. 	<ul style="list-style-type: none"> • Reading a ruler written tests. • Adding, subtracting measurements tests. • Completing AWS entry level welder practical assessments using the required blueprints. • Completing AWS Module 3 Blueprint reading assessment.
Plasma Cutting	<ul style="list-style-type: none"> • Student performs setup and shutdown of oxyfuel equipment. • Student performs safety inspections and makes minor external repairs of Oxy fuel equipment • Student performs oxyfuel and plasma cuts following a line. • Student performs setup and shutdown of plasma equipment. 	<ul style="list-style-type: none"> • Students perform start up/shut down of a OxyFuel unit. (Manual and Machine). • Students layout (create) Sculpture on sheet metal using a plasma cutter. • Students create CNC projects as a group and Individually. • Students create name plates for the welding booths for themselves and others. 	<ul style="list-style-type: none"> • Completing AWS Module 8 Thermal cutting assessment. • Completing plasma and Oxyfuel cutting portion of AWS entry level welder practical assessments. • Creating a CNC project. • Drawing the AWS entry level welder practical assessments to be cut on the CNC plasma.

7111 Shielded Metal Arc Welding	
Course Description	<i>Shielded Metal Arc Welding involves the theory and application of the Shielded Metal Arc Welding process. Process theory will include basic electricity, power sources, electrode selection, and all aspects pertaining to equipment operation and maintenance. Laboratory welds will be performed in basic weld joints with a variety of electrodes in the flat, horizontal and vertical positions. Emphasis will be placed on developing the basic skills necessary to comply with AWS industry standards.</i>
Pre/Co Req	Principles of Welding Technology
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas
ITCC Courses	WELD 108: Shielded Metal Arc Welding I; WELD 206: Advanced Shielded Metal Arc Welding
Promoted Certifications	AWS D.1.1 SMAW

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Shielded Metal Arc Welding</i>
7111.D1.1	Demonstrate electric welding equipment safety.
7111.D1.2	Understand and apply all shielded metal arc welding safety rules.
7111.D1.3	Identify the five basic welding joints.
7111.D1.4	Identify heat input and metal distortion.
7111.D1.5	Describe the capabilities of electric welding equipment.
7111.D1.6	Weld with A.C. and D.C. current.
7111.D1.7	Prepare and tack weld coupons.
7111.D1.8	Make single and multi-pass welds.
7111.D1.9	Weld in the flat, horizontal, vertical, and the overhead position.
7111.D1.10	Identify SMAW electrodes and AWS electrode classification.
7111.D1.11	Describe D.C. straight and reverse polarity.
7111.D1.12	Describe proper electrode manipulation for each type of electrode.
7111.D1.13	Describe proper correct technique for each welding position and electrode type.
7111.D1.14	Demonstrate ability to read and interpret technical documents.
7111.D1.15	Demonstrate ability to use various types of software applicable to the course.

Domain	<i>Advanced Shielded Metal Arc Welding</i>
7111.D2.1	Describe differences in currents and polarities; AC, DC Reverse and DC Straight.
7111.D2.2	Explain how to safely use SMAW equipment.
7111.D2.3	Describe the AWS electrode identification system for SMA process.
7111.D2.4	Perform fillet welds on .5" to 1" plate (21-bead Multi-pass) in horizontal, vertical and overhead positions.
7111.D2.5	Describe how to control magnetic arc blow in DC welding of groove welds.
7111.D2.6	Prepare and tack groove welds as to AWS D1.1 Structural Steel Code.
7111.D2.7	Perform 3/8" and 1" groove welds as per AWS and ASME Code, in all positions.
7111.D2.8	Perform air carbon arc gouging on steel groove welds.
7111.D2.9	Describe heat input and metal warpage and distortion.
7111.D2.10	Describe methods of destructive and non-destructive testing.
7111.D2.11	Attain readiness to take American Welding Society certification exam
7111.D2.12	Demonstrate ability to read and interpret technical documents.
7111.D2.13	Demonstrate ability to use various types of software applicable to the course.

