



Western Technical College

10601137 HVACR Hydronic & Steam Systems

Course Outcome Summary

Course Information

Description	Participants will design hot water systems, select circulating pumps and balance hydronic systems. Components of the course include fluid flow in pipes, pump characteristics and steam systems. Operating boilers efficiently and safely will be emphasized. HVACR is a common reference to Heating, Ventilation, Air Conditioning and Refrigeration.
Career Cluster	Architecture and Construction
Instructional Level	Associate Degree Courses
Total Credits	4
Total Hours	90

Textbooks

Refrigeration and Air Conditioning Technology. 9th Edition. Copyright 2021. Whitman, Bill, Bill Johnson, John Timczyk, and Eugene Silberstein. Publisher: Cengage Learning. **ISBN-13:**978-0-357-12227-3. Required.

Modern Hydronic Heating. 4th Edition. Copy right 2023. Siegenthaler, John. Publisher: Cengage Learning. **ISBN-13:** 978-1-337-90491-9. Required.

Success Abilities

1. Cultivate Passion: Increase Self-Awareness
2. Refine Professionalism: Improve Critical Thinking
3. Refine Professionalism: Practice Effective Communication

High Impact Practices

1. Capstone Experience: in this course, you will develop a project that integrates and applies many of the concepts, skills, and characteristics needed of an industry expert in the field.

Program Outcomes

1. Service HVACR systems
2. Evaluate HVACR system designs

Course Competencies

1. Assemble a copper tubing project

Assessment Strategies

- 1.1. Project

Criteria

You will know you are successful when

- 1.1. the assembled and tested project complies with the standards of a grading rubric

Learning Objectives

- 1.a. Interpret piping diagram
- 1.b. Select proper diameter pipe
- 1.c. Cut pipe to proper length
- 1.d. Select proper filler material

2. Select a boiler given building heat loss

Assessment Strategies

- 2.1. Written Objective Test

Criteria

You will know you are successful when

- 2.1. a boiler is sized correctly on a written test

Learning Objectives

- 2.a. Differentiate between a heating load and a process load
- 2.b. Calculate boiler horsepower given boiler output
- 2.c. Evaluate different types of boilers for a given application
- 2.d. Compare hydronic heating with forced air heating

3. Value the use of modular boilers

Assessment Strategies

- 3.1. Skill Demonstration

Criteria

You will know you are successful when

- 3.1. you calculate the input parameters for the programmable controller
- 3.2. you enter the variables into the controller and boilers operate correctly
- 3.3. sketch accurately represents the piping layout with 80% accuracy

Learning Objectives

- 3.a. Program a modular boiler controller
- 3.b. Sketch piping arrangements for modular boiler systems

4. Use energy calculations

Assessment Strategies

- 4.1. Written Objective Test

Criteria

You will know you are successful when

- 4.1. combustion efficiency test questions are answered with 80% accuracy
- 4.2. heat transfer test questions are answered with 80% accuracy
- 4.3. net IBR rating test questions are answered with 80% accuracy

Learning Objectives

- 4.a. Use boiler combustion efficiency equations appropriately
- 4.b. Calculate net IBR
- 4.c. Use specific heat equation appropriately

5. Evaluate a valve based on the application

Assessment Strategies

- 5.1. Written Objective Test

Learning Objectives

- 5.a. List the five functions of valves
- 5.b. Select a valve given the application
- 5.c. Give precautions when installing and operating valves

6. Specify copper fittings

Assessment Strategies

- 6.1. Skill Demonstration

Criteria

You will know you are successful when

- 6.1. you specify ten copper fittings with 80% accuracy

Learning Objectives

- 6.a. Identify nominal pipe size of the fitting
- 6.b. Identify the designation for the type of connection
- 6.c. Identify the name of the fitting

7. Select a centrifugal pump

Assessment Strategies

- 7.1. Oral Presentation

Criteria

You will know you are successful when

- 7.1. oral presentation explains the process of choosing a particular pump based on the application

