



Guide to Effective Warehouse Design, Maintenance, and Modernization

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A Core Partner of





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A unique alliance

The **Global Cold Chain Alliance (GCCA)** exists to help its members build and strengthen the temperature-controlled supply chain worldwide. We do this by bringing third-party warehouse and transportation business leaders together in events and networking activities, providing advisory and educational services, and being a voice of cold chain to government regulators and other influencers around the world.

The **Global Cold Chain Foundation's (GCCF)** mission is to strengthen the global cold chain through education, research, and international development. Cold Chain Institute trains industry practitioners in the best practices of temperature-controlled product storage, handling, and transportation. Research manuals developed by the foundation serve as the definitive guide for the proper handling, storage, and freezing of perishable products as well as energy and facility management.

International development projects engage industry professionals in the development of cold chain infrastructure in emerging markets.

And a key partner to GCCA is the **Controlled Environment Building Association (CEBA)**. CEBA's mission is to represent expert builders who specialise in designing and constructing controlled environment buildings, including cold storage warehouses, food processing facilities, clean rooms, pharmaceutical facilities, food service, and retail distribution centres. With a strong value proposition and growth momentum, industry participation in CEBA programs has doubled since pre-pandemic levels.

Together we are the cold chain.



1500+
Member companies

91
Countries

1000+
Member facilities



Acknowledgement

With appreciation to the Construction Codes Committee for its leadership, oversight, and valuable input in managing this publication update. Special thanks to committee members who volunteered to review selected chapters.

Executive Summary

This Design Manual establishes a unified set of standards and technical guidelines to support the planning, construction, operation, and maintenance of facilities, aligning with best practices in safety, efficiency, and performance. The manual is intended for engineers, facility managers, designers, and technical consultants who require clear, actionable direction across the full range of facility systems.

To improve accessibility and operational efficiency, this latest edition is being published in a modular format—organized into 15 focused chapters. Each chapter addresses a core system or component of facility design and management, enabling users to quickly reference specific content and apply standards directly to their area of responsibility.

1. Design – Foundational planning principles and performance objectives
2. Maintenance – Preventive strategies and operational reliability standards
3. Structural – Load-bearing frameworks and compliance specifications
4. Walls – Materials, insulation, and environmental controls
5. Floors – Surface treatments, drainage, and durability
6. Roofs – Construction systems, weatherproofing, and safety features
7. Refrigeration – Temperature control systems and efficiency metrics
8. Doors – Selection criteria, access control, and insulation
9. Lighting – Illumination standards, energy use, and fixture design
10. Material Handling – Flow optimization and equipment interfaces
11. Batteries – Storage, charging protocols, and hazard mitigation
12. Fire Protection – Risk reduction measures and system integration
13. Racking – Load standards, anchoring, and spatial planning
14. Dock Equipment – Levelers, seals, and operational safety
15. Automated Systems – Integration of robotics, controls, and data systems

This format enables continuous updates and targeted usage while reinforcing technical consistency across disciplines. The manual is designed to serve as both a foundational reference and an evolving toolset for ongoing facility innovation and compliance.

What follows is Chapter 4

Walls – Materials, insulation, and environmental controls

Chapter 4: Walls

4.1 Introduction

Insulated panel systems are ideally suited for thermally controlled environments such as cold storage freezers and coolers and food processing and packing facilities. Equally, insulated panel systems can be applied to atmospheric controlled environments where, in virtually all cases, finished product protection and hygienic control is of utmost importance. While not the only type of building insulation wall system in use today, insulated panel systems are by far the most common, and the subject of this section of the manual.

An Insulated Metal Panel (IMP) is a strong single unit constructed of a rigid foam core, most commonly polyurethane, sandwiched between two sheets of coated metal that provides an exceptionally strong building enclosure.

The durable metal panel facings resist damage and create a vapor barrier which offers long-term thermal stability. The metal skins also come in a multitude of colors and textures. When compared to other exterior finish options such as stucco, masonry or pre-cast concrete, the IMP provides a unique combination of water and vapor impermeability, excellent thermal performance and visual appeal.

The IMP offers high insulation values and built-in thermal breaks that significantly improve the energy efficiency of buildings, thus reducing heating and cooling costs for building owners. These built in thermal breaks prevent heat conductance from the metal exterior to metal interior skin.

The IMP is a single building enclosure element, so it speeds up project completion and can be installed in almost any kind of weather without risk to system integrity. IMPs are installed using a complete concealed fastener system that typically includes the vapor barrier, air barrier, and water barrier along with a high efficiency insulation system, thereby reducing the need for a large number of components to be installed. The lightweight nature of IMPs also provides framing and foundation savings. They are designed to meet the most demanding performance requirements, which, when combined with the inherent benefits of metal facings, requires less maintenance than most other exterior building systems.

Structures such as cold storage facilities, manufacturing plants, food processing facilities and office buildings are proven to be excellent applications for the IMP. Architecturally, the IMP offers many design options because it is available in various joint sizes, curved and formed panels, and with a variety of high performance coatings or surface textures. Interior coatings also provide easy cleaning and sanitizing, as well as high light reflectivity.

Energy consumption by buildings accounts for 39% of the energy consumed in the United States (EIA 2010). With current concerns over global warming and the associated impacts of energy consumption, energy efficiency has become dramatically more important as a design goal in buildings. Leadership in Energy Efficient Design (LEED) certification is providing a marketing

benefit to energy efficient, sustainable designs. Possible future imposition of carbon taxes on energy consumption, and otherwise increasing energy costs are making the economics of energy efficient buildings increasingly favorable.

IMPs offer a variety of core material types with insulation values from R-25 to R49 for walls and insulation values of up to R-49 are available for roofs in addition to a ceiling system of R-25 to R-49. For the purpose of this guide, IMPs constructed of Modified Polyisocyanurate (PIR) were used as a baseline for cold storage wall and ceiling panels.

4.2 Design

The choice of envelope construction is based on sturdiness to endure harsh environments and a material that requires minimal maintenance. Choices are built up masonry, tilt concrete, and insulated panels, as well as various insulating materials. Factors that determine insulation choice are durability, cost, fire performance, and most importantly, thermal performance and vapor tightness. IMPs provide a highly efficient perimeter for temperature extremes from blast freezers as cold as -50°F to food manufacturing to extremes up to 180°F due to the high insulation characteristics and stability of the insulating material in the panel.