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Shielded Metal Arc Welding	<ul style="list-style-type: none"> • Student performs fillet/groove welds in the horizontal position. • Student performs fillet/groove welds in the vertical position. • Performs safety inspection and makes minor external repairs of equipment. 	<ul style="list-style-type: none"> • Demonstrate proper shop and SMAW welding safety according to OSHA. • Perform SMAW welding in the 2F -3F -4F position using 6010 and 7018 electrodes. 	<ul style="list-style-type: none"> • Complete AWS entry level assessment Module 2 - safety . • Complete Fillet weldments in all positions.
Advanced Shielded Metal Arc Welding	<ul style="list-style-type: none"> • Student performs fillet/groove welds in the horizontal position. • Student performs fillet/groove welds in the vertical position. 	<ul style="list-style-type: none"> • Perform SMAW welding in the 2G Horizontal position using 6010 and 7018 electrodes. • Perform SMAW welding in the 3G vertical position using 6010 and 7018 electrodes. 	<ul style="list-style-type: none"> • Complete AWS entry level assessment Module 4 - SMAW. • Completing Groove weldments in all positions. • Completing AWS entry level welder practical assessment - Horizontal (AWS edu -6). • Completing AWS entry level welder practical assessment - Vertical (AWS edu -6).

7101 Gas Welding Processes	
Course Description	<i>Gas Welding Processes is designed to cover the operation of Gas Metal Arc Welding (MIG) equipment. This will include all settings, adjustments and maintenance needed to weld with a wire feed system. Instruction on both short-arc and spray-arc transfer methods will be covered. Tee, lap, and open groove joints will be done in all positions with solid, flux core, and aluminum wire. Test plates will be made for progress evaluation. Schools may choose to offer the course as a comprehensive MIG Welding course or a combination of introductory MIG and TIG Welding operations.</i>
Pre/Co Req	Principles of Welding Technology
Credits	Credits: 2 semester course, 2 semesters required, 1 credit per semester, 2 credits maximum
Counts Toward	Counts as a directed elective or elective for all diplomas
Additional Notes	Schools may choose to cover both introductory MIG and TIG Welding. This configuration is available for dual credit through ITCC.
ITCC Courses	WELD 207: Gas Metal Arc (MIG) Welding; WELD 272: Advanced Gas Metal Arc Welding
Promoted Certifications	AWS D.1.1 GMAW; AWS D14.1 FCAW

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Gas Metal Arc Welding</i>
7101.D1.1	Employ safety practices involved in gas metal arc welding.
7101.D1.2	Describe constant voltage and wire feed welding processes.
7101.D1.3	Weld with hard wire using short circuit and spray method welding.
7101.D1.4	Weld with flux-core tubular wires.
7101.D1.5	Weld aluminum with spray.
7101.D1.6	Identify the gases used in gas metal arc welding.
7101.D1.7	Perform routine maintenance on gas metal arc welding equipment.
7101.D1.8	Identify and weld five (5) basic types of joints.
7101.D1.9	Demonstrate ability to read and interpret technical documents.
7101.D1.10	Demonstrate ability to use various types of software applicable to the course.
Domain	<i>Advanced Gas Metal Arc Welding</i>
7101.D2.1	Demonstrate the proper safety procedures in Gas Metal Arc welding.

7101.D2.2	Learn proper AWS Standard Welding Terms and Definitions.
7101.D2.3	Perform weld restarts that are smooth and even with GMAW using short circuiting transfer equipment on mild steel.
7101.D2.4	Perform lap, and tee joint welds with GMAW using short circuiting transfer equipment on mild steel in the vertical up, vertical down and overhead position.
7101.D2.5	Perform square groove welds with GMAW using short circuiting transfer equipment on mild steel in the vertical up, vertical down and overhead position.
7101.D2.6	Perform lap, and tee joint welds with GMAW using spray equipment on thick mild steel in the flat and horizontal position.
7101.D2.7	Perform V-Groove welds with GMAW using spray equipment on thick mild steel in the flat position.
7101.D2.8	Perform lap, tee and groove welds with GMAW equipment on aluminum.
7101.D2.9	Understand welding procedure specifications (WPS) and be able to follow them.
7101.D2.10	Understand the basic metallurgical properties of steel and aluminum and how they are affected by welding.
7101.D2.11	Understand the significance of the suffix in GMAW electrode selection.
7101.D2.12	Prepare to create a workmanship sample weldment for GMAW following the AWS provided prints.
7101.D2.13	Gain insight into the Certification for AWS welders
7101.D2.14	Attain readiness to take American Welding Society certification exam
7101.D2.15	Demonstrate ability to read and interpret technical documents.
7101.D2.16	Demonstrate ability to use various types of software applicable to the course.

