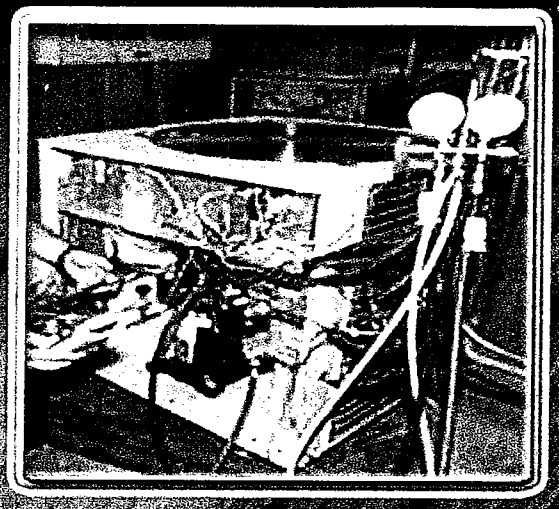
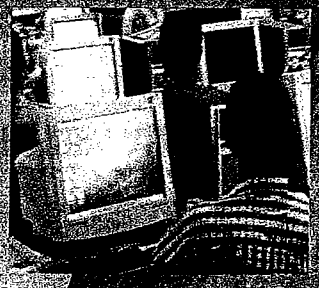
التوظيف والتدريب
EMPLOYMENT & TRAINING





HVAC

HVAC

Direct inquiries to

Ministry of Labor and Social Affairs
Attn: Manager of Vocational and Training Department
Baghdad, Iraq

Management & Training Corporation
500 North Marketplace drive
P.O. Box 10
Centerville, Utah 84014
U.S.A.

Jill L. Elkins – 801- 693 – 2714 (USA)

Michael Roberts – 801 – 691 – 2600 (USA)

The funding for the development of this curriculum was provided by USAID – (United States Aid for International Development)

Acknowledgments

Standards in this document are based on information from the following organizations:

U.S. Office of Job Corps

Office of Job Corps
Employment and Training Administration
U.S. Department of Labor
Francis Perkins Building
200 Constitution Avenue, NW
Washington, D.C. 20210

Contren Learning Series Best Practices

Reprinted with permission from *Contren Learning Series*, Copyright © 2002, National Center for Construction Education and Research, (352) 334-0920, http://www.nccer.org/

Workplace Skills for the 21st Century

Secretary's Commission on Achieving Necessary Skills

Curriculum development, training and translation in Iraq were provided by the following team:

Timothy Mizen-England
Deputy Chief of Party
Iraq Vocational Training Project.

Osama A. Issa - Jordan
Microsoft Certified Trainer (MCT).

Daniel Costelloe-Australia
Electrical Contracting Consultant.

Leslie Alexander Lawrence-Indonesia
Engineering Management Consultant.

Robert R. Caldwell-United States
Automotive Training Consultant.

The Managers and Vocational Trainers
for the Iraq Ministry of Labor and Social Affairs (MOLSA).

The Iraqi Staff of Iraq Vocational Training and Employment Services Project

Overview

Vocational training programs in Iraq are faced with many challenges. Iraq needs a speedy reconstruction and the Iraqi people need a future with the promise of employment and prosperity.

This training will combine occupational skills with technical knowledge and will be competency based. We will customize training to meet employer demands, cultural differences, geographic location, and needs of the trainees. The technical approach is modeled after the U.S. Department of Labor, Employment and Training Administration, Office of Job Corps training model. This curricula is competency-based, meaning that the student actually demonstrates a competency in practice and assessments. The Job Corps vocational training curricula consist of competency objectives with corresponding lessons and tasks or skill assignments. Following completion of each level of difficulty or assigned task, assessment tools determine competency and will help with evaluation and remediation. The competency-based instructional programs will:

- Assess the trainee's needs, including strengths and weaknesses
- Select appropriate instructional goals based on the needs assessment
- Provide trainee-centered instruction aimed at the instructional goals
- Evaluate to determine if the trainee has mastered the goals and can apply them

The instructional design (competency-based) will let the trainees demonstrate competency for the skills they already have and then begin instruction at the point where competency is not demonstrated. From there, the trainee will progress through the competencies listed on a Training Achievement Record until they complete training and are prepared to work.

These instructional materials include a Training Achievement Record (TAR). TARs list each competency required for the trade grouped by skill type. The curricula also include sample lesson plans. The curricula will provide for development in general areas prior to competency in more specific trade areas. This allows those who are not able to complete an entire program to develop skills suitable for lower levels of employment.

This curriculum has been developed in collaboration with MOLSA instructors, Job Corps training experts, and other technical professionals. It was created for use in all MOLSA vocational technical training centers that educate and train students to become competent, entry-level heating, ventilation, air-conditioning and refrigeration technicians. This curriculum will provide instructors with the necessary ingredients for a complete HVAC program. The purpose of this guide is to establish a common language of proficiency standards so that both the Vocational Technical Training Centers and industry have a universal set of standards for HVAC programs.

This curriculum has been developed for use by all Iraq Vocational Technical Training Centers that offer programs in HVAC technology. Because of the great diversity among the different regions of the country, this curriculum was designed, to be a flexible document that allows for the differences in instructor methodology. There are also differerences in the length of programs and differences in equipment at some of the MOLSA centers. All content areas and competencies must be integrated into the training center HVAC curricula so that students become competent in those areas.

This curriculum does not offer a step-by-step formula for teaching an HVAC course. This guide is designed to facilitate the classroom work of HVAC instructors but not to replace the decision-maker.

This curriculum has been aligned to modules in the Contren Learning Series as endorsed by the National Center for Construction Education and Research (NCCER). Students who successfully pass this course may be certified by MOLSA and will receive documentation from MOLSA.

It is the instructor who organizes instructional materials for effective and efficient learning. And **it is the instructor** who integrates the latest teaching technologies into his or her classroom. It is in support of these professionals and of their students that this curriculum has been developed.

Each vocational course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Module Number and Title (TAR Skill Set)

- Suggested Time to Train on Skill Set - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the module. The curriculum framework should account for approximately 75-80 percent of the time in the course.

- Competencies and Outcomes
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a module. The student, instructor and worksite supervisor (if applicable) will evaluate and record a pre-training mastery level for all skillsets, as well as a post-training mastery level review.

- The outcomes represent the enabling and supporting knowledge and demonstrated performances that will indicate mastery of the competency at the course level.

- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources, however, the only required assessment is completion of the TAR checklist.

