### PIPING & PIPING PRACTICES
#### Course Syllabus

<table>
<thead>
<tr>
<th>Course Number:</th>
<th>ARCO-0717</th>
<th>OHLAP Credit:</th>
<th>No</th>
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<tbody>
<tr>
<td>OCAS Code:</td>
<td>None</td>
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<tr>
<td>Course Length:</td>
<td>45 Hours</td>
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<tr>
<td>Career Cluster:</td>
<td>Architecture &amp; Construction</td>
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<tr>
<td>Career Pathway:</td>
<td>Maintenance/Operations</td>
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<tr>
<td>Career Major(s):</td>
<td>HVAC Technician</td>
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**Pre-requisite(s):**
- This course is an introduction to piping material and fabrication, pipe sizing and troubleshooting, sheet metal, airflow principles/duct design, mechanical and electronic filtration, and fans/blowers.

**Textbooks:**
- *Refrigeration & Air Conditioning Technology, 7th Ed, (2013)*, Whitman /Johnson/ Tomczyk Silberstein / Publisher Delmar Cengage

**Course Objectives:**

<table>
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<tr>
<th>A. Use Trade Mathematics.</th>
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<tr>
<td>1. Identify similar units of measurement in both the inch-pound (English) and metric systems and know which units are larger.2</td>
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<tr>
<td>2. Convert measured values in the inch-pound system to equivalent metric values and vice versa.2</td>
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<td>3. Express numbers as powers of ten.2</td>
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<td>4. Determine the powers and roots of numbers.2</td>
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<td>5. Solve basic algebraic equations.2</td>
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<td>6. Recognize various geometric figures.2</td>
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<td>7. Use the Pythagorean theorem to make calculations involving right triangles.2</td>
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<td>8. Convert decimal feet to feet and inches and vice versa.2</td>
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<tr>
<td>9. Use whole numbers to solve air conditioning problems.</td>
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<tr>
<td>10. Solve problems using fractions.</td>
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<tr>
<td>a. in lowest terms (reduce)</td>
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<td>b. as equivalent fractions</td>
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<tr>
<td>c. as whole and mixed numbers</td>
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<tr>
<td>d. determine least common denominators</td>
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<td>11. Add, subtract, multiply, and divide fractions/mixed numbers.</td>
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<td>12. Identify the place value of decimals.</td>
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<td>13. Read and write decimal fractions.</td>
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<tr>
<td>14. Add, subtract, multiply, and divide decimal fractions.</td>
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15. Express common fractions as decimal fractions and vice versa.
16. Use a decimal equivalents table.
17. Change percents to decimals and decimals to percents.
18. Change percents to fractions and fractions to percents.
19. Find a percentage of a number.
20. Use percents in air conditioning applications.
21. Read scale drawings.
22. Add, subtract, multiply, and divide English and metric units.
23. Express metric equivalents and use conversion charts.
24. Add, subtract, multiply, and divide metric units.
25. Define terms associated with measuring.
26. Identify graduations on a rule.
27. Read a rule to the nearest fraction of an inch.
28. Measure dimensions of objects.
29. Read measurements on tapes.
30. Solve problems related to air conditioning physics.

B. Identify General Piping Materials.
1. Explain the use of the following types of plumbing materials.
   a. Steel pipe – Gas
   b. CSST
   c. Polyethylene
   d. Plastic pipe – water + DWV + gas
   e. PEX pipe – water
2. Demonstrate the ability to identify, measure, cut a variety of pipe material.
3. Demonstrate the ability to build a variety of pipe projects.
4. Cut and thread steel pipe.¹
5. Describe methods of insulating pipe and tubing.¹
6. Describe heat sink methods.¹
7. Describe heat exchange techniques.¹
8. Describe the applications and installation of vibration eliminators.¹

C. Identify Types of Pipe and Tubing Used in Refrigeration Systems.¹
1. List types of tubing used in heating, air conditioning and refrigeration applications.
2. Identify applications for using hard and soft drawn copper.
3. Distinguish between refrigeration and plumbing copper.
4. List applications for plastic pipe.

D. Utilize Corrugated Stainless Steel Tubing (CSST).
1. Demonstrate the steps for making a CSST joint.
2. Perform air pressure test.

E. Understand the Uses of Copper and Plastic Piping.
1. State the precautions that must be taken when installing refrigerant piping.²
2. Select the right tubing for a job.²
3. Cut and bend tubing.²
4. Measure, cut and ream copper tubing.
5. Flare, swage and bend copper tubing.¹
6. Demonstrate proper procedure for cleaning copper before soldering or brazing.
7. Safely join tubing by using flare and compression fittings.²
8. Determine the kinds of hangers and supports needed for refrigerant piping.²
9. State the basic requirements for pressure-testing a system once it has been installed.²
F. Understand Ferrous Metal Piping Practices.
1. Identify the types of ferrous metal pipes.
2. Measure the sizes of ferrous metal pipes.
3. Identify the common malleable iron fittings.
4. Cut, ream, and thread ferrous metal pipe.
5. Join lengths of threaded pipe together and install fittings.
6. Describe the main points to consider when installing pipe runs.
7. Describe the method used to join grooved piping.

