CCHRC

Cold Climate Housing Research Center

## Our Mission:

*Promoting the development and advancement of healthy, durable and economically sound SHELTER for Alaskans and other circumpolar people through research on housing and related infrastructure.*

# Emissions and Efficiency of a Masonry Heater

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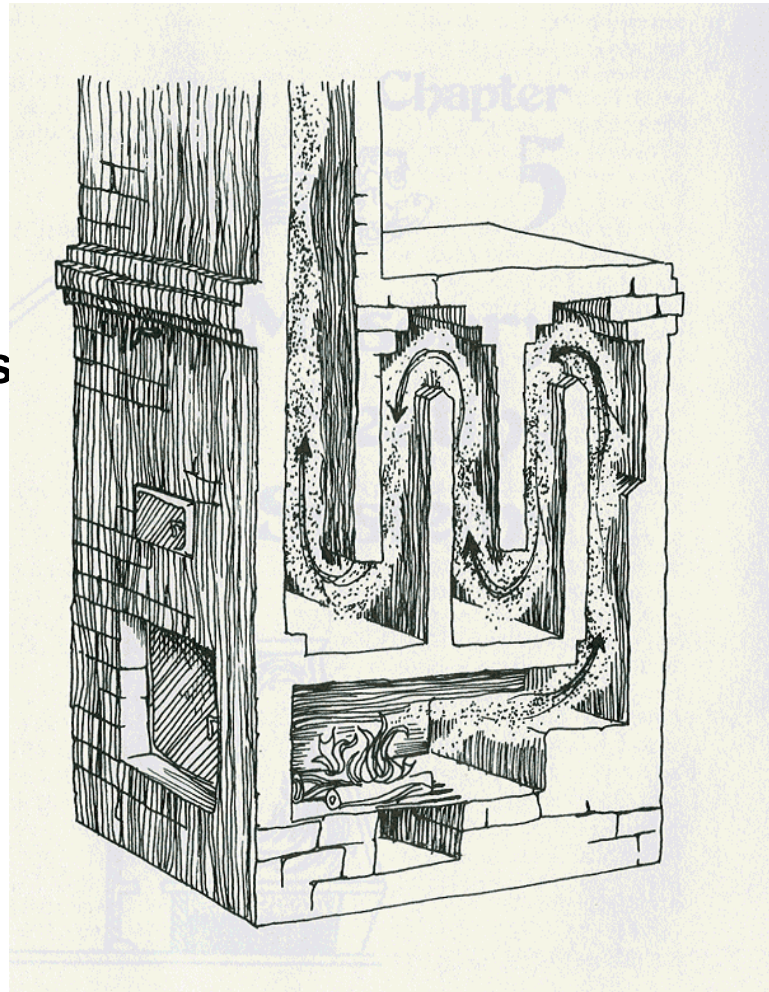
Masonry heater by Gene Hedin
Photo from Masonry Heater Assn

# MHA Masonry Heater Definition

- **A masonry heater is a site-built or site-assembled, solid-fueled heating device constructed mainly of masonry materials in which the heat from intermittent fires burned rapidly in its firebox is stored in its massive structure for slow release to the building.**



Masonry heater by Basilio Lepuschenko
Photo from The Book of Masonry Heating
By David Lyle

