SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

SPI HISTORICAL RESUME Rev. (10/05/2025)

OVER 175 YEARS EXPERIENCE IN RESEARCH AND DEVELOPMENT OF INSULATION AND CORROSION PROTECTION COATINGS

SPI STAFF:

Hand Picked team
Based on skills and Research abilities
Thinking outside the "Box" on new technologies
Thinking based on "we will" build a technology and "fix" problems
Practical Skills in the field
Training Abilities

PRITCHETT, JOSEPH E.
President, Lead Researcher on ceramic compounds for insulation covering 1989 – 2025 (36 years).
Shawnee, Kansas
Researcher and developer of insulation coatings
University of Arkansas BSBA (Science Background) 1970
University of Missouri Rolla – Paint formulations
NASA as independent researcher on ceramic
Compounds (1989 – 1995)

JULI PRITCHETT CFO (33 years experience)
Operations/ Accounting background

BJ RAY Sr Project Manager. (25 years experience)
Travels worldwide checking projects and training
South America, Asia and Middle East
Project management, Quality Controls
AMPP CIP (Coatings Inspector Program) level 1.

JACOB RAY Project Manager (18 years experience)
Travels worldwide for project training
ISO and ABS certification controls and processes
Project Assistance and training, South America and Asia

LOGAN NEELY. Production Mgr. (24 years experience)
Inventory controls, production and Quality Controls
UL certification management

BORIS MINASOV. Engineering (15 years experience)
Energy Calculations for Commercial/industrial projects
Previous QC Eng. Offshore, Russian Oil

CHERISE KUHNS. Office manager (8 years experience)
Shipping, Proforma and Document control

10835 W. 78th Street • Shawnee, Kansas 66214 • Phone: 913-962-4848; Fax: 913-962-6767
Website: www.spicoatings.com Email: sales@spicoatings.com

ARIN SHAHMORADIAN– Indep. Regional Sales Manager (15 years experience)
Key Account Manager
Travels worldwide for technical sales presentations
Published SSPC/NACE/AMPP/NISTM/ILTA speaker
Distributor onboarding and sales training
Engineering specification and ITP support specialist
Cal State Northridge 2008 – Marketing & Management

Experience: (Actual Hands-On Real-World Experiences on "Ceramic" uses by J.E. Pritchett)

President, Superior Products International II, Inc. 1988 -current

The DEE HOWARD Aerospace Testing Facilities (1989)

a. San Antonio, Texas
b. Reverse Blast Plate – SUPER THERM
    i. Various engineers on staff
    ii.

TEEX, Technology and Economic Development Division, Texas Engineering Extension Service. 1989-1990

The Texas A&M University System
    iii. Brett Cornwell, E.D. Manager

Arkansas Science & Technology Authority. 1989-1990

Little Rock, Arkansas
    iv. James T. Benham, VP
    v.

Advanced Refractory Technologies, Inc. (NASA SPIN OFF Program)

Buffalo, NY. 1990
Developing product line of specialty ceramic powders for government and industrial users in oil, automotive electronics and nuclear.

NASA – 6 years (Understudy on ceramic compounds) 1989-1995
Development of SUPER THERM®

Note: **Ceramic Books, Printed Information on Ceramic Compounds and Theory was determined to be completely inaccurate when determining which compounds could or would perform in a coating formulation when the compounds are mixed and covered with water, resins and combined into other compounds and chemicals. The only way to determine the true performance of any compound was to do a lengthy Trial and Error exposure of each compound individually into a coating**

surrey, coat over a control plate and heat test each compound and then in combination with other working compounds to find the true effect that each compound would have on heat reflection or heat blocking. J.E. Pritchett was asked to do the research privately and find which compounds could work in a formulation environment. J.E. Pritchett found the compound combinations over a 5-year period and after testing, was invited to reveal the final product at the 1995 Annual NASA Technology Conference in Chicago.

a. **Marshall Space Flight Center**, Huntsville, Alabama
b C.F. Key, Deputy Director Materials and Processes Lab
c. Dinah Higgins, Manager Outreach and Engineering Application Projects, Technology Utilization Office
d. **NASA Tech Briefs** 1990 - 1991
   Douglas Shaller, Regional Manager
e. **Lyndon B. Johnson Space Center,** Houston, Tx 1989–1995
   Dean C. Glenn, Technology Utilization Officer
f. **Ames Research Center**, Moffett Field, CA 1989-1995
   Walter M. Helland, Manger, TU Office
   Options for Improving Rigidized Ceramic Heatshields
   Daniel B. Leiser, Marnell Smith, and David A.Stewart

NASA Space Flight Center Testing of SUPER THERM®
Flammability NHB 8060.1B/C, Test 1 Rating A (Best)
Toxic Off-gassing NHB 8060.1C, Test 7 Rating K (Best)
Liquid Oxygen Compatibility (Cannot freeze solid and impacted without cracking) (Note: Water-based)
Discussion about SUPER THERM® applied to external tanks. May 1995

MIT engineers in Middle East on heat controls, Center for Radiation controls in Riyadh, Saudi Arabia and Jeddah. 2010

i. PhD staff of 6. SUPER THERM®

Argonne National Laboratory, IIT (Illinois Institute of Technologies) and U.S. Department of ENERGY 2017

Study of insulating surfaces while developing an energy sensor to absorb the radiation energy and store in battery units while keeping the building cool. With SUPER THERM®

ii. PhD John Katsoudas and associates.

Underwriters Laboratories Current
Testing and certification of SUPER THERM®
Formula consistency

EPA ENERGY STAR Energy Saving Award given to Georgia Pacific Corp (Div of Koch Industries) for using HPC which saved 49% of energy on a Digester Unit in

real world conditions inside one of their plants. This 49% savings related to $332,000 savings in one year.
2023

Societies:

THE NATIIONAL ENERGY SPECIALIST ASSOCIATION 1992
(NESA). KS115M

American Society for Testing and Materials 1996
E 06 Committee

ASHRAE – member 2001-

NACE/ SSPC member 2001-

U.S. Green Building Council 2006-

American Society of Naval engineers 2011-

LEED (Leadership in Energy & Environmental Design). Current

CRRC (Cool Roof Rating Council) approval Current

JCP (Joint Certificate Program for Military in US And Canada) # 0064426 Current

MBDC (Cradle to Cradle Program) Silver certificates For certifying all products to be green and non-Harmful to the environment. Current

ICC (International Code Council) Past

BOCA (Building Organization Code Administration) Past

Awards:

Outstanding Young Men of America. Award. 1982
Joseph E. Pritchett
"Outstanding professional achievement, Superior leadership Ability and exceptional service to the community"
Board of Advisors

U.S. Consumer Product Safety Commission – approval 1990

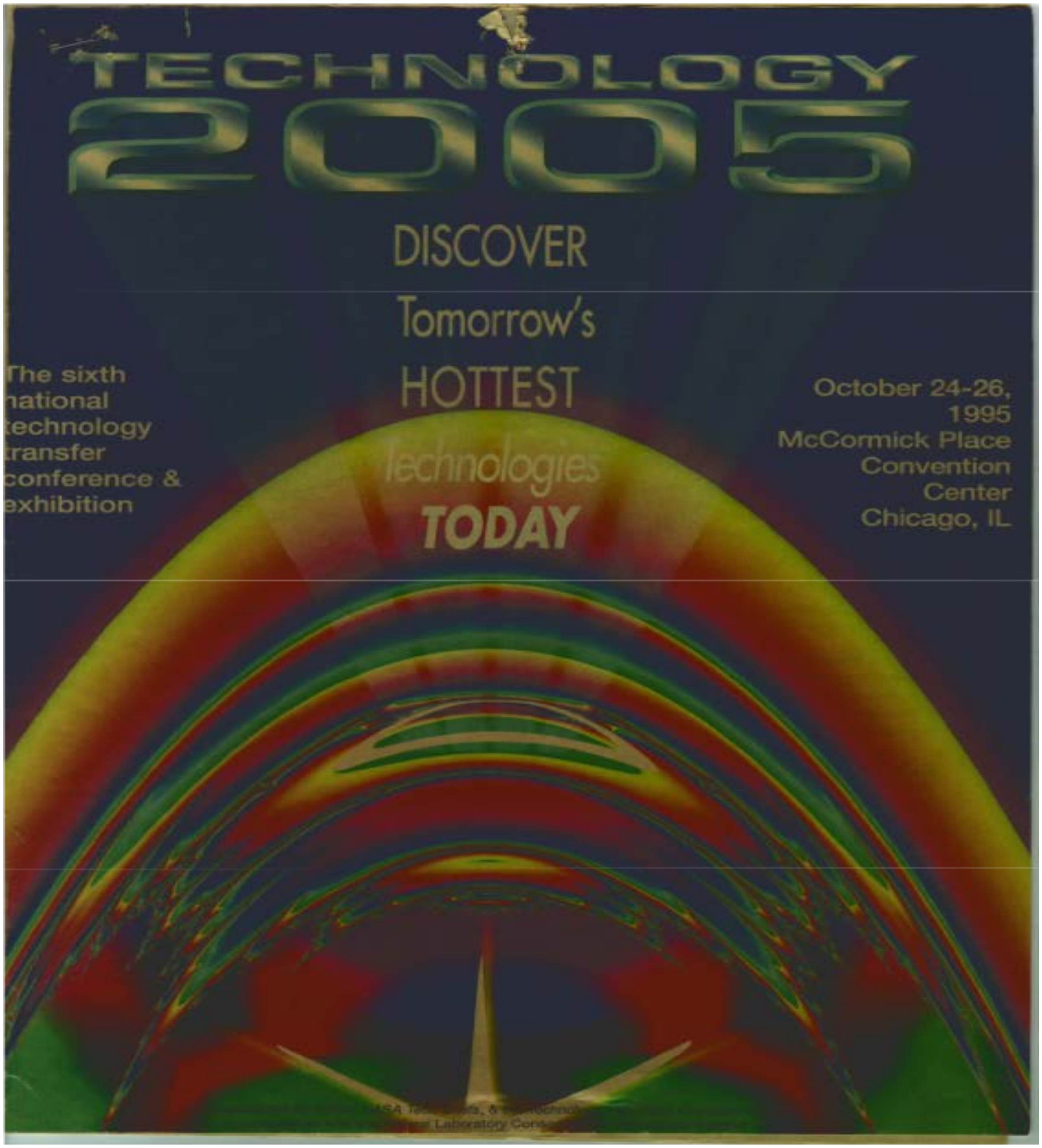
USDA (US Dept of Agriculture) Food safety use 1991

Who's Who in the MidWest 1992

Who's Who Worldwide 1993

1992/3 Platinum Edition
Demonstrated leadership and Achievement in their
Occupation, Industry or Profession

NASA Six years of Research and Speaker at Technology Conference in Chicago. J.E. Pritchett was invited to speak at the conference on the newly developed SUPER THERM "insulation coating". 1995


TECHNOLOGY
2005
DISCOVER
Tomorrow's
HOTTEST
Technologies
TODAY
The sixth
national
technology
transfer
conference &
exhibition
October 24-26,
1995
McCormick Place
Convention
Center
Chicago, IL

...s Research Center
Los Alamos National Laboratory
Machida Inc.
Marshall Space Flight Center
Martek Biosciences Corp.
Material & Electrochemical Research Corp.
Meridian Laboratory Inc.
Merritt Systems Inc.
Micro Surface Corp.
Nanophase Technologies Corp.
NASA
NASA Regional Technology Transfer Centers
NASA Tech Briefs
National Renewable Energy Laboratory
National Security Agency
National Space Society
National Technology Transfer Center
Natural Fibers Corp.
Naval Research Laboratory
Navy Research, Development, Test, & Evaluation
Novespace
Oak Ridge Centers for Manufacturing Technology
Olympus America Inc.–IFD
Optics Technology Inc.
Orbital Sciences Corp.
Paintest
PDA Inc.
Penn State University Applied Research Laboratory
Phillips Business Information Inc.
Phillips Laboratory
Powertronic Systems Inc.
Princeton University Plasma Physics Laboratory
Proto Mfg.
Ribbon Technology Corp.
Russian Space Agency
Sandia National Laboratories
Silicon Mountain Design
Society for the Advancement of Material & Process Engineering
Software Consultants Inc.
Sophia Systems & Technology
Stennis Space Center
Stress Photonics Inc.
→ Superior Products Intl.
Technology Access Report
Technology Transfer Business
Technology Transfer Society
Thermo Electron Tecomet
Thiokol Corp.
Tiodize Co.
Transcience Associates
TRICOR Systems
Triton Systems Inc.
U.S. Air Force Science & Technology
U.S. Army – Dept. of Army Research Labs
U.S. Army Armament Research Development & Engineering Center
U.S. Army Combat Systems Test Activity
U.S. Army TARDEC "National Automotive Center"
U.S. Army – ATC Aberdeen Test Center
U.S. Dept. of Agriculture, Agricultural Research Service
U.S. Dept. of Energy, Office of Technology Utilization
U.S. Dept. of Energy Kansas City Plant
U.S. Dept. of Energy OTD/Triodyne
U.S. Dept. of Energy Office of Clean Coal Technology
U.S. Dept. of Interior
U.S. Navy Best Manufacturing Practices/Production
U.S. Navy SBIR Program
Unitech Research
University of Wisconsin-Madison
Van Nostrand Reinhold
Vector Fields Inc.
Virtual Worlds Inc.
Westinghouse Savannah River Company
XCORP

Is your organization missing from this list? Call Wayne Pierce at (212) 490-3999 to find out how you can exhibit at T2005. (Hurry! Space is limited.)

Exhibition Hours
Oct. 24: 10:00 am to 4:00 pm
Oct. 25: 10:00 am to 4:00 pm
Oct. 26: 10:00 am to 3:00 pm

NASA Rolls Out Its Best New Technologies For Transfer

Centerpiece of the T2005 exhibits hall, NASA's 5000+ square-foot pavilion presents an unparalleled opportunity to see the agency's top technologies & meet its leading researchers & tech transfer agents – all in one place, at one time. Dozens of red-hot inventions from NASA's R&D centers will be demonstrated & displayed, including:

- Active Pixel Sensor – a revolutionary imaging sensor produced at Jet Propulsion Lab (JPL) that shrinks cameras to the size of a computer chip
- Methanol Liquid Feed Fuel Cell – offering enormous potential for the energy industry, this novel solid-state energy storage device (also from JPL) is always operational–unlike batteries–& environmentally friendly
- Sensor Skin – from Kennedy Space Center, an electronic "skin" that enables robots to sense their environments & handle extremely delicate tasks
- The Simulation Virtual Machine – a real-time simulation system developed at Johnson Space Center for space shuttle & airline pilot training, now available for commercial use in entertainment, mass transit, & other industries
- Capillary Pumped Loops – from NASA Goddard, a technology for spacecraft thermal control that can be applied to heat or cool specific parts of the human body without an external power source...a boon for the sporting goods industry, firefighters, & medical device manufacturers

- Self-Nulling Probe – a low-cost, portable, nondestructive evaluation tool developed at Langley Research Center that detects cracks, corrosion, & coating thickness in metallic objects
- Ice Thickness Gauge – also from NASA Langley, a breakthrough technique for measuring & monitoring ice buildup (& in some cases initiating deicing) on aircraft, ships, & power lines

4

3:00 SUPER THERM Ceramic Coating Insulation

JE Pritchett, President, Superior Products Intl.

A water-borne coating spun off from NASA research has proven an outstanding insulator in harsh weathering conditions. Mr. Pritchett will outline how he worked with NASA to commercialize this technology & describe successful applications worldwide.

Medical Technology (part 1)

Moderator: Paul Bennett, Manager, Technical Marketing,

<u>NASA:</u> There are many coating companies claiming association with NASA for the development of a coating product. None can offer proof of this claim, no testing, no actual association with any NASA lab work and results or proof. SPI did work with the assistance of NASA lab personnel for testing and results and help in locating ceramic compounds from sources for JE Pritchett, the SPI researcher to do the Trial and Error R&D for now 34 years. J.E. was a featured speaker at the NASA technology conference in Chicago in 1995 on SUPER THERM.

CSSC (China Center for Technical Testing of Non-Metallic Materials for Ship Building, China Ship – Building Corp. — 1996

Ingram's Corporate Report top 100 -in recognition of corporate Excellence — 1996

Ingram's Kansas City Leading Bus. Mag New Technologies — 1997

IMO (Marine Safety Council) Division approval — 1998

IMO (International Marine Organization) approval — 1998

Green Label – Singapore for green approval in SouthEast Asia — 1999

SAM – US Federal Authorized Vendor and Contractor 2000
For selling directly to the US government agencies
And military.
CAGE: 3RKM5
NAICS: 325510
FSC: 8010
SIC: 28512

ENERGY STAR Product Approval (CRRC testing) 2001
SUPER THERM®

ENERGY STAR Partnership Agreement 2001

NACE, Saudi Arabia Section, Presentation on 2006
the topic of Ceramic Insulation, Fire Protection and Corrosion Controls"

Bureau of Home Furnishings and Thermal Insulation Insulation 2006
(California)
Thermal Insulation Manufacturer
License No. TI 1421
Registry No. CA-1421 (KS)

DET NORSKE VERITAS Notified Body No.0434-02 2007

Gen & Construction Kuwait on "Ceramic Insulation" 2008

NACE International, Saudi Arabian Section, and Bahrain 2008
Society of Engineers "12th Middle East Corrosion And Exhibition"

NACE Green Conference, UAE (saving energy) 2009

"Offshore Arabia Conference and Exhibition" 2010
Certificate Of Appreciation for speaking on energy saving

U.S. Department of Energy Weatherization Assistance (WAP) 2010

Program. Washington DOE office: SUPER THERM® --Test of approval St. Johns Housing Partnership St. Augustine, Florida.
Applied 10 dry mils (250 microns) SPI (mfg) stated: Blocks 95% of three sources of Radiation heat: UV, Visual and IR, The surface Temperature of a roof will always be within 5 Degrees of ambient temperature, once SUPER THERM® is applied, and reducing heating and Cooling costs by up to 70%.

Results as written from DOE staff contractors:
"Because inside temperatures are claimed to drop within minutes, we took initial readings of a portion of the mobile home's roof painted with SUPER THERM® compared with a portion of the roof not painted. We saw an immediate drop of 7º F. For a more extensive comparison of temperature differentials, we took interior photos throughout the mobile home before we applied the product and then returned two days later under similar weather conditions and took additional photos from the same interior locations. The differential among the set of nine before-and-after photos ranged from 7.9 to 12.5 degrees Fahrenheit – **an average reduction of 10.2 F."**
"The exterior surface temperature of the mobile home's metal roof on a windy 85ºF ambient day was 164º F. After application, of SUPER THERM the surface temperature dropped to 86º F **(78º F difference*)**. When we measured the roof surface temperature of a similar mobile home whose roof SJHP had coated with a white elastomeric product, the exterior surface temperature of that roof was 125º F. **(difference between Elastomeric and SUPER THERM® is 39º F.*)**
"When SJHP weatherization auditors returned to the original mobile home a week after our application with SUPER THERM®, the owner reported that she had not turned on her A/C unit since the day the roof was coated. The interior temperature was comfortable, **which offers a tremendous savings** for this particular elderly mobile homeowner who carefully watches her expenses in order to purchase necessary medications."

(*)Note inserted by SPI showing the differences

Energy Savings Note: Reported by ConEdison energy company West Coast in 2001, a 6º change or reduction in cooling demand in the interior ambient temperature results in a 39% reduction in actual energy costs. In this mobile home, the average reduction in interior temperature of 10.2º F, represents a minimum of 66.3% savings as per this calculation; and if the ambient outside temperature rises over 85º F and it will in Florida, the savings will be well over the estimated reduction in energy savings as stated above as per this DOE report.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

The full report is given below:

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

NATIONAL DOE WEATHERIZATION PROGRAM TESTING RESULTS – Proving "up to a 70% energy savings".

Results incorporated into ConEdison Energy reduction analysis.

National DOE results:
Interior temperature of home reduced by average of 10.2F when coated.

Exterior roof surface was reduced from 164F without SUPER THERM to 86F with an ambient of 85F or a 1 degree over ambient.
They compared these finding against our statement that we reduced the roof surface facing the sun within 5 degrees F of ambient. We were 1 Degree within ambient.

They compared our statement of "up to 70% savings".
Their drop in interior ambient temperature (10.2F) compared to the Energy Company, ConEdison (California energy) calculated to a 72.6% savings on only 85F ambient which is low for the area.
ConEdison Calculation report: "Adjust the air conditioner's temperature control to keep your interior no cooler than 78 degrees, it's an efficient setting that's also comfortable. Moving to a colder temperature consumes more energy and costs more money for example, going to 75 degrees cost 18% more and a 72 -degree setting costs 39% more for a drop of a total of 6 degrees F on the interior.

Given the average interior temperature reduction by the DOE team of 10.2 degrees F, and a 6 degree reduction is 39%, a 10.2 F reduction is 72.6% savings as an average. Given that the first 3 degree F drop was an 18%(6%/degree) savings and then a 6 degree F drop was an 39% savings means that the next step drop of 3 more degrees cost went from 18% savings to 21% (7%/degree). The next 3 degrees (7-10.2) is 8% per degree savings and therefore, the entire 10.2 drop SUPER THERM recorded by the DOE team would be a minimum of 8 degree or 4.2 X 8 = 33.6. Add the first 6 degree percentage savings of 39.0 is equal to (39.0 + 33.6) is 72.6 F total savings combined total of the full 10.2 F drop in interior temperature which is a minimal reduction.

The National DOE Weatherization team confirmed the statement of 5 Degree drop on the surface after applying SUPER THERM.

The National DOE Weatherization team confirmed the statement of "up to a 70% savings" by recording an average of 10.2 F drop in interior temperature related to the accepted Energy Company savings calculation report.

Actual savings on the Elderly woman's home was more, because she never turned on her A/C for the entire summer months as witnessed by the team.

10835 W. 78th Street • Shawnee, Kansas 66214 • Phone: 913-962-4848; Fax: 913-962-6767
Website: www.spicoatings.com Email: sales@spicoatings.com

Be aware that these results are only stated for this location in this climate, time and place. Other locations results can vary.

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

St. Johns Housing Partnership Report
U.S. Department of Energy
Weatherization Assistance Program
July 2011

Insulating a Roof with Solar Paint

One weatherization agency's experience with a new product

The St. Johns Housing Partnership is a private, nonprofit agency in St. Augustine, Florida, that promotes safe, decent, and affordable housing. The repair and weatherization of single-family and multi-family residences are a main focus of our work.

In addition to residents' security and comfort, a specific intent is to reduce residents' utility bills. Toward this, we occasionally have the opportunity to experiment with new products and technologies. Recently, SJHP experimented with a new "green" product: SUPERTHERM®—a liquid insulation that blocks the loading of solar heat on roofs. Interior building and ceiling temperatures are said to drop within minutes of applying SUPERTHERM® to the roof surface—and even more over days when the application cures. As its promo reads: "SUPERTHERM® *is leading the green movement by turning black roofs into insulating white roofs.*" And you just paint it on!

As primarily a roof coating, the product can be used on any roof surface—wood, metal, or tile—when used with a recommended primer product. The manufacturer suggests that SUPERTHERM® can also be used to insulate interior ceilings and walls.

We applied SUPERTHERM® to the 14x60-foot metal roof of an older single-wide mobile home and took comparison readings of "before" and "after" temperatures to see what impact this insulating product has on reducing interior temperatures and utility costs. The mobile home's roof had not been cleaned in years. First, we pressure washed the roof to clear it of debris, dirt, and fungus, common in the hot humid Florida climate. Then we applied SUPERTHERM® with paint rollers. Even our high school intern was able to apply the paint with ease.

SUPERTHERM® is a multi-ceramic coating that combines high-performance urethanes and acrylics with resin additives in a waterborne formula. The only care required in application is to ensure the film thickness in order for the coating to be effective. SUPERTHERM® should be applied at 18 mils wet and never less than 10 mils dry. The coating dries within one hour in 70° F and bright sun. Always allow for two hours of direct sunlight to properly dry after application. While we used regular paint rollers, it can be applied with a paint sprayer, but *remove all filters when using a sprayer*. According to the manufacturer, the product fully "cures" in 21 days.

The SJHP's interest in SUPERTHERM® as an insulating paint was to test its promise of reducing heating and cooling costs by up to 70%. The manufacturer states that "SUPERTHERM® blocks 95% of the three sources of heat: visual light, ultra-violet rays, and infrared rays. The surface temperature of a roof will always be within 5 degrees of ambient temperature, once SUPERTHERM® is applied. The manufacturer claims additional benefits of SUPERTHERM® to reduce water and moisture penetration, prevent mold and mildew, and reduce air infiltration—all important features to weatherization work.

According to its MSD reports, SUPERTHERM® is water based and environmentally friendly. Its volatile organic compounds (VOCs) are only 21 grams per liter when the safety limit is 420 grams. SUPERTHERM® is also 11.9 times less toxic than typical latex paint, whose VOCs are 250 grams per liter.

To measure the effectiveness of SUPERTHERM® for lowering interior temperatures, we took readings with an infrared camera. We used a Flir B40 thermal imaging infrared camera pointed at the ceiling from a distance of 3.3 feet. This camera has an image resolution of 14,400 pixels (120x120) and its optimized temperature range is -4° F to 248° F when targeting building applications.

Because inside temperatures are claimed to drop within minutes, we took initial readings of a portion of the mobile home's roof painted with SUPERTHERM® compared with a portion of the roof not painted. We saw an immediate drop of 7° F. For a more extensive comparison of temperature differentials, we took interior photos throughout the mobile home before we applied the product and then returned two days later under similar weather conditions and took additional photos from the same interior locations. The differential among the set of nine before-and-after photos ranged from 7.9 to 12.5 degrees Fahrenheit—an average reduction of 10.2°F.

Data in the following table reflect the differentials in the infrared photos that follow.

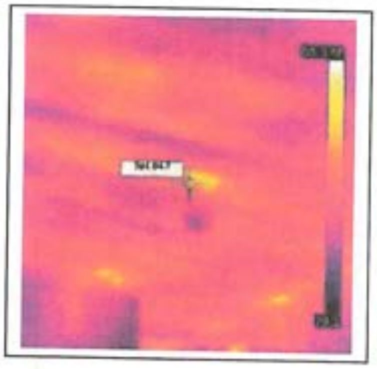
PHOTO LOCATION *within mobile home*	TEMPERATURES ° F *BEFORE 5/26/11*	*AFTER 5/28/11*	DIFFERENTIAL *degrees Fahrenheit*
kitchen ceiling northwest side	84.7	73.0	11.7
kitchen on west side	84.6	72.1	12.5
kitchen ceiling at center	82.6	72.9	9.7
bathroom ceiling	83.7	73.8	9.9
living room southeast ceiling	83.6	72.4	11.2
living room ceiling at center	82.8	74.1	8.7
east bedroom at ceiling fan	83.8	75.9	7.9
east bedroom ceiling	83.7	73.9	9.8
west bedroom ceiling	84.6	74.3	10.3

Average differential is 10.2 degrees Fahrenheit.

For all entries, reflected apparent temperature was 68.0° F and emissivity was 0.98.
Photographs were taken with a Flir B40 Thermal Imaging Infrared Camera. Object distance was 3.3 feet.

Temperature difference of 10.2°F on interior of mobile home

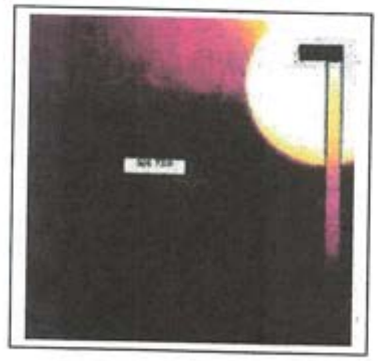
BEFORE 84.7°F



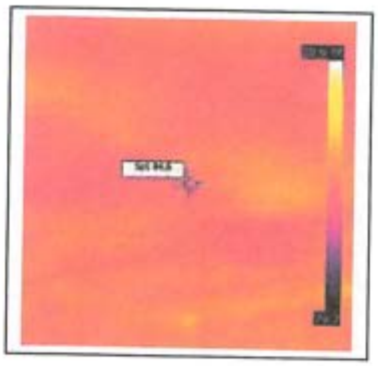
Kitchen ceiling on NW side

11.7°F differential

AFTER 73.0°F



BEFORE 84.6°F



Kitchen on west side

12.5°F differential

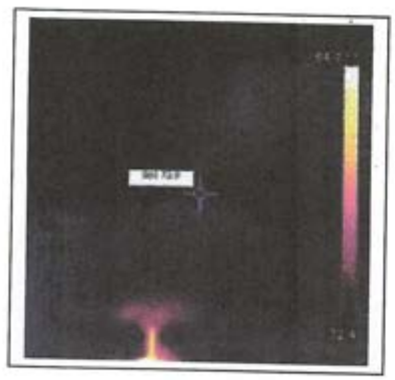
AFTER 72.1°F

BEFORE 82.6°F

Kitchen ceiling at center

9.7°F differential

AFTER 72.9°F



BEFORE **83.7°F**

Bathroom ceiling

9.9°F differential

AFTER **73.8°F**

BEFORE **83.6°F**

Living room SE ceiling

11.2°F differential

AFTER **72.4°F**

BEFORE **82.8°F**

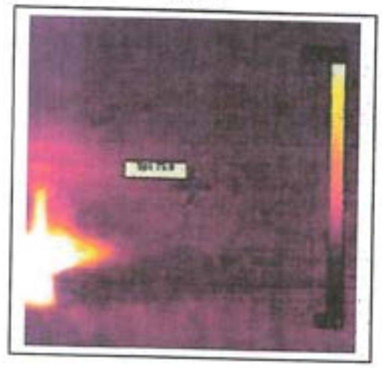
Living room ceiling at center

8.7°F differential

AFTER **74.1°F**

BEFORE 83.8°F

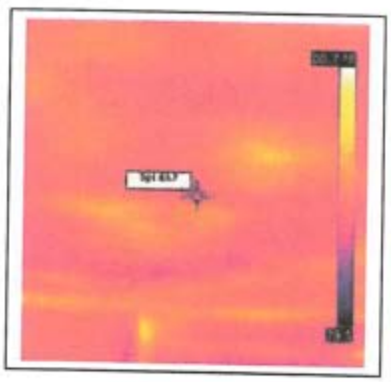
AFTER 75.9°F



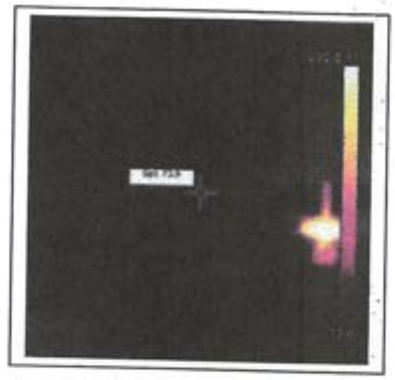
East bedroom at ceiling fan

7.9°F differential

BEFORE 83.7°F



AFTER 73.9°F

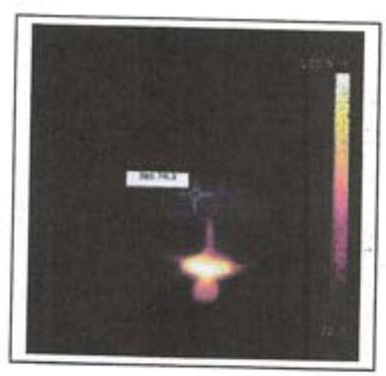


East bedroom ceiling

9.8°F differential

BEFORE 84.6°F

AFTER 74.3°F



West bedroom ceiling

10.3°F differential

The application of SUPERTHERM®, although labor intensive, did not take long: 2 hours to pressure wash the roof the day before and 4 hrs for two employees to apply the paint.

