



The "R-Value" Myth of Insulation

One of the fairy tales of our time is the "[R-value](#)." The "[R-value](#)" is touted to the American consumer to the point where it has taken a "chiseled in stone" status. The saddest part of the fairy tale is the [R-value](#) by itself is almost a worthless number.

It is impossible to define an insulation with a single value or factor. It is imperative we know more than a single "[R](#)" value. So why do we allow the [R-value](#) fairy tale to be perpetuated? I don't know. I don't know if anybody knows. It obviously favors fiber insulation. Consider the [R-value](#) of an insulation after it has been submersed in water or with a 20 mile per hour wind blowing through it. Obviously the [R-value](#) of fiber insulations would go to zero. Under the same conditions, the solid insulations would be largely unaffected. Again [R-value](#) numbers are "funny" numbers. They are meaningless unless we know [other characteristics](#).

None of us would ever buy a piece of property if we knew only one dimension. Suppose someone offered a property for \$10,000 and told you it was a seven. You would instantly wonder if that meant seven acres, seven square feet, seven miles square, or what. You would want to know where it was -- in a swamp, on a mountain, in downtown Dallas. In other words, one number cannot accurately describe anything. The use of an [R-value](#) alone is absolutely ridiculous. Yet we have Code bodies mandating [R-values](#) of 20's or 30's or 40's. A fiber insulation having an [R-value](#) of 25 placed in a house not properly sealed will allow the wind to blow through it as if there were no insulation. Maybe the [R-value](#) is accurate in the tested material in the lab, but it is not even remotely part of the real world. We must start asking for some additional dimensions to our insulation. We need to know its resistance to air penetration, to free water, and to vapor drive ([U values and K values](#)). What is the [R-value](#) after it is subjected to real world conditions?

The [R-value](#) is a fictitious number supposed to indicate a material's ability to resist heat loss. It is derived by taking the "[k](#)" value of a product and dividing it into the number one. The "[k](#)" value is the actual measurement of heat transferred through a specific material.

Test to Determine the R-Value

The test used to produce the "[R](#)" value is an ASTM test. This ASTM test was designed by a committee to give us measurement values that hopefully would be meaningful. A major part of the problem lies in the out dated design of the test. The test favors the fiber insulations -- fiberglass, rock wool, and cellulose fiber. Very little input went into the test for the advanced solid insulations of today, such as foam glass, cork, expanded polystyrene or urethane foam.

The test does not account for air movement (wind) or any amount of moisture (water vapor); the [U factors, K factors or C factors](#) of state-of-the-art insulations. For instance, fiberglass is generally assigned an [R-value](#) of approximately 3.5. It will only achieve that [R-value](#) if tested in an absolute zero wind and zero moisture environment. **Zero wind and zero moisture are not real-world.** Our houses leak air, all our buildings leak air, and they often leak water. Water vapor from the atmosphere, showers, cooking, breathing, etc. constantly moves back and forth through the walls and ceilings. If an attic is not properly ventilated, the water vapor from inside a house will very quickly semi-saturate the insulation above the ceiling. Even small amounts of moisture will cause a dramatic drop in fiber insulation's [R-value](#) -- as much as 50 percent or more.

Vapor Barriers

We are told, with very good reason, that insulation should have a vapor barrier on the warm side. Which is the warm side of the wall of a house? Obviously, it changes from summer to winter -- even from day to night. If it is 20 F below zero outside, the inside of an occupied house is certainly the warm side. During the summer months, when the sun is shining, very obviously the warm side is the outside. Sometimes the novice will try to put vapor barriers on both sides of the insulation. Vapor barriers on both sides of fiber insulation generally [prove to be disastrous](#). It seems the vapor barriers will stop most of the moisture but not all. Small amounts of moisture will move into the fiber insulation between the two vapor barriers and be trapped promoting [mold](#). It will accumulate as the temperature swings back and forth. This accumulation can become a [huge problem](#). We have re-insulated a number of potato storages which originally were insulated with fiberglass having a vapor barrier on both sides. Within a year or two the insulation would completely fail to insulate. The moisture would get trapped between the vapor barriers and saturate the fiberglass insulation to the point of holding buckets of water. Fiber insulation needs ventilation on one side; therefore, the vapor barrier should go on the side where it will do the most good.

