


From: McGirt, Eugene A Eugene.A.McGirt@hud.gov 
Subject: RE: FOIA Request
Date: June 15, 2015 at 6:26 AM
To: Carl Malamud carl@media.org

ME

Carl,

Attached is a copy of Underwriters' Laboratories UL 181-2003, Standard for Safety Factory-Made Air Ducts and Air Connectors.

Let me know if you need anything else.

-----Original Message-----

From: Carl Malamud [mailto:carl@media.org]
Sent: Friday, June 05, 2015 3:38 PM
To: McGirt, Eugene A
Subject: Re: FOIA Request

Dear Mr. McGirt –

The UL 181-2003 standard applies to homes and manufactured housing.

The Code of Federal Regulations indicates that HUD has a copy of this record at:

Office of Manufactured Housing and Regulatory Functions
Manufactured Housing and Construction Standards Division
U.S. Department of Housing and Urban Development
451 Seventh Street, SW., room B-133,
Washington, DC 20410

Here is the section of the Code that states that:

<http://www.gpo.gov/fdsys/pkg/CFR-2014-title24-vol5/pdf/CFR-2014-title24-vol5-sec3280-4.pdf>

The regulation applies to manufactured housing and is cited in 24 CFR 3280.702.

Best regards,

Carl

On Jun 5, 2015, at 12:30 PM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

Carl,

Are you asking for copy of the standard for safety factory-made air ducts and air connectors in homes and manufactured housing? If not, air ducts and air connectors in what location?

That has to be specified in order for the right program office to process this request.

Thanks.

-----Original Message-----

From: Carl Malamud [mailto:carl@media.org]
Sent: Monday, May 25, 2015 12:01 PM
To: McGirt, Eugene A
Subject: Re: FOIA Request

Perfect!

As you can tell, we don't particularly agree with the DOJ position on this matter.

The core issue is that these documents are part and parcel of federal law and we feel strongly that the law belongs to the people, who should have the right to freely read the law and, most importantly, speak the law without getting a license first.

On May 25, 2015, at 8:59 AM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

On May 23, 2015, at 8:55 AM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

You should receive a response within the next 2 weeks.

-----Original Message-----

From: Carl Malamud [mailto:carl@media.org]
Sent: Monday, May 25, 2015 11:58 AM
To: McGirt, Eugene A
Subject: Re: FOIA Request

I would not characterize the DOJ position as such. I believe you need to accept or reject our FOIA request. If you choose to reject it, you must cite the specific exception to FOIA.

Do you think we'll be getting our response from HUD fairly soon? We've made such a request to several agencies and most of them have already provided us with a response. We're well past the designated window required by the law for a response.

Best regards,

Carl

On May 25, 2015, at 8:52 AM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

Mr. Malamud,

Are you aware that the Department of Justice has agreed that denying your request on the basis that IBR material are not covered by FOIA is a good response?

From: Carl Malamud [mailto:carl@media.org]
Sent: Thursday, April 09, 2015 9:33 AM
To: McGirt, Eugene A
Subject: Re: FOIA Request

Understood. It pertains to HUD because HUD has incorporated that document into federal regulations, and it has thus become law and because HUD maintains at least one copy of this federal record in HUD locations. Our position is that this makes it a federal record and is thus something we can request under the FOIA.

I realize this is a somewhat unusual request and appreciate your patience.

Best regards,

Carl

On Apr 9, 2015, at 9:16 AM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

Hello,

I wasn't sending the email to you as a form of "denial" but curious as to how that document pertained to HUD.

Thanks for explaining.

From: Carl Malamud [mailto:carl@media.org]
Sent: Thursday, April 09, 2015 9:12 AM
To: McGirt, Eugene A
Subject: Re: FOIA Request

Dear Mr. McGirt –

That document in question is a federal record incorporated into law, HUD has a copy of that federal record, and we are requesting a copy of that federal record under the Freedom of Information Act.

You are, of course, free to deny our FOIA request, which is what you should do if you would not like to grant the request.

Best regards,

Carl Malamud

On Apr 9, 2015, at 8:53 AM, McGirt, Eugene A <Eugene.A.McGirt@hud.gov> wrote:

Carl,

HUD is in receipt of your FOIA request asking for "copy of Underwriters' Laboratories UL 181-2003, Standard for Safety Factory-Made Air Ducts and Air Connectors which is incorporated by reference in 24 CFR 3280.4 and used in 24 CFR 3280.702."

How does that information pertain to HUD? You should be able to obtain informant directly from Underwriters' Laboratories at www.ul.com and 408.754.6500.



15-1054
Documents.pdf

UL 181

ISBN 1-55989-979-4

Factory-Made Air Ducts and Air Connectors

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Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety for Factory-Made Air Ducts and Connectors, UL 181

Ninth Edition, Dated April 4, 1996

Revisions: This Standard contains revisions through and including May 15, 2003.

Summary of Topics

This revision to UL 181 is being issued to include installation instruction requirements.

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	Reference
May 15, 2004	Paragraph 24.6

The new requirements are substantially in accordance with UL's Bulletin(s) on this subject dated November 22, 2002. The bulletin(s) is now obsolete and may be discarded.

The revisions dated May 15, 2003 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

Page	Date
1-6	May 15, 2003
7-8	April 4, 1996
9	December 14, 1998
10	April 4, 1996
11-14B	December 14, 1998
15-16	April 4, 1996
17	December 14, 1998
18-18B	May 15, 2003
19-22	April 4, 1996
23-24B	May 15, 2003
25-26	April 4, 1996
27-28B	December 14, 1998
29-31	April 4, 1996
32	May 15, 2003

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ORIGINAL AUTHOR

APRIL 4, 1996

(Title Page Reprinted: May 15, 2003)

1

UL 181

Standard for Factory-Made Air Ducts and Air Connectors

The first through the fourth editions were titled "Air Ducts."

The fifth edition was titled "Factory-Made Air Duct Materials and Air Duct Connectors."

The sixth edition was titled "Factory-Made Air Ducts and Connectors."

First Edition – November, 1961

Second Edition – March, 1967

Third Edition – April, 1970

Fourth Edition – May, 1972

Fifth Edition – April, 1974

Sixth Edition – August, 1981

Seventh Edition – April, 1990

Eighth Edition – November, 1994

Ninth Edition

April 4, 1996

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

The Department of Defense (DoD) has adopted UL 181 on July 20, 1994. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

ISBN 1-55989-979-4

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard does not comply with this Standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

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INTRODUCTION

1 Scope

1.1 These requirements apply to materials for the fabrication of air duct and air connector systems for use in accordance with the Standards of the National Fire Protection Association for the Installation of Air-Conditioning and Ventilating Systems, NFPA No. 90A, and the Installation of Warm Air Heating and Air-Conditioning Systems, NFPA No. 90B.

1.2 The air ducts and air connectors covered by these requirements include preformed lengths of flexible or rigid ducts, materials in the form of boards for field fabrication of lengths of rigid ducts, and preformed flexible air connectors.

1.3 For the purpose of these requirements, air ducts and air connectors are classified as follows:

Class 0 – Air ducts and air connectors having surface burning characteristics of zero.

Class 1 – Air ducts and air connectors having a flame-spread index of not over 25 without evidence of continued progressive combustion and a smoke-developed index of not over 50.

1.4 Deleted May 15, 2003

2 General

2.1 Components

2.1.1 A component of a product covered by this standard shall comply with the requirements for that component and shall be used in accordance with its identified rating and other limitations of use. A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

2.1.2 Except as indicated in 2.1.1, a component of a product covered by this standard shall comply with the requirements for that component.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

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2.2 Units of measurement

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

3 Construction

3.1 Materials

3.1.1 Materials for air ducts and air connectors shall be basically metal or mineral. Unbonded asbestos fiber materials shall not be used.

3.1.2 It is not the intent of 3.1.1 to exclude nonmetallic or organic materials used as binders, adhesives, sealants, or finishes when the product otherwise complies with these requirements.

3.2 Corrosion resistance

3.2.1 Metals used in the assembly of air ducts and air connectors shall be resistant to atmospheric corrosion and shall not be used in combinations that results in galvanic action which deteriorates any part of the system formed from such material.

3.2.2 To comply with 3.2.1 with respect to resistance to atmospheric corrosion, metals which are not inherently corrosion resistant, such as sheet steel, or steel wire, are to have a corrosion-resistant coating.

3.2.3 The corrosion-resistant coating shall provide protection against atmospheric corrosion as determined by 10.1.1 at least equivalent to steel having a uniform coating of zinc of not less than 0.3 ounce per square foot (1 g/mm²) of surface area.

3.2.4 Materials which have their protective coating damaged or the effectiveness reduced by the manufacturing process are to be tested after being subjected to such process.

PERFORMANCE

4 General

4.1 Table 4.1 indicates the tests applicable to the specific forms of air ducts, air connectors, and joining materials. Additionally, joining materials intended for factory installation are to be evaluated in conjunction with the air duct and air connector tests when specified in the individual sections of this Standard.

Exception: Joining materials which comply with the requirements in the Standard for Closure Systems for Use With Rigid Air Ducts and Air Connectors, UL 181A or the Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors, UL 181B are not required to be evaluated.

Effective date for 4.1 changed from September 16, 1996 to December 31, 1996

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Table 4.1
Test program

Tests	Air ducts		Air connectors	Joining materials
	Rigid	Flexible		
Surface Burning Characteristics	X	X	X	-
Flame Resistance	-	-	-	X
Flame Penetration	X	X	-	-
Burning	X	X	X	-
Corrosion ^a	X	X	X	X
Mold Growth and Humidity	X	X	X	X
Temperature	X	X	X	-
Puncture	X	X	-	-
Static Load	X	X ^b	X ^b	-
Impact	X	X	-	-
Erosion	X	X	X	-
Pressure	X	X	X	-
Collapse	X	X	X	-
Tension	-	X	X	-
Torsion	-	X	X	-
Bending	-	X	X	-
Leakage	X	X	X	-
NOTES X Test applicable. - Test not applicable. ^a Applicable to parts of metals not inherently corrosion resistant. ^b Test applicable for flexible air ducts and air connectors that incorporate vapor barriers supported by grommets or other means of field support.				

5 Tests for Surface Burning Characteristics

5.1 Representative samples of air ducts and air connectors shall be evaluated for surface burning characteristics and classified according to the requirements in 5.2 and 5.3.

