Roof Construction and Insulation Materials

Guidance Material

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Roof and Insulation Materials

The insurance industry has become increasingly “risk selective” over recent years as the market hardens in response to reduced profitability driven by an upswing in the quantum and frequency of claims, particularly natural catastrophe losses along with ongoing traditional fire losses resulting from the past use of flammable construction and insulation materials.

Insurers continue to write “good quality risks” with moderate rate increases, however “poor quality risks” are likely to be subject to significant rate increases, reduction in cover and increases in sub-limits. In certain instances, insurers may have no appetite to underwrite poor quality risks, leaving some with-out insurance and with no alternative but to self-insure.

Property insurers consider a good quality risk to be one that:

- Actively employs Construction Occupancy Protection and Exposure (COPE) risk management principles and processes when assessing property risks
- Mitigates and minimises their exposures so far as reasonably practicable
- Only uses construction materials that are tested to reputable test standards
- Closely manages contracts, contractors, and suppliers
- Designs and delivers highly protected assets
- Considers asset protection not just compliance with NCC requirements

Fire Tests

To ensure that materials will perform as expected when involved in a fire, testing to reputable test standards is critical. There are a range of International, Australian, and American fire test methods and standards. In general terms large-scale fire tests or corner tests will provide a better indication of material performance than small scale fire tests. This is because small-scale tests are conducted on a benchtop using small quantities of material in a small furnace which does not always represent the behaviour of materials under real fire conditions. Appendix 1 contains links to the different types of fire tests.

When selecting construction materials, approvals provide an excellent insight into the fire performance of various products. The most reputable approvals include Underwriters Laboratory (UL) and Factory Mutual (FM) approvals. Check the technical data sheets for

test results and approvals.

Impact Tests

Hail impact is one of the most damaging and destructive weather events and can lead to expensive product replacement costs. It is crucial during product qualification, especially for aircraft, automobiles, solar panels, and building materials, that hail impact resistance is both tested and understood.

Hail impact testing helps assess a material or product's durability when exposed to hail strike at high velocities up to 700mph and temperatures as low as -20C. Tests are simulated with ice or metal spheres as large as 2 inches. Appendix 2 contains links to the different types of impact tests. Highly Protected Risk

A Highly Protected Risk (HPR) is property assets that are judged to be subject to a much lower than normal probability of loss by virtue of low hazard occupancy or property type, superior construction, special fire protection equipment and procedures, and management commitment to loss prevention.

Beyond Compliance

Whilst compliance with the National Construction Code (NCC) is vitally important to address minimum life safety and climatic zone construction requirements, these codes do not necessarily address matters of best practice asset protection. The proposed construction techniques and intended occupancy should be considered in the context of a buildings' unique risk exposures when deciding upon the type of material to be used and the detection and protection to be installed. The NCC minimum requirements sometimes leave buildings exposed to risks that can be mitigated by thoughtful design, specification, and protection beyond compliance with these codes.

About this Guidance Material

This guideline relates to roofing and insulation materials used in new construction or major refurbishments of existing buildings. Its purpose is to identify materials that should be avoided due to either increased risk of involvement in a fire and potential for flame spread (vertical and horizontal) or which may perform less favourably under strong wind or large hail conditions.

This guide is not intended to be a comprehensive review of all the types of roofing and insulation materials available for use in construction, rather to identify the broad categories of materials, their flammability ratings and hail resistance and some of the other risks associated with those materials.

It is important to understand and interpret the various test results. This is often made simpler by referring to the product approvals, particularly those issued by Underwriters Laboratories (UL) or Factory Mutual (FM). Where available, products with these approvals should be incorporated into construction specifications. Check the technical data sheets for test results and approvals.

Types of roofing and insulation materials

Type of Roofing	Flammability	Hail resistance	Risks	Comments
Terracotta tiles on wood beams, rafters, and purlins	Moderate	Low	• Fire in roof top or ceiling cassette air conditioners • Electrical wiring short circuits • Hail damage • Wind damage	• Beams, rafters, and purlins will become involved in a fire. • Where there are roof top solar arrays, fighting a roof space fire may be difficult. • Large hail will damage terracotta tiles • May be subject to wind damage
Concrete tiles on wood beams, rafters, and purlins	Moderate	Moderate - High	• Fire in roof top or ceiling cassette air conditioners • Electrical wiring short circuits • Hail damage • Wind damage	• Beams, rafters, and purlins will become involved in a fire. • Where there are roof top solar arrays, fighting a roof space fire may be difficult. • Large hail may crack some concrete tiles • May be subject to wind damage
Timber slats on wood beams, rafters, and purlins	High	Moderate	• Fire in roof top or ceiling cassette air conditioners • Electrical wiring short circuits • Hail damage • Wind damage	• Beams, rafters, purlins, and timber slats will become involved in a fire. • Large hail may damage some timber slats • May be subject to wind damage
Slate tiles on wood beams, rafters, and purlins	Moderate	Low-moderate	• Fire in roof top or ceiling cassette air conditioners • Electrical wiring short circuits • Hail damage • Wind damage	• Beams, rafters, and purlins will become involved in a fire. • Large hail will damage slate tiles • May be subject to wind damage

