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Phoenix, AZ

August 3-6, 2008

Duct Sealing

Paul Kistler

U S Navy

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Aerosol Duct Sealant

- What is it, how does it work?
- Data from projects
- Where does it work best?

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What is duct sealing?

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Interior of Duct After Sealing

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Economics

	DeFlorez Bldg Orlando	Bldg 1268 Newport	Bldg 865 Bremerton	Bldg 3339 San Diego Primary System
Annual Energy Cost Savings ($/yr)	$8,689	$2,136	$2,007	$1,828
Installation Costs ($)	$49,057	$23,701	$24,155	$18,080
Simple Payback (yr)	5.6	11.1	12.0	9.9

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De Florez Building
at NAVAIR
Orlando, FL

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De Florez Bldg.Orlando

HVAC Characteristics	Climate Conditions
• Variable-air-volume (VAV) system with chilled water coil and hot water heating coil in the main air-handling unit • Hot water reheat coils in the VAV terminal boxes provide primarily space heating for the building. • Variable frequency drive (VFD) control on the supply fan. No return fan. • The supply-air ducts are located above a drop ceiling system, which also acts as a return air plenum. • Demonstration area is limited to AHU-1, which serves all three floors at the north-end of the building. • Sealed duct work was limited to the supply-air duct between the VAV boxes and the supply registers.	Hot and humid CDD65 = 3312 HDD65 = 686

De Florez Bldg.Orlando

Pre- and post-sealing annual energy and costs for the DeFlorez building

	Chiller		Fan		Total	
	Energy (kWh/yr)	Energy Cost $	Energy (kWh/yr)	Energy Cost $	Energy (kWh/yr)	Energy Cost $
Baseline	210,735	$17,702	122,902	$10,324	333,637	$28,026
Post-Sealant	127,191	$10,684	103,010	$8,653	230,201	$19,337
Savings	83,545	$7,018	19,893	$1,761	103,436	$8,689
%		40%		17%		31%

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Building 1268 at the Naval Station Newport, RI

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Bldg 1268 Newport RI

HVAC Characteristics	Climate Conditions
• Variable-air-volume (VAV) system with chilled water coil and hot water heating coil in the main air-handling unit • Some VAV terminal boxes contain hot water reheat coils and the entire building is primary heated through the fin tube radiators along the perimeter spaces of the building. • VFD control on both the supply and return fans. • Demonstration area was limited to the first floor supply and return air ducts. • Sealed duct work is located in the ceiling plenum on the first floor of the three-story building.	Cold and humid CDD65 = 693 HDD65 = 5659

Bldg 1268 Newport RI

Building 1268 predicted annual energy and cost savings

	Chiller		Fan	
	Energy (kWh)	Energy Cost $	Energy (kWh)	Energy Cost $
Baseline	41,933	$5,032	90,240	$10,829
Post-Sealant	50,032	$6,004	72,443	$8,693
Savings	-8,099	-$972	17,797	$2,136
%		-19%		20%

Bldg 1268 Newport RI

Newport Sealing Summary

Date	Sealing Process Starting Position Description	Sealing Duration (min)	Before Leakage (cfm)	After Leakage (cfm)	Change (%)
24 Jan 06	VAV box TU-5	15	55	2	98
25 Jan 06	TU-6 and TU-7	8	48	3	94
25 Jan 06	Room 110 duct branch	NR	65	2	96
26 Jan 06	TU-22	13	154	16	89
28 Jan 06	North side supply trunk	85	497	53	89
28 Jan 06	South trunk line	41	300	41	91

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Building 865 at the Naval Base Kitsap in Bremerton, WA

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Bldg 865 Bremerton WA

HVAC Characteristics	Climate Conditions
• Constant-air-volume system with hot water heating coil in the air-handling unit. No cooling in the building. A heat wheel ventilation energy recovery system is installed between the make-up air and exhaust-air systems. • The building is primarily heated through the fin tube radiators along the perimeter spaces of the buildings. • Demonstration area limited to the supply air ducts because return air system used an open chase between floors. • Sealed duct works are located in the attic space and the vertical duct shaft of the building.	Cool maritime CDD65 = 106 HDD65 = 5119

