

# Ventilated Nail Base for Commercial and Residential Sloped Roofs

## About Polyiso Insulation

Polyiso is a rigid foam insulation used in over 70% of commercial roof construction, in commercial sidewall construction and in residential construction.

The Benefits of using Polyiso include:

- Quality Mark™ certified LTTR-values
- Highest R-value per inch of thickness
- Excellent fire test performance
- Moisture resistant
- Dimensional stability
- Superior compressive strength
- Extensive building code approvals
- Cost effective
- Recycled content
- Zero ozone depletion potential
- Virtually no global warming potential
- Preferred insurance ratings
- Nationwide availability
- Thinner walls and roofs with shorter fasteners
- Compatible with most roofing systems

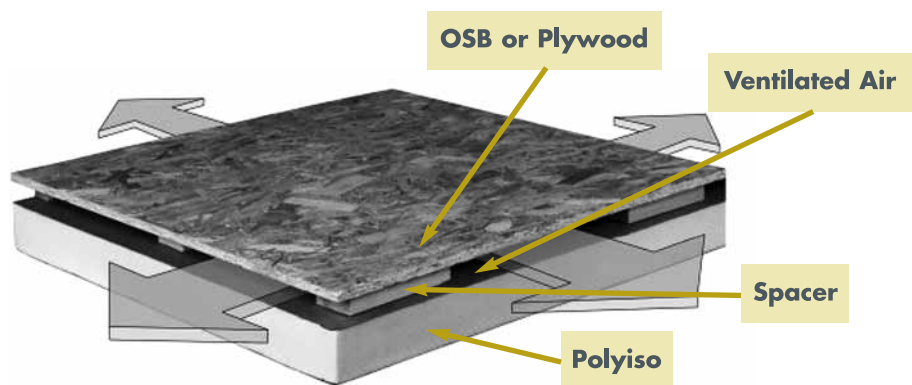
PIMA and polyiso products have received many environmental awards. These include an honorable mention in the Sustainable Buildings Industry Council's (SBIC) 2003 "Best Practice" Sustainability Awards Program and the U.S. EPA's Climate Protection Award for the association's leadership in promoting energy efficiency and climate protection. The EPA also awarded PIMA and its members the Stratospheric Ozone Protection Award for "leadership in CFC phase-out in polyiso insulation and in recognition of exceptional contributions to global environmental protection."



## Introduction

A number of roof coverings, notably asphalt shingles, metal and tile, perform best when the underside of the roof deck is adequately ventilated. In the absence of a non-conditioned attic, as in post and beam construction or a cathedral ceiling design, ventilation must be achieved above the roof insulation through a ventilating air space.

To address this need, the polyiso industry introduced an energy efficient solution generically called ventilated nail base (VNB). As illustrated in Figure 1, this product is composed of a layer of polyiso in thickness from 1" to 4.5", spacers, and a solid layer of OSB or plywood. This technical bulletin focuses on VNB used in commercial and residential sloped roof applications.



VNB provides several outstanding benefits:

- Excellent thermal insulating properties for the entire roof assembly;
- Effective ventilation; and
- Strong nailable base for proper attachment of asphalt shingles, tile, or metal roof coverings.

## Thermal Resistance of Ventilated Nail Base

The thermal resistance value reported for VNB is the LTTR-value of the polyiso foam insulation only. Additional thermal resistance for the air space or the OSB above the air space in VNB is not considered in determining the product LTTR-value, since outside air flowing through the product creates a thermal interruption and does not, therefore, provide any appreciable thermal resistance to the product. Further, the air flowing through a properly ventilated air space eliminates the small thermal resistance provided by the 7/16-inch OSB, as well as the roofing materials and outside air film above the air space, since ambient air is flowing above and below these components.

This position is consistent with the ASHRAE Handbook *Fundamentals*, Chapter 24, Table 3, note b; and Chapter 23, "Factors Affecting Heat Transfer Across Air Spaces." This Chapter states that the thermal resistance values claimed for air spaces are applicable only when the air spaces are sealed against airflow in or out of the space.

PIMA sponsored a full-scale "hot box" test at Oak Ridge National Laboratory (ORNL) to determine whether the air space contributes to the overall thermal resistance of the VNB product. A summary of the test program and results are shown below:

**OBJECTIVE:** The purpose of the test program conducted at ORNL was to determine the effective R-value of the ventilation air space present in the VNB.

**SUMMARY:** The test program was conducted during February and March 2005 at the Buildings Technology Center (BTC) at ORNL. The tests were conducted in the BTC's Large Scale Climate Simulator (LSCS) and were in general conformance with ASTM C 1363, Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus. Results were obtained for both "winter" and "summer" conditions.

