UL 1666

STANDARD FOR SAFETY

Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

UL Standard for Safety for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts, UL 1666

Fifth Edition, Dated February 16, 2007

Summary of Topics

This revision to ANSI/UL 1666 dated September 24, 2021 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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.

The revisions are substantially in accordance with Proposal(s) on this subject dated July 9, 2021.

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UL 1666

Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

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Second Edition – January, 1991
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Fifth Edition

February 16, 2007

This ANSI/UL Standard for Safety consists of the Fifth Edition including revisions through September 24, 2021.

The most recent designation of ANSI/UL 1666 as a Reaffirmed American National Standard (ANS) occurred on September 24, 2021. 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.

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INTRODUCTION

1 Scope

1.1 This is a fire test for determining values of flame propagation height for electrical and optical-fiber cables that are for installation vertically in shafts or in vertical runs that penetrate one or more floors.

1.2 The purpose of this test is to determine whether the flame propagation characteristics of these "riser" cables are in accordance with the National Electrical Code.

1.3 This test does not investigate the toxicity or corrosivity of the products of combustion or decomposition.

1.4 This test does not cover the construction requirements for any cable or the electrical, optical, and other performance requirements for any cable.

2 Units of Measurement

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

PERFORMANCE

3 Fire Test Room

3.1 The fire test room in which the chamber is located is to have provision for a free inflow of air to maintain the room at a controlled pressure of 0 – 0.05 in (0 – 12 Pa) of water column with respect to barometric pressure and at a temperature of 73 ±5°F (23 ±3°C) and a relative humidity of 50 ±5 percent throughout each test.

