



A **SOUTHERN COMPANY**

HVAC Training Center

Course/Curriculum
Information

2388 County Road 93
Verbena, AL
36091

Phone: 1-800-634-0154

Fax: 1-205-755-6168

Alabama Power's HVAC Training Center

One of a kind" is a phrase often used to describe Alabama Power's HVAC Training Center. Centrally located in the state and overlooking picturesque Mitchell Dam, the state-of-the-art facility has provided training, professional development and continuing education to over 20,000 participants from 40 states and three countries since 1986.

The 15,000-square-foot main building houses three classrooms, three laboratories, an auditorium, dining area, computer laboratory, library, offices and administrative area. The three classrooms can easily be expanded to five.

The building is equipped with 29 fully operational trainer units from 26 manufacturers; types include air source, geothermal, and dual-fuel heat pumps and commercial heat pump water heaters. The Center's staff has modified the units so participants can address virtually any technical, electrical, refrigerant or air-related questions.

The facility features 14 heat pumps mounted on casters and used for tasks such as rewiring electrical systems and re-piping refrigerant systems. Simulators with internally metered devices to reflect time and proper trouble-shooting procedures measure the participant's ability to repair potential problems.

In addition to the main building, the Center includes a 1,536-square-foot house with a full basement for duct board fabrication training. One half of the house is of energy-efficient construction; the other half is of conventional construction. Cutaways allow the participant to see the advantages and disadvantages of both types of construction.

Together, the facilities offer the most current equipment supplemented by hands-on, performance-based classroom training.

Some courses may be customized and presented at the customer's location. For more detailed information and a training schedule, call the Training Center at 800-634-0154 or direct written inquires to:

HVAC Training Center
2388 County Road 93
Verbena, AL 36091
(fax) 205-755-6168
www.alabamapower.com/hvac
rslecroy@southernco.com

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SAMPLE TRAINING PLAN FOR HVAC TECHNICIANS

Course 1201: Foundations for Troubleshooting Gas Furnaces
 Course 1501E: Basic Refrigeration and HVAC Operations
 Course 1501: Foundations for Troubleshooting HVAC Refrigerant Systems
 Course 1502E: Basic HVAC Electrical Operations
 Course 1502: Foundations for Troubleshooting HVAC Electrical Systems
 Course 1503: Troubleshooting HVAC Refrigerant Systems
 (Prerequisite: 1501)
 Course 1504: Troubleshooting HVAC Electrical Systems
 (Prerequisite: 1502)
 Course 1505: Servicing HVAC Refrigerant Systems
 Course 1506: Servicing HVAC Electrical Systems
 (Prerequisites: 1502 & 1504)
 Course 1507: Advanced Troubleshooting of HVAC Systems
 (Prerequisites: 1501 – 1506)
 Course 1905: Refrigerant Recovery Certification
 NATE – ACE Exam Preparation Review

The nine main-curriculum courses listed above have been custom-designed to enable HVAC technicians to answer three key questions:

1. Do I have a problem? (Foundations courses 1501 & 1502)
2. What is the problem? (Troubleshooting courses 1503 & 1504)
3. How do I fix the problem? (Servicing courses 1505 & 1506)

If technicians need remedial training in the purpose and identification of HVAC system components, they may wish to enroll first in the 1501E (Refrigeration) and/or 1502E (Electrical).

If technicians are most interested in the technical performance of HVAC refrigerant systems and components, they may wish to enroll first in Course 1501.

If technicians are most interested in the technical operation of electrical circuits and controls on HVAC equipment, they may wish to enroll first in Course 1502.

Additionally, the following courses are offered at the HVAC Training Center to meet the expanding needs of your HVAC employees:

Course #	Course Title
1802	Residential Load Calculations
1803	Residential Duct Design (Prerequisite: 1802)
Manual N	Commercial Load Calculations
Manual Q	Commercial Duct Design
1807	Air Duct Fabrication, Installation, Testing & Repair
1809	Air Infiltration Diagnostics & Repair
IGSHPA	International Ground Source Heat Pump Assn. Closed Loop Cert.
State Board Review	Review for State of Alabama Contractor's Exam
RMV	Residential Mechanical Ventilation Installation

Please refer to the enclosed Post Training Benefits sheets and the HVAC Training Center Schedule for further details concerning the content of each of the above-referenced courses and the dates they will be offered.

SAMPLE TRAINING PLAN FOR MARKETING/SALES REPS.

Course 1800: HVAC System Analysis
Course 1801: Advanced HVAC System Analysis (Prerequisite: 1800)
Course 1501E: Basic Refrigeration and HVAC Operations
Course 1502E: Basic HVAC Electrical Operations
Course 1802: Residential Load Calculations
Course 1803: Residential Duct Design (Prerequisite 1802)
Manual N: Commercial Load Calculations
Manual Q: Commercial Duct Design
Course 1805: Competition in the Residential Market
Course 1806: Residential Energy Efficient Construction
RMV: Residential Mechanical Ventilation Installation

The 11 courses listed above have been custom designed for utility marketing/sales reps who need to improve their knowledge of HVAC equipment, and/or their basic skills in HVAC equipment sizing and air-distribution system design; but do not need to develop technical skills.

If you would like to develop the technician-level skills of your utility marketing/sales rep, the following courses are recommended:

Course #	Course Title
1501:	Foundations for Troubleshooting HVAC Refrigerant Systems
1503:	Troubleshooting HVAC Refrigerant Systems (Prerequisite: 1501)
1505:	Servicing HVAC Refrigerant Systems
1502:	Foundations for Troubleshooting HVAC Electrical Systems
1504:	Troubleshooting HVAC Electrical Systems
1506:	Servicing HVAC Electrical Systems
1600:	Commercial Heat Pump Water Heating
1602:	Ground Source Heat Pumps for Marketing Reps.
1807:	Air Duct Fabrication, Installation, Testing & Repair
1809:	Air Infiltration Diagnostics and Repair Techniques

Please refer to the enclosed Post Training Benefits sheets and the HVAC Training Center Schedule for further details concerning the content of each of the above-referenced courses and the dates they will be offered.

Review for State of Alabama Heating & Air Conditioning Contractor's Certification Test

Course Syllabus:

The objective of this course is to prepare the student to take the State Air Conditioning and Refrigeration Certification Exam. The Exam is to test the knowledge, skill, and proficiency of the applicant.

The emphasis on learning in this course will be placed on:

- ❖ Preparing for the Exam
- ❖ Residential and light Commercial Load Calculation (Manual J & N)
- ❖ Duct Sizing (Manual D & ACCA Ductulator)
- ❖ Psychometrics

We will review the pertinent portions of the following concepts to increase your understanding:

- ❖ HVAC Principles and Theory
- ❖ Refrigeration as Applied to Air Conditioning
- ❖ Duct Installation Techniques
- ❖ Fibrous Duct Construction

We will discuss and acquaint you with these standards and how to research the different sections of the following codes:

- ❖ Code of Federal Regulations Title 29
- ❖ International Fuel Code
- ❖ International Mechanical Code

Upon course completion, the student should be prepared to take the Contractors exam.

Please Note: This class is a review class; therefore no exit exam is given to test knowledge or skills acquired. Participants will take a State of Alabama HVAC Certification exam at a third party location.

1201
Foundations for Troubleshooting Gas Furnaces
4 Days

Course Syllabus

A four day course designed to train technicians to systematically apply procedures to analyze dual fuel equipment operation and comfort conditions. The participant applies troubleshooting procedures to determine if there is a problem with a dual fuel equipment installation without removal of panels.

Fundamentals of Gas Combustion (1)

Lesson Objectives

1. Understand the elements needed for proper combustion.
2. Understand the properties of different fuel gasses.
3. Know the tools needed to determine gas pressure.
4. Understand the effects of improper combustion.
5. Understand AFUE.
6. Know the range of proper operating pressures of gas.

Gas Furnace Operation (2)

Lesson Objectives

1. Understand the different styles of furnaces based on physical location.
2. Understand the different efficiency ratings of furnaces.
3. Understand the types of combustion in different furnaces.

Residential Gas Ignition Controls (3)

Lesson Objectives

1. Understand the different methods of direct burner ignition.
2. Understand the operation of different gas valves.
3. Understand how flame rectification is accomplished.

Dual Fuel Controls (4)

Lesson Objectives

1. Understand the different modes of operation for a dual fuel system.
2. Understand the sequence of operation for a dual fuel system.

Safety (5)

Lesson Objectives

1. Understand how to properly leak test a gas piping system.
2. Understand how safety devices operate on a furnace.

Gas Pipe Sizing (6)

Lesson Objectives

1. Using the proper code book; understand the procedure for sizing a gas piping system.

Venting (7)

Lesson Objectives

1. Understand the categories of vented appliances.
2. Understand the components of a venting system.
3. Using the proper code book; understand the procedure for properly sizing a vent.

Performance (8)

Lesson Objectives

1. Calculate the gas consumption of a furnace.
2. Understand the factors affecting the conditioned space.
3. Calculate the input and output capacity of a furnace.
4. Understand the different methods of calculating air flow.
5. Understand the total and sensible heat formulas.

1501
Foundations for Troubleshooting HVAC Refrigerant Systems
4 Days

Course Syllabus

Hands-on, performance-based training processes are used in this four day course to train participants to systematically implement the HVAC system analysis procedure, and to validate actual sealed-system performance of fully operational HVAC equipment.

Human Comfort Factors (1)

Lesson Objectives

1. Know the properties of moist air and how they relate to human comfort.
2. Know the effects of air velocity within the conditioned space
3. Determine dry bulb temperature.
4. Determine wet bulb temperature.
5. Determine relative humidity.
6. Prepare a psychrometric chart identifying the comfort zone as established by industry standards.

Heat Pump Performance (2)

Lesson Objectives

1. Calculate unit air flow using anemometer.
2. Calculate unit air flow using temperature rise method.
3. Calculate unit capacity in heating cycle.
4. Calculate unit capacity in cooling mode.
5. State factors causing low equipment performance.

Application and Installation Standards (3)

Lesson Objectives

1. Establish heating/cooling performance relative to equipment manufacturer's published data.
2. Establish air distribution system performance relative to air delivery (i.e. Volume/cfm, temperature and location).

Mater and Heat Behavior (4)

Lesson Objectives

1. Define states of matter.
2. Define heat
3. Define the laws of thermodynamics.
4. Define specific heat.
5. Define sensible heat
6. Define latent heat.

Basic Heat Pump Cycle (5)

Lesson Objectives

1. Identify heat pump sealed system components.
2. Know the specific location of each sealed system component.
3. Know the order of refrigerant flow through the sealed system components.
4. Know the differences and similarities of heat pump systems.

Refrigerants (6)

Lesson Objectives

1. Understand the hazards and safety precautions to be observed while handling refrigerants.
2. Understand the pressure-enthalpy diagram relating to R-22

Heat Pump Refrigerant Components and System Operation (7)

Lesson Objectives

1. Understand each heat pump cycle of operation.
2. Understand the importance of proper air flow.
3. Understand the importance of heat pump components which provide safety protection.

1501E
BASIC REFRIGERATION AND HEAT PUMP
OPERATIONS
2 Day

Course Syllabus:

This two day course is designed to improve the competency level of the participant in the basic and fundamental areas of refrigeration definitions and terms, the refrigeration cycle of operation, and component recognition. The expectation of this course is to instill a higher degree of confidence for communication and conversational exchange. The participant gains knowledge primarily through a classroom environment with a smaller degree of laboratory activities.

Terms and Definitions (1)

Lesson Objectives

1. The participant will recognize and define terms related to the refrigeration cycle.

Refrigeration Cycle (2)

Lesson Objectives

1. The participant will plot the flow of refrigerant through a refrigeration system.

Refrigeration Components (3)

Lesson Objectives

1. The participant will identify components of a refrigeration system.

1502
Foundations for Troubleshooting HVAC Electrical Systems
4 Day

Course Syllabus:

In this hands-on, performance based training program, the participant gains a working knowledge of the basic concepts of electricity (volts, amperes, capacitance, inductance, reactance, power factor, ohms law, series/parallel circuits, etc.) The training processes along with laboratory exercises are used to train the participant to systematically implement procedures to analyze HVAC electrical system operation. The expected outcome of the course is for the technician to have the competency skills to determine normal or abnormal system operation. The participant selects and installs high and low voltage wiring for a trainer unit. Homework is assigned for the evening of the first day of training with possible homework on the evening of the third day of training.

Fundamentals of Electricity (1)

Lesson Objectives

1. Learn concepts of AC Power Generation
2. Become familiar with AC circuit characteristics
3. Learn concept using AC Power to do work
4. Learn to manipulate Ohm's Law formulas

HVAC Power Wiring (2)

Lesson Objectives

1. Learn NEC guidelines for HVAC power wiring
2. Determine proper over-current protection and wire size for assigned units.

Component & Symbols (3)

Lesson Objectives

1. Become familiar with components, their symbols, checkout procedures and function within a system

HVAC Electrical Circuit Analysis (4)

Lesson Objectives

1. Develop a systematic approach to troubleshooting a HVAC electrical system
2. Develop a "Control Matrix" for the "Insider" unit.

Schematic Diagrams (5)

Lesson Objectives

1. Become familiar with different types of wiring diagrams
2. Enhance wiring diagram read skills by answering questions on three different exercises.

Unit Exercise (6)

Lesson Objectives

1. Develop a schematic diagram for the "Insider" unit
2. Develop a pictorial wiring diagram for the "Insider" unit
3. Wire the "Insider" unit, learn proper procedures for checking system for ground or short. Operate unit in all modes of operation.

1502E
BASIC HVAC ELECTRICAL OPERATIONS
2 Day

Course Syllabus:

This two day course is designed to improve the competency level of the participant in the basic and fundamental areas of HVAC electrical definitions and terms, basic familiarization with electrical test instruments and meters, the electrical operation and control of the system, and component and component symbol recognition. The expectation of this course is to instill a higher degree of confidence for communication and conversational exchange. The participant gains knowledge primarily through a classroom environment with a smaller degree of laboratory activities.

Terms and Definitions (1)

Lesson Objectives

1. The participant will understand basic electricity definitions, terms and concepts.

Meter Usage (2)

Lesson Objectives

1. Familiarize the participant with the purpose and use of voltmeters, ammeters, and ohmmeters.

Electrical Components (3)

Lesson Objectives

1. The participant will understand the operation, control, and function of the components of the HVAC electrical system.

Wiring Diagrams (4)

Lesson Objective

1. The participant will understand the principles of wiring diagrams, symbols, and the related HVAC service concepts.

1503

Troubleshooting HVAC Refrigerant Systems

4 Days

Course Syllabus

In this four-day course, participants develop refrigerant system troubleshooting skills through hands-on, performance-based application of proper and systematic routines. A training laboratory setting, which closely simulates a technician's normal work environment, enhances the effectiveness of the training as he/she develops confidence to perform the job tasks, while determining future developmental needs, as well.

COVER (1)

Lesson Objectives

1. Understand the value and application of Customer Communication in the heat pump troubleshooting process.
2. Apply a systematic approach for Observing equipment operation in the heat pump troubleshooting process.
3. Apply a systematic approach for Verifying equipment operation in the heat pump troubleshooting process.
4. Apply a systematic approach for Establishing the cause of system failure in the heat pump troubleshooting process.
5. Understand the methods and techniques required to Report and/or recommend appropriate corrective measures when service is required in the heat pump troubleshooting process.

Refrigerant System Analysis and Component Identification (2)

Lesson Objectives

1. Understand refrigerant flow characteristics of heat pump units.
2. Identify and understand the control characteristics of each type metering device in heat pump units.

