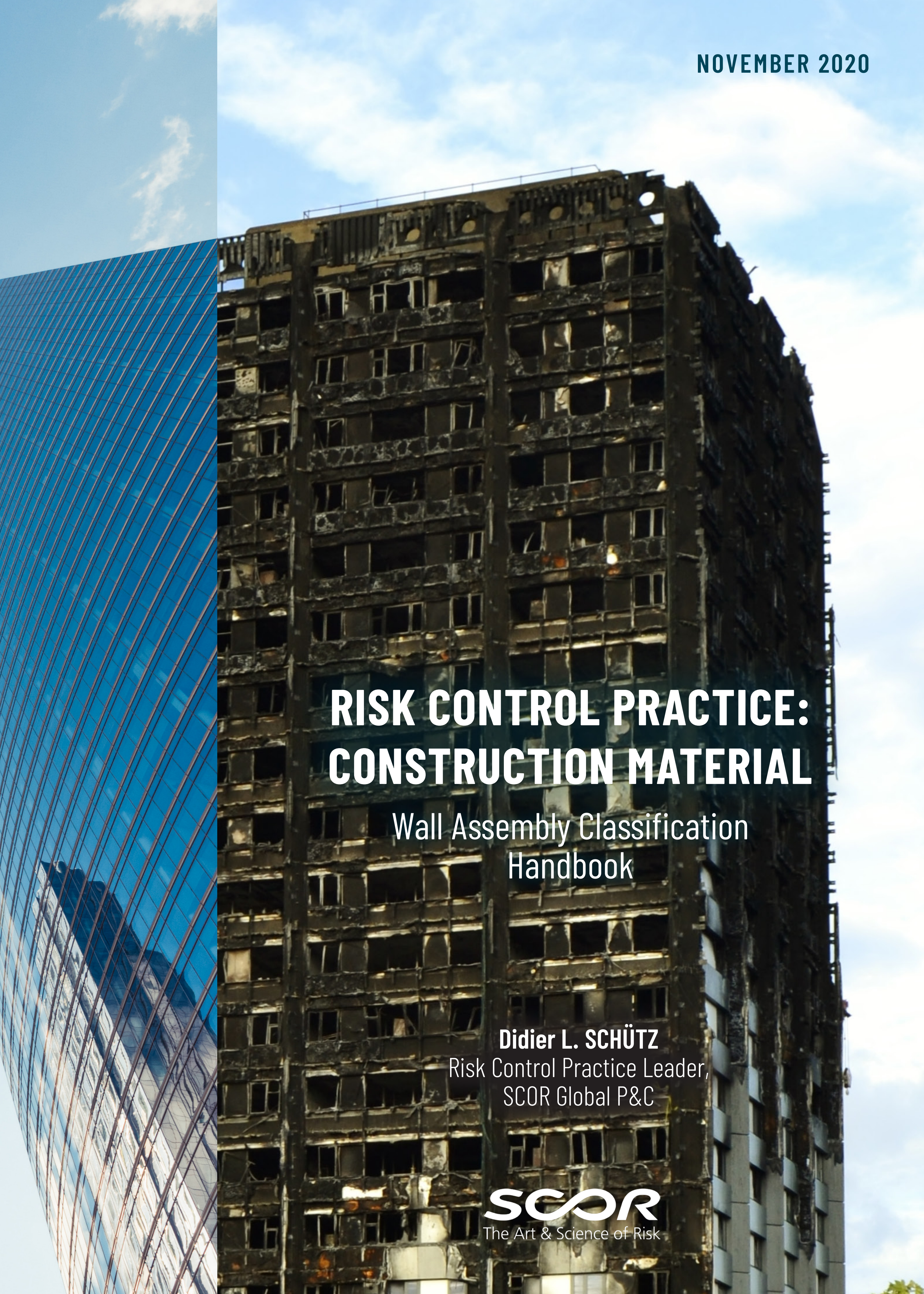

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RISK CONTROL PRACTICE: CONSTRUCTION MATERIAL

Wall Assembly Classification Handbook

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SCOR
The Art & Science of Risk

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First edition in 2017.

CONTENT

SCOPE

This SCOR guidance note has been prepared to provide comprehensive guidance to the underwriter, risk engineer or risk manager when assessing the combustibility of external non-load-bearing wall assemblies, the so-called cladding. This guidance note was prepared with the help and support of qualified Loss Prevention Engineers within SCOR Global P&C and beyond.

