

Delta T & Protective Products

CCC 100 Ceramic Insulation Tests on Metal Boxes

Monday, November 01, 2010



CCC 100 Ceramic Insulation Tests

Objective:

The objective of these tests is twofold.

The first objective is to provide valued customers with a set of test methodologies so they can duplicate and verify our products insulating abilities.

The second objective is to answer questions of how to quantify performance of Ceramic Insulation. There is a lot of controversy and confusion in the building industry with the use of R-values or 'equivalent R-values' for products which have entirely different systems of inhibiting heat transfer. According to current standards, R-values are most reliably stated for conventional bulk insulation materials. Calculating the performance of our CCC100 radiant barrier is more complex. The tests and procedures to evaluate bulk insulators are not applicable to radiant barriers.

Background:

We insulate our houses to keep the heat in during the winter and out during the summer. In our modern world we insulate and control heat energy not only for our homes but in such diverse applications as the NASA space shuttle reentry heat problems, industrial tank protection, food production vessels, shipping containers and numerous other applications.

What we are doing by insulating is controlling Heat which is energy. Scientists and Physicists from Albert Einstein to Isacc Newton have defined principles relating to heat energy. Engineers are specialists in the highly technical Thermodynamics section of Engineering. So one doesn't just throw a few batts of R40 around the nose of the NASA space shuttle and hope to stop it from burning up. The engineer or applicator of the insulator should understand some very important principles of Heat energy.

The first important principle is to realize that Heat Energy is a composition of many other forms of energy. Heat energy from our Sun has a high content of UV (ultraviolet light). InfraRed is another form of light energy that is present in many sources of heat energy. Electromagnetic standing waves are present in many heat sources. So if you insulate you may block one form of energy and others will come waltzing through. So we feel the warmth or heat but it contains many other forms of energy. That is why we use "sun block lotion" at the beach. It doesn't cool us down but it does block out the UV component of the Suns Heat energy.

The second important fact is to understand the Second Law of Thermodynamics. This Law states in its simple form: "heat energy can only move from a higher to a lower temperature" Interested in First Law try this. An example of the second law of Thermodynamics is opening the door of your residence on a cold winter day; one might hear "close the door you are letting the cold in". In actual fact you are letting the Heat out as it is rushing out to the colder outside temperature.

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The third important principal to understand is how Heat Energy moves. Energy will always be moving trying to establish an ideal Thermal equilibrium state. In our case Heat Energy always will see a cooler place to move to. These three methods of Heat Energy moving are convection, conduction, and radiation. In engineering, energy transfer by heat between objects is classified as either heat conduction, also called diffusion, of two objects in contact, by convection, which is the mixing of hot and cold fluid regions (air is considered a fluid), and by thermal radiation, the transmission of electromagnetic radiation described by black body theory. ***Delta T Coatings work only on radiant heat*** and are not too effective with conduction or convection Heat Energy. Radiated heat not only comes from our mighty sun with all its various components such as IR and UV. Radiated heat can be as simple as the heat coming from a wood stove; the metal is radiating the Heat Energy.

What we attempt, when we insulate is to put a barrier up to stop Heat energy from doing its travels. If our barrier can attain a temperature difference from one side to the other of 0° or $\Delta T=0^\circ$, the Heat Energy will not move as it has reached equilibrium. CCC100 Ceramic insulation works on radiant heat energy by reflecting it away or absorbing it to form a Radiant Barrier. Conventional insulation puts up a thick wall of material so the Heat Energy movement is restricted by the many air pockets and has difficulty moving.

As we present our test results on CCC100 Ceramic Insulation we will be referring often to very technical principles of Thermodynamics to demonstrate the insulating properties of Ceramic Insulation. We will keep the discussion as simple as possible so that a normal technical person can understand the insulating ability of CCC100. This can be difficult at times as CCC100 works best as a radiant barrier and this discussion can be complex.

Methodology

Three metal boxes were constructed. A thermocouple was placed inside each box. Each Box had the same inside volume. We placed a heat source into each box and measured the inside and outside temperatures.

We will be working with the Second Law of Thermodynamics to demonstrate the Heat Energy movement in the metal boxes. As we heat the inside of the box up with the Heat Lamp, there will be a larger and larger temperature difference between the inside of the box and the outside. This ΔT will cause the Heat energy inside to leave the box and head for the cooler ambient air.

One of the boxes we will not insulate, so the Heat Energy has the easiest path possible thru the metal via conduction. This is the reason we used metal boxes. For these tests we want the heat to flow out of the box.

The next box is insulated on the inside with 20 mils DFT CC100 Ceramic Insulation to observe the insulating properties of CCC100 to convection and conduction heat energy inside of the Metal Box.

