TP221-02
April 3, 1986

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 221

School Bus Body Joint Strength

Enforcement
Office of Vehicle Safety Compliance
Room 6111 NVS-220
400 Seventh Street, SW
Washington, DC 20590

OVSC LABORATORY TEST PROCEDURE NO. 221
TABLE OF CONTENTS

PAGE

REVISION CONTROL LOG
FOR OVSC LABORATORY
TEST PROCEDURES

TP-221
School bus body joint strength

TEST PROCEDURE		FMVSS 221		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
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02		41FR36027	08/26/76	
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1. PURPOSE AND APPLICATION

The Office of Vehicle Safety Compliance (OVSC) provides contractor laboratories with Laboratory Test Procedures as guidelines for obtaining compliance test data. The data are used to determine if a specific vehicle or item of motor vehicle equipment meets the minimum performance requirements of the subject Federal Motor Vehicle Safety Standard (FMVSS). The purpose of the OVSC Laboratory Test Procedures is to present a uniform testing and data recording format, and provide suggestions for the use of specific equipment and procedures. If any contractor views any part of an OVSC Laboratory Test Procedure to be in conflict with a Federal Motor Vehicle Safety Standard (FMVSS) or observes deficiencies in a Laboratory Test Procedure, the contractor is required to advise the Contracting Officer's Technical Representative (COTR) and resolve the discrepancy prior to the start of compliance testing.

Every contractor is required to submit a detailed test procedure to the COTR before initiating the compliance test program. The procedure must include a step by step description of the methodology to be used. The contractor's test procedure shall contain a complete listing of test equipment with make and model number and a detailed check-off sheet. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the Laboratory Test Procedure and the contractor's in-house test procedure. Written approval of the in-house test procedures shall be obtained from the COTR before initiating the compliance test program. The OVSC Laboratory Test Procedures are not intended to limit or restrain a contractor from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data. These Laboratory Test Procedures do not constitute an endorsement or recommendation for use of any product or method. However, the application of any such testing technique or equipment is subject to prior approval of the COTR.

NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations or NHTSA interpretations regarding the meaning of a FMVSS. The Laboratory Test Procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC Laboratory Test Procedures do not include all of the various FMVSS minimum performance requirements. Recognizing applicable test tolerances, the Laboratory Test Procedures may specify test conditions that are less severe than the minimum requirements of the standard. In addition, the Laboratory Test Procedures may be modified by the OVSC at any time without notice, and the COTR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the standard itself and within the scope of the contract. Laboratory Test Procedures may not be relied upon to create any right or

1. PURPOSE AND APPLICATION....Continued

benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC Laboratory Test Procedures.

2. GENERAL REQUIREMENTS

Each school bus 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 percent of the tensile strength of the weakest joined body panel determined as follows:

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 (ASTM), 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 ASTM, determine its tensile strength by cutting a specimen from the school bus body outside the area of the joint and by testing it as follows:

STRENGTH TEST

(1) Grip the joint specimen on opposite sides of the joint in a tension testing machine calibrated in accordance with ASTM Method E4.

(2) Adjust the testing machine grips so that the joint, under load, will be in stress approximately perpendicular to the joint.

(3) Apply a tensile force to the specimen by separating the heads of the testing machine at any uniform rate NOT less than 0.125 inch and not more than 0.375 inch per minute until the specimen separates.

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism that occur during the storage of test vehicles. Any security problem shall be reported by telephone to the Industrial Property Manager (IPM), Office of Contracts and Procurement, within two working days after the incident. A letter containing specific details of the security problem will be sent to the IPM (with copy to the COTR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Branch or Division Chief. The tested vehicles shall be protected from the elements and retained by the contractor for a minimum of 60 days so that NHTSA personnel can be given an inspection opportunity.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program, shall be allowed to witness any vehicle compliance test unless specifically authorized by the COTR. It is the contractor's responsibility to secure the test site area during a test and to shield the test area from public view by the use of canvas or other blocking devices.

RULES FOR CONTRACTORS

A. No vehicle manufacturer's representative(s) or anyone other than the contractor's personnel working on the NHTSA contract program along with NHTSA personnel shall be allowed to inspect NHTSA vehicles or witness vehicle preparation without prior permission. Such permission shall never be assumed.

B. All communications with vehicle manufacturers shall be referred to the NHTSA. The contractor shall not release test data without the permission of the NHTSA.

4. GOOD HOUSEKEEPING

The contractor shall maintain the entire vehicle compliance testing area, test fixtures and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COTR prior to testing. Tests shall be completed as required in the contract. Scheduling shall be adjusted to permit sample motor vehicles to be tested to other FMVSS as may be required by the OVSC. All testing shall be coordinated to allow monitoring by the COTR.

6. TEST DATA DISPOSITION

The contractor shall make all vehicle preliminary compliance test data available to the COTR on location within four hours after the test. Final test data, including digital printouts and computer generated plots, shall be furnished to the COTR within five working days. Additionally, the contractor shall analyze the preliminary test results as directed by the COTR.

All backup data sheets, strip charts, recordings, plots, technicians notes, etc., shall be either sent to the COTR or destroyed at the conclusion of each delivery order, purchase order, etc.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

ACCEPTANCE OF TEST VEHICLES

The contractor has the responsibility of accepting test vehicles from either new school bus dealers/distributors or bus transporters. In both instances, the contractor acts in the OVSC's behalf when signing an acceptance of test school buses. If a vehicle is delivered by a dealer/distributor, the contractor must check to verify the following:

A. Tires and wheel rims are new.

B. There are no dents or other interior or exterior flaws in the bus body.

C. The school bus has been properly prepared and is in running condition.

D. The glove box contains an owner's manual, warranty document, consumer information, and extra set of keys.

7. GOVERNMENT FURNISHED PROPERTY (GFP)....Continued

E. Proper fuel filler cap is supplied on the school bus.

If the school bus test vehicle is delivered by a government contracted transporter, the contractor should check for damage which may have occurred during transit.

A "Vehicle Condition" form (shown on the next page) will be supplied to the contractor by the COTR when the school bus test vehicle is transferred from the bus manufacturer or distributor or between test contracts. The upper half of the form describes the school bus in detail, and the lower half provides space for a detailed description of the post test condition. School Bus Test Vehicle Condition forms must be returned to the COTR with the copies of the Final Test Report or the reports will NOT be accepted.

NOTIFICATION OF COTR

The COTR must be notified within 24 hours after a school bus test vehicle has been delivered.

7. GOVERNMENT FURNISHED PROPERTY (GFP)....Continued

REPORT OF SCHOOL BUS CONDITION AT THE COMPLETION OF TESTING

CONTRACT NO.: DTNH22-_____ DATE:

FROM:

TO:

The following vehicle has been subjected to compliance testing for FMVSS No.

The vehicle was inspected upon arrival at the laboratory for the test and found to contain all of the equipment listed below. All variances have been reported within 2 working days of vehicle arrival, by letter, to the NHTSA Industrial Property Manager (NPO-220), with a copy to the OVSC COTR. The vehicle is again inspected, after the above test has been conducted, and all changes are noted below. The final condition of the vehicle is also noted in detail.

MODEL YEAR/MAKE/MODEL/BODY STYLE:

NHTSA NO.: _____ ; BODY COLOR: _____ ; VIN:

ODOMETER READINGS: ARRIVAL - _____ miles DATE -

COMPLETION - _____ miles DATE -

PURCHASE PRICE: $_____ DEALER'S NAME:

ENGINE DATA: ____ Cylinders ____ Liters ____ Cubic Inches

TRANSMISSION DATA: ____ Automatic ____ Manual ____ No. of Speeds

FINAL DRIVE DATA: ____ Rear Drive ____ Front Drive ____ 4 Wheel Drive

TIRE DATA: Size - _____ Mfr. -

CHECK APPROPRIATE BOXES FOR VEHICLE EQUIPMENT:

LIST OTHER PERTINENT OPTIONAL EQUIPMENT ON NEXT PAGE (REMARKS SECTION)

	Air Conditioning		Traction Control		Clock
	Tinted Glass		All Wheel Drive		Roof Rack
	Power Steering		Speed Control		Console
	Power Windows		Rear Window Defroster		Driver Air Bag
	Power Door Locks		Sun Roof or T-Top		Passenger Air Bag
	Power Seat(s)		Tachometer		Front Disc Brakes
	Power Brakes		Tilt Steering Wheel		Rear Disc Brakes
	Antilock Brake System		AM/FM/Cassette Radio		Other-

7. GOVERNMENT FURNISHED PROPERTY (GFP)....Continued

REMARKS:

Equipment that is no longer on the test vehicle as noted on previous page:

Explanation for equipment removal:

School Bus Condition:

RECORDED BY: _____ DATE:

APPROVED BY:

8. CALIBRATION OF TEST INSTRUMENTS

Before the contractor initiates the safety compliance test program, a test instrumentation calibration system will be implemented and maintained in accordance with established calibration practices. The calibration system shall be set up and maintained as follows:

A. Standards for calibrating the measuring and test equipment will be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the contractor, or a commercial facility, against a higher order standard at periodic intervals NOT EXCEEDING 6 MONTHS FOR INSTRUMENTS AND 12 MONTHS FOR CALIBRATION STANDARDS. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

Accelerometers shall be calibrated every six months or after a vehicle fails to meet the FMVSS 221 performance requirements whichever occurs sooner.

C. All measuring and test equipment and measuring standards will be labeled with the following information:

(1) Date of calibration

(2) Date of next scheduled calibration

(3) Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the contractor including, as a minimum, the following information for all measurement and test equipment:

(1) Type of equipment, manufacturer, model number, etc.

(2) Measurement range

(3) Accuracy

(4) Calibration interval

(5) Type of standard used to calibrate the equipment

(calibration traceability of the standard must be evident)

8. CALIBRATION OF TEST INSTRUMENTS....Continued

(6) The actual procedures and forms used to perform the calibrations.

E. Records of calibration for all test instrumentation shall be kept by the contractor in a manner that assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR. The calibration system will need the acceptance of the COTR before the test program commences.

F. Test equipment shall receive a calibration adjustment immediately prior to a test and a calibration check after the test. This check shall be recorded by the test technician(s) and submitted with the final report.

G. The contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, “Quality Assurance Requirements for Measuring Equipment” and American National Standard ANSI/NCSL Z540-1, “Calibration Laboratories and Measuring and Test Equipment - General Requirements.”

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COTR's discretion and will be performed without additional cost.

