INTERNATIONAL FIRESTOP COUNCIL
THE Source of Firestop Expertise

Firestop Plan Review and Inspection

ICC PREFERRED EDUCATION PROVIDER

ICC Preferred Provider Course No. 10471
IFC Firestop 108 – Firestop inspection and plan review
0.7 CEUs

1

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AHJ Training Sign in Form (cognitoforms.com)

Copyright Materials

2

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International Firestop Council
-PRESENTATION CODE OF ETHICS-

The Representative, when speaking about firestopping technology and using language, information, presentations, logos, or any other communication means that could be reasonably likely to cause the recipient(s) of such information to believe that the communication represents an official IFC technical viewpoint, shall:

- Hold themselves out to the public with professionalism and sound ethics by conducting themselves in a way that reflects positively on IFC and the IFC members
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- Declare that they are presenting an official (unmodified) presentation prepared by IFC
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- This presentation will not highlight, focus or reference to a specific product of manufacturer

3

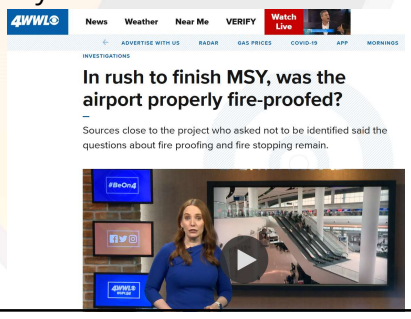
After the seminar....

- Please take our seminar feedback survey: https://www.surveymonkey.com/r/FirestopSeminar (only 3-4 mins!)

You can scan the QR code to take you to the survey

4

New Orleans airport expansion
A cautionary tale.....



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Learning Objectives

1. Outline how fire containment in construction is achieved
2. List code requirements for firestopping
3. Explain how firestopping materials are tested and to what standards
4. Show why system approach to firestopping is required
5. Determine if installation techniques meet applicable standards and code requirements
6. Understand the 2012/15/18 IBC and NFPA 1 requirements for firestop Special Inspection

All International Building Code article numbers and text are from 2018 IBC unless otherwise noted

6

Seminar agenda

- **Overview of Fire Compartmentation**
- **Through Penetration Systems**
- **Membrane Penetrations**
- **Fire Resistive Joint Systems**
- **Perimeter Fire Barrier Systems**
- **Duct Enclosure Systems**
- **Understanding the Online Certification Directories**
- **Special Inspection**
- **Engineering Judgments**
- **Inspection Tips and Techniques**

7

Breaks

- Two in the morning
- Two in the afternoon
- Break durations: ~10 minutes
- Please take advantage of product samples and mock-ups (not to take away! ☺)

8

Let's get started….

- **Overview of Fire Compartmentation**
- Through Penetration Systems
- Membrane Penetrations
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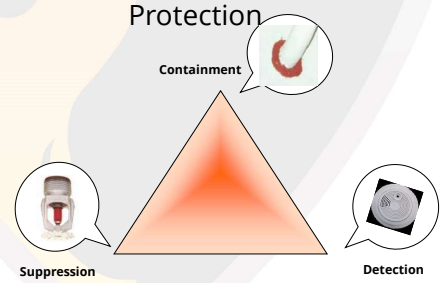
9

Understanding Balanced Fire Protection



10

IBC Balanced fire protection features

Require features that limit spread of fire and products of combustion:

- Sprinkler systems and other suppression systems (control)
- Fire rated horizontal assemblies and wall assemblies
- Smoke barriers
- Opening protection: rated doors, windows, shutters in rated assemblies
- Occupant egress requirements (e.g. dead ends, maximum distance to exit)
- Smoke management systems
- Fire detection and alarm systems
- Limitations on interior finishes and hazardous materials
- Limited heights and areas
- Structural protection

11

Finding The Right Balance

12

Why is containment important?

Smoke & Toxic Gases

13

Fire Statistics – Why We Must Contain Smoke and Toxic Gases

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.

14

Containment in Construction

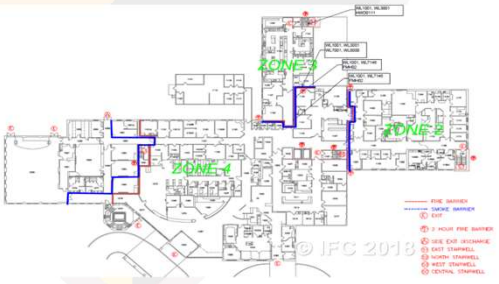
- Fire-resistance-rated assemblies referenced in the IBC:
  - Fire Walls
  - Fire Barriers
  - Fire Partitions
  - Smoke Barriers
  - Horizontal Assemblies

Any gaps or discontinuities in those assemblies must also be fire-rated:

- Through and Membrane Penetrations
- Fire-resistant joint systems (i.e. construction joints and perimeter joints)
- Opening protection (i.e. fire-rated doors and windows)
- Air ducts and air transfer openings (i.e. dampers)

15

Fire Rated Compartments



16

Critical Component of Containment

Firestopping

An assemblage consisting of a fire-resistance-rated floor, floor/ceiling, or wall assembly

+

One or more joints or penetrating items passing through assembly

+

Materials or devices, or both, installed to resist spread of fire through assembly for a prescribed period of time.

17

Where it all began …

Browns Ferry Nuclear Power Plant
March 22, 1975

- the worst fire ever in commercial nuclear power plant operating in US
- fire spread along cable trays from the cable spreading room, through a cable penetration, and into the reactor building
- fire burned cables in cable trays for almost 7 hrs
- portable extinguishers used intermittently to no effect
- After almost 7 hrs, decision made to fight fire with water. Two men using fire hose extinguished fire within 15 mins
- UL was commissioned by US Nuclear Regulatory Commission (NRC) to develop penetration firestop test

(TVA file photo)

Picture of TVA Browns Ferry seal penetration tests

18

Large Loss Fires with Inadequate Containment

First Interstate Bank Building
Los Angeles, 1988

- Fire occurred on the 12th floor extending to 16th floor (62 story high-rise)
  - "The fire extended upward by…non-firestopped openings between the floor slab and the skin."
  - "The vertical spread was also through poke-through, pipe recesses, and utility shafts."
  - "The automatic sprinkler system was drained and building fire pumps shut off at time of fire."

19

Large Loss Fires with Inadequate Containment

"The lack of firestopping between the floor slabs and the skin permitted the fire to spread from floor to floor through this space. Fire was observed spreading through this area even before the glass and mullions failed."

First Interstate Bank Building
Los Angeles, 1988

20

One Meridian Plaza
Philadelphia – Feb. 23, 1991

- Fire destroyed 38-story office building
- Tenants sued owner
- Affected businesses within one block also sued
- Three Fire Fighters died, 24 injuries reported
- Claimed potential exposure: $800 million
- Building owner sued approx. 25 defendants
  - Including the general contractor, sub-contractors and manufacturers

21

21

One Meridian Plaza
Philadelphia – Feb. 23, 1991

- Series of errors during fire
- Filler Type Foam used to "firestop" openings
- Fire spread quickly, knocking out power
- Water pressure inadequate for fire department hose streams
- Back-up generator failed

22

22

One Meridian Plaza
Lawsuits galore!

- Building owner collected $110 million:
  - GC paid over $40 million
    - Claimed failure to supervise, install and inspect the fire protection system
  - Alarm manufacturer and servicer paid $10 million
    - Claimed inadequate alarm system
  - Back-up generator manufacturer
    - Claimed faulty wiring
  - Others settled out of court
- Burned-out building was downtown Philly eyesore until demolition in 1999

23

23

Rockefeller Centre
New York, 1996

Fire occurred in the 5th floor electrical room:

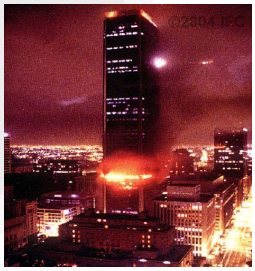
- "Fire and smoke spread beyond the rooms involved due to a number of unprotected horizontal and vertical openings."
- "Based upon the NFPA's investigation and analysis of this fire, the following are considered significant contributing factors to the loss of property in this incident:
  - Unprotected vertical and horizontal penetrations. These openings allowed smoke to spread from beyond the electrical room and into the occupied areas."

Source: NFPA Fire Investigation Summary: "High Rise Fire Rockefeller Center"

24

Why is Firestopping Required?

- Mandated by the Codes
- Life safety and property protection
- Provide time for first responders to perform their duties
- Containment



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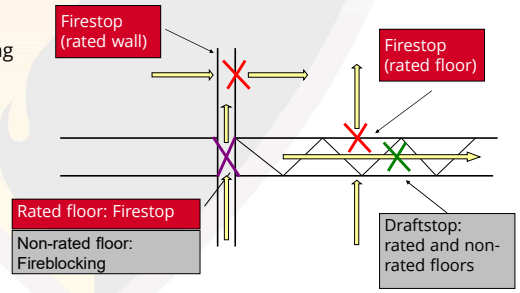
Do you know the difference?

- Firestopping
- Fireblocking
- Draftstopping



26

Codes do not simply require "firestopping" Codes mandate *tested* (proven, rated) firestopping systems

"CLOSE ENOUGH IS NOT GOOD ENOUGH":
A Demonstration of Proper vs. Improper Firestopping

Click to go to YouTube

27

IBC & NFPA 101 Referenced Fire Test Standards

Through Penetration	ASTM E814 UL 1479
Joints	UL 2079 ASTM E1966
Perimeter Barriers	ASTM E2307

ASTM: American Society of Testing and Materials

UL: Underwriters Laboratories Inc.

- Without some proof of testing to the relevant standard, any given firestop installation is not code-compliant

28

Third Party Testing Labs

Underwriters Laboratories Inc.

FM Global (Factory Mutual)

Intertek Testing Services (ITS)

Southwest Research Institute

Labs Test to Standards

American Society of Testing and Materials (ASTM)

Underwriters Laboratories Inc. (UL)

29

How does firestopping protect gaps created by burning/melting items?

- "Intumescent" firestop products will expand during heat of fire to fill gaps

Cast-in-place floor firestop device

Also:
View video at IFC YouTube channel

30

30

How does firestopping protect gaps created by burning/melting items?

- "Intumescent" firestop products will expand during heat of fire to fill gaps

Electrical box insert

Also: View at IFC YouTube channel

31

31

Firestop Plan Review and Inspection

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32

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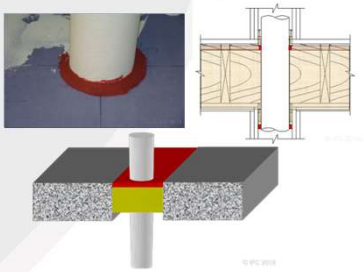
33

Penetration Firestop System

Consists of:
- Assembly being penetrated
- Penetrating item
- Fill, void or cavity materials (firestopping materials)



34

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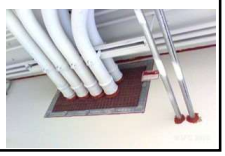
35

Wall Assemblies

714.4 Fire-resistance-rated walls

714.4.1.2 Through-penetration firestop system.
Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E814 or UL 1479, with a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.

➔ T-rating never required by code for wall through-penetrations



36

Horizontal Assemblies

714.5 Horizontal Assemblies

714.5.1.2 Through-penetration firestop system.

Through penetrations shall be protected by an approved through-penetration firestop system installed and tested in accordance with ASTM E814 or UL 1479, with a minimum positive pressure differential of 0.01inch of water (2.49 Pa). The system shall have an F rating/T rating of not less than 1hour but not less than the required rating of the floor penetrated.

Exceptions to T-Rating only:
1. Floor penetrations contained and located within the cavity of a wall
2. Floor penetrations by floor drains, tub drains or shower drain located within the concealed space of a horizontal assembly
3. Max 4-inch diameter metal conduit or tubing penetrating directly into metal-enclosed electrical power switchgear.

37

How to achieve T-rating

- Methods for achieving a T Rating = F-rating include:
  - Wrap metallic pipe with insulation above and/or below floor
    - mineral wool or ceramic insulation above and/or below floor
    - Glass fiber insulation only above floor
    - Proprietary, listed wrap materials (duct wrap, endothermic mats)
  - Small dia. penetrant in thick concrete floor
  - Listed systems provide details of what is needed

38

Code Requirements: Smoke Barriers

- 714.5.4 – Penetrations in smoke barriers shall have an L- Rating at ambient and 400° F per UL2079
  - Max 5.0 CFM / sq ft of opening per penetration, or
  - Max cumulative leakage of 50 cfm for all penetrations within any 100 square feet of wall or floor area

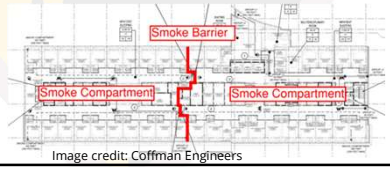


Image credit: Coffman Engineers

39

Annular Space Requirements for automatic fire sprinkler piping in Seismic Areas

NFPA 13 – Installation of Sprinkler Systems

Annular Space requirements to prevent damage to sprinkler pipe

- If Pipe ≤ 3.5" then annular = 1"
- If pipe > 3.5" then annular = 2"
- "…the clearance shall be filled with a flexible material…"
- 2021 edition of NFPA 13 waives annular space for gypsum walls
  - Only IBC 2024 references NFPA 13-2021

40

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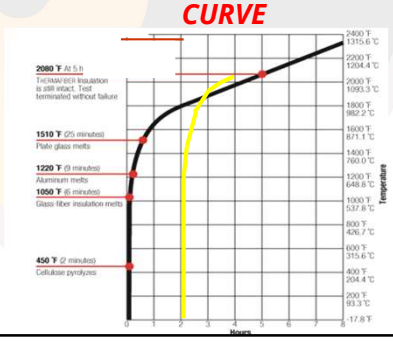
41

ASTM E119 TIME - TEMPERATURE CURVE



42

Before

43

During

44

After

45

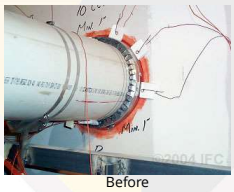
Fire Test & Hose Stream Test

46

Example of Successful Testing

Construction - 4" PVC Through Drywall

Firestopping - Intumescent Device & Sealant



Before

After

47

Ratings

- F-rating (pass/fail)
  - Passage of Flame
  - Hose Stream
- T-rating time is recorded/reported, not a pass/fail
  - Time at which temp rise >325°F on unexposed side
  - Code-mandated only for some floor penetrations
- L-rating: Air Leakage (Optional)
- W-rating: Water Leakage (Optional – never code mandated)

48

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49

Firestop inspection and plan review made easy

- Step 1: Ask the question:
  Show me (give me) the listed system used for every penetration firestop
- Step 2: Verification that the field condition meets the firestop system exactly
- There are 7500+ (!!) UL-listed through penetration firestop systems.
- Each is for very precise set of conditions

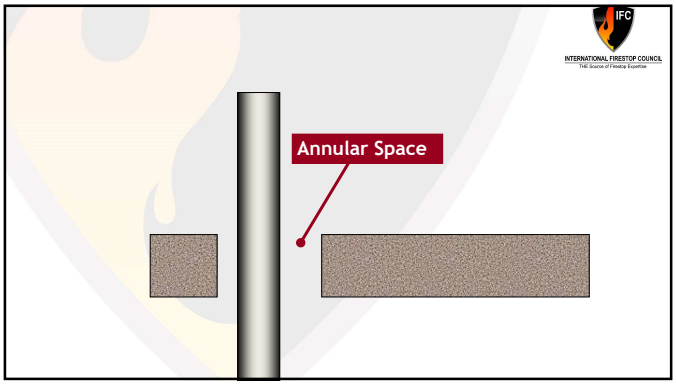
50

50

Factors Affecting Penetrations

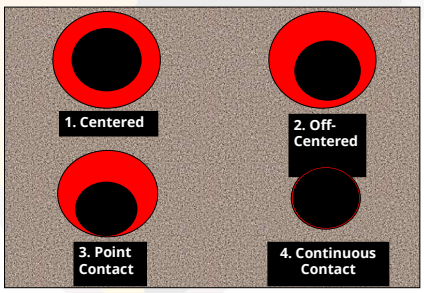
- Floor or wall construction type and thickness
- Size and shape of opening
- Size and type of penetrating item(s)
- Percent fill of cables
- Annular space
- Rating requirement
- Firestopping materials

51



52

Typical Annular Space



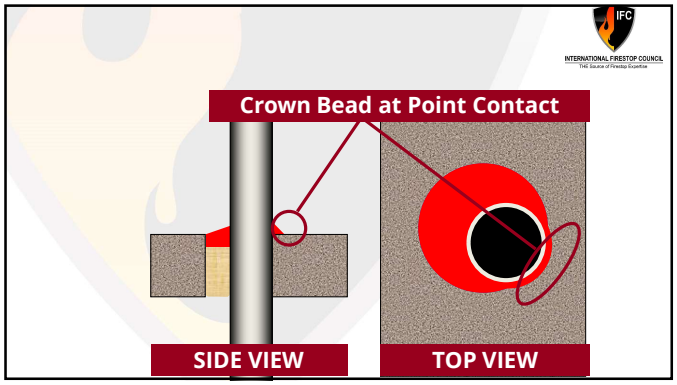
53

Sealant depth & location must be verified

5/8" specified in Listed System

< 5/8" installed in the field

54



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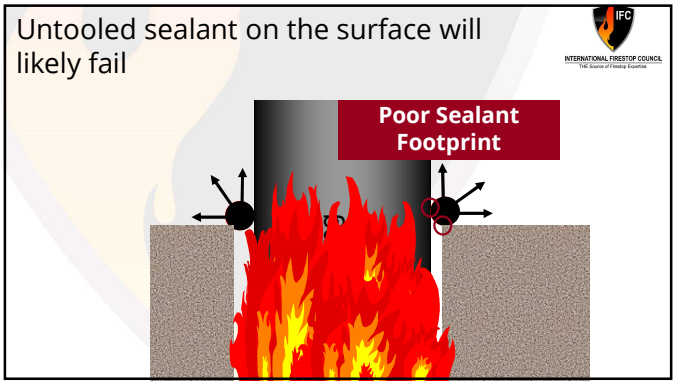
Untooled sealant on the surface will likely fail



56

Properly Tooled Penetrations

- The Firestop sealant must be well bonded to penetrating item and surrounding wall or floor
- Should always inspect both sides

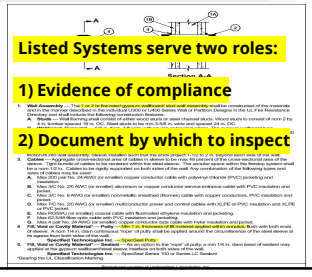
57

Identifying a matching firestop system

- What type of building assembly is requiring firestopping?
  - Floor or Wall
- What type of material is the building assembly
  - Concrete, CMU, Gypsum, Wood Frame
- What is the penetrating item(s)?
  - Metallic, Nonmetallic, Cables, Insulated, Construction Joints, etc.
- What are the specific descriptions regarding the penetrants?
  - Diameter, quantity, type of plastic, type & thickness of insulation, etc.
- What is the hourly rating you are looking for?
  - F Rating, T Rating
- Are there any special considerations?
  - Movement, Environmental exposure

58

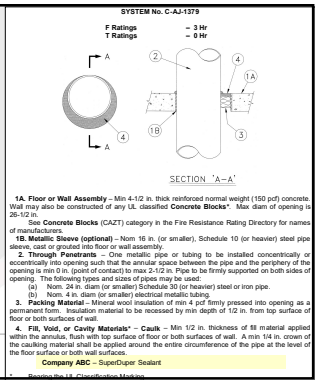
For Authority Having Jurisdiction (AHJ) (building/fire official) and Authorizing Authority (AA)



59

Verify chosen or installed system against field parameters

1. Type of wall or floor assembly, materials
2. Type of penetrating item (if any)
3. Opening size and type
4. Rating requirements (F-rating, T-ratings, etc.)
5. Any special considerations?



