
LAKELAND COMMUNITY COLLEGE - COURSE OUTLINE FORM*

*** WORK-IN-PROCESS VERSION, NOT YET APPROVED ***

ORIGINATION DATE: 8/10/17 **APPROVAL DATE:**
LAST MODIFICATION DATE: 11/14/17 **EFFECTIVE TERM/YEAR:** FALL/ 18
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COURSE ID: WELD1340
COURSE TITLE: Basic FCAW (Flux Cored) and GMAW (MIG/MAG) Welding

	LECTURE	LAB	CLINICAL	TOTAL	OBR MIN	OBR MAX
CREDITS:	1.00	2.00	0.00	3.00	3.00	3.00
CONTACT HOURS:	1.00	4.00	0.00	5.00		

PREREQUISITE:

WELD 1030 (can be taken concurrently)

COURSE DESCRIPTION:

This course introduces students to the basic concepts of utilizing the Flux Cored Arc Welding (FCAW) and Gas Metal Arc Welding (GMAW) processes to make fillet and groove welds in the flat and horizontal positions in carbon steel, stainless steel, and aluminum. Laboratory experience includes skill development in both types of arc welding. Students must furnish: welding helmet (shade #10 or above); safety glasses; work gloves; long pants; welding jacket; leather work boots, preferable steel toe; 8" crescent wrench; soapstone and holder; tape measure; combination square; chipping hammer; wire brush; center punch; 12 oz. ball peen hammer; and tool bag. 4 1/2" grinder is optional.

RATIONALE FOR COURSE:

This course provides practical welding experience and knowledge for students wanting to understand and produce fillet and groove welds using Flux Cored Arc Welding (FCAW) with and without the use of shielding gases (FCAW-G or FCAW-S) and Gas Metal Arc Welding (GMAW) in the flat and horizontal positions. This course will provide a pathway for employment in a welding field and for welding certification.

OUTCOMES:

The course will

1. Introduce students to essential welding safety equipment and procedures.
2. Enable students to recognize the attributes of an acceptable fillet and groove weld that is properly produced in the flat and horizontal positions using the FCAW-S and FCAW-G processes.
3. Enable students to recognize the attributes of an acceptable fillet and groove weld that is properly produced in the flat and horizontal positions using the GMAW process.

4. Familiarize students with how to safely and properly make cost effective FCAW-G and FCAW-S fillet and groove welds in the flat and horizontal positions.
 5. Familiarize students with how to safely and properly make cost effective GMAW fillet and groove welds in the flat and horizontal positions.
 6. Provide knowledge as to the equipment, base materials and consumables used to make FCAW-G and FCAW-S fillet and groove welds in carbon steel and stainless steel in the flat and horizontal positions.
 7. Provide knowledge as to the equipment, base materials and consumables used to make GMAW fillet and groove welds in carbon steel, stainless steel, and aluminum in the flat and horizontal positions.
 8. Familiarize students with the various modes of metal transfer available in the GMAW welding process and advantages and disadvantages of each
 9. Enable students to recognize the advantages and disadvantages of utilizing these welding processes.
 10. Develop students' ability to evaluate welds for quality and determine if they are acceptable by referring to an appropriate standard.
 11. Introduce instruction in how industry uses the American Welding Society (AWS) electrode and filler metal numbering system.
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PERFORMANCE INDICATORS:

Upon completion of the course, the student should be able to

1. Identify and apply safety procedures when working with welding equipment.
 2. Produce acceptable FCAW-G and FCAW-S welds in: T-, butt and lap joints in mild steel and stainless steel.
 3. Produce acceptable GMAW welds in: T-, butt and lap joints in aluminum, mild steel, and stainless steel.
 4. Name and describe the function of each major component of a wire-feed welding machine.
 5. Troubleshoot the FCAW-G, FCAW-S and GMAW machines and processes to ensure proper settings and production of quality weldments.
 6. Demonstrate proficiency in using the FCAW-G and FCAW-S processes to make welds in the 1F, 2F, 1G & 2G positions that meet AWS D1.1 visual inspection standards.
 7. Demonstrate proficiency in using the GMAW process to make welds in the 1F, 2F, 1G & 2G positions that meet AWS D1.1 visual inspection standards.
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COURSE OUTLINE:

