MULTICERAMICS COMMERCIAL AND INDUSTRIAL APPLICATIONS

WHAT IS THE PROPER APPLICATION FOR MULTICERAMICS INSULATION?

Multi-ceramic industrial coatings have been in use for decades as a thermal, radiant insulator for application in aerospace, marine, oil tanks, water tanks, refractory and steam boilers.

Performance specification data is available from 3rd party certified laboratories.

A competitive analysis of basic characteristics of different brands will show differences in application method, curing time, insulation and reflection spectrum.

Ceramic insulation technology will provide the following benefits:

1. Solve problems at a minimum cost and shortest time of implementation
2. Improve energy conservation
3. Eliminate risk of dangerous chemicals and fire hazards
4. Insect and moisture barrier
5. Infrared and ultraviolet radiant barrier
6. Maintains characteristics up to 400 degrees F
7. Application by brush, roller or spray gun
8. Cures in 24 hours at 70 degrees F; in 48 hours at 50 degrees F
9. Odorless and zero VOCs

Retrofit of Insulating on buildings that have poor thermal efficiency after they have been constructed and inhabited can achieve measurable reduction of energy consumption.

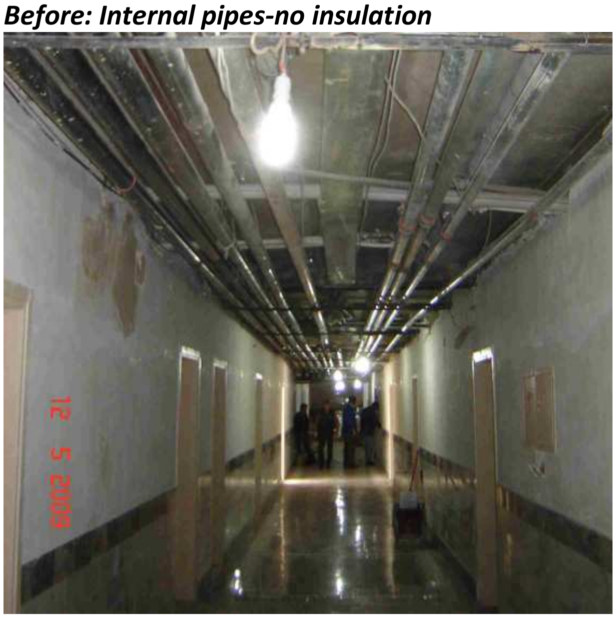
This can be achieved by applying a coat of 7 mils thick of MULTICERAMICS to exterior walls which increases the building envelope R value by additional RE14.28 by reducing thermo conductivity, and by blocking 95% 0f infrared produces and RE equivalence of RE22.

Financial data available upon request.

Before: Hospital R 5

After: MULTICERAMICS RE27

Before: Internal pipes-no insulation



After: Insulated with MULTICERAMICS

This hospital recovered its <u>investment</u> in the <u>first year and one half</u> after implementation.

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What is the maximum/minimum temperature in the workplace?

The law does not state a minimum temperature, but the temperature in workrooms should normally be at least:

- 16°C (60°F), or
- 13°C (55°) if much of the work is physical.

For full details read on:

- The Workplace (Health, Safety and Welfare) Regulations 1992 lay down particular requirements for most aspects of the working environment.
- Regulation 7 of these Regulations deals specifically with the temperature in indoor workplaces and states that during working hours, the temperature in all workplaces inside buildings shall be reasonable.

However, the application of the regulation depends on the nature of the workplace i.e. a bakery, a cold store, an office, a warehouse.

The associated ACOP goes on to explain:

- The temperature in *workrooms should provide reasonable comfort without the need for special clothing.
- Where such a temperature is impractical because of hot or cold processes, all reasonable steps should be taken to achieve a temperature which is as close as possible to comfortable.

*Workroom means a room where people normally work for more than short periods.

Here is one example of a bottom minimum temperature is enhanced with one coat applied to the concrete building:

MULTICERAMICS is the only insulation: no internal heating is activated.

