Advanced Plumbing Unit 2

Content Area: **CTE**
Course(s):
Time Period: **November**
Length: **MP 2 (45 Days)**
Status: **Published**

Unit Overview:

Unit 2: Advanced Water Supply and Gas Piping Systems — Copper, PEX, CPVC, IPS, CSST, and Specialty Piping

Duration: 45 Instructional Days (November–January)

Unit Overview

This unit provides students with advanced skills in the installation, maintenance, and troubleshooting of both water supply and gas piping systems using copper, PEX, CPVC, IPS (Iron Pipe Size), CSST (Corrugated Stainless Steel Tubing), and other specialty piping materials. Students will explore the properties, applications, and advantages of each piping type in both residential and commercial plumbing projects. Emphasis will be placed on proper material selection, advanced joining techniques such as soldering, brazing, crimping, expansion, solvent welding, threading, and specialized fittings for gas systems. Learners will practice safe use and maintenance of tools and equipment for cutting, threading, bending, and securing piping, as well as performing leak and pressure testing for both water and gas systems. Students will learn how to interpret and apply New Jersey Plumbing and Fuel Gas Codes to ensure installations meet regulatory requirements. By the end of this unit, students will be able to evaluate piping materials, apply advanced installation and joining methods, troubleshoot common system issues, and verify that both water supply and gas piping systems are efficient, safe, and code compliant.

Essential Questions:

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1. How do the characteristics of different piping materials influence the design and performance of water and gas piping systems?
2. What are the advantages and limitations of copper, PEX, CPVC, IPS, CSST, and other specialty piping?
3. How can advanced joining and installation techniques improve the safety, reliability, and efficiency of plumbing and gas systems?
4. How do the New Jersey Plumbing and Fuel Gas Codes guide the selection, joining, and installation of piping systems?

Enduring Understandings:

Enduring Understandings

- Selecting the correct piping material and installation method for the intended application is critical to long-term system performance and safety.
- Mastery of advanced joining techniques ensures strong, leak-free, and durable connections for both water and gas systems.
- Proper handling of specialized materials such as IPS and CSST requires adherence to manufacturer guidelines and safety regulations.
- Accurate troubleshooting skills are necessary to maintain and restore system functionality while meeting code requirements.

Standards/Indicators/Student Learning Objectives (SLOs):

Standards / Indicators / Student Learning Objectives

Applicable Architecture & Construction Standards

Cluster: Architecture & Construction

- **9.3.12.AC.1** Use vocabulary, symbols, and formulas common to architecture and construction.
- **9.3.12.AC.3** Comply with regulations and applicable codes to establish and manage a legal and safe workplace.
- **9.3.12.AC.6** Read, interpret, and use technical drawings, documents, and specifications to plan a project.

Pathway: Construction (AC-CST)

- **9.3.12.AC-CST.5** Apply practices and procedures required to maintain jobsite safety.
- **9.3.12.AC-CST.7** Compare and contrast the building systems and components required for a construction project.
- **9.3.12.AC-CST.8** Demonstrate the construction crafts required for each phase of a construction project.
- **9.3.12.AC-CST.9** Safely use and maintain appropriate tools, machinery, equipment, and resources to accomplish construction project goals.

Pathway: Maintenance/Operations (AC-MO)

- **9.3.12.AC-MO.2** Use troubleshooting procedures when solving a maintenance problem in buildings.

9.3.12.AC.1	Use vocabulary, symbols and formulas common to architecture and construction.
9.3.12.AC.3	Comply with regulations and applicable codes to establish and manage a legal and safe workplace.
9.3.12.AC.6	Read, interpret and use technical drawings, documents and specifications to plan a project.
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9.3.12.AC-CST.7	Compare and contrast the building systems and components required for a construction project.
9.3.12.AC-CST.8	Demonstrate the construction crafts required for each phase of a construction project.
9.3.12.AC-CST.9	Safely use and maintain appropriate tools, machinery, equipment and resources to accomplish construction project goals.
9.3.12.AC-MO.2	Use troubleshooting procedures when solving a maintenance problem in buildings.