The [best known solid insulation](#) is expanded [polystyrene](#) or [polyurethane](#). Other solid insulations include cork, foam glass and polyisocyanate or polyisocyanurate board stock. The latter two being variations of urethane foam. Each of these insulations are ideally suited for many uses. Foam glass has been used for years on hot and cold tanks, especially in places where vapor drive is a problem. Cork is of course a very old standby often used in freezer applications. EPS or expanded [polystyrene](#) is seemingly used everywhere from throw away drinking cups and food containers to perimeter foundation insulation, masonry insulations, and more. Urethane board stock is becoming the standard for roof insulation, especially for hot mopped [roofs](#). It is also widely used for exterior sheathing on many of the new houses. The [R-value](#) of the urethane board stock is of course better than any of the other solid insulations. [Solid insulations](#) will always perform far better than fiber insulations whenever wind or moisture is involved.

Some [solid insulations](#) are placed as sheets or board stock. They suffer from one very common problem. They generally don't fit tight enough to prevent [air infiltration](#). It does not matter how thick these board stocks are if the wind gets behind it. We see this often in masonry construction where board stock is used between a brick and a block wall. Unless the board stock is actually physically glued to the block wall air will infiltrate behind it. In this

case as the [air flows](#) through the weep holes in the brick and around the insulation it is rendered virtually useless. Great care must be exercised in placing the solid insulations. The brick ties need to be fitted at the joints and then sealed to prevent [air flow](#) behind the insulation.

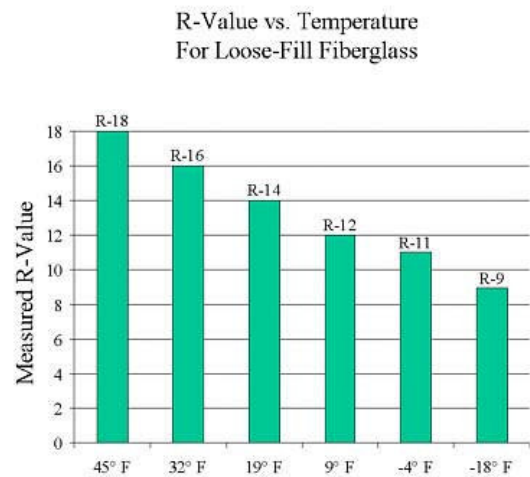
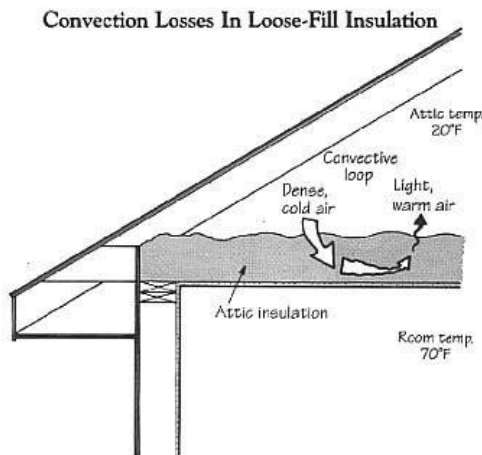
The only commonly used solid insulation that absolutely protects itself from air infiltration is the [spray-in-place polyurethane](#). When it is properly placed between two studs or against the concrete block wall or wherever, the bonding of the spray plus the expansion of the material in place will effect a total seal. This total seal is almost impossible to overestimate. Most of the heat loss in the walls of the home have to do with the [air seal](#) rather than the insulation.

For physical reasons, heat does not conduct horizontally nearly as well as it does vertically. Therefore, if there were no insulation in the walls of the homes, but an absolute airtight seal, there would not necessarily be a huge difference in the heat loss. This would not be the case if the insulation was missing from the ceiling. [Air infiltration](#) can most effectively be stopped with [spray-in-place polyurethane](#). It is the only material (properly applied) that will fill in the corners, the cripples, the double studs, bottom plates, top plates, etc. The [R-value](#) of a material is of no interest or consequence if [air can get past it](#).