What is an insulated metal panel?

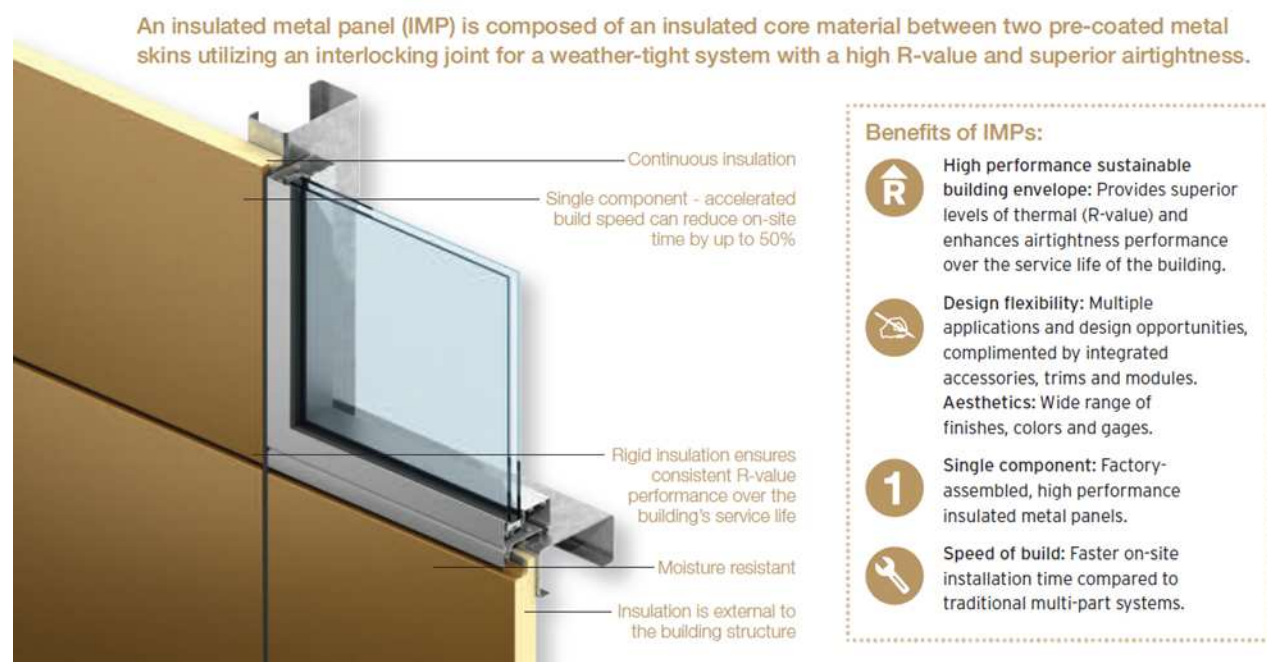


Figure 4. 1

Insulation Thickness

The R-Value of insulation required varies with the temperature held in the refrigerated space and the conditions surrounding that space. However, local code and adopted energy codes should be referenced. The range in R-Value requirements can differ due to variations in energy cost, insulation materials and climate conditions. For exact values consult a qualified Insulated Panel Manufacturer and or an Engineer of Record for the proposed use. As a baseline for current design practices and the use of current and available PIR foam panels the following values has been provided.

Thickness recommendations / R Values based on a mean insulation temperature of 35°F and ASTM C518 R = 8.25 per inch of material. As cited in the 2010 ASHRAE Refrigeration Guide, the following table identifies the recommended R-Values for various cold storage facilities and temperatures.

Recommended R-Values

Panel Thickness	Minimum R-Value	Temperature Range
3"	R-25	40 to 50°F
4"	R-33	25 to 35°F
5"	R-41	10 to -20°F
6"	R-49	-40 to -50°F

4.2.1 Specifications and Selection Criteria

Pre-insulated metal panel cladding system with insulating foam core (non fire rated use) are used for the exterior walls, partitions, liners and ceilings; including flashings, trim and other accessories to make the system complete, as indicated on the drawings and specified herein.

Metal Wall and Ceiling Panel Assembly: Metal wall and ceiling panels, attachment system components, miscellaneous metal framing, thermal insulation, sealants, and accessories are necessary for a complete a vapor tight, thermally broken system.

Performance Requirements

Test	Procedure	Description
Fire	FM-4880	Class 1 classification rating of insulated wall or wall and roof/ceiling panels, interior finish materials or coatings, and exterior wall systems to unlimited height without sprinkler protection
	ASTM E84	Flame spread <25, smoke developed <450
	CAN/ULC-S101	Standard Methods of Fire Endurance Tests of Building Construction and Materials

	CAN/ULC-S102	Standard Method of Test for Surface Building Characteristics of Building Materials and Assemblies
	ULC/ORD-C376	Fire growth of foamed plastic insulated building panels in a full scale room configuration
	CAN/ULC-S126	Standard method of test for fire spread under roof deck assemblies
	CAN/ULC-S134	Standard method of fire test of exterior wall assemblies
	UBC 26-4/NFPA 285	Intermediate multi-story fire test
	NFPA 259	Test method for potential heat of building materials
	NFPA 268	Standard test method for determining ignitability of exterior wall assemblies using a radiant heat energy source
	NFPA 286 (UBC 26-3)	Enclosed Room Corner Test
Weather & Vapor Barrier	ASTM E283	Air leakage <0.001 CFM/sq ft
	ASTM E331	No uncontrolled water penetration
	AAMA 501-94	Panel wall assembly meets air and water tightness criteria
Structural	FM-4881	Class 1 exterior wall systems
	FM-4471	Class 1 panel roofs
	ASTM E72	Standard test methods of conducting strength tests of panels for building construction
Fatigue Tests	Cyclic test to positive and negative wind loading to $\pm L/180$ deflection	The panels exceeded 2 million alternate cycles without failure or damage
Bond Strength	ASTM D1623	Panels tested for tensile bond strength of the metal to foam interference

Structural Tests: The design load/deflection criteria shall be verified from tests per ASTM E 72 “Chamber Method” using a 20 psf simulated wind load. A deflection limit of L/180 for exterior wall panels, L/120 for partition walls and L/240 for ceiling panels shall apply. Walk On Ceilings Panel specification and support spans to be specified to support a minimum 20 psf design load.

