# WHAT ABOUT R VALUES AND HOW DO THEY APPLY TO INSULATING COATINGS?

The R Value is an important aspect to fully understand before using Mascoat Products Insulating Coatings. In a nutshell, R Value is a simplistic way to describe the thermal conductivity of an insulation system. Laymen employed this system because it was much easier to remember a whole number as opposed to a fraction. Scientifically the R Value equation is:

***R value (R) = Thickness of the insulator (normally expressed in inches)/(k)***

***Where k= thermal conductivity expressed in BTU-in/Hr-ft²-F°***

This makes the calculation fairly complicated due to units and mathematical conversion. The real definition of thermal conductivity comes from "k" when expressed in Watts/meter/Kelvin. If proper translation does not occur, then effective R values can be severely skewed

Usually the R Value is the only way in which people think of how effective an insulator blocks heat or cold. The public knows that the higher the R Value number (the lower the k), the better an insulator is. Yet, most people don't even know how the number is created.

## R VALUE QUESTION

Most conventional insulators methods use a standardized ASTM testing method to gauge the insulation's effectiveness or *thermal conductivity*. There are many types of thermal conductivity tests however the two most significant tests in describing insulation are:

> ***ASTM-C-177*** Test Method C177-97 for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
>
> ***ASTM-C-518*** Test Method C518-98 for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

Both tests give an accurate reflection on thermal transmission through a substrate (k). Without going into great detail, the C-177 test is an apparatus that has a heating element placed in the center of two-mirror insulation thickness equaling one foot each (on each side of a heating element). The element is turned on and has a monitor that lets the operator know how much heat is applied into the element. There are thermocouples placed on the outside of the foot of insulation that record how much heat is being transmitted through the insulation. Since the operator knows how much heat is applied to the heating element and how much heat is coming out of the insulation, a calculation can be performed telling how much heat is let through the insulation. This

setup is then analyzed and a corresponding number is then derived to describe the thermal conductivity for the insulation. Thus, little flow of heat or cold means better insulation and therefore the corresponding k value would be low. The higher the heat or cold flow, the higher the k value.

C-518 is also a heat flux test that describes transmission of heat through a substrate. This test is usually a secondary means of describing the insulation effectiveness.

As described above, most engineers, specifiers, and contractors only know R Value. Rarely do they know how the number is created, unless they perform calculations every day with the "k" value. Thus, understanding the tests and the thermal conductivity of insulation is important. But this type of heat transfer is only one element of thermal dynamics and plays a small role in insulating coatings.

Since the ASTM tests are accepted by the mainstream, how does an insulating coating perform in the test? To be honest, not very well at first glance. As noted above, the ASTM tests are designed to measure a foot of insulation. Our coatings or any other insulating coating material will never reach one foot of thickness. This would equate to 600 twenty-mil coats. Also, they use other elements than conduction to produce their temperature differentials. Our coatings have been tested in both ASTM procedures described above resulting in mediocre numbers before the material thickness is considered. Yet, when the value for the coating is then divided by the thickness of the coating, the outcome is a respectable R Value.

As most engineers might note, the division of the coating's R Value number by its thickness also leads to a high margin of discrepancy due to mathematics. Since the k value is described in hundredths and thousands, division by a thin thickness equates to skewed numbers. Or a small fraction of a difference in the k value changes the R Value number dramatically. Thus, it is important to understand the tests, numbers, and mathematics of R Value and Insulating Coatings as described by ASTM tests.

Thus, to examine insulating coatings with standardized mass insulation tests for thermal conductivity is not an effective means for describing its abilities. The conductivity tests are describing insulation that is mass oriented and therefore thick in appearance when compared to insulating coating materials at a thickness equating to 0.020" or 0.5 mm.

## R VALUE EQUVILANCY (RvE)

Currently there is no specific test designed by the American Standards and Testing Methods committee. However since insulated coatings and roofing coatings are becoming more popular, the ASTM is supposed to design a test in the near future.

Thus, most coating systems have examined a method know as R Value Equivalency (RvE). This method compares conventional insulation systems to insulating coatings in a head to head comparison. An engineered test that is designed with like heating

elements and like substrates can reasonably compare insulating coatings against conventional insulation materials. An R Value equivalency is then extrapolated to the insulating coating system if the tested numbers are similar or matches the conventional insulation system. This system is not accepted by the ASTM yet, however, insulation coating and reflective coating manufacturers commonly use it.

This system has its faults as well. The RvE is usually performed by in house testing and can be weighted if not careful. Some insulating coating manufacturers do RvE comparisons without good scientific evaluation. Some coatings systems claim such, as a 10-mil coating is effectively as good as 4" of R20 foam insulation, which is an obvious overstatement. The coating may perform well initially but does it perform equally over time or in cold conditions? Thus these tests have generated much bad press and therefore careful evaluation is a must and should be thoroughly understood.

Yet, our coatings have used RvE comparison method with high scientific documentation. Our coatings have been compared to a wide variety of insulation systems resulting in an RvE of 9 to 15. The difference is due to manufacturers' differentiation of product and the coating's thickness. Our evaluation generated good scientific data as well as results that initially were not considered. This data allowed the generation of predictability as seen in the thickness vs. temperature graph and effects of prolonged immersion.

## EQUATION THEORY

Do not forget about the thermal dynamics lesson regarding the transmission of heat/cold. This is the backbone for understanding why the coating works. In short:

**Conventional insulation** ***= Conduction***

**Mascoat Insulating Coating =** ***Reflection + Conduction + Emissivity + Transmittance + Absorptance***

It is also important to note that the coating reflects heat due to its particles not because it is white in appearance. Also, that the heat that is generated through the coating has an extremely low heat flux (amperage as compared to electricity) resulting in little re-radiated energy.

## FAIRY TALES AND CLAIMS

A coating 20 mils (0.5mm) thick is not going to produce an R Value of 20. The buyer must beware of exaggerated claims. Our industry suffers from these fairy tales and this is why we want to explain what the real truth in thermal insulation coatings is.

The important way to tell if a coating is a true insulating coating is to examine the weight per gallon and solid content. If the weight per gallon is roughly 9-12 lbs, the

coating is a reflective roof barrier system comprised of resin and heavy particulate. These types of coatings provide only reflective blocking agents and no major degree of thermal insulating particles. If the coating's per gallon weight is 6.5 lbs (with a volume solid content of 70% or greater) or less, then it is most likely a true thermal insulation coating. *(*see more on this subject in the document **"Fairy tales**.")

## CONCLUSION

Mascoat's coatings are designed specifically for industrial, marine and commercial environments. These coatings were not a rooftop coating turned into industrial and marine coatings. This allows us to provide you with the best coating for your application. Our coatings are not just thick paints like other coatings or low emissivity coatings. They produce temperature differentials, whether directly exposed to the hot surface, or indirectly exposed (such as under a roof.) We offer an engineered approach to the world of thermal insulation coatings along with validated data and realistic claims.