

**WELDING I /II**

**JANUARY 2007**

# WELDING I

## NEW JERSEY CORE CURRICULA CONTENT STANDARDS

Throughout this vocational/technical program the NJ Core Curricula Content Standards for Career Education and Consumer, Family and Life Skills are regularly reinforced. This includes addressing the standards in throughout all phases of the course outline. The specific standards addressed and the goals for their application include, but are not necessarily limited to, the following as defined by the State of NJ, Department of Education.

### **Career Education and Consumer, Family and Life Skills**

STANDARD 9.1 (CAREER AND TECHNICAL EDUCATION) ALL STUDENTS WILL DEVELOP CAREER AWARENESS AND PLANNING, EMPLOYABILITY SKILLS, AND FOUNDATIONAL KNOWLEDGE NECESSARY FOR SUCCESS IN THE WORKPLACE.

All students will explore career opportunities and make informed choices based on aptitudes and interests. Students will identify and pursue career goals, apply communications skills in work-relevant situations, demonstrate the ability to combine ideas or information in new ways, make connections between unrelated ideas, organize and present information, and allocate financial and other resources efficiently and effectively. Students will identify and use various print and non-print resources in the home, school, and community to seek and plan for employment. They will be able to use the job application process, including resumes, forms, and interviews.

Building upon knowledge and skills gained in preceding grades, by the end of **Grade 12**, students will:

#### **A. Career Awareness/Preparation**

1. Re-evaluate personal interests, abilities, and skills through various measures including self assessments.
2. Evaluate academic and career skills needed in various career clusters.
3. Analyze factors that can impact an individual's career.
4. Review and update their career plan and include the plan in a portfolio.
5. Research current advances in technology that apply to a selected occupational career cluster.

## **B. Employability Skills**

1. Assess personal qualities that are needed to obtain and retain a job related to career clusters.
2. Communicate and comprehend written and verbal thoughts, ideas, directions, and information relative to educational and occupational settings.
3. Select and utilize appropriate technology in the design and implementation of teacher-approved projects relevant to occupations and/or higher educational settings.
4. Evaluate the following academic and career skills as they relate to home, school, community, and employment:
  - Communication
  - Punctuality
  - Time management
  - Organization
  - Decision making
  - Goal setting
  - Resources allocation
  - Fair and equitable competition
  - Safety
  - Employment application skills
  - Teamwork
5. Demonstrate teamwork and leadership skills that include student participation in real world applications of career and technical education skills.

### **All students electing further study in career and technical education will also:**

1. Participate in a structured learning experience that demonstrates interpersonal communication, teamwork, and leadership skills.
2. Participate in simulated industry assessments, when and where appropriate.
3. Prepare industry-specific technical reports/projects that incorporate graphic aids, when and where appropriate.
4. Demonstrate occupational health and safety skills related to industry-specific activities.

## **Career Education and Consumer, Family and Life Skills**

STANDARD 9.2 (CONSUMER, FAMILY, AND LIFE SKILLS) ALL STUDENTS WILL DEMONSTRATE CRITICAL LIFE SKILLS IN ORDER TO BE FUNCTIONAL MEMBERS OF SOCIETY.

All students will develop original thoughts and ideas, think creatively, develop habits of inquiry, and take intellectual and performance risks. They will recognize problems, devise a variety of ways to solve these problems, analyze the potential advantages and disadvantages of each alternative, and evaluate

the effectiveness of the method ultimately selected. Students will understand the components of financial education and make economic choices. Students will demonstrate self-awareness and the ability to respond constructively to criticism and potential conflict. In addition, students will work collaboratively with a variety of groups and demonstrate the essential components of character development and ethics, including trustworthiness, responsibility, respect, fairness, caring, and citizenship. Students apply principles of resource management and skills that promote personal and professional well-being. Wellness, nutrition, child development, and human relationships are an important part of consumer, family, and life skills. However, wellness, nutrition, and human relationship cumulative progress indicators are not listed here as it would duplicate those in Comprehensive Health and Physical Education Standards.