- References - A list of suggested references is provided for each unit in the appendix. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested outcomes. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Table of Contents

Vocational Training Description

HVAC prepares a student for entry-level employment in heating, ventilation and air conditioning careers and/or for further study at the postsecondary level. Emphasis is on safety, history and development, tools and accessories, measurements, tubing and pipe, soldering and welding, mechanical refrigeration, fundamentals of electricity, electrical components, electric motors, wiring diagrams, heating systems, humidifiers, air filtration cleaners, duct work, heat pump systems, refrigerant accessories, and ventilation.

The content of the HVAC curriculum framework follows the recommended national standards for the U.S. office of Job Corps.

Course Outline

Heating, Ventilation and Air Conditioning (HVAC)

Module	Title	Hours
Module 1:	Employability Skills	15.0
Module 2:	History and Development	15.0
Module 3:	Safety	20.0
Module 4:	Tools and Accessories	10.0
Module 5:	Measure	15.0
Module 6:	Tubing and Piping	25.0
Module 7:	Techniques of Soldering and Welding	25.0
Module 8:	Mechanical Refrigeration	25.0
Module 9:	Fundamentals of Electricity	20.0
Module 10:	Electrical Components	20.0
Module 11:	Electric Motors	20.0
Module 12:	Wiring Diagrams	20.0
Module 13:	Heating System	20.0
Module 14:	Humidifiers	15.0
Module 15:	Air Filtration Cleaners	10.0
Module 16:	Duct Work	5.0
Module 17:	Heat Pump Systems	15.0
Module 18:	Refrigerant Accessories	10.0
Module 19:	Ventilation	5.0
	Total	**310**

Employability skills Module 1 (15 hours)

Competencies and Outcomes	Strategies for Competencies
1. Employability Skills a. Demonstrate the ability to dress appropriately for work. b. Demonstrate the ability to be on time. c. Demonstrate the ability to respond to supervision. d. Demonstrate the ability to follow directions. e. Demonstrate the ability to listen effectively. f. Demonstrate the ability to ask for clarification. g. Demonstrate the ability to explain procedures . h. Demonstrate the ability to take initiative. i. Demonstrate the ability to satisfy customers. j. Demonstrate the ability to work in teams. k. Demonstrate the ability to work harmoniously with diverse races, sexes, ages, and culture.	**Teaching:** • Define trade terms related to basic employability skills. • Students will interview individuals in the HVAC industry. Students will be provided questions by the instructor; the student will write a report on the interview and present the report to the class. • Use the Contren Series Core text, Basic Employability Skills Unit related to basic skills. • Use the Job Corps Employability Skills. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

l. Demonstrate the ability to trouble shoot and problem solving. m. Demonstrate the ability to assess and use information manuals and computers. n. Demonstrate the ability to maintain good hygiene. o. Demonstrate the ability to stay on task. p. Demonstrate the ability to maintain tools and equipment properly. g. Demonstrate the ability to maintain a clean and orderly work area. r. Demonstrate the ability to keep up with changing technologies. s. Demonstrate the ability to maintain a positive attitude. t. Demonstrate the ability to self starter, high motivation level. u. Demonstrate the ability to develop good communication skills.	

Module 2 History and Development (15 hours)

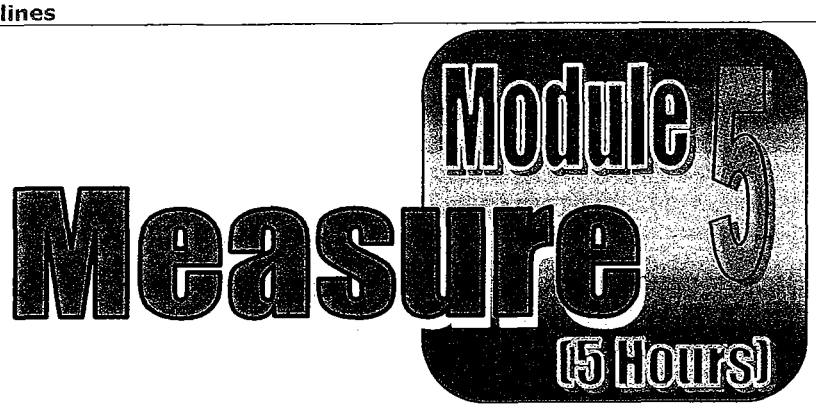
Competencies and Outcomes	Strategies for Competencies
1- History and Development a. List six ways to condition air. b. Distinguish between compression refrigeration components. c. Describe local program and vocational center policies and procedures. o Include dress code, attendance and discipline procedures. o Include employability skills. d. Explain the history of air conditioning and refrigeration. e. Define air conditioning, heating and refrigeration. f. Determine career opportunities in the HVAC industry.	**Teaching:** • Present local center program and MOLSA policies and procedures. • Students will become aware of what is expected of them in relation to the policies and procedures of the center. • This will include dress code, attendance, and discipline. • Use the Contren Services Core Text, Basic Employability Skills Unit to define trade terms related to basic skills. • Discuss the chapter to promote awareness of employability skills. • Use the internet to research a list of courses for which they will be qualified. • Discuss the history and introduction to HVAC Unit. Have the students research the history of HVAC to present day, and develop a short presentation.

	Assessment: • Assess student understanding through instructor observations and written unit test. • Validate mastery of the skillsets using the TAR Checklist.

Competencies and Outcomes	Strategies for Competencies
1. Safety a. Discuss the steps to be followed in case of an accident. b. Select the proper steps for lifting heavy objects. c. Discuss the rescue procedures to be followed in case of an accident. d. Identify color coding on safety tags or signs. e. Discuss procedures for handling refrigerants and cylinders. f. Know and use safety regulations. g. Discuss procedures for using and storing ladders. h. Discuss power tools safety and maintenance. i. Understand fire safety.	**Teaching:** • Identify, discuss, and demonstrate terms, rules, and procedures related to industrial safety. • Use Centren Core Text Basic Safety Unit. • Use guidelines provided for personal safety. Demonstrate the "do's" and "don'ts" of the guidelines. Include tools, spills, working around welding, improper use of ladders or scaffolds, fires and electrical situations. NOTE: SAFETY IS TO BE TAUGHT AS AN ONGOING PART OF THE COURSE. **Assessment:** • Use the TAR when observing students while they are performing safety inspections and procedures for operation. • Validate mastery of the skillsets using the TAR Checklist.

