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# **Examination Standard for Flexible Sprinkler Hose with Threaded End Fittings**

**Class Number 1637**

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# Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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## 1. INTRODUCTION

### 1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for flexible sprinkler hose with threaded end fittings for use in clean rooms, commercial suspended ceilings, and ducts. Other applications shall be evaluated on a case-by-case basis.
- 1.1.2 Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

### 1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for flexible sprinkler hose with threaded end fittings for their intended application of connecting the sprinklers in a clean room, commercial suspended ceiling, or duct to the sprinkler piping.
- 1.2.2 A commercial suspended ceiling is a type of ceiling used predominately in Light Hazard Occupancies. It is also used less frequently in Ordinary Hazard Occupancies. A typical commercial suspended ceiling system is a "T-Bar Grid". In a T-Bar Grid ceiling, a metal component with an inverted "T" cross-section is used to secure and support acoustical lay-in panels.
- 1.2.3 Rigid furring channel is another type of commercial ceiling system.
- 1.2.4 Other applications shall be evaluated on a case-by-case basis. In cases where metric sized flexible sprinkler hose with threaded end fittings are to be examined for certification, test criteria comparable to the equivalent or nearest nominal inch size shall be used.

### 1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of flexible sprinkler hose with threaded end fittings for the purpose of obtaining certification. Flexible sprinkler hose with threaded end fittings having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

### 1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
- the suitability of the product;
  - the performance of the product as specified by the manufacturer and required for certification;
  - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme

to ensure ongoing compliance.

### 1.5 Basis for Continued Certification

The basis for continual certification may include the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agencies product surveillance program.

### 1.6 Effective Date

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

### 1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this standard.

### 1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.:

- ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch)*
- ANSI/IEEE/ASTM SI 10, American National Standard for Metric Practice*
- ISO 10380, Pipework -- Corrugated Metal Hoses and Hose Assemblies*

### 1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

#### *Accepted*

This term refers to installations acceptable to the authority enforcing the applicable installation rules (Authority Having Jurisdiction). Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product, it is installation specific. A product accepted for one installation may thus not be acceptable elsewhere.

**Attachment**

Method of joining end fittings to a flexible metal hose.

**Braid**

Tubular woven stocking of metal wires used to provide pressure strength and/or external protection.

**Clean Rooms**

A clean room is an enclosed space in which airborne particulates, contaminants, and pollutants are kept within strict limits.

**Corrosion Resistant**

Flexible sprinkler hose with threaded end fittings shall be termed corrosion resistant if its interior surface exhibits equivalent resistance to aqueous corrosion as steel pipe which is internally coated with zinc.

**Corrugated Metal Hose**

Pressure-tight hose with corrugations, helicoidally (formed or arranged in a spiral) or annular (formed in a ring) to the axis of the hose. Made by deforming the metal, the corrugations provide flexibility.

**Discharge Coefficient (K-Factor)**

The coefficient of discharge as expressed in the equation:

$$K = \frac{Q}{P^{1/2}}$$

Where Q is the flow in gallons per minute (gal/min), and P is the pressure in pounds per square inch (psi). Expressed in SI units: Q is the flow in liters per minute (l/min) and P is the pressure in bar.

**End Connection**

The fitting/component used to connect components of a pipe system or an individual sprinkler to the flexible sprinkler hose with threaded end fittings.

**End Fitting**

Permanently attached fitting which allows metal hose to be connected to other components.

**Flexibility**

The capability of a metal hose to be repeatedly bent elastically during operation.

**Light Hazard Occupancy**

An occupancy in which the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected. Light Hazard Occupancies include occupancies having conditions similar to: apartments, churches, clubs, eaves and overhangs (if combustible construction with no combustibles beneath), educational facilities, hospitals, institutional facilities, libraries (except large stack rooms), museums, nursing or convalescent homes, office (including data processing), residential facilities, restaurant seating areas, theaters and auditoriums (excluding stages and prosceniums), and unused attics.

**Minimum Bend Radius**

The minimum radius [expressed in inches (mm)], specified by the manufacturer, at which a hose is designed to operate.

**Metal Hose Assembly**

Assembly of a metal hose with its end fittings.

**Ordinary Hazard Occupancy**

An occupancy where the quantity and combustibility of contents is greater than that of a Light Hazard Occupancy.

***Pendent Sprinkler***

An automatic sprinkler designed such that the water exiting its orifice is directed downward against the deflector.

***Rated Working Pressure***

The maximum sustained pressure at which the flexible sprinkler hose with threaded end fittings may operate.

***Sidewall Sprinkler***

An automatic sprinkler intended for installation near a wall and ceiling interface and designed to discharge water horizontally outward and onto adjacent walls.

***Suspended Ceiling***

A ceiling in which the main runners and cross furring are suspended below the structural members of the building.

## 2. GENERAL INFORMATION

### 2.1 Product Information

In order to meet the intent of this standard, flexible sprinkler hose with threaded end fittings shall be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated using identical materials by different manufacturers or, even by different plants of the same manufacturer, have sometimes been shown to perform differently in testing. Sample hoses, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

### 2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- a complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- the minimum bend radius of the flexible sprinkler hose;
- the type of application for the flexible sprinkler hose: clean room, commercial suspended ceiling or duct;
- general assembly drawings, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures;
- The number and location(s) of manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation..

### 2.3 Requirements for Samples for Examination

- 2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:
- Sample requirements to be determined by the certification agency
- 2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.
- 2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency
- 2.3.4 It is the manufacturer's responsibility to provide any special test fixtures which may be required to evaluate the flexible sprinkler hose with threaded end fittings.
- 2.3.5 If there are failures encountered during the examination testing, the certification agency will provide the manufacturer with information regarding what testing will need to be repeated and any additional sample requirements.

### 3. GENERAL REQUIREMENTS

#### 3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use of the flexible sprinkler hose with threaded end fittings. The certification examination results may further define the limits of the final certification.

