PLASTICS IN CONSTRUCTION

IT IS TIME TO FINALLY RETIRE AS1530.3

INTRODUCTION

Plastics are well known to us all, and chemically speaking they are man-made materials derived from petrochemicals. One of the biggest issues with plastics is compared to most other materials, they create a big fire load and can burn out of control when involved in a fire, creating huge quantities of toxic smoke.

Yes, we know they can have fire retardants included in their formulation, but this just limits the ignitability and initial flame spread across the surface, but flame retardant cannot and does not make plastics non- combustible sadly.

Although I have spent a large proportion of my career looking at fire resistance and fire barriers, I have also studied so called reaction to fire properties of plastics and other materials in depth.

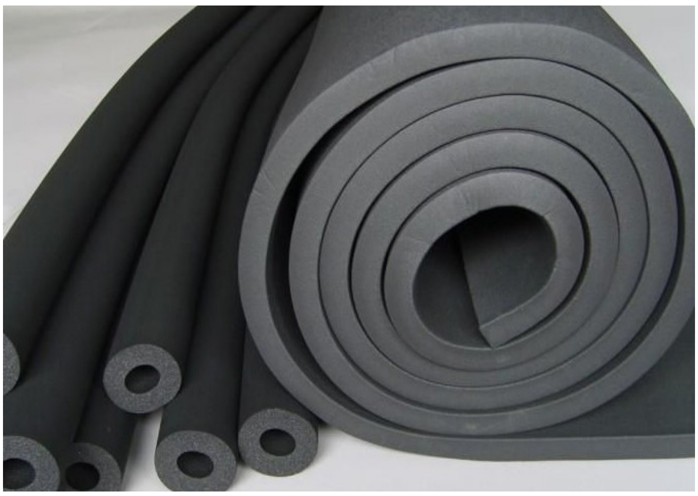
This article is my personal, Australian overview relating to plastics in construction and discusses different applications, fire test methods and their applicability to Building Control Legislation and our National Construction Code.

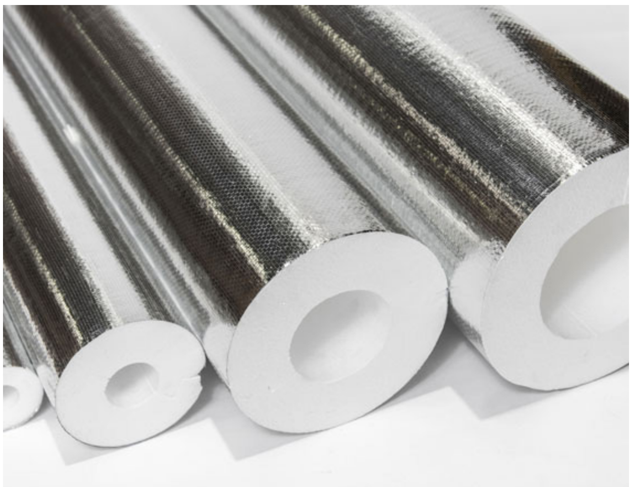
One thing that is obvious is it is time to fully retire the old AS1530.3 fire test method.

TYPES OF PLASTICS

There are many families of plastics and polymers being used in construction industry. Examples of plastics used in building are:

- Acrylic
- Composites
- Expanded Polystyrene (EPS)
- Polycarbonate
- Polyethylene (PE)
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)





SANDWICH PANELS

My first serious involvement with plastics in construction was in 2002, when I was an independent consultant and operating the PFPA (Alliance for Fire & Smoke Containment) in Australia. I was asked by insurance and industry to research and prepare a Guide to the use of so-called insulated sandwich panels following two terrible fires; the Metropolitan Meatworks fire, Brooklyn in 2001 and the George Weston Foods, Tip Top Bakery fire, Fairfield NSW in 2002. These two fires involved polystyrene (EPS) based sandwich panels.

What is an Insulated (sandwich) panel?

Insulated (sandwich) panels are single piece factory engineered units typically comprising two metal faces and a fully insulating core. The facings are fully bonded to the core so that the panel acts compositely when under load, in most cases, providing free standing and load bearing panels. Facings used for insulated panels are predominantly of steel. The core material is usually a material that provides good thermal insulation properties. The insulating core is typically bonded to the facings using a conventional adhesive bond.

