DOE TEAM Initiative

High Tech Buildings
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Berkeley Fume Hood
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Aerosol Duct Sealing

Presented by:

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U.S. Department of Energy
Energy Efficiency and Renewable Energy

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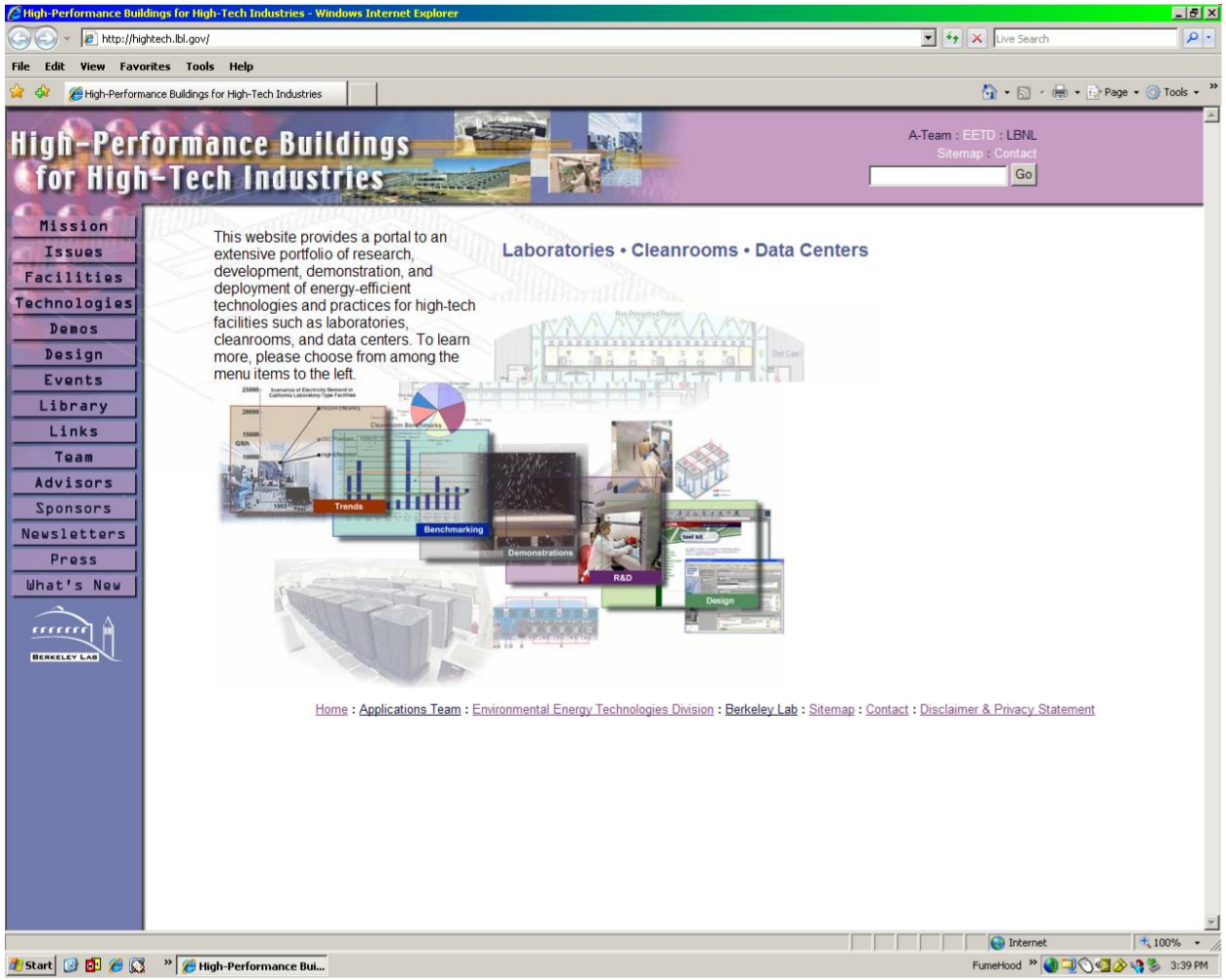
High-Performance Buildings Web Site

High-Performance Building for High-Tech Industries



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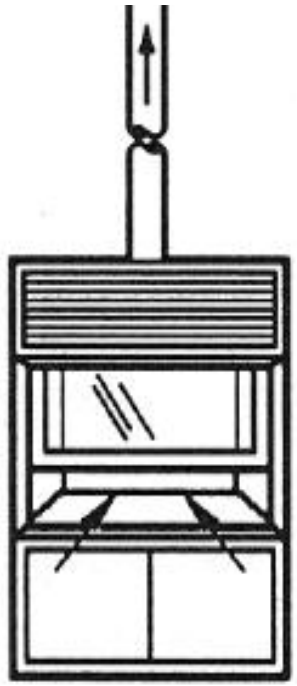
"Tame the Hoods…"

