Achieving and Certifying Building Envelope Air Tightness with an Aerosol-Based Automated Sealing Process

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Presentation

• Background
  ◦ Sealing more than 25% of envelope leakage in existing buildings has historically been very difficult
  ◦ Leakage certification is key in both new construction and existing buildings

• Presentation
  ◦ Technology background/description
  ◦ Lab test results
  ◦ Field test results
Basic Concept
- Seal New-Construction Building Shells at Rough-In
- Seal Existing Construction at Occupancy Change
- Reduce Sealing Cost, Produce Tighter Envelope and Automated Certification

Background
- Similar to commercialized aerosol-based duct sealing technology
- Tested in the laboratory under funding from Building America
- Currently testing in single-family residences under support from California Energy Commission

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
AeroSeal Sealing Process

Test “House” Sealing Process

Test “House”
- 8' by 4' by 8' Tall
- Six removable leakage plates
- 1/10” slots in 1/8” aluminum
- Top, high on wall, far on wall
- 14” round inlet near top of box
Test “House” Sealing Process

Box Leakage vs. Time

Leakage [square inches]

Elapsed Time [minutes]

UCDAVIS

WCEC
• **Leaks:** sealant removed from leaks and weighed after experiment
• **Tubing:** weighed before and after experiment
• **Floor:** plastic sheet weighed before and after experiment
• **Ceiling:** plastic sheet weighed before and after experiment
• **Walls:** wall patches weighed before and after experiment
• **Blown Through Leaks:** calculated by subtraction

### Aerosol sealing of enclosures looks quite encouraging
- Sealing rates in small (nominally quiescent) enclosure as good or **better than that experienced in ducts**
- Deposition on floor is comparable to deposition in leaks
- Negligible deposition on ceiling and walls

### Sensitivity tests performed
- Lower **Operating Pressure** reduced overall sealing time, sealant use, and sealant deposition in/around leaks
- Smaller **Particle Size** did not impact the sealant required for sealing but decreased deposition on floor
Assembling and installing the blower door

Connecting blower door, compressor and monitoring software

AEROSOL ENVELOPE SEALING: New Home

Testing custom injection and data acquisition box

Moving aerosol injector to other rooms in the house
AEROSOL ENVELOPE SEALING: New Home

Sealing of New Construction Home

- Aerosol-sealed leak between can light and drywall
- Aerosol-sealed leak between electrical outlet and wall

TAKEAWAYS
- Sealed 50% of leaks
- Test stopped prematurely
- No residual sealant build-up on floors, wiring or walls
AEROSOL ENVELOPE SEALING: Existing Home

Leakage [ACH @ 50Pa] vs. Sealing Elapsed Time [min]
Multi-Point Injection of New Sealant

\[ y = -5.7317x + 442.77 \quad R^2 = 0.865 \]

\[ y = -1.2531x + 471.19 \quad R^2 = 0.9137 \]

Flow at 50 Pascal [liters per second]

Elapsed Minutes
AEROSOL ENVELOPE SEALING

- Current Status
  - Demonstrated in laboratory
  - Tested in single family residences
    - Sheetrock stage of new construction
    - Occupancy change in existing home
  - Developing and testing alternative sealants and atomization systems
  - Testing at different stages of construction process
  - Investigating non-residential applications