PARTIAL

STURAA TEST

10 YEAR

350,000 MILE BUS

from

GLAVAL BUS, DIVISION of FOREST RIVER, INC.

MODEL GMC 5500

SEPTEMBER 2005

PTI-BT-R0508-P

PENNSTATE

1855

The Pennsylvania Transportation Institute

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The Pennsylvania State University
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EXECUTIVE SUMMARY

Glaval Bus, Division of Forest River, Inc. submitted a model GMC 5500, diesel-powered 32 seat (including the driver) 32-foot bus, for a partial STURAA test in the 10 yr/350,000 mile category. The Federal Transit Administration determined that the following tests would be performed: 1.2 Servicing, P.M. Repair & Maintenance, 2. Reliability and 5.7 Structural Durability Test. Testing started on April 28, 2005 and was completed on August 26, 2005. The Check-In section of the report provides a description of the bus and specifies its major components.

The primary part of the test program is the Structural Durability Test, which also provides the information for the Maintainability and Reliability results. The Structural Durability Test was started on April 29, 2005 and was completed on August 26, 2005.

The test bus is built on a GMC 5500 chassis. The interior of the bus is configured with seating for 32 passengers including the driver. Free floor space will accommodate 16 standing passengers resulting in a potential load of 48 persons. At 150 lbs per person, this load results in a measured gross vehicle weight of 21,750 lbs. In order to avoid exceeding the GAWR (13,500 lbs) of the rear axle, ballast for 10 standing passengers was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 19,670 lbs and was used for all dynamic testing. The middle segment was performed at a SLW of 18,530 lbs and the final segment was performed at a CW of 13,610 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 is 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 failures. Of the twenty-four reported failures, 3 were Class 2, fourteen were Class 3 and 7 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 Glaval Bus, model GMC 5500. The bus has a front door to the rear of the front axle, and a rear emergency only door at the rear of the bus. Note; the test vehicle was not equipped with a handicap device. Power is provided by a diesel-fueled, General Motors model Duramax 6.6 L engine coupled to an Allison model 1000 PTS transmission.

The measured curb weight is 5,410 lbs for the front axle and 8,200 lbs for the rear axle. These combined weights provide a total measured curb weight of 13,610 lbs. There are 32 seats including the driver and room for 16 standing passengers bringing the total passenger capacity to 48. Gross load is 150 lb x 48 = 7,200 lbs. At full capacity, the measured gross vehicle weight is 21,750 lbs. This value was used for all static tests. In order to avoid exceeding the GAWR (13,500 lbs) of the rear axle, ballast for 10 standing passengers was eliminated. This reduction from full capacity resulted in an adjusted measured gross vehicle weight of 19,670 lbs and was used for all dynamic testing.

VEHICLE DATA FORM

Bus Number: 0508	Arrival Date: 4-28-05
Bus Manufacturer:	Vehicle Identification Number (VIN): 1GDE5V1275F518224
Model Number: Titan	Date: 4-28-05
Personnel: S.C.	Chassis: GMC 5500

WEIGHT: *Values in parentheses 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	2,680	2,730	N/A	N/A	4,040	4,160
SLW	2,900	2,940	N/A	N/A	6,340	6,350
GVW	3,280 (3,230)	3,150 (3,110)	N/A	N/A	7,650 (6,680)	7,670 (6,650)

Total Weight Details:

Weight (lb)	CW	SLW	GVW	GAWR
Front Axle	5,410	5,840	6,430 (6,340)	7,000
Middle Axle	N/A	N/A	N/A	N/A
Rear Axle	8,200	12,690	15,320 (13,330)	13,500
Total	13,610	18,530	21,750 (19,670)	GVWR: 19,500

Dimensions:

Length (ft/in)	32 / 10.0
Width (in)	97.00
Height (in)	121.75
Front Overhang (in)	35.75
Rear Overhang (in)	125.00
Wheel Base (in)	233.25
Wheel Track (in)	Front: 79.8
	Rear: 73.2

Bus Number: 0508	Date: 4-28-05

CLEARANCES:

