FEDERAL TRANSIT BUS TEST

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

Manufacturer: The Braun Corporation / BraunAbility
Model: 2022 Chrysler Pacifica / Voyager ADA with Rear Entry Foldout Ramp

Tested in Service-Life Category
4 Year / 100,000 Miles

July 2023

Report Number: LTI-BT-R2023-01

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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 49 CFR Part, 665

Manufacturer: The Braun Corporation / BraunAbility
Manufacturer's address: 631 West 11th Street Winamac, IN 46996

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ACCREDITED
Mechanical Testing Certificate 3172.01

David Klinikowski	Director, Bus Research and Testing Center	July 7th, 2023
Quality Authorization	*Title*	*Date*

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EXECUTIVE SUMMARY

TEST HIGHLIGHTS

The information in this report pertains only to this specific bus, as received from the manufacturer for testing.

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	The Braun Corporation / BraunAbility
Model	2022 Chrysler Pacifica / Voyager ADA with Rear Entry Foldout Ramp
Chassis Make/Model	FCA US, LLC / Voyager LX
Chassis Modified	Yes
Length	16 feet, 11 inches
Fuel	Gasoline
Service Life	4 Year / 100,000 miles
Number of Seats (including driver)	4 and 1 wheelchair position
Manufacturer-Designated Standing Passenger Capacity	0
Gross Vehicle Weight used for testing	5,840 lbs.
Gross Vehicle Weight Rating	6,055 lbs.
Mileage at Delivery	147 miles
Test Start Date	March 1, 2023
Test Completion Date	June 21, 2023
Report Issuance Date	July 7, 2023

The measured curb weight was 2,580 lb. for the front axle and 2,060 lb. for the rear axle. These combined weights provided a total measured curb weight of 4,640 lb. There are four seats including the driver and one wheelchair position, bringing the potential total passenger capacity to five (including the driver). Two seats stow away to make room for an additional wheelchair; however, this configuration would place the weight of the vehicle over the gross vehicle weight rating. Therefore, the gross load represents four seated passengers and one wheelchair position only, for a total of five passengers. Gross load is calculated as (150 lb. x 4) + (600 lb. x 1) = 1,200 lb. At full declared capacity, the measured gross vehicle weight was 5,840 lb. This type of vehicle does not have any free floor space for standing passengers. There is a potential to overload this bus when utilizing both wheelchair positions.

This test vehicle has a modified chassis. The OEM floor section was modified from the back of the front passenger seats to the rear to allow for a lower floor design that accommodates the wheelchair passenger and ramp.

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 with 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 93.1.**

The Braun Corporation / BraunAbility Bus# 2023-01

Test category		Standard	Base Pts.	Bonus Pts.	Range	Range	Test Data	Score	FAIL
1. Maintainability	Unscheduled maint.	< 125 hours	2	14	0	125	0.5	15.94	
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	
		< 158 feet at 45mph	0.5	2	80	158	85.8	2.35	
	Braking	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	13.6	7.00	
	CNG	10-50 scf/mi			10	50	NA	0.00	
	Hydrogen	15-98 cf/mi			15	98	NA	0.00	
	Electric	1-3 kWh/mi			1	3	NA	0.00	
7. Noise	Int. Noise (0-35 mph)	less than 80 db	0.5	3	30	80	78.8	0.57	
	Ext. Noise (0-35 mph)	less than 83 db	0.5	3	50	83	73.2	1.39	
8. Emissions	CO_2	0-4000 g/mi	1	4	0	4000	649	4.35	
	CO	0-20 g/mi		0.4	0	20	0.57	0.39	
	Total hydrocarbon	0-3 g/mi		0.4	0	3	0.02	0.40	
	NMHC	0-3 g/mi		0.4	0	3	0.02	0.40	
	Nitrogen oxides	0-3 g/mi		0.4	0	2	0	0.40	
	Particulates	0-0.1 g/m		0.4	0	0.1	0	0.40	
Total			60	40				93.1	

Note: The use of the scoring system is not mandatory for procurement. It is only necessary that the bus being procured has received a passing score.

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 The Braun Corporation / BraunAbility, 2022 Chrysler Pacifica / Voyager ADA with Rear Entry Foldout Ramp model bus. The bus has a front, streetside driver's door and front, curbside passenger door located behind the front axle. There are also additional passenger entry doors on both the streetside and curbside that are located forward of the rear axle. There is an ADA passenger entry door at the rear of the bus that is equipped with a BraunAbility 516637A manual fold-out ADA ramp. Power is provided by a gasoline-fueled, FCA US, LLC 3.6 L engine coupled to an FCA US, LLC 948 TE transmission.

The measured curb weight was 2,580 lb. for the front axle and 2,060 lb. for the rear axle. These combined weights provided a total measured curb weight of 4,640 lb. There are four seats including the driver and one wheelchair position, bringing the potential total passenger capacity to five (including the driver). Two seats stow away to make room for an additional wheelchair; however, this configuration would place the weight of the vehicle over the gross vehicle weight rating. Therefore, the gross load represents four seated passengers and one wheelchair position only, for a total of five passengers. Gross load is calculated as (150 lb. x 4) + (600 lb. x 1) = 1,200 lb. At full declared capacity, the measured gross vehicle weight was 5,840 lb. This type of vehicle does not have any free floor space for standing passengers. There is a potential to overload this bus when utilizing both wheelchair positions.

VEHICLE DATA FORM

Bus Number: 2023-01	Date of Check-In: 03/01/23
Bus Manufacturer: The Braun Corporation / BraunAbility	Vehicle Identification Number (VIN): 2C4RC1CG1NR204963
Model Number: Voyager	Chassis Mfr./Mod. #: FCA US, LLC / Voyager LX
Personnel: S.R., E.D., J.M. & T.G.	Starting Odometer Reading: 147 miles

WEIGHT:

Individual Wheel Reactions:

Weights (lb.)	Front Axle		Middle Axle		Rear Axle	
	Curb	Street	Curb	Street	Curb	Street
CW	1,260	1,320	N/A	N/A	1,040	1,020
SLW	1,340	1,410	N/A	N/A	1,550	1,540
GVW	1,340	1,410	N/A	N/A	1,550	1,540

Total Weight Details:

Weight (lb.)	CW	SLW	GVW	GAWR
Front Axle	2,580	2,750	2,750	2,950
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	2,060	3,090	3,090	3,200
Total	4,640	5,840	5,840	GVWR: 6,055 (Declared by Manufacturer)

Dimensions:

Length (ft/in)	16 / 11
Width (in)	79.3 (excluding mirrors) 92.3 (including mirrors)
Height of Bus (in)	73.2
Overall Height of Bus (in)	73.2
Front Overhang (in)	38.5
Rear Overhang (in)	42.6
Wheelbase (in)	121.9
Wheel Track (in)	Front: 68.3
	Middle: N/A
	Rear: 68.6

Bus Number: 2023-01	Date: 03/01/23

CLEARANCES:

Lowest Point Outside Front Axle	Location: Tube steel sub-frame on streetside Clearance(in): 7.9
Lowest Point Outside Rear Axle	Location: ADA ramp assembly Clearance(in): 8.9
Lowest Point between Axles	Location: Center of fuel tank Clearance(in): 6.7
Ground Clearance at the center (in)	10.8 to frame rail
Front Approach Angle (deg)*	16.7
Rear Approach Angle (deg)*	13.5
Ramp Clearance Angle (deg)	6.3
Aisle Width (in)	10 (with bucket seats down)
Inside Standing Height at Center Aisle (in)	55.4 (No standees)

*measurements used to calculate approach and departure angles are taken from the centerline of the axles.

BODY DETAILS:

Body Structural Type	Modified Unibody		
Frame Material	Steel		
Body Material	Steel		
Floor Material	Steel		
Roof Material	Steel		
Windows Type	☐ Fixed	■ Movable	
Window Mfg./Model No.	Mopar / 43R-001565 (front doors)		
Number of Doors	_2_ Front _2_ Rear _1_ Rear Hatch (ADA Ramp)		
Mfr. / Model No.	Front Streetside : FCA US, LLC / Chrysler / OEM Front Curbside: FCA US, LLC / Chrysler / OEM Rear Streetside: FCA US, LLC / Chrysler / OEM Rear Curbside: FCA US, LLC / Chrysler / OEM Rear Hatch: FCA US, LLC / Chrysler / OEM		
Dimension of Each Door (in)	Front Streetside : 30.2 x 41.5 Front Curbside: 30.0 x 41.4 Rear Streetside: 28.6 x 43.8 Rear Curbside: 28.6 x 43.8 Rear Hatch: 41.0 x 48.8		
Passenger Seat Type	☐ Cantilever	■ Pedestal	☐ Other
Mfr. / Model No.	Chrysler / OEM (Pedestals are BraunAbility – 50338(streetside) 503573(curbside)		
Driver Seat Type	☐ Air	■ Spring	☐ Other
Mfr. / Model No.	FCA US, LLC / Chrysler / OEM		
Number of Seats (including Driver)	4 with 1 wheelchair position or 2 with 2 wheelchair positions		

Bus Number: 2023-01	Date: 03/01/23

BODY DETAILS (Contd.)