9. PHOTOGRAPHIC DOCUMENTATION

Photographs shall be glossy black and white, 8 x 10 inches, and legible. A tag, label or placard identifying the school bus test vehicle model and NHTSA number shall appear in each photograph and be legible. Each photograph shall be labeled as to subject matter. As a minimum the following photographs shall be included:

A. School Bus Exterior:

(1) Top view
(2) Front view
(3) Rear view
(4) Left side view
(5) Right side view

B. School Bus Interior:

(1) Front-to-rear view
(2) Rear-to-front view

C. The school bus body showing the location, identification, and outline of each specimen selected for testing and analysis.

D. Each school bus body panel specimen which shows the area and mode of failure in the joint.

E. Bus manufacturer's labels and certification labels.

F. To clarify any damage or noncompliance condition that cannot be seen in the above photographs.

10. DEFINITIONS

ACCESS PANELS

Panels that are exempt from the requirements because of their need for removal for routine service to underlying components. Simply because wiring may be present behind a panel does not qualify it for exemption if routine maintenance would not be required on such wiring.

BODY COMPONENT

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.

10. DEFINITIONS....Continued

BODY PANEL

A body component used on the exterior or interior surface to enclose the occupant space.

BODY PANEL JOINT

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. In joints where more than two (2) panels or body components are joined by one fastener, the tensile strength of the weaker panel is determined for each pair of components and the joint is required to sustain a load of not less than 60 percent of that tensile strength. See Figures 1, 2 and 3.

BODY SECTION

A piece of the body that contains the joint specimen together with a sufficient portion of the surrounding bus body whose dimensions approximate those shown in Figure 4.

BUS

Means a motor vehicle with motive power, except a trailer, designed for carrying more than ten (10) persons.

BUS BODY

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

BUS OCCUPANT SPACE

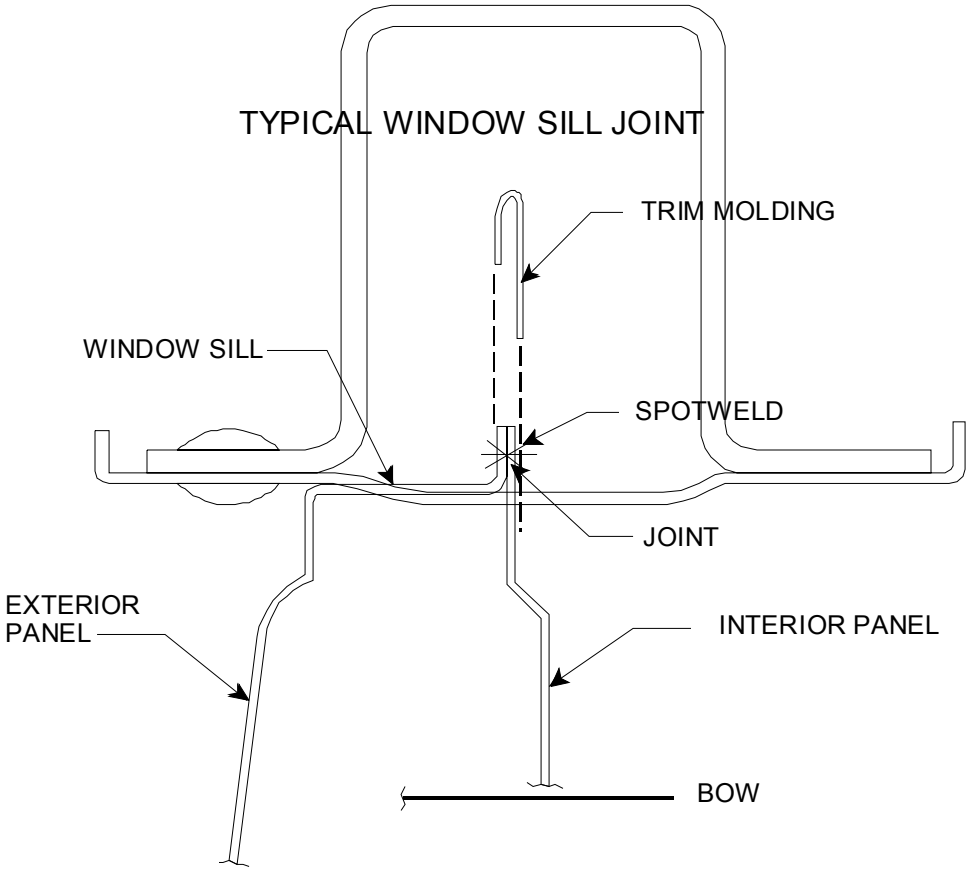
The bus occupant space is defined as that portion of the bus interior that extends from the left and right side walls, from the floor to the ceiling, from the rear wall of the bus up to the forwardmost point of the windshield mounting.

COMPLEX JOINT

A complex joint is defined as any joint wherein the two (2) body panels that are to be tested cannot be pulled in the same or parallel planes. See Figures 5 and 6.

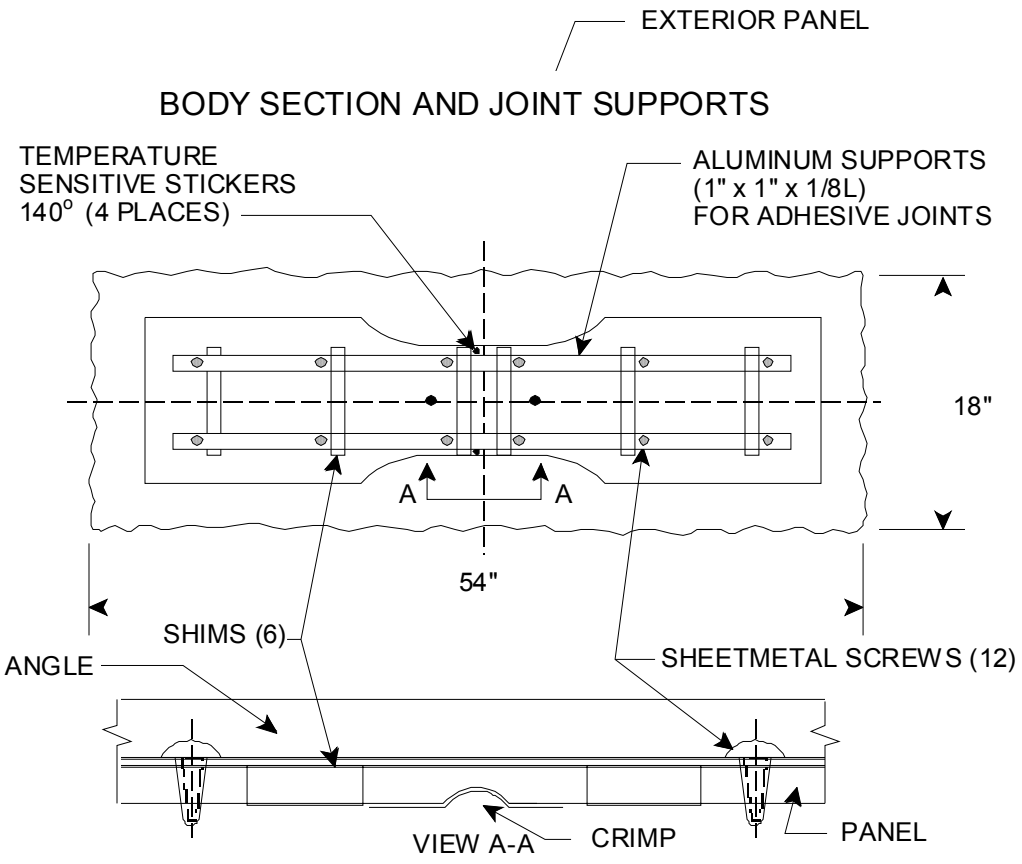
10. DEFINITIONS....Continued

TYPICAL JOINT BETWEEN WINDOWS

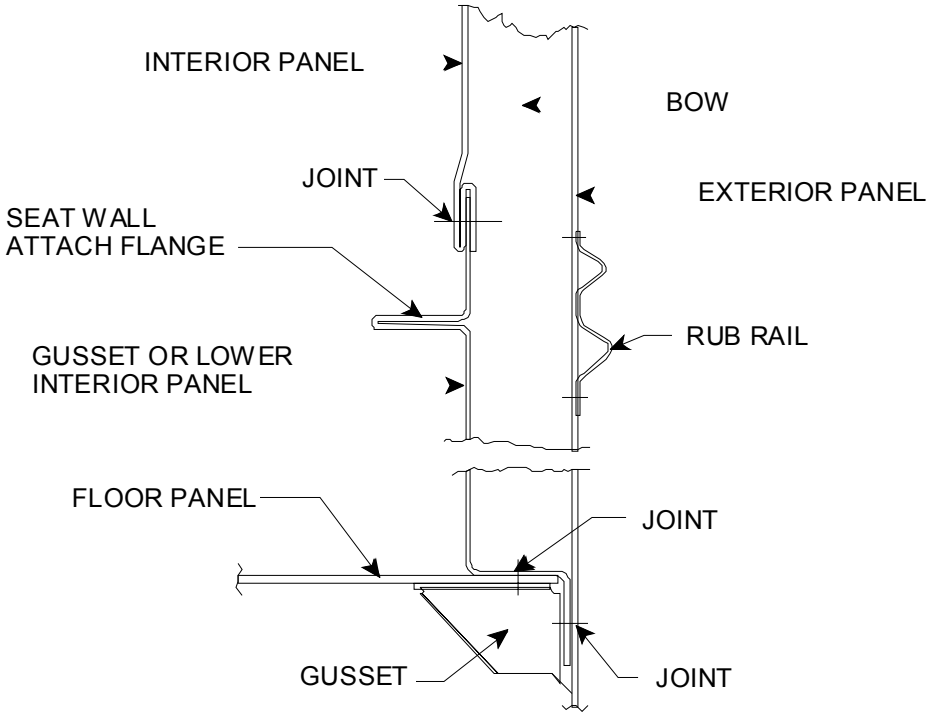


10. DEFINITIONS....Continued

TYPICAL LAP JOINT -- INTERIOR PANEL WITH ADHESIVE BONDING



10. TYPICAL COMPLEX JOINT OF SIDE WALL AND FLOOR



10. DEFINITIONS....Continued

EDGES OF METAL

Where the end of a surface component in a bus that encloses the occupant space comes into contact or close proximity with any other body component, it is a joint and must meet the requirements.

FLOOR LINE

The lowest interior surface that encloses the passenger compartment. Body panels that are located entirely below the level of the floor are not normally subject to the standard. However, body panels that do enclose bus occupant space because a portion lies above the floor line, are subject to the requirements. If plywood is attached to a floor panel on the surface inside the passenger compartment, and is only added to some buses for insulation purposes, it is not considered to have a function in enclosing the occupant space and is therefore not considered a body component for purposes of the requirement.

