

Heating, ventilation, air conditioning, refrigeration

**HEATING, VENTILATION, AIR  
CONDITIONING, REFRIGERATION -  
HVACR**

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**Possible career opportunities**

Upon successful completion of the Heating Ventilation Air Conditioning and Refrigeration (HVACR) program, students will have the necessary knowledge and skills for a career in residential, commercial, or industrial HVACR, including careers as Heating and Air Conditioning Mechanics and Installers and as Refrigeration Mechanics and Installers. Program content includes an introduction to the electrical and mechanical principles used in air conditioning and refrigeration, including meters, circuits, contactors, relays, thermostats, pressure switches, motors, overloads, controls, and boilers. Reading and drawing of schematic diagrams, troubleshooting, and safe electrical practices are also covered.

**Associate in science degree  
Heating, ventilation, air conditioning, and  
refrigeration (HVACR)**

Students completing the program will be able to...

- A. analyze the electrical parts of the refrigeration system.
- B. differentiate between many types of motor.
- C. distinguish between mechanical and electrical controls.
- D. demonstrate basic control design that have applications to the HVACR industry.
- E. identify the different types of controllers for the HVACR industry.
- F. use oral and written communication skills in the HVACR industry.

In collaboration with Plumbers-Steamfitters-Refrigeration Union Local 342 [www.ua342.org](http://www.ua342.org), DVC currently offers three five-year apprenticeship programs: steamfitting, plumbing, and HVACR. Apprenticeship is training that is designed to prepare an individual for a career in the skilled crafts and trades. Apprentices develop technical skills, experience the sharing of assignments and see how technical tasks relate specifically with theoretical knowledge and interpretation. Apprentices earn a wage while learning. Enrollment in this program is restricted. You must be registered as an apprentice with the State of California to participate in the program and accepted into the apprenticeship program by our union partners.

While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn an associate in science degree with a major in HVACR, students must complete 20 out of 31 core courses to meet their individual educational and career goals. In addition they must complete 18 general education units. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the major.

major requirements: units

complete at least 30 units from:

HVACR-110	Electrical Theory I .....	1.5
HVACR-111	Mechanical Refrigeration Theory.....	1.5
HVACR-112	Electrical Theory II.....	1.5
HVACR-113	The Refrigeration Cycle .....	1.5
HVACR-114	Intermediate Electrical I .....	1.5
HVACR-115	Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116	Intermediate Electrical II .....	1.5
HVACR-117	Intermediate Mechanical Refrigeration II.....	1.5
HVACR-118	Electrical Troubleshooting I .....	1.5
HVACR-119	Electrical Troubleshooting II.....	1.5
HVACR-120	Introduction to Direct Digital Controls.....	1.5
HVACR-121	Introduction to Variable Frequency Drives .....	1.5
HVACR-122	Introduction to Market Refrigeration Systems ..	1.5
HVACR-123	Introduction to Pneumatic Controls.....	1.5
HVACR-124	Introduction to Boilers.....	1.5
HVACR-125	Advanced Compressor and Motor Theory .....	1.5
HVACR-126	Start Test Balance: Water Side I.....	1.5
HVACR-127	Start Test Balance: Air Side I.....	1.5
HVACR-128	Start Test Balance: Water Side II.....	1.5
HVACR-129	Start Test Balance: Air Side II .....	1.5

**total units for the major 30**

**Certificate of achievement  
Heating ventilation air conditioning and  
refrigeration (HVACR)**

Students completing the program will be able to...

- A. compare a number of basic principles and laws of electricity as they relate to in AC refrigeration.
- B. analyze the electrical parts of the refrigeration system.
- C. differentiate between many types of motor.
- D. distinguish between mechanical and electrical controls.
- E. demonstrate basic control design that have applications to the HVACR industry.
- F. identify the different types of controllers for the HVACR industry

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While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn a certificate of achievement, students must complete 14 out of 18 core courses. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the certificate. The courses required for the certificate of achievement also meet some of the requirements of the major for the associate in science degree.

