

---

**LAKELAND COMMUNITY COLLEGE – COURSE OUTLINE FORM**

---

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

---

<b>ORIGINATION DATE:</b>	10/5/17	<b>APPROVAL DATE:</b>	
<b>LAST MODIFICATION DATE:</b>	11/14/17	<b>EFFECTIVE TERM/YEAR:</b>	FALL/ 18

---

**PRINTED:** 8/13/2018

**COURSE ID:** WELD2400

**COURSE TITLE:** Welding Inspection

	<b>LECTURE</b>	<b>LAB</b>	<b>CLINICAL</b>	<b>TOTAL</b>	<b>OBR MIN</b>	<b>OBR MAX</b>
<b>CREDITS:</b>	2.00	1.00	0.00	3.00	3.00	3.00
<b>CONTACT HOURS:</b>	2.00	3.00	0.00	5.00		

---

---

**PREREQUISITE:**

None

---

## COURSE DESCRIPTION:

This course introduces students to the basic inspection procedures and processes utilized in the welding industry. Topics include safety concerns; the role of a welding inspector; relevant documents; requirements of a weld; types of defects; acceptance criteria; inspections and verifications performed prior to, during and after welding operations; visual inspection; destructive and nondestructive tests and metallography. Laboratory experience provides skill development in evaluating welds through visual examination using various related measuring instruments, nondestructive examination using liquid penetrant, magnetic particle, ultrasonic, and eddy current tests, and the preparation and examination of metallographic specimens. Students must furnish safety glasses for use in the laboratory.

---

## RATIONALE FOR COURSE:

This course provides the knowledge and practical experience necessary for students to understand and perform inspection procedures typically utilized in the welding industry. This course will provide a pathway for employment in the welding industry as a testing or inspection technician or as a welder responsible for guaranteeing the quality of welds made.

---

## OUTCOMES:

**The course will:**

1. Introduce students to basic inspection procedures and processes utilized in the welding industry and to related career paths such as welding inspector.
2. Familiarize students with safety concerns associated with welding inspection and how to address them.
3. Familiarize students with basic terminology and documents relevant to welding inspection, the requirements of a weld, types of defects and acceptance criteria.
4. Familiarize students with visually inspecting welds, performing basic nondestructive tests, and preparing and evaluating metallographic specimens.

5. Prepare students for entry-level positions as weld inspectors or testing and inspection technicians.
- 

## PERFORMANCE INDICATORS:

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

1. Identify and apply appropriate safety procedures when working as a welding inspector or performing work related to the inspection of weldments.
  2. Describe the types of tasks typically performed by a welding inspector.
  3. Give examples of typical requirements that might be specified for a weld.
  4. Perform visual examinations of fillet and groove welds and determine if the welds meet the applicable acceptance standards.
  5. Identify and describe nondestructive tests commonly used to evaluate weld.
  6. Evaluate a weld by performing liquid penetrant and magnetic particle tests and determine whether the weld meets the applicable acceptance requirements.
  7. Identify and describe the basic mechanical properties of base materials and weldments, and identify the destructive tests used to quantify those properties for a specific piece of material or weldment.
  8. Prepare metallographic micro- and macro-specimens and explain what types of information they can provide.
- 

## COURSE OUTLINE:

- I. Safety
  - A. Health and safety concerns
    1. General concerns when in an industrial facility
    2. General concerns when on a construction site
    3. General concerns when welding or when close to a welding operation
    4. Specific concerns associated with welding inspection
  - B. Use of protective equipment
  - C. Avoid potentially dangerous situations and follow safety procedures
- II. Introduction to Welding Inspection
  - A. Purpose, scope and importance
    1. Role of Quality Assurance
      - a. Interaction of welders and inspectors
  - B. Types of inspections and other activities involved
    1. Review of relevant prints, documents, material test reports, etc.
    2. Pre-weld verifications - materials, joints, fit-up, preheat, welder qualification, proper process and conformance to WPS requirements, etc.
    3. In-process inspections and verification of compliance with WPS requirements including settings, interpass temperature limits, heat input, etc.
    4. Inspection and testing of completed weldment
      - a. Visual inspection
      - b. NDT evaluations
      - c. Verification that post-weld heat treatments, etc. were done
    5. Other

- a. Write report of inspections and verifications, date and sign
- C. Career paths and type work performed
  - 1. Welding Inspector
    - a. AWS Certified Welding Inspector
  - 2. Testing Lab Technician
  - 3. NDT Test Specialists
    - a. Includes PT, MP, UT, RT and other
    - b. ASNT Certified Levels I, II and III
  - 4. Other
    - a. Welding Supervisor
    - b. Testing Equipment Sales Specialist

### III. Relevant Documents

- A. Engineering Drawings and Shop Drawings
- B. Applicable Codes, Standards and Specifications
- C. Material certifications
- D. Welding Procedure Specification (WPS), also WPQR
- E. Welder Qualification Test Record
- F. Work Instructions

### IV. Requirements of a Weld

- A. Physical dimensions, shape, reinforcement and depth of penetration
- B. Limits on surface irregularities and roughness
- C. Limits on internal and surface discontinuities
- D. Mechanical properties (strength, toughness, hardness, other)
- E. Chemical and metallurgical (ferrite content, sensitization, other)

