



POSITION PAPER

Flammability Standards for School Buses

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The National Association of State Directors of Pupil Transportation Services (NASDPTS) and its School Bus Manufacturers Technical Council (SBMTC) support continued efforts towards improving the safety of school buses. Design standards, requirements, and specifications ensure reliable performance so that the chance of fires is reduced and the safety of the school bus occupants and surroundings is maintained.

Motor vehicles used in the United States are required to meet Federal and state specifications regarding vehicle safety standards. These standards are specific to the needs of occupants in these motor vehicles and to their intended transportation purpose. School buses are no exception. In fact, there are many federal standards that are applicable only to school buses. Federal Motor Vehicle Safety Standard (FMVSS) 217 specifies additional emergency exits for school buses, located in close proximity to passengers. FMVSS 301 specifies requirements for the integrity of the fuel system on school buses. School buses also typically receive a frequent number of safety inspections where any potential issues are identified and corrected. These and other requirements have resulted in yellow school buses being the safest form of ground transportation.

In addition to the FMVSSs, many states have adopted additional standards and specifications for their particular needs. One group that has representation from the states, and whose standards work in unison with Federal Motor Vehicle Safety Standards, is the National Congress on School Transportation (NCST), which adopts and publishes the *National School Transportation Specifications and Procedures*¹.

All motor vehicles are required to meet FMVSS 302 – Flammability of Interior Materials. FMVSS 302 was established to specify maximum burn rate requirements for materials used in the occupant compartment of motor vehicles. FMVSS 302 applies to passenger cars, multipurpose passenger vehicles, trucks, and buses (including school buses).

In addition to FMVSS 302, flammability standards are also included in the School Bus Vehicle Specifications of the *National School Transportation Specifications and Procedures*. A maximum burn rate is specified for floor covering, and the specifications also specify that passenger seats meet the criteria of the School Bus Seat Upholstery Fire Block Test. The School Bus Seat Upholstery Fire Block Test requires that the time from ignition to flameout be eight minutes or less, that the flame not spread to any other seat, and that weight loss shall not exceed 10% of the pretest weight of padding and upholstery.

There have been lobbying efforts in some state legislatures to adopt additional flammability standards for school buses. One of the standards proposed is to require that school bus seats meet American Society for Testing and Materials (ASTM) International Standard E1537, "Standard Test Method for Fire Testing of Upholstered Furniture."

As stated, the purpose of ASTM E1537 is to determine the burning behavior of upholstered furniture by measuring specific fire-test responses when the specimen of furniture is subjected to a specified flaming ignition source under well-ventilated conditions. The standard is applicable to public occupancies (section 5.5), such as jails, prisons, nursing care homes, health care facilities, public auditoriums, hotels, and motels, but does not list applicability to any vehicles or modes of transportation.

This test requires a specific burn test room and an exhaust collection system containing an oxygen consumption system in order to measure the rate of heat release. The upholstered furniture specimen is allowed to burn freely after ignition using a propane gas burner. As proposed, the seat assembly cannot exhibit a weight loss of more than three pounds during the first ten minutes of the test or exhibit a heat release rate of greater than 80 kilowatts.

In a closer look at the NCST's School Bus Seat Upholstery Fire Block Test, one finds that the test is initiated by using a weighed amount of newspaper placed in one of three positions; either on top of the seat cushion, behind the seat, or in the aisle adjacent to the seat. The test is conducted inside a simply constructed test chamber that is a representative section of a bus body.

In *Enclosure Fire Dynamics*, by Karlsson and Quintiere², a burning wastepaper basket generates a heat release rate of approximately 100 KW. As a simple comparison the NCST School Bus Seat Upholstery Fire Block Test requires that from ignition to flameout be eight minutes or less – this includes the original ignition source. The seat to be at total flameout simply means that the upholstery cannot carry a flame. So the total heat generation would be miniscule above that of the original ignition source used as fuel; i.e. 100 KW. Section 11.2.8 of the ASTM E1537 test procedure says terminate the test after the first of: burning has ceased, one hour of testing has elapsed, or flashover appears inevitable. Note the last two of these three conditions constitutes a failure

under the School Bus Seat Upholstery Fire Block Test, meaning that the Fire Block Test is more stringent with respect to these two conditions.

