

# FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT  
In accordance with 49 CFR, Part 665

## Altoona Bus Testing and Research Center Test Bus Procedure

### 5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS – STATIC TOWING TEST

Pass/Fail  
October 2016



The Thomas D. Larson  
Pennsylvania Transportation Institute  
201 Transportation Research Building  
The Pennsylvania State University  
University Park, PA 16802  
(814) 865-1891

Bus Testing and Research Center  
2237 Plank Road  
Duncansville, PA 16635  
(814) 695-3404



**PennState**  
College of Engineering

**LTI BUS RESEARCH  
AND TESTING CENTER**

## 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
LTI	Larson Transportation Institute
mpg	Miles per gallon
mph	Miles per hour
NBM	New bus models
PSTT	Penn State Test Track
rpm	Revolutions per minute
SAE	Society of Automotive Engineers
SCF	Standard cubic feet
SCFM	Standard cubic feet per minute
SCH	Test scheduler
SA	Staff Assistant
SI	Spark ignition
SLW	Seated load weight (curb weight plus 150 lb. for every designated passenger seating position and for the driver)
TD	Test driver
TM	Track manager
TP	Test personnel

### **5.3-I. TEST OBJECTIVE**

The objective of this test is to determine the strength characteristics of the bus towing fixtures during static loading conditions.

### **5.3-II. TEST DESCRIPTION**

Using a load-distributing yoke, a hydraulic cylinder is used to apply a static tension load equal to 1.2 times the bus curb weight. The load will be applied to both the front and rear (if applicable) towing fixtures at an angle of approximately 20 degrees with the longitudinal axis of the bus. The first test will be an approximately 20 degree pull upward from the longitudinal axis of the bus, and then an approximately 20 degree downward pull from the longitudinal axis of the bus. The bus will then be positioned for an approximately 20 degree left pull from the longitudinal axis of the bus and then position for an approximately 20 degree right pull from the longitudinal axis of the bus. Any deformation or damage to the tow eyes or adjoining structure will be recorded. The bolts that connect the tow eyes and adjoining brackets must be re-torqued after each test, to the manufacturer's specification to check for any failure.

### **5.3-III. TEST ARTICLE**

The test article is a transit bus with a minimum service life of 4, 5, 7, 10 or 12 years.

### **5.3-IV. TEST EQUIPMENT/FACILITIES/PERSONNEL**

This test will be performed on the structural strength test surface at the Test Track. The following test equipment and personnel are required for this test:

1. Static loading fixture
2. Manufacturer provided towing sling
3. Calibrated tension measuring load cell apparatus
4. Axle anchoring fixture
5. Test personnel (TP)
6. Calibrated measuring tape
7. Calibrated Torque wrench
8. Camera
9. Calibrated weather instrument

### **5.3-V. TEST DATA**

The test data consists of the completed Static Data Test Towing Form. All forms must be completed using a pen. Upon completion of this test, data shall be forwarded to the ABTC manager.

## **5.3-VI. TEST PREPARATION AND PROCEDURES**

Detailed test preparation and procedures are listed in Procedure 5.3-1. This section also includes Static Towing Test Data Form – 5.3.

<b>DETAILED TEST PROCEDURES</b>		<b>TITLE: 5. Structural Integrity</b>
<b>Procedure 5.3-1</b>	<b>NOMENCLATURE: 5.3 Structural Strength and Distortion Tests – Static Towing Test</b>	
<b>OPER STEP</b>	<b>ACTION BY</b>	<b>TEST PREPARATION</b>
1	TP	Record the bus number, date, temperature and personnel on the data sheet.
2	TP	Position bus at the proper angle on the structural strength test surface at the ABTC. Consult with NBM manufacturer to determine proper method for anchoring bus.  <b>WARNING:</b> Ensure that the bus is properly secured to prevent movement during testing.
3	TP	Attach manufacturer supplied load-equalizing towing sling per manufacturer instructions, to front towing fixtures.
4	TP	Photograph bus in position for tests, also take a close-up photograph of towing sling as attached.
5	TP	Zero the digital readout of the load cell conditioner and check calibration value. Record the calibration value before and after the test. Adjust if necessary.

DETAILED TEST PROCEDURES		TITLE: 5. Structural Integrity
Procedure 5.3-1	NOMENCLATURE: 5.3 Structural Strength and Distortion Tests – Static Towing Test	
OPER STEP	ACTION BY	TEST PROCEDURE
1	TP	<b>WARNING: Stay clear of cable and loading apparatus during test. Failure of loaded mechanism may cause serious personal injury.</b> Position the bus such that the cable makes angle of approximately 20 degrees upward from the horizontal plane.
2	TP	Inspect towing sling, axle anchoring apparatus, tension measuring device, and tow cable. Ensure that they are secure and properly installed.
3	TP	Using the loading apparatus, <u>slowly</u> apply a load equal to approximately 1.2 times the curb weight of the bus and release. Photograph the procedure (side view).
4	TP	Visually inspect the towing sling, tow eyes, and adjoining structure for damage or permanent deformation. Torque all bolts on tow eyes and adjoining brackets to manufacturer’s specifications. Record any deformation, bolt failure or any structural change that may occur and photograph any damage.  NOTE: If damage or deformation occurs, terminate test immediately and record observation and maximum load obtained. If rear towing fixtures are to be tested, then proceed with rear tow test.
5	TP	Reposition the bus such that the cable makes an angle of approximately 20 degrees downward from the horizontal plane.
6	TP	Repeat steps 2 through 4.
7	TP	Reposition the bus such that the cable makes an angle of approximately 20 degrees to the left from the vertical plane.
8	TP	Repeat steps 2 through 4.
9	TP	Reposition the bus such that the cable makes an angle of approximately 20 degrees to the right from the vertical.

<b>DETAILED TEST PROCEDURES</b>		<b>TITLE: 5. Structural Integrity</b>
<b>Procedure 5.3-1</b>	<b>NOMENCLATURE: 5.3 Structural Strength and Distortion Tests – Static Towing Test</b>	
<b>OPER STEP</b>	<b>ACTION BY</b>	<b>TEST PROCEDURE</b>
10	TP	Repeat steps 2 through 4.
11	TP	Repeat steps 2 through 10 for rear towing fixture when applicable.
12	TP	Upon completion of this test, data shall be forwarded to the ABTC manager.