5.2 Class 0 material shall have surface burning characteristics of zero (flame spread and smoke developed).

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5.3 Class 1 material shall have a flame-spread index of not over 25 without evidence of continued progressive combustion and a smoke-developed index of not over 50.

5.4 Tests for surface burning characteristics are to be conducted as specified in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

5.5 Samples are to be positioned in the 25 foot (7.62 m) long fire test chamber specified in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723. When the composite duct is rigid, no supplemental supports are to be used. When required, due to unusual characteristics of a composite duct that affects the conduct of the test, 1/4 inch (6.4 mm) diameter steel rods shall be used to support the duct constructions. When supporting rods are used, they are to be spaced between 2 feet and 4 feet (0.6 m and 1.2 m) apart as required for support of the samples.

5.6 When the inside and outside surfaces of an air duct or air connector are of different composition, tests for surface burning characteristics are to be conducted by exposing first one side and then the other to the test conditions, using different samples for each exposure.

5.7 Fabrics, tapes, or other joining materials field-applied to or forming part of a factory-made air duct, air connector, or other parts identified as a component of the product are to be in place during the tests for surface burning characteristics. When, however, the application of the fabric, tape, or other joining material to the sample is likely to affect the various surface burning characteristic indices, samples are to be tested with and without longitudinal seams or joints, and the higher indices taken.

6 Flame Resistance Test

6.1 Fabrics, tapes, or other joining materials shall be those classified for flammability when, as applied to an air duct or air connector, the material is exposed to the internal air stream.

6.2 Tests of fabrics, tapes, or other joining materials to determine compliance with 6.1 are to be made in accordance with the method described in the Standard for Tests for Flame Propagation of Fabrics and Films, UL 214.

7 Bending Test

7.1 Sections of flexible air ducts and air connectors shall not be damaged when bent through a 180-degree arc over a mandrel having a diameter equal to the inside diameter of the air duct or air connector when tested in accordance with 7.3 - 7.5.

7.2 Sections of flexible air ducts shall maintain minimum insulation and scrim (when applicable) overlaps when tested in accordance with 7.6 - 7.10.

Exception: A flexible air duct whose inner core complies with the Flame Penetration Test without insulation is not required to be tested in accordance with 7.6 - 7.10.

7.3 Previously untested samples are to be tested. Samples, at least 8 feet (2.43 m) long, (are to be specified) in accordance with 15.2. Sections of air ducts and air connectors are to be prepared in accordance with 15.3. Steel collars, when not part of the assembly, are to be attached to each end of the test sample in accordance with the manufacturer's instructions. One end of the test sample is to be retained in place and the sample positioned adjacent to the test mandrel so that the center joint of the sample is not located in the area to be subjected to bending. The sample is to be bent through a 180-degree arc around the test mandrel.

7.4 The test is to be repeated five times, and each time the sample is to be returned to its original position.

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7.5 Observations are to be made during and following the test. The sample shall not rupture, break, tear, rip, or separate; any reduction in internal cross-sectional area shall not exceed 20 percent at any time during the test; any joining material shall remain intact; and there shall be no evidence of other damage to the sample which results in it not being suitable for further use.

7.6 To comply with the requirement of 7.2, additional samples of previously untested flexible air ducts are to be tested. Packaged samples of standard length duct, at least 8 feet (2.43 m) long, are to be specified in accordance with 15.2. One end of the test sample is to be retained in place and the sample positioned adjacent to the test mandrel such that the midpoint of the air duct is centered on the test mandrel. The sample is to be positioned such that any insulation/scrim seam is at the outside of the bending radius. The sample is to be bent through a 180-degree arc around the test mandrel.

7.7 The bend is to be repeated five times. Between bends, the sample is to be returned to its original position. Upon completion of the final bend, the sample is to be maintained in the 180-degree bent position.

7.8 The vapor barrier is to be cut around the circumference of the duct at the center point of the duct. The vapor barrier is to be separated at the cut to a distance of 1 inch (25.4 mm). The end point of the insulation and scrim overlap is to be marked on the insulation and scrim. The vapor barrier is to be separated further and the distance from the marks to the end of the insulation and scrim measured.

7.9 The sample is to be removed from the mandrel and overlap measurements are to be made at the quarter points as specified in 7.8.

7.10 Sections of flexible air ducts that incorporate seamed insulation shall maintain a minimum 1-inch (25.4 mm) insulation overlap at each of the points measured in 7.8 and 7.9. When scrim is used as an individual component, it shall also maintain a 1-inch (25.4 mm) overlap.

Exception: Lesser overlaps are capable of being used for constructions that comply with the Flame Penetration Test when such overlaps are directly evaluated. In no case are gaps in the insulation or scrim allowed.

8 Flame Penetration Test

8.1 General

8.1.1 Materials for the fabrication of Class 0 and Class 1 air ducts shall not permit the passage of flame, as described in 8.1.2, for a period of at least 30 minutes when tested in accordance with the method specified in 8.2.1 – 8.5.2.

8.1.1 revised December 14, 1998

8.1.2 The sample shall withstand the flame-penetration test without through opening, evidence of perforation to an extent which allows the direct passage of flame or gases, and without ignition occurring on the surface of the sample exterior to the combustion zone of the test furnace.

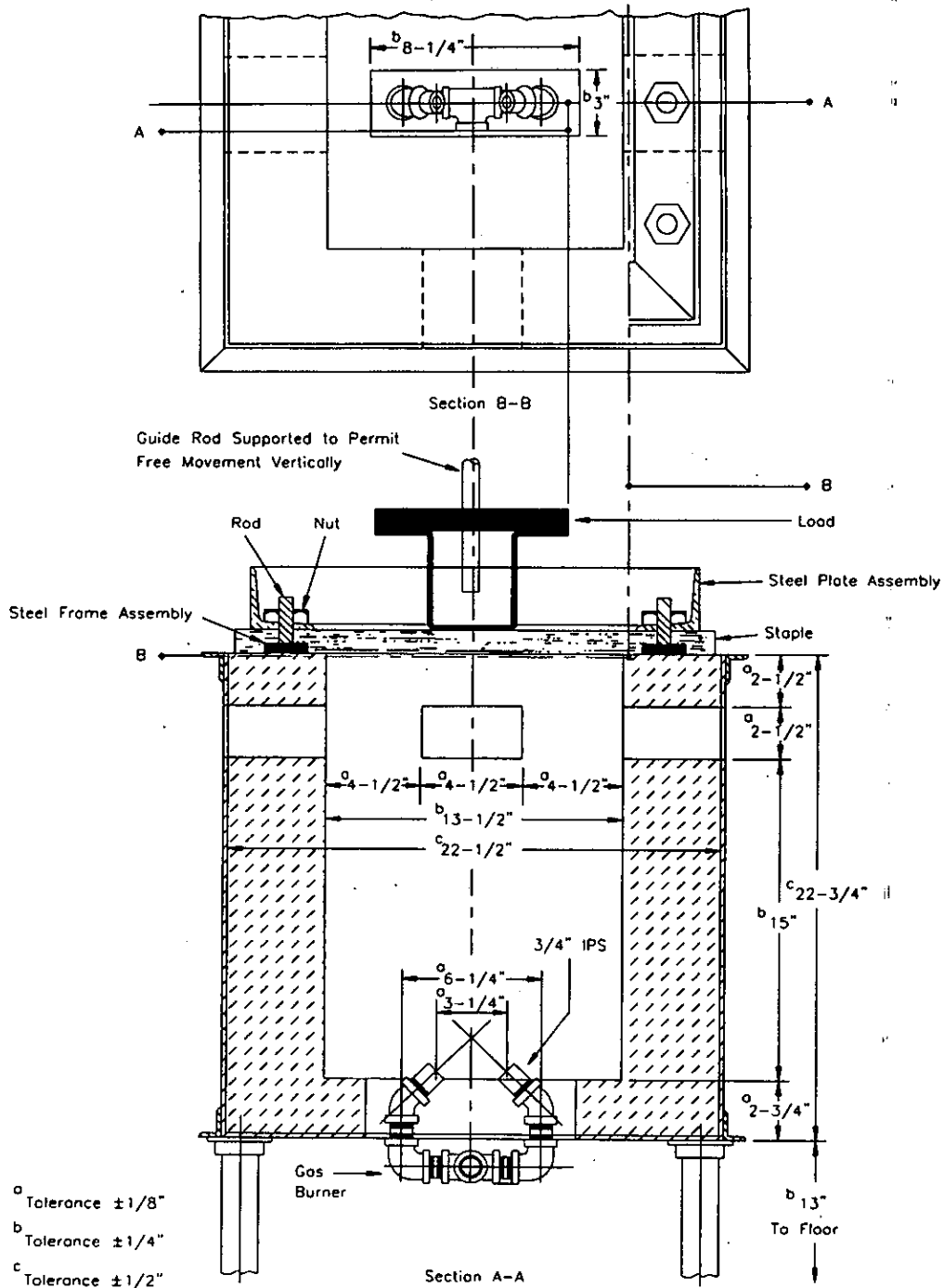
8.1.2 revised December 14, 1998

8.1.3 The test series shall consist of a set of three samples.

8.2 Test equipment

8.2.1 Flame-penetration tests are to be conducted using a refractory-lined gas-fired combustion chamber open at the top. The sample to be tested is to form the top of the chamber, thus forming a test furnace as shown in Figure 8.1.

Figure 8.1
Flame penetration test



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8.2.2 The furnace is to be equipped with a dual-outlet gas burner composed of pipe fittings as shown in Figure 8.1. The gas burner is not to have any means for premixing of gas and combustion air. The gas burner is to be leveled in both the horizontal and vertical planes.

8.2.2 revised December 14, 1998

8.2.3 The furnace is to be vented directly into the room space in which it is located by means of the four vent openings shown. No dampers or regulators are to be employed in openings provided for inlet of combustion air or for venting. The furnace is to be lined as shown with high-duty regular type fireclay brick having a density of 125 – 135 pounds per cubic foot ($2002 - 2162 \text{ kg/m}^3$), Standard for Classification of Fireclay and High-Alumina Refractory Brick, ANSI/ASTM C2.7-70. (For example, A. P. Green, "Empire DP.") The brick lining is not to incorporate mortar to hold the brick in place.