I - CLADDING FOR BUILDING – SCOR ASSESSMENT GUIDANCE MATRIX

This matrix should allow one to assess a given assembly wall compared to the existing main classifications. Please note that the well-proven decades-old NFPA 285 test involving full scale testing is deemed as the most relevant and should prevail in case of uncertainty / conflict with other standard(s).

Classification / SCOR Judgment	USA	Euroclass Ratings	British Standard	French M Classes	German Din 4102-1
Adequate	Passing NFPA 285 test	A1	Non-Combustible	Non-Combustible	A1
Acceptable	Not Applicable	A2-s1,d0 A2-s2, d0 Considering restrictions (*)	No direct comparison possible with Euroclass	M0 M1 Considering restrictions (*)	A2 Considering restrictions (*)
Not Acceptable	Failing NFPA 285 test	All Other Classes than those mentioned in this matrix			

(*) Classes A2-s1,d0, A2-s2,d0: deemed as acceptable when products similar to those of class A1, including small amounts - not exceeding 10% in weight or volume - of organic compounds (such as Glass wool / Rock wool / Ceramic wool + Alu-foil facing, painted Silicate based mineral masonry, Cement particle board, Gypsum wallboard, HD mineral wool + 2 coat render)
EXCLUDING plastic based materials, even so-called retardants such as polyurethane (PUR), polyisocyanurate (PIR), extruded/expended polystyrene (XPS/EPS), Phenolic foams, vinyl, PVC, PP, PET, Reinforced Plastic (glass fibers), etc.

II – LEITMOTIV

Building Exterior Wall Assemblies, or cladding, are commonly used for both low-rise buildings (up to 8 floors) and high-rise buildings (above 8 floors). Combustible materials used as cladding constitute a severe challenge in terms of fire protection. For high-rise buildings, firefighting above 8 floors is virtually impossible with current standard equipment. Even with so called low combustible materials a fire would be able to spread vertically and horizontally along the facade of the building without any possible mitigation or control. **As a result, for our assessment we need to consider more stringent criteria than those given in most of the existing classifications as summarized in the SCOR assessment guidance matrix above**. More details regarding the mentioned classifications are given in the following pages.

III - BACKGROUND

1. “CONNECTING THE DOTS ON TODAY’S FIRE PROBLEM”

Courtesy of Jim Pauley, President and CEO NFPA 2017 (James Pauley NFPA blog June 21, 2017)

“The Grenfell Tower fire in London has been a horrific fire tragedy. With a loss of 79 lives thus far, it is one of the most tragic fires to occur in the UK in recent decades. Our thoughts and prayers go out to the families of the victims as well to the first responders involved in the very difficult recovery operations. We have reached out to the UK to offer NFPA’s support and assistance in any way needed.

News stories have talked about the flammability of exterior cladding, the lack of fire sprinklers and the notion of “shelter in place” amongst other subjects. On its own, it is a horrendous tragedy. In combination with other recent events, some disturbing trends emerge which could set fire safety back for decades.

For example, in less than one year we saw 36 people perish in the Oakland Ghost Ship fire, a former warehouse being used as living and entertainment space. The fire raised questions about appropriate permitting for its use, code enforcement, lack of fire alarms and the role of occupants in understanding the impact of their surroundings on their own personal safety. We saw a fire at a packaging factory in Bangladesh that killed 23 in a building with woefully inadequate fire protection. We saw a wildfire in Tennessee burn over 17,000 acres of land and kill 14 people, prompting questions about pre-planning, building in the urban interface to withstand wildfire, fire service ability to respond to an event of this magnitude and public awareness around this growing threat. Another raging wildfire in Portugal claimed the lives of 62 people, many burned in their cars as they attempted to flee, raising similar questions about planning and preparedness. We saw a six-year-old girl die in Connecticut when a fire ripped through the recently constructed house that, if it had been built to meet the national codes, would have had a home fire sprinkler and likely a much different outcome.

Each of these incidents is an individual tragedy. Taken together, they depict a larger global problem warranting action. Looked at in their entirety, they are a collective example of how, either intentionally or accidentally, the fire prevention and protection system has been broken.

A system that the public believes exists and counts on for their safety. A system that, through complacency, bad policy and placing economics of construction over safety, has let the public down.

Where have we gone astray? In each of these scenarios as well as many more not mentioned we can point to one or more factors:

- the use of outdated codes and standards
- acceptance of reduced safety requirements to save money
- ignoring referenced standards within a code
- lack of education around the application of the codes and standards
- reduced enforcement
- a public unaware of the dangers of fire

When government and other entities don't adopt or designers don't use the latest versions of codes and standards, they lose the benefit of the latest technology, research and collective wisdom related to fire, electrical and life safety.