- I. Safety
 - A. Proper Protective equipment
 - B. Hazards
 - C. Handling the gas cylinders
 - D. Electrical shock
 - E. Arc Ray

- F. Burns
- G. Clean Shop environment

II. GMAW Fundamentals and Conventional Modes of Transfer

- A. Short circuiting transfer
 - 1. Characteristics
 - 2. Polarity
 - 3. Inductance
 - a. Pinch and arc Control
 - 4. Types of gases and there uses
 - a. Inert and Active
 - 5. Positions
 - 6. Voltage
 - 7. Wire feed speed
 - 8. Advantage and limitations
 - 9. Techniques
- B. Globular transfer
 - 1. Characteristics
 - 2. Polarity
 - 3. Gases
 - 4. Voltage
 - 5. Wire Feed speed
 - 6. Position
 - 7. Technique
 - 8. Advantages and disadvantages
- C. Spray transfer
 - 1. Characteristics
 - 2. Polarity
 - 3. Gases
 - 4. Voltage
 - 5. Wire feed speed
 - 6. Position
 - 7. Technique
 - 8. Advantages and Disadvantages

III. GMAW Fundamentals - Pulsing and Waveform Control Technology

- A. Pulse
 - 1. Polarity
 - a. DC+
 - 2. Gases
 - a. Transition current 80% Rule
 - b. 90/10, 98/2, 95/5
 - 3. Maximum amount of oxygen allowed in Mixed gases
 - a. 5%
 - 4. Trim VS Volts
 - 5. Different waveforms
 - 6. Setting up and programing the welding Machine
 - a. Front panels
 - i. .035 AR/CO2 program #11 350 MP
 - 7. Pre-flow
 - 8. Post flow
 - 9. Run-in
 - 10. Start control
 - 11. Arc control
 - 12. Burn back
 - 13. Spot timer
 - 14. Cold feed
 - 15. Purge
- B. Modified short circuiting transfer (STT, PipePro, etc)
 - 1. Peak
 - 2. Background
 - 3. Tail-in

4. Tail-out
 5. WFS wire feed Speed
 6. Voltage
 - a. Advantages and Disadvantages
 - b. Gases
 - c. Wire Size
- IV. Power Sources - (Typically Same for GMAW and FCAW)
- A. Constant Voltage compared to Constant current
 - B. Duty Cycle
 1. Percent of time machine can operate as rated in 10 minute period
 2. 30% for machine rated at 250 amps = 3 min in any 10min period
- V. Wire Feeders- (Typically Same for GMAW and FCAW)
- A. "Smart" Feeders
 - B. "Dumb" feeders
 1. Drive motors
 - a. 2 roll systems
 - b. 4 roll system
 - c. V-groove, U-groove and knurled drive rolls
 - C. Single vs dual-wire feeders
 - D. 2 drive rolls vs 4
 - E. Cold feed
 - F. Gas purge
 - G. Volt control
 - H. Wire feed speed control
 - I. Control cable receptacle
 - J. Wire drive systems
 - K. Wire wheel spindle and adapter
 - L. Wire guides or guide tubes
- VI. Gun and Cables - (Similar for GMAW and FCAW-G, FCAW-S Slight Gun Difference)
- A. Amperage range
 1. 100 to 500
 - B. Parts of a gun and cable
 1. Trigger
 2. Liner
 3. Gas diffuser
 4. Nozzles
 5. Contact tube
 6. Differences in guns used for FCAW-S
- VII. Shielding Gas
- A. Carbon Dioxide
 1. Low cost
 2. less spray transfer
 3. Less radiated
 - B. Argon/Carbon Dioxide
 1. Low spatter
 2. Better mechanical properties
 3. High deposition rate
 4. Less penetration
- VIII. Electrodes and AWS Numbering System - Applies to Both GMAW and FCAW
- A. Solid and tubular electrodes
 1. GMAW uses solid or metal-core tubular
 2. FCAW uses flux-cored tubular
 - B. ER70S-6
 1. E= electrode; R=filler rod
 2. 70= minimum tensile strength
 3. S= solid
 4. 6= chemistry

- C. 309L 308L 316L
 - 1. 3= series
 - 2. 09= chemistry
 - 3. L= low carbon
- D. 4043 5356
 - 1. 4= series
 - 2. 043= chemistry

