KNAUF INSULATION

Minimising risk using the fire triangle principle

Why non-combustible insulation should be non-negotiable

Overview

The fire triangle principal is a well-established method used to educate how a fire occurs. Comprising of three components, Heat, Oxygen, and Fuel source, as being the precursors required for ignition of a fire. Knauf Insulation takes this principle and draws correlation of how building fire risk can be minimised by removing one of these elements, the Fuel source.

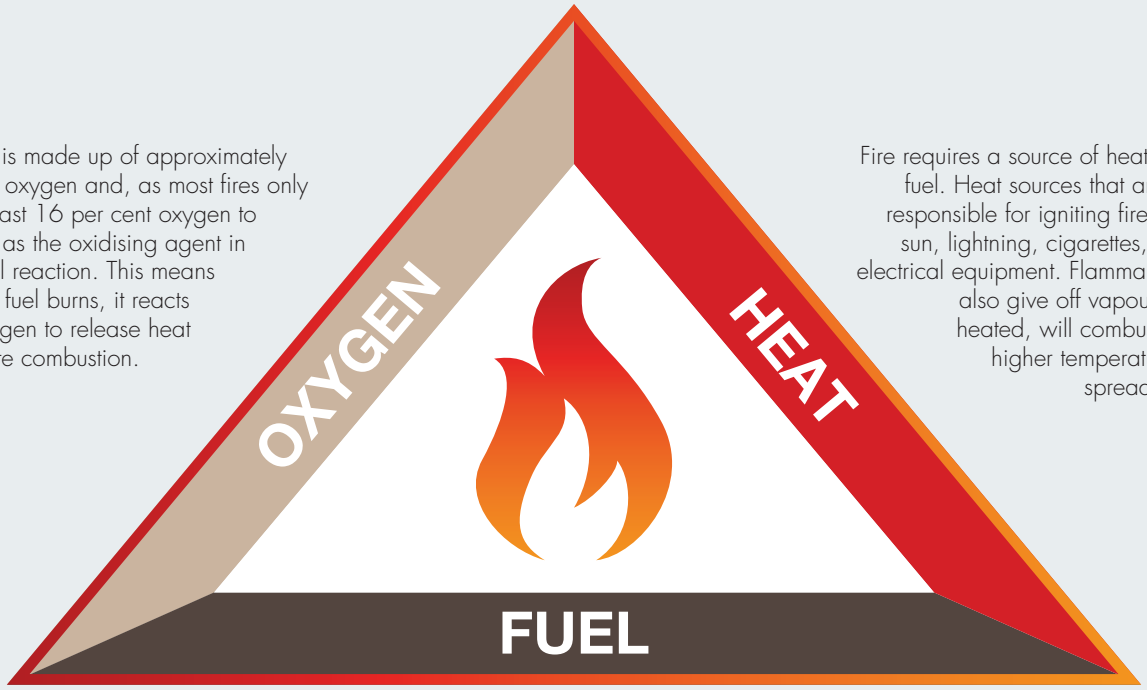
The objective of the Technical Bulletin is to encourage not just designers, but all stakeholders of construction projects to consider the use of non-combustible products, first and foremost, for better design and fire safety levels.

The Fire Triangle principle

There are three elements required to ignite and maintain a fire: heat, fuel and oxygen. Removing any one of these will likely extinguish a fire or mitigate the risk of ignition in the first instance.

Oxygen

Ambient air is made up of approximately 21 per cent oxygen and, as most fires only require at least 16 per cent oxygen to burn, it acts as the oxidising agent in the chemical reaction. This means that when a fuel burns, it reacts with the oxygen to release heat and generate combustion.



Heat

Fire requires a source of heat to ignite the fuel. Heat sources that are commonly responsible for igniting fires include the sun, lightning, cigarettes, heaters and electrical equipment. Flammable materials also give off vapours that, once heated, will combust and cause higher temperatures that can spread fire further.

Fuel

Fire requires a fuel source. A fuel is any kind of combustible material, such as wood, paper, leaves, gas or petrol, fabric, foam, plastic and rubber[1].

What direction does fire spread?

Fire commonly travels vertically however its direction of spread is largely determined by the orientation of its fuel source.

Fire burns vertically due to the upward fuel orientation, however fire can also burn in horizontal and adjacent directions when a fuel source is present. In the instance of a match, the fire will spread faster due to the continual heat in direct contact with the fuel, however, the match will still burn when held horizontally, or in other orientations.

Figure 1 depicts the intensity of the flame for each orientation of an ignited match.

Figure 1: Fuel orientation and its effect on flame spread.[2]

Current National Construction Code non-combustibility requirements

The National Construction Code of Australia (NCC 2019, Vol.1, C1.9) details external wall requirements for commercial buildings based on the building class and the height of the building in storeys. This is used to determine the Type of construction as either Type A, Type B, or Type C to be assigned to the building in order to determine the Deemed to Satisfy (DtS) requirements of the NCC. Both Type A and Type B construction require non-combusitble external walls using components tested in accordance to AS 1530.1. However, Type C buildings currently allow combustible components (including insulation materials) to be permitted for use. Taller buildings, especially those with higher risk occupants, require stringent fire performance requirements due to the length of time it takes to reach safety at the ground level.

