Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.352 Principles of Manufacturing (One Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 9-12. Recommended prerequisite: Algebra I or Geometry. 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) In Principles of Manufacturing, students are introduced to knowledge and skills used in the proper application of principles of manufacturing. The study of manufacturing technology allows students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities. Students will gain an understanding of what employers require to gain and maintain employment in manufacturing careers.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) identify and comply with appropriate dress for manufacturing activities	(i) identify appropriate dress for manufacturing activities
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) identify and comply with appropriate dress for manufacturing activities	(ii) comply with appropriate dress for manufacturing activities
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate positive work behaviors and personal qualities such as punctuality	(i) demonstrate positive work behaviors
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate positive work behaviors and personal qualities such as punctuality	(ii) demonstrate positive personal qualities
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate the ability to work in teams such as developing work schedules and measuring team performance	(i) demonstrate the ability to work in teams
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) demonstrate an understanding of employers' application and interview processes	(i) demonstrate an understanding of employers' application processes

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) demonstrate an understanding of employers' application and interview processes	(ii) demonstrate an understanding of employers' interview processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) identify federal laws and rules applicable to the workplace and enforcement agencies such as the Equal Employment Opportunity Commission and the Occupational Safety and Health Administration (OSHA)	(i) identify federal laws applicable the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) identify federal laws and rules applicable to the workplace and enforcement agencies such as the Equal Employment Opportunity Commission and the Occupational Safety and Health Administration (OSHA)	(ii) identify federal rules applicable to the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) identify federal laws and rules applicable to the workplace and enforcement agencies such as the Equal Employment Opportunity Commission and the Occupational Safety and Health Administration (OSHA)	(iii) identify federal laws applicable to enforcement agencies
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) identify federal laws and rules applicable to the workplace and enforcement agencies such as the Equal Employment Opportunity Commission and the Occupational Safety and Health Administration (OSHA)	(iv) identify federal rules applicable to enforcement agencies

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies manufacturing concepts to specific problems. The student is expected to:	(A) distinguish between disciplines such as engineering, science, manufacturing, and technology	(i) distinguish between disciplines
(2) The student applies manufacturing concepts to specific problems. The student is expected to:	(B) use tools such as calculators and computers to solve problems	(i) use tools
(2) The student applies manufacturing concepts to specific problems. The student is expected to:	(C) use a variety of measuring instruments	(i) use a variety of measuring instruments
(3) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(A) demonstrate communication techniques consistent with industry standards	(i) demonstrate communication techniques consistent with industry standards
(3) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(B) locate relevant information needed to solve problems	(i) locate relevant information needed to solve problems
(3) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(C) apply mathematics concepts to solve manufacturing problems	(i) apply mathematics concepts to solve manufacturing problems
(3) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(D) analyze science principles used to solve problems	(i) analyze science principles used to solve problems

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(E) use the appropriate units of measure	(i) use the appropriate units of measure
(4) The student manufactures products using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(A) analyze the processes needed to complete a project such as initiate, plane, execute, monitor and control, and close	(i) analyze the processes needed to complete a project
(4) The student manufactures products using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(B) use a variety of tools and equipment to produce an item	(i) use a variety of tools to produce an item
(4) The student manufactures products using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(B) use a variety of tools and equipment to produce an item	(ii) use a variety of equipment to produce an item
(5) The student practices safe work habits. The student is expected to:	(A) master relevant safety tests based on OSHA guidelines and principles	(i) master relevant safety tests based on OSHA guidelines
(5) The student practices safe work habits. The student is expected to:	(A) master relevant safety tests based on OSHA guidelines and principles; and	(ii) master relevant safety tests based on OSHA principles
(5) The student practices safe work habits. The student is expected to:	(B) use Material Safety Data Sheets (MSDS) to analyze, store, and safely dispose of hazardous materials	(i) use Material Safety Data Sheets (MSDS) to analyze, hazardous materials
(5) The student practices safe work habits. The student is expected to:	(B) use Material Safety Data Sheets (MSDS) to analyze, store, and safely dispose of hazardous materials	(ii) use Material Safety Data Sheets (MSDS) to store hazardous materials

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student practices safe work habits. The student is expected to:	(B) use Material Safety Data Sheets (MSDS) to analyze, store, and safely dispose of hazardous materials	(iii) use Material Safety Data Sheets (MSDS) to safely dispose of hazardous materials
(6) The student describes the importance of maintenance. The student is expected to:	(A) perform maintenance on selected equipment	(i) perform maintenance on selected equipment
(6) The student describes the importance of maintenance. The student is expected to:	(B) analyze the results of improper maintenance	(ii) analyze the results of improper maintenance
(7) The student describes the factors that affect the evolution of technology. The student is expected to:	(A) analyze how changes in technology affect manufacturing practices	(i) analyze how changes in technology affect manufacturing practices
(7) The student describes the factors that affect the evolution of technology. The student is expected to:	(B) evaluate how the development of technology in manufacturing is influenced by past events	(i) evaluate how the development of technology in manufacturing is influenced by past events
(7) The student describes the factors that affect the evolution of technology. The student is expected to:	(C) analyze the international effects of technology	(i) analyze the international effects of technology
(7) The student describes the factors that affect the evolution of technology. The student is expected to:	(D) demonstrate how advancements in technology have affected the field of engineering	(i) demonstrate how advancements in technology have affected the field of engineering
(7) The student describes the factors that affect the evolution of technology. The student is expected to:	(E) evaluate the factors that affect the implementation of new ideas	(i) evaluate the factors that affect the implementation of new ideas

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student selects and reports on career opportunities, requirements, and expectations in manufacturing and technology. The student is expected to:	(A) investigate an area of interest in manufacturing	(i) investigate an area of interest in manufacturing
(8) The student selects and reports on career opportunities, requirements, and expectations in manufacturing and technology. The student is expected to:	(B) analyze the various specializations in manufacturing	(i) analyze the various specializations in manufacturing
(8) The student selects and reports on career opportunities, requirements, and expectations in manufacturing and technology. The student is expected to:	(C) describe the functions of engineers, technologists, and technicians	(i) describe the functions of engineers
(8) The student selects and reports on career opportunities, requirements, and expectations in manufacturing and technology. The student is expected to:	(C) describe the functions of engineers, technologists, and technicians	ii) describe the functions of technologists
(8) The student selects and reports on career opportunities, requirements, and expectations in manufacturing and technology. The student is expected to:	(C) describe the functions of engineers, technologists, and technicians	(iii) describe the functions of technicians

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.353 Diversified Manufacturing I (One Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: 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) In Diversified Manufacturing I, students gain knowledge and skills in the application, design, production, and assessment of products, services, and systems and how those knowledge and skills are applied to manufacturing. The study of manufacturing systems allows students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities, problems, and settings in a manufacturing setting. Diversified Manufacturing I allows students the opportunity to understand the process of mass production by using a wide variety of materials and manufacturing techniques. Knowledge about career opportunities, requirements, and expectations and the development of skills prepare students for workplace 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate the 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	(i) demonstrate the standards required in the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) use teamwork to solve problems	(i) use teamwork to solve problems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) identify employers' work expectations	(i) identify employers' work expectations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) use time-management techniques to develop work schedules	(i) use time-management techniques to develop work schedules

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(i) demonstrate effective oral communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(ii) demonstrate effective oral communication skills with individuals from varied cultures, including management
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iii) demonstrate effective oral communication skills with individuals from varied cultures, including customers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iv) demonstrate effective written communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(v) demonstrate effective written communication skills with individuals from varied cultures, including management
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(vi) demonstrate effective written communication skills with individuals from varied cultures, including customers

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(i) interpret engineering drawings
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(ii) interpret engineering charts
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iii) interpret engineering diagrams
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iv) interpret engineering welding symbols
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(i) select algebraic principles required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(ii) select algebraic formulas required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iii) select geometric principles required for precision measuring operations

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iv) select geometric formulas required for precision measuring operations
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(A) use tools and equipment commonly employed in manufacturing in a safe manner	(i) use tools commonly employed in manufacturing in a safe manner
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(A) use tools and equipment commonly employed in manufacturing in a safe manner	(ii) use equipment commonly employed in manufacturing in a safe manner
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(B) demonstrate an understanding of the safety regulations for the different types of manufacturing equipment such as cutting, abrasive, boring, turning, shaping, and forming tools	(i) demonstrate an understanding of the safety regulations for the different types of manufacturing equipment
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(C) execute procedures using the different types of manufacturing equipment such as cutting, abrasive, boring, turning, shaping, and forming tools	(i) execute procedures using the different types of manufacturing equipment
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(D) research the modern materials used in manufacturing	(i) research the modern materials used in manufacturing
(3) The student differentiates between the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(E) perform varied measurements, including precision measurements	(i) perform varied measurements, including precision measurements

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student investigates emerging and innovative applications of technology in engineering. The student is expected to:	(A) report on innovative applications of technology in engineering	(i) report on innovative applications of technology in engineering
(4) The student investigates emerging and innovative applications of technology in engineering. The student is expected to:	(B) experiment with new technologies	(i) experiment with new technologies
(4) The student investigates emerging and innovative applications of technology in engineering. The student is expected to:	(C) experiment with different manufacturing materials such as plastic, composites, fiberglass, stone, and wood	(i) experiment with different manufacturing materials
(5) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(A) analyze the processes needed to complete a project such as initiate, plan, execute, monitor and control, and close	(i) analyze the processes needed to complete a project
(5) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(B) use a variety of equipment and machines to produce an item to specification	(i) use a variety of equipment to produce an item to specification
(5) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(B) use a variety of equipment and machines to produce an item to specification	(ii) use a variety of machines to produce an item to specification

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student practices safe work habits. The student is expected to:	(A) master safety tests developed from Occupational Safety and Health Administration regulations	(i) master safety tests developed from Occupational Safety and Health Administration regulations
(6) The student practices safe work habits. The student is expected to:	(B) analyze hazardous materials	(i) analyze hazardous materials
(6) The student practices safe work habits. The student is expected to:	(C) dispose of hazardous materials safely	(i) dispose of hazardous materials safely
(6) The student practices safe work habits. The student is expected to:	(D) store all materials correctly	(i) store all materials correctly
(7) The student participates in a mass manufacturing project. The student is expected to:	(A) participate in the manufacturing of a mass produced project	(i) participate in the manufacturing of a mass produced project
(7) The student participates in a mass manufacturing project. The student is expected to:	(B) develop a method to check and maintain quality control throughout the manufacturing process	(i) develop a method to check quality control throughout the manufacturing process
(7) The student participates in a mass manufacturing project. The student is expected to:	(B) develop a method to check and maintain quality control throughout the manufacturing process	(ii) develop a method to maintain quality control throughout the manufacturing process
(8) The student identifies the factors that influence the cost of an item or service. The student is expected to:	(A) develop a budget for a project	(i) develop a budget for a project
(8) The student identifies the factors that influence the cost of an item or service. The student is expected to:	(B) determine the most effective strategies to minimize costs	(i) determine the most effective strategies to minimize costs

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student describes the relationship between manufacturing and marketing. The student is expected to:	(A) prepare a marketing plan for a product	(i) prepare a marketing plan for a product
(9) The student describes the relationship between manufacturing and marketing. The student is expected to:	(B) analyze the effect of customer satisfaction on the image of a product	(i) analyze the effect of customer satisfaction on the image of a product
(9) The student describes the relationship between manufacturing and marketing. The student is expected to:	(C) analyze how customer demands influence the design of an object	(i) analyze how customer demands influence the design of an object
(10) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(A) demonstrate communication techniques consistent with industry standards	(i) demonstrate communication techniques consistent with industry standards
(10) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(B) locate relevant information needed to solve problems	(i) locate relevant information needed to solve problems
(10) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(C) apply mathematics concepts to solve manufacturing problems	(i) apply mathematics concepts to solve manufacturing problems
(10) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(D) analyze science principles used to solve problems	(i) analyze science principles used to solve problems

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(E) use appropriate units of measure	(i) use appropriate units of measure

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.354. Diversified Manufacturing II (One Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Diversified Manufacturing I. Recommended prerequisite: 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) In Diversified Manufacturing II, students will gain knowledge and skills in the application, design, production, and assessment of products, services, and systems and how those knowledge and skills are applied to manufacturing. The study of manufacturing systems allows students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities, problems, and settings in a manufacturing setting. Diversified Manufacturing II allows students the opportunity to understand the process of mass production by using a wide variety of materials and manufacturing techniques. Knowledge about career opportunities, requirements, and expectations and the development of skills prepare students for workplace 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate the 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	(i) demonstrate the standards required in the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) use teamwork to solve problems	(i) use teamwork to solve problems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) identify employers' work expectations	(i) identify employers' work expectations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) use time-management techniques to develop work schedules	(i) use time-management techniques to develop work schedules

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) explore advanced knowledge and skills required for postsecondary education	(i) explore advanced knowledge required for postsecondary education
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) explore advanced knowledge and skills required for postsecondary education	(ii) explore advanced skills required for postsecondary education
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(i) demonstrate effective oral communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(ii) demonstrate effective written communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iii) demonstrate effective oral communication skills with individuals from varied cultures, including management

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iv) demonstrate effective written communication skills with individuals from varied cultures, including management
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(v) demonstrate effective oral communication skills with individuals from varied cultures, including customers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(vi) demonstrate effective written communication skills with individuals from varied cultures, including customers
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(i) interpret engineering drawings
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(ii) interpret charts
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iii) interpret diagrams

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iv) interpret welding symbols
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(i) select algebraic principles required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(ii) select geometric principles required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iii) select algebraic formulas required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iv) select geometric formulas required for precision measuring operations
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(D) develop the information needed to mass produce a simple project such as flow charts, schedules, equipment lists, and material lists	(i) develop the information needed to mass produce a simple project
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(E) explore the use of jigs and fixtures in mass production	(i) explore the use of jigs in mass production

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of manufacturing. The student is expected to:	(E) explore the use of jigs and fixtures in mass production	(ii) explore the use of fixtures in mass production
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(A) use tools and equipment commonly employed in manufacturing in a safe manner	(i) use tools commonly employed in manufacturing in a safe manner
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(A) use tools and equipment commonly employed in manufacturing in a safe manner	(ii) use equipment commonly employed in manufacturing in a safe manner
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(B) adhere to safety regulations for the different types of manufacturing equipment such as cutting, abrasive, boring, turning, shaping, and forming tools	(i) adhere to safety regulations for the different types of manufacturing equipment
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(C) execute procedures using the different types of manufacturing equipment such as cutting, abrasive, boring, turning, shaping, and forming tools	(i) execute procedures using the different types of manufacturing equipment
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(D) perform varied measurements, including precision measurements	(i) perform varied measurements, including precision measurements
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(E) design and develop the jigs and fixtures for a simple four (or fewer) part product	(i) design the jigs for a simple four (or fewer) part product

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(E) design and develop the jigs and fixtures for a simple four (or fewer) part product	(ii) develop the jigs for a simple four (or fewer) part product
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(E) design and develop the jigs and fixtures for a simple four (or fewer) part product	(iii) design the fixtures for a simple four (or fewer) part product
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(E) design and develop the jigs and fixtures for a simple four (or fewer) part product	(iv) develop the fixtures for a simple four (or fewer) part product
(3) The student differentiates among the technical concepts that form the knowledge and skills of manufacturing. The student is expected to:	(F) participate in the production run off of the product	(i) participate in the production run off of the product
(4) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(A) develop a CNC program using a computer-aided manufacturing (CAM) program	(i) develop a CNC program using a computer-aided manufacturing (CAM) program
(4) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(B) execute the CNC program to machine a product or run a simulation of the program	(i) execute the CNC program to machine a product or run a simulation of the program
(5) The student investigates emerging and innovative applications of technology in manufacturing. The student is expected to:	(A) research innovative technologies in manufacturing	(i) research innovative technologies in manufacturing

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student investigates emerging and innovative applications of technology in manufacturing. The student is expected to:	(B) experiment with different manufacturing materials such as plastic, composites, fiberglass, stone, and wood	(i) experiment with different manufacturing materials
(6) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(A) analyze engineering properties such as the processes needed to complete a project	(i) analyze engineering properties
(6) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(B) analyze the processes needed to complete a project such as initiate, plan, execute, monitor and control, and close	(i) analyze the processes needed to complete a project
(6) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(C) use a variety of tools and equipment to produce a product to specification	(i) use a variety of tools to produce a product to specification
(6) The student manufactures products or systems using the appropriate tools, equipment, machines, materials, and technical processes. The student is expected to:	(C) use a variety of tools and equipment to produce a product to specification	(ii) use a variety of equipment to produce a product to specification
(7) The student practices safe work habits. The student is expected to:	(A) master safety tests based on Occupational Safety and Health Administration regulations	(i) master safety tests based on Occupational Safety and Health Adminstation regulations

