DESIGN GUIDE

FIRE PROTECTION

CSR Bradford Insulation

FIRE PROTECTION

Contents.

Introduction.

The Bradford Insulation Group forms part of the Building Materials Division of CSR Limited. CSR Bradford Insulation manufactures and markets an extensive range of insulation products offering outstanding fire protection, thermal and acoustic properties for use in all types of industrial and marine applications as well as domestic and commercial buildings.

Two mineral fibre insulation types are available; 'Bradford Glasswool', which is manufactured by controlled felting of glass wool bonded with a thermosetting resin; and 'Bradford Fibertex™ Rockwool' which is spun from natural rock and bonded with a thermosetting resin. Both are available in sheet or roll form and as moulded pipe insulation.

Bradford Thermofoil™ comprises a range of aluminium foil laminates available in various grades.

All CSR Bradford Insulation products are tested to meet stringent quality control standards incorporating quality management systems such as AS3902/ISO9002.

Bradford Insulation has a 65 year history of providing insulation for fire protection applications. Bradford's comprehensive fire testing research laboratory in Sydney, Australia is registered by the National Australian Testing Authority (NATA) and, in conjunction with the Australian Government's Commonwealth Scientific and Industrial Research Organisation (CSIRO), is able to undertake fire testing to meet many international standards.

ABOUT THIS GUIDE.

The purpose of the guide is to provide information on the benefits from the use of insulation materials in the fire protection of buildings, industrial processes, ships and other applications. The incorporation of the correct insulation products in the design of passive fire protection systems can save lives and complement the installation of active fire protection equipment.

In most countries the inclusion of fire rated building products such as insulation is covered by strict building codes or other fire safety regulations. Information is provided in this guide to assist the designer in the correct choice of insulation to meet these stringent fire protection requirements.

The range of Bradford products and their applications is presented along with data and worked examples to illustrate design considerations. Sample specifications for applications are also included. In order that the benefits of insulation may be realised most cost effectively, it's inclusion in passive fire protection systems should be considered from the initial stage of design.

Information included in this Design Guide relates to products as manufactured at the date of publication. As the CSR Bradford Insulation policy is one of continual product improvement, technical details as published are subject to change without notice. Similarly, regional fire regulations referenced in this guide may also change over time, and current information should be obtained at the design stage.

TECHNICAL ASSISTANCE.

To assist designers, a free and comprehensive technical service, as well as advice and assistance in specifying and using Bradford products is available from CSR Bradford Insulation offices in your region. Further technical data and product updates are also available on the CSR Building Solutions Website: **www.csr.com.au/bradford**

The Importance of Fire Protection Insulation.

In most countries, approval for the occupancy of a building or the use of an industrial process or the launch of a new ship, depends on passing fire safety regulations. These regulations and codes have been developed around the world from the tragic experiences of real fires resulting in loss of life or property. Investigations by fire fighters and government fire authorities have led to requirements that the use of fire rated building materials should be included in designs, particularly in high fire risk environments.

Whilst many countries are now moving away from prescriptive to performance based regulations, the principle objective remains that of minimising the spread of flames and the release of toxic fumes from fires to ensure occupants have sufficient time to safely escape the inferno.

Rockwool mineral fibre insulation, in particular, has achieved widespread international use as a lightweight, adaptable and effective fire rated building product for use in passive fire protection systems design.

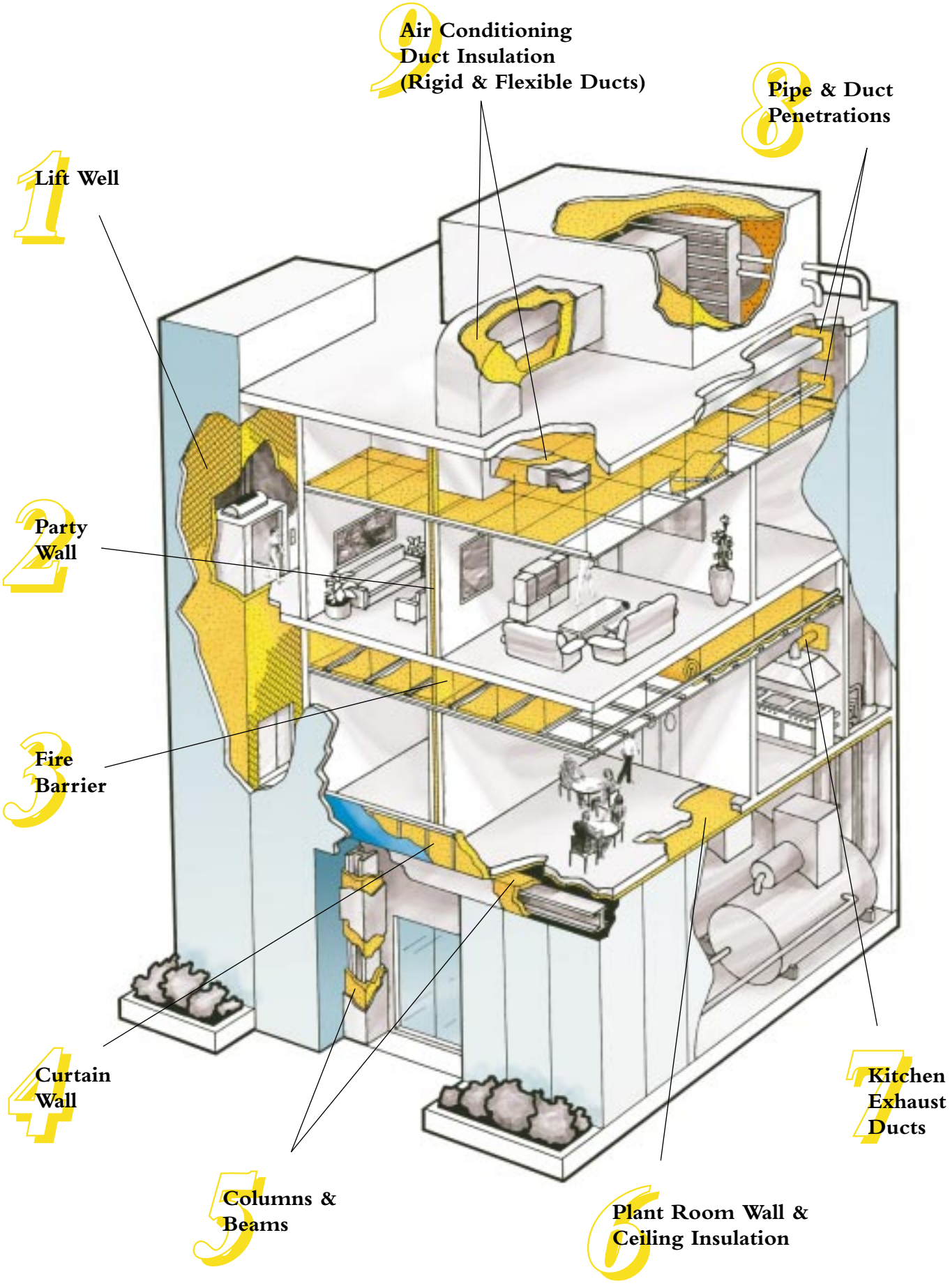
Passive fire protection is a term which describes materials that are an integral part of the construction of a building. These products are most effective when assembled into compartments, forming fire rated barriers. This allows occupants of other parts of a building to safely escape from the dangers of a fire.

PRIMARY BENEFITS OF FIRE RATED INSULATION

Protection of Persons and Installations in case of fire.	Bradford Rockwool is a proven fire protection material which can provide up to four hours fire resistance. Both Rockwool and low binder Glasswool are non-combustible and do not contribute to the propagation of a fire.
Improved Thermal Comfort all year round.	Not only does insulation provide fire protection, it also assists greatly in creating a more comfortable environment all year round due to its excellent thermal characteristics.
Reduced Noise Levels	Bradford Glasswool and Rockwool are excellent sound absorbers and can assist in reducing noise transmission through building elements such as partitions, marine bulkheads and decks.
Durability	Bradford Glasswool and Rockwool insulation are made from durable fibres which are unaffected by their exposure in the building environment. They will perform efficiently without deterioration or need of maintenance for the life of the building.

CSR Bradford Insulation

Fire Protection Insulation for Commercial Buildings.

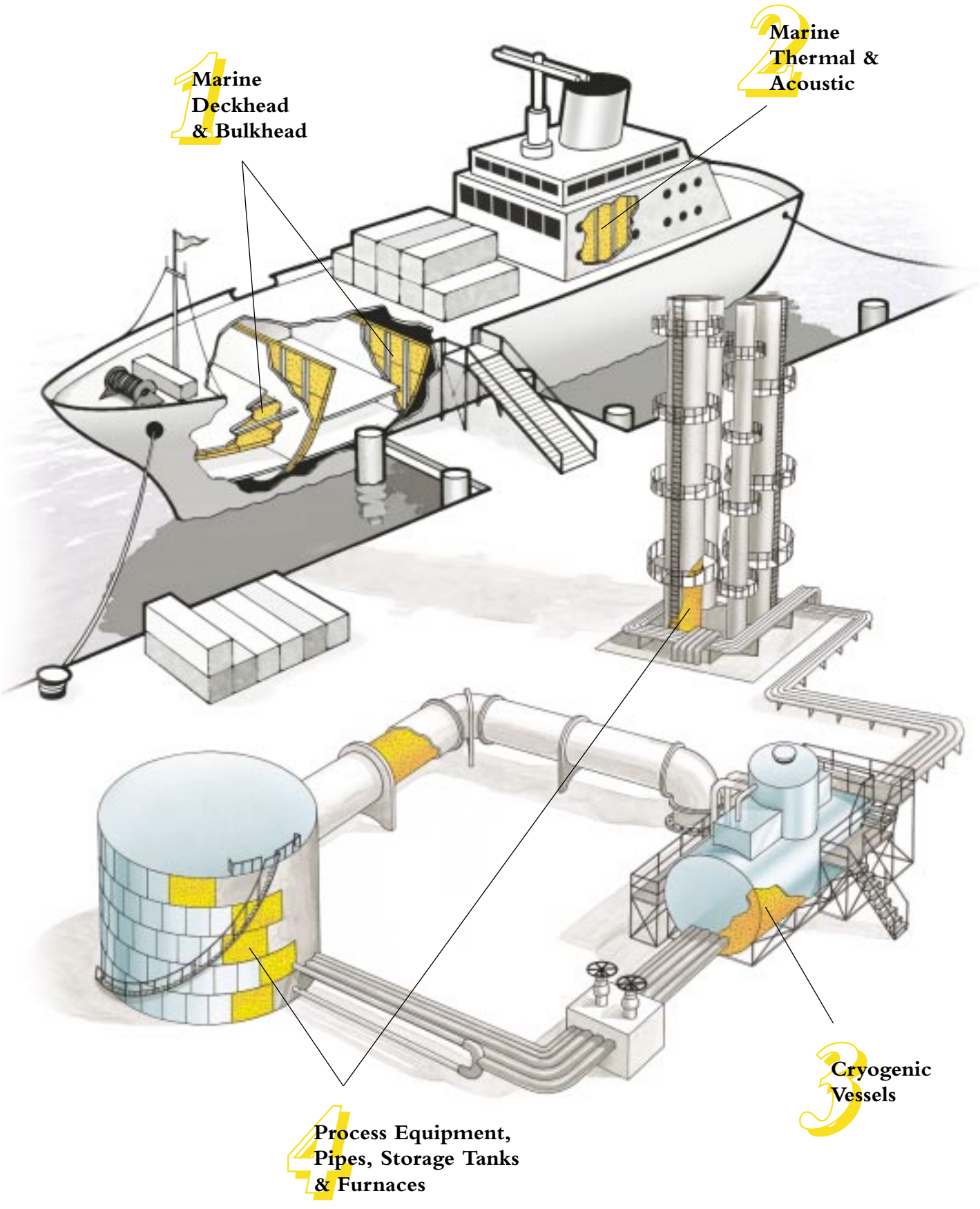


Bradford Insulation Application & Selection Guide for Fire Protection in Commercial Buildings.

Insulation Application	Product Type	Product Range/Facings
1 Lift Well	Bradford FIBERTEX™ 450 Rockwool	25 – 100mm
2 Party Wall	Bradford FIBERTEX™ Rockwool Party Wall Batts	100mm
3 Fire Barrier	Bradford FIBERMESH™ 820 Blanket	50 – 100mm
4 Curtain Wall	Bradford FIBERTEX™ SPANSEAL™ Boards	64 – 100kg/m^3, 50 – 100mm
	Bradford Curtain Wall Batts	135mm
5 Columns & Beams	Bradford FIBERTEX™ HD Rockwool	25 – 100mm
	Bradford FIBERTEX™ Spraywool	12.5kg bags
6 Plant Room	Bradford FIBERTEX™ Rockwool Pipe Insulation	25 – 710mm O.D. 25 – 100mm thickness
	Bradford FIBERMESH™ 650	25 – 100mm
	Bradford FIBERTEX™ Spraywool	12.5kg bags
7 Kitchen Exhaust Ducts	Bradford Glasswool HT THERMATEL™	25 – 50mm, Foil Facing
	Bradford FIBERMESH™ Stitched Blanket	25 – 75mm
8 Pipe & Duct Wall Penetrations	Bradford FIBERTEX™ 450 Rockwool Fire Damper Strips	13mm
	Bradford FIBERTEX™ Loose HT Rockwool	12.5kg bags
	Bradford FIBERTEX™ Rockwool Pipe Insulation	25 – 760mm O.D. 25 – 100mm thickness THERMOFOIL™ facings
	Bradford FIBERTEX™ HD Rockwool	25 – 100mm
9 Air Conditioning Ducts	Bradford Glasswool Ductliner and Ductwrap	25 – 50mm
	Bradford FIBERTEX™ Rockwool Ductliner and Ductwrap	Foil faced with UL181 fire rated tape

CSR Bradford Insulation

Fire Protection Insulation for Industrial & Marine Applications.



Bradford Insulation Application & Selection Guide for Fire Protection in Industrial & Marine Applications.

Insulation Application	Product Type	Product Range/Facings
1 Marine Deckhead & Bulkhead	Bradford FIBERTEX ™ 820	25mm – 75mm
2 Marine Thermal & Acoustic	Bradford FIBERTEX™ 820	25mm – 75mm
	Bradford Glasswool Marine Thermal Grade	25mm – 75mm
3 Cryogenic Vessels	Bradford FIBERTEX™ Loose CR	12.5kg bags
4 Process Equipment Storage Tanks & Furnaces	Bradford FIBERTEX™ 350 HD Rockwool	25mm – 100mm
	Bradford FIBERMESH™ Stitched Banket	25mm – 100mm
	Bradford Glasswool HT THERMATEL™	25mm – 75mm

Design Considerations.

In the selection and design of the optimum type of insulation for fire protection applications, there are several factors which need to be taken into account to ensure total performance requirements are met.

CONSIDERATION	ACTION.
Principles of fire protection in buildings	Ensure passive insulation systems and products provide sufficient fire rating protection to allow occupants to escape.
Building codes and regulations	Confirm local building fire regulations for the class of building under construction.
Testing certification	Ensure test certificates available to meet fire regulations – particularly for marine.
Maximum service temperature	Choose insulation material capable of operating continuously at prescribed temperature.
Facings	Choose facings and adhesives with appropriate fire ratings.
Heat transfer and thermal conductivity	Consider temperature control requirements of processes and ensure insulation type suitable for applications.
Acoustic benefits	Consider noise control regulations and acoustic benefits provided by insulation.
Penetrations/gaps	Ensure all wall penetrations and gaps have fire protection insulation.
Toxicity of product when burnt	Consider toxicity of insulation off-gases and choose insulation with lowest toxicity.
Suitability of sealants	Ensure sealants meet appropriate fire rating for system.
Ease of installation	Allow space for application of thickness of fire protection insulation.
Installation cost	Choose insulation that is readily available and cost effective.
Environmental	Choose environmentally friendly insulation products using ecologically sustainable raw materials and with a positive embodied energy life cycle
Health & Safety	Observe MSDS recommendations

Choice of Insulation Products.

