

Chapter 130. Texas Essential Knowledge and Skills for Career and Technical Education

Subchapter M. Manufacturing

§130.362. Introduction to Welding (One Credit), Adopted 2015.

- (a) General requirements. This course is recommended for students in Grades 9-12. Recommended prerequisite or corequisite: Algebra I. Students shall be awarded one credit for successful completion of this course.
- (b) Introduction.
 - (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - (2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance, and manufacturing/process engineering.
 - (3) Introduction to Welding will provide an introduction to welding technology with an emphasis on basic welding laboratory principles and operating procedures. Students will be introduced to the three basic welding processes. Topics include: industrial safety and health practices, hand tool and power machine use, measurement, laboratory operating procedures, welding power sources, welding career potentials, and introduction to welding codes and standards. Introduction to Welding will provide students with the knowledge, skills, and technologies required for employment in welding industries. Students will develop knowledge and skills related to welding and apply them to personal career development. This course supports integration of academic and technical knowledge and skills. Students will reinforce, apply, and transfer knowledge and skills to a variety of settings and problems. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills will prepare students for future success.
 - (4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
 - (5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (c) Knowledge and skills.
 - (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
 - (A) express ideas to others in a clear, concise, and effective manner through written and verbal communication;
 - (B) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
 - (C) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
 - (D) choose ethical courses of action such as following applicable rules, laws, and regulations;
 - (E) review detailed aspects of both quantitative and qualitative work processes and end products;
 - (F) evaluate systems relative to causes, problems, and patterns to improve operational situations;

- (G) adhere to business practices such as policies, procedures, and health and safety rules; and
 - (H) use time wisely by prioritizing tasks and following schedules in an efficient manner.
- (2) The student explores the 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 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 to health and safety in the workplace as specified by appropriate government regulations.
- (3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:
 - (A) employ welding equipment according to safety standards;
 - (B) identify and properly dispose of environmentally hazardous materials used in welding;
 - (C) evaluate appropriate personal protective equipment; and
 - (D) evaluate skills related to health and safety in the workplace as specified by appropriate government regulations.
- (4) The student compares and contrasts welding joint design, material symbols, and welds. The student is expected to:
 - (A) demonstrate knowledge of welding sketches; and
 - (B) identify types of welds such as fillet, groove, spot, plug, and flanged.
- (5) The student applies academic skills in relationship to welding. The student is expected to:
 - (A) demonstrate mathematical skills related to welding;
 - (B) demonstrate technical writing skills related to welding;
 - (C) apply accurate readings of measuring devices;
 - (D) accurately use appropriate tools to make measurements;
 - (E) calculate problems using whole numbers, fractions, mixed numbers, and decimals; and
 - (F) perform conversions between fractions and decimals;
- (6) The student applies the concepts and skills of welding projects. The student is expected to:
 - (A) explore careers in welding;
 - (B) understand welding codes such as American Petroleum Institute (API) 1104 and American Welding Society (AWS) D1.1;
 - (C) work independently to fabricate a variety of welded projects with minimal assistance; and
 - (D) work collaboratively with other students.
- (7) The student performs oxy-fuel processes on carbon steels. The student is expected to:
 - (A) observe safe operating practices;
 - (B) perform safe handling of compressed gases;

- (C) identify components of oxy-fuel gas cutting;
- (D) demonstrate proper set-up procedures for the oxy-fuel process;
- (E) distinguish among factors affecting base metals such as ferrous and non-ferrous metals; and
- (F) demonstrate proper cutting techniques such as piercing, straight line, and bevel;
- (8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:
 - (A) use safe operating practices;
 - (B) demonstrate knowledge of alternating current;
 - (C) apply shielded metal arc welding principles;
 - (D) demonstrate proper set-up procedure for shielded metal arc welding;
 - (E) determine appropriate electrodes for base metal in shielded metal arc welding;
 - (F) perform welds in varied positions such as techniques in fillet and groove welds; and
 - (G) perform plate preparation.
- (9) The student performs gas metal arc welding principles and practices. The student is expected to:
 - (A) use safe operating practices;
 - (B) apply gas metal arc welding principles;
 - (C) demonstrate proper set-up procedure for gas metal arc welding;
 - (D) use appropriate equipment for base metal in gas metal arc welding; and
 - (E) perform various gas metal arc welding techniques.

§130.363. Welding I (Two Credits), Adopted 2015.

