INSPECTION CHALLENGES OF FIRESTOPPING

Presented by: Brice Miller
Brice Miller

- 25 years as Building Official, Inspector and Plans Examiner with four International Code Council (ICC) Certifications
- Past President of Colorado Chapter of the ICC
- Developed Firestop Presentations for ICC on line training
- Provided firestop training throughout the US for 15 years
- Served as the Executive Director for International Firestop Council for 2-1/2 years
Outline of Presentation

- Welcome and Introductions
- Fire Blocking and Draftstopping
- Importance
- Balanced Fire Protection
- Code Requirements and Testing
- Firestop Code Changes
- Penetration Firestop Systems
- Joint Systems
- Perimeter Fire Containment Systems
- Review of Special Inspection requirements
- ASTM Firestop Inspection Standards
- Existing Buildings – Maintenance
- Firestopping in the Real World
- Plan Review / Inspection of Firestopping
What is Firestopping?

Which of the Following is the Definition of Firestopping:

A) That expensive red goop with the UL logo on the tube.

B) The process of restoring the hourly rating to fire barrier walls and floors that have lost their fire rating from penetrations, joints and other openings (using materials tested to ASTM E-814 and UL1479.)

C) A huge pain in the neck.

Answer: All of the above
How Does Firestopping Work?

- Seals a penetration, or joint in a fire-resistant assembly
- Prevents fire from spreading from one side of the assembly through to the opposite side
- Composed of tested elements (“a system”) to stop fire and hot gases for a prescribed period of time
Definitions

- Firestopping
- Draftstopping
- Fireblocking
Fireblocking and Draftstopping

Draftstopping

- To divide a large concealed spaces into smaller compartment (Intent: limit the movement of air w/n the cavity, reducing the potential for rapid fire spread)

Fireblocking

- Installed within concealed spaces to resist or block the migration of fire and hot gases to isolate movement from vertical to horizontal areas
Firestopping, Fireblocking and Draftstopping
FIRESBLOCKING IN COMBUSTIBLE CONSTRUCTION

- PURPOSE
- MATERIALS
- WHERE REQUIRED
- LOCATIONS
Purpose of Fireblocking is to:

- Cut off both vertical and horizontal concealed draft openings
- Form an effective fire barrier between stories
- Form a fire barrier between top story and the roof space
FIRE BLOCKING MATERIALS - R302.11.1

- 2 x nominal lumber
- 2 layers of 1” nominal lumber with broken lap joints
- 23/32 Wood Structural Panel (WSP) w/ joints backed
- 3/4” particleboard with joints backed
FIRE BLOCKING MATERIALS CONTINUED

- ½” Gypsum
- ¼” Cement fiber board
FIRE BLOCKING MATERIALS CONTINUED

- Batts or blankets of mineral or glass fiber installed to be securely retained in place.
FIRE BLOCKING MATERIALS CONTINUED

- Unfaced fiberglass batt insulation used as fireblocking shall fill the entire cross section of the wall cavity to a minimum height of 16”
OTHER MATERIALS TO CONSIDER

- Spray foam (must approved material)
- Loose fill insulation (must be specifically tested)
- Mineral wool or glass fiber (must be securely retained in place)
- Cellulose insulation (if tested for specific application according to ASTM test)
- Other approved materials
Concealed spaces of stud walls and partitions, furred spaces and parallel rows of studs or staggered studs:

- Vertically at the ceiling and floor levels
- Horizontally at intervals not exceeding 10’
All interconnections between concealed vertical and horizontal spaces such as soffits, drop ceilings & cove ceilings.
FIRE BLOCKING WHERE REQUIRED

- Insulation secured in place
- Wood stud wall
- Soffit
- Floor joist, I-joist or truss
- Finish wall and ceiling materials
- Fiberglass insulation provides fireblock between concealed spaces of wall and floor system
- 2 x 4 fireblock
FIRE BLOCKING WHERE REQUIRED

- Concealed spaces between stair stringers at the top and bottom
- Along the side of stairs IF under stairs unfinished
FIRE BLOCKING WHERE REQUIRED

- chimneys and fireplaces-R1003.19
  - Fireblocked with noncombustible material
Fireblocking of cornices of a two-family dwelling is required at the line of dwelling unit separation.
DRAFTSTOPPING

