Designation: E2574/E2574M – 17

An American National Standard

Standard Test Method for Fire Testing of School Bus Seat Assemblies[1]

This standard is issued under the fixed designation E2574/E2574M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This is a fire-test-response standard.

1.2 This test method assesses the burning behavior of upholstered seating used in school buses by measuring specific fire-test responses when a school bus seat specimen is subjected to a specified flaming ignition source under normally ventilated conditions.

1.3 The ignition source is a gas burner.

1.4 This fire test is primarily useful to distinguish products that, when exposed to an ignition source, will become fully involved in fire from other products that will not.

1.5 Data are obtained describing the burning behavior of the seat assemblies from a specific ignition source until all burning has ceased.

1.6 This test method does not provide information on the fire performance of upholstered seating in fire conditions other than those conditions specified.

1.7 The burning behavior is visually documented by photographic or video recordings, whenever possible.

1.8 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.9 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products or assemblies under actual fire conditions.*

1.10 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

1.11 *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.*

1.12 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D5132 Test Method for Horizontal Burning Rate of Polymeric Materials Used in Occupant Compartments of Motor Vehicles

E176 Terminology of Fire Standards

E1537 Test Method for Fire Testing of Upholstered Furniture

E1590 Test Method for Fire Testing of Mattresses

E2061 Guide for Fire Hazard Assessment of Rail Transportation Vehicles

E2067 Practice for Full-Scale Oxygen Consumption Calorimetry Fire Tests

E2257 Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies

F1550 Test Method for Determination of Fire-Test-Response Characteristics of Components or Composites of Mattresses or Furniture for Use in Correctional Facilities after Exposure to Vandalism, by Employing a Bench Scale Oxygen Consumption Calorimeter

IEEE/ASTM SI 10 American National Standard for Metric Practice

2.2 *National Safety Council Standard:*[3]

School bus seat upholstery fire block test, approved by the National Conference on School Transportation as part of the National Standards for School Buses and National

[1] This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.17 on Transportation.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from National Safety Council (NSC), 1121 Spring Lake Dr., Itasca, IL 60143-3201, http://www.nsc.org.

***A Summary of Changes section appears at the end of this standard**

Standards for School Bus Operations

2.3 *Federal Motor Vehicle Safety Standards:*[4]

FMVSS 222 School Bus Passenger Seating and Crash Protection, U.S. Code of Federal Regulations, Title 49, Transportation, Subtitle B, Chapter V, Part 571, Subpart B.

FMVSS 302 Flammability of Interior Material, U.S. Code of Federal Regulations, Title 49, Transportation, Subtitle B, Chapter V, Part 571, Subpart B

2.4 *NFPA Standard:*[5]

NFPA 286 Standard Method of Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

3. Terminology

3.1 For definitions of terms used in this test method associated with fire issues, refer to the terminology contained in Terminology E176.

3.2 *Definitions:*

3.2.1 *screening test, n—as related to fire*, a fire-response test performed to determine whether a material, product, or assembly *(a)* exhibits any unusual fire-related characteristics, *(b)* has certain expected fire-related characteristics, or *(c)* is capable of being preliminarily categorized according to the fire characteristic in question.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *newspaper, n—as related to this test method*, standard size double sheets of newsprint, with black print and no colored ink or surface treatment.

3.3.2 *paper bag, n—as related to this test method*, a bag constructed of unbleached (brown, #30) kraft paper having four sides and a bottom, with an open top, and held together with adhesive.

4. Summary of Test Method

4.1 A mock-up of a school bus is constructed with three rows of actual seats.

4.2 A gas burner ignition source is used.

4.3 Each test consists of two trials. In each trial a gas burner ignition source is placed at a specified location to ignite the middle row of seats and is ignited.

4.4 A different gas burner is used for the top of the seat and for the bottom of the seat.

4.5 Once flame extinction has occurred, the time to flame extinction, the extent of fire spread (within the seat and to the other seats if applicable) and the mass loss of the seat are assessed.

5. Significance and Use

5.1 In this test method fire test response characteristics of a school bus seat assembly are assessed following ignition by a square gas burner.

5.2 This test method is similar in concept to a fire test currently used, and which has been in such use for many years, as the industry standard for flammability testing of school bus seats (see Appendix X1). However, in this test method the paper bag has been replaced by a gas burner as the ignition source.

5.3 The US federal government has issued a flammability test applicable to interior materials in road vehicles, FMVSS 302. FMVSS 302 remains the only regulatory test for assessing fire-test-response characteristics of school bus seats.

