UM-HSRI-76-11-4
Contract No. DOT-HS-4-00943

EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING
APPENDICES D, E, F, G

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Final Report

June 1976

Highway Safety Research Institute
The University of Michigan

Prepared for:

National Highway Traffic Safety Administration
U. S. Department of Transportation

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DOT-HS-4-00943. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UM-HSRI-76-11-4		

4. Title and Subtitle	5. Report Date
EFFECTS OF TIRE PROPERTIES ON TRUCK AND BUS HANDLING - APPENDICES D, E, F, G	June 1976
	6. Performing Organization Code
	8. Performing Organization Report No. UM-HSRI-76-11-4
7. Author's) R.D. Ervin, C.B. Winkler, J.E. Bernard, R.K. Gupta	
9. Performing Organization Name and Address Highway Safety Research Institute The University of Michigan Huron Parkway & Baxter Road Ann Arbor, Michigan 48109	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DOT-HS-4-00943
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration U. S. Department of Transportation Washington, D.C. 20590	13. Type of Report and Period Covered Final Report 6/28/74 - 12/31/75
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The principal thrust of this project was to identify the importance of tire traction properties of truck tires in determining the steering and braking response of light and heavy commercial vehicles. The study generated a large quantity of parametric data describing the commercial vehicle and, especially, its tires. Tire tests on a large sample of light and heavy truck tires were conducted using two laboratory and one over-the-road tire test device. A computerized simulation study providing a mechanistic understanding of the response sensitivity of the open-loop vehicle to tire properties was conducted. Full-scale vehicle tests permitted validation of the simulation as reinforcement to the basic findings obtained through computerized analysis.

Findings of this study include the illumination of significant differences in the qualitative performance characteristics of truck tires relative to passenger car tires, and the manner in which these unique truck tire properties may affect the yaw stability of the commercial vehicle. Potential problems of vehicle stability were dramatically illustrated by a rollover incident which occurred during testing of a heavy truck.

17. Key Words	18. Distribution Statement
tires, heavy truck, light truck, van, bus, testing, parameters, simulation, stability, yaw divergence, rollover	Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
None	None	163	

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* U. S. GOVERNMENT PRINTING OFFICE : 1973 725-504/328

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APPENDIX D

VEHICLE TEST PROCEDURES

D.1 Introduction

The following sections of Appendix D provide specific, quantitative descriptions of the test procedures called for in Table D-1. This table indicates the tests which were conducted, indicating the specific vehicles and test conditions. The shaded area indicates those tests which were planned, but which were not completed due to the rollover incident discussed in Appendix F. The specific steer angles indicated were obtained by simplified analyses using vehicle and tire parameters available prior to testing. As a result of test experience, certain of these values were altered. In general, steer angles were chosen to make an orderly approach to maximum lateral accelerations of .5 g on the dry asphalt surface and .3 g on the wet asphalt surface.

D.2 Straight-Line Braking

D.2.1 Effectiveness Testing Procedures. With cold brakes (i.e., less than 200°F) and the vehicle traveling in a straight line at the initial velocity of 40 mph, the clutch was depressed and the brake pedal displaced in a quasi-step manner to a predetermined level. This level of pedal displacement and a steering wheel angle of zero was maintained until the vehicle stopped.

Brake system input for hydraulically-braked vehicles was recorded in terms of brake pedal force. For air-braked vehicles, brake system input was recorded as brake line pressure at the output of the treadle valve.

Table D-1. Detailed Vehicle Test Matrix

	Test Condition			Number of Individual Runs per Test Vehicle and Tire Type											
				Pick-Up Truck				Van		Heavy Truck				Bus	
Test No.	Test* Procedure	Load Configuration	Surface	OE	Ext. Var.	Add. 1	Add. 2	OE	Ext. Var.	OE	Ext. Var.	Add. 1	Add. 2	OE	Ext. Var.
1	1	Empty	Dry Asphalt	X				X		X				X	
2	2	Empty	Wet Asphalt	X	X			X		X	X			X	X
3	3	Empty	Wet Asphalt	X	X			X		X	X			X	X
4	2	Empty	Dry Asphalt	X	X	X	X	X		X	X	X	X	X	X
5	3	Empty	Dry Asphalt	X	X	X	X	X		X	X	X	X	X	X
6	4	Empty	Dry Asphalt	X	X	X	X	X		X	X	X	X	X	X
7	5	Empty	Dry Asphalt					X		X					
8	1	Loaded	Dry Asphalt	X				X		X					
9	2	Loaded	Dry Asphalt	X	X			X	X	X	X			X	X
10	3	Loaded	Dry Asphalt	X	X			X	X	X	X			X	X
11	4	Loaded	Dry Asphalt	X	X			X	X	X	X			X	X
12	5	Loaded	Dry Asphalt					X		X					

*Numbers refer to test procedures as follows:

1) Straight-Line Braking
2) Braking-in-a-Turn
3) Sinusoidal Steer
4) Trapezoidal Steer (conducted with increasing severity)
5) Trapezoidal Steer (conducted with decreasing severity)

[shaded] Deleted as a result of rollover incident.

Within the limits of vehicle stability and safe test practice, tests were conducted at a minimum of five levels of brake system input corresponding to 20, 40, 60, 80, and 100% of the input required for the occurrence of first wheel lockup. One repeat test of each input level was conducted.

D.2.2 Front-Only and Rear-Only Braking Tests. For front-only tests, brakes on the vehicle's rear axle were disabled. For rear-only tests, brakes on the vehicle's front axle were disabled.

Tests were conducted identically to those described in Section D.2.1, save the following exceptions:

1) Initial velocity was 28 mph.

2) There were only four runs, two with front brakes only and two with rear brakes only. In all runs, brake system input was 50% of the level required for first wheel lockup (as determined by the effectiveness test of the vehicle in its corresponding load configuration).

D.3 Trapezoidal Steer

With the vehicle traveling in a straight line at the designated initial velocity, a trapezoidal (or quasi-step) steer angle, of the form indicated in Figure D-1, was input to the vehicle via the Automatic Vehicle Controller.

Each trapezoidal steer test called for in Table D-1 implied a full series of trapezoidal steer tests conducted at both 30 and 50 mph. Test procedure number 4, Trapezoidal Steer (conducted with increasing severity), also included quasi-step steer tests at both 30 and 50 mph.

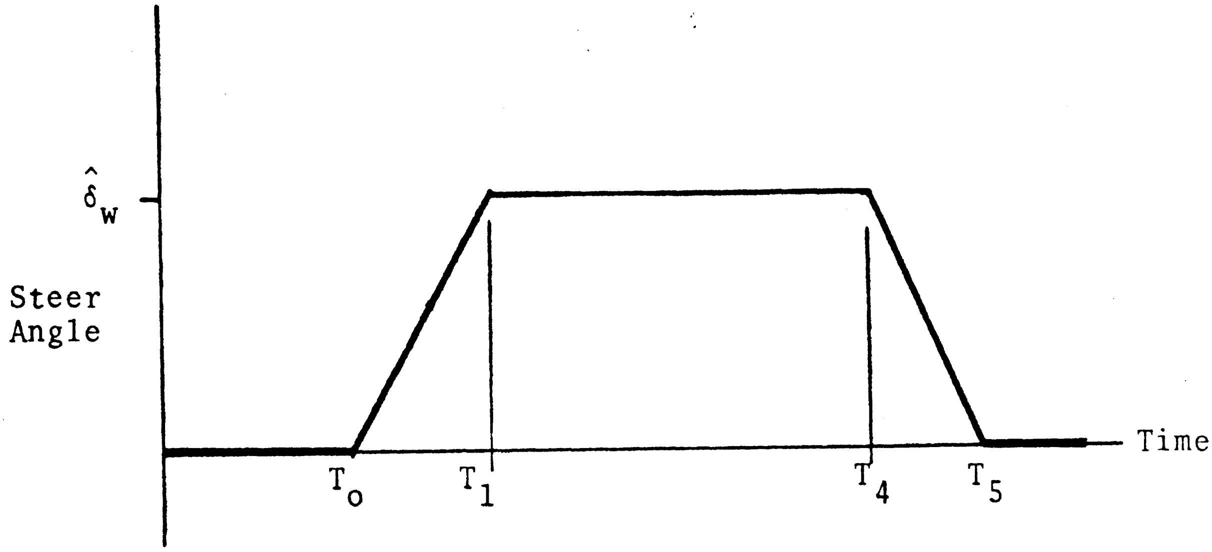


Figure D-1

Table D-2 lists the specific parameters describing the input steer angle wave forms used in each vehicle/test surface configuration called for in Table D-1. Tests conducted at the lower steer angle levels were all done with one polarity of turn.

D.4 Braking In A Turn

The braking-in-a-turn test was conducted in a manner similar to the trapezoidal steer test with the addition of constant level braking introduced during the turn. The vehicle input wave forms are illustrated in Figure D-2.

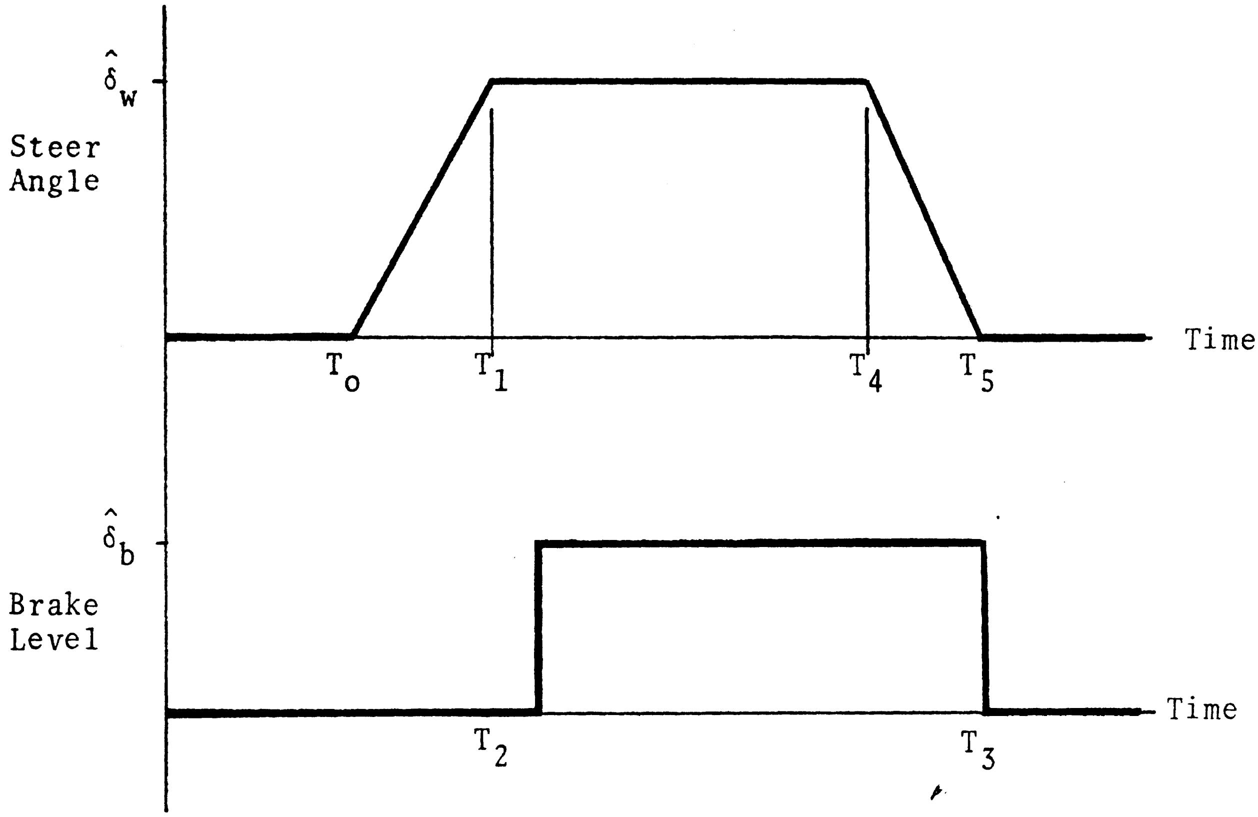
Table D-3 indicates the specific input levels used in testing. Tests were conducted beginning with low levels of braking and progressing to higher levels. Upon the occurrence of first wheel lock, the test series was terminated, i.e., no higher level of braking was employed.

As was the case in trapezoidal steer, successive runs were conducted in one polarity with the highest level test conducted in both directions and with one repeat run in both directions.

Table D-2

Test Type	Initial Velocity, mph	Average Front Wheel Steer Angle, $\hat{\delta}_w$ (degrees)		T_o	T_1-T_o	T_4-T_1	T_5-T_4
		Truck, Van, Pickup	Intercity Bus				
Step Steer	30	4	8		min*	5 sec	1 sec
Step Steer	50	1.5	3	>1 sec	min.	5 sec	1 sec
Trapezoidal Steer	30	3,4,5,6,7	6,8,10,12,14		1 sec	5 sec	1 sec
Trapezoidal Steer	50	1,1.5,2,2.5	2,3,4,5		1 sec	5 sec	1 sec

*For step steer tests, the minimum possible value of T_1-T_o, as determined by the maximum $\hat{\delta}_w$ which the AVC can produce, will be used.



$\hat{\delta}_w$
Steer Angle
Time
T_o
T_1
T_4
T_5
$\hat{\delta}_b$
Brake Level
Time
T_2
T_3

Figure D-2

Table D-3

Surface	Initial Velocity, mph	Steer Angle, $\hat{\delta}_w$	Brake Level, $\hat{\delta}_b$ (%)*	T_o	T_1-T_o	T_2 ****	T_3	T_4-T_1	T_5-T_4
Wet Asphalt	30	**	20,30,40,50	$\geq$1 sec	1 sec	2.5 sec	$=T_5$	5 sec	1 sec
Dry Asphalt	50	***	40,50,60,70						

*Brake input levels are expressed as a percentage of the level required to produce wheel lock during effectiveness testing on the dry surface of the same vehicle in the same load condition.

**Equivalent to a .2 g steady-state turn.

***Equivalent to a .35 g steady-state turn.

****In the earliest testing, T_2 was set equal to T_1, but was later altered to allow full development of steady-state turn.

D.5 Sinusoidal Steer

With the vehicle traveling in a straight line at the prescribed initial velocity, a steer angle of the form shown in Figure D-3 was input to the vehicle. Table D-4 lists the values of the various input parameters used. As the table indicates, tests were run at 30 mph on the wet surface and 30 and 50 mph on the dry surface. As in the other handling tests described, lower level runs were made with one polarity of turn. The highest level tests were then conducted in both directions and with repeat runs. In the case of the sinusoidal steer tests, the highest level runs for both values of T were conducted in this manner.

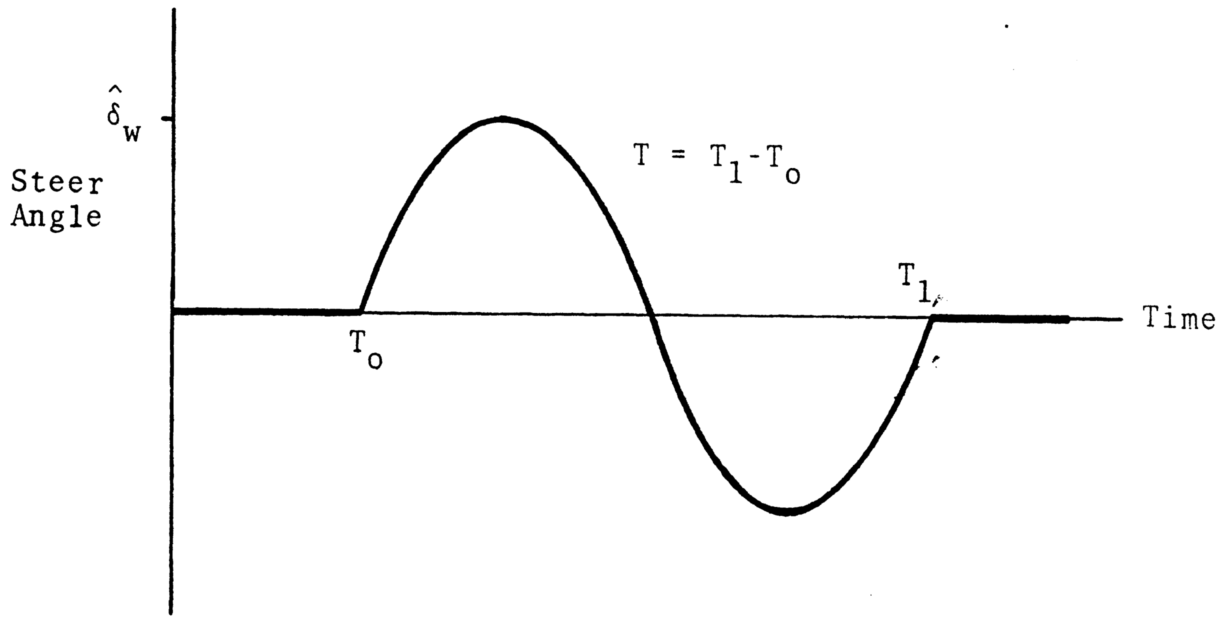


Table D-4

Surface	Initial Velocity mph	Period T, sec. Heavy Vehicle	Period T, sec. Light Vehicle	Average Front Wheel Steer Angle, $\hat{\delta}_w$, deg. Truck, Van Pickup	Average Front Wheel Steer Angle, $\hat{\delta}_w$, deg. Bus
Wet Asphalt	30	2,4	2,3	2,3,4	4,6,8
Dry Asphalt	30	2,4	2,3	2,4,6	4,8,12
Dry Asphalt	50	2,4	2,3	1,2,3	2,4,6

APPENDIX E

DATA FROM FULL-SCALE VEHICLE TESTS

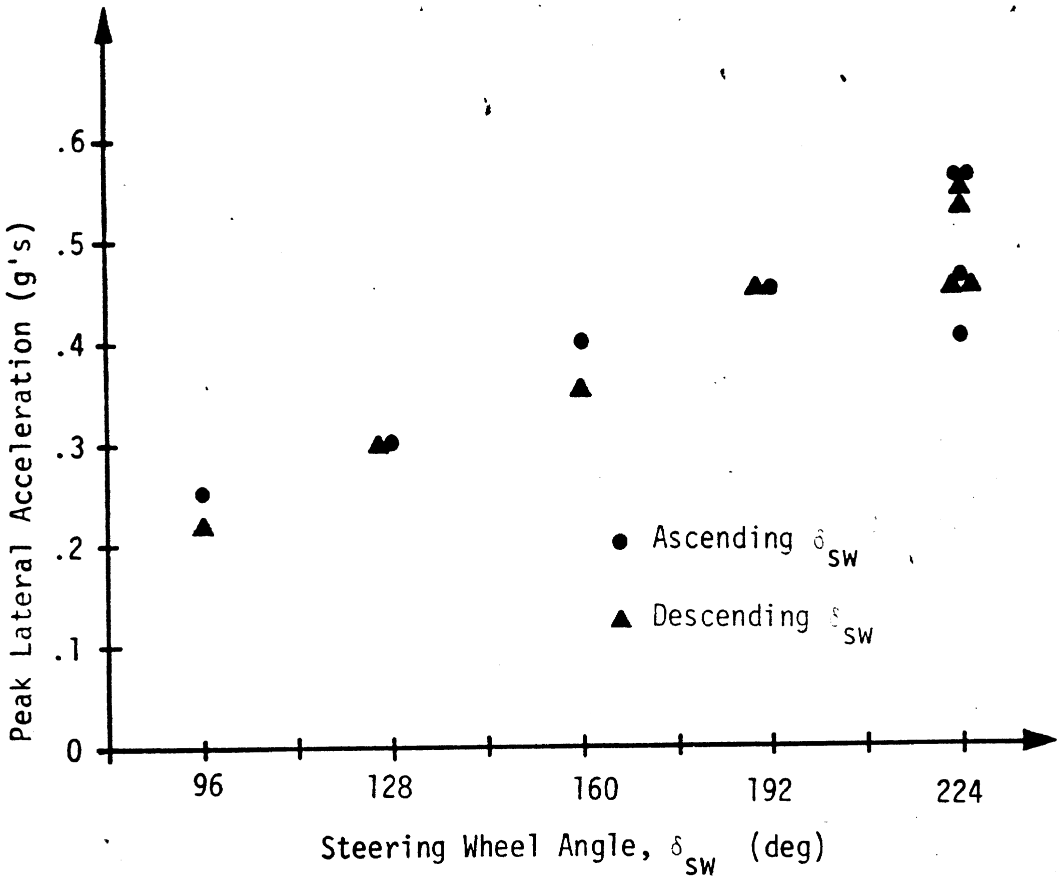
Data plots are provided covering the steering test results obtained on the three test vehicles: van, pickup, and heavy truck. Tabular data follow, covering all tests conducted on all three vehicles in the program.

E.1 Ford Econoline Van Trapezoidal and Sinusoidal Steer Test

Data labeled "OE" refer to the installation of code L-2 tires at all four wheel positions (where tire codes are identified on the attached copy of Table 3.1 from the Technical Discussion). Data labeled extreme variation, "EV," represent the installation of code L-2 tires on the front axle and code L-11 tires on the rear.

