



*Member of the FM Global Group*

**Approval Standard  
for  
Couplings Used in Hubless  
Cast Iron Systems for Drain,  
Waste or Vent, Sewer,  
Rainwater or Storm Drain  
Systems Above and Below  
Ground, Industrial/  
Commercial and Residential**

**Class Number 1680**

**January 1989**

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# Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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# TABLE OF CONTENTS

<b>I INTRODUCTION</b> .....	1
1.1 Purpose .....	1
1.2 Scope .....	1
1.3 Basis for FM Approval .....	1
1.4 Basis for Continued Approval .....	1
1.5 Requirements .....	2
1.6 System of Units .....	2
<b>II GENERAL INFORMATION</b> .....	2
2.1 Product Information .....	2
2.2 Ratings .....	2
<b>III APPLICABLE DOCUMENTS</b> .....	3
<b>IV GENERAL REQUIREMENTS</b> .....	3
4.1 Markings .....	3
4.2 Instructions .....	3
4.3 Physical or Structural Features .....	4
4.4 Drawings/Plans/Specifications Required With Samples .....	5
<b>V PERFORMANCE REQUIREMENTS</b> .....	5
5.1 Hydrostatic Strength .....	5
5.2 Blockage .....	5
5.3 Bending Moment .....	5
5.4 Deflection Angle .....	7
5.5 Sealing Sleeve .....	7
5.6 Clamp Strength .....	8
5.7 Thrust Test .....	8
5.8 Salt Spray .....	9
5.9 Other Tests .....	10
<b>VI OPERATIONS REQUIREMENTS</b> .....	10
6.1 Demonstrated Quality Control Program .....	10
6.2 Facilities and Procedures Audit (F&PA) .....	11
A. At Manufacturing Plant .....	11
B. At Site of Installation .....	11
<b>APPENDIX A MINIMUM REQUIRED COUPLINGS FROM MANUFACTURER TO PERFORM NECESSARY TESTING</b> .....	12
<b>APPENDIX B UNITS OF MEASUREMENT</b> .....	13
<b>APPENDIX C APPROVAL MARKS</b> .....	14

## I INTRODUCTION

### 1.1 Purpose

This standard states FM Approval requirements for couplings used in drain, waste, or vent, storm and sanitary systems.

### 1.2 Scope

1.2.1 This standard is used to evaluate couplings for their intended application of long-term connection to hubless cast iron soil pipe both above and below ground.

1.2.2 There shall be two classes of couplings covered by this standard:

Class I - Industrial/Commercial and Residential  
15 psi (105 kPa) Rated Working Pressure

Class II - Residential up to Two Story Buildings  
8 psi (55 kPa) Rated Working Pressure

### 1.3 Basis for FM Approval

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

1.3.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the proper operation and performance of the product as specified by the manufacturer and required by FM Approvals; and, as far as practical,
- the durability and reliability of the product.

1.3.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product which is examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' Product Follow-Up Program.

### 1.4 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality control procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement; and
- re-examination of production samples for continued conformity to requirements.

## 1.5 Requirements

- 1.5.1 The requirements of this standard are based on experience, research and testing and/or the standards of other national and international organizations. The advice of manufacturers, users, trade associations and loss control specialists was also considered.
- 1.5.2 The requirements of this standard reflect tests and practices used to examine characteristics of couplings for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Couplings having characteristics not anticipated by this standard may be Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, couplings which do meet all the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

## 1.6 System of Units

Units of measurement are U.S. customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. Appendix B lists the selected units for quantities dealt with in testing these products; conversions to SI units are included. Conversion of U.S. Customary units is in accordance with ASTM E 380.

# II GENERAL INFORMATION

## 2.1 Product Information

The use of couplings in hubless cast iron systems provides reliability combined with ease of installation for joining soil pipe.

Couplings are expected to exhibit a service life at least equal to the pipe and fittings joined in drain, waste, or vent, storm and sanitary systems by conventional means.