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Gas Metal Arc Welding	<ul style="list-style-type: none"> ● Student performs GMAW fillet/groove welds in the horizontal position. ● Student performs GMAW fillet/groove welds in the vertical position. ● Student performs GMAW fillet/groove welds in the overhead position. ● Student perform safety inspections and make minor external repairs of GMAW and FCAW equipment. ● Student performs FCAW fillet/groove welds in the horizontal position. ● Student performs FCAW fillet/groove welds in the vertical position. ● Student performs FCAW fillet / groove welds in the overhead position. 	<ul style="list-style-type: none"> ● Demonstrate proper shop and GMAW and FCAW welding safety according to OSHA. ● Perform GMAW welding in the 2F -3F -4F position using Short Circuit transfer. ● Perform GMAW welding in the 2F position using Spray transfer. ● Perform FCAW welding in the 2F -3F -4F position using Self and Gas shielded electrodes. ● Perform FCAW welding in the 2G, 3G and 4G position using Self and Gas shielded electrodes. 	<ul style="list-style-type: none"> ● Complete AWS entry level assessment Module 2 - safety. ● Complete Fillet weldments in all positions using Short circuit transfer. ● Complete Fillet weldments in horizontal positions using Spray transfer. ● Complete AWS entry level assessment Module 6 - FCAW. ● Completing AWS entry level welder practical assessment - FCAW-S. ● Completing AWS entry level welder practical assessment - FCAW-G.
Advanced Gas Metal Arc Welding	<ul style="list-style-type: none"> ● Student performs fillet/groove welds in the horizontal position. ● Student performs fillet/groove welds in the vertical position. 	<ul style="list-style-type: none"> ● Perform GMAW welding in the 2G ,3G and 4G position using Short Circuit transfers. ● Perform GMAW welding in the 2F and 1G Flat position using Spray transfer. ● Perform Safety inspections and make minor external repairs on FCAW/GMAW equipment 	<ul style="list-style-type: none"> ● Complete AWS entry level assessment Module 5- GMAW. ● Completing AWS entry level welder practical assessment - GMAW- Short Circuit (AWS edu- 3). ● Completing AWS entry level welder practical assessment - GMAW-Spray (AWS edu-2).

7226 Welding Technology Capstone	
Course Description	<i>The Welding Technology Capstone course builds upon the knowledge and skills developed in Welding Fundamentals, Shielded Metal Arc Welding, and Gas Metal Arc Welding by developing advanced welding skills in Gas Tungsten Arc Welding (TIG), Pipe Welding, and Fabrication. As a capstone course, students should have the opportunity to apply their knowledge and use skills through an intensive work-based learning experience.</i>
Pre/Co Req	Principles of Welding Technology; Shielded Metal Arc Welding; Gas Welding Processes
Credits	Credits: 2 semester course, 2 semesters required, 1-3 credits per semester, 6 credits maximum
Counts Toward	Counts as a Directed Elective or Elective for all diplomas
ITCC Courses	WELD 208: Gas Metal Arc Welding; WELD 273: Advanced Gas Tungsten Arc Welding II
Postsecondary Credential	ITCC: CT Structural Welding 48.0508
Promoted Certifications	AWS D.1.1 SMAW

