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ABSTRACT

This Idaho state curriculum guide provides lists of tasks, performance objectives, and enabling objectives for instruction in welding. Following an introduction and a list of tasks, the bulk of the document consists of 10 modules, each of which is a list of tasks and the performance objectives and enabling objectives that pertain to each task. The modules cover these areas: (1) Vocational Industrial Clubs of America and employability skills; (2) general safety skills; (3) basic trade skills; (4) oxyacetylene welding; (5) oxy-fuel cutting; (6) shielded metal arc welding; (7) gas tungsten arc welding; (8) gas metal arc and flux cored arc welding; (9) air carbon arc cutting; and (10) plasma arc cutting. (CML)

Vo. Ed. 135

Curriculum Guide for

APPLIED WELDING TECHNOLOGY

Invest in Success

IDAHO VTE VOCATIONAL TECHNICAL EDUCATION

STATE DIVISION OF VOCATIONAL EDUCATION

JUNE 1990

APPLIED WELDING TECHNOLOGY

JUNE 1990

Idaho State Board for Vocational Education

APPLIED WELDING TECHNOLOGY CURRICULUM

MAY 1990

Division of Vocational Education
650 West State Street
Boise, Idaho 83720

State of Idaho
DIVISION OF VOCATIONAL EDUCATION

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Greetings:

The Division of Vocational Education is pleased to provide you with this State Curriculum Guide as a part of our commitment to your efforts in conducting quality educational programs for students who are preparing for employment in meaningful and rewarding occupations.

We know that a great deal of time and effort goes into the operation of a Vocational Education program, and we applaud your local efforts to make these programs available for students. This State Guide should assist you in these efforts.

The competency-based State Guide was developed from a Technical Committee Report prepared with the assistance of industry personnel. The Report includes a Task List which is the basis for the State Guide. The Tasks identified in the Technical Committee Report were representative of the competencies needed by a worker to be hired or employed in Idaho businesses.

Vocational Education has adopted the Competency-Based approach as the primary method of delivering Vocational Education skills to students. Competency Profiles are available for each student enrolled in programs as a means of recording student progress. The Profile is used as a student record when additional training is sought -- aiding in the program articulation process. The Profile also communicates to employers those skills the student has mastered.

We hope you find this document useful. Your comments are welcome!

Trudy Anderson, Ph.D.
Administrator

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The State of Idaho greatly appreciates the permission granted by the States of Alabama and Florida to utilize the program standards developed by those states. Special thanks are extended to Jim Kendrick of Alabama and Dave McOuat of Florida for their assistance in providing the basic materials for this project.

Don Eshelby
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and Technical Education

INTRODUCTION

The Idaho Vocational Curriculum Guide Project was a cooperative effort among secondary and postsecondary instructors and administrators to develop competency-based program standards for curriculum content for the Welding Technology Program.

The Welding Technology Curriculum was developed utilizing the Catalog of Performance Objectives, Criterion-Referenced Measures, and Performance Guides for Welding Technology compiled by the States of Alabama and Florida for the Vocational-Technical Education Consortium of States (V-TECS). V-TECS is a multi-state organization committed to curriculum research in specific occupational areas. The content of this document is directed toward the occupational area of Welding Technology - not toward a specific institution in the State.

The benefits to students and institutions derived from the development of these curriculum standards should be considerable. Articulation of students from secondary to postsecondary programs will be aided through a single set of curriculum standards. Local evaluation of programs and curricula can be accomplished using the standards as an objective measure. Institutions will be able to utilize the curriculum standards in a flexible manner to assure that vocational programs meet the needs of local business and industry.

TASK LIST

The task list is a set of occupational skills or "tasks" which are grouped by modules. Each task describes an occupational activity that, when performed, will result in a finished process and can vary, but should always allow an evaluation using the standards which address the operation, appearance, dimensions, or similar characteristics.

The tasks in each module represent the fundamental activities that should be required of any student seeking institutional credit for performing at an acceptable level of competency. The tasks are sequenced to reflect a progression from the curriculum standards which are unique to an institution's instructional program and which should be added upon approval of the administration.

The capability for providing instructional experiences and practical application of the tasks contained in each module will determine the scope of the vocational-technical program. Primary considerations will obviously be the availability of equipment and the expertise of the instructional staff.

Individual records of student progress based on the task list should be developed or adapted by the vocational institution for use in recording the student's attainment of competency by task and module. Each task has a specific performance objective and a series of enabling objectives. The enabling objectives are steps in the procedure of attaining the knowledge and skill specified in the performance objective. Student's progress is measured by successful completion of the enabling objectives by oral, written or performance testing.

TASK PROFILE

IDAHO CURRICULUM FRAMEWORK — PROGRAM AREA: Trade & Industrial

PROGRAM TITLE: Applied Welding Technology — EFFECTIVE DATE: June, 1990

IDAHO CODE NUMBER: 6236 — CIP 48.0508

I. MAJOR CONCEPTS/CONTENT: The purpose of this program is to prepare students for employment as welders and flame cutters (Division 81), tack welders (810.684-010), welder assemblers (819.381.010), welder helpers (819.687-014), combination welders (819.384.010), arc cutters (816.384-010), arc welders (810.384-014), combination welders (819.384-010), production line welders (819.684-010), or to provide supplemental training for persons previously or currently employed in these occupations.

The content includes, but is not limited to, communication skills, leadership skills, human relations and employability skills, safe and efficient work practices, use of blueprints and shop drawing, use of gases and/or welding processes and brazing parts according to diagrams, blueprints or written specifications.

II. LABORATORY ACTIVITIES: Shop or laboratory activities are an integral part of this program and provide instruction in various processes and techniques of welding and fabrication skills, including oxyacetylene welding and cutting (OAW), brazing, arc welding (SMAW), MIG welding (GMAW), flux core arc welding (FCAW), TIG welding (GTAW), certification test preparation, and use of current industry standards and techniques.

III. SPECIAL NOTE: The Vocational Industrial Clubs of America, Inc. is an appropriate vocational student organization for providing leadership training experiences and reinforcing specific vocational skills. When provided, these activities are considered an integral part of this instructional program.

The cooperative method of instruction may be utilized for this program. Whenever the cooperative method is offered, the following is required for each student: a training plan, signed by the student, teacher and employer, which includes instructional objectives and a list of on-the-job and in-school learning experiences; a work station that reflects equipment, skills and tasks relevant to the occupation the student has chosen as a career goal.

The typical length of this program for the average-achieving student at the post-secondary level is 1200 to 1400 hours for a certificate and 2000 to 2250 hours for an A.A.S. degree. The average length for secondary students is 900 hours with multi period blocks of instruction provided to accomplish a major portion of the listed competencies.

IV. INTENDED OUTCOMES:

After successfully completing this program, the student will be able to:

01. Demonstrate employability skills.
02. Demonstrate general safety skills.
03. Apply basic trade skills.
04. Apply oxyacetylene welding skills.
05. Apply oxy-fuel cutting skills.
06. Apply shielded metal arc welding skills (SMAW).
07. Apply gas tungsten arc welding skills (GTAW).
08. Apply gas metal and flux core welding skills (GMAW)(FCAW).
09. Apply carbon arc cutting skills.
10. Apply plasma arc cutting skills.

- INSTRUCTIONAL LEVEL CODE -

NOTE: The letter key in the task listing is as follows:
LEVEL

E = Entry level skill - denotes basic instructional content necessary to enter job market.

R = Retention level skill - denotes instructional content needed to retain the job.

A = Advanced vocational education level skill - denotes skill training for job retention and promotability.

TASK LISTING

STUDENT PERFORMANCE STANDARDS EFFECTIVE DATE: June 1990

PROGRAM AREA: Applied Welding Technology

01.0 EMPLOYABILITY SKILLS - The student will be able to:

LEVEL		
E	01.01	Identify employment opportunities.
E	01.02	Apply employment-seeking skills.
E	01.03	Interpret employment capabilities.
E	01.04	Demonstrate appropriate work behavior.
E	01.05	Maintain safe and healthy environment.
E	01.06	Maintain a business-like image.
E	01.07	Maintain working relationship with others.
E	01.08	Communicate on the job.
E	01.09	Adapt to change.
E	01.10	Demonstrate a knowledge of business.
E	01.11	Perform mathematical skills.

02.0 DEMONSTRATE GENERAL SAFETY SKILLS - The student will be able to:

LEVEL		
E	02.01	Identify the use and purpose of the safety equipment required for any assigned procedure or operation, i.e., ear plugs.
E	02.02	Set up and maintain a safe working environment for all assigned procedures or operations.
E	02.03	Demonstrate safe operation of a disc grinder.
E	02.04	Demonstrate safe operation of a bench grinder.
E	02.05	Demonstrate safe operation of a cut off saw.
E	02.06	Demonstrate safe operation of a band saw.
R	02.07	Demonstrate safe operation of a hydraulic shear, punch, brake, and roll.
E	02.08	Demonstrate safe operation of a drill press.
E	02.09	Demonstrate safe operation of common hand tools.

03.0 APPLY BASIC TRADE SKILLS - The student will be able to:

LEVEL		
R	03.01	Interpret detail drawings.
E	03.02	List materials for fabrication from blueprints.
E	03.03	Identify fabrication materials.
E	03.04	Identify metals by appearance, weight, and magnetic properties.
E	03.05	Identify metals by spark test.
E	03.06	Apply cutting skills.
R	03.07	Apply bending skills.
E	03.08	Apply drilling skills.
E	03.09	Apply punching skills.
R	03.10	Apply finishing skills.
R	03.11	Apply rolling skills.
E	03.12	Demonstrate proper tip cleaning procedures.
E	03.13	Demonstrate proper regulator adjustment.
R	03.14	Use technical manuals and references.
R	03.15	Demonstrate use of layout tools.
E	03.16	Maintain a clean, well-organized work area.
E	03.17	Identify basic weld symbols.
E	03.18	Identify major welding procedures/processes.

04.0 OXYACETYLENE WELDING - The student will be able to:

LEVEL		
E	04.01	Set up an oxyacetylene station.
E	04.02	Light and adjust torches.
E	04.03	Puddle mild steel plate without filler.
E	04.04	Pad mild steel plate with filler, flat position.
E	04.05	Weld T-joint in the flat position (1-F) with filler.
E	04.06	Weld lap joint in the flat position (1-F).
E	04.07	Weld corner joint in the flat position (1-F).
E	04.08	Weld butt joint in the flat position (1-G).
R	04.09	Deposit weld beads in the horizontal position.
R	04.10	Weld a T-joint in the horizontal position (2-F).
R	04.11	Weld a lap joint in the horizontal position (2-F).
R	04.12	Weld a corner joint in the horizontal position (2-F).
R	04.13	Weld a butt joint in the horizontal position (2-G).
R	04.14	Deposit weld beads in the vertical position.
A	04.15	Weld a T-joint in the vertical position (3-F).
A	04.16	Weld a lap joint in the vertical position (3-F).
A	04.17	Weld a corner joint in the vertical position 3-F).
A	04.18	Weld a butt joint in the vertical position (3-G).
A	04.19	Deposit weld beads in the overhead position.
A	04.20	Weld a T-joint in the overhead position (4-F).
A	04.21	Weld a lap joint in the overhead position (4-F).
A	04.22	Weld a corner joint in the overhead position (4-F).
A	04.23	Weld a butt joint in the overhead position (4-G).
A	04.24	Weld pipe in the flat position (1-G).
A	04.25	Weld pipe in the 2-G, 5-G, and 6-G positions.

E	04.26	**Braze mild steel.**
A	04.27	**Braze cast iron.**
E	04.28	**Braze copper.**
E	04.29	**Silver braze copper pipe joints.**
E	04.30	**Soft solder copper joints**
A	04.31	**Braze cast iron to mild steel.**
R	04.32	**Oxyacetylene weld/braze aluminum.**
R	04.33	**Hardsurface weld with oxyacetylene welding equipment.**

05.0 OXY-FUEL CUTTING - The student will be able to:

LEVEL		
E	05.01	Set up an oxyacetylene station.
E	05.02	Light and adjust torches.
E	05.03	Lay out and cut straight line (manual).
E	05.04	Lay out and cut bevels (manual).
E	05.05	Lay out and cut circles.
E	05.06	Lay out and cut patterns.
R	05.07	Lay out and cut structural shapes, beams, angle, and channel iron.
A	05.08	Lay out and cut pipe.
R	05.09	Lay out and cut square and round solid stock (manual).
E	05.10	Lay out and straight line cut (machine).
E	05.11	Lay out and bevel cut mild steel plates (machine).
R	05.12	Lay out and stack cut mild steel plates (machine).
R	05.13	Discuss heat distortion and preheating apparatus.