5.4 ASTM has issued Test Method D5132 in order to provide a more standardized way of conducting FMVSS 302.

5.5 The test method described in this document provides a significantly higher challenge to school bus seats than the FMVSS 302 federal regulatory test. Therefore, any seat assembly that performs acceptably in this test is likely to meet the requirements of FMVSS 302.

5.6 It is clear that those seat assemblies that exhibit little or no flame spread, short times to flame extinction and little mass loss in this test are likely to exhibit improved performance in an actual fire situation compared to seat assemblies that burn vigorously and have high mass loss.

5.7 This test is primarily useful to distinguish products that, when exposed to these fire conditions, will become fully involved in fire from other products that will not.

6. Apparatus: Test Chamber

6.1 *General*—The test chamber shall be either an actual section of a school bus or it shall comply with the cross section requirements of 6.2.2. Fig. 1 describes the test chamber.

6.2 *Cross Section:*

6.2.1 Use a test chamber that has the same cross section as the body of an actual school bus, in which the seats are intended to be used, with a rear section on each end.

6.2.2 The test chamber cross section shall be 2300 ± 30 mm [91 ± 1 in.] in width by 1900 ± 80 mm [75 ± 3 in.] in height.

6.3 The test chamber shall have a door, which is not intended for use to provide ventilation, in the center of each end of the test chamber. The door shall be 970 ± 80 mm [38 ± 3 in.] in width by 1270 ± 80 mm [53 ± 3 in.] in height and it shall include a latch to keep the door closed during the test. See Fig. 1.

6.4 *Length*—The length of the test chamber shall be such as to allow three rows of seats at the minimum spacing recommended by the installer or as required by FMVSS 222. See Fig. 1, Detail A.

6.4.1 In order for different types of seats to be able to be tested in the same chamber, a length tolerance of plus 1140 mm [45 in.] shall be allowed.

6.5 *Ventilation*—There shall be two ventilation openings in the test chamber, one at each end. Each opening shall have an opening area of 0.210 ± 0.016 m^2 [325 ± 25 $in.^2$]. The bottom of the opening shall be 760 ± 80 mm [30 ± 3 in.] above the chamber floor.

[4] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[5] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