Free Floor Space (ft^2)	N/A
Height of Each Step at Normal Position (in)	Front Streetside: 1. 19.5 2. N/A 3. N/A 4. N/A Front Curbside: 1. 19.4 2. N/A 3. N/A 4. N/A
	Rear Streetside: 1. 22.0 2. N/A 3. N/A 4. N/A Rear Curbside: 1. 21.8 2. N/A 3. N/A 4. N/A
	Rear Hatch: 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.	FCA US, LLC / 3.6 L		
Engine Power	Max hp 287 @ 6400 rpm		
Engine Torque	Max torque Nm 355.2 @ 4000 rpm		
Location	■ Front	☐ Rear	☐ Other (explain)
Fuel Type	■ Gasoline	☐ CNG	☐ Methanol
	☐ Diesel	☐ LNG	☐ Other (explain)
Alternator (Generator) Mfr./Model No.	Denso / TN421000-7181 (PN: 56029732AB)		
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.	Mopar / TN 438000-4562		
Low Voltage Battery	■ 12 Volt ☐ 24 Volt		
Low Voltage Battery Mfr. / Model No.	East Penn Manufacturing Co. / 56029 58 AB		

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TRANSMISSION

Transmission Type	☐ Manual	■ Automatic (9 Speed)	☐ Load Sensing Adaptive
Mfr. / Model No.	FCA US, LLC / 948 TE		
Control Type	☐ Mechanical	■ Electrical	☐ Other
Integral Retarder	☐ Yes	■ No	

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	☐ Beam Axle	
Mfr. / Model No.	FCA US, LLC / OEM		
GAWR (lb.)	2,950		
Axle Ratio (if driven)	Transmission total gear ratio span 9.81		
Suspension Type	☐ Air	■ Spring	☐ Other
No. of Shock Absorbers	2 struts		
Mfr. / Model No.	Streetside: ZF/Sachs / 16465 Curbside: ZF/Sachs / 15816		
Middle Axle Type	☐ Independent	☐ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	☐ Spring	☐ Other
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	■ Independent	☐ Beam Axle	
Mfr. / Model No.	FCA US, LLC / OEM		
GAWR (lb.)	3,200		
Axle Ratio (if driven)	N/A		
Suspension Type	☐ Air	■ Spring	☐ Other
No. of Shock Absorbers	2		
Mfr. / Model No.	ZF / 68484078AA / 801402002901		

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WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Chrysler / OEM
	Wheel weight rating	Chrysler / OEM
	Tire Mfr./ Model No.	Yokohama / AVID S34RV 235 65 R17
	Tire weight rating	1,984 lb.
Rear	Wheel Mfr./ Model No.	Chrysler / OEM
	Wheel weight rating	Chrysler / OEM
	Tire Mfr./ Model No.	Yokohama / AVID S34RV 235 65 R17
	Tire weight rating	1,984 lb.

BRAKES

Front Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	FCA US, LLC / Mopar / OEM		
Middle Axle Brakes Type	☐ Cam	☐ Disc	☐ Other
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	☐ Cam	■ Disc	☐ Other (explain)
Mfr. / Model No.	FCA US, LLC / Mopar / OEM		
Parking Brake Mfr. / Model No.	FCA US, LLC / Mopar / OEM		

HVAC

Driver Heating System Type	■ Engine Coolant	☐Electric	☐ Other
Capacity (Btu/hr.)	Chrysler / OEM		
Mfr. / Model No.	FCA US, LLC / Chrysler / OEM		
Passenger Heating System Type	■ Engine Coolant	☐Electric	☐Other
Capacity (Btu/hr.)	Chrysler / OEM		
Mfr. / Model No.	FCA US, LLC / Chrysler / OEM		
Auxiliary Heater	☐ Yes: Type_____ ■ No		
Mfr. / Model No.	N/A		
Driver Air Conditioner	■ Yes ☐ No		
Location	All A/C components under hood in engine compartment		
Capacity (Btu/hr.)	Chrysler / OEM		
A/C Compressor Mfr. / Model No.	FCA US LLC / 68225206AD / 46177G		

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HVAC (cont.)

Passenger Air Conditioner	■ Yes ☐ No		
Passenger Air Conditioner	■ Engine Coolant	☐Electric	☐ Other
Location	Engine Compartment / rear curbside*		
Capacity (Btu/hr.)	Chrysler / OEM		
A/C Compressor Mfr. / Model No.	Chrysler / OEM		

*Compressor in engine compartment tied to evaporators in front and rear curbside.

STEERING

Steering Gear Box Type	Electric (Electric steering rack with motor assist)
Mfr. / Model No.	FCA US, LLC / Chrysler / OEM
Steering Wheel Diameter	15”
Number of turns (lock to lock)	3 1/8

OTHERS

ADA Ramps	Location: Rear hatch	Type: Manual Fold-out
Wheelchair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	BraunAbility / 516637A	
Emergency Exit	Location: Door	Number: 5
Fire Suppression System Mfr./Model No.	N/A	

CAPACITIES

Fuel Tank Capacity (gallons)	19
Engine Crankcase Capacity (gallons)	1.25
Transmission Capacity (gallons)	1.9
Differential Capacity (quarts)	Not available (Integral to Transmission)
Engine Cooling System Capacity (gallons)	3.2
Power Steering Fluid Capacity (quarts)	Not available (OEM)

Bus Number: 2023-01	Date: 03/01/23

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

■Service manual and operator's manual documentation available
☐Service manual and operator's manual documentation NOT available

Part Number	Description	Qty.
N/A	OEM floor mats	4
N/A	Q-Straint W/C tie downs	2
N/A	ADA Ramp service manual	1
N/A	ADA Ramp operator's manual	1
N/A	Owner's manual '22 Voyager	1

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 2023-01	Date: 03/01/23

Subsystem	Checked	Initials	Comments
Engine	✓	S.R.	None noted.
Fuel System	✓	S.R.	None noted.
Transmission	✓	S.R.	None noted.
Exhaust	✓	S.R.	None noted.
Engine Cooling System	✓	S.R.	None noted.
Electronics Cooling System	N/A	S.R.	N/A
Drive Motor Cooling System	N/A	S.R.	N/A
Drive Motors/Axle	N/A	S.R.	N/A
High Voltage Batteries	N/A	S.R.	N/A
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.
Interior Fasteners	✓	S.R.	None noted.
Axles	✓	S.R.	None noted.
Brakes	✓	S.R.	None noted.
Tires/Wheels	✓	S.R.	None noted.
Air Conditioning Heating and Ventilation	✓	S.R.	None noted.
Accessories	✓	S.R.	None noted.
ADA Lift System	N/A	S.R.	N/A
ADA Ramp System	✓	S.R.	Manual fold-out ramp
Low Voltage Batteries	✓	S.R.	None noted.
Emergency Exits	✓	S.R.	None noted.
Fire Suppression System	N/A	S.R.	N/A – No fire extinguisher included w/vehicle

CHECK - IN

THE BRAUN CORPORATION / BRAUNABILITY
2022 CHRYSLER PACIFICA / VOYAGER ADA WITH REAR ENTRY FOLDOUT RAMP

CHECK - IN CONT.

THE BRAUN CORPORATION / BRAUNABILITY
2022 CHRYSLER PACIFICA / VOYAGER ADA WITH REAR ENTRY FOLDOUT RAMP

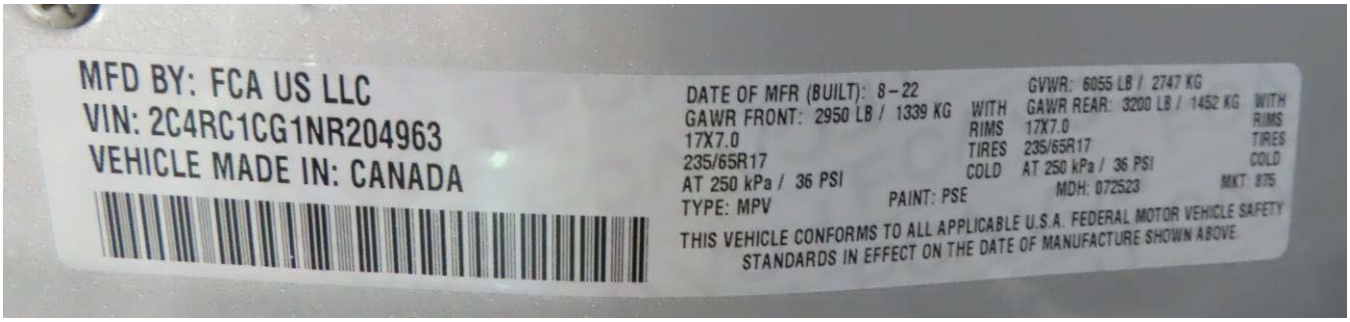
CHECK - IN CONT.

BRAUNABILITY 516637A
MANUAL FOLD-OUT ADA RAMP

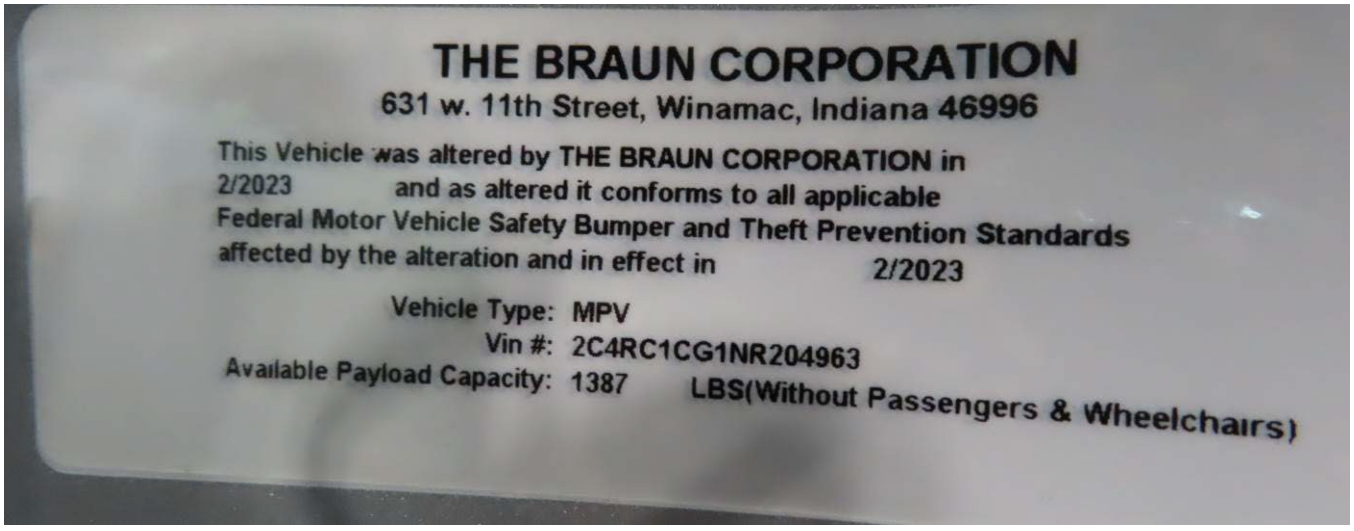
OPERATOR'S AREA

CHECK - IN CONT.