#### 3.2 Physical or Structural Features

- 3.2.1 Flexible sprinkler hose are for use in wet pipe and dry pipe systems.
- 3.2.2 Flexible sprinkler hoses with threaded end fittings shall be designed for a minimum rated working pressure of 175 psi (1205 kPa). Other pressures may be considered at the discretion of the certification agency.
- 3.2.3 Flexible sprinkler hose with threaded end fittings covered by this standard shall be a nominal 3/4, 1, 1-1/4 or 1-1/2 in. diameter. The smallest inside diameter allowed for the flexible sprinkler hose is 0.75 inch (19.05 mm).
- 3.2.4 A flexible sprinkler hose assembly, including end connections, shall have a maximum length of 6 ft (1.8 m). Both ends of the flexible sprinkler hose assembly shall come equipped with end connections.
- 3.2.5 All flexible sprinkler hoses shall have end connections such that they cannot be interconnected to create longer lengths.
- 3.2.6 Flexible sprinkler hoses with threaded end fittings submitted for testing shall be true production samples and shall be free of sharp edges, burrs, or other imperfections which might injure the installer or interfere with proper assembly of the unit.
- 3.2.7 Threaded end fittings on flexible sprinkler hose shall be fabricated from metal.
- 3.2.8 Flexible sprinkler hoses with threaded end fittings shall have a stainless steel braided metallic outer jacket with stainless steel internal bellows.
- 3.2.9 Non-metallic bellows are permitted but are restricted to Polytetrafluoroethylene (PTFE) convoluted hose, with a minimum thickness of 0.039 in. (1 mm).
- 3.2.10 Technical data sheets shall be provided by all manufacturers.
- 3.2.11 All connections shall be suitable for use with fittings having tapered pipe threads which conform to a national or internationally recognized standard. Sprinklers which are to be sold in the United States shall be threaded to suit fittings manufactured in accordance with ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*, per Table 3.2.11.

Table 3.2.11. Threaded Connections

<b>Nominal K-Factor gal/min/(psi)<sup>1/2</sup></b>	<b>U.S. Nominal Pipe Thread Size (NPT), in.</b>
5.6	1/2
8.0	1/2 or 3/4
11.2	1/2 or 3/4
14.0	3/4
16.8	3/4

<i>Nominal K-Factor gal/min/(psi)<sup>1/2</sup></i>	<i>U.S. Nominal Pipe Thread Size (NPT), in.</i>
19.6	1
22.4	1
25.2	1

3.2.12 The automatic sprinklers listed in Table 3.2.11 are acceptable for use in flexible sprinkler hose, providing a friction loss determination is conducted on each K-Factor and with a 1/2, 3/4 or 1 inch orifice size (See Section 4.6).

### 3.3 Materials

All materials used in these hoses shall be suitable for the intended application. Hose parts exposed to water shall be constructed of corrosion resistant materials. When non-standard or unusual materials are used, special tests may be necessary to verify their suitability.

### 3.4 Markings

3.4.1 Each flexible sprinkler hose with threaded end fittings shall be permanently marked on its external surface with the following information:

- Manufacturer's name or trademark;
- Nominal size;
- Rated working pressure;
- Model designation; and
- Certification agency's mark of conformity.

3.4.2 Markings shall be cast or forged in raised characters, etched or die stamped on the fitting assembly.

3.4.3 A corrosion resistant metal nameplate or a corrosion resistant aluminum sticker bearing the same information as stated above shall be considered acceptable if permanently fastened to the flexible hose or fitting assembly.

3.4.4 Other methods of applying permanent markings may be evaluated on a case-by-case basis.

3.4.5 Each required marking listed in Section 3.4.1 shall be legible and durable and applied in any of, or combination of, the above methods.

3.4.6 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.4.7 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

### 3.5 Manufacturer's Installation and Operation Instructions

Installation instructions, including any special dimension requirements and friction loss data, shall be furnished by the manufacturer. Instructions shall be provided in each shipping container.

### 3.6 Calibration

3.6.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was

performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

- 3.6.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of this equipment.

### **3.7 Tolerances**

Tolerances on units of measure shall be as described in Appendix E, unless otherwise specified in this standard.

## 4. PERFORMANCE REQUIREMENTS

### 4.1 Examination

#### 4.1.1 Requirement

The flexible sprinkler hose with threaded end fittings shall conform to the manufacturer's drawings and specifications and to certification requirements.

#### 4.1.2 Test/Verification

A sample shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

### 4.2 Fatigue

#### 4.2.1 Requirement

Flexible sprinkler hose with threaded end fittings shall be subjected to 50,000 cycles of repeated flexing at a rate of 5 cycles/minute to 15 cycles/minute in a direction parallel with the axis of the end fittings while pressured to their rated working pressure. There shall be no deterioration of the flexible sprinkler hose or its performance characteristics. Following the fatigue test, the flexible sprinkler hose with threaded end fittings shall not leak or fail when tested in accordance with the hydrostatic test requirements in Section 4.7 (Hydrostatic Strength).

#### 4.2.2 Test/Verification

Prior to the fatigue test, the test assembly shall be filled with water and subjected to a hydrostatic strength test to four times the rated working pressure, 700 psi (4825 kPa) minimum. The test shall be conducted for a duration of five minutes. No leakage or rupture is allowed.

The fatigue test shall be conducted in a similar fashion to the "U-Bend" test referenced in ISO 10380, *Pipework -- Corrugated Metal Hoses and Hose Assemblies*. A minimum of two samples of flexible sprinkler hose with fittings, of the longest size submitted for certification, shall be subjected to 50,000 cycles of repeated flexing at a rate of 5 cycles/minute to 15 cycles/minute in a direction parallel with the axis of the end fittings while pressurized to their rated working pressure, as shown in Figure C-1. The sample hose shall be mounted in a U shape with the end fittings at a horizontal distance from each other of twice the minimum bend radius,  $r$ , of the hose, as defined by the manufacturer's literature. One end of the sample shall be held in a fixed position and the other end shall be flexed in the vertical plane a distance of 4 times the nominal diameter of the sprinkler fittings above and below the position of the fixed end for a total vertical movement of 8 times the nominal diameter.

After completion of 50,000 cycles, the samples shall be subjected to the hydrostatic post-test as detailed in Section 4.7 (Hydrostatic Strength).

