FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
In accordance with CFR 49, Volume 7, Part 665

Manufacturer: Lone Star Handicap Vans, LLC
Model: Ram Promaster

Submitted for Testing in Service-Life Category
4 Year /100,000 Miles

September 2016

Report Number: LTI-BT-R1607

PENNSTATE

1855

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FEDERAL TRANSIT BUS TEST

Performed for the Federal Transit Administration U.S. DOT
1200 New Jersey Avenue, SE
Washington, DC 20590

In accordance with CFR 49, Volume 7, Part 665

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Manufacturer's address: 12953 Hwy 64 W
Tyler, TX 75704

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ACCREDITED
Mechanical Testing Certificate 3172.01

Quality Authorization | Director, Bus Research and Testing Center (Title) | 9/7/16 (Date)

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EXECUTIVE SUMMARY

Lone Star Handicap Vans, LLC., submitted a model Ram Promaster, gasoline-powered eight seat (including the driver) 20-foot bus, for a 4 yr/100,000 mile STURAA test. The odometer reading at the time of delivery was 3,491 miles. Testing started on March 22, 2016 and was completed on August 12, 2016. 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 March 29, 2016 and was completed on June 29, 2016.

The interior of the bus is configured with seating for eight passengers including the driver plus two wheelchair positions. Note: this test vehicle is not designed to standing passengers. The resulting potential load is eight persons plus two wheelchair positions. At 150 lbs per person, and 600 lbs per wheelchair position this load results in a measured gross vehicle weight of 8,770 lbs. Due to no standing passengers the first segment (GVW) and the second segment (SLW) of the Structural Durability Test were performed at the same weight of 8,770 lbs. The final segment was performed at a CW of 6,360 lbs. Durability driving resulted in unscheduled maintenance consisting of one failure. A description of this failure, and a complete and detailed listing of scheduled and unscheduled 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. The test bus encountered no Class 1, 2 or 4 failures. The one reported Class 3 failure was the result of both rear tires contacting the top of the wheel wells.

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 7.52 seconds. The Stopping Distance phase of the Brake Test was completed with the following results; for the Uniform High Friction Test average stopping distances were 24.79' at 20 mph, 47.35' at 30 mph, 77.35' at 40 mph and 98.56' at 45 mph. The average stopping distance for the Uniform Low Friction Test was 28.06'. There was no deviation from the test lane during the performance of the Stopping Distance phase. During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane during both approaches to the Split Friction Road surface. The Parking Brake phase was completed with the test bus maintaining the parked position for the full five minute period with no slip or roll observed in both the uphill and downhill positions.

The Shakedown Test produced a maximum final loaded deflection of 0.105 inches with a permanent set ranging between -0.001 to 0.004 inches under a distributed static load of 4,200 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 vehicle submitted for testing 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 bus was towed without incident and no damage resulted from the test. The manufacturer does not recommend towing the bus 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 3.8 inches.

A Fuel Economy Test was run on simulated central business district, arterial, and commuter courses. The results were 10.54 mpg, 11.03 mpg, and 20.62 mpg respectively; with an overall average of 12.43 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
PSTT	-	Penn State Test Track
PTI	-	Pennsylvania Transportation Institute
rpm	-	revolutions per minute
SAE	-	Society of Automotive Engineers
SCH	-	test scheduler
SA	-	staff assistant
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 bus consists of a Lone Star Handicap Vans, LLC, model Ram Promaster. The bus has O.E.M. driver's and front passenger doors rear of the front axle. The passenger door, equipped with a Lone Star Handicap Vans model PMR-03 manual fold-out handicap ramp is centered between the axles. The rear O.E.M. cargo door is centered at the rear. Power is provided by a gasoline-fueled, Chrysler model 3.6 L engine coupled to a Chrysler 6 – Speed Auto model 62TE transmission.

The measured curb weight is 3,310 lbs. for the front axle and 3,050 lbs for the rear axle. These combined weights provide a total measured curb weight of 6,360 lbs. There are eight seats including the driver plus two wheelchair positions. Note: the test vehicle is not designed for standing passengers. Gross load is 150 lbs. x 8 = 1,200 lbs. + 1,200 lbs. (2 wheelchair positions) = 2,400 lbs. At full capacity, the measured gross vehicle weight is 8,770 lbs.

VEHICLE DATA FORM

Bus Number: 1607	Date: 3-22-16
Bus Manufacturer: Lone Star Handicap Vans, LLC.	Vehicle Identification Number (VIN): 3C6URVJGXFE520388
Model Number: Ram Promaster	Chassis Mfr./Mod.#: Ram Promaster 3500
Personnel: S.R. & T.G.	Starting Odometer Reading: 3491

WEIGHT:

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	1,660	1,650	N/A	N/A	1,570	1,480
SLW	1,790	2,080	N/A	N/A	2,370	2,530
GVW	1,790	2,080	N/A	N/A	2,370	2,530

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,310	3,870	3,870	4,629
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	3,050	4,900	4,900	5,291
Total	6,360	8,770	8,770	GVWR: 9,350

Dimensions:

Length (ft/in)	20 / 11.25
Width (in)	79.8
Height (in)	97.5
Front Overhang (in)	37.8
Rear Overhang (in)	54.2
Wheel Base (in)	159.25
Wheel Track (in)	Front: 71.5
	Middle: N/A
	Rear: 70.5

Bus Number: 1607	Date: 3-22-16

CLEARANCES:

Lowest Point Outside Front Axle	Location: Engine cover	Clearance(in): 8.1
Lowest Point Outside Rear Axle	Location: Muffler	Clearance(in): 11.3
Lowest Point between Axles	Location: Exhaust pipe	Clearance(in): 6.2
Ground Clearance at the center (in)	7.0	
Front Approach Angle (deg)	17.4	
Rear Approach Angle (deg)	16.0	
Ramp Clearance Angle (deg)	4.4	
Aisle Width (in)	37.0	
Inside Standing Height at Center Aisle (in)	84.4	

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.	CRL / AS3 M4 04 / FW387LF		
Number of Doors	2 Front	1 Rear	1 Passenger
Mfr. / Model No.	Driver's & Passenger FCA / O.E.M.	FCA / O.E.M	FCA / O.E.M.
Dimension of Each Door (in)	Driver - 60.0 x 29.5 Pass. – 59.5 x 29.2	69.0 x 61.5	73.6 x 35.1
Passenger Seat Type	☐ Cantilever	■ Pedestal	☐ Other (explain)
Driver Seat Type	☐ Air	■ Spring	☐ Other (explain)
Mfr. / Model No.	Chrysler / O.E.M.		
Number of Seats (including Driver)	8 + 2 wheelchair positions		

Bus Number: 1607	Date: 3-22-16

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	N/A			
Height of Each Step at Normal Position (in)	Front	1. 11.9	2. N/A	3. N/A 4. N/A
	Middle	1. N/A	2. N/A	3. N/A 4. N/A
	Rear	1. N/A	2. N/A	3. N/A 4. N/A
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)
Alternator (Generator) Mfr. / Model No.	Denso / MX421000		
Maximum Rated Output (Volts / Amps)	12 / 180		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft^3 / min)	N/A		
Starter Type	■ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	Denso / 04S16		

Bus Number: 1607	Date: 3-22-16

TRANSMISSION

Transmission Type	☐ Manual	■ Automatic	☐ Load Sensing Adaptive
Mfr. / Model No.	Chrysler / 6-Speed Auto 62TE		
Control Type	■ Mechanical	☐ Electrical	☐ Other
Integral Retarder	☐ Yes	■ No	

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	☐ Beam Axle	
Mfr. / Model No.	FCA / O.E.M.		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	■ Spring	☐ Other (explain)
No. of Shock Absorbers	2 (struts)		
Mfr. / Model No.	FCA / O.E.M.		
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.	FCA / O.E.M.		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	■ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Cofap / GL13572CEY-68157782AD		

Bus Number: 1607	Date: 3-22-16

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Fumagalli / 6.0 x 16
	Tire Mfr./ Model No.	Nexen / Roadian 225 75R 16
Rear	Wheel Mfr./ Model No.	Fumagalli / 6.0 x 16
	Tire Mfr./ Model No.	Nexen / Roadian 225 75R 16

BRAKES

Front Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	FCA / O.E.M.		
Middle Axle Brakes Type	☐ Cam	☐ Disc	☐ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	FCA / O.E.M.		