Building upon knowledge and skills gained in preceding grades, by the end of **Grade 12**, students will:

### **A. Critical Thinking**

1. Apply communications and data analysis to the problem-solving and decision making processes in a variety of life situations.
2. Describe and apply constructive responses to criticism.
3. Apply the use of symbols, pictures, graphs, objects, and other visual information to a selected project in academic and/or occupational settings.
4. Recognize bias, vested interest, stereotyping, and the manipulation and misuse of information while formulating solutions to problems that interfere with attaining goals.
5. Apply knowledge and skills needed to use various means of transportation within a community.

### **B. Self-Management**

1. Revise and update the personal growth plan to address multiple life roles.
2. Apply project planning and management skills in academic and/or occupational settings.
3. Compare and contrast methods for maximizing personal productivity.

### **C. Interpersonal Communication**

1. Model interpersonal and effective conflict resolution skills.
2. Communicate effectively in a variety of settings with a diverse group of people.

#### **D. Character Development and Ethics**

1. Analyze how character influences work performance.
2. Identify and research privileges and duties of citizens in a democratic society.
3. Discuss consequences and sanctions when on-the-job rules and laws are not followed.
4. Compare and contrast a professional code of ethics or code of conduct from various work fields and discuss similarities and differences.
5. Apply a professional code of ethics to a workplace problem or issue.

#### **E. Consumer and Personal Finance**

1. Analyze factors that influence gross and net income.
2. Design, implement, and critique a personal financial plan.
3. Discuss how to obtain and maintain credit.
4. Prepare and use skills for budget preparation, making predictions about income and expenditures, income tax preparation, and adjusting spending or expectations based on analysis.
5. Use comparative shopping techniques for the acquisition of goods and services.
6. Analyze the impact of advertising, peer pressure, and living arrangements on personal purchasing decisions.
7. Evaluate the actions a consumer might take in response to excess debt and personal financial status.
8. Analyze the interrelationships between the economic system and consumer actions in a chosen career cluster.

#### **F. Safety**

1. Engage in an informed discussion about rules and laws designed to promote safety and health.

2. Describe and demonstrate basic first aid and safety procedures.
3. Analyze the occurrence of workplace hazards.
4. Practice the safe use of tools and equipment.
5. Implement safety procedures in the classroom and workplace, where appropriate.
6. Discuss motor vehicle safety, including but not limited to, New Jersey motor vehicle laws and regulations, methods of defensive driving, and the importance of personal responsibility on public roads/streets.

## **I. COURSE DESCRIPTION**

Welding I is a basic fundamental welding course intended to prepare the student in related subjects and skill proficiency levels to fulfill the Welding II prerequisite requirements. The course topics introduce health and safety, blueprint interpretation, introduction to manual welding and cutting processes, basic welding and cutting techniques, basic metallurgy, math and measurement for welders and simple fabrication techniques.

Students are indoctrinated in the safe and proper use of general welding shop hand tools and power tools, welding power supplies and equipment, manual metal working tools and power metal fabrication equipment. General tool and equipment maintenance and repair procedures are instructed.

Basic weld inspection methods are demonstrated to evaluate the student's cutting and welding exercises. Students learn the fundamental operating variables and techniques for all the manual welding and cutting processes included in the curriculum. General knowledge of weld types, weld dimensions, weld joint designs and welding position techniques are disseminated into the lessons and demonstrations on each topic.

Students will build a fundamental base of knowledge on which to prepare to accomplish all the requirements for the American Welding Society Entry Level Welder Certification Training Program.

## **II. COURSE OBJECTIVE/OUTLINE**

### **A. HEALTH AND SAFETY PRACTICES AND PROCEDURES**

The student will be able to:

1. Identify, explain and report the causes of accidents.
2. Explain the limits of first aid and administer first aid procedures.
3. Demonstrate the correct methods of lifting and material handling.
4. Demonstrate the safe and proper use of all shop personal safety equipment.
5. Demonstrate the emergency evacuation procedures.
6. Demonstrate the safe and proper procedures for the use of fire fighting equipment.
7. List the rules and regulations of fire prevention.
8. Demonstrate proper housekeeping procedures for storage, cleanliness and maintenance.
9. Identify safety zones by color-coding, tags, signs and labels.
10. Identify electrical shock hazards and demonstrate the proper use of electrical emergency stop devices.
11. Demonstrate the safe and proper use of general hand tools and tools of the welding trade.
12. Demonstrate the safe and proper use of power tools.
13. Demonstrate the safe and proper use of welding electrical power supplies and equipment.
14. Explain the methods of prevention of arc flashing and arc burn.
15. Demonstrate the safe and proper use of the Oxyacetylene torch and equipment.
16. Demonstrate the safe and proper handling of compressed gas cylinders.

