NECA 714

Recommended Practice for Firestopping Electrical Penetrations

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(This Foreword is not a part of the Recommended Practice)

Foreword

National Electrical Installation Standards™ (*NEIS™*) are designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services. They define a minimum baseline of quality and workmanship for installing electrical products and systems. *NEIS*™ are intended to be referenced in contract documents for electrical construction projects. The following language is recommended:

> Passive fire protection materials, components, and systems used to firestop electrical penetrations shall be installed in accordance with NECA 714, *Recommended Practice for Firestopping Electrical Penetrations (ANSI)*.

Use of *NEIS*™ is voluntary, and the National Electrical Contractors Association (NECA) assumes no obligation or liability to users of this publication. Existence of a standard shall not preclude any member or non-member of NECA from specifying or using alternate installation methods permitted by applicable regulations.

This publication is intended to comply with the National Electrical Code (NEC). Because they are quality Standards, NEIS may in some instances go beyond the minimum safety requirements of the NEC. It is the responsibility of users of this publication to comply with State and local electrical Codes and Federal and State OSHA safety regulations as well as follow manufacturer instructions when installing electrical products and systems.

Suggestions for revisions and improvements to this Recommended Practice are welcome. They should be addressed to:

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1. Scope

1.1 Products and Applications Included

This Recommended Practice covers the installation of passive fire protection materials, components, and systems used to firestop common electrical penetrations. It applies to fire barrier products and materials and to listed through-penetration or fire-resistive joint assembly systems, including the following installation materials and methods:

- Packing and Forming Material
- Sealant, Caulk, Putty, Mortar, Pillows, Blocks, Plugs, Planks, and Composite Sheets
- Electrical Box Putty and Inserts
- Wrap Strips
- Foam
- Fire Barrier Devices and Kits
- Blankets and Mats
- Labels and Certifications

1.2 Products and Applications Excluded

This Recommended Practice does not cover fireblocking, or firestop materials~~and sealants~~ used for:

- General construction
- Building joints or perimeter joints (curtain walls)
- HVAC, mechanical, or plumbing system penetrations

1.3 Regulatory and Other Requirements

All information in this publication is intended to conform to the National Electrical Code (ANSI/NFPA 70). Installers shall follow the NEC, applicable State and local Codes, manufacturer instructions, and contract documents when firestopping electrical penetrations.

Only qualified persons as defined in the NEC or qualified firestopping tradespersons familiar with the installation of passive fire protection materials, components, and systems shall perform the technical work described in this publication. Administrative functions such as receiving, handling, and storing firestopping materials and components and other tasks shall be performed under the supervision of a qualified person or a qualified firestopping tradesperson. All work shall be performed in accordance with NFPA 70E, *Standard for Electrical Safety in the Workplace.*

General requirements for installing electrical products and systems are described in NECA 1, *Standard Practices for Good Workmanship in Electrical Construction (ANSI).* Other NEIS provide additional guidance for installing particular types of electrical products and systems. A complete list of NEIS is provided in Annex B.

1.4 Mandatory Requirements, Permissive Requirements, Quality and Performance Recommendations, Explanatory Material, and Informative Annexes

Mandatory requirements in manufacturer instructions, Codes, or other mandatory Standards that may or

may not be adopted into law are those that identify actions that are specifically required or prohibited and are characterized in this Recommended Practice by the use of the terms “must” or “must not,” “shall” or “shall not,” or “may not,” or “are not permitted,” or “are required,” or by the use of positive phrasing of mandatory requirements. Examples of mandatory requirements may equally take the form of, “equipment must be protected…,” “equipment shall be protected…,” or “protect equipment…,” with the latter interpreted (understood) as “(it is necessary to) protect equipment…”

Permissive requirements of manufacturer instructions, Codes, or other mandatory Standards that may or may not be adopted into law are those that identify actions that are allowed but not required or are normally used to describe options or alternative means and methods and are characterized in this Recommended Practice by the use of the terms “may,” or “are permitted,” or “are not required.”

Quality and performance instructions identify actions that are recommended or not recommended to improve the overall quality or performance of the installation and are characterized in this Recommended Practice by the use of the terms “should” or “should not.”

Explanatory material, such as references to other Codes, Standards, documents, references to related sections of this Recommended Practice, information related to another Code, Standard, or document, and supplemental application and design information and data, is included throughout this Standard to expand the understanding of mandatory requirements, permissive requirements, and quality and performance instructions. Such explanatory material is included for information only and is identified by the use of the term “NOTE,” or by the use of italicized text.

Non-mandatory information and other reference Standards or documents relative to the application and use of materials, equipment, and systems covered by this Recommended Practice are provided in informative annexes. Informative annexes are not part of the enforceable requirements of this Recommended Practice and are included for information purposes only.

2. Definitions

NOTE: The following terms are used in this Recommended Practice. The definitions below apply only to the context in which the terms are used in this Recommended Practice.

Ablative: Characterized as material that is sacrificial while performing firestop functions, typically charring as it is exposed to heat, creating an additional thermal barrier and helping to fill voids while prolonging the length of time necessary for the material to be consumed.

Annular Space: Gap between the inside edge of the opening in a wall, floor, or ceiling to the outside of the penetrating item(s).

Approved: Acceptable to the authority having jurisdiction.

Approved Methods: Material, device or system tested in accordance with a nationally recognized test standard at a recognized testing facility. Through-penetration firestop systems and fire barriers that meet the test criteria of ASTM E814 (UL 1479) as tested by an independent, recognized laboratory, or another specific product evaluation and compliance with appropriate standards as determined by the Authority Having Jurisdiction.

Authority Having Jurisdiction (AHJ): An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

Backer Rod: Circular, closed cell foam product available in several sizes used to fill voids such as annular spaces or cracks.

Cast-In-Place Device: Pre-manufactured pass-through firestopping device through a concrete slab that is installed during rough-in before the concrete slab is poured.

Collar: Built up layers of fire barrier material, such as wrap strips, at the location where an item passes through a rated assembly (wall or floor). The materials are secured to the face of the assembly and designed to close off the opening as the penetrant melts during a fire event.

Elastomeric: A characteristic of material that is flexible and permits movement.

Endothermic: A chemical reaction that absorbs heat. As a fire intensifies, an endothermic firestop material releases chemically bound water to help cool the outer surface of a protected item.

Engineering Judgment (EJ): An alternative to a tested and listed system provided by the manufacturer to address a specific application. *NOTE: Engineering judgments are site and application specific and are intended to supply a solution to an application outside the scope of a tested system*.

Fire Barrier Foam: Two-part expanding forming material used to fill annular spacing as an alternative to mineral wool and other forming materials.

Fire Resistance: The property of materials or their assemblies which prevents or slows the passage of excessive heat, hot gases or flames under conditions of use.

Fire Resistance Rating: Rating, typically expressed in hours, that indicates the length of time that a building or building component is expected to maintain the ability to confine a fire or continue to perform a given structural function or both.

Fireblocking: Materials installed in a wood-framed wall or ceiling which prevents the rapid propagation of fire within a combustible framing cavity to other areas.

Firestop: A specific system, device, or construction consisting of the materials that fill the openings around penetrating items such as cables, cable trays, conduits, ducts, pipes, and their means of support through the wall, floor, or ceiling openings to prevent the spread of fire.

Firestopping: Approved materials installed to resist the free passage of flame and gases to other areas of the building through-penetrations in fire rated wall, floors, and ceilings.

Forming Materials: Materials, such as mineral wool, ceramic fiber, backer rod, fire barrier foam, and others, that are used as part of a firestop system to either hold the system in place during application, improve fire resistance, and/or fill annular space. *NOTE: Consult manufacturer-specific system data for type, thickness, and density or material required or allowed*.

International Building Code (IBC). A family of building Codes published by the International Code Council, Inc., that establishes minimum requirements for building systems using prescriptive and performance-related provisions.

Intumescence: A characteristic of certain fire barrier products that, when exposed to heat, expands to fill a void in the penetration caused by the deformation or combustion of the through-penetrating item. *NOTE: When exposed to heat, intumescent materials expand at various rates to form a char to seal voids and provide hourly rated protection.*

Membrane Penetration: An opening made through one side of an assembly (wall, floor or ceiling membrane).

Membrane Penetration Firestop: Material, device, construction, or assembly installed to resist, for a prescribed time period, the passage of flame, heat, and hot gases through openings in a protective membrane in order to accommodate cables, cable trays, raceways, or enclosures.

Mineral Wool: High temperature fire resistant batt insulation material. Often used as a forming material.

Nationally Recognized Testing Laboratory (NRTL): A private-sector organization that OSHA has recognized as meeting the legal requirements in 29 CFR 1910.7 to perform testing and certification of products using consensus-based test standards.

