



Certifying the
finest in HVACR

Hydronics Oil Service

KATE

Knowledge Areas of
Technician Expertise

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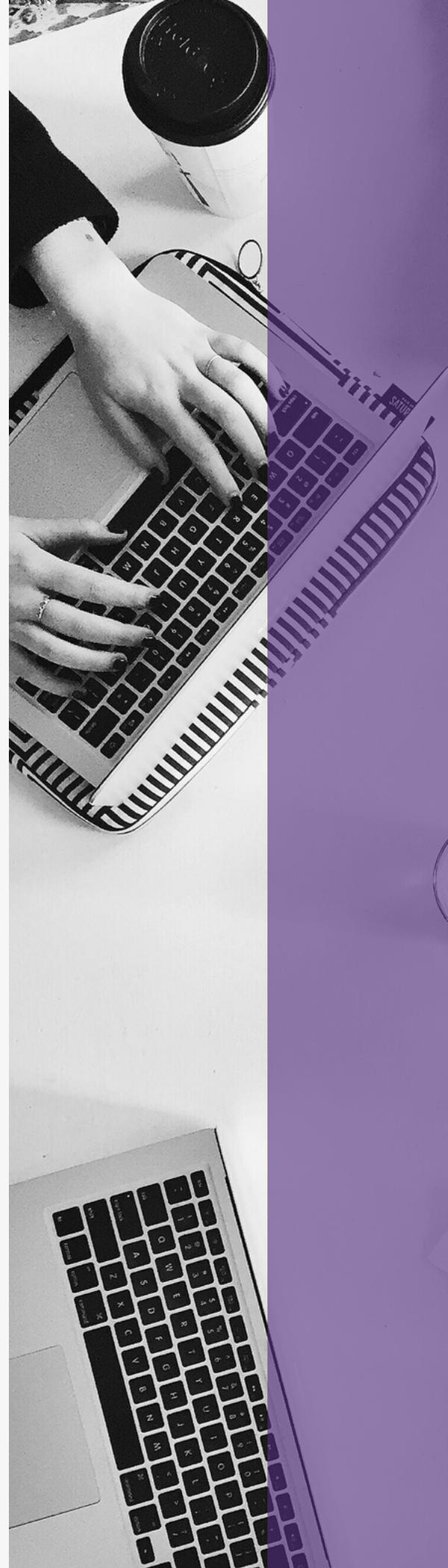
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Hydronics Oil - Service Specialty Exam

Exam Information & Qualifications



The Hydronics - Service specialty exam tests a candidate's knowledge of the installation, service, maintenance, and repair of hot water heating 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 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 Hydronics Oil candidates have an 80% likelihood of encountering at least once during the year on a national basis. Suggested requirement is two years of field experience working on Oil Hydronics systems as a service technician and technical training for theoretical knowledge.

Exam Copyrights

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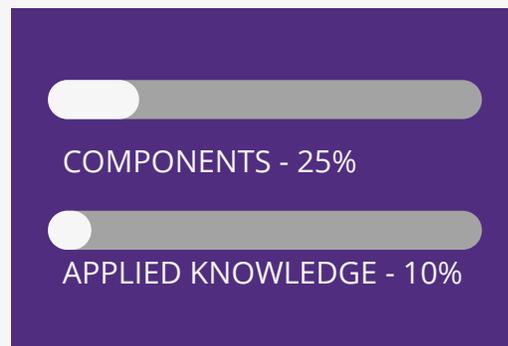
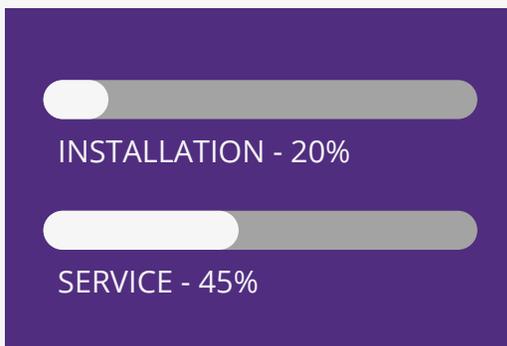
Passing Score Development Process



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
- 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
- HVAC Duct Construction Standards - Metal and Flexible
- Air Diffusion Council Flexible Duct Performance & Installation Standards
- 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



