

STURAA TEST

4 YEAR

100,000 MILE BUS

from

LONE STAR HANDICAP VANS, LLC.

MODEL SXT

SEPTEMBER 2013

PTI-BT-R1309

PENNSTATE



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MECHANICAL TESTING
CERTIFICATE 3172.01

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EXECUTIVE SUMMARY

Lone Star Handicap Vans, LLC submitted a model SXT, gasoline-powered 5 seat (including the driver) 16-foot converted Dodge Grand Caravan minivan, for a 4 yr. /100,000 mile STURAA test. Testing started on June 25, 2013 and was completed on August 19, 2013. The Check-In section of the report provides a description of the bus and specifies its major components.

The primary part of the test program is the Structural Durability Test, which also provides the information for the Maintainability and Reliability results. The Structural Durability Test was started on July 3, 2013 and was completed on August 8, 2013.

The interior of the converted minivan is configured with seating for 5 passengers including the driver. Note: this converted minivan is not designed for standing passengers. Therefore, GVW and SLW are the same 5,520 lbs. At 150 lbs. per person, this load results in a measured gross vehicle weight of 5,520 lbs. The first segment of the Structural Durability Test was performed with the bus loaded to a GVW of 5,520 lbs. The middle seated load weight segment was performed at the same weight of 5,520 lbs and the final segment was performed at a curb weight of 4,640 lbs. Durability driving resulted in no unscheduled maintenance and no failures were encountered during the Structural Durability Test. A complete and detailed listing of scheduled maintenance is provided in the Maintainability section of this report.

Effective January 1, 2010 the Federal Transit Administration determined that the total number of simulated passengers used for loading all test vehicles will be based on the full complement of seats and free-floor space available for standing passengers (150 lbs per passenger). The passenger loading used for dynamic testing will not be reduced in order to comply with Gross Axle Weight Ratings (GAWR's) or the Gross Vehicle Weight Ratings (GVWR's) declared by the manufacturer. Cases where the loading exceeds the GAWR and/or the GVWR will be noted accordingly. During the testing program, all test vehicles transported or operated over public roadways will be loaded to comply with the GAWR and GVWR specified by the manufacturer.

Accessibility, in general, was adequate, components covered in Section 1.3 (Repair and/or Replacement of Selected Subsystems) along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

The Reliability section compiles failures that occurred during Structural Durability Testing. Breakdowns are classified according to subsystems. The data in this section are arranged so that those subsystems with more frequent problems are apparent. The problems are also listed by class as defined in Section 2. This test vehicle encountered no failures during the Structural Durability Test.

The Safety Test, (a double-lane change, obstacle avoidance test) was safely performed in both right-hand and left-hand directions up to a maximum test speed of 45 mph. The performance of the bus is illustrated by a speed vs. time plot. Acceleration

and gradeability test data are provided in Section 4, Performance. The average time to obtain 50 mph was 8.70 seconds.

The Shakedown Test produced a maximum final loaded deflection of 0.020 inches with a permanent set ranging between 0.000 to 0.004 inches under a distributed static load of 1,350 lbs. The Distortion Test was completed with all subsystems, doors and escape mechanisms operating properly. No water leakage was observed throughout the test. All subsystems operated properly.

The test vehicle submitted for testing (converted minivan) was not equipped with any type of tow eyes or tow hooks, therefore the Static Towing Test was not performed. The Dynamic Towing Test was performed by means of a front-lift tow. The towing interface was accomplished using a hydraulic under-lift wrecker. The test vehicle was towed without incident and no damage resulted from the test. The manufacturer does not recommend towing the vehicle from the rear; therefore, a rear test was not performed. The Jacking and Hoisting Tests were also performed without incident. The bus was found to be stable on the jack stands, and the minimum jacking clearance observed with a tire deflated was 3.2 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 13.70 mpg, 16.52 mpg, and 26.95 mpg respectively; with an overall average of 16.90 mpg.

A series of Interior and Exterior Noise Tests was performed. These data are listed in Section 7.1 and 7.2 respectively.

ABBREVIATIONS

ABTC	- Altoona Bus Test Center
A/C	- air conditioner
ADB	- advance design bus
ATA-MC	- The Maintenance Council of the American Trucking Association
CBD	- central business district
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)
GVL	- gross vehicle 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
MECH	- bus mechanic
mpg	- miles per gallon
mph	- miles per hour
PM	- Preventive maintenance
PSBRTF	- Penn State Bus Research and Testing Facility
PTI	- Pennsylvania Transportation Institute
rpm	- revolutions per minute
SAE	- Society of Automotive Engineers
SCH	- test scheduler
SEC	- secretary
SLW	- seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
STURAA	- Surface Transportation and Uniform Relocation Assistance Act
TD	- test driver
TECH	- test technician
TM	- track manager
TP	- test personnel

TEST BUS CHECK-IN

I. OBJECTIVE

The objective of this task is to log in the test bus, assign a bus number, complete the vehicle data form, and perform a safety check.

II. TEST DESCRIPTION

The test consists of assigning a bus test number to the bus, cleaning the bus, completing the vehicle data form, obtaining any special information and tools from the manufacturer, determining a testing schedule, performing an initial safety check, and performing the manufacturer's recommended preventive maintenance. The bus manufacturer must certify that the bus meets all Federal regulations.

III. DISCUSSION

The check-in procedure is used to identify in detail the major components and configuration of the bus.

The test vehicle consists of a converted Dodge Grand caravan. The test vehicle has driver's and front passenger door, rear of the front axle, and left and right side rear passenger doors forward of the rear axle. The right side passenger door is equipped with a Lone Star Handicap Van's CNC Model LSH102 fold out handicap ramp. Power is provided by a gasoline-fueled, Dodge model 3.6 L engine coupled to a Chrysler / 6 speed w/OD transmission.

The measured curb weight is 2,540 lbs for the front axle and 2,100 lbs. for the rear axle. These combined weights provide a total measured curb weight of 4,640 lbs. There are 5 seats including the driver and 1 wheelchair position. Gross load is 150 lbs. $\times 5 = 750$ lbs. + 600 lbs. (1 wheelchair position) = 1,350 lbs. At full capacity, the measured gross vehicle weight is 5,520 lbs. Note: this converted minivan is not designed for standing passengers. Therefore, GVW and SLW are the same 5,520 lbs.

VEHICLE DATA FORM

Page 1 of 7

Bus Number: 1309	Arrival Date: 6-28-13
Bus Manufacturer: Lone Star	Vehicle Identification Number (VIN): 2C4RDGCG2CR153728
Model Number: SXT	Date: 6-28-13
Personnel: E.D., S.R., B.L. & E.L.	Chassis: Dodge / Grand Caravan

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	1,260	1,280	N/A	N/A	1,040	1,060
SLW	1,440	1,440	N/A	N/A	1,310	1,330
GVW	1,440	1,440	N/A	N/A	1,310	1,330

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	2,540	2,880	2,880	2,950
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	2,100	2,640	2,640	3,100
Total	4,640	5,520	5,520	GVWR: 6,050

Dimensions:

Length (ft/in)	16.0 / 9.25
Width (in)	77.0
Height (in)	71.5
Front Overhang (in)	36.25
Rear Overhang (in)	44.0
Wheel Base (in)	121.0
Wheel Track (in)	Front: 66.3
	Rear: 64.8

VEHICLE DATA FORM

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Bus Number: 1309	Date: 6-28-13
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CLEARANCES:

Lowest Point Outside Front Axle	Location: Front Spoiler	Clearance(in): 5.9
Lowest Point Outside Rear Axle	Location: Muffler	Clearance(in): 11.8
Lowest Point between Axles	Location: Front of rear axle	Clearance(in): 4.4
Ground Clearance at the center (in)	5.1	
Front Approach Angle (deg)	9.2	
Rear Approach Angle (deg)	15.0	
Ramp Clearance Angle (deg)	4.2	
Aisle Width (in)	N/A	
Inside Standing Height at Center Aisle (in)	58.0	

BODY DETAILS:

Body Structural Type	Semi-monocoque		
Frame Material	Steel		
Body Material	Steel		
Floor Material	Steel		
Roof Material	Steel		
Windows Type	☒ Fixed	☒ Movable	
Window Mfg./Model No.	Windshield: Mopar DOT 904 PGWM413 Front passenger doors: DOT 15 LOFM-127, DOT 22 GG-M35T3		
Number of Doors	<u>2</u> Front	<u>2</u> Middle	<u>1</u> Rear
Mfr. / Model No.	Chrysler / OEM		
Dimension of Each Door (in)	Front Driver: 27 x 44 Front Pass.: 27.3 x 43	Rear Right: 31.5 x 54 Rear Left: 29.2 x 44.4	Hatch: 48.6 x 40.1
Passenger Seat Type	☐ Cantilever	☒ Pedestal	☐ Other (explain)
Mfr. / Model No.	Chrysler / OEM		
Driver Seat Type	☐ Air	☒ Spring	☐ Other (explain)
Mfr. / Model No.	Chrysler / OEM		
Number of Seats (including Driver)	5 or 2 + wheelchair		

VEHICLE DATA FORM

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Bus Number: 1309	Date: 6/28/13
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BODY DETAILS (Contd..)

Free Floor Space (ft ²)	N/A				
Height of Each Step at Normal Position (in)	Front	1. <u>17.2</u>	2. <u>?</u>	3. <u>?</u>	4. <u>?</u>
	Middle	1. <u>21.0</u>	2. <u>?</u>	3. <u>?</u>	4. <u>?</u>
	Rear	1. <u>N/A</u>	2. <u>?</u>	3. <u>?</u>	4. <u>?</u>
Step Elevation Change - Kneeling (in)	N/A				

ENGINE

Type	☒ C.I.	☐ Alternate Fuel	
	☐ S.I.	☐ Other (explain)	
Mfr. / Model No.	Chrysler / 3.6 L		
Location	☒ Front	☐ Rear	☐ Other (explain)
Fuel Type	☒ Gasoline	☐ CNG	☐ Methanol
	☐ Diesel	☐ LNG	☐ Other (explain)
Fuel Tank Capacity (indicate units)	20 gals		
Fuel Induction Type	☒ Injected	☐ Carburetion	
Fuel Injector Mfr. / Model No.	Chrysler / 3.6 L		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Chrysler / 3.6 L		
Alternator (Generator) Mfr. / Model No.	Chrysler / OEM		
Maximum Rated Output (Volts / Amps)	12 / not available		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft ³ / min)	N/A		
Starter Type	☒ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	Chrysler / 3.6 L		

VEHICLE DATA FORM

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Bus Number: 1309	Date: 6/28/13
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TRANSMISSION

Transmission Type	☐ Manual	☒ Automatic
Mfr. / Model No.	Chrysler / 6 speed w/OD	
Control Type	☐ Mechanical	☐ Electrical
	☐ Other	
Torque Converter Mfr. / Model No.	Chrysler / 6 speed w/OD	
Integral Retarder Mfr. / Model No.	N/A	