BRADFORD FIBERTEX™ ROCKWOOL

All Bradford Fibertex™ Rockwool products achieve 0,0,0,0 when tested to AS1530.3. Internationally, mineral wool products such as Bradford Fibertex™ Rockwool are the leading choice for cost effective passive fire protection building design. Bradford Fibertex™ Rockwool is manufactured by melting rocks at 1300°C and the resulting spun fibrous insulation is less likely to shrink or degrade during fire than many other insulation products.

Bradford Fibertex™ Rockwool is inherently non-combustible, and does not require the addition of expensive fireproof facings to pass international fire testing. It has a low organic binder content and does not add to the fuel source of a fire. It's higher density helps provide dimensional stability and performance at high temperature.

BRADFORD GLASSWOOL.

All Bradford Glasswool unfaced products achieve 0,0,0,0 – 1 when tested to AS1530.3. Glasswool insulation is spun from molten glass and has a generally lower density and temperature resistance than rockwool insulation. Due to its higher organic binder content it is not inherently non-combustible. Only specialty Bradford Glasswool products such as Bradford Glasswool Thermatel™ and Bradford Glasswool Marine Thermal Grade pass non-combustibility testing (AS1530.1) for fire protection applications.

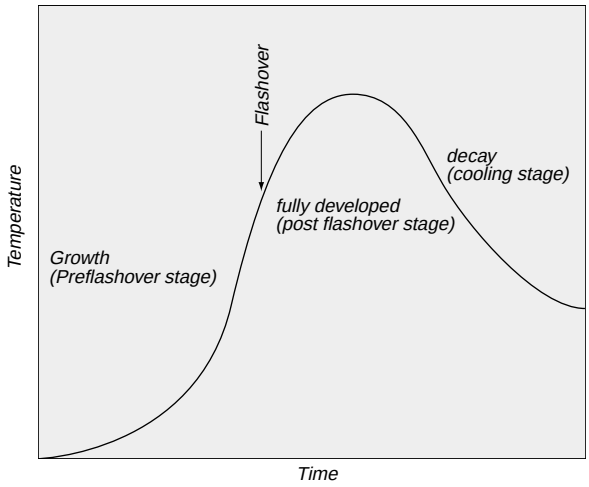
Principles of Fire Protection in Buildings.

Each year building fires cause many deaths and injuries and billions of dollars worth of property damage.

There are four stages in the life of a fire:

- ignition,
- fire growth period (pre flashover),
- fully developed fire (post flashover),
- decay.

FIG 1. FIRE LIFE CYCLE. TYPICAL TIME/TEMPERATURE CURVE.



Combustion requires heat, fuel and oxygen. Fire growth is a function of the fuel itself, with little or no influence from the configuration of a building. Given sufficient fuel and oxygen, fire will continue to grow resulting in an increase in compartment temperature. When substantial heat is generated, over 500 – 600 degrees Celsius, flashover occurs and the fire becomes fully developed, engulfing the whole compartment.

Decay follows when all the fuel or oxygen within the compartment is totally consumed.

REDUCING FIRE HAZARDS

There are principally three key areas for reducing fire hazards:

- controlling fire within a compartment;
- controlling the spread of fire between compartments through openings in external walls;
- providing early warning to building occupants.

CONTROLLING FIRE WITHIN A COMPARTMENT.

A fire compartment is defined as an area of a building which is totally separated from the remainder of the building by continuous fire rated construction. This area can be a single room, a series of rooms or an entire floor. It can also be a vertical shaft for services or a crawl space beneath a floor.

A large proportion of fires do not spread beyond the compartment of origin. Therefore, if careful attention to detail is placed on compartment design fire losses should be reduced.

Fire in a compartment can be controlled by either passive or active fire protection measures. Passive fire protection which includes Bradford Rockwool Insulation is recommended because these products are non combustible and have melting points in excess of 1150°C.

CONTROLLING THE SPREAD OF FIRE BETWEEN COMPARTMENTS VIA OPENINGS IN EXTERNAL WALLS.

Flames escaping from a broken window in a low rise or high rise building tend to curl back to the level above. This is another critical area which needs to be addressed. The flow and intensity of the heat generated is often high enough to be a fire hazard to the compartment above.

The main objective is to prevent the flame from reaching the upper window or wall. The two factors which affect this are:

- window size and shape;
- vertical spandrels and horizontal ledges.

WINDOW SIZE AND SHAPE.

Many studies in this area have revealed that tall narrow windows present a lesser hazard than short wide ones. Tall windows tend to project the flame away from the facade, decreasing the thermal coupling of the flames and keeping the thermal exposure relatively low.

VERTICAL SPANDRELS AND HORIZONTAL LEDGES.

For vertical separation.

To minimise the risk of fire spreading from one floor to another via openings in external walls it is important that any external opening:

- must be separated by a spandrel which is not less than 900mm in height, and extends not less than 600mm above the upper surface of the intervening floor; and,
- is constructed from a non-combustible material having a suitable fire resistant level which complies with the relevant country's requirements. This is usually FRL 60/60/60 or 120/120/120.

FIG 2. BUILDING WITH VERTICAL SPANDREL CURTAIN WALL.

For horizontal separation at floor level.

- the external projections must not be less than 1100mm and extend along the wall not less than 450mm beyond the openings; and,
- is constructed from a non-combustible material having a suitable fire resistant level which complies with the relevant country's requirements. This is usually FRL 60/60/60 or 120/120/120.

FIG 3.
BUILDING WITH CONCRETE LEDGE TO PREVENT VERTICAL SPREAD OF FIRE.

EARLY WARNING.

In today's society due to the regulations for higher acoustic performance of walls and floors it is necessary to ensure that in conjunction with passive fire protection, smoke and fire alarms are located in areas where they will be most useful and audible.

In non residential buildings it is normally necessary for the sound level to be 65dBA for longer than 30 seconds.

For residential buildings where the occupants may be in deep sleep, a sound level of 75dBA minimum is required in the bedrooms.

Typically alarms are located in corridors, and to achieve the necessary sound level requirement for a bedroom, the sound level needs to be at least 130dBA at the source. This may not always be possible and therefore it may be necessary for alarms to be located in bedrooms on different levels.

PASSIVE FIRE PROTECTION DESIGN.

It is incumbent upon building designers to choose passive fire protection materials with great care and attention to detail.

Whilst in many cases active fire protection systems can be added at a later stage, passive systems must be built in.

Insulation products are a key component of passive fire protection systems, as well as providing thermal and acoustic benefits.

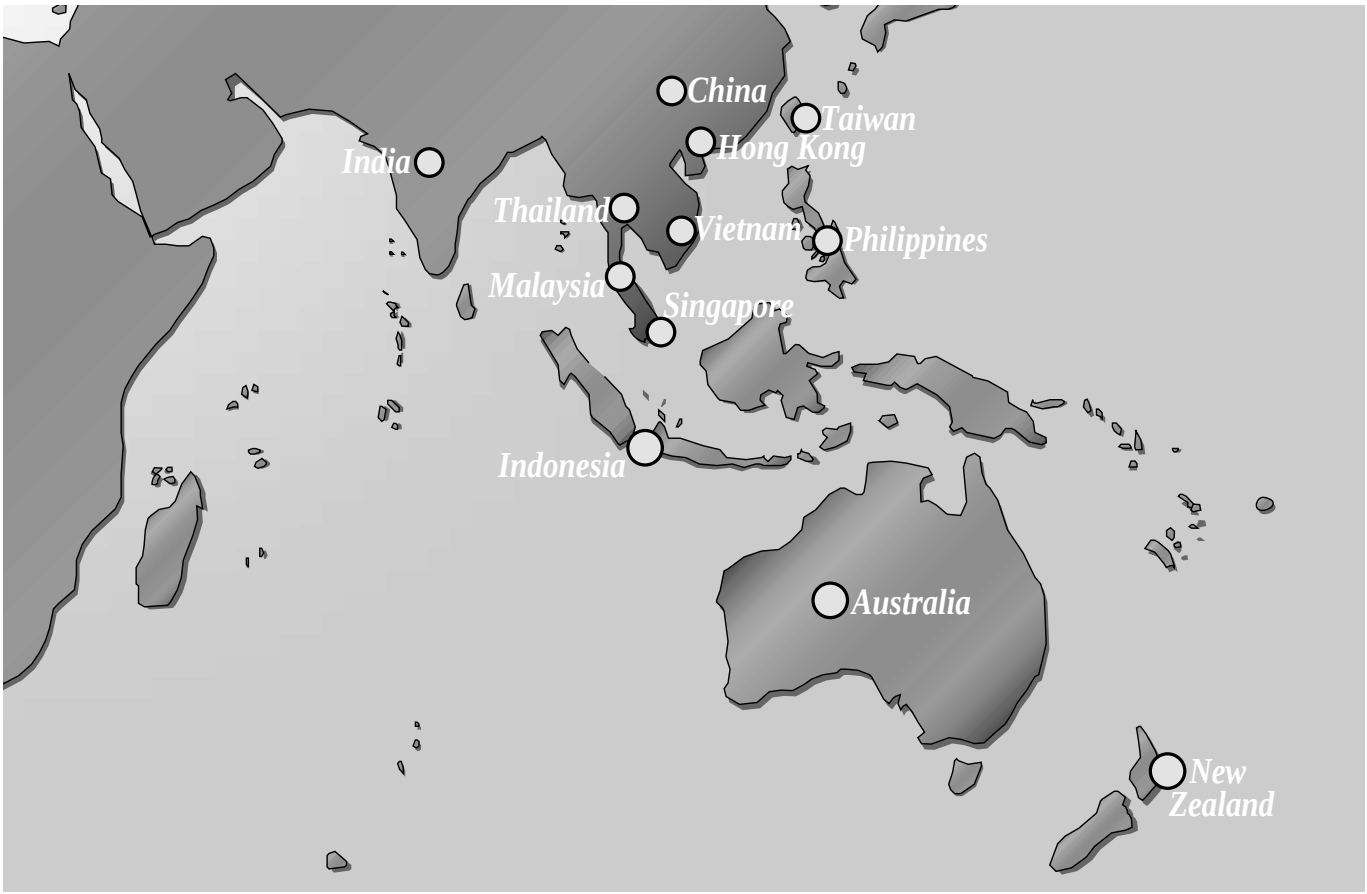
Insulation products should always be chosen with the best fire protection properties demonstrated under rigorous testing regimes.

Fire Testing.

National building codes and fire regulations call upon a variety of test methods to ensure passive fire protection products and systems will guarantee performance in the event of a fire. Unlike other areas of building design, these fire testing requirements are usually mandatory.

Country	Building and Regulatory Tests
Australia/ New Zealand	AS1530.1 Combustibility test AS1530.3 Early Fire Hazard test AS1530.4 Fire Resistant test UL181.16 Burning Test
Burma/Cambodia/China	BS476.4 Combustibility test
Hong Kong/Indonesia	BS476.5 Test for Ignitability
Korea/Laos/Malaysia	BS476.6 Test for Fire Propagation
Singapore/Sri Lanka	BS476.7 Surface Spread of Flame BS476.4, 6 and 22.
Thailand/Vietnam	BS476.8, 20 and 22 Fire Resistant test JISA 1304 JISA 1321 Incombustibility ISO 834
Philippines/Taiwan	ASTM E119 Fire Resistant test ASTM E84 ASTM E136 Combustibility test UL 723 Surface Burning Characteristics
International	ISO 1182 IMO Marine Testing Classification System

FIG 4. REGIONAL MAP.



COMBUSTIBILITY.

Rockwool and low binder glasswool have a low content of organic binder and are deemed to be non-combustible when tested to AS1530.1, BS474.4, ISO1182 , ASTM and IMO Resolution A.472(X11) or equivalent.

Australian Standard AS1668.1 Part 1 'Fire and smoke control in multi compartment buildings' prescribes that materials used in ductwork for fire dampers, smoke spill and exhaust systems shall be deemed to be non-combustible in accordance with AS1530.1.

All insulation used in marine applications must be non-combustible.

EARLY FIRE HAZARD INDICES.

Early Fire Hazard relates to the behaviour of materials in the early stages of fire. The objectives of both Fire Resistance and Early Fire Hazards are:

- to ensure as much time as possible for occupants to leave the premises and for fire fighting personnel to arrive and deal with the situation;
- to minimise the spread of fire and the amount of smoke generated.

Australian Standard AS1530.3 - Early Fire Hazard Indices, provides a standard testing procedure to measure.

- ignitability
- spread of flame
- heat evolved
- smoke developed

Ignitability is rated on a scale of 0 – 20 while the other factors are rated from 0 – 10. The lower the number the smaller the risk.

FIRE RESISTANCE LEVELS.

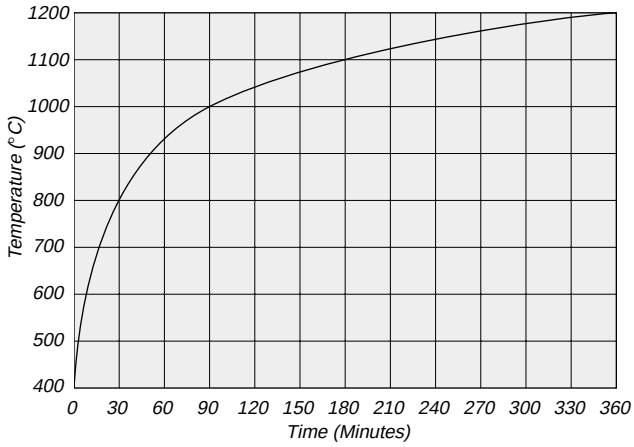
Fire resistance testing is conducted to the Australian Standard AS1530.4 : 1997. This standard gives the test method and criteria of failure for the various elements of construction such as partition walls, floor/ceilings and roof/ceilings.

The specimen assemblies are built into the test furnace and subjected to furnace temperatures in accordance with AS1530.4 Standard Time versus Temperature curve.

The test specimen is heated in the prescribed manner until the failure criteria has been reached, or is terminated by agreement between parties.

Assessment criteria are represented by three performance measurements known as Fire Resistance Levels (FRL).

FIG 5.
STANDARD TIME vs TEMPERATURE CURVE.



STRUCTURAL ADEQUACY.

Failure occurs when the specimen collapses under load.

INTEGRITY.

Failure occurs when the specimen develops cracks or openings through which flames or hot gases can pass.

INSULATION.

Failure occurs when the average temperature of the unexposed surface of the specimen increases by more than 140°C above the initial temperature, or the temperature at any point of the unexposed face increases by more than 180°C above the initial temperature, after allowing for ambient temperatures.

The test performance of the specimen is expressed as a Fire Resistance Level, which indicates the number of minutes for which the specimen fulfils the requirements of three fire test criteria.

For any specified FRL, a system having equal or higher respective criteria may be used.

OTHER FIRE TESTS

A wide variety of specialty fire tests apply to such areas as ductwork e.g. UL181-16 or the Factory Mutual Corner Fire Test for warehouses and factories.

Care must be taken to understand fire test methods and their applications. In some cases insulation products may pass one test but fail another.

It is recommended that for complex issues a fire engineer is consulted. Refer to your nearest Bradford Insulation office for more information.

FIRE CODES BY BUILDING CLASS (BUILDING CODE OF AUSTRALIA).

Building Class	Description	FRL
1	Single occupancy houses and terraces	60/60/60
2 and 3	Dual occupancies/boarding houses	90/90/90
4	Sole dwelling in a commercial building	up to 90/90/90
5	Office Building	up to 120/120/120
6	Retail	180/180/180
7 and 8 <2stories	Industrial	90/90/90
7 and 8 >2stories	Industrial	240/240/240
9	Public Buildings (Hospitals, schools etc)	120/120/120
10	Garage	NA

Prescriptive (Deemed to Satisfy) versus Performance Based Design.