## **B. RELATED SKILLS AND KNOWLEDGE**

The student will be able to:

1. Identify details and interpret specifications.
2. Interpret and follow detailed instructions.
3. Accurately spell, write and relate to technical terms.
4. Locate and develop knowledge of employment opportunities in the welding industry through career information research, lessons, presentations, multi-media events and field trips.

## **C. BLUEPRINT INTERPRETATION**

The student will be able to:

1. Identify and interpret basic elements of a drawing or sketch.
2. Identify and interpret weld and welding symbols.
3. Accurately add, subtract, multiply and divide whole numbers, fractions, mixed numbers and decimals.
4. Demonstrate the use of measuring devices in US standard and metric units.
5. Demonstrate the use of a calculator to perform basic math and metric conversions.
6. Identify geometric shapes and dimensions.
7. Fabricate parts from a drawing or sketch within a specified tolerance.

## **D. ELECTRICAL FUNDAMENTALS**

The student will be able to:

1. Explain the fundamentals of alternating current and direct current electricity.
2. Explain the distribution of heat in a welding circuit relative to the type of electrical current flow.
3. Demonstrate the correct set up of a direct current polarity on a welding power supply.
4. Demonstrate the correct set up of an alternating current on a welding power supply.
5. List the rules and regulations of welding electrical safety.

## **E. WELD INSPECTION AND TESTING**

The student will be able to:

1. Apply the fundamentals of visual weld inspection.
2. Perform visual examination and assess the quality of cut surfaces and edges of prepared base metal parts.
3. Perform visual examination and assess the quality of tack welds, root passes, intermediate layers and completed welds.

## **F. OXYFUEL CUTTING**

The student will be able to:

1. Demonstrate the safe and proper procedures for OFC equipment set up and torch operation.
2. Demonstrate safe and proper methods of OFC equipment assembly, handling and safety inspection.
3. Recall and relate oxyfuel cutting terminology and definitions.
4. Explain the fundamental principles of OFC operation.
5. Perform equipment set up for manual OFC torch operations on carbon steel.
6. Demonstrate the correct technique for straight line, square edge, manual OFC cuts on carbon steel in the 1G and 2G positions.
7. Demonstrate the correct technique for beveled, manual OFC cuts on carbon steel in the 1G and 2G positions.
8. Demonstrate the correct technique for radius and irregular shape, square edge, manual OFC cuts on carbon steel in the 1G and 2G positions.
9. Demonstrate the correct technique for scarfing and gouging, manual OFC torch operations on carbon steel in the 1G and 2G positions.
10. Demonstrate the correct set up and operation of mechanized OFC equipment for straight-line square edge cutting on carbon steel.
11. Demonstrate the correct set up and operation of mechanized OFC equipment for beveled edge cutting on carbon steel.

## **G. PLASMA ARC CUTTING**

The student will be able to:

1. Demonstrate the safe and proper procedures for assembly, set up and safety testing of PAC equipment.
2. Demonstrate the safe and proper handling of compressed air supplies for PAC cutting.
3. Recall and relate PAC terminology and definitions.
4. Explain the fundamental principles of PAC operation.
5. Identify PAC equipment components and the specific functions.
6. Demonstrate the safe and proper operation of the PAC cutting torch.
7. Demonstrate the correct technique for starting and maintaining a PAC cutting torch arc on carbon steel, austenitic stainless steel and aluminum.
8. Demonstrate the correct technique for making square edged straight and curved cuts with a PAC cutting torch on carbon steel, austenitic stainless steel and aluminum in the flat position.

