WASHINGTON STATE FIRE MARSHALS

Fire Prevention Institute

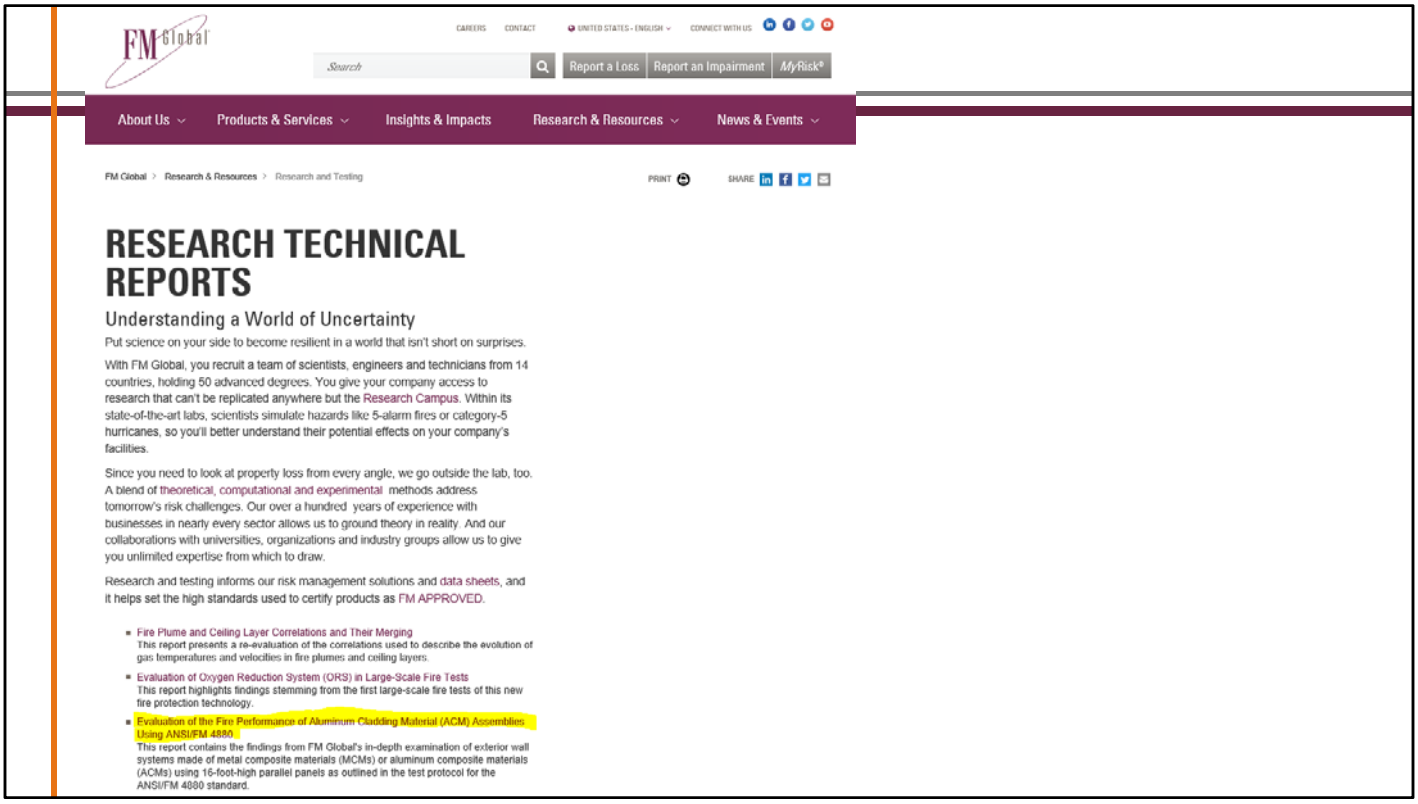
Evaluation of the Fire Performance of Aluminum Composite Assemblies

Mark R. Mannex, PE, FPE
Senior Engineering Specialist
Assistant Vice President
San Francisco Operations
FM Global

Lake Chelan WA

24 Oct 2019

[PUBLIC]


FM Global
CAREERS
CONTACT
UNITED STATES - ENGLISH
CONNECT WITH US
Search
Report a Loss
Report an Impairment
MyRisk®
About Us
Products & Services
Insights & Impacts
Research & Resources
News & Events
FM Global > Research & Resources > Research and Testing
PRINT
SHARE
RESEARCH TECHNICAL REPORTS
Understanding a World of Uncertainty
Put science on your side to become resilient in a world that isn't short on surprises.
With FM Global, you recruit a team of scientists, engineers and technicians from 14 countries, holding 50 advanced degrees. You give your company access to research that can't be replicated anywhere but the Research Campus. Within its state-of-the-art labs, scientists simulate hazards like 5-alarm fires or category-5 hurricanes, so you'll better understand their potential effects on your company's facilities.
Since you need to look at property loss from every angle, we go outside the lab, too. A blend of theoretical, computational and experimental methods address tomorrow's risk challenges. Our over a hundred years of experience with businesses in nearly every sector allows us to ground theory in reality. And our collaborations with universities, organizations and industry groups allow us to give you unlimited expertise from which to draw.
Research and testing informs our risk management solutions and data sheets, and it helps set the high standards used to certify products as FM APPROVED.
Fire Plume and Ceiling Layer Correlations and Their Merging
This report presents a re-evaluation of the correlations used to describe the evolution of gas temperatures and velocities in fire plumes and ceiling layers.
Evaluation of Oxygen Reduction System (ORS) in Large-Scale Fire Tests
This report highlights findings stemming from the first large-scale fire tests of this new fire protection technology.
Evaluation of the Fire Performance of Aluminum Cladding Material (ACM) Assemblies Using ANSI/FM 4880
This report contains the findings from FM Global'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.