- PURPOSE
- MATERIALS
- WHERE REQUIRED
- LOCATIONS
Definition and Purpose of Draftstopping

Definition:
- To divide a large concealed spaces into smaller compartment

Purpose:
- Limit the movement of air w/ n the cavity
- Acts as a barrier to smoke and gases
- Designed to prevent considerable damage from rapid fire spread
DRAFTSTOPPING MATERIALS – 717.2

Materials shall not be less than:
- 1/2-inch gypsum board
- 3/8-inch wood structural panel
Code Requirements for Draftstopping Section 717

- Required For Combustible Construction:
  - **Group R- 2 (Apartments)**
  - Required if three or more dwelling units
  - Where a corridor also serves as a dwelling unit separation, draftstopping is only required above one of the corridor walls.

- **Group R- 1 (Hotels)**
  - Required in all building
  
  **Exception:** Draftstopping not required if equipped with sprinkler system
Draftstops in Floors

- Solid joist or I-joists Draftstops when ceiling finish is added.
- Draftstops in Dropped Ceiling
- Horizontal floor areas can not exceed 1,000 square feet
OPENINGS

- Self-closing doors with automatic latches
Who’s Responsible for Making Certain Firestopping is code compliant?

- Owner
- Design Professional
- Manufacturer
- General Contractor
- Installer
- Plans Examiner
- Firestop Inspector
FIREFSTOP PROCESS

1. Designed
2. Plan Review
3. Installation
4. Inspection
5. Maintenance

- Firestop Systems Designed
- Plan Review
- Inspection
A few years ago the International Code Council (ICC) approved a new Firestop Inspector Certification; however, it was never implemented.

During this approval process an ICC Survey was developed to determine if firestopping needs an ICC exam and if Firestopping was inspected properly.
THE REAL PROBLEM
Firestop Inspections are difficult to perform:

- Firestopping is the only code required work that is installed by every trade.
- Code Officials are frequently limited on the time they can spend on firestopping.
- Code officials typically are not accustomed to providing destructive testing.
- Firestopping is not included in the plan submittals.
Course Objectives:

- Plan Review and Firestopping
- Require firestop submittals
- Impact of firestop inspections according to NEW ASTM Standards
- Review firestop inspection tips and techniques
- Recognize common firestop system code violations and provide solutions
- To become comfortable with requirements for inspection of all firestop systems
- Assist code officials with level of firestop enforcement
- Review methods of firestop inspections
The Life Safety Triangle

COMPARTMENTATION

DETECTION

SUPPRESSION
Why is Firestopping Required

- Mandated by code
- Life Safety
- Property Protection
- Compartmentation
  - Divide buildings into spaces of manageable risk
  - For Escape and Access for fire-fighters
MGM Grand Fire - 1980

- Fire occurred on 1st floor
- Fire never left 1st floor
- 14 victims in casino area
- 64 victims found 20 – 25 floors above
- Total deaths – 84
On May 4, 1988 a fire occurred on the 12th floor extending to 16th floor (62 story high-rise):

- “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.”
- “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.”

Legal Cases

- Only a few examples of why buildings need proper firestopping to Mitigate liability for the building owner and contractors. We do not want anyone to be dangerously vulnerable to liability.

- American States Ins. vs. Hannan Construction
  - Builder allegedly failed to Firestop open plenum
  - Builder found negligent

- Sunlake Apt. Residents vs. Tonti Development
  - Fire destroyed building, residents sued
  - Architect settled then sued government inspectors

- One Meridian Plaza Businesses vs. Owner
  - Fire destroyed 40-story building
  - Tenants and near-by businesses sued owner
  - Building owner sued government officials & GC
Unsealed or Improperly sealed firestopping cost lives and huge liability losses...