HVAC

Heating System Type	☐ Air	■ Water	☐ Other
Capacity (Btu/hr)	52,000		
Mfr. / Model No.	ACCClimate / N/A		
Air Conditioner	■ Yes	☐ No	
Location	Dash		
Capacity (Btu/hr)	35,000		
A/C Compressor Mfr. / Model No.	Design Press / 75BH17C		

STEERING

Steering Gear Box Type	Hydraulic gear / rack & pinion		
Mfr. / Model No.	FCA / O.E.M.		
Steering Wheel Diameter	15.4”		
Number of turns (lock to lock)	3.75		
Control Type	☐ Electric	■ Hydraulic	☐ Other (explain)

Bus Number: 1607	Date: 3-22-16

OTHERS

Wheel Chair Ramps	Location: Right passenger door	Type: Manual bi-fold
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	Lone Star Handicap Vans / PMR-03	
Emergency Exit	Location: Doors Window	Number: 4 1

CAPACITIES

Fuel Tank Capacity (gallons)	24
Engine Crankcase Capacity (quarts)	5
Transmission Capacity (quarts)	12
Differential Capacity (gallons)	Not available.
Cooling System Capacity (quarts)	11
Power Steering Fluid Capacity (pints)	4.2

VEHICLE DATA FORM

Bus Number: 1607	Date: 3-22-16

List all spare parts, tools and manuals delivered with the bus.

Part Number	Description	Qty.
N/A	N/A	N/A

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 1607	Date: 3-22-16

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	S.R.	None noted
Body and Sheet Metal	✓	S.R.	None noted
Frame	✓	S.R.	None noted
Steering	✓	S.R.	None noted
Suspension	✓	S.R.	None noted
Interior/Seating	✓	S.R.	None noted
Axles	✓	S.R.	None noted
Brakes	✓	S.R.	None noted
Tires/Wheels	✓	S.R.	None noted
Exhaust	✓	S.R.	None noted
Fuel System	✓	S.R.	None noted
Power Plant	✓	S.R.	None noted
Accessories	✓	S.R.	None noted
Lift System	✓	S.R.	None noted
Interior Fasteners	✓	S.R.	None noted
Batteries	✓	S.R.	None noted

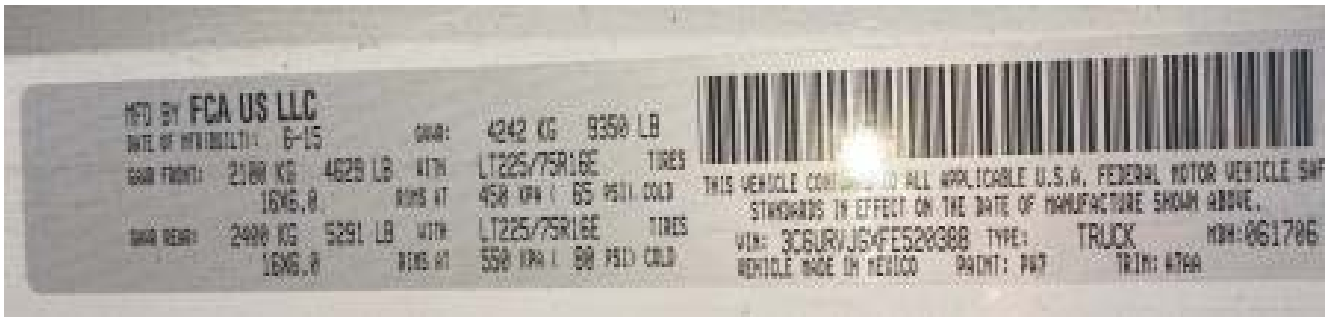
CHECK - IN

LONE STAR HANDICAP VANS, LLC.
MODEL RAM PROMASTER

CHECK - IN CONT.

LONE STAR HANDICAP VANS, LLC.
MODEL RAM PROMASTER EQUIPPED WITH A LONE STAR MODEL PMR-03 FOLD-OUT HANDICAP RAMP

CHECK - IN CONT.



VIN TAG

OPERATOR’S AREA

CHECK - IN CONT.

INTERIOR FORWARD

INTERIOR REAR

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

Bus Number: 1607	Date: 8-10-16

Component	Checked	Comments
ENGINE :		
Oil Dipstick	✓	None noted.
Oil Filler Hole	✓	None noted.
Oil Drain Plug	✓	None noted.
Oil Filter	✓	None noted.
Fuel Filter	✓	None noted.
Air Filter	✓	None noted.
Belts	✓	None noted.
Coolant Level	✓	None noted.
Coolant Filler Hole	✓	None noted.
Coolant Drain	✓	None noted.
Spark / Glow Plugs	✓	None noted.
Alternator	✓	None noted.
Diagnostic Interface Connector	✓	None noted.
TRANSMISSION :		
Fluid Dip-Stick	✓	None noted.
Filler Hole	✓	None noted.
Drain Plug	✓	None noted.
SUSPENSION :		
Bushings	✓	None noted.
Shock Absorbers	✓	None noted.
Air Springs	N/A	None noted.
Leveling Valves	N/A	None noted.
Grease Fittings	N/A	None noted.

ACCESSIBILITY DATA FORM

Bus Number: 1607	Date: 8-10-16

Component	Checked	Comments
HVAC :		
A/C Compressor	✓	None noted.
Filters	✓	None noted.
Fans	✓	None noted.
ELECTRICAL SYSTEM :		
Fuses	✓	None noted.
Batteries	✓	None noted.
Voltage regulator	✓	None noted.
Voltage Converters	✓	None noted.
Lighting	✓	None noted.
MISCELLANEOUS :		
Brakes	✓	None noted.
Handicap Lifts/Ramps	✓	None noted.
Instruments	✓	None noted.
Axles	✓	None noted.
Exhaust	✓	None noted.
Fuel System	✓	None noted.
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. Finally, the Unscheduled Maintenance List along with Unscheduled Maintenance-related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction occurred, a description of the malfunction and repair, and the time required to perform the repair.

(Page 1 of 1)
SCHEDULED MAINTENANCE
LONE STAR 1607

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
04-15-16	949	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-31-16	2,022	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-24-16	3,473	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
08-03-16	3,800	P.M./Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

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 10.00 man-hours (two men 5.00 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

Subsystem	Replacement Time
Transmission	10.00 man hours
Wiper Motor	1.00 man hours
Starter	0.50 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 (10.00 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 (0.50 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. The following Reliability Data Form lists all unscheduled repairs under classes as defined above. 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.

The Unscheduled Repair List is also attached to provide a reference for the repairs that are included in the Reliability Data Forms.

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There were no Class 1, 2 or 4 failures. The one reported Class 3 failure was the result of the rear tires contacting the wheel wells. This failure is available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORM

Bus Number: 1607	Date Completed: 6-29-16
Personal: B.R.	