Lowest Point Outside Front Axle	Location: Stabilizer bar Clearance(in): 11.3
Lowest Point Outside Rear Axle	Location: Fuel tank Clearance(in): 13.3
Lowest Point between Axles	Location: Step well Clearance(in): 10.4
Ground Clearance at the center (in)	9.6
Front Approach Angle (deg)	23.4
Rear Approach Angle (deg)	10.4
Ramp Clearance Angle (deg)	4.7
Aisle Width (in)	16.0
Inside Standing Height at Center Aisle (in)	78.5

BODY DETAILS:

Body Structural Type	Integral		
Frame Material	Steel		
Body Material	Steel & fiberglass		
Floor Material	Plywood		
Roof Material	Fiberglass		
Windows Type	□ Fixed	■ Movable	
Window Mfg./Model No.	KTG / AS3 DOT650 M3		
Number of Doors	1 Front	1 Rear (emergency door)	
Mfr. / Model No.	Glaval / 143283		
Dimension of Each Door (in)	Front– 31.0 x 83.5	Rear – 36.0 x 65.0	
Passenger Seat Type	□ Cantilever	■ Pedestal	□ Other (explain)
Mfr. / Model No.	Freedman Seating / Featherweight high back		
Driver Seat Type	□ Air	□ Spring	■ Other (Cushion)
Mfr. / Model No.	GM / AMI #15236148		
Number of Seats (including Driver)	32		

Bus Number: 0508	Date: 4-28-05

BODY DETAILS (Contd..)

Free Floor Space (ft^2)	24.4			
Height of Each Step at Normal Position (in)	Front	1. 12.6	2. 8.4	3. 8.4 4. 8.3
	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.	Duramax Diesel, General Motors / 6.6 L		
Location	■ Front	□ Rear	□ Other (explain)
Fuel Type	□ Gasoline	□ CNG	□ Methanol
	■ Diesel	□ LNG	□ Other (explain)
Fuel Tank Capacity (indicate units)	63 gals		
Fuel Induction Type	■ Injected	□ Carburetion	
Fuel Injector Mfr. / Model No.	Duramax Diesel, General Motors / 6.6 L		
Carburetor Mfr. / Model No.	N/A		
Fuel Pump Mfr. / Model No.	Duramax Diesel, General Motors / 6.6 L		
Alternator (Generator) Mfr. / Model No.	Delphi Automotive / AD230		
Maximum Rated Output (Volts / Amps)	14 / 140		
Air Compressor Mfr. / Model No.	N/A		
Maximum Capacity (ft^3 / min)	N/A		
Starter Type	■ Electrical	□ Pneumatic	□ Other (explain)
Starter Mfr. / Model No.	Hitachi / S14-100E		

Bus Number: 0508	Date: 4-28-05

TRANSMISSION

Transmission Type	□ Manual	■ Automatic	
Mfr. / Model No.	Allison Transmission / 1000 PTS		
Control Type	■ Mechanical	□ Electrical	□ Other
Torque Converter Mfr. / Model No.	Allison Transmission / 1000 PTS		
Integral Retarder Mfr. / Model No.	N/A		

SUSPENSION

Number of Axles	2		
Front Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Arvin Meritor / MFS07153CNN4		
Axle Ratio (if driven)	N/A		
Suspension Type	■ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	2		
Mfr. / Model No.	General Motors / 88982682		
Middle Axle Type	□ Independent	□ Beam Axle	
Mfr. / Model No.	N/A		
Axle Ratio (if driven)	N/A		
Suspension Type	□ Air	□ Spring	□ Other (explain)
No. of Shock Absorbers	N/A		
Mfr. / Model No.	N/A		
Rear Axle Type	□ Independent	■ Beam Axle	
Mfr. / Model No.	Spicer / S135S		
Axle Ratio (if driven)	4.78		
Suspension Type	□ Air	■ Spring	□ Other (explain)

No. of Shock Absorbers	2
Mfr. / Model No.	General Motors / 1518546

Bus Number: 0508	Date: 4-28-05

WHEELS & TIRES

Front	Wheel Mfr./ Model No.	Accuride / 135X6.75
	Tire Mfr./ Model No.	Goodyear G647 RSA / 225/70R 19.5
Rear	Wheel Mfr./ Model No.	Accuride / 135X6.75
	Tire Mfr./ Model No.	Goodyear G647 RSA / 225/70R 19.5