When policy makers decide to remove life safety and property protection provisions from codes, they have substituted politics for technical requirements that were determined after extensive input from across the spectrum of knowledgeable people.

When users fail to review and follow standards that are referenced in the codes, they aren't ensuring the right practices and products are used in the right situations, increasing vulnerability to disaster.

When the professionals involved in design, installation, enforcement and maintenance have not kept up to date on the latest requirements they can end up applying products improperly leading to catastrophic results.

When jurisdictions, under fiscal pressures or lack of understanding of the importance, reduce enforcement efforts, they place their communities at risk as buildings deteriorate, change ownership or type of use.

And when the public takes safety for granted and is uneducated about fire risks, their improper or uneducated actions can place them in peril.

The system the public relies on for managing fire safety is broken and a single solution isn't the answer. It will take a systems approach to fix it. At NFPA, we are focused on looking at the entire system and working with everyone involved to fill the gaps.

We may not be able to prevent every tragedy from occurring, but by recommitting to and promoting a full system of fire prevention, protection and education, we can help save lives and reduce loss. That is the story that should consume the news of the day."

https://community.nfpa.org/community/nfpa-today/blog/2017/06/21/connecting-the-dots-on-today-s-fire-problem

2. "BUILDING EXTERIOR WALL ASSEMBLY FLAMMABILITY: HAVE WE FORGOTTEN THE PAST 40 YEARS?"

Courtesy of John Valiulis, Valiulis Consulting LLC On Behalf of Fire Safe North America (www.fsna.org), 2015

"This article addresses the disturbing movement in the U.S. towards trading off exterior wall assembly fire performance safety requirements in the building code when internal sprinklers are present in buildings. This has occurred in certain areas of the country and a similar code change was attempted in April 2015 during the 2018 International Building Code development hearings.

High-rise building exterior walls are at risk of fire events consuming entire faces of buildings. Such fires have occurred in countries situated in the developing world, the Middle East, Europe, and in Asia. Where have such fires not been a significant problem? In the United States.

What makes the US different than those countries where such exterior wall fires are occurring? The fire protection engineering community in the U.S. foresaw the increasing use of combustible components in exterior wall construction decades ago.

Through industry-funded research, an appropriate test method was developed to determine if a given wall assembly could support a self-accelerating and self-spreading fire up the wall, either via the outside surface, through concealed spaces within the wall, or by spreading fire into interior floor areas on stories above. The test method, which today is titled NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components, has been applied nationally via adoption in the model building codes, and has resulted in an existing building stock with exterior walls that are inherently resistant to self-propagating fires.

Now that building energy conservation initiatives are increasingly taking center stage in the U.S. and beyond, there is a desire by the design community to use an increasing amount of combustible components within high-rise exterior wall construction, for insulating materials, for cladding, and for water resistive barriers (WRBs).

The well-proven, decades old NFPA 285 fire safety requirement, which ensures that the resulting construction won't allow vertical fire spread, is now said to be an inconvenience to areas of the building industry. The reaction to this "inconvenience" has been a handful of successful attempts convincing select jurisdictions to strike out the model code (IBC) requirements for exterior wall fire safety. There have also been some unsuccessful attempts to modify the IBC to reduce its requirements for exterior wall fire safety, aiming to eliminate the NFPA 285 requirement completely for high-rise buildings.

Given the present push to try to eliminate fire safety requirements, with the goal of allowing unfettered latitude in the use of plastics in exterior walls, this seems to be a good time to review how and why exterior wall flammability limitations were codified in the U.S. in the first place, take a look at the rest of the world where such requirements don't exist, and discuss the options for a future in which fire safety and building energy efficiency can be balanced".

http://www.fireengineering.com/articles/2015/11/building-exterior-wall-assembly-flammability-have-we-forgotten-the-past-40-years.html

Reproduced with permission from John Valiulis, Valiulis Consulting LLC On Behalf of Fire Safe North America (www.fsna.org), 2015.

