

***HEATING, VENTILATION,  
AIR CONDITIONING, AND REFRIGERATION  
CURRICULUM FRAMEWORK***



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**VISION**

*All Nevadans ready for success in the 21st century*

**MISSION**

*To improve student achievement and educator effectiveness by ensuring opportunities, facilitating learning, and promoting excellence*



## INTRODUCTION

The Nevada CTE Curriculum Frameworks are a resource for Nevada’s public and charter schools to design, implement, and assess their CTE programs and curriculum. The content standards identified in this document are listed as a model for the development of local district programs and curriculum. They represent rigorous and relevant expectations for student performance, knowledge, and skill attainment which have been validated by industry representatives.

The intent of this document is to provide a resource to districts as they develop and implement CTE programs and curricula.

This program ensures the following thresholds are met:

- The CTE course and course sequence teaches the knowledge and skills required by industry through applied learning methodology and, where appropriate, work-based learning experiences that prepare students for careers in high-wage, high-skill, or in-demand fields. Regional and state economic development priorities shall play an important role in determining program approval. Some courses also provide instruction focused on personal development.
- The CTE course and course sequence includes leadership and employability skills as an integral part of the curriculum.
- The CTE course and course sequence is part of a rigorous program of study and includes sufficient technical challenge to meet state and/or industry-standards.

The CTE program components include the following items:

- Program of Study
- State Skill Standards
- Employability Skills for Career Readiness Standards
- Career Technical Student Organizations (CTSOs)
- Curriculum Framework
- CTE Assessments:
  - Workplace Readiness Skills Assessment
  - End-of-Program Technical Assessment
- Certificate of Skill Attainment
- CTE Endorsement on a High School Diploma
- CTE College Credit

## NEVADA DEPARTMENT OF EDUCATION

## CURRICULUM FRAMEWORK FOR

## HEATING, VENTILATION, AIR CONDITIONING, AND REFRIGERATION (HVACR)

## PROGRAM INFORMATION

**Program Title:** Heating, Ventilation, Air Conditioning, and Refrigeration

**State Skill Standards:** Heating, Ventilation, Air Conditioning, and Refrigeration

**Standards Reference Code:** HVACR

**Career Cluster:** Architecture & Construction

**Career Pathway:** Maintenance/Operations

**Program Length:** 2 Levels (L1, L2C)

**Program Assessments:** Heating, Ventilation, Air Conditioning, and Refrigeration  
Workplace Readiness Skills

**CTSO:** SkillsUSA

**Grade Level:** 9-12

**Industry Certifications:** See Nevada's Approved Certification Listing

## PROGRAM PURPOSE

The purpose of this program is to prepare students for postsecondary education and employment in the HVACR industry.

The program includes the following state standards:

- Nevada CTE Skill Standards: Heating, Ventilation, Air Conditioning, and Refrigeration
- Employability Skills for Career Readiness
- Nevada Academic Content Standards (alignment shown in the Nevada CTE Skill Standards):
  - English Language Arts
  - Mathematics
  - Science
- Common Career Technical Core (alignment shown in the Nevada CTE Skill Standards)

## CAREER CLUSTERS

The National Career Clusters™ Framework provides a vital structure for organizing and delivering quality CTE programs through learning and comprehensive programs of study (POS). In total, there are 16 Career Clusters in the National Career Clusters™ Framework, representing more than 79 Career Pathways to help students navigate their way to greater success in college and career. As an organizing tool for curriculum design and instruction, Career Clusters™ provide the essential knowledge and skills for the 16 Career Clusters™ and their Career Pathways.\*

\*Cite: National Association of State Directors of Career Technical Education Consortium. (2012). Retrieved from <https://www.air.org/sites/default/files/CTEClusters.pdf> and <https://cte.careertech.org/sites/default/files/CareerClustersPathways.pdf>

**PROGRAM OF STUDY**

The program of study illustrates the sequence of academic and career and technical education coursework that is necessary for the student to successfully transition into postsecondary educational opportunities and employment in their chosen career path. (NAC 389.803)

**PROGRAM STRUCTURE**

The core course sequencing provided in the following table serves as a guide to schools for their programs of study. Each course is listed in the order in which it should be taught and has a designated level. Complete program sequences are essential for the successful delivery of all state standards in each program area.

**HEATING, VENTILATION, AIR CONDITIONING, AND REFRIGERATION**  
Core Course Sequence

COURSE NAME	LEVEL
Heating, Ventilation, Air Conditioning, and Refrigeration I	L1
Heating, Ventilation, Air Conditioning, and Refrigeration II	L2C

The core course sequencing with the complementary courses provided in the following table serves as a guide to schools for their programs of study. Each course is listed in the order in which it should be taught and has a designated level. A program does not have to utilize all of the complementary courses in order for their students to complete their program of study. Complete program sequences are essential for the successful delivery of all state standards in each program area.