## **H. GAS TUNGSTEN ARC WELDING**

The student will be able to:

1. Demonstrate the safe and proper procedures for GTAW equipment set up and operation.
2. Demonstrate the safe and proper handling of compressed shielding gas cylinders.
3. Recall and relate the GTAW process terminology and definitions.
4. Explain the fundamental principles of the GTAW process.
5. Explain the basic welding metallurgy of carbon steel, stainless steel and aluminum.
6. Identify and select filler metals for various GTAW applications.
7. Properly prepare materials and accurately assemble weldments.
8. Perform continuous fusion weld beads on carbon steel, stainless steel and aluminum in the flat and horizontal positions.
9. Perform continuous weld beads with filler wire on carbon steel, stainless steel and aluminum.
10. Perform fillet welds in the 1F and 2F positions on carbon steel, stainless steel and aluminum.
11. Perform groove welds in the 1G and 2G positions on carbon steel, stainless steel and aluminum.
12. Perform fillet and groove welds in the flat and horizontal positions on carbon steel, stainless steel and aluminum butt, lap, corner, T and edge joints.

## **I. SHIELDED METAL ARC WELDING**

The student will be able to:

1. Demonstrate the safe and proper set up and operation of SMAW equipment.

2. Identify the major equipment components of SMAW equipment and explain the specific functions.
3. Explain the fundamental principles of the SMAW process.
4. Explain the SMAW electrode classification number system and select filler metal electrodes classifications.
5. Demonstrate proper preparation of materials and accurately assemble weldments.
6. Demonstrate the correct technique for striking off an arc and running intermittent weld beads on carbon steel in the flat position.
7. Demonstrate the correct technique for running continuous weld beads on carbon steel in the flat position.
8. Demonstrate the correct technique for overlapping multiple pass padding to buildup a surface on carbon steel in the flat position with E-6010 and E-7018 electrodes.
9. Demonstrate single and multiple pass fillet welds in the 1F and 2F positions with E-6010 and E-7018 electrodes on carbon steel.
10. Demonstrate single and multiple pass groove welds in the 1G and 2G positions with E-6010 and E-7018 electrodes on carbon steel.
11. Demonstrate fillet and groove welds in the flat and horizontal positions on carbon steel butt, lap, corner, T and edge joints.

## **J. GAS METAL ARC WELDING**

The student will be able to:

1. Demonstrate the safe and proper procedures for GMAW equipment set up and operation.
2. Demonstrate the safe and proper handling of compressed shielding gas cylinders.
3. Recall and relate GMAW process terminology and definitions.
4. Explain the fundamental principles of the GMAW process.
5. Identify the major equipment components of the GMAW process and explain the specific functions.
6. Perform filler metal spool change operations and drive roller maintenance and repair procedures.
7. Describe the three GMAW modes of filler metal transfer and adjust the process controls for each mode.
8. Explain the GMAW electrode classification number system and select filler metal classifications.
9. Demonstrate the proper preparation of materials and accurately assemble weldments.
10. Demonstrate the correct technique for intermittent and continuous weld beads on carbon steel in the flat position using short circuit transfer.
11. Demonstrate the correct technique for continuous overlapping multiple pass weld beads to build a pad on carbon steel in the flat position using short circuit transfer.

12. Perform fillet welds in the 1F and 2F positions on carbon steel using short circuit transfer on single and multiple pass welds.
13. Perform groove welds in the 1G and 2G positions on carbon steel using short circuit transfer on single and multiple pass welds.
14. Perform fillet welds in the 1F and 2F positions on carbon steel using spray transfer on single pass welds.
15. Perform groove welds in the 1G and 2G positions on carbon steel using spray transfer on single pass welds.

## **K. FLUX CORED ARC WELDING /FCAW with GAS**

The student will be able to:

1. Demonstrate the safe and proper procedure for FCAW equipment set up and operation.
2. Demonstrate the safe and proper handling of compressed shielding gas cylinders.
3. Recall and relate FCAW process terminology and definitions.
4. Explain the fundamental principles of the FCAW process.
5. Identify the major FCAW equipment components and explain the specific functions.
6. Explain the FCAW electrode classification number system and select filler metal classifications.
7. Perform filler metal spool changing operations and drive roll maintenance and repair procedures.
8. Properly prepare materials and accurately assemble weldments.
9. Demonstrate the correct technique for starting and maintaining an arc and produce intermittent and continuous weld beads in the flat position using self-shielded and gas shielded FCAW filler wires.
10. Demonstrate the correct technique for continuous multiple pass weld beads to build a pad on 3/8 carbon steel in the flat position self shielded and gas shielded FCAW filler wires.
11. Perform fillet welds in the 1F and 2F positions using self shielded and gas shielded filler wires on single and multiple pass welds on carbon steel.
12. Perform groove welds in the 1G and 2G positions using self shielded and gas shielded filler wires on single and multiple pass welds on carbon steel.

