



Member of the FM Global Group

Examination Standard for Pipe Fittings and Couplings for Fuel Gas Service

Class Number 7110

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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 couplings and fittings for fuel gas service.
- 1.1.2 Testing and certification criteria may include, but are not limited to, 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 welded, brazed, flanged, threaded, press-fit, compression type or flared end couplings and fittings used to deliver fuel gas, such as, but not limited to, natural gas and liquefied petroleum gas (LP-gas).
- 1.2.2 Other types of couplings and fittings for fuel gas service may be certified if they meet the requirements and intent of this standard. Couplings and fittings for fuel gas service with an unusual design may be subjected to special tests to determine their suitability.

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 couplings and fittings for fuel gas service for the purpose of obtaining Certification. Couplings and fittings for fuel gas service 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; and as far as practical,
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made 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, but is not limited to, 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 certification 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.

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/IEEE/ASTM SI 10, *American National Standard for Metric Practice*
NFPA 54, *National Fuel Gas Code*
NFPA 58, *Liquefied Petroleum Gas Codes*

1.9 Terms and Definitions

For the purposes of this standard, the following terms shall apply:

Accepted

This term refers to installations acceptable to the authority having jurisdiction and enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Factors other than the use of certified equipment impact upon the decision to accept the equipment. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.

Authority Having Jurisdiction

The organization, office, or individual responsible for approving equipment, materials, an installation or a procedure.

End Connections

This term refers to the method of connecting components to a piping system. Typical end connections in fuel gas service piping systems are welded, flanged, threaded, press-fit, compression type or flared end.

Rated Working Pressure

The maximum pressure rating that the coupling or fitting for fuel gas service is intended to operate at for its entire design life.

2 GENERAL INFORMATION

2.1 Product Information

The couplings and fittings covered under this standard are intended for use in fuel gas service systems. Installations shall be in accordance with NFPA 54 or NFPA 58, as applicable; the manufacturer's installation instructions and the requirements of the authority having jurisdiction (AHJ).

In order to meet the intent of this standard, couplings and fittings for fuel gas service must 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 in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample pipe couplings and other pipe fittings, 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 (materials, available end connections, rated working pressure, intended application, etc...) for the products or services being submitted for certification consideration;
- General assembly drawings and one complete set of manufacturing drawings;
- Materials list(s) and material specifications;
- Anticipated marking format;
- Brochures, sales literature, and specification sheets;
- Installation, operation and maintenance procedures; and
- The number and location 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 following review of the preliminary information

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 necessary test fixtures, such as those which may be required to evaluate a particular fitting design or end connection

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

- 3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification examination results may further define the limits of the final certification.

3.2 Physical or Structural Features

- 3.2.1 Couplings and fittings for fuel gas service shall be designed for a maximum rated working pressure of 125 psi (862 kPa) and operating temperature range of -4 to 120°F (-20 to 49°C). Higher pressure ratings or fittings that may be exposed to operating temperatures outside of this range will be examined on a case-by-case basis as requested by the fitting manufacturer.
- 3.2.2 Couplings and fittings for fuel gas service shall use welded, brazed, flanged, threaded, press-fit, compression type or flared ends and shall be cast, forged or extruded from steel, stainless steel, copper or copper alloy, aluminum alloy, malleable, ductile or cast iron. Specific end connection / material combinations shall conform to either NFPA 54 or NFPA 58 requirements, as applicable.
- 3.2.3 Alloys used for brazing shall have a melting point in excess of 1000°F (538°C) and shall not contain more than 0.05 percent phosphorus.
- 3.2.4 When the coupling or fitting is supplied with a gasket (flanged, press-fittings, etc.), the gasket material shall be capable of withstanding the process conditions of the piping system and withstanding exposure to the specific type of gas used without change to the gasket's physical or chemical properties.
- 3.2.5 Threaded end connections shall conform to ASME B.20.1, ISO 7/1 or other recognized national or international standards for their country of use.
- 3.2.6 Couplings and fittings with threaded end connections shall not be larger than 4 inch NPS.

3.3 Markings

- 3.3.1 The following information shall be cast, forged, etched or embossed on the outside surface of each product or, if not possible due to size, on its packaging or label accompanying the product:
- Manufacturer's name or trademark;
 - Product model number;
 - Certification agency's mark of conformity;
 - Nominal pipe size;
 - Manufacturing source code, if made at more than one location;
 - Thread profile mark, if available with multiple thread profiles;
 - Date of manufacture or code traceable to date of manufacture; and,
 - Any additional information required by the national or international standard to which it is manufactured.

When hazard warnings are needed, the markings shall be universally recognizable.

