BSR/ASHRAE/SMACNA Standard 126-2020(W)

Intent to Withdraw

Method of Testing HVAC Air Ducts

Withdrawal Public Review 2026

This standard will be submitted to the American National Standards Institute Board of Standards Review (BSR) with a notice of Intent-to-Withdraw.

This intent-to-withdraw draft has been recommended for public review by the cognizant technical committee and approved by a subcommittee of the Standards Committee. To submit a comment on this proposed withdrawal, go to the ASHRAE website at http://www.ashrae.org/technology/page/331 and access the online comment database. The draft is subject to modification until it is approved for publication by the ASHRAE Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE Web site) remains in effect. The current edition of any standard may be purchased from the ASHRAE Bookstore at www.ashrae.org or by calling 404-636-8400 or 1-800-527-4723 (for orders in the U.S. or Canada).

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SPECIAL NOTE

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ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

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The Senior Manager of Standards of ASHRAE should be contacted for

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

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ANSI/ASHRAE/SMACNA Standard 126-2020
Method of Testing HVAC Air Ducts

NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

First published in 2000, Standard 126 is a joint project of ASHRAE and the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA). It was created to provide methods of testing to determine the strength and durability characteristics of HVAC ducts under various loading and environmental conditions. The intent of Standard 126 is to address all duct shapes and materials. To the project committee's knowledge, no other publication addresses all of the structural and durability tests as comprehensively as this standard, although individual tests are covered under other standards.

A standardized set of comprehensive tests is used to ensure that products meet minimum structural requirements, and to allow products to be compared to one another. Such tests should simulate structural stresses that the duct will experience in service and facilitate the application of safety factors. These tests include pressurizing the ductwork, applying superimposed loads, dropping weighted implements for impact or puncture, applying tension to the duct, bending flexible duct 180 degrees, subjecting the ductwork to temperature and humidity changes, and bursting or collapsing the ductwork under pressure. After an individual test or a series of tests, leakage tests may be conducted to determine the effect of a structural or durability test on a specimen. During a test or series of tests, the ductwork is observed to determine if there is degradation and permanent damage.

Pass/fail criteria are determined by the sponsoring agency, code officials, or other users of this standard. Recommended acceptance criteria are provided in Informative Annex C.

This 2020 revision of Standard 126 was prepared under the auspices of ASHRAE. It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform standards throughout the industry. Changes in the 2020 revision include updated references.

1. PURPOSE

This standard provides laboratory test procedures for the evaluation of HVAC air ducts.

2. SCOPE

2.1 This standard shall be used to determine the structural strength, dimensional stability, durability, and leakage characteristics of HVAC air ducts.

2.2 This standard does not address the following:

a. Fittings
b. Effects of aerosols, solid particulates, corrosive environments, or combustibility
c. Long-term effects of extended service
d. Seismic qualifications
e. Underground ducts
f. Plenums and equipment casings
g. Supports for ductwork and fittings

3. DEFINITIONS AND SYMBOLS

3.1 Definitions

accuracy: the degree of conformity of an indicated value to an accepted standard value, or true value. The degree of inaccuracy is known as "measurement error" and is the sum of bias error and precision error.

bias error (systematic error): the difference between the true or actual value to be measured and the indicated value from the measuring system that persists and is usually due to the particular instrument or technique of measurement. These errors are corrected through calibration.

density of standard air (ρ_s): 1.204 kg/m^3.

duct, HVAC: duct and fittings used for conveying air in residential, commercial, institutional, and industrial heating, ventilating, and air-conditioning systems.

joint: a connection of duct surface elements that is primarily intended to connect lengths of ductwork, to join intersecting ducts, or to join ducts and equipment.

leakage: the volumetric flow rate required to maintain a constant static pressure in a test specimen.

leakage class: leakage of ductwork, L/s per $Pa^{0.65}$ per m^2 of duct surface area.

precision: the closeness of agreement among repeated measurements of the same characteristic by the same method under the same conditions.

random error (precision error): a statistical error that is caused by chance and is not recurring.

sealant: a material or product used to seal longitudinal duct seams, transverse duct joints, and ductwork penetrations. Products include liquids, mastics, tapes, gaskets, heat-activated material, and mastic with an embedded fabric.

seam: a connection of duct surface elements that is primarily oriented in the direction of airflow.

sponsor: a manufacturer, trade association, or some other group that funds, sponsors, or requires ductwork tests in compliance with this standard.

transverse joint: a joint that is used to assemble sections of duct together or connect them to fittings.

3.2 Symbols

A_f = final area, mm^2

A_i = initial area, mm^2

D = diameter, mm

L = length, mm

L_{rs} = reinforcement spacing, mm

L_{us} = user-specified support spacing, mm

PR = percent reduction, %

Q_a = leakage rate at actual conditions, L/s

Q_s = leakage rate at standard air conditions, L/s

R = gas constant, kJ/(kg·K)

W = duct width (flat surface), mm

p_b = barometric pressure, kPa

p_e = saturated vapor pressure of air, kPa

p_p = partial vapor pressure of air, kPa

t_o = dry-bulb temperature, °C

t'_o = wet-bulb temperature, °C

ρ_o = density of atmospheric air, kg/m^3

ρ_s = density of standard air, kg/m^3

φ = relative humidity, percentage

4. INSTRUMENTATION

4.1 Accuracy and Precision. Measurements from the instruments shall be traceable to primary or secondary standards calibrated by the National Institute of Standards and Technology (NIST) or to the Bureau International des Poids et Mesures (BIPM) if a National Metrology Institute (NMI) other than NIST is used. In either case, the indicated corrections shall be applied to meet the accuracy and precision stated in this standard. Instruments shall be calibrated on a regular schedule that is appropriate for each instrument, but in no case less than annually. Calibration records shall be maintained. Instrument accuracy and precision shall be as follows:

a. Temperature measurements shall be made using devices with an accuracy equal to or better than 1°C and with a precision equal to or better than 0.5°C.
b. Pressure shall be measured with an accuracy equal to or better than 1.0 Pa and a precision equal to or better than 0.5 Pa.
c. Barometric pressure shall be measured with accuracy equal to or better than 25 Pa.
d. Flowmeters shall have an accuracy of 2% of reading.

4.2 Temperature

4.2.1 Temperature instruments and measurements shall comply with ASHRAE Standards 41.1 [1] and 41.6 [2].

4.2.2 Calibration. Thermometers and temperature instruments shall be calibrated to traceable standards per Section 4.1.

4.2.3 Wet-Bulb. The wet-bulb thermometer shall have a 3.5 to 10 m/s air velocity over the water-moistened wick-covered bulb or sensor. The dry-bulb thermometer shall be mounted upstream of the wet-bulb thermometer so its reading will not be depressed by the cooling effect of evaporated moisture.

4.3 Pressure

4.3.1 Pressure indicating-instruments shall comply with ASHRAE Standard 41.3 [3].

4.3.2 Calibration. Each pressure instrument shall be calibrated to traceable standards per Section 4.1.

4.4 Barometers. Barometers shall be calibrated to traceable standards per Section 4.1.

4.5 Flowmeters. Flowmeter shall be an orifice or laminar flowmeter.

4.6 Dial Indicators. Dial indicators shall have jewel bearings, a suitable range, and 0.01 mm graduations.

5. TESTS

5.1 Tests to be conducted are listed below. At the discretion of the sponsor, a specific test specimen for more than one test is permitted.

a. Leakage
b. Deflection under pressure
c. Deflection under superimposed loads
d. Impact
e. Tension
f. Bending
g. Pressure cycling
h. Burst/collapse
i. Puncture
j. Temperature
k. Humidity

Informative Note: The purpose of each test is briefly explained in Informative Annex A.

5.2 At the discretion of the sponsor, it is acceptable to omit individual tests.

5.3 When required by the sponsor, a leakage test shall be conducted before and after an individual test.

Informative Note: If a specific test specimen is to be used for a group of tests, a leakage test may be conducted before and after the test series. Exclusive leakage tests may be conducted on any specimen.

6. LEAKAGE TEST

The leakage testing described below is intended to determine the durability and air tightness of ducts and connections related to the testing performed. This leakage test is not suitable to determine the leakage class of a duct system.

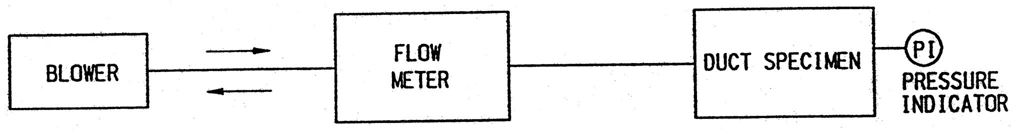


Figure 1 Generic leakage test setup.

6.1 Test Specimen and Test Pressure. The duct assembly and test pressure shall be specified by the sponsor. The ends of the duct assembly shall have sealed end caps.

6.2 Test Setup

6.2.1 The test setup shall be in conformance with Figure 1 and Section 4.

Informative Note: Example test setups are provided in Informative Annex B.

6.2.2 Pressure shall be measured by an inclined manometer or other instrument in compliance with Section 4.3. The pressure connection shall be on the end cap opposite the supply/exhaust connection end cap.