BRAKES

Front Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	Meritor / HVBS		
Middle Axle Brakes Type	□ Cam	□ Disc	□ Other (explain)
Mfr. / Model No.	N/A		
Rear Axle Brakes Type	□ Cam	■ Disc	□ Other (explain)
Mfr. / Model No.	TRW 66mm, 2 piston / N/A		
Retarder Type	N/A		
Mfr. / Model No.	N/A		

HVAC

Heating System Type	□ Air	■ Water	□ Other
Capacity (Btu/hr)	65,000		
Mfr. / Model No.	Dash - General Motors / O.E.M. Floor – Pro Air / 465		
Air Conditioner	■ Yes	□ No	
Location	Dash & Interior roof		
Capacity (Btu/hr)	93,000		
A/C Compressor Mfr. / Model No.	Seltec / TM-16		

STEERING

Steering Gear Box Type	Hydraulic gear

Mfr. / Model No.	ZF / 8014 974 104
Steering Wheel Diameter	15.3
Number of turns (lock to lock)	4.5

Bus Number: 0508	Date: 4-28-05

OTHERS

Wheel Chair Ramps	Location: N/A	Type: N/A
Wheel Chair Lifts	Location: N/A	Type: N/A
Mfr. / Model No.	N/A	
Emergency Exit	Location: Windows Doors Roof hatch	Number: 4 2 1

CAPACITIES

Fuel Tank Capacity (units)	63 gals
Engine Crankcase Capacity (gallons)	3.0
Transmission Capacity (gallons)	3.7
Differential Capacity (gallons)	4.5
Cooling System Capacity (quarts)	6.0 (engine only)
Power Steering Fluid Capacity (gallons)	1.3L

VEHICLE DATA FORM

Bus Number: 0508	Date: 4-28-05

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

Part Number	Description	Qty.
Goodyear G647 225/70R 19.5	Mounted tires	4
W48-115-C2	Belts 6 Rib 345mm	2
L16-011-B2	Air filter	2
1518546	Rear shock	4
88982682	Front shock	4
TP1298	Fuel filter	2
PF 2232	Oil filter	2
29539579	Transmission filter	2
88892858	Hydraulic filter	2

COMPONENT/SUBSYSTEM INSPECTION FORM

Bus Number: 0508	Date: 04/28/05

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

CHECK - IN

GLAVAL BUS
MODEL GMC 5500

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

1.2-I. TEST OBJECTIVE

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

1.2.-II. TEST DESCRIPTION

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

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

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

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

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

B. Preventive Maintenance
    4. Brake adjustments
    5. Lubrication
    6. 3,000 mi (or equivalent) inspection

7. Oil and filter change inspection
8. Major inspection
9. Tune-up

C. Periodic Repairs
1. Brake reline
2. Transmission change
3. Engine change
4. Windshield wiper motor change
5. Stoplight bulb change
6. Towing operations
7. Hoisting operations

1.2-III. DISCUSSION

Servicing and preventive maintenance were performed at manufacturer specified intervals. The following Scheduled Maintenance Form lists the mileage, items serviced, the service interval, and amount of time required to perform the maintenance. Table 1 is a list of the lubricating products used in servicing. Finally, the Unscheduled Maintenance List along with Unscheduled Maintenance related photographs is included in Section 5.7, Structural Durability. This list supplies information related to failures that occurred during the durability portion of testing. The Unscheduled Maintenance List includes the date and mileage at which the malfunction occurred, a description of the malfunction and repair, and the time required to perform the repair.

SCHEDULED MAINTENANCE

Glaval #0508

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-05-05	691	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
05-23-05	1,384	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-07-05	1,762	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-15-05	2,635	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-21-05	3,737	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
06-30-05	4,264	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-05-05	5,071	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

SCHEDULED MAINTENANCE

Glaval #0508

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
07-14-05	6,776	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-21-05	7,636	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
07-26-05	8,304	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-02-05	9,654	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-08-05	10,436	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00
08-26-05	11,253	P.M. / Inspection	Linkage, tie rods, universals/u-joints all lubed; all fluids checked.	4.00	4.00

Table 1. STANDARD LUBRICANTS

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

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

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

2-I. TEST OBJECTIVE

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

2-II. TEST DESCRIPTION

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

CLASS OF FAILURES

Classes of failures are described below:

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

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

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

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

2-III. DISCUSSION

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

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

The classification of repairs according to subsystem is intended to emphasize those systems which had persistent minor or more serious problems. There were no Class 1 failures. The three Class 2 failures were all the result of broken spring beams. Of the fourteen Class 3 failures, eight involved the suspension system, two to the exhaust system and one each with the frame/body, brakes, engine/transmission and steering. These, and the remaining 7 Class 4 failures are available for review in the Unscheduled Maintenance List, located in Section 5.7 Structural Durability.

