UL 641

STANDARD FOR SAFETY

Type L Low-Temperature Venting Systems

UL Standard for Safety for Type L Low-Temperature Venting Systems, UL 641

Eighth Edition, Dated September 21, 2010

Summary of Topics

This revision of ANSI/UL 641 is being issued to reaffirm approval as an American National Standard. No changes in requirements are involved.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated February 9, 2018

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

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UL 641

Standard for Type L Low-Temperature Venting Systems

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The most recent designation of ANSI/UL 641 as a Reaffirmed American National Standard (ANS) occurred on April 23, 2018. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

No Text on This Page

CONTENTS

INTRODUCTION

CONSTRUCTION

PERFORMANCE

MARKINGS

INSTRUCTIONS

INTRODUCTION

1 Scope

1.1 These requirements cover factory-built vent piping and fittings constructed to provide venting systems for use with gas and liquid fuel-burning appliances that exhaust low-temperature flue gases and that are approved for use with Type L venting systems.

1.2 The Type L low-temperature venting systems covered by these requirments are intended for installation in accordance with the National Fire Protection Association Standard for Chimneys, Fireplaces, Vents, and Solid-Fuel Burning Appliances, NFPA 211, the International Mechanical Code, and the Uniform Mechanical Code.

1.3 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.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2 A component is not required to 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.

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

2.4 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.

3 Units of Measurement

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

4 Glossary

4.1 For the purpose of this standard, the following definitions apply.

4.2 COMBUSTIBLE MATERIAL – Material made of or surfaced with wood, compressed paper, plant fibers, or other material that ignites and burns, as applied to materials adjacent to or in contact with heat-producing appliances, chimney connectors and vent connectors, steam and hot water pipes, and warm air ducts. Such material shall be identified as combustible even though flameproofed, fire-retardant treated, or plastered.

4.3 NONCOMBUSTIBLE MATERIAL – A material that, in the form in which it is used and under the conditions anticipated, does not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.

4.4 TYPE L VENTING SYSTEM – A passageway, vertical or nearly so, used for conveying flue gases from oil and gas appliances or their vent connectors to the outside atmosphere.

CONSTRUCTION

5 Materials

5.1 A venting system part shall be made of noncombustible corrosion-resistant materials. Metals shall not be used in combinations at any location within the assembly that causes detrimental galvanic action.

5.2 The minimum thickness of sheet metal, including any coatings, shall be as specified in Table 5.1.

Table 5.1
Minimum metal thickness

Metal	Inch	(mm)
Aluminum alloys (1100, 3003)	0.016	(0.41)
Steel (uncoated or painted)	0.042	(1.07)
Galvanized steel (G-90 coating class)	0.018	(0.46)
Aluminum-coated steel Type T1-40 (regular) [0.40 ounce per square foot (0.12 kg/m^2)]	0.018	(0.46)
Stainless steel	0.012	(0.30)

5.3 Aluminum alloys containing more than 1.0 percent magnesium shall not be used when the reflectivity of the material is employed to reduce the risk of fire.

5.4 A flue-gas conveying conduit shall be of cast refractory or clay tile [minimum thickness 0.400 inch (10.2 mm)], porcelain-coated steel-base metal [minimum thickness 0.026 inch (0.66 mm)], or Series 300 or Types 430 and 446 stainless steels [minimum thickness 0.012 inch (0.30 mm)]. Cast refractory, clay tile, and porcelain-coated steel shall comply with the requirements specified in Section 26, Crushing Test of Nonmetallic Flue-Gas Conduit; Section 27, Resistance to Action of Acids Test of Nonmetallic Flue-Gas Conduit; Section 28, Freezing and Thawing Test of Water-Absorptive Nonmetallic Materials; and Section

29, Cemented Joint Test of Flue-Gas Conduit. Flue-gas conveying conduit of porcelain-coated steel shall also comply with the requirements specified in Section 30, Sulfuric Acid Extraction Test for Porcelain-Coated Steel Used for Flue-Gas Conduit.

5.5 Other parts subject to contact by flue-gases or flue-gas air mixtures at locations beyond the terminus of the flue-gas-conveying conduit, or subject to condensation, shall be of stainless steel Series 300 or Types 430 and 446 or the equivalent.

5.6 An outer casing or other structural part:

a) Whose deterioration or corrosion causes the venting system to collapse or otherwise increase the risk of injury to persons;

b) That adjoins firestopping material; or

c) Is subject to condensation;

shall be of stainless steel, galvanized steel, or aluminum-coated steel. Galvanized steel or aluminum-coated steel shall comply with the requirements of 5.7. Stainless steel shall comply with 5.2.

Exception No. 1: This requirement does not apply to the flue-gas conveying conduit. See 5.4.

Exception No. 2: This requirement does not apply to parts subject to contact by flue-gases or flue-gas air mixtures at or beyond the terminus of the flue-gas conveying conduit. See 5.5.

5.7 Galvanized steel used for outer casings, structural parts, firestopping or other components or subassemblies shall have a zinc coating complying with the coating designation G90 (former coating class 1.25 commercial) in Weight (Mass) of Coating Requirements table in of the Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653, with not less than 40 percent of the zinc on any side, based on the minimum single spot test in the ASTM designation. The weight of zinc coating shall be established in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ANSI/ASTM A90. Aluminum-coated steel shall be of Type T1-40 (regular) [0.40 ounce per square foot (0.12 kg/m^2)].

5.8 A painted part made of steel not less than 0.053 inch (1.35 mm) thick, or of cast iron not less than 0.125 inch (3.18 mm) thick, and for use only in the interior of buildings, is determined to have corrosion resistance equivalent to that required by 5.6. Paint coatings shall remain intact at the maximum temperatures obtained on the part during the tests specified in these requirements.

5.9 Except for binder materials, thermal insulation material shall be noncombustible.

5.10 Thermal insulation as employed shall be in accordance with the following conditions when the system is tested in accordance with these requirements:

a) The products resulting from the combustion or volatilization of any combustible binder shall be discharged to the chimney terminus outside of the building;

b) The insulating material shall remain in its intended position;

c) The thermal conductivity of the insulating material shall not be increased; or

d) The thermal insulation shall not show evidence of softening, melting, or other evidence of malfunction or deterioration.

5.11 Thermal insulation shall not come into contact with products of combustion.

5.12 Thermal insulation that is not self-supporting shall be applied to solid surfaces so that the insulation does not sag. An adhesive or cement used to attach such material shall retain its adhesive qualities at any temperature the adhesive attains when tested in accordance with these requirements and at 0°F (minus 18°C).

5.13 A water-absorbing insulating material shall not be subject to wetting by condensation or rain when installed as intended.

6 Assembly

6.1 A venting system shall consist of all the essential parts required for the intended installation of a complete system for venting. Each part of the assembly shall be constructed for ready attachment of one to the other without requiring alteration by the installer, such as by cutting, threading, drilling, welding, or similar tasks.

Exception: An assembly or component part intended to be cut to length or to be fitted by the installer shall not be provided unless means are furnished for joining any altered part to a companion part or assembly. All fasteners required to complete the assembly shall be provided with the product by the manufacturer. Drilling shall not occur unless:

a) The drilling operation does not weaken the assembly or penetrate into the flue liner; and

b) The size of the required drill bit is specified and the instructions clearly describe the locations to be drilled, such as by the use of drawings, descriptions, or templates.