Packing Materials: See Forming Materials.

Penetration Firestop: A through-penetration or a membrane penetration firestop.

Ratings:

F-Rating: Required rating, typically expressed in hours, that indicates the length of time that a fire-resistive barrier or a firestop system can withstand fire before being consumed or before permitting the passage of flame through the opening in an assembly. *NOTE: In order to receive this rating, the through-penetration must pass the ASTM E814 (UL 1479) fire and hose stream tests*.

L-Rating: Optional rating, typically expressed in cubic meters per minute per square meter of opening (CMM/square meter) or cubic feet per minute per square foot of opening (CFM/square feet), of the amount of air leakage through a penetration that assists authorities having jurisdiction and others to determine the suitability of firestop systems for the protection of penetrations and miscellaneous openings in floors and smoke barriers for the purpose of restricting the movement of smoke in accordance with the National Fire Protection Association Life Safety Code, NFPA 101.

T-Rating: Required rating in many applications, typically expressed in hours, that prohibits flame passage through the system and that indicates the length of time that the maximum temperature on the unexposed surface of a firestop assembly does not exceed 181°C (325°F) above its initial ambient temperature. *NOTE: In order to receive this rating, the through-penetration must pass the ASTM E814 (UL 1479) hose stream test.*

W-Rating: Optional rating that indicates the effectiveness of the firestop material in restricting

the flow of water through penetrations in walls and floors occurring from exposure to the elements during construction and/or from other sources after occupancy that assists authorities having jurisdiction and others in determining the suitability of firestop systems in applications where submersion in water may be a factor. *NOTE: To receive a ~~UL~~ W- Rating - Class 1 rating, a firestop system is subjected to a 0.9144 m (three foot) column of water pressure for 72 hours. Immediately after the removal of the water, the firestop system must pass the ASTM E814 (UL 1479) fire and hose stream tests.*

Restricting Collar: A metal device supplied by the firestop system manufacturer or field fabricated to secure firestop material to the outside or underside of a penetration.

Sleeve: Hollow cylinder, such as a pipe, installed in an assembly during the construction of the assembly or during the installation of the firestop that is used to create and maintain the opening for a penetrant and to retain the firestop system in position during installation, for the life of the assembly, and during a fire event.

Through-Penetration: An opening that passes through an entire assembly.

Through-Penetration Firestop System: A specific field-assembled construction consisting of one or more approved materials used to prevent the spread of fire through openings made in fire rated walls, floors, or ceilings to accommodate through-penetrating items, (i.e., cables, cable trays, and electrical raceways) using ASTM E814 (ANSI/UL 1479) as the test method.

3. Receiving, Inspecting, Handling and Storage

3.1 Receiving and Inspecting

Upon delivery of firestop materials and components, visually inspect packaging for evidence of physical damage. Carefully unpack materials and components sufficiently to inspect for concealed damage resulting from shipping and handling. If physical damage is evident, notify the shipper and the manufacturer in writing immediately.

Compare firestop materials and components received with the bill of materials to verify that the shipment is complete. If the shipment is not complete, notify the manufacturer in writing immediately

Verify that firestop materials and components conform with the approved submittals and manufacturer quotation. If they do not, notify the manufacturer in writing immediately.

If firestop materials and components are to be stored prior to installation, restore original packing materials to protect from exposure to environmental conditions. When conditions permit, leave the packing materials intact until equipment and accessories are ready for installation.

Verify that the firestop materials and/or packaging contain 3rd party certification markings to confirm that they are certified for the applications required by the local codes and/or authority having jurisdiction.

3.2 Handling

Handle firestop materials and components in accordance with manufacturer instructions. Avoid impact, jolting, jarring, and rough handling.

Ensure that materials and components are within the rated capacity of the handling equipment.

3.3 Storage

Store firestop materials and components in accordance with manufacturer instructions.

Store in a clean, dry, environmentally-controlled space. Protect from extreme temperatures and from dust, dirt, moisture, and contamination.

Store in an area to discourage vandalism and theft, and out of the way of construction traffic.

4. Preparation for Installation

4.1 General

There are several varieties of electrical penetrations that must be firestopped in any given installation. Additionally, more than one type of product may be required to firestop any given electrical penetration.

Follow manufacturer specific instructions and the firestop system requirements when installing firestop products and systems.

Perform all work in accordance with applicable codes and standards, and OSHA safety requirements. Follow organizational safety practices, building site safety practices, and all manufacturer product precautions and warning labels.

Verify that the firestop system is appropriate for the specific construction materials and penetrating items. Review and follow specific system installation requirements prior to the start of work, including the following tasks:

- Verify penetrating item(s) sizes and types
- Verify minimum and maximum annular spaces
- Verify packing material and depth requirements
- Verify sealant depth
- Verify F and T ratings, check for optional L and W ratings (if required)
- Verify insulation thickness and type
- Verify penetration labeling requirements.

Use a HEPA vacuum cleaner when drilling or cutting holes. Remove all debris, refuse, and combustibles from the work area. Recycle materials to the greatest extent possible.

Ensure that surfaces are clean and dry, including frost for outdoor applications, and free of debris when applying firestop materials. Tool sealant into place or knead moldable putty by hand prior to installation to achieve better adhesion.

Where re-entry may be required in the future, install products that remain pliable, such as moldable putty, or products that are intended for future removal and reinstallation such as foam, pillows, blocks and planks, or pass-through devices. See Figure 4.1.

Figure 4.1. Wall-mounted pass-through device. Photo courtesy of 3M.

4.1.1 Intumescent Products

Intumescent firestopping materials are designed to expand when exposed to heat, with some products expanding 100 times in volume, and are designed to form a high-strength, insulating, fire-resistive char when exposed to heat. The high-strength char in combination with expansion allows intumescent firestopping materials to seal openings and to resist the thermal and dynamic shocks of the actions that occur within a fire, including fire suppression activities. Intumescent products include sealant, putty, wrap strips, devices, and composite sheets.

4.1.2 Endothermic Products

Endothermic firestopping materials are designed to release chemically bound molecules of water when exposed to heat. As the temperature of a fire increases, the heat drives water out of the material in the form of steam that provides a cooling effect of the material and the assembly.

4.1.3 Ablative Products

Ablative firestopping materials are designed to absorb heat and form a hard char with thermal insulation characteristics to help seal voids when exposed to heat. The charring acts as an insulative layer between the fire and the remainder of the firestopping product.

4.1.4 Insulative Products

Insulative firestopping materials are designed to provide a thermal barrier against heat and fire to

maintain and protect the assembly. While insulative firestop products are used primarily to protect air, chemical, and grease ducts, they are also used to protect combustible items (including cables) in rated plenum areas. Insulative products are typically foil-encapsulated, lightweight, and flexible.

4.2 Applications, Product, and System Selection

Firestopping of electrical penetrations is achieved by using a~~the~~ well-defined firestop~~UL~~ system to determine the appropriate combinations of products and materials necessary to firestop specific applications. Firestopping products and materials are applied together as systems, and the firestopping systems receive ratings. Individual firestopping products and materials alone do not receive ratings.

Firestop product and material manufacturers typically have numerous tested and listed systems that correlate with specific firestop applications and that correspond with NRTL~~UL~~ system designations. A properly installed firestop system can accomplish the following for a specified time period based on its ratings:

- Prevent the passage of fire (F Rating)
- Provide an effective smoke and toxic gas barrier (L Rating, optional)
- Slow the transmission of heat (T Rating)
- Prevent the passage of water through the opening (W Rating, optional)

The hourly ratings apply only to complete systems. Individual components are designated for use in a specific system to achieve specified ratings. Individual components are not assigned ratings and are not intended to be interchanged between systems. Additionally, the substitution or elimination of components required in a system should not be made unless specifically permitted in the individual system, permitted by an engineering judgment, or in the manufacturer general guidelines.

4.2.1 Firestop System Nomenclature

NOTE: Refer to current Underwriters Laboratories Fire Resistance Directory, Intertek Building Products Directory, or other NRTL listing directories~~and referenced engineering studies~~ for additional information and system details.

As an example f~~F~~or through-penetration firestopping, UL uses an alphanumeric system to categorize the type of construction along with the penetrating item(s). For through-penetrations, the UL system nomenclature takes the form of "X-YZ-1234," where X denotes the type of assembly being penetrated, YZ denotes the wall or floor construction type, the first digit denotes the type of penetrating item, and the subsequent three numbers are sequential and proprietary to a specific manufacturer.

