FEDERAL TRANSIT BUS TEST

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

Manufacturer: New England Wheels, Inc.
Model: Frontrunner

Tested in Service-Life Category
5 Year / 150,000 Miles

May 2018

Report Number: LTI-BT-R1716

PENNSTATE 1855

THE LARSON INSTITUTE

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

Bus Testing and Research Center
2237 Old Route 220 North
Duncansville, PA 16635
(814) 695-3404

FEDERAL TRANSIT BUS TEST

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

In accordance with 49 CFR Part, 665

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33 Manning Road
Billerica, MA 01821

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A2LA ACCREDITED
Mechanical Testing Certificate 3172.01

Quality Authorization | Director, Bus Research and Testing Center (Title) | 5-18-18 (Date)

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EXECUTIVE SUMMARY

TEST HIGHLIGHTS

The Check-In section of the report provides a description of the bus and specifies its major components. The following table gives the salient specifications.

Manufacturer	New England Wheels, Inc.
Model	Frontrunner
Chassis Make/Model	FCA US LLC / Ram Promaster 3500
Chassis Modified	Yes
Length	22 feet, 6 ½ inches
Fuel	Gasoline
Service Life	5 year / 150,000 miles
Number of Seats (including driver)	15
Manufacturer-Designated Standing Passenger Capacity	0
Gross Vehicle Weight used for testing	9,200
Gross Vehicle Weight Rating	9,350
Mileage at Delivery	6,127
Test Start Date	01/02/18
Test Completion Date	03/14/18

The measured curb weight was 3,680 lb. for the front axle and 3,270 lb. for the rear axle. These combined weights provided a total measured curb weight of 6,950 lb. There are 15 seats including the driver and free floor space for 22 standing passengers bringing the potential total passenger capacity to 37. However, a placard shows that there are to be no standing passengers. Therefore, the gross load represents seated passengers only, for a total of 15 passengers. Gross load is calculated as 150 lb. x 15 = 2,251 lb. At full declared capacity, the measured gross vehicle weight was 9,200 lb. There is a potential to overload this bus with the available floor space for standing passengers.

BUS TESTING BACKGROUND

On August 1, 2016, FTA announced a final rule for bus testing for improving the process of ensuring the safety and reliability of new transit buses. The rule satisfies requirements in MAP-21 to establish minimum performance standards, a standardized scoring system, and a pass-fail threshold based on the score.

FTA's Bus Testing Program (often referred to as "Altoona Testing" due to the location of the main testing center) tests new transit bus models for:

- Maintainability
- Reliability
- Safety
- Performance (including Braking Performance)
- Structural Integrity (including Structural Durability)

- Fuel Economy (Energy Efficiency and Range, for electric buses)
- Noise
- Emissions

Bus models that fail to meet one or more minimum performance standards will "fail" their test and thus be ineligible for purchase with FTA funds until the failures are resolved and validated through further testing. FTA will use this authority to make sure defects are corrected before a bus model can be acquired with FTA funding.

In each application to FTA for the purchase or lease of any new bus model, or any bus model with a major change in configuration or components to be acquired or leased with funds obligated by the FTA, the recipient shall certify that it has received the appropriate full Bus Testing Report and any applicable partial testing report(s) before final acceptance of the first vehicle. In dealing with a bus manufacturer or dealer, the recipient shall be responsible for determining whether a vehicle to be acquired requires full testing or partial testing or has already satisfied the requirements of this part. A bus manufacturer or recipient may request guidance from FTA in making these determinations.

The purpose of the testing is intended set a "Pass/Fail" standard and grade the performance of the buses in order to provide performance information to the transit authorities that can be used in their purchase or lease decisions. The intent of this report is to provide the grantee a relative measure of the performance of a particular model of transit bus against a standard of performance. The passing of this test should ensure a vehicle has a high probability of meeting its service life in the category it was tested.

The data included in this test report and other applicable reports should be reviewed to choose the most suitable bus for a grantee's operation. A higher scoring bus is not necessarily the best bus for a given application. For example, a bus with a powerful engine may score well because of its performance and gradeability, but another bus with a smaller and more fuel-efficient engine could be a better choice for applications in mostly flat areas. It is the responsibility of the grantee to ensure the proper test report or applicable partial report is in their possession and has been thoroughly reviewed.

The score sheet for the subject vehicle of this test report is provided below. **This bus passed the Altoona test, with an aggregate score of 91.0.**

Bus 17-16 new England Wheels									
Test category		Standard	Base Pts.	Bonus Pts.	Range	Range	Test Data	Score	FAIL
1. Maintainability	Unscheduled maint.	< 125 hours	2	14	0	125	1	15.89	
2. Reliability	# Class 2 failures	< 2 Uncorrected	2	6	0	2	0	8.00	
3. Safety	Hazards	No uncorrected Class 1	10	0	P	F	P	10.00	
	Stability	Lane change, 45 mph?	2.5	0	P	F	P	2.50	
	Braking	< 158 feet at 45mph	0.5	2	80	158	93	2.17	
		Holds Lane, Split coeffient	2.5	0	P	F	P	2.50	
		Parking brake, 20% grade	2.5	0	P	F	P	2.50	
4. Performance	Acceleration 0-30 mph	less than 30 sec	1.5	0	P	F	P	1.50	
	Gradeability 2.5%	more than 40 mph	1.5	0	P	F	P	1.50	
	Gradeability 10%	more than 10 mph	2	0	P	F	P	2.00	
5. Structural Integrity	Distortion	Exits are operational	1	0	P	F	P	1.00	
	Static Towing	No significant deformation	1	0	P	F	P	0.00	
	Dynamic Towing	Towable with std. wrecker	1	0	P	F	P	1.00	
	Jacking	Liftable with std. jack	1	0	P	F	P	1.00	
	Hoisting	Stable on jacks	1	0	P	F	P	1.00	
	Durability-Structural	No uncorrected failures	13	0	P	F	P	13.00	
	Durability-Powertrain	No uncorrected failures	12	0	P	F	P	12.00	
6. Fuel Economy	Liquid fuels	1-13mpg	1	6	1	13	9.5	5.25	
	CNG	10-50 scf/mi			10	50	DATA	0.00	
	Hydrogen	15-98 cf/mi			15	98	DATA	0.00	
	Electric	1-3 kWh/mi			1	3	DATA	0.00	
7. Noise	Int. Noise (0-35 mph)	less than 80 db	0.5	3	30	80	79.1	0.55	
	Ext. Noise (0-35 mph)	less than 83 db	0.5	3	50	83	70.3	1.65	
8. Emissions	CO_2	0-4000 g/mi	1	4	0	4000	943	4.06	
	CO	0-20 g/mi		0.4	0	20	2.7	0.35	
	Total hydrocarbon	0-3 g/mi		0.4	0	3	0.04	0.39	
	NMHC	0-3 g/mi		0.4	0	3	0.02	0.40	
	Nitrogen oxides	0-3 g/mi		0.4	0	2	0.15	0.37	
	Particulates	0-0.1 g/m		0.4	0	0.1	0	0.40	
Total			60	40				91.0	

Note: This test bus was not equipped with any type of tow eyes or tow hooks, therefore, Static Towing Test was not performed and the bus was assigned a passing score on this section, but did not receive any points.

ABBREVIATIONS AND ACRONYMS

ABS - anti-skid braking system
ABTC - Altoona Bus Test Center
A/C - air conditioner, or air conditioning
AC - alternating current
ADA - American Disability Act
CDCTS - chassis dynamometer test control system
CVS - constant volume sampling
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
DC - direct current
DIR - test director
DR - bus driver
EPA - Environmental Protection Agency
GAWR – gross axle weight rating
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
HD-UDDS – Heavy Duty-Urban Dynamometer Driving Schedule
LTI - Larson Transportation Institute
mpg - miles per gallon
mph - miles per hour
PM - Preventive maintenance
PSTT - Penn State Test Track
rpm - revolutions per minute
SAE - Society of Automotive Engineers
SCF - Standard cubic foot
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)
TD - test driver
TECH - test technician
TM - track manager
TP - test personnel
Wh - Watt hour

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 consisted 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 certified 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 consisted of a New England Wheels, Inc., model Frontrunner. The bus has a front driver's door just behind the front axle, and a passenger door in between the two axles. Power is provided by a gasoline-fueled, FCA US LLC 3.6L engine coupled to an OEM 62TE transmission.

The measured curb weight was 3,680 lb. for the front axle and 3,270 lb. for the rear axle. These combined weights provided a total measured curb weight of 6,950 lb. There are 15 seats including the driver and free floor space for 22 standing passengers bringing the potential total passenger capacity to 37. However, a placard shows that there are to be no standing passengers. Therefore, the gross load represents seated passengers only, for a total of 15 passengers. Gross load is calculated as 150 lb. x 15 = 2,251 lb. At full declared capacity, the measured gross vehicle weight was 9,200 lb. There is a potential to overload this bus with the available floor space for standing passengers.

VEHICLE DATA FORM

Bus Number: 1716	Date of Check-In: 01/02/18
Bus Manufacturer: New England Wheels, Inc.	Vehicle Identification Number (VIN): 3C7WRVLG5GE123366
Model Number: Frontrunner	Chassis Mfr./Mod.#: FCA US LLC / Ram Promaster 3500
Personnel: T.S. & E.D.	Starting Odometer Reading: 6,127

WEIGHT:

Individual Wheel Reactions:

Weights (lb.)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	1,850	1,830	N/A	N/A	1,640	1,630
SLW	1,920	2,000	N/A	N/A	2,550	2,730
GVW	1,920	2,000	N/A	N/A	2,550	2,730

Total Weight Details:

Weight (lb.)	CW	SLW	GVW	GAWR
Front Axle	3,680	3,920	3,920	4,629
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	3,270	5,280	5,280	5,291
Total	6,950	9,200	9,200	GVWR: 9,350 Declared by Manufacturer

Dimensions:

Length (ft/in)	22 / 6 ½
Width (in)	94 ¾
Height (in)	112 ¼
Front Overhang (in)	37
Rear Overhang (in)	53 ¾
Wheel Base (in)	179 ¾
Wheel Track (in)	Front: 71.4
	Middle: N/A
	Rear: 83.3

Bus Number: 1716	Date: 01/02/18

CLEARANCES:

Lowest Point Outside Front Axle	Location: Hose Clearance(in): 8.1
Lowest Point Outside Rear Axle	Location: Tailpipe Clearance(in): 8.4
Lowest Point between Axles	Location: Emergency Brake Cable Clearance(in): 7.3
Ground Clearance at the center (in)	7.9
Front Approach Angle (deg)	15.8
Rear Approach Angle (deg)	10.9
Ramp Clearance Angle (deg)	5.0
Aisle Width (in)	16.9
Inside Standing Height at Center Aisle (in)	Front: 87.9 Rear: 79.4

BODY DETAILS:

