Heating and Hot Water Systems:

A Practical Guide for Health Inspectors

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Disclaimer

I have no financial interests or relationships to disclose.

How does this help me?

- Inspection form asks for some but not all relevant information
  - Assessor’s data is not always correct
  - You may want to add detail in your violation description
- Want to be correct and accurate as possible
  - Help’s to make sure the responsible party understands the violation
  - Supports your credibility as an inspector
- Understanding the system as a whole helps you to identify problems when there is a violation

Completing Inspection Form

- Hot Water
  - Fuel Type
  - Hot water temperature/Location taken

- Heating
  - Type
  - Temperature/Location taken

Hot Water/ Drainage	**Water Source (circle):** Public Private		
	Hot Water Temperature: °F **Location Taken:**		
	Fuel Type (circle): Natural Gas Oil Electric Other		
	Drainage Type (circle): Public Private		
	Supply, quantity,	130	

Heating	**Temperature:** °F **Location Taken:**
	Type (circle): Forced Hot Water Forced Hot Air Steam Electric Other:

Relavent Code Sections

- 410.010: Definitions
  - Fuel
  - Heating System
  - Wood or Pellet Stove
- 410.150: Hot Water
- 410.160: Heating Systems
- 410.170: Venting
- 410.180: Temperature Requirements
- 410.200: Provision and Metering of Electricity or Gas
- 410.210: Provision of Oil
- 410.235: Owner's Installation, Maintenance and Repair Responsibilities
- 410.320: Electrical Service

410.180 Temperature Requirements

(A) The owner shall provide heat in every **habitable room and every room containing a toilet, shower, or bathtub** from **September 15th through May 31st** so that it shall be:

(1) At least **68°F** (20°C) between 7:00 A.M. and 11:00 P.M.;
(2) At least **64°F** (17°C) between 11:01 P.M. and 6:59 A.M.

(B) At no time shall the heating system, required by 105 CMR 410.160(A), **used during the heating season** cause the temperature to **exceed 78°F** (25°C) in any room.

(C) The temperature shall be measured at a height of five feet above floor level on a wall any point more than five feet from the exterior wall.

How to Measure Temperature

- Heat
  - Use an ambient thermometer or a probe
  - Measure 5’ away from exterior wall at a height of 5’. Near center of room
  - When investigating no heat complaint measure in multiple locations if possible

- Hot Water
  - Use a probe thermometer
  - Measure at the fixture
    - Note: Plumbers/Plumbing Inspector may be measuring at the HW heater
  - If it seems slow to warm up measure a 2 minutes
  - Make sure to let it run long enough to get to the maximum temperature



When to Measure Temperature

- Limited Inspection - Must check for CDEs:
  - Hot water -
    - Kitchen sink
    - At least 1 bathroom sink
    - At least 1 shower/tub
  - Heat -
    - Measure at least one room
  - Take additional measurements if:
    - there is a specific complaint
    - initial measurements observed in violation

- Comprehensive Inspection:
  - Hot Water - all accessible fixtures
  - Heat - all accessible rooms

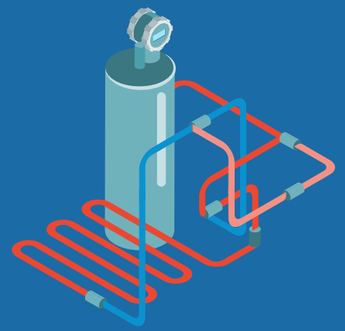
- Infrared Thermometers provide surface temperatures and are not accurate for the purpose of determining the ambient temperature.

Major Components of Heating System

Energy/Fuel



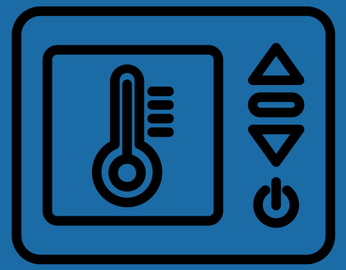
Distribution System



Heat Source



Control System (Thermostat)



Energy Source/Fuels

- Oil



Oil Tank

Energy Source/Fuels

- Oil
- **Gas**
  - **Natural Gas**
  - **Propane**



Gas Meter



Propane Tank

Energy Source/Fuels

- Oil
- Gas
  - Natural Gas
  - Propane
- **Electric**

- Less common
  - **Wood Pellet**



Electric Meter





Wood Pellet Boiler & Silo

Thermostat

- Temperature sensor and a controller
  - Usually a single piece of equipment
  - Mini-splits and Smart Thermostats may be separate
- Minimum temperature of 68°F, may need to be set higher
- Think about where the thermostat is in relation to where you are measuring or where the occupant is saying feels cold.