CONTENT STANDARDS AND COMPETENCIES	
Competency #	Competency
Domain	<i>Gas Tungsten Arc Welding</i>
7226.D1.1	Interpret welding symbols and demonstrate how they apply to shop drawings.
7226.D1.2	Identify the various joint configurations and explain how they affect weld strength.
7226.D1.3	Employ and practice safety procedures and practices used in the welding industry.
7226.D1.4	Identify and describe the function of each component of a GTAW station.
7226.D1.5	Identify and specify GTAW electrodes using the AWS electrode classification system.
7226.D1.6	Identify and specify GTAW filler metals using the AWS filler metal classification system.
7226.D1.7	Explain the effects of DCEN, DCEP, and AC current on electrode life, surface cleaning, and weld characteristics.
7226.D1.8	Describe the shielding gasses used for GTAW, describe their characteristics and their uses.
7226.D1.9	Select the proper power source, current type, shielding gas, flow rate, electrode type and diameter, nozzle size, and filler metal.
7226.D1.10	Properly assemble and adjust all variables required to produce acceptable GTA welds.
7226.D1.11	Properly prepare tungsten electrodes for welding with AC or DC current.

7226.D1.12	Demonstrate the use of square wave and pulse welding technology and how it applies to GTAW.
7226.D1.13	Properly prepare metals for welding.
7226.D1.14	Identify different types of weld defects and describe steps to prevent them.
7226.D1.15	Describe welding characteristics for Mild Steel, Stainless Steel, and Aluminum and other weldable metals.
7226.D1.16	Demonstrate welding on various types of metals.
Domain	Advanced Gas Tungsten Arc Welding
7226.D2.1	Demonstrate the proper safety procedures in Gas Tungsten Arc welding.
7226.D2.2	Learn proper AWS Standard Welding Terms and Definitions.
7226.D2.3	Setup and shut down of a Gas Tungsten Arc station properly and safely.
7226.D2.4	Select and determine the proper electrode and nozzle size for a job.
7226.D2.5	Understand welding procedure specifications (WPS) and be able to follow them.
7226.D2.6	Perform destruction testing with appropriate welds.
7226.D2.7	Perform proper techniques of preparation of tungsten electrodes.
7226.D2.8	Perform balling of tungsten electrodes in preparation for aluminum welding.
7226.D2.9	Gain insight into the Certification for AWS welders.
7226.D2.10	Practice welding, following WPS and instructors guidelines.
7226.D2.11	Lap/T/Square groove/w/wire on 10ga.steel.
7226.D2.12	Lap/T/Square groove on 10ga. Stainless Steel.
7226.D2.13	Lap/T on 10ga. Aluminum.
7226.D2.14	Workmanship sample prints; steel, stainless steel, aluminum.
7226.D2.15	Attain readiness to take the American Welding Society certification exam.
7226.D2.16	Demonstrate ability to read and interpret technical documents.
Domain	Pipe Welding
7226.D3.1	Understand and apply all shielded metal arc pipe welding and gas tungsten arc welding safety rules.
7226.D3.2	Apply American Welding Society D1.1 code welding criteria to guided bend tests.
7226.D3.3	Utilize and apply shielded metal arc pipe welding process and gas tungsten arc welding fundamentals to pass AWS welding certifications.
7226.D3.4	Apply all appropriate equipment settings and adjustments.

7226.D3.5	Understand and apply the basic principles and terminology involved in destructive weld testing.
7226.D3.6	Employ safety procedures in preparation of and welding of pipe.
7226.D3.7	Perform the proper technique for preparing the pipe for welding.
7226.D3.8	Tack pipe in 2G and 5G position.
7226.D3.9	Weld pipe in the 2G position with the stringer bead method.
7226.D3.10	Weld pipe in the 5G position with the stringer or weave bead method.
7226.D3.11	Prepare pipe for weld test.
7226.D3.12	Demonstrate ability to inspect weld joints before, during and after welding.
7226.D3.13	Demonstrate ability to read and interpret technical documents.
Domain	Fabrication
7226.D4.1	Describe equipment used in basic metal fabrication.
7226.D4.2	Use measuring equipment.
7226.D4.3	Prepare a bill of materials from a print chosen for the project.
7226.D4.4	Prepare a list of fabrication steps necessary to fabricate this project.
7226.D4.5	Layout the various tolerances, fits and allowances related to this project.
7226.D4.6	Layout the assigned project.
7226.D4.7	Fabricate the assigned project.
7226.D4.8	Perform visual inspection of the project.
7226.D4.9	Produce a detailed drawing of a project with welding symbols.
7226.D4.10	Demonstrate ability to read and interpret technical documents.

