

## Pipefitting Technology II

PEIMS Code: N1300426

Abbreviation: PIPETEC2

Grade Level(s): 11-12

Award of Credit: 1.0

### State Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to [TAC §74.13](#) for guidance on endorsements.

### Course Description:

Students will learn about, be able to identify and install various types of piping systems and valves. Students will learn to read detail and drawing sheets and how to use mathematics to solve problems related to Pipefitting construction. Students will also be educated in how to prepare, fabricate, and assemble threaded pipe, socket weld, and butt weld installations. Excavating per Occupational Safety and Health Administration (OSHA) standards as well as grading and elevations of trenching and backfilling will also be taught. The course may lead to National Center for Construction Education and Research (NCCER) certification.

### Essential Knowledge and Skills:

- (a) General requirements. This course is recommended for students in Grades 11-12. Required Prerequisite: Pipefitting Technology I. Students shall be awarded one for successful completion of this course.
- (b) Introduction.
  - (1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
  - (2) The Architecture and Construction Career Cluster focuses on designing, planning, managing, building, and maintaining the built environment.
  - (3) In Pipefitting Technology II, students will gain knowledge of how to layout, assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, lubrication, or other liquids or gases for industrial production and process systems. Students will apply pipe system knowledge and blueprint reading capability to select pipe size and type, related equipment and materials such as pipe supports, hangars, and hydraulic supports systems.

- (4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.
- (5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills

- (1) The student is expected to demonstrate professional standards/employability skills as required by business and industry. The student is expected to:
  - (A) demonstrate oral communication, written communication, leadership skills, teamwork skills, conflict management, customer service, professionalism, work ethic, integrity, multitasking, initiative, creativity, and how to follow directions;
  - (B) understand the importance of showing up to work on time, maintaining appropriate personal appearance, working as a team member, and being honest;
- (2) The student demonstrates knowledge of the different types of piping systems. The student is expected to:
  - (A) identify and explain the chemical, compressed air, fuel oil, steam, and water systems;
  - (B) identify piping systems according to color-coding;
  - (C) explain the effects and corrective measures for thermal expansion in piping systems; and
  - (D) explain types and applications of pipe insulation.
- (3) The student demonstrates knowledge of various industrial pipefitting blueprints, drawings and plans. The student is expected to:
  - (A) identify and interpret plot plans, structural drawings, elevation drawings, as-built drawings, equipment arrangement drawings, Piping and Instrumentation Diagram/Drawing (P&IDs), isometric drawings, spool sheets, and detail sheets;
  - (B) explain parts of drawings;
  - (C) distinguish among types of drawings;
  - (D) create field sketches; and
  - (E) interpret drawing indexes and line lists.
- (4) The student demonstrates knowledge of installation methods for different types of valves, and their storage and handling. The student is expected to:
  - (A) identify valves that start and stop flow;
  - (B) identify valves that regulate flow;
  - (C) identify valves that relieve pressure;
  - (D) identify valves that regulate the direction of flow;