4 Fire Test Apparatus

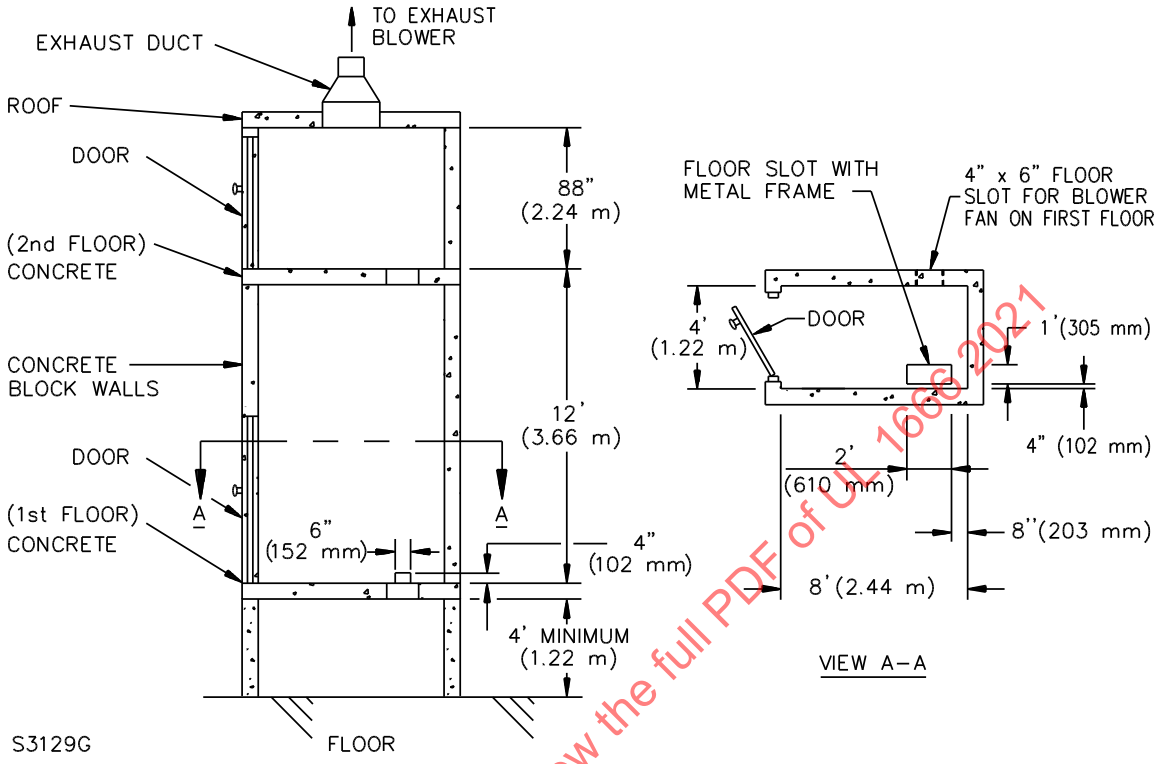
4.1 Fire test chamber

4.1.1 The test chamber is to be as shown in Figure 4.1. The test chamber, all equipment, and the cable specimens are to be protected from the wind and other conditions of weather that could affect the test results. The walls of the structure are to be of standard concrete masonry nominally 8 in (203 mm) thick. The first and second floors shall be constructed of reinforced normal-weight concrete nominally 5 – 8 in (127 – 203 mm) thick. The roof shall be constructed of a suitable building construction capable of providing a tight seal with the walls of the structure. A slot measuring 1 ft by 2 ft (305 mm by 610 mm) is to be located in the first floor, and an identical slot is to be located directly above in the second floor. As shown in Figure 4.1, each slot is to be 8 in (203 mm) from the back wall of the room and 4 in (102 mm) from the side wall of the room. The slots are to be oriented adjacent to either side wall of the room based on installation and position of the fire test chamber. Windows are to be positioned as needed for observation.

4.1.2 The test chamber is to contain steel access doors located on the first and second floors as shown in Figure 4.1 or positioned in any of the other walls. Positioning the second floor door or an additional access hatch in the wall opposite the slot is advantageous as this allows for ease of installation of the cable specimens and positioning of second floor slot thermocouples. The size of each access is not specified. The edges of the door frames are to use an inorganic gasketing material to ensure a tight fit of each door when closed to prevent excessive drafts in the chamber.

Figure 4.1

Fire test chamber



4.2 Burner apparatus

4.2.1 The burner is to consist of 1/2-in steel pipe with a 1/2-in pipe elbow, plus a steel burner diffusion plate as shown in Figure 4.2. The plate is to be located as shown in Figure 4.3. An electronic-spark igniter is to be positioned adjacent to the outlet of the gas-piping outlet for ignition of the pilot flame.

4.2.2 A propane-gas flowmeter is to be installed in the piping feeding the burner for measuring the flow rate of gas during the test. The flowmeter is to be capable of measuring a gas flow rate of 222 SCFH (standard cubic feet per hour) (1743 cm^3/s). Measurements are to be accurate within 3 percent.