Body Structural Type	Monocoque		
Frame Material	Steel		
Body Material	Composite / Steel		
Floor Material	Composite		
Roof Material	Composite		
Windows Type	■ Fixed	☐ Movable	
Window Mfg./Model No.	Taylor Made / AS3 M-20-4 DOT61		
Number of Doors	2 Front	1 Main Passenger	
Mfr. / Model No.	FCA US LLC / OEM Doors		
Dimension of Each Door (in)	Front Left- 29.2 x 59.4	Front Right- 28.9 x 59.4	Rear Passenger Door- 41 x 76.2
Passenger Seat Type	☐ Cantilever	■ Pedestal	☐ Other (explain)
Driver Seat Type	☐ Air	■ Spring	☐ Other (explain)
Mfr. / Model No.	OEM – FCA US / Incomplete Vehicle		
Number of Seats (including Driver)	15		

Bus Number: 1716	Date: 01/02/18

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	36.6			
Height of Each Step at Normal Position (in)	Front 1. 13.3	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)	2.6			

ENGINE

Type	☐ C.I.	☐ Alternate Fuel	
	■ S.I.	☐ Other (explain)	
Mfr. / Model No.	FCA US LLC / 3.6 L		
Location	■ Front	☐ Rear	☐ Other (explain)
Fuel Type	■ Gasoline	☐ CNG	☐ Methanol
	☐ Diesel	☐ LNG	☐ Other (explain)
Alternator (Generator) Mfr./Model No.			
Maximum Rated Output (Volts / Amps)	12 / 220		
Air Compressor Mfr. / Model No.	VIAIR / 480 C		
Maximum Capacity (ft^3 / min)	1.86		
Starter Type	■ Electrical	☐ Pneumatic	☐ Other (explain)
Starter Mfr. / Model No.	Denso / 428000-7200		

Bus Number: 1716	Date: 01/02/18

TRANSMISSION

Transmission Type	☐ Manual	■ Automatic	☐ Load Sensing Adaptive
Mfr. / Model No.	OEM / 62TE		
Control Type	■ Mechanical	☐ Electrical	☐ Other
Integral Retarder Mfr. / Model No.	☐ Yes	■ No	

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	☐ Beam Axle	
Mfr. / Model No.	OEM		
Axle Ratio (if driven)	3.86		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Goldschmitt / 22-196774		
Middle Axle Type N/A	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type N/A	☐ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	☐ Independent	■ Beam Axle	
Mfr. / Model No.	Coxx Mobile System / 8000 66		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	☐ Spring	☐ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	Koni / 822509		

Bus Number: 1716	Date: 01/02/18

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Dodge / OEM
	Tire Mfr./ Model No.	Nexen / LT 225 / 75R16
Rear	Wheel Mfr./ Model No.	Dodge / OEM
	Tire Mfr./ Model No.	Nexen / LT 225 / 75R16

BRAKES

Front Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Dodge Mopar / OEM		
Middle Axle Brakes Type N/A	☐ Cam	☐ Disc	☐ Other
Mfr. / Model No. N/A			
Rear Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	Dodge Mopar / OEM		

HVAC

Heating System Type	☐ Air	■Water	☐ Other
Capacity (Btu/hr)	Driver: OEM Passenger: 45,000		
Mfr. / Model No.	Driver: OEM / Passenger: ProAir / PowerPak 435		
Air Conditioner	■ Yes	☐ No	
Location	Dash and Roof		
Capacity (Btu/hr)	Dash: OEM Roof: 65,000		
A/C Compressor Mfr. / Model No.	OEM #1 Design Press / 75BH17C #2 Sanden / U4864		

STEERING

Steering Gear Box Type	Hydraulic		
Mfr. / Model No.	TRW / E067		
Steering Wheel Diameter	15.3”		
Number of turns (lock to lock)	3 ¾		
Control Type	☐ Electric	■ Hydraulic	☐ Other (explain)

Bus Number: 1716	Date: 01/02/18

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	N/A	
Emergency Exit	Location: Windows Door	Number: 2 1

CAPACITIES

Fuel Tank Capacity (gallons)	24
Engine Crankcase Capacity (quarts)	6
Transmission Capacity (quarts)	9
Differential Capacity (quarts)	N/A (Front Wheel Drive)
Cooling System Capacity (quarts)	10.5
Power Steering Fluid Capacity (quarts)	2

Bus Number: 1716	Date: 01/02/18

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

Part Number	Description	Qty.
VIAIR 480321 1506	Air Compressor	1
Wabco 4728900700	Air Valve Component	1
DU - 4	Air Dryer	1
Wabco 013480-446-170-3000	Air Controller	1
Parker PP51-1C3-RHM	Pressure Sensor	1
Wabco 441 050 1000	Leveling Valve	2
ContiTech SZ 135-19	Air Spring	2
Goldschmitt 22-196774	Air Spring / Strut Assembly	2
Koni 822509	Shocks	2
LT 225 / 75 R16	Spare Tire	1

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 1716	Date: 01/02/18

Subsystem	Checked	Initials	Comments
Air Conditioning Heating and Ventilation	✓	T.S.	None Noted
Body and Sheet Metal	✓	T.S.	Rear bumper cracked above tailpipe. Body cracked & repaired under driver's door
Frame	✓	T.S.	2 rivets sheared off on from behind fuel tank on the left side.
Steering	✓	T.S.	None Noted
Suspension	✓	T.S.	None Noted
Interior/Seating	✓	T.S.	None Noted
Axles	✓	T.S.	None Noted
Brakes	✓	T.S.	None Noted
Tires/Wheels	✓	T.S.	None Noted
Exhaust	✓	T.S.	None Noted
Fuel System	✓	T.S.	None Noted
Power Plant	✓	T.S.	None Noted
Accessories	✓	T.S.	None Noted
ADA Accessible Lift System	N/A	T.S.	N/A
ADA Accessible Ramp System	✓	T.S.	None Noted
Interior Fasteners	✓	T.S.	None Noted
Batteries	✓	T.S.	None Noted

CHECK - IN

NEW ENGLAND WHEELS, INC.
FRONTRUNNER

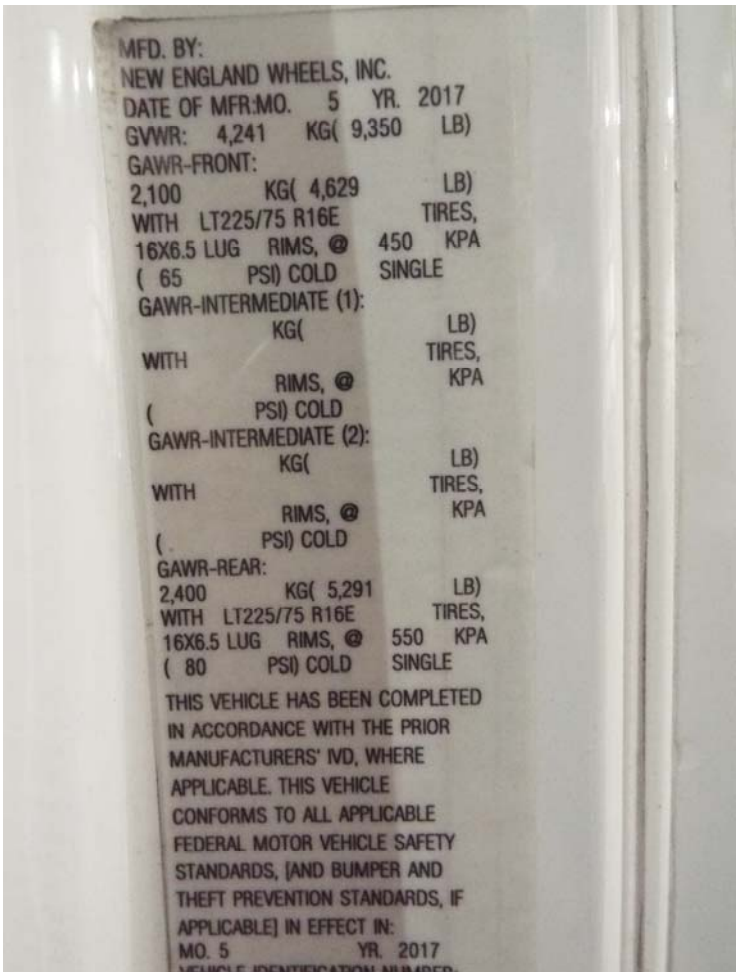
CHECK - IN CONT.

OPERATOR'S AREA

INTERIOR FROM FRONT

CHECK - IN CONT.

VIN TAGS



CHECK - IN CONT.

PLACARD PROHIBITING STANDEES

ENGINE COMPARTMENT

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 was checked, and where accessibility was restricted the subsystem was 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: 1716	Date: 03/13/18

Component	Checked	Comments
ENGINE :		
Oil Dipstick	✓	None Noted
Oil Filler Hole	✓	None Noted
Oil Drain Plug	✓	None Noted
Oil Filter	✓	None Noted
Fuel Filter	✓	Fuel filter is in fuel tank
Air Filter	✓	None Noted
Belts	✓	None Noted
Coolant Level	✓	None Noted
Coolant Filler Hole	✓	None Noted
Coolant Drain	N/A	Remove lower radiator hose to drain
Spark / Glow Plugs	✓	Spark Plugs
Alternator	✓	Refer to picture-took 4.5 hours to remove & reinstall
Diagnostic Interface Connector	✓	None Noted
TRANSMISSION :		
Fluid Dip-Stick	N/A	Not Equipped
Filler Hole	✓	Must be serviced by dealer
Drain Plug	N/A	Must remove pan to drain fluid
SUSPENSION :		
Bushings	✓	None Noted
Shock Absorbers	✓	None Noted
Air Springs	✓	None Noted
Leveling Valves	✓	None Noted
Grease Fittings	N/A	Not Equipped

ACCESSIBILITY DATA FORM

Bus Number: 1716	Date: 03/13/18

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
ADA Accessible 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 was conducted by operating the bus and collecting the following data on work order forms and a driver log.

1. Scheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Results of scheduled inspections
    e. Description of malfunction (if any)
    f. Repair action and parts used (if any)
    g. Man-hours required

2. Unscheduled Maintenance
    a. Bus number
    b. Date
    c. Mileage
    d. Description of malfunction
    e. Place and time of malfunction (e.g., in service or undergoing inspection)
    f. Repair action and parts used
    g. Man-hours required

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

A. Service
    1. Fueling
    2. Consumable checks
    3. Interior cleaning

B. Preventive Maintenance
    1. Brake adjustments
    2. Lubrication
    3. 3,000 mi (or manufacturer recommended) inspection

4. Oil and filter change inspection
5. Major inspection
6. 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

*These items are attended to if found necessary, while the others in the list are removed/replaced/tested for all buses undergoing a full test.

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.

The Unscheduled Maintenance List along with 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 was detected, a description of the malfunction and repair, and the time required to perform the repair.