Lesson Titles:

Lesson Titles (Individual and Groups)

1. Introduction to Advanced Water and Gas Piping Systems
2. Copper Pipe Types, Grades, and Applications
3. Tools for Copper Pipe Installation and Safety Protocols
4. Soldering Copper Pipe: Preparation, Technique, and Safety
5. Brazing Copper Pipe for High-Pressure Systems
6. PEX Pipe: Characteristics, Benefits, and Limitations
7. PEX Crimping and Expansion Tool Use and Maintenance
8. CPVC Pipe: Properties, Applications, and Limitations
9. Solvent Welding for CPVC: Safety and Technique
10. IPS Pipe: Properties, Threading, and Applications in Plumbing and Gas Systems
11. Thread Cutting, Sealants, and Safety Practices for IPS Pipe
12. CSST Gas Piping: Characteristics, Benefits, and Safety Requirements
13. Installing and Securing CSST Pipe to Code
14. Specialty Piping Materials: When and Why They Are Used
15. Selecting the Right Piping Material for Water or Gas Applications

16. Material Handling, Storage, and Safety Best Practices
17. Reading Water and Gas Piping Blueprints and Specifications
18. Installing Copper Water Supply Lines to Code
19. Installing PEX Water Supply Lines to Code
20. Installing CPVC Water Supply Lines to Code
21. Installing IPS Gas Piping Systems to Code
22. Installing CSST Gas Piping Systems to Code
23. Advanced Joining Methods for Mixed-Material Systems
24. Leak and Pressure Testing for Water Supply Systems
25. Leak and Pressure Testing for Gas Piping Systems
26. Troubleshooting Low Water Pressure Issues
27. Troubleshooting Gas Flow and Leak Issues
28. Manufacturer Installation Guidelines vs. Code Requirements
29. Thermal Expansion, Contraction, and Vibration Considerations
30. Insulating Water and Gas Piping for Efficiency and Safety
31. Code Compliance Checklist for Water and Gas Systems
32. Unit Review and Hands-On Performance Assessment

Career Readiness, Life Literacies, & Key Skills:

Career Readiness, Life Literacies, and Key Skills Standards

- **WRK.9.2.12.CAP.3** Investigate how continuing education contributes to one's career and personal growth.
- **WRK.9.2.12.CAP.6** Identify transferable skills in career choices and design alternative career plans based on those skills.
- **WRK.9.2.12.CAP.7** Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements.
- **WRK.9.2.12.CAP.8** Determine job entrance criteria used by employers in various industry sectors.

Technology Literacy Standards

- **TECH.9.4.2.TL.6** Illustrate and communicate ideas and stories using multiple digital tools.

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WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
WRK.9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
WRK.9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
TECH.9.4.2.TL.6	Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).

Inter-Disciplinary Connections:

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- **Math:** Measure pipe lengths, calculate material needs, and perform pressure and flow rate calculations.
- **Science:** Apply heat transfer in soldering and brazing, fluid dynamics for water and gas flow, and study material properties.
- **ELA:** Read and follow installation manuals, code requirements, and prepare clear written reports.
- **Technology:** Use tools, equipment, and blueprints to install and test piping systems.
- **Social Studies:** Understand how codes, permits, and regulations affect projects.

Summative Assessment:

Summative Assessment

High-Stakes Assessments:

- **Comprehensive Exams:** Final exams covering a broad range of course material can assess students' understanding of key concepts and principles.
- **Capstone Project Presentations:** Formal presentations showcase students' project management skills, decision-making, and communication abilities.

Performance-Based Assessments:

- **Project Portfolio Reviews:** A portfolio compiled throughout the program can demonstrate a student's growth, technical skills, and problem-solving abilities in various areas of the plumbing trade.
- **Simulated Project Management Tasks:** Students could be presented with a realistic construction scenario where they must apply their knowledge and skills to develop solutions or make critical decisions.

Industry-Standard Certifications:

- Encouraging students to pursue industry certifications relevant to plumbing can demonstrate their commitment to the field

and mastery of specific skills.

Considerations for Choosing Summative Assessments:

- **Alignment with Learning Outcomes:** Ensure the chosen assessments directly measure the program's overall learning objectives and desired competencies.
- **Depth vs. Breadth:** Balance the need to assess a broad range of knowledge with in-depth exploration of critical skills.
- **Authenticity:** Choose assessments that reflect real-world scenarios and tasks a plumber encounters.
- **Multiple Measures:** Utilize a combination of assessments to provide a holistic picture of student learning.
- **Faculty Collaboration:** Ensure consistency and fairness in assessments across different courses within the program.

Additional Tips:

- Develop clear rubrics outlining specific criteria for evaluating performance on each summative assessment.
- Provide students with ample opportunities to practice and refine their skills before summative assessments.
- Offer feedback on summative assessments to help students identify areas for improvement and guide their future learning.

