CHALLENGES TO AIR FLOW CONTAINMENT IN MISSION CRITICAL FACILITIES

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Business Director
Hilti North America

INTRODUCTION AND TOPICS TO ADDRESS

Firestopping is critical to building design, construction, and operation…

However, beyond Firestopping, what impact does airflow have on…

- data center cooling costs and energy efficiency?
- data hall pressurization for proper operation of suppression systems?
- control of dust & whiskers that could damage server equipment?

Can the firestopping method affect a building's performance?

What do owners, designers & contractors need to understand when addressing cable pathways in critical facilities?

Agenda

1. What is firestop and why is it necessary
2. Elements of compartmentation
3. Designing for real life applications
4. Critical needs in data centers
5. Best practices to help improve a building’s performance

LET'S START WITH THE BASICS

What is firestop?

- **Firestop systems** (if installed correctly), help restore the rating of a floor or wall as it is penetrated by an object such as a cable bundle and resist the spread of smoke and fire.
- **Firestop** is part of the life safety plan in building structures.
- **Life safety** also includes air ducts with dampers, smoke and fire alarms, wired glass, fire rated doors, sprinkler systems etc.

Why is it necessary?

- How do people react during a fire?
- To give people more time to safely exit a structure, even if they don't react right away.
- Mandated by the Codes: NBCC, NFPA, IBC

WHAT IS THE LEADING KILLER IN FIRES?

Smoke and Toxic Gases

NFPA FIRE STATISTICS

2015 facts:
- **1,3 million** fires
- **501,500** structure (building) fires
- **$10.3B** in property damage

A fire department responds to a fire every **23 seconds**

More than **8 out of 10** civilian deaths caused by fire were due to structure (building) fires

Source: NFPA Fire Loss Statistics 2015

WHY CONTAIN SMOKE, TOXIC GASES, & FIRE?

3/4 of all fire deaths are caused by smoke inhalation.

Source: Hall, Jr. John R. NFPA Fire Analysis & Research, Quincy, MA. “Burns, Toxic Gases, and other Hazards”.

Visibility: 47% of survivors caught in a fire could not see more than 12 feet.

Source: NFPA Fire Protection Handbook, 18th Ed. Table 1-1P. Pg.1-15.

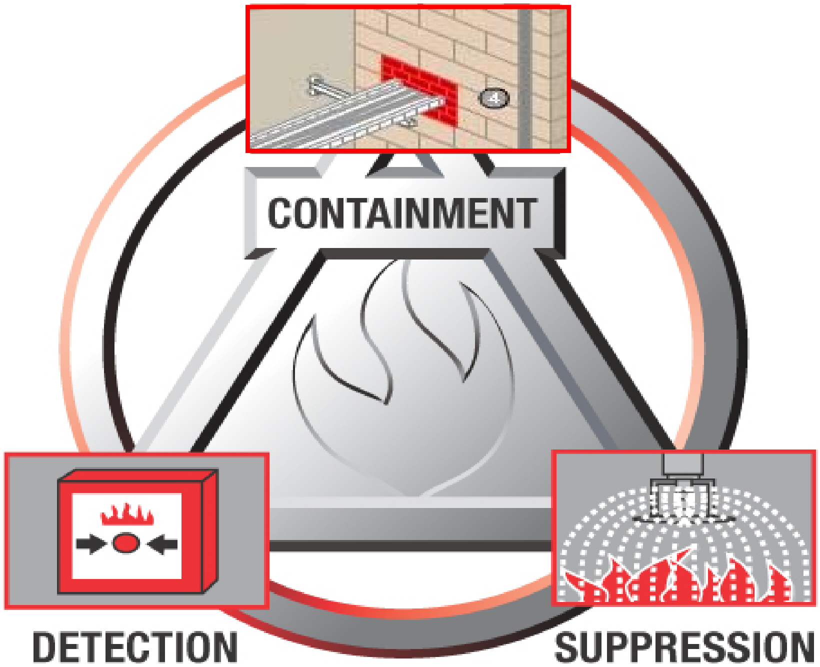
Approximately 57% of people killed in fires are not in the room of the fire’s origin.

Source: NFPA Fire Protection Handbook, 18th Ed. Table 8-1P. Pg. 8-17.

Smoke travels 120-420 feet per minute under fire conditions

Source: Estimate based upon ceiling jet velocity calculations for typical ceiling heights and heat release rates.

WE CAN'T RELY ON ANY SINGLE SAFEGUARD TO PROTECT PEOPLE & PROPERTY



The Balanced Approach to Fire Protection

Agenda

1. What is firestop and why is it necessary
2. Elements of compartmentation
3. Designing for real life applications
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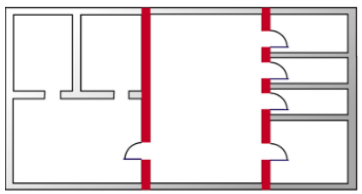
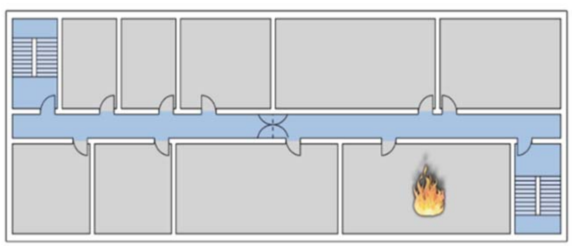
THE ELEMENTS OF COMPARTMENTATION

The spread of fire can be restricted by dividing a building into separate compartments with fire-resistive walls and floors increasing the availability of escape routes for occupants.

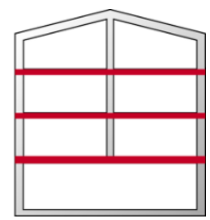
Compartmentation protects escape routes such as corridors or stairs