Seven General Orders of Refrigerant System Operation (3)

Lesson Objectives

1. Identify mechanical heat pump malfunctions that do or do not impact system performance.
2. Understand how refrigerant flow and/or heat transfer effect system capacity.
3. Identify problems that may be caused by failed components, not caused by failed components, or a combination of both.
4. Identify problems caused by equipment size, air distribution, and system charge.
5. Understand problems caused by failed components in the ten primary component areas.
6. Identify problems by analyzing abnormal equipment operation in the fourteen operating parameters.

Charging HVAC Refrigerant Systems (4)

Lesson Objectives

1. Understand the charging methods for thermostatic expansion valve systems.
2. Understand the charging methods for fixed metering systems.
3. Plot a refrigerant cycle on a pressure/enthalpy chart.

Heat Pump System Analysis (5)

Lesson Objectives

1. Understand information needed to complete the Refrigerant System Check Sheet.
2. Compare unit pressures/temperatures with unit manufacturer's information for abnormal conditions.

Skills (6)

Lesson Objectives

1. Understand why the need for a systematic approach to troubleshooting.
2. Identify how troubleshooting moves from the simple to the complex.

1504

Foundations of Electrical Troubleshooting

4 Day

Course Syllabus

In this hands-on, performance based training program, the participant develops skills to apply a systematic troubleshooting procedure to establish the cause for electrical system problems. Modified equipment and simulators are used in a laboratory to closely simulate the technician's normal work environment; and to enhance the effectiveness of the training. An expected outcome is a technician who can confidently and cost effectively complete a service repair request.

Introduction to Troubleshooting HVAC Electrical Systems (1)

Lesson Objectives

1. Apply methods for development of a logical approach to troubleshooting HVAC electrical systems.
 - 1.1 List the five steps to HVAC troubleshooting procedure for the COVER approach.
 - 1.2 List the controlled components (primary operating loads) on HVAC systems.
 - 1.3 In classroom situation, the participants will list the typical control components that affect the HVAC unit functions.
 - 1.4 In a classroom situation, the participant will list the customer selected operating modes of typical HVAC systems.
 - 1.5 Apply a mental process of elimination to the troubleshooting matrix to establish the cause for the malfunction of the controlled component.

Wiring Diagrams and Legend Symbols (2)

Lesson Objectives

1. In classroom/ laboratory situation and with proper tools, the participant will list the various wiring diagrams on the equipment that applies to troubleshooting.

Interpreting Schematic/Ladder Diagrams (3)

Lesson Objectives

1. Given assigned HVAC Trainers in Laboratory A/B with proper tools and available wiring diagrams, the participant will prepare and explain findings to other participants.
 - 1.1. In classroom/ laboratory situation and with proper tools, the participant will list the various wiring diagrams on the equipment that applies to unit relationship of defrost cycle.

Defrost Controls and Sequence of Operation (4)

Lesson Objectives

1. Relate the identification of affected or malfunctioning component to the troubleshooting procedure.
 - 1.1 State the controlled component observed inoperative.

Compressor/Motor Circuits and Accessories (5)

Lesson Objectives

1. Determine the condition of motor winding circuit for a controlled component.
 - 1.1 List the methods of determining the conditions of a capacitor
 - 1.2 List the function of start accessories of compressor motor circuits
 - 1.3 Determine the condition of motor winding in a single phase 230 motor compressor

Develop Troubleshooting Matrix (6)

Lesson Objectives

1. Can determine with confidence the exact cause of an electrical system failure by proper analysis of symptoms (instrument readings/data), schematics and component operations (i.e. use of troubleshooting matrices).

Application of Ladder/Schematic Diagrams (7)

Lesson Objectives

1. Can safely operate test instruments and observe equipment operation to verify the presence of and to identify specific electrical system, failure operating modes.

1505
Servicing HVAC Refrigeration Systems
4 Days

Course Syllabus

This hands-on, performance based training program is designed to develop technician skills to properly service HVAC refrigerant systems. This course emphasizes safety in presenting the proper techniques as the technician fabricates piping, replaces, and assembles a complete operational HVAC refrigerant system.

Refrigeration Tubing and Fabrication (1)

Lesson Objectives

1. Know the type of copper tubing used in HVAC service.
2. Understand the differences in refrigeration tubing and heating/plumbing tubing.
3. Know what is necessary to prepare tubing for fabrication.
4. Understand the process for cutting copper tubing.

Safety Using Oxy-Fuel Torches (2)

Lesson Objectives

1. Know the safety precautions when handling acetylene.
2. Understand the cylinder contents of acetylene.
3. Know the safety precautions when handling oxygen.
4. Understand the cylinder contents of oxygen.
5. Know the proper use of regulators for oxygen and acetylene.

Evacuation (3)

Lesson Objectives

1. Understand the different types of vacuum pumps used in HVAC service.
2. Know the proper evacuation methods used in HVAC service.
3. Understand when the evacuation process has been

1506
Servicing HVAC Electrical Systems
4 Day

Course Syllabus

In this hands-on, performance based training program, the inexperienced and experienced technician learns the importance of safety in servicing HVAC electrical system. Experienced technicians are provided the opportunity to evaluate their own proficiencies and to change their work habits as appropriate. Individual and team laboratory exercises are used to enhance the troubleshooting skills of the technician.

Troubleshooting Review (2)

Lesson Objectives

1. Review foundational information covered in the Course 1502 and 1504
2. Effectively troubleshoot electrical problems in four (4) units in lab.
3. Effectively apply proper troubleshooting techniques (as a team) in establishing the correct repair for two (2) sets of fifteen (15) electrical problems programmed into the computer trainers. (This will be accomplished during the week class is in session)

Solid State Devices (3)

Lesson Objectives

1. Be able to identify solid state components, their symbols, purpose, and how they operate.
2. Demonstrate the proper use of meters while evaluating solid state components.
3. Homework assignment, read content in Carrier GTE 8 and answer questions found within book.

Transformers (4)

Lesson Objectives

1. Understand "VA" calculations of step-down transformers.
2. Proper use of meters used to determine current load of low voltage components.
3. Effectively determine the proper size transformer for assigned units in lab.

Thermostat Installation and Honeywell Cross Reference Guide (5)

Lesson Objectives

1. Understand the proper guidelines for selecting the correct thermostat and proper location for the correct operation of wall mounted thermostats.
2. Understand the effects of wire size and voltage drop.
3. Review the causes of overcooling.
4. Utilize the Honeywell Cross Reference Guide in finding the thermostat replacement for assigned examples.

Programmable Thermostats (6)

Lesson Objectives

1. Learn the operational sequence of Honeywell, White-Roger and Maple Chase Programmable Thermostats.
2. Understand the benefits of Programmable Thermostats

Fossil Fuel Controls (7)

Lesson Objectives

1. Understand the logic of Fossil Fuel controls. (Restrictive, Non-Restrictive, and Modified Restrictive Modes)
2. Review the Fossil Fuel Controls for Rheem, Trane, Carrier, ICP, Nordyne and Goodman.

1507
Advanced Troubleshooting of HVAC Systems
3 Day

Course Syllabus:

To provide the technician with an opportunity to refine troubleshooting skills to solve multiple symptom problems (i.e., electrical, refrigeration, and air distribution).

Electrical System Troubleshooting Procedure (1)

Lesson Objectives: The participant will review and understand methods and techniques to establish the cause for an electrical system malfunction.

- 1.1 To review the electrical troubleshooting approach.
- 1.2 To review defrost controls and operating sequence.
- 1.3 To review dual fuel heat pump control options

Typical Electrical Schematic Wiring Diagrams (2)

Lesson Objectives: The participant will review typical electrical schematic wiring diagrams for the perimeter heat pump trainers.

- 2.1 To be able to interpret and use electrical schematic diagrams to determine the sequence of operation for selected trainers to be used in the lab.
- 2.2 To be able to analyze electrical loads in a circuit.

Refrigerant System Troubleshooting (3)

Lesson Objectives: The participant will review and understand methods and techniques to establish the cause for a refrigerant system failure.

- 3.1 To review the function and characteristics of refrigerant system components in the refrigerant cycle.
- 3.2 To review approach to troubleshooting refrigerant system problems.
- 3.3 To review and understand the operating parameters that may be used to confirm the cause for a refrigerant system problem.
- 3.4 To be able to calculate suction gas superheat.
- 3.5 To be able to calculate liquid line subcooling.
- 3.6 To be able to use a charging calculator to determine proper charging for fixed metering or for TXV type metering device.
- 3.7 To be able to analyze refrigerant flow/quantity type problems.

Typical Refrigerant System Schematics (4)

Lesson Objectives: The participant will review and understand the refrigerant piping, metering device options, drier configurations, valve access ports, and coil circuits for typical heat pump systems.

- 4.1 To be able to interpret and use refrigerant piping schematics to determine the refrigerant flow, and service access ports for typical heat pump systems.

Application and Installation Troubleshooting Procedure (5)

Lesson Objectives: The participant will review and understand methods and techniques to analyze application and / or installation type problems.

- 5.1 To be able to identify an application or installation problem.
- 5.2 To be able to perform an energy balance on an operating system to verify if the problem is an application problem or if the problem is a refrigerant system problem.
- 5.3 To be able to apply non-psychrometric formulas to evaluate the heat transfer capacities of the coil heat exchangers.

Refrigerant System Troubleshooting Decision Tree (6)

Lesson Objectives: The participant will become familiar with a job-aid to assist in analyzing key operating parameters to identify the cause of a refrigerant system problem.

- 6.1 To be able to compare abnormal operating parameters with the appropriate path on the decision tree to determine what could potentially be the cause for the refrigerant system problem.
- 6.2 Given a classroom / laboratory situation, trainer equipment, proper tools and job aids, the participant will apply troubleshooting methods and techniques to establish the cause for an equipment failure or malfunction.

Application of Troubleshooting Methods and Techniques (7)

Lesson Objectives: The participant will gain experience in applying methods and techniques to establish the cause for electrical, refrigerant system problems or combination type problems in a laboratory setting.

- 7.1 Given assigned heat pump trainers or heat pump simulators, proper tools and job aids in a laboratory situation, the participant will establish the cause for multiple equipment malfunctions.

1701
MAST – Module I
Application and Foundations
2 Day

Course Syllabus

This program is composed of four 2-day modules that are designed to equip the apartment maintenance technician with skills to perform preventive maintenance service; and to implement techniques to complete simple appliance and general electrical service and repair. The participant gains knowledge through a classroom environment and laboratory activities. This module includes terminology; an introduction to blueprint reading; safety; fundamentals of electricity; introduction to electrical circuits; and the proper use of meters and test equipment.

Terminology (1)

Lesson Objectives

1. Know and understand the definitions and terms used in maintaining and servicing major appliances; electrical circuits; and heating and cooling equipment in residential mutli-family housing.

Blueprint Reading (2)

Lesson Objectives

1. Understand how to interpret a set of blueprint drawings to obtain information and how to use this information in the maintenance and service of multi-family dwelling units and community buildings of residential developments.

Safety (3)

Lesson Objectives

1. Understand the when, where's and how's in which safety and use of personal protective equipment must be exercised when working in a hazardous location.

Fundamentals of Electricity and Introduction to Electrical Circuits (4)

Lesson Objectives

1. Understand the fundamentals of electricity and electrical circuits.

Meters and Test Equipment (5)

Lesson Objectives

1. Understand the purpose and use of voltmeters, ammeter, ohmmeter, and wattmeter and capacitor tester.

1702
MAST – Module II
Indoor Wiring
2 Day

Course Syllabus:

This program is composed of four 2-day modules that are designed to equip the apartment maintenance technician with skills to perform preventive maintenance service; and to implement techniques to complete simple appliance and general electrical service and repair. The participant gains knowledge through a classroom environment and laboratory activities. This module includes an overview of indoor appliance and lighting circuits; basic electrical components; troubleshooting symptoms; and maintenance and minor repair procedures.

Indoor Wiring (1)

Lesson Objectives

- 1.1 Participants will successfully select the proper definitions for electrical components and circuitry as follows:
(As defined by Richter/Schwan/Hartwell's Wiring Simplified 40th edition)
 - 1.1.1 Branch circuit
 - 1.1.2 Ampacity
 - 1.1.3 Continuous Load
 - 1.1.4 Disconnecting device
 - 1.1.5 Fuse size
 - 1.1.6 Circuit breaker for lighting
 - 1.1.7 Grounding materials
 - 1.1.8 Ground fault circuit interrupter
 - 1.1.9 Identified color for designation of hot wire
 - 1.1.10 equipment grounding
 - 1.1.11 code for residential wiring
 - 1.1.12 balanced load
 - 1.1.13 full load current rating
 - 1.1.14 non metallic shielded cable
 - 1.1.15 Type "S" fuse
 - 1.1.16 receptacle
 - 1.1.17 short circuit
 - 1.1.18 ground fault
 - 1.1.19 splice
 - 1.1.20 pigtail
 - 1.1.21 source
 - 1.1.22 voltage drop
 - 1.1.23 #12 current carrying capability

- 1.1.24 three-way wiring of switches
- 1.1.25 four way switches
- 1.1.26 single throw switches
- 1.1.27 power
- 1.1.28 wire terminal screw
- 1.1.29 hot leg
- 1.1.30 grounding screw for receptacles
- 1.1.31 hot leg from source
- 1.1.32 grounded neutral from source
- 1.1.33 switching wire from receptacle
- 1.1.34 improper wiring of four way switch
- 1.1.35 maximum distance for a receptacle from water
- 1.1.36 home run
- 1.1.37 circuit markings
- 1.1.38 length of receptacle box conductors
- 1.1.39 new construction wire size
- 1.1.40 length of appliance cords
- 1.1.41 ballast
- 1.1.42 HACR breaker
- 1.1.43 duplex receptacle
- 1.1.44 tripping breakers
- 1.1.45 fluorescent lamps flickers
- 1.1.46 wall switch replacement
- 1.1.47 two prong motors
- 1.1.48 too short conductors
- 1.1.49 number of wires in new dryers
- 1.1.50 proper stripping of conductors

Criteria Objective #1.1.1.1 - Given proper meters, wiring boxes, and appropriate components. The participant will be able to wire lighting and switching boxes on 90% of lab exercises.

1703
MAST – Module III
Appliances
2 Day

Course Syllabus

This program is composed of four 2-day modules that are designed to equip the apartment maintenance technician with skills to perform preventive maintenance service; and to implement techniques to complete simple appliance and general electrical service and repair. The participant gains knowledge through a classroom environment and laboratory activities. This module includes an explanation of appliance operation and basic repair procedures including repair of ranges, refrigerators, and water heaters.

Ranges (1)

Lesson Objectives

1. How the Electric Range Operates
2. Preventive Maintenance
3. Technical Assistance/Service Record
4. How to Use Problem Diagnostic Chart
5. Problem Diagnostic Charts
6. Procedures

Refrigerator (2)

Lesson Objectives

1. How a Refrigerator Operates
2. Refrigeration System
3. Preventive Maintenance
4. Safety Information
5. Technical Assistance/Service Record
6. How to Interpret Circuit Diagrams
7. How to Use Problem Diagnostic Chart
8. Problem Diagnostic Charts
7. Procedures

Water Heaters (3)

Lesson Objectives

1. Storage Water Heaters
2. Major Components of Electric Water Heaters
 - 2.1 Controls
 - 2.2 Relief Valve
 - 2.3 Dip Tube
 - 2.4 Anode
 - 2.5 Elements
 - 2.6 Tanks
 - 2.7 Insulation
3. Major Components of Fossil-Fuel Water Heaters
 - 3.1 Controls
 - 3.2 Air Vent
 - 3.3 Flue
 - 3.4 Heat Transfer
 - 3.5 Gas Burner
4. Storage Tank Style Alternatives
5. Service Requirements
6. Energy Conservation Measures

1704
MAST – Module IV
Heating & Air Conditioning Equipment
2 Day

Course Syllabus:

This program is composed of four 2-day modules that are designed to equip the apartment maintenance technician with skills to perform preventive maintenance service; and to implement techniques to complete simple appliance and general electrical service and repair. The participant gains knowledge through a classroom environment and laboratory activities. This module discusses the preventive maintenance procedures to maintain proper equipment performance. Techniques are established to check the operation and performance of the electrical, refrigerant, and air distribution systems; and to complete minor repair and general maintenance procedures.