RELIABILITY DATA FORMS

Bus Number: 0508	Date: 08-26-05
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
Suspension			1,762		1.00	216.00
		2,398			1.00	8.00
		2,709			1.00	2.00
		3,737			1.00	2.00
			3,923		2.00	108.00
		3,923			0.50	0.50
		7,849			0.50	1.00
		7,849			1.00	2.00
	9,654				0.50	0.50
		10,436			0.50	0.50
			10,437		1.00	224.00
Frame/Body		2,900			0.50	2.00
	3,737				1.00	1.00
	9,654				0.50	0.50
Exhaust System		5,064			1.00	24.00
		7,849			1.00	2.00
Windows	1,333				1.00	8.00
	2,709				0.50	0.50

RELIABILITY DATA FORMS

Bus Number: 0508	Date: 08-26-05
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
A/C	7,849				1.00	1.00
Brakes		1,288			1.50	152.00
Engine/Transmission		2,471			0.50	44.00
Steering		7,849			1.00	2.00
Tires	7,636				1.00	1.00

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 11,250 miles; approximately 8,750 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 4,625 miles with the bus operated at GVW. The second segment will consist of approximately 2,000 miles with the bus operated at SLW. The remainder of the test, approximately 4,625 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 April 29, 2005 and was conducted until August 26, 2005. The first 4,625 miles were performed at a GVW of 19,670 lbs. The number of standing passengers was reduced from 16 to 6. The ballast for 10 standing passengers was eliminated. This reduction in passenger weight was necessary to avoid exceeding the GAWR (13,500 lbs) of the rear axle. The GVW segment was completed on July 1, 2005. The next 2000 mile SLW segment was performed at 18,530 lbs and completed on July 14, 2005, and the final 4,625 mile segment was performed at a CW of 13,610 lbs and completed on August 26, 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. Finally, photographs illustrating some of the failures that were encountered during the Structural Durability Test are included.

GLAVAL - TEST BUS #0508
MILEAGE DRIVEN/RECORDED FROM DRIVERS' LOGS
4/25/05 - 5/01/05

DATE	SHIFT	DURABILITY TRACK	OTHER MILES	TOTAL
04/25/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	0.00	0.00
	4 PM/12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
04/26/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	0.00	0.00
	4 PM/12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
04/27/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM /4 PM	0.00	0.00	0.00
	4 PM /12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
04/28/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	0.00	0.00
	4 PM/12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
04/29/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	53.00	53.00
	4 PM/12 AM	89.00	4.00	93.00
		89.00	57.00	146.00
04/30/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	0.00	0.00
	4 PM/12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
05/01/05	12 AM/ 8 AM	0.00	0.00	0.00
	8 AM/ 4 PM	0.00	0.00	0.00
	4 PM/12 AM	0.00	0.00	0.00
		0.00	0.00	0.00
TOTALS		89.00	57.00	146.00