Fume hood Energy Consumption



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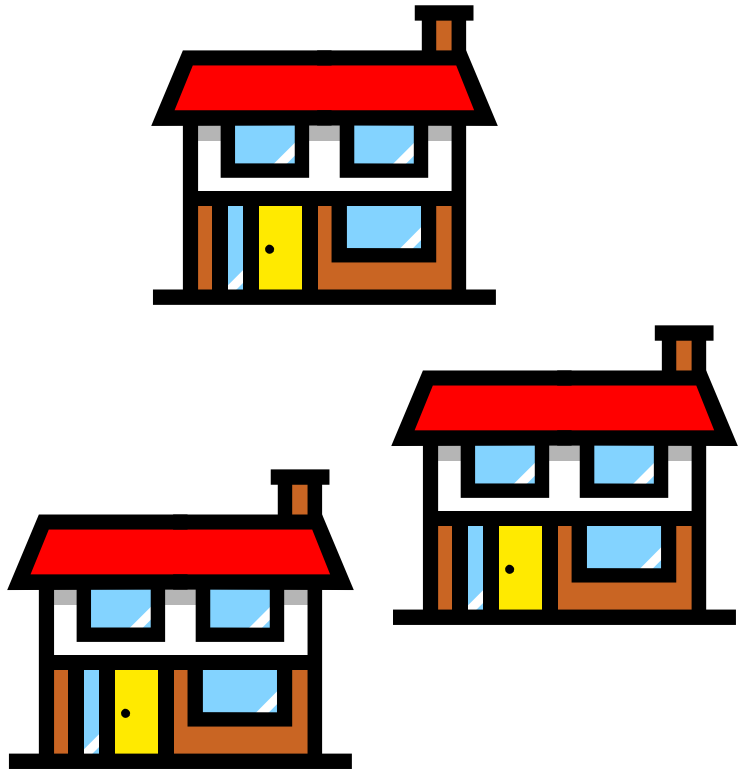
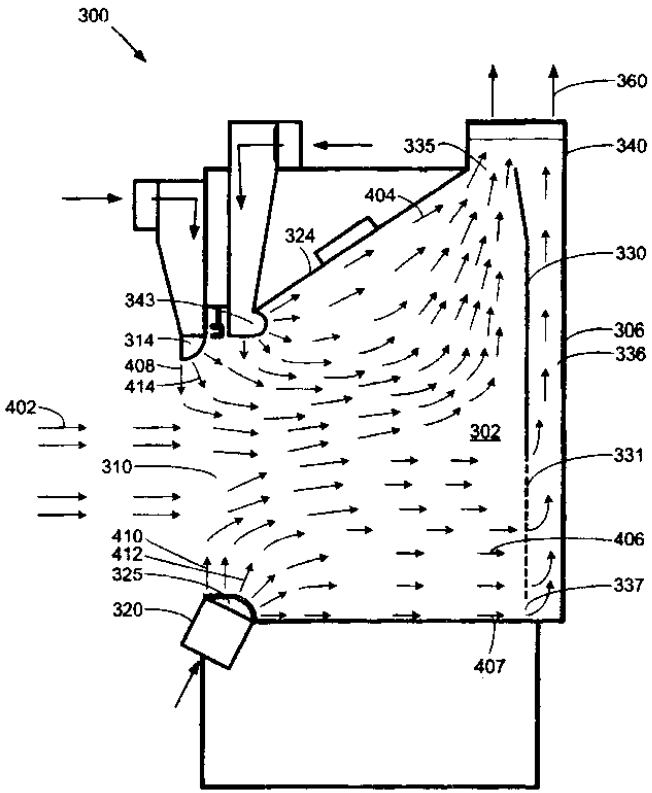


Berkeley Hood Air Divider Technique

Low-turbulence Intensity
Displacement ventilation
Push-Pull Containment



(Sectional view)

U.S. Patents # 6,089,970, # 6,428,408

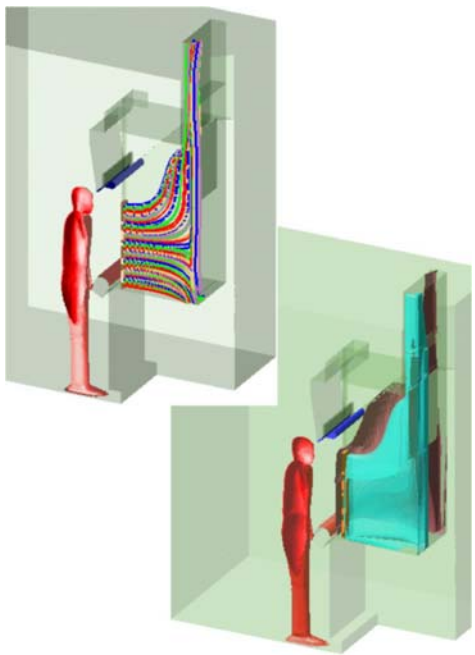
Extensive Standardized Testing…

ASHRAE 110 Testing

- ✓ASHRAE 110-1995 tracer gas containment
- ✓Large and small volume smoke
- ✓Sash-movement effect tests
- ✓Dry Ice tests
- ✓Different SF6 flow rates
- ✓Various mannequin heights

