PARTIAL

STURAA TEST

7 YEAR

200,000 MILE BUS

from

SUPREME CORPORATION

MODEL SENATOR S II

MARCH 2005

PTI-BT-R0502

PENNSTATE

1855

The Pennsylvania Transportation Institute

201 Research Office Building (814) 865-1891
The Pennsylvania State University
University Park, PA 16802

Bus Testing and Research Center

2237 Old Rt. 220 N. (814) 695-3404
Duncansville, PA 16635

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EXECUTIVE SUMMARY

Supreme Corporation submitted a model Senator SII, diesel-powered 17 seat (including the driver) 24-foot bus, for a partial STURAA test in the 7 yr/200,000 mile category. The Federal Transit Administration determined that the following tests would be performed: 2. Reliability and 5.7 Structural Durability Test. Testing started on January 7, 2005 and was completed on March 4, 2005. The Check-In section of the report provides a description of the bus and specifies its major components.

The partial test which involved the Structural Durability Test also provides the information for the Reliability results. The Structural Durability Test was started on January 13, 2005 and was completed on March 3, 2005.

The interior of the bus is configured with seating for 17 passengers including the driver and two wheelchair positions. Free floor space will accommodate 11 standing passengers resulting in a potential capacity of 28 persons and two wheelchair positions. At 150 lbs per person and 600 lbs per wheelchair position, this load results in a measured gross vehicle weight of 15,560 lbs. In order to avoid exceeding the GAWR (9,450 lbs) of the rear axle, ballast for eight standing passengers and one wheelchair position was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 13,840 lbs and was used for all dynamic testing. The SLW segment was performed at 13,440 lbs. Note: one wheelchair position was eliminated in order to avoid exceeding the GAWR (9,450 lbs) of the rear axle, and the final segment was performed at a CW of 10,250 lbs. Durability driving resulted in unscheduled maintenance and failures that involved a variety of subsystems. A description of failures and a complete and detailed listing of scheduled and unscheduled maintenance are provided in the Maintainability section of this report.

The Reliability section compiles failures that occurred during Structural Durability Testing. Breakdowns are classified according to subsystems. The data in this section are arranged so that those subsystems with more frequent problems are apparent. The problems are also listed by class as defined in Section 2. The test bus encountered no Class 1 or Class 2 failures. Of the four reported failures, one was a Class 3 and three were Class 4.

ABBREVIATIONS

ABTC	-	Altoona Bus Test Center
A/C	-	air conditioner
ADB	-	advance design bus
ATA-MC	-	The Maintenance Council of the American Trucking Association
CBD	-	central business district
CW	-	curb weight (bus weight including maximum fuel, oil, and coolant; but without passengers or driver)
dB(A)	-	decibels with reference to 0.0002 microbar as measured on the "A" scale
DIR	-	test director
DR	-	bus driver
EPA	-	Environmental Protection Agency
FFS	-	free floor space (floor area available to standees, excluding ingress/egress areas, area under seats, area occupied by feet of seated passengers, and the vestibule area)
GVL	-	gross vehicle load (150 lb for every designed passenger seating position, for the driver, and for each 1.5 sq ft of free floor space)
GVW	-	gross vehicle weight (curb weight plus gross vehicle load)
GVWR	-	gross vehicle weight rating
MECH	-	bus mechanic
mpg	-	miles per gallon
mph	-	miles per hour
PM	-	Preventive maintenance
PSBRTF	-	Penn State Bus Research and Testing Facility
PTI	-	Pennsylvania Transportation Institute
rpm	-	revolutions per minute
SAE	-	Society of Automotive Engineers
SCH	-	test scheduler
SEC	-	secretary
SLW	-	seated load weight (curb weight plus 150 lb for every designed passenger seating position and for the driver)
STURAA	-	Surface Transportation and Uniform Relocation Assistance Act
TD	-	test driver
TECH	-	test technician
TM	-	track manager
TP	-	test personnel