The achieved walk on ceiling psf rating depends upon the joist/purlin spacing and panel thickness.

Thermal Transmission: When tested in accordance with ASTM C 177, Steady-State heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus, the panels shall provide a K-factor of .117 btu/sf/hr/deg F at a 40°F mean temperature.

Water Penetration: There shall be no uncontrolled water penetration through the panel joints at a static pressure of 12 psf when tested per ASTM E331.

Water Absorption: Maximum 1.0 percent absorption rate by volume when tested according to ASTM C 209

Air Infiltration: Air infiltration shall not exceed .06 cfm per square foot of wall area when tested per ASTM E 283 at a static pressure of 12 psf.

Surface Burning Characteristics: The insulated core shall have been tested in accordance with ASTM E 84 for surface burning characteristics. The core shall have a flame spread of not more than 20 and a smoke developed rating of not more than 145.

Factory Mutual Research Corporation (FMRC): Standard 4880, 50' (15.24 m) High Corner Test for Unlimited Height Structures: The panel assembly shall not support a self-propagating fire which reaches any limits of the 50 foot (15.24 m) high corner test structure as evidenced by flaming or material damage of the ceiling of the assembly.

Thermal Performance: Provide insulated metal wall and ceiling panel assemblies with thermal-resistance value (R-value) indicated when tested according to ASTM C 1363 or ASTM C 518. Cold storage panels of 3", 4", 5", and 6". R-Value can be tested and reported at 35° mean and 75° temperature. However for cold storage facilities most will all retain a 35° mean temperature.

Bond Strength (Fatigue Test): The panel shall withstand deflection cycling at L/180 to two million alternated cycles with no evidence of delamination, core cracking or permanent bowing.

Freeze/Heat Cycling: The panel shall exhibit no delamination, surface blistering or permanent bowing when subjected to cycle temperature extremes of -20°F (-28°C) to +180° (+82°C) for twenty-one (21) eight hour cycles.

Panel Analysis: Most manufacturers are now staffed and equipped to provide panel calculations to verify panels will withstand the design wind loads indicated without detrimental effects or deflection exceeding L/180. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout. Published span charts are established for standard applications. Consult a qualified engineer or technical resource from the manufacturer for specific project requirements regarding wind and thermal loading and panel span performance.

General: Install metal wall and ceiling panels in orientation, sizes, and locations indicated on Drawings. Install panels per Insulated Metal Panel Installation Guide. Typical cold storage installations require the sealant to be applied on the warm side of the panel for a complete vapor seal. However, use of sealant is recommended in the female vertical joint on any side of the

panel that is exposed to wash down. Surface caulking all exposed junctures panel junctures may also be incorporated. The combination of field applied foam; vapor tapes and sealant are common practices and should be used to fill voids behind the trims. Seal the entire edge of the trim to the walls and/or ceiling. Simply caulking the seam on the exterior is unacceptable, although a project may require this in addition to the concealed sealant on the warm side.

Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

Warranty: Most manufacturers provide a standard (2) two year warranty providing panels to be free from defects in materials and workmanship, beginning from the date of shipment of panels, excluding coil coating (paint finishes) that are covered under a separate warranty.

Finish Warranties: Paint manufacturers' finish warranties range from five (5) to twenty (20) year limited warranty on paint finish against cracking, peeling, blistering, chalk and color change. NOTE: Please consult the panel manufacturer for warranties the interior painted surface of the panel. This is particularly important in food processing environments where the rate and application and concentration of chemicals used in wash down applications can't be controlled or monitored by the panel manufacturer. Consult your manufacturer for applicable non-painted surfaces in these environments.

Installation: Always consult a company specializing in the management and installation of Low Temperature or Controlled Environment work with documented experience or approved and trained by the manufacturer.

Manufacturers: The following manufacturers are recognized by the GCCA, IARW and IACSC as acceptable IMP manufacturers of continuous line foam-in-place insulated PIR/PUR foam panels for the cold storage industry

- Kingspan Insulated Panels – Deland Florida
- Metl-Span an NCI Company – Lewiston, Texas
- All Weather Insulated Panels / Vicwest – Vacaville, California
- GreenSpan Panels - Waller, Texas

PANEL MATERIALS

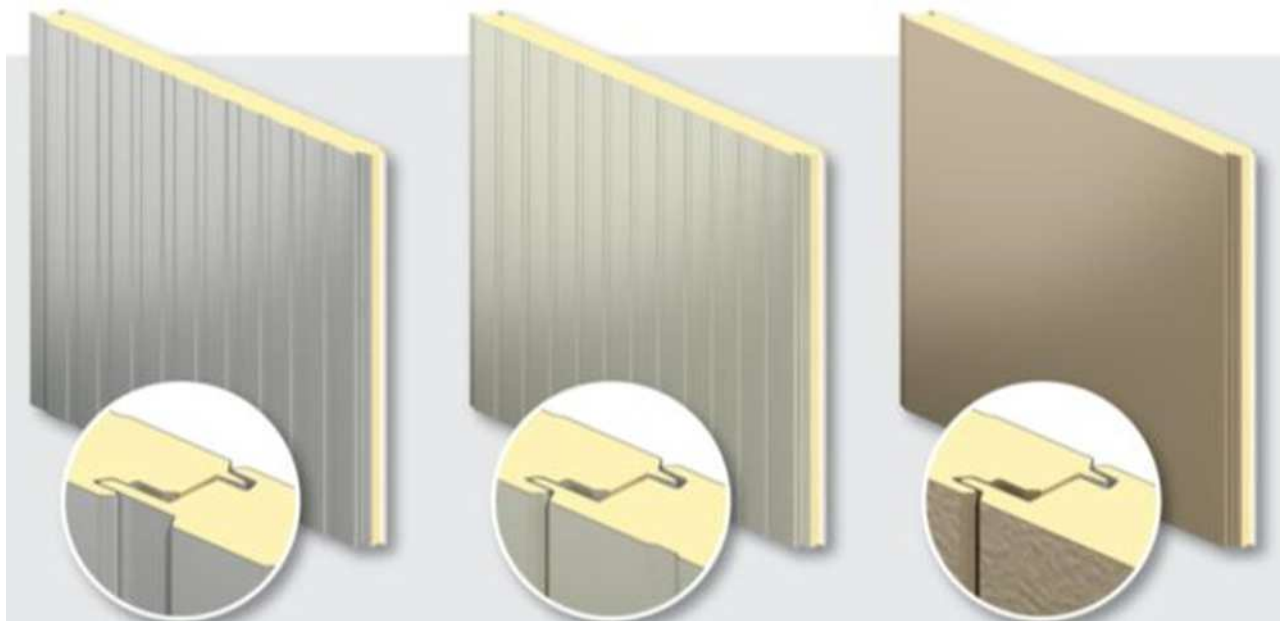
The following is provided as a summarized specification and further demonstrated by specifications and technical product information from each manufacturer.