6.2 Two or more parts or subassemblies that bear a definite relationship to each other in the intended application shall:

a) Be arranged and constructed to permit them to be incorporated into the complete assembly without alteration or alignment and only in the correct relationship with each other; or

b) Be assembled and shipped from the factory as one unit.

6.3 Each part, such as a vent-pipe section or length, elbow, coupling, or tee, shall be completely assembled by the manufacturer at the factory.

6.4 The venting system shall be capable of attachment to chimney connectors having diameters of integral inches.

6.5 The construction of a vent part shall not void the firestopping required between spaces of a building when the part is installed in accordance with the manufacturer's instructions.

6.6 The annulus between any two walls of a multiple-wall vent-pipe section or vent-pipe fitting shall be not less than 1/4 inch (6.4 mm) in width.

6.7 A venting system shall be of uniform cross-sectional shape.

7 Caps

7.1 A cap shall be provided to resist the entrance of debris and rain into the flue-gas conveying conduit and into any cooling-air passage terminating exterior to the building.

7.2 A cap shall be constructed so that leaves and debris fallen or blown onto it are not retained so as to obstruct flue-gas or cooling-air passages.

8 Firestop-Spacers

8.1 A venting system intended to pass through a floor or ceiling of a building shall be provided with an assembly constructed to provide firestopping at the framed joist opening and to establish and maintain required minimum clearances between vent sections and combustible construction. Spacers shall have the strength and bearing surface to maintain the required clearance from vent sections to joists and ceiling and floor material.

8.2 A firestop shall provide complete firestopping when the assembly is installed in a framed joist opening that is 1/2 inch (12.7 mm) greater on each side than the opening for which the assembly is intended. A spacer shall provide for continuous interference with construction for a height of not less than 1 inch (25.4 mm).

8.3 A joint between factory-made parts that provide for firestopping shall have a through opening (total eccentricity) not larger than 1/8 inch (3.2 mm) wide.

9 Fittings

9.1 The nominal cross-sectional area of the flue-gas passage of a vent-pipe fitting shall be equivalent to that of the vent-piping with which it is intended to be used.

10 Joints

10.1 Parts of a venting system shall be joined and secured so that they do not disengage when tested in accordance with these requirements.

10.2 When screws are employed to field-join assemblies, the assemblies to be joined shall provide for use of screws without being field-punched or drilled, except as referenced in 6.1. When cement is employed for this purpose, the cement shall be a quick-setting type. Cement, screws, and instructions shall be furnished. A screw shall not extend into a flue-gas passage.

10.3 A joint shall not retain condensation or rain water, nor permit rain water to flow from the exterior to the interior of the flue-gas conveying conduit, nor permit condensation to flow from the interior to the exterior of the flue-gas conveying conduit.

11 Radiation Shields

11.1 A radiation shield provided to comply with the maximum temperature limits of these requirements for floor or ceiling structures shall:

a) Be an integral part of a firestop-spacer or support assembly; and

b) Provide a continuous barrier for a vertical distance, referenced to the ceiling or floor level, of not less than 10 inches (254 mm).

11.2 The assembly specified in 11.1 shall fit into a framed joist area not larger than the sum of:

a) 1/2 inch (12.7 mm) greater on each side than the outside diameter of the vent pipe; and

b) Twice the dimension specified in the installation instructions for clearance between vent pipe sections and combustible enclosures.

11.3 Parts of a firestop-spacer or support assembly that provide incidental shielding from radiation to combustible construction are not determined to be radiation shields.

11.4 A radiation shield provided to obtain compliance with the maximum temperature limits of these requirements for roof structures shall not be employed in a roof or other terminating assembly intended to be altered in the field when such alteration requires the shifting or relocation of the shield.

12 Roof Assemblies

12.1 A roof assembly installed in accordance with the installation instructions shall resist the entrance of excess water and debris into the building where the chimney passes through the roof. See Rain Test, Section 25.

12.2 A roof assembly shall resist the accumulation of soot and debris therein when such accumulation obstructs flue-gas or cooling-air passages. See Sections 18 – 20.

13 Roof Jacks

13.1 A roof jack constructed for placement in contact with combustible roof, rafter, insulation, and ceiling material shall provide a continuous surface or barrier for a vertical distance, measured from the roof line, of at least 6 inches (150 mm).

13.2 When installed in accordance with the manufacturer's instructions, a roof jack shall protect against the entrance of water and debris into the building where the vent passes through the roof. See Rain Test, Section 25.

13.3 A roof jack shall be constructed so that soot or debris is not capable of accumulating therein when such accumulation obstructs flue-gas or cooling-air passages.

14 Sizes

14.1 A vent-pipe section or vent-pipe fitting shall have an internal cross-sectional area of not less than 7.1 square inches (45.2 cm^2) for 3-inch (76-mm) diameter pipe and not more than 28.3 square inches (181 cm^2) for 6-inch (150-mm) diameter pipe.

14.2 The internal minor axis of a vent pipe or fitting section shall be not less than 3 inches (76 mm).

15 Support Assembly

15.1 A support assembly (such as a ceiling or floor support), when furnished, shall establish and maintain the minimum required clearance between a vent pipe and combustible construction. A support for installation in a joist area shall constitute a complete firestop when tested in accordance with these requirements.

15.2 A support assembly shall sustain a load equivalent to four times the weight imposed upon it by all vent parts it is intended to support. See Vertical Support Test, Section 22.

15.3 A support assembly intended to be secured by nails or screws shall be arranged so that the load on such holding means is a shear load.

PERFORMANCE

16 General

16.1 When a venting system is tested in accordance with these requirements, temperatures on combustible construction shall not exceed the respective maximum temperatures in the individual tests.

16.2 After being subjected to the temperature tests specified in Sections 19 and 20, a venting system shall be capable of being further used.

16.3 Test results indicating compliance with the requirement of 16.2 include the following:

a) No part of the venting system has become damaged or permanently distorted to an extent that it or the chimney assembly does not continue to function as intended;

b) The effectiveness of any required protective coating or finish on metal parts has not been reduced;

c) A ceramic material shows no evidence of cracking, disintegration, or spalling to the extent that serviceability of any part of an assembly has been impaired;

d) Cracks are not observable in porcelain enamel used as a required protective coating when the surface is examined under a microscope of 60 magnification;

e) The reflectivity of a surface has not been impaired when the reflectivity is utilized to reduce the risk of fire;

f) Burning or scaling of metal parts is not evident upon visual observation;

g) The effectiveness of insulating material has not been reduced.