TEST BUS CHECK-IN

I. OBJECTIVE

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

II. TEST DESCRIPTION

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

III. DISCUSSION

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

The test bus consists of a Supreme Corporation, model Senator SII. The test bus is built on a Ford E-450 Super Duty chassis. The bus has an OEM driver's and passenger door rear of the front axle and a passenger door just aft of the cab passenger door equipped with a Braun Model L917FIB hydraulic platform handicap lift. Power is provided by a diesel-fueled, Ford Motor Co. model 6.0 L Power Stroke engine coupled to a Ford Motor Co. model 4R100 transmission.

The measured curb weight is 3,960 lbs for the front axle and 6,290 lbs for the rear axle. These combined weights provide a total measured curb weight of 10,250 lbs. There are 17 seats including the driver, two wheelchair positions and room for 11 standing passengers bringing the total passenger capacity to 28 and 2 wheelchairs. Gross load is 150 lb x 28 = 4,200 lbs = 1,200 lbs (2 wheelchairs) = 5,400 lbs. At full capacity, the measured gross vehicle weight is 15,560 lbs. In order to avoid exceeding the GAWR (9,450 lbs) of the rear axle, ballast for eight standing passengers and one wheelchair position was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 13,840 lbs and was used for all dynamic testing.

VEHICLE DATA FORM

Bus Number: 0502	Arrival Date: 1-7-05
Bus Manufacturer: Supreme Corporation	Vehicle Identification Number (VIN): 1FDXE45P44HA74490
Model Number: Senator S II	Date: 1-7-05
Personnel: S.C., T.S. & M.H.	

WEIGHT: Values in parenthesis indicate the adjusted weights necessary to avoid exceeding the GAWR. These values were used for all dynamic testing.

Individual Wheel Reactions:

Weights (lb)	Front Axle		Middle Axle		Rear Axle	
	Right	Left	Right	Left	Right	Left
CW	2,020	1,940	N/A	N/A	3,410	2,880
SLW	2,150 (2,130)	2,250 (2,200)	N/A	N/A	5,050 (4,280)	4,650 (4,830)
GVW	2,140 (2,120)	2,310 (2,450)	N/A	N/A	5,790 (4,810)	5,320 (4,460)

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	3,960	4,400 (4,570)	4,450 (4,570)	4,600
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	6,290	9,700 (9,110)	11,110 (9,270)	9,450
Total	10,250	14,100 (13,440)	15,560 (13,840)	GVWR: 14,050

Dimensions:

Length (ft/in)	24 / 2.5
Width (in)	98.0
Height (in)	114.0
Front Overhang (in)	29.5
Rear Overhang (in)	85.0
Wheel Base (in)	176.0
Wheel Track (in)	Front: 68.4
	Rear: 77.5

Bus Number: 0502	Date: 1-7-05

CLEARANCES:

Lowest Point Outside Front Axle	Location: Steering stabilizer Clearance(in): 11.1
Lowest Point Outside Rear Axle	Location: Exhaust pipe Clearance(in): 14.2
Lowest Point between Axles	Location: Body @ step well Clearance(in): 9.0
Ground Clearance at the center (in)	11.0
Front Approach Angle (deg)	25.5
Rear Approach Angle (deg)	10.5
Ramp Clearance Angle (deg)	7.9
Aisle Width (in)	19.5
Inside Standing Height at Center Aisle (in)	81.3

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel & fiberglass		
Floor Material	Plywood		
Roof Material	Fiberglass / composite		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	HEHR / AS3 DOT 269		
Number of Doors	1 Front	1 Rear	
Mfr. / Model No.	Supreme Corp. / NA		
Dimension of Each Door (in)	Front– 31.8 x 83.0 Driver-31.8 x 54.4	Handicap – 47.1 x 70.4 Emergency – 32.1 x 57.9	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	Freedman Seating Corp. / Featherweight Mid-Hi		
Driver Seat Type	□ Air	□ Spring	■ Other (explain)
Mfr. / Model No.	Ford Motor Co. / OEM		
Number of Seats (including Driver)	17 + 2 wheelchair positions		