**HEATING, VENTILATION, AIR CONDITIONING, AND REFRIGERATION**  
Core Course Sequence with Complementary Courses

COURSE NAME	LEVEL
Heating, Ventilation, Air Conditioning, and Refrigeration I	L1
Heating, Ventilation, Air Conditioning, and Refrigeration II	L2C
Heating, Ventilation, Air Conditioning, and Refrigeration II LAB*	L2L
Heating, Ventilation, Air Conditioning, and Refrigeration III	AS
Heating, Ventilation, Air Conditioning, and Refrigeration III LAB*	ASL
Heating, Ventilation, Air Conditioning, and Refrigeration Advanced Studies*	AS

\*Complementary Courses

**STATE SKILL STANDARDS**

The state skill standards are designed to clearly state what the student should know and be able to do upon completion of an advanced high school career and technical education (CTE) program. The standards are designed for the student to complete all standards through their completion of a program of study. The standards are designed to prepare the student for the end-of-program technical assessment directly aligned to the standards. (Paragraph (a) of Subsection 1 of NAC 389.800)

**EMPLOYABILITY SKILLS FOR CAREER READINESS STANDARDS**

Employability skills, often referred to as “soft skills,” have for many years been a recognizable component of the standards and curriculum in career and technical education programs. The twenty-one standards are organized into three areas: (1) Personal Qualities and People Skills; (2) Professional Knowledge and Skills; and (3) Technology Knowledge and Skills. The standards are designed to ensure students graduate high school properly prepared with skills employers prioritize as the most important. Instruction on all twenty-one standards must be part of each course of the CTE program. (Paragraph (d) of Subsection 1 of NAC 389.800)

**CURRICULUM FRAMEWORK**

The Nevada CTE Curriculum Frameworks are organized utilizing the recommended course sequencing listed in the program of study and the CTE Course Catalog. The framework identifies the recommended content standards, performance standards, and performance indicators that should be taught in each course.

**CAREER AND TECHNICAL STUDENT ORGANIZATIONS (CTSOs)**

To further the development of leadership and technical skills, students must have opportunities to participate in one or more of the Career and Technical Student Organizations (CTSOs). CTSOs develop character, citizenship, and the technical, leadership and teamwork skills essential for the workforce and their further education. Their activities are considered a part of the instructional day when they are directly related to the competencies and objectives in the course. (Paragraph (a) of Subsection 3 of NAC 389.800)

**WORKPLACE READINESS SKILLS ASSESSMENT**

The Workplace Readiness Skills Assessment has been developed to align with the Nevada CTE Employability Skills for Career Readiness Standards. This assessment provides a measurement of student employability skills attainment. Students who complete a program will be assessed on their skill attainment during the completion level course. Completion level courses are identified by the letter “C”. (e.g., Level = L3C) (Paragraph (d) of Subsection 1 of NAC 389.800)

**END-OF-PROGRAM TECHNICAL ASSESSMENT**

An end-of-program technical assessment has been developed to align with the Nevada CTE Skill Standards for this program. This assessment provides a measurement of student technical skill attainment. Students who complete a program will be assessed on their skill attainment during the completion level course. Completion level courses are identified by the letter “C”. (e.g., Level = L3C) (Paragraph (e) of Subsection 1 of NAC 389.800)

**CERTIFICATE OF SKILL ATTAINMENT**

Each student who completes a course of study must be awarded a certificate which states that they have attained specific skills in the industry being studied and meets the following criteria: A student must maintain a 3.0 grade point average in their approved course of study, pass the Workplace Readiness Skills Assessment, and pass the end-of-program technical assessment. (Subsection 4 of NAC 389.800)

**CTE ENDORSEMENT ON A HIGH SCHOOL DIPLOMA**

A student qualifies for a CTE endorsement on their high school diploma after successfully completing the following criteria: (1) completion of a CTE course of study in a program area; (2) completion of academic requirements governing receipt of a standard diploma; and (3) meet all requirements for the issuance of the Certificate of Skill Attainment. (NAC 389.815)

**CTE COLLEGE CREDIT**

CTE College Credit is awarded to students based on articulation agreements established by each college for the CTE program, where the colleges will determine the credit value of a full high school CTE program based on course alignment. An articulation agreement will be established for each CTE program designating the number of articulated credits each college will award to students who complete the program.

CTE College Credit is awarded to students who: (1) complete the CTE course sequence with a grade-point average of 3.0 or higher; (2) pass the state end-of-program technical assessment for the program; and (3) pass the Workplace Readiness Assessment for employability skills.

Pre-existing articulation agreements will be recognized until new agreements are established according to current state policy and the criteria shown above.