GLAVAL - TEST BUS #0508
MILEAGE DRIVEN/RECORDED FROM DRIVERS' LOGS

DATE	TOTAL DURABILITY TRACK	TOTAL OTHER MILES	TOTAL
04/25/05 TO 05/01/05	89.00	57.00	146.00
TOTAL	89.00	57.00	146.00

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

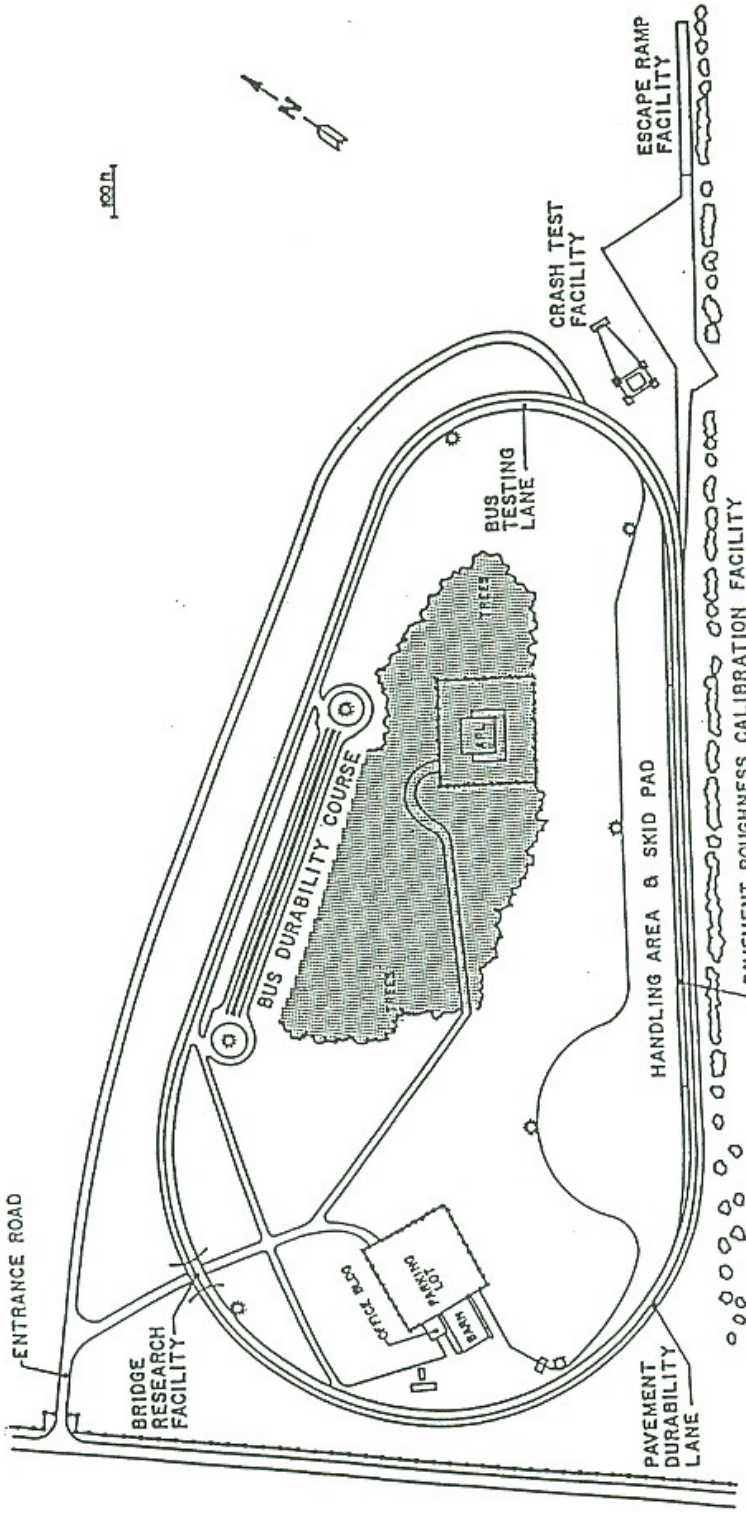
STANDARD OPERATING SCHEDULE

Monday through Friday

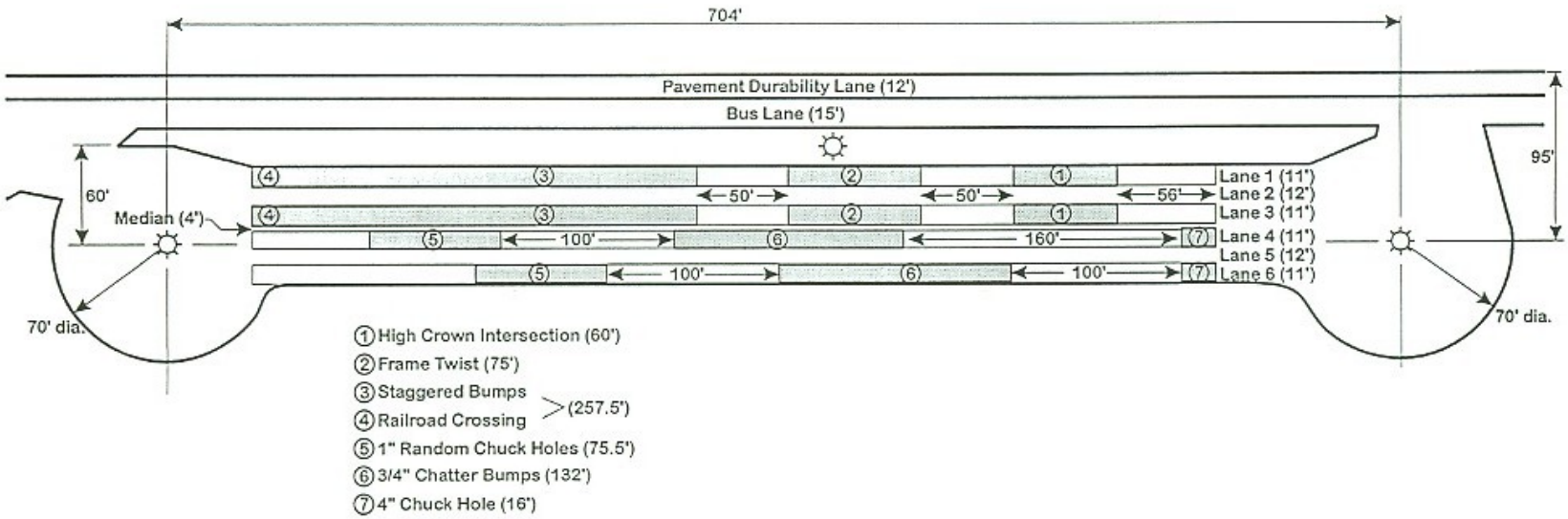
	HOUR	ACTION
Shift 1	midnight	D
	1:40 am	C
	1:50 am	B
	2:00 am	D
	3:35 am	C
	3:45 am	B
	4:05 am	D
	5:40 am	C
	5:50 am	B
	6:00 am	D
	7:40 am	C
	7:50 am	F
Shift 2	8:00 am	D
	9:40 am	C
	9:50 am	B
	10:00 am	D
	11:35 am	C
	11:45 am	B
	12:05 pm	D
	1:40 pm	C
	1:50 pm	B
	2:00 pm	D
	3:40 pm	C
	3:50 pm	F
Shift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



