HEAVY-DUTY 500,000 MILE BUS WITH A MINIMUM SERVICE LIFE OF 12 YEARS

5. STRUCTURAL INTEGRITY

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

APRIL 2006

ABBREVIATIONS

ABTC - Altoona Bus Test Center
A/C - air conditioner
ADB - advance design bus
CBD - central business district
CI - compression ignition
CNG - compressed natural gas
CW - curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A) - decibels with reference to 0.0002 microbar as measured on the "A" scale
DIR - test director
DR - bus driver
EPA - Environmental Protection Agency
FFS - free floor space (floor area available to standees, excluding ingress/egress areas, area under seats, area occupied by feet of seated passengers, and the vestibule area)
FTA - Federal Transit Administration
GAWR - gross axle weight rating
GL - gross load (150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW - gross vehicle weight (curb weight plus gross vehicle load)
GVWR - gross vehicle weight rating
hr - hour
LNG - liquefied natural gas
mpg - miles per gallon
mph - miles per hour
NBM - new bus models
PSBRTF - Penn State Bus Research and Testing Facility
PTI - Pennsylvania Transportation Institute
rpm - revolutions per minute
SAE - Society of Automotive Engineers
SCF - standard cubic feet
SCFM - standard cubic feet per minute
SCH - test scheduler
SEC - secretary
SI - spark ignition
SLW - seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
TD - test driver
TM - track manager
TP - test personnel

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of various subsystems when the bus is placed in a longitudinal twist (simulating operation over a 6-inch curb or through a 6-inch pothole) and subjected to a water spray mechanism (simulating rain and traffic spray).

5.2-II. TEST DESCRIPTION

With the bus loaded to GVW, each wheel of the bus will be raised (one at a time to simulate operation over a curb) and operation of the following will be inspected:

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Wheelchair lift
7. Engine
8. Service doors
9. Escape hatches
10. Steering mechanism

Each wheel will then be lowered (one at a time to simulate operation through a pothole) and the same items inspected.

5.2-III. TEST ARTICLE

The test article is a heavy-duty transit bus with a minimum service life of 12 years or 500,000 mi.

5.2-IV. TEST EQUIPMENT/FACILITITES/PERSONNEL

The test will be performed on the structural strength test surface at the ABTC. The area contains a set of ramps, which will be used to alternately raise and lower each of the bus wheels by 6 inches. The following test equipment is needed for this test:

1. The regulated water spray mechanism that simulates rain and traffic spray.
2. Ballast to simulate passenger loading to GVW.

3. Four 6 inch ramps.

4. Ten copies of the Distortion Test Data Form.

Test personnel required for this test include:

1. Test personnel (TP)

5.2-V. TEST DATA

The test data consist of the completed Distortion Test Inspection Form for the ten test orientations. Upon completion of this test, data shall be forwarded to the ABTC manager.

5-2-VI. TEST PREPARATION AND PROCEDURES

The detailed test preparation and procedures are listed in procedure 5.2-1. This section also includes Distortion Test Data Form - 5.2.

DETAILED TEST PROCEDURES		TITLE: 5. Structural Integrity
Procedure 5.2-1		**NOMENCLATURE: 5.2 Structural Strength and Distortion Tests – Structural Distortion**
OPER STEP	**ACTION BY**	**TEST PREPARATION AND PROCEDURE AND PROCEDURE**
1	TP	Record the bus number on the ten separate Structural Integrity Data Forms. Retrieve a Work Order Form for this test.
2	TP	Maneuver the bus onto the structural strength test surface; i.e., all wheels level.
3	TP	Load the bus to gross vehicle weight using ballast. Gross vehicle weight is curb weight plus gross vehicle load.
4	TP	Verify proper operation of the water spray mechanism.
5	TP	Record environmental data on the Distortion Test Inspection Form.
6	TP	Verify that all test prerequisites are satisfied and test preparation steps complete.

DETAILED TEST PROCEDURES		TITLE: 5. Structural Integrity
Procedure 5.2-1		**NOMENCLATURE: 5.2 Structural Strength and Distortion Tests - Structural Distortion**
OPER STEP	**ACTION BY**	**TEST PROCEDURE**
1	TP	Using a ramp, position the bus so that the left front wheel is 6 inches higher than the other three.
2	TP	Check the appropriate position on a test form.
3	TP	Slowly pass the water spray mechanism over the entire length of the bus.
4	TP	Verify proper operation of the items listed below and record the findings. WINDOWS: Verify that a) All transom windows open and close properly. b) All emergency windows are closed, but will open and close properly c) No windows are cracked or broken. **FRONT DOORS**: Verify that the front doors open and close properly under both normal and emergency controls. **REAR DOORS**: Verify that the rear doors open and close properly under both normal (McKay gate and operator control) and emergency control. **ESCAPE MECHANISMS/ROOF VENTS**: Verify that the roof vents open and close properly. **ENGINE**: Operate the engine in neutral and verify normal operation. **HANDICAPPED DEVICES/SPECIAL SEATING**: Place the special seating in the raised and lowered positions, operate all handicapped equipment and verify proper operation. **UNDERCARRIAGE**: To the extent possible, inspect the undercarriage for cracks, gaps, loose hoses, and other abnormalities.

DETAILED TEST PROCEDURES		TITLE: 5. Structural Integrity
Procedure 5.2-1		NOMENCLATURE: 5.2 Structural Strength and Distortion Tests – Structural Distortion
OPER STEP	ACTION BY	TEST PROCEDURE
		SERVICE DOORS: Verify that all service doors open and close properly. **BODY:** Inspect the interior and exterior for leaks during the water spray. **WINDOWS/BODY LEAKAGE:** Inspect the interior for leaks during the water spray test. **STEERING MECHANISM:** Verify normal operation.
5	TP	Repeat steps 1 through 4 with the right front wheel 6 inches higher than the other three.
6	TP	Repeat steps 1 through 4 with the right rear wheel 6 inches higher than the other three.
7	TP	Repeat steps 1 through 4 with the left rear wheel 6 inches higher than the other three.
8	TP	Repeat steps 1 through 4 with the left front wheel 6 inches lower than the other three.
9	TP	Repeat steps 1 through 4 with the right front wheel 6 inches lower than the other three.
10	TP	Repeat steps 1 through 4 with the right rear wheel 6 inches lower than the other three.
11	TP	Repeat steps 1 through 4 with the left rear wheel 6 inches lower than the other three.
12	TP	Repeat steps 2 through 4 with all wheels level.
13	TP	File the ten completed Structural Integrity Data Forms and Work Order Form.

REVISIONS

All revisions to this test must be identified on this page. Briefly describe each revision in the space provided below.

Revision	Description	Date	Approval

DISTORTION TEST INSPECTION FORM

(Note: Ten copies of this data sheet are required)

Bus Number:	Date:
Personnel:	Temperature(EF):

Wheel Position : (check one)		
All wheels level	• before	• after
Left front	• 6 in higher	• 6 in lower
Right front	• 6 in higher	• 6 in lower
Right rear	• 6 in higher	• 6 in lower
Left rear	• 6 in higher	• 6 in lower
Right center	• 6 in higher	• 6 in lower
Left center	• 6 in higher	• 6 in lower

	Comments
• Windows	
• Front Doors	
• Rear Doors	
• Escape Mechanisms/ Roof Vents	
• Engine	
• Handicapped Device/ Special Seating	
• Undercarriage	
• Service Doors	
• Body	
• Windows/ Body Leakage	
• Steering Mechanism	