17 Test Installation

17.1 General

17.1.1 A venting system is to be tested on the following basis:

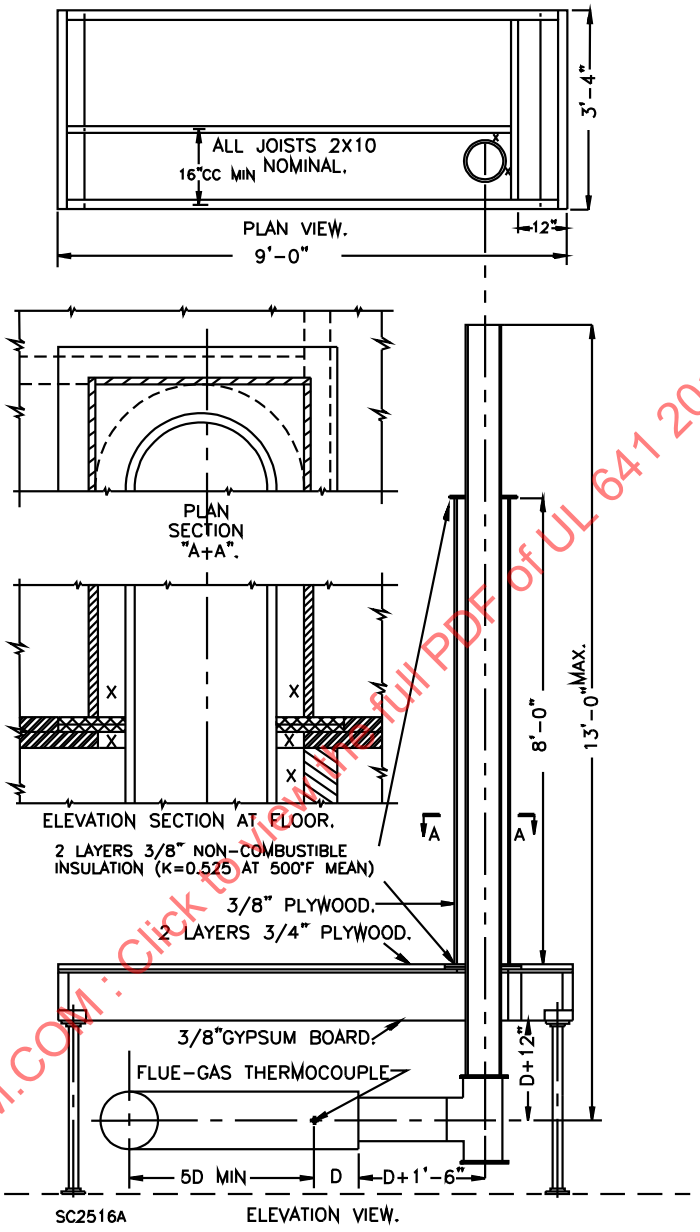
a) Size and type (shape of section);

b) Height in feet (m) of the venting system;

c) Minimum clearance to combustible construction.

17.1.2 The general form for a test structure is illustrated by Figure 17.1. The structure is to provide for various sizes and designs following the details as shown by Figures 17.2 and 17.3.

Figure 17.1
Test structure



Enclosure shown as specified clearance denoted by "X"

