UL 2360

STANDARD FOR SAFETY

Test Methods for Determining the Combustibility Characteristics of Plastics Used in Semi-Conductor Tool Construction

UL Standard for Safety for Test Methods for Determining the Combustibility Characteristics of Plastics Used in Semi-Conductor Tool Construction, UL 2360

First Edition, Dated May 10, 2000

SUMMARY OF TOPICS

This revision of ANSI/UL 2360 is being issued to update the title page to reflect the reaffirmation of ANSI approval.

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 28, 2017.

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UL 2360

Standard for Test Methods for Determining the Combustibility Characteristics of Plastics Used in Semi-Conductor Tool Construction

First Edition

May 10, 2000

This ANSI/UL Standard for Safety consists of the First Edition including revisions through October 10, 2017.

The most recent designation of ANSI/UL 2360 as a Reaffirmed American National Standard (ANS) occurred on October 10, 2017. 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 These requirements cover the test methods for measuring the fire performance of sheet plastics used in semi-conductor wet bench tool construction.

1.2 Plastic materials that are classified as Class 1 or Class 2 demonstrate limited fire propagation without the use of sprinklers.

1.3 Variations from the construction or conditions that are tested are capable of substantially changing the performance characteristics of the plastic.

1.4 This standard is not intended for evaluation of small plastic components used in semi-conductor tool constructions such as tubing or wiring.

1.5 This standard does not measure mechanical or structural properties of plastic, and this standard does not measure the hazards from the smoke generated by the plastic material.

1.6 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 General

2.1 Units of measurement

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

2.2 Undated references

2.2.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

TESTS

3 General

3.1 The plastic material covered by this standard shall be subjected to:

a) Four cone calorimeter ignition response tests, see 4.1;

b) Three cone calorimeter combustibility tests, see 4.2; and

c) Three large scale parallel panel tests, see Parallel Panel Test, Section 5.

When the average flame propagation index is less than 6, as determined by the cone calorimeter tests, then the large scale parallel panel test is not required to be conducted.

3.2 When the Cone Calorimeter Tests, Section 4, and the Parallel Panel Test, Section 5, indicate different performance classifications, then the parallel panel test results shall be utilized in determining the classification of the plastic material tested.

4 Cone Calorimeter Tests

4.1 Cone calorimeter ignition response test

4.1.1 Four cone calorimeter ignition response tests are to be conducted in accordance with ASTM E1354-97[a] using a sample size of 3.9 by 3.9 inches (100 mm by 100 mm) with a thickness representative of the final product, up to 2 inches (50 mm) thick.

[a]ASTM E1354-97 – Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter, American Society for Testing and Materials, Phildelphia, PA.

4.1.2 The cone calorimeter ignition response tests are to be conducted using the following conditions:

a) Horizontal orientation of samples;

b) Samples tested using an edge frame sample holder, and

c) The test conducted with a radiant heat flux setting of 20, 35, 50 and 75 kW/m^2.

The cone calorimeter ignition response tests are terminated when sustained ignition has occurred. When ignition does not occur at values below 75kW/m^2, then intermediate radiant heat flux values shall be selected so that at least four cone calorimeter ignition response tests have flame ignition test results. See 4.3 for test calculations.

4.2 Cone calorimeter combustibility tests

4.2.1 Three cone calorimeter combustibilty tests are to be conducted in accordance with ASTM E1354-97[b] using a sample size of 3.9 by 3.9 inches (100 mm by 100 mm) with a thickness representative of the final product, up tro 2 inches (50 mm) thick.

[b]ASTM E1354-97 Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter, American Society for Testing and Materials, Philadelphia, PA.

4.2.2 The cone calorimeter combustibility tests are to be conducted using the following conditions:

a) Horizontal orientation of samples,

b) Samples tested using an edge frame sample holder,

c) Wire grid, and

d) The tests conducted with a 50 kW/m^2 radiant heat flux setting.

4.3 Fire performance calculation methodology

4.3.1 Thermal Response Parameter (TRP) – To calculate TRP, the time to ignition date is plotted with $1/\sqrt{t_{ig}}$ on the y-axis and the radiant heat flux on the x-axis. The equation for TRP is as follows:

$$\frac{1}{\sqrt{t_{ig}}} = \sqrt{\frac{4}{\pi}}\left(\frac{\dot{q}''_e}{TRP}\right)$$

in which:

t_{ig} *is the ignition time at the radiant heat flux and*

$\dot{q}''_e$ *is the radiant heat flux to the sample.*

A least-square error analysis is used to produce a line (with a slope of m) for the plotted points.

Then:

$$TRP = \frac{1}{m}\sqrt{\frac{4}{\pi}}$$

4.3.2 The Fire Propagation Index (FPI) is calculated as follows:

$$FPI = \frac{1200\ (0.42\ \dot{q}'')^{1/3}}{TRP}$$

in which:

$\dot{q}''$ is the peak heat flux in kW/m^2. The fire propagation index value shall be rounded to the nearest tenth.

