Certifying the finest in HVACR

Air Distribution Service

KATE

Knowledge Areas of Technician Expertise

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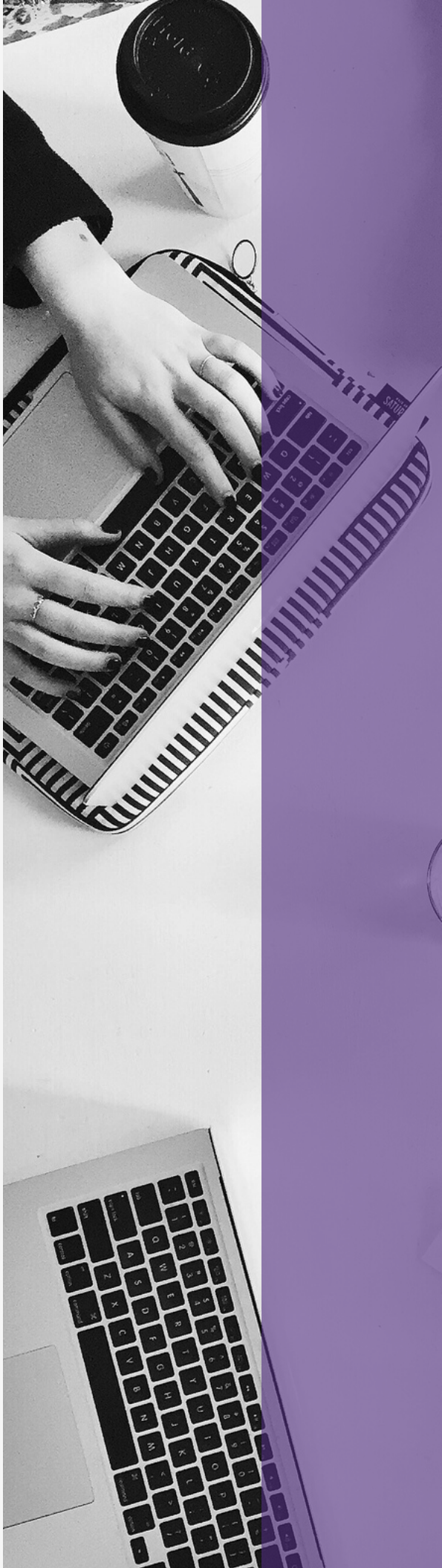


Air Distribution - Service Specialty Exam

Exam Information & Qualifications

The Air Distribution - Service specialty exam tests a candidate's knowledge of the installation, service, maintenance, and repair of HVAC systems. System sizes are limited to 30 tons or less cooling capacity. This is a test and certification for technicians in the HVAC industry. The test is designed for top level service technicians. This test for certification is not intended for the HVAC system designer, sales force, or the engineering community.

To become NATE-certified, you must pass this specialty and the Core exam. This test will measure what 80% of the Air Distribution candidates have an 80% likelihood of encountering at least once during the year on a national basis. Suggested requirement is one year of field experience working on Air Distribution systems as an service technician and technical training for theoretical knowledge.

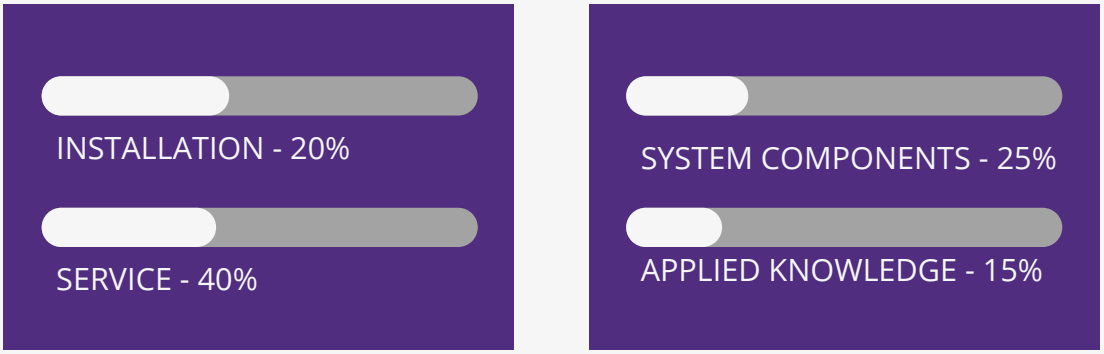
Exam Copyrights

Passing Score Development Process

The passing scores for the NATE tests were established using a systematic procedure (a Passing Score Study). This procedure employed the judgment of experienced HVAC professionals and educators representing various HVAC specialties and geographical areas. The passing scores were set using criteria defining competent performance. The passing score for different test forms may vary slightly due to the comparative difficulty of the test questions.