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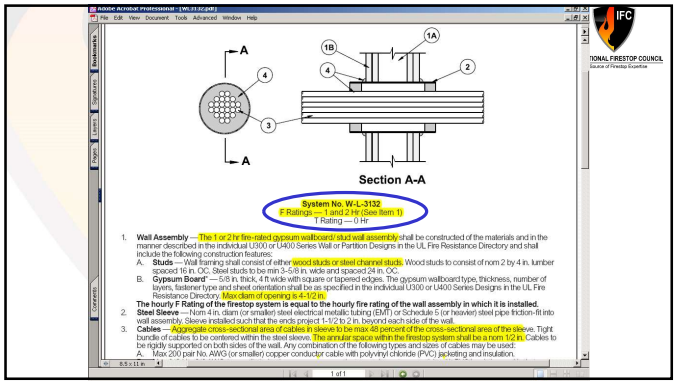

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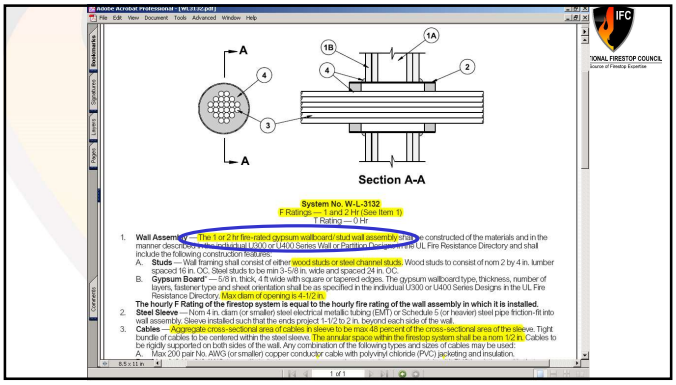

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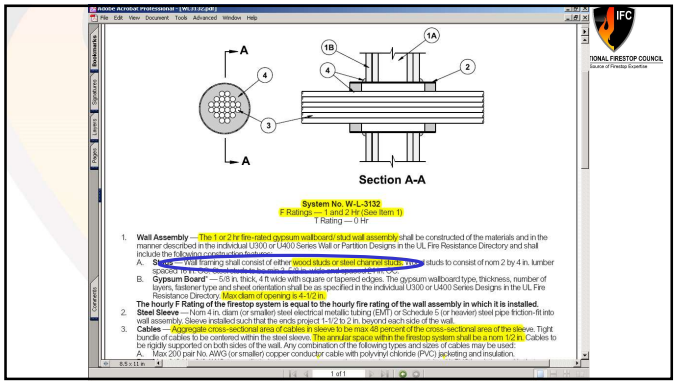

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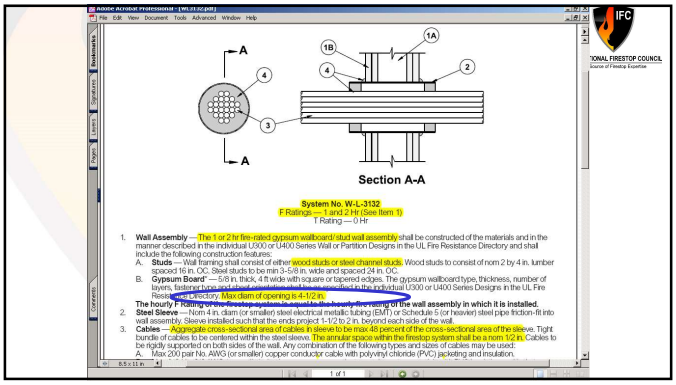

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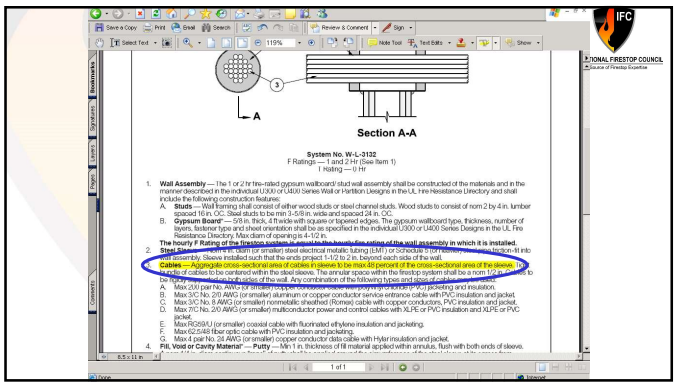

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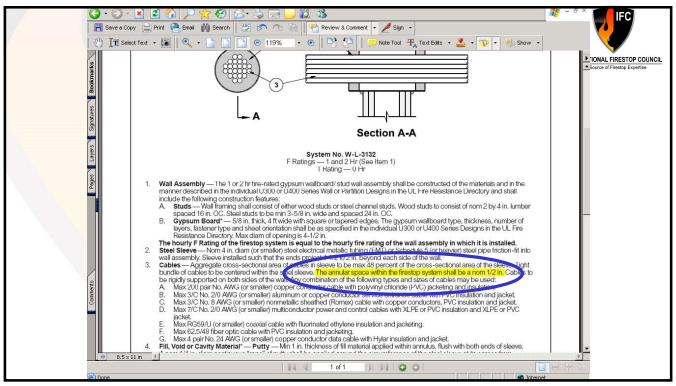

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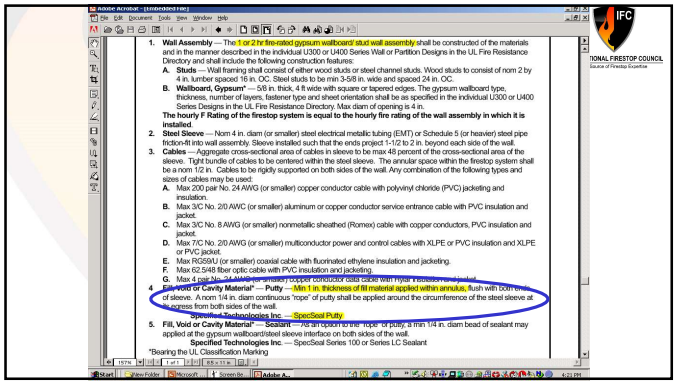

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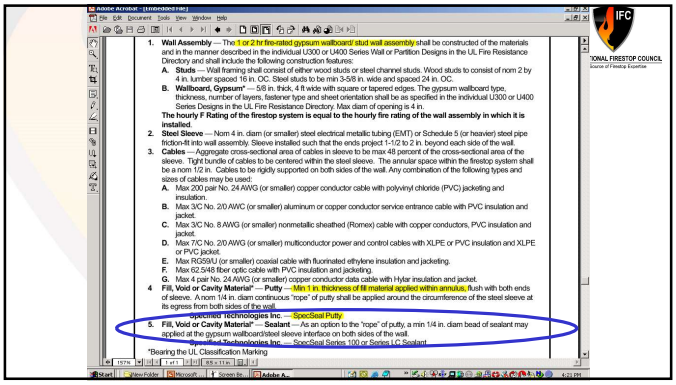

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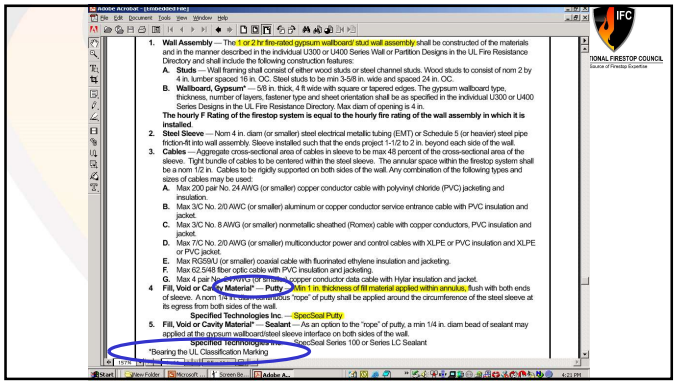
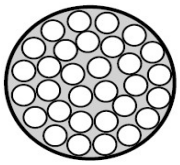


69

Fig. 2: Cable Loading...
Visually Full... Half Empty By Calculation!



Let's calculate the cable loading of this opening:
Diameter of Opening = 4"
Diameter of Cables = 5/8" (.625")
Number of Cables (N) = 21
Area of Opening (A) = πr^2 or 3.1416 x 2^2 = 12.57 sq. in.
Area of Cables (C) = πr^2 or 3.1416 x $.3125^2$ = .307 sq. in.
Cable Loading = $\frac{C \times N}{A} = \frac{.307 \times 21}{12.57} = 51\%$

- UL system listings for cables include "maximum % fill"
  - Some listings cite "visual" cable fill instead of actual

70

Recap: Inspection of Penetrations

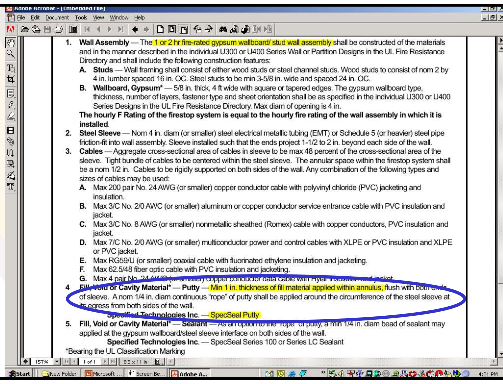
- Firestop system must be installed in accordance with all details of the tested and listed system
- Rating of the system must match the required rating of assembly being penetrated
- Penetrating item and opening size must match the tested and listed system

71

Material Shrinkage

- Understand some sealants may shrink when installed
- Listing always reports wet sealant thickness
- ASTM C1241 shrinkage test
- % shrinkage, if available, is published by UL in manufacturer's listings summary page
  1. Go to UL Product iQ website (free registration)
  2. Type in "XHHW" into search box (listing category)
  3. Select the manufacturer whose product shrinkage data you need
  4. Scroll to very end of the webpage for ASTM C1241 data

72



1. **Wall Assembly** — The 1 or 2 hr fire-rated gypsum wallboard/ stud wall assembly shall be constructed of the materials and in the manner described in the individual U300 or U400 Series Wall or Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:
   - A. **Studs** — Wall framing shall consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 3-5/8 in. wide and spaced 24 in. OC.
   - B. **Wallboard, Gypsum*** — 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300 or U400 Series Designs in the UL Fire Resistance Directory. Max diam of opening is 4 in.

   The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.
2. **Steel Sleeve** — Nom 4 in. diam (or smaller) steel electrical metallic tubing (EMT) or Schedule 5 (or heavier) steel pipe friction-fit into wall assembly. Sleeve installed such that the ends project 1-1/2 to 2 in. beyond each side of the wall.
3. **Cables** — Aggregate cross-sectional area of cables in sleeve to be max 48 percent of the cross-sectional area of the sleeve. Tight bundle of cables to be centered within the steel sleeve. The annular space within the firestop system shall be a nom 1/2 in. Cables to be rigidly supported on both sides of the wall. Any combination of the following types and sizes of cables may be used:
   - A. Max 200 pair No. 24 AWG (or smaller) copper conductor cable with polyvinyl chloride (PVC) jacketing and insulation.
   - B. Max 3/C No. 2/0 AWC (or smaller) aluminum or copper conductor service entrance cable with PVC insulation and jacket.
   - C. Max 3/C No. 8 AWG (or smaller) nonmetallic sheathed (Romex) cable with copper conductors, PVC insulation and jacket.
   - D. Max 7/C No. 2/0 AWG (or smaller) multiconductor power and control cables with XLPE or PVC insulation and XLPE or PVC jacket.
   - E. Max RG59/U (or smaller) coaxial cable with fluorinated ethylene insulation and jacketing.
   - F. Max 62.5/48 fiber optic cable with PVC insulation and jacketing.
   - G. Max 4 pair No. 24 AWG (or smaller) copper conductor data cable with Hylar insulation and jacket.
4. **Fill, Void or Cavity Material* — Putty** — Min 1 in. thickness of fill material applied within annulus, flush with both ends of sleeve. A nom 1/4 in. diam continuous "rope" of putty shall be applied around the circumference of the steel sleeve at its egress from both sides of the wall.

   Specified Technologies Inc. — SpecSeal Putty
5. **Fill, Void or Cavity Material* — Sealant** — As an option to the "rope" of putty, a min 1/4 in. diam bead of sealant may applied at the gypsum wallboard/steel sleeve interface on both sides of the wall.

   Specified Technologies Inc. — SpecSeal Series 100 or Series LC Sealant

*Bearing the UL Classification Marking

73

Firestop Plan Review and Inspection

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- Through Penetration Systems
- **Membrane Penetrations**
  - **What is it?**
  - **Code Requirements**
  - **Fire Testing**
  - **Inspection**
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74

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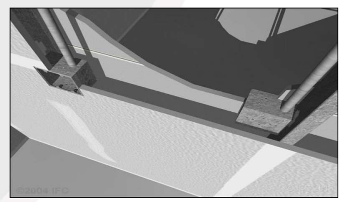
75

Electrical Membrane Penetrations

A breach in one side of a floor-ceiling, roof-ceiling, or wall assembly to accommodate an item installed into or passing through the breach.



76

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77

Firestop Code Requirements - IBC

Membrane Penetrations

- Sections 714.4.2: Membrane Penetrations

 Membrane Penetrations shall comply with Section 714.4.1*. Where walls or partitions are required to have a fire-resistance rating, recessed fixtures shall be installed such that the required fire-resistance will not be reduced.
  - Code Summary:
    - Membrane penetrations are firestopped at the wall membrane or surface, the same as through penetrations
- Metallic boxes installed per limits (exceptions) in IBC
- Nonmetallic boxes installed as tested and listed

* Penetration firestop system tested to E814/UL1479

78

Metallic Electrical Outlet Box Allowances

Metallic boxes acceptable per code (without additional protection) if

- Maximum 16 sq in. outlet box, and
- Maximum 100 sq in. of opening on each side of wall per 100 sq ft of wall area, and
- Maximum 1/8 in. annular space between wall membrane and box, and
- Boxes on opposite sides of wall need to be either separated horizontally by minimum 24 in. or protected by some type of heat barrier

➔ Many installations will not meet all of the above

79

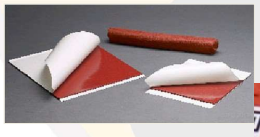
Metallic Electrical Outlet Box Exceptions

- Metallic boxes installed in up to 2 hr rated walls can
  - Exceed 16 sq in. outlet box
  - Exceed 100 sq in. of opening per 100 sq ft of ceiling area
  - Be closer than 24 in. on opposite sides of wall
- Provided such penetrating items are protected by listed putty pads or other listed materials and methods… and
- Installed in accordance with the listing

80

Firestop Putties

- Intumescent Putties
  - Hand moldable intumescent "putties



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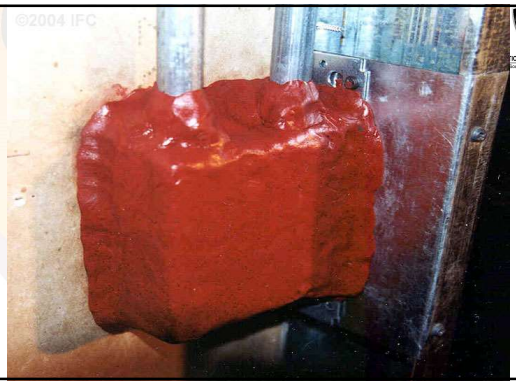
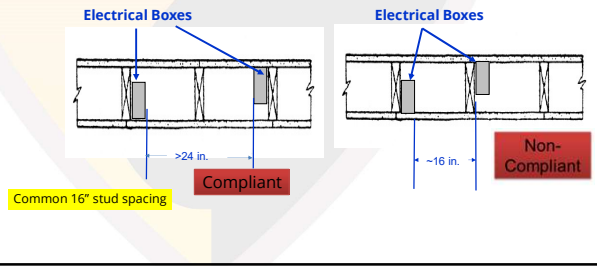


82

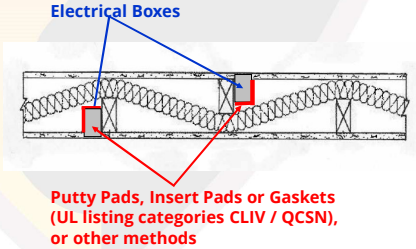
Metallic Electrical Boxes Opposite sides of wall Min 24 in. Spacing



83

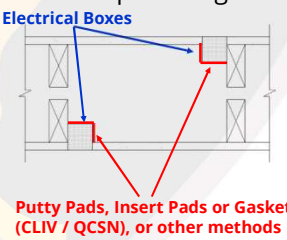
Metallic Electrical Boxes in Staggered Stud Walls

➔ Protection required regardless of spacing



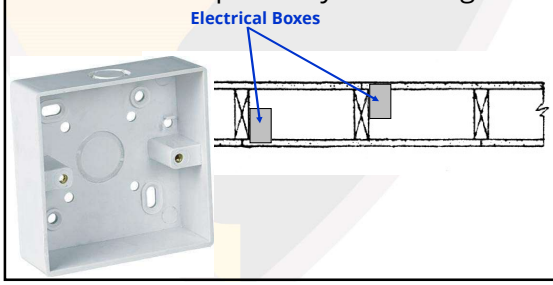
84

Metallic Electrical Boxes
Double Stud Walls
➔ Box protection required regardless of spacing



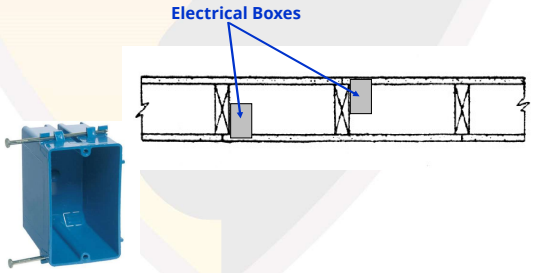
85

Nonmetallic Electrical box
Per fire rated box listing
or per Putty Pad listing



86

Listed Nonmetallic Electrical Spacing: per Listing



87

Misc Utility Boxes in fire-rated walls

- Other, non-electrical boxes **Permitted** when:
  - protected with a tested penetration firestop system, and
  - F & T rating equals required fire-resistance rating of wall penetrated, and
  - installed in accordance with their listing.
- Listed non-electrical boxes exist with inherent (listed) fire rating

88

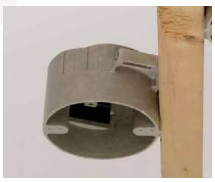
Metallic Electrical Outlet Boxes in Ceilings

- Metallic boxes acceptable per IBC:
  - Maximum 16 sq in. outlet box, and
  - Maximum 100 sq in. of opening per 100 sq ft of ceiling area, and
  - Maximum 1/8 in. annular space between ceiling membrane and box
- Installation not complying with these prescriptive requirements shall be protected by tested and listed solutions
  - UL "Wall opening protective materials" listing category (CLIV) does NOT apply to ceiling penetrations
  - no listed putty pad solutions for non-compliant ceiling boxes

89

Nonmetallic Electrical Outlet Boxes in Ceilings

- Installed as tested and listed
- Maximum 1/8 in. annular space between ceiling membrane and box
- Listing mark must include "C" (for ceiling)



90

Recessed fixtures in Ceilings

- Floor/ceiling assembly listings provide acceptable light fixtures and air transfer openings

91

Recap: 5 possible challenges

- Boxes on opposite sides of wall too close (24" rule)
- Boxes in communicating stud cavity 
- Boxes too big (> 16 sq. in.)
- Too many boxes in one small area (> 100 sq. in. per 100 sq ft of wall)
- Non-metallic outlet boxes
- See IFC "**Guide for Protection of Recessed Boxes in Fire-rated Walls Using Firestop Putty Pads, Box Inserts, Cover Plate Gaskets and Endothermic Mats** " (7 pages)

www.firestop.org/technical-library

92

Firestop Plan Review and Inspection

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93

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94

IBC - Definition

IBC Definition of JOINT

- The opening in or between adjacent assemblies that is created due to building tolerances or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.