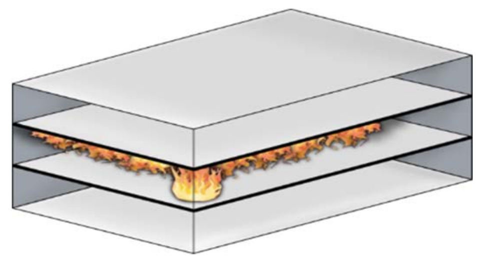
Fire walls



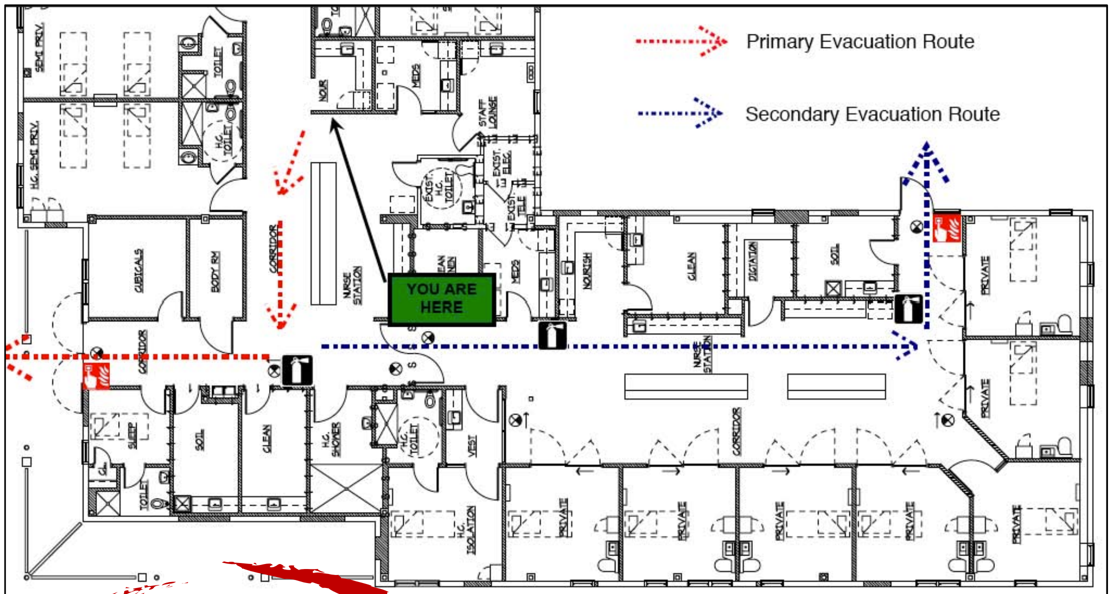


Fire floors





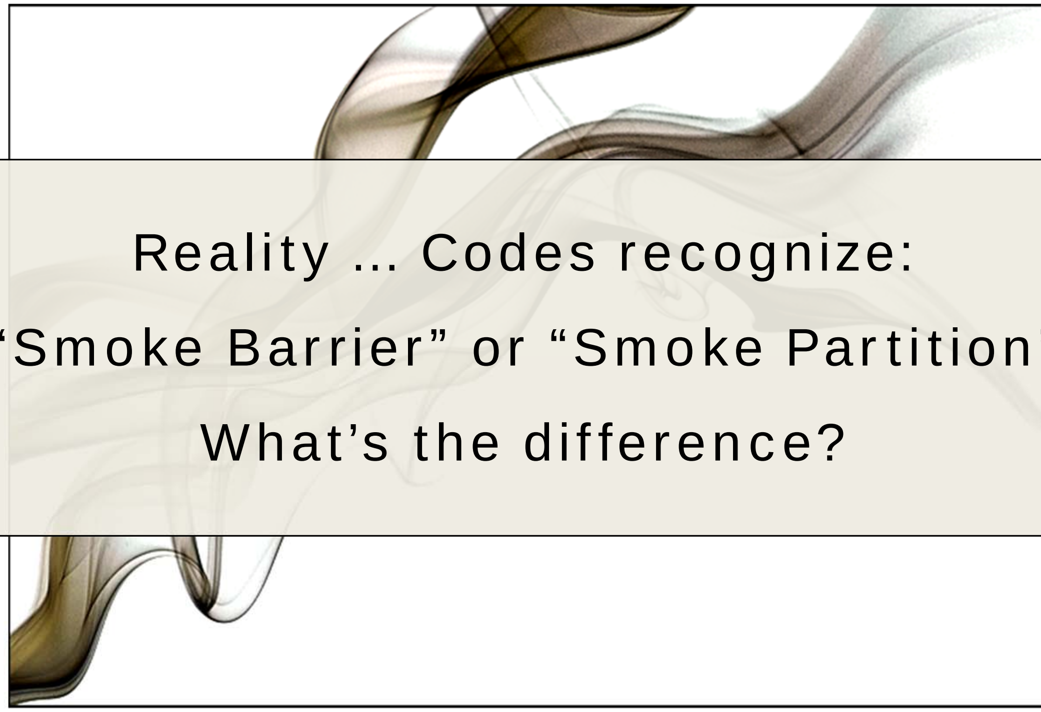
TYPES OF FIRE / SMOKE ASSEMBIES



- Fire Walls
- Fire Barrier Walls
- Shaft Wall
- Fire Partitions

- Smoke Barriers ?
- Smoke Partitions ?

COMMON TERM ON PROJECT PLANS: “SMOKE WALL”



Reality … Codes recognize:

“Smoke Barrier” or “Smoke Partition”

What’s the difference?

WHAT IS A SMOKE BARRIER

Definition: Vertical or horizontal continuous membrane that will restrict movement of smoke

- L-rating (air leakage) must be less than 5 CFM/SQ.FT. for penetrations or 50 cfm leakage per 100 sq. ft. of wall area
- F-rating: 1-hour (U.S. code)

Lower L-ratings means less air leakage

EXAMPLE OF SMOKE PROPAGATION

Real case: fire in a hospital and smoke propagation:

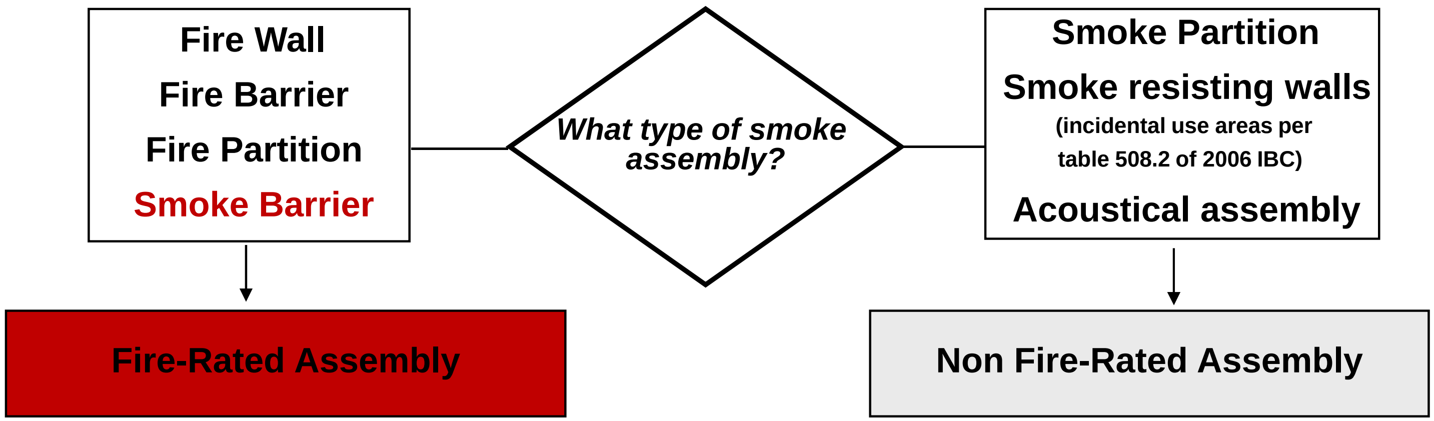
in less than 2 minutes the hallways in this hospital were full of toxic smoke ...

Incorrectly sealed penetrations

WHAT IS A SMOKE PARTITION?

- No fire resistance
- Span floor to floor or Floor to ceiling, if ceiling will limit the transfer of smoke
- Sealed windows
- No louvers in doors
- Doors not required to be self-closing
- Joints and penetrations “shall be filled with an approved material to limit the free passage of smoke”
- Most common use: Corridor walls in sprinklered hospitals

CRITICAL: CLARIFY THE ASSEMBLY TYPE!



