

**DRAFT**

**New Zealand Standard**

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**Draft Number:  
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**Public comment Draft**

**Determination of the  
extinction propensity  
of cigarettes**

Draft	SPEX #	Date

**Committee: 4830**

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## Status

This document is a proposed New Zealand Standard under the Standards Act 1988.

Issue as a draft in this form provides the required statutory opportunity for consideration and comment by the bodies and persons having an interest in the Standard.

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- (f) If the draft is acceptable without change, an acknowledgement to this effect would be appreciated.
- (g) Normally no acknowledgement of comment is sent. All comments received by the due date will be put before the relevant drafting committee. Where appropriate, changes will be incorporated before the Standard is formally approved.

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Insert the number of the clause, paragraph or figure. Do not preface the number with words (use 1 not clause 1). If there is no clause number, use the section heading (for example, Preface). Insert the page, paragraph, and line number as appropriate. Use a new row for each comment.

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Clause/ Para/ Figure/ Table no.	Page no.	Recommended changes and reason  <i>Exact wording should be given of changes recommended.</i>

New Zealand Standard

**Determination of the  
extinction propensity of  
cigarettes**

Adoption of AS 4830-2007

## Preface

This Standard was prepared by Standards Australia Committee CS-102, Reduced Fire Risk Cigarettes. This Standard is based on ASTM E2187-04, *Standard test method for measuring the ignition strength of cigarettes*. The ASTM method was the result of over 10 years work and is reported to have been validated by laboratories in the US, but is yet to be validated in Australia. Although no laboratory test is a perfect predictor of the complex and varied causes of fires, this test method has been developed to determine extinction propensity of cigarettes.

## Committee Representation

This draft Standard was prepared under the supervision of the 4830 Committee the Standards Council established under the Standards Act 1988.

The committee consisted of representatives of the following:

### Nominating Organisation

Action on Smoking Health (ASH)  
BRANZ Ltd  
British American Tobacco NZ  
Consumer Representative (nominated by the Ministry of Consumer Affairs)  
Fire Protection Association New Zealand  
Imperial Tobacco New Zealand Ltd  
Ministry of Consumer Affairs  
Philip Morris (New Zealand) Ltd  
Public Health Research Community  
Safekids New Zealand

## Acknowledgement

Standards New Zealand gratefully acknowledges the contribution of time and expertise from all those involved in developing this Standard.

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## REFERENCED DOCUMENTS

Reference is made in this document to the following:

### AUSTRALIAN STANDARDS/OR OF OTHER NATIONAL STANDARDS BODIES

AS 2484 Fire – Glossary of terms  
AS 2484.1-1990 Part 1: Fire tests

### AMERICAN STANDARDS

ASTM E691 Standard practice for conducting an interlaboratory study to determine the precision of a test method  
ASTM E1352 Standard Test Method for Cigarette Ignition Resistance of Mock-Up Upholstered Furniture Assemblies  
ASTM E1353 Standard Test Methods for Cigarette Ignition Resistance of Components of Upholstered Furniture  
ASTM E2187-04 Standard Test Method for Measuring the Ignition Strength of Cigarettes

### WEBSITES

<http://www.legislation.govt.nz>

## LATEST REVISIONS

The users of this Standard/Handbook (delete whichever does not apply) should ensure that their copies of the above-mentioned New Zealand Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on <http://www.standards.co.nz>.

## REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6140.

## Foreword

A common initiating event in fatal fires in Australia is the dropping of a lit cigarette onto a bed or piece of upholstered furniture. The cigarette coal heats the furnishing materials to the point where smouldering combustion begins, perhaps followed by a transition to flaming combustion. According to statistics provided by the National Coroner's Information System, carelessly handled cigarettes caused approximately 12% of the fire deaths in Australia from 2000 to 2002.

Since limiting the frequency of ignitions is a principal approach to reducing fire loss, it is desirable to establish a test method for the propensity of a cigarette to remain lit and therefore potentially capable of igniting soft furnishings. This test method uses standard substrates to determine the extent to which, as the substrate draws heat from the cigarette, the cigarette combustion remains strong enough to continue smouldering and thus potentially capable of initiating a fire.

