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Five Year HVACR Service Technician Apprenticeship Curriculum

Version 1.6 (Revised 05/12/06)
S.H. Allen

Year 1

Module 1-1 OSHA 10 Hour Certification

A General Safety Practices

1 PPE
2 Fire Safety
3 Tool Safety
4 Electrical Safety
5 Fall Protection
6 Stairways and Ladders
7 Vehicle Safety (DOT)
8 Red Cross Training and CPR
9 *Lock Out and Tag

Module 1-2 UA Heritage

A Your New Partners

1 Describe the Organizational Structure and Emblem of the United Association
2 Describe the History of United Association
3 Describe Role of Career Partnerships (4 Legged Stool)

B Getting Off to the Right Start

4 Identify Opportunities in the Pipe Trades
5 Describe a Winning Attitude
6 Define the Role of the JATC
7 Define Apprentices' Roles and Responsibilities during Their Apprenticeship

C Your Collective Voice

8 Describe the History of Labor Unions in the US
9 Define the Future Role of the Unions in the US
10 Trace the History of the UA in the Pipe Trades Industry
11 Define the UA as It Is Today

D Your Employer as Your Partner

12 Define the Important Role Contractors Play in the Craft
13 Describe the Bidding Process Including Contractors' Direct and Indirect Costs

14 Describe Your Role in Helping Contractors
15 Describe the Role of Contractors' Associations

E Effectiveness on the Job

F 16 Define Effectiveness on the Job
G 17 Develop Good Learning Habits
18 Develop Good Work Habits
19 Think Safety
20 Deal Well with People
21 Learn to Communicate Effectively
22 Representing Your Employer

H Your Most Important Partner

23 Define Attitudes in Action
24 Define Personal Commitmen
25 Define Guidelines for Growth
26 Strive for Excellence
27 Define the Need for Achievement

Module 1-3 Thermal Dynamic Theory and Application

A Theory

1 Temperature
2 Introduction to Heat
3 Conduction
4 Convection
5 Radiation
6 Sensible Heat
7 Latent Heat
8 Specific Heat
9 Sizing Heating Equipment
10 Pressure
11 Atmospheric Pressure
12 Pressure Gages
13 Temperature Conversion--Fahrenheit and Celsius
14 Pressure Measured in Metric Terms

B Matter and Energy

1 Matter and Energy
2 Mass and Weight
3 Density
4 Specific Gravity
5 Specific Volume
6 Gas Laws
7 Energy
8 Conservation of Energy
9 Energy Contained in Heat
10 Energy in Magnetism
11 Purchase of Energy
12 Energy Used as Work
13 Power
14 Electrical Power--the Watt

C Refrigeration Cycle and Refrigerants

1 Introduction
2 Refrigeration
3 Rating Refrigeration Equipment
4 The Refrigeration Process
5 Pressure and Temperature Relationship
6 Refrigeration Components
7 The Evaporator
8 The Compressor
9 The Condenser
10 The Refrigerant Metering Device
11 Refrigeration System and Components
12 Refrigerants
13 Refrigerants Must Be Safe
14 Refrigerants must be detectable
15 The Boiling Point of the Refrigerants
16 Pumping Characteristics
17 Popular Refrigerants and Their Important Characteristics
18 Refrigerant Cylinder Color Codes
19 Recovery, Recycle, or Reclaim of Refrigerants

Module 1-4 Tools and Equipment

A Tools and Equipment

1 General Hand Tools
2 Specialized Hand Tools
3 Tubing Tools
4 Specialized Service and Installation Equipment
5 Refrigerant Leak Detectors

B Fasteners

1 Nails
2 Staples and Rivets
3 Threaded Fasteners
4 Concrete Fasteners
5 Other Fasteners

C Tubing and Piping **(Use with Module 1-6)**

1 Purpose of Tubing and Piping

2 Types and Sizes of Tubing
3 Tubing Insulation 4 Line Sets
5 Cutting Tubing
6 Bending Tubing
7 Soldering and Brazing Processes
8 Heat Sources for Soldering and Brazing
9 Soldering Techniques
10 Brazing Techniques Practical Soldering and Brazing Tips
11 Making Flare Joints
12 Making a Double-Thickness Flare
13 Swaging Techniques
14 Steel and Wrought Iron Pipe
15 Joining Steel Pipe
16 Installing Steel Pipe
17 Plastic Pipe

D Calibrating Instruments

1 The Need for Calibration
2 Calibration
3 Temperature-Measuring Instruments
4 Pressure Test Instruments
5 Electrical Test Instruments
6 Refrigerant Leak Detection Devices
7 Flue-Gas Analysis Instruments
8 General Maintenance

Module 1-5 Basic Electricity

A Basic Electricity and Magnetism

1 Structure of Matter
2 Movement of Electrons
3 Conductors
4 Insulators
5 Electricity Produced from Magnetism
6 Direct Current
7 Alternating Current
8 Electrical Units of Measurement
9 The Electrical Circuit
10 Making Electrical Measurement
11 Ohm's Law