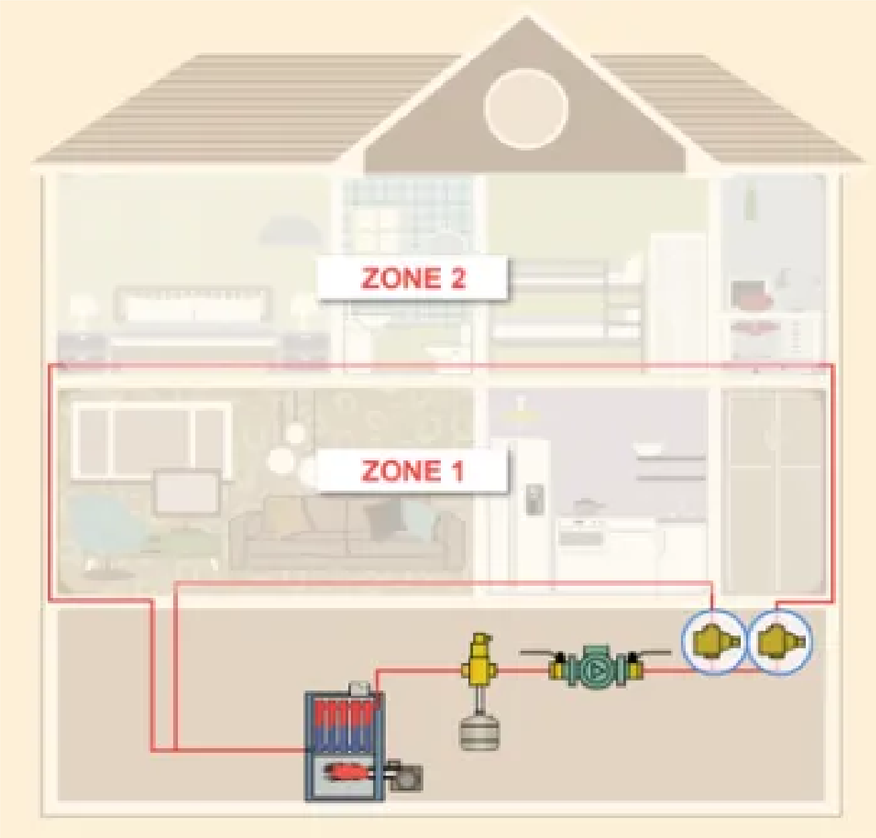






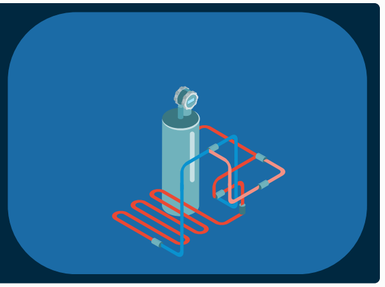
Zones

- A Zone is an area with independent heating control
- Older homes may have only 1 zone for the whole house.
- For mini-splits and electric resistance baseboards each unit has it’s own independent thermostat



Distribution System

Moves warm air, steam or hot water through the home



- **Forced Air – Ductwork, Air Handler, Register**



Rigid Duct with Register



Register



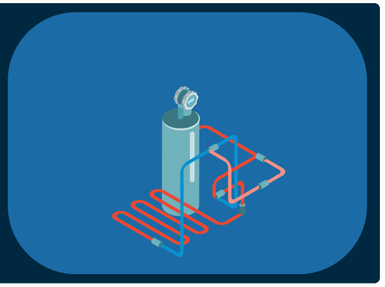
Air Handler



Flex Duct

Distribution System

Moves warm air, steam or hot water through the home



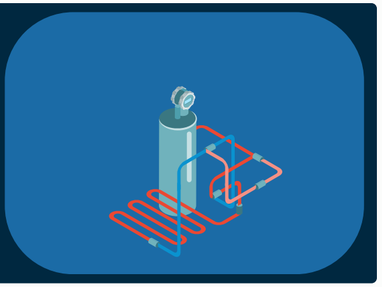
- Forced Air – Ductwork, Air Handler
- **Steam - Radiators**
- Forced Hot Water - Baseboards
- Electric Baseboards