INTERIOR FROM REAR



FCA US LLC VIN TAG



THE BRAUN CORPORATION MODIFIED VEHICLE VIN TAG

CHECK - IN CONT.

ENGINE COMPARTMENT

UNDERSIDE OF BUS – FRONT TO REAR

CHECK - IN CONT.

UNDERSIDE OF BUS – REAR TO FRONT

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: 2023-01	Date: 04/05/23

Component	Checked	Comments
ENGINE:		
Oil Dipstick	✓	None noted.
Oil Filler Hole	✓	None noted.
Oil Drain Plug	✓	None noted.
Oil Filter	✓	None noted.
Fuel Filter	N/A	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 Dipstick	N/A	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: 2023-01	Date: 04/05/23

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:	N/A	None noted.

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. Labor-hours

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. Labor-hours

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
The Braun Corporation / BraunAbility Bus# 2023-01
(Page 1 of 1)

DATE	TEST MILES	SERVICE	ACTIVITY/OBSERVATIONS	DOWN TIME	LABOR HOURS
03/14/23	1,311	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all lubricated; all fluids checked. Inspected frame, body and suspension. Cords showing in rear tires. It was found that the vehicle was out of alignment in both the front and the rear. Four new tires were installed and alignment performed at Courtesy Dodge in Altoona, PA.	4.00	4.00
03/17/23	2,056	P.M./Inspection Fuel Economy	Steering linkage, tie rods, universals/u-joints all lubricated; all fluids checked. Inspected frame, body and suspension.	8.00	8.00
03/27/23	2,349	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all lubricated; all fluids checked. Inspected frame, body and suspension. Rear tires showing wear on outside of tread. It was found that the vehicle was out of alignment in both the front and the rear. Two new rear tires were installed and alignment was performed at Courtesy Dodge in Altoona, PA.	4.00	4.00
04/18/23	3,874	P.M./Inspection	Steering linkage, tie rods, universals/u-joints all lubricated; all fluids checked. Inspected frame, body and suspension.	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 involved components that may be expected to fail or require replacement during the service life of the bus. 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 items on the list were removed and replaced. The transmission assembly took 8.00 labor-hours 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
Engine/Transmission	8.00 labor hours
Wiper Motor	0.17 labor hours
Starter	3.00 labor hours
Alternator	3.00 labor hours
Batteries	0.10 labor hours
Auto Start/Stop Battery	0.07 labor hours

During the test, additional components may have been 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

ENGINE/TRANSMISSION REMOVAL AND REPLACEMENT (8.00 LABOR HOURS)

WIPER MOTOR REMOVAL AND REPLACEMENT (0.17 LABOR HOURS)

1.3 REPLACEMENT AND/OR REPAIR OF SELECTED SUBSYSTEMS CONT.

STARTER REMOVAL AND REPLACEMENT (3.00 LABOR HOURS)

ALTERNATOR REMOVAL AND REPLACEMENT (3.00 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 was only one reported failure during the test. This was a class 3 failure that affected the doors. 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: 2023-01	Date: 06/06/23
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
Doors		3,701			0.50	0.50

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 100-foot-long gates with a spacing distance of 100 feet between them. The bus entered the test course in one lane, crossed over to the other lane within the 100-foot gate, traveled for 100 feet, and then returned back into the original lane within the next 100-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.

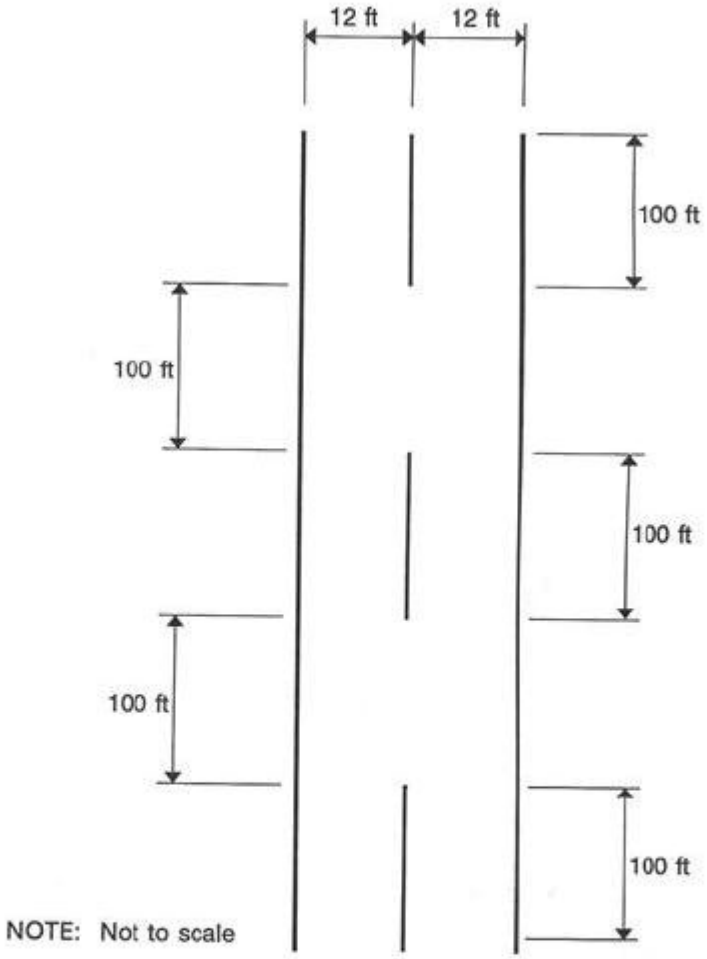


Figure 3.1. Double lane change test course

SAFETY DATA FORM

Bus Number: 2023-01	Date: 03/21/23
Personnel: S.R., F.T., T.G. & J.M.	

Temperature (°F): 55	Humidity (%): 18
Wind Direction: SW	Wind Speed (mph): 7
Barometric Pressure (mbar): 9.83	

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 all portions of testing.	
Comments of the tire/ground contact patch:	
The test vehicle maintained the tire/ground patch throughout all portions of testing.	

LEFT - HAND APPROACH

RIGHT - 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. For buses that have not completed Durability Testing, the brakes will be burnished according to the test procedure. 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. The bus passed this portion of the test.

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 this portion of the test.

Table 3.2-1. Braking Test Data Forms

Bus Number: 2023-01	Date: 03/21/23
Personnel: F.T., S.R., T.G., A.H., J.M. & A.Z.	
Amb. Temperature (ºF): 39	Wind Speed (mph): 6
Wind Direction: SW	Pavement Temp (°F) Start: 29 End: 83

TIRE INFLATION PRESSURE (psi):

Tire Type: Front: Yokohama Avid S34 Rear: Yokohama Avid S3

	Left Tire(s)		Right Tire(s)	
Front	36		36	
	Inner	Outer	Inner	Outer
Middle	N/A	N/A	N/A	N/A
Rear	N/A	36	N/A	36

AXLE LOADS (lb.)

	Left	Right
Front	1,410	1,340
Middle	N/A	N/A
Rear	1,540	1,550

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)	**21.53**	20.33	20.32	20.32	20.63
30 (dry)	41.60	40.73	**42.72**	40.57	41.41
40 (dry)	70.22	72.94	72.37	**73.89**	72.36
45 (dry)	86.19	85.34	**88.43**	83.08	85.76
20 (wet)	21.20	21.47	22.86	**23.66**	22.30

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 (GVW) – GRADE HOLDING						
Vehicle Direction	Attempt	Hold Time (min)	Slide (in)	Roll (in)	Did Hold	No Hold
Front up	1	5:00	N/A	N/A	✓	
	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	N/A	N/A	✓	
	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
03/21/23	None noted.	None noted.

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 safe speed of 80.0 mph. The calculated gradeability results are attached. The average time to reach 30 mph was 5.2 seconds. The maximum gradeablity at 10 mph was 43.4% and at 40 mph was 20.8%. This bus passed this section of the test.

PERFORMANCE DATA FORM

Bus Number: 2023-01	Date: 03/17/23
Personnel: D.B. & S.I.	
Temperature (°F): 87.2	Humidity (%): 39
Barometric Pressure (inHg): 28.3	

		INITIALS:
Air Conditioning - OFF	✓Checked	D.B.
Ventilation fans - ON HIGH	✓Checked	D.B.
Defroster - OFF	✓ Checked	D.B
Exterior and interior lights - ON	✓ Checked	D.B
Windows and doors - CLOSED	✓ Checked	D.B.

