Welding

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Office of the State Superintendent of Education
Postsecondary and Career Education Division
Career and Technical Education Department

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The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Welding Program of Study. The academic standards in this document are theoretical and performance-based. The standards contain content from Colorado, Maryland, Tennessee, and Texas and were validated by D.C. business and industry partners. All content is used with permission.

In addition to academic standards, OSSE has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level.

This document is intended for use by educational administrators and practitioners. A similar document is available for each state-approved CTE Program of Study.

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Course Descriptions: Welding		
Course Level	**Course Information**	**Description**
Level I	**Introduction to Welding** **OSSEID:** 13202G1.0014 **Grades:** 9-12 **Prerequisite:** None **Credit:** 1	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.
Level II	**Welding I** **OSSEID:** 13207G1.0024 **Grades:** 10-12 **Prerequisite:** Introduction to Welding **Credit:** 1	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.
Level III	**Welding II** **OSSEID:** 13207G1.0034 **Grades:** 11-12 **Prerequisite:** Welding I **Credit:** 1	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.
Level IV	**Practicum in Manufacturing** **OSSEID:** 13950G1.0044 **Grades:** 12 **Prerequisite:** Welding II **Credit:** 1	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.

Industry Certifications

(AWS) America Welding Society Certified Welder (CW)
AWS D1.1 Certification
AWS D9.1 Certification
AWS SENSE Welding Level 1
NCCER Welding, Level 1
NIMS (National Institute for Metal Working Skills) Machining Level I - Grinding Skills I
NIMS (National Institute for Metal Working Skills) Machining Level I - Manual Milling Skills I

Work-Based Learning Examples and Resources

Level I Course	Level II Course	Level III Course	Level IV Course
Career Exploration Industry Visits Guest Speakers Participate in a CTSO	**Career Awareness** *All of Level I, plus:* Postsecondary Visits Program-Specific Site Tours Mock Interviews	**Career Preparation** *All of Level I and II, plus:* Job Shadow Paid/Unpaid Internships	**Career Preparation** Paid/Unpaid Internships Apprenticeships

Several resources are available to help instructors meet the Level I and Level II WBL requirements, including:

Career Coach DC (http://careercoachdc.emsicc.com). Online site designed to help students find and connect to a career pathway by providing the most current local data on wages, employment, job postings, and associated education and training. The resource includes a Career Assessment for students.

Nepris (https://dc.nepris.com/). Connects educators and learners with a network of industry professionals virtually, bringing real-world relevance and career exposure to all students. Nepris also provides a skills-based volunteering platform for business and industry professionals to extend their educational outreach.

Virtual Job Shadow (https://virtualjobshadow.com). Provides interactive tools which empower students to discover, plan, and pursue their dreams. Rich video library presents a "day in the life of" view for thousands of occupations.

Labor Market Information Definitions and Data

Career and Technical Education programs of study in the District of Columbia must meet at least one of the High Wage, High Skill, and In-Demand definitions below to be considered appropriate for our students and the regional labor market. These definitions were created in collaboration with Career and Technical Education leaders from District of Columbia LEAs, the University of the District of Columbia Community College, and national guidance from Research Triangle International (RTI) and Education Northwest. Additionally, previous work was consulted by researchers at MIT's Labor Wage Index Project and the DC CTE Task Force's 2012 Strategic Plan for the District of Columbia.

Indicator	Definition	Data for the Welding Program of Study (source: EMSI, August 2022)
High Wage	Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the District of Columbia, and/or leads to a position that pays at least the median hourly or annual wage for the Washington, DC, metropolitan statistical area. *Note: A 25th percentile hourly wage of $23.13 or greater is required to meet this definition.*	**Standard Occupational Code (SOC):** 51-4121.00 Welders, Cutters, Solderers, and Brazers **Hourly Wages** **25th Percentile:** $21.50 **50th Percentile:** $26.43 **75th Percentile:** $332.19
High Skill	Those occupations located within the Washington, DC, metropolitan statistical area with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, or higher.	**Typical Entry-Level Education:** High school diploma or equivalent
In-Demand	Those occupations in the Washington, DC, metropolitan statistical area having more than the median number of total (**growth plus replacement**) annual openings over a five-year period. *Note: An occupation is required to have an annual growth plus replacement rate of 105 openings, or greater, between 2021-2026 to meet this definition.*	**Annual Openings:** 402