Exam Subject Areas

Percentages of questions that will be in each section of the exam:



Exam Specifications:

- **Passing Score: Pass/Fail**
- **2.5 Hour Time Limit**
- **Closed Book**
- **100 Questions**

Industry References

> The reference materials list below will be helpful in preparing for this exam. These materials may not contain all of the information necessary to be competent in this specialty or to pass the exam.

- American National Standards Institute (ANSI) / Air Conditioning Contractors of America (ACCA) Manuals – Latest Edition.
  - Manuals “D” “J” “QI” – Quality Installation, and “S”
- ACCA Manuals “T” and “RS” – Latest Editions
- ACCA Residential Duct Diagnostics and Repair – Latest Edition
- AHRI-Hydronics Section – IBO/RAH – Latest Edition
- International Energy Conservation Code - Latest Edition with Addendum
- International Mechanical Code - Latest Edition with Addendum
- International Plumbing Code - Latest Edition with Addendum
- Uniform Mechanical Code - Latest Edition with Addendum
- Specification of Energy-Efficient Installation and Maintenance Practices for Residential HVAC Systems developed by Consortium for Energy Efficiency (CEE) - Latest Edition with Addendum

References continue on next page

Industry References (continued)

- ASHRAE Standard-62.2 - Latest Edition with Addendum
- ANSI//ASHRAE Standard- 152-2004 – Latest Edition with Addendum
- ENGERY STAR™ Home Sealing Standards – Latest Edition with Addendum
- Duct Calculators – Sheet Metal, Ductboard, and Flexible Duct
- American National Standards Institute (ANSI)/Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
  - HVAC Duct Construction Standards - Metal and Flexible
- Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
  - Fibrous Glass Duct Construction Standards, Residential Comfort System Installation Standards Manual, and HVAC Air Duct Leakage Test Manual
- Air Diffusion Council Flexible Duct Performance & Installation Standards
- orth American Insulation Manufacturers Association (NAIMA) Manuals
  - Fibrous Glass Duct Construction Standards and A Guide to Insulated Air Duct Systems
- International Fuel Gas Code – Latest Edition with Addendum
- National Fuel Gas Code – Latest Edition with Addendum

KATES Knowledge Areas of Technician Expertise

> All NATE exams are based on Knowledge Areas of Technician Expertise (KATEs), statistically proven job task analysis from experts in the HVACR industry. This KATEs outline covers all information tested in the **Air Distribution - Service Exam** and should be used as reference material.

Installation

Duct Fabrication

- Duct Fabrication Equipment
  - Ductboard tools - 90 V-groove, end cutoff, female shiplap, hole cutter, stapler, etc.
  - Flex tools - tensioning strap tools, knives, etc.
  - Metal tools - metal snips, sheers, benders, breaks, hand formers, calipers, rulers, stapler, etc.
- Fabrication Techniques For Metal Duct
  - Seam types - pittsburgh and snap lock
  - Joint types - drive slips, reinforced drive slips, "s" slip, and standing "s" slip
  - Use of strength breaks in rectangular duct
- Fabrication Techniques For Ductboard
  - Layout of duct fitting
  - Groove cutting - hand / machine
  - Use of joint tape

Duct Installation

- Field Construction / Installation
  - Ductboard installation technique
  - Techniques for joining dissimilar duct
  - Duct of alternate materials - wood, aluminum, etc.