Electrical Components (1)

Lesson Objectives

1. Safety
2. What is a Heat Pump?
3. Heating and Air Conditioning Components
4. Air Conditioning Wiring Diagrams
5. Thermostat
6. Component Test Procedure

System Performance (2)

Lesson Objectives

1. Determining Air Flow by Temperature Rise (Electric Heat)
2. Heating Performance (Compressor Only)
3. Cooling Performance
4. Components of the Split System Heat Pump

Maintenance and Minor Repair (3)

Lesson Objectives

1. Preventive Maintenance
2. HVAC Filter Schedule
3. Condensate Drain
4. Air Conditioning Troubleshooting
5. Electric Heat Troubleshooting
6. Heat Pump Troubleshooting

1800
HVAC System Analysis
4 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding of the benefits and knowledge of methods and techniques to analyze the HVAC System for proper performance.

Basic Principles of Refrigeration (1)

Lesson Objectives: The participant will understand the basic heat transfer principles that apply to HVAC system operation.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to identify factors contributing to structural heat gain.
- 1.3 To be able to identify factors contributing to structural heat loss.
- 1.4 To understand air-to-air heat pump performance characteristics.
- 1.5 To be able to recommend over-sizing limits for HVAC equipment applications.
- 1.6 To understand the techniques used to determine the thermal balance point for an example air-to-air heat pump application.
- 1.7 To be able to recommend sizing of an auxiliary heater on an air-to-air heat pump application.

HVAC System Options (2)

Lesson Objectives: The participant will be familiar with and recognize the various HVAC system options.

- 2.1 To be familiar with the various heating fuel equipment options.
- 2.2 To be familiar with the various cooling equipment options.
- 2.3 To be familiar with the efficiency rating methods.

HVAC Electrical System Performance Analysis (3)

Lesson Objectives: The participant will understand the principles of the electrical system operation and components.

- 3.1 To know and understand the electrical system operating modes and sequence of operation for HVAC space conditioning equipment (air-to-air heat pump, closed loop ground source heat pump, conventional air conditioning with fossil furnace).
- 3.2 To be able to perform in a laboratory setting an electrical system operation check (cycle check) to understand sequence of operation and energized loads for each mode of operation.
- 3.3 To be able to explain the defrost operating function of an air-to-air heat pump.
- 3.4 To be familiar with the operation of the two basic types of defrost controls.
- 3.5 To be able to identify the sequence of the defrost operation.
- 3.6 To be able to perform in a laboratory setting a heat pump electric system operation check (cycle check) using a laboratory worksheet to understand the proper load combination(s) to confirm normal operation of the system.
- 3.7 To be able to explain the electrical operation of a dual fuel heat pump installation.
- 3.8 To understand why a fossil fuel kit is needed on a dual fuel heat pump.
- 3.9 To understand thermostat options and operation.

HVAC Refrigerant System Components and Operation (4)

Lesson Objectives: The participant will understand the refrigerant cycle system component function and the effect of external factors on heat transfer performance.

- 4.1 To know and understand the heat pump refrigerant cycle (Inside the Heat Pump).
- 4.2 To understand what is a "Heat Source" and a "Heat Sink."
- 4.3 To recognize the components of the refrigerant cycle and the function of each component (operating and safety).
- 4.4 To understand technology used for HVAC operation under part load conditions.

Human Comfort Factors (Psychrometric Chart with Comfort Zone) (5)

Lesson Objectives: The participant will understand the air conditioning factors achieved by the proper operation of the HVAC equipment; and the use of the psychrometric chart (with the comfort zone plotted) to analyze the relationship of temperature, humidity and air movement on comfort.

- 5.1 To understand how the human body maintains the proper body temperature and the impact of ambient conditions on comfort.
- 5.2 To be able to identify the occupied (breathing) zone.
- 5.3 To understand and use the psychrometric chart as a tool to determine properties of air and analyze HVAC equipment performance as related to human comfort considerations.
- 5.4 To be able to apply in a laboratory setting the industry standard (ASHRAE Standard 55) to evaluate human comfort considerations.
- 5.5 To understand the sensible heat process.
- 5.6 To understand a cooling and dehumidification process.
- 5.7 To understand the sensible heat and total heat formulas.
- 5.8 To be able to explain the effect of equipment selection and operation on humidity control in a hot-humid climate.

Refrigerant System Performance Analysis (Capacity Check) (6)

Lesson Objectives: The participant will know, understand and apply proper methods and techniques for conducting an air conditioning or air-to-air heat pump refrigerant system performance analysis to verify the performance of an operating HVAC system.

- 6.1 In a laboratory setting, to measure and record the airflow across the indoor coil or blower.
- 6.2 In a laboratory setting, to measure and record the entering and leaving conditions (dry bulb and/or wet bulb) temperatures.
- 6.3 To be able to determine the total heat (enthalpy) based on the recorded entering and leaving wet bulb temperatures.
- 6.4 To be able to apply the sensible heat based on the recorded entering and leaving dry bulb temperatures
- 6.5 To be able to determine the latent heat capacity based on the difference between "Total Heat" and "Sensible Heat."
- 6.6 To be able to compare the calculated performance with the expected performance predicted from ARI or manufacturer's performance data.
- 6.7 To be able to determine the heating performance of the refrigerant system's compressor heat (1st stage) if a heat pump.

- 6.8 The participant will apply the methods and techniques in a laboratory setting for assigned heat pump perimeter trainer units.

Evaluating Refrigerant System Performance Analysis (7)

Lesson Objectives: The participant will know and understand the factors affecting the normal heating/cooling performance of the HVAC equipment, and how they affect the HVAC refrigerant system performance.

- 7.1 To understand factors affecting cooling performance.
- 7.2 To understand factors affecting heating performance.
- 7.3 To understand the impact of duct leaks on measured performance.
- 7.4 To understand how the operating conditions affect performance.

Air Distribution System Performance Analysis (8)

Lesson Objectives: The participant will know, understand and apply proper methods and techniques to analyze the air distribution system for a HVAC installation.

- 8.1 To understand the function of air distribution system components.
- 8.2 To understand the considerations used to analyze air distribution system performance. (i.e., airflow, duct leaks, duct loss/gain, and customer comfort problems)
- 8.3 To demonstrate good and poor duct design practices in air distribution in a laboratory setting.

Application and Installation Considerations (9)

Lesson Objectives: The participant will know and understand criteria for analyzing field application and installation considerations of a heat pump installation that could impact equipment performance and reliability.

- 9.1 To understand indoor equipment mounting, location, and support considerations.
- 9.2 To understand outdoor equipment mounting, location, and support considerations.
- 9.3 To understand refrigerant tubing insulation, size, length, lift, etc.
- 9.4 To understand condensate drains and plumbing considerations.
- 9.5 To understand space conditioning thermostat location, operation, mounting, etc.
- 9.6 To know that the indoor coil and outdoor unit must be ARI matched equipment.

Power Wiring Requirements (10)

Lesson Objectives: The participant will understand how to interpret nameplate electrical information.

- 10.1 To be able to determine the minimum circuit ampacity for an installed heat pump system.
- 10.2 To be able to determine the maximum over-current protection (fuse and/or HACR breaker) for an installed heat pump system.
- 10.3 To know that the indoor equipment nameplate on a heat pump with an auxiliary heater package must have the installed heater identified on the list of approved heater packages.
- 10.4 To know that local codes may be different from the National Electrical Code and takes precedence over the national code.

NOTE: This is an optional lesson that is generally omitted while discussing participants' expectations for the course!

Equipment Selection (11)

Lesson Objectives: The participant will be familiar with the application of ARI's Directory of Certified Unitary Equipment for selecting equipment combinations for which performance ratings are available.

- 11.1 To know the difference between ARI ratings and manufacturers' performance data at design rating conditions.
- 11.2 To understand how to access ARI and GAMA web-sites to search for equipment that is listed in the respective directories. These directories are no longer available in paper copy!
- 11.3 To understand the symbols and abbreviations used in the directories.

1801
Advanced HVAC System Analysis
4 Day

Course Syllabus:

To provide the marketing representative with an opportunity to perform a system analysis at a level above that experienced in Course 1800.

General Review of Course 1800 (1)

Lesson Objectives: The participant will review and understand methods and techniques established in Course 1800 to analyze a heat pump installation without removal of equipment panels.

- 1.1 To review the Heat Pump Quality Check form.
- 1.2 To review techniques to analyze a customer complaint.
- 1.3 To be able to identify symptoms related to the complaint.

Electrical System Operation (2)

Lesson Objectives: The participant will understand factors affecting the electrical system operation and performance of heat pump equipment.

- 2.1 In a laboratory setting, be able to determine the proper sequence of operation for the operating modes.
- 2.2 To understand the operating characteristics of a mechanical thermostat and impact on comfort.
- 2.3 To understand and in a laboratory setting apply procedures to determine the correct set-point for an adjustable heating anticipator.
- 2.4 To understand and in a laboratory setting apply procedures to calibrate the thermometer on the thermostat cover.
- 2.5 To understand and explain the purpose for protective controls found on heat pump equipment.

Dual Fuel Heat Pump Applications (3)

Lesson Objectives: The participant will review and understand the electrical operation and control of dual fuel heat pump applications.

- 3.1 To understand the dual fuel control operation for a dual fuel heat pump application.
- 3.2 To understand the operating modes and sequence of operation for a dual fuel heat pump installation...
- 3.3 To understand and apply procedures to determine the thermal or application balance point for a dual fuel heat pump application.
- 3.4 To understand procedures to determine the economic balance point for a heat pump application.

Refrigerant System Performance (4)

Lesson Objectives: The participant will establish the refrigerant system performance by analyzing the airside performance for the cooling and/or 1st stage heating operating modes.

- 4.1 To review the basic refrigeration cycle
- 4.2 To review methods and techniques established in Course 1800 and in a laboratory setting analyze the airside performance of an operating heat pump.
- 4.3 To accurately determine the system airflow across the indoor coil of a heat pump using the velocity or temperature rise method.
- 4.4 To understand and apply non-psychrometric formulas to analyze the airside performance of the condenser and / or evaporator heat exchangers.
- 4.5 To develop a procedure to determine the system airflow across different grille configurations.
- 4.6 To be able to determine the sensible heat ratio (SHR) for a heat pump application.
- 4.7 To understand the impact of changes in indoor wet bulb, dry bulb, outdoor temperature, airflow on performance.
- 4.8 To understand the energy balance diagnostic technique.

Interpreting Product Literature for Various Operating Conditions (5)

Lesson Objectives: The participant will review and understand methods and techniques to interpret product literature and of how the operating conditions affect the refrigerant system performance.

- 5.1 To be able to apply methods and techniques to interpret manufacturers' literature for equipment selection and for performance evaluation.
- 5.2 To understand guidelines for interpretation of manufacturer's performance data.
- 5.3 To understand the limitations of using ARI Directory of Certified Unitary Equipment ratings for equipment selection and for performance analysis.
- 5.4 To understand the effect of various operating conditions on heat pump refrigerant system performance.
- 5.5 To understand the application of generic job-aids for estimating the approximate performance in the absence of extended ratings for the manufacturer's equipment.

Examples of Manufacturer Performance Data (6)

Lesson Objectives: The participant will understand the various formats for providing the extended performance data and the interpolation for conditions not specifically provided.

- 6.1 To be able to interpolate for conditions not listed or provided in the manufacturers' extended performance data.

Laboratory Exercise (7)

Lesson Objectives: The participant will apply methods and techniques to determine the refrigerant system performance and classify the installation as being normal or abnormal.

NOTE: The identification of a system malfunction requires special skills to determine the exact cause of the system problem. The purpose of this exercise is to improve the participant's confidence level to evaluate refrigerant system performance.

- 7.1 Given assigned heat pump perimeter trainers in a laboratory setting and with proper tools, etc., the participant will determine the system airflow; and refrigerant system performance, and note temperature sensations as instructed.

The laboratory exercise for each trainer will be discussed upon and reviewed completion of the exercise. If desired, the participant may repeat the exercise.

Factors Affecting Refrigerant System Performance (8)

Lesson Objectives: The participant will understand factors affecting refrigerant system performance and symptoms indicating the presence of a refrigerant system problem.

- 8.1 To be able to identify heat transfer problems.
- 8.2 To be able to identify symptoms associated with refrigerant quantity problems.
- 8.3 To be able to identify symptoms associated with refrigerant flow problems.
- 8.4 To be able to identify non-refrigerant system performance factors.

Discharge Line Water Heater Applications (DLWH) (9)

Lesson Objectives: The participant will understand the performance factors for discharge line water heater application and installation.

- 9.1 To be able to identify if the installation is acceptable for a proper application.
- 9.2 To understand considerations for the DLWH installation.
- 9.3 To understand refrigerant flow/piping installation considerations.
- 9.4 To be able to size installed water lines between the DLWH and the domestic hot water heater. Use installation guidelines manual.
- 9.5 To be able to verify performance of the DLWH installation for proper operation.

Air Distribution System Performance (10)

Lesson Objectives: The participant will understand the factors affecting the air distribution system performance in providing customer comfort.

- 10.1 To understand the objectives of the air distribution system.
- 10.2 To understand the desired results of the air distribution system performance.
- 10.3 To understand measures for zone control.
- 10.4 To understand supply terminal selection and location on performance.
- 10.5 To understand return grille selection and location on performance.
- 10.6 To understand methods to eliminate noise problems.
- 10.7 To understand air balancing for uniform temperatures.
- 10.8 To understand the importance of duct insulation installation.

1802
Residential Load Calculations
4 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding of how to apply ACCA Manual J, 8th Edition, load calculation procedures to a residential design process; and of how to determine the input values for a software program.

Basic Principles and Terminology (2)

Lesson Objectives: The participant will understand the basic heat transfer principles that apply to residential comfort conditioning and the importance of an accurate heat loss and heat gain load calculation for residential applications.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to apply Tables in the manual to determine the R-Factor for building materials used to construct a wall or ceiling component.
- 1.3 To be able to calculate the total R-Value for a structural component with a parallel path for conduction.
- 1.4 To be able to calculate the U-Factor for a building component.
- 1.5 To be able to identify the proper heat transfer formula for calculating a heating or cooling load.

Area Measurement (2)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately measure component areas separating a conditioned space from an unconditioned space or exposed to outside conditions.

- 2.1 To be able to identify building components from plans or site visit during the survey of the dwelling.
- 2.2 To be able to apply equations to calculate areas of typical shapes (rectangle, trapezoid, triangle, circle, oval, hexagon, octagon) that may be determined during the plan survey.
- 2.3 To be able to apply equations to calculate volumes of typical spaces (box, wedge, cylinder, sphere) that may be determined during the plan survey.
- 2.4 To be able to apply measurement protocols to record the width, length, and height for building components.
- 2.5 To be able to identify the construction number assigned to the possible structural components making up the building envelope.