CONVERSION FACTORS

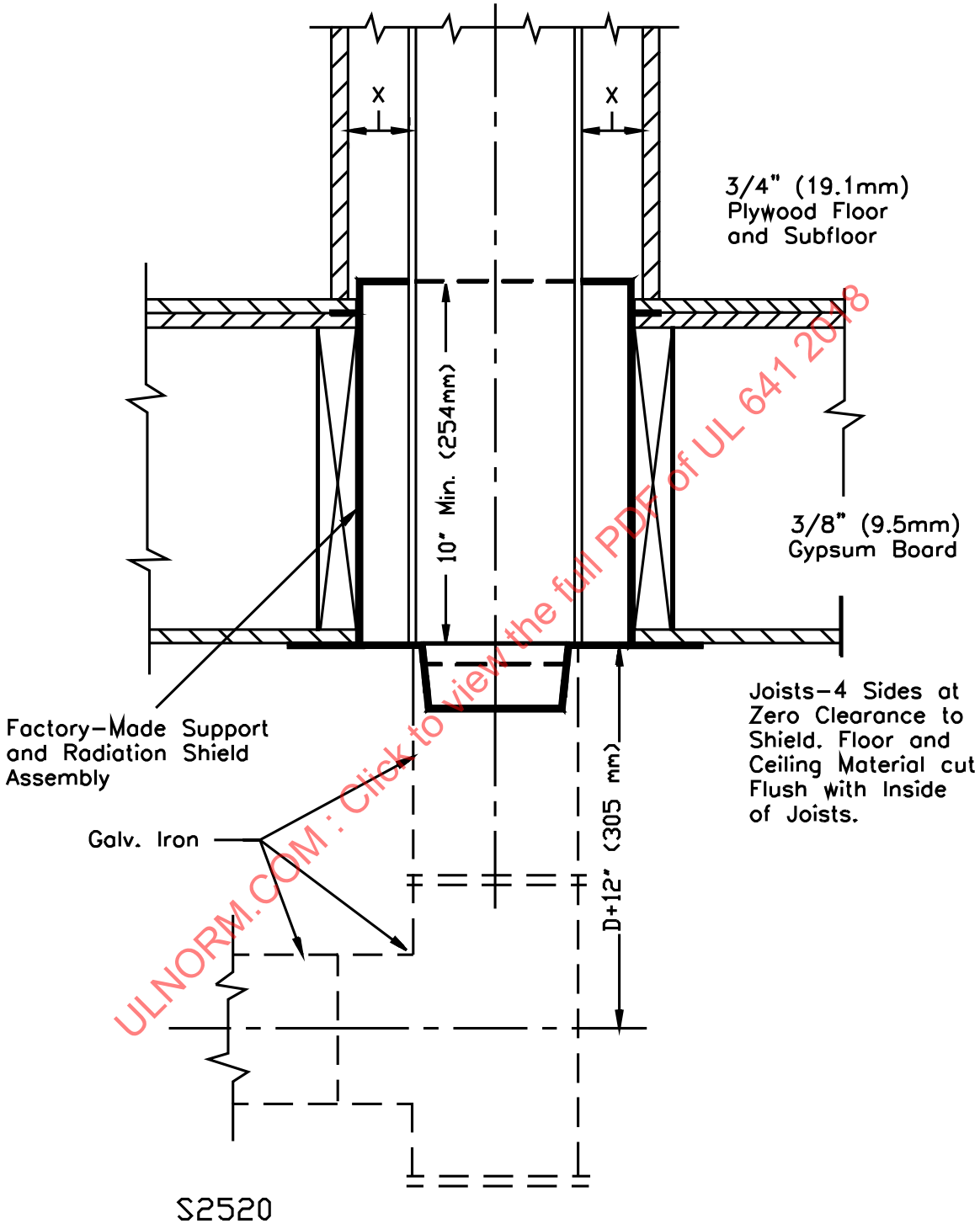
3/8 inch = 9.53 mm

1 inch = 25.4 mm

1 foot = 0.305 m

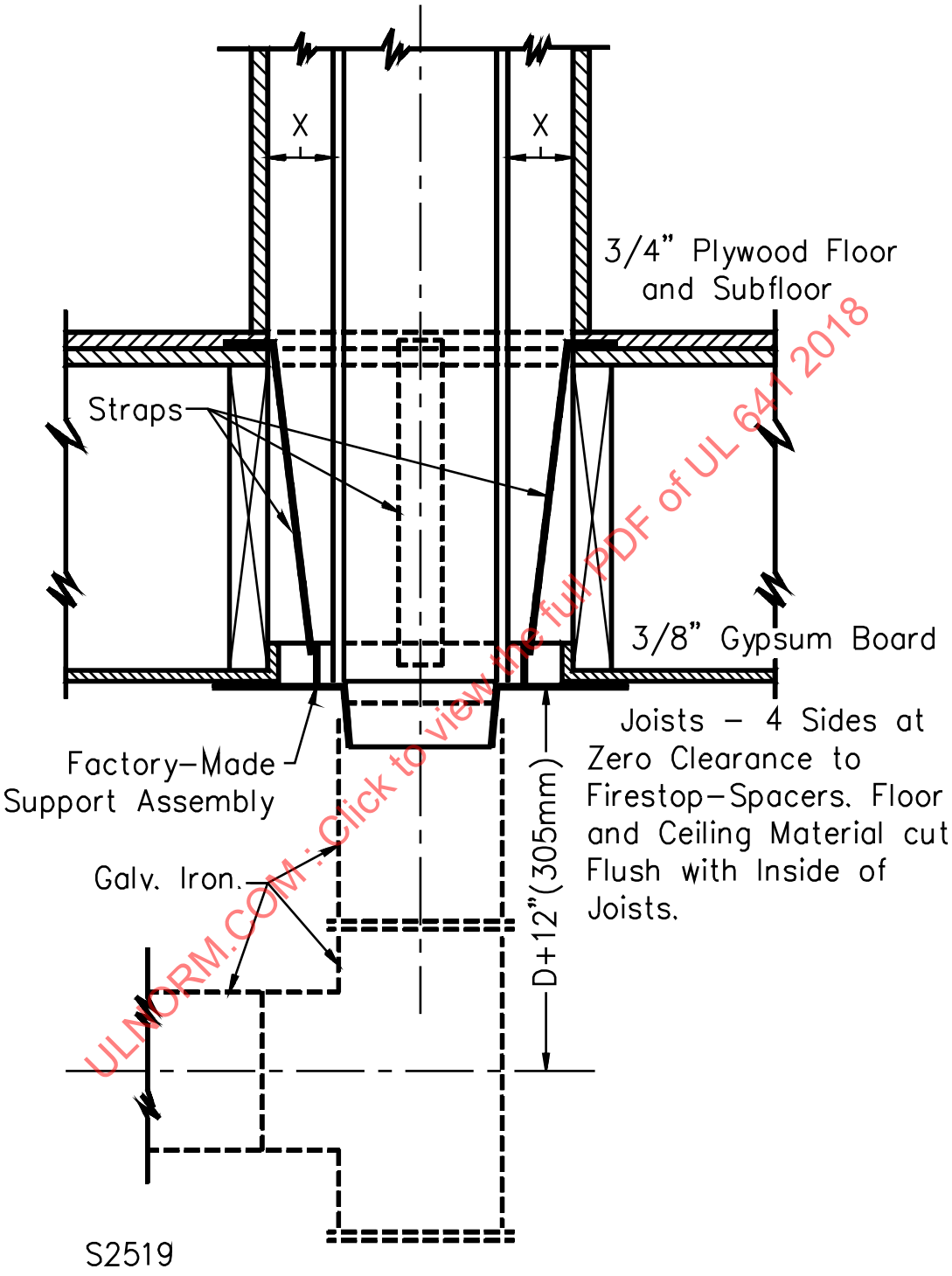
2 x 10 nominal [1-1/2 x 9-1/2 inches (38 x 241 mm)]

Figure 17.2
Test structure details – for support assembly with radiation shield



Enclosure shown at specified clearance denoted by "X"

Figure 17.3
Test structure details – for support assembly



Enclosure shown at specified clearance denoted by "X"

17.1.3 The test structure is to be erected within a room having ventilation capable of maintaining the buildup of carbon monoxide to less than 50 parts per million throughout the period of any tests. The room is to be free of extraneous drafts and the chimney is to exhaust into the same space or into a space freely communicating with the space from which the combustion air is taken. The room is to be such that during any one test the room temperature does not increase by more than 20°F (11°C) above the room temperature recorded at the beginning of the test.

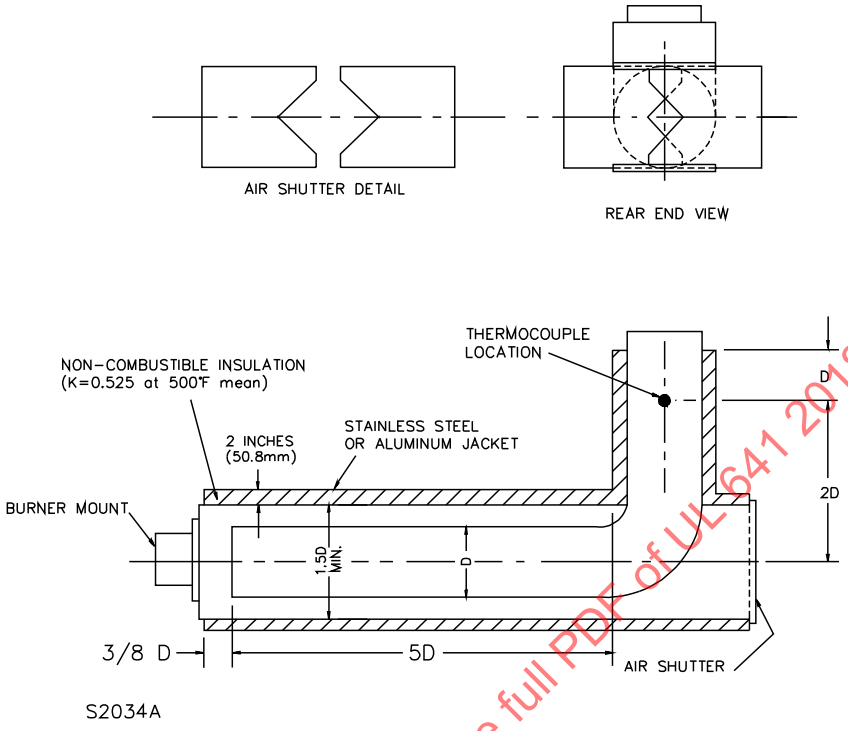
17.1.4 When a venting system provides for taking air from an occupied space and exhausting such air to the outside of a building to cool the venting system, all the openings in the assembled parts that are intended to provide such air flow and that is located within an occupied space of the building are to be sealed closed during the tests.

17.1.5 When a venting system provides for taking air from the outside of a building to cool the venting system, the test arrangement is to maintain the temperature of such air between 70 and 90°F (21 and 32°C).

17.1.6 The venting system under test is to consist of a vertical assembly composed of standard pipe sections and other furnished parts, all erected according to the manufacturer's installation instructions. The top of the venting system is to be terminated by the roof assembly when the roof assembly is always provided as a functional part of the venting system. Other functional parts of the venting system, such as a support or firestop-spacer, are to be used during a test. The height of the venting system for a single-story test structure is to be as shown in Figure 17.1.

17.1.7 A gas-fired flue-gas generator as illustrated in Figure 17.4 is to be used to supply flue gases to the venting system being tested. The generator is to produce flue gases at the specified test temperature when fired at the test input specified in Table 19.2.

Figure 17.4
Flue-gas generator



17.1.8 A premix type burner assembly, such as an Eclipse brand, or the equivalent, capable of supplying an air-gas mixture, with not less than 70 percent primary combustion air (70 percent of premixed theoretical air), to a flame retention burner nozzle tip is to be used. Combustion is to be complete within the horizontal straight length of the flue-gas generator combustion chamber. The insulated flue-gas generator outlet is to be connected to the inlet of the test chimney by means of a stainless steel or galvanized pipe having a diameter equivalent to that of the venting system inlet. The connection is to be made using the 90-degree elbow forming part of the generator and a section of galvanized pipe, together with other galvanized pipe fittings, arranged as shown in Figure 17.1. The pipe and fittings are to be uninsulated.

17.1.9 Joints between pipe or parts at a ceiling and at noncombustible firestop material employed at a floor are to be sealed with paper masking tape or plastic-coated or film-faced pressure-sensitive tape. Joints between two or more factory-made parts, that in combination provide a firestop, are to be similarly sealed.

17.1.10 A part used as a support, spacer, radiation barrier, or firestop intended to be in contact with construction is to be placed in contact with the structure in accordance with the manufacturer's instructions.

