CareerClusters™ PATHWAYS TO COLLEGE & CAREER READINESS
Manufacturing

Learning that works for Colorado CTE®

Colorado CTE Course – Scope and Sequence

Course Name	Welding Technology II	Course Details	Credit = 1.0 Prerequisite: Welding Technology I CTE Credential: CTE Manufacturing
		Course = 0.50 Carnegie Unit Credit	
Course Description	Welding Technology II students will be exposed to more advanced welding process such as MIG/GMAW, as well as an introduction to TIG welding. In addition, they will have the opportunity to refine what they learned from Level I to a higher standard. Students will identify welding symbols on drawings, read detail drawings, identify physical characteristics and mechanical properties of metal, explain pre and post heating of metals, identify equipment and filler metals utilized in GMAW, as well as prepare welding test plates. Through the course of the year, students will have the opportunity to create more advanced welding projects for the community as well as private individuals.		
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.		
SCED Identification #	13207	Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.	

All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**

Instructional Unit Topic	Suggested Length of Instruction	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Career Development		Develop an education and career plan aligned with personal goals. Understand employer expectations for technical and employability skills. Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.	The student explores the employability characteristics of a successful worker in the global economy. The student is expected to: (A) determine academic knowledge and skills required for postsecondary education; (B) identify employers' expectations to foster	Investigate entry-level and work-based learning opportunities. Explore the opportunities available through the program areas, including: •Internships •Job Shadowing •Apprenticeship programs •On-the-Job Training Utilize teambuilding skills in class and work-related situations. a. Define teambuilding.	SkillsUSA Welding Fabrication and Individual Welding Competitions SkillsUSA Personal and Employability Skills Framework

			positive customer satisfaction; (C) demonstrate the professional standards required in the workplace such as interviewing skills, flexibility, willingness to learn new skills and acquire knowledge, self-discipline, self-worth, positive attitude, and integrity in a work situation; (D) evaluate progress toward personal career goals; (E) communicate effectively with others in the workplace to clarify objectives; and (F) apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations.	b. Discuss the attributes of a team. c. Identify the roles included in a team. d. Explore how local employers used effective communication strategies to manage teams and jobsites. Describe employment opportunities in the construction and manufacturing industry. a. Describe employment opportunities, including potential earnings, employee benefits, job availability, working conditions, educational requirements, required technology skills, and continuing education/training. b. Discuss the guidelines for developing a proper résumé. c. Demonstrate completing job applications.	
Workplace Regulations, Safety & Compliance		Apply basic knowledge of using and maintaining	The student evaluates the function and application of the tools,	Accurately read, interpret, and demonstrate adherence to safety rules,	

		professional welding equipment. Identify regulations and safety standards that are implemented within the welding profession. Identify materials and resources commonly used and recycled in welding. Understand the AWS certification requirements.	equipment, technologies, and materials used in welding. The student is expected to: A) operate welding equipment according to safety standards; B) identify and properly dispose of environmentally hazardous materials used in welding; C) explain the importance of recycling materials used in welding; D) choose appropriate personal protective equipment; E) evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulations; and F) understand the AWS certification process.	including rules published by the Occupational Safety and Health Administration (OSHA) guidelines, American Society for Testing Materials; ANSI Z49.1: Safety and Welding, Cutting, and Allied Processes, And state and national code requirements. Be able to distinguish between rules and explain why certain rules apply. Complete safety test with 100 percent accuracy. Identify and explain the intended use of safety equipment available in the classroom. For example, demonstrate how to properly inspect, use, store, and maintain safe operating procedures with tools and equipment. Locate and assess the American Welding Society website and analyze its structure, policies, and requirements for the AWS Entry Welder qualification and certification. Explain a welder certification document, what steps are required to obtain the certification, and how to prepare for the examination.	