KATES Knowledge Areas of Technician Expertise

Installation (continued)

- Installing Metal Duct
  - Assembly methods for rectangular duct
  - Installation technique - rectangular metal
  - Assembly methods for round duct
  - Installation technique - round metal
  - Hanging ductwork
  - Sealing metal duct
  - Insulation - internal and external, vapor barriers
- Installing Flexible Duct
  - Assembly methods - appropriate length
  - Flexible duct joints
  - Hanging flexible duct Installation technique - flex duct
  - Sealing flexible duct
- Installing Ductboard
  - Assembly methods for ductboard - supports
  - Installation technique - ductboard
  - Hanging methods for ductboard
  - Sealing ductboard
- Installing Grilles, Registers, Diffusers, & Damper
  - Mounting to ductwork
  - Securing methods
- Chases Used As Ducts
  - Floor joists as air ducts
  - Vertical chases
- Reconnecting Duct When Replacing Equipment
  - Reconnecting metal duct
  - Reconnecting flexible duct
  - Reconnecting ductboard duct
- INSTALLATION OF PLENUMS AND DUCT
  - Sizing plenums for physical fit
  - Types and styles of plenums selected
  - Insulation of plenums and ducts

KATES Knowledge Areas of Technician Expertise

Installation (continued)

Airflow Measurements

- Airflow Velocity Measurements
  - Pitot tube and manometer in measuring static pressure
  - Discharge velocity equipment
  - Velometer - electronic and mechanical
  - Anemometer
  - Velocity measurement procedures Gauge calibration
  - Introduction to airflow in Residential HVAC
  - Velocity
- AIRFLOW PRESSURE MEASUREMENTS
  - Overview of static pressure measurements Inclined manometer
  - Diaphragm type differential pressure gauge U-tube manometer
  - Electronic manometer / pressure measurement Gauge / meter calibration
  - Absolute vs. Gauge Pressure Static pressure
  - Air pressure measurement terminology Velocity pressure
  - Total pressure
- AIR VOLUME MEASUREMENTS
  - Airflow hood
  - Formulae for determining CFM of air Formulae for weight of air
  - Locations for air volume measurements Airflow volume - CFM / SCFM (Static CFM)

KATES Knowledge Areas of Technician Expertise

Service

Air Balancing

- GATHERING DESIGN INFORMATION
  - Interpreting system design Interpreting specifications
  - Interpreting equipment information
  - Interpreting control data
  - Modifying system design
- PREPARATION OF SYSTEM FOR AIR TESTS
  - Locating registers, grilles, equipment, controls, and dampers in building walkthrough
  - Setting dampers for tests
  - Setting thermostat for tests
  - Checking for proper fan operation and rotation
  - Checking for proper static pressure and temperature
- PROCEDURES FOR CONDUCTING AIR TESTS
  - Measurements of each supply outlet - total readings
  - Measurements of each return inlet - total readings
- MAKING ADJUSTMENTS
  - Adjust airflow to achieve required total airflow
  - Re-measure total supply and return grille airflow
  - Adjust dampers to obtain design airflow
  - Re-measure total airflow to verify that it is within +/- 10%
- FINAL TEST
  - Comparing manufacturer's equipment information with test results
  - Record sheave, pulley, and belt sizes data
  - Test and record full load motor amperes
  - Test and record voltage
  - Test and record motor and fan RPM
  - Test and record supply and return static pressures
  - Test and record supply and return air temperatures - heat and cool
- COMPLETION OF APPROPRIATE FORMS
  - HVAC system report
  - System diagrams
  - Duct traverse or data pulley forms
  - Instrument list - including calibration dates

KATES Knowledge Areas of Technician Expertise

Service (continued)

Basic HVAC System Analysis

- Noise Problems
  - Interpreting supply / return air volume
  - Interpreting supply / return air velocity
  - Noise problems
  - Blower cavitation
  - Oil canning
  - Motor / belt noise
  - Vibration
- HIGH UTILITY BILLS
  - Interpreting supply / return air temperature Interpreting supply / return air volume
  - Evaluating duct leakage
  - Evaluating duct insulation
  - Envelope infiltration
  - Thermostat air sensing
- WIDE TEMPERATURE SWINGS
  - Interpreting supply / return air temperature
  - Interpreting supply / return air volume
  - Evaluating duct leakage
  - Evaluating duct insulation
  - Envelope infiltration
  - Thermostat air sensing
- SINGLE AREA IS HOT OR COLD
  - Interpreting supply / return air temperature
  - Interpreting supply / return air volume
  - Evaluating duct leakage
  - Evaluating duct insulation
  - Envelope infiltration
  - Thermostat air sensing
- INDOOR AIR QUALITY
  - Number of air changes per hour
  - Odor control
  - Contaminants