6.3 Test Procedure

6.3.1 The end caps and instrument tubing shall be sealed. Resealing of end caps during any test is permitted provided that the effects of the resealing are recorded.

6.3.2 The test pressures shall be set at the levels specified by the sponsor.

6.3.3 The duct pressure and leakage rate shall be recorded.

6.4 Leakage Rate Correction

6.4.1 Leakage rates shall be corrected from actual conditions (Q_a) to standard air conditions (Q_s) by using Equation 1:

$$Q_s = Q_a \times (\rho_a/\rho_s) \tag{1}$$

Informative Note: Refer to Informative Annex B, Section B2, for an example problem. For the example, the duct leakage rate at test and standard air density conditions are 5.093 and 4.86 L/s, respectively.

6.4.2 The density of atmospheric air (ρ_o) shall be determined from measurements in the general test area of the dry-bulb temperature (t_o), wet-bulb temperature (t'_o), and barometric pressure (p_b). The saturated vapor pressure at the thermodynamic wet-bulb temperature (p_e) within the general test area is determined by Equation 2:

$$p_e = 0.00325(t'_o)^2 + 0.0186\,(t'_o + 0.692 \tag{2}$$

The partial vapor pressure (p_p) is determined by Equation 3:

$$p_p = p_e - p_b\,(t_o - t'_o/1500) \tag{3}$$

The density of atmospheric air within the general test area is calculated by Equation 4:

$$\rho_o = (p_b - 0.378 p_p)/R(t_o + 273.2) \tag{4}$$

where $R = 0.287$ kJ/(kg·K).

7. STRUCTURAL TESTS

7.1 Deflection under Pressure

7.1.1 Test Specimen. The duct assembly for testing shall be specified by the sponsor. The ends of the duct assembly shall have sealed end caps.

7.1.2 Support Spacing. The sponsor shall specify the support spacing (L_{us}) and the method of support.

7.1.3 Test Pressure. The sponsor shall specify test pressures.

Informative Note: Separate specimens may be used for positive and negative pressure tests when the sponsor requires both positive and negative pressure tests.

7.1.4 Test Setup

7.1.4.1 General

a. For any duct, the number of supports shall be selected so that the end caps and supports do not influence deflections at the measurement points. A duct overhang of $L_{us}/5$ or less beyond the supports is considered sufficiently short that it does not influence deflection at the measurement points.
b. Ducts shall be positioned horizontally. For ducts with flat surfaces, the surface with the greatest dimension shall be on the top not the side.

7.1.4.2 Reinforced Ducts. The duct assembly shall be symmetrically supported with a joint centered between the points of support as shown in Figure 2. The minimum overall length of the test specimen shall be twice the joint spacing. On ducts with flat panels, the following requirements apply:

a. When $L_{rs}/W \leq 4$ and the joint spacings are greater than L_{rs}, the minimum overall length of the test specimen shall be $4L_{rs}$.
b. When $L_{rs}/W > 4$, the minimum overall length of the test specimen shall be $10W$.

7.1.4.3 Unreinforced Ducts. The duct assembly shall be symmetrically supported with a joint centered between the points of support, as shown in Figure 3. The minimum overall length of the test specimen shall be twice the joint spacing. If any flat unreinforced wall length is four times the duct width, the end caps are not considered wall deflection influences.

7.1.4.4 Dial Indicator Support. A rigid straight cross member or other appropriate means of determining zero pressure deflections for flat spans shall be provided. The support frame for the dial indicators shall not rest on ducts. Deflection readings shall be absolute values not relative values.

7.1.4.5 Pressure Taps. One tap shall be installed in each end cap, one for a blower or vacuum pump and the other for a duct pressure indicator.

7.1.5 Deflection Measurement Locations

7.1.5.1 General. Deflection measurement points for duct panels, joints, and reinforcements shall be at points of maximum deflection as shown in Figure 3. Deflection of elements prequalified for the sponsor's criteria need not be recorded unless they influence the element being investigated.

7.1.5.2 Rectangular and Flat Oval Duct, Rigid. Duct deflection shall be measured on at least two panels (see Figure 2[a] or 2[b], points P_1 and P_2), one joint (point J_1), and two intermediate reinforcement locations (points R_1 and R_2). Side panel measurements (points P_3, P_4, and J_2) are optional unless they influence top and bottom deflections. If the duct is unreinforced, the panel measurement point shall be at mid-panel between end caps. No duct panel deflection measurement shall be recorded without recording joint or intermediate reinforcement deflection that influences panel deflection.

Deflections investigated on any one surface of a duct also shall be measured on the opposite surface without rotating the duct.

7.1.5.3 Round Duct, Rigid. Duct deflection shall be measured at 90-degree increments around the perimeter (see Figure 2(c), points P_1, P_2, P_3, and P_4). Deflection measurements at reinforcements are not required.

7.1.5.4 Other Duct Shapes. Displacement indicators shall be located where the maximum deflection of panels and reinforcement is expected to occur.

7.1.6 Test Procedure

7.1.6.1 Determine the displacement of horizontal elements from a nonconcave/convex surface at zero gage pressure. Record the dial indicator readings.

7.1.6.2 Pressurize the test specimen to the specified pressure for a minimum of 5 min. Record the dial indicator readings and examine the duct.

7.1.6.3 Relieve the pressure and record the dial indicator readings.

7.1.6.4 Repeat the test if other pressures are specified.

7.1.7 Test Data and Observations

7.1.7.1 Make a drawing of the test specimen, including supports, and show the deflection measurement points with each point correlated to the data recorded.

7.1.7.2 Record the instrumentation used.

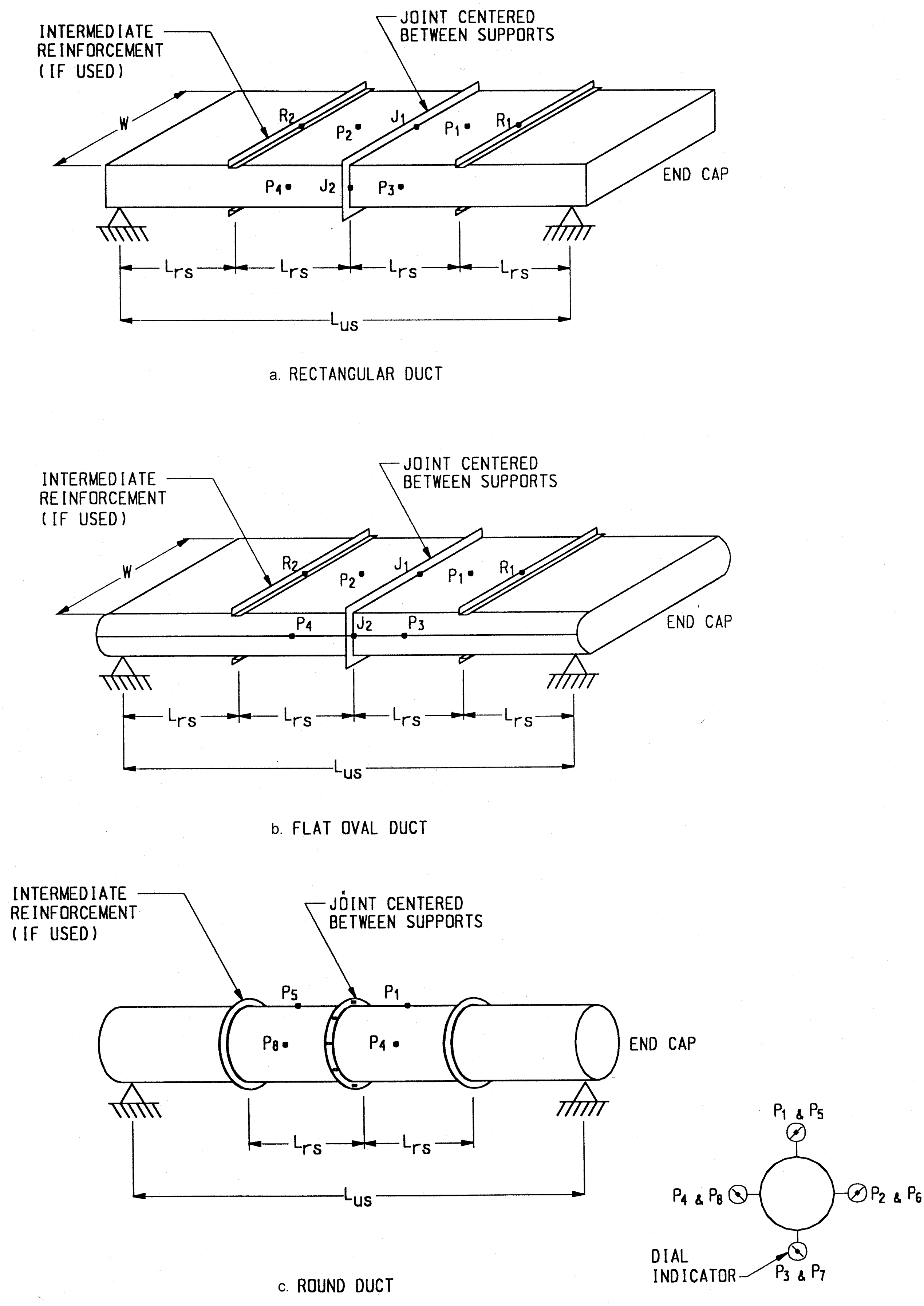
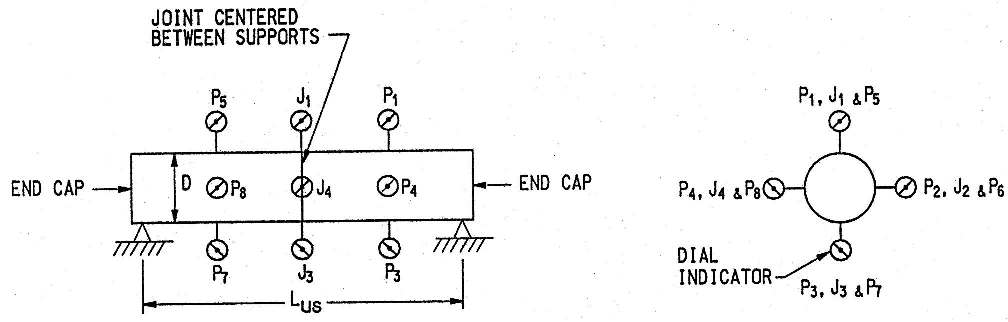


Figure 2 Deflection measurement locations for externally reinforced ducts.