8.2.3 revised December 14, 1998

8.2.4 The furnace is to be equipped with a gas burner as detailed in Figure 8.1. A flanged union incorporating a thin plate orifice sized to be one third of the pipe inside diameter is to be installed in the burner piping located no more than 5 feet (1.5 m) from the gas burner. An adjustable fine tune valve is to be installed no more than 2 feet upstream of the thin plate orifice for the regulation of gas flow.

8.2.4 revised December 14, 1998

8.2.5 The room in which the test furnace is to be located is to be large in relation to the furnace and ventilated to provide adequate air for combustion. Ventilation is to be accomplished without appreciable air movement in the vicinity of the furnace. Controlled ventilation is to be accomplished to maintain constant room temperature and pressure conditions without appreciable air movement around the furnace. (Note: Normal cycling of Heating, Air Conditioning systems may disrupt furnace conditions).

8.2.5 revised December 14, 1998

8.2.6 Methane gas or natural gas is to be used for the pre-heat. During stabilization and test periods the gas fuel is to have a heating value of 1000 – 1050 Btu per cubic foot ($37,642 - 39,525 \text{ kJ/m}^3$). Methane gas from a compressed gas cylinder is to be commercial grade or purer and is to be regulated to deliver fuel at a constant pressure from the cylinder. If natural gas is used, the fuel is to be monitored (via gas calorimeter) during the stabilization and test durations to demonstrate a constant Btu content within $\pm 10 \text{ Btu/cubic foot}$ (376 kJ/m^3).

8.2.6 added December 14, 1998

8.2.7 The static load as referenced in 8.5.1 is to be steel (Grade ASTM A36). The static load is to be a 2 pound-mass per square inch (0.13 kg/cm^2) through a bearing surface of 1 by 4 inches (25.4 by 102 mm). The bearing surface is to be 3/16 inch (4.75 mm) thickness and is to have ends with a 5/16 inch (7.9 mm) radius. The weight is to be configured as shown by Figure 8.3 with an open area with a width of 4 inches and a height of 4-3/16 inches (102 by 106 mm). The upper solid mass is to be 5 3/4 inches wide by 4 inches high (146 by 102 mm) with a 3/8 inch (95 mm) diameter guide rod extending upward.

8.2.7 added December 14, 1998

8.3 Sample preparation

8.3.1 Samples are to be prepared from previously untested materials. Samples of flexible ducts are to be cut from ducts having an inside diameter of at least 12 inches (305 mm). Rigid duct samples are to be prepared in 24 inch (610 mm) flat squares.

Exception: When a duct at least 12 inches (305 mm) in diameter is not produced, then the largest diameter duct that is produced is to be used for the test.

8.3.1 revised December 14, 1998

8.3.1.1 Materials used in the construction of the sample ducts are to be representative of those used in regular finished production. The air duct components of flexible ducts shall be mounted in the metal frame assembly in the order and orientation that they exist in the duct construction. The material surface identified to be the outside surface of the air duct is to be the surface exposed to the flame during the test. Test samples are to be mounted in a frame fabricated as shown in Figure 8.2. Core wires are to be placed so that they run in the direction from one of the sides of the steel frame assembly (see Figure 8.2) containing hold down nuts to the other side of the steel frame assembly containing hold down nuts. The steel plate is to be tightened against the upper frame by tightening the hold down nuts to 30 ± 5 ft-lbs, so that all of the components of the sample are held firmly in place throughout the test duration.

8.3.1.1 added December 14, 1998

8.3.2 When the sample is a flexible air duct that incorporates a seam in the insulation, the sample is to be prepared with the seam at the center of the test frame.

Exception: Flexible air ducts which maintain insulation and seam overlaps of not less than 1-inch (25.4 mm) after being subjected to the Bending Test of Section 7 shall have the sample cut from an area containing no seam.

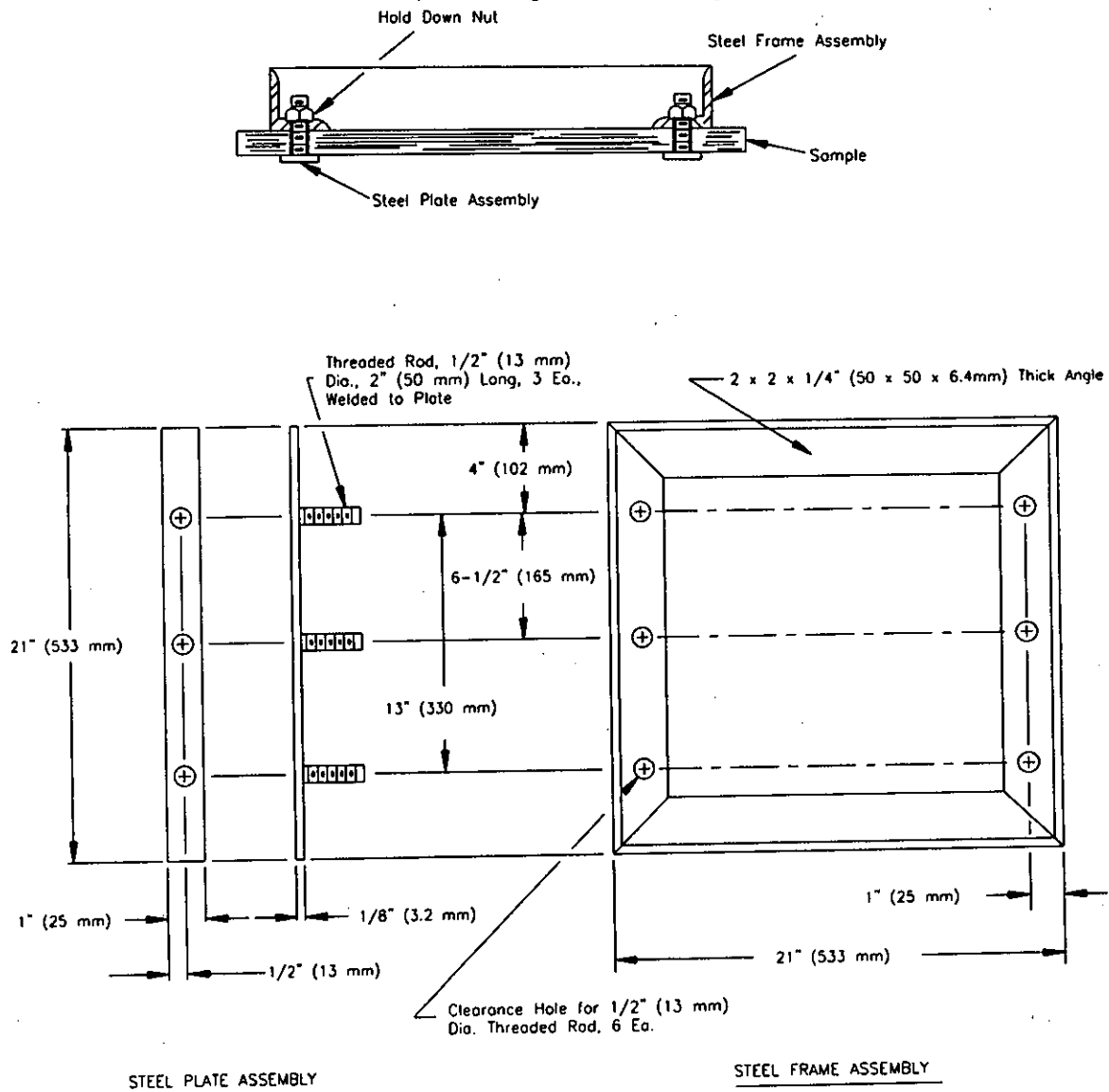
8.4 Pre-heat and stabilization

8.4.1 At the beginning of the test series, the furnace is to be fired for a minimum 2 hour preheat with the gas pressure maintained at 3.5 ± 0.05 inch water gauge as measured upstream of the fine tune valve. The top of the furnace combustion chamber shall be covered by a 1 inch (25.4 mm) thick calcium silicate board that is 18 pounds per cubic feet (288 kg/m^3). The calcium silicate board shall incorporate nine thermocouples of the following type for the measurement of the furnace temperatures: type K, exposed tip, inconel 600 sheath, with magnesium oxide hard packing (i.e., Omega Part No. KMQIN-125E-6 or equivalent). One of the thermocouples shall be centered over the furnace center point and the remaining eight thermocouples shall be equally spaced to form an $8 \pm 1/16$ inch (20.3 ± 0.16 cm) diameter ring concentric with the center point. (See Figure 8.4). The thermocouple tips shall extend $1 \pm 1/16$ inch (2.54 ± 0.16 cm) below the bottom of the board surface. The holes for the penetration of the thermocouples shall maintain a tight clearance. The thermocouples shall be connected to an automatic recording device which records the furnace temperature readings every 10 seconds and additionally averages these reading each minute. The averaged temperatures recorded at each minute are processed to develop the individual center temperature, eight individual temperatures for the ring, the average ring temperature, and each average quadrant temperature. (Quadrant temperatures consist of three ring temperatures and the center temperature).

8.4.1 revised December 14, 1998

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Figure 8.2
Sample holding frame assembly



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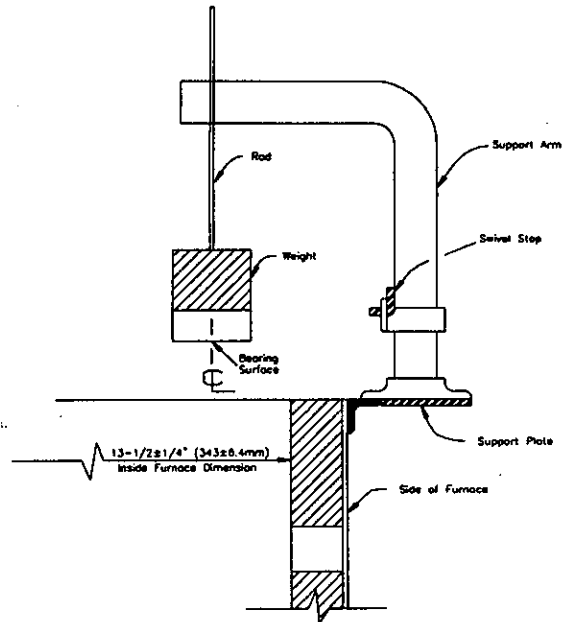
8.4.2 The gas flow shall be adjusted using the fine tune valve to maintain the center temperature in the range of $1425 \pm 70^\circ\text{F}$ ($774 \pm 21^\circ\text{C}$) after 45 minutes of the 2 hour preheat period. The gas pressure is to be maintained at 3.5 inch water gauge. After 1-3/4 hours of the pre-heat, the center, individual ring, average ring, and quadrant temperatures are measured until all the following conditions are met for a continuous 15 minute period before the addition of the test sample:

- a) Furnace center temperature shall be a nominal $1425 \pm 35^\circ\text{F}$ ($774 \pm 21^\circ\text{C}$).
- b) The average ring temperature and the individual quadrant temperatures shall be at least 90 percent of, but not greater than, the center temperature.
- c) No individual ring temperature shall exceed 100°F (38°C) less than or greater than the average ring temperature.