Bldg 865 Bremerton WA

	Supply Fan	
	Energy (kWh)	Energy Cost $
Baseline	72,270	$3,298
Post-Sealant	28,296	$1,291
Savings	43,975	$2,007
%		61%

Building 865 predicted annual energy and cost savings

Bldg 865 Bremerton WA

Puget Sound Sealing Summary

Date	Sealing Process Starting Position Description	Sealing Duration (min)	Before Leakage (cfm)	After Leakage (cfm)	Change (%)
11Jan 06	West Side Supply	55	423	40	91
12 Jan 06	East Side Supply	47	355	32	91
12 Jan 06	Laundry and housekeeping	47	142	48	66

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Building 3339
NB San Diego, CA

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Bldg 3339 San Diego CA

HVAC Characteristics	Climate Conditions
• Include two systems, one is a larger VAV system with chilled water cooling coil and hot water heating coil in the main air-handling unit; the other is a smaller VAV system with a packaged direct-expansion air conditioning unit. • Hot water reheat coils in the VAV terminal boxes provide primarily space heating for the building. • VFD control on the supply and return fans of the larger unit and inlet vane damper control on the supply and return fans of the smaller unit. • Supply and return air ducts located in an unconditioned attic space. Demonstration area limited to the second floor supply and return air ducts. • Sealed duct works will be located inside the ceiling plenum on the top floor of the building.	Warm maritime CDD65 = 662 HDD65 = 1256

Bldg 3339 San Diego CA

Annual energy use and cost for the primary AHU in Building 3339

Primary System (AHU02)	Chiller		Supply Fan		Return Fan		Total	
	Energy (kWh)	Energy Cost ($$)	Energy (kWh)	Energy Cost ($$)	Energy (kWh)	Energy Cost ($$)	Energy (kWh)	Energy Cost ($$)
Baseline	53,544	$6,781	14,044	$1,779	1,907	$242	69,495	$8,802
Post-sealant	40,546	$5,135	12,561	$1,591	1,960	$248	55,067	$6,974
Annual Savings	12,998	$1,646	1,483	$188	-53	-$6	14,428	$1,828
Percent of Savings	24%		11%		-3%		21%	

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As a result of Navy Techval demonstrations, manufacturer states that the cost of future duct sealing projects can be reduced by 10% to 30%

System:	Laboratory supply	Laboratory exhaust	Toilet/shower exhaust, ventilation supply or exhaust	Large office supply	Constant volume packaged system
Key Feature:	100% outside air	Type of construction – welded seams (tight) vs. slip and drive (leaky)	Generally poorly sealed	Leakage downstream vs. upstream of terminal boxes	Existence of insulation above ceiling
General Leakage Indicators	Test and Balance reports; Visible dust streaks on duct work, ceilings near supply diffusers, or electrical boxes; Comfort complaints				
Specific Leakage Indicator	Pressure control problems	Pressure control problems	Spot measurements of flows	Duct Blaster test of downstream leakage	Duct Blaster test of leakage
Approximate Sealing Price: [$/ft^2 building space]	$0.30-$0.70	$0.20-$0.50	$0.10-$0.40	$0.30-$0.80	$0.40-$1.00
Leakage Range [% Fan Flow]	5-40%	5-40%	10-80%	5-30%	10-50%

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Conditions where the technology application would be most cost effective are:

- High site energy costs

- Ducts to be sealed are in unconditioned space

- Heating and/or cooling energy loads primarily met by the air distribution system. Perimeter heating will severely limit the energy savings potential of the technology

- Duct systems that are known to be leaky
  – duct blaster tests on sections of the duct systems will confirm the degree of leakiness.

Would you like to know more about this session?

Paul Kistler P.E. C.E.M.
Mechanical Engineer
Energy Engineering Branch (PW222)
Energy and Utilities Department
NAVFAC Engineering Service Center
1100 23rd Ave.
Port Hueneme CA 93043
(805) 982-1387

https://energy.navy.mil/

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