06.0 SHIELDED METAL ARC WELDING - The student will be able to:

LEVEL		
E	06.01	Set up and adjust a shielded metal arc welder.
E	06.02	Identify and select electrodes.
E	06.03	Strike, maintain, and restart an arc.
E	06.04	Weld straight bead in flat position.
E	06.05	Weld weave bead patterns.
E	06.06	Weld build up pads.
E	06.07	Weld butt joint on plate in flat position.
E	06.08	Weld lap joint in flat position (1-F).
E	06.09	Weld T-joints in flat, horizontal, vertical and overhead positions (1-F to 4-F).
R	06.10	Weld lap joint.
R	06.11	Weld outside corner joint in all positions (1-F through 4-F).
A	06.12	Weld basic joints in overhead positions (4-G and 4-F).
R	06.13	Weld butt joint in horizontal position (2-G).
A	06.14	Weld single V groove in all positions (1-G through 4-G).
A	06.15	Weld pipe joints in all positions.
E	06.16	Plug and slot welds.
A	06.17	Weld light gauge sheet metal (1-G through 4-G and 1-F through 4-F).
A	06.18	Weld cast iron.
A	06.19	Weld alloy steels.
E	06.20	Build up a shaft or round surface.
E	06.21	Weld aluminum.

R	06.22	Cut metals with SMAW.
R	06.23	Hard-surface metals with SMAW.

07.0 GAS TUNGSTEN ARC WELDING - The student will be able to:

LEVEL		
E	07.01	Set up gas tungsten arc welder.
E	07.02	Select and prepare proper tungsten electrode.
E	07.03	Strike an arc.
R	07.04	Weld lap joint mild steel in all positions (1-F through 4-F).
R	07.05	Weld corner joint mild steel in all positions (1-F through 4-F).
R	07.06	Weld T-joint mild steel in all positions (1-F through 4-F).
R	07.07	Weld butt joint mild steel in all positions (1-G through 4-G).
R	07.08	Weld butt joint stainless steel in all positions (1-G through 4-G).
R	07.09	Weld lap joint stainless steel in all positions (1-F through 4-F).
R	07.10	Weld corner joint stainless steel in all positions (1-F thorugh 4-F).
R	07.11	Weld T-joint stainless steel in all positions (1-F through 4-F).
A	07.12	Weld butt joints on aluminum in all positions (1-G through 4-G).
A	07.13	Weld lap joint on aluminum in all positions (1-F through 4-F).
A	07.14	Weld T-joint on aluminum in all positions (1-F through 4-F).
R	07.15	Weld corner joint on aluminum in all positions (1-F through 4-F).
A	07.16	Pipe welding in all positions (1-G, 2-G, 5-G and 6-G)

08.0 GAS METAL ARC AND FLUX CORED ARC WELDING - The student will be able to:

LEVEL		
E	08.01	Set up and adjust GMAW and FCAW equipment.
E	08.02	Weld weave bead patterns.
A	08.03	Weld butt joints in all positions (1-G through 4-G).
R	08.04	Weld lap joints in all positions (1-F through 4-F).
R	08.05	Weld corner joints in all positions (1-F through 4-F).
R	08.06	Weld T-joints in all positions (1-F through 4-F).
A	08.07	Weld aluminum plate (1-F through 4-F and 1-G through 4-G).
A	08.08	Weld stainless steel (1-F through 4-F and 1-G through 4-G).
A	08.09	Weld pipe in 1-G, 2-G, 5-G and 6-G positions.
R	08.10	Explain procedure for hardsurfacing with GMAW.

09.0 CARBON ARC CUTTING - The student will be able to:

LEVEL		
E	09.01	Set up carbon arc cutting equipment.
E	09.02	Gouge, cut, and pierce metals.

10.0 PLASMA ARC CUTTING (PAC) - The student will be able to:

LEVEL		
E	10.01	Set up plasma arc cutting equipment.
E	10.02	Cut bevels and straight cuts on ferrous and nonferrous metals.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 1

EMPLOYABILITY SKILLS

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 1 - EMPLOYABILITY SKILLS

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding Technology. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

Although some provision is made for basic mathematics and communication skills within this guide, they may not be adequate to meet the needs of individual students. Counseling, guidance, and diagnostic test results may indicate a need for further preparation in these areas. In such cases, instructors are encouraged to utilize the resources and personnel within the institution to improve or complement the instructional process.

The benefits to students and institutions derived from this curriculum guide should be considerable. Articulation of students from secondary to post-secondary programs will be aided through the use of a single curriculum guide. The guide provides a tool for evaluation of local curriculum and programs. The guide may be used in a flexible manner to assure that welding programs meet the needs of local business and industry.

It is the goal of this program guide to provide a level of instruction which will impart entry level employment skills. Students should be carefully counseled on the importance of attaining competency in the tasks assigned. As in virtually all occupations today, welding technicians will require periodic up-dating and review in the future. It is important that each student understand that meeting the program standards is essential not only to obtain employment today but also to have a base upon which to retain employment in the future.

01.01 TASK: IDENTIFY EMPLOYMENT OPPORTUNITIES

LEVEL E PERFORMANCE OBJECTIVE: Given the information resources of a library, obtain and compile the information needed to seek a job.

ENABLING OBJECTIVES:

1. Identify the requirements for a job.
2. Investigate educational opportunities.
3. Investigate occupational opportunities.
4. Locate resources for finding employment.
5. Confer with prospective employers.
6. Identify job trends.

01.02 TASK: APPLY EMPLOYMENT-SEEKING SKILLS

LEVEL E PERFORMANCE OBJECTIVE: Given appropriate information, locate a job opportunity, prepare and take an interview for it, complete the required tests, forms and applications, and evaluate the job opportunity.

ENABLING OBJECTIVES:

1. Locate a job opening.
2. Complete a resume.
3. Prepare for an interview.
4. Participate in an interview.
5. Complete tests required.
6. Complete forms required.
7. Complete an application letter.
8. Complete a follow-up letter.
9. Complete an acceptance letter.
10. Evaluate a job offer.
11. Evaluate a job rejection.

01.03 TASK: INTERPRET EMPLOYMENT CAPABILITIES

LEVEL E PERFORMANCE OBJECTIVE: Given the assignment to explain how your capabilities make you employable, demonstrate how to match skills and experience to a job.

ENABLING OBJECTIVES:

1. Match personal interest to job area.
2. Match personal aptitudes to job area.
3. Verify personal abilities.
4. Identify an immediate work goal.
5. Develop a career plan.

1.04 TASK: DEMONSTRATE APPROPRIATE WORK BEHAVIOR

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility of an employee in a new job, demonstrate knowledge of appropriate behavior in the work place.

ENABLING OBJECTIVES:

1. Exhibit dependability.
2. Demonstrate punctuality.
3. Follow rules and regulations.
4. Explain the consequences of dishonesty.
5. Complete assignments accurately and on time.
6. Control personal emotions.
7. Take responsibility for decisions and actions
8. Take pride in work and be a loyal worker.
9. Learn to handle pressures and tensions.
10. Demonstrate ability to set priorities.
11. Demonstrate problem-solving skills.

01.05 TASK: MAINTAIN SAFE AND HEALTHY ENVIRONMENT

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility of an employee in a new job, demonstrate knowledge of safety in the workplace.

ENABLING OBJECTIVES:

1. Comply with safety and health rules.
2. Select correct tools and equipment.
3. Utilize equipment correctly.
4. Use appropriate action during emergencies.
5. Maintain clean and orderly work area.
6. Demonstrate personal hygiene and cleanliness.
7. Identify and locate Material Safety Data Sheets (MSDS).

01.06 TASK: MAINTAIN A BUSINESS-LIKE IMAGE

LEVEL 3 PERFORMANCE OBJECTIVE: Given a responsibility to perform the duties of a new job, with a new employer, demonstrate a knowledge of the actions and behaviors which will project a business-like image.

ENABLING OBJECTIVES:

1. Participate in company or agency orientation.
2. Demonstrate knowledge of company or agency products and services.
3. Exhibit positive behavior.
4. Read current job-related publications.
5. Support and promote employer's company image and purpose.
6. Maintain appearance to comply with company standards.

01.07 TASK: MAINTAIN WORKING RELATIONSHIPS WITH OTHERS

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility to perform the duties of a new job, with a new employer, demonstrate a knowledge of how to successfully work with others.

ENABLING OBJECTIVES:

1. Work productively with others.
2. Show empathy, respect and support for others.
3. Demonstrate procedures and assist others when necessary.
4. Recognize problems and work toward their solution.
5. Minimize the occurrence of problems.
6. Channel emotional reactions in positive ways.

01.08 TASK: COMMUNICATE ON THE JOB

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility to perform the duties of a new job, with a new employer, demonstrate a knowlege of how to successfully communicate with others.

ENABLING OBJECTIVES:

1. Read and comprehend written communications and information.
2. Use correct grammar.
3. Speak effectively with others.
4. Use job-related terminology.
5. Listen attentively.
6. Write legibly.
7. Use telephone etiquette.
8. Follow written and oral directions.
9. Ask questions.
10. Locate information in order to accomplish task.
11. Prepare written communication.

12. Utilize keyboarding skills.
13. Utilize computer skills.

01.09 TASK: ADAPT TO CHANGE

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility to perform the duties of a new job, with a new employer, demonstrate a knowledge of how to adapt to change.

ENABLING OBJECTIVES:
1. Recognize the need to change.
2. Demonstrate a willingness to learn.
3. Demonstrate flexibility.
4. Participate in continuing education.
5. Seek challenge in the work place.
6. Adjust goals and plans when necessary.

01.10 TASK: DEMONSTRATE A KNOWLEDGE OF BUSINESS

LEVEL E PERFORMANCE OBJECTIVE: Given the responsibility to perform the duties of a new job, with a new employer, demonstrate a knowledge of the role of that business, its employees, and the free enterprise system.

ENABLING OBJECTIVES:
1. Explain the role of business in the free enterprise system.
2. List the responsibilities of employees.
3. Identify the responsibilities of managers and employers.
4. Discuss the opportunities for business ownership or management.
5. Describe the planning required to start a business.
6. Discuss the importance of business meetings.

01.11 TASK: PERFORM MATHEMATICAL SKILLS

LEVEL E PERFORMANCE OBJECTIVE: Given mathematics problems associated with welding applications, solve accurately within a specified time period.

ENABLING OBJECTIVES:
1. Add and subtract whole numbers, decimals and fractions.
2. Multiply and divide whole numbers, decimals and fractions.
3. Convert numbers between forms expressed as fractions, decimals and percents.
4. Convert between standard American units of measure.
5. Convert between standard American units and metric units.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 2

DEMONSTRATE GENERAL SAFETY SKILLS

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 2 - DEMONSTRATE GENERAL SAFETY SKILLS

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding Technology. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

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DEMONSTRATE GENERAL SAFETY SKILLS

02.01 TASK: Identify the use and purpose of the safety equipment required for any assigned procedure or operation, i.e., ear plugs

LEVEL E PERFORMANCE OBJECTIVE: Given information on assigned procedures and the proper use of safety equipment, the policies will be adhered to on a day to day basis.

ENABLING OBJECTIVES:

1. Explain the use of safety equipment.
2. Explain safety rules and procedures for using equipment.
3. Identify common hazards in the welding shop.

02.02 TASK: Set up and maintain a safe working environment for all assigned procedures of operations

LEVEL E PERFORMANCE OBJECTIVE: Given examples of welding jobs and shop situations, apply shop safety rules to maintain a safe working environment.

ENABLING OBJECTIVES:

1. Explain safety rules and procedures for using equipment.
2. Identify common hazards in the welding shop, including:
   a. Improper use of tools
   b. Unguarded machinery
   c. Tripping and falling
   d. Electrical hazards
   e. Improper lifting
3. Identify and explain warning signs posted in the shop area.
4. Explain the importance of "good housekeeping" in the shop.
5. Explain the importance of storing material in a secure manner.

02.03 TASK: Demonstrate safe operation of a disc grinder

LEVEL E PERFORMANCE OBJECTIVE: Given a disc grinder and the instruction manual, set up and use a disc grinder. The grinder will operate according to the manufacture'r specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for the use of a disc grinder.
3. Demonstrate the proper use of different types of abrasive discs.
4. Demonstrate the proper use of the other types of cups, blades, and discs.

02.04 TASK: Demonstrate safe operation of a bench grinder

LEVEL E PERFORMANCE OBJECTIVE: Given a bench grinder and the instruction manual, set up and use a bench grinder. The grinder will operate according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for the use of a bench grinder.
3. Demonstrate the proper use of different types of abrasive wheels.
4. Demonstrate the proper use of other types of wheels and brushes.
5. Explain the use of guards and their settings.

02.05 TASK: Demonstrate safe operation of a cut off saw

LEVEL E PERFORMANCE OBJECTIVE: Given a cut-off saw and the instruction manual, set up and use a cut-off saw. The cut-off saw will operate according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for the use of a cut-off saw.
3. Explain the use of guards and vises and their settings.

02.06 TASK: Demonstrate safe operation of a band saw

LEVEL E PERFORMANCE OBJECTIVE: Given a band saw and the instruction manual, set up and use a band saw. The band saw will operate according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for the band saw.
3. Demonstrate the use of different types of band saws.
4. Demonstrate the use of different types of blades.
5. Demonstrate the use of different speeds and settings.
6. Explain the use of guards, vises and coolant.