Note: Round profile shown.
Measurements apply to other profiles.

Figure 3 Deflection measurement locations for unreinforced ducts.

7.1.7.3 Record all dial indicator readings and leakage rates when a leakage test is conducted.

7.1.7.4 Record any joint or seam separation, loss of seals, buckling, fastener release, permanent set, or other anomalies observed.

7.1.8 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C1.

7.2 Deflection under Superimposed Loads

7.2.1 Test Specimen. The test specimen for this test shall be the same as was used for the test in Section 7.1.1.

7.2.2 Superimposed Loads

7.2.2.1 Superimposed loads shall be specified by the sponsor. The recommended location for concentrated and uniform external loads is shown in Figure 4.

7.2.2.2 Simulating superimposed uniform loads is permitted.

7.2.3 Test Setup. The test setup shall be the same as that described in Section 7.1.4.

7.2.4 Test Procedure

7.2.4.1 Without any superimposed load, determine the displacement of horizontal surfaces from a nonconcave/convex surface at zero gage pressure. Record the dial indicator readings.

7.2.4.2 Pressurize the test specimen to the specified pressure for at least 5 min. Record the dial indicator readings and examine the duct.

7.2.4.3 Relieve the pressure and record the dial indicator readings.

Exception to 7.2.4.3: Sections 7.2.4.1 through 7.2.4.3 are not required if the test described in Section 7.1 (deflection under pressure) is conducted prior to this test.

7.2.4.4 Apply loads and pressurize the test specimen to the specified pressure for at least 5 min. Record the dial indicator readings and examine the duct.

7.2.4.5 Relieve the pressure, remove loads, and record the dial indicator readings.

7.2.4.6 Pressurize the test specimen to the specified pressure for at least 5 min. Record the dial indicator readings and examine the duct.

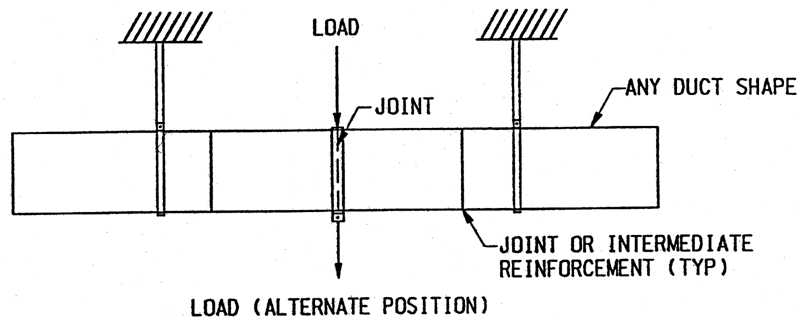
7.2.4.7 Repeat the test if other pressures and/or loadings are specified.

7.2.5 Test Data and Observations

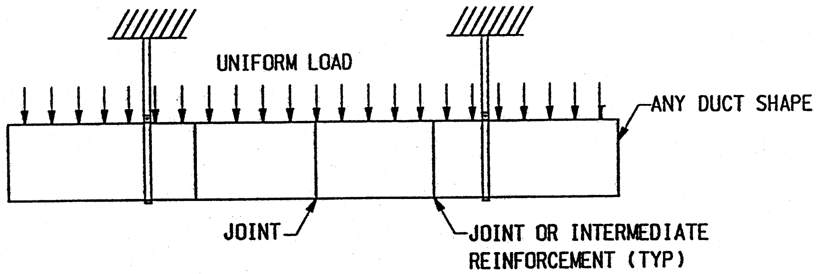
7.2.5.1 Make a drawing of the test specimen, including supports and superimposed loads, and show deflection measurement points with each point correlated to the data recorded.

7.2.5.2 Record the instrumentation used.

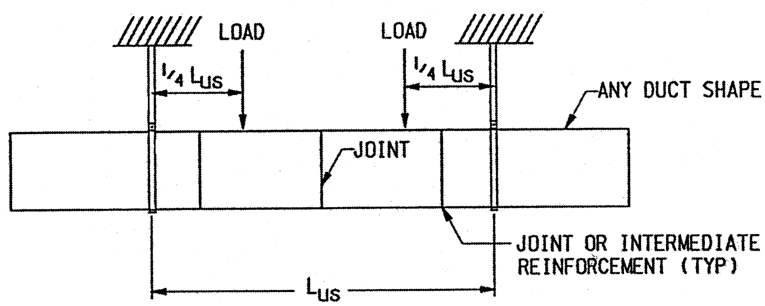
7.2.5.3 Record all dial indicator readings and leakage rates when a leakage test is conducted.



a. External Concentrated Load



b. Exterior Uniform Load



c. Simulated Uniform Loading

Figure 4 Test specimen loading.

7.2.5.4 Record any joint or seam separation, loss of seals, buckling, fastener release, permanent set, or other anomalies observed.

7.2.6 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

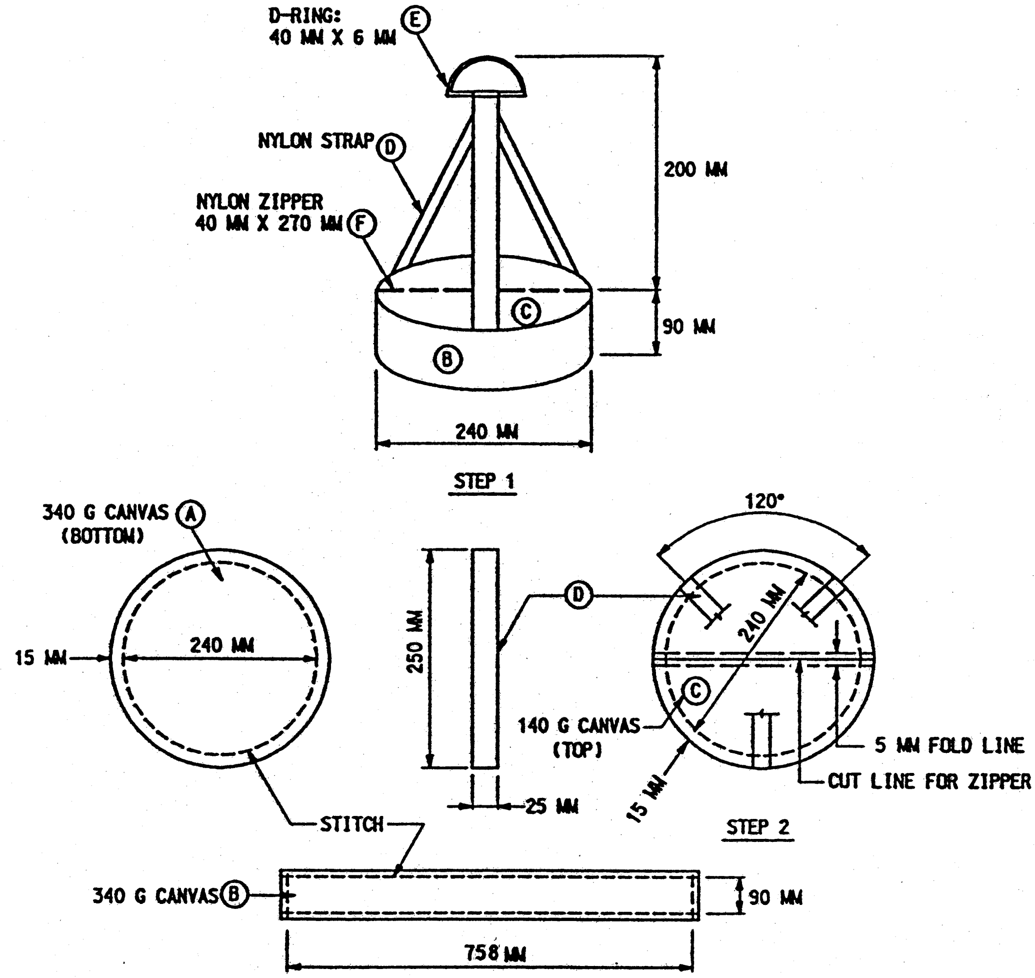
Informative Note: See Informative Annex C, Section C2.