Structural Heat Loss (3)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately determine the heat loss for an in-class residential example.

- 3.1 To be able to select the outdoor design conditions for the example using Table 1 from the manual.
- 3.2 To be able to select the indoor design conditions for the example using default values or customer preference if appropriate.
- 3.3 To be able to calculate the design heating temperature difference (HTD) for the example problem.
- 3.4 To be able to apply the proper formula to calculate the heat loss for each structural component.
- 3.5 To be able to determine the winter infiltration load and HTM using Table 5 and the building tightness description.
- 3.6 To be able to apply tables to calculate the duct heat loss factors for duct locations outside of the conditioned space.
- 3.7 To be able to determine the total heat loss for the in-class residential example.

Structural Heat Gain (4)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately determine the heat gain (sensible and latent) for the in-class residential example used in Lesson 3.

- 4.1 To be able to select the outdoor design conditions for the example using Table 1 from the manual.
- 4.2 To be able to select the indoor design conditions for the example using default values or customer preference if appropriate.
- 4.3 To be able to calculate the design cooling temperature difference (CTD) for the example problem.
- 4.4 To be able to apply the proper formula to calculate the sensible heat gain for each structural component.
- 4.5 To be able to determine the summer infiltration load and HTM using Table 5 and the building tightness description.
- 4.6 To be able to determine the internal sensible heat gain and latent heat load based on the assumptions given in the in-class residential example problem.
- 4.7 To be able to apply Tables to calculate the duct heat gain factors (sensible and latent) for duct locations outside of the conditioned space.
- 4.8 To be able to determine appropriate ventilation considerations for adequate indoor air quality.
- 4.9 To be able to determine the total heat gain for the in-class residential example.

Equipment Selection (5)

Lesson Objectives: The participant will understand and apply techniques to properly size equipment for an example problem to optimize the sensible and latent heat capacities by comparing possible equipment options for an example manufacturer.

- 5.1 To be able to calculate the sensible heat ratio based on the total sensible and total heat gain calculations.
- 5.2 To be able to select the design temperature difference (TD) between the coil entering air temperature (RAT) and the coil leaving air temperature (LAT).
- 5.3 To be able to calculate the approximate or initial cooling cfm for evaluating the sensible and latent heat capacities for possible equipment options.
- 5.4 To be able to interpret performance data for an example manufacturer.
- 5.5 To be able to determine the maximum equipment size for cooling based on industry recommendations.
- 5.6 To be able to determine the maximum equipment size for heating based on industry recommendations.
- 5.7 To be able to calculate the thermal balance point given the total heat loss at a given outdoor design temperature; and heating performance data for a selected heat pump application.
- 5.8 To be able to determine the minimum auxiliary heat requirements (if heat pump).
- 5.9 To be able to determine the recommended auxiliary heat requirement (if heat pump).

Individual Exercise Example – Jay Smith Residence (6)

Lesson Objectives: The participant will apply techniques and skills learned to properly calculate the heating and cooling loads for the example problem.

- 6.1 To be able to complete the Form J-1 and the Average Load Procedure, Single Zone System worksheets for Generic Fenestration. Questions may be asked of the instructor.

Individual Exercise Example – Jay I Residence (7)

Lesson Objectives: The participant will apply techniques and skills learned to accurately calculate the heating and cooling loads for the example problem.

- 7.1 To be able to complete the Form J-1 and the Average Load Procedure, Single Zone System worksheets for Generic Fenestration. Questions may be asked of the instructor.
- 7.2 To be able to record the appropriate areas, etc., on Form J-1 for a room-by-room heat loss and heat gain analysis.

1803
Residential Duct Design
4 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding of how to apply ACCA Manual D, residential duct design procedures to a typical residential air distribution system design process based on Manual J, 8th Edition, room-by-room loads.

Overview of Manual J, 8th Edition (1)

Lesson Objectives: The participant will review Manual J procedures applied to accurately determine the heat loads for a residential application and to recognize the importance of equipment selection and air-distribution systems performance.

- 1.1 To understand the application of design principles to calculate the whole house load; and to calculate the room-by-room loads.
- 1.2 To understand duct loads associated with ducts installed outside of the conditioned area.
- 1.3 To understand the equipment selection process for the installation.
- 1.4 To understand the three requirements of the air distribution system.
- 1.5 To understand the impact of duct leaks on equipment performance and operating costs.

Psychometrics (2)

Lesson Objectives: The participant will understand the psychrometric chart and its use in determining air properties that relate to conditioning of air for human comfort and of equipment performance.

- 2.1 To be able to locate air properties on the chart given any two of the properties.
- 2.2 To be able to plot a dry bulb temperature.
- 2.3 To be able to plot a wet bulb temperature.
- 2.4 To be able to determine if a condition is acceptable for human comfort based on industry standards.
- 2.5 To understand techniques that may be used to increase or decrease the latent heat capacity of an installation.

Air Distribution Selection (3)

Lesson Objectives: The participant will understand the considerations for selecting the type of air distribution system and performance characteristics.

- 3.1 To be able to recognize the air distribution system types by visual reference.
- 3.2 To understand the preferred application for each system type.
- 3.3 To understand the options for the air discharge direction into the room.

Equipment Selection (4)

Lesson Objectives: The participant will apply procedures to select HVAC equipment that will satisfy the heat loads of a residential structure and with adequate airflow for comfort conditioning.

- 4.1 To be able to select the equipment based on sensible cooling and latent heat capacity; and operating conditions.
- 4.2 To understand the importance of selecting the proper equipment capacity for the application.
- 4.3 To be able to select the equipment based on the heating capacity for the design conditions.
- 4.4 To be able to determine the auxiliary heater requirement.
- 4.5 To understand the application of dual fuel heat pumps.
- 4.6 To be able to select and determine the blower performance for the equipment selected.

Duct Design Procedure (Outlined) (5)

Lesson Objectives: The participant will apply methods and techniques presented in a "Duct Design Outlined" handout to locate and size air distribution components for residential applications.

- 5.1 To be able to determine the type of supply and return duct system and where to locate duct.
- 5.2 To be able to select the equipment and air distribution system components.
- 5.3 To be able to determine the number, type and location of airside devices.
- 5.4 To be able to select the space conditioning equipment and blower performance.
- 5.5 To be able to calculate the design cfm for supply branch ducts.
- 5.6 To be able to select a location for the air handling equipment.
- 5.7 To be able to sketch a single line diagram of the supply and return duct systems.

- 5.8 To be able to calculate the design cfm for the supply trunk ducts.
- 5.9 To be able to calculate the design cfm for the return branch ducts.
- 5.10 To be able to calculate the design cfm for the return trunk ducts.
- 5.11 To be able to apply Appendix 3 to determine the equivalent length (EL) for duct fittings and transitions.
- 5.12 To be able to select potential duct runs that could have the highest resistance to air flow (i.e. longest total effective length).
- 5.13 To be able to calculate the Friction Rate (FR) for the design problem.
- 5.14 To be able to apply the Friction Rate (FR) to size the duct runs.
- 5.15 To be able to use a duct slide rule or duct calculator to size duct runs.
- 5.16 To be able to verify acceptable velocity limits using Appendix 1 and duct slide rule or duct calculator.
- 5.17 To be able to select and size the supply and return diffusers, registers, and/or grilles.

Grille and Register Selection (6)

Lesson Objectives: The participant will be familiar with grille and register selection factors used in a manufacturer's catalog that will deliver the required air volume, throw and spread for the space and outlet location selected.

- 6.1 To be familiar with supply outlet location considerations. (Serve heating and cooling, proper mixing of air, uniform room conditions, drapes or furniture placement, length of duct run.)
- 6.2 To be familiar with a list of "Do's and Do Not's & Rules of Thumb."
- 6.3 To be familiar with the comparative performance of outlets (floor, baseboard, low sidewall, high sidewall, and ceiling).
- 6.4 To be familiar with design objectives in selecting supply terminals.
- 6.5 To understand the definitions and relationships of throw, spread, drop, pressure drop and delivered cfm.
- 6.6 To be able to recommend the acceptable locations for supply air terminals.

In-Class Duct Design Exercises (7)

Lesson Objectives: The participant will apply techniques and skills learned to properly calculate the heating and cooling loads for multiple example problems.

- 7.1 To be able to complete the Form D. Questions may be asked of the instructor.
- 7.2 To be able to adjust the design Friction Rate (FR) for different duct construction materials.

Individual Duct Design Exercise (8)

Lesson Objectives: The participant will apply techniques and skills learned to properly calculate the heating and cooling loads for an assigned example problem.

- 8.1 To be able to complete the "Duct Sizing Work Sheet" for all duct runs.
- 8.2 To be able to determine the supply and return duct runs with the longest Total Effective Length (TEL).
- 8.3 To be able to adjust the design Friction Rate (FR) for different duct construction materials.
- 8.4 To be able to verify duct velocity limits.

Short Cut Duct Design Procedure (9)

Lesson Objectives: The participant will compare a short cut duct design procedure to the ACCA, Manual D procedure for the individual design problem.

- 9.1 To be able to complete the "Square-foot" short cut duct sizing technique.
- 9.2 To recognize assumptions that should be considered in applying short cut duct sizing methods. (Internal loads, window areas, exposures, ceiling height, etc.)
- 9.3 To understand that delivered cfm to a room is satisfactory if within ± 10 percent of the design cfm for the room.
- 9.4 To be aware of the potential problems with the application of a short cut method!

1804
Ohm's Law
2 Day

Course Syllabus:

This training course uses classroom and laboratory exercises to enable the participant to learn and develop a working knowledge of Ohm's Law and its application in residential and light commercial electrical loads and services. Follow-up field application of procedures established in this training will enable the participant to more confidently accomplish the anticipated course outcomes.

The Generation Story (1)

Lesson Objectives

1. Be able to identify primary, secondary and transmission lines by inspection.
2. Be able to identify the most common method of Generating AC power in the US.
3. Be able to specify the maximum voltage drop allowed on APCo distribution system.
4. Be able to determine ownership of an overhead service entrance.
5. Be able to determine ownership of an underground service entrance
6. Rate Terms and Definitions.

Definitions Related to Ohm's Law (2)

Lesson Objectives

1. Be able to define an electric circuit
2. Be able to define voltage, current, resistance, and inductance.
3. Be able to identify an insulator and conductor
4. Be able to explain electromagnetic theory and how electricity is generated

Ohm's Law (3)

Lesson Objectives

1. Be able to define a series circuit
2. Be able to define a parallel circuit
3. Be able to calculate real power
4. Be able to apply Ohm's Law in order to calculate voltage, current and resistance
5. Be able to calculate 1 Φ and 3 Φ power

Application of Ohm's Law in the Residential and Commercial Markets (4)

Lesson Objectives

1. Be able to apply the principles of voltage, resistance and current in specified marketing situations
2. Be able to determine the KW requirements of a heat pump's indoor and outdoor units from the name plate.
3. Be able to calculate voltage drop
4. Be able to calculate and balance 3 Φ loads in a power panel

Metering (5)

Lesson Objectives

1. Be able to explain meter movement as it pertains to Kwh and Demand meters.
2. Be able to calculate CT and PT ratios and describe how they determine Kw and Kwh readings.
3. Be able to calculate KW demand by clocking a Kwh meter.
4. Understand how power surges register on demand meters.

Transformer Connections (6)

Lesson Objectives

1. Be able to match service voltages to customer class
2. Be able to identify a 120/240 volt 3 Φ transformer bank
3. Be able to identify a 120/208 volt 3 Φ bank
4. Be able to identify an open delta transformer bank
5. Be able to identify an 277/480 volt bank

1805
Competition in the Residential Market
2 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding and knowledge of customer options or competitive choices in the residential market; and with facts regarding energy choices, efficiency ratings, and energy use.

Efficiency Definitions and Terminology (1)

Lesson Objectives: The participant will know and understand the efficiency definitions and terminology used to compare and rate various energy consuming equipment.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to explain the difference between rating terms.
- 1.3 To be able to explain and use job-aids in presentations.

Comparative Energy Quantities (2)

Lesson Objectives: The participant will know and understand the comparative heat content of various energy sources and units of heat energy for conducting an economic analysis.

- 2.1 To be able to explain the difference between the heat sources for heat pumps and fossil fuel burning appliances.
- 2.2 To know the btus delivered per unit for various fuel sources.
- 2.3 To be able to explain DOE's comparative thermal values for one (1) million btus of energy.
- 2.4 To be able to apply formulas to determine the input energy requirement based on a given output or useable energy.
- 2.5 To be able to complete a practical exercise to compare comparative energy quantities while using various job-aids.
- 2.6 To be able to determine the "Breakeven COP" for a heat pump application given fossil furnace efficiency and unit fuel costs for the appropriate energy source comparisons.

Prospect Proposal (3)

Lesson Objectives: The participant will compare potential customer options for a scenario that assumes a typical average home of 1,800 square-feet located in a region to be selected.

- 3.1 To be able to recognize the customer options in the scenario.
- 3.2 To apply the information provided in a subsequent example.

Space Conditioning Options (4)

Lesson Objectives: The participant will become familiar with the typical options from which a customer may choose their space conditioning equipment and the perceived customer advantages or disadvantages.

- 4.1 To select from a list the primary equipment options customers are likely to select.
- 4.2 To be able to make a list of what may be perceived as customer advantages or disadvantages for assigned option(s).
- 4.3 To be able to identify the major space conditioning option for their region.
- 4.4 To be able to discuss turning disadvantages for preferred options into advantages.

Fossil Equipment Definitions and Terminology (5)

Lesson Objectives: The participant will know and understand the fossil equipment definitions and terms applicable to fossil fuel equipment.

- 5.1 To be able to match a term with a definition from a list.

The Fossil Fuel Furnace (6)

Lesson Objectives: The participant will understand the function, characteristics and operation of the competitors' fossil fuel equipment

- 6.1 To be able to identify the major components on a fossil fuel furnace.
- 6.2 To be familiar with the installation configuration options (upflow, downflow, horizontal, low-boy, etc.)
- 6.3 To know the btuh input rating for each burner.
- 6.4 To know the purpose of the gas regulator.
- 6.5 To know the difference between a standard furnace and a condensing furnace.
- 6.6 To know that heat is released by combustion of the fuel, oxygen, and heat.
- 6.7 To know that the blue flame indicates a Bunsen burner in which air mixes with the gas prior to combustion.

- 6.8 To know that insufficient primary air results in a yellow flame and carbon monoxide may result.
- 6.9 To know that "soot" is the result of insufficient secondary air.
- 6.10 To know that the flue gas temperature decreases with an increase in efficiency.
- 6.11 To know that secondary air is used after ignition.
- 6.12 To know the purpose of the ignition or pilot light.
- 6.13 To know that the return plenum must be sealed to prevent mixing of combustion gases with circulating air - carbon monoxide may result.
- 6.14 To be familiar with the purpose and characteristics of the venting system.

Water Heating Options (7)

Lesson Objectives: The participant will understand the comparison of competition's major domestic appliances with those of electric.

- 7.1 To be able to explain the operation of the two elements in an electric water heater.
- 7.2 To be able to explain the first hour rating of a water heater.
- 7.3 To be able to estimate the operating cost of gas vs. electric water heaters.
- 7.4 To be able to explain the operation of an instantaneous water heater.
- 7.5 To know that the minimum Energy Factor for a gas water heater vs. an electric water heater.
- 7.6 To be able to explain the application and installation of a discharge line water heater (DLWH).