17.1.11 Plywood used for the test enclosure is to be 3/8-inch (9.5-mm) thick. All joints in a test enclosure are to be sealed with paper masking tape or plastic-coated or film-faced pressure-sensitive tape.

17.1.12 When more than one size venting system assembly is to be investigated, tests are to be conducted on as many sizes as required to determine compliance with these requirements. When a venting system has more than one cross-sectional shape (round, oval, polygonal), samples of each shape are to be tested as indicated previously in this paragraph.

17.1.13 One or more venting systems, based on the height limitations specified by the manufacturer and the design, are to be tested. Tests are to be conducted with the venting system installed in a single-story structure. Tests are also to be conducted also with the venting system installed in a multistory test structure when the venting system is intended for installation in multistory buildings.

17.2 Test structure

17.2.1 Tests are to be conducted in the basic test structure arranged as shown in Figure 17.1. The venting system is to be tested on the basis of clearance to the enclosure of 0, 1, 2, or 3 inches (0, 25.4, 50.8, or 76.2 mm) measured between the outer surface of the venting system and the interior surfaces of the enclosing material. Such clearance is designated by the dimension ″X″ in Figures 17.1 – 17.3. The enclosing casing is to be of a square cross section for round or square pipe and of a rectangular cross section for oval and rectangular pipe. The four sides of the enclosing casing are to be 3/8 inch (9.5 mm) thick plywood. The enclosing casing is to be tightly closed at the top and bottom, employing 3/4-inch (19.1-mm) [two layers of 3/8-inch (9.5-mm)] thick noncombustible mineral board as firestop material.

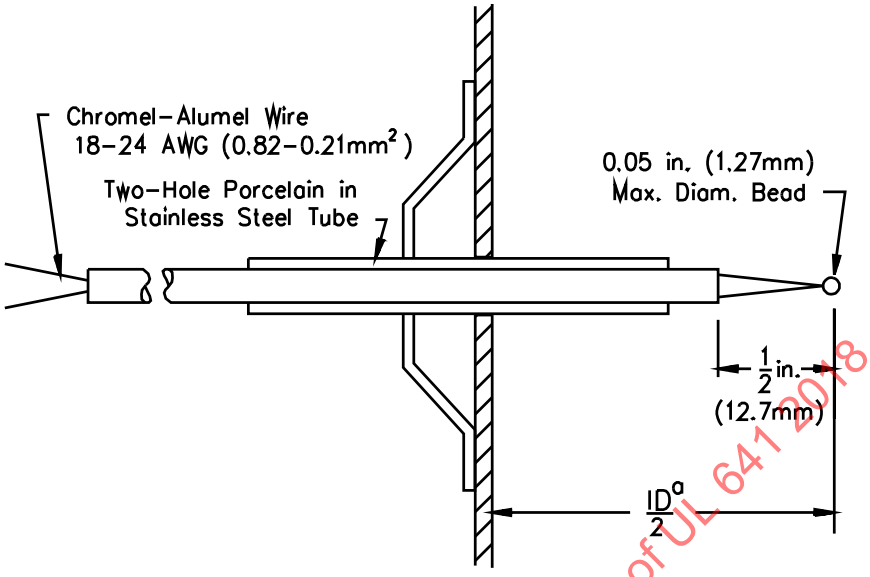
17.2.2 The venting system is to be composed of pipe sections regularly furnished by the manufacturer, in such lengths that at least two joints between sections is located within the vertical test enclosure.

17.2.3 For a test in a multistory test structure, the height of the venting system is to be increased in increments of 9 feet (2.7 m) for each story, and each additional increment is to be encased by a joist and floor area and an enclosure duplicating that shown in Figure 17.1 and with thermocouples similarly placed. Each such additional enclosure is to be placed directly above the one below. Otherwise, the arrangement and method of test are to be as described for the test structure specified in 17.2.1.

18 Temperature Measurement

18.1 Flue-gas temperatures are to be determined for the temperature tests in Sections 19 and 20 by a thermocouple, such as illustrated by Figure 18.1. The thermocouple is to be located within the insulated outlet of the flue-gas generator as illustrated in Figure 17.4. The thermocouple is to be Type K (chromel-alumel) of 18 – 24 AWG (0.82 – 0.21 mm^2) wire with an untwisted welded bare bead junction not more than 0.050 inch (1.27 mm) diameter.

Figure 18.1
Flue-gas thermocouple and support bracket



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18.2 The flue-gas thermocouple is to be inserted at the center of the insulated generator outlet using the entry tube parallel to the long generator axis.

18.3 The gas burner then is to be operated as for the Temperature Test – 570°F (299°C) Flue Gases, Section 19, and the dilution air is to be regulated so that the temperature indicated by the center-point flue-gas thermocouple is 500°F (278°C) above room temperature by using the flue-gas generator input illustrated in Column 1 of Table 19.2, for the size of venting system being tested.

18.4 The dilution air adjustments for the temperature tests described in Sections 19 and 20 are to be set as required to obtain the specified flue-gas temperature for the individual tests as measured by the thermocouple located as described in 18.2.

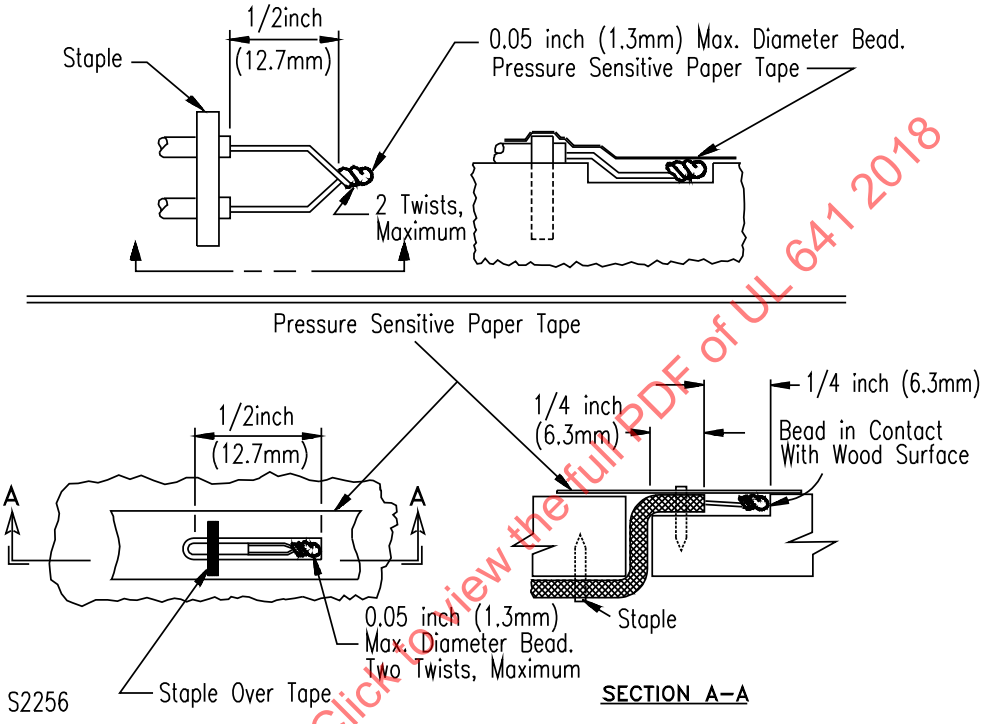
18.5 Temperatures, other than those of flue-gases and metal surfaces, are to be measured using either Type K (chromel-alumel) or Type J (iron-constantan) thermocouples not larger than 24 AWG (0.21 mm^2). For test enclosure elements in contact with the venting system, junctions of thermocouples are to be placed on the venting system surfaces, except that at a point or line contact of a spacer not over 1/8 inch (3.2 mm) diameter, or width, thermocouples are to be placed on the test enclosure at points 1/2 inch (12.7 mm) from the centerline of such point or line contact. Thermocouples are to be:

a) Attached to test enclosure elements having a surface adjacent to the venting system and onto ceilings or roof areas adjacent to the venting system so as to have 1/2 inch (12.7 mm) of wire exposed; and

b) Secured to wood surfaces by staples placed over the insulated portion of the wires.