Please refer to the local high school's course catalog or contact the local high school counselor for more information. (Paragraph (b) of Subsection 3 of NAC 389.800)

**ACADEMIC CREDIT FOR CTE COURSEWORK**

Career and technical education courses meet the credit requirements for high school graduation (1 unit of arts and humanities or career and technical education). Some career and technical education courses meet academic credit for high school graduation. Please refer to the local high school's course catalog or contact the local high school counselor for more information. (NAC 389.672)

**CORE COURSE:****RECOMMENDED STUDENT PERFORMANCE STANDARDS****COURSE INFORMATION:**

**COURSE TITLE:** Heating, Ventilation, Air Conditioning, and Refrigeration I  
**ABBR. NAME:** HVACR I  
**CREDITS:** 1  
**LEVEL:** L1  
**CIP CODE:** 47.0201  
**SCED CODE:** 17055  
**PREREQUISITE:** NONE  
**CTSO:** SkillsUSA

**COURSE DESCRIPTION:**

This course will introduce students to Heating, Ventilation, and Air Conditioning (HVAC). Through a hands-on approach, each student will develop basic understanding in the areas of HVAC: safety, blueprint reading, principles that guide installation and service, electrical components, thermodynamics and heat transfer, and an introduction to heating and refrigeration systems. Practical application of safe work habits and the correct use of tools and equipment will be emphasized throughout this course.

**TECHNICAL STANDARDS:****CONTENT STANDARD 1.0: LAB ORGANIZATION AND SAFETY PROCEDURES**

Performance Standard 1.1: Demonstrate General Lab Safety Rules and Procedures

*Performance Indicators:* 1.1.1-1.1.19

Performance Standard 1.2: Identify and Utilize Hand Tools

*Performance Indicators:* 1.2.1-1.2.5

Performance Standard 1.3: Identify and Utilize Power Tools and Equipment

*Performance Indicators:* 1.3.1-1.3.5

**CONTENT STANDARD 2.0: GENERAL HVACR SKILLS**

Performance Standard 2.1: Demonstrate Print Reading Practices

*Performance Indicators:* 2.1.1-2.1.6

Performance Standard 2.2: Apply Math Skills to HVACR Applications

*Performance Indicators:* 2.2.1-2.2.16

Performance Standard 2.3: Utilize Materials Handling Techniques

*Performance Indicators:* 2.3.1-2.3.6

Performance Standard 2.4: Explore HVACR Career Opportunities

*Performance Indicators:* 2.4.1-2.4.5

**CONTENT STANDARD 3.0: INTRODUCTION TO HEATING, VENTILATION, AIR CONDITIONING, AND REFRIGERATION**

Performance Standard 3.1: Explain Basic Principles of Heating, Ventilation, Air Conditioning, and Refrigeration

*Performance Indicators:* 3.1.1-3.1.4

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Performance Standard 3.2: Describe the Principles That Guide HVACR Installation and Service Techniques

*Performance Indicators:* 3.2.1-3.2.4

**CONTENT STANDARD 4.0: INTRODUCTION TO ELECTRICITY**

Performance Standard 4.1: Describe the Fundamentals of Electricity

*Performance Indicators:* 4.1.1-4.1.4

Performance Standard 4.2: Explain Basic Electrical Theory

*Performance Indicators:* 4.2.1-4.2.4

Performance Standard 4.3: Describe How Electrical Measuring Instruments Are Used in HVACR Work

*Performance Indicators:* 4.3.1

Performance Standard 4.4: Identify Electrical Components Used in HVACR Systems and Describe Their Functions

*Performance Indicators:* 4.4.1-4.4.2

**CONTENT STANDARD 5.0: THERMODYNAMICS AND HEAT TRANSFER**

Performance Standard 5.1: Explore the Science of Refrigeration and Heating

*Performance Indicators:* 5.1.1-5.1.17

Performance Standard 5.2: Explore the Science of Fluids and Pressures as They Relate to Air Conditioning and Refrigeration

*Performance Indicators:* 5.2.1-5.2.11

Performance Standard 5.3: Understand the Relationship of the Components of the Refrigeration Cycle

*Performance Indicators:* 5.3.1-5.3.8

**CONTENT STANDARD 6.0: HEATING AND COMBUSTION**

Performance Standard 6.1: Explain Fundamental Concepts of Heating and Combustion

*Performance Indicators:* 6.1.1-6.1.2

Performance Standard 6.2: Describe Various Heating Systems

*Performance Indicators:* 6.2.1-6.2.5

**CONTENT STANDARD 7.0: REFRIGERATION SYSTEMS**

Performance Standard 7.1: Explain Fundamental Concepts of the Refrigeration Cycle

*Performance Indicators:* 7.1.1-7.1.5

Performance Standard 7.2: Understand the Relationship of the Components of the Refrigeration Cycle