- Alternate Assessment
- Benchmark
- Group Project Assessment
- Individual Project Assessment
- Marking Period Assessment
- Module Section Assessment

Benchmark Assessments

Benchmark Assessments

1. **Material Selection Report** – Written explanation of why a specific piping material is best for a given scenario, referencing code.
2. **Hands-On Joining Test** – Demonstrate correct soldering, brazing, crimping, expansion, and solvent welding techniques.
3. **Water Pressure Test Assessment** – Properly perform a system pressure test and document the results.
4. **Installation Checklist Review** – Complete a checklist for a code-compliant water supply installation.

Alternative Assessment

Alternative Assessments

1. **Piping Materials Presentation** – Small group presentation comparing properties, uses, and limitations of copper, PEX, CPVC, and specialty piping.
2. **Troubleshooting Lab Simulation** – Diagnose and fix a simulated water supply issue in a lab setup.
3. **Manufacturer Spec Analysis** – Compare manufacturer installation guidelines with NJ Plumbing Code requirements.

4. **Video Demonstration** – Record a step-by-step joining process and explain each step.

Formative Assessment:

Formative Assessment

In-Class Activities:

- **Quick Quizzes:** Short, unannounced quizzes at the beginning or end of class can assess comprehension of key concepts from previous lessons or gauge readiness for new material..
- **Think-Pair-Share:** Encourage individual reflection followed by partnered discussions and sharing key takeaways with the class. This promotes active learning and identifies common misconceptions.
- **Minute Papers:** Have students write a one-minute summary of the main points learned or lingering questions they have. This helps identify areas needing clarification.

Classroom Discussions & Activities:

- **Open-ended Questions:** Encourage students to think critically and elaborate on their understanding by posing open-ended questions throughout lessons.
- **Case Studies & Problem-solving:** Present real-world plumbing scenarios or problems for students to analyze and propose solutions. This assesses critical thinking and application of knowledge.
- **Role-playing Activities:** Simulate real-world situations like project meetings or client interactions to practice communication, negotiation, and problem-solving skills.

Peer-Based Assessment:

- **Peer Reviews:** Students can review each other's work, providing constructive feedback on project plans, presentations, or technical drawings. This fosters collaboration and self-assessment skills.
- **Group Work & Discussions:** Collaborative activities encourage students to explain concepts to one another, solidifying their understanding and identifying areas where they can learn from peers.

Technology-Assisted Assessments:

- **Online Quizzes & Polls:** Utilize online platforms for short quizzes, polls, or concept checks to gauge student understanding in real-time and adjust instruction accordingly.
- **Self-assessment Tools:** Provide online quizzes or exercises where students can assess their own understanding of key concepts and identify areas for self-directed learning.

Benefits of Formative Assessment:

- **Improved Student Learning:** Provide ongoing feedback that helps students identify strengths, weaknesses, and adjust their learning strategies.
- **Informed Instruction:** Instructors gain valuable insights into student understanding, allowing them to adapt teaching methods and address misconceptions promptly.
- **Increased Student Engagement:** Active participation in formative assessments keeps students engaged and invested in the learning process.
- **Promotes Self-reflection:** Encourage students to reflect on their learning journey, identify areas for

improvement, and take ownership of their learning.

- Anticipatory Set
- Exit Tickets
- Hands-On Activities (Individual & Groups)
- Hands-On Observations (Individual & Groups)
- Questioning, Scenarios, and Problem-Solving (Open Ended & Multiple Choice
- Warm-Up

Resources & Materials:

Resources & Materials

Plumbing Level 1 Book NCCER Fifth Edition

Plumbing Level 2 Book NCCER Fifth Edition

Plumbing Level 3 Book NCCER Fifth Edition

Google Classroom

Google Gemini

Promethean Board

Canva

Clever

Diffit

Kahoot

MagicSchool

https://www.youtube.com/

CBS Plumbing Trade

https://www.cbsnews.com/video/plying-their-trades/#

Run Time 7:20

Toilet

How The Toilet Changed History

Run Time 7:15

Toilet Parts: What They Are and Common Fixes (DIY) | Family Handyman.

Workplace Hazards Video Run Time

Top 6 Workplace Hazards Identified

Run Time 8:11

PPE Video

PPE - Safety Training Video Course - SafetyInfo.com

Run Time 10:49

NJ Master Plumbers Information

New Jersey Plumbing License Requirements

NJ Plumbing Wages

Plumber salary in New Jersey

Plumbing Trade Video

6 Lessons I Learned as a Plumbing Apprentice

Time 9:03

Plumbing Trade Video

Plumbers Can SPECIALISE In Many Area... Here Are The Different Types!

Run Time 8:23

Mike Rowe On The Trades

https://youtu.be/3h_pp8CHEQ0

Run Time 8:25

PPE

Plumbing PPE Plumbers Must NEVER Work Without!

