Tremco Fire Protection Systems Group
Technical Bulletin

Topic: Firestop Systems with T-Ratings for Metallic Electrical Enclosures (RMC/EMT)

Release Date: October 22, 2004

For more information, contact the Technical Service Department at 866-209-2404.

Most major model codes in the US and Canada require firestop systems with T-Ratings, under specific conditions (see Tremco FPSG Technical Bulletin: "Firestop Systems With F and T Ratings Equal to Penetrated Assemblies" from June 11, 2004). The purpose of these requirements is to prevent fires from being spread by the conduction of heat through the pipes. In order to achieve one and two hour T-Ratings for firestop systems with metallic penetrants, non-combustible thermal pipe insulation, such as mineral wool, is installed on the pipe. This prevents the absorption of heat on the fire side, and transfer of heat from the pipe to combustibles on the non-fire side. In accordance with an appropriate firestop system, the insulation may be installed continuously on the pipe, or only in the area of the penetration.

Although this solution can work with most piping systems, thermally insulating electrical enclosures, such as rigid metallic conduit (RMC) or electrical metallic tubing (EMT) can cause serious problems. When electrical current passes through wiring, heat is generated by the conductor's resistance. This is important because the ability of a conductor to conduct electricity changes in relation to its temperature: the hotter the wire, the less current it can carry. This issue is compounded in enclosures where the heat from adjacent wires adds to the increased temperature and the enclosure itself limits the dissipation of heat away from the wires. For this reason, industry standards have been set establishing the power carrying capacities of each type and size of conductor within a specific normal temperature range as well as conductor loading capacities for electrical enclosures.

When design requirements necessitate that these limits be exceeded, the ampacities of the conductors must be derated. The derating process uses calculations to determine the reduced power carrying capacity of the wire at elevated temperatures. Derating is necessary to ensure that sufficient wiring is supplied to carry the necessary amount of power under the expected conditions. A 50.0 percent derating can mean that two cables must be used instead of one. Furthermore, due consideration must be given to ensure that the temperature of the wires does not exceed the design limitations of the cable insulation or jacketing. Excessive temperatures there can lead to failure of the wiring components, which can, in turn, cause failures in the electrical system. Sec. 310.10 of NFPA 70, the National Electric Code, addresses the issue of heat build-up in enclosures and conductors. According to the NFPA code, the principal determinants of operating temperature are as follows:

(1) Ambient temperature — ambient temperature may vary along the conductor length as well as from time to time.
(2) Heat generated internally in the conductor as the result of load current flow, including fundamental and harmonic currents.
(3) The rate at which generated heat dissipates into the ambient medium. Thermal insulation that covers or surrounds conductors affects the rate of heat dissipation.

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(4) Adjacent load-carrying conductors — adjacent conductors have the dual effect of raising the ambient temperature and impeding heat dissipation.

Few insulated-pipe firestop systems (Category XHEZ in UL Fire Resistance Directory, numbered 5000-5999) listed by UL include RMC/EMT. Even though some codes require T-Ratings under certain circumstances, to achieve a T-Rating for an metallic electrical enclosure would require thermally insulating the enclosure, which would, in turn, impact an important principle of electrical systems design. In order to create a meaningful firestopping system, the model tested by an independent laboratory must be an accurate representation of the system as it is to be installed in the field. Determining the ampacity of the cable to be installed in a hypothetical firestop system is not feasible since ampacity varies according to the actual conditions under which the cable will operate. Sec. 310.15(B), of the NEC states that the calculations for heat dissipation should be carried out by qualified project engineers and that the calculations for derating of ampacities should be done under engineering supervision. This makes it problematic for test sponsors to develop accurate models. A real concern is that firestop systems that might be invalid under certain circumstances, or might conflict with other engineered systems, could contribute to the creation of unsafe conditions despite the validity of the firestopping system with regard to ASTM E 814 or CAN/ULC-S115.

It is important, however to note that there are two significant exceptions to the T-Rating requirement in Sec. 8.3.5.1.4 of NFPA 101 "Life Safety Code" (also: Sec. 12.7.5.4.1: NFPA 1 "Uniform Fire Code"; Sec. 8.8.2.3: NFPA 5000 "Building and Construction Safety Code")

Penetrations in fire resistance–rated horizontal assemblies shall be required to have a T rating of at least 1 hour, but not less than the fire resistance rating of the horizontal assembly, and shall not be required for the following:

1. A T rating is not required for floor penetrations contained within the cavity of a wall assembly.
2. A T rating is not required for penetrations through floors or floor assemblies where the penetration is not in direct contact with combustible material.

This states that a through-penetration in a floor is not required to have a T Rating if (1) it is in a wall cavity or (2) it is not in contact with combustible material. Furthermore, there is no T Rating requirement in this language for walls. This language is not representative of all model codes, but it is indicative of the intent of T-Ratings and provides reasonable exceptions for conditions where T-Ratings add little to that intent. Nonetheless, there are times when the codes require a T-Rating on an electrical enclosure penetrations, and it is often the firestopping or electrical contractor who must deal with seemingly conflicting requirements. In these cases, local authorities having jurisdiction, as well as project designers, would be well advised to bear in mind the potential effects of thermally insulating metallic electrical enclosures as well as to take a common-sense

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approach to possibility of achieving a T-Rating with a non-insulated metallic penetrant. More importantly officials and designers are encouraged recognize that though the language of the codes may seem contradictory, their intent need not be. The purpose of the T-Rating is to prevent the propagation of fire by materials on the non-fire side from being ignited by heat from metal penetrants. Sometimes, the T-Rating can be achieved by using combustible enclosures, where appropriate. In other situations, it may be more effective to simply take design precautions to prevent combustible materials from being in proximity to conductive penetrants.

Everyone involved in a project is responsible for being aware of the life-safety concerns of firestopping as well as the considerations and limitations involved when firestopping systems are used in conjunction with other engineered systems. Tremco Fire Protection Systems Group is dedicated to Helping Contractors Win by providing cost-effective code-conforming firestopping systems that increase life-safety, T-Ratings when appropriate, and helping to avoid potential risks to associated building systems. For more information on Tremco Fire Protection Products and Services, the latest sales and technical information and updated firestopping systems, contact your local Tremco Fire Protection Sales Representative or visit us on the web at www.tremcofirestop.com.

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