*Performance Indicators:* 7.2.1-7.2.3

Performance Standard 7.3: Identify Major Components of Cooling Systems and How They Function

*Performance Indicators:* 7.3.1-7.3.6

Performance Standard 7.4: Identify the Common Controls Used in Cooling Systems

*Performance Indicators:* 7.4.1

**EMPLOYABILITY SKILLS FOR CAREER READINESS STANDARDS:****CONTENT STANDARD 1.0: DEMONSTRATE EMPLOYABILITY SKILLS FOR CAREER READINESS**

Performance Standard 1.1: Demonstrate Personal Qualities and People Skills

*Performance Indicators:* 1.1.1-1.1.7

Performance Standard 1.2: Demonstrate Professional Knowledge and Skills

*Performance Indicators:* 1.2.1-1.2.10

Performance Standard 1.3: Demonstrate Technology Knowledge and Skills

*Performance Indicators:* 1.3.1-1.3.4**ALIGNMENT TO THE NEVADA ACADEMIC CONTENT STANDARDS\*:**

**English Language Arts:** Reading Standards for Literacy in Science and Technical Subjects  
Writing Standards for Literacy in Science and Technical Subjects  
Speaking and Listening

**Mathematics:** Mathematical Practices  
Geometry-Congruence

**Science:** Nature of Science  
Physical Science

\* Refer to the Heating, Ventilation, Air Conditioning, and Refrigeration Standards for alignment by performance indicator.

**CORE COURSE:****RECOMMENDED STUDENT PERFORMANCE STANDARDS****COURSE INFORMATION:**

**COURSE TITLE:** Heating, Ventilation, Air Conditioning, and Refrigeration II  
**ABBR. NAME:** HVACR II  
**CREDITS:** 1  
**LEVEL:** L2C  
**CIP CODE:** 47.0201  
**SCED CODE:** 17055  
**PREREQUISITE:** Heating, Ventilation, Air Conditioning, and Refrigeration I  
**CTSO:** SkillsUSA

**COURSE DESCRIPTION:**

This course is a continuation of Heating, Ventilation, Air Conditioning, and Refrigeration I. This course provides intermediate HVAC students with knowledge and skills in piping principles, compressors, aspects of refrigerants, and metering devices. The appropriate use of technology and industry-standard equipment is an integral part of this course. Upon successful completion of this course, students will have acquired entry-level skills for employment and be prepared for postsecondary education.

**TECHNICAL STANDARDS:****CONTENT STANDARD 8.0: PIPING PRINCIPLES**

Performance Standard 8.1: Recognize and Identify Different Types of Copper Tubing and Their Related Fittings

*Performance Indicators:* 8.1.1-8.1.2

Performance Standard 8.2: Describe and Demonstrate How to Join Copper Tubing Mechanically

*Performance Indicators:* 8.2.1-1.2.3

Performance Standard 8.3: Recognize Different Types of Plastic Piping and Show How it can be Joined

*Performance Indicators:* 8.3.1-8.3.2

Performance Standard 8.4: Describe and Demonstrate the Safe Process of Soldering Copper Tubing

*Performance Indicators:* 8.4.1-8.4.3

Performance Standard 8.5: Describe and Demonstrate the Safe Process of Brazing Copper Tubing

*Performance Indicators:* 8.5.1-8.5.4

Performance Standard 8.6: Describe and Identify the Various Types of Steel Pipe and Fitting

*Performance Indicators:* 8.6.1-1.6.4

Performance Standard 8.7: Describe the Tools and Methods used to Cut and Thread Steel Pipe

*Performance Indicators:* 8.7.1-8.7.2

Performance Standard 8.8: Explain and Demonstrate the Methods of Installing and Mechanically Joining Steel Pipe

*Performance Indicators:* 8.8.1-8.8.4

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**CONTENT STANDARD 9.0: COMPRESSORS**

Performance Standard 9.1: Identify and Describe Various Approaches to Compressor Capacity Control

*Performance Indicators:* 9.1.1-9.1.2

Performance Standard 9.2: Describe the Common Causes of Compressor Failures

*Performance Indicators:* 9.2.1-9.2.2

Performance Standard 9.3: Identify and Explain the Operation of Various Compressor Protection Devices

*Performance Indicators:* 9.3.1-9.3.2

Performance Standard 9.4: Explain How to Analyze the Operation of a Hermetic Compressor

*Performance Indicators:* 9.4.1-9.4.2

**CONTENT STANDARD 10.0: ASPECTS OF REFRIGERANTS**

Performance Standard 10.1: Describe the Desirable Characteristics of Refrigerants and the Various Applications that Require These Characteristics