# Historical Heaters - China



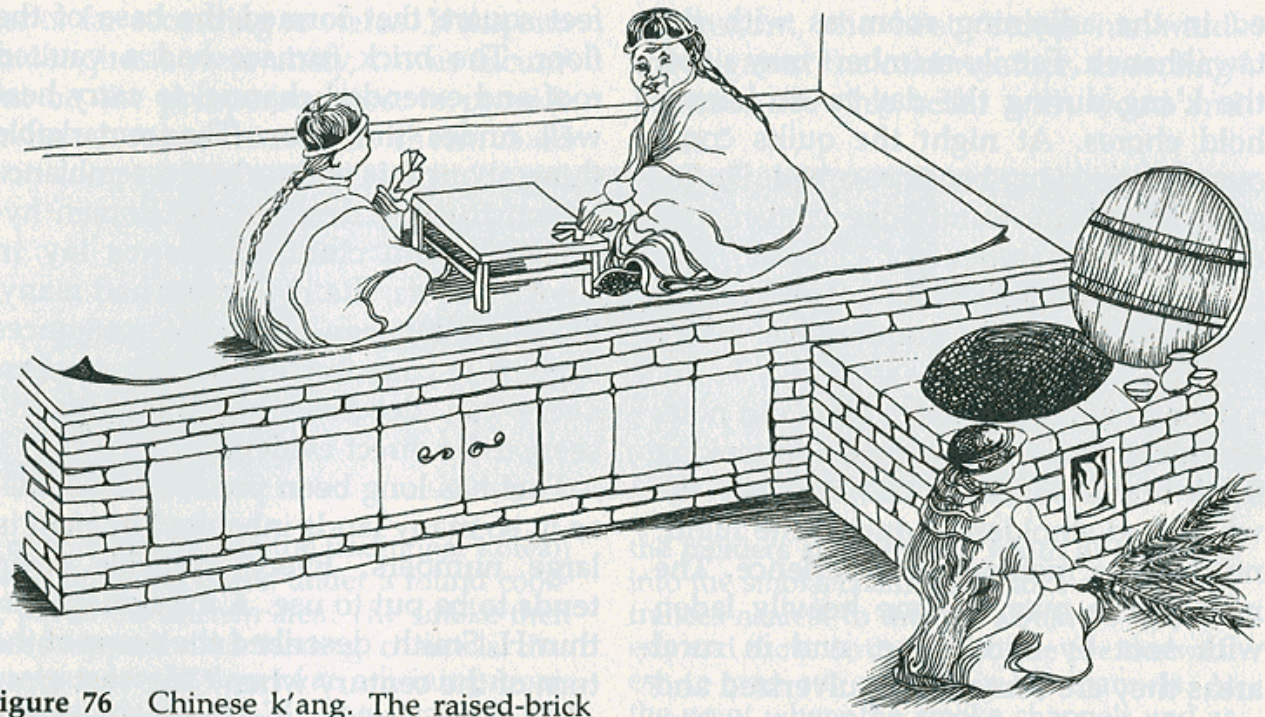
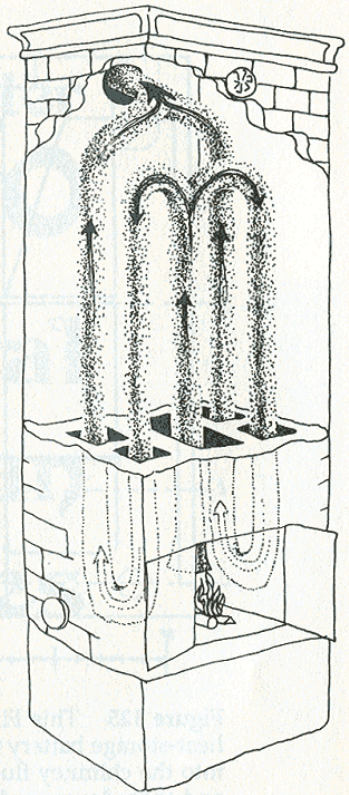


**Figure 76** Chinese k'ang. The raised-brick platform is warmed in this instance by hot gases from a fire in the cooking stove at right. The stove has a wok set into its top. The brick platform is used for sleeping at night, but by day it may be used for a variety of purposes. In this scene, reconstructed from old photographs, a game is in progress.

From The Book of Masonry Heating By David Lyle

# Historical Heaters - Sweden





**Figures 123 and 124** The typical Swedish stove remaining in use today is a five-channel model. Figure 123 shows the exterior of such a stove. (Courtesy of Nordiska Museet). Figure 124 shows the interior.

From The Book of Masonry Heating By David Lyle

# Historical Heaters - Yugoslavia

**Figure 143** Tile stove with bench and sleeping platform. The stove was photographed in 1942 in the Slovenian region of Yugoslavia, formerly a part of Austria. Photo by Erika Groth-Schmachtenberger.

From The Book of Masonry Heating By David Lyle

# Modern Heaters - Vermont

From Turtlerock Masonry Heat By William Davenport

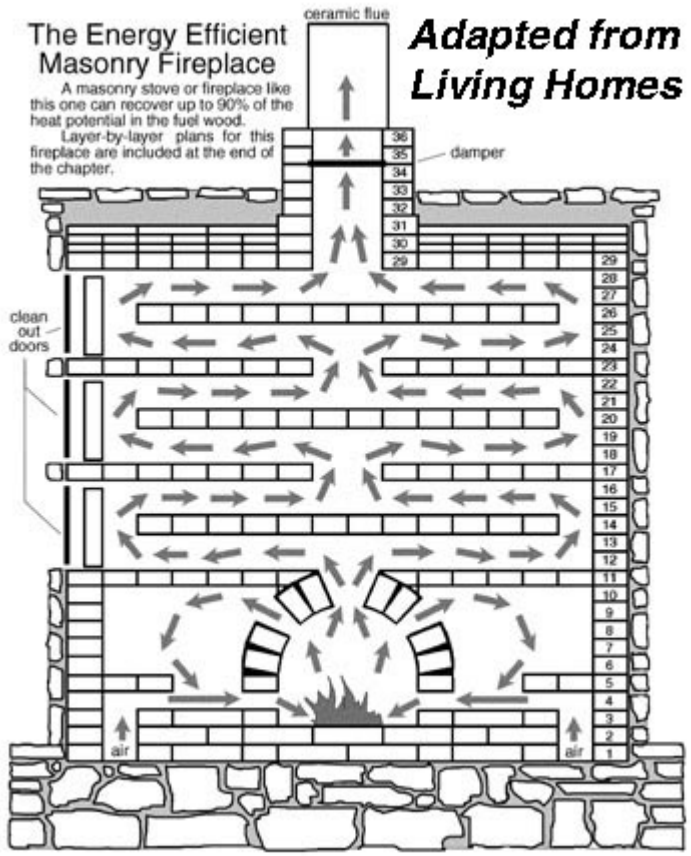
# Modern Heaters - Finland

Tigchel Heater

Finoven

From http://www.tigchelkachels.nl/

# Masonry Fireplace - Montana




From Living Homes by Thomas J. Elpel

# Modern Heaters - Fairbanks

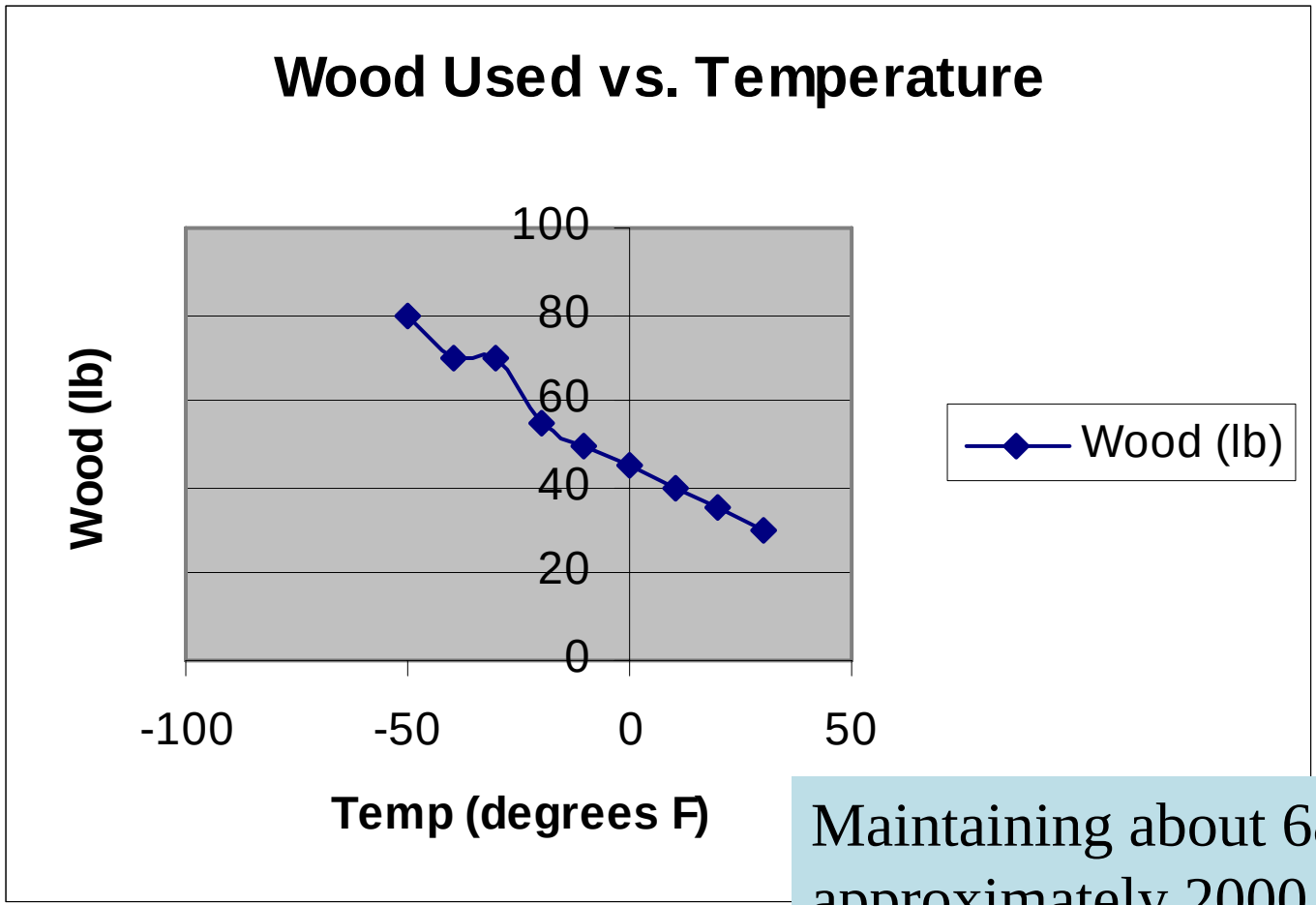
Photo by Bill Reynolds

**Bill Reynolds' masonry heater**

# Oil vs. Wood - Fairbanks

| Heating Degree Days and Fuel Costs for Oil and Wood | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fairbanks, Alaska (1971-2000) | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| **Month** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Annual** |
| HDD | 121 | 283 | 615 | 1287 | 1882 | 2199 | 2315 | 1926 | 1670 | 999 | 504 | 179 | 13,980 |
| MBTU/mo | 1.2 | 2.8 | 6.1 | 12.8 | 18.7 | 21.9 | 23.0 | 19.1 | 16.6 | 9.9 | 5.0 | 1.8 | 139 |
| KBTU/dy | 40 | 94 | 204 | 427 | 624 | 729 | 767 | 638 | 553 | 331 | 167 | 59 | |
| Gal/dy | 0.3 | 0.7 | 1.5 | 3.1 | 4.5 | 5.2 | 5.5 | 4.6 | 4.0 | 2.4 | 1.2 | 0.4 | |
| Gal/mo | 9 | 20 | 44 | 92 | 135 | 157 | 166 | 138 | 119 | 71 | 36 | 13 | 1000 |
| Cords/mo | 0.06 | 0.14 | 0.30 | 0.62 | 0.91 | 1.07 | 1.12 | 0.93 | 0.81 | 0.48 | 0.24 | 0.09 | 6.78 |
| | | | | | | | | | | | | | |
| Assume | | | | | | | 2.3 | $/gal | | Annual | Cost | Oil | $2,300 |
| 139,000 | BTU/gal | | 139 | MBTU/yr | | | 150 | $/cord | | Annual | Cost | Wood | $1,017 |
| 20.5 | MBTU/cord | | | | | | | | | | | | |
| 1000 | gal/yr | | | | | | | | | | | Save | $1,283 |

# Wood Usage in Reynolds' Heater




Maintaining about 68°F in approximately 2000 SF

# Equipment for Gas Analysis

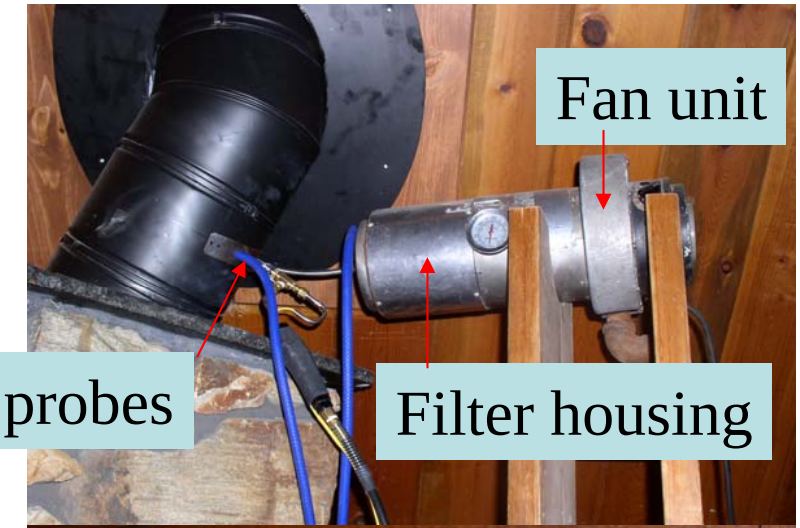
Moisture and temperature meters

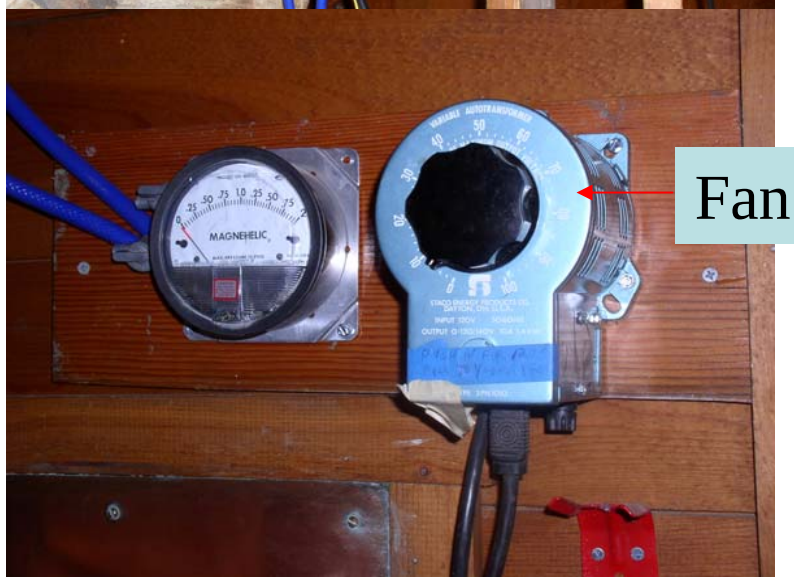
Date logging and display on laptop

Nova flue gas analyzer

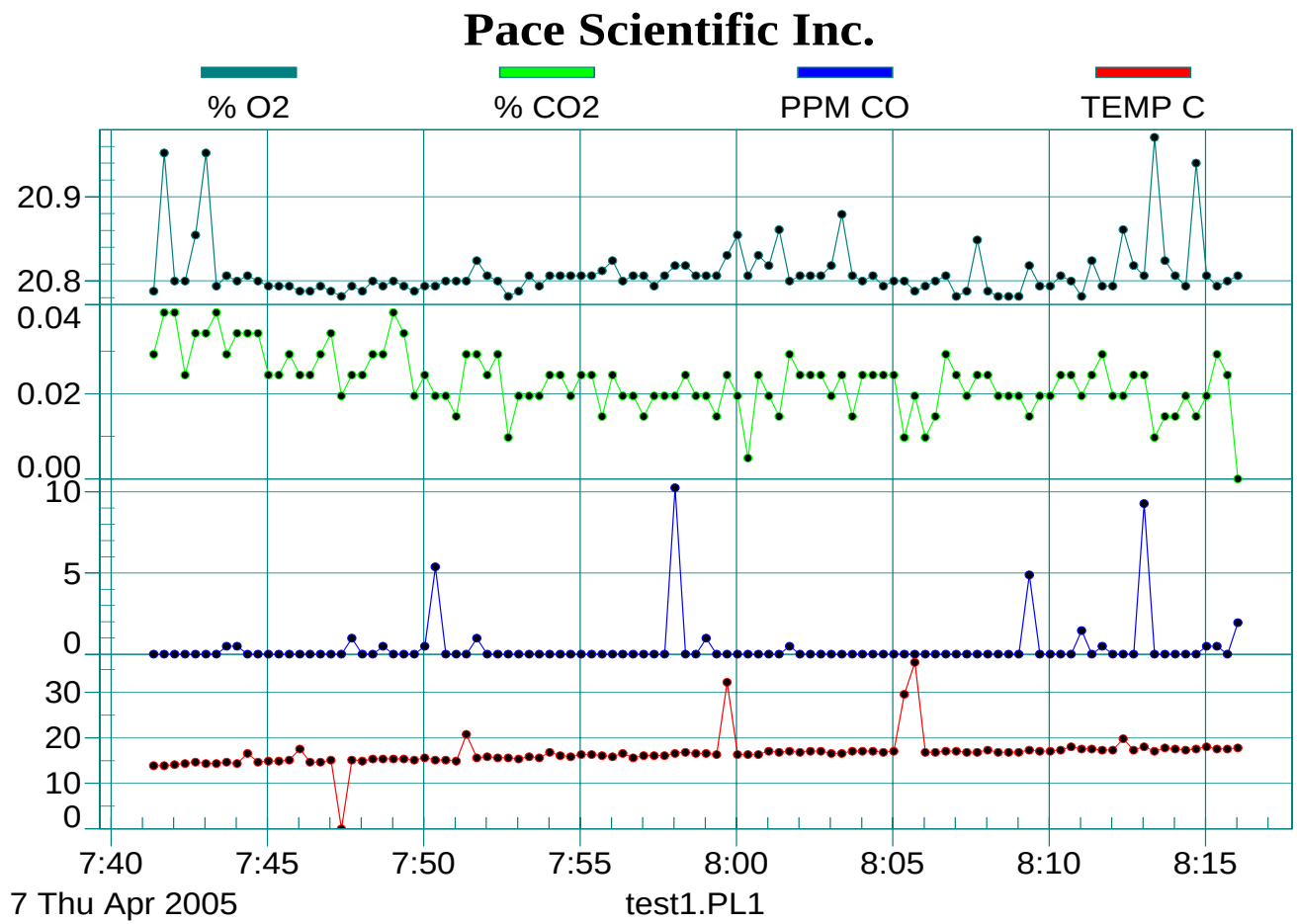
Gas cooler

# Dilution Sampler



# Test Burn Data




% $O_2$