FORCE

Is expressed in pounds of load and when used in this procedure means the material tensile strength of the weakest joined body panel in the specimen multiplied by that material area.

GAUGE

Gauge numbers are used to identify a materials general thickness and are often used to specify a material when the thickness tolerance is not critical.

INTERIOR TRIM

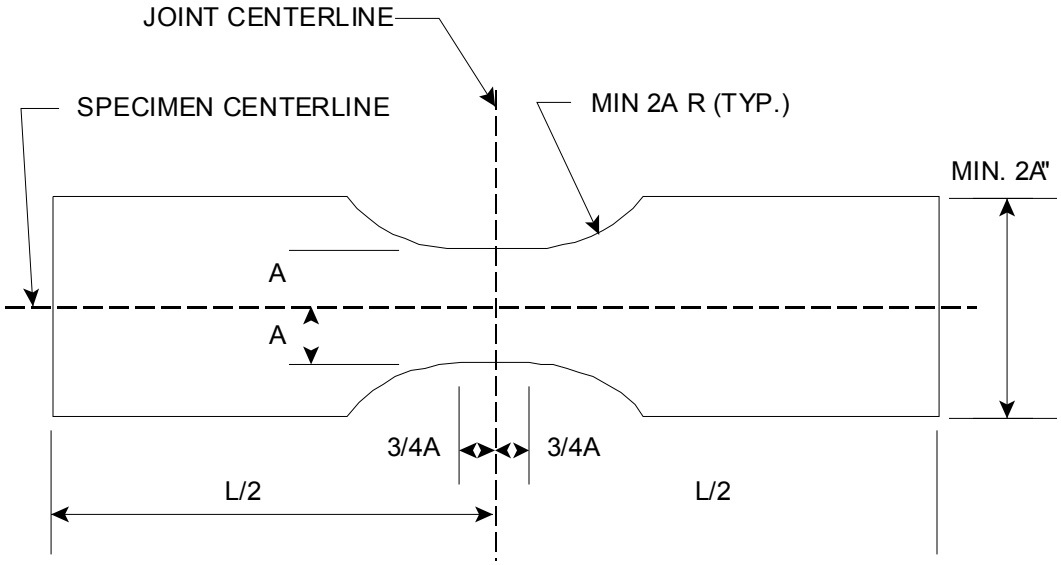
In all cases, except the cove molding, trim or decorative moldings that enclose occupant space are considered to be body panels, and where the edge comes in contact with another body component, creates a joint subject to the requirements of FMVSS 221.

JOINT SPECIMEN

Consists of any randomly selected segment of the joint together with a portion of the bus body whose dimensions are those specified in Figures 7 or 8, so that the specimen's center line is perpendicular to the joint at the midpoint of the joint segment. Joint samples must be as representative as possible of the strength of the entire joint.

10. DEFINITIONS....Continued

DIMENSION REQUIREMENTS OF BODY PANEL SPECIMEN
WHOSE JOINT SEGMENT IS LESS THAN 8 INCHES LONG



LENGTH (L) VARIES ACCORDING TO MATERIAL AVAILABLE
FOR GRIPPING IN THE TENSILE TEST MACHINE

NOTE: TOLERANCE ON ALL DIMENSIONS IS ± 1/16"

10. DEFINITIONS....Continued

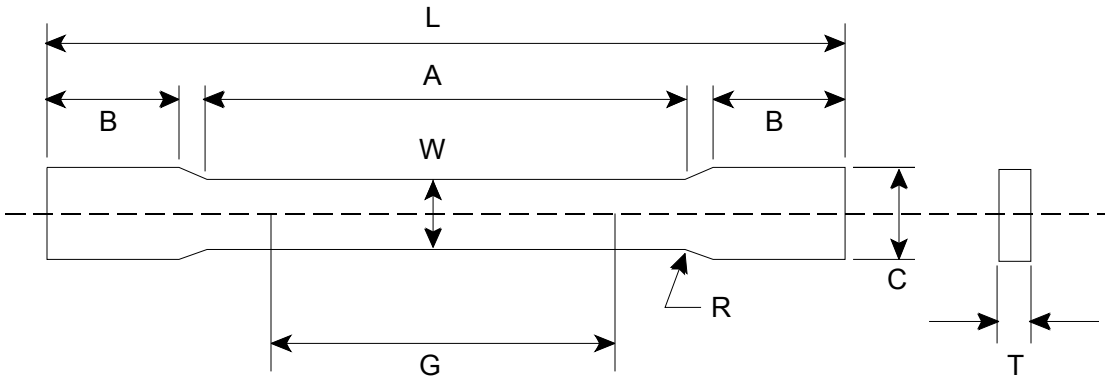
JOINT STRENGTH

The maximum load recorded when a joint specimen is tensile tested to separation. This force must be at least 60 percent of the material strength of the weakest component that was included in the joint specimen test.

MATERIAL SPECIMEN

A piece of material that is cut from the school bus body outside the area of the joint specimen. Its size will conform to the dimensions shown in Figure 9, and it will be used to determine tensile strength of the material when the mechanical properties of a material are not known.

DIMENSIONS OF TENSILE TEST SPECIMEN FOR
DETERMINATION OF MATERIAL PROPERTIES AS TAKEN FROM THE
1973 ANNUAL BOOK OF ASTM STANDARDS
PART 31, METHOD E-8, PAGE 100



10. DEFINITIONS....Continued

MATERIAL TENSILE STRENGTH

The maximum stress which a material is capable of sustaining when subjected to a tensile test. It is expressed in force per unit of area (such as pounds per square inch) and can be calculated from the maximum load (pounds) observed during a tension test that was carried to rupture, divided by the original cross sectional area (square inches) of the material specimen. The material tensile strength will be obtained from the 1973 Annual Book of the ASTM Standards when the mechanical properties and their minimum specified thickness are known. When the mechanical properties of a material are not known, then two (2) each material specimens will be tensile tested and the average result will be used.

MINIMUM THICKNESS

During manufacture, the thickness of materials is permitted to vary from the specific or nominal thickness by a small amount. If the thickness tolerance of a material is specified by the ASTM, use the minimum thickness specified for that material in the 1973 edition of the Annual Book of ASTM Standards. If the thickness tolerance of a material is not specified by the ASTM, use the thickness permitted by the school bus manufacturer's material specifications.

RIVET BONDING

Is a process which uses a structural adhesive to supplement the strength of a riveted sheet metal joint.

RUB RAILS

The majority of school buses today have rub rails that are attached to the exterior surface of the bus body. These rub rails are not considered to have a function in enclosing the occupant space and therefore are not considered body components for purposes of FMVSS 221 requirements. when testing joints to which they are fastened, they should be modified as necessary to prevent them from affecting testing of the underlying joint and so that they are not held by the gripping fixture of the tensile strength test machine.

SCHOOL BUS

A bus that is sold, or introduced into interstate commerce, for purposes that include carrying students to and from school or related events, but does not include a bus designed and sold for operation as a common carrier in urban transportation.

10. DEFINITIONS....Continued

STRENGTH

As used in this procedure means resistance to force.

11. PRETEST REQUIREMENTS

11.1 TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one that does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by telephone, within 24 hours of the test and send written notice to the COTR within 48 hours of the test completion.

C. RETEST NOTIFICATION

The Contracting Officer of NHTSA is the only NHTSA official authorized to notify the Contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the Contracting Officer that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE

NHTSA shall furnish only one vehicle for each test ordered. The contractor shall furnish the test vehicle required for the retest. The retest vehicle shall be equipped as the original vehicle. The original vehicle used in the invalid test shall remain the property of NHTSA and the retest vehicle shall remain the property of the contractor. The contractor shall retain the retest vehicle for a

11. PRETEST REQUIREMENTS....Continued

period not exceeding 180 days if it fails the test. If the retest vehicle passes the test, the contractor may dispose of it upon notification from the COTR that the test report has been accepted.

F. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the contractor to submit such report. The test data from the invalid test must be safeguarded until the data from the retest has been accepted by the COTR. The report and other required deliverables for the retest vehicle are required to be submitted to the COTR within 3 weeks after completion of the retest.

G. DEFAULT

The contractor is subject to the default and subsequent procurement costs for non-delivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

H. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

11.2 DETAILED TEST AND QUALITY CONTROL PROCEDURES REQUIRED

Prior to conducting any compliance test, contractors are required to submit a detailed in-house compliance test procedure to the COTR that includes:

A. A step-by-step description of the methodology to be used.

B. A written Quality Control (QC) Procedure that shall include calibrations, the data review process, report review, and the people assigned to performed QC on each task.

C. A complete listing of test equipment that shall include instrument accuracy and calibration dates as required by Section 8, Calibration of Test Instruments.

11. PRETEST REQUIREMENTS....Continued

D. DETAILED checkoff lists to be used during the test and during the data review. These lists shall include all test procedure requirements and FMVSS requirements pertaining to the safety standard for which testing is being performed. Each separate checkoff sheet shall identify the lab, test date, vehicle and test technicians. These check sheets shall be used to document that all requirements and procedures have been complied with. These sheets shall be submitted with the test report.

There shall be no contradiction between the OVSC Laboratory Test Procedure and the contractor's in-house test procedure. The procedures shall cover all aspects of testing from vehicle receipt to submission of the final report. Written approval of the procedures shall be obtained from the COTR before initiating the compliance test program. After testing commences, written approval shall also be obtained from the COTR prior to any changes in the procedures.

REPORTING OF POSSIBLE NONCOMPLIANCE

A. The following conditions shall be classified as possible noncompliance:

(1) Any defect noted in the test vehicle which indicates an obvious violation of the FMVSS requirements.

(2) Any condition discovered during the compliance test that indicates the test vehicle fails to meet any of the requirements of FMVSS 221.

B. Any suspicion of possible noncompliance shall be communicated immediately by telephone to the NHTSA COTR. In addition, a formal notification of possible noncompliance shall be made within a period of 48 hours to the NHTSA COTR. This notice shall be submitted in writing, using the report sheet shown in this procedure. The report should be accompanied by photographs, sketches, and copies of such test data as required to convey the nature and extent of the possible noncompliance. The Notice of Possible Noncompliance shall be signed by the responsible test engineer, signifying that the information and, if applicable, pictures, etc., are explanatory of the circumstances present at the time the anomaly was detected. In addition, the department manager or other responsible test laboratory officer shall sign the Notice to signify that the circumstances and description provided in the Notice are correct and represent the situation at hand. A signature block has been provided for the NHTSA test witness (COTR). The provisions for this signature are not mandatory, but have been provided to allow complete documentation of a possible noncompliance if the NHTSA test witness (COTR) is present during the inspection and elects to dispose of the situation or test vehicle. For

11. PRETEST REQUIREMENTS....Continued

example, "Note all circumstances and continue the inspection," or "Discontinue the inspection of the applicable vehicle, and collect all data for NHTSA review."