- 3.3.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.
- 3.3.3 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.
- 3.3.4 All markings shall be legible and durable.

3.4 Manufacturer's Installation and Operation Instructions

- 3.4.1 The manufacturer shall
- prepare instructions for the installation, maintenance, and operation of the product;
 - provide facilities for repair of the product and supply replacement parts, if applicable; and
 - provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.5 Calibration

- 3.5.1 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.
- 3.5.2 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.

4 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirement

The couplings and fittings for fuel gas service shall conform to the manufacturer's drawings and specifications and to requirements in this standard.

4.1.2 Test/Verification

Samples shall be examined and compared to drawings and specifications. It shall be verified that the samples conform to the physical and structural requirements described in Section 3, General Requirements, and to the manufacturer's drawings.

4.2 Hydrostatic Pressure Test

4.2.1 Requirement

Couplings and fittings for fuel gas service shall be able to withstand an internal hydrostatic pressure equal to four times the rated working pressure without cracking, rupture, or leakage.

4.2.2 Test/Verification

Compliance shall be verified by testing representative assemblies of each size and model submitted for Approval. The testing shall address each size of the product under evaluation with the corresponding pipe or tube. This testing may be performed using either multiple joints along the same pipe/tube or individual assemblies for each joining method. Pipe/tube segments between test joints, when applicable, shall be approximately 1 ft (0.3 m) long each. Assemblies shall be subjected to a hydrostatic pressure of 250 psi (1720 kPa), or four times the rated working pressure, whichever is greater. Each hydrostatic pressure test shall be conducted for a duration of five minutes. The test pressure for each assembly shall be four times the lowest rated working pressure of any component of the assembly. The certification agency and the manufacturer shall jointly agree on the couplings and fittings to be used in the test assemblies. Figure A-1, in Appendix A, illustrates the required test configuration for a single joint assembly.

4.3 Pneumatic Pressure Test

4.3.1 Requirement

Couplings and fittings for fuel gas service shall be able to withstand the effects of internal pneumatic pressure without cracking, rupture, or leakage.

4.3.2 Test/Verification

4.3.2.1 Compliance shall be verified by testing representative samples of each size, type of joint and classification of pipe or tube under examination.

4.3.2.2 Each coupling and fitting under evaluation shall be connected to a controlled source of compressed air or nitrogen and submerged in a water bath. The internal pneumatic pressure shall be increased to the rated working pressure of the coupling or fitting under evaluation for a period of 5 minutes. Shedding of surface bubbles is acceptable during the first minute

of testing but there shall be no evidence of leakage during the remaining 4 minutes of the test period.

- 4.3.2.3 After completing the initial pressurization period, the internal pneumatic pressure is increased to 125 psi (862 kPa), or two times the rated working pressure, whichever is greater. The pressure shall be maintained for an additional 5 minute period without cracking, rupture, or leakage.

4.4 Tensile Load Resistance

4.4.1 Requirement

Couplings and fittings for fuel gas service shall demonstrate resistance to a tensile load in the axial direction without rupture or pipe pull-out. Following application of the tensile load, assemblies shall be tested in accordance with Section 4.3 (Pneumatic Pressure Test).

4.4.2 Test/Verification

- 4.4.2.1 Compliance shall be verified by subjecting representative samples of each size, type of joint and classification of pipe or tube under examination.
- 4.4.2.2 Each coupling or fitting under evaluation should be centered between two short lengths of the applicable classification of pipe or tube. The coupling or fitting should be installed in accordance with the manufacturer's instructions. The opposite end of each pipe or tube shall allow for the sample to be easily secured to a tensile testing machine.
- 4.4.2.3 Prior to application of the tensile load, each assembly shall be submerged in a water bath and subjected to an internal pneumatic pressure equal to the rated working pressure of the lowest rated component in the assembly. This test shall be conducted for a duration of five minutes. No cracking, rupture, or leakage is allowed.
- 4.4.2.4 Each assembly shall be secured to a tensile testing machine. A tensile load in the axial direction shall be applied to each assembly at a uniform rate until the minimum required load is reached. Minimum tensile load requirements are specified in Table 4.5.2.4 below. There shall be no rupture of the coupling or fitting or pipe/tube pullout from the coupling or fitting as a result of this test.