95

Fire rated Joint System Parameters

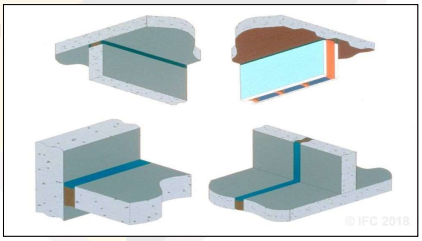
- Nominal Joint Width
- Assembly Rating
- Movement
- Extension
- Compression
- Percent (%) Extension / Compression
- Mineral Wool Compression
- Sealant Depth

96

Types of joint systems
Juncture of two fire-rated assemblies

Head of Wall (Flat Deck)

Head of Wall (Fluted Deck)



Floor to Wall

Floor to Floor and Wall to Wall

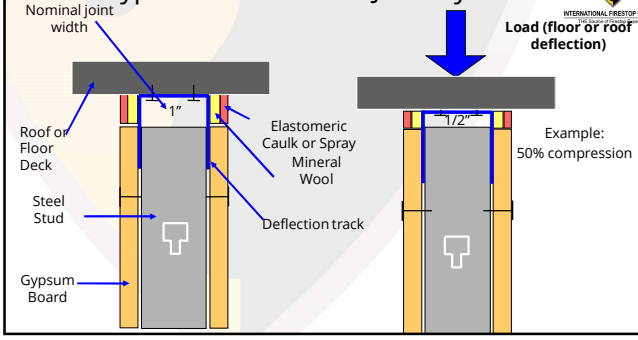
97

Categories of Fire-Resistive Joint systems

- Sealant Systems (Caulks)
- Sprayed /Elastomeric Membranes (Sprays)
- Mechanical Joints
- Pre-formed joint systems

98

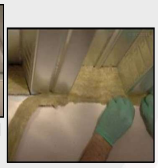
Typical Head of Wall Joint System



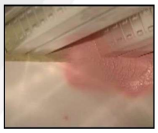
99

Head-of-Wall Spray Application

Flutes are packed with mineral wool per listed system.



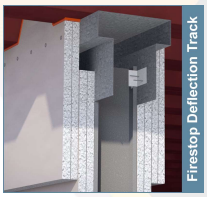
Remaining joint is packed with mineral wool per listed system.

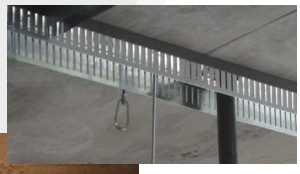


Firestop sealant is applied to both sides of wall per listed system.

100

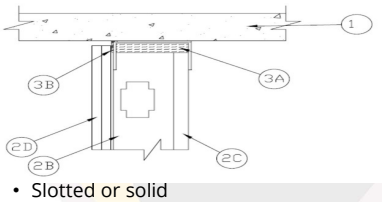
Mechanical top-of-wall Joint Systems

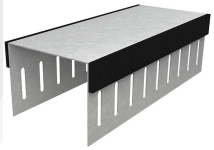




101

Factory Applied Intumescent on Track





- Slotted or solid
- Gap remains unfilled
- 3A = mineral wool inside top track (shaft wall only)
- 3B = factory applied intumescent on top or side of track
- Intumescent on top visible from side view

102

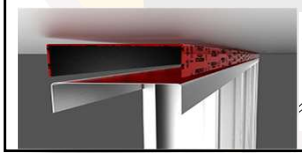
Framing devices with intumescent tape

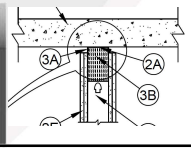
- Post-installed
  - after wall framing, prior to drywall
- Must be installed on both sides

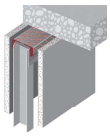
103

U-shaped firestop gasket

- Installed during ceiling runner installation
- Sides must drape down – cover vertical leg
- Side legs can't be penetrated by screws
- For profiled decks, mineral wool is needed in flutes
- Some systems require mineral wool within track

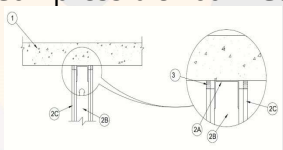






104

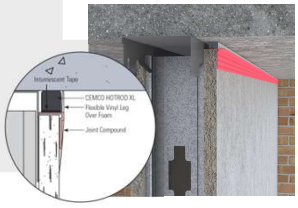
Compressible Foam Gasket



- Only for flat concrete
- 2-hr system may not fill full depth
- Some gasket compression required
- Installed after drywall
- Both sides of wall
- Must verify proper orientation

105

Post-installed preformed joint systems



- Specialty firestop tape used over mineral wool instead of spray or sealant
- Foam gasket factory-applied to vinyl trim

106

Floor-to-floor building expansion joints (Typically large)

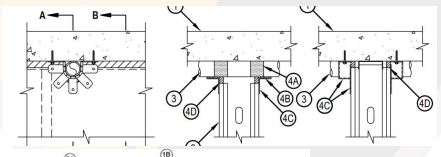
- Must support full live loads
  - "Stuff and spray or caulk" joint systems used for small joints not applicable

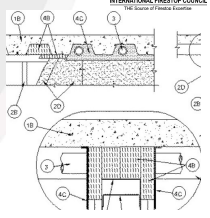
Examples:

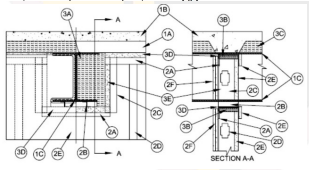
107

107

Penetrations through joints



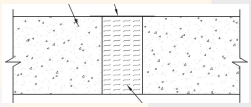




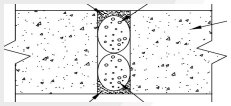
- Some head-of-wall joint systems allow for penetrations
- Beam penetrations are part of some listed joint systems

108

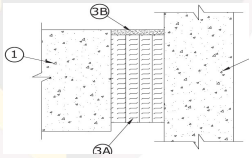
Other Typical Joint Systems



• Floor to Floor



• Wall to Wall



• Floor to Wall

109

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110

Building Code Requirements Fire Resistive Joints

Section 715.1: Fire Resistive Joint Systems

"Joints installed in or between fire-resistance rated walls, floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies shall be protected by an approved fire-resistant joint system designed to resist the passage of fire for a time period not less than the required fire-resistance rating of the wall, floor or roof in or between which the system is Installed."

Exceptions: 9 specific exemptions exist
e.g. walls permitted to have unprotected openings, floors within malls, etc..

111

Building Code requirements Fire Resistive Joints – 715.1 Exceptions

Fire resistive joint systems not required in the following:

Floors
- Within single dwelling unit
- Where joint is protected by shaft enclosure
- Within atriums
- Within malls
- Within parking garages
- Mezzanines

Other locations
- Walls permitted to have unprotected openings
- Roofs where openings are permitted (i.e. almost all roofs)
- Max. 5/8 in wide controls joints if tested as part of assembly in accordance with ASTM E119/UL 263

112

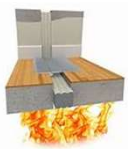
Building Code Requirements IBC – Joints

- 715.2 Installation- A fire-resistant joint system shall be securely installed in accordance with the manufacturer's installation instructions and the listing criteria in or on the joint for its entire length so as not to impair its ability to accommodate expected building movements and to resist the passage of fire and hot gases.
- 715.3 – Fire-resistant joint systems shall be tested to ASTM E 1966 or UL 1479

113

Building Code Requirements IBC – Joints in Smoke Barriers

- Must be designed and constructed to restrict the movement of smoke.
- Rating used: L Rating
  - measurement of air leakage rate through a fire resistive joint system or penetration.
- 715.6 - Joints in smoke barriers shall have an L Rating not in excess of 5 cfm / lineal ft of opening



114

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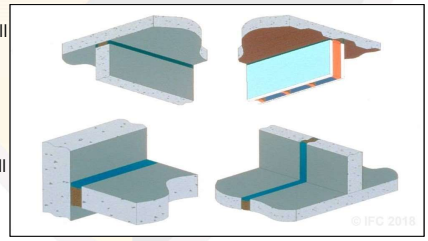
115

Fire Resistive Joint Testing

Head of Wall (Flat Deck)

Head of Wall (Fluted Deck)



Floor to Wall

Floor to Floor and Wall to Wall

116

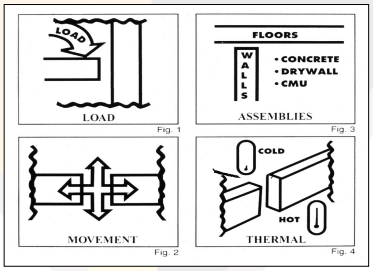
Fire Resistive Joint Testing

Head of Wall Joint

Floor to Floor Joint

117

Forces Which Induce Movement



- Live load
- Thermal
- Seismic

118

Cycling of joint prior to fire test per ASTM E1399:

Cycling Requirements

Class Movement	Min. Cycles	Frequency
I	500	1 cycle / min.
II	500	10 cycle / min.
III	100	30 cycle / min.
IV	100	30 cycle/min and
	400	10 cycle / min.

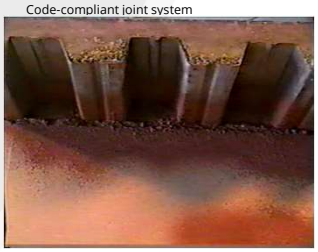
- Cycling conducted prior to fire test
- Joint fire tested at maximum extension
- Listing will report maximum extension and compression
  - Beware systems with compression only – no such real life applications!

119

Joints with/without successful joint cycling test

Non-code-compliant joint seal

Code-compliant joint system

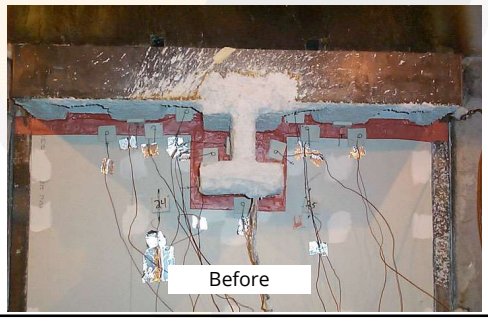


Almost all construction joints will be dynamic

Videos courtesy of Hilti

120

Head of Wall Joint Test per ASTM 1966 / UL 2079



121

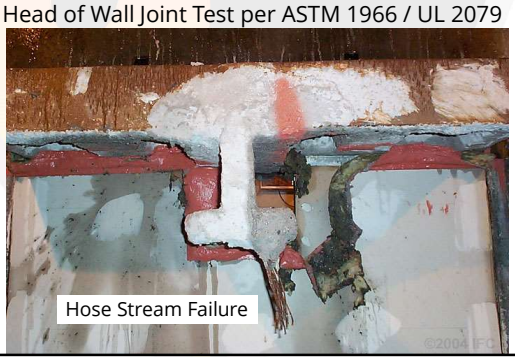
Head of Wall Joint Test per ASTM 1966 / UL 2079

122

Head of Wall Joint Test per ASTM 1966 / UL 2079

123

Head of Wall Joint Test per ASTM 1966 / UL 2079



124

Firestop Plan Review and Inspection

- Overview of Fire Compartmentation
- Through Penetration Systems
- Membrane Penetrations
- **Fire Resistive Joint Systems**
  - What is it?
  - Code Requirements
  - Fire Testing
  - **Inspection**
- Perimeter Fire Barrier Systems
- Duct Enclosure Systems
- Understanding the UL Online Certifications Directory
- Special Inspection
- Engineering Judgments
- Inspection Tips and Techniques

125

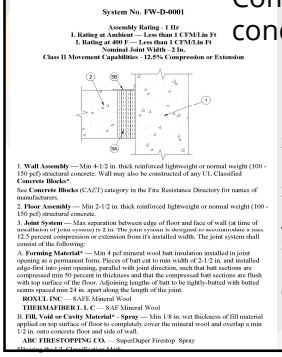
Firestop inspection and plan review made easy

- Step 1: Ask the question:
  Show me (give me) the listed system used for every joint type in/between fire-rated walls or floors
- Step 2: Verification that the field condition meets the firestop system exactly

- There are 2300+ (!!) UL-listed fire resistive joint systems.
- Each is for very precise set of conditions

126

Compare system and field conditions



System No. FW-D-0001

Assembly Rating - 1 Hr
1. Rating at Ambient — Less than 1 CFM/Lin Ft
1. Rating at 400 F — Less than 1 CFM/Lin Ft
Nominal Joint Width - 2 In.
Class II Movement Capabilities - 12.5% Compression or Extension

1. **Wall Assembly** — Min 4-1/2 in. thick reinforced lightweight or normal weight (100 - 150 pcf) structural concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***.
See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.
2. **Floor Assembly** — Min 2-1/2 in. thick reinforced lightweight or normal weight (100 - 150 pcf) structural concrete.
3. **Joint System** — Max separation between edge of floor and face of wall (at time of installation of joint system) is 2 in. The joint system is designed to accommodate a max. 12.5 percent compression or extension from it's installed width. The joint system shall consist of the following:
A. **Forming Material*** — Min 4 pcf mineral wool batt insulation installed in joint opening as a permanent form. Pieces of batt cut to min width of 2-1/2 in. and installed edge-first into joint opening, parallel with joint direction, such that batt sections are compressed min 50 percent in thickness and that the compressed batt sections are flush with top surface of the floor. Adjoining lengths of batt to be tightly-butted with butted seams spaced min 24 in. apart along the length of the joint.
ROXUL INC — SAFE Mineral Wool
THERMAFIBER LLC — SAF Mineral Wool
B. **Fill, Void or Cavity Material* - Spray** — Min 1/8 in. wet thickness of fill material applied on top surface of floor to completely cover the mineral wool and overlap a min 1/2 in. onto concrete floor and side of wall.
ABC FIRESTOPPING CO. — SuperDuper Firestop Spray

1. What type of building assemblies form the joint?
   - Floor/Floor, Floor/Wall, Wall/Wall, Top of Wall/Ceiling
2. What materials are the assemblies constructed from?
   - Concrete, CMU, Gypsum
3. What is the required hourly rating?
   - Assembly rating (1 – 4 hour)
4. What is the width of the joint (inches)?
5. How much movement is required?
   - Must accommodate building movement (% of joint size)
6. Are there any special considerations?
   - Unique construction condition, environmental exposure

127

Does the submitted joint system seem correct?

Reading UL Nomenclature for Joint Systems

128

UL Nomenclature

Navigating the UL Directory: **HW – D – 0060**

JOINT SYSTEMS (XHBN)

First Two Alpha Characters identify the type of joint system:

FF	=	Floor-to-Floor
WW	=	Wall-to-Wall
FW	=	Floor-to-Wall
HW	=	Head-of-Wall

129

UL Nomenclature Cont.

Navigating the UL Directory: **HW – D – 0060**

JOINT SYSTEMS (XHBN)

Third Alpha Character identifies the movement capabilities of the system:

D = Dynamic (movement capabilities)
S = Static (no movement capabilities)

130

UL Nomenclature Cont.

Navigating the UL Directory: **HW – D – 0060**

JOINT SYSTEMS (XHBN)

First Numeric Character identifies the nominal width of the linear opening:

0000 – 0999	= ≤ 2 in.
1000 – 1999	= > 2 in. and ≤ 6 in.
2000 – 2999	= > 6 in. and ≤ 12 in.
3000 – 3999	= > 12 in. and ≤ 24 in.
4000 – 4999	= > 24 in.

131

UL Nomenclature Cont.

Navigating the UL Directory: **HW – D – 0060**

JOINT SYSTEMS (XHBN)

Second Through Fourth Numeric Characters identify the individual system number

132

Common Joint System Correction Notices

- "Deflection is required to be installed with an approved joint system per Section 715 of the IBC. The assemblies need to be designed to allow joints to compress and extend with movement of structure while maintaining the fire-rating of the assemblies."
- "Please clarify building deflection by listing the Maximum and Minimum building deflection movements to determine movement capabilities of assembly and identify listed assemblies for all joint systems."