TABLE 3.1. FLAT-BED TEST TIRES

Tire No.	Manufacturer	Model	Size
Heavy Truck Tires			
H-1	Uniroyal	Triple Tread	10 x 20F
H-2	Uniroyal	Triple Tread	10 x 20G
H-3	Uniroyal	Triple Tread	11 x 22.5F
H-4	B.F. Goodrich	Milesaver Radial Steel H.D.R.	10 R 20 G
H-5	B.F. Goodrich	Milesaver Radial Steel H.D.B.	10 R 20 G
H-6	Goodyear	Unisteel R-1	10 R 20 G
H-7	Goodyear	Unisteel L-1	10 R 20 G
H-8	Firestone	Power Drive	10 x 20F
H-9	Uniroyal	Unimaster Rib	15 x 22.5H
H-10	Michelin	Radial	10 R 20 G
H-11	Uniroyal	Fleetmaster Superlug	10 x 20F
Heavy Bus Tires			
H-12	Firestone	Hiway Mileage	12.5 x 22.5G
H-13	B.F. Goodrich	Intercity Mileage	12.5 x 22.5G
H-14	B.F. Goodrich	Intercity Mileage	11.5 x 20G
H-15	Uniroyal	Intercity	12.5 x 22.5G
H-16	Uniroyal	MaxRoute I	11.00 R 20H
H-17	Goodyear	Custom Cruiser	12.5 x 22.5G
H-18	Michelin	Radial XZA	11 R 20 H
H-19	Michelin	Radial XZA	11 R 22.5 H
H-20	Michelin	Radial XZA	12 R 22.5H
Light Truck Tires			
L-1	Firestone	Transport 500	8.00 x 16.5D
L-2	Goodyear	Custom HiMiler	8.75 x 16.5E
L-3	Goodyear	Rib HiMiler	8.00 x 16.5D
L-4	Firestone	Transport 110	7.50 x 16.5C
L-5	Goodyear	Super Single HiMiler	10.00 x 16.5E
L-6	Firestone	Town & Country Truck	8.00 x 16.5D
L-7	Goodyear	Custom Flexsteel	8.00 R 16.5E
L-8	Goodrich	Milesaver Radial	8.00 R 16.5D
L-9	Goodyear	Glas Guard XG	8.00 x 16.5D
L-10	Goodyear	Glas Guard XG	8.75 x 16.5E
L-11	Firestone	Town & Country Truck	8.75 x 16.5E
L-12	Goodyear	Custom Flexsteel	8.75 R 16.5E
L-13	Michelin	Radial XCA	8.00 R 16.5E
L-14	Wards	Steel Belted Super Wide	9.50 x 16.5D
L-15	Michelin	Radial XCA	8.75 R 16.5D
L-16	General	Jumbo Power Jet	8.00 x 16.5D
L-17	General	Jumbo Power Jet	8.75 x 16.5E
L-18	Goodyear	Glas Guard	8.00 x 16.5D
L-19	Goodyear	Glas Guard	8.75 x 16.5E
L-20	Goodyear	Rib HiMiler	8.75 x 16.5E



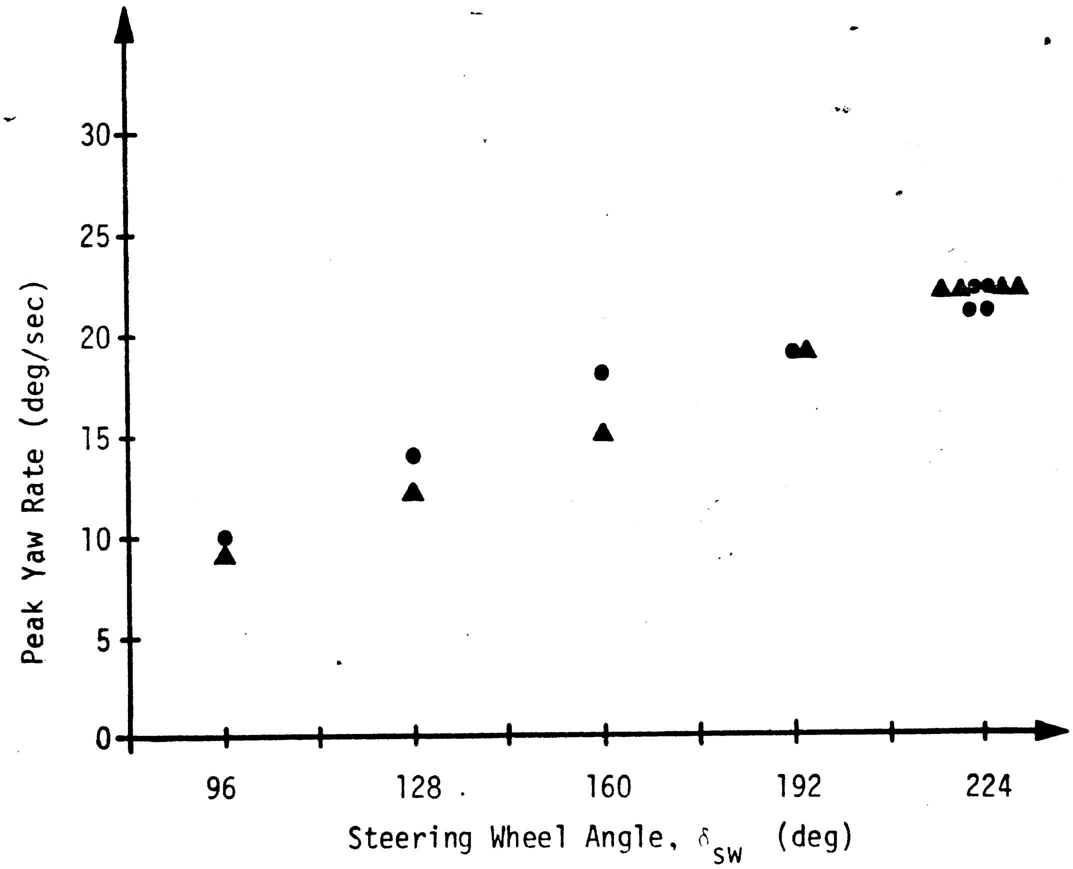
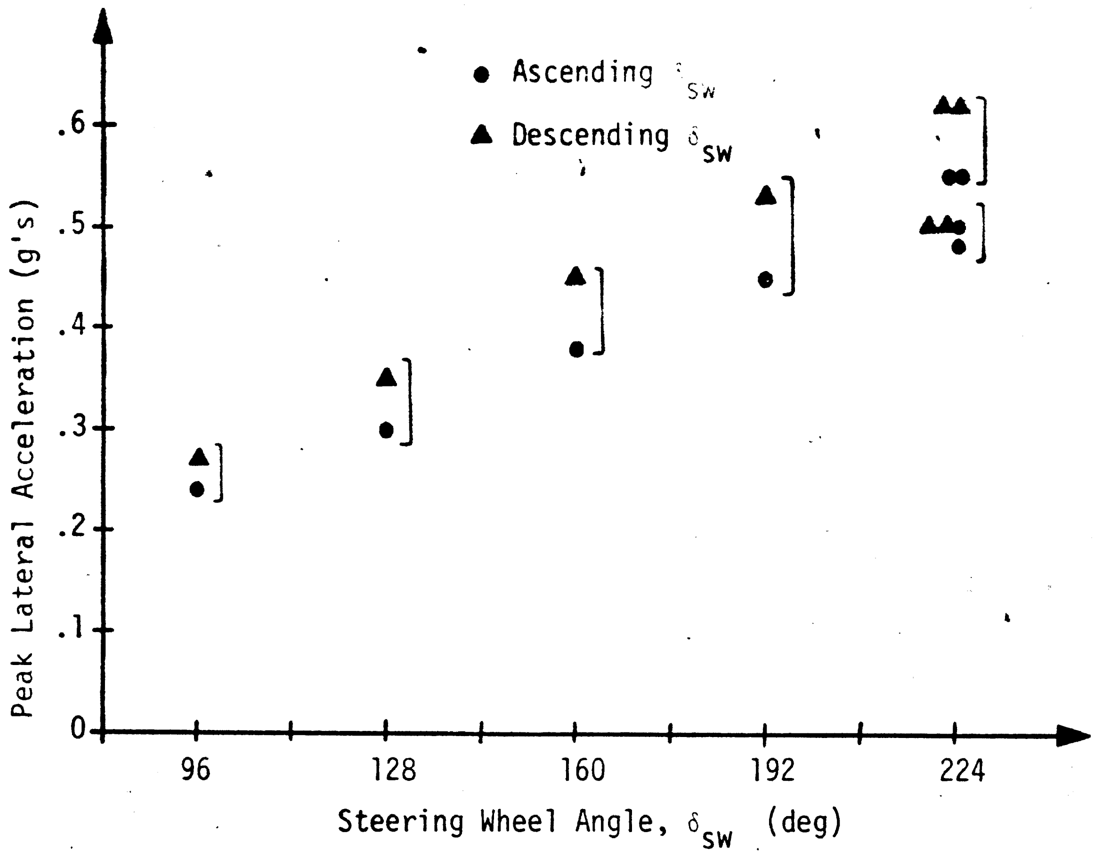


Figure E.1 Light van: loaded OE, trapezoidal steer runs at 30 mph.



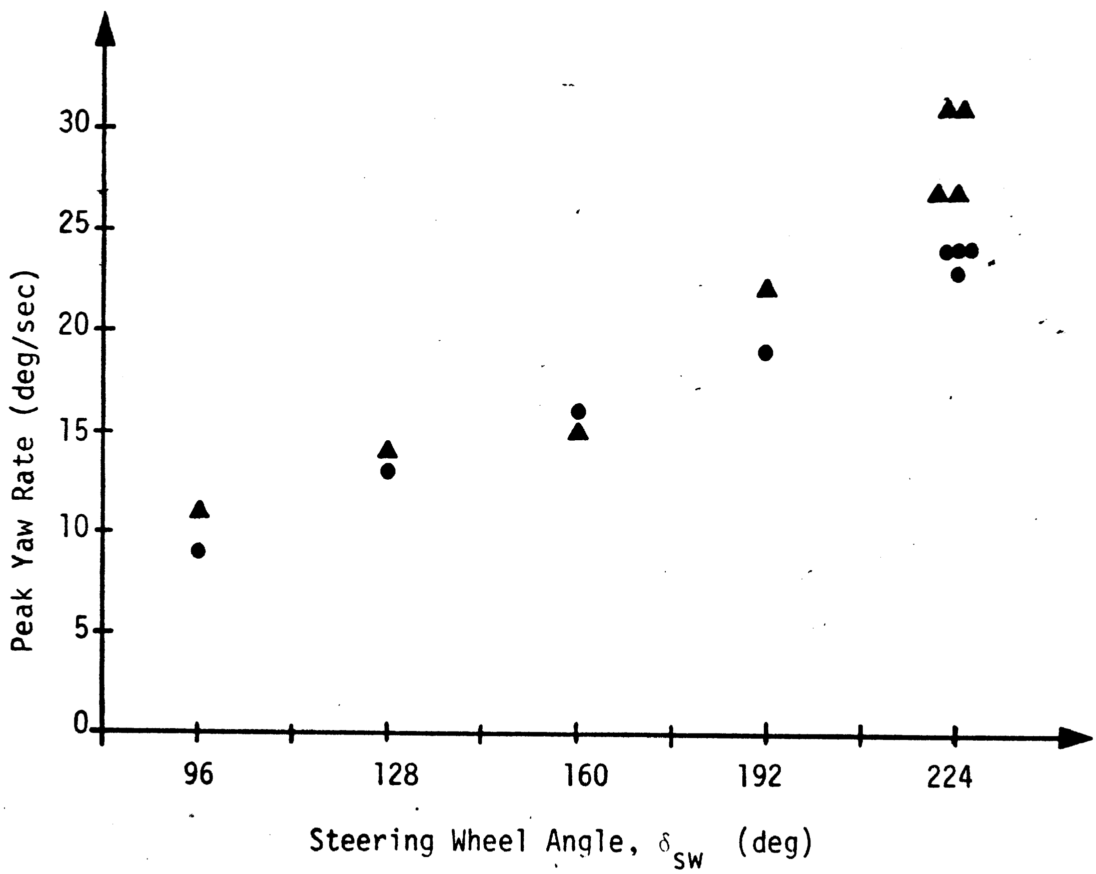
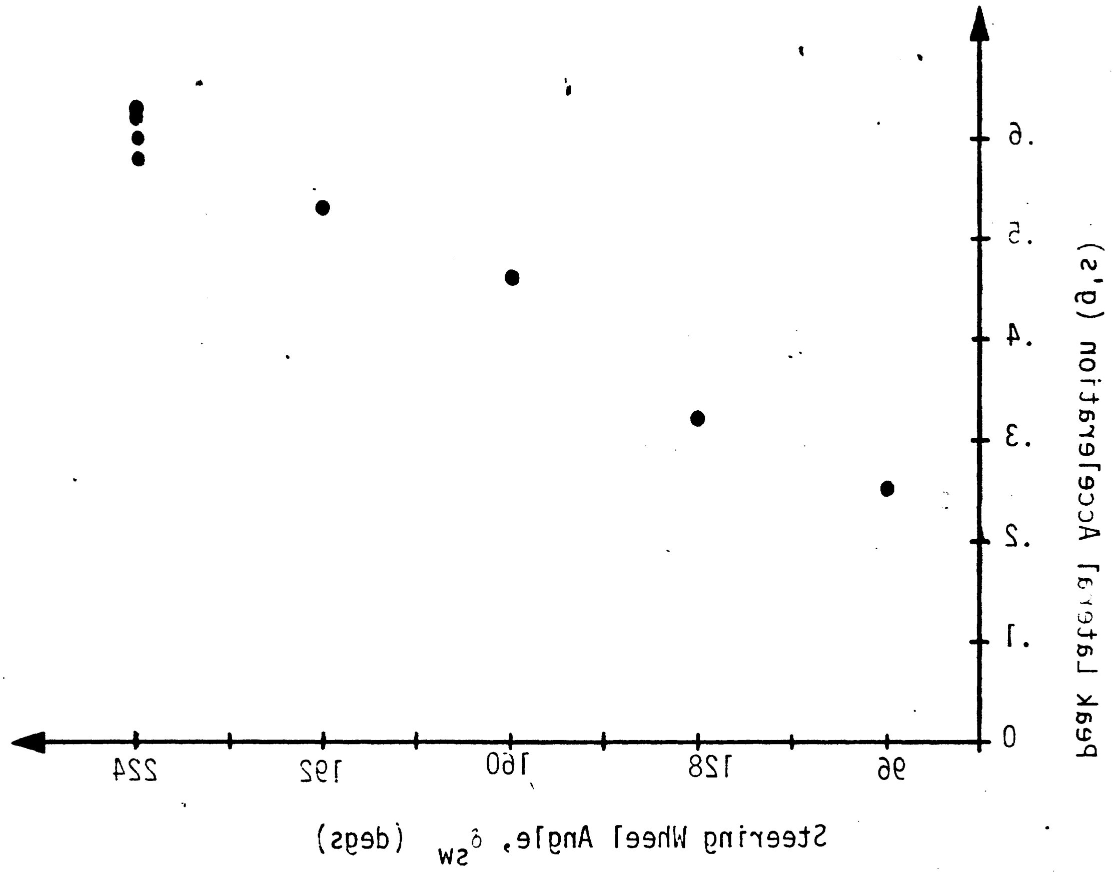


Figure E.2 Light van: loaded OE, trapezoidal steer runs at 30 mph.



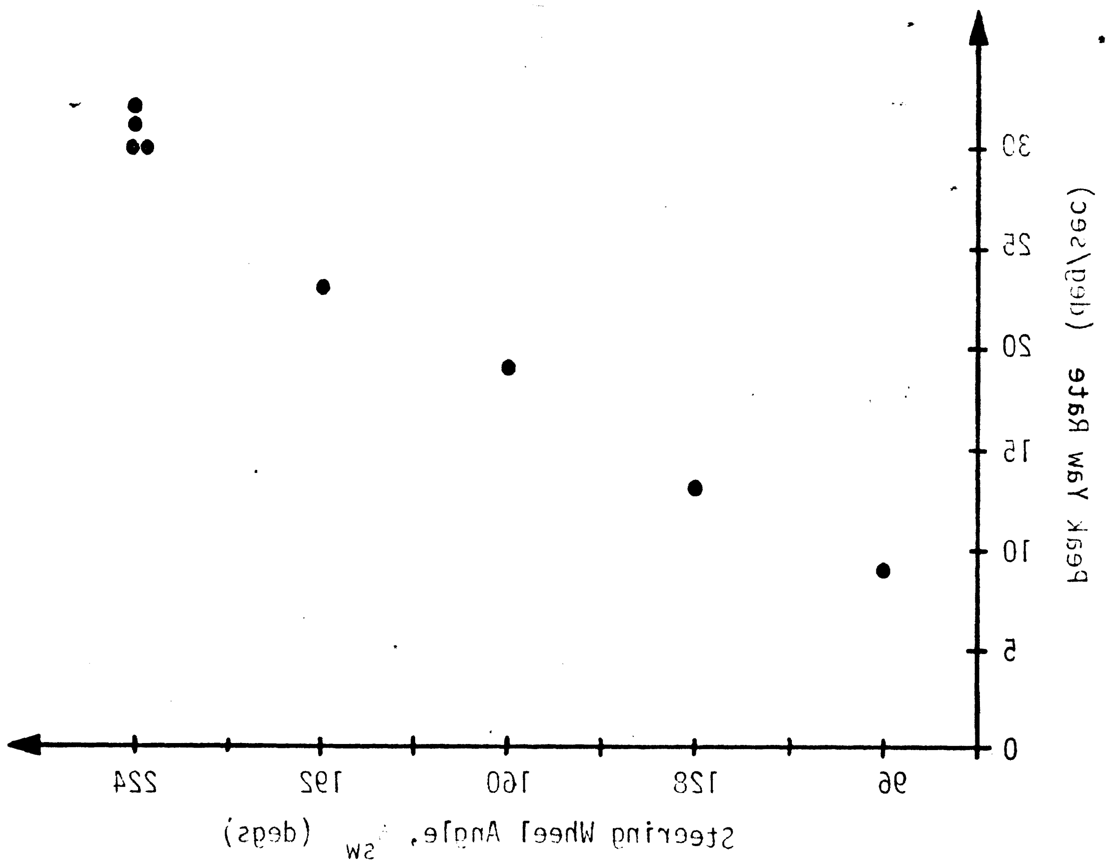
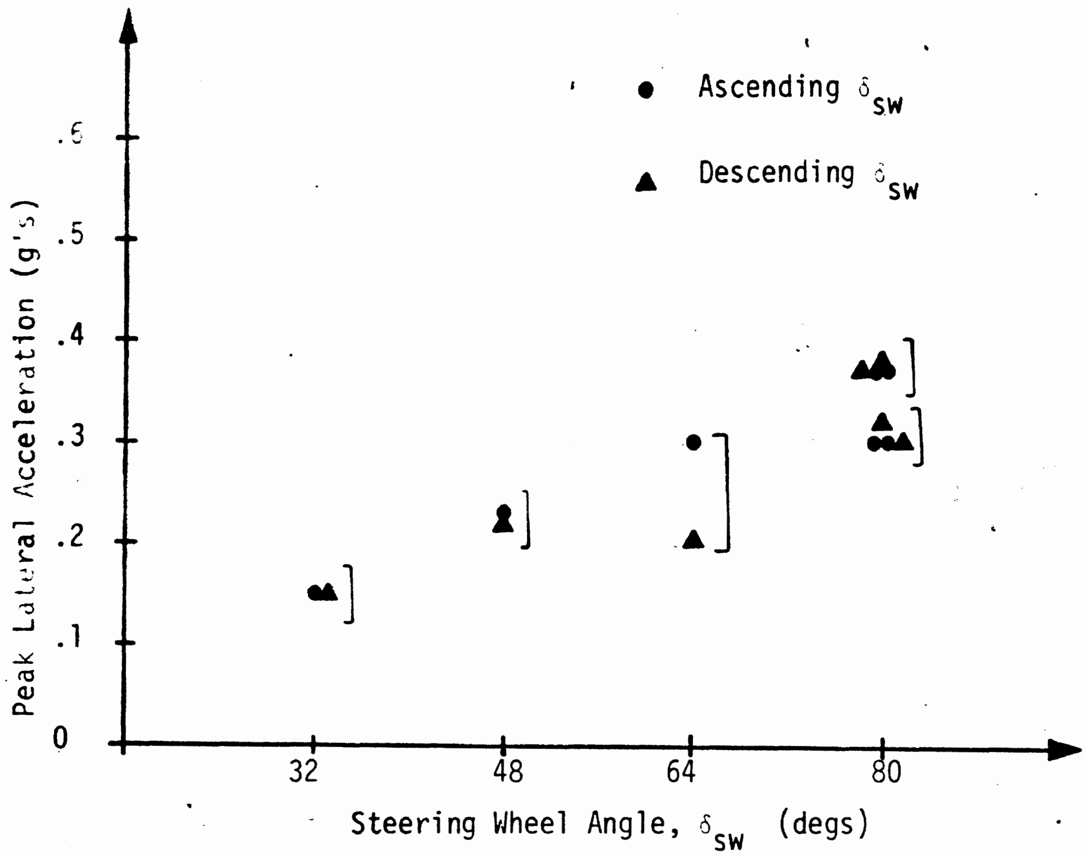


Figure E.3. Light van: loaded EV, trapezoidal steer runs at 30 mph.



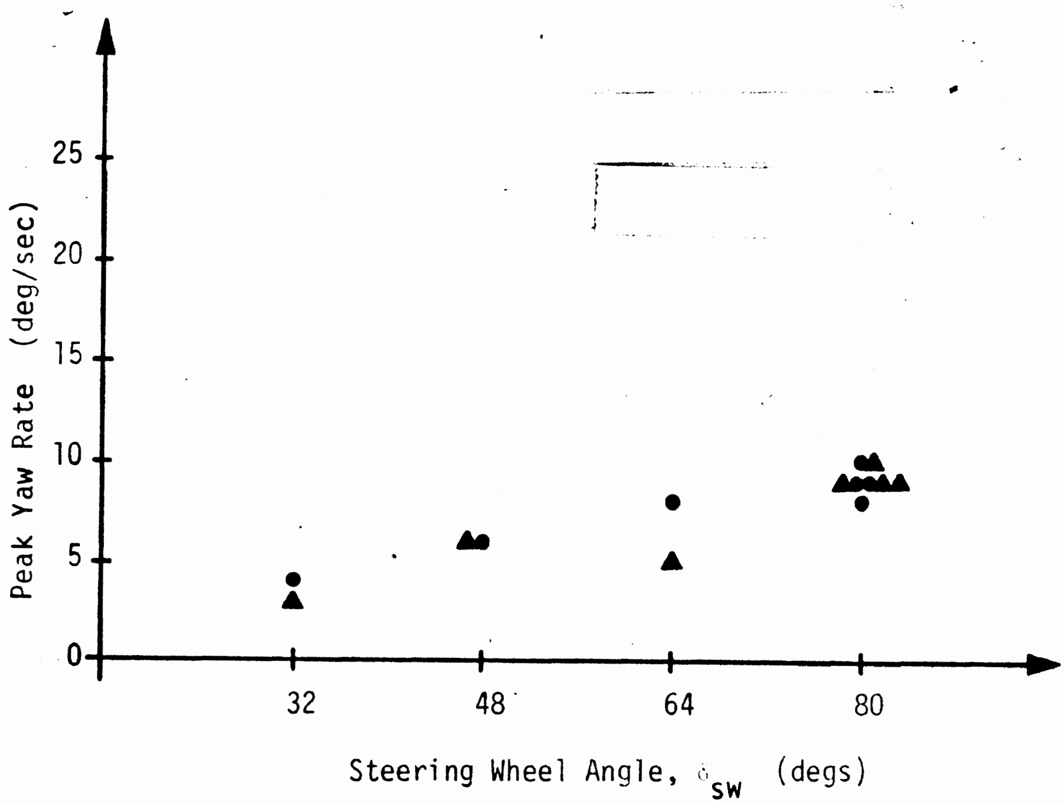


Figure E.4. Light van: unloaded OE, trapezoidal steer runs at 50 mph.

