Dilution Air Venting

A Enabling Technology for Oilheat Advances

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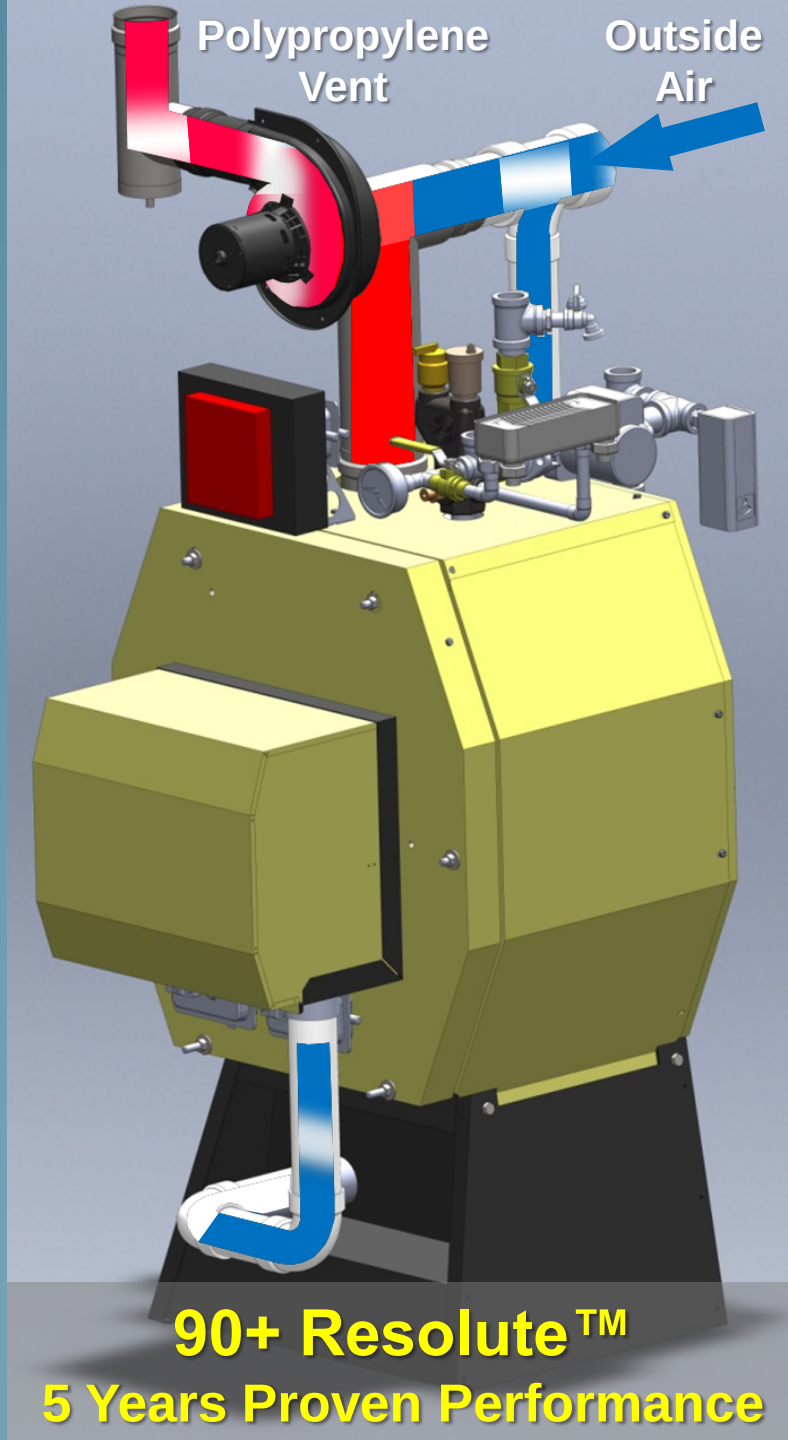
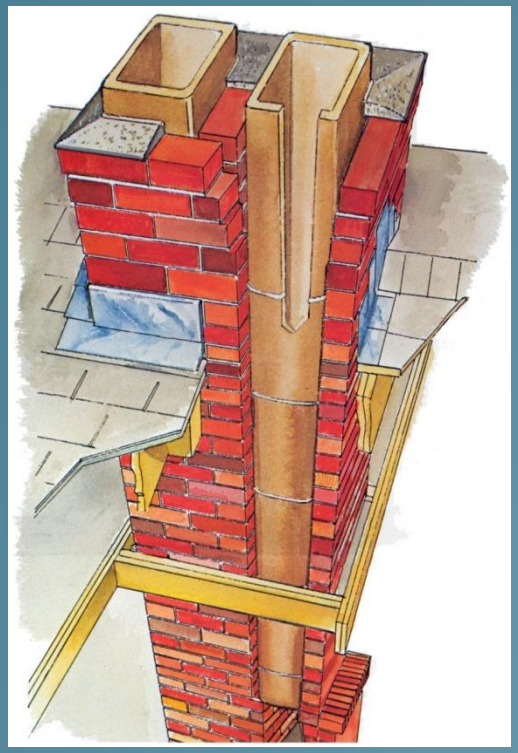