SUSPENSION

Number of Axles	2		
Front Axle Type	☒ Independent	☐ Beam Axle	
Mfr. / Model No.	Chrysler / OEM (Transaxle)		
Axle Ratio (if driven)	Transaxle		
Suspension Type	☐ Air	☒ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Chrysler / OEM		
Middle Axle Type	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	☒ Beam Axle	
Mfr. / Model No.	Chrysler / OEM		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☒ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Chrysler / OEM		

VEHICLE DATA FORM

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WHEELS & TIRES

Front	Wheel Mfr./ Model No.	16 x 6.5
	Tire Mfr./ Model No.	Firestone FR 710 P235 60R16
Rear	Wheel Mfr./ Model No.	16 x 6.5
	Tire Mfr./ Model No.	Firestone FR 710 P235 60R16

BRAKES

Front Axle Brakes Type	☐ Cam	☒ Disc	☐ Other (explain)
Mfr. / Model No.	Chrysler / OEM		
Middle Axle Brakes Type	☐ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	Chrysler / OEM		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	☐ Air	☒ Water	☐ Other
Capacity (Btu/hr)	Not available.		
Mfr. / Model No.	Chrysler / OEM		
Air Conditioner	☒ Yes	☐ No	
Location	Front		
Capacity (Btu/hr)	Not available.		
A/C Compressor Mfr. / Model No.	Chrysler / OEM		

STEERING

Steering Gear Box Type	Rack & pinion
Mfr. / Model No.	Chrysler / OEM
Steering Wheel Diameter	15.2
Number of turns (lock to lock)	2.75

VEHICLE DATA FORM

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Bus Number: 1309	Date: 6/28/13
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OTHERS

Wheel Chair Ramps	Location: Right Rear Passenger Sliding Door	Type: Pull down ramp
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lone Star Handicap Van's CNC / LSH102	
Emergency Exit	Location: N/A	Number: N/A

CAPACITIES

Fuel Tank Capacity (units)	20 gals.
Engine Crankcase Capacity (gallons)	OEM
Transmission Capacity (gallons)	OEM
Differential Capacity (gallons)	OEM
Cooling System Capacity (quarts)	OEM
Power Steering Fluid Capacity (quarts)	OEM

VEHICLE DATA FORM

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Bus Number: 1309	Date: 6/28/13
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List all spare parts, tools and manuals delivered with the bus.

[illegible]

COMPONENT/SUBSYSTEM INSPECTION FORM

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Bus Number: 1309	Date: 6-28-13
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Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	B.L.	
Body and Sheet Metal	✓	B.L.	
Frame	✓	B.L.	
Steering	✓	B.L.	
Suspension	✓	B.L.	
Interior/Seating	✓	B.L.	
Axles	✓	B.L.	
Brakes	✓	B.L.	
Tires/Wheels	✓	B.L.	
Exhaust	✓	B.L.	
Fuel System	✓	B.L.	
Power Plant	✓	B.L.	
Accessories	✓	B.L.	
Lift System	✓	B.L.	Manual fold-out ramp.
Interior Fasteners	✓	B.L.	
Batteries	✓	B.L.	

CHECK - IN



**LONE STAR HANDICAP VANS, LLC,
MODEL SXT**



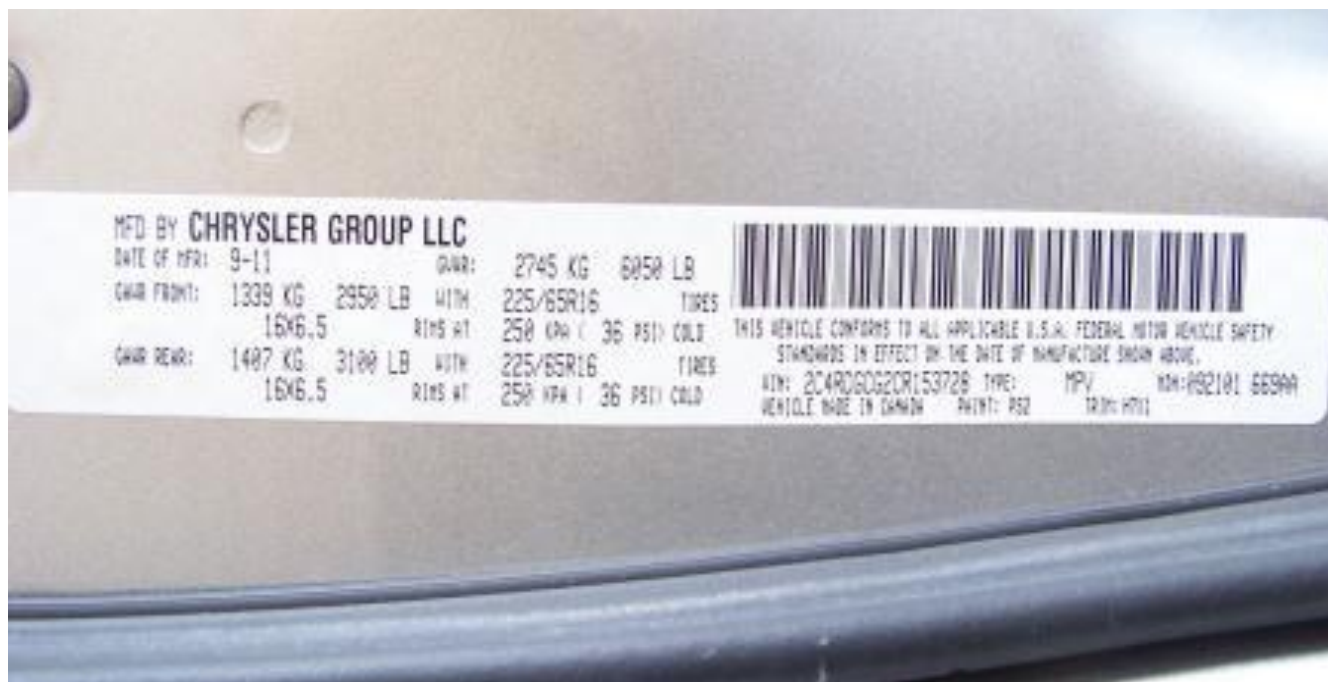
CHECK - IN CONT.



**LONE STAR HANDICAP VANS, LLC,
MODEL SXT EQUIPPED WITH A LONE STAR HANDICAP
VANS CNC MODEL LSH102
FOLD OUT HANDICAP RAMP**



CHECK - IN CONT.



VIN TAG



ENGINE COMPARTMENT

CHECK - IN CONT.



OPERATOR'S AREA



CHECK - IN CONT.



INTERIOR



1. MAINTAINABILITY

1.1 ACCESSIBILITY OF COMPONENTS AND SUBSYSTEMS

1.1-I. TEST OBJECTIVE

The objective of this test is to check the accessibility of components and subsystems.

1.1-II. TEST DESCRIPTION

Accessibility of components and subsystems is checked, and where accessibility is restricted the subsystem is noted along with the reason for the restriction.

1.1-III. DISCUSSION

Accessibility, in general, was adequate. Components covered in Section 1.3 (repair and/or replacement of selected subsystems), along with all other components encountered during testing, were found to be readily accessible and no restrictions were noted.

ACCESSIBILITY DATA FORM

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Bus Number: 1309	Date: 8-14-13
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Component	Checked	Initials	Comments
ENGINE :			
Oil Dipstick	✓	B.L.	
Oil Filler Hole	✓	B.L.	
Oil Drain Plug	✓	B.L.	
Oil Filter	✓	B.L.	
Fuel Filter	✓	B.L.	
Air Filter	✓	B.L.	
Belts	✓	B.L.	
Coolant Level	✓	B.L.	
Coolant Filler Hole	✓	B.L.	
Coolant Drain	✓	B.L.	
Spark / Glow Plugs	✓	B.L.	
Alternator	✓	B.L.	
Diagnostic Interface Connector	✓	B.L.	
TRANSMISSION :			
Fluid Dip-Stick	✓	B.L.	
Filler Hole	✓	B.L.	
Drain Plug	N/A	B.L.	
SUSPENSION :			
Bushings	✓	B.L.	
Shock Absorbers	✓	B.L.	
Air Springs	N/A	B.L.	
Leveling Valves	N/A	B.L.	
Grease Fittings	N/A	B.L.	

ACCESSIBILITY DATA FORM

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Bus Number: 1309	Date: 8-14-13
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Component	Checked	Initials	Comments
HVAC :			
A/C Compressor	✓	B.L.	
Filters	✓	B.L.	
Fans	✓	B.L.	
ELECTRICAL SYSTEM :			
Fuses	✓	B.L.	
Batteries	✓	B.L.	
Voltage regulator	✓	B.L.	
Voltage Converters	N/A	B.L.	
Lighting	✓	B.L.	
MISCELLANEOUS :			
Brakes	✓	B.L.	
Handicap Lifts/Ramps	✓	B.L.	
Instruments	✓	B.L.	
Axles	✓	B.L.	
Exhaust	✓	B.L.	
Fuel System	✓	B.L.	
OTHERS :			

1.2 SERVICING, PREVENTIVE MAINTENANCE, AND REPAIR AND MAINTENANCE DURING TESTING

1.2-I. TEST OBJECTIVE

The objective of this test is to collect maintenance data about the servicing, preventive maintenance, and repair.

1.2.-II. TEST DESCRIPTION

The test will be conducted by operating the NBM and collecting the following data on work order forms and a driver log.

1. Unscheduled Maintenance
 - a. Bus number
 - b. Date
 - c. Mileage
 - d. Description of malfunction
 - e. Location of malfunction (e.g., in service or undergoing inspection)
 - f. Repair action and parts used
 - g. Man-hours required
2. Scheduled Maintenance
 - a. Bus number
 - b. Date
 - c. Mileage
 - d. Engine running time (if available)
 - e. Results of scheduled inspections
 - f. Description of malfunction (if any)
 - g. Repair action and parts used (if any)
 - h. Man-hours required

The buses will be operated in accelerated durability service. While typical items are given below, the specific service schedule will be that specified by the manufacturer.

- A. Service
 1. Fueling
 2. Consumable checks
 3. Interior cleaning
- B. Preventive Maintenance
 4. Brake adjustments
 5. Lubrication
 6. 3,000 mi (or equivalent) inspection

7. Oil and filter change inspection
 8. Major inspection
 9. Tune-up
- C. Periodic Repairs
1. Brake reline
 2. Transmission change
 3. Engine change
 4. Windshield wiper motor change
 5. Stoplight bulb change
 6. Towing operations
 7. Hoisting operations

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer-specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance. Table 1 is a list of the lubricating products used in servicing.

(Page 1 of 1)
SCHEDULED MAINTENANCE
 Lone Star Bus #1309

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
07-12-13	1,136	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-18-13	2,326	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-24-13	3,505	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-29-13	3,536	P.M. / Inspection Fuel Economy Prep	Linkage, tie rods, universals/u-joints all lubed. Oil changed. Oil, fuel, and air filters changed. Transmission oil and filter changed.	8.00	8.00
08-08-13	3,800	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

Table 1. STANDARD LUBRICANTS

The following is a list of Texaco lubricant products used in bus testing conducted by the Penn State University Altoona Bus Testing Center:

<u>ITEM</u>	<u>PRODUCT CODE</u>	<u>TEXACO DESCRIPTION</u>
Engine oil	#2112	URSA Super Plus SAE 30
Transmission oil	#1866	Automatic Trans Fluid Mercon/Dexron II Multipurpose
Gear oil	#2316	Multigear Lubricant EP SAE 80W90
Wheel bearing & Chassis grease	#1935	Starplex II

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

1.3-I. TEST OBJECTIVE

The objective of this test is to establish the time required to replace and/or repair selected subsystems.