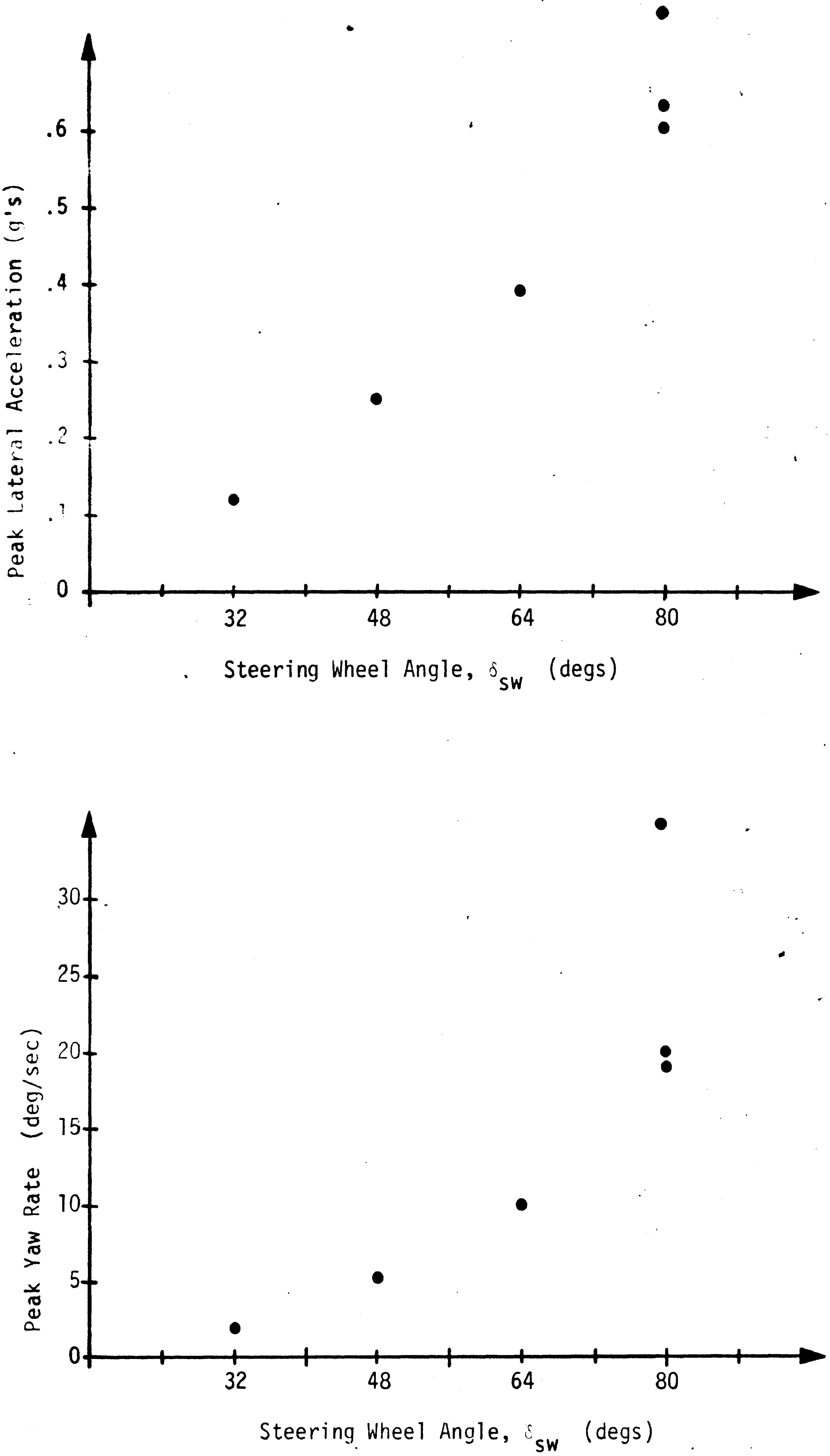
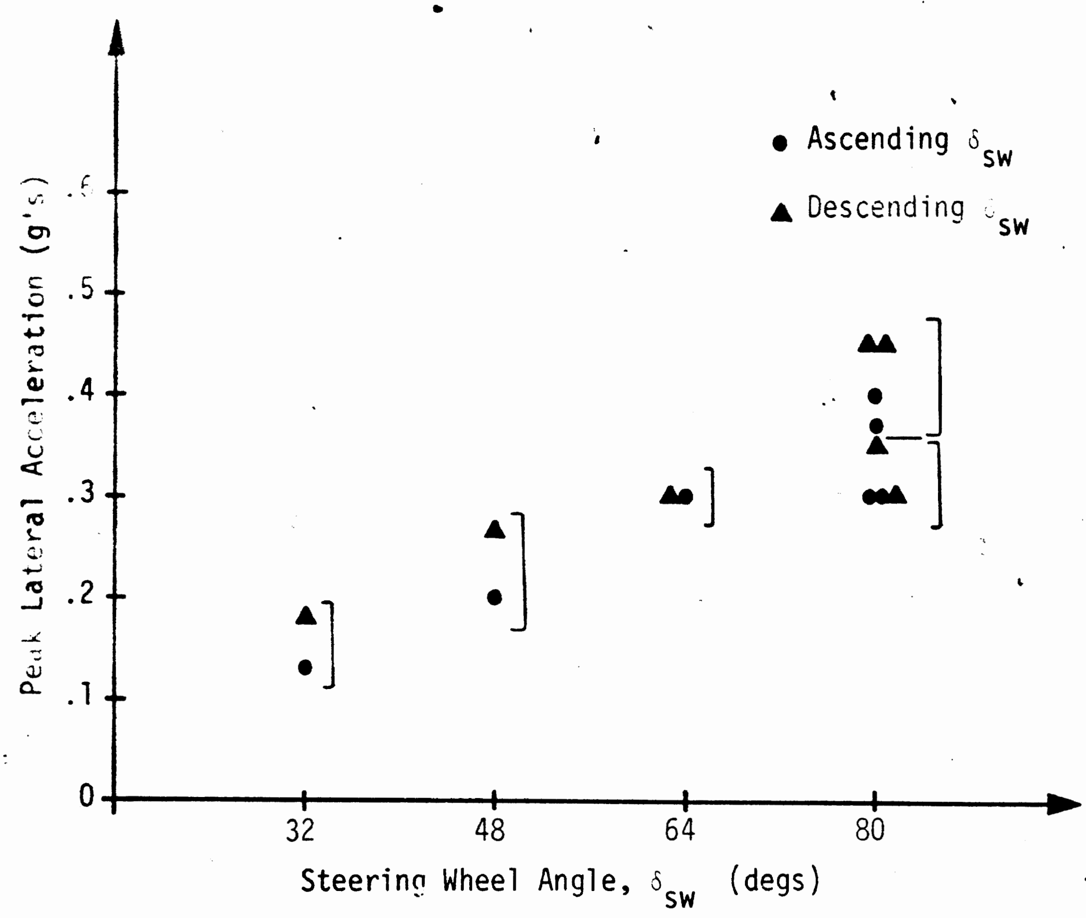


Figure E.5. Light van: loaded EV, trapezoidal steer runs at 50 mph.



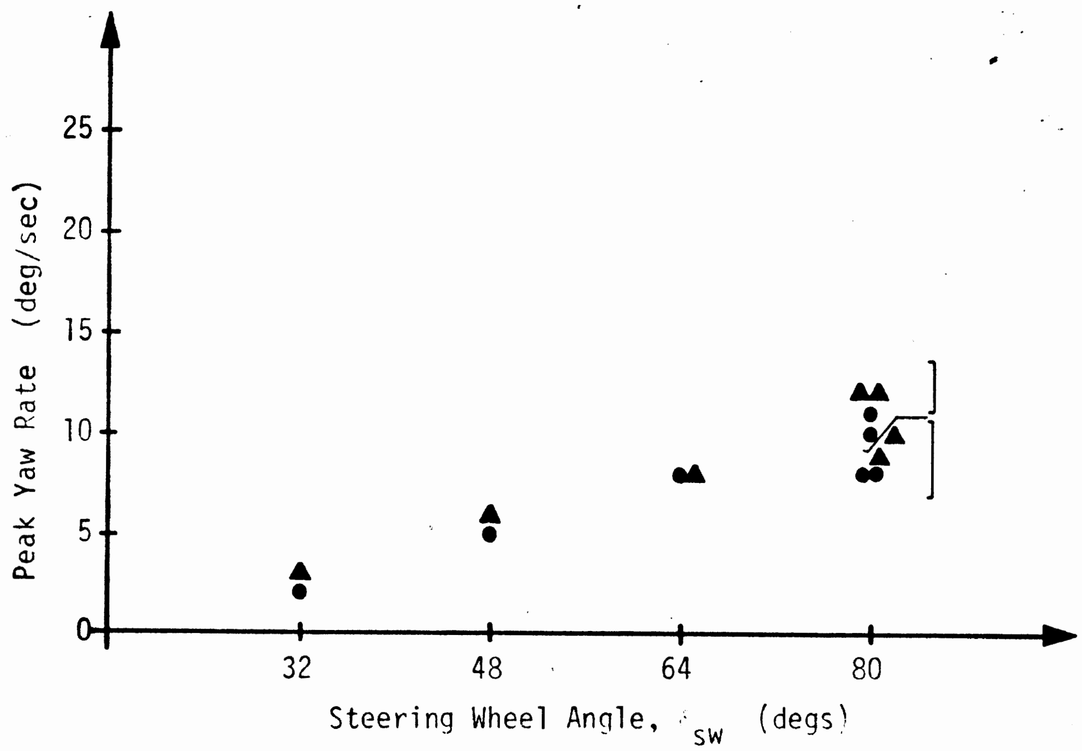


Figure E.6. Light van: loaded OE, trapezoidal steer runs at 50 mph.

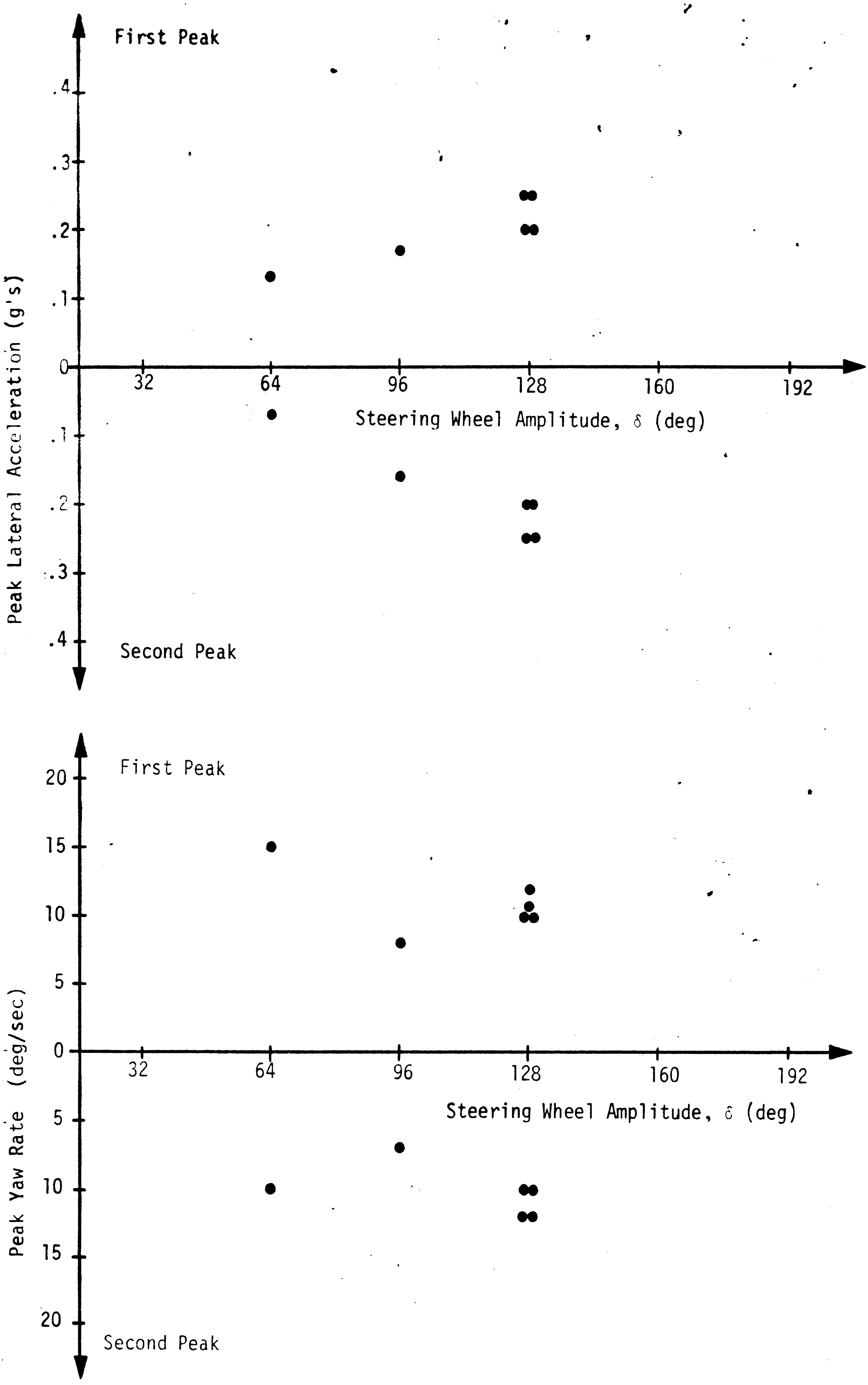
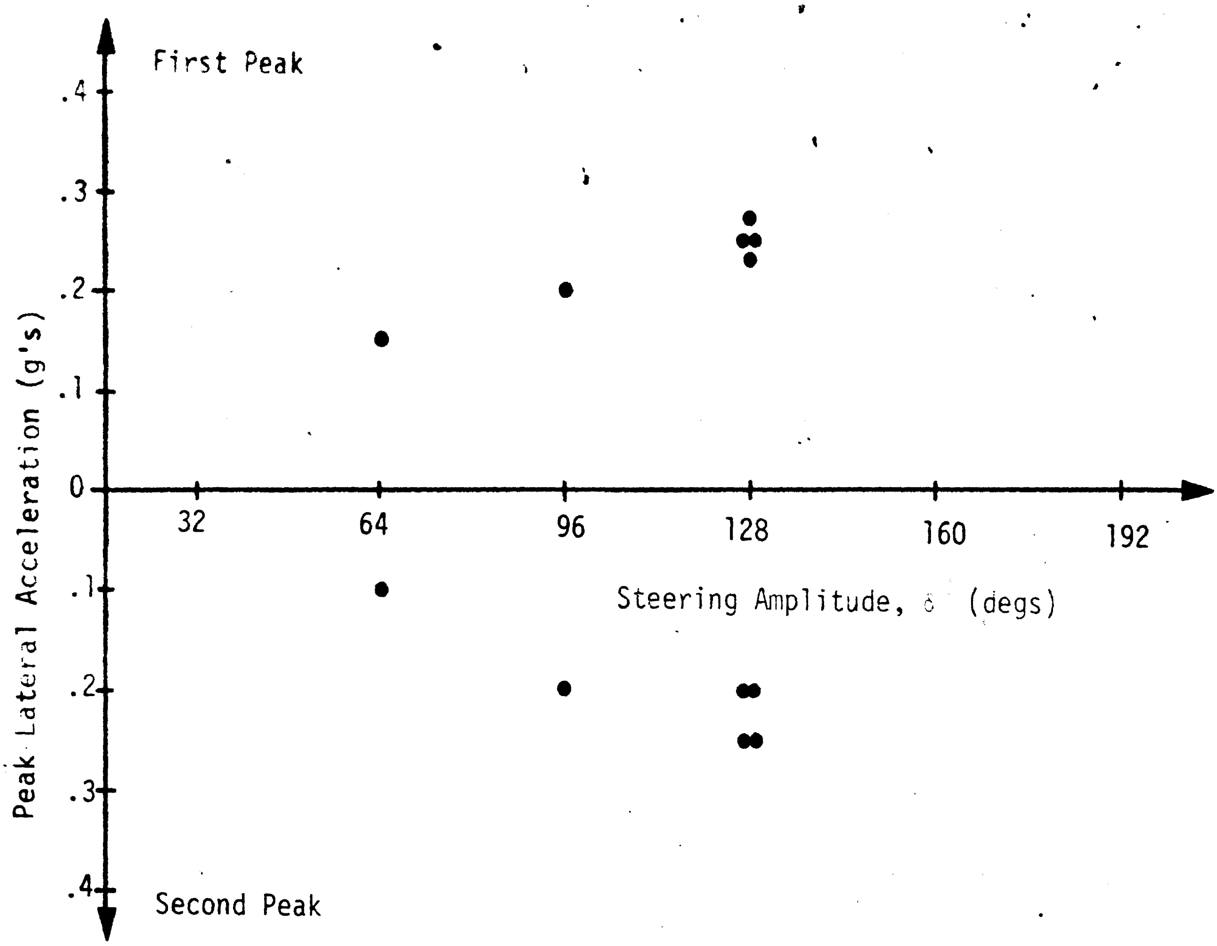


Figure E.7. Light van: unloaded, sinusoidal steer runs at 30 mph, wet asphalt, τ = 2 sec.



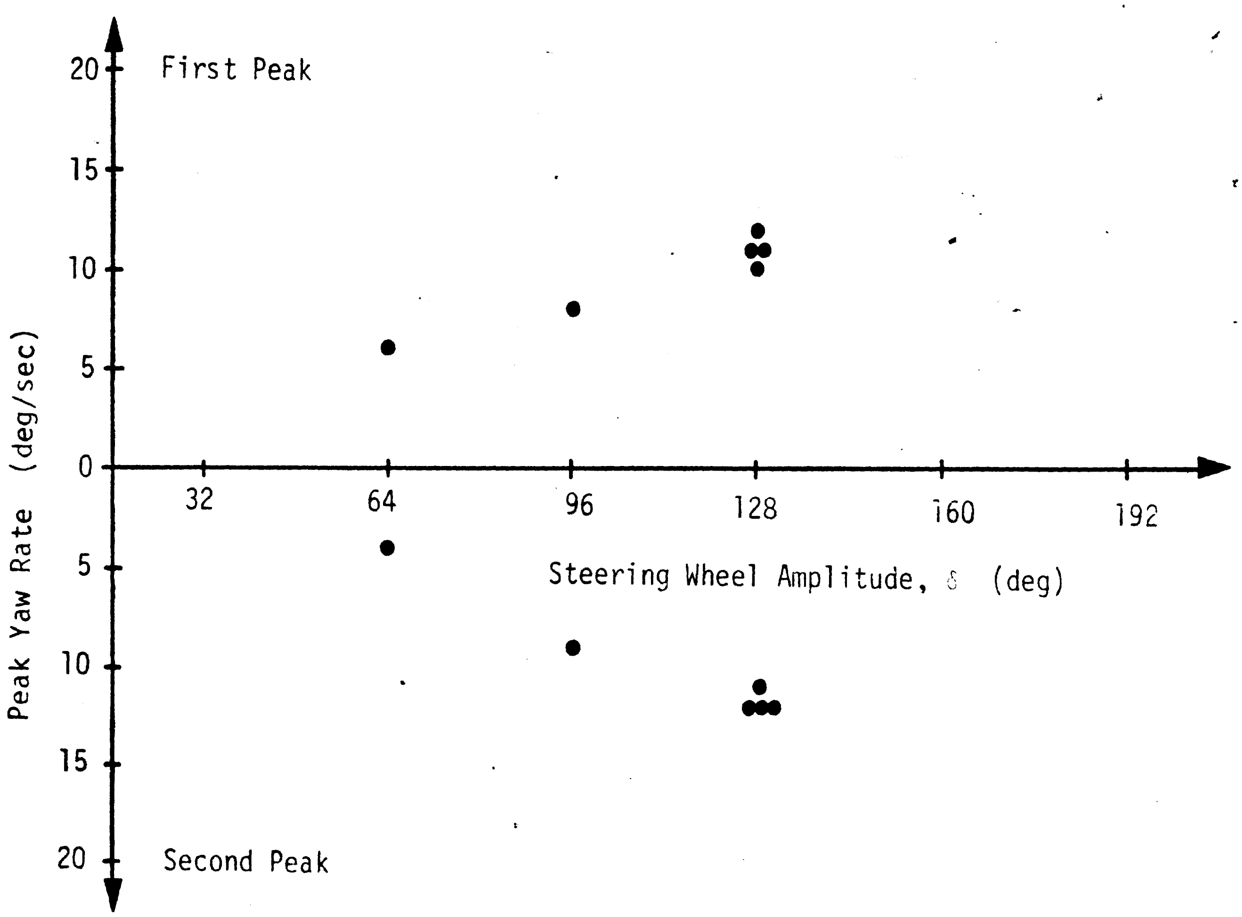


Figure E.8. Light van: unloaded OE, sinusoidal steer runs at 30 mph, wet asphalt, τ = 3 sec.

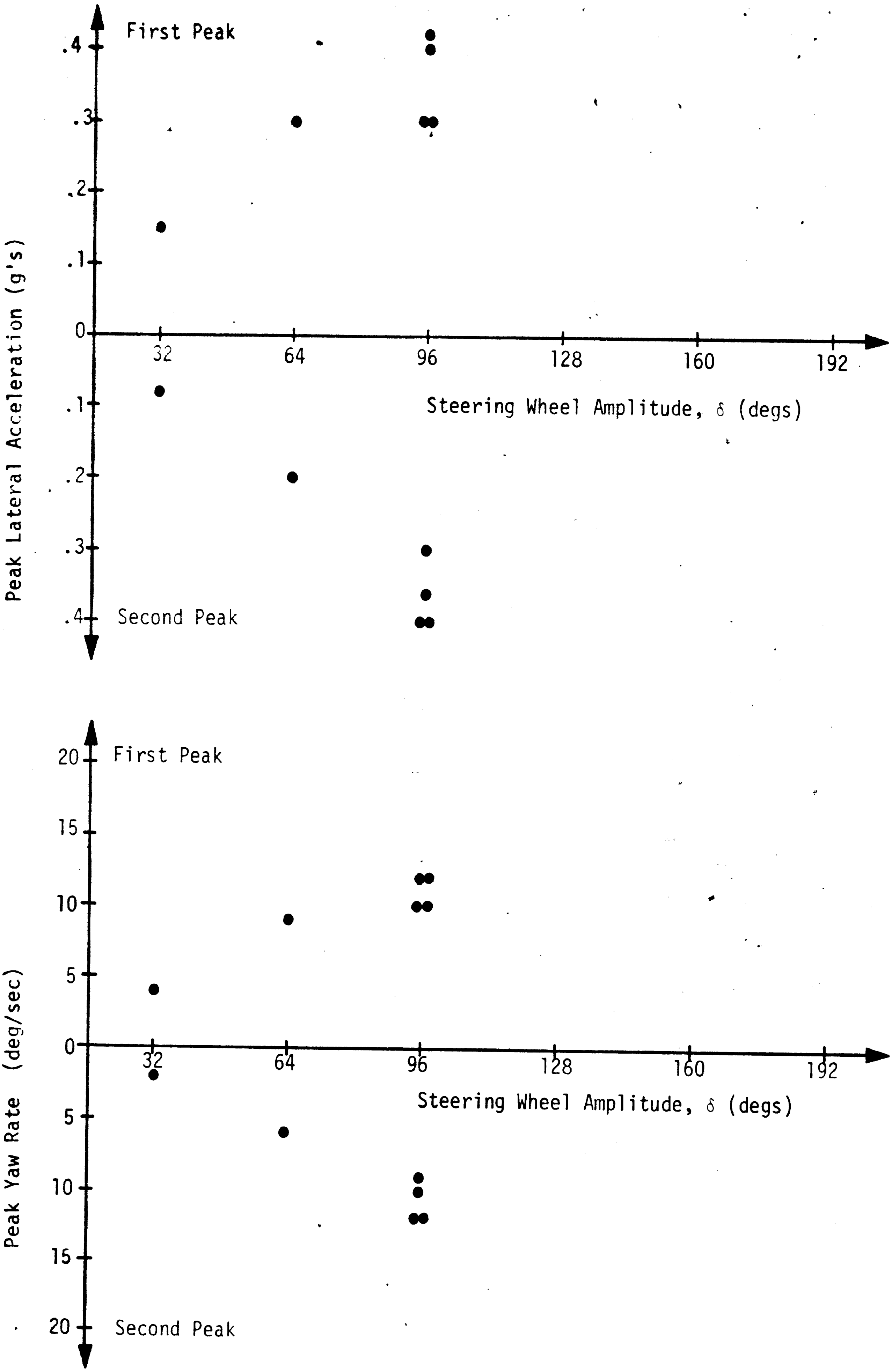


Figure E.9. Light van: unloaded OE, sinusoidal steer runs at 50 mph, dry asphalt, τ = 3 sec.

