RIMA International™
REFLECTIVE INSULATION MANUFACTURERS ASSOCIATION

Technical Bulletin
#107

REFLECTIVE INSULATION, RADIANT BARRIERS, AND INTERIOR RADIATION CONTROL COATINGS FOR USE IN PRE-ENGINEERED METAL BUILDINGS

Scope:
In both the United States and Canada there is significant growing interest throughout the pre-engineered steel building industry for the application of reflective insulation materials and IRCCs in pre-engineered steel buildings. This bulletin has been prepared by the Reflective Insulation Manufacturers Association International (RIMA-I) to address applications and their performance.

Definitions:

Reflective Insulation: Thermal insulation consisting of one or more low emittance surfaces, bounding one or more enclosed air spaces.

Radiant Barrier: A reflective material having a surface emittance of 0.1 or less used for the sole purpose of limiting heat transfer.

Interior Radiation Control Coatings: A non-thickness dependent, low-emittance coating. Formulated coatings with thermal emittance less than 0.25.

Emittance: Emittance refers to the ability of the surface to emit radiant energy. Emittance ranges from 0 to 1. A lower value indicates a reflective surface with a low level of radiation.

High- Emittance Facer: White Plastic films Numbers 0.85-0.95

Low-Emittance Facer: Foil or metalized films 0.03-0.05

R-Value: Property of an insulation material used to characterize the effectiveness of the insulation in reducing heat transfer. The higher the "R" value, the better the insulation's ability to reduce heat transfer.

U-Value: A measure of the heat transmission through a building part or given thickness of a material (as insulation). The lower the "U" value, the better the insulation's ability to reduce heat transfer.

Types of Products

1. Foil or metallized film-faced polyethylene bubblepack reflective insulation.
2. Foil or metallized film-faced polyethylene or polypropylene foam reflective insulation.
3. Reflective insulation and mass insulation combinations (hybrid systems).
4. Interior radiation control coating (IRCC) – low-emittance coatings.

Applications

Wall Assembly: (See Drawings Appendix A)

1. Reflective insulation - One side facing one-inch closed air space and other side facing an open air space.
2. Reflective insulation - One side facing eight-inch closed air space and other side facing an open air space.
3. Radiation control coatings (low-emittance sprayed to the inside of wall panels).

Roof Assembly: (See Drawings Appendix B)

1. Reflective insulation - Draped over purlins. One-inch closed air space facing up with an open air space below.

2. Reflective insulation - Attached to bottom of purlin. Eight-inch closed air space facing up with an open air below.
3. Reflective insulation - Installed over existing metal roof with ¾-inch spacers and new metal roof with ¾-inch enclosed air space between the reflective insulation and the roof panels.
4. Radiation control coating (low-emittance) sprayed to the underside of the roof deck.

Roof Assembly Hybrid System: (See Drawings Appendix C)

1. Reflective insulation and mass insulation combination.
2. Radiation control coatings (low-emittance) sprayed to the underside of the roof deck.

Thermal Performance

The thermal resistance values for reflective insulation systems installed in metal buildings depend on heat flow direction and the design of the reflective insulation material. The overall thermal performance also depends on the type of exposed facing material that is used. The following tables show a range of R-values that can be anticipated for systems that are presently in use. (Three reflective insulation systems for walls, four reflective insulation systems for roofs, and four reflective hybrid systems per the drawings in the appendix.) The hybrid systems consist of 6.25-in. thick (R 19) batts installed between 8-in. purlins. These tables are not intended to represent all available products or systems. (References: Calculated Thermal Performance of Reflective Systems in Metal Building Applications based on ASHRAE 90.1-2005 - R&D Services, Inc.)

