BRANZ

BULLETIN

ISSUE 569

METAL-CLAD INSULATED PANELS

February 2014

Metal-clad insulated panels consist of an insulating core between two thin metal sheets or skins.

While commonly associated with industrial and warehouse facilities, these panels are also used in residential buildings, farm buildings, storage facilities, commercial buildings and recreational and community facilities.

This bulletin provides an overview of the features and applications of the panels.

1.0 INTRODUCTION

1.0.1 Metal-clad insulated panels consist of a rigid insulating core sandwiched between two thin sheets of metal. They are also described as ISP (insulated sandwich panels), SIPS (structural insulated panel systems, which can also describe panels with skins other than metal), PIP (polystyrene insulated panels), EPS or IPS (insulated panel systems) or metal sandwich panels. Generally, the panel core is a plastic material, either thermoplastic or thermosetting, although other core compositions such as mineral wool are available. While products may be described as one of the above panel systems (SIPS, IPS etc.), construction variations occur within the generic description.

1.0.2 This bulletin provides an overview of the features and applications of metal-skinned panels. It does not cover panels with an outer skin of:

- oriented strand board (OSB)
- plywood
- fibre-cement board
- fibre-reinforced plastic.

1.0.3 Metal-clad insulated panels are a proprietary system. Individual manufacturers provide system-specific literature to support both the design and installation of their proprietary system(s). This bulletin is not a substitute for manufacturer-specific and system-specific literature.

1.0.4 When sourcing information, always obtain manufacturer-specific literature and do not substitute parts of one system for another without approval from the manufacturer. Manufacturers will stand behind their proprietary systems provided their system is adhered to as specified.

1.0.5 While commonly associated with industrial and warehouse facilities, these panels are also used in residential buildings, farm buildings, storage facilities, commercial buildings and recreational and community facilities.

1.0.6 Panel manufacturers usually have specific details for construction of coolstores (below 0 °C), fire-rated construction and other specialised building types where the general details are not considered applicable.

1.0.7 The Insulated Panel Council Australasia Ltd – of which New Zealand companies may be members – has an industry Code of Practice (IPCA Ltd 003.2 2013) downloadable from www.insulatedpanelcouncil.org/the-code-latest-version.

2.0 APPLICATIONS

2.0.1 Metal-clad insulated panels can be used for:

- exterior wall and roof cladding (non-fire-rated core) in both loadbearing (full or partial) and non-loadbearing situations
- interior walls or partitions
- ceiling panels
- wall cladding panels or spandrels on commercial buildings and community facilities
- enclosing elements for temperature-controlled spaces or for food-processing areas, coolstores and freezers, and clean rooms used by the bio-technology and pharmaceutical industries or electronics and data-processing industries where a high level of hygiene or environmental control is required.

3.0 NEW ZEALAND BUILDING CODE

3.0.1 Building Code clauses that may apply to the use of metal-clad insulated panels include:

- B1 *Structure*: where the panels are a structural component or a non-structural component such as cladding
- B2 *Durability*: meeting a minimum durability requirement where any other Building Code requirement applies – a 50-year minimum durability applies for structural applications
- C1–6 *Protection from fire*: when used as an external wall in close proximity to the boundary, where internal and/or external fire spread requirements apply and because panels contain foamed plastics
- E2 *External moisture*: when used as cladding
- E3 *Internal moisture*: when used as a component of the external walls of habitable buildings
- F2 *Hazardous building materials*
- G3 *Food preparation and prevention of contamination*: such as when used in areas where food is processed or industrial processes take place
- H1 *Energy efficiency*: when specific thermal performance is a Building Code requirement.

4.0 PANEL CONSTRUCTION

4.1 INSULATING CORE

4.1.1 The core of a metal-clad insulated panel is a lightweight, typically rigid sheet made from a material that provides excellent insulation properties (Table 1).

TABLE 1: PROPERTIES OF METAL-CLAD INSULATED PANELS

Core material	Properties of core material
Expanded polystyrene (EPS)	Pre-expanded atactic polystyrene (the phenyl groups are randomly distributed on both sides of the polymer chain) beads formed into sheets.
Expanded polystyrene (SPS)	Pre-expanded syndiotactic polystyrene (the phenyl groups are positioned on alternating sides of the polymer chain) beads formed into sheets.
Extruded polystyrene (XPS)	A closed-cell rigid polystyrene insulation board with a better thermal performance than EPS but not typically used for metal-clad insulated panels.
Mineral wool (MF)	Molten rock, glass or slag spun into a wool-like fibre, bound with resin and then compressed into sheet form.
Polyurethane (PUR) Polyisocyanurate (PIR)	These are thermoset foam plastics. Each has its own distinct characteristics and performance properties but it is difficult to tell the difference between them visually.
Phenolic foam (PF)	A closed-cell foam with excellent self-extinguishing properties; however, it can contract up to 2% after curing.
Hybrid	A core material manufactured from two or more of the above materials or as a composite.