7.3 Impact Test

7.3.1 Test Specimen

7.3.1.1 The duct assembly shall have two sections with one transverse joint when the section length exceeds seven times the height or diameter of the duct; otherwise, the test specimen shall have three sections. The length of each section shall be specified by the sponsor.

7.3.1.2 Three specimen assemblies are required for the impact test.



1. Cut piece A, B, and C from cavas material.
2. Sew piece B end-to-end with 15 mm seam overlap.
3. Sew piece A to piece B as shown with 15 mm seam allowance each piece.
4. Cut piece C on the centerline, fold 5 mm each half and sew zipper as shown.
5. Sew nylon straps to piece C, 120º 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 strap ends to the D-ring leaving 200 mm length from top of D-ring to top of bag measured perpendicularly.

Figure 5 Sandbag details.
Reproduced with permission of Underwriters Laboratories, Inc. [4]

7.3.2 Test Setup

7.3.2.1 The impact test shall be performed on the specimen assembly supported by a stationary, rigid, and flat surface. Fix the specimen assembly to the stationary support by tape.

7.3.2.2 The impact shall be imposed from a free-falling sandbag released by a mechanism that does not cause lateral motion or rotation. The sandbag shall be a 340 g canvas bag fabricated in accordance with Figure 5. The bag shall be filled with 6.8 kg of clean sand.

7.3.2.3 The sandbag drop distance, measured from the highest point on the duct to the bottom of the sandbag, shall be specified by the sponsor.

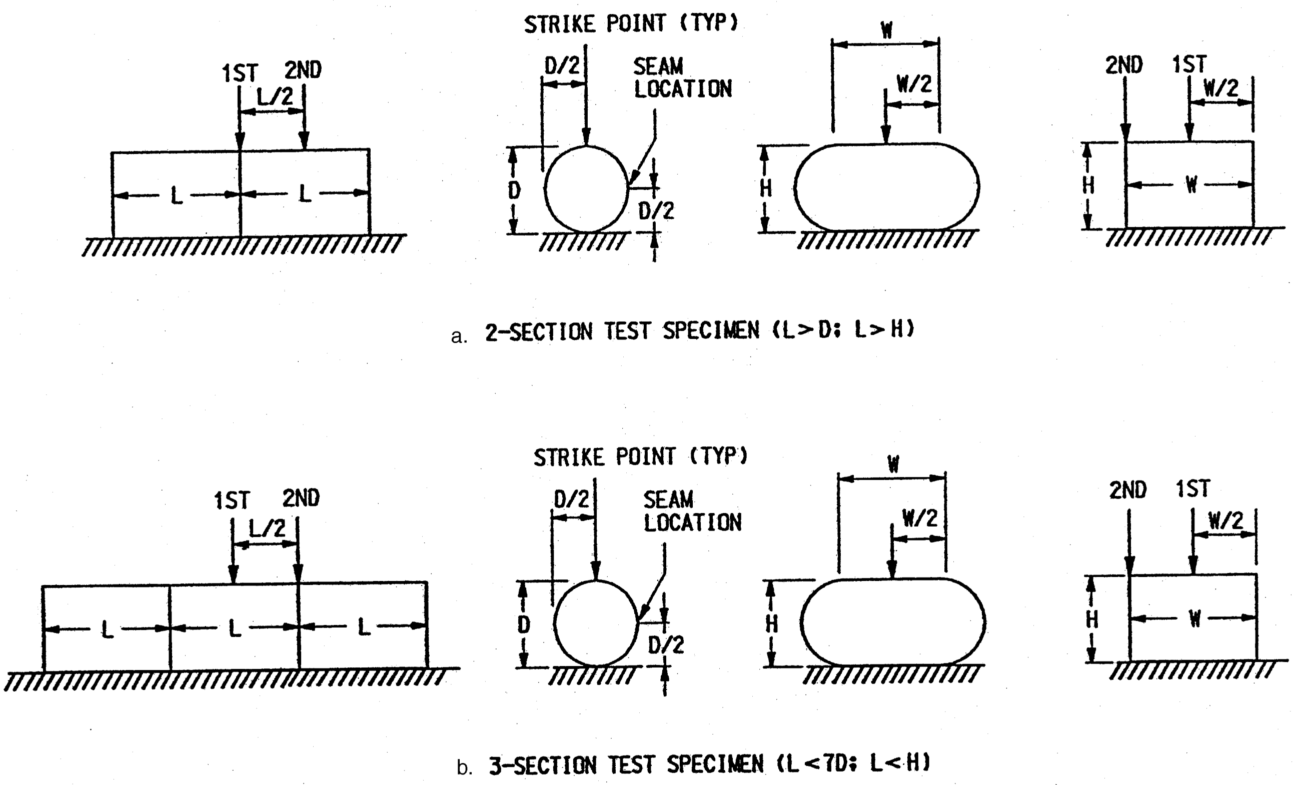


Figure 6 Test specimen impact configurations and strike points.

7.3.3 Test Procedure

7.3.3.1 For standard duct shapes, the points of impact shall be in compliance with the locations shown in Figure 6. For ducts of other shapes, the strike points shall be the most vulnerable to damage under the conditions of the test. Flexible specimens shall be stretched to their maximum length and retained in that position by tape.

7.3.3.2 Prior to a test, the sandbag shall be flattened by dropping it from a height of at least 400 mm onto a flat surface.

7.3.3.3 Release the sandbag over each strike point. Strike points are not required to be at longitudinal seams. Allow the sandbag to come to rest on the duct, then remove it. If the tape used to restrain the test specimen breaks loose during impact, the test is still considered valid.

7.3.3.4 Repeat this test for other test specimens.

7.3.4 Test Data and Observations

7.3.4.1 Record the mass of the sandbag and the free-fall distance of the sandbag from the top of the duct to the bottom of the sandbag.

7.3.4.2 Record the duct specimen details and the sandbag strike points.

7.3.4.3 Record any changes in dimensions, damage (tears, joint and seam separations, indentations, openings, splits), and other anomalies observed.

7.3.4.4 Record the leakage rates when a leakage test is conducted.

7.3.4.5 Calculate and record the reduction in a cross-sectional area of each specimen and the average reduction in a cross-sectional area for the three tests. The percent reduction (PR) in the cross-sectional area shall be calculated by Equation 5, where A_i and A_f are the initial and final areas.

$$PR = [(A_i - A_f)/A_i] \times 100 \qquad (5)$$

7.3.5 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C3.

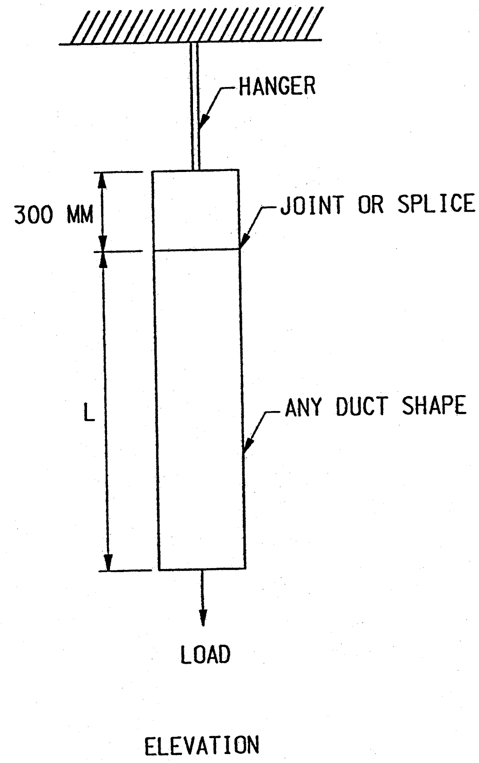


Figure 7 Tension test setup.

7.4 Tension Test

7.4.1 Test Specimen

7.4.1.1 The duct assembly for the test shall have a field splice or transverse joint and be in compliance with Figure 7. The minimum overall length of the assembly shall be one-half the intended distance between vertical supports.

7.4.1.2 The field splice or transverse joint shall be specified by the sponsor.

7.4.2 Test Setup and Test Procedure

7.4.2.1 The test setup shall be in compliance with Figure 7. Secure one end of the duct to an overhead support. Attach a load-distributing clamp, ring, or end cap securely to the lower end of the duct. Use the end cap if a leakage test is to be conducted.

Informative Note: This test is not intended to evaluate the load attachment method or the end caps.

7.4.2.2 The mass attached to the vertical duct shown in Figure 7 shall be the mass of the duct assembly or 3.6 kg mass per 100 mm of duct perimeter, whichever is greater.

7.4.2.3 The duration of the test shall be at least 24 hours.

7.4.3 Test Data and Observations

7.4.3.1 Record the instrumentation used.

7.4.3.2 Record the duct specimen details.

7.4.3.3 Record any joint or seam separation, tears, splits, breaks, loss of seals, fastener release, or any other anomalies observed.

7.4.3.4 Record any displacement of joining materials, such as tapes, in excess of 4 mm from their initial position, disregarding movement due to slack or stretch that does not produce a separation of materials.