Wall System	Minor Rib/Shadowline/Mesa
Panel Thickness	3", 4", 5" and 6" per the requirements of the project

Core	Modified polyisocyanurate density of 2.0-2.6 lbs. / cu.ft.
Panel Width	40" -45" wide X Length up to 50'-66'
Facing	Hot dipped, commercial quality pre-coated 26-gauge galvanized steel conforming to ASTM A755/A755M, ASTM A446/A446M, Grade D, Coating Designation G-90. Or A653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) 26 ga. AZ50 Grade CS-B Embossed
Finish	Exterior: Standard 1.0 mil. Modified Polyester; Siliconized Modified Polyester or 70% PVDF Kynar – Energy Star SRI compliant
Warranty	Manufacturers 2yr – Panel Warranty
Finish Warranty	20 year finish warranty for exterior; 10 year finish warranty for interior sheet materials

4.2.2 Wall Types

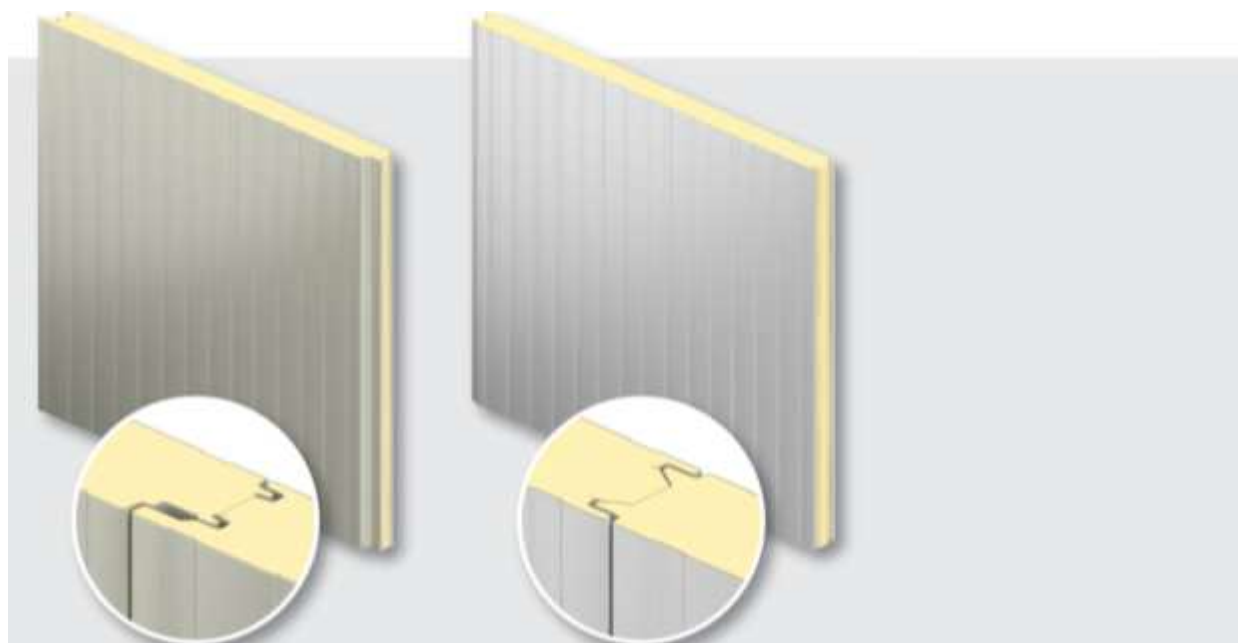
Exterior Profiles: Typically referred to as Mesa, Fluted, or Inverted Rib Exteriors. Also available in a heavy embossed non-profiled panel. They are typically 40"-42" wide.



Source: Kingspan Insulated Panels 2012

Figure 4.2

Interior Partition Panels and profiles: Typically referred to as Shadowline, Minor Rib, Light Mesa. They are typically 42”-45” wide.



Source: Kingspan Insulated Panels 2012

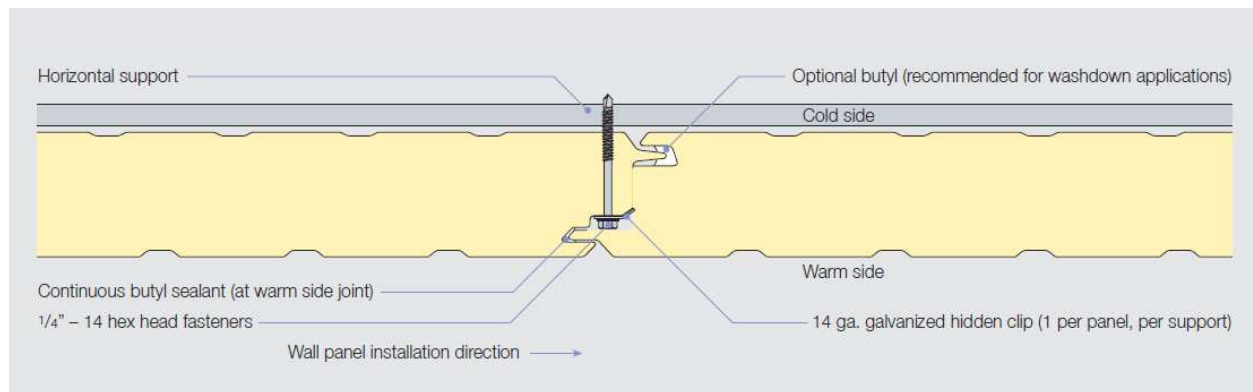
Figure 4.3



Source: Kingspan Insulated Panels 2012

Figure 4.4

Wall Panel Joints: Typically offset or parallel interlocking double tongue and groove with concealed fastener attachment and vapor seal on the warm side of the joint. Panel fasteners attach both faces of the panel at the connections of the panel ends to the support framing to conform to the requirements of the wall panel’s fire resistance rating. The side joint of the wall panel shall have flush double tongue and groove joinery of the metal faces and foam to foam contact for uninterrupted continuity of the Polyisocyanurate core.