<i>required courses:</i>	<i>units</i>
<i>complete at least 21 units from:</i>	
HVACR-112 Electrical Theory II.....	1.5
HVACR-113 The Refrigeration Cycle .....	1.5
HVACR-114 Intermediate Electrical I .....	1.5
HVACR-115 Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116 Intermediate Electrical II .....	1.5
HVACR-117 Intermediate Mechanical Refrigeration II.....	1.5
HVACR-118 Electrical Troubleshooting I .....	1.5
HVACR-119 Electrical Troubleshooting II.....	1.5
HVACR-120 Introduction to Direct Digital Controls.....	1.5
HVACR-121 Introduction to Variable Frequency Drives .....	1.5
HVACR-122 Introduction to Market Refrigeration Systems.....	1.5
HVACR-123 Introduction to Pneumatic Controls.....	1.5
HVACR-124 Introduction to Boilers.....	1.5
HVACR-125 Advanced Compressor and Motor Theory.....	1.5
HVACR-126 Start Test Balance: Water Side I.....	1.5
HVACR-127 Start Test Balance: Air Side I.....	1.5
HVACR-128 Start Test Balance: Water Side II.....	1.5
HVACR-129 Start Test Balance: Air Side II .....	1.5
<b>total minimum required units</b>	<b>21</b>

**Certificate of accomplishment  
Heating ventilation air conditioning and  
refrigeration (HVACR)**

Students completing the program will be able to...

- A. identify tools and equipment, used in the industry.
- B. demonstrate general safety practices.
- C. compare a number of basic principles and laws of electricity as they relate to AC refrigeration.
- D. analyze the electrical parts of the refrigeration system.
- E. differentiate between many types of motor.
- F. distinguish between mechanical and electrical controls.

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While completing their HVACR apprenticeship, DVC students can earn awards at three levels of completion: a certificate of accomplishment, a certificate of achievement, and an associate in science degree. To earn a certificate of accomplishment, students must complete five out of seven core courses. Students must complete each course used to meet a major requirement with a "C" grade or higher and maintain an overall GPA of 2.5 or higher in the coursework required for the certificate. The courses required for the certificate of accomplishment also meet some of the requirements of the certificate of achievement and major for the associate in science degree.

<i>required courses:</i>	<i>units</i>
<i>complete at least 7.5 units from:</i>	
HVACR-110 Electrical Theory I.....	1.5
HVACR-111 Mechanical Refrigeration Theory.....	1.5
HVACR-112 Electrical Theory II .....	1.5
HVACR-113 The Refrigeration Cycle.....	1.5
HVACR-114 Intermediate Electrical I.....	1.5
HVACR-115 Intermediate Mechanical Refrigeration I.....	1.5
HVACR-116 Intermediate Electrical II.....	1.5
<b>total minimum required units</b>	<b>7.5</b>

**HVACR-110 Electrical Theory I**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by The United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course introduces concepts of electrical principles used in air conditioning and refrigeration. Topics include meters, circuits, contactors, relays, thermostats, pressure switches, motors, overloads, circuitry and troubleshooting. Kirchhoffs Law, and Ohms Law. Safety topics for the Heating Ventilation Air Conditioning and Refrigeration (HVACR) industry will also be covered.

## Heating, ventilation, air conditioning, refrigeration

### HVACR-111 Mechanical Refrigeration Theory

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents the study of the design, assembly, and operation of compression systems. Topics include basic liquid and vapor control and metering devices as well as the design and construction of system piping including techniques of leak detection, dehydration of systems, charging methods, recovery and troubleshooting. In addition, safety, torch techniques, cutting, fitting, and brazing of various copper projects will be explored. Further, the techniques for isometric drawing and pipe symbols for soldering and brazing will be practiced.

### HVACR-112 Electrical Theory II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents advanced concepts of electrical principles used in air conditioning and refrigeration. Topics include installation of heating, cooling, and refrigeration systems; basic electric motors and their components; contactors, relays, and overloads; thermostats, pressure switches, common electrical components used on a schematic, and other electric control devices; heating control devices; and troubleshooting.

### HVACR-113 The Refrigeration Cycle

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers the design, assembly and operation of refrigeration compression systems. Topics include charging, recovery, recycling, and reclamation; installation of heat pumps, safety procedures, leak testing and troubleshooting.

### HVACR-114 Intermediate Electrical I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the United Association of Union Plumbers, Fitters, Welders, and Service Technicians and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course introduces basic series and parallel circuits related to air conditioning (AC) and refrigeration. Motors, relays, contactors, thermostats, pressure switches and overloads will be examined and wired. Emphasis will be placed on electrical circuit troubleshooting.

### HVACR-115 Intermediate Mechanical Refrigeration I

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers components and applications of refrigeration systems; electric, gas, oil, and alternative (stoves, fireplace inserts, and solar) heating; indoor air quality, comfort and psychometrics; and refrigeration applied to air conditioning.