7.4.3.5 Record the leakage rates when a leakage test is conducted.

7.4.4 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C4.

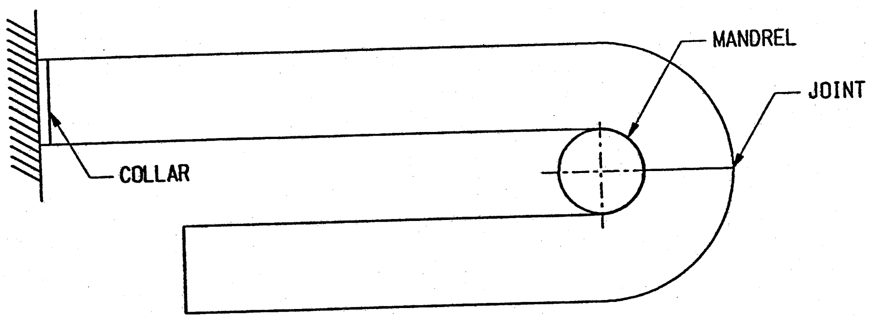


Figure 8 Bend test setup.

7.5 Bending Test

7.5.1 Test Specimen

7.5.1.1 Two specimens are required: one without a transverse joint and the other with a transverse joint.

7.5.1.2 The length of the single duct and each length of the multiple-section duct shall be a minimum of 2.4 m. The transverse joint shall be specified by the sponsor.

7.5.2 Test Setup

7.5.2.1 Both ends of the test assembly shall have collars or end caps. One end of the duct shall be rigidly fixed and oriented with its centerline perpendicular to the mandrel. The mandrel diameter shall be the same as the nominal diameter or depth of the duct (see Figure 8).

7.5.2.2 For the multiple-section test specimen, the transverse joint shall be located at the mandrel as shown in Figure 8.

7.5.2.3 The distance between the mandrel and the fixed end shall be such that the duct is fully extended.

7.5.3 Test Procedure

7.5.3.1 This test shall be conducted on both test specimens.

7.5.3.2 Bend the sample through a 180-degree arc around the mandrel. Hold the bend for 30 seconds. Return the test specimen to its original position.

7.5.3.3 Repeat the process described in Section 7.5.3.2 five times, and each time the sample is to be returned to its original position.

7.5.3.4 Remove the duct and determine the diametrical changes in the flow cross-sectional area.

7.5.4 Test Data and Observations

7.5.4.1 Make a drawing of the test setup.

7.5.4.2 Record the instrumentation used.

7.5.4.3 Record the duct specimen details.

7.5.4.4 Record any joint or seam separation, tears, splits, buckling, breaks, fastener release, or other anomalies observed.

7.5.4.5 Record the diametrical changes in the flow cross-sectional area of the duct specimen.

7.5.4.6 Record the leakage rates when a leakage test is conducted.

7.5.5 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C5.

7.6 Pressure Cycling Test

7.6.1 Test Specimen. The test assembly shall be specified by the sponsor. The ends of the duct assembly shall have sealed end caps.

7.6.2 Test Pressure. The sponsor shall specify the test pressures.

7.6.3 Test Setup. A system consisting of a fan, dampers, cycle counter, and pressure indicator shall be arranged to switch damper positions while the fan is in continuous operation. When the damper is open, the sample duct shall be at the sponsor's specified pressure. When the damper is closed, the pressure in the sample duct shall be vented to ambient through a second damper.

7.6.4 Test Procedure

7.6.4.1 Pressure cycling tests shall be conducted for the positive and/or negative pressures specified by the sponsor.

7.6.4.2 Connect the test apparatus to the test specimen at ambient conditions and energize the fan.

7.6.4.3 Cycle the damper to increase and decrease the pressure from ambient to the test pressure. The number of cycles shall be specified by the sponsor; however, the number of cycles shall not be less than 20,000.

Informative Note: The test may be interrupted to reseal the end caps if necessary.

7.6.4.4 Stop the fan and remove the fan system.

7.6.4.5 Inspect the test specimen for anomalies.

7.6.4.6 Whenever more than one test pressure is specified, repeat this test on a new test specimen (one for each pressure that is specified).

7.6.5 Test Data and Observations

7.6.5.1 Make a drawing of the test setup.

7.6.5.2 Record the instrumentation used.

7.6.5.3 Record the duct specimen details.

7.6.5.4 Record the test pressure, cycles completed, cycle rate, and ambient pressure.

7.6.5.5 Record any failures, degradation, or anomalies that are observed.

7.6.5.6 Record the leakage rates when a leakage test is conducted.

7.6.6 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C6.

7.7 Burst/Collapse Test

7.7.1 Test Specimen. The test assembly shall be specified by the sponsor. The ends of the duct assembly shall have end caps.

7.7.2 Test Pressure. The test pressures shall be specified by the sponsor.

7.7.3 Test Setup

7.7.3.1 Pressure taps shall be provided in the end caps, using one end for the pressure source and the other end for a pressure indicator.

7.7.3.2 For a flexible duct, the ends shall be attached to a stationary fixture. The distance between fixtures shall be such that the duct is fully extended.

7.7.4 Test Procedure

7.7.4.1 When more than one test pressure is specified by the sponsor, the tests shall be conducted in an increasing-pressure sequence.

7.7.4.2 Gradually increase the test pressure to the specified pressure and hold for one hour. Maintain pressure for the duration of the test.

7.7.4.3 Repeat the test as many times as necessary when more than one pressure is specified by the sponsor.

7.7.5 Test Data and Observations

7.7.5.1 Make a drawing of the test setup.

7.7.5.2 Record the instrumentation used.

7.7.5.3 Record the duct specimen details.

7.7.5.4 Record the history of all test pressures during the test period.

7.7.5.5 Record any anomalies.

7.7.5.6 The positive and/or negative pressure at which the duct surface, seams, or joints fail shall be recorded.

7.7.5.7 Record leakage rates when a leakage test is conducted.

7.7.6 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C7.

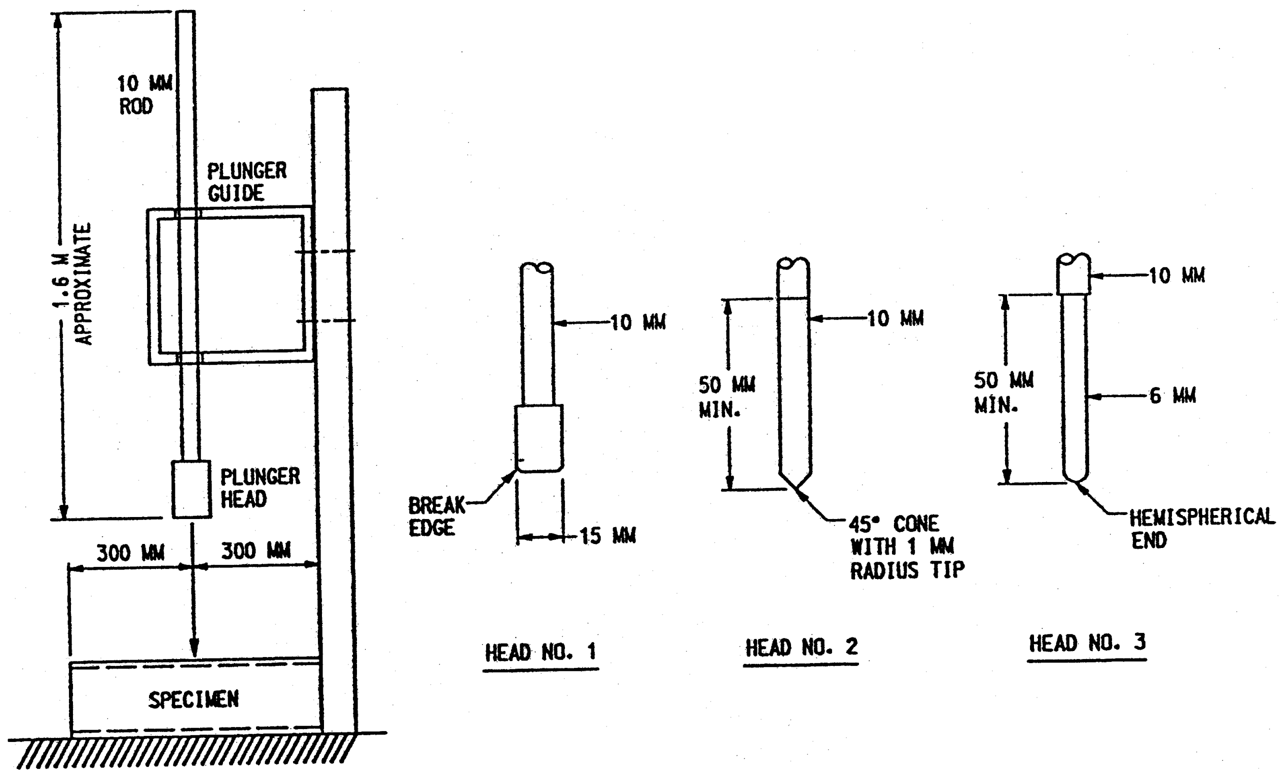


Figure 9 Puncture test apparatus.