The thermocouple insulation and tip are to be depressed for a length of 1/2 inch into the wood so as to be flush with the wood surface at the point of measurement and held in thermal contact with the surface at that point by the use of flat black pressure-sensitive paper tape. See Figure 18.2.

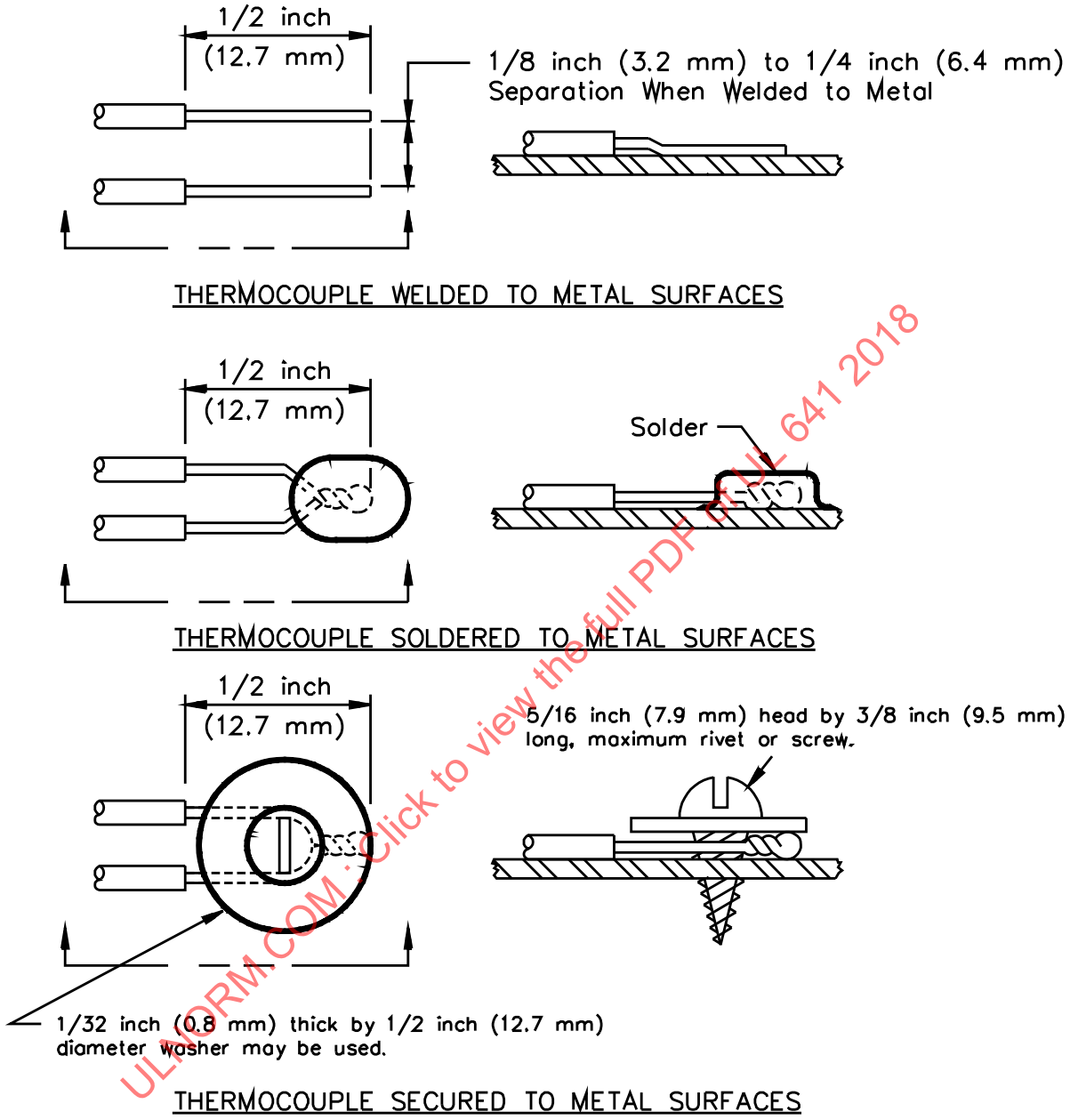
Figure 18.2
Thermocouple installation methods on wood surfaces



18.6 Thermocouples attached to interior surfaces of the test enclosure are to be located 3 inches (76.2 mm) above each floor level and 3 inches below each ceiling level and at the midpoint of the vertical enclosure. At least four thermocouples are to be placed at each level, one on each interior face of the enclosure, located at points of minimum clearance. Additional thermocouples are to be placed on joists, floor edges, and other locations that are in contact with or subject to radiation from surfaces of the venting system.

18.7 Temperatures attained by surfaces of parts of the venting system are to be obtained by means of thermocouples applied to the parts. Thermocouples are to be attached to metal surfaces by screws, rivets, silver soldering, brazing, or welding of the tip to the metal surface. See Figure 18.3. Thermocouples to be attached to surfaces of nonmetallic or nonwood parts are to have junctions and at least 1 inch (25 mm) of the lead wires imbedded flush with the surface of the material. Furnace cement is to be smoothed over such indentations to maintain thermal contact. Such thermocouples are to be located at points attaining maximum temperature. Additional thermocouples are placed at other locations that are in contact with or subject to radiation from surfaces of the venting system.

Figure 18.3
Thermocouple installation methods on metal surfaces



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18.8 The room or ambient temperature is to be determined by a shielded thermocouple located centrally within a vertically oriented 6-inch (150-mm) length of aluminum-painted 2-inch steel pipe (ANSI B36.10) open at both ends.

18.9 The shielded thermocouples are to be located at the elevation of the horizontal axis of the flue-gas generator and also at an elevation of 4 feet (1.2 m) above each floor level, each to be on a vertical line located 2 feet (610 mm) horizontally from the pipe tee or from the vertical test enclosure. The ambient temperature in the space above a roof line is to be determined by a shielded thermocouple located 2 feet (610 mm) horizontally from the vent pipe or roof assembly and 1 foot (305 mm) above the roof.

18.10 The flue-gas temperature rise is to be based on the room temperature at the level of the flue-gas generator. For purposes of determining temperature rises on vent parts and on enclosures and structures, the temperatures are to be referenced to ambient temperatures determined as specified above. Temperatures of joists and rafters are to be referenced to the average of the ambient temperatures above and below the joist or rafter area. Temperatures of floor or roof material are to be referenced to the ambient temperatures above the floor or roof. Temperatures of floor or roof material are to be referenced to the ambient temperature below the ceiling.

18.11 During the Temperature Test – 1700°F (927°C) Flue Gases, Section 20, temperature rises are to be based on the ambient or room temperature recorded at the end of the firing period prescribed for the test.