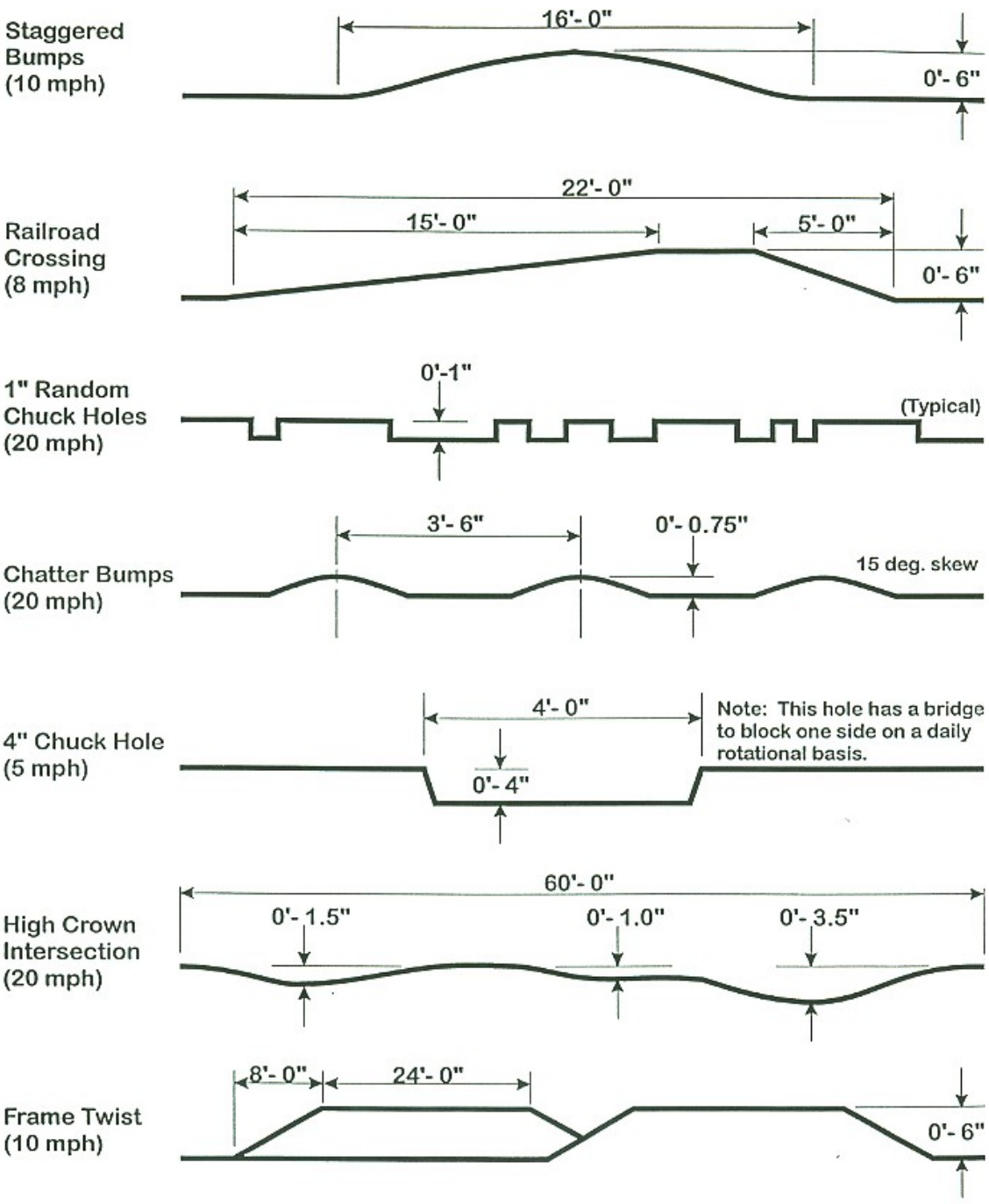
BUS TESTING AND RESEARCH TEST TRACK
UNIVERSITY PARK, PA



Plan View

Vehicle Durability Test Track

The Pennsylvania Transportation Institute
Penn State



Durability Element Profiles

The Pennsylvania Transportation Institute
Penn State

UNSCHEDULED MAINTENANCE

Glaval 0508

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
05-19-05	1,288	Hydraulic fluid is leaking at the brake booster pump. One o-ring is split.	Both o-ring seals at the pump replaced. Hydraulic fluid topped off, system bled.	152.00	1.50
05-23-05	1,333	Five emergency window latches are broken.	Five window latches replaced.	8.00	1.00
06-07-05	1,762	The lower spring ply is broken on the left front spring beam.	Left front spring beam replaced.	216.00	1.00
06-10-05	2,398	The lower mounting stud is broken on the left front shock.	Left front shock replaced.	8.00	1.00
06-14-05	2,471	The engine accessory belt is broken.	Belt replaced.	44.00	0.50
06-15-05	2,709	The left anchor point bolt for the front sway bar is broken.	Bolt replaced.	2.00	1.00
06-15-05	2,709	Four emergency window latches are broken.	Four window latches replaced.	0.50	0.50
06-16-05	2,900	The right side, forward mounting bolt is broken and the spacer is missing on the cross member below the engine.	Broken bolt replaced.	2.00	0.50
06-21-05	3,737	The right side bolt is broken on the front sway bar bracket.	Bolt and spacer replaced.	2.00	1.00
06-21-05	3,737	The third and fifth body-to-frame bolts are missing on the left side.	Two body-to-frame bolts replaced.	1.00	1.00