Figure 4.2

Burner diffusion plate

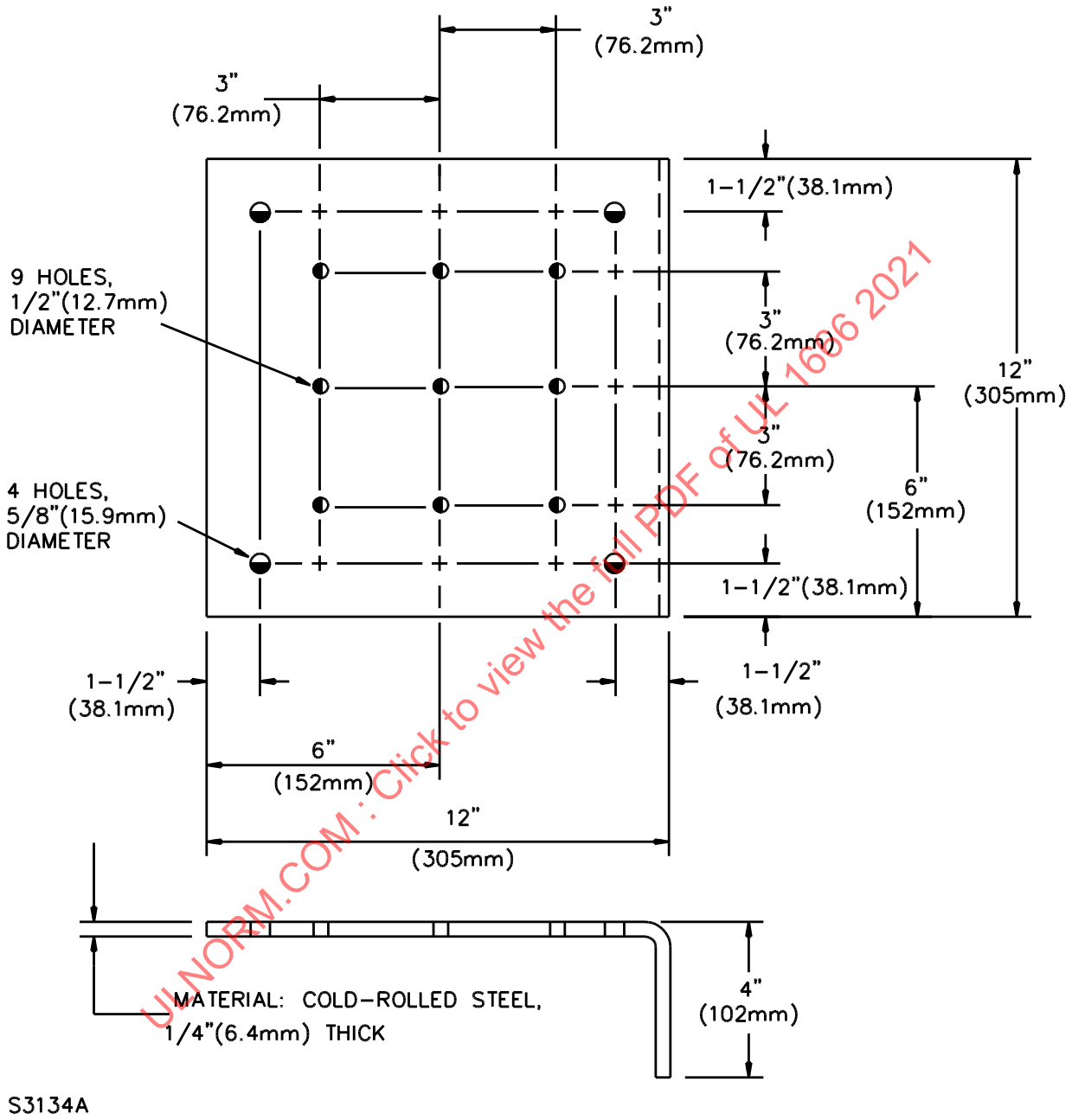
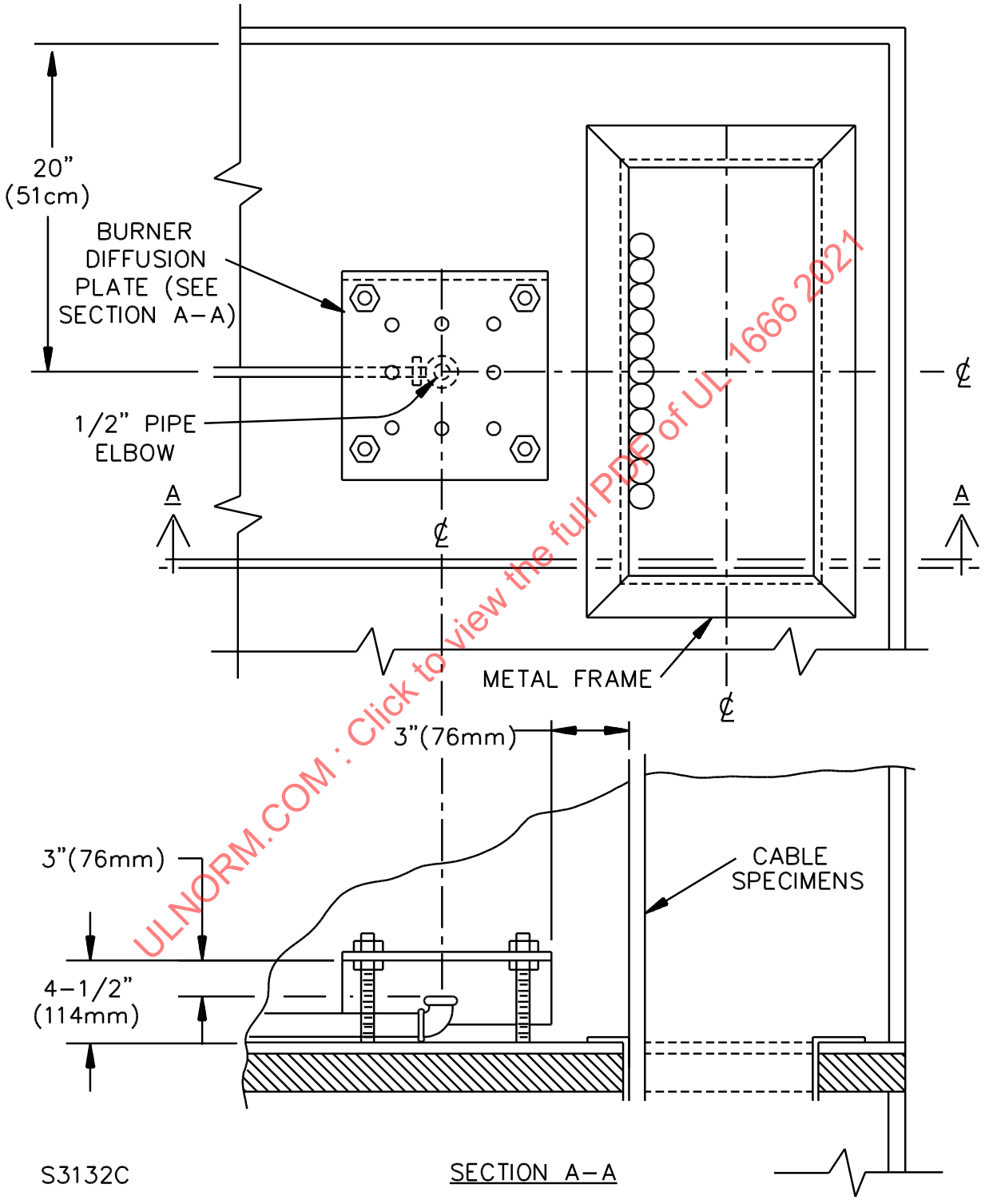