SCHEDULED MAINTENANCE

New England Wheels, Inc. Bus# 1716

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	LABOR HOURS
01/18/18	902	P.M./Inspection	Checked steering linkage, tie rods, universals/u-joints and all fluids. Inspected frame, body and suspension.	4.00	4.00
01/29/18	2,231	P.M./Inspection	Checked steering linkage, tie rods, universals/u-joints and all fluids. Inspected frame, body and suspension.	4.00	4.00
02/02/18	3,148	P.M./Inspection	Checked steering linkage, tie rods, universals/u-joints and all fluids. Inspected frame, body and suspension.	4.00	4.00
02/13/18	4,384	P.M./Inspection	Checked steering linkage, tie rods, universals/u-joints and all fluids. Inspected frame, body and suspension.	4.00	4.00
02/28/18	5,028	P.M./Inspection Fuel Economy	Checked steering linkage, tie rods, universals/u-joints and all fluids. Inspected frame, body and suspension. Oil, oil filter, fuel filter and air filter changed.	8.00	8.00

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 involved components that may be expected to fail or require replacement during the service life of the bus. In addition, any component that failed during testing of the bus was added to this list. Components to be included are:

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

1.3-III. DISCUSSION

At the end of the test, the items on the list were removed and replaced. The transmission assembly took 8.50 labor-hours (2 persons @ 4.25 hrs) to remove and replace. The time required for repair/replacement of the other four components is given on the following Repair and/or Replacement Form.

REPLACEMENT AND/OR REPAIR FORM

Subsystem	Replacement Time
Transmission	8.50 labor hours
Wiper Motor	0.75 labor hour
Starter	1.50 labor hours
Alternator	4.50 labor hours
Batteries	0.50 labor hour

During the test, additional components were removed for repair or replacement and the details are available in Section 5.7 in Unscheduled Maintenance.

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS

TRANSMISSION REMOVAL AND REPLACEMENT (8.50 LABOR HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT (0.75 LABOR HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT (1.50 LABOR HOURS)

ALTERNATOR REMOVAL AND REPLACEMENT (4.50 LABOR 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, labor-hours to repair, and hours out of service were 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 Injury, a crash and/or significant physical damage.

(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 was accumulated during the Structural Durability Test. The following Reliability Data Form lists all unscheduled repairs under classes as defined above.

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, Class 2 or Class 4 failures. There was one Class 3 failure that involved the suspension system. This failure is available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

This bus passed the Structural and Powertrain Durability sections of the test.

RELIABILITY DATA FORMS

Bus Number : 1716	Date: 05/07/18
Personnel: B.L.	

	Failure Type					
	Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety		
Subsystems	Mileage	Mileage	Mileage	Mileage	Labor Hours	Down Time
Suspension		1,621			1.00	1.00

3.1 SAFETY - A DOUBLE-LANE CHANGE (OBSTACLE AVOIDANCE)

3.1-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.

3.1-II. TEST DESCRIPTION

The Safety Test consisted of an obstacle avoidance maneuver to evaluate the handling and stability of the bus. The test was conducted at the LTI test track on the vehicle dynamics pad. The bus was driven through a double-lane change course at increasing speeds until the test was determined to be unsafe or a speed of 45 mph is reached. The test is determined unsafe if vehicle handling becomes unstable or if any of the tires lose contact with the pavement.

The layout of the test course was defined by placing pylons along painted guidelines that delineated the course. The guidelines marked off two 12 foot center-to-center lanes. Each lane had two 80 foot long gates with a spacing distance of 80 feet between them. The bus entered the test course in one lane, crossed over to the other lane within the 80 foot gate, traveled for 80 feet, and then returned back into the original lane within the next 80 foot gate. This maneuver was repeated from 20 mph with speed increasing in increments of 5 mph. The test was performed starting from both the right and left lanes.

A test run is considered valid if the bus is able to perform the maneuver at a constant speed without deviating from the test course or striking pylons. If the bus is not able to successfully complete the maneuver due to vehicle instability, the test will be terminated. The highest speed at which the maneuver can be successfully performed up to a maximum speed of 45 mph is recorded on the Safety Data Form.

3.1-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, and therefore, passed this portion of the test.

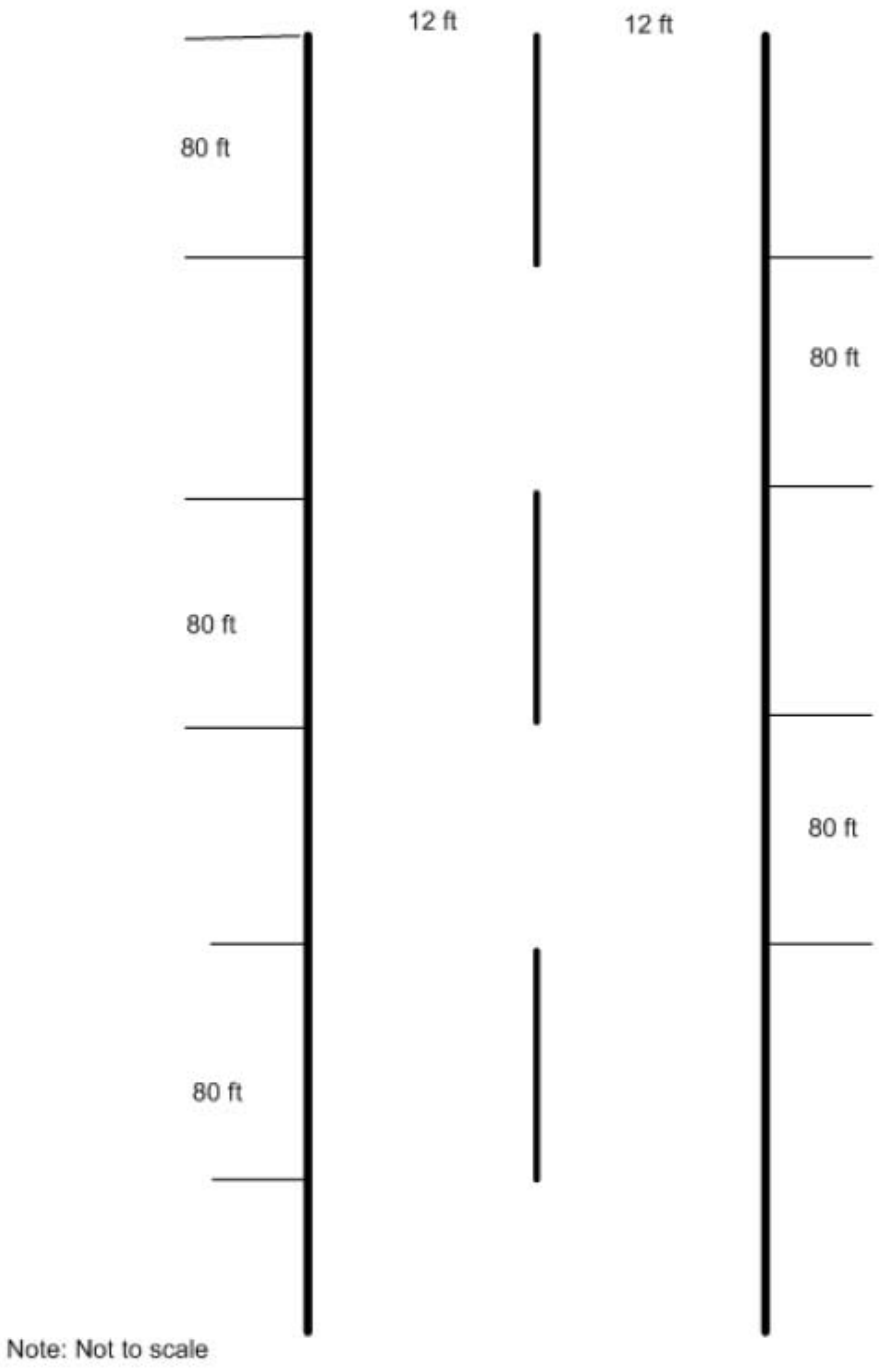


Figure 3.1. Double lane change test course.

SAFETY DATA FORM

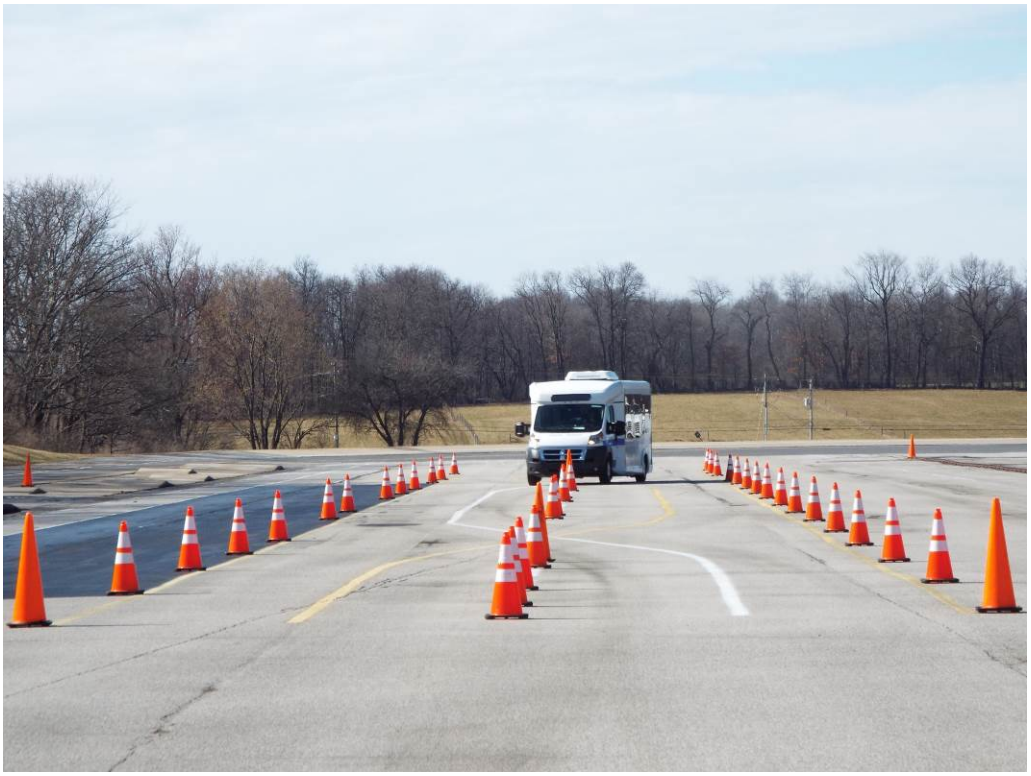
Bus Number: 1716	Date: 02/26/18
Personnel: T.S., E.D. & M.R.	

Temperature (°F): 44	Humidity (%): 52
Wind Direction: W	Wind Speed (mph): 7
Barometric Pressure (in.Hg): 30.00	

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 bus	
Maintained a safe position throughout the test.	
Comments of the tire/ground contact patch: The bus tires maintained ground	
contact throughout the test.	