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student practices safe work habits. The student is expected to:	(B) analyze hazardous materials	(i) analyze hazardous materials
(7) The student practices safe work habits. The student is expected to:	(C) dispose of hazardous materials	(i) dispose of hazardous materials
(7) The student practices safe work habits. The student is expected to:	(D) store all materials safely	(i) store all materials safely
(8) The student participates in the manufacturing of a mass-produced product. The student is expected to:	(A) participate in the manufacturing of products	(i) participate in the manufacturing of products
(8) The student participates in the manufacturing of a mass-produced product. The student is expected to:	(B) develop a method to check and maintain quality control throughout the manufacturing process	(i) develop a method to check quality control throughout the manufacturing process
(8) The student participates in the manufacturing of a mass-produced product. The student is expected to:	(B) develop a method to check and maintain quality control throughout the manufacturing process	(ii) develop a method to maintain quality control throughout the manufacturing process
(9) The student identifies the factors that influence the cost of an item. The student is expected to:	(A) calculate costs associated with production of a mass-produced product	(i) calculate costs associated with production of a mass-produced product
(9) The student identifies the factors that influence the cost of an item. The student is expected to:	(B) re-examine the manufacturing process to maximize efficiency and minimize costs without compromising the integrity and marketability of the product	(i) re-examine the manufacturing process to maximize efficiency without compromising the integrity of the product

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student identifies the factors that influence the cost of an item. The student is expected to:	(B) re-examine the manufacturing process to maximize efficiency and minimize costs without compromising the integrity and marketability of the product	(ii) re-examine the manufacturing process to minimize costs without compromising the integrity of the product
(9) The student identifies the factors that influence the cost of an item. The student is expected to:	(B) re-examine the manufacturing process to maximize efficiency and minimize costs without compromising the integrity and marketability of the product	(iii) re-examine the manufacturing process to maximize efficiency without compromising the marketability of the product
(9) The student identifies the factors that influence the cost of an item. The student is expected to:	(B) re-examine the manufacturing process to maximize efficiency and minimize costs without compromising the integrity and marketability of the product	(iv) re-examine the manufacturing process to minimize costs without compromising the marketability of the product
(10) The student describes the relationship between manufacturing and marketing. The student is expected to:	(A) prepare a marketing plan for a product	(i) prepare a marketing plan for a product
(10) The student describes the relationship between manufacturing and marketing. The student is expected to:	(B) analyze the effect of customer satisfaction on the image of a product	(i) analyze the effect of customer satisfaction on the image of a product
(10) The student describes the relationship between manufacturing and marketing. The student is expected to:	(C) analyze how customer demands influence the design of an object	(i) analyze how customer demands influence the design of an object

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(A) demonstrate communication techniques consistent with industry standards	(i) demonstrate communication techniques consistent with industry standards
(11) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(B) locate relevant information needed to solve problems	(i) locate relevant information needed to solve problems
(11) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(C) apply mathematics concepts to solve manufacturing problems	(i) apply mathematics concepts to solve manufacturing problems
(11) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(D) analyze science principles used to solve problems	(i) analyze science principles used to solve problems
(11) The student applies communication, mathematics, and science knowledge and skills to manufacturing activities. The student is expected to:	(E) use appropriate units of measure	(i) use appropriate units of measure

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.355 Manufacturing Engineering Technology I (One Credit), Adopted 2015.**

(a) General Requirements.This course is recommended for students in Grades 10-12. Recommended prerequisite: 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) In Manufacturing Engineering Technology I, students will gain knowledge and skills in the application, design, production, and assessment of products, services, and systems and how those knowledge and skills are applied to manufacturing. Students will prepare for success in the global economy. The study of manufacturing engineering will allow students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities, problems, and settings in a manufacturing setting.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) describe how teams function	(i) describe how teams function
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) explain employers' work expectations	(i) explain employers' work expectations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate knowledge of the concepts related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate knowledge of the concepts related to safety in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(iii) demonstrate knowledge of the skills related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate knowledge of the concepts and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(iv) demonstrate knowledge of the skills related to safety in the workplace as specified by appropriate governmental regulations
(2) The student applies software skills to manufacturing. The student is expected to:	(A) use computer-aided design (CAD) software to complete a design	(i) use computer-aided design (CAD) software to complete a design

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies software skills to manufacturing. The student is expected to:	(B) analyze the results of product testing in a simulated modeling environment	(i) analyze the results of product testing in a simulated modeling environment
(2) The student applies software skills to manufacturing. The student is expected to:	(C) fabricate a prototype design of a mechanical part	(i) fabricate a prototype design of a mechanical part
(3) The student gains skills in writing programmable logic controls so that a robot can work in coordination with a machine. The student is expected to:	(A) use computer-integrated manufacturing techniques to simulate a manufacturing process	(i) use computer-integrated manufacturing techniques to simulate a manufacturing process
(3) The student gains skills in writing programmable logic controls so that a robot can work in coordination with a machine. The student is expected to:	(B) troubleshoot programmable logic circuit devices	(i) troubleshoot programmable logic circuit devices
(4) The student performs functions and solves problems in the electricity and electronics field. The student is expected to:	(A) research the use of control devices	(i) research the use of control devices
(4) The student performs functions and solves problems in the electricity and electronics field. The student is expected to:	(B) demonstrate the use of control devices	(i) demonstrate the use of control devices
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(A) design a product using a computer-aided manufacturing (CAM) software for production on a CNC lathe	(i) design a product using a computer-aided manufacturing (CAM) software for production on a CNC lathe

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(B) produce a product on the CNC lathe or a simulation	(i) produce a product on the CNC lathe or a simulation
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(C) design a product using a CAM software for production on a CNC mill	(i) design a product using a CAM software for production on a CNC mill
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(D) produce a product on the CNC mill or a simulation	(i) produce a product on the CNC mill or a simulation
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(E) complete data sheets for plan, do, check, and act forms and projects	(i) complete data sheets for plan, do, check and act forms
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(E) complete data sheets for plan, do, check, and act forms and projects	(ii) complete data sheets for plan, do, check and act projects
(6) The student knows mechanical and fluid systems. The student is expected to:	(A) identify, describe, and demonstrate the use of mechanical devices	(i) identify the use of mechanical devices
(6) The student knows mechanical and fluid systems. The student is expected to:	(A) identify, describe, and demonstrate the use of mechanical devices	(ii) describe the use of mechanical devices

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student knows mechanical and fluid systems. The student is expected to:	(A) identify, describe, and demonstrate the use of mechanical devices	(iii) demonstrate the use of mechanical devices
(6) The student knows mechanical and fluid systems. The student is expected to:	(B) identify, describe, and demonstrate the use of fluid devices	(i) identify the use of fluid devices
(6) The student knows mechanical and fluid systems. The student is expected to:	(B) identify, describe, and demonstrate the use of fluid devices	(ii) describe the use of fluid devices
(6) The student knows mechanical and fluid systems. The student is expected to:	(B) identify, describe, and demonstrate the use of fluid devices	(iii) demonstrate the use of fluid devices
(7) The student knows electrical and thermal systems. The student is expected to:	(A) identify and describe electrical devices	(i) identify electrical devices
(7) The student knows electrical and thermal systems. The student is expected to:	(A) identify and describe electrical devices	(ii) describe electrical devices
(7) The student knows electrical and thermal systems. The student is expected to:	(B) demonstrate the use of electrical devices	(i) demonstrate the use of electrical devices
(7) The student knows electrical and thermal systems. The student is expected to:	(C) research the effects of heat energy and temperature on products	(i) research the effects of heat energy on products
(7) The student knows electrical and thermal systems. The student is expected to:	(C) research the effects of heat energy and temperature on products	(ii) research the effects of temperature on products

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student understands quality-control systems. The student is expected to:	(A) research and recognize industrial standards such as International Standards Organization and Military Specifications	(i) research industrial standards
(8) The student understands quality-control systems. The student is expected to:	(A) research and recognize industrial standards such as International Standards Organization and Military Specifications	(ii) recognize industrial standards
(8) The student understands quality-control systems. The student is expected to:	(B) explain attribute and Pareto charts	(i) explain attribute charts
(8) The student understands quality-control systems. The student is expected to:	(B) explain attribute and Pareto charts	(ii) explain Pareto charts
(8) The student understands quality-control systems. The student is expected to:	(C) apply statistical process control	(i) apply statistical process control

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.356 Manufacturing Engineering Technology II (One Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Manufacturing Engineering Technology I. Recommended prerequisite: Algebra II, Computer Science I, or Physics. This course satisfies a high school mathematics graduation requirement. 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) In Manufacturing Engineering Technology II, students will gain knowledge and skills in the application, design, production, and assessment of products, services, and systems and how those knowledge and skills are applied to manufacturing. The study of Manufacturing Engineering Technology II will allow students to reinforce, apply, and transfer academic knowledge and skills to a variety of interesting and relevant activities, problems, and settings.
(4) The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, paper and pencil, and technology and techniques such as mental math, estimation, and number sense to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.
(5) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
(6) 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) use teamwork to solve problems	(i) use teamwork to solve problems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate a work ethic that meets common employers' expectations	(i) demonstrate a work ethic that meets common employers' expectations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) use time-management techniques to develop work schedules	(i) use time-management techniques to develop work schedules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) describe how teams measure results	(i) describe how teams measure results
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) demonstrate the skills 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	(i) demonstrate the skills required in the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) apply skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) apply skills related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) apply skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) apply skills related to safety in the workplace as specified by appropriate governmental regulations
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(A) apply mathematics to problems arising in everyday life, society, and the workplace	(i) apply mathematics to problems arising in everyday life
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(A) apply mathematics to problems arising in everyday life, society, and the workplace	(ii) apply mathematics to problems arising in society
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(A) apply mathematics to problems arising in everyday life, society, and the workplace	(iii) apply mathematics to problems arising in the workplace
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution	(i) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution	(ii) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the reasonableness of the solution
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(i) select tools, including real objects as appropriate to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(ii) select tools, including manipulatives as appropriate to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(iii) select tools, including paper and pencil as appropriate to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(iv) select tools, including technology as appropriate to solve problems

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(v) select techniques, including mental math as appropriate, to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(vi) select techiques, including estimation as appropriate, to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems	(vii) select techiques, including number sense as appropriate, to solve problems
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(i) communicate mathematical ideas using multiple representations, including symbols as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(ii) communicate mathematical ideas using multiple representations, including diagrams as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(iii) communicate mathematical ideas using multiple representations, including graphs as appropriate

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(iv) communicate mathematical ideas using multiple representations, including language as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(v) communicate mathematical reasoning using multiple representations, including symbols as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(vi) communicate mathematical reasoning using multiple representations, including diagrams as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(vii) communicate mathematical reasoning using multiple representations, including graphs as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(viii) communicate mathematical reasoning using multiple representations, including language as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(ix) communicate [the] implications [of mathematical ideas] using multiple representations, including symbols as appropriate

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(x) communicate [the] implications [of mathematical ideas] using multiple representations, including diagrams as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xi) communicate [the] implications [of mathematical ideas] using multiple representations, including graphs as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xii) communicate [the] implications [of mathematical ideas] using multiple representations, including language as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xiii) communicate [the] implications [of mathematical reasoning] using multiple representations, including symbols as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xiv) communicate [the] implications [of mathematical reasoning] using multiple representations, including diagrams as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xv) communicate [the] implications [of mathematical reasoning] using multiple representations, including graphs as appropriate

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate	(xvi) communicate [the] implications [of mathematical reasoning] using multiple representations, including language as appropriate
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(i) create representations to organize mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(ii) create representations to record mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(iii) create representations to communicate mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(iv) use representations to organize mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(v) use representations to record mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(E) create and use representations to organize, record, and communicate mathematical ideas	(vi) use representations to communicate mathematical ideas

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(F) analyze mathematical relationships to connect and communicate mathematical ideas	(i) analyze mathematical relationships to connect mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(F) analyze mathematical relationships to connect and communicate mathematical ideas	(ii) analyze mathematical relationships to communicate mathematical ideas
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(i) display mathematical ideas using precise mathematical language in written or oral communication
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(ii) display mathematical arguments using precise mathematical language in written or oral communication
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(iii) explain mathematical ideas using precise mathematical language in written or oral communication
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(iv) explain mathematical arguments using precise mathematical language in written or oral communication
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(v) justify mathematical ideas using precise mathematical language in written or oral communication

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:	(G) display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication	(vi) justify mathematical arguments using precise mathematical language in written or oral communication
(3) The student applies design skills to manufacturing. The student is expected to:	(A) use computer-aided design (CAD) software to complete a design	(i) use computer-aided design (CAD) software to complete a design
(3) The student applies design skills to manufacturing. The student is expected to:	(B) analyze the results of product testing in a simulated modeling environment	(i) analyze the results of product testing in a simulated modeling environment
(3) The student applies design skills to manufacturing. The student is expected to:	(C) fabricate a prototype design of a mechanical part	(i) fabricate a prototype design of a mechanical part
(3) The student applies design skills to manufacturing. The student is expected to:	(D) use computer-integrated manufacturing techniques to simulate a manufacturing process	(i) use computer-integrated manufacturing techniques to simulate a manufacturing process
(4) The student performs functions and solves problems in the electricity and electronics field. The student is expected to:	(A) develop solutions to use control devices	(i) develop solutions to use control devices
(4) The student performs functions and solves problems in the electricity and electronics field. The student is expected to:	(B) troubleshoot control devices such as programmable logic circuit devices	(i) troubleshoot control devices
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(A) design a project using a computer-aided manufacturing (CAM) software for a CNC lathe	(i) design a project using a computer-aided manufacturing (CAM) software for a CNC lathe

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(B) produce a product on a CNC lathe or simulator	(i) produce a product on a CNC lathe or simulator
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(C) design a project using CAM software for a CNC mill	(i) design a project using CAM software for a CNC mill
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(D) produce a product on a CNC mill or simulator	(i) produce a product on a CNC mill or simulator
(5) The student learns skills in production and programming of computer numerical control (CNC) operations. The student is expected to:	(E) complete projects using a production cycle such as a Plan-Do-Check-Act cycle	(i) complete projects using a production cycle
(6) The student demonstrates an understanding of mechanical and fluid systems. The student is expected to:	(A) use mechanical devices	(i) use mechanical devices
(6) The student demonstrates an understanding of mechanical and fluid systems. The student is expected to:	(B) use pneumatics devices	(i) use pneumatics devices
(6) The student demonstrates an understanding of mechanical and fluid systems. The student is expected to:	(C) use hydraulics devices	(i) use hydraulics devices

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student demonstrates an understanding of electrical and thermal systems. The student is expected to:	(A) use electrical controls	(i) use electrical controls
(7) The student demonstrates an understanding of electrical and thermal systems. The student is expected to:	(B) analyze the effects of heat energy and temperature on products	(i) analyze the effects of heat energy on products
(7) The student demonstrates an understanding of electrical and thermal systems. The student is expected to:	(B) analyze the effects of heat energy and temperature on products	(ii) analyze the effects of temperature on products
(7) The student demonstrates an understanding of electrical and thermal systems. The student is expected to:	(C) develop an understanding of ventilation such as heating, air conditioning, and refrigeration	(i) develop an understanding of ventilation
(8) The student analyzes quality-control systems. The student is expected to:	(A) apply statistical process control	(i) apply statistical process control
(8) The student analyzes quality-control systems. The student is expected to:	(B) determine hardness values of different materials	(i) determine hardness values of different materials
(8) The student analyzes quality-control systems. The student is expected to:	(C) analyze attribute and Pareto charts	(i) analyze attribute charts
(8) The student analyzes quality-control systems. The student is expected to:	(C) analyze attribute and Pareto charts	(ii) analyze Pareto charts

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student develops a system using electrical controls and pneumatics or hydraulics devices. The student is expected to:	(A) design a system that incorporates electrical controls and either a pneumatic or hydraulic device	(i) design a system that incorporates electrical controls and either a pneumatic or hydraulic device
(9) The student develops a system using electrical controls and pneumatics or hydraulics devices. The student is expected to:	(B) build a system that incorporates electrical controls and either a pneumatic or hydraulic device	(i) build a system that incorporates electrical controls and either a pneumatic or hydraulic device
(9) The student develops a system using electrical controls and pneumatics or hydraulics devices. The student is expected to:	(C) test and troubleshoot the system that incorporates electrical controls and either a pneumatic or hydraulic device	(i) test the system that incorporates electrical controls and either a pneumatic or hydraulic device
(9) The student develops a system using electrical controls and pneumatics or hydraulics devices. The student is expected to:	(C) test and troubleshoot the system that incorporates electrical controls and either a pneumatic or hydraulic device	(ii) troubleshoot the system that incorporates electrical controls and either a pneumatic or hydraulic device

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.357. Metal Fabrication and Machining I (Two Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: 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) Metal Fabrication and Machining I provides the knowledge, skills, and certifications required for equal employment opportunities in the metal production industry. Students must 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) use teamwork to solve problems	(i) use teamwork to solve problems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate the standards required in the workplace such as interviewing skills, flexibility, willingness to learn new skills and acquire knowledge, self-discipline, positive attitude, and integrity in a work situation	(i) demonstrate the standards required in the workplace
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(i) demonstrate effective oral and communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(ii) demonstrate effective oral and communication skills with individuals from varied cultures, including management

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iii) demonstrate effective oral and communication skills with individuals from varied cultures, including customers
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(iv) demonstrate effective written communication skills with individuals from varied cultures, including fellow workers
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(v) demonstrate effective written communication skills with individuals from varied cultures, including management
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(A) demonstrate effective oral and written communication skills with individuals from varied cultures, including fellow workers, management, and customers	(vi) demonstrate effective written communication skills with individuals from varied cultures, including customers
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(i) interpret engineering drawings
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(ii) interpret engineering charts

