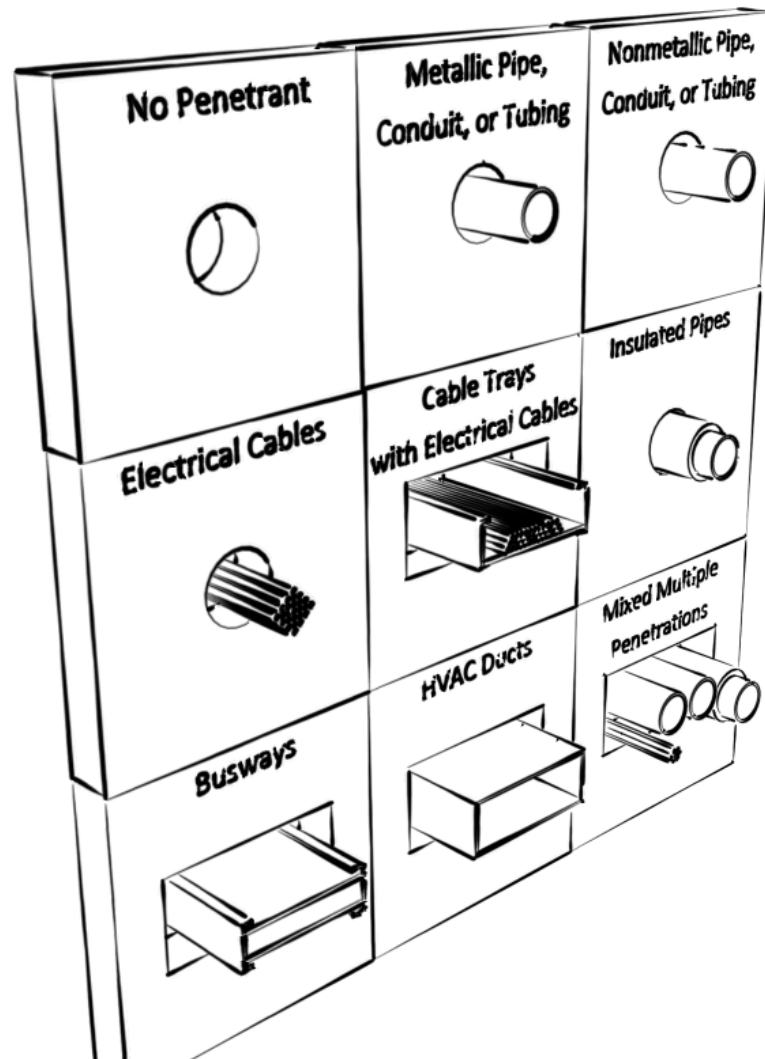


Understanding and Applying Through-Penetration Firestop Systems



Department of Permitting Services
Montgomery County, Maryland

Scope and Purpose

The following guide has been developed as reference tool to improve the understanding of *through-penetration* firestopping systems. This guide is also intended to serve as a common reference point in discussions between design professionals, government regulators, and field contractors for the selection and application of *through-penetration* firestopping systems.

Other forms of firestopping systems, such as *fire resistive joint systems* and *perimeter fire barrier systems*, are not within the scope of this document. Additionally, this guide is not intended to provide complete and comprehensive information regarding firestopping systems, but only to serve as a starting point for understanding.

Why Firestop Systems are Necessary

The *model codes* have very clear requirements on passive fire protection, and with good reason. Historical records of structure fires consistently show that unprotected or improperly protected *through-penetrations* of fire-rated *assemblies* result in injuries, loss of life, and millions of dollars in property damage and due to the unrestrained extension of fire, smoke, and toxic gases. To mitigate these fire-related losses, *model codes* require fire testing for *through-penetration* firestop systems. These provisions are included in Chapter 7, Fire and Smoke Protection Features, of the International Code Council's (ICC) International Building Code (IBC), and Chapter 8, Features of Fire Protection, of the National Fire Protection Association's (NFPA) Life Safety Code (NFPA101).

Where required by a *model code*, the fire resistance ratings of walls, floor/ceiling, or roof/ceiling *assemblies* must be restored when an opening is made to accommodate penetrations for mechanical, electrical, plumbing, fire protection, and communication systems.

Review and Inspection

As part of the Montgomery County Department of Permitting Services (DPS) permit application process, the submitted construction documents are subjected to a review for compliance with the adopted *model codes*, as well as state and local amendments to the adopted *model codes*. During this review, the specifics of any proposed firestopping system may be investigated to determine that the fire-resistance rating of a particular fire-rated assembly is being maintained. The details, system numbers, manufacturer installation recommendations, and other design listing information should be provided on the plan submittals and made available to field inspectors.

During construction, inspections are required to verify that the methods and materials are appropriate for the firestopping system and the assembly the firestop system is installed in, the firestop system is installed in accordance with the manufacturer's recommendations, and that the fire resistance rating of the assembly has not been reduced. These inspections must occur prior to concealing any installed firestopping systems. In Montgomery County, unless otherwise approved, these inspections are conducted by inspectors from DPS.

Testing and Approval

Nationally recognized testing laboratories (NRTL) are testing facilities that provide independent product testing and certification services, typically to product manufacturers. Testing and certification is required to be conducted in conformance with applicable product safety test standards that have been developed through a consensus-based process.

Assuming the fire-rated assembly or firestop system meets the testing standards, the fire test results are typically included as design listings in the fire resistance directories published by the NRTL. These directories are an important source of information during the plan review and inspection processes.

The following are some of the NRTLs that conduct tests of firestop systems:

Underwriters Laboratories (UL)
Factory Mutual (FM)
Intertek Testing Services
Omega Point Laboratories (OPI)
Southwest Research Institute (SRI)
Warnock Hersey (WH)

Our example:

To assist in understanding through-penetration firestop systems, we will use an example to demonstrate key points in the selection and application of through-penetration firestop systems.

Our project's design professional has decided to utilize firestopping systems tested and Classified (listed) by Underwriters Laboratories (UL).

Although firestopping systems listed by other NRTL may be acceptable (or even identical to those listed by UL), for the example project used in this guide, we will utilize the UL Classification System.

Types of Firestopping Systems

First character – the first character of a firestop systems model designation indicates what type of assembly is being penetrated: floor, wall, or an assembly that may be used as a floor or wall.

F = Floor *assemblies*

W = Wall *assemblies*

C = Floor *assemblies* and wall *assemblies*

Our example:

Let's say that we are trying to pass several electrical cables from one room to another, penetrating a wall. These two rooms are separated by a 2-hour fire resistance rated wall *assembly*.

The firestopping selected by our project's design professional is UL Listed System No. C-AJ-3154.

C-AJ-3154

Based upon the first character of the system number, we can see that the firestopping system is listed for both wall and floor *assemblies*.

Second and subsequent characters – the second character, and any following characters, indicates construction the type of the floor or wall assembly being penetrated. In general, the construction type can be broken down into three categories: concrete, framed (using a variety of materials), and steel partitions in marine vessels.

A = Concrete floor *assemblies* less than or equal to 5" thick

B = Concrete floor *assemblies* greater than 5" thick

C = Framed floor *assemblies*

D = Steel decks in marine vessels

E, F, G, H, I = Reserved for future use

J = Concrete or masonry wall *assemblies* less than or equal to 8" thick

K = Concrete or masonry wall *assemblies* greater than 8" thick

L = Framed wall *assemblies*

M = Bulkheads in marine vessels

N, O, P, Q, R, S, T, U, V, W, X, Y, Z = Reserved for future use

Our example:

C-AJ-3154

Based upon the second and subsequent characters of the system number, we can see that the firestopping system is listed for:

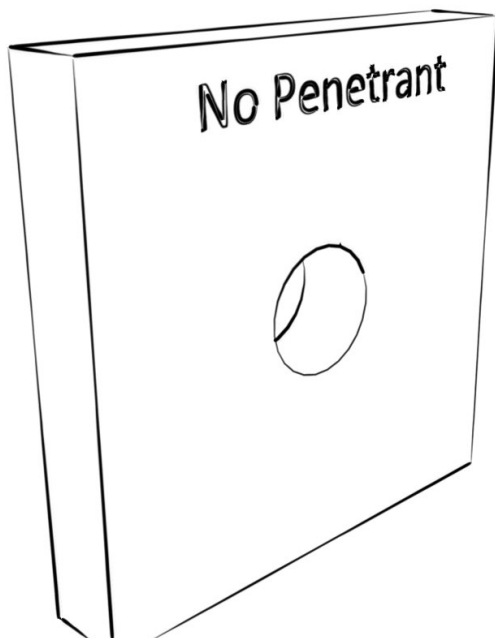
1. A – concrete floor *assemblies* less than or equal to 5 inches thick; and
2. J – concrete or masonry wall *assemblies* less than or equal to 8 inches thick.

For the purpose of our example, we will assume that the electrical cable is penetrating a 4 inch thick concrete wall.

Numeric component

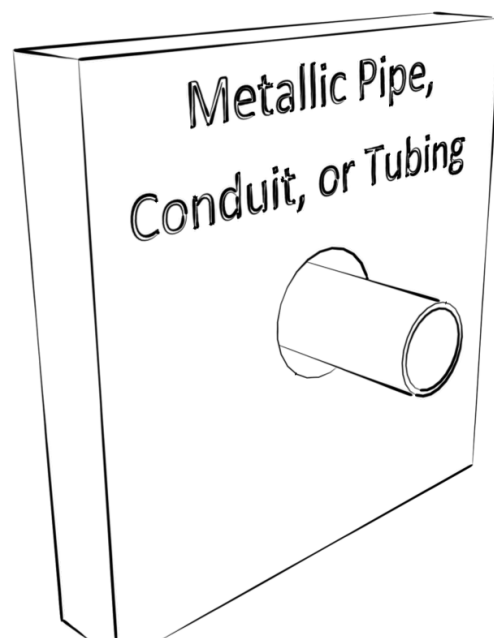
The final four numerals, under the UL numbering system, are the individual system number. The first number of the system number indicates the type of penetrating item that is passing through the assembly. The subsequent three digits are individual system identifying numbers used to distinguish one classified system from another.

The UL system categorizes *through-penetration* firestop systems into nine different categories based on the penetrating item, with a tenth category reserved for future use.



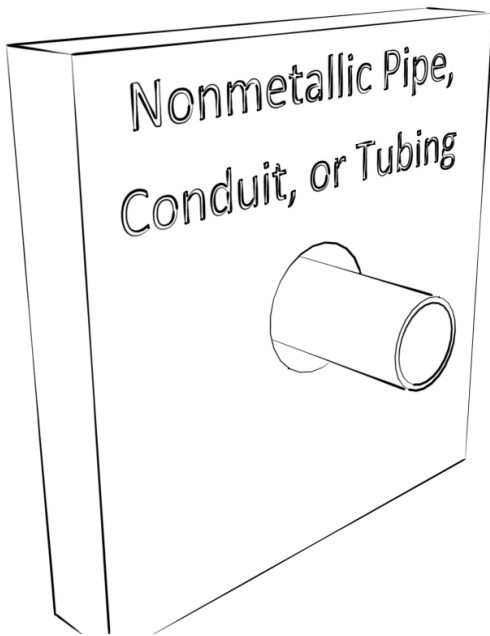
0000-0999

No penetrating item.

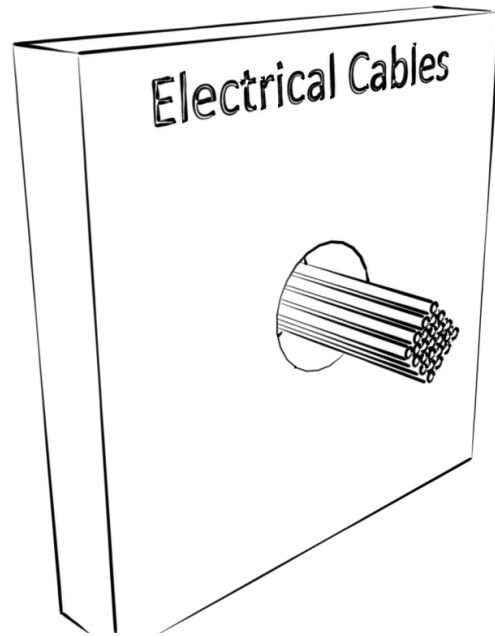


1000-1999

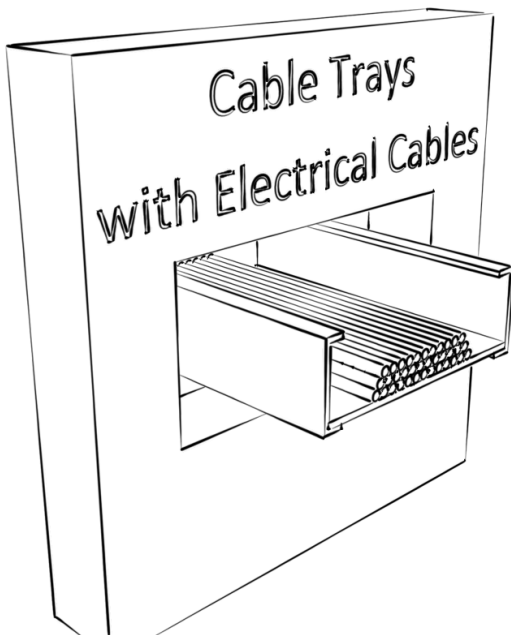
Metallic pipe, conduit, or tubing penetrant.



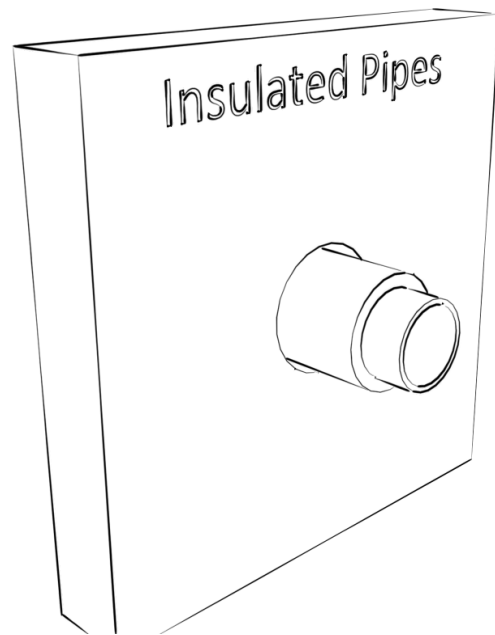
2000-2999
Nonmetallic pipe, conduit, or tubing penetrant.



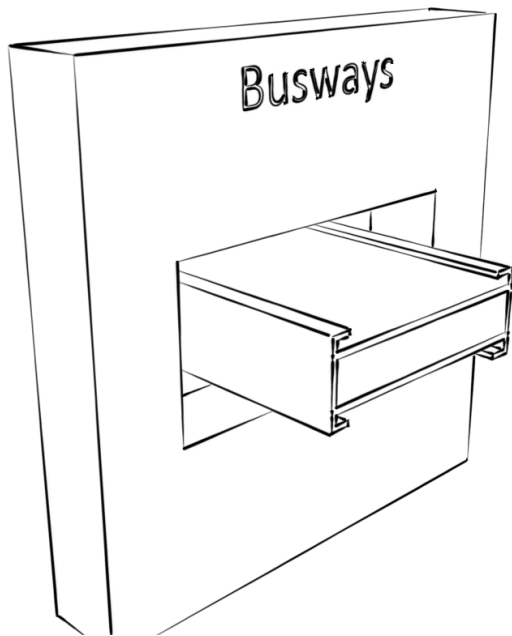
3000-3999
Electrical cables.



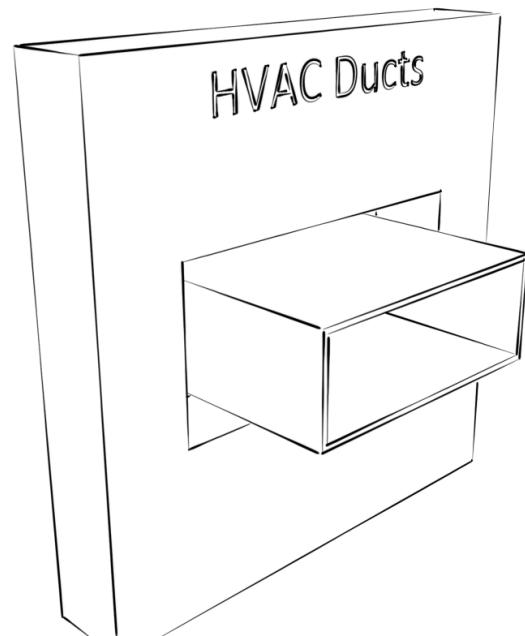
4000-4999
Cable trays with electrical cables.



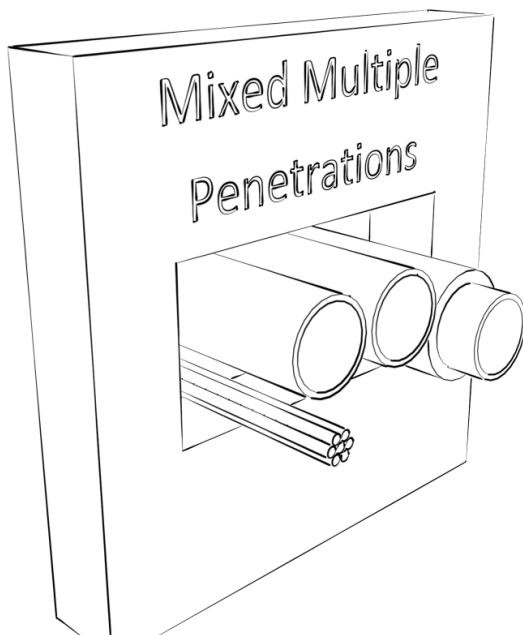
5000-5999
Insulated pipes (metallic and nonmetallic).



6000-6999
Busways.



7000-7999
HVAC Ducts.



8000-8999
Mixed, multiple penetrating items in a
single opening.

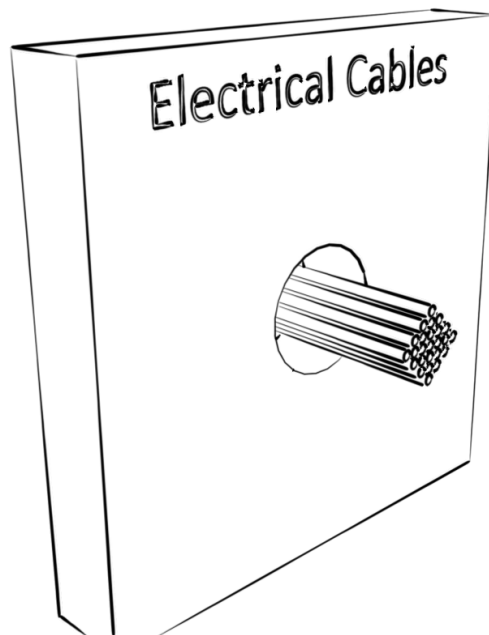
RESERVED

9000-9999
Reserved for future use.

Our example:

C-AJ-3154

Based upon the first digit of the individual system identifying number, we can see that the firestopping system is listed for protection of electrical cables.



C-AJ-3154

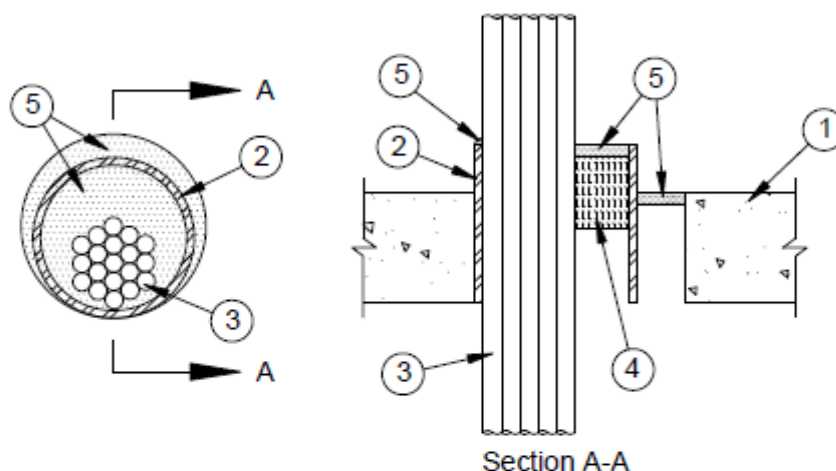
The last three digits of the individual system identifying number complete the system number. These last three digits are assigned to systems in numerical order.

C-AJ-3154, the firestop system used in our example:

System No. C-AJ-3154



ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings - 2, 3 and 4 Hr (See Item 5)	F Ratings - 2, 3 and 4 Hr (See Item 5)
T Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	FT Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)
	FH Ratings - 2, 3 and 4 Hr (See Item 5)
	FTH Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)



- Floor or Wall Assembly** -- Min 2-1/2 in. (64 mm) or 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified Concrete blocks*. Floor may also be constructed of any UL Classified hollow-core Precast Concrete Units*. Max diam of opening is 10 in. (254 mm).
See Concrete Blocks (CAZT) and Precast Concrete Units (CFTV) categories in the Fire Resistance Directory for names of manufacturers.
- Sleeve** -- (Optional) - Nom 6 in. (152 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe sleeve, nom 6 in. (152 mm) diam (or smaller) No. 26 ga (0.022 in. or 0.56 mm thick) sheet steel sleeve with square anchor flange spot welded to sleeve at approx mid-height or nom 6 in. (152 mm) diam (or smaller) Schedule 40 polyvinyl chloride (PVC) pipe sleeve cast or grouted into floor or wall flush with floor or wall surfaces. Steel pipe sleeve may be installed to project a max of 6 in. (152 mm) beyond the floor or wall surfaces. Steel sleeve to be supported on top side of floor and both sides of wall when not cast or grouted into floor. The annular space between sleeve and periphery of opening shall be min 0 in. (0 mm, point contact) to max 3-3/8 in. (86 mm).
- Cables** -- Aggregate cross-sectional area of cables in sleeve to be max 45 percent of the cross-sectional area of the sleeve. See Item 5 for specific cable fill requirements. Tight bundle of cables to be installed in the steel sleeve. The annular space within the firestop system shall be a min of 0 in. (point contact) to a max of 2 in. (51 mm). In 4 hr fire rated assemblies, the annular space within the firestop system shall be a min of 1/4 in. (6 mm) to a max of 1 in. (25 mm). Cables to be rigidly supported on both sides of the floor or wall assembly. Any combination of the following types and sizes of cables may be used:
 - Max 400 pair No. 24 AWG (or smaller) copper conductor cable with polyvinyl chloride (PVC) or plenum-rated jacketing and insulation.
 - Max 3/C No. 2/0 AWG (or smaller) aluminum or copper conductor service entrance cable with PVC insulation and jacket.
 - Max 3/C No. 2/0 AWG (or smaller) copper conductor PVC jacketed aluminum clad or steel clad TECK 90 cable.
 - Max 3/C No. 8 AWG (or smaller) nonmetallic sheathed (Romex) cable with copper conductors, PVC insulation and jacket.
 - Max 1/C 1000 kcmil (or smaller) copper conductor power cable with XLPE or PVC insulation and XLPE or PVC jacket.



Specified Technologies Inc. 210 Evans Way Somerville, NJ 08876

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Created or Revised: November 09, 2012

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F. Max RG59/U (or smaller) coaxial cable with fluorinated ethylene or plenum-rated insulation and jacketing.

G. Max 62.5/48 fiber optic cable with PVC or plenum-rated insulation and jacketing.

H. Max 4 pair No. 24 AWG (or smaller) copper conductor data cable with PVC or plenum-rated insulation and jacket.

- 3A. **Through Penetrating Product*** -- (Not Shown) - Max 4/C No. 2/0 AWG (or smaller) steel or aluminum Armored Cable+ or Metal Clad Cable+ with copper or aluminum conductors. Diam of cable bundle (Item 3) including armored cable not to exceed 4 in. Through penetrating product to be rigidly supported on both sides of a floor or wall assembly.

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4. **Packing Material** -- Min 2, 3 or 4 in. (51, 76 or 102 mm) thickness of min 4 pcf (64 kg/m³) density mineral-wool batt insulation tightly packed into opening as a permanent form for 2, 3 or 4 hr fire rated assemblies, respectively. Packing material to be recessed from top edge of sleeve or from top surface of concrete in cast concrete floor assemblies to accommodate the required thickness of fill material. Packing material to be recessed from both edges of sleeve or from both surfaces of assembly in walls and in floor constructed with hollow-core precast concrete units to accommodate the required thickness of fill material. When the annular space between the sleeve and the periphery of the opening exceeds 2 in. (51 mm), mineral-wool batt insulation tightly packed to a 3 in. depth and recessed from the top surface of the floor or both surfaces of the wall in order to accommodate the required thickness of sealant (Item 5, not shown). Otherwise, packing material is optional in annular space between the sleeve and the periphery of the opening.
5. **Fill, Void or Cavity Material*** -- **Sealant or Putty** -- Min 1/2 in. (13 mm) thickness of sealant applied within the annulus between steel sleeve and periphery of the opening, flush with the top surface of the floor or both surfaces of the wall. Min 1/2 in. (13 mm) diam bead of sealant shall be applied at point contact locations between sleeve and concrete interface on top surface of floor or both surfaces of the wall. Min 1/2 in. (13 mm) thickness of fill material applied within the annulus for 2 and 3 hr F Ratings. Min 3/4 in. (19 mm) thickness of fill material applied with the annulus for 4 hr F Rating. In floors, fill material to be installed flush with top edge of sleeve or top surface of floor. In walls and in floor constructed of hollow-core precast concrete units, fill material to be installed flush with both ends of sleeve or both surfaces of assembly. F and T Ratings of firestop system are dependent upon the through opening size, thickness of concrete, sleeve type and percent cable fill, as shown in the following table:

Max Opening Diam	Min Concrete Thickness	Optional Sleeve Type	Cable Type	Percent Cable Fill	F Rating	T Rating
6 in. (152mm)	2-1/2 in. (64mm)	PVC	A to H, 3A	37	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	PVC	H	45	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	Steel	A to H, 3A	37	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	Steel	H	45	2 hr	0 hr
6 in. (152mm)	4-1/2 in. (114mm)	Steel	A to H, 3A	34	3 hr	1/2 hr
6 in. (152mm)	4-1/2 in. (114mm)	Steel	H	45	3 hr	1/2 hr
2 in. (52mm)	4-1/2 in. (114mm)	Steel	H	40	3 hr	2-3/4 hr
2 in. (52mm)	4-1/2 in. (114mm)	Steel	H	40	4 hr	2-3/4 hr

SPECIFIED TECHNOLOGIES INC -- SpecSeal Series SSS Sealant or SpecSeal LCI Sealant. When min floor or wall thickness is 4-1/2 in. (114 mm), SpecSeal Putty may be used.

*Bearing the UL Classification Mark



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Reading a Firestop System Detail


Details for *firestop systems* can be very specific as to how the system is constructed and what materials may be utilized.

Unless otherwise permitted by the adopted *model code(s)*, the fire rating of the *firestop system* must equal the fire resistance rating of the penetrated fire separating *assembly* in which the *firestop system* is installed. The methods and materials used in penetrations and joints are tested as a system to demonstrate the methods and materials function as fire containment for the required fire endurance rating.

Use of materials other than those listed is not permitted, and a modification to a tested system voids the rating of the system.

<div> <div>  </div> <div> System No. C-AJ-3154 </div> </div>	
ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings - 2, 3 and 4 Hr (See Item 5)	F Ratings - 2, 3 and 4 Hr (See Item 5)
T Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	FT Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)
	FH Ratings - 2, 3 and 4 Hr (See Item 5)
	FTH Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)

At the top of the detail is the system number.

<u>System No. C-AJ-3154</u>		
ANSI/UL1479 (ASTM E814)	CAN/ULC S115	
F Ratings - 2, 3 and 4 Hr (See Item 5)	F Ratings - 2, 3 and 4 Hr (See Item 5)	
T Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	FT Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	
	FH Ratings - 2, 3 and 4 Hr (See Item 5)	
	FTH Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	

1. Floor or Wall Assembly – Min 2-1/2 in. (64 mm) or 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified Concrete blocks*. Floor may also be

The detail also indicates whether the system was tested against a US standard (ANSI/UL 1479) and a Canadian standard (CAN/ULC S115).

2. **Sleeve -- (Optional) -** Nom 6 in. (152 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe sleeve, nom 6 in. (152 mm) diam (or smaller) No. 26 ga (0.022 in. or 0.56 mm thick) sheet steel sleeve with square anchor flange spot welded to sleeve at approx mid-height or nom 6 in. (152 mm) diam (or smaller) Schedule 40 polyvinyl chloride (PVC) pipe sleeve cast or grouted into floor or wall flush with floor or wall surfaces. Steel pipe sleeve may be installed to project a max of 6 in. (152 mm) beyond the floor or wall surfaces. Steel sleeve to be supported on top side of floor and both sides of wall when not cast or grouted into floor. The annular space between sleeve and periphery of opening shall be min 0 in. (0 mm, point contact) to max 3-3/8 in. (86 mm).
3. **Cables --** Aggregate cross-sectional area of cables in sleeve to be max 45 percent of the cross-sectional area of the sleeve. See Item 5 for specific cable fill requirements. Tight bundle of cables to be installed in the steel sleeve. The annular space within the firestop system shall be a min of 0 in. (point contact) to a max of 2 in. (51 mm). In 4 hr fire rated assemblies, the annular space within the firestop system shall be a min of 1/4 in. (6 mm) to a max of 1 in. (25 mm). Cables to be rigidly supported on both sides of the floor or wall assembly. Any combination of the following types and sizes of cables may be used:
 - A. Max 400 pair No. 24 AWG (or smaller) copper conductor cable with polyvinyl chloride (PVC) or plenum-rated jacketing and insulation.

System No. C-AJ-3154



ANSI/UL 1479 (ASTM E814)	CAN/ULC S115
F Ratings - 2, 3 and 4 Hr (See Item 5)	F Ratings - 2, 3 and 4 Hr (See Item 5)
T Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)	FT Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)
	FH Ratings - 2, 3 and 4 Hr (See Item 5)
	FTH Ratings - 0, 1/2 and 2-3/4 Hr (See Item 5)

The detail provides all the ratings the system achieved. UL assigns the following ratings for *firestop systems* based on the characteristics of each system:

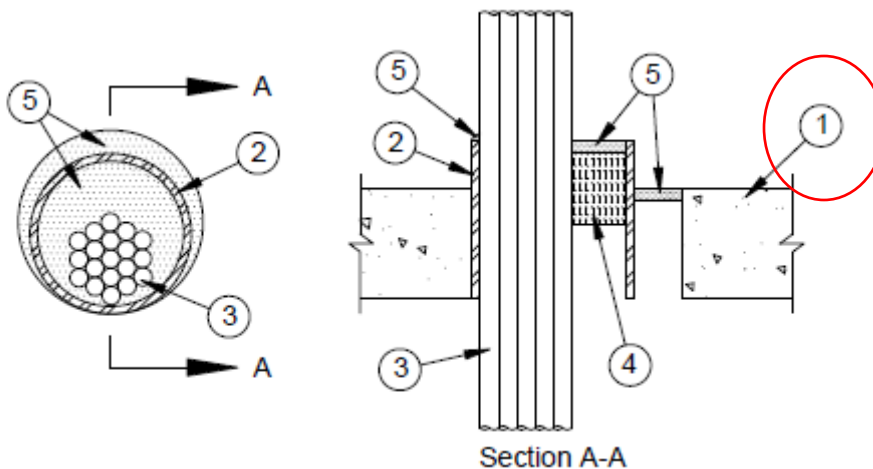
F = rating for passage of flame

T = rating for fire and temperature

L = rating based on the amount of air and smoke leakage

W = rating based on water resistance

Through-penetration firestop systems are required by the *model codes* to have *F ratings* and *T ratings*. Typically, the *firestop systems* must have *F ratings* and *T ratings* of at least 1 hour, but not less than the required fire rating of the *assembly* being penetrated. Floor penetrations located within a wall cavity are not required by the IBC or NFPA 101 to have a *T rating*.



1. Floor or Wall Assembly -- Min 2-1/2 in. (64 mm) or 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified Concrete blocks*. Floor may also be constructed of any UL Classified hollow-core Precast Concrete Units*. Max diam of opening is 10 in. (254 mm). See Concrete Blocks (CAZT) and Precast Concrete Units (CFTV) categories in the Fire Resistance Directory for names of manufacturers.

A graphic illustration detailing the construction of the system will be provided. Each

component of the system is shown and callouts match individual components to detailed information on what materials are to be used, tolerances, how the materials are to be installed, and installation of any required fastening devices.

1. **Floor or Wall Assembly** – Min 2-1/2 in. (64 mm) or 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified Concrete blocks*. Floor may also be constructed of any UL Classified hollow-core Precast Concrete Units*. Max diam of opening is 10 in. (254 mm).
See Concrete Blocks (CAZT) and Precast Concrete Units (CFTV) categories in the Fire Resistance Directory for names of manufacturers.
2. **Sleeve** – (Optional) – Nom 6 in. (152 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe sleeve, nom 6 in. (152 mm) diam (or smaller) No. 26 ga (0.022 in. or 0.56 mm thick) sheet steel sleeve with square anchor flange spot welded to sleeve at approx mid-height or nom 6 in. (152 mm) diam (or smaller) Schedule 40 polyvinyl chloride (PVC) pipe sleeve cast or grouted into floor or wall flush with floor or wall surfaces. Steel pipe sleeve may be installed to project a max of 6 in. (152 mm) beyond the floor or wall surfaces. Steel sleeve to be supported on top side of floor and both sides of wall when not cast or grouted into floor. The annular space between sleeve and periphery of opening shall be min 0 in. (0 mm, point contact) to max 3-3/8 in. (86 mm).
3. **Cables** – Aggregate cross-sectional area of cables in sleeve to be max 45 percent of the cross-sectional area of the sleeve. See Item 5 for specific cable fill requirements. Tight bundle of cables to be installed in the steel sleeve. The annular space within the firestop system shall be a min of 0 in. (point contact) to a max of 2 in. (51 mm). In 4 hr fire rated assemblies, the annular space within the firestop system shall be a min of 1/4 in. (6 mm) to a max of 1 in. (25 mm). Cables to be rigidly supported on both sides of the floor or wall assembly. Any combination of the following types and sizes of cables may be used:
 - A. Max 400 pair No. 24 AWG (or smaller) copper conductor cable with polyvinyl chloride (PVC) or plenum-rated jacketing and insulation.
 - B. Max 3/C No. 2/0 AWG (or smaller) aluminum or copper conductor service entrance cable with PVC insulation and jacket.
 - C. Max 3/C No. 2/0 AWG (or smaller) copper conductor PVC jacketed aluminum clad or steel clad TECK 90 cable.
 - D. Max 3/C No. 8 AWG (or smaller) nonmetallic sheathed (Romex) cable with copper conductors, PVC insulation and jacket.
 - E. Max 1/C 1000 kcmil (or smaller) copper conductor power cable with XLPE or PVC insulation and XLPE or PVC jacket.

It is important to note the specific requirements of the system. All components are mandatory, unless they are indicated as being optional. If optional components are to be installed, then they must be installed within the specifications provided.

Tolerances, such as *annular space* requirements, and size and type of penetrating items, must be adhered to. Tolerances may change based upon the desired rating of the firestop system.

F. Max RG59/U (or smaller) coaxial cable with fluorinated ethylene or plenum-rated insulation and jacketing.

G. Max 62.5/48 fiber optic cable with PVC or plenum-rated insulation and jacketing.

H. Max 4 pair No. 24 AWG (or smaller) copper conductor data cable with PVC or plenum-rated insulation and jacket.

- 3A. **Through Penetrating Product*** -- (Not Shown) - Max 4/C No. 2/0 AWG (or smaller) steel or aluminum Armored Cable+ or Metal Clad Cable+ with copper or aluminum conductors. Diam of cable bundle (Item 3) including armored cable not to exceed 4 in. Through penetrating product to be rigidly supported on both sides of a floor or wall assembly.