Energy Estimating Methods (8)

Lesson Objectives: The participant will be familiar with the methods and job-aids that may be used to estimate energy consumption for space conditioning equipment.

- 8.1 To be able to estimate the energy use for a fossil furnace based on a given heat loss and a given location by using the heating degree day method.
- 8.2 To be able to estimate the fan energy use for a fossil furnace of a stated size based on a given heat loss and a given location.
- 8.3 To be able to estimate the energy use for a heat pump with a stated HSPF based on a given heat loss and a given location by using the heating degree day method.
- 8.4 To be able to estimate the cooling energy use for an air conditioner or heat pump using the cooling degree method.

- 8.5 To be able to estimate the cooling energy use for an air conditioner or heat pump using the EFLH (Equivalent Full Load Hour) method.
- 8.6 To understand the temperature bin method to estimate heating energy use for a heat pump.

Owning and Operating Cost (9)

Lesson Objectives: The participant will be familiar with the various methods used to compare the operating cost (i.e. simple payback, present worth, etc.)

- 9.1 To be able to match a term with a definition from a list.
- 9.2 To be able to apply the simple payback formula to compare two options.
- 9.3 To be able to apply the present value formulas to compare two options.

1806
Residential Energy Efficient Construction
3 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding of the benefits and knowledge of energy efficient building construction methods; thermally efficient materials; construction techniques to reduce air infiltration in new construction.

Efficiency Definitions and Terminology (1)

Lesson Objectives: The participant will know and understand efficiency definitions and terminology used to compare and rate various energy conserving options.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to explain the difference between efficiency rating terms.

The Planning and Construction Process (2)

Lesson Objectives: The participant will understand the process of the building of a house from the developer, architect, house planner, builder, realtor, and the home buyer.

- 2.1 To be familiar with the four steps of the planning and construction process.
- 2.2 To be familiar with the general activities and inspections required during construction until certificate of occupancy is issued.
- 2.3 To be familiar with the plan specifications describing materials to be used.
- 2.4 To be informed that some companies use a computer program to compare the cost differentials for different construction features.

The Building Envelope (3)

Lesson Objectives: The participant will understand the building and environmental factors to be considered in an energy efficient building envelope; and to understand the proper location of the thermal, air, and moisture barriers.

- 3.1 To recognize concerns of climate factors and conditions in energy efficient construction.
- 3.2 To recognize changes in the heating / cooling load profiles (i.e. sensible, latent).
- 3.3 To be more informed when communicating with clients.
- 3.4 To recognize the impact of a proposed change on customer comfort or health.

Construction Details and Materials (4)

Lesson Objectives: The participant will understand the nomenclature relating to construction details for typical residential construction practices; traditional and alternative construction materials; and to review a guideline for energy efficient construction practices.

- 4.1 To be familiar with construction nomenclature and framing details.
- 4.2 To understand a guideline for energy efficient construction.
- 4.3 To be able to discuss the options for enhancing the energy efficient of the building envelop shell. (Foundation, Basement and Crawl Space, Exterior Wall, Windows, Doors).
- 4.4 To be able to communicate options with the consumer.

Infiltration and Moisture Barrier Options (5)

Lesson Objectives: The participant will understand the infiltration and moisture barrier options used in residential energy efficient construction and the sources of air infiltration.

- 5.1 To be able to identify the major sources of air infiltration.
- 5.2 To be able to identify the air leakage sites in conventional construction.
- 5.3 To be able to discuss measures to reduce air leakage with the consumer.

Roof and Ceiling Types and Options (6)

Lesson Objectives: The participant will understand the characteristics of roof and ceiling types and the energy efficient construction options.

- 6.1 To be able to discuss ceiling insulation R-Values with the consumer.
- 6.2 To be familiar with measures to seal penetrations in the ceiling boundary.
- 6.3 To be familiar with raised trusses and insulation baffles as measures to increase insulation effectiveness in restricted spaces near the exterior load bearing walls.
- 6.4 To recognize the typical roof types used in residential construction.
- 6.5 To be able to communicate options with the consumer.

Ventilation Options (7)

Lesson Objectives: The participant will understand the FHA requirements for attic ventilation and options for ventilation of crawl spaces.

- 7.1 To be able to discuss attic ventilation options with the consumer.
- 7.2 To be able to discuss alternatives for ventilating of crawl space areas.
- 7.3 To be able to calculate the ventilation requirements for a house with a gable roof this is built over a crawl space with a 6 mil polyethylene vapor barrier.

Radiant Barriers (8)

Lesson Objectives: The participant will be familiar with the application and with the expected benefit of radiant barriers installed under a vented attic space.

- 8.1 To be able to discuss the use of radiant barriers in attic applications with the consumer.

Water Heater and Appliance Options (9)

Lesson Objectives: The participant will be familiar with water heater options.

- 9.1 To be able to discuss the energy efficiency of water heating appliances with the consumer.
- 9.2 To be able to discuss installation techniques that may be helpful to the consumer in reducing energy consumption.
- 9.3 To be able to discuss water heater appliance alternatives.
- 9.4 To be able to inform the consumer that ENERGY STAR labeled appliances are more energy efficient.

Space Conditioning System Options (10)

Lesson Objectives: The participant will be familiar with the proper application and installation of space conditioning equipment.

- 10.1 To be able to discuss the necessity to properly size and select the HVAC equipment.
- 10.2 To be able to discuss installation techniques that may be helpful to the consumer in reducing energy consumption of the HVAC equipment.
- 10.3 To be able to discuss changes in the sensible and latent load percentages in energy efficient homes...
- 10.4 To be able to inform the consumer of the need for proper maintenance of the equipment.

Air Distribution System Options (11)

Lesson Objectives: The participant will be familiar with the proper application and installation of the air distribution system.

- 11.1 To be able to discuss the necessity to properly size the duct system.
- 11.2 To be able to discuss installation techniques to better seal the duct system.
- 11.3 To be able to discuss the proper selection of supply outlets to adequately handle reduced airflow volumes associated with smaller equipment.
- 11.4 To be able to inform the consumer of the need for proper maintenance of the air filtration system.

Air Infiltration and Duct Leakage (12)

Lesson Objectives: The participant will be familiar with the impact that air infiltration and duct leakage has on operating cost and comfort. A blower door and air duct tightness tester will be demonstrated to evaluate the effectiveness of air sealing of the building envelope.

- 12.1 To understand the increased energy costs resulting from higher infiltration rates (ach) and duct leakage.
- 12.2 To be able to discuss the advantages of airtight construction with the consumer.
- 12.3 To understand the results of the blower door tests and duct air tightness tester.
- 12.4 To be able to inform the consumer of other benefits resulting from air tight construction.

1807
Air Duct Fabrication, Installation, Testing and Repair
4 Day

All course material and classroom presentations are copyright by NAIMA – North America Insulation Manufacturers Association. Participant will receive a certificate upon completion of course material. No exam, only hands-on fabrication in lab through out the week.

1807 – Air Duct Fabrication, Installation, Testing and Repair

Course Syllabus:

In this hands-on, performance based training program, processes are used to enable inexperienced personnel to understand and apply recommended methods and techniques to fabricate duct from fibrous board material; select outlet location; size duct based on general CFM requirements; to attach the branch ducts to the trunk duct; seal duct system component attachment fittings; and to repair air leaks in the air distribution system. Experienced personnel are provided the opportunity to enhance their knowledge of fibrous duct fabrication and installation methods and practices.

Anticipated Outcomes:

1. Can use tools and accessories in a safe manner in the fabrication and installation of fibrous duct board material.
2. Can apply short-cut techniques to size the duct to deliver the required airflow (CFM).
3. Can layout the dimensions to form the trunk duct using the "shiplap" grove fabrication methods for fibrous board duct material.
4. Can apply methods and techniques to layout and form duct transition and offset fittings.
5. Can apply methods and practices to assemble the duct using approved duct closure methods.
6. Can apply approved techniques to attach the round branch duct to the trunk duct using spin-in or dovetail take-off collars; understand methods and requirements for support duct materials.
7. Can demonstrate methods to determine and quantify duct leakage.
8. Can apply approved duct sealant to repair duct leaks.

1809
Air Infiltration Diagnostics and Repair Techniques
4 Day

Course Syllabus:

To provide the residential marketing representative (and other participants) with an understanding and knowledge to systematically implement state-of-the-art diagnostic techniques and equipment to locate and to repair penetrations in the air barrier of the structural envelope.

Air Infiltration Diagnostics Terminology (1)

Lesson Objectives: The participant will know and understand the definitions and terminology used in the discussion and implementation of air infiltration diagnostics.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to associate the proper term with diagnostic procedures.

Physics of Pressures and Differences (2)

Lesson Objectives: The participant will know and understand the causes and consequences of pressure differences across the pressure boundary of the building envelope.

- 2.1 To be able to explain the "House as a System."
- 2.2 To be able to define a Pascal as a metric unit of pressure measurement.
- 2.3 To understand the requirements (air + driving force + hole) for movement of substances across the pressure boundary.
- 2.4 To be able to identify the key air and thermal envelope connections.
- 2.5 To be able to identify the typical envelope and air leakage sites.
- 2.6 To understand the distribution of air infiltration by building component.
- 2.7 To be able to identify the six driving forces for air flow.
- 2.8 To be able to identify the dominant duct leak source.
- 2.9 To be able to explain the result of interior door closures.
- 2.10 To be able to identify conditions for combustion appliance back-drafting.
- 2.11 To be able to identify moisture sources that may enter across the pressure boundary.

Health and Safety Considerations for Pre/Post Repairs (3)

Lesson Objectives: The participant will be aware of the importance of identifying any pre-existing health and safety conditions that must be corrected before repairs are initiated or will be corrected as a result of repairs.

- 3.1 To be able to recognize the responsibility of knowing what is happening or may happen.
- 3.2 To be able to determine the House Depressurization Limits (HDL) where fossil fired appliances are used.
- 3.3 To be able to identify carbon monoxide exposure limits for a one-hour and for an eight-hour exposure.
- 3.4 To understand when duct repair should not be undertaken.
- 3.5 To be able to apply procedures in a laboratory setting to conduct a combustion safety test by completing a dominant duct leak test, door closure test, and worst case fan depressurization test.

Blower Door Set-up Techniques for a Depressurization / Pressurization Test (4)

Lesson Objectives: The participant will demonstrate proficiency to unpack and install the blower door components and accessories and conduct a depressurization or pressurization test.

- 4.1 To understand suggested "Tips and Tricks" for successfully installing the blower door.
- 4.2 To be able to properly install the blower door.
- 4.3 To be able to identify the hose color recommendations for measuring reference pressures.
- 4.4 To be able to survey the house prior to conducting the test to identify any suspected problems.
- 4.5 To be able to prepare the house for conducting the test.
- 4.6 To be able to conduct a single point test in a laboratory setting using a worksheet or other form.
- 4.7 To be able to apply charts or job-aids to evaluate the Building Tightness Limits ($\text{cfm}_{50\text{min}}$) for Zone 3.
- 4.8 To be able to evaluate the potential for air infiltration reduction based on minimum infiltration air changes per hour (ach_{na}).

Envelope Air Leakage Quantity (Cfm) / Air Changes per Hour (ach) (5)

Lesson Objectives: The participant will know and understand how to conduct a multipoint test to estimate the infiltration cfm and natural air changes per hour.

- 5.1 To be able to install blower door equipment and components for a multipoint test.
- 5.2 To be able to operate the blower door fan control to obtain fan pressures/cfm for six to ten readings that is approximately 5 PASCAL's difference between subsequent readings.
- 5.3 In a laboratory/classroom setting, be able to record readings on a test form for subsequent entering into a computer software program.
- 5.4 In a laboratory/classroom setting, be able to determine the estimated natural air changes per hour for summer, winter and annual average conditions.

Cost Effective Repair Measures (6)

Lesson Objectives: The participant will understand considerations for establishing guidelines for cost effective repairs.

- 6.1 To be able to pressurize or depressurize the structure to identify where large leaks appear to be located.
- 6.2 To be familiar with the implementation of testing and repair considerations for air sealing that reduce the potential for health and safety problems as repairs are made.
- 6.3 To be able to select a minimum cfm rate based on number of occupants, exposure, levels, and area.
- 6.4 To be familiar with establishing a cost-effective guideline where it is economical to continue repairs.

Air Duct Tightness Tester Set-Up (Duct Blaster™) (7)

Lesson Objectives: The participant will understand the techniques for using an air duct tightness tester to evaluate the total duct leakage for a dwelling and the duct leakage to the inside.

- 7.1 To be able to prepare the duct system for the air duct tightness test.
- 7.2 To be able to install the air duct tightness tester for a pressurization or depressurization test.
- 7.3 To be able to operate the air duct tightness fan control to maintain the desired duct pressure.
- 7.4 To be able to calculate or record the total duct leakage.
- 7.5 To be able to set-up the blower door and air duct tightness tester (7.2) to estimate the duct leakage to the inside.
- 7.6 To be able to operate the air duct tightness fan control while a helper operates the blower door fan control to maintain the desired duct and house pressures.

Establish Air Distribution System Air Leakage Quantity (8)

Lesson Objectives: The participant will be familiar with the different methods and techniques; and instruments to quantify duct leakage.

- 8.1 To be able to conduct a blower door subtraction test to estimate total duct leakage.
- 8.2 To be able to use a smoke stick, pressure pan or blocked supply outlet to identify potentially large leak site.

Cost Effective Duct Repair Measures (9)

Lesson Objectives: The participant will be familiar with considerations for implementing duct repair priorities.

- 9.1 To understand the pressure gradients across an air distribution duct.
- 9.2 To understand that the preferred time to seal ducts is during the installation of the air distribution system.
- 9.3 To evaluate an example for establishing air distribution duct repair target averages.
- 9.4 To be able to use a theatrical smoke generator to identify and prioritize the repair of duct leaks.

Airflow Measurement, Testing, Adjustment and Balance Techniques (10)

Lesson Objectives: The participant will review methods and techniques to measure airflow and to understand techniques to balance airflow to the air terminals after duct system repair.

- 10.1 To review the instruments that may be used to establish system airflow.
- 10.2 To understand the benefits for ensuring proper air balance of the system.
- 10.3 To understand techniques and procedures for air balancing the system.
- 10.4 To be able to implement the proportional balance (ratio) procedure in a laboratory setting.

1905
Refrigerant Recovery Certification Training
1 Day

Course Syllabus:

This one-day comprehensive training course is designed to certify all technicians involved with refrigerant handling. The course is expected to meet the anticipated Environmental Protection Agency (EPA) regulations pertaining to refrigerant recovery. The course will involve five hours of classroom activities with ESCO prepared study manual followed by an examination (approximately two hours in length). A certificate and wallet size card will be issued to the participant upon successful completion of the course exam. The certification program is open to all HVAC contractors, schools, city and county government agencies, appliance service group, apartment maintenance personnel, and/or other groups needing this training.

Note: EPA may require periodic training or review for continued refrigerant recovery certification.

Following are key objectives of the course:

1. Complete assignments and discussion using the ESCO prepared study manuals.
2. Know the EPA regulations regarding the handling and disposal of refrigerants.
3. Understand the ozone depletion issue; the Clean Air Act; EPA regulations; recovery, recycling and reclamation; safe handling of refrigerants and leak detection.
4. Discussion on alternative refrigerants.
5. Successfully complete a supervised examination.