The exterior surface temperature of the mobile home's metal roof on a windy 85° F day was 164° F. After application, the surface temperature dropped to 86° F. When we measured the roof surface temperature of a similar mobile home whose roof SJHP had coated with a white elastomeric product, the exterior surface temperature of that roof was 125° F.

When SJHP weatherization auditors returned to the original mobile home a week after our experiment with SUPERTHERM®, *the owner reported that she had not turned on her A/C unit since the day the roof was coated.* The interior temperature was comfortable, which offers a tremendous savings for this particular elderly mobile homeowner, who carefully watches her expenses in order to purchase necessary medications.

Follow-up measurements may be taken in the weeks after application to verify additional readings. Even without further readings, SJHP's assessment to date is that SUPERTHERM® works well and meets our purpose and budget. It was relatively easy to apply and does not require significant application skills, other than normal diligence and care .We were very impressed with the immediate temperature changes after application.

Exterior surface temperature dropped 78°F after Super Therm® was applied

White Industrial Reflective Coating - exterior surface temperature = 125°F
Super Therm® - exterior surface temperature = 86°F
Difference of 39°F in performance

Summary
Ambient Air Temperature = 85°F
Roof Temperature without Super Therm® = 164°F
Roof Temperature with Super Therm® = 86°F
Owner reported to SJHP that, after one week with same daily ambient air temperatures, the temperature in the trailer was comfortable without the use of air conditioning

What does a 6 Degree F drop in interior temperature of a building mean to the A/C (Energy or Kilowat use) in operating the temperature control in that building.

ConEdison (a major Energy supplier) did a study and the following is the results to answer that exact question.

In this test survey performed by Walmart, SUPER THERM made a difference of no less than a 5 degree and as much as 11 degree difference on the **interior heat load** of these trailers or in relationship, any building where it could be used.

A 6 degree F change to further cool a room will cost

39% more

in actual cost of operation.

Using SUPER THERM over the other standard insulation materials will cost less energy and save the consumer 39% on utilizes as witnessed by this testing.

ConEdison Report

- If you're using only the room where your air conditioner is located, shut the doors to that room. It makes the room more comfortable, and it prevents cool air from escaping to unoccupied parts of the house.

- Adjust the air conditioner's temperature control to keep your interior no cooler than 78 degrees. It's an efficient setting that's also comfortable. Moving to a colder temperature consumes more energy and costs more money. For example, going to 75 degrees costs 18% more, and a 72-degree setting costs 39% more!

- If you're buying a new air conditioner, look for the Energy Star® label. It tells you the unit has been designed with energy savings in mind. Energy Star® air conditioners are much more efficient than ordinary units. They use less power so you spend less money.

- When buying a new air conditioner, choose one that's the right size for the space it will cool. The salesperson will help you determine which unit is best. Too big wastes energy by providing more cooling than you need. Too small wastes energy because the air conditioner is constantly working to keep up with cooling demand that exceeds its ability.

How it helps: In summer, your air conditioner uses more energy than any other appliance. By using it efficiently you can really help lower your demand for electricity and since cool air is expensive air, you lower your energy bill too.

Keep the sunshine out

What to do: On sunny days, keep daylight out.

How to do it: Close the curtains or draw down the blinds. Add curtains or blinds to glass doors facing a sunny exposure. Apply reflective plastic film to the inside of windows and glass doors. It can screen out about 75% of the sun's rays. Just cut it to size, and it clings to the glass on its own. And, it's reusable.

How it helps: Full sunlight entering through windows and glass doors raises indoor temperature. This temperature rise can be considerable. By keeping sunlight out, you make your home cooler so air conditioners don't need to work as hard to make you comfortable. That lowers electrical usage and helps reduce costs.

Keep hot air out, cool air in

What to do: Keep windows shut, seal drafts around window frames and door frames, and if you own a home, have it well insulated.

How to do it: For tips on sealing out drafts and insulating effectively, check the "Around The House" section of this booklet. Close windows during daylight hours to keep the heat out. Most air conditioners let you select a fresh-air setting. Choosing this keeps the air conditioner running efficiently while it draws some outside air to keep interiors fresh.

6

<u>From this directive, the Federal DOE did a "competent and reliable scientific evidence" study by their experts meeting the directive of the FTC RULE.</u>

Federal DOE Auditor's comments on checking the advertising statements from Superior Products International II, Inc. to actual results are as follows (*)

*In addition to residents' security and comfort a specific intent is to reduce residents' utility bills.

*Recently, SJHP experimented with a new "green" product: SUPER THERM® - a liquid insulation that blocks the loading of solar heat on roofs.

*We applied SUPER THERM® to the 14X60-foot metal roof of an older single-wide mobile home and took comparison readings of "before" and "after" temperatures to see what impact this insulating product has on reducing interior temperatures and utility costs.

*The SJHP's interest in SUPER THERM® as an insulating paint was to test its promise of reducing heating and cooling costs by up to 70%. The manufacturer states that "SUPER THERM® blocks 95% of the three sources of heat: visual light, ultra-violet rays, and infrared rays.

*The surface temperature of a roof wiii always be within 5 degrees of ambient temperature once SUPER THERM® is applied.

*To measure the effectiveness of SUPER THERM® for lowering interior temperatures, we took readings with an infrared camera. Because inside temperatures are claimed to drop within minutes, we took initial readings of a portion of the mobile home's roof painted with SUPER THERM® compared with a portion of the roof not painted.

*We saw an immediate drop of 7° F.

*The differential among the set of nine before-and-after photos ranged from 7.9 to 12.5 degrees Fahrenheit – an average reduction of 10.2° F.

*The exterior surface temperature of the mobile home's metal roof on a windy 85°Fday was 164°F. After application, the surface temperature dropped to 86°F. When we measured the roof surface temperature of a similar mobile home whose roof SFJP had coated with a white elastomeric product, the exterior surface temperature of that roof was 125°F.

*When SJHP weatherization auditors returned to the original mobile home a week after our experiment with SUPER THERM®, the owner reported that she had not turned on her A/C unit since the day the roof was coated. The interior temperature was comfortable, which offers a tremendous savings for this particular elderly mobile homeowner, who carefully watches her expenses in order to purchase necessary medications.

***Even without further readings, SJHP's assessment to date is that SUPER THERM® works well and meets our purpose and budget.**

***We were very impressed with the immediate temperature changes after application.**

Having the FEDERAL DOE do this testing with their experts, meets the "FTC Substantiation Policy".

HPC®
Award Winning EPA
October 2023

HPC® (Hot Pipe Coating) a thick film water-based coating applied over hot surfaces to block heat escape from surface therefore holding heat inside the unit to save heat loss and save energy.

Wins the EPA ENERGY STAR Award for Saving Energy with the Georgia Pacific Engineering study performed.

-Insulation material giving 13-18 month ROI established to Save Koch (GP) industries millions

-Provides Employee burn protection

-Stopped CUI completely

Koch Industries and one of their subsidiaries (Georgia Pacific) did a over two year insulation effectiveness test using a new technology saving hundreds of thousands of dollars on one unit in one year.

Look at a couple of paragraphs from their engineering report submitted to EPA ENERGY STAR award group which did win. This is identifying the new technology they used to win the energy saving award and only some of the results.

"The fully insulated digester reduced heat loss by 49% and saved Naheola an estimated $332,000 in energy costs annually. It also improved the quality of the cooking process by allowing the digester to better maintain its internal temperature. The HPC also protected the digester from corrosion. The Naheola digester had already begun to experience corrosion, a common issue for digesters of its age. The HPC hermetically sealed the digester to keep out any new moisture, so when some of the HPC was removed in 2022 to allow for repairs to the digester, there was no evidence of new corrosion.

GP is already using HPC at other mills following the results of this experiment. In addition to the energy savings, HPC's ability to protect manufacturing assets from corrosion could save GP and FHR millions of dollars in equipment replacement costs."

Georgia Pacific has 30 or more plants with each having several digester units described in this engineering report including hot piping. If one unit saved $332,000 after the unit was perhaps losing money, times all the digesters in all 30 plants plus additional pipes and tanks, what would that savings be??? $20 million dollars plus??
Now take the protection from developing corrosion costing millions per year on repair, tear down and replacement each year, could that be twice the savings cost n loss energy??? Could a couple of million spent on applying a true "insulation coating" save $40 plus million. The ROI is amazing when you take a couple of seconds to calculate to realize how effective HPC performs.

New Technology Award from EPA – Insulation Coatings

Georgia Pacific (part of Koch Industries - equity value of $13.21 billion) received a **New Technology Award at the ENERGY ENGINEERS CONFERENCE**

in Orlando Florida October 25, 2023 for using thick **HPC® Ceramics Thermal Insulation Coating** at one of their plants after removing the standard insulation and finding that the coating could have an ROI of less than a year after replacing the standard insulation.

Standard insulation never offers ROI.

The award was given out by **ENERGY STAR** run by the **US EPA** after studying the savings numbers and engineering report. This shows in real world use and measured by the engineering staff how effective thick C-TIC can prevent energy loss off the surface of tanks and pipes.

"We are pleased to announce two of our mills have been awarded the 2023 ENERGY STAR® by the U.S. Environmental Protection Agency for

superior energy performance. Both our Leaf River cellulose mill in New Augusta, Mississippi, and pulp and paper mill in Brewton, Alabama, have been certified for three years indicating these two facilities are first quartile energy efficient."

Georgia Pacific Facebook

https://www.linkedin.com/posts/j-e-pritchett-07897025_georgia-pacific-receives-epa-energy-star-activity-7138371885821480961-Hgg7?utm_source=share&utm_medium=member_ios

Georgia-Pacific Receives EPA ENERGY STAR and SmartWay Recognitions for Sustainability Work

ENVIRONMENT

Share this article

ENVIRONMENTAL STEWARDSHIP

November 7, 2023

Atlanta - Georgia-Pacific's commitment to environmental stewardship and continuously improving energy efficiency has resulted in several recent awards from the Environmental Protection Agency (EPA).

Two GP facilities received ENERGY STAR® certifications for 2023, and another helped GP earn recognition for a Top Project at the 2023 ENERGY STAR Industrial Partner Meeting.

Meanwhile, the company was also named a 2023 SmartWay High Performer.

ENERGY STAR Industrial Partner Meeting Recognizes GP for Top Project

The ENERGY STAR® program recognized the work of GP, Flint Hills Resources and their parent company Koch Industries for a Top Project at the 2023 ENERGY STAR Industrial Partner Meeting. The recognition comes for their efforts to improve energy efficiency and reduce corrosion in Koch manufacturing assets.

Together with FHR, GP tested a wide range of insulation options to protect manufacturing equipment and found a solution: HPC® ceramic insulation spray. HPC reduces heat loss, prevents corrosion, and can be applied to equipment that operates at temperatures up to 1,200 degrees F.

GP first tested HPC on a condensate receiver at its Naheola paper mill in Pennington, Alabama. The condensate receiver captured excess steam and condensation produced by a paper machine. GP then moved forward with coating a full digester at Naheola with HPC in March 2020. Digesters cook wood chips in chemicals at high temperatures to obtain the pulp fibers used to make paper products.

The fully insulated digester reduced heat loss by 49% and saved Naheola an estimated $332,000 in energy costs annually. It also improved the quality of the cooking process by allowing the digester to better maintain its internal temperature. The HPC also protected the digester from corrosion. The Naheola digester had already begun to experience corrosion, a common issue for digesters of its age. The HPC hermetically sealed the digester to keep out any new moisture, so when some of the HPC was removed in 2022 to allow for repairs to the digester, there was **no evidence of new corrosion**.

GP is already using HPC at other mills following the results of this experiment. In addition to the energy savings, HPC's ability to protect manufacturing assets from corrosion could save GP and FHR millions of dollars in equipment replacement costs.

ENERGY STAR® Industrial Partner Meeting Top Projects are selected by partner companies across manufacturing industries that want to learn more about the projects at the annual event.

Leaf River, Brewton Earn ENERGY STAR Certifications

GP has also earned additional recognition from the EPA's ENERGY STAR programs this year. GP's Leaf River Cellulose mill in New Augusta, Mississippi, is the first paper pulp mill in the U.S. to receive EPA's ENERGY STAR certification. The Leaf River facility uses less energy to produce a ton of pulp than 75% of plants with identical characteristics, putting it in the 90th percentile of plants evaluated by ENERGY STAR.

The company's containerboard mill in Brewton, Alabama, also received ENERGY STAR certification. Combined the facilities have saved 5,732,130 MMBtus in 2022 alone, enough to power 150,011 homes for a year, and both have been certified for three years.

The EPA works with manufacturing companies through ENERGY STAR to improve energy efficiency, allowing the agency and industry corporate energy managers to work together to build unique and helpful energy management tools.

GP Named 2023 SmartWay High Performer

The company was also named by the EPA as a SmartWay High Performer for 2023, a recognition that the company has earned five times, along with several other awards, since GP became a partner in 2009.

Moving products from one location to another often requires using multiple transport systems. The result is increased fuel consumption that leads to more air pollution, negatively impacting health and the environment. GP actively works to lessen the impact of its business on the environment through its stewardship framework. The company utilizes software that gathers and analyzes data to identify optimized travel routes, cutting fuel consumption and decreasing air pollution.

Less than 5% of the EPA's SmartWay shippers meet the emissions and carrier selection criteria to make the SmartWay High Performer list for shippers. EPA's SmartWay Transport Partnership helps companies and organizations achieve their freight supply chain sustainability goals by providing credible tools, data, and standards—at no cost—for measuring, benchmarking, and improving environmental performance.

These recognitions are an affirmation of how GP strives to continuously improve performance to create sustainable outcomes that benefit society, creating value for people while using fewer resources.

Learn more about GP's approach to environmental stewardship.

To learn more about energy efficiency and ENERGY STAR®,

[redacted]

Georgia Pacific (part of Koch Industries) received a New Technology Award at the ENERGY ENGINEERS CONFERENCE in Orlando Florida October 25 for using HPC coating at one of their plants after removing the standard insulation and finding that HPC could have an ROI of less than a year after replacing the standard insulation. Standard insulation never offers ROI. The award was awarded by ENERGY STAR . This shows in real world use and measured by the engineering staff how effective HPC can prevent energy loss off the surface of tanks and pipes. If you were waiting for an engineering firm to support the effectiveness of HPC, this is a major group with ENERGY STAR supporting the fact HPC works as stated.

Now here's the perfect way to stop losing valuable energy through high heat and production dollars with ceramics thermal insulation coatings - HPC - Hot Pipe Coating.

This technology (HPC manufactured by SPI COATINGS), which replaced traditional insulation at their facility, demonstrated a significant return on investment within a year, a feat not achievable with standard insulation. ENERGY STAR's endorsement, based on a thorough review of savings data and an engineering report, confirms HPC's effectiveness in reducing energy loss from surfaces such as tanks and pipes.

This recognition marks a pivotal advancement in energy-saving technology, encouraging industries worldwide to adopt HPC for substantial energy and cost savings. This technology blocks heat loss with a water-based coating simply sprayed in place while operating and not requiring a shut down. Easy, safe and works as experienced in actual field use by customers who decided to make the change over. Now here's the perfect way to stop losing valuable energy and production dollars.

Find out more about HPC (Hot Pipe Coating) that manages heat from 100°C to 650°C:
https://lnkd.in/d3vqruPU

HOOVER DAM BYPASS BRIDGE- (hand rails)

2011

SSPC (Society for Protective Coatings). E. Crone Knoy Award.

Award for "a single, recent, outstanding achievement In industrial or commercial coatings work that **Demonstrates innovation**." On behalf of the Hoover Dam Bypass Bridge – Colorado River Bridge – spans Between Nevada and Arizona. Under the supervision Of the Federal Highway Administration. SUPER THERM®

Note: SUPER THERM was chosen to reduce the heat on the hand-rails (140F) down to ambient temperature to prevent visitor burns from leaning onto the railing. Awarded the E. CRONE KNOY AWARD by SSPC for new efficient technology.

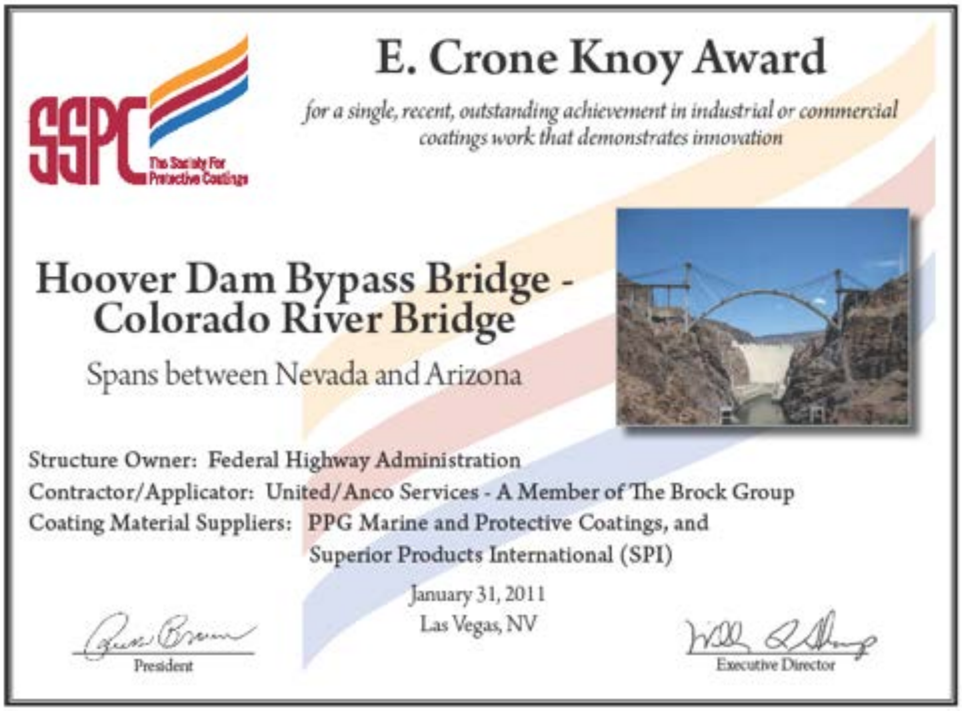
Many insulation / reflective coatings and paints were tested and failed to block heat load and protect visitors from burning themselves when leaning on and over the rails when viewing the Dam. SUPER THERM® was tested by the Contract engineering staff to find it blocked the loading of heat down to within two degrees of ambient and won the contract to paint the railings.

HOOVER DAM BYPASS BRIDGE RAILINGS.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Several "reflective coatings or paints" were tested and none could block heat load on the surface that SUPER THERM did block to protect visitors from being burned when leaning on the handrails while looking over the rails at the Hoover Dam.

NOTE: these readings may not be the same for you in different locations, weather conditions or climates.



E. Crone Knoy Award

for a single, recent, outstanding achievement in industrial or commercial coatings work that demonstrates innovation

SSPC The Society For Protective Coatings

Hoover Dam Bypass Bridge - Colorado River Bridge

Spans between Nevada and Arizona

Structure Owner: Federal Highway Administration

Contractor/Applicator: United/Anco Services - A Member of The Brock Group

Coating Material Suppliers: PPG Marine and Protective Coatings, and Superior Products International (SPI)

January 31, 2011

Las Vegas, NV

President

Executive Director

DEPARTMENT OF THE AIR FORCE WASHINGTON DC
OFFICE OF THE ASSISTANT SECRETARY. 2011

Subject: Innovative Use of Ceramic Coatings to Alter the Approach to Building Heat Gain.
"Your presentation on Innovative Use of Ceramic Coatings to Alter the Approach to building Heat Gain was very informative and valuable to our efforts. The Air Force energy team, including our senior staff here in the Secretariat, look forward to additional discussion with you and overcoming challenges in our movement to a clean, renewable energy future. Sincerely, Kevin T. Geiss, PhD SES, Deputy Assistant Secretary of the Air Force, Energy".

"White House energy official tours D-M" – Arizona Daily Star Feb 2012. "Nancy Sutley, chairwoman of the White House Council on Environmental Quality and Tucson Mayor Jonathan Rothschild tour Davis-Monthan Air Force Base's alternative-energy projects. She quoted the Obama administration's economic catchphrase as she proclaimed these test projects are examples that should be transferred to civilian life to build a clean-energy economy.
Sutley, touring with Tucson Mayor Jonathan Rothschild, saw: A ceramic-paint building with nontoxic paint that's supposed to use 22 percent less energy due to the ceramic material's insulating qualities. It was one of four projects under development that Sutley saw at the aging-aircraft maintenance facility known as the boneyard."

Concrete parking area for aircraft will be coated with Ceramic to test cooling effect on aircraft and equipment y reducing radiant heat from concrete back to planes, personnel and equipment. "This test is an effort to help reduce the overheating problem for aircraft parked on the ramp in the Middle East areas which was requested by General Hoffman during his recent visit."

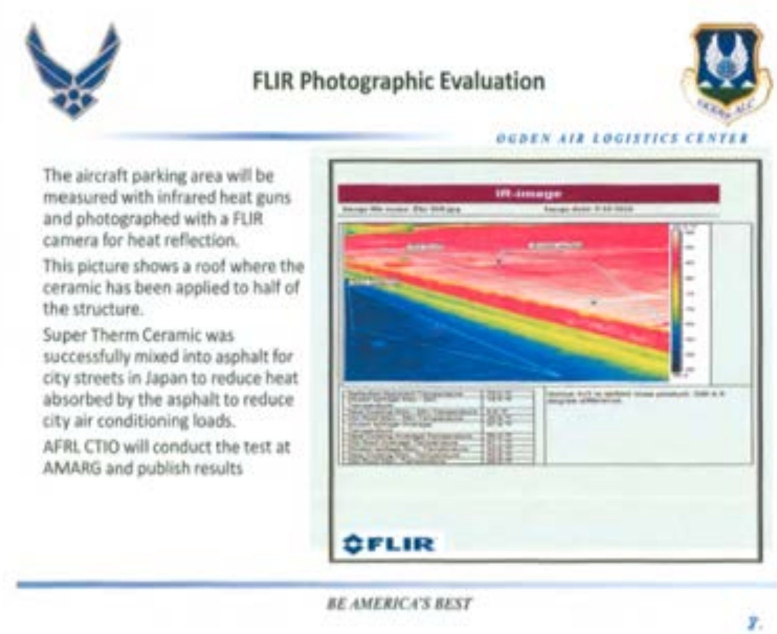
"FY11 309 AMARG Leading Edge Alternative Energy Aircraft Hangar – Ceramic Coated Exterior. Area 23 Portable Office and Microturbine Enclosure Metal Exteriors painted with SUPER THERM Ceramic Heat Reflective Coating to reduce heat loading.
Air Force Research Lab will perform a one year accelerated test to provide four years of data. On-site simultaneous actual testing here on A-10, F-16, F-15 and NAVY F-18 aircraft. Reduce twice the heat loading on aircraft skin compared to current Spraylat – better for electronics." **Full report given below:**

US Air Force: The first metal double wide building to be coated with SUPER THERM at 10 dry mils (250 microns) on Davis-Monthan Airbase in Tucson, Arizona. A metal building without fiberglass and a drop ceiling. The day before the conference and review of the building by 400 attendees was 111F (44C) and the day of the conference when J.E. Pritchett spoke at the conference and when all attendees touched the building and went inside to check the interior the ambient temperatures was 113 F (45C). The Air conditioning units had been turned off three days prior to the conference to show how well SUPER THERM would block the loading of radiation heat onto the exterior skin of the building (mobile home metal trailer). Doors were locked shut during the three days and no air conditioning was on. When the doors were opened for the attendees to walk into the building and experience the results, the interior temperature was 85F (29C). So, after three days in temperatures of 111F to 113F, SUPER THERM tinted slightly to a tan color to match the desert tan scheme, metal, and facing the sun without ventilation, 85F on the interior is exceptional. When uncoated metal was tested next to the trailer, the metal was read at 198F and 205F surface temperature.

The Assistant Secretary of the Air Force sent a letter to SPI in appreciation for the presentation and support of the Air Force Renewable Energy Symposium in Tucson.

SUPER THERM is applied to buildings, aircraft to protect electronics, aircraft parking areas to reduce concrete heat loads under the planes and bridges. (Pictures attached in back of this specification report.).

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."



SuperTherm and the US Air Force

DEPARTMENT OF THE AIR FORCE WASHINGTON DC
OFFICE OF THE ASSISTANT SECRETARY

Mr. Joseph E. Pritchett
President and Chief Operating Officer, Superior Products International II, Inc.
10835 W. 78th Street
Shawnee, Kansas 662 14

4 August 2011

Subject: Innovative Use of Ceramic Coatings to Alter the Approach to Building Heat Gain

Dear Mr. Pritchett,

I extend my personal thanks and appreciation for your support of the Air Force Renewable Energy Symposium in Tucson on June 28 and 29111. The Air Force is committed to be a leader in developing and using renewable energy to support our mission and reduce reliance on fossil fuels. We can only meet this objective with the involvement and support of a wide range of government, regulatory and renewable industry leadership. Your presentation on Innovative Use of Ceramic Coatings to Alter"the Approach to Building Heat Gain was very informative and valuable to our efforts.

The Air Force energy team, including our senior staff here in the Secretariat, look forward to additional discussion with you and overcoming challenges in our movement to a clean, renewable energy future.

Sincerely,

KEVIN T. GEISS, PhD, SES Deputy Assistant Secretary of the Air Force, Energy

NACE Western Area Conference Thermal Insulation Coatings and Corrosion Control"	2015
United States / Canada Joint Certification Program "Approved Militarily Critical Technical Data"	Current
International Trade Council member	Current
U.S. Department of Commerce – Gold Key Program **I have the ability to use International Embassies to present new technologies world-wide.**	Current
ABS (American Bureau of Shipping) Manufacturing Assessment and Coatings Approval	Current
ISO International Standards Organization audited Approval for paperwork, processes, Quality control, Management processes, Raw material receiving/ logging system, and Finished product quality and function **ISO 9001-2015 Approved**	Current
BOSIET (Basic Offshore Safety Induction & Emergency Training)	Current

Invited Lectures: All invitations were addressing Real-World Problems. All these locations were traveled to and insulation and corrosion presentations were given on site in each country. This is not the entire list but is a snapshot.

NACE	Insulation and Corrosion 5 locations	USA
SSPC	Insulation and Corrosion 2 locations	USA
NACE	Insulation and Corrosion Controls	Saudi Arabia
NACE	Insulation and Corrosion Controls	Bahrain
NACE Oil/Gas	Insulation and Corrosion Abu Dhabi	UAE
GREEN Conference	Insulation and Corrosion	Dubai, UAE
Global Insulation Conference	Insulation	Barcelona, Spain
COSMO	Insulation and Corrosion Controls	Tokyo JP
Industrial	Insulation and Corrosion Controls	Osaka JP
Building Conference	Insulation Beijing.	China
Industrial/Power.	Insulation and Corrosion Shenyang	China
Industrial Conference	Insulation and Corrosion	Seoul Korea
Industrial/Steel	Insulation and Corrosion	Pusan Korea
Petronas	Insulation and Corrosion Controls	Malaysia
Industrial	Insulation and Corrosion Controls	Singapore
Petrobras	Insulation and Corrosion Controls	Brazil

Brasilia/gov Insulation and Sound Controls Brazil
Industrial/Deep Sea Insulation and Corrosion Rio, Brazil
Industrial Insulation and Corrosion San Paulo, Brazil
Aerospace/Military Insulation and Corrosion. Salvador Brazil
DuPont Mexico Insulation and Corrosion Mexico City, Mexico
Grupo Bimbo Insulation Monterrey, Mexico
Pemex Insulation and Corrosion Mexico City Mexico
Pemex Offshore Insulation and Corrosion, Ciudad de Carmen, Mex
Pemex Fac Insulation and Corrosion Coatzaceaicos, Mexico
Ingersoll Rand Insulation Monterrey, Mexico
PDVSA Oil Insulation and Corrosion Caracas, Venezuela
Industrial Insulation and Corrosion Controls Moscow
Ecopetrol Oil Insulation and Corrosion Baranca Colombia
Industrial HQ Insulation and Corrosion Bogota Colombia
Industrial Gas Insulation and Corrosion Bucaramanga Colombia
Industrial Insulation and Corrosion Barranquilla Colombia
Industrial Insulation and Corrosion Cartagena Colombia
PDO Insulation and Corrosion Controls OMAN
U.S. Commercial Service Insulation and Corrosion Egypt
PICKERING (NUCLEAR)Insulation/Corrosion Toronto Canada
Industrial / ships Insulation and corrosion Vancouver Canada
Industrial Insulation and Corrosion Controls Taiwan
Industrial Insulation and Corrosion Controls Mali Africa
Industrial/Gov Insulation and Corrosion Controls Gabon-Africa
Industrial Insulation and Corrosion Sevilla, Spain
GOV Insulation/Corrosion/Graffiti Controls Rome, Italy
Industrial Insulation and Corrosion Munich, Germany
Industrial Insulation and Corrosion Paris, France
Industrial/Aerospace Insulation Bordeaux, France
Industrial tanks. Insulation and Corrosion Normandy, France
Industrial/Building Insulation and Corrosion Antwerpian, Belgium
Industrial/Ships Insulation and Corrosion Rotterdam Belgium
Industrial/Building Insulation and Corrosion. Vilnius, Lithuania
Industrial Insulation and Corrosion Istanbul, Turkey
Industrial/Building Insulation and Corrosion Athens, Greece
Industrial/Tunnels Insulation and Corrosion Baku Azerbaijan
Industrial/gov Insulation and Corrosion Controls Kazakhstan
Industrial Insulation and Corrosion Santiago, Chile
Industrial/ tanks Insulation and Corrosion Newfoundland
Industrial/ Canal. Insulation and Corrosion Panama
Formosa Plastics Group Insulation and Corrosion Taiwan

Patents:

US 7,368,150 B2 May 6, 2008

"Method of Applying a Heat Reflective Coating to a Substrate Sheet"
Different construction materials, such as fiberglass batts, to add effectiveness, block moisture load and air filtration. Joseph E. Pritchett

US 5,695,812. December 9, 1997
"Method For Abating Bio-Hazardous Materials Found in Coatings"
The abatement of bio-hazardous particulate materials, such as asbestos. Encapsulating the particles and prevent from flying into the air while being resistant to abuse, abrasion and impact. Joseph E. Pritchett

US 18/917,236 October 16, 2024
"Compounds for insulating Hot Pipes" New technology of precoating pipes for above and below ground to insulate, stop CUI (Corrosion Under Insulation) and employee protection. This system is used also for current operating pipes, tanks, heat exchangers, furnaces and such hot surface assets while in operation requiring no shut down. Currently, the HPC system is the only system available for providing this system.