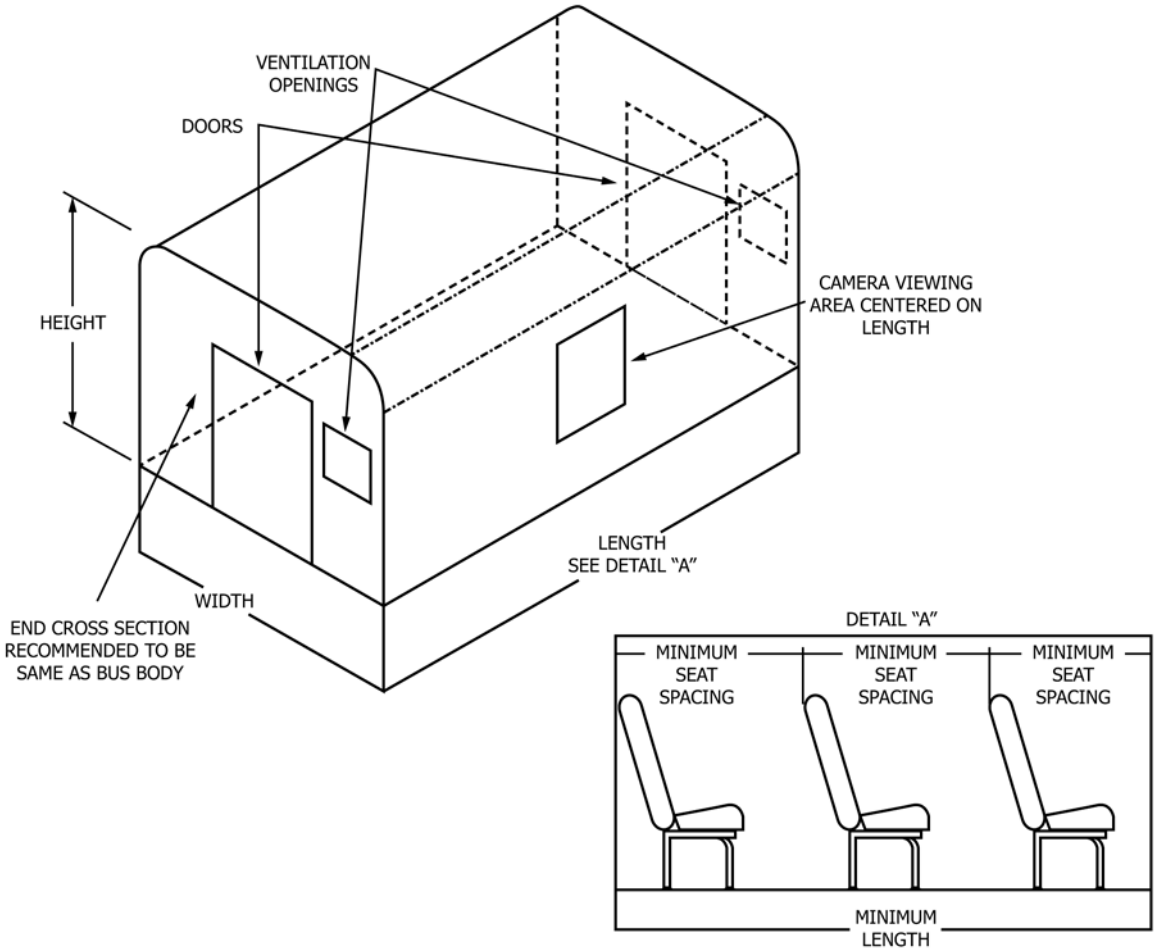


FIG. 1 Test Chamber

6.5.1 There shall be no ventilation openings along the length of the test chamber.

6.5.2 There shall be no forced air ventilation system. Baffles shall be used to prevent wind from blowing directly into the ventilation openings.

6.6 *Camera View Area*—A viewing area (such as an opening covered with a glazing material) shall be provided at the midpoint of the chamber length for camera viewing. The opening shall allow the camera to view the seat parallel to the seat width. See Fig. 1.

7. Ignition Sources

7.1 *Top of the Seat:*

7.1.1 For the top of the seat use the square gas burner described in Figs. 2-7.

NOTE 1—This is essentially the same burner used in Test Method E1537, except for the arm.

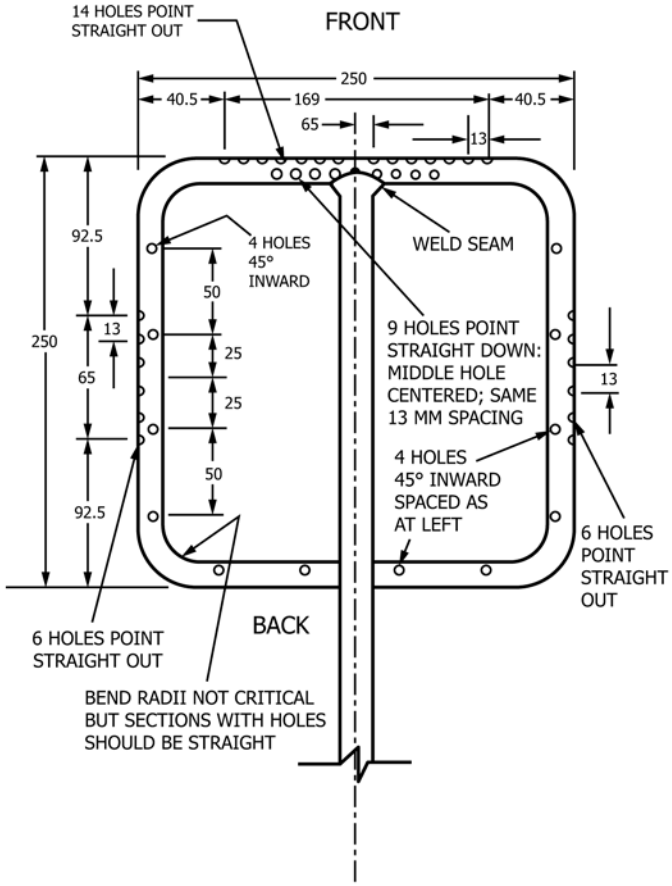
7.1.2 Construct the 250 ± 10 by 250 ± 10 mm [approximately 10 by 10 in.] square burner of 13 ± 1 mm [0.5 in.] outside diameter stainless steel tubing, with 0.89 ± 0.05 mm [0.035 in.] wall thickness (see Fig. 2). The front side shall have 14 holes pointing straight out and spaced 13 ± 1 mm [0.5 in.] apart and nine holes pointing straight down and spaced 13 ± 1 mm [0.5 in.] apart. The right and left sides shall have six holes pointing straight out and spaced 13 ± 1 mm [0.5 in.] apart and four holes pointing inward at a 45° angle and spaced 50 ± 2 mm [2 in.] apart. All holes shall be of 1 ± 0.05 mm [0.039 in.] diameter (see Fig. 2, Fig. 3 and Fig. 4). The burner shall have an arm 288 ± 10 mm [11.3 ± 0.4 in.] long and welded on to the rear of the front side (see Fig. 3) at a 30° angle. The arm shall then include a vertical length before extending horizontally for a length appropriate for the stand being used (see Figs. 5-7). Mount the burner on an adjustable height pole at a height of 460 ± 13 mm [18 ± 0.5 in.] and balance it by a counterweight or other appropriate mechanism (see Fig. 4).