Basic Commercial Rates

1 Day

Course Syllabus:

The course studies, in detail, the basic rates that a commercial marketing representative/account manager deals with daily. It covers ratchet and contract KW, ECR and taxes. It spells out proper rate applications for electrically heated and gas heated buildings. The material goes into how rates can be used to sell electric load, and it discusses how to prospect for electric heating. It compares natural gas pricing from AlaGasCo and Mobile Gas and LP gas. The load estimating, energy, demand and revenue estimating methods presented are CLEAR and the Excel Spreadsheet Green Sheet. Other rule-of-thumb methods of estimating revenue and energy are presented. The class is recommended for all commercial and major accounts representatives.

Rate Terms and Definitions (1)

Lesson Objective

1. Be able to define energy and capacity.

Pricing Logic (2)

Lesson Objective

1. Be able to define the summer and winter off peak periods in our TOU rates.

Rate Sheets (3)

Lesson Objective

1. Be able to quote the approximate cost per Kwh for Rates LPS, LPM, LPSE, LPME and the cost per Therm on AlaGasCo Rate SC

Rate Exercises (4)

Lesson Objectives

1. Be able to calculate a customer's bill manually on Rates FPL, LPM, LPS, LPSE, LPME and LPL.

CLEAR Rate Summary Sheets (5)

Lesson Objectives

1. Be able to estimate the average cost of a Kwh to use with the CLEAR estimating program.
- 2.

Green Sheet and CLEAR Load Estimating (6)

Lesson Objective

1. Be able to explain how CLEAR estimates Kw Demands.

Commercial Rules of Thumb (7)

Lesson Objective

1. Be able to estimate the electric bill using average cost per sq ft per year for typical office, retail shop and restaurant operations.

Evaluating Billing Histories for Sales Opportunities (8)

Lesson Objective

1. Be able to evaluate customer billing data in order to prospect for selling electric heat.

Actual Commercial Billing Histories (9)

Lesson Objective

1. Be able to estimate the power bill by using the cost per sq ft per year from commercial customer billing histories.

Class Exercise - Making a Presentation on Electric vs. Gas (10)

Lesson Objective

1. Be able to estimate a customer's gas and electric bills with limited information.

Commercial Energy Efficiency

1 Day

Course Syllabus:

The course focuses on appliances/end uses from the perspective of energy efficiency. (From an efficiency perspective, electric end use equipment is always more efficient than gas. Sell efficiency!) Covered in the class are the energy usages, efficiencies and energy costs of operating air conditioners, heat pumps, lighting, cooking and water heating equipment and electric motors. Proper estimation techniques are covered in detail. Of particular interest is a major 1993 cooking efficiency study comparing the cost of gas and electricity on commercial cooking equipment. The class is recommended for all commercial, food service and major accounts representatives.

Definitions (1)

Lesson Objective

1. Be able to define the term "energy efficiency".

Heating Values of Fuels (2)

Lesson Objective

1. Be able to state the energy content of natural gas, propane, electricity.

Lighting Efficiency (3)

Lesson Objective

1. Be able to state the energy efficiency, (efficacy) of incandescent and fluorescent lighting.

Heat and AC Efficiency (4)

Lesson Objective

1. Be able to define the terms EER, COP, SEER and AFUE.

Motor Efficiency (5)

Lesson Objective

1. Be able to define and calculate motor efficiency.

Water Heater Efficiency (6)

Lesson Objective

1. Be able to calculate water heater efficiency.

Cooking Efficiency (7)

Lesson Objective

1. Be able to define cooking efficiency and be able to calculate the energy utilized in food preparation.

Cost of Energy (8)

Lesson Objective

1. Be able to state the present day cost of electricity, natural gas and liquid propane and be able to show the recent changes in the cost of energy nationally and in the State.

Energy Cost Calculations (9)

Lesson Objective

1. Be able to set up the equations that are used to calculate the operating costs of cooling, heating, steam heating, water heating, electric and gas cooking, lighting and motors.

Commercial Rules of Thumb (10)

Lesson Objective

1. Be able to estimate the annual cost of gas and electricity used by the customer based on the sq ft of the building.

Commercial HVAC Systems

1 Day

Course Syllabus:

This course covers chillers, boilers, condensers, heat pumps, DX systems, straight AC, electric and gas space heating, gas unit heaters, closed loop water-to-air heat pumps, VAV, 2-pipe, 4-pipe, energy recovery ventilators, and evaporative cooling. Commercial HVAC estimation methods that are studied are watts/sq ft, sq ft /ton, \$/ton and \$/CFM. HVAC demand and energy estimating is studied using the Excel Green Sheet method and CLEAR. Proper rate applications for gas and electrically heated buildings are presented and a method of prospecting for electric heating is discussed. The course touches on gas and electric desiccant systems, economizers and thermal storage systems. Meter pulse requests and building energy management systems are included in the class material. The course is recommended for commercial, food service, major account and industrial account managers that have had at least 1 year of experience in commercial or industrial marketing.

Definitions and Terms (1)

Lesson Objective

1. Be able to define heat transfer and BTUH.
2. Be able to explain how refrigerant systems work.

Commercial Building Characteristics (2)

Lesson Objective

1. Be able to compare a commercial building to a residence
2. Be able to estimate the cooling tons from building area.

Equipment Types Heating/Cooling Ratings (3)

Lesson Objective

1. Be able to state the typical Kw per ton for unitary AC equipment.

Terminal Systems (4)

Lesson Objective

1. Be able to define an HVAC terminal system.

Primary Systems (5)

Lesson Objective

1. Be able to define an HVAC primary system.

Typical Commercial Systems and Costs (6)

Lesson Objective

1. Be able to match HVAC systems to building type.

Sales Tools (7)

Lesson Objective

1. Be able to demonstrate how you would prospect for electric heat and heat pumps in the LPM customer class.

Rates (8)

Lesson Objective

1. Be able to compare the cost of gas to resistance heat to resistance heat and to pump heat.

Three Reasons Why Your Building Should Be Electric (9)

Lesson Objective

1. Be able to state the 3 reasons why commercial office buildings should be electrically heated and cooled

Allies (10)

Lesson Objective

1. Be able to estimate a mechanical engineer's design fee on an HVAC project.

Other Commercial Systems (11)

Lesson Objective

1. Be able to name 7 other HVAC technologies besides unitary and built up systems.

Building Electrical Equipment Sizing (12)

Lesson Objective

1. Be able to estimate the proper amp loading on a heat pump outdoor unit electric circuit.

Building Energy Systems (13)

Lesson Objective

1. Be able to explain the percent savings that can be realized by installing higher efficiency T-8 fluorescent lighting in an office.

Request for Electric Service for Commercial Buildings (14)

Lesson Objective

1. Be able to correctly estimate a commercial request for electric service for a commercial building.

Commercial Outdoor Lighting Design

1 Day

Course Syllabus:

The basic principals of light, HID, fluorescent and incandescent lighting sources and lighting efficiencies and color rendering are studied. Outdoor illumination design techniques, pole spacing, and the "Quick Estimator Sizing Method" are covered, along with IES recommended foot candle design levels for area and street lighting. Customer rate options and costs are studied as well as rates SLM, FPL, and LTU. In the spring and fall classes, the 2 day class begins at 4:00 PM the day before the class room session with Lighting after Dark Tour of Birmingham streets and parking lots. The course may be utilized as an introduction to the one (1) day CAD lighting design program, *Visual* provided by Acuity Lighting. Course is recommended for all commercial and industrial reps involved with street or area lighting.

Definitions (1)

Lesson Objective

1. Be able to define the foot-candles, luminance, and luminance

APCo Street and Flood Lights (2)

Lesson Objective

1. Be able to state the types and sizes of outdoor light fixtures we purchase.

National Electric Code and NESC Review (3)

Lesson Objective

1. Be able to state the difference between the NEC and the NESC as it pertains to outdoor lighting design.

Design Lighting Loss Factors and Mounting Heights (4)

Lesson Objective

1. Be able to state recommended mounting heights for proper lighting design.

Area Lighting Design (5)

Lesson Objective

1. Be able to determine pole locations and IES recommended illumination levels on a typical area lighting project.

Street and Roadway Lighting Design (6)

Lesson Objective

1. Be able to state the pole layouts and spacing and recommended illumination levels on a street lighting project.

Other Outdoor Design Levels (7)

Lesson Objective

1. Be able to state the recommended IES lighting level of any outdoor lighting application.

Quick Calculator Graph for Lighting Design (8)

Lesson Objective

1. Be able to estimate the number of lights required to illuminate a specified area based on the design foot candle levels.

Rates, EGMs, Contracts (9)

Lesson Objective

1. Be able to manually estimate an FPL bill.

Athletic Field Lighting Design Layouts (10)

Lesson Objective

1. Be able to state the recommended number of poles for a sports field layout.

Manufacturer Reps (11)

Lesson Objective

1. Be able to list the manufacturer rep for GE Lighting.

Bulb Disposal (12)

Lesson Objective

1. Be able to state Ala Power Company's bulb disposal policy.

HID Lamp Life

Lesson Objective

1. Be able to state the lamp life of an HID bulb.

Commercial Reference Manual

1 Day

Course Syllabus:

This course is geared to the commercial marketing representative that works in the non-segment side of sales. The manual is designed to be a quick field reference. The topics and procedures covered include LAF lighting constants, athletic field transformer leasing, traffic signal lighting guidelines, load estimating and energy costing, cable TV amplifiers, the premise rule, UCD procedures, service voltages and transformer connections, meter pulse procedures, and sales prospecting for electric heating.

The class is recommended for all marketing commercial and combination representatives.

Helpful Forms and Data (1)

Lesson Objective

1. Be able to determine the number of commercial customers in the area where you work and be able to state the approximate percentage of customers in each rate classification.

Standby Generator Program (2)

Lesson Objective

1. Be able to state the customer requirements for being on the standby generator program.

Request for Service (3)

Service Extension Guidelines

Lesson Objective

1. Be able to state the Company's cost-to-revenue policy for all classes of customers.

Roadway Advertising Signs (4)

Lesson Objective

1. Be able to spell out the metered and un-metered service policy as it relates to advertising sign lighting.

Prospecting For Electric Heat (5)

Lesson Objective

1. Be able to explain how converting from gas heat to electric heat can save the customer money on installation cost and energy cost.

Premise Rule (6)

Lesson Objective

1. Be able to define the “premise rule” as it pertains to commercial accounts.

Traffic Signals (7)

Lesson Objective

1. Be able to correctly estimate monthly revenue for a traffic signal account.

UCD Underground Service (8)

Lesson Objective

1. Be able to explain the customer and Company requirements for securing underground service to a commercial building.

Rates and Energy Cost Calculations (9)

Lesson Objective

1. Be able to state the proper base rates used to estimate a customer’s annual revenue.

Manufacturer Reps (10)

Lesson Objective

1. Be able to match the end use appliance to the correct local manufacturer representative.

Commercial Methods for Estimating (11)

Lesson Objective

1. Be able to estimate the annual energy and the associated cost to the customer for different gas, electric and heat pump heating and cooling schemes.

Service Voltages and Transformer Connections (12)

Lesson Objective

1. Be able to tell the difference between a 120/240 volt service and a 120/208 volt service by inspecting the overhead transformer bank or the pad mounted transformer or transclosure.

Athletic Field Lighting and Transformer Leases (13)

Lesson Objective

1. Be able to calculate the billing constant for an athletic field service with primary metering and state the difference between this and standard secondary metering.

Commercial Water Heating

1 Day

Course Syllabus:

Resistance, thermal storage, heat pump, instantaneous and point-of-use water heating systems are studied. The material covers methods for properly sizing storage tanks and heating element KW and gas burner BTUs. Methods of estimating energy use and cost for gas and electric systems is covered, and the cost of electric and gas water heaters is studied. ASHRAE Service Water Heating design methods are presented as a guide for sizing. A free computer sizing program from Rheem entitled "Certispec" is presented as a tool to assist reps with sizing systems and providing proposals. Also discussed is an Excel spreadsheet developed by a State Health Department for sizing food service water heating systems. The class is recommended for all commercial reps.

Properties of Water (1)

Lesson Objectives

1. Be able to state the physical properties of water

Types of Water Heaters and Capacities (2)

Lesson Objectives

1. Be able to identify the 7 different types of commercial water heaters

Water Heater Efficiencies, System Efficiencies (3)

Lesson Objective

1. Be able to state the current efficiencies for gas and electric water heaters as rated by industry associations
2. Be able to calculate the energy saved by installing insulation on hot water piping.

Advantages and Benefits (4)

Lesson Objective

1. Be able to state the advantages and benefits of electric water heaters
2. Be able to state the advantages of gas water heaters

Fuels, Energy and Rates (5)

Lesson Objective

1. Be able to state the heating values and costs of common fuels
2. Be able to calculate the cost of heating water with any fuel type.

Water Heater and Tank Costs (6)

Lesson Objective

1. Be able to estimate the rough cost of various types of water heating equipment

Usage Curves, Sizing Methods, Rheem Certispec Sizing Program (7)

Lesson Objective

1. Be able to estimate the volume of hot water used in various commercial establishments
2. Be able to state the web location of Rheem's water heater sizing program: Certispec.

Sizing Building Electric Equipment (8)

Lesson Objective

1. Be able to calculate single phase and three phase Kva, Kw, amps
2. Be able to select the NEC allowable diversity on kitchen electric panels with multiple pieces of cooking equipment.
3. Be able to estimate the approximate cost of installing an electric panel and circuits in a kitchen.

Incentives Programs and Margins (9)

Lesson Objective

1. Be able to calculate the customer incentive for an electric tank-type water heater that is replacing a gas tank-type unit
2. Be able to estimate the incentive for a thermal storage water heater in a hotel w/o a restaurant

Reps, Distributors, Associates (10)

Lesson Objective

1. Be able to state the ally contact at Southern Pipe

Commercial Applications and Calculating Payback (11)

Lesson Objective

1. Be able to calculate simple payback on the installation of a heat pump water heater installation in a restaurant

Testimonials (12)

Lesson Objective

1. Be able to tell the story of a working and successful commercial electric water heating system.

Sales Potentials and Financing (13)

Lesson Objective

1. Be able to recall ally contacts at Southern Pipe
2. Be able to explain financing for water heater installations

Friction and Duct Design

4 Hour

Course Syllabus:

In this four and a half-hour presentation the participant gains skills to successfully design forced air systems to deliver the proper airflow; at the proper temperature; to the proper location. Participant will work a sample problem using the following tools; ACCA Air Duct Calculator, principles in ACCA Manual D and "Understanding Friction".

No exam given in this course, due to time restraints.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Can apply correct methods and knowledge to properly design a forced air system
2. Can understand friction and the effect it has on air volume
3. Can understand air movement in the "comfort zone"

Gas Furnace Safety

4 Hour

Course Syllabus:

This four hour comprehensive training course is designed to train technicians in fundamentals of safe furnace operation; understanding combustion air requirements; proper sizing of gas pipe lines; and use of venting tables.

Participant will effectively complete a gas piping exercise and a vent exercise in classroom setting. No exam given.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Understand combustion air needs for safe operation of a gas furnace.
2. Understand gas pipe sizing for safe operation of a gas furnace.
3. Understand the importance of proper venting for safe operation of a gas furnace.

Green Sheets and Blue Prints

1 Day

Course Syllabus:

The class covers the manual and electronic versions of estimating demand and energy using manual and Excel versions of the Green Sheet and the power delivery load estimating program, *CLEAR*. Diversity factors are studied for single and multiple pieces of equipment and various end use types, from lighting to large electric boilers. In the Blue Print portion of the class, a load "take off" is done using actual restaurant blueprints, and a Green Sheet is completed by class teams. This class is recommended for all commercial and combination Residential/Commercial Representatives.

