WCEC
WESTERN COOLING EFFICIENCY CENTER

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FIELD EXPERIENCE WITH SEALING LARGE-BUILDING DUCT LEAKAGE WITH AN AEROSOL-BASED SEALING PROCESS

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3rd AIVC TightVent Workshop on Building and Ductwork Airtightness

Mark Modera, WCEC-UC Davis

Presentation

- Classification of large buildings
- Technology description and history
- Large-building duct sealing
  - Rationale for sealing
  - Exhaust sealing results

Acknowledgements: Data provided by Aeroseal LLC

AEROSEAL

Large Building Classification

- **Office Buildings**
  - High duct pressures
  - Significant fan power
  - Supply, return and exhaust ducts

- **Hospitals and Laboratories**
  - 100% Outside air
  - Higher flow rates
  - Airflow safety concerns
    - spread of contaminants and biohazards
    - smoke, pressure and humidity control

- **Apartment buildings, dorms and hotels**
  - Kitchen and bath exhaust
  - Health and safety, odors, infiltration

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Aerosol Sealing: A Brief History

- Duct sealing technology developed at Lawrence Berkeley National Laboratory
- First sold by Aeroseal Inc. in 1999 for residential applications
- ~100,000 residential duct systems sealed to date by independent dealers
- Sealing of commercial-building duct systems initiated in 2003

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Background – Aerosol Duct Sealing

- Block all grilles
- Pressurize duct system with a fog of atomized sealant particles
- Particles seal the leaks as they try to exit the duct system
- Track leakage throughout the sealing process
  - Computer uses measured pressurization flow and duct pressure to calculate leakage area

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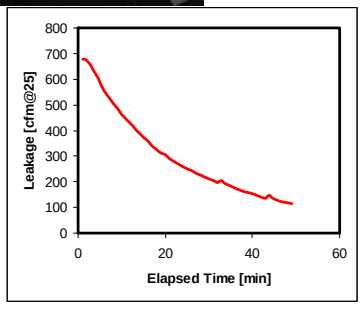
Aeroseal Sealing Process



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Leakage Downstream of VAV Boxes

- "Low-Pressure" Leakage Diagnostic
  - **Fan Pressurization for Leakage Downstream of VAV Boxes**

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Leakage Measured Downstream of VAV Boxes

State	Best Estimate Leakage	Upstream Pressure [Pa]	Estimated Average Pressure at leaks [Pa]
CA	8%	250	25
WA	15%	375	25
RI	14%	300	25
RI	11%	108	25
FL	19%	550	50
TX	6%	155	40
TX	4%	155	40
CA	9%	375	67
CA	6%	488	50
CA	13%	488	50
Average	**11%**	**324**	**40**
Standard Dev [%]	45%	48%	37%
Std Err in Mean [%]	14%	15%	12%

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Exhaust-System Aerosol Sealing

- Observed rationales for Exhaust Duct Sealing
  - Hospitals
    - Avoid increasing fan size to provide needed depressurization
    - Meet flow requirements for occupancy of renovated section
    - Control moisture in laundry room
  - Hotels
    - Improve ventilation
    - Meet leakage requirements
    - Facilitate operation of pressure-independent grilles
    - Facilitate reduced kitchen/bath exhaust requirements
  - Office Building Toilet Exhaust
    - Address order complaints from tenants
  - Laboratory General Exhaust
    - Improve pressure control
    - Save energy

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Example Buildings Seeking Exhaust Sealing

Building Type	Bldg.	Bldg. Age	Bldg. Size [m²]	Bldg. Stories	Location	Exhaust System
Hotel	1	2007	~150,000	57	Las Vegas, NV	Bathroom
	2	2005	>200,000	45	Las Vegas, NV	Bathroom
	3	2008	>100,000	63	Las Vegas, NV	Bathroom
Condominium/Apartment/Dormitory						
Condominium	4	1971	~70,000	40	Boston, MA	Bath/Kitchen
Dormitory	5	2003	4,600	6	Columbus, OH	Bathroom
Apartments	6	1979	~25,000	23	Camden, NJ	Bath/Kitchen
Apartments	7	1960s	N/A	5	Bordeaux France	Bathroom
Large Office Bldg.	8	1958	300,000	59	New York City	Toilet (one section)
Hospital	9	N/A	N/A	6	San Francisco, CA	General
	10	2012	29,000	3	Abu Dhabi, UAE	General
Laboratory	11	~1965	~4,000	2	Berkeley, CA	General

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Aerosol Sealing of Exhaust Systems

Building	Nominal Fan Flow [l/s]	Estimated Average Leak Pressure [Pa]	Effective Leakage Area [cm^2]	Estimated Fractional Leakage [%]	Fraction Sealed [%]
Hotel	35,000	100	3900	16%	97%
Hotel	128,000	50	47,800	36%	93%
Hotel	48,000	50	13,700	28%	92%
Condo	30,000	25	11,000	24%	96%
Dorm	7,300	500	512	27%	95%
Apartments	14,500	25	8190	36%	81%
Apartments	N/A	80	58	N/A	89%
Large Office Building	20,400 (treated section)	250	1630	20% (treated section)	96%
Hospital	N/A	N/A	N/A	N/A	0%
Hospital	17,900	250	2340	34%	85%
Laboratory	10,400	150	1670	31%	85%

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Laboratory Building Exhaust Systems

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Laboratory Building Exhaust Systems

- **Small Lab Exhaust Sealing**

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Toilet/Kitchen Exhaust Systems

Available Data Suggests >35% Leakage on Average

Aerosol generally produces >85% Sealing

(including sheetrock shafts)

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Sealing Ventilation/Exhaust Systems

- Dormitory/Hotel Sealing
  - 10 stories, 8 vertical shaft supply ducts, trunks in attic
  - 13,300 cfm axial fan
  - Fire damper for each two rooms

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Sealing of Toilet Exhaust in Large Office Building

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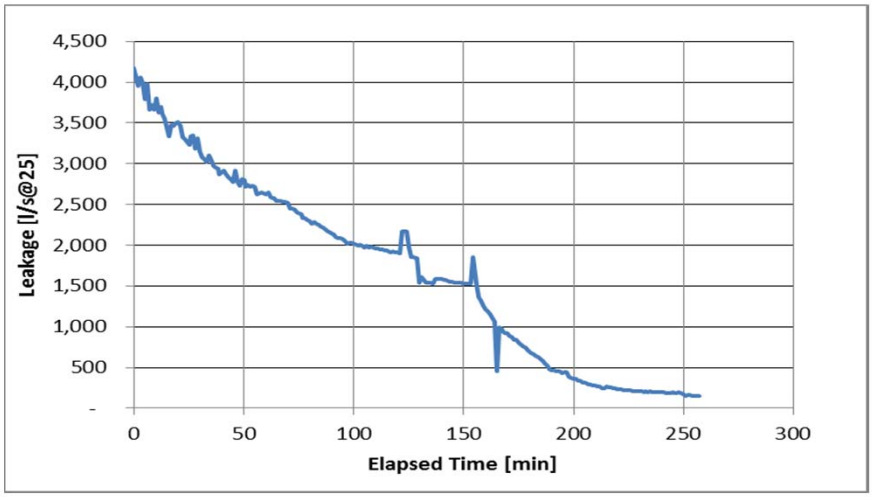
Sealing of Toilet Exhaust in Large Office Building



SUMMARY

- Leaky ducts in large buildings are not uncommon - particularly “low pressure” ductwork
- Impetus for sealing existing ductwork is variable, with energy savings often being secondary
- Aerosol process has been successfully applied in many different large-building applications