NOTE 2—**Warning**—It is common for the burner holes to become clogged up following a test. Inspect burner holes after each test, and clean thoroughly, if required. Take care not to enlarge the holes when cleaning them.

7.2 *Under the Seat:*

7.2.1 For use underneath the seat the ignition source shall be a gas burner with a nominal 305 by 305 mm [nominal 12 by 12 in.] porous top surface as shown in Fig. 8. This material, through which the gas is supplied, shall be a minimum 102 mm [4 in.] layer of white Ottawa sand used to provide the horizontal surface through which the gas is supplied.

NOTE 3—This is the same burner used in Test Method E2257 and in NFPA 286.



NOTE 1—All tubing 13 mm outside diameter, stainless steel, 0.89 mm wall thickness.

NOTE 2—All holes 1 mm in diameter.

NOTE 3—All units are mm unless otherwise noted.

NOTE 4—See text for tolerances.

FIG. 2 Plan View of Square Gas Burner

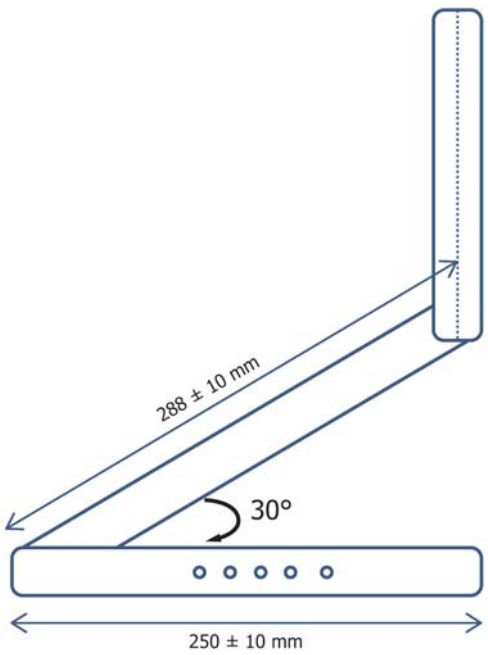


FIG. 3 Side View of Square Gas Burner

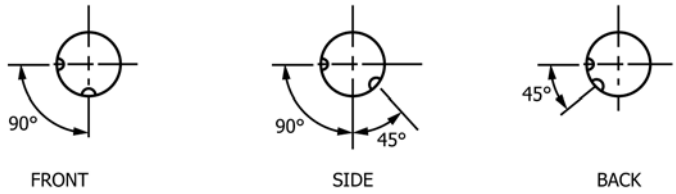


FIG. 4 Cross-sectional View of Each Side of Square Gas Burner

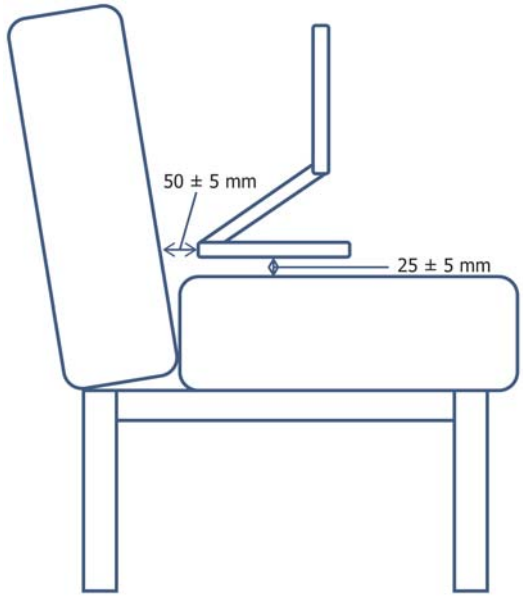


FIG. 5 Top Burner Placement – Side View

7.2.2 The top surface of the burner through which the gas is applied shall be located horizontally 300 ± 50 mm [12 ± 2 in.] above the floor.

