Natural Polymers, LLC
Natural Choice Polymer Design

NATURAL-THERM™

www.naturalpolymersllc.com
Natural Polymers mission is to design exceptional polyurethane foam systems that utilize renewable, recyclable raw materials with a low VOC signature. Our Polymer Chemistry is different from other Bio and Agri based systems. We use a proprietary process designed to maximize the polymers that Nature has made. Natural Polymer’s Water Blown Hybrid Urethane Technology has one of the highest biological raw material bases in the industry, with the lowest amount of embodied energy in the finished product. We feel that it is our responsibility to reduce our carbon footprint through innovative technology and to push the envelope of design and chemistry.

Traditional Polymer Chemistry is based solely on propylene oxide (PO) and ethylene oxide (EO), which are petroleum-based building blocks. Other companies have tried to develop Bio and Argi based foams by replacing small percentages of the petroleum components with vegetable based polyols, which in many cases still rely heavily on petroleum-based raw materials. This results in finished products that are still greater than 90% petroleum based.

The products made by Natural Polymers are different. We reduce the amount of petroleum by 15-30%, but still maintain the performance and physical properties of a 100% petroleum based system. Through innovative and exciting research and development, Natural Polymers has accomplished what has been an elusive goal in the polymer industry.

NATURAL-THERM™ LIGHT Semi Ridged Polyurethane Foam Insulation
NATURAL-THERM™ 0.50 Semi Ridged Polyurethane Foam Insulation
NATURAL-THERM™ Zero Semi Ridged Polyurethane Foam Insulation
Water Blown Hybrid Insulation
NATURAL-THERM™ 2.0 HFO IBW/IBS Ridged Polyurethane Foam Insulation

Re-defining green building technology for the Polyurethane Industry.
www.naturalpolymersllc.com
Overview:

Many people are confused as to which type of spray polyurethane foam insulation (SPF) they should use. A common debate when trying to choose the right type of (SPF) occurs when the terms open cell and closed cell are introduced. Usually people search for answers on web sites or through local insulation contractors. Depending on where the information comes from, a bias for one type insulation over another usually forms.

Not all spray polyurethane foam insulations (SPF) are the same. If you are just becoming familiar with (SPF), you will soon recognize the terms open cell and closed cell. Sometimes they are referred to as open cell or 0.50 lb/ft³ (pcf), or closed cell 2.0 lb/ft³, pcf. There are differences between open and closed cell (SPF). Your choice may depend on your climate and geographic area. Some people believe that closed cell (SPF) is superior to open cell (SPF); while others feel just the opposite. An argument can be made on either side, depending on the particular application. In applications where water permeability and water absorption are a concern, usually a closed cell (SFP) is preferred. In applications where a breathable membrane is required, then open cell (SPF) is more preferable.

However, there are several other factors, which affect spray polyurethane foams (SPF) performance. This brochure outlines the most common differences by comparing the physical properties associated with each (SPF). It also highlights a less well-known class of (SPF), which some refer to as a hybrid spray foam insulation. Hybrid foam insulation is in the middle density range and has both open cell and closed cell properties. This mid density spray foam insulation is around 1.5 lb/ft³, (pcf) density.
Natural-Therm™ Zero Hybrid Foam:

Unlike other low-density LIGHT and 0.50-pcf spray foams, Natural Polymers, LLC has developed a mid density Zero spray foam insulation, which has a finer cell size and a smaller opening in the cellular window. This allows for improved R-Values and superior dimensional stability.

A smaller cellular window also allows for better water vapor permeance than low density 0.50 pcf (SPF). Hybrid foam does not absorb water when exposed to moisture. If moisture becomes trapped between the foam surface and the substrate, the foam has a high enough permeability to allow trapped moisture to transfer through the foam and dry out over time. Natural-Therm™ Hybrid foam acts like a breathable membrane system as opposed to closed cell foams that don’t allow for moisture mitigation. In application where a higher permeability is needed a traditional closed cell foam should be used.

In applications where increased structural strength, low water vapor permeance, a higher R-Value per inch, and an overall tighter cell structure is desirable, then the Natural-Therm™ Zero Hybrid SPF is the superior product.

Natural-Therm™ ZERO Hybrid foam is preferred in applications such as the underside of a roof decks or closed wall cavities. Because of the unique cellular design, if a leak in the building envelope does occur, the leak will either be detected or have a chance to dry out over time. In these applications, there is less concern about condensation or vapor drive into Hybrid open cell foams. It has been well documented by Independent National Laboratories that over 90% of vapor drive is through air infiltration not the insulation permeability rating. An effective air barrier will stop 90% of condensation or vapor drive, while the unique cellular structure of Natural-Therm™ Hybrid foam will help stop the rest.