- The exterior temperature is **10*°C (50°F)*** after the application of Multiceramics.
- The Interior temperature **18°C** For a Delta T of ***8 °C (14.4 °F)***.


Apartment Complex upgraded to RE27 with MULTICERAMICS color matched to original painting.

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Measurement of Delta T with Multiceramics Insulation

ON ALUMINUM WINDOW FRAMES

Deltas T test of a thermally insulated European Window frame design:

- The reference temperature is Dry ICE at minus ***74.3 °F*** at one side of the frame
- On the opposite side of the insulated frame *The other side of the frame is at* ***+ 49.8°F***
- ***Delta T 124.1°.***

Substitution of ***10 mils*** of **PIPESULATE** for **MULTICERAMICS**

- The reference temperature is Dry ICE at minus ***78.5 °F*** at one side of the frame
- On the opposite side of the Multiceramics insulated frame *is at* ***+*** **59.1*°F***
- ***Result: Delta T of 137.6 °F***
- The cost of painting a window frame is just a fraction of the cost of the specialty frame
- The performance of the Pipesulate Multiceramics is 9.4 ***°F*** better than the costly designed frame.

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MULTICERAMICS - PIPESULATE SOLUTIONS

FOR THE MOST CHALLENGING INDUSTRIAL APPLICATIONS

The Insulation problems in industrial applications can be of a higher degree of sophistication, mainly because of various degrees of environmental exposure, and the higher temperatures needed to be insulated by the industry.

In most cases, the problem lies on chemical exposure to the substrates and the danger that the high temperature on surfaces which can pose to physical bodily injury. Therefore reducing the surface temperatures will increase safety. Chemical exposure prevents the use of the most common insulation materials

Spray on insulation foams seemed to have offered some solutions. However after some time metal surfaces begin to corrode undetected under the foam until the imminent structural failure becomes visible.   By then the cost of unit replacement or repair if possible, escalates in to the thousands of dollars.

The following photographs illustrate these problems.

The obvious reason for these failures is the porosity of the foams and fiberglass insulation substrates.

Moisture and chemicals can slip under the surface and start the deterioration without been detected, until it is too late, creating dangerous exposure and structural damage.

With MULTICERAMICS - PIPESULATE™, the insulation is complete and condensation or weather deterioration problems are eliminated.







When insulating with MULTICERAMICS - PIPESULATE™ we have experienced a peculiar phenomenon:

- While overseas one of our engineers was demonstrating the efficiency of PIPESULATE™ on steam pipes at temperatures of 370°F.
- After applying a coat of PIPESULATE™ at a thickness of 80 mils the temperatures were reduced to 180°F and some areas were the thickness was about 60 to 70 mils the temperatures were measured by several different methods that included thermo couplers, infrared beams, and thermo imaging devices.

All these devices showed the 60 mil coated surface temperatures to be about 240F, however when the safety team touched the pipes they were surprised to find the pipes safe to touch. This phenomenon is due to the low thermal inertia of the ceramics as demonstrated by the ASTM C1055 test.

ASTM Test Standard C1055

ASTM Test Standard C1055 defines the "safe" or "acceptable" heated surface temperature (in industrial applications).

- This considers the effect on the skin that takes place within a five (5) second contact exposure interval.
- The result of such a contact time/temperature event is to be the first-degree burn injury for the average subject.

ASTM Test Standard C1055 "Safe" Contact Skin Temperature

ASTM C1055 test shows that this "safe" contact skin temperature, for an exposure time of five seconds, is approximately **60°C (140°F)**:

- The upper limit, beyond which there is tissue damage that goes beyond the first degree burn, (i.e. the onset of second degree burning).

A surface coated with MULTICERAMICS:

- Would be safe beyond the upper safe limit due to the very low thermal inertia of the ceramics.
- A 242°F is lowered to 162°F with a thin coat but the surface temperature feels as cool as 90°F.

