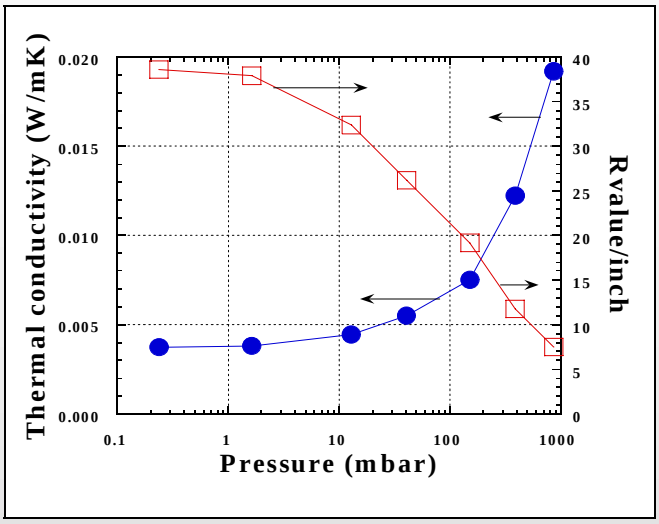
NanoPore™

Vacuum Insulation Panels and Inserts

NanoPore ™ Thermal Insulation

NanoPore™ thermal insulation is a porous solid that is prepared by one of several processes which yield both low density and small pores. Its chemical composition is silica, titania and/or carbon in a 3-D, highly branched network of primary particles (2-20 nm) which aggregate into larger (nm to µm) particles The material has pore sizes ranging from 10-100 nm. It is this nano-scale porosity that gives NanoPore its excellent thermal performance



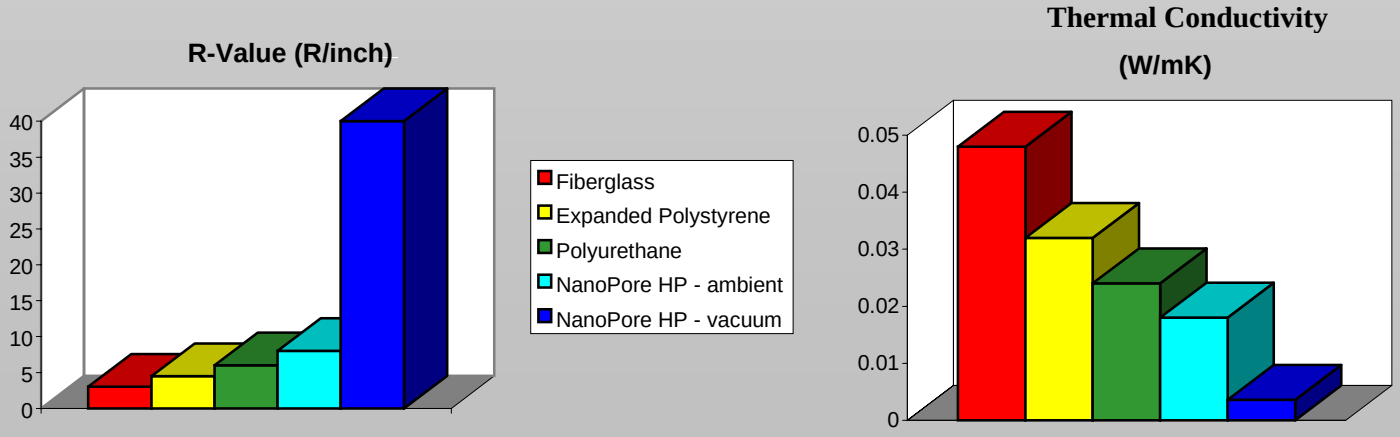
NanoPore™ HP thermal properties at various pressures.

High Performance

NanoPore™ thermal insulation provides exceptional performance at both ambient pressure and moderate vacuum levels.

Due to unique structure, its conductivity can actually be lower than air at the same pressure. Its superior insulation characteristics are due to the unique shape and small size of its large number of pores. Gas molecules within the matrix experience what is known as the Knudsen effect, which virtually eliminates exchange of energy in the gas, effectively eliminating convection and lowering overall thermal conductivity. Solid phase conduction is low due to the materials low density and high surface area, and NanoPore's proprietary blend of infra-red opacifiers greatly reduce radiant heat transfer

A comparison graph of NanoPore™ HP to other forms of insulation such as polyurethane, expanded polystyrene (EPS), and fiberglass is illustrated with thermal conductivity and R value per inch in the charts below. Thermal conductivity and R value per inch are inversely related. The total resistance to heat transfer is the product of the R-value per inch and the thickness. For example, a one inch thick NanoPore™ HP vacuum panel provides the same insulation value as over twelve inches of fiberglass or eight inches of polystyrene foam.