Advanced, Non-standard Testing…

CFD Analyses



- ✓Side-by-side Equivalent Containment Tests
- ✓Human-as-Mannequin Testing
- ✓Cluttered hood interior
- ✓Helium Bubbles
- ✓Schlieren flow studies
- ✓Envelope testing
- ✓Expert evaluations
- ✓New SF6 ejector designs
- ✓Cross drafts

Berkeley Hood: Results and Future…

- Estimated energy reductions to be 70 percent, compared to "standard" constant velocity (CV) fume hood.

- Equivalent containment performance verified with side-by-side ASHRAE 110-1995 testing and LBNL Human-as-Mannequin Testing Protocol
  - Independent testing performed by Exposure Control Technologies

- Two variances were granted by CAL/OSHA to operate the Berkeley hood at 80 FPM at its design sash-height of 18 inches.
  - Total exhaust airflow is one-half of a standard hood's flow
  - Containment has been verified in this configuration

- ESCO Global has licensed the Berkeley hood technology
  - Commercial hood expected by January 2008

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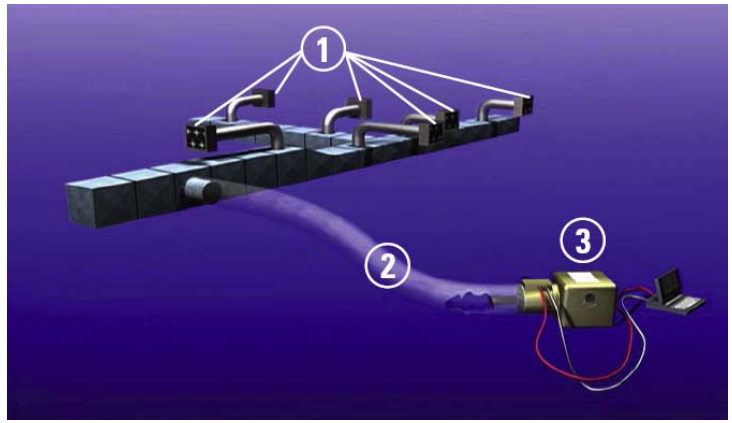
Aerosol ductwork sealing