IX. Trouble Shooting

- A. Welding application

X. FCAW-S Fundamentals - (Similar to GMAW Except for Following)

- A. "Innershield" welding
- B. Tubular wire - primary difference is chemistry: has more de-oxidizers
- C. Polarity sensitive wires - GMAW typically DC+ (DCEP)
 - 1. DC-
 - 2. DC+

XI. Flux Core Self-shielded Advantages

- A. Outdoor welding
- B. Minimizes restarts
- C. No shielding gas required
- D. Deposition rate are very high

XII. Flux Core Self Shielded Limitations

- A. Smoke fumes - more fume is produced
- B. Spatter
- C. Slag

XIII. Electrical Stick-Out Vs Visible Stick Out - (Applies to Both GMAW and FCAW)

- A. From the end of the electrode to the molten puddle
- B. From the end of the nozzle to molten puddle

XIV. Equipment and Setup - (Almost Identical for Both GMAW and FCAW)

- A. Gun & cable
- B. Contact tip
- C. Drive motor
- D. Local and remote
- E. Wire speed receptacle
- F. Amps volt meter

XV. Trouble shooting

- A. ESO = Electrical Stick out
- B. Too Short
 - 1. Porosity
- C. Too long
 - 1. Ropey and too cold
 - 2. Decrease penetration
 - 3. Increase spatter

XVI. Core Elements in the Wire - (Effects Are Similar for Both GMAW and FCAW)

- A. Aluminum
 - 1. Deoxidizer & denitrify
- B. Calcium
 - 1. Provides shielding and forms slag
- C. Carbon ETC.
- D. Function of core elements
 - 1. Mechanical properties
 - 2. Metallurgical properties

INSTRUCTIONAL PROCEDURES THAT MAY BE UTILIZED:

Lectures videos, online, or handouts may be used for instruction of the fundamental concepts. Students set up and practice welding using various types of welding equipment during laboratory.

GRADING PROCEDURES:

Examinations and/or quizzes
Class participation and discussion
Lab work, individual projects, papers or reports and/or
Homework

COURSE EVALUATION PROCEDURES:

This course will be reviewed bi-annually by faculty and the Advisory Committee. Students will complete course evaluations each semester.

****See pages 17-19 of Curriculum Procedures & Guidelines for definitions of course outline terms.***

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LAKELAND STUDENT LEARNING OUTCOMES

LEARNS ACTIVELY	I	R	D
1. Takes responsibility for his/her own learning.			
2. Uses effective learning strategies.			
3. Reflects on effectiveness of his/her own learning strategies.			
THINKS CRITICALLY	I	R	D
4. Identifies an issue or idea.			
5. Explores perspectives relevant to an issue or idea.			
6a. Identifies options or positions.			D
6b. Critiques options or positions.			
7. Selects an option or position.			D
8a. Implements a selected option or position.			D
8b. Reflects on a selected option or position.			
COMMUNICATES CLEARLY	I	R	D
9a. Uses correct spoken English.			
9b. Uses correct written English.			
10. Conveys a clear purpose.			
11. Presents ideas logically.			D
12a. Comprehends the appropriate form(s) of expression.			D
12b. Uses the appropriate form(s) of expression.			D
13. Engages in an exchange of ideas.			
USES INFORMATION EFFECTIVELY	I	R	D
14. Develops an effective search strategy.			
15a. Uses technology to access information.			
15b. Uses technology to manage information.			
16. Uses selection criteria to choose appropriate information.			
17. Uses information responsibly.			
INTERACTS IN DIVERSE ENVIRONMENTS	I	R	D
18a. Demonstrates knowledge of diverse ideas.			
18b. Demonstrates knowledge of diverse values.			
19. Describes ways in which issues are embedded in relevant contexts.			
20a. Collaborates with others.			
20b. Collaborates with others in a variety of situations.			
21. Acts with respect for others.			

Definitions:

Introduces (I)

Students first learn about key ideas, concepts, or skills related to the performance indicator. This usually happens at a general or very basic level, such as learning one idea or concept related to the broader outcome.

Reinforces (R)

Students are given the opportunity to synthesize key ideas of skills related to the performance indicator at increasingly proficient levels.

Demonstrates (D)

Students should demonstrate mastery of the performance indicator with the level of independence expected of a student attaining an associate's degree.