FIRESTOP SYSTEMS WITH F AND T/FT RATINGS EQUAL TO FIRE RATED ASSEMBLIES

Compartmentalization products and design play a key role in protecting lives and property from fire. Understanding the tools and techniques available for firestopping is of utmost importance to designers, code writers, code enforcement professionals, and contactors alike. Although the F Rating is widely utilized throughout the industry, the T Rating (or FT Rating in Canada) is also an important tool in the design of firestopping systems. The Tremco Firestopping Systems Group is dedicated to Helping Contactors Win, and we know that understanding T/FT Ratings, their meaning and application, will help contractors win by identifying effective and economical ways to meet the needs of designers and inspectors in building safer buildings.

ASTM E119: BASIS OF THE T RATING

In order to effectively compartmentalize a fire, a floor or wall must prevent the passage of smoke and flame and also prevent the temperature on the non-fire side from rising high enough to ignite materials stored on the non-fire side. This means that fire-rated assemblies are required to meet both Fire and Temperature standards. The temperature standard is the origin of the T/FT Rating for through penetration firestop systems, but to better understand the firestopping requirements, we must know something about the test for floors and walls.

ASTM E119 “Standard Test Methods for Fire Tests of Building Construction and Materials,” is the test used on floor and wall assemblies to ensure that they will perform all these functions. The results of this test are recorded as the F Rating of the design. The F Rating of a floor or wall indicates the number of hours (or fractions of hours) for which the assembly has been tested to keep fire from moving from one side to the other. It also indicates the duration for which the assembly has been tested to prevent the temperature on the un-exposed side from rising excessively.
On the un-exposed side, the temperature must not increase more than 250º above room temperature (as an average of temperatures at various locations on the surface), or more than 325º above room temperature (at any one location). Figure 1, reprinted from the Underwriter’s Laboratories Fire Resistance Directory – Volume I describes UL 263, the UL test standard and time-temperature curve used to determine the F Rating of a floor or wall assembly. In order to measure the temperature rise on the unexposed side, and to determine the F Rating of the assembly, thermocouples are placed at random over the un-exposed side, as well as at any point where high temperature rise can reasonably be expected. This is important to firestopping because it means that through penetrations would have thermocouples place on them in this test.

Fig.1
Fire Resistance Ratings - ANSI/UL 263 Design Information Section

I. INTRODUCTION

Fire ratings specified in this section of the Directory pertain to Classifications that are based upon the test method and acceptance criteria in ANSI/UL 263 (ASTM E119 and NFPA 251), "Fire Tests of Building Construction and Materials." The ratings are expressed in hours and are applicable to floor-ceilings, roof-ceilings, beams, columns, walls and partitions.
The average furnace temperature from which these ratings are derived is 1000°F at 5 min., 1400°F at 15 min., 1550°F at 30 min., 1700°F at 60 min., 1850°F at 120 min., 1925°F at 180 min. and 2000°F at 240 min.1

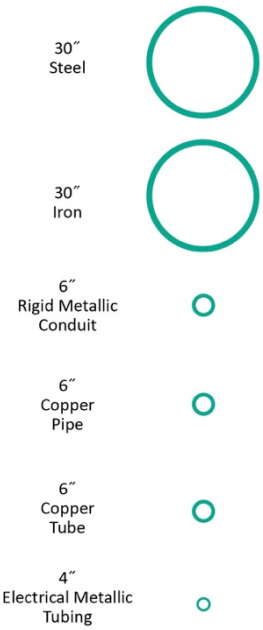
ASTM E814: T RATINGS IN THE STANDARD

Through penetrations present a problem in ASTM E119 testing for two reasons. One is that the openings made in the assembly will allow the passage of smoke and flame. The other is that some through penetrating items, such as metallic pipes, conduits, beams, and ducts, both absorb and conduct heat readily. Figure 2 demonstrates equivalencies used to estimate heat conduction in various types of pipe. According to these equivalencies, each of these pipes will cause about the same temperature rise on the un-exposed side of the assembly. As you can see, copper is a much better conductor of heat than steel, thus a 6 inch diameter copper pipe shows similar temperature rise as a 30 inch diameter steel pipe. Clearly, the thermocouples placed on these types of penetrants would quickly exceed the temperature limitations in ASTM E119.