## **L. METAL FABRICATION**

The student will be able to:

1. Demonstrate the safe and proper operation of manual metal forming equipment including the: ring rollers, hydraulic press, hand bender and sheet metal brake.
2. Identify base metal materials by type and dimensional sizes.
3. Demonstrate the safe and proper use of power metal working equipment including the: shear, vertical band saw, cut off saw, power roller, drill press and pedestal grinders.

4. Demonstrate the safe and proper use of all general welding shop hand tools.
5. Demonstrate the safe and proper use of all welding shop power hand tools including: angle grinders, drills, hand shear, die grinder, air sanders and air tools.
6. Demonstrate the ability to fabricate practice weldments and basic projects by cutting material sizes, performing forming operations, assembling parts, application of tack welds and performing final welding operations following a sketch or engineers drawing with in a specified dimensional tolerance.

### **III. TEXTBOOKS AND INSTRUCTIONAL MATERIALS**

American Welding Society, S.E.N.S.E., Curriculum Guide for the Training of Welding Personnel: Level 1-Entry Level Welder, AWS EG2.0:2006, reference publications:

- ANSI Z39.1 Safety in Welding , Cutting and Allied Processes.
- AWS A2.4 Standard Symbols for Welding, Brazing and Nondestructive Examination.
- AWS A3.0 Standard Welding Terms and Definitions.
- AWS B1.11 Guide for the Visual Inspection of Welds.
- AWS C4.2 Recommended Practices for Safe Oxyfuel Gas Cutting Torch Operation.
- AWS C5.2 Recommended Practices for Plasma Arc Cutting and Gouging.
- AWS C5.5 Recommended Practices for Gas Tungsten Arc Welding.
- AWS C5.6 Recommended Practices for Gas Metal Arc Welding.
- WHB-2.X Welding Handbook Volume Two, Welding Processes-Part 1.
- WHB-3.X Welding Handbook Volume Three, Welding Processes-Part 2.
- WHB-4.X Welding Handbook Volume Four, Materials and Applications-Part 1.
- WHB-5.X Welding Handbook Volume Five, Materials and Applications-Part 2.

Hobart Institute of Welding Technology Curriculum Video Training Modules:  
Blueprint Reading for Welders and Fitters.

Shielded Metal Arc Welding Basic.

Gas Metal Arc Welding Basic.

Flux-Cored Arc Welding.

Gas Tungsten Arc Welding Basic.

Welding Discontinuities and Defects.

Instruction Manual for the Plasma Cam Cutting System, Plasma Cam Inc., Colorado City, CO, 2002.

Ornamental Iron idea and design book, Marshall Bulle, Rye, Colorado, 2002.

### **IV. INSTRUCTIONAL STRATEGIES**

In order to meet the individual needs of our students, differentiated instruction is utilized in every class. This involves the use of a variety of instructional strategies, including but

not necessarily limited to: readings and exercises from the approved text(s) and related supplemental materials; hands-on practical projects; cooperative group activities; teacher generated handouts; lecture in conjunction with class discussion and notes; debates; role playing activities; oral and written reports; simulations; multimedia presentations; related field trips; related technology based projects, Internet and ITV presentations and conferences.

## **V. EVALUATION**

Students will be evaluated objectively in accordance with state and local guidelines. It is our goal to afford students every opportunity to succeed and to include both formative and summative methods of assessment. A wide variety of evaluation methods will be utilized in order to accommodate the multiple intelligences of our students, and incorporate the variety of learning styles and diversification of instructional methods. Evaluation methods will include, but are not necessarily limited to, the following:

1. Tests and Quizzes (questioning strategies include essay, multiple choice, true and false, matching, fill in the blank, and short answer);
2. Projects;
3. Classroom activities;
4. Research;
5. Reports;
6. Notebook maintenance;
7. Class participation;
8. Rubrics;
9. Portfolios;
10. Teacher observation.
11. Entry Level Welder Closed Book Examination (see AWS EG2.0:2006).
12. Entry Level Welder Workmanship Performance Qualification sample weldments (see AWS EG2.0:2006-AWS EDU Drawing No. AWS-1through 5, AWS QC10).
13. Entry Level Welder Standard Performance Qualification, visual examination and bend test criteria (see AWS EG2.0:2006-AWS EDU Drawing No. AWS-6, AWS QC10).