Module 4 Tools and Accessories (10 Hours)

Competencies and Outcomes	Strategies for Competencies
1. Tools and Accessories • Identify and describe use of: a. Basic hand tools and accessories. b. Power tools. c. Fasteners. d. Pipe and tubing tools. e. Lubrications: grease, guns, oilers, and sprays. f. Manifold gauge set.	**Teaching** • Use Contren Core Text Introduction to Power Tools. • Discuss safety factors. • Describe accidents that can occur while using tools. • Demonstrate the uses of various hand and power tools. • Provide each student with a description of a project to be completed. Have the student select the appropriate tools for the project. **Assessment:** • Evaluate the selection of the proper tools. • Validate mastery of the skillsets using the TAR Checklist.



Competencies and Outcomes	Strategies for Competencies
1. Measure a. Identify measuring instruments. b. Measure lines to the nearest millimeter. c. Measure inside diameters. d. Read the circumference rule.	**Teaching:** • Discuss the metric system and its importance. • Distribute a variety of metric measuring tools for length, weight, volume, and temperature. Have students measure assigned materials using the appropriate tools and record the measurements. • Discuss and demonstrate the basic mathematic applications in HVAC. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Module 6 Tubing and Pipe (25 hours)

Competencies and Outcomes	Strategies for Competencies
1. Tubing and Pipe a. Determine nominal size copper tubing and copper and tubing applications. b. Identify tube and flexible refrigerant fittings. c. Make a single flare with a compression type flaring block. d. Make a single flare with a generating type flaring block. e. Make a swage joint. f. Make a 90 degree bend. g. Make a 180 degree bend. h. Make a 45 degree offset bend. i. Construct a tubing project. j. Identify iron, brass, flexible plastic and PVC pipe fittings. k. List three common methods of measuring pipes. l. Measure fitting sizes.	**Teaching:** • Discuss the differences of copper tubing applications. • Demonstrate to students how to measure fittings and determine lengths. • Demonstrate how to prepare tubing and fittings. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

m. Determine lengths of PVC and fittings necessary to construct a condensate line. n. Demonstrate cleaning, cutting, and preparing tubing and pipe dilator.	

Module 7
Techniques of Soldering and Welding
(25 hours)

Competencies and Outcomes	Strategies for Competencies
1. Techniques of Soldering and Welding a. Identify the components oxyacetylene torch outfit. b. Light and adjust the oxyacetylene torch. c. Clean, Flux and solder a joint. d. Solder an inverted joint. e. Solder a horizontal joint. f. Soft solder with oxyacetylene torch. g. Describe the types of silver brazing alloys. h. Silver braze an upright joint. i. Silver braze an inverted joint. j. Silver braze a horizontal joint. k. Silver braze a copper to steel joint. l. Sliver braze a joint while circulating dry nitrogen. m. Silver braze copper to brass tubing. n. Silver braze the copper tubing object.	**Teaching** • Explain the safety procedures for soldering and brazing. • Explain the purposes and use of solder, filler metal and fluxes. • Discuss and demonstrate the procedures for assembly and operation of oxyacetylene torch. • Observe students while soldering tubing and fittings according to specifications. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

o. Set-up equipment for oxyacetylene cutting. p. Turn on light, adjust to a natural flame, and turn off the oxyacetylene cutting equipment.	

Module 8 Mechanical Refrigeration (25 hours)

Competencies and Outcomes	Strategies for Competencies
1- Mechanical Refrigeration a. Draw a basic refrigeration cycle. b. Assemble a basic refrigeration system. c. Install a filter-drier with flare fittings. d. Install a liquid indicator with flare fittings. e. Use a stem-type service value. f. Install an access core-type service valve. g. Complete temperature pressure problems. h. Determine the type of refrigerant used. i. Demonstrate proper use of vacuum pump. j. Use a vacuum gauge. k. Leak check using soap bubbles. l. Leak check using ultra-violet ultrasonic detector.	**Teaching:** • Discuss the safety precautions to be used in working with refrigerant cylinders and manifold gauges. • Demonstrate the proper procedures for connecting the manifold gauge to the cylinder and explain the purpose of the gauge. • Discuss the method of charging a system, using high side or low side methods. • Demonstrate the methods of charging a system. • Demonstrate the methods of detecting leaks. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

m. Leak check using en electronic detector. n. Pressurize system with dry nitrogen and leak check. o. Techniques for proper refrigerant charging.	

Module 9
Fundamentals of Electricity
(20 hours)

Competencies and Outcomes	Strategies for Competencies
1. Fundamentals of Electricity. a. Use Ohm's law. b. Calculate wattage. c. Select the series parallel loads. d. Solder electrical wire. e. Read a voltmeter scale. f. Read an ammeter scale. g. Read an ohmmeter scale. h. Determine start, run, and common of a single-phase motor. i. Use a voltmeter. j. Use an ohmmeter. k. Use a wattmeter. l. Use an ammeter. m. Use a hermetic analyzer. n. Use a capacitor analyzer. o. Test a capacitor with an ohmmeter. p. Distinguish between single phase and three-phase current characteristics.	**Teaching:** • Define and discuss the terms related to electricity. Match terms with the definitions. • Discuss and demonstrate the various types of meters and their uses. • Given the formula for Ohm's law, calculate current, resistance, and voltage. • Perform calculations to find the power consumed in a circuit or load. • Discuss the difference between a series circuit and a parallel circuit. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

q. Read an electric watt-hour meter. r. Identify electronic controls and symbols.	

Module 10 Electrical Components (20 hours)

Competencies and Outcomes	Strategies for Competencies
1. Electrical Components a. Identify different types/ styles of thermostats. b. Install a wall thermostat. c. Determine heat anticipation (load). d. Wire a potential relay. e. Wire a fan relay. f. Check relays with an ohmmeter. g. Check relays with a voltmeter. h. Check relays with an ammeter. i. Adjust a high pressure switch. j. Adjust a low pressure switch. k. Install an oil pressure switch. l. Install a lockout relay or time relay. m. Check a solid-state compressor motor protector. n. Wire a start capacitor with a potential relay. o. Wire a run capacity with a P.S.C compressor motor.	**Teaching:** • Discuss and demonstrate various types of thermostats and their uses. • Demonstrate proper wiring techniques. • Discuss differences in switches. • Discuss and demonstrate the use of ohmmeters, voltmeters and ammeters. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