Research Interests:

Ceramic compound discovery to provide heat blocking against 1500F up to 3000F so that someone can lay their hand on the coated unit without burn. Also, using ceramic compounds for impact resistance, design a bullet proof full body suit.

Working with Group that makes Graphene to toughen, water-proof and build anti-fouling pails for hulls of ships. Sam Weaver, inventor, John Key, Mike Phillips and **Terry Virts (retired NASA Astronaut and Commander of Space Station).**

Test Offerings

ASTM C1363. Required by FTC to qualify as an insulation Coating

ASTM C 1549. Reflectivity

ASTM C 1371 Emissivity

***ASTM C177** Required for "mass" materials to show value. We tested SUPER THERM under this to show value, but it is strictly for absorption of all the heat to transfer instead of blocking the heat load, which is what SUPER THERM® is designed to do.

ASTM E1269 Differential scanning calorimeter, Blocking Initial heat Load
ASTM E 1461-92 Laser Flash Technique, Blocking Initial heat load using density of coating film loaded with a unique balance of four ceramic compounds

Japan Testing Center for Construction Materials. Solar reflectively JIS A 5759 5.3.4 (b). 92.2%

Japan Testing Center for Construction Materials. Long wavelength emissivity 99,5%

Russian Academy of Sciences: The Russian Academy of Sciences institution Institute for Solid State Physics RAS. SUPER THERM test result for blocking all heat wave lengths is 96%. Outperforming polished mirrors.

NOTE: All standard ("mass") insulation materials are only tested in a Steady State Controlled Laboratory setting and tested at only one temperature: 75º F ambient. If you live where it is only 75º F (24C) and it never changes, then these materials work for you as tested and advertised. Geographically, conditions change, and this testing does not relate to your climate.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Point: The "Mass" insulation materials developed the "R"value back in the early 1970's. It was designed specifically for how they work – absorbing heat and slowly transferring all the heat through the material to the cold side. Once the material is full of heat or reaches heat flux, the resistance factor is no longer a value. This is the "ONLY" insulation value "allowed" by code departments throughout the US and countries. This is a "MONOPOLY" (as stated by engineering on the Utube) under any definition and enforced by governmental agencies. This Monopoly must be changed because as explained, these types of materials only work for a short period of time before they age, compress, load moisture and allow air to blow through them to cancel most of their insulation effect. As expected, they work best at night or non-sunny environments. The savings during sunny days are handled 67% by SUPER THERM® and 33% by mass insulation (summer heating hours). The overall savings day after day is obviously the heat blocking performed by SUPER THERM®. In winter, the combination of mass and SUPER THERM® is best with mass providing the most insulation during dark and cold periods (exception is wind drafts and moisture load into the mass materials). In summer, the A/C

<u>cost more to operate than gas heat in the winter, meaning the summer months are the concentration to save energy dollars.</u>

Japan Testing Center for Construction Materials, Yokyo

Simulation and calculation of temperature and heat
Penetration due to solar reflectivity and long wavelength
Emissivity of the reflective thermal coating "SUPER THERM®"
Solar Reflectivity Blocking 92.2 % average
Long wavelength emissivity Blocking 99.5 %

2.3 Measurement results

The measurement results for solar reflectivity and long wavelength emissivity are shown in Table 2.

Table 1. Test body

Product name	Measured item	Dimensions	Quantity
SUPERTHERM	solar reflectivity	50 x 50 mm	3
	long wavelength emissivity		1

Table 2. Measurement results

Test item \ Test body no.	1	2	3	Average
solar reflectivity	92.1	92.4	92.0	92.2
long wavelength emissivity	99.5			

(Note) For normally utilized white paint, solar reflectivity of about 80%, and long wavelength emissivity is about 90% (source: Architecture (handbook), compiled by the Architectural Institute of Japan, 1980).

Japan Testing Center for Construction Materials

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

The Russian Academy of Sciences Institution, Institute for Solid State Physics – July 2012

Result:

Reflection Coefficient%

Polished Aluminum Mirror – 90.4%

Fresh electro-zinc coating – 65.3%

SUPER THERM sample 1 – 96.1%

SUPER THERM sample 2 – 95.9%

SUPER THERM sample 3 – 94.3%

SUPER THERM sample 4 – 94.5%

Conclusion: "Total coefficients of diffuse light reflection for SUPER THERM coat samples in visible band are consistent with (and even several percentages higher) aluminum mirror reflection coefficient, and are substantially higher than reflection coefficients of galvanized iron and duralumin". …"SuperTerm makes absorbing ability of this surface in Visible-light spectrum circa 20 times less in comparison with absorbing ability of an absolute black body..

Research Supervisor
Doctor of Physical and Mathematical Sciences, Leading Scientist
V.B. Yefimov

It is understood that blocking the "heat load" over a facility is more effective than allowing 100% of the heat load to occur and then using a standard type insulation to absorb and offer a slow conducting into the facility. Also, once the standard material is loaded with hot moist air and the sun goes down, this will accelerate is fully loaded with heat and will take hours to finish unloading the heat into the cool side before the A/C can cycle.

Point: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Results of reflection coefficients measurement

In the course of the measurements, it was defined that obtained reflection coefficients values do not depend on the size of samples used for measurements, and spread in values of the same type samples stays within the limit of a photometer accuracy.

The Table gives summary data of total reflection coefficients measurement with the use of a resolving light filter, i.e. in visible band.

Table. Absolute values of reflection coefficients of Super Therm coat samples and comparison samples.

Reflection coefficient ρ (%)							
Mirror (*Al*)	*D16*	Fresh electro-zinc coating	Oxygenated electro-zinc coating	"*ST*" Sample 1	"*ST*" Sample 2	"*ST*" Sample 3	"*ST*" Sample 4

90.4	45.7	65.3	16.3	96.1	95.9	94.3	94.5

As you can see in the table, coat samples have much higher reflection coefficient in comparison with bottom layer made of galvanized iron (both fresh and oxygenated) and duralumin samples. And what is more, the coats reflection coefficient in visible band appeared to be a little higher than the aluminum mirror reflection coefficient too.

"Research on Cool Roof in Japan" by Mr. Yasushi Kondo, PhD of Musashi Institute of Technology.

Dr. Kondo is a researcher with authority in the high reflectance coating field. "Twenty one (21) high-reflectance coatings have been tested based on the JIS (Japan Institute of Standards) standard as a part of the heat island mitigation effect investigation program by the city of Tokyo. The result of the newly applied product was publicly released before, but the result later it aged has just been released in the "international Workshop on Countermeasures to Urban Heat Island" in a presentation "Research on Cool Roof in Japan" by Mr. Yahushi Kondo, PhD of Musashi Institute of Technology."

Result: of the 21 coatings tested and after only 571 days (1.5 years), the reflectance had decreased by about 30%. Comparison was made to SUPER THERM® on the reduction in visual light reflectivity after **15 years** (not just 1.5 yr) which was only 8.1%. This project test roof was re-visited after 30 years and the reduction was still between 8-9% and stable. SUPER THERM® unlike "all" reflective paints will continue to insulate after becoming weathered and dirty. It is not just a "reflective white" coating, but has unique ceramic compounds that will not absorb heat throughout their life span. **Printed study report is shown below.**

Reflectivity Change with reflective coatings at 1.5 year aging vs SUPER THERM at 15 year aging-- TOKYO Japan

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

<u>See official report on next page:</u>

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

Reflectivity change with aging of other reflective coatings

Twenty one high-reflectance coatings have been tested based on the JIS Standard as a part of the heat island mitigation effect investigation program by the city of Tokyo. The result of the newly applied product was publicly released before, but the result after it aged has just been released in the “International Workshop on Countermeasures to Urban Heat Island” in a presentation “**Research on Cool Roof in Japan**” by Mr. Yasushi Kondo, PhD of Musashi Institute of Technology. Dr. Kondo is a researcher with authority in the high reflectance coating field.

There are many high-reflectance coatings in the market nowadays, but not enough research has been done on its product quality. Therefore, it is difficult for users to select reliable products.

In the test done by Dr. Kondo, the product No.13 had one of its highest reflectance in the new stage, but only after one and a half years (571 days) the reflectance had decreased by about 30%.

<Product No.13>

	Solar Reflectance (300~2500nm)		**Visible Light Reflectance** (300~780nm)		**Near-Infrared Reflectance** (780~2500nm)	
	New	571 days	New	571 days	New	571 days
White	80. 8 →	**54.8**	85. 2 →	**50.4**	82.1	61.4
Black	40. 4 →	30.7	5. 8 →	6.9	71.2	51.5

Test Method: JIS R 3106 (Reflectance Test on Plate Glass)

On the contrary to this test result, Super Therm’s reduction in Visible Light reflectivity after **15 years** was only **8.1%**(92.2% - 84.1%=8.1%), compared to the 35% loss of the 21 tested reflective coatings above in only 1.5 years. This result proves that SUPER ThERM's long term durability in reflectivity is excellent. No other coating can show this result.

<Super Therm>

- The Solar Reflectance at the new stage was **92.2%** (Building Material Test Center)
- The Solar Reflectance **After 15 years** (K-Teck, Kansas)

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

Projects: Limited listing to high profile

Tucson Airport – reduced entire energy cost first month by 22%

TUCSON AIRPORT: 374,804 sq.ft of roofing coated with SUPER THERM. Saved 22% on total utilities for the entire building which relates to a 40% reduction in A/C energy reduction. Based on utility bill from year before to the coated period. Bills pulled on August 2008 compared to August 2009 after roof coated with SUPER THERM. Chris Wilt, Airport Facilities Manager

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Nissan Motor Co., Ltd. , Sagamihara Parts Distributor Center165,000 sqm (1,800,000 sq.ft) roof.

Beijing Logistics Warehouse for 2008 Olympics Uncoated Roof: 61.2C (142F)
Coated Roof: 29.5C (84F)

Blue Chip Casino Boat, Michigan City, Indiana 2005

SUPER THERM® replaced fiber insulation on interior wall of metal ship. SUPER THERM® was applied on interior and exterior of walls and roofing. Condensation stopped on the interior and during hot summers, the heat load on the exterior was reduced to ambient temperature. The condensation was so bad in winter time that they had to weld horizontal ribs along the sides to catch the water draining down the walls to divert it to a catch tank and pump out. The reason was that the warm humid air on the interior absorbed (as "mass" materials are designed to do) and when it reached the cold side of the metal ship, it cooled and dropped out all it's moisture causing the entire insulation "mass" material to become soaked and not work at all. SUPER THERM® simply worked with the normal air flow to repel the heat off the surface of the metal back into the interior ambient air and move with the air flow to prevent any condensation and keep the interior warmer.

BLUE CHIP CASINO II Michigan City, Indiana January 2005 - January 2006

Chicago Bridge & Iron, Austin, Texas

187,000 sq.ft to reduce operating temperature inside the Facility

Container Jails in El Savador,

Without SUPER THERM®
Wall Interior 48.6C Roof Interior 58C
Exterior 48C Exterior 49

With SUPER THERM® applled
Wall Interior 30.4C Roof Interior 27.8C
Exterior 30.8 C Exterior 30.2

For more humane treatment of prisoners.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

DRYDOCKS WORLD, United Arab Emirates

Containers, bringing heat on containers to ambient

ARAMCO OIL/ GAS , Saudi Arabia LNG Storage tanks SUPER THERM ® applied to stop flare off for safety and reduction of gas loss due to evaporation. Evaporation is flared meaning it is ignited and a constant flame in the environment.

Aramco Oil and Gas: Jyaymah NGL Spherial Tanks

In the Natural Gas tank fields, the sun radiation (UV, Visual and IR) waves heat the skin of the tanks causing a critical increase in psi pressure inside the tanks that causes flaring. Most all flaring is burned off with a constant flame. This, in itself, is dangerous and is a concern for the safety engineers more so than the loss of gas. SUPER THERM was applied to a full tank to compare directly to the identical tanks around it being the same size and shape. In November the ambient was 32C (90F). The uncoated tank surface was 50.9C (124F) while the SUPER THERM coated tank surface was 35.1C (95F) or near 30F surface temperature difference. The SUPER THERM tank allowed the interior temperature to drop low enough to stop the blow-off or reduce the pressure to stop the flaring. This was very significant in employee protection but loss of gas.

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

NATIONAL ELECRICITY SAVING COMMITTEE 1999

Good-Standing Factories in Energy Control, Improvement Case Examples, Japan
Factories that were awarded by the Secretary of State for Trade and Industry-Director and General of the Agency of Natural Resources and Energy.Goal: Energy Savings and R.O.I. (Return On Investment) 49,000 sq.m (530,000 sq ft) applied with SUPER THERM®.Metal Roofs already had 10mm sprayed Rock Wool fiber on interior side for insulation but not working well. Exterior had a Bituminous Coating to seal and help block heat load but not doing the job.SUPER THERM® applied at 180 microns (7.2 mils) (Note: Manufacturer recommends 250 microns or 10 dry mils for best performance) over the existing coating on the exterior facing the sun radiation to block the radiation heat from loading into the roof.

Results: Energy Saving

Fine day in summer. Outside ambient 32C (90F)	Outside Surface Temp	Room Surface Temp
Before	63C (145F)	61C (141F)
After Coating	41C (105F)	38C (100F)
Difference	22C (40F)	23C (41F)

Energy Saving Effect:
40,300sqm X 23C (73F) X 2.76K cal/hk: sqm *C
(K Value: over-all coefficient of heat transfer for steel) = 2,558,244 kcal/h
Saving 2,558,244 kcal/h X 8h/day X 20 days/month X 6 months/year X 0.75 (Period of Air Conditioning Used) (Fine Sky Ratio) = 1,841,760 Mcal/year
Calculation of Elecricity:
1,841,760 X 10(3)kcal/year divided 3,000kcal/h X RTX 1.2kW/RT= 736,704k Wh/year

Energy Saving Cost:
786,704k Wh/year X yen(Japan currency) 15/kWh = Yen 11,050,560/ year. (103 yen exchange to $1 US) = $107,287

Prolongation of Life Span. The re-painting cycle as extended from 7 years to 9 years (est)

Improvement Evaluation

Initial Cost for Improvement (¥10,000) (A)	Energy Saving Effect (¥10,000/year) (B)	Pay-Back Period (year) Excluding Interest (A/B)
Ceramic Insulation Coating 6,850 Bituminous Coating 5,680 Difference 1,170	1,105	1.06

ROI: Thirteen (13) month payback savings to investment. Comparison of cost: Bituminous versus SUPER THERM® is 20% more in cost but returns its total investment in 13 months compared to 0 return from Bituminous. (See report below – 7 pages)
NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Official report below

Good-Standing Factories in Energy Control
Improvement Case Examples
Japan

Factories that were awarded by
the Secretary of State for Trade and Industry-Director
and General of the Agency of Natural Resources and Energy.

(1998 Electric Category : 19 Case Examples)

April, 1999

National Electricity Saving Committee

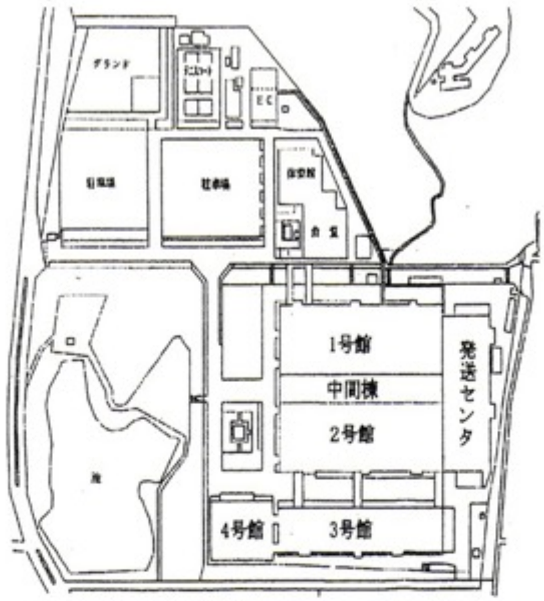
Application of Insulation Coating on Factory Roofs

ï **Factory Information**

Capital	¥2000Million ($17Million)	Contract Demand	4,700kW	Voltage	33kV	Site Area	181,751 sqm	Building Area	86,000 sqm
Main Product	Video Camera	Electric Power Consumption Rate	1,320,000kwh/ ¥1million	% of Electricity Costin Production Price	0.18%	Workers	2,500	Electricit y Related Workers	7

ï **Factory Site Map**

Bldg. Name	Area (sqm)	Note
Bldg.1	12,600	
Bldg.2	12,600	
Bldg.3	7,100	NotApplied
Bldg.4	NotIncluded	
Middle Bldg.	4,400	

 ShippingCenter	6,900	
Dining Bldg.	2,400	
Gym	1,600	NotApplied
EnergyCenter	1,400	
TOTAL	49,000	

*40,300sqm is applied so far.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Reasons for improvement

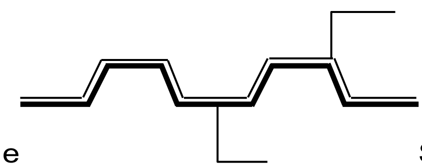
Out of all electric energy that this factory consumes, the energy used for air conditioning is high, and it takes up about 30%. The energy consumption rate for air-conditioning in summer is especially increasing due to the automation of offices and factories.

There are nine buildings in this factory and the first construction of Building 1 began in 1973, and the construction of the roofs was corrugated metal sheets + paint. Due to this roof construction, it had poor insulation performance, and it was a burden to the air conditioners in summer.

The temperature of the roof surface was very high due to the radiant heat, and the work environment was also poor. They had to lower the temperature setting of the air conditioner. Therefore, there was a need for improvement in energy saving.

Improvements

Before: Roof Construction



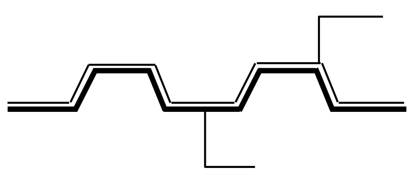
Outside Inside

Surface Bituminous Coating

Inside: Rock Wool Sprayed(t=10mm)

Due to the deterioration of coating, application was done as a part of the renovation project. (Change of Coatings)

After: Roof Construction



Outside Inside: Surface: Ceramic Insulation Coating (Thickness: 180 micron)

Inside: Rock Wool Sprayed(t=10mm)

Ceramic Insulation Coating was applied by spray in two layers to the surface of corrugated metal sheet roof.

Composition: **COOL THERM (SUPER THERM®)**

Water-Base Paint (Acrylic Resin + Urethane Resin + Three Kinds of Ceramics)

*Insulation Mechanism-----Two kinds of ceramics repel sun light.

The third ceramic works as a vapor barrier

○ **Results**

1. Energy Saving

Condition: Fine day in summer   Outside Temperature: 32C (90F)

	Outside Surface Temp	Room Surface Temp.
Before	63C (145F)	61C (141F)
After	41C (105F)	38C (100F)
Difference	▲22C (40F)	▲23C (41F)

Energy Saving Effect:

40,300sqm × 23C (73F) × 2.76Kcal/h · sqm · C
(K Value: over-all coefficient of heat transfer for steel)
= 2,558,244kcal/h
2,558,244kcal/h × 8h/day × 20 days/month × 6 months/year × 0.75
(Period of Air-conditioning Used) (Fine Sky Ratio)

= 1,841,760 Mcal/year

Calculation of Electricity:

1,841,760 × 10^3kcal/year ÷ 3,000kcal/h · RT × 1.2kW/RT
= 736,704kWh/year

Energy Saving Cost:

736,704kWh/year × \15/kWh = \11,050,560/year

2. Prolongation of Life Span

The re-painting cycle has extended from seven years to nine years.

○ **Improvement Evaluation**

Initial Cost for Improvement (\10,000) (A)	Energy Saving Effect (\10,000/year) (B)	Pay-Back Period (year) Excluding Interest (A/B)
Ceramic Insulation Coating 6,850 Bituminous Coating 5,680 Difference 1,170	1,105	1.06

ROI : Thirteen (13) month payback savings to investment over the difference in cost of applying Bituminous Coating which has no insulation payback.

Comparison of cost: Bituminous versus COOL THERM (SUPER THERM®). COOL THERM (SUPER THERM®) is 20% more in cost but returns its total investment in 13 months compared to 0 return from Bituminous basing on the difference in cost of both systems.

COOL THERM (SUPER THERM) alone has a 6.16 year ROI.

Mitsubishi Related Tank Terminal – Japan 1996

From Mr. Hanaoka of Kitazawa Yakuhin Corporation "A whole surface of a tank (1,000KL) in Hokko Terminal a had Coated with SUPER THERM® in 1996, and we had recognized. The beneficial effects. Therefore all of the 39 tanks in Hokko Terminal (30,000KL) were coated with insulating coating. The maximum effect is that VOC emission in the atmosphere has been reduced strongly. This is because the temperature inside the tanks are kept at a low temperature constantly by full coating with SUPER THERM®, and breathing of tanks are depressed."
The temperature in the tanks were controlled by using electricity and water before, but it is not needed any more after coating. SUPER THERM® is the superior eco product which lessens the burden on the environment.

The tank coated in 1996, which had rest of tanks coated in 2009, the heat insulating effect is still continuing, and the durability is demonstrated. We are promoting insulation coating of tanks and storages s part of environmental protection.

Reported in 2010 giving a 14year history from first tank.
AST Inc. (Advanced Storage & Transportation)
Environment Safety Department
Hideki Yonedura, Department Manager. **(Pictures see below)**

Mitsubishi Related Tank Terminal Feb. 10, 2010

39 storage tanks coated with fuel. The VOC emission in the atmosphere has been reduced strongly. Tanks are now cool and no evaporation. Temperature inside tanks were controlled by electricity and water, but is not needed any more. COOL THERM (name in Japan) is the superior eco product which lessens the burden on the environment.
NOTE: Your experience may be different.
NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Japan re-testing after 15, 16 and 18 years shows no loss to only 1C degree drop in performance on the exterior and interior of roofing.

TOSHIBA Logistics Corp . Application August 1996, 16,500sqm (178,000 sq.ft)
“I still maintains the same room temperature and effect after 16 years.”

KOKUYO Co., Ltd.

After 10 years （1994）

AfAfter 18 years （2012）

	Outside Temperature	Room Temperature
BEFORE （1994)	33.5℃	39℃
AFTER （1994)	32.5℃	32℃
After 10 years （2004)	34.3℃	33.5℃
After 18 years（2012)	33.5℃	35.5℃

“Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®’s application. Results may vary depending on these factors.”

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

Daiko Shokai. Co., Lt

Japan Recap of major users results from Daiko Shokai Corporation First one given by customer shows an 87% reduction in KW usage

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

SUMMARY

SONY – KODA
RESULTS: KW (Power) USAGE INSIDE A SPECIFIC BUILDING

	MAY	JUNE	
1994	3767KW	5647 KW	Before SUPER THERM
1995	519 KW	1869 KW	After SUPER THERM applied
		SAVINGS 3248 KW - 3778 KW	

2. HITACHI ELECTRIC
RESULTS: TEMPERATURE RECORDED ON UNDERSIDE OF ROOFING
UNCOATED: 82C
COATED WITH SUPER THERM: 47C
REDUCTION OF HEAT: 35C/63F

3. SEKISUT
RESULTS: REDUCING ROOM TEMPERATURE
AMBIENT TEMPERATURE: 33C
ROOM TEMPERATURE: 43C
ROOM TEMPERATURE after applying SUPER THERM: 31 C
REDUCTION OF ROOM TEMPERATURE: 12C/22F

4. YOKOHAMA TIRE-RUBBER
RESULTS: REDUCED ROOM TEMPERATURE
UNCOATED: 47C
COATED WITH SUPER THERM: 28C
REDUCTION TN ROOM TEMPERATURE. 19C/34F

5. KIRIN BREWERY (Fukuoka) 52% share of beer business in Japan
RESULTS: REDUCED ROOM TEMPERATURE
UNCOATED: 63C
COATED WITH SUPER THERM: 48C
REDUCTION IN ROOM TEMPERATURE: 15C/27F

6. MITSUBISHI MATERIAL
RESULTS: REDUCED METAL SURFACE TEMPERATURE
UNCOATED: 54C
COATED WITH SUPER THERM. 28C
REDUCTION IN SURFACE TEMPERATURE: 26C/47F

7. SUMITOMO LIGHT METAL INDUSTRY
RESULTS: REDUCED ROOM TEMPERATURE
UNCOATED: 52C
ROOF COATED WITH SUPER THERM: 35C
REDUCTION IN ROOM TEMPERATURE: 17C/31F

8. PANASONIC - MATSUSHITA ELECTRIC
RESULTS: SURFACE TEMPERATURE ROOF:
UNCOATED SURFACE: 70C
SUPER THERM COATED SURFACE: 46C
REDUCTION IN SURFACE TEMPERATURE: 24C/43F

RESULTS: UNDERNEATH SIDE OF ROOF SURFACE
UNCOATED SURFACE: 59C
SUPER THERM COATED SURFACE: 43C
REDUCTION IN UNDERSIDE TEMPERATURE: 16C/29F
AMBIENT TEMPERATURE: 39C/70F

McCarron Airport Las Vegas, Nv

Jet Bridges

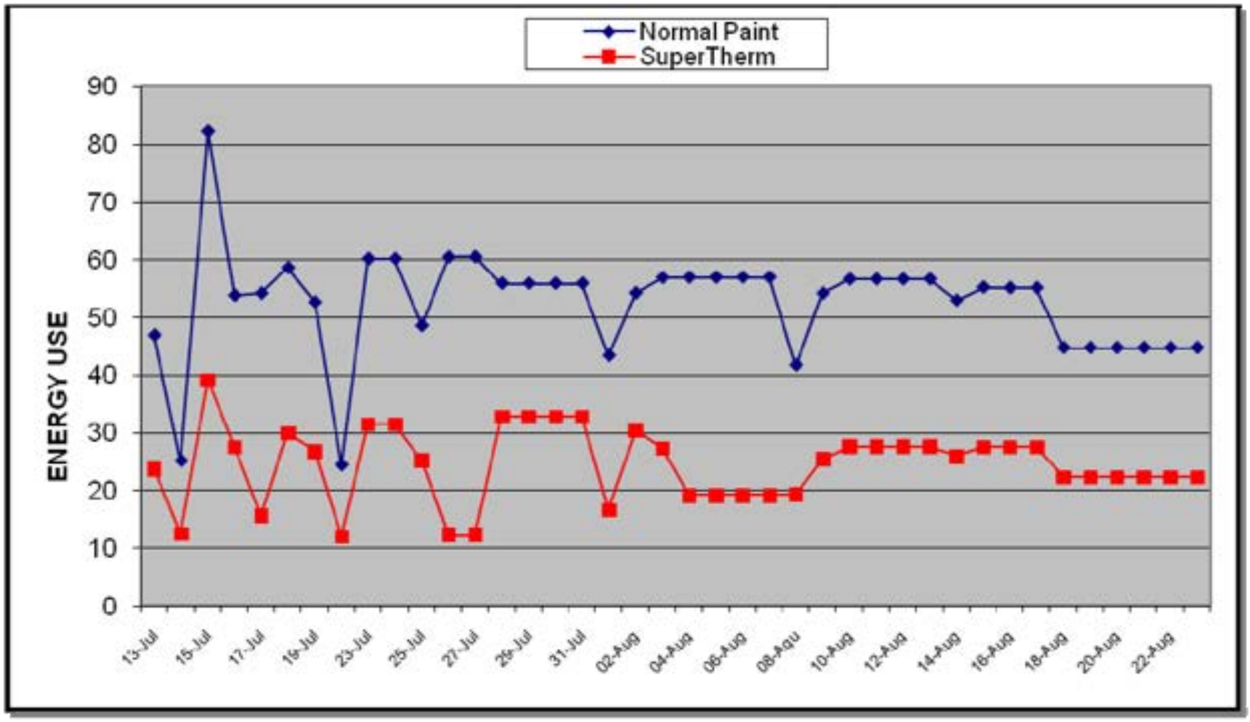
The temperature inside the jet bridge (passenger walkway to and from the terminal to the aircraft) becomes extremely hot in summer months.