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

Installation

INSTALLING OIL BOILERS

- SELECTING OIL TANK LOCATION
 - Locating oil tanks outdoors - above ground
 - Locating oil tanks outdoors - below ground
 - Locating oil tanks in basements
- SELECTING OIL BOILER SITES
 - Locating boilers in attics
 - Locating boilers in crawlspaces
 - Locating boilers in closets
 - Locating boilers in basements
 - Locating boilers in utility rooms
 - Locating boilers in garages
 - Locating packaged rooftops with boilers
 - Locating boilers outdoor
- PLACEMENT OF BOILERS
 - How to place boilers in attics
 - How to place boilers in crawlspaces
 - How to place boilers in closets
 - How to place boilers in basements
 - How to place boilers in utility rooms
 - How to place boilers in garages
 - How to place packaged rooftops with boilers
 - How to place boilers outdoor
- INSTALLATION OF UTILITIES
 - Installation of oil supply
 - Installation of oil returns
 - Wiring oil boilers
- 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 venting equipment

KATES Knowledge Areas of Technician Expertise

Installation (continued)

- INSTALLATION OF COMBUSTION AIR INLET 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
- SIZING OIL BOILERS
 - Sizing for structure capacity
 - Sizing for domestic water capacity
 - Sizing for radiant capacity
 - Sizing for total capacity
 - Sizing for snow melt capacity

DUCT INSTALLATION FOR HOT WATER HEATING SYSTEMS

- DUCT FAB EQPMNT - INSTALL/REPAIR DUCTS TO HW COILS
 - 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/INSTALL-CONNECTING HW COILS
 - Duct board installation technique Techniques for joining dissimilar duct
 - Duct of alternate materials- wood, aluminum, etc.
 - INSTALL/REPAIRMETAL DUCT - CONNECTING HW COILS
 - Assembly methods for rectangular duct Installation technique - rectangular metal
 - Assembly methods for round duct
 - Installation technique - round metal
 - Hanging duct work
 - Sealing metal duct
 - Insulation - internal and external, vapor barriers Assembling for low noise and low pressure drop
- INSTALL/REPAIR FLEXIBLE DUCT - CONNECTING HW COILS
 - Assembly methods- appropriate length Flexible duct joints
 - Hanging flexible duct Installation technique - flex duct Sealing flexible duct
- INSTALL/REPAIR DUCTBOARD- CONNECTING HW COILS
 - Assembly methods for duct board - supports Installation technique - duct board
 - Hanging methods for duct board
 - Sealing ductboard

KATES Knowledge Areas of Technician Expertise

Installation (continued)

- INSTALL GRILLE, REGISTER, DIFFUSER, DAMPER-HWCOIL
 - Mounting to ductwork
 - Securing methods
- CHASES USED AS DUCTS FOR HOT WATER COIL SYSTEMS
 - Floor joists as air ducts
 - Vertical chases
- REPAIR DUCT WHEN REPLACING EQUIPMENT- HW COILS
 - Reconnecting metal duct
 - Reconnecting flexible duct
 - Reconnecting ductboard duct
- INSTALL/REPAIR OF PLENUMS & DUCT - HW COIL SYSTEMS
 - Sizing plenums for physical fit
 - Types and styles of plenums selected
 - Insulation of plenums and ducts

HYDRONIC COMPONENT INSTALLATION

- INSTALLATION OF HEATING COMPONENTS (EMITTERS)
 - Sizing and placement of baseboard units
 - Sizing and placement of kickspace heaters
 - Sizing and placement of unit heaters
 - Sizing and placement of duct mounted heating coils
 - Sizing and placement of hot water coil air handlers
 - Sizing and placement of heating units
 - Sizing and placement of air vents (manual or auto)
 - Sizing and placement of domestic hot water heating
 - Sizing and placement of radiant panels-floor and ceiling
 - Sizing and placement of radiators
 - Sizing, placement, and conversion of steam radiators to hot water radiators
 - Sizing, placement, and conversion of steam systems to hot water systems
- INSTALLATION OF COMPONENTS
 - Location, selection, and sizing of circulators
 - Location and sizing of Expansion tanks
 - Location of Air Separators
 - Location of Pressure Reducing Valve
 - Location of Backflow Preventer
 - Location and sizing of Relief Valves
 - Location of Zone Valves
 - Location of Flow Check Devices
 - Location of indirect hot water heating
 - Location and placement of heat emitters
 - Location of Low water cutoffs
 - Location of manual reset aquastats

