NAVFAC Naval Facilities Engineering Command
ENGINEERING AND EXPEDITIONARY WARFARE CENTER

TechData Sheet

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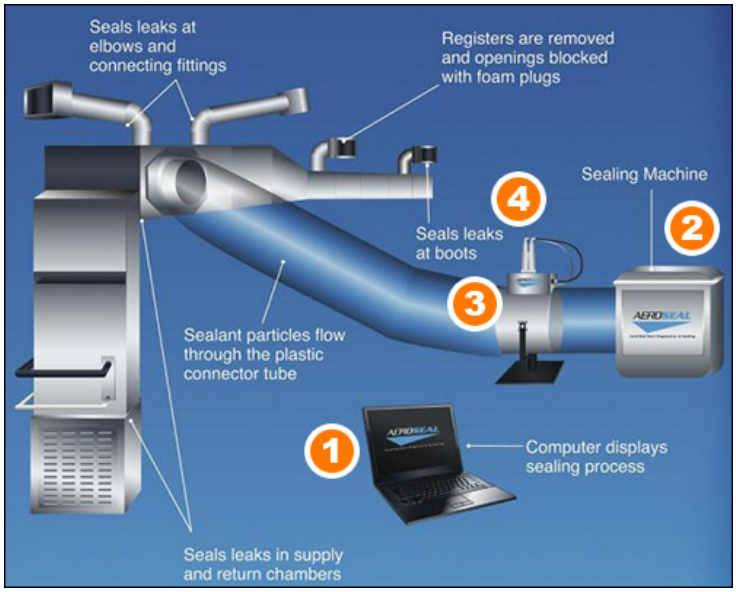
HVAC; Heating, Ventilation, Air Conditioning - Aerosol Duct Sealant

The Aeroseal™ duct sealant technology was demonstrated in four buildings at four different Navy facilities around the country. The four demonstration buildings were 1) the DeFlorez Building at NAVAIR Orlando, FL 2) Building 1268 at the Naval Station Newport, RI 3) Building 865 at the Naval Base Kitsap in Bremerton, WA and 4) Building 3339 at the Naval Base San Diego, CA. The four buildings represent four different climatic conditions and different air distribution systems types. Data on thermal energy and fan power was collected before and after the duct sealant material was applied. Annual energy and cost savings were predicted based on a typical weather year for each site.

The installation of the duct sealant product was supervised by SEI Group, Inc. at each of the four demonstration buildings. Application of the duct sealant product was performed by Carrier Aeroseal.

What is the Technology?

Duct Sealing is an energy reduction technology that was demonstrated by the NAVFAC Engineering and Expeditionary Warfare Center. This technology internally seals leaks in air distribution ducts by injecting a fog of aerosolized sealant particles into a pressurized duct system. The product keeps the particles suspended within the air stream. As the duct work is pressurized, the particles deposit at the leak edges, collect, and eventually seal the leaks



Source: http://www.aerosealcalifornia.com/images/aeroseal-process.jpg

How Does It Save Energy?

Energy savings are realized through sealing air leaks in the duct work, which reduces the amount of air requiring movement by fans throughout the air distribution systems. This will, in turn, result in fan motor power reduction. In addition, the reduction of air leaks in the duct work can reduce the thermal energy lost in the space heating and cooling systems.

Where Should the Navy Apply It?

In general, conditions most favorable for cost savings are:

- High energy cost (> $0.06/kWh)
- Ducts in unconditioned space
- Heating/Cooling loads should be within

the air distribution system (e.g., no perimeter heating)

- Leaky duct systems that have high flow rates such as laboratory supply and exhaust systems
- Leaky duct systems that have large heating and/or cooling loads
- Systems typically not well-sealed during initial construction such as toilet/shower supply and exhaust ventilation systems having minimal retrofit or replacement needs, such as variable air volume (VAV) systems.

Aeroseal outlines a very simple decision tool that identifies buildings/systems for which the decision to seal can be made without significant analysis. To use this tool, the duct systems on a Navy base have been divided into five categories, as summarized in Table 1. The table describes typical situations that the duct sealant technology should be applied to.

The following section provided by Carrier

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%

Table 1. Applicability of duct sealant on Navy bases – decision advice if you have high energy costs (-> $0.06/kWh) or require 10 CFM/person or 0.18cfm/sqft fresh air minimum or minimum exhaust rate of 1.00 CFM/sqft based on ASHRAE 62.1 guidelines for laboratories.

How Much Does It Cost and How Much Did It Save?

Of the four sites, the greatest impact from the duct sealant was at the DeFlorez Building in Orlando, which was also the site with the greatest cooling degree-day (CDD) value. At this site, the technology resulted in a total annual energy use savings of 103,438 kWh, resulting in the annual energy cost savings of $8,689 with a simple payback period of 5.7 years.

Table 2 below, summarizes annual energy and cost savings at the demonstration sites.