Several insulation coatings were tested and SUPER THERM® outperformed all other such coatings claiming insulation. As stated by the manufacturer in their marketing materials and proven by DOE Weatherization Program, when SUPER THERM® is applied to a surface facing the sun radiation, the coated surface will remain within 1º-5º of ambient temperature. This reduction in heat load translates to a huge drop in interior temperature providing a cooler walk through for the passengers, but provides health benefits to prevent over-heating. The Airport is considering coating the entire airport to save energy costs as the Tucson Airport has done.

VODAPHONE TURKEY, MOBLE PHONE CONTAINERS

For transmitting the reception signal for mobile phones in Turkey, an air conditioned container is used. Problem is the heat will build up inside and cause problems with the electrical systems. They must be kept at 23C at all times and cost of A/C is high. Conclusion: Inside temp was achieve at 23C and average savings of energy was over 50%. NOTE: Your savings could be different. **(See graph below)**

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."



CONTAINER jails in El Savador

Metal containers used as Jails. Coated with 10 dry mils (250 microns) of SUPER THERM to block the heat load from heating the trailers. Container without coating Wall 48.6C and Roof 58C, coated with SUPER THERM Wall 30.4C and Roof 27.8C. (See report below)

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

S_U_P_E_R_ _T_H_E_R_M_® _-_P_i_n_t_u_r_a_ _M_a_g_i_c_a_

Subject: FW: Compass Container-NSIA Oakland California

After one day of applying Super Therm (SPT) it seems to works fine. We took temp at 10:50 am to a side panel and roof container with and w/o SPT and look the difference:

Container w/o SPT

	Wall	Roof
IN	48.6	58

OUT	48	49

Container with SPT

Wall	Roof	
IN	30.4	27.8
OUT	30.8	30.2

ADDITIONAL TESTING AND ENGINEERING VALUATIION

SUPER THERM Heat Insulation Coating Specifications

Features: Insulation Coating

NUMBER ONE FEATURE: "HEAT BLOCKING"

BLOCKS 99% OF THE INITIAL HEAT LOAD ONTO A SURFACE and therefore, reduces the "Heat Available for transfer to the cool side" by the same percentage.

TESTING FOR THIS STATEMENT:
ASTM E1269 "Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry".

ASTM E 1461-92 "Standard Test Method for Thermal Diffusivity of Solids by the Flash Method".

Test levels:
Bare steel plate without SUPER THERM

Temp @ C	BTU Loading and Conducting through
23 (73F)	350.54
50 (122F)	366.39
75 (167F)	366.30
100 (212F)	367.20

Steel Plate coated with 14 mils dry

Temp @ C	BTU Loading and Conducting through
23 (73F)	3.77
50 (122F)	3.92
75 (167F)	4.07
100 (212F)	3.99

Average Bare Metal: 362.60 BTU load and passing
Average SUPER THERM plate: 3.94 BTU load and passing

99% Blocking of heat load and conduction to cool side.

Remember: If Heat is reduced to a 1% load onto a surface, there is only 1% of the heat to transfer.

Note: According to humidity level, wind and climate, this BTU conduction will change.

SUPER THERM covers 100% of the wall or surface, AND. "NOT JUST BETWEEN THE STUDS".

Standard insulation materials – absorb 100% of the heat and slows the speed by means of conductivity and thickness. The more the thickness, the longer it takes to transfer to the cool side. Due to moisture load (see ASHRAE reports), wind and compaction into walls, this does not work very well. Remember also, all the standard insulation is "between" studs in the walls and rafters which can be 12.5% of the entire wall space—not insulated.

ADDITIONAL FEATURES of how SUPER THERM blocks heat:

- Reflects 95% of the sum total of all three heat waves
  - UV – 99%
  - Short Wave (Visual) – 92%(JIS A5759 5.3.4 (b) specific waves. CRRC (Cool Roof Rating Council) testing: 83.5% (ASTM C1549) combination of a limited number of waves
  - Long Wave (Infrared) – 99.5% (JIS A5759 5.3.4 (c) specific waves. CRRC testing: Not specific on testing IR range of waves.

- ASTM C236 (Revised to C1363-93) VTEC Lab and National Certified Testing Laboratories, Tested 2002 ("Standard Test Method for Steady-State Thermal performance of Building Assemblies by Means of a Guarded Hot Box". Fiberglass at 3" rated 0.53 BTU K value. One coat of SUPER THERM at 10 dry mils rated 0.31 BTU K value and one coat applied at 10 dry mils to one side of wall and another coat applied to opposite side at 10 dry mils rated BTU K value of 0.21.
-
- Emissivity rating of 0.91 – **R&D Services** May 2, 2006.
  Emits any heat absorbed from its' surface at a 91% rate.
  Heat that comes in contact with surface of SUPER THERM is repelled at a 91% rate back to the atmosphere or room.

Emissivity rating of 99.5 on long wave emissivity (IR) and 92.2 Reflectivity on solar reflectivity – **Japan Testing Center** for Construction Materials November 8th, 1994.

Local University office of DOE (as listed in FTC Rule – page 15, last paragraph) on representing Energy Savings was asked to do Three separate tests performed in three different parts of the US and different environments to show insulation/heat blocking results. "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

US DEPARTMENT OF ENERGY has been very hands-on with proving SUPER THERM works in blocking heat load as reported and advertised by Superior Products International.

FLORIDA ENERGY OFFICE "ECAP" (Energy Conservation Assistance Program). Performed three geographic tests in Miami, Denver and LaPorte, Texas as requested by FTC to show consistency in performance.

Prepared by Alexander Othmer CEA/CBA/NDE III, Director Florida Energy Office/ ECAP Program, University of South Florida/Small business Development Center.

TEST 1: **February 10th and 11th, 2003**, Dade County, Florida. Test method of comparing Utility loads in Standard constructed building. Objective: reduced utility loads in occupied residential, commercial and government buildings. "Comparison to energy related products to displaced conventional utility loads". Only ½ of the roof was covered with SUPER THERM. Roof solar Gain Loads reduced by 20%-30%. This qualifies as an effective Energy Conservation Measure (ECM). Over 5,780 data points were taken over a 24 hr period. Load reduction was 22%, rejecting 121 BTU/Sqft/hr. Air conditioning load savings from the SUPER THERM retrofit was approximately 11.09 tons of load per 24 hour period. Solar gain: Standard roof 206 BTU load per sq ft. solar gain/ 145 thermal load and 98.0 UV absorption compared to SUPER THERM coated roof having 85 BTU load per sq.ft solar gain/ 118 thermal load and 03.0 UV absorption. **Reduced Environmental Impact:** Reduced 66 pounds of power plant emissions/ hour. ROI (Payback) is 2.2 years.
NOTE: these readings may not be the same for you in different locations, weather conditions or climates.

TEST 2: **July 19th and 20th 2004**, Denver, Colorado. Energy loads reduced approximately 26% - 30% (ECM). Average savings of BTU load is 202 BTU's per sq.ft. per hour. "The thermal energy necessary to heat or cool the building coated with the ceramic coating product required 26% less energy". 7,250 data points were recorded at 2 min. intervals for a 24 hr period. Standard building requires 1,037 BTU's of heating or cooling energy per sq. ft to maintain a minimal comfort level. SUPER TEHRM coated building requires 766 BTU's per sq.ft. Reduction of 271 BTU's per hour.
NOTE: these readings may not be the same for you in different locations, weather conditions or climates.

TEST 3: Shipping container **August 23rd and 24 th 2006** Intermodal Facility and Maintenance, Inc. La Porte, Texas. Conduction related energy loads were reduced and energy needed to cool the container would require approximately 46% to 52% less energy by applying SUPER THERM. NOTE: "This is the third time we have had the pleasure to test SUPER TEHRM products, it is rare that a single product will show such Repeatable Results in three totally different environments, South Florida, Denver Colorado and La Port, Texas – a true testimonial to your products ENERGY STAR rating."

TEST 4: 2011 Contractors working with the US DOE WEATHERIZATION ASSISTANCE PROGRAM tested SUPER THERM on the tops of low income home

units in Northern Florida proving that SUPER THERM will drop surface temperature down to within 1 degree F of ambient and making an average of 10.2F inside the coating unit. Only the roof was coated making this dramatic drop in interior temperature.

NOTE: "Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

2.) Water Barrier Coating

ASTM D 6904 Resistance to Wind Driven Rain for Exterior Coatings
ASTM D 7088 Resistance to hydrostatic Pressure for Coatings
Passed all testing standard to 55 mph wind driven rain.

3.) Flame Spread Class A fire rating

ASTM E 84-89 "0" Flame Spread and "0" Smoke

4.) Sound Reduction

ASTM E90 "Standard Method for Laboratory measurement of Airborne Sound Transmission Loss of building Partitions."
ASTM E413 "Standard Classification for Determination of sound Transmission Class."
Both sides total accumulative result is STC 41
Talking range of 1000 Hz to 1600 Hz – STC 50 and again at 5000 Hz.

5.) Mold / Mildew Resistance

ASTM D-3273-82T tested for severe mold environment – Temp 90F and RH of 95%-98% for 5 ½ weeks. Rated 9 out of 10.

6.) Condensation Control

Field Study Testing

7.) Static Coefficient of Friction is an average of **1.14** when tested in 2007.
Kinetic Coefficient of Friction is and average of **0.78**.

8.) Certifications:

UL, ABS, ENERGY STAR, California Bureau of Home Furnishings and Thermal Insulation, ICC (International Code Council #21-25), CRRC (Cool Roof Rating Council – Emissivity of 0.91), JIS (Japanese Institute of Standards) A 5759. US GREEN BUILDING COUNCIL- Certified, LEED program, MBDC Cradle to Cradle Program – Certificates for LEED and Environment, USDA approval letter and US Consumer Council approved.

Testing Properties:

SuperTherm® Laboratory Tests:

1. ASTM (American Society for Testing and Materials):

- ASTM B177 - Salt spray (fog) corrosion tests, 450h exposure **(Passed)**
- ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus **(Passed)**
- ASTM C236 - Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box - Testing for measuring R-values **(Passed)**
- ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation **(Passed)**
- ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers **(Passed)**
- ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer **(Passed)**
- ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension - Tensile strength - 444 psi, modulus of elasticity 13,248 psi **(Passed)**
- ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (resistance to cracking on metal or rubber type materials / 1"(25mm)bend / 1/4"(96mm)bend) **(Passed)**
- ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films **(Passed 3%)**
- ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments Salt spray (fog/weathering) 450 Hour Salt Spray (Fog) **(Passed - 2000 hours)**
- ASTM D3273-82T - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber **(Passed)**
- ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation (Rating degree of fungal growth or soil and dirt accumulation on paint film) **(Passed - Excellent (8 out of 9))**
- ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test **(Rated: 5B)**
- ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser **(Passed)**
- ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied to Masonry **(3000 cycles)**
- ASTM D7088 - Standard Practice for Resistance to Hydrostatic Pressure for Coatings Used in Below Grade Applications Applied to Masonry **(Passed)**
- ASTM E84-89a - Standard Test Method for Surface Burning Characteristics of Building Materials (Flame Index "0" / Smoke Index "0" - Class "A" Rating) **(Passed - "0" development)**
- ASTM E90 - Standard test method for laboratory measurement of airborne sound transmission loss of building partitions **(Passed)**

- ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials water vapor transmission **(Perm Rating - 8.8 avg)**
- ASTM E108 - Standard Test Method for Fire Tests of Roof Coverings **(Passed)**
- ASTM E413 - Standard Classification for Determination of Sound Transmission Class **(STC 40 to 50 based on sound frequency)**
- ASTM E514 - Standard Test Method for Water Penetration and Leakage Through Masonry Resistance to Wind Driven Rain **(Passed)**
- ASTM E903-96 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres **(Passed)**
- ASTM E903-96 - 4 Year Retest **(Passed)**
- ASTM E1269 - Standard Test Method for Determining Specific Heat Capacity by Differential Scanning Calorimetry - TPRL **(Passed)**
- ASTM E1461-92 - Standard Test Method for Thermal Diffusivity of Solids by the Flash Method **(Passed)**
- ASTM G53 - exposure to UV, elevated temperature and humidity **(Passed**

2. NASA (National Aeronautics and Space Administration):

- **NHB 8060.1B/C Test 1**- Flammability testing ("0" Burn, Class "A" rating) **(Passed)**
- **NHB 8060.1C, Test 7** - Toxic Off gassing ("K" no Toxic off gassing / "K" Rating for toxicity) **(Passed)**

3. ICC (International Code Council):

Council that formally consolidates approvals for:

BOCA (Building Officials Code Administrators)

- **Section 723.2** Exposed installations, Thermal insulation
- **Section 723.3** Concealed installations, Thermal insulation
- **Section 803.2** Classification, Interior finish
- 1998 International Mechanical Code
- **Section 604.3** Coverings and Linings, Insulation

ICBO (International Conference of Building Officials

* SBCCI (Southern Building Code Congress International)

- Passed ASTM E 84 For Flame Spread
- Passed ASTM C 411 for High Temperature for Surface Performance
- Section 803.2 Classification, Interior finish
- Passed ASTM C 177 for Thermal Conductivity

5. ECAP-CUL-1-03 - ENERGY CONSERVATION ASSISTANCE PROGRAM:

Standard Method for Comparing Utility Loads in Standard Constructed Buildings

- * FLORIDA: ECAP REPORT (report available on request)
- * DENVER: ECAP REPORT (report available on request)
    - ***"This is the second time we have had the pleasure to test your product, it is rare that a single product will show such Repeatable Results in two totally different environments, South Florida and Denver Colorado, a true testimonial to your products ENERGY STAR rating."***
      Alexander Othmer - Director FEO Energy Conservation Assistance / USF Tampa, Florida
- * TEXAS: Container ECAP Report Houston (report available on request)
    - ***"This is the third time we have had the pleasure to test SuperTherm product, it is rare that a single product will show such Repeatable Results in three totally different environments, South Florida and Denver Colorado and LaPorte Texas a true testimonial to your products ENERGY STAR rating."***

4. ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers):

- 90.1 CODE COMPLIANCE ("U" value used to measure "area-weighted average", insulated walls or roofs)

6. ENERGY STAR PROGRAM:

Approved and accepted as an energy star partner for saving energy

- ASTM E 903-96 Reflectivity = 80%
- Only 1% Reduction in Reflectivity over 3 Years (3% over 10 years)
- ASTM C 1371 and C 1549 Solar Reflectance and Thermal Emittance

7. LEED (Leadership in Energy & Environmental Design):

- Qualifies under Sustainable Sites Credit 7.1 Heat Island Effect - non roof **(1 point)**
- Qualifies under Sustainable Sites Credit 7.2 Heat Island Effect - roof **(1 point)**
- Qualifies under Energy and Atmosphere Credit 1 Optimize Energy Performance ie. reduce thermal bridging **(1-10 point)**
- Indoor Environmental Quality Credit 4.2 Low Emitting Materials - paint **(1 point)**
- Innovation & Design Process Credit 1.1 Innovation in Design **(5 point)**
- Under Category **CORE AND SHELL** in the latest 2009 LEED program:
    - SS Credit 7.2 Heat Island Effect: Roof - 1 point for having a SRI above 78 (ST-120)
    - EA Credit 1: Optimize Energy Performance 1-21 Points SUPER THERM – 17 points.
- MBDC Cradle to Cradle GOLD CERTIFICATION
- LEED Rating System (available upon request)

8. DNV (Det Norske Veritas):

DNV Certification **for SuperTherm®** (available upon request)

- Passed DNV Audit and DNV Compliant
- Approved for worldwide salt water and Maritime use
- Complies with DNV's Interpretation of SOLAS 1974 Convention as Amended
- Low Flame Spread material, not generating excessive quantities of smoke nor toxic products in fire
- DNV rules for Classifications of Ships and Mobile Offshore Units

9. JISC (Japanese Industrial Standards Corporation):

- JIS A 5759 Reflectivity of sunlight on window or coating film **(Passed)**
- Reflective ratio 92.2 - Long Wave Radiation ratio 99.5 (Infrared) **(Passed)**
- 15 Year Re Test Solar Reflectance JIS R 3106 **(Passed)**

10. USDA (United States Department of Agriculture):

- Environmentally safe and safe for use around animals
- Letter of Written Certification as Accepted by USDA from Manufacturer (available upon request)

11. China Center for Technical Testing of Non-Metallic Materials for Ship Building, China Ship-Building Corporation:

- National Bureau for the Inspection of Technologies (97), Measurement Approval (National) No. (M0729) **(Passed - 2000 hours)**
- GB/T 1771-91 - Resistance to Salt Fog (2000 hours) **(Passed)**
- GB/T 1866-88 - Manual Aging (2000 hours) **(Passed)**
- GB/T 10834-88 - Resistance to Salt Water (1000 hours) **(Passed)**
- GB/T 5219-85 - Adhesion (pulling apart method) **(4.07MPa)**
- GB/T 1733-93 - Boiling Water Immersion **(8 Hours)**

12. IMO (International Marine Organization):

- IMO A. 653 (16) - Flame Spread Test for Bulkhead, Wall, and Ceiling Linings **(Passed)**

13. Marine Safety Council:

- MSC.41 (64) - Toxic Gas Generation, Used Colorimetric Gas Detector Tubes, Met All Toxic Gas Requirements **(Passed)**

14. SOUND PROOFING Barrier:

- Sound Reduction: STC (Sound Transmission Coefficient)-Rated 48-51 per ASTM E 90
- Stoughton Trailer Ultra Sound testing shows a 68% Reduction
- Sound testing performed by Hot-Cold Air and Fire Control by Pat Saulson, PhD
- Sound reduced an average of 50.2% by using SuperTherm® on the interior walls of a house

15. VOC – 24 grams/ litre

16. USDA (US Dept. of Agriculture) approved for use around foods- no off gassing.

17. GREEN LABEL

- "Certified" means that an examination of samples of a Product or investigation has been performed by the Council to determine compliance with the Guidelines and that permission has been granted in accordance with this Agreement for the User to represent its Product as Certified.

18. US FEDERAL AUTHORIZED VENDOR AND CONTRACTOR APPROVAL STAMP FOR SELLING DIRECTLY TO US GOVERNMENT AGENCIES AND MILITARY

Complete System for Award Management Assitance

Let your customers and government procurement officers know that you are registered in SAM with our "Verified Vendor" seal. Just like an association or license seal, with this seal you can show interested clients that you are a registered vendor on your website, letterhead, email or other correspondence.

For more information on SPI Products, please send us an email at info@spicoatings.com or phone us at 913-963-4848. SPI products are manufactured in the USA in Shawnee, Kansas.

Prep: Surface must be clean and dry for application.
If any existing surface is glossy, this must be sanded to dull the surface and have no gloss showing.
Oils and residues of any kind must be Power Washed using a Citrus cleaner or any cleaner that can stripe oils and residues and leave the surface clean with no surface residue.
Do not use Degreasers as a cleaning agent. These leave oil films and residues when dried.
If rust is showing, use RUST GRIP (single component urethane) as the primer to encapsulate the rust before applying SUPER THERM.
If pack rust or scale is present, SP 6 must be used to blast the rust down to only a surface rust of 1-2mm thickness, dried completely and RUST GRIP applied at 14sq.m per gallon (3.5 sq.m per litre). Then SUPER THERM applied over the RUST GRIP.

NOTES:

SUPER THERM is designed specifically to block radiation heat from "LOADING" onto the surface of the tank. This blocking of heat load, stabilizes the tank surface, the coating does not expand and contract because it cannot load the heat. There is not cracking and peeling over time.
SUPER THERM is a water barrier (not just a moisture barrier) to block and stop any moisture from humid air or rains from touching the surface of the tank surface to prevent any development of corrosion. With a permeability of 8.8, the SUPER THERM can breathe air, but not allow moisture to enter and bring moist air to the surface.

Below are pictured IR shots of roofing coated and before coating with SUPER THERM. Additional pictures are from US Air Force and NASA.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

Strictly Thermal

Tuned Coatings, LLC
Steffen Mehnert, Mgr
8006 E Arapahoe Rd #10
Centennial, CO 80112

www.tunedcoatings.com

This report is an initial examination of the roofing materials being applied to a large office building in Lakewood, CO

This is an initial report with no controlled samples or environment. We would ask to complete that in a controlled environment to ascertain more accurate numbers.

However, we are certain of a large percentage decrease in thermal heating due to the application of the product. It also appears it has been applied in a consistent and accurate manner as the images reveal.

The images were obtained 12 May 2010 from 1:05 to 1:25 pm MST
Ambient air temp: 62 degrees F
Humidity: 27%
Wind speed: Avg 11 MPH, Max 16.9 MPH from the NNW.

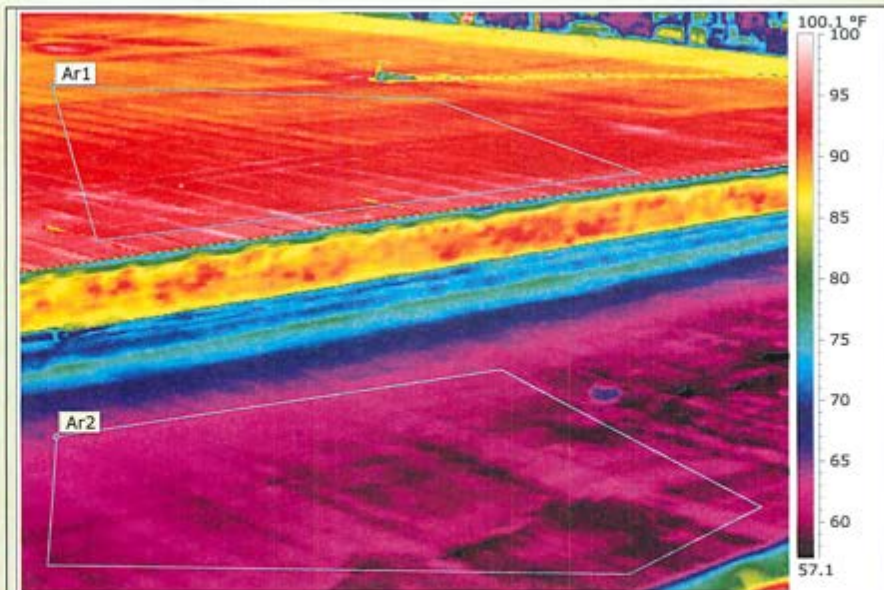
STRICTLY THERMAL LLC

FLIR

1153 BERGEN PARKWAY, STE M254
EVERGREEN, CO 80439
www.strictlythermal.com
Office: 303-674-1803
Fax: 303-674-7712

IR-image

Image file name: Flir 001.jpg **Image date: 5/10/2010**



Reflected Apparent Temperature	68.0 °F
Image Time	1:10:46 PM
Ar1 Min. Temperature	86.4 °F
Ar2 Min. Temperature	56.6 °F
Ar1 Max - Min Temperature	13.4 °F
Ar2 Max - Min Temperature	7.2 °F
Ar1 Average Temperature	93.6 °F
Ar2 Average Temperature	60.1 °F

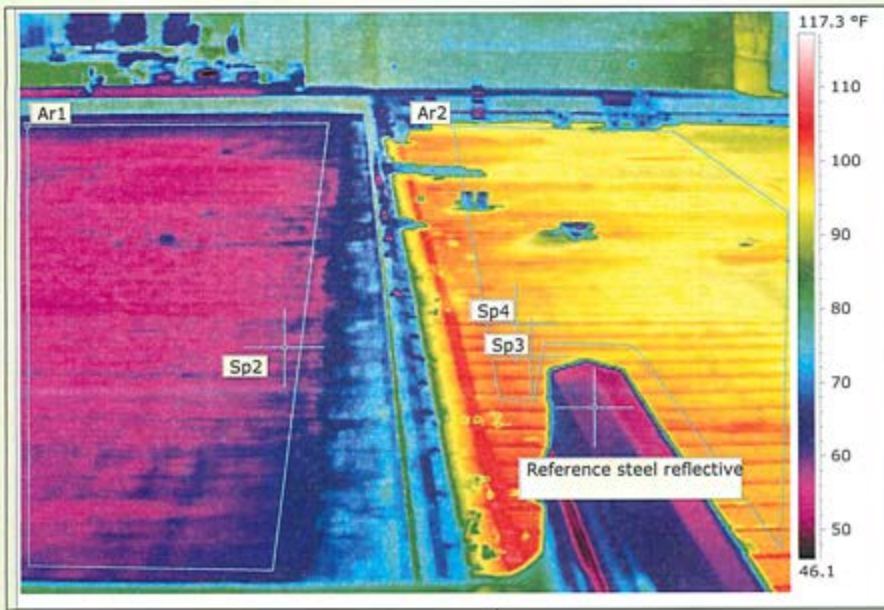
Looking north onto lower roof.
The diagonal yellow area is a raised firebreak wall.
Smoothness and consistency of the coating is apparent.

The apparent average temperature difference from Ar1 (old roof) to Ar2 (New Coating) is 33.3 degrees.
Also the Delta Temp (High to Low difference) Is 6.2 degrees narrower.

FLIR

IR-image

Image file name: Flir 003.jpg **Image date: 5/10/2010**



Reflected Apparent Temperature	78.0 °F
Emissivity	0.91
Relative Humidity	27.0 %
Reference steel reflective Temperature	61.4 °F
Sp2 Temperature	61.3 °F
Sp3 Temperature	98.2 °F
Sp4 Temperature	99.9 °F
Ar1 Min. Temperature	47.4 °F
Ar2 Min. Temperature	48.8 °F
Ar1 Max - Min Temperature	14.5 °F
Ar2 Max - Min Temperature	50.9 °F
Ar1 Average Temperature	53.8 °F
Ar2 Average Temperature	91.5 °F
Ar1 Max. Temperature	61.9 °F
Ar2 Max. Temperature	99.6 °F

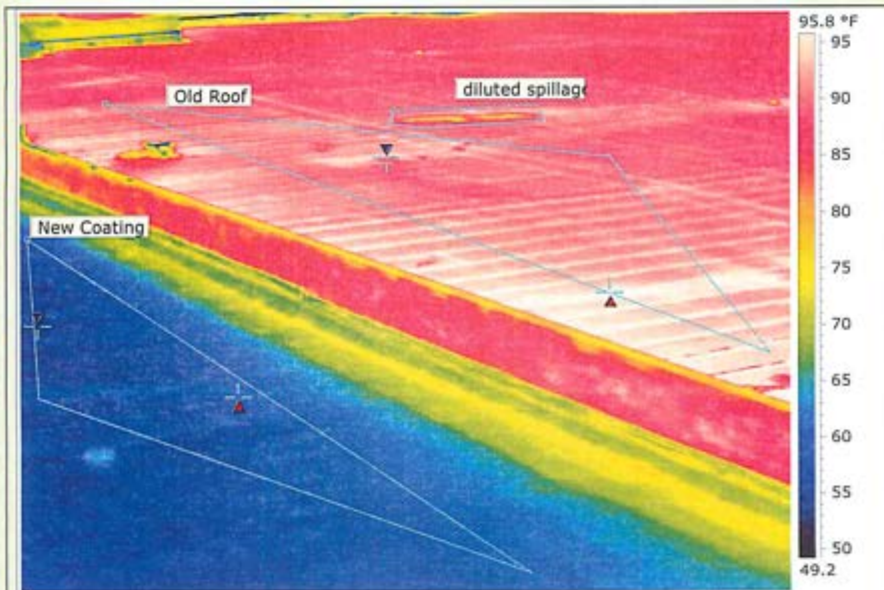
No control sample. Suspected .91 emissivity
Distance approximated.
No measurements made under roof.
Need sample and angles for comparative measurement.
1 degree rise between laps on right side roof (Sp3 and Sp4)

That being said, a 37.7 difference (Delta) is impressive and in line with the other measurements indicated.

FLIR

IR-image

Image file name: Flir 008.jpg **Image date: 5/10/2010**



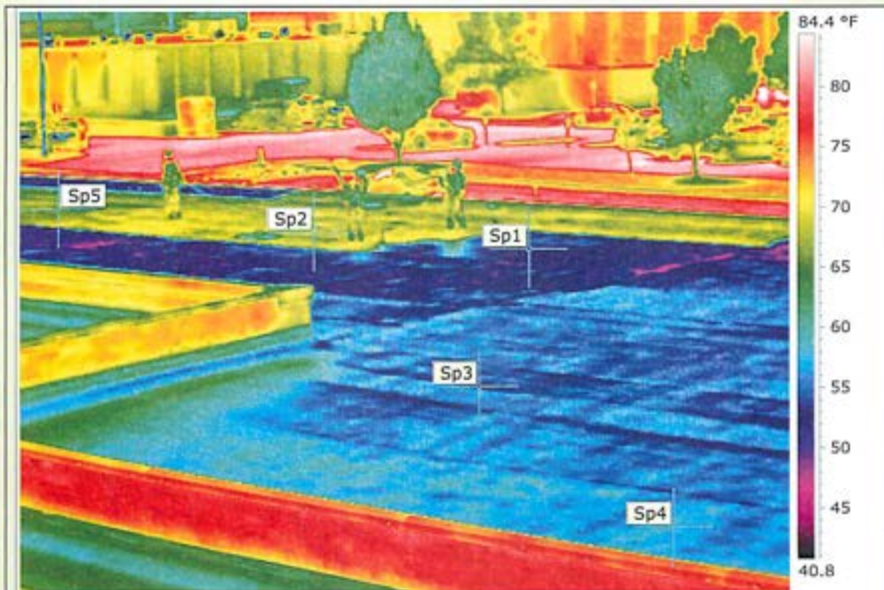
Reflected Apparent Temperature	78.0 °F
diluted spillage Max - Min Temperature	18.4 °F
New Coating Max - Min Temperature	9.0 °F
Old Roof Max - Min Temperature	20.9 °F
diluted spillage Average Temperature	87.9 °F
New Coating Average Temperature	59.0 °F
Old Roof Average Temperature	91.1 °F
Diluted spillage Max. Temperature	93.9 °F
New Coating Max. Temperature	63.5 °F
Old Roof Max. Temperature	99.0 °F

Notice Ar3 is spilled rinse product. Still a 6 degree difference.