*Performance Indicators:* 10.1.1-10.1.2

Performance Standard 10.2: Identify Various Refrigerant Classifications and Describe Their Environmental Impact

*Performance Indicators:* 10.2.1-10.2.4

Performance Standard 10.3: Explain How to Use Pressure-Temperature (PT) Charts to Calculate Superheat and Subcooling

*Performance Indicators:* 10.3.1-10.3.2

Performance Standard 10.4: Identify and Describe Lubricating Oils and Issues Related to Their Function

*Performance Indicators:* 10.4.1-10.4.5

Performance Standard 10.5: Describe Considerations Related to Refrigerant Conversions

*Performance Indicators:* 10.5.1-10.5.2

Performance Standard 10.6: Describe the Equipment and Approaches used to Leak Test Refrigerant Circuits

*Performance Indicators:* 10.6.1-10.6.2

Performance Standard 10.7: Describe Refrigerant Containment and Management Requirements and the Equipment Used to Recover Refrigerants

*Performance Indicators:* 10.7.1-10.7.2

Performance Standard 10.8: Explain the Related Principles and Identify the Equipment Used to Evacuate Refrigerant Circuits

*Performance Indicators:* 10.8.1-10.8.2

Performance Standard 10.9: Describe the Procedures for Charging Refrigerant Circuits

*Performance Indicators:* 10.9.1-10.9.2

**CONTENT STANDARD 11.0: METERING DEVICES**

Performance Standard 11.1: Explain the Function of Refrigerant Metering Devices and Their Effect on Refrigerants

*Performance Indicators:* 11.1.1-11.1.3

Performance Standard 11.2: Identify Fixed Metering Devices and Explain How They Function

*Performance Indicators:* 11.2.1-11.2.3

Performance Standard 11.3: Identify Types of Expansion Valves and Explain How They Operate

*Performance Indicators:* 11.3.1-11.3.5

**EMPLOYABILITY SKILLS FOR CAREER READINESS STANDARDS:****CONTENT STANDARD 1.0: DEMONSTRATE EMPLOYABILITY SKILLS FOR CAREER READINESS**

Performance Standard 1.1: Demonstrate Personal Qualities and People Skills

*Performance Indicators:* 1.1.1-1.1.7

Performance Standard 1.2: Demonstrate Professional Knowledge and Skills

*Performance Indicators:* 1.2.1-1.2.10

Performance Standard 1.3: Demonstrate Technology Knowledge and Skills

*Performance Indicators:* 1.3.1-1.3.4

**ALIGNMENT TO THE NEVADA ACADEMIC CONTENT STANDARDS\*:**

**English Language Arts:** Reading Standards for Literacy in Science and Technical Subjects  
Writing Standards for Literacy in Science and Technical Subjects  
Speaking and Listening

**Mathematics:** Mathematical Practices  
Geometry-Congruence

**Science:** Nature of Science  
Physical Science

\* Refer to the Heating, Ventilation, Air Conditioning, and Refrigeration Standards for alignment by performance indicator.

**COMPLEMENTARY COURSE(S):****RECOMMENDED STUDENT PERFORMANCE STANDARDS**

Programs that utilize the complementary courses can include the following courses. The Heating, Ventilation, Air Conditioning, and Refrigeration III course allows continued study in the HVACR field.

**COURSE INFORMATION:**

**COURSE TITLE:** Heating, Ventilation, Air Conditioning, and Refrigeration III

**ABBR. NAME:** HVACR III

**CREDITS:** 1

**LEVEL:** AS

**CIP CODE:** 47.0201

**SCED CODE:** 17055

**PREREQUISITE:** Heating, Ventilation, Air Conditioning, and Refrigeration II

**CTSO:** SkillsUSA

**COURSE DESCRIPTION:**

This course is a continuation of Heating, Ventilation, Air Conditioning, and Refrigeration II. This course provides advanced HVAC students with knowledge and skills in air distribution systems, heat pumps, common types of duct work, commercial airside systems, indoor air quality and hydronic systems. Through hands-on projects, students develop technical skills that are used throughout the HVAC industry. The appropriate use of technology and industry-standard equipment is an integral part of this course.

**TECHNICAL STANDARDS:**

Students have achieved all program content standards and will pursue advanced study through investigation and in-depth research.

**EMPLOYABILITY SKILLS FOR CAREER READINESS STANDARDS:**

Students have achieved all program content standards and will pursue advanced study through investigation and in-depth research.

**COMPLEMENTARY COURSE STANDARDS:**

The following standards will be continued from the Heating, Ventilation, Air Conditioning, and Refrigeration Standards.