A typical design consists of an elastomeric sleeve wrapped by a stainless steel band and fastened with stainless steel strip clamps, or a cast iron housing with bolts. Other designs may be Approved subject to special investigation, if they meet the requirements of Section IV.

## 2.2 Ratings

A manufacturer may apply for either a Class I or a Class II rating. Class II installations are limited to residential applications for up to two-story usage.

Either product may be installed below ground when done per manufacturer's installation instructions, and with proper support or restraint, as described in Paragraph 4.3.6.

### III APPLICABLE DOCUMENTS

The following specifications are referenced in this Standard:

Cast Iron Soil Pipe Institute (CISPI) 301-85 “Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.”

American Society for Testing and Materials (ASTM) B117-85 “Method of Salt Spray (Fog) Testing”.

American Society for Testing and Materials (ASTM) C564-70 “Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings”.

International Association of Plumbing and Mechanical Officials (IAPMO) Draft Standard “Shielded Couplings for Use with Hubless Cast Iron Soil Pipe and Fittings”. (Proposed Standard P.S.-xx-88. Draft #4 of February, 1988)

International Association of Plumbing and Mechanical Officials (IAPMO) Installation Standard IS-6-88 “Hubless Cast Iron Sanitary and Rainwater Systems” Appendix B.

### IV GENERAL REQUIREMENTS

#### 4.1 Markings

4.1.1 Each Approved coupling shall be permanently marked on its external surface with, at minimum:

- manufacturer’s name or trademark
- model or type designation (unique to the Approved model)
- nominal pipe size
- FM Approval Mark (see Appendix C).

Couplings shall also be marked with the rated pressure in psi.

4.1.2 All information need not appear on each piece of multicomponent coupling assembly; however, all information required by Paragraph 4.1.1 shall be visible without disassembly of an installed coupling, and the coupling shall be so designed that it shall not be possible to assemble coupling components to produce an incompletely marked assembly.

4.1.3 The sealing sleeve compound shall be per ASTM C564-70. Manufacturers may submit alternate materials if performance equal to that of ASTM C564-70 can be demonstrated.

4.1.4 The sealing sleeve shall be marked with raised letters. This marking shall consist of nominal pipe size, manufacturer’s identifying mark, mold number, cavity number, material identification, and the FM Approval Mark.

#### 4.2 Instructions

Each shipment shall be packaged with complete installation instructions, including any dimensional requirements, fastener torque requirements, and specific torquing sequence.

### 4.3 Physical or Structural Features

#### 4.3.1 Materials

All materials shall be suitable for the intended service.

Sealing sleeve materials shall be suitable for continuous service in the temperature range of 0° to 180°F (-18° to 82° C). They shall be pliable, smooth, and free of obvious surface porosity and mold flash.

#### 4.3.2 Pressure Rating

All couplings shall be designed for a rated working pressure as listed in Paragraph 1.2.2 or greater. Higher rated working pressures are allowable if the requirements outlined in Section V are met.

#### 4.3.3 Sizes

The standard nominal pipe sizes for drain, waste, or vent, storm and sanitary systems are from 1½ through 10 inches nominal diameter. Other sizes will be considered on a case-by-case basis, including reducing couplings.

The dimensions of a coupling shall allow its use with standard hubless cast iron soil pipe and fittings used in drain, waste, vent, storm and sanitary systems, as defined in Cast Iron Soil Pipe Institute (CISPI) 301-85 "Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications".

#### 4.3.4 Connections

**A.** Couplings shall be readily installed with no possibility of incorrect assembly.

**B.** When required by the given design, couplings shall mesh together properly with no interference. Assembly should not cause a pocket or recess with a lip, or reduction in pipe area, or cause an obstruction in flow path. No special tools shall be required for coupling assembly, except torque wrenches, which are specifically allowed.