4.2 OUTER SKIN

4.2.1 Metal-clad insulated panels have metal skins on both faces that, when adhered to the core, allow the panel to act in a similar manner to a beam, provide the panel with its strength and protect the insulating core. Metals that can be used to skin panels include:

- galvanised steel
- aluminium alloy/zinc-coated steel
- aluminium
- stainless steel.

4.2.2 The most common metal used in the manufacture of metal-clad insulated panels in New Zealand is steel. The treatment given to the steel (galvanising or aluminium alloy/zinc coating) will vary depending on the product's finish, intended use and the in-use environment. The skin thickness is generally 0.4 mm or 0.55 mm for steel and 0.7 mm for aluminium.

4.3 COATINGS/FINISHES

4.3.1 Metal-clad insulated panel skins can be painted during the coil manufacturing process, before being formed into the desired profile for the panel. The specification of the paint coating applied to the metal will depend on:

- the base metal – steel, aluminium, or stainless steel
- the corrosion protection applied to the metal
- the in-use environment – benign or corrosive, interior or exterior.

4.3.2 Painted finishes should comply with AS/NZS 2728:2013 *Prefinished/prepainted sheet metal products for interior/exterior building applications – Performance requirements*.

4.3.3 Stainless steel skins may be left natural as they are sufficiently durable in most environments, although grade 316 is likely to be required in more aggressive environments.

4.3.4 Aluminium-clad panels can also be left natural as a mill finish or factory coated.

4.3.5 Metal-clad insulated panels may be supplied with an additional protective film coating adhered to the metal surfaces of the panel for protection during handling and installation. The film must be removed immediately after the panels are installed when exposed to UV light.

4.3.6 Panels can be supplied with microbiological finishes to inhibit bacteria growth and retention for use within areas that have specific requirements for hygiene or prevention of contamination.

5.0 PHYSICAL ATTRIBUTES

5.0.1 Because metal-clad insulated panels are a proprietary system, each manufacturer's panel range and detailing (such as panel joints) may vary.

5.1 LENGTH

5.1.1 Metal-clad insulated panels are manufactured to either standard lengths or lengths to suit the application. All manufacturers have maximum lengths depending on manufacturing and transportation capabilities, with maximum panel lengths between 11.8 and 30 metres.

5.2 WIDTH

5.2.1 Metal-clad insulated panel widths are governed by the coil width used for the skins and roll forming, and the finished module width will generally be in the range of 600–1200 mm.

5.3 THICKNESS

5.3.1 Panels are typically 50–300 mm thick, generally increasing in 25 mm increments. The thickness of the panel is primarily determined by either thermal or structural (span) requirements or fire resistance.

5.3.2 Where a panel has raised ribs, the raised portions are not included in the thickness dimension.

5.4 PROFILES

5.4.1 Metal-clad insulated panels' skins may be flat or profiled by roll forming. Typical profiles are ribbed, corrugated and trapezoidal (Figure 1). Profiles vary between manufacturers, and there may be regional variations between one manufacturer's plants. Panels used to clad roofs generally have different profiles to those used to clad walls. Inner and outer skins may also have different profiles or no profile.

Figure 1 Common profiles

5.5 EDGE-JOINTING DETAILS

5.5.1 Joints between metal-clad insulated panels are usually formed as tongue and groove-type connections to allow adjoining panels to interlock. In addition to these joints, some panels may have extended edge laps along one side of the exterior metal face of the panel to overlap the adjoining panel. For trapezoidal metal profiles, the edge lap typically consists of just the metal skin. Other types of panels may have edge laps formed from both the metal skin and a sculpted portion of the insulating core, which allows for secret or hidden fixings.

5.5.2 Depending on the complexity and design, the edge-jointing detail may have:

- the insulated core visible until two panels are fitted together – the more common detail
- the metal skin folded to envelop the insulating core. (This is illustrated on the front cover where the panels have been roughly cut to show the joint.)