To solve these problems, firestopping systems are designed to restore the rating of ASTM E119 tested assemblies that have been penetrated by pipes, ducts, cables, etc. Typically, firestop sealants are used to create a continuous membrane across the opening to prevent the passage smoke, flame, and hot gases. ASTM E814 "Standard Test Method for Fire Tests of Through-Penetration Fire Stops" is the method for testing firestopping assemblies to ensure that they will restore the rating of the penetrated assembly (ULC-S115 is the corresponding standard used in Canada). The F rating of a firestop assembly indicates the duration for which the firestop assembly will prevent the passage of smoke and flame, but does not include limiting the rise of temperature on the un-exposed side.
While the temperature component is part of the F Rating for a floor or wall, it has been separated from the F Ratings for through penetrations. The ability of a firestop system to prevent the temperature from rising on the un-exposed side of the assembly is recorded as the T/FT Rating. In ASTM E814 testing, T Ratings are regarded as useful information that may be recorded at the test sponsor's option, but is not required. Although the T/FT Rating is not required in E814, as it is in E119, it is still related to the temperature component of E119.

Fig.2

All the pipes below demonstrate about the same temperature rise on the un-exposed side during ASTM E814 testing.



BUILDING CODES: REQUIREMENTS FOR T AND FT RATINGS

In the past, T/FT Ratings have not been extensively used in the firestopping industry because the firestopping systems that have T/FT Ratings are subject to important limitations. However, local authorities having jurisdiction are increasingly aware of the importance of T/FT Ratings in preventing the spread of fires. As Figure 3 shows, the International Building Code and the NFPA Life Safety Code and Uniform Fire Code all require firestopping assemblies to have F and T Ratings equal to or greater than the penetrated assembly, unless the penetration is located within a fire rated wall. Also, the National Building Code of Canada requires that firestop systems for noncombustible penetrants have an FT Rating equal to or greater than the penetrated assembly. Although the impracticality of this requirement has often led to spotty adoption and enforcement, expectations are changing. As the capabilities of the firestopping industry have matured, there has been an increasing demand for firestopping assemblies that can provide F and T/FT Ratings equal or greater than the rating of the penetrated assemblies, at least for the common 2 Hr F Rating. 6

Figure.3

International Building Code 20032	NFPA 101 "Life Safety Code"3 & NFPA 1 "Uniform Fire Code"4	National Building Code (Canada) 5
Section 712.4.1.2 Through-penetration firestop system. Through penetrations shall be protected by an approved through-penetration firestop system installed and tested in accordance with ASTM E814 or UL 1479, with a minimum posited pressure differential of 0.01 in (2.49 Pa) of water. The system shall have and F rating and a T rating of not less than 1 hour but not less than the required rating of the floor penetrated. Exception: Floor penetrations contained and located within the cavity of a wall do not require a T rating.	**NFPA 101: 8.3.5.1.4 & NFPA 1:12.7.5.1.4** 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. []	**Section 3.1.9.1 Firestopping of Service Penetrations; 2):** [Non-combustible through penetrants] …and other similar building services that penetrate a firewall or a horizontal fire separation that is required to have a fire-resistance rating . . . shall be sealed at the penetration by a fire stop system that, when subjected to the fire test method in ULC-S115, "Fire Tests of Firestop Systems," has an FT rating not less than the fire-resistance rating for the fire separation.

