UL 1489

STANDARD FOR SAFETY

Fire Tests of Fire Resistant Pipe Protection Systems Carrying Combustible Liquids

UL Standard for Safety for Fire Tests of Fire Resistant Pipe Protection Systems Carrying Combustible Liquids, UL 1489

First Edition, Dated September 22, 2016

Summary of Topics

This revision of ANSI/UL 1489 dated October 5, 2021 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated August 6, 2021.

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UL 1489

Standard for Fire Tests of Fire Resistant Pipe Protection Systems Carrying Combustible Liquids

First Edition

September 22, 2016

This ANSI/UL Standard for Safety consists of the First Edition including revisions through October 5, 2021.

The most recent designation of ANSI/UL 1489 as a Reaffirmed American National Standard (ANS) occurred on October 5, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover the investigation of products such as, but not limited to, sleeve, wrap or spray-on type fire protection systems of various materials and construction intended to protect rigid piping networks containing combustible liquids from a fire exposure, such as diesel fuel or heating oil, that are routed in buildings between the supply tank and utilizing equipment.

1.2 Under these requirements, samples of fire resistive pipe protection systems are exposed to a fire exposure for a duration based on a desired hourly rating, and then to an application of a water hose stream. The fire resistive pipe protection system will also be evaluated for its ability to resist leakage of liquid from the pipe. The following measurements and determinations are made during the fire exposure and water hose stream tests:

a) Measurement of temperature on the exposed surface of the outermost pipe of the test specimen.

b) Determination of the integrity of the fire resistive pipe protection systems during the fire exposure and water hose stream test.

c) Determination of tightness and leakage resistance of the pipe after the fire exposure and water hose stream test.

1.3 The fire exposure and water hose stream tests may not be representative of all fire conditions. Conditions may vary with changes in the amount, nature, and distribution of fire loading, ventilation, compartment size and configuration, and heat conducting and dissipating characteristics of the compartment in which the fire resistive pipe protection system is installed. These requirements provide a relative measure of fire performance of comparable assemblies under these specified fire exposure conditions. Any variation from the construction or operating condition tested, such as size, method of assembly, and materials, may substantially change the performance characteristics of the system.

1.4 The classifications for building construction and materials are intended to register performance during the period of fire exposure and are not intended to be interpreted as having determined their acceptability for use after fire exposure.

1.5 This standard does not evaluate the fuel pipe construction in terms of components or assembly techniques. This is a test to evaluate the fire protection element of the assembly. It is assumed that fuel pipe requirements (e.g. sealing compounds/lubricants etc.) that are established by other codes and standards will be satisfied outside of this test method.

1.6 These requirements do not cover:

a) Accumulation of data as to performance of fire resistive pipe protection systems constructed with components or sizes other than those tested.

b) Evaluation of the contribution of the fire resistive pipe protection systems generation of smoke, toxic gases, or other products of combustion.

c) Measurement of flame spread over the surface of the tested elements.

d) Evaluation of the firestop system in openings penetrated by the fire resistive pipe protection systems. Firestop systems for fire resistive pipe protection systems shall be evaluated to the Standard for Fire Tests of Penetration Firestops, UL 1479.

e) Evaluation of the impact of fire and elevated temperatures on the pipe and associated fittings and other construction features.

f) Pipe systems that carry fuels with a boiling point below room temperature.

g) The compatibility, including the potential for corrosion, between the protection system and the pipe material.

1.7 The results obtained by use of this test method are intended to develop data that will assist designers, authorities having jurisdiction, end-users, installers and others in determining the acceptability, with reference to fire resistive pipe protection systems for use with specific pipe applications.

1.8 Tests for burning characteristics of building materials, based on rate of flame spread and the density of smoke developed when exposed to a standard fire, can be found in the requirements for surface burning characteristics of building materials in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

1.9 Tests for fire resistance of firestop systems which penetrate walls, floors and other membranes can be found in the requirements for the Standard for Fire Tests of Penetration Firestops, UL 1479.

1.10 Application of these test results to predict fire resistance of pipe protection systems in actual installations requires careful evaluation of the pipe and fire resistive pipe protection system materials under normal operating conditions.