#### 4.3.5 Test Pipe

Because of the inconsistencies in different lots and brands of hubless pipe, both in surface finish, dimension and porosity, as well as the irregular coating applied, all tests in this standard shall be run using the modified steel pipes or fabricated segments described below.

Steel pipes or fabricated steel segments used during testing shall be machined to the maximum and minimum outside diameters (in pairs) of CISPI Standard 301-85, and shall have 0.015 in. (0.38 mm) deep grooves circumferentially around the pipe. The grooves shall have a 60° included vee angle and be spaced at ⅜ in. (4.8 mm) intervals the width of the area covered by the coupling sleeve. The surface of the maximum and minimum diameter areas shall be 125 rms between vee grooves. Surfaces shall be uncoated during testing, and shall be solvent-cleaned prior to assembly.

#### 4.3.6 Underground Installation

The Approval of couplings per the requirements of this Standard extends to underground service only when systems are laid on a continuous, firm bed, or on concrete or other adequate supports. Restraints, thrust blocks, and other supports may be necessary to prevent damaging external loads from being transmitted to couplings.

Joints shall be made up and torqued per manufacturer's instructions. Any required clamps, restraints, or supports shall be installed or framed prior to careful placement of backfill, and shall conform to the requirements of the authority having jurisdiction.

#### 4.4 Drawings/Plans/Specifications Required With Samples

(See Appendix A for required samples.)

Couplings submitted for testing shall be true production samples and shall be free of sharp edges, burrs or other imperfections likely to injure the installer or interfere with proper assembly of the unit.

In addition to the production samples, the manufacturer shall provide complete detail and assembly drawings and material specifications.

## V PERFORMANCE REQUIREMENTS

### 5.1 Hydrostatic Strength

#### 5.1.1 Requirement

A coupling shall withstand 150 percent of its rated working pressure without leaking.

#### 5.1.2 Test/Verification

A minimum of one coupling of each size under examination shall be assembled in conformance with the manufacturer's instructions onto a test module which restrains the pipe from separation. A set of test pipes with one piece machined to the maximum diameter and one to the minimum diameter as described in Paragraph 4.3.5 shall be used. Each test assembly shall be pressurized to 1.5 times the rated working pressure of the coupling for 5 minutes. There shall be no leakage.

### 5.2 Blockage

#### 5.2.1 Requirement

Couplings shall not leak when operating for extended periods of time at rated working pressure.

#### 5.2.2 Test/Verification

A minimum of one of each size of coupling under investigation shall be mounted on a set of test pipes, be pressurized at the rated working pressure for a period of not less than 8 hours, and examined for leakage. Leakage within the 8 hour period shall be considered a failure of that coupling size which leaked. A fixture which restrains the pipes from separation may be used if such restraint is specified in the manufacturer's installation instructions.

### 5.3 Bending Moment

#### 5.3.1 Requirement

Couplings shall not leak or otherwise fail when subjected to specified bending moments.



5.3.2 Test/Verification

Couplings shall be assembled as described below and subjected to the required bending moments listed in Table 1. The required moments are calculated from the application of a factor of two (2) to the moment produced by a water-filled hubless cast iron pipe on a coupling which is adjacent to a pipe hanger, with the next hanger broken on the maximum allowable hanger spacing of 10 feet (3.07 m).

Couplings 10 inches nominal size and smaller shall be mounted per manufacturer's instructions between two pieces of test pipe at least 5 feet (1.8 m) long each. The outboard ends of the pipes shall be closed. The assembly shall be set on supports 24 inches (0.6 m) apart with the coupling centered as indicated in Figure 1. The assembly shall be filled with water and hydrostatically pressurized to the rated working pressure of the coupling, and held at that pressure for the duration of the test. The load shall be applied vertically on both sides of the coupling with a bridge within 1 inch (25 mm) of the maximum gripping dimension of the coupling, until the maximum bending moment as listed in Table 1 is reached. With this test configuration, the moment arm is taken to be 1 foot (0.3 m) and the load which must be applied to the coupling is numerically equal to twice the required moment in English System units. No leakage shall occur at the maximum bending moment.