FLIR

IR-image

Image file name: Flir 011.jpg **Image date: 5/10/2010**



Reflected Apparent Temperature	68.0 °F
Sp1 Temperature	54.0 °F
Sp2 Temperature	69.0 °F
Sp3 Temperature	53.5 °F
Sp4 Temperature	58.4 °F
Sp5 Temperature	65.8 °F

Employees applying material, west side of building.
Notice temperature reading just before and after application Sp1 & Sp2.
Temperature readings appear consistent as the material cures.

FLIR

INSULATION Types: "Clarification"

1. **Conduction (absorb and transfer),** The R and U measures the absorption speed in which the heat transfers through the insulation material to the cool side. These values are made based on conductivity and thickness. Must have thickness to slow the time for the heat to absorb and transfer. The thicker the material, supposedly, the longer it takes for the heat to transfer to the cool side. The problem with this method is that it was tested as per ASTM testing on 75F on the hot side and the cool side is 25F. This is the only temperature approved by the testing and Federal oversight as the average temperature that represents all climates??? The hotter the hot side becomes above or even below the ambient and given these materials absorb moisture then according to ASHRAE (American Society of Heat and A/C Engineers) studies, above ambient can result in 115 times lose in the R value. In the same study, below ambient and accounting for the humidity in the materials can result in 17 times lose in the R value. Considering the humidity trapped inside the insulation materials, "…above ambient applications, the insulation is not only rendered useless, but the net energy loss actually can be greater than if there were no insulation at all (Insulation.org ASHRAE Research Project 721– Gordon H. Hart P.E. ARTEK Engineering, LLC. With 30 years working in the insulation industry and problems with humidity loading into the materials).

2. **Reflective (to reflect mostly visual and UV waves until the surface film fades or becomes dirty).** "Twenty-One high-reflectance coatings have been tested based on the JIS Standard as a part of the heat island mitigation effect investigation program by the city of Tokyo. "International Workshop on Countermeasures to Urban Heat Island" in a presentation "Research on Cool Roof in Japan" by Mr. Yasushi Kondo, PhD of Musashi Institute of Technology. Dr. Kondo is a researcher with authority in the high reflectance coating field. In the test done by Dr. Kondo, the product No. 13 had one of its highest reflectance in the new stage, but only after one and a half years (571 days) the reflectance had decreased by about 30%.
   SUPER THERM was compared to these 21 reflective coatings and after 15 years, the reflectivity drop was only 8.1% (92.2% to 84.1%). A re-check of a test roof in Western Kansas monitored by the Japanese and SPI for 30 years shows no further drop in performance nor loss of thickness in the coating film.

3. **HEAT BLOCKING** (built with the correct ceramic compounds that will not absorb nor load radiation heat waves and continues to perform when dirty). **HEAT BLOCKING** is the newest technology in controlling heat load from radiation heat and reducing the level of heat "available for transfer" to the cool side. After 30 years of ceramic compound study, the correct compounds were discovered (7,000 compounds researched) to find the 12 compounds

that would continue to work in a coating formula, applied, dried and perform. NASA did have a part in this development by helping with the ceramic compound suppliers to be contacted for samples. SPI was the research lab to determine the compounds ability to perform (NASA invited J.E. Pritchett to speak at their Technology Conference about **SUPER THERM** in 1995). As a compound was discovered to perform alone, it was blended with other performing compounds to form the formula blend in **SUPER THERM**. When the correct compounds are blended and facing the radiation waves of the sun, they can refract, bend and repel the heat waves. The UV, Short Wave and Long Wave are all in the heat wave mix to block from loading initially onto the surface.

IF A HEAT WAVE IS BLOCKED, the heat load is reduced by the amount of heat blocked (see below blocking 99%). This reduction in heat can easily be achieved with a single coat at 10 dry mils (250 microns) of coating when the correct balance of ceramic compounds are used. This was taken to certified labs for ASTM testing before marketed to substantiate the performance ability.

ANY Reflective coating or material needing thicknesses more than 10 mils to give effective insulation is not based on ceramic compounds designed to catch and block all three of the sun's initial heat waves hitting the surface facing the sun. This is for reflecting and blocking radiation waves only.

Other coatings made to thicknesses up to three inches that can show ability to block or resist the absorption of surface heat and then resist the transfer of heat from a hot surface to the atmosphere or escape from the surface is a blocker of heat transfer. This is different types of ceramics at work. Reflective ceramics cannot work in this type of insulation coating because it is physically impossible to throw lower heat leaving the surface back into higher heat coming off a surface. These types of ceramics must be able to "catch and hold" heat and keep it on the hot surface. The Goal in holding heat on the surface is to resist any loss of heat off the surface. If the coating can hold or maintain the heat on the surface, then the interior heat cannot escape and the efficiency of the operating unit increases by 80% or more. The loss of heat off of hot surfaces is the real cost of all operations. Wrapping with standard "mass" materials that are designed to "absorb" the heat and transfer it to the atmosphere is useless after the material is loaded and equalizes with the heat coming off the surface. It offers no resistance to the loss of heat and is a superhighway for the loss of heat.

Georgia PhD's and students asked how SUPER THERM could compare to standard "Mass" insulation materials such as fiberglass, foam, green roofs, Calcium Silicate and Cellulose. The staging was on actual roofs on campus designed for testing. What the entire Georgia Team came to realize is that none of the standard materials could be tested in real-world conditions – only inside a "controlled laboratory under controlled conditions – no humidity, no wind, no change of temperatures and pressures.

MAJOR FINDING:

GEORGIA TECH UNIV.: An important test trial was performed at Georgia Tech Univ. in 2012 which involved establishing all the "R" rating machines and equipment into the field (outside a laboratory setting) to judge the heat blocking

ability of SUPER THERM® compared to green roof settings and standard insulation materials to find the "R" value. After all equipment was set up and started, it was realized that none of the "R" value testing equipment could work in a real-world environment. Changes in ambient temperature, humidity or wind will not allow the measuring devices to work and record properly. It was determined that "R" values can only be certified and evaluated in a "solid state environment" or simply a laboratory with has no changes in environment. This conclusion verifies the fact that "R" rated materials cannot function in real world conditions to the reported values it claimed in a laboratory setting and cannot carry this rating into the field usage.

Listed Below : Laboratories used for Testing SUPER THERM®

1. VTEC LABORATORIES
2. D&L SERVICES, INC (Expert witness -David Yarbrough- for FTC on emissivity, reflectivity and energy savings).
3. SOUTHWEST RESEARCH INSTITUTE
4. UNDERWRITERS LABORATORY (UL)
5. TPRL (Thermophysical Properties Research Laboratory)
6. Japan Testing Center for construction Materials – Tokyo
7. The Russian Academy of Sciences Institution, Insitute for Solid State Physics – Moscow
8. Research on Cool Roof in Japan by Mr. Yashushi Kondo, PhD of Musashi Institute of Technology ("international Workshop on Countermeasures to Urban Heat Island"

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

FOLLOWING STUDY WAS PERFORMED BY PhD DAVID YARBROUGH (USA) AND PhD HAMED H. SABER (SAUDI)

Advanced Modeling of Enclosed Airspaces to determine Thermal Resistance for Building Applications

PhD Yarbrough is the Expert Witness for the FTC (Federal Trade Commission) in the US to assure truth in advertising.

Some questions came up from the FTC as prompted by the Fiberglass group (NAIMA) that any and all reflective insulation coatings should be investigated (FTC Rule 16 CFR 460 for adverting an R-value – page 3 in writing for everyone to see). The Fiberglass group has been the main and sometimes only consultant to the FTC on insulation materials and how to judge them for over 42 years. Conflict of interest?? – I think so.

Presently, Mr. Yarbrough published this study on reflective materials including coatings where the emittance and reflectivity was discussed. The study takes in consideration of the testing SUPER THERM was placed into when following the FTC required testing to validate its' ability to insulate. The charts and graphs in the study show how well SUPER THERM places in the insulation effect by verifying the testing and results for emittance, emissivity and reflectivity as required by this study.

This study is 46 pages (including Page 46 attachment put in by SPI and not part of the original report) but backs up page 39 of this report.

10835 W. 78th Street • Shawnee, Kansas 66214 • Phone: 913-962-4848; Fax: 913-962-6767
Website: www.spicoatings.com Email: sales@spicoatings.com

Tested: Low-e Thin foil

Open Access Article

Advanced Modeling of Enclosed Airspaces to Determine Thermal Resistance for Building Applications

by

Hamed H. Saber [1,*] and David W. Yarbrough [2]

[1] Prince Saud bin Thuniyan Research Center, Mechanical Engineering Department, Jubail University College, Royal Commission of Jubail and Yanbu, Jubail Industrial City 35716, Saudi Arabia

[2] R&D Services, Inc., Watertown, TN 37184, USA

[*] Author to whom correspondence should be addressed.

Academic Editor: Adélio Rodrigues Gaspar

Energies **2021**, *14*(22), 7772; https://doi.org/10.3390/en14227772

1.

NOTE: All red markings are made by J.E. Pritchett as highlights to see in alll the written material points of references. This study proved SUPER THERM equals the standard insulation material (6"/ 150mm) effectiveness with only 10 mils/ 250 micron/ 0.25mm.

Received: 7 October 2021 / Revised: 30 October 2021 / Accepted: 3 November 2021 / Published: 19 November 2021
(This article belongs to the Special Issue Design Considerations for Low Energy Resilient Buildings)

Abstract

Enclosed airspaces to reduce heat flow have been recognized for well over 100 years. Airspaces with one or more reflective surfaces define reflective insulation (RI) assemblies, a product type used in walls, roofs, windows with multiple panes, curtain walls and skylights. The thermal resistance (R value) of airspaces depends on the emittance of all surfaces, airspace dimensions and orientation, heat flow direction and surfaces temperatures. The modeling of RI now includes CFD coupled with radiation to quantify the total heat transfer. This study compares a validated model for airspace R values with existing methods such as ISO 6946 and hot-box results that provide the R values in the ASHRAE Handbook of Fundamentals. The existing methods do not include an airspace aspect ratio. This study showed that the aspect ratio can impact the R value by a factor of two. The impact of aspect ratio was calculated for double airspaces variation such as that for single airspaces. The present calculations are two-dimensional and also consider all the bounding airspace surfaces, while previous methods are one-dimensional and do not include surface temperature variations or detailed radiative transport.

Keywords: reflective insulations; aspect ratio; enclosed airspace; low-emittance materials; radiation and convection heat transfer; R value

* SUPER Therm. Emittance is .91 high Emittance = .89
** SUPER Therm Blocks avg. of 95% of Heat Radiation Load.

1. Introduction

The use of all types of thermal insulations for energy use reduction for conditioning is an important part of efforts to achieve zero energy buildings. One example of these insulations is material with low thermal emittance (high thermal reflectance) that has been studied and utilized for over 100 years to reduce thermal radiation across airspaces [1]. The resulting product type, reflective insulation, utilizes air, with low thermal conductivity (25.1 mW/(m·K) at 25 °C) [2], to reduce radiative heat transport and, in some cases, reduce convective heat transport to provide high thermal resistance. Many insulations used in buildings rely on the thermal resistance of air with fibers or particles to limit heat transfer by convection and radiation [3]. Reflective insulation assemblies belong to the above class of "air-based" insulations.

ceramic Particles

The thermal resistance provided by airspaces, especially reflective airspaces, gained recognition in the mid-20th century due to the publication of thermal test results from the U.S. National Bureau of Standards (NBS) [4]. The NBS' results provided a basis for calculating the thermal resistance of airspaces for conditions typically encountered in buildings. The ASHRAE Handbook of Fundamentals (HOF) contains selected data from the NBS database [5,6]. The database for the thermal resistances of airspaces was extended by additional data published in

2.

SUPER THERM blocks heat radiation consistently all day. Does not absorb and never reaches a "heat flux" (Fully loaded with heat - as the Fiberglass does). At end of day, it maintained only a 5% heat load whereas Fiber loaded 100%.

1990–1991 [7,8] and the evaluation of reflective airspaces has been represented at the international level by ISO 6946 [9].

Briefly, the thermal resistances or R values based on the Standard ISO 6946 used equations C.1, D.1, D.3 and D.4 in Annex D of the Standard [9]. The R value is defined as the ratio of ΔT (the temperature difference across the airspace) to (the heat flux across the airspace). The coefficients for convection–conduction are provided for the following heat flow directions: (a) upward (horizontal airspace, $\theta = 0°$), (b) downward (horizontal airspace, $\theta = 0°$) and (c) horizontal (vertical airspace, $\theta = 90°$) as either constants or proportional to $\Delta T^{1/3}$. The terms for upward heat flow include a term for the airspace distances/thicknesses (δ). The ISO calculation uses the Stefan–Boltzmann Equation for determining the net radiative transport between large/infinite parallel surfaces [10]. Thus, the effects of the aspect ratio and heat transfer by radiation on the surfaces of the two ends of the airspace on the thermal resistance are not included in ISO 6946. The total heat flux in ISO 6946 is represented as the sum of the radiation flux and the conduction–convection flux. The ISO method for calculating the thermal resistance differs from the method used by Robinson and Powell [4] in the procedure for determining the convection–conduction flux. In addition, ISO 6946 does not include a reference to the basis for the equations presented in the Standard.

Fiberglass absorbing heat until it becomes full (Heat Flux). When the Fiber becomes full, the resistance is no longer there.

different ways to calculate heat flow but Robinson & Powell still accepting heat absorption which Ceramics will not do.

The correlations for thermal resistance in HRP 32 use data from 146 guarded hot box tests of enclosed reflective airspaces for different types of reflective insulations [4]. An important part of the analysis and correlation was a determination of the heat flux due to convection–conduction by subtracting the radiative component from the experimentally determined total heat flux with a subsequent graphical presentation of the Nusselt Number (Nu). Addition test data and analytical representations of the Nu data for five heat flow directions commonly discussed were published in 1990–1991 [7,8] with a recently improved set of constants [11]. The data contained in the ASHRAE Handbook of Fundamental [6] are a sub-set of the NBS data set mentioned above. Similar to the ISO 6946, the effects of aspect ratio and the heat transfer by radiation on the surfaces of the two ends of airspace on the R value are not discussed in HRP 32 [4] or the ASHRAE Handbook of Fundamental [6].

As the methodology that was used for determining the convection–conduction heat flux in ISO 6946 [9] is different from that used in HRP 32 [4], the calculated R values using ISO and HRP 32 are different. As will be shown later for a given effective emittance, the differences between the ISO R values and HRP 32 R value depend mainly on both the heat flow direction and the orientation of the enclosed airspaces.

- Not using a heat absorption formula changes the "R" value. Depends on heat flow direction

The data sets used for evaluating the thermal resistance of airspaces described above have limitations. The test data are representative of only parallel isothermal surfaces with five heat flow directions represented [6]. These data were obtained for a single airspace aspect ratio with a few exceptions in the 1991 data from Tye and Desjarlais [7], and the number of independent variable assignments needed to quantify the resistance to heat flow.

Advanced numerical models and an ever-increasing computational speed have made the simulation of heat transfer in enclosed regions by all the modes achievable. The governing equations that were solved by the present model using the finite element method have been described in previous publications [12,13,14,15]. The model includes CFD to characterize convective heat transport inside the enclosed airspaces. This capability to accurately calculate heat transfer with all the modes of heat transfer represented enables results to be obtained as a function of heat flow direction, aspect ratio, operating conditions and all of the previously considered independent variables [16,17]. Additionally, the model was used to assess the hygrothermal performance of building envelopes (e.g., see [18] for the case of roofing systems subjected to hot and humid climate).

With a numerical model that is used in this research study and briefly described below, practical correlations were developed for regions with various orientations, dimensions and environments [19,20,21,22,23,24]. In addition, the capabilities of this model were recently extended to estimate the impact of (a) wind washing, (b) air infiltration/exfiltration, (c) cross-airflow between adjacent reflective airspaces [25] and (d) the imperfect installation of low-emittance materials/sheets on the overall thermal resistance of regions for a range of aspect ratios, inclinations, temperatures and heat flow directions [25]. These capabilities remove many of the limitations of previous techniques for evaluating the heat transfer across enclosed reflective airspaces [25]. The theoretical background of the present model is briefly presented in the Appendix A.

2. Description and Validation of the Numerical Model

For the various airspace thicknesses (δ), aspect ratios (A_R), average temperatures (T_{avg}), temperature differences (ΔT) and effective emittances (E), the numerical model used in this study provides R value results for vertical enclosed airspaces ($\theta = 90°$) with horizontal heat flow [19], horizontal enclosed airspaces ($\theta = 0°$) with an upward and downward heat flow [20,21], sloped enclosed airspaces ($\theta = 45°$) with an upward and downward heat flow [22,23] and low-sloped enclosed airspaces ($\theta = 30°$) with a downward heat flow [24]. The model has been widely used to create a design and optimization tool called "Reflective Airspace Tool" for use by the technical community to determine thermal resistances for a variety of unventilated/enclosed airspaces with different dimensions and operating conditions. The full capabilities and features of this tool were recently presented to the membership of the trade association for reflective insulation [26]. As provided in [25] for non-rectangular airspaces, this model was recently used to assess the performance of an attic radiant barrier and the impact of the imperfect installation of multilayer airspaces on the R value. In addition, the model has been used to investigate the effect of cross-airflow through openings of different sizes at different locations between adjacent airspaces on the assembly R value [25].

The model simultaneously solves the moisture transport equation, the energy equation, the surface-to-surface radiation equation, such as shown in Figure 1, and surface-to-surface and surface-to-ambient radiation for the case of open airspaces such as radiant barriers and adjust airspaces with an opening between them (e.g., see [25]), and the air transport equation for the layers of materials present in the structure. The Navier–Stokes equation is used for the airspace layers, while the Darcy equation for Darcy numbers $D_N < 10^{-6}$ and the Brinkman equation for $D_N > 10^{-6}$ are used for porous material layers. The full details of moisture transport equation are available in [13]. Additionally, the full details of the energy equation, momentum equation (Navier–Stokes equation, Darcy equation, Brinkman equation), surface-to-surface equation and surface-to-ambient radiation equation are available in [12,14,15]. These equations were discretized using the finite element method (FEM). The use of the FEM is important as it permits modelling complicated geometries with less discretizing errors. The model has been validated for a number of building applications involving full-scale and small-scale building assemblies with and without reflective insulations (see [12,13,14,15,16,17,18] for more details).

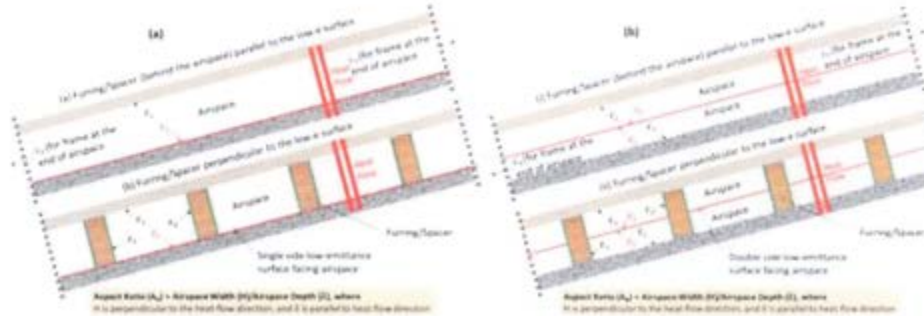


Figure 1. Schematic of enclosed airspace systems for building applications ((**a**) single-enclosed airspace system and (**b**) double-enclosed airspace system).

For the case of building assemblies with reflective insulations, the results obtained with the model have been successfully compared with the test results for a reflective insulation in a full-scale wall system [15] obtained using a guarded hot box facility in accordance with ASTM C1363 [27]. The calculated R value differed from the measured value by 1.2%. Additionally, the model predictions for the thermal resistance results were also compared with test data obtained using a heat flow meter apparatus in accordance with the ASTM C518 [28]. The predicted heat fluxes were within ±1.0% of the measured values [16,29].

For Testing A Enclosed Space. C1363 Tests a Space inside a building

C518 only Test a piece of material alone and not a enclosed space.

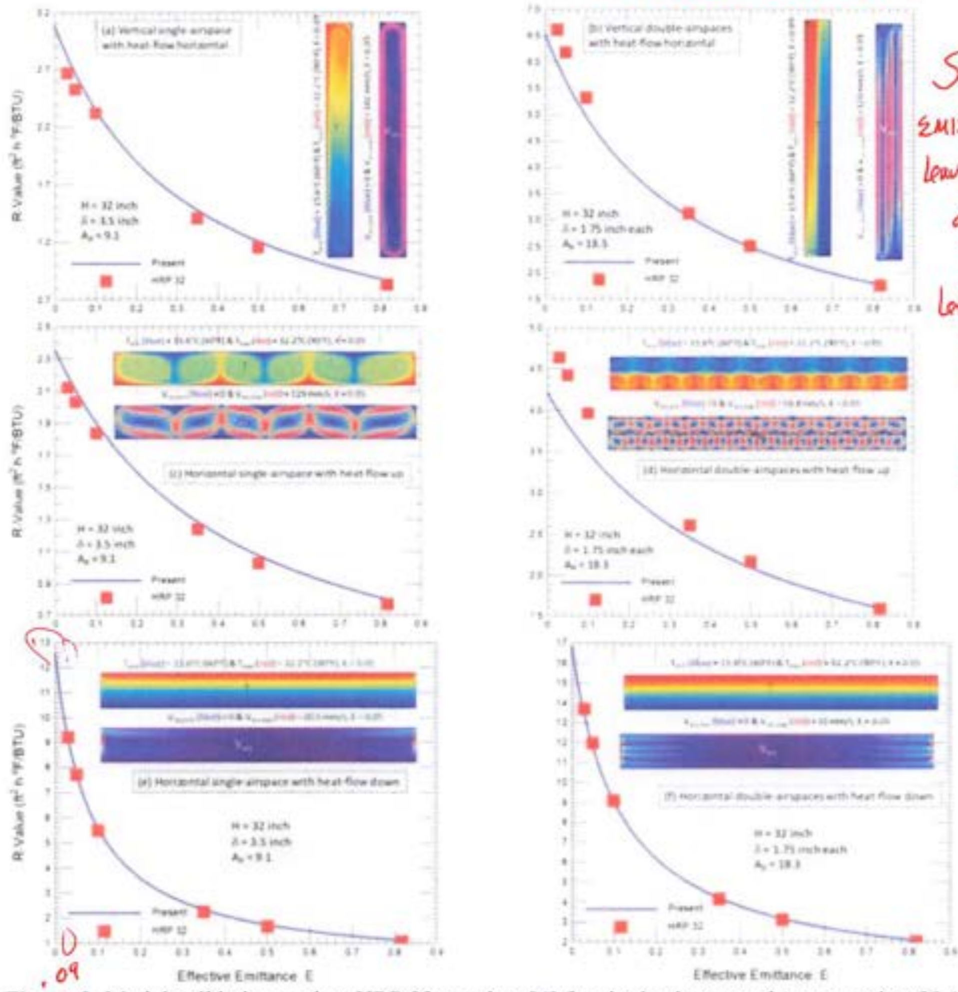
In this study, the model was also validated by comparing the predicted R values with the HRP 32 R values [4]. The guarded hot box specimens used for the HRP 32 were 813 mm (32 inches) wide with various airspace thicknesses. These specimens were subjected to horizontal, upward and downward heat flow. The model validations were conducted for single airspaces of 89 mm (3.5 inches) thick (i.e., aspect ratio of 9.1) and double airspaces of 45.5 mm (1.75 inches) thick each (i.e., aspect ratio of 18.3). For single and double airspaces with an average temperature of 23.9 °C (75 °F) and a temperature difference of 16.6 °C (30 °F) (i.e., T_H = 32.2 °C (90 °F) and T_L = 15.6 °C (60 °F)), Figure 2a through Figure 2f show comparisons of the predicted R values with the HRP 32 R values for a wide range of effective emittance (0–0.82). The inserts in these figures show the temperature (T) and resultant air velocity (V_{res}) distributions in the enclosed airspaces at an effective emittance of 0.05. With a horizontal heat flow in a vertical single airspace in which one convection loop was formed, Figure 2a shows that both predicted and HRP 32 R values are in good agreement. Likewise, for vertical double airspaces with a horizontal heat flow (one convection loop was formed in each airspace), the predicted R values are in good agreement with the HRP 32 R values, as shown in Figure 2b.

For Testing Specification
1. One Temp.
2. wide Range of emittance.

This entire Test is based on one Temperature 23.9C (75F) and emittance (0 - .82) - A wide Range dilutes any result.
SUPER THERM Tested @ 25C, 50C, 75C & 100C and showed the same and consistant performance at all temperatures (TPRL, 1997).
SUPER THERM has a emittance of .09 (The Lower The better).

5.

Look at These Charts
bottom – The lower The Emittance The higher The R-value (Left Side).



SUPER Therm
Emissivity .91
leaving Emittance at .09

Left side bottom .09 = very high R value Left side Top

Figure 2. Model validation against HRP 32 test data [4] for single airspace of Aspect ratio of 9.1 and double airspaces of aspect ratio of 18.3 for a horizontal heat flow (**a**,**b**), an upward heat flow (**c**,**d**) and a downward heat flow (**e**,**f**).

not important heat does not sink — not important

heat rises and this is the main test

For a horizontal single airspace with an upward heat flow, six convection loops were formed in the airspace (Figure 2c). However, for horizontal double airspaces with an upward heat flow, 16 convection loops were formed in the top airspace, and 22 convection loops were formed in the bottom airspace (Figure 2d). As shown in Figure 2c for a horizontal single airspace with an upward heat flow, the predicted R values were in good agreement with HRP 32 R values for the full range of effective emittance. For horizontal double airspaces with an upward heat flow, Figure 2d shows that the predicted R values are in good agreement with the HRP 32 R value for the high effective emittance values (≥0.35); but, the predicted R values were lower than the HRP-32 R values for the low effective emittance values (≤0.1). For an upward heat flow up in horizontal

6.

single airspace and double airspaces, two convection loops were formed in each airspace (Figure 2e,f). For the full range of effective emittance, Figure 2e shows that both predicted and HRP 32 R values are in good agreement for a horizontal single airspace with a downward heat flow. Furthermore, for horizontal double airspaces with a downward heat flow, the predicted R values are in good agreement with the HRP 32 R values (Figure 2f).

Providing that the uncertainties in the R value measurements using guarded hot box in accordance with ASTM C1363 are ±5% [27], Figure 2a through Figure 2f show that most of the predicted R values are in good agreement with HRP 32 R values (within the same uncertainties of ±5%). As such, the model was used with confidence in this study to quantify the effects of the aspect ratio and radiative heat transfer at the two airspace ends on the R values for single and double airspaces of various inclination angles and subjected to different operating conditions and heat flow directions.

Describes as "Insulation Coating"

3. Objectives

Reflective insulation products use thin foil/coatings of low emittance, usually less than 0.2 mm thick. The lower the emittance is, the higher the thermal resistance is for a building assembly with reflective insulation [30,31]. Previous studies (e.g., see [32,33] for more details) have shown degradations/reductions in the thermal performance of reflective insulation products as a result of surface contamination or the condensation of water on the low-e surfaces. Dust accumulation or water condensation on low-e surfaces increases their emittance. Thus, an important reason for this study was to quantify the effect of increasing the effective emittance on the thermal resistance of unventilated air spaces. Furthermore, the enclosed region aspect ratio, A_R (A_R = airspace width perpendicular to the heat flow direction (H)/airspace depth parallel to the heat flow direction (δ)), is not accounted for in the currently available methods to calculate the thermal resistance. Hence, another objective was to establish the dependence of the R value on the aspect ratio of unventilated airspaces of various inclination angles and heat flow directions.

For a wide range of simulation variables, the model was used to quantify the increase in the R values as a result of dividing the enclosed airspace into two enclosed airspaces of equal thickness. As shown in Figure 1, the main airspace was divided using a foil with low-emittance sides. The calculated R values were compared with those from the HRP 32 data for single airspaces and double airspaces [4] as well as those calculated using the ISO 6946 [9] for single airspaces. Finally, consideration was given to investigate the effect of radiative exchange with the surfaces of the ends of the enclosed airspaces, called "end effect", on the thermal resistance. Note that the surfaces of the two ends represent the surfaces of the framing/spacers of the enclosed airspaces (e.g., furred airspace assembly shown in Figure 1). This end effect is not accounted for in the other available methods, for example, ISO 6946 [9] and ASHRAE [5,6].

credit card thickness 8 mils
lower emittance Super Therm .09
This test used a range from 0-.82.
Higher Thermal Resistance Super Therm blocked 99% (TPRL 1997) and (Federal DOE 2010) 99% blocking of heat

4. Results and Discussions

The calculated thermal performance for five cases is contained in the section:

(a)

Vertical airspaces (θ = 90°) with horizontal heat flow to represent walls, windows and curtain walls with reflective insulation (RI).

(b)

SUPER THERM emittance .09
Lower The better

They tested 0-.82 ?

SUPER THERM Thermal Resistance 99%
higher The better

They do not have a tested % because basic materials are not consistant.

7.

Horizontal airspaces ($\theta = 0°$) with upward heat flow to represent building components such as flat roofs or skylights with RI during the cold season.

(c)

Horizontal airspaces ($\theta = 0°$) with downward heat flow to represent building components such as flat roofs or flat skylights with RI during the hot season.

(d)

Sloped airspaces ($\theta = 45°$) with upward heat flow to represent building components such as sloped roofs or skylights with RI during the cold season.

(e)

Sloped airspaces ($\theta = 45°$) with downward heat flow to represent building components such as sloped roofs or flat skylights with RI during the hot season.