What Are the Maintenance Costs/Savings Issues?

Maintenance after application of sealant is similar to that performed during routine servicing. However, if routine filter changes are not performed the duct work may contain significant levels of dust or dirt, and it could become problematic. The issue is that, once applied, the sealant remains tacky, thereby attracting additional dust and other particles.

Table 2. Summary of annual energy and cost savings at the demonstration sites

Location / Status		Chiller Energy (kWh)	Chiller Energy Cost ($)(1)	Heating Energy (kBtu)	Heating Energy Cost ($)(1)	Fan Energy (kWh)	Fan Energy Cost ($)(1)	Total Energy Cost ($)
DeFlorez Bldg, NAVAIR Orlando	Pre-sealant	210,735	$17,702	0	$0	122,902	$10,324	$28,026
	Post-sealant	127,191	$10,684	0	$0	103,010	$8,653	$19,337
	Savings	83,545	$7,018	0	$0	19,893	$1,761	$8,689
Bldg 1268, NS Newport	Pre-sealant	41,933	$5,032	0	$0	90,240	$10,829	$15,861
	Post-sealant	50,032	$6,004	0	$0	72,443	$8,693	$14,697
	Savings	-8,099	-$972	0	$0	17,797	$2,136	$1,164
Bldg 865, NB Kitsap	Pre-sealant	Note 2		0	$0	72,270	$3,298	$3,298
	Post-sealant			0	$0	28,295	$1,291	$1,291
	Savings			0	$0	43,975	$2,007	$2,007
Bldg 3339, NB San Diego Primary System(3)	Pre-sealant	53,544	$6,781	0	$0	15,951	$2,021	$8,802
	Post-sealant	40,546	$5,135	0	$0	14,521	$1,839	$6,974
	Savings	12,998	$1,646	0	$0	1,430	$182	$1,828

Bldg 3339, NB San Diego Secondary System	Pre-sealant	Note 4	0	$0	8,950	$1,138	$1,138
	Post-sealant		0	$0	8,056	$1,020	$1,020
	Savings		0	$0	894	$118	$118

Note:
(1) Annual energy cost savings are based on 2006 local unit energy prices for each Navy installation.
(2) Building does not have cooling.
(3) Includes chiller and fan energy from the primary system.
(4) Includes fan energy only from the secondary system. Cooling system energy data was invalid for the secondary system.

What Are the Findings, Conclusions, and Recommendations?

Findings

Fan energy savings for all four demonstration sites was consistently good and was sufficient by itself for the payback to be less than the expected 25 year lifespan of the sealant. Cooling energy savings at the Orlando building was significant, but at Newport, the savings from the duct sealant was masked by other undocumented changes in the building. The Bremerton building does not have cooling. The San Diego building has a significant cooling energy reduction in percentage, but the annual cooling energy use and cost savings were small because of the mild weather conditions and less cooling demand at San Diego. Results of heating energy savings from the duct sealant technology were inconclusive from the demonstration because of insignificant heating of the air stream at the heating coil.

Conclusions

This duct sealant technology demonstration has shown that application of the Aeroseal™ duct sealant can reduce both thermal energy and fan energy consumption, depending on the HVAC system type and the location of the ducts that were sealed. The cost effectiveness of the technology is site specific, primarily a function of local energy costs, the building thermal loads, and the cost of sealant application.

Recommendations

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

- High site energy costs (>$0.06/kWh)
- Ducts to be sealed are in unconditioned space
- Large 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 extent of leakiness.

To achieve the maximum benefit from the duct sealant, all building systems must be fully operational and performing as designed before the duct sealant can begin. Any system deficiencies must be corrected.

User findings/comments

EXWC contacted Steven Wagner at NAVAIR in Orlando, Florida to evaluate the implementation of the duct sealant technology. It was reported that the duct sealant technology remained installed during facility renovations. There are no maintenance or quality issues to report at this time. The quality of the technology has been validated with no further complaints or

comments. While the duct sealant was beneficial, it has not been implemented anywhere else at the NAVAIR base. The technology did not require any maintenance and therefore there are no additional costs due to malfunctions. Steven Wagner reports that there are no complaints regarding the technology and there was an overall positive experience. The final product was successful in reducing air leakage which reduced the use of the fan. In one specific case there was a 25% reduction in fan use which led to energy savings. Overall the duct sealant was well received with no foreseen complication in maintenance, quality, and performance.

Are More Studies or Demonstrations Needed?

Although several studies have been done on the effectiveness of sealing leaky HVAC ductwork with aerosol duct sealant, few studies have been done on the resulting energy savings, especially heating and cooling savings. These savings can be highly variable.

For a full report on this project go to:

https://hub.navfac.navy.mil/webcenter/portal/exwc/Business_-_Program_Lines/page16/page160/page1455?_afrLoop=45662220730323&_adf.ctrl-state=2gppxgl9i_105#!

For additional information

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