- (a) General requirements. This course is recommended for students in Grades 10-12. Recommended prerequisites: Algebra I, Principles of Manufacturing, Introduction to Precision Metal Manufacturing, or Introduction to Welding. Students shall be awarded two credits for successful completion of this course.
- (b) Introduction.
 - (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - (2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance, and manufacturing/process engineering.
 - (3) Welding I provides the knowledge, skills, and technologies required for employment in metal technology systems. Students will develop knowledge and skills related to this system and apply them to personal career development. This course supports integration of academic and technical knowledge and skills. Students will reinforce, apply, and transfer knowledge and skills to a variety of settings and problems. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for future success.
 - (4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
 - (5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

- (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
 - (A) express ideas to others in a clear, concise, and effective manner through written and verbal communication;
 - (B) convey written information that is easily understandable to others;
 - (C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
 - (D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
 - (E) choose the ethical course of action and comply with all applicable rules, laws, and regulations;
 - (F) review the fine, detailed aspects of both quantitative and qualitative work process and end products;
 - (G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;
 - (H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules; and
 - (I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner.
- (2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:
 - (A) explore academic knowledge and skills required for postsecondary education;
 - (B) identify employers' expectations to foster 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 personal career goals;
 - (E) communicate effectively with others in the workplace to clarify objectives; and
 - (F) demonstrate skills related to health and safety in the workplace as specified by appropriate government regulations.
- (3) The student applies academic skills to the requirements of welding. The student is expected to:
 - (A) demonstrate effective communication skills with individuals from varied cultures such as fellow workers, management, and customers;
 - (B) demonstrate mathematical skills to estimate costs;
 - (C) demonstrate technical writing skills related to work orders;
 - (D) apply accurate readings of measuring devices;
 - (E) use appropriate tools to make accurate measurements;
 - (F) compute measurements such as area, surface area, volume, and perimeter;
 - (G) calculate problems using whole numbers, fractions, mixed numbers, and decimals;
 - (H) use various methods, including a calculator, to perform computations;
 - (I) perform conversions between fractions and decimals;

- (J) calculate and apply the functions of angles such as using the Pythagorean Theorem; and
- (K) employ the parts of a circle.
- (4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:
 - (A) employ welding equipment according to safety standards;
 - (B) identify and properly dispose of environmentally hazardous materials used in welding;
 - (C) evaluate appropriate personal protective equipment; and
 - (D) evaluate skills related to health and safety in the workplace as specified by appropriate government regulations.
- (5) The student understands welding joint design, symbols, and welds. The student is expected to:
 - (A) demonstrate knowledge of engineering drawings, charts, and diagrams;
 - (B) describe orthographic and isometric views of three-dimensional figures;
 - (C) interpret engineering, drawings, charts, and diagrams;
 - (D) analyze components of the welding symbol;
 - (E) analyze types of welding joints;
 - (F) analyze positions of welding; and
 - (G) identify types of welds such as fillet, groove, spot, plug, and flanged.
- (6) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:
 - (A) evaluate weld inspection processes; and
 - (B) analyze welding codes.
- (7) The student analyzes oxy-fuel processes on carbon steels. The student is expected to:
 - (A) observe safe operating practices;
 - (B) perform safe handling of compressed gases;
 - (C) identify components of oxy-fuel gas cutting;
 - (D) demonstrate proper set-up procedures for oxy-fuel process;
 - (E) distinguish factors affecting base metals;
 - (F) demonstrate proper cutting techniques such as piercing, straight line, and bevel;
 - (G) identify acceptable cuts; and
 - (H) evaluate alternative fuels such as propane, propylene, and chemtane.
- (8) The student analyzes plasma arc cutting on metals. The student is expected to:
 - (A) observe safe operating practices;
 - (B) demonstrate knowledge of the theories of plasma arc cutting;
 - (C) apply safe handling of compressed air supply;
 - (D) identify components of plasma arc cutting;
 - (E) demonstrate correct set-up procedure for plasma arc cutting;
 - (F) define cutting terms; and
 - (G) perform shape cutting.