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3 Undated References

3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4 Glossary

4.1 For the purpose of this Standard, the following definitions apply.

4.2 COMBUSTIBLE LIQUID – A liquid having a closed cup flash point at or above 100°F (38°C).

4.3 FIRE RESISTIVE PIPE PROTECTION SYSTEM – A specific construction of devices, materials or protective coatings installed around (such as sleeve or wrap types), or applied to (such as spray-on types), pipe and associated components (for example pipe hangers) to maintain the integrity of the pipe subjected to a standardized fire exposure.

4.4 RIGID PIPING NETWORK – An assembly of pipe, connections, fittings and other components that when combined provide a stable and continuous channel for conveying combustible liquids. Such pipe shall meet the minimum specifications established by others for its anticipated use in the field.

4.5 TEST ASSEMBLY – The construction on to which the fire resistive pipe protection system is installed and suspended.

4.6 TEST SPECIMEN – The fire resistive pipe protection system being evaluated.

PERFORMANCE

5 Fire Exposure Test

5.1 Test sample

5.1.1 Each representative type of fire resistive pipe protection system for which rating is desired is to be tested beneath a floor assembly unless it is determined that all features of its intended use can be evaluated by testing with a wall assembly. A minimum of 5 ft of the test specimen shall be exposed to the fire.

5.1.2 The floor or wall assembly is to be constructed of materials which offer adequate support for the fire resistive pipe protection system during both the fire exposure and water hose stream tests, but which do not influence the physical fire performance of the fire resistive pipe protection system, for example, due to excessive deflection or falling debris.

5.1.3 The pipe and fire resistive pipe protection system are to be installed as complete systems and are to each incorporate at least one intermediate support, connection and fitting for which is representative of that for which a rating is desired. If the fire resistive pipe protection system is applied in segments, a segment (splice, joint or overlap) representative of the field application shall be included in the test sample.

5.1.4 If a rating is desired only for a specific rigid fuel pipe network, the installed fire resistive pipe protection system shall simulate the condition for which rating is desired.

5.1.5 Unless a rating is desired for a specific construction, the firestop system for the floor opening is to be constructed using materials and techniques that provide an effective heat and smoke seal without influencing the performance of the fire resistive pipe protection system, for example as a result of degradation or excessive heat transfer to the fire resistive pipe protection system within the firestop system. The firestop system is not being evaluated as part of this standard.

5.1.6 The periphery of the test sample is to be not closer than 12 in (305 mm) from the furnace edge. The distance between the test sample periphery and furnace edge may be reduced if it is demonstrated that the edge effects do not affect the test results.

5.2 Conditioning

5.2.1 Prior to fire testing, each fire resistive pipe protection system and floor or wall assembly is to be conditioned, if necessary, to provide a moisture condition representative of that likely to exist in similar constructions in buildings. The floor or wall assembly may be conditioned independently of the fire resistive pipe protection systems. The test moisture condition is to be considered as that which would be established in equilibrium resulting from drying of a sample in air having 50% relative humidity at 73°F (23°C). If it is impractical to achieve this equilibrium moisture condition, the test may be conducted when the dampest portion of the test assembly and test sample have achieved an equilibrium moisture content corresponding to drying in air having 50 to 75% relative humidity at 73 ±5°F (23 ±3°C).

Exception: These requirements may be waived if:

a) An equilibrium moisture condition is not achieved within a 12 month conditioning period; or

b) The construction is such that drying of the interior of the assembly is prevented by hermetic sealing of the construction materials. In these cases, the conditioning need then be continued only until the test assembly has developed sufficient strength to retain the test samples securely in position.

5.2.2 A procedure with electric sensing elements may be used to determine the relative humidity within a test assembly and test sample made of materials other than concrete.

5.3 Protection of assembly and sample

5.3.1 The testing equipment, test sample and assembly are to be protected from any condition of wind or weather that might influence the test results. The ambient air temperature at the beginning of the test is to be within the range of 50 to 90°F (10 to 32°C). The velocity of air across the unexposed surface of the test sample, measured immediately before the test begins, is not to exceed 4.4 ft/s (1.3 m/s) as determined by an anemometer placed at right angles to the unexposed surface. If mechanical ventilation is employed during the test, an air stream is not to be directed across the surface of the sample.