The specific types of assemblies are:

- F: Floor is penetrated
- W: Wall is penetrated
- C: Either a floor or a wall is penetrated

The specific construction types of walls and floors are:

- A: Concrete floors with a minimum thickness less than or equal to 12.74 cm (5 inches)
- B: Concrete floors with a minimum thickness greater than 12.74 cm (5 inches)
- C: Framed floors
- D: Steel decks in marine vessels

- E: Floor-ceiling assemblies consisting of concrete with membrane protection
- G: Cross laminated timber (CLT) floor assembly
- F, H-I: Currently not used
- J: Concrete or masonry wall with a minimum thickness less than or equal to 20.32 cm (8 inches)
- K: Concrete or masonry wall with a minimum thickness greater than 20.32 cm (8 inches)
- L: Framed wall
- M: Bulkheads in marine vessels
- N: Composite wall panels
- O: Cross laminated timber (CLT) wall assembly
- P-Z: Currently not used

The specific penetrating items and manufacturer-specific firestop system are:

- 0000-0999: No penetrating items (blanks)
- 1000-1999: Metallic pipe, conduit, or tubing
- 2000-2999, 21000-29999: Nonmetallic pipe, conduit, or tubing
- 3000-3999: Electrical cables
- 4000-4999: Cable trays with electrical cables
- 5000-5999: Insulated pipes
- 6000-6999: Miscellaneous electrical penetrants such as busway
- 7000-7999: Miscellaneous mechanical penetrants such as air ducts
- 8000-8999: Groupings of penetrations including any combination of items listed above
- 9000-9999: Currently not used

For example, UL system C-AJ-1044 translates to:

- C: Either floor or wall is penetrated
- A: Concrete floors with a minimum thickness less than or equal to 12.74 cm (5 inches)
- J: Concrete walls with a minimum thickness less than or equal to 20.32 cm (8 inches)
- 1044: Metallic pipe, conduit, or tubing as the penetrating item

Due to the complexity of building construction, electrical products, and fire safety, ensure that the correct firestop system is employed for each specific firestop application as the details vary within each system in a category, such as maximum size of penetrating items (such as raceways), annular distances, and products used.

All elements of a tested and rated firestop system, including the assembly into which the system is installed, constitute a specifically engineered system of protection that must be installed in strict accordance with the system details, instructions, and description.

4.2.2 Engineering Judgments (EJs)

When an application is encountered that is not specifically addressed by an existing firestop~~UL~~ system, consult the firestop product and material manufacturer for an Engineering Judgment (EJ). EJs are site specific and application specific when a system that has been tested and listed by a third-party testing agency does not exist for a specific application. The firestop manufacturer is able to provide an EJ based on existing systems to recommend a unique firestop solution or system for unique applications. An EJ is an alternative to tested and listed systems. See “Recommended IFC Guidelines for Evaluating Firestop System Engineering Judgments” for additional information.

4.2.3 Dielectric Strength

Dielectric strength can be an important firestop material property when firestopping components protect an active, uninsulated electrical load (i.e., bus ducts). Ensuring that the firestopping material's dielectric strength is greater than the operating voltage of the protected circuits and equipment will prevent the firestop installation from becoming electrically conductive and possibly creating an external electrical pathway for fault current.

4.2.4 Ampacity Derating

Firestopping electrical penetrations creates a thermal barrier that restricts the ability of conductors and cables to conduct heat to the ambient air. Consequently, when firestopping electrical penetrations, conductor ampacity must be evaluated and derated when necessary.

Where indicated in the firestop system, the derating of conductor ampacity has been incorporated into the firestop system design in accordance with UL Subject 1712, Outline of Investigation for Tests for Ampacity of Insulated Electrical Conductors Installed in Fire Protective Systems.

If not specified in the firestop system for the application, the effect of the firestop system on conductor ampacity has not been investigated. See IEEE 848, IEEE Standard Procedure for the Determination of the Ampacity Derating Factor for Fire-Protected Cable Systems, for additional information.

4.2.5 Choosing the Correct Firestop System Detail

Selecting the correct firestop system detail is contingent upon the following information:

- Floor or wall construction type and thickness
- Hourly fire rating of the assembly
- Penetrating item(s) and size(s)
- Size of the opening/annular space
- Percent conductor fill
- Packing and forming materials, if required
- Optional or required steel sleeve

5. Common Electrical Penetrations

5.1 Cable Penetrations

When cables penetrate rated assemblies, openings should be small to minimize the amount of heat transfer and firestopping required. Cables may penetrate as individual cables or as part of a cable bundle. Selecting the proper firestopping system depends on the size, type, and number of cables penetrating the assembly and whether dielectric strength of a certain level is required during the operation of the system. Cables must be supported on both sides of a wall assembly penetration as well as the top-side of a floor penetration.

Firestopping products that work well for this application include sealants, wrap strips (for large bundles),

devices, fire rated foam, and foam plugs (when routed through a section of conduit piping or sleeve at the penetration). Cables and other combustible items that are routed through an open-air plenum of a building are required to have additional protections to limit the flame spread and smoke development indices.

5.2 Conduit Penetrations

When conduits penetrate rated assemblies, openings should be kept as small as possible to minimize the amount of heat transfer and firestopping required. Conduits must be supported on both sides of a wall assembly penetration as well as the top-side of a floor penetration.

Selecting the correct firestop system detail is contingent upon the following information:

5.2.1 Metallic Conduit

Metallic conduits are typically classified in one of three thicknesses, namely Rigid Metallic Conduit (RMC), Intermediate Metallic Conduit (IMC), or Electrical Metallic Tubing (EMT).

Metallic conduit material is typically steel. Aluminum conduits require more firestopping as aluminum has a much lower melting point than steel. Consequently, aluminum conduits would not be expected to maintain their integrity during a fire event, similarly to non-metallic conduits, and require different firestopping materials and methods than steel conduits. Carefully select the firestop system to ensure suitability with the conduit material and conduit wall thickness.

Firestopping products that work well for metallic conduits include sealants, devices, fire rated foam, and foam plugs. See Figure 5.2.1.

Figure 5.2.1. Fire rated foam application.
Photo courtesy of 3M.

5.2.2 Non-Metallic Conduit

Non-metallic conduits are typically classified in one of two categories, namely Rigid Non-metallic Conduit (RNC) or Electrical Non-metallic Tubing (ENT). Non-metallic conduits will typically burn in a fire and would not be expected to continue in service during a fire event. Carefully select the firestop system to ensure suitability with the conduit material.

Non-metallic conduit and other combustible items that are routed through an open-air plenum of a building are required to have additional protections to limit the flame spread and smoke development indices.

Firestopping products that work well for this application include sealants (for small diameter conduits), devices, fire rated foam, and foam plugs.

5.3 Cable Tray Penetrations

Cable trays will need to be supported on both sides of a wall assembly penetration as well as the top-side of a floor penetration.

When cable trays penetrate rated assemblies, openings should be kept as small as possible, but adequately sized to accommodate the cable tray. Avoid routing additional penetrations through the same opening with cable trays.

Determine the dimensions of the cable tray and the number of conductors contained within the cable tray to select a suitable firestopping system.

Firestopping products that work well for cable trays include composite sheets, pillows, blocks and planks, and devices (for small-dimensioned trays/baskets) in conjunction with sealants, wrap strips, putty, and fire rated foam to fill the interstices between cables.

5.4 Data/Communication System Penetrations

Data and communication system penetrations may be firestopped using any of the previously mentioned methods in accordance with an approved firestopping system. Keep in mind that any critical building systems, such as first responder communication systems and fire alarm systems, may require additional fire protection coverage to ensure continuous operation during a fire event. Critical systems can be protected with flexible mat systems as well as other approved methods in the applicable codes.

For communication systems that are not critical to maintain during a fire event, consider using firestopping materials that allow for easy repair and/or replacement. Firestop devices, putty, and fire rated foam are examples of materials that can be used and lend themselves well for cable upgrades and future work.

5.5 Busway and Bus Duct Penetrations

While less common penetrants, busways and bus ducts require specific care when routed through fire rated assemblies. Busways will often require products with a known dielectric strength and will need to be de-energized during firestop installations. Bus ducts may require firestop materials to be installed both around the duct and inside of the duct.

Mineral wool and sealant can be used when the size of the opening is kept to a minimum. Larger openings may be firestopped using pillows, blocks and planks, or composite sheets. Select the proper firestop system suitable for the busway or bus duct materials and loading and dielectric requirement.

5.6 Large (Combination) Openings

Large penetration openings with multiple utilities should be avoided whenever possible as different

materials require different types of firestop, which can make the opening more difficult to close in the event of a fire and may not be as stable compared to multiple smaller openings.