1.3-II. TEST DESCRIPTION

The test will involve components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that fails during the NBM testing is added to this list. Components to be included are:

1. Transmission
2. Alternator
3. Starter
4. Batteries
5. Windshield wiper motor

1.3-III. DISCUSSION

At the end of the test, the remaining items on the list were removed and replaced. The transmission assembly took 11.00 man-hours (two men 5.50 hrs.) to remove and replace. The time required for repair/replacement of the four remaining components is given on the following Repair and/or Replacement Form.

During the test, no other additional components were removed for repair or replacement.

REPLACEMENT AND/OR REPAIR FORM

Page 1 of 1

Subsystem	Replacement Time
Transmission	11.00 man hours
Wiper Motor	1.00 man hours
Starter	2.50 man hours
Alternator	2.50 man hours
Batteries	0.50 man hours

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS



TRANSMISSION REMOVAL AND REPLACEMENT (11.00 MAN HOURS)



WIPER MOTOR REMOVAL AND REPLACEMENT (1.00 MAN HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.



**STARTER REMOVAL AND REPLACEMENT
(2.50 MAN HOURS)**



**ALTERNATOR REMOVAL AND REPLACEMENT
(2.50 MAN HOURS)**

2. RELIABILITY - DOCUMENTATION OF BREAKDOWN AND REPAIR TIMES DURING TESTING

2-I. TEST OBJECTIVE

The objective of this test is to document unscheduled breakdowns, repairs, down time, and repair time that occur during testing.

2-II. TEST DESCRIPTION

Using the driver log and unscheduled work order forms, all significant breakdowns, repairs, man-hours to repair, and hours out of service are recorded on the Reliability Data Form.

CLASS OF FAILURES

Classes of failures are described below:

- (a) Class 1: Physical Safety. A failure that could lead directly to passenger or driver injury and represents a severe crash situation.
- (b) Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.
- (c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.
- (d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

A listing of breakdowns and unscheduled repairs is accumulated during the Structural Durability Test. These classifications are somewhat subjective as the test is performed on a test track with careful inspections every two hours. However, even on the road, there is considerable latitude on deciding how to handle many failures.

Note: no failures occurred during Structural Durability testing.

3. SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3-I. TEST OBJECTIVE

The objective of this test is to determine handling and stability of the bus by measuring speed through a double lane change test.

3-II. TEST DESCRIPTION

The Safety Test is a vehicle handling and stability test. The bus will be operated at SLW on a smooth and level test track. The bus will be driven through a double lane change course at increasing speed until the test is considered unsafe or a speed of 45 mph is reached. The lane change course will be set up using pylons to mark off two 12 foot center to center lanes with two 100 foot lane change areas 100 feet apart. The bus will begin in one lane, change to the other lane in a 100 foot span, travel 100 feet, and return to the original lane in another 100 foot span. This procedure will be repeated, starting first in the right-hand and then in the left-hand lane.

3-III. DISCUSSION

The double-lane change was performed in both right-hand and left-hand directions. The bus was able to safely negotiate the test course in both the right-hand and left-hand directions up to the maximum test speed of 45 mph.

SAFETY DATA FORM

Page 1 of 1

Bus Number: 1309	Date: 8/6/13
Personnel: T.S., S.R. & M.R.	

Temperature (°F): 67	Humidity (%): 68
Wind Direction: WNW	Wind Speed (mph): 2
Barometric Pressure (in.Hg): 30.07	

SAFETY TEST: DOUBLE LANE CHANGE	
Maximum safe speed tested for double-lane change to left	45 mph
Maximum safe speed tested for double-lane change to right	45 mph
Comments of the position of the bus during the lane change: A safe profile was maintained through all portions of testing.	
Comments of the tire/ground contact patch: Tire/ground contact was maintained through all portions of testing.	

3. SAFETY



RIGHT - HAND APPROACH



LEFT - HAND APPROACH

4.0 PERFORMANCE

4.1 PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4.1-I. TEST OBJECTIVE

The objective of this test is to determine the acceleration, gradeability, and top speed capabilities of the bus.

4.1-II. TEST DESCRIPTION

In this test, the bus will be operated at SLW on the skid pad at the PSBRTF. The bus will be accelerated at full throttle from a standstill to a maximum "geared" or "safe" speed as determined by the test driver. The vehicle speed is measured using a Correvit non-contacting speed sensor. The times to reach speed between ten mile per hour increments are measured and recorded using a stopwatch with a lap timer. The time to speed data will be recorded on the Performance Data Form and later used to generate a speed vs. time plot and gradeability calculations.

4.1-III. DISCUSSION

This test consists of three runs in both the clockwise and counterclockwise directions on the Test Track. Velocity versus time data is obtained for each run and results are averaged together to minimize any test variability which might be introduced by wind or other external factors. The test was performed up to a maximum speed of 50 mph. The fitted curve of velocity vs. time is attached, followed by the calculated gradeability results. The average time to obtain 50 mph was 8.70 seconds.

PERFORMANCE DATA FORM

Page 1 of 1

Bus Number: 1309		Date: 8-6-13	
Personnel: T.S., S.R. & M.R.			
Temperature (°F): 67		Humidity (%): 68	
Wind Direction: WNW		Wind Speed (mph): 2	
Barometric Pressure (in.Hg): 30.07			
			INITIALS:
Ventilation fans-ON HIGH	✓Checked	T.S.	
Heater pump motor-Off	✓Checked	T.S.	
Defroster-OFF	✓ Checked	T.S.	
Exterior and interior lights-ON	✓ Checked	T.S.	
Windows and doors-CLOSED	✓ Checked	T.S.	
ACCELERATION, GRADEABILITY, TOP SPEED			
Counter Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	1.83	1.91	1.83
20 mph	3.55	3.55	3.30
30 mph	5.33	4.99	5.03
40 mph	6.86	6.64	6.60
Top Test Speed(mph) 50	9.07	8.81	8.65
Clockwise Recorded Interval Times			
Speed	Run 1	Run 2	Run 3
10 mph	2.08	1.91	1.90
20 mph	3.58	3.36	3.15
30 mph	5.22	4.89	4.78
40 mph	6.68	6.57	6.47
Top Test Speed(mph) 50	8.73	8.47	8.48

1309.ACC

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER : LONE STAR HANDICAP V BUS NUMBER : 1309
 BUS MODEL : SXT TEST DATE : 8/6/13

TEST CONDITIONS :

 TEMPERATURE (DEG F) : 67.0
 WIND DIRECTION : WNW
 WIND SPEED (MPH) : 2.0
 HUMIDITY (%) : 68
 BAROMETRIC PRESSURE (IN. HG) : 30.1

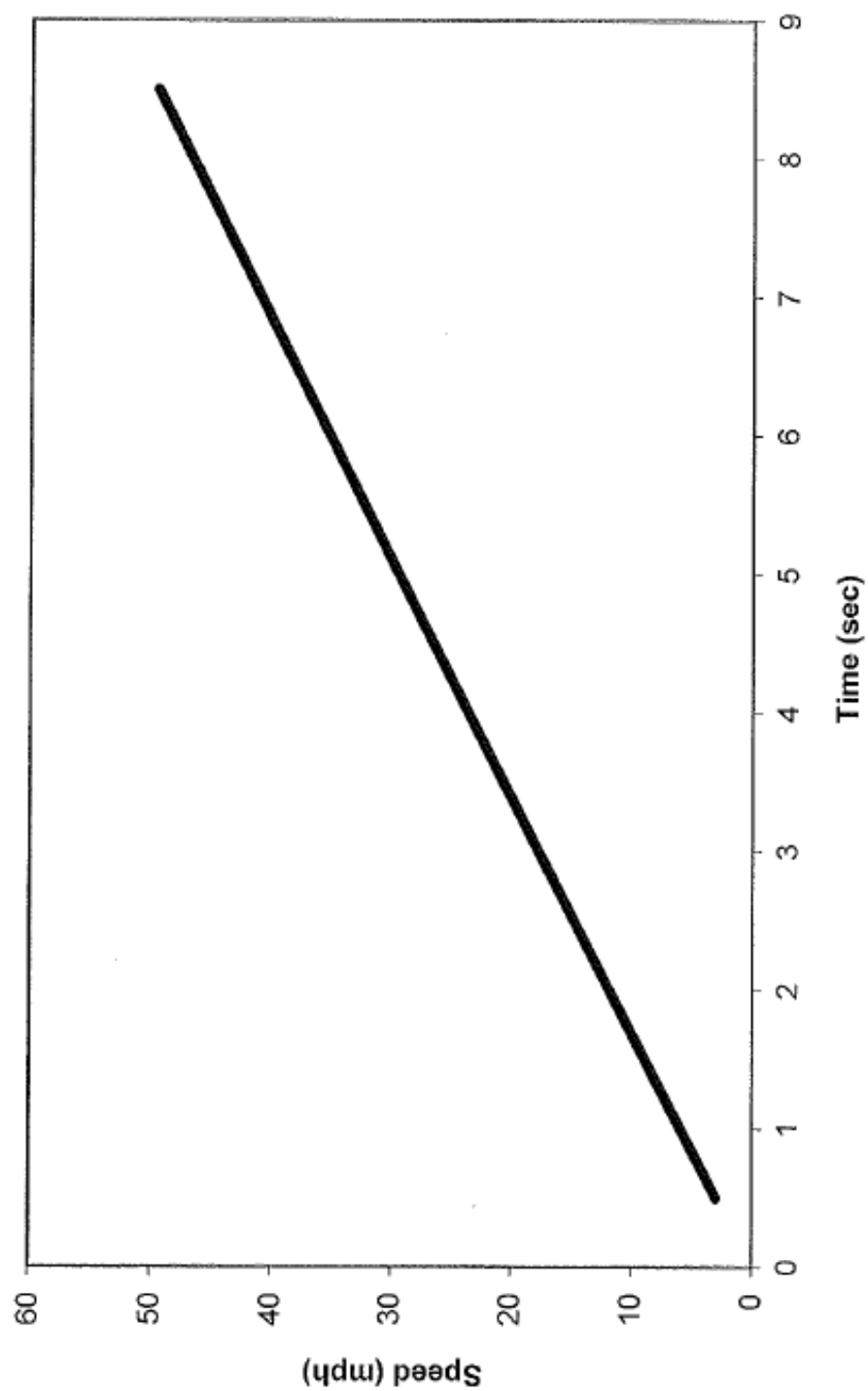
VEHICLE SPEED (MPH)	AVERAGE TIME (SEC)		
	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	1.86	1.96	1.91
20.0	3.47	3.36	3.42
30.0	5.12	4.96	5.04
40.0	6.70	6.57	6.64
50.0	8.84	8.56	8.70

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.17	8.7	28.1
5.0	.84	8.7	28.0
10.0	1.69	8.7	27.9
15.0	2.54	8.6	27.8
20.0	3.39	8.6	27.7
25.0	4.24	8.6	27.6
30.0	5.10	8.5	27.4
35.0	5.97	8.5	27.3
40.0	6.83	8.4	27.2
45.0	7.70	8.4	27.1
50.0	8.57	8.4	26.9

NOTE : Gradeability results were calculated from performance
 ----- test data. Actual sustained gradeability performance
 for vehicles equipped with auto transmission may be
 lower than the values indicated here.