KATES Knowledge Areas of Technician Expertise

Service (continued)

Analyzing Reported Symptoms in Cooling

- POOR COOLING
  - Interpreting supply / return air temperature
  - Interpreting supply / return air volume
  - Interpreting supply / return air velocity
  - Determining and interpreting the sensible heat ratio
  - Evaluating duct leakage
  - Using temperature drop across evaporator coil
- HUMIDITY PROBLEMS
  - Interpreting wet bulb and dry bulb temperatures
  - Interpreting supply / return air volume
  - Determining and interpreting the sensible heat ratio
  - Evaluating duct leakage
- DRAFTY
  - Interpreting supply / return air temperature
  - Interpreting supply / return air volume
  - Interpreting supply / return air velocity

Analyzing Reported Symptoms in Heating

- POOR HEATING
  - Interpreting supply / return air temperature Interpreting supply / return air volume
  - Interpreting supply / return air velocity
  - Evaluating duct leakage
  - Using temperature drop across evaporator coil
- HUMIDITY PROBLEMS
  - Interpreting wet bulb and dry bulb temperatures
  - Interpreting supply / return air volume
  - Evaluating duct leakage
- DRAFTY
  - Interpreting supply / return air temperature
  - Interpreting supply / return air volume
  - Interpreting supply / return air velocity

KATES Knowledge Areas of Technician Expertise

Service (continued)

Planned Maintenance

- MECHANICAL PLANNED MAINTENANCE
  - Performance checks - heat exchanger temperature rise
  - Fan blades / blower scroll
  - Diffusers, grilles, and registers
  - Lubrication of blowers

Airflow Measurements

- AIRFLOW CHECKS & DESIGN TOOLS
  - Using temperatures to determine airflow
  - Using manufacturer's airflow charts and/or tables
  - Measuring total supply and return airflow

System Components

Introduction To Basic Systems & Components

- Heat Transfer And The Basic Cooling Cycle
  - Heat transfer and cooling
  - Basic refrigeration circuit - 10 components
  - Dynamic analysis of temperatures and pressure in the refrigerant circuit.
  - Psychrometrics
  - Subcooling
  - Superheat

NON-SENSING CONTROLS

- RELAYS AND CONTACTORS
  - Introduction to relays and contactors
  - Basics of relay and contactor operation - inrush and holding
  - Selecting relays and contactors
  - Application considerations for relays and contactors
- ELECTRIC HEAT CONTROLS
  - Sequencers - warp switch
  - Sequencers - electronically sequenced relays

KATES Knowledge Areas of Technician Expertise

System Components (continued)

Duct Systems

- Basic Duct Systems
  - Overview of duct systems for split and package systems
  - Duct configuration - extended plenum
  - Duct configuration - reducing extended plenum
  - Duct configuration - perimeter radial
  - Duct configuration - perimeter loop
  - Duct configuration - overhead radial
  - Duct configuration - branching flexible
  - Duct configuration - concentric
- Duct Location
  - Attic
  - Basement
  - Crawlspace
  - Slab
  - Roof
  - Furr down
  - Exposed
  - Chases
- Basic Zone Systems
  - Equipment zoned
  - Air side zoned
- Duct Materials
  - Define / recognize ductboard
  - Define / recognize metal duct
  - Define / recognize flexible duct
  - Define / recognize PVC pipe
  - Insulating material

KATES Knowledge Areas of Technician Expertise

System Components (continued)

