



# With Polyimide-Foam Duct Liner, Air Is Felt, not Heard, in School Auditorium

*Nonfibrous insulation eases air-quality concerns*

Used by 13 student musical ensembles and nearly 20 community organizations, the arts wing of Houlton Jr/Sr High School in Houlton, Maine, was badly oversubscribed, as well as outdated, spurring a \$5 million expansion and renovation. The result: the Houlton Community Arts Center, Phase 1 of which was completed in January 2010.

When audience members settled in for the first performances in the newly renovated auditorium, they could hear the performers beautifully. What they could not hear was the HVAC system.

"We had three major concerts in our auditorium in December (2009), and the air-exchange system could not be heard, only felt," Joseph A. Fagnant, president of the Houlton Community Arts Center Council (HCACC) and chair of the Houlton High School Music Department, said. "It was encouraging to have an air-handling system that did not interfere with the acoustics of the space nor interfere with the performance taking place."

PHOTO BY EMILY DEWAN



**Phase 1 of the Houlton Community Arts Center project included a new balcony, a new entry vestibule, and renovation of the gymnasium, kitchen, and cafeteria. The second phase will add 13,000 sq ft, including a band room, a chorus room, theater/dance space, and an art room. Polyimide foam will be used throughout.**

The excellent acoustics are in part the result of the use of SOLCOUSTIC, a non-fibrous coated polyimide-foam duct liner from Evonik Foams Inc.

## Insulation and Indoor-Air Quality

Developed by NASA for use in space vehicles, non-fibrous polyimide foam is an alternative to fiberglass.

"Because of concerns about fibrous liners delaminating in the airflow, the idea of non-

**Polyimide-foam lining was installed throughout ductwork in the Houlton Community Arts Center.**



PHOTO BY STEVEN H. MILLER



PHOTO BY STEPHANIE H. AYERS

fibrous is often attractive," Ben Markham, LEED AP, senior acoustic consultant for Acentech Inc., which consulted on the project, said. "There are certain kinds of projects—schools and hospitals, for example—where

any kind of liner is prohibited, unless it is encapsulated. But that encapsulation, unless done with great care, often negates acoustical performance of the liner, even though it may be fine thermally."

Open-cell polyimide foam can equal or exceed the sound-absorbing performance of fiberglass of similar thickness.

What's more,

polyimide foam liners meet the same performance criteria concerning response to heat and flame as fiberglass. The material was tested according to UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*/ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*/NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, and can withstand temperatures of up to 250°F. It is almost as efficient in terms of thermal resistance as fiberglass of similar thickness.

## Return on Investment

In the case of Houlton Jr/Sr High School, where fundraising for the project is ongoing, cost was a serious consideration. Although polyimide-foam duct liner costs more than fiberglass, the HCACC decided it was a worthwhile investment.

"I was there when the demolition was started in June 2009," Fagnant said. "The old fiberglass liner had



completely collapsed down the length of the ducts. I saw all the dirt in it and how the batts were falling apart, and I suddenly said, 'Now, the idea of using foam makes sense.' I also saw the foam being installed, and I could tell that it wasn't going to have any issues."

Fagnant said he is pleased with the product and the installation.

"It is a great asset to the auditorium," Fagnant said. "With our old system, there was no air exchange. It would reach 85 degrees in there with an audience present. And you could hear the heat kick on and off, hear the fans making noise. With the new system, it feels much more pleasant, and you don't hear a thing. We had our first performance in November (2009)—'Damn Yankees'—and the auditorium was sold out. People could

hear things differently. They were very positive in their response."

Information and photographs courtesy of Evonik Foams Inc.

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## DUCTS AND ACOUSTICS

Noise in HVAC ducts is reduced through one of two actions:

- Scattering, or the redirection of sound waves.
- Absorption, or the conversion of sound to other forms of energy—generally, a small amount of heat.

Thus, duct liners do not contain or filter noise, but, rather, break it up and weaken its force. Their effectiveness depends on how much of their surface area is exposed to sound waves. This means the greater the length of duct that is lined, the greater the amount of noise that is reduced.

For general environments (e.g., an office or a classroom), acceptable noise reduction often requires the lining of the first 10 to 20 ft of ducts adjoining a fan system. An engineer calculates how much lining is needed by determining an acceptable noise level for the application, using the documented noise output of the fans and the known acoustic properties of the lining material.

For spaces with exacting sound requirements, lining an entire duct for maximum noise control may be desirable.

To dissipate room-to-room transmission, ducts joining two rooms can be designed in a U-shape and lined.

Duct-lining materials must:

- Have sound-absorbing properties.
- Be of minimal thickness so they do not significantly restrict airflow.
- Be resistant to heat.
- Be able to prevent the spread of flame and smoke.

TEST METHOD	PERFORMANCE STANDARD
<b>ASTM C518</b> , <i>Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus</i> ; <b>ASTM C177</b> , <i>Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus</i> ; <b>ASTM C1114</b> , <i>Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus</i> (i.e., thermal conductivity at 75°F)	0.27 (Btu-in/hr/sf°F)
<b>ASTM C1104/C1104M</b> , <i>Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation</i>	Not more than 3 percent by weight
<b>ASTM C1338</b> , <i>Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings</i>	No fungal growth
<b>ASTM C411</b> , <i>Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation</i>	Air-stream surface has no evidence of flaming, glowing, smoldering, visible smoke, delamination, cracking, deformation, or reduction in thickness
<b>ASTM C1071</b> , <i>Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)</i>	Insulation should not break away, crack, peel, flake off, or show evidence of delamination or continued erosion when air is passed through typical duct sections
<b>ASTM C1304</b> , <i>Standard Test Method for Assessing the Odor Emission of Thermal Insulation Materials</i>	Cannot have an objectionable odor recorded by more than two of five panel members
<b>ASTM E84</b> , <i>Standard Test Method for Surface Burning Characteristics of Building Materials</i> ; <b>UL 723</b> , <i>Standard for Test for Surface Burning Characteristics of Building Materials</i> ; <b>NFPA 255</b> , <i>Standard Method of Test of Surface Burning Characteristics of Building Materials</i>	Flame Spread Index of 25, Smoke Developed Index of 50
<b>NFPA 259</b> , <i>Standard Test Method for Potential Heat of Building Materials</i>	Potential heat ≤ 8,141 kJ per kilogram (3,500 Btu per pound)
<b>ASTM D665</b> , <i>Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water</i>	Pass

### Duct-liner performance standards.

- Be resistant to mold.

Both fiberglass and polyimide foam meet those criteria. The foam generally is coated with an acrylic product that protects against dust, moisture, and mold. Polyimide is a low-emitting product in terms of volatile organic compounds and has been certified under the GREENGUARD Children &

Schools program.

Installation of polyimide foam is similar to that of standard fiberglass rigid plenum liner board. The biggest difference is that workers installing foam generally do not feel the need to wear dust masks, respirators, gloves, or long sleeves, as they do when handling fiberglass.