Velocity vs. Time
Lone Star Bus #1309



5.1 STRUCTURAL INTEGRITY

5.1 STRUCTURAL STRENGTH AND DISTORTION TESTS – STRUCTURAL SHAKEDOWN TEST

5.1-I. DISCUSSION

The objective of this test is to determine certain static characteristics (e.g., bus floor deflection, permanent structural deformation, etc.) under static loading conditions.

5.1-II. TEST DESCRIPTION

In this test, the bus will be isolated from the suspension by blocking the vehicle under the suspension points. The bus will then be loaded and unloaded up to a maximum of three times with a distributed load equal to 2.5 times gross load. Gross load is 150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space. For a distributed load equal to 2.5 times gross load, place a 375-lb load on each seat and on every 1.5 sq ft of free floor space. The first loading and unloading sequence will “settle” the structure. Bus deflection will be measured at several locations during the loading sequences.

5.1-III. DISCUSSION

This test was performed based on a maximum passenger capacity of 2 people including the driver plus 1 wheelchair position. The resulting test load is $(2 \times 375 \text{ lb.}) = 750 \text{ lb.} + 600 \text{ lbs. (1 wheelchair position)} = 1,350 \text{ lbs.}$ The load is distributed evenly over the passenger space. Deflection data before and after each loading and unloading sequence is provided on the Structural Shakedown Data Form.

The unloaded height after each test becomes the original height for the next test. Some initial settling is expected due to undercoat compression, etc. After each loading cycle, the deflection of each reference point is determined. The bus is then unloaded and the residual (permanent) deflection is recorded. On the final test, the maximum loaded deflection was 0.020 Inches at reference point 10. The maximum permanent deflection after the final loading sequence ranged from 0.000 Inches at reference points 1, 8, 9, 12 to 0.004 inches at reference point 10.

STRUCTURAL SHAKEDOWN DATA FORM

Page 1 of 2

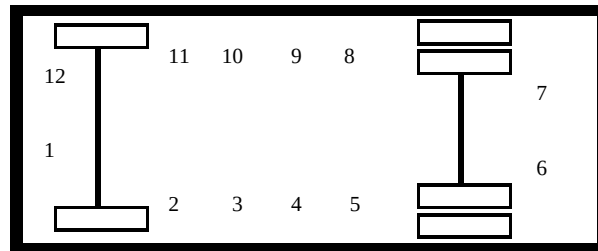
Bus Number: 1309	Date: 7/1/13
Personnel: E.D., T.G., J.P. & P.D.	Temperature (°F): 75
Loading Sequence: ☒ 1 ☐ 2 ☐ 3 (check one) Test Load (lbs.): 1350 (2 seated + 1 wheelchair)	

Indicate Approximate Location of Each Reference Point

Right

Front
of
Bus

Left



Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	0	-.007	-.007	.000	.000
2	0	.003	.003	.000	.000
3	0	.011	.011	.002	.002
4	0	.022	.022	.011	.011
5	0	.010	.010	.003	.003
6	0	.018	.018	.004	.004
7	0	.018	.018	.003	.003
8	0	.000	.000	.000	.000
9	0	.008	.008	-.003	-.003
10	0	.021	.021	.010	.010
11	0	.007	.007	.003	.003
12	0	-.008	-.008	.000	.000

STRUCTURAL SHAKEDOWN DATA FORM

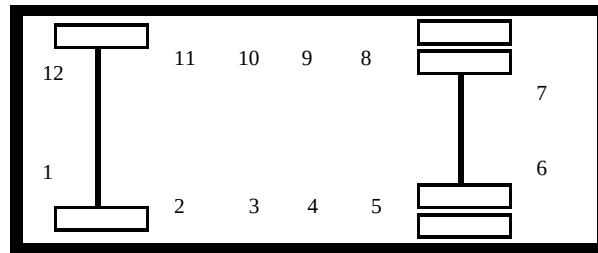
Page 2 of 2

Bus Number: 1309	Date: 7/1/13
Personnel: E.D., T.G., J.P. & P.D.	Temperature (°F): 75
Loading Sequence: ☐ 1 ☒ 2 ☐ 3 (check one) Test Load (lbs.): 1350 (2 seated + 1 wheelchair)	

Indicate Approximate Location of Each Reference Point

Right

Front
of
Bus



Left

Top View

Reference Point No.	A (in) Original Height	B (in) Loaded Height	B-A (in) Loaded Deflection	C (in) Unloaded Height	C-A (in) Permanent Deflection
1	.000	-.007	-.007	.000	.000
2	.000	.005	.005	.001	.001
3	.002	.012	.010	.003	.001
4	.011	.025	.014	.013	.002
5	.003	.011	.008	.004	.001
6	.004	.019	.015	.006	.002
7	.003	.019	.016	.005	.002
8	.000	.000	.000	.000	.000
9	-.003	.008	.011	-.003	.000
10	.010	.030	.020	.014	.004
11	.003	.009	.006	.005	.002
12	.000	-.007	-.007	.000	.000

5.1 STRUCTURAL SHAKEDOWN TEST



DIAL INDICATORS IN POSITION



**TEST VEHICLE LOADED TO 2.5 TIMES GVL
(1,350 LBS)**

5.2 STRUCTURAL STRENGTH AND DISTORTION TESTS - STRUCTURAL DISTORTION

5.2-I. TEST OBJECTIVE

The objective of this test is to observe the operation of the bus subsystems when the bus is placed in a longitudinal twist simulating operation over a curb or through a pothole.

5.2-II. TEST DESCRIPTION

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

1. Body
2. Windows
3. Doors
4. Roof vents
5. Special seating
6. Undercarriage
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. DISCUSSION

The test sequence was repeated ten times. The first and last test is with all wheels level. The other eight tests are with each wheel 6 inches higher and 6 inches lower than the other three wheels.

All doors, windows, escape mechanisms, engine, steering and handicapped devices operated normally throughout the test. The undercarriage and body indicated no deficiencies. No water leakage was observed during the test. The results of this test are indicated on the following data forms. **Note:** the test vehicle was unable be driven onto the ramp in the right rear 6" higher position due to the framing under the wheelchair ramp. Refer to pictures. The test vehicle was jacked up and the ramp placed under the wheel.

DISTORTION TEST INSPECTION FORM

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

Page 1 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM

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

Page 2 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 3 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 4 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 5 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 6 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
■ Front Doors	No deficiencies.
■ Rear Doors	No deficiencies.
■ Escape Mechanisms/ Roof Vents	No deficiencies.
■ Engine	No deficiencies.
■ Handicapped Device/ Special Seating	No deficiencies.
■ Undercarriage	No deficiencies.
■ Service Doors	No deficiencies.
■ Body	No deficiencies.
■ Windows/ Body Leakage	No deficiencies.
■ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 7 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 8 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 9 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

DISTORTION TEST INSPECTION FORM
 (Note: Ten copies of this data sheet are required)
 Page 10 of 10

Bus Number: 1309	Date: 8/9/13
Personnel: S.R., T.S., E.L. & T.G.	Temperature(°F): 75

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	No deficiencies.
☒ Front Doors	No deficiencies.
☒ Rear Doors	No deficiencies.
☒ Escape Mechanisms/ Roof Vents	No deficiencies.
☒ Engine	No deficiencies.
☒ Handicapped Device/ Special Seating	No deficiencies.
☒ Undercarriage	No deficiencies.
☒ Service Doors	No deficiencies.
☒ Body	No deficiencies.
☒ Windows/ Body Leakage	No deficiencies.
☒ Steering Mechanism	No deficiencies.

5.2 STRUCTURAL DISTORTION TEST



LEFT FRONT WHEEL SIX INCHES HIGHER

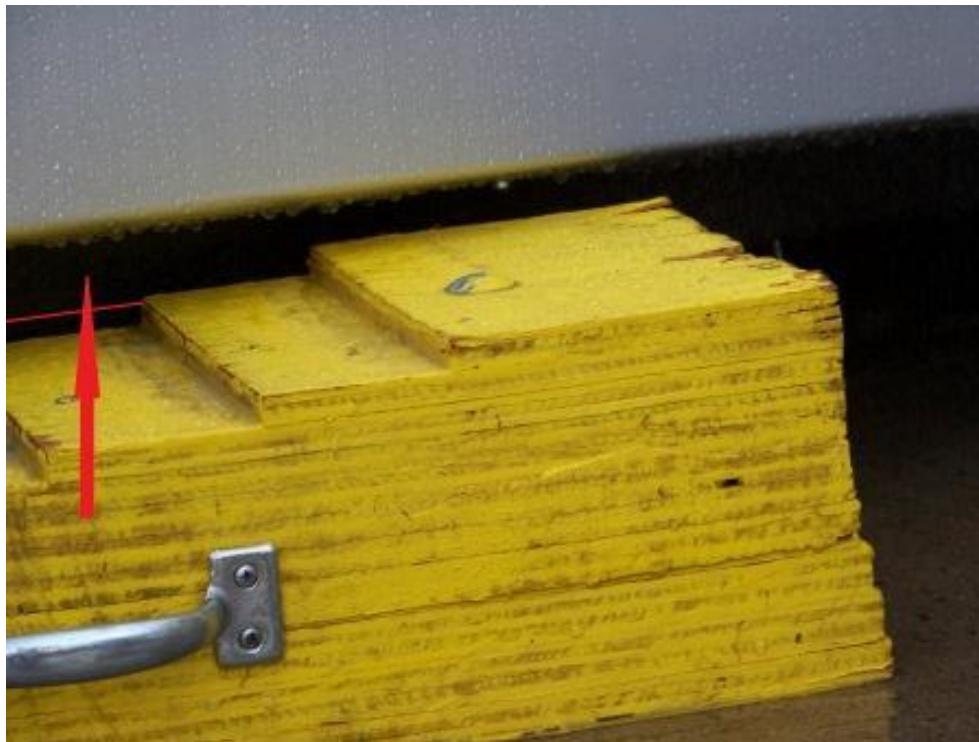


**LEFT REAR WHEEL SIX INCHES HIGHER
WITH HANDICAP RAMP DEPLOYED**

5.2 STRUCTURAL DISTORTION TEST



RIGHT REAR INTERFERENCE



**PAN/COVER UNDER HANDICAP RAMP
INTERFERES WITH RAMP**

5.3 STRUCTURAL STRENGTH AND DISTORTION TESTS - STATIC TOWING TEST

5.3-I. TEST OBJECTIVE

The objective of this test is to determine the characteristics of the bus towing mechanisms under static loading conditions.