ACCELERATION, GRADEABILITY, TOP SPEED

Recorded Interval Times

Speed	Run 1	Run 2	Run 3
10 mph	1.3	1.2	1.2
20 mph	3.9	3.7	3.7
30 mph	5.4	5.2	5.1
40 mph	7.4	7.2	7.1
50 mph	9.8	9.5	9.5
60 mph	13.1	12.7	12.8
70 mph	17.5	17.0	17.1

Maximum Speed (mph): 80.0 (maximum safe dynamometer speed reached)

PERFORMANCE SUMMARY SHEET

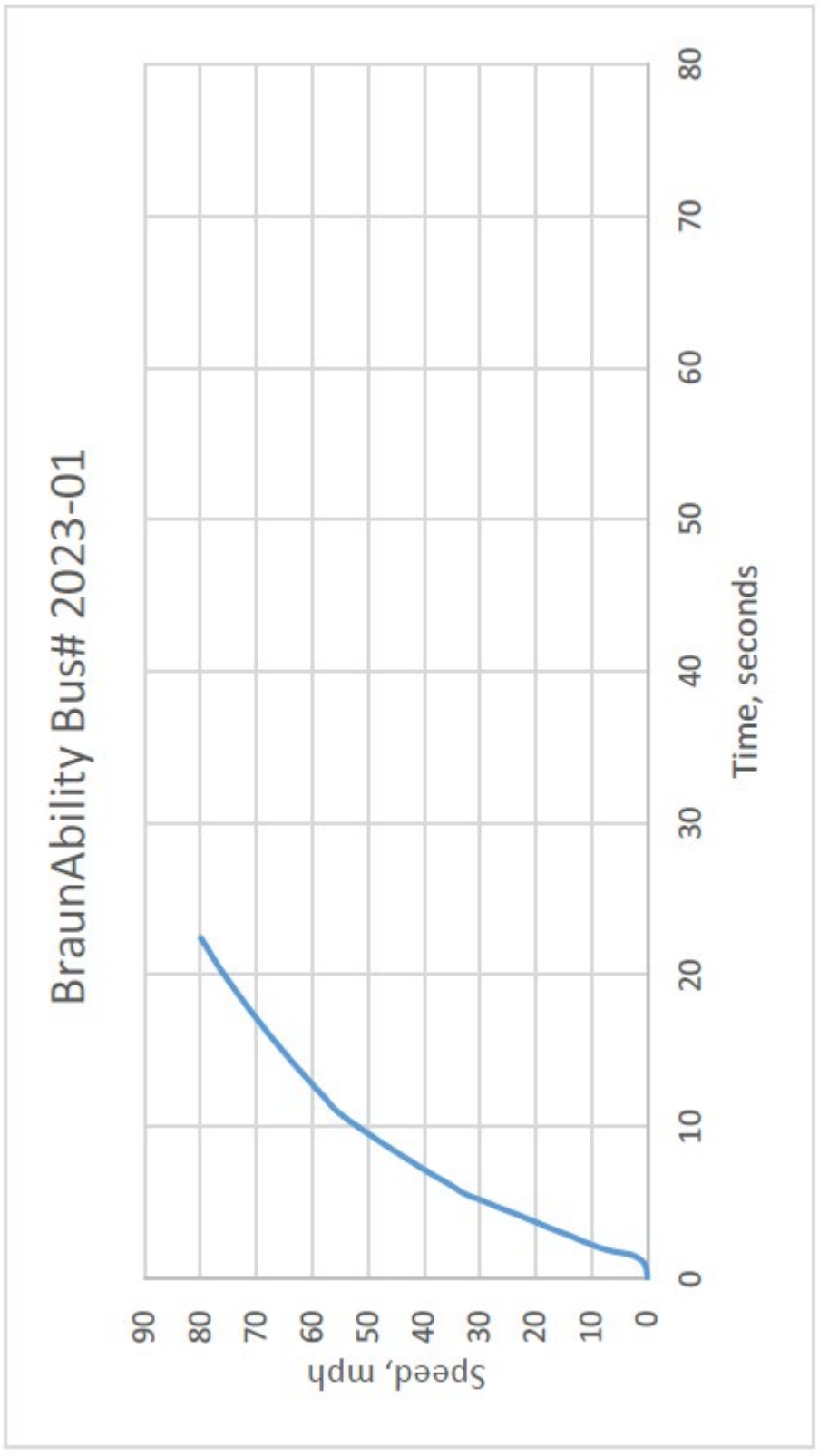
Bus Number: 2023-01	Date: 03/17/23
Personnel: D.B. & S.I.	

Test Conditions:

Temperature (°F): 87.2	Humidity (%): 39
Barometric Pressure (inHg): 28.3	

Test Results:

Vehicle Speed (MPH)	Time (SEC)	Acceleration (FT/SEC^2)	Max. Grade (%)
1.0	1.2	6.74	21.4
5.0	1.7	12.20	40.9
10.0	2.2	12.81	43.4
15.0	3.0	9.79	31.9
20.0	3.8	9.78	31.9
25.0	4.4	10.10	33.0
30.0	5.2	9.63	31.3
35.0	6.2	6.64	21.1
40.0	7.2	6.56	20.8
45.0	8.4	6.22	19.7
50.0	9.6	5.90	18.6
55.0	10.9	4.76	14.9
60.0	12.8	3.63	11.3
65.0	14.9	3.39	10.6
70.0	17.2	3.12	9.7
75.0	19.7	2.81	8.8
80.0	22.5	Maximum Speed	


BraunAbility Bus# 2023-01
Speed, mph
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
Time, seconds

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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)

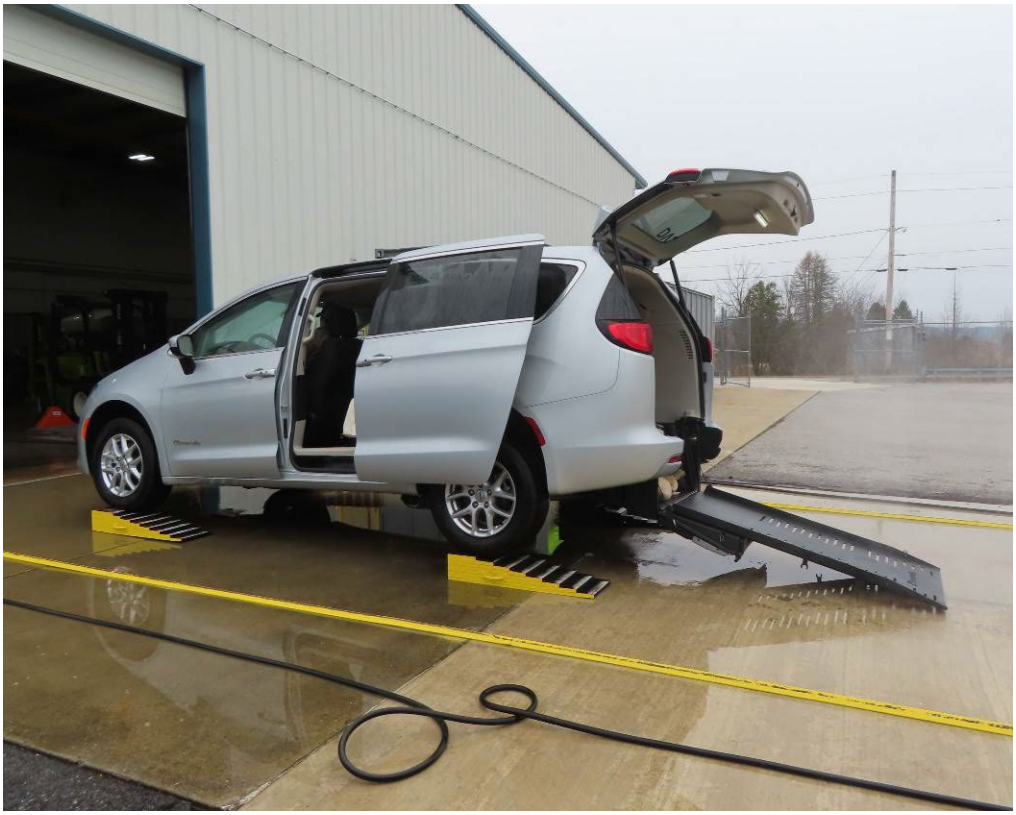
Bus Number: 2023-01	Date: 03/03/23
Personnel: T.G., J.M., S.R., E.D. & P.D.	Temperature(°F): 36

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

LEFT FRONT WHEEL SIX INCHES HIGHER



RIGHT FRONT 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 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: 2023-01	Date: 06/21/23
Personnel: S.R. & F.T.	

Temperature (°F): 74	
Wind Direction: E	Wind Speed (mph): 8

Inspect tow equipment-bus interface.
Comments: A safe and adequate connection was made between the tow equipment and the bus using a hydraulic under-wheel lift.
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: None noted.

5.4 DYNAMIC TOWING TEST

TEST BUS IN TRANSPORT

TOWING INTERFACE

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

During the deflated portion of the test, the jacking point clearances ranged from 5.6 inches to 11.3 inches. No deformation or damage was observed during testing. A complete listing of jacking point clearances is provided in the Jacking Test Data Form. This bus passed this section of the test.

JACKING CLEARANCE SUMMARY

Condition	Frame Point Clearance
Front axle – one tire flat	10.7
Rear axle – one tire flat	9.8
Rear axle – two tires flat	N/A

JACKING TEST DATA FORM

Bus Number: 2023-01	Date: 03/02/23
Personnel: S.R., J.M., E.D. & T.G.	Temperature (°F): 71