Model Six-Year Plan: Welding

College: University of the District of Columbia Community College
Program/CIP:
Plan:

Entity: Office of the State Superintendent of Education
Career Cluster: Manufacturing
Program of Study: Welding

High School					College			
Subject	**9th Grade**	**10th Grade**	**11th Grade**	**12th Grade**	**Semester I**	**Semester II**	**Semester III**	**Semester IV**
English (4)	English I	English II	English III	English IV				
Math (4)	Algebra I	Geometry	Algebra II	Math				
Science (4)	Biology	Lab Science	Lab Science	Science				
Social Studies (4)	World History and Geography I: Middle Ages	World History and Geography II: Modern World	U.S. History	U.S. Government (.5) and D.C. History (.5)				
Health (.5) and Physical Ed (1)	Health (.5) Physical Ed (.5)	Physical Ed (.5)						
World Languages (2)			World Language I	World Language II				
Art (.5)		Art (.5)						
Music (.5)		Music (.5)						
Elective / Major Courses	Introduction to Welding	Welding I	Welding II	Practicum in Welding				
Total possible college credits completed in high school: XX					***Credit hours required to complete the AAS program: XX***			

Course Standards

Introduction to Welding

1. **General requirements.** This course is recommended for students in Grades 9-12. Students shall be awarded one credit for successful completion of this course.

2. **Introduction.**
   A. 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.

   B. 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.

   C. 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.

   D. Students will participate in at least two Career Exploration Work-Based Learning experiences in this course, which might include guest speakers and work-place tours relevant to the program of study.

   E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

3. **Knowledge and skills.**
   A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
      1. express ideas to others in a clear, concise, and effective manner through written and verbal communication;
      2. demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
      3. conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
      4. choose ethical courses of action such as following applicable rules, laws, and regulations;
      5. review detailed aspects of both quantitative and qualitative work processes and end products;
      6. evaluate systems relative to causes, problems, and patterns to improve operational situations;
      7. adhere to business practices such as policies, procedures, and health and safety rules; and

8. use time wisely by prioritizing tasks and following schedules in an efficient manner.

B. **The student explores the characteristics of a successful worker in the global economy. The student is expected to:**
   1. determine academic knowledge and skills required for postsecondary education;
   2. identify employers' expectations to foster positive customer satisfaction;
   3. 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;
   4. evaluate progress toward personal career goals;
   5. communicate effectively with others in the workplace to clarify objectives; and
   6. apply knowledge and skills to health and safety in the workplace as specified by appropriate governmental regulations.

C. **The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:**
   1. employ welding equipment according to safety standards;
   2. identify and properly dispose of environmentally hazardous materials used in welding;
   3. explain the importance of recycling materials used in welding;
   4. choose appropriate personal protective equipment; and
   5. evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulations.

D. **The student compares and contrasts welding joint design, material symbols, and welds. The student is expected to:**
   1. demonstrate knowledge of welding sketches; and
   2. identify types of welds such as fillet, groove, spot, plug, and flanged.

E. **The student applies academic skills in relationship to welding. The student is expected to:**
   1. demonstrate mathematical skills related to welding;
   2. demonstrate technical writing skills related to welding;
   3. apply accurate readings of measuring devices;
   4. accurately use appropriate tools to make measurements;
   5. solve problems using whole numbers, fractions, mixed numbers, and decimals;
   6. perform conversions between fractions and decimals; and
   7. perform conversions between standard units and metric units.

F. **The student applies the concepts and skills of welding projects. The student is expected to:**
   1. explore careers in welding;
   2. understand welding codes such as American Petroleum Institute (API) 1104 and American Welding Society (AWS) D1.1;
   3. work independently to fabricate a variety of welded projects with minimal assistance; and
   4. work collaboratively with other students.