5.3-II. TEST DESCRIPTION

Utilizing 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 20 degrees with the longitudinal axis of the bus, first to one side then the other in the horizontal plane, and then upward and downward in the vertical plane. Any permanent deformation or damage to the tow eyes or adjoining structure will be recorded.

5.3-III. DISCUSSION

The test vehicle submitted for testing was not equipped with any type of tow eyes or tow hook, therefore the Static Towing Test was not performed.

5.4 STRUCTURAL STRENGTH AND DISTORTION TESTS - DYNAMIC TOWING TEST

5.4-I. TEST OBJECTIVE

The objective of this test is to verify the integrity of the towing fixtures and determine the feasibility of towing the bus under manufacturer specified procedures.

5.4-II. TEST DESCRIPTION

This test requires the bus be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus will be towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus will be visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms will be inspected for proper operation.

5.4-III. DISCUSSION

The bus was towed using a heavy-duty wrecker. The towing interface was accomplished by incorporating a hydraulic under lift. A front lift tow was performed. Rear towing is not recommended. No problems, deformation, or damage was noted during testing.

DYNAMIC TOWING TEST DATA FORM

Page 1 of 1

Bus Number: 1309	Date: 8-2-13
Personnel: T.S. & B.L.	

Temperature (°F): 74	Humidity (%): 56
Wind Direction: W	Wind Speed (mph): 10
Barometric Pressure (in.Hg): 29.93	

Inspect tow equipment-bus interface.
Comments: A safe and adequate connection was made between the tow equipment and the bus.
Inspect tow equipment-wrecker interface.
Comments: A safe and adequate connection was made between the tow equipment and the wrecker.
Towing Comments: A front lift tow was performed incorporating a hydraulic under lift wrecker.
Description and location of any structural damage: No damage or deformation was observed.
General Comments: No problems with the towing interface or towing procedures were encountered.

5.4 DYNAMIC TOWING TEST



TOWING INTERFACE



TEST VEHICLE IN TOW

5.5 STRUCTURAL STRENGTH AND DISTORTION TESTS – JACKING TEST

5.5-I. TEST OBJECTIVE

The objective of this test is to inspect for damage due to the deflated tire, and determine the feasibility of jacking the bus with a portable hydraulic jack to a height sufficient to replace a deflated tire.

5.5-II. TEST DESCRIPTION

With the bus at curb weight, the tire(s) at one corner of the bus are replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack is then positioned in a manner and location specified by the manufacturer and used to raise the bus to a height sufficient to provide 3-in clearance between the floor and an inflated tire. The deflated tire(s) are replaced with the original tire(s) and the jack is lowered. Any structural damage or permanent deformation is recorded on the test data sheet. This procedure is repeated for each corner of the bus.

5.5-III. DISCUSSION

The jack used for this test has a minimum height of 8.75 inches. During the deflated portion of the test, the jacking point clearances ranged from 3.2 inches to 6.8 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	3.7"
Rear axle – one tire flat	3.2"
Rear axle – two tires flat	N/A

JACKING TEST DATA FORM

Page 1 of 1

Bus Number: 1309	Date: 7-1-13
Personnel: E.D., T.G. & J.P.	Temperature (°F): 71

Record any permanent deformation or damage to bus as well as any difficulty encountered during jacking procedure.

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	6.1" I 3.8" D	6.2" I 3.8" D	
Left front	6.0" I 3.8" D	6.1" I 3.7" D	
Right rear—outside	NA	NA	
Right rear—both	6.5" I 4.5" D	6.1" I 3.2" D	
Left rear—outside	NA	NA	
Left rear—both	8.9" I 6.8" D	6.1" I 3.4" D	
Right middle or tag—outside	NA	NA	
Right middle or tag—both	NA	NA	
Left middle or tag—outside	NA	NA	
Left middle or tag—both	NA	NA	
Additional comments of any deformation or difficulty during jacking:			
None noted.			

5.6 STRUCTURAL STRENGTH AND DISTORTION TESTS - HOISTING TEST

5.6-I. TEST OBJECTIVE

The objective of this test is to determine possible damage or deformation caused by the jack/stands.

5.6-II. TEST DESCRIPTION

With the bus at curb weight, the front end of the bus is raised to a height sufficient to allow manufacturer-specified placement of jack stands under the axles or jacking pads independent of the hoist system. The bus will be checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure is repeated for the rear end of the bus. The procedure is then repeated for the front and rear simultaneously.

5.6-III. DISCUSSION

The test was conducted using four posts of a six-post electric lift and standard 19 inch jack stands. The bus was hoisted from the front wheel, rear wheel, and then the front and rear wheels simultaneously and placed on jack stands.

The bus easily accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted.

HOISTING TEST DATA FORM

Page 1 of 1

Bus Number: 1309	Date: 7-1-13
Personnel: E.D., T.G. & J.P.	Temperature (°F): 73

Comments of any structural damage to the jacking pads or axles while both the front wheels are supported by the jack stands:

None noted.

Comments of any structural damage to the jacking pads or axles while both the rear wheels are supported by the jack stands:

None noted.

Comments of any structural damage to the jacking pads or axles while both the front and rear wheels are supported by the jack stands:

None noted.

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

The objective of this test is to perform an accelerated durability test that approximates up to 25 percent of the service life of the vehicle.

5.7-II. TEST DESCRIPTION

The test vehicle is driven a total of 3,800 miles; approximately 2,500 miles on the PSBRTF Durability Test Track and approximately 1,300 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 1,500 miles with the bus operated at GVW. The second segment will consist of approximately 800 miles with the bus operated at SLW. The remainder of the test, approximately 1,500 miles, will be conducted with the bus loaded to CW. If GVW exceeds the axle design weights, then the load will be adjusted to the axle design weights and the change will be recorded. All subsystems are run during these tests in their normal operating modes. All recommended manufacturers servicing is to be followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests will be compressed by 10:1; all others will be done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs are recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle shall be washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on July 3, 2013 and was conducted until August 8, 2013. **Note:** this test vehicle is not designed to accommodate standing passengers, therefore GVW and SLW are the same weight. The first 1,500 miles were performed at a GVW of 5,520 lbs. and completed on July 12, 2013. The next 800 mile SLW segment was performed at 5,520 lbs. and completed on July 16, 2013, and the final 1,500 mile segment was performed at a CW of 4,640 lbs and completed on August 8, 2013.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions. **This test vehicle had no failures during the Structural Durability Test.**

LONE STAR TEST BUS #1309
MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
07/01/13 TO 07/07/13	198.00	9.00	207.00
07/08/13 TO 07/14/13	949.00	144.00	1093.00
07/15/13 TO 07/21/13	1272.00	126.00	1398.00
07/22/13 TO 07/28/13	81.00	786.00	867.00
07/29/13 TO 08/04/13	0.00	72.00	72.00
08/05/13 TO 08/11/13	0.00	165.00	165.00
TOTAL	2500.00	1302.00	3802.00

Table 4. Driving Schedule for Bus Operation on the Durability Test Track.

STANDARD OPERATING SCHEDULE

Monday through Friday		
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift 3	4:00 pm	D
	5:40 pm	C
	5:50 pm	B
	6:00 pm	D
	7:40 pm	C
	7:50 pm	B
	8:05 pm	D
	9:40 pm	C
	9:50 pm	B
	10:00 pm	D
	11:40 pm	C
	11:50 pm	F

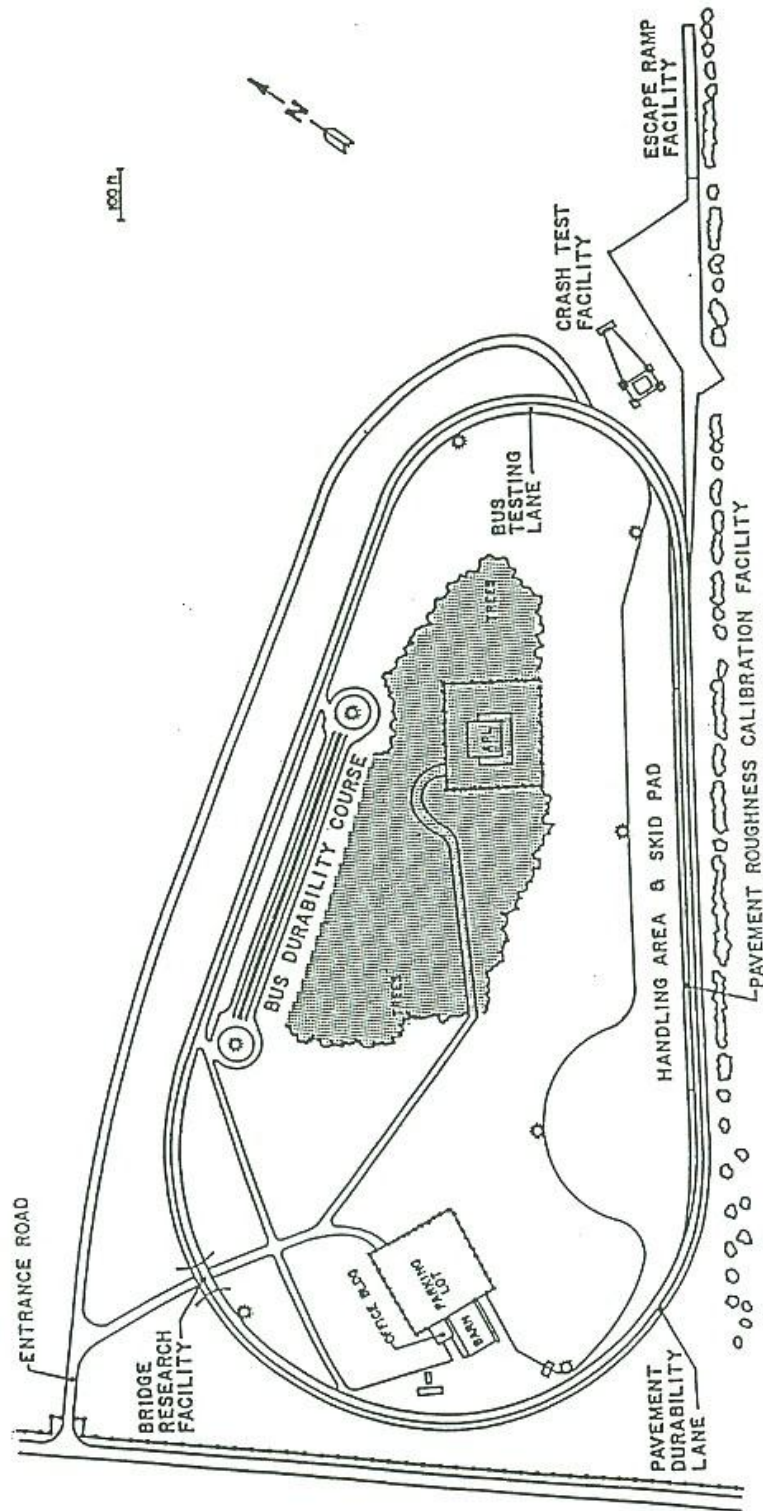
B—Break

C—Cycle all systems five times, visual inspection, driver's log entries

D—Drive bus as specified by procedure

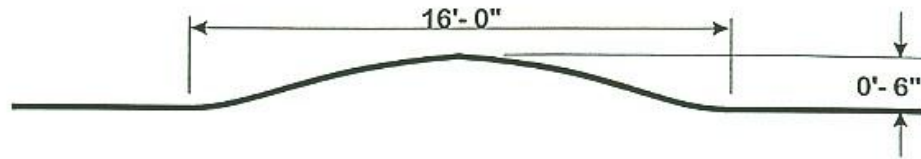
F—Fuel bus, complete driver's log shift entries