Key Points:

- The term “Smoke Wall” is not referenced by codes. Clarify the assembly type!
- “Smoke Barriers” are 1 hour fire-rated assemblies! They require firestop systems and products
- “Smoke Partitions” are non fire-rated and must only resist the passage of smoke.

SUCCESSFUL COMPARTMENTATION

People with complete trust in a building's compartmentation

Agenda

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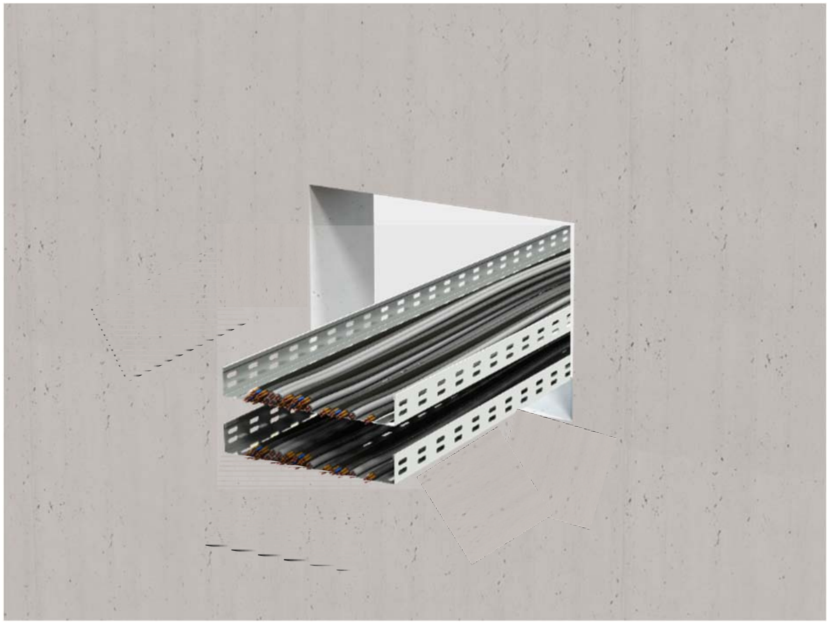
HOW TO ADDRESS THIS APPLICATION?



Cable trays through 2 hour fire-rated concrete wall assembly

MULTIPLE CODES REQUIRING FIRESTOPPING

ICC
INTERNATIONAL CODE COUNCIL®

NFPA®

GLOBAL CODES & TEST STANDARDS

- Codes in most countries require firestopping to be designed and installed per a testing standard.

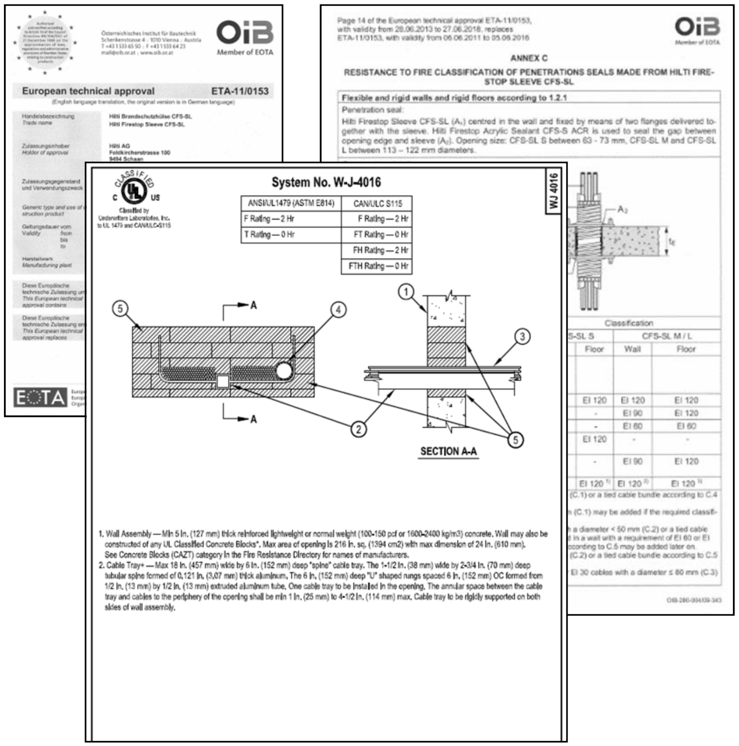
- Firestop systems are tested according to international standards such as:

  USA: ASTM E 814 / UL 1479

  Canada: CAN/ULC S-115

  Europe: BS 476, EN 1363, DIN 4102

- A successful test yields an approval or firestop listing.



TESTING LABORATORIES

Intertek (Omega Point) Listings

Underwriters Laboratories Inc.

Warnock Hersey

Factory Mutual Standards Laboratories

All "nationally recognized test agencies" are of equal status (code acceptance)

Each agency publishes its own listing directory

COMMON TESTING PARAMETERS

Rating	Reference Standards	Definition
F rating	ASTM E814, UL 1479, CAN/ULC S115	Time period (expressed in hours) that assembly resists the passage of flames
T rating	ASTM E814, UL 1479	Time by which unexposed (non-fireside) of assembly reaches 325°F (163°C) over ambient temperature
L rating	UL 1479	Air leakage test run at ambient and 400°F (204°C)
W rating	UL 1479	Water leakage testing

- To achieve successful testing in the U.S. the firestop system must also pass the hose stream test

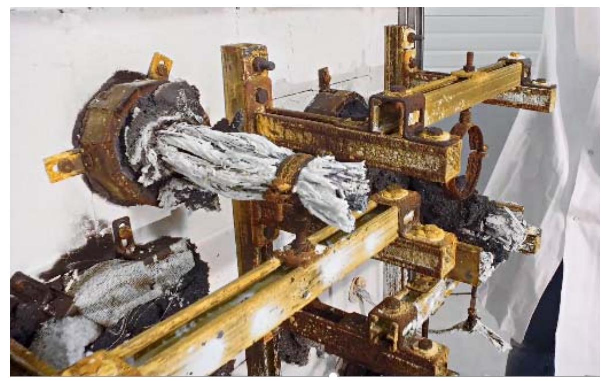
Option A: Show slides

FIRE TEST PROCEDURE

1. Assembly is placed on furnace.

2. Assembly is exposed to fire test.

3. Assembly is subjected to hose stream test (if required)



4. Assembly results after hose stream.

HOSE STREAM VERIFIES MECHANICAL INTEGRITY OF SYSTEM AFTER FIRE

Stream delivered through 2½ inch hose with a straight-bore nozzle at:

- 30 psi - 1, 2 & 3-hour tests
- 45 psi - 4-hour test

Time duration calculated based on the area of test assembly and the fire resistance rating.

Hose stream test not required in Canada.