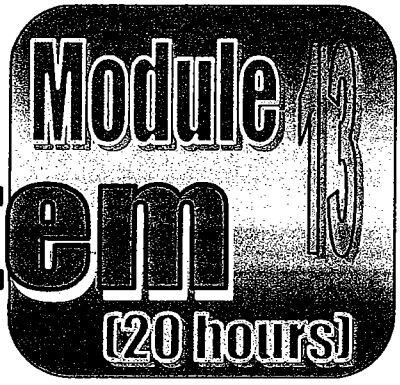
Module #11
Electric Motors
[20 hours]

Competencies and Outcomes	Strategies for Competencies
1. Electric Motors a. List safety rules pertaining to working with electric motors. b. Identify the common types of motor mounts. c. Troubleshoot motor problems. d. Wire a split-hasp dual-voltage motor. e. Check a shaded-pole motor. f. Identify the wiring diagrams of A.T.P. and P.S.C. motor. g. Troubleshoot a seized hermetic compressor motor. h. List the three major types of three-phrase motors. i. Describe the procedures of reversing the rotation of a three-phase motor. j. Demonstrate proper maintenance-cleaning and oiling.	**Teaching:** • Define magnetic theory. • Define and explain the use of three-phase motors, split-phase motors. • Describe the starting components associated with single-phase and three phase motors. • Explain the significance of the power factor. • Explain electric motor theory. (i.e magnetism, electromotive force, etc.). • Demonstrate the proper use of testing equipment for motors. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Module #12
Wiring Diagrams
(20 hours)

Competencies and Outcomes	Strategies for Competencies
1. Wiring Diagrams a. Draw a basic schematic wiring diagram. b. Draw a potential relay wiring diagram. c. Draw a gas furnace wiring diagram. d. Draw outdoor condensing unit wiring diagrams. e. Draw gas furnace wiring diagrams with two limit switches. f. Draw electronic furnace wiring diagrams. g. Draw indoor air handler and outdoor condensing unit wiring diagrams. h. Draw a ladder schematic by looking at a system with a low voltage control circuit. i. Draw a ladder schematic for a heat pump.	**Teaching:** • Identify and draw all electrical symbols used by the HVAC industry. • Explain and draw electrical circuits to conform to standard industry logic and symbols using appropriate loads and controls. • Interpret detailed instructions for wiring circuits. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Heating System



Competencies and Outcomes	Strategies for Competencies
1. Heating systems a. List component parts of a gas heating. b. List component parts of an oil heating systems. c. List component parts of an electrical heating system. d. Install a gas heating system. e. Install an oil heating system. f. Install an electrical heating system. g. Demonstrate basic diagnostic and repair on an oil heating system. h. Demonstrate repairs on an oil-heating system. i. Demonstrate repairs on an electrical heating system.	**Teaching:** • Provide students with terms, definitions, and sample schedules. • Have students discuss and develop a maintenance schedule. • Read and discuss information concerning fuels, systems, and methods of heat transfer. • Discuss the emerging technologies in heating systems and facts. • Have students perform maintenance on a specified heating system. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Humidifiers

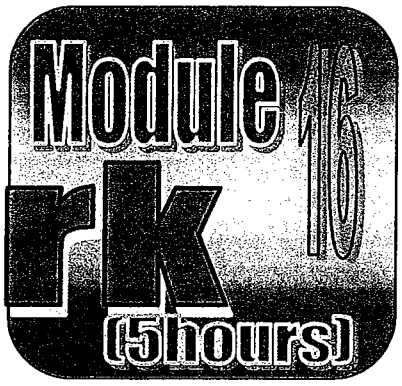
Module 14
(15 hours)

Competencies and Outcomes	Strategies for Competencies
1. Humidifiers a. List component parts of the humidifier. b. Install a humidifier.	**Teaching:** • Describe the various types of humidifiers. • Explain the importance of humidifiers. • Explain factors affecting humidity in business and residence. • Demonstrate proper installation of humidification equipment. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Module #15
Air Filtration Cleaners
(10 hours)

Competencies and Outcomes	Strategies for Competencies
1. Air Filtration Cleaners a. List types of air filters. b. Explain filter efficiency. c. Install an electronic air cleaner.	**Teaching:** • Identify the types of mechanical filters. • Describe the operation of electronic air cleaners. • Discuss and demonstrate how to install an electronic air cleaner system into existing duct work. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Duct Work



Competencies and Outcomes	Strategies for Competencies
1. Duct Work. a. Identify types of duct work. b. Identify duct connectors. c. Cut and measure straight duct, fittings and connectors. d. Identify duct tools and know their use. e. Demonstrate knowledge of CFM and velocities requirements.	**Teaching:** • Describe the various types of pipes and tubing used in HVAC. • Describe layout of return and supply runs. • Calculate equivalent length of trunk and breach line. • Demonstrate use of duct calculator to find duct size, velocity, CFM, and friction loss. • Demonstrate how to fabricate fittings. • Discuss and demonstrate the use of all basic hand held sheet metal tools, and tools for duct board. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Heat Pump Systems

Module 17
(15 hours)

Competencies and Outcomes	Strategies for Competencies
1. Heat Pump Systems a. Troubleshoot defrost cycle. b. Click and adjust system operations in the heating and cooling modes. c. Understand methods for checking and adjusting refrigerant changes. d. List component parts of a heat pump system. e. Install a heat pump system. f. Make basic repairs on a heat pump system.	**Teaching:** • Discuss and demonstrate how to test and evaluate the operation of a refrigeration cycle in cooling and heating modes. • Describe how to test the operation of the supplementary heat components. • Explain how to record appropriate date to evaluate complete system orientation. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Module 13 Refrigerant Accessories (10 hours)

Competencies and Outcomes	Strategies for Competencies
1. Refrigerant Accessories a. List metering devices. b. Identify filter dryer applications. c. Maintain recovery equipment. d. Maintain vacuum pump. e. Miscellaneous devices.	**Teaching:** • Describe the sequence and operation of various types of refrigeration systems. • Use and read various tools and instrumentation needed for checking. • Define terms associated with refrigeration recovery and recycling. • Describe safety procedures needed. • Perform refrigerant recovery and recycling. • Discuss and perform maintenance of recovery equipment. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

Module 10 Ventilation (5 hours)

Competencies and Outcomes	Strategies for Competencies
1. Ventilation a. Describe make up air and exhaust air and its applications.	**Teaching:** • Define indoor air quality. • Explain the different sectors that make up acceptable indoor air quality. **Assessment:** • Validate mastery of the skillsets using the TAR Checklist.