	Failure Type					
	Class 4 Bad order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystem	Mileage	Mileage	Mileage	Mileage	Man hours	Down Time
Body		215			4.00	4.00

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 80 foot lane change areas 80 feet apart. The bus will begin in one lane, change to the other lane in a 80 foot span, travel 80 feet, and return to the original lane in another 80 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

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	

Temperature (°F): 53	Humidity (%): 90
Wind Direction: NE	Wind Speed (mph): 6
Barometric Pressure (in.Hg): 29.90	

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:	
The test vehicle maintained a safe profile throughout the test.	
Comments of the tire/ground contact patch:	
Tire / ground contact was maintained through all portions of testing.	

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 7.52 seconds.

PERFORMANCE DATA FORM

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	

Temperature (°F): 53	Humidity (%): 94
Wind Direction: N	Wind Speed (mph): 2
Barometric Pressure (in.Hg): 29.90	

		INITIALS:
Air Conditioning - OFF	✓Checked	S.R.
Ventilation fans - ON HIGH	✓Checked	S.R.
Heater pump motor - OFF	✓Checked	S.R.
Defroster - OFF	✓ Checked	S.R.
Exterior and interior lights - ON	✓ Checked	S.R.
Windows and doors - CLOSED	✓ Checked	S.R.

ACCELERATION, GRADEABILITY, TOP SPEED

Counter Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	1.70	1.32	1.41
20 mph	2.89	2.78	2.83
30 mph	4.69	4.58	4.40
40 mph	6.69	6.48	5.99
Top Test Speed(mph) 50	8.11	7.91	7.48

Clockwise Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	1.28	1.41	1.40
20 mph	2.79	2.69	2.72
30 mph	3.98	4.40	4.38
40 mph	5.58	5.87	6.02
Top Test Speed(mph) 50	7.07	7.32	7.20

PERFORMANCE SUMMARY SHEET

BUS MANUFACTURER:Lone Star Handicap Vans, LLC BUS NUMBER:1607
BUS MODEL:Ram Promaster TEST DATE:5/3/16

TEST CONDITIONS :

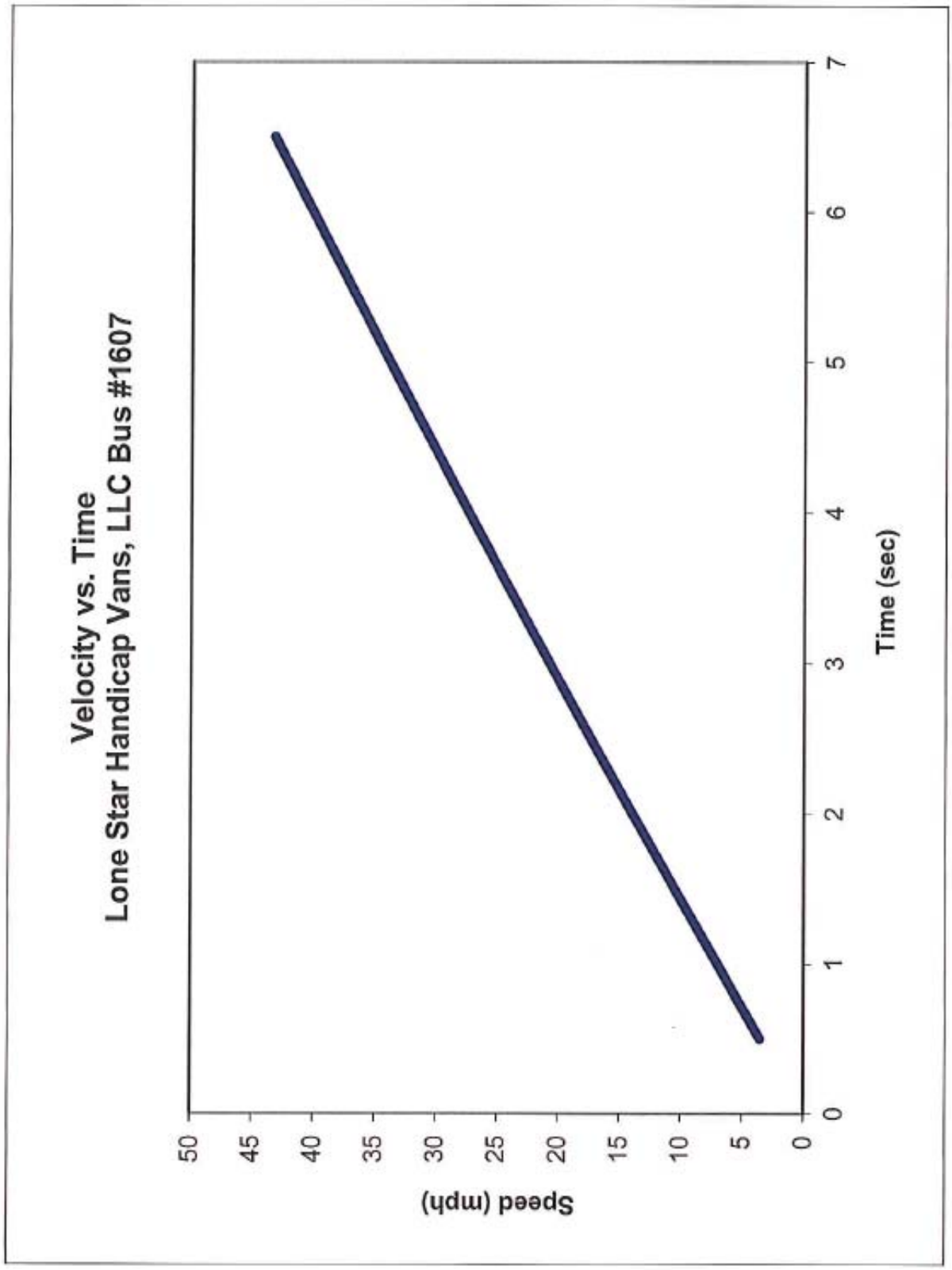
TEMPERATURE (DEG F)	: 53.0
WIND DIRECTION	: N
WIND SPEED (MPH)	: 2.0
HUMIDITY (%)	: 94
BAROMETRIC PRESSURE (IN. HG)	: 29.9

VEHICLE SPEED	AVERAGE TIME (SEC)		
(MPH)	CCW DIRECTION	CW DIRECTION	TOTAL
10.0	1.48	1.36	1.42
20.0	2.83	2.73	2.78
30.0	4.56	4.25	4.40
40.0	6.39	5.82	6.11
50.0	7.83	7.20	7.52

TEST SUMMARY :

VEHICLE SPEED (MPH)	TIME (SEC)	ACCELERATION (FT/SEC^2)	MAX. GRADE (%)
1.0	.14	10.4	34.3
5.0	.70	10.3	33.9
10.0	1.42	10.2	33.3
15.0	2.15	10.0	32.7
20.0	2.89	9.8	32.1
25.0	3.64	9.7	31.5
30.0	4.40	9.5	31.0
35.0	5.18	9.4	30.4
40.0	5.97	9.2	29.8
45.0	6.77	9.0	29.2
50.0	7.59	8.9	28.7

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 Handicap Vans, LLC Bus #1607
Speed (mph)
0
5
10
15
20
25
30
35
40
45
50
Time (sec)
0
1
2
3
4
5
6
7

4.0 PERFORMANCE

4.2 Performance - Bus Braking

4.2 I. TEST OBJECTIVE

The objective of this test is to provide, for comparison purposes, braking performance data on transit buses produced by different manufacturers.