Table 4.4.2.4 – Minimum Tensile Load

<i>Pipe/Tube Dimensions</i>				<i>Minimum Required Tensile Load</i>					
<i>Outside Diameter</i>		<i>Wall Thickness</i>		<i>Compression Fittings</i>		<i>Flared Fittings</i>		<i>All Other Fittings</i>	
<i>in.</i>	<i>(mm)</i>	<i>in.</i>	<i>(mm)</i>	<i>lbf</i>	<i>(N)</i>	<i>lbf</i>	<i>(N)</i>	<i>lbf</i>	<i>(N)</i>
1/8	(3.2)	0.030	(0.76)	250	(1110)	250	(1110)	250	(1110)
3/16	(4.8)	0.030	(0.76)	350	(1555)	400	(1780)	400	(1780)
1/4	(6.4)	0.030	(0.76)	450	(2000)	500	(2225)	500	(2225)
5/16	(7.9)	0.032	(0.81)	450	(2000)	650	(2890)	650	(1110)
3/8	(9.5)	0.032	(0.81)	450	(2000)	800	(3560)	800	(3560)
7/16	(11.1)	0.032	(0.81)	500	(2225)	900	(4005)	900	(4005)
1/2	(12.7)	0.032	(0.81)	500	(2225)	1000	(4450)	1150	(5115)
9/16	(14.3)	0.035	(0.89)	700	(3115)	1250	(5560)	1350	(6005)
5/8	(15.9)	0.035	(0.89)	900	(4005)	1450	(6450)	1600	(7120)
3/4	(19.1)	0.035	(0.89)	1300	(5780)	1900	(8450)	2000	(8895)
7/8	(22.2)	0.045	(1.14)			2400	(10 675)	2500	(11 120)
1	(25.4)	0.045	(1.14)			2600	(11 565)	2900	(12 900)

<i>Pipe/Tube Dimensions</i>				<i>Minimum Required Tensile Load</i>					
<i>Outside Diameter</i>		<i>Wall Thickness</i>		<i>Compression Fittings</i>		<i>Flared Fittings</i>		<i>All Other Fittings</i>	
<i>in.</i>	<i>(mm)</i>	<i>in.</i>	<i>(mm)</i>	<i>lbf</i>	<i>(N)</i>	<i>lbf</i>	<i>(N)</i>	<i>lbf</i>	<i>(N)</i>
1-1/8	(28.6)	0.050	(1.27)			2850	(12 675)	3300	(14 680)
1-1/4	(31.8)	0.050	(1.27)			3050	(13 565)	3500	(15 570)
1-3/8	(34.9)	0.055	(1.40)			3250	(14 455)	3700	(16 460)
1-1/2	(38.1)	0.060	(1.52)			3450	(15 345)	3950	(17 570)
1-5/8	(41.3)	0.060	(1.52)			3650	(16 235)	4150	(18 460)
1-3/4	(44.5)	0.060	(1.52)			3850	(17 125)	4350	(19 350)
1-7/8	(47.6)	0.065	(1.65)			4050	(18 015)	4550	(20 240)
2	(50.8)	0.065	(1.65)			4250	(18 905)	4750	(21 130)
2-1/8	(54.0)	0.072	(1.83)			4500	(20 017)	5000	(22 240)

4.4.2.5 After application of the tensile load, each assembly shall be tested in accordance with Section 4.3 (Pneumatic Pressure Test). No cracking, rupture or leakage shall be observed during the test.

4.5 Vibration Resistance

4.5.1 Requirement

Couplings and fittings for fuel gas service shall be able to withstand the effects of vibration without cracking, rupture or leakage. Following vibration exposure, assemblies shall be tested in accordance with Section 4.3 (Pneumatic Pressure Test).

4.5.2 Tests/Verification

- 4.5.2.1 Compliance shall be verified by testing representative samples of each size, type of joint and classification of pipe or tube under examination.
- 4.5.2.2 Each coupling or fitting under evaluation should be centered between two short lengths of the applicable classification of pipe or tube. The coupling or fitting should be installed in accordance with the manufacturer's instructions.
- 4.5.2.3 Prior to vibration exposure, each assembly shall be submerged in a water bath and subjected to an internal pneumatic pressure equal to the rated working pressure of the lowest rated component in the assembly. This test shall be conducted for a duration of five minutes. No cracking, rupture, or leakage is allowed.
- 4.5.2.4 Each assembly shall be secured to a vibration table and pneumatically pressurized to 50 psi (345 kPa). Each assembly shall be subjected to a 24 hour vibration sequence with an amplitude of 1/8 inch (3.2 mm) and a frequency of 18 Hz. The plane of vibration shall be vertical. No cracking, rupture, or leakage is allowed.
- 4.5.2.5 After vibration exposure, each assembly shall be tested in accordance with Section 4.3 (Pneumatic Pressure Test). No cracking, rupture or leakage shall be observed during the test.