A firestop system can be listed if no gaps are detected after hose stream test

AIR LEAKAGE TESTING

L-rating (UL)

- Measures the amount of air leakage through the firestop system in CFM
- Tested at ambient (cold smoke) and at 400°F (hot smoke) temperature.
- Leakage testing is desired in datacenters to protect equipment against smoke damage (fire), zinc whiskers, and for improved energy efficiency

L-rating test chamber

AIR LEAKAGE TESTING

Air Permeability (EN)

- Measures the amount of air leakage through the firestop system in CFM
- Measures air leakage at multiple pressures levels and cable % fill

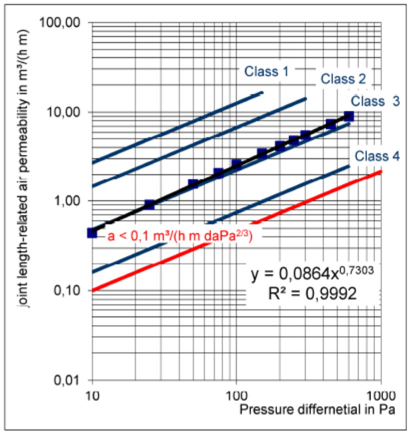


Diagram Joint length-related air permeability pressures

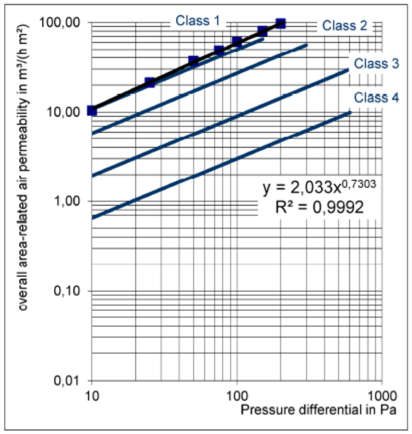
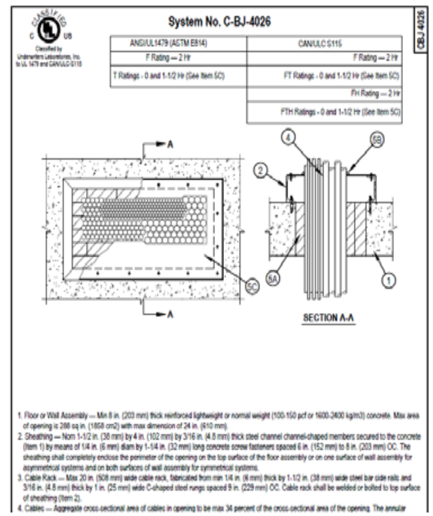


Diagram overall area-related air permeability pressures

WHAT IS THE HOURLY RATING OF A TYPICAL FIRESTOP PRODUCT?

ZERO



System No. C-BJ-4026

CBJ 4026

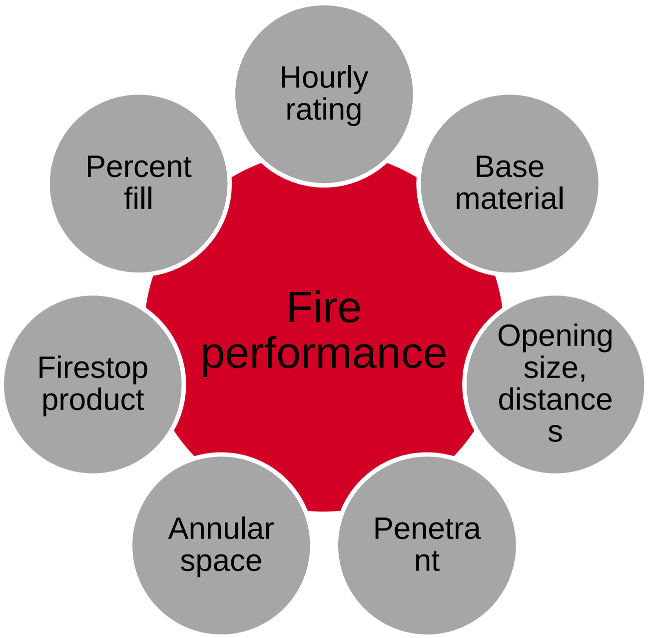
Classified by Underwriters Laboratories, Inc. to UL 1479 and CAN/ULC-S115

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Ratings - 0 and 1-1/2 Hr (See Item 5C)	FT Ratings - 0 and 1-1/2 Hr (See Item 5C)
	FH Rating — 2 Hr
	FTH Ratings - 0 and 1-1/2 Hr (See Item 5C)

1. Floor or Wall Assembly — Min 8 in. (203 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m3) concrete. Max area of opening is 288 sq in. (1858 cm2) with max dimension of 24 in. (610 mm).
2. Sheathing — Nom 1-1/2 in. (38 mm) by 4 in. (102 mm) by 3/16 in. (4.8 mm) thick steel channel channel-shaped members secured to the concrete (Item 1) by means of 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long concrete screw fasteners spaced 6 in. (152 mm) to 8 in. (203 mm) OC. The sheathing shall completely enclose the perimeter of the opening on the top surface of the floor assembly or on one surface of wall assembly for asymmetrical systems and on both surfaces of wall assembly for symmetrical systems.
3. Cable Rack — Max 20 in. (508 mm) wide cable rack, fabricated from min 1/4 in. (6 mm) thick by 1-1/2 in. (38 mm) wide steel bar side rails and 3/16 in. (4.8 mm) thick by 1 in. (25 mm) wide C-shaped steel rungs spaced 9 in. (229 mm) OC. Cable rack shall be welded or bolted to top surface of sheathing (Item 2).
4. Cables — Aggregate cross-sectional area of cables in opening to be max 34 percent of the cross-sectional area of the opening. The annular

Only Firestop <u>systems</u> have ratings!

MULTIPLE PARAMETERS OF A FIRESTOP SYSTEM



Firestop system performance can change completely if altering any parameter

A FIRESTOP SYSTEM IS ISSUED IF ALL ELEMENTS OF THE TEST ARE PASSED

C UL US CLASSIFIED
Classified by
Underwriters Laboratories, Inc.
to UL 1479 and CAN/ULC-S115

System No. C-BJ-4026

CBJ 4026

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Ratings - 0 and 1-1/2 Hr (See Item 5C)	FT Ratings - 0 and 1-1/2 Hr (See Item 5C)
	FH Rating — 2 Hr
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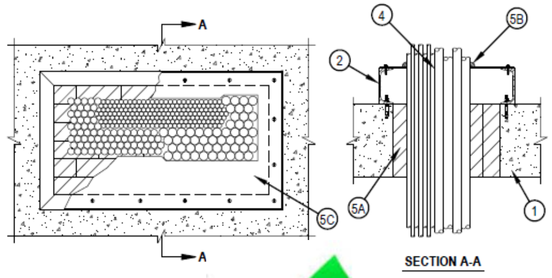