FORMULATED THEORY

Our engineering team formulated the theory that while the ceramic surfaces had reached the measured temperatures, they were safe to touch because of their nonconductive properties:

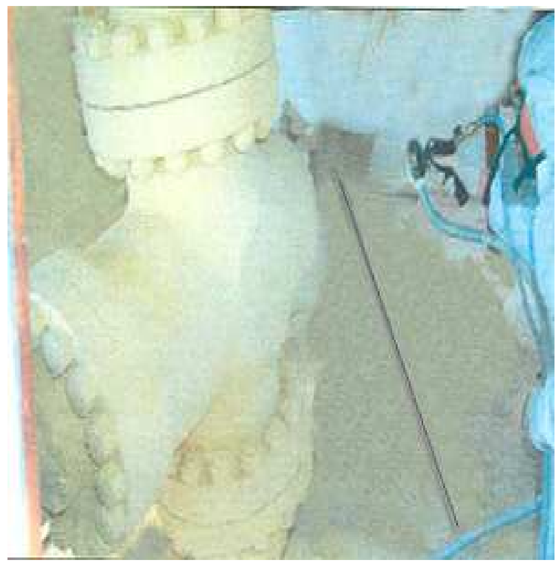
- The ceramics could not transfer by conduction enough energy, and unlike the bare steel surfaces did not represent a safety concern even at higher surface temperatures.
- Further studies have demonstrated this phenomenon is similar to having electrical conductors at the same voltage, but with different amperage. The lower amperage does not have the same punch. For instance, a thousand volts at milliamps would not be as dangerous as 120 volts at ten amps.

UNDERSTANDING THE THERMODYNAMICS

We are continuing to promote this technology, and as it become more understood by the controlling authorities:

- It will become the most efficient method to permanently insulate pipes for energy conservation and safety concerns.





Test I. ASTM C1057 "Standard Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model"

Method "A" of this standard provides a mathematical model to approximate the transient heat flow and to predict the skin temperature that will result from contact with steel surface that is coated with Ceramic Coating.
The following information summarizes the findings in the previous 2 pages.
With 80 to 83 mils thickness of multi-ceramic:
At 266deg F source temperature the touch surface is 60Deg F from Table 1 below
At 152deg F source temperature the touch surface is 105Def F from table 2 below
This shows a non - linear temperature drop across the insulator.

Test C1057 is a complement to ASTM Test

Standard C1055 in that it accounts for the variability of skin contact temperature as it relates to the thermo physical properties of the substrate that the skin is contacting. Attached is a copy of the spreadsheet used in this evaluation.

ASTM Test Standard C1055 defines the "safe" or "acceptable" heated surface temperature (in industrial applications). This considers the effect on the skin that takes place within a five (5) second contact exposure interval.

- The result of such a contact time/temperature event is to be the first-degree burn injury for the average subject.

Figure 1 in test C1055 shows that this "safe" contact skin temperature, for an exposure time of five seconds, is approximately 60°C (140°F) which is the upper limit, beyond which there is tissue damage that goes beyond the first degree burn, (i.e. the onset of second degree burning). For the purposes of evaluating Ceramic Coating in the mathematical model in ASTM C1057, the "safe" contact skin temperature is not to exceed 60°C.

Table 1: Below shows the thickness of Ceramic Coating that is required to bring various steel surface temperatures down to such a defined "safe" level. For the purpose of this evaluation, the physical properties used for the heated surface were those of steel. (See Table 1 of ASTM C0157).

Table 1. ASTM C1057 Mathematical Model Results for Ceramic Coating Heated Surface

Temperature (°C)	Ceramic Coating Thickness (mils)	Skin Temperature after 5 seconds (°C)
124	15	60
150	22	60
212	40	60
266	80	60

Using the mathematical model, one can clearly see that the low thermal inertia and low conductivity properties of Ceramic Coating can bring hot surfaces down to "safe "operating levels. This is achieved at relatively low film thickness. It is generally recognized that metal substrate temperatures above 70°C are considered unsafe for skin contact. However, 40 mils of Ceramic Coating applied to the surface will provide a surface that is "safe" for contact exposure, even when the heated steel is as high as 210°C. (This has been validated using the ASTM C 1057 Model).