### 4.3 Vibration

#### 4.3.1 Requirements

Flexible sprinkler hose with threaded end fittings and its attachment hardware shall be able to withstand the effects of vibration without deterioration of their performance characteristics. Following the vibration test detailed in Section 4.3.2, there shall be no deterioration of the sprinkler hose, its fittings or its attachment hardware. Following exposure to the vibration test the flexible

sprinkler hose with threaded end fittings shall not leak when tested in accordance with Section 4.7 (Hydrostatic Strength).

4.3.2 Tests/Verification

4.3.2.1 A flexible sprinkler hose assembly, depending on intended installation application, shall be secured to a vibration table with the outlet end fitting in a vertical plane and the hose bent in a 90° angle, at its minimum bend radius, as defined by the manufacturer’s literature. The inlet of the flexible sprinkler hose with threaded end fittings shall be securely fixed in a horizontal plane, as shown in Figure C-5. The flexible hose shall be filled with water and pressurized to 90 psi (620 kPa) while being subjected to the vibration conditions in Table 4.3.2.

*Table 4.3.2 Vibration Conditions*

<b>Total Table Stroke in. (mm)</b>	<b>Frequency Hz</b>	<b>Time Hours</b>
0.020 (0.51)	28	5
0.040 (1.04)	28	5
0.150 (3.81)	28	5
0.040 (1.04)	18 to 37 variable	5
0.070 (1.78)	18 to 37 variable	5

4.3.2.2 If the flexible sprinkler hose under examination is for use in ducts, a 12 inch (305 mm) long, 12 inch (305 mm) diameter duct is secured to the vibration table. The outlet end of the flexible hose is secured to the duct, and is placed in a vertical plane. The inlet end of the hose is bent in a 90° angle at its minimum bend radius, as defined by the manufacturer’s literature, while the inlet is securely fixed in the horizontal plane and vibration tested.

4.3.2.3 If the flexible sprinkler hose under examination is for use in a cleanroom ceiling grid, a 15 inch (380 mm) long cleanroom ceiling grid under examination is secured to the vibration table. The outlet end of the flexible hose is secured in the ceiling grid. With the outlet end fitting in a vertical plane, the hose is bent in a 90° angle at its minimum bend radius, as defined by the manufacturer’s literature, and vibration tested.

4.3.2.4 If the flexible sprinkler hose under examination is for use in a commercial suspended ceiling application, a 24 x 24 inch (610 x 610 mm) commercial ceiling frame assembly is secured to the vibration table. The required bracket, screws and clamps for assembly in a commercial suspended ceilings system are required to be submitted for the vibration test. The outlet end of the flexible hose is secured in the ceiling assembly, and with the outlet end fitting in a vertical plane, the hose is bent in a 90° angle at its minimum bend radius, as defined by the manufacturer’s literature, and vibration tested.

4.3.2.5 During the vibration tests, acoustical lay-in ceiling panels are not required to be used in the metal framing assembly, as the testing determines the integrity of the flexible sprinkler hose connected with the associated hardware (brackets, clamps, screws, washers, lock washers etc), which the manufacturer supplies for their specific application. Acoustical lay-in ceiling panels may be used during the testing if deemed necessary by the certification agency.

4.3.2.6 Vibration Test Requirements:

- Commercial Suspended Ceiling: A vibration test is conducted on hose assemblies for use in a commercial suspended ceiling. The required bracket, screws, clamps for

assembly in a commercial suspended ceilings system need to be submitted. A 2 x 2 ft (610 x 610 mm) ceiling frame is required to be submitted for test.

- Cleanroom Ceiling: A vibration test is conducted on hose assemblies for use in a cleanrooms. A 12 inch long cleanroom ceiling grid is required to be submitted for each cleanroom ceiling grid submitted, and all screws to attach the grid to the hose assembly need to be submitted for test.
- Duct: A vibration test is conducted on hose assemblies for use in ducts. A 12 inch diameter, 12 inch long duct, mounting block and all associated screws, and hardware is required to be submitted for test.

4.3.2.7 After completion of the vibration test, the hose sample shall not leak or fail when tested in accordance to the hydrostatic post-test as detailed in Section 4.7 (Hydrostatic Strength).

#### 4.4 Pressure Cycling Test

##### 4.4.1 Requirement

Flexible sprinkler hose with threaded end fittings shall withstand 20,000 cycles of varying pressure while bent 90° with the threaded end fittings restrained and the hose unrestrained on a flat surface. There shall be no deterioration of the flexible sprinkler hose performance characteristics. Following the 20,000 cycles detailed in Section 4.4.2, the flexible sprinkler hose with threaded end fittings shall not leak or fail when tested in accordance with Section 4.7 (Hydrostatic Strength).

##### 4.4.2 Test/Verification

4.4.2.1 Prior to cycling, the test assembly shall be filled with water and subjected to a hydrostatic strength test equal to four times the rated working pressure, 700 psi (4825 kPa) minimum. The test shall be conducted for a duration of five minutes. No leakage or rupture is allowed.

4.4.2.2 The test sample shall be bent at a 90° angle, with the threaded end fittings restrained and the hose unrestrained on a flat surface, at its minimum bend radius, as specified in the manufacturer's literature. The hose assembly shall then be subjected to 20,000 cycles of hydrostatic pressure varying from 0 to 175 psi (0 to 1205 kPa) or its rated working pressure, whichever is greater, at a rate of approximately 6 cycles per minute.

4.4.2.3 After completion of 20,000 cycles, the samples shall not leak or fail when subjected to the hydrostatic post-test as detailed in Section 4.7 (Hydrostatic Strength).

#### 4.5 Vacuum Test

##### 4.5.1 Requirement

Flexible sprinkler hose with threaded end fittings shall withstand a vacuum of 26 in. Hg (0.88 bar) without collapse, leakage or deterioration of the flexible sprinkler hose performance characteristics. Following the vacuum test detailed in Section 4.5.2, there shall be no deterioration of its performance characteristics and the flexible sprinkler hose with threaded end fittings shall not leak or fail when tested in accordance with Section 4.7 (Hydrostatic Strength).

##### 4.5.2 Tests/Verification

4.5.2.1 One previously untested hose sample shall be subjected to a vacuum of 26 in. Hg (0.88 bar) for a period of 5 minutes, during which time there shall be no collapse or leakage.