Suitable firestop products for large openings can include composite sheets, blocks and planks, and pillows, and will also likely require the use of sealant, fire rated foam, and wrap strips. See Figure 5.6. There are systems for large combination openings with mineral wool and sealant, but particular care needs to be taken to ensure that the size of the opening, size and number of penetrants and spacing between penetrants is within the parameters of the selected firestop system.

Figure 5.6. Large opening closed with fire barrier pillows and putty. Photo courtesy of 3M.

5.7 Panel Box/Control Box/Other Large Wall Openings

Membrane openings for electrical outlet boxes in rated walls either need to meet all the exemption criteria in the building code, or will need to have additional protections applied in order to restore the fire and temperature ratings of the assembly.

Smaller openings for electrical switches and receptacles are typically protected with either moldable putty pads or an intumescent insert. For larger membrane openings, such as panelboard enclosures, firestop materials are typically applied to the outside surfaces of the box to restore the fire and temperature ratings of the wall.

Common products for this application include endothermic mats, and putty pads when used in conjunction with mineral wool insulation. Care should be taken to ensure that requirements for the box, coverplate, and other parameters are followed as required by the selected firestop system.

6. Installation and Product Type Overview

6.1 General

Select and install firestopping products and materials in accordance with the approved firestop system or EJ for the specific application.

In general, the ratings for firestop systems installed in walls apply when either face of the wall is exposed to fire, and the ratings for firestop systems installed in a floor apply when the underside or ceiling surface is exposed to fire. For wall applications, install the firestop on both sides of the wall.

Where used for firestop applications, hardware, anchors, fasteners, clamps, struts, supports, and other

miscellaneous and similar materials are required to be steel.

Dispose of waste firestop material and empty and partially empty containers in accordance with applicable state and federal environmental regulations. Recycle packaging materials to the greatest extent possible.

6.1.1 Penetrating Items

Wiring methods, such as electrical raceways, cable trays, busway, conductors, and cables, must be approved, permitted, and installed in accordance with the NEC. Firestop systems shall specifically describe the wiring methods used for the electrical penetration made, including the maximum sizes of raceways, conductors, and cables and the maximum number of conductors in individual cables, as applicable. All electrical conductors are intended to be constructed of copper unless indicated otherwise in the firestop system.

Where the firestop system specifies that the penetrating item is to be rigidly supported on both sides of the wall or floor, the support system should be designed assuming that the firestop system provides no support of the penetrating item.

Penetrating items should penetrate the wall or floor assembly at a 90-degree angle unless otherwise indicated in the firestop system. Where the penetrating item is a metallic conduit, tube, duct or cable, and where the firestop system consists of a fill material, such as sealant, caulk, putty, or mortar, installed along with packing material, the penetrant may be permitted to pass through the opening in the wall or floor assembly with at least a 45-degree angle, provided the annular space is maintained on both sides of the wall or floor assembly.

Maintain the minimum and/or maximum annular space referenced in the firestop system to achieve the hourly rating of the system.

Some systems do not include penetrating items. These firestop systems are intended to be used to seal openings where the penetrating items have been removed, such as during demolition, or where the penetrating items have not yet been installed.

6.1.2 Cleaning and Preparing Substrates

Remove loose dirt and debris from the substrate and penetrating item(s). Clean the substrate and penetrating item(s) in accordance with manufacturer instructions and accepted trade practices using manufacturer approved means and methods.

Ensure that the substrate and penetrating item(s) are dry, including clean of frost, if applicable, prior to installing listed firestop systems.

6.1.3 Packing and Forming Materials

Where required in accordance with the approved firestop system or EJ, install packing and forming materials in accordance with manufacturer instructions and firestop system or EJ requirements.

Ensure that the specified properties of the packing and/or forming material conform to the specific firestop system, such as the material type (mineral wool, backer rod, fiberglass, or similar), physical properties (size and density), and installation (depth, orientation, and compression). Install material that matches the manufacturer specified in the firestop system, where applicable. *NOTE: The packing and forming material properties are critical to the fire-resistance rating of the firestop system.*

Where more than one type of packing material is specified within a firestop system, in general it is intended that any single material listed may be used.

Tightly pack mineral wool, fiberglass, backer rod, or other manufactured packing material to fill the annular space and to provide a substrate for other firestop materials, such as sealant, caulk, putty, or mortar. Ensure that packing material completely fills the void and is recessed from the finished surface by the depth required in the firestop system.

Do not remove packing materials specified for a firestop system after the fill material has cured unless removal is specified in the description of the system.

6.2 Common Firestopping Products

6.2.1 Sealant

Where required in accordance with the approved firestop system or EJ, install fire barrier sealants, including caulk, in accordance with manufacturer instructions and system or EJ requirements.

Sealants are typically used in conjunction with other firestop materials to seal gaps in openings around penetrants or other firestop products, such as pillows, blocks, plugs, planks, blankets, mats, sheets, wrap strips, devices, and collars. See Figure 6.2.1.1.

Figure 6.2.1.1. Fires barrier sealant applied to wall penetration.
Photo courtesy of 3M.

Use sealants with either intumescent, endothermic, or ablative technologies designed to help provide a tight and dependable seal against fire, draft, smoke, toxic fumes, moisture, and sound transmission, as applicable, for through-penetration and membrane penetration firestop applications.

Apply sealants using a standard caulking gun, pneumatic or battery powered pumping equipment, and/or putty knife or trowel, as applicable.

Ensure that sealants are compatible with penetrating items, substrate, and packing materials, if applicable. Ensure that substrates and penetrating items are clean, dry, and free of debris before applying sealant.

Tool sealant into the opening after it has been applied to improve adhesion between the sealant and the penetrating item(s) and substrate.

Completely fill the annular space with sealant. Ensure that sealant meets the minimum depth requirement in accordance with the listed firestop system. After sealants have cured, determine whether sealants comply with an acceptable percentage of shrinkage in accordance with the respective manufacturer's Classification Card in the UL Fire Resistance Directory under XHHW and XHHW7, Fill, Void, and Cavity Materials.

Where penetrating items are in direct contact with the substrate, apply the minimum bead of sealant at the point of contact in accordance with the listed firestop system to completely firestop the penetration.

Mix two-part sealants in accordance with manufacturer instructions. When required by manufacturer instructions, discharge sealant from tubes until the sealant is a consistent color. Dispose of waste sealant in accordance with state and federal environmental regulations.

Use self-leveling sealants only for horizontal or floor applications. Do not use self-leveling sealants for vertical applications, such as on walls. See Figure 6.2.1.2.

Figure 6.2.1.2. Firestop sealant applied to floor penetration. Photo courtesy of 3M.

Do not use interior products for outdoor applications.

6.2.2 Putty

Where required in accordance with the approved firestop system or EJ, install fire barrier putty products in accordance with manufacturer instructions and system or EJ requirements.

Firestop putty can be easily formed to firestop through-penetrations, membrane penetrations, and blank

openings in fire-rated assemblies. During a fire, firestop putty intumesces (expands) in the annular space, completely surrounds the penetrating item, helps prevent the spread of fire, smoke, and toxic gas, and acts as a draft and cold smoke seal for systems with L-Ratings when required and when properly installed.

Putty is moldable and remains pliable, is often used to fill voids in large and/or complex firestop systems, and can typically be removed and reinstalled to re-enter the penetration if needed. Firestop putty can be used in conjunction with other firestop materials to seal gaps in products, such as pillows, blocks, plugs, planks, blankets, mats, sheets, wrap strips, devices, and collars.

When properly installed on electrical boxes and enclosures, firestop putty pads help provide thermal and fire resistance along with reducing sound transmission in fire rated wall assemblies. See Figure 6.2.2. In addition to its fire-resistant properties, pads have airborne sound reduction characteristics which helps minimize sound transmission through assemblies requiring an STC rating when properly installed. See Section 7 for additional information.

Figure 6.2.2. Firestop putty applied to an electrical box.
Photo courtesy of 3M.

Knead putty by hand to improve adhesion between the sealant and the penetrating item(s) and the substrate. Apply putty in the required thickness in accordance with the requirements of the firestop system.

6.2.3 Mortar

Where required in accordance with the approved firestop system or EJ, install fire barrier mortar in accordance with manufacturer instructions and system or EJ requirements.

Firestop mortar is used to firestop penetrations in floors or walls, and the water to mortar mixing ratio can be adjusted to accommodate the two different applications.

Firestop mortar is a lightweight cementitious firestop with variable mix ratios used to firestop through-penetration applications and helps prevent the spread of fire, smoke, and toxic gases when required and when properly installed. In general, higher water concentrations in the mix allow mortar to be self-leveling, such as for floor applications, and lower water concentrations permit troweling, such as for wall applications.