C. Incidental expenses incurred by the test laboratory as a result of a noncompliance such as manufacturer's inspections, removal, and installation of minor vehicle components are considered to be part of the test program and will not be compensated for separately.

D. In the event of an indicated failure to the performance requirements of the standard, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for this calibration check will be at the COTR's discretion and will be performed without additional costs.

TEST EQUIPMENT DESCRIPTION

The following is a list of minimum test equipment needed to evaluate the minimum requirements as outlined in FMVSS 221:

A. TENSILE TESTING DEVICE

A tensile testing device having a load range capable of testing all joints and material specimens specified in the test procedure at a uniform rate between 0.125 inch per minute and 0.375 inch per minute.

B. FORCE MEASURING APPARATUS

A calibrated force measuring apparatus will be installed at the tensile testing machine with the output recorded along with the displacement. The apparatus must be capable of measuring 120 percent of the specified load.

C. LOADING RATE MEASURING DEVICE

The permanent recording media for the force and displacement data will also furnish the rate of the force application. If an oscillograph is used, the chart speed can be constant, thereby furnishing a definite load slope for the rate of movement.

11. PRETEST REQUIREMENTS....Continued

D. TEST DATA PERMANENT RECORDING INSTRUMENT

A continuous recorder with visual trace is recommended for the recording instrument. Paper speed and beam deflections will be calibrated prior to the test.

E. POWER MEDIA

The type of power used to actuate the tensile test machine will be an acceptable type that also permits control of rate of travel.

F. D.C. POWER SUPPLY

The tensile test machine and displacement measuring device may require a D.C. power supply for the signal conditioning equipment. A stabilized D.C. power supply will be provided along with the signal conditioning equipment.

G. FORCE/DISPLACEMENT DATA RECORDING EQUIPMENT

A permanent recording type oscillograph or equivalent will be used to record the force/displacement/rate. The recording media needs to be visual for instant reference of displacement and/or force.

H. MEASURING SCALES

Sufficient measuring scales necessary to determine and verify dimensions and specifications of tensile test specimens. Items include micrometer, steel scales or rulers and longer tapes to measure the 48 inch specimens as well as the perimeter of the bus.

SPECIMEN REMOVAL EQUIPMENT

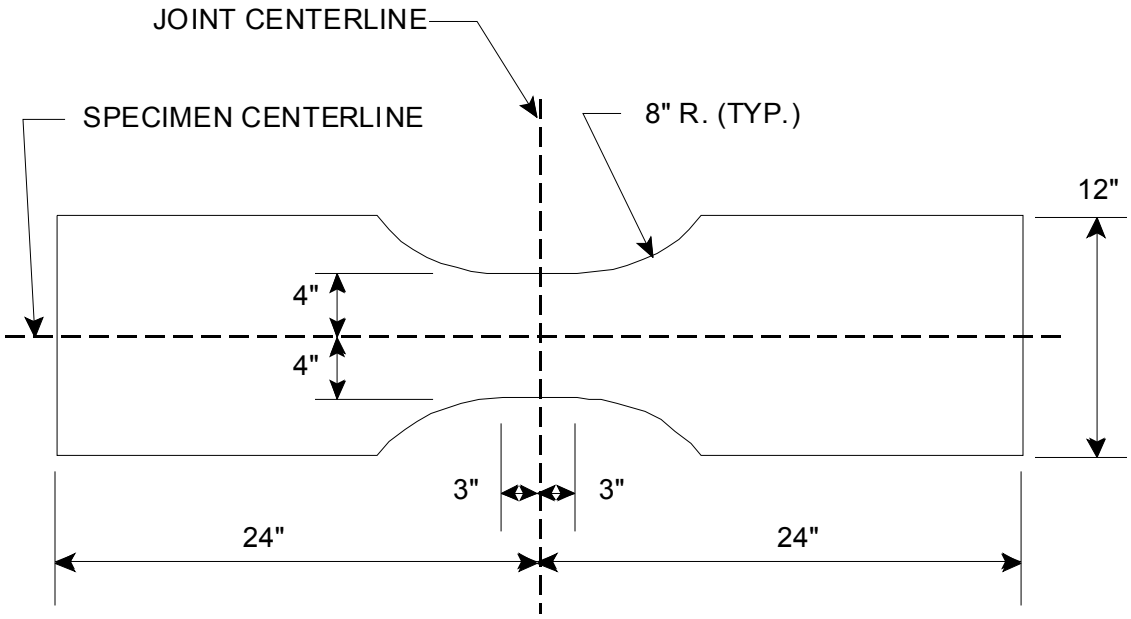
Tools, such as friction blade saws, sabre saws, or cutting torch, having the capabilities of cutting and removing oversized body sections of the bus body from which test specimens can then be excised in the machine shop. It is essential to avoid distortion and excessive temperatures during this operation. Temperature indicating devices must be applied to the body panels at the joint locations before removal from the body to assure that the body panel's temperature never exceeds 140°F.

11. PRETEST REQUIREMENTS....Continued

MACHINE SHOP FACILITIES

Facilities capable of cutting and shaping the test specimen to the requirements of this test procedure. To avoid damage to the joint where adhesives are used, the joint must be reinforced with wood blocks and/or clamps and an abrasive coated band saw blade should be used during this final cutting and shaping operation. (see Figure 7)

DIMENSION REQUIREMENTS OF BODY PANEL SPECIMEN
WHOSE JOINT SEGMENT IS 8 INCHES LONG



NOTE: TOLERANCE ON ALL DIMENSIONS IS ± 1/16"

11. PRETEST REQUIREMENTS....Continued

K. TENSILE TEST SPECIMEN GRIPS

Clamp type grips are to be fabricated to fit each different type of joint tensile specimen selected for testing. Primarily, the grips will fit all flat specimens. Special grips will be necessary for 90º or contoured specimens. The gripping devices are used to transmit the measured load applied by the testing machine to the test specimen. To ensure axial tensile stress, the axis of the test specimen in all planes must coincide with the centerline of the heads of the testing machine so that bending stresses are not introduced. Section E-8 of the 1973 edition of the ASTM Handbook should be used as a guide for the design and elation of these gripping devices.

L. PHOTOGRAPHIC EQUIPMENT

Photographic equipment necessary to provide a permanent record by illustrating test setup, conduct of test, mode of failure, test vehicle required interior and exterior views, etc.

TEST EQUIPMENT ACCURACY

ITEM	RANGE	ACCURACY
Tensile Testing Device (Must be calibrated in accordance with Method E-4, Verification of Testing Machines of the American Society for Testing and Materials (11973 Annual Book of ASTM Standards))	0 to 1,000 lbs	± 0.5% Full Scale
	0 to 10,000 lbs	
	0 to 50,000 lbs	
	0 to 100,000 lbs	
	0 to 200,000 lbs	
Continuous Recorder (Load/Deflection/Rate)	Readout Capability of 5% of maximum load	± 2%
12 inch steel rule	0 to 12 inches	± 0.0050 inch
Steel tape	0 to 100 feet	± 0.10 inch
Micrometer	0 to 0.999 inches	± 0.0005 inch
Sabre saw	6 inch depth	NA
Friction cutoff saw	4 inch depth	NA
Grips – tension	0 to 14 inches wide	NA

11. PRETEST REQUIREMENTS....Continued

SEQUENCE FOR TESTING

The test shall be conducted in the order shown below:

A. Perform a receiving-inspection of the school bus

B. Selection of joints to be tested

C. Preparation of test specimen

D. Conduct tensile tests of specimens

E. Analysis of joint strength by calculation

SELECTION OF JOINTS TO BE TESTED

Figure 10 is an illustration showing details of a typical school bus body that has unitized construction and is made of steel. It should be noted that there are numerous and varied joints on the interior and exterior surfaces that are covered by the standard's requirements. A detailed inspection must be made of all accessible panels to determine if there are joints that are suspect of not meeting the requirements. If necessary, floor coverings, access panels, moldings, trim panels, etc., will be removed to allow for an adequate inspection and determination on the adequacy of each joint. Some of these joints cannot be tested in a tensile test machine, as required, because there is not sufficient surrounding material to obtain a satisfactory specimen (meeting the dimensional requirements of Figures 7 and 8) for compliance testing. These types of joints will be reviewed by the test laboratory and COTR and any that appear suspect of insufficient strength will be evaluated by a suitable calculation method by the test laboratory. Joints that are suspect of having insufficient strength characteristics will be reported to the COTR on the Notice of Possible Noncompliance Form. In addition, the test laboratory, after consultation with the COTR, will select a number of six (6) joints for tensile testing from the following locations on the bus body:

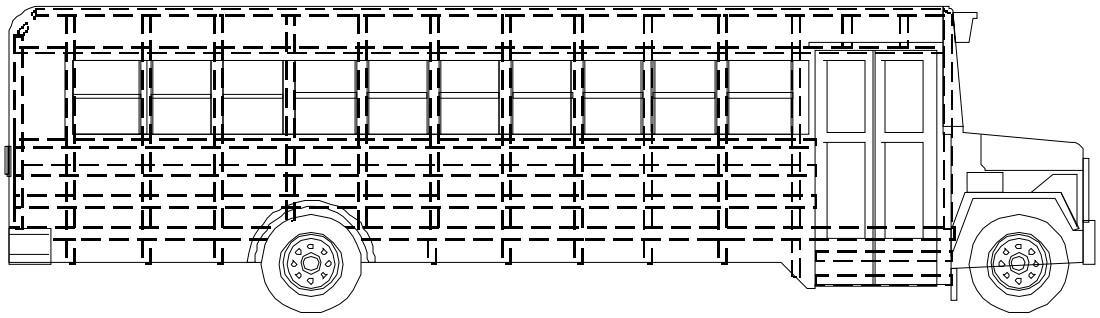
A. Exterior and interior roof panel joints

B. Exterior and interior side panel joints

C. It is that up to 6 additional miscellaneous joints will be selected for testing from any exterior or interior location which, in the judgment of the COTR or test laboratory, may be determined critical to satisfying the joint strength requirement.