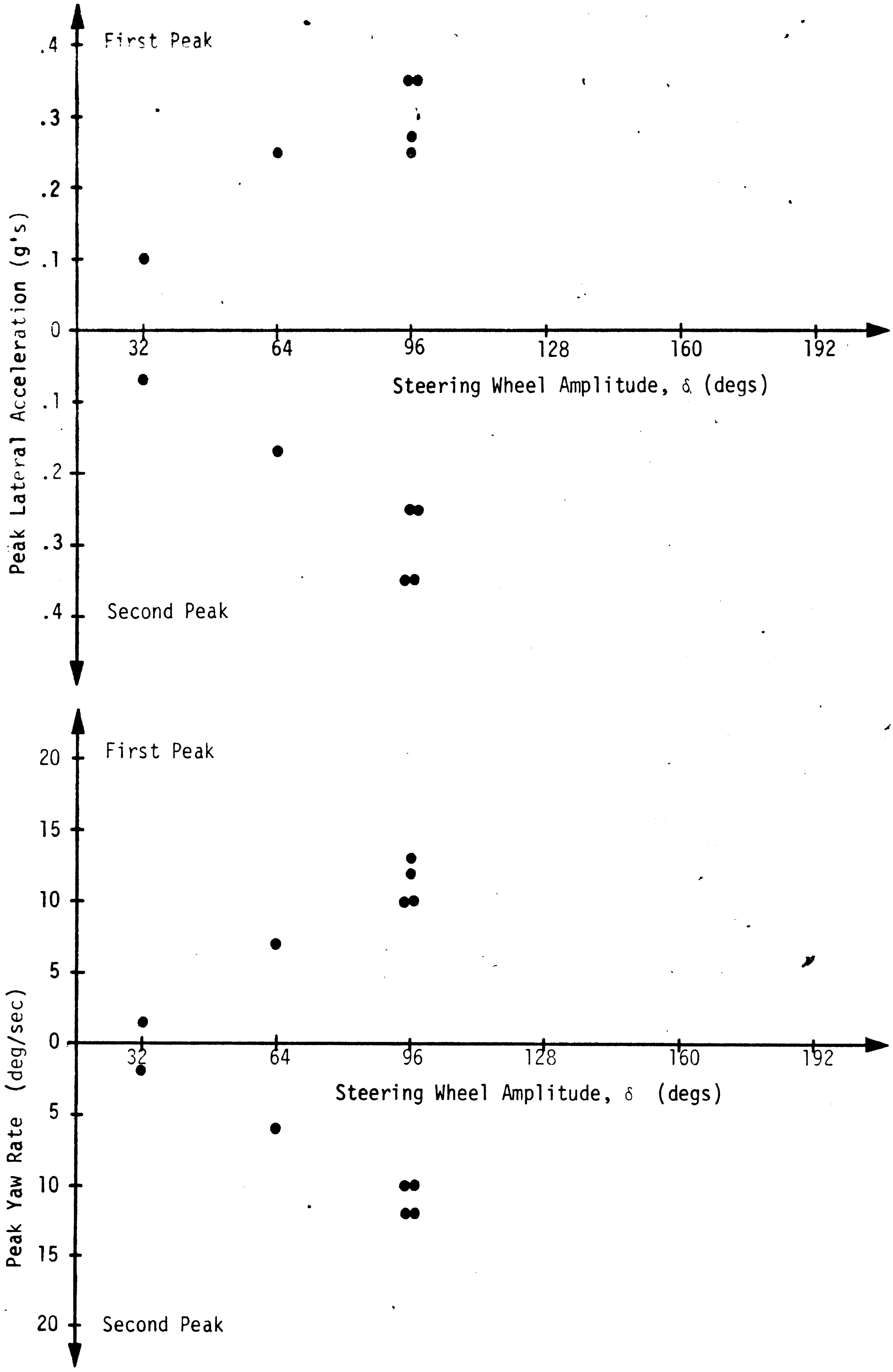
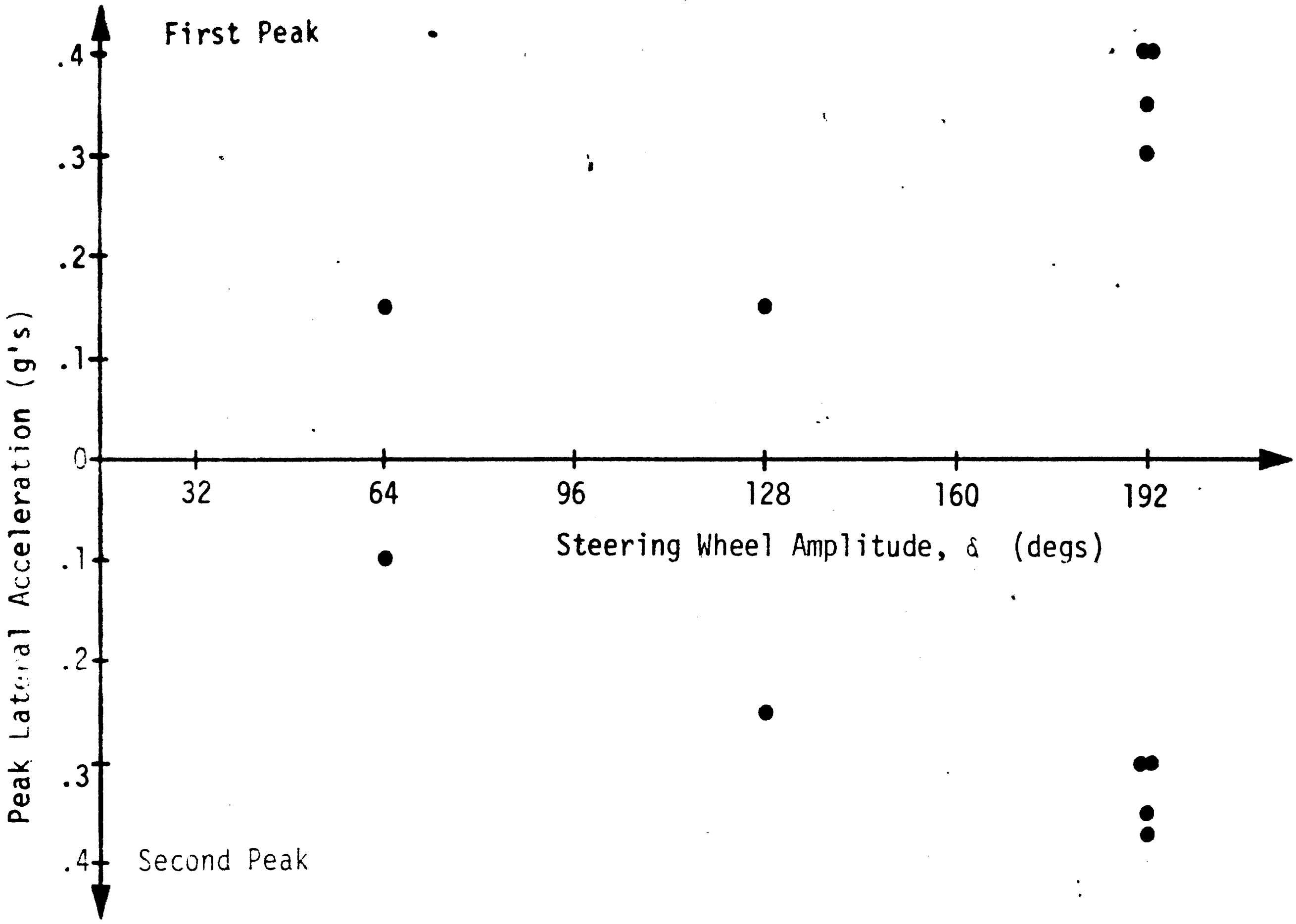


Figure E.10. Light van: unloaded OE, sinusoidal steer runs at 50 mph, dry concrete, τ = 2 sec.



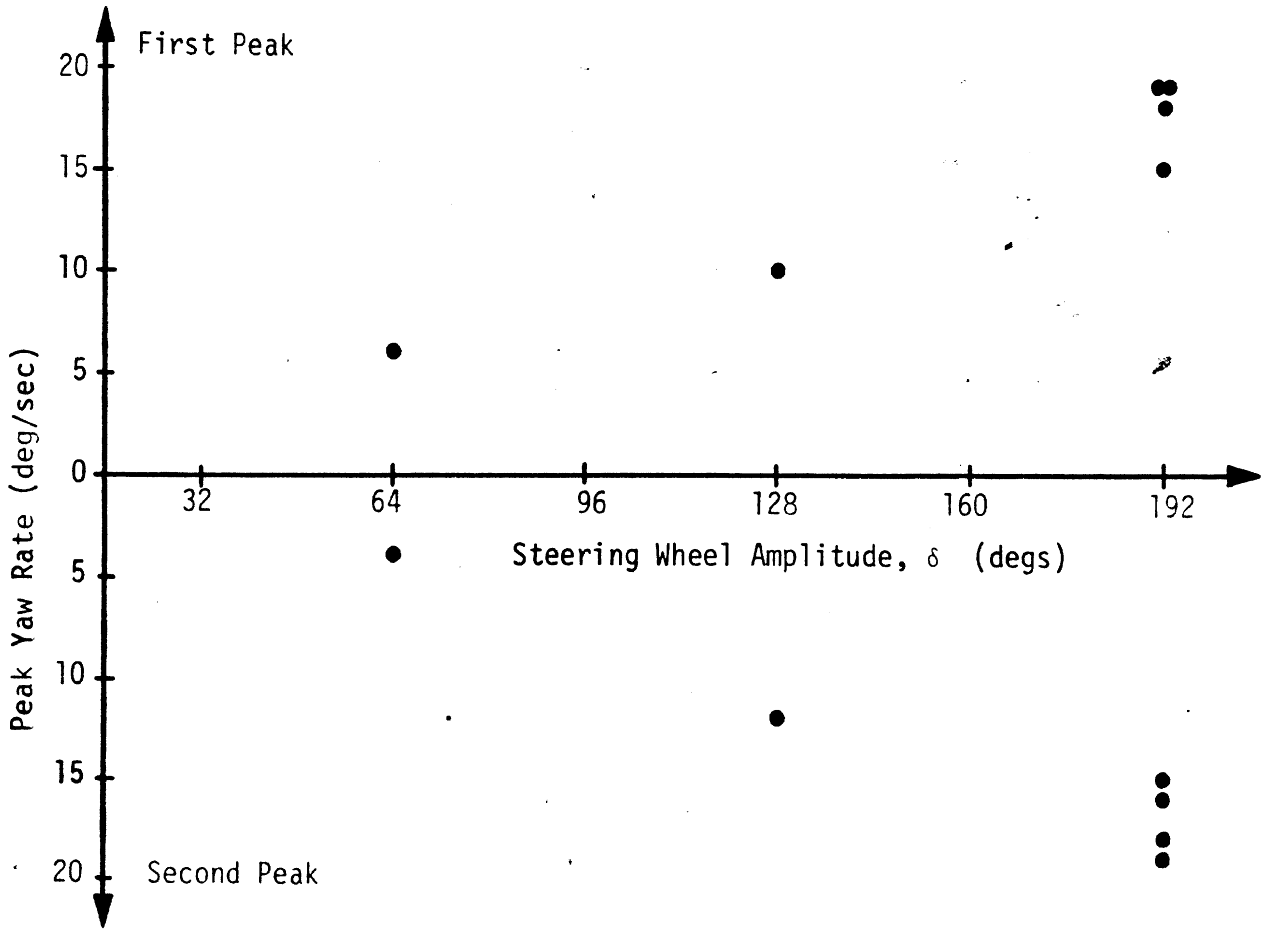


Figure E.11. Light van: unloaded OE, sinusoidal steer runs at 30 mph, dry concrete, τ = 2 sec.

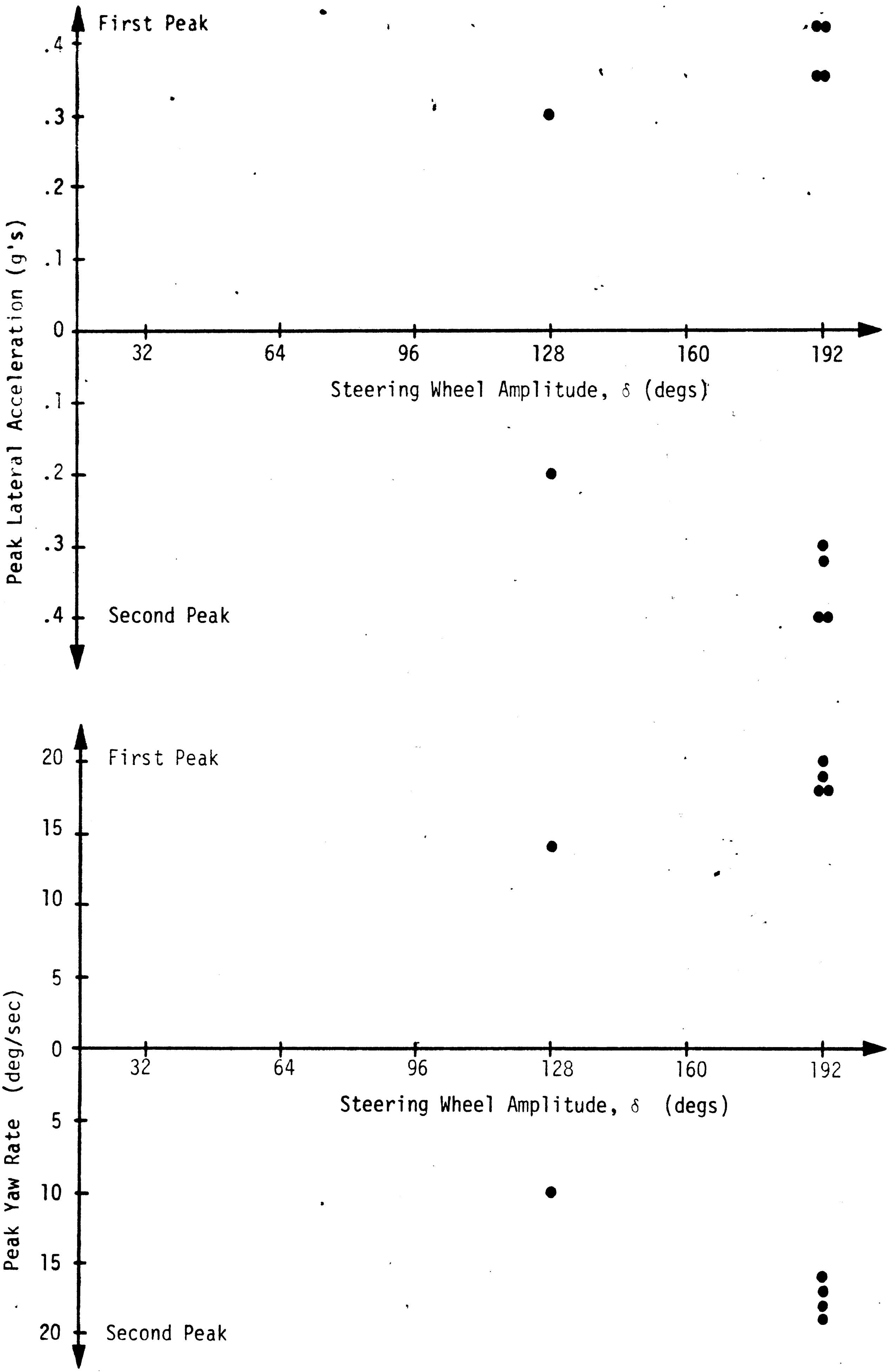


Figure E.12. Light van: unloaded OE, sinusoidal steer runs at 30 mph, dry concrete, τ = 3 sec.

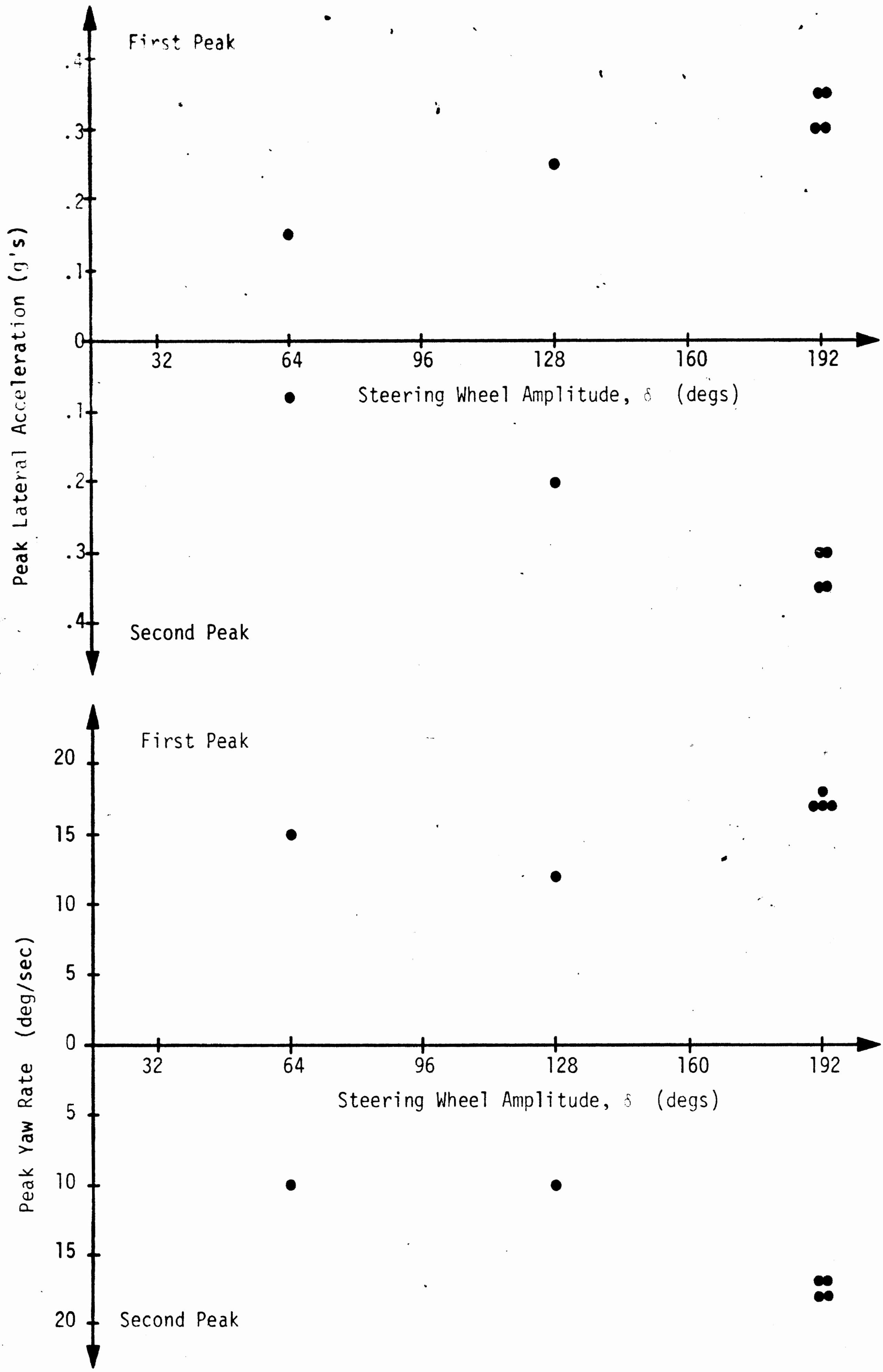


Figure E.13. Light van: unloaded OE, sinusoidal steer runs at 30 mph, dry concrete, τ = 2 sec.

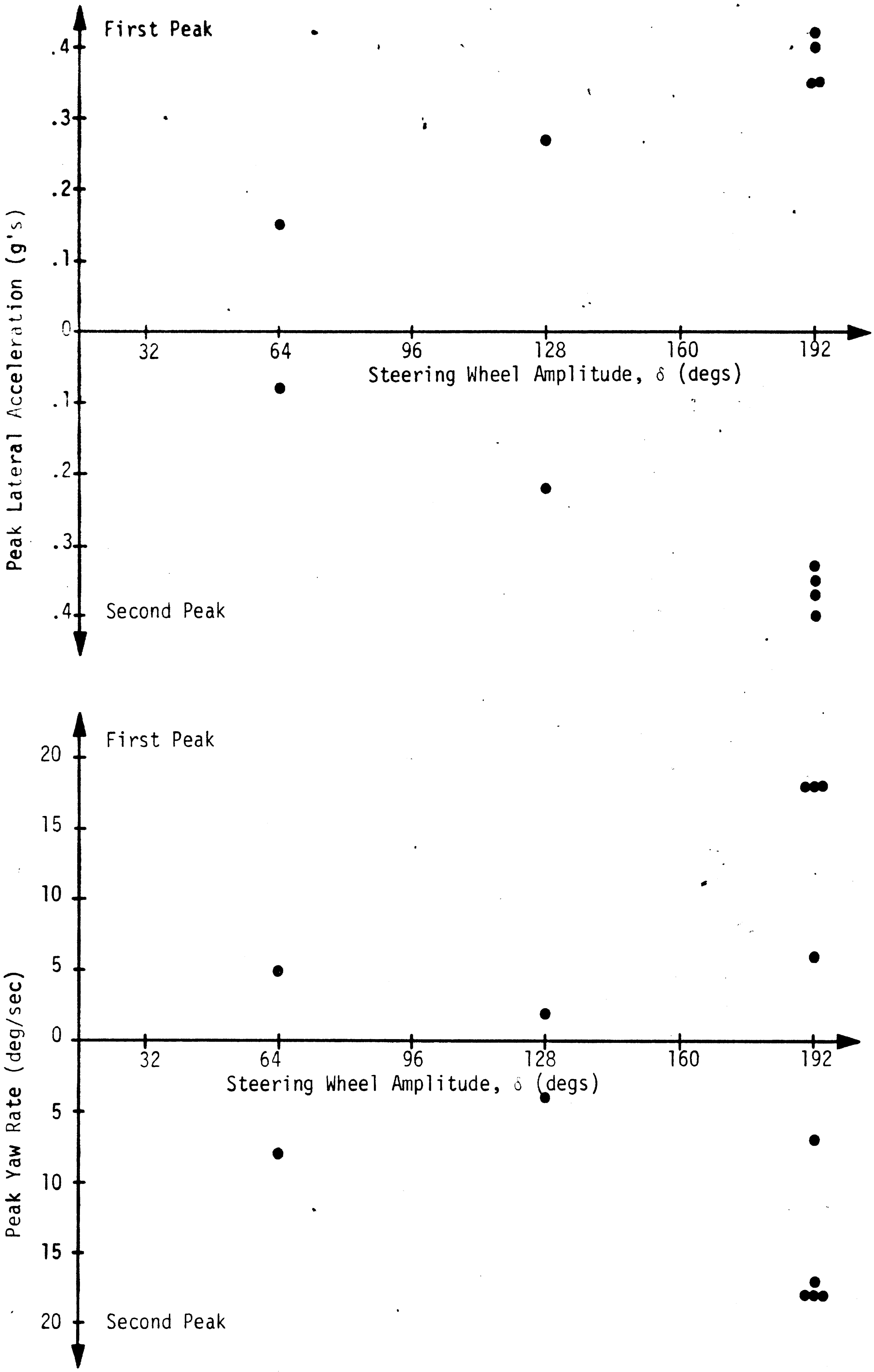
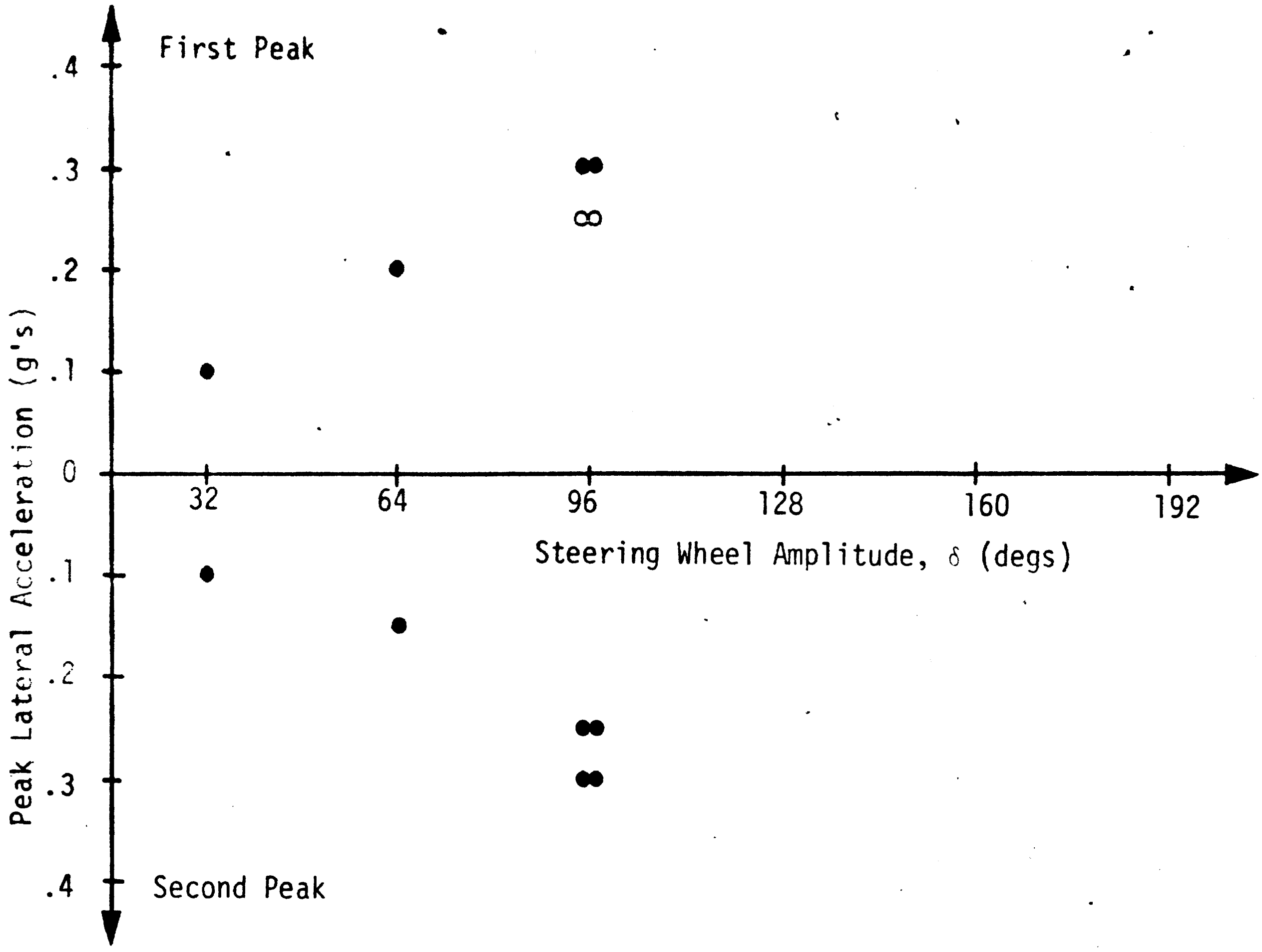


Figure E.14. Light van: loaded OE, sinusoidal steer runs at 30 mph, dry concrete, τ = 3 sec.