4.2 II. TEST DESCRIPTION

The testing will be conducted at the PTI Test Track skid pad area. Brake tests will be conducted after completion of the GVW portion of the vehicle durability test. At this point in testing the brakes have been subjected to a large number of braking snubs and will be considered well burnished. Testing will be performed when the bus is fully loaded at its GVW. All tires on each bus must be representative of the tires on the production model vehicle

The brake testing procedure comprises three phases:

1. Stopping distance tests

    i. Dry surface (high-friction, Skid Number within the range of 70-76)
    ii. Wet surface (low-friction, Skid Number within the range of 30-36)

2. Stability tests
3. Parking brake test

Stopping Distance Tests

The stopping distance phase will evaluate service brake stops. All stopping distance tests on dry surface will be performed in a straight line and at the speeds of 20, 30, 40 and 45 mph. All stopping distance tests on wet surface will be performed in straight line at speed of 20 mph.

The tests will be conducted as follows:

1. **Uniform High Friction Tests:** Four maximum deceleration straight-line brake applications each at 20, 30, 40 and 45 mph, to a full stop on a uniform high-friction surface in a 3.66-m (12-ft) wide lane.

2. **Uniform Low Friction Tests:** Four maximum deceleration straight-line brake applications from 20 mph on a uniform low friction surface in a 3.66-m (12-ft) wide lane.

When performing service brake stops for both cases, the test vehicle is accelerated on the bus test lane to the speed specified in the test procedure and this speed is maintained into the skid pad area. Upon entry of the appropriate lane of the skid pad area, the vehicle's service brake is applied to stop the vehicle as quickly as possible. The stopping distance is measured and recorded for both cases on the test

data form. Stopping distance results on dry and wet surfaces will be recorded and the average of the four measured stopping distances will be considered as the measured stopping distance. Any deviation from the test lane will be recorded.

Stability Tests

This test will be conducted in both directions on the test track. The test consists of four maximum deceleration, straight-line brake applications on a surface with split coefficients of friction (i.e., the wheels on one side run on high-friction SN 70-76 or more and the other side on low-friction [where the lower coefficient of friction should be less than half of the high one] at initial speed of 30 mph).

(I) The performance of the vehicle will be evaluated to determine if it is possible to keep the vehicle within a 3.66m (12 ft) wide lane, with the dividing line between the two surfaces in the lane's center. The steering wheel input angle required to keep the vehicle in the lane during the maneuver will be reported.

Parking Brake Test

The parking brake phase utilizes the brake slope, which has a 20% grade. The test vehicle, at its GVW, is driven onto the brake slope and stopped. With the transmission in neutral, the parking brake is applied and the service brake is released. The test vehicle is required to remain stationary for five minutes. The parking brake test is performed with the vehicle facing uphill and downhill.

4.2-III. DISCUSSION

The Stopping Distance phase of the Brake Test was completed with the following results; for the Uniform High Friction Test average stopping distances were 24.79' at 20 mph, 47.35' at 30 mph, 77.35' at 40 mph and 98.56' at 45 mph. The average stopping distance for the Uniform Low Friction Test was 28.06'. There was no deviation from the test lane during the performance of the Stopping Distance phase.

During the Stability phase of Brake Testing the test bus experienced no deviation from the test lane during both approaches to the Split Friction Road surface.

The Parking Brake phase was completed with the test bus maintaining the parked position for the full five minute period with no slip or roll observed in both the uphill and downhill positions.

Table 4.2-6. Braking Test Data Forms

Bus Number: 1607	Date: 4-14-16
Personnel: T.S., S.R. & P.D.	
Amb. Temperature (ºF): 47	Wind Speed (mph): 5
Wind Direction: N	Pavement Temp (°F) Start: 64 End: 78

TIRE INFLATION PRESSURE (psi):

Tire Type: Front: Nexen Roadian CT8 HL / 225 / 75R 16
Rear: Nexen Roadian CT8 HL / 225 / 75R 16

	Left Tire(s)		Right Tire(s)	
Front	65		65	
	Inner	Outer	Inner	Outer
Rear	N/A	N/A	N/A	N/A
Rear	N/A	80	N/A	80

AXLE LOADS (lb)

	Left	Right
Front	2,080	1,790
Rear	2,530	2,370

Table 4.2-7. Record of All Braking System Faults/Repairs.

Date	Fault/Repair	Description
4-14-16	T.S., S.R. & P.D	None noted.

Table 4.2-8.1. Stopping Distance Test Results Form

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	**Stop 1**	**Stop 2**	**Stop 3**	**Stop 4**	**Average**
20 (dry)	26.92	23.52	24.61	24.11	24.79
30 (dry)	47.50	46.87	45.82	49.19	47.35
40 (dry)	80.35	77.62	75.71	75.70	77.35
45 (dry)	97.59	98.03	102.30	96.30	98.56
20 (wet)	28.58	29.90	29.22	24.53	28.06

Table 4.2-8.2. Stability Test Results Form

Stability Test Results (Split Friction Road surface)			
Vehicle Direction	Attempt	Did test bus stay in 12' lane? (yes/no)	Comments
Drivers side on high friction	1	Yes	N/A
	2	Yes	N/A
Drivers side on low friction	1	Yes	N/A
	2	Yes	N/A

Table 4.2-8.3. Parking Brake Test Form

PARKING BRAKE (Fully Loaded) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5:00	0	0	**X**	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A
Front down	1	5:00	0	0	**X**	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A

Parking Brake Test

20% Uphill

20% Downhill

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 8 people including the driver plus 2 wheelchair positions. The resulting test load is 8 X 375 lbs. = 3,000 lb. + 1,200 lbs (2 wheelchair positions) = 4,200 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 0.105 Inches at reference point 5. The maximum permanent deflection after the final loading sequence ranged from -0.001 Inches at reference point 4 to 0.004 inches at reference point 6.

STRUCTURAL SHAKEDOWN DATA FORM

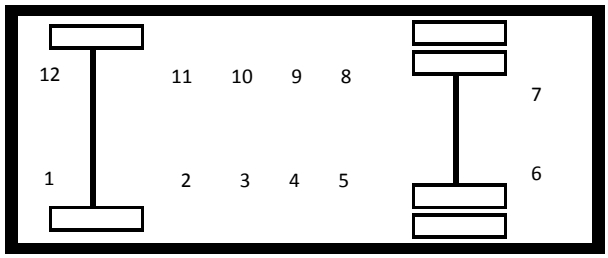
Bus Number: 1607	Date: 3-28-16
Personnel: E.D., E.L., T.G. & J.P.	Temperature (°F): 64
Loading Sequence: ■ 1 ☐ 2 ☐ 3 (check one) Test Load (lbs): 4,200 (8 seated + 2 W/C)	

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	.016	.016	-.002	-.002
2	0	.069	.069	.012	.012
3	0	.093	.093	.018	.018
4	0	.100	.100	.009	.009
5	0	.127	.127	.025	.025
6	0	.094	.094	.028	.028
7	0	.007	.007	.007	.007
8	0	.065	.065	.014	.014
9	0	.055	.055	.015	.015
10	0	.031	.031	.009	.009
11	0	.016	.016	.007	.007
12	0	.001	.001	.002	.002

STRUCTURAL SHAKEDOWN DATA FORM

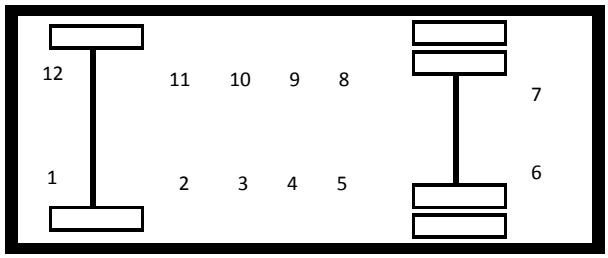
Bus Number: 1607	Date: 3-28-16
Personnel: E.D., E.L., T.G. & J.P.	Temperature (°F): 63
Loading Sequence: ☐ 1 ■ 2 ☐ 3 (check one) Test Load (lbs): 4,200 (8 seated + 2 W/C)	

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	-.002	.017	.019	-.002	.000
2	.012	.069	.057	.012	.000
3	.018	.095	.077	.020	.002
4	.009	.098	.089	.008	-.001
5	.025	.130	.105	.028	.003
6	.028	.095	.067	.032	.004
7	.007	.007	.000	.008	.001
8	.014	.067	.053	.016	.002
9	.015	.060	.045	.018	.003
10	.009	.050	.041	.010	.001
11	.007	.016	.009	.007	.000
12	.002	.000	-.002	.002	.000

5.1 STRUCTURAL SHAKEDOWN TEST

DIAL INDICATORS IN POSITION

BUS LOADED TO 2.5 TIMES GVL
(4,200 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.

