Technical Bulletin

01.1207 Door Core Material Comparisons

A Case Study in Polyurethane and Polystyrene Cores

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By: Stiles Custom Metal, Inc.

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Our technical bulletins are prepared as tools designed to inform our customers of updates and other technical data as it relates to our products and services. It is our goal that the data herein will help you to make informed decisions when designing, specifying, or ordering Stiles products.

Stiles makes no guarantee as to the accuracy of information obtained from outside sources. Whenever possible, links will be provided for additional information, and sources cited.

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Summary

There has existed an ongoing debate within our industry regarding the comparison of two distinct door core materials: 1) EPS, more commonly known as Expanded Polystyrene or "Styrene", and 2) Polyurethane, or "Urethane." These materials have been utilized as insulated core material in the hollow metal industry for many years, both showing good results in terms of quality, performance, and impact resistance.

Over the past several years, there has been a rapidly growing movement toward the utilization of "green" building materials in most all facets of construction. This new-found environmental awareness has sparked controversy over the public safety and environmental impact (both during manufacturing and end-use) of many products.

At Stiles, we maintain a state-of-the-art Research & Development department that is responsible for the continual improvement of our products. After careful testing and study, we have concluded that there are both advantages and disadvantages to both polyurethane and EPS core materials that must be considered when specifying doors for a particular application. In order to assist you in making intelligent choices based on facts, this study will include the following data:

1. Definition of Terms
2. Products and Product Data
3. Product Comparisons
3. Environmental Advisory
4. Recommendation

Definition of Terms

R-Value

R-Value is an indicator of an insulation's resistance to heat flow. The higher the R-Value, the greater the insulating effectiveness.

Thermal Drift

The breakdown (measure in R-Value) of various insulations over time.

HCFCs

HCFCs, or hydrochlorofluorocarbons, are gasses found in polyurethane insulation.

EPS

Expanded Polystyrene

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Product Descriptions

Polyurethane Insulation Materials

Polyurethane is a closed-cell foam insulation material that contains a low-conductivity gas (hydrochlorofluorocarbons or HCFC) in its cells. The high thermal resistance of the gas gives polyurethane insulation materials an R-value typically around R-6 to R-8 per inch.

Over time, the R-value of polyurethane insulation can drop as some of the low-conductivity gas escapes and air replaces it. This phenomenon is known as thermal drift. Experimental data indicates that most thermal drift occurs within the first two years after the insulation material is manufactured. The R-value then slowly decreases. For example, if the insulation has an initial R-value of R-9 per inch, it will probably eventually drop to R-7 per inch. The R-value then remains unchanged unless the foam is damaged.

Polyurethane insulation is available as a liquid sprayed foam and rigid foam board. It can also be made into laminated insulation panels with a variety of facings.

Polystyrene Insulation Materials

Polystyrene, also called EPS or Expanded Polystyrene, is a colorless thermoplastic commonly used to make form board insulation, concrete block insulation, and a type of loose-fill which consists of small beads of polystyrene.

Other polystyrene insulation materials similar to MEPS are expanded polystyrene (EPS) and extruded polystyrene (XPS). EPS and XPS are both made from polystyrene but the manufacturing process is different. EPS is composed of small plastic beads that are fused together. XPS begins as a molten material that is pressed out of a form into sheets.

XPS is most commonly used as foam board insulation. EPS is commonly produced in blocks. Both MEPS and XPS are also often used as the insulation for structural insulating panels (SIPs), and insulating concrete forms (ICFs).

The thermal resistance or R-value of polystyrene foam board depends on its density. They typically range from R-3.8 to R-5.0 per inch, depending on density.