G. **The student performs oxy-fuel cutting processes on carbon steels. The student is expected to:**
   1. use safe operating practices;
   2. perform safe handling of compressed gases;
   3. identify components of oxy-fuel gas cutting;
   4. demonstrate proper set-up procedures for the oxy-fuel process;
   5. identify the factors affecting the oxy-fuel cutting of base metals; and
   6. demonstrate proper cutting techniques such as piercing, straight line, and bevel.

H. **The student performs shielded metal arc welding principles and practices on metals. The student is expected to:**
   1. use safe operating practices;
   2. demonstrate knowledge of welding currents;
   3. apply shielded metal arc welding principles;
   4. demonstrate proper set-up procedure for shielded metal arc welding;
   5. determine appropriate electrodes for base metal in shielded metal arc welding;
   6. perform fillet and groove welds in all positions; and
   7. prepare joints for welding.

I. **The student performs gas metal arc welding principles and practices. The student is expected to:**
   1. use safe operating practices;
   2. apply gas metal arc welding principles;
   3. demonstrate proper set-up procedure for gas metal arc welding;
   4. use appropriate equipment setup for base metal in gas metal arc welding; and
   5. perform fillet and groove welds using gas metal arc welding with various metal transfer processes.

J. **The student develops technology skills. The student is expected to:**
   1. Use technology as a tool to research, organize, evaluate, and communicate information.
   2. Use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
   3. Demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry.
   4. Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

K. **The student develops technology skills. The student is expected to:**
   1. use technology as a tool to research, organize, evaluate, and communicate information.
   2. use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
   3. demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry; and
   4. apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

Welding I

1. **General requirements.** This course is recommended for students in Grades 10-12. Prerequisite: Introduction to Welding. Students shall be awarded one credit for successful completion of this course.

2. **Introduction.**
   A. 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.

   B. 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.

   C. 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.

   D. Students will participate in at least two Career Awareness Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.

   E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

3. **Knowledge and skills.**
   A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
      1. express ideas to others in a clear, concise, and effective manner through written and verbal communication;
      2. convey written information that is easily understandable to others;
      3. demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
      4. conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
      5. choose the ethical course of action and comply with all applicable rules, laws, and regulations;
      6. review the fine, detailed aspects of both quantitative and qualitative work process and end products;
      7. evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;
      8. follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules; and
      9. prioritize tasks, follow schedules, and work on goal-relevant activities in a way that uses time wisely in an effective, efficient manner.

B. **The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:**
   1. explore academic knowledge and skills required for postsecondary education;
   2. identify employers' expectations to foster positive customer satisfaction;
   3. 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;
   4. evaluate personal career goals;
   5. communicate effectively with others in the workplace to clarify objectives; and
   6. demonstrate skills related to health and safety in the workplace as specified by appropriate governmental regulations.

C. **The student applies academic skills to the requirements of welding. The student is expected to:**
   1. demonstrate effective communication skills with individuals from varied cultures such as fellow workers, management, and customers;
   2. demonstrate mathematical skills to estimate costs;
   3. demonstrate technical writing skills related to work orders;
   4. apply accurate readings of measuring devices;
   5. use appropriate tools to make accurate measurements;
   6. compute measurements such as area, surface area, volume, and perimeter;
   7. solve problems using whole numbers, fractions, mixed numbers, and decimals;
   8. use various methods, including a calculator, to perform computations;
   9. perform conversions between fractions and decimals;
   10. perform conversions between standards units and metric units;
   11. calculate and apply the functions of angles such as using the Pythagorean Theorem; and
   12. diagram the parts of a circle.

D. **The student evaluates the function and application of the tools, equipment, technologies, and materials used in welding. The student is expected to:**
   1. operate welding equipment according to safety standards;
   2. identify and properly dispose of environmentally hazardous materials used in welding;
   3. explain the importance of recycling materials used in welding;
   4. choose appropriate personal protective equipment; and
   5. evaluate skills related to health and safety in the workplace as specified by appropriate governmental regulations.