4.5.2.2 After completion of the vacuum test, the sample shall not leak or fail when subjected to

the hydrostatic post-test as detailed in Section 4.7 (Hydrostatic Strength).

**4.6 Friction Loss (Equivalent Length of Pipe)**

4.6.1 Requirements

To determine the effect of the flexible sprinkler hose with threaded end fittings on the hydraulic system, the average friction loss through the flexible sprinkler hose with threaded end fittings shall be equated to the theoretical length of nominal 1 in. diameter schedule 40 sprinkler pipe, with a C-factor of 120, which would produce the same amount of friction loss.

4.6.2 Test/Verification

To determine the friction loss of flexible sprinkler hose, flow measurements shall be taken at 5 gal/min. (18.9 L/min.) increments from 25 gal/min. to 65 gal/min. (94.6 L/min. to 246 L/min.) on each hose length with a sprinkler head threaded into the outlet of the test assembly. The sprinklers used for this test shall have nominal discharge coefficients (K-factors) as listed in Table 4.6.1. Each flexible hose length shall be tested with a requested nominal K-Factor sprinkler listed in Table 4.6.1. The sprinkler shall be attached to the hose, and the hose shall be tested with its maximum number of bends, as shown in Table 4.6.2, but not to exceed the minimum radius (see Figure C-3) as specified by the manufacturer’s literature. A series of flow versus pressure drop ( $\Delta P$ ) measurements shall be conducted to obtain the net friction loss across the hose. The average  $C_v$  coefficient shall then be calculated using the formula  $C_v = Q/P^{1/2}$  where  $Q$  is the flow rate in gpm and  $\Delta P$  is the net friction loss in psi across the hose.

*Table 4.6.1 Nominal Discharge Coefficients (K-factors)*

<b>Nominal K-Factor gal/min/(psi)<sup>1/2</sup></b>	<b>Nominal K-Factor dm<sup>3</sup>/min/(kPa)<sup>1/2</sup></b>	<b>U.S. Nominal Thread Size, in.</b>
5.6	8.0	1/2
8.0	11.5	1/2 or 3/4
11.2	16.0	1/2 or 3/4
14.0	20.0	3/4
16.8	24	3/4
19	27	1
22	31.7	1
25.2	36.0	1

The testing of flexible sprinkler hose for Friction Loss determination shall be conducted to produce reproducible and comparable test data. It is important that friction loss testing be standardized and that comparative data between hoses with the same lengths from various manufacturers be available. Table 4.6.2 may be used as a guideline.

*Table 4.6.2 Number of Bends*

<b>Flexible Sprinkler Hose Lengths (m)</b>	<b>Number of Bends</b>
Up to 2 ft (0.61 m)	1
From 2 ft to 3 ft (0.61 m to 0.91 m)	2
From 3 ft to 4 ft (0.91 m to 1.21 m)	3
From 4 ft to 6 ft (1.21 m to 1.81 m)	4

## 4.7 Hydrostatic Strength

### 4.7.1 Requirement

Flexible sprinkler hose with threaded end fittings shall withstand a hydrostatic pressure of four times the rated working pressure without rupture, cracking, permanent distortion or deterioration of its performance characteristics.

### 4.7.2 Test/Verification

Flexible sprinkler hose with threaded end fittings of each length shall be subjected to a hydrostatic pressure of 700 psi (4825 kPa) or four times the rated working pressure, whichever is greater, for five minutes. There shall be no visible rupture, cracking, permanent distortion or any deterioration of hose performance as a result of this test.

## 4.8 Seal Integrity

### 4.8.1 Requirement

Flexible sprinkler hose with threaded end fittings that incorporate a sealing mechanism, such as o-rings or gaskets, shall withstand an exposure to temperatures of -40°F (-40°C) [low temperature] and 275°F (135°C) [high temperature] without cracking, leaking, permanent deformation or deterioration of the performance characteristics of the seal.

### 4.8.2 Test/Verification

#### 4.8.2.1 High Temperature Exposure

One sample of the flexible sprinkler hose with threaded end fittings and sealing mechanism, for each sealing mechanism material under examination, shall be hydrostatically tested to confirm that there is no leakage at the rated working pressure. Then the hose shall be drained and subjected to a high temperature oven-air exposure of 275°F (135°C) for 45 days. After exposure, the hose shall be allowed to cool to ambient air temperature. It shall then be pneumatically pressurized to 50 psi (345 kPa) and submerged in water. No leakage shall occur. The sealing mechanism, after removal from the hose, shall not crack when squeezed together from any two diametrically opposite points.

#### 4.8.2.2 Low Temperature Exposure

One sample of the flexible sprinkler hose with threaded end fittings and sealing mechanism, for each sealing mechanism material under examination, shall be hydrostatically tested to confirm that there is no leakage at the rated working pressure. Then the hose shall be drained and subjected to a low temperature exposure of -40°F (-40°C) for 4 days. Immediately after exposure, the hose shall be submerged in an antifreeze solution at a temperature of -40°F (-40°C) and shall be pneumatically pressurized to 50 psi (345 kPa). No leakage shall occur. The depressurized hose shall then be allowed to warm to ambient temperature and disassembled. The sealing mechanism, after removal from the hose, shall not crack when squeezed together from any two diametrically opposite points.

## 4.9 High Pressure Flow

### 4.9.1 Requirement

Flexible sprinkler hose with threaded end fittings attached to commercial suspended ceiling frame assemblies shall be able to withstand the effects of a high pressure flow from an operated automatic sprinkler. Following the high pressure flow test detailed in Section 4.9.2, there shall be no deterioration of the sprinkler hose, its fittings or its attachment hardware.

### 4.9.2 Tests/Verification

A flexible sprinkler hose with threaded end fittings shall be fitted with a sprinkler and secured in a commercial ceiling assembly. The sprinkler shall be operated using a suitable heat source and allowed to discharge for a period of one minute. Five tests shall be conducted with pressures ranging from 40 psi to 175 psi (275 kPa to 1205 kPa) in approximately 35 psi (240 kPa) increments.

During and after the high pressure flow tests, the flexible sprinkler hose, fittings and attachment hardware shall be examined for leakage, rupture and movement.

