



Certifying the
finest in HVACR

Oil Furnace Service

KATE

Knowledge Areas of
Technician Expertise

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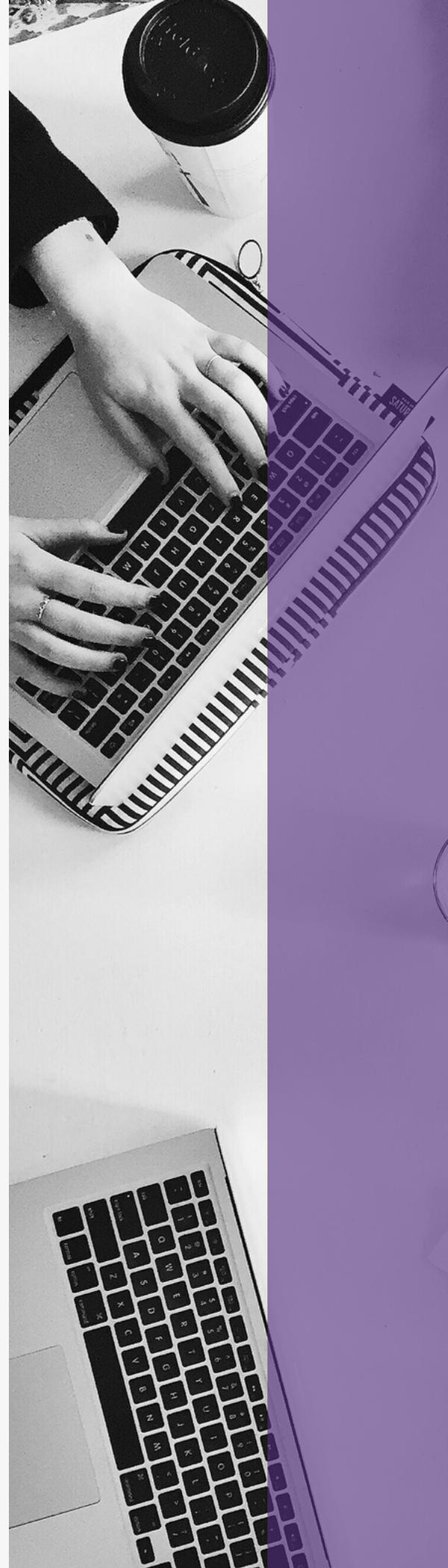
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KATES



Oil Furnaces - Service Specialty Exam

Exam Information & Qualifications



The Oil Furnaces - Service specialty exam tests a candidate's knowledge of the installation, service, maintenance, and repair of HVAC systems. System sizes are limited to 400,000 BTU or less heating capacity. This is a test and certification for technicians in the HVAC industry. The test is designed for top level installation 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 Oil Furnaces 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 Oil Furnaces systems as an installation technician and technical training for theoretical knowledge.

Exam Copyrights

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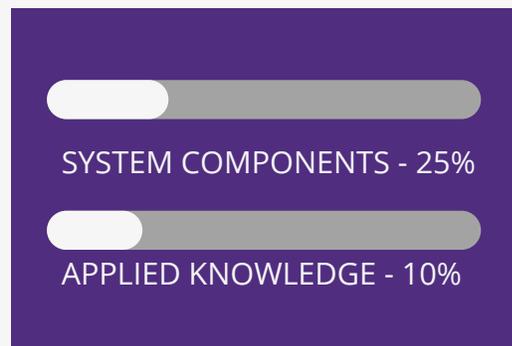
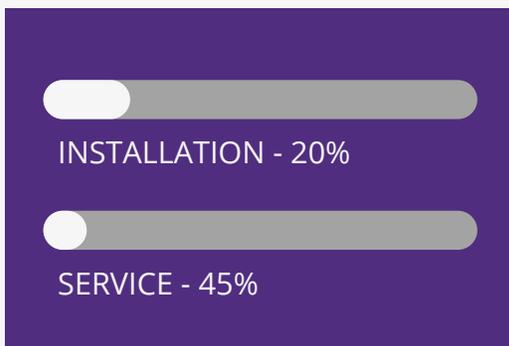
Passing Score Development Process



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
- North 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 **Oil Furnaces - Service Exam** and should be used as reference material.