- (9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:
- (A) use safe operating practices;
 - (B) analyze electrical relationships such as alternating current and direct current, heat transfer, and polarity;
 - (C) apply shielded metal arc welding principles;
 - (D) demonstrate proper set-up procedure for shielded metal arc welding;
 - (E) determine appropriate filler for base metal in shielded metal arc welding; and
 - (F) perform passes such as root, hot, filler, and cover.
- (10) The student analyzes gas metal arc welding principles and practices. The student is expected to:
- (A) observe safe operating practices;
 - (B) analyze electrical relationships such as alternating current and direct current, heat transfer, and polarity;
 - (C) apply gas metal arc welding principles;
 - (D) demonstrate proper set-up procedure for gas metal arc welding;
 - (E) determine appropriate filler for base metal in gas metal arc welding; and
 - (F) perform fillet welds.
- (11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:
- (A) observe safe operating practices;
 - (B) analyze electrical relationships such as alternating current and direct current, heat transfer, and polarity;
 - (C) apply flux cored arc welding principles;
 - (D) demonstrate proper set-up procedure for flux cored arc welding;
 - (E) determine appropriate filler for base metal in flux cored arc welding;
 - (F) perform fillet welds; and
 - (G) perform welds in all appropriate positions.
- (12) The student analyzes gas tungsten arc welding on metals. The student is expected to:
- (A) demonstrate safe operating practices;
 - (B) analyze electrical relationships such as alternating current and direct current, heat transfer, and polarity;
 - (C) determine the common types of tungsten and filler materials;
 - (D) demonstrate proper set-up procedure for gas tungsten arc welding;
 - (E) perform welds in all appropriate positions; and
 - (F) perform welds on carbon steel.

§130.364. Welding II (Two Credits), Adopted 2015.

- (a) General requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Welding I. Recommended Corequisite: Welding II Lab. Recommended prerequisites: Algebra I or Geometry. Students shall be awarded two credits for successful completion of this course.

(b) Introduction.

- (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- (2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance, and manufacturing/process engineering.
- (3) Welding II builds on the knowledge and skills developed in Welding I. Students will develop advanced welding concepts and skills as related to personal and career development. Students will integrate academic and technical knowledge and skills. Students will have opportunities to reinforce, apply, and transfer knowledge and skills to a variety of settings and problems.
- (4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
- (5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

- (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
 - (A) express ideas to others in a clear, concise, and effective manner through written and verbal communication;
 - (B) convey written information that is easily understandable to others;
 - (C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
 - (D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
 - (E) choose the ethical course of action and comply with all applicable rules, laws, and regulations;
 - (F) review the fine, detailed aspects of both quantitative and qualitative work process and end products;
 - (G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;
 - (H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules;
 - (I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner;
 - (J) analyze how teams function; and
 - (K) evaluate employers' work expectations to measure project success.
- (2) 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 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 government regulations.
- (3) The student applies academic skills to the requirements of welding. The student is expected to:
 - (A) demonstrate mathematical skills to estimate costs;
 - (B) determine the impact of inaccurate readings of measuring devices on cost estimates;
 - (C) justify the selection of a tool to make accurate measurements;
 - (D) compute measurements such as area, surface area, volume, and perimeter;
 - (E) calculate problems using whole numbers, fractions, mixed numbers, and decimals;
 - (F) apply right triangle relationships using the Pythagorean Theorem; and
 - (G) defend the choice of a mathematical solution using estimation.
- (4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:
 - (A) use welding equipment according to safety standards;
 - (B) dispose of environmentally hazardous materials used in welding;
 - (C) determine the performance impact of emerging technologies in welding;
 - (D) use appropriate personal protective equipment to follow safety measures; and
 - (E) investigate the use of automated welding machines such as numerical control, computer numerical control, and robotics-controlled welding machines.
- (5) The student illustrates welding joint design, symbols, and welds. The student is expected to:
 - (A) use knowledge of engineering drawings to complete an advanced project; and
 - (B) inspect projects using engineering drawing specifications.
- (6) The student applies the concepts and skills of welding to perform tasks. The student is expected to:
 - (A) work independently in fabricating welded projects;
 - (B) work collaboratively with other students to complete a real-world application item; and
 - (C) troubleshoot equipment.
- (7) 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 advanced codes for weld inspections; and
 - (C) critique and evaluate the weldments of team members.
- (8) The student performs advanced cutting processes on carbon steels. The student is expected to:
 - (A) observe safe operating practices;
 - (B) apply safe handling of compressed gases; and
 - (C) perform advanced cutting processes according to accepted welding standards.

- (9) The student performs shielded metal arc welding on metals. The student is expected to:
 - (A) employ safe operating practices; and
 - (B) demonstrate advanced knowledge of qualified welding positions using accepted welding standards.
- (10) The student performs flux cored metal arc welding. The student is expected to:
 - (A) use safe operating practices;
 - (B) perform fillet welds;
 - (C) perform groove welds; and
 - (D) perform welds in all appropriate positions according to accepted welding standards.
- (11) The student performs gas tungsten arc welding on metals. The student is expected to:
 - (A) employ safe operating practices;
 - (B) perform fillet welds;
 - (C) perform groove welds;
 - (D) perform welds in all appropriate positions according to accepted welding standards; and
 - (E) perform welds on metals such as carbon steel, stainless steel, pipe, and aluminum.