Pipes may be axially restrained in a fashion which does not interfere with application of the bending load, if such restraint is specified in the manufacturer's installation instructions.

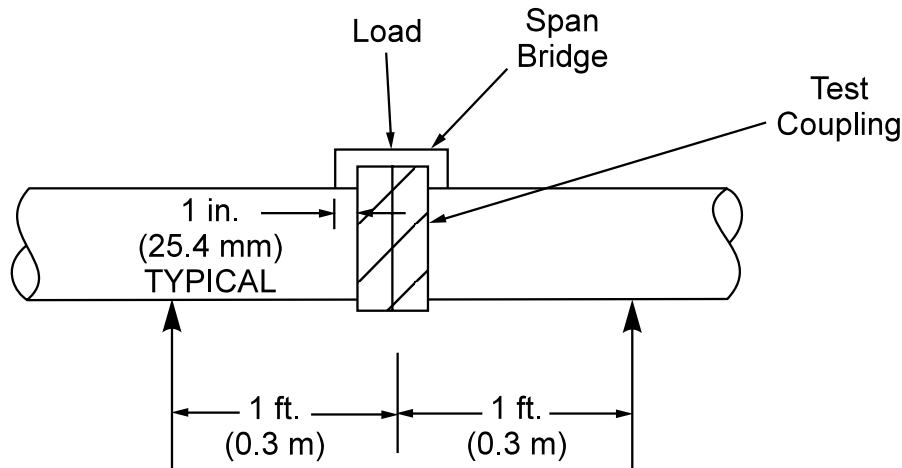


Figure 1. Bending Moment Test Configuration

Table 1

COUPLING NOMINAL SIZE	REQUIRED BENDING MOMENT	
	lb. ft.	(N·m)
1½	90	(122)
2	110	(150)
3	183	(248)
4	293	(384)
5	367	(498)
6	481	(652)
8	821	(1113)
10	1309	(1775)

Couplings larger than 10 inches nominal size shall be tested to bending moments determined on a case-by-case basis.

## 5.4 Deflection Angle

### 5.4.1 Requirement

Each coupling shall withstand a deflection of 1 inch per lineal foot of pipe, without leakage, while pressurized to the rated working pressure.

### 5.4.2 Test/Verification

Each nominal size of coupling 10 inches or smaller shall be mounted per manufacturer's instructions between two pieces of test pipe. The outboard ends of the pipes shall be closed. The assembly shall be filled with water and hydrostatically pressurized to the rated working pressure of the coupling for the duration of the test. One pipe shall be rigidly supported while the opposite end of the other pipe shall be raised 1 in. (25.4 mm) per lineal foot of pipe. No leakage shall be permitted. Then the pipe shall continue to be raised until a failure (leakage or otherwise) occurs and the maximum deflection shall be recorded for information.

Couplings larger than 10 inches nominal size shall be tested on a case-by-case basis.

## 5.5 Sealing Sleeve

### 5.5.1 Requirement

The sealing sleeve shall not crack or permit leakage when subjected to temperature and vibration exposure.