Source: Kingspan Insulated Panels 2012

Figure 4.5

4.2.3 Manufacturing Processes

Current panel manufacturing processes include de-continuous and continuous foam in place panel construction. Many of the past practices of structurally laminated panels for the warehouse and distribution market have gone by the way side as efficiencies in production and equipment improved on the continuous line process.

There are three main chemical components needed to make polyurethane insulation for continuous line panels:

- MDI/Isocyanate
- Polyol
- Blowing agent

Polyols provide the opportunity for proprietary performance:

- Catalysts; Flame retardants; Surfactants; Processing additives/aids to a base polyol

Polyurethane foam classification can be broken down to two different types of products:

- PUR (Polyurethane)
- PIR (Polyisocyanurate)

Most manufacturers fall under one or the other acceptable processes to promote and allow for the manufacture of PIR or PUR foam:

- Blowing agents are required to be environmentally compliant. The blowing agents are non-CFC HCFC used have zero ODP (Ozone Depletion Potential) and negligible GWP (Global Warming Potential).
- With closed cell content of the foam measured as high as 98%, this traps the gasses which allows for the insulation property of the product to work.

The following images represent an example of a continuous foam manufacturing process as seen in today's factories:

Full Continuous Line



Source: Kingspan Insulated Panels 2012

Figure 4.6

Double Coil Feed Up Station



Source: Kingspan Insulated Panels 2012

Figure 4.7

Profiling Mill



Source: Kingspan Insulated Panels 2012

Figure 4.8

Cooling Rack



Source: Kingspan Insulated Panels 2012

Figure 4.9

Stacker and Packaging



Source: Kingspan Insulated Panels 2012

Figure 4.10

4.2.4 Coatings

Exterior/Interior Facing Options

Exterior / Interior Facing Options

Modified Polyester (MP)

(standard for interior facing, optional for exterior facing)

A high-performance 2-coat system with cost effective resistance to environmental weathering, offering remarkable color, gloss retention, and chalk resistance. A 1.0 mil total coating made up of 0.2 mil primer and 0.8 mil top coat USDA, CFIA approved for food contact areas.

Weather X

Siliconized Modified Polyester (SMP)

WEATHER X coating systems utilize only ceramic and inorganic pigments offering superior color stability, chalk and fade resistance as well as gloss retention.



Solid Fluoropon® PVDF Colors – Kynar 500® / Hylar 5000

Fluoropon coatings are durable polyvinylidene coating system containing 70% Kynar or Hylar resins, ceramic and other inorganic pigments. This system provides a powerful chemical bond, superior resistance to ultraviolet radiation resulting in exceptional color retention, resistance to chalking and chemical degradation.

Epoxy Primer

A 0.2 mil primer only finish for concealed areas or ready to receive site applied top coat.

Plastisol

A 4.0 mil total coating made up of 0.2 mil primer and 3.8 mil top coat of vinyl Plastisol, USDA and CFIA approved for food contact areas.



Figure 4.11

Panel Finishes



Figure 4.12

Exterior face sheet shall be treated with 0.2 mil (5 microns) base primer, followed by a nominal 0.7 mil (17.5 microns) full strength 70% PVF2 fluoropolymer (Kynar) coating in USDA accepted Imperial White or Sandstone. If Sandstone finish is used, it may be necessary to increase the steel thickness to prevent thermal bow and compression buckling. Panel supplier will determine to what extent this is necessary.

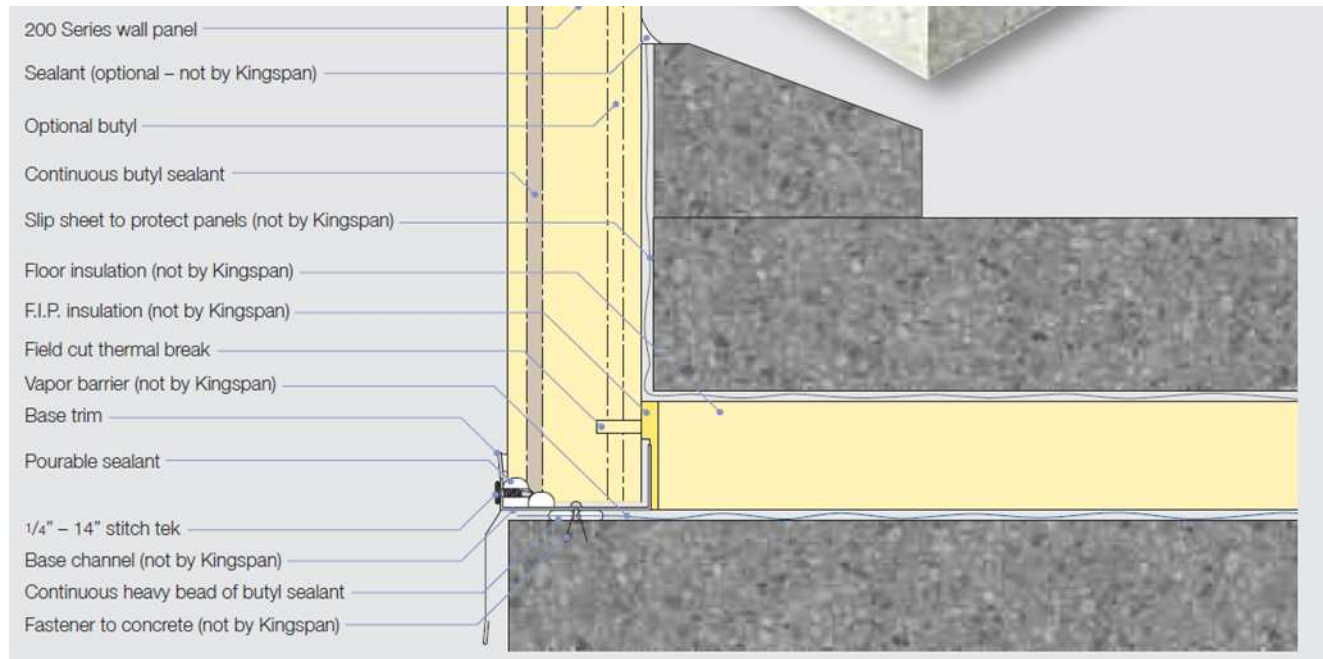
Interior sheet shall be 0.2 mil (5 microns) primer and a nominal 0.7 (17.5 microns) full strength 70% PVF2 fluoropolymer (Kynar) finish in USDA accepted White or USDA accepted Modified Polyester White.