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

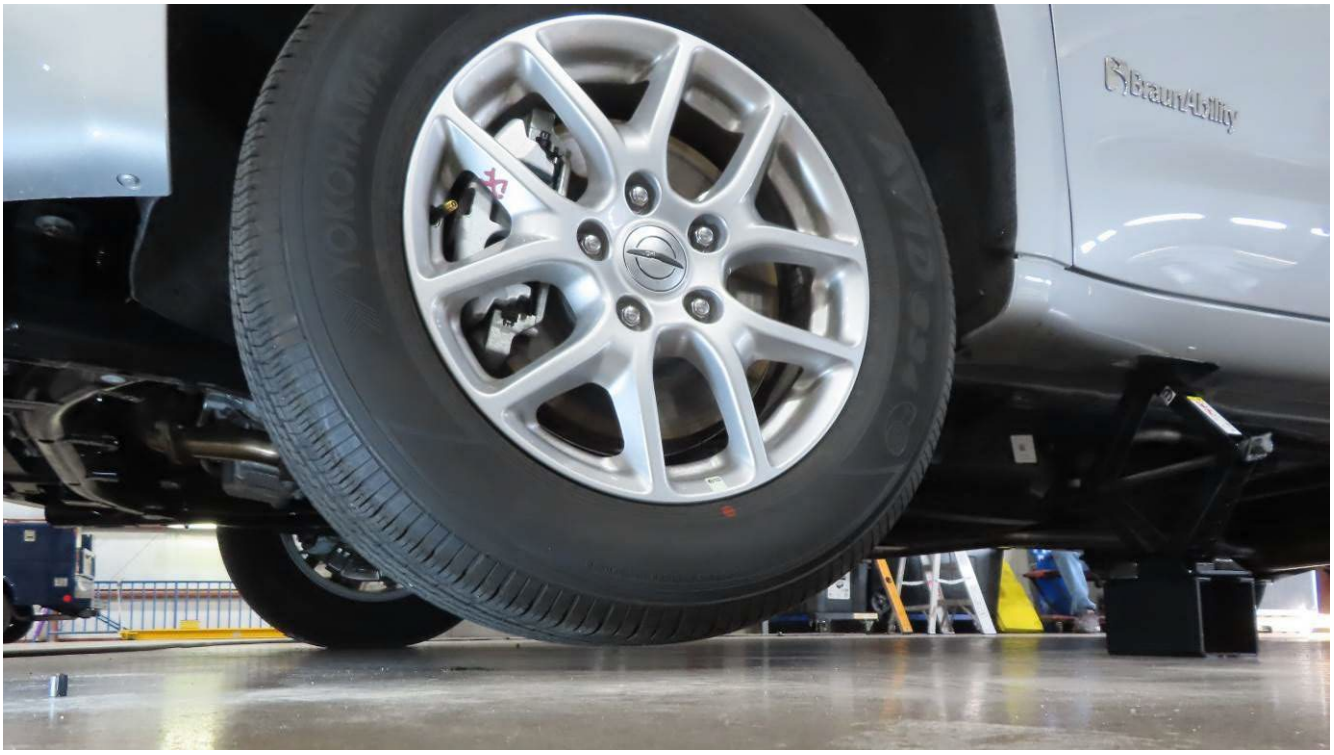
I= Inflated D= Deflated

Deflated Tire	Jacking Pad Clearance Body/Frame (in)	Jacking Pad Clearance Axle/Suspension (in)	Comments
Right front	12.7“I 11.3 “D	11.2“I 9.2”D	Frame / Suspension
Left front	12.6“I 10.7“D	11.2“I 8.4“D	Frame / Suspension
Right rear—outside	12.4“I 10.0“D	8.0“I 5.6“D	Body / Suspension
Right rear—both	N/A	N/A	N/A
Left rear—outside	12.2“I 9.8“D	7.8“I 5.6“D	Body / Suspension
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

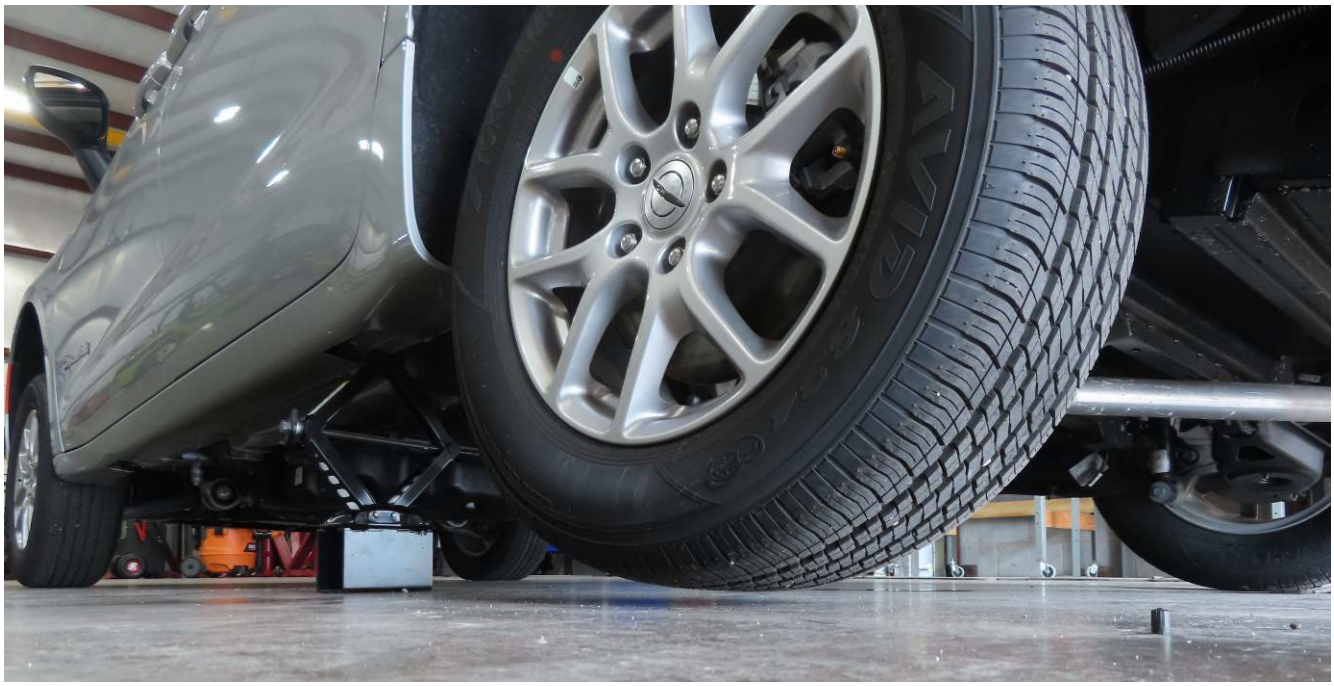
Additional comments of any deformation or difficulty during jacking:

Utilized OEM jack included with vehicle to lift.

5.5 JACKING TEST



JACK IN PLACE – FRONT STREETSIDE



JACK IN PLACE – REAR STREETSIDE

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 and then from the rear wheels, and then from 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: 2023-01	Date: 03/03/23
Personnel: S.R., E.D., J.M. & T.G.	Temperature (°F): 69

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 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

JACK STANDS IN PLACE – REAR

JACK STANDS IN PLACE – FRONT AND 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 3,927 miles; approximately 2,500 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 1,500 miles with the bus operated at GVW. The second segment consisted of approximately 800 miles with the bus operated at SLW. The remainder of the test, approximately 1,500 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 March 3, 2023, and was conducted until April 17, 2023. The first 1,500 miles were performed at a GVW of 5,840 lb. and completed on March 14, 2023. The next 800-mile SLW segment was performed at 5,840 lb. and completed on March 21, 2023 and the final 1,500-mile segment was performed at a CW of 4,640 lb. and completed on April 17, 2023.

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, photographs illustrating some of the failures that were encountered during the Structural Durability Test are 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 0.50 hours was less than 125 hours.

The Braun Corporation / BraunAbility Bus# 2023-01

MILEAGE DRIVEN/RECORDED FROM DRIVER'S LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
02/27/23 To 03/05/23	46.00	47.00	93.00
03/06/23 To 03/12/23	892.00	89.00	981.00
03/13/23 To 03/19/23	440.00	596.00	1036.00
03/20/23 To 03/26/23	122.00	113.00	235.00
03/27/23 To 04/02/23	772.00	248.00	1020.00
04/03/23 To 04/09/23	228.00	268.00	496.00
04/10/23 To 04/16/23	0.00	19.00	19.00
04/17/23 To 04/23/23	0.00	47.00	47.00
Total	**2500.00**	**1427.00**	**3927.00**

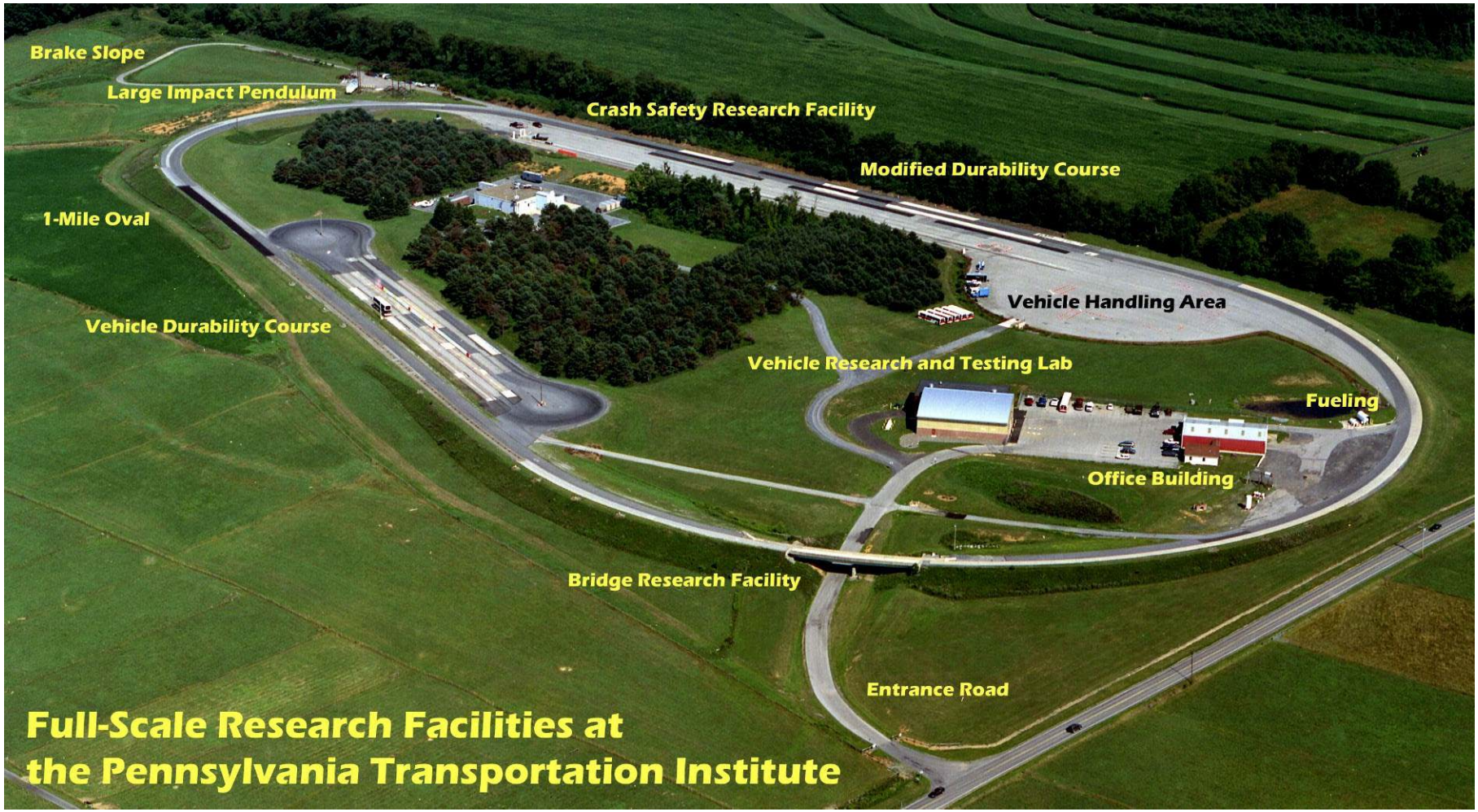
Driving Schedule for Bus Operation on the Durability Test Track.