Installation

Installing Oil Furnaces

- Selecting Oil Tank Location
 - Locating oil tanks outdoors - above ground
 - Locating oil tanks outdoors - below ground
 - Locating oil tanks in basements
- Selecting Oil Furnace Sites
 - Locating furnaces in attics
 - Locating furnaces in crawlspaces
 - Locating furnaces in closets
 - Locating furnaces in basements
 - Locating furnaces in utility rooms
 - Locating furnaces in garages
 - Locating packaged furnaces on rooftops
 - Locating packaged furnaces for outdoor ground level installations
- Mounting Furnaces
 - How to suspend horizontal furnaces in attics
 - How to suspend horizontal furnaces in crawlspaces
 - How to mount horizontal furnaces on attic floors
 - How to mount upflow / downflow furnaces in closets
 - How to mount upflow / downflow furnaces in basements
 - How to mount upflow / downflow furnaces in utility rooms
 - How to mount upflow / downflow furnaces in garages
 - How to mount packaged furnaces on rooftops
 - How to mount packaged furnaces for outdoor ground level installations

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

- Installation Of Utilities
 - Installation of oil supply
 - Installation of oil returns
 - Wiring oil furnaces
- Installation Of Metal Venting Systems
 - Determination of routing
 - Cutting of metal vent systems to proper length
 - Assembly of metal vent systems
 - Securing of metal vent systems
 - Installing power venters
- Installation Of Combustion Air Inlets Accessories
 - Combustion air inlets in confined spaces - attics
 - Combustion air inlets in confined spaces - basements
 - Combustion air inlets in confined spaces - closets
 - Combustion air inlets in confined spaces - crawlspaces
 - Installation of powered combustion air intakes

Duct Installation

- 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.
- 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
 - Assembling for low noise and low pressure drop
- 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)

Installing Accessories

- Installing Thermostats
 - Locating and mounting
 - Wiring electromechanical thermostats
 - Wiring electronic thermostats
 - Programming of electronic thermostats
- Installing Humidifiers
 - Installing humidifiers
 - Wiring humidifiers
 - Controlling humidifiers
- Installing Electronic Air Cleaners
 - Installing electronic air cleaners
 - Wiring electronic air cleaners
 - Controlling electronic air cleaners

Start-up And Checkout

- Pre-start Procedures
 - Oil supply and proper shutoff
 - Electrical
 - Adequate combustion air provisions
 - Venting system
 - Ductwork system
 - Condensate system for AC
- Start-up Procedures And Checks
 - Voltage checks
 - Check thermostat and set heat anticipator
 - Motor checks-burner motor, supply blower motor
 - Airflow checks - static pressure
 - Check call for heat sequences
 - Oil supply checks

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

- Oil Burner Adjustments
 - Unit preparations
 - Nozzle checks
 - Electrode adjustments
 - Air adjustment at burner
 - Adjusting oil pressure
 - Adjusting draft
 - Checking smoke readings
 - Smoke vs. Carbon Dioxide graph
 - Final adjustments
 - Measuring stack temperature
 - Checking ignition
 - Checking pump cutoff
- Combustion Checks
 - Flame checks
 - Stack temperature check
 - Carbon Dioxide checks
 - Smoke test
 - Overfire draft check
 - Breech draft check
 - Oxygen checks
 - Efficiency check
 - Burner motor checks - output pressure, amp draw, etc.
 - Supply and return airflow checks
- Leak Detection Tools
 - Electronic leak detectors
 - Ultrasonic leak detector
 - Pressurization for leak detection

Oil Burner Combustion Setup Tools

- Oil Pressure Measurements
 - High pressure dial gauges
 - Vacuum dial gauges

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Knowledge Areas of
Technician Expertise

Installation (continued)

- Flue Gas Analysis
 - Draft gauge Smoke tester
 - Carbon Dioxide analyzer
 - Combustion efficiency slide rule
 - Stack Thermometer
- Leak Detection - CO
 - Carbon Monoxide detector - electrical
 - Carbon Monoxide detector - manual-monoxor
- Set-Up
 - Nozzle wrench
 - Oiling cans
 - Electrode/Nozzle gauge
 - Flame mirror

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

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

- 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)