Cut a temporary form from a substantial structural material, such as from plywood, to fit around raceways and attach to the underside of floors or one side of a wall to support mortar in the annular space. Measure

and cut one layer of fire barrier wrap strip, or sheet to wrap around each raceway to protect it from the mortar. Secure the wrap strip, or sheet with the foil side exposed with a 50mm (2 inch) wide band of 0.1 mm (4 mil) thick aluminum foil tape. Slide the wrap strip into the opening so that it is flush with the temporary form, either on the bottom side of the floor surface or on the opposite face of the wall.

Pour water into a bucket. Add firestop mortar mix to the bucket and mix well. Add water and/or mortar mix to reach the desired quantity and required consistency.

For floor and other horizontal applications, pour the mortar mixture into the opening around the raceway to completely fill the annular space. Level off the mortar with a trowel so that it is flush with the top of the finished surface.

For wall and other vertical applications, trowel the mortar mixture into the opening around the raceway to completely fill the annular space. Level off the mortar so that it is flush with the finished surface.

6.2.4 Pillows

Where required in accordance with the approved firestop system or EJ, install fire barrier pillows in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier pillows are used to firestop penetrations in walls and floors, such as raceways, sleeves, cables, cable trays, and irregularly shaped openings.

Fire barrier pillows are intumescent and expand when exposed to fire, locking in place and surrounding penetrating items to help stop smoke, fire and toxic gases from spreading to the next room or next floor through the penetration for the rated time period when properly installed. Locking fire barrier pillows feature interlocking capabilities which firmly hold pillows together. Pillows can be removed and reinstalled to re-enter the penetration if needed.

Determine the size and number of pillows required for each penetration in accordance with manufacturer instructions.

Prepare penetrating items in accordance with manufacturer instructions and system or EJ requirements, such as wrapping penetrating items with the required thickness and width of moldable putty prior to installing pillows.

Install fire barrier pillows with the long axis projecting into the opening. See Figure 6.2.4. Verify that pillows are oriented in accordance with manufacturer instructions, such as which direction any logos or labels are required to face. Center the pillows in the opening. Align the ends of pillows such that the pillows extend an equal distance from each wall surface, ensuring that the pillows will expand equally and remain contained within the framed opening in the event of a fire.

Figure 6.2.4. Installing fire barrier pillows.
Photo courtesy of 3M

When needed, resize pillows in accordance with manufacturer instructions using approved materials and methods, such as removing the outer cover, cutting lengthwise using a serrated knife, and resealing using the removed outer cover and/or 51mm (2 inch) wide tape. Compress pillows in accordance with manufacturer instructions. When permitted by the manufacturer and when needed, create a small puncture in each pillow to allow air to escape from the pillow more readily when it is compressed. Tightly pack pillows such that the pillows fill the annular space of the opening.

Fill any openings between pillow, framing, and penetrating items in accordance with manufacturer instructions and system or EJ requirements, such as filling to the required depth with moldable putty. If required by the system or manufacturer's instructions, secure the pillows in place with wire mesh or other specified support system.

6.2.5 Plugs

Where required in accordance with the approved firestop system or EJ, install fire barrier plugs in accordance with manufacturer instructions and system or EJ requirements.

Pre-formed foam fire barrier plugs are used to firestop penetrations in walls and floors, typically filling either empty openings or capping a sleeve that may either be flush with the wall or floor, or extends a limited distance from the wall or floor surface. See Figure 6.2.5.

Figure 6.2.5. Firestop plug and plank installation.
Photo courtesy of 3M

Fire barrier plugs are used to maintain a tight firestop seal to prevent fire, smoke, and toxic gas transmission.

Install fire barrier plugs within the opening flush with the top surface of the floor or both sides of the wall. Plugs may be compressed to fit smaller openings or a wedge may be cut from the plug to reduce its size to fit within the opening. Cut plugs as needed to fit around penetrants. Cut or punch holes through plugs to route cables through the plug. Fill any openings between plugs, framing, and penetrating items in accordance with manufacturer instructions and system or EJ requirements, such as filling any visible openings with expanding fire barrier foam to the full depth of the plug. Provide additional firestop as needed for non-metallic penetrating items in accordance with manufacturer instructions and system or EJ requirements.

6.2.6 Blocks and Planks

Where required in accordance with the approved firestop system or EJ, install fire barrier blocks and planks in accordance with manufacturer instructions and system or EJ requirements.

Pre-formed foam fire barrier blocks and planks are used to firestop penetrations in walls and floors, including medium and large openings, for penetrating items such as raceways, sleeves, cables, and cable trays. See Figure 6.2.5, above.

Fire barrier blocks and planks are used to maintain a tight firestop seal to prevent fire, smoke, and toxic gas transmission.

Install fire barrier blocks and planks into the opening. Verify that blocks and planks are oriented in accordance with manufacturer instructions, such as which direction any logos or labels are required to face or with the integrated grid not in contact with the substrate or in a grid-to-grid manner. Center blocks and planks in the opening. Install approved sealant, such as fire barrier foam, between blocks and planks and the periphery of the opening and between blocks/planks and penetrants to the full depth of the blocks and planks. Align the ends of blocks and planks such that the blocks and planks extend an equal distance from each wall surface.

When needed, resize blocks and planks in accordance with manufacturer instructions using approved materials and methods, such as cutting lengthwise using a serrated knife. Compressing blocks and planks is not required. Tightly pack such that the blocks and planks fill the annular space of the opening.

Fill any openings between blocks and planks, framing, and penetrating items in accordance with manufacturer instructions and system or EJ requirements, such as filling any visible openings with expanding fire barrier foam to the required depth.

Provide additional firestop as needed for penetrating items in accordance with manufacturer instructions and system or EJ requirements. If required by the system or manufacturer's instructions, install additional opening supports to secure the blocks or planks into the opening.

6.2.7 Composite Sheets

Where required in accordance with the approved firestop system or EJ, install intumescent or composite sheets in accordance with manufacturer instructions and system or EJ requirements.

Composite sheets are used to firestop medium and large penetrations in masonry and concrete construction, such as walls and floors, for penetrating items such as raceways, sleeves, and cable trays. Composite sheets are thermally conductive, which reduces the effects of heat build-up and helps mitigate derating issues with conductors. Composite sheets can be removed, modified if necessary, and reinstalled to allow future access to the penetration.

Composite sheets are an intumescent firestop material that combines steel, intumescent material, wire mesh, and aluminum foil into a composite sheet to help slow the spread of flame, smoke, and toxic gases when properly installed. Composite sheets are relatively easy to handle and can be cut and formed to exact sizes using common trade tools to fit irregular penetrating items and openings.

Lay composite sheets flat and hold tightly before measuring to minimize waste. Measure the opening. Add the prescribed minimum of overlap to all four sides to provide needed space for fasteners. Measure the distance between penetrating items, such as raceways and cable trays, and between penetrating items and the edges of the opening. Transfer the measurements to the composite sheet. Alternatively, create a template using cardboard or other suitable material or use a contour gauge to transfer dimensions to the intumescent sheet prior to cutting.

Cut composite sheets using a jigsaw with a metal cutting blade. Cut sheets with the sheet metal side facing up. Cut each sheet to tightly follow the contour of the firestopping applied to the penetrating items, such as wrap or strips.

Ensure that the sheet metal side of the composite sheet is facing out. Test fit the sheet to the opening and penetrating items. Adjust or modify the sheet as needed to ensure a tight fit and to ensure that the minimum overlap of sheet material is bearing against the substrate on all four sides.

Temporarily secure the intumescent sheet in place with the sheet metal side facing out, and drill through the sheet into the masonry or concrete surface using a masonry bit and hammer drill to install anchors and fasteners. Use anchors, fasteners, and hardware in accordance with manufacturer instructions and system or EJ requirements. Install fasteners within the prescribed distance from each corner and from each seam where sheets butt together as prescribed by the system or EJ. Do not exceed maximum fastener spacing prescribed by the system or EJ measured on center.

Install sealant, such as fire barrier caulk or moldable putty, where composite sheets butt together and around penetrating items that pass-through sheets. Use a wire brush to clean the perimeter area where sheets are anchored to the substrate and install sealant.

6.2.8 Wrap Strips

Where required in accordance with the approved firestop system or EJ, install fire barrier wrap strips in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier wrap strips are flexible one-part fire resistive materials designed to expand to fill the voids around and between combustible items. Wrap strips are designed to maintain a tight firestop seal to prevent fire, smoke, and toxic gas transmission and are used to firestop metallic and non-metallic raceways, cable trays, and cables and cable bundles that penetrate fire rated assemblies.

The minimum layers of wrap strip required depends on the size and material of the penetrating item, the duration of fire protection required, and the fire intensity.