Cooler/Freezer	Imperial White – Embossed Kynar
Processing/High Wash Down	Imperial White – Embossed Kynar or 3042B SS / 316 SS

Finish guideline shall be used to determine Modified Polyester (MP); Siliconized Modified Polyester (SMP); Kynar (KN); Vinyl Plastisol (PVC) or Stainless Steel(SS).

4.2.5 Critical Requirements and Details of Walls

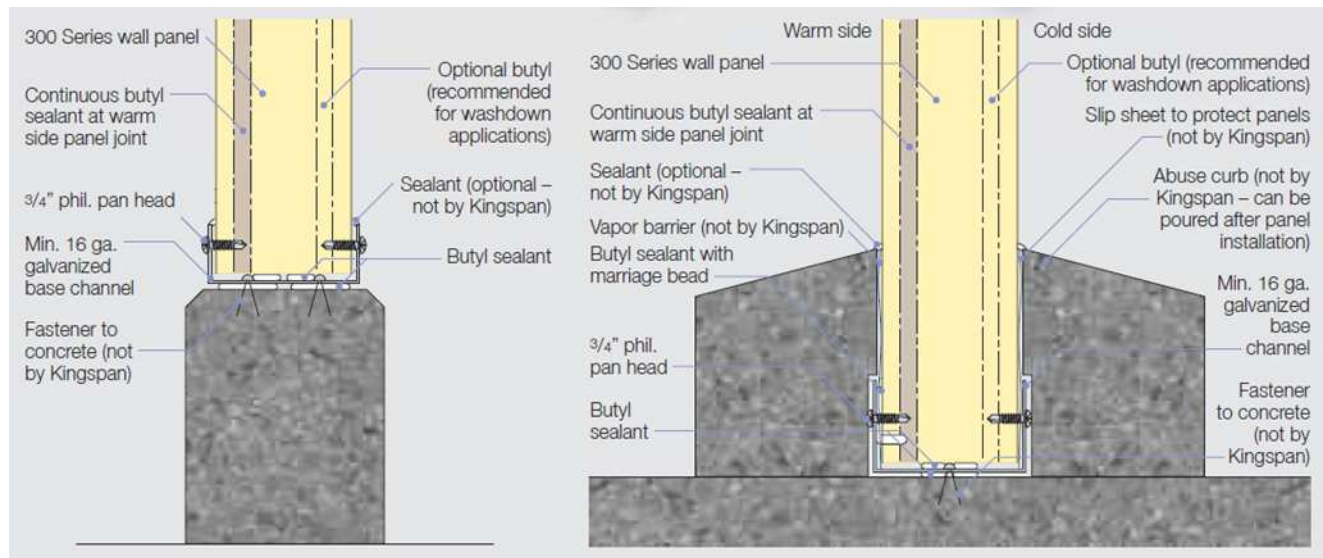
Exterior Base Detail



Source: Kingspan Insulated Panels 2012

Figure 4.13

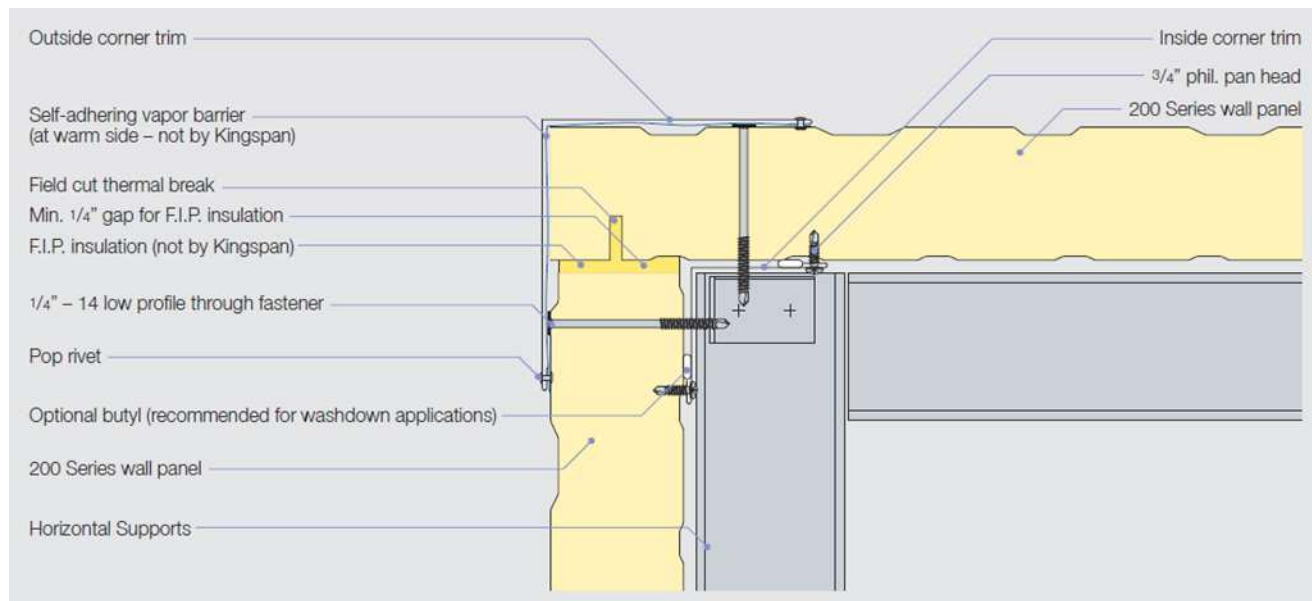
Interior Partition Base Detail



Source: Kingspan Insulated Panels 2012

Figure 4.14

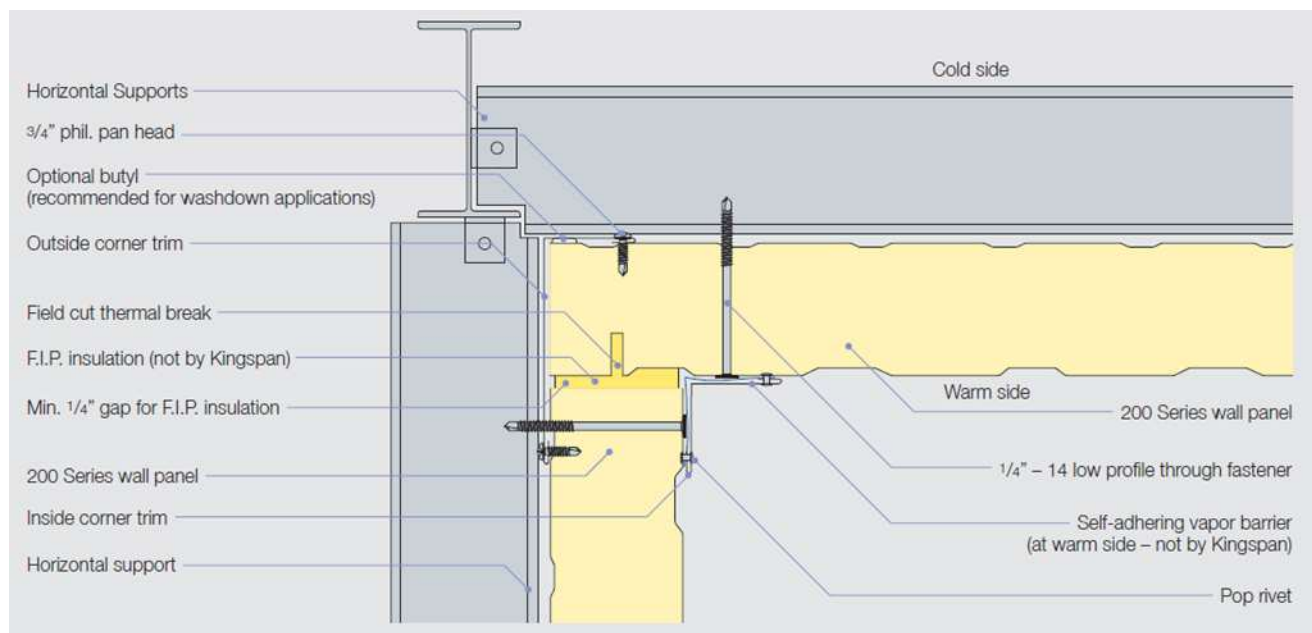
Outside Corner Trim



Source: Kingspan Insulated Panels 2012

Figure 4.15

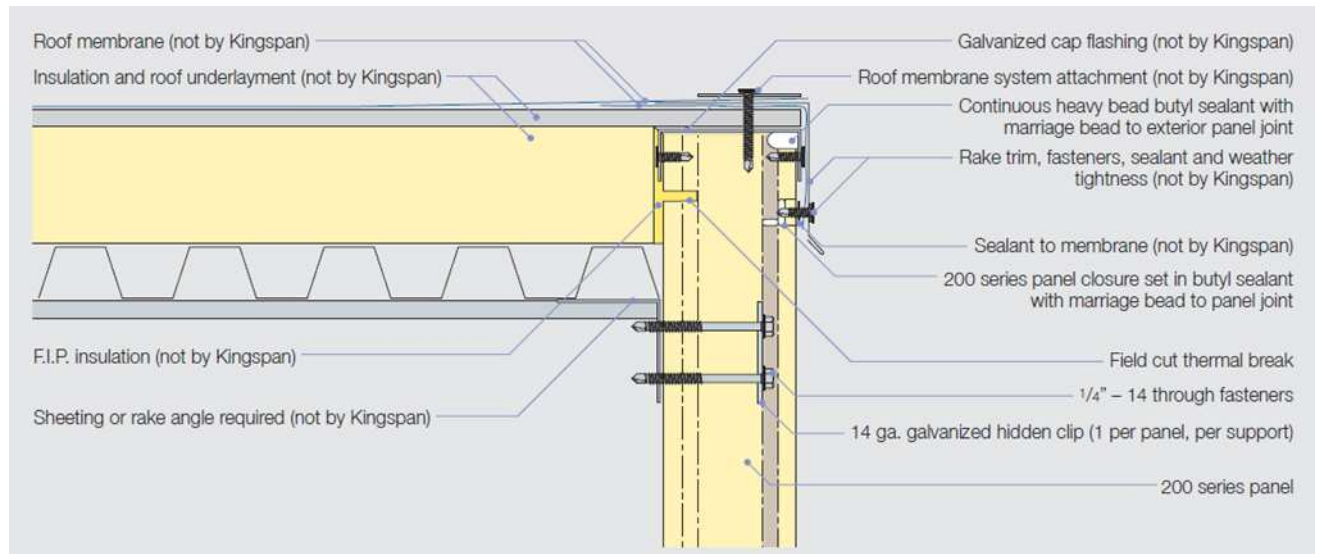
Inside Corner Trim



Source: Kingspan Insulated Panels 2012

Figure 4.16

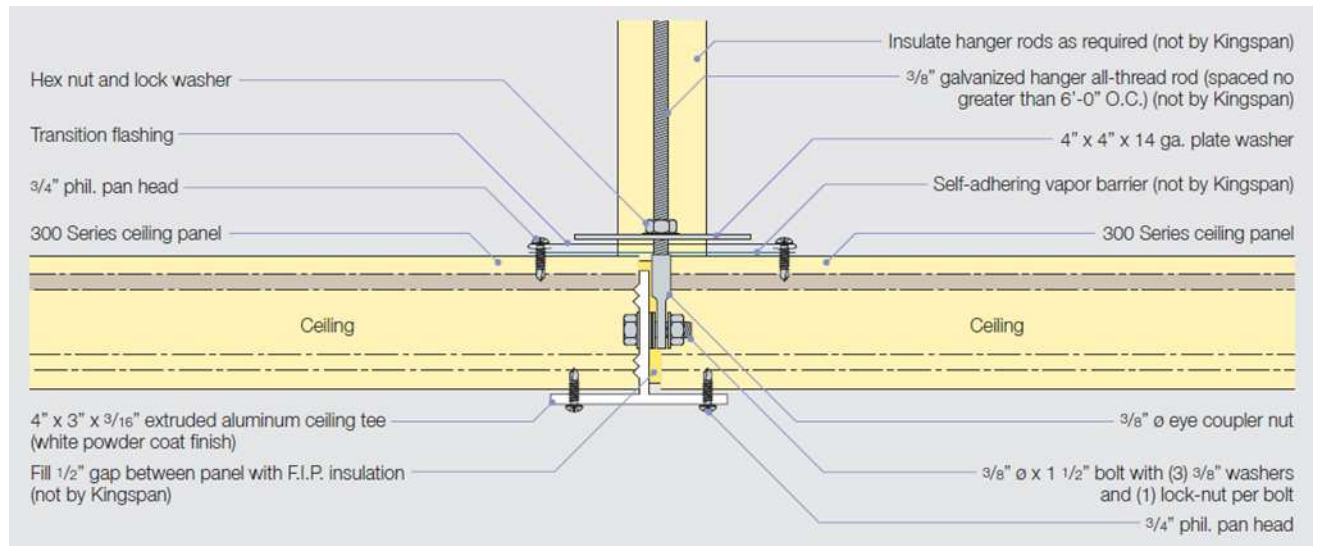
Roof Wall Transition



Source: Kingspan Insulated Panels 2012

Figure 4.16

Ceiling Tee Detail



Source: Kingspan Insulated Panels 2012

Figure 4.17

4.2.6 Desired R-Value and ROI for Additional Thickness

The following is an exercise to determine the return on investment.

Summary:

Identify the Return on Investment (ROI) based on an analysis of the energy efficiency impact of constructing a typical refrigerated warehouse with high performance IMP wall systems, an insulated built up roof system, and the additional steps necessary to achieve a simple payback by utilizing different types and thicknesses of insulation materials in a freezer warehouse in three climates.

The Locations:

Sacramento

Chicago

Boston

The Warehouse:

A 100,000 ft² refrigerated warehouse: The warehouse is a single story, rectangular building, modeled as a single freezer zone.

A Baseline Warehouse building in various climate locations which is compliant with ASHRAE Standard 90.1-2004 and 90.1-2007 was developed. The envelope will then be improved with varying insulated metal panel wall and roof systems. Through a series of inputs, simulate and evaluate the ROI for incremental changes in the insulation values of walls, roofs and floors, while also demonstrating the energy reduction in BTU's for a typical refrigerated warehouse. The baseline was determined in developing the simulation using the minimum requirements of ASHRAE 2010 Standards for Refrigerated Warehouses.