12 Characteristics of Series Circuits
13 Characterizes of Parallel Circuits
14 Electrical Power
15 Magnetism
16 Inductance

17 Transformers
20 Electrical Measuring Instruments
21 Sine Waves (Single Phase AC)
22 Wire Sizes

23 Circuit Protection Devices

Module 1-6 Copper Tube Soldering and Brazing (See1-4-C)

A Copper Tube Soldering and Brazing Certification

Safety and Safe Work Practices
Introduction
Types and Uses of Copper Tube
Solder, Brazing Filler Metals and Fluxes
Joint Preparation and Assembly
Heating Equipment
Making a Soldered Joint
Performance Test for Soldering
Making a Brazed Joint
Brazing Performance Test
Brazeable Metals
Nitrogen Use and Regulator Safety

Module 1-7 Basic Math

A Whole Numbers

1 Addition of Whole Numbers
2 Subtraction of Whole Numbers
3 Multiplication of Whole Numbers
4 Division of Whole Numbers
5 Combined Operations with Whole Numbers

B Common Fractions

1 Addition of Common Fractions
2 Subtraction of Common Fractions
3 Multiplication of Common Fractions
4 Division of Common Fractions
5 Combined Operations with Common Fractions

C Decimal Fractions

1 Addition of Decimal Fractions
2 Subtraction of Decimal Fractions
3 Multiplication of Decimal Fractions
4 Division of Decimal Fractions
5 Decimal and Common Fraction Equivalents
6 Combined Operations with Decimal Fractions

D Ratio and Proportion

1 Ratio
2 Proportion

E Percent, percentage, and Discount

1 Percent and Percentage
2 Discounts

Module 1-8 Customer Relations

A Basics of Customer Service

1 Defining Customer Service
2 First Impressions
3 Cleanliness and Neatness Equal Professionalism
4 Who Are Your Customers?
5 Qualities for the Service Technician
6 Fixing the Customer versus Fixing the Equipment
7 Verbal/Nonverbal Communication
8 Basic Writing Skills

Year 2

Module 2-1 Refrigerant Safety

A Soldering and Refrigerant Handling and Safety
B Chemical Safety
C Hazardous Materials (MSDS)
D Respiration (SCBA)

Module 2-2 Refrigerant Characteristics and Handling

A Refrigerant Oil Chemistry and Management (Recovery, Recycling, Reclaiming, And Retrofitting

1 Refrigerants and the Environment
2 Ozone Depletion
3 Global Warming
4 Refrigerants
5 CFC Refrigerants
6 HCFC Refrigerants

7 HFC Refrigerants
8 HC Refrigerants
9 Naming Refrigerants
10 Refrigerant Blends
11 Popular Refrigerants and Their Compatible Oils
12 Refrigerant Oils and Their Applications
13 Oil Groups
14 Regulations (EPA)
15 Recovery, Recycle, or Reclaim
16 Methods of Recovery
17 Mechanical Recovery Systems
18 Recovering Refrigerant from Small Appliances
19 Reclaiming Refrigerant
20 Refrigerants and Tools In the Future

B System Evacuation

1 Reliable and Efficient Systems
2 Standing Pressure Test
5 Leak Detection Methods
6 Leak Detection Tips
7 Repairing Leaks
8 Purpose of System Evacuation
9 Theory Involved With Evacuation
10 Measuring the Vacuum
11 Recovering Refrigerant
12 The Vacuum Pump
13 Deep Vacuum
12 Multiple Evacuation
13 Leak Detection While in a Vacuum
14 Removing Moisture with a Vacuum
15 General Evacuation Procedures
16 Systems with Schrader Valves
17 Gauge Manifold Hoses
18 System Valves
19 Using Dry Nitrogen
20 Cleaning a Dirty System (Filter Dryers)

C System Charging

1 Charging a Refrigeration System

2 Vapor Refrigerant Charging
3 Liquid Refrigerant Charging
4 Weighing Refrigerant
5 Using Charging Devices
6 Using Charging Charts
7 Sub-Cooling Method of Charging For TXV Systems
8 Charging Near-Azeotropic (Zeotropic) Refrigerant Blends

Module 2-3 Electric Motors

A Types of Electric Motors

1 Uses of Electric Motors
2 Parts of an Electric Motor

3 Electric Motors and Magnetism
4 Determining a Motor's Speed
5 Start Windings
6 Starting and Running Characteristics
7 Electrical Power Supplies
8 Single-Phase Open Motors
9 Split-Phase Motors
10 The Centrifugal Switch
11 The Electronic Relay
12 Capacitor-Start Motors
18 Capacitance
19 Impedance
13 Capacitor-Start, Capacitor-Run Motors
14 Permanent Split-Capacitor Motors
15 Shaded-Pole Motors 16 Three-Phase Motors
17 Single-Phase Hermetic Motors
18 The Potential Relay
19 The Current Relay
20 Positive Temperature Coefficient Start Device
21 Two-Speed Compressor Motors
22 Special Application Motors
23 Three-Phase Motor Compressors
24 Variable-Speed Motors
25 DC Converters (Rectifiers)
26 Inverters
27 Electronically Commutated Motors
28 Cooling Electric Motors