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iii) interpret engineering diagrams
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(B) interpret engineering drawings, charts, diagrams, and welding symbols	(iv) interpret engineering welding symbols
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(i) select algebraic principles required for precision measuring operations
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations.	(ii) select algebraic formulas required for precision measuring operations
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iii) select geometric principles required for precision measuring operations
(2) The student applies academic skills to the requirements of metal manufacturing. The student is expected to:	(C) select algebraic and geometric principles and formulas required for precision measuring operations	(iv) select geometric formulas required for precision measuring operations

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(A) analyze the resources found in *The Machinery's Handbook* as well as the specifications and codes written by the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API)	(i) analyze the resources found in *The Machinery's Handbook*
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(A) analyze the resources found in *The Machinery's Handbook* as well as the specifications and codes written by the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API)	(ii) analyze the specifications and codes written by the American Welding Society (AWS)
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(A) analyze the resources found in *The Machinery's Handbook* as well as the specifications and codes written by the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API)	(iii) analyze the specifications and codes written by Canadian Welding Bureau (CWB)
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(A) analyze the resources found in *The Machinery's Handbook* as well as the specifications and codes written by the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API)	(iv) analyze the specifications and codes written by the American National Standards Institute (ANSI)

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(A) analyze the resources found in *The Machinery's Handbook* as well as the specifications and codes written by the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API)	(v) analyze the specifications and codes written by the American Petroleum Institute (API)
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(B) examine the theory of shielded metal arc welding and gas metal arc welding	(i) examine the theory of shielded metal arc welding
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(B) examine the theory of shielded metal arc welding and gas metal arc welding	(ii) examine the theory of gas metal arc welding
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(C) examine the sheet metal industry	(i) examine the sheet metal industry
(3) The student differentiates the technical concepts that form the knowledge and skills of metal manufacturing. The student is expected to:	(D) examine the nomenclature of abrasive wheels	(i) examine the nomenclature of abrasive wheels
(4) The student differentiates the function and application of the tools, equipment, technologies, and materials used in metal manufacturing. The student is expected to:	(A) use hand and power tools and equipment commonly employed in metal manufacturing	(i) use hand tools commonly employed in metal manufacturing

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student differentiates the function and application of the tools, equipment, technologies, and materials used in metal manufacturing. The student is expected to:	(A) use hand and power tools and equipment commonly employed in metal manufacturing	(ii) use power tools commonly employed in metal manufacturing
(4) The student differentiates the function and application of the tools, equipment, technologies, and materials used in metal manufacturing. The student is expected to:	(A) use hand and power tools and equipment commonly employed in metal manufacturing	(iii) use equipment commonly employed in metal manufacturing
(4) The student differentiates the function and application of the tools, equipment, technologies, and materials used in metal manufacturing. The student is expected to:	(B) dispose of environmentally hazardous materials used in metal manufacturing	(i) dispose of environmentally hazardous materials used in metal manufacturing
(5) The student applies the technical concepts and skills of the machining industry to simulated and actual work situations. The student is expected to:	(A) use various work mounting procedures on all appropriate machines	(i) use various work mounting procedures on all appropriate machines
(5) The student applies the technical concepts and skills of the machining industry to simulated and actual work situations. The student is expected to:	(B) operate machine tools such as drill press, lathe, saw, grinders, and milling machines	(i) operate machine tools
(5) The student applies the technical concepts and skills of the machining industry to simulated and actual work situations. The student is expected to:	(C) execute lathe procedures such as cutting threads, turning tapers, drilling, reaming, polishing, knurling, and boring	(i) execute lathe procedures
(5) The student applies the technical concepts and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) execute milling procedures such as milling flat surfaces, bevels, chamfers, grooves, and key-way seats needed to machine precision pieces	(i) execute milling procedures

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(A) perform cutting processes such as straight cuts, bevel cuts, and hole piercing with oxy-fuel and plasma	(i) perform cutting processes with oxy-fuel
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(A) perform cutting processes such as straight cuts, bevel cuts, and hole piercing with oxy-fuel and plasma	(ii) perform cutting processes with plasma
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(B) use the common types of electrodes with the shield metal arc welding process	(i) use the common types of electrodes with the shield metal arc welding process
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) practice using gas metal arc welding to weld in multiple positions to produce groove and fillet welds	(i) practice using gas metal arc welding to weld in multiple positions to produce groove welds
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) practice using gas metal arc welding to weld in multiple positions to produce groove and fillet welds	(ii) practice using gas metal arc welding to weld in multiple positions to produce fillet welds
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(i) inspect groove welds to AWS codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(ii) inspect groove welds to CWB codes

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(iii) inspect groove welds to ANSI codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(iv) inspect groove welds to API codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(v) inspect fillet welds to AWS codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(vi) inspect fillet welds to CWB codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(vii) inspect fillet welds to ANSI codes
(6) The student applies the technical concepts and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect groove and fillet welds to AWS, CWB, ANSI, and API codes	(viii) inspect fillet welds to API codes
(7) The student applies the technical concepts and skills of the sheet metal industry to simulate actual work situations. The student is expected to:	(A) use mathematics in precision measuring operations	(i) use mathematics in precision measuring operations

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student applies the technical concepts and skills of the sheet metal industry to simulate actual work situations. The student is expected to:	(B) interpret engineering drawings, charts, and diagrams as related to the sheet metal industry	(i) interpret engineering drawings as related to the sheet metal industry
(7) The student applies the technical concepts and skills of the sheet metal industry to simulate actual work situations. The student is expected to:	(B) interpret engineering drawings, charts, and diagrams as related to the sheet metal industry	(ii) interpret charts as related to the sheet metal industry
(7) The student applies the technical concepts and skills of the sheet metal industry to simulate actual work situations. The student is expected to:	(B) interpret engineering drawings, charts, and diagrams as related to the sheet metal industry	(iii) interpret diagrams as related to the sheet metal industry
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(A) analyze the types, sizes, and properties of sheet metal materials	(i) analyze the types of sheet metal materials
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(A) analyze the types, sizes, and properties of sheet metal materials	(ii) analyze the sizes of sheet metal materials
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(A) analyze the types, sizes, and properties of sheet metal materials	(iii) analyze the properties of sheet metal materials
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(B) analyze the fundamentals of oxy-fuel processes as related to sheet metal	(i) analyze the fundamentals of oxy-fuel processes as related to sheet metal

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(C) analyze the fundamentals of shielded metal arc welding and gas metal arc welding as related to sheet metal under various AWS codes	(i) analyze the fundamentals of shielded metal arc welding as related to sheet metal under various AWS codes
(8) The student differentiates the concepts that form the technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(C) analyze the fundamentals of shielded metal arc welding and gas metal arc welding as related to sheet metal under various AWS codes	(ii) analyze the fundamentals of gas metal arc welding as related to sheet metal under various AWS codes
(9) The student understands the function and application of the tools, equipment, technologies, and materials used in sheet metal manufacturing. The student is expected to:	(A) practice safe use of equipment	(i) practice safe use of equipment
(9) The student understands the function and application of the tools, equipment, technologies, and materials used in sheet metal manufacturing. The student is expected to:	(B) dispose of hazardous materials used in sheet metal manufacturing	(i) dispose of hazardous materials used in sheet metal manufacturing
(10) The student applies the knowledge and skills of sheet metal manufacturing in simulated and actual work situations. The student is expected to:	(A) draw simple metal layouts	(i) draw simple metal layouts
(10) The student applies the knowledge and skills of sheet metal manufacturing in simulated and actual work situations. The student is expected to:	(B) construct common sheet metal seams	(i) construct common sheet metal seams

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.358. Metal Fabrication and Machining II (Two Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Metal Fabrication and Machining I. Recommended prerequisites: Geometry and Algebra II. 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) Metal Fabrication and Machining II builds on the knowledge, skills, and certifications students acquire in Metal Fabrication and Machining I. Students will develop advanced concepts and skills as related to personal and career development. This course integrates 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) determine advanced knowledge and skills required to gain industry-recognized certifications	(i) determine advanced knowledge required to gain industry-recognized certifications
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) determine advanced knowledge and skills required to gain industry-recognized certifications	(ii) determine advanced skills required to gain industry-recognized certifications
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) identify employers' work expectations	(i) identify employers' work expectations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate the standards required in the workplace such as interviewing skills, flexibility, willingness to learn new skills and acquire knowledge, self-discipline, positive attitude, promptness, attendance, and integrity in a work situation	(i) demonstrate the standards required in the workplace
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) evaluate personal career goals	(i) evaluate personal career goals
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by the Occupational Safety and Health Administration and other appropriate agencies	(i) demonstrate skills related to health in the workplace as specified by the Occupational Safety and Health Administration
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by the Occupational Safety and Health Administration and other appropriate agencies	(ii) demonstrate skills related to health in the workplace as specified by other appropriate agencies
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by the Occupational Safety and Health Administration and other appropriate agencies	(iii) demonstrate skills related to safety in the workplace as specified by the Occupational Safety and Health Administration
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by the Occupational Safety and Health Administration and other appropriate agencies	(iv) demonstrate skills related to safety in the workplace as specified by other appropriate agencies
(2) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:	(A) use teamwork to solve problems	(i) use teamwork to solve problems
(2) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:	(B) distinguish among team roles such as team leaders and team members	(i) distinguish among team roles
(2) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:	(C) discuss Equal Employment Opportunity law in the workplace	(i) discuss Equal Employment Opportunity law in the workplace

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student describes the importance of teamwork, leadership, integrity, honesty, work habits, and organizational skills. The student is expected to:	(D) use time-management techniques to develop work schedules	(i) use time-management techniques to develop work schedules
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(A) demonstrate effective communication skills with individuals from varied cultures such as fellow workers, management, and customers	(i) demonstrate effective communication skills with individuals from varied cultures
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(B) successfully complete work orders	(i) successfully complete work orders
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(C) estimate labor costs using various algebraic formulas	(i) estimate labor costs using various algebraic formulas
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(D) interpret advanced engineering drawings, charts, diagrams, and welding symbols	(i) interpret advanced engineering drawings
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(D) interpret advanced engineering drawings, charts, diagrams, and welding symbols	(ii) interpret advanced charts
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(D) interpret advanced engineering drawings, charts, diagrams, and welding symbols	(iii) interpret advanced diagrams

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(D) interpret advanced engineering drawings, charts, diagrams, and welding symbols	(iv) interpret advanced welding symbols
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(E) demonstrate calculation of precision measuring operations using algebra, geometry, and trigonometry	(i) demonstrate calculation of precision measuring operations using algebra
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(E) demonstrate calculation of precision measuring operations using algebra, geometry, and trigonometry	(ii) demonstrate calculation of precision measuring operations using geometry
(3) The student applies advanced academic skills to the requirements of metal fabrication and machining. The student is expected to:	(E) demonstrate calculation of precision measuring operations using algebra, geometry, and trigonometry	(iii) demonstrate calculation of precision measuring operations using trigonometry
(4) The student knows the advanced concepts that form the technical knowledge and skills of metal fabrication and machining. The student is expected to:	(A) analyze the resources found in various manufacturing reference materials	(i) analyze the resources found in various manufacturing reference materials
(4) The student knows the advanced concepts that form the technical knowledge and skills of metal fabrication and machining. The student is expected to:	(B) demonstrate knowledge of the various welding processes	(i) demonstrate knowledge of the various welding processes

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student knows the advanced concepts that form the technical knowledge and skills of metal fabrication and machining. The student is expected to:	(C) examine the sheet metal industry	(i) examine the sheet metal industry
(4) The student knows the advanced concepts that form the technical knowledge and skills of metal fabrication and machining. The student is expected to:	(D) examine the advanced use of abrasives	(i) examine the advanced use of abrasives
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(A) operate various welding machines, cutting equipment, and grinding equipment commonly employed in metal fabrication	(i) operate various welding machines commonly employed in metal fabrication
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(A) operate various welding machines, cutting equipment, and grinding equipment commonly employed in metal fabrication	(ii) operate various cutting equipment commonly employed in metal fabrication
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(A) operate various welding machines, cutting equipment, and grinding equipment commonly employed in metal fabrication	(iii) operate various grinding equipment commonly employed in metal fabrication
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(B) demonstrate knowledge of computer numerical control (CNC) machines	(i) demonstrate knowledge of computer numerical control (CNC) machines

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(C) demonstrate knowledge of the concepts of automated welding machines	(i) demonstrate knowledge of the concepts of automated welding machines
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(D) demonstrate knowledge of emerging technologies that may affect metal manufacturing	(i) demonstrate knowledge of emerging technologies that may affect metal manufacturing
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(E) dispose of environmentally hazardous materials associated with and used in metal fabrication manufacturing	(i) dispose of environmentally hazardous materials associated with metal fabrication manufacturing
(5) The student knows the function and application of the tools, equipment, technologies, and materials used in metal fabrication and machining. The student is expected to:	(E) dispose of environmentally hazardous materials associated with and used in metal fabrication manufacturing	(ii) dispose of environmentally hazardous materials used in metal fabrication manufacturing
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(A) use various work mounting procedures on appropriate machines	(i) use various work mounting procedures on appropriate machines
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(B) examine the cutting operations such as drill press, lathe, saw, grinders, and milling machines	(i) examine the cutting operations

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(C) execute lathe procedures such as cut threads, turn tapers, drills, reams, polishes, knurls, and bores	(i) execute lathe procedures
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) mill flat surfaces, bevels, chamfers, grooves, and key-seats	(i) mill flat surfaces
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) mill flat surfaces, bevels, chamfers, grooves, and key-seats	(ii) mill bevels
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) mill flat surfaces, bevels, chamfers, grooves, and key-seats	(iii) mill chamfers
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) mill flat surfaces, bevels, chamfers, grooves, and key-seats	(iv) mill grooves
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(D) mill flat surfaces, bevels, chamfers, grooves, and key-seats	(v) mill key-seats

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student applies the advanced concepts and technical knowledge and skills of the machining industry to simulated and actual work situations. The student is expected to:	(E) machine precision pieces	(i) machine precision pieces
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(A) demonstrate cutting processes such as oxy-fuel and plasma	(i) demonstrate cutting processes
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(B) demonstrate the use of the common types of electrodes using the shielded metal arc welding process	(i) demonstrate the use of the common types of electrodes using the shielded metal arc welding process
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(i) use shielded metal arc welding to weld fillet welds using various positions
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(ii) use shielded metal arc welding to weld groove welds using various positions
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(iii) use gas metal arc welding to weld fillet welds using various positions

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(iv) use gas metal arc welding to weld groove welds using various positions
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(v) use gas tungsten arc welding to weld fillet welds using various positions
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(C) use shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding to weld fillet and groove welds using various positions	(vi) use gas tungsten arc welding to weld groove welds using various positions
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect welds to the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API) codes	(i) inspect welds to the American Welding Society (AWS), Canadian Welding Bureau (CWB) codes
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect welds to the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API) codes	(ii) inspect welds to the American National Standards Institute (ANSI) codes
(7) The student applies the advanced concepts and technical knowledge and skills of the welding industry to simulated and actual work situations. The student is expected to:	(D) inspect welds to the American Welding Society (AWS), Canadian Welding Bureau (CWB), American National Standards Institute (ANSI), and American Petroleum Institute (API) codes	(iii) inspect welds to the American Petroleum Institute (API) codes

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(A) estimate labor costs	(i) estimate labor costs
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(B) use advanced mathematics in precision measuring operations	(i) use advanced mathematics in precision measuring operations
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(C) interpret industrial standard blueprints, drawings, charts, and diagrams	(i) interpret industrial standard blueprints
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(C) interpret industrial standard blueprints, drawings, charts, and diagrams	(ii) interpret industrial standard drawings
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(C) interpret industrial standard blueprints, drawings, charts, and diagrams	(iii) interpret industrial standard charts
(8) The student applies the advanced concepts and technical knowledge and skills of the sheet metal industry to simulated and actual work situations. The student is expected to:	(C) interpret industrial standard blueprints, drawings, charts, and diagrams	(iv) interpret industrial standard diagrams

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(A) analyze properties of sheet metal materials and fasteners	(i) analyze properties of sheet metal materials
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(A) analyze properties of sheet metal materials and fasteners	(ii) analyze properties of sheet metal fasteners
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(B) analyze oxy-fuel processes as related to sheet metal	(i) analyze oxy-fuel processes as related to sheet metal
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(C) demonstrate knowledge of shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding as related to sheet metal under AWS code	(i) demonstrate knowledge of shielded metal arc welding as related to sheet metal under AWS code
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(C) demonstrate knowledge of shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding as related to sheet metal under AWS code	(ii) demonstrate knowledge of gas metal arc welding as related to sheet metal under AWS code
(9) The student knows the advanced concepts and technical knowledge and skills of sheet metal manufacturing. The student is expected to:	(C) demonstrate knowledge of shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding as related to sheet metal under AWS code	(iii) demonstrate knowledge of gas tungsten arc welding as related to sheet metal under AWS code
(10) The student knows the function and application of the tools, equipment, technologies, and materials used in sheet metal. The student is expected to:	(A) use equipment commonly employed in sheet metal safely	(i) use equipment commonly employed in sheet metal safely