### 5.5.2 Test/Verification

- A. One sealing sleeve of each material under examination shall be subjected to high temperature exposure and one to low temperature exposure. Samples subjected to the temperature exposure tests shall be installed per manufacturer's instructions in coupling-pipe assemblies during exposure. One sample shall be exposed to a vibration environment while pressurized to the rated working pressure.
- B. A sample nominal 3 inch coupling shall be installed between two pieces of 6 to 12 inch (152 to 305 mm) long test pipe. The high temperature exposure shall consist of 180°F (82°C) oven-air exposure of 45 days. After exposure, the assembly shall be allowed to cool to ambient air temperature. It shall then be pneumatically pressurized to the rated working pressure and submerged in water. No leakage shall occur. The sealing sleeve, after removal from the housing assembly, shall not crack when squeezed together from any two opposite points.
- C. A sample nominal 2 inch coupling shall be installed between two pieces of 6 to 12 inch (152 to 305 mm) long test pipe. The low temperature exposure shall consist of 0°F (-18°C) air exposure for 4 days. After exposure, the assembly shall be submerged in a pail of 0°F (-18°C) antifreeze and pneumatically pressurized to the rated working pressure. No leakage shall occur. The assembly shall then be allowed to warm to ambient temperature and shall then be disassembled. The sealing sleeve shall not crack when squeezed together from any two opposite points.
- D. A sample nominal 4 inch coupling shall be assembled according to Figure 2. connecting two 6 to 12 inch (152 to 305 mm) pipes with closed outer ends. The assembly shall be approximately one-half full of water, pneumatically pressurized to the rated working pressure and subjected to 0.020 inch (0.51 mm) full stroke vibration at a frequency constantly varying between 18 and 37 Hertz for 5 hours. At the conclusion of the vibration test, the assembly shall be hydrostatically pressurized to the rated working pressure for 5 minutes. No leakage shall be evident.

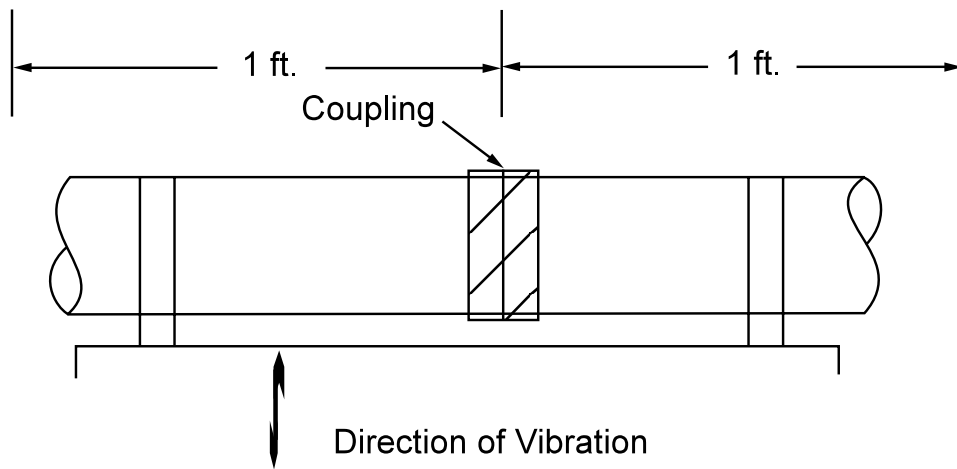


Figure 2. Vibration Test Configuration

**5.6 Clamp Strength**

5.6.1 Requirement

Clamp assemblies shall not separate from the housing when over-tightened.

5.6.2 Test/Verification

Sample clamp assemblies in nominal 2, 4, 6 and 8 inch sizes, as described in Paragraph 2.1, without elastomer sleeves, shall be placed over pipes and tightened to 115 percent of the manufacturer’s highest rated installation torque. Strip clamps shall not separate from the housing during this test. Other designs shall be evaluated on a case-by-case basis.

**5.7 Thrust Test**

5.7.1 Requirement

Pipe sections shall not separate more than 0.150 in. (3.8 mm) when assembled and tested according to the procedure below.

5.7.2 Test/Verification

One coupling of each diameter shall be assembled per Figure 3 onto two steel pipes or test segments as described in Paragraph 4.3.5. The assembly shall be filled with water and the hydrostatic pressure increased at the rate of 1 psi (7 kPa) every 30 seconds until the following test pressure is reached. The test pressures shall be:

COUPLING NOMINAL SIZE	PRESSURE	
	psi	(kPa)
in.		
1½ through 6	15	(105)
8	10	( 70)
10	6	( 41)

The dial indicator shall be set to zero. Pressure shall be held for 10 minutes. Leakage at the coupling, or joint separation of more than 0.150 in. (3.8 mm) from the initial pressurized position shall be considered as a failure.