5.4 Furnace temperature control and measurement

5.4.1 The temperature of the furnace is to be controlled so that the area under the measured time-temperature curve of furnace temperature, obtained by averaging the result from thermocouple (see 5.4.3 – 5.5.2) or pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 h or less duration, within 7.5% for tests longer than 1 h but not longer than 2 h, and within 5% for tests exceeding 2 h in duration. The points on the curve that determine its character areas follows in (a) – (h) below.

a) 50 – 90°F (10 to 32°C) at 0 min

b) 1000°F (538°C) at 5 min

c) 1300°F (704°C) at 10 min

d) 1550°F (843°C) at 30 min

e) 1700°F (927°C) at 1 h

f) 1850°F (1010°C) at 2 h

g) 2000°F (1093°C) at 4 h

h) 2300°F (1260°C) at 8 h

5.4.2 For a more precise definition of the time-temperature curve, see Appendix A. The test sponsor may also elect to utilize the time-temperature curve of the Standard for Rapid Rise Fire Tests of Protection Materials for Structural Steel, UL 1709 (Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies, ASTM E1529) to expose to the test assembly.

5.4.3 The measured temperature to be compared with the standard time-temperature curve is to be the average temperature obtained from the readings of thermocouples symmetrically disposed and distributed within the test furnace to indicate the temperature near all parts of the test assembly.

5.4.4 A minimum of three thermocouples are to be used, and there are to be no fewer than five thermocouples per 100 ft^2 (9.3 m^2) of floor surface, and no fewer than nine thermocouples per 100 ft^2 of wall surface. The floor or wall surface area is to be the gross area of test assembly and system areas.

5.4.5 For floors, the junctions of the thermocouples are to be placed 12 in (305 mm) from the exposed surface of the floor assembly. For walls, the junctions of the thermocouples are to be placed 6 in (152 mm) from the exposed surface of the wall assembly.

5.4.6 The temperatures are to be read and recorded at intervals of 1 min or less during the first 2 h and at intervals of 2 min or less thereafter.

5.5 Furnace thermocouple preparation

5.5.1 Each furnace thermocouple is to be enclosed in a sealed protection tube. The exposed combined length of protection tube and thermocouple in the furnace chamber is not to be less than 12 in (305 mm). Other types of protection tubes can be used provided that the temperature measurements are within the limits of accuracy specified in 5.5.2.

5.5.2 The time constant of the protected thermocouple assembly is to be within the range of 5.0 to 7.0 min. A typical thermocouple assembly complying with the time constant requirement shall be fabricated by fusion-welding the twisted ends of 18 AWG (0.82 mm^2) chromel-alumel wires, mounting the leads in porcelain insulators and inserting the assembly into a standard weight nominal 1/2-in (13 mm) diameter iron, steel, or inconel pipe, and sealing the end of the pipe that is inside the furnace. The thermocouple junction is to be inside the pipe, 1/2 in from the sealed end.

5.6 Sample temperature measurement

5.6.1 Temperature measurements are to be made by thermocouples placed at each of the following locations underneath the fire resistive pipe protection material, as illustrated in Figure 5.1.

Group A)

1) A minimum of two thermocouples evenly distributed around the perimeter of the pipe at a point 1 in (25 mm) from the floor or wall surface facing the furnace;

2) A minimum of four thermocouples evenly distributed around the perimeter of the pipe immediately adjacent to the pipe support;

3) A minimum of two thermocouples evenly distributed around the perimeter of the pipe at a point 12 in (305 mm) from the floor or wall surface on the leg of the pipe;

4) A minimum of four thermocouples evenly distributed around the perimeter of the pipe at the center of the pipe elbow;

5) A minimum of two thermocouples evenly distributed around the perimeter of the pipe at a point 12 to 18 in (305 to 457 mm) from and on both sides of the pipe support; and