Distribution System

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- Forced Air – Ductwork, Air Handler
- Steam - Radiators
- **Forced Hot Water - Baseboards**
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Vents for Fuel Burning Appliances

Single Steel Exhaust Vent

- Could be vented straight outside or through a chimney

Fuels

- Oil
- Lower efficiency gas





Vents for Fuel Burning Appliances



Dual PVC Exhaust Vent & Intake

- Usually vented straight outside
- Newer high efficiency unit
- Gas

Heat Source

Provides warm air or water to heat the house



- Furnace
- Boiler
- Heat Pump
  - Ducted
  - Ductless Mini Split
- Electric
- Vented Wall Heater

- Other sources that may be used in addition to the system
  - Wood/Pellet Stove
  - Fire Place
  - Outdoor Wood Boiler
  - Space Heaters

Boiler

Heats (boils) water.

Common Fuels

- Oil
- Gas
- Propane

Common Distribution Systems:

- Steam Radiators
- Hot Water Baseboards
- Radiant Floors





Furnace

Heats Air, Connected to Air Handler which distributes the air throughout the home through ductwork.

Possible Fuels
- Oil
- Gas
- Propane

Possible Distribution Systems
- Forced Hot Air (Ducts)

The air handler can also be connected to central A/C



Heat Pumps (General)

- Indoor (Evaporator) and Outdoor (Condenser) Unit
- Works by moving heat from outside to inside during heating season, reverses to provide cooling during summer.
- Most common - Air Source
- Ground source or Geothermal Heat Pumps





Heat Pump (Ductless Mini-Split)

- Multiple indoor units (evaporators) connected to at least one outdoor unit (condenser)
- Remotes/Thermometer





Wall Mount Evaporators



Condenser



Remote

Heat Pump (Ducted)

- Connected to an air handler/duct system
- May be used independently or may be complementary to a furnace



Condenser



Air Handler

Electric Resistance

- Electric Baseboard heaters
- Independent control - thermostat may be on the unit or on the wall in each room
- Cheap to install, expensive to run



Electric Baseboard with Temperature Control



High Voltage Termostat

Supplemental Heating

Direct vent wall heaters
- Essentially a permanent space heater
- Gas on Gas Stove
- If centrally located it may be the sole heat source

Does not meet requirements of Heating System
- Fireplace
- Wood/Pellet Stove
- Portable electric Space Heaters



Parlor Heater, Cabinet Heater





Gas on Gas Stove

Unsafe Prohibited Space Heater

- 410.320(A) - Temporary Wiring
  - Otherwise safe portable electric space heater plugged into an extension cord, power strip or series of extension cords is likely unsafe.



- 410.160(C) - Prohibited Heating Systems
  - Unvented, portable, combustion
  - “Wick type space heater”
  - Some unvented gas space heaters are approved by the fire code. If you are unsure reach out to your Fire Department and/or Plumbing & Gas Inspector



Hot Water - Tank

- **Independent Unit**
  - **Gas, Oil (Vented outside/to chimney)**
  - **Electric (No vent heavy duty wire)**
- Indirect Water Heater
  - Heated by boiler



Gas Water Heater



Electric Water Heater

Hot Water - Tankless



- Independent Unit
  - Gas
  - Electric

- Part of Boiler



Occupant says: House is Cold

- What is thermostat set to? Where is it located?
  - Please turn the thermostat up before the inspection
- Do you use supplemental heaters? Where are they located?
  - Next to thermostat? Won’t call for heat
  - Please do not use any supplemental heating leading up to inspection
- Just document the observed violation and do not offer solutions
  - Maybe the heating system in broken or undersized
  - Maybe the house is uninsulated and the windows are old
  - It could be a minor adjustment/repair or a costly replacement
- Heat related violations will typically be CDEs. Codemnation should be on your radar but may not be necessary

Occupant says: One Room gets cold

- Pay attention to location of the heat source/distribution system
  - Is the cold room on the opposite side of the house from the heat source?
  - Is the a register/baseboard in the cold room?
- Does the occupant keep the door closed?
  - Please keep it open for a few hours before the inspection
  - They may need to consistently leave the door open to keep the room comfortable
- Is it actually a habitable room?
- Possible Solutions:
  - Adjust the heating distribution to send more heat to that room
  - Install a smaller supplemental heater in that room

Occupant says: Temperature gets up to 68°F but 8o°F in another room

- Could be a result of the wrong solution for our previous example
- Could be a Gas on Gas Stove that is not really distributing the heat well
- Measure the temperature in multiple rooms. If it is above 78°F document and cite the violation
- Remember 78°F is referring to actual measured temperature. Not the thermostat set point.