TAR

(Training Achievement Record)

Evaluation Checklist for HVAC

Directions for Completing TARs

A. When the student performs a task listed in the "DUTIES AND TASKS" column, the instructor should rate the student's level of performance by circling a, b, or c in the "PERFORMANCE RATING" column.

RATING

a - Proficient and able to teach others	The student consistently performs the task accurately without supervision. The student possesses sufficient skill to teach the task to others.
b - Proficient	The student performs the task to industry standards with little or no supervision. This is the minimum performance rating for TAR skill completion.
c - Exposed/not proficient	The student has been introduced to the task, but cannot perform the task to industry standards.

1. If the student performs the task at a level c, circle the number in pencil so that it can later be erased and entered permanently as b or a when the student improves his/her performance. A performance level of b is satisfactory (passing) and can be entered permanently or, at the instructor's discretion, circled in pencil to allow the student to improve his/her performance at a later date.
2. When the student performs the task to the instructor's satisfaction, (**at a level of b or a**) circle the appropriate performance rating, and enter the date in the **"DATE COMPLETED"** column. The instructor and student should initial the **DUTY** area when **all the tasks** in that duty area are completed.

B. When the student completes the TAR or terminates the program before completing the TAR, the instructor must finalize the TAR by doing the following:

1. Check the appropriate box and enter the date that the student completed the TAR or terminated the training program in the space provided at the top of page 1:

□ Completed or □ Terminated Training: _____
Date

HEATING AND AIR - CONDITIONING TAR HVAC

TRAINING ACHIEVEMENT RECORD (TAR) FOR:

Name: _____

IDNo.: _____

Date Entered Training: _____

☐ Completed or ☐ Terminated Training: _____
Date

CENTER: _____

Address: _____

_____

Phone: _____

Instructor: _____

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
A. EMPLOYABILITY SKILLS				
1. Demonstrate the ability to dress appropriately for work.	a b c			
2. Demonstrate the ability to arrive for work on time.	a b c			
3. Demonstrate the ability to respond appropriately to supervision.	a b c			
4. Demonstrate the ability to follow verbal directions.	a b c			
5. Demonstrate the ability to listen effectively to instructions.	a b c			
6. Demonstrate the ability to ask for clarification for information accurately.	a b c			
7. Demonstrate the ability to explain procedures to others.	a b c			
8. Demonstrate the ability to take initiative.	a b c			
9. Demonstrate the ability to satisfy costumers.	a b c			
10. Demonstrate the ability to work as a team.	a b c			
11. Demonstrate the ability to work harmoniously as a member of a team with diverse races, sexes, ages and cultures, treating all with respect.	a b c			
12. Demonstrate the ability to trouble shoot and problem solving.	a b c			
13. Demonstrate the ability to access trade information from manuals and computers.	a b c			
14. Demonstrate the ability to maintain good grooming dress appropriately for work and hygiene.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
15. Demonstrate the ability to stay on task and use time wisely and to complete assigned tasks.	a b c			
16. Demonstrate the ability to respect the worth of tools, equipment, materials and other people's property.	a b c			
17. Demonstrate the ability to maintain a clean orderly work area.	a b c			
18. Demonstrate the ability to keep up with changing technologies.	a b c			
19. Demonstrate a positive attitude toward work and people with supervision.	a b c			
20. Demonstrate the ability to show high motivation level and self starting abilities.	a b c			
21. Demonstrate the ability to develop good communication skills.	a b c			
B. HISTORY AND DEVELOPMENT				
1. Demonstrate the ability to list six ways to condition air.	a b c			
2. Demonstrate the ability to distinguish between compression refrigeration components and absorption refrigeration components.	a b c			
C. SAFETY				
1. Demonstrate the ability to discuss the steps to be followed in case of an accident.	a b c			
2. Demonstrate the ability to follow the steps for lifting and carrying heavy objects properly.	a b c			
3. Demonstrate the ability to discuss rescue procedures to be followed in case of an accident.	a b c			
4. Demonstrate the ability to identify color coding on safety tags of signs.	a b c			
5. Demonstrate the ability to discuss procedures for handling refrigerant cylinders.	a b c			
6. Demonstrate the ability to discuss procedure for using and storing ladders.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
7. Demonstrate the ability for using and storing ladders.	a b c			
8. Demonstrate the ability to use power tools safely and maintaining them.	a b c			
9. Demonstrate the ability to understand fire safety.	a b c			
D. TOOLS AND ACCESSORIES				
3. Identify and describe the use of basic hand tools and accessories.	a b c			
4. Identify and describe use of power tools.	a b c			
5. Identify and describe the use of fasteners.	a b c			
4. Identify and describe the use of pipe and tubing tools.	a b c			
5. Identify and describe the use of lubrications: grease guns, oilers and sprays.	a b c			
6. Identify and describe the use of manifold gauge set.	a b c			
E. MEASURE				
6. Identify measuring instruments.	a b c			
7. Identify measuring lines to the nearest quarter, eighth and sixteenth of an inch.	a b c			
3. Identify measuring inside and outside diameters.	a b c			
4. Identify the way to make read the circumference rule.	a b c			
F. TUBING AND PIPES				
1. The ability to distinguish between nominal size copper tubing applications and ACR copper tubing	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
applications.				
2. The ability to identify tube and flexible refrigerant fittings.	a b c			
3. The ability to make single flare with a compression-type flaring block.	a b c			
4. The ability to make a single flare with a generating-type flaring block.	a b c			
5. The ability to make a swage joint.	a b c			
6. The ability to make a 90 degree bend.	a b c			
7. The ability to make 180 degree bend.	a b c			
8. The ability to make a 45 degree offset bend.	a b c			
9. The ability to construct a tubing project.	a b c			
10. The ability to identify iron, brass, flexible plastic and PVC pipe fittings.	a b c			
11. The ability to list three common methods of measure pipes	a b c			
12. The ability to measure fitting sizes.	a b c			
13. The ability to determine the length of PVC and fittings necessary to construct a condensate line.	a b c			
14 The ability to clean cut and prepare tubing and pipe dilator.	a b c			
G. TECHNIQUES OF SOLDERING AND WELDING				
8. Identify the components of the air-acetylene torch outfit.	a b c			
9. Identify the components of the air-propane torch outfit.	a b c			
3. Identify the components of the oxyacetylene torch outfit.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
4. Light and adjust the air-acetylene torch.	a b c			
5. Light and adjust the oxyacetylene torch	a b c			
6. Identify, clean, flux and solder a joint.	a b c			
7. Identify the way to solder an inverted joint.	a b c			
8. Identify the way to solder a horizontal joint.	a b c			
9. Identify the way to soft solder with oxyacetylene torch.	a b c			
10. Identify and describe the types of silver brazing alloys.	a b c			
11. Identify and describe silver braze an upright joint.	a b c			
12. Identify and describe silver braze an inverted joint.	a b c			
13. Identify and describe silver braze a horizontal joint.	a b c			
14. Identify and describe silver braze a copper to steel joint.	a b c			
15. Identify and describe silver braze joint while circulating dry nitrogen.	a b c			
16. Identify and describe silver braze copper to brass tubing.	a b c			
17. Identify and describe silver braze the copper tubing object.	a b c			
18. Identify and describe set-up equipment for oxyacetylene cutting.	a b c			
19. Identify and describe the way to turn on light adjust to a natural flame, and turn off oxyacetylene cutting equipment.	a b c			
H. MECHANICAL REFRIGERANT				
10. Identify a way to draw a basic refrigerant cycle.	a b c			
11. Demonstrate the way to assemble a basic refrigerant system.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
3. Demonstrate the way to install a filter-drier with flare- sweet fittings.	a b c			
4. Demonstrate the way to install a liquid indicator with flare-sweet fittings.	a b c			
5. Demonstrate the ability to use a stem-type service valve.	a b c			
6. Demonstrate the ability to install an access core-type service valve.	a b c			
7. Demonstrate the ability to compute temperature-pressure problems.	a b c			
8. Demonstrate the ability to determine the type of refrigerant used.	a b c			
9. Demonstrate the ability to use vacuum pump.	a b c			
10. Demonstrate the ability to use vacuum gauge.	a b c			
11. Demonstrate the ability to check leaks using soap bubbles.	a b c			
12. Demonstrate the ability to check leaks using ultra-violet ultrasonic detector.	a b c			
13. Demonstrate the ability to check leaks using an electronic detector.	a b c			
14. Demonstrate the ability to use pressuring system with dry nitrogen and leak check.	a b c			
15. Demonstrate the ability to use techniques for proper refrigerant charging.	a b c			
I. FUNDAMENTALS OF ELECTRICITY				
12. Demonstrate the ability to use Ohm's law.	a b c			
13. Demonstrate the ability to Compute Wattage.	a b c			
3. Demonstrate the ability Select the series parallel loads.	a b c			
4. Demonstrate the ability to Solder electrical wire.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
5. Demonstrate the ability to read a voltmeter scale.	a b c			
6. Demonstrate the ability to read and ammeter scale.	a b c			
7. Demonstrate the ability to read an ohmmeter scale.	a b c			
8. Demonstrate the ability to determine start, run, and common of a single-phase motor.	a b c			
9. Demonstrate the ability to use a voltmeter.	a b c			
10. Demonstrate the ability to use an ohmmeter.	a b c			
11. Demonstrate the ability to use a wattmeter.	a b c			
12. Demonstrate the ability to use an ammeter	a b c			
13. Demonstrate the ability to use a hermetic analyzer	a b c			
14. Demonstrate the ability to use a capacitor analyzer	a b c			
15. Demonstrate the ability to test a capacitor with an ohmmeter.	a b c			
16. Demonstrate the ability to distinguish between single-phase and three-phase current characteristics	a b c			
17. Demonstrate the ability to read an electric watt-hour meter.	a b c			
18. Demonstrate the ability to identify electronic controls and symbols.	a b c			
J. ELECTRICAL COMPONENTS				
14. Identifying different types\ styles of thermostats.	a b c			
15. Identify the way to install a wall thermostat.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
16. Identify the way to determine heat anticipation..	a b c			
17. Identify the way to wire a potential relay.	a b c			
5. Identify the way to wire a fan relay.	a b c			
6. Identify the way to check relays with an ohmmeter.	a b c			
7. Identify the way to check relays with a voltmeter.	a b c			
8. Identify the way to check relays with an ammeter.	a b c			
9. Identify the way to adjust a high pressure switch.	a b c			
10. Identify the way to adjust a low pressure switch.	a b c			
11. Identify the way to install an oil pressure switch.	a b c			
12. Identify the way to install a lockout relay or time relay.	a b c			
13. Identify the way to check a solid-state compressor motor protector.	a b c			
14. Identify the way to install a wire a start capacitor with a potential relay.	a b c			
15. Identify the way to wire a run capacitor with a P.S.C compressor motor.	a b c			
K. ELECTRIC MOTORS				
18. Demonstrate the ability to list safety rules pertaining to working with electric motors.	a b c			
19. Demonstrate the ability to identify the common types of motor mounts	a b c			
20. Demonstrate the ability to troubleshoot motor problems.	a b c			
4. Demonstrate the ability to wire a split-hasp dual-voltage motor to a 208\204 VAC supply	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
1. Demonstrate the ability to list components parts of gas heating system.	a b c			
2. Demonstrate the ability to list components parts of an oil heating system.	a b c			
3. Demonstrate the ability to list components parts of an electrical heating system.	a b c			
4. Demonstrate the ability to install a gas heating system.	a b c			
5. Demonstrate the ability to install an oil heating system.	a b c			
6. Demonstrate the ability to install an electric heating system.	a b c			
7. Demonstrate the ability to perform basic diagnose and repairs on an oil heating system.	a b c			
8. Demonstrate the ability to repair on an oil-heating system.	a b c			
9. Demonstrate the ability to repair on an electronic heating system.	a b c			
N. HUMIDIFIERS				
1. Demonstrate the ability to list component parts of the humidifier.	a b c			
2. Demonstrate the ability to install a humidifier.	a b c			
O. AIR FILTERATION CLEANERS				
1. Demonstrate the ability to list types of air filter.	a b c			
2. Demonstrate the ability to explain filter efficiency	a b c			
3. Demonstrate the ability to install an electronic air cleaner.	a b c			
P. DUCT WORK				