02.07 TASK: Demonstrate safe operation of a hydraulic shear, punch, brake and roll

LEVEL R PERFORMANCE OBJECTIVE: Given a hydraulic sheet, punch, brake and roll and the instruction manuals, set up and use this equipment according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for the use of a hydraulic sheet, punch, brake and roll.
3. Demonstrate the use of different types of punches, dies and blades.
4. Explain the use of guards and safety equipment.

02.08 TASK: Demonstrate safe operation of a drill press

LEVEL E PERFORMANCE OBJECTIVE: Given a drill press and the instruction manual, set up and use a drill press. The drill press will operate according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for a drill press.
3. Demonstrate the use of different types of drills and drill chucks.
4. Demonstrate the use of different drill speeds and how to set them.
5. Explain the use of guards and vises and their settings.

02.09 TASK: Demonstrate safe operation of common hand tools

LEVEL E PERFORMANCE OBJECTIVE: Given common hand tools and the instruction manual, set up and use the hand tools.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. List the safety rules for common hand tools.
3. Demonstrate the proper use of different types of hand tools.
4. Demonstrate how to maintain different common hand tools.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 3

APPLY BASIC TRADE SKILLS

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 3 - APPLY BASIC TRADE SKILLS

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

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APPLY BASIC TRADE SKILLS

03.01 TASK: Interpret detail drawings

LEVEL R PERFORMANCE OBJECTIVE: Given appropriate instructional materials and sample detail drawing, interpret lines, views, dimensions, tolerances and notes in a practical application.

ENABLING OBJECTIVES:

1. Match terms related to blueprint reading with their correct definitions.
2. Match basic elements in welding blueprints with their functions.
3. Identify lines in the alphabet of lines.
4. List common blueprint abbreviations with their meanings.
5. Differentiate between size dimensions and location dimensions.

03.02 TASK: List materials for fabrication from blueprints

LEVEL E PERFORMANCE OBJECTIVE: Given blueprints and appropriate instructional materials through proper sequencing, compile a list of materials required for the object under construction. This list of materials should be completed without error.

ENABLING OBJECTIVES:

1. Differentiate between types of bills of materials.
2. List requirements for a formal bill of materials.
3. List requirements for an informal bill of material.
4. List the proper methods in dimensioning sequence of structural shapes.
5. Complete statements concerning how tolerances are expressed on a drawing.
6. Indicate proper use of tolerances in a bill of materials.
7. Prepare a formal bill of materials from a blueprint.
8. State the reason for a work point on a blueprint.
9. Make a cut list from a blueprint.

03.03 TASK: Identify fabrication materials

LEVEL E PERFORMANCE OBJECTIVE: Given appropriate instructional materials, list reasons for metal identification, definitions of related terms, illustrate various alloys and the properties associated with each. A complete understanding must be evidenced by the student.

ENABLING OBJECTIVES:

1. Complete a list of reasons for proper metal identification.
2. Define basic categories of metals.
3. Define alloys and their characteristics.
4. Match mechanical properties of metals with their characteristics.
5. Match types of mechanical strengths of metals with their meanings.
6. Match physical properties of metals with their characteristics.
7. Match principle alloying agents of steel with their characteristics.
8. Complete a chart of carbon steel classifications, characteristics, and uses.
9. Complete a chart of alloy steel classifications, characteristics, and uses.
10. Complete a chart of iron classifications, characteristics, and uses.
11. Match non-ferrous metals with their typical uses.
12. Identify standard metal shapes available for welding.
13. Identify metal shapes used for welding.

03.04 TASK: Identify metals by appearance, weight, and magnetic properties

LEVEL E PERFORMANCE OBJECTIVE: Given the necessary various types of metal alloys, a magnet, a well lighted area, accurately identify metals by appearance, weight, and magnetic properties.

ENABLING OBJECTIVES:

1. List magnetic metals.
2. Construct a chart showing the comparisons in relation to appearance, weight per cubic inch and magnetic properties of each of the following metals:
   a. Low carbon steel.
   b. Medium carbon steel.
   c. High carbon steel.
   d. High sulfur steel.
   e. Manganese steel.
   f. Stainless steel.
   g. Cast iron.
   h. Wrought iron.
   i. Nickel alloy.
   j. Copper alloy.
3. Match metals with ways to identify by appearance.
4. Conduct magnet tests to identify common metals used for welding.
5. Explain the importance of metal identification in relation to welding.

03.05 TASK: Identify metals by spark test

LEVEL E PERFORMANCE OBJECTIVE: Given a pedestal grinder with a minimum of 5,000 surface feet per minute, a face shield, and necessary safety equipment, identify various metal alloys with the use of a spark test. Metals must be identified accurately.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures used in identifying metals by the spark test.
2. Demonstrate the proper procedure for grinding metal and performing a spark test.
3. Identify low carbon steel by the sparks produced.
4. Identify medium carbon steel by the sparks produced.
5. Identify high carbon steel by the sparks produced.
6. Identify high sulfur steel by the sparks produced.
7. Identify manganese by the sparks produced.
8. Identify stainless by the sparks produced.
9. Identify cast iron by the sparks produced.
10. Identify wrought iron by the sparks produced.
11. Identify nickel alloys by the sparks produced.
12. Select true statements concerning equipment requirements for spark testing.
13. Select true references to terminology used in spark testing.
14. Conduct spark tests to identify common metals used for welding.

03.06 TASK: Apply cutting skills

LEVEL E PERFORMANCE OBJECTIVES: Given appropriate power equipment and relevant instructional material, explain and safely perform the cutting operations done by this equipment. Explanations must be complete and cut locations must be accurate to within 1/32 of an inch.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures used in cutting skills.
2. Explain the proper use of an abrasive saw.
3. Explain the proper use of a power bandsaw.
4. Explain saw blade teeth-size re[illegible]ements.
5. Describe the use of a hand hacks[illegible]w.
6. List the uses of a power hacksaw.
7. List the uses of a power squaring shear.
8. Explain the uses of a foot-operated squaring shear.
9. List the different types of hand held metal cutting power tools.
10. Describe the proper use of liquid coolant when cutting with power equipment.
11. Explain the importance of cutting on the proper side of a dimension location with a metal removing saw.
12. Cut metal with a power saw to a 1/32 inch tolerance.

13. Cut metal with a power shear to a 1/32 inch tolerance.
14. Cut odd shapes with a hand held power tool.
15. Explain the differences in cutting carbon steels, stainless steels, and non ferrous metals.

03.07 TASK: Apply bending skills

LEVEL R PERFORMANCE OBJECTIVES: Given appropriate instructional materials, tools and equipment, demonstrate a complete understanding of stretch-out dimensions of metal to be bent or rolled. Demonstrate the ability to use the tools and equipment to bend and roll metal according to desired size, location, and degree angle.

ENABLING OBJECTIVES:

1. Describe relevant safety precautions in bending.
2. Calculate the stretch-out of metal with multiple bends.
3. Calculate the stretch-out of metal when formed from flat to cylindrical shape.
4. Explain the difference between a press and a press brake.
5. Explain the difference between a mechanical press brake and a hydraulic press brake.
6. Describe the three major parts of a press brake.
7. Explain the proper use of a power brake.
8. Describe five different kinds of dies.
9. Explain the proper use of a power slip roll.
10. Explain the proper use of a power angle iron roll.
11. Explain the use of a box and pan brake.
12. Select the proper size nose bars and fingers for the job being done in a box and pan brake.
13. Adjust a hand brake for various thicknesses of sheet metal.
14. Demonstrate the proper use of a box and pan brake.
15. Demonstrate the ability to heat and bend flat bar.
16. Demonstrate the ability to heat and bend round bar.
17. Brake metal in a power press brake.
18. Brake metal in a leaf brake.
19. Roll metal in a power slip roll.

3.08 TASK: Apply drilling skills

LEVEL E PERFORMANCE OBJECTIVES: Given appropriate instructional material, tools, and equipment, demonstrate a complete understanding of metal cutting twist drills and their function. Drill holes that are accurate in location and size using appropriate safety precautions.

ENABLING OBJECTIVES:

1. Explain the relevant safety precautions in drilling holes.
2. List three methods of designating twist drill sizes.
3. Describe the parts of a twist drill.
4. Explain the importance of the degree angle of the chisel edge of a twist drill.
5. Explain the importance in the length and the angle of the cutting lips on a twist drill.
6. Explain the cutting function of a properly sharpened twist drill.
7. Explain the desired degree angles in a properly sharpened twist drill.
8. Explain the proper use of a lubricant coolant while drilling.
9. Explain the purpose of a pilot hole.
10. Explain RPM in relation to drilling.
11. Explain the use of a drilling feed speed chart.
12. Explain the proper use of a center punch.
13. Demonstrate the ability to sharpen a twist drill with the use of a sharpening gauge.
14. Demonstrate the ability to properly tighten the drill in the chuck.
15. Demonstrate the proper use of a center punch.
16. Demonstrate the proper use of a hand held drill.
17. Demonstrate the proper use of a drill press.

03.09 TASK: Apply punching skills

LEVEL E PERFORMANCE OBJECTIVE: Given appropriate instructional materials, tools, and equipment, demonstrate an understanding and use of hole punching equipment.

ENABLING OBJECTIVES:

1. Describe the safety precautions to observe while operating hole punching equipment.
2. Describe the iron worker and explain its operation.
3. Explain the difference between the punch and the die.
4. Explain the importance of sufficient clearance between the punch and the die.
5. Explain the proper use of a stripper.
6. Explain the importance in a lubricant for punching various metal alloys.
7. Explain the different types of equipment used for punching.
8. Explain the different hole shapes that can be punched.
9. Demonstrate the proper use of a hole punch.

03.10 TASK: Apply finishing skills

LEVEL R PERFORMANCE OBJECTIVE: Given a hand held grinder with sanding disc and mild steel plate, sand off all rust and mill scale down to parent metal.

ENABLING OBJECTIVES:

1. Identify all safety equipment.
2. Explain safety procedures.
3. Identify grinder and sanding disc.
4. Identify different grades of finish.
5. Demonstrate the use of grinder.

03.11 TASK: Apply rolling skills

LEVEL R PERFORMANCE OBJECTIVE: Given rolling equipment and a flat mild steel plate, roll mild steel plate into a form of a round pipe.

ENABLING OBJECTIVES:

1. Explain safety procedure.
2. Describe rolling machine and its adjustments.
3. Demonstrate proper preparation of plate ends to ensure a round finished product.
4. Demonstrate rolling flat plate into a round pipe.

03.12 TASK: Demonstrate proper tip cleaning procedure

LEVEL E PERFORMANCE OBJECTIVE: Given an oxy-acetylene cutting tip, a welding tip, and a standard set of tip cleaners, demonstrate how to clean a tip.

ENABLING OBJECTIVES:

1. Explain safety procedure.
2. Describe tip cleaner.
3. Describe the oxy-acetylene tip.
4. Describe the pre-heat orifices.
5. Describe the cutting orifices.
6. Demonstrate proper procedure for cleaning welding tips.

03.13 TASK: Demonstrate proper regulator adjustment

LEVEL E PERFORMANCE OBJECTIVE: Given an oxygen and acetylene regulator, and working equipment, identify the different types of the gauges and adjust the regulators.

ENABLING OBJECTIVES:

1. Explain safety procedure.
2. Describe working pressure gauge.
3. Describe cylinder pressure gauge.
4. Describe the purpose of the needle valve.
5. Identify right hand and left hand nut.
6. Identify regulator adjustment screw and hose outlet fitting.
7. Adjust regulators.

03.14 TASK: Use technical manuals and references

LEVEL R PERFORMANCE OBJECTIVE: Given a technical handbook or reference material, interpret information to assist with the application of welding processes.

ENABLING OBJECTIVES:

1. Demonstrate ability to use and apply appropriate manuals and references. Example: AWS and ASME.
2. Identify appropriate manuals to use with particular welding equipment.

03.15 TASK: Demonstrate the use of layout tools

LEVEL R PERFORMANCE OBJECTIVE: Given a set of common layout tools, demonstrate their proper use.

ENABLING OBJECTIVES:

1. Identify various layout tools.
2. Demonstrate use of layout tools.

03.16 TASK: Maintain a clean, well organized working area

LEVEL E PERFORMANCE OBJECTIVE: Given a welding job and shop situation, apply shop safety rules by identifying safe and unsafe shop practices.

ENABLING OBJECTIVES:

1. Explain safety rules.
2. Keep work area clean.
3. Place shield around work area.
4. Identify hazards in shop area.
   a. Improper use of tool
   b. Tool left on the floor
5. Identify signs in shop area.
6. Explain good housekeeping.

03.17 TASK: Identify basic weld symbols

LEVEL E PERFORMANCE OBJECTIVE: Given welding symbols, place complete welding information on a drawing.

ENABLING OBJECTIVES:

1. Identify the current symbol for the type of welded joint.
2. Correctly place an arrow and reference line to indicate the position of the weld.
3. Apply additional weld details where necessary.
4. Add proper symbols for supplementary information.

03.18 TASK: Identify major welding procedures

LEVEL E PERFORMANCE OBJECTIVE: Given lectures and demonstrations on welding processes, identify and describe these processes.