7.8 Puncture Test

7.8.1 Test Specimen. The duct test specimen shall be 600 mm in length with raw, open ends.

7.8.2 Test Apparatus

7.8.2.1 The test apparatus shall provide for the free fall of a steel rod plunger onto the surface of a duct test sample (see Figure 9). The plunger, including the head, shall weigh 1 kg minimum and drop at least 500 mm (test duct height not included) with the plunger guides imposing a minimum resistance on the falling plunger. The test specimen shall be firmly supported on a flat surface throughout its length and width (see Figure 9 for plunger strike locations).

7.8.2.2 The plunger shall be outfitted with a flat, conical, or hemispherical head in accordance with Figure 9. All surfaces of the rod and impact head shall be smooth.

7.8.2.3 The test apparatus shall include a means to measure the distance the impact head falls.

7.8.2.4 When the natural sag in the duct wall exceeds 15 mm, the duct shall be braced internally as near to the duct ends as possible.

7.8.2.5 Flexible ducts shall be held in place by tension.

7.8.3 Test Procedure

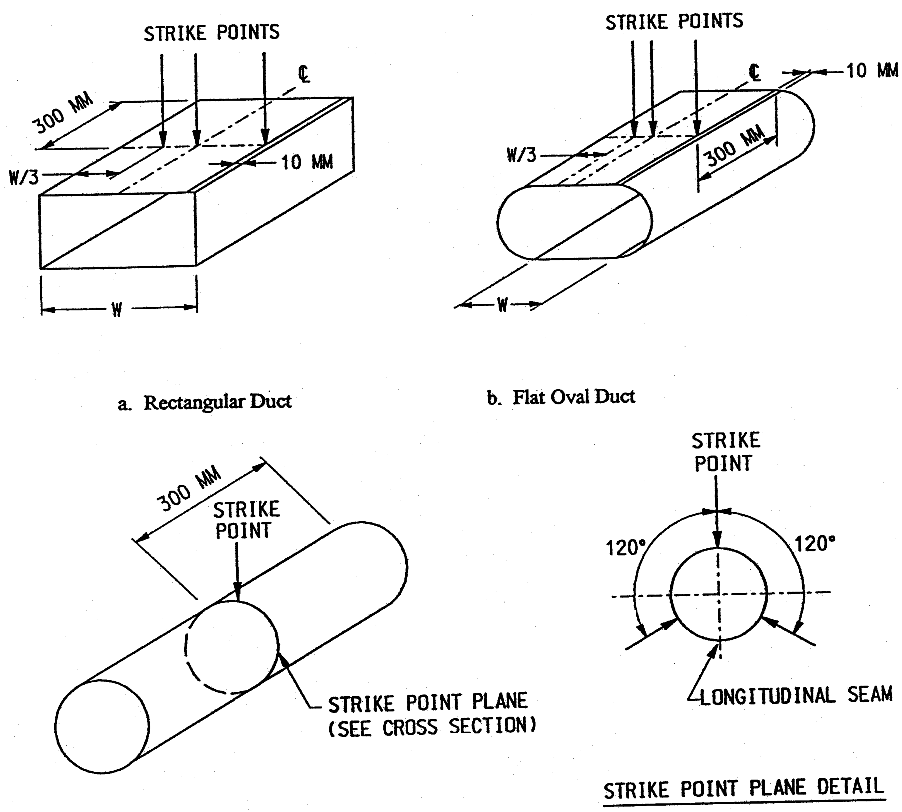
7.8.3.1 Prepare the test setup with a plunger specified by the sponsor.

7.8.3.2 For ducts that have fibrous, granular, or powder materials in the wall composition, place a clean sheet of plastic in the bottom of the duct to collect particles that are released as a result of impact.

7.8.3.3 Drop the plunger from the specified height. The plunger strike points shall be in compliance with Figure 10. For duct shapes other than round, rectangular, and flat oval, the sponsor shall specify the strike points.

Exceptions to 7.8.3.3:

1. Whenever the strike point is between the center of a rectangular or flat oval duct and the edge of the duct is less than 150 mm, the edge test is not required to be conducted.



a. Rectangular Duct

b. Flat Oval Duct

c. Round Duct

Figure 10 Puncture test specimen strike-point locations.

2. Whenever the strike point is between the center of a rectangular or flat oval duct and *W*/3 is less than 150 mm (see Figure 10), the *W*/3 strike-point test is not required to be conducted.
3. Whenever the duct is so small that only one drop test occurs (in accordance with Section 7.8.3.3), reposition the duct by rotating it 180 degrees (by placing the bottom surface on the top) and repeat the plunger test.

7.8.4 Test Data and Observations

7.8.4.1 Make a drawing of the test setup.

7.8.4.2 Record the instrumentation used.

7.8.4.3 Record the duct specimen details.

7.8.4.4 Record the size of specimens, location of strike points, proximity of any strike point to any reinforcement used in the specimen test assembly, weight of the plunger, head shape, and height from which plunger was dropped.

7.8.4.5 Record any anomalies observed and the following:

a. Any complete puncture (penetration) of the duct wall
b. Any rupture, split, tear, or penetration of an outer layer of a tape closure and of the surface layer of a composite duct wall
c. Any indentation not involving puncture or rupture (described in terms of depth or multiples of wall thickness)
d. Any particles collected
e. Any other visible signs of damage

7.8.5 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C8.

8. DURABILITY TESTS

8.1 General. The temperature and relative humidity tests shall be conducted sequentially using the same specimen.

8.2 Temperature Test

8.2.1 Test Specimen. The test duct assembly shall have two sections with one joint. The length of each duct section shall be at least 600 mm. The duct sealant and method of joint closure shall be specified by the sponsor.

8.2.2 Test Setup. Two chambers meeting the following criteria are required:

a. They are of sufficient size to enclose the test sample and are designed to allow quick transfer of the test specimen from one chamber to the other.
b. One chamber shall be able to maintain a temperature of 75°C ± 2°C and the other a temperature of –20°C ± 2°C.

8.2.3 Test Procedure

8.2.3.1 Place the test duct in a chamber that has been preheated to 75°C ± 2°C and maintain it at this temperature for four hours.

8.2.3.2 Quickly (within five minutes) move the test duct to the other test chamber that has been precooled to –20°C ± 2°C and maintain it at this temperature for four hours.

8.2.3.3 Quickly move the test duct to the first chamber, which has been kept at 75°C ± 2°C, and maintain it at this temperature for four hours.

8.2.3.4 Repeat the procedure described in Sections 8.2.3.2 and 8.2.3.3.

8.2.3.5 Remove the test duct from the chamber and allow it to cool to room temperature.

8.2.4 Test Data and Observations

8.2.4.1 Make a drawing of the test setup.

8.2.4.2 Record the instrumentation used.

8.2.4.3 Record the duct specimen details.

8.2.4.4 Record the test durations and temperatures.

8.2.4.5 Record any split, joint, or seam separation as well as any loss of sealant adhesion or other anomalies.

8.2.4.6 Record the leakage rates when a leakage test is conducted.

8.2.5 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C9.

8.3 Humidity Test

8.3.1 Test Specimen. The test duct assembly shall be the same as that used for the temperature test.

8.3.2 Test Setup. A humidity chamber is required that is of sufficient size to enclose the test specimen and maintain a temperature of 55°C and 90% relative humidity (RH).

8.3.3 Test Procedure

8.3.3.1 Place the test duct into the humidity chamber and ramp up the chamber temperature and RH from ambient conditions to 55°C ± 2°C and 90% RH minimum during a two-hour period. Maintain 55°C and 90% RH minimum for six hours. Relative humidity (φ) shall be calculated by Equation 6, where p_e and p_p are calculated by Equations 2 and 3.

$$\varphi = (p_p/p_e) \times 100 \tag{6}$$

8.3.3.2 During the next eight hours, ramp the temperature and relative humidity down to 25°C and 80% RH.

8.3.3.3 Repeat the procedures described in Sections 8.3.3.1 and 8.3.3.2 two more times.

8.3.3.4 Remove the test specimen from the chamber and allow it to stand for four hours to reach room temperature.

8.3.4 Test Data and Observations

8.3.4.1 Make a drawing of the test setup.

8.3.4.2 Record the instrumentation used.

8.3.4.3 Record the duct specimen details.

8.3.4.4 Record the test durations, coincident dry- and wet-bulb temperatures, and leakage rates when a leakage test is conducted.

8.3.4.5 Record any split, joint, or seam separation as well as any loss of sealant adhesion or other anomalies.

8.3.5 Compliance. The duct test specimen shall meet nationally accepted or other sanctioned criteria for compliance.

Informative Note: See Informative Annex C, Section C10.