11. PRETEST REQUIREMENTS....Continued

TYPICAL SCHOOL BUS ILLUSTRATION SHOWING CONSTRUCTION DETAILS



D. It is expected that up to six (6) additional joints may require mathematical analysis, at the option of the COTR, to determine their strength characteristics. In some cases it may be necessary to cut out specimens to determine their construction details.

E. All access panels that appear to have less than 60 percent joints be removed and the underlying areas inspected to determine:

(1) That there are serviceable items to qualify the panel for the access panel exemption.

(2) If there are joints which may be weaker than the required 60 percent strength, such joints are not exempted simply because they are covered by an exempt access panel.

F. After selection of the joints to be tested, the specimens to be cut from the bus body will be outlined, and photographs taken of the bus body showing the location, identification, and outline of each specimen. Be sure to get enough view area such that orientation/location of the joint is evident. Place an arrow in the view indicating the front and -top of the bus. Each specimen will be identified with a coded identifying number (See Attachment 1). Enter the specimens joint identification data on the appropriate data sheet.

11. PRETEST REQUIREMENTS....Continued

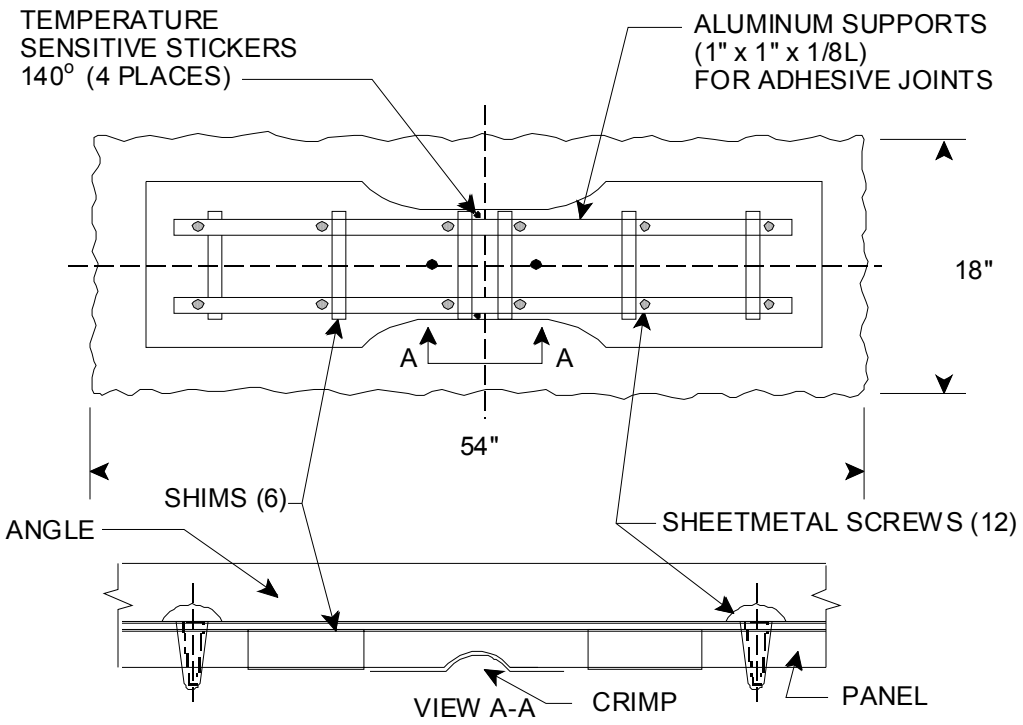
NOTE: It is recognized that when selecting test specimens from the bus side walls, it is possible to obtain only one test specimen from each joint length due to the short height of the panels. It is also recognized that corrugations, seat mountings, or other interferences limit the location from which a satisfactory specimen can be obtained. Care must be exercised to select the best representative portion of the joint to use for the test specimen. On the roof, ceiling, and other areas where assembled panels form longer joints, good judgment must be used to select joint specimens that appear to represent the overall construction characteristics of the entire joint length. Caution must also be exercised in the selection process to avoid taking specimens from areas that have been stressed due to previous FMVSS tests, or contain mounting holes, lights, grills, etc. or any items that might affect the transfer of forces in the test specimen during the tensile strength test.

REMOVAL OF A BODY SECTION AND TEST SPECIMEN PREPARATION

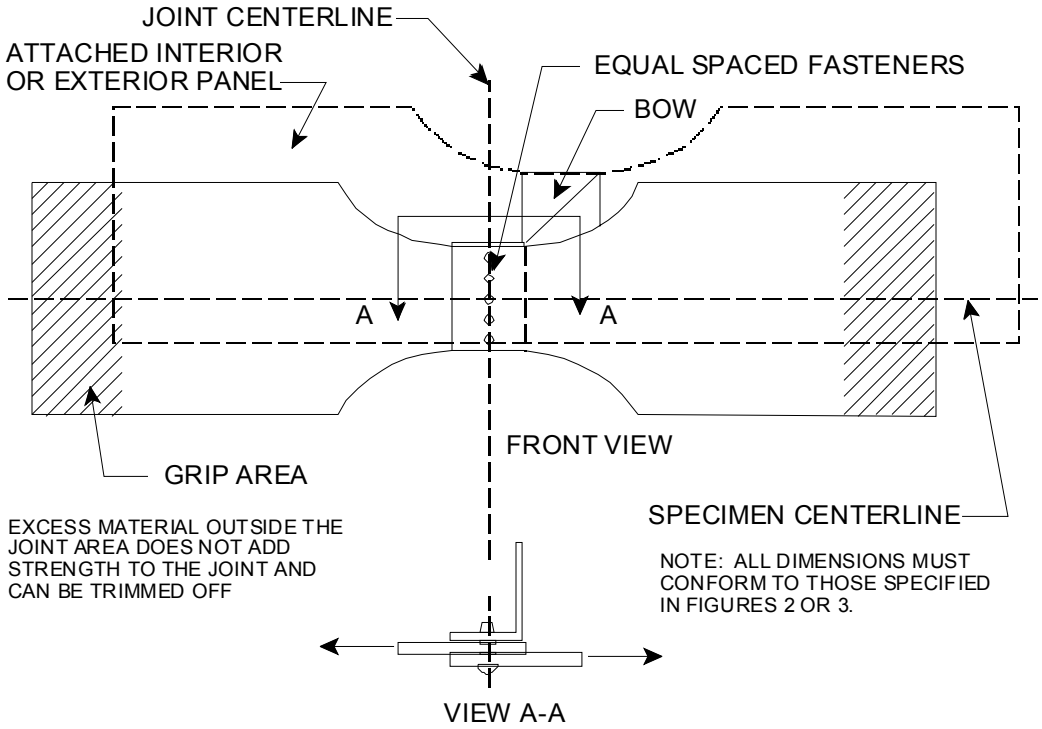
Cut a body section of approximately 18 x 54 inches (as shown in Figure 4) from which the finished test specimen can be fabricated (as shown in Figure 7). Where a body section containing the joint selected for testing is constructed so that exterior and interior panels are fastened to a common bow, header, stringer, etc., the section must be removed from the bus body as an assembly. The assembly will include both exterior and interior panels fastened as an integral part of the body panel joint as shown in Figure 11. (Exterior rub rails may be included as part of the joint). Apply 140º F temperature sensitive stickers at the 4 locations around the specimen joint area as shown on Figure 4. They should remain on the specimen throughout the entire cutting, shaping and testing process to show that the temperature of 140º F was never exceeded. During the cutting, shaping and transfer operations of the body section or test specimen, exercise extreme care not to flex the joint in any manner in order to preserve the integrity of the joint. For joints which appear to contain adhesives, additional precautions must be taken before starting the body section removal. Install two 1 x 1 x 0.125 inch aluminum angles across the joint and attach them to the panels, as shown in Figure 4, to prevent flexing of the joint. Be sure to shim as necessary to clear the panel ribs or irregular surfaces. It is important that the sheet metal screws attaching the angles to the test specimen are located a minimum of six (6) inches away from the joint. The support angles must be removed after the specimen is installed in the tensile testing device and before actual testing begins. If it is not possible to cut out a body section of 18 x 54 inches, it is permissible to obtain any width greater than 8 inches and any length greater than the necked down portion as shown in Figure 7 and long enough to allow proper clamping

11.

BODY SECTION AND JOINT SUPPORTS



TYPICAL LAP JOINT SPECIMEN PREPARED FOR TENSILE TESTING



11. PRETEST REQUIREMENTS....Continued

in the grips of the tensile testing machine. The radius of the necked down section must always be equal to or greater than the joint length. If a joint test specimen contains a joint segment less than 8 inches long, cut out a test specimen having the dimensions shown in Figure 8. After selection of the body section to be removed from the bus body, and before its removal, outline the test specimen and take photographs showing its location.

The selected test specimen will be cut from the body section such that it contains an 8 inch segment of the joint together with a portion of the bus body, in accordance with dimensions shown in Figure 7 (except specimens less then 8 inches long as shown in Figure 8). Mark the removed end pieces of the joint with the joint number and save for future reference in case it is necessary to compare the before and after test assemblies.

When preparing the joint test specimen:

A. If the ASTM material properties and material minimum thicknesses are known for the 2 components to be tested in the specimen, determine the minimum allowable strength of the joint test specimen as follows:

(1) Determine the minimum material tensile strength (psi) from the appropriate part of the 1973 Annual Book of ASTM Standards for each material.

(2) Determine which of the two (2) components to be tested has the least tensile strength (F_{tu} - weaker member).

(3) Measure the material width of the weaker member at the joint in the specimen.