Bus Number: 0502	Date: 1-7-05

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	16.8
Height of Each Step at Normal Position (in)	Front 1. 10.3 2. 8.4 3. 8.6 4. N/A
	Middle 1. N/A 2. N/A 3. N/A 4. N/A
	Rear 1. N/A 2. N/A 3. N/A 4. N/A
Step Elevation Change - Kneeling (in)	N/A

ENGINE

Type	■ C.I.	□ Alternate Fuel	
	□ S.I.	□ Other (explain)	
Mfr. / Model No.	Ford Motor Co. / 6.0 L Power Stroke		
Location	■ Front	□ Rear	□ Other (explain)
Fuel Type	□ Gasoline	□ CNG	□ Methanol
	■ Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	55 gals		
Fuel Induction Type	■ Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	Ford Motor Co. / 6.0 L Power Stroke		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Ford Motor Co. / 6.0 L Power Stroke		
Alternator (Generator) Mfr. / Model No.	Ford/Motorcraft / 3GLF		
Maximum Rated Output (Volts / Amps)	12 / 130		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft^3 / min)	N/A		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Visteon / 484720		

Bus Number: 0502	Date: 1-7-05

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Ford Motor Co. / 4R100		
Control Type	■ Mechanical	□ Electrical	□ Other
Torque Converter Mfr. / Model No.	Ford Motor Co. / 4R100		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	■ Independent	□ Beam Axle	
Mfr. / Model No.	Ford Motor Co. / Twin I-Beam		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	■ Spring	□ Other
No. of Shock Absorbers	2		
Mfr. / Model No.	Motorcraft / 1C24-18045-AA		
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.	Dana Corp. / 10.75 HD		
Axle Ratio (if driven)	4.10		
Suspension Type	□ Air	■ Spring	□ Other
No. of Shock Absorbers	2		
Mfr. / Model No.	Motorcraft / XC25-18080-EA		

Bus Number: 0502	Date: 1-7-05

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Michelin / LTX LT225/75R 16
Rear	Wheel Mfr./ Model No.	Accuride / 16 x 6
	Tire Mfr./ Model No.	Michelin / LTX LT225/75R 16

BRAKES

Front Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Ford Motor Co. / 13.03		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Ford Motor Co. / 12.9		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	18,000 = 65,000		
Mfr. / Model No.	Ford OEM 7 Pro-Air / 18,000 OEM & 65,000		
Air Conditioner	■ Yes	□ No	
Location	Dash & rear ceiling		
Capacity (Btu/hr)	18,000 & 68,000		
A/C Compressor Mfr. / Model No.	Seltac / TM16		

STEERING

Steering Gear Box Type	Hydraulic gear
Mfr. / Model No.	Power Ford / XR-50 HD

Steering Wheel Diameter	15.5
Number of turns (lock to lock)	4.0

Bus Number: 0502	Date: 1-7-05

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: Right rear	Type: Hydraulic platform
Mfr. / Model No.	Braun Corp. / L917FIB	
Emergency Exit	Location: Windows Doors	Number: 3 2

CAPACITIES

Fuel Tank Capacity (units)	55 gals
Engine Crankcase Capacity (gallons)	3.75
Transmission Capacity (gallons)	2.375
Differential Capacity (pints)	8.25
Cooling System Capacity (quarts)	6.9
Power Steering Fluid Capacity (gallons)	Not available

VEHICLE DATA FORM

Bus Number: 0502	Date: 1-7-05

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

Part Number	Description	Qty.
Michelin LTX LT225/75 R 16	Mounted tire	1
NA	Operators manual	1

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0502	Date: 1-7-05

Subsystem	Checked	Comments
Air Conditioning Heating and Ventilation		
Body and Sheet Metal		
Frame		
Steering		
Suspension		
Interior/Seating		
Axles		
Brakes		
Tires/Wheels		
Exhaust		
Fuel System		Diesel
Power Plant		
Accessories		
Lift System		
Interior Fasteners		
Batteries		

CHECK - IN

SUPREME CORPORATION'S
MODEL SENATOR SII

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

2-I. TEST OBJECTIVE

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

2-II. TEST DESCRIPTION

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

CLASS OF FAILURES

Classes of failures are described below:

(a) Class 1: Physical Safety. A failure that could lead directly to passenger or driver injury and represents a severe crash situation.

