

ATPF-2814: ST: U/A 21 WELDING

Cuyahoga Community College

Viewing: ATPF-2814 : ST: U/A 21 Welding

Academic Term:

Fall 2026

Subject Code

ATPF - Applied Ind Tech - Pipefitters

Course Number:

2814

Title:

ST: U/A 21 Welding

Catalog Description:

United Association (UA) welding certification course covering test procedures and certification opportunities for highly skilled pipe fitter welders. Included are guidelines as prescribed by the American Petroleum Institute API and the American Society of Mechanical Engineers ASME for processed piping. Successful completion of the course requires passing weld test in accordance with API, ASME and U/A standards.

Credit Hour(s):

3

Lecture Hour(s):

3

Requisites

Prerequisite and Corequisite

Departmental approval: admission to Pipefitter's apprenticeship program.

Outcomes

Course Outcome(s):

Discuss the purpose of the U/A 21 weld test, including pipe sizes, qualifications, and employment opportunities resulting from industry certification.

Objective(s):

1. Explain the purpose of the course as it pertains to qualified pipe fitter welders.
2. List and define the terms related to the U/A 21 qualification test.
3. List and explain the weld test package related to specific weld processes.
4. Differentiate between the pipe sizes and the relative importance of technique with respect to the quality of welds.
5. List the welding defects that disqualify weld certification.
6. Explain the specifications of visual weld acceptance to be followed during testing.
7. Discuss the opportunities available through certification of the U/A 21 test.

Course Outcome(s):

Discuss the guidelines for pipe welding acceptance as described in B.31.3, 31.1 of the American Petroleum Institute (API) 1104, of the American Society of Mechanical Engineers (ASME) for processed piping.

Objective(s):

1. List the different types of processed pipe covered under the 31.3 code.
2. Explain the pipefitter welder qualifications required for work performed under 31.3
3. Relate the U/A 21 weld test to code acceptance
4. Explain the limit range of qualifications of the U/A 21 weld test, including pipe thickness, diameter, and filler rod size.
5. Compare the respective codes, B.31.1, B.31.3, and API 1104 with respect to engineers' piping systems.

Course Outcome(s):

Demonstrate the ability to successfully pass the U/A welder qualification test using 2-inch xx H/carbon steel pipe in accordance with the weld test specifications of the United Association.

Objective(s):

1. Prepare the test coupon 2-inch xx H/carbon steel pipe with proper root gap, land, and alignment.
2. Select the required set-up jig, hand tools, and equipment to ensure proper coupon preparation.
3. Review the weld test package to work within the specified acceptable range.
4. Align and tack the coupon to adhere to specified test limits.
5. Apply the initial root pass according to the specification and visual inspection.
6. Proceed with the qualification test by reviewing and applying the test specifications using the correct electrode to fill and cap the coupon to meet the test requirements.
7. Submit the test coupon to the certified welding inspector for evaluation

Methods of Evaluation:

1. Assignments
2. Participation
3. Attendance
4. Exams/quizzes

Course Content Outline:

1. U/A 21 Test
 - a. Purpose
 - i. Job security
 - ii. Industry value
 - iii. Individual achievement
1. Terminology
 - a. U/A 21
 - b. weld procedure sheet (WPS)
 - c. welder qualification record (WQR)
 - d. radiographic examination
 - e. visual examination
 - f. National Certified Pipe Welding Bureau
 - g. Discontinuities
 - h. Pre heat
 - i. As welded condition
 - j. Arc strike
 - k. Excessive reinforcement
 - l. Hold points
 - m. Root concavity
 - n. Porosity
 - o. Crater crack
 - p. Restart
2. Weld test package
 - a. Components
 - i. WQR
 - ii. Independent test lab report
 - iii. Weld test specifications
 - iv. WPS
3. Processes
 - a. Shielded metal arc welding (SMAW)
 - b. Uphill progression
 - c. Open root

- d. Single V groove
- e. DC electrode positive
- 4. Quality: pipe size and technique
 - a. Pipe size
 - i. 2 inch
 - ii. Schedule 160
 - iii. Schedule 80
 - iv. Super coupon
- 5. Technique
 - a. Open root
 - b. Weave beads
 - c. Stringer bead
- 1. Quality
 - a. Smooth surface
 - b. Restart
 - c. Weld cleaning
- 2. Defects
 - a. Slag
 - b. Undercut
 - c. Arc strike
 - d. Porosity
 - e. Under fill
 - f. Lack of fusion
 - g. Incomplete joint penetration
 - h. Cracks
 - i. Root concavity
 - j. Excessive reinforcement
 - k. Surface grinding
- 3. Visual weld specifications
 - a. Root gap
 - b. Land
 - c. Bevel angle
 - d. Electrode size
 - e. Electrode amperage
 - f. Preheat
 - g. Inner-pass temperature
 - h. Weld stand height
 - i. Maximum cap height
- 4. Employment opportunities
 - a. Continuous job security
 - b. Advancement
 - c. Travel
 - d. Monetary
 - e. Individual satisfaction
 - f. Inspector/instructor
- 1. U/A 21 Pipe Welding Codes
- 1. Processed pipe systems
 - a. Engineer driven
 - b. Chilled water
 - c. Heating water
 - d. geothermal
 - e. specialty
 - i. Air cooled condenser
 - ii. Snow melt
 - iii. Condensed water
- 2. Pipefitter welder qualifications