Hybrid foams are water resistant

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Thermal Conductivity (ASTM C-518):
R-value is a laboratory-generated value. R-value does not factor in the other major conditions that affect an insulation’s performance. Some primary factors that can affect a material’s insulation performance are: wind velocity, convection, openings, cracks, and pressure differential between the inside and outside of a building. Natural-Therm™ spray foam insulation addresses these major performance factors. It does this by inhibiting convection loops, reducing conduction and radiation from high energy sunlight.

1. Conduction is the transfer of thermal energy between neighboring molecules in a substance due to a temperature gradient.

2. Radiation is electromagnetic waves that directly transport energy through space.

3. Convection is the transfer of heat within fluids (i.e. liquids, gases inside the polymers matrix) by the actual movement of the matter.

4. Convection in the form of air infiltration into a closed wall cavity transfers heat through gaseous air.

5. Convection in the form of liquid water washing against the building envelope helping create a pressure differential.

6. Moisture drive into a wall cavity can cause further diminishing of actual R-values in traditional insulation materials.

Natural-Therm helps to create an Air Barrier Isolation System

Air Barrier ASTM E-283:
This test method is standard procedure for determining the air leakage characteristics under specified air pressure differences at ambient conditions.

<table>
<thead>
<tr>
<th>Natural-Therm™ LIGHT/0.50</th>
<th>Natural-Therm™ Zero</th>
<th>Natural-Therm™ 2.0 IBW/IBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Barrier</td>
<td>Air Barrier</td>
<td>Air Barrier</td>
</tr>
<tr>
<td>5.5” is an air barrier</td>
<td>3.5” is an air barrier</td>
<td>1.5” is an air barrier</td>
</tr>
</tbody>
</table>

Intertek a third party accredited testing laboratory using ASTM E-283 conducted all testing.

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Thermal Conductivity (ASTM C-518):
K factor machine –HFM (heat flow meter)
K factor is a measure of the thermal conductivity of the foam.
R value is a measure of the thermal resistance of the foam.

Stationary Top Plate (cold ~55°F)
Moving Bottom Plate (hot ~95°F)
Heat Flows from the bottom plate through a foam sample to the top plate

Thermal Conductivity (ASTM C-518):

<table>
<thead>
<tr>
<th>ASTM C-518</th>
<th>Natural-Therm™ LIGHT and 0.50</th>
<th>Natural-Therm™ ZERO</th>
<th>Natural-Therm™ 2.0 HFO IBW/IBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>3.81</td>
<td>6.00</td>
<td>7.1</td>
</tr>
<tr>
<td>3”</td>
<td>14.31</td>
<td>18.6</td>
<td>22.2</td>
</tr>
<tr>
<td>4”</td>
<td>16.76</td>
<td>26.8</td>
<td>29.6</td>
</tr>
</tbody>
</table>

By law reported R-values are required to be third party test.

How Polymer Insulation works on a cellular level to reduce heat flow.

- The Polymer interface serves as an energy barrier
- Polymers collide against the interface and energy is transferred through the polymer and to molecules in the neighboring cell
- Smaller cells ⇒ Larger number of cells
  ⇒ More energy barriers
  ⇒ Lower rate of heat transfer

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**Water Vapor Permeance (ASTM E-96):**

A laboratory test designed to simulate the rate of water vapor infiltration through construction materials and membranes. In the laboratory a sample is placed in a device that has two chambers, one that controls temperature and humidity and another where a desiccant maintains humidity at or near zero.

Note: As density decreases the water absorption increases. As a result open cell foams are more hydrophilic (water loving) than closed foams. Closed cell foams have a low water vapor perm and therefore are considered more hydrophobic (water repelling). Natural-Therm™ ZERO Hybrid Foam is more hydrophobic (water repelling) than your typical open cell foam. These properties should be taken into consideration when choosing a substrate to spray against.

