

FCIA “DIIM” Symposium

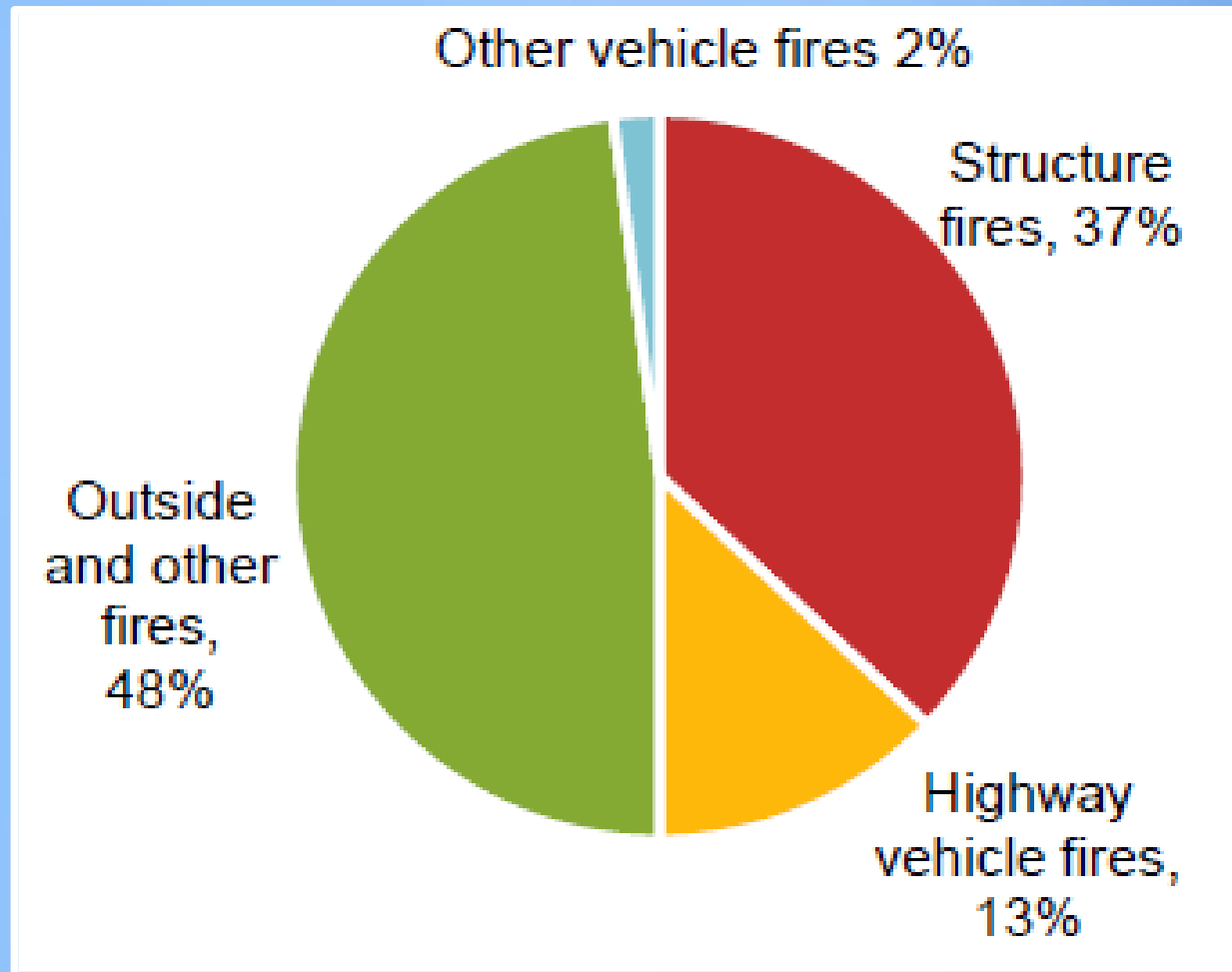
Passive Fire Protection in Canadian Codes

Tony Crimi, A.C. Consulting Solutions Inc.

**Overview of Fire Test Standards for
Building Materials in Canadian Codes**

2017 - US Fire Statistics

1,319,500 Fires reported in the US



US Fire Loss Clock



One highway vehicle fire was reported every **188 seconds**.



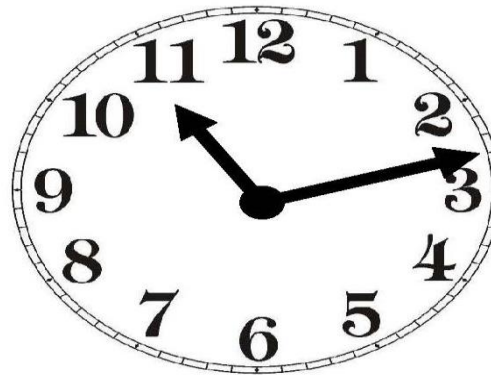
One outside fire was reported every **52 seconds**.



A fire department responded to a fire every **24 seconds**.



One structure fire was reported every **64 seconds**.



One civilian fire injury was reported every **33 minutes**.



One home structure fire was reported every **86 seconds**.



One civilian fire death occurred every **2 hours and 41 minutes**.

Source: *Fire Loss in the United States during 2014*, Hylton J.G. Haynes

Source: *Fire Loss in the United States During 2015*, by Michael J. Karter, Jr. National Fire Protection Association, Quincy, MA,



A.C. Consulting Solutions Inc.
(905) 508-7256

Summary of 2017 U.S. Fire Problem

•499,000 structure fires in the U.S. (37% of total) resulting in:

- 🔥 3,000 civilian fire deaths (88% of all)
- 🔥 12,167 civilian fire injuries (83% of all)
- 🔥 10.7 billion in property damage (82%)*
* Excludes 10 Billion Cal Wildfire Losses
- 🔥 One structural fire every 64 sec



Source: NFPA Records

Summary of 2002 Canadian Fire Problem

Summary 1993 - 2002

Table 1 - Canada Fire Losses, Fire Deaths and Fire Injuries

Year	Estimated Population*	Number of Fires	\$ Loss	Per Capita \$ Loss	Fire Deaths	Death Rate**	Injuries	Injuries Rate**
1993	28 703 142	65 877	1 181 892 872	41.18	417	1.45	3 463	12.06
1994	29 035 981	66 719	1 151 546 461	39.66	377	1.30	3 539	12.19
1995	29 353 854	64 251	1 110 839 184	37.84	400	1.36	3 551	12.10
1996	29 671 892	60 138	1 163 336 515	39.21	374	1.26	3 152	10.62
1997	30 003 955	56 292	1 291 640 983	43.05	416	1.39	3 149	10.50
1998	30 300 422	57 602	1 175 553 135	38.80	337	1.11	2 697	8.90
1999	30 464 255	55 169	1 231 936 723	40.44	388	1.27	2 287	7.51
2000	30 737 179	53 720	1 185 233 793	38.56	327	1.06	2 490	8.10
2001	31 081 887	55 323	1 420 779 985	45.71	338	1.09	2 310	7.43
2002	31 485 263	53 589	1 489 012 263	47.29	304	0.97	2 547	8.09
10-Year Average		59 936	1 222 238 193	40.61	374	1.25	3 072	10.26

* Source: 2002 Census, Statistics Canada

** Fire deaths rate and fire injuries rate - number of deaths/injuries per 100 000 population per annum



A.C. Consulting Solutions Inc.
(905) 508-7256

Summary of 2007 Canadian Fire Problem

- 43,196 fires in building structures resulting in:
 - 277 civilian deaths,
 - 2,547 civilian injuries, and
 - \$1.69 billion in property damage.



Canada's Code Development System



The National Research Council:

- Canada's Science and Technology Institution
 - NRC Institute for Research in Construction (IRC)
 - NRC-IRC Canadian Codes Centre (CCC)

Provides research and administrative support to the overall system

Canada's Code Development System



The Governing Principles:

- code users drive the code change process
- provinces and territories are involved at every step
- public review is key “check and balance”

The CCBFC does not approve a change unless due process has taken place.

Canada's Code Development System

Why did Canadian national codes adopt an objective-based format since 2005?

- To clarify the scope of the code
- To better explain the intent of code provisions
- To make the codes easier to apply to existing buildings
- To remove barriers to the use of new and innovative building materials and systems.

Canada's Code Development System

Objective-Based Codes

Use current code requirements, and give user more information to

- interpret code
- assess conformance
- evaluate equivalents



Canada's Code Development System

Alternative Solutions

- Not “anything goes”
- Must perform at least as well as the acceptable solutions it is proposed as an alternative to
- Administrative provisions for accepting an alternative solution are demanding



A.C. Consulting Solutions Inc.
(905) 508-7256

Combustibility



A.C. Consulting Solutions Inc.
(905) 508-7256

Combustibility in the Building Codes

🔥 *The typical dictionary Definition of "Noncombustible" is:*

🔥 not capable of undergoing combustion under specified conditions.



So what does this mean for BUILDINGS ?



Match



Candle



Torch



Flame Thrower

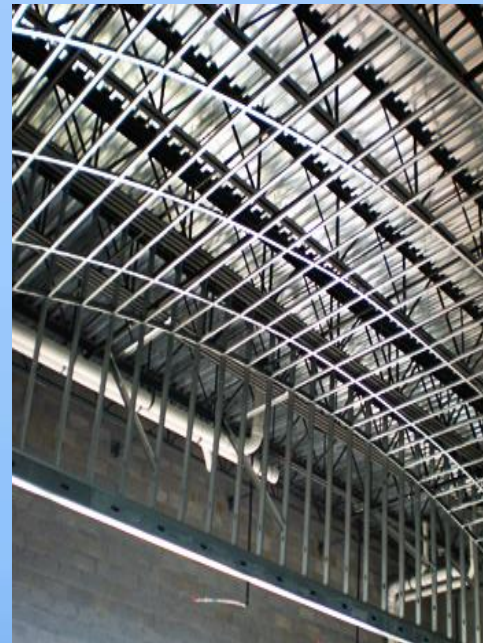


Other Adhoc Methods

Combustibility in the Building Codes

Noncombustible means that a material meets the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials."

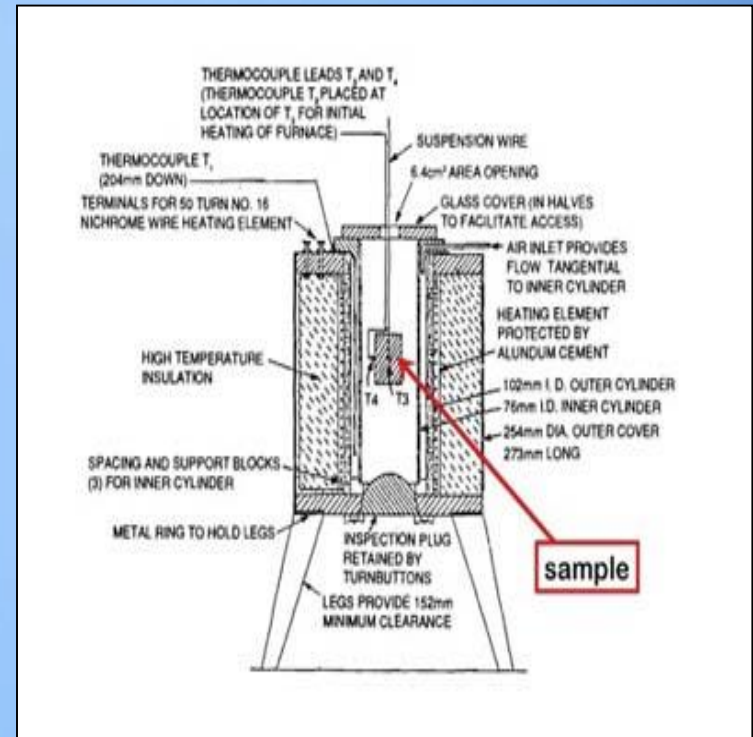
Combustible means that a material fails to meet the acceptance criteria of CAN/ULC-S114, "Test for Determination of Non-Combustibility in Building Materials."