(4) Compute the material area of the weaker member at the joint which will be in tension when the specimen is under load, according to the following expression:

$A_t = t \times w$, where –

A_t = area in tension of the weaker member (sq. in.)
t = thickness (inch)
w = material width (inch)

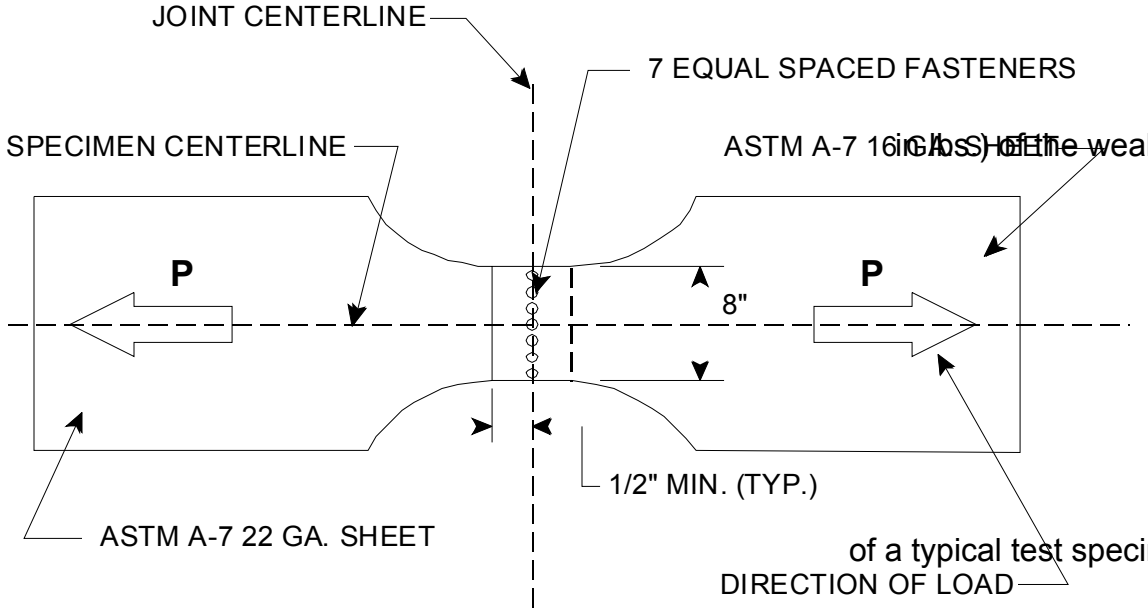
11. PRETEST REQUIREMENTS....Continued

(5) Determine the strength requirements (P_t in lbs) of the weaker member as follows:

TYPICAL TEST SPECIMEN

$P_t = F_{tu} \times A_t$

$P_s = 0.60 \times P_t$



FRONT VIEW

11. PRETEST REQUIREMENTS....Continued

(1) Minimum ultimate tensile strength (F_{TU}) of ASTM A7 steel is 45,000 psi:

F_{tu} = 45,000 psi

(2) Minimum thickness of 22 gauge sheet is 0.0296 inches.

(3) Minimum thickness of 16 gauge sheet is 0.0575 inches.

(4) Use thickness of 22 gauge sheet (weaker member) in computing At:

w = 8.0 inches

$A_t = t \times w = 0.0296 \times 8.0 = 0.237$ sq. in.

(5) The allowable strength (P_t) of the weaker member is calculated by substituting in the equation:

$F_{tu} = P_t / A_t$

$P_t = (F_{tu})(A_t)$

$P_t = 45{,}000 \times 0.237$

P_t = 10,665 pounds

(6) The minimum allowable strength (P_s) of the joint shall be at least 60 percent of the strength (P_t) of the material in the weaker component of the test specimen.

$P_s = 0.60 \times P_t$

$P_s = 0.60 \times 10{,}665$

P_s = 6,399 pounds

(7) The test specimen must be capable of withstanding at least Ps = 6,399 pounds before separation of the joint occurs.

11. PRETEST REQUIREMENTS....Continued

B. If the ASTM material properties and thickness are NOT known for each material component to be tested in the test specimen, the minimum allowable strength for that joint will be determined as follows:

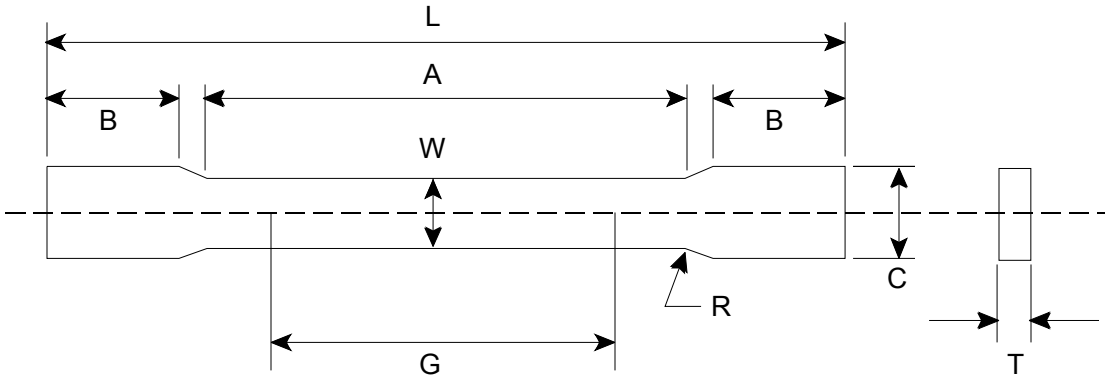
(1) Measure the material thickness of both materials that will be tensile tested.

(2) The thinnest material will be identified as the weaker member and its tensile strength will be determined.

(3) Cut 2 specimens of the weaker member material from the school bus body in an area outside the joint specimen and machine them to the dimensions shown in Figure 9.

(4) Determine the tensile strength (F_{tu}) of that material in accordance with the procedures outlined in Method E8, Tension Testing of Metallic Materials, of the 1973 Annual Book of ASTM Standards, Part 31, pages 196 - 215, of that method.

DIMENSIONS OF TENSILE TEST SPECIMEN FOR
DETERMINATION OF MATERIAL PROPERTIES AS TAKEN FROM THE
1973 ANNUAL BOOK OF ASTM STANDARDS
PART 31, METHOD E-8, PAGE 100



11. PRETEST REQUIREMENTS....Continued

(5) Record calculation results on Data Sheet 5.

(6) Using the average tensile strength determined above, compute the minimum allowable strength of the selected joint in* accordance with the procedures described in Item 1. B - F above.

(7) Record calculation results on Data Sheet 4.

C. Cut out the test specimen from the previously selected body section in accordance with Figures 7 or 8 as applicable. On body sections containing adhesive joints, the aluminum angle supports are not to be removed during the test specimen shaping operation and care is to be exercised in handling the body section and the specimen to preclude flexing of the joint.

D. Where a body panel joint is not fastened continuously, i.e., discrete fasteners do not occur at equally spaced intervals across the midpoint of the joint segment, the joint will be cut out and machined so that a spot weld or discrete fastener is not bisected. Good judgment must also be exercised to center the fastener pattern in the test joint section as closely as possible.

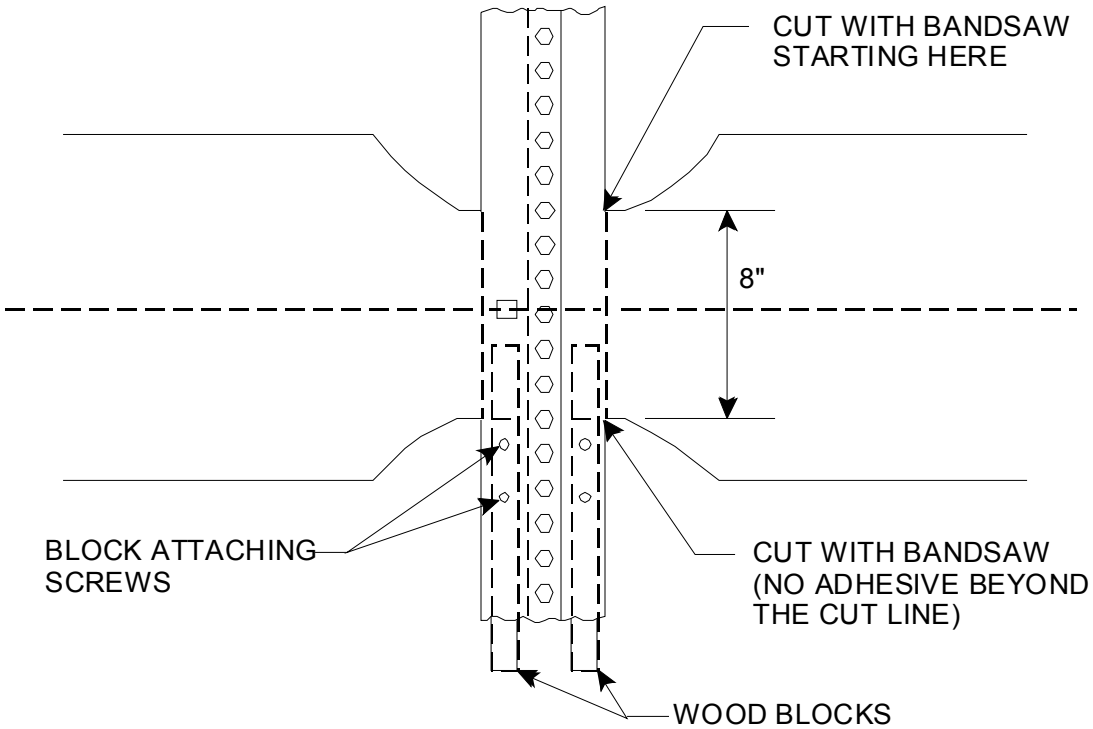
E. When cutting out and machining the selected test specimens, care must be taken to prevent distortion, excessive vibrations or excessive temperatures of any joint components. A special grit-edge tungsten carbide continuous grit band saw blade, when used for the final shaping of the 6 inch straight section across the specimen joint area, will minimize vibration during the cutting operation. On body sections containing adhesive joints, special blocks will be applied prior to starting the band saw cut. Wood blocks will be inserted below the joint panels and attached to each panel with screws and/or adhesives to further minimize vibration generation during the band saw cutting operation. (See Figure 13)

F. Obtain suitable tensile test machine grips capable of holding each test specimen in the tensile test machine.

G. Install and align the selected test specimen in the tensile test machine, which has been calibrated in accordance with the procedures outlined in Method E4, Verification of Testing Machines, of the 1973 Annual Book of ASTM Standards, Part 10, pages 502 - 507 of that method.

11. PRETEST REQUIREMENTS....Continued

APPLICATION OF WOOD BLOCKS TO SPECIMENS CONTAINING ADHESIVE JOINTS (TYPICAL)



H. Photograph the test setup with the specimen installed in the tensile test machine for each test specimen.

I. Prepare a sketch of each test specimen showing details of the joint selected for testing. The sketch should include all specimen dimensions and material identifications, thicknesses, description of fasteners, and tensile strength of the components to be tested. In addition, the sketch will illustrate which joint components are being pulled in the tensile test machine. This sketch will also be attached to the data sheet used for each test specimen.

CAUTION: Extreme care must be exercised at all times when handling the body section and the test specimen to avoid damage to the joint section.