NABLING OBJECTIVES:

1. Describe GTAW.
2. Describe SMAW.
3. Describe OAW.
4. Describe GMAW.
5. Describe FCAW.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 4

OXYACETYLENE WELDING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 4 - OXYACETYLENE WELDING

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OXYACETYLENE WELDING

04.01 TASK: Set up an oxyacetylene station

LEVEL E PERFORMANCE OBJECTIVE: Given oxyacetylene torch, regulators, hoses, check valves, cylinder wrench, personal safety equipment, oxygen and fuel cylinders, set up an oxyacetylene welding station. The oxyacetylene equipment will not leak and will operate safely according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. Describe the oxygen and acetylene cylinders.
3. List the safety rules for the use of the cylinders.
4. List the safety rules for use of oxyacetylene equipment.
5. Describe oxygen and acetylene regulators.
6. List the purpose and types of oxyacetylene regulators.
7. Identify oxygen and acetylene hose.
8. Describe the purpose of the torch and control valve or throttle valve.
9. Give the two general classes of torches.
10. Demonstrate the correct sequence for the set up.
11. Describe the methods used for leak detection and repair.
12. Demonstrate hose cleaning methods.
13. Demonstrate methods of cleaning cylinder valves.

04.02 TASK: Light and adjust torches

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, a selection of tips, personal safey equipment and access to the necessary tools and equipment, light and adjust the torches. Properly light and adjust the flow to produce a neutral, and oxidizing, and a carburizing flame. Each flame will be the correct size, color and have a distinct appearance.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. Explain the purpose of the tip.
3. Specify pressures for each size tip.
4. Describe the proper procedure for cleaning a tip.
5. Describe the spark lighter.
6. Identify the three parts of the flame.
7. Distinguish the three flames by size.
8. Give the purpose for adjusting to each flame.
9. Distinguish the flames by color.
10. Demonstrate the steps in sequence to close the station.
11. Demonstrate the manufacturers procedure for lighting the model torch being used.

04.03 TASK: Puddle mild steel plate without filler

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, a mild steel plate, personal safety equipment and access to the necessary tools and equipment, carry a puddle without filler rod in a straight line, maintaining conformity throughout the length of multiple six inch runs.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. Identify all safety gear.
3. Describe the purpose of each piece of safety gear.
4. Demonstrate the safe methods of cleaning metal.
5. Identify methods of holding the torch.
6. Describe the correct angle to hold the torch.
7. Demonstrate the correct movement and travel speed of the torch.
8. Identify the causes of burn-through, porosity and oxidation.
9. Explain how to select the correct size tip to use.
10. Demonstrate how tip to work distance offsets the puddle.
11. Demonstrate the ability to start puddle.

04.04 TASK: Pad mild steel plate with filler, flat position

LEVEL E PERFORMANCE OBJECTIVE: Given necessary oxyacetylene equipment, personal safey equipment, mild steel plate and welding rod, carry puddles with filler rod. Make at least four bead welds in the flat position the full length of the strip that are straight, uniform in height and width, and without undercut, porosity, craters or oxidation. Ripples will be evenly spaced and uniform.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. Explain how to select the correct size and type of rod to use.
3. Demonstrate the movements of the rod and torch.
4. Explain how puddle build up can be accomplished.
5. Explain the angle and position of the rod.
6. Demonstrate ripple spacing techniques.
7. Describe the method of freeing a frozen rod.
8. Explain the causes of oxidation and undercut.
9. Demonstrate the methods of filling a crater.
10. Describe the defects caused by insufficient heat.
11. Explain how the width and height of a bead can be controlled.

04.05 TASK: Weld T-joint in the flat position (1-F) with filler

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, personal safety equipment, mild steel plates and rod, construct a T-joint weld in the flat position. Weld will be consistent in uniformity, penetration and appearance and will bend 90 degrees without fracture or breaks.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. Demonstrate the method of tack welding.
3. Describe the angle of the torch.
4. Describe the method of starting the puddle.
5. Determine at what point the rod should be fed into the puddle.
6. Describe how to prevent pocketing (bridging).
7. List the causes of insufficient penetration.
8. Demonstrate the procedures for welding a T-joint in the flat position.
9. Demonstrate the testing method.

04.06 TASK: Weld lap joint in the flat position (1-F)

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, personal safety equipment, mild steel plate and rods, construct a lap joint weld in the flat position. Weld will be straight, have consistency of width and height with proper build up and no slag, and will bend 180 degrees without cracks or breaks.

ENABLING OBJECTIVES:

1. Explain relevant safety precautions.
2. List the causes of bead sagging.
3. Describe a lap joint.
4. Demonstrate proper fit up of the joint.
5. Demonstrate the proper tacking method.
6. Describe methods for buildup of the bead.
7. Demonstrate the procedures for welding a lap joint in the flat position.
8. Demonstrate the testing method.

04.07 TASK: Weld corner join in the flat position (1-F)

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a corner joint weld in the flat position. Bead must be straight and uniform in height and width; have a uniform ripple formation; have no undercut, porosity, craters, or oxidation; and must be fused with base metal.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe the various types of corner joints.

3. Explain surface preparation procedures.
4. Describe the procedures for laying out mild steel coupons to form a corner joint in the flat position.
5. Describe the procedures for lighting a torch and adjusting the flame.
6. Describe the tacking procedures for a corner joint welded in flat position.
7. Determine torch and filler rod angles and the speed of movement in relation to work.
8. Demonstrate the procedures for welding a corner joint in the flat position.
9. Explain the testing methods for corner joints.

04.08 TASK: Weld butt joint in the flat position (1-G)

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, filler rod, mild steel coupons, personal safety equipment, necessary tools and materials, construct a butt joint weld in the flat position. Bead must be straight and uniform in height and width, have a uniform ripple formation; have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal.

ENABLING OBJECTIVES:
1. Explain relevant safety precautions.
2. Describe a butt joint.
3. Explain procedures for lighting a torch and adjusting the flame.
4. Determine torch and filler rod angles and the speed of movement in relation to work.
5. Describe the tacking procedures for butt joints in flat position.
6. Demonstrate the procedures for laying out mild steel coupons to form a butt joint.
7. Demonstrate the procedures for welding butt joints in flat position.
8. Explain testing procedures for a butt joint.

04.09 TASK: Deposit weld beads in the horizontal position

LEVEL R PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rod, personal safety equipment, and the necessary tools and materials, deposit weld beads in the horizontal position. Bead must be straight and uniform in height and width; have a uniform ripple formation; have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal.

ENABLING OBJECTIVES:
1. Explain relevant safety precautions.
2. Describe the surface preparation procedures.
3. Explain the procedures for lighting a torch and adjusting the flame.

4. Determine the torch and filler rod angles and speed of movement in relation to work.
5. Demonstrate the procedures for depositing weld beads in the horizontal position.

04.10 TASK: Weld a T-joint in the horizontal position (2-F)

LEVEL R PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a T-joint weld in the horizontal position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters or oxidation. Weld must be fused with base metal.

ENABLING OBJECTIVES:
1. Explain relevant safety procedures.
2. Describe the procedure for lighting a torch and adjusting a neutral flame.
3. Determine torch and filler rod angles and speed of movement in relation to work.
4. Describe the tacking procedures for T-joints in horizontal position.
5. Demonstrate the procedures for laying out mild steel coupons to form a T-joint.
6. Demonstrate the procedures for welding a T-joint in the horizontal position.
7. Explain testing methods for T-joints.

04.11 TASK: Weld a lap joint in the horizontal position (2-F)

LEVEL R PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a lap joint weld in the horizontal position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and show no visible penetration on side opposite the weld.

ENABLING OBJECTIVES:
1. Explain relevant safety procedures.
2. Describe a lap joint.
3. Describe the procedures for lighting a torch and adjusting the neutral flame.
4. Describe torch and filler rod angles and speed of movement in relation to work.
5. Describe tacking procedures for lap joints in horizontal position.
6. Demonstrate the procedures for laying out mild steel coupons to form a lap joint in the horizontal position.
7. Demonstrate the procedure for welding a lap joint in horizontal position.
8. Explain the testing methods for lap joint.

04.12 TASK: Weld a corner joint in the horizontal position (2-F)

LEVEL R PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a corner joint weld in the horizontal position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe a corner joint.
3. Describe procedures for lighting a torch and adjusting neutral flame.
4. Determine torch and filler rod angles and speed of movement in relation to work.
5. Describe tacking procedures for corner joints in horizontal position.
6. Demonstrate procedure for laying out mild steel coupons to form corner joint in the horizontal position.
7. Demonstrate the procedure for welding corner joint in horizontal position.
8. Explain testing methods for corner joints.

04.13 TASK: Weld a butt joint in the horizontal position (2-F)

LEVEL R PERFORMANCE OBJECTIVE: Given oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a butt joint weld in the horizontal position. Bead must be straight and uniform in height and width, have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. The weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe butt joint.
3. Describe procedure for lighting torch and adjusting neutral flame.
4. Determine torch and filler rod angles and speed to movement in relation to work.
5. Describe tacking procedures for butt joints in horizontal position.
6. Demonstrate procedure for laying out mild steel coupons to form butt joint in horizontal position.
7. Demonstrate the procedure for welding butt joints in horizontal position.
8. Explain testing methods for butt joints.

04.14 TASK: Deposit weld beads in the vertical position

LEVEL R PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupon, filler rod, personal safety equipment, necessary tools and materials, deposit weld beads in the vertical position. Bead must be straight and uniform in height and width; have a uniform ripple formation; have no undercut, porosity, craters, or oxidation, and be fused with base metal.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe surface preperation procedures for weld beads in vertical position.
3. Explain procedures for lighting torch and adjusting neutral flame.
4. Determine torch and filler rod angle and speed of movement for weld beads in vertical position.
5. Demonstrate procedure for depositing weld beads in vertical position.

04.15 TASK: Weld a T-joint in the vertical position (3-F)

LEVEL A PERFORMANCE OBJECTIVE. Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and equipment, construct a T-joint weld in the vertical position. Bead must be straight and uniform in the height and width; have uniform ripple formation; and have no undercut, porosity craters, or oxidation. Weld must be fused with base metal.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a T-joint.
3. Identify and select filler rods by type and size for welding mild steel in ertical position.
4. Describe surface preparation procedures.
5. Explain procedures for lighting torch and adjusting neutral flame.
6. Determine torch and filler rod angles and speed of movement in relation to work.
7. Describe tacking procedures for T-joint.
8. Demonstrate procedure for laying out mild steel coupons to form a T-joint in vertical position.
9. Demonstrate procedures for welding T-joint in vertical position.
10. Describe testing method for T-joints.

04.16 TASK: Weld a lap joint in the vertical position (3-F)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a lap joint weld in the vertical position. Bead must be straight and uniform in height and width; have a uniform ripple formation, and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal, and show no visible penetration on the side opposite the weld.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a lap joint.
3. Identify and select filler rods by type and size for welding mild steel in vertical position.
4. Describe surface preparation procedures.
5. Explain procedures for lighting torch and adjusting neutral flame.
6. Describe tacking procedures for lap joints in vertical position.
7. Demonstrate procedure for laying out mild steel coupons to form a lap joint in vertical position.
8. Demonstrate procedures for welding lap joint in vertical position.
9. Explain testing methods for lap joints.

04.17 TASK: Weld a corner joint in vertical position (3-F)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a corner joint weld in vertical position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have not undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a corner joint.
3. Identify and select filler rods by type and size for welding mild steel in vertical position.
4. Explain procedure for lighting torch and adjusting neutral flame.
5. Determine torch and filler rod angles and speed of movement in relation to work.
6. Describe tacking procedures for corner joints in vertical position.
7. Demonstrate procedure for laying out mild steel coupons to form a corner joint in vertical position.
8. Demonstrate procedures for welding corner joint in vertical position.
9. Explain testing methods for corner joints.

04.18 TASK: Weld a butt joint in the vertical position (3-G)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and equipment, construct a butt joint weld in the vertical position. Bead must be a uniform ripple formation and have no undercut porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a butt joint.
3. Describe surface preparation procedures.
4. Identify and select filler rods by type and size for welding mild steel in vertical position.
5. Determine torch and filler rod angles and speed of movement in relation to work.
6. Explain testing methods for butt joints.
7. Demonstrate procedure for laying out mild steel coupons.
8. Demonstrate procedures for welding butt joints in vertical position.

04.19 TASK: Deposit weld beads in the overhead position

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, deposit weld beads in the overhead position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe surface preparation procedures for weld beads in overhead position.
3. Explain procedures for lighting torch and adjusting neutral flame.
4. Determine torch and filler rod angle and speed of movement in relation to work.
5. Demonstrate procedure for depositing weld beads in overhead position.

04.20 TASK: Weld a T-joint in the overhead position (4-F)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct T-joint weld in the overhead position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a T-joint.
3. Explain surface preparation procedures.
4. Determine torch and filler rod angles and speed of movement in relation to work.
5. Explain procedures for lighting torch and adjusting neutral flame.
6. Describe tacking procedures for T-joints in overhead position.
7. Demonstrate procedures for laying out mild steel coupons to form a T-joint in the overhead position.
8. Demonstrate procedures for welding a T-joint in the overhead position.
9. Explain testing methods for T-joints.