(b) Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

(c) Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

(d) Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade coach operation. The failure shall be reported by driver, inspector, or hostler.

2-III. DISCUSSION

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

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

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There was no Class 1 or 2 failures. The one Class 3 failure was the result of a failed alternator. This and the remaining three Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0502	Date: 3/3/05
Personnel: Bob Reifsteck	

	Failure Type			
	Class 4 Bad Order	Class 3 Bus Change	Class 2 Road Call	Class 1 Physical Safety

Subsystems	Mileage	Mileage	Mileage	Mileage	Man Hours	Down Time
Exhaust System	5,894				0.50	0.50
	6,622				1.00	1.00
Electrical		4,177			2.50	2.50
Wheel/Tires	6,622				0.50	0.50

5.7 STRUCTURAL DURABILITY TEST

5.7-I. TEST OBJECTIVE

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

5.7-II. TEST DESCRIPTION

The test vehicle is driven a total of 7,500 miles; approximately 5,000 miles on the PSBRTF Durability Test Track and approximately 2,500 miscellaneous other miles. The test will be conducted with the bus operated under three different loading conditions. The first segment will consist of approximately 3,000 miles with the bus operated at GVW. The second segment will consist of approximately 1,500 miles with the bus operated at SLW. The remainder of the test, approximately 3,000 miles, will be conducted with the bus loaded to CW. If GVW exceeds the axle design weights, then the load will be adjusted to the axle design weights and the change will be recorded. All subsystems are run during these tests in their normal operating modes. All recommended manufacturers servicing is to be followed and noted on the vehicle maintainability log. Servicing items accelerated by the durability tests will be compressed by 10:1; all others will be done on a 1:1 mi/mi basis. Unscheduled breakdowns and repairs are recorded on the same log as are any unusual occurrences as noted by the driver. Once a week the test vehicle shall be washed down and thoroughly inspected for any signs of failure.

5.7-III. DISCUSSION

The Structural Durability Test was started on January 13, 2005 and was conducted until March 3, 2005. The first 3,000 miles were performed at a GVW of 13,840 lbs. The ballast for standing passengers was reduced from 11 to 8 and one handicap position was eliminated. The GVW segment was completed on January 27, 2005. The next 1,500 mile SLW segment was performed at 13,440 lbs and was completed on February 10, 2005. Note: one wheelchair position was eliminated to avoid exceeding the GAWR (9,450 lbs) of the rear axle. The final 3,000 mile segment was performed at a CW of 10,250 lbs and completed on March 3, 2005.

The following mileage summary presents the accumulation of miles during the Structural Durability Test. The driving schedule is included, showing the operating duty cycle. A detailed plan view of the Test Track Facility and Durability Test Track are attached for reference. Also, a durability element profile detail shows all the measurements of the different conditions.