Approval of couplings tested for conformance to this requirement does not, of itself, assess their ability to resist the axial loads imposed by blockage. If piping passes through several floors without connection to plumbing fixtures, then the pressures generated by blockage could exceed the test pressures tabulated above. If a manufacturer so requests, couplings can be tested for thrust resistance to higher pressures.

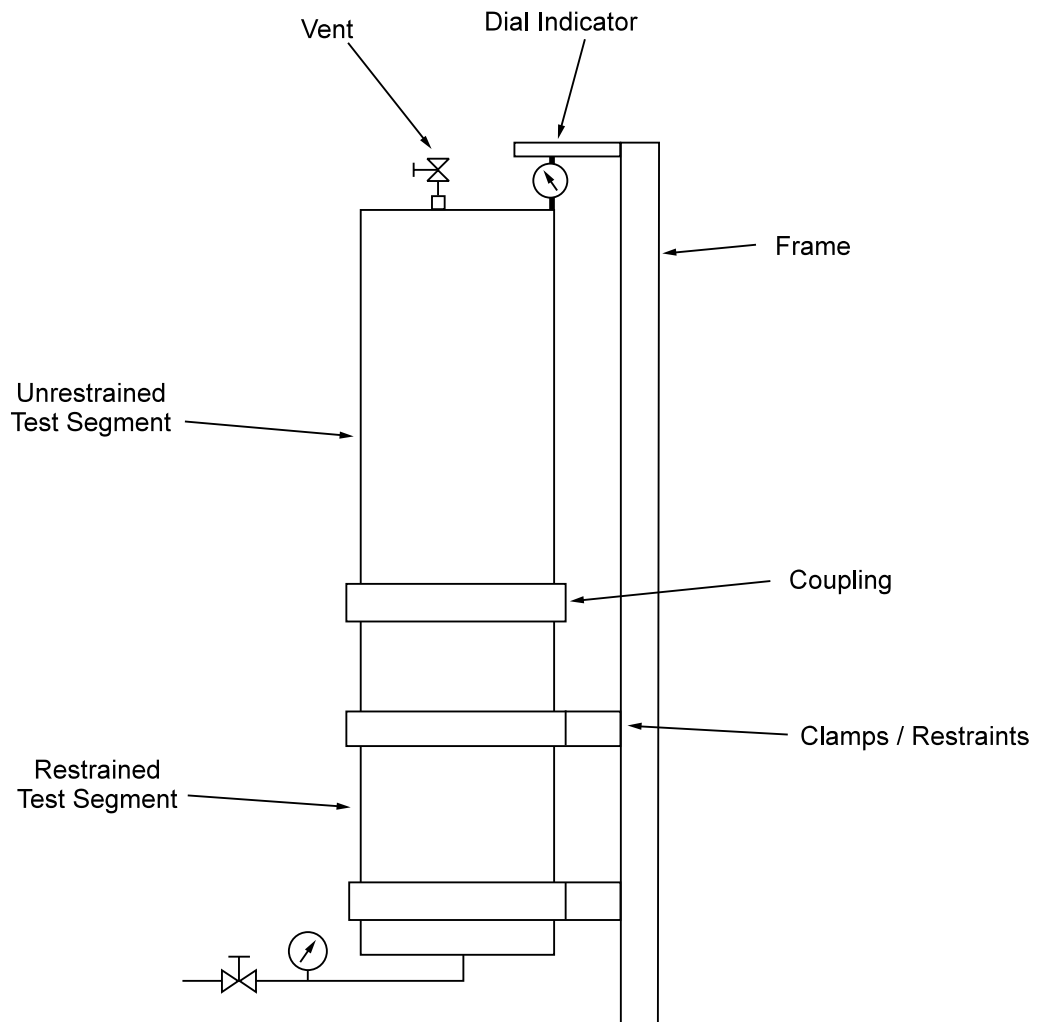


Figure 3. Thrust Test Setup

## 5.8 Salt Spray

### 5.8.1 Requirement

Clamp assemblies shall not corrode or deteriorate when exposed to a salt fog environment.