SMAW		Demonstrate understanding of safety hazards, protective devices used, and operation of SMAW equipment.	Explain the SMAW electrode classification system and how to select the proper electrode for the task. Student is expected to: (A) recognize the AWS filler metal specification system and various electrode characteristics; (B) describe the characteristics of the four main electrode groups; (C) explain how to select electrodes and describe their proper care and handling; (D) select the proper electrodes for any given welding task; (E) perform multi-pass groove welds in all positions according to industry-accepted welding standards; and (F) demonstrate the proper handling and storage of electrodes.		
GMAW		Demonstrate proper set-up and procedure for gas metal arc welding.	The student analyzes gas metal arc welding principles and practices.	Safely set up equipment for gas metal arc welding (GMAW). Identify and explain	

			The student is expected to: (A) use safe operating practices; (B) explain the effects that weld angle, work angle, and electrode extension have on welds; (C) setup and perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas; (D) setup and perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas; (E) explain the AWS identification system for gas metal arc welding filler metal; (F) determine appropriate filler metal	the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages of using GMAW over conventional electrode-type arc (stick) welding. Write a brief informative paper distinguishing the characteristics. For example, explain why it is easier to control the small molten weld pool using the GMAW process. Research the American Welding Society (AWS) filler metal classification system, and write a brief paper explaining the system, discussing the multiple factors that affect electrode selection for gas metal arc welding (GMAW). For example, the 80 in ER80S-D2 designates the minimum tensile strength of the deposited weld metal in thousands. Using the gas metal arc welding (GMAW) process and various metal transfer methods (e.g., short-circuit, pulse-arc, globular, and spray transfer), demonstrate how to	

			for base metal in gas metal arc welding; and (G) perform fillet and groove welds in all positions.	pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results, distinguishing between the metal transfer methods used, and explain the equipment adjustments made to change between metal transfer methods as if narrating a technical process to an audience.	
FCAW		Demonstrate proper set-up and procedure for flux cored arc welding.	The student analyzes flux cored arc welding principles and practices on metals. The student is expected to: (A) use safe operating practices; (B) explain the effects that weld angle, work angle, and electrode extension have on welds; (C) apply flux cored arc welding principles; (D) demonstrate proper set-up procedure for flux cored arc welding;	Safely set up equipment for flux cored arc welding (FCAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, research the advantages and limitations of FCAW. Write a brief informative paper distinguishing these characteristics. For example, determine which types of metals and alloys are most applicable for the use of FCAW. Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Using proper domain-	

			(E) explain the AWS identification system for flux cored arc welding electrodes; (F) determine appropriate filler metal for base metal in flux cored arc welding; and (G) perform fillet and groove welds in all positions.	specific terminology, explain in a presentation to a technical audience the multiple factors that affect electrode and shielded gas selection for flux cored arc welding (FCAW). For example, manufacturers sometimes consider the exact composition of fluxes a trade secret and do not provide enough details to classify electrodes. As a result, AWS uses G for electrodes that have not been classified. Using various electrodes and the flux cored arc welding (FCAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel in all feasible positions (e.g., horizontal, flat, vertical, overhead). Over time, routinely document observations such as the effects of metal surface conditions, voltage drop, welding position, and wire feed speed. Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources.	

				Identify and explain the following distinctive features about flux cored arc welding (FCAW): arc-control, oxidation-prevention, self-shielded FCAW, and gas-shielded FCAW. Describe and demonstrate specific examples of how metal transfer is affected by arc-control, self-shielded, and gas-shielded FCAW. Explain the importance of using recommended gas mixtures.	
Introduction to TIG (GTAW)		Explain the GTAW welding process including safety procedures. Identify the various types and appropriate uses of GTAW filler metals.	The student analyzes gas tungsten arc welding on metals. The student is expected to: (A) use safe operating practices; (B) analyze electrical welding current relationships such as alternating current and direct current, heat transfer, and polarity; (C) identify the common types of tungsten and filler metals according to the AWS identification system;	Safely set up equipment for gas tungsten arc welding (GTAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast water-cooled welding torches versus air-cooled welding torches used in GTAW. Write a brief paper distinguishing the characteristics and the appropriate applications of each torch type. For example, determine which torch is preferred in production welding contexts and explain why. Refer to previous research conducted on the filler metal classification system by the	