Adjustments in the gas flow, followed by adjustments in gas pressure, are made during this and any subsequent stabilization period to obtain the required pretest conditions. Any adjustments to gas flow will require a restarting of the 15 minute stabilization period prior to conducting a test. For each succeeding test, the thermocouple grid is to be replaced on the furnace until the stabilization conditions are met for the 15 minute stabilization period.

8.4.2 revised December 14, 1998

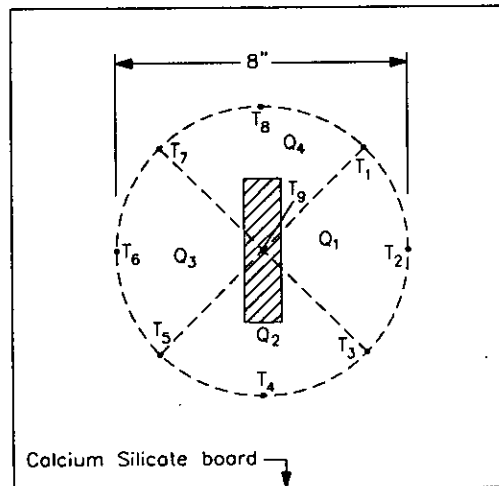
Figure 8.3
Typical support configuration



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Figure 8.4
Thermocouple placement

Figure 8.4 added December 14, 1998



Note: $Q_{1,2,3,4}$ = Quadrants, consisting
of 3 ring TC's plus the center
(i.e. $Q_1 = \frac{T_1 + T_2 + T_3 + T_9}{4}$)

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8.4.3 Deleted December 14, 1998

8.4.4 Deleted December 14, 1998

8.4.5 Deleted December 14, 1998

8.5 Test method

8.5.1 At the end of the pre-heat and stabilization period, the calcium silicate board is to be removed and the air duct test sample substituted in its place within 10 seconds with the sample oriented such that the core wires are parallel to the burners. The test sample is to be subjected during the test to a static load located at the geometric center and rotated to any position determined to be most critical for penetration on the upper surface of that part of the sample exposed to the flame. See Figure 8.3. The static load is to be gently lowered onto the test sample 3 to 5 seconds after the test sample is in place.

8.5.1 added December 14, 1998

8.5.2 The gas input to the furnace is not to be disturbed during this changeover and any subsequent test period.

8.5.2 added December 14, 1998

8.5.3 The test is to be continued for a period of 30 minutes. The test period is to be measured from the time the static load is applied to the test sample.

8.5.3 added December 14, 1998

9 Burning Test

9.1 Air ducts and air connectors shall not continue to burn progressively, and exterior surfaces of the material shall not drop particles that ignite untreated surgical cotton.

9.2 Representative samples of assembled air duct sections or air connectors are specified for test. When the material is of uniform grade and thickness for all sizes of air ducts and air connectors and of similar cross-sectional shape (rectangular or round), samples are required from the larger and smaller sizes. When the air ducts or air connectors vary in shape or the material varies in grade and thickness with size, additional samples to be representative of the complete line shall be evaluated for testing. The samples selected shall be those expected to burn under the conditions of test.

9.3 Six samples are to be provided for each product required in accordance with 9.2. The samples are to be sections of air duct or air connector 3 feet (0.914 m) long without a transverse joint. Any adhesive or cement is to be allowed to cure for a period of at least 24 hours. Samples are not to be exposed to relative humidity greater than 70 percent during the 24-hour period prior to the test.

9.4 The apparatus to be employed consists of a Bunsen burner with a 3/8-inch (17.2-mm) diameter tube and means for controlling the primary air and gas input, a support for the burner, a stopwatch or other timing device, and a supply of untreated surgical cotton. The Bunsen burner is to be supported and held in place by means of a burner stand, ring stand with clamps or an equivalent type of mechanical support. The gas used is to be commercial grade or purer propane (bottled) gas having a heating value of 2500 Btu per cubic foot. The gas bottle is to have a regulator and a valve located between the regulator and the burner. The test stand is to be similar to that illustrated in Figure 9.1. The samples are to be extended to their full length so that all slack is removed. The samples are to be supported by the test stand as illustrated in Figures 9.2 – 9.6. When evaluating the interior surface of the sample in the horizontal and 45 degree orientations, the sample is to be secured to the test stand support rods using three wire ties. The tests are to be conducted in a location free from drafts.

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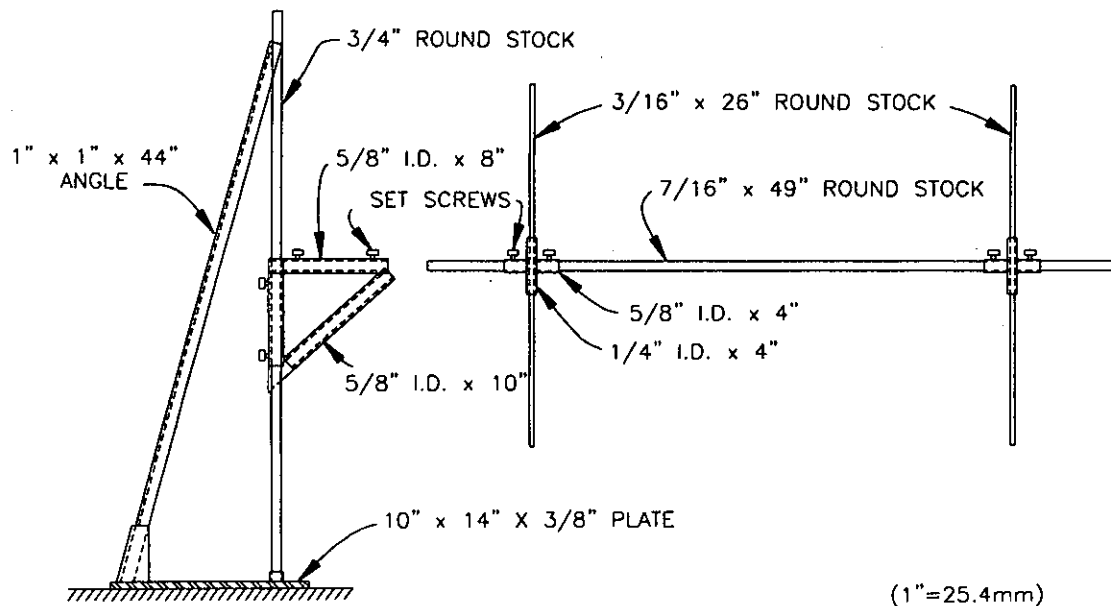
9.5 The six samples are to be mounted as follows: one in the Interior Horizontal position (see Figure 9.2), one in the Exterior Horizontal position (see Figure 9.3), two in the Vertical position (see Figure 9.4), one in the Interior 45-degree position (see Figure 9.5), and one in the Exterior 45-degree position (see Figure 9.6). Prior to the application of the burner to the sample, the burner is to be adjusted to produce a flame 2-1/2 inches (63.5 mm) high. The air and fuel input are to be adjusted such that the flame has equal parts of blue and yellow. The valve then is to be turned off and the burner positioned such that 1-1/4 inches of the test flame impinges the test sample 3 inches (76.2 mm) from the end of the sample. See Figures 9.2 – 9.6. The valve then is to be turned on and the flame ignited.

9.6 The outside surface of three samples oriented in the three positions is to be exposed to the flame for 1 minute and then the flame is to be withdrawn. When flaming or glowing combustion of the sample ceases 60 seconds or less after removal of the test flame, the test flame is to be reapplied at the same place for 1 minute immediately after flaming or glowing combustion of the sample stops. The test flame again is to be withdrawn and the duration of flaming or glowing combustion of the sample noted. During the test of an individual sample, the original size and characteristic of the test flame is not to be changed.

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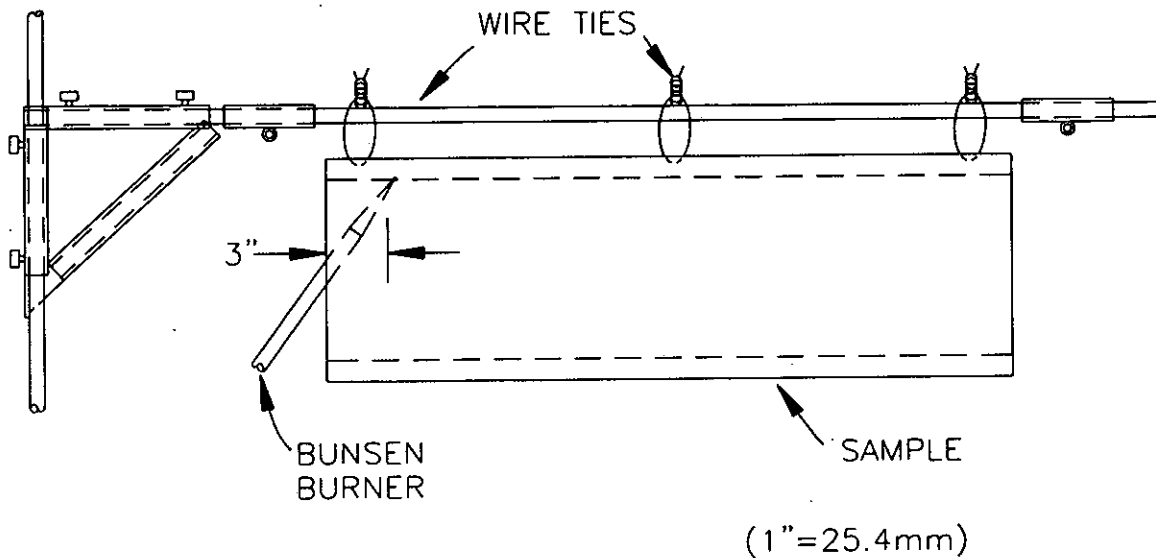
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Figure 9.1
Burning test stand