### 5.8.2 Test/Verification

One sample nominal 4 inch coupling assembly shall be mounted per manufacturer's instructions on two pieces of pipe approximately 14 inches (0.35 m) long. The assembly shall then be placed in a salt spray

(fog) environment as specified by ASTM B117-85, "Standard for Salt Spray (Fog) Testing". The salt solution shall consist of  $5 \pm 1$  percent by weight of common salt (sodium chloride) dissolved in demineralized water. The chamber temperature shall be maintained at  $95^{\circ} +2^{\circ} -3^{\circ}\text{F}$  ( $35^{\circ} +1.1^{\circ} -1.7^{\circ}\text{C}$ ).

Following 10 days exposure to the salt spray, the sample shall be permitted to air dry for 2 to 4 days. A visual inspection shall be made for deterioration or impending failure. If corrosion is not obviously severe, then the assembly shall be washed with tap water and dried with a compressed air spray. Visual inspection shall then be made again to look for deterioration or impending failure of any component.

The coupling and sealing sleeve shall be removed from the pipe and examined again. Then the coupling and sealing sleeve shall be reassembled to the pipe and hydrostatically tested to the rated working pressure for 5 minutes. The coupling shall exhibit no indications of failure.

## 5.9 Other Tests

Various authorities allowing the use of couplings for hubless soil pipe impose different requirements to evaluate their suitability. If a manufacturer requests that the requirements of a specific jurisdiction be assessed in the course of an Approval examination, FM Approvals will review the requirements of that jurisdiction and either confirm that the tests imposed as part of the Approval examination meet or exceed those requirements, or conduct other testing as necessary to satisfy the additional requirements. That is, the more severe testing will be conducted in such cases.

# VI OPERATIONS REQUIREMENTS

## 6.1 Demonstrated Quality Control Program

6.1.1 A Quality Control Program is required to assure that each subsequent coupling produced by the manufacturer shall present the same quality and reliability as the specific coupling samples examined. Design quality, conformance to design, and performance are the areas of primary concern.

Design quality is determined during the examination and tests and is covered in the Approval report.

Conformance to design is verified by control of quality in the following areas:

- existence of corporate quality control guidelines
- incoming inspection, including test
- in-process inspection, including test
- final inspection and test
- equipment calibration
- drawing and change control
- packaging and shipping
- handling discrepant materials.

Quality of performance is determined by field performance and by re-examination and test.

6.1.2 The manufacturer shall establish a system of product configuration control to prevent unauthorized changes, including, as appropriate:

- engineering drawings
- engineering change requests
- engineering orders
- change notices

These shall be executed in conformance with a written policy and detailed procedures. Records of all revisions to all Approved products shall be kept.

6.1.3 The manufacturer shall assign an appropriate person or group to be responsible to obtain FM Approvals' authorization of all changes applicable to Approved Products. FM Approvals' Form 797, "Approved Product Revision Report or Address/Contact Change Notice", is provided to notify FM Approvals of pending changes in advance of implementation.

## **6.2 Facilities and Procedures Audit (F&PA)**

### ***A. At Manufacturing Plant***

6.2.1 An inspection of the product manufacturing facility shall be part of the Approval investigation. Its purpose shall be to determine that equipment, procedures, and the manufacturer's controls are properly maintained to produce a product of the same quality as initially tested.

6.2.2 Unannounced follow-up inspections shall be conducted to assure continued quality control and product uniformity at least annually.

### ***B. At Site of Installation***

6.2.3 At the discretion of FM Approvals, field inspections may be conducted to review an installation. When conducted, the inspections shall assess ease of application, workability, and conformance to written specifications. When more than one application technique is used, one or all may be inspected.

