Evaluating Cooker Hood Effectiveness

Dr. Iain Walker
Lawrence Berkeley National Laboratory
Berkeley USA

Cooking & burners emit air pollutants

- CO₂ & H₂O
- NO, NO₃, HONO, Formaldehyde
- Ultrafine particles
- Ultrafine particles, NOₓ
- Ultrafine particles
- Formaldehyde
- Acetaldehyde
- Acrolein
- PM₂.₅
- PAH
Induction cooking emits less Ultrafine Particles

When is a cooker hood not a cooker hood?

If it blows hot greasy air in your face... it is NOT a cooker hood

It must vent to outside
When is a cooker hood not a cooker hood?

Downdraft has no “hood”

How can you tell if a cooker/range hood works well?

The effectiveness of range hoods at capturing cooking pollutants is called capture efficiency.
Performance Metric – Capture Efficiency

- Capture Efficiency (CE) is the fraction of pollutants generated by cooking that are exhausted by the cooker hood
- Cooking plume seeded with CO$_2$
  - From gas burner or deliberate injection
- CO$_2$ measured in outside air ($C_i$), room ($C_c$) & exhaust air ($C_e$)

$$CE = \frac{C_e - C_c}{C_e - C_i}$$

Studies of cooker hood performance

In the lab

In homes
Big range of range hood performance in homes

What is important:
1. Air flow: more = better
2. Geometry:
   - Back burner capture better than front
   - Coverage of burners
   - Hood shape and air inlet design
3. Industry needs a rating

Big range of performance in the under controlled lab testing
Bad coverage = poor capture

Typical coverage = OK for back burners
Good coverage = good capture

Standardized testing

Uniform test chamber & cooktop/countertop
2.3m x 4.6 m floor plan
Standardized testing

Tracer gas emitter plate

Standard emitter plate

Standard temperature and power input to plume

- A typical cooking event: 160 C and 600W per burner
- 2 Front burners
Standardized testing results

Repeatability typically +/- 0.5 CE
Worst case +/- 1.4% CE

ASTM test method + Ratings

Designation: E3087 - 17

Standard Test Method for Measuring Capture Efficiency of Domestic Range Hoods

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

This standard is issued under the fixed designation E3087; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

CERTIFIED HOME VENTILATING PRODUCTS DIRECTORY

HVI
HOME VENTILATING INSTITUTE

Certified Ratings in Air Delivery, Sound and Energy Accuracy
Specifications and Comparisons
Island/downdraft Test Chamber

Well sealed
Multiple air inlets with diffuser screens
Double size of wall-mount test chamber

Island Hood In Test Chamber

Hot plates built into custom cooktop

Air inlet (one of four)
- Low velocity air inlet a necessity

Tracer gas injection tubing

Emitter Plates

Kitchen cabinets
Preliminary Island Results

More flow = better capture
Less variability above 400W

Kitchen venting: What to look for

- Good coverage
- CE ratings coming soon (>80%CE)
- Flow >100 L/s
- Quiet
- Shortest path to outside for ducting
- Follow manufacturers installation recommendations for mounting height
- Use an induction cooktop

Simple advice:
- Cook on back burners
- If too noisy on high use it on low – much better than doing nothing