Instructional/Task Analysis

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 1: Psychrometrics for Residential HVAC

1. Terms and definitions
2. Basic information found on a psychrometric chart
3. The location of dry-bulb temperature readings
4. The location of wet-bulb temperature readings
5. The location of dew point temperature readings
6. The location of relative humidity readings
7. Three basic cumulative psychrometric processes
8. Typical air-conditioning processes that can be shown on a psychrometric chart
9. Sling psychrometers
10. Operating a sling psychrometer
11. Determine relative humidity when only dry-bulb and wet-bulb temperatures are known
12. Determine dew point when only dry-bulb and wet-bulb temperatures are known
13. Determine how outside air should be conditioned to provide a comfortable humidity and temperature combination in winter heating
14. Determine how outside air should be conditioned to provide a comfortable humidity and temperature combination in summer cooling
15. Determine the relative humidity of a conditioned space
16. Determine the relative humidity of an outdoor space
17. Determine the wet-bulb temperature of the air inside a duct

Unit 2: Residential Load Calculation

1. Terms and definitions
2. The value of standardized load calculations
3. Factors in determining heat loss and heat gain
4. Steps in calculating heat transfer multipliers
5. Factors to consider when sizing heating equipment
6. Factors to consider when sizing cooling equipment
7. Ways structural modifications can affect equipment selection
8. Calculate heat loss and heat gain for a residence using “entire house” for a quick calculation
9. Determine shaded and unshaded glass area for use in heat gain calculations
10. Calculate heat loss for a residence, room by room
11. Calculate heat gain for a residence, room by room

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 3: Residential Duct Design and Sizing

1. Terms and definitions
2. Types of supply duct systems
3. Factors affecting system design and the effects they have on the system
4. Major steps in air system design and their procedures
5. Factors affecting return air duct design
6. Location of registers and grilles
7. Advantages and disadvantages for locations of registers and grilles
8. Climatic zone conditions
9. Control devices and their applications
10. Factors to consider in the distribution of conditioned air
11. Grille design factors and their meanings
12. Outlet replacement and recommended velocities
13. Air duct calculators
14. Solve problems using the friction loss per 100 feet chart
15. Solve problems using the friction chart for flex duct
16. Design an air distribution system from a drawing
17. Determine the pressure drop across an evaporator coil
18. Determining the CFM being delivered by a selected forced air system

Unit 4: Residential Air Treatment

1. Terms and definitions
2. Air contaminants that affect humans
3. The advantages of maintaining proper humidity in a residence
4. Factors which affect humidity in a residence
5. Common types of residential filtering equipment
6. Operation of an electronic air cleaner
7. Operation of a dehumidifier
8. Operation of a typical humidifier with a forced air furnace
9. Air-to-air exchangers
10. Radon monitoring
11. Install a humidifier with low voltage controls
12. Install an electronic air cleaner

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 5: Psychrometrics for Light Commercial HVAC

1. Terms and definitions
2. Using a psychrometric chart for light commercial applications
3. Specific humidity
4. Enthalpy
5. Specific volume
6. The load triangle
7. Determine relative humidity when dry bulb and wet bulb temperatures are known.
8. Determine dew point and enthalpy when dry bulb and wet bulb temperatures are known
9. Determine the condition of air presented to the evaporator coil when outside air for ventilation is mixed with room return air
10. Plot a load triangle on a psychrometric chart when return and supply air dry bulb/wet bulb temperatures are known
11. Calculate a load triangle for a given light commercial installation

Unit 6: Light Commercial Load Calculations

1. Terms and definitions
2. *Manual N* and light commercial load calculations
3. Load components for heat loss and heat gain in a light commercial space
4. Other sources of light commercial heat gain
5. The winter humidification load
6. Time of day corrections
7. Selecting equipment for a normal cooling application
8. U values
9. Calculate the heat gain for an office
10. Calculate the heat loss for an office

