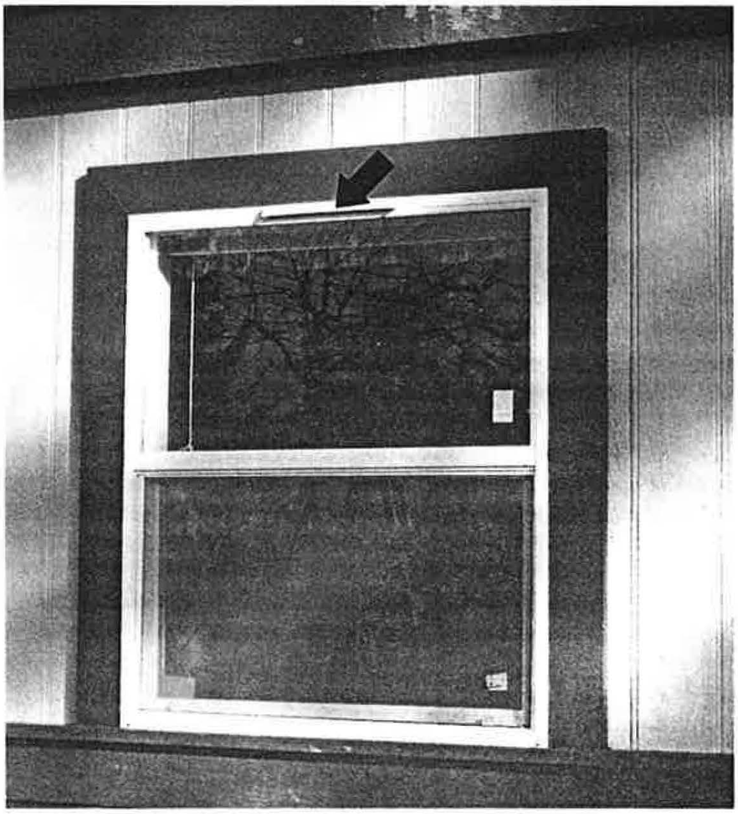
Ventilation Facts and Fallacies in Manufactured Homes



MIKE LUBLINER

Window inlet vents are an alternate way to provide fresh air using an exhaust fan. When the fan is on, it slightly depressurizes the house, causing makeup air to enter through the window vents with minimal heat loss. However, in high winds, pressure changes can suck heat out of the vent on the downwind side of the home.

Manufactured housing has grown in size, features, popularity, and market; it currently comprises about 30% of all single-family housing in the United States. In some rural areas, these homes account for over 50% of single-family residences, with nearly 300,000 units being built each year.

In the past, manufactured homes have been known to be poor energy performers. But producers have recently improved the design of new homes, significantly reducing energy consumption.

Furnace-Based Systems

The 1976 U.S. Department of Housing and Urban Development (HUD) standards required that manufactured homes have either the equivalent of 4% of their floor area in operable windows or a mechanical ventilation system that would provide whole house ventilation. These requirements led many manufacturers to build homes with furnace-based ventilation systems, using a fresh-air duct from the outside to the furnace.

The 1994 revised HUD standards eliminated the option of operable windows or passive vents. They also required that the occupant be able to control the systems with an on/off switch. In spite of these changes, many manufacturers continue to rely on either electric or gas furnace-based systems to ventilate their homes. Many simply installed a timer on the furnace fan to meet the occupant-control requirement.

Fanning in the Northwest

Over the past seven years, electric utilities in the Pacific Northwest have been working to improve the performance of manufactured homes. One outcome of their efforts is that many new manufactured homes in the Northwest are today equipped with dedicated whole-house exhaust fans. Generally located in a hallway, these fans operate continuously, are relatively quiet (rated at 1.0 sone or less) and include a switch to turn the fan off during long periods of vacancy.

The continuous-exhaust fans use as little as 15 watts to run the fan motor. This is considerably less than the 60–75 watts typically used by the 1.5 sone combination bathroom/whole-house exhaust fans. The annual fan energy cost of the quieter continuous-exhaust system is less than $10 in most Pacific Northwest locations. This system relies on inlet vents in the window frames, which help to introduce outside air to living areas at a rate of about 5 CFM per vent with no noticeable cooling effects.