- Fitting Nomenclature
  - Define / recognize plenum
  - Define / recognize transition
  - Define / recognize elbow - 90 degrees and 45 degrees
  - Define / recognize round duct
  - Define / recognize rectangular duct
  - Define / recognize turning vanes
  - Return configurations - ducted, central, etc.
  - Define / recognize wye - rectangular and round
  - Define / recognize damper - rectangular and round
  - Sheet metal duct joints - "s" and drive, snaplock, button lock, etc.
- Dampers
  - Balancing
  - Splitters
  - Economizers
  - Fresh air
  - Fire
- Grilles
  - Types and uses
  - Selecting grilles by volume and velocity
- Registers
  - Types and uses
  - Selecting registers
  - Selecting registers by use of fan specifications
  - Selecting registers by air spread and throw capacity
- Diffusers
  - Types and uses
  - Selecting diffusers
  - Selecting diffusers by air spread and throw capacity
- Filtration Systems
  - Media type filters
  - Electronic air cleaners (EAC's)
  - Electrostatic filters - non-electric
-

KATES Knowledge Areas of Technician Expertise

System Components (continued)

- Ventilation Systems
  - Attic exhaust
  - Residential exhaust(s)
  - Lt. Commercial exhaust(s)
  - Heat / energy recovery ventilators
  - Infiltration
- Humidifiers
  - Fundamentals of operation
  - Types
  - Duct material requirements
  - Installation support and location

Basic Gas Furnaces

- Gas Heat - Components
  - Define heat exchanger
  - Define limit controls
  - Define vent system
  - Define burners
  - Define fan controls
  - Define gas valve
  - Combustion air proving (pressure) switch
- Gas Heat - Operation
  - Define combustion air system
  - Air side requirements
  - Define sequence of operation

Basic Oil Furnaces

- Oil Heat - Components
  - Define limit controls
  - Define heat exchanger
  - Define vent system
  - Define oil burners
- Oil Heat - Operation
  - Define combustion air system
  - Air side requirements
  - Define sequence of operation

KATES Knowledge Areas of Technician Expertise

System Components (continued)

Basic Air Conditioning / Heat Pumps

- Basic Components
  - Define evaporator
  - Define condenser
  - Define compressor
  - Define metering device
  - Reversing valves
  - Defrost controls
- Basic Operation
  - Define sequence of operation
  - Air side requirements

Basic Airflow Principles

- Introduction To Airflow
  - Velocity
  - Static pressure
  - Airflow volume - CFM / SCFM (Static CFM)
- Blowers And Fans
  - Introduction to indoor blowers
  - Indoor blowers - types and selection
  - Fan operation
  - Adjustable pulley

Electronic Controls

- OVERVIEW OF ELECTRONIC CONTROLLERS
  - Input / output operations
  - Logic
  - Electronic interface
  - Tap boards
- ELECTRONIC THERMOSTATS
  - Fundamentals of electronic thermostats
  - Selecting electronic thermostats
  - Overview of electronic thermostat operation
  - Electronic fossil fuel kits

KATES Knowledge Areas of Technician Expertise

System Components (continued)

- ZONE CONTROLS
  - Fundamentals of zone controls
  - Selecting zone controls
  - Typical zone control logic
  - Bypass dampers
  - Types of zone controls
- ELECTRONIC COMPRESSOR CONTROLS
  - Compressor staging controls
  - Compressor time delays
- ELECTRONIC TIMERS
  - Introduction to blower delay timers
- ECONOMIZER CONTROLLERS
  - Dry bulb controllers
  - Enthalpy controllers
  - Potentiometers Sensors

ELECTROMECHANICAL SENSING CONTROLS

- ELECTROMECHANICAL WALL THERMOSTATS
  - Basic thermostat types and operation
  - Thermostat terminals and wiring
  - Selecting wall thermostats and sub-bases
  - Using electromechanical thermostats
- ELECTROMECHANICAL TEMPERATURE CONTROLS
  - Introduction to bimetal controls
  - Disc type temperature limit controls
  - Overview of electric heat high limits
  - Fuses and fuse links
  - Motor overloads
  - Fossil fuel kits
- PRESSURE CONTROLS
  - Introduction to disc type pressure controls and hi/low controls
  - Selection of disc type pressure controls
  - Using disc type pressure controls
  - Low ambient cooling controls
- ELECTROMECHANICAL OUTDOOR THERMOSTATS
  - Overview of outdoor thermostats
  - Outdoor thermostat wiring