Results have been obtained for enclosed airspaces with a thickness/depth, δ, of 89 mm (3.5 inches); aspect ratios, A_R, from 1.1 to 27.4; with an effective emittance, E, from 0 to 0.82. In each case, the warm side temperature, T_H, was taken to be 32.2 °C (90 °F) and the cool side temperature, T_L, was taken to be 15.6 °C (60 °F) (i.e., $\Delta T = 16.6$ °C (30 °F)). In addition, results are obtained in this paper for the five cases, (a) through (e), listed above after splitting the airspace shown in Figure 1a ($\delta = 89$ mm (3.5 inches)) into two airspaces of equal thickness ($\delta = 45.5$ mm (1.75 inches), see Figure 1b) by installing a thin sheet with emittances on both sides ranging from 0 to 0.9.

Unlike the other available methods, such as ISO 6946 [9] and ASHRAE [5,6], for calculating the thermal resistance of enclosed air-filled regions, the heat transfer by radiation from all the surfaces that bound the airspace was included in the present model. In this study, the emittance value of all the surfaces that bound the airspace (ε_2 and ε_3) except the low-emittance surface (ε_1) were taken to be 0.9 [6] (i.e., $\varepsilon_2 = \varepsilon_3 = 0.9$, see Figure 1a,b). The effective emittance of the enclosed airspace (E) is calculated as follows [5,6]:

$$E = 1/[1/\varepsilon_1 + 1/\varepsilon_2 - 1] \quad (1)$$

Note that for the case of no low-emittance foil/coating installed in the enclosed airspace (i.e., $\varepsilon_1 = \varepsilon_2 = 0.9$ [6]), the corresponding value of E is equal to 0.82. Throughout this paper, unless otherwise specified, the case before splitting the airspace (Figure 1a) is called a "single airspace", whereas the case after splitting the airspace into two airspaces of equal thickness (Figure 1b) is called "double airspaces". The present values for thermal resistances were checked against those obtained using ISO 6946 [9] and those based on the data contained in HRP 32 [4]. Since the ISO 6946 method is not applicable for sloped airspaces and double airspaces, the ISO 6946 R values for only cases (a), (b) and (c) listed above are compared with the present thermal resistances for single airspaces.

Heat transfer occurs in the air-filled regions by conduction, radiation and convection. To show the importance of convection, calculations were conducted with and without heat transfer by convection for single and double airspaces of 89 mm (3.5 inches) thick and 16 inches long at T_H = 90 °F and T_L = 60 °F. These simulations were conducted for the following two cases:

(i)

No radiation takes place at the two ends of airspace surfaces (i.e., $\varepsilon_3 = 0.0$, see the insert in Figure 3). This case is called "without end effect", which represents the case of net radiative transport between two large/infinite parallel surfaces that are currently being used in the ISO 6946 [9] and ASHRAE [5,6] methods. The surfaces of the two ends of the airspace are usually the surfaces of the framing (e.g., furring or spacers) that bind the airspace. Note that the case of without end effect would represent the situation in which low-e material is present on the surfaces of the framing/spacers facing the airspace. It is important to point out that the main reason to address this case in this study is to explore, for reflective insulation manufactures, building authorities and designers, the impact on R value due to installing low-e foil or coating on the surfaces of the framing/spacers that face the airspace and parallel to the heat-flow direction (see the green lines in Figure 1a,b).

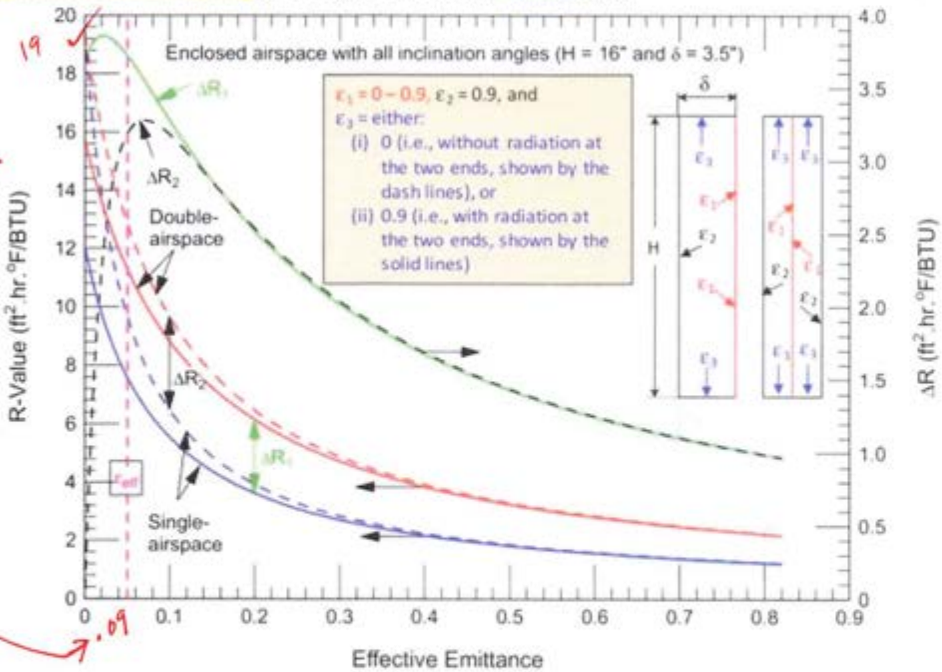


Figure 3. Comparisons of the thermal resistances for single and double airspaces in the absence of heat transfer by convection with end effect (i.e., $\varepsilon_3 = 0.9$) and without end effect (i.e., $\varepsilon_3 = 0.0$) at H = 16 inches, total δ = 3.5 inches, T_H = 90 °F, T_L = 60 °F.

(ii)

Radiation takes place at the two ends of the airspace surfaces represented by green lines in Figure 1a,b (i.e., $\varepsilon_3 = 0.9$ [6]). This case is called the "with end effect".

4.1. R Values in Absence of Convection

In the absence of convection, the R value results for the range of effective emittance (E) from 0 to 0.82 are plotted on the left y-axis of Figure 3 for the cases (i) and (ii) listed above. In this figure, ΔR_1 and ΔR_2, respectively, which are plotted on the right y-axis, represent the contributions to the R values due to splitting the main airspace into two airspaces of equal thickness with end effect (i.e., $\varepsilon_3 = 0.9$) that is shown by the solid green line, and without end effect (i.e., $\varepsilon_3 = 0.0$) that is shown by a black line. The results shown in Figure 3 are applicable for single and double airspaces (H = 16 inches and δ = 89 mm (3.5 inches)) of various inclination angles (θ). At a theoretical effective emittance of zero (E = 0 at which foil or coating emittance, ε_1, equal 0.0), no

9.

heat transfer by radiation takes place for the case without end effect (i.e., $\varepsilon_3 = 0.0$). As such, in the absence of convection in this case ($E = 0$), the heat transfer inside the airspace is by conduction only in which the R values for both single and double airspaces are the same (i.e., $\Delta R_2 = 0$, see Figure 3). However, for the case with end effect ($\varepsilon_3 = 0.9$), Figure 3 shows that at a theoretical effective emittance of zero, the value of ΔR_1 was 3.69 ft²·h·°F/BTU. Increasing the effective emittance resulted in increasing both ΔR_1 and ΔR_2 until they reached their highest values ($\Delta R_{1,max}$ = 3.86 ft²·h·°F/BTU at which $E = 0.02$ and $\Delta R_{2,max}$ = 3.28 tf²·h·°F/BTU at which $E = 0.07$). Further increasing the effective emittance has resulted in decreasing both ΔR_1 and ΔR_2 (see Figure 3). At an effective emittance of 0.03 and 0.05, respectively, the obtained values for ΔR_1 were 3.85 and 3.72 ft²·h·°F/BTU, and those for ΔR_2 were 2.75 and 3.19 ft²·h·°F/BTU.

Figure 3 shows that both cases with end effect and without end effect have resulted in an insignificant effect on the R values for effective emittance greater than ~0.3 for both single and double airspaces, and thus, there is no need to include radiative transport at the two ends of the airspace. In other words, the use of the Stefan–Boltzmann Equation is adequate for determining the R values of airspaces with $E > 0.4$. However, the end effect has resulted in significant changes in the R values of the single and double airspaces with $E < 0.2$. For example, for effective emittance of 0.03 and 0.05, respectively, for a single airspace, the R values with end effect (R = 8.89 and 7.57 ft²·h·°F/BTU) were overestimated by 3.19 and 2.08 ft²·h·°F/BTU due to the end effect at which R = 12.08 and 9.69 ft²·h·°F/BTU being neglected. Similarly, for double airspaces with the same effective emittance (0.03 and 0.05, respectively), the R values with end effect (R = 12.74 and 11.29 ft²·h·°F/BTU) were also overestimated by 2.09 and 1.55 ft²·h·°F/BTU due to the end effect at which R = 14.83 and 12.88 ft²·h·°F/BTU being neglected. Note that the contribution of the end effect to the R values of single and double airspaces can be greater for a shorter width ($H < 16$ inches) and smaller for a longer width ($H > 16$ inches) than those shown in Figure 3.

4.2. Impact of Convection on R Values

For a given operating condition (T_H and T_L), convective heat transport depends on the angle of inclination (θ), heat-flow direction and dimensions (δ and H). By accounting for the heat transfer by convection for the same operating condition (T_H = 90 °F and T_L = 60 °F), single and double airspaces' dimensions (δ = 89 mm (3.5 inches) and H = 406 mm (16 inches)) and an effective emittance range of 0–0.82, numerical simulations were performed for vertical airspaces with a horizontal heat flow, horizontal airspace with upward and downward heat flow, and 45° sloped airspace with upward and downward heat flow. These simulations were conducted for both cases with end effect ($\varepsilon_3 = 0.9$) and without end effect ($\varepsilon_3 = 0.0$).

At an E value of 0.05, Figure 4a, Figure 5a, Figure 6a and Figure 7a, respectively, show the contours of temperature (T), horizontal velocity (V_x) vertical velocity (V_y) and resultant velocity (V_{res}) for single airspaces as a function of orientation and heat-flow direction. The corresponding results for double airspaces are shown in Figure 4b, Figure 5b, Figure 6b and Figure 7b, respectively. Additionally, in order to show the number, shapes and sizes of the convections loops, these figures also show the streamlines of the air velocity field. Due to the large differences in the velocities in the airspaces, auto contour levels were used in Figure 5 for V_x, Figure 6 for V_y and Figure 7 for V_{res}.

Must have the lowest emittance number possible as close to .01 as possible. For this testing to consider .82 as the emittance

10.

$E \geq 0.35$. However, the ISO 6946 and HRP 32 R values agree best with the present R values for a single airspace of 24 inches long (i.e., $A_R = 6.9$, see Figure 10 in Section 4.3.1 for more details). Neglecting the end effect (i.e., without radiation at the two airspace ends) results in a higher calculated R value than that with end effect for $E < 0.2$. For example, at $E = 0.05$, the R value with no end effect (2.48 ft²·h·°F/BTU) exceeded the result with end effect by 6% (2.35 ft²·h·°F/BTU). Furthermore, at $E = 0.05$, the heat transfer by convection resulted in reducing the R value (2.35 ft²·h·°F/BTU in Figure 8a) by 5.22 ft²·h·°F/BTU in relation to the case with no convection (7.57 ft²·h·°F/BTU in Figure 3).

It is important to point out that the correlations for HRP 32 R values [4] are provided independent of the aspect ratio. However, these correlations were obtained using test data from 146 guarded hot box tests of enclosed reflective airspaces of 32 inches long (i.e., the aspect ratio of 9.1 and 18.3 for single airspace and double airspaces, respectively). As shown in Figure 2b, the HRP 32 R values for double airspaces with horizontal heat flow are in good agreement with the present R values for an airspace with the same dimensions as in the test (i.e., 32 inches long, A_R = 18.3).

Figure 8b compares the present R values with HRP 32 R values [4] for 16-inch-long double airspaces. For E = 0.05 or 0.1, the HRP 32 R values are 25 or 20% greater than the present R values. However, as indicated above, the present and HRP 32 R values are in good agreement for an airspace of 32 inches long at which the HRP 32 correlations were obtained (see Figure 2b). On the other hand, both the present R values and HRP 32 R values are in closest agreement for the full range of the effective emittance of 48-inch-long double airspaces (A_R = 27.4, see Figure 11 in Section 4.3.1 for more details). At E values of 0.03 and 0.05 for 16-inch-long double airspaces, the R values (5.18 and 4.94 ft²·h·°F/BTU in Figure 8b) were reduced by 7.56 and 6.35 ft²·h·°F/BTU, respectively, due to convection (12.74 and 12.29 ft²·h·°F/BTU in Figure 3).

4.2.2. Horizontal Airspaces ($\theta = 0°$) with Downward Heat Flow

The distributions of the temperature, horizontal air velocity, vertical air velocity and resultant air velocity inside a horizontal single airspace of 16 inches long with a downward heat flow at an E value of 0.05 are shown in Figure 4(aiii), Figure 5(aiii), Figure 6(aiii) and Figure 7(aiii), respectively. The corresponding results occur inside 16-inch-long double airspaces as shown in Figure 4(biii), Figure 5(biii), Figure 6(biii) and Figure 7(biii). These results demonstrate that with a downward heat flow, a relatively stable stratification exists. This can easily be observed in the shape of the temperature distributions shown in Figure 4(aiii,biii), where two convection loops were formed inside each airspace with quite slow air movement in relation to vertical airspaces with horizontal heat flow (see Figure 5(ai,bi), Figure 6(ai,bi) and Figure 7(ai,bi)) and for horizontal airspaces with upward heat flow (to be shown next). For example, the highest resultant velocity inside the single airspace was 17.4 mm/s (Figure 7(aiii) and Table 1) and the corresponding value inside the double airspaces was 9.78 mm/s (Figure 7(biii) and Table 1). The R value reductions due to convection with a downward heat flow ($\theta = 0°$) is much smaller than that for other airspace orientations of different heat-flow directions.

Figure 8c compares the present R values with and without end effect with the ISO 6946 [9] and HRP 32 [4] R values for a single airspace of 16 inches long. As indicated earlier, both the ISO and HRP 32 methods used different methodologies in determining the convection–conduction heat flux through the airspace. As the contribution of heat transfer by convection inside the enclosed airspaces for the case of a downward heat flow is insignificant in relation with the cases of horizontal heat flow and upward heat flow, the calculated R values using these methods for the case of downward heat flow are approximately the same as shown in Figure 8c and Figure 12 in Section 4.3.2. Figure 8c shows that both ISO 6946 and HRP 32 R values are in good agreement

SUPER THERM Performed ASTM C1363 Hot box Test To satisfy This procedure & satisfy The FTC Rule.

Heat flow is The absorption of heat which Therm Repells so heat does not Absorb

17.

with the present R values for $E \geq 0.1$. At $E = 0.05$, both ISO 6946 and HRP 32 R values exceed the present R value by 15%. Figure 12, however, shows that the ISO 6946 and HRP 32 R values agree closely with the present R values for a 24- and 36-inch-long single airspace ($A_R = 6.9$ or 10.3). For double airspaces, Figure 8d compares the present R values with HRP 32 R values. As shown in this figure, the present and HRP 32 R values are in good agreement for $E \geq 0.1$, while the HRP 32 R value are 9% greater than the present R values at $E = 0.05$. As will be shown later in Section 4.3.3, Figure 13 that both the present and HRP 32 R values are approximately the same within the whole range of effective emittance for double airspaces of 36 inches or 48 inches long ($A_R = 20.6$ or 27.4).

Similar to airspaces with horizontal heat flow ($\theta = 90°$), neglecting the end effect in airspaces with downward heat flow ($\theta = 0°$) has resulted in obtaining a higher R value than that with end effect for the range of low effective emittance ($E < 0.3$). At $E = 0.05$ for single airspaces, Figure 8c shows that the R value without end effect (9.66 ft²·h·°F/BTU) exceeded the R value with end effect by 44% (6.70 ft²·h·°F/BTU). At this E value (0.05) for double airspaces, the R value without end effect (12.86 ft²·h·°F/BTU) exceeded the case with end effect (10.95 ft²·h·°F/BTU, Figure 8d) by 17%. Additionally, at $E = 0.05$ for single airspaces, convection reduced the R value (6.70 ft²·h·°F/BTU, Figure 8c) by only 0.87 ft²·h·°F/BTU when compared to the case with no convection (7.57 ft²·h·°F/BTU, Figure 3). Furthermore, at this E value for double airspaces, the convection resulted in reducing the R value (10.95 ft²·h·°F/BTU, Figure 8d) by 0.34 ft²·h·°F/BTU relative to no convection (11.29 ft²·h·°F/BTU, Figure 3).

Larger the air space the better a reflective material performs.

4.2.3. Horizontal Airspaces ($\theta = 0°$) with Upward Heat Flow

At $E = 0.05$, Figure 4(aii), Figure 5(aii), Figure 6(aii) and Figure 7(aii) show temperature, horizontal air velocity, vertical air velocity and resultant air velocity profiles for horizontal 16-inch-long single airspaces with upward heat flow. The corresponding results in 16-inch-long double airspaces are shown in Figure 4(bii), Figure 5(bii), Figure 6(bii) and Figure 7(bii). The maximum and minimum values of the contour bars in these figures are provided in Table 1. The effect of density variation with upward heat flow results in a flow with a varying number of convection loops. For a single airspace (89 mm (3.5 inches) thick), four convection loops were formed inside the airspace. However, for double airspaces (44.5 mm (1.75 inches) thick each), twelve convection loops were formed inside the top airspace, whereas fourteen convection loops were formed inside the bottom airspace.

heat rises

The air velocity for an upward heat flow exceeds that for a downward heat flow. For a single airspace with an upward heat flow, the highest velocity (133 mm/s, Figure 7(aii) and Table 1) was 7.64 times that with a downward heat flow (17.4 mm/s, Figure 7(biii) and Table 1). Additionally, for double airspaces with an upward heat flow, the highest velocity (63.2 mm/s, Figure 7(bii) and Table 1) was also 7.50 times that with a downward heat flow (9.78 mm/s, Figure 7(biii) and Table 1). As such, the reductions in the R values due to heat transfer by convection inside the airspaces with an upward heat flow would be significantly greater than that with a downward heat flow. At $E = 0.05$ for single airspaces with an upward and downward heat flow, respectively, the R values with convection (1.95 ft²·h·°F/BTU shown in Figure 8e and 6.70 ft²·h·°F/BTU shown in Figure 8c) were 25 and 86% of that with no convection (7.57 ft²·h·°F/BTU, Figure 3). Similarly, at $E = 0.05$ for double airspaces with an upward and downward heat flow, respectively, the R values with convection (3.62 ft²·h·°F/BTU shown in Figure 8f and 10.95 ft²·h·°F/BTU shown in Figure 8d) were 32 and 97% of that with no convection (11.29 ft²·h·°F/BTU, Figure 3).

For a 16-inch-long single airspace, Figure 8e compares the present R values with and without end effect with the ISO 6946 and HRP 32 R values. The contribution of heat transfer by convection

18.

inside the enclosed airspace for the case of an upward heat flow is significant in relation with, for example, a downward heat flow. The different methodologies that were used in both methods of ISO 6946 [9] and HRP 32 [4] in determining the convection–conduction heat flux have resulted in obtaining different R values with these methods (see Figure 8e and Figure 14 in Section 4.3.3). For example, at an E value of 0.03, 0.05, 0.1 and 0.35, respectively, the HRP-32 R values were 15.3, 14.7, 13.3 and 8.9% higher than ISO 6946, whereas the HRP-32 R values agree with the present R values to within 4.6, 3.8, 1.9 and −3.4%, respectively. For the full range of E, Figure 14 shows that the HRP 32 R values were in closest agreement with the present R values for the 42-inch-long single airspaces (A_R = 12.0), whereas the ISO 6946 R values are less than the present R values for all the E values and aspect ratios considered in this study. Figure 8f compares the present R values and HRP 32 R values for the 16-inch-long double airspaces. As shown in this figure, both the present and HRP 32 R values were in good agreement for E ≥ 0.5. At an E of 0.03, 0.05, 0.1 and 0.35, respectively, the HRP 32 R values were 23.1, 21.8, 18.7 and 9.6% higher than the present R value. However, for double airspaces of 32 inches long at which the HRP 32 correlations were obtained, the HRP 32 R values are in reasonable agreement with the present R values (see Figure 2b). Additionally, Figure 15 shows that the HRP 32 R values and the present R values are in good agreement for the 66-inch-long double airspaces of (A_R = 37.7). The greatest deviation between the HRP 32 and the present R values (5.1%) occurred at E = 0.03.

Similar to airspaces with a horizontal (θ = 90°) and downward heat flow (θ = 0°), neglecting the end effect in airspaces with upward heat flow (θ = 0°) has resulted in a higher R value than that with end effect for E < 0.3. Figure 8e shows that the R value without end effect (2.11 ft²·h·°F/BTU) for a single airspace at E = 0.05 exceeds the R value calculated with end effect (1.95 ft²·h·°F/BTU) by 8%. Additionally, Figure 8f shows that at E = 0.05 for double airspaces, the R value without end effect (3.77 ft²·h·°F/BTU) exceeds the case with end effect (3.62 ft²·h·°F/BTU) by 4%.

Finally, at E = 0.05 for a single airspace with an upward heat flow (θ = 0°), convection reduces the R value (1.95 ft²·h·°F/BTU, Figure 8e) by 5.62 ft²·h·°F/BTU in comparison to only 0.87 ft²·h·°F/BTU for a downward heat flow (θ = 0°) and 5.22 ft²·h·°F/BTU for a horizontal heat flow (θ = 90°) (7.57 ft²·h·°F/BTU, Figure 3). Likewise, at this E value for double airspaces with an upward heat flow (θ = 0°), convection reduces the R value (3.62 ft²·h·°F/BTU, Figure 8e) by 7.67 ft²·h·°F/BTU compared to only 0.34 ft²·h·°F/BTU for a downward heat flow (θ = 0°) and 6.35 ft²·h·°F/BTU for a horizontal heat flow (θ = 90°) in relation to the case of no convection cases (11.29 ft²·h·°F/BTU, Figure 3).

4.2.4. Sloped Airspaces (θ = 45°) with Downward Heat Flow

For a 45° single airspace of 16 inches long at an E value of 0.05 and subjected to a downward heat flow, Figure 4(av), Figure 5(av), Figure 6(av) and Figure 7(av) show T, V_x, V_y and V_{res} distributions. The corresponding results for double airspaces are shown in Figure 4(bv), Figure 5(bv), Figure 6(bv) and Figure 7(bv). These figures show the buoyancy results in a mono-cellular airflow in each airspace. Additionally, the air velocity in the single airspace is greater than that in the double airspaces. For example, the highest V_{res} in the single airspace (97.1 mm/s, Figure 7(av) and Table 1) is 50% higher than in the double airspaces (64.9 mm/s, Figure 7(bv) and Table 1). Thus, the reduction in the R value due to convection in the single airspace would be greater than in double airspaces. Additionally, for the same E value without convection, the reduction in the R value due to radiation in the single airspace is greater than in the double airspaces (see Figure 3). At a fixed E, the combined effect of convection and radiation results in lower R values for the single airspace than that for the double airspaces, as shown in Figure 9a (single airspace) and Figure 9b (double airspaces). For example, at E = 0.05, the predicted R value

heat rises - which reduces the heat flux (Trapped heat) Therefore shows as a lower R-value because the heat escaped. They want to capture + hold heat (heat flux) as with Fiberglass or "mass" materials

19.

They cannot compare "mass" materials R-value testing directly to "Reflective" material using heat flux.

Reflective Coating (Super Therm) Repels heat.

As indicated earlier, the use of ISO 6946 [9] for calculating R values is limited to vertical and horizontal single airspaces. As a result, the present R values are compared with HRP 32 R values for a 45° single airspace and 45° double airspaces of 16 inches long, as shown in Figure 9a,b, respectively. For the single airspace, Figure 9a shows that the present and HRP 32 R values are in good agreement for $E > 0.35$. For $E < 0.35$, the HRP 32 R values are 23% at E = 0.03, 20% at E = 0.05 and 16% at E = 0.1 greater than the present R values. However, the HRP 32 R values are approximately the same as the present R values for the 48-inch-long single airspaces (i.e., A_R = 13.7, see Figure 16 in Section 4.3.5 for more details). Figure 9a also shows that neglecting the end effect has resulted in obtaining R values that are greater than those with end effect for $E < 0.3$. For E = 0.03, 0.05 and 0.1, respectively, the R values without end effect (3.19, 3.00 and 2.60 ft²·h·°F/BTU) exceed the R values with end effect (2.88, 2.74 and 2.42 ft²·h·°F/BTU) by 11, 9 and 7%. In addition, at E = 0.03, 0.05 and 0.1, convection reduces the R values (2.88, 2.74 and 2.42 ft²·h·°F/BTU, Figure 9a) by 5.97, 4.83 and 3.12 ft²·h·°F/BTU compared with the case without convection (8.85, 7.57 and 3.12 ft²·h·°F/BTU, Figure 3).

The present and HRP 32 R values for the 16-inch-long double airspaces are contained in Figure 9a. As shown in this figure, the present R values agree closely with R values based on HRP 32 for $E \geq 0.5$. For E = 0.03, 0.05 and 0.10, the R values based on HRP 32 are 53, 47 and 37%, respectively, greater than the present R values. However, the HRP 32 R value (independent of the aspect ratio as indicated earlier) are closer to the present R values for the case of larger aspect ratios. As will be shown later in Section 4.3.5 in Figure 17, the present and HRP 32 R values are in closest agreement for all the E values of the 93- or 96-inch-long double airspaces (A_R = 53.1 or 54.9). For the 16-inch-long double airspaces at E = 0.03, 0.05 and 0.1, the R values (5.89, 5.59 and 4.93 ft²·h·°F/BTU, Figure 9b) were reduced by 6.85, 5.70 and 3.92 ft²·h·°F/BTU in comparison with no convection values (12.74, 12.29 and 8.85 ft²·h·°F/BTU, Figure 3), respectively.

4.2.5. Sloped Airspaces (θ = 45°) with Upward Heat Flow

At E = 0.05, Figure 4(aiv), 5(aiv), 6(aiv) and 7(aiv) show the temperature, V_x, V_y and V_{res} distributions for the 16-inch-long, 45° single airspaces with an upward heat flow. The corresponding results for the double airspaces are shown in Figure 4(biv), Figure 5(biv), Figure 6(biv) and Figure 7(biv). As with the 45° airspace with a downward heat flow, these figures show that a mono-cellular airflow is developed in each airspace. However, the air velocity in the 45° airspace with an upward heat flow is greater than that in the 45° airspace with a downward heat flow. For example, the highest resultant velocity in the 45° single airspace with an upward heat flow (123 mm/s, Figure 7(aiv) and Table 1) is 27% higher than that in the 45° single airspace with a downward heat flow (97.1 mm/s, Figure 7(av) and Table 1). In addition, the highest resultant velocity in the 45° double airspaces with an upward heat flow (78.3 mm/s, Figure 7(biv) and Table 1) is 21% higher than that in the 45° double airspaces with a downward heat flow (64.9 mm/s, Figure 7(bv) and Table 1). Consequently, the reduction in the R value due to convection in the 45° airspace with an upward heat flow is greater than that in the 45° airspace with a downward heat flow. In addition, for a specific E, the R value reduction due to radiation in the absence of convection for airspaces with an upward and downward heat flow is the same.

Heat Rises causing This To be The Outcome — ??? why spend Time on This.

As shown in Figure 9, the combined effect of both convention and radiation has resulted in that the overall thermal resistance of 45° airspaces with an upward heat flow is less than that with 45° airspaces with a downward heat flow. For example, at E = 0.05, the R value for the 45° single airspace with an upward heat flow (2.39 ft²·h·°F/BTU, Figure 9c) is 13% lower than that for the 45° single airspace with a downward heat flow (2.74 ft²·h·°F/BTU, Figure 9a). Additionally, at E = 0.05, the R value for the 45° double airspaces with an upward heat flow (5.09

ft²·h·°F/BTU, Figure 9d) is 9% lower than that for the 45° double airspaces with a downward heat flow (5.59 ft²·h·°F/BTU, Figure 9b). At E = 0.05, the R values of the 45° airspaces with an upward and downward heat flow were more than doubled as result of installing a low-e foil to divide the airspace into two equal regions.

For the 16-inch-long, 45° single airspace with an upward heat flow, Figure 9c shows that the present R values are greater than the HRP 32 R value for the whole range of E values. For example, at E = 0.05 and 0.82, respectively, the present R values are 10 and 16% greater than the HRP 32 R values. However, Figure 18 shows that the HRP 32 R values, which were obtained from HRP 32 correlations (independent of the aspect ratio), agree best with the present R values for the 8- or 12-inch-long single airspaces (A_R = 2.3 or 3.4). Finally, Figure 9d shows a comparison between the present R values and the HRP 32 R values [4] for the 45° double airspaces of 16 inches long with an upward heat flow. As shown in this figure, the present R values agree with HRP 32 R values for E < 0.3, while the present R values are greater than the HRP 32 R values for E > 0.3. However, as provided in Section 4.3.5 in Figure 19, both the present and HRP 32 R values for all the E values are approximately the same for 96-inch-long double airspaces (A_R = 54.9).

4.3. Effect of Aspect Ratio on the R Values

At an average temperature (T_{avg}) of 23.9 °C (75 °F) and temperature difference (ΔT) of 16.6 °C (30 °F) (i.e., T_H = 32.2 °C (90 °F) and T_L = 15.6 °C (60 °F)), numerical simulations were conducted for single airspaces (89 mm (3.5 inches) thick) and double airspaces (44.5 mm (1.75 inches) thick each) with an horizontal heat flow for an inclination angle of θ = 90°, a downward heat flow for θ = 0° and 45°, and an upward heat flow for θ = 0° and 45° in order to observe the impact of the aspect ratio on the thermal resistance. As indicated earlier, reflective insulation assemblies use thin foil or coatings with low emittances. The emittance can increase due to corrosion, dust accumulation or water vapor condensation on the low-e surfaces. Consequently, the R value calculations were made for E values from 0 to 0.82. For single airspaces, these calculations included the height or width values from 102 mm (4 inches) to 2438 mm (96 inches), which represent aspect ratios from 1.1 to 27.4. Additionally, for the double airspaces, the simulations were conducted for height/width values from 102 mm (4 inches) to 2438 mm (96 inches) representing aspect ratios from 2.3 to 54.9 for each region. The case of an airspace height/width (H) of 16 inches can represent furred airspace assemblies with 16-inch o.c. constructions. For these constructions, the distributions of T, V_x, V_y and V_{res} at E = 0.05 are shown in Figure 4(ai–v) to Figure 7(ai–v) for single airspaces and Figure 4(bi–v) to Figure 7(bi–v) for double airspaces.