E. **The student understands welding joint design, symbols, and welds. The student is expected to:**
   1. demonstrate knowledge of engineering drawings, charts, and diagrams;
   2. interpret orthographic and isometric views of three-dimensional figures;
   3. interpret engineering, drawings, charts, and diagrams;
   4. analyze components of the welding symbol;
   5. identify types of welding joints;
   6. identify positions of welding; and
   7. identify types of welds such as fillet, groove, spot, plug, and flanged.

F. **The student analyzes the concepts and intricacies of inspections and related codes. The student is expected to:**
   1. explain weld inspection processes; and
   2. interpret welding codes.

G. **The student analyzes oxy-fuel cutting processes on carbon steels. The student is expected to:**
   1. practice safe operating practices;
   2. perform safe handling of compressed gases;
   3. identify components of oxy-fuel gas cutting system;
   4. demonstrate proper set-up procedures for oxy-fuel cutting process;
   5. identify factors affecting oxy-fuel cutting of base metals;
   6. demonstrate proper cutting techniques such as piercing, straight line, and bevel;
   7. identify acceptable cuts; and
   8. evaluate alternative fuel gasses such as propane, propylene, and Chemtane 2®.

H. **The student analyzes plasma arc cutting on metals. The student is expected to:**
   1. use safe operating practices;
   2. demonstrate knowledge of the theories of plasma arc cutting;
   3. apply safe handling of compressed air supply;
   4. identify components of plasma arc cutting;
   5. demonstrate correct set-up procedure for plasma arc cutting;
   6. define cutting terms; and
   7. perform straight line, piercing, bevels, and shape cuts.

I. **The student analyzes shielded metal arc welding principles and practices on metals. The student is expected to:**
   1. use safe operating practices;
   2. analyze welding current relationships such as alternating current and direct current, heat transfer, and polarity;
   3. apply shielded metal arc welding principles;
   4. demonstrate proper set-up procedure for shielded metal arc welding;
   5. explain the American Welding Society (AWS) identification system for shielded metal arc welding electrodes;
   6. determine appropriate electrodes for base metal in shielded metal arc welding; and
   7. perform multi-pass groove welds in all positions according to industry-accepted welding standards.

J. **The student analyzes gas metal arc welding principles and practices. The student is expected to:**
   1. use safe operating practices;
   2. explain the effects that weld angle, work angle, and electrode extension have on welds;
   3. apply gas metal arc welding principles;
   4. demonstrate proper set-up procedure for gas metal arc welding;
   5. explain the AWS identification system for gas metal arc welding filler metal;
   6. determine appropriate filler metal for base metal in gas metal arc welding; and
   7. perform fillet and groove welds in all positions.

K. **The student analyzes flux cored arc welding principles and practices on metals. The student is expected to:**
   1. use safe operating practices;
   2. explain the effects that weld angle, work angle, and electrode extension have on welds;
   3. apply flux cored arc welding principles;
   4. demonstrate proper set-up procedure for flux cored arc welding;
   5. explain the AWS identification system for flux cored arc welding electrodes;
   6. determine appropriate filler metal for base metal in flux cored arc welding; and
   7. perform fillet and groove welds in all positions.

L. **The student analyzes gas tungsten arc welding on metals. The student is expected to:**
   1. use safe operating practices;
   2. analyze electrical welding current relationships such as alternating current and direct current, heat transfer, and polarity;
   3. identify the common types of tungsten and filler metals according to the AWS identification system;
   4. demonstrate proper set-up procedure for gas tungsten arc welding;
   5. perform fillet and groove welds in all positions; and
   6. perform welds on metals such as carbon steel, stainless steel, and aluminum.

M. **The student develops technology skills. The student is expected to:**
   1. use technology as a tool to research, organize, evaluate, and communicate information.
   2. use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
   3. demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry; and
   4. apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

Welding II

1. **General requirements.** This course is recommended for students in Grades 11 and 12. Prerequisite: Welding I. Students shall be awarded one credit for successful completion of this course.

