OIL HYDRONICS  

Certification Information

Scope - 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.

Qualifications

✔ 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 a CORE SERVICE exam.
✔ This test will measure what 80% of the Oil Hydronics 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.

Test Specifications

<table>
<thead>
<tr>
<th>Closed Book</th>
<th>2.5 Hour Time Limit</th>
<th>100 Questions</th>
<th>Passing Score: PASS/FAIL</th>
</tr>
</thead>
</table>

Listed are the percentages of questions that will be in each section of the Oil Hydronics exam.

<table>
<thead>
<tr>
<th>SECTION AREA DESCRIPTION</th>
<th>SECTION PERCENTAGE</th>
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<tbody>
<tr>
<td>Installation</td>
<td>20%</td>
</tr>
<tr>
<td>Service</td>
<td>45%</td>
</tr>
<tr>
<td>Components</td>
<td>25%</td>
</tr>
<tr>
<td>Applied Knowledge</td>
<td>10%</td>
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Oil Hydronics Industry References

The reference materials listed 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
  - “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 Mechanical Code - Latest Edition with Addendum
- International Plumbing Code - Latest Edition with Addendum
- Uniform Mechanical Code - Latest Edition with Addendum
- ENERGY 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

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 Copyrights

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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

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

INSTALL/REPAIR METAL DUCT - CONNECTING HW COILS
- Assembly methods for rectangular duct
Heating - Hydronics - Oil - Service
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 piping system
Installation of multiple zone systems
Installation of system bypass and boiler bypass piping
Installation of Indirect Water Heaters
Installation of Low Water Cutoffs
Installation of direct water 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 AIR CLEANERS
Installing electronic air cleaners
Wiring electronic air cleaners
Controlling electronic air cleaners

START-UP AND CHECKOUT
PRE-START PROCEDURE
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
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
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
Pressurization for leak detection

AIRFLOW - DUCTED SYSTEMS W/ 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
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)

WATER MEASUREMENTS
WATER PRESSURE MEASUREMENTS
Pressure Requirements
Pump head
Static fill pressure
Pressure Drop

WATER VOLUME MEASUREMENTS
GPM Requirements

TEMPERATURE MEASUREMENTS
Temperature Rise
Temperature Drop

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

SERVICE

PLANNED MAINTENANCE

SYSTEM MECHANICAL PM CHECKS
Filter-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 water coils 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
Low Water Cut Off (LWCO) Operation

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 - odors, fumes, etc.
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

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
Capacitor - Burner Motor
Limit control-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

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

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

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 thermostats 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

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

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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

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

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

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

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 tee
Series loop
Direct return
Reverse return
Pump Return
Air handling systems
Zone Control
Wet-base Dry-base
Horizontal Tube
Near boiler piping
Radiant
Primary / secondary loop piping

OIL BOILER WITH SPLIT OR HYDRO-AIR AC SYSTEMS
Introduction to oil boiler with split system AC
Electrical layouts
Specifications
Attic layouts
Crawlspace layouts
Closet layouts
Basement layouts
Ventilation options
Regional considerations

OIL TRANSFER PRINCIPLES
Fundamentals of oil transfer
Basic oil supply circuit

COMBUSTION PROCESS FOR OIL BOILERS

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

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

HEAT EXCHANGERS
- 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

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

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
Relays and contactors
Relay and contactor operation - inrush and holding
Selecting relays and contactors
Applications for relays and contactors

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-zoned systems
Outdoor Reset Controllers for zone systems (pump and/or zone valves)

ELECTRONIC TIMERS
Blower delay timers
Purging timers

PRIMARY CONTROLS
Construction
Operation

APPLIED KNOWLEDGE: REGS, CODES, & DESIGN

REGULATIONS FOR ENVIRONMENTAL PROTECTION
INDOOR AIR QUALITY
Fresh air intake supplies

FUEL HANDLING AND STORAGE REQUIREMENTS
Storage tank regulations-above the ground
Storage tank regulations-below ground

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 licensing requirements for technicians
- Use of Carbon Monoxide detectors
- Smoke detector requirements

CODES
- Plumbing
- Municipalities
- Oil boilers for light commercial
- Oil boilers 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

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

DESIGN CONSIDERATIONS - OIL BOILER EQUIPMENT

OIL BOILER 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.

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

OIL 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
\[
\frac{CFM_n}{CFM_o} = \frac{RPM_n}{RPM_o} \quad o = \text{old}, \quad n = \text{new}
\]

CFM and RPM are interchangeable.

\[
\left(\frac{CFM_n}{CFM_o}\right)^2 = \frac{Sp_n}{Sp_o} \quad \text{OR} \quad CFM_o = CFM_n \times \frac{Sp_n}{Sp_o}
\]

\[
\left(\frac{CFM_o}{CFM_n}\right)^2 = \frac{BHP_n}{BHP_o} \quad \text{OR} \quad CFM_o = \frac{BHP_n}{BHP_o}
\]

Hydronics: \(AP = Sp, \quad CFM = GPM, \quad RPM = GPM\)

\[
MAT = (OAT \times \%0A) + (RAT \times \%RA)
\]

\(0 = \text{Outside} \quad T = \text{Temperature} \quad R = \text{Return} \quad M = \text{Mixed} \quad A = \text{Air}\)

\[
AC/Hr \times \text{Volume} \quad CFM = \frac{\text{v}}{60\text{min}} \quad v = 4005 \times Jvp \quad Vp = <4:05 >^2
\]

Pressure (PSI) = 0.433 x Head (feet of water)

Pressure 1 x Volume 1 = Pressure 2 x Volume 2

\[
Area = 1t \times radius^2
\]

\[
A^2 + B^2 = C
\]

Diameter = \(1t\)

\[
\text{Circumference} = \pi t
\]

\[
\text{ASP} \times 100
\]

\[
FR = \text{TEL} \quad (IWq100)
\]

\[
\text{Rectangular Duct Area (ft}^2) = \frac{\text{Length} \times \text{Width}}{144}
\]

\[
\text{Round Duct Area (ft}^2) = \frac{1t \times \text{diameter}}{576}
\]

\[
\text{mfd} = (2650 \times 1) \quad E
\]

\[
CFM = \text{Velocity (fpm)} \times \text{Duct Area (ft}^2) \quad (\text{Watts} \times 3.413)
\]

\[
\text{Cr (Series)} = \frac{1}{1 + \frac{1}{C1} + \frac{1}{C2} + \ldots + \frac{1}{Cn}}
\]

\[
\text{Cr (Parallel)} = C_1 + C_2 + \ldots + C_n
\]
To determine subcooling for 404A, 407C, and 4220, use BUBBLE POINT values (temperatures above 50°F -gray background)
To determine superheat for 404A, 407C, and 4220, use DEW POINT values (temperatures 50°F and below)

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CONTINUED
Temperature Pressure Chart at Sea Level

Pressure (PSIG), Vacuum (in. of Hg) - Bold Italic Figures
To determine subcooling for 404A, 407C, and 4220, use BUBBLE POINT values (temperatures above 50°F - gray background)
To determine superheat for 404A, 407C, and 4220, use DEW POINT values (temperatures 50°F and below)

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