Code Required Non-Combustibility Testing

Combustibility & Heat Release:

Traditionally, non-combustibility measured using CAN/ULC-S114 (750°C, 15 min, 62.5 Kw/m²)

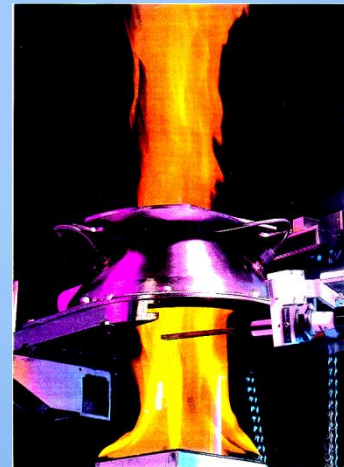


Flame Retardants do NOT make a material Non-Combustible

Reaction-to-Fire Testing

Combustibility & Heat Release:

- NBC 2005 introduced new alternative criteria based on CAN/ULC-S135 Cone Calorimeter which measures combustion parameters such as:
 - Time to Ignition
 - Peak Heat Release Rate
 - Total Heat Release
 - Mass Loss Rate
 - Smoke Development



Reaction-to-Fire Testing

Combustibility & Heat Release:

NBC non-combustibility criteria:

A material is permitted to be used in *noncombustible construction* provided that when tested in accordance with CAN/ULC-S135:

- a) its average total heat release is not more than 3 MJ/m^2 ,
- b) its average total smoke extinction area is not more than 1.0 m^2 , &
- c) the test duration is extended until it is clear that there is no further release of heat or smoke



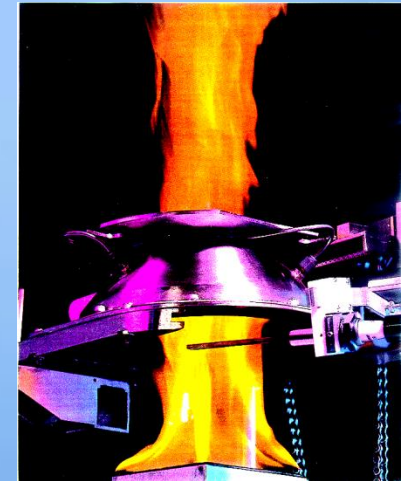
Reaction-to-Fire Flammability Testing



A.C. Consulting Solutions Inc.
(905) 508-7256

Reaction-to-Fire Testing

- Basic Concept Covers:
 - Combustibility & Heat Release
 - Flame spread
 - Ignitability
 - Smoke Production & Toxicity



Reaction-to-Fire Testing

Flame Spread & Fire Growth:

- Canadian Codes Currently use “Tunnel” tests in:
 - CAN/ULC-S102
 - CAN/ULC-S102.2
 - ULC –S127 (via references in S102 & S102.2)

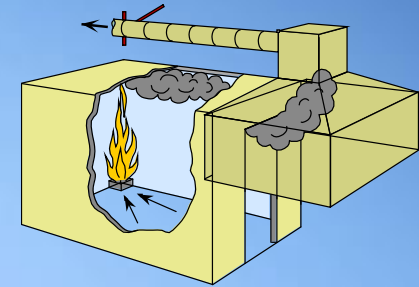
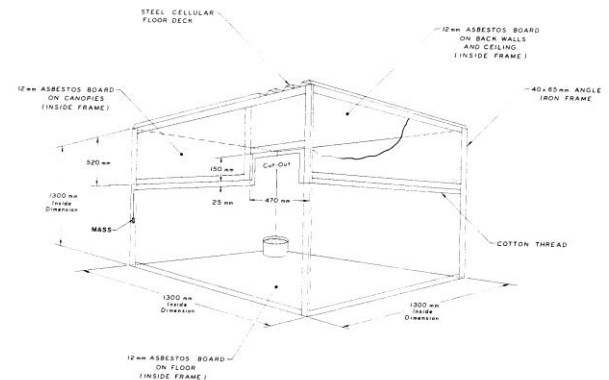


FIGURE 1
FOUR FOOT CORNER WALL TEST COMPARTMENT



Reaction-to-Fire Testing

Flame Spread & Fire Growth:

3.1.12.1.Determination of Ratings

- 1) Except as required by Sentence (2) and as permitted by Sentence (3), the *flame-spread rating* and smoke developed classification of a material, assembly, or structural member shall be determined on the basis of not less than three tests conducted in conformance with **CAN/ULC-S102**, “Test for Surface Burning Characteristics of Building Materials and Assemblies.”
- 2) The *flame-spread rating* and smoke developed classification of a material or assembly shall be determined on the basis of not less than three tests conducted in conformance with **CAN/ULC-S102.2**, “Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies,” if the material or assembly
 - a) is designed for use in a relatively horizontal position with only its top surface exposed to air,
 - b) cannot be tested in conformance with Sentence (1) without the use of supporting material that is not representative of the intended installation, or
 - c) is thermoplastic.

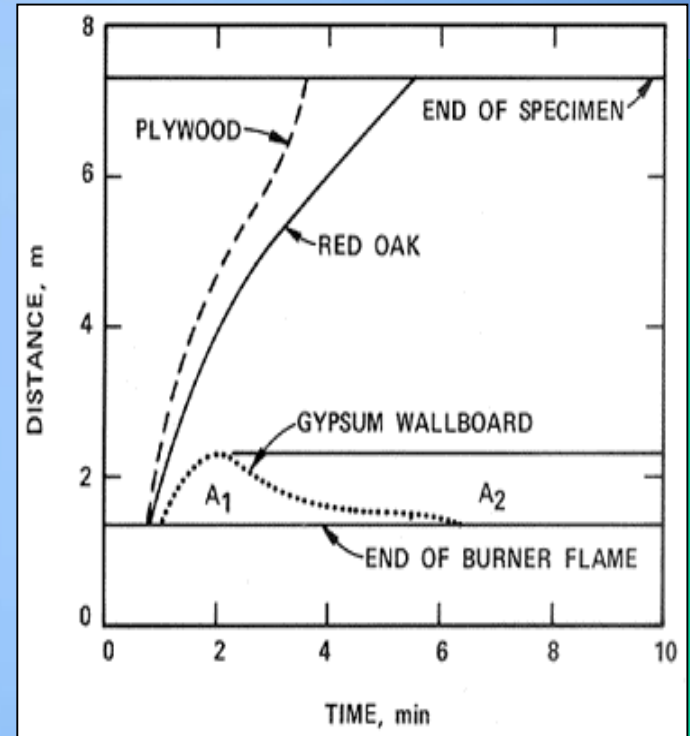


What are Flame Spread & Smoke Developed ratings?

🔥 **Index** because calibrated against red oak and cement board, 0 & 100 reference – time distance curve

🔥 **Smoke developed** rating calculated by comparing integrated obscuration area under the curve for red oak reference material versus test specimen.

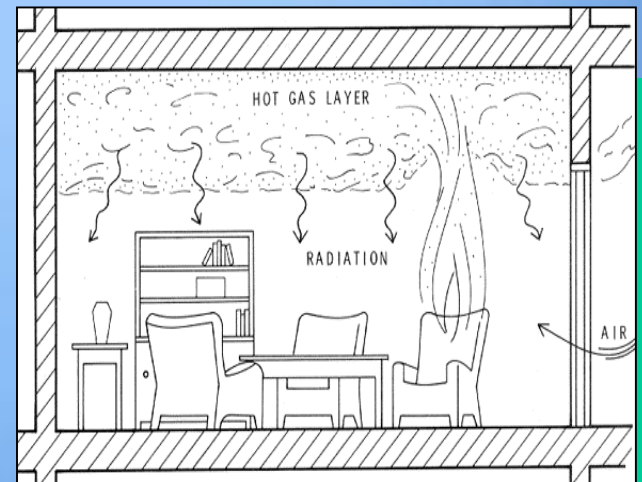
🔥 **Flame spread rating** calculated as the total area under the distance-time plot determined by ignoring any flame front recession, and normalized to red oak area.



What do Flame Spread ratings Mean? How do they relate to the “real world” & time to escape?

In a standard 8 ft by 8 ft room fire test using a (~ 100 kW equivalent in intensity to a severe waste paper basket fire):

- 🔥 FSC 15 (e.g. Mineral Wool) = Infinite time to flashover, e.g. does not occur
- 🔥 FSC 135 (e.g. 6 mm douglas fir plywood) = 3 minutes or less to room flashover
- 🔥 FSC 500 (e.g. foamed plastics) = 13 seconds to room flashover





NBCC Flame Spread Ratings for 3.2.6 (High) Buildings

Table 3.1.13.7.
Flame-Spread Rating and Smoke Developed Classification in High Buildings
 Forming Part of Sentence 3.1.13.7.(1)

Location or Element	Maximum <i>Flame-Spread Rating</i>			Maximum Smoke Developed Classification		
	Wall Surface	Ceiling Surface ⁽¹⁾	Floor Surface	Wall Surface	Ceiling Surface ⁽¹⁾	Floor Surface
<i>Exit</i> stairways, vestibules to <i>exit</i> stairs and lobbies described in Sentence 3.4.4.2.(2)	25	25	25	50	50	50
Corridors not within <i>suites</i>	(2)	(2)	300	100	50	500
Elevator cars	75	75	300	450	450	450
Elevator vestibules	25	25	300	100	100	300
<i>Service spaces</i> and <i>service rooms</i>	25	25	25	50	50	50
Other locations and elements	(2)	(2)	No Limit	300	50	No Limit

Reaction-to-Fire Testing



Smoke Production & Toxicity:

- Canadian Codes limit smoke production of materials based on “quantity” rather than composition/toxicity
- Currently use “Tunnel” tests in:
 - CAN/ULC-S102
 - CAN/ULC-S102.2
- NBC Committees have identified in their intents that “fire hazard” includes “*fire & smoke*”

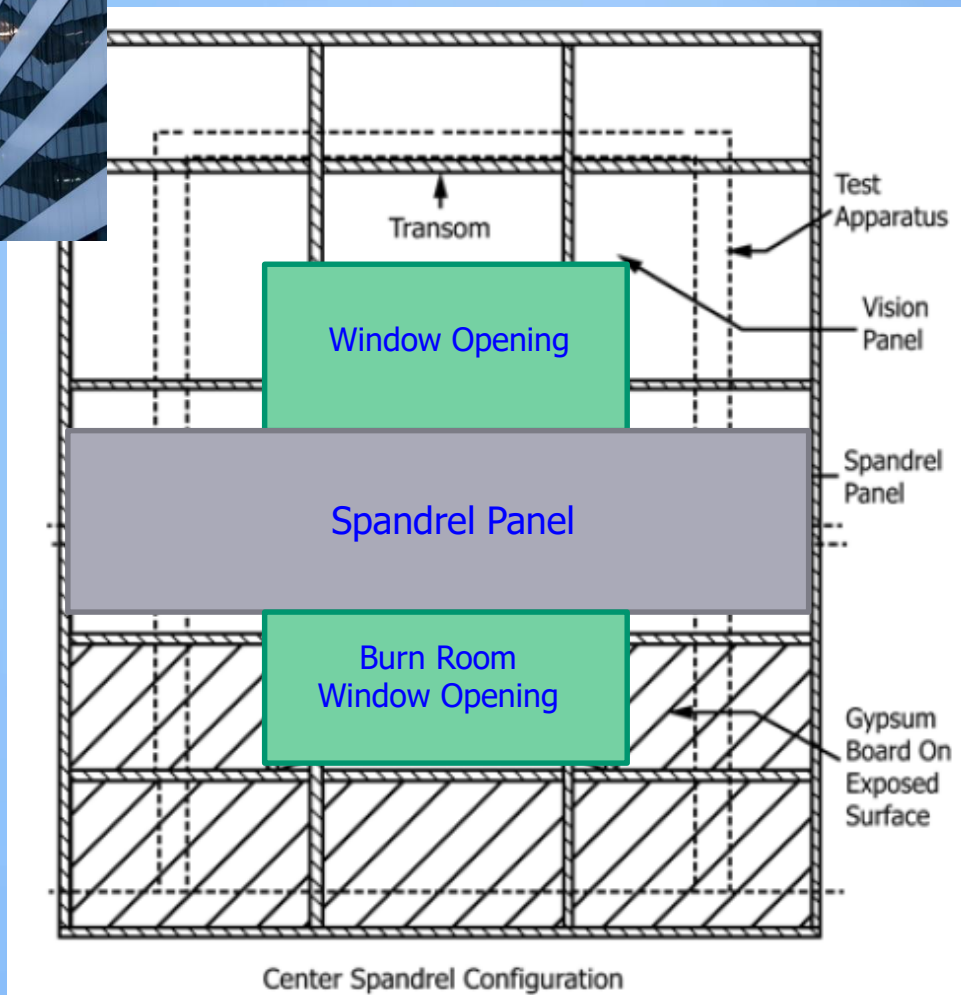
Reaction-to-Fire Testing

Exterior Walls

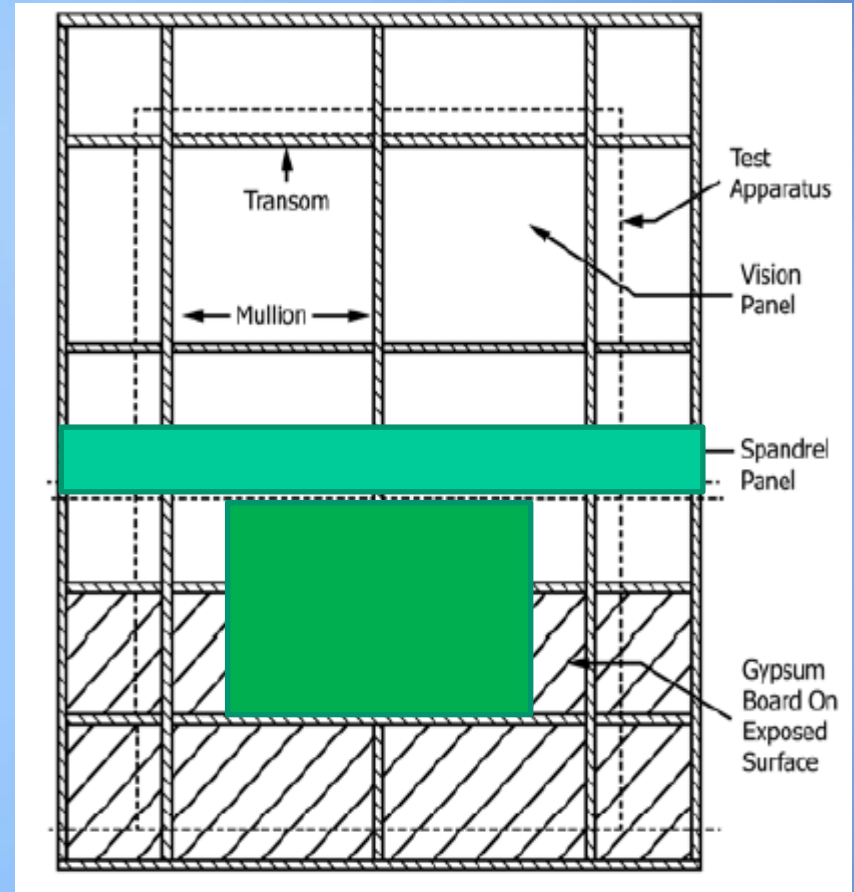


A.C. Consulting Solutions Inc.
(905) 508-7256

Windows on Adjacent Stories



Window & Spandrel heights vary widely



[Narrower Spandrel; Window raised to bottom](#)

