
Appendix A

WORK PROCESS SCHEDULE

AND

RELATED INSTRUCTION OUTLINE



Appendix A

WORK PROCESS SCHEDULE

Heating and Air Conditioning Mechanic and Installer

O*NET-SOC CODE: 49-9021.01 RAPIDS CODE: 0637

This schedule is attached to and a part of these Standards for the above identified occupation.

1. APPRENTICESHIP APPROACH

Time-based Competency-based Hybrid

2. TERM OF APPRENTICESHIP

The term of the apprenticeship is 4 years with an OJL attainment of 8,000 hours, supplemented by the minimum required 1,050 hours of related instruction.

3. RATIO OF APPRENTICES TO JOURNEYWORKERS

The apprentice to journeyworker ratio is: 1 Apprentice(s) to 1 Journeyworker(s).

4. APPRENTICE WAGE SCHEDULE

Apprentices shall be paid a progressively increasing schedule of wages based on either a percentage or a dollar amount of the current hourly journeyworker wage rate, which is: \$24.00.

Starting wage: \$18 per hour

Completion of 35 credits earned: \$20 per hour

Completion of 70 credits earned: \$22 per hour

Completion of 6,000 OJT: \$23 per hour

5. PROBATIONARY PERIOD

Every applicant selected for apprenticeship will serve a probationary period of 12 weeks.



6. SELECTION PROCEDURES

The sponsor has adopted the following selection procedures, consistent with the requirements set forth in 29 CFR § 30.10(b):

Application Procedures:

- A. Employer posts available jobs on ApprenticeNH, New Hampshire Works Job Match System, other job postings in NH, and shares with Manchester Community College HVAC Department Chair.
- B. The Community College System of New Hampshire, under the Apprenticeship State Expansion grant, provides an information session(s) to discuss the registered apprenticeship program, the expectations, and the training provided for the selected occupation.
- C. Names of candidates who attend the information session are forwarded to Dowling Corporation and the attendees are all encouraged to apply by completing an application with Dowling Corporation.

Selection Procedures:

- D. Prior to the interview, each applicant will be given the opportunity to review the Apprenticeship Standards and will be provided information about the program. If the applicant has any additional questions on the qualifications or needs additional information, it will be provided by the sponsor.
- E. The Sponsor will schedule interviews based upon hiring needs. All applicants whose qualifications meet the minimum requirements will be invited to participate in an in-person interview with the service manager, field supervisor, operations manager, and president.
- F. Applications of candidates who do not meet the minimum requirements will be kept on file for one year.
- G. During the interview, the interview team will ask standardized questions to be answered by candidates.
- H. Candidate responses are kept by written record along with notes by each member of the interview team.
- I. Interview notes are kept on file along with the application for one year.
- J. After the interview is conducted, the interview team will meet to review applicant's answers, compare notes and determine who will be hired to participate in the apprenticeship program. All hiring decisions are based on an applicant's ability to meet the qualifications for the job.



- K. Candidates who meet these criteria will be notified of a formal job offer within 48 hours of interview and have up to three days after an offer is made to accept the position.
- L. Candidates who are not being hired for the apprenticeship will notified within two weeks from their last interview.
- M. Hired apprentices will be informed of hiring paperwork to be completed on first day of employment.



WORK PROCESS

Heating and Air Conditioning Mechanic and Installer O*NET/SOC CODE: 49-9021.01 RAPIDS CODE: 0637

Occupational Description: Install, service, or repair heating and air conditioning systems in residences or commercial establishments.

Work Process Schedule

Approximate Hours:

General trade orientation	200
<ol style="list-style-type: none">1. Use and care of tools2. Test and measurement devices3. Types and sizes of piping, tubing, and fittings4. Introduction to refrigeration system components5. Safety procedures and first aid6. Equipment records and reports7. Codes and licensing	
Fabrication of system components	400
<ol style="list-style-type: none">1. Cut, thread, flare, bend, and shape piping and tubing2. Install fittings3. Solder, braze, and tin fittings and components4. Care and use of oxy-acetylene and air-acetylene torches5. Silver and soft soldering	
System installation and connection	1500