### V. Weld Defects

- A. Defects are discontinuities within or on the surface of a weld, or unacceptable physical irregularities relating to shape, smoothness, etc.
  - 1. Not all discontinuities are defects
    - a. Depends on size, shape and type
- B. Types of discontinuities
  - 1. Cracks
    - a. Never acceptable regardless of size
    - b. Surface, internal and underbead
    - c. Longitudinal and transverse
    - d. Hot cracks vs hydrogen-induced cold cracks
    - e. Crater
  - 2. Incomplete fusion
  - 3. Incomplete penetration
  - 4. Overlap
  - 5. Undercut
  - 6. Inclusions
  - 7. Porosity
    - a. Surface and internal
    - b. Scattered/Random
    - c. Linear
    - d. Elongated
    - e. Wormhole
- C. Acceptance criteria
  - 1. Typically specified for each type in applicable code or weldment specification written by customer, manufacturer or design engineer

### VI. Visual Inspection Of Welds

- A. Things to be measured or checked
  - 1. Physical dimensions
    - a. Location, size, length, spacing
    - b. Profile, roughness and excessive reinforcement
    - c. Mismatch

- d. Underfill
    - e. Unfilled craters
    - f. Incomplete penetration
  - 2. Visible discontinuities that might be defects
    - a. Cracks (including crater cracks)
    - b. Overlap (rollover)
    - c. Undercut
    - d. Porosity
    - e. visible inclusions
    - f. Arc strikes
  - 3. Other
    - a. Excessive oxidation or discoloration
    - b. Excessive spatter
- B. Inspection instruments, gauges and aids
  - 1. Instruments
    - a. Tape measure
    - b. Digital caliper
    - c. 6-inch machinists scale (64ths of an inch)
    - d. Bevel protractor
  - 2. Gauges
    - a. Multi-piece, adjustable and combination types of fillet weld gauges
    - b. Bridge/cam gauge
    - c. V-WAC gauge
    - d. Hi-Lo gauge
    - e. AWS butt/fillet bridge gauge
    - f. Tapered gap gauge
    - g. Other special purpose types
  - 3. Aids
    - a. Flashlight
    - b. Magnifying glass

## VII. Metallography

- A. General introduction
  - 1. Reasons for use
  - 2. Micro and Macro specimens
  - 3. Equipment
- B. Preparation of specimens
  - 1. Cutting, sanding and polishing of specimens
  - 2. Etching
- C. Examination

## VIII. Destructive Testing

- A. Types of mechanical properties related to welding and significance
  - 1. Tensile and Yield Strength
  - 2. Ductility
  - 3. Hardness
  - 4. Toughness
  - 5. Fatigue properties
  - 6. Influence of temperature and service environment on properties
- B. Test methods, equipment and instruments
- C. Typical types of test specimens
- D. Standards relating to mechanical property testing

## IX. Nondestructive Testing

- A. General Introduction
  - 1. Reasons for use
  - 2. Types of tests commonly used, type defects found and limitations
    - a. Liquid penetrant (PT)
    - b. Magnetic particle (MT)
    - c. Ultrasonic (UT)
    - d. Radiographic (RT)
    - e. Other - Eddy current, Acoustic emission, etc.

- B. Equipment and instruments
  - C. Applicable Standards and certification of inspectors
  - X. Understanding and Using Codes and Specifications, Record Keeping, Etc.
    - A. General Introduction
      - 1. Why important
      - 2. Codes, standards and specifications related to welding
      - 3. Differences between a code, specification and a standard
    - B. Codes
      - 1. Information typically presented in a code and order of presentation
      - 2. Typical codes relating to welding
    - C. Welding Procedure Specifications
      - 1. Information typically presented in a WPS and significance
    - D. Welder Qualification Test Record
      - 1. Information typically presented in a WQTR
        - a. Time sensitive - importance of record keeping and checking records
    - E. Other applicable requirements to be aware of that require compliance
      - 1. Local, state and federal laws and regulation
    - F. Resolving disposition of rejected welds
      - 1. Per Material Review Board, Supervisor, Engineer, etc.
- 

## 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.

This workforce product was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The U.S. Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. The course and services are available without regard to a participant's race, color, religion, ancestry, age, handicap, sex, marital status or national origin. The number for TDD/TYY or relay services is 440-525-7006.



This work is licensed under the Creative Commons Attribution 4.0 International License. It is attributed to Ohio TechNet. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>

# LAKELAND STUDENT LEARNING OUTCOMES

<b>LEARNS ACTIVELY</b>		<b>I</b>	<b>R</b>	<b>D</b>
1.	Takes responsibility for his/her own learning.			
2.	Uses effective learning strategies.			
3.	Reflects on effectiveness of his/her own learning strategies.			
<b>THINKS CRITICALLY</b>		<b>I</b>	<b>R</b>	<b>D</b>
4.	Identifies an issue or idea.			D
5.	Explores perspectives relevant to an issue or idea.			
6a.	Identifies options or positions.			D
6b.	Critiques options or positions.			D
7.	Selects an option or position.			D
8a.	Implements a selected option or position.			D
8b.	Reflects on a selected option or position.			
<b>COMMUNICATES CLEARLY</b>		<b>I</b>	<b>R</b>	<b>D</b>
9a.	Uses correct spoken English.			
9b.	Uses correct written English.			
10.	Conveys a clear purpose.			D
11.	Presents ideas logically.			
12a.	Comprehends the appropriate form(s) of expression.			
12b.	Uses the appropriate form(s) of expression.			D
13.	Engages in an exchange of ideas.			
<b>USES INFORMATION EFFECTIVELY</b>		<b>I</b>	<b>R</b>	<b>D</b>
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.			
<b>INTERACTS IN DIVERSE ENVIRONMENTS</b>		<b>I</b>	<b>R</b>	<b>D</b>
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.