7.3 For both ignition sources use propane gas, with a known net heat of combustion of 2050 ± 50 kJ/mol, as a fuel for this ignition source. Meter the flow rate of propane and keep it constant throughout the test.

7.4 For both ignition sources, use the gas burner at a flow rate of 19.5 ± 0.25 L/min for a total of 120 s. Measure the gas flow rate at a pressure of 101 ± 5 kPa (standard atmospheric pressure, measured at the flow gage) and a temperature of 20 ± 5°C.

8. Mass Measurements

8.1 Use a balance that is capable of assessing the mass of the test specimen and of the individual test specimen components with a precision of ±150 g.

8.2 Calibrate the balance regularly to ensure its accuracy.

9. Test Specimens

9.1 The test specimen shall be a fully-assembled seat.

9.2 Measure the weight of all padding and upholstery prior to assembly.

9.3 Measure the weight of the non-combustible components of the seat (steel frame, etc.). Record this weight.

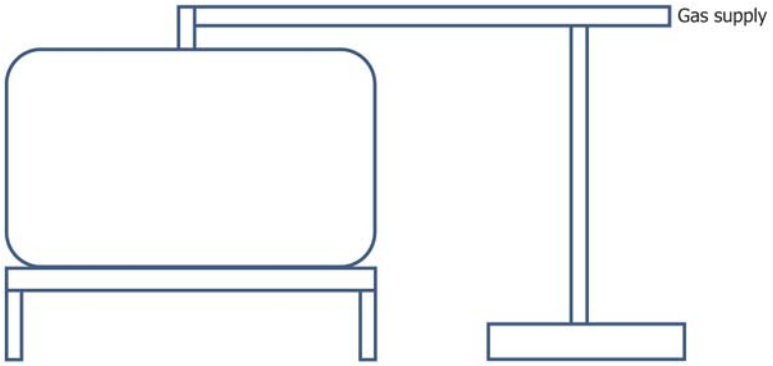


FIG. 6 Top Burner Placement – Rear View

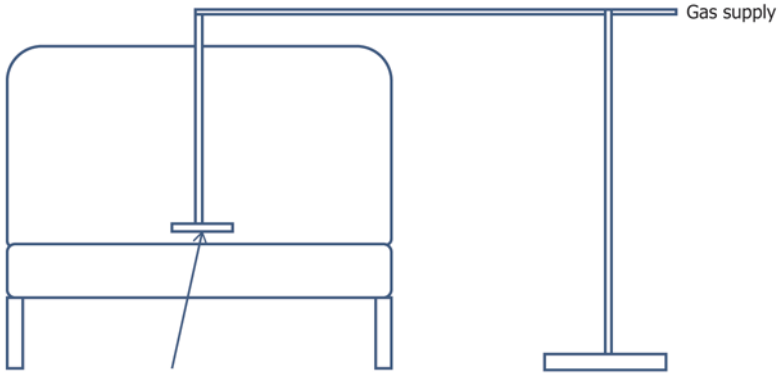


FIG. 7 Top Burner Placement – Front View

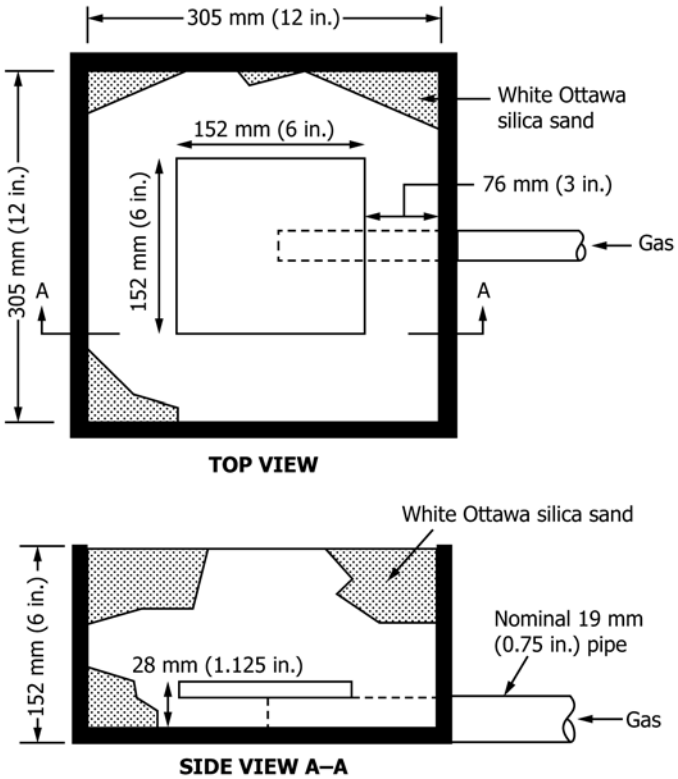


FIG. 8 Ignition Burner for Use Under Seat

9.4 Record the weight of the fully-assembled seat. This shall be done in one of two ways: *(a)* weighing the complete seat assembly or *(b)* weighing each component separately and calculating the total weight by summing the weight of each of the combustible and non-combustible components.

10. Preparation of Apparatus

10.1 Prior to running each trial, ensure that the test chamber is clean and free of debris.

11. Conditioning

11.1 Condition specimens to equilibrium (constant weight) at an ambient temperature of 23 ± 3°C [73 ± 5°F] and a relative humidity of 50 ± 5 % for a period of 24 h prior to the test.

12. Procedure

12.1 Install three rows of seats in the test chamber. The spacing between seat rows shall be the minimum spacing recommended by the installer or the spacing required by FMVSS 222. The exact spacing between rows shall be reported.

12.2 Seats shall be perpendicular to the dimension indicated as "length" in Fig. 1.

12.3 Install seats so that seat frames will not fall during the test.

12.4 Seat width shall be determined so that a maximum passenger capacity per row (2 seats) for the seat style is tested.

12.5 A complete test shall consist of two trials.

12.6 The first trial shall consist of the application of the ignition source in 7.1 at the ignition position on top of the seat assembly. After each trial, the test chamber shall be evacuated and the debris shall be removed before the next trial is performed.

12.7 The first trial shall consist of the application of the ignition source in 7.1 at the ignition position on top of the seat assembly.

12.7.1 Position the burner at the center of the seat assembly, 50 ± 5 mm [2 ± 0.2 in.] away from the seat assembly back and 25 ± 5 mm [1 ± 0.2 in.] above the seating surface.