5.5.3 Indicative examples of edge-jointing details are shown in Figure 2.

Figure 2 Examples of edge-jointing details – the dark line is the metal skin outline

5.6 ACCESSORIES

5.6.1 Manufacturers typically supply all components to complete the installation. Components include:

- aluminium or steel channels and angles for non-fire-rated panels
- steel angles for fire-rated and insurance-approved panels
- internal and external metal flashings (same material as the skins)
- cover strips/flashings
- fasteners/fixings
- gaskets/seals
- inserts/fillers
- caps.

5.6.2 Accessories are made of the same material as the panel skins or materials compatible with the panels and are generally coated to match the metal colour.

5.7 ORIENTATION

5.7.1 Most manufacturers of metal-clad insulated panels design their systems so they can be installed either horizontally or vertically.

5.7.2 Panel joints should be oriented to ensure suitable weathertightness performance.

6.0 FEATURES

6.1 THERMAL PERFORMANCE

6.1.1 Metal-clad insulated panels provide high levels of thermal performance when compared to other materials and traditional construction methods. Their ability to maintain a controlled, stable internal environment can reduce energy consumption and therefore reduce heating, refrigeration and air-conditioning costs. In the coolstore market, the insulation is needed for the controlled environment required – for example, minus 40°C.

6.1.2 The actual R-value will depend on the panel thickness, the density of the insulating core material and the presence of any thermal bridging. Typically, thermal bridging occurs at the panel junctions.

6.1.3 For metal-clad insulated panels of the same thickness, mineral wool cores generally perform the least efficiently, rigid foam polyurethane cores (PUR, PIR) perform the most efficiently, and EPS cores perform somewhere in between. For any given material, the thicker the core, the higher the R-value. For polyurethane cores, published literature identifies a decline in R-value until an equilibrium with the environment is reached.

6.1.4 The interlocking design of the jointing system between panels may contribute to the overall thermal performance through eliminating air leakage at these junctions.

6.1.5 In controlled environment applications, the exterior metal skin together with the manufacturer's recommended sealing or sealant details will also need to perform a vapour barrier function.

6.1.6 In cold storage and controlled environment applications, the building will often require an insulated floor and associated continuous vapour barrier.

6.2 FIRE PERFORMANCE

6.2.1 As a minimum requirement, manufacturers must ensure that their products and systems meet the requirements of the Building Code clause C *Protection from fire* documents where applicable. In addition, some manufacturers may comply with other performance standards, such as the international insurance industry tests.

6.2.2 Mineral wool cores in metal-clad insulated panels are rated as non-combustible, but foamed plastic cores are considered combustible even though fire-retardant chemicals (PIR and PF do not contain fire retardants) may be incorporated into the foam.

6.2.3 Specific Building Code clause C *Protection from fire* requirements apply when metal-clad insulated panels are used as an external wall depending on height and proximity to the boundary (exterior surface finishes provisions) and when panels with foamed plastic cores are used in internal wall/ceiling/roof situations (group number and flame propagation provisions). Where sprinklers are used, their design needs to take account of the panel performance. In multi-storey applications, testing to NFPA 285 or similar may be required.

6.2.4 Steps that can be taken to mitigate fire risk when using metal-clad insulated panels include the following:

- Fix panels firmly to the building frame in accordance with the manufacturer's installation instructions to mitigate early delamination of the metal facing in a fire incident.
- Use steel fasteners at panel-to-panel joints to reduce involvement of core in fire growth.
- Ensure no foam core is left exposed.
- Avoid penetrations through the panel. Where penetrations are necessary for cables and services, they should be contained in a non-combustible housing and openings sealed with fire-stopping materials with the same performance as the panel system.
- Compartmentalise areas where hazardous operations are to take place and fit within the requirements of the specified suppression system.
- Repair or replace any damaged panels immediately.
- Install impact skirtings and crash barriers to avoid damage to the panels.
- Do not mount machinery or equipment directly onto the panels.

- Do not store combustibles and flammable liquids near panels unless stored within approved storage cabinets.

6.3 SPAN CAPABILITY

6.3.1 Metal-clad insulated panels can self-support over longer lengths than conventional cladding and lining materials. The bonding of the metal skin to the core gives a composite action allowing the panels to be installed with long spans. Panel manufacturers provide span capability data for each of their panels in given situations as part of their technical literature.

6.3.2 For the same panel thickness, span capability is a function of core density, skin-to-core bond, skin thickness and skin profile. The thicker the panel, the greater the span. For panels of the same thickness, mineral wool cores have the smallest span, rigid foam polyurethane cores (PUR and PIR) have the largest, and EPS cores fit somewhere in between.