FIRESTOP SYSTEM DESIGN: ACHIEVING 1 AND 2 HR T AND FT RATINGS

In general, firestopping assemblies can be designed to prevent excessive temperature rise on the un-exposed side. For example, firestopping assemblies for blank openings can restore the rating of a partition as though it were never penetrated at all. Similarly, firestopping assemblies for combustible penetrants can often, but not always, have F and T/FT Ratings equal to the penetrated assembly, as combustible penetrants do not conduct heat through the opening. This has contributed to the increased use of combustible pipe in many applications. Often, however, metallic penetrants are still the accepted standard, and are required in certain applications by many codes.

Achieving 1 and 2 hour T/FT Ratings with metallic penetrants, however, remains problematic. This has left designer with two basic options when T/FT Ratings are required. One option is to use combustible piping instead of metallic. This is often the simplest solution, as combustible equivalents to metallic systems are well established and firestopping assemblies with 1 and 2 hour T/FT Ratings are commonly available.

The other design option has been to insulate the metallic pipe systems; F and T/FT Ratings equal to 1 and 2 hour rated assemblies can be achieved when the pipe system is insulated with the proper type of insulation. Although fiberglass and plastic foam insulation (typically listed by UL as AB/PVC insulation) are common, these types of insulation may not be capable of withstanding the temperatures of a fire, and often melt away during the testing. Therefore, attaining a high T/FT Rating is almost impossible with these types of insulation. Mineral wool insulation, however, has a higher melting point, and continues to insulate the pipe on both sides of the assembly throughout the fire test. The insulation reduces the amount of heat absorbed by the pipe in the furnace and insulates the thermocouple from the hot pipe on the un-exposed side. Thus, the temperature on the un-exposed side can be kept from rising more than 325° F. This is an effective method for achieving equal F and T/FT Ratings, but it also has disadvantages. Among them are increased material and labor costs, as well as design issues raised when a 6 inch diameter iron pipe becomes a 10 inch diameter insulated pipe.

TREMCO FIRE PROTECTION: SOLUTIONS FOR T AND FT APPLICATIONS

Tremco has recognized the necessity to provide an economical and design friendly alternative to continuous insulation where 1 and 2 hour T/FT Ratings are required. Recent testing by Tremco provides this new alternative in the form of a firestopping system design that utilizes mineral wool pipe insulation to insulate only a limited portion of the through penetrant on each side of the test assembly. In this non-continuous insulation design, mineral wool pipe insulation is butted to the surfaces of the firestop system on both sides and installed for a minimum length of 36 inches above and 12 inches below (or 36 inches on each side for walls) the firestopping system. The testing procedures that differentiate this alternative from fully insulated pipe are minor, but the results are significant. This new firestop design method will significantly reduce the cost of improving life safety in new and remodeled buildings when compared to the traditional method of continuously insulating the entire pipe system. It should be noted, however, that neither of these insulating solutions may be used with Rigid Metallic Conduit or Electrical Metallic Tubing due to code prohibitions against insulating electrical conduits.

In recognition of the value both contractors and designers will derive from this new technique for meeting the code requirements, Tremco Fire Protection Systems Group has tested two new systems at Underwriter's Laboratories that provide F and T/FT Ratings of at least 2 hours. These systems are to be published by UL as System No.'s C-AJ-1518 and C-AJ-1519 (Figures 4 and 5 below, respectively). Both systems are currently available from your Tremco Sales Representative in Draft versions.

C-AJ- 1518 is for a multiple penetration through a concrete floor or wall, of up to 300 square inches. The firestop product is TREMstop M, Tremco's fire rated mortar. It allows up to six metallic penetrants, each of up to 8 inches in diameter, and each with 1inch thick mineral wool pipe insulation on each side. The F Rating for this system is 3 hours, and the T Rating is 2 hours.

C-AJ-1519 is for a single penetration through a concrete wall or floor, of up to 10 inches in diameter. The firestop product used is TREMstop IA, Tremco's high performance intumescent acrylic caulk. It allows one metallic pipe of up to 8 inches in diameter with 1 inch thick mineral wool pipe insulation on each side. The F Rating for this system is 3 hours, and the T Rating is 2 hours.