Roll out wrap strip material flat and hold tightly before measuring and cutting to minimize waste. Measure the length of material needed in accordance with manufacturer instructions. Carefully measure the length of material needed to wrap penetrating items, considering any required overlap of the material and considering the additional length needed to accommodate the thickness of prior layers of wrap material installed. Butted joints may be allowed where wrap strips adjoin other pieces on the same layer.

Provide additional firestop materials as needed for penetrating items in accordance with manufacturer instructions and system or EJ requirements. Refer to the system or EJ requirements for how and where to secure the wrap strips to the opening, supporting construction, or other firestop components.

6.2.9 Fire Barrier Foam

Where required in accordance with the approved firestop system or EJ, install fire barrier rated foam in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier foam is a two-part sag-resistant quick curing ~~intumescent~~ expanding material. See Figure 6.2.9. Fire barrier foam is designed to maintain a tight firestop seal to prevent fire, smoke, and toxic gas transmission and is used to fill the annular space in small and large openings created by raceways, sleeves, and cables that penetrate fire rated assemblies. Fire barrier foam is an alternative to firestopping with a sealant in conjunction with mineral wool, blocks, pillows, and backer rods~~other foams~~ used to fill annular space. Fire barrier foam remains pliable after installation to install new cables or raceways in the existing penetration. Note that this is a different product from many single component fireblocking spray foams. Fireblocking materials should not be used in a location that requires firestopping. ~~confused with or used to replace firestop systems.~~

Figure 6.2.9. Firestop foam.
Photo courtesy of 3M

Follow manufacturer instructions for using fire barrier foam. Use manufacturer recommended dispensing application tools and equipment. Ensure that the cartridge is properly aligned in the dispenser to prevent damage to the cartridge.

Ensure that fire barrier foam is at least the minimum recommended temperature for dispensing in accordance with manufacturer instructions to prevent damage to the dispensing tool and/or the cartridge. Do not install fire barrier foam that has been stored in temperatures below manufacturer requirements.

Holding the dispensing tool vertically, fill the mixing tube and verify that the foam is mixing properly prior to installation. Install foam once it has reached a consistent color. Discard any waste foam in accordance with state and federal environmental regulations.

Dispense fire barrier foam from the back to the front of the annular space for wall applications and from the bottom to the top for floor applications. Completely fill the opening as detailed in manufacturer instructions and system or EJ requirements.

After the foam has completed expansion and has slightly cured, remove any foam that has expanded outside of the opening in accordance with manufacturer instructions. Cured foam may be re-used in other openings where allowed by the manufacture's installation requirements. Curing time is dependent upon ambient conditions, such as temperature and humidity. Refer to manufacturer instructions for more information.

When fire barrier foam has cured in the mixing nozzle, remove the plugged mixing nozzle and replace with a new nozzle before dispensing more foam. Do not attempt to dispense foam through a plugged nozzle, which can result in damage to the dispensing tool and/or the cartridge.

6.2.10 Fire Barrier Pass-Through Devices

Where required in accordance with the approved firestop system or EJ, install fire barrier pass-through devices for raceways, cables, and penetrant bundles in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier pass-through devices are easy to install firestop assemblies that are used in high-traffic areas where cables are frequently being added, upgraded, or removed. Pass-through devices protect and organize penetrating items. Pass-through devices are available in different sizes in round and square configurations. Square devices may be stacked in multiple device configurations for larger cable management and firestop applications. See Figure 6.2.10.

Figure 6.2.10. Modular fire barrier pass-through device. Photo courtesy of 3M.

Install fire barrier pass-through devices in accordance with manufacturer instructions. Fire barrier pass-through devices are one-piece metal collar assemblies or enclosures with fixed firestopping intumescent material that works in conjunction with foam smoke seals and/or intumescent fire barrier wrap material

and approved fire barrier sealants for cables and metallic and non-metallic raceways. In the event of a fire, intumescent material quickly expands to seal the inside of the device, helping to prevent the spread of smoke and fire into other compartments when properly installed. Install mounting brackets where required to support single or multiple devices.

6.2.11 Fire Barrier Sleeve Kits

Where required in accordance with the approved firestop system or EJ, install fire barrier sleeve kits in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier sleeve kits are designed to help prevent the passage of fire and smoke in new or existing cable penetrations through walls or floors when properly installed.

Install fire barrier sleeve kits in accordance with manufacturer instructions. Fire barrier kits may include two-part metallic sleeves, two-part metallic flanges, sealant such as fire barrier caulk or moldable putty, sheet metal screws, drywall screws, and identification labels. Two-part sleeves can be installed as one piece for new installations or can be split/hinged for existing cable installations.

6.2.12 Cast-in-Place Devices and Adapters

Where required in accordance with the approved firestop system or EJ, install cast-in-place devices and adapters in accordance with manufacturer instructions and system or EJ requirements.

Cast-in-place devices and adapters are typically one-piece firestopping devices that are installed to firestop metallic and non-metallic raceways and cable penetrations through concrete floor assemblies. Devices and adapters are available in a variety of sizes. Additionally, accessories are available for fluted deck applications and height adjustments to accommodate a variety of field installation conditions.

Cast-in-place devices and adapters are installed during rough-in before concrete is placed. See Figure 6.2.12. Devices and adapters are attached directly to concrete forms or other supports prior to placing concrete. After concrete has cured, raceways and/or cables are passed through devices and adapters.

Figure 6.2.12. Cast-in-Place Devices.
Photo courtesy of 3M

Cast-in-place devices for both metallic and non-metallic raceways typically include intumescent wrap, a flexible smoke seal, and a water-resistant seal to complete the installation.

During rough-in, adjust the device to the proper height. Install the cover on the device. Layout the device at the correct location on the deck and secure to the deck with the screws included with the installation kit.

After concrete is placed to the proper depth, finished, and cured, and from the top side of the floor, break the plastic cap with a hammer and remove. From the bottom side of the floor, remove the label. Install raceways and/or cables through the device from the bottom side of the floor.

Install intumescent wrap, flexible smoke seal, water resistant seal, and other components and accessories in accordance with manufacturer instructions.

6.2.13 Wraps and Mats

Where required to provide continuity of operation of critical circuitry or systems, install fire barrier wraps and/or mats in accordance with manufacturer instructions and system or EJ requirements.

Fire barrier wraps and mats are flexible fire resistive materials designed to wrap around critical building systems to minimize the heat exposure to the wrapped (protected) item. Wraps and mats are designed to maintain a tight protective envelope to prevent transmission of fire, heat, and smoke to the protected item(s).

The minimum layers of wrap and mat required depends on the size of the protected item, the duration of fire protection required, and the fire intensity.

Roll out wrap and mat material flat and hold tightly before measuring and cutting to minimize waste. Measure the length of material needed in accordance with manufacturer instructions. Carefully measure the length of material needed to wrap protected item(s), considering any required overlap of the material and considering the additional length needed to accommodate the thickness of prior layers of wrap material installed. Butted joints may be allowed where wrap and mat adjoin other pieces on the same layer.

Additional support materials may be required for larger width cable trays. Prior to installing wrap material, install approved support materials such as filament tape, wire, metallic braces or covers tightly around the cable tray to support the span of wrap material across the cable tray opening to prevent the wrap material from sagging into the cable tray. Support materials may be omitted where cable trays have sufficient cables and conductors installed to support the span of fireproof mat or wrap across the cable tray opening.

Install fire barrier wrap or mat around raceway sweeps and elbows and around cable tray bends and transitions. See Figure 6.2.13. Cut and install material to accommodate irregular shapes in accordance with manufacturer instructions.

Figure 6.2.13. Cable tray wrapped in fire barrier mat.
Photo courtesy of 3M.

Install each layer of fire barrier wrap or mat material completely before progressing to the next layer. Install wrap or mat material with the material oriented correctly and properly aligned to the protected item. Secure in place temporarily using approved filament tape. Fill all seams, joints, and gaps with fire

barrier sealant to the depth of the wrap in accordance with manufacturer instructions and system or EJ requirements. Tool sealant into the seams and joints. After the sealant is applied, tape all seams and joints with an approved tape product in accordance with the firestop system details. Press the tape down firmly. Use a roller to smooth and shape the tape and to ensure a firm bond.

Install each layer completely until the minimum number of layers are installed in accordance with the firestop system. You may mark or notate each layer as it is installed to keep track of the progress of the installation. Mark the locations of butt joints and seams to ensure that the seams of subsequent layers are offset the minimum distance from the seam in the prior layer.

