BETHLEHEM AREA VOCATIONAL-TECHNICAL SCHOOL
3300 CHESTER AVENUE BETHLEHEM PA 18020

HVAC
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47.0201 HEATING, AIR CONDITIONING, VENTILATION AND REFRIGERATION MAINTENANCE TECHNOLOGY

Course Description

Heating, Ventilation, and Air Conditioning (HVAC) personnel install, maintain, service and sell environmental equipment for homes and businesses. These products and services not only include Heating and Air Conditioning but also Indoor Air Quality (IAQ), Refrigeration and Energy Management Systems.

After successfully completing this course students will be able to demonstrate a competency in core skills including use of tools, blueprint reading, piping and tubing applications, sheet metal and electrical systems. A theoretical background in thermodynamics will allow the student to advance into the installation and service fields. If the student chooses to pursue continuing education it will permit them to advance into the design and application aspects of the Heating, Ventilation, Air Conditioning/Refrigeration industry.

At the end of the program, a student's job readiness and mastery of occupational skills will be measured based on testing and standards of the National Testing Institute.

Skills and Competencies Required for This Industry

An HVAC technician works not only with their hands but also with their mind to solve problems. A good candidate for this career would be someone who enjoys science, has good math skills, and is mechanically inclined. As the industry is constantly changing and updating, those who enter the industry must be willing to continue to learn and keep pace with today's technical advancements.

Good interpersonal skills will be required to satisfy customer needs. The job environment includes travel, working indoors and outdoors and being exposed to varying weather conditions.

Career Opportunities

Cooperative Education: *Students who have attended six quarters in their career and technical program are eligible to participate in a paid working experience during the PM session of BAVTS. Positions must be available and the students must be recommended by the CTE teacher to be eligible.*

Advanced Degree: *Associates in Applied Sciences*

Post-Secondary Institutions Offering HVAC Education

- *Pennsylvania College of Technology*
- *Montgomery County Community College*
- *Thaddeus Stevens State College of Technology*
- *Associated Builders & Contractors (ABC) Apprentice Program*

HVAC Industry Careers

- **Semi-Skilled:** *Helper, Apprentice, Retail Sales, Laborer*
- **Skilled:** *Installer, Service Mechanic, Boiler Operator, Estimator, Contractor*
- **Technician:** *CEM (Cert. Energy Mgr.), Energy Consultant, Manufacturer Representative*
- **Professional:** *Mechanical Engineer, Stationary Engineer, Professional Engineer, Instructor*

HVAC Mechanics and Installers Salary and Job Outlook

Salary Range (Percentile)

	25th	Average	75th
Annual Salary	$37,034	$46,671	$53,177
Monthly Salary	$3,086	$3,889	$4,431
Weekly Salary	$712	$898	$1,023
Hourly Salary	$18	$22	$26

Reference Material

Textbooks:

- *NCCER Fourth Edition, Level 1 & 2*
- *Practical Problems in Mathematics for Heating and Cooling Technicians Fourth Edition, Dr. Russell B. DeVore*
- *Refrigeration and Air Conditioning Technology 8th edition Cengage*

Classroom Tools:

- *Basic Hand Tools Associated with the HVAC Trade*
- *Rigid Pipe Threading Equipment*
- *Reciprocating Saw*
- *Screw Gun/Hammer Drill*
- *Circular Saw*
- *Manifold Gauge Set*
- *Evacuation Tools*
- *Pressurized cylinders (nitrogen, refrigerant, acetylene, oxygen)*
- *Pittsburgh Machine*
- *Digital Multi Meters*
- *Refrigerant Leak Testers*
- *Foot Shear*
- *Refrigerant Recovery Devices*

Classroom Equipment:

- *Condensers and Air Handlers*
- *Gas and Oil-Fired Boilers*
- *Electric and Gas Water Heaters*
- *Gas Fired Warm Air Furnaces*
- *Oil Burners*
- *Replicated working environment as it pertains to the trade for students to learn and master required skills.*

Level 1 – Marking Period 1- First Semester (Rotation)

Rotation- ***A 10 to 15-day introductory course for students to explore and participate in an HVAC environment to develop an understanding of the industry.***

Duties and Tasks Covered

100 Introduction to HVAC:

101 *Identify HVAC systems*

102 *Demonstrate awareness of the occupational requirements*

200 ***Basic Safety***

203 *Identify and demonstrate the use of personal protection equipment*

300 ***Tools for HVAC/R***

301 *Use and maintain basic hand tools in the trade*

302 *Use and maintain basic power tools in the trade*

500 Piping Practices

501 *Identify piping material*

502 *Select, measure, cut and ream piping and tubing*

503 *Cut, ream, thread and assemble steel piping projects and pressure test*

505 *Assemble copper tubing projects and pressure test according to industry standards*