04.21 TASK: Weld a lap joint in the overhead position (4-F)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct lap joint weld in the overhead position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe lap joint.
3. Describe procedure for lighting torch and adjusting neutral flame.
4. Determine torch and filler rod angles and speed of movement in relation to work.
5. Describe tacking procedures for lap joints in overhead position.
6. Demonstrate procedure for laying out mild steel coupons to form a lap joint in the overhead position.
7. Demonstrate procedures for welding a lap joint in the overhead position.
8. Explain testing methods for lap joints.

04.22 TASK: Weld a corner joint in overhead position (4-F)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a corner joint weld in the overhead position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe an overhead corner joint.
3. Describe procedure for lighting torch and adjusting neutral flame.
4. Describe surface preparation procedures.
5. Determine torch and filler rod angles and speed of movement in relation to work.
6. Describe tacking procedures for corner joints in overhead position.
7. Explain testing methods for corner joints.
8. Demonstrate procedures for laying out mild steel coupons to form overhead corner joint.
9. Demonstrate procedures for welding corner joints in the overhead position.

04.23 TASK: Weld a butt joint in the overhead position (4-G)

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupons, filler rods, personal safety equipment, necessary tools and materials, construct a butt joint weld in the overhead position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation. Weld must be fused with base metal and have full penetration.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe a butt joint.
3. Describe AWS reference positions 11.3-16.
4. Explain procedure for lighting torch and adjusting neutral flame.
5. Describe surface preparation procedures.
6. Determine torch and filler rod angles and speed of movement in relation to work.
7. Explain testing methods for butt joints.
8. Describe tacking procedures for butt joints in overhead position.
9. Demonstrate procedures for laying out mild steel coupons to form overhead butt joint.
10. Demonstrate procedures for welding butt joints in the overhead position.

04.24 TASK: Weld pipe in the 1-G position

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel pipes, filler rods, personal safety equipment, necessary tools and materials, construct pipe joint weld in the flat position. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation; and must be smooth on inside of pipe. Root bead must completely penetrate into root of joint.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe pipe welding process.
3. Explain 1-G position.
4. Discuss beveling procedure.
5. Explain joint preparation procedure for all roll and fixed groove pipe welding.
6. Discuss spacing and tacking procedures for pipe welding.
7. Identify and select filler rods by type and size for welding mild steel pipes.
8. Determine torch and filler rod angles and speed of movement in relation to work.
9. Explain procedures for depositing root bead.
10. Demonstrate procedures for welding pipe in the 1-G.

04.25 TASK: Weld pipe in the 2-G, 5-G and 6-G positions

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel pipes, filler rods, personal safety equipment, necessary tools and materials, construct a fixed butt pipe joint weld in the 2-G, 5-G and 6-G positions. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters, or oxidation; and must be smooth on inside of pipe. Root bead must completely penetrate into root of joint.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe pipe welding in the 2-G, 5-G and 6-G positions.
3. Discuss beveling procedures.
4. Explain joint preparation procedures for pipe welding in 2-G, 5-G and 6-G.
5. Discuss spacing and tacking procedures for pipe welding.
6. Identify and select filler rods by type and size for welding mild steel pipes, schedule 40 up to 2".
7. Explain procedures for lighting torch and adjusting flame for pipe welding.
8. Determine torch and filler rod angles and speed of movement in relation to work.
9. Explain procedures for depositing root bead.
10. Demonstrate procedures for constructing pipe welds in the 2-G, 5-G and 6-G positions.

04.26 TASK: Braze Mild Steel

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, mild steel coupon, brazing rod, flux, personal safety equipment, necessary tools and materials, braze mild steel. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity craters or oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define brazing.
3. Explain difference between brazing and welding.
4. Identify applications for brazing.
5. Identify types of mild steel which require brazing.
6. Determine temperatures required for brazing.
7. Explain function of flux in brazing.
8. Identify and select brazing rods by size and type for brazing mild steel.
9. Explain how puddle buildup can be accomplished.
10. Explain angle and position of the rod.
11. Describe ripple spacing techniques.
12. Describe how width and height of bead can be controlled.
13. Demonstrate rod and torch movement for brazing.
14. Demonstrate procedures for brazing mild steel.

04.27 TASK: Braze cast iron

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, cast iron coupon, brazing rod, flux, personal safety equipment necessary tools and materials, braze cast iron. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters or oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define brazing.
3. Explain difference between brazing and welding.
4. Identify applications for brazing.
5. Determine temperatures required for brazing.
6. Explain function of flux in brazing.
7. Identify and select brazing rods by size and type of brazing cast iron.
8. Explain angle and position of the rod.
9. Demonstrate rod and torch movement for brazing.
10. Demonstrate procedures for brazing cast iron.

04.28 TASK: Braze copper

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, copper coupons, brazing rod, flux, personal safety equipment, necessary tools and materials, braze copper. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, craters or oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define brazing.
3. Explain the difference between brazing and welding.
4. Identify applications for brazing.
5. Determine temperatures required for brazing copper.
6. Explain function of flux in brazing.
7. Identify and select brazing rods by size and type for brazing copper.
8. Describe surface preparation procedures.
9. Demonstrate rod and torch movement for brazing copper.
10. Demonstrate procedures for brazing copper.

04.29 TASK: Silver braze copper pipe joints

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, copper pipe, silver brazing rod, flux, personal safety equipment, necessary tools, and materials, silver braze copper pipe. Bond must have uniform coverage at the joint with no area uncovered; and with no porosity and oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define silver brazing.
3. Explain the difference between soldering, brazing, welding, and silver welding.
4. Identify and select silver brazing rods by size and type for welding on copper pipes.
5. Describe surface preparation procedures.
6. Explain procedures for lighting torch and adjusting flame.
7. Describe rod and torch movement for silver brazing on copper pipe.
9. Demonstrate procedures for silver brazing copper pipe.

04.30 TASK: Soft solder copper joints

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, copper plate or pipe, soft solder, flux, personal safety equipment, necessary tools and materials, soft solder copper joints in plate or pipe. Bond must have uniform coverage over the joint area and have no porosity or oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define soft soldering.
3. Explain the difference between soldering, brazing, and welding.
4. Identify and select the proper solder grade, size and flux for soft soldering on copper joints.
5. Describe surface preparation procedures.
6. Explain procedures for lighting torch and adjusting flame.
7. Describe rod and torch movement for soft soldering on copper joints.
8. Demonstrate procedures for soft soldering copper joints.

04.31 TASK: Braze cast iron to steel

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, cast iron and mild steel plates, brazing rod, flux, personal safety equipment, necessary tools and materials, braze cast iron to steel. Bead must be straight and uniform in height and width; have a uniform ripple formation; and have no undercut, porosity, or oxidation.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define brazing.
3. Explain difference between brazing and welding.
4. Determine temperatures required for brazing cast iron to steel.
5. Identify and select brazing rods by size and type of brazing cast iron.
6. Describe surface preparations procedures.
7. Explain procedures for lighting torch and adjusting flame.
8. Demonstrate rod and torch movement for brazing cast iron to steel.
9. Demonstrate procedures for brazing cast iron to steel.

04.32 TASK: Oxyacetylene weld/braze aluminum

LEVEL A PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, aluminum material, aluminum rod (flux cored), flux, personal safety equipment, necessary tools and materials, weld aluminum. Bead must be uniform in height and width; have complete joint coverage; and have no undercut, porosity, or craters.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain the difference between welding and brazing aluminum.
3. Determine proper temperatures for aluminum by sooting.
4. Describe surface preparation procedures.
5. Explain procedures for lighting torch and adjusting flame.
6. Describe torch and rod movement for aluminum welding.
7. Demonstrate procedures for welding/brazing aluminum.

04.33 TASK: Hard surfacing welding with oxyacetylene welding equipment

LEVEL B PERFORMANCE OBJECTIVES: Given an oxyacetylene station, materials to be surfaced, hard-surfacing rod, personal safety equipment, necessary tools and materials, hard-surface weld. Bead must be straight and uniform in height, width and depth penetration; and have no undercut, porosity, or craters. Base metal must not have been overheated.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Define hard-surfacing.
3. Explain the difference between hard-surfacing and welding, and similarity to braze welding.
4. Identify and select hard-facing rods by size and type for the material and usage.
5. Describe surface preparation and its importance.
6. Determine temperature required for hard-surfacing.
7. Explain procedures for lighting torch and adjusting flame.
8. Describe torch and rod movement for hard-surfacing.
9. Demonstrate procedures for hard-surfacing.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 5

OXY-FUEL CUTTING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 5 - OXY-FUEL CUTTING

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

Although some provision is made for basic mathematics and communication skills within this guide, they may not be adequate to meet the needs of individual students. Counseling, guidance, and diagnostic test results may indicate a need for further preparation in these areas. In such cases, instructors are encouraged to utilize the resources and personnel within the institution to improve or complement the instructional process.

The benefits to students and institutions derived from this curriculum guide should be considerable. Articulation of students from secondary to post-secondary programs will be aided through the use of a single curriculum guide. The guide provides a tool for evaluation of local curriculum and programs. The guide may be used in a flexible manner to assure that welding programs meet the needs of local business and industry.

It is the goal of this program guide to provide a level of instruction which will impart entry level employment skills. Students should be carefully counseled on the importance of attaining competency in the tasks assigned. As in virtually all occupations today, welding technicians will require periodic up-dating and review in the future. It is important that each student understand that meeting the program standards is essential not only to obtain employment today but also to have a base upon which to retain employment in the future.

OXY-FUEL CUTTING

05.01 TASK: Set up an oxyacetylene station

LEVEL E PERFORMANCE OBJECTIVE: Given oxyacetylene torch, regulators, hoses, check valves, cylinder wrench, oxygen and fuel cylinders, set up an oxyacetylene cutting station. The oxyacetylene equipment will not leak and will operate safely according to the manufacturer's specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe the difference between oxygen and acetylene cylinders.
3. List the safety rules for use of oxyacetylene equipment.
4. List the safety rules for the use of the cylinders.
5. Demonstrate methods of cleaning cylinder valves.
6. Describe oxygen and acetylene regulators.
7. List the purpose and types of oxyacetylene regulator.
8. Identify oxygen and acetylene hose and connectors.
9. Demonstrate hose cleaning methods.
10. Describe the purpose of the torch and control valve or throttle valve.
11. Describe the two general classes of torches.
12. Demonstrate the correct sequence for the set up.
13. Describe the methods used for leak detection and repair.

05.02 TASK: Light and adjust the torches

LEVEL E PERFORMANCE OBJECTIVE: Given an oxyacetylene welding station, a selection of tips and access to the necessary tools and equipment, light and adjust the torches. Properly light and adjust the flow to produce a neutral flame.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain the purpose of the tip.
3. Specify pressures for each size tip.
4. Describe the manufacturers specifications for lighting the model torch being used.
5. Describe the spark lighter.
6. Identify the three parts of the flame.
7. Differentiate the three flames by size.
8. Light and adjust a torch.
9. Describe the purpose for adjusting to each flame.
10. Identify the flames by color.
11. Demonstrate the steps in sequence to close the station down.

05.03 TASK: Lay out and cut straight lines (Manual)

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications, 1/8" to 1" thick mild steel, layout instruments, oxy-fuel cutting station, and personal safety equipment, lay out and cut straight lines in mild steel plates. Cut will be within 1/16" of specifications and plates will maintain conformity throughout the length of the cuts without any underside slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify, select, and demonstrate the use of lay out instruments.
3. Describe the procedures for laying out and cutting lines on mild steel.
4. Select cutting tip for mild steel plates.
5. Demonstrate procedures for lighting torch and adjusting flame.
6. Demonstrate procedures for cutting straight lines in mild steel.

05.04 TASK: Lay out and cut bevels (Manual)

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications, 1/4" to 1" mild steel plates, layout instruments, oxy-fuel cutting station, and personal safety equipment; lay out and cut bevels in mild steel plates. Cut will be within 10% of degrees specified and plates will maintain conformity throughout the length of the cuts without any underside slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe the procedures for laying out and cutting bevels in mild steel.
3. Select cutting tip for mild steel.
4. Explain procedures for lighting torch and adjusting flame.
5. Demonstrate the use of lay out instruments.
6. Demonstrate procedures for laying out and cutting bevels in mild steel.

05.05 TASK: Lay out and cut circles

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications, 1/4" to 1" mild steel plates, layout instruments, oxy-fuel cutting station, and personal safety equipment, lay out and cut circles in mild steel. Cut will be within 1/16" of specifications and plates will maintain conformity throughout the length of the cuts without any underside slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain the use of lay out instruments.
3. Describe the procedures for laying out and cutting circles in mild steel.

4. Select tip for cutting mild steel.
5. Explain procedures for lighting torch and adjusting flame.
6. Demonstrate procedures for laying out and cutting circles in mild steel.

05.06 TASK: Lay out and cut patterns

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications for a pattern, 1/4" to 1" mild steel plates, layout instruments, oxy-fuel cutting station, and personal safety equipment, lay out and cut patterns in mild steel plates. Cut will be within 1/16" of specifications and plates will maintain conformity throughout the length of the cuts without any underside slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain the use of lay out instruments.
3. Describe the procedures for laying out and cutting patterns in mild steel.
4. Select tip for cutting mild steel.
5. Explain procedures for lighting torch and adjusting flame.
6. Demonstrate procedures for laying out and cutting patterns in mild steel.