133

Field Inspection of Joint Systems

- Identify the type of building assemblies that form the joint (e.g. type, thickness)
- Verify the materials and installation of the joint system
- Are there any special considerations?
  - Conditions that require Engineering Judgments (not within listed system parameters)
  - High movement requirements

134

What to Look For

- Ensure the framing members allow for required movement
- Confirm appropriate backing material is used if required
  - Mineral wool may be used above the track or inside top track
  - Manufacturer and type (eg. Type SAF and SAFE)
  - Nominal density (typically 4pcf if field cut. 6pcf for prefab)
  - Compression and orientation per listing

135

Joint Inspection Process

- Inspect joint systems during framing inspection
- Contractor to provide you with the listed assembly as shown / approved on the plans
- Confirm all joint systems will accommodate required movement
- For Mechanical Joints observe the ceiling runner for the label located on the side of the runner

136

Joint Systems - Summary

- Provide tested and listed systems that includes joint movement at Plan Review or before field inspection
- Joints must accommodate expected building movement
- Inspect some joint systems during framing inspection

137

Firestop Plan Review and Inspection

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  - **What is it?**
  - **Code Requirements**
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138

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139

What is a Curtain Wall?

An exterior building wall which carries no roof or floor loads and consists of metal, glass or stone or any combination thereof supported by a metal frame.

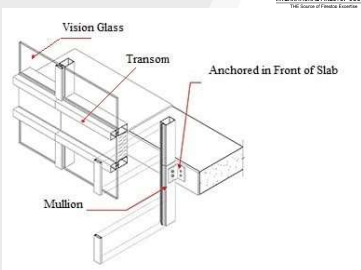


Image credit: Theconstructor.org

140

Unprotected perimeter joints or improperly installed perimeter fire containment systems cost lives and huge liability losses…

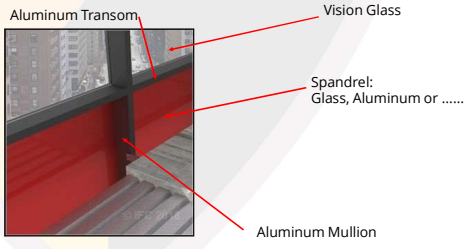
- Summerland, Isle of Man, British Isles. Fire spread through safing joint. 50 people killed.
- Hilton Hotel, Las Vegas, NV. Fire spread from 8th to 13th floor in 25 minutes. 8 fatalities.
- First Interstate Bank, Los Angeles, CA. Flames spread from 13th to 16th floor via perimeter joint. One death.
- One Meridian Plaza, Philadelphia, PA. Fire spread from 22nd to 30th floor through unprotected openings including slab edge.

141

Perimeter Fire Containment Systems

142

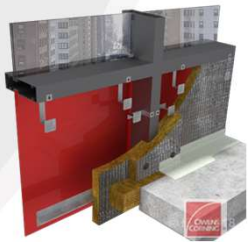
Common Terminology



143

Curtain Wall Fire Containment Six Basic Design Principles

1. **Reinforcement Member**
2. **Mineral Wool Spandrel Insulation** (ASTM E2307 approved)
3. **Mechanically Attached MW Spandrel Insulation**
4. **Compression Fit MW Safing** (ASTM E2307 approved)
5. **Protect Vertical Mullions**
6. **Smoke Barrier** (ASTM E2307 approved)



144

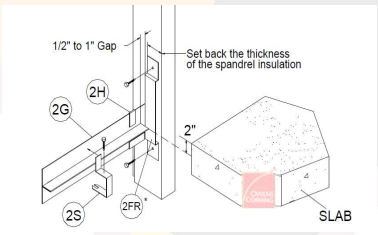
Typical Curtain Wall System Cont.

Mechanical attachments are used to hold the curtain wall insulation (not shown) in place and are attached to the curtainwall framing. These come in many forms such as hangers, stick pins, steel angles, as well as other forms.

- Design Listings outlines required method of attachment

145

Typical Curtain Wall System Cont.

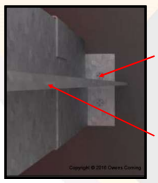


Reinforcement member or backer bar set 2" below top of slab to support curtain wall insulation from bowing due to compression of Safing insulation. Can be a T-bar, hat channel, steel angle, as well as others. Must be mechanically attached to mullions.

146

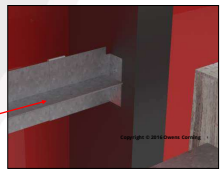
Typical Curtain Wall System Cont.

Reinforcement member or backer bar



Mechanically Attached (screw)

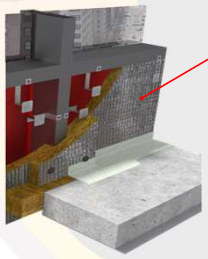
Reinforcement Member



147

147

Typical Curtain Wall System Cont.



Minimum 2 in. thick, nom. 8 pcf density mineral wool spandrel insulation (ASTM E2307 compliant) faced on one side with aluminum foil scrim. Curtain wall insulation tightly fitted between framing members and mechanically attached to mullions and transoms.

148

ASTM E2307 Tested Mineral Wool

All Mineral Wools are NOT the same

Firest

149

149

ASTM E2307 Tested Mineral Wool

- Non Combustible
- Thermal Performance
- Sound Control
- Moisture Performance

Firestop Plan Review and Inspection

150

150

ASTM E2307 Tested Mineral Wool

3rd Party Certification of Products & Systems

Firestop Plan Review and Inspection 151

151

ASTM E2307 Tested Mineral Wool

All Mineral Wools are NOT the same

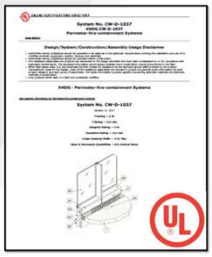
G. **Curtain Wall Insulation*** — Nom 3 in. (76 mm) thick mineral wool batt insulation faced on one side with aluminum foil/scrim vapor retarder. Unfaced mineral wool batt insulation is also acceptable. Insulation batts to be installed with no vertical or horizontal seams, and are tightly-fitted between vertical mullions and the transoms, flush with the interior surface of framing. Score curtain wall insulation panels so that the L-angle stems fit into the score of the insulation, allowing curtain wall insulation panels to fit tightly up against the steel back pan. Insulation panels secured to steel backpan with cup head weld pins (Item 2I) spaced max 12 in. (304 mm) OC both vertically and horizontally, with perimeter weld pins spaced maximum 2 in. (50 mm) from edge of each curtain wall framing member. Cup head weld pins are minimum 12 ga, 3 in. (76 mm) long, with length to match the thickness of the curtain wall insulation, and have a minimum 1-1/16 in. (30.2 mm) diameter head washer.

THERMAFIBER INC — Firespan 90

J. **Safing System** — Has separation between edge of floor assembly and face of framing member at time of installation is 4 in. (102 mm). The safing system is designed to accommodate vertical shear up to 5 percent of its installed width. The safing system shall incorporate the following construction features:

A. **Forming Material*** — Nom 4 pcf (64 kg/m³) density mineral wool batt insulation. Batt sections cut to a 4 in. (102 mm) width and stacked to a thickness which is min 25 percent greater than the width of the linear gap between the curtain wall insulation and the edge of the concrete floor slab. The forming material is compressed and inserted cut-edge-first into linear gap such that its top surface is flush with the top surface of the floor assembly. A max of one tightly-butted seam is permitted between mullions. Additional piece of forming material to be friction-fit into gap between batt sections above mullion mounting clip at each mullion location.

THERMAFIBER INC — SAF



Firestop Plan Review and Inspection 152

152

ASTM E2307 Tested Mineral Wool

All Mineral Wools are NOT the same

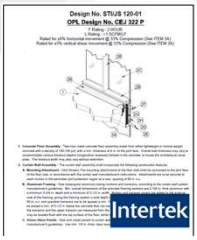
3. **PERIMETER JOINT PROTECTION**: The perimeter joint (linear opening) is not to exceed a 4 in. nominal joint width (joint width at installation). The perimeter joint treatment shall incorporate the following construction features:

A. **CERTIFIED MANUFACTURER:** Only Intertek Certified Manufacturer

CERTIFIED PRODUCT: Mineral Wool

CERTIFIED MODEL: Only Intertek Certified Manufacturer's product meeting the min. requirements listed

Install min. 4 in. thick, 4 pcf density, mineral wool batt insulation in the joint opening, installed with the fibers running parallel to the slab edge and curtain wall. Compress the packing material 25% in the nominal joint width. Compress the batt insulation into the perimeter joint flush with the top surface of the concrete floor slab (Item 1) and its mid-depth is compressed against the interior surface of the insulation-filled box pan (Item 2D). Splices (butt joints) in the lengths of mineral wool batt insulation are to be tightly compressed together.

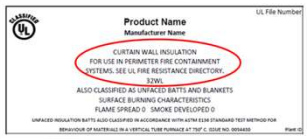


Firestop Plan Review and Inspection 153

153

ASTM E2307 Tested Mineral Wool

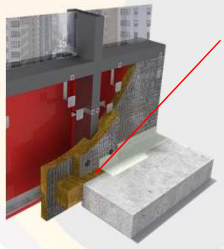
All Mineral Wools are NOT the same



Firestop Plan Review and Inspection 154

154

Typical Curtain Wall System Cont.



4 in. thick, 4 pcf density ASTM E2307 tested mineral wool installed with the fibers orientated vertically. Mineral wool to be properly compressed per listed system in the thickness dimension, and installed flush with the top of the floor slab.

Example. An 8 in. joint requires 10-2/3" of mineral wool safing within the joint. (25% compression)

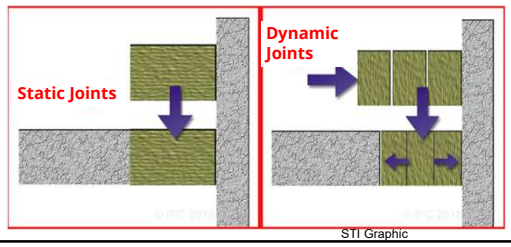
$T_{uncomp} = (W_{nom} \times 100) / (100 - I_{comp})$
$= (8 \times 100) / (100 - 25)$
$= 800/75 = 10.67$

T_{uncomp} = Uncompressed Thickness Necessary, in.
I_{comp} = Insulation Compression Percentage Specified in System, percent
W_{nom} = Nominal (Installed) Joint Width, in.

155

Typical Curtain Wall System Cont.

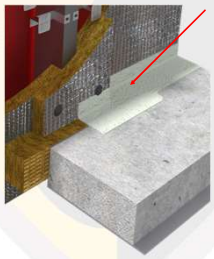
When movement is required, mineral wool must be inserted perpendicular to the joint for dynamic joints and compressed to the proper percentage



STI Graphic

156

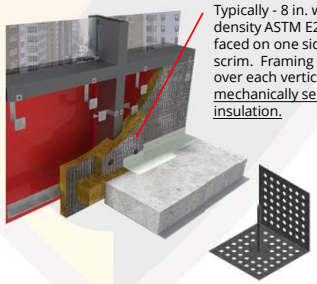
Typical Curtain Wall System Cont.



Min. 1/8 in. wet thickness spray applied over mineral wool overlapping onto concrete floor and curtain wall assembly. See listed system for correct overlap and spray applied thickness

157

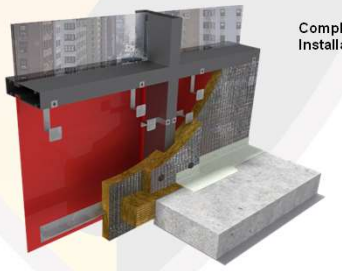
Typical Curtain Wall System Cont.



Typically - 8 in. wide x 2 in. thick, nom. 8 pcf density ASTM E2307 tested mineral wool faced on one side with aluminum foil scrim. Framing covers are to be centered over each vertical framing member and mechanically secured to the curtain wall insulation.

158

Typical Curtain Wall System Cont.



Completed Installation!

159

Installation of Perimeter Barrier Safing

160

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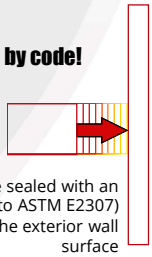
161

Extending the Rated Floor to the curtain wall...

Mandated by code!



The perimeter joint must be sealed with an approved PFC system (tested to ASTM E2307) that extends this rating to the exterior wall surface

162

Firestop Code Requirements - IBC

715.4 Exterior curtain wall/floor intersection. Where fire resistance-rated floor or floor/ceiling assemblies are required, voids created at the intersection of the exterior curtain wall assemblies and such floor assemblies shall be sealed with an *approved* system to prevent the interior spread of fire. Such systems shall be securely installed and tested in accordance with ASTM E 2307 to provide an *F rating* for a time period **not less than** the *fire-resistance rating* of the floor assembly. Height and fire-resistance requirements for curtain wall spandrels shall comply with Section 705.8.5.

163

Firestop Code Requirements – IBC
Curtain wall to non-rated walls or floors

Joint between non-rated floors and curtain wall

715.4.1 Exterior curtain wall/nonfire-resistance-rated floor assembly intersections. Voids created at the intersection of exterior curtain wall assemblies and nonfire-resistance-rated floor or floor/ceiling assemblies *shall be sealed with an approved material or system to retard the interior spread of fire and hot gases between stories*.

Joint between interior rated wall and curtain wall

715.4.2 Exterior curtain wall/vertical fire barrier intersections. Voids created at the intersection of nonfire-resistance-rated exterior curtain wall assemblies and fire barriers shall be filled. *An approved material or system shall be used to fill the void and shall be securely installed* in or on the intersection for its entire length so as not to dislodge, loosen or otherwise impair its ability to *accommodate expected building movements and to retard the passage of fire and hot gases*.

164

Perimeter fire containment does NOT prevent exterior fire spread

165

Preventing exterior fire spread

- 705.8.5 – Vertical Separation of Openings -requires unprotected openings in exterior walls not separated horizontally by 5 ft to be:
  - Separated 3 ft (915 mm) minimum vertically by 1 hr wall (spandrel), or
  - 1-hr Flame barriers that extend min 30 in. (760 mm) beyond exterior wall (usually concrete balcony), or
  - These requirements waived if building is sprinklered and/or three stories of less
- Protects against exterior "leap-frog" fire spread
- 715.4.5 – Where section 705.8.5 does not apply, the requirements of section 715.4 shall still apply
  - Perimeter joint firestopping required regardless of what's done for exterior fire spread prevention

166

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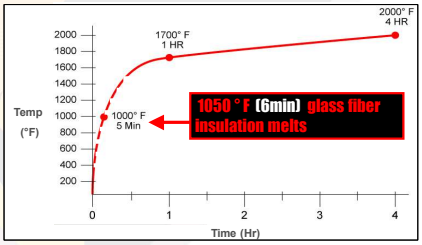
167

ASTM E2307

Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus

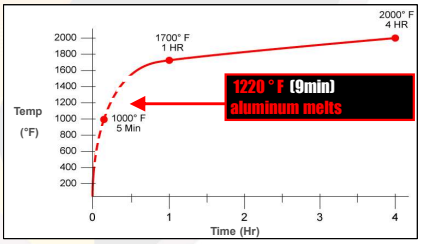
168

ASTM E2307 Time – Temperature Curve



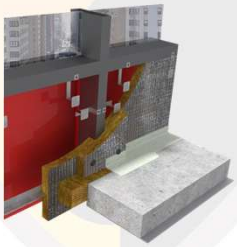
169

ASTM E2307 Time – Temperature Curve



170

Factors Affecting Perimeter Joint Performance



- Floor and/or wall construction type and thickness
- Quality of Fire Barrier System Installation
- Stiffener Channel(s)/Attachment
- Spandrel Height
- Joint Width
- Movement requirements
- Firestopping materials

171

Curtain Wall Test Assembly

Pre-Burn

- Transom above floor
- Mineral wool insulation at spandrel area
- Mechanical attachments supporting insulation
- Transom below floor
- Mullions

172

Firestop Plan Review and Inspection

- Overview of Fire Compartmentation
- Through Penetration Systems
- Membrane Penetrations
- Fire Resistive Joint Systems
- **Perimeter Fire Containment Systems**
  - What is it?
  - Code Requirements
  - Fire Testing
  - **Inspection**
- Duct Enclosure Systems
- Understanding the UL Online Certifications Directory
- Special Inspection
- Engineering Judgments
- Inspection Tips and Techniques

173

Perimeter fire containment systems are highly detailed

1. What is the composition of the exterior wall?
   - Concrete panel, Spandrel Glass, Aluminum Panel, Brick Veneer, etc.
2. What supports the exterior wall?
   - Steel stud, aluminum mullions, etc.
3. What is the required hourly rating?
   - F rating (1 – 2 hour)
4. What is the joint width (inches)?
   - Measured from edge of slab to nearest point of curtain wall
5. How much movement is required?
   - Must accommodate building movement (% of joint size)
6. Are there any special considerations?
   - Unique construction conditions, environmental exposure
7. What reinforcement is required behind spandrel insulation?
8. What type of mechanical fasteners are required?
9. Is Mullion Cover protection required?
10. Has E2307 Compliant Materials been installed

174

Seems time consuming and complicated! ☹

What's the alternative to verifying that the proposed perimeter fire containment system is a full match to the field conditions?

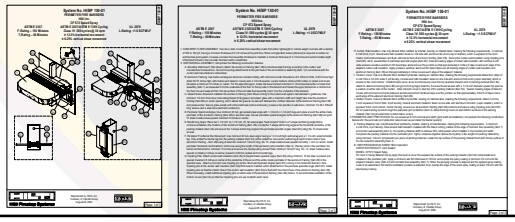
175

Does the submitted perimeter fire containment system seem correct (in the right ballpark)?

Reading Intertek and UL Nomenclature

176

Intertek Design Nomenclature Example: HI-BP-150-01			
2-3 digit client reference	Code that ties to the CSI designation	Rating in minutes	Sequential number for design listing for particular client
HI (Hilti)	BP (Building Perimeter)	150	01



177

177

UL Nomenclature

Navigating the UL Directory: **CW – D – 2005**

PERIMETER FIRE CONTAINMENT SYSTEMS (XHDG)

First Two Alpha Characters identify the type of system:

CW = Curtain Wall

178

UL Nomenclature Cont.

Navigating the UL Directory: **CW – D – 2005**

PERIMETER FIRE CONTAINMENT SYSTEMS (XHDG)

Third Alpha Character identifies the movement capabilities of the system:

D = Dynamic (movement capabilities)

S = Static (no movement capabilities)

179

UL Nomenclature Cont.

Navigating the UL Directory: **CW – D – 2005**

PERIMETER FIRE CONTAINMENT SYSTEMS (XHDG)

First Numeric Character identifies the nominal width of the linear opening:

0000 – 0999 = ≤ 2 in.