The pipe insulation is not continuous in either system, meaning that the insulation can be installed before or after the firestopping system with minimal material or labor cost, and with minimal impact on the general design of the piping system. Both these systems are cUL listed and can be used throughout Canada.

Firestop Systems With F and T/FT Ratings Equal to Fire Rated Assemblies: just one more way Tremco Fire Protection Systems

Group is dedicated to Helping Contractors Win.

If you have any further questions regarding Firestop Systems with F and T/FT Ratings Equal to Fire Rated Assemblies or for more information on Tremco Fire Protection Systems Group Firestopping systems or products, please contact you local Tremco Fire Protection Sales Representative.

1 -- reprinted from UL fire Resistance Directory – Vol. 1, 2004
2 -- International Code Council; 2003 International Building Code; Country Club Hill, IL; 2002
3 -- National Fire Protection Association; NFPA 101 Life Safety Code; 2003 ed.; Minneapolis, MN; 2003
4 -- National Fire Protection Association; NFPA 1 Uniform Fire Code, 2003 ed.; Minneapolis, MN; 2003
5 -- National Research Council of Canada; National Building Code of Canada 1995, Ottawa, ON; 1995
6 – Always refer to your local building code or Authority Having Jurisdiction for requirements that apply to your project.

1. FLOOR OR WALL ASSEMBLY

Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf (1600-2400 kg/cu meter)) structural concrete. Wall may also be constructed of any UL Classified Concrete Blocks*. Max area of opening is 300 sq in. (1935 sq cm) with max dimension of 30 in. (762 mm).

See Concrete Block (CAZT) category in the Fire Resistance Directory for names of manufacturers.

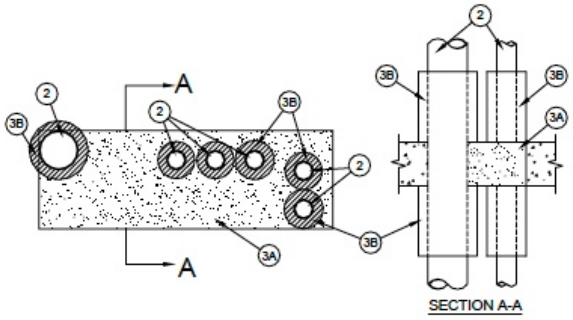


Fig. 4
System No. C-AJ-1518
Draft
F Rating —3 Hr
T Rating —2 Hr
L Rating at Ambient – Less Than 1 CFM/sq ft L
Rating at 400F – Less Than 1 CFM/sq ft

*Bearing the UL Classification Mark
*Reproduced courtesy of Underwriters Laboratories, Inc.® (UL / cUL)

2. THROUGH PENETRANTS

A max of six pipes or tubing to be installed within the opening. Of the six penetrants, only one penetrant shall have a nom diam greater than 2 in. (51 mm). The min space between pipes or tubing shall be 3 in. (76 mm). The max space between pipes or tubing shall be 8-7/8 in. (225 mm). The min space between pipes or tubing and periphery of opening shall be 0 in. (point contact). The max space between pipes, conduits or tubing and periphery of opening shall be 5-5/8 in. (143 mm). Pipe, conduit or tubing to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of pipes, conduits or tubing may be used:

A. Steel Pipe Nom 8 in. (203 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.
B. Iron Pipe Nom 8 in. (203 mm) diam (or smaller) cast or ductile iron pipe.
C. Copper Tubing Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tubing.
D. Copper Pipe Nom 4 in. (102 mm) diam (or smaller) Regular (or heavier) copper pipe.

3. FIRESTOP SYSTEM THE FIRESTOP SYSTEM SHALL CONSIST OF THE FOLLOWING:

A. Fill, Void or Cavity Material* — Mortar — Min 4-1/2 in. (114 mm) thickness of fill material applied within the annulus, flush with top and bottom surface of floor or with both surfaces of wall.