3.1 SAFETY

RIGHT - HAND APPROACH



LEFT - HAND APPROACH

3.2 Safety - Braking

3.2 I. TEST OBJECTIVE

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

3.2 II. TEST DESCRIPTION

The testing was conducted at the LTI Test Track skid pad area. Brake tests were 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 was performed when the bus was fully loaded at its GVW. All tires on each bus were representative of the tires on the production model vehicle and inflated to the bus manufacturer's specified pressures.

The brake testing procedure is comprised of 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

3.2-III. DISCUSSION

The results of the Stopping Distance phase of the Brake Test are available in table 3.2-2. 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.

This bus passed all three phases of the Safety –Braking Test.

Table 3.2-1. Braking Test Data Forms

Bus Number: 1716	Date: 01/26/18
Personnel: T.S., E.L. & P.D.	
Amb. Temperature (ºF): 33	Wind Speed (mph): 5
Wind Direction: N	Pavement Temp (°F) Start: 31.1 End:40.6

TIRE INFLATION PRESSURE (psi):

Tire Type: Front: Nexen Rodian LT 225 / 75R16 Rear: Nexen Rodian LT 225 / 75R16

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

AXLE LOADS (lb.)

	Left	Right
Front	2,000	1,920
Middle	N/A	N/A
Rear	2,730	2,550

Table 3.2-2. Stopping Distance Test Results Form
(longest stopping distance in each test condition in bold)

Stopping Distance (ft)					
Vehicle Direction	CW	CW	CCW	CCW	
Speed (mph)	Stop 1	Stop 2	Stop 3	Stop 4	**Average**
20 (dry)	25.64	**27.48**	25.74	23.12	25.49
30 (dry)	45.13	**53.23**	47.13	47.26	48.18
40 (dry)	74.42	**82.82**	79.99	78.06	78.82
45 (dry)	86.85	95.54	**97.94**	91.64	92.99
20 (wet)	25.02	23.25	**26.33**	23.97	24.64

Table 3.2-3. Stability Test Results Form

Stability Test Results (Split Friction Road surface)			
Vehicle Direction	Attempt	Did test bus stay in 12' lane? (Yes/No)	Comments
Driver side on high friction	1	Yes	None noted
	2	Yes	None noted
Driver side on low friction	1	Yes	None noted
	2	Yes	None noted

Table 3.2-4. 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	✓	
	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	✓	
	2	N/A	N/A	N/A	N/A	N/A
	3	N/A	N/A	N/A	N/A	N/A

Table 3.2-5. Record of All Braking System Faults/Repairs.

Date	Fault/Repair	Description
N/A	N/A	N/A

3.2 Safety - Bus Braking

PARKING BRAKE TEST
PARKING BRAKE HELD FOR 5 MINUTES IN
BOTH 20% UP AND 20% DOWN POSITIONS

4. PERFORMANCE - AN ACCELERATION, GRADEABILITY, AND TOP SPEED TEST

4-I. TEST OBJECTIVE

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

4-II. TEST DESCRIPTION

In this test, the bus was operated at SLW on a chassis dynamometer. The procedure dictates that the test bus be accelerated to a maximum "power-limited"/"governed" or maximum "safe" speed not exceeding 80 mph. The maximum power-limited/governed speed, if applicable, is the top speed as limited by the engine control system. The maximum safe speed is defined as the maximum speed that the dynamometer, the tires or other bus components are limited to. The test vehicle speed was measured using a speed encoder built in the chassis dynamometer. The time intervals between 10 mph increments were recorded using a Data Acquisitions System. Time-speed data and the top speed attained were recorded on the Performance Data Form. The recorded data was used to generate a percent grade versus speed table and a speed versus time curve. All the above are available in the following pages.

4-III. DISCUSSION

This test consisted of three runs from standstill to full throttle on the chassis dynamometer. Speed versus time data was obtained for each run and results are averaged to minimize test variability. The test was performed up to a maximum power limited/governed speed of 77 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 6.67 seconds. The maximum gradeablity at 10 mph was 23.9% and at 40 mph was 11.5%. This bus passed this section of the test.

PERFORMANCE DATA FORM

Bus Number: 1716	Date: 03/06/18
Personnel: S.I./ R.C.	
Temperature (°F): 77	Humidity (%): 45
Barometric Pressure (in.Hg): 28.6	

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

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	2.6	2.6	2.6
20 mph	4.8	4.8	4.7
30 mph	7.1	7.1	6.9
40 mph	10.1	10.1	9.8
50 mph	14.2	14.2	14.0
60 mph	19.5	19.8	19.4
70 mph	35.3	34.5	32.8

Maximum Speed (mph): 77 (maximum power limited/governed speed reached)

PERFORMANCE SUMMARY SHEET

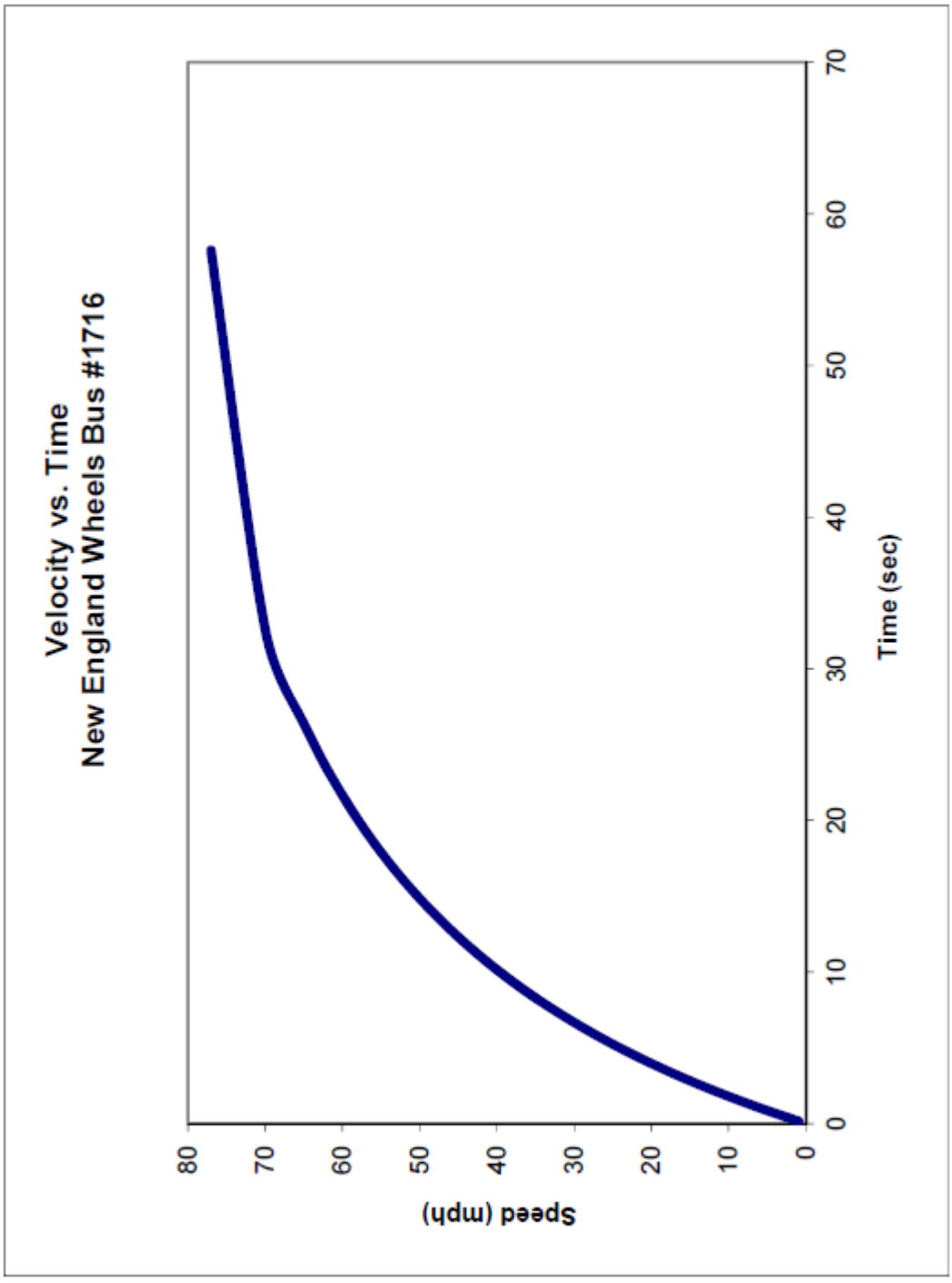
Bus Number: 1716	Date: 03/06/18
Personnel: S.I. & R.C.	

Test Conditions:

Temperature (°F): 77	Humidity (%): 45
Barometric Pressure (in.Hg): 28.6	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	.17	8.7	28.2
5.0	.86	8.2	26.3
10.0	1.80	7.5	23.9
15.0	2.83	6.8	21.5
20.0	3.97	6.1	19.3
25.0	5.24	5.5	17.2
30.0	6.67	4.8	15.2
35.0	8.29	4.2	13.3
40.0	10.15	3.7	11.5
45.0	12.31	3.1	9.8
50.0	14.86	2.6	8.2
55.0	17.91	2.2	6.8
60.0	21.66	1.8	5.4
65.0	26.40	1.4	4.2
70.0	32.63	1.0	3.2


Velocity vs. Time
New England Wheels Bus #1716
Speed (mph)
0
10
20
30
40
50
60
70
80
Time (sec)
0
10
20
30
40
50
60
70

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 GVW, each wheel of the bus was raised (one at a time) to simulate operation over a curb and the following were 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 was then 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 ADA accessible 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. This bus passed this section of the test.

DISTORTION TEST INSPECTION FORM

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

Bus Number: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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: 1716	Date: 01/12/18
Personnel: E.D., E.L., P.D. & J.P.	Temperature(°F): 60

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.
ADA Accessible/ 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 SIDE WHEELS SIX INCHES LOWER

ALL WHEELS LEVEL

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 was used to apply a static tension load equal to 1.2 times the bus curb weight. The load was 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 was recorded.

5.3-III. DISCUSSION

The test bus submitted for testing was not equipped with any type of tow eyes or tow hooks. Therefore, the static towing test was not performed. This bus is deemed to pass this section of the test, but no points were allotted for this section.

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 required the bus to be towed at curb weight using the specified equipment and instructions provided by the manufacturer and a heavy-duty wrecker. The bus was towed for 5 miles at a speed of 20 mph for each recommended towing configuration. After releasing the bus from the wrecker, the bus was visually inspected for any structural damage or permanent deformation. All doors, windows and passenger escape mechanisms were 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. No problems, deformation, or damage was noted during testing. This bus passed this section of the test.

DYNAMIC TOWING TEST DATA FORM

Bus Number: 1716	Date: 03/01/2018
Personnel: S.R. & E.D.	