Table 1

Calculated R-values and U-factors for Pre-engineered Metal Buildings

Wall 1

Type System		R-Value	R (no interior air film)	U-Value – No Thermal Block	U-Value with Thermal Block
Summer	E= 0.03*	6.3	4.6	0.22	n/a
	E= 0.05	6.1	4.4	0.23	n/a
Winter	E=0.03	6.3	4.6	0.22	n/a
	E=0.05	6.1	4.4	0.23	n/a

*Effective emittance

Wall 2

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer	E=0.03	5.8	4.1	0.24	n/a
	E=0.05	5.6	3.9	0.24	n/a
Winter	E=0.03	5.8	4.1	0.24	n/a
	E=0.05	5.6	3.9	0.24	n/a

Wall 3

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer -	E= 0.05	2.5	n/a	0.42	n/a
	E= 0.20	1.8	n/a	0.56	n/a
	E= 0.22	1.7	n/a	0.59	n/a
	E= 0.25	1.6	n/a	0.62	n/a
Winter -	E= 0.05	2.4	n/a	0.44	n/a
	E= 0.20	1.8	n/a	0.56	n/a
	E= 0.22	1.7	n/a	0.59	n/a
	E= 0.25	1.7	n/a	0.59	n/a

Table 2

Calculated R-values and U-factors for Pre-engineered Metal Buildings

Roof 1

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer	E=0.03	10.0	5.5	0.16	0.11
	E=0.05	9.6	5.1	0.16	0.12
Winter	E=0.03	4.6	3.3	0.29	0.22
	E=0.05	4.5	3.2	0.29	0.22

Roof 2

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer	E=0.03	14.0	9.5	0.13	0.084
	E=0.05	12.4	7.8	0.14	0.093
Winter	E=0.03	5.2	3.9	0.26	0.20
	E=0.05	5.1	3.7	0.26	0.20

Roof 3

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer	E=0.03	9.1	4.6	0.17	0.12
	E=0.05	8.9	4.3	0.17	0.13
Winter	E=0.03	4.5	3.2	0.29	0.22
	E=0.05	4.5	3.1	0.29	0.22

Roof 4

Type System		R-Value	R (no interior air film)	U-Value – No Block	U-Value with Thermal Block
Summer	E=0.05	3.7	n/a	0.38	n/a
	E=0.20	2.3	n/a	0.71	n/a
	E=0.22	2.2	n/a	0.76	n/a
	E=0.25	2.0	n/a	0.89	n/a
Winter	E=0.05	1.9	n/a	0.76	n/a
	E=0.20	1.5	n/a	1.07	n/a
	E=0.22	1.5	n/a	1.07	n/a
	E=0.25	1.4	n/a	1.20	n/a

Table 3

Calculated R-values and U-factors for Pre-engineered Metal Buildings with R 19 Mass Insulation between Eight-Inch Purlins

Hybrid 1

Type System		R-Value	R (no interior air film)	U-Value (no thermal block)	U-Value with Thermal Block
Summer	E=0.03	31	26.5	0.090	0.042
	E=0.05	30.2	25.7	0.090	0.042
Winter	E=0.03	24.6	23.3	0.097	0.050
	E=0.05	24.4	23.1	0.097	0.050

Hybrid 2

Type System		R-Value	R (no interior air film)	U-Value (no thermal block)	U-Value with Thermal Block
Summer	E=0.03	27.4	26.5	0.093	0.046
	E=0.05	26.6	25.7	0.094	0.047
Winter	E=0.03	23.9	23.3	0.098	0.051
	E=0.05	23.7	23.1	0.098	0.052

Hybrid 3

Type System		R-Value	R (no interior air film)	U-Value (no thermal block)	U-Value with Thermal Block
Summer	E=0.03	27.9	27.0	0.092	0.045
	E=0.05	27.4	26.5	0.093	0.047
Winter	E=0.03	26.6	26.0	0.094	0.049
	E=0.05	26.2	25.6	0.094	0.049

Hybrid 4

Type System		R-Value	R (no interior air film)	U-Value (no thermal block)	U-Value with Thermal Block
Summer	E=0.03	22.6	21.7	0.100	0.054
Winter	E=0.03	21.8	21.2	0.100	0.055