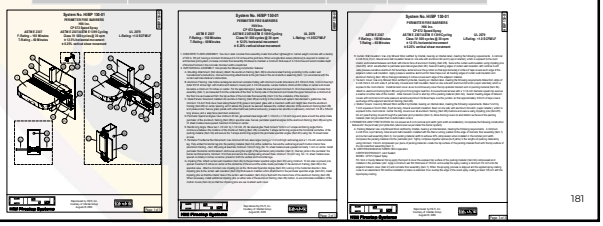
1000 – 1999 = > 2 in. and ≤ 6 in.

2000 – 2999 = > 6 in. and ≤ 12 in.

180

Intertek Design Nomenclature
Example: HI-BP-150-01

2-3 digit client reference	Code that ties to the CSI designation	Rating in minutes	Sequential number for design listing for particular client
HI (Hilti)	BP (Building Perimeter)	150	01



181

181

Design Questions…

Question: Why aren't floor-to-wall (FW) systems acceptable for curtain walls?

Answer: Floor-to-wall systems test fire resistance between a ***rated*** floor and ***rated*** wall tested per ASTM E1966.

CW systems are specific perimeter tests between a ***rated*** floor and ***non-rated*** curtain wall using the Intermediate Scale Multi-story Apparatus (ISMA) per ASTM E2307.

182

Additional Design Questions…

Question: What if the application isn't a perfect match for a system?

Answer: We *strongly* suggest specifying tested systems. However, real world designs are seldom a perfect match!

Manufacturers or Engineers can possibly provide an engineering judgment if a listed system is available that is *reasonably close* in construction

183

Additional Design Questions…

Question: What if an Engineering Judgment is proposed that does not detail the curtain wall construction details?

Example EJ information:

1. **Floor Assembly**— Min 4-1/2 in. thick reinforced lightweight or normal weight (100-150 pcf) structural concrete
2. **Curtain/Window Wall Assembly-** Vision panel, design by others

Note-The F-rating of this system is dependent upon the performance of the untested component of this system, the window wall assembly (Item 2). The performance of the system will not exceed the performance of the untested component of the system, the window wall assembly (item 2).

Answer: ASTM E2307 test results are very strongly dependent on the exact construction details of the curtain wall itself. Any proposed EJ that does not detail the curtain wall construction, or that states that the proposed solution is "only as good as (dependent on) the fire performance of the wall" is really saying that the fire performance of the proposed perimeter fire containment is completely unknown.

184

Firestop Plan Review and Inspection

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- Special Inspection
- Engineering Judgments
- Inspection Tips and Techniques

185

Firestop Plan Review and Inspection

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  - Fire Testing
  - Inspection
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- Inspection Tips and Techniques

186

Duct Applications

- Commercial Kitchen Grease Ducts
- Ventilation Ducts

187

Damper use Restrictions & Shaft Alternative

- Grease Ducts
- Stairwell Pressurization Ducts by design
- Hazardous Exhaust Ducts
- Dryer Exhaust Ducts
- Laundry and Refuse Chutes

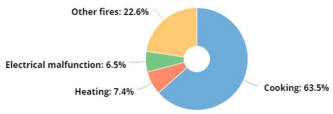
In the absence of dampers, ducts need to either be "Fire Resistive" or protected by "Fire Resistance Rated" enclosures. Engineers & Architects may elect to use these in lieu of dampers & shafts

188

Grease Duct, the Numbers*

- For each year from 2010 to 2014, an estimated 7,410 restaurant fires resulting in three deaths, 110 injuries, and $165 million in property damage.
- Over 60% of restaurant fires were caused by cooking equipment
- Cooking materials (grease, oil) were the most frequent items first ignited

*Statistics from NFPA



189

2018 IBC – Grease Duct

712.1.6 Ducts and air transfer openings. Penetrations by ducts and air transfer openings shall be protected in accordance with Section 717. Grease ducts shall be protected in accordance with the *International Mechanical Code*.

190

2018 IMC – Grease Duct

506.3.6 Grease duct clearances. Where enclosures are not required*, grease duct systems and exhaust *equipment* serving a Type I hood shall have a *clearance* to combustible construction of not less than 18 inches (457 mm), and shall have a *clearance* to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 3 inches (76 mm).

506.3.11 Grease duct enclosures – A …duct… that penetrates a ceiling, wall, floor, or any concealed space shall be enclosed from the point of penetration to the outlet terminal.

506.3.11.1 Shaft enclosure – ASTM E119 (UL 263)

506.3.11.2 Field-applied grease duct enclosure – ASTM E2336, E814 (UL1479)

Partial application of a field-applied grease duct enclosure shall not be installed for the sole purpose of reducing clearances to combustibles at isolated sections of grease duct.

506.3.11.3 Factory-built grease duct enclosure assemblies – UL2221, ASTM E814 (UL1479)

*Enclosure not required only if duct does not penetrate a ceiling, wall, floor or any concealed space

191

2018 IMC – Grease Duct

506.3.12 Grease duct fire-resistive access opening.

Where cleanout openings are located in ducts within a fire resistance-rated enclosure, access openings shall be provided in the enclosure at each cleanout point. Access openings shall be equipped with tight-fitting sliding or hinged doors that are equal in fire-resistive protection to that of the shaft or enclosure. An *approved* sign shall be placed on access opening panels with wording as follows:

"ACCESS PANEL. DO NOT OBSTRUCT."

192

2018 Uniform Mechanical Code Grease Duct

Part II – Commercial Hoods and Kitchen Ventilation

507.0 General Requirements

507.4 Clearance Where an enclosure are not required, hoods, grease removal devices, exhaust fans, and shall have a clearance of not less than 18 inches (457 mm) to combustible material, 3 inches (76 mm) to limited-combustible material, and 0 inches (0 mm) to noncombustible material. [NFPA 96:4.2.1]

507.4.4 Factory Built Factory-built grease duct enclosure shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an "F" and "T" rating equal to the fire resistance rating of the assembly being penetrated from the point at which the duct penetrates a ceiling, wall, or floor to the outlet terminal. The factory-built grease duct protection shall be listed in accordance with UL 2221. The factory-built grease duct protection system shall be installed in accordance with the manufacturers' installation instructions and the listing requirements. [NFPA 96:4.3.3]

507.4.4 Field Applied Field-applied grease duct enclosure shall be protected with a through-penetration firestop system classified in accordance with ASTM E814 or UL 1479 having an "F" and "T" rating equal to the fire resistance rating of the assembly being penetrated from the point at which the duct penetrates a ceiling, wall, or floor to the outlet terminal. The field-applied grease duct protection shall be listed in accordance with ASTM E2336. The factory-built grease duct protection system shall be installed in accordance with the manufacturers' installation instructions and the listing requirements. [NFPA 96:4.3.3.1]

193

NFPA 96 – Grease Duct

NFPA 96 mirrors the IMC & UMC

4.3 Field-Applied and Factory-Built Grease Duct Enclosures.

4.3.1 Field-applied grease duct enclosures shall be protected with a through-penetration firestop system classified in accordance with ASTM E 814 or UL 1479 having an "F" and "T" rating equal to the fire resistance rating of the assembly being penetrated.

4.3.1.1 The surface of the field fabricated grease duct shall be continuously covered on all sides from the point at which the duct enclosure penetrates a ceiling, wall, or floor to the outlet terminal.

4.3.1.2 The field-applied grease duct shall be listed in accordance with ASTM E2336, and installed in accordance with the manufacturer's instructions and the listing requirements.

4.3.3.1 The factory-built grease duct protection system shall be listed in accordance with UL 2221.

194

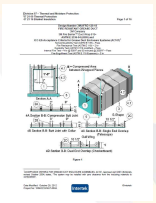
194

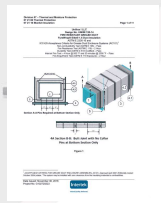
Fire Testing – ASTM E2336/UL 2221

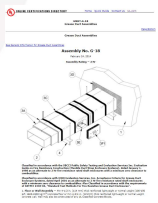
Tested for fire exposure both inside and outside the duct separately

195

Laboratory Certifications







196

Ventilation Ducts

197

Code Requirements

- Shaft enclosures shall be constructed as fire barriers
- Fire barriers must have a fire resistance rating per ASTM E119
- Fire barriers must comply with *ALL* parts of ASTM E119
- Systems not meeting temperature rise limits do not achieve a fire resistance rating
- No provisions in ASTM E119 to test a duct enclosure; ISO 6944 & ASTM E2816 are utilized – purpose built standards for ducts

Fire Resistance, n—the ability of a material, product, or assembly to withstand fire or give protection from it for a period of time. (Contrast fire resistance rating.) (2004)

DISCUSSION—As applied to elements of buildings, fire resistance is characterized by the ability to confine a fire or to continue to perform a given structural function, or both. More specific examples of this ability include retention of **stability** (loadbearing capacity), **integrity** or thermal **insulation**. Once a measure of time is defined for fire resistance, and exposure conditions specified for that measure, the result is a fire resistance rating. (2004)

198

Determining Fire Resistance

703.3 Methods for determining fire resistance. The application of any of the methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263. The required *fire resistance* of a building element, component or assembly shall be permitted to be established by any of the following methods or procedures:

- 1. Fire-resistance designs document in approved sources.
- 2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in section 721.
- 3. Calculations in accordance with Section 722.
- 4. Engineering analysis based on a comparison of building element, component or assemblies designs having *fire-resistance ratings* as determined by the test procedures set forth in ASTM E119 or UL 263.
- 5. Alternative protection methods as allowed by Section 104.11.
- 6. Fire-resistance designs certified by an approved agency.

199

Demonstrating Equivalent Fire Resistance

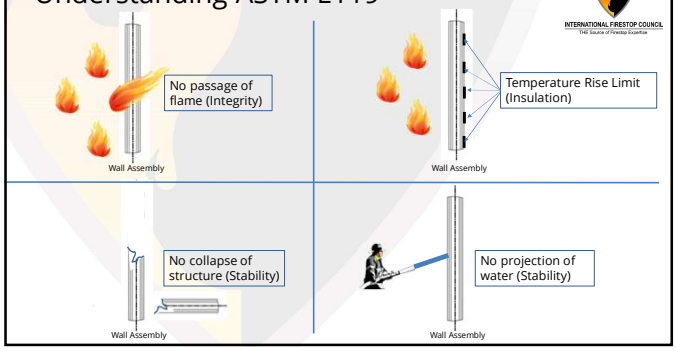
Section 104.11 provides a path for alternative approaches…

104.11 Alternative materials, design and methods of construction and equipment. …..An alternative material, design or method of construction shall be *approved* where the *building official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, **at least the equivalent** of that prescribed in this code in quality, strength, effectiveness, ***fire resistance***, durability and safety.

Stability, integrity, and insulation requirements must be achieved

200

Understanding ASTM E119



201

Real World Implications

- ASTM E119 tests flat walls and flat floors
  - Corners and connections not included
- ASTM E119 measures temperatures on unexposed (non-fire) side
  - Needed to achieve compartmentation
- ASTM E119 prohibits any flame passage to unexposed (non-fire) side
  - Needed to achieve compartmentation
- ASTM E119 requires structural integrity
  - Needed to achieve compartmentation
  - Prohibits collapse
- ASTM E119 requires a hose stream test
- ASTM E119 tests non-symmetrical walls twice
  - Once from each side, since simultaneous exposure from both sides is not possible
  - The rating is assigned based on the lesser of the two

ASTM E119: No provision for testing duct enclosures!

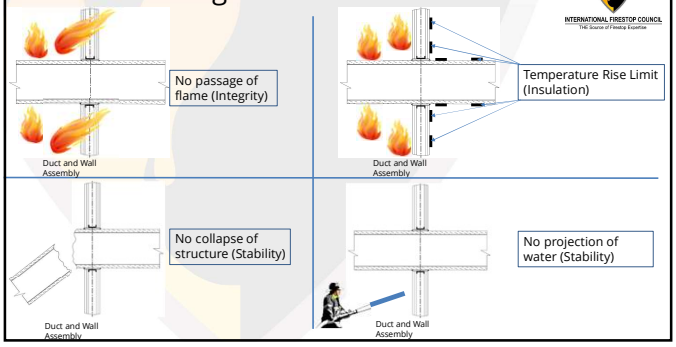
202

Understanding ISO 6944 and ASTM E2816

- ISO 6944 and ASTM E2816 are both used to test Fire Resistive Ducts
  - Tests ducts with openings *or* ducts without openings
  - Tests at defined duct pressures and air flow rates
- Tests Duct Enclosure Systems in a fire engulfment test
  - Vertical or horizontal ducts
  - Includes the support system
  - Bends and connections
- Prohibits Duct Collapse
  - Needed for functional compliance
- Tests Through Penetration Firestop Systems
  - Needed for compartmentation

203

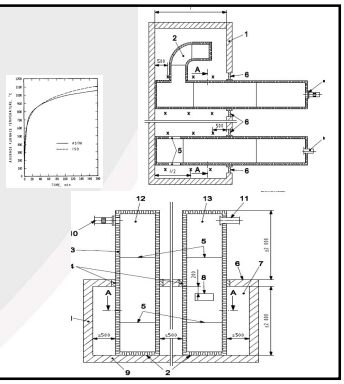
Understanding ISO 6944 / ASTM E2816



204

Fire Testing – ISO 6944

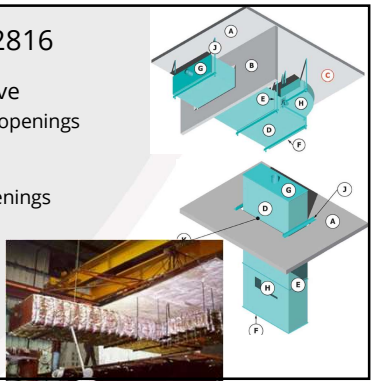
ISO 834 Time/Temp curve
- Duct A = without openings
  - Horizontal and vertical
  - Negative pressure in duct
- Duct B = with openings
  - Horizontal and vertical
  - Air velocity in duct
  - "fan off", "fan on" simulation



205

Fire Testing – ASTM E2816

ASTM E119 Time/Temp curve
- Conditions A&B = without openings
  - Horizontal and vertical
  - Negative pressure in duct
- Conditions C&D = with openings
  - Horizontal and vertical
  - Air velocity in duct
  - "fan off", "fan on" simulation



206

Comparing ASTM E119 vs. ISO 6944 / ASTM E2816

Features	ASTM E119	ISO 6944	ASTM E2816
Unexposed Surface Temperature Limitation	Maximum 325°F Rise	Maximum 325°F Rise (Insulation)	Maximum 325°F Rise
Flaming on unexposed (non-fire) side	No	No (Integrity)	No
Tested with Through Penetrations	No	Yes	Yes
Prohibits Collapse	Yes	Yes (Stability)	Yes
Tested as Constructed in Field	No	Yes	Yes
Tested for Resistance to Load Effects	No	Yes	Yes
Performance Outputs	Single Rating (minutes/hours)	Stability and Integrity and Insulation	Single Rating (minutes/hours)

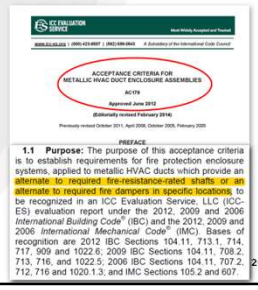
You can't pick and choose from these Features

207

ICC-ES AC179

"Acceptance Criteria for Metallic HVAC Duct Enclosure Assemblies"

"This acceptance criteria has been issued to provide interested parties with guidelines for demonstrating compliance with performance features of the codes referenced in the criteria. The criteria was developed through a transparent process involving public hearings of the ICC-ES Evaluation Committee, and/or on-line postings where public comment was solicited."


ACCEPTANCE CRITERIA FOR METALLIC HVAC DUCT ENCLOSURE ASSEMBLIES

AC179

Approved June 2012

(Editorially revised February 2014)

PREFACE

1.1 **Purpose:** The purpose of this acceptance criteria is to establish requirements for fire protection enclosure systems, applied to metallic HVAC ducts which provide an alternate to required fire-resistance-rated shafts or an alternate to required fire dampers in specific locations, to be recognized in an ICC Evaluation Service, LLC (ICC-ES) evaluation report under the 2012, 2009 and 2006 *International Building Code*® (IBC) and the 2012, 2009 and 2006 *International Mechanical Code*® (IMC). Bases of recognition are 2012 IBC Sections 104.11, 713.1, 714, 717, 909 and 1022.6; 2009 IBC Sections 104.11, 708.2, 713, 716, and 1022.5; 2006 IBC Sections 104.11, 707.2, 712, 716 and 1020.1.3; and IMC Sections 105.2 and 607.

208

208

ICC-ES AC179

AC179 utilizes ASTM E2816

Cross reference between ISO 6944 and ASTM E2816

Description	ISO 6944	ASTM E 2816
Horizontal – Duct w/o openings	Type A_{horz}	Condition A
Vertical – Duct w/o openings	Type A_{vert}	Condition B
Horizontal – Duct with openings	Type B_{horz}	Condition C
Vertical – Duct with openings	Type B_{vert}	Condition D

209

209

ICC-ES Acceptance Criteria 179

ACCEPTANCE CRITERIA FOR METALLIC HVAC DUCT ENCLOSURE ASSEMBLIES

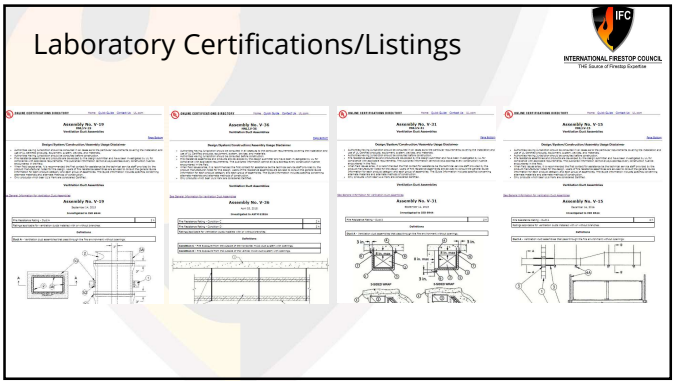
'Ducts with Fire Protection Enclosure Systems in lieu of Fire-resistance-rated Shaft Walls'
Test To ASTM E 2816 conditions B&D (These are analogous to ISO 6944 Type A_{vert} & Type B_{vert}) + ASTM E 814

'Fire Protection for Horizontal and Vertical HVAC Ducts with Dedicated Fire Protection Systems in Lieu of Required Fire Dampers'
Test To ASTM E 2816 conditions A&C (These are analogous to ISO 6944 Type A_{horz} & Type B_{horz}) + ASTM E 814

'Fire Protection for Horizontal and Vertical Stair or Elevator Hoistway Pressurization Systems with Dedicated Fire Protection Systems'
Test To ASTM E 2816 conditions A&B (These are analogous to ISO 6944 Type A_{horz} & Type A_{vert})

210

Laboratory Certifications/Listings



211

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Assembly No. V-6
HNLJ.V-6
Ventilation Duct Assemblies

Page Bottom

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

Ventilation Duct Assemblies

See General Information for Ventilation Duct Assemblies

Assembly No. V-6
September 23, 2015
Investigated to ISO 6944

Fire Resistance Rating - Duct A	2 h
Fire Resistance Rating - Duct B	3/4 h
Ratings applicable for ventilation ducts installed with or without branches.	