B Application of Motors

C 1 Motor Applications
2 The Power Supply
3 Electric Motor Working Conditions
4 Insulation Type or Class 5 Types of Bearings
6 Motor Mounting Characteristics
7 Motor Drives

D Motor Controls

1 Introduction to Motor Control Devices
2 Run-Load and Locked-Rotor Current
3 The Relay

4 The Contactor
5 Motor Starters
6 Motor Protection
7 Inherent Motor Protection
8 External Motor Protection
9 National Electrical Code's Standards
10 Temperature-Sensing Devices
11 Magnetic Overload Devices
12 Restarting the Motor

E Troubleshooting Electric Motors

1 Electric Motor Troubleshooting
2 Mechanical Motor Problems
3 Removing Drive Assemblies
4 Belt Tension
5 Pulley Alignment
6 Electrical Problems
7 Open Windings
8 Shorted Motor Windings
9 Short Circuit to Ground (Frame)
10 Single-Phase Motor Starting Problems
11 Checking Capacitors
12 Identification of Capacitors
13 Wiring and Connectors
14 Troubleshooting Hermetic Motors
15 Service Technician Calls

Module 2-4 Controls

A Introduction to Automatic Controls

1 Types of Automatic Controls
2 Devices That Respond to Thermal Change
3 The Bimetal Device
4 Control by Fluid Expansion
5 The Thermocouple
6 Electronic Temperature-Sensing Devices

B Automatic Control Components and Application

1 Recognition of Control Components
2 Temperature Controls
3 Space Temperature Controls, Low Voltage
4 Space Temperature Controls, High (Line) Voltage
5 Sensing the Temperature of Solids
6 Measuring the Temperature of Fluids
7 Sensing Temperature in an Airstream
8 Things to Remember About Sensing Devices
9 Pressure-Sensing Devices
10 Pressure Transducers
11 High-Pressure Controls
12 Low-Pressure Controls
13 Oil Pressure Safety Controls
14 Air Pressure Controls
15 Gas Pressure Switches
16 Devices That Control Fluid Flow and Do Not Contain Switches
17 Water Pressure Regulators
18 Gas Pressure Regulators
19 Mechanical Controls
20 Electromechanical Controls
21 Maintenance of Mechanical Controls
22 Maintenance of Electromechanical Controls
23 Service Technician Calls

Module 2-5 Basic Commercial Refrigeration

A Evaporators and the Refrigeration System

1 Refrigeration
2 Temperature Ranges of Refrigeration
3 The Evaporator
4 Boiling and Condensing
5 The Evaporator and Boiling Temperature
6 Removing Moisture
7 Heat Exchange Characteristics of the Evaporator
8 Types of Evaporators
9 Evaporator Evaluation
10 Latent Heat in the Evaporator
11 The Flooded Evaporator
12 Dry-Type Evaporator Performance
13 Evaporator Superheat
14 Hot Pull Down (Excessively Loaded Evaporator)

15 Pressure Drop in Evaporators
16 Liquid Cooling Evaporators (Chillers)
17 Evaporators for Low-Temperature Application
18 Defrost of Accumulated Moisture

B Condensers 1 The Condenser
2 Water-Cooled Condensers
3 Tube within a Tube Condenser
4 Mineral Deposits
5 Cleanable Condensers
6 Shell and Coil Condensers
7 Shell and Tube Condensers
8 Wastewater Systems
9 Refrigerant-to-Water Temperature Relationship for Wastewater Systems
10 Re-circulated Water Systems
11 Cooling Towers
12 Natural-Draft Towers
13 Forced- or Induced-Draft Towers
14 Evaporative Condensers
15 Air-Cooled Condensers
16 High-Efficiency Condensers
17 The Condenser and Low Ambient Conditions
18 Head Pressure Control
19 Using the Condenser Superheat
20 Heat Reclaim
21 Floating Head Pressures
22 Condenser Evaluation

C Compressors
1 The Function of the Compressor
2 Types of Compressors
3 Reciprocating Compressor Components
4 Belt-Drive Mechanism Characteristics
5 Direct-Drive Compressor Characteristics
6 Reciprocating Compressor Efficiency
7 Discus Valve Design
8 Liquid in the Compressor Cylinder
9 System Maintenance and Compressor Efficiency