ASTM Standards

ASTM C 1224, “Standard Specification for Reflective Insulation for Building Applications”
ASTM C 727, “Standard Practices for Installation and Use of Reflective Insulation in Building Constructions”
ASTM C 1313, “Standard Specification for Sheet Radiant Barriers for Building Construction Applications”
ASTM C 1258, “Standard Test Method for Elevated Temperature and Humidity Resistance of Vapor Retarders for Insulation”
ASTM C 1158, “Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Building Construction”
ASTM C 1321, “Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction”

Other Compliance Standards

ASHRAE/IESNA Standard 90.1

IECC (International Energy Conservation Code) Chapter 5

Primary Testing Requirements

1. Flammability
   ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials"
   i. UL 1715, "Standard for Safety Fire Test of Interior Finish Material"
   ii. NFPA 286, "Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth"
2. Vapor Transmission
   i. ASTM E 96, "Standard Test Methods for Water Vapor Transmission of Materials"
3. Thermal Performance
   i. ASTM C 1363, "Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus"
   ii. Calculation based on data from the U.S. National Bureau of Standards (HRP 32, Robinson and Powell)
   iii. Calculated Thermal Performance of Reflective Systems in Metal Building Application – R&D Services, Inc. (Using procedure published in ASTM STP 1116 and ASHRAE Handbook of Fundamentals)

Installation

In accordance with manufacturer's instructions. It is recommended to contact the manufacturer of the product being used for specific installation instructions.

Aesthetics and Comfort

1. Improves lighting.

Health and Safety

1. The manufacturer shall provide the users with information regarding any hazards and recommended protective measures to be employed for safe installation and use of the material.
2. Lightweight and easy to handle.
3. No itchy fibers.
4. Refer to manufacturer's MSDS Data Sheets.

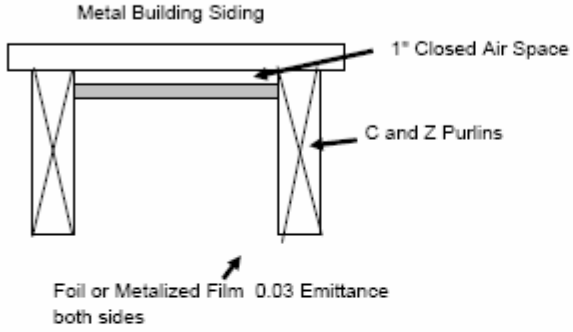
Storage

1. The material shall be stored in accordance with the manufacturer's recommendations.

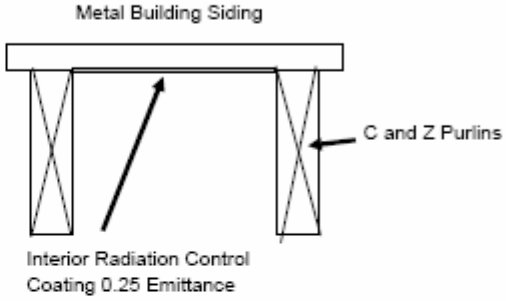
Appendix A

(DRAWINGS AND PICTURES OF WALL APPLIATIONS)

No. 1 - Wall



No. 3 - Wall



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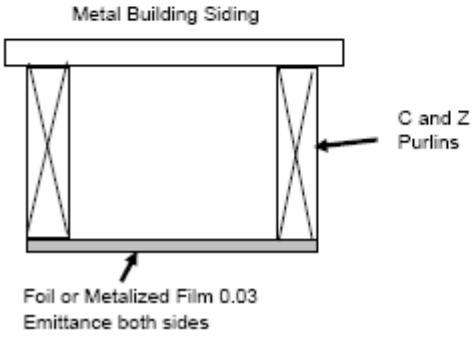
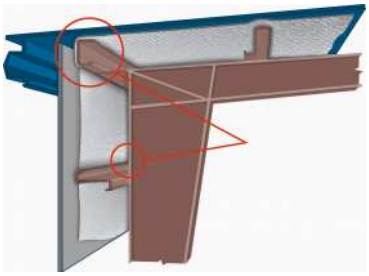
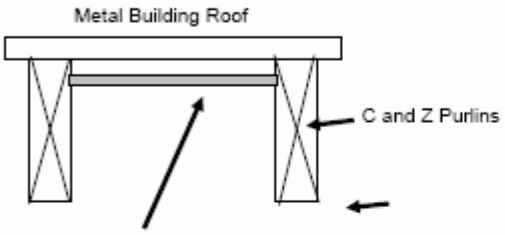