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
5. Demonstrate the ability to check a shaded-pole motor.	a b c			
6. Demonstrate the ability to identify the wiring diagrams of various types of motors.	a b c			
7. Demonstrate the ability to troubleshoot a seized hermetic compressor motor.	a b c			
8. Demonstrate the ability to list the three major types of three-phase motors.	a b c			
9. Demonstrate the ability to describe the procedure of reversing the notation of a three- phase motor.	a b c			
10. Demonstrate the ability to perform proper maintenance – cleaning and oiling.	a b c			
L. WIRING DIAGRAMS				
1. Demonstrate the ability to draw a basic schematic wiring diagram.	a b c			
2. Demonstrate the ability to draw potential relay wiring.	a b c			
3. Demonstrate the ability to draw gas furnace wiring diagrams.	a b c			
4. Demonstrate the ability to draw outdoor condensing unit wiring diagrams.	a b c			
5. Demonstrate the ability to draw gas furnace wiring diagrams with two limit switches.	a b c			
6. Demonstrate the ability to draw gas furnace wiring diagrams.	a b c			
7. Demonstrate the ability to draw indoor air handler and outdoor condensing unit wiring diagrams.	a b c			
8. Demonstrate the ability to draw a ladder schematic by looking at system with low voltage control circuit.	a b c			
9. Demonstrate the ability to draw a ladder schematic for heat pump.	a b c			
M. HEATING SYSTEMS				

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
1. Demonstrate the ability to identify types of duct work.	a b c			
2. Demonstrate the ability to identify duct connectors.	a b c			
3. Demonstrate the ability to cut and measure straight duct, fittings and connectors.	a b c			
4. Demonstrate the ability to identify duct tools and knows their use.	a b c			
5. Demonstrate knowledge of CFM and velocity requirements.	a b c			
Q. HEAT PUMP SYSTEMS				
1. Demonstrate the ability to trouble shoot defrost cycle.	a b c			
2. Demonstrate the ability to check and adjust system operations in the heating and cooling modes.	a b c			
3. Demonstrate knowledge of methods for checking and adjusting refrigerant charges.	a b c			
4. Demonstrate the ability to list component parts of a heat pump system.	a b c			
5. Demonstrate the ability to install a heat pump system.	a b c			
6. Demonstrate the ability to make basic repairs on a heat pump system.	a b c			
R. REFRIGERANT ACCESSORIES				
1. Demonstrate the ability to list metering devices.	a b c			
2. Demonstrate the ability to identify filter dryer applications.	a b c			
3. Demonstrate the ability to maintain recovery equipment.	a b c			
4. Demonstrate the ability to maintain vacuum pump.	a b c			

DUTIES AND TASKS	PERFORMANCE RATING	DATE COMPLETED	INSTRUCTOR'S INITIALS	STUDENT'S INITIALS
5. Demonstrate the ability to miscellaneous devices.	a b c			
S. VENTILATION				
1. Demonstrate the ability to describe make up air & exhaust air and its applications.	a b c			
T. ADDITIONAL				
1. GED/HSD obtained.	a b c			
B. EMPLOYER SPECIFIC SKILLS				
1.	a b c			
2.	a b c			
3.	a b c			
4.	a b c			
o	a b c			

[1] a - Proficient and able to teach others; b - Proficient; c -Exposed/not proficient

Appendix B

Workplace Skills for the 21st Century for HVAC

For Module 1- Employability Skills

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 2- History and Development

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 3- Safety

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.

WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 4- Tools and Accessories

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 5- Measure

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 6- Tubing and Pipe

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 7- Techniques of Soldering and Welding

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 8- Mechanical Refrigeration

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.

WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 9- Fundamentals of Electricity

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 10- Electrical Components

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 11- Electric Motors

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management

For Module 12- Wiring Diagrams

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 13- Heating System

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.

WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

For Module 14- Humidifiers

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

Appendix C

Suggested References

Suggested References

Choices [Computer software]. Ogdensburg, NY: Careerware, IMS Information Systems Management.

Davies, D. (1997). *Grammar? No problem!* Mission, KS: SkillPath.

Gould, M. C. (2002). *Developing literacy & workplace skills*. Bloomington, IN: National Education Service.

Jeffus, L. (2004). *Refrigeration and air conditioning.* Upper Saddle River, NJ: Pearson Prentice Hall.

Local District Policy Handbook

National Center for Construction Education and Research. (2004). *Core curriculum.* Upper Saddle River, NJ: Pearson Prentice Hall.

National Center for Construction Education and Research. (2001). *HVAC level I.* Upper Saddle River, NJ: Pearson Prentice Hall.

National Center for Construction Education and Research. (2004). *Tools for success.* Upper Saddle River, NJ: Pearson Prentice Hall.

SkillsUSA. (2002). *Leadership and competition curricula.* Tinley Park, IL: Goodheart-Wilcox.

Don Swenson S. (2004). HVAC Heating Ventilation and Air conditioning. Third Edition. Homewood, Illinois. American Technical Publisher.

Barrows, R., & Jones, B. (2002). *Fundamentals of math with career applications*. Upper Saddle River, NJ: Pearson Prentice Hall.

Boyce, J. G., Margolis, L., & Slade, S. (2000). *Mathematics for technical and vocational students*. Upper Saddle River, NJ: Prentice Hall.

Carman, R. A., & Saunders, H. M. (2005). *Mathematics for the trades: A guided approach.* Upper Saddle River, NJ: Pearson Prentice Hall.

Cook, N. P. (2004). *Mathematics for technical trades.* Upper Saddle River, NJ: Pearson Prentice Hall.

Cook, N. P. (2004). *Introductory mathematics.* Upper Saddle River, NJ: Pearson Prentice Hall.

Silberstein, E. (2005). *Residential construction academy: HVAC.* Albany, NY: Delmar.

Whitman, W., Johnson, W., & Tomczyk, J. (2005). *Refrigeration and air conditioning technology.* Albany, NY: Delmar.