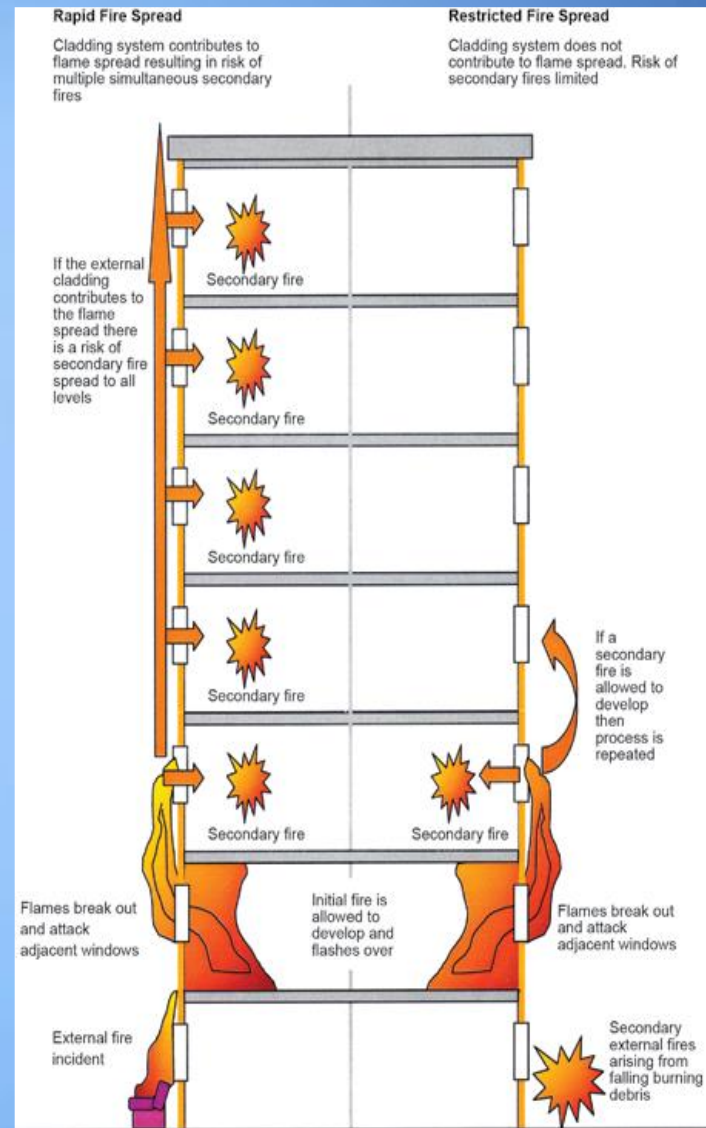
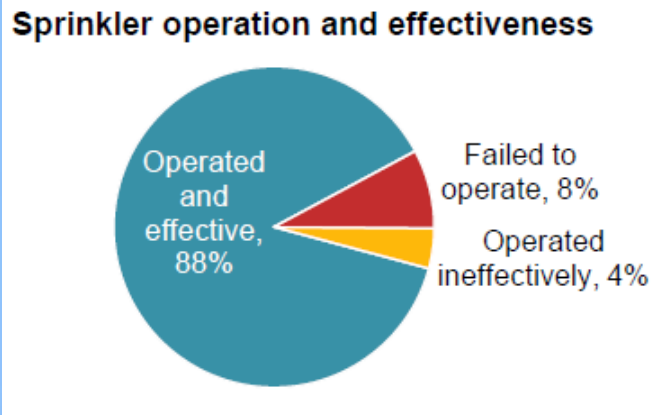


A.C. Consulting Solutions Inc.
(905) 508-7256

But my Building is Sprinklered ...?

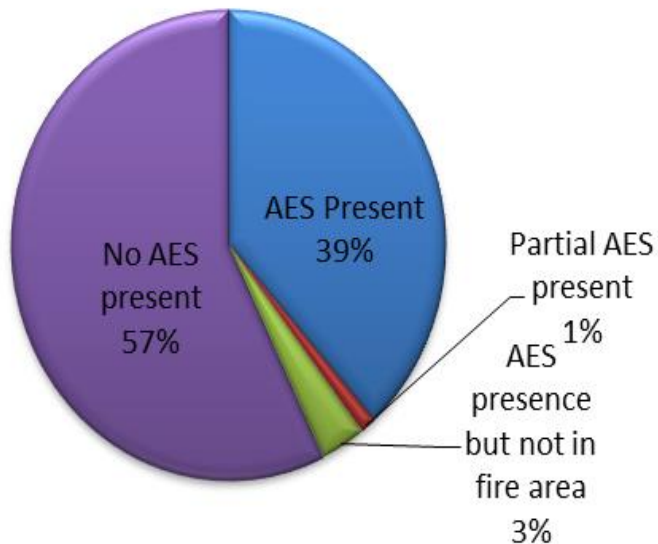
➤ *In 2014, NFPRF published a report on Fire Hazards of Exterior Walls with Combustible Components, which stated:*

➤ *“The percentage of exterior wall fires occurring in buildings with sprinkler systems installed ranges from 15-39% for the building height groups considered. This indicates that whilst sprinklers may have some positive influence, a significant portion of external wall fires still occur in sprinkler protected buildings, which may be due to both external fire sources or failure of sprinklers.”*

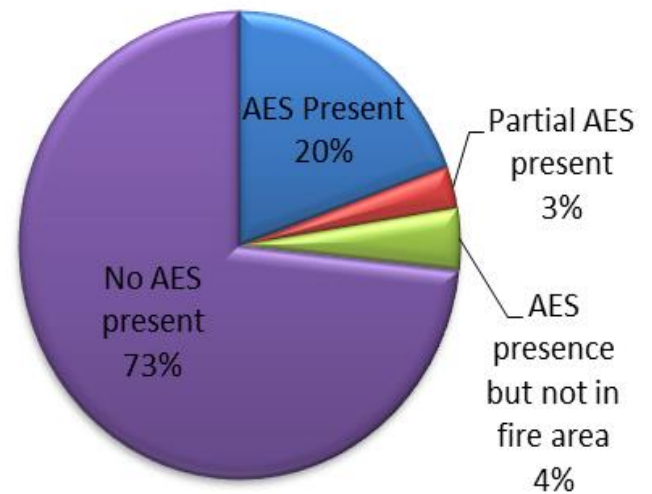


NFPA STATISTICS

Exterior wall fires in buildings 6-10 stories



Exterior wall fires in buildings 11-100 stories



But my Building is Sprinklered ...?

➤ *Similarly, NRC/IRC studies published as far back as 1997 also found that various types of glazing will fail at even lower temperatures when water is sprayed onto hot glazing;*

Thermal Shock

Tests with a small-scale radiant panel demonstrated that cold water applied to hot glazing can cause premature failure of the glass.[2] Without water protection, tempered and heat-strengthened glazing can sustain a glazing temperature on the exposed side of more than 350°C. However, when water was sprayed onto the hot glazing, the glazing failed at much lower temperatures. The critical temperatures established for heat-strengthened and tempered glazing are 150–165°C and 200°C, respectively.[2] The critical temperature for plain glass (80–90°C) is too low to allow for effective protection using a sprinkler system. These investigations established that in order for a sprinkler to provide effective protection, it must be activated before the glazing temperature exceeds its critical level.



ASTM E2874-19 Acceptance Criteria

A. *"I" Integrity Rating*—The integrity rating of the spandrel-panel assembly shall be determined as the time at which one of the following conditions first occurs:

1. The total heat flux measured by the heat flux transducers in in room above reaches 3 kW/m², or
2. The occurrence of flames or hot gases on any portion of the unexposed surface of the test specimen sufficient to ignite the cotton pad.

B. *"T" Rating*—The "T" rating of the spandrel-panel assembly shall be determined as the time at which one of the following conditions first occurs:

1. The temperature rise of any of the unexposed surface thermocouples on the unexposed face of the spandrel panel assembly or adjacent supporting construction is more than 325 °F (181 °C) above the initial temperature, and
2. The average temperature rise as indicated by all unexposed surface thermocouples is more than 250 °F (139 °C) above the initial temperature.

C. *"F" Rating*—The "F" rating of the spandrel-panel assembly shall be determined as the time at which visible flame penetration through the building spandrel-panel assembly or around its boundaries, occurs.



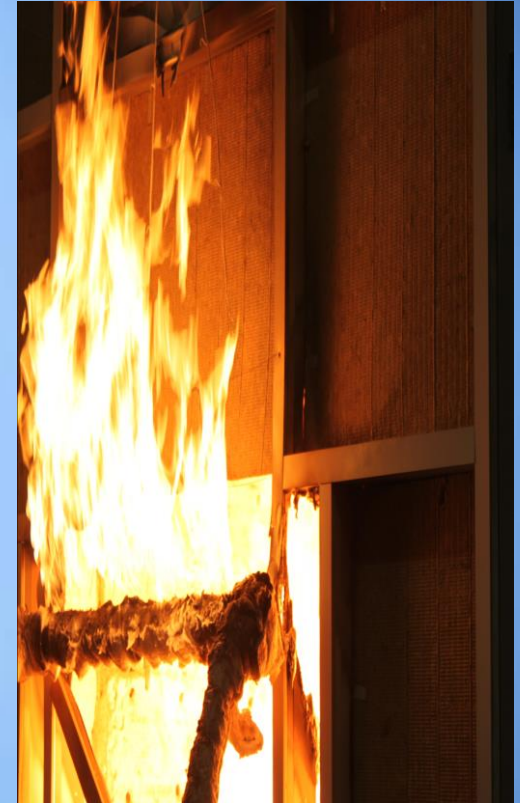
Summary

When considering floor-to-floor fire spread via openings (e.g. windows), the nature of exterior wall/curtain wall designs is a critical factors that will dictate the relative capability to resist floor-to floor fire spread.

Key factors that impact curtain wall resistance to vertical fire spread, which need to be evaluated by testing, can include:

- Full height or partial height vision glass or spandrel panel design
- Nature of the glass used to construct glazing system
- Nature of the curtain wall components (e.g. framing, spandrel panels, rain screen, air gap)
- Vertical or horizontal projections on exterior that may deflect or enhance flame behavior
- Building geometry at curtain wall – inclined, staggered, sloped, etc.
- Operable windows/openings – size and orientation
- The vertical alignment of windows/openings

A Spandrel-Panel assembly impedes the vertical spread of fire via exterior fire spread, from the floor of origin to the floor(s) above.