Occupant says: It's always cold and I pay $500 per month for my heating bill

- States "The house is old and completely uninsulated"
- Keeps the thermostat set low to save money
- Can't assess whether the temperature requirements are met if the thermostat isn't set to at least 68°F.
- Could be no violation if:
  - it gets warm when the thermostat is turned up and
  - you don't observe any violations with weathertightness.
- Recommend fuel assistance, MassSave, or other local resources to see if there are any rebates/incentives that could be available

Occupant says: I don’t have control of my thermostat

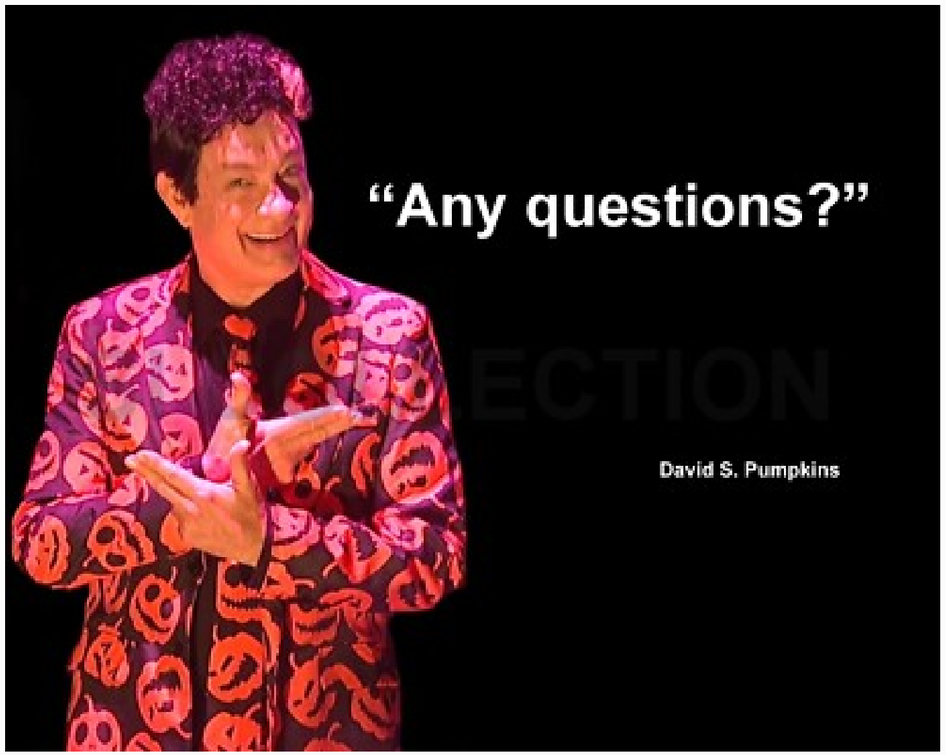
- More common in older homes converted from single family to multifamily, and older apartment buildings.
- No violation if:
  - the owner is paying for the heat and
  - the temperature requirements are met
- Thermostat could be in another unit.
- Possible solutions:
  - Tell the other unit that their thermostat controls the whole building
  - Put a lockbox around the thermostat
  - Install a smart thermostat that the owner can control remotely
  - Install an independent heating system in each unit

Documenting Observations

- 410.160 Heating Systems
  - “Heating system not functioning.Did not observe any response after turning the thermostat up to 80°F.”
    - Hear – water/steam flowing, burner turn on
    - Feel – warm air, warm radiators/baseboards (good use of infrared)

- 410.180 Temperature Requirements
  - Heating temperature requirement not met. Measured with calibrated thermometer to be 65°F at 4:00 pm in the living room.
- Reminder - Don’t offer solutions

Thank You!



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