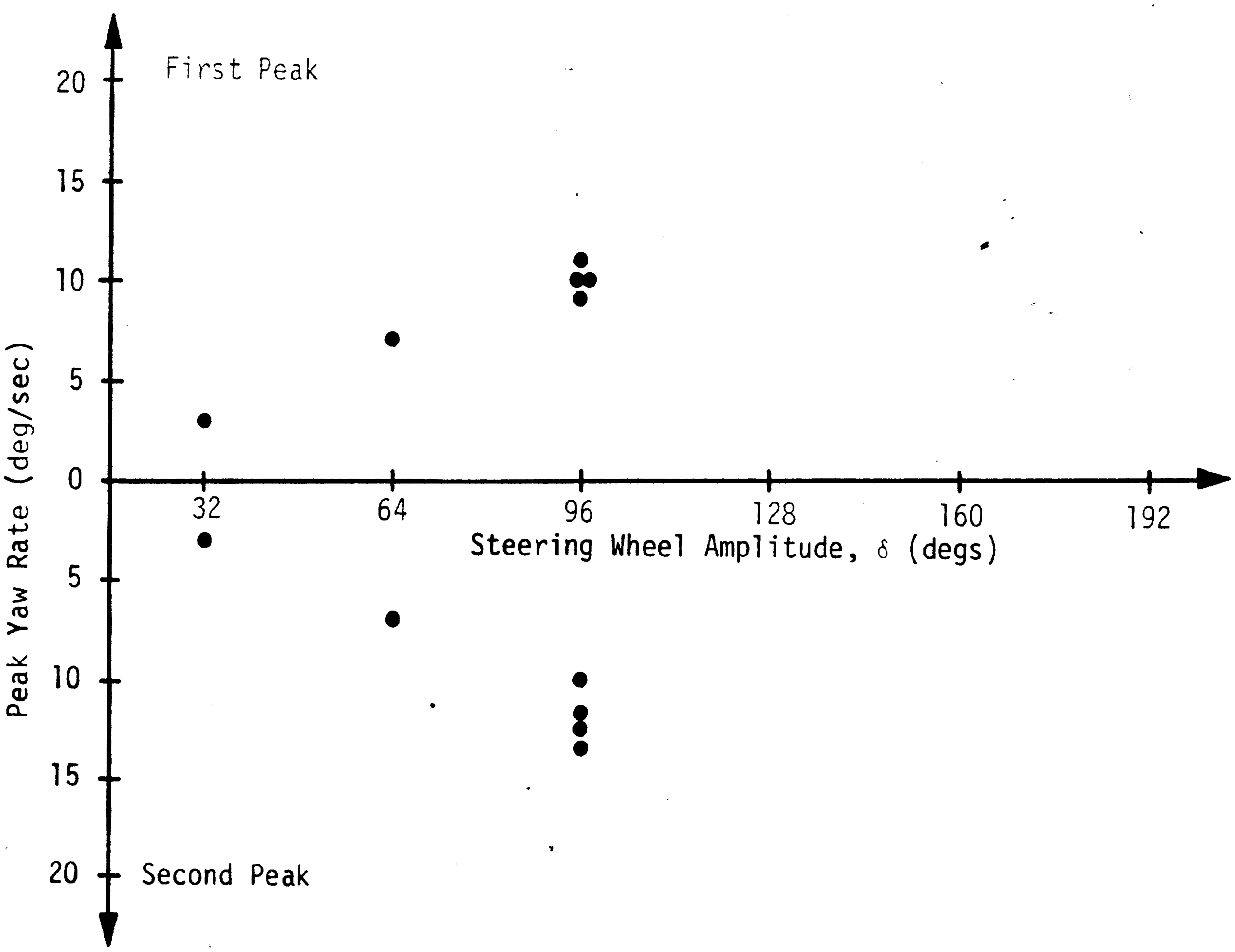
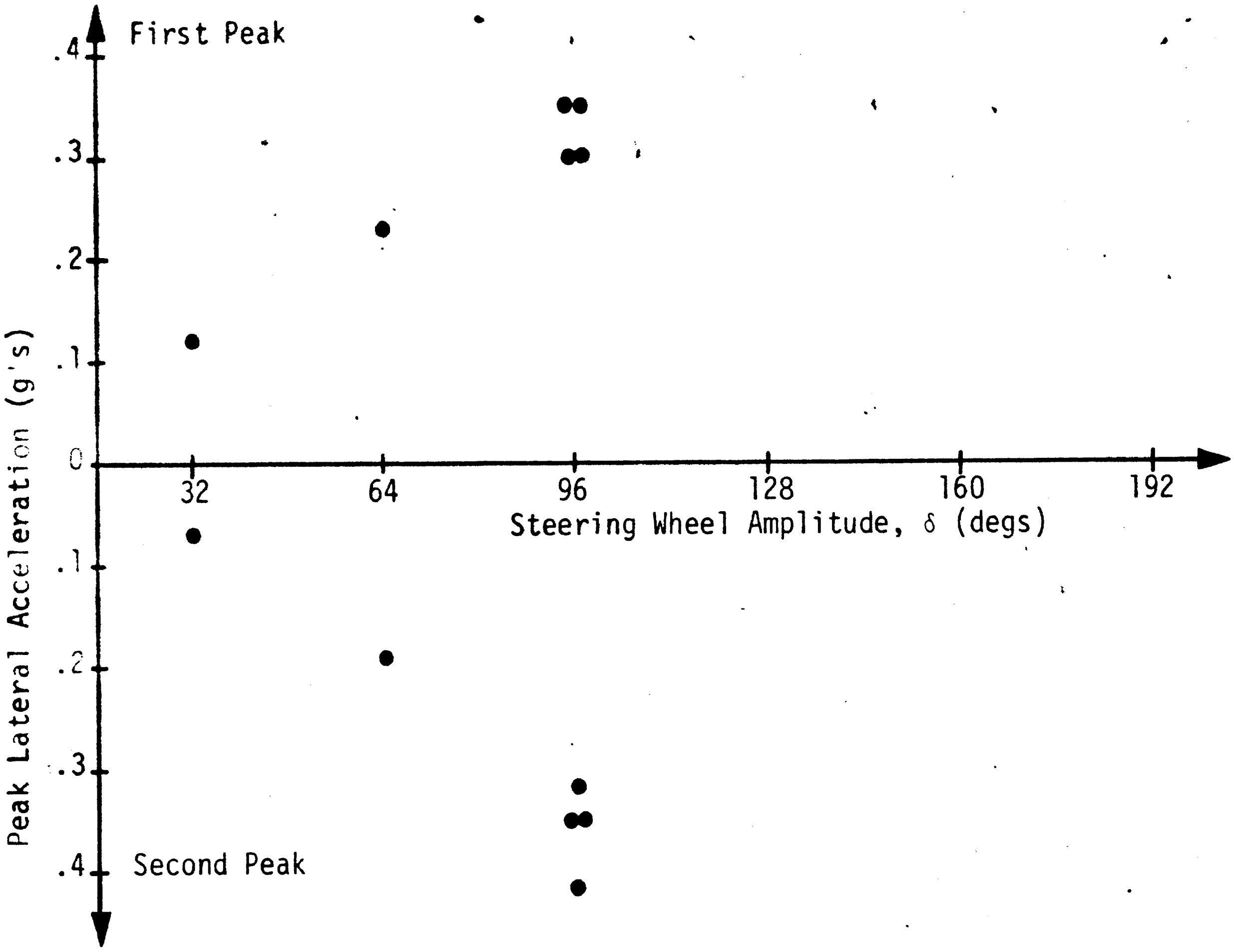


Figure E.15. Light van: loaded OE, sinusoidal steer runs at 50 mph, dry concrete, τ = 2 sec.



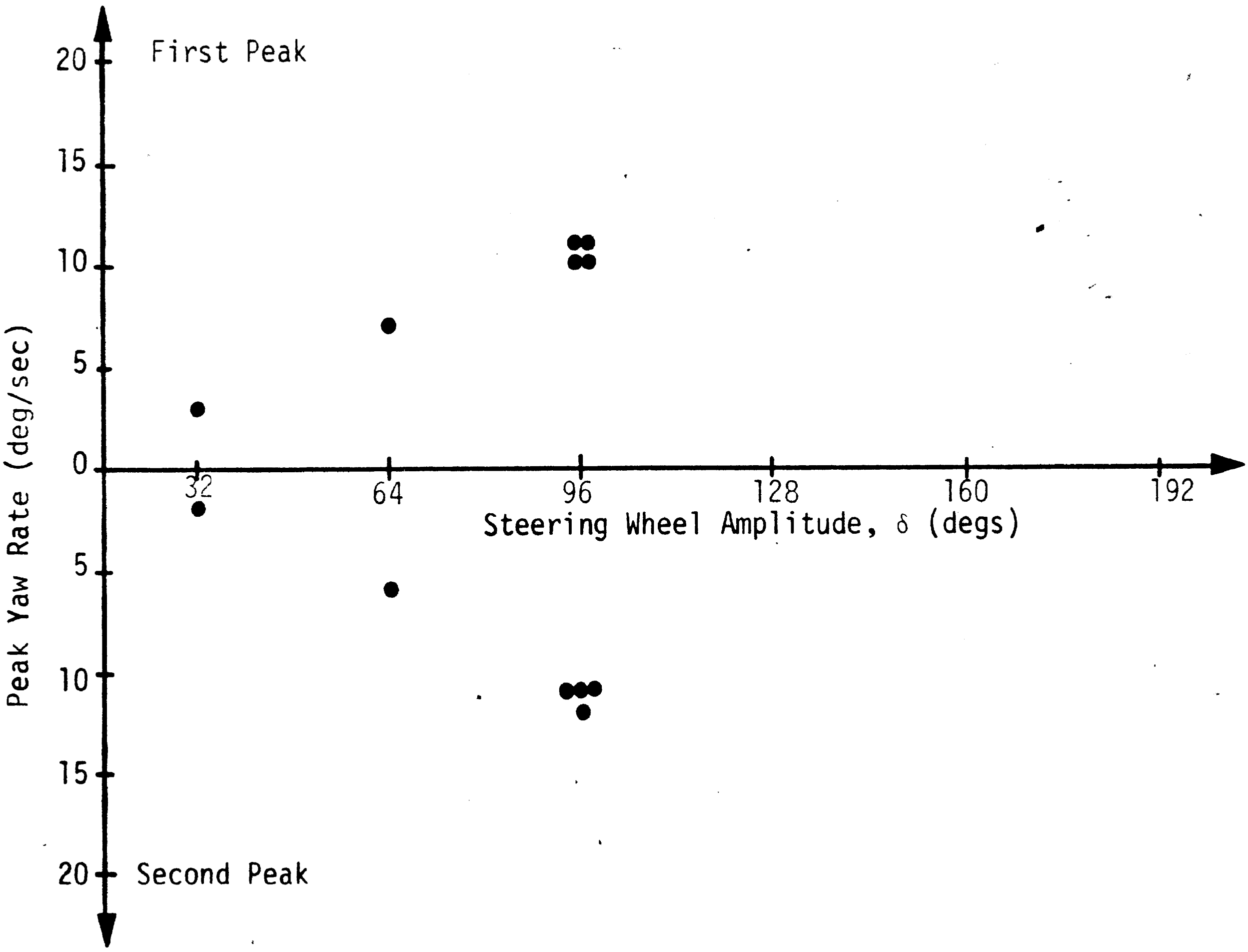


Figure E.16. Light van: loaded OE, sinusoidal steer runs at 50 mph, dry concrete, τ = 3 sec.

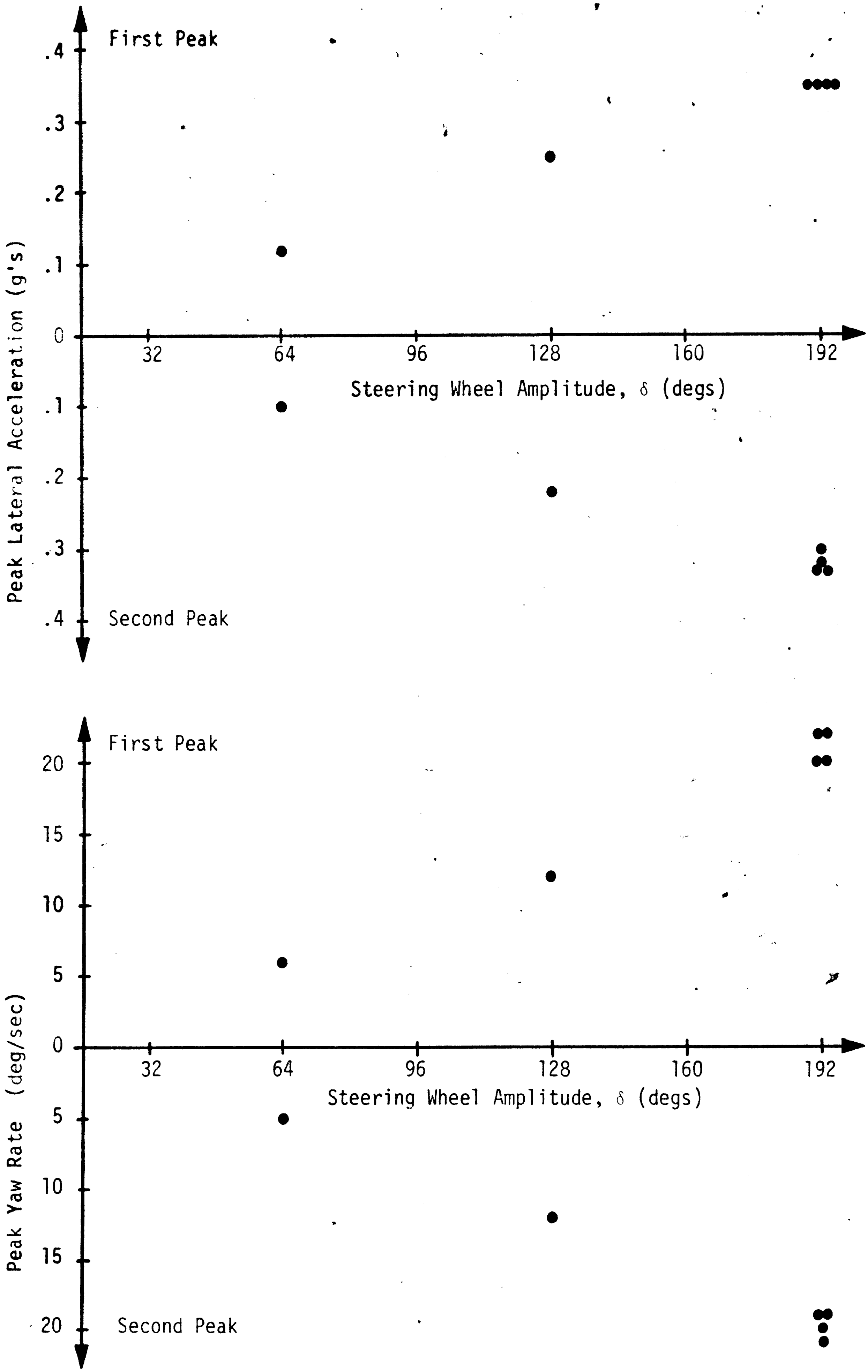
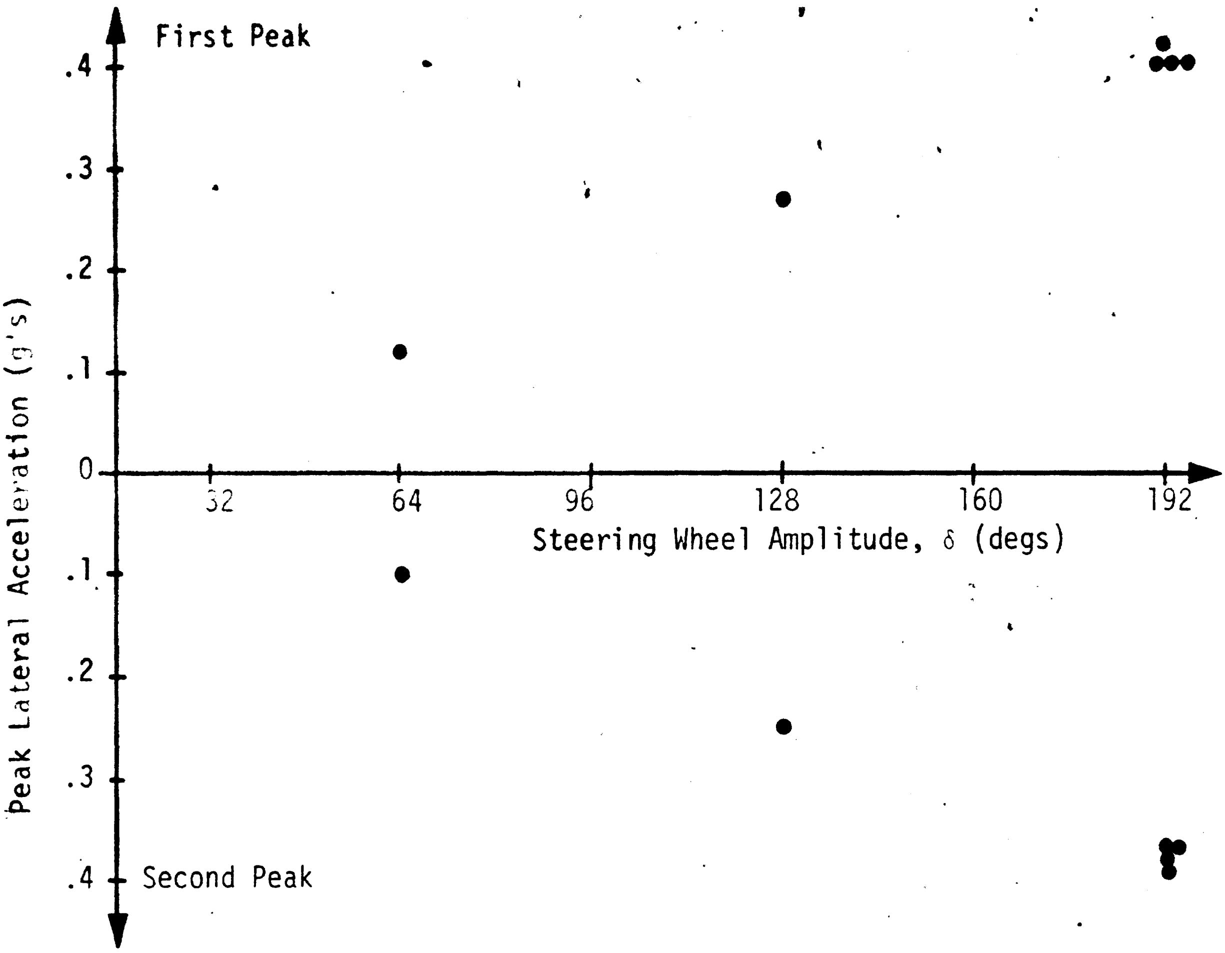


Figure E.17. Light van: loaded EV, sinusoidal steer runs at 30 mph, dry concrete, τ = 2 sec.