## VI. SCOPE AND SEQUENCE CHART

Key I=Introduced

D=Developed in Depth

R=Reinforced

<b>SKILL TO BE LEARNED</b>	<b>10</b>	<b>11</b>	<b>12</b>
<u>Gain knowledge of welding shop safety practices.</u>	IDR		
<u>Gain an understanding of employment opportunities in the Welding industry.</u>	IDR		
<u>Gain an understanding of the proper use of hand tools.</u>	IDR		
<u>Gain an understanding of the proper use of power tools.</u>	IDR		
<u>Gain an understanding of the proper use of power cutting tools.</u>	IDR		
<u>Gain an understanding of blueprint interpretation.</u>	ID		
<u>Gain an understanding of the use of measuring tools.</u>	IDR		
<u>Gain an understanding of electricity in the welding circuit.</u>	ID		
<u>Gain an understanding visual weld inspection.</u>	ID		
<u>Gain an understanding of oxyfuel cutting equipment.</u>	IDR		
<u>Demonstrate basic skills performing oxyfuel cutting techniques.</u>	IDR		
<u>Gain an understanding of plasma cutting equipment.</u>	IDR		
<u>Demonstrate basic skills performing plasma-cutting techniques.</u>	IDR		
<u>Gain an understanding of gas tungsten arc welding equipment.</u>	IDR		
<u>Demonstrate basic skills performing gas tungsten arc welding techniques.</u>	IDR		
<u>Gain an understanding of shielded metal arc welding equipment.</u>	IDR		
<u>Demonstrate basic skills performing shielded metal arc welding techniques.</u>	IDR		
<u>Gain an understanding of gas metal arc welding equipment.</u>	IDR		
<u>Demonstrate basic skills performing gas metal arc welding techniques.</u>	IDR		
<u>Gain an understanding of flux-cored arc welding equipment.</u>	IDR		

Demonstrate basic skills performing flux-cored arc welding techniques.	IDR
Gain an understanding of metal fabrication equipment.	IDR
Demonstrate basic skills performing metal fabrication techniques.	IDR

## **PASSAIC COUNTY TECHNICAL INSTITUTE**

### **X. STUDENT HANDOUT**

#### **WELDING I**

##### **COURSE OVERVIEW**

Welding I is a basic fundamental welding course intended to prepare the student in related subject and skill proficiency levels to fulfill the Welding II prerequisite requirements. The course topics introduce health and safety, blueprint interpretation, introduction to manual welding and cutting processes, basic welding and cutting techniques, basic metallurgy, math and measurements for welders and simple fabrication techniques.

Students are indoctrinated in the safe and proper use of general welding shop hand tools and power tools, welding power supplies and equipment, manual metal working tools and power metal fabrication equipment. General tool and equipment maintenance and repair procedures are instructed.

Basic weld inspection methods are demonstrated to evaluate the students cutting and welding exercises. Students learn the fundamental operating variables and techniques for all the manual welding and cutting processes included in the curriculum. General knowledge of welding metallurgy, weld types, weld dimensions, weld joint designs and welding position techniques are disseminated into the lessons and demonstrations on each topic.

Students will build a fundamental base of knowledge on which to prepare to accomplish all the requirements for the American Welding Society Entry Level Welder Certification Training Program.

**PROFICIENCIES** – Upon successful completion of the requirements of this course, the student will be able to:

- A. Demonstrate knowledge of welding shop health and safety practices.
- B. Develop knowledge of employment opportunities in the welding industry.
- C. Develop an understanding of a craftsman's attitude toward attributes of quality, accuracy, efficiency and pride in workmanship.
- D. Demonstrate the use of basic hand tools, power tools and measuring tools.
- E. Demonstrate knowledge of basic blueprint interpretation, math for welders and project fabrication procedures.
- F. Demonstrate knowledge of metal identification, welding joint design and basic welding metallurgy.
- G. Demonstrate skill in oxyfuel cutting and plasma arc cutting techniques.
- H. Demonstrate basic skill in gas tungsten arc welding, gas metal arc welding, flux-cored arc welding and shielded metal arc welding techniques.