D Expansion devices

1 Expansion Devices
2 Thermostatic Expansion Valve
3 TXV Components
4 The Valve Body
5 The Diaphragm
6 Needle and Seat
7 The Spring
8 The Sensing Bulb and Transmission Tube
9 Types of Bulb Charge
10 The Liquid Charge Bulb
11 The Cross Liquid Charge Bulb 12 The Vapor Charge Bulb
13 The Cross Vapor Charge Bulb
14 Functioning Example of a TXV with Internal Equalizer
15 TXV with External Equalizers
16 TXV Response to Load Changes
17 TXV Valve Selection
18 Balanced-Port TXV
19 Dual-Port TXV
20 Pressure-Limiting TXV
21 Servicing the TXV
22 Sensing Element Installation
23 The Solid-State Controlled Expansion Valve
24 Step-Motor Expansion Valves
25 Algorithms and PID Controllers
26 The Automatic Expansion Valve
27 Automatic Expansion Valve Response to Load Changes
28 Special Considerations for the TXV and AXV
29 The Capillary Tube Metering Device
30 Operating Charge for the Capillary Tube System

Module 2-6 Customer Relations

A Communicating with Customers

1 Review of Year One
2 Strategies When Communicating
3 Speak the Customer's Language
4 Listening
5 Asking Appropriate Questions

6 Clarifying and Restating
7 The Cycle of Service

Module 2-7 CFC Certifications

A EPA Universal Certification CFC (Required)
B R410A Certification (Required)

Module 2-8 Routine Maintenance

A Coil Cleaning

Year 3

Module 3-2 Air Conditioning (Heating and Humidification)

A Electric Heat

1 Introduction
2 Portable Electric Heating Devices
3 Radiant Heating Panels
4 Electric Baseboard Heating
5 Unit Heaters
6 Electric Hydronic Boilers
7 Central Forced-Air Electric Furnaces
8 Automatic Controls for Forced-Air Electric Furnaces
9 The Low-Voltage Thermostat
10 Controlling Multiple Stages
11 Wiring Diagrams
12 Control Circuits for Forced Air Electric Furnaces.
13 Fan Motor Circuits
14 Contactors to Control Electric Furnaces
15 Airflow in Electric Furnaces
16 Service Technician Calls

B Gas Heat

1 Introduction to Gas Fired Forced Hot - Air Furnaces
2 Types of Furnaces
3 Gas Fuels

4 Gas Combustion
5 Gas Regulators
6 Gas Valve
7 Solenoid Valve
8 Diaphragm Valve
9 Heat Motor-Controlled Valve
10 Automatic Combination Gas Valve
11 Manifold
12 Orifice
13 Burners
14 Heat Exchangers
15 Fan Switch
16 Limit Switch
17 Pilots
18 Safety Devices at the Standing Pilot
19 Ignition Systems
20 Flame Rectification
21 High-Efficiency Gas Furnaces
22 Electronic Ignition Modules and Integrated Furnace Controllers
23 Two-Stage Gas Furnaces
24 Modulating Gas Furnaces
25 Venting
26 Gas Piping
27 Gas Furnace Wiring Diagrams and Troubleshooting Flowcharts
28 Troubleshooting the Safety Pilot-Proving Device-The Thermocouple
29 Troubleshooting Spark-Ignition or Intermittent Pilot Systems
30 Combustion Efficiency
31 Service Technician Calls

C Oil Heat

1 Introduction to Oil-Fired Forced-Warm Air Furnaces
2 Physical Characteristics
3 Fuel Oils
4 Preparation of Fuel Oil for Combustion
5 By-Products of Combustion
6 Gun-Type Oil Burners
7 Oil Furnace Wiring Diagrams
8 Stack Switch Safety Control
9 Cad Cell Safety Control
10 Fuel Oil Supply Systems

11 Combustion Chamber

12 Heat Exchanger
13 Condensing Oil Furnace
14 Service Procedures
15 Combustion Efficiency
16 Service Technician Calls

D Hydronic Heat

1 Introduction to Hydronic Heating
2 Boiler
3 Limit Control
4 Water-Regulating Valve
5 Pressure Relief Valve
6 Air Cushion Tank or Expansion Tank
7 Zone Control Valves
8 Centrifugal Pumps
9 Finned-Tube Baseboard Units
10 Balancing Valves
11 Flow Control Valves
12 Horizontal and Vertical (Downflow) Forced-Air Discharge Unit Heaters
13 Hydronic Heating Piping Systems
14 Tankless Domestic Hot Water Heaters
15 Service Technician Calls

E Indoor Air Quality

1 Introduction
2 Sources of Indoor Air Pollution
3 Controlling Indoor Air Contamination
4 Common Pollutants
5 Contamination Source Detection and Elimination
6 Ventilation
7 Air Cleaning
8 Duct Cleaning
9 Air Humidification
10 Sizing Humidifiers
11 Installation
12 Service, Troubleshooting, and Preventive Maintenance

Module 3-3 Air Conditioning (Cooling)