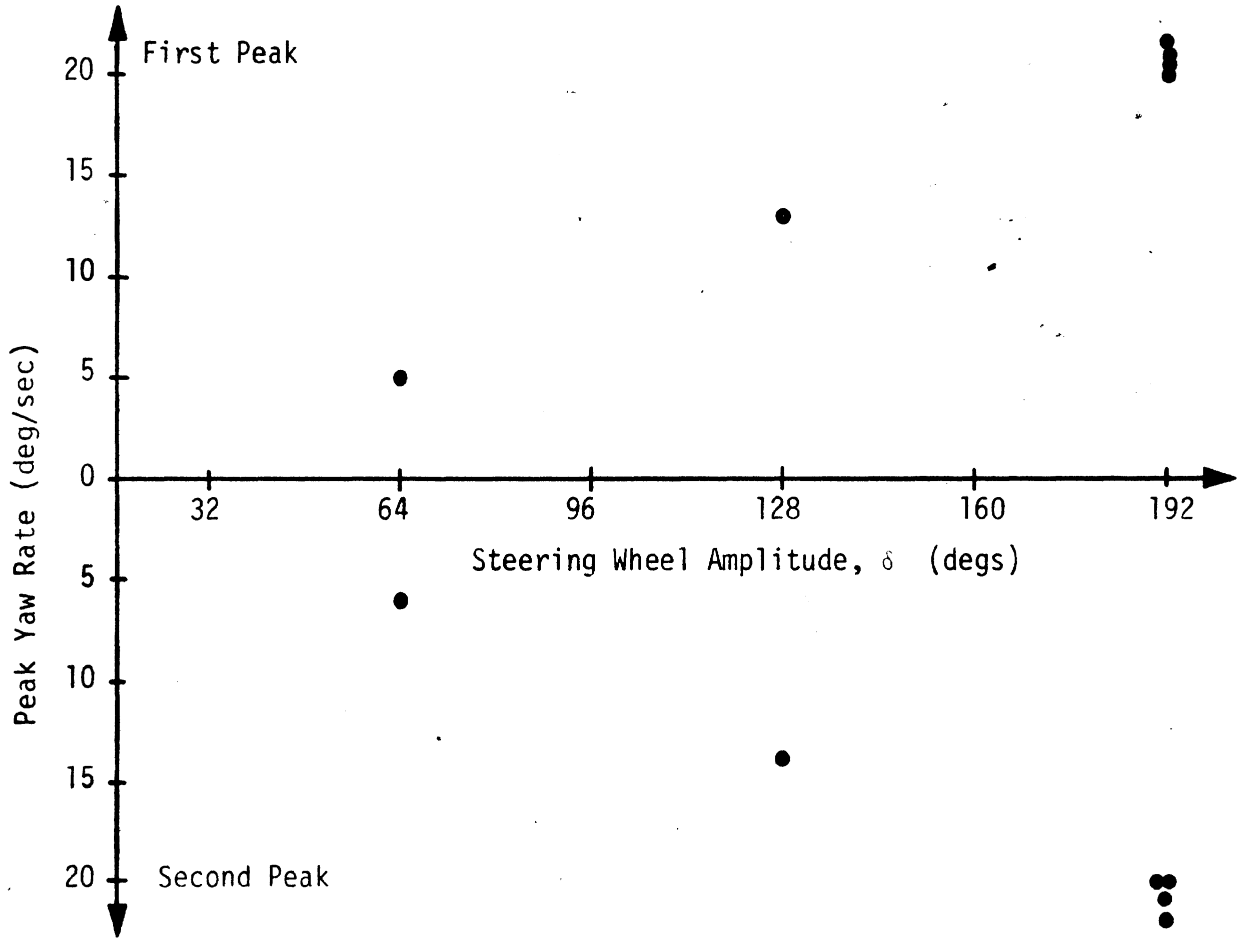
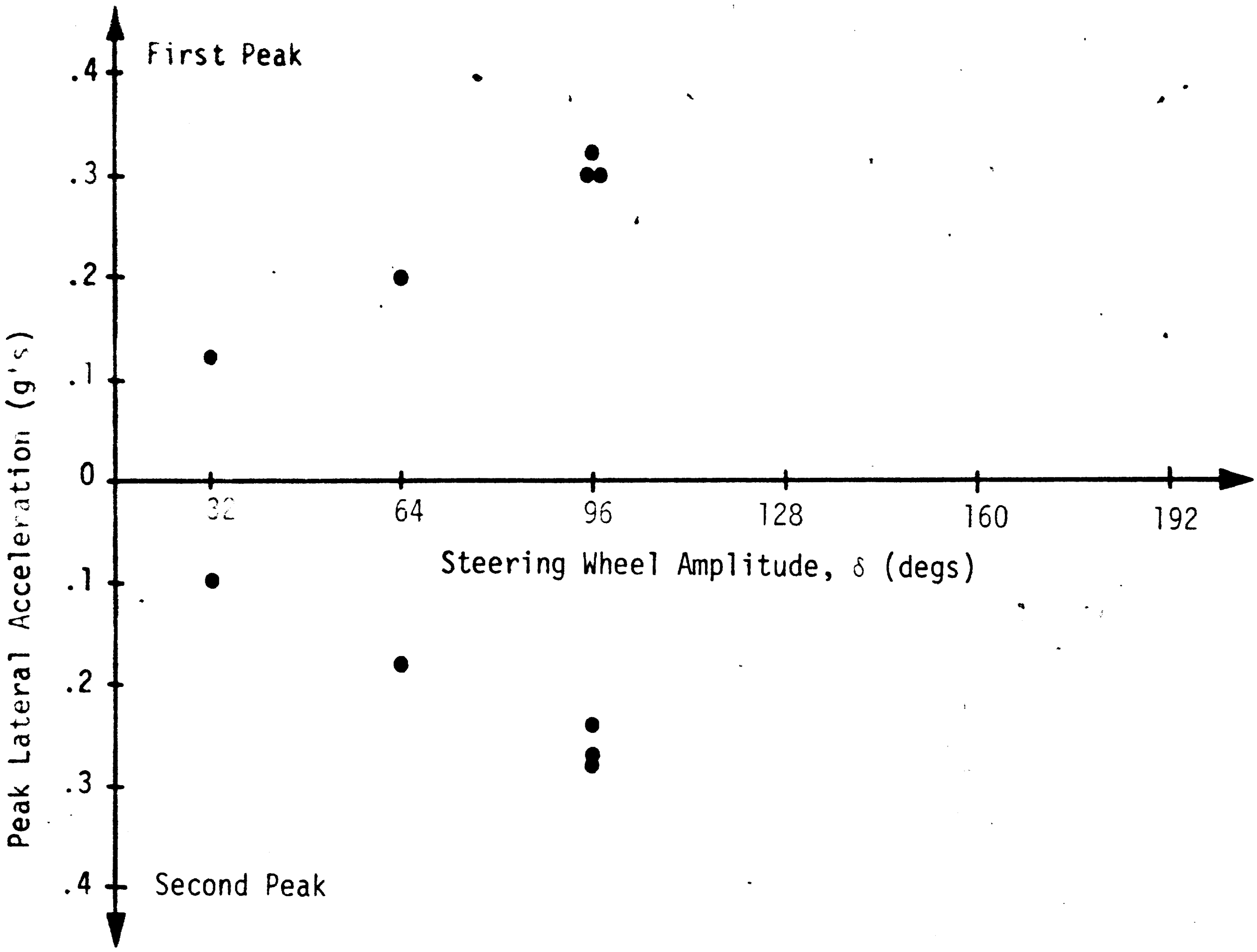


Figure E.18. Light van: loaded EV, sinusoidal steer runs at 30 mph, dry concrete, τ = 3 sec.



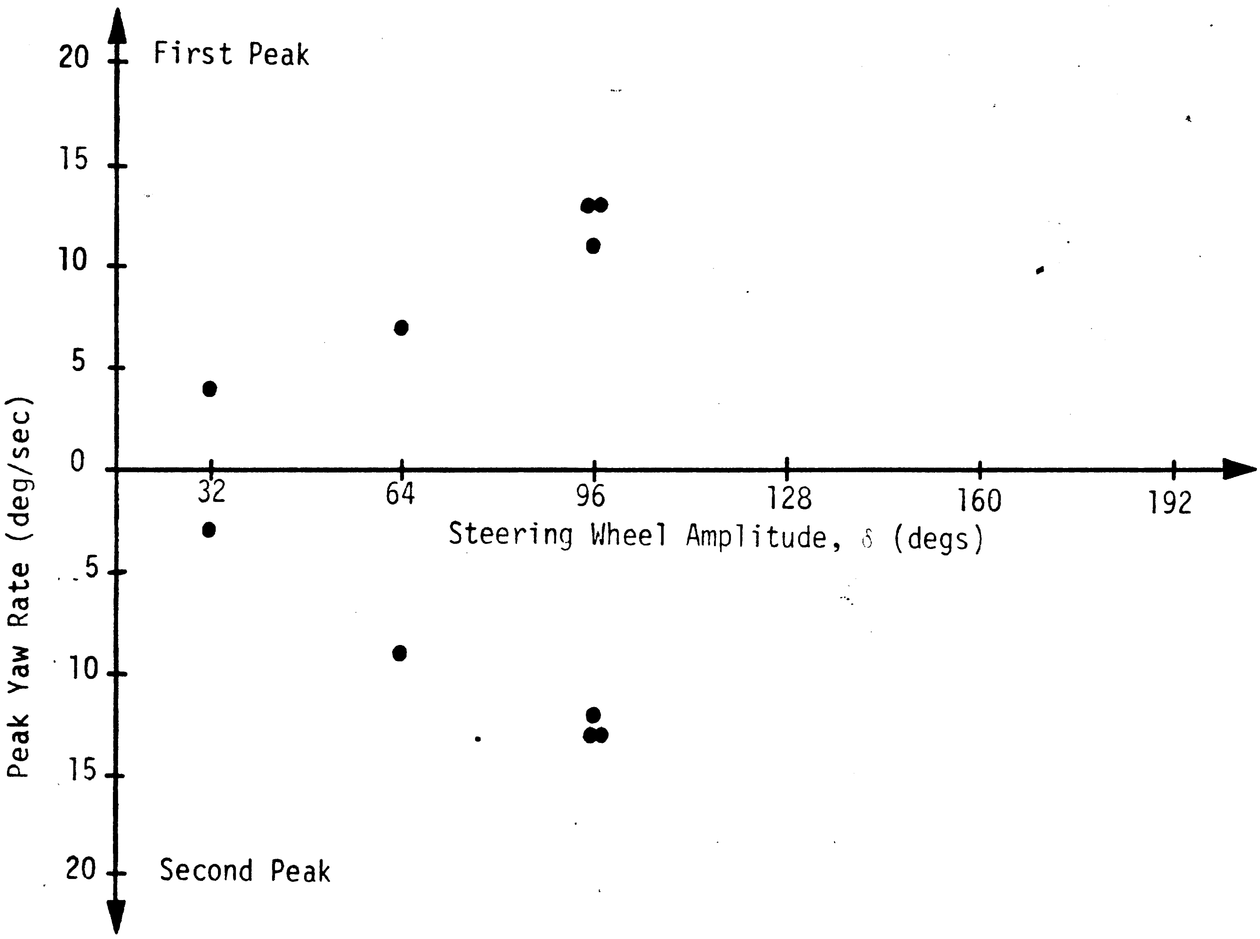


Figure E.19. Light van: loaded EV, sinusoidal steer runs at 50 mph, dry concrete, τ = 2 sec.

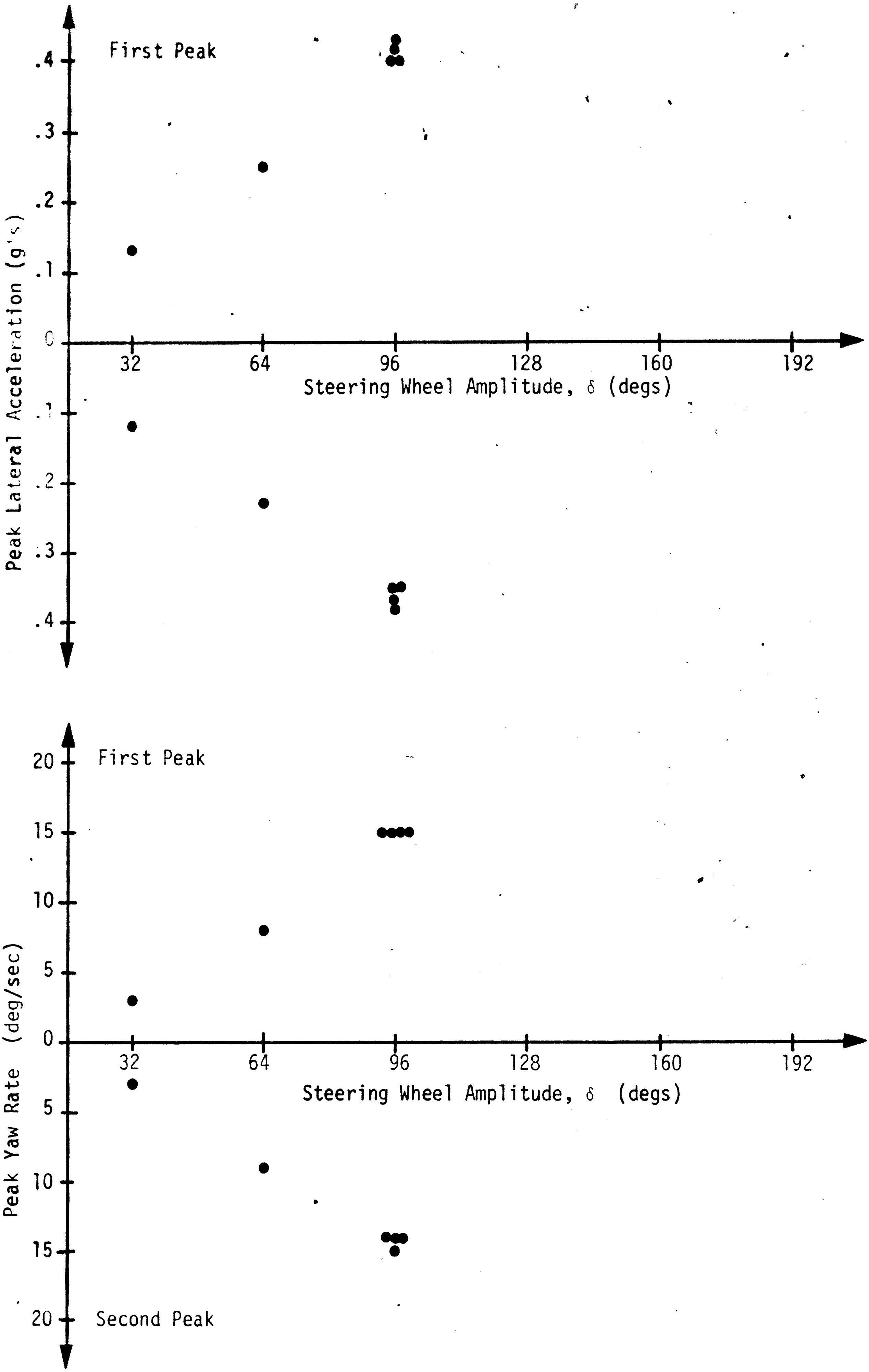
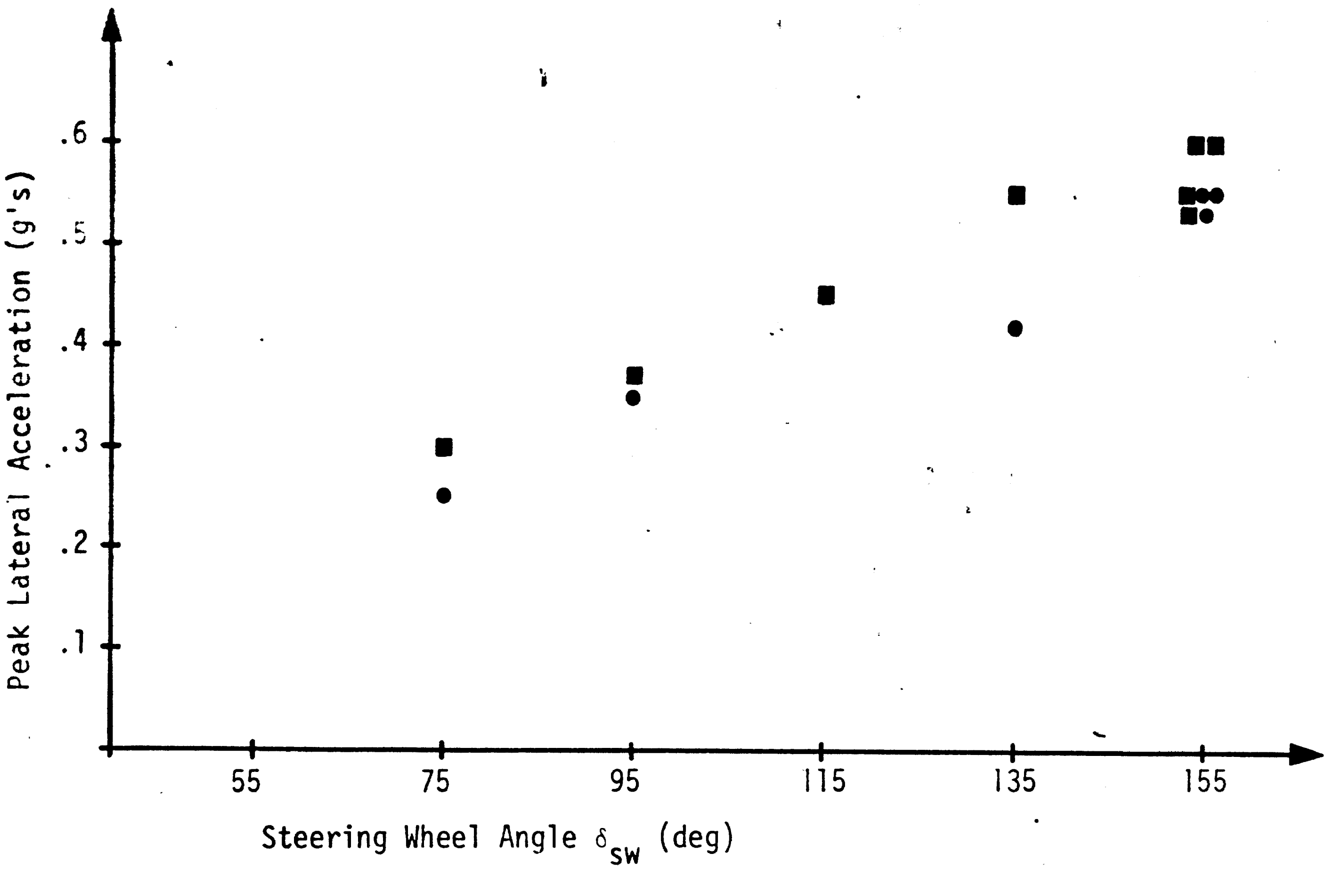


Figure E.20. Light van: loaded EV, sinusoidal steer runs at 50 mph, dry concrete, τ = 3 sec.

E.2 Test Results - Ford F-250 Pickup Truck - Trapezoidal and Sinusoidal Steer Test Results

Test conditions are identified by the following codes:

Test Code	Front Tires	Rear Tires
	Tire code no.'s refer to Table 3.1 in the text (pg. 24)	
OE	L1 (bias-rib)	L1 (bias-rib)
TC 13	L13 (radial-rib)	L13 (radial-rib)
TC 14	L16 (bias-rib)	L16 (bias-rib)
TC 15	L1 (bias-rib)	L9 (bias-lug/snow)



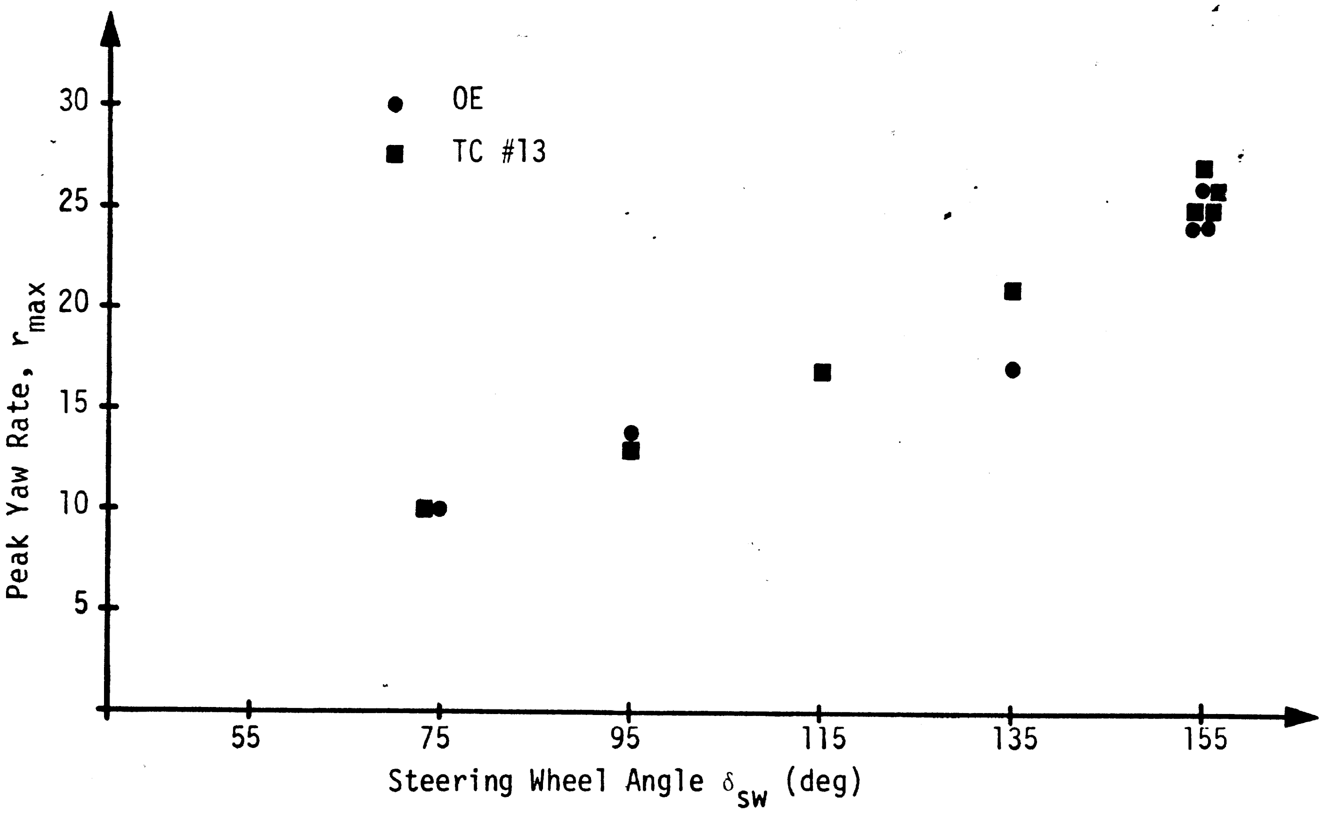


Figure E.21. Loaded light pickup: trapezoidal steer runs at 30 mph.