Fire Resistance Rating is listed

212

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Assembly No. V-36
HNLJ.V-36
Ventilation Duct Assemblies

Page Bottom

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Ventilation Duct Assemblies

See General Information for Ventilation Duct Assemblies

Assembly No. V-36
November 16, 2017
Investigated to ASTM E2816

Fire Resistance Rating - Condition C	2 h
Fire Resistance Rating - Condition D	2 h
Ratings applicable for ventilation ducts installed with or without branches.	

Fire Resistance Rating is listed

213

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HNLN.V-5
Uninsulated Ventilation Duct Assemblies

Page Bottom

Uninsulated Ventilation Duct Assemblies

See General Information for Uninsulated Ventilation Duct Assemblies

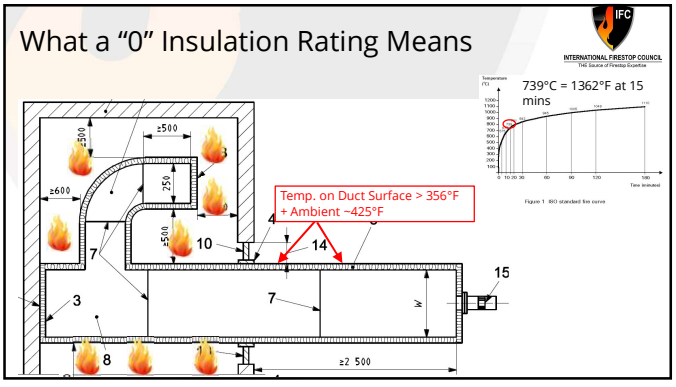
Assembly No. V-5
January 21, 2016

	Duct A	Duct B
Integrity and Stability rating	2 hr	2 hr
Insulation Rating	0 hr	0 hr
Ratings applicable for Ventilation Ducts installed with or without branches.		
Uninsulated ventilation duct assemblies are intended for use in environments where the clearance to combustible materials and combustible assemblies is at least 18 in.		

Shaft alternatives must fulfill all objectives of ASTM E119. Temperature rise requirements are never an exception (i.e. Insulation Rating)

214

What a "0" Insulation Rating Means



215

Closer look at "T-Rating"

- Not to be confused with Insulation Rating from ISO 6944/ASTM E2816
  - Recall earlier in the presentation, T-Rating not req'd when penetrating vertical assembly
  - The Insulation Rating from ISO/ASTM is always required as part of the Duct Assembly's Fire Resistance Rating
  - The T-Rating from E814 is required to maintain the rating of the assembly penetrated
- UL article: *Ducts – Providing Clarity on Fire Rated Ventilation Ducts and Assemblies*
  - Link to article: https://collateral-library-production.s3.amazonaws.com/uploads/asset_file/attachment/12040/the-fire-and-security-authority-May-2017.pdf

216

Ventilation Duct Summary

- The code allows innovative approaches to be used provided they meet the full intent
- Other than code prescribed shafts or fire dampers, ALL other approaches must be pursued via the alternative methods approach
- Per section 104.11 Alternative Means and Methods, jurisdictions can approve systems tested to ISO 6944 and ASTM E2816
- Shaft alternatives must fulfill all objectives of ASTM E119. Temperature rise requirements are never an exception (i.e. Insulation Rating)

217

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218

Inspection

- Determine application – grease or air
- Ask for the tested listing
- Verify the proper material overlap, butt joints etc. for wrap systems
- Verify proper material attachment for wraps – banding, pins, etc.
- Verify proper product for prefabricated duct systems
- Check for clearances where required per listing
- If penetrating wall or floor assembly, same applies from "through penetration systems" discussed earlier
- Regardless of application grease or air, partial applications of product are not permitted on ducts for the purpose of reducing clearance to combustibles

219

Firestop Plan Review and Inspection

- Overview of Fire Compartmentation
- Through Penetration Systems
- Membrane Penetrations
- Fire Resistive Joint Systems
- Perimeter Fire Barrier Systems
- Duct Enclosure Systems
- **Understanding the Online Certifications Directories**
- Special Inspection
- Engineering Judgments
- Inspection Tips and Techniques

220

Listing laboratories provide trustworthy, tested firestop designs

Fire Test ⇨ Test Report ⇨ Listing/Classification

- No need to blindly trust a manufacturer's or installer's firestop performance claims

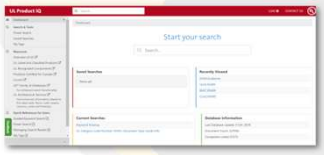
➔ Verify the published system listing for *exact* conformance to installed conditions

- Some firestop vendors or installers might use old system details that have since been modified or withdrawn completely
- Should not approve if no conformance between installation and referenced system
  - Another system might provide the needed compliance documentation (ask for it!)
  - If no matching system, installer would need to investigate possibility of Engineering Judgment

221

Where Can I Find The Most Current Listings?

UL (free account required)



https://iq.ulprospector.com/info/

INTERTEK

https://whdirectory.intertek.com/Pages/DLP_Search.aspx

222

"Guide Information" for each UL class of systems

- General installation and specification rules applicable to all systems listed in that Class
- Equipment, materials or systems included in the Category
- Intended use, restrictions or supplemental information that apply
- Standard(s) used to evaluate products under the Category
- Listing or Classification Mark information for the Category

223

Examples of Guide Information for penetration firestop Systems (UL Listing category XHEZ)

- General Description of a Firestop System
- Standard
- Description of Ratings
- Permitted Substitutions
- Specifications of Penetrating Items
- Support of Penetrating Items
- Angle of Penetration
- Description of Numbering System

➔ Go to firestop.org/reading-list for links to all UL GuideInfo docs

224

Existing Systems

There are thousands of Tested and Listed Systems:

Each one belongs to a particular manufacturer
And are tested ONLY for a particular product(s)

Different manufacturers' products may never be substituted into a design where it is not specified.

225

UL terminology

- UL Approved — No Such Thing! (Only AHJ approves products/systems)

•UL Classified, Listed, Certified: all used somewhat interchangeably, depending on the product category

Common usage within firestopping:

- UL Classified — Lab has used the country requirements to evaluate the product for specific hazards or properties
- UL Listed — Firestop system has passed the standard fire resistance test and is in the lab's directory

226

Searching the UL online directory

- Enter system number to retrieve system
- Enter listing category (e.g. XHEZ) to see and sort through all listings (7500+!!)

iq.ulprospector.com

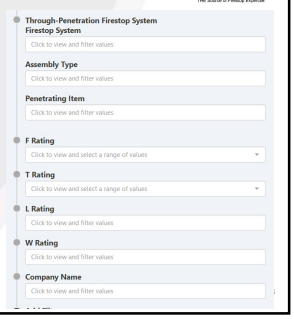
Scroll down webpage for advanced search of
- *Firestop systems (penetrations)*
- *Joint systems*
- *Perimeter fire containment systems (curtain wall gap)*
- *Continuity Head-of-Wall Joint Systems*
- *All fire rated roofs, walls, floors, beams and columns*

227

Searching the UL online directory

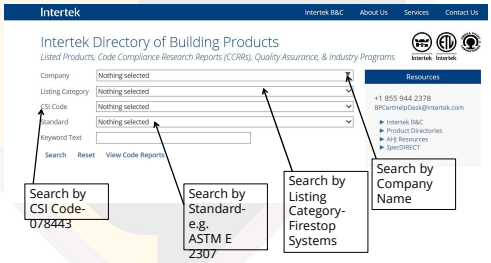
Example:
Firestop systems advanced search:

Via Direct link:
iq.ulprospector.com/en/_?tt=1027



228

Searching the Online Intertek Directory



229

229

Firestop Plan Review and Inspection

- Overview of Fire Compartmentation
- Through Penetration Systems
- Membrane Penetrations
- Fire Resistive Joint Systems
- Perimeter Fire Barrier Systems
- Duct Enclosure Systems
- Understanding the UL Online Certifications Directory
- **Special Inspections**
- Engineering Judgments
- Inspection Tips and Techniques

230

Firestop Code Requirements - IBC

AHJ Inspections

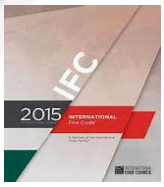
- 110.3.6 Protection of joints and penetrations in fire-resistance-rated assemblies, *smoke barriers and smoke partitions* shall not be concealed from view until inspected and *approved*.

231

Firestop Code Requirements Fire Codes

Inspection during life of a building

- Fire codes govern the fire safety requirements of buildings throughout their lifespan
  - International Fire Code
  - NFPA 1



232

International Fire Code (IFC)

Inspection during life of a building

701.6 Owner's responsibility. The owner shall maintain an inventory of all required fire-resistance-rated construction... Such construction shall be visually inspected by the owner annually and properly repaired, restored or replaced where damaged, altered, breached or penetrated. Records of inspections and repairs shall be maintained.

233

International Fire Code (IFC)

Inspection during life of a building

SECTION 703 PENETRATIONS, 703.1 Maintaining protection.
Materials and firestop systems used to protect membrane and through penetrations in fire-resistance-rated construction and construction installed to resist the passage of smoke shall be maintained. The materials and firestop systems shall be securely attached to or bonded to the construction being penetrated with no openings visible through or into the cavity of the construction. Where the system design number is known, the system shall be inspected to the listing criteria and manufacturer's installation instructions.

SECTION 704 JOINTS AND VOIDS, 704.1 Maintaining protection.
Where required when the building was originally constructed, materials and systems used to protect joints and voids in the following locations shall be maintained. The materials and systems shall be securely attached to or bonded to the adjacent construction, without openings visible through the construction.

234

3rd party inspections mandatory as of 2012 IBC

- Chapter 17: Special inspections and tests

  1705.17 Fire-resistant penetrations and joints. In high-rise buildings or in buildings assigned to *Risk Category* III or IV [Section 1604.5], special inspections for through-penetrations, membrane penetration firestops, fire-resistant joint systems, and perimeter fire barrier systems that are tested and listed in accordance with Sections 714.4.1.2, 714.5.1.2, 715.3 and 715.4 shall be in accordance with Section 1705.17.1 or 1705.17.2.
- Mandatory Independent 3rd Party Inspection
- All High-Rise and Risk Category 3 or 4 Buildings
- All tested/listed Firestopping Penetrations and Joints

235

Risk category III buildings IBC 1604.5

Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to:

- public assembly > 300 occupants.
- elementary school, secondary school or day care > 250 occupants
- adult education > 500 occupants
- Group I-2 > 50 occupants, no surgery or emergency
- Group I-3 (prisons, jails)
- > 5,000 occupants
- Power-generating stations, water treatment facilities for potable water, waste water treatment facilities and other public utility facilities not included in Risk Category IV.
- Buildings/structures not included in Risk Category IV containing quantities of toxic or explosive materials that exceed certain thresholds and hazardous to public if released

OCCUPANT LOAD. The number of persons for which the *means of egress* of a building or portion thereof is designed.

236

Risk category IV buildings IBC 1604.5

Buildings and other structures designated as essential facilities, including but not limited to:

- Group I-2 occupancies having surgery or emergency treatment
- Fire, rescue, ambulance and police stations and emergency vehicle garages.
- Designated earthquake, hurricane or other emergency shelters.
- Designated emergency preparedness, communications and operations centers and other facilities required for emergency response.
- Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures.
- Aviation control towers, air traffic control centers and emergency aircraft hangars.
- Buildings and other structures having critical national defense functions.
- Water storage facilities and pump structures required to maintain water pressure for fire suppression.
- Buildings and other structures containing quantities of highly toxic materials that exceed certain thresholds and pose a threat to public if released

237

General inspection requirements

1703.1.1 Independence. An *approved agency* shall be objective, competent and independent from the contractor responsible for the work being inspected. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed.

1703.1.3 Personnel. An *approved agency* shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.

238

General inspection requirements: Who pays?

1704.2 Special inspections. Where application is made for construction as described in this section, the owner or the *registered design professional in responsible charge* acting as the owner's agent shall employ one or more *approved agencies* to perform inspections during construction on the types of work listed under Section 1705. These inspections are in addition to the inspections identified in Section 110.

239

General inspection requirements: Inspector qualifications

- 1704.2.1 Special inspector qualifications.

  The special inspector shall provide written documentation to the building official demonstrating his or her competence and relevant experience or training. Experience or training shall be considered relevant when the documented experience or training is related in complexity to the same type of *special inspection* activities for projects of similar complexity and material qualities. These qualifications are in addition to qualifications specified in other sections of this code.
- The *registered design professional in responsible charge* and engineers of record involved in the design of the project are permitted to act as the *approved agency* and their personnel are permitted to act as the special inspector for the work designed by them, **provided they qualify as special inspectors.**

240

How is the inspection conducted?

1705.16.1 Penetration firestops. Inspections of penetration firestop systems that are tested and listed in accordance with Sections 714.3.1.2 and 714.4.1.2 shall be conducted by an approved inspection agency in accordance with ASTM E 2174.

1705.16.2 Fire-resistant joint systems. Inspection of fire-resistant joint systems that are tested and listed in accordance with Sections 715.3 and 715.4 shall be conducted by an approved inspection agency in accordance with ASTM E 2393.

241

NFPA 1: Firestop QC Program + ASTM-compliant inspections for 3 stories and higher

12.3.2* Quality Assurance for Penetrations and Joints.
In new buildings three stories or greater in height, a quality assurance program for the installation of devices and systems installed to protect penetration and joints shall be prepared and monitored by the RDP responsible for design.
Inspections of firestop systems and fire-resistive joint systems shall be in accordance with 12.3.2.1 and 12.3.2.2.

A.12.3.2 The scoping provision of 12.3.2 is extracted from NFPA 5000, Building Construction and Safety Code, but limited to new buildings that are three or more stories in height. Such threshold is reasonable from the fire inspection perspective.

242

NFPA 1 same as IBC: Penetrations to be inspected to ASTM E2174

12.3.2.1 Inspection of firestop systems of the types tested in accordance with ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, or /UL 1479, *Standard for Fire Tests of Through-Penetration Firestops*, shall be conducted in accordance with ASTM E 2174, *Standard Practice for On-Site Inspection of Installed Fire Stops*. [**5000:**40.9.1]

243

NFPA 1 same as IBC: Joint systems to be inspected to ASTM E2393

12.3.2.2 Inspection of fire-resistive joint systems of the types tested in accordance with ASTM E 1966, Standard Test Method for Fire-Resistive Joint Systems, or UL 2079, Standard for Tests for Fire Resistance of Buildings Joint Systems, shall be conducted in accordance with ASTM E 2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers. [5000:40.9.2]

244

The special inspection process

- Statistical sampling
- Verify materials prior to installation
- Verify against listed systems and/or EJs
- Verify that ALL firestops installed

ASTM E2174: *Standard Practice for On-Site Inspection of Installed Fire Stops*
- For each "type" of firestop being installed:
  - Witness 10% of Installations, or
    Destructive Testing on 2% of Installations

ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- For each "type" of fire resistive joint system being installed:
  - Witness 5% of linear feet being installed, or
    Destructive (or disassembly) testing on 1 ft. per every 500 ft.

245

If non-compliance identified

- One non-compliant:
  one full additional inspection of that type
- 10% non-compliance of one type:
  inspection halted, installer re-inspects own work
- Non-compliant firestop must be repaired/replaced
- E2174/E2393: no guidance on what is an acceptable non-compliance percentage

246

ASTM E2174/E2393: Inspector Requirements

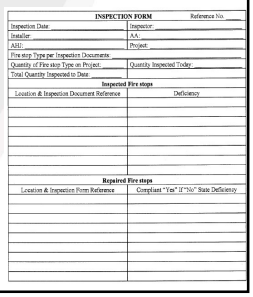
- Acceptable to AHJ
- Qualifications:
  - Meet the criteria in ASTM E699 (Construction Quality assurance agencies), OR
  - Min. 2 years construction inspection experience and credentials acceptable to Authorizing Authority, OR
  - Quality assurance agency accredited by AHJ (e.g. IAS AC291 – Special Inspection Agencies)
- No conflicts of interest
  - Completely independent of installer, contractor, manufacturer, or supplier of any material
  - Not a competitor to those above
  - Inspector to submit notarized statement indicating compliance
- Must not interfere or direct
- ASTM E3038 details the required firestop special inspector qualifications
  - Not yet referenced in ASTM 2174/2393 due to committee dysfunction

How do you decide if a proposed special inspector is acceptable?

247

ASTM E 2174 and ASTM E 2393 Reporting/Inspection Forms

- Inspection Date
- Inspectors Name
- Project
- Reference No.
- Firestop type per Inspection
- Quantity of Firestop type on Project
- Quantity Inspected (the day of Inspection)
- Total Quantity Inspected to Date
- Locations of Inspected Firestop
- Deficiency (if non-compliant)


INSPECTION FORM

Reference No.

Inspection Date:

Inspector:

Installer:

AA:

AHJ:

Project:

Fire stop Type per Inspection Documents:

Quantity of Fire stop Type on Project:

Quantity Inspected Today:

Total Quantity Inspected to Date:

Inspected Fire stops

Location & Inspection Document Reference	Deficiency

Repaired Fire stops

Location & Inspection Form Reference	Compliant "Yes" if "No" State Deficiency

248

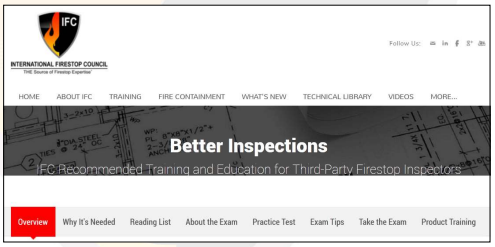
ASTM E 2174 and ASTM E 2393 Final Report

Report should contain:

- Cover Page
- Name and Address of Inspector
- Name and Address of each firestop Installer, as well as the prime contractor
- Name and Address of the AA
- Name and Address of the AHJ
- Executive Summary outlining verification method used to ascertain compliance
- Notarized written statement of Conflict of Interest
- Summary of contain percentages of deficiencies
- All daily inspection reports

249

EDUCATION FOR THIRD-PARTY FIRESTOP INSPECTORS: IFC INSPECTOR TRAINING



FIRESTOP SPECIAL INSPECTION TRAINING CAN BE FOUND AT WWW.FIRESTOP.ORG/OVERVIEW

250

IFC Education Program Overview

- Typical 1-day class is insufficient for a special inspector
- Comprehensive study material from multiple authoritative sources
- Only firestop inspector exam developed and written by
  - 3rd Party Firestop Inspectors
  - Manufacturers that develop the technology and test the firestop systems
  - Scientists and engineers experienced in firestop technology
- All reading curriculum relevant to firestop inspectors
- Online curriculum at no cost*

(ASTM inspection standards must be purchased from ASTM)

251

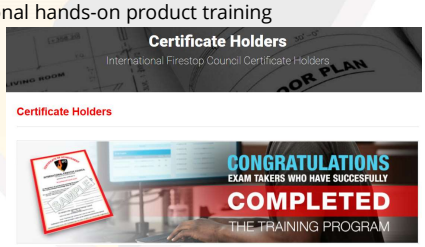
IFC Education Program Overview (con't)

- Reading list of linked documents and videos
- Optional online proctored exam
  - Free practice test
- Passing the exam = Certificate of Achievement
  - Space to record hands-on product training from 4 IFC-member firestop manufacturers
- AHJs: Ask inspectors for their IFC education program certificate!