The test methods ASTM E1352, *Test method for cigarette ignition resistance of mock-up upholstered furniture assemblies* and ASTM E1353, *Test method for cigarette ignition resistance of components of upholstered furniture* have been developed to evaluate the susceptibility of upholstered furniture mock-ups and components to ignition by cigarettes.

# 1 GENERAL

## 1.1 Scope

This Standard provides a measure of the capability of a machine-made cigarette, positioned on a standard substrate, as specified in Appendix A, to generate sufficient heat to continue burning and thus potentially cause ignition.

This method is applicable to machine-made cigarettes that burn along the length of a tobacco column including filtered and unfiltered machine-made cigarettes.

This method does not apply to cigars, cigarillos, loose tobacco or other tobacco products.

## 1.2 Application

This Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific hazard statements, see Clause 4.

## 1.3 Interpretation

For the purposes of this Standard, the word 'shall' refers to requirements that are essential for compliance with the Standard, while the word 'should' refers to practices that are advised or recommended.

Clauses prefixed 'C' and printed in italic type are intended as comments on the corresponding clauses. They are not to be taken as the only or complete interpretation. The Standard can be complied with if the comment is ignored.

The terms 'Normative' and 'Informative' have been used in this Standard to define the application of the Appendix to which they apply. A 'Normative' Appendix is an integral part of a Standard while an 'Informative' Appendix is only for information and guidance.

# 2 DEFINITIONS

For the purpose of this Standard, the definitions in AS 2484.1 and those below apply:

**Full-length burn (n)**

The outcome of a determination in which the specimen burns to or past the front plane of the tipping paper, which covers the filter and perhaps a short section of the tobacco column in a filter tip specimen, or past the tips of the metal pins (see Clause 5.5) if the cigarette specimen has no filter.

**Test specimens**

Cigarette samples for testing.

**Substrate**

Horizontal surface consisting of layers of filter paper on which the test is carried out.

# 3 PRINCIPLE

This test enables comparison of the extinction propensity of different cigarette designs in standard laboratory conditions.

The test measures the probability that a specimen, placed on a substrate, will generate sufficient heat to maintain burning of the tobacco column. Each determination consists of placing a lit specimen on the horizontal surface consisting of a set number of layers of filter paper. Observation is made of whether or not the specimen achieves a full-length burn to a point specified in the method. Forty determinations (comprising of one test) are performed on the substrate to obtain the relative probability that the specimen will continue burning despite heat abstraction by the substrate. Alternative substrate selection is detailed in Appendix A.

## 4 HEALTH AND SAFETY OF OPERATORS

### 4.1 General

This test method involves the use of combustible materials that are exposed to ignition sources. Consequently, proper precautions shall be taken to avoid thermal injuries.

### 4.2 Smoke inhalation hazard

Personnel shall take proper precautions to avoid inhaling combustion products. The following systems shall be in place:

- (a) Exhaust systems shall be checked regularly to ensure that they are removing all products of combustion from the workplace.
- (b) Respiratory equipment shall be made available for personnel.

### 4.3 Fire Hazard

Personnel shall be instructed on general procedures to handle an unwanted fire. Appropriate fire extinguishing equipment shall be provided to suppress any fires that exceed normal controlled limits.

The user shall ensure that all burning has ceased before discarding used test materials. An appropriate closed metal waste container shall be used in each fire test laboratory for safe disposal of specimens and test assemblies after being exposed to heat and fire.

## 5 APPARATUS

### 5.1 Test and conditioning environment

An environmental conditioning room shall be maintained which provides an area adequate for conditioning both specimens and substrate. This room shall be capable of maintaining a relative humidity of  $55 \pm 5\%$  and a temperature of  $23 \pm 2^\circ\text{C}$  and shall be continuously monitored. The room in which the tests are conducted, which may also be the conditioning room, shall be maintained within the same temperature and relative humidity ranges.

*NOTE – This test method is carried out under laboratory conditions on specimens that have also been exposed to laboratory conditions. If different conditions are substituted or the end use conditions are changed, it may not be possible, using this test, to predict quantitative changes in the fire test response characteristics measured. Therefore, the quantitative results are valid only for the fire test exposure conditions described in this procedure.*

### 5.2 Test chamber

A test chamber, as detailed in Figure 1, shall be constructed of clear plastic such as polymethyl methacrylate (PMMA), nominally 6 mm in thickness. The inside dimensions shall be: height:  $340 \pm 25$  mm, width:  $292 \pm 6$  mm, depth:  $394 \pm 6$  mm. The full front panel of the chamber shall be hinged, with a latch to effect positive closure. The top of the chamber shall have a flattop cylindrical chimney of height  $165 \pm 13$  mm and inside diameter  $152 \pm 6$  mm. The chimney shall be centered on the chamber top and sealed to the chamber top panel.