Temperature (°F): 47	
Wind Direction: SE	Wind Speed (mph): 2

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 to note.

General Comments: Nothing unusual to note.

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 were replaced with deflated tire(s) of the appropriate type. A portable hydraulic floor jack was 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) were replaced with the original tire(s) and the jack was lowered. Any structural damage or permanent deformation was recorded on the test data sheet. This procedure was 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 3.1 inches to 8.5 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form. This bus passed this section of the test.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	8.3
Rear axle – one tire flat	5.6
Rear axle – two tires flat	N/A

JACKING TEST DATA FORM

Bus Number: 1716	Date: 01/10/18
Personnel: T.S. & E.D.	Temperature (°F): 68

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

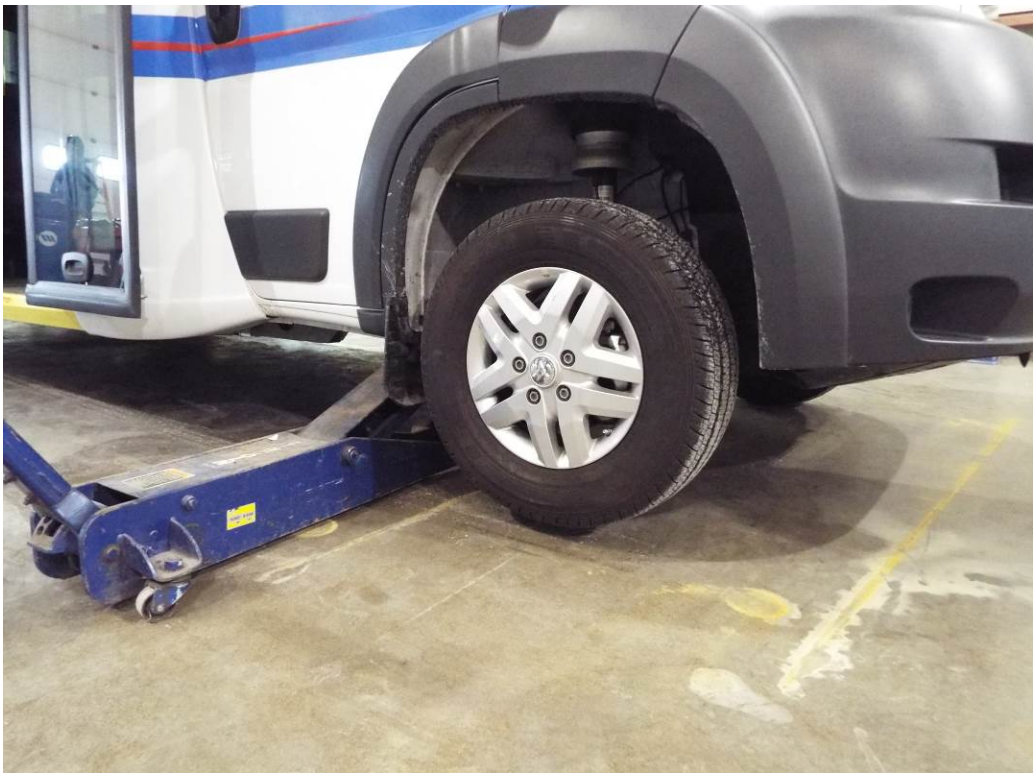
I= Inflated D= Deflated

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	10.2“ I 8.5“ D	9.2“ I 7.1” D	Body & Suspension
Left front	10.0“ I 8.3“ D	9.3“ I 6.9“ D	Body & Suspension
Right rear—outside	8.8“ I 5.7“ D	6.1“ I 3.1“ D	Body & Axle
Right rear—both	N/A	N/A	None
Left rear—outside	8.9“ I 5.6“ D	6.3“ I 3.1“ D	Body & Axle
Left rear—both	N/A	N/A	None
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.

5.5 JACKING TEST



PLACEMENT OF JACK- FRONT AXLE

REAR TIRE DEFLATED

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 was 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 was checked for stability on the jack stands and for any damage to the jacking pads or bulkheads. The procedure was repeated for the tag/middle axles (if equipped), and rear end of the bus. The procedure was then repeated for the front, tag/middle (if equipped) axles, and rear simultaneously.

5.6-III. DISCUSSION

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

The bus accommodated the placement of the vehicle lifts and jack stands and the procedure was performed without any instability noted. This bus passed this section of the test.

HOISTING TEST DATA FORM

Bus Number: 1716	Date: 01/11/18
Personnel: E.D. & E.L.	Temperature (°F): 68

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:
N/A
Comments of any structural damage to the jacking pads or axles while the front, tag axle and rear wheels are supported by the jack stands:
None noted.
Comments of any problems or interference placing wheel hoists under wheels:
None noted.

5.6 HOISTING TEST

HOISTING- FRONT AND REAR

HOISTING- REAR

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

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

5.7-II. TEST DESCRIPTION

The test vehicle was driven a total of 5,050 miles; approximately 3,750 miles on the LTI Durability Test Track and approximately 1,300 miscellaneous other miles. The test was conducted with the bus operated under three different loading conditions. The first segment consisted of approximately 1,625 miles with the bus operated at GVW. The second segment consisted of approximately 500 miles with the bus operated at SLW. The remainder of the test, approximately 1,625 miles, was conducted with the bus loaded to CW. The loads on both axles and GVW were within their ratings with the bus loaded as specified by the manufacturer. All subsystems were running during these tests in their normal operating modes. All manufacturer-recommended servicing was followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests were compressed by 10:1; all others were done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs were recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle was washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on January 12, 2018 and was conducted until March 6, 2018 . The first 1,625 miles were performed at a GVW of 9,200 lb. and completed on January 24, 2018. The next 500-mile SLW segment was performed at 9,200 lb. and completed on February 1, 2018 and the final 1,625-mile segment was performed at a CW of 6,950 lb. and completed on March 6, 2018.

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 LTI 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, a photograph illustrating the failure that was encountered during the Structural Durability Test is included. This bus passed this section of the test, as there were no uncorrected Class 1 or Class 2 failures and the unscheduled maintenance of 1.00 hour was less than 125 hours.

New England Wheels, Inc. Bus # 1716

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
01/08/18 TO 01/14/18	96.00	53.00	149.00
01/15/18 TO 01/21/18	966.00	145.00	1111.00
01/22/18 TO 01/28/18	845.00	61.00	906.00
01/29/18 TO 02/04/18	489.00	634.00	1123.00
02/05/18 TO 02/11/18	784.00	32.00	816.00
02/12/18 TO 02/18/18	570.00	120.00	690.00
02/19/18 TO 02/25/18	0.00	0.00	0.00
02/26/18 TO 03/04/18	0.00	188.00	188.00
03/05/18 TO 03/11/18	0.00	99.00	99.00
Total	3750.00	1332.00	5082.00

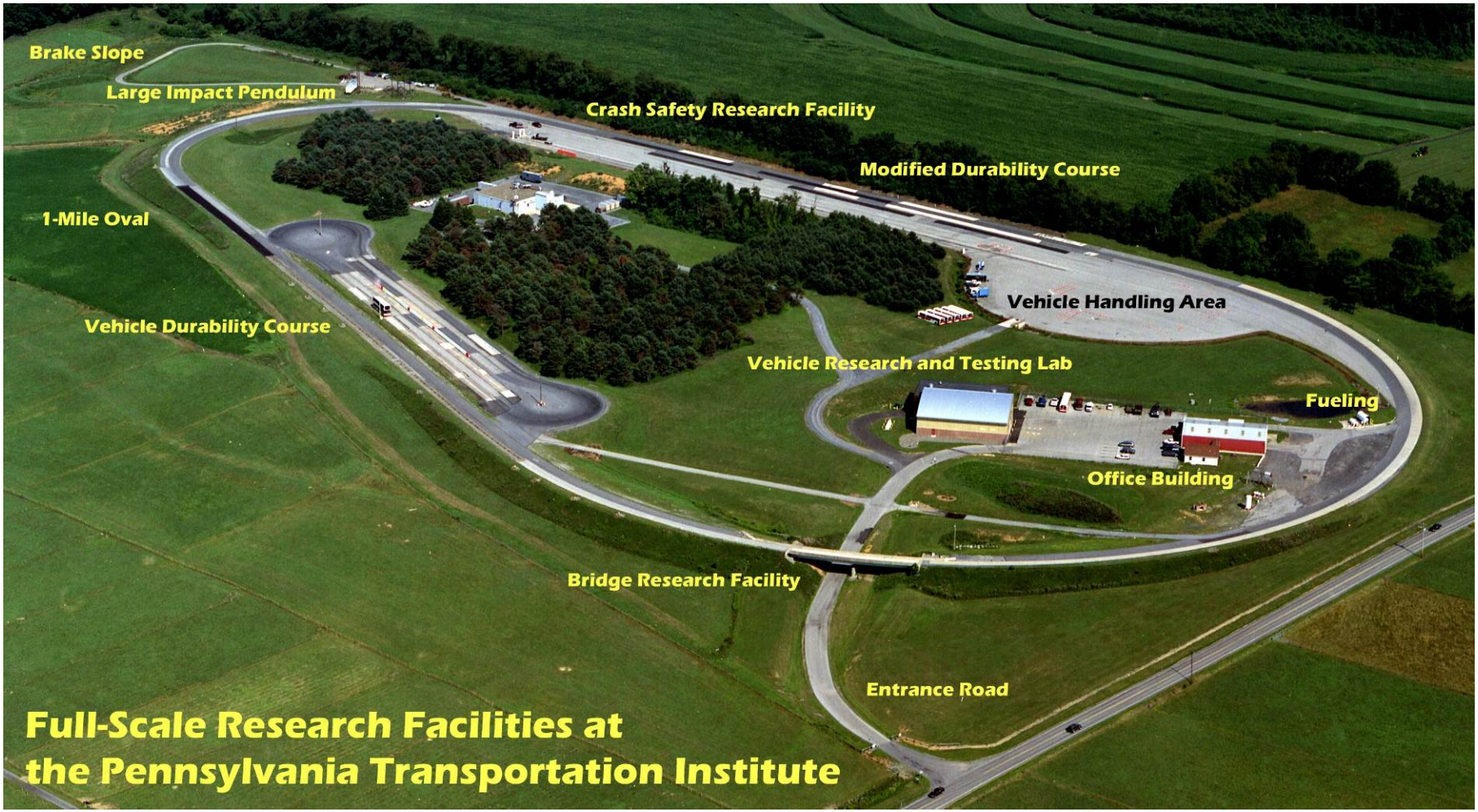
Driving Schedule for Bus Operation on the Durability Test Track.

