Outdoor Wood Boilers

The Northern Michigan Experience
A Brief and Smoky History

- Started appearing in the early 1990’s
- Number of smoke and odor complaints increased with number of installations.
- Have gradually made their way south through the state.
- Michigan is the #1 state in terms of sales.
- About 35,000 units now installed.
- U.P. Communities began passing bans and ordinances in the mid to late 1990’s.
- Nearly every U.P. city and numerous townships have ordinances regulating installation of OWB’s
What Are They

- Basically a wood stove with a water jacket, housed within a shed
- Located outside the structure being heated
- Utilize a liquid media to transfer heat energy from the stove to the structure
Secondary Combustion Area with intense heat collection and transfer surfaces.
What They Are Not

- Not a true boiler, technically most are Outdoor Wood-Fired Hydronic Heaters
- Not designed to heat water under pressure or above the boiling point
- Not inexpensive
Why Are They So Popular?

The price of carbon fuels and electricity
Other Advantages

- Slightly Lower Insurance Rates
- Wood and mess stays outside
Environmental Effects

- Improperly sited or operated units generate numerous smoke and odor complaints
- Significant number of units constitute an area source of PM 2.5
- Can quickly turn neighbors into the Hatfield’s and McCoy’s
What Can Be Burned?

- They should burn only clean, seasoned wood.
- Unfortunately we also find people burning:
  - Garbage
  - Tires
  - Railroad Ties
  - Dead animals
  - About any combustible substance that will fit through the doors.
What Some Dealers and Manufacturers Have Claimed

- Efficiencies up to 95%
- No need to split or season wood
- Burn times up to 96 hours on one fuel load
- Accepts fuel up to 30” diameter and 72” long
- Heats water year round
Efficiency Ratings

- Commonly accepted in HVAC Industry:
  - < 70%: Low efficiency
  - 70 – 85%: Medium efficiency
  - > 85%: High efficiency

82% is the maximum for wood fired appliances (non-condensing units)
Green Wood Burns Great!

Moisture Content and Heat Output

Moisture Content of Firewood

Available BTU’s per # Wood Fiber
Heating Costs per million BTU

- Wood @ $150/cord = $6.00 – $9.00 (dependent on moisture content)
- Natural Gas @ $1.07/K ft³ = $10.70
- Fuel Oil @ $2.20/gal = $16.30
- Propane @ $2.20/gal = $24.00
- Electric @ $0.09/kw = $25.00
# Heating Cost Corrected for Efficiencies

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cost per Unit</th>
<th>Efficiency</th>
<th>Corrected Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>$10.70</td>
<td>.80</td>
<td>$13.37</td>
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<tr>
<td>Fuel Oil</td>
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<tr>
<td>Electric</td>
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<tr>
<td>Propane</td>
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<td>$30.00</td>
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<tr>
<td>OWB</td>
<td>$6.00</td>
<td>.30</td>
<td>$20.00</td>
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<tr>
<td>OWB (High Eff)</td>
<td>$6.00</td>
<td>.70</td>
<td>$8.50</td>
</tr>
</tbody>
</table>
Problems

- Combustion controlled by an aquastat
- Firebox is surrounded by a water tank which continuously quenches combustion
- Large fireboxes encourage overloading
- In cool weather the units tend to smolder continuously rather than burn
- Short stacks/poor dispersion
Problems

- No state or federal performance standards
- No recognized test method to determine emissions or efficiencies
- Overselling
- Put it all together, and.....
Getting a Cleaner Burn

- Secondary combustion is key – must attain temperatures > 1200 F for complete combustion
- Smoke is simply unburned fuel
- Run in one mode – hot
- Use the heater like a battery charger and store the energy for later use
Redneck Furnace
BAXI/HS-TARM boiler with Heat Storage System.
What Are We Doing?

- ASTM Workgroup E06.54.08
- Developing a test method specific to the outdoor units. Four units have undergone bench scale testing.
- Moving towards a certification program similar to the Wood Stove Standard
- Individual states are developing performance standards
- Encouraging responsible use of wood as a fuel
- Working with municipalities to draft local ordinances
- Working with manufacturers and owners to reduce smoke and odor
- Taking enforcement actions
Our Goal. Reasonable Performance Standards which will:
- Reduce Average Emissions by 80-90%
- Double Average Heating Efficiencies