Source: US Department of Energy

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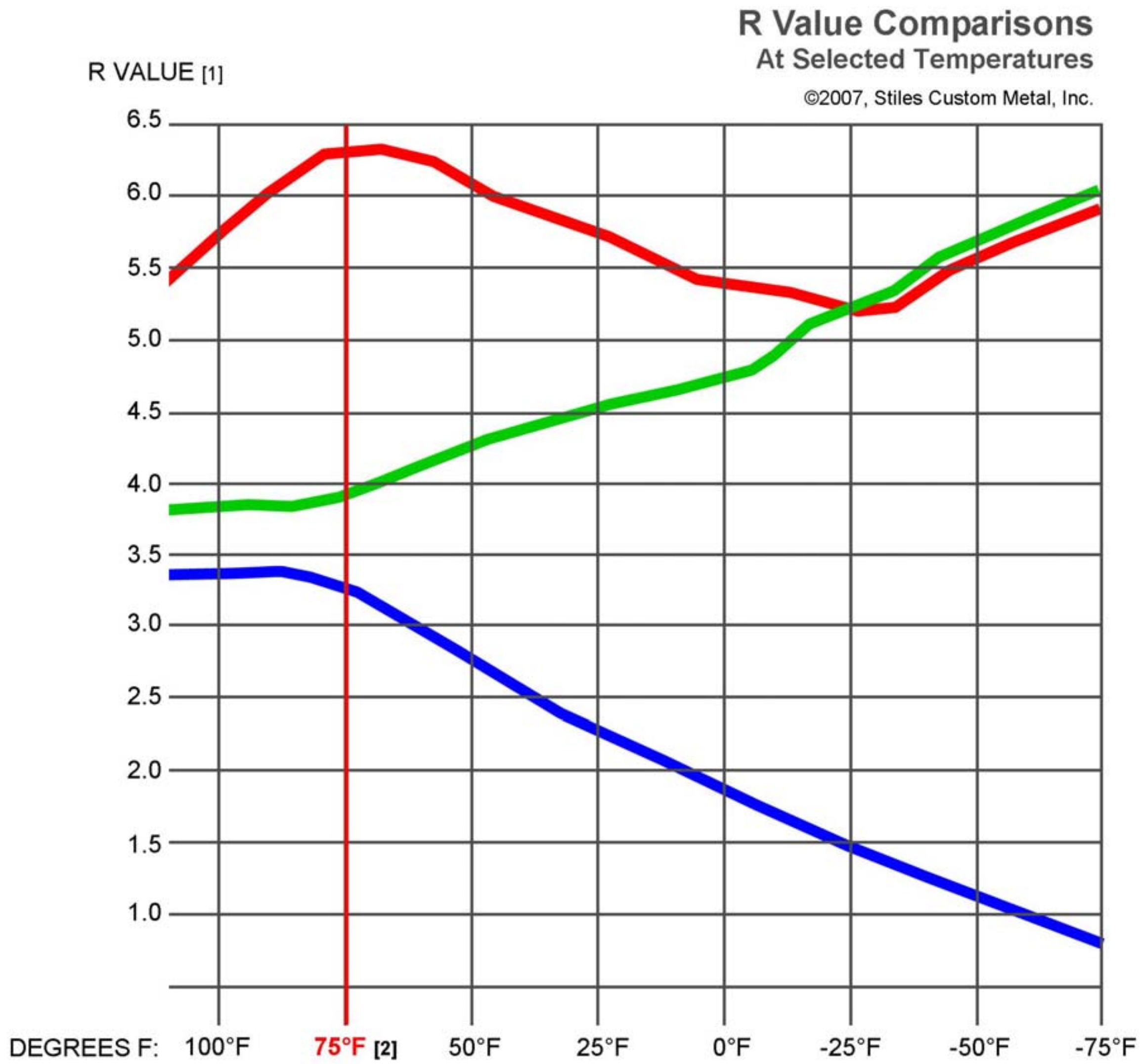
Product Comparisons



POLYURETHANE (Sheet)

EXPANDED POLYSTYRENE (EPS Sheet, 1 lb density)

FIBERGLASS (Batt)

NOTES:

[1] R Value per inch of material
[2] Benchmark temperature of establishing R Value