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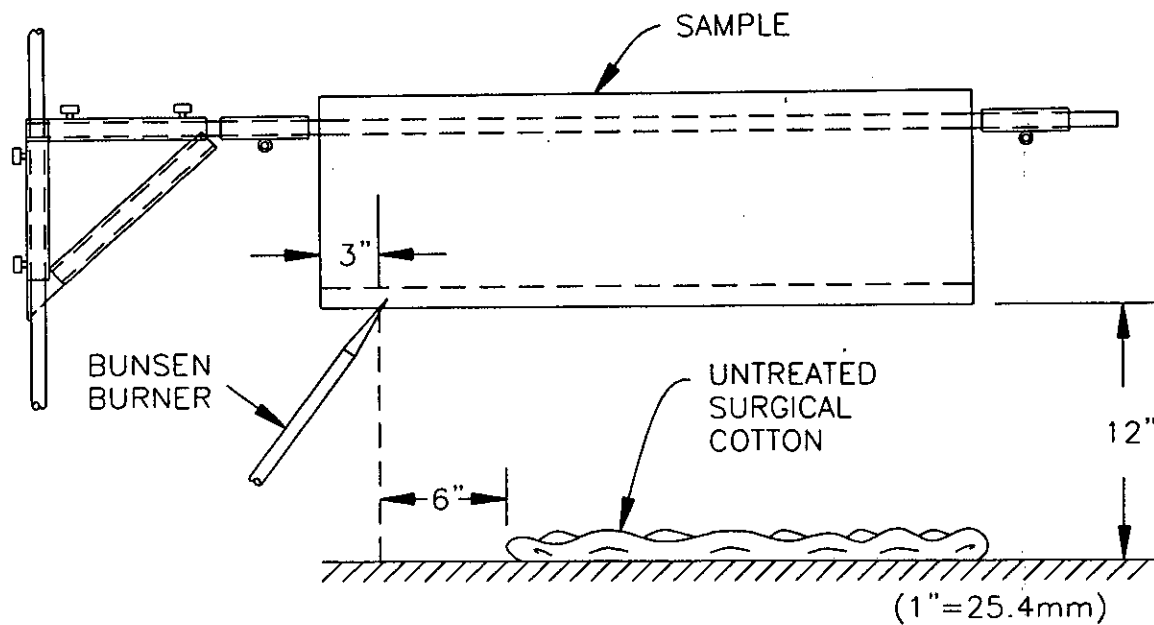
Figure 9.2
Horizontal burning test interior exposure



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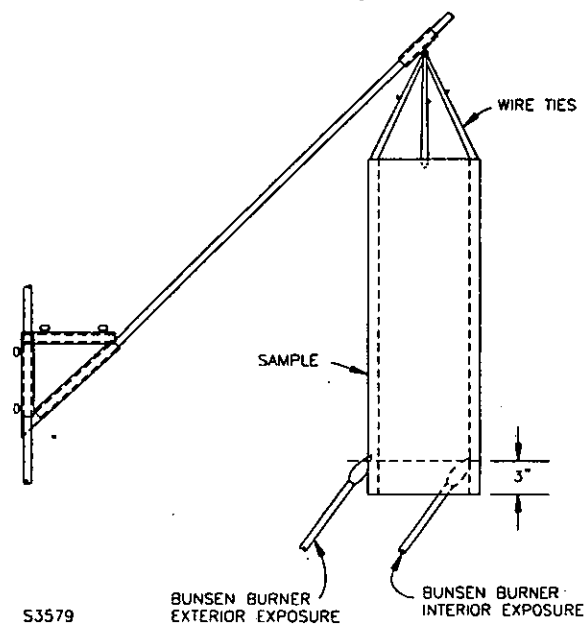
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Figure 9.3
Horizontal burning test exterior exposure



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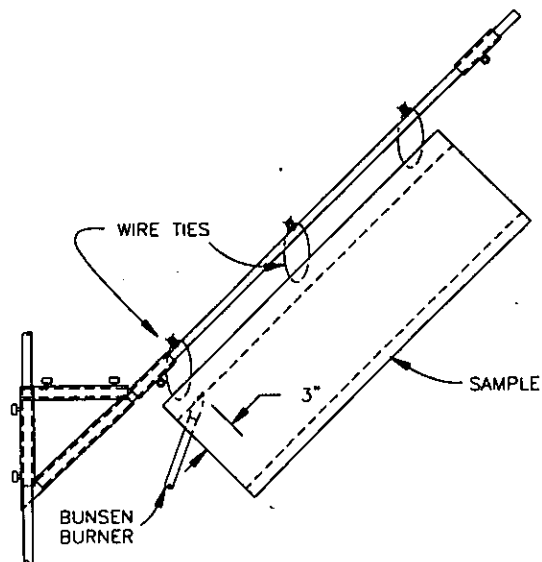
Figure 9.4
Vertical burning test



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Figure 9.5
45-Degree burning test interior exposure

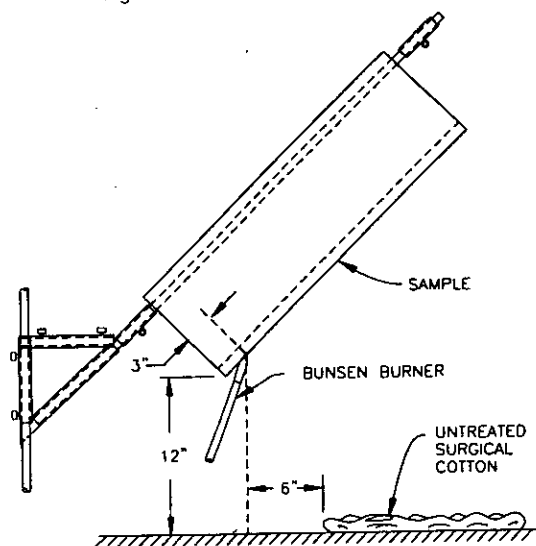


(1"=25.4mm)

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Figure 9.6
45-Degree burning test exterior exposure

Figure 9.6 revised December 14, 1998



(1"=25.4mm)

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9.7 When particles drop from the sample that is oriented horizontally and 45-degrees from the horizontal during the exterior exposure tests, these particles are to be allowed to fall onto a horizontal plane 1 foot (304 mm) below the nearest part of the test sample. The plane is to be covered with a layer of untreated surgical cotton except for that portion of the area directly below the burner extending for a distance of 6 inches (152.4 mm) measured horizontally in all directions from a vertical axis through the tip of the burner flame.

9.8 Following exposure of the exterior surface of the first three samples, similar tests are also to be conducted on the remaining three samples of the set by applying flame to the inside surface. When required based on size and orientation of the sample, it shall be necessary, in some cases, to cut away part of the sample in order to apply the test flame to the interior surface. These samples are to be observed for flaming or glowing combustion only and surgical cotton is not to be placed beneath the samples during this test.

9.9 The duration of flaming or glowing of any sample after withdrawal of the test flame is not to exceed 60 seconds; flaming or glowing is not to travel to the end of the sample farthest from the point of application of the test flame; and particles dropped from the exterior surface of the sample during the vertical and 45-degree exterior exposures are not to ignite the surgical cotton.

10 Corrosion Resistance

10.1 Test for zinc-coated steel

10.1.1 To determine compliance with 3.2.3, the amount of zinc coating shall be determined by the Standard Method of Test for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles, ANSI/ASTM A90-69.

10.1.2 When flaking or cracking of the zinc coating at the outside radius of a bent or formed section is visible at 25 power magnification, or when the coating is scored, the zinc coating is damaged and does not comply.

10.2 Tests for coated steel (other than zinc-coated steel)

10.2.1 General

10.2.1.1 The tests in 10.2.2.1 – 10.2.4.1 are to be conducted on coated materials other than galvanized steel after the material has been formed for use in the finished product. The tests are to be conducted on samples of the coated material and on zinc-coated steel having the minimum coating of zinc specified in 3.2.3, and continued until equivalency is demonstrated. Samples having organic coatings are to be tested in the as received condition and also after having been exposed to temperature as encountered in the high-temperature phase of the temperature test, 12.3.1 – 12.3.4.

10.2.2 Salt-spray test

10.2.2.1 The apparatus for salt-spray (fog) testing is to consist of a fog chamber, the inside of which measures 48 by 30 by 36 inches (1219.2 by 762 by 914.4 mm), salt-solution reservoir, a supply of conditioned compressed air, one dispersion tower constructed in accordance with Salt Spray Testing, ASTM B117-73, for producing a salt fog, specimen supports, provision for heating the chamber, and required means of control.

10.2.2.2 The dispersion tower for producing the salt fog is to be located in the center of the chamber and is to be supplied with humidified air at a pressure of 17 to 19 psig (117.2 – 131 kPa) so that the salt solution is aspirated as a fine mist or fog into the interior of the chamber.

10.2.2.3 The salt solution is to consist of 20 percent by weight of common salt (sodium chloride) and distilled water, and the pH value of the collected solution is to be between 6.7 and 7.2 with a specific gravity of 1.126 to 1.157 at 35°C (95°F). The temperature of the chamber is to be maintained at 35 plus 1 or minus 2°C (95 plus 2 or minus 3°F) throughout the test.

10.2.2.4 Drops of solution that accumulate on the ceiling or cover of the chamber are not to be permitted to drop on the specimens, and drops of solution that fall from the specimens are not to be recirculated and are to be removed by drains located at the bottom of the apparatus.

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10.2.3 Industrial-atmosphere test

10.2.3.1 The test specimens are to be supported vertically in a closed chamber having openings for gas inlet and outlet.

10.2.3.2 Sulfur dioxide and carbon dioxide are to be supplied to the test chamber from commercial cylinders containing these gases under pressure. An amount of sulfur dioxide equivalent to 1 percent of the volume of the test chamber, and an equal volume of carbon dioxide are to be introduced into the chamber each working day. A small amount of water is to be maintained at the bottom of the chamber.