A Comfort and Psychrometrics

1 Comfort
2 Food Energy and the Body
3 Body Temperature
4 The Comfort Chart
5 Psychrometrics
6 Moisture in Air
7 Superheated Gases in Air
8 Humidity
9 Dry-Bulb and Wet-Bulb Temperatures
10 Dew Point Temperature
11 The Psychrometric Chart
12 Plotting on the Psychrometric Chart
13 Total Heat

B Refrigeration Applied to Air Conditioning

1 Refrigeration
2 Structural Heat Gain
3 Evaporative Cooling
4 Refrigerated Cooling or Air Conditioning
5 The Evaporator
6 The Function of the Evaporator
7 Design Conditions
8 Evaporator Application
9 The Compressor
10 The Reciprocating Compressor
11 Compressor Speeds (rpm)
12 Cooling the Compressor and Motor
13 Compressor Mountings
14 Rebuilding the Hermetic Compressor
15 The Rotary Compressor
16 The Scroll Compressor
17 The Condenser
18 Side-Air-Discharge Condensing Units
19 Top-Air-Discharge Condensers
20 Condenser Coil Design
21 High-Efficiency; Condensers
22 Cabinet Design

23 Expansion Devices
24 Air-Side Components
25 Installation Procedures

C Air Distribution and Balance

1 Conditioning Equipment
2 Correct Air Quantity
3 The Forced Air System
4 The Blower
5 System Pressures
6 Air-Measuring Instruments for Duct Systems
7 Types of Fans
8 Types of Fan Drives
9 The Supply Duct System
10 The Plenum System
11 The Extended Plenum System
12 The Reducing Plenum System
13 The Perimeter Loop System
14 Duct System Standards
15 Duct Materials
16 Galvanized Steel Duct
17 Fiberglass Duct
18 Spiral Metal Duct
19 Flexible Duct
20 Combination Duct Systems
21 Duct Air Movement
22 Balancing Dampers
23 Duct Insulation
24 Blending the Conditioned Air with Room Air
25 The Return Air Duct System
26 Sizing Duct for Moving Air
27 Measuring Air Movement for Balancing
28 The Air Friction Chart
29 Practical Troubleshooting Techniques
30 Residential Duct System Problems
31 Commercial Duct Systems

D Installation

1 Introduction to Equipment Installation
2 Square and Rectangular Duct
3 Round Metal Duct Systems
4 Insulation for Metal Duct
5 Ductboard Systems
6 Flexible Duct
7 Electrical Installation
8 Installing the Refrigeration System
9 Installing Split-System Air Conditioners
10 The Split-System Condensing Unit
11 Installing Refrigerant Piping
12 Equipment Start-Up

E Controls

1 Controls for Air Conditioning
2 Prime Movers-Compressors and Fans
3 Low-Voltage Controls
4 Some History of Residential Central Air Conditioning
5 Economics of Equipment Design
6 Operating Controls for Older Air-Cooled Systems
7 Safety Controls for Older Air-Cooled Systems
8 Operating Controls for Modern Equipment
9 Safety Controls for Modern Equipment
10 The Working Control Package
11 Electronic Controls and Air-Conditioning Equipment

F Typical Operating Conditions

G 1 Mechanical Operating Conditions
H 2 Relative Humidity and the Load
3 System Component Relationships under Load Changes
4 Evaporator Operating Conditions
5 High Evaporator Load and a Cool Condenser
6 Grades of Equipment
7 Documentation with the Unit
8 Establishing a Reference Point on Unknown Equipment
9 Metering Devices for High-Efficiency Equipment
10 Equipment Efficiency Rating
11 Typical Electrical Operating Conditions
12 Matching the Unit to the Correct Power Supply

13 Starting the Equipment with the Correct Data
14 Finding a Point of Reference for an Unknown Motor Rating
15 Determining the Compressor Running Amperage
16 Compressors Operating at Full-Load Current
17 High Voltage, the Compressor, and Current Draw
18 Current Draw and the Two-Speed Compressor

I Troubleshooting

1 Introduction
2 Mechanical Troubleshooting
3 Gage Manifold Usage
4 When to Connect the Gages
5 Low-Side Gage Readings
6 High-Side Gage Readings
7 Temperature Readings
8 Charging Procedures in the Field
9 Electrical Troubleshooting
10 Compressor Overload Problems
11 Compressor Electrical Checkup
12 Troubleshooting the Circuit Electrical Protectors-Fuses and Breakers
13 Service Technician Calls

Module 3-4 Mechanical

A Troubleshoot/Repair/Replace Bearings and Bushings
B Troubleshoot/Repair/Replace Shafts
C Troubleshoot/Repair/Replace Seals and O-Rings
D Troubleshoot/Replace Belts, Sheaves/Pulley
E Perform Alignment and Balancing
F Maintain Couplings