252

Verifying whether someone has passed the IFC inspector exam

- www.firestop.org/certificate-holders
  - Premier certificate holders: additional hands-on product training



253

Intertek IQP Program Qualified Firestop Inspector

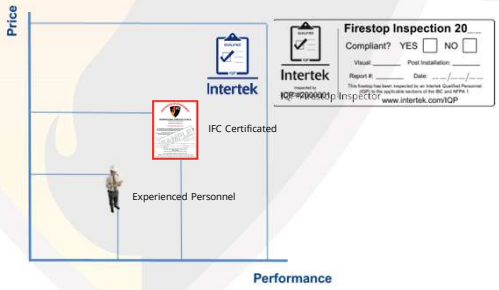
254

IQP Differentiator

	Experienced Inspector/Installer	IFC Training	Intertek
Industry Experience	X	X	X
Formalized Training		X	X
Required Retesting		X	X
Regular Quality Audits			X
Inspector Network			X
Backing of Intertek			X

255

IQP Differentiated: Firestop Inspectors



256

Special Inspection Agency accreditation IAS AC291

- International Accreditation Service, Inc. "ACCREDITATION CRITERIA FOR SPECIAL INSPECTION AGENCIES"
- Accreditation of company, not of individual inspectors
- Requires one employee to have passed UL Firestop Examination or FM Firestop Examination or IFC Firestop Special Inspector Examination.
- **Potential conflict with ASTM E2174/E2393 conflict of interest mandates***

6.2.2 *Conflicts of Interest:*

6.2.2.1 The contract inspector shall be completely independent of, and divested from, the installer, contractor, manufacturer, or supplier of any material being inspected.

6.2.2.2 The contract inspector shall not be a competitor of the installer, contractor, manufacturer, or supplier of any material being inspected.

***potential conflict of interest if the agency with AC291 is a contractor or installer**

257

Special inspections summary

- Since 2012 IBC makes firestop special inspection mandatory for high-rises and Risk Category III and IV buildings
- Approved agency shall be objective, competent and independent
- Special inspector shall provide written documentation to building official demonstrating competence and relevant experience or training
- Property owner pays for inspection
- Inspection per ASTM E2174, E2393
- IFC program provides both education and needed written documentation/examination

258

Firestop Plan Review and Inspection

- Overview of Fire Compartmentation
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- Understanding the UL Online Certifications Directory
- Special Inspection
- **Engineering Judgments**
- Inspection Tips and Techniques

259

Engineering Judgments:

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

260

Engineering Judgments

- An Engineering Judgment is a letter or report issued by some knowledgeable party which evaluates 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.
- EJ should NOT be a guess of how some different condition would perform *if it were to be fire tested*
  - Some evidence leading to that conclusion should be expected and provided

261

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)
  - Typically products are not required by code to be listed
- Contractor or architect initiates process

262

Engineering Judgments Cont.

- Engineering Judgment letter issued, summarizing construction and making conclusion on applicable rating
- AHJ makes decision on validity of Engineering Judgment letter and if approved, inspects construction for consistency with letter
- Discussion: who critically reviews and Approves proposed EJs in your jurisdiction?

263

Who Issues Engineering Judgments?

- Manufacturer
- Fire protection engineer
- Professional engineer
- Testing laboratory

- Must be acceptable to the Building Official or the AHJ

264

When are they acceptable?

- When tested systems do not exist
- When modifying the application is unrealistic
- When existing test data supports the interpolation
  - Referenced listing numbers should be included on the Engineering Judgment
- When the author has experience with the performance of the system and knowledge of the conditions

  Prove it!
  - IFC EJ Guidelines state that a proper EJ should include "Reference tested system(s)upon which design (EJ) is based on"
  - Is the EJ truly *close enough* to the referenced listings?
  - Ask for some evidence if "internal testing" is a key justification
- When issued only for a specific jobsite

265

Important Points of an Engineering Judgment

- No guidance from the International Code Council nor from the various I-Codes
- No guidance from UL
- Most relevant documents available are from the International Firestop Council (IFC)
  www.firestop.org/**engineering-judgment**-guidelines.html

266

IFC Engineering Judgment Guidelines

Four Documents

- Recommended IFC Guidelines for Evaluating Firestop System Engineering Judgments
  - Covers firestops, joint systems
- Recommended IFC Guidelines for Evaluating Firestop Systems in EJs – Perimeter Fire Barrier Systems (a.k.a. perimeter fire containment systems or perimeter joints)
- Recommended IFC Guidelines for Evaluating Firestop Systems in EJs – Air Ducts
- Recommended IFC Guidelines for Evaluating Firestop Systems in EJs – Grease Ducts

267

IFC Engineering Judgments 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."
- Download IFC Guidelines at:
  www.***firestop***.org/***engineering-judgment-guidelines***


Recommended IFC Guidelines for Evaluating Firestop System Engineering Judgments

About the IFC

The Premise of Firestop Systems

Fire Test Standards Commonly Referenced in Codes

Application	Test Standard
Service penetrations (e.g. pipes, cables, ducts)	ASTM E814, UL 1479, CAN/ULC-S115, EN1366-3, EN 1366-5, ISO 10295-1
Joint System	ASTM E1966, UL 2079, CAN/ULC-S115, EN1366-4, ISO 10295-2, BS 476 Part 20
Perimeter Joint Firestops (e.g. curtain wall/floor intersections)	ASTM E2307, EN 1366-4
Continuity Head of Wall (e.g. curtain wall/floor rated floor/roof intersections)	ASTM E2307
Grease Ducts	ASTM E2336, UL2221, CAN/ULC-S144, EN1366-1, ASHRAE 6
Ventilation Ducts	ASTM E2336 (ACCP), ISO 6944, EN1366-1, EN1366-8, ASHRAE 6

Rev 2016.01

268

WHAT CAN BE DONE TO REDUCE QUESTIONABLE EJ'S?

THE UL TECHNICAL EVALUATION DEVELOPER PROGRAM

269

UL Technical Evaluation Developer Program (TEDP)

- What the Program is
- What the Program is not
- Hierarchy of the Program Participants

270

TEDP - What the program is

- Self-governed process guided by a management system
- Management system adherence with oversight by UL through routine audits
- Recognition of qualified personnel through subject matter testing and demonstrated experience
- Verification of Quality Assurance through random fire testing of Technical Evaluations
- Applicable to all TE's whether based on UL or other 3rd party systems.
- An international program.

271

271

TEDP - What the program is not

- UL approval of technical evaluations
- A replacement for engineered systems developed by licensed professional engineers
- An authorization or determination of suitability

272

272

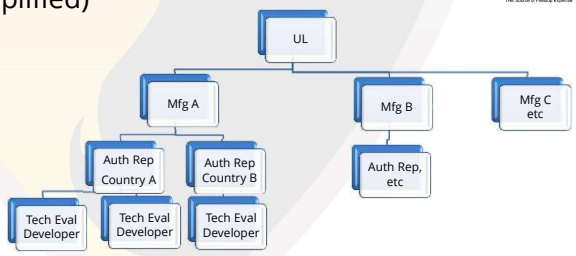
TEDP – Hierarchy of the Program

- Program Administrator (UL)
- Manufacturer organization (listed in UL directory)
- Manufacturer's Authorized Representative (MAR)
  - Managing the TE developer team
  - Adherence to the management system
  - Liaison with UL, audit contact
  - Manage/track TE team CEUs
- Technical Evaluation Developer (TED)

273

273

TEDP – Hierarchy of the program (simplified)



274

274

REVIEW

- AHJ's are the approving body for Engineering Judgments
  - AHJ's are not obligated to approve an Engineering Judgment
  - Is the proposed EJ truly "close enough" to the referenced fire tests?
  - Be critical! Ask questions!
- It is not appropriate to accept an Engineering Judgment if there are available tested and listed systems
- UL's *Technical Evaluation Developer Program* should increase quality, consistency and reliability of EJs

275

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276

IFC Video
Inspecting Firestop for Compliance
(19 mins, if time permits)

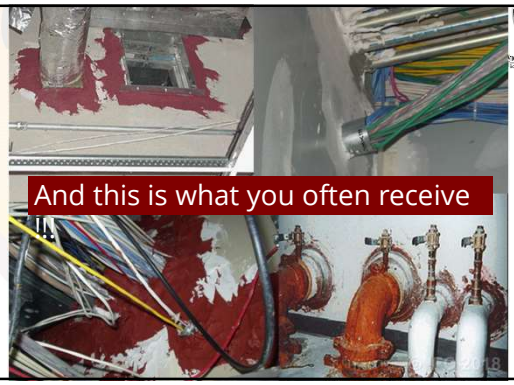
Low-res (unfortunately) at YouTube
https://youtu.be/UsaVu5pSgaU

277

RECOGNIZING FIRESTOP INSTALLATION PROBLEMS

278

279



280

Firestopping in the Real World

- Firestop system details are hardly ever on plans
- Code Officials generally do not ask for copies of approved firestop systems
- Tested/Listed systems rarely installed correctly
- Joints are generally not inspected during the framing inspection and installed to provide movement
- Engineering judgments are being used when there are tested and listed systems available
- Firestopping considered beneath contractors
- Most users are untrained
- No Licensed firestop contractors

Discussion: how can each of these be solved?

281

AHJ Plan Review and Inspection Process recommendations

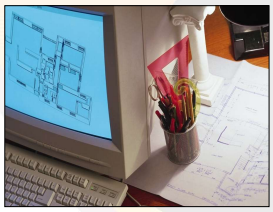
282

Pre-Construction Meeting

- Review Design Drawings Submittals
- Obtain Pre-Approved Engineering Judgments
- Establish inspection guidelines and expectations
- Review qualifications/experience of firestop installers
- Schedule firestop Inspections
- Review qualifications/experience of special inspectors (if applicable)

283

PROCESS
Building Department Submittals



- 107.2.1 - … Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code

284

PROCESS
Plans Examination/Review

- Firestop systems details should be included on the plans and specifications (Project Documents)
- Recommended to have all firestop Details reproduced, including the system number for firestop applications on the plans
- Firestopping is often a "deferred submittal" – available only later on in the project

285

PROCESS
Plans Examination/Review Cont.

- For unique conditions have policy for Engineering Judgments
- The structural engineer should specify amount of movement required for all joints
- Consider requiring special inspection for firestopping on large projects
- Require or encouraging use of Firestop Qualified Contractor

286

Firestop Systems
Recommended Correction Notice

- All firestop systems for fire rated construction need to be reproduced on the plans as tested by an approved testing laboratory. If an EJ is needed, it must be noted on plans and this system must be approved by Building Official.
- The above information must be provided for the field inspectors.

287

Inspection Practices for Firestopping

- Inspections typically done by AHJ, but may be inspected by approved agency or individual
- Require construction documents that detail all firestop locations and systems
- During framing inspection observe that joints are installed in manner that required movement can be achieved

288

Inspection Practices for Firestopping Cont.

- Observe the products, empty containers or boxes for label with name, description and approved testing agency
- Have your inspection tools such as a flashlight, coring device, wire, tape measure and other appropriate tools
- General Contractor should understand that you may require a ladder or lift

289

Inspection Practices for Firestopping Cont.

- Verify firestopping was installed in accordance with the published system
- Verify who did installation of systems to determine reasonable verification
- When necessary destructive evaluation will be made on various types of systems
- During inspection have firestop contractor follow-up to repair systems after destructive testing

290

Inspection Practices for Firestopping Cont.

- What to do if firestopping is not acceptable:
  - Notify ALL effected persons of deficiencies in a timely manner.
  - If firestop system is repaired (not replaced) the manufacturers need to recommend proper procedures and methods
  - Will require more inspections to verify compliance
  - Observe firestop contractor re-doing the non-compliant installation.
  - May need to "Stop Work" on part of the project
  - Re-inspect when appropriate and thank personnel effected by the delay of the project.

291

FREQUENTLY ASKED QUESTIONS

292

Frequently Asked Questions?

ARE ALL FIRESTOP SEALANTS EQUAL?

• NO. Each manufacturer's material has its own unique properties and functions when applied in a firestop system design.

• Similar firestop products cannot be used interchangeably

• Each firestop system must be judged on its own merits and within the parameters of each manufacturer's system specific design

293

Frequently Asked Questions?

IS MINERAL WOOL 1-HOUR RATED?

• NO. Mineral wool is a component of many firestop systems but is normally used in conjunction with sealants or coatings
• Mineral wool alone does not pass the hose stream test

• Mineral wool alone will not provide a smoke seal

294

Frequently Asked Questions?

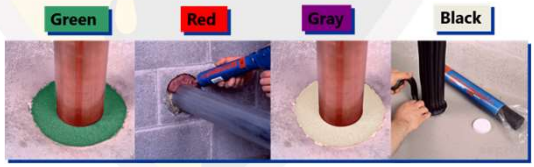
WHAT IS THE FIRE RATING FOR YOUR CAULK?

- Firestopping products do not have a fire rating (e.g. 1" of caulk does not equate to a 1 hr rating, etc.)
- The assembly in which it is installed has the fire rating
- The thousands of different firestop systems each detail the required parameters and building components

295

Are firestop caulks required to be RED?

Answer: There is NO building code requirement anywhere that mandates product color. However, most manufacturers deliberately use colors that stand out to facilitate inspection and different colors to distinguish between products.



296

Is safing insulation an adequate firestop?

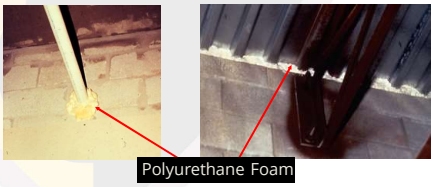
Answer: Fire safing, or packing an opening with mineral wool is certainly better than nothing, but is *not* a firestop. Using only mineral wool does not provide a *smoke seal,* does not address combustible penetrants and cannot withstand the shock from the hose stream.

Fire blocking or safing with wool

297

FICTION: Polyurethane foam is a firestop.

FACT: Polyurethane foams, frequently used as draft stops, burn vigorously and are not generally not acceptable firestopping materials. Some are UL Classified for surface flammability only, but typically are not fire resistant.



298

Visual vs destructive inspection

- Visual inspection often sufficient for:
  - Pre-formed firestop devices e.g. collars, cast-in, cable sleeve devices
  - Pre-formed joint systems
  - Mechanical Joints
- Destructive inspection needed for
  - Firestop sealant depth (wet vs dry)
    - Look for movement during cure
  - Mineral wool depth, compression, orientation

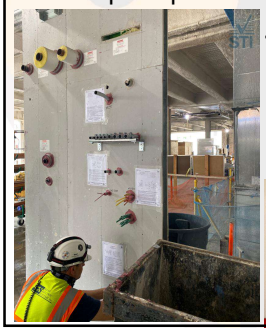
299

Firestop Inspection Best Practices

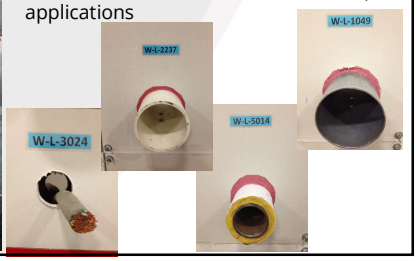
- Pre-construction Firestop Meeting with all Trade firestop installers to make sure inspection process works properly.
- Have clearly marked set of drawings highlighting fire and smoke walls along with approved firestop submittals

300

Firestop Inspection Best Practices (con't)



- Have firestop mock ups built that would show construction of foreseen firestop applications



301

Firestop Inspection Best Practices (con't)

- Have contractors Identify each installed firestop system by labeling or other methods.

302

302

Firestopping is only installed to the level of knowledge of the AHJ

- You are the last line of defense!
- You need to ensure:
  - The code is enforced
  - Contractors do the job per specifications
  - Buildings are safe for occupants and first responders

303

Question for your Building Official

- What is our Building Department's Plan Review and Building Inspection Policy and Procedure for Firestopping?

304

During last break of the afternoon....

- Please take our seminar feedback survey:

Paper copy
or
https://www.surveymonkey.com/r/FirestopSeminar
(only 3-4 mins!)

