

S4. *Requirements.* When a force in Newtons equal to $1\frac{1}{2}$ times the unloaded vehicle weight in kilograms multiplied by 9.8 m/sec^2 is applied to the roof of the vehicle's body structure through a force application plate as specified in S5, Test procedures—

(a) The downward vertical movement at any point on the application plate shall not exceed 130 mm and

(b) Each emergency exit of the vehicle provided in accordance with Standard No. 217 (§ 571.217) shall be capable of opening as specified in that standard during the full application of the force and after release of the force, except that an emergency exit located in the roof of the vehicle is not required to be capable of being opened during the application of the force. A particular vehicle (i.e., test specimen) need not meet the emergency exit opening requirement after release of force if it is subjected to the emergency exit opening requirements during the full application of the force.

S5. *Test procedures.* Each vehicle shall be capable of meeting the requirements of S4, when tested in accordance with the procedures set forth below.

S5.1 With any non-rigid chassis-to-body mounts replaced with equivalent rigid mounts, place the vehicle on a rigid horizontal surface so that the vehicle is entirely supported by means of the vehicle frame. If the vehicle is constructed without a frame, place the vehicle on its body sills. Remove any components which extend upward from the vehicle roof.

S5.2 Use a flat, rigid, rectangular force application plate that is measured with respect to the vehicle roof longitudinal and lateral centerlines.

(a) In the case of a vehicle with a GVWR of more than 4,536 kg, 305 mm shorter than the vehicle roof and 914 mm wide; and

(b) In the case of a vehicle with a GVWR of 4,536 kg or less, 127 mm longer and 127 mm wider than the vehicle roof. For purposes of these measurements, the vehicle roof is that structure, seen in the top projected view, that coincides with the passenger and driver compartment of the vehicle.

S5.3 Position the force application plate on the vehicle roof so that its rigid surface is perpendicular to a

vertical longitudinal plane and it contacts the roof at not less than two points, and so that, in the top projected view, its longitudinal centerline coincides with the longitudinal centerline of the vehicle, and its front and rear edges are an equal distance inside the front and rear edges of the vehicle roof at the centerline.

S5.4 Apply an evenly-distributed vertical force in the downward direction to the force application plate at any rate not more than 13 mm per second, until a force of 2,224 N has been applied.

S5.5 Apply additional vertical force in the downward direction to the force application plate at a rate of not more than 13 mm per second until the force specified in S4, has been applied, and maintain this application of force.

S5.6 Measure the downward movement of any point on the force application plate which occurred during the application of force in accordance with S5.5.

S5.7 To test the capability of the vehicle's emergency exits to open in accordance with S4.(b)—

(a) In the case of testing under the full application of force, open the emergency exits as specified in S4.(b) while maintaining the force applied in accordance with S5.4 and S5.5; and

(b) In the case of testing after the release of all force, release all downward force applied to the force application plate and open the emergency exits as specified in S4.(b).

S6. *Test conditions.* The following conditions apply to the requirements specified in S4.

S6.1 *Temperature.* The ambient temperature is any level between 0°C and 32°C .

S6.2 *Windows and doors.* Vehicle windows, doors, and emergency exits are in the fully-closed position, and latched but not locked.

[41 FR 3875, Jan. 27, 1976, as amended at 41 FR 36026, 36027, Aug. 26, 1976; 63 FR 28948, May 27, 1998]

§ 571.221 Standard No. 221; School bus body joint strength.

S1. *Scope.* This standard establishes requirements for the strength of the body panel joints in school bus bodies.

§571.221

49 CFR Ch. V (10-1-02 Edition)

S2. *Purpose.* The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes.

S3. *Application.* This standard applies to school buses with gross vehicle weight ratings of more than 10,000 pounds.

S4. *Definitions.* *Body component* means a part of a bus body made from a single piece of homogeneous material or from a single piece of composite material such as plywood.

Body panel means a body component used on the exterior or interior surface to enclose the bus' occupant space.

Body panel joint means the area of contact or close proximity between the edges of a body panel and another body component, excluding spaces designed for ventilation or another functional purpose, and excluding doors, windows, and maintenance access panels.

Bus body means the portion of a bus that encloses the bus' occupant space, exclusive of the bumpers, the chassis frame, and any structure forward of the forwardmost point of the windshield mounting.

S5. *Requirement.* When tested in accordance with the procedure of S6., each body panel joint shall be capable of holding the body panel to the member to which it is joined when subjected to a force of 60% of the tensile strength of the weakest joined body panel determined pursuant to S6.2.