Service

Planned Maintenance

- System Mechanical PM Checks
 - Air filter checks and changeout
 - Lubrication
 - Packaged unit cabinet care
 - Fan blades / blower scroll
 - Flue / vent stack inspection
 - Duct
 - Heat exchanger - inspection, cleaning, replace gaskets etc
 - System airflow
 - Oil tank
 - Combustion tests
 - Combustion chamber inspection
 - Barometric regulator
 - Combustion air supply
- Burner Mechanical PM Checks
 - Oil lines / connections
 - Combustion air supply check and adjustment
 - Nozzle replacement
 - Oil pump-pressure, vacuum etc
 - Pump strainers
 - Oil filter cleaning and cartridge replacement
 - Electrodes - clean, inspect and adjust
 - Ohm cad cell and clean
 - Combustion head
 - Transformers
 - Burner motor

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Knowledge Areas of Technician Expertise

Service (continued)

- Electrical PM Checks
 - General wiring
 - Power burner operation
 - Burner motor operation
 - Furnace supply air blower motor
 - Furnace operating sequence
 - Thermostat calibration and operation
 - Fan switch and high limit control

Diagnostics And Repair

- Troubleshooting Sequence Of Operation
 - Check for proper sequence of operation
 - Interpreting system at sequence interruption
- Analyzing Reported Symptoms
 - Insufficient / no heat
 - Short cycle
 - Humidity problems
 - Drafty
 - Noise problems
 - System runs continuously
 - High utility bills
 - Wide swings in room temperatures
 - Air quality - odors, fumes, etc.
- Analyzing Combustion
 - Carbon Dioxide checks for efficiency
 - Interpreting a smoke test
 - Balancing excess air and the smoke test
 - Diagnosing air leaks and efficiency loss
 - Diagnosing low draft-stack, overfire
 - Diagnosing excessive draft-stack, overfire
 - Diagnosing excessive draft on off cycle
 - Interpreting steady state efficiency measurements - stack loss calculations
 - Interpreting oxygen content for combustion diagnostics

KATES

Knowledge Areas of
Technician Expertise

Service (continued)

- System Air Side Diagnostics
 - Temperature checks
 - Checking system static pressure
 - Checking total CFM
 - Checking supply CFM at registers and diffusers
 - Checking return CFM
 - Checking for leaks in supplies
 - Checking for leaks in returns
- Electrical Circuit Checks
 - Supply voltage
 - Supply air blower
 - High voltage transformer
 - Low voltage transformer
 - Power burner
 - Room thermostat
 - Electronic controllers - input / output
- Electrical Component Checks
 - Room thermostat
 - High voltage transformers
 - Low voltage transformers
 - Oil burner motor Electrodes
 - Flame sensor/cad cell
 - Overcurrent protection
 - Relays and contactors
 - Capacitor - supply air blower
 - Limit control-high temperature
 - Door interlock switch
 - Supply air motor
 - Stack switches-flame proving

KATES

Knowledge Areas of
Technician Expertise

Service (continued)

- Repair Excluding Power Burner
 - Electrical wiring
 - Flue stack / venting system
 - Combustion chamber-lining
 - Oil lines
 - Supply air blowers-shafts, bearings, mounts etc
- Repair - Power Burners
 - Output pressure adjustment
 - Bleeding air
 - Cleaning burner - end cone, blower wheel, blast tube, etc.
 - Clean and adjust electrodes
- Component Replacements
 - High voltage transformers
 - Low voltage transformers
 - Flame retention heads
 - Electrodes
 - Nozzle
 - Combustion chamber
 - Heat exchanger
 - Oil burner blower Relay
 - Supply air blower- motor, wheel
 - Capacitors
 - Oil pump
 - Safety circuit switches-limit
 - Barometric damper
 - Primary control Cad cells
 - Blast tubes
 - Fan and limit switches
 - Circuit boards - fan
- Vent System Checks
 - Checking draft
 - Correcting insufficient draft
 - Checking for leaks
 - Checking for obstructions - vent connection and chimney

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Knowledge Areas of
Technician Expertise

Service (continued)

- Diagnosing Oil Combustion Problems
 - Overheated nozzle
 - Sooting
 - Discolored flame
 - Intermittent flame
 - Partial burner flame-low viscosity
 - Delayed ignition - puffback
 - Carbon build up
 - Retention head burnoff
 - Trip on high limit-overfiring
 - Carbon Monoxide
 - Off center burn
 - Airtube burn-off
 - Nozzle afterdrip
 - Lack of ignition
 - Afterburn
 - Low capacity-clogging, oil supply contamination