4.3.1. Vertical Airspaces (θ = 90°) with Horizontal Heat Flow

For the E value range from 0 to 0.82, Figure 10 shows how the aspect ratio (A_R) impacts the R values of a vertical single airspace (θ = 90°) with a horizontal heat flow. The corresponding results for the double airspaces are provided in Figure 11. Note that the effect of the aspect ratio is not included in the methods that are commonly used to calculate the R values of reflective airspaces (ISO 6946 [9] and ASHRAE [5,6]). The R value contained in these figures increases significantly with an increasing A_R for all the E values. For high E values, however, the R value increases insignificantly with an A_R increase. The R value lines for different aspect ratios tend to converge as the E value tends to 0.82 at which the emissivities of all the enclosed-airspace surfaces are 0.9. For example, for single airspaces at low E values of 0.03, 0.05 and 0.1, respectively, the R value increased by 99, 90 and 71% with an increasing A_R from 1.1 (H = 4 inches at which R = 1.86, 1.81 and 1.71 ft²·h·°F/BTU) to 27.4 (H = 96 inches at which R = 3.70, 3.44 and 2.93 ft²·h·°F/BTU). At these E values (0.03, 0.05 and 0.1, respectively), the HRP 32 (R = 2.67, 2.53 and 2.32 ft²·h·°F/BTU [4]) overestimated the R values by 44, 40 and 36% at an A_R of 1.1, and

SUPER THERM is Tested 5000 hours Corrosion-passed Wind + Rain Tested- NO penetration Repels heat with dust over IT.

Foils AND Such CANNOT perform after Covered with dust - wet & Corrosion.

22.

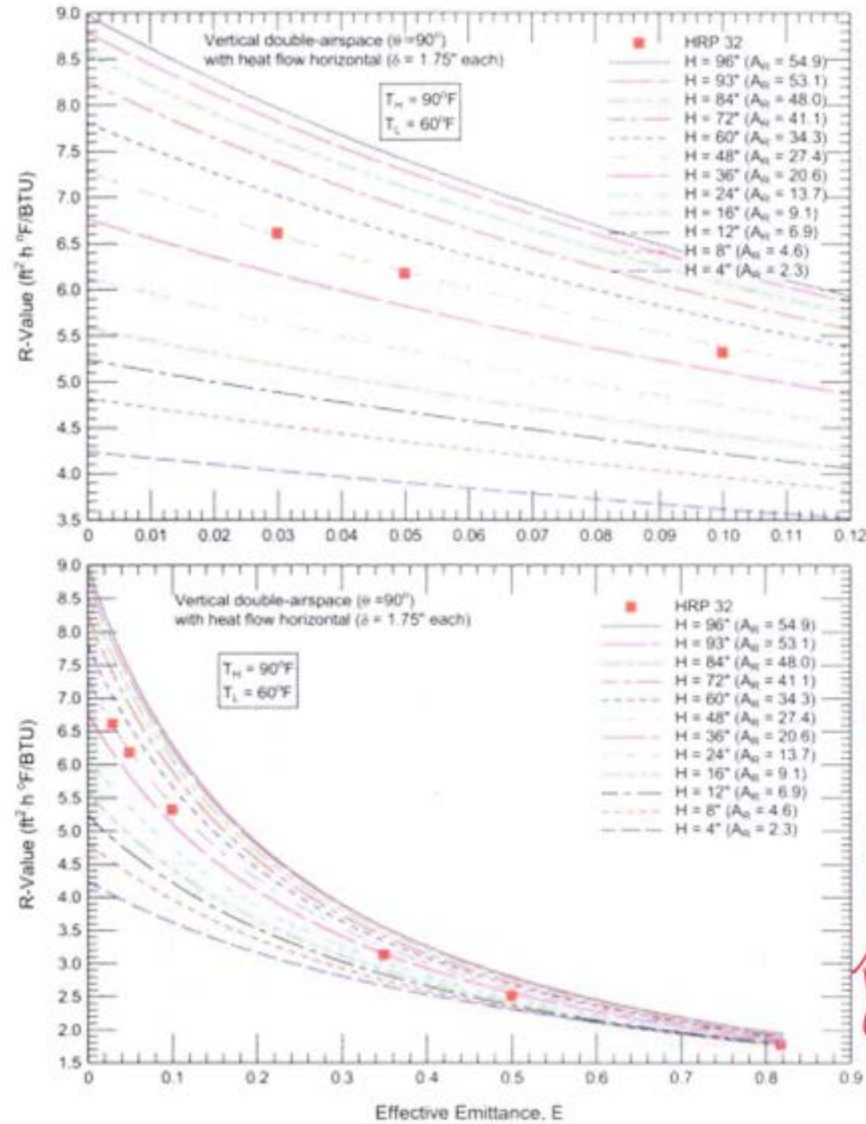


Figure 11. Comparisons of R values of HRP 32 [4] with present model predictions of various A_R for double airspaces subjected to a horizontal heat flow (θ = 90°, total δ = 3.5 inches, T_H = 90 °F, T_L = 60 °F).

The Larger The open space of The Room or building, The Reflective Coating (SUPER THERM) can double or Triple The R value.

For double airspaces at E = 0.03, 0.05 and 0.1, Figure 11 shows that the R values increased by 98, 90 and 74%, respectively, by increasing A_R from 2.3 (H = 4 inches at which R = 4.03, 3.91 and 3.62 ft²·h·°F/BTU) to 54.9 (H = 96 inches at which R = 7.97, 7.42 and 6.30 ft²·h·°F/BTU). At these E values (0.03, 0.05 and 0.1, respectively), the HRP 32 (R = 6.61, 6.18 and 5.32 ft²·h·°F/BTU

24.

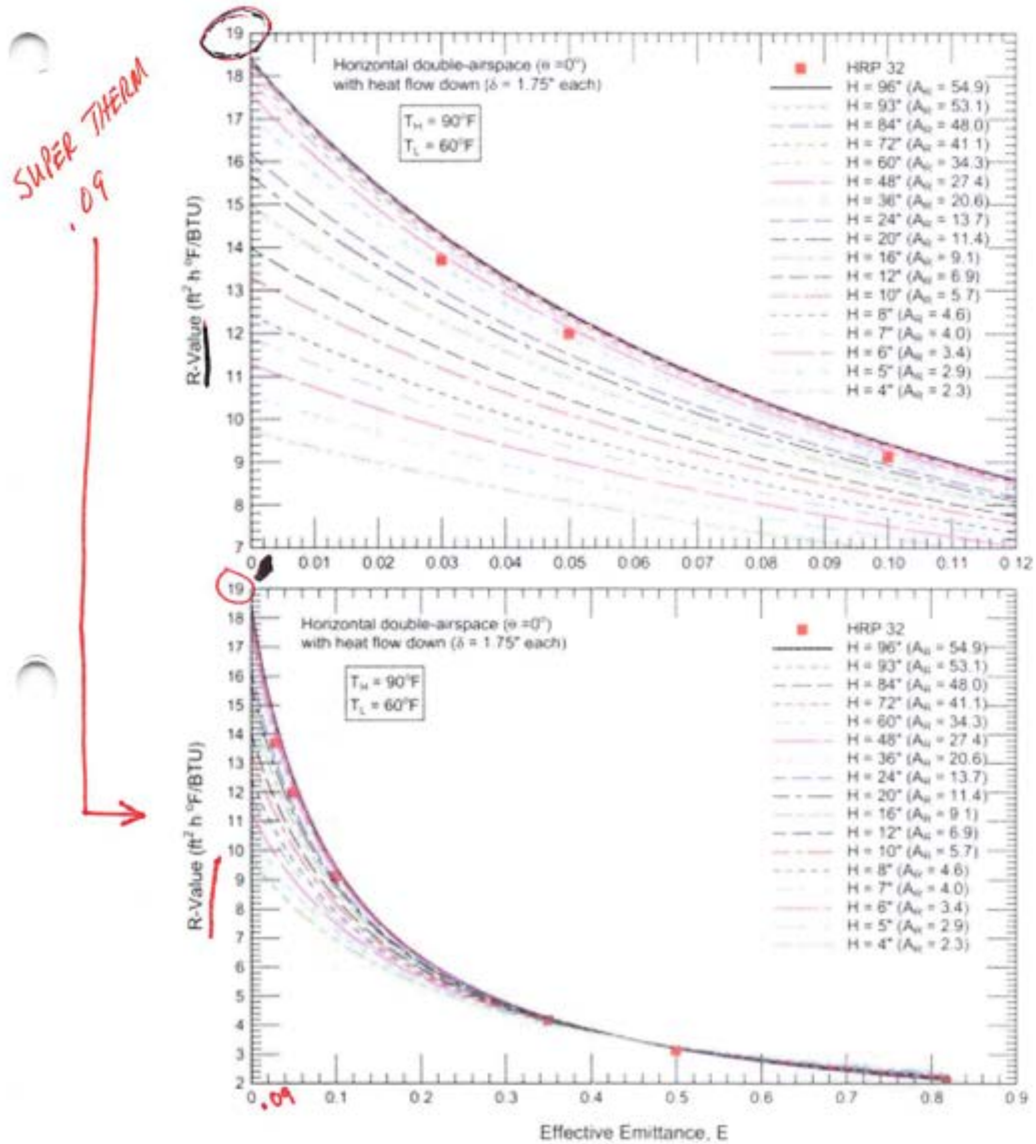


Figure 13. Comparisons of R values of HRP 32 [4] with present model predictions of various A_R for double airspaces subjected to a downward heat flow (θ = 0°, total δ = 3.5 inches, T_H = 90 °F, T_L = 60 °F).

4.3.3. Horizontal Airspaces (θ = 0°) with Upward Heat Flow

For vertical airspaces with a horizontal heat flow (θ = 90°) and horizontal airspaces with a downward heat flow (θ = 0°), the number of convection loops is the same for different aspect ratios: one convection loop for the case of a horizontal heat flow (e.g., see Figure 4(ai,bi)

27.

SPI COATINGS
PROVEN PERFORMANCE • REAL WORLD SOLUTIONS

through Figure 7(ai,bi) for an airspace of 16 inches long), and two convection loops for the case of a downward heat flow (e.g., see Figure 4(aiii,biii) through Figure 7(aiii,biii)) for an airspace of 16 inches long). In these two cases, the R value increases with an increasing aspect ratio, as discussed above. Conversely, for horizontal airspaces with an upward heat flow, the number of convection loops changes with the changing aspect ratio. For example, the number of convection loops in a single airspace of 16 inches long (A_R = 4.6) and 60 inches long (A_R = 17.1), respectively, are four (see Figure 4(aii) through Figure 7(aii) for H = 16 inches) and ten. For horizontal double airspaces (44.5 mm (1.75 inches) thick each), however, the number of convection loops in the airspaces of 16 inches long (A_R = 9.1) and 60 inches long (A_R = 34.3), respectively, are 12 in the top airspace and 14 in the bottom airspace (see Figure 4(bii) through Figure 7(bii) for H = 16 inches), and 24 in the top airspace and 42 in the bottom airspace. Note that the number of convection loops in horizontal airspaces with an upward and downward heat flow must be an even number due the symmetry at the vertical plane located at the mid-width of the airspace. For given values for H, δ, E, T_{avg} and ΔT, a greater number of convection loops inside the airspace per unit width, called "γ", would enhance its thermal conductance, resulting in obtaining a lower R value than that for a smaller value of γ. This phenomenon was addressed in more detail in previous publications (e.g., see [20,21,22]). As such, depending on the value of γ for a given operating condition, increasing A_R can result in either an increase in the R value (for small value of γ) or a decrease in the R value (for large value of γ).

With an upward heat flow, Figure 14 and Figure 15 show the effect of the aspect ratio on the R values of horizontal single- and double airspaces, respectively. For 15 aspect ratio values for a single airspace, Figure 14 shows that the R value changes significantly with the changing aspect ratio for the full range of the effective emittance (0–0.82). For a given E value within the range of low effective emittance (E ≤ 0.1), the highest R value occurred for an A_R of 17.1 (H = 60 inches), and the lowest R value occurred for an A_R of 1.7 (H = 6 inches). At an E value of 0.05, the R value for A_R of 1.7 (1.86 ft²·h·°F/BTU) was 20% lower than that for an A_R of 17.1 (2.24 ft²·h·°F/BTU) at which the HRP 32 overestimated the R value by 9% for an A_R of 1.7 and underestimated the R value by 9% for an A_R of 17.1. At this E value (0.05), the ISO 6946 underestimated the R value by 5 and 21%, respectively, for an A_R of 1.7 and 17.1. On the other hand, for a given E value within the range of high effective emittance (E > 0.2), the highest R value occurred for an A_R of 1.1 (H = 4 inches), whereas the lowest R value occurred for an A_R of 10.3 (H = 36 inches). At an E value of 0.82, the R value for an A_R of 10.3 (0.80 ft²·h·°F/BTU) was 48% lower than that for an A_R of 1.1 (1.53 ft²·h·°F/BTU). At this E value (0.82) for an A_R of 10.3 and 1.1, the HRP 32 and ISO 6946, respectively, underestimated the R value by 4 and 50%, and by 9 and 52% that for an A_R of 17.1 (2.24 ft²·h·°F/BTU), at which the HRP 32 overestimated the R value by 9% for an A_R of 1.7 and underestimated the R value by 9% for an A_R of 17.1. At this E value (0.05), the ISO 6946 underestimated the R value by 5 and 21%, respectively, for an A_R of 1.7 and 17.1. On the other hand, for a given E value within the range of high effective emittance (E > 0.2), the highest R value occurred for an A_R of 1.1 (H = 4 inches), whereas the lowest R value occurred for an A_R of 10.3 (H = 36 inches). At an E value of 0.82, the R value for an A_R of 10.3 (0.80 ft²·h·°F/BTU) was 48% lower than that for an A_R of 1.1 (1.53 ft²·h·°F/BTU). At this E value (0.82) for an A_R of 10.3 and 1.1, the HRP 32 and ISO 6946, respectively, underestimated the R value by 4 and 50%, and by 9 and 52%.

– This procedure channels hot air and makes it move. Finding how much hot air will load on a surface cannot be found if the air is constantly moving. Example: it takes less thickness of insulation to control a flowing pipe at 300°C than a non-flowing pipe because the heat is passing quickly.

the A_R of 20.6 (H = 36 inches). However, within the range of low effective emittance ($E < 0.1$), the highest R value occurred for an A_R of 37.7 (H = 66 inches), whereas the lowest R value occurred for an A_R of 3.4 (H = 6 inches). At an E value of 0.05, the R value for an A_R of 37.7 (4.22 $ft^2 \cdot h \cdot °F/BTU$) was 17% higher than that for an A_R of 3.4 (3.60 $ft^2 \cdot h \cdot °F/BTU$). At this E value (0.05), the HRP 32 overestimated the R value by 5 and 23%, respectively, for an A_R of 37.7 and 3.4.

4.3.4. Sloped Airspaces (θ = 45°) with Downward Heat Flow

For a sloped airspace of θ = 45° subjected to a downward heat flow, Figure 16 and Figure 17 show the effect of the aspect ratio on the R values of a single airspace and double airspaces, respectively. Similar to airspaces of θ = 90° with a horizontal heat flow and airspaces of θ = 0° with a downward heat flow, these figures show that the R value increases significantly with an increasing A_R for the range of low effective emittance; and for the range of high effective emittance, the R value increases insignificantly with an increasing A_R. Figure 16 shows that for single airspaces at low E values of 0.03, 0.05 and 0.1, respectively, the R value increased by 55, 48 and 38% with an increasing A_R from 2.0 (H = 7 inches at which R = 2.66, 2.56 and 2.31 $ft^2 \cdot h \cdot °F/BTU$) to 27.4 (H = 96 inches at which R = 4.11, 3.80 and 3.18 $ft^2 \cdot h \cdot °F/BTU$ [4]). At these E values (0.03, 0.05 and 0.1), HRP 32 (R = 3.53, 3.29 and 2.81 $ft^2 \cdot h \cdot °F/BTU$) overestimated the R values by 33, 29 and 22% at an A_R of 2.0, and underestimated the R values by 14, 13 and 12% at an A_R of 27.4, respectively. Similarly, for double airspaces at E values of 0.03, 0.05 and 0.1, respectively, Figure 17 shows that the R value increased by 78, 71 and 57% with an increasing A_R from 2.3 (H = 4 inches at which R = 5.02, 4.81 and 4.38 $ft^2 \cdot h \cdot °F/BTU$) to 54.9 (H = 96 inches at which R = 8.95, 8.24 and 6.86 $ft^2 \cdot h \cdot °F/BTU$). At these E values (0.03, 0.05 and 0.1, respectively), the HRP 32 (R = 8.99, 8.22 and 6.76 $ft^2 \cdot h \cdot °F/BTU$ [4]) overestimated the R values by 79, 71 and 54% at an A_R of 2.3, whereas both the present and HRP 32 R values are approximately the same at an A_R of 54.9.

Again Reflective Coating Repelling heat off the Surface shows better results for Larger Areas.

31.

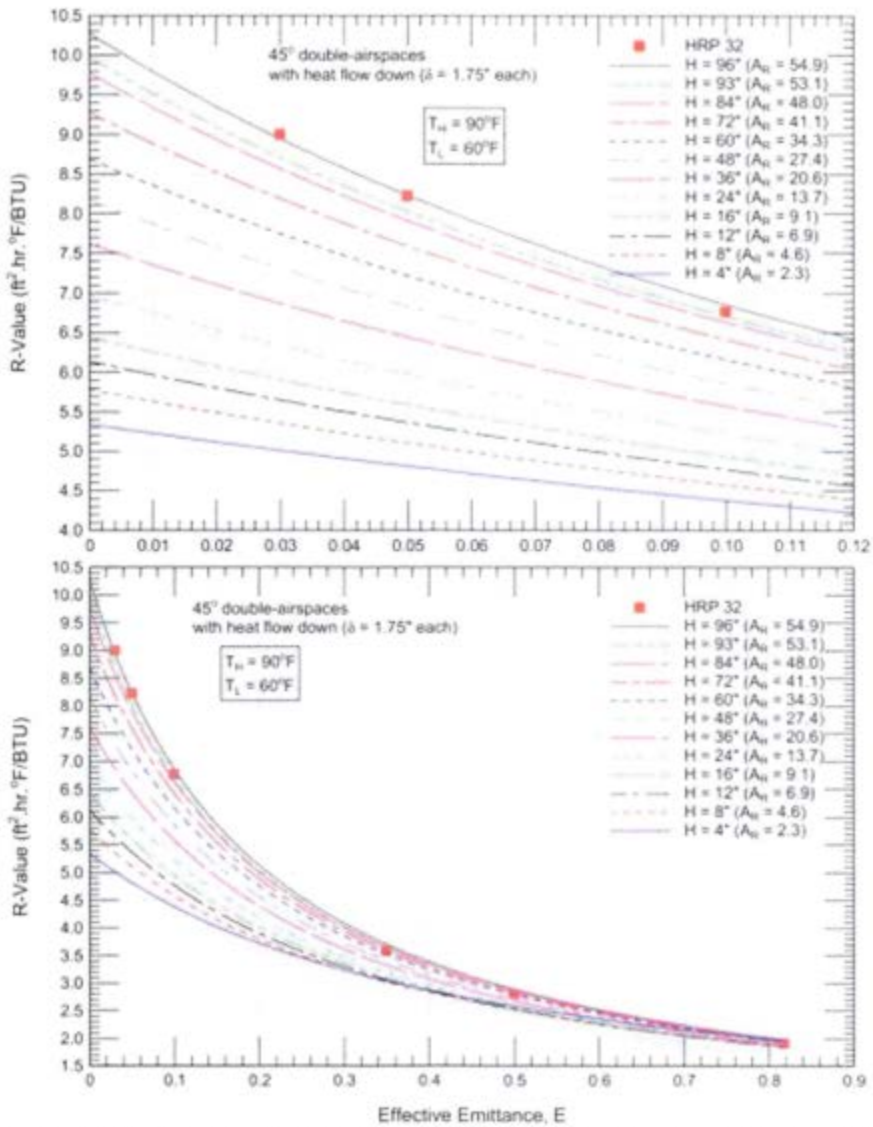


Figure 17. Comparisons of R values of HRP 32 [4] with present model predictions of various A_R for sloped double airspaces subjected to a downward heat flow (θ = 45°, total δ = 3.5 inches, T_H = 90 °F, T_L = 60 °F).

4.3.5. Sloped Airspaces (θ = 45°) with Upward Heat Flow

Similar to horizontal airspaces (θ = 0°) with an upward heat flow, a different number of convection loops was developed in each airspace for sloped airspaces (θ = 45°). For the 45° single airspaces of H ≤ 36 inches (A_R ≤ 10.3, see Figure 4(aiv) through Figure 7(aiv) for single airspace

33

forcing hot air through loops does not register the true heat load on a surface.

maybe other areas.

emittance (E > 0.4). Within the range of low effective emittance (E < 0.4), the highest R value occurred for an A_R of 53.1 (H = 93 inches), whereas the lowest R value occurred for the A_R of 2.3 (H = 4 inches). At E values of 0.03, 0.05 and 0.1, respectively, the lowest R values (R = 3.99, 3.87 and 3.59 $ft^2 \cdot h \cdot °F/BTU$ at an A_R = 2.3, which are about twice of that for single airspace) were 44, 40 and 33% lower than the highest R values (R = 5.73, 5.42 and 4.76 $ft^2 \cdot h \cdot °F/BTU$ A_R = 53.1, which are also about twice of that for single airspace). At these E values (0.03, 0.05 and 0.1, respectively), the HRP 32 overestimated the R values by 33, 30 and 24%, respectively for an A_R of 2.3 and underestimated the R values by about 7.3, 7.2 and 6.7%, respectively, at an A_R of 53.1.

Longer the area The SUPER THERM performs best by controlling the "heat Load" on the surface facing the heat. - Keeping the substrate cool.

36.

effect of the aspect ratio at an E value of 0.03 has resulted in increasing the R values by the following:

- 99% (from 1.86 to 3.70 ft²·h·°F/BTU for a vertical single airspace with a horizontal heat flow, Figure 10),
- 98% (from 4.03 to 7.97 ft²·h·°F/BTU for vertical double airspaces with a horizontal heat flow, Figure 11),
- 125% (from 4.84 to 10.87 ft²·h·°F/BTU for a horizontal single airspace with a downward heat flow, Figure 12),
- 65% (from 8.66 to 14.31 ft²·h·°F/BTU for horizontal double airspaces with a downward heat flow, Figure 13),
- 23% (from 1.91 to 2.35 ft²·h·°F/BTU for a horizontal single airspace with an upward heat flow, Figure 14),
- 19% (from 3.72 to 4.41 ft²·h·°F/BTU for horizontal double airspaces with an upward heat flow, Figure 15),
- 54% (from 2.66 to 4.11 ft²·h·°F/BTU for a 45° single airspace with a downward heat flow, Figure 16),
- 78% (from 5.02 to 8.95 ft²·h·°F/BTU for 45° double airspaces with a downward heat flow, Figure 17),
- 57% (from 1.93 to 3.02 ft²·h·°F/BTU for a 45° single airspace with an upward heat flow, Figure 18) and
- 44% (from 3.99 to 5.73 ft²·h·°F/BTU for 45° double airspaces with an upward heat flow, Figure 19).

5. Summary and Conclusions

In this research study, a validated numerical model was used to determine the effective thermal resistance (R value) of vertical ($\theta = 90°$), horizontal ($\theta = 0°$) and sloped ($\theta = 45°$) single and double airspaces of different aspect ratios (A_R) when these airspaces were subjected to horizontal, upward and downward heat flows. As the emittance of reflective insulation products such as foils and coatings can increase due to corrosion, dust accumulation and/or moisture condensation on the low emittance surfaces, the numerical simulations were conducted for the full range of effective emittance (E) (0–0.82). Consideration was given to the effect of heat transfer by radiation at the two ends that represent the surfaces of the framing (e.g., furring or spacers) of the airspaces on the R value. The predicted thermal resistances were compared with the available methods for calculating the thermal resistances of enclosed airspaces based on ISO 6946 and HRP 32, whereas these methods do not account for (a) the heat transfer by radiation at the two ends of the airspace, and (b) the effect of the airspace A_R. For the given airspace orientation and direction of the heat flow, the results showed that the ISO 6946 and HRP 32 R values were in good agreement with the present R values for a specified A_R. However, ISO 6946 and HRP 32 overstated or underestimated the R values for other A_R values.

The results of this study showed that the A_R of the enclosed airspace can have a significant effect on its thermal resistance. For single and double airspaces subjected to horizontal and downward heat flows, the results showed that increasing the A_R has resulted in a significant increase in the R value for the range of low E values, whereas for the range of high E values, the R value increased insignificantly with an increasing A_R. However, for single and double airspaces subjected to an upward heat flow, the results showed that the effective thermal resistance changed

SUPER THERM works strictly to block "Heat Transfer by Radiation" to reduce the amount of heat absorbed into a building interior.

This is the entire concept of blocking radiation heat load & this entire process says this is not important.

Based on being able to hold the absorbed heat.

SUPER THERM is designed to block heat load & therefore reduce the quantity of heat being recorded. Using the heat flux or absorbed heat over a period of time is for "MASS" material & not reflective materials.

Conclusion

significantly with a changing A_R for the full range of E. Additionally, for a given E value in the case of single and double airspaces with an upward heat flow, the results showed that the highest R value corresponded to the case of A_R having the lowest value of the number of convection loops per unit airspace width (called, in this study, "γ"). Finally, this study showed that depending on the E value, the R value could be doubled by incorporating a thin sheet/layer of low-e on its both sides in the middle of the enclosed airspace. Last but not the least, at a low E value, the results showed that the effect of A_R can result in doubling the R value of single and double airspaces.

Author Contributions

Conceptualization, H.H.S. and D.W.Y.; methodology, H.H.S. and D.W.Y.; software, H.H.S.; validation, H.H.S. and D.W.Y.; formal analysis, H.H.S. and D.W.Y.; investigation, H.H.S. and D.W.Y.; resources, D.W.Y.; data curation, H.H.S. and D.W.Y.; writing—original draft preparation, H.H.S. and D.W.Y.; writing—review and editing, H.H.S. and D.W.Y.; visualization, H.H.S. and D.W.Y.; supervision, H.H.S. and D.W.Y.; project administration, H.H.S.; funding acquisition, D.W.Y. All authors have read and agreed to the published version of the manuscript.

Conclusion: when applying Super Therm on both sides of a substrate, the R-value can be doubled.
In testing with ASTM C236 (rev. C1363): one coat tested +68% over Fiberglass board.
Two coats tested +148% over Fiberglass board.

Funding

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

This testing confirms R-value can be doubled by coating both sides of the substrate from this study. SEE: Attachment A Page 46.

Appendix A

This section briefly presents the theoretical background of the governing equations that were solved using the present model and the boundary conditions and simulation parameters for this research as well.

Appendix A.1. Governing Equations

In an enclosed airspace, the contribution of heat transfer by convection is obtained by solving the continuity and momentum equations (Navier–Stokes equation) for the air velocity field ($\vec{v}_a$). These equations are as follows [34]:

39.

Georgia Tech Univ. Engineering did a study outside trying to use standard R-value measurement equipment. SUPER THERM worked as advertised. None of the "MASS" insulation materials could work because of humidity, wind & changes in temp. Georgia Tech PhD's staff stated "MASS" materials could only work inside a controlled laboratory.

$$\frac{\partial \rho_a}{\partial t} = -\nabla\cdot(\rho_a \vec{v}_a) \quad \text{(A1)}$$

$$\rho_a\frac{\partial \vec{v}_a}{\partial t} + \rho_a \vec{v}_a\cdot\nabla\vec{v}_a = -\nabla P_a + \nabla\cdot\left(\mu_a\left(\nabla\vec{v}_a + (\nabla\vec{v}_a)^T\right) - \frac{2}{3}\mu_a(\nabla\cdot\vec{v}_a)\, I\right) + \rho_a\vec{g} \quad \text{(A2)}$$

where I is the unit matrix, μ_a is air the dynamic viscosity (Pa.s), $\vec{g}$ is the vector of gravitational acceleration (m²/s), ρ_a is the air density (kg/m³), P_a is the air pressure (Pa) and t is the time (s).

The energy equation for the airspace layers is given as follows [34]:

$$\rho_a C p_a \frac{\partial T}{\partial t} = \underbrace{-\rho_a C p_a(\vec{v}_a\cdot\nabla T)}_{\text{convection}} + \underbrace{\nabla\cdot(k_a\nabla T)}_{\text{conduction}} + \underbrace{\mu_a\left(\left(\nabla\vec{v}_a + (\nabla\vec{v}_a)^T\right) - \frac{2}{3}(\nabla\cdot\vec{v}_a)\, I\right):\nabla\vec{v}_a}_{\text{viscous heating}} - \underbrace{\frac{T}{\rho_a}\frac{\partial\rho_a}{\partial T}\Big|_p\left(\frac{\partial P}{\partial t}\right)}_{\text{Pressure work}} + q'''_{source/sink} \quad \text{(A3)}$$

where k_a is the air thermal conductivity (W/(m.K)) and Cp_a is the air specific heat capacity at a constant pressure (J/(kg.K)). The term $q'''_{source/sink}$ in Equation (A3) represents the volumetric heat source/sink, for example, due to moisture condensation/evaporation, which is neglected, since no moisture transport is considered in this study. However, for solid layers (e.g., low-emittance foil), the energy equation is the heat conduction equation, which is given as follows [34]:

$$\rho_s C p_s \frac{\partial T}{\partial t} = \nabla\cdot(k_s\nabla T) \quad \text{(A4)}$$

where ρ_s is the solid density (kg/m³), Cp_s is the solid specific heat capacity (J/(kg.K)) and k_s is solid thermal conductivity (W/(m.K)).

