Insulation Insights
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Firwin FAQ – What Is the "R Value" of your Insulation Blankets?

Many of us are familiar with the kind of insulation used in the construction industry – that pink fiberglass stuff that typically goes in your walls and attic. These insulations, typically fiberglass, come with 'R' values, with are provided by the manufacturer as a measure of the effectiveness of the insulation. The 'R' value is a relative number, meaning that the higher the 'R' value, the more effective the insulation, so that an insulation with an 'R' value of 30 will perform better, keeping my home warmer in the winter and colder in the summer, than an insulation with an 'R' value of 20. Correct?

Well, if you're looking to insulate your home, then you would be right. An 'R' value is determined by a material's "thermal resistance" at a given temperature. In the home and building industry it is generally calculated at 75°F (24°C). Since a typical building will hover around this temperature, the 'R' values for building industry applications will give you a good idea of their performance. However, when it comes to insulating engines, exhaust systems, and other industrial applications, temperatures can vary and get extremely high. The 'R' value of an insulator at 500°F (260°C) will differ from its 'R' value at 750°F (390°C). So when comparing insulation materials, or trying to determine how effective a given insulation is, for these type of applications one would need to know the 'R' values over the temperature range. Knowing the 'R' value at the temperature where building insulation is rated will have little if no use.

'R' Value and 'K' Value - Definitions

In order to get a better understanding of what an 'R' value, and its inverse, the 'K'

value mean, it useful to look at their definitions. 'K' value is a measure of a material's "thermal conductivity", which is defined as "the time rate of steady state heat flow through a unit area of a homogenous material induced by a unit temperature gradient in a direction perpendicular to that unit area".[1] In other words, the 'K' value is the actual measurement of heat transferred through a specific material.[2] Its unit of measure is Btu-inch/hour per square foot per degree F (or W/(m.k)).

The 'R' value, a measure of a material's "thermal resistance", is defined as "the quantity determined by the temperature difference, at steady state, between two defined surfaces of a material of construction that induces a unit heat flow though a unit area".[3] In other words, it is an indicator of a material's ability to resist heat loss. [4] It is the inverse of the 'K' value, multiplied by the thickness of the insulation. For example, if a material's 'K' value is 0.25, then the 'R' value for 2" thick material would be 1 / 0.25 x 2, or an 'R' value of 8. In short, the lower the 'K' value, the higher the 'R' value, and the more effective the insulation. A 'K' value will be constant at a given temperature, while an 'R' value will fluctuate based on the thickness of the insulation.

Other Factors to Consider

Ok, you might say, but once I know the 'R' values in the temperature range of my application, does that mean that the higher 'R'-rated insulation will be the more effective insulator for my application? Well, the answer to that would be only a partial 'yes'.

"The problem with using 'R' values to rate an insulation material's effectiveness is that the 'R' value is just one of a number of critical variables to consider that can affect insulation performance", said Brett Herman, Firwin's Vice President of Sales and Customer Service. "For instance, how does an insulation material perform when it gets wet? Some insulation materials will stand up well to moisture over time and retain their integrity, while others will deteriorate. For applications where insulation blankets may come into contact with the elements, choosing an insulation with a high 'R' rating but which does not perform well when wet is

[1] Gordon Hart, Insulation Outlook, March 2009, "Understanding the Value in All These Values", p10.
[2] David South, The Monolithic Dome, " 'R' Fairy Tale – The Myth of Insulation Values", p 1.
[3] Gordon Hart, Insulation Outlook, March 2009, "Understanding the Value in All These Values", p12.
[4] David South, The Monolithic Dome, " 'R' Fairy Tale – The Myth of Insulation Values", p 1.

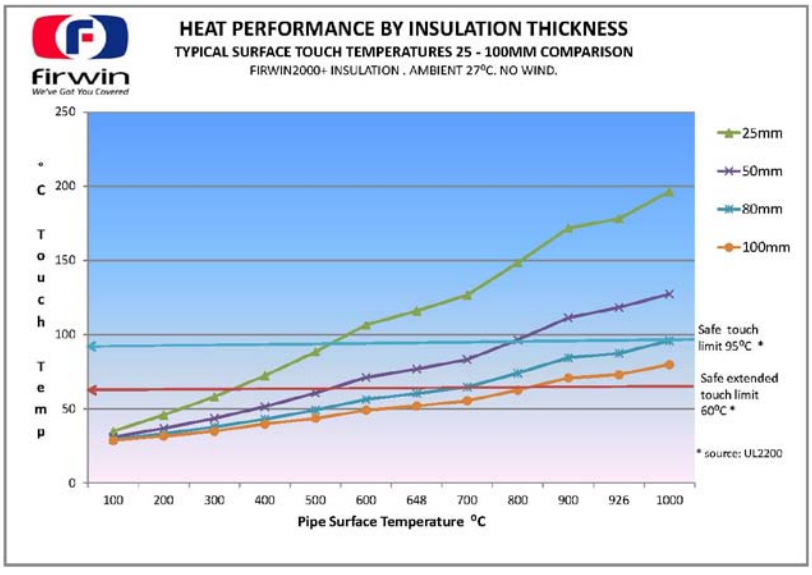
obviously not the correct solution no matter how high is its 'R' rating", added Brett.

Resistance to compression is another variable that can effect insulation performance. "The geometry of the components we insulate are often complex – elbows, silencers, catalysts, SCRs, valves, flanges", said Joash Katsivo, Firwin's Sales and Design Engineer. "Because of this we use dense insulation that resists compression even when formed to the shape of the component, thus retaining its insulation value. A low-density insulation may have a high 'R' value, but is easily compressed. If we were to wrap such an insulation around some of the exhaust components we cover, it would compress to very thin and lose its insulation value", added Joash.

Other variables that may effect an insulation's effectiveness are:
Temperature rating – What is the temperature range within which a given insulation is effective? Obviously, a high rated 'R' insulation will not be effective if the application's temperature falls outside the accepted temperature range for that insulation.
Vibration resistance – Some insulation materials are better at withstanding vibration than others. So an insulation with a high 'R' rating which does not stand up well to vibration would not be the best choice for a high vibration application.

Putting It All Together

"We find that when a customer is asking about an 'R' value, what he really wants to know is what material will meet the goals that he is trying to achieve by using insulation blankets. For instance, often the customer is concerned with personnel safety, and wants to ensure that the outside touch temperature of the insulation blanket will be within safe-touch limits", said Brett.



"What we will do in this case is gather the variable

information that is necessary to formulate this calculation. This information includes not only the material's 'K' / 'R' value, but also other variables that can affect the insulation blanket's performance - i.e. ambient temperature, air flow, and pipe diameter. We can then provide the customer with the outside temperature he can expect using certain insulation materials and thicknesses. This can also be illustrated graphically using Heat Flow Charts, so the customer can get a visual representation of how the outside surface blanket temperature will be affected by various material and thickness combinations", added Brett.

So what, if any, use do 'R' and 'K' values have in industrial settings where Firwin removable insulation blankets are typically found? "I would look at 'R' and 'K' values as indicators to be considered along side others when trying to determine the appropriateness of an insulation", said Brett. "Ultimately, the customer needs to inform us what it is they are trying to achieve, and then we can advise them accordingly".

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