## 4.10 Elongation

### 4.10.1 Requirement

The length of flexible sprinkler hose with threaded end fittings shall not exceed 101 percent of its unstressed length after being subjected to a hydrostatic pressure equal to 1.5 times the rated working pressure.

### 4.10.2 Test/Verification

The length of a flexible sprinkler hose with threaded end fittings of the maximum length submitted for certification shall be placed in a straight assembly then measured and subjected to a hydrostatic pressure of 1.5 times the rated working pressure and held for 1 minute. After the 1 minute exposure, the test pressure shall be released and the sample length shall be measured again and the length shall not exceed 101 percent of the pre-test hose length.

## 5. OPERATIONS REQUIREMENTS

### 5.1 Demonstrated Quality Control Program

5.1.1 A quality control program is required to assure that subsequent flexible sprinkler hose with threaded end fittings produced by the manufacturer, at an authorized location, shall demonstrate the same quality and reliability as the specific hoses examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests, may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- Corporate quality assurance guidelines;
- Incoming quality assurance, including testing;
- In-process quality assurance, including testing;
- Welding Procedures and welder training;
- Final inspection and tests;
- Equipment calibration;
- Drawing and change control;
- Packaging and shipping; and,
- Handling and disposition of non-conforming materials.

In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed for a minimum period of two years from the date of manufacture of the flexible sprinkler hose with threaded end fittings.

#### 5.1.3 Documentation/Manual

The manufacturer shall maintain an authoritative collection of quality procedures and policies. Such documentation shall provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and to verify operation of the quality system.

#### 5.1.4 Drawing and Change Control

The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.

Records of all revisions to all certified products shall be maintained.

### 5.2 Surveillance Audit Program

5.2.1 An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a

uniform product consistent with that which was tested and certified.

- 5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

### 5.3 Manufacturer's Responsibilities

The manufacturer shall notify the certification agency for changes in product construction, design, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation of such changes.

### 5.4 Manufacturing and Production Tests

#### 5.4.1 *Test Requirement - Pressure Test*

The manufacturer shall hydrostatically test 100 percent of production flexible sprinkler hoses with threaded end fittings for leakage at the rated working pressure. The minimum hydrostatic test duration shall be 30 seconds. Alternately the manufacturer can pneumatically test 100 percent of production flexible sprinkler hoses with threaded end fittings for leakage at one third the rated working pressure. The minimum test duration shall be 10 seconds.

#### 5.4.2 *Test Requirement - Visual Inspection*

The manufacturer shall visually inspect 100 percent of production flexible sprinkler hoses with threaded end fittings. This inspection shall verify that all hoses are free from visual defects (especially damaged hose braid or threads).

### 5.5 Welder Training Requirements

The manufacturer shall train and maintain certified welders. The training records shall be maintained and available for the auditor to review during the facility and procedure audit.