Install a collar where required at the locations of butt joints of the outermost layers or where the seams of layers are not offset in accordance with the firestop system requirement. Provide the required number of layers of wrap or strips of the required minimum width. Carefully measure the length of the collar material and overlap the material onto itself as required. Center the collar over the joint and ensure that the collar extends the minimum distance on each side of the joint. Secure the collar material with approved filament tape. Apply sealant and tool into seams if required. Seal the edges with approved tape. Press the tape down firmly. Use a roller to smooth and shape the tape and to ensure a firm bond. Apply the minimum number of layers of collar material in accordance with the firestop system requirements.

Insulate hangers and supports, such as threaded rods, that penetrate the protective envelope and are in direct contact with raceways and cable trays with fire barrier wrap or mat to prevent excessive heat from a fire from being conducted by the hangers and supports to inside the protection. Consult the system requirements to determine the minimum distance and number of layers required for threaded rod supports. When the design goal is to not only prevent heat from affecting the raceway via conduction through the hanger assembly, but to also protect the hanger assembly itself, it may be necessary to firestop the entirety of the hanger assembly to the underside of its support structure. When wrapping hangers and supports is not required, provide temporary support for the raceway or cable tray and temporarily remove individual hangers and supports one at a time, firestop the raceway or cable tray, and reinstall hangers and support on the outside of the wrap or mat.

Secure the material in place by installing bands around wrap and mat in accordance with manufacturer instructions and firestop system or EJ requirements. Position bands in accordance with the system, EJ, or manufacturer requirements on the outermost layer of material. Do not overtighten bands, which can cut into the material or covering.

Where access is required to cable trays for inspections or for the future installation of cables or conductors, provide access through the firestop mat in accordance with manufacturer instructions. In general, provide a removable section of firestop material where needed along the length of the cable tray. Stagger joints in the adjacent layers of firestop material with the minimum amount of overlap in a stairstep fashion on each side of the accessible location, resulting in each outer layer of firestop material being larger in length and width than the previous layer. Alternatively, access can be cut into the finished firestop mat assembly in the future. Using a sharp knife set to a depth of the thickness of the mat, cut the top layer of firestop mat or wrap. Remove the top layer of firestop mat and set aside for later reinstallation. Cut subsequent layers of firestop mat but reducing the opening cut into the layer by the minimum amount of overlap required in each direction, length and width, to stagger the joints in a stairstep fashion between the layers. Remove and retain the firestop material for later reinstallation.

6.3 Labels and Certifications

Where required in accordance with the approved firestop system or EJ, install labels identifying the firestop system and materials that are installed. Identify the ~~UL~~ firestop system nomenclature for each type of firestop system installed.

When required, provide a qualified third-party inspector to provide a firestop special inspection and to provide a firestop special inspection label when the firestopping passes the inspection. Documentation and labeling from this third-party inspection provides evidence to the AHJ and other Code authorities that the Certified firestop system has been properly installed. This documentation can also be used to verify compliance of the installation during the final inspection for issuance of the certificate of occupancy, when applicable.

Provide certifications of the qualifications, training, and experience of installers of firestop systems and materials.

Provide certifications of compliance for all materials and means and methods of installation for each firestop system installed. Identify the model Code requirements for the installation of listed firestop systems for each application and provide certifications of compliance with applicable Code requirements.

Provide documentation of any EJs that were obtained from a manufacturer of firestopping materials for the project, if applicable.

7. Electrical Boxes

7.1 Code Requirements

7.1.1 NFPA 70, National Electrical Code (NEC) Requirements

In general, firestopping of electrical penetrations is required in NFPA 70, National Electrical Code (NEC) Section 300.21, which requires that electrical installations in hollow spaces, vertical shafts, and ventilation or air-handling ducts be made so that the possible spread of fire or products of combustion will not be substantially increased. Additionally, openings around electrical penetrations into or through fire-resistant-rated walls, partitions, floors, or ceilings must be fire-stopped using approved methods to maintain the fire resistance rating of the assembly.

Consult applicable building Codes, fire resistance directories, and product listings for assistance in complying with the requirements of NEC Section 300.21.

7.1.2 IBC Requirements for Steel Electrical Boxes That Do Not Exceed 103 Square cm (16 Square Inches)

For steel electrical boxes not exceeding 103 square cm (16 square inches), the IBC permits the installation of unprotected boxes within a rated wall assembly provided that the sum total area of openings (wall cutouts) for those boxes does not exceed 645 square cm (100 square inches) for any 9.3 square meters (100 square feet) of wall. The annular space between electrical boxes and the wall membrane must not exceed 3.2 mm (1/8 inch).

Steel electrical boxes not exceeding 103 square cm (16 square inches) located on opposite sides of a fire-rated wall or partition must be spaced or separated in accordance with one of the following:

1. A horizontal distance of not less than 610 mm (24 inches) in walls constructed of individual noncommunicating cavities provided that the fire-rated wall board attaches to the same stud on both sides of the wall.
2. A horizontal distance greater than the depth of the wall cavity in walls where the wall cavity is filled with rockwool, slag mineral wool insulation, or cellulose loose-fill.
3. By solid fire-blocking in accordance with IBC Section 718.2.1 Fireblocking materials.
4. By installing putty pads wrapped around electrical boxes on both sides of the wall. See Figure 6.2.2, above.
5. By other listed materials or methods (e.g., firestop box inserts, firestop cover plate gaskets).

Putty pads and other listed materials or methods in Item Numbers 4 and 5, above, must be installed in accordance with the listing, and provide equal fire (F) and temperature (T) ratings. See UL listing category CLIV for suitable firestop systems.

7.1.3 IBC Requirements for Steel Electrical Boxes that Exceed 103 Square cm (16 Square Inches)

Install steel electrical boxes that exceed 103 square cm (16 square inches) in accordance with the installation instructions and listing limitations for Certified products used to preserve the fire resistance rating of the assembly.

Provide additional firestop protection, such as putty pads, for steel electrical boxes that exceed 103 square cm (16 square inches) regardless of the spacing to other boxes on the opposite sides of the wall. *NOTE: Certification listings of putty pads will typically indicate the largest steel box that can be protected with the specific putty pad*.

See UL listing category CLIV or XHEZ for suitable firestop systems.

7.1.4 IBC Requirements for Nonmetallic Electrical Boxes

Install nonmetallic electrical boxes tested for use in fire-resistance-rated assemblies. Install in accordance with the instructions included in the listing. See UL listing category CEYY, Outlet Boxes and Fittings Classified for Fire Resistance. The annular space between electrical boxes and the wall membrane must not exceed 3.2 mm (1/8 inch).

For nonmetallic electrical boxes, the total area of openings (wall cutouts) for boxes must not exceed 645 square cm (100 square inches) for any 9.3 square meters (100 square feet) of wall with no single opening exceeding 141.9 square cm (22.0 square inches).

Nonmetallic electrical boxes located on opposite sides of a fire-rated wall or partition must be spaced or separated in accordance with one of the following:

1. A horizontal distance specified in the listing of the electrical boxes.
2. By solid fire-blocking in accordance with IBC Section 718.2.1 Fireblocking materials.
3. By installing putty pads wrapped around electrical boxes on both sides of the wall. See Figure 7.1.4.
4. By other listed materials or methods (e.g., firestop box inserts, firestop cover plate gaskets).

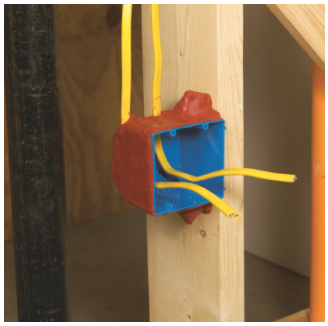

Figure 7.1.4. Firestop putty application on non-metallic electrical box. Photo courtesy of 3M.

Putty pads and other listed materials or methods in Item Numbers 3 and 4, above, must be installed in accordance with the listing. See UL listing category CLIV for suitable firestop systems.

7.2 Products and Applications

Firestop electrical boxes using listed firestop materials, means, and methods in accordance with manufacturer instructions and in accordance with the NEC and IBC.

Install firestop putty pads or use other tested and Certified materials, such as firestop box inserts, firestop coverplate gaskets, and endothermic mats, for firestopping recessed electrical outlet boxes. *NOTE: Firestop putty pads provide thermal and fire resistance along with reducing sound transmission in fire rated wall assemblies when properly installed*.

Apply the minimum required thickness of moldable firestop putty pads to completely cover the external surfaces of metallic and nonmetallic electrical boxes. Where electrical boxes are installed against a stud within the wall cavity, install putty pads to completely seal the box against the stud within the wall cavity. For some firestop systems, extend the putty pads a minimum of 13 mm (1/2 inch) onto the stud and on to the adjacent gypsum board within the stud cavity. See Figure 6.2.2, above. Overlap adjoining pieces of moldable putty pads at all seams to achieve the minimum required thickness.