### HVACR-116 Intermediate Electrical II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents continued study of series and parallel circuits related to complex air conditioning (AC) and refrigeration systems. Advanced applications for motors, relays, contactors, thermostats, magnetic starters, pressure switches and overloads are examined and wired. Emphasis will be placed on electrical circuit troubleshooting.

### HVACR-117 Intermediate Mechanical Refrigeration II

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents the practical and theoretical aspects of heating, air conditioning, and refrigeration (HVACR). Topics include gas controls, gas ignition systems, gas furnace troubleshooting and safety.

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**HVACR-118 Electrical Troubleshooting I**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course will cover advanced electrical controls with special emphasis on troubleshooting and repair. Topics include proportional controls, economizers and variable air volume (VAV) controls and motors. Safety procedures will be stressed.

**HVACR-119 Electrical Troubleshooting II**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents additional topics in advanced electrical controls with emphasis on troubleshooting and repair. Topics include proportional, open/closed transition, pump, fans, economizers, and variable air volume (VAV) controls, as well as motor starting techniques including variable frequency drives (VFD). Safety procedures are also emphasized.

**HVACR-120 Introduction to Direct Digital Controls**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course will cover direct digital controls (DDC) as they apply to the heating, air conditioning and refrigeration industry. Techniques to troubleshoot and diagnose hardware and software problems with DDC systems will be presented. The course includes hands-on wiring, testing, and programming of typical components found in the industry. Basic programming languages and pneumatic actuators to better understand the internal operation of the system will also be introduced.

**HVACR-121 Introduction to Variable Frequency Drives**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

this course provides an introduction to variable frequency drives (VFD's), applications of use, and limited troubleshooting. Parameterization for start up, open loop, closed loop, floating point, and preset speed profiles will be covered.

**HVACR-122 Introduction to Market Refrigeration Systems**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers refrigeration equipment, cases, defrost methods, timers, control devices, oil float systems, and heat reclaim controls. Topics will include print reading, wiring and piping diagrams, and refrigeration schedule in a typical market setting. Operation and location of compressors, evaporators, condensers, refrigerated cases, walk-ins, heat reclaim, and connecting paraphernalia will also be presented.

**HVACR-123 Introduction to Pneumatic Controls**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course presents the operation of direct and reverse acting controls, air compressors, sizing of valves and dampers, thermostats, auxiliary devices, transmitters, pneumatic and receiver controllers.

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**HVACR-124 Introduction to Boilers**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course covers the components and operation of boiler systems used in hotels, apartment buildings, schools, and other large institutions. A comprehensive overview of the safe and efficient operation of high pressure boilers and related equipment is provided, including the latest combustion control technology, and Environmental Protection Agency (EPA) regulations and their implications. This course is designed to prepare students for licensing examinations.

**HVACR-125 Advanced Compressor and Motor Theory**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

The course presents reciprocating compressor disassembly and assembly. Topics include compressor function, safety, troubleshooting, alignment, and performance. Unloaders, oils, electrical, refrigerant gas, starters, and start-up procedures will also be explored.

**HVACR-126 Start Test Balance: Water Side I**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course introduces the basic principles of air and water flow. The Mollier Diagram will be used to apply these principles to air conditioning and refrigeration.

**HVACR-127 Start Test Balance: Air Side I**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course provides an overview of commercial air conditioning systems operations. Topics include direct expansion (DX) and chiller systems, fan types, pumps, boiler controls, related systems, and service methods. The use and application of heat load equations, charts, and procedures is introduced.

**HVACR-128 Start Test Balance: Water Side II**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course describes proper procedures for start, test, and balance of air conditioning systems utilizing principles of air and water flow. Topics include sizing of refrigerant piping for liquid, the benefits of psychrometrics on human comfort, fan laws, air movement, pumps, piping, evaporative cooling, and air and water measurement.

**HVACR-129 Start Test Balance: Air Side II**

1.5 units LR

- 18 hours lecture/36 hours laboratory per term
- Note: This program is sponsored by the International Brotherhood of Steamfitters and Plumbers and is for apprenticeship only. Course enrollment is limited to those who have been accepted by the union local responsible for the section.

This course provides an overview of commercial air conditioning systems emphasizing air distribution, heat flow, and service methods. Students will also investigate air measurement and the impact of duct design on air distribution.