### 5.3 Filter paper holder

A cylindrical support for the layers of filter paper, shown in Figure 2, shall be made of PMMA or similarly rigid material, dimensioned as follows. The outer diameter shall be  $165 \pm 1$  mm, the inner diameter shall be  $127 \pm 1$  mm, and the height shall be  $50 \pm 1$  mm. A recess in the top,  $10 \pm 2.5$  mm deep, shall expand the inner diameter to  $152 \pm 1$  mm. Three or four legs shall raise the bottom of the holder approximately 20 mm above the chamber floor. The outer diameter of the metal rim shall not exceed the inner diameter of the recess in the filter paper holder.

### 5.4 Metal rim

A circular brass or other dense metal rim, shown in Figure 2, shall be used to hold the sheets of filter paper flat against each other. The outside diameter of the rim shall be  $150 \pm 2$  mm. The inner diameter shall be  $130 \pm 2$  mm. The thickness shall be  $6.4 \pm 1$  mm. The rim surface shall be flat and smooth.

## 5.5 Metal pins

A pair of parallel metal pins, each approximately 1 mm in diameter and  $8.1 \pm 0.05$  mm apart, shall protrude  $17 \pm 4$  mm toward the center of the rim. The pins shall be spaced to keep the non-ignited end of a specimen from rolling, but without pressuring the specimen. The clearance between the pins shall be equal to the nominal diameter of the specimen and located at a height equal to one half of the nominal diameter of the specimen. (See Figure 3.) If specimens of significantly different nominal diameter are to be tested, other pairs of pins, appropriately positioned, shall be inserted into the rim.

## 5.6 Specimen holder

A holder shall be used to support the lit specimen in a horizontal position in the test chamber prior to placement of the specimen onto the substrate. A holder shall not clamp the specimen, nor stress it in any other manner and shall not contact the specimen within a nominal 30 mm of its lit end.

## 5.7 Specimen ignition system

A system consisting of an air draw component and an ignition source shall be used to ignite the test specimen. The specimen shall be supported in a horizontal position. A hot coil igniter shall be used for lighting the specimen. The airflow and the draw time through the lit specimen shall be sufficient to establish a coal to within  $\pm 1$  mm of the mark 5 mm from the tip of the specimen. Appropriate filtering media shall be used downstream of the specimen to remove smoke and condensable combustion gases in order to prevent contamination of the downstream components.

## 5.8 Exhaust hood

A chemical or canopy hood shall be used for removing combustion products from the test room. Air flow through the hood shall be sufficient to remove specimen and substrate combustion products while not being high enough to influence the combustion processes in the test chamber(s). (See Clause 6.2.) A means shall be provided to adjust the airflow to the required value.

## 5.9 Extinguishment

A means for extinguishing burning or smouldering sheets of substrate and specimen shall be provided by either smothering or by application of water.