12. COMPLIANCE TEST EXECUTION

CONDUCT TENSILE TEST OF SPECIMENS

At the beginning of each test program (at least once each year) the strain gauged specimen shaped coupon into the tensile test load frame using the standard flat end clamps for the load transfer to simulate an actual compliance test. Apply a load to the coupon at the standard rate to a level of 7,500 pounds. Record the output of all 5 strain gauge locations. At the conclusion of the test, analyze the strain gauge data to confirm that the maximum strain gradient at the joint location is less than 3 percent. After conducting the tensile test on the specimen to verify that all test equipment and data recording equipment is operational and has been correctly calibrated, proceed to conduct tests on the selected body panel specimen as follows:

A. Apply load to the tensile test specimen at a uniform rate of not less than 0.125 inch per minute and not more than 0.375 inch per minute until the specimen separates.

B. Record the maximum load obtained during the tensile test and determine if it is at least 60 percent of the allowable strength of the weaker member of the test specimen.

C. Photograph the test specimen to show details of the separation at the joint.

D. Record results on Data Sheets 3 or 4 as applicable.

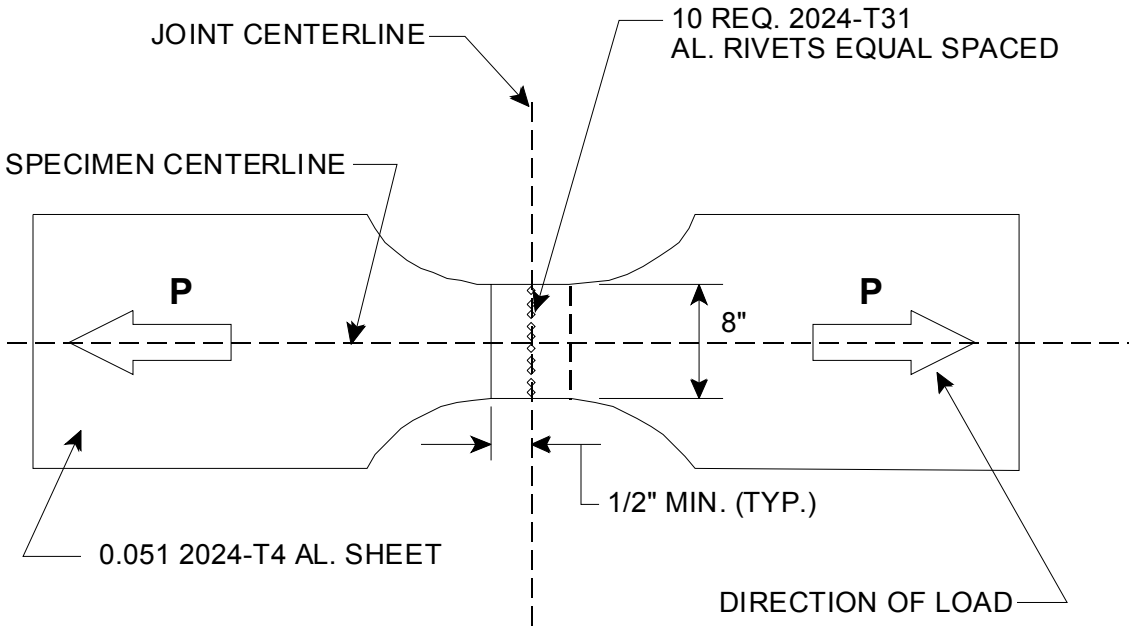
ANALYSIS OF JOINT STRENGTH BY CALCULATION

Shown below is a typical example of calculations that could be used to conduct analysis of joints. Record calculation results on Data Sheet 6.

A. Given: The side body panels of a bus body are 2024-T4, aluminum sheet and 0.25 inch diameter 2024-T31 cold-driven rivets are used for assembly at the joint. Panels are 0.051 inch thick and their edges are attached to gussets. Normal minimum rivet pitch is 0.75 inch and all edge distances are 0.50 inch minimum. A typical fabricated test specimen would be as shown in the sketch shown on the next page.

12. COMPLIANCE TEST EXECUTION....Continued

TYPICAL TEST SPECIMEN



FRONT VIEW

B

Preparation of Test Specimen, p.

F_{tu} = 62,000 psi

(2) Area in tension (A_1) of weaker member, thickness (t) = 0.051 inch and width (w) = 8.0 inches.

A_t = t x w = 0.051 x 8.0 = 0.408 sq. in.

12. COMPLIANCE TEST EXECUTION....Continued

(3) The strength (P_t) of the weaker member (w = 8.0 and t = 0.051 per this example) is calculated by substituting in the equation:

$F_{tu} = P_t / A_t$

P_t = (62,000) (0.408) = 25,296 pounds

(4) The allowable shear strength of the joint (P_s) shall be at least 60 percent of the strength (P_t) of the weaker member.

$P_s = 0.60 \times P_t = 0.60 \times 25{,}296 = 15{,}178$ pounds

(5) The typical test specimen joint must be capable of withstanding a load of at least 15,178 pounds before separation occurs when subjected to a tensile test to demonstrate compliance with the standard.

C. Strength of Rivets (to check adequacy of riveted joint)

(1) Rivet In Shear (Rivet load method) 0.25 inch diameter, 2024-T-31 Al. rivets are capable of 2,180 pound loads per rivet in single shear.

Rivet load (P_R) becomes (for 10 rivets) –

P_R = 10 (2,180) = 21,800 pounds > 15,178 pounds -- **O.K.**

(2) Rivet In Shear (Allowable stress method)

(A) Allowable single shear stress (F_s) for 2024-T31 rivets is 42,000 psi.

F_S = 42,000 psi

(B) Rivet Shear Area (A_s) for 0.25 inch diameter rivet (cold-driven) is 0.05187 square inches per rivet:

A_s = 0.05187 sq. in./rivet

12. COMPLIANCE TEST EXECUTION....Continued

(C) Shear Load (P_s) for ten (10) 0.25 inch diameter rivets is found by substituting in the equation:

$F_s = P_s / A_s$

$P_s = (42,000) (10) (0.05187)$

$P_s = 21,785$ pounds > 15,178 pounds – **O.K.**

(3) Body Panel In Bearing

(A) Allowable bearing stress (F_b) of 2024-T4 Al. Sheet is 118,000 psi

$F_b = 118,000$ psi

(B) Rivet Bearing Area (A_b) for cold-driven 0.25 inch diameter rivet is 0.051. Sheet is 0.01311 square inches per rivet:

$A_b = 0.01311$ sq. in./rivet

(C) Bearing Load (P_b) for ten (10) 0.25 inch diameter rivets per sketch is found by substituting in the equation:

$F_b = P_b / A_b$

$P_b = (118,000) (0.01311) (10)$

$P_s = 15,470$ pounds > 15,178 pounds -- **O.K.**

NOTE: The use of adhesives at the joint may increase the strength of the joint and would require additional calculations from data supplied by the manufacturer.

(4) This analysis of the body panel joint shows it to be near critical in bearing.

13. POST TEST REQUIREMENTS

The contractor shall re-verify all instrumentation and check data sheets and photographs.

A. Protect the school bus from further damage and the elements

B. Move the school bus to a secure area

C. Prepare the vehicle final test report

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The contractor shall submit a Monthly Test Status Report and a Vehicle Status Report to the COTR (both reports shown in the FORMS Section 16). The Vehicle Status Report shall be submitted until all vehicles or items of equipment are disposed of.

14.2 APPARENT TEST FAILURE

Any indication of an apparent test failure shall be communicated by telephone to the COTR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). A Notice of Apparent Test Failure, shown in the FORMS Section 16, with a copy of the particular compliance test data sheet(s) and preliminary data plot(s) shall be included.

In the event of an apparent test failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OVSC.

14.3 FINAL TEST REPORT

14.3.1 COPIES

In the case of a test failure or retest (another test of a vehicle that exceeded the FMVSS 221 performance requirements), **SEVEN** copies of the Final Test Report, **FOUR** copies of the test film, and **ONE** copy of the test check sheets shall be submitted to the COTR for acceptance within three weeks of test completion. The Final Test Report format to be used by all contractors can be found in this section.

14. REPORTS....Continued

Where there has been no indication of a test failure, **FIVE** copies of each Final Test Report, **THREE** copies of the test film, and **ONE** copy of the test check sheets shall be submitted to the COTR within three weeks of test completion. Payment of contractor's invoices for completed compliance tests may be withheld until the Final Test Report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within two weeks after the compliance test is conducted. The contractor and the COTR will then be able to discuss the details of both test conduct and report content early in the compliance test program. Contractors are required to PROOF READ all Final Test Reports before submittal to the COTR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

14.3.2 REQUIREMENTS

The Final Test Report, associated documentation (including photographs) are relied upon as the chronicle of the compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COTR. For these reasons, each final report must be a complete document capable of standing by itself.

The contractor should use **detailed** descriptions of all compliance test events. Any events that are not directly associated with the standard but are of technical interest should also be included. The contractor should include as much **detail** as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

14. REPORTS....Continued

14.3.3 FIRST THREE PAGES

FRONT COVER

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

A. Final Report Number such as 221_ABC_9X_001, where –

221 is the FMVSS tested
ABC are the initials for the laboratory
9X is the Fiscal Year of the test program (or 0X after 1999)
001 is the Group Number (001 for the 1st test, 002 for the 2nd test, 003 for the 3rd test, etc.)