Overview Of Electrical Troubleshooting

- Low Voltage Circuits
 - Voltage tests
 - Control string analysis
 - Understanding the logic of low voltage troubleshooting
 - Troubleshooting equipment with electronic devices
 - Troubleshooting with schematics
 - Troubleshooting without schematics
 - Current tests
 - Equipment continuity tests
 - Ground tests

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Knowledge Areas of
Technician Expertise

Service (continued)

- Line Voltage Circuits
 - Voltage tests
 - Current tests
 - Component tests
 - Circuit tracing line voltages
 - Troubleshooting with schematics
 - Troubleshooting without schematics
 - Equipment continuity tests
 - Ground tests

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%

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Knowledge Areas of
Technician Expertise

Service (continued)

- 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

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

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Knowledge Areas of
Technician Expertise

Service (continued)

- 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

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
 - Determining the need for additional humidity
 - Evaluating duct leakage
- Drafty
 - Interpreting supply / return air temperature
 - Interpreting supply / return air volume
 - Interpreting supply / return air velocity

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Knowledge Areas of
Technician Expertise

System Components

Introduction To Systems

- Oil Transfer Principles
 - Fundamentals of oil transfer
 - Basic oil supply circuit

Furnace Configurations & Applications

- Furnace Configurations
 - Upflow
 - Downflow
 - Horizontal
 - Lowboy
- Oil Furnaces With Split System Air Conditioner
 - Introduction to oil furnace with split system
 - AC Electrical layouts
 - Specifications Attic layouts
 - Crawlspace layouts
 - Closet layouts
 - Basement layouts
 - Ventilation options
 - Regional considerations
- Multi-position Furnace
 - Two way
 - Three way

Combustion Process For Oil Furnaces

- Combustion - Fuel Oil
 - Describe combustion of fuel oil
 - Describe carbon dioxide as a product of combustion
 - Describe oxygen's role in combustion
 - Describe carbon monoxide as a product of incomplete combustion
 - Water vapor as product of combustion
 - Contaminants from improper combustion
 - Effects of contaminated oil on combustion

KATES

Knowledge Areas of
Technician Expertise

System Components (continued)

- Vent Systems
 - Fundamentals of natural draft systems
 - Natural draft systems with power venters
 - Vent system options-masonry chimneys, manufactured chimneys
 - Role of barometric dampers in vent systems
- Control Functions
 - Fan control
 - Heat exchanger limit control
 - Flame proving - cad cell
 - Introduction to primary controls
 - Door interlocks
 - Room thermostats

Natural Draft Oil Furnace - Components

- Oil Supply Systems
 - Above ground tanks
 - Below ground tanks
 - Indoor tanks
 - Supply lines
 - Filters
 - Manual shutoffs
 - Single pipe systems
 - Two pipe systems
 - Single pipe to two pipe conversion
 - Electric shutoffs, solenoids
 - Check valves
- Power Burners
 - Functions of the power burner
 - Gun type burners
 - Single stage pumps
 - Two stage pumps
 - Combustion air blowers
 - Flame retention heads
 - Combustion intakes - outdoor

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Knowledge Areas of
Technician Expertise

System Components (continued)

- Combustion Chambers
 - Construction
 - Refractory
 - Non refractory
 - Stainless steel
 - Role of configuration in proper combustion
- Heat Exchangers
 - Construction
 - Materials
 - Functions of heat exchanger
- Nozzles
 - Construction
 - Flow rates
 - Angles and patterns
 - Effects of excess air
 - Atomization
 - Selection of nozzles
 - Effects of viscosity on nozzle flowrate and pattern
 - Filters for nozzles

Combustion Air Requirements

- Outdoor Air Specifications
 - Attic applications
 - Crawlspace applications
 - Closet applications
 - Basement applications
 - Rooftop applications
- Air Distribution Duct Systems
 - Duct system design
 - Duct configurations - extended plenum, reducing trunk etc.
 - Return configurations
 - Return grille locations
 - Supply locations

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Knowledge Areas of
Technician Expertise

System Components (continued)

- Supply Blowers
 - Introduction to supply blowers
 - Supply blowers - types and selection
 - Blower operation
 - Fan laws

Wiring Layouts

- Power Wiring
 - Power wiring for split system furnace
- Low Voltage
 - Overview of low voltage wiring