SUPREME - TEST BUS #0502

MILEAGE DRIVEN/RECORDED FROM DRIVERS= LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
01/10/05 TO 01/16/05	146.00	67.00	213.00
01/17/05 TO 01/23/05	1011.00	144.00	1155.00
01/24/05 TO 01/30/05	843.00	933.00	1776.00
01/31/05 TO 02/06/05	685.00	348.00	1033.00
02/07/05 TO 02/13/05	461.00	126.00	587.00
02/14/05 TO 02/20/05	885.00	245.00	1130.00
02/21/05 TO 02/27/05	810.00	37.00	847.00
02/28/05 TO 03/06/05	159.00	600.00	759.00
TOTAL	5000.00	2500.00	7500.00

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

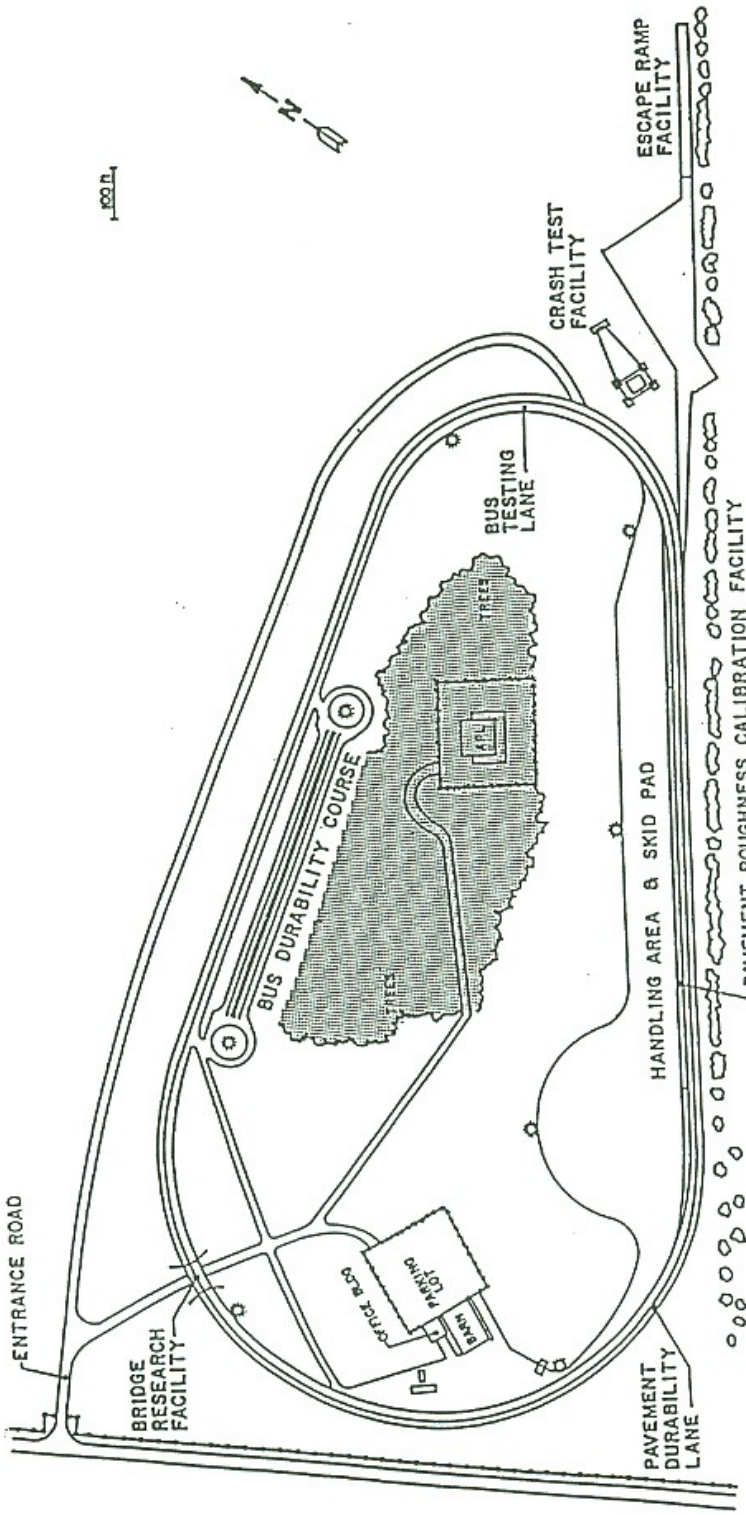
STANDARD OPERATING SCHEDULE

Monday through Friday

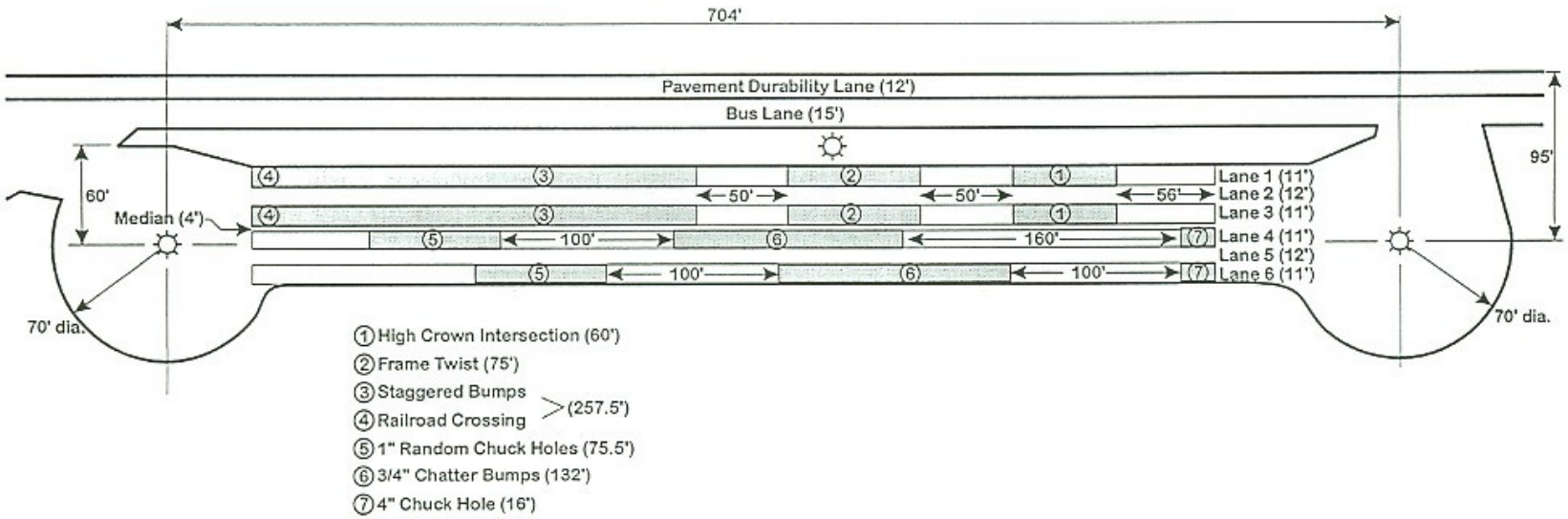
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift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

B---Break
C----Cycle all systems five times, visual inspection, driver's log entries
D----Drive bus as specified by procedure
F----Fuel bus, complete driver's log shift entries

"PLAN VIEW OF PENN STATE BUS TESTING AND RESEARCH FACILITY"