Oilheat Venting



Chimneys

350°F Base Temperature

- Establish draft (negative pressure)
- Avoid condensing

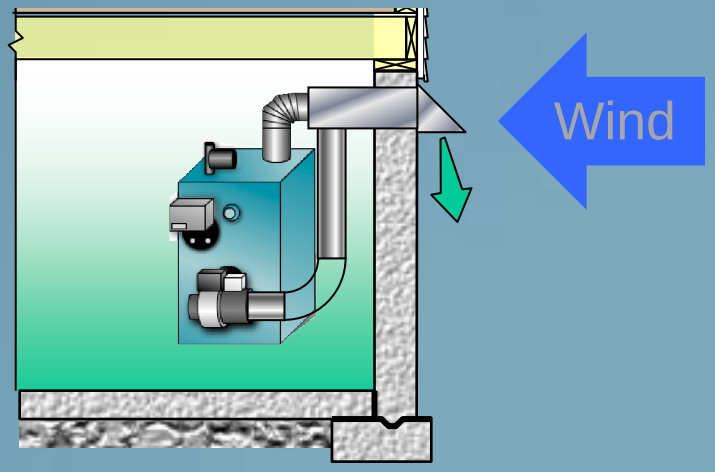
Lower temperatures

- Positive pressure
- Chimney deterioration

Stainless Steel Liners

- Expensive Installation
- Non-condensing
- Not rated for positive pressure

Direct Vent



- Positive pressure even with "balanced flue"
- Wetted vent with low temp flue

High Efficiency Challenge:

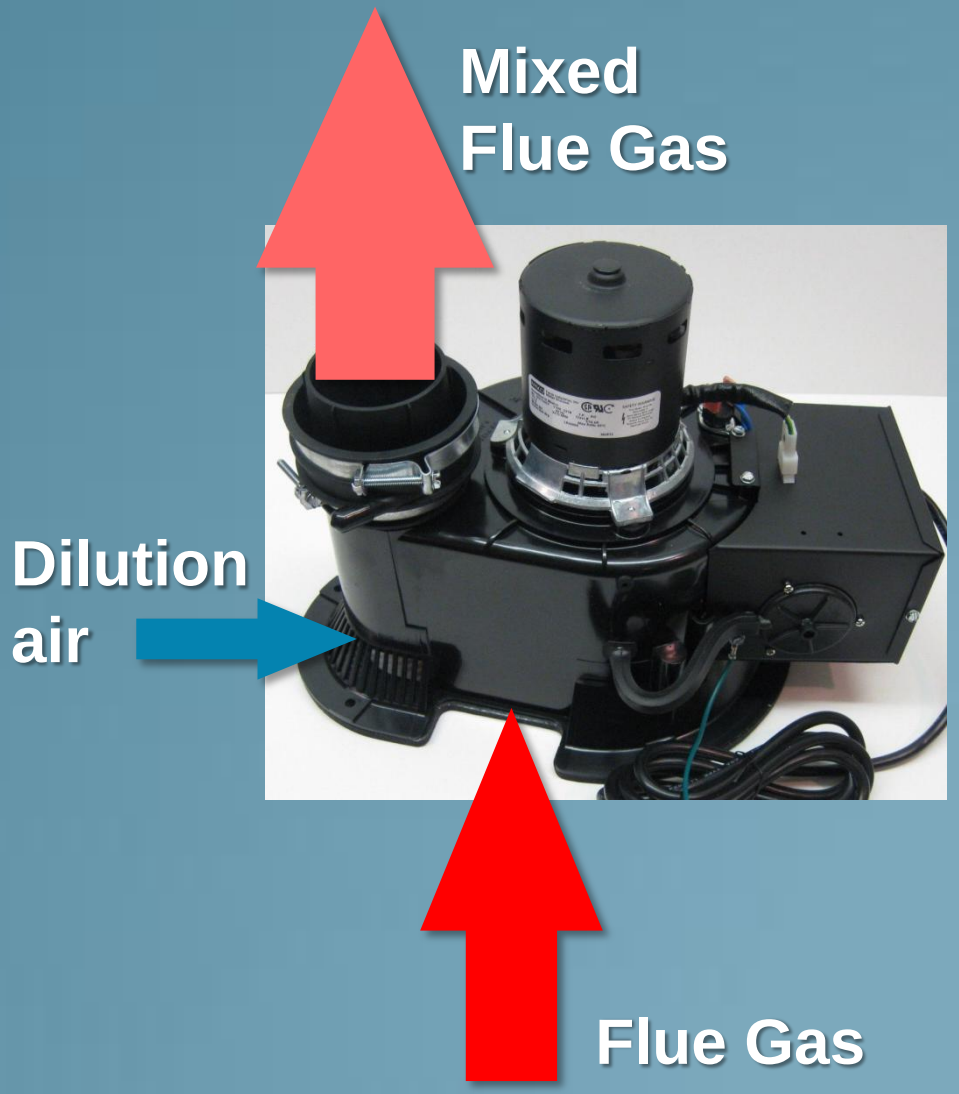
- Low stack temperatures (<325˚F)
  - Natural Draft not effective for chimneys
  - Condensation can damage clay liners
- Sulfur content in fuel can cause fouling of heat exchanger and vent system
- Condensing flue gas with sulfur aggravates long term serviceability and performance
- PVC falling out of favor (NYC, New Hampshire)

Opportunity:

- Oil can reach a higher AFUE rating without condensing compared to natural gas and propane
- 87.5 AFUE low mass non-condensing oilheat has greater efficiency than 95 AFUE natural gas mod-con
- We can do even better

Dilution venting

A page out of the water heater playbook…



Years of success…how to improve?

Real efficiency gains

- Eliminate the draft regulator
- Sealed combustion (isolate from ambient)
- Dedicate combustion and dilution air from outside the building envelope
- Idle loss is already a minimum
- Reduce stack temperature for higher steady state efficiency