4.3.3 The Smoke Damage Index (SDI) is calculated as follows:

$$SDI = \frac{\sigma\ (FPI)}{8500}$$

in which:

σ is the specific extinction cross section area (m^2/kg). The smoke damage index value shall be rounded to the nearest tenth.

5 Parallel Panel Test

5.1 General

5.1.1 The test specimen rating shall be determined using the test criteria described in Table 6.1.

5.2 Test equipment

5.2.1 The test equipment is to consist of the following components:

a) A propane sand burner ignition source, see 5.3;

b) A collection hood and exhaust duct, see 5.4; and

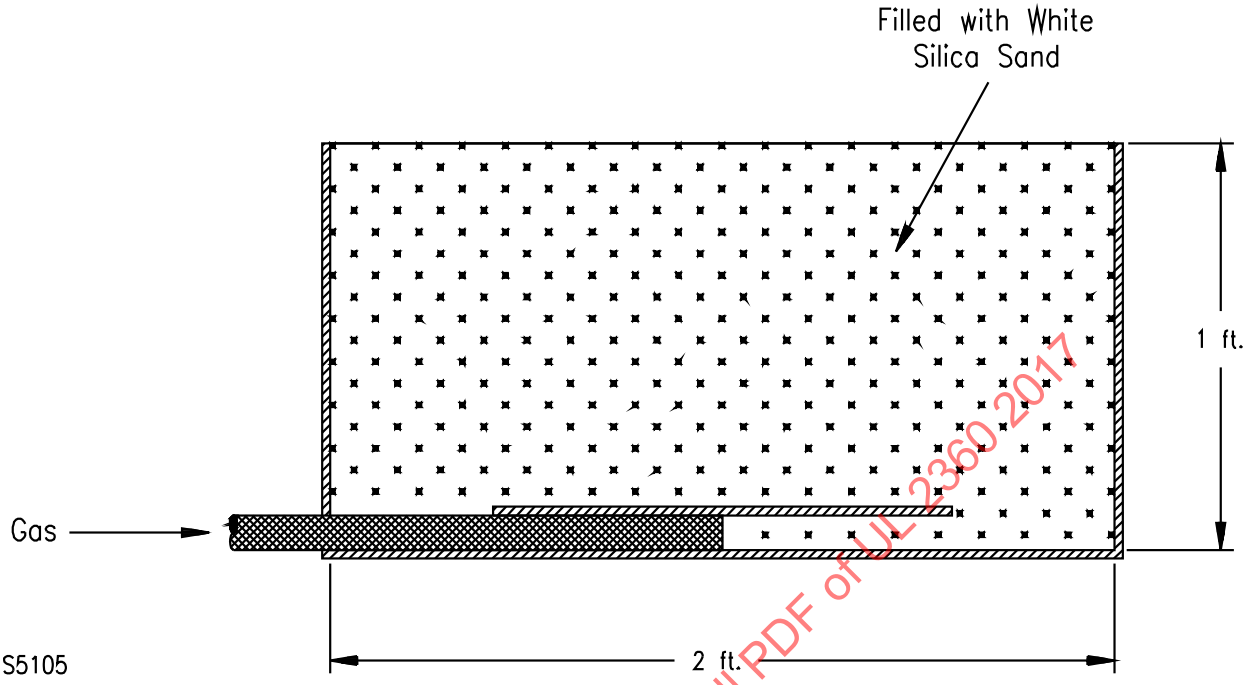
c) Photographic and video equipment, see 5.5.

5.2.2 The building in which the tests are conducted is to have vents for the discharge of the combustion products and have provisions for fresh air intake so that no oxygen-deficient air is introduced into the test configuration during the test.

5.3 Propane sand burner ignition source

5.3.1 The ignition source for the test is to consist of a 2 foot (0.61 m) long, 1 foot (0.31 m) wide and 1 foot (0.31 m) high propane sand burner as shown in Figure 5.1.