## 6. BIBLIOGRAPHY

ISO 7369, Pipework - *Metal Hoses and Hose Assemblies - Vocabulary*

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*

**APPENDIX A:**

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**APPENDIX B:**

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### APPENDIX C: Figures

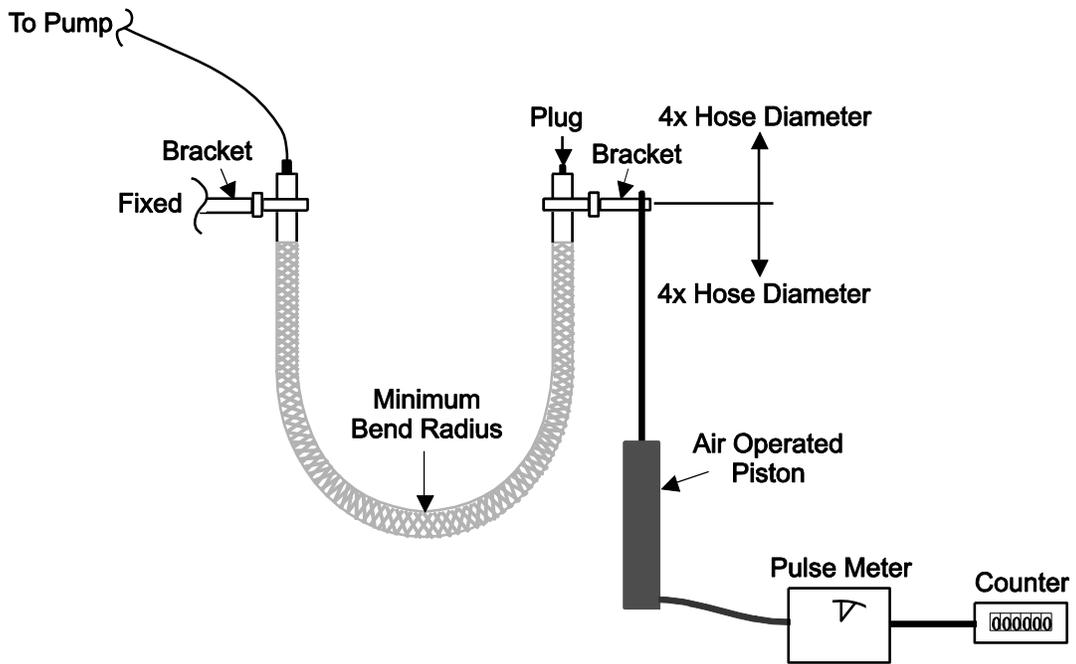
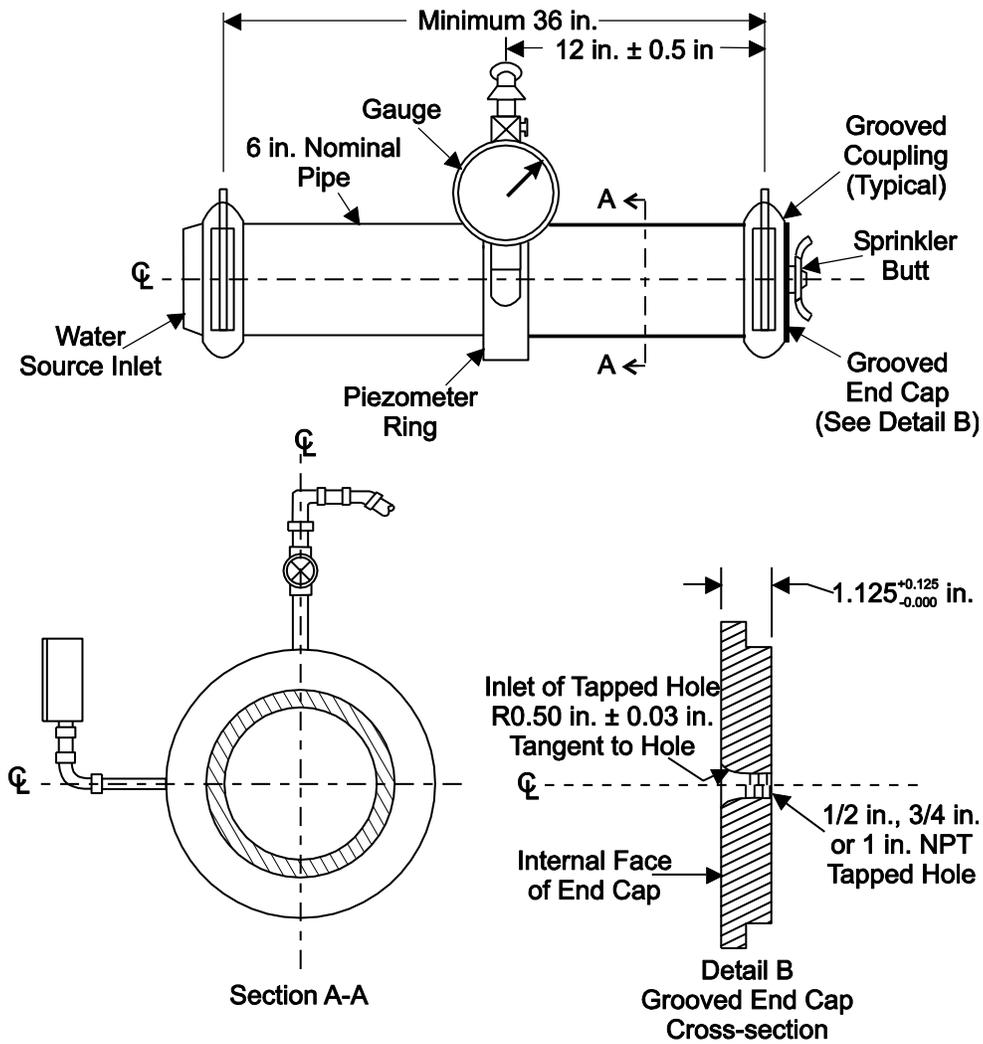
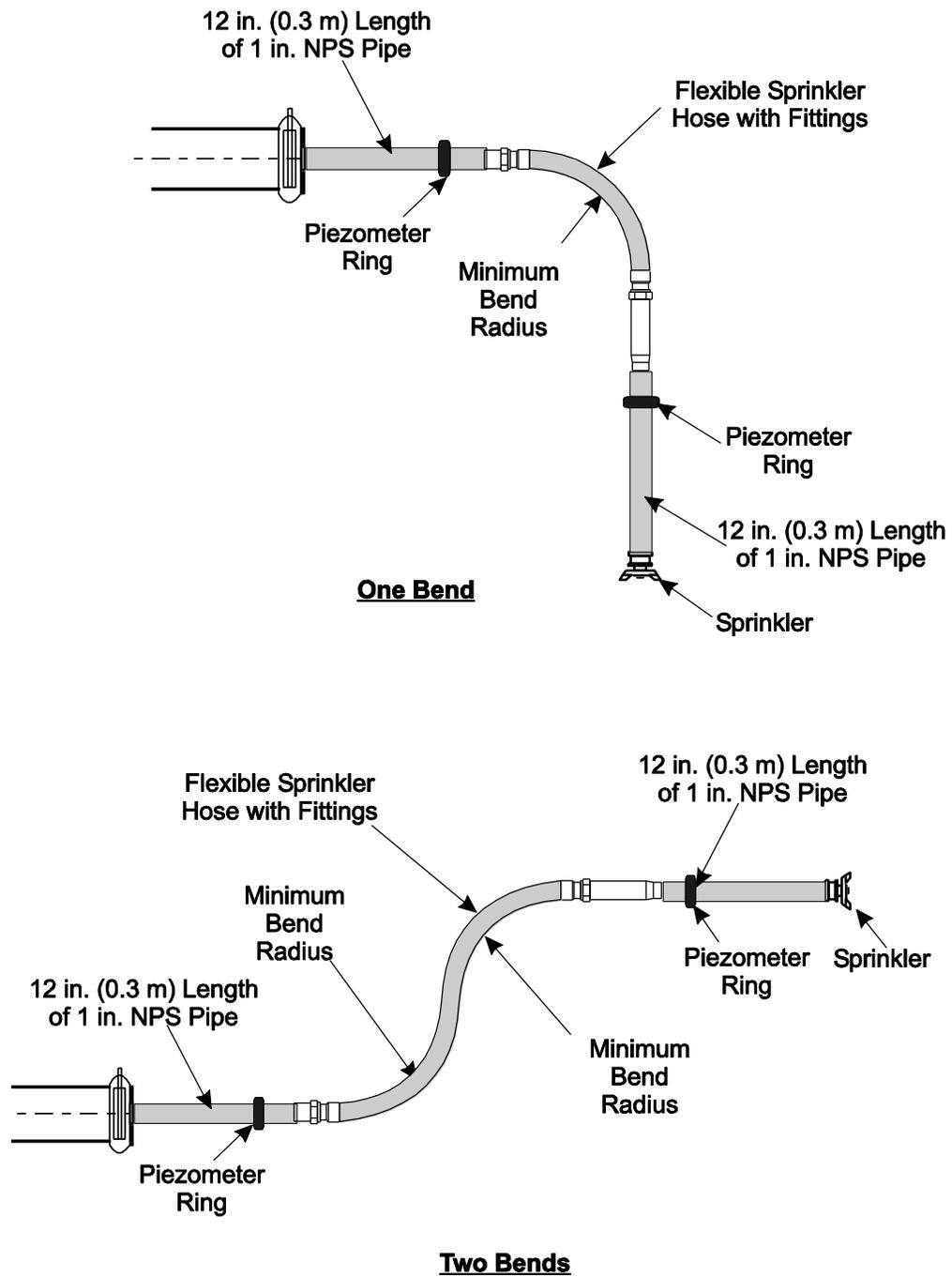