Type of Roofing	Flammability	Hail resistance	Risks	Comments
Screw fastened metal roof on wood beams, rafters, and purlins	Moderate	Moderate - high	• Fire in roof top or ceiling cassette air conditioners • Electrical wiring short circuits • Hail damage • Wind damage	• Beams, rafters, and purlins will become involved in a fire, but metal sheets will not promote a fire • Smoke damage may lead to corrosion of metal sheets • Where there are roof top solar arrays, fighting a roof space fire may be difficult. • Large hail will create dents which may lead to corrosion and partial or full roof replacement. • Edge fastening to avoid wind damage
Screw fastened metal roof (includes all forms of metal roof sheeting) on metal beams, rafters, and purlins	Low	Moderate - High	• Hail damage • Wind damage	• Smoke damage may lead to corrosion of metal sheets, beams, and rafters • Where there are roof top solar arrays, fighting a roof space fire may be difficult. • Large hail will create dents which may lead to corrosion and partial or full roof replacement. • Edge fastening to avoid wind damage
Concealed cliplok on metal beams, rafters, and purlins	Low	Moderate	• Hail damage • Wind damage	• Smoke damage may lead to corrosion of metal sheets, beams, and rafters • Where there are roof top solar arrays, fighting a roof space fire may be difficult. • Large hail may lead to clip damage and sheet dents and corrosion resulting in partial or full roof replacement. • Hail can damage the concealed clips. Heavy accumulations can also lead to failure of cliplok systems. • Edge fastening to avoid wind damage

Type of Roofing	Flammability	Hail resistance	Risks	Comments
Cross Laminated Timber	Low-Moderate	High	• Water staining • Mould development • Delamination	• Pre-treat with fire retardant and water repellent • Charring of timber surfaces will occur but should not burn through unless the fire is not promptly controlled. • Steel joints tend to be the failure point in a fire. • Good hail resistance when used as roof sheeting.
Flat concrete trafficable membrane on reinforced concrete or steel beams	Low	High	• Water ingress • Hail damage to exposed roof top plant	• Excellent fire, hail, and wind resistance • Water ingress from internal box gutters can occur
Flat concrete membrane with ballast on reinforced concrete or steel beams	Low	High	• Water ingress • Hail damage to exposed roof top plant	• Excellent fire, hail, and wind resistance • Water ingress from internal box gutters can occur
Built up roof – bitumen membrane above vapour barriers on a metal deck	Low- Moderate	Moderate to high	• Hail damage to roof top plant • Wind damage	• UL and FM approved built up roofs. • Flammability increases with thickness of layers of bitumen • Water ingress from internal box gutters can occur
Glazing over central atriums	Low	Moderate	• Hail damage	• Toughened glass will provide greater hail resistance
Skylights and polycarbonate sheeting	Moderate	Moderate	• Hail damage • Water ingress	• Polycarbonate sheeting will melt when involved in a fire. • Polycarbonate sheeting will become brittle after prolonged exposure To UV and become susceptible to hail damage.

Type of Roofing	Flammability	Hail resistance	Risks	Comments
Standard grade glass for glasshouses	Low	Low	• Hail damage	• Likely to be damaged by hail greater than 2cm in diameter
Plexiglass for glasshouses	Low	Low – moderate	• Hail damage	• Likely to be damaged by hail greater than 2cm in diameter • Will melt when involved in a fire
PV panels	Low	Moderate	• Hail damage • Short circuits can lead to wiring fires • Difficulties fighting roof fires	• Amount of hail damage will vary depending upon orientation of panels. • Microcracks might not appear until some months after hail impact. • Isolation switches should be easily accessible, ideally at the ground floor • Firefighting strategy should be discussed with the Fire Brigade
Kingspan polyisocyanurate	Low - moderate	Moderate	• Hail damage • Wind damage	• FM approved 4880 & 4881 • Will likely char in a fire and require replacement
MetecnoSpan	Low - moderate	Moderate	• Hail damage • Wind damage	• FM approved 4880 & 4881 • Will likely char in a fire and require replacement
Purline (EPS)	High	Moderate	• Hail damage • Will become involved in a fire • Smoke damage	• Not FM approved • Highly combustible • Will produce large amounts of soot
Equideck (EPS)	High	Moderate	• Hail damage • Will become involved in a fire • Smoke damage	• Not FM approved • Highly combustible • Will produce large amounts of soot

Type of Roofing	Flammability	Hail resistance	Risks	Comments
SolarSpan (EPS)	High	Moderate	• Hail damage • Will become involved in a fire • Smoke damage	• Not FM approved • Highly combustible • Will produce large amounts of soot
Ethylene Tetrafluoroethylene (ETFE roofing systems)	Low	Low-Moderate	• Hail damage • Will be damaged by fire	• NFP 92-505 - M2 • NFPA 701 - Pass • Melting point 225–280°C

https://cdn.ymaws.com/www.polyiso.org/resource/resmgr/Tech_Bulletins/tb104_Feb2017.pdf