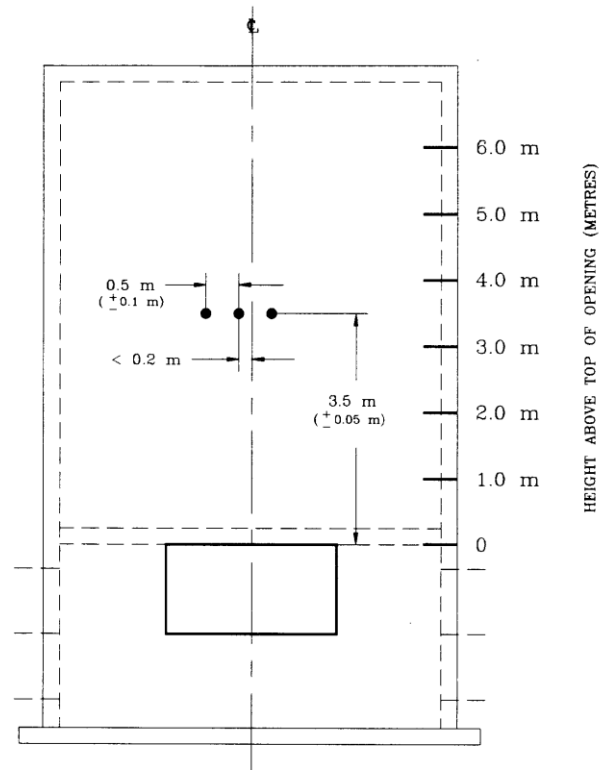
Reaction-to-Fire Testing

Exterior Walls

CAN/ULC –S134

FIGURE 2

HEAT FLOW TRANSDUCER LOCATIONS



ELEVATION VIEW

● - heat flow transducer

Reaction-to-Fire Testing

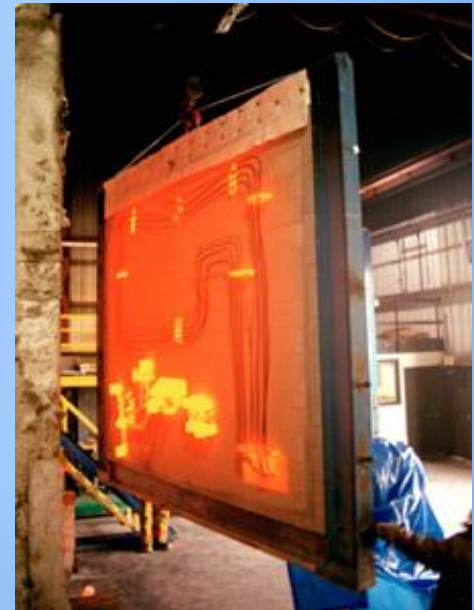
Exterior Walls

Section 3.1.5.5 & 3.1.5.6 permit exterior, non-loadbearing wall assembly containing combustible claddings and components to be used in buildings required to be of noncombustible construction provided the building:

1. Is unsprinklered and less than 3 storeys in building height, or
2. The building is sprinklered throughout, and
3. The interior surfaces of the walls are protected with a thermal barrier as required by 3.1.5.11 (3) discussed above, and
4. The wall meets the performance requirements of 3.1.5.5 (2) & (3) when tested in accordance with **CAN/ULC-S134 “Fire test of Exterior Wall Assemblies”**.
 1. Flaming on or in the wall assembly shall not spread more than 5 m above the opening during or following the test procedure referenced in Sentence (1). (See Appendix A.)
 2. The heat flux during the flame exposure on a wall assembly shall be not more than 35 kW/m^2 measured 3.5 m above the opening during the test procedure referenced in Sentence (1). (See Appendix A.)



Fire Resistance Ratings & Compartmentation



A.C. Consulting Solutions Inc.
(905) 508-7256

Fire Resistance

Common Terminology:

- ❑ **Fire Resistance**
 - Time in minutes that a material or assembly withstands passage of flame, temperature and retain structural integrity under conditions of CAN/ULC-S101 (ASTM E119) test

- ❑ **Fire Protection Rating**
 - Time in minutes that a closure withstands passage of flame, and retain structural integrity under Standard test conditions

- ❑ **Fire Compartment**
 - In a building, an enclosed space separated by vertical & horizontal fire separations



Fire Resistance

Common Terminology:

- **Fire Resistant Floor or Wall Assembly**
 - “Listed” fire-rated assemblies or
 - generic fire rated floor or wall as determined by the National/Provincial Building Codes (I.e. Appendix D NBC, Tables for Part 9)

- **Closures**
 - *Closure* means a device or assembly for closing an opening through a *fire separation* or an exterior wall, such as a door, a shutter, wired glass or glass block, and includes all components such as hardware, closing devices, frames and anchors.



Fire Resistance

- A “fire separation” is a construction assembly that acts as a continuous barrier to the spread of fire and/or smoke.
- A fire separation may or may not need to have a Fire Resistance Rating



Fire Separations

Purpose of "Fire Separations"

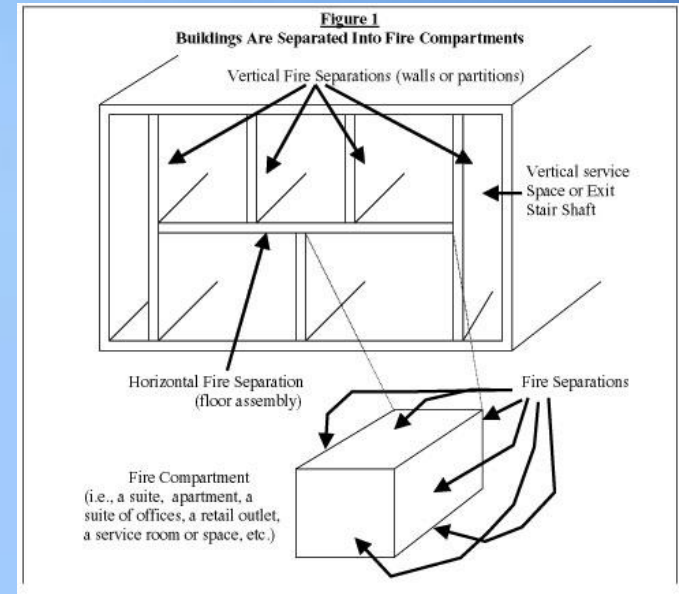
- (a) Impede movement of fire in order to
Limit the potential fire size and inhibit
movement of smoke
- (b) Contain the fire long enough to evacuate
occupants and allow fire department to
gain access
- (c) Act as components of a "fire
compartment"



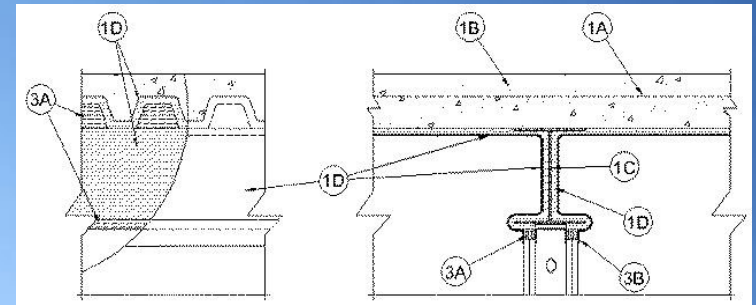
Fire Separations

Fire Compartments

Usually, several “fire separations” are used in combination to surround a given space to contain fire within it.



Firestop Systems



Continuity of “fire separations”:

- 3.1.8.1. General Requirements

- 1) Any wall, *partition* or floor assembly required to be a *fire separation* shall

- a) except as permitted by Sentence (2), be constructed as a continuous element, and
- b) as required in this Part, have a fire-resistance rating as specified (see Appendix A).

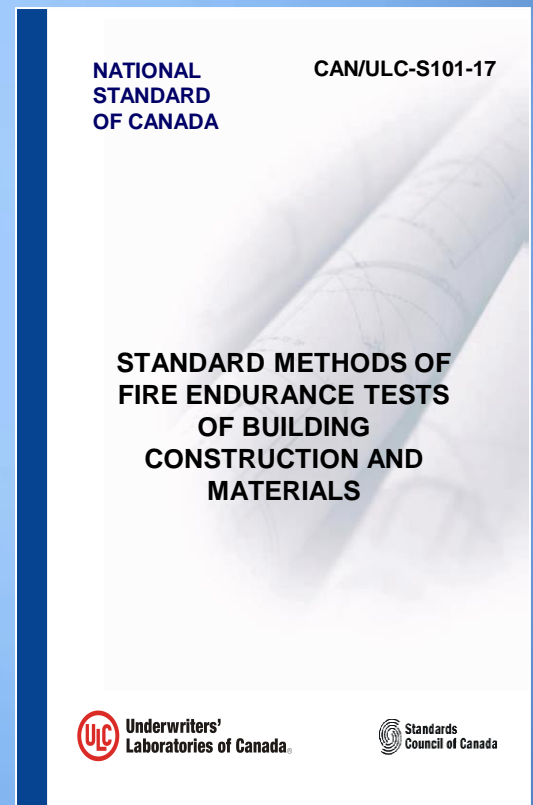
- 2) Openings in a *fire separation* shall be protected with *closures*, shafts or other means in conformance with Articles 3.1.8.4. to 3.1.8.17. and Subsections 3.1.9. and 3.2.8. (See Appendix A.)

- Openings and gaps must be protected with a closure, or be effectively fire stopped.

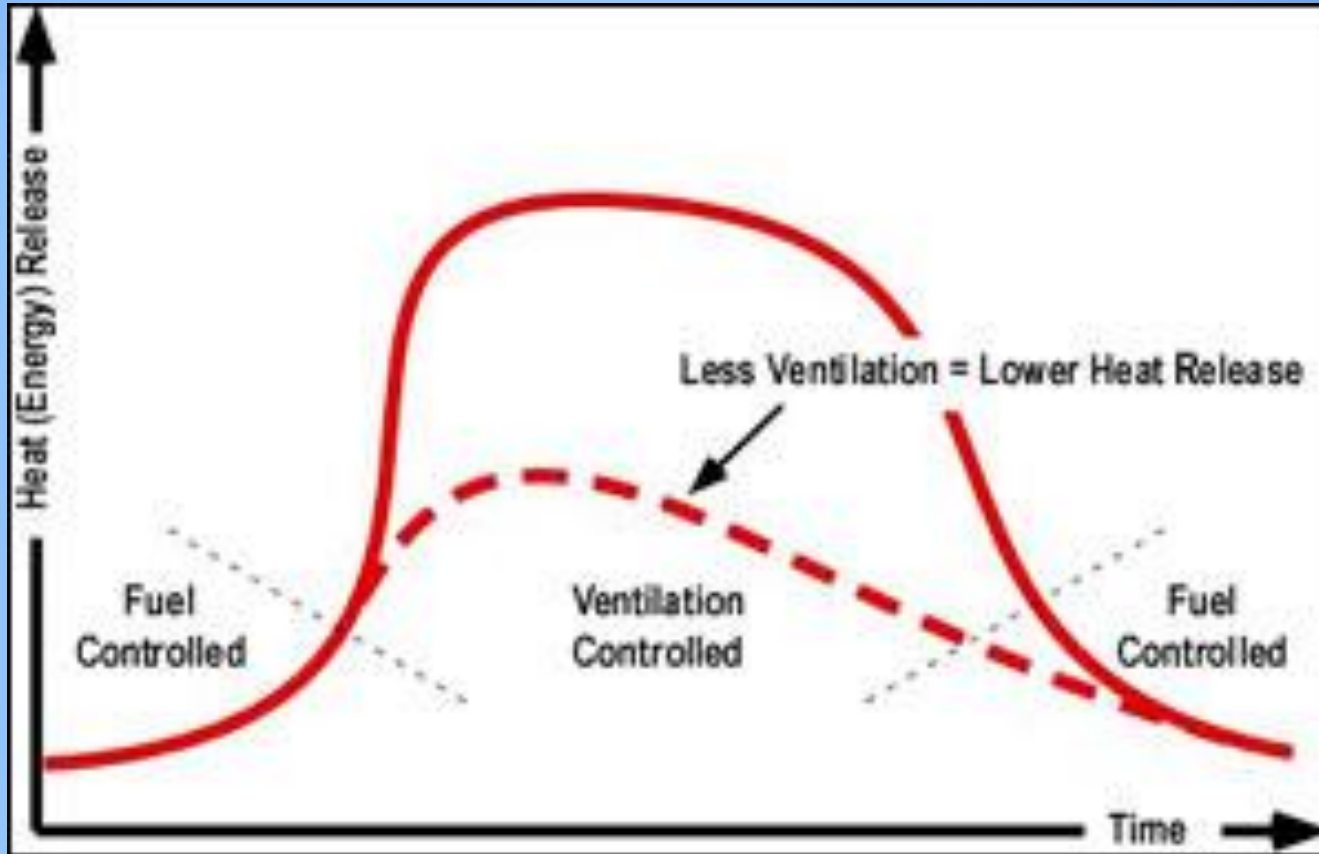
Fire Separations

Evaluation of “Fire Resistance”

Fire Resistance Rating – usually based on the assembly meeting the acceptance criteria in the standard CAN/ULC-S101-M, “Standard Method of Fire Endurance Tests of Building Construction and Materials”.