Presentation Outline

- Background
- Large-scale fire tests
- Recent research - ACMs
- FM Approval standards
  - ANSI/FM 4880
  - FM 4411
- Next steps
- Summary and Questions

Exterior-wall Fires

- Catastrophic in nature
- Vertical/accelerated spread
- Life and property losses

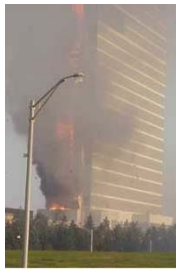
Knowsley Heights (UK) – 1991
Source: Dumpster fire
~$1 Billion (PL & Litigations)

Shanghai – 2010
Source: Welding
58 fatalities

Recent Cladding Fires

- ACM fire catastrophes
  - Accelerated/Uncontrolled vertical spread
- International efforts
  - Scrutinize codes and fire testing methods

Grenfell (UK) – 2017
Source: Interior
71 causalities, No Sprinklers



Atlantic City (US) – 2007
Hot-work sparks in cavity wall

Korea 2010
Electrical fire

France 2012
Exterior/Balcony

Australia 2014
Exterior/Balcony

Dubai 2015
Electrical short-circuit

Turkey 2018
Source: Unknown

Accelerated and uncontrolled vertical flame spread.

Recent catastrophes leading to worldwide scrutiny of building codes and fire testing methods.

FM Global

Types of Exterior Wall Systems

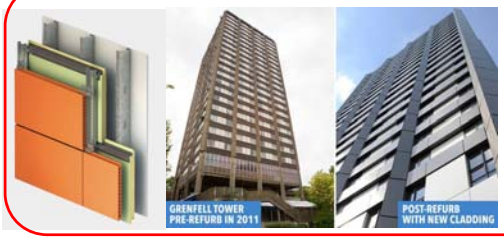
Single-component systems

Sandwich panels
- Industrial, warehouse, commercial,..

Mass Timber
- Residential, aesthetic applications.

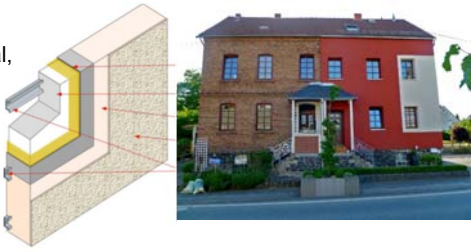
[PUBLIC]

Multi-component wall systems



Cavity-wall/Claddings
- High-rise, residential, commercial..
- ACMs/MCMs/HPLs..

EIFS
- Residential, commercial, aesthetic applications.



Two type of exterior wall systems: 1) Single component wall assemblies and 2) Multi-component wall assemblies.

Exterior **I**nsulation **F**inishing **S**ystem

ACM Applications

High-rises

Malls (Interior)

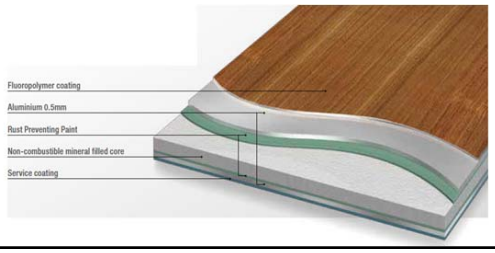
Airport/Subways (Interior)

Stadiums/Libraries/Museums (Roof/walls)

Apartments/Dormitories

Cladding System Components

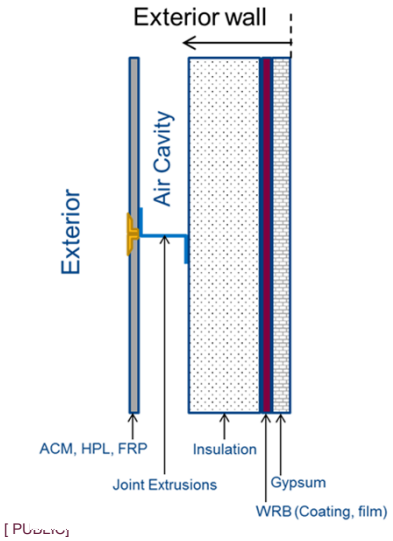
- Non-combustible exterior sheathing
- Water Resistive Barriers (WRBs)
- Continuous insulation (CI)
- Claddings/Rain screens
  - ACMs/MCMs, HPLs, FRPs..



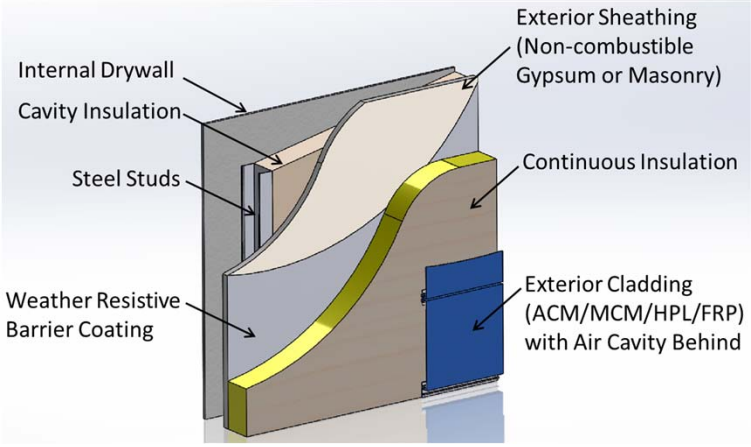
Core Type	Combustible %	Heat of comb (kJ/g)
Combustible	100%	~ 45
Fire-retardant - FR	30%	~ 13
Mineral fill – A2	10%	~ 3
Non combustible	0%	< 1

Three main combustible components of cladding assembly 1) Claddings (ACM/HPL/MCM), 2) Insulation, 3) Weather barrier.
The mineral fill (A2) type ACMs are not available in north American market because FR-ACMs pass NFPA-285 and CAN/ULC S134 tests for many configurations. In Europe, where more realistic fire exposure tests are present, the (A2) type ACMs are prevalent.