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2. Sheathing — Nom 1-1/2 in. (38 mm) by 4 in. (102 mm) by 3/16 in. (4.8 mm) thick steel channel channel-shaped members secured to the concrete (Item 1) by means of 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long concrete screw fasteners spaced 6 in. (152 mm) to 8 in. (203 mm) OC. The sheathing shall completely enclose the perimeter of the opening on the top surface of the floor assembly or on one surface of wall assembly for asymmetrical systems and on both surfaces of wall assembly for symmetrical systems.
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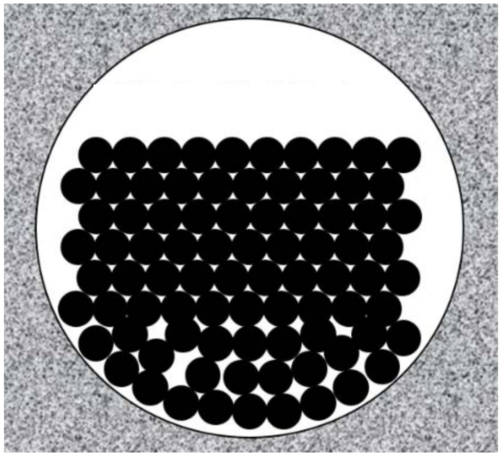
4. Cables — Aggregate cross-sectional area of cables in opening to be max 34 percent of the cross-sectional area of the opening. The annular space between cables and the periphery of the opening to be min 1 in. (25 mm). Cables to be rigidly supported on both sides of floor or wall assembly. Any combination of the following types and sizes of cables may be used:
   A. Max 300 pair No. 24 AWG telephone cable with polyvinyl chloride (PVC) insulation and jacket.
   B. Max 750 kcmil power cable with cross-linked polyethylene (XLPE) insulation and polyvinyl chloride (PVC) jacket.
   C. Multiple fiber optic communication cable with polyvinyl chloride (PVC) jacket, having a max OD of 1/2 in. (13 mm).

WHAT IS PERCENT FILL?

Definition: The cross-sectional area of an opening that is occupied by penetrating items, typically cables. Percent fill is specific to each firestop system.

What is the actual percent fill?



Visually, the opening appears to be 2/3 full

4” circular opening

85 cables, ¼” diameter

Let’s calculate actual percent fill…

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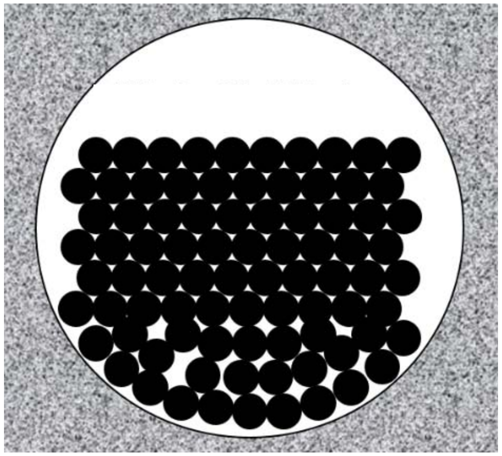


Answer:

$(A_o)=3.14 \times (2^2)=12.56 \text{ in}^2$

$(A_c)=[3.14 \times (.125^2)] \times 85 = 4.17 \text{ in}^2$

$(\%_f)=(4.17/12.56) \times 100 = 33.2\%$

Actual % fill

Warning: Actual % fill rates are typically half of what they visually appear

PERCENT FILL HAS AN IMPACT ON FUTURE CAPACITY

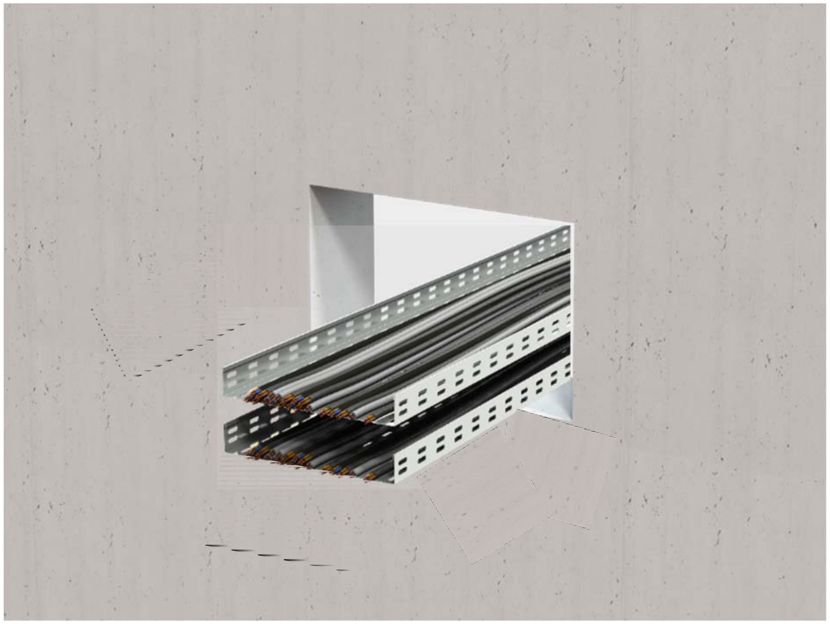
Consider
Many firestop solutions limits cable fill to ~ 25% of opening

Challenge
How do you ensure this is not exceeded during actual use?

Solution
When designing networks, consider a firestop system's percent fill and plan for future MAC work

Design tip: Specify sleeve solutions allowing up to 100% visual fill

HOW TO ADDRESS THIS APPLICATION?



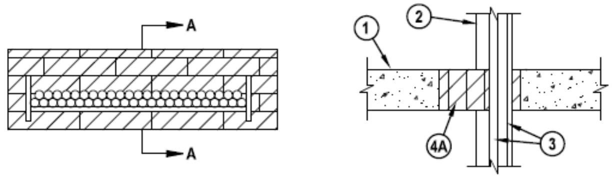
Cable trays through 2 hour fire-rated concrete wall assembly

CAJ 4035

Classified by Underwriters Laboratories, Inc. to UL 1479 and CAN/ULC-S115

System No. C-AJ-4035

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 3 Hr
	FTH Rating — 0 Hr



SECTION A-A

1. Floor or Wall Assembly — Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m3) concrete. Wall may also be constructed of any UL Classified Concrete Blocks*. Max area of opening is 270 sq in (1742 cm2) with max dimension of 30 in. (762 mm).

See Concrete Blocks (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. Cable Tray* — Max 24 in. (610 mm) wide by max 4 in. (102 mm) deep open-ladder or solid-back cable tray with channel-shaped side rails formed of 0.10 in. (2.54 mm) thick aluminum or 0.060 in. (1.52 mm) thick galv steel and with 1-1/2 in. (38 mm) wide by 1 in. (25 mm) channel shape rungs spaced 9 in. (229 mm) OC or a 0.029 in. (0.74 mm) thick steel solid back, respectively. The annular space between the cable tray and the periphery of the opening shall be min 1 in. (25 mm) to max 4 in. (102 mm). Cable tray to be rigidly supported on both sides of floor or wall assembly.

3. Cables — Aggregate cross-sectional area of cables in cable tray to be max 40 percent of the cross-sectional area of the cable tray. Any combination of the following types and sizes of copper conductor or fiber optic cables may be used:

A. 1/C, 500 kcmil with thermoplastic insulation and PVC jacket.
B. 300 pair — No. 24 AWG cable with PVC insulation and jacket.
C. 24 fiberoptic cable with PVC subunit and jacket.
D. Three 1/C No. 12 AWG wire, insulated with polyvinyl chloride, in a nominal 3/4 in. (19 mm) flexible metal conduit.