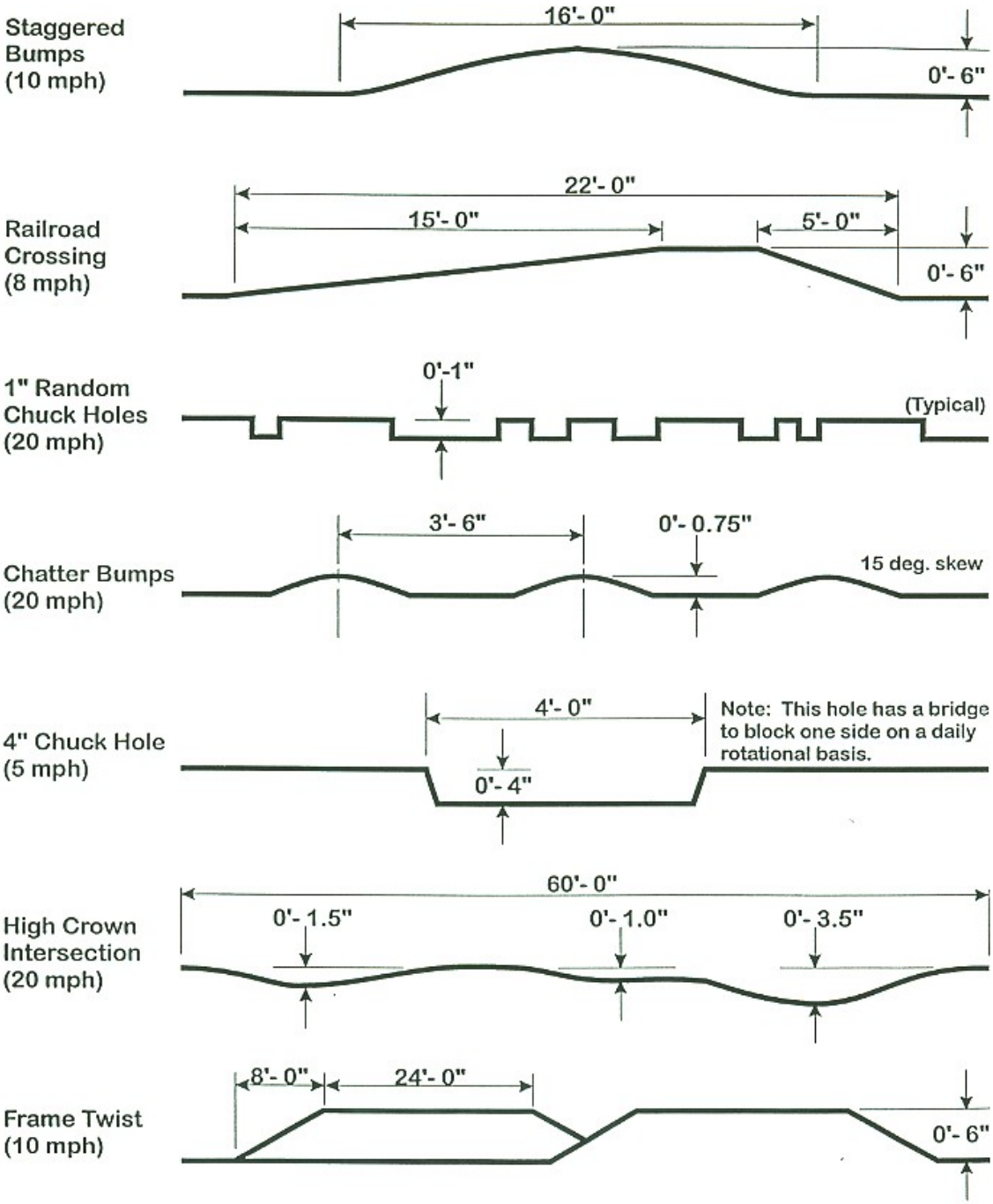
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

Supreme 0502

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
02/07/05	4,177	The engine won't crank, battery will not take charge and charging system is below 12 volts.	Battery and alternator replaced.	2.50	2.50
02/21/05	5,894	The tail pipe is loose.	One broken tail pipe hanger replaced.	0.50	0.50
02/25/05	6,622	The right front tire is leaking air.	Right front tire leak located and hole plugged.	0.50	0.50
02/25/05	6,622	The tail pipe is loose.	Two broken tail pipe hangers replaced.	1.00	1.00

Filename: Report.0502.doc
Directory: E:
Template: C:\Documents and Settings\vnocek\Application Data\Microsoft\Templates\Normal.dot
Title: 5
Subject:
Author: Sondra Hoover
Keywords:
Comments:
Creation Date: 3/22/2005 10:49:00 AM
Change Number: 2
Last Saved On: 3/22/2005 10:49:00 AM
Last Saved By: shoover
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