V - NFPA 285 STANDARD FIRE TEST METHOD

1. NFPA 285 PRINCIPLES

NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components (2012 Edition). This standard shall be used to evaluate the fire propagation characteristics of exterior non-load-bearing wall assemblies and panels used as components of curtain wall assemblies that are constructed using combustible materials or that incorporate combustible components within the wall assemblies as specified in the following:

1) The ability of the wall assembly to resist flame propagation over the exterior face of the wall assembly
2) The ability of the wall assembly to resist vertical flame propagation within the combustible components from one story to the next
3) The ability of the wall assembly to resist vertical flame propagation over the interior surface of the wall assembly from one story to the next
4) The ability of the wall assembly to resist lateral flame propagation from the compartment of fire origin to adjacent compartments or spaces

2. ORIGIN OF NFPA 285

"The first exterior wall assemblies to use a significant amount of combustible materials were EIFS (Exterior Insulation Finish System) walls. These used a layer of insulating materials such as expanded polystyrene, polyurethane, or polyisocyanurate. EIFS systems were first developed in Europe during the 1950's. As the name of the system indicates, it is an insulating system installed on the exterior of buildings. It can be fashioned to look like concrete, stucco, and even brick. Because of this, it can easily be mistaken for a substantial non-combustible construction. In a widely publicized fire in the U.S. northeast during the late 1980's, the fire department that was battling a large building fire was shocked to see the neighbouring building 20 ft. away catch fire. They thought it was a concrete building"

The research to develop such a test method was funded by the Society of Plastics Industry (SPI). Clearly it was in the interests of the plastics industry to provide a method to distinguish the safe from the less-safe uses of wall construction using plastic materials. Establishing the construction details for the safe use of plastic materials that would not increase the risk of out-of-control fire spread could allow for the reasonable increase in the use of plastic materials, such as of EIFS walls.

Figure 1: SPI wall fire propagation test
Courtesy of JENSEN HUGHES

As shown in this picture, the fire test protocol that was developed used a full-scale, 26 ft. tall, 2-story test assembly. This apparatus allowed for observations as to what would happen when fire starts in or on one story of a building. Could it spread at least one full story higher? If so, would it then be reasonable to assume that after spreading to the story above, it could then spread to the next one and so on and so on.

An ignition source needed to be standardized. As is common in reaction-to-fire testing, an ignition source was chosen that would be capable of causing some initial ignition and the ensuing fire behaviour would be dependent on the tested material itself. Setting an upper limit to the ignition source, it still had to be within the order of magnitude of a true-to-life fire ignition. The ignition source chosen was an extension of flames out of a lower floor fire compartment "window".

Courtesy of John Valiulis, Valiulis Consulting LLC On Behalf of Fire Safe North America (www.fsna.org), 2015

3. UNDERSTANDING NFPA 285

"The assembly is considered to have failed the test, and categorized as allowing unacceptable flame propagation, if any of the following are observed (slightly simplified):

1) A temperature > 1000°F at 10 feet or higher above the top of the window opening, as measured by thermocouples mounted on the surface of the test specimen. This temperature is considered to be evidence of a luminous flame at that location.
2) Flames visually observed on the exterior face of the specimen at 10 feet or higher above the top of the window opening
3) Flames visually observed on the exterior face of the specimen at 5 feet or further from the centerline of the window opening
4) Temperature rise > 750°F within any combustible wall components more than ¼ inch thick
5) Temperature > 1000°F within any wall cavity air space
6) Temperature rise > 500°F in the second story room, measured 1 in. from the interior surface of the wall assembly
7) Flames visually observed within the second-story test room.

This figure shows the post-test damage to a foam plastic insulated wall.

Courtesy of John Valiulis, Valiulis Consulting LLC On Behalf of Fire Safe North America (www.fsna.org), 2015

4. SO, WHAT IF WALLS ARE NOT TESTED TO NFPA 285?

The model building codes in the US have included limitations, for a few decades, on the use of combustible components in exterior walls of Types I, II, III and IV buildings, subject to certain allowances and exceptions. Those requirements include the need for compliance with NFPA 285 and its predecessor tests. As a result, the US has a building stock that can be mostly assumed to be free of the danger of unfettered multi-story vertical fire spread on outside walls. The notable exception is Type V buildings, which are combustible buildings that can have combustible exterior walls, but which are therefore significantly limited in their maximum height and area, depending on building occupancy.

In other countries, particularly in developing countries where the emphasis has been on maximum economic growth and development, building code requirements related to fire safety are notably weaker. For construction of exterior building walls, many jurisdictions have very few fire safety restrictions at all, allowing designers and materials suppliers to dictate the construction materials and assembly methods for exterior building walls. Such countries have provided, and continue to provide, loss lessons for what can happen when combustible materials in exterior non-load bearing wall assemblies are not limited to proven, fire-tested assemblies.