Cladding System arrangement



[PUBLIC]

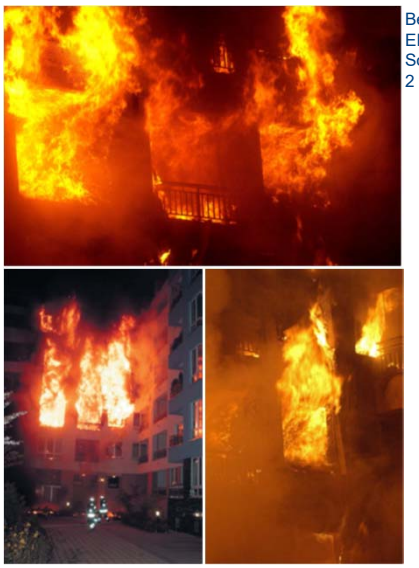


Façade Fire Scenarios

1. Post-flashover interior fire
2. Exterior fires
3. Wall-Cavity fires

Façade Fire Scenarios

1. Post-flashover interior fire
   - Spreads via openings (windows,.) to next level.
   - Re-entrant corner situations
2. Exterior fires
   - Dumpster fire, combustible storage..
   - Re-entrant corner situations
3. Wall Cavity fires
   - Initiate within cavity walls
   - Electrical fires, welding sparks
     - Insulation, cladding, weather barriers



Berlin 2005
EIFS façade
Source: Candle
2 fatalities

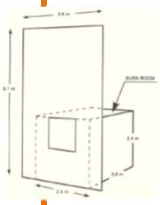
FM Global

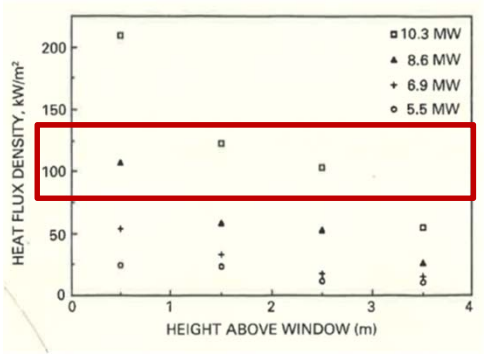
*Heat flux - Thermal exposure to wall assembly

Façade Fire – Post-flashover

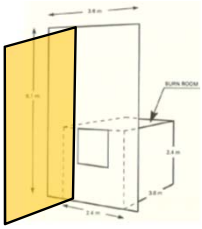
- Oleszkiewicz 1990: Realistic Heat Flux ~ 100 kW/m^2

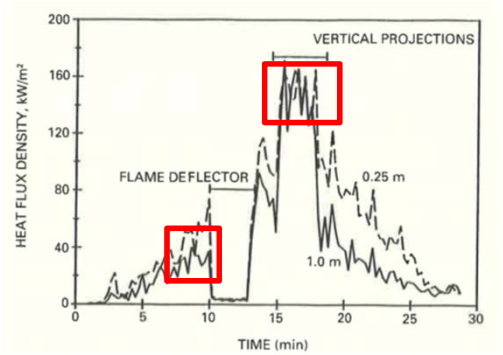
Single-wall





Re-entrant Corner





[PUBLIC]

Oleszkiewicz, "Fire Exposure to Exterior Walls and Flame Spread on Combustible Cladding", Fire Technology, 1990

Realistic fire exposure for post-flashover fire scenarios is on the order of 100 kW/m^2.

Walls with re-entrant corner has more severe exposure than single-wall fire scenario.

Façade Fire Scenarios

1. Post-flashover interior fire
   - Spreads via openings (windows,.) to next level.
   - Re-entrant corner situations
2. Exterior fires
   - Dumpster fire, combustible storage..
   - Re-entrant corner situations
3. Wall Cavity fires
   - Initiate within cavity walls
   - Electrical fires, welding sparks
     - Insulation, cladding, weather barriers

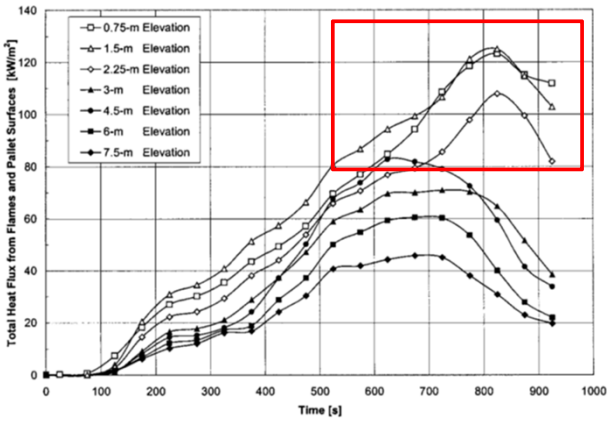
UK– 1991
Cavity wall façade
Dumpster fire

France 2010
EIFS façade
Dumpster fire
7 fatalities

Munich 1996
EIFS façade
Dumpster fire

Façade Fire Scenarios – Exterior fires

- Alpert & Davis 2002: Wood crib fire in corner – Dumpster fire
- Realistic Heat Flux ~ 100 kW/m^2



Alpert & Davis, "Evaluation of Exterior Insulation and Finish System Fire Hazard for Commercial Applications", J. Fire Protection Eng., 2002

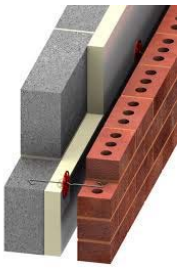
Realistic fire exposure for exterior fires is also of the order of 100 kW/m^2.

FM Global

Façade Fire Scenarios

1. Post-flashover interior fire
   - Spreads via openings (windows,.) to next level.
   - Re-entrant corner situations
2. Exterior fires
   - Dumpster fire, combustible storage..
   - Re-entrant corner situations
3. Wall Cavity fires
   - Initiate within cavity walls
   - Electrical fires, welding sparks
     - Insulation, cladding, weather barriers

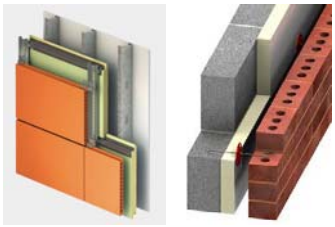
[PUBLIC]



Atlantic City (US) – 2007
Hot-work sparks from roof in cavity wall
ACM cladding, PS insulation

Atlantic city fire: Hot work sparks from roof fell into cavity wall comprising of ACM and PS insulation.
Wall cavity fire tests are discussed first, and post-flashover and exterior fire tests are discussed afterwards.