S6. *Procedure.*

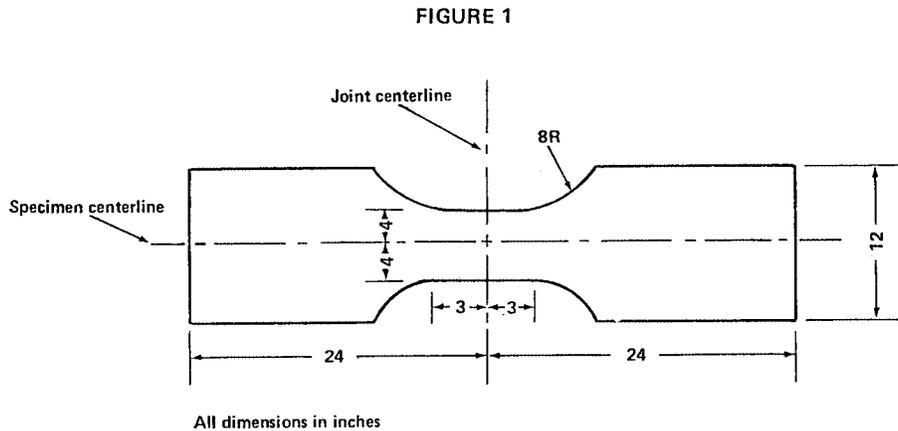
S6.1 *Preparation of the test specimen.*

S6.1.1 If a body panel joint is 8 inches long or longer, cut a test specimen that consists of any randomly selected 8-inch segment of the joint, together with a portion of the bus body whose dimensions, to the extent permitted by the size of the joined parts, are those specified in Figure 1, so that the specimen's centerline is perpendicular to the joint at the midpoint of the joint segment. Where the body panel joint is not fastened continuously, select the segment so that it does not bisect a spot weld or a discrete fastener.

S6.1.2 If a joint is less than 8 inches long, cut a test specimen with enough of the adjacent material to permit it to be held in the tension testing machine specified in S6.3.

S6.1.3 Prepare the test specimen in accordance with the preparation procedures specified in the 1973 edition of the Annual Book of ASTM Standards, published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

S6.2 *Determination of minimum allowable strength.* For purposes of determining the minimum allowable joint strength, determine the tensile strengths of the joined body components as follows:



(a) If the mechanical properties of a material are specified by the American Society for Testing and Materials, the relative tensile strength for such a material is the minimum tensile strength specified for that material in the 1973 edition of the Annual Book of ASTM Standards.

(b) If the mechanical properties of a material are not specified by the American Society for Testing and Materials, determine its tensile strength by cutting a specimen from the bus body outside the area of the joint and by testing it in accordance with S6.3.

S6.3 *Strength test.*

S6.3.1 Grip the joint specimen on opposite sides of the joint in a tension testing machine calibrated in accordance with Method E4, Verification of Testing Machines, of the American Society for Testing and Materials (1973 Annual Book of ASTM Standards).

S6.3.2 Adjust the testing machine grips so that the joint, under load, will be in stress approximately perpendicular to the joint.

S6.3.3 Apply a tensile force to the specimen by separating the heads of the testing machine at any uniform rate not less than 1/8 inch and not more than 3/8-inch per minute until the specimen separates.

[41 FR 3872, Jan. 27, 1976, as amended at 41 FR 36027, Aug. 26, 1976]

EFFECTIVE DATE NOTE: At 66 FR 64366, Dec. 13, 2001, §571.221 was amended by revising S3; revising the definitions of "body panel joint" and "bus body" in S4; adding, in alphabetical order, the definitions of "maintenance access panel", "passenger compartment" and "serviceable component" to S4; and revising S5 and S6 and figure 1, effective Jan. 1, 2003. For the convenience of the user, the revised text is set forth as follows:

§ 571.221 Standard No. 221, School Bus Body Joint Strength.

* * * * *

S3. Application. This standard applies to school buses.

S4. Definitions.

Body panel joint means the area of contact or close proximity between the edges of a body panel and another body component, including but not limited to floor panels, and body panels made of composite materials such as plastic or plywood, excluding trim and decorative parts which do not contribute to the strength of the bus body, members

such as rub rails which are entirely outside of body panels, ventilation panels, components provided for functional purposes, and engine access covers.