DISTORTION TEST INSPECTION FORM

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

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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)

Bus Number: 1607	Date: 3-29-16
Personnel: S.R., E.D., E.L. & P.D.	Temperature(°F): 46

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

	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

RIGHT FRONT WHEEL SIX INCHES HIGHER

LEFT REAR WHEEL SIX INCHES LOWER

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 bus 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

Bus Number: 1607	Date: 7-28-16
Personnel: T.S. & E.D.	

Temperature (°F): 78	
Wind Direction: SSW	Wind Speed (mph): 1

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: None noted.
General Comments: No problems with the towing interface or towing procedures was encountered.

5.4 DYNAMIC TOWING TEST

TOWING INTERFACE

TEST BUS 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 3.8 inches to 13.3 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	9.0”
Rear axle – one tire flat	13.2”
Rear axle – two tires flat	NA

JACKING TEST DATA FORM

Bus Number: 1607	Date: 3-24-16
Personnel: E.D. & S.R.	Temperature (°F): 62

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	11.8 “ I 9.0 “ D	9.4 “ I 6.4 “ D	Body & axle
Left front	12.0 “ I 9.2 “ D	9.4 “ I 6.4 “ D	Body & axle
Right rear—outside	15.8 “ I 13.2 “ D	6.9 “ I 3.8 “ D	Body & axle
Right rear—both	N/A	N/A	N/A
Left rear—outside	15.8 “ I 13.3 “ D	7.0 “ I 3.9 “ D	Body & axle
Left rear—both	N/A	N/A	N/A
Right middle or tag—outside	N/A	N/A	N/A
Right middle or tag—both	N/A	N/A	N/A
Left middle or tag—outside	N/A	N/A	N/A
Left middle or tag—both	N/A	N/A	N/A

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 tag axle and rear end of the bus. The procedure is then repeated for the front, tag axle 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

Bus Number: 1607	Date: 3-24-16
Personnel: S.R. & E.D.	Temperature (°F): 65

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 tag axle wheels are supported by the jack stands:
This vehicle is not equipped with a tag axle.
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.
Comments of any problems or interference placing wheel hoists under wheels:
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 March 29, 2016 and was conducted until June 29, 2016. The first 1,500 miles were performed at a GVW of 8,770 lbs. and completed on April 19, 2016. Note: this test vehicle is not designed to accommodate standing passengers; therefore, GVW and SLW were performed at the same weight. The next 800 mile SLW segment was performed at the same 8,770 lbs and completed on May 31, 2016, and the final 1,500 mile segment was performed at a CW of 6,360 lbs and completed on June 29, 2016.

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. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included.

Lone Star Handicap Vans, LLC Bus #1607

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
03/28/16 TO 04/03/16	158.00	57.00	215.00
04/04/16 TO 04/10/16	0.00	49.00	49.00
04/11/16 TO 04/17/16	590.00	188.00	778.00
04/18/16 TO 04/24/16	542.00	23.00	565.00
04/25/16 TO 05/01/16	42.00	2.00	44.00
05/02/16 TO 05/08/16	0.00	102.00	102.00
05/09/16 TO 05/15/16	122.00	53.00	175.00
05/16/16 TO 05/22/16	0.00	0.00	0.00
05/23/16 TO 05/29/16	0.00	46.00	46.00
05/30/16 TO 06/05/16	407.00	66.00	473.00
06/06/16 TO 6/12/2016	593.00	33.00	626.00
06/13/16 TO 6/19/2016	0.00	400.00	400.00
06/20/16 TO 06/26/16	0.00	0.00	0.00
06/27/16 TO 07/03/16	46.00	282.00	328.00
TOTAL	2500.00	1301.00	3801.00