**PROCEDURE:** The VNB product, consisting of nominal 1.0" polyiso, 1" ventilated air space, and 7/16" oriented strand board (OSB), was installed on a 4:12 slope metal deck. The top surface of the OSB was covered by standard roofing felt. The test deck was installed in the LSCS, properly instrumented and insulated to prevent thermal bridges at the test deck extremities. The test deck was then subjected to testing at both "winter" and "summer" conditions with various levels of measured air circulation in the air space.

**RESULTS:** Effective R-value of the air space is affected by the air circulation. The amount of outside air circulating through the air space determines the effective R-value. The effective R-value of the air space is at a maximum with no air circulation. However, since air circulation is a major feature of the VNB product, the effective R-value at various levels of air circulation was determined.

The effective R-value of a 7/8" ventilation air space decreases as the air circulation increases in both the "winter" and "summer" conditions. The R-value of the air space at both winter and summer conditions at zero ventilation agrees with the ASHRAE Handbook *Fundamentals* values for these spaces. At ventilation rates corresponding to a 5 mph wind speed, the R-value of the ventilated air space drops off slightly but is close to the R-value at the zero ventilation rate. However, at increased circulation rates, the R-value of the air space drops off quickly.

Because each installation of VNB will likely be subjected to varying wind speeds and temperatures, the effective R-value is impossible to predict. Therefore, PIMA members have chosen to discount any potential contribution of the air space to the overall thermal performance of the product.

## Effective Ventilation

VNB insulation is available in many different configurations and air space dimensions, depending upon the polyiso manufacturer. However, a standard method to calculate the expected ventilation rate of a particular product is available. The Net Free Area of Ventilation Per Linear Foot (NFA/LF) is derived by multiplying the air space in inches by the length in inches of the VNB (less the area of the spacers) and then dividing by the length in feet of the VNB panel. The ventilating capabilities of the soffit and ridge vents should be matched to the NFA of the ventilated nail base product.

## Installation of Ventilated Nail Base

VNB panels shall be installed in accordance with the manufacturer's installation instructions. In general, ventilated nail base insulation is installed over a solid roof deck with the 8 ft. dimension parallel to the eave.

## Use of a Vapor Retarder

Moisture vapor tends to migrate from warmer to cooler areas. In building construction, vapor retarders are used to inhibit or block the passage of moisture into walls or roofing assemblies. Sealed vapor retarders also serve as air barriers to limit the movement of moisture-laden air from the interior to the exterior. To determine whether a vapor retarder is necessary, calculations based on interior relative humidity, interior temperature, and outside design temperature must be performed. Excessive moisture migration will potentially damage the roof system and cause unwanted condensation. Consult the NRCA Roofing and Waterproofing Manual (Fifth Edition) for more information regarding vapor retarders and dew point calculations. VNB is not intended to substitute for a vapor retarder. The decision to use a vapor retarder is the responsibility of the architect or designer.

## Conclusion

It is easy to specify polyiso insulation by referring to product standard ASTM C 1289 (in United States) or CAN/ULC-S704 (in Canada). Polyiso manufacturers provide experienced personnel to consult and educate the specifying community on the selection of the proper ASTM C 1289 or CAN/ULC-S704 type for the job. With all these benefits and tools available, it is easy to see why specifiers and roofing contractors consider polyiso their product of choice.

## PIMA

For over 20 years, PIMA (Polyisocyanurate Insulation Manufacturers Association) has served as the unified voice of the rigid polyiso industry proactively advocating for safe, cost-effective, sustainable and energy efficient construction.

PIMA produces technical bulletins in an effort to address frequently asked questions about polyiso insulation. PIMA's technical bulletins are published to help expand the knowledge of specifiers and contractors and to build consensus on the performance characteristics of polyiso. Individual companies should be consulted for specifics about their respective products.

PIMA's membership consists of manufacturers of polyiso insulation and suppliers to the industry. Our members account for a majority of all of the polyiso produced in North America.

## SAFETY

Polyiso insulation, like wood and other organic building materials is combustible. Therefore, it should not be exposed to an ignition source of sufficient heat and intensity (e.g., flames, fire, sparks, etc.) during transit, storage or product application. Consult the product label and/or the PIMA members' Material Safety Data Sheets (MSDS) for specific safety instructions. In the United States, follow all regulations from OSHA, NFPA and local fire authorities; in Canada, follow all regulations from Health Canada Occupational Health and Safety Act (WHMIS) and local fire authorities.

**For more information on polyisocyanurate insulation, visit [www.polyiso.org](http://www.polyiso.org)**



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