Electromechanical Sensing Controls

- Electromechanical Room Thermostats
 - Basic thermostat types and operation
 - Selecting room thermostats and sub-bases
 - Thermostat terminals and wiring
 - Using electromechanical thermostats
 - Selecting location
 - Role of anticipators in thermostatic control
- Electromechanical Temperature Controls
 - Introduction to bimetal controls
 - Disc type temperature limit controls
 - Fuses and fuse links
 - Fossil fuel kits
 - Motor overloads
 - Stack temperature controls
- Pressure Controls
 - Operation of pressure control-power venters
 - Using pressure controls-power venters
 - Vacuum relief valve to regulate inlet combustion air

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Knowledge Areas of
Technician Expertise

System Components (continued)

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

Electronic Controls

- Overview Of System Electronic Controllers
 - Input / output operations
 - Logic
- Electronic Thermostats
 - Fundamentals of electronic thermostats
 - Selecting electronic thermostats
 - Overview of electronic thermostat operation
 - Fossil fuel kits for use with heat pumps
- Electronic Timers
 - Introduction to blower delay timers
 - Purging timers
- Primary Controls
 - Basic construction of oil furnace primary controls
 - Basics of operation - oil furnace primary controls

Applied Knowledge: Regs, Codes, and Design

Air Quality Regulations

- Indoor Air Quality
 - Fresh air supplies
- Fuel Handling And Storage Requirements
 - Storage tank regulations-above the ground
 - Storage tank regulations-below ground

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Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

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
 - Safety listings - UL / ARL / ETL

State And Local Regulations And Codes

- State And Local Regulations
 - State licensing requirements for technicians
 - Use of Carbon Monoxide detectors
 - Smoke detector requirements
- Codes
 - Plumbing Municipalities
 - Oil furnace for light commercial
 - Oil furnace for residential

Fire Protection Regulations And Codes

- Combustion Air
 - Sizing air intakes in confined spaces
 - Sources of combustion air
- Furnace Access
 - Access to furnace
 - Access to service panel
- Oil Piping
 - Sizing for capacity
 - Length limitations
 - Attachment to appliance
- Installations
 - Installation of oil burning equipment
- Venting Requirements
 - Venting of oil burning equipment

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Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

Design Considerations - Comfort

- Temperature
 - Designing for capacity
 - Using industry standards
- Humidity
 - Role of humidity in comfort
 - Using industry standards
- Indoor Air Quality
 - Ventilation - comfort
 - Air cleaning for comfort
 - Industry standards for air quality
- Sound Level
 - Equipment location considerations
 - Isolation, mounting pad, duct, and structure

Design Considerations - Oil Furnace Equipment

- Oil Furnaces With Split System Air Conditioner
 - System designs - closets, basements, etc.
 - Equipment location
 - Electrical layouts
 - Ventilation - fresh air
 - Regional design considerations
 - Combustion flue gases
 - Ventilation - equipment
 - Condensate drains / pans
 - Mounting of equipment
 - Combustion air
 - Fuel oil burner - forced air system
- Venting
 - Sizing flue pipe
 - Flue pipe layout
 - Adapting vent draft control - damper
 - Roof fittings - cap, collar, flashing, etc.
 - Pipe types - L-metal

KATES

Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

Design Considerations - External Components

- Diffusers, Registers, And Grilles
 - Selecting diffusers, grilles, and registers for capacity
 - Selecting diffusers, grilles, and registers for reduced sound
 - Selecting diffusers, grilles, and registers for throws, spread, and pressure drop
 - Locations
- Accessories
 - Humidifier sizing
 - Twinning kits
 - Electronic air cleaners (EAC's)

Industry Standards

- Equipment Standards
 - Performance and safety standards- UL
 - Efficiency requirements - DOE
- System Standards
 - Introduction to industry standards
 - Industry standards
- Bids And Proposals System Sizing
 - Survey of requirements
 - Selecting equipment
 - Sizing components
 - Adding accessories
 - Basic calculation of heating loads
- Estimating Installation
 - Installation price
 - Understanding proposal forms
 - Understanding bid forms - bid to specs and flat rate pricing
 - Legal implications of a bid
- Effect Of Electrical Supply On Bid
 - Effects of electrical power on bid
 - Electrical analysis - power