HEATING SYSTEMS 101
Objective

• Provide non-heating personnel with a basic understanding of heating systems:
  – Types of Heating Systems
  – Identification of Components and Basic Operation
  – When do I Replace?
  – Specifications for Installation
  – Installation
  – Venting
  – Health and Safety Concerns
  – Partnerships
Fuels

• Fossil
  – #2 Fuel Oil—home heating interior tank
  – Kerosene—exterior tank (mobile homes)
• Gas
  – Natural Gas
  – Propane
• Solid Fuels
  – Wood
  – Pellets
• Electric
Types of Equipment

• Oil Fired
  – Power Gun Burner (Mid Efficiency)

• Gas/Propane Fired
  – Atmospheric-Cat I (Mid Efficiency)
  – Induced Draft-Cat III (Slightly Higher Efficiency)
  – Condensing-Cat IV (High Efficiency)

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Gas Forced Air High Boy
Oil Fired Boiler
Mobile Home-Counterflow
Heating System Components

• Burner
• Fire box
• Heat Exchanger
• Distribution System
  – Forced Air
    • Blower, Plenums-hot and cold air, Ductwork
  – Boiler
    • Circulator Pump, Piping, Radiators or Baseboard
• Basic Controls
• Safety switches
Components of a Gas Fired Forced Air System

1. Heat Exchanger
2. Fire box
3. Burner
4. Blower
Components of a Boiler

- Supply
- Zone Valves
- Return
- Pump
- Expansion Tank
- Fill Valve
- Air Separator
- Purge Cock
- Boiler
When do I Replace?

- Non-functioning and;
  - Price of repair exceeds value of furnace
- Major health and safety concern
  - Cracked Heat Exchanger
What is a Cracked Heat Exchanger?
Testing for a Cracked Heat Exchanger

• Visual Inspection of Heat Exchanger
  – From the Top
    • Through humidifier
    • Remove Plenum
  – From the Bottom
    • Remove blower and inspect through blower compartment

• Smoke Bomb

• Oil of Wintergreen
Additional Heat Exchanger Inspections

• Performed when the blower energizes
  – Draft
    • Should stay consistent, before blower and after blower energizes
  – $O_2$ / $CO_2$
    • Increase in $O_2$ (or decrease in $CO_2$) after blower energizes indicates additional air is entering the combustion process
  – Visual flame examination
    • Should not waver when blower energizes
Visual Inspection with Light
Visual Inspection with Mirror
Vents and Chimneys
Venting – Category I

- Negative pressure, non-condensing
- Materials
  - Masonry - solid fuels, oil, *gas
    - Outside masonry chimneys may need to be lined to accommodate replacement gas heating appliances
  - B-vent – gas
    - Approved for installation within the envelope only
  - L-vent - oil
  - All fuel - solid fuel, oil, gas
- Ensure termination is per manufacturer specification
Venting - Category IV

• Positive pressure, condensing
• PVC vented directly outdoors
  – Proper support and pitch are essential
Category IV

- Positive pressure condensing appliances, joints must be sealed
- 90%+ AFUE
- Appliances are designed to dispose of flue condensate as well as condensate formed within the secondary heat exchanger through condensate drain
- Must be 4 feet from any doors or windows
Category IV

• PVC
  – Low cost
  – Sealed joints
  – Must be provided with adequate hanging support
  – Pitch – back to appliance ¼” per Ft.

• CPVC
  – Higher operating temperatures than PVC

• Follow manufacturer instructions
  – Manufacturer specific
  – Sealed Joints
Orphaned GAS Hot Water

• When removing a heating appliance from an existing Category I flue the hot water heater may become stranded or “orphaned” in a vent that is oversized.
• Problem-Potential Backdrafting
• Solution (IF the unit IS backdrafting):
  – Reline if a masonry chimney with a flexible liner or “B” vent
  – Power Vent
  – Replace water heater
    • Direct vent
    • Electric
Chimney Liner

- Flexible Chimney Liner
- Liner diameter is based on:
  - Total, simultaneous input,
  - Chimney height,
  - Length of vent connector(s),
  - Natural draft and/or fan assisted
Forced Air Distribution Systems
Forced Air Connections
Boiler Distribution
System Sizing

• What is a (BTU)?
  – British Thermal Unit
  – The amount of heat energy required to raise 1 pound of water 1 degree Fahrenheit

• Heat Load Calculations
  – Volume of House
  – Insulation Values-Walls, Ceiling, etc...
  – Windows and Doors
  – Air infiltration
  – Distribution System
Reading and Writing Proposals and Specifications

- Should be as complete as possible and indicate:
  - Installation per manufacturers instructions
  - All local codes will be followed
  - System size
  - Warrantee for parts and labor
  - Timeframe for completion
Installation Guidelines

• Appliance installed on solid blocks above the floor
• Installed per manufacturer specifications
• Venting per NFPA (National Fire Protection Association)
• Distance to combustibles per NFPA
• Ensure adequate combustion air
• Electric (neat connection following electric code)
• Fuel (In-line filter should be installed on oil)
• Duct transitions should be neat and sealed
• Balance of ductwork should be sealed
• Complete filter carriage (with cover) on forced air
• System tested for proper draft (when possible)
• Combustion efficiency test (when possible)
Managing Your Contractor

• What are you folks doing now?
Partnerships

- ** HEAP Emergency Repair and Replacement Program**
  - Only during heating season
  - Emergency response to “no heat”
- ** Weatherization Assistance Program**
  - Efficiency is primary goal
  - Last resort when responding to emergency
- ** NYSERDA-EmPower and Home Performance**
  - Efficiency repairs eligible
  - Generally does not have funds for replacement unless coordinated
Questions?
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