Per the ASTM E1537 testing proposal, the seat assembly cannot exhibit a weight loss of more than three pounds during the first ten minutes. Again, consider that the School Bus Seat Upholstery Fire Block Test, which is a part of the *National School Transportation Specifications and Procedures*, requires that the flameout occur within eight minutes. It also states that the weight loss is not to exceed 10% of the pretest weight of padding and upholstery. This is a more conservative (stringent) value than requiring that the seat not lose more than three pounds, since the weight of padding and upholstery in a typical school bus seat would not exceed 30 pounds.

To date, no school bus seat suppliers are aware of an ASTM E1537 burn test being performed on a school bus passenger seat. The complex burn chambers and oxygen depletion measurement equipment required would make compliance testing very difficult, without any real performance benefit in reducing the flammability of school bus seats already defined in the School Bus Seat Upholstery Fire Block Test. Further, in section 14.1 of ASTM E1537 it states that the precision of the test has not been determined. This simply means that the repeatability or reproducibility - or the likelihood of getting the same results for two identical ASTM E1537 tests, is uncertain. This uncertainty makes it difficult to use as a compliance test method.

Another proposed standard is to require that each plastic component contained in the engine compartment of school buses meet a V-0 classification when tested in accordance with the Underwriters Laboratories, Inc. Standard 94 (UL 94), "Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing."

Based on the scope document for UL94³:

"1.1 These requirements cover tests for flammability of polymeric materials used for parts in devices and appliances. They are intended to serve as a preliminary indication of their acceptability with respect to flammability for a particular application."

"1.2 The methods described in this Standard involve standard size specimens and are intended to be used solely to measure and describe the flammability properties of materials, used in devices and appliances, in response to a small open flame or radiant heat source under controlled laboratory conditions."

As stated, UL 94 was developed for plastic parts used in "devices and appliances" rather than plastic parts in the engine compartments of motor vehicles. Based on chassis supplier feedback, requiring plastic parts to meet V-0 classification of UL 94 in engine compartment applications may have detrimental effects on durability, abrasion resistance, and temperature performance over the expected life cycle of the vehicle. All of the current safety standards for motor vehicles work together for the entire vehicle's

systems. This includes reliability of the engine system, to avoid stalling and breakdowns on the roadways.

In addition to major concerns regarding durability and performance of plastic components made to meet the UL 94 V-0 classification, there are also concerns with the chemicals that could be required to treat the plastics. Brominated Flame Retardant (BFR) chemicals are typically used to meet UL94 V-0 classification, and it is unknown what effect these BFR chemicals could have on plastic components in the engine compartment environment. There are over 100 items that could be interpreted to be a “plastic component contained in the engine compartment of a school bus.” Any proposed material change to meet UL 94V-0 requirements would have to be qualified through normal vehicle development, validation, and life cycle testing. Also, thorough evaluations would be needed to assess the interactions of UL94 V-0 requirements with all of the other existing design requirements for other engine compartment components. These evaluations would include but not be limited to, mechanical durability, ultraviolet stability, pressure stability, fluid resistance, and impact resistance.

Summary

Neither ASTM E1537 “Standard Test Method for Fire Testing of Upholstered Furniture,” nor UL 94 “Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances Testing,” were developed for motor vehicles, and there are significant concerns with the negative effects of these standards on pupil transportation. NASDPTS and the SBMTC do not recommend that these standards be used to govern flammability on school buses. For states and school districts that want enhanced flammability performance, we recommend adopting the School Bus Seat Upholstery Fire Block Test that is a part of the *National School Transportation Specifications and Procedures*. In addition to this standard, there are fire suppression systems and other available measures that have been used on special needs buses and are required in some states. The SBMTC recommended considering the use of fire suppression systems on special needs buses and fire evacuation training pursuant to RESOLUTION NO. 8: ENGINE COMPARTMENT FIRE PROTECTION from the 2005 *National School Transportation Specifications and Procedures*. NASDPTS and the SBMTC also support required passenger evacuation drills that ensure students know what to do in the event of an emergency.

1. <http://www.ncstonline.org/>
2. Karlsson, B., and J.G. Quintiere, Chapter 3, "Energy Release Rates," *Enclosure Fire Dynamics*. CRC Press LLC, New York, pp. 25–46, 1999.
3. <http://ulstandardsinfonet.ul.com/scopes/0094.html>