UNSCHEDULED MAINTENANCE

Glaval 0508

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
06-28-05	3,923	The left front spring is broken approximately 20” from the front.	Left front spring replaced.	108.00	2.00
06-28-05	3,923	The bottom stud is broken on the left front shock.	Left front shock replaced.	0.50	0.50
07-05-05	5,064	The flange is broken on the exhaust drop pipe to the catalytic converter.	Pipe replaced.	24.00	1.00
07-21-05	7,636	Both front tires are worn.	Both front tires replaced.	1.00	1.00
07-22-05	7,849	The rear taper is loose on the front steering drag link.	Drag link replaced.	2.00	1.00
07-22-05	7,849	The right front shock is broken.	Right front shock replaced.	1.00	.0.50
07-22-05	7,849	The front sway bar is broken.	Front sway bar replaced.	2.00	1.00
07-22-05	7,849	The flange is broken on the exhaust drop pipe to the catalytic converter.	Pipe welded/repaired.	2.00	1.50
07-22-05	7,849	Both front and rear A/C’s are not functioning.	Repaired wires that were chaffing on the radiator support. Replaced relay for the rear high speed fan.	1.00	1.00
08-02-05	9,654	Two body-to-frame bolts are broken, left side, one forward and one rear of the rear axle.	Both bolts replaced.	0.50	0.50

UNSCHEDULED MAINTENANCE

Glaval 0508

DATE	TEST MILES	SERVICE	ACTIVITY	DOWN TIME	HOURS
08-02-05	9,654	The right front spring beam is missing a mounting bolt.	Mounting bolt replaced.	0.50	0.50
08-08-05	10,436	The lower stud is broken on the left front shock.	Shock replaced.	0.50	0.50
08-22-05	10,437	The main spring on the right front spring beam is cracked approximately 8” from the eye.	Right front spring beam replaced.	224.00	1.00

UNSCHEDULED MAINTENANCE

FAILED BRAKE BOOSTER PUMP O-RING
(1,288 TEST MILES)

BROKEN WINDOW LATCHES
(1,333 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

BROKEN LOWER SPRING PLY--
LEFT FRONT SPRING BEAM
(1,762 TEST MILES)

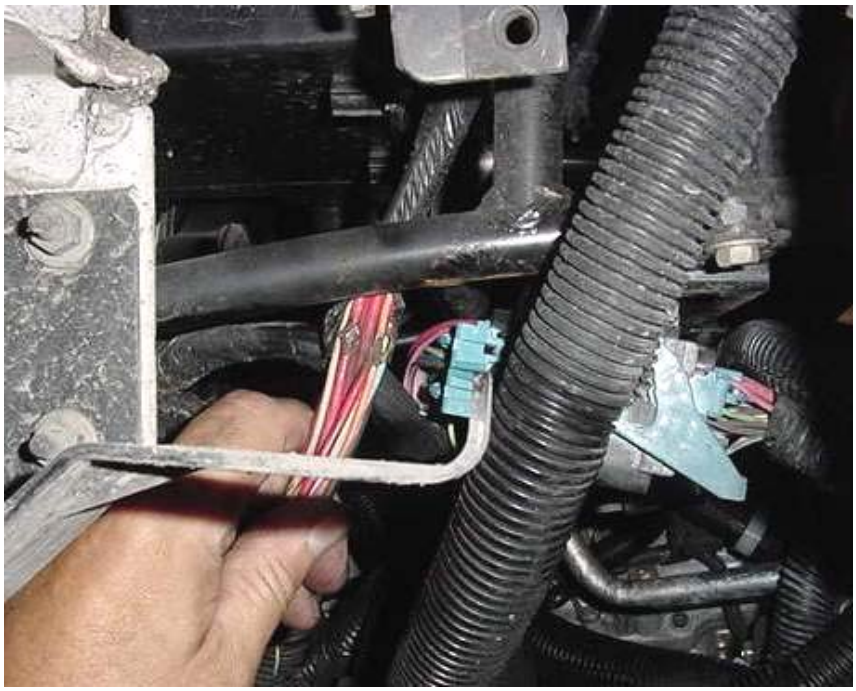
BROKEN BOLT FROM CROSS MEMBER
BELOW ENGINE
(2,900 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.

BROKEN FLANGE ON EXHAUST DROP PIPE
(5,064 TEST MILES)

WORN STEERING DRAG LINK
(7,849 TEST MILES)

UNSCHEDULED MAINTENANCE CONT.



A/C WIRING HARNESS
CHAFFING ON THE RADIATOR SUPPORT
(7,849 TEST MILES)

FAILED LEFT FRONT SHOCK
(10,436 TEST MILES)

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