The superior thermal performance of NanoPore™ HP is shown compared to conventional insulation materials.

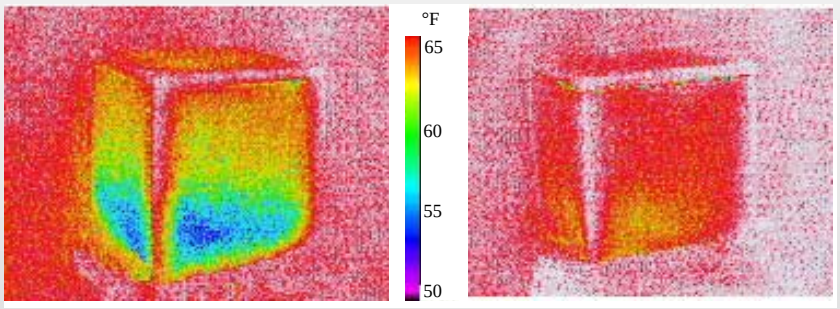
Vacuum Insulation Panels

NanoPore™ thermal insulation begins as a powder which is pressed into boards. These are cut to size, and then shrink-wrapped. At this stage, they are called inserts. Next, the inserts are encased in a metalized plastic barrier film, and then sealed under vacuum. The completed product is a Vacuum Insulation Panel (VIP). VIP thickness can range from slightly over 1/16" (2mm) to over 1 ½" (40mm), and panel size from less than 1" (25mm) square to a maximum size of 22" (560mm) x 28" (711mm).

A standard VIP can operate in a temperature range from below 330°F (-200°C) to 250°F (120°C), the maximum continuous working temperature of the barrier film. For higher temperature applications, custom vacuum enclosures, made from metal or another impermeable skin, may be used to house the core material.

Vacuum Insulation Panels

Applications for NanoPore™ Thermal Insulation



30mm thick Polystyrene insulated box filled with dry ice.

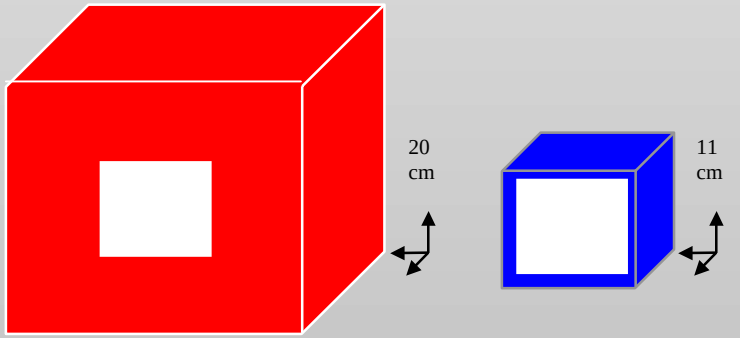
The same box lined with 6mm thick NanoPore™ HP vacuum panels and filled with dry ice.

- **Products that Require High Energy Efficiency**
- **Applications where the Lowest Conductivity Insulation is Critical**
- **Space Critical Projects**
- **Products Requiring Close Thermal Tolerances**
- **Weight Critical Applications**

Current applications include shipping containers, pipe insulation, refrigeration, coolers, and many others in such diverse industries as consumer and industrial appliances, electronics, pharmaceuticals, cryogenics, aerospace, and automotive.

The NanoPore Advantage

- **Performance Unmatched in Conventional Insulation Materials**
- **Reduction in Device Size**
- **Shipping Containers**
  Smaller package = Less shipping costs.
- **Environmentally friendly and recyclable**
- **No CFC's or HCFC's. Nonflammable.**
- **VIPs – Cryogenic to 250°F (120°C)**
- **NanoPore core – Cryogenic to > 1470°F (800°C)**



50 mm thick expanded polystyrene
Insulation volume = 7000 cm^3
External heat transfer area = 0.240 m^2
Internal volume = 1000 cm^3

Equivalent VIP thickness = 5 mm
Insulation volume = 330 cm^3
External heat transfer area = 0.072 m^2
Internal volume = 1000 cm^3

Contact

NanoPore Incorporated
2501 Alamo Avenue SE
Albuquerque, New Mexico 87106

www.nanopore.com

(505) 247-4041
(505) 247-4046 Fax
info@nanopore.com