Use proven components

Use “off the shelf” solutions

Wide window of operation

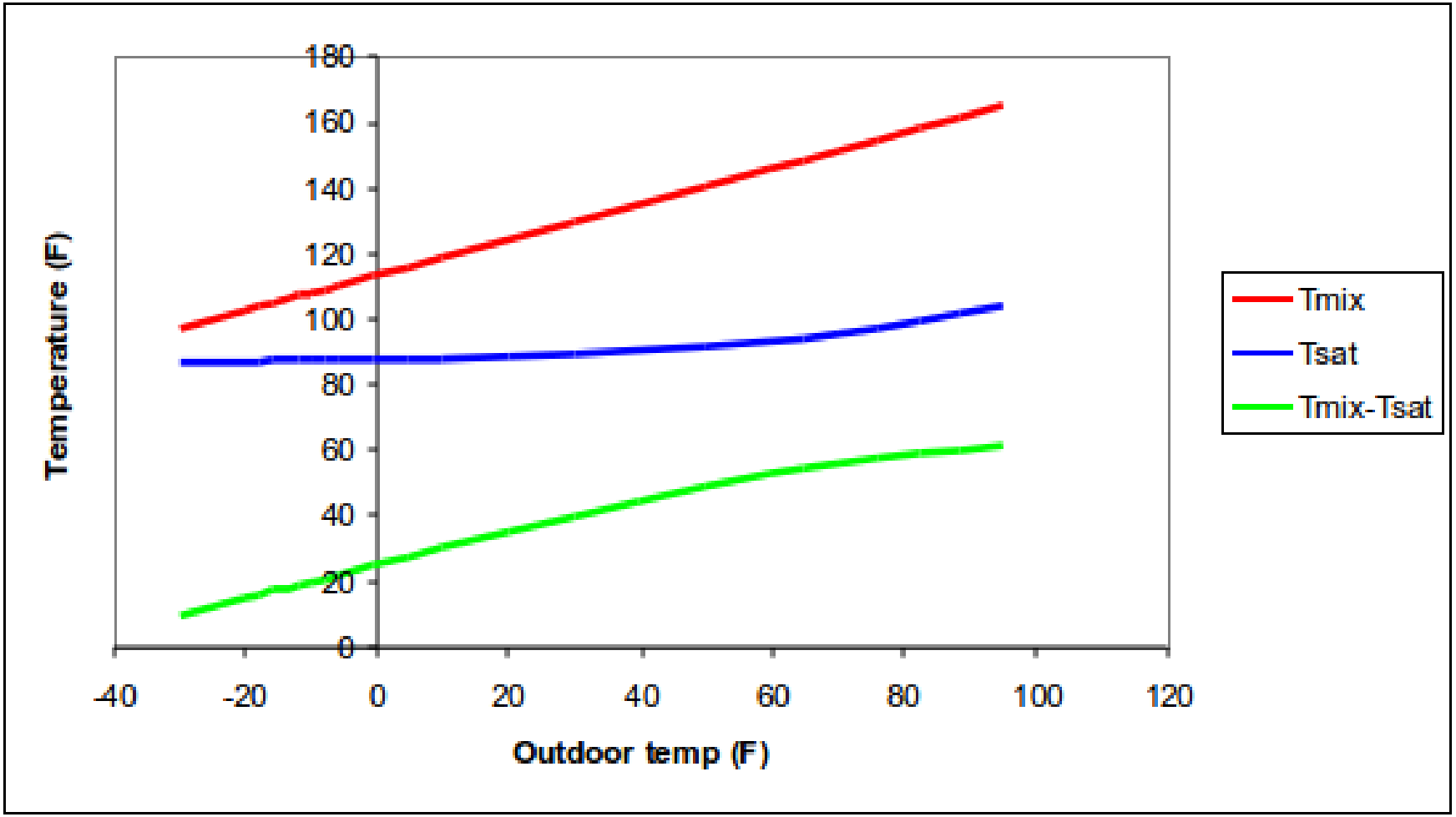
- Clean light off and burner operation (low to high CO_2)
- Robust high and low draft operation
- Cold, warm, low and high humidity

Polypropylene Vent (PVC phasing out)

Concerns:

- ✓ **Cold weather**
  - ❑ Will it condense?
  - ❑ How cold is too cold?
  - ❑ Impact on components?
- ✓ **Humid make up on hot summer days?**
  - ❑ Lower relative humidity with burner running.
- ✓ **Vent system condensing?**
  - ❑ No. Provision for rain or condensate built in.
- ✓ **Wind loads?**
  - ❑ 60 MPH sustained winds, 80 MPH gusts
- ✓ **Burner Clean Operation?**
  - ❑ Lightoff comparable to a very good chimney (no draft loss on light off)
  - ❑ Chamber delivers exceptionally clean performance at low and high draft, cold and warm temperatures

Calculation Results Example



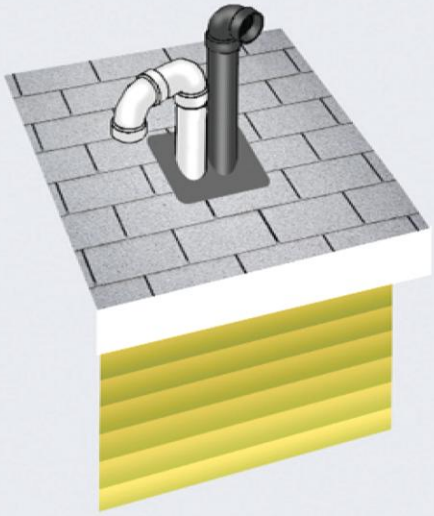
Texhaust = 250 F, R = 1.2 (dilution/flue), RH = 100%, CO2 = 10.6

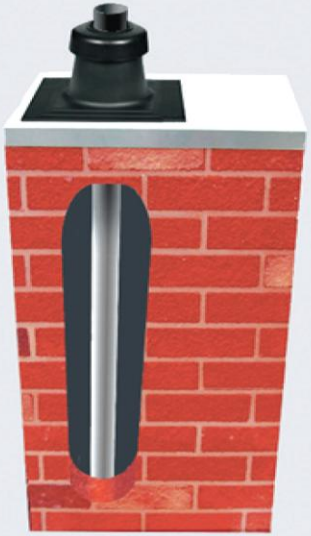
Field Results: Fairbanks Alaska

Winter 2011 Prototype Combination Hood
Stainless Steel “Nozzle”

Modified design so no icicle growth which occurred at -40°F and colder temperatures.
Combination hood preheats dilution air.
No issues at sustained -60°F temperatures.
Condensing gas boiler hotel example.

Venting Solutions
(Centrotherm Example)