The goal was that measurable energy savings for incremental insulation increases in walls, roofs and floors should be realized in certain locations and climates. However, are these upgrades necessary and does the savings in energy provide a reasonable return on initial investment?

Regardless of the outcome, a well-insulated, low leakage envelope provides a foundation for all other energy efficiency strategies. As reduced cooling and energy loads are achieved through efficiency upgrades, the cost of making those systems more efficient is decreased. Installing efficient building systems by starting with the "Envelope First" is an ideal approach.

4.3 Maintenance

This section is a reproduction of content printed in the 2008 Guidelines for the Design, Specification, Construction, Maintenance and Fire Management of Insulated Envelopes for Temperature Controlled Environments published by the International Association for Cold Storage Construction (European Division). It has been provided as a courtesy to members of IARW and IACSC.

Without a proper and considered program of regular maintenance any insulated envelope is likely to deteriorate to the point of losing thermal efficiency and potentially to the point of sustaining significant damage to the envelope itself. A proper management regime supported by a system of active maintenance will ensure that damage and defects in the envelope are recognized at an early stage and that the appropriate corrective action is taken before any serious deterioration may occur. Failure to do this may result in the following:

- The vapor barrier of the outer facings to the insulated envelope may be breached allowing vapor to penetrate the insulant core and condense to form ice.
- Contamination of the enclosed environment and stored product with particles of insulant from damaged panels. This is particularly acute for mineral wool.
- The insulant core, which may be combustible, may be dangerously exposed and encourage fire and smoke spread.
- The thermal insulating capacity of the envelope may be compromised.
- Vermin may be provided with access/egress from/to the store.