KATES Knowledge Areas of Technician Expertise

Applied Knowledge: Regs, Codes, & Design

Air Quality Regulations

- INDOOR AIR QUALITY
  - Fresh air supplies

ELECTRICAL CODE

- REQUIREMENTS
  - Overview of electrical code
  - Circuit breaker and fuse requirements
  - General wiring practices
  - Class I wire sizing
  - Class II wire sizing
  - Conduit sizing Definitions

STATE AND LOCAL REGULATIONS AND CODES

- STATE AND LOCAL REGULATIONS
  - State requirements for technicians
- CODES
  - Plumbing Municipalities
  - HVAC for Lt. Commercial

FIRE PROTECTION REGULATIONS AND CODES

- REQUIRED COMPONENTS
  - Return air sensors
  - Fire dampers
- FIRE PREVENTION
  - Overview

KATES Knowledge Areas of Technician Expertise

Applied Knowledge (continued)

Design Considerations - Comfort

- TEMPERATURE
  - Designing for capacity
  - Using standards
- HUMIDITY
  - Role of humidity in comfort
  - Using standards
- INDOOR AIR QUALITY
  - Ventilation - comfort
  - Air cleaning for comfort
  - Standards for air quality
  - Outside air
- SOUND LEVEL
  - Equipment location considerations
  - Isolation, mounting pad, duct, and structure
  - Duct systems - flex joints
- ZONING
  - Single zone
  - Multizone

Design Considerations - Components

- DIFFUSERS
  - Selecting diffusers for capacity
  - Selecting diffusers for reduced sound
  - Selecting diffusers for spread, throw, and pressure drop
  - Locations
- GRILLES
  - Selecting grilles for capacity
  - Selecting grilles for reduced sound
  - Selecting location
- REGISTERS
  - Selecting registers for capacity
  - Selecting registers for reduced sound
  - Selecting registers for spread, throw, and pressure drop
  - Locations
- DUCTS & FITTINGS
  - Specifying physical dimensions
  - Sketching duct layout
  - Duct fitting equivalency - EQ to duct size

KATES Knowledge Areas of Technician Expertise

Applied Knowledge (continued)

- SPECIAL DUCTS & FITTINGS
  - Working drawings vs. Isometric drawings
  - Markings and abbreviations for duct fitting and manufacturing
  - Measurement for replacement of special duct or fitting
- STATIC PRESSURE LOSSES IN FILTRATION SYSTEMS
  - Filter grilles
  - Electronic air cleaners (EAC's) Electrostatic
  - Media type filters
- BLUEPRINT READING
  - Determination of dimension from scale blueprint / plans
  - Introduction to blueprints/plans reading
  - Visualizing duct layout from blueprints/plans

Mechanical Code

- EQUIPMENT ACCESS
  - Minimum clearance
  - Electrical disconnects
  - Fire dampers
- REFRIGERANT LINE ROUTING
  - Support requirements
  - Inspection requirements
- CONDESATE DRAINS
  - Materials
  - Sizing

INDUSTRY STANDARDS

- EQUIPMENT STANDARDS
  - Introduction to industry standards
  - ARI standards for ratings
- SYSTEM STANDARDS
  - Introduction to industry standards
  - Industry standards

KATES Knowledge Areas of Technician Expertise

Applied Knowledge (continued)

Design Conbsiderations - Light Commercial

- SPLIT SYSTEMS
  - System designs - closets, basements, etc.
  - Air distribution systems
  - Ventilation - fresh air
  - Ventilation - equipment
- PACKAGED SYSTEMS
  - System designs
  - Economizers
  - Ventilation - equipment
- AIR BALANCING
  - Duct sizing
  - Blower speed adjustments
  - Damper position adjustments
  - Measurement of air flow rate
  - Fan laws

BIDS AND PROPOSALS

- SYSTEM SIZING
  - Survey of requirements
  - Selecting equipment
  - Selecting accessories
- PREPARATION FOR AIR DISTRIBUTION PROPOSAL
  - Understanding forms for proposals and bids
  - Understanding legal implications of a bid