- (E) identify valve actuators;
  - (F) explain how to properly store and handle valves;
  - (G) explain valve locations and positions;
  - (H) determine factors that influence valve selection; and
  - (I) interpret valve markings and nameplate information.
- (5) The student applies knowledge and skills in algebraic and geometric mathematics and measurements as they relate to the basic operations of pipefitters. The student is expected to:
- (A) demonstrate the use of measuring devices such as calculators, compasses, protractors, rulers, measuring tapes, transits and levels;
  - (B) interpret tables of weights and measurements;
  - (C) calculate mathematical piping problems such as fitting take-offs (90 degree, 45 degree and odd angles), equal spread offsets, unequal spread offsets, and rolling offsets;
  - (D) troubleshoot pipefitting problems, including problems with pressure, force, and medical advantage.
  - (E) solve mathematical problems in related pipefitting scenarios, including area, volume, circumference, and right triangles using the Pythagorean theorem.
- (6) The student describes the materials used in threaded piping systems. The student is expected to:
- (A) identify and explain the materials used in threaded piping systems;
  - (B) identify and explain pipe fittings;
  - (C) read and interpret screwed fitting joint drawings;
  - (D) identify and explain types of threads;
  - (E) determine pipe lengths between joints; and
  - (F) perform threading and assembling piping and valves; and
  - (G) perform calculations for offsets.
- (7) The student describes the materials used in socket weld piping systems. The student is expected to:
- (A) identify and explain types of socket weld piping materials;
  - (B) identify and explain socket weld fittings;
  - (C) read and interpret socket weld piping drawings;
  - (D) determine pipe lengths between socket weld fittings; and
  - (E) fabricate socket weld fitting to pipe.
- (8) The student demonstrates knowledge of butt weld piping systems. The student is expected to:
- (A) identify butt weld piping materials and fittings;
  - (B) read and interpret butt weld piping drawings;

- (C) prepare pipe ends for fit-up;
  - (D) determine pipe lengths between fittings;
  - (E) select and install backing rings;
  - (F) fabricate channel iron welding jigs;
  - (G) demonstrate how to use and care for welding clamps; and
  - (H) perform alignment procedures for various types of fittings.
- (9) The student demonstrates knowledge of shoring materials and systems per Occupational Safety and Health Administration (OSHA) standards. The student is expected to:
- (A) identify and explain the use of premanufactured support systems;
  - (B) demonstrate how to install a vertical shore used for shoring;
  - (C) determine the overall fall of a sewer line;
  - (D) determine and set the grade and elevation of a trench; and
  - (E) explain backfilling procedures.
- (10) The student describes pipe installation procedures and guidelines. The student is expected to:
- (A) identify and explain the types of underground piping materials, including the procedures for cast iron, ductile iron, concrete, carbon steel, fiberglass and thermoplastic pipe;
  - (B) determine the size classifications of underground pipe;
  - (C) identify and explain the use of underground pipe fittings;
  - (D) explain the joining methods for underground pipe;
  - (E) describe the storage and handling methods of underground pipe;
  - (F) discuss underground pipe installation guidelines;
  - (G) demonstrate joining Chlorinated polyvinyl chloride (CPVC) and polyvinyl chloride (PVC); and
  - (H) demonstrate joining ductile iron;
  - (I) list necessary precautions to be taken when working with materials or procedures to join pipes;
  - (J) cut pipe lengths manufactured from the various pipes materials, as required by a piping system layout;
  - (K) prepare and assemble the various pipe joints;
  - (L) identify the materials, tools, and equipment needed for pipe; and
  - (M) perform basic pipe welding tasks.

## Recommended Resources and Materials:

### Textbook

NCCER (2006). *Pipefitting Level 2 Trainee Guide* (3<sup>rd</sup> ed.). Alachua, FL:Pearson.

### Curriculum Resources, Materials, Course Planning Tools; performance Profiles, Course Maps, Equipment and Material Lists:

National Center for Construction Education & Research. (2017). *Pipefitting*. Retrieved from National Center for Construction Education & Research: <https://www.nccer.org/workforce-development-programs/disciplines/craft-details/pipefitting>

## Recommended Course Activities:

*Under the supervision of the instructor, the trainee should be able to do the following through worksheets, projects, reading assignments and exercises:*

1. Identify the type of piping system designated by a red color-code.
2. Identify the type of piping system designated by a yellow color-code
3. Identify the type of piping system designated by a green color-code.
4. Identify the type of piping system designated by a bright blue color-code.
5. Identify parts of a drawing:
  - a. Title block
  - b. Scales and measurements
  - c. Symbols and abbreviations
  - d. Notes
  - e. Revision blocks
  - f. Coordinates
6. Interpret the following:
  - a. Drawing indexes
  - b. Line lists
7. Identify the following types of drawings:
  - a. Plot plans
  - b. Structural drawings
  - c. Elevation and section drawings
  - d. Equipment arrangement drawings
  - e. P&IDs

