Maryland CTE Programs of Study

Plumbing II (2025)

GENERAL REQUIREMENTS. This course is recommended for students in Grades 11-12. [1]

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INTRODUCTION [2]

A Career and Technical Education (CTE) 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.A]

B The Construction Career Cluster prepares students for careers in designing, planning, and building sustainable infrastructure. This field includes architects, engineers, construction managers, and skilled trades professionals. [2.B]

C The Plumbing Program of Study prepares students for a career in the plumbing trade through a comprehensive three-course sequence. Students learn essential skills such as measuring and cutting different types of pipe, installing fixtures and appliances, assembling water supply and drainage systems, and interpreting building plans. The program emphasizes hands-on experience with industry-standard tools and materials while teaching students to calculate measurements, perform system testing, and ensure all work meets building codes and safety requirements. Through progressive skill development, students gain experience with both residential and commercial plumbing applications, including installation, maintenance, and troubleshooting of various plumbing systems. Upon successful completion of the program, graduates earn three industry-recognized certifications: NCCER Core, OSHA 30 Construction, and NCCER Plumbing Levels 1 and 2, preparing them to enter the workforce with verified skills and knowledge. [2.C]

D Plumbing II builds upon core construction knowledge to introduce students to fundamental Plumbing theory and hands-on applications in the Plumbing trade. Students master advanced piping calculations, including various types of offsets and rolling measurements. The course covers the interpretation of commercial drawings, installation of sophisticated drainage systems, and comprehensive testing procedures for both DWV and water supply systems. Students learn to work with advanced components such as water heaters, fuel gas systems, and electrical circuits in plumbing applications. Special emphasis is placed on structural considerations, insulation requirements, and firestopping techniques. The curriculum includes extensive hands-on practice with valve installation, system testing, and troubleshooting. Upon completion, students will be prepared

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to tackle complex plumbing installations, perform advanced calculations, and handle commercial plumbing applications while adhering to relevant codes and safety standards. 2.D

E **Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.** 2.E

F **Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.** 2.F

KNOWLEDGE AND SKILLS 3

A **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:** 3.A

1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work. 3.A.1
2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn. 3.A.2
3. Employ effective reading, writing, and technical documentation skills. 3.A.3
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies. 3.A.4
5. Demonstrate leadership skills and collaborate effectively as a team member. 3.A.5
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines. 3.A.6
7. Exhibit an understanding of legal and ethical responsibilities in the construction field, following applicable laws and best practices for safety. 3.A.7
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting. 3.A.8

B **The student identifies various career pathways in the Plumbing field. The student is expected to:** 3.B

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as an Electrician or in the Plumbing field. 3.B.1
2. Create a professional resume and portfolio that reflect skills, projects, certifications, and recommendations. 3.B.2
3. Demonstrate effective interview skills for roles in the Plumbing field. 3.B.3

C **The student identifies the issues associated with Plumbing hazards found on a jobsite. The student is expected to:** 3.C

1. Demonstrate safe working procedures in a construction environment. 3.C.1

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2 Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job. 3.C.2

3 Identify Plumbing hazards and how to avoid or minimize them in the workplace. 3.C.3

4 Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection. 3.C.4

D The student integrates core academic skills into Plumbing construction practices. The student is expected to: 3.D

1 Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards. 3.D.1

2 Apply mathematical concepts such as the 3-4-5 ratio method for squaring corners and calculate various types of pipe offsets, including parallel and rolling offsets at different angles (11¼, 22½, 45, 60, and 72 degrees). Students will practice advanced geometric calculations, trigonometric principles for determining offset constants, and more complex grade and elevation calculations. Students perform detailed material takeoffs and apply mathematical principles to commercial plumbing applications. 3.D.2

3 Use scientific principles including electrical theory including voltage, current, resistance, and power calculations as applied to water heaters and electronic plumbing controls. The students will review thermodynamics in relation to water heater operation and heat transfer through piping systems. Students learn about the chemical properties and behavior of different fuel gases and oils, principles of combustion, and the science behind backflow prevention. The course includes advanced concepts in hydraulics and pneumatics for pressure testing and system design, as well as the scientific principles behind firestopping and insulation. 3.D.3

E The student demonstrates advanced mathematical applications in plumbing. The student is expected to: 3.E

