

A Report on Some Heat Transfer Experiments

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Heat Transfer to the Pot

- Weak link in getting an efficient stove.
- Thermal conductivity of gases is very low.
- Only 20-50% of available energy is transferred to pot.

New Testing Method

- Use natural gas as the fuel.
- Meter the gas flow accurately to give firepower.
- Burn gas in non-premixed manner to simulate wood flame.

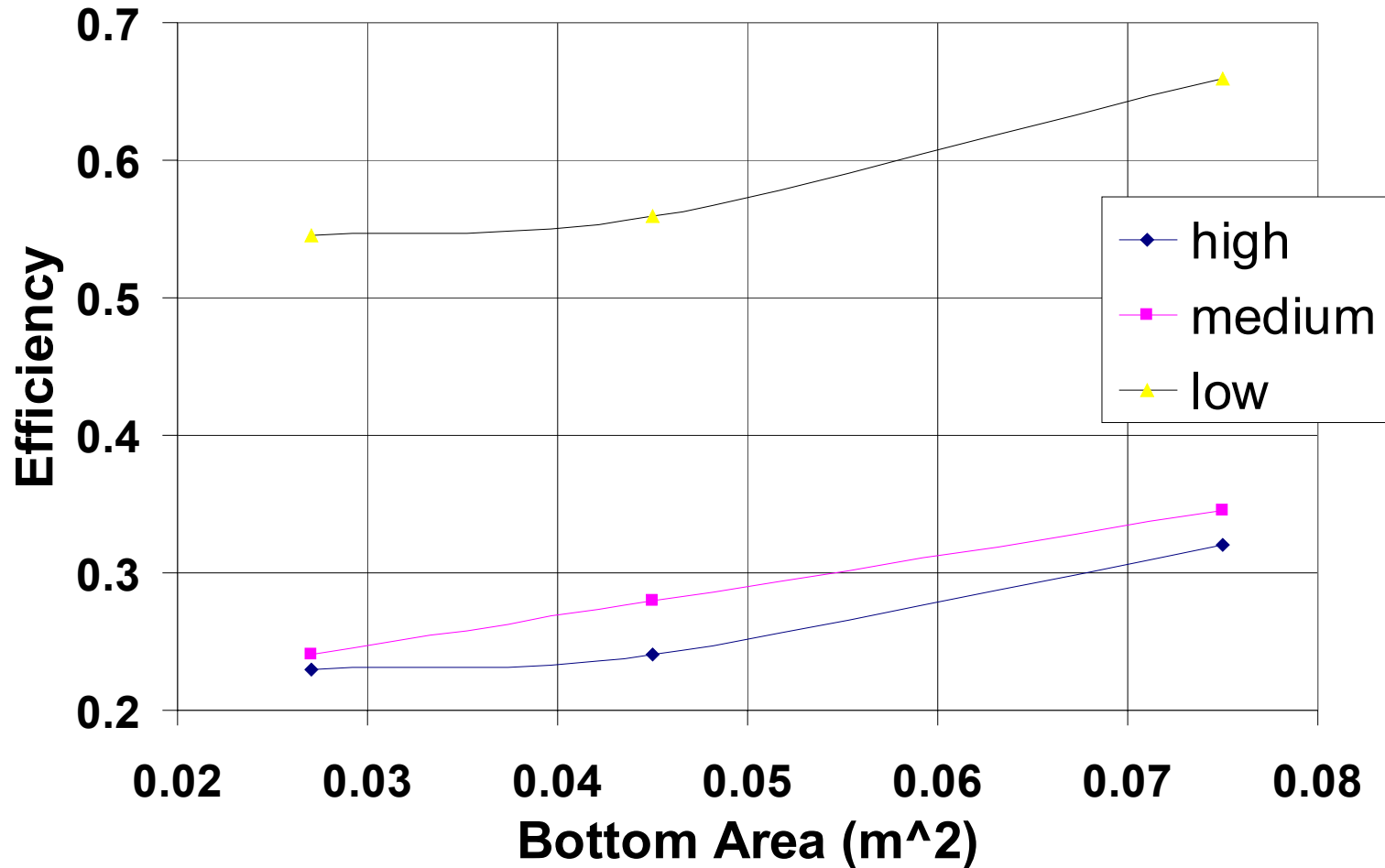




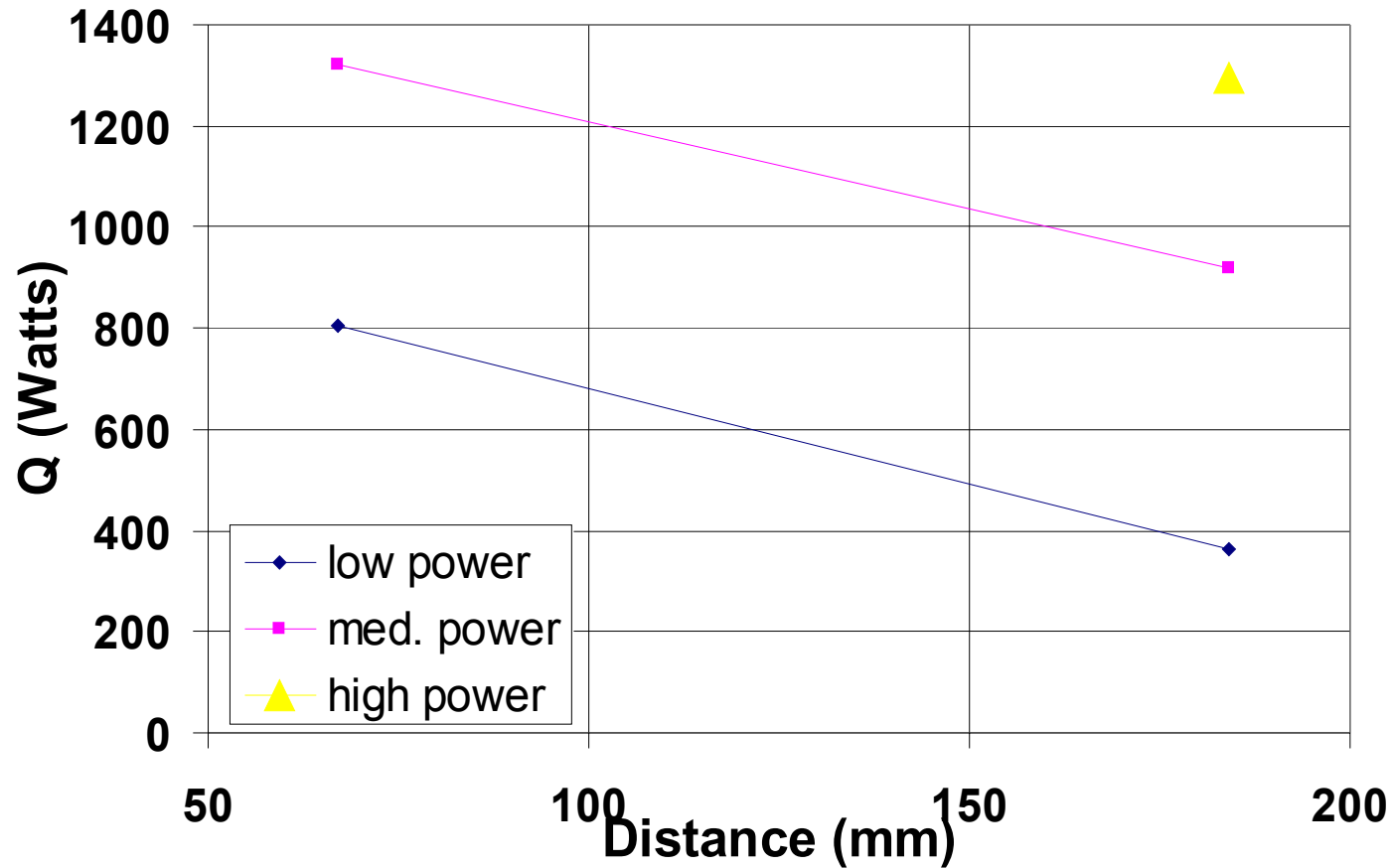
Some temperature profiles were measured

- Temperatures and temperature gradients on the bottom of the pot are much higher than around the sides.

The Effect of Pot Size (open flames)



Open Fire Heat Transfer vs. Height Above Burner



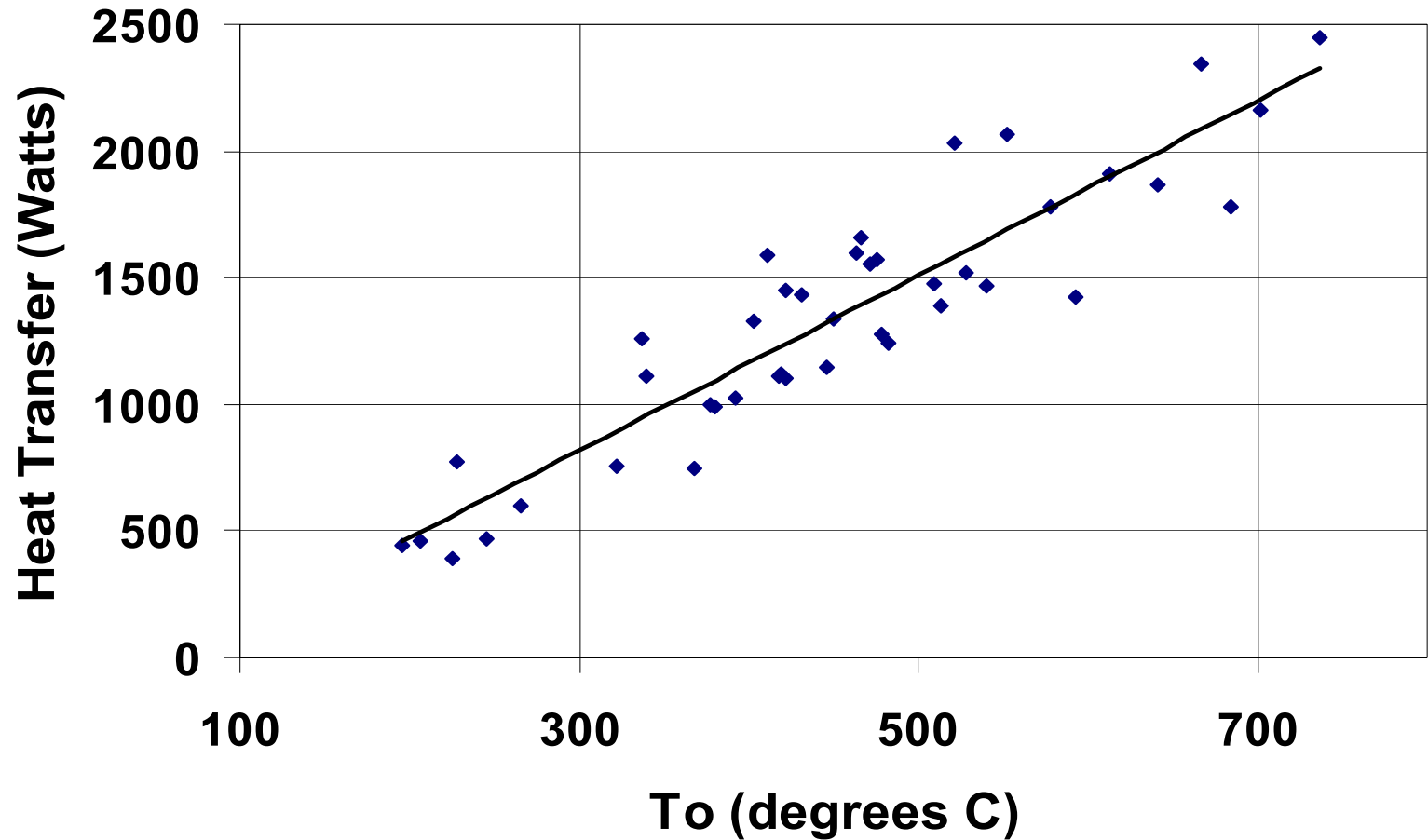
New Calculation Method

Use easily measured quantities to estimate-

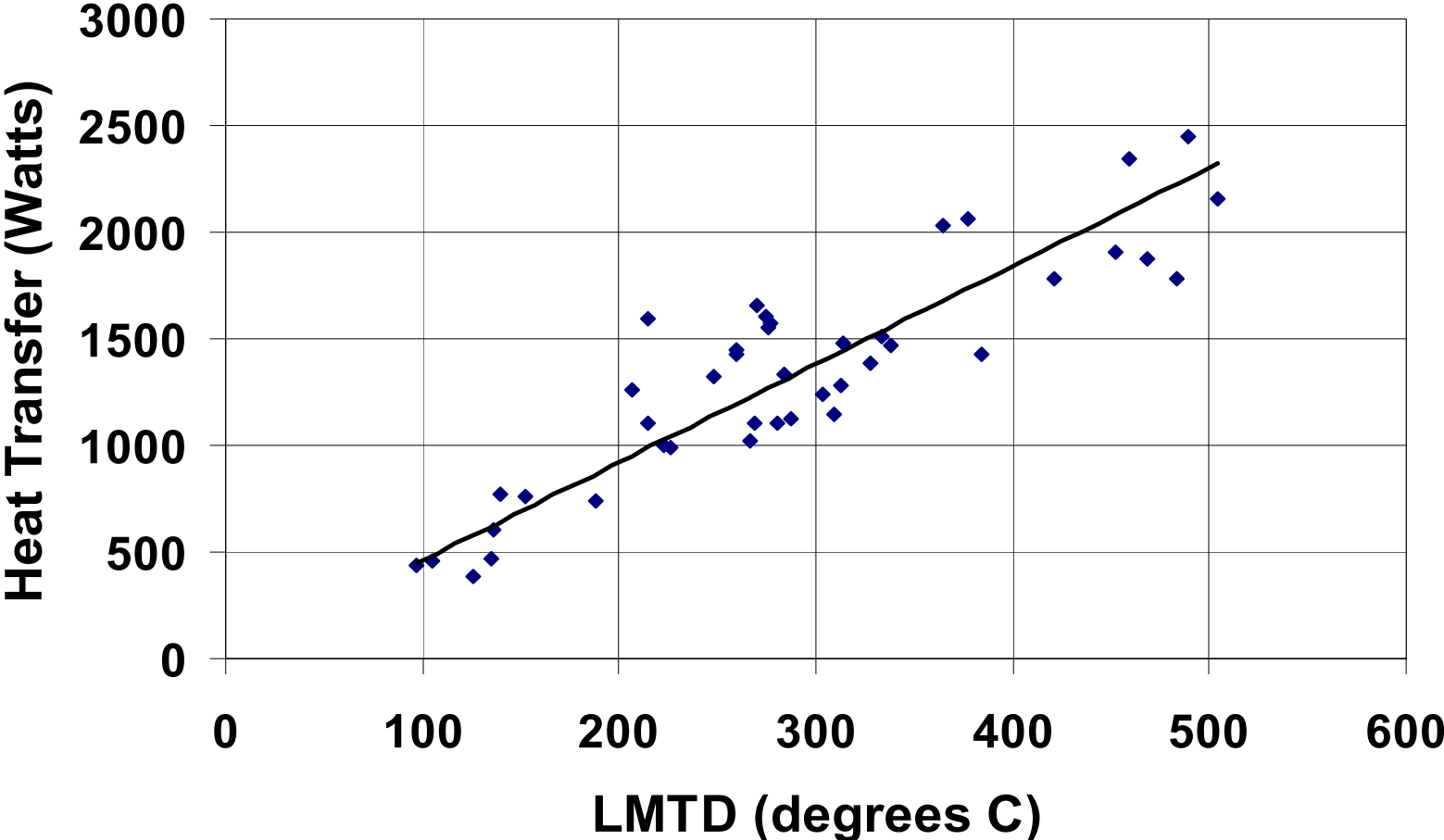
1. Mass flow through stove
2. Average temperature of gases hitting pot
3. Air-fuel ratio (excess air ratio)
4. Log-mean temperature difference (more or less the average difference in temperature between the pot and the gases flowing around the pot).

- This method was used on 42 tests (of a total of 100).
- The 42 test covered a wide variety of geometries and conditions.
- Can plot heat transfer vs. riser temperature (T_o) or log-mean temp. difference (LMTD).