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student knows the function and application of the tools, equipment, technologies, and materials used in sheet metal. The student is expected to:	(B) dispose of environmentally hazardous materials used in sheet metal manufacturing properly	(i) dispose of environmentally hazardous materials used in sheet metal manufacturing properly
(10) The student knows the function and application of the tools, equipment, technologies, and materials used in sheet metal. The student is expected to:	(C) demonstrate knowledge of emerging technologies that may affect sheet metal	(i) demonstrate knowledge of emerging technologies that may affect sheet metal
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(A) draw advanced sheet metal layouts	(i) draw advanced sheet metal layouts
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(B) construct sheet metal seams	(i) construct sheet metal seams
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(C) construct transitions and offsets	(i) construct transitions
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(C) construct transitions and offsets	(ii) construct offsets
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(D) use the gas tungsten arc welding process in sheet metal construction	(i) use the gas tungsten arc welding process in sheet metal construction

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(E) apply the principles of sheet metal construction to the fabrication of various sheet metal products	(i) apply the principles of sheet metal construction to the fabrication of various sheet metal products
(11) The student applies the advanced concepts and technical skills in simulated and actual work situations. The student is expected to:	(F) apply skills in sheet metal to career preparation learning experiences	(i) apply skills in sheet metal to career preparation learning experiences

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.359. Precision Metal Manufacturing I (Two Credits), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 10-12. Recommended prerequisite: Principles of Manufacturing and completion of or concurrent enrollment in 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) Precision Metal Manufacturing I will provide the knowledge, skills, and technologies required for employment in precision machining. While the course is designed to provide necessary skills in machining, it also provides a real-world foundation for any engineering discipline. This course may address a variety of materials such as plastics, ceramics, and wood in addition to metal. Students will develop knowledge of the concepts and skills related to precision metal manufacturing to apply them to personal and career development. This course supports integration of 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. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for success. This course is designed to provide entry-level employment for the student or articulated credit integration into a community college and dual credit with a community college with completion of the advanced course.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through written communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(i) choose the ethical course of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(ii) comply with all applicable rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(iii) comply with all applicable laws
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(iv) comply with all applicable regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work processes and end products	(i) review the fine, detailed aspects of quantitative work processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work processes and end products	(ii) review the fine, detailed aspects of qualitative work processes

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work processes and end products	(iii) review the fine, detailed aspects of end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) evaluate operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) identify causes, problems, patterns, or issues
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iv) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions including health and safety rules

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(i) prioritize tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(ii) follow schedules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(iii) work toward goal-relevant activities in an effective manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(iv) work toward goal-relevant activities in an efficient manner

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) determine academic knowledge required for postsecondary education
(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	(ii) determine academic skills required for postsecondary education
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(B) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(i) demonstrate the professional standards required in the workplace
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(D) evaluate personal career goals	(i) evaluate personal career goals
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental regulations
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(A) demonstrate technical writing skills related to writing requirements found in manufacturing	(i) demonstrate technical writing skills related to writing requirements found in manufacturing
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(B) demonstrate mathematical skills such as algebra, geometry, trigonometry, statics, and conversion as applied to machining	(i) demonstrate mathematical skills as applied to machining
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(C) interpret engineering drawings, including drawings using geometric dimensioning and tolerancing	(i) interpret engineering drawings, including drawings using geometric dimensioning and tolerancing
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(D) describe orthographic and isometric views of three-dimensional figures	(i) describe orthographic views of three-dimensional figures
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(D) describe orthographic and isometric views of three-dimensional figures	(ii) describe isometric views of three-dimensional figures

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(E) evaluate mathematics as it applies to precision machining operations	(i) evaluate mathematics as it applies to precision machining operations
(3) The student applies advanced academic skills to the requirements of precision metal manufacturing. The student is expected to:	(F) discuss basic concepts of physics as applied to machining	(i) discuss basic concepts of physics as applied to machining
(4) The student recognizes the concepts and skills that form the technical knowledge required in precision machining. The student is expected to:	(A) examine the resources found in recognized manufacturing reference materials such as *The Machinery's Handbook*	(i) examine the resources found in recognized manufacturing reference materials
(4) The student recognizes the concepts and skills that form the technical knowledge required in precision machining. The student is expected to:	(B) demonstrate knowledge of the uses of reference charts such as tap drill charts, drill size charts, and feed-speed charts	(i) demonstrate knowledge of the uses of reference charts
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(A) practice safety while running equipment commonly employed in machine shops	(i) practice safety while running equipment commonly employed in machine shops
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in machine shops	(i) identify environmentally hazardous materials used in machine shops

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in machine shops	(ii) properly dispose of environmentally hazardous materials used in machine shops
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(C) demonstrate knowledge of computer numerical control (CNC) operations	(i) demonstrate knowledge of computer numerical control (CNC) operations
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(D) demonstrate knowledge of emerging technologies that may affect the machine shop	(i) demonstrate knowledge of emerging technologies that may affect the machine shop
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(E) demonstrate knowledge of heating metals such as hardening, tempering, annealing, normalizing, and case hardening steel	(i) demonstrate knowledge of heating metals
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(F) apply technical knowledge and skills in a machine shop to career preparation experiences	(i) apply technical knowledge in a machine shop to career preparation experiences
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(F) apply technical knowledge and skills in a machine shop to career preparation experiences	(ii) apply technical skills in a machine shop to career preparation experiences

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(G) identify basic metallic and non-metallic materials	(i) identify basic metallic materials
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(G) identify basic metallic and non-metallic materials	(ii) identify basic non-metallic materials
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(H) compare various abrasives for type, structure, bond, and use	(i) compare various abrasives for type
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(H) compare various abrasives for type, structure, bond, and use	(ii) compare various abrasives for structure
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(H) compare various abrasives for type, structure, bond, and use	(iii) compare various abrasives for bond
(5) The student evaluates the function and application of the tools, equipment, technologies, and materials used in precision machining. The student is expected to:	(H) compare various abrasives for type, structure, bond, and use	(iv) compare various abrasives for use

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(A) use equipment commonly employed in bench work and layout in a safe manner	(i) use equipment commonly employed in bench work in a safe manner
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(A) use equipment commonly employed in bench work and layout in a safe manner	(ii) use equipment commonly employed in layout in a safe manner
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(B) develop the ability to use a file to cut flats, angles, and radiuses	(i) develop the ability to use a file to cut flats
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(B) develop the ability to use a file to cut flats, angles, and radiuses	(ii) develop the ability to use a file to cut angles
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(B) develop the ability to use a file to cut flats, angles, and radiuses	(iii) develop the ability to use a file to cut radiuses
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(C) employ standard layout tools to transfer a part design to the actual part	(i) employ standard layout tools to transfer a part design to the actual part
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(D) perform center punching and hand drilling of holes using an electric or air hand drill	(i) perform center punching and hand drilling of holes using an electric or air hand drill
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(E) perform hand tapping of holes	(i) perform hand tapping of holes
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(F) perform hand reaming of holes using an electric or air hand drill	(i) perform hand reaming of holes using an electric or air hand drill

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(G) develop a detailed layout part such as the National Institute for Metalworking Skills (NIMS) Level 1 layout part	(i) develop a detailed layout part
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(H) develop a detailed bench work part such as the NIMS Level 1 bench work part	(i) develop a detailed bench work part
(6) The student employs skills necessary to perform bench work and layout. The student is expected to:	(I) employ basic housekeeping skills as applied to a machine shop	(i) employ basic housekeeping skills as applied to a machine shop
(7) The student employs skills necessary to perform precision measurement. The student is expected to:	(A) use equipment commonly used during precision measurement in a safe manner	(i) use equipment commonly used during precision measurement in a safe manner
(7) The student employs skills necessary to perform precision measurement. The student is expected to:	(B) write an inspection plan	(i) write an inspection plan
(7) The student employs skills necessary to perform precision measurement. The student is expected to:	(C) identify and select the required measuring instrument(s) to conduct the required inspection procedure(s)	(i) identify the required measuring instrument(s) to conduct the required inspection procedure(s)
(7) The student employs skills necessary to perform precision measurement. The student is expected to:	(C) identify and select the required measuring instrument(s) to conduct the required inspection procedure(s)	(i) select the required measuring instrument(s) to conduct the required inspection procedure(s)
(7) The student employs skills necessary to perform precision measurement. The student is expected to:	(D) describe statistical process control	(i) describe statistical process control

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(A) use equipment such as accessories commonly implemented on and around a lathe in a safe manner.	(i) use equipment in a safe manner
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(B) analyze the advantages and disadvantages between a four-jaw independent chuck, a three-jaw universal chuck, and a collet workholding system	(i) analyze the advantages between a four-jaw independent chuck, a three-jaw universal chuck, and a collet workholding system
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(B) analyze the advantages and disadvantages between a four-jaw independent chuck, a three-jaw universal chuck, and a collet workholding system	(ii) analyze the disadvantages between a four-jaw independent chuck, a three-jaw universal chuck, and a collet workholding system
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(C) indicate a part in a four-jaw independent chuck within .003" total indicated runout (TIR) using a standard indicator	(i) indicate a part in a four-jaw independent chuck within .003" total indicated runout (TIR) using a standard indicator
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(D) identify and describe the function of the components of a lathe	(i) identify the function of the components of a lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(D) identify and describe the function of the components of a lathe	(i) describe the function of the components of a lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(E) identify and use most accessories and tooling for turning operations	(i) identify and use most accessories and tooling for turning operations

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(i) demonstrate the standard turning operations of boring on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(ii) demonstrate the standard turning operations of chamfering on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(iii) demonstrate the standard turning operations of cutting tapers on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(iv) demonstrate the standard turning operations of drilling on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(v) demonstrate the standard turning operations of facing on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(vi) demonstrate the standard turning operations of grooving on a manual lathe

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(vii) demonstrate the standard turning operations of knurling on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(viii) demonstrate the standard turning operations of polishing on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(ix) demonstrate the standard turning operations of threading on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(F) demonstrate the standard turning operations of boring, chamfering, cutting tapers, drilling, facing, grooving, knurling, polishing, threading, and turning on a manual lathe	(x) demonstrate the standard turning operations of turning on a manual lathe
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(G) write a detailed process plan for turning, including appropriate processes such as feeds, speeds, tool selection, and sequencing	(i) write a detailed process plan for turning, including appropriate processes
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(H) develop a detailed turning part such as the NIMS Level 1 turning, chucking or turning between centers part	(i) develop a detailed turning part between centers part

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student employs skills necessary to perform manual lathe work. The student is expected to:	(I) employ basic preventative maintenance on the lathe	(i) employ basic preventative maintenance on the lathe
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(A) use equipment commonly used with a milling machine in a safe manner	(i) use equipment commonly used with a milling machine in a safe manner
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(B) analyze the advantages and disadvantages of various work holding methods such as using a vise, clamping to a table, and clamping to an angle plate	(i) analyze the advantages of various work holding methods to an angle plate
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(B) analyze the advantages and disadvantages of various work holding methods such as using a vise, clamping to a table, and clamping to an angle plate	(ii) analyze the disadvantages of various work holding methods to an angle plate
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(C) contrast the various ancillary tools used on milling machines such as a rotary table, indexing head, and super spacer	(i) contrast the various ancillary tools used on milling machines
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(D) identify or describe the function of the components of a milling machine	(i) identify or describe the function of the components of a milling machine
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(E) tram in the head of a vertical milling machine	(i) tram in the head of a vertical milling machine
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(F) locate and set a work piece in a milling vise employing a dial indicator	(i) locate a work piece in a milling vise employing a dial indicator

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(F) locate and set a work piece in a milling vise employing a dial indicator	(ii) set a work piece in a milling vise employing a dial indicator
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(G) develop a square block in the milling machine to close tolerances	(i) develop a square block in the milling machine to close tolerances
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(H) demonstrate various hole-making activities such as spot drilling, drilling, reaming, tapping, countersinking, and boring on the milling machine	(i) demonstrate various hole-making activities on the milling machine
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(I) demonstrate various milling activities such as climb milling, conventional milling, slotting, grooving, cutting angles, and chamfering	(i) demonstrate various milling activities
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling	(i) write a detailed process plan, including appropriate feeds for milling
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling	(ii) write a detailed process plan, including appropriate speeds for milling
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling	(iii) write a detailed process plan, including appropriate tool selection for milling

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling	(iv) write a detailed process plan, including appropriate work holding methods for milling
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(J) write a detailed process plan, including appropriate feeds, speeds, tool selection, work holding methods, and sequencing for milling	(v) write a detailed process plan, including appropriate sequencing for milling
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(K) develop a detailed milling part such as the NIMS Level 1 milling part	(i) develop a detailed milling part
(9) The student employs skills necessary to perform manual milling work. The student is expected to:	(L) employ basic preventative maintenance on the milling machine	(i) employ basic preventative maintenance on the milling machine
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(A) use various support equipment commonly found in a machine shop in a safe manner	(i) use various support equipment commonly found in a machine shop in a safe manner
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(B) understand basic pedestal grinder functions such as wheel selection criteria and requirements	(i) understand basic pedestal grinder functions
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(C) understand basic sawing functions such as band type, speed, and feeds for various types of material	(i) understand basic sawing functions for various types of material

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(D) understand basic drill press operations, including work holding, appropriate speeds, and feeds	(i) understand basic drill press operations, including work holding
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(D) understand basic drill press operations, including work holding, appropriate speeds, and feeds	(ii) understand basic drill press operations, including appropriate speeds
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(D) understand basic drill press operations, including work holding, appropriate speeds, and feeds	(i) understand basic drill press operations, including feeds
(10) The student employs skills necessary to perform work on various support equipment commonly found in a machine shop. The student is expected to:	(E) use proper safety procedures for surface grinding operations	(i) use proper safety procedures for surface grinding operations

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.360. Precision Metal Manufacturing II (Two Credits), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grades 11 and 12. Prerequisite: Precision Metal Manufacturing I. Recommended corequisite: Precision Metal Manufacturing II Lab. 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) Precision Metal Manufacturing II will provide students the knowledge, skills, and technologies required for employment in precision machining. While this course is designed to provide necessary skills in machining, it also provides a real-world foundation for any engineering discipline. This course addresses a variety of materials such as plastics, ceramics, and wood in addition to metal. Students will develop knowledge of the concepts and skills related to these systems to apply them to personal and career development. This course supports integration of 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. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for success. This course is designed to provide entry-level employment for the student or articulated credit integration into a community college and dual credit with a community college with completion of the advanced course.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) comply with all applicable rules, laws, and regulations	(i) comply with all applicable rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) comply with all applicable rules, laws, and regulations	(ii) comply with all applicable laws
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) comply with all applicable rules, laws, and regulations	(i) comply with all applicable regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(i) review with a critical eye the fine, detailed aspects of [the] quantitative work processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(ii) review with a critical eye the fine, detailed aspects of [the] qualitative work processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(iii) review with a critical eye the fine, detailed aspects of end products

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) evaluate operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) identify causes, problems, patterns, or issues
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(vi) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices including health rules

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies including health rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures, including health rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(vi) adhere to established business practices including safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(vii) adhere to established business policies including safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(viii) adhere to established business procedures, including safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that uses time in an effective, efficient manner	(i) prioritize tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that uses time in an effective, efficient manner	(ii) follow schedules

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that uses time in an effective, efficient manner	(iii) tend to goal-relevant activities in a way that uses time in an effective manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and tend to goal-relevant activities in a way that uses time in an effective, efficient manner	(iv) tend to goal-relevant activities in a way that uses time in an efficient manner
(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	(i) determine academic knowledge and skills required for postsecondary education
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(B) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(C) demonstrate the 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	(i) demonstrate the standards required in the workplace
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(D) evaluate progress toward personal career goals	(i) evaluate progress toward personal career goals

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental regulations
(3) The student applies the technical knowledge and skills of advanced precision metal manufacturing. The student is expected to:	(A) apply the technical aspects found in *The Machinery's Handbook* resource	(i) apply the technical aspects found in *The Machinery's Handbook* resource
(3) The student applies the technical knowledge and skills of advanced precision metal manufacturing. The student is expected to:	(B) select appropriate resources from the Internet as applied to manufacturing.	(ii) select appropriate resources from the Internet as applied to manufacturing.
(4) The student builds on the manual machining skills gained in Precision Metal Manufacturing I. The student is expected to:	(A) develop a detailed turning part such as the National Institute for Metalworking Skills (NIMS) Level 1 turning, chucking, or turning between centers part with zero defects (100% to the print) in a safe manner	(i) develop a detailed turning part in a safe manner
(4) The student builds on the manual machining skills gained in Precision Metal Manufacturing I. The student is expected to:	(B) develop a detailed milling part such as the NIMS Level 1 milling part with zero defects (100% to the print) in a safe manner	(i) develop a detailed milling part in a safe manner

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student learns about standard computer numerical control (CNC) machinery. The student is expected to:	(A) research the history of numerical control machines	(i) research the history of numerical control machines
(5) The student learns about standard computer numerical control (CNC) machinery. The student is expected to:	(B) distinguish among different types of CNC machines used in the industry	(i) distinguish among different types of CNC machines used in the industry
(5) The student learns about standard computer numerical control (CNC) machinery. The student is expected to:	(C) demonstrate safety rules for CNC operation	(i) demonstrate safety rules for CNC operation
(5) The student learns about standard computer numerical control (CNC) machinery. The student is expected to:	(D) demonstrate the methods by which programs can be entered into a controller	(i) demonstrate the methods by which programs can be entered into a controller
(5) The student learns about standard computer numerical control (CNC) machinery. The student is expected to:	(E) use appropriate machining terminology to enhance CNC vocabulary	(i) use appropriate machining terminology to enhance CNC vocabulary
(6) The student appraises various CNC systems to differentiate the development and implementation of those systems. The student is expected to:	(A) examine the types of drive motors used on CNC machinery	(i) examine the types of drive motors used on CNC machinery
(6) The student appraises various CNC systems to differentiate the development and implementation of those systems. The student is expected to:	(B) explain the Cartesian coordinate system	(i) explain the Cartesian coordinate system