To account for heat transfer by radiation inside enclosed or open airspaces, the surface-to-surface heat radiation equation is solved simultaneously with the energy equation listed above. At every point on a radiative surface, the contribution of the net inward radiative heat source (q_{RAD}) is added, which is given as follows [15]:

$$q_{RAD} = \varepsilon\,[q_{irr} - \sigma T^4], \text{ where } q_{irr} = G_m + F_{amb}\,\sigma\, T^4_{amb} \quad \text{(A5)}$$

In Equation (A5), q_{irr} is the total irradiation (W/m²), F_{amb} is the ambient view factor, T_{amb} is the ambient temperature (K), σ is the Stefan–Boltzmann constant (5.67 × 10⁻⁸ W/(m².K⁴)) and ε is the surface emissivity. As an example of enclosure, ε is equal to ε_a, ε_b, ε_c and ε_d, respectively, for all the points on surfaces a, b, c and d shown in Figure A1. The parameter G_m in Equation (A5) represents the mutual irradiation coming from other radiative surfaces, which is a function of the radiosity q_{radi}.

The general expression for the radiosity q_{radi} was derived in a previous publication [15]. For every point on the surface boundaries (3D geometry) or every point on the line boundaries (2D geometry) that participate in the surface-to-surface radiation, the final expression for the radiosity q_{radi} is given as follows [15]:

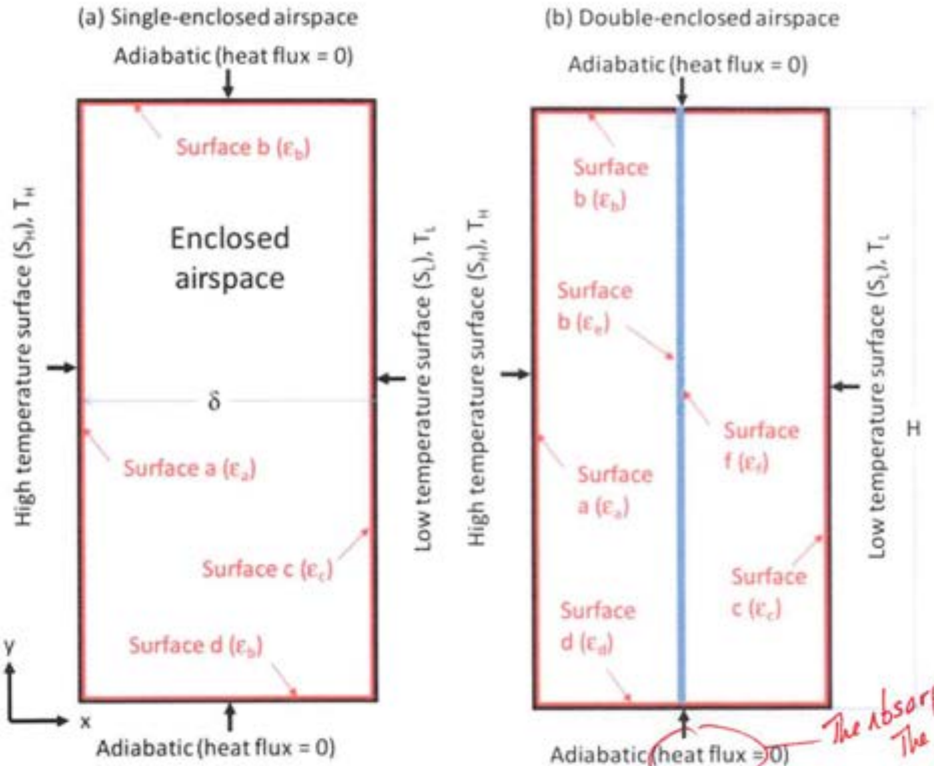
$$q_{radi} = (1-\varepsilon)\,[G_m + F_{amb}\,\sigma\, T^4_{amb}] + \varepsilon\,\sigma\, T^4 \quad \text{(A6)}$$

To avoid repetition, the detailed expressions for G_m and F_{amb} and their associated kernel functions for both 3D geometry and 2D geometry are available in [15]. Equation (A6) is applicable to all the points on the surface/line boundaries that participate in surface-to-surface radiation, which forms a system of equations in radiosity q_{radi}. This system of equations is solved simultaneously with the energy equation (Equations (A3) and (A4)) for the temperature T and radiosity q_{radi}.

If the Relative Humidity is 60% - there is 60% moisture in the air that leads into the "MASS" (Fibers) whereas SUPERTHERM tested under ASTM to block-moisture, air filtration and blowing rain to maintain a dry surface.

To make a study on insulation without considering moisture & air filtration is nonsense. This only happens inside a controlled laboratory & not the real-world.

40.



The absorption of the heat to a match temp load. This only works for "Mass" type insulation materials

Figure A1. Schematic showing the boundary conditions for single- airspace (**a**) and double airspaces (**b**) involving surfaces of various emissivities.

The ultimate goal of this research study was to investigate the effect of the aspect ratio on the *R* values of single and double airspaces of different orientations and subjected to various heat-flow directions. Thus, for each numerical simulation, the *R* value is calculated as follows:

$$R\text{-value}=\frac{\Delta T}{q_{avg}}, \text{ where } \Delta T=T_H-T_L. \quad (A7)$$

In Equation (A7), q_{avg} is the normal average heat flux on the high-temperature surface ($q_{avg,H}$), which is the same as that on the low-temperature surface ($q_{avg,L}$) due to energy balance since the two ends of the airspace are adiabatic. The average normal heat flux on the high temperature surface (S_H) and the average normal heat flux on the low temperature surface (S_L) are calculated by conducting the following numerical integrations (Figure A1):

$$q_{avg,H}=\frac{1}{H}\int_{S_H} q_n(y)\cdot dy \text{ and } q_{avg,L}=\frac{1}{H}\int_{S_L} q_n(y)\cdot dy \quad (A8)$$

References

42.

Most info pulled from Google. So how much was actually tested for accuracy ???

1. Goss, W.P.; Miller, R.G. Literature Review of Measurements and Predictions of Reflective Building Insulation Systems Performance: 1900–1986. *ASHRAE Trans.* **1989**, *95*, 651–664. [Google Scholar]
2. Stephan, K.; Laesecke, A. The Thermal Conductivity of Fluid Air. *J. Phys. Chem. Ref. Data* **1985**, *14*, 227–234. [Google Scholar] [CrossRef]
3. Pratt, A.W. *Heat Transmission in Buildings*; John Wiley and Sons: New York, NY, USA, 1981; pp. 31–40. [Google Scholar]
4. Robinson, H.E.; Powell, F.J. *The Thermal Insulation Value of Air Spaces, Housing Research Paper 32*; National Bureau of Standards (now N.I.S.T), Project ME-12; U.S. Department of Commerce, U.S. Government Printing Office: Washington, DC, USA, 1956.
5. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Design Heat Transmission Coefficients. In *ASHRAE Handbook of Fundamentals*; ASHRAE: Peachtree Corners, GA, USA, 1972; Chapter 20. [Google Scholar]
6. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Heat, Air, and Moisture Control in Building Assemblies-Material Properties. In *ASHRAE Handbook of Fundamentals*; Table 3; ASHRAE: Peachtree Corners, GA, USA, 2017; Chapter 26. [Google Scholar]
7. Desjarlais, A.O.; Tye, R.P. Research and Development Data to Define the Thermal performance of Reflective Materials Used to Conserve Energy in Building Applications. In *Oak Ridge National Laboratory Report ORNL/Sub/88-SA825/1*; Oak Ridge National Laboratory: Oak Ridge, TN, USA, 1990. [Google Scholar]
8. Desjarlais, A.O.; Yarbrough, D.W. Prediction of the Thermal Performance of Simple and Multi-Airspaces Reflective insulation Materials. In *Insulation Materials: Testing and Applications*; Graves, R.S., Wysoci, D.C., Eds.; ASTM STP 1116; ASTM International: West Conshohocken, PA, USA, 1991; Volume 2, pp. 24–43. [Google Scholar]
9. ISO 6946:2017. *Building Components and Building Elements-Thermal Resistance and Thermal Transmittance-Calculation Methods-Annex D-Thermal Resistance of Airspaces*; European Committee for Standardization, CEN-CENELEC Management Centre: Avenue Marnix, Belgium, 2017. [Google Scholar]
10. Seigel, R.; Howell, J.R. *Thermal Radiation Heat Transfer*; McGraw-Hill Book Company: New York, NY, USA, 1972; pp. 240–241. [Google Scholar]
11. Yam, K.W.; Teh, K.S.; Loi, P.; Yarbrough, D.W. Reflective insulation assemblies for above-ceiling applications. *J. Build. Phys.* **2020**, *44*, 272–283. [Google Scholar] [CrossRef]
12. Saber, H.H.; Maref, W.; Elmahdy, A.H.; Swinton, M.C.; Glazer, R. 3D thermal model for predicting the thermal resistances of spray polyurethane foam wall assemblies. In Proceedings of the Building XI Conference, Clearwater, FL, USA, 5–9 December 2010. [Google Scholar]
13. Saber, H.H.; Maref, W.; Lacasse, M.A.; Swinton, M.C.; Kumaran, M.K. Benchmarking of hygrothermal model against measurements of drying of full-scale wall assemblies. In Proceedings of the 2010 International Conference on Building Envelope Systems and Technologies, ICBEST 2010, Vancouver, BC, Canada, 27–30 June 2010; pp. 369–377. [Google Scholar]

43.

29. Saber, H.H.; Maref, W.; Sherrer, G.; Swinton, M.C. Numerical modeling and experimental investigations of thermal performance of reflective insulations. *J. Build. Phys.* **2012**, *36*, 163–177. [Google Scholar] [CrossRef]
30. Saber, H.H.; Maref, W.; Swinton, M.C. Thermal response of basement wall systems with low-emissivity material and furred airspace. *J. Build. Phys.* **2011**, *35*, 353–371. [Google Scholar] [CrossRef]
31. Saber, H.H. Thermal performance of wall assemblies with low emissivity. *J. Build. Phys.* **2012**, *36*, 308–329. [Google Scholar] [CrossRef]
32. Cook, J.C.; Yarbrough, D.W.; Wilkes, K.E. Contamination of reflective foils in horizontal applications and the effect on thermal performance. *ASHRAE Trans.* **1989**, *95*, 677–681. [Google Scholar]
33. Lee, S.W.; Lim, C.H.; Bin Salleh, E.I. Reflective thermal insulation systems in building: A review on radiant barrier and reflective insulation. *Renew. Sustain. Energy Rev.* **2016**, *65*, 643–661. [Google Scholar] [CrossRef]
34. Bird, R.B.; Stewart, W.E.; Lightfoot, E.N. *Transport Phenomena*; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 1960. [Google Scholar]

Energies, EISSN 1996-1073, Published by MDPI Disclaimer

45.

"Super Therm® works by reflecting solar heat. The results achieved in this [test/field report] are unique to the structure, geographic location, weather conditions, and time period of Super Therm®'s application. Results may vary depending on these factors."

ATTACHMENT A Full Test Document.

VTEC Laboratories Inc.

October 31, 2002

Mr. Francisco Morales Véliz
Bombardier Transportation
Domicilio Conocido, Zona Industrial
Cd. Sahagún, Edo. De Hgo C.P. 43990 México

RE: Comparison of completed ASTM C236 Tests

Dear Mr. Véliz,

Below is the summary of the results from the referenced job files. The percentages listed for the "Sample" fiberglass panels are compared to the "Control" panel; the "Plywood Laminate" and "Stainless Steel" panels did not have a "control" sample available for comparison. For specific test specimen data and test conditions please refer to the appropriate test report.

Report Number (NCTL-110-)	Test Specimen (24" x 48")	Thermal Conductance (Excluding Air Films)	R-Value (Per inch of thickness)	Percent Increase (from Control)	
8373-01	Control – 3" Fiberglass with no coatings	0.52	1.92	-	
8373-02	System 2 – 3" Fiberglass with 10 mil Super Therm coating on interior (ONE SIDE)	0.31	3.23	68%	ONE SIDE
8373-05	System 4 – 3" Fiberglass with 50 mil Hot Therm and 10 mil Super Therm coating on interior	0.28	3.57	86%	
8373-03	System 1 – 3" Fiberglass with 10 mil Super Therm coating on both sides	0.21	4.76	148%	BOTH SIDE
8373-06	Plywood laminate with 50 mil Hot Therm and 10 mil Super Therm coating on interior	0.79	1.27		

If you have any questions, please contact me at your convenience.

Neil Schultz

This Test verifies Page 39 of This Report.

46

212 Manida Street • Bronx, New York 10474 • (718) 542-8248 • Fax: (718) 542-8759 • www.vteclabs.com

Final statement on Reflectivity and Emissivity:

Reflectivity is based on light bounce. Our US ASTM tests are not as sophisticated as Japan Building Materials or Russian Academy of Sciences in judging the range of energy waves hitting the target .

This is why I did testing with both.

Emissivity is based on a single point or scattered but using a handheld monitor gives what they believe to be a "heat" reading. ASTM C 1371-04 is the scattered method we used to be more correct.

Understand what emissivity is:

Emissivity is based on a black box. A black box set in the sun absorbs 100% of the heat to a point that it equalizes itself by giving off 100% of the absorbed heat back to the atmosphere, meaning it holds all the heat and on touch you feel the 100% heat on the surface. It conducts 100% of the heat absorbed also.

With this understanding, all the emissivity readings being made are based on the black box "throwing off heat at 100%" and therefore all the ASTM testing is based purely on the heat being thrown off the surface. The assumption of the test is that as the heat tries to absorb into the surface the emissivity is the amount of this heat being thrown off. The higher the number the better.

The fallacy on this assumption is that the amount of the emissivity is the amount of heat not absorbed and therefore, released back to the atmosphere meaning if the emissivity is .91, then 91% of the heat that tried to absorb into the surface never absorbed and it was thrown off.

Go back to the black box, it absorbed 100% of the heat which did transfer to the cool side, while the 100% of heat in the black surface was released in an equilibrium back to the atmosphere that you can feel on touching the surface.

So, the point is this: Does recording a high emissivity number on the surface mean (according to the black box) you absorbed (example the .91) 91% of the heat and you are simply releasing in an equilibrium back to the atmosphere while the 91% also transferred to the cool side?? -Based on the black box effect.

My point: SUPER THERM is made from ceramic research performed with SPI and NASA between 1989-1995 studying the effects of "HEAT LOAD". Reflectivity was part of the effect of throwing off visual light mainly and trying to cool the surface somewhat. Emissivity was not part of this at all. This was proposed later by well-intentioned researchers to find a method showing how much heat could be measured being thrown off a surface after the heat begin to absorb into said surface. What I learned with NASA and I being the researcher was that what is important is how much heat absorbs and transfers to the cool side. Ceramic compounds designed or developed to specifically "block heat load" outperforms any measures of reflectivity and emissivity being tested and produced. We are talking about heat not light bounce or wave bounce. A white paint has a 70 reflectivity and emissivity or higher. A white car hood on a 90F+ day will burn your hand if you touch it. Wait- if the reflectivity and emissivity is showing 70%, then this should not be as hot as a piece of metal uncoated beside it. The visual light bounce is light - not heat. The emissivity is a measure of waves that represent heat but does not block heat and the metal under the white paint heated up within 30degrees as much as a black car hood.

HEAT WAVES: UV - 3% of the radiation heat, Visual Light or short wave is 40% of the radiation heat and Infrared or IR long waves is 57% of the radiation heat.

The testing of "reflectivity" does not account for all the IR waves.   I worked with the labs performing the ASTM testing and this was a fact.

This is why I did the testing with the Japanese Building Materials lab to find out the ability of SUPER THERM to thrown off IR (57% of the heat) off the surface. Result: 99.5%. and visual light 92%.
This is why I did additional testing with the Russian Academy of Sciences to find the true reflectivity number for all waves using sophisticated equipment as seen in the test report and compared to known heat repelling surfaces.

To accept the US ASTM test results as gospel I found is a bad mistake. The argument between engineers and researchers on test results and which tests are the best is non-sense to me because they limit themselves to only what is in front of them.

As a last example of "heat blocking" is the testing performed by the FEDERAL DOE when they bought SUPER THERM to test on a roof in Florida to specifically check out our advertised statements. They say this in their report.   They found that all we said was true and better than they expected. We kept a roof surface to within one degree F of the ambient temperature. Here is the important part, SUPER THERM made an average of 10.2F drop in temperature inside the home. This is the proof of performance, not some reflectivity or emissivity number.

With the attachments, the explanation of 34 years studying heat effects and there is still doubt about SUPER THERM, then we cannot help.

J.E.

SHOW ME the competition for SUPER THERM and HPC "Insulation Coatings" and then relate what they can provide to the following below **proof of performance**:

SUPER THERM – repelling "heat" radiation off a surface and
HPC designed to "Hold heat" on the surface and therefore inside the unit to improve efficiency like no other coating can.

*[Show me **"any"** competition that can do this and certify with in-field, Government DOE or major Industrial companies doing engineering performance studies on process equipment]*

US DEPARTMENT OF ENERGY WEATHERIZATION PROGRAM

Testing on SUPER THERM® "Radiation Control Coating"

NATIONAL DOE WEATHERIZATION PROGRAM TESTING RESULTS – Proving resistance of heat loading. Using the ConEdison model to show up to a 71% energy savings.

Results incorporated with (supplied upon request)

- ConEdison Energy reduction, energy savings analysis model
- Radiation Control – Oak Ridge National Laboratory showing
  - Emissivity, Heat Load resistance and energy savings
- Japanese Testing Center for Construction Materials
  - Emissivity / Reflectivity Results
- Russian Reflectivity testing by Russian Academy of Sciences institution,
  - Institute for Solid State Physics – reflectivity results

SUMMARY of DOE Test Results: **

*Ambient: 85°F. (29°C)
*ROOF without coating: 164°F (73°C)
*Roof coated with SUPER THERM : 86°F (30°C). (1°F over ambient)
*Roof coated with a white Elastomeric Reflective paint: 125°F (52°C)
*Interior ambient reduced: 10.2°F (6°C – 84F reduced to 74F)
*ConEdison Power (West Coast USA) study on a 6°F raise in thermostat to relieve the A/C unit will produce a 39% savings in energy usage. Using their calculation: a 10.2F rise in thermostat to maintain a comfortable interior ambient temperature equals a 71% energy savings.
*Upon the return to the home a week later, the owner told the auditors that she had never turned on the A/C because it was comfortable.

Attachments: (supplied upon request)

- Google: Weatherization assistance program- US Dept of Energy
- The Weatherization Testing Report
- ConEdison model
- ORNL(DOE Natl Lab) Building/tools/radiation-control for coatings
- Japan Testing Center results for SUPER THERM®
- Russian Academy of Sciences test results on SUPER THERM®

From this directive, the Federal DOE did a "competent and reliable scientific evidence" study by their experts meeting the directive of the FTC RULE. Federal DOE Auditor's comments on checking the advertising statements from Superior Products International II, Inc. to actual results are as follows (*)

*In addition to residents' security and comfort a specific intent is to reduce residents' utility bills.

***Recently, SJHP experimented with a new "green" product: SUPER THERM® - a liquid insulation that blocks the loading of solar heat on roofs.**

***We applied SUPER THERM® to the 14X60-foot metal roof of an older single-wide mobile home and took comparison readings of "before" and "after" temperatures to see what impact this insulating product has on reducing interior temperatures and utility costs.**

***The SJHP's interest in SUPER THERM® as an insulating paint was to test its promise of reducing heating and cooling costs by up to 70%. The manufacturer states that "SUPER THERM® blocks 95% of the three sources of heat: visual light, ultra-violet rays, and infrared rays.**

***The surface temperature of a roof wiii always be within 5 degrees of ambient temperature once SUPER THERM® is applied.**

***To measure the effectiveness of SUPER THERM® for lowering interior temperatures, we took readings with an infrared camera. Because inside temperatures are claimed to drop within minutes, we took initial readings of a portion of the mobile home's roof painted with SUPER THERM® compared with a portion of the roof not painted.**

***We saw an immediate drop of 7° F.**

***The differential among the set of nine before-and-after photos ranged from 7.9 to 12.5 degrees Fahrenheit – an average reduction of 10.2° F.**

***The exterior surface temperature of the mobile home's metal roof on a windy 85°Fday was 164°F. After application, the surface temperature dropped to 86°F. When we measured the roof surface temperature of a similar mobile home whose roof SFJP had coated with a white elastomeric product, the exterior surface temperature of that roof was 125°F.**

***When SJHP weatherization auditors returned to the original mobile home a week after our experiment with SUPER THERM®, the owner reported that she had not turned on her A/C unit since the day the roof was coated. The interior temperature was comfortable, which offers a tremendous savings for this particular elderly mobile homeowner, who carefully watches her expenses in order to purchase necessary medications.**

***Even without further readings, SJHP's assessment to date is that SUPER THERM® works well and meets our purpose and budget.**

***We were very impressed with the immediate temperature changes after application.**

NEXT is **HPC (Heat Blocking coating)** over hot surfaces to "hold the heat" on the surface and inside the unit coated.

HPC®

Award Winning EPA October 2023

HPC® (Hot Pipe Coating) a thick film water-based coating applied over hot surfaces to block heat escape from surface therefore holding heat inside the unit to save heat loss and save energy.

Wins the EPA ENERGY STAR Award for Saving Energy with the Georgia Pacific Engineering study performed.

-Insulation material giving 13-18 month ROI established to Save Koch (GP) industries millions

-Provides Employee burn protection due to pure "insulation effect"

-Stopped CUI completely after cutting

into coating and removing sections

Koch Industries and one of their subsidiaries (Georgia Pacific) did a over two-year insulation effectiveness test using a new technology saving hundreds of thousands of dollars on one unit in one year.

Look at a couple of paragraphs from their engineering report submitted to EPA ENERGY STAR award group which did win. This is identifying the new technology they used to win the energy saving award and only some of the results.

"The fully insulated digester reduced heat loss by 49% and saved Naheola an estimated $332,000 in energy costs annually. It also improved the quality of the cooking process by allowing the digester to better maintain its internal temperature. The HPC also protected the digester from corrosion. The Naheola digester had already begun to experience corrosion, a common issue for digesters of its age. The HPC hermetically sealed the digester to keep out any new moisture, so when some of the HPC was removed in 2022 to allow for repairs to the digester, there was no evidence of new corrosion.

GP is already using HPC at other mills following the results of this experiment. In addition to the energy savings, HPC's ability to protect manufacturing assets from corrosion could save GP and FHR millions of dollars in equipment replacement costs."

Georgia Pacific has 30 or more plants with each having several digester units described in this engineering report including hot piping. If one unit saved $332,000 after the unit was perhaps losing money, times all the digesters in all 30 plants plus additional pipes and tanks, what would that savings be??? $20 million dollars plus??
Now take the protection from developing corrosion costing millions per year on repair, tear down and replacement each year, could that be twice the savings cost n loss energy??? Could a couple of million spent on applying a true "insulation coating" save $40 plus million. The ROI is amazing when you take a couple of seconds to calculate to realize how effective HPC performs.

New Technology Award from EPA – Insulation Coatings

Georgia Pacific (part of Koch Industries - equity value of $13.21 billion) received a **New Technology Award at the ENERGY ENGINEERS CONFERENCE**

in Orlando Florida October 25, 2023 for using thick **HPC® Ceramics Thermal Insulation Coating** at one of their plants after removing the standard insulation and finding that the coating could have an ROI of less than a year after replacing the standard insulation.

Standard insulation never offers ROI.

The award was given out by **ENERGY STAR** run by the **US EPA** after studying the savings numbers and engineering report. This shows in real world use and measured by the engineering staff how effective thick C-TIC can prevent energy loss off the surface of tanks and pipes.

> *"We are pleased to announce two of our mills have been awarded the 2023 ENERGY STAR® by the U.S. Environmental Protection Agency for superior energy performance. Both our Leaf River cellulose mill in New Augusta, Mississippi, and pulp and paper mill in Brewton, Alabama, have been certified for three years indicating these two facilities are first quartile energy efficient."*

Georgia Pacific Facebook

https://www.linkedin.com/posts/j-e-pritchett-07897025_georgia-pacific-receives-epa-energy-star-activity-7138371885821480961-Hgg7?utm_source=share&utm_medium=member_ios

Georgia-Pacific Receives EPA ENERGY STAR and SmartWay Recognitions for Sustainability Work

ENVIRONMENT

Share this article

ENVIRONMENTAL STEWARDSHIP

November 7, 2023

Atlanta - Georgia-Pacific's commitment to environmental stewardship and continuously improving energy efficiency has resulted in several recent awards from the Environmental Protection Agency (EPA).

Two GP facilities received ENERGY STAR® certifications for 2023, and another helped GP earn recognition for a Top Project at the 2023 ENERGY STAR Industrial Partner Meeting. Meanwhile, the company was also named a 2023 SmartWay High Performer.

ENERGY STAR Industrial Partner Meeting Recognizes GP for Top Project

The ENERGY STAR® program recognized the work of GP, Flint Hills Resources and their parent company Koch Industries for a Top Project at the 2023 ENERGY STAR Industrial Partner Meeting. The recognition comes for their efforts to improve energy efficiency and reduce corrosion in Koch manufacturing assets.

Together with FHR, GP tested a wide range of insulation options to protect manufacturing equipment and found a solution: HPC® ceramic insulation spray. HPC reduces heat loss, prevents corrosion, and can be applied to equipment that operates at temperatures up to 1,200 degrees F.

GP first tested HPC on a condensate receiver at its Naheola paper mill in Pennington, Alabama. The condensate receiver captured excess steam and condensation produced by a paper machine. GP then moved forward with coating a full digester at Naheola with HPC in March 2020. Digesters cook wood chips in chemicals at high temperatures to obtain the pulp fibers used to make paper products.

The fully insulated digester reduced heat loss by 49% and saved Naheola an estimated $332,000 in energy costs annually. It also improved the quality of the cooking process by allowing the digester to better maintain its internal temperature. The HPC also protected the digester from corrosion. The Naheola digester had already begun to experience corrosion, a common issue for digesters of its age. The HPC hermetically sealed the digester to keep out any new moisture, so when some of the

HPC was removed in 2022 to allow for repairs to the digester, there was **no evidence of new corrosion**.

GP is already using HPC at other mills following the results of this experiment. In addition to the energy savings, HPC's ability to protect manufacturing assets from corrosion could save GP and FHR millions of dollars in equipment replacement costs.

ENERGY STAR® Industrial Partner Meeting Top Projects are selected by partner companies across manufacturing industries that want to learn more about the projects at the annual event.

Leaf River, Brewton Earn ENERGY STAR Certifications

GP has also earned additional recognition from the EPA's ENERGY STAR programs this year. GP's Leaf River Cellulose mill in New Augusta, Mississippi, is the first paper pulp mill in the U.S. to receive EPA's ENERGY STAR certification. The Leaf River facility uses less energy to produce a ton of pulp than 75% of plants with identical characteristics, putting it in the 90th percentile of plants evaluated by ENERGY STAR.

The company's containerboard mill in Brewton, Alabama, also received ENERGY STAR certification. Combined the facilities have saved 5,732,130 MMBtus in 2022 alone, enough to power

150,011 homes for a year, and both have been certified for three years.

The EPA works with manufacturing companies through ENERGY STAR to improve energy efficiency, allowing the agency and industry corporate energy managers to work together to build unique and helpful energy management tools.

GP Named 2023 SmartWay High Performer

The company was also named by the EPA as a SmartWay High Performer for 2023, a recognition that the company has earned five times, along with several other awards, since GP became a partner in 2009.

Moving products from one location to another often requires using multiple transport systems. The result is increased fuel consumption that leads to more air pollution, negatively impacting health and the environment. GP actively works to lessen the impact of its business on the environment through its stewardship framework. The company utilizes software that gathers and analyzes data to identify optimized travel routes, cutting fuel consumption and decreasing air pollution.

Less than 5% of the EPA's SmartWay shippers meet the emissions and carrier selection criteria to make the SmartWay

High Performer list for shippers. EPA's SmartWay Transport Partnership helps companies and organizations achieve their freight supply chain sustainability goals by providing credible tools, data, and standards—at no cost—for measuring, benchmarking, and improving environmental performance.

These recognitions are an affirmation of how GP strives to continuously improve performance to create sustainable outcomes that benefit society, creating value for people while using fewer resources.

Learn more about GP's approach to environmental stewardship.

To learn more about energy efficiency and ENERGY STAR®,

[redacted]

Georgia Pacific (part of Koch Industries) received a New Technology Award at the ENERGY ENGINEERS CONFERENCE in Orlando Florida October 25 for using HPC coating at one of their plants after removing the standard insulation and finding that HPC could have an ROI of less than a year after replacing the standard insulation. Standard insulation never offers ROI. The award was awarded by ENERGY STAR . This shows in real world use and measured by the engineering staff how effective HPC can prevent energy loss off the surface of tanks and pipes. If you were waiting for an engineering firm to support the effectiveness of HPC, this is a major group with ENERGY STAR supporting the fact HPC works as stated.

Now here's the perfect way to stop losing valuable energy through high heat and production dollars with ceramics thermal insulation coatings - HPC - Hot Pipe Coating.

This technology (HPC manufactured by SPI COATINGS), which replaced traditional insulation at their facility, demonstrated a significant return on investment within a year, a feat not achievable with standard insulation. ENERGY STAR's endorsement, based on a thorough review of savings data and an engineering report, confirms HPC's effectiveness in reducing energy loss from surfaces such as tanks and pipes.

This recognition marks a pivotal advancement in energy-saving technology, encouraging industries worldwide to adopt HPC for substantial energy and cost savings. This technology blocks heat loss with a water-based coating simply sprayed in place while operating and not requiring a shut down. Easy, safe and works as experienced in actual field use by customers who decided to make the change over. Now here's the perfect way to stop losing valuable energy and production dollars.

Find out more about HPC (Hot Pipe Coating) that manages heat from 100°C to 650°C: https://lnkd.in/d3vqruPU