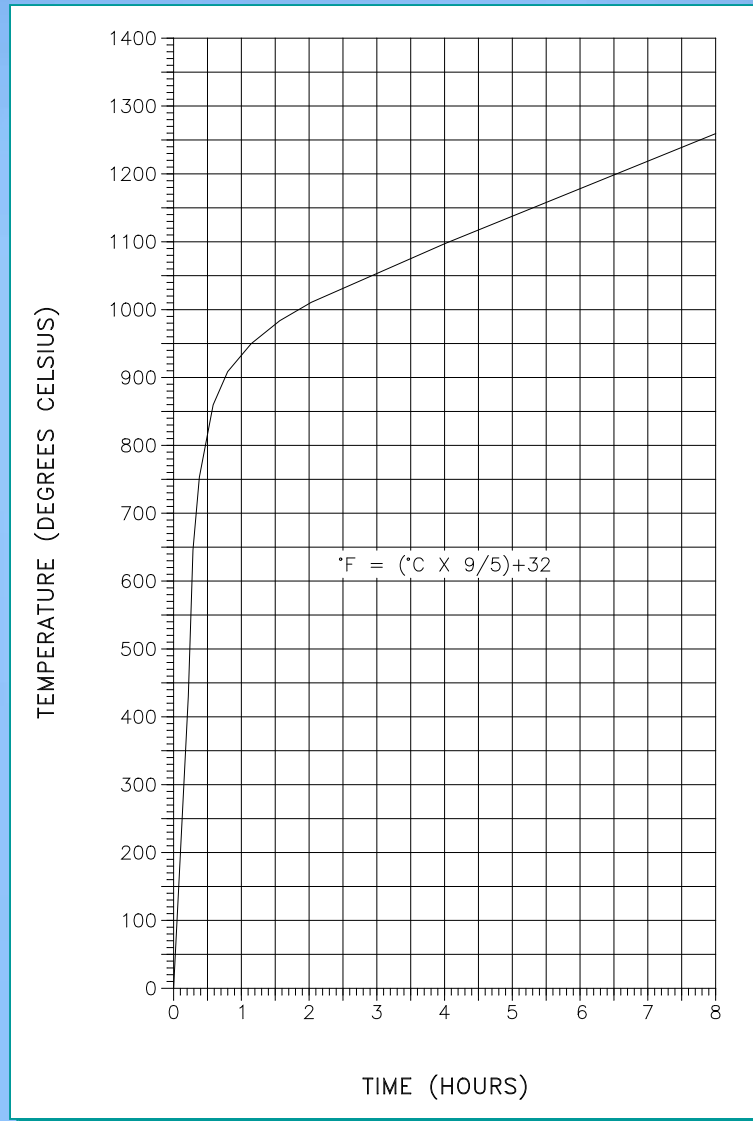


Fire Performance Testing



Typical "real world" Fire Exposure Curves

Fire Performance Testing



CAN/ULC-S101 Standard
Fire Exposure Curve

Fire Resistance Criteria



Generalized Acceptance Criteria (CAN/ULC-S101)

- No passage of flames or hot gases
- Temperature rise on the unexposed side limited to - 140° C average or 180°C individual – **Includes "Roving TC" per ISO.**
- Assembly must remain in place & not collapse under design loads
- No through openings created during the fire or hose stream test (up to 45 psi water pressure).
- Maximum temperature of steel structural supporting elements (floors, ceilings, beams, columns) of 593°C average, 704°C indiv.



Comparison of CAN/ULC-S101 & UL 1709 Fire Exposure Curves

Time (min)	CAN/ULC-S101 (°C)	UL 1709 (°C)
0	20	20
2.5	269	900
5	538	1093
30	843	1093
60	927	1093
90	978	1093
120	1010	1093
240	1093	1093
300	1135	1093



E119 Hose Stream Test

Performed after fire exposure test.

- Assesses the integrity of building elements after fire exposure test.

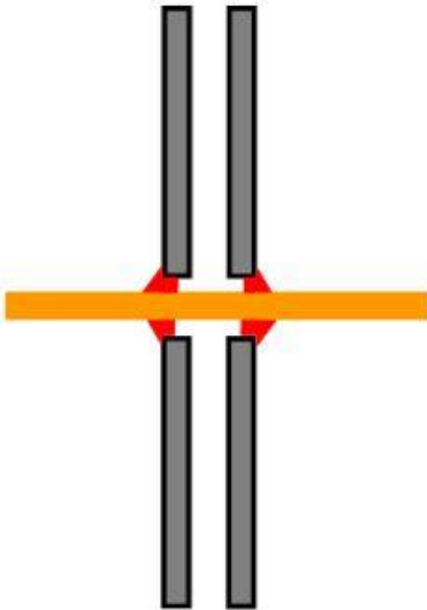


**FIRESTOPPING
SERVICE
PENETRATIONS**

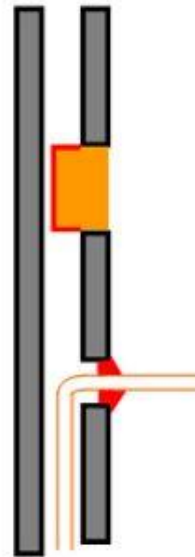


FIRESTOP SYSTEMS

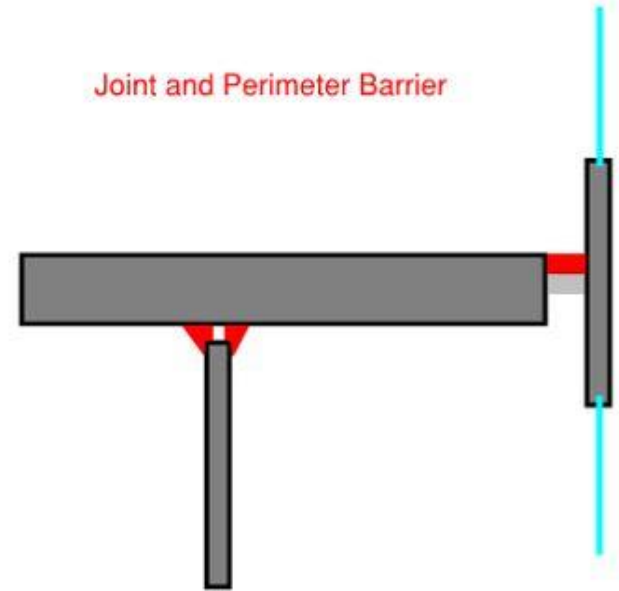
Through Wall Penetrations



Membrane Penetrations

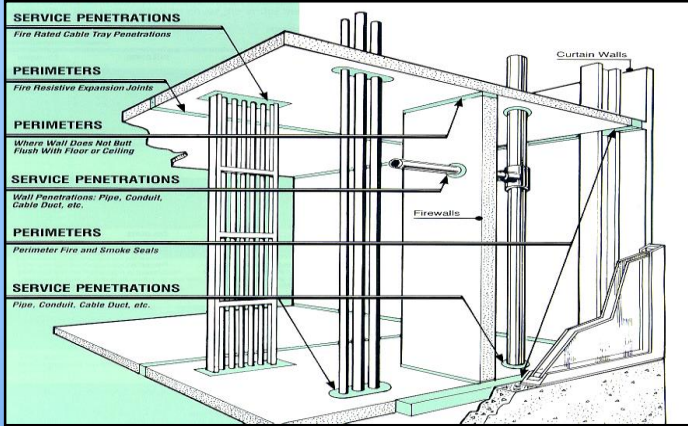


Joint and Perimeter Barrier



FIRESTOP SYSTEMS

CAN/ULC-S115 Firestop System Ratings (F, FT, FH, FTH)



FIRESTOP SYSTEMS

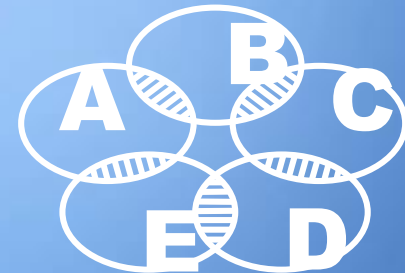


Definition of a “System”

- “An assemblage or combination of things or parts, forming a complete or unitary whole...

.....acting together according to certain natural laws for some special purpose.”

(The Random House Dictionary of English Language)

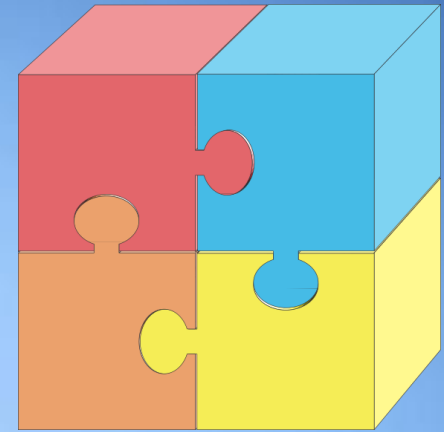


A.C. Consulting Solutions Inc.
(905) 508-7256

Firestop Systems

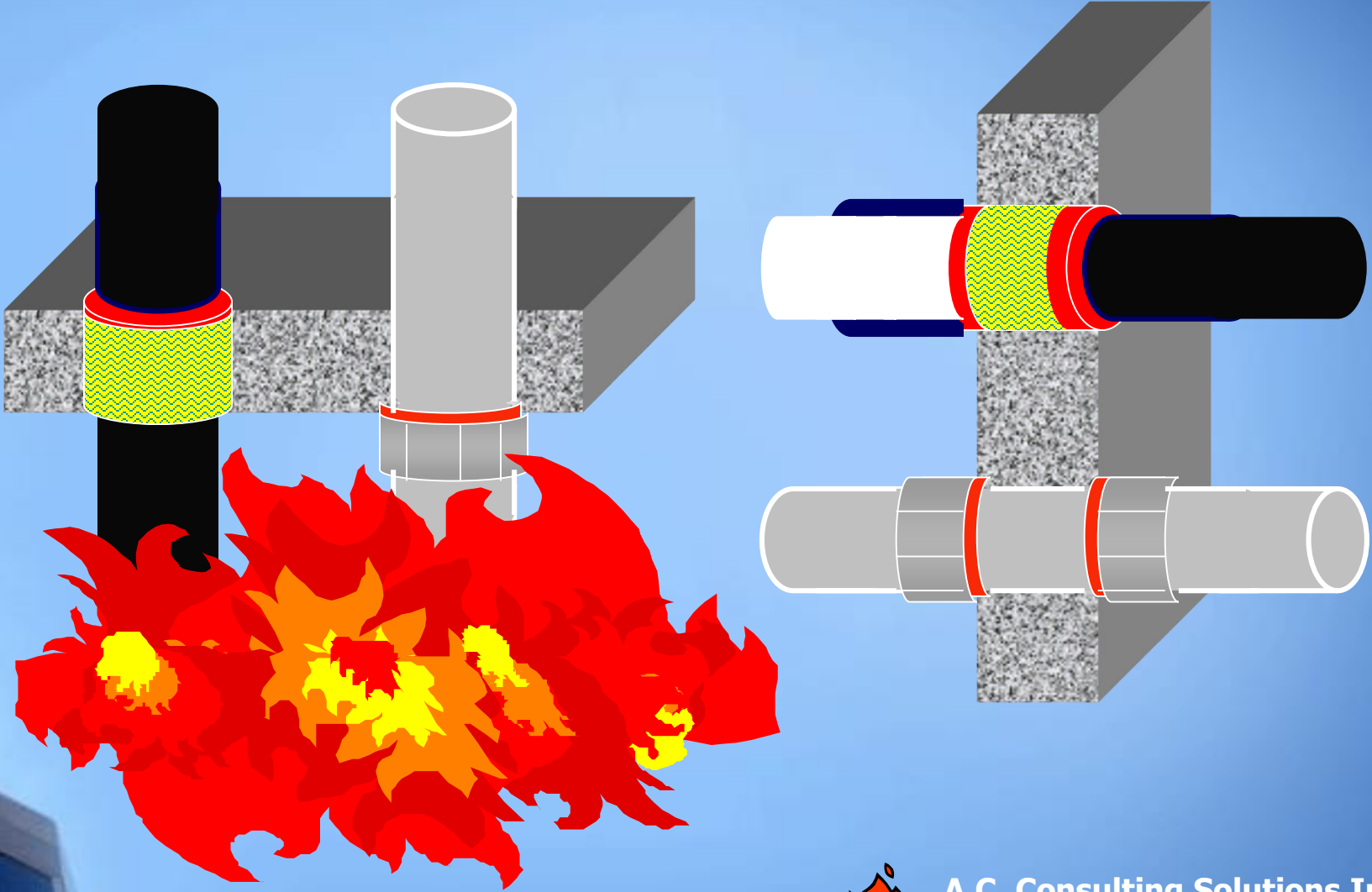
Consists of:

- Assembly being penetrated
- Penetrating item
- Firestopping system materials and components



A.C. Consulting Solutions Inc.
(905) 508-7256

Pipe Transition FS System



A.C. Consulting Solutions Inc.
(905) 508-7256

Pipe Transition FS System



Pipe Transition FS System - NBCC

PROPOSED - 3.1.9.5 Combustible Piping Penetrations

7) Transitions between vertical *non-combustible* drain, waste and vent piping and *combustible* branches for drain, waste and vent piping are permitted where a combustible pipe transitions to a non-combustible pipe on either side of a *fire separation* provided they are not located in a *vertical service space*.