6.3.3 Other factors that need to be considered when determining span are:
- panel colour and thermal loading (potential expansion and contraction) particularly when dark and/or part of coolstore construction
- viscoelastic long-term creep when used as a ceiling or roofing element
- single-span or multiple-span application
- the likelihood of equipment being mounted over a roof or ceiling or there being foot traffic over the panel (walkways should be installed where foot traffic is likely).

6.4 LATERAL LOADING

6.4.1 Metal-clad insulated panels are comparatively lightweight and, therefore, generate low bracing demand during an earthquake. As a result of the rigid nature of the panels, they also have inherent bracing capacity to resist wind and seismic loading. However, determining an actual bracing value is difficult, and many manufacturers treat the panel as a cladding element only, with the structure providing the bracing. When panels are wind loaded or subject to thermal movement, some bowing may occur, which may change the plane in which the panel is bracing.

6.5 BUILD TIME

6.5.1 The use of metal-clad insulated panels to provide the cladding, insulation and internal finish makes for quick construction. The structural properties of the panels mean that they require less support members, which also reduces build times.

6.6 CONSTRUCTION DETAILS

6.6.1 The methods of construction employed with metal-clad insulated panels differ from manufacturer to manufacturer.

6.6.2 Designers and contractors should follow the specific detailing provided by individual manufacturers to ensure the complete system performs as designed, tested and intended.

6.7 TYPES OF STRUCTURE

6.7.1 Metal-clad insulated panels are typically fixed to and/or suspended from the building's support structure (forming the exterior cladding and interior lining of the building).

6.7.2 EPS-cored panels may also be constructed as free-standing structures independent of the building's structure (modular cells contained inside the enclosed building envelope).

6.8 TREATMENT OF EXPOSED PANEL CORES

6.8.1 Any part of the insulating core that is exposed by the manufacturing, installation or maintenance processes must be protected from:
- deterioration caused by the environmental conditions the panel is exposed to
- moisture
- fire
- physical damage by birds and vermin
- vandalism or unintentional damage.

6.8.2 Manufacturers provide a complete range of proprietary flashings, caps, mouldings, extrusions and cover strips for finishing of the extremities, joins, openings and penetrations.

6.9 INSTALLATION OF DOORS AND WINDOWS

6.9.1 Exterior joinery and interior components can be installed:
- as modular units that are installed in the same manner as the metal-clad insulated panels within the system
- as independent units that are fixed (sometimes to support framing) within an opening formed in the metal-clad insulated panels
- as specialised face-fit components sealed to the panel system.

6.9.2 Exterior doors and windows use proprietary flashings that are integrated into the panel system. Some flash over the item of joinery while others create negative details or distinct lines as a feature within the overall panel system.

6.9.3 Interior doors often need to ensure that a compartment – such as a freezer, food preparation area or isolation room – is contained. Proprietary joinery with specially designed fittings and seals are used to achieve this.

7.0 MAINTENANCE

7.0.1 Metal-clad insulated panels are predominantly prefinished on both internal and external metal faces with durable paint systems that require minimal maintenance. Smooth, flat-faced white panels are typically seen in food preparation, processing and coolstore environments with one of their key features being ease of cleaning and maintenance.

BRANZ

THE CORE PURPOSE OF BRANZ IS TO IMPROVE PEOPLE'S LIVES THROUGH OUR RESEARCH AND OUR DRIVE TO INFORM, EDUCATE AND MOTIVATE THOSE WHO SHAPE THE BUILT ENVIRONMENT.

BRANZ ADVISORY HELP LINES

FOR THE BUILDING INDUSTRY
0800 80 80 85

FOR THE HOME OWNER AND PUBLIC ENQUIRIES
0900 5 90 90

Calls cost $1.99 per minute plus GST. Children please ask your parents first.

HEAD OFFICE AND RESEARCH STATION
Moonshine Road, Judgeford
Postal Address – Private Bag 50 908, Porirua 5240, New Zealand
Telephone – (04) 237 1170, Fax – (04) 237 1171
www.branz.co.nz

Standards referred to in this publication can be purchased from Standards New Zealand by phone 0800 782 632 or by visiting the website: www.standards.co.nz.

Please note, BRANZ books or bulletins mentioned in this publication may be withdrawn at any time. For more information and an up-to-date list, visit BRANZ Shop online: www.branz.co.nz or phone BRANZ 0800 80 80 85, press 2.

ISSN 1170-8395