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

- INSTALLATION OF PIPING SYSTEMS
 - Installation of Series-loop system
 - Installation of One-pipe system
 - Installation of Two-pipe system(Reverse return)
 - Installation of two-pipe system (direct return)
 - Installation of Primary-secondary pipingsystem
 - Installation of multiple zone systems
 - Installation of system bypassand boiler bypassiping
 - Installation of Indirect Water Heaters
 - Installation of Low Water Cutoffs
 - Installation of directwater heaters
 - Installation and selection of antifreeze solutions

Installing Accessories

- INSTALLING THERMOSTATS
 - Locating and mounting
 - Wiring electromechanical thermostats
 - Wiring electronic thermostats
 - Programming of electronic thermostats
 - Installation of Outdoor Reset Controls
- INSTALLING HUMIDIFIERS
 - Installing humidifiers
 - Wiring humidifiers
 - Controlling humidifiers
- INSTALLING ELECTRONIC AIRCLEANERS
 - Installing electronic air cleaners
 - Wiring electronic air cleaners
 - Controlling electronic air cleaners

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

Start-Up and Checkout

- Pre-Start Procedures
 - Oil supply and proper shutoff
 - Electrical Adequate combustion air provisions
 - Venting system
 - Coils connected to ducted systems
 - Condensate system
 - Filling and purging boiler and piping system
- Start-Up Procedures and Checks
 - Voltage checks
 - Check thermostat and set heat anticipator Motor checks
 - Motor checks
 - Water circulation checks
 - Airflow checks for coils connected to ducted systems
 - Check call for heat sequences
 - Oil supply checks including purging fuel lines
- 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
- Leak Detection Tools
 - Pressurization for leak detection

KATES Knowledge Areas of Technician Expertise

Installation (continued)

Airflow - Ducted Systems With Hot Water Coils

- AIRFLOW VELOCITY MEASUREMENTS
 - Pitot tube and manometer in measuring static pressure
 - Discharge velocity equipment
 - Velometer - electronic and mechanical
 - Anemometer
 - Velocity measurement procedures
 - Gauge calibration
 - Velocity
- AIRFLOW PRESSURE MEASUREMENTS
 - Pitot tube and manometer in measuring static pressure
 - Discharge velocity equipment
 - Velometer - electronic and mechanical
 - Anemometer
 - Velocity measurement procedures
 - Gauge calibration
 - Velocity
- AIRFLOW PRESSURE MEASUREMENTS
 - Overview of static pressure measurements
 - Inclined manometer
 - Diaphragm type differential pressure gauge
 - Utube 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 (StaticCFM)

Water Measurements

- TEMPERATURE MEASUREMENTS
 - Temperature Rise Temperature Drop
- WATER PRESSURE MEASUREMENTS
 - Pressure Requirements Pump head

KATES

Knowledge Areas of
Technician Expertise

Installation (continued)

Water Measurements

- WATER PRESSURE MEASUREMENTS
 - Pressure Requirements
 - Pump head
 - Static fill pressure
 - Pressure Drop
- TEMPERATURE MEASUREMENTS
 - Temperature Rise
 - Temperature Drop
- WATER VOLUME MEASUREMENTS
 - GPM Requirements
- FREEZE PROTECTION FLUID
 - Checking and correcting acidity

OIL BURNER COMBUSTION SETUP TOOLS

- OIL PRESSURE MEASUREMENTS
 - High pressure dial gauges
 - Vacuum dial gauges
- 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
- SETUP
 - Nozzle wrench
 - Oiling cans
 - Electrode/Nozzle gauge
 - Flame mirror

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Knowledge Areas of
Technician Expertise

Service

Planned Maintenance

- SYSTEM MECHANICAL PM CHECKS
 - Filters - check and change
 - Lubrication
 - Cabinet care
 - Fan blades/ blower scroll
 - Oil connections
 - Flue / vent stack inspection
 - Combustion air supply
 - Duct inspection for systems with hot watercoils installed in ducts
 - Heat exchanger - inspection, cleaning, replace gaskets etc
 - Burner assembly
 - System airflow
 - Oil tank
 - Combustion tests
 - Combustion chamber inspection
 - Barometric regulator
 - Combustion air supply
 - Expansion Tank
 - Water treatment
 - Circulators
- 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
- ELECTRICAL PM CHECKS
 - General wiring
 - Power burner operation
 - Burner motor operation
 - Air distribution blower motor
 - Boiler operating sequence
 - Thermostat calibration and operation
 - Fan switch and high limit control
 - Limit controls operation
 - Aquastat operation

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Knowledge Areas of
Technician Expertise