18.12 For a venting system intended to take air from the outside of a building to cool the venting system, the ambient temperature of the space into which the system exhausts is to be measured by a thermocouple located on the same horizontal plane as the opening provided for the admission of outside air, 3 feet (0.9 m) from the opening. This temperature is to be maintained between 70 and 90°F (21 and 32°C) during all tests for temperature.

19 Temperature Test – 570°F (299°C) Flue Gases

19.1 The maximum temperature attained on surfaces of the test enclosure and on surfaces of venting-system parts at points of zero clearance to the test structure shall not be more than 90°F (50°C) above room temperature when tested as specified in 19.2 – 19.4. Also, the temperature of any part of the venting system shall be not more than the maximum temperature specified for the materials used. See Table 19.1.

Exception: For a venting system intended for installation at a clearance of 2 or 3 inches (50.8 or 76.2 mm) to enclosing material in the test structure, the temperatures on surfaces of the test enclosure shall not be more than 117°F (65°C) above room temperature, beginning 4-1/2 hours after the start of the test.

Table 19.1
Maximum temperature rises for some materials

Materials	Maximum rise above room temperature	
	Degrees C	Degrees F
Low-carbon steel, cast iron	461	830
Aluminum alloys		
1100(2S)	183	330
3003(3S)	239	430
2014, 2017, 2024, 5052[a]	294	530
Aluminum-coated steel[b]	572	1030
Stainless steel		
Types 302, 303, 304, 321, 347	686	1235
Type 316	667	1200
Type 309S	867	1560
Types 310, 310B	894	1610
Type 430	728	1310
Type 446	961	1730
Galvanized steel[c]	267	480
Carbon steel-coated with Type A19 ceramic	572	1030

NOTE – The specified maximum temperature rises apply to parts whose malfunction causes the product to be not capable of further use.

[a] These and other alloys containing more than 1.0 percent magnesium shall not be used when the reflectivity of the material is utilized to reduce the risk of fire.

[b] When the reflectivity of aluminum-coated steel is utilized to reduce the risk of fire, the maximum allowable temperature rise shall be 830°F (461°C).

[c] The specified maximum temperature rise shall apply when the galvanizing is required as a protective coating or when the reflectivity of the surface is utilized to reduce the risk of fire.

19.2 The test is to be started with the test venting system and the test structure at (ambient) room temperature. The flue-gas generator is to be fired at the input specified in Column 1, Table 19.2, and the air shutter regulated to produce flue gases at a temperature of 500°F (278°C) above room temperature at the location in the flue pipe designated in Figure 17.1. Combustion is to be complete within the combustion chamber of the flue-gas generator.

Table 19.2
Flue-gas generator inputs

Equivalent nominal diameter of venting system		Minimum input to flue-gas generator			
		Column 1		Column 2	
Inches	(mm)	btu/hr	(j/sec)	btu/hr	(j/sec)
3	(76)	15,400	(4,466)	28,500	(8,265)
4	(102)	27,500	(7,975)	43,100	(12,499)
5	(127)	43,000	(12,470)	67,500	(19,575)
6	(153)	61,600	(18,264)	97,000	(28,130)

19.3 The flue-gas generator inputs specified in Table 19.2 are based on values derived from the nominal rated capacity of heating equipment which is to be connected to a venting system of a given size. The flue-gas generator inputs are consistent with the heat loss to the venting system by such heating appliances.

19.4 The flue-gas generator input is to be fired until equilibrium temperatures are attained on surfaces of the venting system parts and the test enclosure.

20 Temperature Test – 1700°F (927°C) Flue Gases

20.1 The maximum temperature attained on the test structure, such as ceilings, enclosures, floors, and joists, and on surfaces of the venting system at points of zero clearance to the test structure, shall be not more than 175°F (97°C) above ambient temperature when tested as described in 20.2 or after the flue-gas generator is shut off.

20.2 After equilibrium temperatures are attained under the test conditions described in the Temperature Test – 570°F (299°C) Flue Gases, Section 19, the input to the flue-gas generator is to be increased to that specified in Column 2 of Table 19.2 and regulated to produce a temperature of 1630°F (906°C) above room temperature at the location designated in Figure 17.1 and the test continued for 10 minutes, at which time the burner is to be shut off.

21 Draft Loss Test

21.1 A cap for a venting system shall not impose a draft loss of more than 0.01 inch (0.25 mm) water column as determined in accordance with the test method described in 21.2.

21.2 The test vent is to be installed and the flue-gas generator is to be fired as for the Temperature Test – 570°F (299°C) Flue Gases, Section 19. The draft in the venting system at the inlet is to be determined while the cap is in place and also while the cap is removed. The difference between these two values shall be not greater than 0.01 inch (0.25 mm) water column.

22 Support Test

22.1 An assembly intended to support the venting system shall not be damaged, nor shall the security of its attachment to the building structure be impaired, when tested as described in 22.2.

22.2 The support assembly is to be installed as described in the manufacturer's installation instructions in a framework simulating a typical installation. A section of the venting-system pipe is to be placed on the support, and the assembly is to be loaded by means of weights or by a machine. The maximum static load applied is to be equal to four times the load imposed by the heaviest venting system assembly that the support is required to sustain in service. The load is to be applied for a minimum of 60 minutes.

23 Strength Test

23.1 General

23.1.1 A section of a venting system shall not open up, break apart, or become damaged to the extent that it is not capable of further use as a result of impacts of a sandbag as described in 23.2.

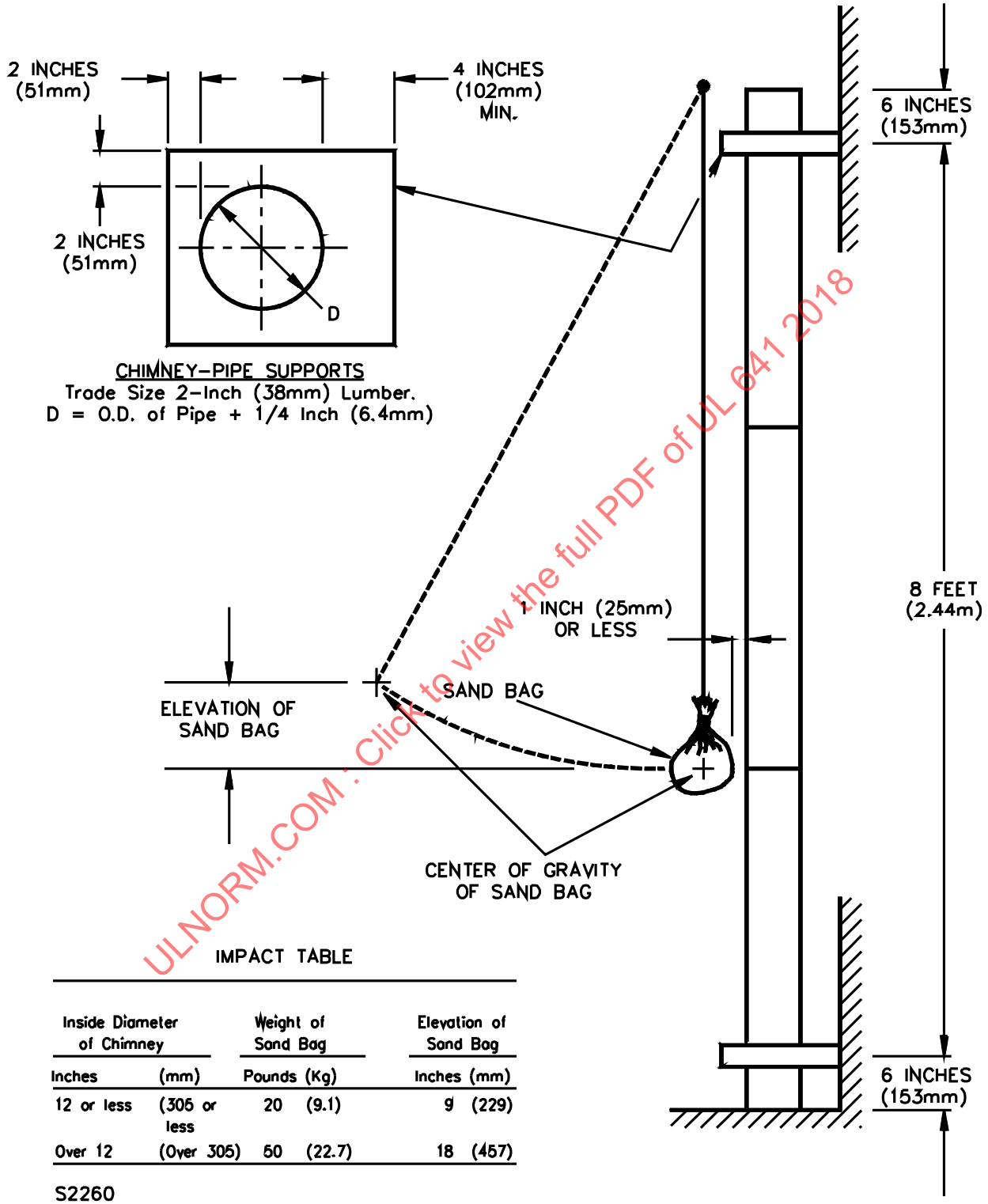
23.1.2 Parts shall not open up, break apart, or become damaged to the extent that they are not capable of further use when subjected to a longitudinal force of 100 pounds (445 N) applied as described in 23.3.