“PLAN VIEW OF PENN STATE BUS TESTING AND RESEARCH FACILITY”

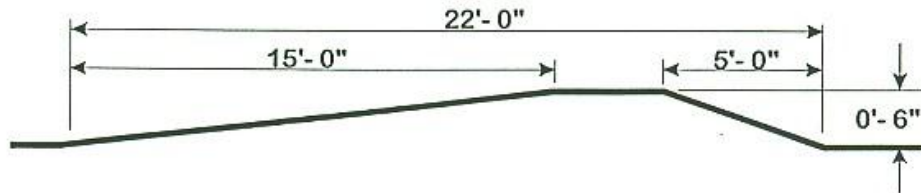


**BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA**

Staggered
Bumps
(10 mph)



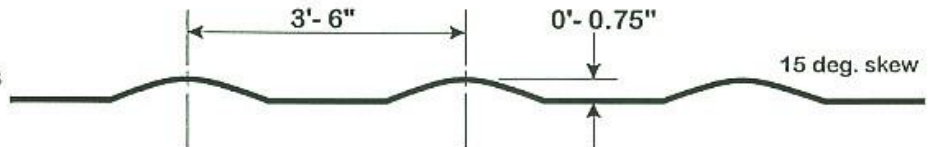
Railroad
Crossing
(8 mph)



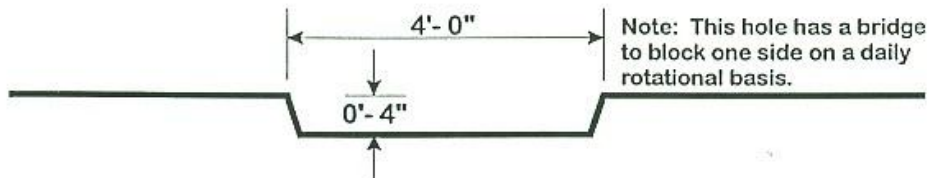
1" Random
Chuck Holes
(20 mph)



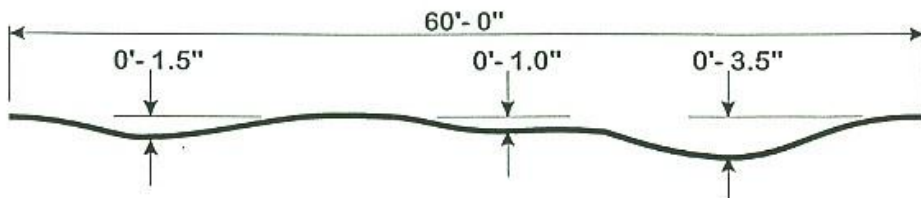
Chatter Bumps
(20 mph)



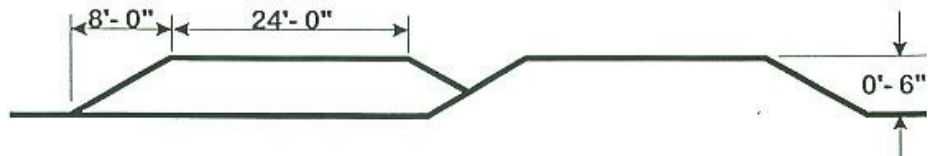
4" Chuck Hole
(5 mph)



High Crown
Intersection
(20 mph)



Frame Twist
(10 mph)



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

6. FUEL ECONOMY TEST - A FUEL CONSUMPTION TEST USING AN APPROPRIATE OPERATING CYCLE

6-I. TEST OBJECTIVE

The objective of this test is to provide accurate comparable fuel consumption data on transit buses produced by different manufacturers. This fuel economy test bears no relation to the calculations done by the Environmental Protection Agency (EPA) to determine levels for the Corporate Average Fuel Economy Program. EPA's calculations are based on tests conducted under laboratory conditions intended to simulate city and highway driving. This fuel economy test, as designated here, is a measurement of the fuel expended by a vehicle traveling a specified test loop under specified operating conditions. The results of this test will not represent actual mileage but will provide data that can be used by recipients to compare buses tested by this procedure.

6-II. TEST DESCRIPTION

This test requires operation of the bus over a course based on the Transit Coach Operating Duty Cycle (ADB Cycle) at seated load weight using a procedure based on the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82. The procedure has been modified by elimination of the control vehicle and by modifications as described below. The inherent uncertainty and expense of utilizing a control vehicle over the operating life of the facility is impractical.

The fuel economy test will be performed as soon as possible (weather permitting) after the completion of the GVW portion of the structural durability test. It will be conducted on the bus test lane at the Penn State Test Facility. Signs are erected at carefully measured points which delineate the test course. A test run will comprise 3 CBD phases, 2 Arterial phases, and 1 Commuter phase. An electronic fuel measuring system will indicate the amount of fuel consumed during each phase of the test. The test runs will be repeated until there are at least two runs in both the clockwise and counterclockwise directions in which the fuel consumed for each run is within ± 4 percent of the average total fuel used over the 4 runs. A 20-minute idle consumption test is performed just prior to and immediately after the driven portion of the fuel economy test. The amount of fuel consumed while operating at normal/low idle is recorded on the Fuel Economy Data Form. This set of four valid runs along with idle consumption data comprise a valid test.

The test procedure is the ADB cycle with the following four modifications:

1. The ADB cycle is structured as a set number of miles in a fixed time in the following order: CBD, Arterial, CBD, Arterial, CBD, and Commuter. A separate idle fuel consumption measurement is performed at the beginning and end of the fuel economy test. This phase sequence permits the reporting of fuel consumption for each of these phases separately, making the data more useful to bus manufacturers and transit properties.
2. The operating profile for testing purposes shall consist of simulated transit type service at seated load weight. The three test phases (figure 6-1) are: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph; an arterial phase of 2 miles with 2 stops per mile and a top speed of 40 mph; and a commuter phase of 4 miles with 1 stop and a maximum speed of 40 mph. At each designated stop the bus will remain stationary for seven seconds. During this time, the passenger doors shall be opened and closed.
3. The individual ADB phases remain unaltered with the exception that 1 mile has been changed to 1 lap on the Penn State Test Track. One lap is equal to 5,042 feet. This change is accommodated by adjusting the cruise distance and time.
4. The acceleration profile, for practical purposes and to achieve better repeatability, has been changed to "full throttle acceleration to cruise speed".

Several changes were made to the Fuel Economy Measurement Test (Engineering Type) For Trucks and Buses: SAE 1376 July 82:

1. Sections 1.1, and 1.2 only apply to diesel, gasoline, methanol, and any other fuel in the liquid state (excluding cryogenic fuels).

1.1 SAE 1376 July 82 requires the use of at least a 16-gal fuel tank. Such a fuel tank when full would weigh approximately 160 lb. It is judged that a 12-gal tank weighing approximately 120 lb will be sufficient for this test and much easier for the technician and test personnel to handle.

1.2 SAE 1376 July 82 mentions the use of a mechanical scale or a flowmeter system. This test procedure uses a load cell readout combination that provides an accuracy of 0.5 percent in weight and permits on-board weighing of the gravimetric tanks at the end of each phase. This modification permits the determination of a fuel economy value for each phase as well as the overall cycle.

2. Section 2.1 applies to compressed natural gas (CNG), liquefied natural gas (LNG), cryogenic fuels, and other fuels in the vapor state.

2.1 A laminar type flowmeter will be used to determine the fuel consumption. The pressure and temperature across the flow element will be monitored by the flow computer. The flow computer will use this data to calculate the gas flow rate. The flow computer will also display the flow rate (scfm) as well as the total fuel used (scf). The total fuel used (scf) for each phase will be recorded on the Fuel Economy Data Form.

3. Use both Sections 1 and 2 for dual fuel systems.

FUEL ECONOMY CALCULATION PROCEDURE

A. For diesel, gasoline, methanol and fuels in the liquid state.

The reported fuel economy is based on the following: measured test quantities-- distance traveled (miles) and fuel consumed (pounds); standard reference values-- density of water at 60EF (8.3373 lbs/gal) and volumetric heating value of standard fuel; and test fuel specific gravity (unitless) and volumetric heating value (BTU/gal). These combine to give a fuel economy in miles per gallon (mpg) which is corrected to a standard gallon of fuel referenced to water at 60EF. This eliminates fluctuations in fuel economy due to fluctuations in fuel quality. This calculation has been programmed into a computer and the data processing is performed automatically.

The fuel economy correction consists of three steps:

- 1.) Divide the number of miles of the phase by the number of pounds of fuel consumed

<u>phase</u>	<u>miles per phase</u>	<u>total miles per run</u>
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$FE_{o_{mi/lb.}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{lb of fuel}}$$

- 2.) Convert the observed fuel economy to miles per gallon [mpg] by multiplying by the specific gravity of the test fuel G_s (referred to water) at 60°F and multiply by the density of water at 60°F

$$FE_{o_{mpg}} = FE_{c_{mi/lb}} \times G_s \times G_w$$

where G_s = Specific gravity of test fuel at 60°F (referred to water)
 G_w = 8.3373 lb/gal

- 3.) Correct to a standard gallon of fuel by dividing by the volumetric heating value of the test fuel (H) and multiplying by the volumetric heating value of standard reference fuel (Q). Both heating values must have the same units.

$$FE_c = FE_{o_{mpg}} \times \frac{Q}{H}$$

where

H = Volumetric heating value of test fuel [BTU/gal]
 Q = Volumetric heating value of standard reference fuel

Combining steps 1-3 yields

$$\Rightarrow FE_c = \frac{\text{miles}}{\text{lbs}} \times (G_s \times G_w) \times \frac{Q}{H}$$

- 4.) Convert the fuel economy from mpg to an energy equivalent of miles per BTU. Since the number would be extremely small in magnitude, the energy equivalent will be represented as miles/BTU $\times 10^6$.

Eq = Energy equivalent of converting mpg to mile/BTU $\times 10^6$.

$$Eq = ((mpg)/(H)) \times 10^6$$

B. CNG, LNG, cryogenic and other fuels in the vapor state.

The reported fuel economy is based on the following: measured test quantities-- distance traveled (miles) and fuel consumed (scf); density of test fuel, and volumetric heating value (BTU/lb) of test fuel at standard conditions ($P=14.73$ psia and $T=60^\circ\text{F}$). These combine to give a fuel economy in miles per lb. The energy equivalent

(mile/BTUx10⁶) will also be provided so that the results can be compared to buses that use other fuels.