Heat Transfer vs. Average Riser Temperature



Heat Transfer vs. Log-mean Temp. Difference

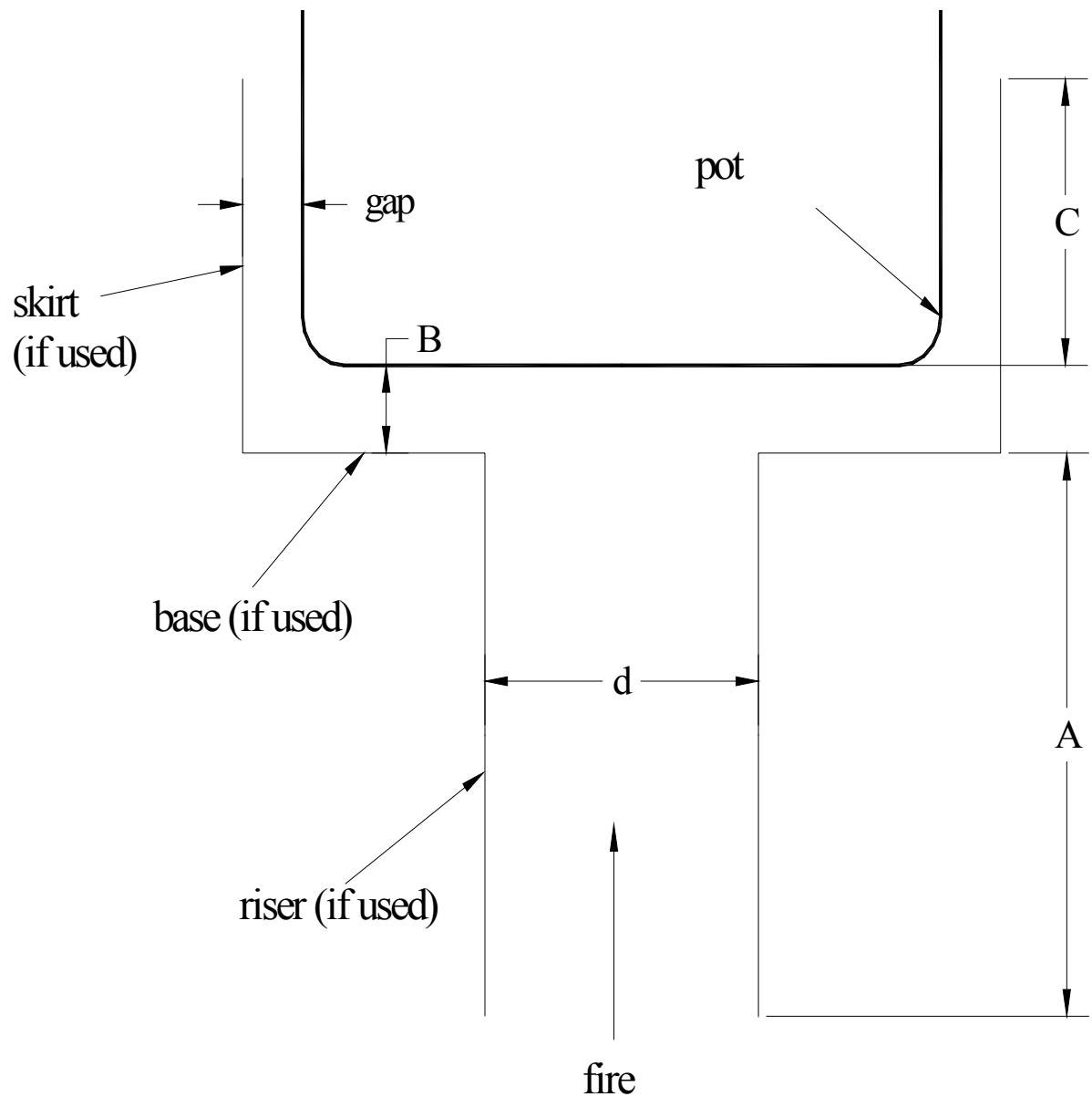


To get good heat transfer

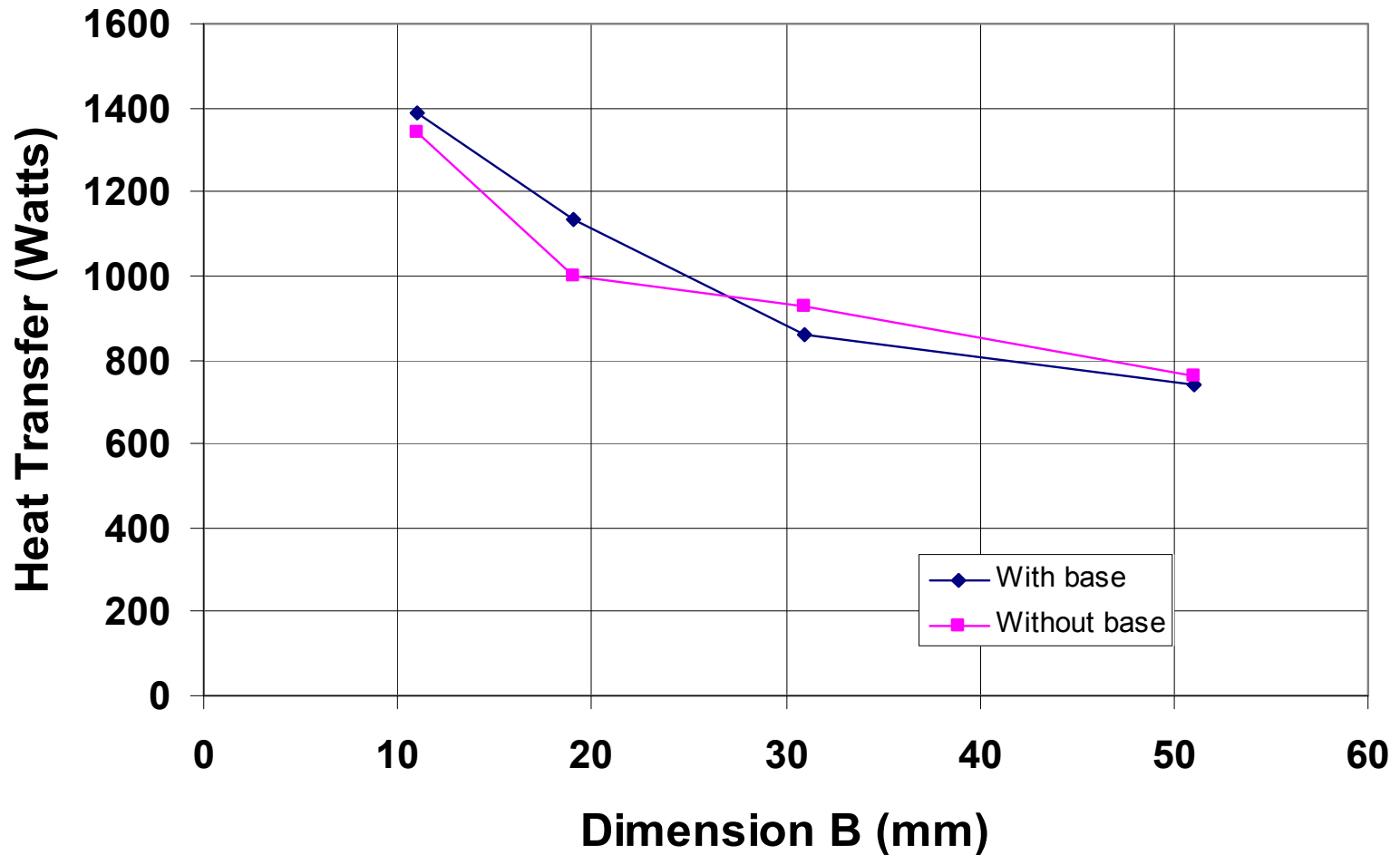
- The most important variable, by far, is the gas temperature.
- One way to maximize the gas temperature is to restrict the flow of air (minimize excess air).
- Restricting excess air too much can lead to soot.

Skirts and tight passages increase efficiency, but why?

- Skirts improve heat transfer greatly by transferring heat to the sides of the pot?
- No, skirts improve heat transfer greatly by choking down the excess air leading to higher temperatures.
- Can get high temperatures by simpler means.



Heat Transfer vs. Pot-to-Riser Dimension





Skirted Campfire Stove

- Yes, it looks like a wastebasket.
- Made of a single piece of sheet metal.
- Vary air flow by varying height of pot, which varies gap through which gas flows.
- Promising initial numbers.
- Needs more testing.