Sidewall direct venting

Through the roof

Chimney

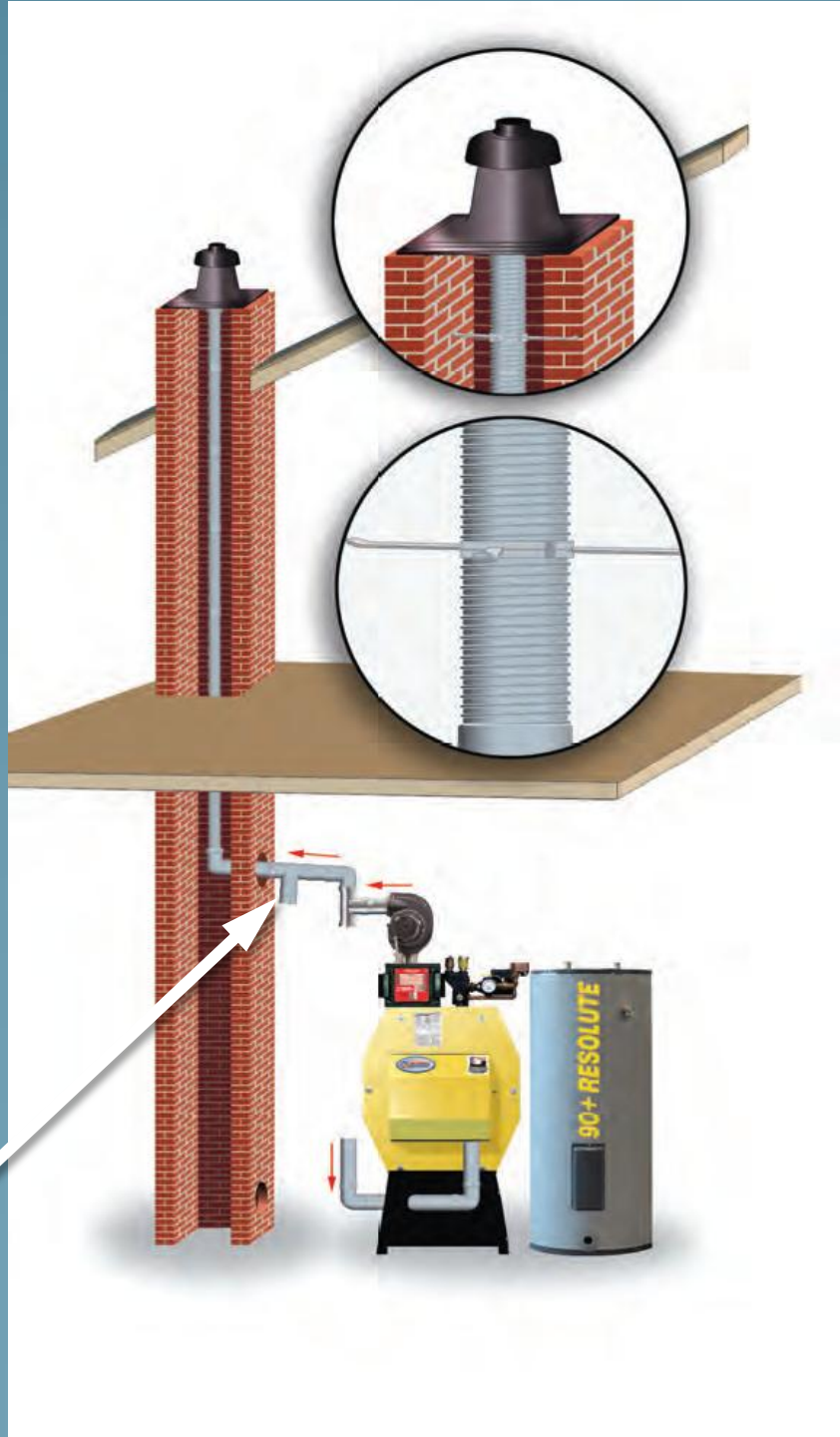
Vent with 3” Polypropylene or Stainless Steel (cleanable)
248°F Max Flue Temperature Rating for Oilheat (100°F to 150°F)
Pipe air intake with PVC or Polypropylene
Maximum length 50’ equiv. intake plus 50’ equiv. exhaust

Venting Vertically with 3” Centrotherm Flex Polypropylene

Air intake from side wall

-or-

Second Flex line



Rain Trap at Thimble
(dries out)
No draft regulator

Chimney Flex Vent

- ✓ Separate intake in same chase preheats dilution air in extreme cold
- ✓ We have not seen condensation occur
- ✓ Stainless flex liners not rated for positive pressure
- ✓ Polypropylene rate at 50 in. wc
- ✓ No flex vent applications in Alaska
  - ❑ Virginia to Maine very successful

Conventional Boiler Benefits

- ✓ **Comparable to condensing efficiency**
- ✓ **No corrosive condensate**
- ✓ **Designed for baseboard and high temperature radiation (>200°F OK)**
- ✓ **Long expected lifecycle**
  - Boiler and components proven longevity
  - Inducer has over 15 years of field success
- ✓ **Lower Sulfur levels mean even cleaner operation**
- ✓ **Wide open flue passes – easy cleaning**
- ✓ **Wide open water passes – no primary/secondary required**
- ✓ **Familiar Components – easy service**
  - Beckett and Carlin Burners
  - Taco and Grundfos Circulators
  - Centrotherm Venting

90+ Resolute Boiler

5 Years Proven Performance

0.68 GPH to 1.0 GPH
Multi-Fuel

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