Insulation and Fire Stopping			
Type of Insulation and fire stopping	**Flammability**	**Risks**	**Comments**
Polyurethane spray-on insulation	High	• Will become involved in a fire • Will generate heavy smoke deposits when involved in fire.	• Not FM approved
Expanded Polystyrene (EPS)	High	• Will become involved in a fire • Can accelerate fire spread • Release of toxic smoke and thick soot	• Not FM approved
Firestopping - expandable foam	High	• Will typically have a polyurethane component • Will become involved in a fire	• Not FM approved • Will impair the integrity of fire compartments during a fire • Local approvals have restrictions on the thickness of gaps that can be filled.
Firestopping – pillows and mastic	Low	• Incorrect installation can impair the integrity of fire compartments	• Most products are FM approved – check the technical data sheet
Mineral wool	Low	• Low risk asset protection product	• FM approved

Internal and External Wall Panel systems			
Type of Wall Panel	**Flammability**	**Risks**	**Comments**
Equitilt (EPS-FR)	High	• Will become involved in a fire • Will produce excessive smoke and soot	• Not FM approved
Equitilt Flame guard plus (MW)	Low	• Will char when involved in a fire • Some smoke development	• FM approved 4880 & 4881
MetecnoPanel	Low	• Will char when involved in a fire • Some smoke development	• FM approved 4880 & 4881
Kingspan internal and external wall systems	Low	• Will char when involved in a fire • Some smoke development	• FM approved 4880 & 4881
PIR Polyisocyanurate	Low	• Will char when involved in a fire • Some smoke development	• FM approved 4880 & 4881

Appendix 1 – Fire Test Standards

The following is not an exhaustive list of fire test standards.

- AS 1530.4:2014 Methods for Fire Tests on Building Materials, Components and Structures - Fire-resistance tests for Elements of Construction
- ISO 834-1:1999 Fire-resistance tests — Elements of building construction — Part 1: General requirements
- ISO 834-1:1999/AMD 1:2012 Fire-resistance tests — Elements of building construction — Part 1: General requirements — Amendment 1
- ISO 834-1:1999/AMD 2:2021 Fire-resistance tests — Elements of building construction — Part 1: General requirements — Amendment 2
- ISO 834-2:2019 Fire-resistance tests — Elements of building construction — Part 2: Requirements and recommendations for measuring furnace exposure on test samples
- ISO/TR 834-3:2012 Fire-resistance tests — Elements of building construction — Part 3: Commentary on test method and guide to the application of the outputs from the fire-resistance test
- NFPA 251 Standard Methods of Tests of Fire Resistance of Building Construction and Materials
- UL 263 Fire Tests of Building Construction and Material
- ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials
- British standard 476 Test Methods for Fire Tests of Building Construction and Materials

Appendix 2 – Hail Impact Testing Standards

The following is not an exhaustive list of hail impact testing standards.

- ASTM F320
- ASTM E822
- ASTM E1038
- FM 4470
- FM 4473
- SN 564 2801

http://iibec.org/wp-content/uploads/2016/04/2009-09-flueler.pdf

- Property Loss Prevention Data Sheet 1-34, "Hail Damage" (FM 1-34)

https://www.professionalroofing.net/Articles/Designing-for-hail-resistance--05-01-2018/4230

- UL 1703
- UL 61703 Standards.

https://www.ul.com/news/all-hail-ul-solar-panel-testing

- Register of hail impact resistant (HIR) building materials of the Swiss association of public building
- IBL-7 (Ice ball launcher) protocol - Haag Research & Testing Co.

https://jeffhuntexpert.com/news/laboratory-hail-testing.html
https://haageducation.com

Appendix 3 – Photo Voltaic Array Standards

The following is not an exhaustive list of photo voltaic array standards.

Relevant Australian Standards include:

- AS / NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays
- AS / NZS 1170.2 Structural Design Actions Part 2: Wind Actions
- AS / NZS 4509.1 Stand-alone Power Systems Part 1: Safety and Installation
- AS / NZS 3000:2018 Electrical Installations
- AS / NZS 1768:2007 Lightning Protection
- AS / NZS 4777.1:2016 Grid Connection of Energy Systems via Inverters - Installation Requirements
- AS 4086.2 Secondary Batteries for Use with Stand-alone Power Systems, Part 2: Installation and Maintenance.

There are also a range of other standards and approvals including:

- International Electrotechnical Commission (IEC)
- Underwriters Laboratories (UL)
- American Society for Testing and Materials (ASTM)
- Factory Mutual (FM)

Disclaimer

The information contained in this document is intended solely for the purpose of assisting Unimutual personnel in the management of the Unimutual Protection program and providing Members with information in relation to the selection, specification, and use of lower risk construction material in new construction or major refurbishments ("the Member's construction material specification"). It is current as at the date of this document.

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