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student appraises various CNC systems to differentiate the development and implementation of those systems. The student is expected to:	(C) differentiate between absolute and incremental positioning	(i) differentiate between absolute and incremental positioning
(6) The student appraises various CNC systems to differentiate the development and implementation of those systems. The student is expected to:	(D) illustrate the difference between datum and delta dimensioning	(i) illustrate the difference between datum and delta dimensioning
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(i) develop a detailed process plan, including proper tool selection for the material being cut
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(ii) develop a detailed process plan, including proper tool selection for the finish specifications on the engineering drawing
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(iii) develop a detailed process plan, including proper tool selection for the logical sequence of operations

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(iv) develop a detailed process plan, including proper tool selection for the appropriate inspection points
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(v) develop a detailed process plan, including proper feeds for the material being cut
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(vi) develop a detailed process plan, including proper feeds for the finish specifications on the engineering drawing
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(vii) develop a detailed process plan, including proper feeds for the logical sequence of operations
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(viii) develop a detailed process plan, including proper feeds for the appropriate inspection points

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(ix) develop a detailed process plan, including proper speeds for the material being cut
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(x) develop a detailed process plan, including proper speeds for the finish specifications on the engineering drawing
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(xi) develop a detailed process plan, including proper speeds, for the logical sequence of operations
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(A) develop a detailed process plan, including proper tool selection, feeds, and speeds, for the material being cut and finish specifications on the engineering drawing, logical sequence of operations, and appropriate inspection points	(xii) develop a detailed process plan, including proper speeds, for the appropriate inspection points
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(B) develop a logical sequence of operations and appropriate inspection points	(i) develop a logical sequence of operations

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(B) develop a logical sequence of operations and appropriate inspection points	(ii) develop appropriate inspection points
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(C) demonstrate use of carbide inserts	(i) demonstrate use of carbide inserts
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(D) apply various carbide inserts by determining the correct type, grade, style, feed, and speed for the most common materials machined in a basic machine shop	(i) apply various carbide inserts by determining the correct type for the most common materials machined in a basic machine shop
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(D) apply various carbide inserts by determining the correct type, grade, style, feed, and speed for the most common materials machined in a basic machine shop	(ii) apply various carbide inserts by determining the correct grade for the most common materials machined in a basic machine shop
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(D) apply various carbide inserts by determining the correct type, grade, style, feed, and speed for the most common materials machined in a basic machine shop	(iii) apply various carbide inserts by determining the correct style for the most common materials machined in a basic machine shop
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(D) apply various carbide inserts by determining the correct type, grade, style, feed, and speed for the most common materials machined in a basic machine shop	(iv) apply various carbide inserts by determining the correct feed for the most common materials machined in a basic machine shop
(7) The student learns the process planning and tool selection within a CNC lab environment. The student is expected to:	(D) apply various carbide inserts by determining the correct type, grade, style, feed, and speed for the most common materials machined in a basic machine shop	(v) apply various carbide inserts by determining the correct speed for the most common materials machined in a basic machine shop

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(A) perform various types of tool changes	(i) perform various types of tool changes
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(B) demonstrate quick change tooling used on CNC milling machines	(i) demonstrate quick change tooling used on CNC milling machines
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(C) demonstrate appropriate tool storage	(i) demonstrate appropriate tool storage
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(D) demonstrate the proper use of tool offset registers	(i) demonstrate the proper use of tool offset registers
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(E) determine tool offset length	(i) determine tool offset length
(8) The student evaluates tool changing and tool offset registers in the CNC lab environment. The student is expected to:	(F) incorporate tool offsets for a set up	(i) incorporate tool offsets for a set up
(9) The student operates a CNC lathe. The student is expected to:	(A) use equipment commonly associated with a CNC lathe in a safe manner	(i) use equipment commonly associated with a CNC lathe in a safe manner

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(i) recognize the function of the primary components of a CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(ii) name the function of the primary components of a CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(iii) describe the function of the primary components of a CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(C) perform preventative maintenance checks on a CNC lathe such as checking all fluid levels, system pressure, tooling wear, and component lubrication and cleaning	(i) perform preventative maintenance checks on a CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(i) test the coolant for proper density
(9) The student operates a CNC lathe. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(ii) adjust accordingly in order to reach the correct mixture
(9) The student operates a CNC lathe. The student is expected to:	(E) perform a power up on a standard CNC lathe	(i) perform a power up on a standard CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(F) demonstrate the use of the jog controls on the operator panel to jog the lathe's axes	(i) demonstrate the use of the jog controls on the operator panel to jog the lathe's axes

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(i) demonstrate the ability to locate tooling according to work instructions
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(ii) demonstrate the ability to assemble tooling according to work instructions
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(iii) demonstrate the ability to measure tooling according to work instructions
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(iv) demonstrate the ability to locate tooling according to job documentation
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(v) demonstrate the ability to assemble tooling according to job documentation
(9) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(vi) demonstrate the ability to measure tooling according to job documentation
(9) The student operates a CNC lathe. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(i) install tools and tool holders in the automatic tool changer locations according to work instructions

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student operates a CNC lathe. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(ii) install tools and tool holders in the automatic tool changer locations according to job documentation
(9) The student operates a CNC lathe. The student is expected to:	(I) locate and set workpiece to zero on a CNC lathe	(i) locate and set workpiece to zero on a CNC lathe
(9) The student operates a CNC lathe. The student is expected to:	(J) set any required work offsets for the part to be machined after a basic tool setting process has been completed	(i) set any required work offsets for the part to be machined after a basic tool setting process has been completed
(9) The student operates a CNC lathe. The student is expected to:	(K) set the proper geometry/tool offsets for each tool in a standard tool setting process	(i) set the proper geometry/tool offsets for each tool in a standard tool setting process
(9) The student operates a CNC lathe. The student is expected to:	(L) operate a CNC lathe in automatic mode	(i) operate a CNC lathe in automatic mode
(9) The student operates a CNC lathe. The student is expected to:	(M) illustrate the proper power down process on a CNC lathe	(i) illustrate the proper power down process on a CNC lathe
(10) The student operates a CNC mill. The student is expected to:	(A) use equipment commonly found on and around a CNC mill in a safe manner	(i) use equipment commonly found on a CNC mill in a safe manner
(10) The student operates a CNC mill. The student is expected to:	(A) use equipment commonly found on and around a CNC mill in a safe manner	(ii) use equipment commonly found around a CNC mill in a safe manner

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(i) recognize the function of the primary components of a CNC mill
(10) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(ii) name the function of the primary components of a CNC mill
(10) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(iii) describe the function of the primary components of a CNC mill
(10) The student operates a CNC mill. The student is expected to:	(C) perform preventative maintenance checks on a CNC mill such as checking all fluid levels, system pressure, tooling wear, and component lubrication and cleaning	(i) perform preventative maintenance checks on a CNC mill
(10) The student operates a CNC mill. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(i) test the coolant for proper density
(10) The student operates a CNC mill. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(ii) adjust accordingly in order to reach the correct mixture
(10) The student operates a CNC mill. The student is expected to:	(E) perform a power up on a standard CNC mill	(i) perform a power up on a standard CNC mill
(10) The student operates a CNC mill. The student is expected to:	(F) demonstrate the use of the jog controls on the operator panel to jog the mill's axes	(i) demonstrate the use of the jog controls on the operator panel to jog the mill's axes

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(i) demonstrate the ability to locate using a presetter or other means according to work instructions
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(ii) demonstrate the ability to locate using a presetter or other means according to job documentation
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(iii) demonstrate the ability to assemble using a presetter or other means according to work instructions
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(iv) demonstrate the ability to assemble using a presetter or other means according to job documentation
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(v) demonstrate the ability to measure tooling using a presetter or other means according to work instructions
(10) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(vi) demonstrate the ability to measure tooling using a presetter or other means according to job documentation
(10) The student operates a CNC mill. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(i) install tools and tool holders in the automatic tool changer locations according to work instructions

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student operates a CNC mill. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(ii) install tools and tool holders in the automatic tool changer locations according to job documentation
(10) The student operates a CNC mill. The student is expected to:	(I) locate and set workpiece to zero on a CNC mill	(i) locate and set workpiece to zero on a CNC mill
(10) The student operates a CNC mill. The student is expected to:	(J) set any required work offsets for the part to be machined after a basic tool setting process has been completed	(i) set any required work offsets for the part to be machined after a basic tool setting process has been completed
(10) The student operates a CNC mill. The student is expected to:	(K) set the proper geometry/tool offsets for each tool in a standard tool-setting process	(i) set the proper geometry/tool offsets for each tool in a standard tool-setting process
(10) The student operates a CNC mill. The student is expected to:	(L) operate a CNC mill in automatic mode	(i) operate a CNC mill in automatic mode
(10) The student operates a CNC mill. The student is expected to:	(M) illustrate the proper power down process on a CNC mill	(i) illustrate the proper power down process on a CNC mill
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(A) calculate trigonometry to determine coordinates from technical drawings to cut arcs and angles	(i) calculate trigonometry to determine coordinates from technical drawings to cut arcs and angles

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(B) use trigonometry for determining cutter offsets	(i) use trigonometry for determining cutter offsets
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(C) use appropriate mathematical skills to solve problems while programming a CNC lathe	(i) use appropriate mathematical skills to solve problems while programming a CNC lathe
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(D) write a simple program to face and turn	(i) write a simple program to face and turn
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(i) write a simple program to cut radiuses
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(ii) write a simple program to cut angles
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(iii) write a simple program to cut grooves

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(iv) write a simple program to cut threads
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(F) write a program using cutter radius compensation	(i) write a program using cutter radius compensation
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(G) write a program using canned cycles such as G71	(i) write a program using canned cycles
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(H) write a program and produce a complex part such as a NIMS Level 1 CNC lathe part with zero defects	(i) write a program
(11) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(H) write a program and produce a complex part such as a NIMS Level 1 CNC lathe part with zero defects	(ii) produce a complex part
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(A) use trigonometry to determine coordinates from technical drawings to cut arcs and angles	(i) use trigonometry to determine coordinates from technical drawings to cut arcs and angles

Knowledge and Skill Statement	Student Expectation	Breakout
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(B) use trigonometry for determining cutter offsets	(i) use trigonometry for determining cutter offsets
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(C) use appropriate mathematical skills to solve problems while programming a CNC lathe	(i) use appropriate mathematical skills to solve problems while programming a CNC lathe
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(D) write a simple program to perform hole operations	(i) write a simple program to perform hole operations
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(E) write a simple program to cut radiuses and angles	(i) write a simple program to cut radiuses
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(E) write a simple program to cut radiuses and angles	(ii) write a simple program to cut angles
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(F) write a program using cutter radius compensation and ramping	(i) write a program using cutter radius compensation
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(F) write a program using cutter radius compensation and ramping	(ii) write a program using cutter radius ramping

Knowledge and Skill Statement	Student Expectation	Breakout
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(G) write a program and produce a complex part such as a NIMS Level 1 CNC milling part with zero defects	(i) write a program
(12) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(G) write a program and produce a complex part such as a NIMS Level 1 CNC milling part with zero defects	(ii) produce a complex part
(13) The student develops a deeper understanding of quality control. The student is expected to:	(A) evaluate engineering drawings using geometric dimensioning and tolerancing	(i) evaluate engineering drawings using geometric dimensioning and tolerancing
(13) The student develops a deeper understanding of quality control. The student is expected to:	(B) discuss the American Society of Mechanical Engineers (ASME) Y14.5M standard that defines geometric dimensioning and tolerancing	(i) discuss the American Society of Mechanical Engineers (ASME) Y14.5M standard that defines geometric dimensioning and tolerancing
(13) The student develops a deeper understanding of quality control. The student is expected to:	(C) appraise various quality control/management programs	(i) appraise various quality control/management programs

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.361. Precision Metal Manufacturing II Lab (One Credit), Adopted 2015.**

(a) General Requirements. This lab course is recommended for students in Grades 11 and 12. Prerequisite: Precision Metal Manufacturing I. Corequisite: Precision Metal Manufacturing II. This course must be taken concurrently with Precision Metal Manufacturing II and may not be taken as a stand-alone course. Districts are encouraged to offer this lab in a consecutive block with Precision Metal Manufacturing II to allow students sufficient time to master the content of both courses. 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) Precision Metal Manufacturing II Lab provides the knowledge, skills, and technologies required for employment in precision machining. While Precision Metal Manufacturing II Lab is designed to provide necessary skills in machining, it also provides a real-world foundation for any engineering discipline. This course may address a variety of materials such as plastics, ceramics, and wood in addition to metal. Students will develop knowledge of the concepts and skills related to these systems to apply them to personal and career development. This course supports integration of 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. Knowledge about career opportunities, requirements, and expectations and the development of workplace skills prepare students for success. This course is designed to provide entry-level employment for the student or articulated credit integration into a community college and dual credit with a community college with completion of the advanced course.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(i) choose the ethical course of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(ii) comply with all applicable rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(iii) comply with all applicable laws
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(iv) comply with all applicable regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(i) review with a critical eye the fine, detailed aspects of [the] quantitative work processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(ii) review with a critical eye the fine, detailed aspects of [the] qualitative work processes

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review with a critical eye the fine, detailed aspects of both quantitative and qualitative work processes and end products	(iii) review with a critical eye the fine, detailed aspects of end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) evaluate operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) identify causes, problems, patterns, or issues
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iv) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(i) prioritize tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(ii) follow schedules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(iii) work on goal-relevant activities in a way that uses time wisely in an effective manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(iv) work on goal-relevant activities in a way that uses time wisely in an efficient manner

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student builds on the manual machining skills gained in Precision Metal Manufacturing I. The student is expected to:	(A) develop a detailed turning part such as the National Institute for Metalworking Skills (NIMS) Level 1 turning, chucking, or turning between centers part with zero defects (100% to the print) in a safe manner	(i) develop a detailed turning part in a safe manner
(2) The student builds on the manual machining skills gained in Precision Metal Manufacturing I. The student is expected to:	(B) develop a detailed milling part such as the NIMS Level 1 milling part with zero defects (100% to the print) in a safe manner	(i) develop a detailed milling part in a safe manner
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(A) perform various types of tool changes	(i) perform various types of tool changes
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(B) demonstrate quick change tooling used on CNC milling machines	(i) demonstrate quick change tooling used on CNC milling machines
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(C) demonstrate appropriate tool storage	(i) demonstrate appropriate tool storage
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(D) demonstrate the proper use of tool offset registers	(i) demonstrate the proper use of tool offset registers
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(E) determine tool offset length	(i) determine tool offset length

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student evaluates tool changing and tool offset registers in a computer numerical control (CNC) lab environment. The student is expected to:	(F) enter tool offsets for a set up	(i) enter tool offsets for a set up
(4) The student operates a CNC lathe. The student is expected to:	(A) use equipment commonly found on and around a CNC lathe in a safe manner	(i) use equipment commonly found on a CNC lathe in a safe manner
(4) The student operates a CNC lathe. The student is expected to:	(A) use equipment commonly found on and around a CNC lathe in a safe manner	(ii) use equipment commonly found around a CNC lathe in a safe manner
(4) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(i) recognize the function of the primary components of a CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(ii) name the function of the primary components of a CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC lathe	(iii) describe the function of the primary components of a CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(C) perform preventative maintenance checks on a CNC lathe such as checking all fluid levels, system pressure, tooling wear, and component lubrication and cleaning	(i) perform preventative maintenance checks on a CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(i) test the coolant for proper density

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student operates a CNC lathe. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(ii) adjust accordingly in order to reach the correct mixture
(4) The student operates a CNC lathe. The student is expected to:	(E) perform a power up on a standard CNC lathe	(i) perform a power up on a standard CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(F) demonstrate the use of the jog controls on the operator panel to jog the lathe's axes	(i) demonstrate the use of the jog controls on the operator panel to jog the lathe's axes
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(i) demonstrate the ability to locate tooling according to work instructions
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(ii) demonstrate the ability to assemble tooling according to work instructions
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(iii) demonstrate the ability to measure tooling according to work instructions
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(iv) demonstrate the ability to locate tooling according to job documentation

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(v) demonstrate the ability to assemble tooling according to job documentation
(4) The student operates a CNC lathe. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling according to work instructions and job documentation	(vi) demonstrate the ability to measure tooling according to job documentation
(4) The student operates a CNC lathe. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(i) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation
(4) The student operates a CNC lathe. The student is expected to:	(I) locate and set workpiece to zero on a CNC lathe	(i) locate and set workpiece to zero on a CNC lathe
(4) The student operates a CNC lathe. The student is expected to:	(J) set any required work offsets for the part to be machined after a basic tool setting process has been completed	(i) set any required work offsets for the part to be machined after a basic tool setting process has been completed
(4) The student operates a CNC lathe. The student is expected to:	(K) set the proper geometry/tool offsets for each tool in a standard tool setting process;	(i) set the proper geometry/tool offsets for each tool in a standard tool setting process;
(4) The student operates a CNC lathe. The student is expected to:	(L) operate a CNC lathe in automatic mode	(i) operate a CNC lathe in automatic mode
(4) The student operates a CNC lathe. The student is expected to:	(M) illustrate the proper power down process on a CNC lathe	(i) illustrate the proper power down process on a CNC lathe