TREMCO INC — TREMSTOP FIRE MORTAR

B. Pipe Covering Materials* — - Nom 1 in. (51 mm) thick unfaced mineral fiber pipe insulation shall be installed on each through penetrant (Item 2). The insulation is sized to the outside diam of each pipe or tube. Insulation is tightly wrapped around penetrant to extend min 12 in. (305 mm) below floor and min 36 in. (914 mm) above floor or min 36 in. (914 mm) beyond both surfaces of wall.

IIG MINWOOL L L C — High Temperature Pipe Insulation 1200, High Temperature Pipe Insulation BWT and High Temperature Pipe Insulation Thermaloc

C. Sheathing Material* — Used in conjunction with Item 3B. All service jacket material shall be wrapped around the outer circumference of the pipe insulation (Item 3B) with the kraft side exposed. Longitudinal and transverse joints sealed with butt tape.

See Sheathing Materials - (BVDV) category in the Building Materials Directory for names of manufacturers. Any sheathing material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

D. Forms - (Not Shown) — Used as a form to prevent leakage of fill material during installation. Forms to be rigid sheet material fastened to the underside of the floor or both sides of wall. Forms to be removed after fill material has cured.

1. FLOOR OR WALL ASSEMBLY

Min 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*. Max diam of opening is 10 in. (254 mm).

See Concrete Blocks (CAZT) category in Fire Resistance Directory for names of manufacturers.

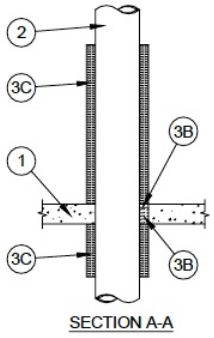


Fig. 5
System No. C-AJ-1518
Draft
F Rating —3 Hr
T Rating — 2 Hr
L Rating at Ambient – Less Than 1 CFM/sq ft L Rating at 400F – Less Than 1 CFM/sq ft

*Bearing the UL Classification Mark
*Reproduced courtesy of Underwriters Laboratories, Inc.® (UL / cUL)

2. THROUGH-PENETRANT

One metallic pipe or tubing installed concentrically or eccentrically within opening. Annular space between penetrant and periphery of opening shall be min of 0 in. (0 mm) (point contact) to max 1 in. (25 mm). Penetrant to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of penetrants may be used:

A. Steel Pipe — Nom 8 in. (203 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. Iron Pipe — Nom 8 in. (203 mm) diam (or smaller) cast or ductile iron pipe.

C. Copper Tubing — Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tubing.

D. Copper Pipe — Nom 4 in. (102 mm) diam (or smaller) Regular (or heavier) copper pipe.

3. FIRESTOP SYSTEM — THE DETAILS OF THE FIRESTOP SYSTEM SHALL BE AS FOLLOWS:

A. Packing Material — Min 4 in. (102 mm) thickness of min 4 pcf (64 kg/m3) mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces of wall to accommodate the required thickness of fill material.

B. Fill, Void or Cavity Materials* - Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with top surface of floor or with both surfaces of wall.

TREMCO INC — TREMstop Intumescent Acrylic

B. Pipe Covering Materials* - Nom 1 in. (51 mm) thick unfaced mineral fiber pipe insulation shall be installed on the through penetrant (Item 2). The insulation is sized to the outside diam of the pipe or tube. Insulation is tightly wrapped around penetrant to extend min 12 in. (305 mm) below floor and 36 in. (914 mm) above floor or min 36 in. (914 mm) beyond both surfaces of wall.

IIG MINWOOL L L C — High Temperature Pipe Insulation 1200, High Temperature Pipe Insulation BWT and High Temperature Pipe Insulation Thermaloc

C. Sheathing Material* — Used in conjunction with Item 3B. All service jacket material shall be wrapped around the outer circumference of the pipe insulation (Item 3B) with the kraft side exposed. Longitudinal and transverse joints sealed with butt tape.

See Sheathing Materials - (BVDV) category in the Building Materials Directory for names of manufacturers. Any sheathing material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

WP Equal F and T-