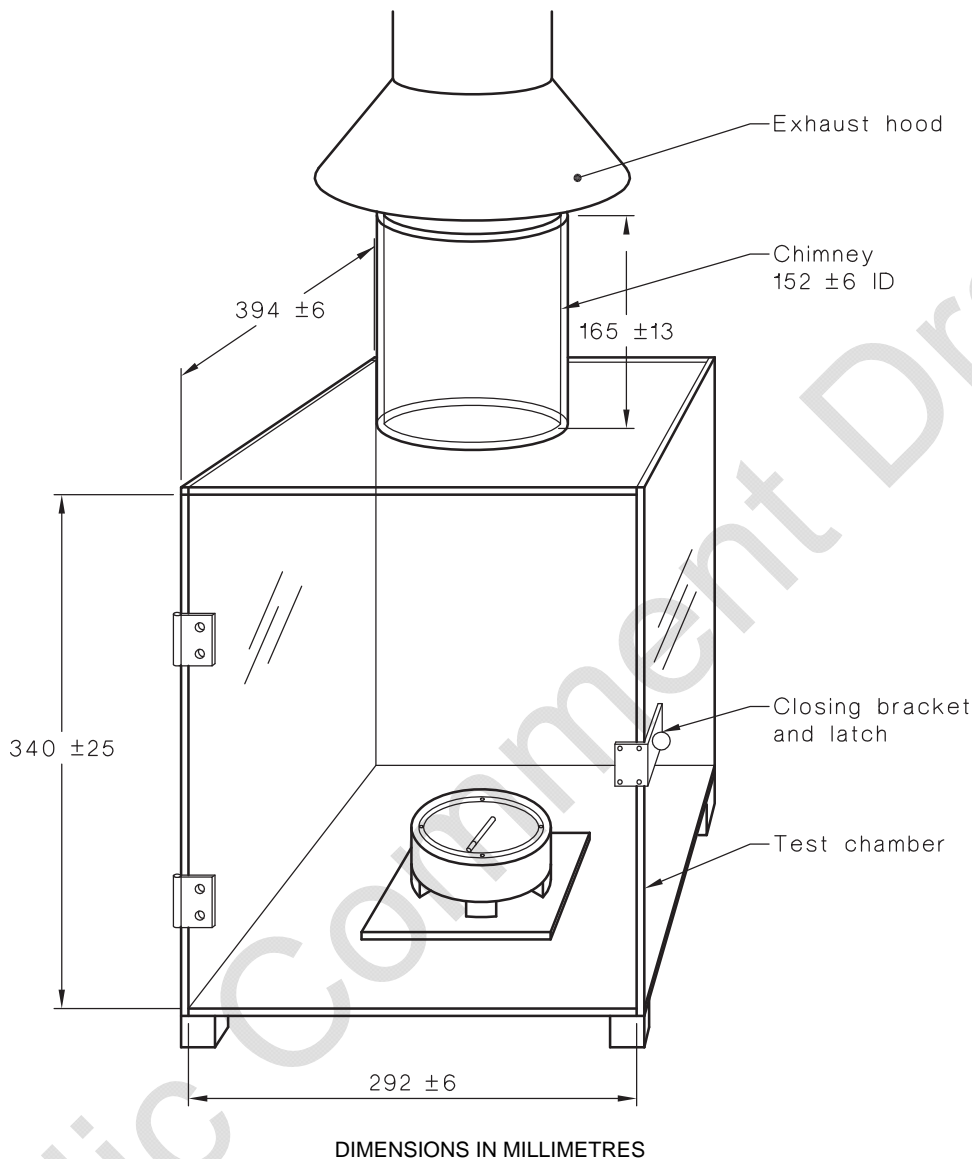


Figure 1 – Diagram of test chamber and position of filter paper holder

## 6 CALIBRATION AND STANDARDIZATION

### 6.1 General

Calibration of equipment shall be carried out as specified below and at any time when equipment or test conditions indicate that evaluation and re-calibration are necessary.

*NOTE – Regular testing of reference specimens may assist in enhancing the repeatability of the test.*

### 6.2 Test chamber

The test chambers shall be checked daily or before use to minimize air leakage so that the smoke plume from a specimen rises undisturbed during testing. Door seals shall be checked visually to ensure that they are closed flush against the chamber's side wall and the latching device secures the door tightly. All construction seams shall be inspected to ensure they are airtight and no cracks shall be visible on any

surface of the test chamber. If leaks are detected, measures shall be taken to ensure that these areas are again made sufficiently air tight.