Benefits and features…

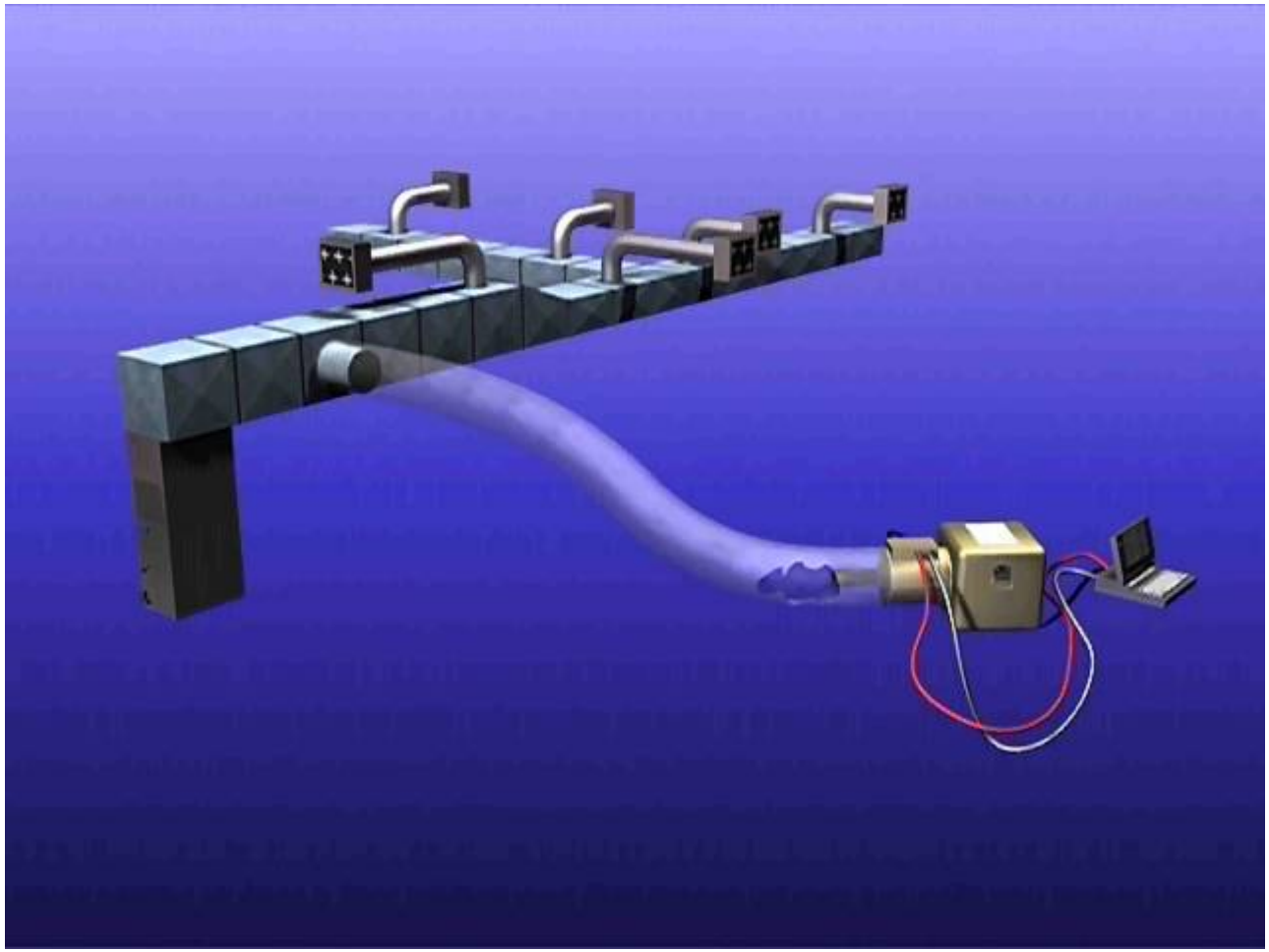


- Seals holes up to 3/8” across
- Vinyl polymer is safe
- No lingering odors or off-gassing
- Does not coat ductwork
- Cleaning ductwork not required before sealing
- Cleaning after sealing generally does not hurt seals
- Sealant remains rubbery
- Lasts >10 years

Aerosol wand in operation…

Sealant spray pattern from injection wand

Aerosol sealing apparatus in action…



Aerosol Sealing Results

Buildup of polymer sealant

Recent aerosol duct sealing results…

Building	Fan Flow [cfm]	Initial Leakage [%]	Fraction Sealed	Notes
#1	69,000	19%	87%	4 Floors, 6 coils/floor
#2	93,000	36%	78%	2 Floors, 3 Loops, Hot/Cold/Lab Make-Up 1-2 inject/loop, 2 Fans
	22,000	27%	85%	80 grilles on 2 Floors, single point injection
#3	N/A	3000 cfm25	93%	Shower/Toilet Exhaust
#4	14,000	19%	87%	Dorm Room Supply, Return was chase with large penetrations
#5	46,200	19%	92%	Downstream Leakage Only, Slot diffusers, Sealed w/Fan On, 3 flrs
	10,000	10%	90%	No Pre-Qualification
#6	16,610	15%	92%	Blew thru terminal system-power induction boxes, pneumatic line connected to pitot inlet
#7	10995	1% - 23%	87%	No Pre-Qualification
#8	8,200	19%	85%	Found undocumented take-offs, 11 stories, penthouse inject

Aerosol Sealing Results at LBNL…

Section (Bldg 70)	Date	Pre-seal	2-min	Final	Post-Seal	Inj Time	%
		cfm25	cfm25	cfm25	cfm25	minutes	sealed
3rd Floor Annex Return	**11/6/2005**	30.7		15.6	14.5	27	53%
3rd Floor Annex Supply	**11/6/2005**	721	722	835	804	37	-12%
2nd Floor Annex Supply	**11/16/2005**	403	543	31	30.6	35	92%
1st Floor Corridor	**11/20/2005**	2373		134	135	171	94%
2nd Floor Corridor	**11/30/2005**	2805		717	919	240	67%
1st Floor Cold	**12/3/2005**	3087	1777.2	796	851	189	72%
2nd Floor Cold	**12/4/2005**	2007	1361.7	262	309	137	85%
1st Floor hot	**12/10/2005**	1040			273	138	74%
2nd Floor Hot	**12/11/2005**	1318			346	119	74%
Exhaust	**12/23/2005**	2277			335	319	85%
Total		15310			3198	1349	79%
Assuming avg leak press of 0.5" H2O		40212			8400		
%Leak at avg leak press of 0.5" H2O		35%			7%		
To keep the same total flow into zones, should be able to reduce fan flow to							80681
%reduction in fan flow							30%
%reduction in fan power							65%

>12% electrical savings in first month!

For More Information

Lawrence Berkeley National Laboratory
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Energy Efficient Building Design Applications

http://ateam.lbl.gov

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