Anecdotes

During the 1970 our firm insulated a bunch of new homes with 1.25 inches of spray-in-place [polyurethane foam](#) in the walls. In 1970 the popular number for the [R-value](#) of one inch of [urethane foam](#) was 9.09 per inch. Using this value, we were putting an R of $1.25 \times 9.09 = 11.36$ in the walls. This was much less than the R = 16 claimed by the fiberglass insulators. Today, using the charts from an ASHRAE book, we would only be able to claim an [R-value](#) for the 1.25 inches of 7.5 to 9. Neither of these numbers make for a very big [R-value](#). The reality is that the people for whom we insulated their homes invariably would thank us for the savings in their heat bills. They would tell us their heating bill was half of their neighbor's. They felt as if they saved the cost of the [polyurethane](#) in one, or at most two, years. This is anecdotal evidence, we know, but anecdotal evidence is also compelling and very real in our world. Most of these customers were savvy people. They would not have paid the extra to get the urethane [spray foam insulation](#) if it had not been better.

- Our Company
- MediaCenter
- Containment Systems
- Sealants & Coatings
- Thermal
- Welcome
- 3 Factors to Consider
- Advantage Program
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- Architect Residential
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- Case Studies
- Cellulose
- Corrosion
- Energy Savings
- FAQs - Cellulose
- FAQs - Spray Foam
- Fire Safety
- Gallery Commercial
- Gallery Residential
- Healthy Home
- Hotbox
- Acoustic Support



There is a problem with loose-fill fiberglass attic insulation in cold climates. It appears that, as attic temperature drops below a certain point, air begins to circulate into and within the insulation, forming "convective loops" that increase heat loss and decrease

In full-scale attic tests at Oak Ridge national Laboratory, the [R-value](#) of 6 inches of cubed loose-fill attic insulation progressively fell as the attic air temperature dropped. At -18 F, the [R-value](#) measured only R-9. The problem seems to occur with **any low-density, loose-fill fibrous insulation**.

Nisson, J.D. Ned, JLC, "Attic Insulation Problems In Cold Climates" March 1992, pp 42-43 the effective [R-value](#). At very cold temperatures (-20F), the [R-value](#) may decrease by up to 50%."

With the lowest [k-factor](#) and the highest [R-value](#), urethane foam can provide more thermal resistance with less material than any other insulation.

About mid 1975 All Tech Insulation received a call from a division manager of one of the major fiberglass insulation manufacturers. The caller asked, "I understand that you are spraying [polyurethane](#) in the walls of homes?" We told him that was true. He was calling because we were cutting into the fiberglass insulation sales in his area. He asked, "[How can we do it?](#)"

We knew what he meant. He wanted to know how we could look somebody in the eye and sell them a more expensive insulation than the cheap old fiberglass. We told him the way we did it is with a spray gun. Of course, that wasn't the answer he wanted. He wanted to know how we could not feel guilty. We told him of insulating one of two nearly identical houses built side by side. We insulated the walls of one with 1.25 inches of [urethane](#). The other house was insulated with full thick fiberglass batts put in place by a reputable installer. Not only did we use

only 1.25 inches of [urethane](#) as the total wall insulation, but we had the builder leave off the insulated sheathing. At the end of the first winter, the [urethane](#) insulated home had a heating bill half of their neighbor's. We know that is not terribly scientific, but it is very real. We're not sure he was convinced, but it should be noted that same company jumped into the [urethane spray foam](#) insulation supply business the next year.

One and a quarter inch of [polyurethane](#) sprayed properly in the wall of a house will prevent more heat loss than all the fiber insulation that can be crammed in the walls -- even up to an eight inch thickness. Not only does it provide better insulation, but it provides significant [additional strength to the house](#).

One of our early clients was Brent. All Tech Insulation had insulated several potato storages for him. He knew what spray-in-place foam urethane insulation could do. When he decided to build his new, very large, very fancy new home, he asked All Tech Insulation to come insulate it. We told him we would be delighted. The builder pitched a fit. He "didn't need any of that spray-in-place [foam urethane insulation](#) in his buildings. He made his buildings [air tight](#), and fiberglass was just as good."

Brent explained to the builder, "I know who is going to insulate the building. It is not as definite as to who is going to be the contractor. You can make up your mind. We are going to have the urethane [spray foam insulation](#) and you build the building, or we are going to have the [urethane spray foam insulation](#), and I will have someone else build the building." It didn't take the contractor long to decide he wanted to use All Tech Insulation and have us install urethane [spray foam insulation](#).

[Contact an All Tech Insulation engineer](#) today **(989-826-9999)** for a deeper discussion about your insulation requirements.



Live Help: Available

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