Test II. "Physical Contact Exposure Test on Ceramic Coating"

The second thermal study involved physical contact with the coated surface to identify a more conservative "safe" (for physical contact) surface temperature of Ceramic Coating.

For the purpose of this test, the maximum "safe" temperature was defined as the temperature where the average person could physically place a finger on the surface of the Ceramic Coating for an exposure interval of five seconds, without having to pull it away to prevent injury. It is estimated that this temperature corresponds to the 44°C internal skin tissue temperature as referenced in ASTM C1055, the temperature at which the average person does not become injured (burned). By way of comparison, the 60°C skin temperature that is mentioned in the ASTM C 1057 model can result in a first degree burn if the contact duration is five seconds.

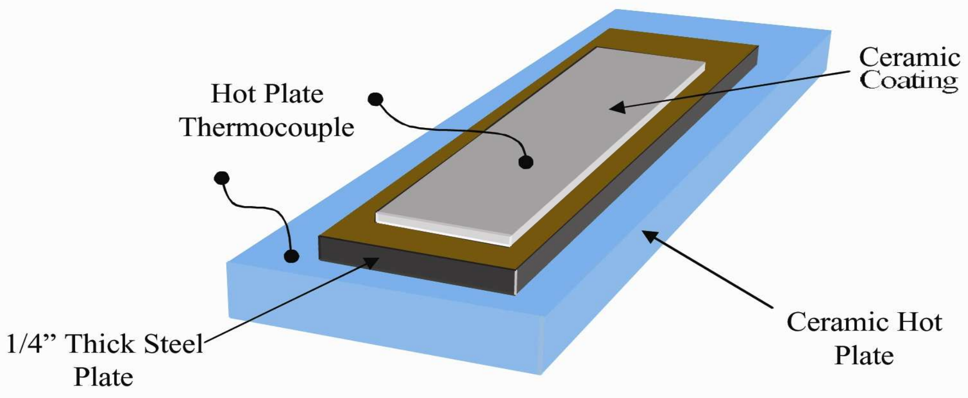
Once the "safe" Ceramic surface temperature objective was determined, a series of tests were performed to identify the thickness of Ceramic required to achieve this.

For this test several ¼" steel samples were coated with varying thicknesses of Ceramic. The thickness of the Ceramic samples was measured in several locations using a dry film thickness gage and then marked on the surface of the Ceramic.

The samples were then placed on a ceramic hot plate and the surface temperatures of the ceramic hot plate and the Ceramic were measured using a Type K Beaded-wire Thermocouple. The thermocouples were placed on the surface of both substrates, with the beaded-wire in intimate contact with the substrate (see Graphic 1).

When the ceramic hot plate temperature reading was constant and the steel plate had enough time to equilibrate, the second thermocouple was brought into contact with the surface of the Ceramic, and the temperature reading was recorded. (During this testing it was observed that an uncoated area on the surface of the steel plate exhibited a temperature that was approximately fifteen degrees cooler than that of the ceramic hot plate). The temperature of the hot plate was progressively increased and the procedure repeated.

Graphic 1. Physical Contact Test Apparatus



Test II. "Physical Contact Exposure Test on Ceramic Coating"(Cont.)