10.2.4 High-temperature and humidity test

10.2.4.1 The test specimens are to be supported vertically in a closed chamber at a constant temperature of 40°C (104°F) and 100 percent relative humidity.

11 Mold Growth and Humidity Test

11.1 Materials for air ducts and air connectors, including any tapes, fabrics, cements, or other materials to be used in assembly during installation shall be resistant to the effects of high humidity under standard atmospheric temperature conditions. The mold shall not spread beyond the inoculated area, and no significant growth of mold is to be observed. Structural material shall not become deformed or delaminated; tapes, casings, and lining shall remain securely in place; and joints shall not open or show evidence of separation.

11.2 Three samples representing typical wall areas of the assembled air ducts or air connectors are to be prepared. Each sample is to be 4 by 4 inches (102 by 102 mm) square and is to include any joining material employed in the installation of duct systems.

11.3 Mold mycelia and spores from bread are to be applied to the samples. The samples are to be placed in a closed vessel in which an atmosphere saturated with water vapor is maintained at room temperature and under dark conditions. The samples are to remain in this atmosphere until the extent of growth has been demonstrated or until the mold and spores have disintegrated, and not less than 60 days.

11.4 The samples then are to be examined visually for extent of mold growth and for indications of deterioration in wall structure, exterior casing, inner lining, tapes, and fabrics.

11.5 As an alternate, the test specified in 11.1 – 11.4 shall be conducted using Chaetomium Globosum instead of bread mold.

12 Temperature Test

12.1 General

12.1.1 Materials for air ducts and air connectors, including any tapes, fabrics, cements, or other materials intended to be used in assembly during installation, shall be resistant to the effects of the temperatures to which they are exposed in the following tests.

12.2 Low temperature

12.2.1 Structural material shall not become deformed or show delamination; tapes, casings, and lining shall remain securely in place; and joints shall not open or show evidence of separation when a sample is subjected to the test described in 12.2.2 – 12.2.4.

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12.2.2 Three samples representing typical wall areas of the assembled product are to be prepared. Each sample is to be 8 by 8 inches (203 by 203 mm) square and is to include joining material, when such is employed in the installation of duct systems.

12.2.3 The samples are to be placed in a closed vessel in which an atmosphere saturated with water vapor is maintained at room temperature for a period of 48 hours. The samples then are to be removed and immediately placed in a refrigerated compartment and maintained at a temperature of minus 17.8°C (0°F) for a period of 24 hours.

12.2.4 The samples then are to be examined visually for indications of deterioration in wall structure, exterior casing or interior linings, tapes, fabrics, and cements.

12.3 High temperature

12.3.1 To comply with the requirements of 12.1.1, the exterior and interior surfaces of samples of air duct sections and air connectors are to be simultaneously exposed to air maintained at not less than 51.7°C (125°F) on the exterior and not less than 129.4°C (265°F) on the interior. Any arrangement using samples of air duct sections or air connectors shall be employed. The test arrangement is to provide means for maintaining air at the specified test temperatures in moving contact with the two surfaces of the test samples. As a result of the test described in 12.3.2 - 12.3.4, structural material shall not become deformed or show delamination; tapes, casings, and lining shall remain securely in place; and joints shall not open or show evidence of separation.

12.3.2 At least two representative samples are to be specified and prepared for this test. When the product is of uniform grade, thickness, and cross section, such as square or round, the samples are to be chosen from the smaller sizes. Square or round sections, varying in grade and thickness with size, may also require samples in other size ranges. Rectangular sections are to be specified on the basis of grade, thickness, and size. Shapes of air duct sections or air connectors which are vulnerable to damage under the conditions of the puncture test are to be tested. See 13.1.

12.3.3 Each sample is to be 3 feet (0.91 m) long and is to be assembled from two sections of air duct or air connector, providing for a joint between sections located 2 feet (0.60 m) from one end or a single piece of material. At least one end of each sample is to be attached to a metal collar in accordance with the manufacturer's instructions.

12.3.4 The conditions of test are to be maintained for a period of 60 days. The samples then are to be examined visually for indications of deterioration in wall structure, exterior casings or interior linings, tapes, fabrics, and cements.

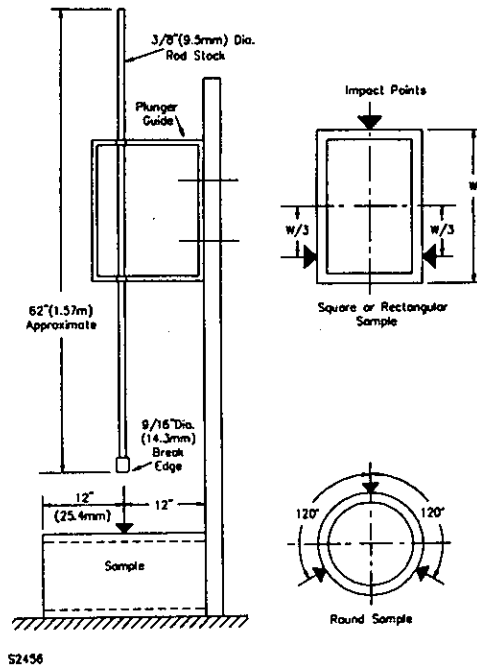
13 Puncture Test

13.1 An air duct shall not be punctured when tested in accordance with these requirements.

13.2 Test apparatus providing for a free fall of a plunger onto the surface of the sample is to be used for this test. The apparatus is to be as illustrated by Figure 13.1.

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Figure 13.1
Puncture test



13.3 The plunger is to consist of 3/8-inch (9.52 mm) diameter steel rod having a steel head, 9/16-inch (14.2 mm) diameter, attached to the impact end. The length of the plunger assembly is to provide a 2-pound (0.90 kg) weight. The surfaces of the rod and head are to be smooth. The impact end of the rod is to be formed as shown in Figure 13.1.

13.4 Guides arranged to allow for frictionless fall of the plunger are to be provided. A means for measuring the height of fall is to be provided.

13.5 Pieces, 2 feet (0.60 m) long, are to be taken from duct sections previously subjected to the temperature test, and identical samples prepared from untested product are to be subjected to this test. The samples are to be provided with a firm support below and throughout their length and width. At least three areas of each sample are to receive the impact of the plunger at the impact points shown in Figure 13.1.

13.6 The samples shall prevent the complete penetration through the wall of the sample of the plunger head falling through a distance of 20 inches (330.2 mm) as measured to the top surface of the sample.

14 Static Load Test

14.1 General

14.1.1 Sections of rigid air ducts assembled in accordance with the manufacturer's instructions shall not sag, permanently deform, or be damaged as the result of static loading applied according to the requirements of 14.2.1 – 14.2.7. Sections of flexible air ducts and air connectors that incorporate vapor barriers supported by grommets or other mechanical means of field support shall not be damaged as the result of static loading applied according to 14.3.1 – 14.3.4.

14.2 Tests for rigid air ducts

14.2.1 Following the test, the inner and outer surfaces of the sample shall not be ruptured, broken, torn, ripped, or separated; joints and seams shall remain intact and not be fractured; and there shall be no evidence of other damage to the samples which result in the sample to be unusable.

14.2.2 Previously untested representative samples are to be specified or prepared. When sections are of uniform grade, thickness, and cross section, such as square or round, the samples from the largest and smallest sizes are to be tested. Square or round sections varying in grade and thickness with size also require samples in the intermediate size range. Rectangular sections are to be selected on the basis of grade thickness, and size, as well as the largest ratio of width to depth specified by the manufacturer. Samples of shapes which are vulnerable to damage under the conditions of test are to be specified.

14.2.3 Samples for test are to be at least 2 feet (0.60 m) longer than the maximum distance between supports specified in the manufacturer's instructions for the various sizes, grades, and shapes, and not less than 8 feet (2.43 m) long. Samples are to be assembled to provide for a circumferential joint at the center of the sample, unless supports are specified to be located at each such joint, in which case the manufacturer's instructions are to be followed. When joints are reinforced to the extent that the section shall be more resistant to load than a section without a joint, additional samples of sections without the joint are to be tested. Any adhesives or cements are to be allowed to cure for a period of at least 24 hours. Samples are not to be exposed to relative humidity greater than 70 percent during the 24-hour period prior to the test.

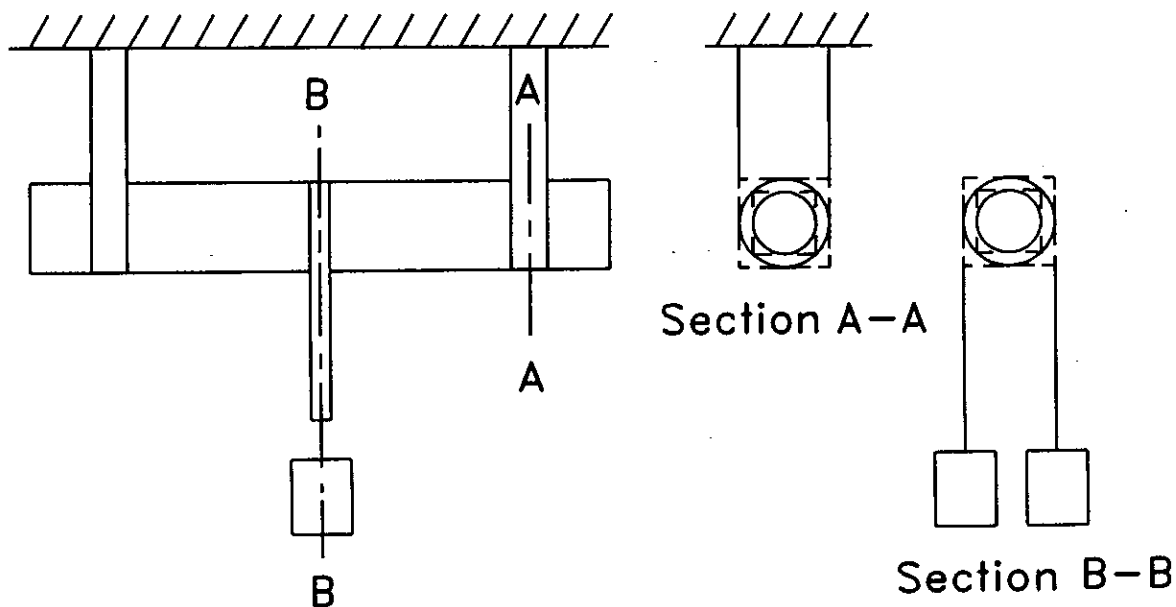
Exception: If the longest section obtainable from the material under test is less than 8 feet, additional pieces shall be joined thereto, so that the longest section is midway between the supports. "

14.2.4 The samples are to be placed horizontally on hangers located at the interval specified in the manufacturer's instructions, except that hangers are to be located on centers not less than 16 inches (0.40 m) apart. Rectangular samples are to be placed with the major axis in the horizontal plane. Special bearing blocks, or other reinforcing means, are to be used when supplied as factory-made parts. Steel pipe strap hanger material 1 inch (25.4 mm) wide is to be used to support the test sample, locating each hanger not less than 1 foot (0.30 m) from the end of the sample. When support at intervals less than 6 feet (1.82 m) is specified, additional support straps as needed to support the 8 foot (2.43 m) test sample at the specified interval are to be provided.