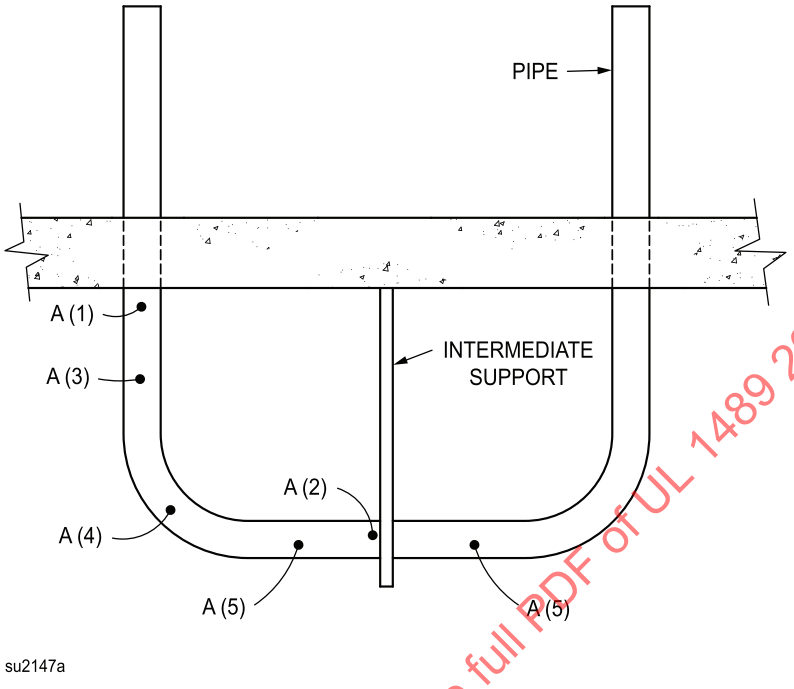
6) A minimum of two thermocouples evenly distributed around the perimeter of the pipe at a point directly beneath a representative joint or splice in the fire resistive protection material.

Group B)

1) At all anticipated hot spots on the pipe and at the discretion of the testing body.

Figure 5.1

Temperature measurement locations



NOTE – Thermocouple location. See 5.6.1 for description of alpha-numerical symbols.

5.6.2 Temperature measurements shall be made at locations in addition to those described in 5.6.1 for the purpose of evaluating the performance of the fire resistive pipe protection system and firestop.

5.6.3 Temperatures on the surface of the pipe are to be measured with thermocouples screwed, bolted, riveted, welded, wire-tied, taped or peened to the pipe in a manner to ensure their securement to the pipe at the required location. The thermocouple leads are to be not larger than 18 AWG (0.82 mm^2) and are to be electrically insulated with heat- and moisture-resistant coverings.

5.6.4 Temperatures are to be measured and recorded at intervals of 10 s or less.

5.7 Differential pressure measurements

5.7.1 General

5.7.1.1 The differential pressure between the exposed and unexposed surfaces of the floor or wall assembly is to be 2.5 Pa or controlled with ±20% of the intended value as outlined in 5.7.3.1 during the test (excluding the first 10 min), and is to be measured at a point on each side of the floor or wall, 0.78 in (20 mm) from the surface of the assembly, as follows:

a) At the center and quarter points of the longitudinal center line for a floor assembly; and

b) At the center and quarter points of the vertical center line for a wall assembly.