One Meridian Plaza – 1991

- Building **owner collected $110 million:**
  - Building owner sued approx. 25 defendants including the general Contractor, sub-contractors and manufacturers
  - The **GC paid over 40 million** – Claimed failure to supervise, install and inspect the fire protection system
Firestop & Liability

ONE MERIDIAN PLAZA BUSINESSES vs. BUILDING OWNER

» Fire destroyed 40-story building.
   - Tenants sued owner
   - Affected businesses within one block also sued
   - Three fire-fighters dead; numerous injuries

» Claimed potential exposure: $800 million
   - Building owner sued approx. 25 defendants, including the General Contractor / Subcontractors / Manufacturers
Sprinklers suppress flames, NOT smoke & gasses

75% 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”.
Contain fire, smoke and toxic gases to the point of origin

- Create compartments with fire-resistive walls and floors
- Increases Time Available to Escape (TAE)
- Increases number of escape routes
- Increases structural safety for fire fighters
- Limit property loss
Firestopping needed in many Applications

- Curtain Wall
- Edge of Slab Joint
- Top of Wall Joint
- Through Penetrations
- Expansion Joint
- HVAC Ducts
- Sprinklers
- Stub-Outs
- Insulated Pipe
- Block-Outs
- Cable Trays
- Barrier Joints
When Reviewing and Inspecting Firestopping the code can be Vague

- We will give you our opinion at times
- Feel free to research our recommendations
- The Authority Having Jurisdiction (AHJ) will make the final decision
Code Requirements – Firestopping
Containment in Construction

International Building Code requires firestop systems to be used in the below locations:

- Fire-resistance-rated wall assemblies
- Fire-resistance-rated floor and roof assemblies
- Joints in fire-resistance-rated assemblies
- Perimeter exterior wall systems
Containment in Construction

- Fire-resistance-rated assemblies
  - *Fire Walls* - 706
  - *Fire Barriers* - 707
  - *Fire Partitions* - 708
  - *Smoke Barriers* - 709
  - *Smoke partitions* - 710

- Family of Walls and firestopping
  - Fire wall is most restrictive and fire Partitions is the least restrictive
  - Fire Barriers include shafts and exit Passageways
  - Smoke Barriers will always need to have an L rating
  - Smoke partitions require joints and penetrations to be filled with an approved material.
  - All Walls have different types of ratings and usages
Code Requirements – Firestopping

Minimum requirements for New Construction & Maintenance

- International Building Code – Chapter 7
  - New Construction
- International Fire Code – Chapter 7
  - Existing Buildings
- NFPA 101 – Chapter 8
- NFPA 1 – Chapter 12
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.

12.3.2.1 Inspection of Penetration firestop systems shall be conducted in accordance with ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops. [5000:40.9.1]

12.3.2.2 Inspection of fire-resistive 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]
1705.18 Fire-resistant penetrations and joints. In high-rise buildings or, in buildings assigned to Risk Category III or IV, or in fire areas containing Group R occupancies with an occupant load greater than 250, special inspections for through-penetrations, membrane penetration firestops, fire resistant joint systems, and perimeter fire containment systems that are tested and listed

1705.1.1 Special cases. *Special inspections shall be required for proposed work that is, in the opinion of the building official, unusual in its nature*
12.3.3* Maintenance of Fire-Resistive Construction, Draft-Stop Partitions, and Roof Coverings.

12.3.3.1 ........ shall be maintained and shall be properly repaired, restored, or replaced where damaged, altered, breached, penetrated, removed, or improperly installed.
701.6 Owner’s responsibility. The owner shall maintain an inventory of all required fire-resistance-rated construction, construction installed to resist the passage of smoke. 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.
Code provisions provide clear direction for inclusion information on the plans.

- **107.2.1.** Information on 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.

- **107.3.4.1 Deferred submittals.** Deferred submittals are defined as those portions of the design that are not submitted at the time of the application and that are to be submitted to the building official within a specified period.

  - Typically approved prior to the start of Firestop system installation.
UL / IFC Video

“CLOSE ENOUGH IS NOT GOOD ENOUGH”: A Demonstration of Proper vs. Improper Firestopping
## Code Requirements – IBC

### International Building Code Firestop Test Standards

<table>
<thead>
<tr>
<th>Category</th>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through Penetration</td>
<td>ASTM E814, UL 1479</td>
</tr>
<tr>
<td>Joints</td>
<td>UL 2079, ANSI 2079</td>
</tr>
<tr>
<td>Perimeter Barriers</td>
<td>ASTM E2307</td>
</tr>
</tbody>
</table>
Third Party Testing Labs

Underwriters Laboratories Inc.
Intertek (Warnock Hersey & ETL)
FM Global (Factory Mutual)
Southwest Research Institute

Labs Test to Standards
American Society of Testing and Materials (ASTM)
Underwriters Laboratories Inc. (UL)
Time – Temperature Curve