Fire's in buildings made from insulated (sandwhich) panels have caused huge losses which have been borne by the insurance industry and have resulted in additional protection requirements imposed by insuance on building owners,above and beyond the Building Code of Australia.

In 2003, FPA Australia co-ordinated a seminar series on Plastics in Construction and Andre Mierzwa (FM Global) and myself presented with other to each State around Australia about the fire hazards and plastics in construction. Following on from this seminar series and the reaction by the insurance industry to the fires and large payouts, some more definitive testing requirements were required for sandwich panels utilising a full-scale room corner fire testing to ISO 9705 for example.

SOME FIRES AT MEAT PROCESSING PLANTS IN OCEANIA

2001 – Metropolitan Meatworks, Brooklyn, VIC

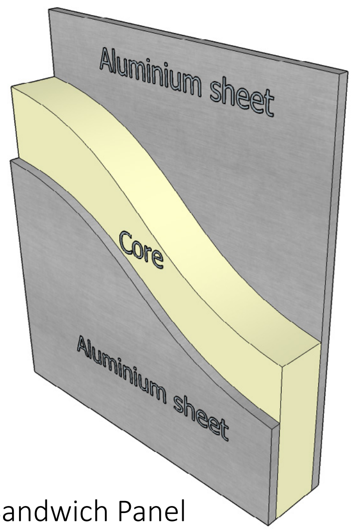
2002 – Tip Top Bakery, NSW

2007 – Tegel Poultry, Christchurch, NZ

2010 – Inghams Chicken, VIC

2013 – Ralph's Meat Co – Cranbourne, VIC

2018 – Thomas Foods, Murray Bridge, SA

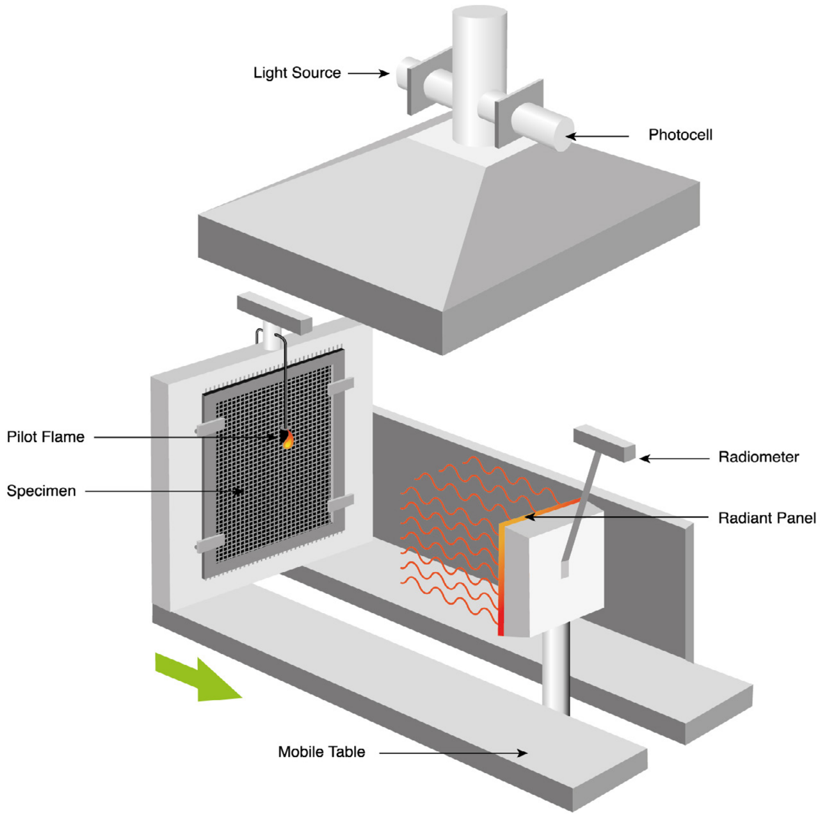


Sandwich Panel

WALL & CEILING LINING FIRE TEST METHODS

AS1530.3 - NOW OBSOLETE FOR WALL AND CEILING LININGS

In 2006 here in Australia we retired the old AS1530.3 fire test method for use in validating the suitability of wall & ceiling linings and floor coverings. For wall and ceiling linings, we are interested in their tendency to ignite and once ignited their heat release rate and the amount of smoke developed. In fire safety terms, we are trying to limit the tendency for a fire in an occupied space to flashover. It is really about the speed of fire spread across the surface and the amount of fuel load the linings contribute to a fire starting.