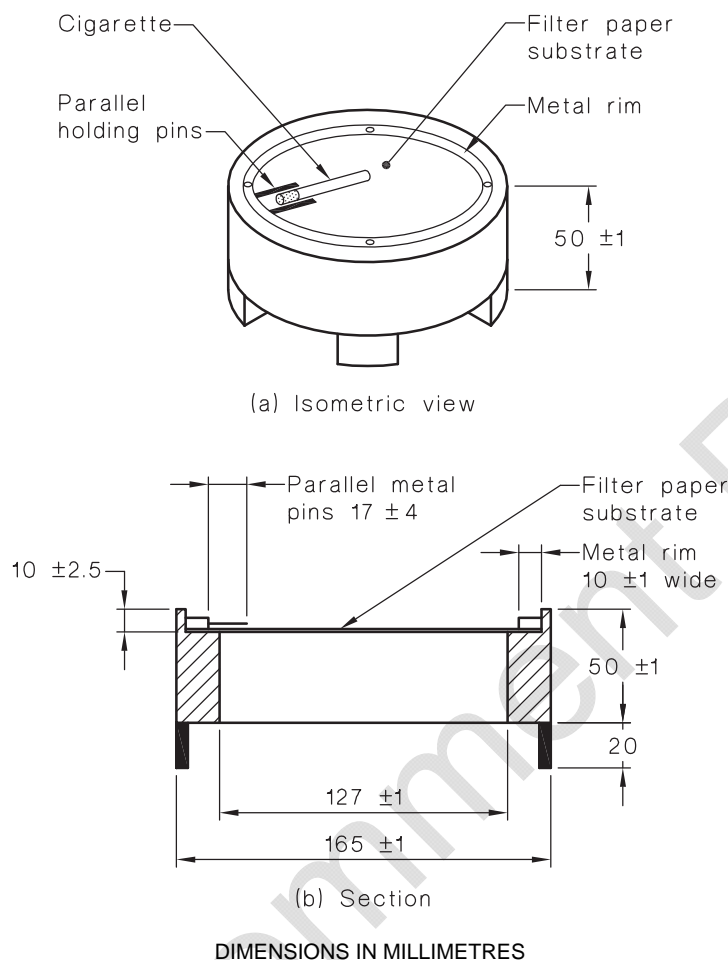


Figure 2 – Diagram of test specimen, filter paper holder, metal pins and metal rim

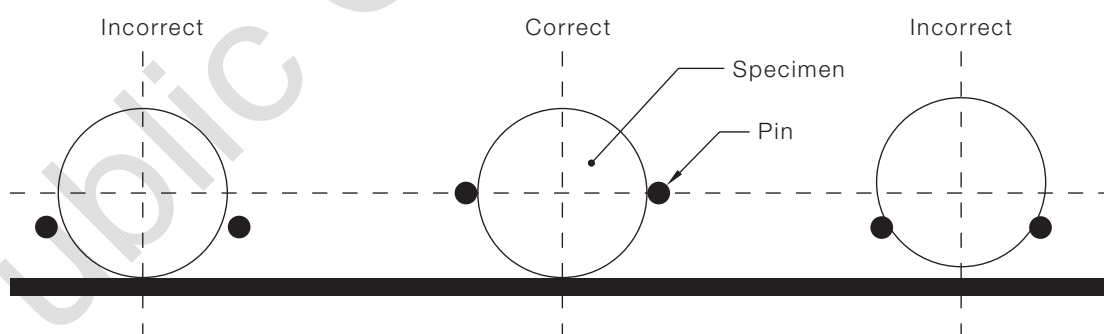


Figure 3 – Cross sectional view of the relative positions of the two pins and the specimen

### 6.3 Determination of air stability

Stability of air inside the test chamber shall be determined daily by placing a lit specimen in the test position on three or more layers of filter paper then closing the chamber door. Air movement in the chamber shall be observed to ensure that smoke being emitted by the specimen is rising vertically and is not showing turbulence within nominally 150 mm above the lit end of the specimen. If turbulence is noted, then—

- (a) the test chamber shall be checked for leaks;
- (b) the test chamber locations shall be evaluated for excess air flow in the laboratory; and

(c) the air flow of the exhaust system shall be evaluated as the source of the disturbance.

## 6.4 Test facility conditioning

The humidity and temperature sensors used to record environmental conditions in the conditioning room or the chamber and test room shall be checked for accuracy at least once a week. The accuracy of the sensors shall be taken into consideration when setting the required conditions.

# 7 TEST SPECIMENS AND STANDARD SUBSTRATE ASSEMBLIES

## 7.1 General

The test specimens and substrate assemblies are sensitive to contamination. Test specimens shall be handled only by the last nominal 25 mm of the end of the specimen that is not to be lit. The sheets of filter paper shall not be handled in the vicinity where the specimen will contact the paper during a test. In all cases, the materials shall be handled with dry hands only.