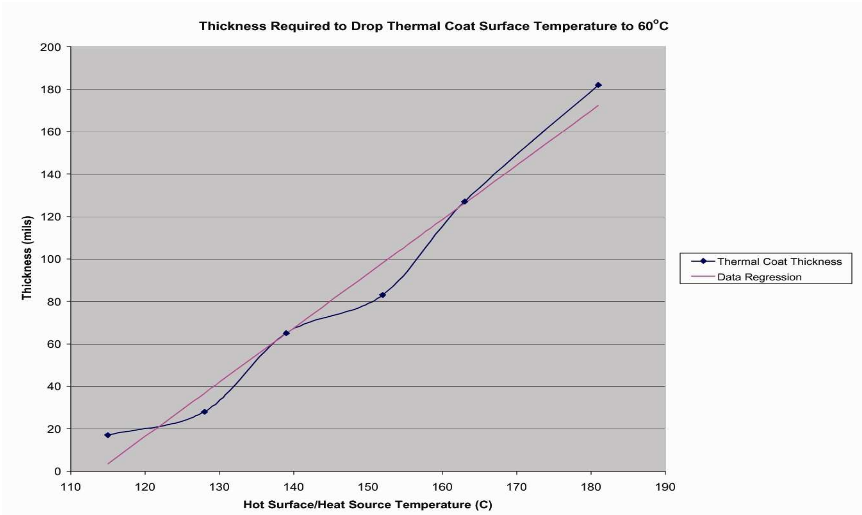
This test showed that at a Ceramic surface temperature of 115°C (240°F) the test subject could hold a finger on the Ceramic for a minimum of five seconds without having to pull away. In an effort to be conservative, a temperature of 105°C (220°F) was used as the "safe" temperature on the varying thickness test.

The data presented in Table 2 summarizes the results of the testing in a format that will correlate the relationship between the thickness of the Ceramic and the achievement of the 105°C surface temperature objective.

Table 2. Results of Touch Tests with Ceramic Hot Plate Temperature

Source Temperature (°C)	Ceramic Coating Temperature °C	Thickness (mils)
115	105	17
128	105	28
139	105	65
152	105	83
163	105	127
181	105	182

Figure 1 below shows the relationship between the heat source temperature and the thickness of Ceramic Coating required to bring its surface down to the "safe" level (105°C). The figure also includes a regression of the data, showing its approximation as a straight line (regression calculation is y = 2.557x – 290.56; R_2 = 0.9700).



Thermal Coat Thickness
Data Regression

Skin Temperature Tests on Ceramic Coating, Results Summary

As can be seen from the results of these two studies, one can conclude that the low thermal inertia of Ceramic allows for relatively low thicknesses to provide "safe" operating conditions for hot surfaces, even when the "safe" level is as conservation as no burn injury.

CONCLUSION

Two separate tests were completed to identify the “safe” surface temperatures of Ceramic Coating when it is used as a mechanism to protect personnel who come into contact with heated tanks and pipes.

Both the mathematical model listed in ASTM C1057, as well as a more conservative touch-testing method demonstrate that the “safe” surface temperature that is contributed by the Ceramic Coating constitutes an effective mechanism to provide such operational safety to hot metal surfaces.

The “safe” surface temperature that is established in the ASTM method is 140°F (60°C), which is the resulting skin tissue temperature that is the result of contact, but such a skin tissue temperature can result in first degree burn in a contact time interval of five seconds.

As an alternative, the touch-testing method has shown that the Ceramic Coating, because of its low thermal inertia and low heat transfer coefficient, will resist the transport of heat energy. Therefore when it is touched by human skin, it feels cooler and significantly reduces the risk of injury to personnel.

The testing provides the basis for determining the film thickness of EZHC Ceramic, which is required to provide the corresponding protection.

Our real-world testing and findings showed that Ceramic Coatings are an excellent safety products for a multitude of uses that, the concerning regulating authorities should embrace and openly engage in promoting to help the success of these emerging manufacturing companies.

The materials in this discussion are used to provide safety to personnel processing and manufacturing high temperature materials like rubber. The same thermodynamics apply to insulation used in the construction of building envelopes.

A case study following Protocols from test procedures of NWPCC insulation committee can be used to validate the insulation properties of the Multiceramics being considered.   The selected protocol will be used to perform a case study of thermal performance of a food storage refrigerator with an operating temperature of 41 degrees F, located in an industrial facility operated at 65 to 75degrees F. The quantity of heat energy to be transferred in this thermal model must be defined to establish a baseline for this model.