SAMPLE ACTIVITIES			
Domain	Technical Skills	Activity	Assessment / Evaluation
Gas Tungsten Arc Welding	<ul style="list-style-type: none"> ● Student performs fillet/groove welds in the horizontal position on steel material. ● Student performs fillet/groove welds in the horizontal position on stainless steel material. ● Student performs fillet welds in the horizontal position on aluminum material. 	<ul style="list-style-type: none"> ● Demonstrate proper shop and GTAW welding safety according to OSHA. ● Perform GTAW welding in the 2F and 2G position on thin gage steel. ● Perform GTAW welding in the 2F and 2G position on thin gage Stainless Steel. ● Perform GTAW welding in the 2F position on aluminum. 	<ul style="list-style-type: none"> ● Complete AWS entry level assessment Mod 2 - safety. ● Complete Fillet weldments in horizontal positions using thin gage steel. ● Complete Groove welds in the 1G and 2G position on thin gage steel. ● Complete Fillet weldments in horizontal positions using thin gage Stainless steel. ● Complete Groove welds in the 1G and 2G position on thin gage Stainless steel. ● Complete Fillet weldments in horizontal positions using aluminum.
Advanced Gas Tungsten Arc Welding	<ul style="list-style-type: none"> ● Student performs fillet/groove welds in the vertical position on steel material. ● Student performs fillet/groove welds in the overhead position on steel material. ● Student performs fillet/groove welds in the vertical position on stainless steel material. ● Student performs fillet welds in the horizontal position on aluminum material. ● Student performs groove welds in the flat position on aluminum material. 	<ul style="list-style-type: none"> ● Perform GTAW welding in the 3F and 3G position on thin gage steel. ● Perform GTAW welding in the 4F and 4G position on thin gage steel. ● Perform GTAW welding in the 3F and 3G position on thin gage Stainless Steel. ● Perform GTAW welding in the 1G position on aluminum. 	<ul style="list-style-type: none"> ● Complete AWS entry level assessment Mod 7- GTAW. ● Completing AWS entry level welder practical assessment - GTAW-Steel (AWS edu- 3). ● Completing AWS entry level welder practical assessment - GTAW-Stainless Steel (AWS edu-4). ● Completing AWS entry level welder practical assessment - GTAW-Aluminum (AWS edu-5).

Pipe Welding	<ul style="list-style-type: none"> ● Student performs fillet/groove welds in the horizontal position on steel material using GTAW and SMAW. 	<ul style="list-style-type: none"> ● Demonstrate 2G pipe welding using GTAW root and SMAW out. ● Demonstrate 5G pipe welding using GTAW root and SMAW out. 	<ul style="list-style-type: none"> ● Observe 2G pipe welding using GTAW root and SMAW out. ● Observe 5G pipe welding using GTAW root and SMAW out.
Fabrication	<ul style="list-style-type: none"> ● Student reads and understands basic measurements on a ruler (Standard and Metric). ● Student reads a blueprint and works from that print to complete a project. ● Student reads and understands standard AWS welding symbols. ● Student has ability to apply measurement and blueprint skills to fabricate projects. 	<ul style="list-style-type: none"> ● Reading a ruler classroom activities. ● Using a tape measure/ Ruler students will measure, layout, and Tack certification tests according to the provided AWS blueprint. ● Identify Fabrication tools and their uses. ● Build small projects. ● Perform quality inspection on each weldment and verbalize discontinuities. 	<ul style="list-style-type: none"> ● Create a material list for each AWS entry level welder blueprints. ● Use Blueprints and material list to layout and assemble AWS practical assessments. ● Complete AWS entry level assessment Module 9- Inspections.