4. Firestop System — The firestop system shall consist of the following:

A. Fill, Void or Cavity Material* — Fire blocks installed with the long dimension placed horizontally within the opening, flush with bottom of floor assembly or centered within wall opening. In concrete block walls, fire block to fill entire thickness of wall opening unless wall is solid filled. Blocks to be firmly packed and completely fill the entire width and height of opening. Either one or a combination of the block specified below may be used.

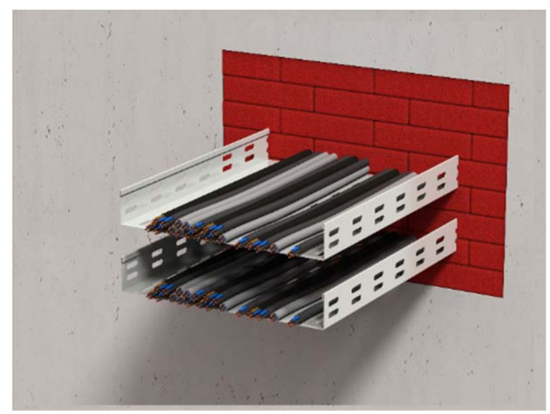
HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS 657 Fire Block or CFS-BL Firestop Block

B. Fill, Void or Cavity Material* -Sealant or Putty- Not Shown — Fill material to be forced into interstices of cables and between cables and cable trays to max extent possible on both surfaces of the penetration.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant, FS-ONE MAX Intumescent Sealant or CP618 Firestop Putty Stick.

Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

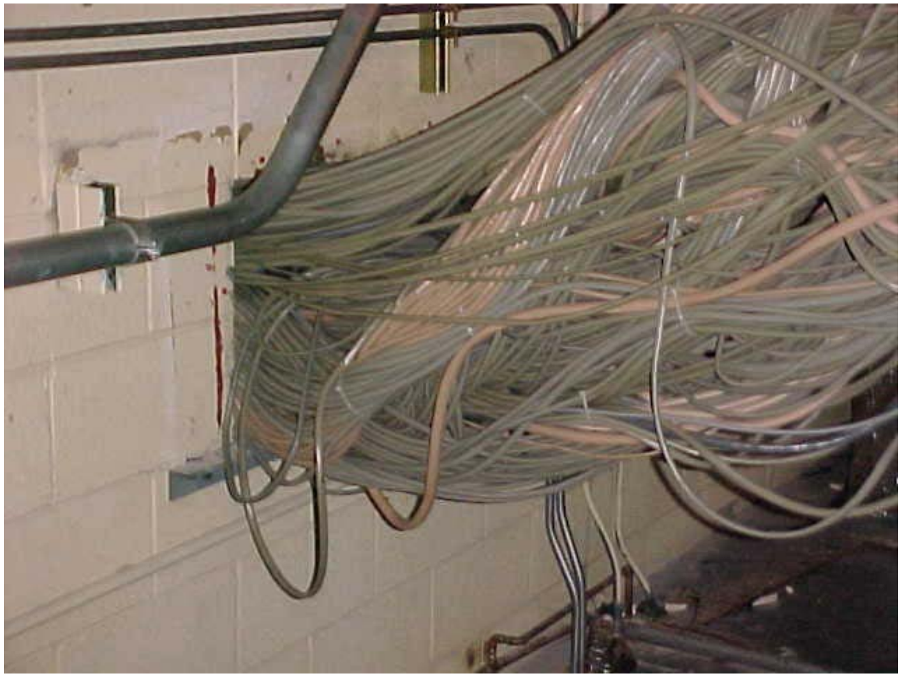
- System Number, Test Standard
- F-Rating: up to 3 hours
- Concrete Floor or Wall
- Allowable cable type, size
- Allowable opening size
- Allowable percent fill
- Preformed, reusable Firestop product



We learned about firestop system selection. Let's put our knowledge to the test.

How would you address the following application?

HOW WOULD YOU ADDRESS THIS APPLICATION?



Not all firestop applications are tested

ENGINEERING JUDGMENTS

For conditions where a tested system does not exist, an Engineering Judgment may be needed

Typical Engineering Judgment Conditions:

- Annular space larger/smaller than tested
- Irregular hole shape
- Hole shape different than tested
- More penetrating items or cable % fill in opening than system allows
- Access to one side only
- Structural member penetrations
- Intersections of rated assembly with non-rated assembly

Engineering Judgments should only be designed by qualified firestop manufacturer's personnel

LET'S REVIEW …

- Test standards & requirements for fire barrier management
  - ❑F-rating, T-rating, etc.
- Elements of a firestop test
- Parameters included in a tested system
- Engineering Judgments

IS THERE A RELATIONSHIP BETWEEN FIRESTOP AND BUILDING PERFORMANCE?

Airflow control in fire barrier management is becoming increasingly important in data centers as it can impact:

- Cooling costs
- Room pressurization
- Dust control
- Damage to expensive equipment
- Noise transmission
- Seismic issues

How does firestop system selection impact these design needs?

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DATA CENTER STAKEHOLDERS

What keeps you up at night?

DATA CENTER PERFORMANCE CONCERNS

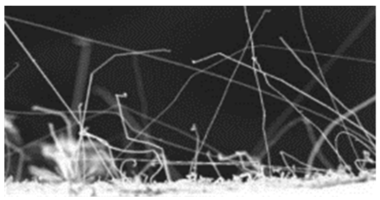
Construction Costs	Risk Mitigation	Operating Costs
Materials	Fire & Smoke Protection (continuous)	Cooling Facility
Labor (construction & design)	Airborne Particulates (dust & whiskers)	
	Training/ Certification	
	Code Compliance	
	Pressure Control	

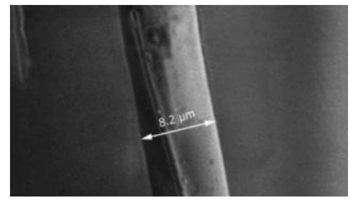
Future

Seismic	Sound
Earthquake resistance	Noise nuisance

Design & installation considerations should factor firestop airflow control solutions

AIRBORNE PARTICULATES POSE RISK IN DATA CENTERS





Conductive particles:

- A main cause of conductive dust is zinc whiskers which «grow» on ferrous (steel) surfaces, especially those that have been coated with tin, zinc or cadmium to help protect them from corrosion

Risk:

– Whiskers may physically detach from their surfaces and enter a data center's airflow causing electronic system failures and short circuits

Non-conductive particulates

- Contamination from construction activities such as cement and drywall dust, or paper and cardboard fibers can cause problems such as optical interference or obstruct cooling airflow, resulting in:

Risk:

- lower thermal efficiency and increased cooling costs
- overheating and equipment failure
- shortened equipment life span
- server failures causing enterprise disruption

"Particulate contamination can increase a data center's power demand by 2% or more[1]"

Source: "The Threat of Data Center Contamination" - datacenterknowledge

HEALTH, SAFETY, ENVIRONMENTAL (HSE) COMPLIANCE

Leadership in Energy & Environmental Design (LEED V4)