Definitions and Green Sheet Terminology (1)

Lesson Objective

1. Be able to define energy and capacity.

Commercial Rate Terminology, Rate Pages, Rate Applications (2)

Lesson Objective

1. Be able to define ECR.
2. Be able to state the meaning of the term Ratchet.

Distribution of Commercial Accounts (3)

Lesson Objective

1. Be able to estimate the number of LPS accounts in a local area.

Histories from Selected Commercial Building Types (4)

Lesson Objective

1. Be able to estimate the annual electric bill for a typical retail shop based on sq ft of heated and cooled area.

Rate Calculations (5)

Lesson Objective

1. Be able to manually calculate an electric bill on any commercial rate.

Commercial Estimators, Rules of Thumb (6)

Lesson Objective

1. Be able to estimate the peak summer demand for an office or retail account based on sq ft of the building.

Service Extension Guidelines, Service Voltages (7)

Lesson Objective

1. Be able to state the cost to estimated revenue ration for extending a line to a new commercial customer.

Blue Prints, Load Take-Offs, Green Sheet Estimating (8)

Lesson Objective

1. Be able to state where, in a typical set of plans, you will find the mechanical and electrical plan sheets.

Consulting Engineers (9)

Lesson Objective

1. Be able to estimate a mechanical engineer's design fee for a commercial building.

Heat Pump Overview Class

2 Day

Course Syllabus:

In this training program, inexperienced personnel learn terminology related to HVAC equipment applications. The participant gains a general understanding of refrigerant system components and component function; operating modes and sequence of operation; Efficiency rating terminology; supplemental heat sizing; dual fuel heat pump applications; geo-exchange heat pump applications; and a limited introduction to energy cost estimation. Follow-up field application of training will enable participants to more confidently accomplish the anticipated outcomes.

HVAC Training Center Course Descriptions (2)

Lesson Objective

1. Be able to identify the courses needed by a HVAC technician just starting in the HVAC business

Definitions and Terms (3)

Lesson Objectives

1. Be able to identify indoor and outdoor components of a heat pump
2. Be able to convert BTUH of cooling to tons
3. Be able to convert BTUH of heating to KWh
4. Be able to read a wet and dry bulb thermometer
5. Be able to identify the Human Comfort Zone on a psychrometric chart
6. Be able to determine the AFUE of a typical gas furnace

Basic Refrigeration, Heat Pump Operation (4)

Lesson Objectives

1. Be able to define sensible and latent heat
2. Be able to explain conduction, convection, radiation heat transfer
3. Be able to identify refrigerant by the color of the drum
4. Be able to explain reversing valve operation
5. Be able to identify compressor, condenser, evaporator, rev valve, metering devices and accumulator

Inside the Heat Pump (5)

Lesson Objectives

1. Be able to calculate EER of an AC and a heat pump
2. Be able to estimate 17F BTUH heating output from the heat pump name plate data
3. Be able to calculate the COP of electric resistance heat
4. Be able to size supplemental heat strips from a Balance Point Graph

Heat Pump Buyers Guide (6)

Lesson Objectives

1. Be able to identify package heat pump when you see it
2. Be able to identify a gas package unit when you see it.
3. Be able to estimate savings if a thermostat is set back or set up

Basic Electrical Components (7)

Lesson Objectives

1. Be able to identify the electric components that operate in cooling, heating, emergency heating, auto, off, on modes
2. Be able to tell the difference in 24 volt components and 240 volt components.

Wall Thermostat Operation (8)

Lesson Objective

1. Be able to identify a 2, 3, 4 bulb thermometer
2. Be able to explain the operation of a thermostat

Dual Fuel (9)

Lesson Objective

1. Be able to state advantages of electric over gas dual fuel systems and visa versa.

Comparing Systems (10)

Lesson Objectives

1. Be able to explain the relative cost, energy use, and safety of gas, air-to-air, and ground coupled systems

GeoExchange Heat Pump – How It Works (11)

Lesson Objectives

1. Be able to explain how geothermal systems work
2. Be able to explain residential geothermal system operation and savings
3. Be able to explain commercial geothermal operation and savings
4. Be able to identify the system components and be able to compare a geothermal and a typical gas heat/electric ac system

Cost of Energy (12)

Lesson Objectives

1. Be able to calculate the cost of 1,000,000 BTU of gas, propane and electric energy
2. Be able to calculate savings from SEER ratings

How Efficient Is a Heat Pump (13)

Lesson Objectives

1. Be able to calculate COP from a heat pump name plate
2. Be able to calculate Gas Furnace efficiency from the name plate on the furnace
3. Be able to calculate EER from an air conditioner name plate

A House Is a HVAC System (14)

Lesson Objectives

1. Be able to discuss how duct leaks cause system inefficiencies in heating mode
2. Be able to explain how dust leaks cause system inefficiencies in cooling mode
3. Be able to explain the effect a positive pressure has on infiltration.
4. Be able to determine the temperature of the air coming off a heat pump in heat mode if there are duct leaks

HVAC Wiring 101

4 or 8 Hour

Course Syllabus:

This four or eight hour comprehensive training course is designed to train technicians in fundamentals of electrical circuitry, voltage, and wire sizing; HVAC electrical components and their functions and the logic behind their operation; wiring diagrams, symbols, types, building wiring diagrams and using diagrams for electrical troubleshooting. Participant will participate in a laboratory exercises on component identification and a wiring exercise to diagnose electrical system functions.

No exam given.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Can apply the fundamentals of electricity, circuits, types of circuits, voltage types, and wire sizing to HVAC application
2. Can understand HVAC electrical components, their operation and function
3. Understands the operating modes of HVAC systems
4. Know wiring diagram symbols
5. Know and understand types of wiring diagrams
6. Know how to build and use wiring diagrams for troubleshooting HVAC electrical systems

IGSHPA
Ground-Source Heat Pump Closed Loop Certification Course
3 Day

Course Syllabus:

This training program is designed to provide participants with factual information related to material included in the International Ground Source Heat Pump Association's closed loop certification exam. The participant learns application and installation considerations to be considered in a quality ground-source heat pump installation. Follow-up field application of training will enable contractors and their personnel to more confidently accomplish the anticipated outcomes. The certification exam is administered at the conclusion of the course.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Understands the importance of properly sizing ground-source heat pump equipment and the air distribution system.
2. Understands the importance of performing and documenting a site survey of the loop field.
3. Can evaluate soil types in designing and selecting the closed loop configuration and piping.
4. Understands considerations for sizing the water loop circulation pump.
5. Understands methods and requirements for water loop flushing and freeze protection.
6. Understands grouting methods and materials.
7. Understands pipe fusion methods and demonstrates performance of skills in hands-on laboratory exercise.

Manual N
Commercial Load Calculations
4 Day

Course Syllabus:

To provide the commercial marketing representative (and other participants) with an understanding of how to apply ACCA Manual N, commercial load calculation procedures to a small commercial design process; and of how to determine the input values for a software program.

Basic Heat Transfer Principles and Terminology (1)

Lesson Objectives: The participant will understand the basic heat transfer principles that apply to residential comfort conditioning and the importance of an accurate heat loss and heat gain load calculation for commercial applications.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to apply Tables in the manual to determine the R-Factor for building materials used to construct a wall or ceiling component.
- 1.3 To be able to calculate the total R-Value for a structural component with a parallel conduction path.
- 1.4 To be able to calculate the U-Factor for a building component.
- 1.5 To be able to identify the proper heat transfer formula for calculating a heating or cooling load.

Area Measurement (2)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately measure component areas separating a conditioned space from an unconditioned space or exposed to outside conditions.

- 2.1 To be able to identify building components from plans or site visit during the survey of the dwelling.
- 2.2 To be able to apply equations to calculate areas of typical shapes (rectangle, trapezoid, triangle, circle, oval, hexagon, octagon) that may be determined during the plan survey.
- 2.3 To be able to apply equations to calculate volumes of typical spaces (box, wedge, cylinder, sphere) that may be determined during the plan survey.
- 2.4 To be able to apply measurement protocols to record the width, length, and height for building components.
- 2.5 To be able to identify the construction number assigned to the possible structural components making up the building envelope.

Psychrometric (3)

Lesson Objectives: The participant will understand the psychrometric chart and its use in determining air properties that relate to conditioning of air for human comfort and of equipment performance.

- 3.1 To be able to locate air properties on the chart given any two of the properties.
- 3.2 To be able to plot a dry bulb temperature.
- 3.3 To be able to plot a wet bulb temperature.
- 3.4 To be able to determine if a condition is acceptable for human comfort based on industry standards.
- 3.5 To understand techniques that may be used to increase or decrease the latent heat capacity of an installation.
- 3.6 To be able to plot conditions to define the room and equipment load processes.
- 3.7 To be able to interpret and enthalpy chart to determine total heat for a condition.
- 3.8 To be able to apply non-psychrometric formulas to calculate the cooling and heating performance for the installation.

Infiltration and Ventilation (4)

Lesson Objectives: The participant will understand the components contributing to the infiltration load and the ventilation requirement for adequate indoor air quality.

- 4.1 To understand the difference between infiltration and ventilation.
- 4.2 To understand the various case scenarios for classifying the building pressure as positive, negative or neutral.
- 4.3 To calculate the ventilation air requirement based on the supply air, exhaust air, and infiltration air (if permitted by local code).
- 4.4 To be able to calculate the building infiltration ach and leakage cfm.
- 4.5 To be able to calculate the door traffic infiltration based on given assumptions.
- 4.6 To be familiar with the current ASHRAE Standard 62 ventilation requirements for various occupant/industrial processes.

Small Commercial Example—Structural Heat Gain (5)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately determine the heat gain (sensible and latent) for the in-class commercial example presented in Manual N, Section 14.

- 5.1 To be able to select the outdoor design conditions for the example using Table 1 from the manual.
- 5.2 To be able to select the indoor design conditions for the example using default values or customer preference if appropriate.
- 5.3 To be able to calculate a time-of-day correction.
- 5.4 To be able to calculate the design cooling temperature difference (CTD) for the example problem.
- 5.5 To be able to calculate the building component areas.
- 5.6 To be able to apply the Tables to determine the U-Factors for appropriate building sections.
- 5.7 To be able to calculate fenestration solar radiation loads.
- 5.8 To be able to calculate transmission heat gain for building components.
- 5.9 To be able to apply the proper formula to calculate the sensible heat gain for each structural component.
- 5.10 To be able to determine the summer building infiltration load and HTM using Table 13A and the building tightness description.
- 5.11 To be able to determine the summer door traffic load.
- 5.12 To be able to calculate the estimated supply cfm for the space sensible load.
- 5.13 To be able to determine the internal sensible heat gain and latent heat load based on the assumptions given in the in-class commercial example problem.
- 5.14 To be able to apply tables to calculate the duct heat gain factors for duct locations outside of the conditioned space.
- 5.15 To be able to determine appropriate ventilation considerations for adequate indoor air quality.
- 5.16 To be able to determine the total heat gain for the in-class commercial example.

Small Commercial Example—Structural Heat Loss (6)

Lesson Objectives: The participant will understand and apply equations and procedures to accurately determine the heat loss for the in-class commercial example presented in Manual N, Section 14.

- 6.1 To be able to select the outdoor design conditions for the example using Table 1 from the manual.
- 6.2 To be able to select the indoor design conditions for the example using default values or customer preference if appropriate.
- 6.3 To be able to calculate the design heating temperature difference (HTD) for the example problem.
- 6.4 To be able to apply the proper formula to calculate the heat loss for each structural component.
- 6.5 To be able to determine the winter infiltration load and HTM using Table 13A and the building tightness description.
- 6.6 To be able to determine the winter door traffic rate and heat loss.
- 6.7 To be able to determine the ventilation requirement as appropriate.
- 6.8 To be able to apply tables to calculate the duct heat loss factors for duct locations outside of the conditioned space.
- 6.9 To be able to determine the total heat loss for the in-class commercial example.

Equipment Selection (7)

Lesson Objectives: The participant will understand and apply techniques to properly size equipment for an example problem to optimize the sensible and latent heat capacities by comparing possible equipment options for an example manufacturer.

- 7.1 To be able to calculate the sensible heat ratio based on the total sensible and total heat gain calculations.
- 7.2 To be able to select the design temperature difference (TD) between the coil entering air temperature (RAT) and the coil leaving air temperature (LAT).
- 7.3 To be able to calculate the approximate or initial cooling cfm for evaluating the sensible and latent heat capacities for possible equipment options.
- 7.4 To be able to interpret performance data for an example manufacturer.
- 7.5 To be able to determine the maximum equipment size for cooling based on industry recommendations.
- 7.6 To be able to determine the maximum equipment size for heating based on industry recommendations.

- 7.7 To be able to calculate the thermal balance point given the total heat loss at a given outdoor design temperature; and heating performance data for a selected heat pump application.
- 7.8 To be able to determine the minimum auxiliary heat requirements (if heat pump).
- 7.9 To be able to determine the recommended auxiliary heat requirement (if heat pump).

Individual Exercise Example – Easy Street Service Company (8)

Lesson Objective: The participant will apply techniques and skills learned to accurately calculate the heating and cooling loads for the example problem.

- 8.1 To be able to complete the Form N-1. Questions may be asked of the instructor.

Manual Q
Commercial Duct Design
3 Day

Course Syllabus:

To provide the commercial marketing representative (and other participants) with an understanding of how to apply ACCA Manual N, Commercial Duct Design, procedures to a typical small commercial air-distribution system design.

Definitions and Terminology (1)

Lesson Objectives: The participant will know and understand the definitions and terminology used in the discussion and implementation of commercial air-distribution system design procedures.

- 1.1 To be able to match a term with the proper definition.
- 1.2 To be able to associate the proper term with design procedures.

Review Manual N Example Problem (2)

Lesson Objectives: The participant will understand the cooling and heating components by reviewing the Manual N load summary.

- 2.1 To review the sensible and heating results for each line input on Form N-1 for the example problem.
- 2.2 To review the form used for the Form N-1 Load Summary.

Equipment Selection (3)

Lesson Objectives: The participant will understand and be aware of the importance of analyzing the part load conditions in selecting the equipment for the design cooling load.

- 3.1 To be able to recognize the impact of performance problems at part load on maintaining the desired indoor conditions for acceptable air quality.
- 3.2 To be able to interpret example manufacturer's performance data in selecting equipment that satisfies the calculated sensible and latent cooling loads.
- 3.3 To know the recommended over-sizing limits in selecting equipment capacity for cooling.
- 3.4 To be able to determine the cooling coil entering conditions from a psychrometric analysis based on room and equipment loads.
- 3.5 To know the recommended over-sizing limits in selecting equipment capacity for heating.
- 3.6 To be able to verify acceptable air velocities within the occupied (breathing) zone of the space.

- 3.7 To be able to recommend noise criteria (NC) for air diffuser selection based on noise level recommendations for the application.

Psychrometric Analysis (4)

Lesson Objectives: Using a psychrometric chart, the participant will demonstrate proficiency in plotting a process for a psychrometric analysis.

- 4.1 To be able to plot a condition on the psychrometric chart.
- 4.2 To be able to identify the values for the remaining air properties.
- 4.3 To be able to determine if an indoor condition is within the industry standard comfort zone.
- 4.4 To be able to plot conditions to define the room and equipment load processes.
- 4.5 To be able to interpret an enthalpy chart to determine total heat for a condition.
- 4.6 To be able to apply non-psychrometric formulas to calculate the cooling and heating performance for the installation.

Air Distribution Duct System Selection (5)

Lesson Objectives: The participant will understand the considerations for selecting the type of air distribution duct system and performance characteristics.