Source: Thermasave US, 2007

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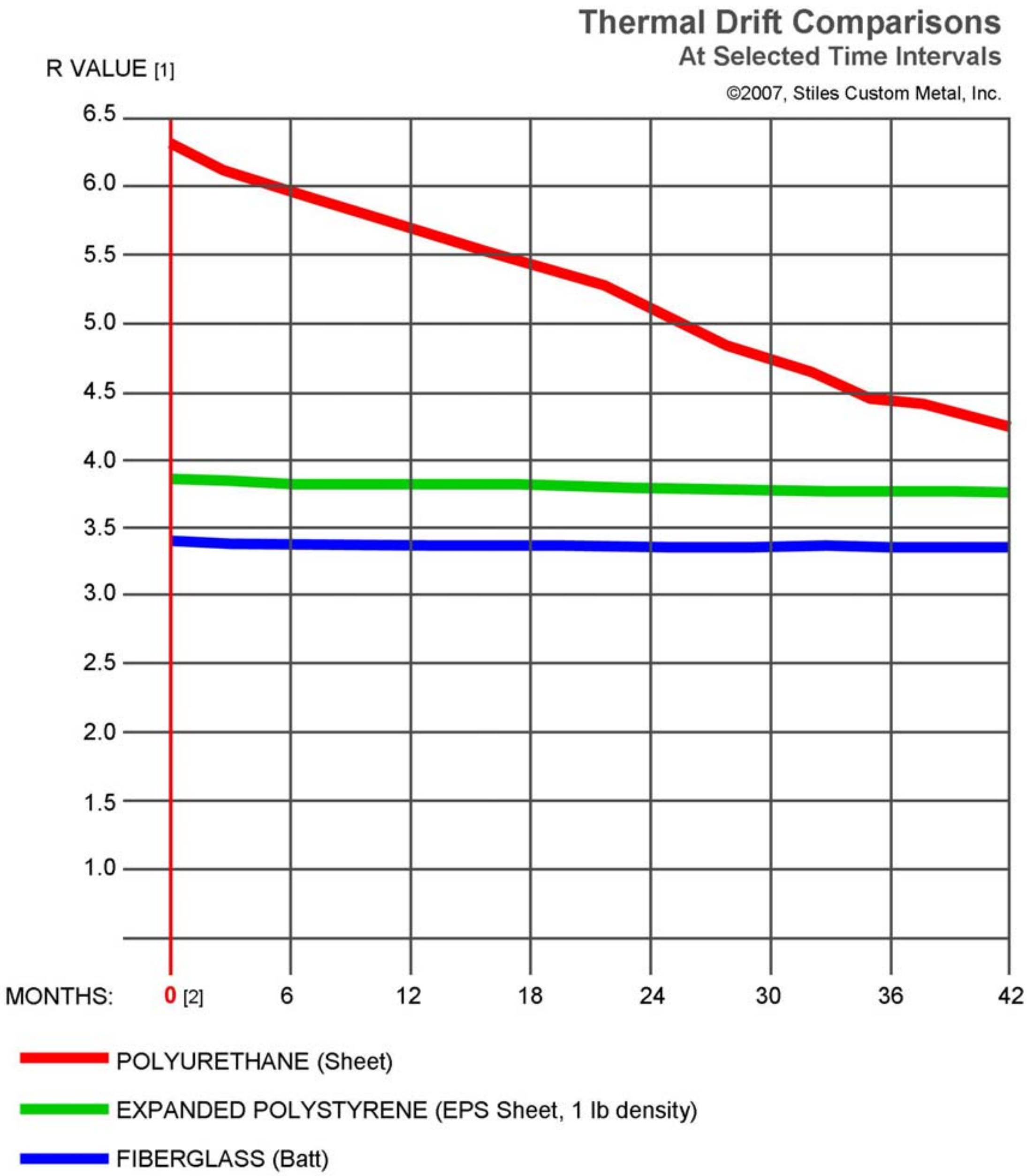