AS1530.3 Fire test method

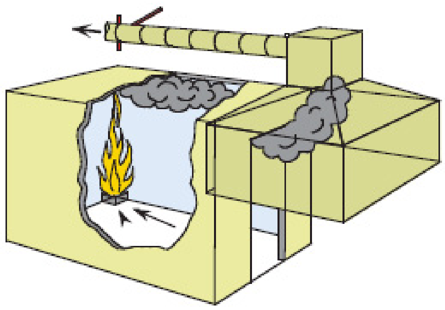
The new Australian regulatory framework introduced Group Numbers which are determined from either full-scale room corner tests (ISO 9705) or for some materials a smaller scale cone calorimeter fire test (AS3837) and subsequent modelling to determine the Group Number.

Australian Standard, AS5637.1, provide guidance on determination of the Group number and the so called fire hazard properties.

ISO 9705 & AS3837

Showing below are some diagromatic representations of both the small scale AS3837 Cone Calorimeter fire test method and the ISO 9705 full scale room corner fire test.

Both these fire test methods provide a much better measure of fuel load, flame spread mechanisms and smoke developed. The ultimate objective of the NCC requiring Group Numbers is to limit the possibility of a fully developed fire whereby flashover occurs.

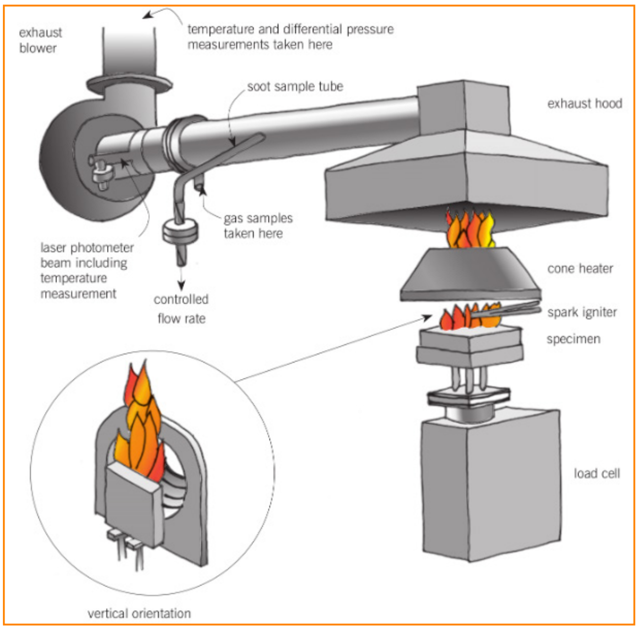


*Schematic drawing of the room corner setup according to **ISO 9075**- schematic courtesy of SP Swedish National Testing and Research Institute*

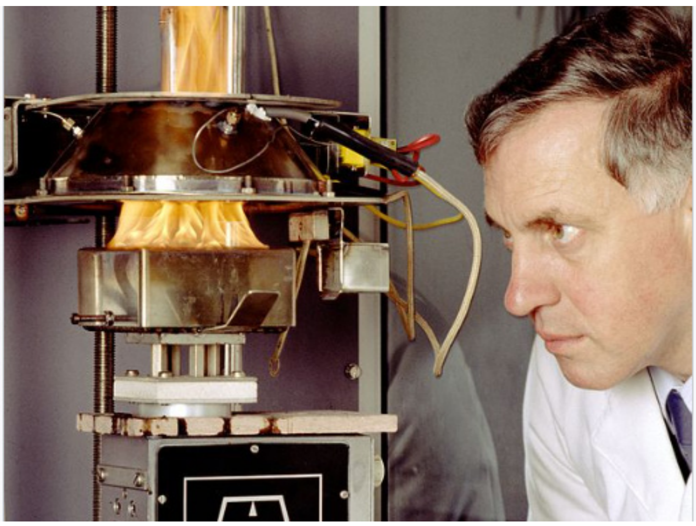
Room Corner test before Flashover- Photo courtesy of Factory Mutual

Room Corner test after Flashover- Photo courtesy of Factory Mutual

ISO 9705 fire test method



AS3837 fire test method



FLOOR COVERINGS

AS1530.3 - NOW OBSOLETE FOR FLOOR COVERINGS

After retiring the old AS1530.3 in 2006, a new fire testing method for validating floor coverings was needed.