Unit 7: Light Commercial System Design

1. Terms and definitions
2. Structural and space considerations in system design
3. Equipment location in system design
4. Control requirements in system design
5. Electrical considerations in system design
6. How ceiling design affects system design

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 7: Light Commercial System Design (continued)

7. Air distribution and system design
8. Noise and system design
9. Odor control and system design
10. Fire codes and system design
11. Filters and system design
12. Humidification and system design
13. Duct materials and system design
14. The methods of sizing duct
15. Twining furnaces
16. Balancing an air distribution system

Unit 8: Light Commercial Air Treatment

1. Terms and definitions
2. Comfort level in a light commercial structure
3. Air cleaners and existing light commercial structures
4. Common electronic air cleaning devices for light commercial applications
5. Performance factors for air cleaner applications
6. Basic air patterns for air cleaners
7. Capacity sizing
8. Mechanical filters
9. Humidification for light commercial applications
10. Air-to-air exchanges for light commercial structures
11. Determine the number of electronic air cleaners needed for an office

Unit 9: Standard Gas-Fired Furnaces

1. Terms and definitions
2. Furnace classifications
3. Gas furnace safety
4. Parts of a combustion triangle

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 9: Standard Gas-Fired Furnaces (continued)

5. Types of gas furnaces and their applications
6. Major components of a standing pilot furnace
7. Automatic ignition systems and their operations
8. Components of a gas burner assembly
9. Types of gas valves and their characteristics
10. Components of a combination electric gas valve
11. Characteristics of heat exchangers
12. Characteristics of draft diverters
13. Types of blower assemblies
14. Components of a control system
15. The functions of a transformer
16. Types of thermostats and their functions
17. Limit switch operation
18. Fan switch operation
19. Combination fan-limit switch operation
20. Pilot light operation
21. Thermocouple operation
22. Pilot safety operation
23. Potential sources for thermocouple failure
24. Potential sources of fan switch failure
25. Potential sources of transformer failure
26. Potential sources of high limit switch failure
27. Potential sources of gas valve failure
28. Potential sources of fan relay failure
29. Potential blower section failures and component sources
30. Potential sources of heat exchanger failure
31. Potential sources of pilot safety failure

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 9: Standard Gas-Fired Furnaces (continued)

32. Factors needed to determine gas pipe sizing
33. Energy conservation devices designed for retrofitting
34. Set back thermostats
35. Intermittent ignition systems
36. Vent dampers and their uses
37. Combustion air for a gas furnace
38. Trace the high and low voltage circuits of a gas furnace
39. Construct wiring diagrams for gas furnaces
40. Size a gas piping system
41. Install a gas furnace
42. Start and adjust a gas furnace
43. Disassemble, inspect, and reassemble an upflow gas furnace
44. Perform maintenance on a gas furnace
45. Troubleshoot a gas furnace on a “no heat” complaint
46. Install a retrofit package to replace a standing pilot with a cycling pilot

Unit 10: High-Efficiency Gas-Fired Furnaces

1. Terms and definitions
2. Induced draft furnaces
3. Condensing furnaces
4. Pulse furnaces
5. Safety with high-efficiency furnaces
6. Maintaining and servicing high-efficiency furnaces
7. Trace the high voltage circuitry for an induced draft furnace
8. Trace the low voltage circuitry for an induced draft furnace
9. Troubleshoot an induced draft furnace on a “no heat” complaint
10. Troubleshoot a condensing furnace on a “no heat” complaint

Unit 11: Oil-Fired Furnaces

1. Terms and definitions
2. Oil furnace types and their performance characteristics
3. Oil storage tanks
4. Major components of an oil burner assembly
5. Operation of a gun type atomizing burner
6. Flame retention
7. Visual flame detection and cad cell location

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 11: Oil-Fired Furnaces (continued)