**CONTENT STANDARD 12.0: AIR DISTRIBUTION SYSTEMS**

Performance Standard 12.1: Identify Fixed Metering Devices and Explain How They Function

*Performance Indicators:* 12.1.1 Describe how pressure, velocity, and volume are interrelated in air flow

*Performance Indicators:* 12.1.2 Describe air distribution in a typical residential system

*Performance Indicators:* 12.1.3 Identify common air measurement instruments

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- Performance Standard 12.2: Describe the Mechanical Equipment and Materials Used to Create Air Distribution Systems
- Performance Indicators:* 12.2.1 Describe various blower types and applications
- Performance Indicators:* 12.2.2 Describe various fan designs and applications
- Performance Indicators:* 12.2.3 Demonstrate an understanding of the fan laws
- Performance Indicators:* 12.2.4 Describe common duct materials and fittings
- Performance Indicators:* 12.2.5 Identify the characteristics of common grilles, registers, and dampers
- Performance Standard 12.3: Identify the Different Approaches to Air Distribution System Design and Energy Conservation
- Performance Indicators:* 12.3.1 Identify various air distribution system layouts
- Performance Indicators:* 12.3.2 Describe heating and cooling air movement resulting from various air distribution system designs
- Performance Indicators:* 12.3.3 Explain how to maximize energy efficiency through the proper sealing and testing of air distribution systems
- CONTENT STANDARD 13.0: HEAT PUMPS**
- Performance Standard 13.1: Explain Heat Pump Operating Principles and Their Related Performance Ratings
- Performance Indicators:* 13.1.1 Explain how heat pumps can extract heat from air and water
- Performance Indicators:* 13.1.2 Describe the Coefficient of Performance (COP) and how it is determined
- Performance Indicators:* 13.1.3 Describe the Heating Seasonal Performance Factor (HSPF) and how it is determined
- Performance Indicators:* 13.1.4 Describe the Seasonal Energy Efficiency Ratio (SEER) and how it is determined
- Performance Standard 13.2: Describe the Operation of Heat Pump Systems
- Performance Indicators:* 13.2.1 Describe the refrigeration cycle of heat pumps
- Performance Indicators:* 13.2.2 Identify the various types of heat pump systems
- Performance Indicators:* 13.2.3 Describe the basic control strategies for heat pumps and defrost cycles
- Performance Indicators:* 13.2.4 Identify unit components that are important to heat pump operation
- Performance Indicators:* 13.2.5 Describe sources of supplemental and/or emergency heat used in heat pump systems
- Performance Standard 13.3: Identify common installation practices associated with heat pumps
- Performance Indicators:* 13.3.1 Explain how electric heating equipment operates
- Performance Indicators:* 13.3.2 Identify the major components of an electric heater
- Performance Standard 13.4: Describe the operation of electric heating equipment commonly used with heat pumps
- Performance Indicators:* 13.4.1 Identify installation practices associated with split systems
- Performance Indicators:* 13.4.2 Identify installation practices associated with packaged systems
- CONTENT STANDARD 14.0: COMMON TYPES OF DUCT WORK**
- Performance Standard 14.1: Identify various methods of joining sheet metal
- Performance Indicators:* 14.1.1 Identify various types of steel sheet metals
- Performance Indicators:* 14.1.2 Identify various types of alloy sheet metals

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- Performance Standard 14.2: Identify various types of alloy sheet metals  
*Performance Indicators:* 14.2.1 Identify various types of duct seams  
*Performance Indicators:* 14.2.2 Identify various methods of duct component connection
- Performance Standard 14.3: Describe the methods used to suspend and support sheet metal duct  
*Performance Indicators:* 14.3.1 Describe methods used to suspend sheet metal duct  
*Performance Indicators:* 14.3.2 Describe methods used to support sheet metal duct
- Performance Standard 14.4: Describe methods used to insulate and attenuate sheet metal duct  
*Performance Indicators:* 14.4.1 Describe the selection and installation of duct lining products  
*Performance Indicators:* 14.4.2 Describe the selection and installation of external duct wraps
- Performance Standard 14.5: Identify various sheet metal duct accessories and describe their installation  
*Performance Indicators:* 14.5.1 Identify and describe the installation of various types of dampers  
*Performance Indicators:* 14.5.2 Identify and describe the installation of duct takeoffs and access doors
- Performance Standard 14.6: Identify different types of flexible duct and explain how it is installed  
*Performance Indicators:* 14.6.1 Identify different types of flexible duct  
*Performance Indicators:* 14.6.2 Explain how flexible duct is connected and supported
- Performance Standard 14.7: Describe the standards and application considerations related to fiberglass duct  
*Performance Indicators:* 14.7.1 Identify the standards related to fiberglass duct  
*Performance Indicators:* 14.7.2 Identify application considerations related to fiberglass duct
- Performance Standard 14.8: Describe the methods used to fabricate and repair fiberglass duct  
*Performance Indicators:* 14.8.1 Describe how to close and join fiberglass duct using various methods  
*Performance Indicators:* 14.8.2 Describe how to repair both minor and major fiberglass duct damage
- Performance Standard 14.9: Describe the methods used to suspend and support fiberglass duct systems  
*Performance Indicators:* 14.9.1 Describe methods used to suspend and support fiberglass duct  
*Performance Indicators:* 14.9.2 Describe methods used to suspend and support fiberglass duct fittings and risers
- Performance Standard 14.10: Describe fabric-based air distribution products and their installation methods  
*Performance Indicators:* 14.10.1 Identify various types and designs of fabric-based air distribution products  
*Performance Indicators:* 14.10.2 Describe the various methods of installing and suspending fabric-based air distribution products
- CONTENT STANDARD 15.0: COMMERCIAL AIRSIDE SYSTEMS**
- Performance Standard 15.1: Identify the characteristics and components of various airflow sources  
*Performance Indicators:* 15.1.1 Describe the typical operating characteristics of a commercial airside system  
*Performance Indicators:* 15.1.2 Describe the purpose and function of ventilation and exhaust systems  
*Performance Indicators:* 15.1.3 Explain how to size a thermal expansion valve