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student operates a CNC mill. The student is expected to:	(A) use equipment commonly found on and around a CNC mill in a safe manner	(i) use equipment commonly found on a CNC mill in a safe manner
(5) The student operates a CNC mill. The student is expected to:	(A) use equipment commonly found on and around a CNC mill in a safe manner	(ii) use equipment commonly found around a CNC mill in a safe manner
(5) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(i) recognize the function of the primary components of a CNC mill
(5) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(ii) name the function of the primary components of a CNC mill
(5) The student operates a CNC mill. The student is expected to:	(B) recognize, name, and describe the function of the primary components of a CNC mill	(iii) describe the function of the primary components of a CNC mill
(5) The student operates a CNC mill. The student is expected to:	(C) perform preventative maintenance checks on a CNC mill such as checking all fluid levels, system pressure, tooling wear, and component lubrication and cleaning	(i) perform preventative maintenance checks on a CNC mill
(5) The student operates a CNC mill. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(i) test the coolant for proper density
(5) The student operates a CNC mill. The student is expected to:	(D) test the coolant for proper density and adjust accordingly in order to reach the correct mixture	(ii) adjust accordingly in order to reach the correct mixture

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student operates a CNC mill. The student is expected to:	(E) perform a power up on a standard CNC mill	(i) perform a power up on a standard CNC mill
(5) The student operates a CNC mill. The student is expected to:	(F) demonstrate the use of the jog controls on the operator panel to jog the mill's axes	(i) demonstrate the use of the jog controls on the operator panel to jog the mill's axes
(5) The student operates a CNC mill. The student is expected to:	(G) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation	(i) demonstrate the ability to locate, assemble, and measure tooling using a presetter or other means according to work instructions and job documentation
(5) The student operates a CNC mill. The student is expected to:	(H) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation	(i) install tools and tool holders in the automatic tool changer locations according to work instructions and job documentation
(5) The student operates a CNC mill. The student is expected to:	(I) locate and set workpiece to zero on a CNC mill	(i) locate and set workpiece to zero on a CNC mill
(5) The student operates a CNC mill. The student is expected to:	(J) set any required work offsets for the part to be machined after a basic tool setting process has been completed	(i) set any required work offsets for the part to be machined after a basic tool setting process has been completed
(5) The student operates a CNC mill. The student is expected to:	(K) set the proper geometry/tool offsets for each tool in a standard tool setting process	(i) set the proper geometry/tool offsets for each tool in a standard tool setting process
(5) The student operates a CNC mill. The student is expected to:	(L) operate a CNC mill in automatic mode	(i) operate a CNC mill in automatic mode

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student operates a CNC mill. The student is expected to:	(M) illustrate the proper power down process on a CNC mill	(i) illustrate the proper power down process on a CNC mill
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(A) use trigonometry to determine coordinates from technical drawings to cut arcs and angles	(i) use trigonometry to determine coordinates from technical drawings to cut arcs
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(A) use trigonometry to determine coordinates from technical drawings to cut arcs and angles	(ii) use trigonometry to determine coordinates from technical drawings to cut angles
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(B) use trigonometry for determining cutter offsets	(i) use trigonometry for determining cutter offsets
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(C) use appropriate mathematical skills to solve problems while programming a CNC lathe	(i) use appropriate mathematical skills to solve problems while programming a CNC lathe
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(D) write a simple program to face and turn	(i) write a simple program to face and turn

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(i) write a simple program to cut radiuses
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(ii) write a simple program to cut angles
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(iii) write a simple program to cut grooves
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(E) write a simple program to cut radiuses, angles, grooves, and threads	(iv) write a simple program to cut threads
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(F) write a program using cutter radius compensation	(i) write a program using cutter radius compensation
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(G) write a program using canned cycles such as G71	(i) write a program using canned cycles

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(H) write a program and produce a complex part such as a NIMS Level 1 CNC lathe part with zero defects	(i) write a program
(6) The student learns to manually program a CNC lathe without the help of computer-aided design or manufacturing (CAD/CAM) software. The student is expected to:	(H) write a program and produce a complex part such as a NIMS Level 1 CNC lathe part with zero defects	(ii) produce a complex part
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(A) use trigonometry to determine coordinates from technical drawings to cut arcs and angles	(i) use trigonometry to determine coordinates from technical drawings to cut arcs
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(A) use trigonometry to determine coordinates from technical drawings to cut arcs and angles	(ii) use trigonometry to determine coordinates from technical drawings to cut angles
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(B) use trigonometry to determine cutter offsets	(i) use trigonometry to determine cutter offsets
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(C) use appropriate mathematical skills to solve problems while programming a CNC lathe	(i) use appropriate mathematical skills to solve problems while programming a CNC lathe

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(D) write a simple program to perform hole operations	(i) write a simple program to perform hole operations
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(E) write a simple program to cut radiuses and angles	(i) write a simple program to cut radiuses
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(E) write a simple program to cut radiuses and angles	(ii) write a simple program to cut angles
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(F) write a program using cutter radius compensation and ramping	(i) write a program using cutter radius compensation
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(F) write a program using cutter radius compensation and ramping	(ii) write a program using cutter radius ramping
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(G) write a program and produce a complex part such as a NIMS Level 1 CNC milling part with zero defects	(i) write a program
(7) The student learns to manually program a CNC mill (without the help of CAD/CAM software). The student is expected to:	(G) write a program and produce a complex part such as a NIMS Level 1 CNC milling part with zero defects	(ii) produce a complex part

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) choose ethical courses of action such as following applicable rules, laws, and regulations	(i) choose ethical courses of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) review detailed aspects of both quantitative and qualitative work processes and end products	(i) review detailed aspects of both quantitative and qualitative work processes
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) review detailed aspects of both quantitative and qualitative work processes and end products	(ii) review detailed aspects of both quantitative and qualitative end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) evaluate systems relative to causes, problems, and patterns to improve operational situations	(i) evaluate systems relative to causes to improve operational situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) evaluate systems relative to causes, problems, and patterns to improve operational situations	(ii) evaluate systems relative to problems to improve operational situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) evaluate systems relative to causes, problems, and patterns to improve operational situations	(iii) evaluate systems relative to patterns to improve operational situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) adhere to business practices such as policies, procedures, and health and safety rules	(i) adhere to business practices

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) use time wisely by prioritizing tasks and following schedules in an efficient manner	(i) use time wisely by prioritizing tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) use time wisely by prioritizing tasks and following schedules in an efficient manner	(ii) use time wisely by 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	(i) determine academic knowledge required for postsecondary education
(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	(ii) determine academic skills required for postsecondary education
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(B) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(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	(i) demonstrate the professional standards required in the workplace

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(D) evaluate progress toward personal career goals	(i) evaluate progress toward personal career goals
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills to health and safety in the workplace as specified by appropriate governmental regulations	(i) apply knowledge to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills to health and safety in the workplace as specified by appropriate governmental regulations	(ii) apply knowledge to safety in the workplace as specified by appropriate governmental regulations
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills to health and safety in the workplace as specified by appropriate governmental regulations	(iii) apply skills to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills to health and safety in the workplace as specified by appropriate governmental regulations	(iv) apply skills to safety in the workplace as specified by appropriate governmental 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	(i) employ welding equipment according to safety standards

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(i) identify environmentally hazardous materials used in welding
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(ii) properly dispose of environmentally hazardous materials used in welding
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(C) explain the importance of recycling materials used in welding	(i) explain the importance of recycling materials used in welding
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(D) choose appropriate personal protective equipment	(i) choose appropriate personal protective equipment
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(E) evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) evaluate skills related to health in the workplace as specified by appropriate governmental regulations
(3) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(E) evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) evaluate skills related to safety in the workplace as specified by appropriate governmental 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	(i) demonstrate knowledge of welding sketches

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student compares and contrasts welding joint design, material symbols, and welds. The student is expected to:	(B) identify types of welds such as fillet, groove, spot, plug, and flanged	(i) identify types of welds
(5) The student applies academic skills in relationship to welding. The student is expected to:	(A) demonstrate mathematical skills related to welding	(i) demonstrate mathematical skills related to welding
(5) The student applies academic skills in relationship to welding. The student is expected to:	(B) demonstrate technical writing skills related to welding	(i) demonstrate technical writing skills related to welding
(5) The student applies academic skills in relationship to welding. The student is expected to:	(C) apply accurate readings of measuring devices	(i) apply accurate readings of measuring devices
(5) The student applies academic skills in relationship to welding. The student is expected to:	(D) accurately use appropriate tools to make measurements	(i) accurately use appropriate tools to make measurements
(5) The student applies academic skills in relationship to welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(i) solve problems using whole numbers
(5) The student applies academic skills in relationship to welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(ii) solve problems using fractions
(5) The student applies academic skills in relationship to welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iii) solve problems using mixed numbers

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student applies academic skills in relationship to welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iv) solve problems using decimals
(5) The student applies academic skills in relationship to welding. The student is expected to:	(F) perform conversions between fractions and decimals	(i) perform conversions between fractions and decimals
(5) The student applies academic skills in relationship to welding. The student is expected to:	(G) perform conversions between standard units and metric units	(i) perform conversions between standard units and metric units
(6) The student applies the concepts and skills of welding projects. The student is expected to:	(A) explore careers in welding	(i) explore careers in welding
(6) The student applies the concepts and skills of welding projects. The student is expected to:	(B) understand welding codes such as American Petroleum Institute (API) 1104 and American Welding Society (AWS) D1.1	(i) understand welding codes
(6) The student applies the concepts and skills of welding projects. The student is expected to:	(C) work independently to fabricate a variety of welded projects with minimal assistance	(i) work independently to fabricate a variety of welded projects with minimal assistance
(6) The student applies the concepts and skills of welding projects. The student is expected to:	(D) work collaboratively with other students	(i) work collaboratively with other students
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(B) perform safe handling of compressed gases	(i) perform safe handling of compressed gases
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(C) identify components of oxy-fuel gas cutting	(i) identify components of oxy-fuel gas cutting
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(D) demonstrate proper set-up procedures for the oxy-fuel process	(i) demonstrate proper set-up procedures for the oxy-fuel process
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(E) identify the factors affecting the oxy-fuel cutting of base metals	(i) identify the factors affecting the oxy-fuel cutting of base metals
(7) The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:	(F) demonstrate proper cutting techniques such as piercing, straight line, and bevel	(i) demonstrate proper cutting techniques
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(B) demonstrate knowledge of welding currents	(i) demonstrate knowledge of welding currents
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(C) apply shielded metal arc welding principles	(i) apply shielded metal arc welding principles

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(D) demonstrate proper set-up procedure for shielded metal arc welding	(i) demonstrate proper set-up procedure for shielded metal arc welding
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(E) determine appropriate electrodes for base metal in shielded metal arc welding	(i) determine appropriate electrodes for base metal in shielded metal arc welding
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(F) perform fillet and groove welds in all positions	(i) perform fillet and groove welds in all positions
(8) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(G) prepare joints for welding	(i) prepare joints for welding
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(B) apply gas metal arc welding principles	(i) apply gas metal arc welding principles
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(C) demonstrate proper set-up procedure for gas metal arc welding	(i) demonstrate proper set-up procedure for gas metal arc welding
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(D) use appropriate equipment setup for base metal in gas metal arc welding	(i) use appropriate equipment setup for base metal in gas metal arc welding

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(E) perform fillet and groove welds using gas metal arc welding with various metal transfer processes	(i) perform fillet welds using gas metal arc welding with various metal transfer processes
(9) The student performs gas metal arc welding principles and practices. The student is expected to:	(E) perform fillet and groove welds using gas metal arc welding with various metal transfer processes	(ii) perform groove welds using gas metal arc welding with various metal transfer processes

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(i) choose the ethical course of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(ii) comply with all applicable rules, laws, and regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(i) review the fine, detailed aspects of both quantitative and qualitative work process
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(ii) review the fine, detailed aspects of both quantitative and qualitative end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems and operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) identify causes, problems, patterns, or issues

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(i) prioritize tasks in a way that uses time wisely in an effective, efficient manner

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(ii) follow schedules in a way that uses time wisely in an effective, efficient manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner	(iii) 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	(i) explore academic knowledge required for postsecondary education
(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	(ii) explore academic skills required for postsecondary education
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(B) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(i) demonstrate the professional standards required in the workplace

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(D) evaluate personal career goals	(i) evaluate personal career goals
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) demonstrate skills related to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) demonstrate skills related to safety in the workplace as specified by appropriate governmental 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	(i) demonstrate effective communication skills with individuals from varied cultures
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(B) demonstrate mathematical skills to estimate costs	(i) demonstrate mathematical skills to estimate costs
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(C) demonstrate technical writing skills related to work orders	(i) demonstrate technical writing skills related to work orders

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(D) apply accurate readings of measuring devices	(i) apply accurate readings of measuring devices
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(E) use appropriate tools to make accurate measurements	(i) use appropriate tools to make accurate measurements
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(F) compute measurements such as area, surface area, volume, and perimeter	(i) compute measurements
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(G) solve problems using whole numbers, fractions, mixed numbers, and decimals	(i) solve problems using whole numbers
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(G) solve problems using whole numbers, fractions, mixed numbers, and decimals	(ii) solve problems using fractions
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(G) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iii) solve problems using mixed numbers
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(G) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iv) solve problems using decimals
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(H) use various methods, including a calculator, to perform computations	(i) use various methods, including a calculator, to perform computations
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(I) perform conversions between fractions and decimals	(i) perform conversions between fractions and decimals

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(J) perform conversions between standards units and metric units	(i) perform conversions between standards units and metric units
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(K) calculate and apply the functions of angles such as using the Pythagorean Theorem	(i) calculate the functions of angles
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(K) calculate and apply the functions of angles such as using the Pythagorean Theorem	(ii) apply the functions of angles
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(L) diagram the parts of a circle	(i) diagram 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) operate welding equipment according to safety standards	(i) operate welding equipment according to safety standards
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(i) identify environmentally hazardous materials used in welding
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(ii) properly dispose of environmentally hazardous materials used in welding
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(C) explain the importance of recycling materials used in welding	(i) explain the importance of recycling materials used in welding

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(D) choose appropriate personal protective equipment	(i) choose appropriate personal protective equipment
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(E) evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulation	(i) evaluate skills related to health in the workplace as specified by appropriate governmental regulation
(4) The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(E) evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulation	(ii) evaluate skills related to safety in the workplace as specified by appropriate governmental regulation
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(A) demonstrate knowledge of engineering drawings, charts, and diagrams	(i) demonstrate knowledge of engineering drawings
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(A) demonstrate knowledge of engineering drawings, charts, and diagrams	(ii) demonstrate knowledge of engineering charts
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(A) demonstrate knowledge of engineering drawings, charts, and diagrams	(iii) demonstrate knowledge of engineering diagrams
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(B) interpret orthographic and isometric views of three-dimensional figures	(i) interpret orthographic views of three-dimensional figures
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(B) interpret orthographic and isometric views of three-dimensional figures	(ii) interpret isometric views of three-dimensional figures

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(C) interpret engineering, drawings, charts, and diagrams	(i) interpret engineering
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(C) interpret engineering, drawings, charts, and diagrams	(ii) interpret drawings
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(C) interpret engineering, drawings, charts, and diagrams	(iii) interpret charts
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(C) interpret engineering, drawings, charts, and diagrams	(iv) interpret diagrams
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(D) analyze components of the welding symbol	(i) analyze components of the welding symbol
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(E) identify types of welding joints	(i) identify types of welding joints
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(F) identify positions of welding	(i) identify positions of welding
(5) The student understands welding joint design, symbols, and welds. The student is expected to:	(G) identify types of welds such as fillet, groove, spot, plug, and flanged	(i) identify types of welds

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:	(A) explain weld inspection processes	(i) explain weld inspection processes
(6) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:	(B) interpret welding codes	(i) interpret welding codes
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(A) practice safe operating practices	(i) practice safe operating practices
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(B) perform safe handling of compressed gases	(i) perform safe handling of compressed gases
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(C) identify components of oxy-fuel gas cutting system	(i) identify components of oxy-fuel gas cutting system
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(D) demonstrate proper set-up procedures for oxy-fuel cutting process	(i) demonstrate proper set-up procedures for oxy-fuel cutting process
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(E) identify factors affecting oxy-fuel cutting of base metals	(i) identify factors affecting oxy-fuel cutting of base metals
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(F) demonstrate proper cutting techniques such as piercing, straight line, and bevel	(i) demonstrate proper cutting techniques

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(G) identify acceptable cuts	(i) identify acceptable cuts
(7) The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:	(H) evaluate alternative fuel gasses such as propane, propylene, and Chemtane 2®	(i) evaluate alternative fuel gasses
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(B) demonstrate knowledge of the theories of plasma arc cutting	(i) demonstrate knowledge of the theories of plasma arc cutting
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(C) apply safe handling of compressed air supply	(i) apply safe handling of compressed air supply
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(D) identify components of plasma arc cutting	(i) identify components of plasma arc cutting
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(E) demonstrate correct set-up procedure for plasma arc cutting	(i) demonstrate correct set-up procedure for plasma arc cutting
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(F) define cutting terms	(i) define cutting terms
(8) The student analyzes plasma arc cutting on metals. The student is expected to:	(G) perform straight line, piercing, bevels, and shape cuts	(i) perform straight line, piercing, bevels, and shape cuts

