

# **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.

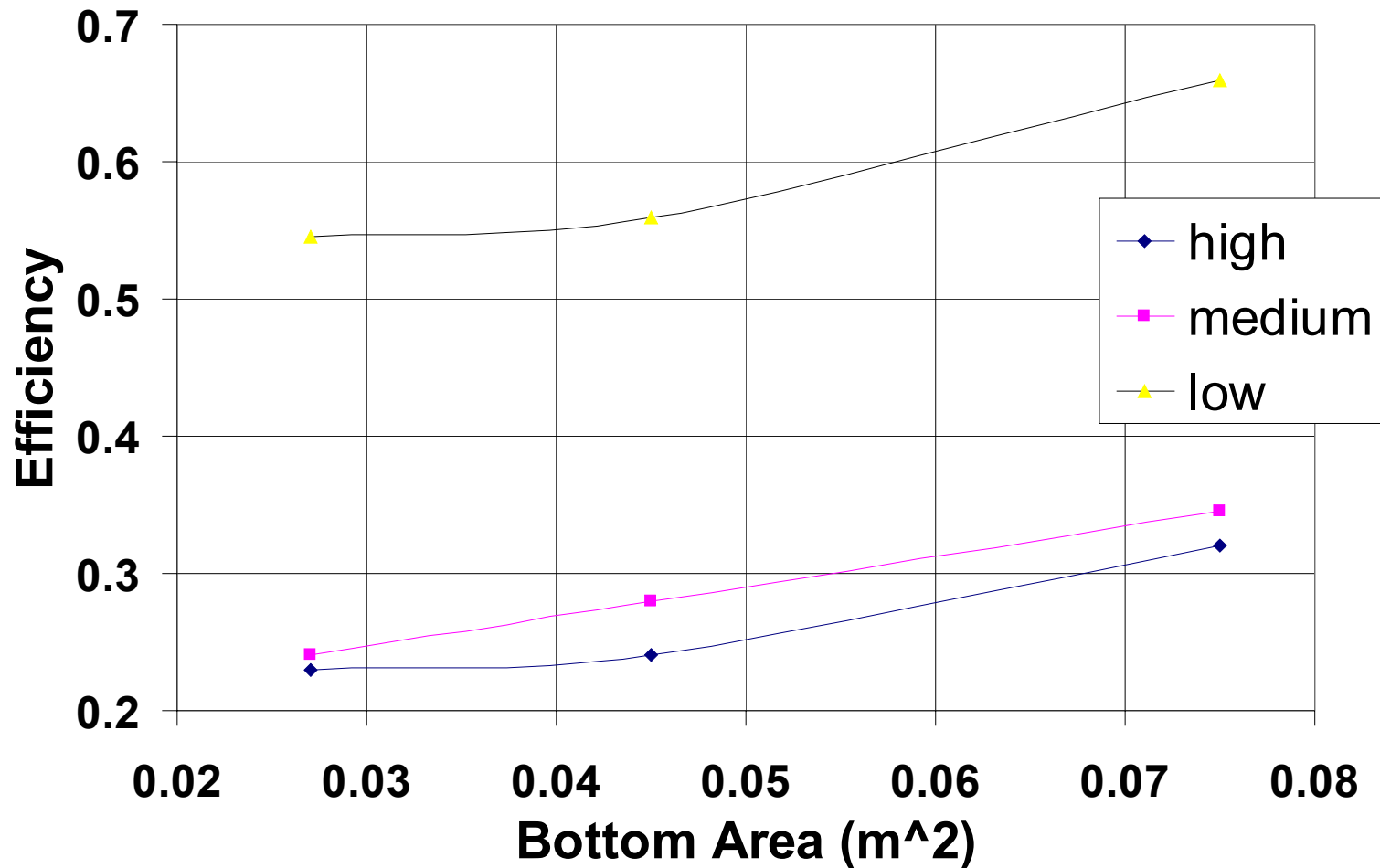




# Some temperature profiles were measured