As shown in Table 1, Type A construction is for projects three storeys and greater, while Type B construction is for projects two to three storeys. Such projects include apartments (Class 2), office buildings (Class 5), hospitals (Class 9a), public assembly buildings such as tertiary buildings (Class 9b), and aged care buildings (Class 9c).

Table 1: Commercial building classifications and construction types[3]

Description	Classification	Storey	Type of construction
 Apartment	2	1	C
		2	B
		3 or greater	A
 Office	5	1	C
		2	C
		3	B
		4 or greater	A
 Hospital	9a	1	C
		2	B
		3	A
		4 or greater	A
 School (assembly building)	9b	1	C
		2	B
		3 or greater	A
 Aged care building	9c	1	C
		2	B
		3 or greater	A

In accordance with the NCC, both Type A and Type B construction projects require external walls and common walls to be constructed using non-combustible materials, including insulation materials. Manufacturers are required to be compliant with non-combustibility standard AS 1530.1, particularly for external wall applications.

It is critical for all stakeholders of a project to be conscious of products fire performance, as liability does not solely fall upon the fire engineer. For example, after the Lacrosse building fire in Melbourne in 2014, legal proceedings found that despite the fire igniting from a resident's un-extinguished cigarette, the choice and installation of unsuitable materials was also to blame. The court ordered that damages be shared between the fire engineer (39%), building surveyor (33%), the architect (25%), and the resident (3%)[4].

Regulatory requirements for walls to include non-combustible building elements effectively remove a fuel source for potential fires and is a great example of the fire triangle principle in action. Without a fuel source such as flammable or non-regulatory construction materials, heat sources such as cigarettes are far less likely to cause a fire to ignite and spread. However, risk can be mitigated further by applying this non-combustible requirement to additional applications such as soffits, and roofs where the risk of ignition is still prevalent.

Alternatively, performance solutions are a method that enables the use of combustible materials in Type A and Type B project types. This method is a combination of system tests and professional evaluations of suitability, However, risk is retained due to site conditions which often make it difficult to install products to the same standard of the that during the system test.

What about roof and soffit applications?

Materials that are combustible currently use a Group number test, in accordance with AS 5637.1, to comply with the building standards of Australia. This standard involves a full room corner burn test with insulation materials installed to both the walls and ceiling of a rectangular test rig.

A common inconsistency associated with AS 5637.1 testing is that the time allowed (20 minutes) for the initial Group number test will rarely equate in comparison to real-life situations allowing highly combustible products to be approved and installed. Ultimately, testing designed to determine a products combustibility should continue until the product fails, as building fires are rarely extinguished before 20 minutes.

While the room corner burn is an effective test to determine the smoke development of a product when exposed to an open source of fire, it does allow manufacturers to engineer materials to meet minimum standards rather than mitigate the risk entirely. An example of this is foam insulant manufacturers increasing the thickness of the foil facing. This extends the time it takes for flame in the full room burn test to make contact with the combustible bulk insulation component of the foam insulation panels. This is of great concern because specific installation guidelines must be strictly adhered to in order to meet compliance. The continued use of combustible materials in soffits therefore retains the fuel source element of the fire triangle, which in turn creates greater risk for the likelihood of fire occurrence in comparison to installing non-combustible products.

Knauf Insulation products that are engineered for use in soffits and roof applications have been rigorously tested in accordance with AS 5637.1 (as required by the NCC 2019) and have received a Group 1, the highest possible Group number rating.

In addition to a Group 1 rating, the following Knauf Insulation products have undergone further testing and achieved an additional "non-combustible" performance rating in accordance with AS 1530.1:

- Earthwool® Wall batt
- Earthwool® Ceiling batt
- Knauf Insulation Acoustic internal wall solutions
- SprayWool Thermal and Acoustic soffit insulation
- DriTherm® Cavity slab for double masonry walls
- Earthwool® Roof blanket for roof and soffit applications (blanket only)

Combustible vs. Non-combustible

To demonstrate the effectiveness of Knauf Insulation non-combustible products, Table 2 compares the performance of SprayWool Thermal and Acoustic with PIR (Polyisocyanurate) Panels.

Table 2: Comparison of Group 1 testing to AS 5637.1

Material type	Group number – AS 5637.1	Combustibility – AS 1530.1	NRC	Image
PIR (Polyisocyanurate)	Group 2	Combustible	Not published Low absorbance	
SprayWool Thermal and Acoustic	Group 1	Non-combustible	1 at 60mm Very high absorbance	

*Both images captured at the 20 minute mark of the AS 5637.1 test

In the SprayWool image, the product is shown to produce far less smoke in comparison to the PIR product, and the lower intensity of the flame is clearly visible. This demonstrates that the non-combustible product's performance greatly exceeds that achieved by foil faced foam insulant boards, when used in soffit and roof applications.

Currently in Australia there are multiple applications where a product with a Group 2 rating or higher can be used. This not only amplifies the risk of fire occurring in the first instance, but also adds potential hazards for emergency services when entering buildings in the unfortunate event of a fire. Selecting a Group 1 and non-combustible product will effectively design out the risk of fire at the earliest stage of the project.

For support with selecting the right non-combustible solution for your project, contact our technical support team at **tech.au@knaufinsulation.com**

REFERENCES

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4 Dunstan, J., 2021. Fire engineer, architect and surveyor wear $5.7m of damages from flammable cladding blaze. https://www.abc.net.au/news/2019-02-28/lacrosse-apartment-owners-win-5.7-million-cladding-fire-damages/10857060

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