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(B) analyze welding current relationships such as alternating current and direct current, heat transfer, and polarity	(i) analyze welding current relationships
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(C) apply shielded metal arc welding principles	(i) apply shielded metal arc welding principles
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(D) demonstrate proper set-up procedure for shielded metal arc welding	(i) demonstrate proper set-up procedure for shielded metal arc welding
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(E) explain the American Welding Society (AWS) identification system for shielded metal arc welding electrodes	(i) explain the American Welding Society (AWS) identification system for shielded metal arc welding electrodes
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(F) determine appropriate electrodes for base metal in shielded metal arc welding	(i) determine appropriate electrodes for base metal in shielded metal arc welding
(9) The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:	(G) perform multi-pass groove welds in all positions to the AWS Schools Excelling through National Skills Education standards	(i) perform multi-pass groove welds in all positions to the AWS Schools Excelling through National Skills Education standards

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(i) explain the effects that weld angle have on welds
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(ii) explain the effects that work angle have on welds
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(iii) explain the effects that electrode extension have on welds
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(iv) explain the effects that electrode extension have on welds
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(C) apply gas metal arc welding principles	(i) apply gas metal arc welding principles
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(D) demonstrate proper set-up procedure for gas metal arc welding	(i) demonstrate proper set-up procedure for gas metal arc welding
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(E) explain the AWS identification system for gas metal arc welding filler metal	(i) explain the AWS identification system for gas metal arc welding filler metal
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(F) determine appropriate filler metal for base metal in gas metal arc welding	(i) determine appropriate filler metal for base metal in gas metal arc welding

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(G) perform fillet and groove welds in all positions	(i) perform fillet welds in all positions
(10) The student analyzes gas metal arc welding principles and practices. The student is expected to:	(G) perform fillet and groove welds in all positions	(ii) perform groove welds in all positions
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(i) explain the effects that weld angle have on welds
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(ii) explain the effects that work angle have on welds
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(B) explain the effects that weld angle, work angle, and electrode extension have on welds	(iii) explain the effects that electrode extension have on welds
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(C) apply flux cored arc welding principles	(i) apply flux cored arc welding principles

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(D) demonstrate proper set-up procedure for flux cored arc welding	(i) demonstrate proper set-up procedure for flux cored arc welding
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(E) explain the AWS identification system for flux cored arc welding electrodes	(i) explain the AWS identification system for flux cored arc welding electrodes
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(F) determine appropriate filler metal for base metal in flux cored arc welding	(i) determine appropriate filler metal for base metal in flux cored arc welding
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(G) perform fillet and groove welds in all positions	(i) perform fillet welds in all positions
(11) The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:	(G) perform fillet and groove welds in all positions	(ii) perform groove welds in all positions
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(B) analyze electrical welding current relationships such as alternating current and direct current, heat transfer, and polarity	(i) analyze electrical welding current relationships

Knowledge and Skill Statement	Student Expectation	Breakout
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(C) identify the common types of tungsten and filler metals according to the AWS identification system	(i) identify the common types of tungsten metals according to the AWS identification system
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(C) identify the common types of tungsten and filler metals according to the AWS identification system	(ii) identify the common types of filler metals according to the AWS identification system
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(D) demonstrate proper set-up procedure for gas tungsten arc welding	(i) demonstrate proper set-up procedure for gas tungsten arc welding
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(E) perform fillet and groove welds in all positions	(i) perform fillet welds in all positions
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(E) perform fillet and groove welds in all positions	(ii) perform groove welds in all positions
(12) The student analyzes gas tungsten arc welding on metals. The student is expected to:	(F) perform welds on metals such as carbon steel, stainless steel, and aluminum	(i) perform welds on metals

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§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 prerequisites: Algebra I or Geometry. Recommended corequisite: Welding II Lab. 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(i) choose the ethical course of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(ii) comply with all applicable rules, laws, and regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(i) review the fine, detailed aspects of both quantitative and qualitative work process
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(ii) review the fine, detailed aspects of both quantitative and qualitative end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems and operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) identify causes, problems, patterns, or issues

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(i) prioritize tasks in a way that uses time wisely in an effective, efficient manner

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(ii) follow schedules in a way that uses time wisely in an effective, efficient manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(iii) work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(J) analyze how teams function	(i) analyze how teams function
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(K) evaluate employers' work expectations to measure project success	(i) 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	(i) determine academic knowledge required for postsecondary education
(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	(ii) determine academic skills required for postsecondary education
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(B) identify employers' expectations to foster positive customer satisfaction	(i) identify employers' expectations to foster positive customer satisfaction

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(i) demonstrate the professional standards required in the workplace
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(ii) acquire knowledge in a work situation
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(iii) acquire self-discipline in a work situation
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(iv) acquire self-worth in a work situation
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(v) acquire positive attitude in a work situation

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(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	(vi) acquire integrity in a work situation
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(D) evaluate progress toward personal career goals	(i) evaluate progress toward personal career goals
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(E) communicate effectively with others in the workplace to clarify objectives	(i) communicate effectively with others in the workplace to clarify objectives
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(i) apply knowledge related to health in the workplace as specified by appropriate governmental regulations
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(ii) apply knowledge related to safety in the workplace as specified by appropriate governmental regulations
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(iii) apply skills related to health in the workplace as specified by appropriate governmental regulations

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:	(F) apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations	(iv) apply skills related to safety in the workplace as specified by appropriate governmental regulations
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(A) demonstrate mathematical skills to estimate costs	(i) demonstrate mathematical skills to estimate costs
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(B) explain the impact of accurate readings of measuring devices on cost estimates	(i) explain the impact of accurate readings of measuring devices on cost estimates
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(C) justify the selection of a tool to make accurate measurements	(i) justify the selection of a tool to make accurate measurements
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(D) compute measurements such as area, surface area, volume, and perimeter	(i) compute measurements
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(i) solve problems using whole numbers
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(ii) solve problems using fractions
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iii) solve problems using mixed numbers

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(E) solve problems using whole numbers, fractions, mixed numbers, and decimals	(iv) solve problems using decimals
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(F) apply right triangle relationships using the Pythagorean Theorem	(i) apply right triangle relationships using the Pythagorean Theorem
(3) The student applies academic skills to the requirements of welding. The student is expected to:	(G) select a mathematical formula for estimation	(i) select a mathematical formula for 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	(i) use welding equipment according to safety standards
(4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(B) dispose of environmentally hazardous materials used in welding	(i) dispose of environmentally hazardous materials used in welding
(4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(C) explain the importance of recycling materials used in welding	(i) explain the importance of recycling materials used in welding
(4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(D) evaluate the performance impact of emerging technologies in welding	(i) evaluate the performance impact of emerging technologies in welding

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(E) use appropriate personal protective equipment to follow safety measures	(i) use appropriate personal protective equipment to follow safety measures
(4) The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:	(F) investigate the use of automated welding machines such as numerical control, computer numerical control, and robotics-controlled welding machines	(i) investigate the use of automated 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	(i) use knowledge of engineering drawings to complete an advanced project
(5) The student illustrates welding joint design, symbols, and welds. The student is expected to:	(B) evaluate projects using engineering drawing specifications	(i) evaluate 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	(i) work independently in fabricating welded projects
(6) The student applies the concepts and skills of welding to perform tasks. The student is expected to:	(B) work collaboratively with other students to complete a real-world application item	(i) work collaboratively with other students to complete a real-world application item
(6) The student applies the concepts and skills of welding to perform tasks. The student is expected to:	(C) troubleshoot equipment	(i) 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	(i) inspect the welding projects of team members

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student analyzes the concepts and intricacies of inspections related to welding codes. The student is expected to:	(B) select codes for weld inspections	(i) select codes for weld inspections
(7) The student analyzes the concepts and intricacies of inspections related to welding codes. The student is expected to:	(C) critique and evaluate the weldments of team members	(i) critique the weldments of team members
(7) The student analyzes the concepts and intricacies of inspections related to welding codes. The student is expected to:	(C) critique and evaluate the weldments of team members	(ii) 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	(i) observe safe operating practices
(8) The student performs advanced cutting processes on carbon steels. The student is expected to:	(B) apply safe handling of compressed gases	(i) apply safe handling of compressed gases
(8) The student performs advanced cutting processes on carbon steels. The student is expected to:	(C) perform cutting processes according to accepted welding standards	(i) perform 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	(i) employ safe operating practices

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student performs shielded metal arc welding on metals. The student is expected to:	(B) demonstrate skills required to make welds in all positions according to the American Welding Society (AWS) Schools Excelling through National Skills Education (SENSE) welding standards	(i) demonstrate skills required to make welds in all positions according to the American Welding Society (AWS) Schools Excelling through National Skills Education (SENSE) welding standards
(10) The student performs flux cored metal arc welding. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(10) The student performs flux cored metal arc welding. The student is expected to:	(B) perform fillet and groove welds	(i) perform fillet welds
(10) The student performs flux cored metal arc welding. The student is expected to:	(B) perform fillet and groove welds	(ii) perform groove welds
(10) The student performs flux cored metal arc welding. The student is expected to:	(C) perform welds in all appropriate positions according to the AWS SENSE welding standards	(i) perform welds in all appropriate positions according to the AWS SENSE welding standards
(11) The student performs gas tungsten arc welding on metals. The student is expected to:	(A) employ safe operating practices	(i) employ safe operating practices
(11) The student performs gas tungsten arc welding on metals. The student is expected to:	(B) perform fillet and groove welds in all positions	(i) perform fillet welds in all positions
(11) The student performs gas tungsten arc welding on metals. The student is expected to:	(B) perform fillet and groove welds in all positions	(ii) perform groove welds in all positions

Knowledge and Skill Statement	Student Expectation	Breakout
(11) The student performs gas tungsten arc welding on metals. The student is expected to:	(C) perform welds on metals such as carbon steel, stainless steel, pipe, and aluminum to the AWS SENSE welding standards	(i) perform welds on metals

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§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. Corequisite: Welding II. This course must be taken concurrently with Welding II and may not be taken as a stand-alone course. Districts are encouraged to offer this course in a consecutive block with Welding II to allow students sufficient time to master the content of both courses. 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.

Knowledge and Skill Statement	Student Expectation	Breakout
(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	(i) express ideas to others in a clear, concise, and effective manner through written communication
(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	(ii) express ideas to others in a clear, concise, and effective manner through verbal communication
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) convey written information that is easily understandable to others	(i) convey written information that is easily understandable to others
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(i) demonstrate acceptable work ethics in reporting for duty
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed	(ii) demonstrate acceptable work ethics in performing assigned tasks as directed
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(i) conduct oneself in a manner acceptable for the profession

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech	(ii) conduct oneself in a manner acceptable for the work site
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(i) choose the ethical course of action
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) choose the ethical course of action and comply with all applicable rules, laws, and regulations	(ii) comply with all applicable rules, laws, and regulations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(i) review the fine, detailed aspects of both quantitative and qualitative work process
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) review the fine, detailed aspects of both quantitative and qualitative work process and end products	(ii) review the fine, detailed aspects of both quantitative and qualitative end products
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(i) evaluate systems and operations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(ii) identify causes, problems, patterns, or issues

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations	(iii) explore workable solutions or remedies to improve situations
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(i) follow written instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(ii) follow oral instructions including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iii) adhere to established business practices, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(iv) adhere to established business policies, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(H) follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules	(v) adhere to established business procedures, including health and safety rules
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(i) prioritize tasks in a way that uses time wisely in an effective, efficient manner

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(ii) follow schedules in a way that uses time wisely in an effective, efficient manner
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(I) prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner	(iii) work on goal-relevant activities in a way that uses time wisely 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	(i) use welding equipment according to safety standards
(2) The student demonstrates the functions and applications of the tools, equipment, technologies, and metals used in code welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(i) identify environmentally hazardous materials used in welding
(2) The student demonstrates the functions and applications of the tools, equipment, technologies, and metals used in code welding. The student is expected to:	(B) identify and properly dispose of environmentally hazardous materials used in welding	(ii) properly dispose of environmentally hazardous materials used in welding
(2) The student demonstrates the functions and applications of the tools, equipment, technologies, and metals used in code welding. The student is expected to:	(C) explain the importance of recycling materials used in welding	(i) explain the importance of recycling materials used in welding

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student demonstrates the functions and applications of the tools, equipment, technologies, and metals used in code welding. The student is expected to:	(D) use appropriate personal protective equipment	(i) 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	(i) work independently to fabricate welded projects with minimal assistance
(3) The student applies the concepts and skills of welding of actual work situations. The student is expected to:	(B) work collaboratively with other students to complete relevant projects	(i) work collaboratively with other students to complete relevant projects
(3) The student applies the concepts and skills of welding of actual work situations. The student is expected to:	(C) troubleshoot equipment	(i) troubleshoot equipment
(4) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:	(A) explain weld inspection processes	(i) explain weld inspection processes
(4) The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:	(B) produce acceptable weldments to standards related to industry codes such as the American Welding Society (AWS), American National Standards Institute, and Canadian Welding Bureau	(i) produce acceptable weldments to standards related to industry codes such as the American Welding Society (AWS) , American National Standards Institute, and Canadian Welding Bureau
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(B) perform safe handling of compressed gases	(i) perform safe handling of compressed gases
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(C) assemble components involved in setting up for oxy-fuel gas cutting processes	(i) assemble components involved in setting up for oxy-fuel gas cutting processes
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(D) demonstrate proper set-up for cutting techniques such as piercing, straight line, and bevel	(i) demonstrate proper set-up for cutting techniques such as piercing, straight line, and bevel
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(E) evaluate acceptable and unacceptable cuts	(i) evaluate acceptable cuts
(5) The student performs oxy-fuel cutting processes. The student is expected to:	(E) evaluate acceptable and unacceptable cuts	(ii) evaluate unacceptable cuts
(6) The student performs plasma arc cutting on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(6) The student performs plasma arc cutting on metals. The student is expected to:	(B) explain the difference between safe and unsafe storage and handling of compressed gas supply	(i) explain the difference between safe and unsafe storage and handling of compressed gas supply
(6) The student performs plasma arc cutting on metals. The student is expected to:	(C) employ proper set-up procedures for plasma arc cutting	(i) employ proper set-up procedures for plasma arc cutting
(6) The student performs plasma arc cutting on metals. The student is expected to:	(D) demonstrate proper cutting techniques, including straight line, piercing, and bevels	(i) demonstrate proper cutting techniques, including straight line

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student performs plasma arc cutting on metals. The student is expected to:	(D) demonstrate proper cutting techniques, including straight line, piercing, and bevels	(ii) demonstrate proper cutting techniques, including piercing
(6) The student performs plasma arc cutting on metals. The student is expected to:	(D) demonstrate proper cutting techniques, including straight line, piercing, and bevels	(iii) demonstrate proper cutting techniques, including bevels
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(B) demonstrate shielded metal arc welding principles	(i) demonstrate shielded metal arc welding principles
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(C) demonstrate proper set-up procedures for shielded metal arc welding	(i) demonstrate proper set-up procedures for shielded metal arc welding
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(D) select appropriate electrodes for base metal in shielded metal arc welding	(i) select appropriate electrodes for base metal in shielded metal arc welding
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(E) perform welds such as fillet and groove according to the AWS Schools Excelling through National Skills Education (SENSE) welding standards	(i) perform welds according to the AWS Schools Excelling through National Skills Education (SENSE) welding standards

Knowledge and Skill Statement	Student Expectation	Breakout
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(F) perform multiple pass welds	(i) perform multiple pass welds
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(G) prepare joints for welding	(i) prepare joints for welding
(7) The student performs shielded metal arc welding principles and practices on metals. The student is expected to:	(H) explain heating processes such as pre-heating and post-heating	(i) explain heating processes
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(B) demonstrate gas metal arc welding principles	(i) demonstrate gas metal arc welding principles
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(C) demonstrate proper set-up for gas metal arc welding	(i) demonstrate proper set-up for gas metal arc welding
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(D) select appropriate filler metals for base metal in gas metal arc welding	(i) select appropriate filler metals for base metal in gas metal arc welding

Knowledge and Skill Statement	Student Expectation	Breakout
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(E) perform fillet and groove welds in all positions according to the AWS SENSE welding standards	(i) perform fillet welds in all positions according to the AWS SENSE welding standards
(8) The student demonstrates proper set-up procedure for gas metal arc welding. The student is expected to:	(E) perform fillet and groove welds in all positions according to the AWS SENSE welding standards	(ii) perform groove welds in all positions according to the AWS SENSE welding standards
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(B) employ and appraise flux cored arc welding principles	(i) employ flux cored arc welding principles
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(B) employ and appraise flux cored arc welding principles	(ii) appraise flux cored arc welding principles
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(C) demonstrate proper set-up procedures for flux cored arc welding	(i) demonstrate proper set-up procedures for flux cored arc welding
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(D) appraise appropriate filler metal for base metal in flux cored arc welding	(i) appraise appropriate filler metal for base metal in flux cored arc welding

Knowledge and Skill Statement	Student Expectation	Breakout
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(E) perform fillet and groove welds	(i) perform fillet welds
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(E) perform fillet and groove welds	(ii) perform groove welds
(9) The student performs flux cored arc welding principles and practices on metals. The student is expected to:	(F) perform welds in all appropriate positions according to the AWS SENSE welding standards	(i) perform welds in all appropriate positions according to the AWS SENSE welding standards
(10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:	(A) use safe operating practices	(i) use safe operating practices
(10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:	(B) demonstrate gas tungsten arc welding principles	(i) demonstrate gas tungsten arc welding principles
(10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:	(C) demonstrate proper set-up for gas tungsten arc welding	(i) demonstrate proper set-up for gas tungsten arc welding
(10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:	(D) select appropriate use of filler metals for base metal in gas tungsten arc welding	(i) select appropriate use of filler metals for base metal in gas tungsten arc welding

Knowledge and Skill Statement	Student Expectation	Breakout
(10) The student performs gas tungsten arc welding principles and practices on metals. The student is expected to:	(E) perform welds in all appropriate positions according to the AWS SENSE welding standards	(i) perform welds in all appropriate positions according to the AWS SENSE welding standards
(11) The student performs weldment fabrications. The student is expected to:	(A) identify layout tools	(i) identify layout tools
(11) The student performs weldment fabrications. The student is expected to:	(B) perform a part layout on plate according to a blueprint	(i) perform a part layout on plate according to a blueprint
(11) The student performs weldment fabrications. The student is expected to:	(C) perform a layout of a pipe fitting according to a blueprint	(i) perform a layout of a pipe fitting according to a blueprint
(11) The student performs weldment fabrications. The student is expected to:	(D) perform an assembly according to a blueprint	(i) perform an assembly according to a blueprint

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.366. Practicum in Manufacturing (Two Credits), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grade 12. The practicum course is a paid or unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Manufacturing Career Cluster. Students shall be awarded two credits for successful completion of this course. A student may repeat this course once for credit provided that the student is experiencing different aspects of the industry and demonstrating proficiency in additional and more advanced knowledge and skills.