Cavity Wall Fire Scenarios



- FM fire test for cavity wall and cladding assemblies
  - FM 4411

- Two panels: 8 ft. x 4 ft.
  - Panel 1: Cladding (inner side) or Gypsum
  - Panel 2: Insulation or Weather Barrier
  - Air cavity separation per end-installation

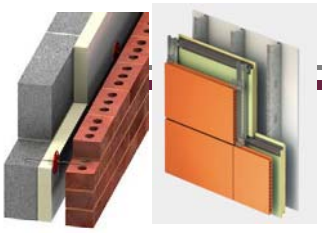
- Ignition source in wall cavity
  - Examples: Electrical fires, welding etc.
  - 40 kW/m^2 heat flux

K.L.T Jamison, D.A. Boardman, A new fire performance test for cavity wall insulation. MATEC Web of Conferences, 2016

The only standard fire test for simulating an ignition source within wall cavity. Simulates combustion of insulation/cladding/weather barrier due to ignition sources such as electrical/welding etc.

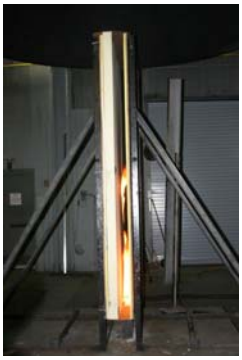
FM Global

Cavity Wall Fire Scenarios



- Fail criteria
  - Propagation height > 6 ft or Peak HRR > 100 kW

Gypsum with XPS
Fail



Gypsum with PIR or PU foam
Pass

FR-core ACM with PIR
Pass

[PUBLIC]

K.L.T Jamison, D.A. Boardman, A new fire performance test for cavity wall insulation. MATEC Web of Conferences, 2016

Some examples of cavity wall fire tests – results shown cannot be generalized for all product manufacturers

Large-scale Fire Tests


NFPA 285 (US)


Canada

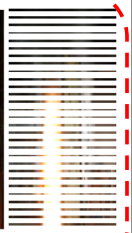

BS-8414 (UK)

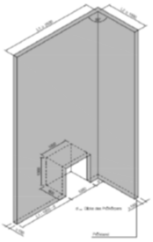

ISO-13785

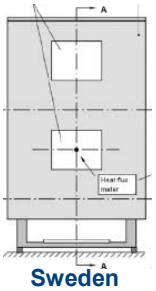
FM Global (ANSI/FM 4880) Tests


25 ft corner


50 ft corner


16 ft-PPT


Germany


Sweden


France


Russia


Draft Germany

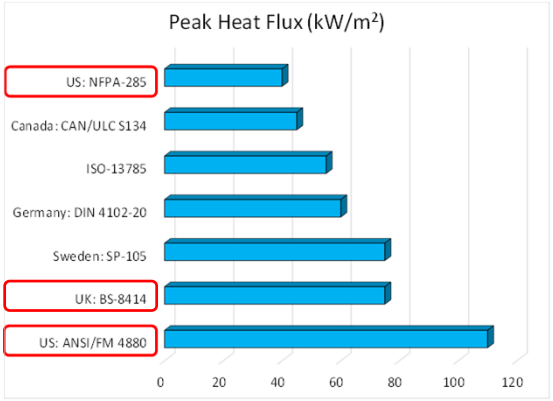

Hungary

The two north-American tests use single-wall post-flashover fire scenarios. The UK and ISO tests simulate corner situations in post-flashover fires. The FM Global has its suite of fire tests that are under the umbrella of FM 4880; these will be discussed in later slides.

Large-scale Fire Tests - Comparison

- Must simulate realistic fire scenarios:
  - Realistic and high heat flux
  - Better tests metal, joint systems, insulation..
- Research and literature:
  - Realistic fires > 100 kW/m^2 heat flux

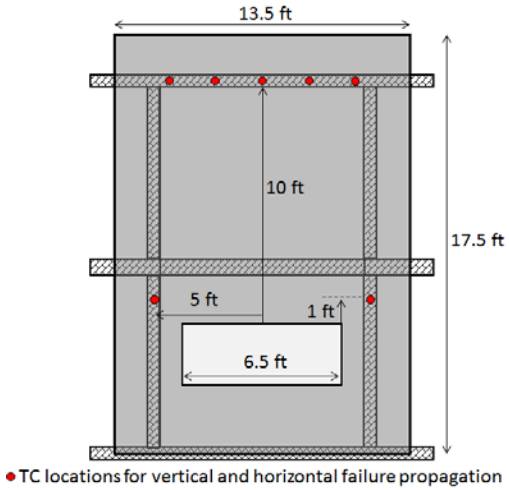
*Heat flux - Thermal exposure to wall assembly



Main characteristic distinguishing all large-scale fire tests is the heat flux exposure to the wall assembly. The heat flux exposure needs to be realistic and high, such that the metal, joint systems, and insulation behind can be tested for reaction to fire. As discussed, the realistic exposure for the post-flashover and exterior fires is on the order of 100 kW/m2. While comparing the large-scale fire tests, the US and Canadian tests use fire exposure to the order of ~40 kW/m^2 heat flux, the UK fire test with corner situation use ~75 kW/m^2, and the FM 4880 fire tests use ~100 kW/m^2 heat flux.