- 1.) Divide the number of miles of the phase by the number of standard cubic feet (scf) of fuel consumed.

phase	miles per phase	total miles per run
CBD	1.9097	5.7291
ART	1.9097	3.8193
COM	3.8193	3.8193

$$\text{FEO}_{\text{mi/scf}} = \text{Observed fuel economy} = \frac{\text{miles}}{\text{scf of fuel}}$$

- 2.) Convert the observed fuel economy to miles per lb by dividing FEO by the density of the test fuel at standard conditions (Lb/ft³).

Note: The density of test fuel must be determined at standard conditions as described above. If the density is not defined at the above standard conditions, then a correction will be needed before the fuel economy can be calculated.

$$\text{FEO}_{\text{mi/lb}} = \text{FEO} / \text{Gm}$$

where Gm = Density of test fuel at standard conditions

- 3.) Convert the observed fuel economy (FEOmi/lb) to an energy equivalent of (miles/BTUx10⁶) by dividing the observed fuel economy (FEOmi/lb) by the heating value of the test fuel at standard conditions.

$$\text{Eq} = ((\text{FEOmi/lb})/\text{H}) \times 10^6$$

where

Eq = Energy equivalent of miles/lb to mile/BTUx10⁶

H = Volumetric heating value of test fuel at standard conditions

6-III. DISCUSSION

This is a comparative test of fuel economy using gasoline fuel with a heating value of 19,289.0 btu/lb. The driving cycle consists of Central Business District (CBD), Arterial (ART), and Commuter (COM) phases as described in 6-II. The fuel consumption for each driving cycle and for idle is measured separately. The results are corrected to a reference fuel with a volumetric heating value of 126,700.0 btu/gal.

An extensive pretest maintenance check is made including the replacement of all lubrication fluids. The details of the pretest maintenance are given in the first three Pretest Maintenance Forms. The fourth sheet shows the Pretest Inspection. The next sheet shows the correction calculation for the test fuel. The next four Fuel Economy Forms provide the data from the four test runs. Finally, the summary sheet provides the average fuel consumption. The overall average is based on total fuel and total mileage for each phase. The overall average fuel consumption values were; CBD – 13.70 mpg, ART – 16.52 mpg, and COM – 26.95 mpg. Average fuel consumption at idle was 0.34 gph.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 1 of 3

Bus Number: 1309	Date: 7-24-13 & 7-29-13	SLW (lbs.): 5,520
Personnel: E.L., T.G., S.R., E.D., T.S. & B.L.		

FUEL SYSTEM	OK	Date	Initials
Install fuel measurement system	✓	7/29/13	B.L.
Replace fuel filter	✓	7/24/13	B.L.
Check for fuel leaks	✓	7/29/13	T.S.
Specify fuel type (refer to fuel analysis)	Gasoline		
Remarks: None noted.			
BRAKES/TIRES	OK	Date	Initials
Inspect hoses	✓	7/24/13	T.G.
Inspect brakes	✓	7/24/13	T.G.
Relube wheel bearings	✓	7/24/13	T.G.
Check tire inflation pressures (mfg. specs.)	✓	7/24/13	T.G.
Remarks: None noted.			
COOLING SYSTEM	OK	Date	Initials
Check hoses and connections	✓	7/24/13	E.D.
Check system for coolant leaks	✓	7/24/13	E.D.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 2 of 3

Bus Number: 1309	Date: 7-24-13		
Personnel: E.L., T.G., S.R. & E.D.			
ELECTRICAL SYSTEMS	OK	Date	Initials
Check battery	✓	7/24/13	S.R.
Inspect wiring	✓	7/24/13	S.R.
Inspect terminals	✓	7/24/13	S.R.
Check lighting	✓	7/24/13	S.R.
Remarks: None noted.			
DRIVE SYSTEM	OK	Date	Initials
Drain transmission fluid	✓	7/24/13	E.L.
Replace filter/gasket	✓	7/24/13	E.L.
Check hoses and connections	✓	7/24/13	E.L.
Replace transmission fluid	✓	7/24/13	E.L.
Check for fluid leaks	✓	7/24/13	E.L.
Remarks: None noted.			
LUBRICATION	OK	Date	Initials
Drain crankcase oil	✓	7/24/13	T.G.
Replace filters	✓	7/24/13	T.G.
Replace crankcase oil	✓	7/24/13	S.R.
Check for oil leaks	✓	7/24/13	S.R.
Check oil level	✓	7/24/13	S.R.
Lube all chassis grease fittings	N/A	7/24/13	T.G.
Lube universal joints	N/A	7/24/13	T.G.
Replace differential lube including axles	N/A	7/24/13	T.G.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Page 3 of 3

Bus Number: 1309	Date: 7-24-13		
Personnel: E.L., T.G., S.R. & E.D.			
EXHAUST/EMISSION SYSTEM	OK	Date	Initials
Check for exhaust leaks	✓	7/24/13	E.L.
Remarks: None noted.			
ENGINE	OK	Date	Initials
Replace air filter	✓	7/24/13	E.D.
Inspect air compressor and air system	N/A	7/24/13	E.D.
Inspect vacuum system, if applicable	✓	7/24/13	E.D.
Check and adjust all drive belts	✓	7/24/13	E.D.
Check cold start assist, if applicable	✓	7/24/13	E.D.
Remarks: None noted.			
STEERING SYSTEM	OK	Date	Initials
Check power steering hoses and connectors	✓	7/24/13	T.G.
Service fluid level	✓	7/24/13	T.G.
Check power steering operation	✓	7/24/13	T.G.
Remarks: None noted.			
	OK	Date	Initials
Ballast bus to seated load weight	✓	7/24/13	E.D.
TEST DRIVE	OK	Date	Initials
Check brake operation	✓	7/24/13	S.R.
Check transmission operation	✓	7/24/13	S.R.
Remarks: None noted.			

FUEL ECONOMY PRE-TEST INSPECTION FORM

Page 1 of 1

Bus Number: 1309	Date: 7-30-13
Personnel: T.S. & E.D.	
PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front <u>38</u> Middle <u>N/A</u> Rear <u>38</u>	T.S.
Tire wear:	T.S.
Engine oil level	T.S.
Engine coolant level	T.S.
Interior and exterior lights on, evaporator fan on	T.S.
Fuel economy instrumentation installed and working properly.	T.S.
Fuel line -- no leaks or kinks	T.S.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TECH and Driver.	T.S.
Bus is loaded to SLW	T.S.
WARM-UP	If OK, Initial
Bus driven for at least one hour warm-up	T.S.
No extensive or black smoke from exhaust	T.S.
POST WARM-UP	If OK, Initial
Warm tire pressure (psi): Front <u>42</u> Middle <u>N/A</u> Rear <u>42</u>	T.S.
Environmental conditions Average wind speed <12 mph and maximum gusts <15 mph Ambient temperature between 30°F(-1C°) and 90°F(32°C) Track surface is dry Track is free of extraneous material and clear of interfering traffic	T.S.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 1 of 4

Bus Number: 1309		Manufacturer: Lone Star		Date: 7-30-13			
Run Number: 1		Personnel: T.S., E.D. & G.C.					
Test Direction: ☐ CW or ☒ CCW		Temperature (°F): 63		Humidity (%): 77			
SLW (lbs.): 5,520		Wind Speed (mph) & Direction: 3 / S		Barometric Pressure (in.Hg): 20.25			
Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish			Start	Finish	
CBD #1	0	8:43	8:43	29.9	0	.151	.151
ART #1	0	3:55	3:55	26.0	0	.122	.122
CBD #2	0	8:28	8:28	25.6	0	.146	.146
ART #2	0	3:50	3:50	25.7	0	.124	.124
CBD #3	0	8:26	8:26	25.6	0	.148	.148
COMMUTER	0	5:54	5:54	25.7	0	.147	.147
Total Fuel = 0.838 gals							
20 minute idle : Total Fuel Used = 0.121 gals							
Heating Value = 19,289.0 BTU/LB							
Comments: None noted.							

FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 2 of 4

Bus Number: 1309		Manufacturer: Lone Star		Date: 7-30-13			
Run Number: 2		Personnel: T.S., E.D. & G.C.					
Test Direction: ☒ CW or ☐ CCW		Temperature (°F): 70		Humidity (%): 57			
SLW (lbs.): 5,520		Wind Speed (mph) & Direction: 5 / NW		Barometric Pressure (in.Hg): 30.24			
Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish			Start	Finish	
CBD #1	0	8:36	8:36	26.5	0	.149	.149
ART #1	0	3:49	3:49	27.3	0	.127	.127
CBD #2	0	8:35	8:35	27.1	0	.148	.148
ART #2	0	3:51	3:51	27.6	0	.123	.123
CBD #3	0	8:29	8:29	27.3	0	.150	.150
COMMUTER	0	5:54	5:54	27.3	0	.153	.153
Total Fuel = 0.850 gals							
20 minute idle : Total Fuel Used = N/A gals							
Heating Value = 19,289.0 BTU/LB							
Remarks/comments/recommended changes: None noted.							

FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 3 of 4

Bus Number: 1309		Manufacturer: Lone Star		Date: 7-30-13			
Run Number: 3		Personnel: T.S., E.D. & G.C.					
Test Direction: ☐ CW or ☒ CCW		Temperature (°F): 72		Humidity (%): 55			
SLW (lbs.): 5,520		Wind Speed (mph) & Direction: 5/WNW		Barometric Pressure (in.Hg): 30.22			
Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish			Start	Finish	
CBD #1	0	8:27	8:27	27.0	0	.145	.145
ART #1	0	3:53	3:53	26.6	0	.121	.121
CBD #2	0	8:27	8:27	27.3	0	.147	.147
ART #2	0	5:52	3:52	27.3	0	.121	.121
CBD #3	0	8:34	8:34	27.1	0	.146	.146
COMMUTER	0	5:54	5:54	26.8	0	.150	.150
Total Fuel = 0.830 gals							
20 minute idle : Total Fuel Used = N/A gals							
Heating Value = 19,289.0 BTU/LB							
Remarks/comments/recommended changes: None noted.							

FUEL ECONOMY DATA FORM (Liquid Fuels)

Page 4 of 4

Bus Number: 1309		Manufacturer: Lone Star		Date: 7-30-13			
Run Number: 4		Personnel: T.S., E.D. & G.C.					
Test Direction: ☒ CW or ☐ CCW		Temperature (°F): 77		Humidity (%): 37			
SLW (lbs.): 5,520		Wind Speed (mph) & Direction: 2/WNW		Barometric Pressure (in.Hg): 30.22			
Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish			Start	Finish	
CBD #1	0	8:42	8:42	27.0	0	.143	.143
ART #1	0	4:00	4:00	26.9	0	.118	.118
CBD #2	0	8:42	8:42	26.7	0	.144	.144
ART #2	0	4:02	4:02	27.0	0	.118	.118
CBD #3	0	8:36	8:36	27.0	0	.144	.144
COMMUTER	0	5:52	5:52	27.6	0	.147	.147
Total Fuel = 0.814 gals							
20 minute idle : Total Fuel Used = 0.120 gals							
Heating Value = 19,289.0 BTU/LB							
Remarks/comments/recommended changes: None noted.							

FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER :Lone Star BUS NUMBER :1309
 BUS MODEL :SXT TEST DATE :07/30/13

FUEL TYPE : GASOLINE
 SP. GRAVITY : .7400
 HEATING VALUE : 19289.00 BTU/Lb
 FUEL TEMPERATURE : 79.00 deg F
 Standard Conditions : 60 deg F and 14.7 psi
 Density of Water : 8.3373 lb/gallon at 60 deg F

CYCLE	TOTAL FUEL USED (GAL)	TOTAL MILES	FUEL ECONOMY MPG (Measured)	FUEL ECONOMY MPG (Corrected)
Run #1, CCW				
CBD .445		5.73	12.876	13.55
ART .246		3.82	15.528	16.34
COM .147		3.82	25.986	27.35
TOTAL .838		13.37	15.955	16.79
Run #2, CW				
CBD .447		5.73	12.819	13.49
ART .250		3.82	15.280	16.08
COM .153		3.82	24.967	26.28
TOTAL .850		13.37	15.729	16.56
Run #3, CCW				
CBD .438		5.73	13.082	13.77
ART .242		3.82	15.785	16.61
COM .150		3.82	25.467	26.80
TOTAL .830		13.37	16.108	16.95
Run #4, CW				
CBD .431		5.73	13.295	13.99
ART .236		3.82	16.186	17.04
COM .147		3.82	25.986	27.35
TOTAL .814		13.37	16.425	17.29

IDLE CONSUMPTION (MEASURED)

First 20 Minutes Data: .12GAL Last 20 Minutes Data: .12GAL
 Average Idle Consumption: .36GAL/Hr

RUN CONSISTENCY: % Difference from overall average of total fuel used

Run 1: -.6 Run 2: -2.0 Run 3: .4 Run 4: 2.3

SUMMARY (CORRECTED VALUES)

Average Idle Consumption : .34 G/Hr
 Average CBD Phase Consumption : 13.70 MPG
 Average Arterial Phase Consumption : 16.52 MPG
 Average Commuter Phase Consumption : 26.95 MPG
 Overall Average Fuel Consumption : 16.90 MPG
 Overall Average Fuel Consumption :141.99 Miles/ Million BTU

7. NOISE

7.1 INTERIOR NOISE AND VIBRATION TESTS

7.1-I. TEST OBJECTIVE

The objective of these tests is to measure and record interior noise levels and check for audible vibration under various operating conditions.

7.1-II. TEST DESCRIPTION

During this series of tests, the interior noise level will be measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system shall provide a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories will be switched off and all openings including doors and windows will be closed. This test will be performed at the ABTC.
2. The bus accelerating at full throttle from a standing start to 35 mph on a level pavement. All openings will be closed and all accessories will be operating during the test. This test will be performed on the track at the Test Track Facility.
3. The bus will be operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles will be noted. This test will be performed on the test segment between the Test Track and the Bus Testing Center.

All tests will be performed in an area free from extraneous sound-making sources or reflecting surfaces. The ambient sound level as well as the surrounding weather conditions will be recorded in the test data.

7.1-III. DISCUSSION

This test is performed in three parts. The first part exposes the exterior of the vehicle to 80.0 dB(A) on the left side of the bus and the noise transmitted to the interior is measured. The overall average of the six measurements was 44.1 dB(A); ranging from 42.4 dB(A) in line with the middle speakers to 44.8 dB(A) in line with the front speaker. The interior ambient noise level for this test was < 30.0 dB(A).

The second test measures interior noise during acceleration from 0 to 35 mph. This noise level ranged from 74.6 dB(A) at the rear passenger seats to 77.9 dB(A) at the middle passenger seats. The overall average was 76.4 dB(A). The interior ambient noise level for this test was < 30.0 dB(A).

The third part of the test is to listen for resonant vibrations, rattles, and other noise sources while operating over the road. No vibrations or rattles were noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 1: 80 dB(A) Stationary White Noise

Page 1 of 3

Bus Number: 1309	Date: 6-28-13
Personnel: S.R., E.D., E.L. & P.D.	
Temperature (°F): 78	Humidity (%): 79
Wind Speed (mph): 7	Wind Direction: SW
Barometric Pressure (in.Hg): 29.61	
Initial Sound Level Meter Calibration: ■ checked by: S.R.	
Interior Ambient Noise Level dB(A): < 30.0	Exterior Ambient Noise Level dB(A): 48.1
Microphone Height During Testing (in): 29" above seat cushion	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	43.8
Front Passenger Seats	44.6
In Line with Front Speaker	44.8
In Line with Middle Speaker	42.4
In Line with Rear Speaker	44.6
Rear Passenger Seats	44.2

Final Sound Level Meter Calibration: ■ checked by: S.R.

Comments: All readings taken in the center aisle.
Remarks/comments/recommended changes: None noted.

INTERIOR NOISE TEST DATA FORM

Test Condition 2: 0 to 35 mph Acceleration Test

Page 2 of 3

Bus Number: 1309	Date: 8-6-13
Personnel: T.S., S.R. & M.R.	
Temperature (°F): 69	Humidity (%): 68
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: ■ checked by: S.R.	
Interior Ambient Noise Level dB(A): < 30.0	Exterior Ambient Noise Level dB(A): 37.4
Microphone Height During Testing (in): 29" from seat cushion.	

Measurement Location	Measured Sound Level dB(A)
Driver's Seat	76.0
Front Passenger Seats	77.2
Middle Passenger Seats	77.9
Rear Passenger Seats	74.6

Final Sound Level Meter Calibration: ■ checked by: S.R.

Comments: All readings taken in the center aisle.
Remarks/comments/recommended changes: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 3: Audible Vibration Test
Page 3 of 3

Bus Number: 1309	Date: 8-6-13
Personnel: T.S., S.R. & M.R.	
Temperature (°F): 77	Humidity (%): 52
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.08	

Describe the following possible sources of noise and give the relative location on the bus.

Source of Noise	Location
Engine and Accessories	None noted.
Windows and Doors	None noted.
Seats and Wheel Chair lifts	None noted.

Comment on any other vibration or noise source which may have occurred that is not described above: None noted.
Remarks/comments/recommended changes: None noted.

7.1 INTERIOR NOISE TEST



**TEST BUS SET-UP FOR 80 dB(A)
INTERIOR NOISE TEST**

7.2 EXTERIOR NOISE TESTS

7.2-I. TEST OBJECTIVE

The objective of this test is to record exterior noise levels when a bus is operated under various conditions.

7.2-II. TEST DESCRIPTION

In the exterior noise tests, the bus will be operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed at or below 35 mph and just prior to transmission up shift.
2. Accelerating at full throttle from standstill.
3. Stationary, with the engine at low idle, high idle, and wide open throttle.

In addition, the buses will be tested with and without the air conditioning and all accessories operating. The exterior noise levels will be recorded.

The test site is at the PSBRTF and the test procedures will be in accordance with SAE Standards SAE J366b, Exterior Sound Level for Heavy Trucks and Buses. The test site is an open space free of large reflecting surfaces. A noise meter placed at a specified location outside the bus will measure the noise level.

During the test, special attention should be paid to:

1. The test site characteristics regarding parked vehicles, signboards, buildings, or other sound-reflecting surfaces
2. Proper usage of all test equipment including set-up and calibration
3. The ambient sound level

7.2-III. DISCUSSION

The Exterior Noise Test determines the noise level generated by the vehicle under different driving conditions and at stationary low and high idle, with and without air conditioning and accessories operating. The test site is a large, level, bituminous paved area with no reflecting surfaces nearby.

With an exterior ambient noise level of 39.2 dB(A), the average test result obtained while accelerating from a constant speed was 71.5 dB(A) on the right side and 72.0 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 38.5 dB(A), the average of the results obtained were 73.8 dB(A) on the right side and 73.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 45.0 dB(A) at low idle and 64.8 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 2.4 dB(A) lower at low idle and 0.2 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 34.9 dB(A).

EXTERIOR NOISE TEST DATA FORM

Accelerating from Constant Speed

Page 1 of 3

Bus Number: 1309	Date: 8-6-13
Personnel: T.S., S.R. & M.R.	
Temperature (°F): 69	Humidity (%): 68
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.10	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.	
Initial Sound Level Meter Calibration: ■ checked by: S.R.	
Exterior Ambient Noise Level dB(A): 39.2	

Accelerating from Constant Speed Curb (Right) Side		Accelerating from Constant Speed Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	71.6	1	69.1
2	70.4	2	71.1
3	71.2	3	69.6
4	71.3	4	70.0
5	70.2	5	72.9
Average of two highest actual noise levels = 71.5 dB(A)		Average of two highest actual noise levels = 72.0 dB(A)	
Final Sound Level Meter Calibration Check: ■ checked by: S.R.			
Remarks/Comments/recommended changes: None noted.			

EXTERIOR NOISE TEST DATA FORM

Accelerating from Standstill

Page 2 of 3

Bus Number: 1309	Date: 8-6-13
Personnel: T.S., S.R. & M.R.	
Temperature (°F): 69	Humidity (%): 68
Wind Speed (mph): 0	Wind Direction: Calm
Barometric Pressure (in.Hg): 30.04	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.	
Initial Sound Level Meter Calibration: ■ checked by: S.R.	
Exterior Ambient Noise Level dB(A): 38.5	

Accelerating from Standstill Curb (Right) Side		Accelerating from Standstill Street (Left) Side	
Run #	Measured Noise Level dB(A)	Run #	Measured Noise Level dB(A)
1	72.7	1	74.1
2	73.9	2	72.4
3	72.3	3	73.5
4	73.6	4	72.2
5	72.9	5	71.9
Average of two highest actual noise levels = 73.8 dB(A)		Average of two highest actual noise levels = 73.8 dB(A)	
Final Sound Level Meter Calibration Check: ■ checked by: S.R.			
Remarks/comments/recommended changes: None noted.			

EXTERIOR NOISE TEST DATA FORM

Stationary

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Bus Number: 1309		Date: 8-6-13	
Personnel: T.S., S.R. & M.R.			
Temperature (°F): 68		Humidity (%): 70	
Wind Speed (mph): 0		Wind Direction: Calm	
Barometric Pressure (in.Hg): 30.04			
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■ checked by: T.S.			
Initial Sound Level Meter Calibration: ■ checked by: S.R.			
Exterior Ambient Noise Level dB(A): 34.9			
Accessories and Air Conditioning ON			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	700	46.6	43.4
High Idle	N/A	N/A	N/A
Wide Open Throttle	4,000	64.9	64.6
Accessories and Air Conditioning OFF			
Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	700	43.3	41.9
High Idle	N/A	N/A	N/A
Wide Open Throttle	4,000	65.3	64.6
Final Sound Level Meter Calibration Check: ■ checked by: S.R.			
Remarks/Comments/recommended changes: None noted.			

7.2 EXTERIOR NOISE TESTS



**TEST VEHICLE UNDERGOING
EXTERIOR NOISE TESTS**