12.7.2 The widest seat in the center row shall be tested.

12.8 The second trial shall consist of the application of the ignition source in 7.2 at the ignition position beneath the seat assembly.

12.8.1 Position the burner on the floor under the seat, centered on width so that the gas burner flame is directed towards the seat upholstery and not towards a metal frame.

12.8.2 The widest seat in the center row shall be tested.

12.9 Ignite the gas burner.

12.10 The test period shall begin once the ignition source has been ignited and end once all flaming of the specimen has ceased, including any flaming of the specimen at the ignition source, unless safety considerations dictate an earlier termination.

12.11 A new set of seats shall be used for each trial.

12.12 After the completion of each trial, weigh the entire seat assembly, excluding any loose material which has fallen off the seat onto the floor.

12.13 After the completion of each trial, the test chamber shall be evacuated and the debris shall be removed before the next trial is performed.

13. Report

13.1 For each trial, report the information required in 13.2 through 13.6.

13.2 Detailed description of the seat assembly being tested, including the weights and how those weights were determined.

13.3 Detailed description of the actual test layout, including seat spacing and test chamber dimensions.

13.4 Time elapsed between ignition and cessation of flaming (in s).

13.5 The mass loss of the seat upholstery (difference between the total assembly mass before and after the test) (in g).

13.6 Whether flame has spread from the seat with the ignition source to adjacent seats or adjacent surfaces.

13.7 Whether melting of the seat materials has occurred and whether it has resulted in flaming drips beneath the seat.

14. Precision and Bias

14.1 The precision and bias of this test method has not yet been established.

14.2 Precision and bias information is available for Test Method E1537 and for Test Method E2257.

15. Keywords

15.1 bus; fire test; flame spread; gas burner; paper bag; school bus; transportation

ANNEX

(Mandatory Information)

A1. OPTIONAL HEAT RELEASE MEASUREMENTS

A1.1 If optional heat release measurements are to be conducted, they shall be conducted in accordance with the requirements of Practice E2067.

APPENDIXES

(Nonmandatory Information)

X1. NATIONAL SAFETY COUNCIL PAPER BAG SCREENING TEST (for reference only, see also 2.2)

X1.1 *Ignition Source*:

X1.1.1 The ignition source for each trial in an optional screening test shall be a paper bag with approximate dimensions of 180 by 280 by 460 mm [7 by 11 by 18 in.], containing enough double sheets of newspaper (black print only, approximately 560 by 710 mm [22 by 28 in.] in size) so that the total combined mass of paper is 200 ± 15 g [7 ± 0.5 oz]. Crumple the newsprint loosely, to fit inside the bag.