Figure C-1. Test Apparatus for Fatigue Test



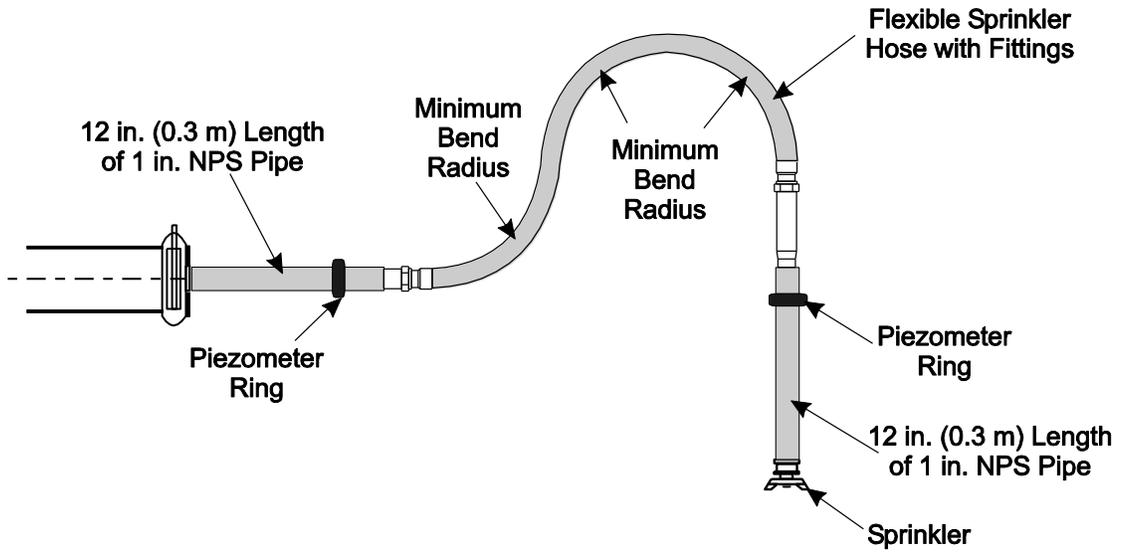
Note: All dimensions are nominal size unless otherwise indicated.  
Radius on Inlet may be truncated on internal face.

Figure C-2. Test Apparatus for Measuring Sprinkler Nominal K-Factors

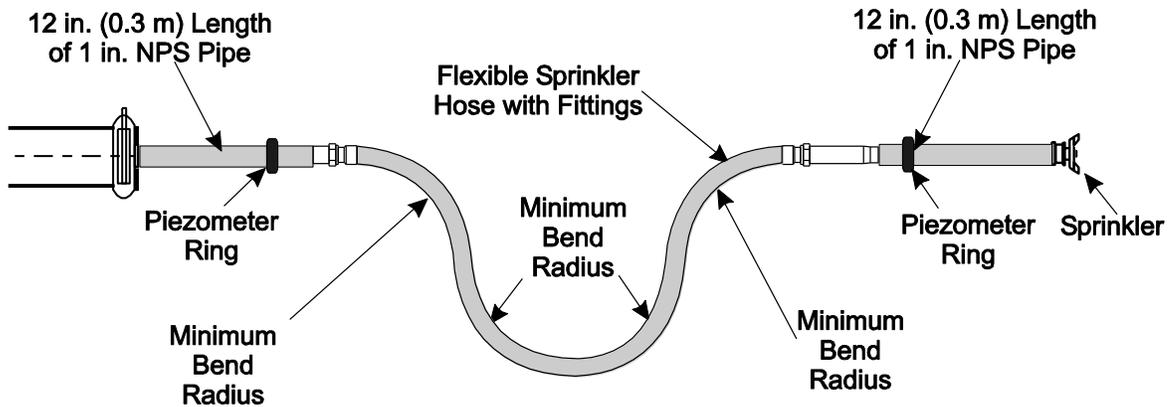


Note: All dimensions are nominal size

Figure C-3. Test Apparatus with Flexible Sprinkler Hose with Threaded End Fittings for Measuring Friction Loss (Equivalent Length of Pipe) With One or Two Bends on the Hose



**Three Bends**



**Four Bends**

Note: All dimensions are nominal size

Figure C-4. Test Apparatus with Flexible Sprinkler Hose with Threaded End Fittings for Measuring Friction Loss (Equivalent Length of Pipe) With Three or Four Bends on the Hose