- 5.1 To be able to recognize the air distribution system types by visual reference.
- 5.2 To understand the preferred application for each system type.
- 5.3 To understand the options for the air discharge direction into the space.

Air Distribution System Terminal Selection (6)

Lesson Objectives: The participant will be familiar with the various options to introduce conditioned air into the space for typical commercial applications.

- 6.1 To be able to recognize the air distribution terminal types by visual reference.
- 6.2 To understand the preferred application for each system type.
- 6.3 To understand how the air is discharged into the space by the various terminal options.

Basic Principles of Fan and Duct System Performance (7)

Lesson Objectives: The participant will understand the basic principles of fan and duct system performance factors, formulas, charts, etc.

- 7.1 To understand and apply the sensible heat equation.
- 7.2 To understand and apply the velocity pressure equation.
- 7.3 To understand the duct pressure measurements (Total, Static, and Velocity).
- 7.4 To understand and apply manufacturer fan performance curves and/or tables.
- 7.5 To understand the effect of duct system components on the duct system curve.
- 7.6 To understand the system operating point as a relationship between blower selection and a given duct design static loss.
- 7.7 To apply friction charts and duct sizing slide rules to size duct runs.
- 7.8 To apply appropriate duct material correction factor(s).
- 7.9 To understand components causing duct system pressure changes.

Fitting Losses (8)

Lesson Objectives: The participant will understand how to use the appendixes to calculate the pressure drop for various fittings.

- 8.1 To understand fitting losses due to friction, dynamic, and/or velocity changes...
- 8.2 To understand the concept of equivalent length.
- 8.3 To apply the appropriate appendixes to find dynamic pressure losses for a fitting.
- 8.4 To understand and apply the dynamic loss coefficient to calculate the pressure drop for a fitting.
- 8.5 To understand and determine the air side device pressure losses.

Blower Fan and Duct System Interface (9)

Lesson Objectives: The participant will understand the techniques used in selecting a blower to overcome the total static pressure losses for the proposed duct design.

- 9.1 To understand the concept of effective duct length to air turbulence in a duct.
- 9.2 To understand the characteristics of blower operation.
- 9.3 To know the objective of duct sizing.
- 9.4 To be able to calculate a design Friction Rate (FR) or Pressure Drop (PD) for a proposed design.
- 9.5 To understand the fan discharge outlet system effect pressure losses.
- 9.6 To understand the fan inlet system effect losses.

Basic Design Principles (10)

Lesson Objectives: The participant will be familiar with some basic design principles desirable for an efficiently performing system.

- 10.1 To understand design considerations that emphasize the selection of fittings, devices, and fan outlets that will contribute to an efficient system.
- 10.2 To understand the importance for allowing for changes in the use of the floor space.
- 10.3 To understand the benefits of a design that minimizes the length of duct runs.
- 10.4 To understand the benefits of optimizing the duct shape and dimensions in reducing duct surface area.
- 10.5 To understand the importance of selecting fittings that minimizes the creation of turbulence within the duct.
- 10.6 To understand the importance of designing transitions that provide for gradual velocity changes.
- 10.7 To understand the impact that the interior duct surface has on duct static pressure losses.
- 10.8 To understand the importance of installing and using balancing dampers.

Duct System Design Procedure (11)

Lesson Objectives: The participant will be familiar with a general duct design procedure for a single or multi-zone; or variable volume system.

- 11.1 To understand design considerations for selecting and locating air distribution devices.
- 11.2 To understand design considerations for locating the central equipment and preliminary layout of duct runs.
- 11.3 To understand initial design sizing calculations (i.e. initial velocity, fan fitting, fan to duct transitions, etc.)
- 11.4 To be able to select the appropriate HVAV duct design symbol notation.
- 11.5 To be able to calculate the total pressure loss for the system based on a given layout, selected fittings, and terminals.
- 11.6 To be able to select a fan that will provide the design airflow at the total pressure loss for the duct system.
- 11.7 To be able to determine acceptable noise criteria for the application.
- 11.8 To understand the completion of the final drawings and specifications for the proposed design.

In-Class Example Problem (12)

Lesson Objectives: The participant will complete Form Q-1 using Manual Q design procedures for an example problem.

- 12.1 To apply the duct system design procedure to size the duct for a constant volume system.
- 12.2 To complete the design process using the step-by-step procedure as a class project.

Individual Example Problem Assignment (13)

Lesson Objectives: The participant will complete Form Q-1 using Manual Q design procedures for an example problem.

- 13.1 To apply the duct system design procedure to size the duct for a constant volume system.
- 13.2 To complete the design process using the step-by-step procedure as an individual assignment.

Airflow Measurement, Testing, Adjustment and Balance Techniques (14)

Lesson Objectives: The participant will review methods and techniques to measure airflow and to understand techniques to balance airflow to the air terminals after duct system repair.

- 14.1 To review the instruments that may be used to establish system airflow.
- 14.2 To understand the benefits for ensuring proper air balance of the system.
- 14.3 To understand techniques and procedures for air balancing the system.
- 14.4 To be able to implement the proportional balance (ratio) procedure in a laboratory setting.

Motors, Starters, Flicker

1 Day

Course Syllabus:

This course presents material on the electro-magnetic principal of ac motor operation. It goes into single and three phase motor starting schemes, locked-rotor inrush, fusing and how substation, line and service flickers are calculated at the customer's service. It defines the acceptable levels of flicker and how to achieve these levels with various starter schemes. It covers methods of calculating KVA, KW and estimating power factor. Motor, motor starter and electric circuit costs are also covered. The class is geared toward the commercial and industrial markets and it may also benefit Power Delivery engineers.

Definitions (1)

Lesson Objective

1. Be able to define all terms associated with electric motors.

Electric Motor Basics (2)

Lesson Objective

1. Be able to identify the windings, rotor and stator in an electric induction motor.

Ohm's Law, Voltage Drop (3)

Lesson Objective

1. Be able to define Ohm's Law formulas and be able to calculate voltage drop on single or three phase lines.

Motor Starting, Flicker, Threshold of Objection Charts (4)

Lesson Objective

1. Be able to explain motor starting and "Threshold of Objection" Charts.

Flicker Calculations – Data - Flicker Study - Follow Up (5)

Lesson Objective

1. Be able to explain the Power Delivery methodology in calculating flicker and be able to define running flicker and starting flicker.

Motor FLA, LRA, Starter Data (6)

Lesson Objective

1. Be able to estimate locked rotor starting current from NEMA code letters.

Transformer Bank Fusing (7)

Lesson Objective

1. Be able to explain the 60 second fuse blow rule and be able to match transformer size to proper fuse size.

Single and Three Phase Converters (8)

Lesson Objective

1. Be able to explain how rotary and static phase converters produce three phase power.

Service Entrance Sizes, Motor Controls, Single Phasing (9)

Lesson Objective

1. Be able to explain the difference between a Main Breaker and a Main Lugs panel.
2. Be able to explain "single phasing"

Cost of Motors, Starters, Branch Circuits (10)

Lesson Objective

1. Be able to "ballpark" the cost of an electric motor.

Motor Power Factor, PF Correction, Kva/Horsepower (11)

Lesson Objective

1. Be able to state the Kva/hp for 1 phase and 3 phase motors.
2. Be able to state the power factor for light, medium and heavily loaded motors.

Motor Efficiency, Energy Savings (12)

Lesson Objective

1. Be able to calculate savings on the electric bill due to installation of high efficiency motors.

Motor Manufacturers, Distributors (13)

Lesson Objective

1. Be able to state the name of a world wide motor supplier.

NATE-ACE Exam Preparation Review

2 Day

Course Syllabus:

To provide the installer or service technician with a general review of topics pertaining to Knowledge Areas of Technical Expertise (KATES) on which the examinee may be tested while taking the ACE exam for an Install / Service Core or for an Install / Service Specialty (air conditioning, air distribution, heat pump, gas furnace, or oil furnace).

NOTE: This course is not a training course to develop troubleshooting skills, but to review previously learned and/or infrequently used knowledge and skills.

Although the HVAC Training Center proctor's the exams, the exams are prepared and graded by an outside testing agency.

Review (1)

Lesson Objectives: This presentation uses various means to reach the expected specific objectives for the course

- 1.1 To review terminology.
- 1.2 To review selected objectives from previous courses.
- 1.3 To review basic science and electrical systems.
- 1.4 To review human comfort considerations
- 1.5 To review diagnostic and troubleshooting techniques.
- 1.6 To review regulations, codes and design considerations
- 1.7 To review topics in listed in the NATE curriculum guides.

Exam: The NATE-ACE exams are obtained from NATE or are taken electronically during an on-line test session on the internet using the computers in the computer lab of the HVAC Training Center. A registered proctor must be present.

General Objective: The participant will individually complete exam(s) for which registered.

Performance Standard:

1. To successfully complete the exam, the participant must attain an overall score of 70 percent or higher.
2. To receive certification in a specialty, the technician must attain an overall score of 70 percent or higher on both the appropriate Core exam and the chosen specialty exam.

Ohm's Law for HVAC Technicians

4 or 8 Hour

Course Syllabus:

This four or eight-hour training course uses classroom and exercises to enable the participant to learn and develop a working knowledge of Ohm's Law and its application in residential and light commercial electrical loads and services. Follow-up field application of procedures established in this training will enable the HVAC technician to more confidently accomplish the anticipated course outcomes. No exam given.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Can apply an increased knowledge of electrical terms.
2. Can recognize circuitry configurations as being series, parallel, or series-parallel.
3. Can determine the proper way to calculate voltage, current, resistance and power in a given circuit.
4. Can apply methods to calculate the load for sizing service entrances and service panels.
5. Can verify the power wire size and over-current protection device required for specific electrical loads.
6. Can calculate power consumption for single-phase and three-phase loads.

R-410A Safety

4 Hour

Course Syllabus:

This four hour comprehensive training course is designed to train technicians in fundamentals of the safe use of R-410A Refrigerant.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Understand the safe use of R-410A.
2. Understand the safe transportation of R-410A.
3. Understand the importance of proper storage

Residential Heat Gain/Heat Loss Calculation

4 Hour

Course Syllabus:

In this four and a half-hour presentation the participant gains skills to calculate the heating and cooling requirements of a residential structure, using accepted technique illustrated in ACCA Manual J. In addition to Manual J the participant will complete a sample problem using Manual J short form.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Can apply factors to determine the heating and cooling requirements of a residential structure.
2. Can understand methods heat movement.
3. Gains confidence and knowledge so they maybe able to calculate the heat gain/heat loss of a residential structure using accepted practices illustrated in ACCA Manual J.

Residential Water Heating

1 Day

Course Syllabus:

Resistance, thermal storage, heat pump, instantaneous and point-of-use water heating systems are compared. The material covers the Gas Appliance Manufacturer's Association ratings for gas and electric water heaters. Typical hot water use for a family of 3 and 4 is used to estimate the comparative cost of heating water with gas and electricity. The recovery time for gas water heaters is compared to electric unit recovery, and the "first hour rating" for rating water heaters is studied. The first cost of gas and electric water heaters are compared and the cost increases of the new FVIR gas water heaters are presented. Apollo gas water heating and whole house heating systems are discussed. The class is recommended for all residential representatives.

Definitions and Types of Water Heaters (1)

Lesson Objective

1. Be able to identify the various types of gas and electric water heaters
2. Be able to identify heat transfer and the definitions associated with water heating

Components and Operation of Gas and Electric Water Heaters (2)

Lesson Objective

1. Be able to identify the parts of a gas and electric water heater

GAMA Energy Factors, Efficiency and Performance (3)

Lesson Objectives

1. Understand First Hour Rating
2. Be able to define gas and electric energy factors
3. Be able to calculate tank losses
4. Be able to explain gas and electric life expectancy
5. Be able to calculate how fast gas and electric water heaters heat water.

Usable Storage Gallons, Shower Flow Rates, Dual Tank Water Heaters, Hot Water Use Trends (4)

Lesson Objectives

1. Understand water use patterns for a typical family
2. Be able to define hot water “run outs”
3. Be able to explain how to get the best performance from an electric water heater

Southern Co Metered Data; Equipment Costs, Operating Costs and Electric Service Entrance Sizing (5)

Lesson Objective

1. Be able to calculate the cost of heating water for a family of 3
2. Be able to show the energy cost equivalency of gas and electric water heaters
3. Be able to calculate the service entrance size for an existing house
4. Be able to explain the advantages and benefits of electric water heaters
5. Be able to compare the equipment cost of gas and electric water heaters

Advantages, Benefits, Misconceptions, Misconceptions (6)

Lesson Objective

1. Be able to explain the advantages of electric and gas water heaters
2. Be able to explain how the “first hour rating” is misleading to the consumer

Point of Use and Tankless Water Heaters (7)

Lesson Objective

1. Be able to explain the advantages of tankless water heaters
2. Be able to explain how tankless water heaters work and why they are considered to be more efficient than tank-type water heaters

EPRI Desk book Water Heater Reference Guide and The California Energy Commission (8)

Lesson Objective

1. Be able to show how to access EPRI and California web sites

Advertising and Incentives Standardized Residential Water Heating Procedure (9)

Lesson Objective

1. Be able to explain the correct procedure for applying incentive payments in the new and existing residential water heating markets

Codes and Standards (10)

Lesson Objective

1. Be able to explain the new (2005) GAMA Consumer Information
2. Be able to explain the new DOE Energy Factors for Water Heaters
3. Be able to explain the new FVIR gas water heater requirements

RMV
Residential Mechanical Ventilation
2 Day

All course material, classroom presentations and certification exam is copyright by HRAI – Heating Refrigeration and Air Conditioning Institute of Canada.

Participant will receive a certificate and wallet card if they attain a mark of 75% or better on the certification exam.

Residential Mechanical Ventilation (RMV)

Course Syllabus:

This fourteen hour comprehensive training course provides invaluable information for those involved with designing and installing residential mechanical ventilation systems including HRV's and ERV's. Residential Mechanical Ventilation focuses on the concepts of building science and how to apply the "House as a System" approach to pressure conditions.

Anticipated Outcomes:

The expected outcomes are that the participant:

1. Learn the concepts of building science and how to apply the "House as a System" approach to pressure conditions.
2. Know the fundamentals of air quality assessment, system requirements and focus specifically on system design and installation.

13 SEER: What to expect

2 Hour

This two hour comprehensive training course is designed to provide technicians with information to better understand why 13 SEER; and the changes it brings from manufacturer to consumer and what to expect in the future.

ANTICIPATED OUTCOMES:

A. The presentation uses various means to reach the expected outcomes for the course.

These means include:

1. PowerPoint presentation.
2. Handouts.

B. The expected outcomes are that the participant:

1. Understand the why 13 SEER.
2. Understand the changes made at manufacturer level.
3. Understand how changes effect distribution, contractors and consumers.

1810 - Dehumidification Training

1 Day

I. COURSE SYLLABUS:

This one day course is designed to provide the foundation for understanding the dehumidification process and the allowable temperature and humidity levels for acceptable human comfort. It includes material on heat transfer, psychrometric, sensible and latent heat loss/gain and building ventilation standards.

II. ANTICIPATED OUTCOMES:

1. A hands-on lab session allows the participant to measure unit air flow and the cooling/dehumidification capacity of an air conditioner and the cooling/dehumidification capacity of a desiccant unit.
2. Manufacturer's representatives from Munters will be on hand to present technical information on the application and operation of their desiccant HCU unit and similar systems.
3. The course is recommended for anyone wanting to learn more about dehumidification, products and current dehumidification control strategies.