8) Except as permitted by Sentences (7), penetrations of a fire separation that incorporate transitions between *combustible* and *non-combustible* drain waste and vent piping shall be tested in accordance with sentence 3.1.9.5 (4)(a), where the penetrating pipe is combustible, or Article 3.1.9.1 where the penetrating pipe is non-combustible.

A-3.1.9.5.(7) the permission to use combustible piping also permits the use of combination systems consisting of both combustible and non-combustible piping. Combustible branches for drain, waste and vent are permitted to be used to connect to a plumbing fixture within a fire compartment. The integrity of the fire separation is maintained through the use of a fire stop system where the vertical stack piping penetrates the fire separation.



Pipe Transition FS System



FIRESTOP SYSTEMS

- F Rating - System must remain in opening without permitting passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the firestop system.



Note that this definition is different than in the US Codes & Standards



**A.C. Consulting Solutions Inc.
(905) 508-7256**

FIRESTOP SYSTEMS

- FT Rating - in addition to meeting the F Rating requirement, no heat transmission such as to raise the temperature of any thermocouple on the unexposed surface more than 180°C above its initial start temperature



FIRESTOP SYSTEMS

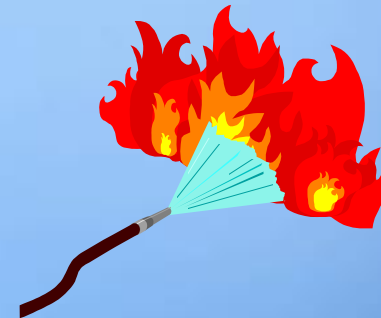
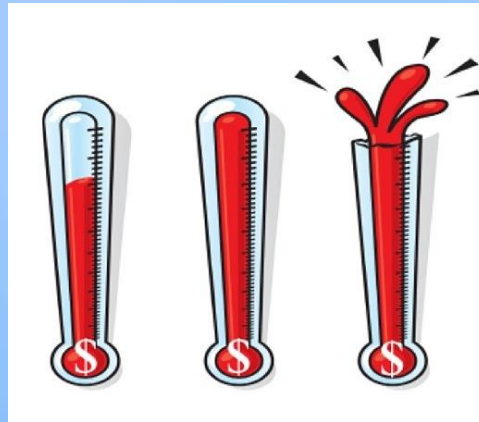
FH Rating - In addition to F Rating requirement, must not develop opening that would permit projection of water from the hose stream beyond the unexposed side during hose stream test.

- *This equates to an “F” –Rating per UL 1479 & ASTM E814*



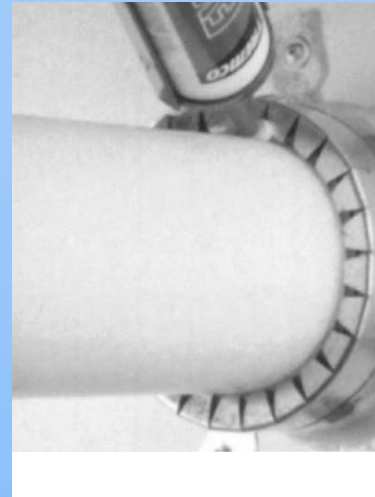
FIRESTOP SYSTEMS

- FTH Rating - must meet the requirements of F, FT and FH Ratings.
 - Closest to a Fire Resistance Rating per CAN/ULC-S101



FIRESTOP SYSTEMS

- Optional L Rating - air leakage rate expressed as *Volume of Air/Cross sectional area of sample opening.*



Close Enough is not Good Enough !!!



INTERNATIONAL FIRESTOP COUNCIL

THE Source of Firestop Expertise™

<https://Proper vs Improper Firestopping – Video>



A.C. Consulting Solutions Inc.
(905) 508-7256

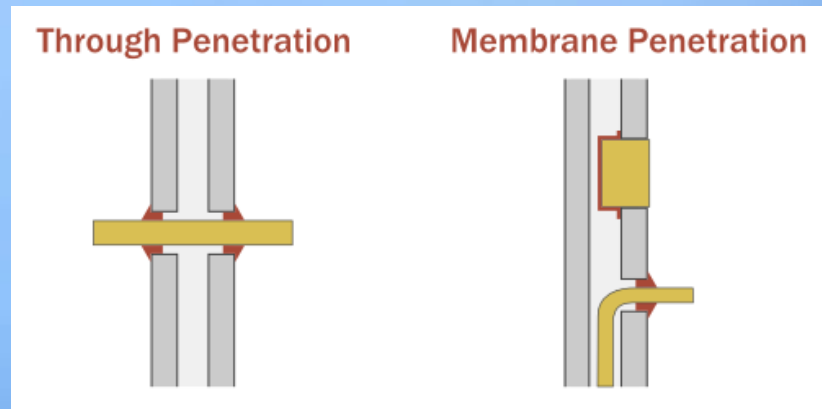
NBCC & Firestop Systems

3.1.9.1. Fire Stopping of Service Penetrations

1) Except as provided in Sentences (2) to (5) and Article 3.1.9.4., penetrations of a *fire separation* or a membrane forming part of an assembly required to have a *fire-resistance rating* shall be

- a) sealed by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, “Fire Tests of Firestop Systems,” has an F rating not less than the fire-protection rating required for closures in the fire separation in conformance with Table 3.1.8.4., or
- b) cast in place (see Note A-3.1.9.1.(1)(b)).

Note: Membrane Penetrations versus Firestopping not specifically differentiated in NBC



Closure Systems

Rating of Closures:

Table 3.1.8.4.
Fire-Protection Rating of Closures
Forming part of Sentence 3.1.8.4.(2)

FRR of Fire Separation	Required FR of Closure
45 min	45 min
1 h	45 min
1.5 h	1 h
2 h	1.5 h
3 h	2 h
4 h	3 h



NBCC & Firestopping

3.1.9.1. Fire Stops

2) Penetrations of a *firewall or a horizontal fire separation that is required to have a fire-resistance rating in conformance with Article 3.2.1.2.* shall be sealed at the penetration by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, “Fire Tests of Firestop Systems,” has an FT rating not less than the fire-resistance rating for the fire separation.

3) Penetrations of a *fire separation in conformance with Sentence 3.6.4.2.(2)* shall be sealed by a fire stop that, when subjected to the fire test method in CAN/ULC-S115, “Fire Tests of Firestop Systems,” has an FT rating not less than the fire-resistance rating for the fire separation of the assembly.

(Note: Applies to limited condition for horizontal service space)



A.C. Cons



Firestop Systems

NBC of Canada 2015

3.1.9.5.(4)

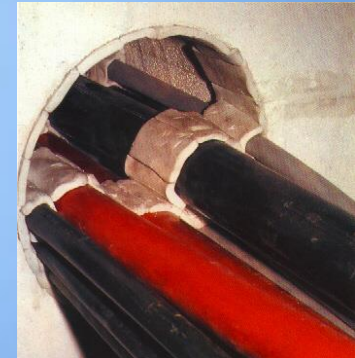
4) Combustible drain, waste and vent piping is permitted to penetrate a fire separation required to have a fire-resistance rating or a membrane that forms part of an assembly required to have a fire-resistance rating, provided

a) the piping is sealed at the penetration by a fire stop that has an F rating not less than the fire-resistance rating required for the fire separation when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems," with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side, and

b) the piping is not located in a vertical service space.

- **OBC goes further - requires this 50 Pa for virtually All Combustible Pipe in non-sprinklered buildings**

- **OBC has exception to 50 Pa testing for sprinklered buildings**



- Lab Published FS & Joint Directory Information:

- Alpha-numeric identification systems for Service Penetration Firestop System with or without penetrating items



- ULC – “SP” or “SPC” for combustible pipes at 50 Pa



- UL – F for floor, W for wall, or C for both



- WHI – P for penetrations, H - horizontal, V – vertical



FIRESTOP SYSTEMS

Tools & Resources

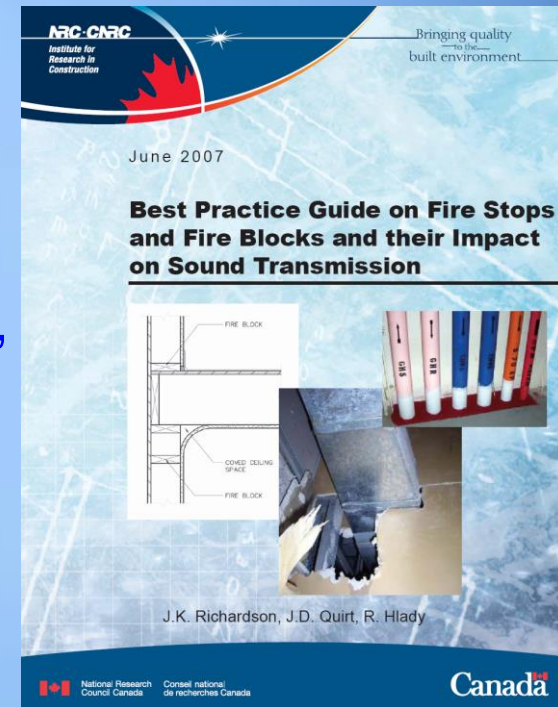
- **International Firestop Council**
- **FCIA Manual of Practice**
- **FS Contractor Certification (ULC Certification Program or FM 4991)**
 - **Implemented in conjunction with FCIA**
- **ASTM E2174 & ASTM E2393 – Standard Methods for Inspection and Verification of Installed FS, Joint & Perimeter Fire Barrier Systems**
- **International Firestop Council - Inspection Guidelines/Seminars**
- **NRC Best Practice Guide**



A.C. Consulting Solutions Inc.
(905) 508-7256

Firestop Tools & Resources

- NRC Special Interest Group- Suitable Acoustic and Firestop Technologies (SIG-SAFT)
- 3 year project completed June 2007
- The stated objective was;
 - "To describe, using a synthesis of available data, the technical solutions necessary to obtain, with firestop systems and fire blocks, appropriate fire and sound control in buildings."
- Developed through "Broad-based" consensus of contributors, including regulators



A.C. Consulting Solutions Inc.
(905) 508-7256



- Most Labs & FS manufacturers provide easy-to-use selection tools for FS systems:
- UL/ULC <http://productspec.ul.com/index.php>
- *Intertek Testing* www.Intertek.com/building
- *Southwest Research Institute* www.fire.swri.org
- QAI Labs <https://qai.org/listing-directory/building-products-directory/>



System Selection Tools

- **3M Fire Protection Products** www.mmm.com/firestop
- **Hilti, Inc.** <https://www.us.hilti.com/firestop>
- **Rectorseal Corporation** www.rectorseal.com
- **Specified Technologies, Inc.** www.stifirestop.com
- **ROCKWOOL** www.rockwool.com
- **Thermafiber (an Owens Corning company)**
www.thermafiber.com
- Etc

UL

UL PRODUCT SPEC™ Quickly find, specify, or verify UL Certified products for your projects.

1. HOW DO YOU WANT TO SEARCH? **2. RESULTS**

Search with Specific Parameters

Select from the following menus, then click Search.

Assembly type: Floor-Ceilings	Construct group: Wood Joist or Combination Wood and Steel Assemblies	Protection type: Gypsum Board
Hourly ratings: Rating ≥ 2 hr and < 3 hr	Manufacturer (optional): Example: "XYZ Co."	Keyword (optional): truss

Search

Back

UL

Other helpful UL resources

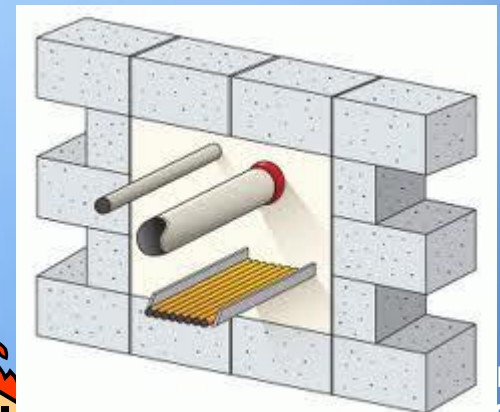
Engineering Judgments:

- What are they?
- When are they acceptable?
- When are they not appropriate?
- What are the guidelines?