For floor covering the new fire test method is AS ISO 9239.1 and this testing determines the critical heat flux for materials used for floor coverings such as carpet and underlay assemblies and the like.

AS ISO 9239.1 fire test method

COMBUSTIBLE CLADDING AND INSULATION ON BUILDING FACADES

LACROSSE TOWER, DOCKLANDS, VIC, NOVEMBER 2014

In many ways it was déjà vu for me; after experiencing and working on insulated sandwich panels and the fires in 2001 & 2002 at the meat works (abattoir) and bakery, I watched in horror in 2014 when the cladding on Neo Towers in Melbourne was ablaze. The speed at which the composite aluminium cladding panels (ACP) with PE plastic core (sandwich panel) construction allowed vertical flame spread was alarming. It was in my opinion a miracle the winds were favourable on the day or lives may very well have been lost.

Lacrosse apartment owners awarded $5.7 million in damages after flammable cladding blaze

A Fire took place in the early hours of the morning of 25 November 2014. The fire at Lacrosse building is a first in Melbourne in that it directly affected approximately 450 to 500 people who required immediate evacuation and accommodation. In addition the fire spread vertically and was not contained in the room or area of fire origin. Fortunately in this incident there were no fatalities or serious injuries.

This fire saw the courts rule on those responsible for the damages and found the following parties would pay damages in these proportions:

Fire Engineers – 39%

Certifier (Building Surveyors) – 35%

Architect – 25%

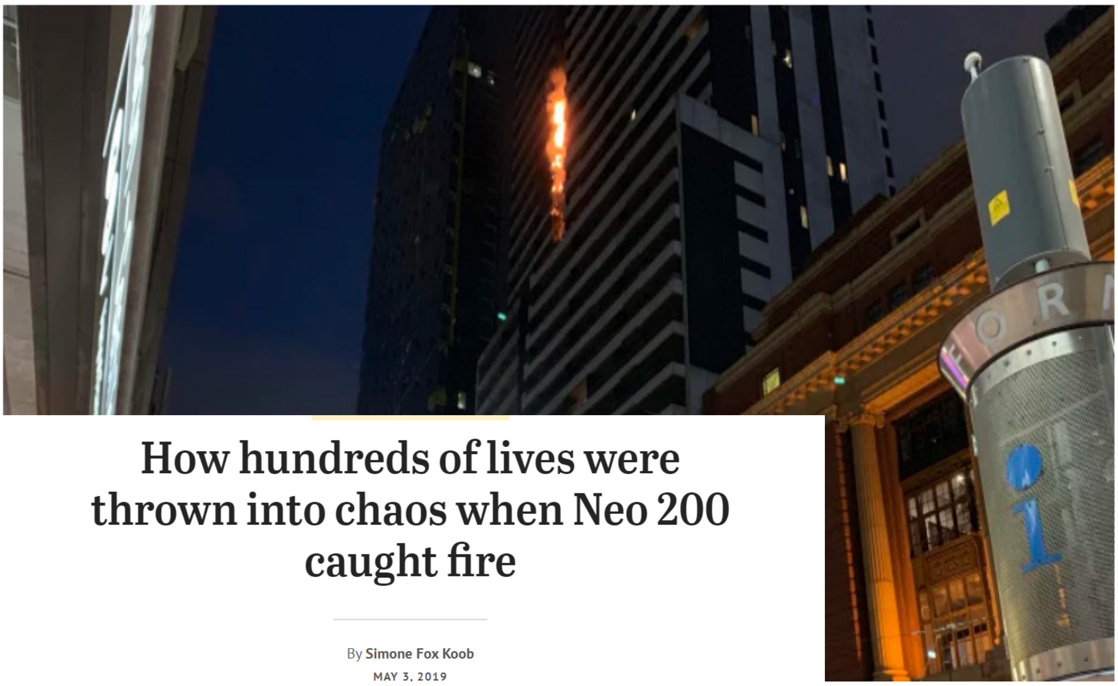
Builder – 3%

GRENFELL TOWER, WEST LONDON, UK, JUNE 2017

The tragic event on June 14, 2017 has been well publicised where sadly 72 innocent people lost their lives in one of our the worst fires history has seen.

In this case, both combustible insulation and combustible ACP cladding were involved and provided the huge fire load.