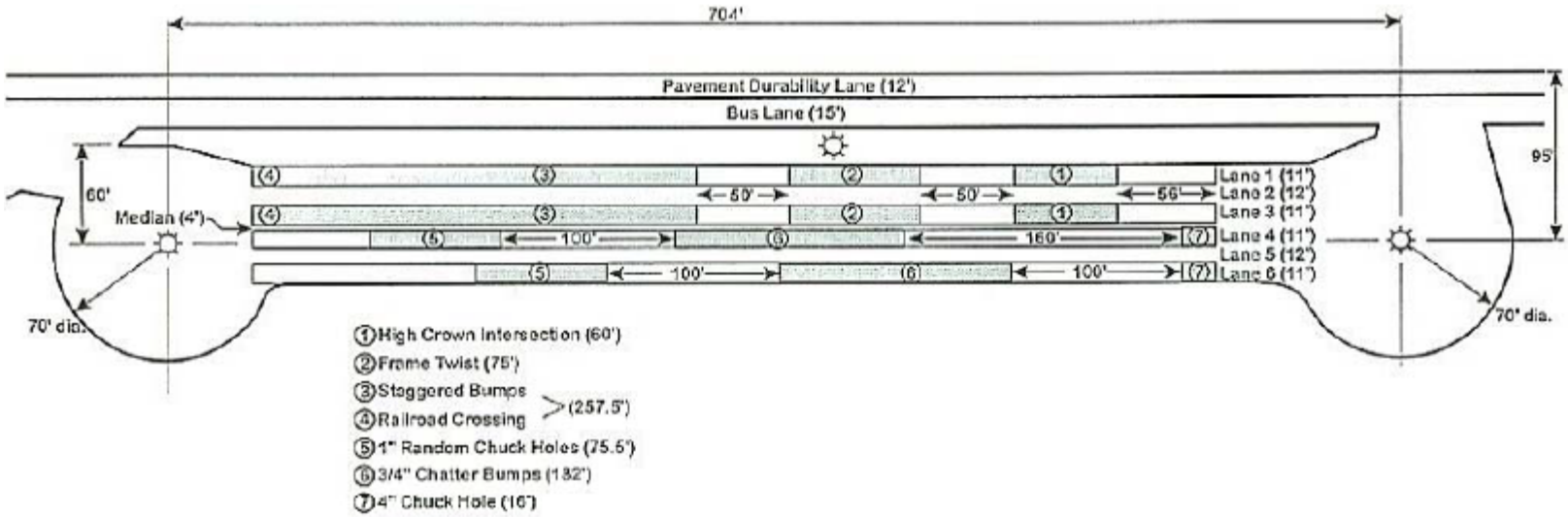
STANDARD OPERATING SCHEDULE

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


Brake Slope
Large Impact Pendulum
Crash Safety Research Facility
Modified Durability Course
1-Mile Oval
Vehicle Handling Area
Vehicle Durability Course
Vehicle Research and Testing Lab
Fueling
Office Building
Bridge Research Facility
Entrance Road
Full-Scale Research Facilities at
the Pennsylvania Transportation Institute



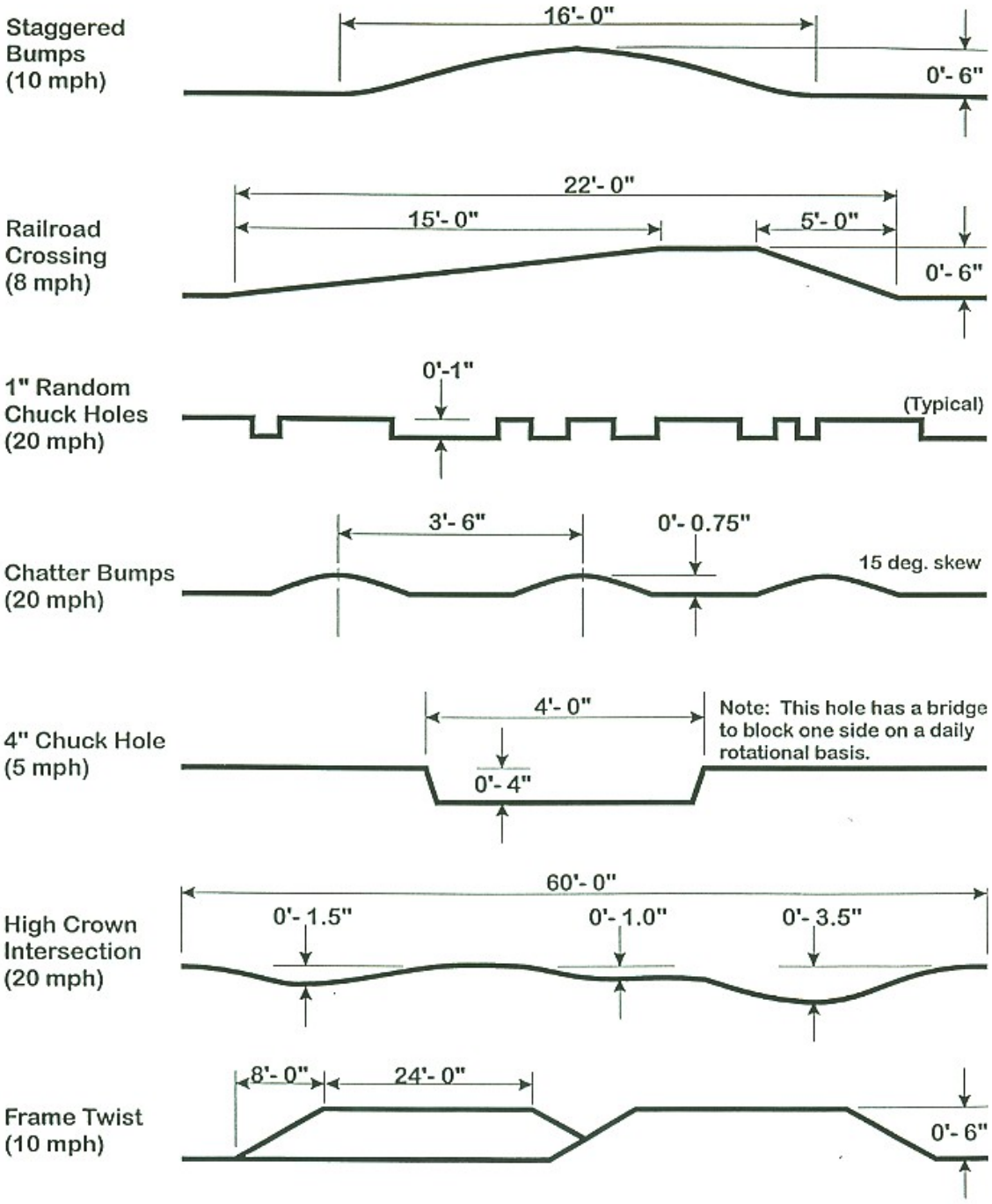
Plan View

Vehicle Durability Test Track

Track 1 (Track 2 has similar layout)

The Larson Transportation Institute

Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE
New England Wheels, Inc. Bus# 1716

DATE	TEST MILES	ISSUE	ACTION	LABOR HOURS	DOWN TIME
01/23/18	1,621	Broken left side spring saddle and hub assembly bolt.	Replaced broken left side spring saddle and hub assembly bolt.	1.00	1.00

UNSCHEDULED MAINTENANCE

REPLACED BROKEN SPRING SADDLE AND HUB ASSEMBLY BOLT (7,748 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 operating profile, under specified operating conditions that are typical of transit bus operation. The results of this test may not represent actual mileage in transit service, but will provide data that can be used by FTA Grantees to compare the efficiency of buses tested using this procedure.

6-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). A fuel economy test was comprised of two runs for the three different driving cycles, and the average value was reported.

The test procedure for liquid-fueled buses such as this one uses a calibrated flowmeter system and/or a calibrated fuel weighing scale. The flowmeter system utilizes a precise four-piston positive displacement flow meter. The weighing scale system includes heat exchangers to maintain temperature in diesel and common-rail injection systems.