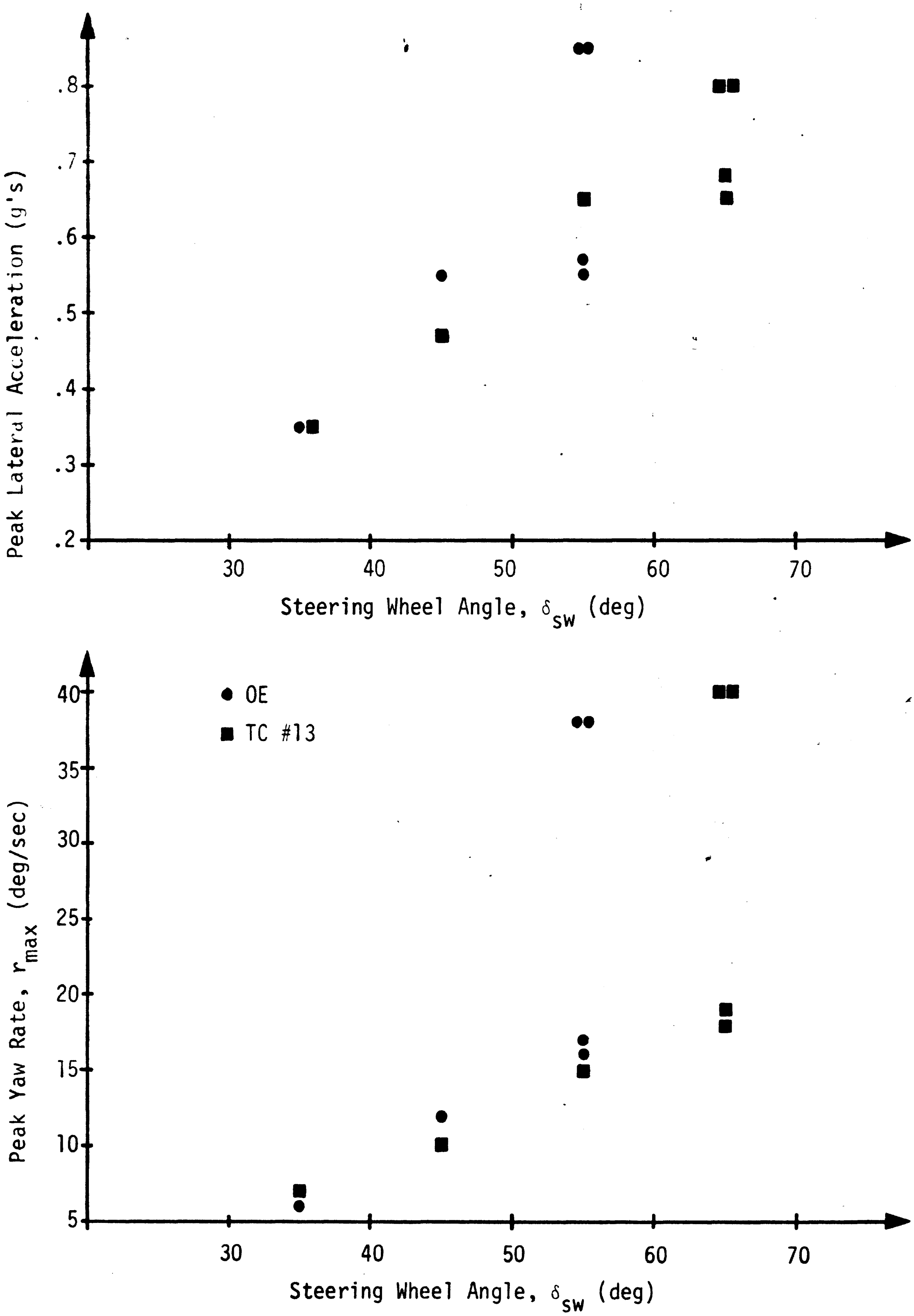
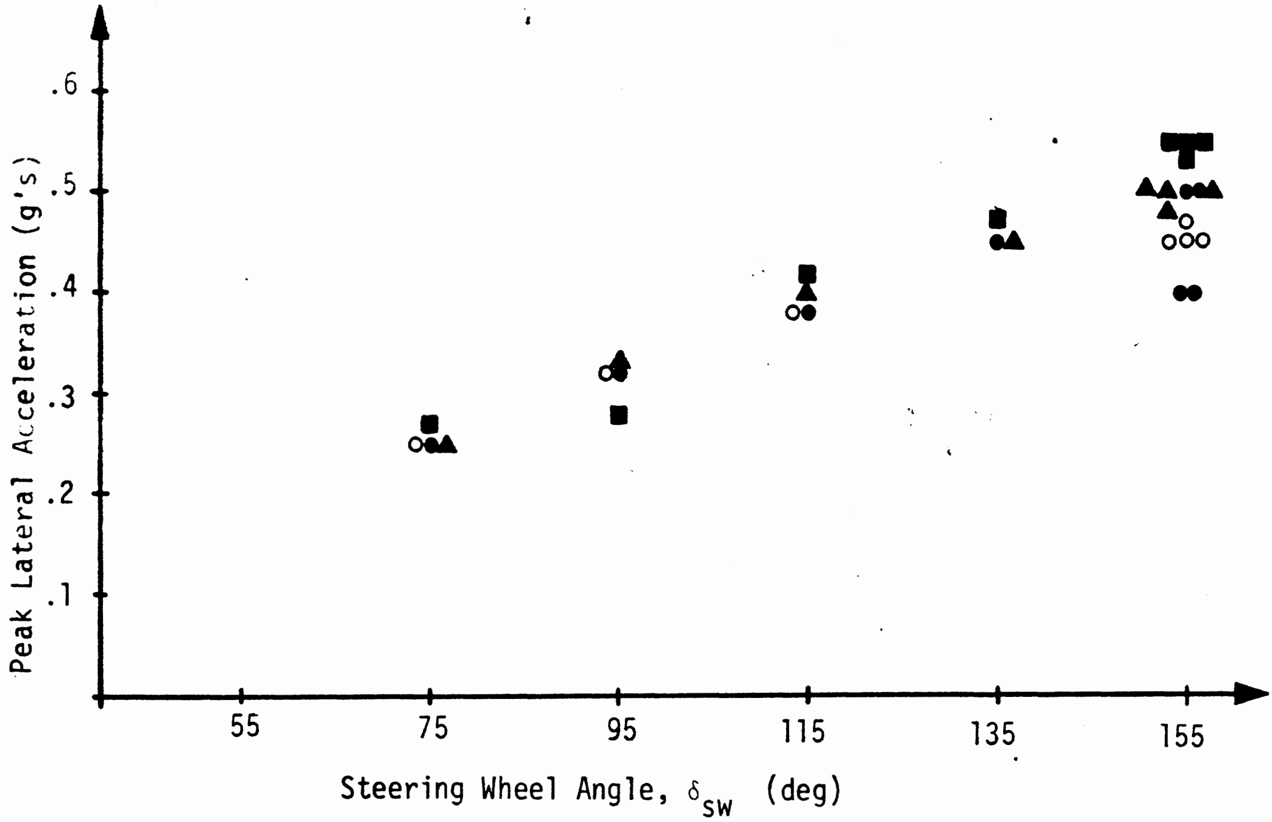


Figure E.22. Loaded light pickup: trapezoidal steer runs at 50 mph.



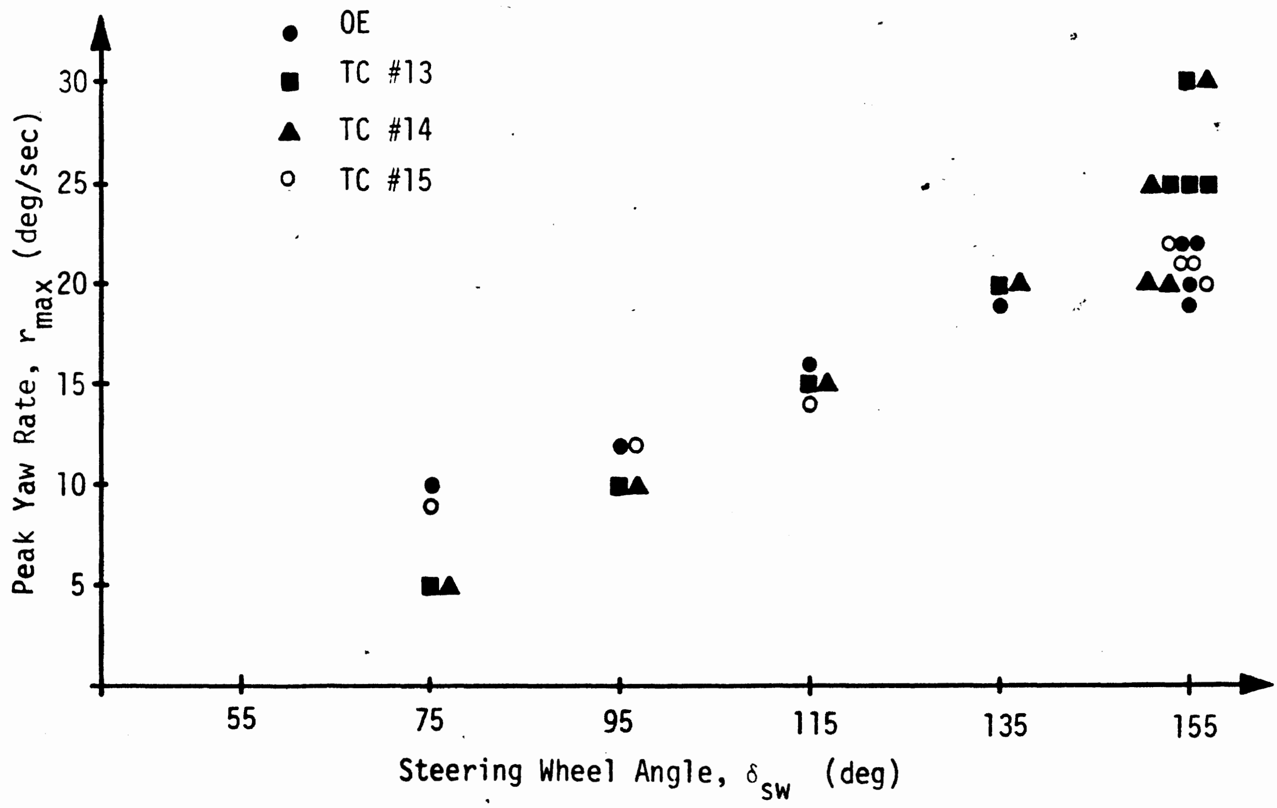


Figure E.23. Unloaded light pickup: trapezoidal steer runs at 30 mph.

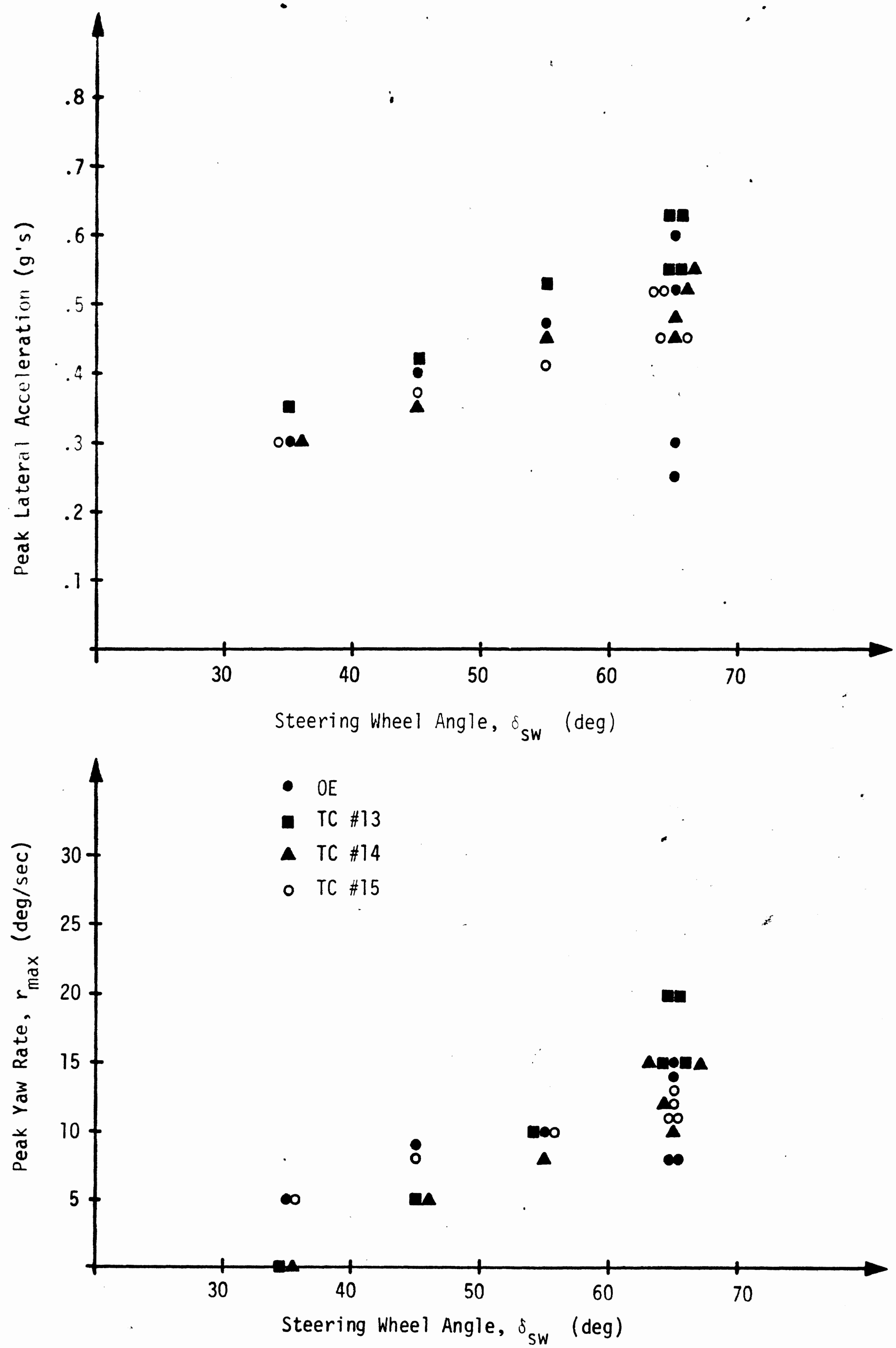


Figure E.24. Unloaded light pickup: trapezoidal steer runs at 50 mph.

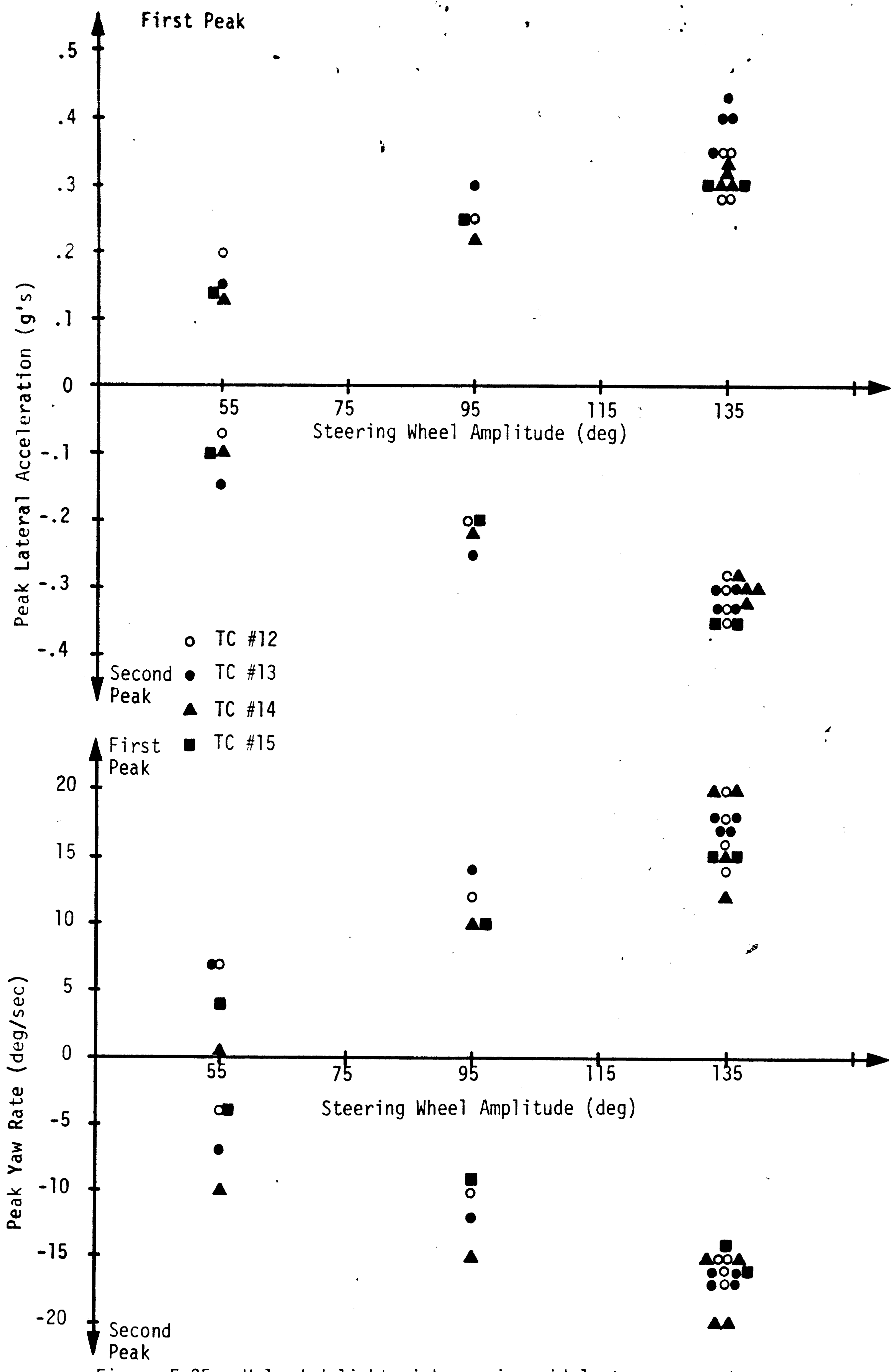


Figure E.25. Unloaded light pickup: sinusoidal steer runs at 30 mph, dry asphalt, τ = 2 sec.

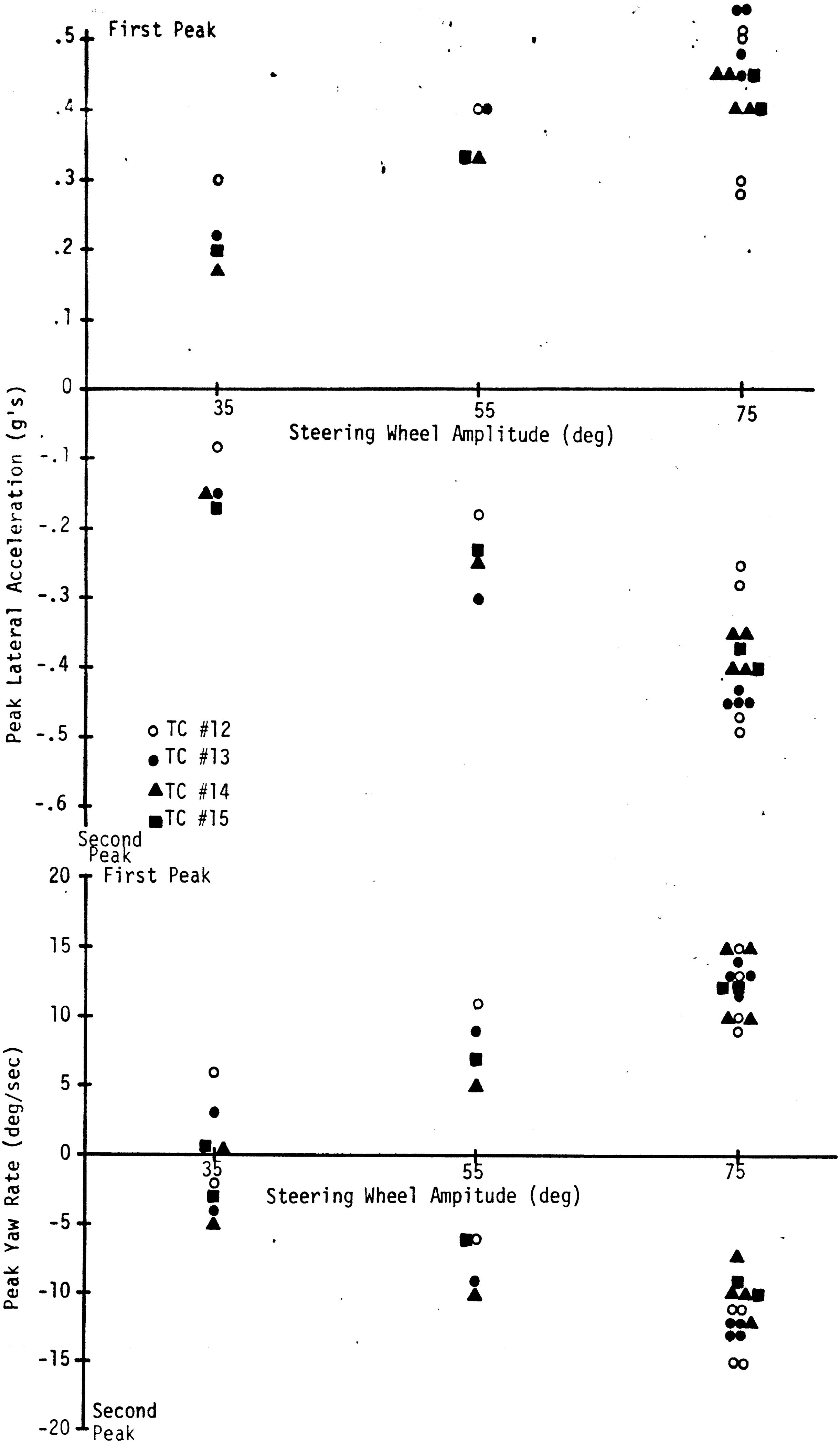


Figure E.26. Unloaded light pickup: sinusoidal steer runs at 50 mph, dry asphalt, τ = 4 sec

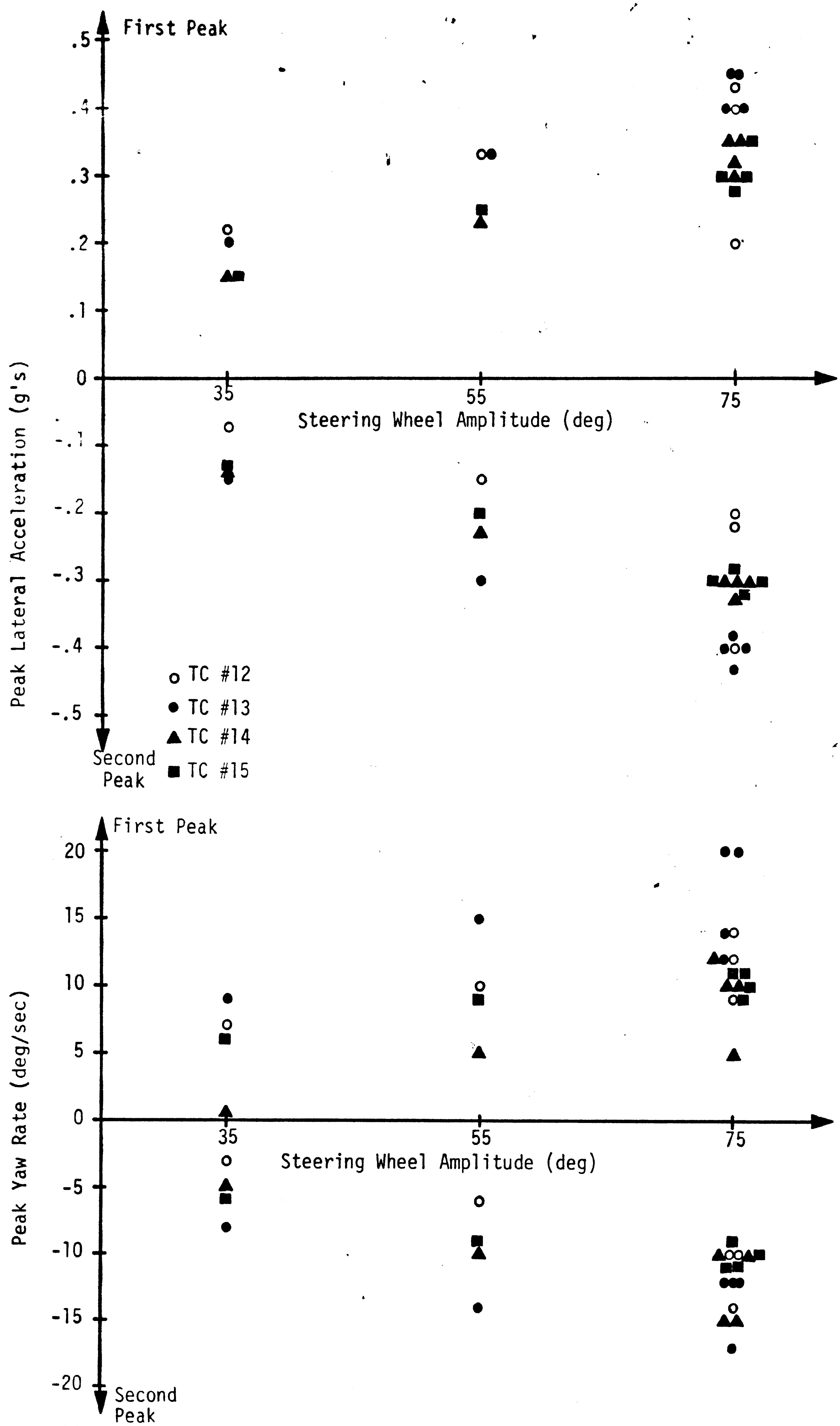


Figure E.27. Unloaded light pickup: sinusoidal steer runs at 50 mph dry asphalt, τ = 2 sec.