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

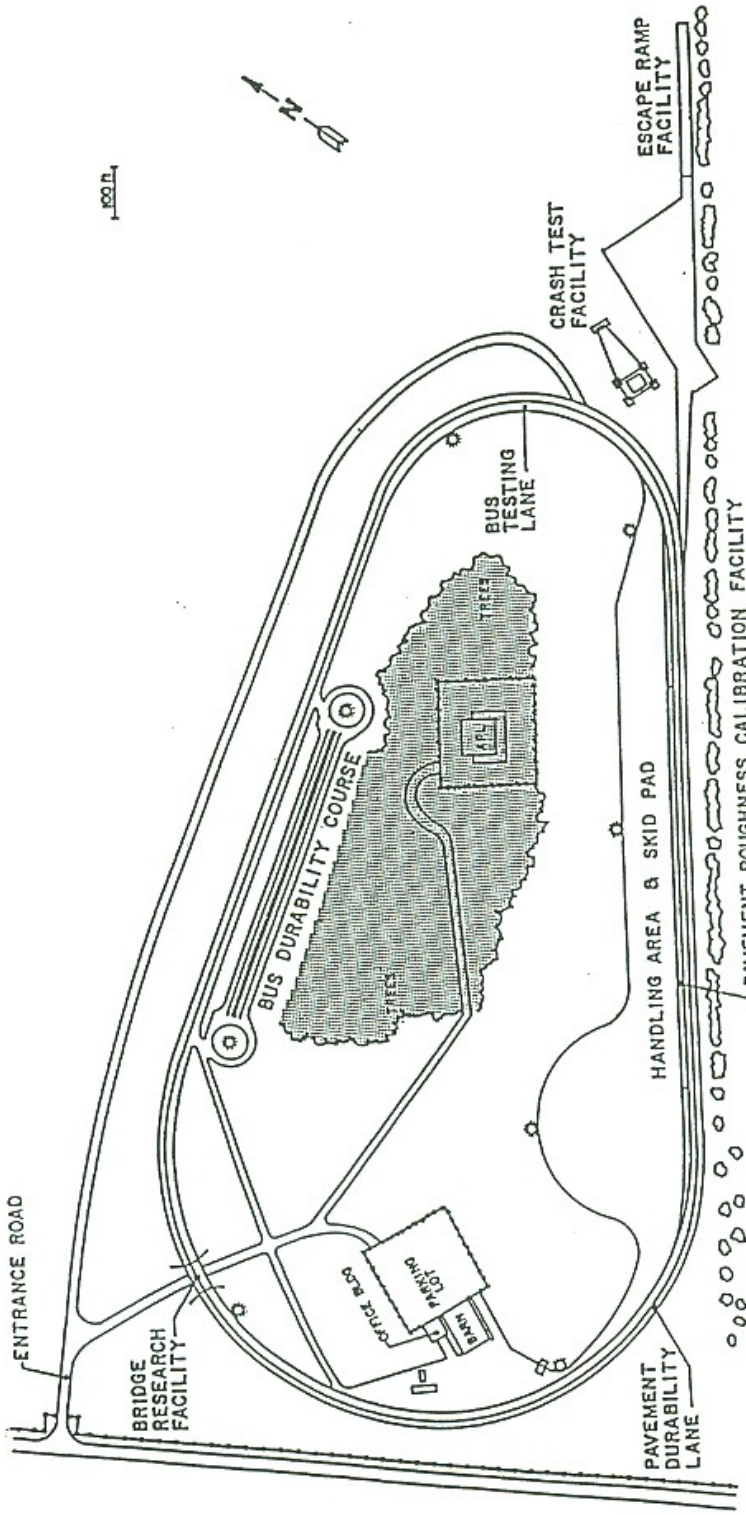
STANDARD OPERATING SCHEDULE

Monday through Friday

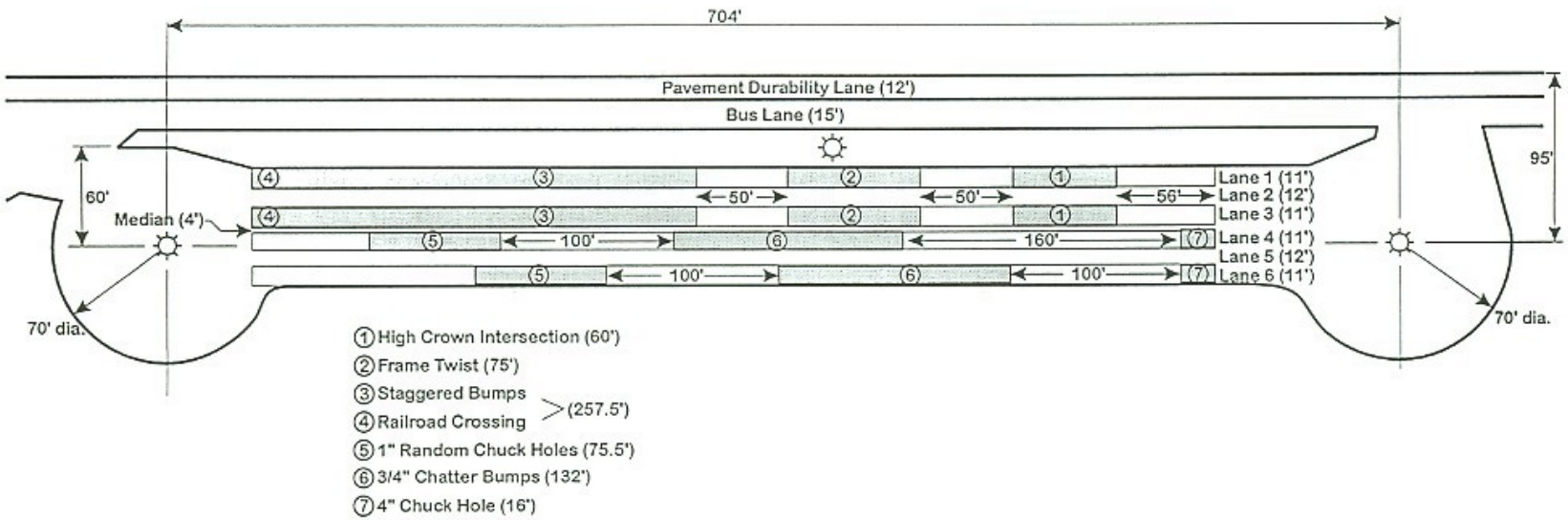
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift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



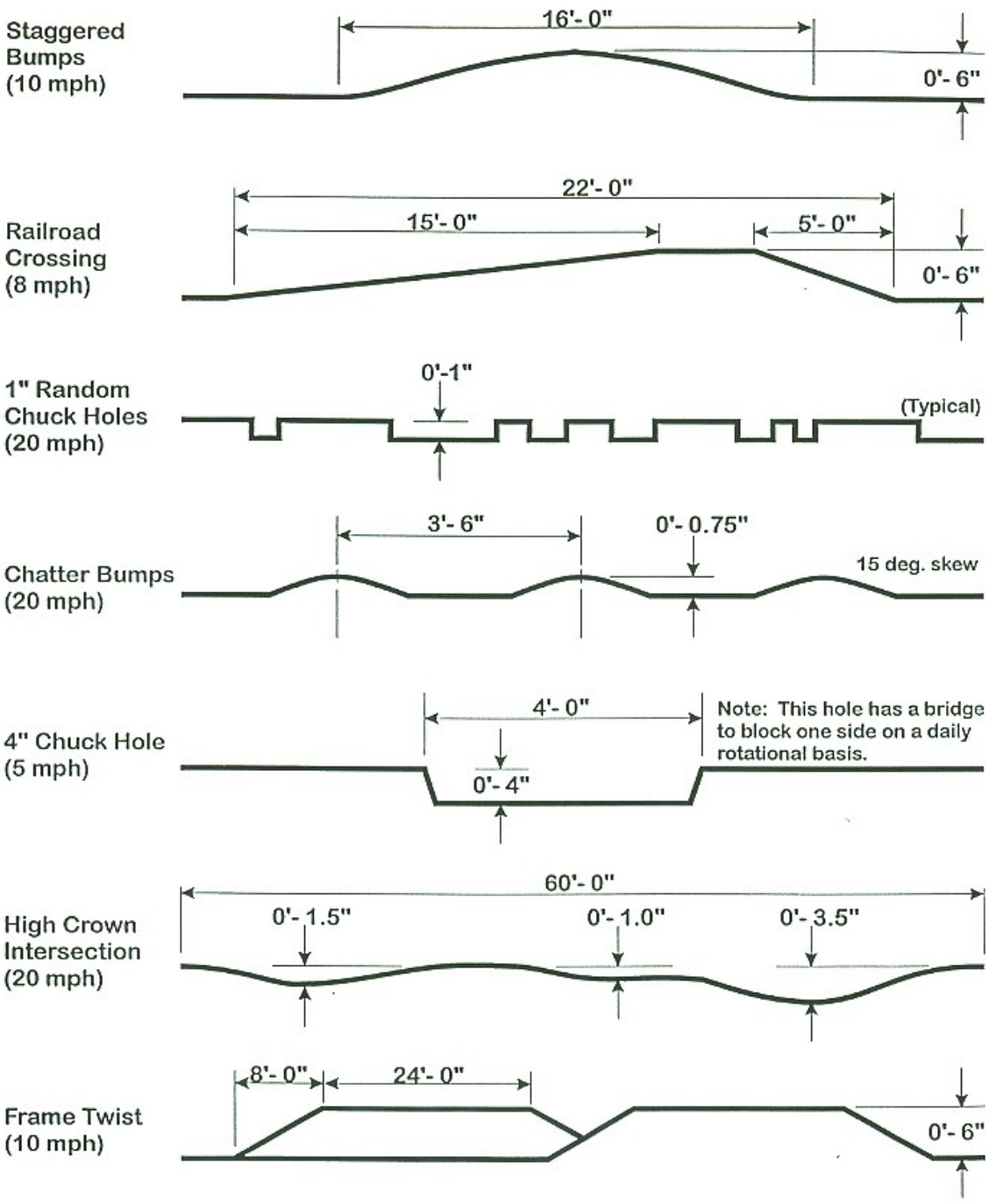
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

(Page 1 of 1)
UNSCHEDULED MAINTENANCE
LONE STAR 1607

DATE	TEST MILES	SERVICE	ACTIVITY	MAN HOURS	DOWN TIME
04-08-16	215	The rear wheels are contacting the top of the wheel well.	Wheel well cut out and raised 1 5/8".	4.00	4.00

REAR WHEELS CONTACTING WHEEL WELL
(215 TEST MILES)

WHEEL WELL CUT OUT AND RAISED.
(215 TEST MILES)

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

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

$FEo_{mi/lb}$ = 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 Gs (referred to water) at 60°F and multiply by the density of water at 60°F

$$\mathbf{FEo_{mpg}} = \mathbf{FEc_{mi/lb}} \times Gs \times Gw$$

where **Gs** = Specific gravity of test fuel at 60°F (referred to water)
Gw = 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.

$$\mathbf{FEc} = \mathbf{FEo_{mpg}} \times \frac{Q}{H}$$

where

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

Combining steps 1-3 yields

$$\Rightarrow \quad FEc = \frac{\text{miles}}{\text{lbs}} \times (Gs \times Gw) \times \frac{Q}{H}$$

4.) Covert 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/BTUx10^6.