No organization or agency is known to systematically collect detailed summaries of fire incidents involving exterior wall fires around the world. The media have at least captured many of the more interesting ones."

5. ALTERNATIVE PROTOCOL

On December 14, 2017 FM Global declared on their web site “FM Global urges better safety tests for high-rise exterior claddings that have fuelled deadly building fires”.

An alternative protocol improves testing and overcomes the flaws in desktop certification.

Costly and sometimes fatal fires in some of the world’s newest and tallest buildings have recently been stoked by highly combustible exterior claddings chosen for aesthetics, energy efficiency, weatherproofing and cost-effectiveness - not safety.

Moreover, prevailing methods for testing the combustibility of exterior claddings enable potentially life-threatening product assemblies to sail through regulatory approvals and onto the façades of residential and commercial properties throughout the developed world.

In fact, some product combinations are not subjected to fire testing. Instead, their combustibility is judged through desktop assessments and the only real, physical test will come when they are in the built environment in a real fire situation. The reason for this is due to the costs and time to complete large-scale fire testing, which have allowed “desktop assessments” to rise.

FM Global, one of the world’s largest commercial property insurers, regularly conducts fire research and participates in global building-code improvement efforts. It understands that scientifically robust, repeatable, cost-effective and timely testing must be completed to properly assess if a building material is fit for purpose.

For that reason, FM Global today proposes a better testing protocol that follows the company’s in-depth examination of exterior wall systems made of metal composite materials (MCMs) or aluminum composite materials (ACMs) using 16-foot-high parallel panels as outlined in the test protocol for the ANSI/FM 4880 standard [PDF].

FM Global outlines the strengths of the proposed protocol in a new research technical report, “Evaluation of the Fire Performance of Aluminum Cladding Material (ACM) Assemblies Using ANSI/FM 4880.

“While many fire engineering firms perform desktop assessments in good faith, current practices and regulations introduce the possibility that substandard, dangerous assembly will slip through the cracks,” said Dr. Louis Gritzo, vice president, manager of research at FM Global. “We can’t afford to take this risk as buildings burn and lives are lost, even in the developed world. We believe the protocol in ANSI/FM 4880 is a key to the solution.”

The research technical report complements a recently released FM Global white paper, “Grenfell: The Perfect Formula for Tragedy,” that explores the dangers of combustible cladding.

About FM Global:

Established nearly two centuries ago, FM Global is a mutual insurance company whose capital, scientific research capability and engineering expertise are solely dedicated to property risk management and the resilience of its client-owners. These owners, who share the belief that the majority of property loss is preventable, represent many of the world’s largest organizations, including one of every three Fortune 1000 companies.

They work with FM Global to better understand the hazards that can impact their business continuity in order to make cost-effective risk management decisions, combining property loss prevention with insurance protection.

V - EUROPEAN STANDARD

1. EUROCLASS

The European standard EN 13501-1+A1 (Reaction to Fire) provides a number of performance criteria to measure the fire characteristics of building products. The ISO 9705 Room Corner test is used.

- The Euroclass fire classification is used for construction elements
- The main properties to determine the Euroclass for a specific product is its non-combustibility, ignitability, flame spread, calorific value as well as the development of smoke and burning droplets.
- Depending on the outcome of the various properties, the product is assigned a fire classification from A to F as follows:

Euroclass	Contribution to fire
A1	Non-combustible
A2	Limited combustible – No flashover
B	No flashover
C	No flashover after 10 minutes
D	Flashover before 10 minutes
E	Flashover before 2 minutes
F	No performance determined

Examples of products in each category are:

A: stone wool, rock wool, glass wool, gypsum boards

B: painted gypsum boards, some classified Polyisocyanurate (PIR), some phenolic foams

C: gypsum boards with paper-based wallpaper, some PIR foams

D: wood, most PIR foams

E: fire retardant expanded polystyrene (EPS), polyurethane (PUR)

F: non-tested materials, expanded polystyrene, some phenolic foams.

Class F means that the product is not documented, the product does not meet the criteria for any class, or the manufacturer has not provided the fire properties for the product.

