

Ventilated Nail Base for Commercial and Residential Sloped Roofs

TECHNICAL BULLETIN 114

Polyiso insulation presents many superior features that designers need when specifying insulation for use in roof systems:

- Quality MarkSM certified LTR-values
- Highest thermal performance available
- Excellent fire test performance
- Dimensional stability
- Superior compressive strength
- Moisture resistance
- Extensive building code approvals
- Zero ozone depletion potential
- Negligible global warming potential
- Cost effective
- Preferred insurance ratings
- Recycled content
- Compatible with most roofing systems

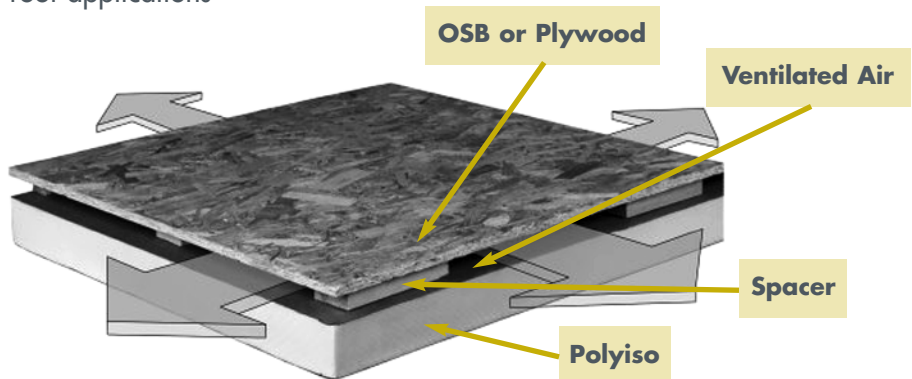
PIMA and polyiso products have received many environmental awards. These include an honorable mention in the Sustainable Buildings Industry Council's (SBIC) 2003 "Best Practice" Sustainability Awards Program and the U.S. EPA's Climate Protection Award for the association's leadership in promoting energy 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, adequate 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
- 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 LTR-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 LTR-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 also sponsored a full-scale "hot box" test at Oak Ridge National Laboratory to determine whether the air space contributes to the overall thermal resistance of the VNB product. Below please find a short overview of the test and results.

OBJECTIVE: The purpose of the test program conducted at Oak Ridge National Laboratory (ORNL) was to determine the effective R-value of the ventilation air space present in the VBN.

SUMMARY: The test program was conducted during February and March 2005 at the Buildings Technology Center (BTC) at Oak Ridge National Laboratory located in Oak Ridge, TN. 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. For further discussion on vapor retarders refer to PIMA TB 106.

Conclusion

It is easy to specify polyiso insulation by referring to product standard ASTM C1289. Polyiso manufacturers provide experienced personnel to consult and educate the specifying community on the selection of the proper ASTM C 1289 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

The Polyisocyanurate Insulation Manufacturers Association (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.

The Polyisocyanurate Insulation Manufacturers Association (PIMA) is the North American trade association that advances the use of polyisocyanurate (polyiso) insulation. Polyiso is one of the nation's most widely used and cost-effective insulation products available.

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.

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