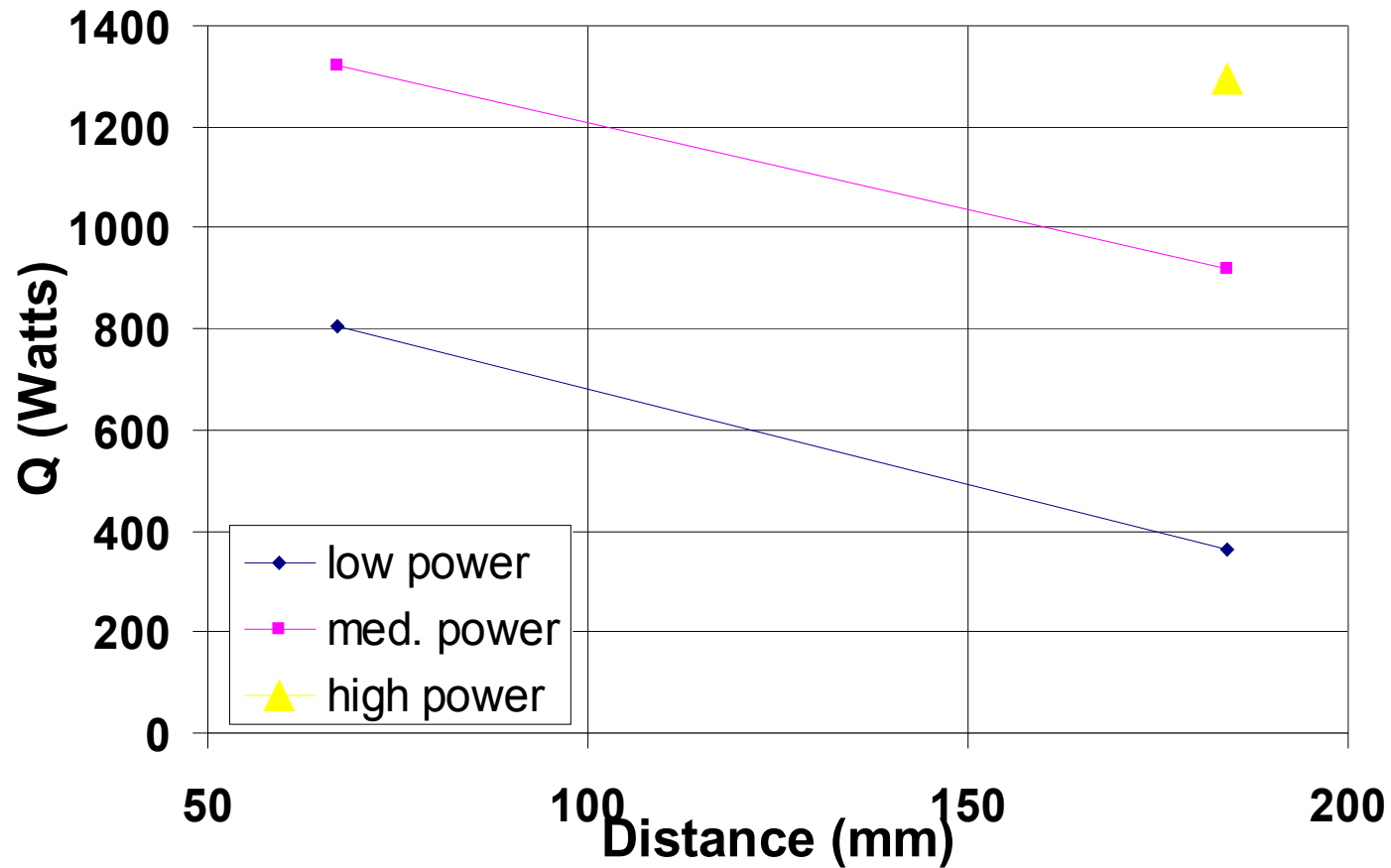
- Temperatures and temperature gradients on the bottom of the pot are much higher than around the sides.