Module 3-5 Blueprint Reading

A Basic Mechanical Symbols
B Basic Blueprint Symbols
C Interpret Schematics

Module 3-6 Controls

A Troubleshooting Basic Controls

1 Introduction to Troubleshooting
2 Troubleshooting a Simple Circuit
3 Troubleshooting a Complex Circuit
4 Troubleshooting the Thermostat
5 Troubleshooting Amperage in the Low-Voltage Circuit
6 Troubleshooting Voltage in the Low-Voltage Circuit
7 Electrically Troubleshooting Switches and Loads
8 Pictorial and Line Diagrams
9 Service Technician Calls

Module 3-7 Math for Troubleshooting

A Direct Measure

1 Equivalent Units of Temperature Measure
2 Angular Measure
3 Units of Length Measure
4 Equivalent Units of Length Measure
5 Length Measure

B Computed Measure

1 Area Measure
2 Equivalent Units of Area Measure
3 Rectangular Volumes
4 Cylindrical Volumes

C Formulas

1 Ohm's Law and Electrical Relationships
2 Gas Laws
3 Heat Load Calculations

D Stretchouts and Lengths of Arcs

1 Stretchouts of Square and Rectangular Ducts
2 Stretchouts of Circular Ducts
3 Lengths of Arcs of Circles

E Trigonometry

1 Trigonometric Functions

F Graphs

1 Graphs and Graphing

G Billing

1 Estimates and Bills

Module 3-8 Customer Relations

A Dealing with the customer

1 Review of Year Two
2 The Relationship between Service and Customer Loyalty
3 Behavior Breeds Behavior
4 Empathy
5 Saying "No" Effectively
6 Develop Successful Recovery Skills
7 Dealing with Irate, Demanding, and Indifferent Customers

Module 3-9 Residential Light Commercial Air Conditioning

A Residential Light Commercial Air Conditioning

1 Domestic Refrigerators
2 Domestic Freezers
3 Room Air Conditioners

B Insert "UA STAR Residential-Light Commercial Study Guide"

C *UA STAR Residential-Light Commercial Certification Exam*

Requirement- Three years work experience or be in 3rd year of Apprenticeship.

D *UA STAR Commercial Refrigeration Certification Exam*

Requirement- Three years work experience or be in 3rd year of Apprenticeship.

Year 4

Module 4-1 Intermediate Commercial Refrigeration

A Special Refrigeration System Components

1 The Four Basic Components
2 Mechanical Controls
3 Two-Temperature Controls
4 Evaporator Pressure Control
5 Multiple Evaporators
6 Electric Evaporator Pressure Regulator Valve
7 Crankcase Pressure Regulator
8 Adjusting the CPR Valve
9 Relief Valves
10 Low Ambient Controls
11 Fan-Cycling Head Pressure Controls
12 Fan Speed Control for Controlling Head Pressure
13 Air Volume Control for Controlling Head Pressure
14 Condenser Flooding for Controlling Head Pressure
15 The Solenoid Valve

16 Pressure Switches
17 Low-Pressure Switch
18 Low-Pressure Control Applied as a Thermostat
19 Automatic Pump-Down Systems
20 High-Pressure Control
21 Low Ambient Fan Control
22 Oil Pressure Safety Control

23 Defrost Cycle
24 Medium-Temperature Refrigeration
25 Random or Off-Cycle Defrost

26 Planned Defrost

27 Low-Temperature Evaporator Design
28 Defrost Using Internal Heat (Hot Gas Defrost)

29 External Heat Type of Defrost
30 Defrost Termination and Fan Delay Control
31 Refrigeration Accessories

32 Receivers
33 The King Valve on the Receiver
34 Filter Driers
35 Refrigerant Check Valves
36 Refrigerant Sight Glasses
37 Liquid Refrigerant Distributors
38 Heat Exchangers
39 Suction-Line Accumulators
40 Suction-Line Filter Driers
41 Suction Service Valves
42 Discharge Service -Valves
43 Refrigeration Line Service Valves
44 Diaphragm Valves
45 Ball Valves
46 Oil Separators
47 Vibration Eliminators
48 Pressure Access Ports
49 Crankcase Heat
50 Plotting the Refrigerant Cycle
51 Plotting the Refrigerant Cycle for Blends with Noticeable Temperature Glide (Zeotropic Blends)

B Application of Refrigeration Systems

1 Application Decisions
2 Reach-In Refrigeration Merchandising
3 Self-Contained Reach-In Fixtures
4 Individual Condensing Units
5 Multiple Evaporators and Single- Compressor Applications
6 Parallel Compressor Systems
7 Secondary Fluid Refrigeration Systems
8 Pressurized Liquid Systems
9 Unitary Stand-Alone Refrigeration Systems
10 Evaporator Temperature Control