Bus body means that portion of a bus that encloses the bus occupant space, including the floor, but excluding the bumpers and chassis frame and any structure forward of the passenger compartment.

* * * * *

Maintenance access panel means a body panel which must be moved or removed to provide access to one or more serviceable component(s).

Passenger compartment means space within the school bus interior that is between a vertical transverse plane located 762 mm in front of the forwardmost passenger seating reference point and including a vertical transverse plane tangent to the rear interior wall of the bus at the vehicle centerline.

Serviceable component means any part of the bus, of either a mechanical or electrical nature, which is explicitly identified by the bus chassis and/or body manufacturer in the owner's manual or factory service manual as requiring routine maintenance actions at intervals of one year or less. Tubing, wires and harnesses are considered to be serviceable components only at their attachments.

S5 Requirements.

S5.1 Except as provided in S5.2, each body panel joint, including small, curved, and complex joints, when tested in accordance with the procedure of S6, shall hold the body panel to the member to which it is joined when subjected to a force of 60 percent of the tensile strength of the weakest joined body panel determined pursuant to S6.2.

S5.1.1 Body panels attached to each other shall have no unattached segment at the joint longer than 203 mm.

S5.2 Exclusions

S5.2.1 The requirements of S5.1 do not apply to—

(a) Any interior maintenance access panel or joint which lies forward of the passenger compartment.

(b) Any interior maintenance access panel within the passenger compartment that does not exceed 305 mm when measured across any two points diametrically on opposite sides of the opening.

(c) Trim and decorative parts which do not contribute to the strength of the joint, support members such as rub rails which are entirely outside of body panels, doors and windows, ventilation panels, and engine access covers.

S6 Procedure

S6.1 Preparation of the test specimen.

S6.1.1 If a body panel joint is 203 mm or longer, cut a test specimen that consists of any 203 mm segment of the joint, together

with a portion of the bus body whose dimensions are those specified in Figure 1, so that the specimen's centerline is perpendicular to the joint at the midpoint of the joint segment. Where the body panel joint is not fastened continuously, select the segment so that it does not bisect a spot weld or a discrete fastener. Support members which contribute to the strength of a body panel joint, such as rub rails on the outside of body panels or underlying structure attached to joint members, shall remain attached to the test specimen, except that material may be removed from the support members as necessary to clear the gripping areas of the joint members being tested.

S6.1.2 If a joint is less than 305 mm long, cut a test specimen with enough of the adjacent material to permit it to be held in the tension testing machine specified in S6.3.

S6.1.3 Prepare the test specimen in accordance with the preparation procedures specified in the 1989 edition of the Annual Book of American Society for Testing and Materials (ASTM) Standards.

S6.2 *Determination of minimum allowable strength.* For purposes of determining the minimum allowable joint strength, determine the tensile strengths of the joined body components as follows:

(a) If the mechanical properties of a joint component material are specified by the ASTM in the 1989 Annual Book of ASTM

Standards, the lowest value of that material's thickness and tensile strength per unit of area shown in that source shall be used.

(b) If the mechanical properties of a material are not specified by the ASTM in the 1989 Annual Book of ASTM Standards, determine its tensile strength by cutting a sheet specimen from outside the joint region of the bus body in accordance with Figure 1 of E 8-89 Standard Test Methods of Tension Testing of Metallic Materials, in Volume 03.01 of the 1989 Annual Book of ASTM Standards, and by testing it in accordance with S6.3.

(c) The cross sectional area of material removed to facilitate the installation of fasteners shall be subtracted from the cross-sectional area of the panel in the determination of the tensile strength of the weakest joined body panel.

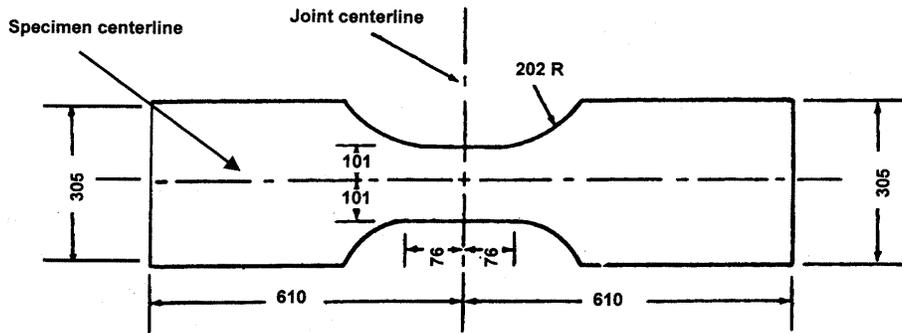
S6.3 Strength Test.