Figure 4.3

Location of ignition burner relative to floor slot and cables



4.3 Burner fan

4.3.1 An electric blower fan capable of providing an air velocity across the burner outlet as specified in 8.3 is to be positioned outside the chamber perpendicular to the centerline of the burner as shown in Figure 4.1. A slot that is 6 in wide by 4 in high (152 mm by 102 mm) is to be provided in the wall of the test chamber at the first floor level to enable the fan to move air across the burner.

4.4 Propane

4.4.1 The gas supplied to the burner is to be CP-grade propane having a nominal heating value of 2500 Btu (thermochemical) per cubic foot [93.0 MJ/m^3 or 22.2 kilocalories (thermochemical) per cubic meter].

4.5 Exhaust blower and duct

4.5.1 A steel exhaust duct is to be positioned in the center of the roof of the fire test chamber as shown in Figure 4.1. An exhaust blower is to be connected to the exhaust duct. The blower is to have the capacity to maintain the required air velocity specified in 8.2 throughout the duration of the test.

4.6 Temperature and flow measurement instrumentation

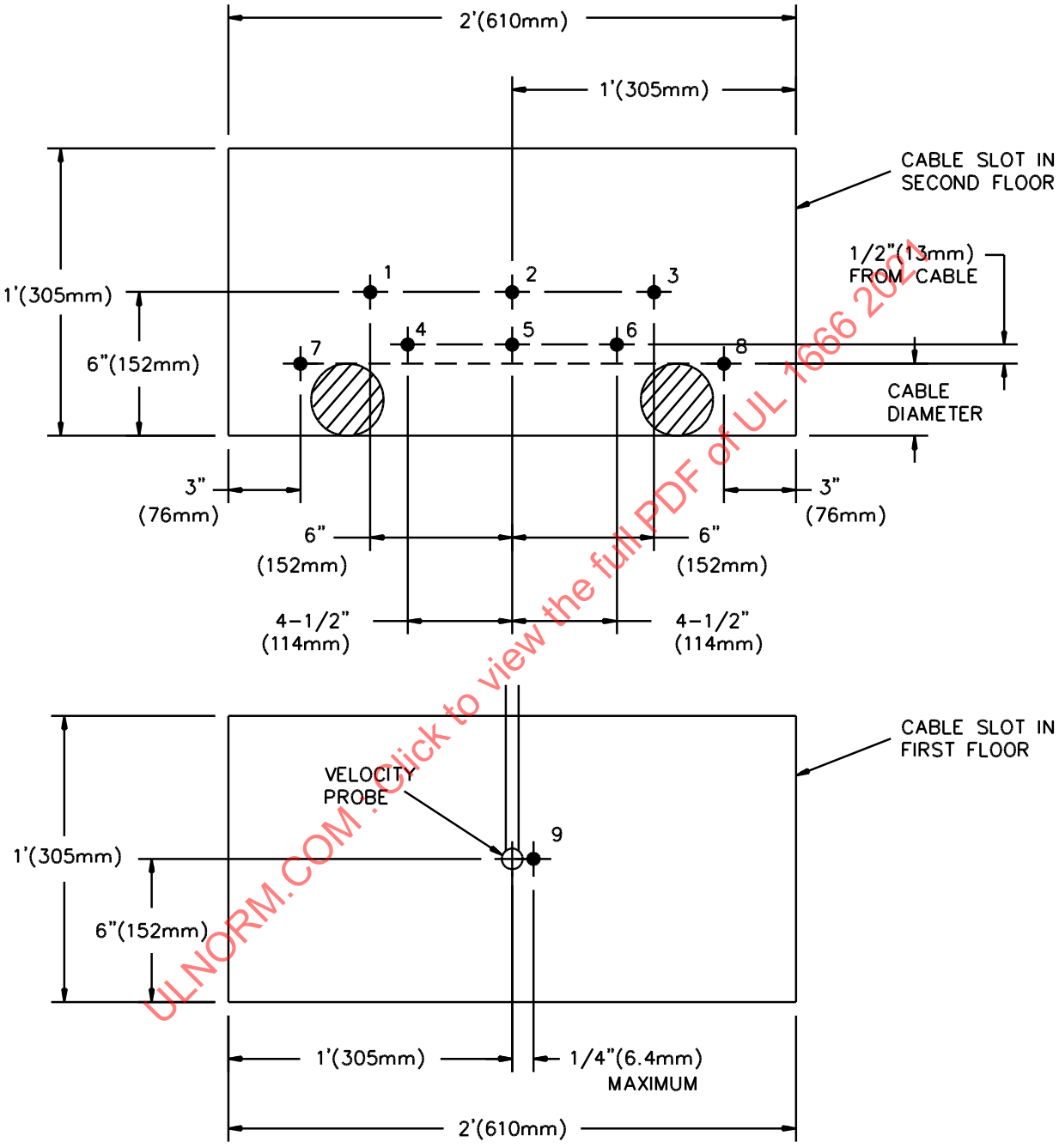
4.6.1 Eight 28 AWG Type K thermocouples with an inconel sheath are to be located in the slot in the second floor, and one thermocouple is to be located in the first floor slot, as shown in Figure 4.4.