*NOTE – The use of clean, dry, non-powdered surgical gloves can mitigate incidental contamination of the test materials while maintaining operator dexterity.*

## 7.2 Specimens

### 7.2.1 Storage

Test specimens shall be protected from physical or environmental damage while in handling and storage. It is important that the specimens not be crushed or deformed in any manner. Measures shall be taken to ensure that the specimens are not contaminated while in storage and they shall be protected from degradation by insects. If the specimens are to be stored by the testing laboratory for more than one week, they shall be placed in a freezer at 0°C to –20°C reserved for the sole protection of specimens to minimize the risk of contamination. The specimen shall be brought to ambient temperatures within sealed packet prior to conditioning.

### 7.2.2 Marking of test samples

Prior to testing, test specimens shall be marked, using a #2, HB or softer graphite pencil or other marking device, 5 ±1 mm and 15 ±1 mm from the end of the specimen that will be lit. These marks are used to establish the start and completion of a uniform pre-burn period, respectively. Neither the process of marking specimen nor the mark itself shall significantly affect the specimen burn rate.

## 7.3 Substrate

### 7.3.1 General

The substrate consists of nominal 150 mm diameter circles of ash-free cellulosic filter paper that meets the requirements of Clause 7.3.2. Substrates are formed by placing multiple layers of filter paper into the holder assembly, then placing the metal rim on top to ensure good contact between the layers.

### 7.3.2 Filter paper criteria<sup>1</sup>

Filter paper samples to be used in this test method shall meet the following criteria:

- (a) For paper from a manufacturer's batch to be used in testing, the mean mass of 15 sheets of the conditioned filter paper shall be 26.1 ±0.5 g. This shall be determined by weighing five samples of 15 sheets, each sample being from a different box from the manufacturer's batch. The standard deviation of the five samples shall be no more than 0.3 g.
- (b) For paper from a manufacturer's batch to be used in testing, the mean mass of 15 sheets of the dried filter paper shall be 24.7 ±0.5 g. This shall be determined by weighing five samples of 15 sheets, each sample being from a different box from the manufacturer's batch. Each set of 15 sheets shall have been

<sup>1</sup> At the time of publication, Whatman #2 or identical has been found to be a suitable filter paper for this substrate.

stored at  $60 \pm 2^\circ\text{C}$  for at least 16 h, placed in a sealed plastic bag upon removal from the oven, cooled to  $23 \pm 3^\circ\text{C}$ , and weighed within 3 min of opening the bag. The standard deviation of the five samples shall be no more than 0.3g.

- (c) Pending assurance of the availability of filter paper that meets the specifications in Items (a) and (b), the following provisions shall apply:
- (i) Paper with a mean conditioned mass of 25.1 to 26.6 g (for 15 sheets) and a mean dry mass of 23.7 to 25.2 g shall be used for the testing of specimens.
  - (ii) The standard deviation of at least five samples (dry and conditioned) shall not exceed 0.4 g.

## 8 CONDITIONING

### 8.1 Specimens

Specimens shall be removed from their packs and conditioned at a relative humidity of  $55 \pm 5\%$  and a temperature of  $23 \pm 2^\circ\text{C}$  for at least 24 h prior to testing. The specimens shall be placed in a clean, open container, with the number of specimens being sufficiently small as to enable free air access to the specimens, for example, a maximum of 20 specimens in a 250 mL beaker.

### 8.2 Filter paper

Boxes of filter paper shall be conditioned at a relative humidity of  $55 \pm 5\%$  and a temperature of  $23 \pm 2^\circ\text{C}$  for at least one week prior to testing. The top of each 100 sheet box of filter paper shall be removed prior to being placed in the conditioning room. The top opening of the box shall not be obstructed. The paper sheets need not be removed from the box. Alternatively, sets of no more than 15 sheets of filter paper shall be conditioned at a relative humidity of  $55 \pm 5\%$  and a temperature of  $23 \pm 2^\circ\text{C}$  for at least 8 h prior to testing. These filter paper sets shall have been removed from the box and shall be stored upright with at least 1 mm spacing between the sets to enable free access of air to the specimens.