2. **Introduction.**
   A. 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.

   B. 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.

   C. 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.

   D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which might include paid or unpaid internship experiences relevant to the program of study.

   E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

3. **Knowledge and skills.**
   A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
      1. express ideas to others in a clear, concise, and effective manner through written and verbal communication;
      2. convey written information that is easily understandable to others;
      3. demonstrate acceptable work ethics in reporting for duty and performing assigned tasks as directed;
      4. conduct oneself in a manner acceptable for the profession and work site such as suitable dress and polite speech;
      5. choose the ethical course of action and comply with all applicable rules, laws, and regulations;
      6. review the fine, detailed aspects of both quantitative and qualitative work process and end products;
      7. evaluate systems and operations; identify causes, problems, patterns, or issues; and explore workable solutions or remedies to improve situations;
      8. follow written and oral instructions and adhere to established business practices, policies, and procedures, including health and safety rules;
      9. prioritize tasks, follow schedules, and work toward goal-relevant activities in an effective, efficient manner;
      10. analyze how teams function; and
      11. evaluate employers' work expectations to measure project success.

   B. **The student explores the employability characteristics of a successful worker in the global economy. The student is expected to:**

1. determine academic knowledge and skills required for postsecondary education;
2. identify employers' expectations to foster positive customer satisfaction;
3. 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;
4. evaluate progress toward personal career goals;
5. communicate effectively with others in the workplace to clarify objectives; and
6. apply knowledge and skills related to health and safety in the workplace as specified by appropriate governmental regulations.

C. **The student applies academic skills to the requirements of welding. The student is expected to:**
1. demonstrate mathematical skills to estimate costs;
2. explain the impact of accurate readings of measuring devices on cost estimates;
3. justify the selection of a tool to make accurate measurements;
4. compute measurements such as area, surface area, volume, and perimeter;
5. solve problems using whole numbers, fractions, mixed numbers, and decimals;
6. apply right triangle relationships using the Pythagorean Theorem; and
7. select a mathematical formula for estimation.

D. **The student knows the functions and applications of the tools, equipment, technologies, and materials used in welding. The student is expected to:**
1. use welding equipment according to safety standards;
2. dispose of environmentally hazardous materials used in welding;
3. explain the importance of recycling materials used in welding;
4. evaluate the performance impact of emerging technologies in welding;
5. use appropriate personal protective equipment to follow safety measures; and
6. investigate the use of automated welding machines such as numerical control, computer numerical control, and robotics-controlled welding machines.

E. **The student illustrates welding joint design, symbols, and welds. The student is expected to:**
1. use knowledge of engineering drawings to complete an advanced project; and
2. evaluate projects using engineering drawing specifications.

F. **The student applies the concepts and skills of welding to perform tasks. The student is expected to:**
1. work independently in fabricating welded projects;
2. work collaboratively with other students to complete a real-world application item; and
3. troubleshoot equipment.

G. **The student analyzes the concepts and intricacies of inspections related to welding codes. The student is expected to:**
1. inspect the welding projects of team members;
2. select codes for weld inspections; an
3. critique and evaluate the weldments of team members.

H. **The student performs advanced cutting processes on carbon steels. The student is expected to:**

1. observe safe operating practices;
2. apply safe handling of compressed gases; and
3. perform cutting processes according to accepted welding standards.

I. **The student performs shielded metal arc welding on metals. The student is expected to:**
1. employ safe operating practices; and
2. demonstrate skills required to make welds in all positions according to industry-accepted welding standards.

J. **The student performs flux cored metal arc welding. The student is expected to:**
1. use safe operating practices;
2. perform fillet and groove welds; and
3. perform welds in all appropriate positions according to to industry-accepted welding standards.

K. **The student performs gas tungsten arc welding on metals. The student is expected to:**
1. employ safe operating practices;
2. perform fillet and groove welds in all positions; and
3. perform welds on metals such as carbon steel, stainless steel, pipe, and aluminum according to industry-accepted welding standards.