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- Performance Standard 15.2: Describe the various approaches used in commercial air distribution
- Performance Indicators:* 15.2.1 Describe single-zone constant volume system operation
- Performance Indicators:* 15.2.2 Describe multi-zone constant volume system operation
- Performance Indicators:* 15.2.3 Describe variable volume, variable temperature (VVT) system operation
- Performance Indicators:* 15.2.4 Describe variable air volume (VAV) system operation
- Performance Standard 15.3: Describe common air terminal operation and related air delivery devices
- Performance Indicators:* 15.3.1 Explain the basic operation of VVT and single-duct VAV terminal devices
- Performance Indicators:* 15.3.2 Explain the basic operation of fan powered VAV terminals
- Performance Indicators:* 15.3.3 Identify various styles of commercial grilles and registers
- Performance Standard 15.4: Identify the characteristics and components of various airflow sources
- Performance Indicators:* 15.4.1 Describe the various forms and components of packaged systems
- Performance Indicators:* 15.4.2 Describe the various forms and components of air handling units
- Performance Indicators:* 15.4.3 Describe the purpose and function of economizers
- Performance Indicators:* 15.4.4 Describe common accessories used with commercial airside systems
- CONTENT STANDARD 16.0: INDOOR AIR QUALITY**
- Performance Standard 16.1: Explain the importance of indoor air quality and the factors to be controlled
- Performance Indicators:* 16.1.1 Identify the factors related to the quality of indoor air
- Performance Indicators:* 16.1.2 Describe the elements of human comfort and their relationship to air properties
- Performance Standard 16.2: Describe the processes and equipment used to control humidity levels
- Performance Indicators:* 16.2.1 Explain the relationship between air and moisture content
- Performance Indicators:* 16.2.2 Describe the processes and equipment used to humidify and dehumidify air
- Performance Standard 16.3: Describe the equipment and devices used to control air cleanliness
- Performance Indicators:* 16.3.1 Identify the various types of media-based air filters
- Performance Indicators:* 16.3.2 Describe the operation of non-media-based air filtration and purification equipment
- Performance Standard 16.4: Identify the equipment used to provide and control the introduction of fresh air into buildings
- Performance Indicators:* 16.4.1 Explain how dampers and economizers are used to control the introduction of fresh air
- Performance Indicators:* 16.4.2 Describe the function and operation of energy and heat recovery ventilation systems
- CONTENT STANDARD 17.0: HYDRONIC SYSTEMS**
- Performance Standard 17.1: Describe hydronic systems and the principles of closed-system water flow
- Performance Indicators:* 17.1.1 Describe the basic properties of water and the significance of its contents
- Performance Indicators:* 17.1.2 Describe the relationship between water flow and system pressures

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- Performance Standard 17.2: Describe the primary types of hot-water heating systems and their components
- Performance Indicators:* 17.2.1 Identify gravity and forced hydronic systems
  - Performance Indicators:* 17.2.2 Describe the different types of boilers used
  - Performance Indicators:* 17.2.3 Identify primary boiler components
  - Performance Indicators:* 17.2.4 Identify common components related to air and water control
- Performance Standard 17.3: Identify various hot-water heating piping systems and the terminal devices used
- Performance Indicators:* 17.3.1 Describe the characteristics of one- and two-pipe systems
  - Performance Indicators:* 17.3.2 Describe the function of hot-water zoning systems
  - Performance Indicators:* 17.3.3 Identify various hot-water heating system terminal devices
- Performance Standard 17.4: Describe the methods and devices used to select pumps and balance water flow in hydronic systems
- Performance Indicators:* 17.4.1 Identify the devices used to measure and control water flow in hydronic systems
  - Performance Indicators:* 17.4.2 Describe how circulating pumps are selected based on required flow rates
  - Performance Indicators:* 17.4.3 Explain how to measure pump pressures and system flow rates in an operating system

**COMPLEMENTARY COURSE(S):****RECOMMENDED STUDENT PERFORMANCE STANDARDS**

Programs that utilize the complementary courses can include the following courses. The Advanced Studies course allows for additional study through investigation and in-depth research.