'Deemed to Satisfy' provisions for the fire protection of buildings have been developed over the years based on proven performance systems.

However, in some circumstances an alternative design may be as appropriate as the prescriptive method, and it may prove more economical. The compliance with 'Deemed to Satisfy' is not compulsory if alternative means can be found to satisfy that the performance requirements will be achieved.

Factors affecting the fire must be taken into consideration including:

- the likelihood or risk of a fire occurring in the building;
- the size, load or intensity of any fire in the building;
- the difficulty of evacuation and or/rescue;
- the risk of spreading a fire to another building;
- the fire safety systems in the building.

It is helpful to use the 'Deemed to Satisfy' provisions for guidance purposes. Fire Design Engineers are then suitably qualified to evaluate each project on its merit through risk-cost assessment models and seek optimal solutions which benefit the client and the public.

The aim of the Building Code of Australia (BCA) is to maximise the safety, health and amenity of people in and around buildings. The protection of property is not a primary aim, yet it is necessary to maintain structural adequacy of building elements in the event of a fire to ensure evacuation can be carried out in safety.

The installation of Bradford Fibertex Rockwool in passive fire protection systems has been found to be highly beneficial. This guide provides sample specifications for various fire protection applications utilising Bradford Fibertex Rockwool.

TOXICITY.

DIN53436 is a German test used in about six European countries to measure the toxicity of smoke produced by burning substances. In most circumstances the smoke produced in a fire tends to be the cause of human fatalities rather than the heat emitted from a fire.

A classification system was presented to rate the acute lethal potential of each material on the basis of the amount of material required to generate sufficient smoke to kill 50% of the laboratory animals within 30 minutes of exposure and 10 minutes of post exposure.

The classification system is as follows (Reference: Alairie and Anderson 1980):

LC50 – expressed in grams

LT50 – time in minutes

LTC50 – grams x minutes

Class – defined as:

A: 'As toxic as wood'

B: 'More Toxic than wood'

C: 'Much more toxic than wood'

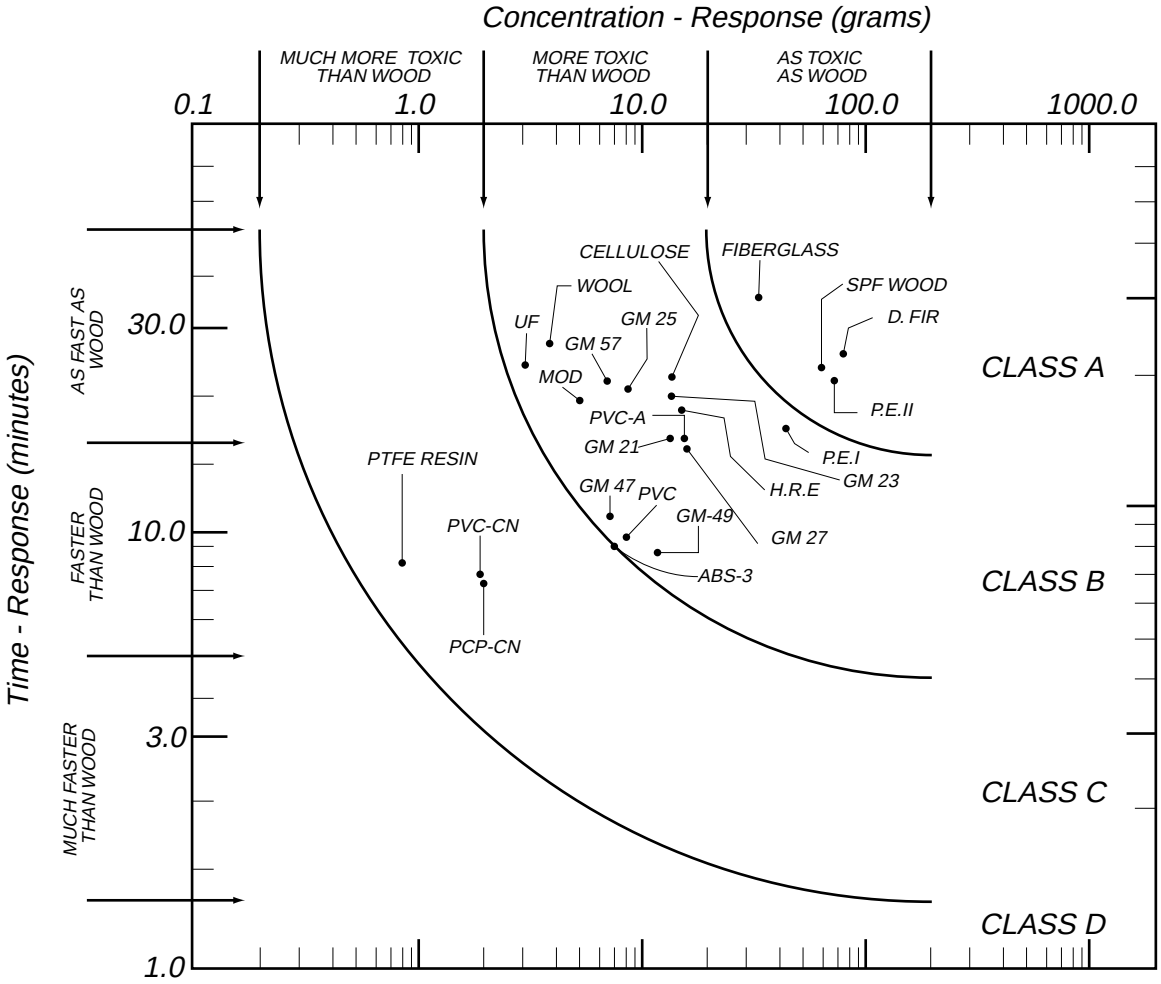
D: 'More severe than class C'

The reference point has been designated to be Douglas Fir wood and materials are classified by comparison against Douglas Fir. (FIG 6)

Based on this data, glasswool and rockwool insulation have been found to be on the lower end of the toxicity scale, similar to timber when compared to other products readily available in the market.

Petrochemical based insulation products such as foams or polyester, along with paper (cellulose) and wood based insulation products are usually classed as more toxic or much more toxic than Douglas Fir.

FIG 6. TOXICITY CLASSIFICATION.



Installation Issues.

The construction process as set out in the 'Sample Specifications' must be strictly adhered to when installing Bradford glasswool or rockwool into fire rated systems.

The fire rating achieved has been tested in a laboratory under supervised conditions. It is therefore necessary to install the insulation product in a manner which closely resembles that used in the test.

CSR Bradford Insulation recommends the following:

- All insulation be cut square and butted together firmly to ensure there are no air gaps when installed as part of fire rated systems. In some cases such as party wall and curtain wall batts, there is a requirement for the rockwool to be compressed by at least 15% of its height or width.
- The product specified is as stated on the packaging (dimensions, density).
- The product is to be kept dry at all times to ensure maximum performance.
- Observe the requirements for the handling of glasswool and rockwool in accordance with the Bradford Insulation Material Safety Data Sheets (MSDS).

Service Temperatures.

Thermal insulation products must be suitable for the maximum operating or service temperature of the metal surface which is to be insulated.

The maximum service temperatures for mineral fibre insulation is specified to ensure minimal dimension change and low thermal conductivity at the design temperature. Higher density products such as rockwool are required at elevated temperatures for dimensional stability and the low conductivity of radiant heat.

The range of Bradford Insulation rockwool products are suitable for a maximum service temperature of 350°C up to 820°C, and all are suitable for sub zero operating temperatures. For faced products the temperature at the facing should not exceed the melt temperature of the adhesive or facing material. This is generally around 70°C to 120°C.

Maximum service temperatures for the full range of Bradford Insulation products are shown in the Bradford Insulation Fire Protection Product Guide.

HEAT UP.

As precautionary advice, products designed for high temperature industrial applications (above 177°C) may

release gases (CO_2, formaldehyde, amines) which may be irritating to the eyes, nose and throat during initial heat up. In confined or poorly ventilated areas, it is recommended to use air supplied respirators during the first heat up cycle.

In certain circumstances 'punking' may occur on startup. Punking is where the exothermic reaction binder burn-out is contained within a thick insulation roll and further fuels binder degradation, resulting in undetected smouldering.

Heat Transfer & Thermal Conductivity.

The thermal conductivity, or k-value (W/mK) is a measure of heat transfer through a material and therefore is the principle property of an insulation material. If a temperature difference exists between two parts of a system heat transfer will take place. There are three modes of heat transfer in a mineral wool insulation:-

CONDUCTION.

The flow of heat by conduction results from a transfer of vibrational energy from one molecule to another. This energy transfer occurs as Fibre Conduction; conduction between molecules of air trapped in tiny cavities.

CONVECTION.

Heat transfer by convection occurs from the movement of heated air rising and the subsequent replacement by gravity of colder, denser air. If the air movement arises from the heat transfer process itself, then natural convection occurs. Convection heat flow adds very little contribution to the total k-value of Glasswool and Fibertex Rockwool insulation products.

RADIATION.

Heat flow from radiation is caused by electromagnetic waves which are reflected, transmitted or absorbed by a material. The effect of radiation heat transfer rises significantly at higher temperatures, however high density mineral fibre will effectively reduce heat flow from radiation.

In many applications of heat transfer, each of the mechanisms of conduction, convention and radiation are involved.

The total heat flow is a sum total of the individual modes of heat transfer.

Q total = Q conduction + Q convection + Q radiation

THERMAL CONDUCTIVITY.

The thermal conductivity of an insulating material will vary with the mean temperature under operating conditions. In heat transfer calculations, the thermal conductivities are derived for the design operating temperature and calculated mean temperature, dependent on thickness and type of insulation.

Typical thermal conductivity (k) values of insulation boards and blankets are derived from measurements taken in accordance with laboratory test methods detailed in AS2464.6, ASTM C177 or BS874.

Detailed thermal conductivity data is shown in the Bradford Insulation Fire Protection Product Guide.

Personnel Protection.

To minimise the risk of injury to personnel, the temperature of the exposed surface of an insulated vessel or pipe should be no greater than 55°C in locations where the surface is accessible.

Surface temperature has traditionally been used as a 'rule of thumb' test for the effectiveness of insulation. While such a test may locate hot spots, it is not a reliable indication of the effectiveness of the insulation system as a whole.

For a given insulation thickness, the surface temperature of polished aluminium cladding will always be higher than that of weathered zincanneal cladding, yet the heat loss through the aluminium will be the lower of the two, particularly at high operating temperatures.

Cladding surface temperature is also heavily influenced by the ambient air temperature and wind speed under operating conditions, which can be quite different from the air temperature specified and used for design calculations. The designer therefore should take into account the worst case ambient conditions for calculation purposes.

Noise Control.

All Bradford Fibertex Rockwool and Glasswool products offer excellent sound absorption properties. Alone, or in combination with other selected materials, they offer solutions to problems involving both sound transmission and reverberation.

Guidance in handling these noise problems can be found in the Bradford Insulation Acoustic Design Guide.

Health and Safety

Bradford Fibertex Rockwool and Bradford Glasswool products have been widely used in industry for several decades. There is no evidence to demonstrate any long term health effects from these products when used in accordance with the simple procedures of the Australian National Worksafe Standard and Code of Practice for the Safe Use of Synthetic Mineral Fibres (1990, Reprinted with Amendments 1994).

Full health and safety information is provided in the Bradford Insulation Material Safety Data Sheets.

Fire Protection for Building Applications.

Fire Protection in Homes.

Most building codes and regulations concerning passive fire protection refer to commercial buildings and public areas. Generally passive fire protection in homes is left to the designer, builder and home owner.

Bradford Insulation recommends that consideration be given to fire protection insulation in homes in the following areas:-

- Fire rated sarking to be used in the roof – particularly in bushfire prone areas. Refer AS3999.
- Bradford Rockwool Building Blanket to be installed under ridge capping in bushfire prone areas.
- Thermal insulation in ceilings and walls to be chosen with the best fire rating (in Australia, a four zero product when tested to AS1530.3 is recommended – particularly above the kitchen).
- Insulation of air conditioning ducting to similarly have the best fire rating and that the ducting passes UL181 Part 16 – burning test.
- Kitchen exhaust ducts to be insulated with either Bradford Fibertex™ Rockwool or Bradford Glasswool.
- Use fire rated insulation under timber floors.

Industrial Fire Protection.

The general design principle for buildings apply to industrial sites. In addition fire protection insulation is an essential engineering design element for high temperature or chemical industrial processes.

For more information on industrial fire protection design please refer to the CSR Bradford Insulation Industrial Design Guide.

Curtain Wall.

Fire protection has always been a major concern for building occupants, fire fighters and building insurers. Innovative materials and fast track construction methods have resulted in increased complexity and uncertainty when selecting suitable products.

The tragic fires in high rise buildings in Brazil and Thailand have demonstrated that flames can spread quickly over a facade. Many fires have been reported to have moved floor to floor directly through the gap between the floor slab and the curtain wall, and generally via unsealed floor penetrations.

FIG 7.

Fires in lower floors of multi-storey buildings can threaten occupants of upper floors if the fire spreads up the exterior of the building. Cladding and facade materials must be tested for flammability.

Very little research has been carried out in this area, and as a result, CSR Bradford Insulation saw it as an opportunity to provide economical passive solutions through their range of rockwool products. Tests were carried out at the CSIRO in Sydney, Australia through their fire research and testing department. A full scale test was constructed to investigate the effects of rockwool insulation both in the spandrel and floor cavity.

The results were impressive, and highlighted the superior performance of Bradford Rockwool as a fire barrier when compared to other insulation products such as glasswool and polyester. The products used in the spandrel were Bradford Rockwool Spanseal™ Boards, and the cavity was sealed with Bradford Fireseal™ Curtain Wall Batts. The system achieved both 1 hour and 2 hour fire ratings.

As well as fire protection, rockwool provides thermal and acoustic benefits. In some countries the insurance premiums may be reduced due to the lower risk of fire damage.

The Bradford Fireseal™ Curtain Wall System is a total building solution for fire protection, and Bradford Insulation also offers fire rated sealant and support clips to complement the system. Bradford Spanseal™ Boards are available in a wide variety of facing options including Thermofoil™, Black Matt Facing Tissue (BMF) and Flex-skin™. For further details please refer to the Bradford Insulation Fireseal™ Curtain Wall brochure.

The biggest benefit of the Bradford Fireseal™ Curtain Wall System is that the masonry spandrel wall which has been necessary to prevent vertical spreading of flame in other systems is no longer required. The high melt temperature of rockwool provides a superior barrier which cannot be matched with polyester or glasswool insulation. Over the entire perimeter and height of a building, the elimination of the masonry spandrel can amount to significant savings in materials and labour.

FIG 8.
WOOD CRIB PRIOR TO TESTING.

FIG 9.
AT PEAK OF FIRE.

FIG 10. ROCKWOOL STILL INTACT ON FIRST FLOOR, REMAINING INSULATION HAS FAILED.

BRADFORD FIRESEAL™ CURTAIN WALL SYSTEMS.

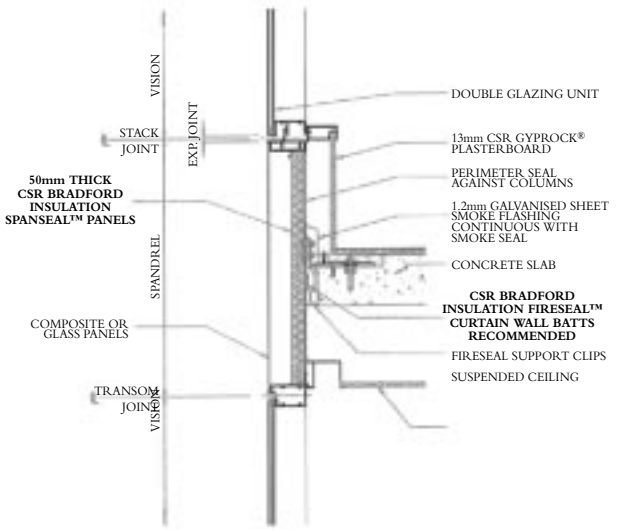
1. AUSTRALIA/NEW ZEALAND

Complies with Building Code of Australia.