<ol style="list-style-type: none">1. Electrical supply lines and cables2. Electrical connections3. Gas lines4. Air system duct layout and zoning5. Steam lines6. Suction and discharge lines7. Gauges8. Filter Dryers9. Filters10. Controls	
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Equipment Installation	1500
<ol style="list-style-type: none">1. Install condensers2. Prepare compressor and motor bases3. Install and align compressors and motors4. Install condensers, evaporators and other cooling.5. Install boilers; hydronic zoning, primary / secondary6. Refrigeration systems, walk in panels and doors7. Safe equipment moving - slings, lines, blocks and falls, chain hoists, rollers, dollies, and skids	
System maintenance	1500
<ol style="list-style-type: none">1. Troubleshoot field systems2. Test pressure, flow, etc.3. Super heat and sub cooling4. AMP draw and voltage5. Check liquid levels6. Check repair leaks (refrigerants, liquids)7. Purge, evacuate and charge systems8. Repair, align, and adjust fans and blower sections9. Align pulleys, bearing blocks, belt tension	
Equipment repair	2500
<ol style="list-style-type: none">1. Disassemble and clean, repair, perform shop tests and run-in compressors2. Repair, pressure test, dehydrate evaporators3. Repair, clean condensers4. Remove, replace, disassemble, test, clean, calibrate, and renew defective parts on controls of all types including: pneumatic, electrical, electro-pneumatic, thermostatic, humidity, pressure, vacuum	



Field tools	200
1. Use of grinders, drill presses, lathes	
2. Tool and drill sharpening	
3. Recovery machines	
4. Vacuum pumps	
5. Megameter	
6. Compressor analyzer	
7. Pressure tools	
8. Micron gauge	
9. Combustion analyzer	
Miscellaneous	200
1. Orientation	
2. Company policies and forms	
3. Housekeeping	
4. Safety	
5. Operation of company vehicle	
6. Activities not otherwise listed	
Total Hours	8,000



RELATED INSTRUCTION OUTLINE
Heating and Air Conditioning Mechanic and Installer
 O*NET/SOC CODE: 49-9021.01 RAPIDS CODE: 0637

Related Training Provider: Manchester Community College



Related Instruction Training Outline:

Approximate Hours:

Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
HVAC101M	Introduction to HVAC Systems	3	0	45
<p>This course introduces the fundamental concepts and principles that apply to the HVAC industry. Topics include a basic understanding of; thermodynamics, industry terminology and units of measurement, common HVAC systems and components, materials used in the installation of HVAC equipment and methods for joining materials. Industry standards and codes are explored. Techniques for proper use of hand and power tools are presented. Safely working on HVAC systems and components is emphasized.</p>				
HVAC109M	Related Electricity I Theory	3	0	45
<p>Theory work on the principles of DC and AC electricity that are fundamental to the HVAC area. These include: Ohm's law, series circuits, parallel circuits, meters, wire gauges, magnetism, AC generation, AC calculations, and basic electric motor principles.</p>				
HVAC110M	Related Electricity I Lab	0	3	15
<p>Lab work on the principles of DC and AC electricity that are fundamental to the HVAC area. These include: Ohm's law, series circuits, parallel circuits, meters, wire gauges, magnetism, AC generation, AC calculations, and basic electric motor principles</p>				
HVAC111M	Fundamentals of Refrigeration I Theory	3	0	45
<p>This course provides an introduction to the principles of heat and its transfer, with emphasis on the refrigeration compression cycle and its major components.</p>				
HVAC112M	Fundamentals of Refrigeration I Lab	0	3	15
<p>Upon successful completion of this course the student will be able to solder, silver braze, flare, swag and use specialized refrigeration tools. Students will receive hands-on experience with equipment using manifold gauges, reading pressure/temperature charts, and learning service procedures.</p>				



Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
HVAC114M	Fundamentals of Heating I Theory	3	0	45
A through study of the residential high pressure gun type oil burner. Topics covered include: basic combustion theory, how the components of high pressure gun type burners operate, choosing replacement parts, mechanical troubleshooting, oil tank installation, advanced combustion theory, and steady state efficiency testing				
HVAC115M	Fundamentals of Heating I Lab	0	3	15
An introduction to residential high pressure, gun-type burners which includes an in-depth, hands-on course covering the components, component testing, replacement, maintenance and burner troubleshooting, and steady-state efficiency testing.				
HVAC119M	Related Electricity II Theory	3	0	45
A theory-based continuation of HVAC109M covering electrical circuit controls commonly found in air conditioning and heating systems.				
HVAC120M	Related Electricity II Lab	0	3	15
A lab-based continuation of HVAC119M covering electrical circuit controls commonly found in air conditioning and heating systems.				
HVAC121M	Fundamentals of Refrigeration II Theory	3	0	45
A continuation of Fundamentals of Refrigeration I. This course covers: electrical circuits, controls and motors necessary for operation of various residential and small commercial units; components necessary for optimum operation and efficiency; basic mechanical and electrical troubleshooting.				
HVAC122M	Fundamentals of Refrigeration II Lab	0	3	15
A continuation of Fundamentals of Refrigeration I lab. This course covers electrical meter testing of controls; motors and circuits; reading wiring diagrams; troubleshooting and repair various system problems.				
HVAC134M	Fundamentals of Gas Heating and Piping Installation Theory	3	0	45



An in depth study of propane and natural gas piping from the point of delivery to the gas appliance or utilization equipment. Basic gas theory involving a thorough understanding of the physical properties and characteristics of propane and natural gas will be covered. Piping installations involving gas pipe sizing, material selection, proper installation, and pressure and leak testing of piping is also covered. National Fuel Gas Code as it relates to the above topics is also emphasized.

Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
HVAC135M	Fundamentals of Gas Heating and Piping Lab	0	3	15

An introduction to gas piping distribution systems which includes an in-depth hands-on course covering: the design, installation, component selection, methods of joining, pressure and leak testing, and the ability to safely work on gas distribution systems. The student designs and installs gas piping distribution systems following relevant codes. Troubleshooting, and steady-state efficiency testing of gas utilization equipment is also introduced.

HVAC211M	Commercial Refrigeration Theory	3	0	45
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This course covers: system design and layout; selection of proper components; pipe sizing and layout; wiring, controls and troubleshooting.

HVAC212M	Commercial Refrigeration Lab	0	6	30
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This lab covers the installation of complete refrigeration systems found in small stores, restaurants and supermarkets. Students develop a stock list of required electrical and mechanical components, calculate pipe and component sizes and learn charging procedures.

HVAC223M	Warm Air and Steam Systems Theory	3	0	45
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Introduces residential steam and warm air system components, along with methods of piping and duct layout. Maintenance, troubleshooting, replacement, alteration and total system designs are emphasized to help the student learn the various concepts involved.

HVAC224M	Warm Air and Steam Systems Lab	0	6	30
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This lab is a continuation of HVAC214M that covers installation of steam and warm air systems, layout and make up of ductwork, multi-fuel units and gas heating.

HVAC221M	Residential and Commercial Air Conditioning and Heat Pumps Theory	3	0	45
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Topics include procedures for proper installation and start-up of central air conditioning systems; troubleshooting of the electrical and mechanical aspects of systems; the proper use and understanding of the psychometric chart; heat gain calculations for residential and small commercial buildings; and special requirements and components of heat pumps.



Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
HVAC222M	Residential and Commercial Air Conditioning and Heat Pumps Lab	0	6	30
This lab covers: the installation and start-up of central air conditioning systems and heat pumps; troubleshooting and mechanical/electrical repair of various makes and models; and pricing components and billing procedures.				
HVAC213M	Hydronic Systems Theory	3	0	45
Topics include: heat loss calculation; forced hot water system and steam system components; piping layout; selection of system components; and problem solving, which involves troubleshooting and replacement, as well as various methods of heating domestic hot water.				
HVAC 214M	Hydronic Systems Lab	0	6	30
This lab includes an in-depth study of residential forced hot water and steam heating systems. The student designs and installs a complete hot water system including the piping arrangement, control system and method of heating domestic hot water. Forced hot water service skills are emphasized. The student also begins a steam system installation.				
FYE100M	MCC Essentials	1	0	15
Required for new students and grounded in best practices for student retention, this course is designed to increase student success through 1) focus on major / career exploration and academic planning for timely degree completion; 2) introduction to MCC policies and procedures, resources, and opportunities; 3) development and practice of skills critical for academic and career success, including but not limited to goal setting, effective reading and study skills, time management, and communication skills. Proactive engagement with faculty and academic advisors is a key component of the course.				
ENGL110M	College Composition I	4	0	60
As the cornerstone of College Composition I, students will conduct intensive semester-long research on a topic culminating in an appropriately formatted and documented 10-12 page persuasive research paper. The course emphasizes writing as a process that undergoes various stages toward completion and engages a variety of rhetorical approaches. This process-writing method gives students the tools that underlie effective academic writing and ensures adherence to the conventions of standard written English. College Composition I				
English Elective	Any course with the academic subject code of ENGL and a course number of at least 100	3	0	45



Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
MATH135M	Numerical Algebra and Trigonometry	3	0	45
<p>Students are required to take <i>either MATH135M or MATH155M</i> to meet requirements.</p> <p>Provides students with the basic algebra and trigonometry manipulatives to compute solutions in their curricula. Algebra topics offered are signed numbers, polynomial operations, solutions of linear equations involving numerical and literal terms, word problems and formula manipulation. Trigonometric topics are trigonometric ratios as applied to right triangles and computation of measures in oblique triangles, using the Law of Sines and the Law of Cosines.</p>				
MATH155M	College Algebra with Trigonometry	4	0	60
<p>Students are required to take <i>either MATH135M or MATH155M</i> to meet requirements.</p> <p>This course covers the essentials of numerical algebra, geometry, and trigonometry and is designed for science, engineering, technology, computer science, and mathematics students. It provides a solid preparation for student toward Precalculus and Calculus track. A short review of elementary algebra is followed by an introduction to geometric and trigonometric functions. Applied problems are solved by integrating the above mathematical strategies. The trigonometric functions include ratios in solving right triangles and vector applications, and Law of Sines and Cosines in solving oblique triangles.</p>				
Math Elective	Any course with the academic subject code of MATH and a course number of at least 100.	3	0	45
PHYS100M	Introductory Physics	2	3	45
<p>Students are required to take <i>either PHYS100M or PHYS135M</i> to meet requirements.</p> <p>This course is an introduction to the basic principles related to the composition of matter, simple machines, mechanical properties of solids, fluids, and gases, forces and static equilibrium, potential and kinetic energy, power, and force transformers. Emphasis is placed on the development of problem solving techniques and on the appropriate application of those techniques to solve problems along with understanding measurement errors. Dimensional/unit analysis is stressed as a method to evaluate problems. This course is offered in a face-to-face and hybrid format.</p>				



Course Number	Course Title	Credits		Total Hours
		Lec	Lab	
PHYS135M	College Physics	3	3	60
<p>Students are required to take <i>either PHYS100M or PHYS135M</i> to meet requirements.</p> <p>Introduces the basic principles of Newtonian mechanics with emphasis on the application of these principles when solving problems. Topics include kinematics of motion, vectors, Newton's laws, friction, work-energy, impulse-momentum for both translational and rotational motion and the mechanical properties of matter. Dimensional (unit) analysis and critical thinking are stressed.</p>				
Foreign Language/ Humanities/Fine Arts Elective		3	0	45
<p>Fine Arts Elective: any course with the academic subject code of ARTS</p> <p>Foreign Language Elective: ASL110M, FREN110M, SPAN110M</p> <p>Humanities Elective: includes any course with the academic subject code of HUMA or PHIL as well as the following: HIST120M, HIST130M, ENGL113M, ENGL200M, ENGL201M, ENGL202M, ENGL207M, ENGL208M, ENGL210M, ENGL213M, ENGL214M, ENGL218M, ENGL220M, ENGL223M, ENGL224M, ENGL225M, ENGL227M, ENGL228M, ENGL229M, ENGL230M, ENGL235M</p>				
Social Science Elective		3	0	45
<p>Social Science Elective: any of these designations: ANTH, ECON, GEOG, HIST, POLS, PSYC, SOCI. Foreign Language/Humanities Elective/Fine Arts Elective:</p>				
TOTAL MINIMUM HOURS				1050

A credit hour shall be allocated by the following:

	Contact Hours per week	Contact Hours per semester (based on min. 15 week semester)
Class	1	15
Laboratory	2 or 3	30-45