**COURSE INFORMATION:**

**COURSE TITLE: Heating, Ventilation, Air Conditioning, and Refrigeration  
Advanced Studies**

**ABBR. NAME: HVACR AS**

**CREDITS: 1**

**LEVEL: AS**

**CIP CODE: 47.0201**

**SCED CODE: 17055**

**PREREQUISITE: Heating, Ventilation, Air Conditioning and Refrigeration II**

**CTSO: SkillsUSA**

**COURSE DESCRIPTION:**

This course is offered to students who have achieved all content standards in a program and desire to pursue advanced study through investigation and in-depth research. Students are expected to work independently or in a team and consult with their supervising teacher for guidance. The supervising teacher will give directions, monitor, and evaluate the students' topic of study. Coursework may include various work-based learning experiences such as internships and job shadowing, involvement in a school-based enterprise, completion of a capstone project, and/or portfolio development. This course may be repeated for additional instruction and credit.

**TECHNICAL STANDARDS:**

Students have achieved all program content standards and will pursue advanced study through investigation and in-depth research.

**EMPLOYABILITY SKILLS FOR CAREER READINESS STANDARDS:**

Students have achieved all program content standards and will pursue advanced study through investigation and in-depth research.

**SAMPLE TOPICS:**

- Demonstrate a positive work ethic.
- Demonstrate effective speaking and listening skills by communicating effectively with customers and employees and following directions.
- Demonstrate job acquisition and advancement skills by preparing to apply for a job and seeking promotion.
- Demonstrate time, task, and resource management skills by organizing and implementing a productive plan of work.

**COMPLEMENTARY COURSE(S):****RECOMMENDED STUDENT PERFORMANCE STANDARDS**

Programs that utilize the complementary courses can include the following courses. The lab courses allow additional time to be utilized in developing the processes, concepts, and principles as described in the classroom instruction. The standards and performance indicators for each lab course are shown in the corresponding course listed in the previous section.

**COURSE INFORMATION:**

**COURSE TITLE:** Heating, Ventilation, Air Conditioning, and Refrigeration II LAB  
**ABBR. NAME:** HVACR II L  
**CREDITS:** 1  
**LEVEL:** L2L  
**CIP CODE:** 47.0201  
**SCED CODE:** 17055  
**PREREQUISITE:** Concurrent enrollment in Heating, Ventilation, Air Conditioning and Refrigeration II  
**CTSO:** SkillsUSA

**COURSE DESCRIPTION:**

This course is designed to expand the students' opportunities for applied learning. This course provides an in-depth lab experience that applies the processes, concepts, and principles as described in the classroom instruction. The coursework will encourage students to explore and develop advanced skills in their program area. The appropriate use of technology and industry-standard equipment is an integral part of this course.

**COURSE INFORMATION:**

**COURSE TITLE:** Heating, Ventilation, Air Conditioning, and Refrigeration III LAB  
**ABBR. NAME:** HVACR III L  
**CREDITS:** 1  
**LEVEL:** L3L  
**CIP CODE:** 47.0201  
**SCED CODE:** 17055  
**PREREQUISITE:** Concurrent enrollment in Heating, Ventilation, Air Conditioning and Refrigeration III  
**CTSO:** SkillsUSA

**COURSE DESCRIPTION:**

This course is designed to expand the students' opportunities for applied learning. This course provides an in-depth lab experience that applies the processes, concepts, and principles as described in the classroom instruction. The coursework will encourage students to explore and develop advanced skills in their program area. The appropriate use of technology and industry-standard equipment is an integral part of this course.

**COURSE INFORMATION:****COURSE TITLE: CTE Work Experience – Architecture and Construction****ABBR. NAME: WORK EXPER CONST****CREDITS: 1****LEVEL: WK****CIP CODE: 99.0002****SCED CODE: 17998****PREREQUISITE: Level 1 course and concurrently enrolled in the Level 2 or higher course****CTSO: SkillsUSA****COURSE DESCRIPTION:**

This course is designed to expand the students' opportunities for applied learning. This course provides an in-depth CTE work experience that applies the processes, concepts, and principles as described in the classroom instruction. This course will encourage students to explore and develop advanced skills through work-based learning directly related to the program of study. The course must follow NAC 389.562, 389.564, 389.566 regulations.