11 Interconnecting Piping in Multiple- Evaporator Installations
12 Temperature Control of the Fixture
13 The Evaporator and Merchandising
14 Chest-Type Display Fixtures
15 Refrigerated Shelves
16 Closed-Type Chest Fixtures
17 Controlling Sweating on the Cabinet of Fixtures
18 Maintaining Store Ambient Conditions
19 Walk-In Refrigeration
20 Knock-Down Walk-In Coolers
21 Walk-In Cooler Doors
22 Evaporator Location in a Walk-In Cooler
23 Condensate Removal
24 Refrigeration Piping
25 Package Refrigeration for Walk-In Coolers
26 Vending Machine Refrigeration
27 Water Coolers
28 Refrigerated Air Driers **C Commercial Ice Machines**

1 Ice-Making Equipment, Packaged Type
2 Making Flake Ice

3 Making Cube Ice

4 Microprocessors
5 Making Cylindrical Ice
6 Water and Ice Quality
7 Package Ice Machine Location,
8 Troubleshooting Ice Makers
9 Service Technician Calls

D Special Refrigeration Applications

1 Special Application Refrigeration
2 Transport Refrigeration
3 Truck Refrigeration Systems
4 Railway Refrigeration
5 Extra -Low-Temperature Refrigeration
6 Cascade Systems
7 Quick Freezing Methods

8 Marine Refrigeration
9 Air Cargo Hauling

E Troubleshooting and Typical Operating Conditions for Commercial Refrigeration 1

Organized Troubleshooting

3 Troubleshooting High-Temperature Applications
4 Troubleshooting Medium-Temperature Applications
Troubleshooting Low-Temperature Applications
5 Typical'-Air-Cooled Condenser Operating Conditions
6 Calculating the Correct Head Pressure for Air-Cooled Equipment

7 Typical Operating Conditions for Water-Cooled Equipment
8 Typical Operating Conditions for Wastewater Condenser Systems
9 Typical Operating Conditions for Recirculated Water Systems
10 Six Typical Problems
11 Low Refrigerant Charge
12 Refrigerant Overcharge
13 Inefficient Evaporator
14 Inefficient Condenser
15 Refrigerant Flow Restrictions
16 Inefficient Compressor
17 Compressor Vacuum Test
18 Closed-Loop Compressor Running Bench Test

19 Closed-Loop Compressor Running Field Test
20 Compressor Running Test in the System
21 Service Technician Calls

Module 4-2 All-Weather Systems

A Electric, Gas, and Oil Heat with Electric Air Conditioning

1 Comfort All Year
2 Five Processes for Conditioning Air

3 Add-On Air Conditioning
4 Insulation for Existing Ductwork
5 Evaluation of an Existing Duct System

6 Cooling Versus Heating Air Quantity

7 Control Wiring for Cooling and Heating
8 Two Low-Voltage Power Supplies
9 Phasing Two Low-Voltage Transformers
10 Adding a Fan Relay
11 New All-Weather Systems
12 All-Weather Split Systems
13 Package or Self-Contained All-Weather Systems
14 Wiring the All-Weather System
15 Servicing the All-Weather System

B Air Source Heat Pumps

1 Reverse-Cycle Refrigeration
2 Heat Sources for the Winter
3 The Four-Way Valve
4 Types of Heat Pumps
5 Solar-Assisted Heat Pumps

6 The Air-to-Air Heat Pump
7 Refrigerant Line Identification
8 Metering Devices
9 Thermostatic Expansion Valves
10 The Capillary Tube
11 Combinations of Metering Devices
12 Electronic Expansion Valves

13 Orifice Metering Devices
14 Liquid-Line Accessories
15 Application of the Air-to-Air Heat Pump
16 Auxiliary Heat
17 Balance Point
18 Coefficient of Performance
19 Split-System Air-to-Air Heat Pump

20 The Indoor Unit
21 Air Temperature of the Conditioned Air
22 The Outdoor Unit Installation
23 Package Air-to-Air Heat Pumps
24 Controls for the Air-to-Air Heat Pump
25 The Defrost Cycle
26 Indoor Fan Motor Control

27 Auxiliary Heat
28 Servicing the Air-to-Air Heat Pump
29 Troubleshooting the Electrical System
30 Troubleshooting Mechanical Problems
31 Troubleshooting the Four-Way Valve
32 Troubleshooting the Compressor
33 Checking the Charge
34 Special Applications for Heat Pumps
35 Heat Pumps Using Scroll Compressors
36 Heat Pump Systems with Variable Speed Motors
37 Service Technician Calls

C Geothermal Heat Pumps

38 Reverse-Cycle Refrigeration

39 Geothermal Heat Pump Classifications
40 Open-Loop Systems
41 Water Quality
42 Closed-Loop Systems
43 Ground-Loop Configurations and Flows
44 System Materials and Heat Exchange Fluids
45 Geothermal Wells and Water Sources
46 Troubleshooting
47 Waterless, Earth-Coupled, Closed-Loop Geothermal Heat Pump Systems
48 Service Technician Calls