Metallic outlet boxes may be provided with steel attachment brackets that offset the box a minimum of 6 mm (1/4 inch) from the stud. When steel attachment brackets are used, apply putty pads to the back and all four sides of the box.

Apply firestop putty around raceway and cable connectors and fittings at the box according to the system, EJ, or manufacturer's requirements. For Type NM cable, apply a thick layer of putty around each cable at its connection to the box in accordance with the system requirements. Extend the putty along the conductor away from the box as required by the firestop system, EJ, or manufacturer instructions.

Where steel electrical boxes are interconnected by means of metallic raceways, a ball of firestop putty may be required in the opening of each raceway within the electrical box to prevent the passage of smoke or fire between boxes.

When used, install firestop box inserts, which are pre-shaped thin rectangular pads of intumescent material, inside the electrical box between the back of the box and any conductors or wiring. Install firestop box inserts in accordance with the installation instructions supplied with the product. Inserts may be cut and combined to achieve the required dimensions for coverage and adhered to the interior back

wall of the outlet box if allowed by the system.

When used, position firestop cover plate gaskets, which are similar to intumescent box inserts and are pre-cut to match the shape of an electrical box cover plate, behind the faceplate of the electrical box.

When used, cut and apply endothermic mats, which are rolls of semi-flexible multi-layered material, usually with one metal foil surface, to the exterior sides of larger recessed boxes as needed to provide the code-mandated fire resistance rating.

8. Adverse Conditions

8.1 Exposure to Liquids

In general, care should be taken to avoid exposure to liquids for firestop systems. Some firestop systems are rated for water exposure and can help prevent the unintended flow of water from one building compartment to another. These systems are listed with a "W" rating and have been tested and evaluated in accordance with UL 1479. These systems can maintain their fire protection rating, even after an exposure to water. A class 1 W rating means that the firestop system is capable of withstanding a 36-inch water column for a minimum of 72 hours without any infiltration of water through the firestopping system.

For liquids other than water, care should be taken to avoid exposure to firestop systems. If there is an incident of liquid exposure, the manufacturer of the firestop material should be contacted to evaluate the potential impact on the firestop system. Additionally, ASTM E2785 Standard Test Method for Exposure of Firestop Materials to Severe Environmental Conditions may be used to help evaluate the impact of any liquid exposure to the firestop system.

If the surrounding construction has been damaged due to exposure to water or other liquids and must be replaced, the firestop system should be removed and replaced once the surrounding construction is restored.

8.2 Exposure to Smoke

If a firestop system is exposed to smoke at low temperatures with no exposure to fire or flames and the service temperatures of the firestop materials has not been exceeded, it may be possible to clean and retain the firestop materials in place.

If the surrounding construction has been damaged due to exposure to smoke and must be replaced, the firestop system should also be removed and repaired or replaced once the surrounding construction is restored. Consult the firestop system material manufacturer to determine whether the firestop materials can be reused or must be replaced.

8.3 Exposure to Heat and/or Flames

Disassemble firestopping that has been exposed to flames or to heat that exceeded the service temperatures of the firestop materials or components used in the firestop system and inspect for failure of the firestop system, such as passage of smoke or flames through the penetration, and for internal damage

to the fire-rated assembly. After the fire-rated assembly has been repaired and/or replaced by skilled tradespersons, install new firestopping in accordance with the firestop system required for the application.

(This Annex is not part of the Recommended Practice)

Annex A: Maintenance

A.1 General

In accordance with NFPA 1, Fire Code, Section 12.3.2 Quality Assurance of Penetrations and Joints, a quality assurance program for the installation of devices and systems installed to protect penetrations must be prepared and monitored by the Registered Design Professional (RDP) responsible for design.

Inspections of firestop systems of the types tested in accordance with ASTM E814 (ANSI/UL 1479), Standard Test Method for Fire Tests of Penetration Firestop Systems must be conducted in accordance with ASTM E2174, Standard Practice for On-Site Inspection of Installed Firestop Systems.

While the quality assurance program for inspecting, maintaining, and repairing firestop systems is provided by the RDP for the specific firestop systems installed, the guidance for inspecting, maintaining, and repairing firestop systems, below, is general in nature.

A.2 Inspections

Inspections of firestop systems shall be conducted by properly trained and qualified inspectors with specialized knowledge and experience in the proper installation of firestopping systems. See ASTM E3038, Standard Practice for Assessing and Qualifying Candidates as Inspectors of Firestop Systems and Fire-Resistive Joint Systems, and ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection, for guidance in determining the qualifications of an inspection agency and/or individual inspector.

When special inspections of firestop are required for a building, the inspection process shall follow the ASTM E2174 procedures.

Review up-to-date life safety drawings that are stamped by a licensed Fire Protection Engineer for the site, when available, to identify fire rated walls and assemblies prior to conducting field inspections of penetrations and firestopping.

Check for physical damage to firestop systems. When possible, repair damage to firestop systems in accordance with Section A.3. When required, replace firestop systems in accordance with the firestop system requirements.

Verify that sealant and other firestop materials are certified and have been tested to the required standard for the code mandated hourly fire rating, referring to the life safety drawings for the site for fire-rated walls and assemblies.

Check for improper patching and repairs, such as sections of gypsum wall board installed over holes in a fire-rated assembly in lieu of a proper firestop system to maintain the integrity of the passive fire-resistance assembly.

Check for proper labeling of installed firestop systems and/or third-party certifications indicating that the construction site practices comply with the model code requirement for the installation of listed firestop systems in these applications.

A.3 Patching, Repairs, and Re-Entry

Patch and repair damaged firestop systems using materials, means, and methods identified in the original firestop system. Clean substrates before installing new firestop materials.

Ensure that all surfaces and substrates are clean, dry, and free from debris. To ensure adequate pressure against the bonding surfaces, tool sealant into the area being repaired, when applicable. Allow sufficient curing time for sealants before exposure to normal circumstances of operation, such as vibration, compression, or tension.

Where sealants are damaged or have lost adhesion, cut out and replace damaged or compromised sealant or repair by installing new sealant.

For firestop systems that are re-enterable, such as firestop pillows and/or firestop putty, remove and rework the penetration in accordance with the firestop system instructions. Maintain the integrity of the installed system to the greatest extent possible while re-entering the penetration. Use only identical firestop materials, means, and methods to restore the firestop system when work is complete. When required, install a different firestop system and/or different firestopping products to accommodate changes in the type and/or size of penetrant, number of penetrants, or allowable spacing within the firestop system.

(This Annex is not part of the Recommended Practice)

Annex B: Reference Standards

This publication, when used in conjunction with the National Electrical Code and manufacturers' literature, provides recommended guidelines for firestopping electrical penetrations. The following publications may also provide useful information:

National Fire Protection Association 1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
800-344-3555
www.nfpa.org

NFPA 1, Fire Code

NFPA 70, National Electrical Code (ANSI)

NFPA 101, Life Safety Code

NFPA 221, Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls

ASTM International
100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA 19428-2959
610-832-9500
www.astm.org/

ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection,

ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems

ASTM E1725 Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems for Electrical System Components

ASTM E2174, Standard Practice for On-Site Inspection of Installed Firestop Systems

ASTM E2785, Standard Test Method for Exposure of Firestop Materials to Severe Environmental Conditions

ASTM E3038, Standard Practice for Assessing and Qualifying Candidates as Inspectors of Firestop Systems

ASTM E3157 Standard Guide for Understanding and Using Information Related to Installation of Firestop Systems

International Code Council, Inc.
200 Massachusetts Ave, NW, Suite 250
Washington, DC 20001
888-422-7233
www.iccsafe.org

International Building Code (IBC)

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, 17th Floor
New York, NY 10016-5997
212-419-7900
www.ieee.org

IEEE 848, IEEE Standard Procedure for the Determination of the Ampacity Derating Factor for Fire-Protected Cable Systems

Underwriters Laboratories
333 Pfingsten Road
Northbrook: Illinois, 60062
847-272-8800
www.ul.com

UL Fire Resistance Directory

ANSI/UL 1479, Fire Tests of Penetration Firestops

UL Subject 1712, Outline of Investigation for Tests for Ampacity of Insulated Electrical Conductors Installed in Fire Protective Systems

International Firestop Council
10045 Baltimore National Pike
Ste A7 PMB 203
Ellicott City, MD 21042
(201) 471-0235
info@firestop.org

Recommended IFC Guidelines for Evaluating Firestop System Engineering Judgments

Current National Electrical Installation Standards™ published by NECA: