

January 3, 2019

Jeanie Bourke
Code Enforcement Officer/LPI/Plan Reviewer
City of Portland
Permitting and Inspections Department
389 Congress Street, RM 315
Portland, ME 04101

**RE: Maine Medical Center- East Tower Expansion Project
Through Floor Firestopping T Rating Compliance Alternative**

Dear Jeanie,

Code Red Consultants has been retained by Maine Medical Center (MMC) to serve as the firestopping special inspector in accordance with Maine Uniform Building Code (amended versions of the International Building Code (IBC), 2015 Edition) Section 1705.17 on the East Tower Expansion project. A proposed alternative method of compliance has been proposed on the project relative to providing the required temperature rise rating (hereafter referred to as "T Rating") for through floor penetrations located outside of wall cavities on the project (IBC Section 714.4.1.2). In our role as special inspector, we do not have the authority under Section 104.11 of the Maine Building Code to approve an alternative method of compliance. We have developed this letter to summarize the information we have reviewed on this issue for your consideration.

Facility Description and Background Information

This project consists of a two-story addition to the existing East Tower Building on campus. The project will also include the construction of a new penthouse and heli-pad. The use of the space will be primarily Group I-2, Hospital. Each floor is approximately 29,000 SF in area. The extension of the building will also classify the structure as a high-rise building. The East Tower Building is of Type IB Construction and is fully sprinkler protected.

As part of the project, new through floor penetrations will be created through the existing 2-hour floor slabs as well as the newly created 2-hour floors. These through penetrations will have varied conditions consisting of ducts, pipes, electrical conduits and cables, and other penetrating items to serve building systems. A majority of these through floor penetrations occur within wall cavities, chases, and other locations where the penetrating items are not open to rooms or other occupied spaces. There are a number of typical rooms and spaces that will have through floor penetrations which are not enclosed in the building construction such as electrical rooms, IT rooms, and mechanical rooms. The following section of this report presents the language in the IBC relative to the required firestopping assembly applicable to through floor penetrations through a rated horizontal floor assembly.

Applicable Code Requirements

IBC Section 714.4.1.2 requires the following:

714.4 Horizontal assemblies. Penetrations of a *fire-resistance-rated* floor, floor/ceiling assembly or the ceiling membrane of a roof/ceiling assembly not required to be enclosed in a shaft by Section 712.1 shall be protected in accordance with Sections 714.4.1 through 714.4.4.

714.4.1 Through penetrations. Through penetrations of *horizontal assemblies* shall comply with Section 714.4.1.1 or 714.4.1.2.

Exceptions:

1. Penetrations by steel, ferrous or copper conduits, pipes, tubes or vents or concrete or masonry items through a single fire-resistance-rated floor assembly where the *annular space* is protected with materials that prevent the passage of flame and hot gases sufficient to ignite cotton waste when subjected to ASTM E 119 or UL 263 time-temperature fire conditions under a minimum positive pressure differential of 0.01 inch (2.49 Pa) of water at the location of the penetration for the time period equivalent to the *fire-resistance rating* of the construction penetrated. Penetrating items with a maximum 6-inch (152 mm) nominal diameter shall not be limited to the penetration of a single fire-resistance-rated floor assembly, provided the aggregate area of the openings through the assembly does not exceed 144 square inches (92 900 mm²) in any 100 square feet (9.3 m²) of floor area.
2. Penetrations in a single concrete floor by steel, ferrous or copper conduits, pipes, tubes or vents with a maximum 6-inch (152 mm) nominal diameter, provided the concrete, grout or mortar is installed the full thickness of the floor or the thickness required to maintain the *fire-resistance rating*. The penetrating items shall not be limited to the penetration of a single concrete floor, provided the area of the opening through each floor does not exceed 144 square inches (92 900 mm²).
3. Penetrations by *listed* electrical boxes of any material, provided such boxes have been tested for use in fire-resistance-rated assemblies and installed in accordance with the instructions included in the listing.

714.4.1.1 Installation. *Through penetrations* shall be installed as tested in the *approved* fire-resistance-rated assembly.

714.4.1.2 Through-penetration firestop system. *Through penetrations* shall be protected by an *approved through-penetration firestop system* installed and tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (2.49 Pa). The system shall have an *F rating/T rating* of not less than 1 hour but not less than the required rating of the floor penetrated.

Exceptions:

1. Floor penetrations contained and located within the cavity of a wall above the floor or below the floor do not require a T rating.
2. Floor penetrations by floor drains, tub drains or shower drains contained and located within the concealed space of a horizontal assembly do not require a T rating.
3. Floor penetrations of maximum 4-inch (102 mm) nominal diameter penetrating directly into metal-enclosed electrical power switchgear do not require a T rating.

As shown in the excerpt above, a through penetration of a rated horizontal assembly can be protected with several different approaches. In summary, those approaches are:

1. Penetrations protected with a material meeting with the requirements of ASTM E119 in the arrangement prescribed in Section 714.4.1, Exception 1. *This exception is rarely used in our experience, as the ASTM E119 test is an assembly test and not a test for specific products.*
2. Penetrations protected with concrete or grout in the arrangement prescribed in Section 714.4.1, exception 2. *Note that there is no reference in this arrangement to a T Rating for the penetrating item.*
3. Installation of a listed firestop assembly with an F and T rating that equals the rating of the floor penetrated. There are three exceptions where a T rating is permitted to be omitted based on the lack of adjacent combustible materials coming in contact with the penetrating item in specific arrangements.

Reason Necessitating Relief

The temperature rise or “T Rating” is defined in Section 202 of the IBC as an increase of 325^o F above its initial temperature over the course of the fire test performed. The commentary language from the 2015 IBC provides valuable insight in to the practical challenges in achieving a T rating.

T RATING. The time period that the *penetration firestop system*, including the penetrating item, limits the maximum temperature rise to 325°F (163°C) above its initial temperature through the penetration on the nonfire side when tested in accordance with ASTM E814 or UL 1479.

❖ See the definition of “Through-penetration firestop system.” Some through penetrations having a high thermal conductivity (e.g., metal pipes, cables) will not be able to achieve a T rating without some method to prevent the heat from being transmitted from the fire side to the nonfire side. For metallic pipes, insulation must be applied to the through penetrant for some distance on one or, more often, both sides of the fire-resistance-rated assembly. Thus, when a T rating is desired, the seemingly unusual situation can arise of needing to insulate items that would normally not need insulation, such as drain pipes or conduit. Some plastic pipes are also unable to achieve a T rating without some insulation, particularly those used and, therefore, tested as “open” systems, where hot gases from the test furnace are able to flow within the plastic pipe once the pipe burns through. The type and thickness of insulation required, as well as the length over which it must be applied, are all indicated in the through-penetration firestop system listings.

Some highly intumescent firestop products can close (choke down) a plastic pipe early enough during a fire test to prevent hot gases from heating up the pipe from inside, thus allowing plastic pipe through-penetration firestop systems to be developed that have a T rating without the need for any insulation.

To avoid the need for a T rating altogether, through penetrations that pass through floors can be contained within a chase wall (see Section 714.4.1.2 exceptions). It is particularly important for the designer to plan ahead to have through penetrations concealed within a chase wall or located in a shaft in cases where adding insulation to the through penetrant is an undesirable or unacceptable option.

In the case of cable through penetrations, the need for heat dissipation would usually make the application of additional insulating material unacceptable. The few cable through-penetration firestop systems that do have a T rating achieve this by enclosing the cables within some protective enclosure for a distance from the rated assembly, thus allowing any heat transmitted through the cables during fire exposure to be dissipated, resulting in the exposed section of cabling to be cool enough for the duration of the fire test exposure to meet the T rating requirement [see Commentary Figure 202(37)].

Overall, due to the unavoidable difficulty in having a conductive or semiconductive through penetrant obtain a T rating, less than 5 percent of all tested and listed through-penetration firestop systems have a T rating. This is because the T rating indicates that the firestop system is not only capable of stopping the fire, flame and hot gases from passing through the assembly at the penetration as an F rating does, but it also must limit the temperature transfer to the unexposed side of the assembly.

In addition to the challenges in identifying a method of achieving a T rating based on limited products available on the market, the installation of insulation around electrical cables and conduits can present additional compliance issues. The following is an excerpt from a National Insulation Association (NIA) Article by Jerry Heid titled *Firestopping; Fortifying the Front Line, Who's responsible, what's required and what major code and enforcement issues have an impact on planning and firestop application.*

Walke identifies other issues that may constitute obligations for firestop installers even when solutions or code requirements are less than clear. To the first point, he advises that IBC and NFPA 5000 both require T ratings equal to floor ratings for all firestops through floors. This is difficult to achieve for metallic penetrations because of the thermal conductivity of the penetrants. The 2004 UL directory includes various systems using thermal insulation, such as fiberglass or mineral wool, to achieve these ratings. However, these systems will not work for copper pipe conduit for cabling, which generates heat that cannot dissipate normally when insulated, potentially leading to hazardous overheating.

The National Electrical Code, NFPA 70, addresses the need for "ampacity derating" in conduit using tests for determining what reduction in current load is needed to maintain temperature within acceptable limits. However, manufacturers have not done much testing to this standard. Although some AHJs are overlooking this issue, until tested solutions become available Walke encourages firestop installers to plan ahead and protect themselves by raising the issue for discussion with AHJs.

We have researched the code change proposals relative to this requirement in the IBC to identify if the committee has considered a change to the T rating requirements. As shown in Appendix A of this letter, there have been code change proposals made to insert an exception that would allow the omission of a T rating where the penetrations are not in direct contact with combustible materials. The reason given for not approving this proposal is that the proposal did not provide a minimum specified distance.

An additional consideration from the owner's perspective on the use of insulation to achieve the T rating is that the insulation is often not reliably maintained over the life of a building. When work needs to be performed on a penetration, especially an active penetration where IT cables may be regularly pulled, the insulation is removed and often never replaced.

Maine Medical Center is requesting approval of an alternative approach on the basis of the limited products available to achieve a T rating, the compliance challenges created by insulating electrical conduits and cables and the potential conflicts with the electrical code, and the challenge in reliably maintaining the insulation over the life of the building.

Alternative Approach Proposed

The proposed alternative approach is based on the requirements of NFPA 101, *Life Safety Code*, 2009 Edition, as adopted by Ch. 20 of the Maine Rules of the State Fire Marshal. NFPA 101 Section 8.3.5. is the equivalent requirement for firestopping of through penetrations as Section 714.4.1.2 of the IBC referenced above. Sub section 8.3.5.1.4 also contains an exception that allows the omission of the T rating where the hazard of an adjacent combustible coming in contact with the penetrating item doesn't exist.

8.3.5.1.4 Penetrations in fire-rated horizontal assemblies shall have a minimum 1-hour T rating, but not less than the fire resistance rating of the horizontal assembly. Rated penetrations shall not be required for the following:

- (1) Floor penetrations contained within the cavity of a wall assembly
- (2) Penetrations through floors or floor assemblies where the penetration is not in direct contact with combustible material

This exemption has been included in the *Life Safety Code* since the 2003 edition, the same edition where the concept of F ratings and T ratings were also introduced.

The challenge in applying this exception is assurance that combustible materials will not be stored next to a through floor penetration. To properly utilize the exemption in NFPA 101-8.3.5.1.4(2), Maine Medical Center is proposing the following measures:

1. Permanent signage adjacent to the through-floor penetrations indicating that there shall be no storage in the area.
2. Permanent flooring or painted markings installed in a contrasting color shall be applied to the finished floor a minimum of 12" from the outer edge of the penetration. A sample of the proposed signage and marking is shown below.

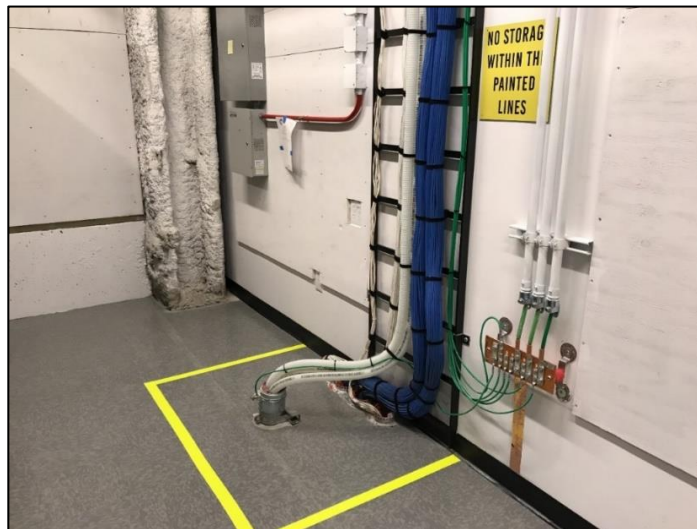


FIGURE 1: SAMPLE SIGN AND PAINTED LINES SURROUNDING PENETRATION

In order to establish the minimum proposed separation distance of 12" (stated above), we reviewed similar applications within the NFPA standards that could be applied. NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2016 Edition Table 8.3.2.5 (C) shows the recommended separation distance of an ordinary or intermediate-temperature sprinkler head from an adjacent heat source. NFPA 13 Table 6.2.5.1 specifies the use of intermediate-temperature sprinkler heads in applications where the maximum ceiling temperature will not exceed 150°F, to prevent inadvertent activation; the actual activation temperatures of intermediate-temperature sprinklers ranges from 175°F to 225°F.