1 Hour Fire Rating (Spandrel and Firesafing).

1 Hour Smoke Rating (Smokeseal flashing).

FS 001

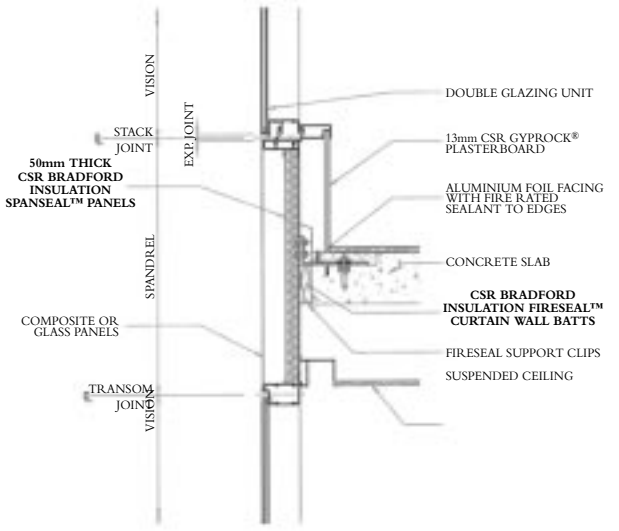


2. ASIA

Complies with 2 hour Fire Rating regulations (firesafing).

Premium smoke control system (smokeseal flashing, sealant and foil faced firesafing).

FS 002

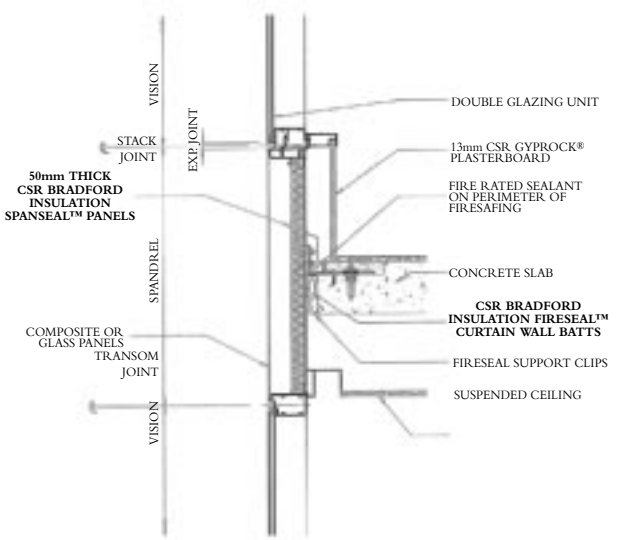


3. ASIA

Complies with 2 hour Fire Rating regulations (firesafing).

Standard Smoke Control System (with sealant).

FS 003

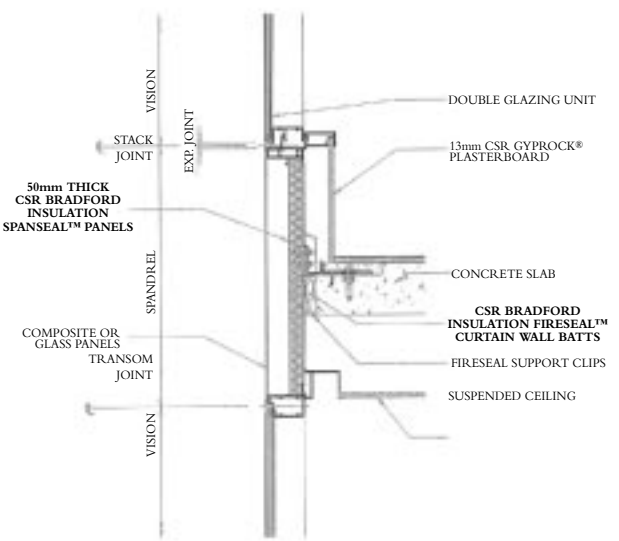


4. ASIA

Complies with 2 hour Fire Rating regulations (firesafing).

Standard Smoke Control (without sealant).

FS 004



Please consult your local CSR Bradford Insulation office if your system varies to those above.

Specialty Building System Specifications.

Curtain Walls.

SPANDREL PANELS.

1. Insulation shall be installed to fully cover the non-vision areas of the curtain wall exterior cladding system.

   The insulation shall be Spanseal™ Rockwool Boards as manufactured by CSR Bradford Insulation, to achieve an FRL 60/60/60 in accordance with AS1530.4; (also refer to Bradford Fireseal™ System FS001). In Asia, this requirement is generally FRL 120/120/120.

   Where spandrel fire protection is to be provided by a fire rated masonry wall, the insulation shall be *Bradford Spanseal™ Rockwool Boards*.

2. The thickness of insulation shall be ……*mm*. For determination of thermal resistance refer to Table 1.

TABLE 1. THERMAL RESISTANCE

Description	Thickness	Thermal Resistance
Bradford Spanseal™ Rockwool Boards	50mm	R1.5
Bradford Glasswool	75mm	R2.3
Bradford Supertel™	100mm	R3.0
Where Aluminium Foil is used on one (or both) faces and an airspace is present:		
Vertical Reflective Airspace	20mm	R0.58
Vertical Reflective Airspace	>20mm	R0.61

3. Where the insulation shall be installed behind tinted glass, the exterior surface of the insulation shall be faced with black tissue (BMF) to reduce light reflection. (NOTE: This facing should always be carried out by CSR Bradford Insulation to ensure a professional finish is achieved.)
4. Where a vapour barrier is required to prevent condensation, the internal surface of the insulation shall be faced with *Thermofoil™ (light/medium/heavy duty)* reinforced foil laminate.
5. The insulation shall be supported by flanges fixed to the metal framing of the spandrel at ……*mm* centres.

FIRE SAFING.

1. Fire Safing insulation shall be installed continuously at all exterior cladding beam/column edge separations around the complete perimeter of each floor and roof line. The insulation shall be Fireseal™ Curtain Wall Batts as manufactured by CSR Bradford Insulation.
2. The minimum effective depth of the fire safing insulation shall be 135mm to achieve a two hour fire rating. The batts shall be compressed to 85% of their original width in order to seal properly, and are to be inserted into the cavity between the curtain wall and concrete edge.
3. The fire safing shall be installed in conjunction with a smoke seal of continuous galvanised steel sheeting at least 1.2mm thickness, sealed with a fire rated sealant between the back pan and the floor slab.

   NOTE: For further details refer to the Bradford Fireseal™ Curtain Wall Systems brochure.

FIG 11. BRADFORD FIRESEAL INSTALLED AS FIRE SAFING IN CURTAIN WALL SYSTEM.

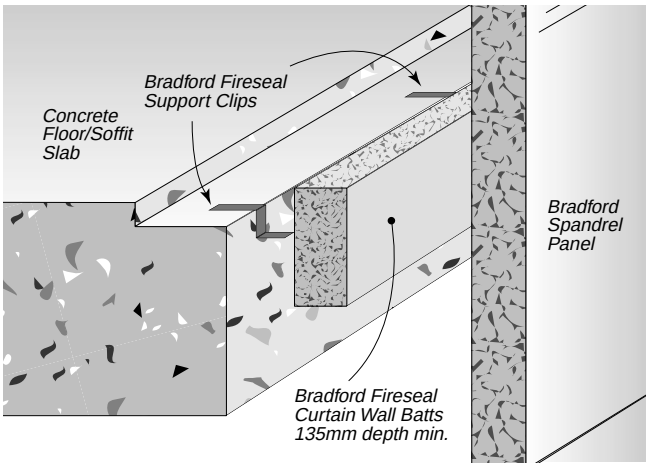
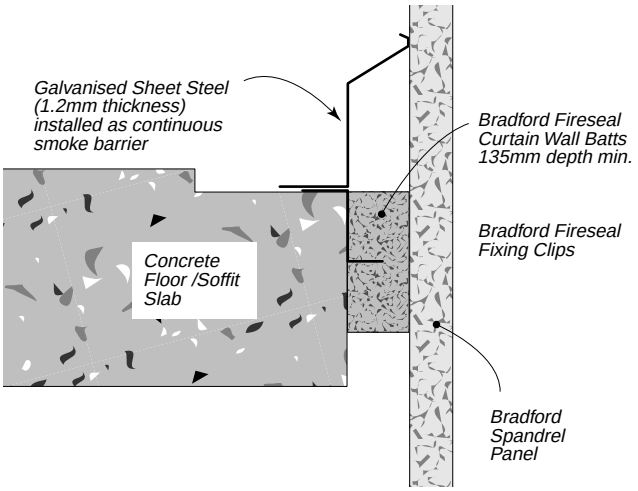


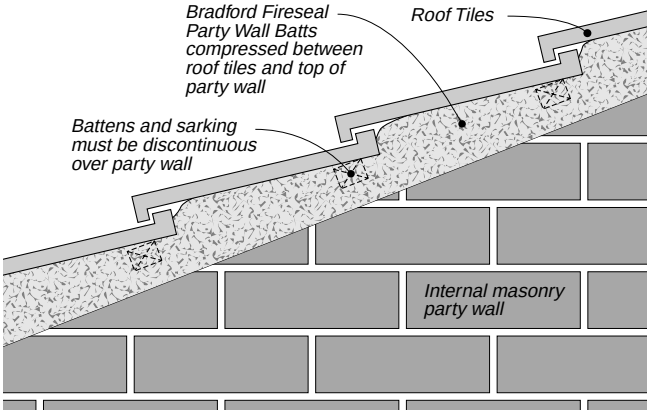
FIG 12. BRADFORD FIRESEAL INSTALLED AS FIRE SAFING IN CURTAIN WALL SYSTEM.



Party Wall Fire Protection.

1. The fireproofing insulation shall be Fireseal™ Party Wall Batts as manufactured by CSR Bradford Insulation.
2. The top of the internal party wall must be constructed so that it provides enough depth to fit the party wall batts below the underside of the roofing. The width of the batt is determined by the fire rating requirement.
3. The roof battens or sarking must not cross the party wall line.
4. The party wall batts shall be cut to fit tightly into the prepared opening. The batt must be compressed by at least 15% of its height in order to ensure adequate sealing.
5. Lengths of galvanised hoop iron, 500 x 25 x 1.3mm are then nailed to the battens to bridge the gap. The weight of the roof tile assists in retaining the insulation in position.
6. There must be no penetrations through the party wall batts.

FIG 13.
BRADFORD PARTY WALL FIRE PROTECTION.



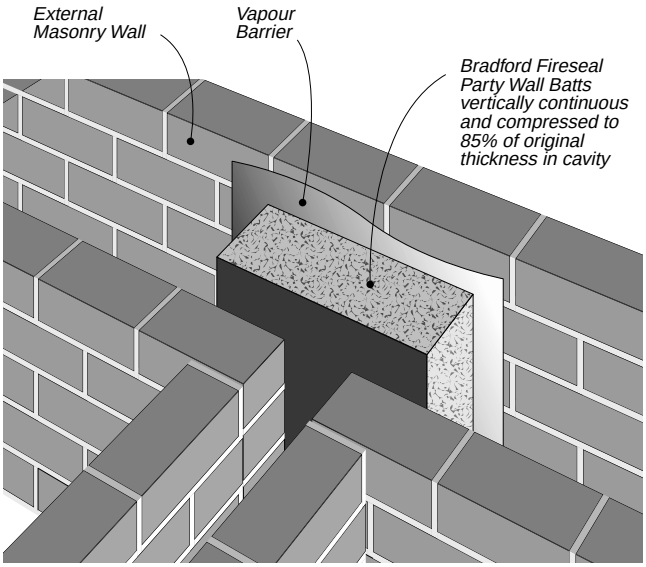
PARTY WALL FIRE CLOSER.

Bradford Fireseal™ Party Wall Fire Closer will provide at least 1 hour resistance to the spread of fire through the cavity walls of adjoining rooms.

Where a separating wall meets the cavity wall, building regulations also require the use of a mineral wool closer for sound insulation purposes.

Bradford Fireseal™ Party Walls Fire Closer will also meet this requirement, significantly reducing flanking transmission through the masonry wall cavities.

FIG 14. TYPICAL INSTALLATION FOR BRADFORD PARTY WALL FIRE CLOSER.



External Wall Systems (Zero Line Allotment).

The CSR RendaLine™ External Wall Cladding System is designed for residential and small commercial projects as an alternative to traditional brick veneer or rendered masonry construction techniques.

This innovative system provides an attractive rendered style wall with traditional recessed window and door openings and raked sills. With the inclusion of 30mm Bradford Fibertex™ 450 Rockwool (80kg/m^3), it will achieve a Fire Resistance Level of 60 and 90 minutes.

For further details contact CSR Fibre Cement or the CSR Bradford Insulation office in your region.

Fire Barrier Stops.

This is a particularly simple system for providing an effective fire break in roof and ceiling spaces. It consists of a draped rockwool blanket which is suspended between two fire rated elements. In offices these are usually a masonry wall and a concrete slab.

Fire Barrier Stops are most suited to refurbishments of existing buildings such as hospitals, offices and multi residential dwellings.

These cavities above the ceilings are potential hazards as they are out of view, and also provide easy access for flames to spread before the fire is detected.

1. The fire barrier stop shall be Rockwool Fibermesh™ 820 Blanket as manufactured by Bradford Insulation. The blanket shall be …….mm thickness.
   - 50mm thick blanket provides 30 minutes fire resistance.
   - Two staggered 50mm thick blankets provide 90 minute fire resistance.
2. The top of the blanket shall be secured to the soffit with a mild steel angle. The angle should be no less than 60 x 40 x 2mm, with the short leg fixed to the soffit.
3. The angle should be secured to the concrete soffit at 500mm maximum centres with M8 x 60mm masonry anchors.
4. The edges of the fire barrier should also be clamped. The bottom of the barrier should drape over the masonry wall and turned horizontally.
5. The bottom edge of the blanket should be secured with a metal strap of 50 x 2mm which is fixed at 500mm centres.
6. Where blankets require joining, it is recommended that they be butted tightly and sewn together with galvanised wire of 1mm thickness.

   NOTE: Also refer to alternative fixing methods detailed in FIG 15, 16 and 17.

SERVICES.

Where pipes or ducts are required to pass through the fire barrier, the blanket may be cut to provide a tight fit. It is recommended that the protruding pipe or duct be insulated by at least 500mm on either end to ensure fire integrity.

SMOKE RESISTANCE.

If smoke resistance is required through the cavity it will be necessary to specify an aluminium foil facing on one side of the blanket.

VENTILATION.

Specifiers should consider the effects on ventilation once areas have been compartmentalised. This should be discussed with a mechanical engineer.

FIG 15. BRADFORD FIRE BARRIER STOP BETWEEN A MASONRY SOFFIT AND MASONRY WALL.