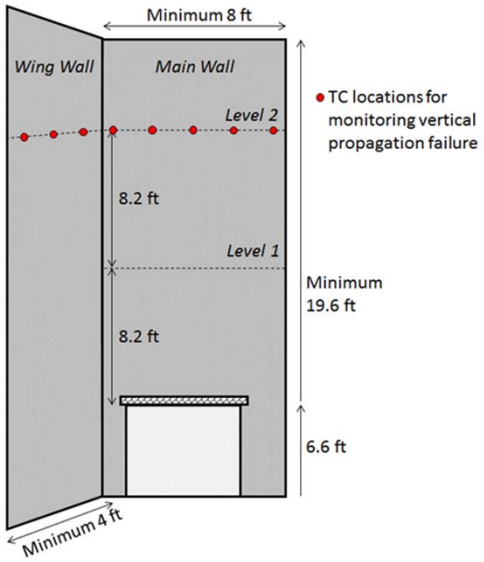
Key Fire Tests: NFPA-285

- Post-flashover fire: single wall
- Peak heat flux to wall: 40 kW/m2 –
- Pass criteria
  - Max 10 ft vertical propagation above window
  - Max 5 ft horizontal propagation from centerline



Key Fire Tests: BS-8414

- Post-flashover fire: re-entrant corner
- Peak heat flux to wall: ~75 kW/m^2
- Pass criteria
  - Max 16.4 ft (5 m) vertical propagation above window



ANSI/FM 4880

- Exterior and flashover fire exposures: re-entrant corner
- Peak heat flux to wall: 100 kW/m^2

25 ft corner test
Since 1970s

50 ft corner test
Since 1990s

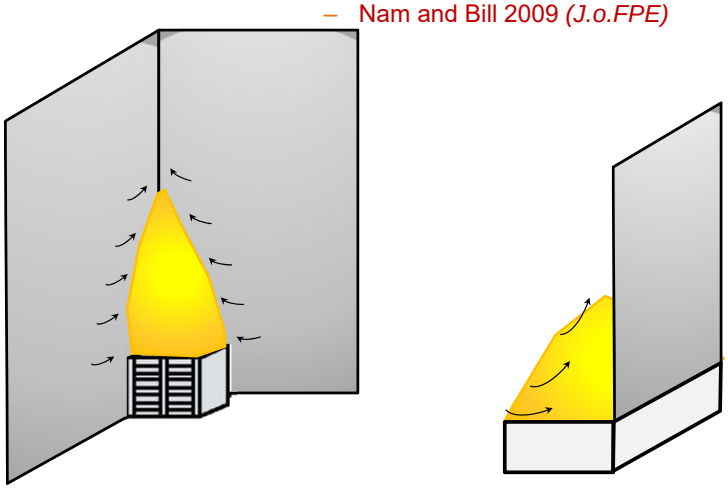
16 ft PPT
Since 2000s

FM Global

16-ft PPT of ANSI/FM 4880

- Correlated with corner tests
- Same radiation view factors
- Same heat flux – 100 kW/m^2
- Same entrainment dynamics
- End-results match
  - Cost-effective, repeatable

- Newman & Tewarson 1991 *(FSS)*
- Newman 1993 *(J.o.Plastics)*
- Tewarson 2001 *(F&M)*
- Alpert 2003 *(FSS)*
- de Ris & Orloff 2005 *(FSS)*
- Nam 2005, 2007 *(FSS)*
- Nam and Bill 2009 *(J.o.FPE)*



S. Nam and R. G. Bill, "A New Intermediate-scale Fire Test for Evaluating Building Material Flammability," *Journal of Fire Protection Engineering*, 2009.

Since 1990's FM Global have invested in researching a cost-effective alternative to corner fire tests that simulates the same severe fire condition and delivers same results. As a result, 16-ft PPT was developed in mid 2000's that was a result of extensive research and optimization to replace corner fire tests. To summarize the research briefly, the following factors were addressed: a) Radiation view factors between the corner fire tests and the parallel panel tests remain same 2) Heat flux from corner fire tests and PPTs remain same ~100 kW/m2 3) The entrainment dynamics of corner fires and PPTs is similar, and finally 4) the end results match between the corner fire tests and PPTs.

Comparison of Fire Tests: Size and Burners

NFPA-285 (US)

17 ft x 13 ft
Propane line burners: 1300 kW

BS 8414 (UK)

26 ft x 8 ft x 4 ft
Wood crib

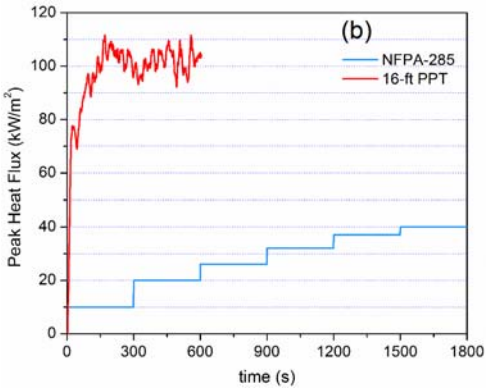
ANSI/FM 4880 - 16 ft. PPT

16 ft x 3.5 ft
360 kW Propane sand burner

Even though both NFPA-285 and 16-ft PPT of FM 4880 use propane burners, the NFPA-285 use line burner that produces a thin flame sheet. While the 16-ft PPT uses a ~2 ft wide sand burner. This results in heat flux exposure difference between the two tests. BS-8414 use 1.5 m^3 wood crib as ignition source.

Comparison of Fire Tests – Heat flux

	NFPA-285	BS-8414	ANSI/FM 4880 - 16 ft PPT
Scenario	Single-wall (flashover)	Re-entrant corner (flashover)	Re-entrant corner (Exterior/flashover)
Peak Heat flux	40 kW/m^2	75 kW/m^2	100 kW/m^2



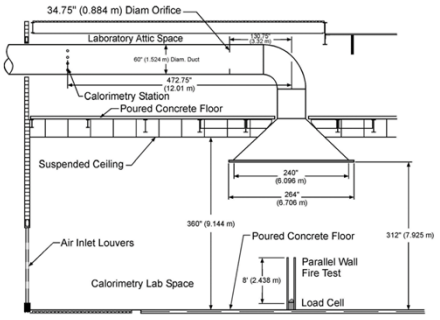
Not just the peak heat flux, the manner in which the heat flux is increased is tests is different. While in NFPA-285, the peak heat flux increases from 10 kW/m2 to 40 kW/m2 in span of 30 minutes, the heat flux in 16-ft PPT increases realistically quickly to the order of 100 kW/m2 in a matter of 2 minutes.