NFPA 13 Table 8.3.2.5(C) identifies a minimum horizontal separation of 12" between intermediate-temperature sprinkler heads and a coal or wood burning stove, hot air flue, or uninsulated hot water pipes and ducts; as this distance is considered adequate to prevent ceiling temperatures from exceeding 150°F and to prevent activation of the 175°F to 225°F sprinkler heads. These temperatures are much lower than the ignition temperature of cotton (approximately 400°F), which is utilized in fire testing. Note that this firestopping application does not have a radiant heat source such as an open flame in a fire place so those data points were not utilized in this analysis.

TABLE 8.3.2.5(c) Temperature Ratings of Sprinklers in Specified Residential Areas

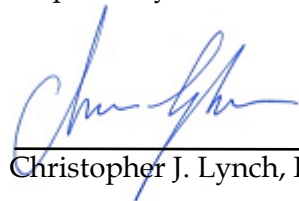
Heat Source	Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler		Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler	
	in.	mm	in.	mm
Side of open or recessed fireplace	36	914	12	305
Front of recessed fireplace	60	1524	36	914
Coal- or wood-burning stove	42	1067	12	305
Kitchen range	18	457	9	229
Wall oven	18	457	9	229
Hot air flues	18	457	9	229
Uninsulated heat ducts	18	457	9	229
Uninsulated hot water pipes	12	305	6	152
Side of ceiling- or wall-mounted hot air diffusers	24	607	12	305
Front of wall-mounted hot air diffusers	36	914	18	457
Hot water heater or furnace	6	152	3	76
Light fixture: 0 W–250 W	6	152	3	76
250 W–499 W	12	305	6	152

Maine Medical is proposing to apply this compliance alternative approach primarily within electrical rooms, IT rooms, and open mechanical rooms where the installation does not already qualify for one of the T rating exceptions previously noted and which would be prescriptively allowed within the code. If the specific conditions of the proposed alternative compliance option cannot be met, a T rating solution will be required.

Conclusion

In our professional opinion the proposed compliance alternative approach outlined herein provide an equivalent level of safety as intended by the IBC and is based on an exception within a nationally recognized life safety standard.

Sincerely,
Prepared By:



Christopher J. Lynch, P.E.(Registered in MA)

1/3/2019

Date

Reviewed By:



Chad Farrell, P.E.(Registered in ME)

1/3/2019

Date

Appendix A: IBC Proposals and Actions Relative to T Ratings

FS88-06/07 712.4.1.1.2

Proponent: James P. Stahl Jr., Specified Technologies Inc.

Revise as follows:

712.4.1.1.2 Through-penetration firestop system. Through penetrations shall be protected by an approved through penetration firestop system installed and tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (2.49 Pa). The system shall have an F-rating and a T-rating of not less than 1 hour but not less than the required rating of the floor penetrated.

Exceptions:

1. Floor penetrations contained and located within the cavity of a wall do not require a T-rating.
2. Floor penetrations that are not in direct contact with combustible material do not require a T-rating

FS88-06/07 Committee Action: Disapproved

Committee Reason: The proposal language is vague by limiting direct contact but not specifying a distance. The combustible could be separated by a very small distance and not be in "direct" contact but still be exposed. The proposal does not take into account the thickness of the assembly which will affect the protection. There are more and more products available which have higher T ratings. Most countries do require an equal F and T rating for these assemblies.
Assembly Action: None

FS68-09/10 713.4.1.1.2

Proponent: John Valiulis, representing Hilti, Inc.

Revise as follows:

713.4.1.1.2 Through-penetration firestop system. Through penetrations shall be protected by an approved throughpenetration firestop system installed and tested in accordance with ASTM E 814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water (2.49 Pa). The system shall have an F rating/T rating of not less than 1 hour but not less than the required rating of the floor penetrated.

Exceptions:

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

2. Floor penetrations consisting of power cables or busbars do not require a T-rating.

FS68-09/10 Committee Action: Disapproved

Committee Reason: The different methods of protecting the power cables should be described in the proposal for clarity. The proposal assumes that the power cables are metal clad and insulated, which may not always be the case. Lastly, the allowable voltage of the power cables should be indicated.

Assembly Action: None

No relative proposals in the 2012/2013/2014 cycle

No relative proposals in the 2015/2017 cycle