§130.365. Welding II Lab (One Credit), Adopted 2015.

- (a) General requirements. This lab course is recommended for students in Grades 11 and 12. Prerequisite: Welding I. Recommended corequisite: Welding II. Students shall be awarded one credit for successful completion of this course.
- (b) Introduction.
 - (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - (2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance, and manufacturing/process engineering.
 - (3) Welding II Lab provides an introduction to welding technology with an emphasis on basic welding laboratory principles and operating procedures. Topics include: industrial safety and health practices, hand tool and power machine use, measurement, laboratory operating procedures, welding power sources, welding career potentials, and introduction to welding codes and standards. This course provides knowledge, skills, and technologies required for employment in welding industries. Students will develop knowledge and skills related to this system and apply them to personal career development. This course supports integration of academic and technical knowledge and skills. Students will reinforce, apply, and transfer knowledge and skills to a variety of settings and problems. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for future success.
 - (4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
 - (5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.
- (c) Knowledge and skills.

- (1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:
 - (A) express ideas to others in a clear, concise, and effective manner through written and verbal communication;
 - (B) convey written information that is easily understandable to others;
 - (C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
 - (D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
 - (E) choose the ethical course of action and comply with all applicable rules, laws, and regulations;
 - (F) review the fine, detailed aspects of both quantitative and qualitative work process and end products;
 - (G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;
 - (H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules; and
 - (I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner.
- (2) The student demonstrates the functions and applications of the tools, equipment, technologies, and metals used in code welding. The student is expected to:
 - (A) use welding equipment according to safety standards;
 - (B) identify and properly dispose of environmentally hazardous materials used in welding; and
 - (C) use appropriate personal protective equipment.
- (3) The student applies the concepts and skills of welding of actual work situations. The student is expected to:
 - (A) work independently to fabricate welded projects with minimal assistance;
 - (B) work collaboratively with other students to complete relevant projects; and
 - (C) troubleshoot equipment.
- (4) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:
 - (A) evaluate weld inspection processes; and
 - (B) produce acceptable weldments to standards related to industry codes such as the American Welding Society, American National Standards Institute, and Canadian Welding Bureau.
- (5) The student performs oxy-fuel processes. The student is expected to:
 - (A) employ safe operating practices;
 - (B) perform safe handling of compressed gases;
 - (C) assemble components involved in setting up for oxy-fuel gas cutting processes;
 - (D) demonstrate proper ratios of compressed gases in cutting techniques such as piercing, straight line, bevel; and

- (E) evaluate acceptable and unacceptable cuts.
- (6) The student performs plasma arc cutting on metals. The student is expected to:
 - (A) judge safe operating practices;
 - (B) differentiate between safe and unsafe handling of compressed air supply;
 - (C) employ proper set-up procedures for plasma arc cutting; and
 - (D) demonstrate shape cutting.
- (7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:
 - (A) employ safe operating practices;
 - (B) demonstrate shielded metal arc welding principles;
 - (C) demonstrate proper set-up procedures for shielded metal arc welding;
 - (D) select appropriate filler for base metal in shielded metal arc welding;
 - (E) employ welds such as fillet and groove;
 - (F) employ passes such as root, hot, filler, and cover;
 - (G) employ plate preparation; and
 - (H) employ and evaluate heating processes such as pre-heating and post-heating.
- (8) demonstrate proper set-up procedure for gas metal arc welding. The student is expected to:
 - (A) employ safe operating practices;
 - (B) demonstrate gas metal arc welding principles;
 - (C) demonstrate proper ratios procedures of compressed gases for proper set-up for gas metal arc welding;
 - (D) judge appropriate use of fillers for base metal in gas metal arc welding; and
 - (E) employ welds in all appropriate positions.
- (9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:
 - (A) employ safe operating practices;
 - (B) employ and appraise flux cored arc welding principles;
 - (C) demonstrate proper set-up procedures for flux cored arc welding;
 - (D) appraise appropriate filler for base metal in flux cored arc welding;
 - (E) perform fillet welds; and
 - (F) employ welds in all appropriate positions.
- (10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:
 - (A) employ safe operating practices;
 - (B) demonstrate gas tungsten arc welding principles;
 - (C) demonstrate proper ratios procedures of compressed gases for proper set-up for gas tungsten arc welding;
 - (D) judge appropriate use of fillers for base metal in gas tungsten arc welding; and
 - (E) employ welds in all appropriate positions.