1 Apply the 3-4-5 method to create and verify square corners. 3.E.1

2 Calculate standard and rolling offsets of varying angles. 3.E.2

3 Measure and calculate parallel offsets for 11¼, 22½, 45, 60, and 72-degree angles. 3.E.3

4 Calculate rolling offsets using constants and framing squares. 3.E.4

5 Solve complex mathematical problems related to plumbing installations. 3.E.5

F The student interprets and applies commercial plumbing drawings. The student is expected to: 3.F

1 Use commercial drawings to locate utilities and install piping systems. 3.F.1

2 Document and communicate needed changes on construction drawings. 3.F.2

Determine pipe entry points, routes, and fixture locations from plans. 3.F.3

Create and interpret material takeoffs and isometric drawings. 3.F.4

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5 Apply coordination, BIM, and as-built drawing principles. 3.F.5

G The student demonstrates knowledge of structural penetrations, insulation, and firestopping. The student is expected to: 3.G

1 Execute proper cutting, boring, and sleeving of structural members according to code. 3.G.1

2 Select and install appropriate pipe insulation materials. 3.G.2

3 Identify and install firestopping materials in required locations. 3.G.3

4 Apply reinforcement techniques for structural modifications. 3.G.4

5 Demonstrate proper protection and support of pipe installations. 3.G.5

H The student installs and tests complete DWV systems. The student is expected to: 3.H

1 Plan and execute DWV system installations using appropriate materials. 3.H.1

2 Calculate proper grade using various leveling tools. 3.H.2

3 Install and connect building sewers and drains according to code. 3.H.3

4 Locate and install stacks and fixture connections. 3.H.4

5 Execute proper testing procedures for both underground and aboveground systems. 3.H.5

I The student installs specialized drainage systems. The student is expected to: 3.I

1 Install and set elevations for floor drains, area drains, and floor sinks. 3.I.1

2 Install primary and secondary roof drainage systems. 3.I.2

3 Install trap primers and waterproof membranes for shower pans. 3.I.3

4 Apply proper installation techniques for specialty drainage applications. 3.I.4

5 Test and verify proper operation of drainage systems. 3.I.5

J The student installs and tests complete water supply systems. The student is expected to: 3.J

1 Evaluate and plan domestic water distribution systems using plans. 3.J.1

2 Select appropriate materials and sizes for water service and distribution. 3.J.2

3 Install water service lines including backflow prevention. 3.J.3

4 Perform proper testing procedures on water supply systems. 3.J.4

5 Document and verify system compliance with local codes. 3.J.5

K The student installs and maintains various types of valves. The student is expected to: 3.K

1 Identify and explain the operation of different valve types. 3.K.1

2 Select appropriate valves for specific applications. 3.K.2

3 Install valves according to manufacturer specifications. 3.K.3

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4 Service and maintain various types of valves. 3.K.4

5 Troubleshoot common valve problems and failures. 3.K.5

L The student demonstrates understanding of water heater systems. The student is expected to: 3.L

1 Identify and explain the operation of various water heater types. 3.L.1

2 Apply safety procedures when working with water heating systems. 3.L.2

3 Install different types of water heaters according to code. 3.L.3

4 Test and verify proper water heater operation. 3.L.4

5 Perform basic maintenance and troubleshooting. 3.L.5

M The student applies electrical principles in plumbing applications. The student is expected to: 3.M

1 Implement electrical safety practices when working with plumbing systems. 3.M.1

2 Calculate voltage, current, resistance, and power in circuits. 3.M.2

3 Test electrical components using appropriate equipment. 3.M.3

4 Interpret electrical diagrams and symbols for plumbing systems. 3.M.4

5 Troubleshoot electrical issues in plumbing equipment. 3.M.5

N The student installs and tests fuel gas and oil systems. The student is expected to: 3.N

1 Demonstrate safe practices in working with gas/fuel systems to include proper ventilation, safe handling, collection, disposal, etc. 3.N.1

2 Identify components and properties of various fuel systems. 3.N.2

3 Install and connect appliances to fuel gas systems. 3.N.3

4 Size, purge, and test fuel gas systems according to code. 3.N.4

5 Verify proper system pressure using appropriate testing equipment 3.N.5