8. Troubleshooting cad cell systems
9. Combustion chambers
10. Fuel pumps
11. Nozzles
12. Nozzle service guide
13. Venting
14. Normal operating sequence
15. Electrodes
16. Combustion testing
17. Burner components and required maintenance
18. Install an oil-fired furnace
19. Perform a stack temperature test of an oil-fired furnace
20. Perform a CO_2 test and determine the combustion efficiency of an oil-fired furnace
21. Perform a smoke test on an oil-fired furnace
22. Perform an “overfire draft” and a “flue draft” test on an oil-fired furnace
23. Perform fuel pump service on an oil-fired furnace

Unit 12: Electrical Heating Systems

1. Terms and definitions
2. Types of electrical heating systems
3. Duct heaters and electric heaters
4. Components of electric heating equipment
5. Causes of common failures of electric heating equipment components
6. Staging methods and their operations
7. Installing duct heaters
8. Installing heaters smaller or larger than ductwork
9. Installing slip-in heaters
10. Installing flange-type heaters
11. General recommendations for installing duct heaters
12. Gathering information for system sizing
13. Formulas for sizing electrical heating systems
14. Install, start, and check an electrical heating unit
15. Disassemble, inspect, and reassemble an electric fan
16. Troubleshoot an electric furnace
17. Perform maintenance on an electric furnace

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do

Unit 13: Cooling Systems

1. Terms and definitions
2. Basic mechanical components of a cooling system
3. Additional components found on some residential and light commercial units
4. Electrical components and their functions
5. Steps in a cooling cycle
6. Indoor fan operation
7. Compressor motor failures and ways to detect them
8. Compressor mechanical failures and ways to detect them
9. Causes of compressor failures
10. Problems with condensing units and their probable causes
11. Functions of low side section components in an air conditioner
12. Problems of low side sections and their probable causes
13. Steps in using a charging table
14. Guidelines for charging a system
15. The scroll compressor
16. Evaporative coolers
17. Evaporative cooling applications
18. Refrigerant recovery and recycling

19. Trace the cooling circuit on a single phase package heat/cool unit.
20. Trace the cooling circuit on a $7\frac{1}{2}$ ton three phase rooftop unit.
21. Troubleshoot an air conditioning condenser section on a “no cooling” complaint
22. Use a changing table to check the charge in a capillary cooling system
23. Perform maintenance on an air conditioner

Unit 14: Heat Pump Systems

1. Terms and definitions
2. Heat pump configurations
3. Components of a heat pump
4. Components of a 4-way reversing valve
5. Operation of a 4-way reversing valve in the heating and cooling modes
6. Metering devices and check valves
7. A heat pump in the defrost mode

Unit 14: Heat Pump Systems (continued)

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
8. Methods of defrost initiation and termination	20. Trace operational circuits for a heat pump in the cooling mode
9. Components of a heat pump indoor section	21. Trace operational circuits for first stage heating in a heat pump
10. Components failures of heat pumps	22. Trace operational circuits for a heat pump in the defrost mode
11. The heat pump touch test	23. Trace operational circuits for second stage supplemental heat in a heat pump
12. Special precautions for replacing reversing valves	24. Trace operational circuits for a fossil fuel heat pump system in first stage heat mode below 40°F outdoor ambient
13. Special precautions for driers	26. Wire a control system for a heat pump
14. General guidelines for supplemental heating strips	27. Troubleshoot a heat pump indoor section in the cooling mode
15. Temperature controls	28. Perform maintenance on an indoor section of a heat pump in the cooling mode
16. Fossil fuel/add-on heat pumps	29. Troubleshoot a heat pump on a “no cooling” complaint
17. Water source heat pumps	30. Troubleshoot a heat pump outdoor section on an “insufficient cooling” complaint
18. Closed loop/ground source heat pumps	31. Perform maintenance on the indoor section of a heat pump
19. Rules for good heat pump operation	32. Troubleshoot supplemental heat on a heat pump
	33. Perform maintenance on heat pump supplemental heating
	34. Troubleshoot a heat pump on a “no heat” complaint when the compressor will not run
	35. Troubleshoot a heat pump on a “no heat” complaint when the compressor runs but cycles on compressor overload
	36. Troubleshoot a heat pump on an “insufficient heat” complaint when the compressor will run
	37. Check operation of an Essex solid state time-temperature defrost mode