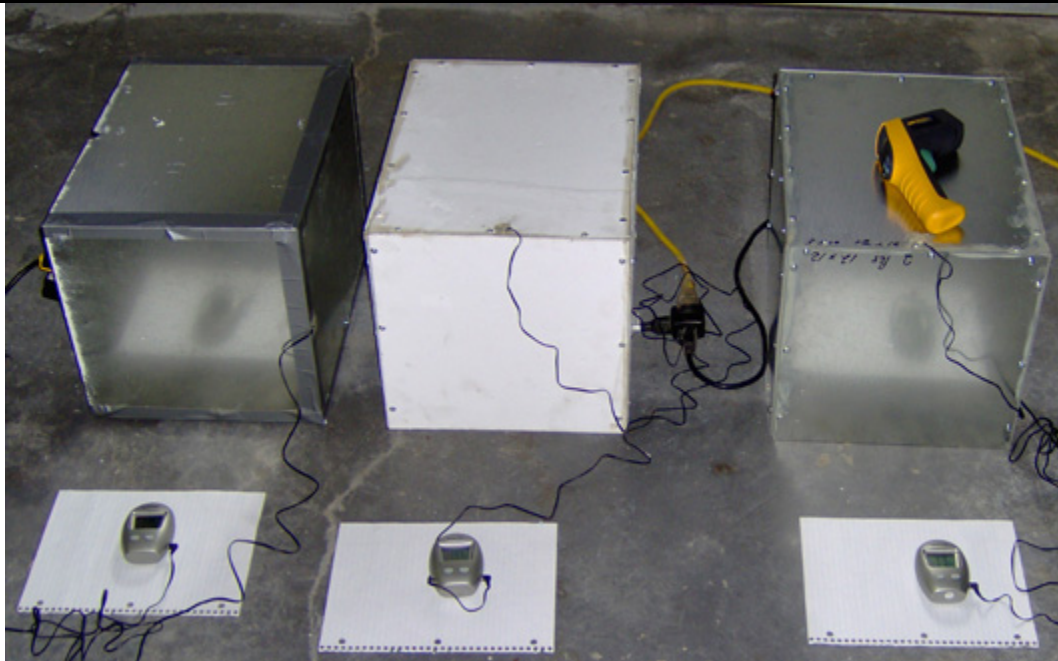
The next box is insulated on the outside with 20 mils DFT CC100 Ceramic Insulation to observe the forming of a Radiant Barrier to the Radiant Heat coming off the metal on the outside of the box

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Each box was heated inside with a 100 Watt Halogen Lamp for three hours. Temperature measurements were taken with our instrumentation, on the inside of the box and the outside of the box every 15 minutes. Delta T was calculated and charts were plotted for the three hour period.

In addition we used a 175 Watt Infrared lamp to further stress test the two boxes that were coated with CCC100 Radiant Heat Barrier Protection. This we recorded and charted.

Equipment



Three Metal boxes were constructed. Each metal box had the same dimensions of 12"x16"x16" so that the volume of each box was the same. Each metal box had a thermocouples installed inside the box to measure the inside temperature in degrees Centigrade. The meter used was a ACU-TEMP accurate to +/- 0.50C.

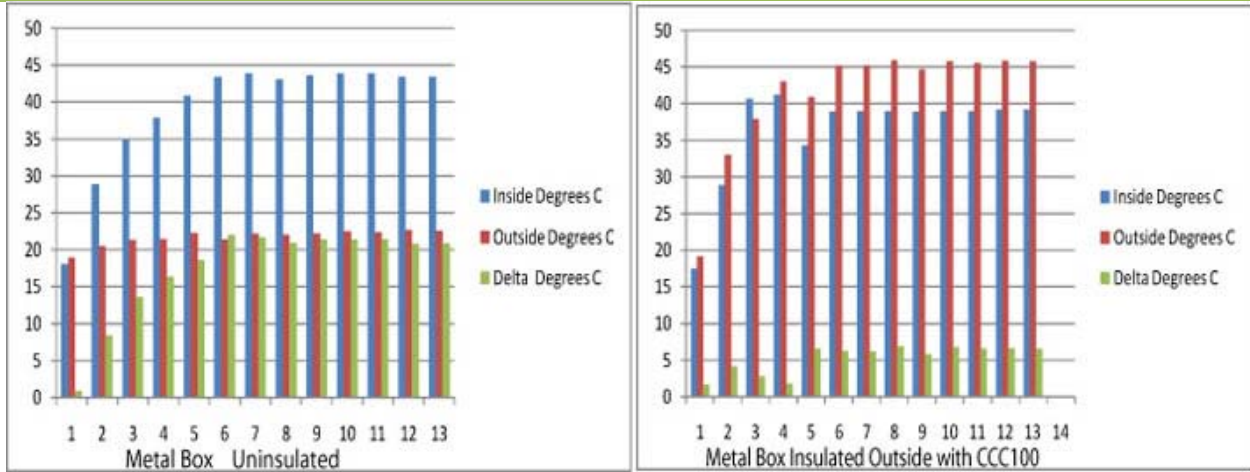
The box on the right in the upper Photo was un-insulated. The box in the middle was coated on the outside with 20 mils DTF CCC100 Ceramic Insulation. The Box on the Left was coated on the inside with 20 mils DTF of CCC100 Ceramic Insulation.