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4. **Packing Material** -- Min 2, 3 or 4 in. (51, 76 or 102 mm) thickness of min 4 pcf (64 kg/m³) density mineral-wool batt insulation tightly packed into opening as a permanent form for 2, 3 or 4 hr fire rated assemblies, respectively. Packing material to be recessed from top edge of sleeve or from top surface of concrete in cast concrete floor assemblies to accommodate the required thickness of fill material. Packing material to be recessed from both edges of sleeve or from both surfaces of assembly in walls and in floor constructed with hollow-core precast concrete units to accommodate the required thickness of fill material. When the annular space between the sleeve and the periphery of the opening exceeds 2 in. (51 mm), mineral-wool batt insulation tightly packed to a 3 in. depth and recessed from the top surface of the floor or both surfaces of the wall in order to accommodate the required thickness of sealant (Item 5, not shown). Otherwise, packing material is optional in annular space between the sleeve and the periphery of the opening.
5. **Fill, Void or Cavity Material*** -- Sealant or Putty -- Min 1/2 in. (13 mm) thickness of sealant applied within the annulus between steel sleeve and periphery of the opening, flush with the top surface of the floor or both surfaces of the wall. Min 1/2 in. (13 mm) diam bead of sealant shall be applied at point contact locations between sleeve and concrete interface on top surface of floor or both surfaces of the wall. Min 1/2 in. (13 mm) thickness of fill material applied within the annulus for 2 and 3 hr F Ratings. Min 3/4 in. (19 mm) thickness of fill material applied with the annulus for 4 hr F Rating. In floors, fill material to be installed flush with top edge of sleeve or top surface of floor. In walls and in floor constructed of hollow-core precast concrete units, fill material to be installed flush with both ends of sleeve or both surfaces of assembly. F and T Ratings of firestop system are dependent upon the through opening size, thickness of concrete, sleeve type and percent cable fill, as shown in the following table:

Max Opening Diam	Min Concrete Thickness	Optional Sleeve Type	Cable Type	Percent Cable Fill	F Rating	T Rating
6 in. (152mm)	2-1/2 in. (64mm)	PVC	A to H, 3A	37	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	PVC	H	45	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	Steel	A to H, 3A	37	2 hr	0 hr
6 in. (152mm)	2-1/2 in. (64mm)	Steel	H	45	2 hr	0 hr
6 in. (152mm)	4-1/2 in. (114mm)	Steel	A to H, 3A	34	3 hr	1/2 hr
6 in. (152mm)	4-1/2 in. (114mm)	Steel	H	45	3 hr	1/2 hr
2 in. (52mm)	4-1/2 in. (114mm)	Steel	H	40	3 hr	2-3/4 hr
2 in. (52mm)	4-1/2 in. (114mm)	Steel	H	40	4 hr	2-3/4 hr

SPECIFIED TECHNOLOGIES INC -- SpecSeal Series SSS Sealant or SpecSeal LCI Sealant. When min floor or wall thickness is 4-1/2 in. (114 mm), SpecSeal Putty may be used.

*Bearing the UL Classification Mark

Some systems require the use of proprietary materials, components, or penetrating items. If specific materials are called for, only those materials may be used. For firestop system C-AJ-3154, the following specific materials must be used:

- **Through penetrating item** – Armored Cable+ or Metal Clad Cable+ by AFC Cable Systems Inc.
- **Fill, void or cavity material** – SpecSeal Series SSS Sealant, SpecSeal LCI Sealant, or SpecSeal Putty by Specified Technologies Inc.

Glossary

Annular space - The opening around a penetrating item.

ANSI – American National Standards Institute.

Assembly – an assemblage of parts that is regarded as a single entity.

ASTM – American Society for Testing and Materials.

DPS – Montgomery County Department of Permitting Services.

Fire resistive joint system - An assemblage of specific materials or products that are designed to provide a fire separating function along continuous linear openings, including changes in direction, between or bounded by fire separating elements.

Firestop system – A specific construction consisting of materials that protect the opening around the penetrating item such as cables, cable trays, conduits, ducts, pipes and their means of support through the wall or floor opening to prevent the spread of fire.

F Rating - The time period that a *penetration firestop system* resists the spread of fire and flaming through the penetration.

IBC – International Building Code.

ICC – International Code Council; the developers and publishers of the IBC.

L Rating – A measurement of the air leakage rate through a penetration *firestop system* or *fire resistive joint system* without fire exposure.

Model code – A code providing requirements for the construction of structures and that is developed and maintained by a standards organization independent of the jurisdiction responsible for enacting the code.

NFPA – National Fire Protection Association; the developers and publishers of NFPA 101, Life Safety Code.

NRTL – Nationally recognized testing laboratory. A product testing facility that provides independent product testing and certification services.

Perimeter fire barrier system - An assemblage of specific materials along the perimeter of a floor with an hourly fire endurance rating and a non-rated exterior curtain wall to ensure continuity of the separating function of the floor *assembly*.

Through-penetration - An opening that passes through the entire separating *assembly* to accommodate penetrating items for mechanical, electrical, plumbing, fire protection, and communication systems.

T Rating – The time period that a penetration *firestop system* limits the maximum temperature rise on the unexposed side of an *assembly* or penetrating item, not to exceed 325°F above ambient.

UL – Underwriters Laboratories.

Resources and References

American National Standards Institute (ANSI) – www.ansi.org

American Society for Testing and Materials (ASTM) – www.astm.org

International Code Council (ICC) – www.iccsafe.org

International Firestop Council (IFC) - www.firestop.org

National Fire Protection Association (NFPA) – www.nfpa.org

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) – www.smacna.org

Underwriters Laboratories (UL) – www.ul.com