# The Effect of Pot Size (open flames)





# Open Fire Heat Transfer vs. Height Above Burner





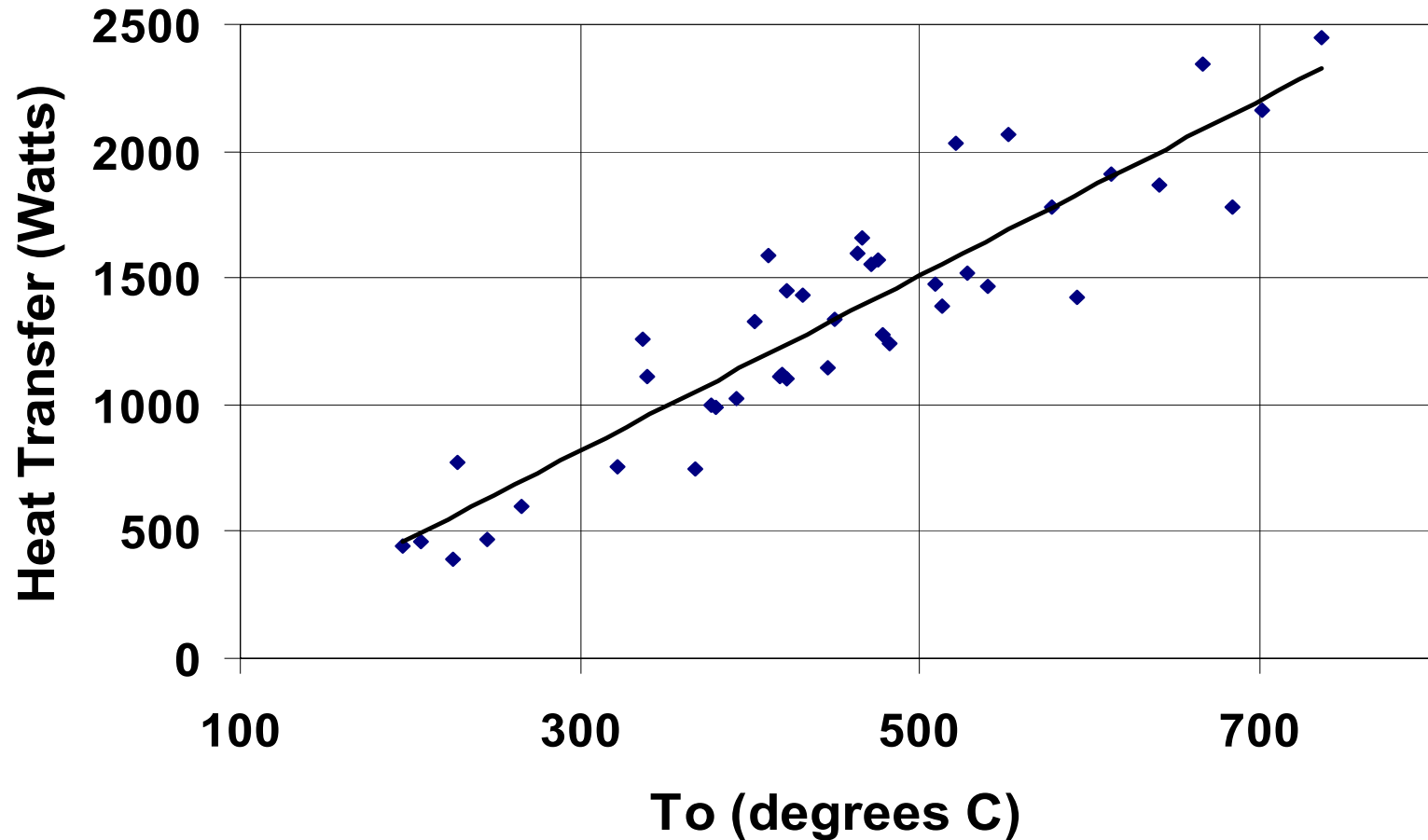
# New Calculation Method

Use easily measured quantities to estimate-

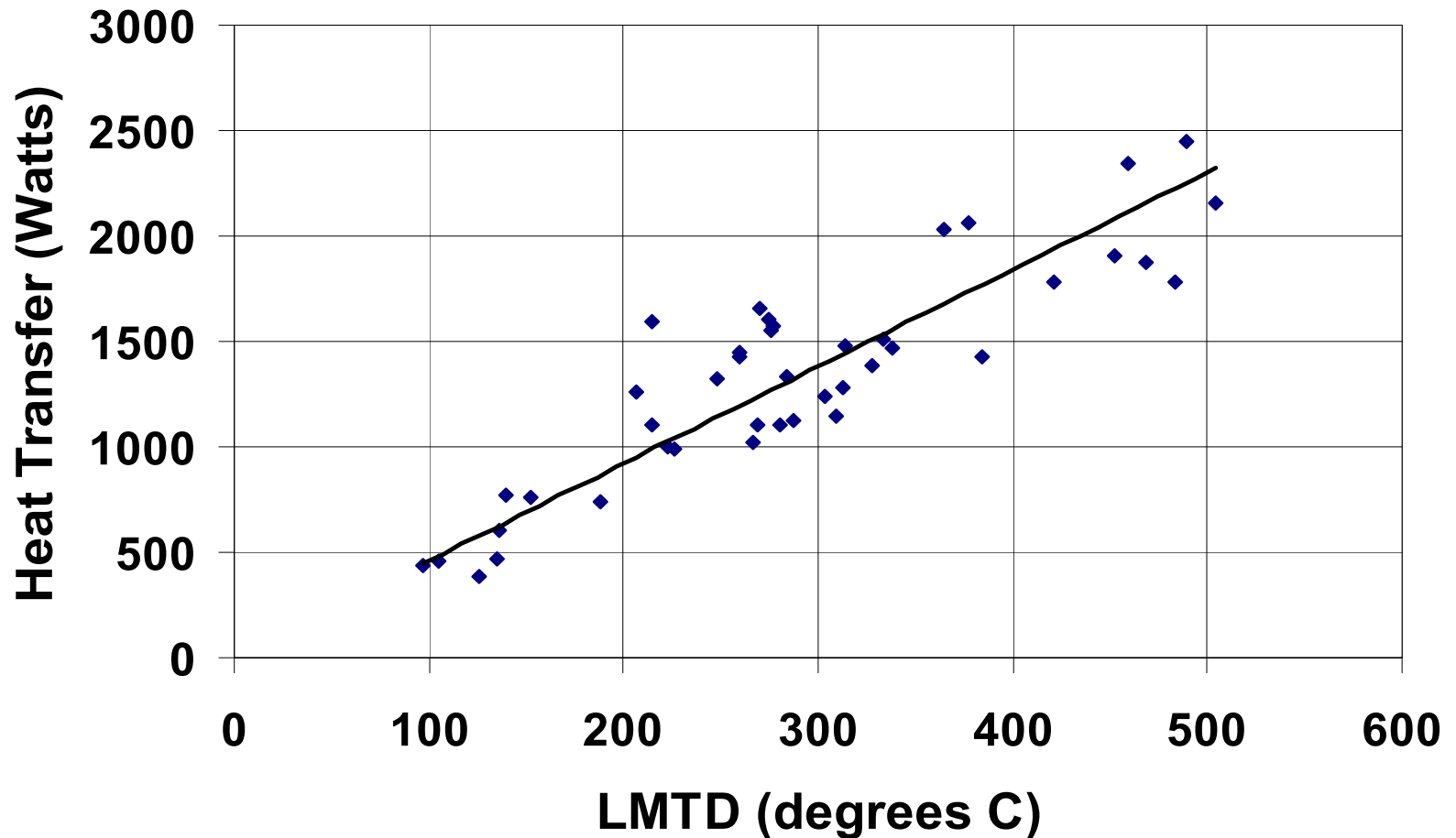
1. Mass flow through stove
2. Average temperature of gases hitting pot
3. Air-fuel ratio (excess air ratio)
4. Log-mean temperature difference (more or less the average difference in temperature between the pot and the gases flowing around the pot).