NOTES:

[1] R Value per inch of material
[2] Point of Product Manufacture

Source: Thermasave US, 2007

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R-Value - Loss and Thermal Drift Comparison					
Core Material	Density	R-Value (per in @ 75°F)	R-Value Loss (per in @ 0°F)	R-Value Loss (per in @ -25°F)	Thermal Drift (42 months)
Rigid Polyurethane	2.0 pcf	6.4	-1.1 (Loss)	-1.15 (Loss)	-2.10 (Loss)
Rigid Polystyrene	1.0 pcf	3.8	+1.7 (Gain)	+1.45 (Gain)	-0.01 (Loss)
Loose Fiberglass Batt	1.5 pcf	3.2	-1.4 (Loss)	-0.92 (Loss)	-0.002 (Loss)

Polyurethane

POSITIVE ATTRIBUTES

- Very High Initial R-Value per inch of insulation
- High Moisture / Mold Resistance
- Good Chemical Resistance
- Good Impact Resistance

NEGATIVE ATTRIBUTES

- Contains hyrdochlorofluorocarbons (HCFCs)
The HCFC gases in polyurethane's cells dissipate into atmosphere over time, thus causing breakdown of integrity of insulation and environmental damage
- High Thermal Drift Rate
(loss of R-Value over time)
- Produces toxic gases when exposed to fire
- More costly than Polystyrene
(especially in the long-run)
- Produces toxic airborne dust as a result of cutting
- Takes more energy to produce than polystyrene

Polystyrene

POSITIVE ATTRIBUTES

- Inert, organic material, HCFC and CFC free
- High R-Value per inch of insulation
- Very Low Thermal Drift Rate
(retains R-Value over time)
- High Moisture / Mold Resistance
- Withstands constant temperature fluctuations
- Less costly than polyurethane
- Fully recyclable
(Recycled content in material can be specified post-consumer)
- Cut with a hot-wire, eliminating airborne dust
- Does not affect indoor air quality
- Takes less energy to manufacture than polyurethane
- Good Impact Resistance

NEGATIVE ATTRIBUTES

- Lower **initial** R-Values than polyurethane
- Poor Chemical Resistance

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Environmental Advisory

While all insulation is inherently 'green' due to its energy savings capabilities, green attributes will differ based on each material's physical properties and its subsequent ability to enhance sustainability.

Ployurethane Concern: HCFCs

HCFCs, or hydrochlorofluorocarbons, are gasses found in polyurethane insulation. HCFC's emerged in the 1990s to phase out older and more ozone-damaging chlorofluorocarbons (CFCs). CFCs were blamed for a hole in the ozone layer, the atmospheric layer that helps protect against the sun's most harmful rays and traps the Earth's heat. The hole contributed to a rise in average surface temperatures.

However, while HCFCs are less destructive to the ozone layer, they are considered potent greenhouse gases that harm the climate — up to 10,000 times worse than carbon dioxide emissions. U.N. climate experts claim that the atmosphere could be spared the equivalent of 1 billion tons of carbon dioxide emissions if countries used ammonia, hydrocarbons, carbon dioxide or other ozone-friendly chemicals, rather than HCFCs and hydrofluorocarbons or HFCs, in foams and refrigerants.

Polystyrene Attribute: HCFC Free

Since the 1950s, polystyrene, unlike polyurethane, has always been CFC and HCFC free.

Recommendation

It is our conclusion that polystyrene door core material should be specified and utilized whenever possible. We have carefully gathered, reviewed, and considered a great deal of data pertaining to both polyurethane and polystyrene. Both are fine products and have been utilized for many years. In light of the facts, we ask that you consider the following key issues when making a determination between these two products:

1. **Environmental Concerns**
2. **Insulating longevity over the lifespan of the product**
3. **Toxicity of gasses emitted during fire of polyurethane**
4. **Cost effectiveness (dollar spent per R-Value point)**

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