- 1050 °F (6min) glass fiber insulation melts
- 1700 °F (1 HR)
- 2000 °F (4 HR)
Definition of Intumescent

Intumescent – A substance which swells, inflates or expands as a result of heat exposure thus increasing in volume and decreasing in density.
ASTM E 814 / UL 1479 Test Standards for Through Penetration Firestop Systems

**F- Rating**
The duration of time in which flames must not pass through the system

**T- Rating**
The time it takes for the non-fire side to reach 325°F
ASTM E 814 / UL 1479 Test Standards for Through Penetration Firestop Systems

- **L-Rating**
  - Rate of air leakage through the system at ambient and 400°F
  - Measured in CFM/sq. ft. The lower the number, the better.

- **W-rating** (currently optional)
  - the ability of a system to restrict the flow of water
  - Class 1-rated systems resist a 3 foot water column for 72 hours
Fire Resistive Joint Testing

Head of Wall Joint

Floor to Floor Joint
## Conditioning Prior to Fire Test

<table>
<thead>
<tr>
<th>Movement Class</th>
<th>Min. No. of Cycles</th>
<th>Min. Cycling Rate (Cycles / Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I (Thermal)</td>
<td>500</td>
<td>1</td>
</tr>
<tr>
<td>Class II (Wind Sway)</td>
<td>500</td>
<td>10</td>
</tr>
<tr>
<td>Class III (Seismic)</td>
<td>100</td>
<td>30</td>
</tr>
</tbody>
</table>
New UL Test Method for Measuring Movement capabilities of Through Penetration Firestop Systems

- ASTM E3037 movement test for firestop Penetration systems are now called the “M Rating”
- This movement cycling is independent of fire test
- After movement tests still requires full compliance with the fire tests
- The codes do not address this issue
Why do we need a New Firestop Movement Test

- **Movement** during construction and natural influences will happen.
- **Some examples are:**
  - Thermal Expansion
  - Building Vibrations
  - **Seismic** activity
  - Building Settlement
  - Mechanical vibrations
  - Water Hammer
  - Wind forces
Now that we understand testing of firestopping

How are they expressed?

- Shop Drawings
- UL systems (or another lab)
- Design Listings

All are essentially “Firestop Systems”
Why should code officials require Tested and Listed Firestop Systems?

- Required by Code
- Cut down on fire and life safety risk
- Prevent a potential weak link or hole in the assembly
- Provide required firestopping resistance
- Meet ASTM requirements
REACTION OF CONTRACTORS WHEN ASK FOR THE PAPERWORK OF THE TESTED, LISTED FIRESTOP SYSTEMS

1. Shock (Deer in the headlight look)
2. Denial (We never had to do that in....)
3. Irritation
4. Negotiating
5. Despair
6. Consent
Evaluating Firestopping

It is all about the SYSTEMS

Points to remember

• Firestop materials are not systems
• Systems employ Firestop materials
• Products do not receive ratings, “Systems Do”
Types of Approved Firestopping

There are two kinds of Classifications:

- *TYPICAL (Tested and Listed)*: Those for which a third-party tested system exists.

- *Engineering Judgement*: Those unique conditions when tested systems do not exist.
Engineering Judgments

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

- **Engineering Judgments are commonly called EJ’s.**

- They are also known as:
  - Qualified Technical Judgment
  - Engineering recommendations
  - Alternative solutions
  - Manufactured Certified Installation Instructions
What are Some Variances to Tested and Listed Systems?

- Too many penetrating items
- Annular space/gap too large or too small
- Joint width
- Movement
- Oversized penetrating item
- Oversized Insulation
- Backing material
IBC References Justifying Engineering Judgments

- IBC 104.11 Alternative materials, design and methods of construction and equipment
- IBC 703.2 Fire-resistance ratings
- IBC 703.3 Alternative methods for determining fire resistance
Contractor or architect typically initiates process
Can be in letter and/or drawing
AHJ makes decision on validity of engineering judgment letter and if approved, inspects construction for consistency with letter.
Who Issues and Reviews Engineering Judgments?

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

- Must be acceptable to the Building Official and recommended to be submitted for review and approval by the Design Professional or Plan’s Examiner.
Are EJ’s provided when tested listed systems are available?

Sometimes
Maybe
Yes-ish
Perhaps
Not always

Maybe we should examine this further...
When are they acceptable?