- 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

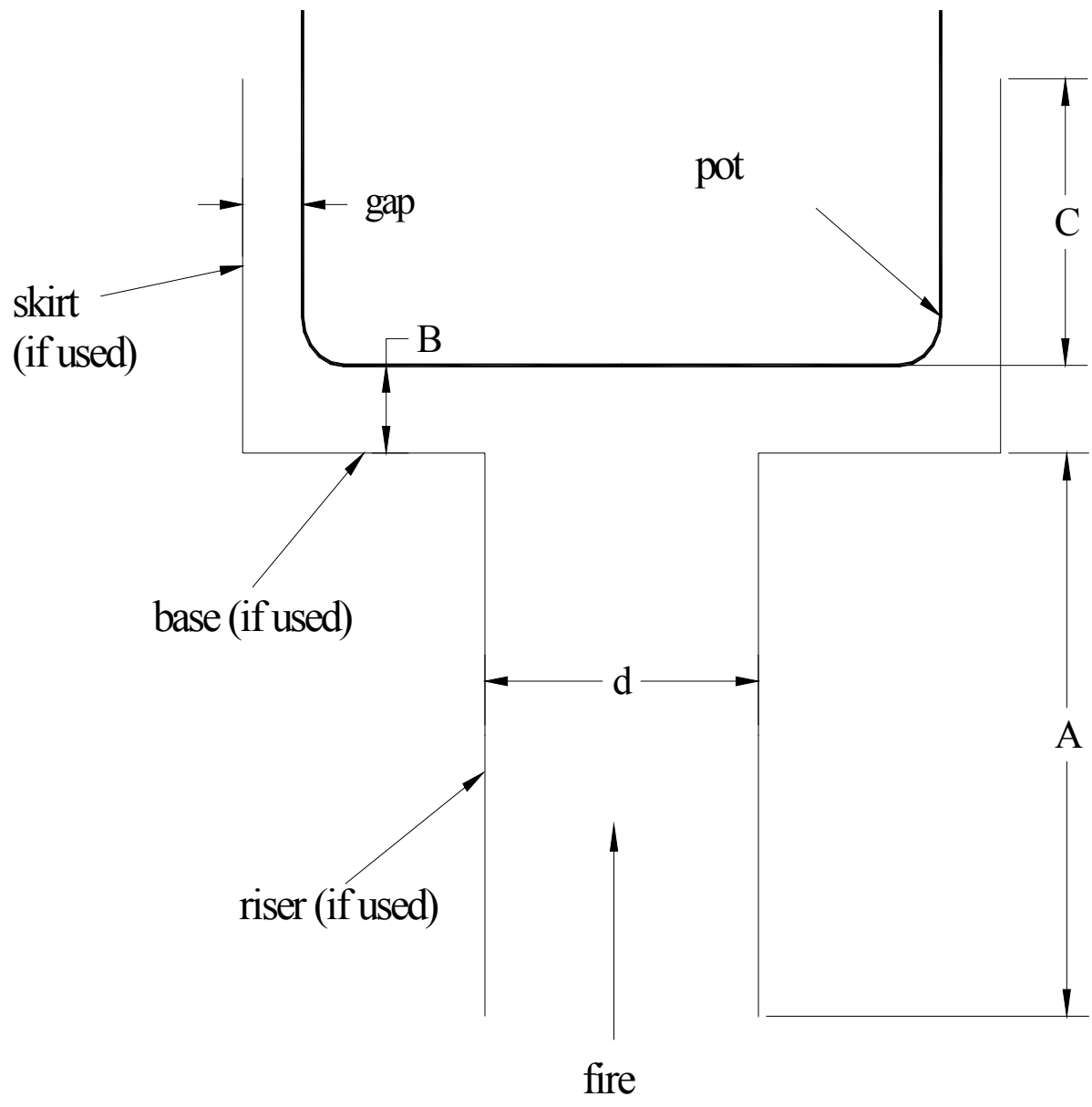


# To get good heat transfer

- 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.