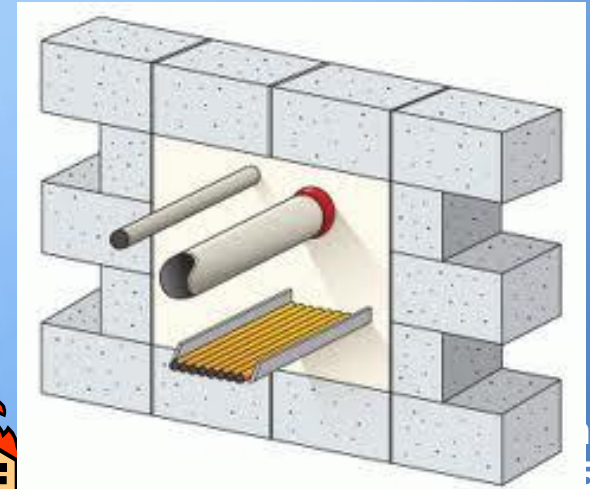
Engineering Judgments

- An Engineering Judgment is a letter or report issued by some knowledgeable party which evaluates the construction of some site-specific application which deviates from a tested design, system or assembly and concludes with a judgment of the applicable rating of that assembly
- Engineering Judgments are commonly called EJ's.



Engineering Judgments Cont.

- Most often applied to fire resistive construction
- Applications for an Engineering Judgment
 - Design and system concept where multiple components, some listed and some unlisted, are used to field construct the finished assembly (e.g. wall)
- Contractor or architect initiates process



Who Issues Engineering Judgments?

- Professional engineer
 - Fire protection engineer
 - Manufacturer
 - Testing laboratory
 - Etc
-
- Must be acceptable to the Building Official or the AHJ



Canada's Code Development System

Alternative Solutions

- Not “anything goes”

1.2.1.1. Compliance with this Code

1) Compliance with this Code shall be achieved by

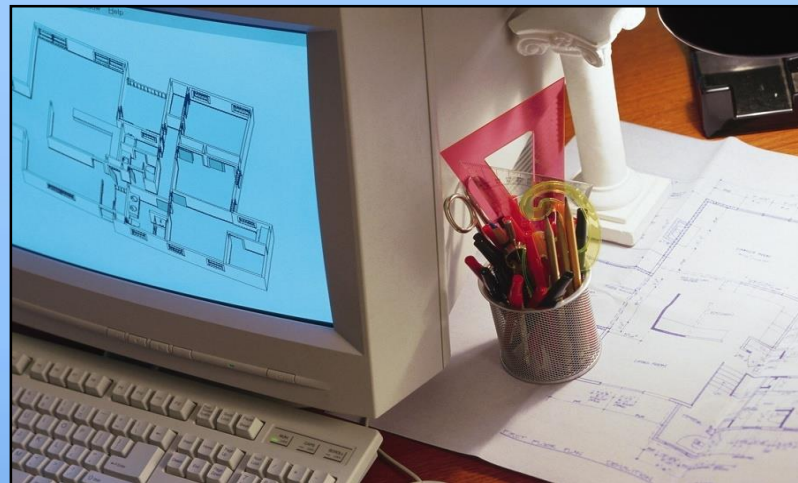
a) complying with the applicable acceptable solutions in Division B (see Note A-1.2.1.1.(1)(a)), **or**

b) using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable acceptable solutions (see Note A-1.2.1.1.(1)(b)).



When are they acceptable?

- When tested systems do not exist.
- When modifying the application is unrealistic.
- When existing test data supports the interpolation.
- When the author has experience with the performance of the system and knowledge of the conditions.
- When an illustration is provided to aid in installation.
- When issued only for a specific jobsite



Important Points of an Engineering Judgment

- These are “Alternative Solutions” under the Canadian Code System
- No guidance from 3rd party testing/certification Labs
- Best documents available are from the International Firestop Council (IFC) – www.firestop.org



IFC Engineering Judgements Guidelines

- According to the International Firestop Council *“listed firestop systems can be broadened within the context of their originally tested and rated conditions through the careful and restricted application of accepted engineering principles and fire protection testing guidelines.”*



25 NORTH BROADWAY • TARRYTOWN, NEW YORK 10591
FAX NO. (914) 332-1541 • (914) 332-0040

April 2001

RECOMMENDED IFC GUIDELINES FOR EVALUATING FIRESTOP SYSTEMS ENGINEERING JUDGMENTS (EJ's)

The International Firestop Council is a not-for-profit association of manufacturers, distributors and users of fire protective materials and systems. IFC's mission is to promote the technology of fire containment in modern building construction through research, educational programs and the development of safety standards and code provisions. These recommended guidelines are presented as part of IFC's educational information program. They are for informational and educational purposes.

THE PREMISE OF FIRESTOP SYSTEMS

Firestop systems protect against the passage of fire, hot gases and toxic smoke through openings in walls, floors and floor/ceiling assemblies for through-penetrations, membrane penetrations, joints, blanks, gaps and voids. These systems are required by building codes to be tested and rated as part of an assembly in accordance with ASTM E 814 (UL 1479) for through-penetration systems or ASTM E 1966 (UL 2079) for construction joint systems*. This ensures that each specifically designed system will maintain the fire rated integrity of the particular type of assembly in which it is intended for use.

* Note: A new Draft ASTM Standard is under development for determining the fire endurance of perimeter fire barrier systems.

All elements of a tested and rated firestop system, including the assembly into which the system is installed, constitute a specific and inseparable engineered unit that must be utilized as such. Firestop systems (designs) are tested and listed by independent testing agencies and the specific elements of each design become part of the listing.

Beyond the listed firestop systems, there is a need for a means to properly address unanticipated construction configurations that fall outside of the envelope of tested systems. Because such conditions often cannot be redesigned and must not be ignored, the firestop industry addresses these types of occurrences through the issuance of engineering judgments (EJ's). In that these recommendations are not based upon identical fire testing of the specific design in question, it is important that engineering judgments be developed in accord with sound engineering practice to ensure that life safety and structural integrity concerns are not compromised.

© Copyright 2001 International Firestop Council www.firestop.org

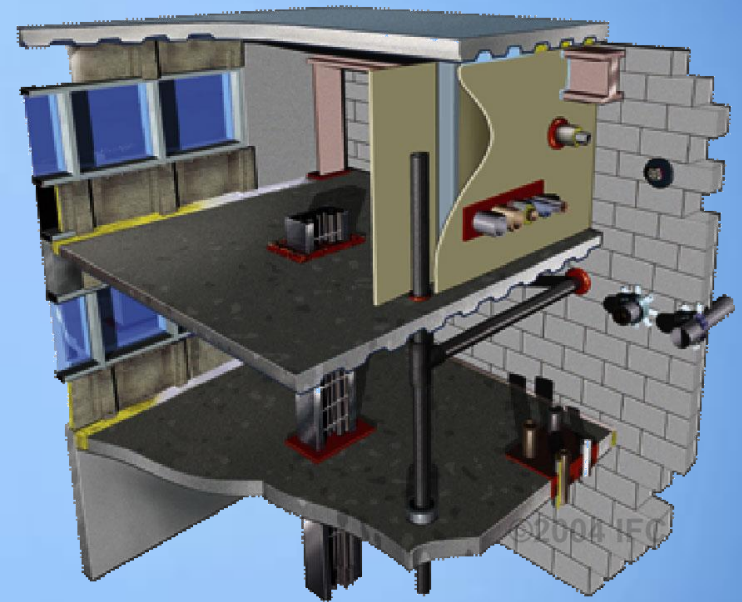
1



A.C. Consulting Solutions Inc.
(905) 508-7256

IFC Guidelines

- Two Documents
 - Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs)
 - Covers firestops, joint systems and grease/air duct assemblies
 - Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs) – Perimeter Fire Barrier Systems
 - Covers perimeter fire barriers systems (a.k.a. perimeter fire containment systems or perimeter joints)



NBCC 2020 Code Changes



A.C. Consulting Solutions Inc.
(905) 508-7256

Firestop Proposals in the 2020 NBCC/NFCC

Summary of Significant Proposed Changes – 2020 NBCC NATIONAL BUILDING CODE OF CANADA



A.C. Consulting Solutions Inc.
(905) 508-7256

Proposals in the 2020 NBCC/NFCC

NATIONAL BUILDING CODE OF CANADA

Combustible Construction (Part 3)

- Introduces an additional compliance option for street access requirements in mid-rise combustible construction and reduces the 25% perimeter access to only 10% provided the exterior cladding is noncombustible.

Encapsulated Mass Timber Construction (NBC Part 3 and NFC Part 5)

- Introduction and definition of encapsulated mass timber construction (EMTC) as a third construction type permitted for buildings up to 12 storeys in building height

Residential Sprinklers (Part 3)

- Expands application of NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes, to row houses, thus ensuring more economical designs and consistent approaches.

Fire Alarm and Detection Systems (Part 3)

- Expands requirements for fire alarms to require a low frequency audible signal as well as a visible signal in 10% of sleeping guest suites in hotels and motels.



Proposals in the 2020 NBCC/NFCC

NATIONAL BUILDING CODE OF CANADA

Fire Alarm and Detection Systems (Part 3 and Part 9)

- Introduces performance criteria that permit the use of wireless interconnected smoke alarms.

Home-Type Care Occupancies (Part 9)

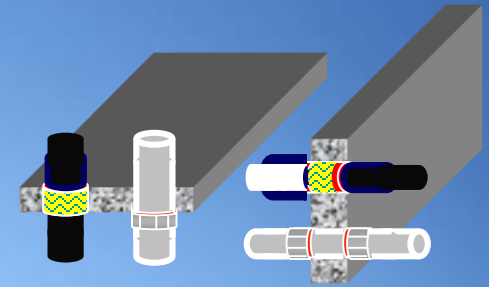
- Introduces provisions on a new type of occupancy classification called “home-type care occupancy” (Group B, Division 4), which allows affordable care accommodation in a single housekeeping building for residents who require in home-type care without compromising fire and life safety.

Solar Collectors (Part 4)

- Introduces provisions for roof-mounted solar panels that are based on guidance from the Structural Commentaries (User's Guide – NBC 2015: Part 4 of Division B) to ensure that the additional loads due to the installation of solar panels are accounted for in the design of the building structure and that a harmonized method is used for the design.



Proposals under Consideration for 2020



Firestop related proposals in the current 2020 cycle

- F-rating to be equal to FRR (not FPR)
- Cast-in place penetration seals to be acceptable only for noncombustible penetrations
- Two Changes - Exceptions to T-ratings for penetrations of firewalls and horizontal fire separations
- Clarifying (requiring?) that a penetration by a noncombustible raceway containing cables must be firestopped
- Eliminate allowance of 25 mm cable diameter unprotected penetrations
- Remove apparent waiver of firestopping for single conductor cables in unlimited sized holes
- Remove blanket allowance for combustible outlet boxes without any protection
- Allow putty pads as an alternative to 24 inch outlet box separation
- Combustible pipe penetrations: 50 Pa rule limited to 4 stories and above, waived when building is sprinklered
- Appendix text to better describe the role of FRR joint systems
- Credit for firestopping in establishing building compartmentation, regardless of the type of penetration



Proposals under Consideration for 2020

Combustible Pipe Transitions

■ 3.1.9.5. Combustible Piping Penetrations



[7] Except as provided in Sentence (8), penetrations of a fire separation that incorporate transitions between combustible and noncombustible drain, waste and vent piping shall be sealed by a *fire stop* that has an F rating not less than the *fire-resistance rating* required for the *fire separation* when subjected to the fire test method in CAN/ULC-S115, "Fire Tests of Firestop Systems", with a pressure differential of 50 Pa between the exposed and unexposed sides, with the higher pressure on the exposed side.

[8] Transitions between vertical noncombustible drain, waste and vent piping and combustible branches for drain, waste and vent piping are permitted on either side of a *fire separation*, provided they are not located in a *vertical service space*. (See Note A-3.1.9.5.(8).)

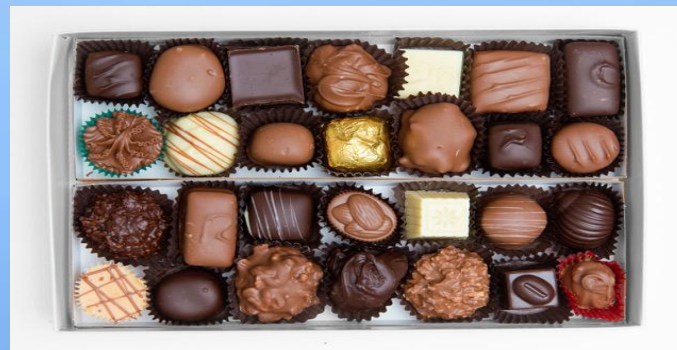
A-3.1.9.5.(8) Combustible branches for drain, waste and vent piping are permitted to be used to connect to a plumbing fixture within a fire compartment. The integrity of the fire separation is maintained through the use of a fire stop system where the vertical stack piping penetrates the fire separation.