Cradle to Cradle

Living Building Challenge (LBC) Red List

Environmental Protection Agency (EPA) 40CFR Part 59

National Volatile Organic Compound Emission Standards

South Coast Air Quality Mgmt District (SCAQMD)

HSE regulations are increasing and influencing firestop product selection

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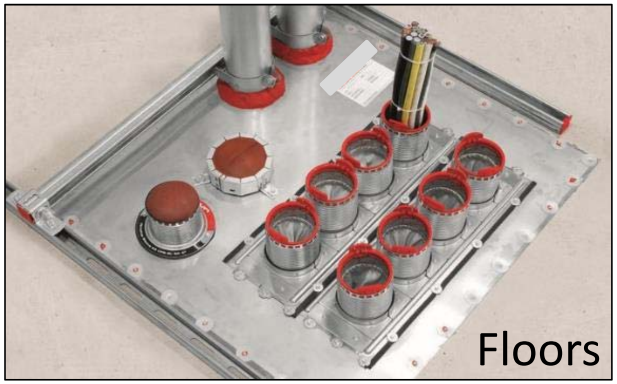
SOLUTIONS: TRADITONAL FIRESTOP METHODS

Sprays, Caulks, Sealants
Advantages • Economical • Versatile, covers multiple applications • Multiple listings available **Disadvantages** • Non re-penetrable • Correct installation challenges • Mineral wool use … particulates • Messy installation • Wash-off, shrinkage issues • Inspection concerns

SOLUTIONS: "PRE-FORMED" FIRESTOP METHODS



Pre-formed Devices
Advantages • Re-penetrable • Reliable, fast installation • Superior air flow performance vs. traditional methods* • Pre-cured, always the right amount of product • Easier to design - BIM • Inspection advantages – no destructive testing per IBC 2012 (U.S.) **Disadvantages** • Higher material cost (~neutral TIC) * Always refer to listed system

INITIAL DESIGN CONSIDERATIONS

Performance Requirements

- ✓ Minimum Code compliance for firestop system rating

- ✓ Room pressurization
- ✓ Reduce cooling and heating costs
- ✓ Prevent airborne disease transmission
- ✓ Correct installation
- ✓ Better ensure life safety and property loss prevention
- ✓ Ease of inspection
- ✓ Re-penetrability (MAC work)
- ✓ Labor cost savings

Solution

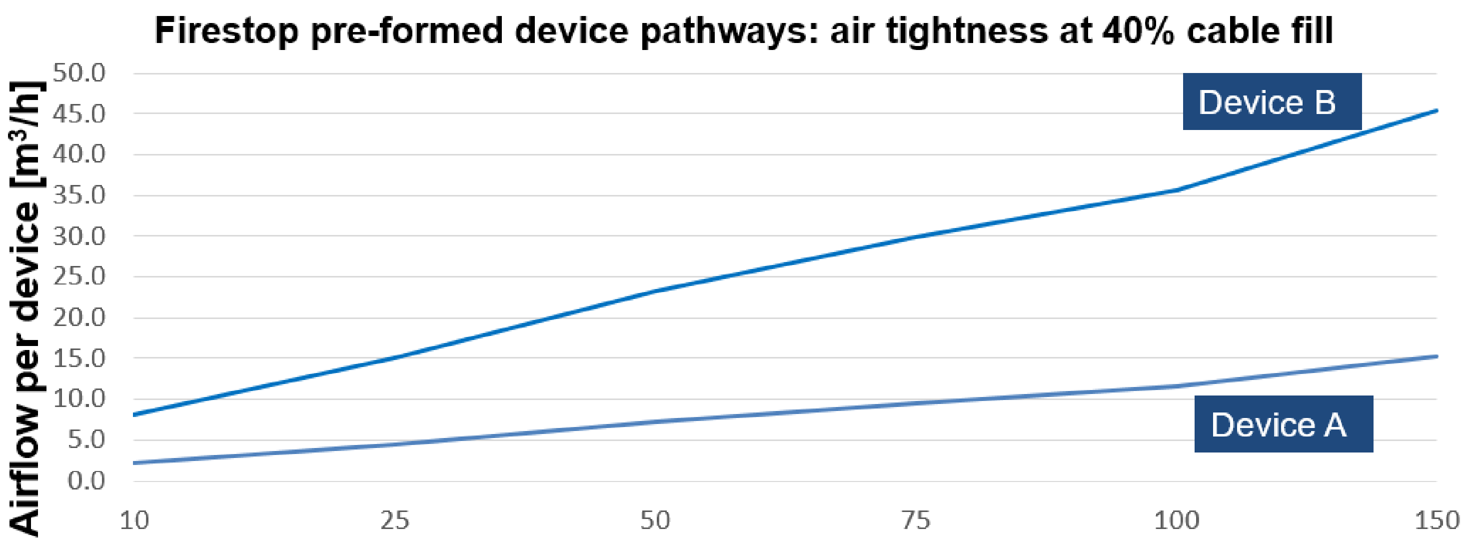
Traditional Firestop System

(no air leakage performance required)

Pre-formed firestop system

(with superior airflow control testing)

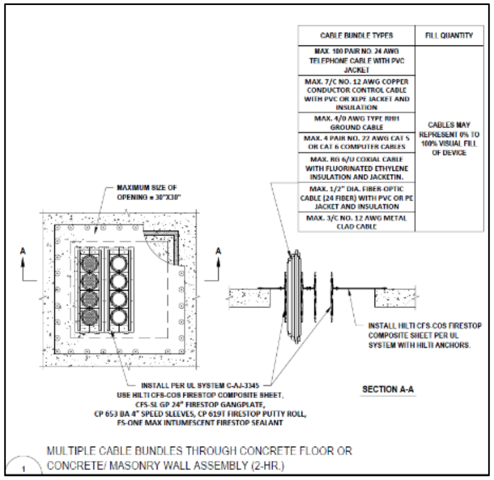
COMPARE AIRFLOW SOLUTIONS



Testing compared 4" Firestop cable devices with 40% cable fill (57x CAT 6 cables); both devices installed acc. to manufacturer IFU
Leakage measured @ 21 °C ; 52 - 57% RH and tested according to EN 1026
Airflow in [m³/h] measured for over- and underpressure, chart displays average values

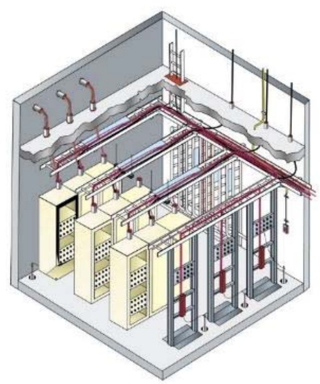
CLEARLY CONVEY YOUR DESIGN INTENT

- **Detail firestop / airflow cable pathways on Datacom or Telecom plans**
- **Include in Division 26 or 27 specs**
- **BIM/Revit design**