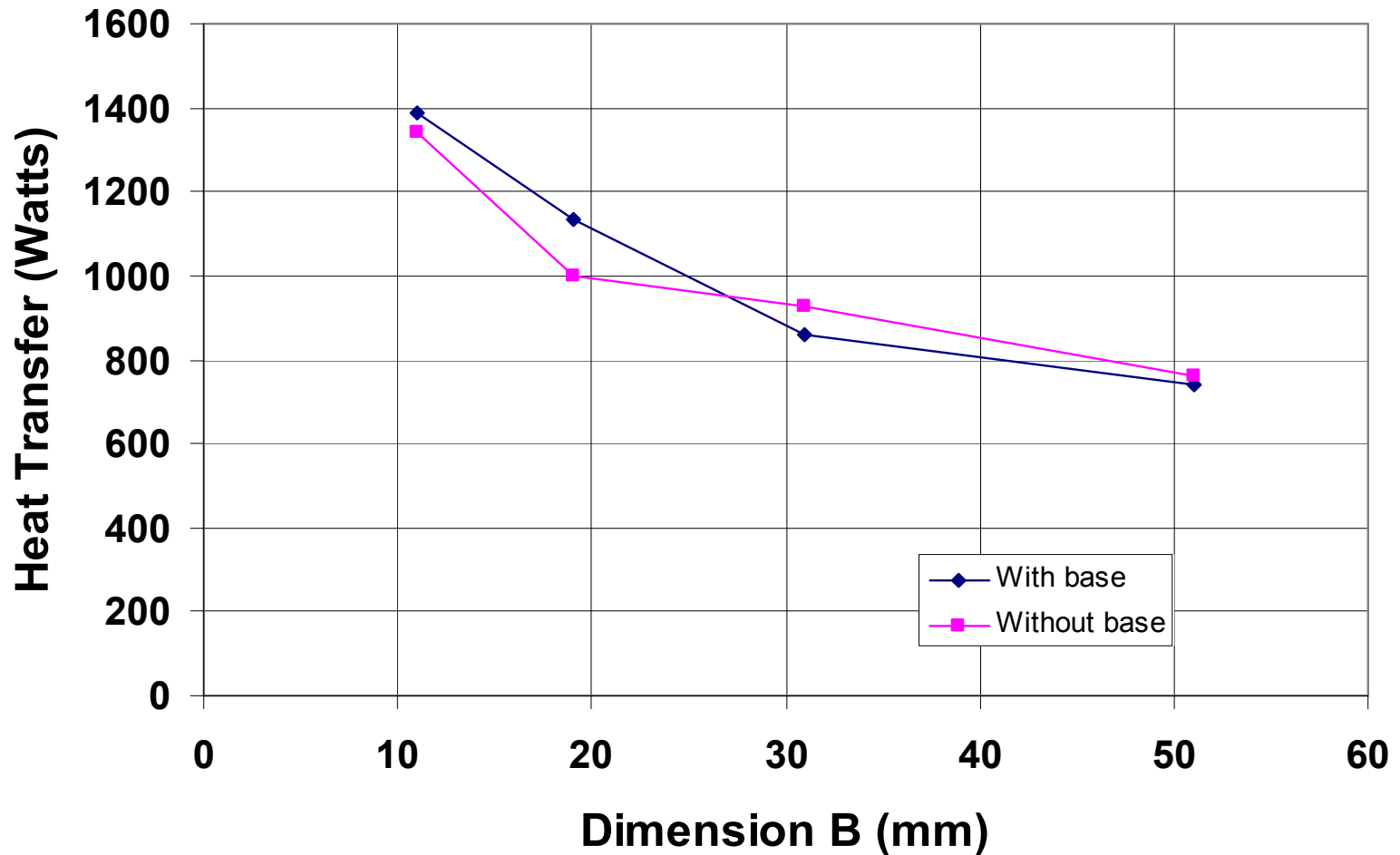
Skirts and tight passages increase efficiency,  
but why?

- 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.