Proposals under Consideration for 2020

NATIONAL BUILDING CODE OF CANADA

- Clarification of limitations on factory-assembled exterior wall panels
- Thermal Barriers - Proposed addition of CAN/ULC-S145, “Standard Method of Test for the Evaluation of Protective Coverings for foamed plastic insulation – Full-Scale Room Test” for some applications
- Changes to Part 9 Fire & Sound Tables that could effect some exterior wall assemblies (e.g. EW1 & EW2).
- Safety Glazing – potentially major restrictions on use of wired glass
- Updating of Farm Building Code
- Permission to use combustible (wood) windows in Part 3 buildings
- Limitations on installation of combustible cladding on 12-storey EMTC buildings
- Criteria for percentage of exposed mass timber on walls and ceilings within suites



Requirements for Protection of Joints

Continuity of “fire separations”:

- 3.1.8.1. General Requirements

- 1) Any wall, *partition* or floor assembly required to be a *fire separation* shall

- a) except as permitted by Sentence (2), be constructed as a continuous element, and

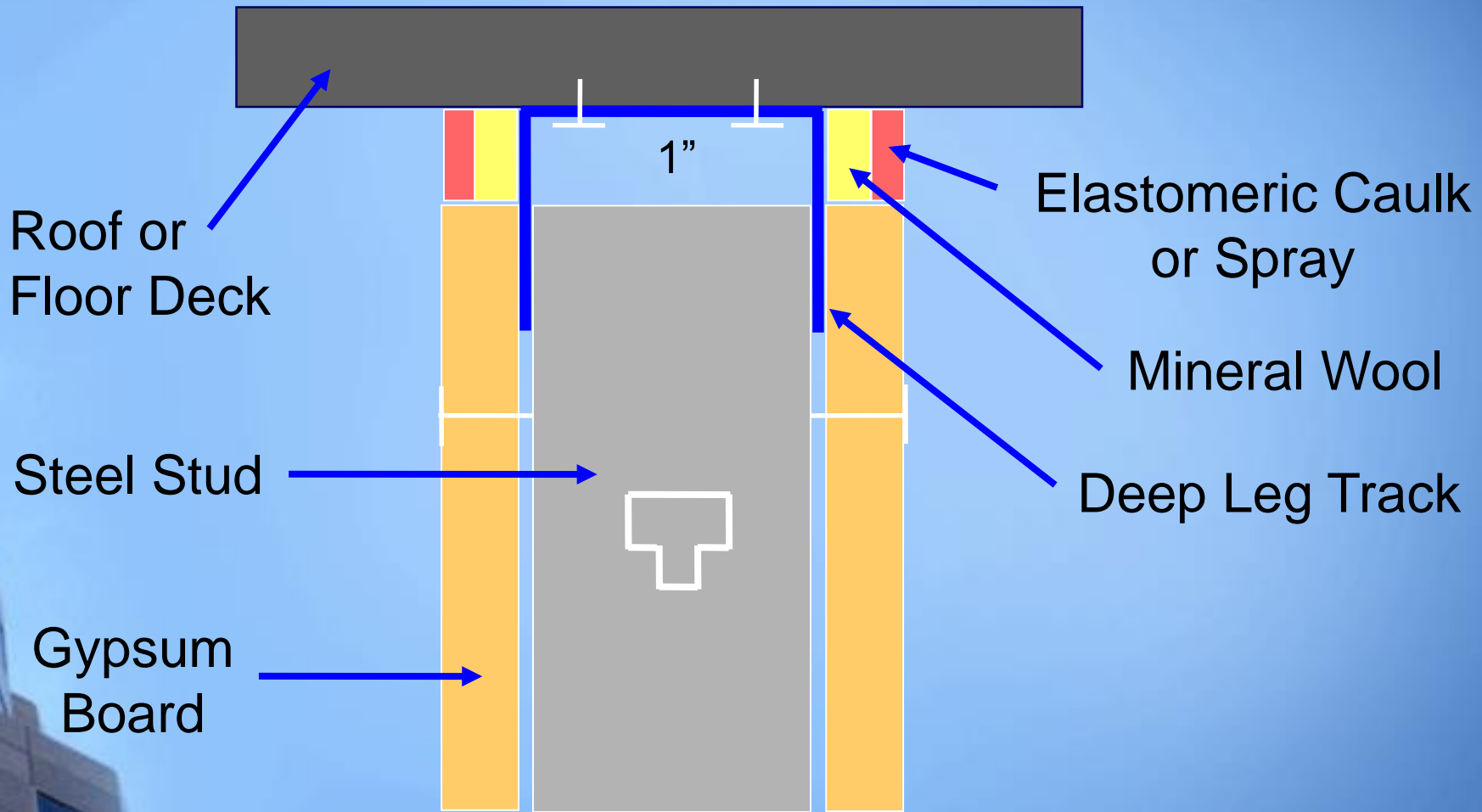
- b) as required in this Part, have a fire-resistance rating as specified (see Appendix A).

- 2) Openings in a *fire separation* shall be protected with *closures*, shafts or other means in conformance with Articles 3.1.8.4. to 3.1.8.17. and Subsections 3.1.9. and 3.2.8. (See Appendix A.)

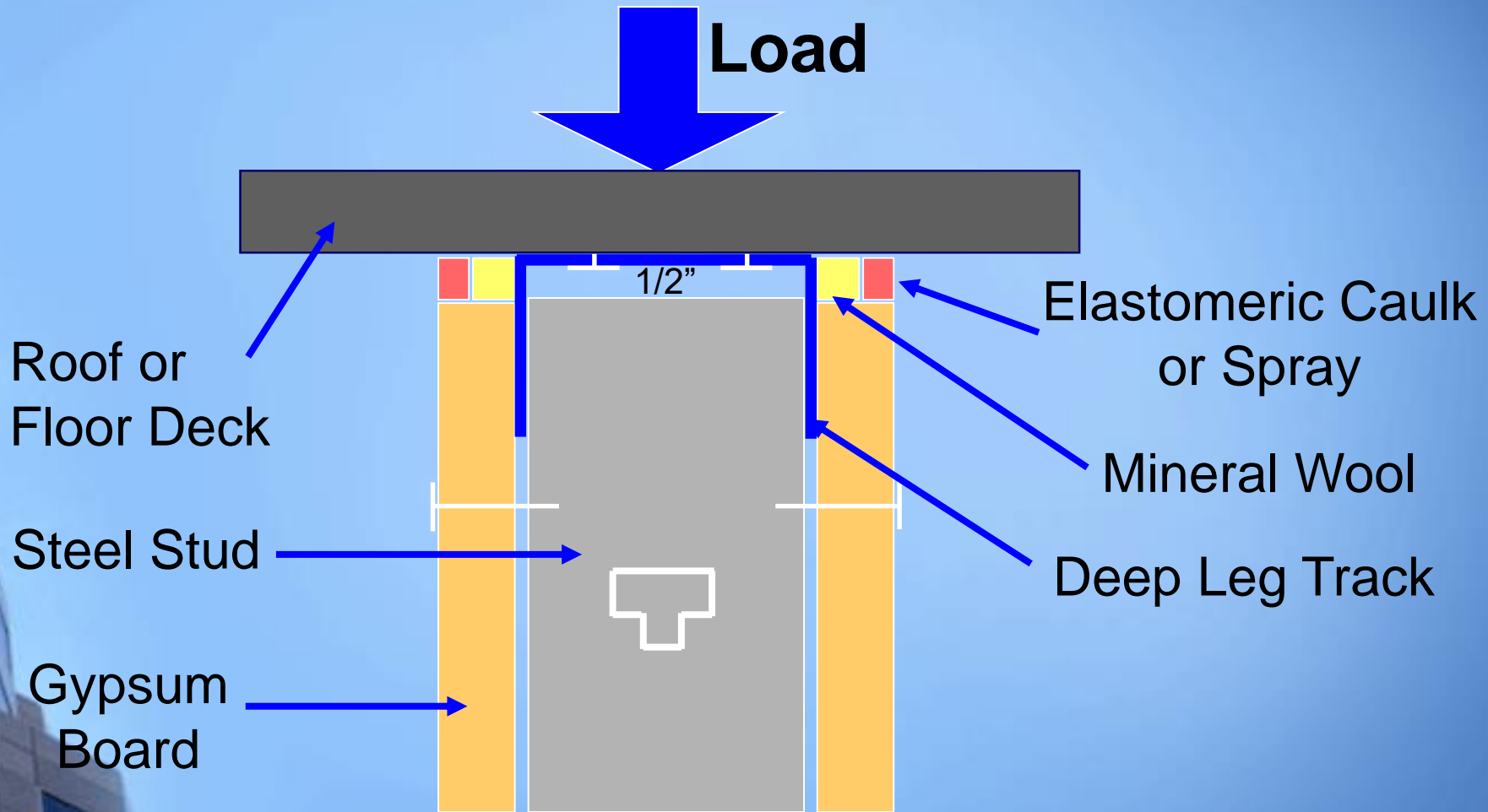
- Openings and gaps must be protected with a closure, or be effectively fire stopped.



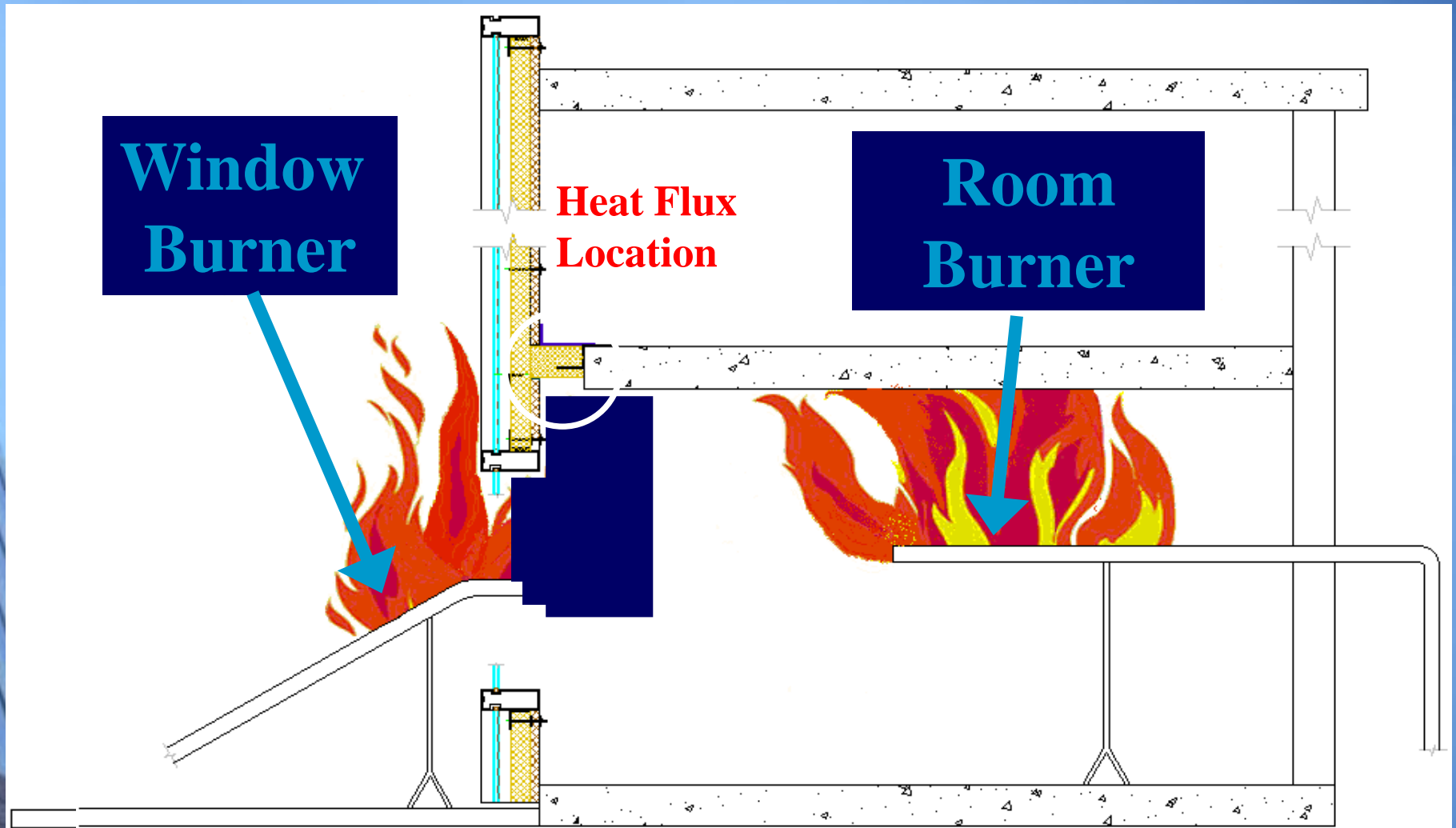
Typical Head of Wall Joint System With Nominal Joint Width



Typical Head of Wall Joint System



Perimeter Fire Barriers – ASTM E2307/ CAN/ULC-S115





Thank You

QUESTIONS?

Contact Information: Tony Crimi,
A.C. Consulting Solutions Inc.
tcrimi@sympatico.ca
(905) 508-7256