Learning Objectives

- 7.a. Determine the total GPM of the piping system
- 7.b. Determine the head pressure of the piping system
- 7.c. Determine the operating point of a pump
- 7.d. Determine the pump efficiency at the operating point
- 7.e. Determine net positive suction head for the pump

8. Use the pump laws

Assessment Strategies

- 8.1. Written Objective Test

Criteria

You will know you are successful when

- 8.1. pump law calculations are answered with 80% accuracy

Learning Objectives

- 8.a. Calculate GPM when RPM changes
- 8.b. Calculate head pressure when RPM changes
- 8.c. Calculate break horsepower when RPM changes

9. Design a series-loop pipe system

Assessment Strategies

9.1. Project

Criteria

You will know you are successful when

- 9.1. design spreadsheet has correctly sizes terminal units
- 9.2. design spreadsheet has correct size boiler
- 9.3. design spreadsheet has correct size expansion tank
- 9.4. design spreadsheet has correct size piping
- 9.5. design spreadsheet has correct required pump GPM
- 9.6. design spreadsheet has correct required pump head

Learning Objectives

- 9.a. Select heat emitters
- 9.b. Select expansion tank
- 9.c. Determine GPM for the system
- 9.d. Use good design principles
- 9.e. Locate thermostat
- 9.f. Size supply piping
- 9.g. Size return piping

10. Design a two-pipe reverse return hydronic system

Assessment Strategies

10.1. Project

Criteria

You will know you are successful when

- 10.1. design spreadsheet has correctly sizes terminal units
- 10.2. design spreadsheet has correct required pump head
- 10.3. design spreadsheet has correct required pump GPM
- 10.4. design spreadsheet has correct size piping
- 10.5. design spreadsheet has correct size expansion tank
- 10.6. design spreadsheet has correct size boiler

Learning Objectives

- 10.a. Select expansion tanks
- 10.b. Determine GPM flow rate
- 10.c. Select boilers
- 10.d. Select terminal units
- 10.e. Determine required head pressure
- 10.f. Select pump
- 10.g. Size return piping
- 10.h. Size supply piping

11. Complete a radiant floor heating design worksheet

Criteria

You will know you are successful when

- 11.1. Uponor design spreadsheet is completed with 80% accuracy
- 11.2. report complies with written report grading rubric

Learning Objectives

- 11.a. Write a report listing advantages and disadvantages of in-floor radiant heating
- 11.b. Use good Uponor Design Manual to layout tubing in a house
- 11.c. Determine GPM for the system

12. Balance a hydronic system

Assessment Strategies

12.1. Skill Demonstration

Criteria

You will know you are successful when

- 12.1. you meet the criteria outlined in lab sheet L121
- 12.2. you use the flow chart to determine flow rate
- 12.3. you set the balancing valves at AHU coil in correct sequence
- 12.4. you adjust the final flow rate at coils to within $\pm 10\%$ of design rate
- 12.5. you accurately fill out the balance report
- 12.6. you use the flow meter correctly

Learning Objectives

- 12.a. Explain the operation of balancing valves
- 12.b. Operate a flow meter
- 12.c. Complete a balancing report
- 12.d. Interpret balancing valve flow charts

13. Value steam boiler water treatment

Assessment Strategies

- 13.1. Written Objective Test

Learning Objectives

- 13.a. Describe how condensation damages boilers
- 13.b. List three reasons for water treatment
- 13.c. Describe how dissolved gases damage boilers
- 13.d. Describe how dissolved minerals damage boilers

14. Value proper steam trap maintenance

Assessment Strategies

- 14.1. Written Objective Test

Criteria

You will know you are successful when

- 14.1. test questions about steam trap maintenance are answered with 80% accuracy
- 14.2. test questions about steam trap deferred maintenance are answered with 80% accuracy
- 14.3. you overhaul a steam trap and it functions properly without leaks

Learning Objectives

- 14.a. List the causes of faulty steam traps
- 14.b. Summarize the benefits of steam trap maintenance
- 14.c. Overhaul a steam trap