05.07 TASK: Layout and cut structural shapes, beams, angle and channel iron

LEVEL R PERFORMANCE OBJECTIVE: Given cutting specifications, beams, angle and channel iron, layout tools, oxy-fuel cutting station, and personal safety equipment, lay out and cut beams, angles, and channel iron. Cuts will be within 1/16" of specifications and plates will maintain conformity throughout the length of the cuts without any underside slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain the use of lay out instruments.
3. Describe procedures for laying out and cutting beams, angle and channel iron.
4. Select cutting tip for mild steel.
5. Explain procedures for lighting torch and adjusting flame.
6. Demonstrate procedures for cutting out beams, angle and channel iron.

05.08 TASK: Lay out and cut pipe

LEVEL A PERFORMANCE OBJECTIVE: Given cutting specifications, a selection of different pipe, layout instruments, oxy-fuel cutting station, and personal safety equipment, lay out and manually cut pipe. Cuts will be within 1/16" of specifications and pipe will be square without any slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify lay out instruments.
3. Select appropriate lay out instruments.
4. Demonstrate the use of lay out instruments.
5. Select cutting tip for pipe.
6. Explain procedures for lighting torch and adjusting flame.
7. Demonstrate procedures for laying out and cutting pipe.

05.09 TASK: Lay out and cut square and round solid stock (Manual)

LEVEL B PERFORMANCE OBJECTIVE: Given cutting specifications, square and round solid stock, layout instruments, oxy-fuel cutting station, and personal safety equipment, lay out and manually cut square and round solid stock. Cuts will be within 1/16" of specifications and will be square without any slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify lay out instruments.
3. Select appropriate lay out instruments.
4. Demonstrate the use of lay out instruments.
5. Select cutting tip for square and round solid stock.
6. Explain procedures for lighting torch and adjusting flame.
7. Demonstrate procedures for laying out and cutting square and round solid stock.

05.10 TASK: Lay out and straight line cut (Machine)

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications, 1/4" to 3/4" mild steel plates, layout tools, oxy-fuel cutting station, semi-automatic cutting equipment, and personal safety equipment, lay out and straight line cut the mild steel plates. Cuts will be within 1/32" of specifications and will be square without any slag.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify lay out instruments.
3. Select appropriate lay out instruments.
4. Demonstrate the use of lay out instruments.
5. Explain procedures for use of semi-automatic cutting machine.
6. Explain procedures for lighting torch and adjusting flame.
7. Select cutting tip for mild steel.
8. Demonstrate procedures for straight line cutting.

05.11 TASK: Lay out and bevel cut mild steel plates (Machine)

LEVEL E PERFORMANCE OBJECTIVE: Given cutting specifications, 1/4" to 3/4" mild steel plates, layout tools, oxy-fuel machine torch, and personal safety equipment, lay out and bevel cut mild steel plates. Angle of cut will be within ± 5 degrees of specified angle with smooth straight edges that maintain a feather edge.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify lay out instruments.
3. Select appropriate lay out instruments.
4. Demonstrate the use of lay out instruments.
5. Explain the procedures for laying out bevel lines on mild steel.
6. Select cutting tip for mild steel plates.
7. Describe procedures for lighting torch and adjusting flame.
8. Demonstrate procedures for bevel cutting mild steel plates.

05.12 TASK: Lay out and stack cut mild steel plates (Machine)

LEVEL A PERFORMANCE OBJECTIVE: Given cutting specifications, 1/4" to 1/2" mild steel plates, layout tools, oxy-fuel machine torch, and personal safety equipment, lay out and stack cut mild steel plates. Cuts will be within 1/16" of specifications and the flame must burn evenly throughout all stacked plates without any blowout.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify lay out instruments.
3. Select appropriate lay out instruments.
4. Demonstrate the use of lay out instruments.
5. Describe procedures for laying out cutting lines on stacked mild steel plates.
6. Identify and select cutting tip for stack cutting mild steel plates.
7. Explain procedures for lighting torch and adjusting flame.
8. Demonstrate procedures for stack cutting mild steel plates.

05.13 TASK: Heat distortion and preheating apparatus

LEVEL R PERFORMANCE OBJECTIVE: Given access to necessary materials, tools and equipment for proper preheating and assembly procedures, describe heat distortion and preheating apparatus.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain what effect heat has on metal.
3. Identify different types of metal and how heat affects them.
4. Describe different ways of tacking up metal to allow for distortion.
5. Explain different heating equipment and jigs used for the job at hand.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 6

SHIELDED METAL ARC WELDING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

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SHIELDED METAL ARC WELDING

06.01 TASK: Set-up and adjust a shielded metal arc welder

LEVEL E PERFORMANCE OBJECTIVE: Given the three types of welding power supplies.DC motor generators. AC transformers and AC/DC transformers - rectifier, the student will demonstrate manually or in writing, the set-up and adjustment of three machines.

ENABLING OBJECTIVES:

1. Explain safety regulations.
2. Explain polarity.
3. Describe the process of switching to polarity with and without a polarity switch.
4. Explain remote and panel control switch.
5. Explain arc adjustment and how it pertains to welding.
6. Explain why start current is used.
7. Explain high pulse and low pulse and the benefits of it.
8. Demonstrate how to turn electric gas and diesel machines on and off.

06.02 TASK: Identify and select electrodes

LEVEL E PERFORMANCE OBJECTIVE: The student will learn how to identify and select the proper electrode to be used on particular job applications.

ENABLING OBJECTIVES:

1. Explain the electrode identification and numbering system under A.W.S.
2. Describe the different types of mild steel electrodes and their particular application.
3. Describe the different types of copper base electrodes and their particular application.
4. Describe the different types of nickel electrodes and their applicatio..
5. Describe the different types of stainless steel electrodes and their application.
6. Describe the different types of aluminum electrodes and their application.
7. Explain other types of welding electrodes.

06.03 TASK: Strike, maintain and restart an arc

LEVEL E PERFORMANCE OBJECTIVE: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to adjust the welding machine, strike an arc and restart an arc, running a bead to industrial standards.

ENABLING OBJECTIVES:

1. Describe proper safety procedures.
2. Describe machine settings to proper current and polarity with 1/8 inch electrode.
3. Select 1/8 E6010 or E7018 electrode and adjust machine correctly.
4. Demonstrate proper procedure for cleaning metal to be welded.
5. Strike an arc using the tapping method and the scratching method.

06.04 TASK: Weld straight bead in flat position

LEVEL E PERFORMING OBJECTIVES: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to run flat beads using a whipping motion to industrial standards.

ENABLING OBJECTIVES:

1. Describe proper safety procedures.
2. Determine proper setting for the welding machine with proper current and polarity.
3. Select proper electrode.
4. Strike an arc holding proper arc length determined by the desired contour of the bead.
5. Demonstrate procedure to run flat beads.

06.05 TASK: Weld weave bead patterns

LEVEL E PERFORMANCE OBJECTIVE: Given the shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to weave a bead using an oscillating method in the 1-G and 3-G positions.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Determine proper settings for the welding machine to proper current and polarity
3. Select proper electrode
4. Run a weave bead in both flat and vertical position
5. Explain the reason for maximum width of beads

06.06 TASK: Weld build-up pads

LEVEL E PERFORMANCE OBJECTIVE: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to tie beads together using a whipping motion in the flat position to form a pad to industrial standards.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Determine proper settings for the welding machines with proper current and polarity
3. Select proper electrode
4. Explain proper method of cleaning metal
5. Explain the sequence for 1st, 2nd and 3rd layers
6. Demonstrate tieing beads together to form a pad

06.07 TASK: Weld butt joint on plate in flat position

LEVEL E PERFORMING OBJECTIVES: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to make a flat butt weld to conform to industrial standards.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Determine proper settings for the welding machine with proper current and polarity
3. Select proper electrode
4. Demonstrate proper method of cleaning metal
5. Demonstrate proper procedure for tacking of coupons
6. Weld a butt joint

06.08 TASK: Weld lap joint in flat position (1-F)

LEVEL E PERFORMANCE OBJECTIVES: Given shielded metal arc machine, necessary tools, materials, and personal safety equipment, the student will be able to make a lap weld in the flat position.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Determine proper settings for the welding machine with proper current and polarity
3. Select proper electrode
4. Demonstrate proper method of cleaning metal
5. Demonstrate the proper procedure for a one pass 1/4" fillet weld

06.09 TASK: Weld T-joints in flat, horizontal, vertical and overhead position (1-F to 4-F)

LEVEL E PERFORMANCE OBJECTIVE: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to make a multiple pass "T" fillet weld to industrial standards, using E-6010 electrode in flat, horizontal, vertical and overhead positions.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Determine proper current and polarity on equipment
3. Select proper electrode
4. Explain the different types of cleaning methods for the metal
5. Explain tack welds
6. Describe the position of the two individual plates to be welded
7. Demonstrate proper procedure for a 3 pass fillet weld

06.10 TASK: Weld lap joint

LEVEL R PERFORMANCE OBJECTIVE: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to make a lap weld to industrial standards, using E-6010 electrode in flat, horizontal, vertical and overhead positions.

ENABLING OBJECTIVES:

1. Describe proper safety procedures
2. Demonstrate proper current and polarity settings
3. Select proper electrode
4. Explain proper methods of cleaning metal
5. Explain reason for tacking of coupons
6. Demonstrate proper procedure for a 3 pass lap weld

06.11 TASK: Weld outside corner joint in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given shielded metal arc machine, necessary tools, material, and personal safety equipment, the student will be able to make open corner joints in all positions to A.W.S. standards using E-6010 electrode.

ENABLING OBJECTIVES:

1. Describe proper safety procedure
2. Demonstrate proper current and polarity settings
3. Select proper electrodes
4. Describe method of cleaning metal
5. Demonstrate proper procedure for the first pass (Root pass) with 100% penetration

6. Demonstrate proper procedure for the 2nd pass
7. Demonstrate proper procedure for a wash or stringer cap pass

06.12 TASK: Weld basic joints in overhead position (4G & 4F)

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld basic joints in the overhead position, 4G and 4F, in accordance with industry standards. Weld should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures for overhead welding.
2. Describe procedures for laying out mild steel coupons to form a T-fillet and a groove weld in the overhead position.
3. Explain surface preparation procedures.
4. Describe rod angle, filler material, proper amperage and speed of travel in relation to overhead welding.
5. Describe the procedure to set amperage according to plate thickness and electrode diameter.
6. Describe tacking procedures for overhead welding in both 4F and 4G.
7. Demonstrate the proper procedure for overhead welding in 4F and 4G positions.
8. Describe the procedures for testing 4G and 4F overhead welds.

06.13 TASK: Weld butt joint in horizontal position (2-G)

LEVEL B PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld butt joint in horizontal 2G position, in accordance with industry standards. Weld should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe a horizontal butt weld.
3. Describe procedures for laying out mild steel coupons to form a butt weld in the horizontal position.
4. Explain surface preparation procedures.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to horizontal butt welds in the 2G position.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter particular to a horizontal butt weld.
7. Describe tacking procedures for butt welds in the horizontal 2G position.
8. Demonstrate the proper procedure for horizontal butt welds in the 2G position.
9. Describe the procedure for testing horizontal butt welds in the 2G position.

06.14 TASK: Weld single V-groove in all positions

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld single V-grooves in all positions (1G thru 4G) in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe the step to complete single V-groove welds in all positions.
3. Describe procedures for laying out mild steel coupons to form single V-groove welds in all positions.
4. Explain surface preparation procedures.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to single V-groove welds in all positions.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to single V-groove welds.
7. Describe tacking procedures for single V-groove welds in all positions.
8. Demonstrate the proper procedure for single V-groove welds in all positions.
9. Describe procedure for testing single V-groove welds in all positions.

06.15 TASK: Weld pipe joints in all positions

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld pipe in all positions (1G thru 6G) in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures for pipe welds.
2. Describe the procedure to perform pipe welds in all positions.
3. Explain surface preparation procedures.
4. Describe rod angle, filler material, proper amperage and speed of travel in relation to pipe welds in all positions.
5. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to pipe welds in all positions.
6. Describe tacking procedures for pipe welds in all positions.
7. Demonstrate the proper procedure for pipe welds in all positions.
8. Describe the procedure for testing pipe welds in all positions.

06.16 TASK: Plug and slot welds

LEVEL E PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld plug and slot welds in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe plug and slot welds.
3. Describe procedures for laying out mild steel coupons to form plug and slot welds.
4. Explain surface preparation procedures.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to plug and slot welds.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to plug and slot welds.
7. Describe tacking procedures for plug and slot welds.
8. Demonstrate the proper procedure for plug and slot welds.
9. Describe the procedure for testing plug and slot welds.