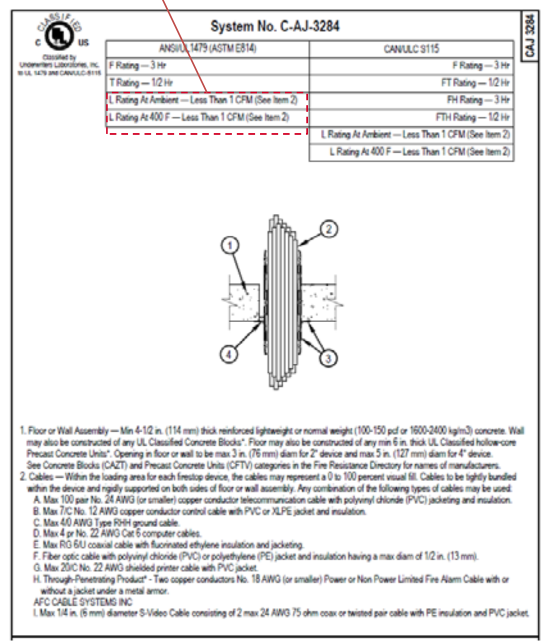
CABLE BUNDLE TYPES	FILL QUANTITY
MAX. 100 PAIR NO. 24 AWG TELEPHONE CABLE WITH PVC JACKET	CABLES MAY REPRESENT 0% TO 100% VISUAL FILL OF DEVICE
MAX. 7/C NO. 12 AWG COPPER CONDUCTOR CONTROL CABLE WITH PVC OR XLPE JACKET AND INSULATION	
MAX. 4/0 AWG TYPE RHH GROUND CABLE	
MAX. 4 PAIR NO. 22 AWG CAT 5 OR CAT 6 COMPUTER CABLES	
MAX. RG 6/U COXIAL CABLE WITH FLUORINATED ETHYLENE INSULATION AND JACKETIN.	
MAX. 1/2" DIA. FIBER-OPTIC CABLE (24 FIBER) WITH PVC OR PE JACKET AND INSULATION	
MAX. 3/C NO. 12 AWG METAL CLAD CABLE	

MULTIPLE CABLE BUNDLES THROUGH CONCRETE FLOOR OR CONCRETE/ MASONRY WALL ASSEMBLY (2-HR.)



L Rating At Ambient — Less Than 1 CFM (See Item 2)

L Rating At 400 F — Less Than 1 CFM (See Item 2)



System No. C-AJ-3284

CAJ 3284

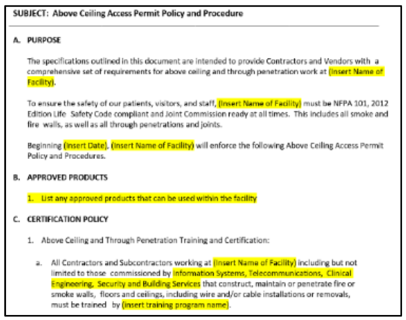
Classified by Underwriters Laboratories, Inc. to UL 1479 and CAN/ULC-S115

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Rating — 1/2 Hr	FT Rating — 1/2 Hr
L Rating At Ambient — Less Than 1 CFM (See Item 2)	FH Rating — 3 Hr
L Rating At 400 F — Less Than 1 CFM (See Item 2)	FTH Rating — 1/2 Hr
	L Rating At Ambient — Less Than 1 CFM (See Item 2)
	L Rating At 400 F — Less Than 1 CFM (See Item 2)

1. Floor or Wall Assembly — Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m3) concrete. Wall may also be constructed of any UL Classified Concrete Blocks*. Floor may also be constructed of any min 6 in. thick UL Classified hollow-core Precast Concrete Units*. Opening in floor or wall to be max 3 in. (76 mm) diam for 2" device and max 5 in. (127 mm) diam for 4" device. See Concrete Blocks (CAZT) and Precast Concrete Units (CFTV) categories in the Fire Resistance Directory for names of manufacturers.
2. Cables — Within the loading area for each firestop device, the cables may represent a 0 to 100 percent visual fill. Cables to be tightly bundled within the device and rigidly supported on both sides of floor or wall assembly. Any combination of the following types of cables may be used:
   A. Max 100 pair No. 24 AWG (or smaller) copper conductor telecommunication cable with polyvinyl chloride (PVC) jacketing and insulation.
   B. Max 7/C No. 12 AWG copper conductor control cable with PVC or XLPE jacket and insulation.
   C. Max 4/0 AWG Type RHH ground cable.
   D. Max 4 pr No. 22 AWG Cat 6 computer cables.
   E. Max RG 6/U coaxial cable with fluorinated ethylene insulation and jacketing.
   F. Fiber optic cable with polyvinyl chloride (PVC) or polyethylene (PE) jacket and insulation having a max diam of 1/2 in. (13 mm).
   G. Max 20/C No. 22 AWG shielded printer cable with PVC jacket.
   H. Through-Penetrating Product* - Two copper conductors No. 18 AWG (or smaller) Power or Non Power Limited Fire Alarm Cable with or without a jacket under a metal armor.
   AFC CABLE SYSTEMS INC
   I. Max 1/4 in. (6 mm) diameter S-Video Cable consisting of 2 max 24 AWG 75 ohm coax or twisted pair cable with PE insulation and PVC jacket.

PROCEDURE / PERMIT PROGRAMS

Implementing a firestop cable pathway procedure or "permit program" for ongoing operation of each data center facility is critical



SUBJECT: Above Ceiling Access Permit Policy and Procedure

A. PURPOSE

The specifications outlined in this document are intended to provide Contractors and Vendors with a comprehensive set of requirements for above ceiling and through penetration work at (Insert Name of Facility).

To ensure the safety of our patients, visitors, and staff, (Insert Name of Facility) must be NFPA 101, 2012 Edition Life Safety Code compliant and Joint Commission ready at all times. This includes all smoke and fire walls, as well as all through penetrations and joints.

Beginning (Insert Date), (Insert Name of Facility) will enforce the following Above Ceiling Access Permit Policy and Procedures.

B. APPROVED PRODUCTS

1. List any approved products that can be used within the facility

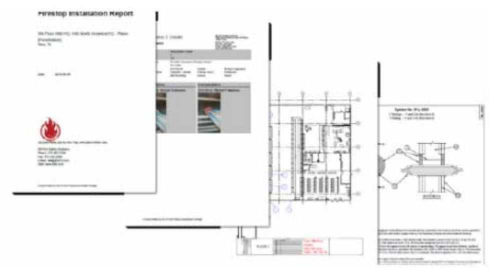
C. CERTIFICATION POLICY

1. Above Ceiling and Through Penetration Training and Certification:

   a. All Contractors and Subcontractors working at (Insert Name of Facility) including but not limited to those commissioned by Information Systems, Telecommunications, Clinical Engineering, Security and Building Services that construct, maintain or penetrate fire or smoke walls, floors and ceilings, including wire and/or cable installations or removals, must be trained by (insert training program name).

Installer training procedures

Electronic documentation



2019 ICT CANADA PRESENTED BY BICSI

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SUMMARY OF KEY LEARNINGS

- Elements of firestop and compartmentation
- Code and test standard requirements for fire barrier management
- Tested systems and engineering judgments
- Impact of firestop systems in building performance
- Key owner design considerations
- Best design practices

THANK YOU

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