Module 4-3 Commercial Refrigeration

A Supermarket Refrigeration

1. Insert “UA STAR Commercial Refrigeration Study Guide”

Module 4-4 Lifting and Rigging

A Insert UA Material

Module 4-5 Customer Relations

A Maintaining the Customer Relationship

1 Review of Year Three
2 The Customer Is Always Right
3 Customer Perceptions versus Reality
4 Writing the Work Order
5 Creating Options and Alternatives
6 Keeping Customers Informed
7 Adapting to Customer Requests

Year 5

Module 5-1 Chilled Water Air Conditioning Systems

A High Pressure, Low Pressure, and Absorption Chilled Water Systems

1 Chillers
2 Compression Cycle Chillers
3 Reciprocating Compressor Chillers
4 Cylinder Unloading and Variable Frequency Drives
5 Scroll Compressor Chillers
6 Rotary Screw Compressor Chillers
7 Centrifugal Compressor Chillers (High-Pressure)
8 Evaporators for High-Pressure Chillers
9 Direct Expansion Evaporators
10 Flooded Evaporator Chillers
11 Condensers for High-Pressure Chillers
12 Water-Cooled Condensers
13 Condenser Sub-cooling
14 Air-Cooled Condensers
15 Sub-cooling Circuit
16 Metering Devices for High-Pressure Chillers
17 Thermostatic Expansion Valve 18 Orifice
19 Float-Type Metering Devices
20 Electronic Expansion Valve
21 Low-Pressure Chillers
22 Compressors
23 Condensers for Low-Pressure Chillers
24 Metering Devices for Low-Pressure Chillers
25 Purge Units
26 Absorption Air-Conditioning Chillers
27 Solution Strength
28 Solutions Inside the Absorption System
29 Circulating Pumps for Absorption Systems
30 Capacity Control
31 Crystallization
32 Purge System
33 Absorption System Heat Exchangers
34 Direct-Fired Systems
35 Motors and Drives for Compression Cycle Chillers
36 Part-Winding Start

37 Autotransformer Start
38 Wye-Delta
39 Electronic Starters
40 Motor Protection
41 Load-Limiting Devices
42 Mechanical-Electrical Motor Overload Protection
43 Electronic Solid-State Overload Device Protection
44 Anti-Recycle Control
45 Phase Failure Protection
46 Voltage Unbalance
47 Phase Reversal

B Cooling Towers and Pumps

1 Cooling Tower Function
2 Types of Cooling Towers
3 Fire Protection
4 Fill Material
5 Flow Patterns
6 Tower Material

7 Fan Section
8 Tower Access
9 Tower Sump
10 Makeup Water
11 Blowdown
12 Balancing the Water Flow for a Tower
13 Water Pumps

C Operation, Maintenance, and Troubleshooting Of Chilled Water Air-Conditioning Systems

1 Chiller Start-Up
2 Scroll Chiller Start-Up
3 Reciprocating Chiller Start-Up
4 Rotary Screw Chiller Start-Up
5 Centrifugal Chiller Start-Up
6 Scroll and Reciprocating Chiller Operation
7 Large Positive Displacement Chiller Operation
8 Centrifugal Chiller Operation
9 Air-Cooled Chiller Maintenance
10 Water-Cooled Chiller Maintenance

11 Absorption Chilled Water System Start-Up
12 Absorption Chiller Operation and Maintenance
13 General Maintenance for All Chillers
14 Low-Pressure Chillers
15 Recovering Refrigerant from a Low-Pressure Chiller
16 High-Pressure Chillers
17 Service Technician Calls

Module 5-2 Pneumatic Fundamentals

A Air Station
B Function of Air Station
C Air Filtration
D Pressure Regulators
E Thermostat
F Controllers Sensors
H Transmitter
I Receiver Controllers Switches & Relays
K Controlled Devices

Module 5-3 Building Automation Fundamentals

A Terminology
B Hardware/Softwar
C Input/Output Types
D Data Types
E User Interfaces
F Network Types and Devices
G Network Cabling
H Programming Introduction

Module 5-4 Steam Systems

A Maintain Steam Traps
B Maintain Steam Regulators
C Maintain Steam Coils

D Maintain Vacuum Breakers
E Maintain Steam Flash (Vent) Tanks
F Maintain Insulation Systems

Module 5-5 Controls

A Advanced Automatic Controls (Including DDC, Pneumatics)

1 Control Applications
2 Types of Control Systems
3 Pneumatic Controls Cleaning and
4 Drying Control Air
5 Control Components
6 Direct Digital Controls (DDC)
7 Residential Electronic Controls

Module 5-6 Customer Relations

A Evaluating Your Service

1 Review of Year One Through Four
2 Exceeding Customers' Expectations
3 Dimensions of Quality Service
4 Personal Quality Audit
5 Resolving Service Conflicts
6 Evaluating the Service You Provide

Module 5-7 Codes and Standards

A ASHRAE
B BOCA
C IRC
D ARI Standards
E UBC Code
F Local Codes
G NFPA
H Permits and Inspections

Module 5-8 Final Exam

A UA STAR HVACR Certification

B Review and Prep