Run Time 9:04

FATAL Plumbing Mistakes EVERY Plumber Needs To Know About!

Run Time 8:09

NJ One Call

New Jersey One Call

Power Tools

Let's learn about a couple of plumbing power tools - Plumbing Power Tools

Run Time 12:34

Types Of Hot/Cold Water Pipes And Fittings

PEX vs COPPER vs CPVC plumbing pipes

Run Time 16:55

Plastic Pipe

Gluing PVC Pipe & ABS Pipe [How To]

Run Time 8:16

Plastic Pipe

10 MISTAKES When Working With Plastic Pipes (PVC, CPVC & ABS) | GOT2LEARN

Run Time 8:26

IPS

When to Use Pipe dope, Teflon Tape, Neither or Both for Threaded Connection

Run Time 3:54

IPS

How to Use a Pipe Wrench

Run Time 4:31

IPS

RIDGID 300 Compact Threading Machine

Run Time 18:26

OSHA

Top OSHA 10 OSHA Violations of 2023 | And how to prevent similar citations.

Run Time 8:51

Ladder Safety

Run Time 4:33

Personal Protective Equipment Milwaukee

Old vs. new growth trees and the wood products they make

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

Instructional Strategies

- Direct instruction with visual aids for material identification and joining methods
- Teacher-led demonstrations on soldering, brazing, crimping, expansion, solvent welding, and threaded connections
- Guided practice sessions for students to replicate joining techniques
- Use of manufacturer videos and New Jersey Plumbing Code excerpts for applied learning
- Peer collaboration in small groups for troubleshooting and testing water supply systems
- Problem-based learning scenarios that require students to design code-compliant installations

Learning Activities

- Material selection comparison charts for copper, PEX, CPVC, gas piping, IPS, and CSST
- Hands-on joining method practice with feedback from the instructor
- Pressure testing and leak detection exercises
- Blueprint reading for water supply layouts
- Code compliance checklist creation for a sample installation

- Troubleshooting lab with staged installation defects
- Manufacturer's manual review and application to a real-world build

Bloom's Taxonomy / DOK Levels

- **Remember**: Identify properties of copper, PEX, CPVC, gas, IPS, and CSST piping (DOK 1)
- **Understand**: Explain how joining methods differ between piping types (DOK 2)
- **Apply**: Demonstrate proper installation of mixed-material systems (DOK 2)
- **Analyze**: Compare code requirements to manufacturer guidelines (DOK 3)
- **Evaluate**: Inspect and critique a peer's piping installation for safety and compliance (DOK 3)
- **Create**: Design a complete water supply system for a residential structure (DOK 4)

Modifications

ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Vary test formats

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments

- Tiered centers

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Technology Materials and Standards

Technology Materials

- Promethean Board
- Google For Educators
- Google Classroom
- Google Gemini
- MagicSchool
- Canva
- Clever
- Diffit

Technology Literacy Standards

- **TECH.9.4.2.CI.2** Demonstrate originality and inventiveness in work
- **TECH.9.4.2.IML.2** Represent data in a visual format to tell a story about the data.
- **TECH.9.4.2.IML.3** Use a variety of sources including multimedia sources to find information about topics.
- **TECH.9.4.2.TL.4** Navigate a virtual space to build context and describe the visual content.
- **TECH.9.4.2.TL.7** Describe the benefits of collaborating with others to complete digital tasks or develop digital artifacts.

TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.TL.4	Navigate a virtual space to build context and describe the visual content.

TECH.9.4.2.TL.7	Describe the benefits of collaborating with others to complete digital tasks or develop digital artifacts (e.g., W.2.6., 8.2.2.ED.2).
TECH.9.4.2.IML.2	Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
TECH.9.4.2.IML.3	Use a variety of sources including multimedia sources to find information about topics such as climate change, with guidance and support from adults (e.g., 6.3.2.GeoGI.2, 6.1.2.HistorySE.3, W.2.6, 1-LSI-2).

Computer Science and Design Thinking Standards

Computer Science and Design Thinking Standards

- **CS.9-12.8.1.12.AP.5** Decompose problems into smaller components using systematic analysis.
- **CS.9-12.8.1.12.AP.6** Create artifacts by combining data and procedures.
- **CS.9-12.8.1.12.CS.2** Model interactions between application software, system software, and hardware.
- **CS.9-12.8.2.12.ED.3** Evaluate several models of the same type of product and recommend improvements.
- **CS.9-12.8.2.12.ED.5** Evaluate the effectiveness of a product or system based on requirements and constraints.

CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.AP.6	Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).