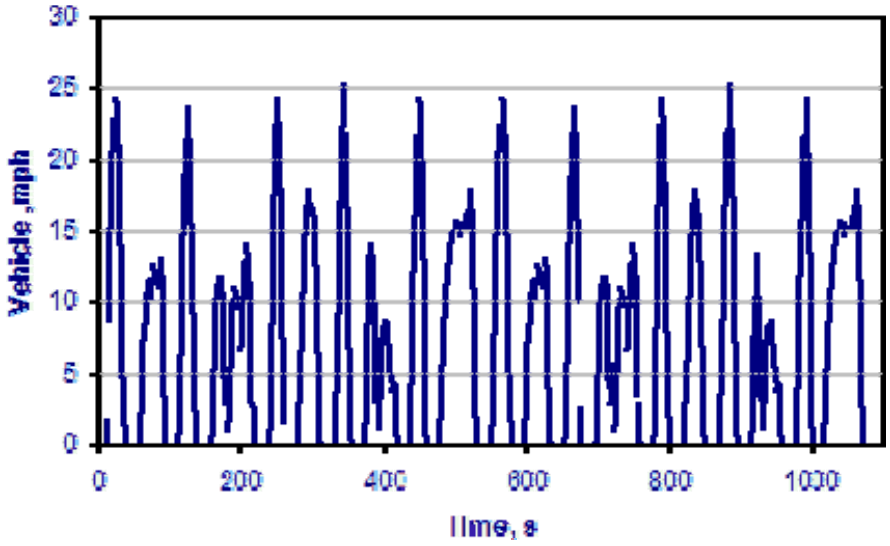


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

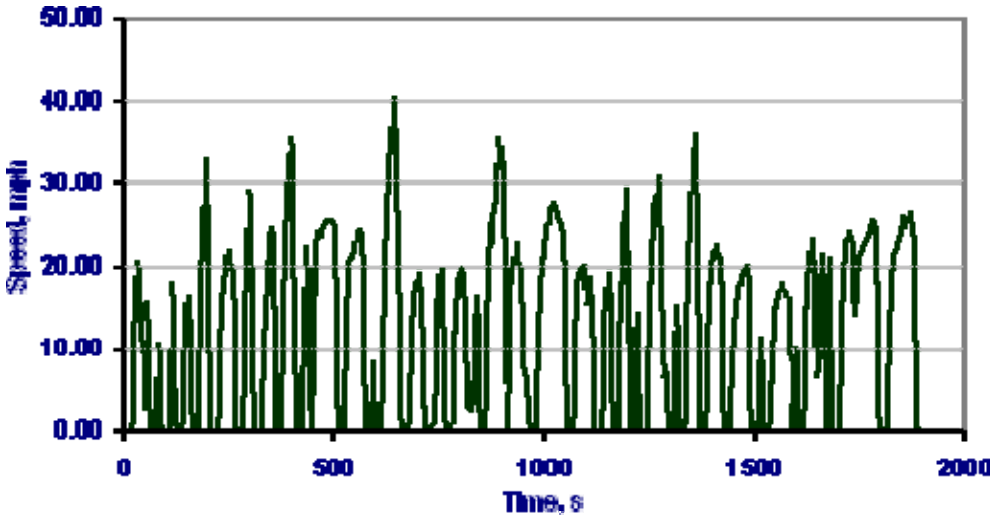


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

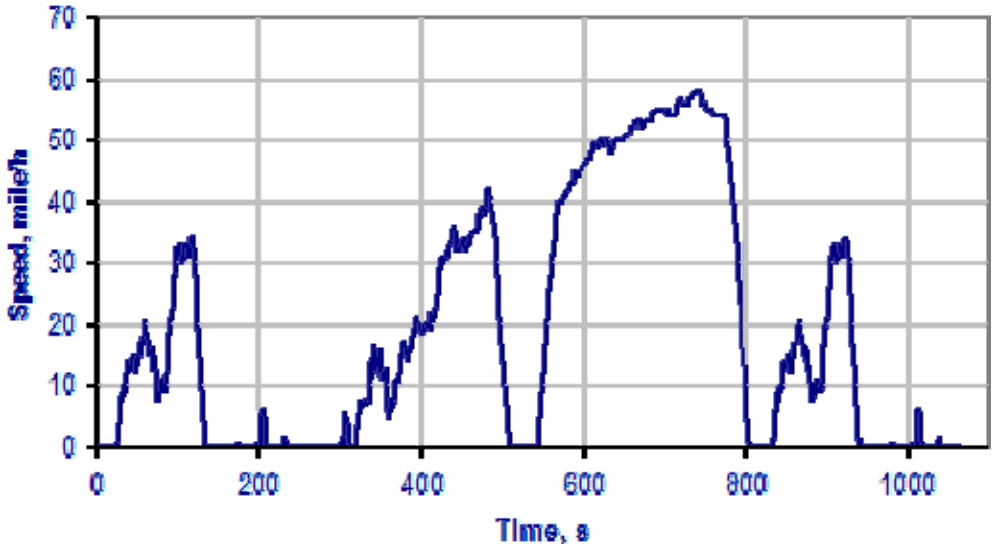


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

6-III. DISCUSSION

The driving cycle consists of three simulated transit driving cycles: Manhattan, Orange County Bus Cycle and the HD-UDDS, as described in 6-II. The fuel consumption for each driving cycle and idle was measured.

An extensive pretest maintenance check was 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 Form. Finally, the summary sheet provides the average fuel consumption for the three test cycles and for a 20 minute idle. **The average fuel consumption for the Manhattan, OCBC and the HD-UDDS were 7.1 mpg, 10.1 mpg and 11.2 mpg respectively. For idle, the fuel consumption was 0.30 gal/hr**.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1716	Date: 02/28/18	SLW (lb.): 9,200
Personnel: P.D. & E.L.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	N/A
Check for fuel leaks	✓
Specify fuel type: Gasoline	✓
Remarks: Fuel filter in tank	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
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: 1716	Date: 02/28/18
Personnel: P.D. & E.L.	

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

DRIVE SYSTEM	OK
Drain transmission fluid	N/A
Replace filter/gasket	N/A
Check hoses and connections	N/A
Replace transmission fluid	N/A
Check for fluid leaks	N/A
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	N/A
Replace differential lube including axles	N/A
Remarks: None noted.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 1716	Date: 02/28/18
Personnel: P.D. & E.L.	

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

ENGINE	OK
Replace air filter	✓
Inspect air compressor and air system	✓
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: 1716	Date: 03/05/18
Personnel: T.S. & S.R.	

PRE WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	T.S.
Cold tire pressure (psi): Front 65 Middle N/A Rear 80	T.S.
Engine oil level	T.S.
Engine coolant level	T.S.
Fuel economy instrumentation installed and working properly.	T.S.
Fuel line -- no leaks or kinks	T.S.
Bus is loaded to SLW during coast down	T.S.
WARM-UP & Testing	If OK, Initial
Interior and exterior lights on	R.C.
Air conditioning off	R.C.
Defroster off	R.C.
Windows and doors closed	R.C.
Do not drive with left foot on brake	R.C.

FUEL ECONOMY DATA FORM
(Gaseous and Liquid fuels)

Bus Number: 1716	Manufacturer: New England Wheels	Date: 03/06/18
Fuel Type: Gasoline	Personnel: S.I. & R.C.	
Temperature (°F): 76.8	Humidity (%): 48	Barometric Pressure (in.Hg):28.6
SLW (lb.): 9,200		

Run/Cycle	Manhattan	Orange County	HD-UDDS	20 Min Idle
Fuel Consumption mpg	7.1	10.1	11.2	0.30 gal / hr

Comments: None noted

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 was measured at several locations with the bus operating under the following three conditions:

1. With the bus stationary, a white noise generating system provided a uniform sound pressure level equal to 80 dB(A) on the left, exterior side of the bus. The engine and all accessories were switched off and all openings including doors and windows were closed. This test was performed at the LTI Test Track Facility.

2. The bus was accelerated at full throttle from a standing start to 35 mph on a level pavement. All openings were closed and all accessories were operating during the test. This test was performed on the track at the LTI Test Track Facility.

3. The bus was operated at various speeds from 0 to 55 mph with and without the air conditioning and accessories on. Any audible vibration or rattles were noted. This test was performed on the test segment between the LTI Test Track and the Bus Testing Center.

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

7.1-III. DISCUSSION

For the first part, the overall average of the six measurements was 49.8 dB(A); ranging from 47.0 dB(A) in line with the front speaker to 51.4 dB(A) at the rear passenger seats. The interior ambient noise level for this test was less than 30 dB(A).

For the second part, the interior noise level ranged from 75.9 dB(A) at the rear passenger seats to 79.1 dB(A) at the driver's seat. The overall average was 77.7 dB(A). The interior ambient noise level for this test was less than 30 dB(A).

No vibrations or rattles were noted during the third part of this test. This bus passed this section of the test.

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

Bus Number: 1716	Date: 02/15/18
Personnel: S.R., T.G., E.L. & P.D.	
Temperature (°F): 56	Humidity (%): 80
Wind Speed (mph): 7	Wind Direction: SW
Barometric Pressure (in.Hg): 29.90	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 42.8
Microphone Height During Testing (in): 47.2	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	48.0
Front Passenger Seats	50.3
In Line with Front Speaker	47.0
In Line with Middle Speaker	51.1
In Line with Rear Speaker	51.2
Rear Passenger Seats	51.4

Comments: None noted.

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

Bus Number: 1716	Date: 02/26/18
Personnel: T.S., E.D. & M.R.	
Temperature (°F): 44	Humidity (%): 52
Wind Speed (mph): 7	Wind Direction: W
Barometric Pressure (in.Hg): 30.00	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 38.6
Microphone Height During Testing (in): 47.0	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	79.1
Front Passenger Seats	78.8
Middle Passenger Seats	76.8
Rear Passenger Seats	75.9

Comments: None noted.

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

Bus Number: 1716	Date: 02/26/18
Personnel: T.S., E.D. & M.R.	
Temperature (°F): 53	

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	N/A
Windows and Doors	None	N/A
Seats and Wheel Chair lifts	None	N/A
Other	None	N/A

Comment on any other vibration or noise source which may have occurred
that is not described above: None noted.
Comments: 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 was operated at a SLW in three different conditions using a smooth, straight and level roadway:

1. Accelerating at full throttle from a constant speed starting from 35 mph.

2. Accelerating at full throttle from standstill.

3. Stationary, with the engine at low idle, high idle, and wide open throttle, where applicable. In addition, the bus was tested with and without the air conditioning operating.

The test site is at the Larson Transportation Institute Test Track and the test procedures were performed 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 was used to measure the noise level.

During the test, special attention was 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 outside ambient noise level of 42.1 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 69.4 dB(A) on the right side and 70.3 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 42.0 dB(A), the average of the two highest readings obtained were 67.0 dB(A) on the right side and 67.2 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 45.9 dB(A) at low idle, 49.3 dB(A) at high idle and 57.9 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 43.4 dB(A) at low idle, 49.7 dB(A) at high idle and 57.0 dB(A) at wide open throttle. The exterior ambient noise level measured during this test was 43.6 dB(A). This bus passed this section of the test.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 1716	Date: 02/27/18
Personnel: S.R., E.D., P.D. & C.S.	
Temperature (°F): 47	Humidity (%): 43
Wind Speed (mph): 5	Wind Direction: S
Barometric Pressure (in.Hg): 30.4	

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: 42.1 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	69.1	1	68.9
2	69.2	2	68.2
3	69.6	3	69.2
4	68.9	4	71.0
5	68.9	5	69.6
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 = 69.4 dB(A)		Average of two highest actual noise levels = 70.3 dB(A)	

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 1716	Date: 02/27/18
Personnel: S.R., E.D., P.D. & C.S.	
Temperature (°F): 49	Humidity (%): 40
Wind Speed (mph): 4	Wind Direction: S
Barometric Pressure (in.Hg): 30.40	
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: 42.0 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	65.1	1	64.2
2	66.8	2	65.6
3	67.2	3	67.2
4	65.7	4	66.8
5	66.0	5	67.2
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 = 67.0 dB(A)		Average of two highest actual noise levels = 67.2 dB(A)	

Final Sound Level Meter Calibration Check: 93.9 dB(A)
Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 1716	Date: 02/27/18
Personnel: S.R., E.D., P.D. & C.S.	
Temperature (°F): 50	Humidity (%): 40
Wind Speed (mph): 8	Wind Direction: SW
Barometric Pressure (in.Hg): 30.40	
Initial Sound Level Meter Calibration: 93.8 dB(A)	
Exterior Ambient Noise Level: 43.6 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	750	48.1	43.7
High Idle	1500	49.1	49.5
Wide Open Throttle	3000	57.9	57.9

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	750	42.2	44.6
High Idle	1500	48.9	50.4
Wide Open Throttle	3000	57.0	57.0

Final Sound Level Meter Calibration Check: 93.9 dB(A)

Comments: None noted.

7.2 EXTERIOR NOISE TESTS

TEST BUS UNDERGOING EXTERIOR NOISE TESTING

8.0 EMISSIONS TEST – DYNAMOMETER-BASED EMISSIONS TEST USING TRANSIT DRIVING CYCLES

8-I. TEST OBJECTIVE

The objective of this test is to provide comparable emissions data on transit buses produced by different manufacturers. This chassis-based emissions test bears no relation to engine certification testing performed for compliance with the Environmental Protection Agency (EPA) regulation. EPA's certification tests are performed on an engine by itself on a dynamometer operating under the Federal Test Protocol.

The Bus Testing Center emissions test is a measurement of the gaseous engine emissions CO, CO2, NOx, HC and particulates (diesel vehicles) produced by a complete vehicle operating on a large-roll chassis dynamometer. The test is performed for three differed driving cycles intended to simulate a range of transit operating environments. The test is performed under laboratory conditions in compliance with EPA 1065 and SAE J2711. The results of this test may not represent actual in-service vehicle emissions but will provide data that can be used by recipients to compare the emissions of buses tested under a range of consistent operating conditions.