FM Global

Fire Tests – Failure Criteria

Test	Criteria for Fail
NFPA-285	Temperature at 10 ft height > 1000 °F
BS-8414	Temperature at 16.4 ft height > 1110 °F
16 ft. PPT	Peak HRR > 1100 kW

Approval Height ↓	Test Criteria ↓
Unlimited height	Peak HRR ≤ 830 kW
50 ft	Peak HRR ≤ 1100 kW



*HRR – Heat Release Rate
Rate of energy release in fires

- ❑ Global measurement of fire performance.
- ❑ Correlated to peak fire propagation height in corner fire tests.
- ❑ Objective and Repeatable.

S. Nam and R. G. Bill, "A New Intermediate-scale Fire Test for Evaluating Building Material Flammability," *Journal of Fire Protection Engineering*, 2009.

Failure criteria in NFPA-285 and BS-8414 is determined through thermocouple measurements at certain height. Passing the temperature thresholds provide unlimited height installation for both tests. Thermocouples are a local measurement tool. The 16-ft PPT uses heat release rate (HRR) as the criteria for pass/fail of assembly. HRR is a global measurement of fire performance, and is objective and repeatable. Based on HRR, assemblies are provided 50-ft limited height or unlimited height approval as per FM 4880.

Recent FM Research

- Evaluate fire performance of exterior cladding assemblies using 16-ft PPT
- Compare test results
  - NFPA 285 (US), BS 8414 (UK)

FM Global Research Technical Report

"Evaluation of the Fire Performance of Aluminum Composite Material (ACM) Assemblies using ANSI/FM 4880"

http://www.fmglobal.com/research-and-resources/research-and-testing/research-technical-reports

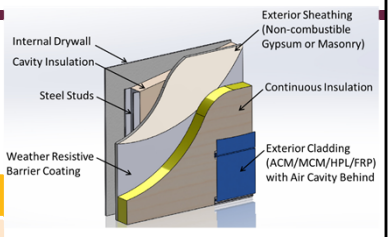
Tested Assemblies

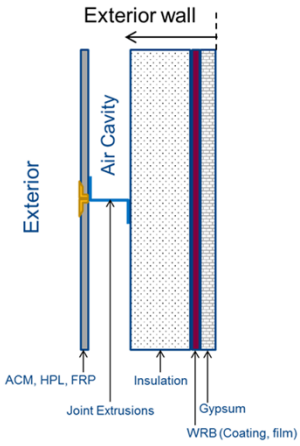
- Wide representation of practiced installations

Test #	Exterior Sheathing	WRB	Insulation	Air Cavity	ACM
1	Gypsum	Yes	--	0.2 inch	PP-core
2	Gypsum	Yes	PIR1 (2 inch)	1.2 inch	PP-core
3	Gypsum	--	--	2.0 inch	PE-core

Test #	Exterior Sheathing	WRB	Insulation	Air Cavity	ACM
4	Gypsum	--	--	2.0 inch	FR-core
5	Gypsum	Yes	--	2.0 inch	FR-core
6	Gypsum	Yes	PIR1 (2 inch)	2.0 inch	FR-core
7	Gypsum	Yes	PIR2 (2 inch)	2.0 inch	FR-core

PP – Polypropylene PE – Polyethylene WRB – Water Resistive Barrier
FR – Fire Retardant PIR– Polyisocyanurate

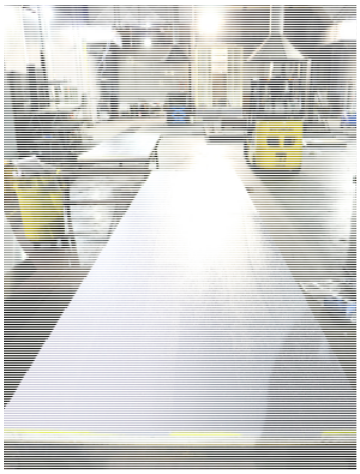




Test #1-3 – Combustible core ACMs
Test $4&5: FR-core ACMs but no combustible insulation behind
Test #6&7: FR-core ACMs but two different type foil-faced polyisocyanurate insulations behind.

Assembly Prep Example

Gypsum and WRB



Insulation

Joint system & ACMs with air cavity

Assembly Example

Central Vertical/Horizontal Joints

16-ft PPT

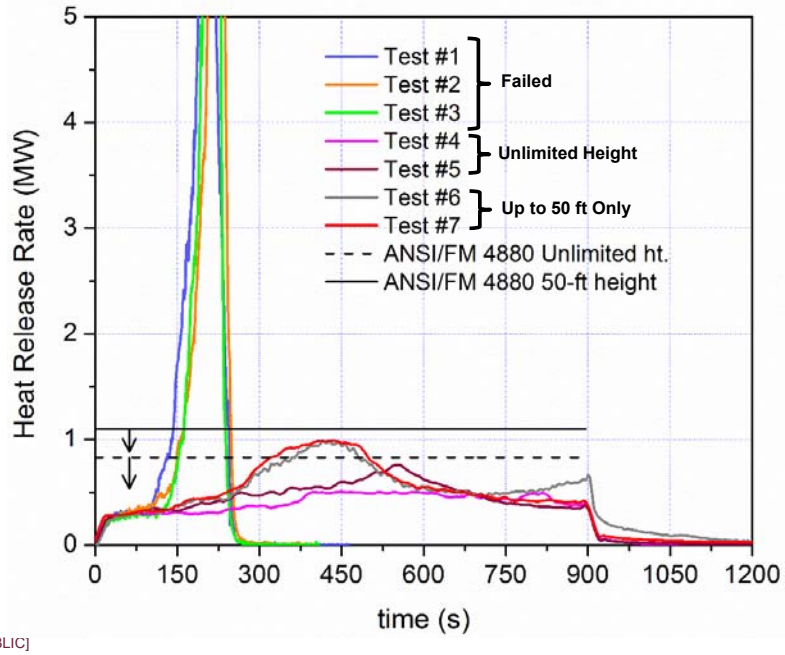
- 16 ft x 3.5 ft (2 walls)
- 360 kW fire source
- Placed under calorimeter
- Approval Criteria:

Approval Height	Test Criteria
50 ft	830 < HRR ≤ 1100 kW
Unlimited height	HRR ≤ 830 kW

Categorize fire performance:

- Unlimited Height
- Up to 50 ft (15.2 m)
- Very bad performers

FM Global



Categorize fire performance:

- Unlimited Height
- Up to 15.2 m
- Very bad performers

Test #	Assembly
1	PP-Core → WRB → Gypsum
2	PP-Core → PIR1 → WRB→ Gypsum
3	PE-Core → Gypsum

Test #	Assembly
4	FR-Core → Gypsum
5	FR-Core → WRB → Gypsum
6	FR-Core → PIR1 → WRB → Gypsum
7	FR-Core → PIR2 → WRB → Gypsum

[PUBLIC]

All combustible-core decisively ACMs fail 16-ft PPT. The HRR increased within a matter of minutes to more than 5 MW, clearly failing HRR thresholds for unlimited height or 50-ft limited height.
Assemblies with FR-core ACM but with no combustible insulation passed the unlimited height approval because peak HRR <= 830 kW
Assemblies with FR-core ACM but with specific combustible polyisocyanurate insulation failed the unlimited height approval but passed the 50-ft limited height approval.
Disclaimer: The results are specific to products tested and cannot be generalized.

Unlimited ht. vs. 50-ft vs. Failed Assemblies

Unlimited Height
HRR ≤ 830 kW
Burnt height < 8 ft

Test #4 | FR-Core ACM with Non-comb.

50-ft limited height
830 < HRR ≤ 1100 kW
8 ft < Burnt height < 16 ft

Test #6 | FR-Core ACM with PIR Comb.

Failed
HRR > 1100 kW
Burnt height > 16 ft

Test #3 | PE-Core ("Grenfell-like" ACM)

- Assemblies passing Unlimited height approval have HRR <= 830 kW and fire propagates up to 8 ft from base.
- Assemblies with 50-ft limited height approval have HRR <=1100 kW. Material burns less than 16 ft height but flames can go higher.
- Assemblies failing the test have HRR > 1100 kW and the material burns all the way to the top.

FM Global

Post-test pictures

Unlimited Height
HRR ≤ 830 kW
Burnt height < 8 ft

Test #4 | FR-Core ACM with Non-comb.

50-ft limited height
830 < HRR ≤ 1100 kW
8 ft < Burnt height < 16 ft

Test #6 | FR-Core ACM with PIR Comb.

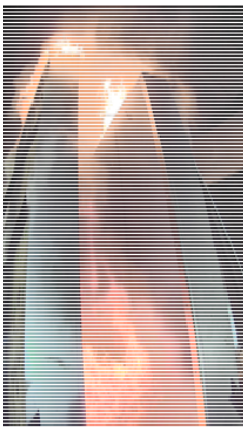
Failed
HRR > 1100 kW
Burnt height > 16 ft

Test #3 | PE-Core ACM

- Unlimited height assembly: Fire propagation limited to the area of burner impact.
- 50-ft height assembly: ACM burns up to 8 ft. The joint systems open up to 12 ft, and insulation burns up to 14 ft. A better acm, or its joint system, or insulation are few practical ways to reduce the fire propagation.

FM Global

Other Observations – Cavity fire spread



- Cavity fire and external fire spread phenomena captured in 16-ft PPT

[PUBLIC]

Besides external fire phenomena, the cavity fire was also observed. The 100 kW/m2 exposure burns through the ACM near burner, thereby exposing the insulation to high heat flux and cavity fire scenario.

FM Global

Comparison with NFPA-285 and BS-8414

Unlimited height

Test #	Exterior Sheathing	ANSI/FM 4880	BS-8414	NFPA-285
1	PP-Core → WRB → Gypsum	Fail	Not tested	**Pass** (tested)
2	PP-Core → PIR1 → WRB→ Gypsum	Fail	Not tested	**Pass** (desk top)
3	PE-Core → Gypsum	Fail	Fail	Fail
4	FR-Core → Gypsum	**Pass Unlimited Height**	**Pass**	**Pass** (tested)
5	FR-Core → WRB → Gypsum	**Pass Unlimited Height**	Not tested	**Pass** (tested)
6	FR-Core → PIR1 → WRB → Gypsum	Fail Unlimited ht. Pass 50 ft ht.	Fail (6 inch PIR)	**Pass** (desk top)
7	FR-Core → PIR2 → WRB → Gypsum	Fail Unlimited ht. Pass 50 ft ht.	Fail (6 inch PIR)	**Pass** (desk top)

[PUBLIC]

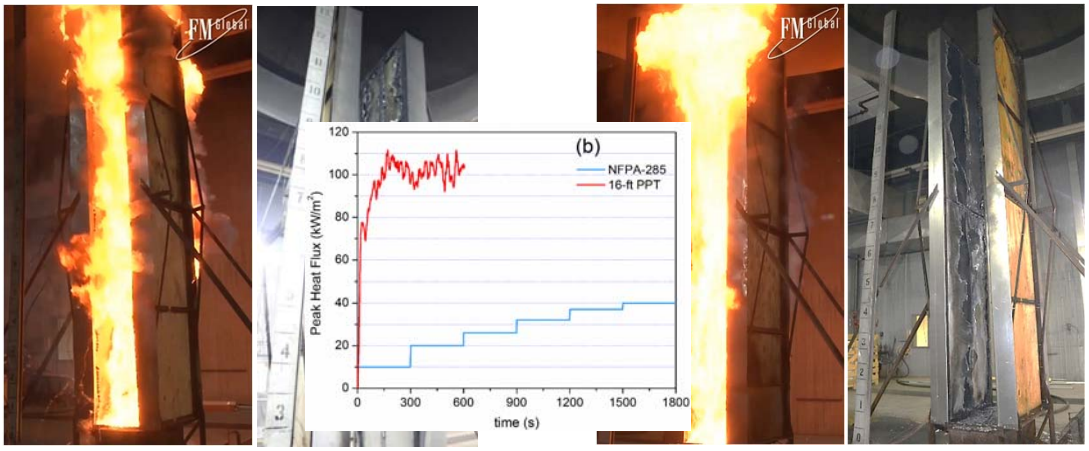
Heat flux of ANSI/FM 4880 and BS-8414 higher than in NFPA-285

- Assembly in Test #1 with combustible core ACM passed NFPA-285 test with report available. The NFPA-285 tested and passed assembly decisively failed 16-ft PPT of FM 4880.
- Similarly, assembly in Test #2 with combustible insulation is deemed pass for NFPA-285 per a desktop assessment. This assembly also decisively failed.
- Test #6 and 7 pass NFPA-285 for unlimited height in US buildings. These assemblies fail unlimited height approval, and pass 50-ft height limited approval per FM 4880. These two assemblies also fail BS-8414 tests for unlimited height.
- For the limited testing, the evaluations of FM 4880 are consistent with BS-8414.