Eq = Energy equivalent of converting mpg to mile/BTUx10^6.

$$Eq = ((mpg)/(H))x10^6$$

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°F). These combine to give a fuel economy in miles per lb. The energy equivalent (mile/BTUx10^6) 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

$FEo_{mi/scf}$ = 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/ft^3).

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.

$$FEo_{mi/lb} = FEo / Gm$$

where Gm = Density of test fuel at standard conditions

3.) Convert the observed fuel economy (FEomi/lb) to an energy equivalent of (miles/BTUx10^6) by dividing the observed fuel economy (FEomi/lb) by the heating value of the test fuel at standard conditions.

$$Eq = ((FEomi/lb)/H)x10^6$$

where

Eq = Energy equivalent of miles/lb to mile/BTUx10^6
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 19,303 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 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 – 10.54 mpg, ART – 11.03 mpg, and COM – 20.62 mpg. Average fuel consumption at idle was 0.44 gph.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1607	Date: 6-24-16	SLW (lbs): 8,770
Personnel: T.S., E.D. & T.G.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	✓
Check for fuel leaks	✓
Specify fuel type (refer to fuel analysis)	Gasoline
Remarks: None noted.	

BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Relube wheel bearings	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: None noted.	

COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: None noted.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1607	Date: 6-24-16
Personnel: T.S., E.D. & P D.	

ELECTRICAL SYSTEMS	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: None noted.	

DRIVE SYSTEM	OK
Drain transmission fluid	✓
Replace filter/gasket	✓
Check hoses and connections	✓
Replace transmission fluid	✓
Check for fluid leaks	✓
Remarks: None noted.	

LUBRICATION	OK
Drain crankcase oil	✓
Replace filters	✓
Replace crankcase oil	✓
Check for oil leaks	✓
Check oil level	✓
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	✓
Remarks: None noted.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1607	Date: 6-24-16
Personnel: T.S., E.D. & P.D.	

EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: None noted.	

ENGINE	OK
Replace air filter	✓
Inspect air compressor and air system	N/A
Inspect vacuum system, if applicable	✓
Check and adjust all drive belts	✓
Check cold start assist, if applicable	N/A
Remarks: None noted.	

STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	✓
Check power steering operation	✓
Remarks: None noted.	

	OK
Ballast bus to seated load weight	✓

TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: None noted.	

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 1607	Date: 6-27-16
Personnel: T.S., E.D.,T.G. & M.R.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	E.D.
Cold tire pressure (psi): Front 75 Middle N/A Rear 90	M.R.
Engine oil level	M.R.
Engine coolant level	M.R.
Interior and exterior lights on, evaporator fan on	M.R.
Fuel economy instrumentation installed and working properly.	E.D.
Fuel line -- no leaks or kinks	E.D.
Speed measuring system installed on bus. Speed indicator installed in front of bus and accessible to TECH and Driver.	E.D.
Bus is loaded to SLW	E.D.
WARM-UP	**If OK, Initial**
Bus driven for at least one hour warm-up	E.D.
No extensive or black smoke from exhaust	E.D.
POST WARM-UP	**If OK, Initial**
Warm tire pressure (psi): Front 75 Middle N/A Rear 90	E.D.
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	E.D.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1607	Manufacturer: Lone Star	Date: 6-27-16
Run Number: 1	Personnel: T.S., E.D. & M.R.	
Test Direction: □CW or ■CCW	Temperature (°F): 77	Humidity (%): 69
SLW (lbs): 8,770	Wind Speed (mph) & Direction: 6 / SW	Barometric Pressure (in.Hg): 30.05

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:35	8:35	27.2	0	.188	.188
ART #1	0	3:59	3:59	28.8	0	.183	.183
CBD #2	0	8:28	8:28	29.5	0	.190	.190
ART #2	0	3:58	3:58	30.3	0	.181	.181
CBD #3	0	8:27	8:27	29.8	0	.187	.187
COMMUTER	0	6:00	6:00	31.0	0	.194	.194
							Total Fuel = 1.123 gals

20 minute idle : Total Fuel Used = .154 gals

Heating Value = 19,303 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1607	Manufacturer: Lone Star	Date: 6-27-16
Run Number: 2	Personnel: T.S., E.D. & M.R.	
Test Direction: ■CW or □CCW	Temperature (°F): 81	Humidity (%): 69
SLW (lbs): 8,770	Wind Speed (mph) & Direction: 1 / SW	Barometric Pressure (in.Hg): 30.05

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:34	8:34	28.3	0	.184	.184
ART #1	0	3:57	3:57	27.9	0	.181	.181
CBD #2	0	8:32	8:32	29.4	0	.185	.185
ART #2	0	3:59	3:59	28.2	0	.181	.181
CBD #3	0	8:28	8:28	29.5	0	.185	.185
COMMUTER	0	6:04	6:04	28.7	0	.184	.184
							Total Fuel = 1.100 gals

20 minute idle : Total Fuel Used = N/A gals
Heating Value = 19,303 BTU/LB
Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1607	Manufacturer: Lone Star	Date: 7-8-16
Run Number: 3	Personnel: S.R., T.S. & M.R.	
Test Direction: □CW or ■CCW	Temperature (°F): 75	Humidity (%): 80
SLW (lbs): 8,770	Wind Speed (mph) & Direction: 2 / N	Barometric Pressure (in.Hg): 29.90

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:29	8:29	28.3	0	.194	.194
ART #1	0	3:55	3:55	28.5	0	.177	.177
CBD #2	0	8:26	8:26	29.7	0	.193	.193
ART #2	0	3:57	3:57	29.9	0	.179	.179
CBD #3	0	8:29	8:29	32.4	0	.190	.190
COMMUTER	0	5:58	5:58	31.5	0	.191	.191
						Total Fuel =	1.124 gals

20 minute idle : Total Fuel Used = N/A gals

Heating Value = 19,303 BTU/LB

Comments: None noted.

FUEL ECONOMY DATA FORM (Liquid Fuels)

Bus Number: 1607	Manufacturer: Lone Star	Date: 7-8-16
Run Number: 4	Personnel: S.R., T.S. & M.R.	
Test Direction: ■CW or □CCW	Temperature (°F): 81	Humidity (%): 68
SLW (lbs): 8,770	Wind Speed (mph) & Direction: 11/WSW	Barometric Pressure (in.Hg): 29.90

Cycle Type	Time (min:sec)		Cycle Time (min:sec)	Fuel Temperature (°C)	Flow Meter Reading (gals)		Fuel Used (gals)
	Start	Finish		Start	Start	Finish	
CBD #1	0	8:26	8:26	30.4	0	.197	.197
ART #1	0	3:56	3:56	31.6	0	.190	.190
CBD #2	0	8:25	8:25	30.6	0	.196	.196
ART #2	0	3:55	3:55	31.2	0	.183	.183
CBD #3	0	8:21	8:21	31.0	0	.194	.194
COMMUTER	0	6:00	6:00	31.5	0	.211	.211
							Total Fuel = 1.171 gals

20 minute idle : Total Fuel Used = .151 gals

Heating Value = 19,303 BTU/LB

Comments: None noted.