NEO 200 APARTMENT BLOCK, MELBOURNE, VIC, FEBRUARY 2019



THE EARLY MORNING BLAZE OF FEBUARY 4 AT THE SPENCER STREET BUILDING- A 41 LEVEL APARTMENT COMPLEX BUILT IN 2004 CALLED - NEO 200, WAS BROUGHT UNDER CONTROL IN OVER AN HOUR BY MORE THAN 80 FIREFIGHTERS

FIRE TEST METHODS FOR CLADDING

In terms of Building Control here in Australia and fire testing requirements, I think it is fair to say that the state of play is panic, confusion and a state of change.

So called ACP (combustible sandwich panels made from aluminium skins and PE core material) have been banned and the requirements have been tightened up to require non combustible cladding materials, insulation materials and initially components like sarking, gaskets, thermal bridging and sealants and the like.

To me, just like passive fire protection and fire resistance, the cladding or building envelope SYSTEM needs to limit both vertical and horizontal flame spread around the façade of a build in fire.

Full scale system fire tests to me are the only way to understand and quantify fire system performance, both BS8414 in the UK and NFPA 285 in the USA are fire test methods used to assess and measure the performance of cladding systems in fires.

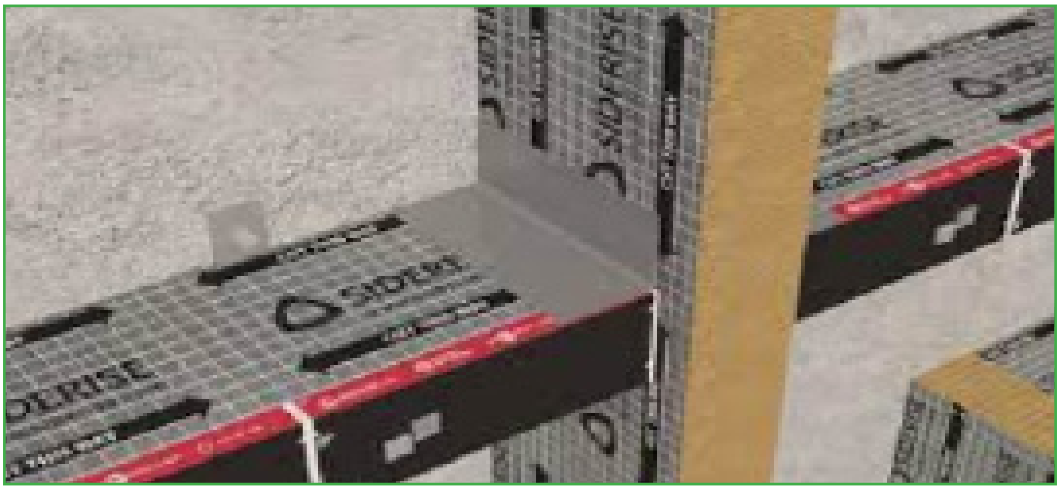
Australia has had the Australian Standard, AS5113, Classification of external walls of buildings based on reaction top fire performance since 2016. This uses the BS8414 fire test method and suggest some performance criteria for possible use in building control purposes.

BS8414 fire test method

However, at the time of writing, AS5113 has very onerous debris criteria compared to other countries. The additional requirement in the NCC requires sprinklers on balconies, where tested and approved AS5113 systems are used, along with CV3 requiring an Alternative Solution and Fire Engineer to provide sign off for their use, is blocking its use and stopping system development and innovation.

Around 5 million square metres of combustible cladding was estimated to need to be removed from Australian building stocks and the so-called recladding requirement except for NSW under Project Remediate are poorly defined.

Full scale fire testing shows the use of carefully designed and so-called cavity barriers can limit the spread of fire in the cavities formed by cladding on the building envelope.



BS8414 Fire Testing of solid aluminium cladding with and without SIDERISE cavity barriers.

PIPE INSULATION FOR HVAC&R APPLICATIONS

The advent of Section J of the NCC has seen important Energy saving provisions and requisite insulation needed on heating, air conditioning and refrigeration piping.

These requirements manifest themselves in Australia as R values for pipe insulation.