4.4 Modernization

IMP manufacturers work closely with government and industry associations to promote the use of IMPs as energy efficient and economical building construction methodology. The MCA and IMP manufacturers are currently spearheading a campaign to define IMPs within the ASHRAE 90.1 and IECC standards by including IMP assemblies as a standard construction type.

The Federal Energy Policy Act of 2005 established a tax deduction for energy-efficient commercial/industrial buildings applicable to qualifying systems and buildings through 2013. Section 303 of the Federal Energy Improvement and Extension Act of 2008 (H.R. 1424, Division B) was enacted in October 2008. A tax deduction of \$1.80 per square foot is available to owners of new or existing buildings. Deductions of \$0.60 per square foot are available to owners of buildings in which individual lighting, building envelope, or heating and cooling systems meet target levels that would reasonably contribute to an overall building savings of 50% if additional systems were installed. This would actually put some urgency of getting the projects (new or retrofit) funded and completed. These deductions can apply to architects and owners.

Energy Analysis for Credit (EA): Demonstrating percentage of performance improvement compared with the baseline building performance rating. Based on the LEED Rating System, the following pertains to IMPs.

- Material and Resources (MR) Product Certificates for credit for products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
- Product Certificates for credit for products and materials required to comply with requirements for regionally manufactured materials. Include statement indicating

cost, location of manufacturer, and distance to project for each regionally manufactured material.

- Indoor Environmental Quality (IEQ) Product Data for credit for sealants, including printed statement of VOC content. Product Data for credit for paints and coatings, including printed statement of VOC content.
- Pilot Credit 43: Certified Products. Provide a UL Certified EPD Qualification.
- Submit documentation that products have been certified in accordance with ISO 14025.