- f. Isometric drawings
  - g. Spool drawings
  - h. Pipe support drawings and detail sheets
  - i. Orthographic drawings
8. Make field sketches:
    - a. Orthographic
    - b. Isometric
  9. Identify valves that start and stop flow.
  10. Identify valves that regulate flow.
  11. Identify valves that relieve pressure.
  12. Identify valves that regulate the direction of flow.
  13. Identify valve actuators.
  14. Given a select number of valves, match each valve to its given application.
  15. Interpret valve markings and nameplate information.
  16. Read and interpret screwed fitting joint drawings.
  17. Determine pipe lengths between fittings, using the center-to-center method.
  18. Determine pipe lengths between fittings, using the center-to-face method.
  19. Determine pipe lengths between fittings, using the face-to-face method.
  20. Given the length of travel of a 45-degree piping offset, calculate the length of the set.
  21. Given the length of the set and the degree of the fittings, use the table of elbow constants to figure the travel and the run.
  22. Calculate offsets, using the table of multipliers used to calculate offsets.
  23. Calculate the travel of a rolling offset.
  24. Thread pipe, using manual threaders.
  25. Thread pipe, using a threading machine.
  26. Apply pipe joint compound to the male threads of the pipe.
  27. Make up the pipe and fittings.
  28. Install a screwed valve.
  29. Identify various socket weld fittings.
  30. Interpret socket weld drawings.
  31. Calculate pipe lengths from line drawings, using the center-to-center method.
  32. Calculate pipe lengths from line drawings, using the center-to-face method.
  33. Calculate pipe lengths from line drawings, using the face-to-face method.

34. Align a 90-degree elbow to the end of a pipe.
35. Square a pipe into a 90-degree elbow.
36. Align a flange to the end of a pipe.
37. Align a 45-degree elbow to the end of a pipe.
38. Align pipes joined by a coupling.
39. Install a valve.
40. Identify various butt weld fittings.
41. Interpret a butt weld drawing.
42. Clean a beveled pipe end, using a portable grinder.
43. Calculate pipe lengths from line drawings, using the center-to-center method.
44. Calculate pipe lengths from line drawings, using the center-to-face method.
45. Calculate pipe lengths from line drawings, using the face-to-face method.
46. Align straight pipe.
47. Align a pipe to a 45-degree elbow.
48. Align a pipe to a 90-degree elbow.
49. Square a pipe into a 90-degree elbow.
50. Align a pipe to a flange.
51. Align a pipe to a tee.
52. Install a valve.
53. Identify and explain the types of underground piping materials.
54. Identify the size classifications of underground pipe.
55. Identify and explain the use of underground pipe fittings.
56. Explain the joining methods for underground pipe.
57. Explain the storage and handling methods of underground pipe.
58. Identify and explain underground pipe installation guidelines.
59. Join CPVC and PVC.
60. Join ductile iron.

**Suggested methods for evaluating student outcomes:**

- 1) Quick Quizzes
- 2) Laboratory activities that correspond to Performance TasksModule Projects
- 3) Module Review
- 4) Module Examination

## Pipefitting Technology II

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- a) Trainees must score 70% or higher to receive recognition from NCCER.
  - b) Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
- 5) Performance Testing
- a) Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
  - b) Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

### Teacher qualifications:

An assignment for Pipefitting Technology I and Pipefitting Technology II is allowed with one of the following certificates:

- (1) Trade and Industrial Education: Grades 6-12. This assignment requires appropriate work approval.
- (2) Trade and Industrial Education: Grades 8-12. This assignment requires appropriate work approval.
- (3) Vocational Trades and Industry. This assignment requires appropriate work approval.

### Additional information:

After the Level II course, students will be prepared for the National Center for Construction Education and Research (NCCER) Pipefitting Level 2 Credential