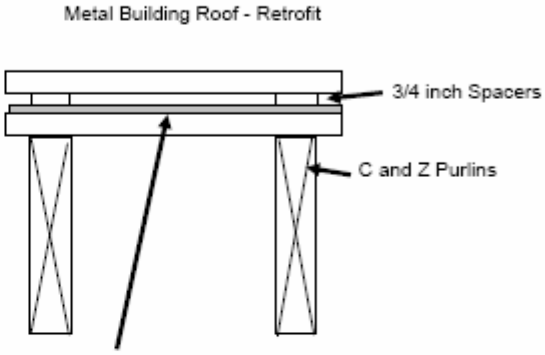
Appendix B
(DRAWINGS AND PICTURES OF ROOF APPLICATIONS)

No. 1 Roof System



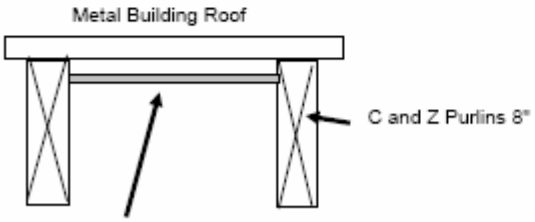
Foil or Metalized Film 0.03 Emittance facing up

No. 3 Roof System



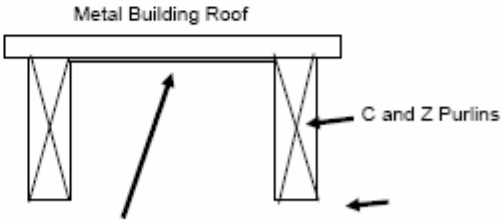
Foil or Metalized Film 0.03 Emittance facing down and up

No. 2 Roof System

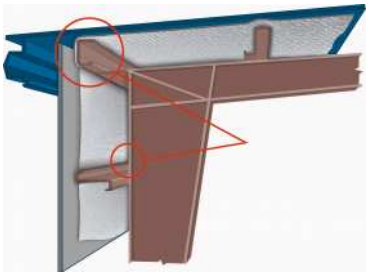


Foil or Metalized Film 0.03 Emittance

No. 4 Roof System

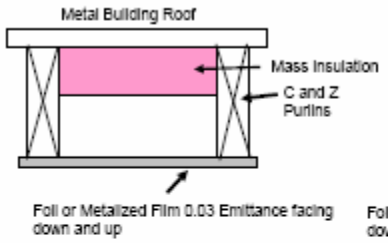


Interior Radiation Control Coatings 0.25 Emittance

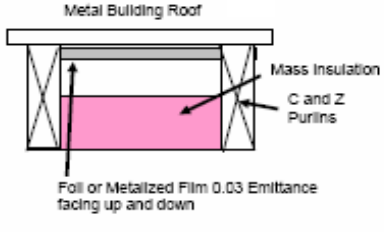


APPENDIX C
(DRAWINGS AND PICTURES OF HYBRID SYSTEM APPLICATIONS)

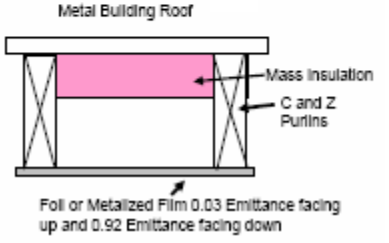
Roof Hybrid System 1



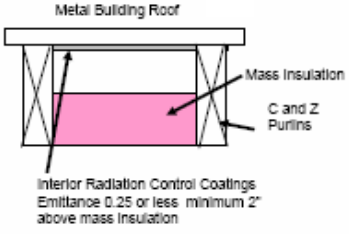
Roof Hybrid System 3



Roof Hybrid System 2



Roof Hybrid System 4



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