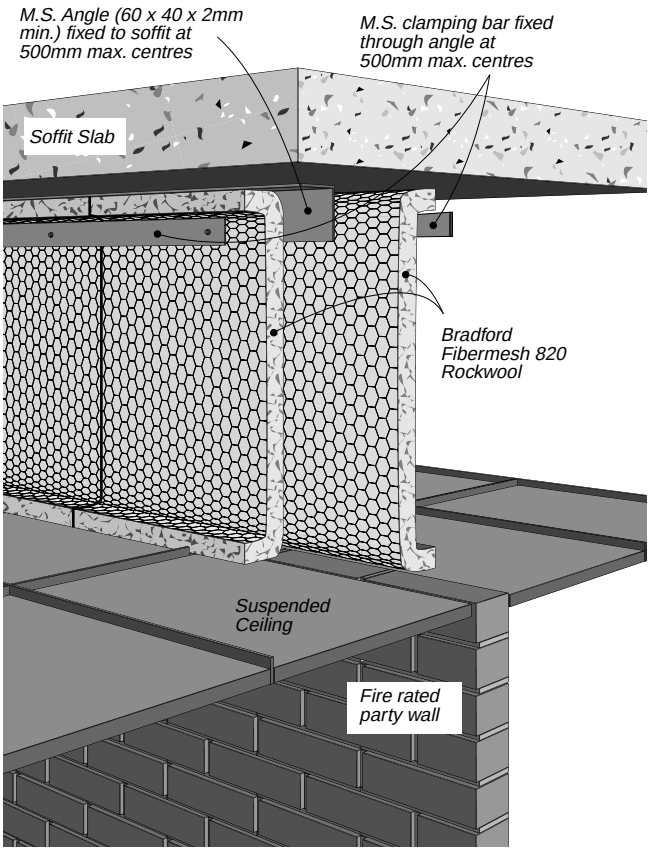


FIG 16. BRADFORD FIRE BARRIER STOP FOR A TRUSSED ROOF SPACE.

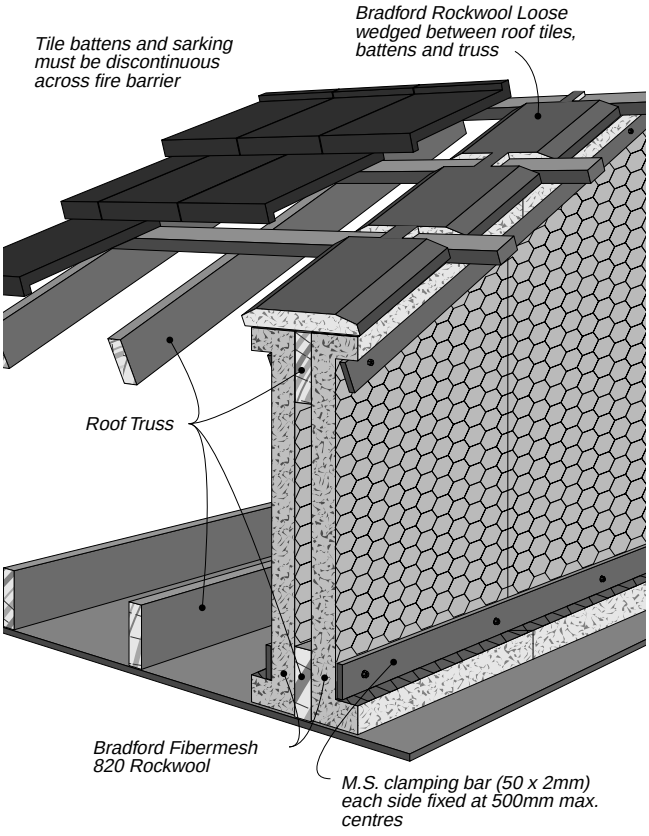
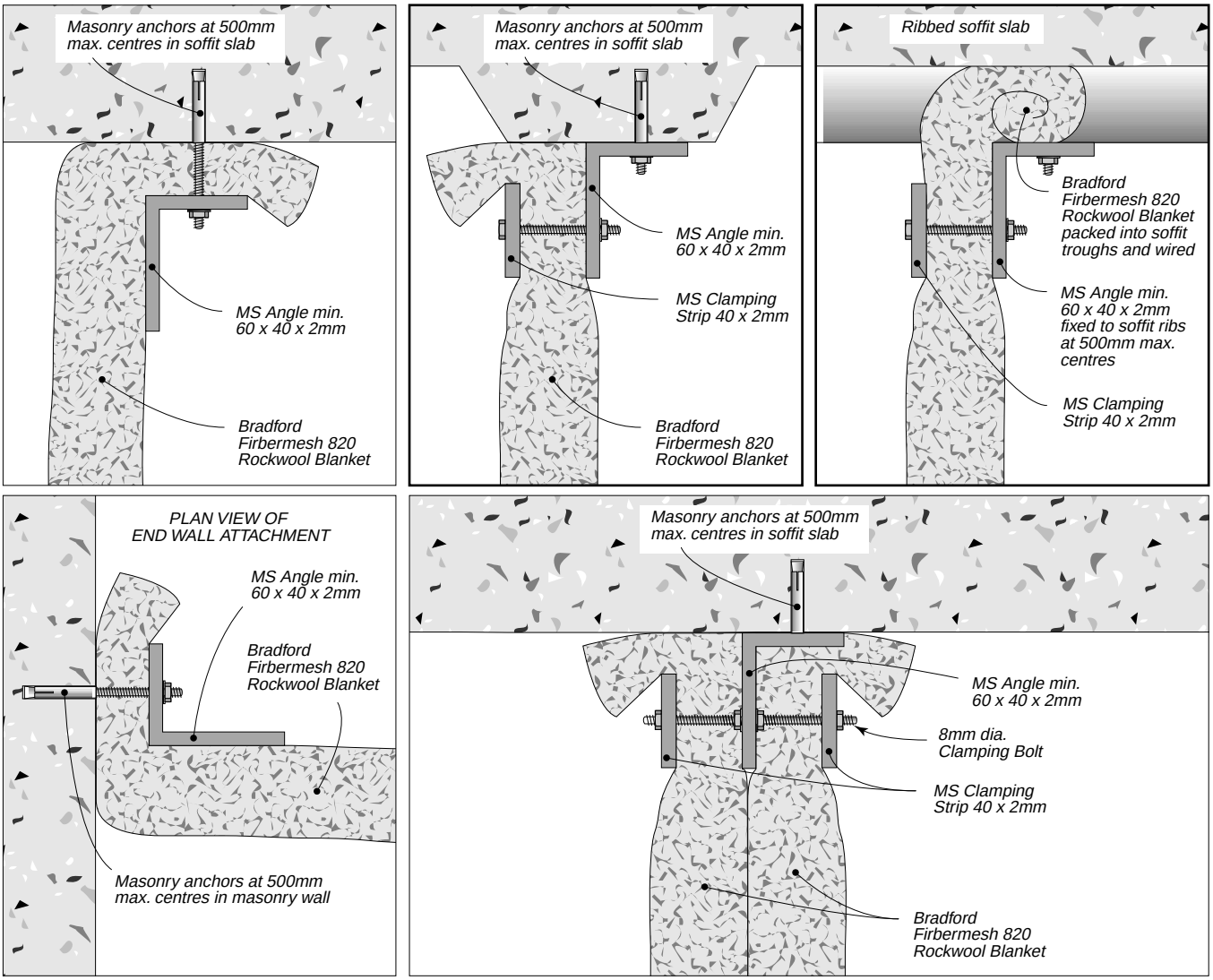


FIG 17. ALTERNATIVE FIXING METHODS FOR BRADFORD FIRE BARRIER STOPS IN A CEILING SPACE.



Fire Stops for Raised Access Floors.

Raised floors are a convenient method of allowing services to run beneath offices. There are many patented systems on the market and those interested should contact the appropriate manufacturers.

1. The fireproofing insulation shall be Bradford Curtain Wall Batts as manufactured by CSR Bradford Insulation.
2. Bradford Curtain Wall Batts are 1500mm long x 168mm wide x 100mm high. In order to gain additional height simply place one Curtain Wall Batt on top of another. Please refer to Table 2 for specific product details. Galvanised steel pins should be used to secure Curtain Wall Batts together at 500mm centres.
3. When determining the correct number of floor stops, the height beneath the floor should be measured and an additional 15% should be added to this value.
4. Care should be taken to allow for floor tolerances.
5. The FRL in Table 2 is limited to the fire performance of the surrounding floors.

TABLE 2. SPECIFICATIONS OF BRADFORD FLOOR FIRE STOPS.

Void depth (mm)	Fire Stop Width (mm)	Fire Stop Height (mm)	FRL
Up to 175	168	200	0/240/240
175 – 350	168 – 336	200 – 400	0/240/240
350 – 600	336 – 504	400 – 700	0/240/240

FIG 18. TYPICAL LAYOUT FOR BRADFORD FIRE STOPS IN RAISED ACCESS FLOORING SYSTEM.

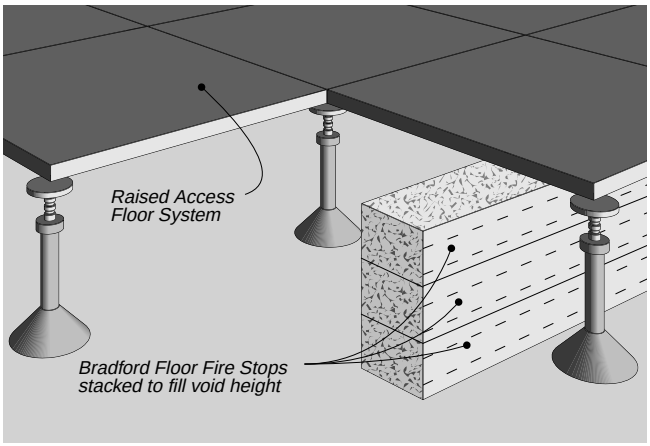
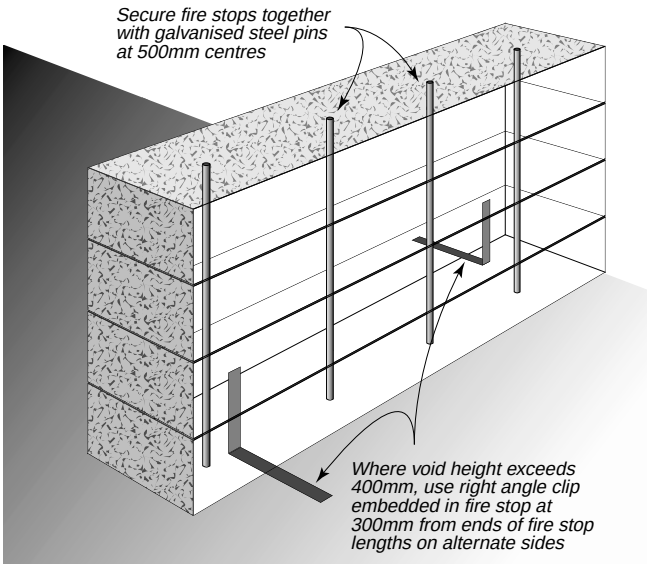


FIG 19. SECURING OF BRADFORD FIRE STOPS FOR RAISED ACCESS FLOORING SYSTEM.

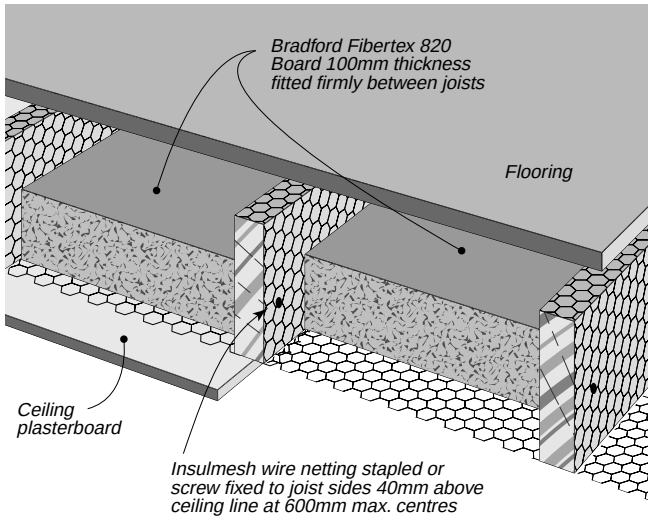


Fire Rated Floor System.

Bradford Fire Rated Floor Insulation can be installed from above the joists. This is particularly useful when seeking to achieve a fire rating of a ceiling without disturbing the ceiling or amenity to a habitable area below.

1. The fire proofing insulation shall be Fibertex™ 820 Rockwool Boards as manufactured by Bradford Insulation. The thickness of the insulation shall be at least 100mm in order to achieve a maximum one hour fire rating.
2. Insulmesh 1.2 – 1.6mm wire netting is to be applied to the floor joists in order to support the rockwool boards. It is to be secured into position by screwing or stapling at 600mm centres, 40mm above the line of the ceiling.
3. The Rockwool boards should be carefully laid into this cradle of mesh. It is advisable that there should be some compression of the rockwool against the floor joists.
4. Attention to detail is necessary when abutting two pieces of rockwool together end to end. There must be no air gaps which would reduce the fire performance of the system.
5. The joist width should be limited to 75mm maximum width and have a maximum spacing of 600mm centres.

FIG 20. BRADFORD FIRE PROTECTION FOR A FIRE RATED FLOOR/CEILING SYSTEM.



Fire Damper Strip.

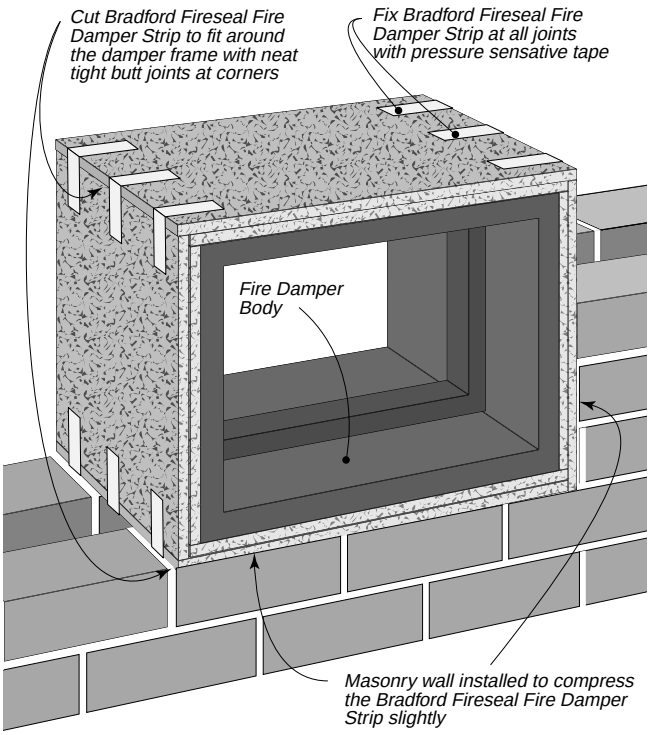
When fitting a fire damper into a new fire rated wall it is important to maintain integrity of the system:

1. The fireproofing gasket shall be Rockwool Fireseal™ Fire Damper Strip installed in layers of 13mm thickness as manufactured by Bradford Insulation.
2. Fire damper strips shall be cut to fit neatly around the frame of the damper, and retained in position using lengths of pressure sensitive tape. The damper strips shall butt firmly at all joins.
3. When the fire rated building section is being completed, the masonry wall around the damper shall compress the strips slightly.
4. The level of fire resistance can be determined from Table 3.

TABLE 3. FIRE RESISTANCE LEVELS.

Width of Insulation	Fire Resistance Level (FRL)
110 mm	NA/30/30
120 mm	NA/60/60
128 mm	NA/90/90
135 mm	NA/120/120
150 mm	NA/180/180
165 mm	NA/240/240

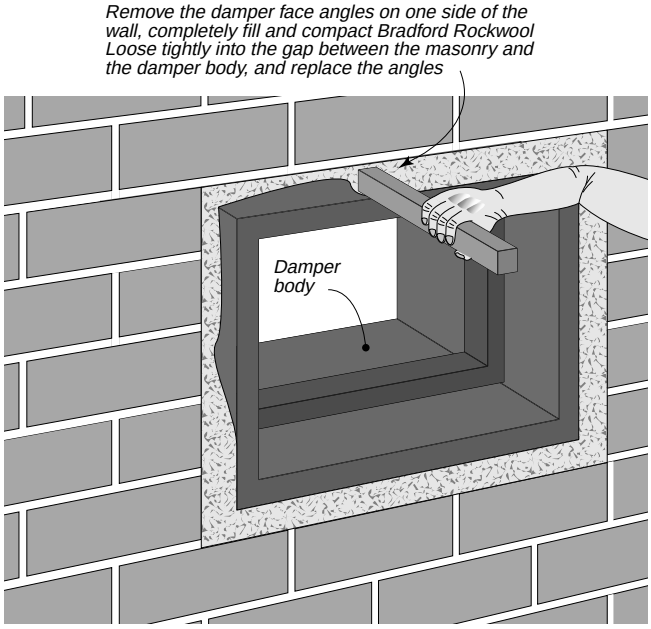
FIG 21. BRADFORD FIRE PROTECTION FOR A FIRE DAMPER INSTALLED DURING THE CONSTRUCTION OF A WALL.