4.6 Additional Tests

Additional tests may be required, at the discretion of the certification agency, depending on design features and results of any foregoing tests.

Any test following a failure shall be acceptable only with a technical justification of the conditions or reasons for failure.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and 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:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should 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 verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 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

- 5.2.1 An audit of the manufacturing facility may be part of the certification agencies 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 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications.

5.4 Manufacturer's Responsibilities

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

5.5 Manufacturing and Production Tests

5.5.1 Test Requirement No. 1 – *Visual Inspection*

The manufacturer shall perform a visual inspection on 100 percent of fitting production. The visual inspection shall look for obvious surface or casting defects that would affect the performance of the part. Samples that have defects as outlined by the manufacturer's criteria shall be scrapped. Equivalent mechanical test methods for inspecting surface or casting defects will be evaluated on a case-by-case basis.

5.5.2 Test Requirement No. 2 – *Dimensional Inspection*

The manufacturer shall perform dimensional inspections on a sampling of the production of each fitting discussed in this Approval Standard. The frequency of the dimensional inspections shall be outlined in the manufacturer's quality manual including the dimensions that will be checked, and the data records that will be maintained. At minimum, dimensional inspections shall be recorded once per shift.

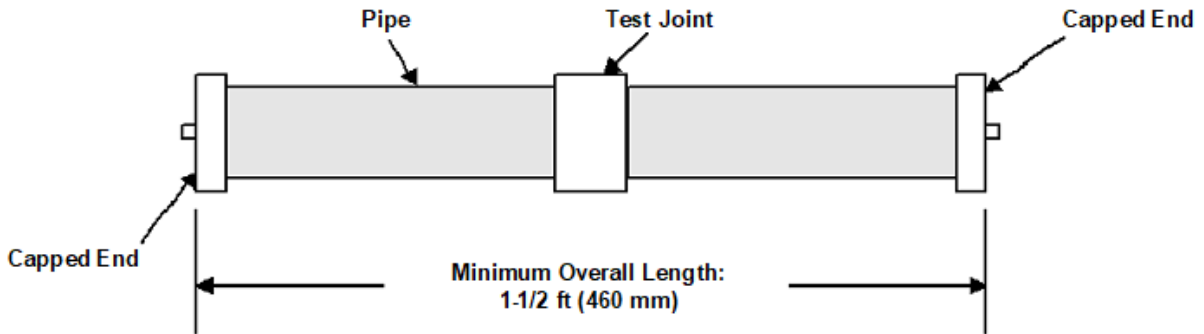
5.5.3 Test Requirement No. 3 – *Leakage*

The manufacturer shall perform leakage testing on a sampling of the production of each fitting discussed in this Approval Standard. The frequency of the leakage tests shall be outlined in the manufacturer's quality manual including the test pressure, test time, and the data records that will be maintained. Equivalent test methods will be evaluated on a case-by-case basis.

6 BIBLIOGRAPHY

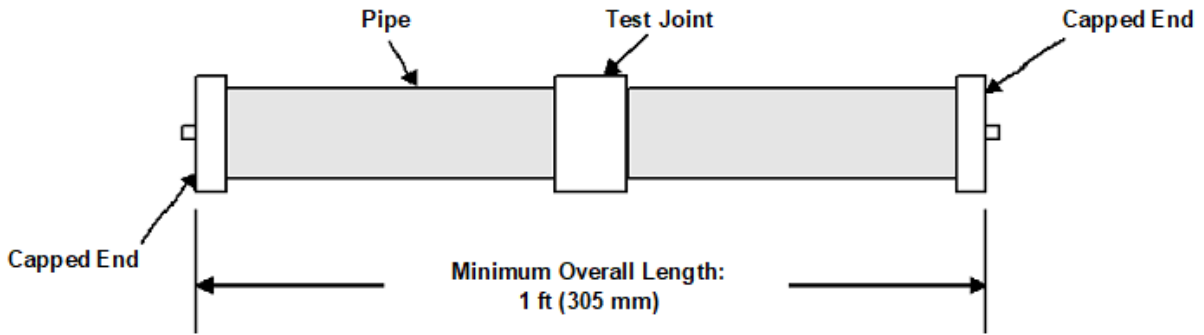
ANSI/American Society of Mechanical Engineers (ASME) B1.20.1 – 2013 (R2018), *Pipe Threads, General Purpose, Inch*
ASTM F1387-19, *Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings*
CSA B149.1, *Natural Gas and Propane Installation Code*
IAPMO/ANSI UMC 1, *Uniform Mechanical Code*
IFGC, *International Fuel Gas Code*
ISO 7-1:1994, *Pipe threads: Dimensions, tolerances and designation*
ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories.*
UL 109, *Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use*