## 9 PROCEDURE

The test procedure for each specimen shall be as follows:

- (a) Turn on the exhaust system designated for removal of test combustion products 30 min prior to the beginning of the testing session and adjust to the appropriate exhaust rate (see Clause 5.8).
- (b) Ensure that the filter paper holder is in the test chamber at the geometric center of its bottom.
- (c) Cover the chimney on the test chamber.
- (d) Select the number of layers of filter paper for the scheduled determinations using the procedure in Appendix A.
- (e) Immediately before testing, place the required number of filter papers on the filter holder and place the metal test rim on top. Ensure that filter papers are lying flat and are in intimate contact with adjacent sheets. Discard filter papers that will not lie flat.
- (f) Place the specimen holder on the floor of the chamber, just forward of the center of the filter paper holder.
- (g) Without delay, remove a specimen from the conditioned space. Insert the unmarked end of the specimen into the specimen ignition system and hold it in a horizontal position. Turn on the air draw. Hold the hot wire coil just in front of the marked end of the specimen for as long as is necessary to achieve uniform ignition without passing the 5 mm mark. During the ignition process, the specimen shall be rotated as needed to obtain an approximately symmetrical burn.
  - (i) If the operator is performing concurrent determinations in multiple test chambers, the operator shall not light a third specimen until each of the first two specimens has been placed on its respective set of filter papers. No more than two specimens shall be in the pre-burn stage at any time.
  - (ii) This provision need not be followed by an individual test operator if that operator has demonstrated that lifting the restriction does not introduce error that significantly changes either the measured extinction propensity or the uncertainty of that measurement. This determination shall be the responsibility of the testing laboratory.

- (h) Holding the specimen vertically, coal end up, transport the specimen to the test chamber.

*NOTE – It has been found that holding a 600 mL beaker over the lit specimen is helpful in mitigating the likelihood of a foreign object or room air current impacting the specimen during transport and thus leading to the need to terminate the determination.*

- (i) Place the lit specimen, in a horizontal position with the specimen paper seam up, in the specimen holder.
- (j) Simultaneously close the door and remove the chimney cover.
- (k) If the specimen self-extinguishes while in the specimen holder, terminate the determination and record the results as a self-extinguishment, noting that this occurred in the holder.

This attempt shall count as a valid determination. The test operator shall be permitted to re-use this set of filter paper sheets.

- (l) When the specimen has burned to the 15 mm mark, simultaneously cover the chimney and open the chamber door, gently remove the specimen from the holder, and move the holder to the front corner of the test chamber.
- (m) With the specimen paper seam turned up, gently lay the specimen with the ash still attached onto the top of the filter paper so that the non-ignited end is placed between the appropriately sized specimen anti-roll parallel metal pins. (See Figure 3). Do not drop the specimen onto the filter papers and do not press the coal into the papers. If the ash falls off during any part of the transport or positioning process, terminate the determination and begin again; do not count the attempt.
- (n) Without delay, simultaneously remove the chimney cover and gently close the door.
- (o) Observe the burning specimen. The smoke plume near the specimen must remain undisturbed. If it does not, the chamber and exhaust system shall be readjusted as in Clause 6.3. If readjustment has resulted in an undisturbed plume, continue with the test. If after adjustment a disturbed plume continues to be present, disregard those test results and conduct a calibration of the test chamber (see Clause 6.3).
- (p) Record the following results:
- (i) Whether any of the tobacco column burns to or past the front plane of the tipping paper (filter tip cigarettes) or past the tips of the metal pins (see Clause 5.5) for non-filter tip specimens.
  - (ii) Whether the burning ceases before reaching the front plane of the tipping paper (filter tipped specimens) or to or past the tips of the pins for non-filter tip specimens.
  - (iii) The observations stated in Clause 9, Items (k) and (o).
- (q) Ensure that neither the specimen nor the filter papers are burning.
- (r) Open the test chamber door to allow air to circulate throughout its volume. After the chamber has cleared, remove the specimen and filter paper.
- (s) The specimen and sheets of filter paper shall be completely extinguished by smothering or by application of water. Dispose of the extinguished specimen and filter paper safely into a closed metal container.
- (t) Prepare for the next determination.
- (u) Repeat the determination 40 times for each batch of cigarette specimens to be tested.
- (v) Calculate the percentage of determinations in which the specimens exhibited full-length burns. This percentage is the test result.
- (w) Repeat this procedure on other substrate assemblies if required.

## 10 TEST REPORT

Results shall be reported for one test procedure on each of the three substrates if required, as described in Appendix A.

Report the following information for each test procedure:

- (a) Laboratory name and name of person performing the determinations.
- (b) Reference to this test method; i.e. AS 4830.
- (c) Date and start time of each determination.
- (d) Specimen identification.
- (e) Number of layers of filter paper per determination.
- (f) The percentage of full length burns.
- (g) The observations noted in Clause 9, Items (k) and (o).