9. REPORT

The report shall include, at a minimum, the following:

a. Laboratory, identified by name and location
b. Identification of the test sponsor
c. Date of report
d. Test plan with the sequence of tests specified by the sponsor
e. Test results as follows:
    1. Type of test, including the applicable section number of this standard
    2. Description of the test setup, including the instrumentation
    3. Description, including details, of test specimens
    4. Test results, including data and a description of anomalies
    5. Description of any deviations from this standard
f. Signature of laboratory representative

10. REFERENCES

1. ASHRAE. 2013. ANSI/ASHRAE Standard 41.1, *Standard Methods for Temperature Measurement*. Atlanta: ASHRAE.
2. ASHRAE. 2014. ANSI/ASHRAE Standard 41.6, *Standard Method for Humidity Measurement.* Atlanta: ASHRAE.
3. ASHRAE. 2014. ASHRAE Standard 41.3, *Standard Methods for Pressure Measurement*. Atlanta: ASHRAE.
4. UL. 2013. ANSI/UL Standard 181, *Factory-Made Air Ducts and Air Connectors*, 11th ed., Figure 17.1, p. 29. Northbrook, IL: Underwriter's Laboratory.

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INFORMATIVE ANNEX A
COMMENTARY

Structural testing determines the strength of a duct assembly under internal and external loading. Leakage tests are conducted to evaluate containment of flow and to determine the effect of individual tests or a series of tests. Deflection under pressure simulates the internal pressure loading on an installed HVAC system. Deflection under superimposed loads determines the resistance of a duct assembly to deflect due to insulation, a snow load, and other types of superimposed loads. The impact test evaluates the tendency of ducts to tear, separate, and distort when subjected to forces simulating incidental contact. Tension tests for rigid ducts determine some of the effects of duct risers and their supports. This test series does not include strain measurements and does not require stress calculations. However, the tension tests are significant indicators of serviceability and safety factors.

Flexible duct tension tests determine the effect of stretching flexible ducts, while bending determines the durability of flexible ducts. The pressure cycling test simulates duct pressure modulation due to systems starting and stopping. The burst/collapse test determines the ability of the duct to resist complete failure under positive and/or negative pressures. The puncture test determines the ability of the test duct to remain functional when struck by objects.

Durability testing determines the effects of subjecting a duct test sample to conditions that simulate aging. The temperature test is designed to create stresses within the test sample caused by expansion and contraction, while the humidity test is designed to create a heavy condensate that will corrode the test sample as though it has seen several years of service. The tests and test setups relate primarily to straight sections of duct. Tests and test setups may be adapted by the sponsor for evaluation of the duct fittings.

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INFORMATIVE ANNEX B
LEAKAGE TEST SETUPS AND EXAMPLE PROBLEM

B1. LEAKAGE TEST SETUPS

B1.1 Laminar Flow Test Setup[B-1]

B1.1.1 Test setups may be as shown in Figure B-1 for positive pressure tests and as shown in Figure B-2 for negative pressure tests.

B1.1.2 The number and capacity of blowers shall be selected to maintain the required positive and negative test pressures. Blowers may be operated individually or in combination at full or reduced speed using variable frequency or voltage control. A bleed valve may be installed in the fan/ flowmeter manifold for flow adjustment.

B1.1.3 Laminar flowmeters with ranges to measure leakage individually shall be provided. A micromanometer may be used to measure the pressure differential across the laminar flow element.

B1.2 Orifice Tube Test Setup

B1.2.1 The test setup may be in conformance with Figure B-3.

B1.2.2 The orifice tube assembly shall be calibrated against an orifice plate, nozzle, or venturi tube that is in compliance with *ISO Standard 5167-1, Measurement of Fluid Flow by Means of Pressure Differential Devices—Part 1: Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-section Conduits Running Full*,[B-2] or a device traceable to NIST.

B2. EXAMPLE PROBLEM

B2.1 Recorded Test Data

Q_a	5.093 L/s
Test Pressure	0.750 kPa
t_o	21.7°C
t'_o	13.3°C
p_b	97.63 kPa

B2.2 Atmospheric Air Density Calculation

From Equation 2:

$$p_e = (0.00325)(13.3^2) + (0.0186)(13.3) + 0.692 = 1.514 \text{ kPa}$$

From Equation 3:

$$p_p = 1.514 - 97.63\ [(21.7 - 13.3)/1500] = 0.968 \text{ kPa}$$

From Equation 4:

$$\rho_o = \frac{97.63 - 0.378(0.968)}{0.287(21.7 + 273.2)} = 1.149 \text{ kPa}$$

B2.3 The measured leakage rate (Q_a) determined by a laminar flowmeter is 5.093 L/s at 0.750 kPa. The leakage rate referenced to standard air density is 4.86 L/s, calculated as follows:

From Equation 1:

$$Q_s = 5.093\left(\frac{1.149}{1.204}\right) = 4.86 \text{ kPa}$$

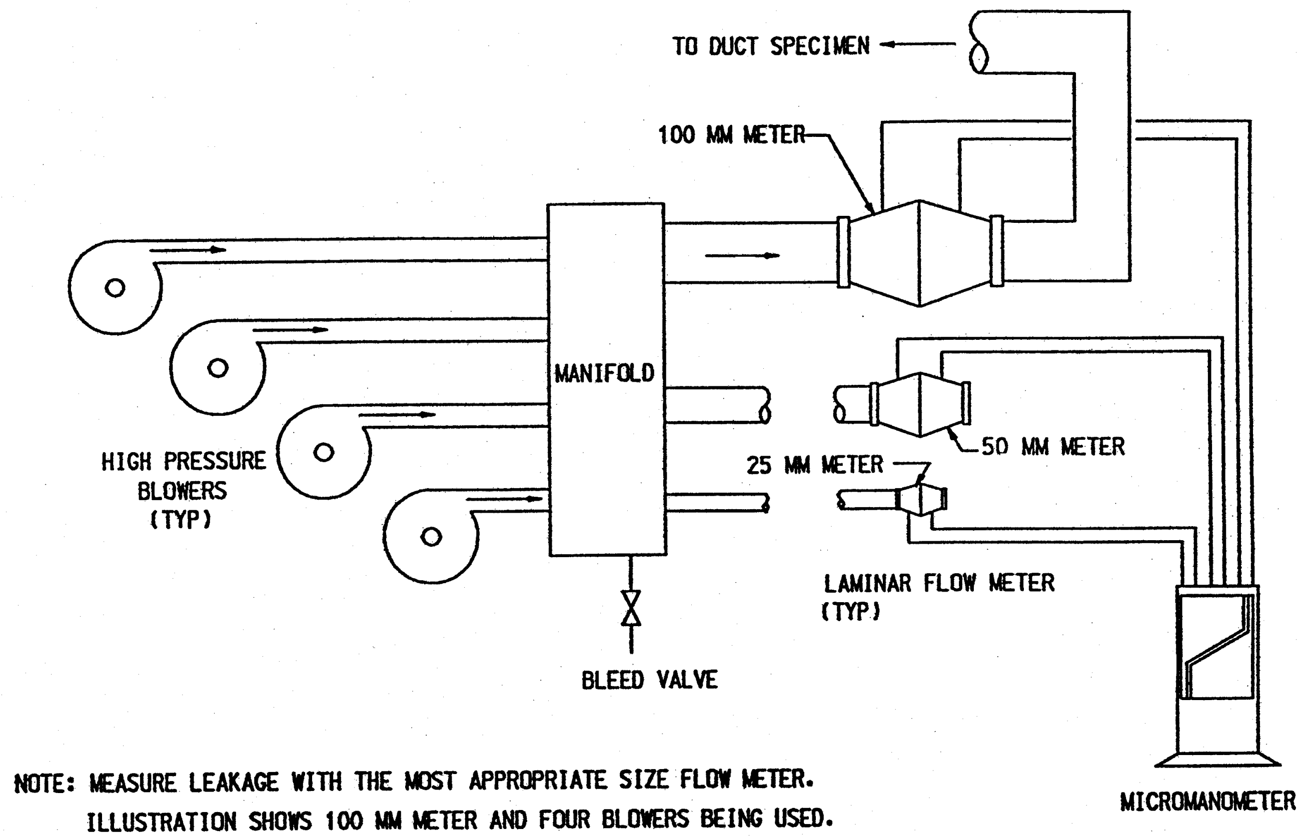

Figure B-1 Example of leakage measurement by a laminar flow system for positive pressure tests.

B3. REFERENCES FOR ANNEX B

B-1. Swim, W.B., and E.I. Griggs. 1995. Duct leakage measurement and analysis. *ASHRAE Transactions* 101(1).

B-2. ISO 2003. ISO 5167-1, *Measurement of Fluid Flow by Means of Pressure Differential Devices—Part 1: Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular Cross-section Conduits Running Full*. New York: International Organization for Standardization.

B4. BIBLIOGRAPHY FOR ANNEX B

ASHRAE. 1985. Investigation of Duct Leakage. Final Report of RP-308. Atlanta: ASHRAE.