S6.3.1 The joint specimen is gripped on opposite sides of the joint in a tension testing machine in accordance with the 1989 Annual Book of ASTM Standards.

S6.3.2 Adjust the testing machine grips so that the applied force on the joint is at 90 degrees plus or minus 3 degrees from the joint centerline, as shown in Figure 1.

S6.3.3 A tensile force is applied to the specimen by separating the heads of the testing machine at any uniform rate not less than 3 mm and not more than 10 mm per minute until the specimen separates.

FIGURE 1



All dimensions in millimeters

EDITORIAL NOTE: At 65 FR 11754, Mar. 6, 2000, §571.221 was amended by revising S5.2.1(a), effective Apr. 5, 2000. However,

paragraph S5.2.1(a) does not exist in the text in effect at that time. The revised text reads as follows:

§ 571.221 Standard No. 221, School bus body joint strength.

* * * * *

S5.2.1 The requirements of S5.1.1 and S5.1.2 do not apply to—

(a) Any interior maintenance access panel which lies forward of the passenger compartment, or which is less than 305 mm when measured across any two points diametrically on opposite sides of the opening.

* * * * *

§ 571.222 Standard No. 222; School bus passenger seating and crash protection.

S1. *Scope.* This standard establishes occupant protection requirements for school bus passenger seating and restraining barriers.

S2. *Purpose.* The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from the impact of school bus occupants against structures within the vehicle during crashes and sudden driving maneuvers.

S3. *Application.* This standard applies to school buses.

S4. *Definitions. Contactable surface* means any surface within the zone specified in S5.3.1.1 that is contactable from any direction by the test device described in S6.6, except any surface on the front of a seat back or restraining barrier 76 mm or more below the top of the seat back or restraining barrier.

School bus passenger seat means a seat in a school bus, other than the driver's seat.

Wheelchair means a wheeled seat frame for the support and conveyance of a physically disabled person, comprised of at least a frame, seat, and wheels.

Wheelchair occupant restraint anchorage means the provision for transferring wheelchair occupant restraint system loads to the vehicle structure.

Wheelchair securement anchorage means the provision for transferring wheelchair securement device loads to the vehicle structure.

Wheelchair securement device means a strap, webbing or other device used for securing a wheelchair to the school bus, including all necessary buckles and other fasteners.

S4.1 The number of seating positions considered to be in a bench seat is expressed by the symbol W, and calculated as the bench width in millimeters divided by 381 and rounded to the nearest whole number.

S5. *Requirements.* (a) Each vehicle with a gross vehicle weight rating of more than 4,536 kg shall be capable of meeting any of the requirements set forth under this heading when tested under the conditions of S6. However, a particular school bus passenger seat (i.e., test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or having been subjected to either S5.1.3, S5.1.4, or S5.3.

(b) Each vehicle with a gross vehicle weight rating of 4,536 kg or less shall be capable of meeting the following requirements at all seating positions other than the driver's seat:

(1)(A) In the case of vehicles manufactured before September 1, 1991, the requirements of §§ 571.208, 571.209, and 571.210 as they apply to multipurpose passenger vehicles; or

(B) In the case of vehicles manufactured on or after September 1, 1991, the requirements of S4.4.3.3 of § 571.208 and the requirements of §§ 571.209 and 571.210 as they apply to school buses with a gross vehicle weight rating of 4,536 kg or less; and

(2) The requirements of S5.1.2, S5.1.3, S5.1.4, S5.1.5, S5.3, and S5.4 of this standard. However, the requirements of §§ 571.208 and 571.210 shall be met at W seating positions in a bench seat using a body block as specified in Figure 2 of this standard, and a particular school bus passenger seat (i.e., a test specimen) in that weight class need not meet further requirements after having met S5.1.2 and S5.1.5, or after having been subjected to either S5.1.3, S5.1.4, or S5.3 of this standard or § 571.210.

S5.1 *Seating requirements.* School bus passenger seats shall be forward facing.

S5.1.1 [Reserved]

S5.1.2 *Seat back height and surface area.* Each school bus passenger seat shall be equipped with a seat back that, in the front projected view, has a front surface area above the horizontal plane that passes through the seating reference point, and below the horizontal plane 508 mm above the seating