8-II. TEST DESCRIPTION

This test was performed in the emissions bay of the LTI Vehicle Testing Laboratory. The Laboratory is equipped with a Schenk Pegasus 300 HP, large-roll (72 inch diameter) chassis dynamometer suitable for heavy-vehicle emissions testing. The emissions laboratory provides capability for testing heavy-duty diesel, gasoline, and alternative-fueled buses for a variety of tailpipe emissions including particulate matter, oxides of nitrogen, carbon monoxide, carbon dioxide, and hydrocarbons. It is equipped with a Horiba full-scale dilution tunnel and a constant volume sampling (CVS) emissions measurement system. The system includes Horiba Mexa 7400 Series gas analyzers and a Horiba HF47 Particulate Sampling System. Test operation is automated using Horiba CDTCS software. The computer controlled dynamometer is capable of simulating over-the-road operation for a variety of vehicles and driving cycles.

The emissions test was performed as soon as practical after the completion of the GVW portion of the structural durability test. The driving cycles are the Manhattan cycle, a low average speed, highly transient urban cycle (Figure 1), the Orange County Bus Cycle, a medium average speed transient urban cycle (Figure 2), and the EPA HD-UDDS Cycle, which consists of urban and highway driving segments (Figure 3). An emissions test was comprised of two runs for

each of the three different driving cycles, and the average values were reported. Test results reported include the average grams per mile value for each of the gaseous emissions of carbon dioxide, carbon monoxide, oxides of nitrogen, total hydrocarbons and non-methane hydrocarbons. In addition, emissions of particulate matter will also be reported for diesel fuel buses. Testing is performed in accordance with EPA CFR49, Part 1065 and SAE J2711 as practically determined by the FTA Emissions Testing Protocol developed by West Virginia University and Penn State University.

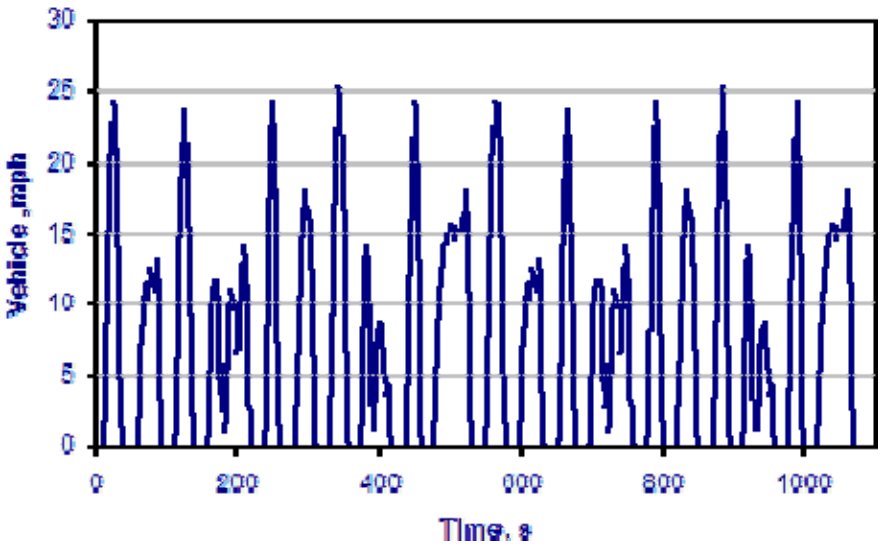


***Figure 8.1**. Manhattan Driving Cycle (Duration 1089 sec, Maximum Speed 25.4 mph, Average Speed 6.8 mph)*

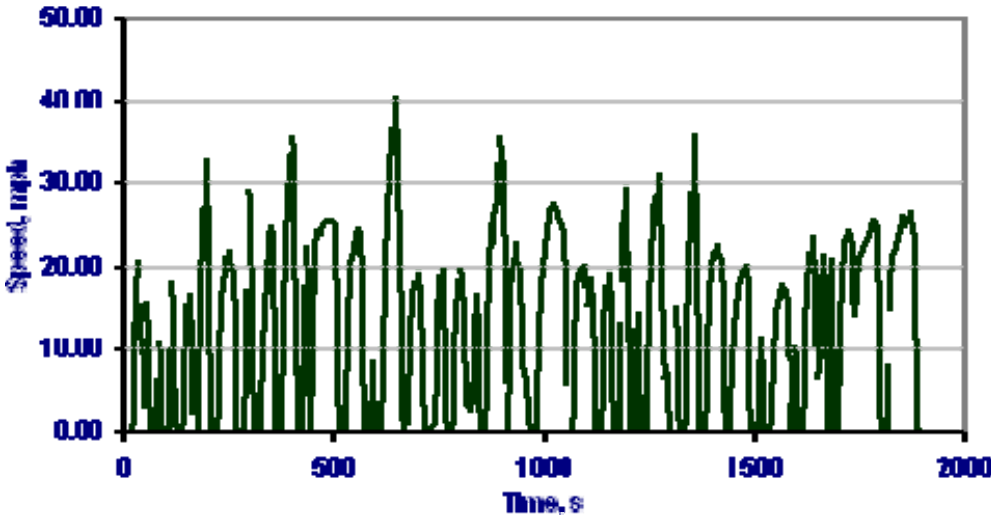


***Figure 8.2**. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph)*

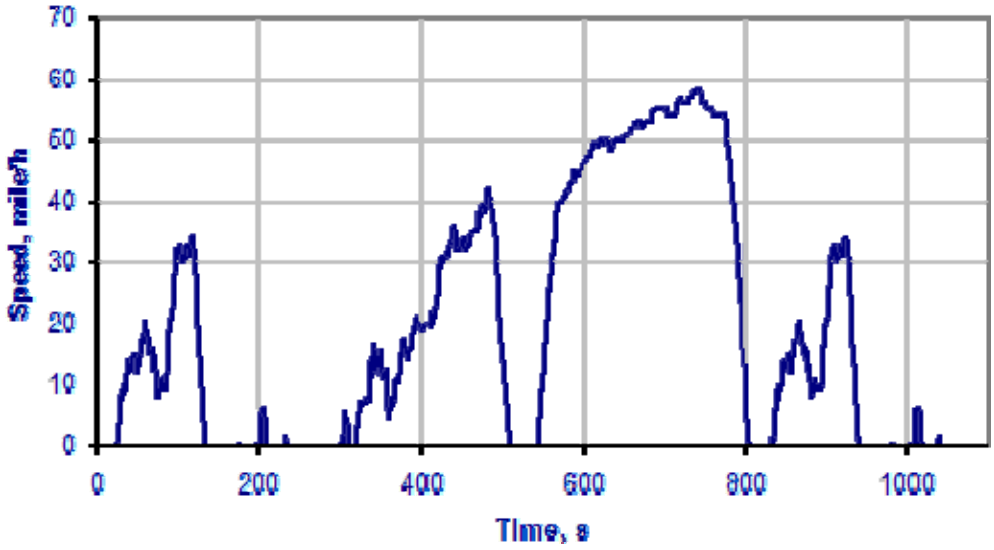


***Figure 8.3**. HD-UDDS Cycle (Duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph)*

8-III. TEST ARTICLE

The test article is a New England Wheels, Inc., Frontrunner model transit bus equipped with a gasoline fueled FCA US LLC 3.6L motor. The bus was tested on March 6, 2018 with the odometer reading 11,155 miles.

8-IV. TEST EQUIPMENT

Testing was performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Schenk Pegasus 72-inch, large-roll chassis dynamometer. The dynamometer is electronically controlled to account for vehicle road-load characteristics and for simulating the inertia characteristics of the vehicle. Power to the roller is supplied and absorbed through an electronically controlled 3-phase ac motor. Absorbed power is returned to the electrical grid.

Vehicle exhaust is collected by a Horiba CVS, full-flow dilution tunnel. The system has separate tunnels for diesel and gasoline/natural gas fueled vehicles. In the case of diesel vehicles, particulate emissions are measured gravimetrically using 47mm Teflon filters. These filters are housed in a Horiba HF47 particulate sampler, per EPA 1065 test procedures. Heated gaseous emissions of hydrocarbons and NOx are sampled by Horiba heated oven analyzers.

Gaseous emissions for CO, CO2 and cold NOx are measured using a Horiba Mexa 7400 series gas analyzer. System operation, including the operation of the chassis dynamometer, and all calculations are controlled by a Dell workstation running Horiba CDCTS test control software. Particulate Filters are weighed in a glove box using a Sartorius microbalance accurate to 1 microgram.

8-V. TEST PREPARATION AND PROCEDURES

The test bus was prepared for emissions testing in accordance with the Fuel Economy Pre-Test Maintenance Form. (In the event that fuel economy test was performed immediately prior to emissions testing this step does not have to be repeated) This is done to ensure that the bus is tested in optimum operating condition. The manufacturer-specified preventive maintenance shall be performed before this test. The ABS system is disabled for operation on the chassis dynamometer. Any manufacturer-recommended changes to the pre-test maintenance procedure must be noted on the revision sheet. The Fuel Economy Pre-Test Inspection Form will also be completed before performing the Emissions test. Both the Fuel Economy Pre-Test Maintenance Form and the Fuel Economy Pre-Test Inspection Form are found in section 6, Fuel Economy Test.

Prior to performing the emissions test, each bus is evaluated to determine its road-load characteristics using coast-down techniques in accordance with SAE J1263. This data is used to program the chassis dynamometer to accurately simulate over-the-road operation of the bus.

Warm-up consisted of driving the bus for 20 minutes at approximately 40 mph on the chassis dynamometer. During emissions testing, the test driver followed the prescribed driving cycle by watching the speed trace and instructions on the Horiba Drivers-Aid monitor which is placed in front of the windshield. The CDCTS computer monitored the test and collected data for calculation of emissions at the end of the test.

This bus was tested for emissions at seated load weight. The emissions data was obtained at the following conditions:

1. Air conditioning off
2. Heater off
3. Defroster off
4. Exterior and interior lights on
5. Windows and Doors closed
6. Seated load weight

The test tanks or the bus fuel tank(s) were filled prior to the fuel economy test with gasoline.

8-VI DISCUSSION

Table 8.1 provides the emissions testing results on a grams per mile basis for each of the exhaust constituents measured and for each driving cycle performed.

TABLE 8.1 Emissions Test Results

Test Completed at SLW: 9,200 lb.			
Driving Cycle	**Manhattan**	**Orange County Bus**	**UDDS**
CO_2, gm/mi	1215	850	765
CO, gm/mi	3.6	1.71	2.78
THC, gm/mi	0.03	0.03	0.07
CH_4, gm/mi	0.01	0.01	0.03
NO_x, gm/mi	0.11	0.17	0.15
Particulates. gm/mi	N/A	N/A	N/A