FUEL ECONOMY SUMMARY SHEET

BUS MANUFACTURER: Lone Star BUS NUMBER: 1607
BUS MODEL : 3500 TEST DATE : 07/08/16
FUEL TYPE : GASOLINE
SP. GRAVITY : .7382
HEATING VALUE : 19303.00 BTU/Lb
FUEL TEMPERATURE : 86.00 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	.565	5.73	10.142	10.65
ART	.364	3.82	10.495	11.02
COM	.194	3.82	19.691	20.67
TOTAL	1.123	13.37	11.906	12.50
Run #2, CW				
CBD	.554	5.73	10.343	10.86
ART	.362	3.82	10.552	11.08
COM	.184	3.82	20.761	21.80
TOTAL	1.100	13.37	12.155	12.76
Run #3, CCW				
CBD	.577	5.73	9.931	10.43
ART	.356	3.82	10.730	11.27
COM	.191	3.82	20.000	21.00
TOTAL	1.124	13.37	11.895	12.49
Run #4, CW				
CBD	.587	5.73	9.761	10.25
ART	.373	3.82	10.241	10.75
COM	.211	3.82	18.104	19.01
TOTAL	1.171	13.37	11.418	11.99

IDLE CONSUMPTION (MEASURED)

First 20 Minutes Data: .15GAL Last 20 Minutes Data: .15GAL
Average Idle Consumption: .46GAL/Hr

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

Run 1: .6 Run 2: 2.6 Run 3: .5 Run 4: -3.7

SUMMARY (CORRECTED VALUES)

Average Idle Consumption : .44 G/Hr
Average CBD Phase Consumption : 10.54 MPG
Average Arterial Phase Consumption: 11.03 MPG
Average Commuter Phase Consumption: 20.62 MPG
Overall Average Fuel Consumption : 12.43 MPG
Overall Average Fuel Consumption :104.66 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 Test Track Facility.

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 45.8 dB(A); ranging from 44.0 dB(A) at the driver's seat to 46.7 dB(A) in line with the rear 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 67.4 dB(A) at the rear passenger seats to 73.2 dB(A) at the front passenger seats. The overall average was 70.5 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. A loud "whirring" noise coming from the bottom of the door at highway speeds. Pushing on the door and bottom gasket caused noise to lessen greatly. No other vibrations or rattles were noted.

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

Bus Number: 1607	Date: 7-26-16
Personnel: S.R., T.S. & E.D.	
Temperature (°F): 76	Humidity (%): 77
Wind Speed (mph): 6	Wind Direction: W
Barometric Pressure (in.Hg): 30.10	
Initial Sound Level Meter Calibration: 93.7 dB(A)	
Interior Ambient Noise Level dB(A): < 30.0	Exterior Ambient Noise Level dB(A): 35.9
Microphone Height During Testing (in): 46.5	
Initial Reading at Bus: 80.1 dB(A)	Final Reading at Bus: 80.3dB(A)

Reading Location	Measured Sound Level dB(A)
Driver's Seat	44.0
Front Passenger Seats	45.4
In Line with Front Speaker	45.4
In Line with Middle Speaker	46.6
In Line with Rear Speaker	46.7
Rear Passenger Seats	46.5

Final Sound Level Meter Calibration: 93.7 dB(A)

Comments: None noted.

INTERIOR NOISE TEST DATA FORM
Test Condition 2: 0 to 35 mph Acceleration Test

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	
Temperature (°F): 53	Humidity (%): 86
Wind Speed (mph): 4	Wind Direction: NE
Barometric Pressure (in.Hg): 29.90	
Initial Sound Level Meter Calibration: 93.8 dB(A)	
Interior Ambient Noise Level dB(A): < 30.0	Exterior Ambient Noise Level dB(A): 41.9
Microphone Height During Testing (in): 54.75	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	70.6
Front Passenger Seats	73.2
Middle Passenger Seats	70.9
Rear Passenger Seats	67.4

Final Sound Level Meter Calibration: 93.8 dB(A)

Comments: None noted.

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

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	
Temperature (°F): 54	

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

Source of Noise	Location	Description of Noise
Engine and Accessories	None noted.	None noted.
Windows and Doors	Passenger doors	Road noise.
Seats and Wheel Chair lifts	None noted.	None noted.
Other	None noted.	None noted.

Comment on any other vibration or noise source which may have occurred that is not described above: A loud “whirring” noise coming from the bottom of the door at highway speeds. Pushing on the door and bottom gasket caused noise to lessen greatly.

Comments: Adjustment of the lower door gasket may eliminate the noise.

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 38.8 dB(A), the average test result obtained while accelerating from a constant speed was 66.0 dB(A) on the right side and 65.2 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 42.9 dB(A), the average of the results obtained were 67.5 dB(A) on the right side and 69.8 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 41.6 dB(A) at low idle and 64.1 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 0.1 dB(A) lower at low idle and 0.3 dB(A) higher at wide open throttle. The exterior ambient noise level measured during this test was 39.4 dB(A). Note; this test vehicle is not equipped with a high idle mode.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	
Temperature (°F): 51	Humidity (%): 93
Wind Speed (mph): 3	Wind Direction: N
Barometric Pressure (in.Hg): 29.90	

Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■

Initial Sound Level Meter Calibration: 93.8 dB(A)

Exterior Ambient Noise Level: 38.8 dB(A)

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	66.3	1	64.4
2	64.4	2	63.8
3	63.9	3	64.4
4	65.6	4	63.3
5	64.2	5	65.9
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 66.0 dB(A)		Average of two highest actual noise levels = 65.2 dB(A)	

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	
Temperature (°F): 52	Humidity (%): 93
Wind Speed (mph): 3	Wind Direction: ENE
Barometric Pressure (in.Hg): 29.90	
Verify that microphone height is 4 feet, wind speed is less than 12 mph and ambient temperature is between 30°F and 90°F: ■	
Initial Sound Level Meter Calibration: 93.8 dB(A)	
Exterior Ambient Noise Level: 42.9 dB(A)	

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	66.2	1	68.5
2	66.4	2	69.9
3	66.4	3	68.6
4	66.7	4	69.6
5	68.2	5	69.7
6	N/A	6	N/A
7	N/A	7	N/A
8	N/A	8	N/A
9	N/A	9	N/A
10	N/A	10	N/A
Average of two highest actual noise levels = 67.5 dB(A)		Average of two highest actual noise levels = 69.8 dB(A)	

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 1607	Date: 5-3-16
Personnel: T.S. & S.R.	
Temperature (°F): 53	Humidity (%): 93
Wind Speed (mph): 4	Wind Direction: ENE
Barometric Pressure (in.Hg): 29.90	

Initial Sound Level Meter Calibration: 93.8 dB(A)

Exterior Ambient Noise Level: 39.4 dB(A)

Accessories and Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	750	41.7	41.4
High Idle	N/A	N/A	N/A
Wide Open Throttle	3,000	64.6	63.6

Accessories and Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side dB(A)
		Measured	Measured
Low Idle	750	41.2	41.7
High Idle	N/A	N/A	N/A
Wide Open Throttle	3,000	65.0	63.8

Final Sound Level Meter Calibration Check: 93.8 dB(A)

Comments: This test vehicle is not equipped with a high idle mode.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING
EXTERIOR NOISE TESTING