Thermal Tutorial

1. **How does heat move?**

   Heat moves through one of three basic methods:

   - *Conduction* is the energy transfer through solids. Different types of solids transfer heat more easily than others, with metals among the most conductive and ceramics among the least conductive.
   - *Convection* is energy transfer through gasses or liquids. Currents carry heat energy through the liquid or gas. Most heat energy is transferred through convection.
   - *Radiation* is energy transferred through electromagnetic waves. Radiative energy converts to convection when it touches a solid surface.

2. **Where is heat attracted?**

   As a simple rule, heat always follows cold. Just like water, heat will move through the path of least resistance until it reaches a state of equilibrium.

3. **What is R-value?**

   An R-value is a measure of how well a convectional insulation resists heat transfer through conduction only. It was developed to test the insulating properties of traditional insulation, and ignores heat transfer by radiation and convection. It measures only "conductive heat transfer" – how much and how fast it absorbs heat and transfers it through a specific insulation.

4. **Is there a downside to R-value testing?**

   Yes. R-values are measured in a controlled environment and do not measure insulation against convective or radiational heat transfer. Real-world situations can compromise the R-value of traditional insulation substantially. For example, traditional insulation can lose 35% of its R-value when as little as 1.5% humidity is introduced.

5. **How does conventional insulation work?**

   Traditional insulation, including fiberglass, cellulose, polyurethane foam and other solids, contain small pockets of air that slow only conductive heat transfer. They do not block or prevent the transfer of heat, and therefore in traditional insulation heat will be absorbed, will load, and will transfer.

6. **How is Super Therm® different?**

Reflective Coating vs. Fiberglass vs. Super Therm®

Manufacturers in the past have marketed "reflective" coatings by making claims that they continuously repel heat, and have specific "R" values. The problem with such claims is that these coatings only reflect visual light or short wave radiation, and when they become dirty they stop working completely. Once these claims proved false, all similar coatings were put into the same category and deemed non-viable.

Super Therm® was designed and developed with the assistance of NASA, a fact that can be substantiated. The "ceramic compound" blends found to work the best, and are now used in Super Therm®, resulted from 18 years of testing and research. The difference between the technology of "reflective" coatings of the past and Super Therm® today, is

Super Therm®'s has the ability to block all the different radiation waves produced by the sun. Super Therm® not only blocks these waves when first applied, but continues to block them after the coating becomes dirty, which happens to all coatings. Engineering studies performed by the US Government and independent firms, have concluded that the sun's radiation produces heat from the following sources:

a. Ultra Violet (UV) represents 3% of the heat

b. Visual light or short wave radiation represents 40% of the heat

c. Infrared radiation or long wave represents 57% of the heat

Once these facts became known, the technology of blocking radiation heat was developed using laboratory testing to identify what methods and elements worked best to address these different types of heat. The ceramics used in Super Therm® were chosen from over 3,200 compounds, which were studied and tested in order to prove that they would block the different radiation waves the most effectively, producing the following results:

1. Super Therm® blocks 99% of UV heat

2. Super Therm® blocks 92% of Visual Light (short wave) heat

3. Super Therm® blocks 99% of Infrared (long wave) heat

This results in an average of over 96% of heat blocked!

What does this mean? In order to block heat using the old methods of insulation, such as fiberglass, rock wool, foam, etc., the heat is 100% accepted to load into the initial surface facing the sun. In order to slow down the heat transfer into the interior area, a thick material is placed on the opposite side of the initial surface to control this heat load. The ability to do this determines the "R" value of the insulation.

The "R" value is determined by an insulations capability to control heat "after the fact" - meaning that the initial surface facing the sun has absorbed 100% of the radiation heat LOAD, and then evaluating the thick layer of insulation's ability to control the transfer of heat, thus resulting in the appropriate "R" value.

Super Therm® blocks 95%+ of the initial heat load, meaning that the initial surface facing the sun only absorbs 5% of the initial heat load, not 100% as in traditional insulating technologies. This 5% value represents substantially less heat transfer than that experienced by traditional insulations, which slow down but do not stop, the transfer of heat.