4.6.2 One 28 AWG Type K thermocouple with an inconel sheath is to be located at the centerpoint of the first floor chamber ceiling and is to extend downward 1 ±1/16 in (25.4 ±1.6 mm) perpendicular to the ceiling. This thermocouple is used to determine the test chamber temperature prior to conducting a test.

4.6.3 A bi-directional air-velocity probe is to be located at the horizontal and vertical center (]·[) of the first floor slot as shown in Figure 4.4. The velocity probe for flow measurements is to be connected to an electronic pressure gauge to obtain differential pressure.

Figure 4.4

Location of thermocouples in slot



● — THERMOCOUPLES 1 – 8 AT FLOOR SURFACE LEVEL. THERMOCOUPLE 9 ADJACENT TO VELOCITY PROBE.

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4.7 Data acquisition equipment

4.7.1 A digital data acquisition system shall be used to collect and record the air inlet slot velocity and second floor slot thermocouple temperature at intervals of 5 seconds or less.

5 Specimen Conditioning

5.1 Prior to testing, all cable specimens are to be conditioned for a minimum of 24 h in a controlled environment of 73 ±5°F (23 ±3°C) and relative humidity of 50 ±5 percent. Samples which are supplied on reels shall have any wrapping materials removed before conditioning.

6 Determination of Specimen Diameter

6.1 Use either a diameter tape, vernier caliper, or a micrometer with an accuracy of 0.001 in (0.025 mm) to measure the specimen diameter.

6.2 The diameter tape is appropriate for specimens that are uniformly round. Ensure that the tape is wrapped tightly around the specimen, but not so tight that the specimen is compressed. Use an arithmetic average of three readings over a 1 ft (0.3 m) length of the specimen as the specimen diameter.

6.3 The vernier caliper is appropriate for all sizes of cable specimens, and is especially useful for small diameter cables which are not uniform in cross section.

6.4 If the specimen is round, close the caliper gently around the cable being careful not to compress it and take the reading. Repeat the measurement a minimum of five times over a length of 1 ft (0.3 m) of cable. The arithmetic average of the five readings is used as the diameter of the cable specimen.

6.5 If the specimen is not uniform in cross section, with the width to thickness ratio less than 2:1, take three measurements at the wide points, and three measurements at the narrow points of the specimen. The diameter is an arithmetic average of the six readings.

6.6 If the width to thickness ratio of the specimen is greater than 2:1, then the width of the specimen is taken as the specimen diameter. Measure the width of the specimen at six locations on a 1 ft (0.3 m) length of the cable. The specimen diameter is an arithmetic average of the six readings.

6.7 The micrometer is appropriate for a cable specimen with a uniform cross section. Take five measurements of the specimen diameter over a 1 ft (0.3 m) length of the cable. The arithmetic average of the five readings is the diameter of the cable specimen.

7 Number of Cable Lengths

7.1 The number (N) of cable lengths (rounded to the next lower whole number) to be used in a given test is to be determined by means of the following formula,

$$N = 12 / D$$

in which:

for round cables, D is the outside diameter of the cable in inches, and

for non-round cables, D is the largest dimension of the cable diameter.

7.2 A guide for mounting cables is given in 11.1 – 12.5.