Table 1

Cost Comparison of Whole-House versus Furnace-Based Ventilation Systems in Manufactured Homes *

System	Annual Energy to Run System (kWh)	Annual Heating Energy for Introduced Ventilation Air (kWh)	Total Annual Energy Cost (Assuming $0.08/kWh)
Continuous exhaust fan	112	1,213	$106
Furnace-based system	2,848	835	$295

* Consumption estimates were calculated using Ecotope's SUNDAY 3.1 simulation software. Assumptions included: electric heating, 50% heat recovery from the furnace motor fan, 70°F setpoint, base infiltration at 0.2 ACH, and typical Seattle weather.

Which Consumes Less?

To better understand how furnace-based and continuous-exhaust fans contribute to energy performance in manufactured homes, the Bonneville Power Administration asked Ecotope in Seattle, Washington to compare annual operating costs of the two systems. Using a computer model, Ecotope evaluated the systems on the basis of their ability to ventilate an identical 1,500 ft^2, double-section home to an effective ventilation rate of 0.35 air changes per hour (ACH).

The modeling results show that even in an area with a mild climate and relatively low electric rates, the continuous-exhaust system costs less to operate than the furnace system. With an initial cost of under $100, the continuous exhaust system has a payback period of less than six months. In more extreme climates or in areas with higher energy costs, the payback is even quicker. In general, systems that depend on the furnace fan will cost $175–$300 more per year to operate than a continuous exhaust system.

Another drawback of the furnace-based system is that it requires a pressure relief damper to keep from pressurizing the home. Without this valve, furnace systems have been known to pressurize the home and drive moisture into the attic, causing condensation in cold and cool climates. HUD has recently allowed manufacturers to use the exhaust fan ducts to provide pressure relief. The irony of HUD's requirement is that furnace systems with supply ducts and no return ducts often create negative pressures inside the home due to duct leakage, which has caused some water heaters to backdraft.

The results clearly show that a continuous-exhaust ventilation system is more cost-effective than a furnace-based system. It offers homeowners efficient mechanical ventilation systems, maintains comfort, and reduces operating costs. These systems can thus allow manufactured homes to be made tighter without creating indoor air quality problems.

—Don Stevens and Mike Lubliner

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Rock Wool Fills the Void

Mention rock wool to most people in the energy audit and retrofit business and you get a visceral reaction. Immediately they start scratching and coughing, recalling dusty mats from old homes, heavy with 40 years of accumulated mouse droppings. Similarly, ask almost any builder about rock wool and you get a quizzical, bemused look that says, "rock what?"

Although relatively unknown in building circles, rock wool has actually been around for awhile. It is produced naturally during volcanic eruptions—formed by the action of high winds on lava streams—and was first patented as a commercial product in the United States in 1875.

Rock wool has had a variety of applications, including use as an industrial insulator and as a soil amendment. While it has been used as an attic insulation and retrofit wall insulation for some time, its history as a wall insulation in new residential construction is more recent; it was first applied to open wall cavities of some Texas homes approximately ten years ago. In North Carolina, it is currently being used in attic, cathedral ceiling, and side wall applications.

Rock wool is part of a generic category of materials, called mineral wool, that includes rock wool, slag wool, and fiberglass. The rock wool used for building insulation is often a mixture of basalt, slag (a byproduct from steel furnaces), and limestone. It is manufactured under high heat, and is spun from a molten substance using centrifugal force and compressed air.

Rock wool is applied just like wet-spray cellulose. The material, which contains a starch adhesive, is mixed with a small amount of water and blown into open wall cavities at a density of about 4 lb/ft^3. The water activates the glue, which strengthens the bonding of the material to the sheathing and studs. To remove excess and overspray, contractors "screed" the walls using a motorized roller that runs down the face of the studs.

COURTESY OF AMERICAN ROCKWOOL

An installer "screeds" rock wool off a filled wall using a stud scrubber. Under normal conditions, a face mask is recommended (though not required) when spraying in rock wool.

Rock wool is very effective for insulating behind and around electrical boxes, wires, and pipes. It can fill the most difficult wall cavities, leaving virtually no voids. Rated R-value in wall applications is R-4.1 per inch or about R-14.5 in a 3½-inch wall cavity.

I first came upon rock wool while attempting to insulate my own home. Because of the unusual geometry of my walls, which included numerous full-width triangular braces in the framing, I knew that installing batts in the cavities would be difficult if not impossible. I thus wanted to use a wet spray and decided on rock wool after I found a contractor who was installing it.

At the time, such open-cavity applications of rock wool were still experimental in my area. In attempting to find the right mix, the contractor used too much water