% $CO_2$

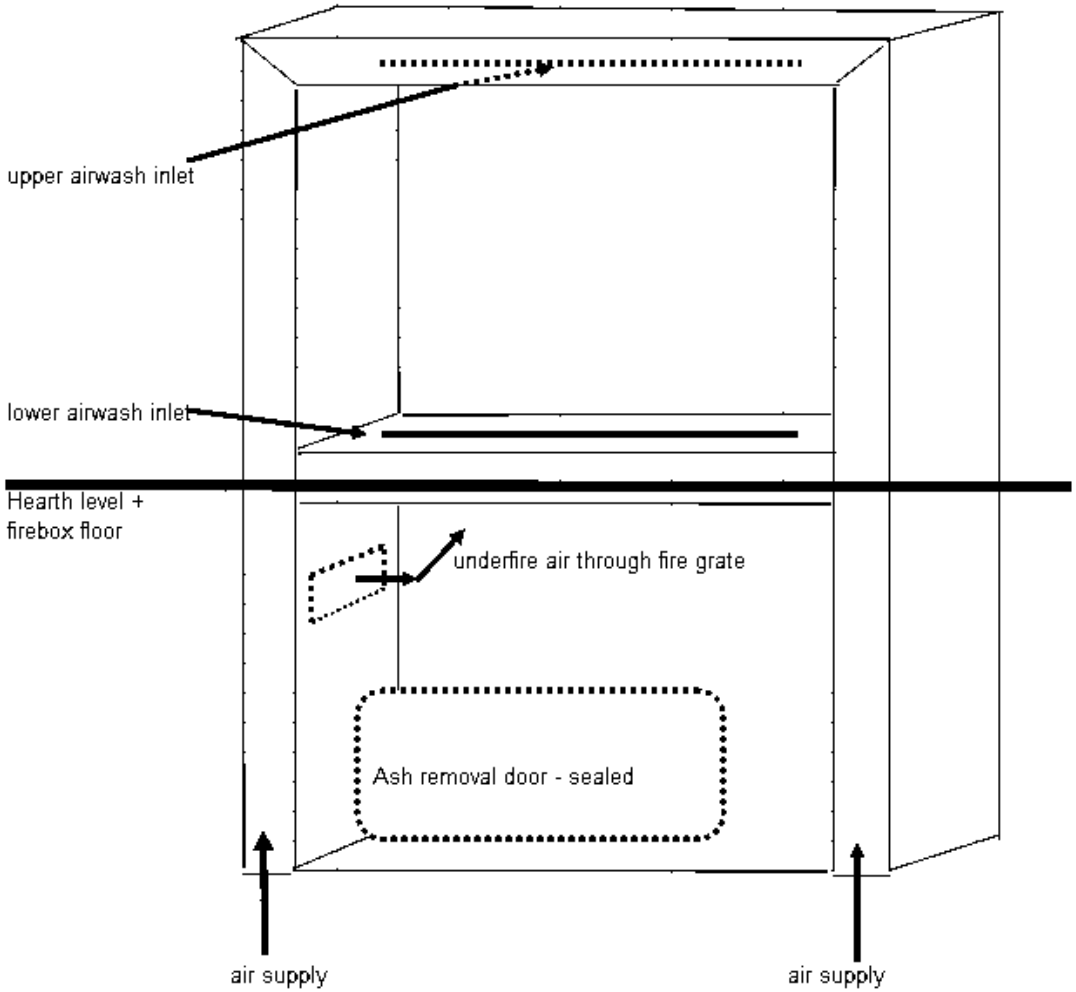
ppm CO

temp $^oC$

# Fairbanks Masons

Bill Reynolds & Dan Givens (Stonecastle Masonry)

# Combustion Air Design




# Project Objectives

1. To establish an accepted protocol for testing masonry and other wood-burning devices.
2. To determine the emissions from an existing wood-burning masonry heater.
3. To determine the calculated burn efficiency of an existing wood-burning masonry heater.
4. To determine most effective way to regulate the combustion air to the heater
5. To compare emissions and efficiency between a masonry heater and (1) a conventional fireplace and (2) a high efficiency manufactured wood burning heater.
6. To determine viability of masonry heaters in Alaska.