Public Comment Draft

# APPENDIX A – PROCEDURE FOR SELECTION OF SUBSTRATE ASSEMBLIES FOR TESTING

(Normative)

## A1 General

The performance of a specimen design on all three substrate assemblies shall be reported as specified in Paragraph A3.

## A2 Substrate selection

### A2.1 General

The specimen shall be tested on a substrate with either 15 layers or with 3 and 10 layers depending on the availability of test data. The selection criteria for the substrate is specified in Paragraphs A2.2 and A2.3.

### A2.2 Performance data not available

In the absence of any information about the likely performance of the specimen design, testing shall begin with 15 layers of filter paper as follows:

- (a) If full length burning of the specimen is observed in over 90% of the determinations with 15 layers, then it shall be presumed that testing on 3 or 10 layers would also produce full length burns and no testing on those substrate assemblies shall be performed.
- (b) If full length burning is observed in under 90% of the determinations with 15 layers, then testing shall proceed using 10 layers. If full length burning is observed in over 90% of the tests with 10 layers, then it shall be presumed that testing on 3 layers would also produce full length burns and no testing on those shall be performed. If full length burning is observed in under 90% of the tests with 10 layers, then testing shall proceed using 3 layers.

### A2.3

If there is information about the likely performance of a specimen design that suggests a high extinction propensity, the test operator shall have the option to begin testing with 10 or 3 layers of filter paper as follows:

- (a) Starting with 10 layers. If full length burning is observed in over 10 % of the tests with 10 layers, testing shall proceed using 15 layers. It shall be presumed that testing on the assemblies using 3 layers would also produce full length burns and no testing on that substrate assembly shall be performed. If full length burning is observed in under 10 % of the tests with 10 layers, then testing using 15 layers shall not be performed and testing shall proceed using 3 layers.
- (b) Starting with 3 layers. If full length burning is observed in under 10 % of the tests with 3 layers, then testing using 10 and 15 layers shall not be performed. If full length burning is observed in over 10 % of the tests with 3 layers, testing shall proceed using 10 layers. If full length burning is observed in over 10% of the tests with 10 layers, testing shall proceed using 15 layers.

## A3 Reporting

The test report (see Clause 10) shall classify the performance of a specimen on all 3 types of substrate assemblies. For those assemblies on which no testing was performed, as prescribed in Paragraphs A2.2 and A2.3, the outcome of the trial shall be described as 'substrate not required to be tested'.

It should be recognized that because the result is binomial (pass/fail), this test method is inherently subject to statistical variability. Confidence in a given result can be increased by repeated testing. An example of repeatability and reproducibility limits is provided in Appendix B.

## APPENDIX B – REPEATABILITY AND REPRODUCIBILITY LIMITS

(Informative)

### B1 Abstract

The repeatability and reproducibility of a test method nearly identical to this was determined during an interlaboratory evaluation conducted according to ASTM E691. The only difference was that the specimens were supported in a vertical rather than a horizontal position during the pre-burn period. The evaluation involved 9 laboratories, 5 specimen types and 3 substrates, each with a different number of filter papers.

### B2 Repeatability and reproducibility limits

From the ASTM evaluations, the calculated repeatability,  $r$ , and reproducibility,  $R$ , limits have been established for 40 determinations in a test and the percentages of specimens that produced full-length burns ( $P$ ). These results are shown in Table B1.

**Table B1 –Repeatability and reproducibility limits for a test involving forty replicate determinations**

$P\%$	$r\%$ (n)	$R\%$ (N)
5 or 95	10% (4)	11(4)
10 or 90	13(5)	16(6)
20 or 80	18(7)	21(8)
30 or 70	20(8)	24(10)
40 or 60	22(9)	26(10)
50	22(9)	26(10)

LEGEND:

- $r$  = band within which differences among test results (same laboratory) will fall about 95% of the time
- $R$  = band within which differences among test results from different laboratories will fall about 95% of the time.
- $n$  = number of full-length burns within which differences among repeat test results (same laboratory) will fall about 95% of the time.
- $N$  = number of full-length burns within which differences among repeat test results from different laboratories will fall about 95% of the time.

Intervals containing negative values were omitted.