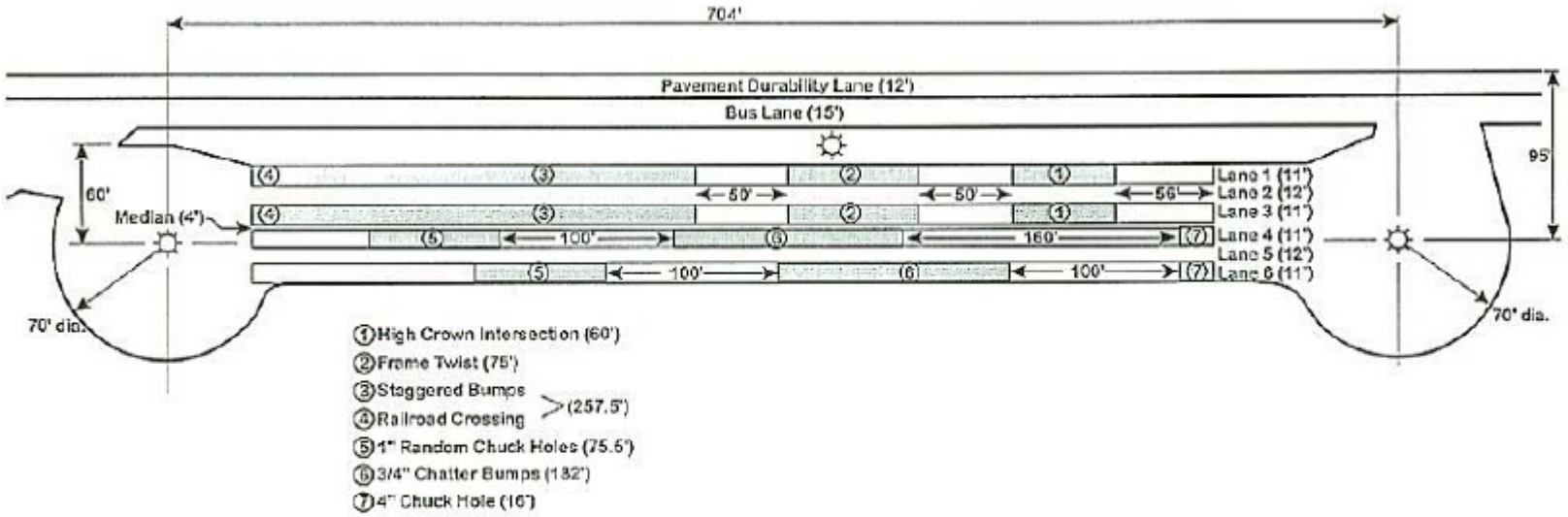
STANDARD OPERATING SCHEDULE

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



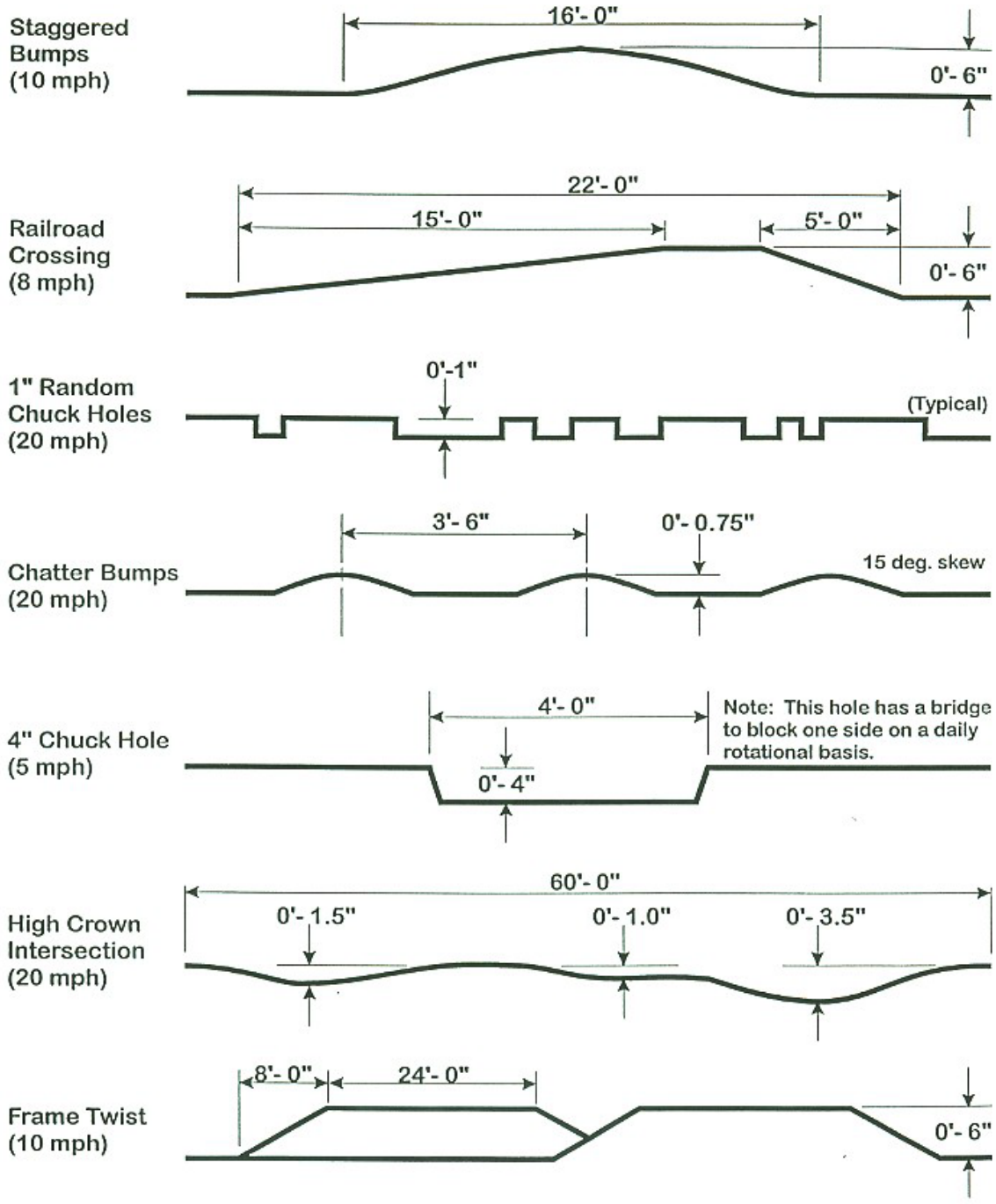
Plan View

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
The Braun Corporation / BraunAbility Bus# 2023-01
(Page 1 of 1)

Date	Test Miles	Issue	Action	Labor Hours	Sub-system	Class
04/04/23	3,701	Threads found stripped on curbside latch on door at rear of bus.	Removed and replaced latch and backing plate with a new a nut welded in place.	0.50	Doors (Rear hatch)	3

UNSCHEDULED MAINTENANCE

BROKEN REAR DOOR LATCH
(3,701 TEST MILES)

REPLACED REAR DOOR LATCH
(3,701 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 Horiba 500 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. A weighing scale was used for this test.