Recommended Tools & Equipment

ITEM	المادة	العدد
		QTY
Thermal Unit Meter, Dial Type	مقياس وحدة حرارية	10
Gas Leak Tester, Electronic	فاحص تسريب الغاز - ليبك	6
Complete Air – Conditioning Unit, Split-system, reverse cycle	وحدة تبريد كاملة	2
Ivo Meter	افو ميتر	35
Clamp Meter	كلامب متر	2
Vernier / Caliper	فيرنية - قدمة	2
Air – Conditioner 2 Ton Window Type	جهاز تبريد 2 طن	2
Dual Grinder Table Type	كوسرة منضدية مزدوجة	1
Bench/metal top with metal vise	منضدة حديدية مع منكنة حديدية	10
C clamps, assorted sets—6", 8", 10"	كلاب - سي - سيتات متنوعة 6، 8 و 10 إنج	1
Divider set	سيت مقسم مسافة - ديفايدر	1
Drill, ½" electric	دريل 3\8 و 1\2 إنج كهربائي	5
Electronic leak detector	كاشف تسريب - ليبك - الكتروني	10
Pop rivet gun set	مسدس تونك - رفت أو ريد	1
Snips: straight, left, right (2left, 2 right, 2 streight)	قصاصات : مستقسم ،يسار ، يمين	2
Soldering station	علبة لحام	1
Combination squares	مربعات ربط	2
Tap and die set (1 metric and 1 SAE)	سيت عدة تسنين خارجي و داخلي قياس متري و قياس انكليزي	1
25 ft. tape measure, retractable (10 m)	شريط قياس 25 فوت	2
Three-foot metal rules	مساطر معدنية ثلاثة - فوتات	2
Universal appliance truck	عربة معدات رئيسية	1
Vacuum (wet or dry)	شافطة (فاكيوم) رطب أو جاف	1
Oxy-fuel welding units, Complete set (Regulator, hoses, head Piece & Tips)	وحدات لحام اوكسجين - وقود	10
Pipe wrench set	سيت مفك بوري	1
Chisel set	سيت أزاميل	2
Combination wrench sets (1 metric and 1 SAE), open end and box type	سيتات مفك ربط قياس متري و إنكليزي	10
Diagonal cutters	قاطع - كتر - قطري مائل	10
Reciprocating saw	منشار ترددي	1
Grinder, side (4" and 7")	كوسرة جانبية 4 و 7 إنج	1
File set	سيت مبرد	10
Flare/swage sets	سيت فرش نهاية البوري - فلير	10
Nitrogen tank and recycling regulator and relief valve	خزان نيتروجين مع منظم تدوير و صمام تنفيس	1
First aid kit, Industrial	عدة إسعاف أولي	1
Schrader valve core removal tool	اداة ازالة مركز الصمام	20
Low loss fitting	لوازم (فتنكات) ذات رخاوة واطئة	3
Industrial flashlight	فلاش لايت صناعي	1
Hack saws	منشار قطع	10

Ball peen hammer sets	سيت مطرقات كروية الرأس	10
Set, refrigeration flare nut wrench, Spanner set	سيت مفك صمولة فلير تبريد	10
Pinch off tool	قارصة	10
Pliers (slip joint/needle nose/linesman locking)	بلايس ذو مفصل متحرك / لاوية / بلايس كهربائيين	10
Scratch awls, Scriber	مثاقب خدش	10
Screwdriver sets (straight and Phillips)	سيت درنفيسات - عدل و مربع	10
Sockets and ratchet set—½" and ¼" drive (1 metric and 1 SAE)	سيت قابس و سقاطة قياس 2 ،3\8 ، 4\1 على القياس المتري و القياس الإنكليزي	10
Tubing bender set	سيت معواجة أنابيب	2
Tubing cutter kits	عدة قطع أنابيب	10
Wire strippers	قاشطة وايرات	2
Allen wrenches sets (Imperial & Metric)	سيت مفكات ألنكي	10
Wire end crimpers (Crimping tool, Rachet wiring, terminal)	مجعدة نهايات الوايرات	3
8 ft. fiberglass ladder	سلم فايبر كلاس 8 فوت	1
Cordless drills, ½"	مثاقب لاسلكية (3\8 و 2) إنج	5
Four wheel cart	عربة ذات أربعة عجلات	1
Appliance lift	رافعة عدة	1
Claw hammers	مطارق مخلبية	3
Stainless steel brush	فرشاة ستينليس ستيل	10
Stainless steel wire brush (toothbrush)	فرشاة ستينليس ستيل سلكية - على شكل فرشاة الاسنان	10
Adjustable wrenches 4" - 6" - 8" - 10"	كندك 6 - 8- 10	10
Pipe vise with tripod	منكنة بوريات مع حامل ثلاثي	1
Pipe reamer (Deburring Tool)	منعم بوري - رايمر	10
High speed drill bit set with ½" shank 1/16" through 2"	بريمة دريل عالي السرعة طول 2 إنج من قياس 16\1 إنج الى قياس 2 إنج	2
Eyewash station	عدة غسل العيون	1
Digital multi-meter	مقاييس رقمية (دجتل) متعددة الاغراض	10
PCV cutters—3/8" through 1"	مقصات البلاستك (بي في سي) من 3\8 إنج الى 1 إنج	2
Pump sprayer	بخاخ مضخة	5
Clamp-on ammeters	أميترات - كلامب	2
Hermetic analyzer	محلل محكم السد	2
Electronic thermometer, digital	مقياس حرارة الكتروني دجتال	20
Electronic charging scale	مقياس شحن الكتروني دجتل	2
Micron vacuum gauge (Digital)	مقياس تفريغ - فاكيوم مايكرون	1
Manifold gauge sets (Complete)	سيت كيج متفرع	15
Temperature recorder	مسجل قراءات حرارة	1
Vacuum pumps	مضخات فاكيوم	4
Storage tanks	خزانات كبيرة 25 كغ	5
Hand oil pump	مضخات زيت يدوية	1
U-tube manometer	مانوميتر - مكثاف على شكل حرف U	1
Velocity meter (Dual purpose—for heating and cooling instruction)	مقياس انطلاق (سرعة) للاستخدام المزدوج لمعدات التدفئة و التبريد	1
safety glasses	نظارات وقاية	30

LPG Burner Kit	مشعل غاز	5
MAAP Burner Kit	مشعل غاز تربو	5
Drill Press, Pedistal, Commercial ½"	بريس دريل تجاري 2\1 انج	1
Electronic Soldering Iron (100 watt)	كاوية لحام 100 واط	1
Torch, (Flashlight)	لايت (تورج)	10
Dead Blow Hammer (Rubber Mallet)	مطرقة بلاستك	10
Pin Streikghtening Kit (Pin Combs)	فرشاة تقويم	10
Thermometer, Infra Red	محرار اشعة تحت الحمراء	1
Inspection mirrors (Dentist Mirror)	مراة طبيب اسنان	20
Refrigeration Tool	عدة تبريد	10
Recovery Unit for 134a	عدة استرجاع ل a134	2
Recycle/Charging Station for 134a	عدة شحن و تدوير ل a134	1
Die leak Dectector Kit	عدة فحص التسريب (ليك)	1
Paint Brush (25mm)	فرشاة صبغ (25 ملم)	10
Bending Springs (Various Sizes)	سبرينغات لوي قياسات متعددة	10
Valve Piercing Tools	عدة ثقب الصمامات	15
Tool Box	صندوق عدة	10
Process Tube Adapter Kit	محولات انابيب	2