Table J5.8a Piping — Minimum insulation R-Value

Fluid temperature range	Minimum insulation *R-Value* — nominal pipe diameter ≤ 40 mm	Minimum insulation *R-Value* — nominal pipe diameter > 40 mm and ≤ 80 mm	Minimum insulation *R-Value* — nominal pipe diameter between > 80 mm and ≤ 150 mm	Minimum insulation *R-Value* — nominal pipe diameter > 150 mm
Low temperature chilled — ≤ 2°C	1.3	1.7	2.0	2.7
Chilled — > 2°C but ≤ 20°C	1.0	1.5	2.0	2.0
Heated — > 30°C but ≤ 85°C	1.7	1.7	1.7	1.7
High Temperature heated — > 85°C	2.7	2.7	2.7	2.7

Note to Table J5.8a: The minimum *required R-Value* may be halved for *piping* penetrating a structural member.

Table J5.8b Vessels, heat exchangers and tanks — Minimum insulation R-Value

Fluid temperature range	Minimum insulation *R-Value*
Low temperature chilled — ≤ 2°C	2.7
Chilled — > 2°C but ≤ 20°C	1.8
Heated — > 30°C but ≤ 85°C	3.0
High temperature heated — > 85°C	3.0

Engineered plastics can play an important role as the requisite pipe insulation material, but it is important to address the fire load and fire hazards properties of these materials.

Sadly, the NCC still allows the use of the very tired and less than suitable AS1530.3 fire test method for pipe insulation materials.

2.1 General requirement

The *fire hazard properties* of assemblies and their ability to screen their core materials as *required* under Specification C1.10 must be determined by testing in accordance with this Clause.

2.2 Form of test

Tests must be carried out in accordance with—

(a) for the determination of the *Spread-of-Flame Index* and *Smoke-Developed Index* — AS/NZS 1530.3; and

AS1530 Part 3, does not assess the fire hazard correctly. It uses a flat specimen and assesses the performance of the surface of the material only. If the material melts and falls off this is not assessed.

For example, foiled materials, which are strategically fire tested to AS1530 Part 3 with the foil exposed to the radiant heat source will fair well, but if the core material without the foil is tested the results are horrific for some plastic materials such as PE core. This should be not surprising with what we have learnt from cladding where only 3mm of core is present; imagine 50 to 100mm of PE core material!

It is time to retire AS1530.3

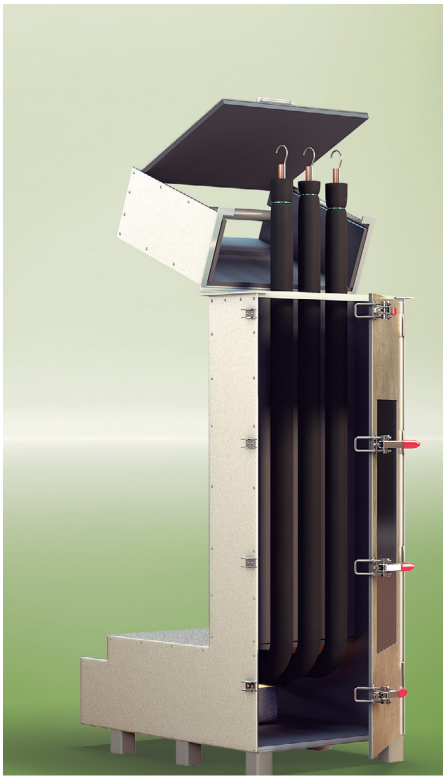
Australia, like many other countries needs to adopt a more suitable fire test methods that deal with the real fire hazards of pipe insulation materials, especially when large volumes run inside riser shafts, or so-called chases, or chimneys.

The same applies to large runs on car park concrete soffits for example, which significantly increase the fire load and propagate flame spread causing molten plastic droplets which typically occur in a fire, further exacerbating the effects of the fire.