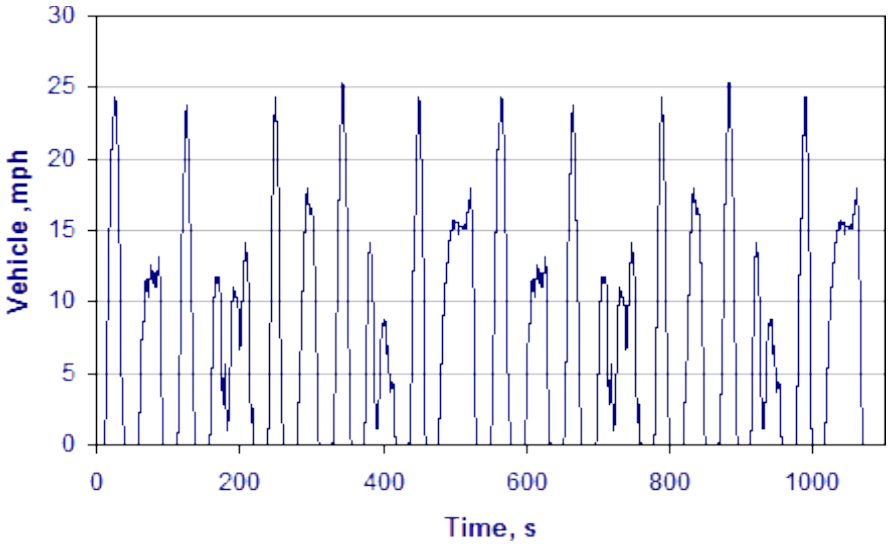


Figure 1. Manhattan Driving Cycle (duration 1089 sec, Maximum speed 25.4 mph, average speed 6.8 mph)

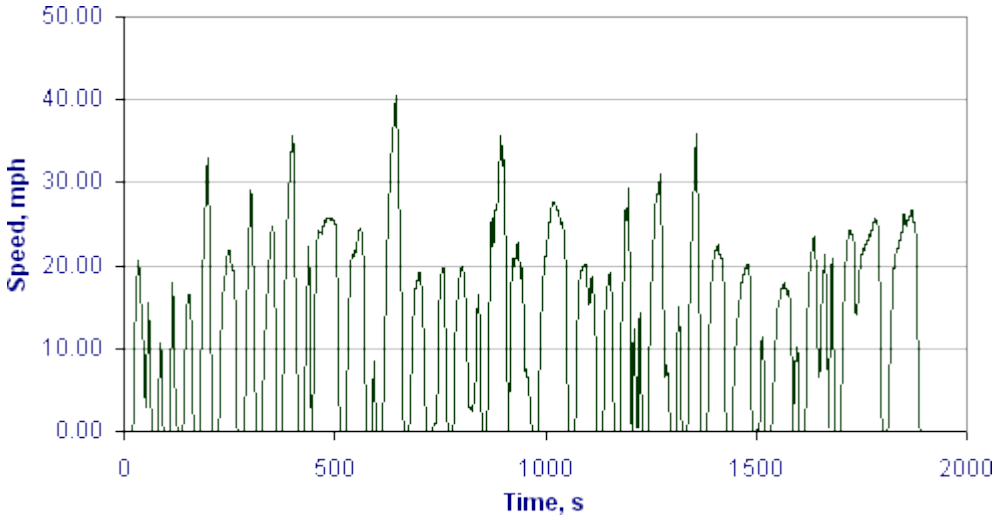


Figure 2. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph).

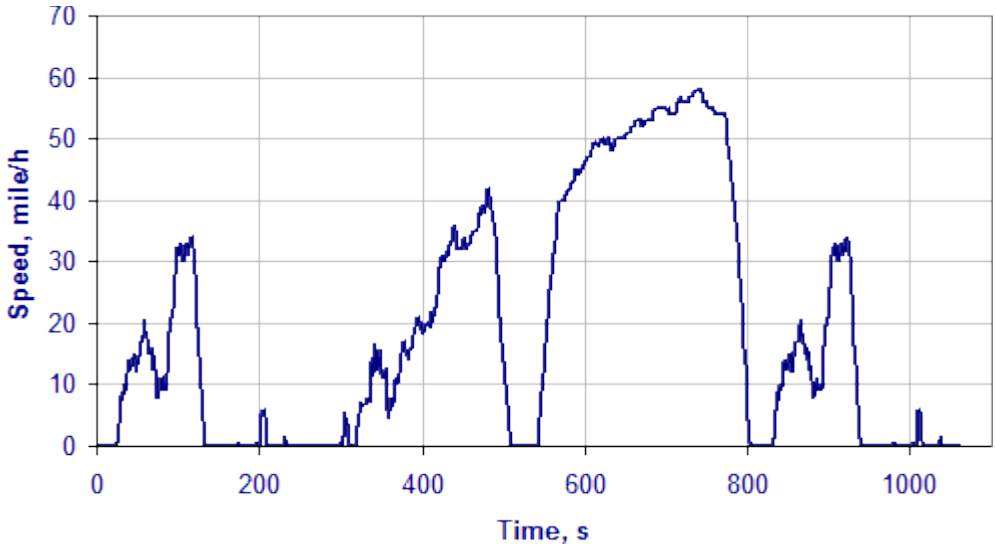


Figure 3. HD-UDDS Cycle (duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph).

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 10.0 mpg, 13.7 mpg and 17.1 mpg, respectively. Idle fuel consumption was not measured. The vehicle's engine switched off during idle periods.

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 2023-01	Date: 03/17/23	SLW (lb.): 5,840
Personnel: R.M.		

FUEL SYSTEM	OK
Install fuel measurement system	✓
Replace fuel filter	N/A
Check for fuel leaks	✓
Specify fuel type (Gasoline)	✓
Remarks: No issues or leaks with fuel system and connections	
BRAKES/TIRES	OK
Inspect hoses	✓
Inspect brakes	✓
Check tire inflation pressures (mfg. specs.)	✓
Check tire wear (less than 50%)	✓
Remarks: No issues found within brake system. Tire pressures were to specifications and above 50%.	
COOLING SYSTEM	OK
Check hoses and connections	✓
Check system for coolant leaks	✓
Remarks: No issues found within the cooling systems and components.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 2023-01	Date: 03/17/23
Personnel: R.M.	

ELECTRICAL SYSTEMS	OK
Check battery	✓
Inspect wiring	✓
Inspect terminals	✓
Check lighting	✓
Remarks: No issues found with electrical system. All wiring and terminals look good. Lighting checked.	

DRIVE SYSTEM	OK
Drain transmission fluid	N/A
Replace filter/gasket	N/A
Check hoses and connections	✓
Replace transmission fluid	N/A
Check for fluid leaks	✓
Remarks: All hoses and connections checked out and no fluid leaks.	

LUBRICATION	OK
Drain crankcase oil	N/A
Replace filters	N/A
Replace crankcase oil	N/A
Check for oil leaks	✓
Check oil level	✓
Lube all chassis grease fittings	✓
Lube universal joints	✓
Replace differential lube including axles	N/A
Remarks: Greased all fittings and checked all fluids.	

FUEL ECONOMY PRE-TEST MAINTENANCE FORM

Bus Number: 2023-01	Date: 03/17/23
Personnel:	

EXHAUST/EMISSION SYSTEM	OK
Check for exhaust leaks	✓
Remarks: No exhaust leaks found.	

ENGINE	OK
Replace air filter	N/A
Inspect air compressor and air system	N/A
Inspect vacuum system, if applicable	N/A
Check and adjust all drive belts	✓
Check cold start assist, if applicable	N/A
Remarks: All belts checked out ok.	

STEERING SYSTEM	OK
Check power steering hoses and connectors	✓
Service fluid level	✓
Check power steering operation	✓
Remarks: No issues found within the steering system.	

	OK
Ballast bus to seated load weight during coast down test on Test Track	✓

TEST DRIVE	OK
Check brake operation	✓
Check transmission operation	✓
Remarks: Transmission and brakes both work as they should.	

FUEL ECONOMY PRE-TEST INSPECTION FORM

Bus Number: 2023-01	Date: 03/17/23
Personnel: R.M., F.T. & E.L.	

PRE-WARM-UP	If OK, Initial
Fuel Economy Pre-Test Maintenance Form is complete	R.M.
Cold tire pressure (psi): Front 36 Middle N/A Rear 36	R.M.
Engine oil level	R.M.
Engine coolant level	R.M.
Fuel economy instrumentation installed and working properly.	R.M.
Fuel line -- no leaks or kinks	R.M.
Bus is loaded to SLW during coast down	R.M.
WARM-UP	**If OK, Initial**
Interior and exterior lights on, evaporator fan on	D.B.
Air conditioning off	D.B.
Defroster off	D.B.
Windows and doors closed	D.B.
Do not drive with left foot on brake	D.B.

FUEL ECONOMY DATA FORM
(Gaseous and Liquid fuels)

Bus Number: 2023-01	Manufacturer: BraunAbility	Date: 03/17/23
Fuel Type: Gasoline	Personnel: D.B. & S.I.	
Temperature (°F): 87.1	Humidity (%): 41	Barometric Pressure (in.Hg): 28.3
SLW (lb.): 5,840		

Cycle	Manhattan	Orange County	HD-UDDS	Idle
Fuel Consumption mpg	10.0	13.7	17.1	N/A

Comments: Idle consumption (fuel) was not measured as the vehicle's engine switched off
during idle periods.

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 40.1 dB(A); ranging from 38.1 dB(A) at the driver's seat and front passenger seats to 43.3 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 70.1 dB(A) at the driver's seat and front passenger seats to 78.8 dB(A) at rear passenger seats. The overall average was 72.4 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: 2023-01	Date: 03/30/23
Personnel: E.D., F.T., S.R., P.D., G.C. & A.H.	
Temperature (°F): 40	Humidity (%): 51
Wind Speed (mph): 3	Wind Direction: N
Barometric Pressure (mbar): 985	
Interior Ambient Noise Level dB(A): Less than 30	Exterior Ambient Noise Level dB(A): 36.7
Microphone Height During Testing (in): 39.8	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	38.1
Front Passenger Seats	38.1
In Line with Front Speaker	38.3
In Line with Middle Speaker	40.4
In Line with Rear Speaker	42.4
Rear Passenger Seats	43.3

Comments: None noted.

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

Bus Number: 2023-01	Date: 04/13/23
Personnel: S.R. & F.T.	
Temperature (°F): 80	Humidity (%): 26
Wind Speed (mph): 7	Wind Direction: WSW
Barometric Pressure (mbar): 977	
Interior Ambient Noise Level dB(A): less than 30	Exterior Ambient Noise Level dB(A): 39.8
Microphone Height During Testing (in): 39.8	

Reading Location	Measured Sound Level dB(A)
Driver's Seat	70.1
Front Passenger Seats	70.1
Middle Passenger Seats	70.5
Rear Passenger Seats	78.8

Comments: Manufacturer made the following modifications to pass this test:

1. Installed rubber matting at the ADA ramp under the exterior panel at the hole positions around the latches.

2. Applied caulking to 19 holes on the floor under the plastic covers below the middle seats.

3. Installed half inch foam to the rear corner by the ADA ramp behind the plastic panel on the curbside.

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

Bus Number: 2023-01	Date: 03/27/23
Personnel: S.R. & J.M.	
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 noted.	None noted.
Windows and Doors	None noted.	None noted.
Seats and Wheelchair 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: None noted.
Comments: No unusual noises or vibrations to note.