23.2 Impact test

23.2.1 With reference to the requirements in 23.1.1, the impact is to be applied to an unenclosed vent installed as shown in Figure 23.1. Tests are to be conducted on samples of each vent size. Each section is to be joined together as specified by the manufacturer. When cemented joints are included in an assembly, the cement is to be allowed to dry before the test is conducted.

23.2.2 The impact is to be produced by a pendulum consisting of a rope suspending a cloth bag filled with sand and having the weight as shown in Figure 23.1. The bag is to be formed by tightly drawing up all sides and corners of a flat section of canvas around the sand and tying the excess canvas. The bag is to have an at-rest position with not more than 1 inch (25.4 mm) distance between the edge of the bag and the surface of the vent. The point of impact is to be on the same horizontal plane as the center of gravity of the bag at rest. The distance of swing is to be that required to raise the center of gravity of the bag to the elevation specified in Figure 23.1 above the center of gravity of the bag at its at-rest position.

Figure 23.1
Strength test



IMPACT TABLE

Inside Diameter of Chimney		Weight of Sand Bag		Elevation of Sand Bag	
Inches	(mm)	Pounds	(Kg)	Inches	(mm)
12 or less	(305 or less	20	(9.1)	9	(229)
Over 12	(Over 305)	50	(22.7)	18	(457)

S2260

23.2.3 The length of the pendulum is varied, for convenience.

23.2.4 The three impacts are to be made successively at the following points:

a) At the level of a joint;

b) At the level halfway above the first joint tested and the next joint; and

c) At the same level as in (b), and rotated 90 degrees from the impact point in (b).

23.3 Longitudinal force test

23.3.1 With reference to the requirements in 23.1.2, the longitudinal force is to be applied on a number of assemblies, as required to provide for representative samples of each size of part intended to be field-joined together. The force is to be exerted on the assembly in a direction tending to pull the assembly apart. When cemented joints are included in an assembly, the cement is to be allowed to dry before the test is conducted.

23.3.2 Two or more companion parts are to be joined in accordance with the manufacturer's instructions. A longitudinal force of 100 pounds (445 N) is to be applied by gripping one part as to pull it from the part to which it is joined.

24 Wind Load Test

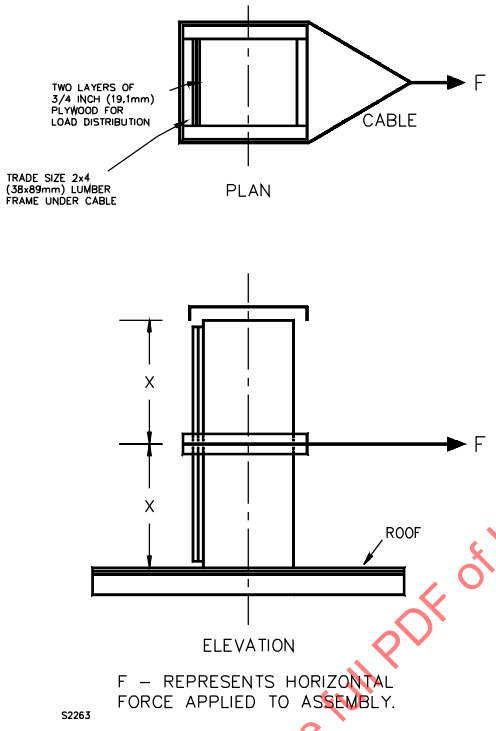
24.1 A roof assembly shall resist, without damage or opening of joints, a load equivalent to 30 pounds per square foot (146 kg/m^2) of exposed area applied to any surface extending above the roof, when tested as described in 24.2 – 24.4.

24.2 The test is to be conducted on the tallest roof assembly representative of each style furnished by the manufacturer. The assembly is to be installed in a flat roof deck as described in the manufacturer's installation instructions.

24.3 The projected area of the largest surface of the roof assembly exposed to wind is to be computed by multiplying the diameter or the widest average dimension of the roof assembly, whichever is greater, by the greatest height of the assembly measured from the roof to the top of the venting system.

24.4 A load equivalent to the product of the projected area, expressed in square feet, multiplied by an assumed wind pressure of 30 pounds per square foot (146 kg/m^2) and expressed in pounds-force is to be applied to the surface of the assembly in a horizontal direction. When a uniform surface load is not applied, the load is to be applied at the middle of the height used to calculate the projected area so that the load is evenly distributed over the surface. See Figure 24.1. The load is to be sustained for 60 minutes.

Figure 24.1
Wind load test on roof assembly



25 Rain Test

25.1 The quantity of water entering the flue-gas conduit or any other individual passageway shall not exceed 2 percent of that which enters the conduit or passageway when unprotected by a cap or other means tested as described in 25.2 – 25.6.

25.2 Representative sizes and styles of caps, roof assemblies, and roof jacks are to be subjected to the tests described in 25.3 – 25.6. The vent, roof assembly, or roof jack is to be sealed or flashed into a roof section of water-tight material that sheds the water spray away from the underside of the test assembly. The arrangement is to permit any water entering the test assembly from above to be observed at the underside of the simulated roof and collected.

25.3 The rain test apparatus is to consist of three spray heads mounted in a water-supply pipe rack illustrated in Figure 25.1. Spray heads are to be constructed in accordance with the details illustrated in Figure 25.2. The water pressure for all tests is to be maintained at 5 psig (34.5 kPa) at each spray head. The spray is to be directed toward the top and side of the cap, roof assembly, or roof jack. The cap, roof assembly, or roof jack is to be centrally located within the spray pattern and the top of the cap, roof assembly, or roof jack under test is to be at least 3 feet (0.9 m) below the plane of the lower spray head outlet.