Service

Diagnostics and Repair

- TROUBLESHOOTING SEQUENCE OF OPERATION
 - Check for proper sequence of operation
 - Interpreting system fault during 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
 - Noisy conditions due to air in piping
- ANALYZING COMBUSTION
 - CO₂ and O₂ 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
- SYSTEM AIR SIDE DIAGNOSTICS - SYSTEMS W/ HW COILS
 - 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

KATES

Knowledge Areas of
Technician Expertise

Service (continued)

- 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
 - Thermostat
 - High voltage transformers
 - Low voltage transformers
 - Oil burner motor
 - Electrodes
 - Flame sensor/cad cell
 - Overcurrent protection
 - Relays and contactors
 - Capacitors - Burner Motor
 - Limit controls-high temperature
 - Door interlock switch
 - Burner motor
 - Stack switches-flame proving
 - Circulators
 - Zone valves
 - Boiler water controls (high limit, low limit, and operating)
 - Low water cut-off
 - Flow switch
- REPAIR EXCLUDING POWER BURNER
 - Electrical wiring
 - Flue stack / venting system
 - Combustion chamber-lining
 - Oil lines
 - Shafts, bearings, mounts etc
 - Circulators - shafts, bearings, mounts, etc.
 - Piping repair
- REPAIR - POWER BURNERS
 - Output pressure adjustment
 - Bleeding air
 - Cleaning burner - end cone, blower wheel, blast tube, etc
 - Clean and adjust electrodes

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Knowledge Areas of
Technician Expertise

Service (continued)

- COMPONENT REPLACEMENTS
 - High voltage transformers
 - Low voltage transformers
 - Flame retention heads
 - Electrodes
 - Nozzle
 - Combustion chamber
 - Heat exchanger
 - Oil burner blower
 - Relay and Contactors
 - Motor, shaft, and wheel-Burner, Pumps, etc.
 - Capacitors
 - Oil pump-Fuel Unit
 - Safety circuit switches-limit
 - Barometric damper
 - Primary control
 - Cad cells
 - Blast tubes
 - Fan and limit switches
 - Circuit boards – fan
 - Circulators
 - Zone Valves for non-radiant systems
 - Zone Valves for radiant systems
 - Boiler water controls
 - Bearing Assemblies
 - Low Water Cut Off (LWCO)
 - Indoor/Outdoor Resets
 - Modulating Valves
 - Mixing Valves
 - Boiler Protection
- 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
- SYSTEM WATER SIDE DIAGNOSTICS
 - Temperature checks
 - Checking system water pressure
 - Checking zone valve operation
 - Checking supply GPM
 - Checking for leaks in supplies
 - Checking for leaks in returns
 - Checking low water cutoffs
 - Checking flow control valves
 - Checking mixing valves
 - Checking relief valves

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Knowledge Areas of
Technician Expertise

Service (continued)

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
- 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 FOR SYSTEMS WITH HOT WATER COILS

- 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 pump 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

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Knowledge Areas of
Technician Expertise

Service (continued)

- 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 water-flow and air-flow to verify that it is within design requirements
- 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

Water Balancing

- GATHERING DESIGN INFORMATION
 - Interpreting system design
 - Interpreting specifications
 - Interpreting equipment information
 - Interpreting control data
 - Modifying system design

KATES Knowledge Areas of Technician Expertise

Service (continued)

- PREPARATION OF SYSTEM FOR WATER TESTS
 - Locating equipment and controls building walkthrough Setting equipment and controls for tests
 - Setting thermostat for tests
 - Checking for proper pump operation and rotation Checking for proper pressure and temperature
- PROCEDURES FOR CONDUCTING WATER TESTS
 - Measurements of each supply outlet - total readings Measurements of each return inlet - total readings
- MAKING ADJUSTMENTS
 - Adjust flow to achieve required total flow Re-measure total supply and return flow Adjust valves to obtain design flow
 - Re-measure total flow to verify that it is within +/- 10%
- FINAL TEST
 - Comparing manufacturer's equipment information with test results Record equipment data
 - Test and record full load motor amperes Test and record voltage
 - Test and record motor and pump RPM with visible components Test and record supply and return pressures
 - Test and record supply and return temperatures - heat and cool
- COMPLETION OF APPROPRIATE FORMS
 - HVAC system report System diagrams
 - Instrument list - including calibration dates

Basic HVAC System Analysis

- NOISE PROBLEMS
 - Interpreting supply/ return water volume
 - Noise problems
 - Pump cavitation
 - Oil canning
 - Motor / belt noise
 - Vibration
- HIGH UTILITY BILLS
 - Interpreting supply/ return water temperature
 - Interpreting supply / return water volume
 - Evaluating Leakage
 - Evaluating Insulation
 - Envelope infiltration
 - Thermostat location and adjustment