L. **The student develops technology skills. The student is expected to:**
1. use technology as a tool to research, organize, evaluate, and communicate information.
2. use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
3. demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry; and
4. apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.

Practicum in Welding

1. **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. Prerequisite: Welding II. Students shall be awarded one credit for successful completion of this course.

2. **Introduction.**
   A. 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.

   B. 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.

   C. 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.

   D. Students will participate in a Career Preparation Work-Based Learning experience in this course, which includes paid or unpaid internship, pre-apprenticeship, or apprenticeship experiences relevant to the program of study.

   E. Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

3. **Knowledge and skills.**
   A. **The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:**
      1. identify and apply the employer's standard operating procedures;
      2. demonstrate positive work behaviors such as attitudes, punctuality, time management, initiative, and cooperation;
      3. communicate appropriately and accept constructive criticism;
      4. research and discuss business ethics;
      5. complete tasks such as quality products and services with the highest standards;
      6. model professional appearance such as dress, grooming, and personal protective equipment as appropriate; and
      7. comply with safety rules such as regulations to maintain safe working conditions and environments appropriate to the work setting.

   B. **The student applies concepts of critical thinking and problem solving. The student is expected to:**
      1. analyze elements of a problem;
      2. analyze information critically to determine its value; and
      3. conduct technical research to gather information for decision making.

C. **The student demonstrates leadership and teamwork skills in collaborating with others to accomplish goals and objectives. The student is expected to:**
   1. analyze leadership characteristics such as trust, positive attitude, integrity, and willingness to accept key responsibilities in a work situation;
   2. demonstrate teamwork skills through working cooperatively with others to achieve tasks;
   3. demonstrate teamwork processes such as promoting team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution;
   4. demonstrate responsibility for organization tasks such as shared group and individual work tasks; and
   5. establish and maintain effective working relationships.

D. **The student demonstrates oral and written communication skills. The student is expected to:**
   1. demonstrate the use of content such as technical concepts and vocabulary;
   2. employ verbal skills when obtaining and conveying information;
   3. use informational texts such as Internet websites and technical materials for occupational tasks;
   4. evaluate the reliability of information such as Internet websites, technical materials, and resources;
   5. interpret verbal and nonverbal cues and behaviors to enhance communication;
   6. apply active listening skills such as obtaining and clarifying the information; and
   7. use academic skills such as effective written and oral communication.

E. **The student demonstrates technical knowledge and skills required to pursue a career in the manufacturing cluster. The student is expected to:**
   1. use information literacy skills such as accessing, evaluating, and disseminating information;
   2. describe information management;
   3. maintain records to facilitate ongoing business operations;
   4. develop goals;
   5. prioritize tasks;
   6. develop timelines using time-management skills;
   7. use project-management skills such as initiate, plan, execute, monitor and control, and close to improve workflow;
   8. evaluate proficiencies in technical skills; and
   9. accept critical feedback provided by the supervisor.

F. **The student documents technical knowledge and skills using a professional portfolio. The student is expected to:**
   1. demonstrate growth of technical skill competencies;
   2. demonstrate technical knowledge and skills by completing activities such as earning licensures or certifications;
   3. develop an abstract of key points of the practicum;
   4. create a job-skills resume;
   5. collect representative work samples;
   6. maintain copies of evaluations from the practicum supervisor and/or industrial representative; and
   7. present the portfolio to interested stakeholders.

A. **The student develops technology skills. The student is expected to:**

1. use technology as a tool to research, organize, evaluate, and communicate information.
2. use digital technologies (computers, PDAs, media players, GPSs, etc.), communication/networking tools, and social networks appropriately to access, manage, integrate, evaluate, and create information to successfully function in a knowledge economy.
3. demonstrate utilizing current and new technologies specific to the program of study, course, and/or industry; and
4. apply a fundamental understanding of the ethical/legal issues surrounding the access and use of information technologies.