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 32.2 dB(A), the average of the two highest readings obtained while accelerating from a constant speed was 83.9 dB(A) on the right side and 77.7 dB(A) on the left side.

When accelerating from a standstill with an exterior ambient noise level of 36.3 dB(A), the average of the two highest readings obtained were 72.7 dB(A) on the right side and 73.2 dB(A) on the left side.

With the vehicle stationary and the engine, accessories, and air conditioning on, the measurements averaged 42.7 dB(A) at low idle, 57.4 dB(A) at high idle and 57.4 dB(A) at wide open throttle. With the accessories and air conditioning off, the readings averaged 41.5 dB(A) at low idle, 57.3 dB(A) at high idle and 57.3 dB(A) at wide open throttle. The exterior ambient noise level measured during this test was 32.4 dB(A). This bus passed this section of the test.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Constant Speed

Bus Number: 2023-01	Date: 03/28/23
Personnel: F.T., E.L. & R.M.	
Temperature (°F): 52	Humidity (%): 45
Wind Speed (mph): 5	Wind Direction: NE
Barometric Pressure (mbar): 977	

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: 94.0 dB(A)

Exterior Ambient Noise Level: 32.2 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	75.7	1	74.6
2	80.1	2	78.1
3	81.0	3	75.7
4	83.9	4	75.1
5	83.9	5	75.8
6	N/A	6	77.2
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 = 83.9 dB(A)		Average of two highest actual noise levels = 77.7 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Accelerating from Standstill

Bus Number: 2023-01	Date: 03/28/23
Personnel: F.T., R.M. & E.L.	
Temperature (°F): 54	Humidity (%): 46
Wind Speed (mph): 5	Wind Direction: NE
Barometric Pressure (mbar): 976	

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: 94.0 dB(A)

Exterior Ambient Noise Level: 36.3 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	70.8	1	72.3
2	70.4	2	71.7
3	72.4	3	70.6
4	72.2	4	74.0
5	73.0	5	71.8
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 = 72.7 dB(A)		Average of two highest actual noise levels = 73.2 dB(A)	

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: None noted.

EXTERIOR NOISE TEST DATA FORM
Stationary

Bus Number: 2023-01	Date: 03/28/23
Personnel: F.T., R.M. & E.L.	
Temperature (°F): 54	Humidity (%): 46
Wind Speed (mph): 5	Wind Direction: NE
Barometric Pressure (mbar): 978	
Initial Sound Level Meter Calibration: 94.0 dB(A)	
Exterior Ambient Noise Level: 32.4 dB(A)	

Air Conditioning ON

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	630	44.4	41.0
High Idle	3000	58.2	56.5
Wide Open Throttle	3000	58.2	56.5

Air Conditioning OFF

Throttle Position	Engine RPM	Curb (Right) Side dB(A)	Street (Left) Side db(A)
		Measured	Measured
Low Idle	630	42.5	40.5
High Idle	3000	58.3	56.2
Wide Open Throttle	3000	58.3	56.2

Final Sound Level Meter Calibration Check: 94.0 dB(A)

Comments: High idle same as wide open throttle.

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 Horiba 500 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.

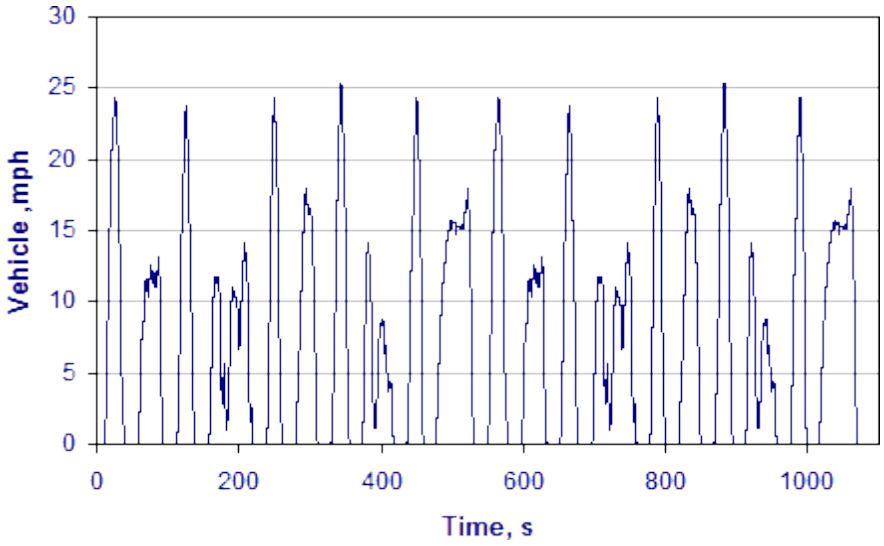


***Figure 8.1**. Manhattan Driving Cycle (Duration 1089 sec, Maximum Speed 25.4 mph, Average Speed 6.8 mph)*

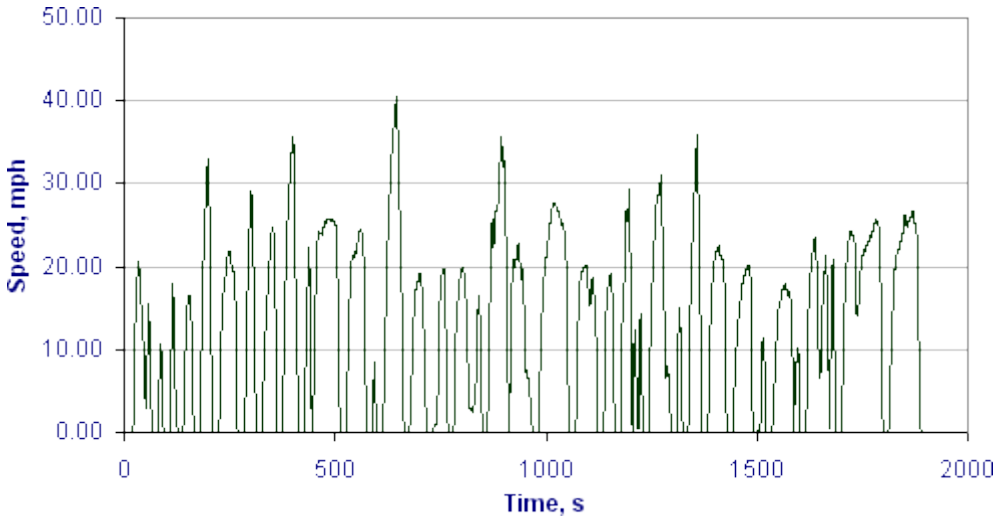


***Figure 8.2**. Orange County Bus Cycle (Duration 1909 Sec, Maximum Speed 41 mph, Average Speed 12 mph)*

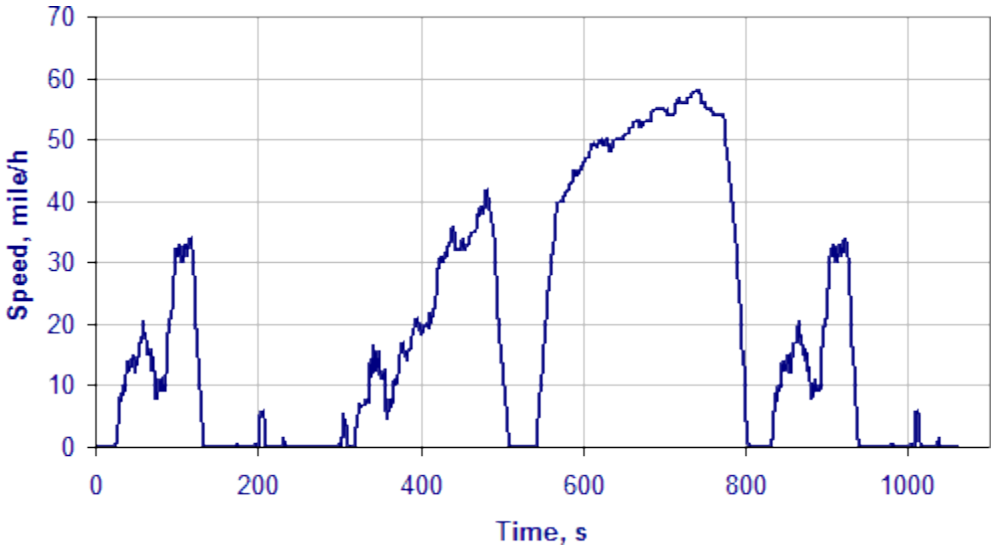


***Figure 8.3**. HD-UDDS Cycle (Duration 1060 seconds, Maximum Speed 58 mph, Average Speed 18.86 mph)*

8-III. TEST ARTICLE

The test article is The Braun Corporation / BraunAbility, Voyager ADA with Rear Entry Foldout Ramp model transit bus equipped with a gasoline fueled FCA US LLC 3.6 L motor. The bus was tested on March 17, 2023 with the odometer reading 2,203 miles.

8-IV. TEST EQUIPMENT

Testing was performed in the LTI Vehicle Testing Laboratory emissions testing bay. The test bay is equipped with a Horiba 500 hp 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 the 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: 5,840 lb.			
Driving Cycle	**Manhattan**	**Orange County Bus**	**UDDS**
CO_2, gm/mi	876	595	476
CO, gm/mi	0.68	0.51	0.52
THC, gm/mi	0.03	0.01	0.03
NMHC, gm/mi	0.03	0.01	0.02
NO_x, gm/mi	0.00	0.00	0.00
Particulates. gm/mi	0.00	0.00	0.00

8. EMISSIONS TEST

BUS TESTED ON CHASSIS DYNAMOMETER FOR PERFORMANCE, FUEL ECONOMY AND EMISSIONS