## APPENDIX A

**MINIMUM REQUIRED COUPLINGS FROM MANUFACTURER  
TO PERFORM NECESSARY TESTING**

<i>Paragraph</i>	<i>Couplings Nominal Size</i>	<i>Additional Materials Required</i>
4.4	1 Complete Set plus 1 Set of Detail Drawings	
5.1	1 Complete Set	2 1-foot (0.3 m) lengths of each size test pipe
5.2	1 Complete Set	(Reuse above material)
5.3	1 Complete Set	2 5-foot (1.5 m) lengths of each size test pipe
5.4	1 Complete Set	(Reuse above material)
5.5.2 B	1 3-in. Coupling	1 1-foot (0.3 m) length of 3-inch test pipe 1 6-in. (0.15 m) length of 3-inch test pipe
5.5.2 C	1 2-in. Coupling	1 1-foot (0.3 m) length of 2-inch test pipe 1 6-in. (0.15 m) length of 2-inch test pipe
5.5.2 D	1 4-in. Coupling	2 1-foot (0.3 m) lengths of 4-inch test pipe
5.6	1 each: 2, 4, 6, 8-in. couplings	None
5.7	1 Complete Set	2 1-foot (0.3 m) lengths of test pipe (Reuse above material)
5.8	1 4-in. Coupling	2 pcs. 14-in. (0.34 m) long 4-in. test pipe

## TOTALS:

7 complete sets couplings, 1½ through 10 in., plus 1 4-in. coupling	2 1-ft lengths test pipe each size 2 5-ft lengths test pipe each size 1 6-in. length 2-in. pipe 1 6-in. length 3-in. pipe 2 14-in. lengths 4-in. pipe
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## APPENDIX B

### UNITS OF MEASUREMENT

<b>LENGTH:</b>	in. – “inches” (mm – “millimeters”) mm = in. $\times$ 25.4  ft – “feet” (m – “meters”) m = ft $\times$ 0.3048
<b>PRESSURE:</b>	psi – “pounds per square inch”; (bar – “bar”) kPa = psi $\times$ 6.895 bar – “bar”; (kPa – “kilopascals”) bar = kPa $\times$ 0.01 bar = psi $\times$ 0.06895
<b>TEMPERATURE:</b>	$^{\circ}$ F – “degrees Fahrenheit” $^{\circ}$ C – “degrees Celsius” $^{\circ}$ C = ( $^{\circ}$ F – 32) $\times$ 0.556
<b>FORCE:</b>	lb – “pounds” (N – “newtons”)  N = lb $\times$ 2.205
<b>TORQUE OR MOMENT:</b>	lb·ft – “pound-feet” (N·m – “newton – meters”)  N·m = lb·ft $\times$ 1.356



## APPENDIX C

### APPROVAL MARKS

#### REPRODUCTION ART: FM Approval Marks

**For use on nameplates, in literature, advertisements, packaging and other graphics.**



- 1) The FM Approval diamond mark is acceptable to FM Approvals as an Approval mark when used with the word "Approved."
- 2) The FM Approval logomark has no minimum size requirement, but should always be large enough to be readily identifiable.
- 3) Color should be black on a light background or a reverse may be used on a dark background.

#### For Cast-On Marks



- 4) Where reproduction of the mark described above is impossible because of production restrictions, a modified version of the diamond is suggested. Minimum size specifications are the same as for printed marks. Use of the word "Approved" with this mark is optional.

NOTE: These Approval marks are to be used only in conjunction with products or services that have been FM Approved. The FM Approval marks should never be used in any manner (including advertising, sales or promotional purposes) that could suggest or imply FM Approval or endorsement of a specific manufacturer or distributor. Nor should it be implied that Approval extends to a product or service not covered by written agreement with FM Approvals. The Approval marks signify that products or services have met certain requirements as reported by FM Approvals.

Additional reproduction art is available through

FM Approvals  
P.O. Box 9102,  
Norwood, Massachusetts 02062  
USA