(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) The Practicum in Manufacturing course is designed to give students supervised practical application of previously studied knowledge and skills. Practicum experiences can occur in a variety of locations appropriate to the nature and level of experience.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) identify and apply the employer's standard operating procedures	(i) identify the employer's standard operating procedures
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) identify and apply the employer's standard operating procedures	(ii) apply the employer's standard operating procedures
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) demonstrate positive work behaviors such as attitudes, punctuality, time management, initiative, and cooperation	(i) demonstrate positive work behaviors
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) communicate appropriately and accept constructive criticism	(i) communicate appropriately
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) communicate appropriately and accept constructive criticism	(ii) accept constructive criticism
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) research and discuss business ethics	(i) research business ethics

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) research and discuss business ethics	(ii) discuss business ethics
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) complete tasks such as quality products and services with the highest standards	(i) complete tasks with the highest standards
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) model professional appearance such as dress, grooming, and personal protective equipment as appropriate	(i) model professional appearance as appropriate
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(G) comply with safety rules such as regulations to maintain safe working conditions and environments appropriate to the work setting	(i) comply with safety rules appropriate to the work setting
(2) The student applies concepts of critical thinking and problem solving. The student is expected to:	(A) analyze elements of a problem	(i) analyze elements of a problem
(2) The student applies concepts of critical thinking and problem solving. The student is expected to:	(B) analyze information critically to determine its value	(i) analyze information critically to determine its value
(2) The student applies concepts of critical thinking and problem solving. The student is expected to:	(C) conduct technical research to gather information for decision making	(i) conduct technical research to gather information for decision making

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(A) analyze leadership characteristics such as trust, positive attitude, integrity, and willingness to accept key responsibilities in a work situation	(i) analyze leadership characteristics in a work situation
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(B) demonstrate teamwork skills through working cooperatively with others to achieve tasks	(i) demonstrate teamwork skills through working cooperatively with others to achieve tasks
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(C) demonstrate teamwork processes such as promoting team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution	(i) demonstrate teamwork processes
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(D) demonstrate responsibility for organization tasks such as shared group and individual work tasks	(i) demonstrate responsibility for organization tasks
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(E) establish and maintain effective working relationships	(i) establish effective working relationships
(3) The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:	(E) establish and maintain effective working relationships	(ii) maintain effective working relationships

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student demonstrates oral and written communication skills The student is expected to:	(A) demonstrate the use of content such as technical concepts and vocabulary	(i) demonstrate the use of content
(4) The student demonstrates oral and written communication skills The student is expected to:	(B) employ verbal skills when obtaining and conveying information	(i) employ verbal skills when obtaining information
(4) The student demonstrates oral and written communication skills The student is expected to:	(B) employ verbal skills when obtaining and conveying information	(ii) employ verbal skills when conveying information
(4) The student demonstrates oral and written communication skills The student is expected to:	(C) use informational texts such as Internet websites and technical materials for occupational tasks	(i) use informational texts for occupational tasks
(4) The student demonstrates oral and written communication skills The student is expected to:	(D) evaluate the reliability of information such as Internet websites, technical materials, and resources	(i) evaluate the reliability of information
(4) The student demonstrates oral and written communication skills The student is expected to:	(E) interpret verbal and nonverbal cues and behaviors to enhance communication	(i) interpret verbal cues to enhance communication
(4) The student demonstrates oral and written communication skills The student is expected to:	(E) interpret verbal and nonverbal cues and behaviors to enhance communication	(ii) interpret nonverbal cues to enhance communication
(4) The student demonstrates oral and written communication skills The student is expected to:	(E) interpret verbal and nonverbal cues and behaviors to enhance communication	(iii) interpret behaviors to enhance communication
(4) The student demonstrates oral and written communication skills The student is expected to:	(F) apply active listening skills such as obtaining and clarifying the information	(i) apply active listening skills

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student demonstrates oral and written communication skills The student is expected to:	(G) use academic skills such as effective written and oral communication	(i) use academic skills
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(A) use information literacy skills such as accessing, evaluating, and disseminating information	(i) use information literacy skills
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(B) describe information management	(i) describe information management
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(C) maintain records to facilitate ongoing business operations	(i) maintain records to facilitate ongoing business operations
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(D) develop goals	(i) develop goals
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(E) prioritize tasks	(i) prioritize tasks
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(F) develop timelines using time-management skills	(i) develop timelines using time-management skills

Knowledge and Skill Statement	Student Expectation	Breakout
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(G) use project-management skills such as initiate, plan, execute, monitor and control, and close to improve workflow	(i) use project-management skills to improve workflow
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(H) evaluate proficiencies in technical skills	(i) evaluate proficiencies in technical skills
(5) The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:	(I) accept critical feedback provided by the supervisor	(i) accept critical feedback provided by the supervisor
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(A) demonstrate growth of technical skill competencies	(i) demonstrate growth of technical skill competencies
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(B) demonstrate technical knowledge and skills by completing activities such as earning licensures or certifications	(i) demonstrate technical knowledge and skills by completing activities
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(C) develop an abstract of key points of the practicum	(i) develop an abstract of key points of the practicum
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(D) create a job-skills resume	(i) create a job-skills resume

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(E) collect representative work samples	(i) collect representative work samples
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(F) maintain copies of evaluations from the practicum supervisor and/or industrial representative	(i) maintain copies of evaluations from the practicum supervisor and/or industrial representative
(6) The student documents technical knowledge and skills using a professional portfolio. The student is expected to:	(G) present the portfolio to interested stakeholders	(i) present the portfolio to interested stakeholders

Subject	**Chapter 130. Career and Technical Education, Subchapter M. Manufacturing**
Course Title	**§130.367. Extended Practicum in Manufacturing (One Credit), Adopted 2015.**

(a) General Requirements. This course is recommended for students in Grade 12. The practicum course is a paid or unpaid capstone experience for students participating in a coherent sequence of career and technical education courses in the Manufacturing Career Cluster. Corequisite: Practicum in Manufacturing. This course must be taken concurrently with Practicum in Manufacturing and may not be taken as a stand-alone course. Students shall be awarded one credit for successful completion of this course. A student may repeat this course once for credit provided that the student is experiencing different aspects of the industry and demonstrating proficiency in additional and more advanced knowledge and skills.

(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) The Extended Practicum in Manufacturing course is designed to give students supervised practical application of previously studied knowledge and skills. Practicum experiences can occur in a variety of locations appropriate to the nature and level of experience.
(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.

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) participate in a paid or unpaid, laboratory- or work-based application of previously studied knowledge and skills related to manufacturing	(A) participate in a paid or unpaid, laboratory- or work-based application of previously studied knowledge related to manufacturing
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(A) participate in a paid or unpaid, laboratory- or work-based application of previously studied knowledge and skills related to manufacturing	(A) participate in a paid or unpaid, laboratory- or work-based application of previously studied skills related to manufacturing
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(B) participate in training, education, or preparation for licensure, certification, or other relevant credentials to prepare for employment	(i) participate in training, education, or preparation for licensure, certification, or other relevant credentials to prepare for employment
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate professional standards and personal qualities needed to be employable such as self-discipline, positive attitude, integrity, leadership, appreciation for diversity, customer service, work ethic, and adaptability with increased fluency	(i) demonstrate professional standards needed to be employable
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(C) demonstrate professional standards and personal qualities needed to be employable such as self-discipline, positive attitude, integrity, leadership, appreciation for diversity, customer service, work ethic, and adaptability with increased fluency	(ii) demonstrate personal qualities needed to be employable

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(i) use personal information management applications with increased fluency
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(ii) use email applications with increased fluency
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(iii) use Internet applications with increased fluency
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(iv) use writing and publishing applications with increased fluency
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(v) use presentation applications with increased fluency
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(D) use personal information management, email, Internet, writing and publishing, presentation, and spreadsheet or database applications with increased fluency	(vi) use spreadsheet or database applications with increased fluency

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) employ teamwork and conflict-management skills with increased fluency to achieve collective goals	(i) employ teamwork with increased fluency to achieve collective goals
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(E) employ teamwork and conflict-management skills with increased fluency to achieve collective goals	(ii) employ conflict-management skills with increased fluency to achieve collective goals
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(i) employ planning skills with increased fluency to enhance results
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(ii) employ planning skills with increased fluency to complete work tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(iii) employ planning tools with increased fluency to enhance results
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(iv) employ planning tools with increased fluency to complete work tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(v) employ time-management skills with increased fluency to enhance results

Knowledge and Skill Statement	Student Expectation	Breakout
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(vi) employ time-management skills with increased fluency to complete work tasks
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(vii) employ time-management tools with increased fluency to enhance results
(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:	(F) employ planning and time-management skills and tools with increased fluency to enhance results and complete work tasks	(viii) employ time-management tools with increased fluency to complete work tasks
(2) The student implements advanced professional communications strategies. The student is expected to:	(A) demonstrate verbal and non-verbal communication consistently in a clear, concise, and effective manner	(i) demonstrate verbal communication consistently in a clear, concise, and effective manner
(2) The student implements advanced professional communications strategies. The student is expected to:	(A) demonstrate verbal and non-verbal communication consistently in a clear, concise, and effective manner	(ii) demonstrate non-verbal communication consistently in a clear, concise, and effective manner
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(i) analyze information
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(ii) analyze data

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(iii) analyze observations
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(iv) interpret information
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(v) interpret data
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(vi) interpret observations
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(vii) effectively communicate information
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(viii) effectively communicate data
(2) The student implements advanced professional communications strategies. The student is expected to:	(B) analyze, interpret, and effectively communicate information, data, and observations	(ix) effectively communicate observations

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(i) observe verbal cues to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(ii) observe nonverbal cues to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(iii) observe verbal behaviors to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(iv) observe nonverbal behaviors to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(v) interpret verbal cues to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(vi) interpret nonverbal cues to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(vii) interpret verbal behaviors to enhance communication

Knowledge and Skill Statement	Student Expectation	Breakout
(2) The student implements advanced professional communications strategies. The student is expected to:	(C) observe and interpret verbal and nonverbal cues and behaviors to enhance communication	(viii) interpret nonverbal behaviors to enhance communication
(2) The student implements advanced professional communications strategies. The student is expected to:	(D) apply active listening skills to obtain and clarify information	(i) apply active listening skills to obtain information
(2) The student implements advanced professional communications strategies. The student is expected to:	(D) apply active listening skills to obtain and clarify information	(ii) apply active listening skills to clarify information
(3) The student implements advanced problem-solving methods. The student is expected to:	(A) employ critical-thinking skills with increased fluency both independently and in groups to solve problems and make decisions	(i) employ critical-thinking skills with increased fluency independently to solve problems
(3) The student implements advanced problem-solving methods. The student is expected to:	(A) employ critical-thinking skills with increased fluency both independently and in groups to solve problems and make decisions	(ii) employ critical-thinking skills with increased fluency in groups to solve problems
(3) The student implements advanced problem-solving methods. The student is expected to:	(A) employ critical-thinking skills with increased fluency both independently and in groups to solve problems and make decisions	(iii) employ critical-thinking skills with increased fluency independently to make decisions
(3) The student implements advanced problem-solving methods. The student is expected to:	(A) employ critical-thinking skills with increased fluency both independently and in groups to solve problems and make decisions	(iv) employ critical-thinking skills with increased fluency in groups to make decisions

Knowledge and Skill Statement	Student Expectation	Breakout
(3) The student applies concepts of critical thinking and problem solving. The student is expected to:	(B) analyze elements of a problem to develop creative and innovative solutions	(i) analyze elements of a problem to develop creative solutions
(3) The student applies concepts of critical thinking and problem solving. The student is expected to:	(B) analyze elements of a problem to develop creative and innovative solutions	(ii) analyze elements of a problem to develop innovative solutions
(3) The student applies concepts of critical thinking and problem solving. The student is expected to:	(C) conduct technical research to gather information necessary for decision making	(i) conduct technical research to gather information necessary for decision making
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(A) demonstrate an understanding of and consistently follow workplace safety rules and regulations	(i) demonstrate an understanding of workplace safety rules and regulations
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(A) demonstrate an understanding of and consistently follow workplace safety rules and regulations	(ii) consistently follow workplace safety rules and regulations
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(B) demonstrate knowledge of procedures for reporting and handling accidents and safety incidents	(i) demonstrate knowledge of procedures for reporting accidents
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(B) demonstrate knowledge of procedures for reporting and handling accidents and safety incidents	(ii) demonstrate knowledge of procedures for reporting safety incidents

Knowledge and Skill Statement	Student Expectation	Breakout
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(B) demonstrate knowledge of procedures for reporting and handling accidents and safety incidents	(iii) demonstrate knowledge of procedures for handling accidents
(4) The student understands and applies proper safety techniques in the workplace. The student is expected to:	(B) demonstrate knowledge of procedures for reporting and handling accidents and safety incidents	(iv) demonstrate knowledge of procedures for handling safety incidents
(5) The student understands the professional, ethical, and legal responsibilities in teaching and training. The student is expected to:	(A) demonstrate a positive, productive work ethic by performing assigned tasks as directed	(i) demonstrate a positive, productive work ethic by performing assigned tasks as directed
(5) The student understands the professional, ethical, and legal responsibilities in teaching and training. The student is expected to:	(B) apply ethical reasoning to a variety of situations in order to make ethical decisions	(i) apply ethical reasoning to a variety of situations in order to make ethical decisions
(5) The student understands the professional, ethical, and legal responsibilities in teaching and training. The student is expected to:	(C) comply with all applicable rules, laws, and regulations in a consistent manner	(i) comply with all applicable rules in a consistent manner
(5) The student understands the professional, ethical, and legal responsibilities in teaching and training. The student is expected to:	(C) comply with all applicable rules, laws, and regulations in a consistent manner	(ii) comply with all applicable laws in a consistent manner
(5) The student understands the professional, ethical, and legal responsibilities in teaching and training. The student is expected to:	(C) comply with all applicable rules, laws, and regulations in a consistent manner	(iii) comply with all applicable regulations in a consistent manner

Knowledge and Skill Statement	Student Expectation	Breakout
(6) The student participates in a manufacturing experience. The student is expected to:	(A) conduct, document, and evaluate learning activities in a supervised manufacturing experience	(i) conduct learning activities in a supervised manufacturing experience
(6) The student participates in a manufacturing experience. The student is expected to:	(A) conduct, document, and evaluate learning activities in a supervised manufacturing experience	(ii) document learning activities in a supervised manufacturing experience
(6) The student participates in a manufacturing experience. The student is expected to:	(A) conduct, document, and evaluate learning activities in a supervised manufacturing experience	(iii) evaluate learning activities in a supervised manufacturing experience
(6) The student participates in a manufacturing experience. The student is expected to:	(B) develop advanced technical knowledge and skills related to the student's occupational objective	(i) develop advanced technical knowledge related to the student's occupational objective
(6) The student participates in a manufacturing experience. The student is expected to:	(B) develop advanced technical knowledge and skills related to the student's occupational objective	(ii) develop advanced technical skills related to the student's occupational objective
(6) The student participates in a manufacturing experience. The student is expected to:	(C) demonstrate growth of technical skill competencies	(i) demonstrate growth of technical skill competencies
(6) The student participates in a manufacturing experience. The student is expected to:	(D) evaluate strengths and weaknesses in technical skill proficiency	(i) evaluate strengths in technical skill proficiency
(6) The student participates in a manufacturing experience. The student is expected to:	(D) evaluate strengths and weaknesses in technical skill proficiency	(ii) evaluate weaknesses in technical skill proficiency
(6) The student participates in a manufacturing experience. The student is expected to:	(E) collect representative work samples	(i) collect representative work samples