APPENDIX A: Test Assembly Sketches



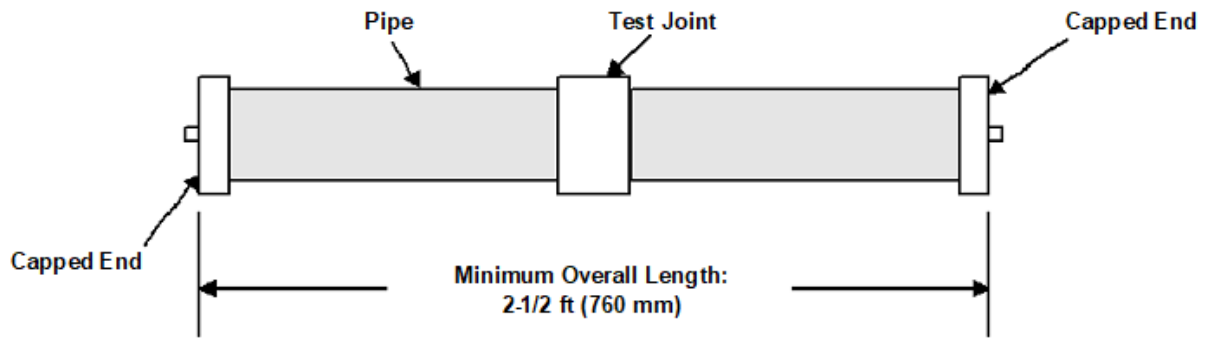
End caps should be drilled and tapped to 3/8 or 1/2 inch NPT in order to make use of standard connectors. Manufacturer to supply connectors if other than NPT.

Figure A-1. Sample for Hydrostatic or Pneumatic Pressure Test



End caps should be drilled and tapped to 3/8 or 1/2 inch NPT in order to make use of standard connectors. Manufacturer to supply connectors if other than NPT.

Figure A-2. Sample for Tensile Load Resistance Test



End caps should be drilled and tapped to 3/8 or 1/2 inch NPT in order to make use of standard connectors. Manufacturer to supply connectors if other than NPT.

Figure A-3. Sample for Vibration Resistance Test

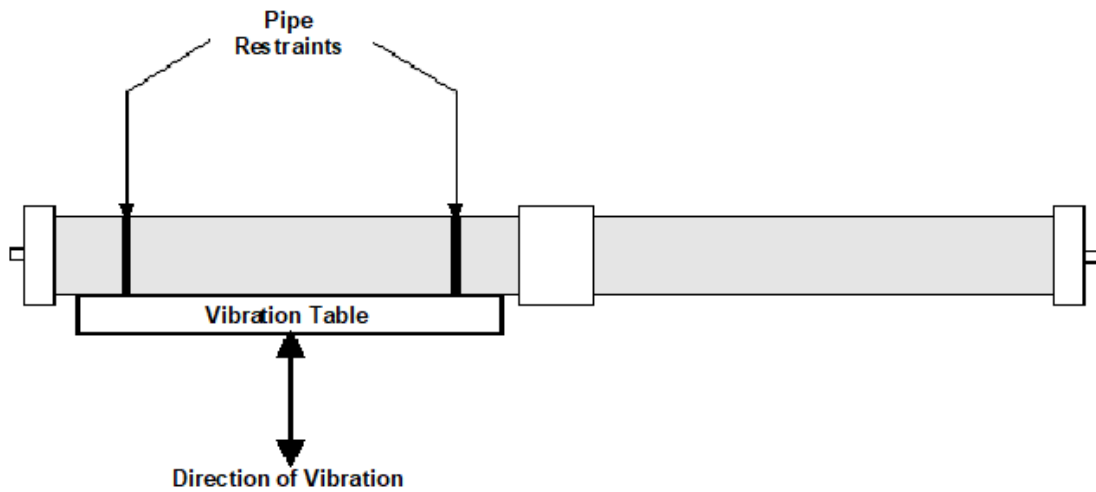


Figure A-4. Vibration Resistance Test Setup

APPENDIX B: Tolerances

Unless otherwise stated, the following tolerances shall apply:

Angle: $\pm 2^\circ$

Frequency (Hz): ± 5 percent of value

Length: ± 2 percent of value

Volume: ± 5 percent of value

Pressure: + 5 percent of value
- 0 percent of value

Temperature: $\pm 4^\circ\text{F}$ (2°C)

Time: + 5/-0 seconds
+0.1/-0 minutes
+0.1/-0 hours

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