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
Unit 14: Heat Pump Systems (continued)	
	38. Check operation of a Ranco E-15 mechanical time-temperature defrost control
	39. Check operation of an Essex 149-600 solid state demand defrost control
Unit 15: Balance Points	
1. Terms and definitions	13. Size a heat pump on the cooling load
2. The COP of a direct electrical heating element and the COP of a heat pump	14. Plot balance points for a heat pump at given design conditions
3. The COP of a heat pump at a given design temperature	15. Locate equipment to obtain maximum COP from a heat pump
4. Balance points and their relation to COP	16. Set outdoor thermostats for proper staging of auxiliary heat
5. Balance points and typical stages in heating continuity	
6. Factors needed to plot balance points	
7. A heat pump performance curve from manufacturer's specifications	
8. Balance point #1 and design conditions	
9. Additional balance points and design conditions	
10. The procedure for sizing a heat pump on the cooling load	
11. Advantages of controlled heating stages	
12. Installation considerations related to heat pump performance	
Unit 16: Introduction to Hydronics	
1. Terms and definitions	
2. Basic types of hydronic systems	
3. Classifications of hydronic systems with their water temperature/pressure characteristics	
4. Types of common hydronic system designs	

Related Information: What the Student Should Know

Application: What the Student Should Be Able to Do

Unit 16: Introduction to Hydronics (continued)

5. Common hydronic system designs and their advantages and disadvantages
6. Design water temperature
7. Design water temperature drop
8. Design water flow rates through circuits
9. Flow rates through terminal units and their tubing sizes
10. Placement of terminal units
11. Terminal units, their characteristics and uses
12. Steps in the selection and sizing of terminal units
13. Fuels, ratings, and selection of boilers
14. Advantages and disadvantages of types of residential expansion tanks
15. Steps in selection of residential expansion tanks
16. Types, design, and sizing of residential pumps
17. Factors in the selection of residential pumps
18. Steps in the selection of residential pumps
19. Factors affecting pipe sizing
20. The procedure for selection of pipe sizes
21. Types of hydronic specialties and their characteristics and uses
22. Steps in designing a hydronic system
23. Integrated systems
24. Pulse combination boilers
25. Wall-mounted boilers
26. Lay out a series loop single circuit hydronic system with boiler located under floor of dining room
27. Select boiler and expansion tanks
28. Make a trial selection of pump and select pipe size for series loop system

Instructional/Task Analysis

Related Information: What the Student Should Know	Application: What the Student Should Be Able to Do
Unit 17: Customer Relations	
1. Terms and definitions	9. Respond to problem situations
2. Ways good personal habits contribute to good customer relations	
3. General rules in dealing with customers	
4. Basic rules for service calls	
5. Ways to turn service calls into good customer relations opportunities	
6. Ways to handle an irritated customer	
7. Ways vehicle operations affect customer relations	
8. Ways to earn a customer's respect	
Unit 18: Service Operations	
1. Terms and definitions	14. Complete a return goods tag
2. Objectives of good service operations	
3. Guidelines for maintaining inventory control	
4. Guidelines for maintaining records of installations, service calls, and maintenance calls	
5. Ways to gather information for a good equipment file	
6. Procedure for handling return goods	
7. Special precautions in handling return goods	
8. Vehicle use, maintenance, and safety	
9. Basic rules for scheduling and service calls	
10. Ways to avoid legal problems with equipment and service	
11. Other operations items and how they contribute to good service operations	
12. How to handle accounting and money with service customers	
13. The most important rule of good service operations	