- For classes A2 to D there are additional classes for smoke development s1, s2 or s3, and the amount of burning droplets emitted d0, d1 or d2 (e.g. A2-s1, d0) as follows:

Additional classes for smoke development:

- s1 the structural element may emit a very limited amount of combustion gases – low smoke
- s2 the structural element may emit a limited amount of combustion gases – medium smoke contribution
- s3 high smoke release

Additional classes for burning droplets:

- d0 burning droplets or particles must not be emitted from the structural element – no flaming droplets
- d1 burning droplets or particles may be released in limited quantities - droplets that remain swollen less than 10 s
- d2 flaming droplets
- Class E has only the additional class d2 (Ed2). The flashover occurs in less than 2 minutes.

Warning:

- Some polyisocyanurate panels found on the market and qualified as non-combustible are rated Bs1d0.
- Some expanded polystyrene panels found on the market qualified as M1 French class and A2s1d0 Euroclass

Although Euroclass ratings provide information about smoke intensity and production of burning droplets, these are measured using a relatively small fire source (31 kW) and the tested constructions are positioned vertically. This might not be representative of an actual situation on site.

2. THE TRANSPOSITION OF EUROCLASSES

Prior to the introduction of Euroclasses, a manufacturer would have to undertake more than 30 different fire tests for Reaction to Fire in order to sell in the various EU countries. Because the test results were expressed differently in each country, meaningful comparisons and acceptability of data was virtually impossible.

The Euroclass system simplifies this daunting task, so that tests in one country will be valid across the European Community as a whole. Each Member State's national requirements or guidance will now incorporate Euroclasses.

Throughout the EU, existing national classifications for the performance of building products in fire do not automatically equate with those arising from the new Euroclasses, so products cannot typically assume a Euroclass unless they have been suitably tested or documented as 'classified without further testing'.

To enable the use of the Euroclass system in support of national Building Regulations, the government regulators of each member state have agreed to make 'a progressive transposition' to include Euroclasses within published guidance or requirements.

The Euroclass transposition may vary from one EU member state to another (see next section), according to national needs, but all EU countries will use the same Euroclass classification system.

3. EU, EXISTING NATIONAL CLASSIFICATIONS

British standard:

British standard:	Transposition to Euroclasses
Non-Combustible	A1, or considered as A1 “without the need for further testing” as defined in Commission Decision 96/603/EC dated 4th October 1996.
Limited Combustibility	A2 - s3, d2 or better
Class 0	B – s3, d2 or better
Class 1	C – s3, d2 or better
Class 3	D – s3, d2 or better

French M classification:

Fire reaction classes according to NF 13501-2			M (French Classification)
A1	-	-	Non- Combustible
A2	s1	d0	M0
A2	s1	d1	M1
B	s2 s3	d0 d1	M2
C	s1 s2 s3	d0 d1	M3
D	s1 s2 s3	d0 d1	M4 (non-dripping)
All classes except E-d2 and F			M4

Warning:

despite the above table there is no reliable comparison possible between the French class and Euroclass as some expanded polystyrene panels found on the market qualified as M1 French class are qualified as A2 s1 d0 as per Euroclass (corresponding to M0 in the following table).

German classes as per DIN 4102-1:

Bauaufssichtliche Bezeichnung	Baustoffklasse nach DIN 4102-1	Euroklasse
Nicht brennbar	A1	A1
	A2	A2
Schwer entflammbar	B1	B
		C
Normal entflammbar	B2	D
		E
Leicht entflammbar	B3	F

VI - OTHER CLASSIFICATIONS (ASIA PACIFIC)

BS 476 Part 4, 7 & 11 – Used in Singapore and Malaysia. In Singapore, the authority also recognizes EN13501 & NFPA 285

GB 8624 – 2012 - China (Classification for burning behaviour of building materials and products). This standard draw reference to EN13501.

NFPA 285 – Used in Philippines

AS ISO 9750 – Used in Australia and New Zealand

In New Zealand, the co-relation of the wall and ceiling surface finishes derived from Australian or European classifications of the Group Number requirements of NZBC Clause 3.4(a) can, without the need for further testing, be taken as described in the following table.

New Zealand Group Number according to NZBC Clause C3.4(a) using ISO 9705-1993	Australian Group Number according to NCC Specification C1.10 Clause 4 using AS ISO 9705:2003	European Classification using EN 13501-1:2007+A1:2009
Group Number 1-S	Group 1, and a smoke growth rate index not more than 100	Class A1, A2 or B and Smoke production rating s1 or s2
Group Number 1	Group 1	Class A1, A2 or B
Group Number 2-S	Group 2 and a smoke growth rate index not more than 100	Class C and Smoke production rating s1 or s2
Group Number 2	Group 2	Class C
Group Number 3	Group 3	Class D
Group Number 4	Group 4	Class E and F

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