B. Final Report Title And Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS 221
School Bus Body Joint Strength
* * * * * * * * * * * * * * * * * * *
World Motors Corporation
199X World XYZ 65-Passenger School Bus
NHTSA No. CX0901

C. Contractor's Name and Address such as

ABC LABORATORIES, INC.
405 Main Street
Detroit, Michigan 48070

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (C) AND (D)

D. Date of Final Report completion

E. The words "FINAL REPORT"

14. REPORTS....Continued

F. The sponsoring agency's name and address as follows –

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
Mail Code: NVS-220, Room 6111
400 Seventh Street, SW
Washington, DC 20590

14. REPORTS....Continued

FIRST PAGE AFTER FRONT COVER

A disclaimer statement and an acceptance signature block for the COTR shall be provided as follows:

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared By: _____

Approved By: _____

Approval Date: _____

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: _____

Acceptance Date: _____

14. REPORTS....Continued

SECOND PAGE AFTER FRONT COVER

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 — REPORT NUMBER

221_ABC_9X_001

Block 2 — GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 — TITLE AND SUBTITLE

Final Report of FMVSS 221 Compliance Testing
of a 199X World XYZ 65-Passenger School Bus
NHTSA No. CX0901

Block 5 — REPORT DATE

March 1, 199X (or 200X after year 1999)

Block 6 — PERFORMING ORGANIZATION CODE

ABC

Block 7 — AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT NUMBER

ABC_DOT_XXX_001

14. REPORTS....Continued

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories, Inc.
405 Main Street
Detroit, MI 48070

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22_9X_C_12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

United States Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220
400 Seventh Street, SW, Room 6111
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
March 7 to March 15, 199X (or 200X after year 1999)

Block 14 — SPONSORING AGENCY CODE

NVS_220

Block 15 — SUPPLEMENTARY NOTES

Leave blank

14. REPORTS....Continued

Block 16 — ABSTRACT

Compliance tests were conducted on the subject 199X World XYZ 65-passenger school bus in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP_221_0X for the determination of FMVSS 221 compliance. Test failures identified were as follows:

None (or, if any, describe)

Block 17 — KEY WORDS

Compliance Testing
Safety Engineering
FMVSS 221

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from the following:

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Mail Code: NPO-230
400 Seventh St., SW, Room 5108
Washington, DC 20590
Telephone No. 202-366-4946

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES

Add appropriate number

Block 22 — PRICE

Leave blank

14. REPORTS....Continued

14.3.4 TABLE OF CONTENTS

Sample Test Report Table of Contents:

Section 1 — Purpose of Compliance Test

Section 2 — Compliance Data Summary

Section 3 — Test Data (including acceleration and velocity plots)

Section 4 — Test Equipment List and Calibration Information

Section 5 — Photographs

Section 6 — Notice of Test Failure (if applicable)

15. DATA SHEETS

DATA SHEET 1
ADMINISTRATIVE DATA

CONTRACT NO.: DTNH22-_____

LABORATORY NAME: _____

DESCRIPTION OF SCHOOL BUS:

A. Incomplete Vehicle (if applicable)

(1) MFR.: _____

(2) MODEL: _____

(3) VIN: _____

(4) BUILD DATE: _____

(5) CERTIFICATION DATE: _____

Completed Vehicle (SCHOOL BUS)

(1) MFR.: _____

(2) MAKE/MODEL: _____

(3) VIN: _____

(4) NHTSA NO.: _____

(5) COLOR: _____

6) GVWR: _____

7) BUILD DATE: _____

(8) CERTIFICATION DATE: _____

REMARKS:

15. DATA SHEETS .... Continued

DATES:

(1) VEHICLE RECEIPT: _____

(2) START OF COMPLIANCE TEST: _____

(3) COMPLETION OF COMPLIANCE TEST: _____

TEST VEHICLE (SCHOOL BUS) DISPOSITION:

COMPLIANCE TEST:

All tests were performed in accordance with the references outlined in:

A. FMVSS 221

B. ASTM STANDARDS

REMARKS

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

DATA SHEET 2
SUMMARY OF DATA

BUS NHTSA NO.: _____; BUS DESCRIPTION: _____

JOINT SPECIMEN I.D.	JOINT LOCATION	JOINT LOAD REQMT. (60%)	MAX. LOAD AT JOINT SEPARATION (Lbs)	CALCULATED LOAD AT JOINT SEPARATION (Lbs)	PASS	FAIL

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

DATA SHEET 3
JOINT STRENGTH WHEN ASTM MATERIAL
PROPERTIES OF SPECIMEN ARE KNOWN

BUS NHTSA NO.: _____; BUS DESCRIPTION: _____

SPECIMEN DESCRIPTION: _____

RESULTS OF TENSILE TEST ON SPECIMEN

	WEAKER MEMBER	STRONGER MEMBER
MATERIAL		
TENSILE STRENGTH		
GAGE/THICKNESS		
FASTENER HOLES (NO./DIAMETER - inches)		
NET AREA (square inches)		
MATERIAL STRENGTH (lbs)		
60% OF MATERIAL STRENGTH (lbs)		
MAXIMUM LOAD FROM JOINT TENSILE TEST (lbs)		
PASS		
FAIL		

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

DATA SHEET 4
JOINT STRENGTH WHEN ASTM MATERIAL
PROPERTIES OF SPECIMEN ARE NOT KNOWN

BUS NHTSA NO.: _____; BUS DESCRIPTION: _____

SPECIMEN DESCRIPTION: _____

SPECIMEN IDENTIFICATION: _____

Attach sketch of specimen as described.

RESULTS OF TENSILE TEST ON SPECIMEN

	WEAKER MEMBER	STRONGER MEMBER
MATERIAL TENSILE STRENGTH (psi)		
AREA OF JOINT (square inches)		
MATERIAL STRENGTH		
60% OF MATERIAL STRENGTH (lbs)		
MAX. LOAD FROM JOINT TENSILE TEST (lbs)		
PASS		
FAIL		

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

DATA SHEET 5
MATERIAL TENSILE STRENGTH WHEN ASTM MATERIAL
PROPERTIES OF SPECIMEN ARE NOT KNOWN

BUS NHTSA NO.: _____; BUS DESCRIPTION: _____

SPECIMEN DESCRIPTION: _____

SPECIMEN IDENTIFICATION: _____

Attach sketch showing area of bus body where specimen was taken and its proximity to joint specimen.

RESULTS OF TENSILE TEST ON MATERIAL SPECIMEN

	SAMPLE 1	SAMPLE 2	SAMPLE 3
TENSILE LOAD AT MATERIAL SPECIMEN SEPARATION (lbs)			
CROSS SECTIONAL AREA OF MATERIAL SPECIMEN (square inches)			
MATERIAL TENSILE STRENGTH (psi)			

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

DATA SHEET 6
ANALYSIS OF JOINT STRENGTH BY CALCULATION

BUS NHTSA NO.: _____; BUS DESCRIPTION: _____

JOINT LOCATION: _____

Attach sketch similar to Figure 13 showing details of the joint construction. Include dimensions of all components involved.

	WEAKER MEMBER	STRONGER MEMBER
MATERIAL TENSILE STRENGTH (psi)		
AREA OF JOINT (square inches)		
MATERIAL STRENGTH (lbs)		
60% OF MATERIAL STRENGTH (lbs)		
CALCULATED MINIMUM JOINT STRENGTH (lbs)		
PASS		
FAIL		

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS .... Continued

ATTACHMENT 1 – TEST SPECIMEN IDENTIFICATION NUMBER

1	2	3	4	5	6	7	8	9	10	11	12
T	S	R	L	F	E	1	8	6	A	R	H

CODES:

1.	SCHOOL BUS NAME	6.	INTERIOR/EXTERIOR
	B. BLUE BIRD		I – INTERIOR
	S. SUPERIOR		E – EXTERIOR
	T. THOMAS	7.	SAMPLE NUMBER
	C. CARPENTER		1 – FIRST
			2 – SECOND
		8.	JOINT WIDTH (inches)
2.	SMALL/LARGE SCHOOL BUS	9.	NO. OF FASTENERS (inches)
	S – SMALL	10.	SPECIMEN TOTAL SIZE
	L – LARGE		A – 12" WIDE X 24" LONG
3.	GENERAL SAMPLE LOCATION		B – 12" WIDE X 48" LONG
	S – SIDE		C – SPECIAL
	F – FLOOR	11.	JOINT DESCRIPTION
	R – ROOF		A – ADHESIVE + RIVETS
	H – HEADLINER		B – ADHESIVE + SCREWS
	O – OTHER		C – ADHESIVE ONLY
4.	LATERAL LOCATION		R – RIVETS
	L – LEFT		W – WELDED
	R – RIGHT		S – SCREWS
	C – CENTER (ROOF/FLOOR)		O – OTHER
5.	FORE/AFT LOCATION	12.	JOINT DIRECTION
	F – FRONT QUARTER		H – HORIZONTAL
	M – MIDDLE HALF		V – VERTICAL
	R – REAR QUARTER		O – OTHER

15. DATA SHEETS .... Continued

ATTACHMENT 2
MATERIAL CHARACTERISTICS FROM ASTM A525 FOR
GRADE A ZINC COATED STEEL SHEETS

GAGE	THICKNESS	MINIMUM THICKNESS	AREA 8" SECTION	STRENGTH 8" SECTION (lbs)	STRENGTH (60%)	STRENGTH PER INCH	STRENGTH PER INCH (60%)
10	0.1382	0.1302*	1.0416	46,822	28,123	5,859	3,515
11	0.1233	0.1153*	0.9224	41,508	24,905	5,188	3,113
12	0.1084	0.1004*	0.8032	36,144	21,686	4,518	2,711
13	0.0934	0.0854	0.6832	30,744	18,446	3,843	2,306
14	0.0785	0.0705	0.5640	25,380	15,228	3,172	1,904
15	0.0710	0.0650	0.5200	23,400	14,040	2,925	1,755
16	0.0635	0.0575	0.4600	20,700	12,420	2,587	1,553
17	0.0575	0.0525	0.4200	18,900	11,340	2,362	1,418
18	0.0516	0.0466	0.3728	16,776	10,065	2,097	1,258
19	0.0456	0.0406	0.3248	14,616	8,770	1,827	1,096
20	0.0396	0.0356	0.2848	12,810	7,686	1,601	961
21	0.0366	0.0326	0.2608	11,736	7,042	1,467	880
22	0.0336	0.0296	0.2348	10,566	6,340	1,321	793
23	0.0306	0.0266	0.2128	9,578	5,745	1,197	718
24	0.0276	0.0236	0.1888	8,496	5,098	1,062	637

* Reduce buy 0.001 for sheets wider than 40"

16. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 221 TEST DATE: _____

LABORATORY:
_____

CONTRACT NO.: _____DELV. ORDER NO.: _____

LABORATORY PROJECT ENGINEER'S NAME:
_____

TEST VEHICLE MAKE/MODEL/BODY STYLE:
_____

_____

VEHICLE NHTSA NO.: _____ VIN: _____

VEHICLE MODEL YEAR: _____ BUILD DATE: _____

TEST FAILURE DESCRIPTION:
_____

_____

_____

_____

S210 REQUIREMENT, PARAGRAPH _____:
_____

_____

_____

NOTIFICATION TO NHTSA (COTR):

DATE: _____ BY: _____

REMARKS:

16. FORMS....Continued

MONTHLY TEST STATUS REPORT

FMVSS 221

DATE OF REPORT: _____

No.	SCHOOL BUS NHTSA No., MAKE & MODEL	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						

16. REPORT FORMS....Continued

MONTHLY VEHICLE STATUS REPORT

FMVSS 221

DATE OF REPORT: _____

No.	SCHOOL BUS NHTSA No., MAKE & MODEL	DATE OF DELIVERY	TEST COMPLETE DATE	SCH. BUS SHIPMENT DATE	CONDITION OF SCHOOL BUS
1					
2					
3					
4					
5					