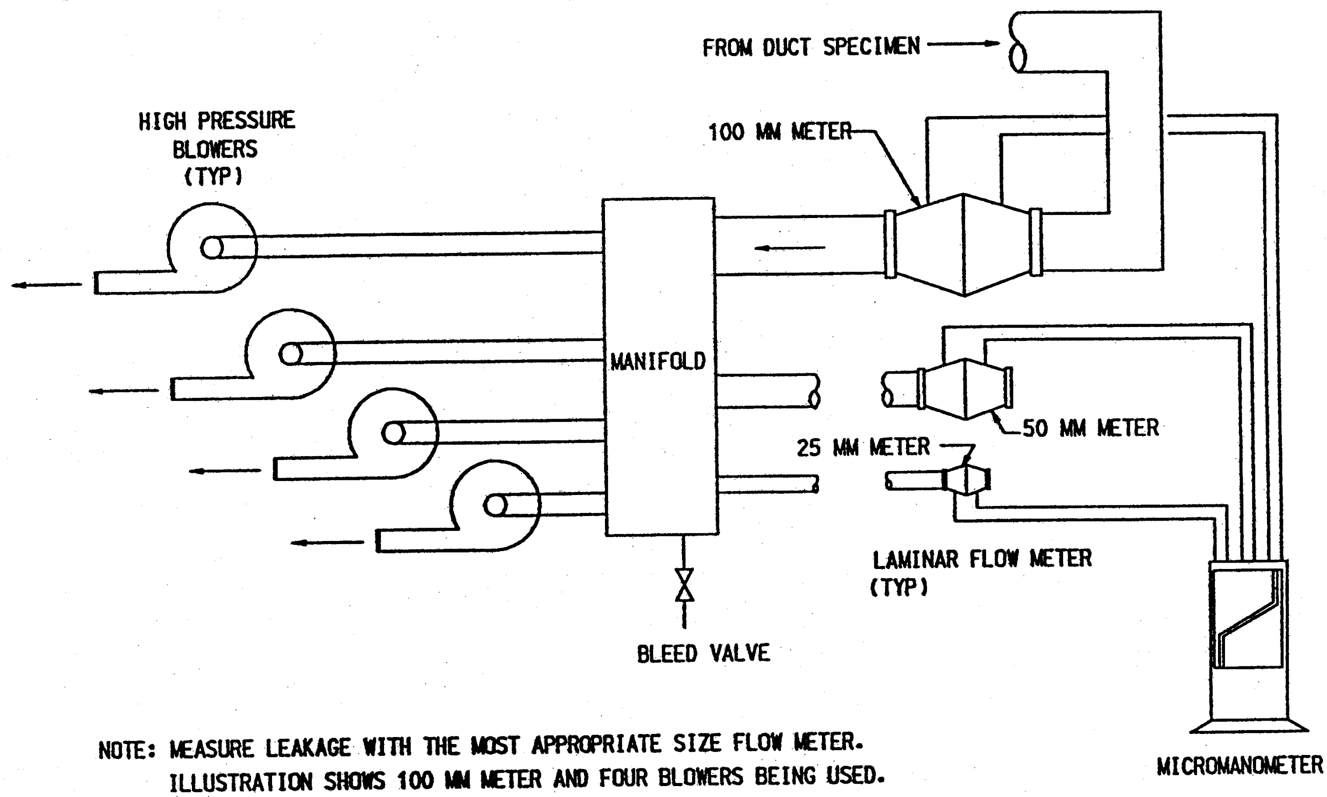

Figure B-2 Example of leakage measurement by a laminar flow system for negative pressure tests.

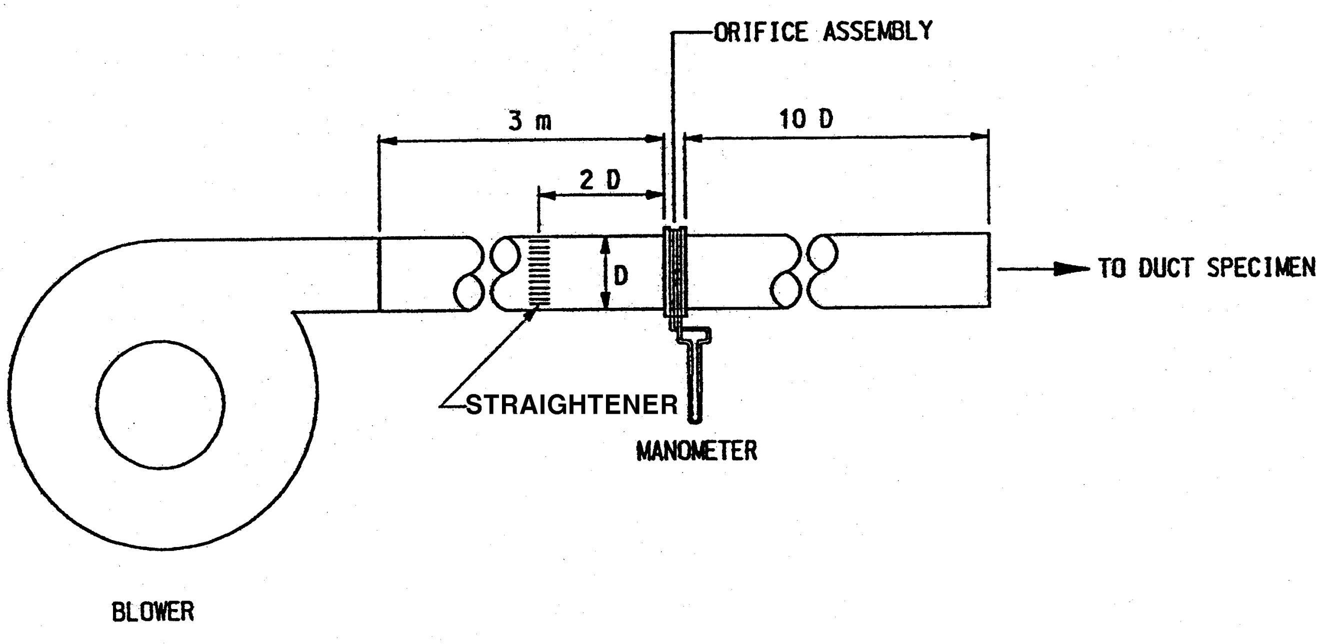

Figure B-3 Example of leakage measurement by an orifice tube system for positive pressure tests.

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INFORMATIVE ANNEX C
RECOMMENDED ACCEPTANCE CRITERIA

Standard 126 does not include product acceptance criteria. Test conditions must be specified by the sponsoring agency and/or the code official. Each of the following sections of Annex C provides recommendations or list reference standards that may be used as one source of acceptance criteria for the test indicated. The number in parenthesis corresponds to the section in this standard to which the item relates.

C1. DEFLECTION UNDER PRESSURE (7.1)

ANSI/SMACNA *HVAC Duct Construction Standards—Metal and Flexible*, 3d ed. (2005); *Duct Performance Test Standard No. DPTS-2005*, Sections 3.2, 3.3, and 3.4 (p. 11.6).

C2. DEFLECTION UNDER SUPERIMPOSED LOADS (7.2)

ANSI/SMACNA *HVAC Duct Construction Standards—Metal and Flexible*, 3d ed. (2005); *Duct Performance Test Standard No. DPTS-2005*, Sections 3.2, 3.3, and 3.4 (p. 11.6).

C3. IMPACT (7.3)

The test specimen should not tear, split, collapse, or have any joint or seam separation. There should be no evidence of other damage to the test specimen that would cause it to be unusable. *Collapse* is defined as an average internal cross-sectional area reduction in excess of 20% or any individual reduction in cross-sectional area in excess of 25%.

C4. TENSION (7.4)

The test specimen should not tear, split, or have any joint or seam separation. There should be no evidence of other damage to the test specimen that would cause it to be unusable.

C5. BENDING (7.5)

The test specimen should not tear, split, buckle, or have any joint or seam separation. There should be no evidence of other damage to the test specimen that would cause it to be unusable.

C6. PRESSURE CYCLING (7.6)

The test specimen should not tear or have any joint or seam separation. There should be no evidence of other damage to the test specimen that would cause it to be unusable.

C7. BURST/COLLAPSE (7.7)

ANSI/SMACNA *HVAC Duct Construction Standards—Metal and Flexible*, 3d ed. (2005); *Duct Performance Test Standard No. DPTS-2005*, Section 3.1 (p. 11.6).

C8. PUNCTURE (7.8)

The duct specimen should not be punctured when tested in accordance with this standard.

C9. TEMPERATURE (8.2)

Materials for ducts, including sealants and tapes, should be resistant to the effects of temperature to which they were exposed in the test conducted in compliance with this standard. There should be no evidence of damage to the test specimen that would cause it to be unusable.

C10. HUMIDITY (8.3)

Materials for ducts, including sealants and tapes, should be resistant to the effects of humidity to which they were exposed in the test conducted in compliance with this standard. There should be no evidence of damage to the test specimen that would cause it to be unusable.

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INFORMATIVE ANNEX D
BIBLIOGRAPHY

ADC. 2010. *Flexible Duct Performance and Installation Standards*, 5th Edition. Schaumburg, IL: Air Diffusion Council.

NAIMA. 2002. *Fibrous Glass Duct Construction Standards (Low Velocity Systems 2 Inches [500 Pa] Maximum Static Pressure*, 5th Edition. Alexandria, VA: North American Insulation Manufacturers Association.

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UL. 2013. ANSI/UL 181A, *Closure Systems for Use with Rigid Air Ducts and Air Connectors*, 4th Edition. Northbrook, IL: Underwriters Laboratories.

UL. 2013. ANSI/UL 181B, *Closure Systems for Use with Flexible Air Ducts and Air Connectors*, 3rd Edition. Northbrook, IL: Underwriters Laboratories

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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