1. RANGE
 - a. Pipe Diameter
 - b. Pipe Thickness
 - c. Filler Material Classification
 - d. Welder Process Shielded Metal Arc Welding (SMAC)

2. Acceptance
 - a. Root pass
 - b. Fill pass
 - c. Weld cap

3. Radiography
 - a. Visual QW-302.4
 - b. X ray

1. U/A 21 and code acceptance

1. ASME section 9
2. Uphill weld progression
3. National Pipe Welding Bureau (NPWB)

1. Limit range
 1. electrode usage 3/32 to 5/32
 2. base metal P.1 thru P.15 F
 3. all position welding
 4. uphill
 5. thickness .622 "
6. SMAW

1. Code comparison
 1. Pressure pipe
 2. Process pipe with respect to code
 3. Pressure pipe API
 4. Process pipe with respect to API

1. U/A weld test
 - a. Coupon preparation
 - i. Root gap
 - ii. Land
 - iii. Alignment

1. Set-up tools/equipment
 - a. Alignment jig
 - b. Specialty tools
 - i. Gap gage
 - ii. Fit-up wedge
 - c. Grinder
 - d. Safety equipment

2. Weld test range
 - a. Joint configuration
 - i. single V groove
 - ii. bevel
 - iii. root gap
 - iv. misalignment
 - b. test position
 - c. welding conditions initial inspection
 - i. filler diameter
 - ii. deposit
 - iii. amperage
 - iv. polarity
 - v. tungsten
 - vi. cup size
 - vii. shielding gas
 - d. balance
 - e. general welding technique

- i. pre heat temperature
 - ii. root penetration
 - iii. reinforcement
 - iv. uphill progression
 - v. stringer bead
 - vi. brushing and grinding
3. align and tack
 4. root pass
 - a. penetration
 - b. heat
 - c. uphill progression
 - d. fusion
 1. qualification test specification
 - a. filler metal
 - b. electrode selection
 - c. base material
 - d. radiographic acceptance
 - e. pipe size and thickness
 2. test inspection
 - a. certified welding inspector
 - b. fit-up and hold point
 - c. root pass hold point
 - d. fill and cap hold pass
 - e. final
 - i. inside inspection
 - ii. outside inspection
 - iii. non-destructive evaluation

Religious Accommodation

Before reviewing the course schedule, students should carefully review the following religious accommodation policy and other required instructional policies:

Religious Accommodation:

Students seeking an accommodation for absences permitted under Ohio's Testing Your Faith Act must provide the instructor with written notice of the specific dates for which the student requires an accommodation and must do so not later than fourteen (14) days after the first day of instruction. Please submit requests for accommodations at this link: <https://portal2.tri-c.edu/ReligiousAccommodation/ReligiousAccommodationForm>. Students with questions about their religious accommodations under Ohio's Testing Your Faith Act may contact the College's Office of General Counsel and Legal Services by phone at 216.987.4856 or via email at legal@tri-c.edu.

Other Required Instructional Policies:

<https://www.tri-c.edu/student-resources/curriculum/documents/syllabus-part-b.pdf>

Weekly Schedule

	Topics
Week 1	Employment opportunities and benefits of U/A certification
Week 2	Employment opportunities and benefits of U/A certification
Week 3	Pipe size and type for certification test
Week 4	Pipe size and type for certification test
Week 5	Weld discontinuities and weld acceptance
Week 6	Weld discontinuities and weld acceptance
Week 7	Terminology, weld joint preparation, test specifications
Week 8	ASME weld code/section #9
Week 9	Visual acceptance and radiographic evaluation
Week 10	Machine setting and weld techniques
Week 11	Review weld test package WPS

Week 12	Review weld test package WPS
Week 13	Fit up and tack/visual inspection
Week 14	Fill pass and cleaning techniques
Week 15	Weld and cap inspection
Week 16	Evaluation

The Course Schedule is subject to change due to pedagogical needs, instructor discretion, parts of term, and unexpected events.

Required/Recommended Readings

Instructor-provided materials

Resources for the Instructor

Gosse, Jonathan F. . *Welding Skills Workbook*. 5th. American Technical Publisher, 2015.

United Association Training Center. *Oxy-Acetylene Cutting / Shielded Metal Arc Welding Training*. Annapolis, MD: United Association, www.ua.org/training

Additional Resources for the Instructor

www.ua.org (<https://catalog.tri-c.edu>www.ua.org)

<http://www.praxair.com/industries/welding-and-metal-fabrication/welding-process> (<http://www.praxair.com/industries/welding-and-metal-fabrication/welding-process/>)

<http://earlbeck.com/types-of-welding.html>

welding-advisers.com (<https://catalog.tri-c.edu>welding-advisers.com)

www.JFLF.org (<https://catalog.tri-c.edu>www.JFLF.org)

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