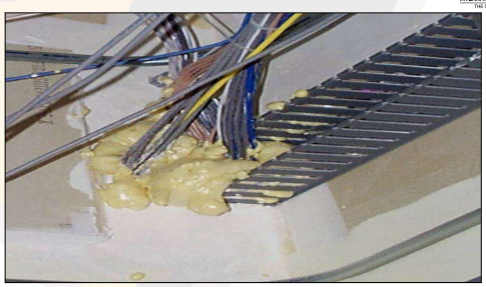
You can scan the QR code to take you to the survey

305

Improper Firestop Installations: What it should not look like

306

Improper Firestop Installations



307

Improper Firestop Installations

308

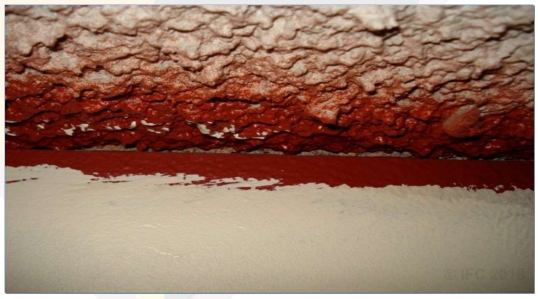
Improper Firestop Installations

309

Improper Firestop Installations

310

Improper Firestop Installations



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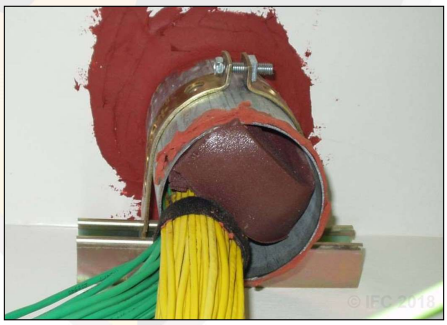
Improper Firestop Installations



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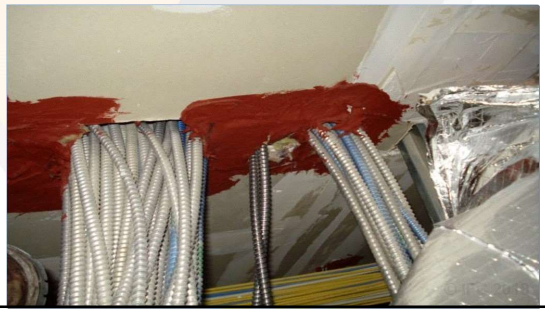
Improper Firestop Installations



313

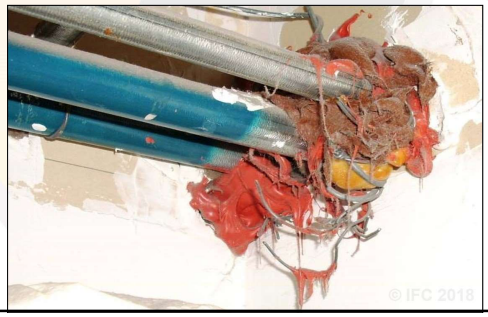
Improper Firestop Installations

314

Improper Firestop Installations

315

Improper Firestop Installations



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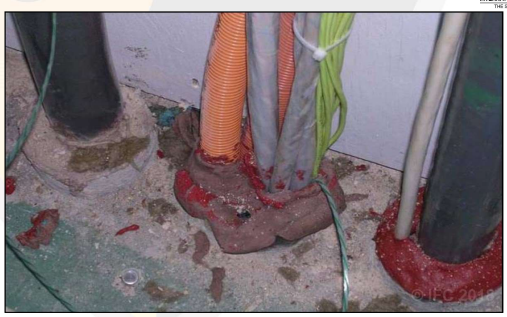
Improper Firestop Installations



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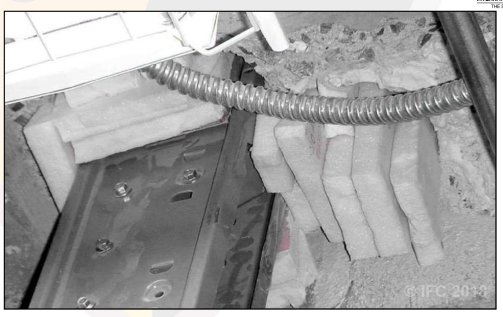
Improper Firestop Installations

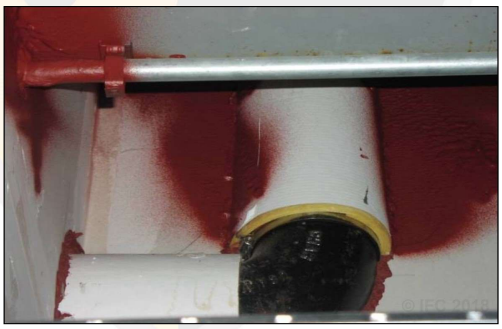


318

Improper Firestop Installations

319

Improper Firestop Installations



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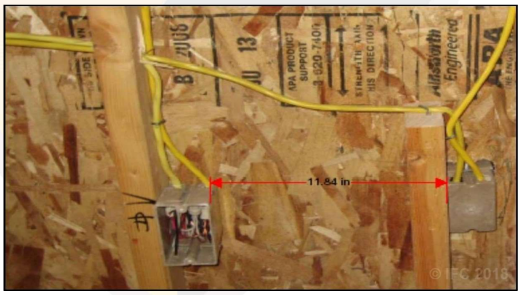
Improper Firestop Installations

321

Improper Firestop Installations



322

Improper Firestop Installations

323

Improper Firestop Installations

324

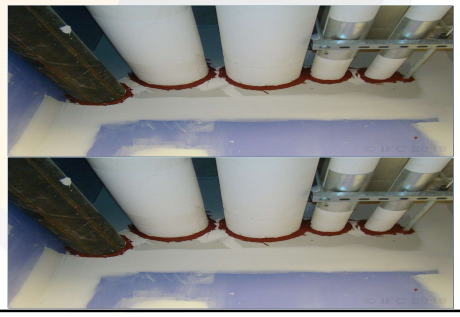
Improper Firestop Installations

325

Improper Firestop Installations

326

Questionable Firestop Installation



327

Correct Firestop Installations

328

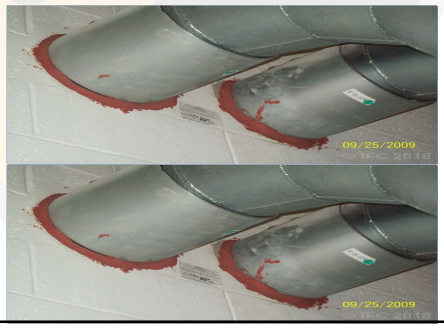
Correct Firestop Installations

329

Correct Firestop Installations

330

Correct Firestop Installations



331

Correct: First Floor
Underside of curtain wall joint

332

Correct: Second Floor
Top side of curtain wall Joint

333

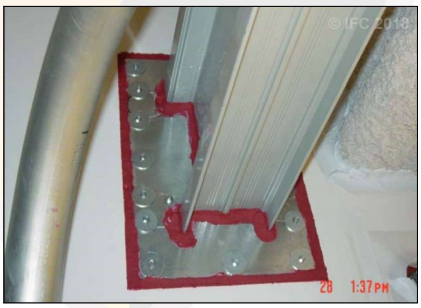
Correct Firestop Installations

334

Correct Firestop Installations

335

Correct Firestop Installations



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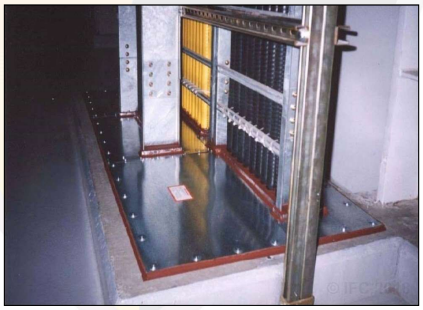
Correct Firestop Installations



337

Correct Firestop Installations

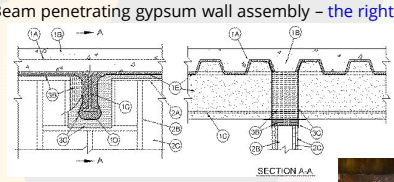
338

Correct Firestop Installations

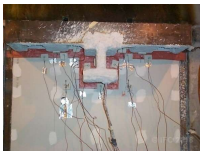
339

Common Mis-installed Conditions

Beam penetrating gypsum wall assembly – the right way!



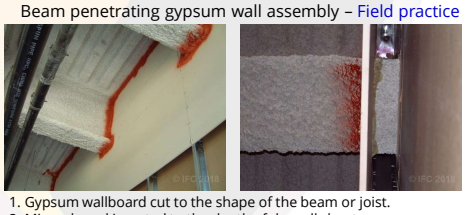
1. Frame studs around beam or joist
2. Tightly compress mineral wool below and on sides of beam/joist
3. Spray coating over mineral wool overlapping wall and fireproofing



340

Common Misinstalled Conditions

Beam penetrating gypsum wall assembly – Field practice



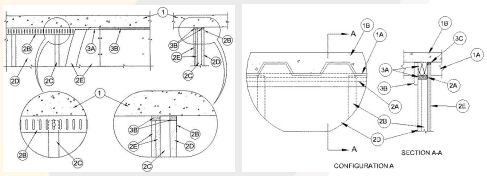
1. Gypsum wallboard cut to the shape of the beam or joist.
2. Mineral wool inserted to the depth of drywall sheet
3. Firestop coating sprayed over mineral wool with little overlap on fireproofing and wall

There are no listed systems that permit this !!!

341

Common Mis-installed Conditions

Gypsum shaft wall assembly



- Typically install fire sealant on finish of wall only. Fire sealant is required on both the finish side of wall and above shaft liner within wall cavity.
- J-Runner Track with 1" front leg installed for the head-of-wall joint will not provide a long enough track leg to provide backing for the head of wall joint. Slotted track or longer leg (1-1/2" leg) J-Runner Track should be used
- J-Runner Tracks Space above 1" liner board inside the J runner must also be protected (usually with sealant) otherwise fire has direct path in from shaft side
- Impossible to inspect inside wall cavity after wallboard is installed (must do during construction)

342

Visual Inspection Quiz
What's wrong with these installs?


Dissimilar products in the same opening is not allowed

343

Visual Inspection Quiz
What's wrong with these installs?

Drywall compound is never an acceptable firestop material

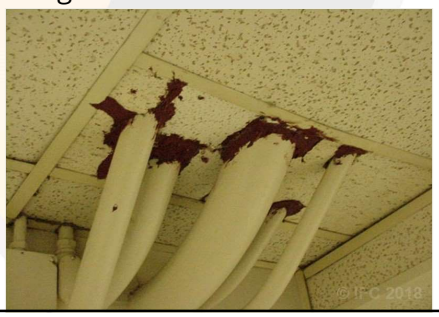
Collar must be flush with ceiling surface

344

Visual Inspection Quiz
What's wrong with this install?

345

Visual Inspection Quiz
What's wrong with this install?



346

Visual Inspection Quiz
What's wrong with this install?

Head of wall joint is firestopped, but penetrations are not

Penetrant opening at top of wall must be firestopped with same product as head of wall

Gysum repair must meet GA-225, e.g. studs to support patch

347

Visual Inspection Quiz
Is there anything wrong with these installs?

Does thickness and overlap of coating match design?

What type and amount of backing material is behind coating?

Visually ... Nothing

Does number and type of wrap strip match design?

Is there sealant in the void?

348

Firestopping Code Changes 2009, 2012, 2015, 2018 IBC

Are you enforcing the latest provisions?

349

Barrier Identification

350

IBC Barrier Marking (since 2009 IBC)

- IBC Section 703.7 Marking and Identification.
  - Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling.

351

IBC Barrier Marking

Such Identification shall be located in accessible concealed floor, floor ceiling or attic spaces.

- Within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition
- Include lettering not less than 3 inches (76 mm) in height with a minimum 3/8 inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording:
  FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS

352

International Fire Code (IFC)

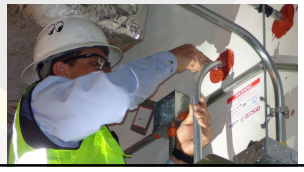
Inspection and Maintenance of buildings

- 703.1 Maintenance. The required fire-resistance rating of fire-resistance-rated construction (including walls, firestops, shaft enclosures, partitions, smoke barriers, floors, fire-resistive coatings and sprayed fire-resistant materials applied to structural members and fire-resistant joint systems) shall be maintained.
- 2009 IFC addition:
  Building owners to annually inspect all fire-resistance-rated construction including firestops and joint systems
  - Firestopping needs to be properly repaired, restored or replaced when damaged, altered, breached or penetrated.

353

Firestopping Special Inspections Approved in 2012 IBC

- **1705.16 Fire-resistant penetrations and joints.** special inspections for through-penetrations, membrane penetration firestops, fire resistant joint systems, and perimeter fire barrier systems that are tested……
- Required for buildings over 75 ft. and for Category 3 and 4 buildings
- ASTM Inspection Standards ASTM E 2174 and ASTM E 2393 are required



354

2012 New penetration T-rating exception

- 2009: 1. Floor penetrations contained and located within the cavity of a wall above floor or below the floor do not require a T-Rating

- 2012 IBC: 2. Floor penetrations by floor drains, tub drains or shower drains contained and located within concealed space of a horizontal assembly do not require a T-Rating.

355

2015/18 New penetrations T-rating exception

- 2015 IBC:
  3. Floor penetrations of maximum 4-inch (102 mm) nominal diameter penetrating directly into metal-enclosed electrical power switchgear do not require a T-Rating.
- 2018 IBC: clarified that penetrant is to be metal conduit or tubing.

356

2009 IBC: 24 inch rule only for "non-communicating stud cavities"

714.3.2 Membrane penetrations. Membrane penetrations shall comply with Section 713.3.1. Where walls or partitions are required to have a *fire-resistance rating*, recessed fixtures shall be installed such that the required fire-resistance will not be reduced.

Exceptions:

1. Membrane penetrations of maximum 2-hour fire-resistance-rated walls and partitions by steel electrical boxes that do not exceed 16 square inches (0.0103 m2) in area, provided the aggregate area of the openings through the membrane does not exceed 100 square inches (0.0645 m2) in any 100 square feet (9.29m2) of wall area.

357

2009 IBC: 24 inch rule only for "non-communicating stud cavities"

Such boxes on opposite sides of the wall or partition shall be separated by one of the following:

1.1. By a horizontal distance of not less than 24 inches (610 mm) where the wall or partition is constructed with individual noncommunicating stud cavities;

358

Staggered stud walls must use an alternative to 24 inch separation

Such boxes on opposite sides of the wall or partition shall be separated by one of the following:

- 1.1 By a horizontal distance of not less than 24 inches (610 mm) where the wall or partition is constructed with individual noncommunicating stud cavities;
- 1.2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose-fill,
- rockwool or slag mineral wool insulation;
- 1.3. By solid fireblocking in accordance with Section 717.2.1;
- 1.4. By protecting both outlet boxes with listed putty pads; or
- 1.5. By other listed materials and methods.

359

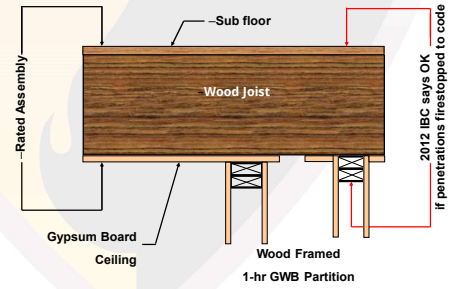
IBC 2012 changes: Code clarity Firestopping of double top plate

- Membrane penetrations of horizontal assemblies, new exception:
  714.4.1.2
  Exception 7. The ceiling membrane of 1- and 2-hour fire-resistance rated horizontal assemblies is permitted to be interrupted with the double wood top plate of a fire resistance rated wall assembly, provided that all penetrating items through the double top plates are protected in accordance with 714.4.1.1.1 or 714.4.1.1.2.
- 714.4.1.1 = penetration tested as part of assembly
- 714.4.1.2 = penetration firestopped

See Drawing.....

360

Wood Composite Floor/Ceiling System



361

Continuity head-of-wall joints

- IBC 2012
- 707.9 Voids at intersections

  The voids created at intersection of fire barrier and non-fire resistance rated roof assembly shall be filled. An approved material or system shall be used to fill the void, shall be securely installed in or on intersection for its entre length so as not to dislodge, loosen or otherwise impair its ability to accommodate expected building movements and to retard the passage of fire and hot gases.
- Tested system NOT required
- Listed system instead of EJs:
  - Approval should be easier/faster
  - Save time/money

362

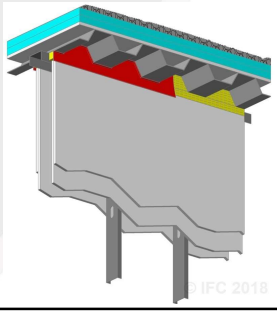
Joint: Rated wall to non-rated floor or roof

- ASTM E2837-11:
  Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies
- UL listing category XHBO
  - Nomenclature, e.g. CJ-D-0001

363

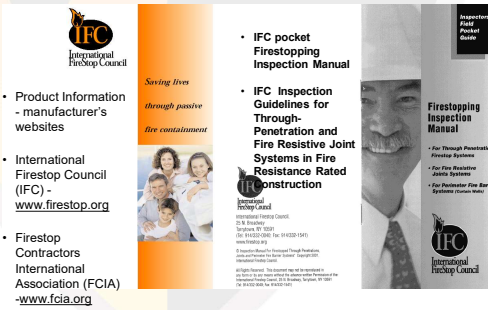
ASTM E2837 listings

- Many for insulated steel deck roof
- No modifications ever needed to roof or wall
- Typical "stuff and spray" joint systems similar to E1966/UL2079 listings



364

Available Resources



- Product Information - manufacturer's websites
- International Firestop Council (IFC) - www.firestop.org
- Firestop Contractors International Association (FCIA) -www.fcia.org

365

Additional firestop training

- IFC offers:
  - Free 1.5 to 8 hour educational seminars for AHJs
  - Free Online special inspector training program www.firestop.org/inspection
  - 1-day hands-on training seminar for special inspectors (inspect to ASTM E2174/E2393)
- Contact info@firestop.org to request training seminar

ICC PREFERRED PROVIDER PROGRAM

366

366

Would you like to help shape Codes and Standards?

- For assistance with passive fire protection issues feel free to contact the International Firestop Council
- Please call or e-mail the IFC Technical Director
  - 918-200-3757
  - JohnV@firestop.org

367

Available Resources

- International Firestop Council (IFC)
  www.firestop.org
- Firestop Contractors International Association
  www.fcia.org
  Free webinars
  Free magazine "Life Safety Digest" (request from info@fcia.org)
- Fire Safe North America
  www.firesafenorthamerica.org
- ASTM International standards
  www.astm.org

368

Available self-education documents on IFC website include.....

www.firestop.org

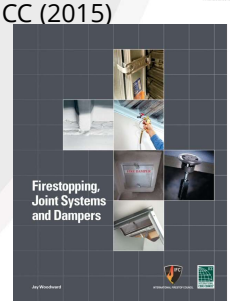
- Firestop 101 – An introduction to firestopping
- Perimeter Curtain Wall Fire Protection
- Firestop System Selection
- Flexible Duct Wrap Systems
- Fire Protection of Construction Joints

Videos: International Firestop Council Channel on YouTube

369

Further your knowledge of firestopping and codes:
Reference book published by ICC (2015)

- http://www.firestop.org/online-store
- http://shop.iccsafe.org/firestopping-joint-systems-and-dampers-1.html



370

If not already completed....

- Please take our seminar feedback survey:

Paper copy
or
https://www.surveymonkey.com/r/FirestopSeminar
(only 3-4 mins!)

You can scan the QR code to take you to the survey

371

THANK YOU FROM THE IFC

The International Firestop Council(IFC) is a not-for-profit association of manufacturers and industry partners of fire protective materials and systems.

IFC's mission is to promote the technology of fire containment in modern building construction through research, education and development of safety standards and code provisions.

Website - www.firestop.org

Email - Info@firestop.org

372