<table>
<thead>
<tr>
<th>Natural-Therm™ LIGHT and 0.50</th>
<th>Natural-Therm™ ZERO</th>
<th>Natural-Therm™ 2.0 IBS/IBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Vapor Permeance</td>
<td>Water Vapor Permeance</td>
<td>Water Vapor Permeance</td>
</tr>
<tr>
<td>11.50 perm @ 2”</td>
<td>8.21 perm @ 2”</td>
<td>&lt;0.5 @ 2”</td>
</tr>
<tr>
<td>7.97 perm @ 5”</td>
<td>3.3 perm @ 5”</td>
<td>&lt;1 @ 1.0”</td>
</tr>
</tbody>
</table>

*PRI a third party accredited testing laboratory using ASTM E-96 conducted all testing.*
**Better In Door Indoor Air Quality**

The American Society of Heating, Air-conditioning and Refrigeration Engineers (ASHRAE) provide ventilation standards that are cited in the national building codes and used across the United States. These standards are commonly drawn from ASHRAE Standards 62 (commercial buildings) and 62.2 (residential structures). The official title of 62.2 is, “Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings.”

The ASHRAE 62.2 ventilation rate is based on the home’s square footage and the number of occupants. The number of bedrooms is used to estimate how many people will be in the home on average, and the assumption is there will be one person in each bedroom and two in the master bedroom. The standard calls for providing 10 cubic feet per minute of outside air for each 1,000 square feet of floor space plus 7.5 cubic feet per minute for each person (number of bedrooms plus one). The equation for ventilation rate in cubic feet per minute (CFM) is then:

\[
\text{VENTILATION} = \frac{\text{sqft}}{100} + ((\#\text{BRs} + 1) \times 7.5)
\]

Generally, recommended ventilation rates range from 50 to 90 CFM of outside air, with most homes in the 50 - 65 CFM range. It’s a relatively small airflow, but it provides critical benefits.

ASHRAE 62.2 recommends using mechanical ventilation when homes reach 0.35 ACH or lower under natural conditions to ensure adequate indoor air quality. Because SPF-insulated homes generally are in the 0.10 to 0.20 ACH range, ventilation will always be recommended in newly-built SPF homes to maintain good indoor air quality.

It’s up to the home builder to select a ventilation plan and ensure that it is executed. Most ventilation plans are at least partially the responsibility of the HVAC contractor, but one method simply involves the specification and installation of a special exhaust fan.

**Equipment & Techniques for Ventilation**

Ventilation for residential homes can be provided naturally or mechanically. Because SPF houses are tightly constructed, mechanical ventilation must be used. A home can be mechanically ventilated by either:

**Exhaust Ventilation** - Installing an exhaust fan, pulling air from the house and blowing it outside, which in-turn draws in outside air from random holes in an equal amount to replace it.

**Supply Ventilation** - Drawing air into the HVAC return side and then blowing it into the house through the HVAC system, which forces an equal amount of air out of the house.

**Balanced Ventilation** - Providing an equal flow in both directions, exhausting as much air as we bring in, creating no pressure at all. This is accomplished with a heat recovery ventilator (HRV) or an enthalpy recovery ventilator (ERV).

Either way, one cubic foot of air coming in equals one cubic foot of air going out and vice versa.

**Exhaust Ventilation**

Exhaust ventilation is often the least expensive option and can most easily be done using a new type of ultra quiet, high-efficiency bathroom exhaust fan. These fans use continuous duty-rated DC motors and make less than 0.5 sones or 1/10th the noise of traditional bathroom fans. They can operate 24/7 all year for under $30 of electricity for the ENERGY STAR-rated units. The flow rates most homes need to maintain healthy indoor air quality are well within these fans’ operating range. This method does not provide a means to control the quality or distribution of fresh air. However, it is an easy and inexpensive way to meet home ventilation needs.
High-performance insulation system with Natural-Therm™ Spray Foam Insulation

Insulate and air seal your residential and commercial with Natural-Therm™

Without proper air sealing, a building can lose a great deal of its energy efficiency through air leakage. It's one of the primary causes of hot and cold spots that can cause discomfort for building occupants. But as with any building product, insulation is only as effective as its installation and where it’s applied. Natural-Therm foam is only installed by Natural Polymers qualified contractors. That’s why you should specify Natural-Therm foam knowing that it will be installed to the most rigorous standards. Developed with Building Science principles in mind, Natural-Therm foam is the latest insulation option from the brand most trusted by building professionals—Natural-Therm by Natural Polymers, LLC.

Why Natural-Therm Foam:

Natural-Therm foam provides outstanding air sealing and thermal performance, so it minimizes hot and cold spots that can affect the energy efficiency, comfort and resale value of a home or building.

With its excellent air sealing properties, Natural-Therm foam complements your sustainable building practices. With all its performance advantages, you can rely on Natural-Therm foam again and again.