506 *Solder copper tubing*

507 *Braze ACR tubing*

Perform basic duct fabrication functions

1500 Computer Fundamentals

1502 *Utilize the internet for research*

Projects: *Various copper piping projects comprised of measuring, cutting, soldering, brazing, bending, swaging and flaring copper tubing. Emphasis will be placed on safety while brazing and soldering. In addition, various sheetmetal projects consisting of cutting metal with right and left angle aviation snips and shears and bending metal in order to fabricate a miniature duct.*

Assessment: *HVAC Career Exploration (source to be determined)*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 1 Marking Period 2- First Semester:

Duties and Tasks Covered

100 Introduction to HVAC

- ***101*** *Identify HVAC Systems*
- ***102*** *Describe career opportunities in the HVAC profession*
- ***103*** *Demonstrate awareness of the occupational requirements*
- ***105*** *Use soft skills when interacting with customers*

200 Basic Safety

- ***203*** *Identify and demonstrate the use of personal protection equipment.*
- ***204*** *Apply OSHA regulations to identify hazards and measures to prevent job site accidents from occurring.*
- ***205*** *Set up and use stepladders, extension ladders and scaffold.*

300 Tools for HVAC/R

- ***301*** *Identify and safely use basic hand tools used in the trade*
- ***302*** *Identify and safely use basic power tools used in the trade*

500 Piping Practices:

- ***501*** *Identify piping material*
- ***502*** *Select, measure, cut and ream piping and tubing*
- ***503*** *Assemble piping projects and pressure test according to trade standards*
- ***504*** *Identify and assemble PVC pipe and fittings*
- ***505*** *Assemble copper tubing projects and pressure test according to trade standards*
- ***506*** *Solder copper tubing*
- ***507*** *Braze/silver solder ACR tubing*
- ***508*** *Identify and demonstrate proper use of fittings and tools for steel (black) pipe*

1500 Computer Fundamentals

- ***1502*** *Utilize the internet for research*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

HVAC Career Exploration (source to be determined)

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 1 Marking Period 3 – Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

101 *Identify HVAC Equipment*

103 *Demonstrate awareness of the occupational requirements*

300 Tools for HVAC/ R

301 *Use and maintain basic hand tools in the trade*

302 *Use and maintain basic power tools in the trade*

500 Piping Practices

Identify and describe basic black pipe, copper and refrigeration fittings required in the trade

505 *Assemble tubing projects and pressure test according to industry standards*

600 Basic Electricity

603 *Explain how magnetism is used in different HVAC components*

604 *Implement safe electrical Practices*

606 *Apply proper wiring techniques*

900 Air Distribution Systems

902 *Identify and describe the different types of duct system components*

906 *Compare, identify and fabricate using various duct material*

1500 Computer Fundamentals

1502 *Utilize the internet for research*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

Level 1 Marking Period 4 - Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

- ***101*** *Identify HVAC Equipment*
- ***103*** *Demonstrate awareness of the occupational requirements*

300 Tools for HVAC/ R

- ***301*** *Use and maintain basic hand tools in the trade*
- ***302*** *Use and maintain basic power tools in the trade*

500 Piping Practices

- *Identify and describe basic black pipe, copper and refrigeration fittings required in the trade*
- ***505*** *Assemble tubing projects and pressure test according to industry standards*

600 Basic Electricity

- **601** *Compare and analyze methods for producing electricity*
- ***603*** *Explain how magnetism is used in different HVAC components*
- ***604*** *Implement safe electrical Practices*
- ***606*** *Apply proper wiring techniques*
- ***608*** *Wire series circuit, wire parallel circuit, wire series / parallel circuit*

900 Air Distribution Systems

- ***902*** *Identify and describe the different types of duct system components*
- ***906*** *Compare, identify and fabricate using various duct material*
- ***907*** *Perform basic installation practices*

1500 Computer Fundamentals

- ***1502*** *Utilize the internet for research*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 2

Level 2: Marking Period 1- First Semester

Duties and Tasks Covered

100 Introduction to HVAC

- ***103*** *Demonstrate awareness of occupational requirements*
- ***105*** *Use soft skills when interacting with customers*

300 Tools for HVAC

- ***302*** *Use and maintain basic hand tools*
- ***303*** *Use and maintain basic power tools*