Combustible ACMs – All Fail 16ft PPT

FM 16-ft Test #1
Passed NFPA-285

FM 16-ft Test #3 (Similar to Grenfell)
Failed NFPA-285



[PUBLIC]

Heat flux difference → Different Evaluations.

- When exposed to realistic fire conditions in 16-ft PPT, the Test #1 assembly that passed NFPA-285 demonstrated similar fire hazard when compared to the Test #3 assembly, that used similar ACM as used in Grenfell tower.
- In NFPA-285 test, the assembly in Test #1 only propagated to 5 ft above window by the end of the test (10 ft propagation is failure criteria).
- The main reason between different evaluations of Test #1 assembly by NFPA-285 and 16-ft PPT of FM 4880 is due to 1) the wide difference in the applied peak heat flux, and 2) the manner in which the peak heat flux is increased over the course of the tests.
- The result demonstrate that NFPA-285 is not robust enough for evaluating fire performance of ACM assemblies in realistic fire conditions.

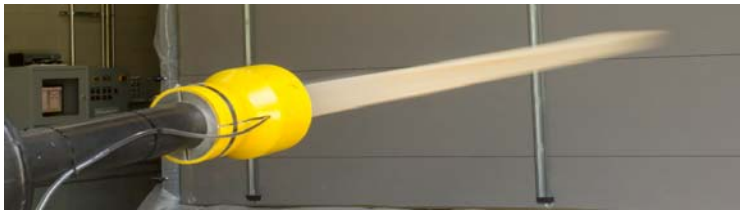
FM Approvals

- Comprehensive approach to loss prevention
- Performance based requirements
- Focus not on components but assembly
- Realistic fire scenario tests and cavity wall tests
- Realistic natural hazards: wind and hail
- Products monitored for continued approval

FM

FM

[PUBLIC]

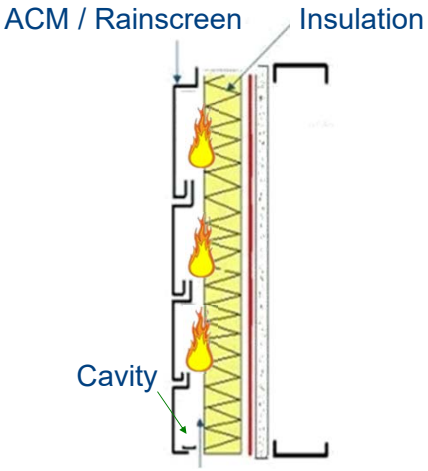


FM Approval of ACM / Rainscreen

ANSI FM 4881

ANSI FM 4880

FM 4411



ANSI FM 4880: Interior and Exterior Walls

- Fire Rating of Building Panels or Interior Finish Materials
- Small scale tests evaluate combustibility of assembly components
  - Tests to characterize combustibility of combustible insulations
  - Tests to categorize insulation as non-combustible
- Large scale tests evaluate combustibility of entire assembly
  - Room corner fire test - Interior finish materials
  - 16 ft Parallel Panel test

FM 4411: Cavity Wall & Rainscreen Systems

- Cavity Wall Fire Test: Rainscreen and Insulation

- Small Scale Component Tests:
  - Corrosion Resistance of Fasteners
  - Determination of pH of Aqueous Insulation Extraction

- Assembly Must Pass ANSI FM 4880 (Fire: 16-ft PPT)

- Assembly Must Pass ANSI FM 4881 (Natural Hazards)

Summary

- Comprehensive approach in evaluating ACM / Rainscreen assembly
- Performance based criteria--not prescriptive based
- Fire testing of cavity and small scale tests per 4411
- Fire testing of exterior façade per 4880
- Natural hazards testing of assembly per 4881

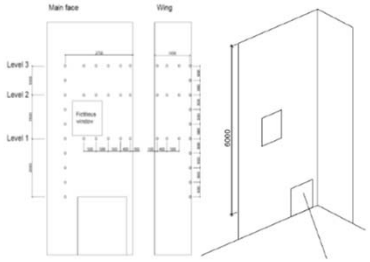
International Codes and Fire Tests

- UK
  - Dame Judith Hackitt's Review of Building Regulations and the Grenfell Inquiry
  - RISC Report: insurer relevant recommendations:
    - More severe and realistic fire test than BS-8414 is needed

Draft DIN E4102-24

- Germany
  - Development of new severe corner fire test for realistic fires
  - Draft DIN E4102-24

Proposed Harmonized Test



- Europe – Harmonization
  - Development of new severe and realistic post-flashover fire test
  - Based on BS-8414 with modifications

International Codes and Fire Tests

- Australia
  - Adoption of BS-8414 fire test
  - Modifications:
    - 30 minute test
    - Falling debris limit
    - No flaming on ground
- US
  - ICC code proposals
  - NFPA building code proposals
  - Desktop assessments
    - Using one or very few actual large-scale test
    - Multiple certifications and no repository
    - Limited engineering basis

Next Steps

- Research
  - Testing more wall assemblies with different claddings and insulations
  - NFPA fire test committee approved development of draft standard based on 16-ft PPT.
- FM Approvals
  - FM 4411 update roll-out and FM Approved ACM Assemblies
- Engineering Standards
  - Client Specific Testing and Support
  - Datasheet Updates

Thank you! Questions?

FM 16-ft Test #1
Passed NFPA-285

FM 16-ft Test #3 (Similar to Grenfell)
Failed NFPA-285