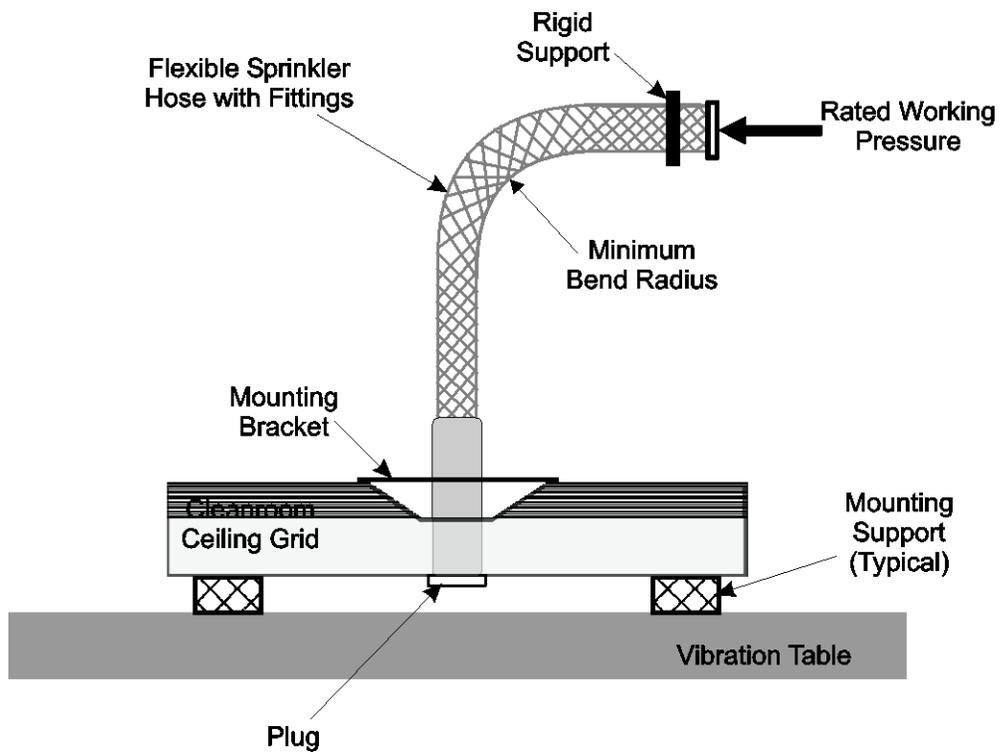


Figure C-5. Test Arrangement for Vibration Test

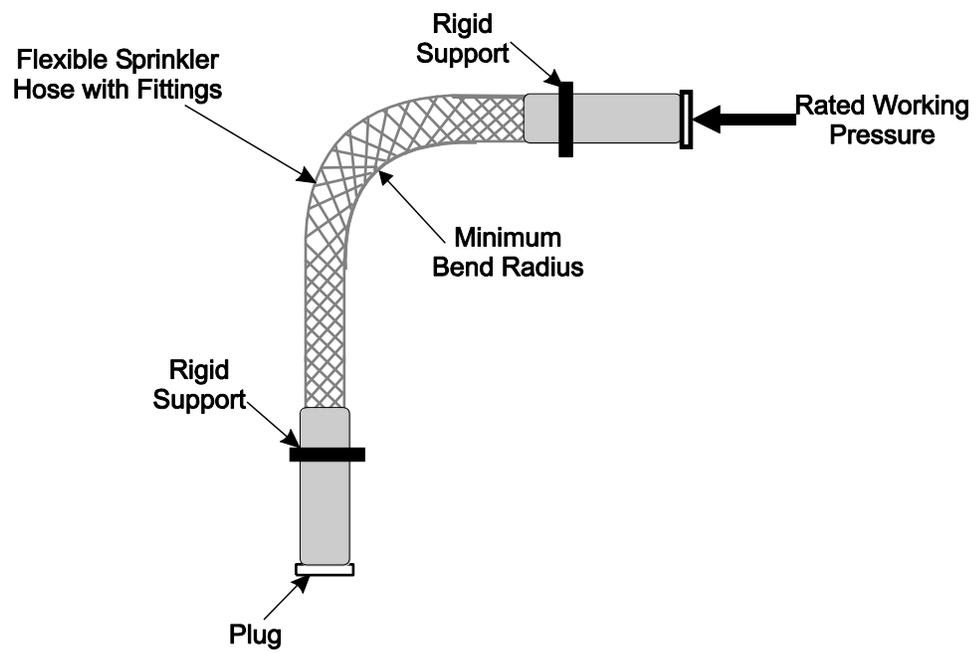


Figure C-6. Test Arrangement for Pressure Cycling Test

## APPENDIX D: Sample Listing

### Flexible Sprinkler Hose with Threaded End Fittings (1637)

- \* Fire Protection Division
  - \* Automatic Sprinkler Systems
    - \* Flexible Sprinkler Hose with Fittings
      - \* For Cleanroom Ceilings
 

Flexible sprinkler hose with threaded end fittings are for use in cleanroom ceilings. The flexible hoses are to be installed according to the manufacturer's directives. Unless indicated, the hoses have a rated working pressure of 175 psi (1205 kPa).
      - \* For Commercial Suspended Ceilings
 

Flexible sprinkler hose with threaded end fittings are for use in commercial suspended ceilings. The flexible hoses are to be installed according to the manufacturer's directives. Unless indicated, the hoses have a rated working pressure of 175 psi (1205 kPa).
      - \* For Ducts
 

Flexible sprinkler hose with threaded end fittings are for use in ducts. The flexible hoses are to be installed according to the manufacturer's directives. All of the models listed below are 1 in. nominal dia. flexible metal sprinkler hose for providing a connection to automatic sprinklers in ducts. Approval is limited for use in ducts only. Unless indicated, the hoses have a rated working pressure of 175 psi (1205 kPa).

**PJC Company, 123 Any Street, Your Town, State, USA 01234**

<i>Model</i>	<i>Outlet size, NPT (inch)</i>	<i>Hose assembly length, ft</i>	<i>Maximum Number of 90° bends</i>	<i>Minimum Bend radius, inch</i>	<i>Equivalent Length of 1 inch schedule 40 pipe, (C=120)</i>	
					<i>ft</i>	<i>(m)</i>
PJC13	1/2	3	2	6	15	(4.6)
PJC16	1/2	6	4	7	11	(3.3)
PJC987	3/4	4	2	8	19	(5.8)
PJC9	3/4	5	3	6	21	(6.4)

## APPENDIX E: Tolerances

Unless otherwise stated, the following tolerances shall apply:

<b>Amps:</b>	$\pm 0.25$ percent of value
<b>Angle:</b>	$\pm 2^\circ$
<b>Frequency (Hz):</b>	$\pm 5$ percent of value
<b>Length:</b>	$\pm 2$ percent of value
<b>Pressure:</b>	within + 5 (35 kPa)/- 0 psi (0 kPa) of value
<b>Temperature:</b>	$\pm 4^\circ\text{F}$ ( $2^\circ\text{C}$ )
<b>Time:</b>	+ 5/-0 seconds + 0.1/-0 minutes + 0.1/-0 hours + 0.25/-0 days
<b>Volume:</b>	$\pm 5$ percent of value

Unless stated otherwise, all tests other than operating tests shall be conducted at a room (ambient) temperature of  $68^\circ\text{F} \pm 9^\circ\text{F}$  ( $20^\circ\text{C} \pm 5^\circ\text{C}$ ).