A quality Fluke 561 IR Thermometer, shown in the photo above was used to measure the outside surface temperature of the boxes. The Fluke 561 has a EMS setting (emisstivity) to accurately measure temperatures on shiny surfaces. The Fluke 561 EMS setting was set to medium.

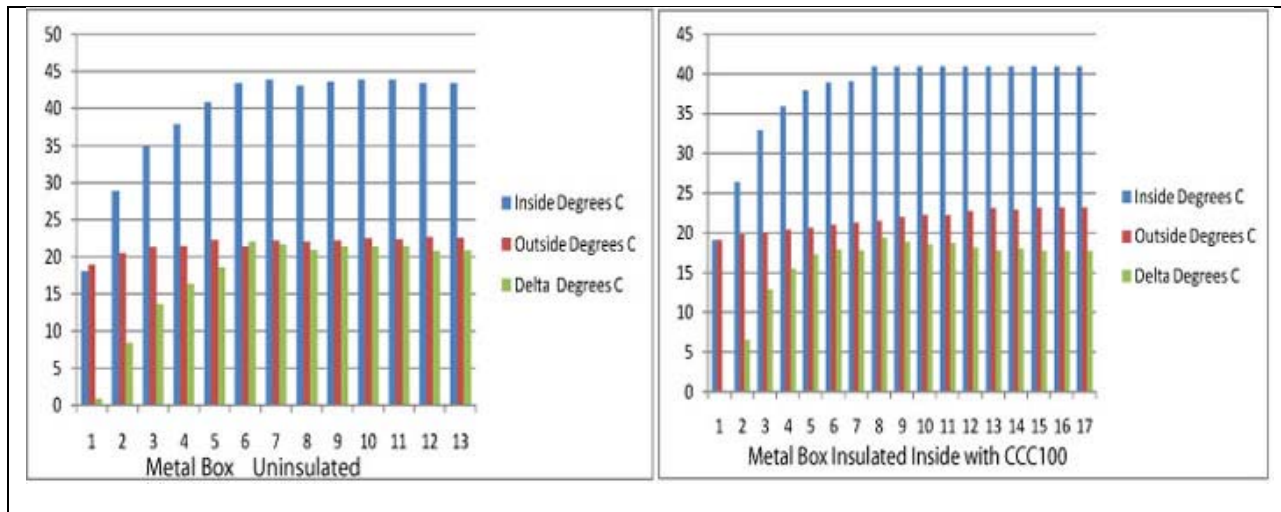
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Conclusions

Un-insulated Box compared to Box insulated Outside with CC100

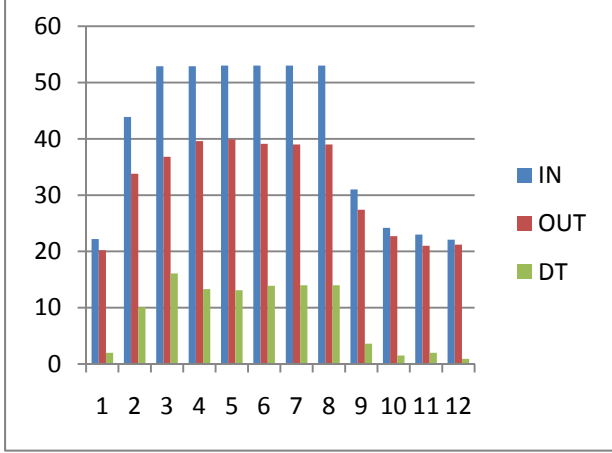
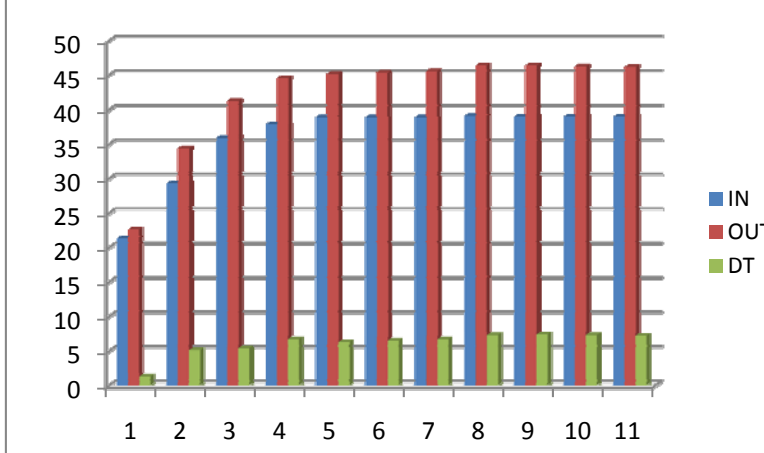


Un-insulated Box compared to Box insulated Inside with CC100



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Box insulated Outside with CC100 Stress Tested with 175 Watt IR Heat Lamp

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