Figure 5.1
Propane sand burner ignition source



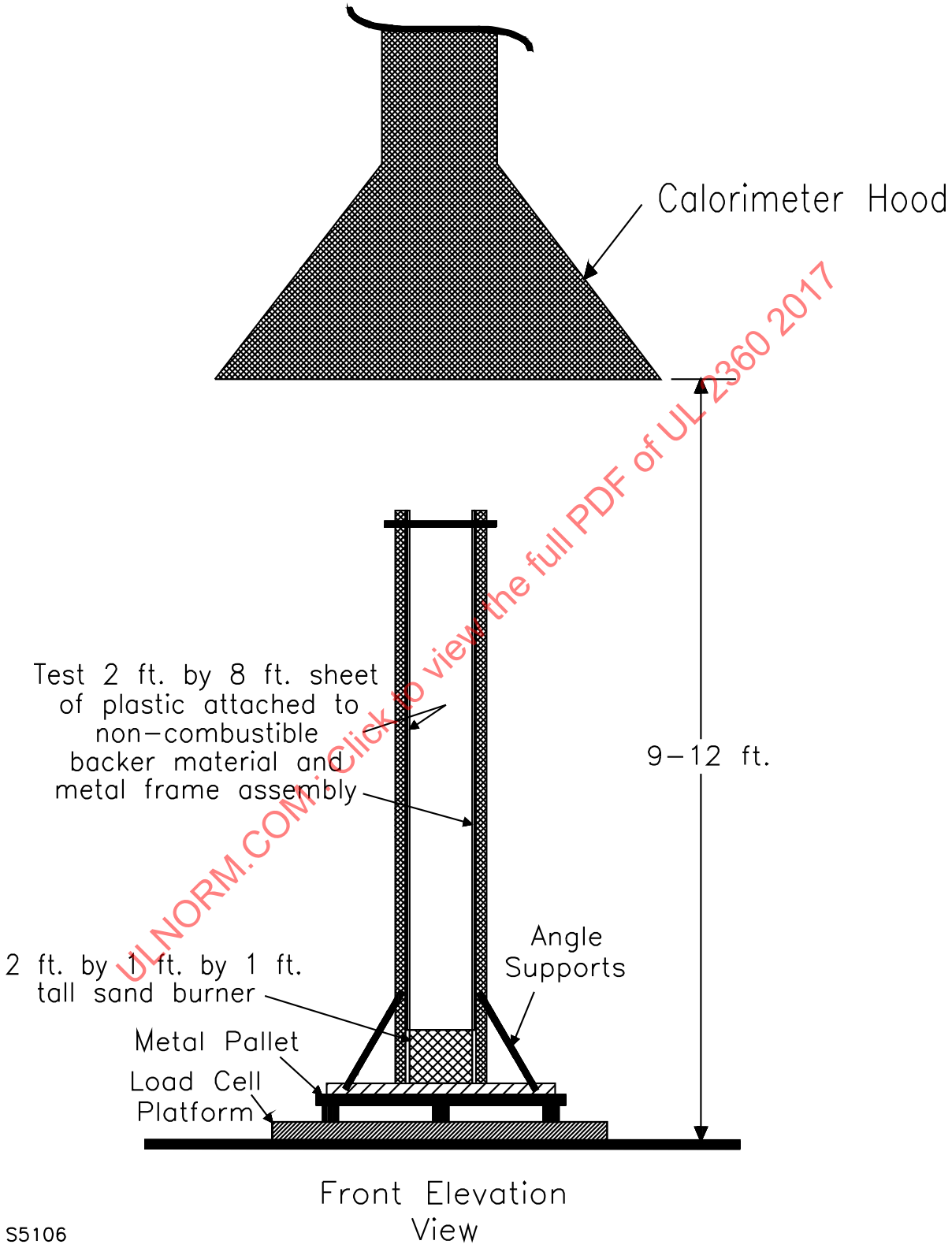
5.3.2 The propane gas supplied to the burner is to be CP-grade propane (99 percent pure) having a nominal heating value of 2500 Btu (thermochemical) per cubic foot [93.0 MJ/m^3 or 22.2 Kilo-calories (thermochemical) per cubic meter].

5.3.3 The propane gas flow is to be adjusted to provide a heat release rate of 60 kW.

5.4 Collection hood and exhaust duct

5.4.1 The face dimensions of the hood are to be at least 8 by 8 feet (2.4 by 2.4 m) and the depth is to be at least 3.5 feet (1.07 m). The distance between the lower edge of the hood and the floor is to measure 9 – 12 feet (2.7 – 3.6 m). The system is shown in Figure 5.2.

Figure 5.2
Collection hood and exhaust duct system



5.4.2 The exhaust system is to have sufficient draft to collect all products of combustion developed by the burning sample. The exhaust flow is to be variable from 1000 – 7500 cubic feet per minute (0.47 – 3.5 m^3/s).

5.5 Photographic and video equipment

5.5.1 A still camera, camera video equipment, or both are to be used to record the test specimen performance throughout each test.

5.6 Samples

5.6.1 The test samples shall have a thickness representative of the final product, up to 2 inches (50 mm thick).

5.6.2 The test samples shall be composed of one or more continuous 8-foot (2.4-m) lengths so that the backer board is completely covered.

5.6.3 Prior to the test, the three test specimens are to be conditioned at 74 ±6°F (23 ±3°C) and 50 ±5 percent RH for a minimum of 24 hours.

5.6.4 The test samples are to be mechanically fastened to inorganic noncombustible backer boards[c] measuring 2 by 8 feet (620 by 2438 mm), which are mechanically fastened to the test frame with Type 1/4 by 20 bolts, and washers spaced 16 inches (0.41 m) on centers along the perimeter of the test specimen as indicated in Figures 5.3 and 5.4.

[c]1/4 inch thick ″Dens-Deck″, manufactured by Georgia-Pacifica has been determined suitable for this purpose.

Figure 5.3
Test specimen setup