Choose Natural-Therm foam for:

• Superior air sealing and thermal performance
• Outstanding energy efficiency
• Filling every void, especially irregular cavities
• Superior comfort and indoor air quality
• Excellent sound control
• Environmentally friendly performance

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Unlimited Design Potential

Don’t let any worries of potential air leakage restrain the originality of your designs. Natural-Therm foam insulation enables intricate wall, roof and ceiling architectural details - expanding to fill every crevice of even hard-to-reach areas.

Design with Confidence

You have Natural Polymers sterling reputation working for you, plus the support and resources of Natural Polymers Building Science team to help you succeed.

Where Air Infiltration Occurs

Nearly 50% of air infiltration in a home occurs in ceilings, walls, floors, around plumbing and electrical outlets. These areas can be significantly improved with Natural-Therm foam insulation. (Source: energystar.org)

Both residential and commercial applications can benefit from Natural-Therm foam insulation.
The Smarter Choice
Natural-Therm™ Foam Insulation

Supported by Natural Polymers and Our Network of Trusted Partners.

If you want to design a thermally efficient and airtight built environment, it’s not enough just to insulate. You must specify the right insulation and air sealing system for the application.

Adding Natural-Therm Foam to Your Designs Provides:

- Outstanding energy efficiency - Natural Therm foam reduces air leakage that can contribute to energy loss
- Excellent sound control - It diminishes noise coming from outside such as wind, traffic and planes; minimizes sounds inside, too.
- Superior comfort and indoor air quality - By reducing air leakage, Natural-Therm foam reduces the penetration of moisture, outdoor allergens and pollutants that can affect indoor air quality.
- Environmentally friendly performance - Natural-Therm foam reduces energy demand to contribute to your sustainable residential and commercial designs.

Supported by Natural Polymers and Our Network of Trusted Partners.

Our Building Science experts understand the principles of heat, air and moisture flow, and how the building envelope interacts with a building’s mechanical systems as well as its occupants. They can help you in specifying the right insulation system for your local climate. Contact our Building Science experts with your inquiries at 888-563-3111 or www.naturalpolymersllc.com.

Installed by a Network of Qualified Contractors

- Superior air sealing and thermal performance
- Outstanding energy efficiency
- Filling every void, especially irregular cavities
- Superior comfort and indoor air quality
- Excellent sound control
- Environmentally friendly performance
Summary:

There is no doubt the debate will continue as to which product is a superior insulation. Based on the results of this brochure you can now do a side by side comparison of the different properties that are used in the industry to classify spray foam insulation. These industry tests are designed to insure the integrity of the products being used. If you are looking for a more flexible membrane system that is also a breathable air barrier then either the 0.50 pcf or 1.0 pcf is the right insulation for the job. If the insulation is required to be in direct contact with water, needs structural strength, or is being used in a restricted cavity were a higher R-value is required, the appropriate choice would be a closed cell 2.0 pcf spray foam insulation.

<table>
<thead>
<tr>
<th>Open Cell</th>
<th>Zero</th>
<th>Closed Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good insulation value (R=3.8 per inch)</td>
<td>Better insulation value over Open Cell foams (R=6.0 per inch)</td>
<td>Best insulation value over both Open Cell and Hybrid cell foams (R=6.5 to 7.0 per inch)</td>
</tr>
<tr>
<td>Higher vapor permeability when compared to Hybrid cell and closed cell foams.</td>
<td>Better vapor permeability when compared to open cell.</td>
<td>Considered a low vapor permeability, vapor barrier at 1”.</td>
</tr>
<tr>
<td>Mets criteria for air barrier at &gt;3.5” pre ASTM E-283.</td>
<td>Mets criteria for air barrier at &gt;2” pre ASTM E-283.</td>
<td>Mets criteria for air barrier at &gt;1” pre ASTM E-283</td>
</tr>
<tr>
<td>Will not increase wall strength.</td>
<td>Will help increase wall strength better then open cell foams.</td>
<td>Will increase the wall water due to the higher tensive and shear strength characteristics.</td>
</tr>
<tr>
<td>Low density foam 0.40 to 0.50 lbs./ft³.</td>
<td>Low to Medium density foam 1.3 to 1.8 lbs./ft³</td>
<td>Medium density foam 1.8 to 2.2 lbs./ft³</td>
</tr>
<tr>
<td>Absorbs sound better especially.</td>
<td>Absorbs sound better due to its unique cellular structure</td>
<td>Not as good as a sound absorption when compared to other density foams.</td>
</tr>
<tr>
<td>High Yield</td>
<td>Good Yield</td>
<td>Medium Yield</td>
</tr>
</tbody>
</table>