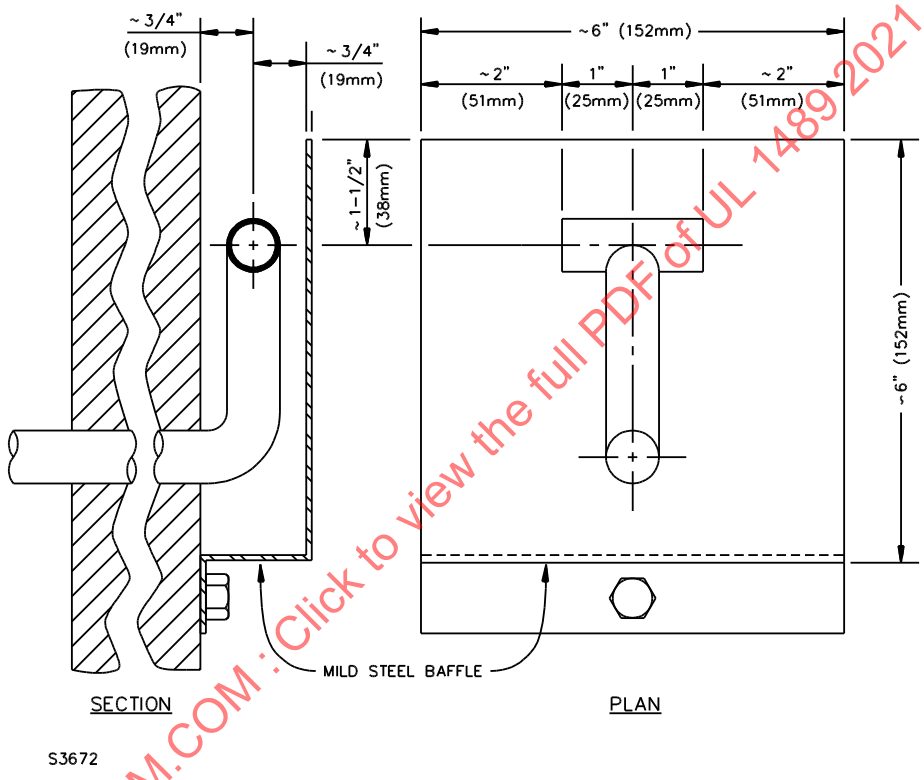
5.7.2 Pressure measurement apparatus

5.7.2.1 The differential pressure is to be measured by means of a manometer or equivalent transducer capable of reading pressure within an accuracy of 0.01 in (2.5 Pa) of water.

5.7.2.2 The pressure measuring probe tips are to be as illustrated in Figure 5.2, or the equivalent, and manufactured form stainless steel or equivalent material.

Figure 5.2

Pressure measurement probe



5.7.3 Differential pressure selection

5.7.3.1 The differential pressure employed in testing is to be that determined by either:

a) Code requirements;

b) The design pressure that may occur in the type of installation for which the test is proposed; or

c) Other circumstances.

5.8 Duration of test

5.8.1 The test specimen and assembly are to be subjected to fire exposure as described in 5.4 for a period equal to or greater than the desired rating of the system.

6 Hose Stream Test

6.1 Within 10 min after the fire exposure test, the test assembly is to be subjected to the impact, erosion, and cooling effects of a water hose stream, as described in Table 6.1, directed first at the middle and then at all other parts of the exposed surface, with all changes in direction being made slowly.

Table 6.1
Pressure and duration – hose stream test

Desired F rating (F), min	Water pressure at base of nozzle, psi (kPa)	Duration of application, s/ft^2 (s/m^2) of exposed area[a]
240 ≤ F < 480	45 (310)	3.0 (32)
120 ≤ F < 240	30 (210)	1.5 (16)
90 ≤ F < 120	30 (210)	0.90 (9.7)
F < 90	30 (210)	0.60 (6.5)

[a] The rectangular area of the wall or floor assembly into which the test assembly is mounted is to be considered as the exposed area, as the hose stream must traverse this calculated area during its application.

6.2 The stream is to be delivered through 2-1/2 in (63.5 mm) hose and discharged through a National Standard playpipe of corresponding size equipped with a 1-1/8 in (28.6 mm) discharge tip of the standard-taper, smooth-bore pattern without a shoulder at the orifice. The water pressure and duration of application is to be as specified in Table 6.1.

6.3 The nozzle orifice is to be 20 ft (6.1 m) from the center of the exposed surface of the test specimen if the nozzle is located so that, when directed at the center, its axis is normal to the surface of the test specimen. If otherwise located, its distance from the center is to be less than 20 ft by an amount equal to 1 ft (305 mm) for each 10 degrees of deviation from the normal.

7 Leakage Test

7.1 After the test assembly cools from the fire endurance test, conduct the leakage test as follows:

7.2 Pressurize the pipe with water to 150 percent of the working pressure rating of the pipe. For example, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, ASTM A53 B may be used as a guide to determine the working pressure rating of schedule 40 steel pipe.

7.3 A leakage test conducted prior to the fire endurance test is not required but may be useful to ensure the piping network is free of openings and to establish a benchmark pressure value.

7.4 The leakage test pressure shall be maintained for at least 15 min after which time the test specimen shall be examined for leaks. The test pressure within the pipe system shall not be reduced while performing this examination.

CONDITIONS OF ACCEPTANCE

8 General

8.1 Fire exposure

8.1.1 The fire resistive pipe protection system shall remain intact during the fire exposure and water hose stream tests without developing any openings through which the interior of the pipe is visible. The test