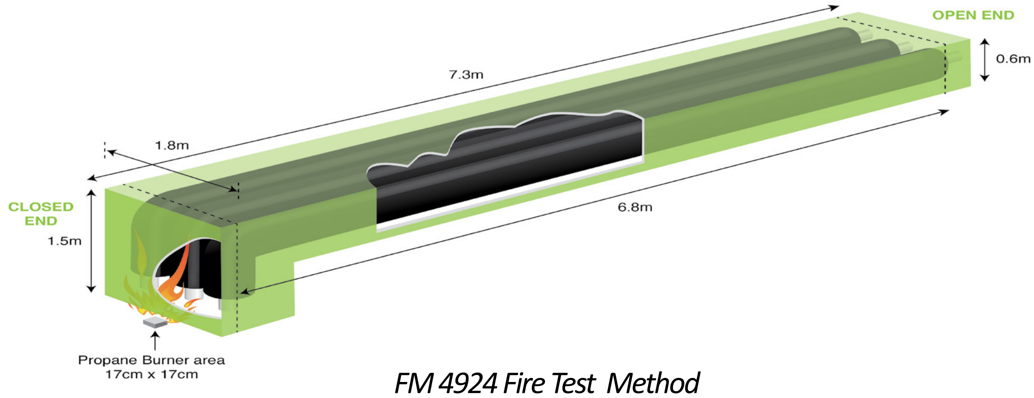
Serious fires have occurred in both Australia and globally, hence why more appropiate fire tests have been put in place to placard these scenarios in other countries.

NFPA 274 and FM 4924 are much more appropriate fire test methods for pipe insulation materials. Warrington Australia has and can run the NFPA 274 fire test method for insulation on piping.

This fire test method uses a direct flame on pipes with requisite insulation and measures total and peak heat release rates, smoke release rates and temperature rise on pipes above the insulation inside the enclosed space or chase.



NFPA 274 Fire Test Method



FM 4924 Fire Test Method

Independent fire testing comparisons of Armaflex FRV material and white pair coil and other PE pipe insulation materials were conducted to both NFPA 274 and AS1530 Part 3 and the results shown below speak louder than words.

	NFPA 274 –						AS/NZS 1530.3 (SFI, SDI)			
Material/ criteria	Peak heat release rate (kW)	Total heat released (THR600) (MJ)	Total smoke released (m^2)	Extent of flames (m)	Maximum temperature above pipe chase (°C)	Result (Pass/ fail)	Ignitability index (0–20)	Spread of flame index (0–10)	Heat evolved index (0–10)	Smoke developed index (0–10)
NCC Criteria							– –	≤5 5<SFI≤9	– –	(no req) ≤8
ANSI UMC Criteria	**< 300**	**< 50**	**< 500**	**< 0.305**	**< 538**					
Armaflex FRV pipe 25x60 (2/4/14)	127	49.6	295.9	< 0.300 Nil above pipe chase	223	Pass	0	0	0	5
Armaflex FRV pipe 25x60 (20/5/14)	139	28.2	269.3	< 0.300 Nil above pipe chase	220	Pass	0	0	0	5
Armaflex FRV 25mm (2/4/14)	105	42.5	281.5	< 0.300 Nil above pipe chase	227	Pass	0	0	0	5
Non cross-linked PE(2/4/14)	2156	127.7	345.4	> 0.305	568	Fail	8	0	1	3
Non cross-linked PE foil faced (2/4/14)	795	62.3	493.2	> 0.305	567	Fail	0	0	0	2
Non cross-linked PE (20/5/14)	801	21.1	709.7	> 0.305	568	Fail	8	0	1	3

Table 2: Comparison of NFPA 274 Limiting Values &Test Results with AS/NZS 1530.3 indices.

To watch some NFPA 274 comparison fire tests for pipe insulation materials used in Australia, please watch here:

https://local.armacell.com/fileadmin/cms/australia/products/Armaflex_FRV/NFPA_274_fire_test_video_-_final_-_web.mp4.

In my personal opinon, thje NFPA 274 Fire test Method should be adopted in the next version of the NCC. This will provide confidence in selecting and installing pipe insulation materials which do not add significantly to the fire load, flame spread and just as importantly volume of toxic smoke production.

CONCLUSIONS

Plastics have been widely used in construction of building here in Australia.

Real fires, property damage and the reaction from insurance have forced changes to our fire testing methods and Building Code.

We learnt the hard way for sandwich panels and got ahead of the curve for wall, ceiling and floor covering with new improved fire test method being adopted, making the old and tired AS1530 Part 3 fire test method redundant.

Sadly, we learnt the hard way yet again with combustible cladding and our Building Code is working toward a better long-term solution based on full scale system fire testing where the benefit of correctly designed and cavity barriers will see a huge improvement in overall mitigation of fire spread.

Pipe insulation materials are on the last materials which desperately need some better fire testing methods and NFPA 274 seems like the best option for us here in Australia. Let's be proactive and not require some large fires to prompt changes.

It is time to fully retire AS1530.3