14.2.5 The general arrangement for test is to be that illustrated in Figure 14.1.

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Figure 14.1
Static load test



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14.2.6 With a sample supported as described above, means are to be provided for measuring to the nearest 1/16 inch (1.6 mm) the vertical deflection at the center of the horizontal length. This measurement is to be that taken between the bottom of the sample at the center and the floor or other datum point below the sample. Any deflection due to stretching of the hangers is to be deducted.

14.2.7 A static load is to be applied at the longitudinal center of the sample by suspending two 5-pound (2.26-kg) weights on a 1-inch (25.4-mm) wide pipe strap material as illustrated in Figure 14.1. The maximum vertical deflection measured at the bottom of the test sample, expressed as a percentage of the distance between supports, is not to exceed:

- 0.7 percent at the end of 5 minutes.
- 0.8 percent at the end of 1 hour.
- 1.0 percent at the end of 24 hours.
- 0.8 percent at the end of 5 minutes after removal of the load.

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14.3 Tests for flexible air ducts and air connectors.

14.3.1 After supporting the load for 24 hours, the sample shall not be ruptured, broken, torn, ripped, collapsed, or separated; and there shall be no evidence of other damage to the sample which results in it being unusable.

14.3.2 Previously untested representative samples are to be specified or prepared. Samples of duct sizes that result in the maximum weight intended to be supported by any given grommet size or spacing are to be specified for this test. Samples, 8 feet (2.43 m) long, are to be used.

14.3.3 Any adhesives or cements are to be allowed to cure for a period of at least 24 hours. Samples are not to be exposed to relative humidity greater than 70 percent during the 24-hour period prior to the test.

14.3.4 Samples are to be supported in accordance with the methods and spacings specified by the manufacturer. A load of 2-1/2 times the total weight of the sample is to be uniformly applied to the duct so that it is supported by the support system. When possible, the load is to be applied by laying rods on the inside of the duct. The load shall remain for 24 hours.

15 Impact test

15.1 Sections of air ducts assembled in accordance with the manufacturer's instructions, when tested in accordance with the requirements, shall not be damaged as a result of the impact applied as specified in 15.4 – 15.7. Following the test, the inner and outer surfaces of the samples shall not have ruptured, broken, torn, ripped, collapsed, or separated; and there shall be no evidence of other damage to the sample which results in it being unusable. The average reduction in internal cross-sectional area is to be determined for the three tests. Collapse is defined as an average internal cross-sectional area reduction in excess of 20 percent, or any individual reduction in cross-sectional area in excess of 25 percent.

15.2 Previously untested representative samples are to be prepared on the basis of grade, thickness, size, and shape. Consideration is to be given to tested samples which are vulnerable to damage under the conditions of test. Such samples may include air ducts prepared with a representative field splice of a type as specified by the manufacturer. Samples of non-symmetrical cross section are to be evaluated in the orientations identified as being vulnerable under the conditions of test.

15.3 Three samples, each measuring 8 feet (2.43 m) in length, of the finished duct construction are to be assembled for test. In assembling the test samples, all duct materials are to be extended to their full length. Any adhesives or cements are to be allowed to cure for a period of at least 24 hours. Samples are not to be exposed to relative humidity greater than 70 percent during the 24-hour period prior to test.

15.4 An impact test is to be performed on each of the three samples. The impact test is to be performed over a firm rigid flat surface. The impact is to be that of a canvas bag containing sand and weighing 15 pounds (6.8 kg). The bag is to be constructed of nominal 12 ounce (0.33 kg) canvas duck in accordance with Figure 15.1. The test fixture is to incorporate a mechanism which is capable of releasing the bag in a quick and smooth motion which imparts no lateral momentum to the sand bag.

15.5 Prior to each test, the sand bag is to be dropped a distance of 2 feet (0.61 m) onto the floor in order to flatten the bottom of the bag. Without altering the sand bag profile, the sand bag is to be secured to the test fixture. The sand bag is to be raised so that the distance between the bottom of the bag and the top of the sample is 10 inches (0.25 m).

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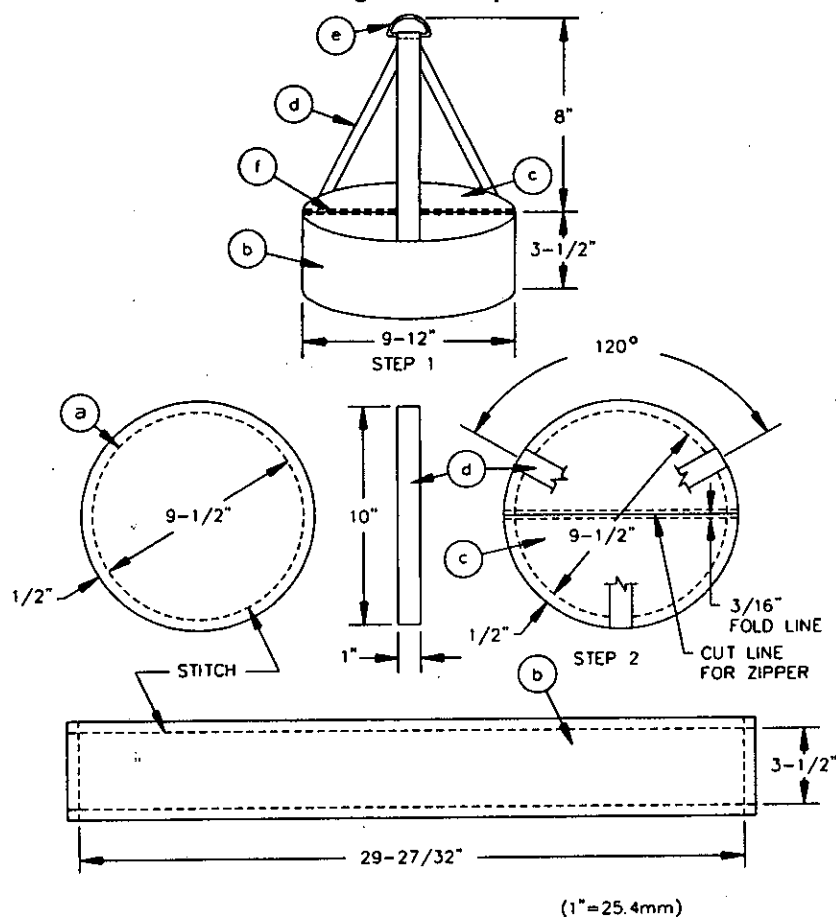
15.6 The sample is to be positioned such that the sample center is directly beneath the center of the sand bag. The distance from the bottom of the sand bag to the top of the air duct sample is to be adjusted to 10 inches (0.25 m). The sample shall be examined to verify that all materials have been extended to their full length. The samples are then to be restrained by taping each end of the sample to the floor with a 1/2-inch-by-6-inch (12.7 mm by 152.4 mm) length of masking tape. See Figure 15.2.

15.7 The sand bag is to be released from the test fixture and allowed to free fall onto the test sample. The sand bag is to come completely to rest before being removed from the test sample. The test is determined valid even when the masking tape used to restrain the test sample breaks loose during impact.

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Figure 15.1
Sand bag for the impact test



a bottom	12 oz. canvas duck
b side	12 oz. canvas duck
c top	5 oz. canvas duck
d strap nylon	1 in. wide
e D-ring	1-1/2 x 1/4 in.
f nylon zipper	1-5/8 in. wide x 10-1/2 in. long

1. Cut piece a, b, and c from canvas material.
2. Sew piece b end-to-end with 1/2 inch seam allowance each piece.
3. Sew piece a to piece b as shown with 1/2 inch seam allowance each piece.
4. Cut piece c centerline, fold 3/16 inch each half and sew zipper as shown.
5. Sew nylon straps to piece c, 120° apart as shown in Step 2.
6. With all pieces inside-out sew piece c to piece b opposite piece a. (Note: Insure zipper is unzipped.)
7. Turn bag inside-out to obtain end construction shown in Step 1.
8. Sew 3 strap ends to D-ring leaving 8 inch length from top of D-ring to top of bag measured perpendicularly.

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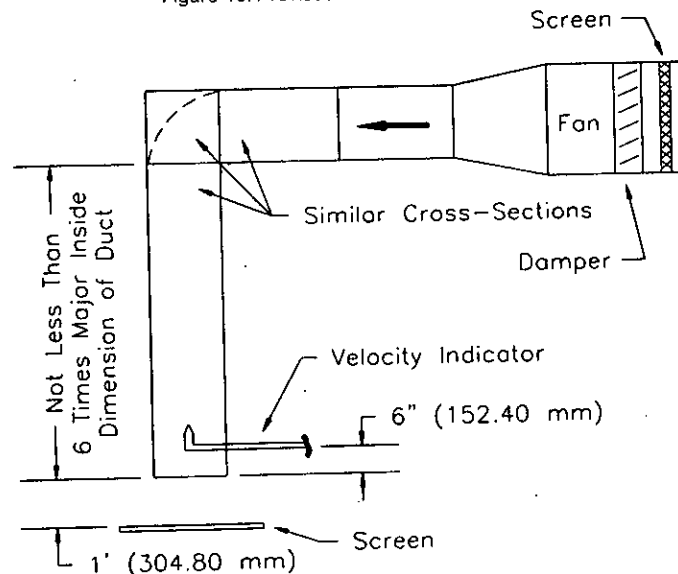
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16.2 Test installation

16.2.1 One or more of the samples of duct sections previously subjected to the impact test (15.1 – 15.6) and one or more samples of air connectors required in accordance with 15.2 are to be subjected to this test. The sample or samples are to be arranged in an L-shaped assembly. When sections of duct are to be tested, the leg of the assembly connected to the fan outlet is to be the section which has been subjected to the impact test and the vertical leg is to be of similar untested material having a length of not less than six times the major inside dimension of the duct section. A connector for this test is to be 12 feet (3.65 m) long. For rigid air ducts and air connectors, the 90 degree bend is to be made with an elbow as normally employed for installations. Flexible air ducts and air connectors are to be bent at a radius equivalent to the inside diameter of the air duct or air connector to form the 90-degree bend. The entire assembly is to have similar cross sections. See Figure 16.1.