The "R" value rating system was designed for thick insulation materials. For any material to actually have an "R" value, it must be a minimum of one inch (25mm) thick. We commissioned certified laboratories to do testing on heat available for transfer, and what actually makes it through the substrate to give an "R" equivalent value, and thus show it's effectiveness.

"Emissivity" has recently become very important issue in heat control for engineering and architectural groups. The higher the emissivity value, the more effective the surface of the coating is in throwing off the heat that was absorbed. The "black box" testing procedure is used to determine how much of the radiation heat loading is emitted after it has been absorbed. Super Therm® absorbs only 5% of the radiation heat and then throws off 91% of this absorbed heat. This has been tested and listed by three agencies to be correct under the newly developed testing procedures.

Bombardier Engineering decided to test Super Therm® against standard wrap type insulations that have the "R" rating values, such as Fiberglass, to compare the performance of each. Three inches (75mm) of fiberglass thickness was tested to have a "K" value of 0.53. In comparison, a 250-micron thickness (10 mils or credit card thickness) of Super Therm® was tested in the lab and found to have a "K" value of 0.31. When both sides of the same wall were coated with 250-microns (10 mils) of Super Therm®, the "K" value was 0.21. The lower the "K" value, the better the "R" value.

Fiberglass has only an "R 19" value when it is a full 6 inches (150mm) thick, not compacted in any way, and when there is "0" humidity in the air. Fiberglass must be fully protected from the atmospheric elements by a metal jacket. During varied weather conditions, the metal jacket changes temperatures, which results in condensation and causes the fiberglass to become wet. This destroys all of its insulative ability and can happen as quickly as 1 month of use. Fiberglass or rock wool only works in a controlled lab, and never in the field to its reported "R" value.

Super Therm® has been consistent in blocking heat LOAD in all weather conditions over many years. In 15 years of evaluation on sections of an old roof, Super Therm® only lost 8% of it's heat blocking ability. There is no comparison between Super Therm® and traditional insulation.

In the insulation field, it is known that air flows through walls, around windows and cracks, and can blow air through the existing insulation and prevent it from "holding" the heat. Also moisture from humidity is another factor that will load into the walls and materials, which allows heat to pass through at a faster rate, resulting in heat either being lost in winter, or gained in summer. Tyvek wrap is used throughout the building industry as a moisture and wind barrier. When the advertising material stamped on the Tyvek is read, it says it is an "air retarder" and nothing more. How many times have you passed by a building and the Tyvek is waving in the wind, which makes one wonder how much air and moisture is being blocked?

Super Therm® is a tested and proven "water barrier", and not just a moisture barrier. It surpasses the testing that "Dry Lock" and other water barrier materials have attained. Super Therm® can breathe, but is tight enough to block air flow, while also blocking moisture load. When Super Therm® is applied to block heat load, it automatically blocks wind and moisture, thus replacing the requirement of Tyvek and other plastics or foams.

Super Therm® provides an STC 50 rating for sound reduction between walls, a "0" flame spread, Class A fire resistance, and also resists mold or mildew development. No other insulation, water resistant or flame resistant products can cover all the areas that Super Therm® provides in a normal application.

7. **How can ceramic coatings help me?**

Ceramic coatings effectively lower temperatures inside of buildings, leading to reduced energy costs and less heat stress. Super Therm® blocks heat load, moisture penetration, and air filtration.

8. **When should I use Super Therm®?**

Super Therm® can be used as replacement for traditional insulation on most substrates and in most conditions. Super Therm® is extremely effective because it reduces moisture load into a substrate and air infiltration through a wall cavity, which substantially increases its insulation value over traditional insulation. Super Therm® will prevent moisture load, seal surfaces and cracks, which reduces air flow as well as blocking heat transfer.

For more information on SPI Products, please send us an email at **info@ecosolv.com**.
SPI products are manufactured by SPI in the USA in Shawnee, Kansas.