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Knowledge Areas of
Technician Expertise

Service (continued)

- WIDE TEMPERATURE SWINGS
 - Interpreting supply/ return water temperature
 - Interpreting supply / return water volume
 - Interpreting Leakage
 - Interpreting Insulation
 - Envelope infiltration
 - Thermostat air sensing
- SINGLE AREA IS HOT OR COLD
 - Interpreting supply/ return water temperature
 - Interpreting supply / return water volume
 - Evaluating Leakage
 - Evaluating Insulation
 - Envelope infiltration
 - Thermostat air sensing
 - Zone Valves
 - Circulator
 - Circulator controls
 - Venting
 - Variable speed pumps
 - Multi- zone controls
 - Set point boiler protection
- INDOOR AIR QUALITY
 - Number of air changes per hour
 - Odor control
 - Contaminants
 - Humidity

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Knowledge Areas of
Technician Expertise

Service (continued)

Analyzing Reported Symptoms in Heating

- IMPROPER HEATING
 - Interpreting supply/ return water temperature (TD)
 - Interpreting supply / return water volume
 - Interpreting system sizing
 - Evaluating leakage
 - Temperature
 - Drop/Rise of air in ducted hot water coil systems
 - Zone Valves
 - Circulators
 - Circulator controls
 - Outdoor Reset
 - Control Venting
- HUMIDITY PROBLEMS
 - Interpreting Low Humidity
 - Interpreting High Humidity
 - Interpreting Correct Humidity
- DRAFTY
 - Interpreting supply/ return water and air temperature
 - Interpreting supply / return water and air volume

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Knowledge Areas of
Technician Expertise

System Components

Introduction to Basic Systems & Components

- Heat Transfer
 - Fundamentals of heat transfer
 - Psychrometrics

Boiler Configurations & Applications

- BOILER CONFIGURATIONS
 - Gravity hot water
 - Forced hot water
 - Diverter T
 - Series loop
 - Direct return
 - Reverse return
 - Pump Return
 - Air handling systems
 - Zone Control
 - Wet-baseDry- base
 - Horizontal Tube
 - Copper fin boilers
 - Near boiler piping
 - Radiant
 - Primary / secondary loop piping
- OIL BOILERS WITH SPLIT OR HYDRO-AIR AC SYSTEMS
 - Introduction to oil boiler with split system AC
 - Electrical layouts
 - Specifications
 - Attic layouts
 - Crawl space layouts
 - Closet layouts
 - Basement layouts
 - Ventilation options
 - Regional considerations
- OIL TRANSFER PRINCIPLES
 - Fundamentals of oil transfer
 - Basic oil supply circuit

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Knowledge Areas of
Technician Expertise

System Components (continued)

Combustion Process for Oil Boiler Systems

- COMBUSTION - FUEL OIL
 - Describe combustion of fuel oil
 - Describe carbon dioxide as a product of combustion
 - Describe air'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
- FUNDAMENTALS OF OIL COMBUSTION BOILERS
 - Natural draft oil boilers
 - Overview of operation for oil boilers
- 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 limit control
 - Flame proving Introduction to primary controls
 - Door interlocks
 - Room thermostats

Atmospheric Oil Boilers - 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

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Knowledge Areas of
Technician Expertise

System Components (continued)

- POWER BURNERS
 - Functions of the power burner
 - Gun type burners
 - Single stage pumps/fuel units
 - Two stage pumps /fuel units
 - Combustion air blowers
 - Flame retention heads
 - Combustion intakes - outdoor
- COMBUSTION CHAMBERS
 - Construction
 - Refractory
 - Non refractory
 - Stainless steel
 - Role of configuration in proper combustion
- HEATEXCHANGERS
 - Construction
 - Materials
 - Functions of heat exchanger
- NOZZLES
 - Construction
 - Flow rates vs. pressure
 - 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
 - Outdoor applications

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Knowledge Areas of
Technician Expertise

System Components (continued)

Air Distribution For Systems with Hot Water Coils

- DUCT SYSTEMS
 - Duct system design
 - Duct configurations
 - Return configurations
 - Return grille locations
 - Supply locations
- SUPPLY BLOWERS
 - Introduction to supply blowers
 - Supply blowers - types and selection
 - Blower operation
 - Fan laws