When fitting a fire damper strip into an existing wall:

1. The fireproofing gasket shall be Fireseal™ Rockwool Loose as manufactured by CSR Bradford Insulation
2. The angles on the side of the damper shall be removed and the damper supported centrally in the space provided
3. The insulation material shall be compacted, a little at a time, into the space between the frame of the damper and the masonry, ensuring there are no voids.
4. The metal angles shall be replaced.

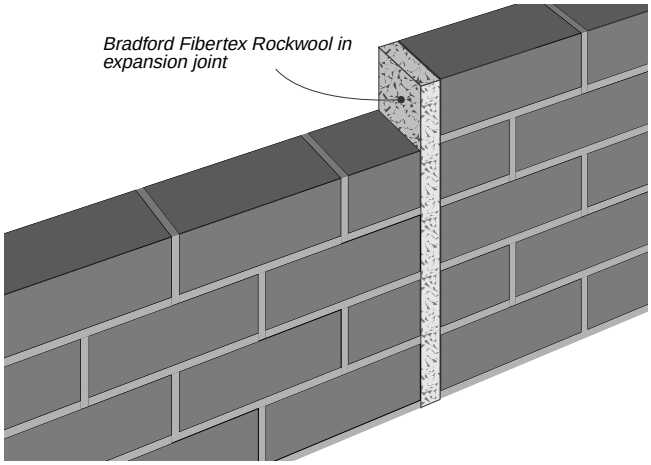
FIG 22. BRADFORD FIRE PROTECTION FOR A FIRE DAMPER IN AN EXISTING MASONRY WALL.



EXPANSION JOINTS.

Bradford Fire Damper Strips may also be used to fill expansion joints as shown in FIG 23.

FIG 23. BRADFORD FIRE PROTECTION FOR AN EXPANSION JOINT IN A FIRE RATED MASONRY WALL.



Penetrations.

AS4072.1 : 1992 'Components for the protection of openings in fire-resistant separating elements', specifies testing requirements and standards for penetrations.

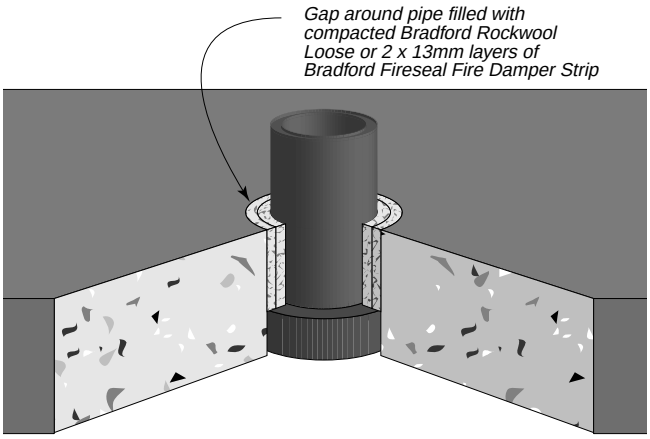
Loose rockwool is commonly used in sealing the gap between service pipes and penetrations through concrete floors. For this to be effective it must be compressed firmly by tamping with a rod.

Alternatively, based on past tests and a current opinion FCO 0725, two 13mm layers of Bradford Rockwool Fireseal Damper Strip wrapped around metal pipes (copper or cast iron) penetrating a concrete slab are capable of providing a 240 minute fire rating for structural adequacy and integrity.

For chilled water piping using polystyrene insulation, Bradford Fibertex™ Rockwool Pipe Insulation has been tested by TICA Qld to be suitable to meet AS4072.1, when installed through the penetration section.

Bradford Insulation also manufactures a range of very high density Rockwool boards for protection of large penetrations against fire ingress.

FIG 24. BRADFORD FIRE PROTECTION FOR A STEEL OR COPPER PIPE THROUGH A CONCRETE FLOOR SLAB.



Fire Protection Spraywool.

Sprayed fire protection insulation systems are commonly used under floor slabs and for fire protection of columns and beams.

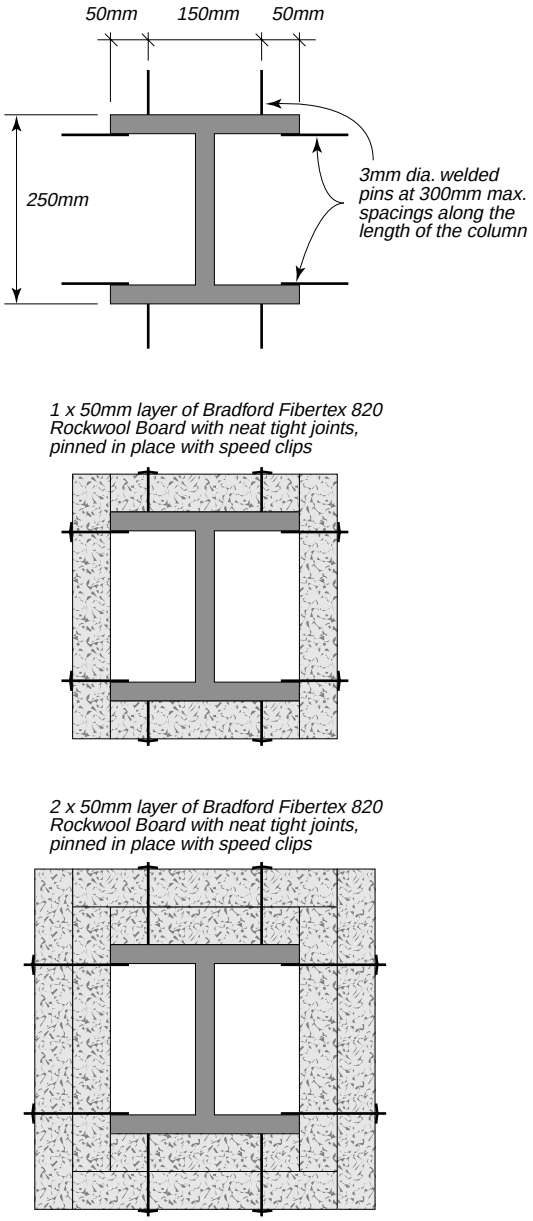
CSR Bradford Insulation manufactures a specialty product for these applications called Bradford Rockwool Spraywool.

For information about sprayed fire protection service providers in your region, please contact your nearest CSR Bradford Insulation office.

Steel Column Fire Protection.

CSR Bradford Insulation manufactures a range of very high density and fire rated Bradford Fibertex™ 820 Rockwool boards for installation around steel columns and beams. FIG 25 shows a typical installation design for these applications.

FIG 25. BRADFORD FIRE PROTECTION FOR A TYPICAL STEEL COLUMN.



Bradford Insulation Marine Applications.

Principles of Marine Fire Protection.

Bradford Insulation has been supplying the marine industry in Australia and Asia for many years. Rockwool and glasswool have been specified for fire protection, as well as thermal and acoustic performance.

The strong growth of the shipbuilding and maintenance industry in the Asia/Pacific region reinforced the need for CSR Bradford Insulation to continue its focus in this developing segment.

CSR Bradford Insulation products are manufactured to the highest standards of quality in facilities located in Australia and Asia. CSR Bradford Insulation products are tested to conform to the regulations of the International Maritime Organisation (IMO) which convenes with the International Convention on Safety of Life at Sea (SOLAS).

In areas where fire resistance is necessary for compartmentation, rockwool has been the preferred choice among ship builders, naval architects and government authorities.

Rockwool has been proven to be an economical, high performance insulating material with a fusion temperature in excess of 1150°C.

MARK OF CONFORMITY.

Since 1997 a 'Directive on Marine Equipment' has been in force in the European Economic Area (EEA). The mark of Conformity confirms that equipment complies with the Maritime Equipment Directive as well as other applicable Directives.

The Council of the European Union issues Directives for products being placed on the EEA market, defining conditions for free trade and essential health and safety requirements. This implies that the Class Societies (Det Norske Veritas (DNV), Lloyds Register of Shipping (LRS), American Bureau of Shipping (ABS), Bureau Veritas (BV), China Classification Society (CCS/ZC), etc. are no longer able to monopolise the approval process in Europe as they have done previously.

Classification Authorities must accept each others approvals and testing. This new standard is referred to as the 'CE Marking'.

The Marine Equipment Directive 96/98/EC as amended by 98/85/EC is mandatory for all new ships and existing ships not previously carrying such equipment.

In particular the Directive applies to rockwool and glasswool in fire protection applications. All products and systems offered by Bradford Insulation comply with the FTP Code 'International Code for Application of Fire Test Procedures' as published by IMO 1998 (International Maritime Organisation) Resolution MSC.61(67). This Resolution convenes the international Convention on Safety of Life At Sea (SOLAS).

A-CLASS DIVISIONS.

This series of tests is suitable for use in passenger ships, cargo ships and fishing vessels. Fire insulation is used to protect an area from the influence of a fire in an adjoining area by having separating performance during fire. Such constructions are A-class bulkheads and decks. Bulkheads are tested vertically whereas deckheads are tested horizontally to simulate real fire conditions.

PERFORMANCE CRITERIA.

The average unexposed face temperature rise should not be more than 140°C, and the temperature rise recorded by any thermocouples should not be more than 180°C during the periods given below for each classification:

Class 'A-60'	60 minutes
Class 'A-30'	30 minutes
Class 'A-15'	15 minutes
Class 'A-0'	0 minutes

'B' Class divisions allow for a temperature rise of up to 225°C above the original temperature.

FIG 26. BRADFORD MARINE FIRE PROTECTION SYSTEM DURING TESTING.

Installation Recommendations.

The marine specification can be used in the following applications but not limited to:

- A-class ship decks and bulkheads;
- General passenger facilities;
- Accommodation;
- Engine rooms;
- Air-conditioning machine rooms;
- Doors and panels;
- Ducts;
- Aluminium or steel construction.

1. The fire proofing insulation shall be Bradford Fibertex™ 820 Rockwool as manufactured by CSR Bradford Insulation. The thickness of the insulation shall be .....*mm* in accordance with the DNV EC-Type Examination Certificate.
2. The board or blanket must be carefully attached to the structural steel/aluminium bulkhead or deckhead using fixing pins. These pins are usually welded to the core, each insulation piece is firmly pressed over the pin and secured in position by a circular locking washer also referred to as a 'speed clip'.
3. Attention to detail is necessary when abutting two pieces of rockwool together. There must be no air gaps which will reduce the fire performance of the system.
4. Where two separate layers of rockwool are required, sheets should be staggered to ensure joints in adjacent layers do not coincide. Refer to system drawings.
5. It is recommended that when attaching two pieces of rockwool together a spiral pin be used.
6. Where a covered fire insulation finish is required for aesthetic purposes it is recommended that glass fibre cloths between 200 – 400g/m^2 be used. These coverings are easily cleaned and provide low maintenance to trafficable areas. For additional information contact the manufacturer direct. It may also possible to use aluminium foil as an alternative.
7. Glass fibre cloth tapes are also available for taping separate products together. These products must have a low flame spread to satisfy these stringent conditions.

For steel ship applications, refer to CSR Bradford Insulation drawings SD001 and SB002.

For aluminium ship applications, refer to CSR Bradford Insulation drawings AD001 and ALB002.

UNCOVERED FIRE INSULATION.

This is a common application in areas that are behind other constructions and visibly not important to specifiers.

The Bradford Insulation products Bradford Fibertex™ 820 Rockwool satisfies classifications for:

- non-combustibility in accordance with IMO Res. A. 799 (19); and
- Fire Protection for aluminium and steel constructions of Class A-0, A-15, A-30; and A-60 for both bulkheads and deckheads to IMO Res. A. 754 (18).

'A' Class divisions which consist of an uninsulated steel bulkhead or deckhead and without openings can be deemed to satisfy the requirements for class A-0 divisions, ie, satisfy the requirements for the passage of smoke and flame, without the need for testing.

Cores of aluminium are required to be tested to gain A-0 class divisions.

COVERED FIRE INSULATION.

Where a clean finish is necessary Bradford Fibertex™ 820 Rockwool is available with a prefinished fire rated cloth or aluminium foil. This is suitable for car decks and engine rooms where the insulation is the final surface.

This satisfies classifications for:

- non-combustibility in accordance with IMO Res. A. 799 (19); and
- Fire Protection for aluminium and steel constructions of Class A-0, A-15, A-30; and
- A-60 for both bulkheads and deckheads to IMO Res. A. 754 (18).

UNCOVERED THERMAL INSULATION.

In certain parts of a ship there is no fire protection requirement, however all insulation material used must comply with the strict guidelines of IMO Res. A. 799 (19) for non-combustibility.

This is generally lightweight insulation which is primarily installed to provide thermal resistance between bulkheads and deckheads.

As well as thermal benefits there are also acoustic benefits to be gained in applications such as partitions and ceilings. For further details regarding the acoustic performance of these products please refer to the Bradford Insulation Acoustic Design Guide.

Tested insulation materials to IMO Res. A. 799 (19) for non-combustibility can be used in 'A', 'B' and 'C' class divisions.

Bradford Insulation Marine Fire Protection Systems.

CSR Bradford Insulation has developed a number of marine fire protection insulation systems.

System development was undertaken initially at the CSR Building Materials Research Laboratories, Sydney, Australia. Full scale testing was conducted by the CSIRO Building Construction and Engineering Fire Research facilities, Sydney, Australia to IMO test standards. EC Type – Examination Certificates were issued by Det Norske Veritas (DNV) under Council Directive G6/98/EC of 20 December, 1996 in Marine Equipment.

Copies of test reports and marine certificates are available on request from any Bradford Insulation office in Australia, New Zealand or Asia.

ALUMINIUM SHIPS.

- **A60 Deckhead – System Description**

The system comprised an aluminium deckhead section lined on the exposed face with one layer of 50mm thick 110kg/m^3 and one layer of 25mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets.

The aluminium deckhead assembly included a 6mm plate stiffened at 600mm centres by 150mm x 100mm x 10mm aluminium angle sections. The ends of the sample were stiffened by 150mm x 10mm aluminium flat plates.

Aluminium pins (3mm diameter x 85mm long) were welded to the exposed side of the deckhead stiffeners in places indicated in drawing AD001.

The deckhead was insulated with 1 layer of 50mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets applied across the tops of the stiffeners.

A second layer comprising 25mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets was similarly applied. Sheet joints in adjacent layers were staggered a minimum of 30mm.

Each Rockwool sheet in each layer was firmly butted against each other to ensure tight joints. Both layers were fixed in place with speed clips and restrained by 0.7mm diameter steel wire wrapped around the pins in a diagonal formation.

Bradford Insulation standard production sizes such as 1500 x 900mm, 1200 x 750mm or 1200 x 600mm can be used, provided joints in adjacent layers do not coincide. Pins and wiring should be installed to ensure minimal sheet deflection.

Construction is detailed in drawing AD001 dated 19 February 2001, by CSR Bradford Insulation.

- **A60 Bulkhead – System Description**

The system comprised an aluminium bulkhead section 2480mm high and 2420mm wide, lined on the exposed face with one layer 38mm thick 110kg/m^3 and one layer of 25mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets.