06.17 TASK: Weld light gauge sheet metal (1G thru 4G) and (1F thru 4F)

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld light gauge sheet metal in 1G thru 4G and 1F thru 4F in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe light gauge sheet metal fillet and groove welds.
3. Describe procedures for laying out mild steel coupons to form light gauge sheet metal groove and fillet welds.
4. Explain surface preparation procedures.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to light gauge sheet metal welds.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to light gauge sheet metal welds.
7. Describe tacking procedures for plug and slot welds.
8. Demonstrate the proper procedure for light gauge sheet metal fillet and groove welds.
9. Describe the procedure for testing light gauge sheet metal welds.

06.18 TASK: Weld cast iron

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld cast iron in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe difficulties and procedures for welding cast iron.
3. Describe procedures for laying out coupons for cast iron welds.
4. Explain surface preparation procedures for welding cast iron.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to welding cast iron.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to welding cast iron.
7. Describe tacking/fitup procedures for welding cast iron.
8. Demonstrate the proper procedure for cast iron welding.
9. Describe the procedure for testing cast iron welds.

06.19 TASK: Weld Alloy Steels

LEVEL A PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld alloy steels, in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Explain methods for correctly identifying alloy steels.
3. Describe the characteristics of alloy steels.
4. Explain why alloy steels are used in specific welding applications.
5. Describe difficulties and procedures welding alloy steels.
6. Describe procedures for laying out coupons for alloy steel welds.
7. Explain surface preparation procedures for welding alloy steels.
8. Describe rod angle, filler material, proper amperage and speed of travel in relation to welding alloy steels.
9. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to welding alloy steels.
10. Describe tacking/fitup procedures for welding alloy steels.
11. Demonstrate the proper procedure for alloy steel welding.
12. Describe the procedure for testing alloy steel welds.

06.20 TASK: Buildup shaft or round surface

LEVEL E PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, buildup a shaft or round surface in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe difficulties and procedures for welding a shaft or round surface.
3. Describe procedures for laying out coupons for buildup of a shaft or round surface weld.
4. Explain surface preparation procedures for welding shafts or round surfaces.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to welding shafts or round surfaces.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to building up shafts or round surfaces.
7. Describe fitup procedures for building up shafts or round surfaces.
8. Describe the proper procedure for buildup welding of shafts or round surfaces.
9. Describe the procedure for testing buildup welds of shafts or round surfaces.

06.21 TASK: Weld Aluminum

LEVEL E PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, weld aluminum in accordance with industry standards. Welds should be free of porosity, slag inclusions, undercut and present a uniform appearance.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe difficulties and procedures for welding aluminum.
3. Describe procedures for laying out coupons for welding aluminum.
4. Explain surface preparation procedures for welding aluminum.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to welding aluminum.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to welding aluminum.
7. Describe fitup procedures for welding aluminum.
8. Demonstrate the proper procedure for welding aluminum.
9. Describe the procedure for testing aluminum welds.

06.22 TASK: Cut metals with S.M.A.W.

LEVEL R PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, cut metal in accordance with industry standards. Cuts should be accurate to within 1/16".

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Describe difficulties and procedures for cutting with S.M.A.W.
3. Describe procedures for laying out pieces for cutting.
4. Explain surface preparation procedures for cutting with S.M.A.W.
5. Describe rod angle, filler material, proper amperage and speed of travel in relation to cutting with S.M.A.W.
6. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to cutting with S.M.A.W. equipment.
7. Demonstrate the proper procedure for cutting metal with S.M.A.W. equipment.

06.23 TASK: Hard-surface metals with S.M.A.W.

LEVEL R PERFORMANCE OBJECTIVE: Given the appropriate S.M.A.W. equipment and metal, hard surface metals in accordance with industry standards.

ENABLING OBJECTIVES:

1. Explain pertinent safety procedures.
2. Explain different applications for hardsurfacing (abrasion, impact, etc.).
3. Describe difficulties and procedures for hardsurfacing with S.M.A.W. equipment.
4. Describe procedures for laying out pieces for hardsurfacing.
5. Explain surface preparation procedures for hardsurfacing with S.M.A.W. equipment.
6. Describe rod angle, filler material, proper amperage and speed of travel in relation to hardsurfacing with S.M.A.W. equipment.
7. Describe the procedure to set amperage according to plate thickness and electrode diameter in regard to hardsurfacing with S.M.A.W. equipment.
8. Demonstrate the proper procedure for hardsurfacing with S.M.A.W. equipment.
9. Describe the procedure for testing hardsurface welds.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 7

GAS TUNGSTEN ARC WELDING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

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GAS TUNGSTEN ARC WELDING

07.01 TASK: Set up gas tungsten arc welder

LEVEL E PERFORMANCE OBJECTIVE: Given tungsten arc equipment, and manufacturer's operating manual, set up and adjust a gas tungsten arc welder.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Identify the components that make up a GTAW welding station and state their respective function.
3. Describe procedures for setting up and operating GTAW equipment.
4. List the steps of assembly and disassembly in their proper sequence.
5. Demonstrate the ability to set up and adjust a gas tungsten arc welder.

07.02 TASK: Select and prepare proper tungsten electrode

LEVEL E PERFORMANCE OBJECTIVE: Given a selection of tungsten electrodes, select and explain proper preparation of electrodes.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Match characteristics of four types of electrodes to their proper color codes.
3. Describe the electrode tip shaping procedure.
4. Explain the importance of length-wise grinding of an electrode tip.
5. Select proper electrode for base metal to be welded.

07.03 TASK: Strike an arc

LEVEL E PERFORMANCE OBJECTIVE: Given the proper gas tungsten arc welding equipment and mild steel plate, strike and maintain an arc.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain proper procedures for striking and maintaining an arc.
3. Demonstrate the ability to strike and maintain an arc.

07.04 TASK: Weld lap joint mild steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given joint and weld specifications, tungsten electrode, filler rod, gas cup, mild steel plate, AC-DC welding machine, flow meter and regulator, personal safety equipment, and access to necessary hand tools, weld lap joint in all positions. Finished bead will be straight with uniform width and a slightly crowned finish. Finished joint will be within print specifications.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe procedures for laying out and welding a lap joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Describe the procedure for tacking lap joints.
5. Demonstrate procedures for laying out mild steel coupons to form lap joint in all positions.
6. Demonstrate procedures for welding mild steel coupons to form lap joint in all positions.
7. Explain the testing methods for lap joints.

07.05 TASK: Weld corner joint mild steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, mild steel plate, personal safety equipment, and joint weld specifications, construct a corner joint in all positions. Finished bead must have same width, straightness, slightly crowned finish, and fuse into the base metal, with clean appearance.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a corner joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Describe the procedure for tacking corner joints.
5. Demonstrate procedures for laying out mild steel coupons to form corner joints in all positions.
6. Demonstrate procedures for welding mild steel coupons to form corner joints in all positions.
7. Explain the testing methods for corner joints.

07.06 TASK: Weld T-joint mild steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, mild steel plate, personal safety equipment, and joint weld specifications, construct a T-joint in all positions. Weld must be straight, have consistency of width and height with proper buildup.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a T-joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Describe the procedure for tacking T-joints.
5. Demonstrate procedures for laying mild steel coupons to form T-joints in all positions.
6. Demonstrate procedure for welding mild steel coupons to form T-joints in all positions.
7. Explain the testing methods for T-joints.

07.07 TASK: Weld butt joint mild steel in all positions (1-G through 4-G)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, mild steel plate, personal safety equipment, and joint specifications, construct a butt joint, in all positions. The bead will be straight and slightly crowned with no undercuts into the base metal.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a butt joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Describe the procedure for tacking butt joints.
5. Demonstrate procedures for laying out mild steel coupons to form butt joints in all positions.
6. Demonstrate procedure for welding mild steel coupons to form butt joints in all positions.
7. Explain the testing methods for butt joints.

07.08 TASK: Weld butt joint stainless steel in all positions (1-G through 4-G)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, stainless steel plate, personal safety equipment, and joint weld specifications, construct a butt joint on stainless steel in all positions. The bead should be straight, slightly crowned and the same width. The joint should have a rounded contour when finished, with no undercut or overlap of the base metal.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a butt joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Explain the effects of oxidation on stainless steel when welding.
5. Describe carbide precipitation.
6. Classify the different types of stainless steel alloys by micro structure.
7. Describe the procedures for tacking butt joints.
8. Demonstrate procedures for laying out stainless steel coupons to form butt joints in all positions.
9. Demonstrate procedures for welding stainless steel coupons to form butt joints in all positions.
10. Explain the testing methods for butt joints.

07.09 TASK: Weld lap joint stainless steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, stainless steel coupons, personal safety equipment, and joint weld specifications, construct a lap joint on stainless steel in all positions. Weld joint with and without filler rod. The bead will be straight with no undercut or overlap of base metal.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedure for laying out and welding a lap joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Explain the effects of oxidation on stainless steel when welding.
5. Describe carbide precipitation.
6. Classify the different types of stainless steel alloys by microstructure.
7. Describe the procedure for tacking lap joints.
8. Demonstrate procedures for laying out stainless steel coupons to form lap joints in all positions.
9. Demonstrate procedures for welding stainless steel coupons to form lap joints in all positions.
10. Explain the testing methods for lap joints.

07.10 TASK: Weld corner joint stainless steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, stainless steel coupons, personal safety equipment, and joint specifications, construct an corner joint on stainless steel in all positions. The bead must be the same width and straightness, slightly crowned, and must fuse into the base metal with no undercuts or cold laps.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding corner joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Explain the effects of oxidation on stainless steel when welding.
5. Describe carbide precipitation.
6. Classify the different types of stainless steel alloys by microstructure.
7. Describe the procedure for tacking corner joints.
8. Demonstrate procedure for laying out stainless steel coupons to form corner joints in all positions.
9. Demonstrate procedure for welding stainless steel coupons to form corner joints in all positions.
10. Explain the testing methods for corner joints.

07.11 TASK: Weld T-joint stainless steel in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, stainless steel coupons, personal safety equipment, and joint weld specifications, construct a T-joint in all positions. Weld must be straight, have consistency of width and height with proper buildup.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a T-joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Explain the effects of oxidation on stainless steel when welding.
5. Describe carbide precipitation.
6. Classify the different types of stainless steel alloys by microstructure.
7. Describe the procedure for tacking T-joints.
8. Demonstrate procedures for laying out stainless steel coupons to form T-joint in all positions.
9. Demonstrate procedures for welding stainless steel coupons to form T-joint in all positions.
10. Explain the testing methods for T-joints.

07.12 TASK: Weld butt joints on aluminum in all positions (1-G through 4-G)

LEVEL A PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, aluminum coupons, personal safety equipment, and joint weld specifications, construct a butt joint on aluminum in all positions. The bead should be slightly crowned, same width, fused into base metal with clean appearance with no undercuts or cold laps.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a butt joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Classify the different types of aluminum alloys.
5. Describe the term hot cracking as applied to aluminum alloys.
6. Describe the procedure for tacking butt joints.
7. Demonstrate procedures for laying out aluminum coupons to form butt joints in all positions.
8. Demonstrate procedures for welding aluminum coupons to form butt joints in all positions.
9. Explain the testing methods for butt joints.

07.13 TASK: Weld lap joint on aluminum in all positions (1-F through 4-F)

LEVEL A PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, aluminum coupons, personal safety equipment, and joint weld specifications, construct a lap joint on aluminum and weld in all positions. The bead should be the same width, slightly crowned, fused into base metal with clean appearance with no undercuts or cold laps.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding a lap joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Classify the different types of aluminum alloys.
5. Describe the term "hot cracking" as applied to aluminum alloys.
6. Describe the procedure for tacking lap joints.
7. Demonstrate procedures for laying out aluminum coupons to form lap joints in all positions.
8. Demonstrate procedures for welding aluminum coupons to form lap joints in all positions.
9. Explain the testing methods for lap joints.

07.14 TASK: Weld T-joint on aluminum in all positions (1-F through 4-F)

LEVEL A PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, aluminum coupons, personal safety equipment, and joint weld specifications, construct a T-joint on aluminum and weld in all positions. The bead should be the same width, slightly crowned, fused into base metal with clean appearance with no undercuts or cold laps.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedures for laying out and welding T-joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Classify the different types of aluminum alloys.
5. Describe the term "hot cracking" as applied to aluminum alloys.
6. Describe the procedure for tacking T-joints.
7. Demonstrate procedures for laying out aluminum coupons to form T-joints in all positions.
8. Demonstrate procedures for welding aluminum coupons to form T-joints in all positions.
9. Explain the testing methods for T-joints.

07.15 TASK: Weld corner joint on aluminum in all positions (1-F through 4-F)

LEVEL B PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, aluminum coupons, personal safety equipment, and joint weld specifications, construct a corner joint on aluminum and weld in all positions. The bead should be the same width, slightly crowned, fused into base metal with clean appearance with no undercuts or cold laps.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Describe procedure for laying out and welding a corner joint in all positions.
3. Describe filler rod and torch angles and speed of travel.
4. Classify the different types of aluminum alloys.
5. Describe the term "hot cracking" as applied to aluminum alloys.
6. Describe the procedure for tacking corner joints.
7. Demonstrate procedures for laying out aluminum coupons to form corner joints in all positions.
8. Demonstrate procedures for welding aluminum coupons to form corner joints in all positions.
9. Explain the testing methods for corner joints.