400 Blueprint Reading

- ***401*** *Compare types of blueprint plans*
- ***402*** *Read and interpret blueprint plans*

500 Piping Practices

700 Introduction to Cooling

- ***701*** *Measure temperature and pressure of a cooling system*
- ***702*** *Calculate super heat and sub cooling*
- ***703*** *Locate and describe basic components of the basic refrigeration cycle*
- ***710*** *Evaluate the effects of air flow on cooling system performance*

900 Air Distribution Systems

- ***901*** *Identify and design different types of duct systems*
- ***902*** *Identify and describe the different duct system components*

1100 Leak Detection, recovery, evacuation and charging

- ***1102*** *Perform refrigerant recovery*
- ***1103*** *Perform system evacuation and dehydration*
- ***1109*** *Identify pump down applications and perform system pump down operation*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets. HVAC Career Exploration (source to be determined)*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 2: Marking Period 2 First Semester

Duties and Tasks Covered

100 Introduction to HVAC

103 *Demonstrate awareness of occupational requirements*

105 *Use soft skills when interacting with customers*

300 Tools for HVAC

302 *Use and maintain basic hand tools*

303 *Use and maintain basic power tools*

500 Piping Practices

600 Basic Electricity

601 *Compare and analyze methods of producing electricity and appropriate terms*

602 *Calculate basic electrical quantities using Ohms law*

604 *Implement safe electrical practices*

605 *Interpret and draw various types of electrical schematics and symbols*

609 *Install and size electrical disconnects, circuit breakers and fuses*

611 *Identify electric motors and their applications*

613 *Apply electrical codes*

614 *Determine transformers and their applications*

615 *Size, apply and ground electrical circuits and raceways*

1000 Introduction to Hydronic Systems

1001 *Identify and compare various hot water heating system components, piping schematics and their applications*

1002 *Service and maintain hydronic systems*

1500 Computer Fundamentals

1503 *Use computer software*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets. HVAC Career Exploration (source to be determined)*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 2: Marking Period 3- Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

103 *Demonstrate awareness of occupational requirements*

105 *Use soft skills when interacting with customers*

300 Tools for HVAC

302 *Use and maintain basic hand tools*

303 *Use and maintain basic power tools*

500 Piping Practices

600 Basic Electricity

602 *Calculate basic electrical quantities using Ohms law*

604 *Implement safe electrical practices*

605 *Interpret and draw various types of electrical schematics and symbols*

1000 Introduction to Hydronic Systems

1001 *Identify and compare various hot water heating system components, piping schematics and their applications*

1002 *Service and maintain hydronic systems*

1500 Computer Fundamentals

1503 Use computer software

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 2: Marking Period 4- Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

103 *Demonstrate awareness of occupational requirements*

105 *Use soft skills when interacting with customers*

300 Tools for HVAC

302 *Use and maintain basic hand tools*

303 *Use and maintain basic power tools*

500 Piping Practices

800 Introduction to Heating

811 *Install heating and air conditioning thermostats*

1000 Introduction to Hydronic Systems

1001 *Identify and compare various hot water heating system components, piping schematics and their applications*

1002 *Service and maintain hydronic systems*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 3: Marking Period 1 - First Semester

Duties and Tasks Covered

100 Introduction to HVAC

- ***103*** *Demonstrate awareness of occupational requirements*
- ***105*** *Use soft skills when interacting with customers*

200 Basic Safety

- ***203*** *Identify and demonstrate the use of personal protection equipment.*
- ***204*** *Apply OSHA regulations to identify hazards and measures to prevent job site accidents from occurring.*

300 Tools for HVAC

- ***302*** *Use and maintain basic hand tools*
- ***303*** *Use and maintain basic power tools*

700 Introduction to Cooling

- ***704*** *Evaluate refrigerants using temperature pressure charts for various refrigerants*

800 Introduction to Heating

- ***807*** *Install and adjust gas furnaces*
- ***811*** *Install Heating and cooling thermostats*
- ***813*** *Perform combustion analysis on gas fired equipment*
- ***814*** *Identify the sequence of operation of various warm air furnaces*

1300 Troubleshoot cooling

- ***1301*** *Identify control system components*
- ***1302*** *Install cooling equipment*

1500 Computer Fundamentals

- ***1502*** *Utilize internet for research*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets. HVAC Career Exploration (source to be determined)*

- Read and Summarize
- Measuring handouts and quizzes
- Periodic Chapter Test/s
- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 3: Marking Period 2 – First Semester