NOTE X1.1—The sheets of newspaper used are best free of photographs and have a typical amount of writing.

X1.1.2 The dimensions of the paper bag and newsprint shall be permitted to vary, but the total mass of paper shall fall within the limits specified in X1.1.1.

X1.2 *Balance*—Weigh the mass of paper by using a balance that is capable of assessing the mass of the ignition source with a precision of ±15 g.

X1.3 *Apparatus*—The test apparatus shall be the chamber described in Section 6.

X1.4 *Test Specimen*—The test specimens shall be fully assembled seats as described in Section 9.

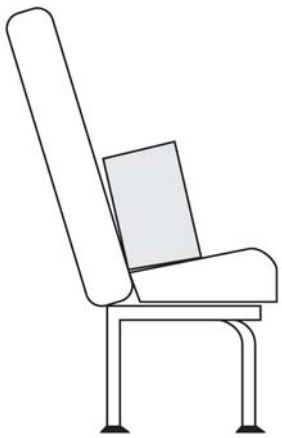


FIG. X1.1 Ignition Position A

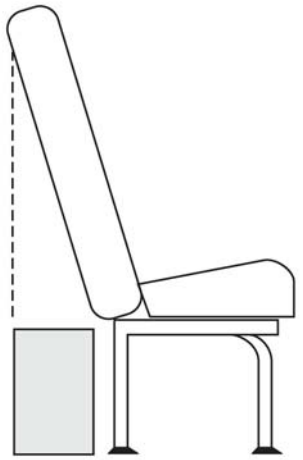


FIG. X1.2 Ignition Position B

X1.5 *Apparatus Preparation*—Prior to running each trial, ensure that the test chamber is clean and free of debris.

X1.6 *Conditioning*:

X1.6.1 Condition specimens to equilibrium (constant weight) at an ambient temperature of 23 ± 3°C [73 ± 5°F] and a relative humidity of 50 ± 5 % for a period of 24 h prior to the test.

X1.6.2 Condition the paper ignition source to equilibrium (constant mass) at an ambient temperature of 23 + 3°C [73 + 5°F] and a relative humidity of 50 + 5 % for a period of 24 h prior to the test.

X1.7 *Procedure*:

X1.7.1 Install three rows of seats in the test chamber. The spacing between seat rows shall be the minimum spacing recommended by the installer or the spacing required by FMVSS 222. The exact spacing between rows shall be reported.

X1.7.2 Seats shall be perpendicular to the dimension indicated as “length” in Fig. 1.

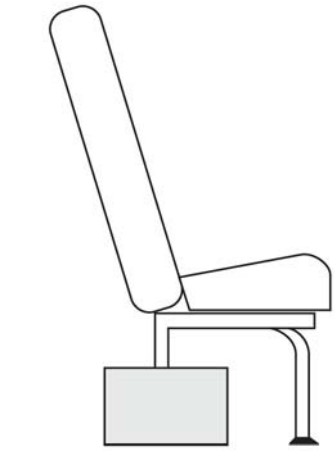


FIG. X1.3 Ignition Position C

X1.7.3 Install seats so that seat frames will not fall during the test.

X1.7.4 Seat width shall be determined so that a maximum passenger capacity per row (2 seats) for the seat style is tested.

X1.7.5 A complete test shall consist of three trials.

X1.7.6 Each trial shall consist of the application of the ignition source at one of the three ignition positions in a seat assembly. After each trial, the test chamber shall be evacuated and the debris shall be removed before the next trial is performed.

X1.7.7 For each separate trial, position the ignition source at one of the positions outlined in X1.7.8 through X1.7.10. In each case, the widest seat in the center row shall be tested.

X1.7.8 *Ignition Position A*—Position the ignition source with the long dimension in contact with the seat cushion and touching the seat back. Center the bag on the top of the seat cushion. See Fig. X1.1.

X1.7.9 *Ignition Position B*—Position the ignition source on the floor, behind the seat, with the long dimension on the floor and parallel to the seat width, centered on width so that the rear of the bag does not extend beyond the rear seat back. See Fig. Fig. X1.2.

X1.7.10 *Ignition Position C*—Position the ignition source on the floor, on the aisle side of the seat, with the long dimension on the floor and perpendicular to the seat width, so that the bag is touching the seat leg, with the centerline of the bag at the center of the seat back. See Fig. X1.3.