07.16 TASK: Pipe welding in all positions (1-G, 2-G, 5-G and 6-G)

LEVEL A PERFORMANCE OBJECTIVE: Given necessary gas tungsten arc welding equipment, personal safety equipment, and joint weld specifications, weld a butt joint, multiple pass, 1-G, 2-G, 5-G and 6-G, on 3-inch Schedule 40 pipe. The root bead will show proper penetration, 1/32" to 1/16" and the cover pass will be slightly convexed, with a face reinforcement not to exceed 1/8". There should be no overlapping or undercutting.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Describe the procedure for the preparation of the pipe specimens.
3. Describe the procedure for the tack weld and the position of the workpiece.
4. Describe the procedure for electrode maintenance and adjustment.
5. Demonstrate the procedure for developing the proper root penetration and torch manipulation.
6. Demonstrate the procedure for developing a proper finished weld as related to the convex surface and fusion to the beveled edges.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 8

GAS METAL ARC AND FLUX CORED ARC WELDING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

MODULE 8 - GAS METAL ARC AND FLUX CORED ARC WELDING

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

Although some provision is made for basic mathematics and communication skills within this guide, they may not be adequate to meet the needs of individual students. Counseling, guidance, and diagnostic test results may indicate a need for further preparation in these areas. In such cases, instructors are encouraged to utilize the resources and personnel within the institution to improve or complement the instructional process.

The benefits to students and institutions derived from this curriculum guide should be considerable. Articulation of students from secondary to post-secondary programs will be aided through the use of a single curriculum guide. The guide provides a tool for evaluation of local curriculum and programs. The guide may be used in a flexible manner to assure that welding programs meet the needs of local business and industry.

It is the goal of this program guide to provide a level of instruction which will impart entry level employment skills. Students should be carefully counseled on the importance of attaining competency in the tasks assigned. As in virtually all occupations today, welding technicians will require periodic up-dating and review in the future. It is important that each student understand that meeting the program standards is essential not only to obtain employment today but also to have a base upon which to retain employment in the future.

GAS METAL ARC AND FLUX CORED ARC WELDING

08.01 TASK: Set up and adjust GMAW and FCAW equipment

LEVEL E PERFORMANCE OBJECTIVE: Given proper welding equipment and demonstrations, set-up and shut down GMAW and FCAW equipment. This procedure will be carried out accurately and safely.

ENABLING OBJECTIVES:

1. Explain safety rules and hazards.
2. Explain and demonstrate setting and adjusting voltage and amperage/wire speed.
3. Describe GMAW and FCAW welding processes.
4. Demonstrate set up.
5. Demonstrate shut down.

08.02 TASK: Weld weave bead patterns

LEVEL E PERFORMANCE OBJECTIVE: Given proper GMAW and FCAW equipment, personal safety equipment and a demonstration of proper weave pattern, weld weave patterns in all positions to meet industrial specifications.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Discuss vertical down/vertical up patterns.
3. Discuss forehand and backhand methods of welding.
4. Demonstrate welding weave bead patterns in all positions.

08.03 TASK: Weld butt joints in all positions (1-G through 4-G)

LEVEL A PERFORMANCE OBJECTIVE: Given the proper GMAW and FCAW equipment, personal safety equipment, and demonstrations of welding procedure, weld butt joints in 1-G through 4-G positions in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain welding butt joints in the 1-G through 4-G positions.
3. Discuss advantages of forehand and backhand methods of welding.
4. Demonstrate welding butt joints in all positions.

08.04 TASK: Weld lap joints in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given the proper GMAW and FCAW welding equipment, personal safety equipment, and demonstrations, weld lap joints in 1-F through 4-F positions in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain welding lap joints in the 1-F through 4-F positions.
3. Discuss advantages of forehand and backhand methods of welding.
4. Demonstrate welding lap joints in all positions.

08.05 TASK: Weld corner joints in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given the proper GMAW and FCAW welding equipment, personal safety equipment, and demonstrations, weld corner joints in the 1-F through 4-F positions in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain welding corner joints in the 1-F through 4-F positions.
3. Discuss the advantages of forehand and backhand methods of welding.
4. Demonstrate welding corner joints in all positions.

08.06 TASK: Weld T-joints in all positions (1-F through 4-F)

LEVEL R PERFORMANCE OBJECTIVE: Given the proper GMAW and FCAW welding equipment, personal safety equipment, and demonstrations, weld T-joints in the 1-F through 4-F positions in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain welding T-joints in the 1-F through 4-F positions.
3. Discuss the advantages of forehand and backhand methods of welding.
4. Demonstrate welding T-joints in all positions.

08.07 TASK: Weld aluminum plate (1-F through 4-F and 1-G through 4-G)

LEVEL A PERFORMANCE OBJECTIVE: Given the proper GMAW welding equipment, personal safety equipment, demonstrations on welding aluminum and reference material on aluminum alloys, weld aluminum plate on 1-F through 4-F positions and 1-G through 4-G position in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain aluminum alloy and the code system for alloy identification.
3. Explain setup for aluminum welding with the GMAW process, including gas, special liners, and procedures.
4. Discuss the advantages of forehand and backhand methods of welding.
5. Demonstrate welding aluminum plate in the 1-F through 4-F and 1-G through 4-G positions.

08.08 TASK: Weld stainless steel (1-F through 4-F and 1-G through 4-G)

LEVEL A PERFORMANCE OBJECTIVE: Given the proper GMAW welding equipment, personal safety equipment, demonstrations on welding stainless steel and reference material on stainless steel alloys, weld stainless steel plate on 1-F through 4-F positions and 1-G through 4-G position in a safe and competent manner.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain stainless steel alloy and the code system for alloy identification.
3. Explain setup for stainless steel welding with the GMAW process, including gas, special liners, and procedures.
4. Discuss the advantages of forehand and backhand methods of welding.
5. Demonstrate welding stainless steel in the 1-F through 4-F and 1-G through 4-G positions.

08.09 TASK: Weld pipe in 1-G, 2-G, 5-G and 6-G positions

LEVEL A PERFORMANCE OBJECTIVE: Given the proper GMAW and FCAW welding equipment, personal safety equipment, and demonstrations of proper pipe welding procedure, weld pipe in 1-G, 2-G, 5-G and 6-G positions.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Explain pipe weld positions 1-G, 2-G, 5-G, 6-G.
3. Discuss advantages of forehand and backhand methods of welding.
4. Demonstrate procedure for welding pipe.

08.10 TASK: Explain procedure for hard-surfacing with GMAW

LEVEL R PERFORMANCE OBJECTIVE: Given the proper reference manuals, demonstrations, and lectures on proper uses and alloys of hard-surfacing, explain the hard-surfacing GMAW procedure.

ENABLING OBJECTIVES:

1. Explain the relevant safety procedures.
2. Explain the different uses, alloys and positions, for hard-surfacing GMAW process.
3. Describe welding procedure for welding hard-surface.
4. Explain set-up and gas use for hard-surface.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 9

AIR CARBON ARC CUTTING

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

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Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

Although some provision is made for basic mathematics and communication skills within this guide, they may not be adequate to meet the needs of individual students. Counseling, guidance, and diagnostic test results may indicate a need for further preparation in these areas. In such cases, instructors are encouraged to utilize the resources and personnel within the institution to improve or complement the instructional process.

The benefits to students and institutions derived from this curriculum guide should be considerable. Articulation of students from secondary to post-secondary programs will be aided through the use of a single curriculum guide. The guide provides a tool for evaluation of local curriculum and programs. The guide may be used in a flexible manner to assure that welding programs meet the needs of local business and industry.

It is the goal of this program guide to provide a level of instruction which will impart entry level employment skills. Students should be carefully counseled on the importance of attaining competency in the tasks assigned. As in virtually all occupations today, welding technicians will require periodic up-dating and review in the future. It is important that each student understand that meeting the program standards is essential not only to obtain employment today but also to have a base upon which to retain employment in the future.

AIR CARBON ARC CUTTING

09.01 TASK: Set up air carbon arc cutting equipment

LEVEL E PERFORMANCE OBJECTIVE: Given air carbon arc cutting equipment and operating manual, demonstrate the correct procedure for assembly and disassembly of the cutting unit.

ENABLING OBJECTIVES:

1. Describe safety rules and procedures for safe operation of the air carbon arc cutting process.
2. Select the personal equipment needed for safe operation of the process.
3. Identify the parts of the air arc gun.
4. Identify types of electrodes and polarity.
5. Demonstrate the ability to set up and shut down the air carbon arc cutting unit.
6. Select correct type of electrode.
7. Select correct polarity for electrode.

09.02 TASK: Gouge, cut, and pierce metals

TASK E PERFORMANCE OBJECTIVE: Given air carbon arc cutting equipment and personal safety equipment, demonstrate the correct operating procedures to gouge, cut and pierce ferrous and non-ferrous metals to meet industry standards.

ENABLING OBJECTIVES:

1. Explain relevant safety procedures.
2. Classify ferrous and non-ferrous metals by the:
   a. Appearance test
   b. Magnetic test
   c. Flame test
   d. Chisel test
   e. Spark test
3. Demonstrate the procedures for gouging ferrous and non-ferrous metals.
4. Demonstrate the procedures for cutting ferrous and non-ferrous metals.
5. Demonstrate the procedures for piercing ferrous and non-ferrous metals.

CURRICULUM GUIDE FOR

WELDING TECHNOLOGY

MODULE 10

PLASMA ARC CUTTING (PAC)

Division of Vocational Education
State of Idaho
Boise, Idaho
1990

This is one of a series of modules which comprise the Idaho Curriculum Guide for Welding. Each module contains a listing of the tasks, performance objectives, and enabling objectives required to enable a student to achieve competency in a specific system or field of study within the basic welding technician occupational field. The numbering of these modules is not intended to dictate an order of instruction or scheduling. The order in which these modules may be taught is determined by each institution and its instructors.

Each task describes an occupational activity which will result in a finished process or product. The tasks listed in each module represent the basic activities required of each student to demonstrate entry level competence for that specific system or field of study within the welding occupation. Individual records of student performance in completing the tasks listed within each module should be maintained.

Although some provision is made for basic mathematics and communication skills within this guide, they may not be adequate to meet the needs of individual students. Counseling, guidance, and diagnostic test results may indicate a need for further preparation in these areas. In such cases, instructors are encouraged to utilize the resources and personnel within the institution to improve or complement the instructional process.

The benefits to students and institutions derived from this curriculum guide should be considerable. Articulation of students from secondary to post-secondary programs will be aided through the use of a single curriculum guide. The guide provides a tool for evaluation of local curriculum and programs. The guide may be used in a flexible manner to assure that welding programs meet the needs of local business and industry.

It is the goal of this program guide to provide a level of instruction which will impart entry level employment skills. Students should be carefully counseled on the importance of attaining competency in the tasks assigned. As in virtually all occupations today, welding technicians will require periodic up-dating and review in the future. It is important that each student understand that meeting the program standards is essential not only to obtain employment today but also to have a base upon which to retain employment in the future.

PLASMA ARC CUTTING (PAC)

10.01 TASK: Set up plasma arc cutting equipment

LEVEL E PERFORMANCE OBJECTIVE: Given plasma arc cutting equipment, personal safety equipment, and operating manual, demonstrate the correct procedure for assembly and disassembly of the cutting unit to manufacturer's specifications.

ENABLING OBJECTIVES:

1. Describe safety rules and procedures for safe operation of the plasma arc cutting process.
2. Select the personal equipment needed for safe operation of the process.
3. Identify the parts of the plasma arc cutting torch.
4. Demonstrate the ability to replace all consumables for the plasma arc cutting process.
5. Set up and shut down the plasma arc cutting equipment.

10.02 TASK: Cut bevels and straight cuts on ferrous and non-ferrous metals

LEVEL E PERFORMANCE OBJECTIVE: Given plasma arc cutting equipment, personal safety equipment, and demonstrations on the correct operating procedures, cut bevels and straight cuts on ferrous and non-ferrous metals to meet industry standards.

ENABLING OBJECTIVES:

1. Select personal safety equipment and follow all relevant safety procedures.
2. Classify ferrous and non-ferrous metals by the:
   a. Appearance test
   b. Magnetic test
   c. Flame test
   d. Spark test
3. Demonstrate the procedures for cutting bevels in ferrous and non-ferrous metals.
4. Demonstrate the procedures for cutting straight cuts in ferrous and non-ferrous metals.

10.03 TASK: Gouging with plasma arc.

LEVEL E PERFORMANCE OBJECTIVE: Given plasma arc cutting equipment, personal safety equipment, and demonstrations on the correct operating procedures, gouge ferrous and non-ferrous metals according to industry standards.

ENABLING OBJECTIVES:

1. Select safety equipment and follow all relevant safety procedures.
2. Classify ferrous and non-ferrous metals by the:
   a. Appearance test
   b. Magnetic test
   c. Flame test
   d. Spark test
3. Demonstrate the procedures for gouging ferrous metals.
4. Demonstrate the procedures for gouging non-ferrous metals.

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