G. Practice Pipe Sizing and Troubleshooting.
1. Explain capacities of refrigerant lines.
2. Explain effects of refrigerant velocity in lines.
3. Explain equivalent lengths of piping for fittings.
4. Explain use of traps in vapor risers.
5. Explain the effects of pressure drop in the refrigeration system.
7. Calculate total effective length of pipe runs.
8. Calculate amount of refrigerant in lines.
10. Calculate pressure drop in liquid line risers.
11. Size liquid and vapor lines.
12. Calculate gas piping sizes to multiple units, fed from a single meter.

H. Demonstrate Soldering Techniques.
1. Assemble and operate the tools used for soldering.
2. Prepare tubing and fittings for soldering.
3. Identify the purposes and uses of solder and solder fluxes.
4. Identify soldering and brazing alloys used in HVACR.
5. Explain applications of soldering and brazing alloys.
6. Solder copper tubing and fittings.
7. Discuss conditions for creating capillary action of solders.
8. Clean, flux and solder horizontal, vertical and inverted swage joints.
9. Identify types of torches.
10. Make soft solder joints using air-acetylene and oxyacetylene torches.

I. Demonstrate Brazing Techniques.
1. Assemble and operate the tools used for brazing.
2. Prepare tubing and fittings for brazing.
3. Identify the purposes and uses of filler metals and fluxes used for brazing.
4. Identify soldering and brazing alloys used in HVACR.
5. Explain applications of soldering and brazing alloys.
6. Choose tip size for brazing.
7. Braze copper tubing and fittings.
   a. Braze copper tubing using 15% silver brazing material (silfos) without flux.
   b. Braze copper tubing to brass or steel using 45% silver brazing material (silver solder) with flux.
   c. Braze horizontal, vertical and inverted swage joints using 15% silver brazing material (silfos).
8. Braze aluminum tubing.
9. Identify the inert gases that can safely be used to purge tubing when brazing.

J. Select Gas Piping Fittings.
1. Identify various types of fittings.¹
2. Follow the letter sequence to identify or read the sizes of reducing plumbing fittings.
3. Select the correct size fitting or a job.

K. Design and Estimate Gas Piping.
1. Design and estimate the cost of gas piping materials.
2. Estimate the cost of labor.
3. Estimate the cost of overhead/profit.

L. Understand Plastic Pipe Joints.
1. List the four methods for joining plastic pipe and fittings.
2. Explain how solvent weld joints are made.
3. Discuss the three things necessary to get a permanent, welded joint.
4. Explain the difference in materials and joining methods of the following:
   a. P.V.C. pipe
   b. C.P.V.C. pipe
   c. P.E. pipe
   d. P.E.X. water pipe
5. Demonstrate procedure for joining PVC, PEX, polyethylene.

M. Join Pipe Joints.
1. Explain different types of joints used to join threaded steel pipe.
2. Demonstrate the steps for making an external pipe thread.
3. Perform air pressure test on gas pipe project.

N. Understand the Use of Sheetmetal.
1. Explain use of bending tools.¹
2. Explain use of cutting tools.¹
3. Explain the types of ductwork and fittings.¹
4. Demonstrate use of tin snips left, right and straight.¹
5. Identify the different pressures of ductwork.¹
6. Identify the different types of connections.¹

O. Construct Piping Project.
1. Interpret piping diagram; collect necessary tools and materials.
2. Measure, cut, and ream pieces of copper needed for project.
3. Swage, flare, and bend copper; then fit together as shown on diagram.
4. Braze all copper joints.
5. Pressurize with nitrogen and test for leaks.

¹ ODCTE objective
² NCCER objective
All unmarked objectives are TTC instructor developed.

Teaching Methods: The class will primarily be taught by the lecture and demonstration method and supported by various media materials to address various learning styles. There will be question and answer sessions over material covered in lecture and media presentations. Supervised lab time is provided for students to complete required projects.
Grading Procedures:
1. Students are graded on theory and shop practice and performance.
2. Each course must be passed with seventy (70%) percent or better.
3. Grading scale: A=90-100%, B=80-89%, C=70-79%, D=60-69%, F=50-59%.

Description of Classroom, Laboratories, and Equipment:
Tulsa Technology Center campuses are owned and operated by Tulsa Technology Center School District No. 18. All programs provide students the opportunity to work with professionally certified instructors in modern, well-equipped facilities.

Available Certifications/College Credit:
The student may be eligible to take state, national or industry exam after completion of the program. College credit may be issued from Oklahoma State University-Okmulgee or Tulsa Community College. See program counselor for additional information.

College Credit Eligibility:
The student must maintain a grade point average of 2.0 or better.