X1.7.11 Use a wooden match to light the ignition source at each position. The match shall be removed once the ignition of the paper source has been verified.

X1.7.12 The test period shall begin once the ignition source has ignited and end once all flaming has ceased, including any flaming at the ignition source.

X1.7.13 A new set of seats shall be used for each trial.

X1.8 Report the results in the same way as the results of the test with the gas burner are reported (see Section 13).

X2. HEAT RELEASE FROM THE PAPER BAG IGNITION SOURCE IN Appendix X1

X2.1 Three heat release tests were conducted by igniting the paper bag ignition source in this test and assessing heat release rate (in kW) and total heat released, in accordance with the guidelines of Practice E2067.

X2.2 The results indicated that a peak hat release rate of 33.8 kW was obtained, with a standard deviation of 7.7 kW and a relative standard deviation of 22.7 %. The range of peak heat release rate values was 28.5 to 42.6.

X2.3 The results also indicated that a total heat release of 2.3 MJ as obtained, with a standard deviation of 0.3 MJ and a relative standard deviation of 13.1 %. The range of total heat release values was 2.0 to 2.6.

X2.4 See Table X2.1 for a comparision of some gas burners. The proposed gas burner heat release rate and total heat released is similar to those of the paper bag used in the school bus test.

TABLE X2.1 Gas Burner and Paper Bag Intensities

Units	ASTM E1537	ASTM E1590	This test method	School bus paper bag
		Propane Gas Flow		
kW/[L/min]	1.485	1.485	1.485	
L/min	13	12	19.5	
		Input		**Pk HRR**
kW	19.3	17.8	29.0	33.8
kJ/s	19.3	17.8	29.0	33.8
BTU/h	65 900	60 800	98 900	115 400
		Time for gas burner to be applied		
s	80	180	120	

X3. NATIONAL SAFETY COUNCIL CRITERIA FOR PAPER BAG SCREENING TEST

X3.1 The paper bag seat test requirements used by the National Safety Council are as shown in X3.1 through X3.4.

X3.2 For each ignition source position used, the seat tested must meet all of the following criteria.

X3.3 The maximum time from ignition to cessation of flaming shall be 8 min.

X3.4 Flame shall not spread to any other seat with ignition source in Position A and Position C.

X3.5 Weight loss shall not exceed 10 % of the pretest weight of padding upholstery.

X4. USE OF THE PAPER BAG SCREENING TEST IN Appendix X1

X4.1 A number of U.S. state and local jurisdictions, including the states of Delaware, Iowa, Mississippi, Missouri, Nebraska, Nevada, North Carolina, Ohio, Oregon, Tennessee, Texas and Washington, as well as some Canadian provinces, mandate the use of the paper bag test method described in this appendix, and the National Safety Council criteria from Appendix X3.

X4.2 The school bus manufacturing industry uses the paper bag screening test, on a voluntary basis, to assess the fire-test-response characteristics of the seats used.

X5. POTENTIAL FOR VANDALISM

X5.1 Fire scenarios intended to reflect willful (vandalism) or accidental damage of the initially fabricated seat assembly, before fire ignition, testing of damaged (or vandalized) seat assemblies should be considered.

X5.2 An analysis should be conducted that considers the operating environment within which the seat assemblies will be used in relation to the risk of vandalism, puncture, cutting, or other acts which may expose the individual components of the assemblies. Bench-scale representations of the proposed damage should take into account the test specimen size.

X5.3 If it is believed that the potential exists for vandalism of seat assemblies in a specific case, Test Method F1550 provides a means to assess the fabric/padding combination to determine whether seat vandalism would affect fire safety. Test Method F1550 consists of an application of the cone calorimeter in which a test specimen of a seat composite consisting of fabric and padding is tested at an initial test heat flux of 35 kW/M^2 after slashing an X in the fabric. The test results are compared with those of the same composite without the slashed fabric to determine the effect, if any, of vandalism.

X5.4 Another example of a means to assess damage to the seat assembly would be a knife cut 6 in. long and 1 in. deep in the middle of an actual seat assembly, which is offered as an option for rail transportation vehicles in Guide E2061.

SUMMARY OF CHANGES

Committee E05 has identified the location of selected changes to this standard since the last issue (E2574/E2574M-12A) that may impact the use of this standard. (Approved July 1, 2012.)

(1) Former Appendix X5, Optional Heat Release Measurements, was revised and moved to Annex A1.