The aluminium bulkhead assembly included a 6mm plate stiffened at 600mm centres by 100mm x 75mm x 9mm aluminium angle sections. The ends of the sample were stiffened by 100mm x 9mm aluminium flat plates. The bulkhead was fabricated as per specifications described in clause 2.1 of International Maritime Organization, Fire Test Procedures Resolutions A. 754 (18).

The bulkhead was insulated with 1 layer of 25mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets applied across the tops of the stiffeners.

A second layer comprising 38mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets was similarly applied. Sheet joints in adjacent layers were staggered a minimum of 50mm.

Each rockwool sheet in each layer was firmly butted against each other to ensure tight joints. Both layers were fixed in place with 28mm diameter speed clips.

Bradford Insulation standard production sizes such as 1500 x 900mm, 1200 x 750mm or 1200 x 600mm can be used, provided joints in adjacent layers do not coincide.

Construction is detailed in drawings ALB002 dated 19 April 2001, by CSR Bradford Insulation.

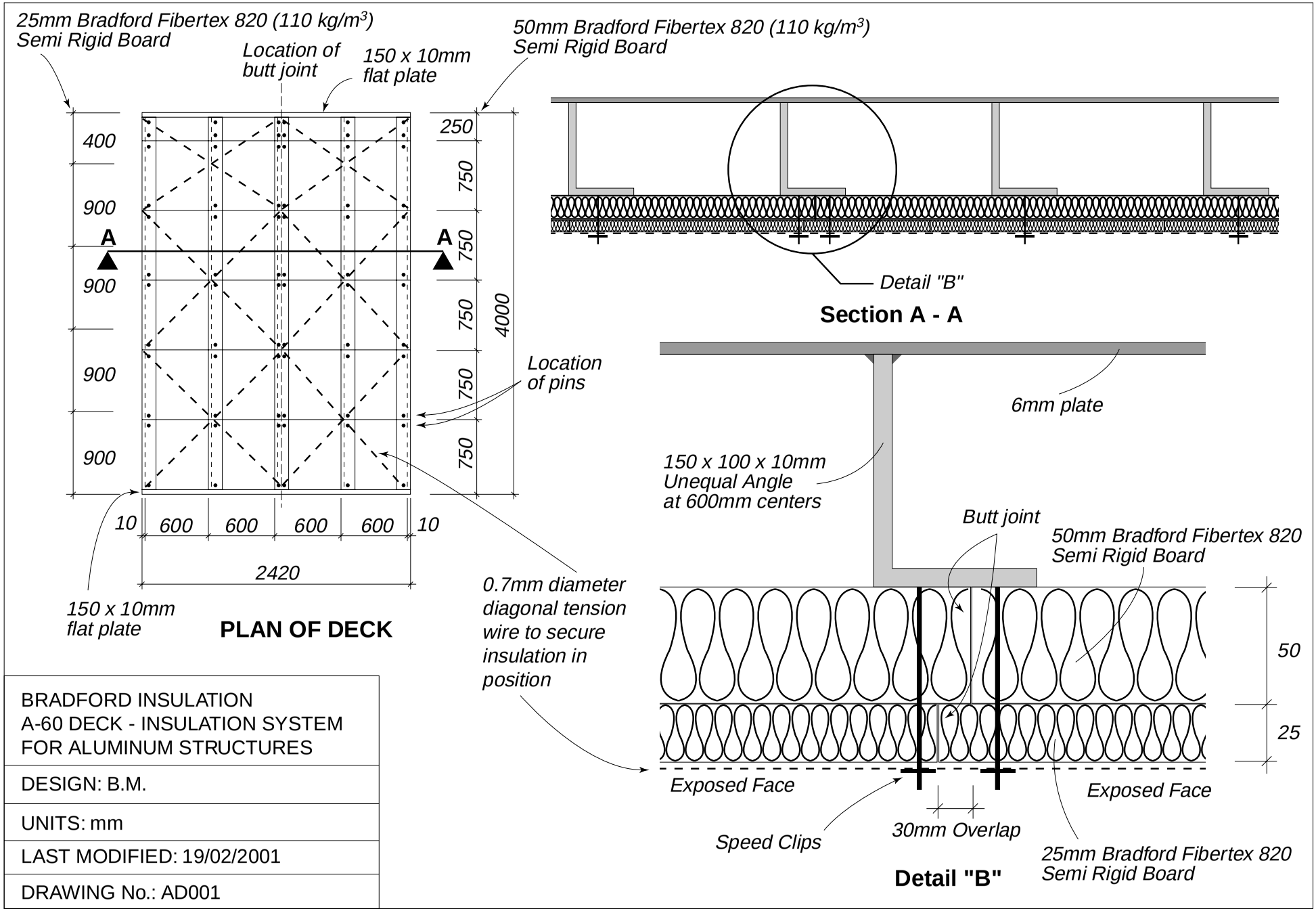
- **A30 Deckhead – System Description**

The system comprised an aluminium deckhead section lined on one side with Bradford Fibertex™ HT Rockwool 90kg/m^3 and clad with 0.4mm galvanised mild steel sheeting.

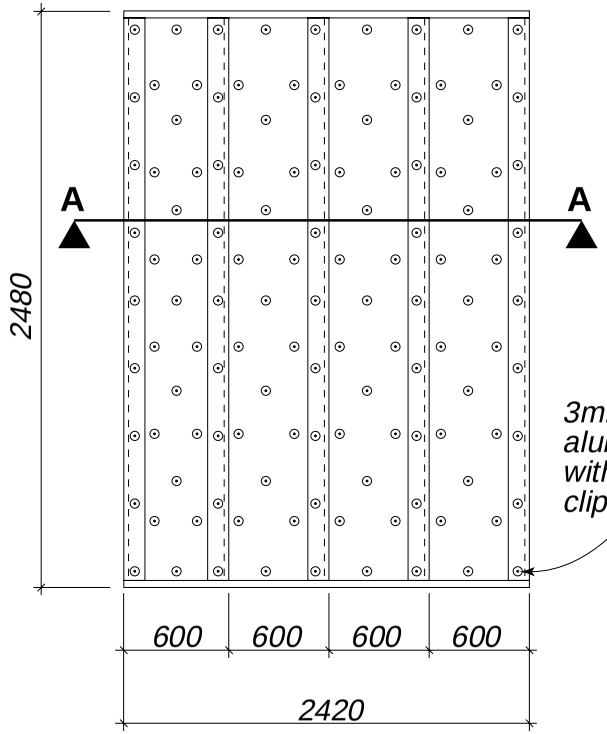
The deckhead, nominally 2440mm wide x 4000mm long was constructed from 6mm thick aluminium deck plate and four 150mm x 100mm x 9mm aluminium angle stiffeners spaced at 600mm centres.

The deckhead was insulated with one layer of 50mm thick x 90kg/m^3 Bradford Fibertex™ HT Rockwool with batts butt jointed. The batts were laid across the angle stiffeners of the deckhead and clad with 0.4mm thick galvanised mild steel sheeting. The sheets were fixed in place by speed clips.

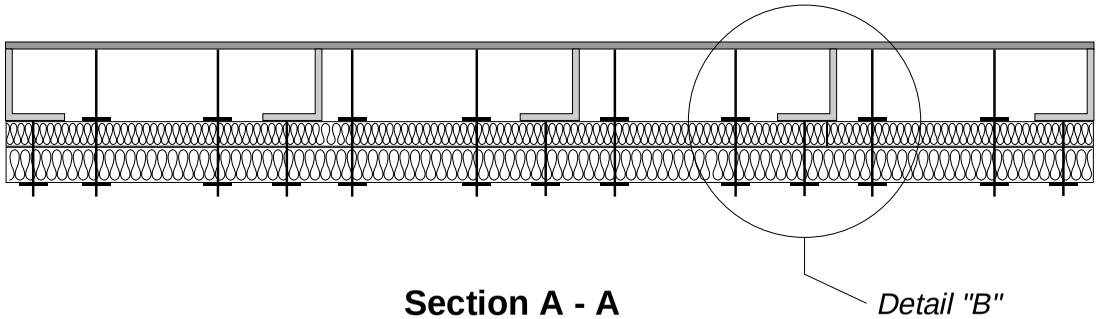
Certification pending at the time of publication.



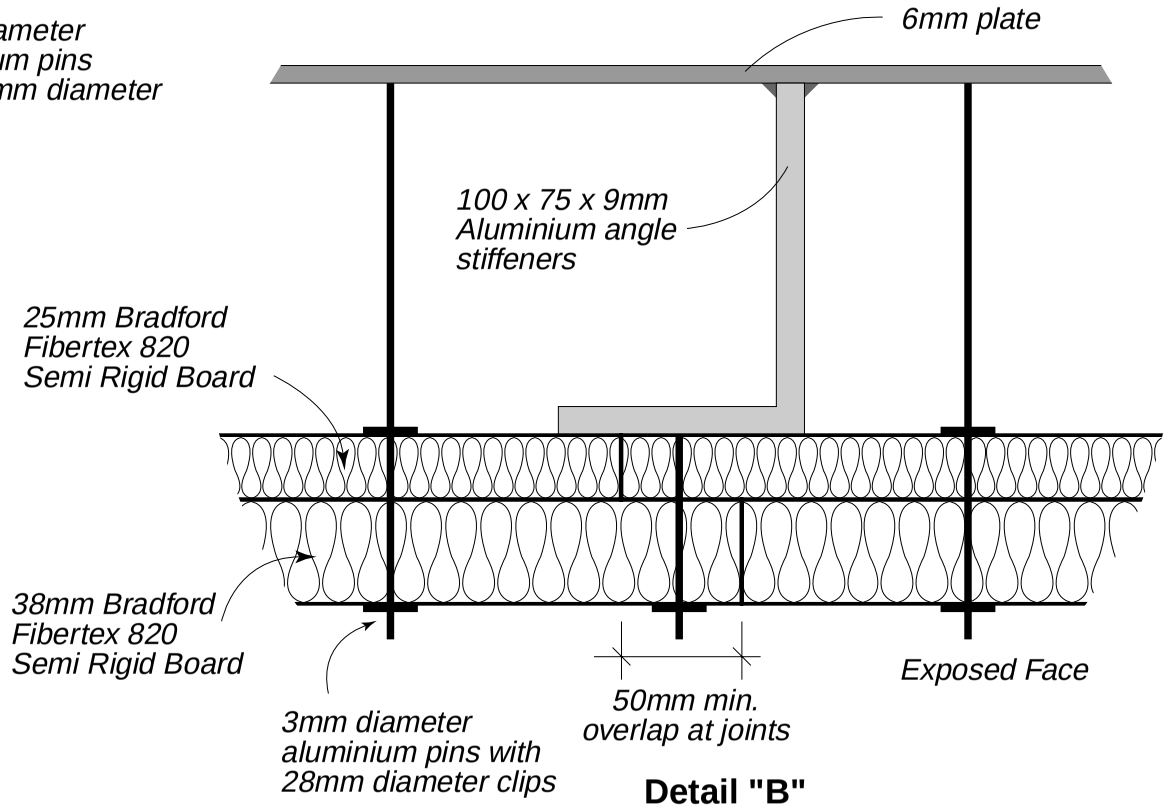
BRADFORD INSULATION A-60 DECK - INSULATION SYSTEM FOR ALUMINUM STRUCTURES
DESIGN: B.M.
UNITS: mm
LAST MODIFIED: 19/02/2001
DRAWING No.: AD001



PLAN VIEW



Section A - A



Detail "B"

A-60 ALUMINIUM BULKHEAD INSULATED WITH 110 kg/m^3 FIBERTEX ROCKWOOL 820 BOARD
DESIGN: BRADFORD INSULATION
UNITS: mm
LAST MODIFIED: 1/7/01 BMS
DRAWING No.: ALB002

STEEL SHIPS.

- **A60 Deckhead – System Description**

The system comprised a steel deckhead section lined on the exposed face with one layer of 50mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets.

The steel deckhead assembly included a 5mm plate stiffened at 600mm centres by 100mm x 70mm x 8mm steel angle sections. The ends of the sample were stiffened by 100mm x 8mm steel flat plates. The Deckhead was fabricated as per specifications described in clause 2.2 of International Maritime Organization, Fire Test Procedures Resolution A 754 (18). Details of the steel deckhead construction are shown in drawing SD001.

Steel pins (3mm diameter x 75mm long) were welded to the exposed side of the deckhead stiffeners in places indicated in drawing SD001.

The deckhead was insulated with 1 layer of 50mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets applied across the tops of the stiffeners. Each rockwool sheet was firmly butted against each other to ensure tight joints. The sheets were fixed in place with speed clips.

Bradford Insulation standard production sizes such as 1500 x 900mm, 1200 x 750mm or 1200 x 600mm can be used.

Construction is detailed in drawing SD001 dated 16 February, 2001, by CSR Bradford Insulation.

- **A60 Bulkhead – System Description**

The system comprised a steel bulkhead section 2480mm high and 2420mm wide, lined on the exposed face with one layer of 25mm thick 110kg/m^3 and one layer of 38mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets.

The steel bulkhead assembly included a 6mm plate stiffened at 600mm centres by 65mm x 65mm x 6mm steel angle sections. The ends of the sample were stiffened by 65mm x 6mm steel flat plates.

Steel pins (3mm diameter x 160mm long) were welded to the exposed side of the bulkhead plate and stiffeners in places indicated in drawing SB002.

The bulkhead was insulated with 1 layer of 25mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets applied across the tops of the stiffeners.

A second layer comprising 38mm thick 110kg/m^3 Bradford Fibertex™ 820 Rockwool insulation sheets was similarly applied. Sheet joints in adjacent layers were staggered a minimum of 50mm.

Each Rockwool sheet in each layer, was firmly butted against each other to ensure tight joints. Both layers were fixed in place with speed clips.

Construction is detailed in drawing SB002, dated 2 July, 2001, by CSR Bradford Insulation.

General Purpose Marine Insulation

NON-COMBUSTIBILITY.

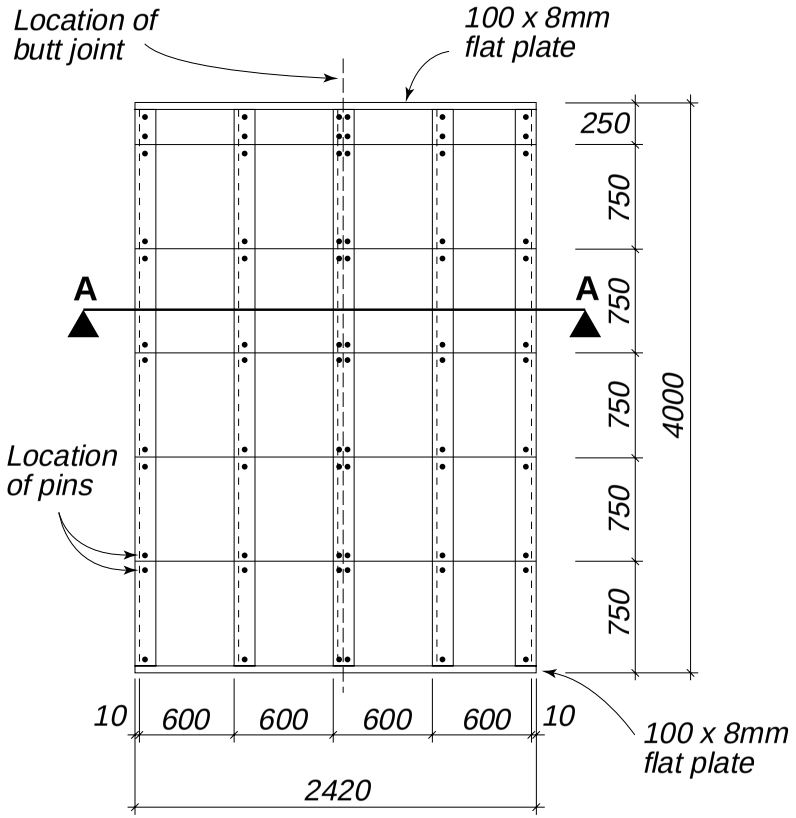
Non-combustible material is a material which neither burns nor gives off flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C. Any other material is a combustible material.

Bradford Fibertex™ 820 Rockwool

Bradford Fibertex™ 820 Rockwool products are certified as 'non combustible materials' for use in 'A', 'B' and 'C' class dimensions in an EC-Type examination certificate issued by Det Norske Veritas under council directive 96/98/EC of 20 December 1996 in Marine equipment, and complies with IMO standards and SOLAS regulations.

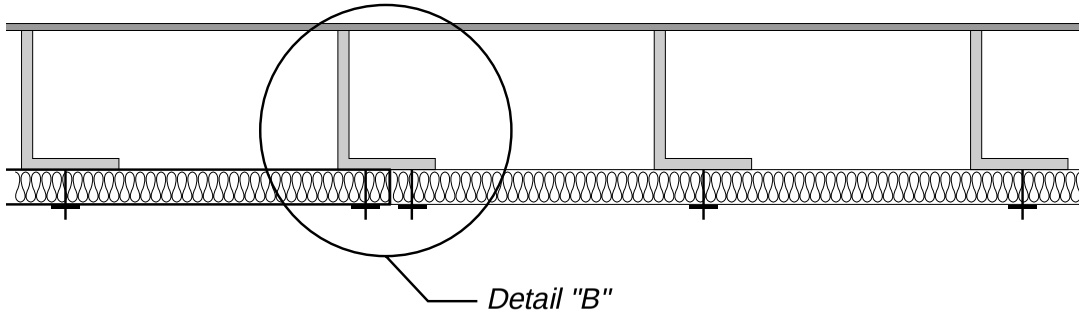
Bradford Glasswool Marine Thermal Grade

Bradford Glasswool Marine Thermal Grade has similarly been certified as 'non-combustible' for use in marine applications under IMO standards and SOLAS regulations.

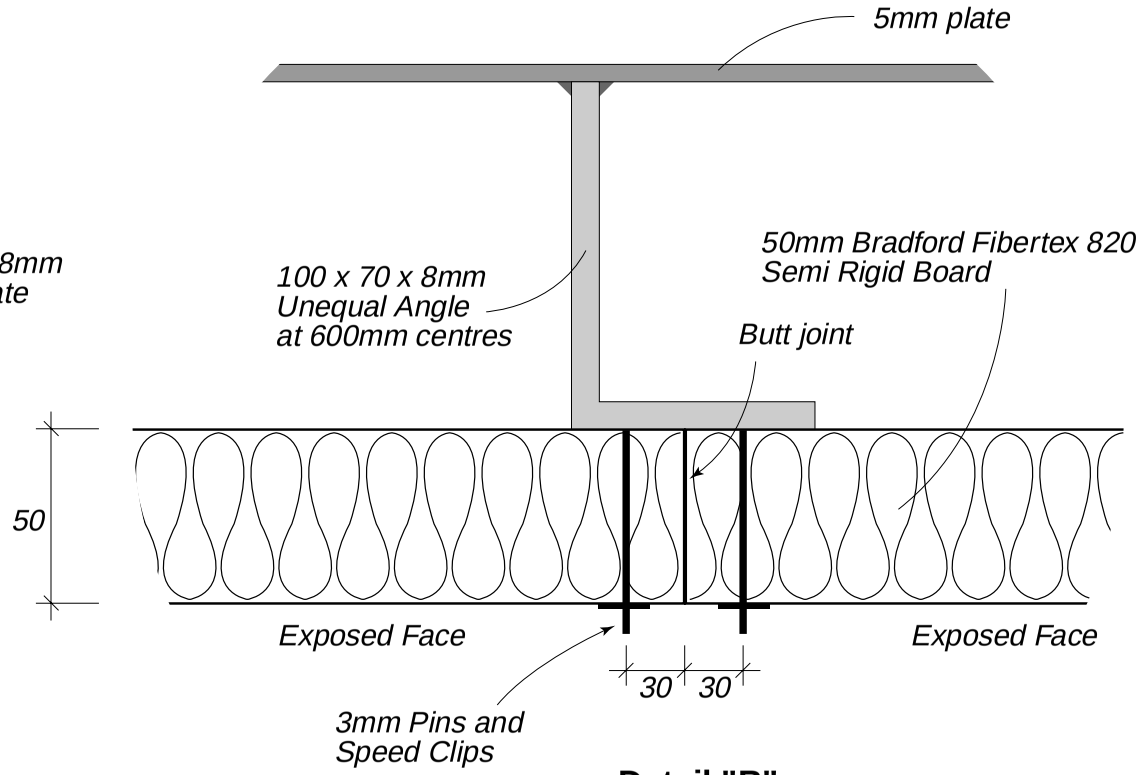


PLAN OF DECK

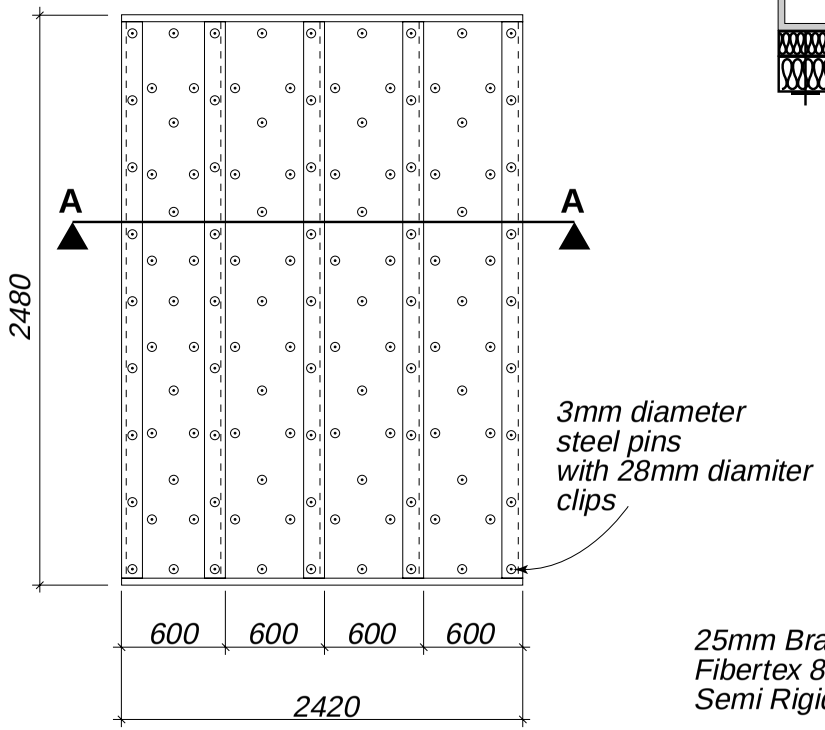
BRADFORD INSULATION A-60 DECK - INSULATION SYSTEM FOR STEEL STRUCTURES
DESIGN: B.M.
UNITS: mm
LAST MODIFIED: 16/02/2001 BMS
DRAWING No.: SD001



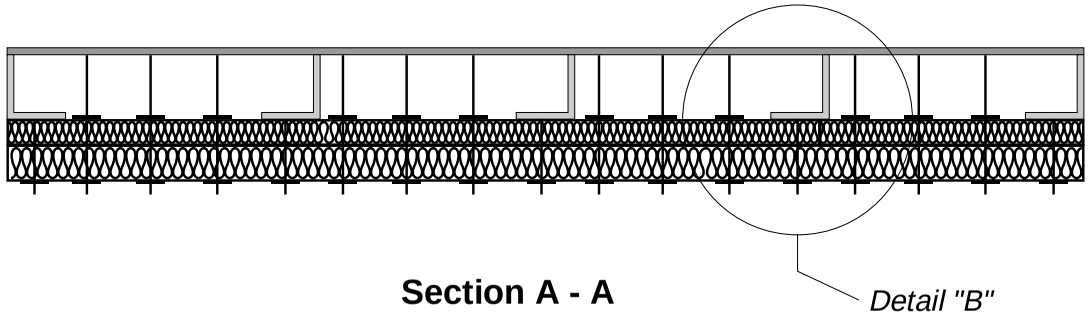
Section A - A



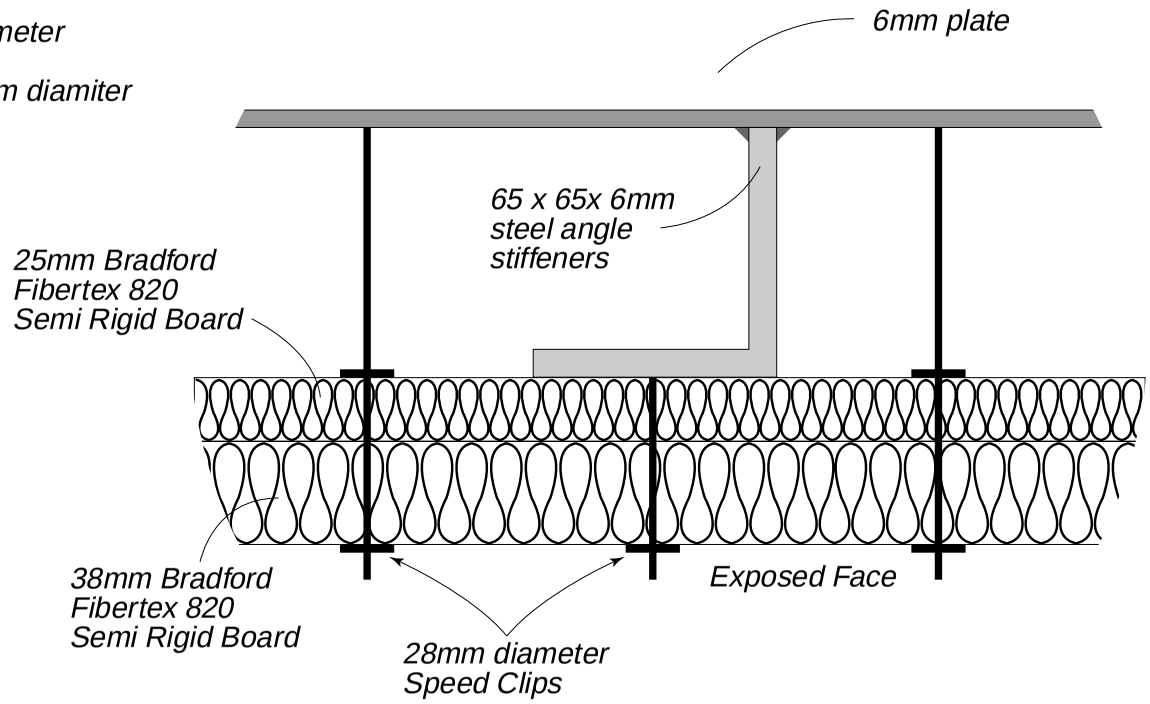
Detail "B"



PLAN VIEW



Section A - A



Detail "B"

A-60 STEEL BULKHEAD INSULATED WITH 110 kg/m^3 FIBERTEX ROCKWOOL 820 BOARD
DESIGN: BRADFORD INSULATION
UNITS: mm
LAST MODIFIED: 2/7/01 BMS
DRAWING No.: SB002

APPENDIX A.

Frequently Asked Questions and Answers.

Q. Which insulation type is most suitable for fire protection in curtain walling?

A. Bradford Rockwool Spanseal™ and Curtain Wall Batts are recommended because of their ability to withstand elevated temperatures generated in a fire. It is one of the few products to have been successfully tested in a full scale fire test to prevent vertical flame spread. This system can provide up to 2 hours fire protection.

Q. Why are spandrels insulated?

A. Spandrels in buildings are insulated for three reasons namely, fire protection, thermal resistance, and noise control.

Q. Do I require a masonry wall or fire rated stud wall behind the curtain wall?

A. No, when the Bradford Fireseal system is specified it is not necessary to construct an additional masonry wall as suggested in the Building Code of Australia to achieve an FRL of 60/60/60.

Q. Can standard Rockwool be used in marine applications?

A. No. Only products tested to IMO standards and issued with a valid approval certificate can be used.

Q. What facings are suitable for use in fire rated systems?

A. Many facing materials such as foil laminates are not suited to some fire rated applications. The best facing products for fire protection applications are aluminium foil and woven glass cloths.

Q. Do ducts insulated with Bradford Insulation pass UL181?

A. The UL181-16 burning test is designed to test the entire duct system. The duct insulation system will pass using Bradford insulation provided a fire rated tape such as PPC494 is used. The use of non fire rated tapes for fastening insulation or sleeve can cause the system to fail the test.

APPENDIX B.

Terminology.

Fire Resistance Level	This is a measure of the effectiveness of the system to prevent the ingress of fire. It is normally classified in terms of structural adequacy, integrity and insulation in minutes.
Flame Spread	The rate at which a material will propagate flame on its surface.
Non-combustible	A material which will not contribute heat or fuel to a fire.
Curtain Wall	Outside skin or shell of a building that is supported off each individual slab level.
Spandrel Insulation	Solid wall element below the window sill of a building which is fitted with glasswool or rockwool insulation.
Vision Glass	This is the portion of the curtain wall above the spandrel.
Firesafing	Rockwool mineral fibre installed to the cavity between the edge of the slab and the curtain wall frame. Its purpose is to impede fire and smoke.
Binder	The cementing material that binds the fibres of mineral wool products together.
Decibel (dB)	A logarithmic measure of sound levels of the ratio of two comparable sound intensities.
Fire resistance	Property of a construction to resist deterioration when exposed to a fire.

CSR™

Bradford Insulation

CSR Building Solutions Website.
www.csr.com.au/bradford

Manufacturing Facilities.

CSR Bradford Insulation is a leading insulation manufacturer in Australia and Asia with manufacturing facilities located throughout the region.

AUSTRALIA.

Glasswool factory, Ingleburn NSW.

Rockwool factory, Clayton VIC.

Thermofoil factory, Dandenong VIC.

ASIA.

Glasswool factory, Zhuhai, China.
Rockwool factory, Dongguan, China.
Rockwool factory, Rayong, Thailand.
Rockwool factory, Kuala Lumpur, Malaysia.
Flexible Duct factory, Singapore.

Sales Offices.

AUSTRALIA.

State	Phone	Fax
Head Office	61 2 9765 7100	61 2 9765 7029
NSW	(02) 9765 7100	(02) 9765 7052
ACT	(02) 6239 2611	(02) 6239 3305
VIC	(03) 9265 4000	(03) 9265 4011
TAS	(03) 6272 5677	(03) 6272 2387
QLD	(07) 3875 9600	(07) 3875 9699
SA	(08) 8344 0640	(08) 8344 0644
NT	(08) 8984 4070	(08) 8947 0034
WA	(08) 9365 1666	(08) 9365 1656

INTERNATIONAL.

Country	Phone	Fax
New Zealand	64 9579 9059	64 9571 1017
Hong Kong	852 2754 0877	852 2758 2005
China (Glasswool)	86 756 551 1448	86 756 551 1447
China (Rockwool)	86 769 611 1401	86 769 611 2900
Thailand	66 2736 0924	66 2736 0934
Malaysia	60 3 3341 3444	60 3 3341 5779
Singapore	65 861 4722	65 862 3533

Health and Safety Information.

Information on any known health risks of our products and how to handle them safely is displayed on the packaging and/or the documentation accompanying them. Additional information is listed in product Material Safety Data Sheets available from your regional CSR Bradford Insulation office or visit our website.

Warranty.

CSR Limited warrants its Bradford Insulation products to be free of defects in materials and manufacture. If a CSR Bradford Insulation product does not meet our standard, we will, at our option, replace or repair it, supply an equivalent product, or pay for doing one of these. This warranty excludes all other warranties and liability for damage in connection with defects in our products, other than those compulsorily imposed by legislation.

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