			(D) demonstrate proper set-up procedure for gas tungsten arc welding; (E) perform fillet and groove welds in all positions; and (F) perform welds on metals such as carbon steel, stainless steel, and aluminum.	American Welding Society (AWS). Discuss the multiple factors that affect electrode selection for gas tungsten arc welding (GTAW). For example, pure tungsten (EWP) is not typically used Safely set up equipment for gas tungsten arc welding (GTAW). Identify and explain the equipment, equipment setup, power sources, and the electrical current used in the welding process. Drawing on multiple resources, compare and contrast water-cooled welding torches versus air-cooled welding torches used in GTAW. Write a brief paper distinguishing the characteristics and the appropriate applications of each torch type. For example, determine which torch is preferred in production welding contexts and explain why. Refer to previous research conducted on the filler metal classification system by the American Welding Society (AWS). Discuss the multiple factors that affect electrode selection for gas tungsten arc welding (GTAW). For example, pure tungsten (EWP) is not typically used with alternating	

				current (AC) welding of materials because it has poor heat resistance and electron emission. Using various electrodes and the gas tungsten arc welding (GTAW) process, demonstrate how to pad beads and make fillet welds on plain carbon steel, stainless steel, and aluminum in all feasible positions (e.g., horizontal, flat, vertical, overhead). Summarize the demonstration results of using various electrodes and explain the findings using supporting evidence from the AWS metal classification system and other resources. Identify and explain the following distinctive features about gas tungsten arc welding (GTAW): arc-control, oxidation-prevention, and gas-shielded GTAW. Describe and demonstrate specific examples of how metal transfer is affected by various shielded gas GTAW (e.g., argon, helium, hydrogen, nitrogen). Identify which gases are noble inert gases and explain why this is a distinguishing characteristic.	

Welding Procedure Specification Development		Understand how welding procure and specifications are used in the welding and joining process. Understand how AWS determines welding qualifications.	Interpret and demonstrate the planning and layout operations used in the welding processes. Student is expected to: (A) Interpret scaled welding blueprints; gather design and materials information; perform calculations; and use the detail to plan, lay out, and produce parts or finished products; (B) Analyze welding symbols on drawings, specifications, and welding procedure specifications; (C) Research AWS welding specifications; and (D) Critique the design parameters across welding processes to produce a welded part or product.	Research the American Welding Society (AWS) Specification for Welding Procedure and Performance Qualification (AWS B2.1/B2.1M) to learn more about Welding Procedure Specifications and the use of the document. Explain the significance of this document and define the following elements: a. Joint Design b. Base Metal c. Filler Meta d. Position e. Preheat and Interpass f. Heat Treatment g. Shielding Gas h. Electrical Investigate procedure qualification variables associated with the above elements and their effects on welding processes. Describe techniques to mitigate the effects of these variables that can occur during the welding process. Write a report summarizing and explaining the findings. Justify all explanations with supporting evidence gathered from observations and welding principles.	

				Read and interpret an example of a welding procedure specification and observe demonstrations of qualified welders to understand the proper procedures involved in conducting a welding procedure test. Create a training document to instruct a new welders on how to properly use the welding procedure specification to help successfully conduct a welding procedure test. Include the following: a. Code Requirements b. Materials c. Documentation d. Destructive Testing e. Inspection and evaluation Apply knowledge previously learned to properly demonstrate the ability to review a welding procedure specification and conduct a welding procedure test. Steps must include: a. Properly setting up welding equipment for the process being tested b. Properly select base material and filler metal (gas shielding if required) c. Gathering equipment needed to capture welding variables	

				d. Properly set up test coupon (per code, or as performed in production) e. Properly document data as coupon is being welded f. Performing visual inspection g. Performing destructive testing h. Completing the Welding Procedure Specification document	
Quality Control		Understand and defend the purposes and processes of inspection and quality control in welding manufacturing processes. Apply quality control processes and procedures to welding tasks.	The student analyzes the concepts and intricacies of inspections related to welding codes. The student is expected to: (A) inspect the welding projects of team members; (B) select codes for weld inspections; and (C) critique and evaluate the weldments of team members.	Drawing upon multiple resources, research and write a text explaining the relationship between discontinuities and defects. Describe various examples of defects found in welded products. Also identify and explain both destructive and nondestructive tests used as quality control techniques to prevent manufacturing defects in welding. Compare and contrast these techniques and provide specific examples when they are most appropriately used. Cite evidence to justify the examples. Measure and visually inspect welded products for acceptability to American Welding Society QC-10 standards. Record discontinuities and defects,	

				and compare data to given project specifications using class-defined analysis methods. Interpret and communicate results both written and verbally. If necessary, recommend changes that will reduce the number of product defects during the manufacturing process.	