Figure 16.1
Erosion test

Figure 16.1 revised December 14, 1998



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16.2.2 Connection to the outlet of the fan is to be by means of a transformation piece of any intended material to provide for uniform air entry to the test sample. The fan is to have the capacity to provide a maximum velocity of two and one-half times the maximum velocity specified by the manufacturer, but not less than 2500 feet per minute (762 m/min) of air at room temperature.

16.2.3 The air velocity for purposes of the test is to be measured by a pitot tube, or direct-reading velometer, positioned in the center of the outlet end of the sample. Room air handled by the fan and ranging in temperature between 15.6 and 37.8°C (60 and 100°F) shall be employed.

16.2.4 The inlet of the air fan used for the test is to be covered with a double layer of cheesecloth (14 to 15 square yards per pound (5.2 to 5.6 m²/g) and known to the trade as "count of 32 by 28").

16.2.5 A damper, when employed for regulating velocity in the air duct or air connector system, is to be located between the screen and the fan or between the fan and the inlet of the test sample.

16.2.6 A collecting screen consisting of a double layer of cheesecloth, as specified in 16.2.4, stretched taut on a frame sized to provide for an area not less than five times the inside cross-sectional area of the test sample, is to be located 1 foot (0.30 m) from the outlet end of the test sample.

16.3 Test method

16.3.1 Samples are not to be exposed to relative humidities greater than 70 percent during the 24-hour period prior to the test.

16.3.2 Air is to be passed through the sample at test velocity with the collecting screen removed for a period of at least 1 hour and not more than 24 hours. The collection screen then is to be placed in position.

16.3.3 The test then is to proceed at test velocity and continued for a period of 4 hours. The collecting screen is to be examined for macroscopic particles at the end of each hour during the test period by taping the screen with the adhesive side of transparent tape, or tapes, in order to remove and record any eroded particles.

17 Pressure Test

17.1 Air ducts and air connector sections with joints, assembled in accordance with the manufacturer's instructions, shall withstand without rupture an internal air pressure of 2-1/2 times the manufacturer's rated positive pressure, and not less than 1-1/4-inch water column (3.0 Pa). The sample is not to rupture, as evidenced by breaks, tears, rips, or other openings greater than 1/8 inch (3.2 mm) in length; any joining material is to remain intact to the extent that materials such as tapes do not become displaced more than a total for both edges of 1/8 inch (3.2 mm) from their initial position, disregarding movement due to slack or stretch which does not produce a separation of materials; and there is to be no evidence of other damage which results in the samples becoming unusable.

17.2 Air ducts and air connector sections of samples previously untested are to be used for the test. Samples, 8 feet (2.43 m) long, are to be used in accordance with 15.2. Air ducts and air connector sections are to be prepared in accordance with 15.3. Each end of the sample is to be sealed airtight by any means consistent with the use of the material under test. In the case of a flexible air duct or air connector, to permit the air duct or air connector to be fully extended to its maximum length, the air duct or air connector is to be pressurized to 0.25 inch water column (62.2 Pa). Each end of the flexible air duct or air connector is to be attached to a stationary fixture.

17.3 A pressure tap consisting of pipe or tubing is to be sealed into one end of the test sample and connected to a water manometer which shall be read directly to 0.05 inch water column (0.01 Pa). The manometer is to be checked for zero reading at the beginning and at the end of each test.

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17.4 An air supply tap consisting of pipe or tubing is to be sealed into the same or the other end of the sample and connected to a source of air pressure capable of maintaining the specified air pressure in the sample. The manufacturer's rated pressure is to be gradually attained in not less than 45 seconds nor more than 60 seconds from the initial application of the test pressure. This pressure is to be held for 1 minute. The pressure then is to be increased to 2-1/2 times the manufacturer's rated pressure in not less than 45 seconds nor more than 60 seconds.

17.5 The air pressure in the test sample is to be maintained at the designated test pressure for a period of 1 hour.

18 Collapse Test

18.1 Sections of air ducts and air connectors and the joints between sections, assembled in accordance with the manufacturer's instructions, shall resist collapse, damage, and excessive deformation when subjected to negative pressure of 2-1/2 times the manufacturer's rated negative pressure, and not less than a negative pressure of 1-1/4-inch water column (3.0 Pa).

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18.2 The sample shall not collapse, any joining material shall remain intact to the extent that materials such as tapes do not become displaced more than a total for both edges of 1/8 inch (3.2 mm) from their initial position, disregarding movement due to slack or stretch which does not produce a separation of materials; and there shall be no evidence of other damage which results in it to be not capable of further use. Any reduction in either external or internal cross-sectional area shall not exceed 20 percent at any time during the test.

18.3 Air ducts and air connectors and sections of samples previously untested are to be used for the test. Samples, 8 feet (2.43 m) long, are to be required in accordance with 15.2. Air duct and air connector sections are to be prepared in accordance with 15.3. The arrangement of the samples for test and the instrumentation are to be as for the pressure test.

18.4 A means for creating and maintaining a negative pressure in the test sample is to be connected to the air tap. The manufacturer's rated pressure is to be gradually attained in not less than 45 seconds nor more than 60 seconds from the initial application of the test pressure. This pressure is to be held for 1 minute. The pressure then is to be increased to 2-1/2 times the manufacturer's rated pressure in not less than 45 seconds nor more than 60 seconds.

18.5 The negative air pressure in the test sample is to be maintained at the designated test pressure for a period of 1 hour.

19 Tension Test

19.1 Sections of flexible air ducts and air connectors and the joints between sections, assembled in accordance with the manufacturer's instructions, shall not be damaged when subjected to a 25-pound-force (111.2 N) pull for 24 hours, as specified in 19.2 and 19.3. The sample shall not rupture, break, tear, rip, collapse, or separate; any joining material shall remain intact to the extent that materials such as tapes do not become displaced more than a total for both edges of 1/8 inch (3.2 mm) from their initial position, disregarding movement due to slack or stretch which does not produce a separation of materials; and there shall be no evidence of other damage to the sample which causes it to be not capable of further use.

19.2 Samples previously untested are to be used for this test. Samples, 8 feet (2.43 m) long, are to be required in accordance with 15.2. Sections of air ducts and air connectors are to be prepared in accordance with 15.3. Steel collars that meet the intent of the requirement, when not part of the assembly, are to be attached to each end of the test sample in accordance with the manufacturer's instructions. One end collar then is to be secured to an overhead support to allow the sample to be suspended vertically. A 25-pound-mass (11.3-kg) weight is to be attached to the lower end collar and shall remain for 24 hours.

19.3 Observations are to be made during and following the application of the test load.

19.4 As an alternate, the tension test shall be conducted only on the core constructions of insulated flexible air ducts and air connectors. When so tested, the core construction alone shall also comply with the Bending Test, Section 7; Pressure Test, Section 17; Collapse Test, Section 18; Torsion Test, Section 20; and Leakage Test, Section 21.

20 Torsion Test

20.1 Sections of flexible air ducts and air connectors and the joints between sections, assembled in accordance with the manufacturer's instructions, shall not be damaged when subjected to a torque of 25 foot-pounds (33.7 N·m) or a torque capable of producing an angular rotation of 180 degrees, whichever occurs first.

20.2 The sample shall not rupture, break, tear, rip, collapse, or separate; any joining material shall remain intact to the extent that materials such as tapes do not become displaced more than a total for both edges of 1/8 inch (3.2 mm) from their initial position, disregarding movement due to slack or stretch which does not produce a separation of materials; and there shall be no evidence of other damage to the sample which results in it not being capable of further use.

20.3 Samples previously untested are to be tested. Samples, 8 feet (2.43 m) long, are to be required in accordance with 15.2. Sections of air ducts are to be prepared in accordance with 15.3. Steel collars that meet the intent of the requirement, when not part of the assembly, are to be attached to each end of the test sample in accordance with the manufacturer's instructions. One end collar then is to be secured to an overhead support so as to allow the sample to be suspended vertically. Means to apply a torque to the lower end collar are to be provided.

20.4 The test is to be conducted by first applying the test torque so as to rotate the bottom end clockwise, releasing the torque, and returning the end to its initial position; then applying the test torque to rotate the bottom end counterclockwise, releasing the torque, and returning the end to its initial position. This test series is to be repeated five times.

20.5 Observations are to be made during and following the application of the torque.

21 Leakage Test

21.1 Sections of air ducts and air connectors and joints between sections, assembled in accordance with the manufacturer's instructions, shall not leak as determined by the requirements of 21.5, when tested as specified in 21.2 - 21.5.

21.2 The samples individually subjected to the tests for static load, impact, pressure, collapse, bending, tension, and torsion as appropriate for the product under investigation, are to be subjected to this test. The arrangement for test and the instrumentation are to be as for the pressure test, except the water manometer is to be one which shall be read directly to 0.01 inch water column (0.02 Pa). Samples longer than 8 feet (2.43 m) are to be reduced in length to provide a test sample 8 feet long.

21.3 An air meter is to be placed in the air supply system between the supply source and the test sample to indicate the total volume of air supplied to the sample during the test. The meter is to be accurate within plus or minus 0.50 cubic feet (0.014 m³) under the conditions of the test.

21.4 The volume within the test sample is to be calculated, based upon inside measurements to the nearest 1/16 inch (1.58 mm).

21.5 An air pressure of 0.50-inch water column (1.25 Pa) is to be maintained in the test sample for a period of 1 hour. The total volume of air recorded by the air meter from the time beginning with the establishment of the test pressure in the sample, to the end of the test period, is not to exceed 20 multiplied by the volume of the sample.

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