- When tested **systems do not exist**.
- When modifying the application is unrealistic.
- When existing **test data supports** the interpolation.
- When the **author has experience** with the performance of the system and knowledge of the conditions.
- When issued only for a **specific jobsite**
IFC Guidelines

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

https://www.firestop.org/engineering-judgment-guidelines.html
Questions and General info on EJ’s

- Should field inspectors approve Engineering Judgments?
- Is it ever appropriate to accept an Engineering Judgments if there are other tested listed systems?
- If develop policy for EJ’s consider charging for each EJ that you review.
PROCESS to find Tested Listed Systems or Engineers Judgment

- Always try to find Tested Listed System by employing ALL firestop manufactures

- If non exists, then develop Engineering Judgment that is the same fire resistance rated.
General Discussion of EJ’s

- EJ’s Should Raise Flag
- Manufacturers provide EJ’s even though there are Tested And Listed Systems from other manufactures.
- Often A Symptom Of Poor Planning
- Remember EJ’s Are Untested!
- Increases Hopes and Paperwork; One piece of paper for every opening.
- In Renovation Or Unique Construction, A Necessary Evil
- May Increase Liability For Contractor
Penetration Firestop System

Consists of:

- Assembly being penetrated
- Penetrating item
- Fill, void or cavity materials (firestopping materials)
1st Part of a Listed Firestop System:
2nd Part of a Listed Firestop System:
3rd Part of a Listed Firestop System:
Firestop System Materials

- **Sealants**
  - Silicone, Latex, Intumescent

- **Wrap Strips**
  - “Thick, Thin, Wide, Less Wide”

- **Putties**

- **Pillows**

- **Composite Sheets**

- **Bricks / Plugs**

- **Pre Fabricated Kits**

- **Mortar**

- **Spray Products**
So, what is the rating of the firestop *material*?

ZERO!

Only *systems* have ratings.
714.4. Penetrations into or through fire walls, fire barriers, smoke barrier walls and fire partitions shall be protected.

714.5. Penetrations of horizontal assemblies not required to be protected by shaft enclosure shall be protected per Section 713.4.

714.4.3 and 714.5.3. Noncombustible penetrants shall not be connected to combustible material beyond point of firestop system.
714.4.1. Through penetration shall be protected by one of the following:

- As tested as part of the entire wall assembly
- As tested to ANSI/UL 1479 / ASTM E814
- Exceptions:
  - Full Thickness of Concrete, grout or mortar
  - Annular space protection materials

714.4.1.2. When tested to ANSI/UL 1479 or ASTM E814, systems shall have F Rating equal to rating of wall penetrated
714.5.1.2 Through-penetration shall be protected by one of the following:

- As tested as part of the entire horizontal assembly
- As tested to UL 1479 / ASTM E814
- Exceptions:
  - Annular space protection material
  - Concrete, grout or mortar
  - Listed electrical boxes (poke-throughs) of any material installed per listing
Conditions of Acceptance

T Rating

- No Passage of Flame
- Not to exceed 325°F Temperature Rise
- Hose Stream
**IBC – T Rating**

- Required for through- or membrane-penetrations of horizontal assemblies only
- Floor penetrations contained and located within the cavity of a wall either above or below the horizontal assembly do not require a T rating
- Methods for achieving a T Rating include:
  - Wrap metallic pipe with mineral wool or ceramic insulation
  - A listed device around metallic pipe that will cool pipe during a fire
Sprinkler Pipe Considerations

Metallic Sprinkler Pipe Penetrations:

- NFPA 13 Annular Space Limitations in Seismic Regions
  - If pipe ≤ 3.5”, hole diameter shall be 2 in. larger than nominal pipe diameter
  - If pipe ≥ 4”, hole diameter shall be 4 in. larger than nominal pipe diameter
Crown Bead at Point Contact

SIDE VIEW

TOP VIEW
Properly Tooled Penetrations

- The Firestop sealant must be well bonded to penetrating item and surrounding wall or floor
- Should always inspect both sides
Sleeves are commonly used where penetration needs to be removed or changed frequently

- The sleeve need to be securely fastened to assembly
- Both the space between penetrant and annular space needs to be firestopped
Steel Collars and Intumescent Wrap Strips

- Intumescent sealant expands and fills the void
- The collar expands to crush pipe