Duties and Tasks Covered

100 Introduction to HVAC

103 *Demonstrate awareness of occupational requirements*

105 *Use soft skills when interacting with customers*

200 Basic Safety

203 *Identify and demonstrate the use of personal protection equipment.*

204 *Apply OSHA regulations to identify hazards and measures to prevent job site accidents from occurring*

300 Tools for HVAC

302 *Use and maintain basic hand tools*

303 *Use and maintain basic power tools*

500 Piping Practices

800 Introduction to Heating

807 *Install and adjust gas furnaces*

813 *Perform combustion analysis on gas fired equipment*

814 *Identify the sequence of operation of various warm air furnaces*

900 Air Distribution Systems

908 *Identify and compare the application air distribution accessories to increase air quality and comfort*

1400 Heat Pumps

1401 *Describe heat pump modes of operation*

1402 *Identify and describe heat pump components*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets. HVAC Career Exploration (source to be determined)*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 3: Marking Period 3 - Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

- ***103*** *Demonstrate awareness of occupational requirements*
- ***105*** *Use soft skills when interacting with customers*

200 Basic Safety

- ***203*** *Identify and demonstrate the use of personal protection equipment.*
- ***204*** *Apply OSHA regulations to identify hazards and measures to prevent job site accidents from occurring*

300 Tools for HVAC

- ***302*** *Use and maintain basic hand tools*
- ***303*** *Use and maintain basic power tools*

500 Piping Practices

800 Introduction to Heating

- ***807*** *Install and adjust gas furnaces*
- ***813*** *Perform combustion analysis on gas fired equipment*
- ***814*** *Identify the sequence of operation of various warm air furnaces*

1100 Leak Detection, recovery, evacuation and charging

- ***1102*** *Perform refrigerant recovery*
- ***1103*** *Perform system evacuation and dehydration*
- ***1105*** *Weigh in correct system charge*
- ***1108*** *Apply knowledge of EPA 608*
- ***1109*** *Identify pump down applications and perform system pump down operation*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets. HVAC Career Exploration (source to be determined)*

- Read and Summarize
- Measuring handouts and quizzes
- Periodic Chapter Test/s
- Adding and subtracting fractions and mixed numbers handouts and quizzes

Level 3: Marking Period 4 – Second Semester

Duties and Tasks Covered

100 Introduction to HVAC

103 *Demonstrate awareness of occupational requirements*

105 *Use soft skills when interacting with customers*

200 Basic Safety

203 *Identify and demonstrate the use of personal protection equipment.*

204 *Apply OSHA regulations to identify hazards and measures to prevent job site accidents from occurring*

300 Tools for HVAC

302 *Use and maintain basic hand tools*

303 *Use and maintain basic power tools*

500 Piping Practices

800 Introduction to Heating

807 *Install and adjust gas furnaces*

813 *Perform combustion analysis on gas fired equipment*

814 *Identify the sequence of operation of various warm air furnaces*

1100 Leak Detection, Recovery, Evacuation and Charging

1102 *Perform refrigerant recovery*

1103 *Perform system evacuation and dehydration*

1105 *Weigh in correct system charge*

1108 *Apply knowledge of EPA 608*

1109 *Identify pump down applications and perform system pump down operation*

Assessment: *Students will demonstrate knowledge of competencies through hands on demonstration, written tests, quizzes and work sheets.*

- Read and Summarize

- Measuring handouts and quizzes

- Periodic Chapter Test/s

- Adding and subtracting fractions and mixed numbers handouts and quizzes

Supplemental Learning Activities

Students who participate in this program will also have opportunities to participate in the following program and school-sponsored activities:

SkillsUSA: Professional Development Conference, Local Competitions, State Competitions, National Competitions. Students will also be able to participate in annual events held at BAVTS: Chapter Meeting and fundraising.

NTHS: Level II and Level III students who have received an "A" in their career and technical program as well as a "B" average at their sending school are eligible to become a member of the BAVTS Chapter of the National Technical Honor Society.

Cooperative Education: Students who have attended six quarters in their career and technical program are eligible to participate in a paid working experience during the PM session of BAVTS. Positions must be available and the students must be recommended by the CTE teacher to be eligible.

Job Shadowing: Students are eligible to visit business and industry partners for one or more days to view the day-to-day operations of this career area.

Internships: Students who have completed six or more quarters of their CTE program are eligible to work for a business and industry partner with the recommendation of the instructor and the availability of assignment.

Field Trips: Students in this program will on occasion attend field trips that expose them to educational experiences within the career field.