HYDRONIC DISTRIBUTION

- WATER DISTRIBUTION
 - Pumps
 - Two way valves
 - Three way valves
 - Diverter tee systems
- PIPING SYSTEM
 - Piping system design
 - Piping configurations
- FLUID FLOW
 - Introduction to circulators
 - Zone Valves
 - Flow Checks
 - Mixing valves
 - Thermostatic valves
 - Diverter tee systems
 - Balancing Zones
 - Compression / expansion tanks

Wiring Layouts

- POWER WIRING
 - Power wiring for boiler
 - Power wiring for split system
 - Air Handler
- LOW VOLTAGE
 - Overview of low voltage wiring
 - Zone control wiring
 - Outdoor reset wiring

KATES

Knowledge Areas of
Technician Expertise

System Components (continued)

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
- FLUID LEVEL AND FLOW CONTROLS
 - Operation of low water controls
 - Using low water controls
 - Operation of fluid flow switches
 - Using fluid flow switches

Non-Sensing Controls

- RELAYS AND CONTACTORS
 - Relay and contactor operation - inrush and holding
 - Selecting relays and contactors
 - Applications for relays and contactors

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Knowledge Areas of
Technician Expertise

System Components (continued)

Electronic Controls

- ELECTRONIC CONTROLLERS
 - Input / output operations
 - Logic
- ELECTRONIC THERMOSTATS
 - Fundamentals of electronic thermostats
 - Selecting electronic thermostats
 - Electronic thermostat operation
 - Outdoor Reset Controllers for non-zone systems
 - Outdoor Reset Controllers for zone systems(pump and/or zone valves)
- ELECTRONIC TIMERS
 - Blower delay timers
 - Puring timers
- Primary Controls
 - Construction
 - Operation

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Knowledge Areas of
Technician Expertise

Applied Knowledge

Regulations for Environmental Protection

- INDOOR AIR QUALITY
 - Fresh air intake supplies

ELECTRICAL CODE

- ELECTRIC REQUIREMENT
 - Overview of electric code
 - Overcurrent protection
 - Wiring methods and materials
 - Line voltage wiring sizing
 - Low voltage wiring sizing
 - Conduit sizing
 - Definitions
 - Safety listings - UL / ARL / ETL

State and Local Regulations and Codes

- STATE AND LOCAL REGULATIONS
 - State requirements for technicians
 - Use of Carbon Monoxide detectors
 - Smoke detector requirements
 - Gas detectors
- CODES
 - Plumbing
 - Municipalities
 - Oil boiler for Lt. Commercial
 - Oil boiler for Residential

Fire Protection Regulations and Codes

- REQUIRED COMPONENTS
 - Return air sensors
 - Fire dampers
 - Smoke dampers
 - Components
- COMBUSTION AIR
 - Sizing air intakes in confined spaces
 - Sources of combustion air

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Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

- BOILER ACCESS
 - Access to boiler for service
 - Access to utilities for service
- OIL PIPING
 - Sizing for capacity
 - Length limitations
 - Attachment to appliance
- INSTALLATIONS
 - Installation of oil burning equipment
- FIRE PREVENTION
 - Overview of fire prevention
- VENTING REQUIREMENTS
 - Specifications for venting
 - Types of venting systems to be used

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

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Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

Design Considerations - Oil Boiler Equipment

- OIL BOILERS WITH SPLIT OR HYDRO-AIR AC SYSTEMS
 - 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

Design Considerations - External Components

- FLUID DISTRIBUTION ACCESSORIES
 - Distribution for capacity including baseboard, floor, kick-space, panel and other emitters
 - Distribution for reduced sound including baseboard, floor, kick-space, panel and other emitters
 - Locations
- AIR SIDE ACCESSORIES
 - Humidifier sizing
 - Twinning kits
 - Electronic air cleaners (EAC's)
 - Selecting diffusers, grilles, registers for systems with distribution devices in ducts.

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Knowledge Areas of
Technician Expertise

Applied Knowledge (continued)

Mechanical Code

- COMBUSTION AIR
 - Air intakes in confined spaces
 - Sources of combustion air
- BOILER ACCESS
 - Access to boiler for service
 - Access to utilities for service
- GAS PIPING
 - Sizing for capacity
 - Length limitations
 - Attachment to appliance
- WATER PIPING
 - Cross Contamination/backflow prevention

Industry Standards

- EQUIPMENT STANDARDS
 - Performance and safety standards
 - Efficiency requirements
 - Manufacturers specifications
- SYSTEM 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