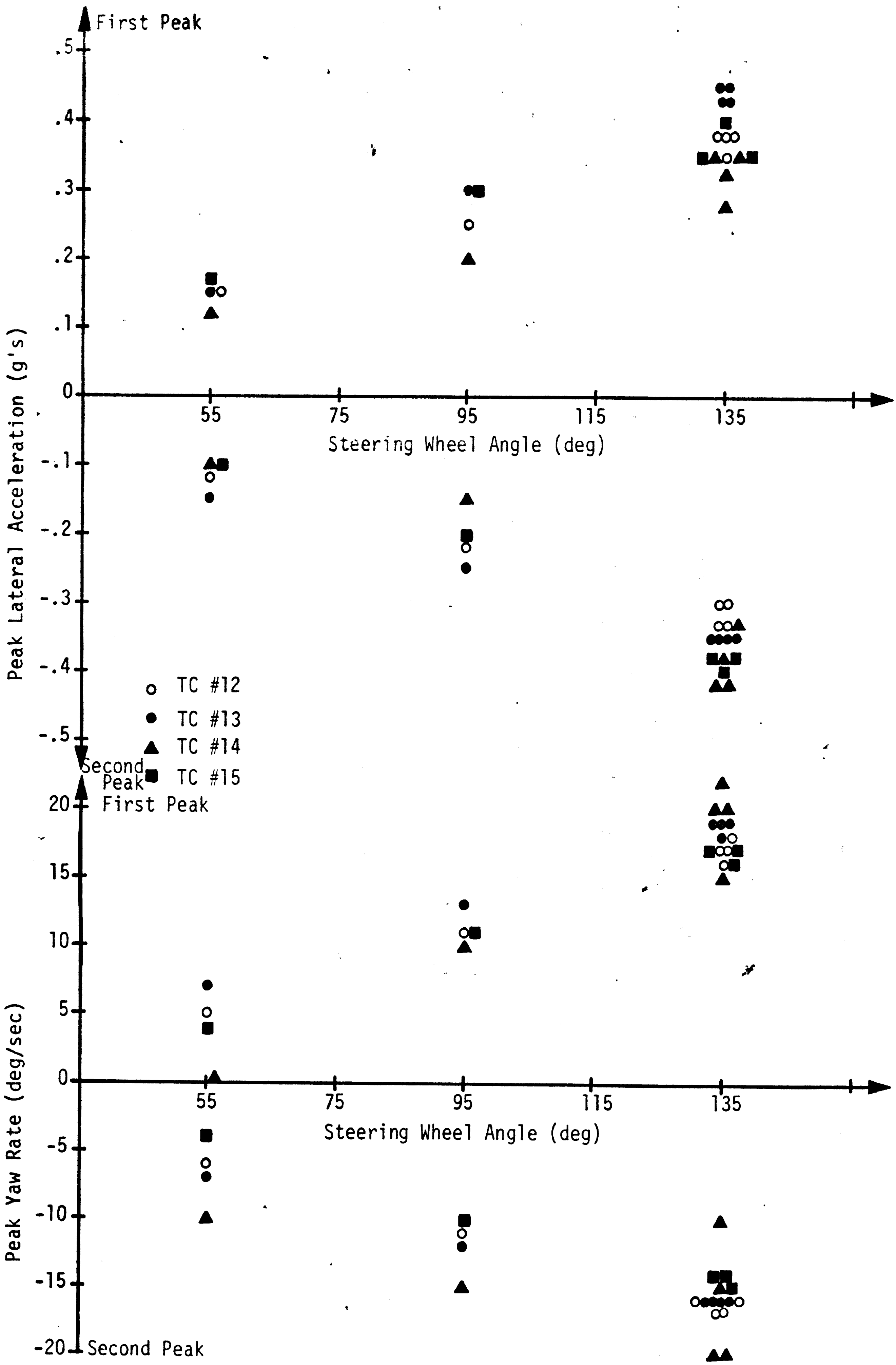


Figure E.28. Unloaded light pickup: sinusoidal steer runs at 30 mph, dry asphalt, τ = 4 sec.

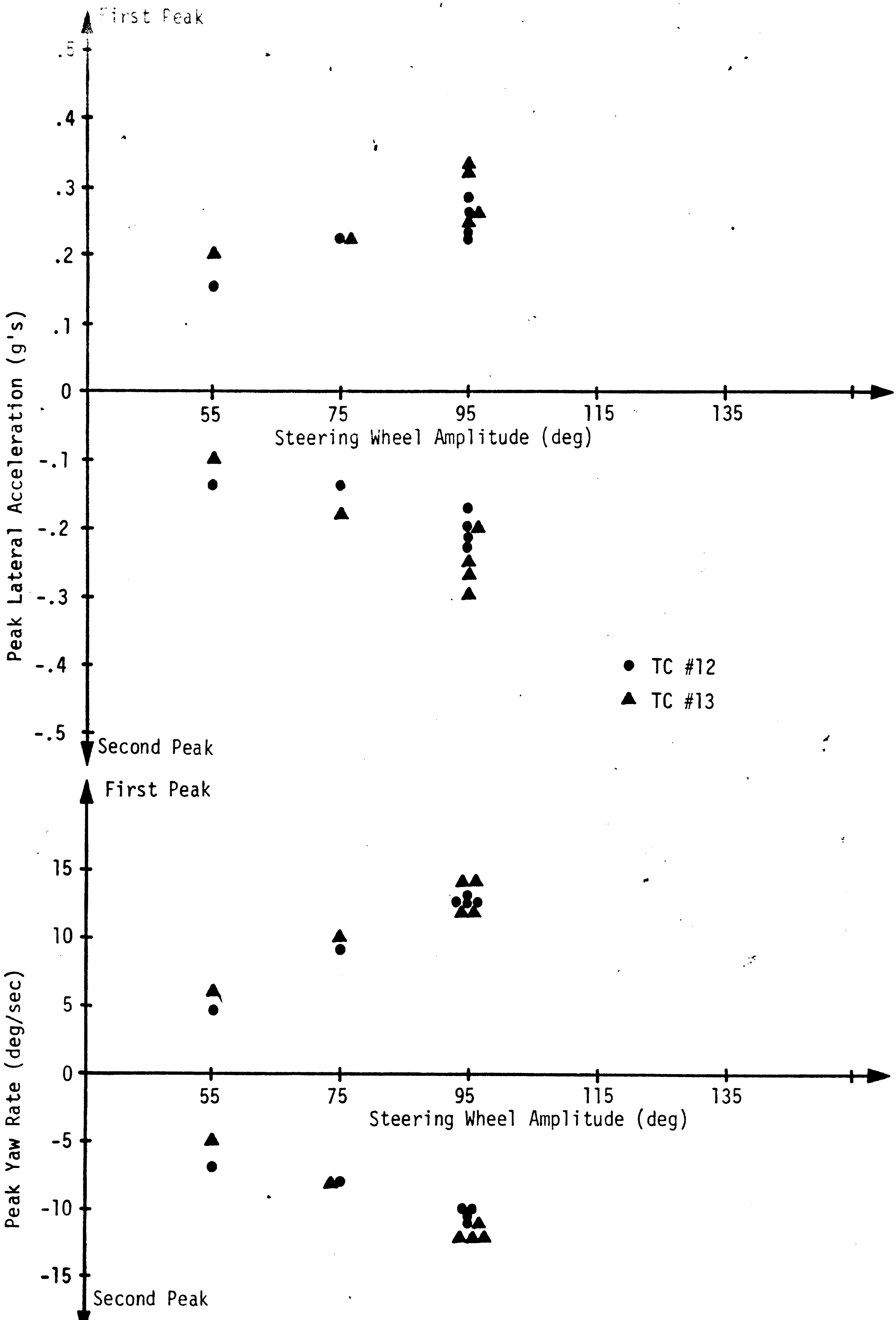


Figure E.29. Unloaded light pickup: sinusoidal steer runs at 30 mph, wet jennite, τ = 4 sec.

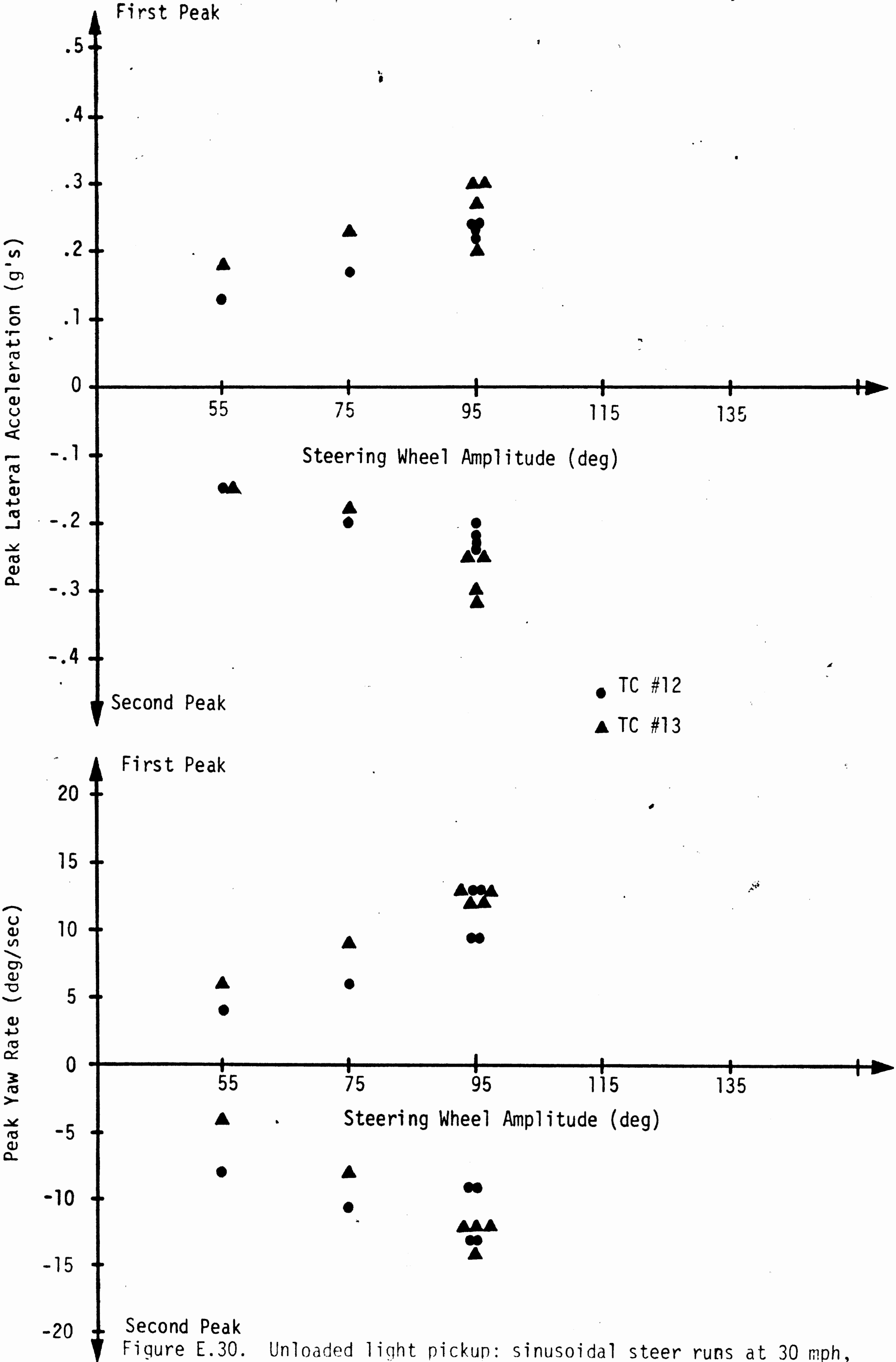


Figure E.30. Unloaded light pickup: sinusoidal steer runs at 30 mph, wet jennite, τ = 2 sec.

30mph Loaded

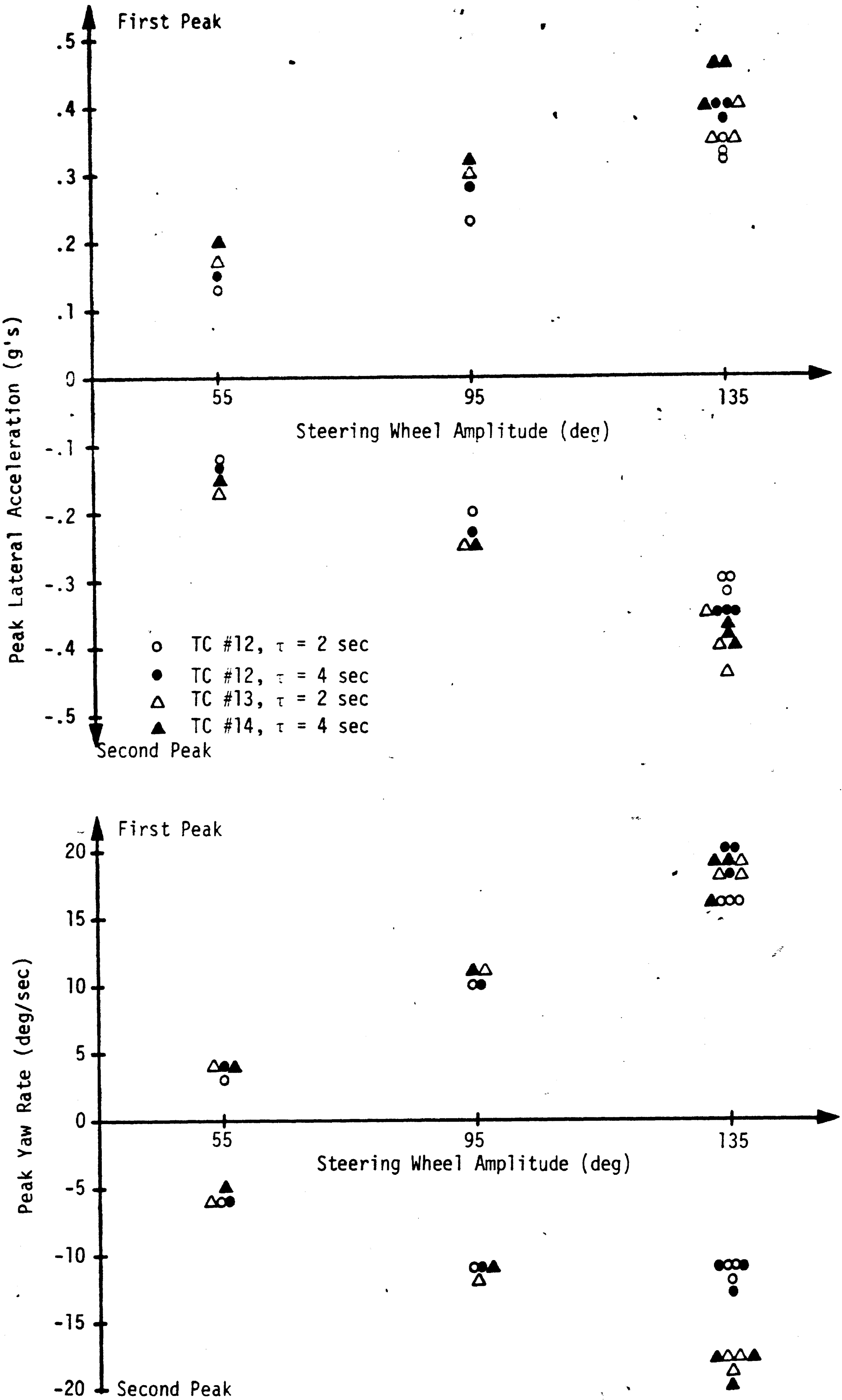


Figure E.31. Loaded light pickup: sinusoidal steer runs at 30 mph, dry asphalt.

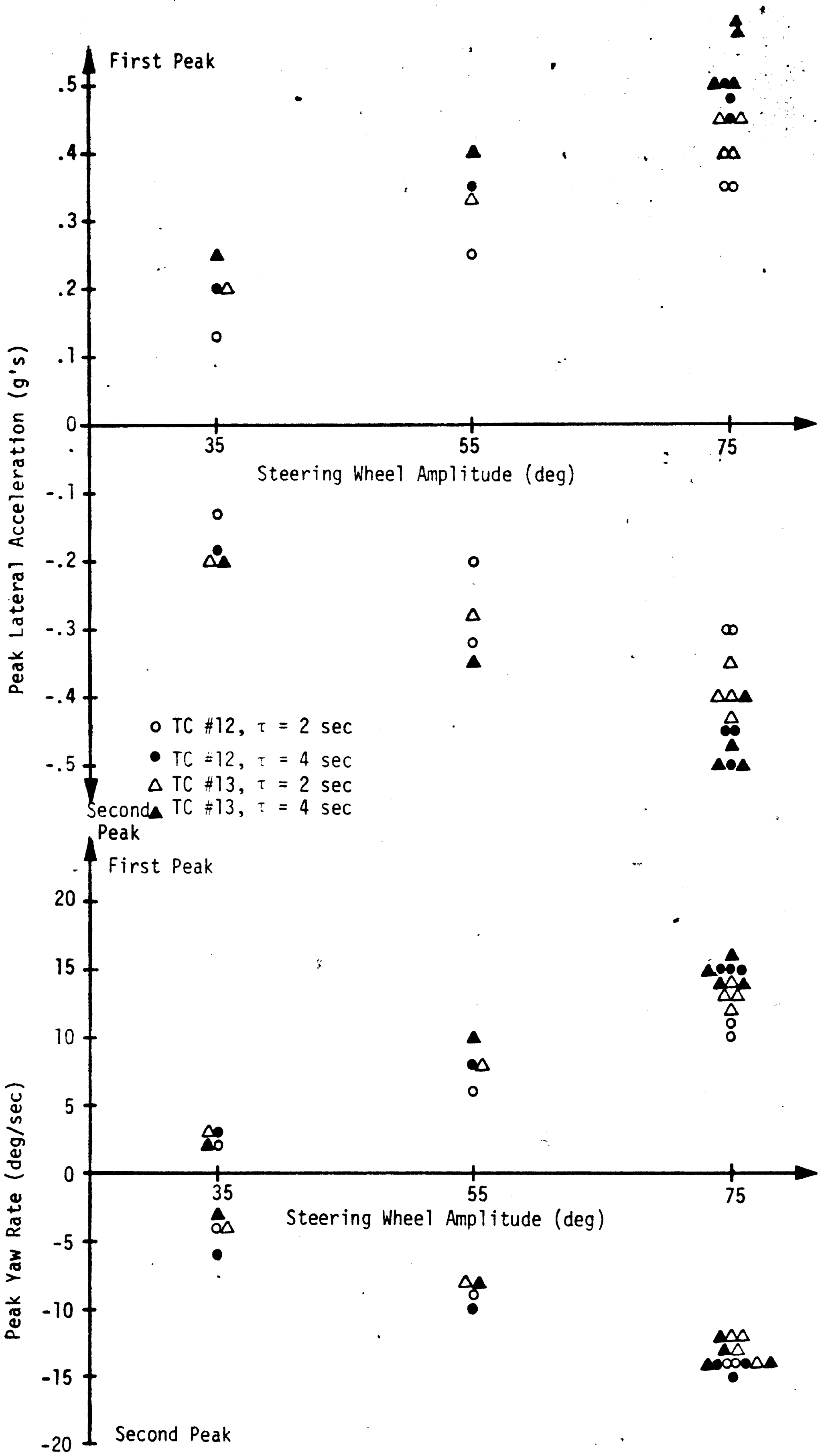
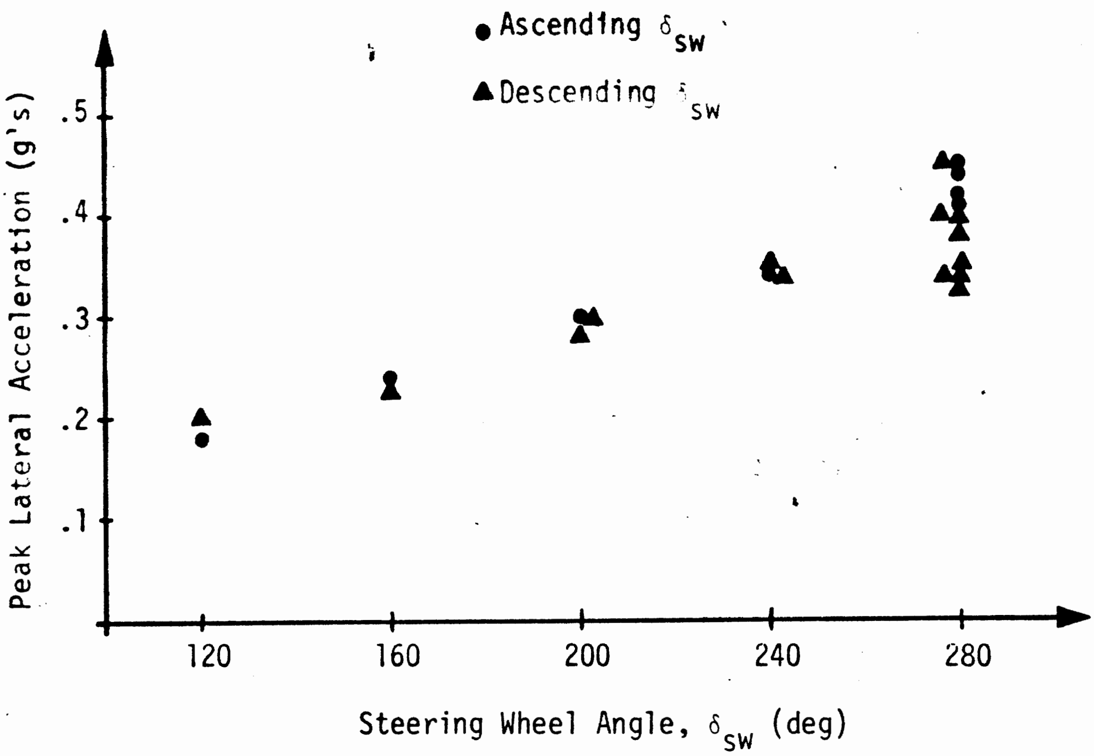


Figure E.32. Loaded light pickup: sinusoidal steer runs at 50 mph, dry asphalt.

E.3 White Road Boss Heavy Truck Trapezoidal Steer Results

Data describing the trapezoidal steer numerics for the baseline truck equipped with code H1 tires at all six wheel positions.



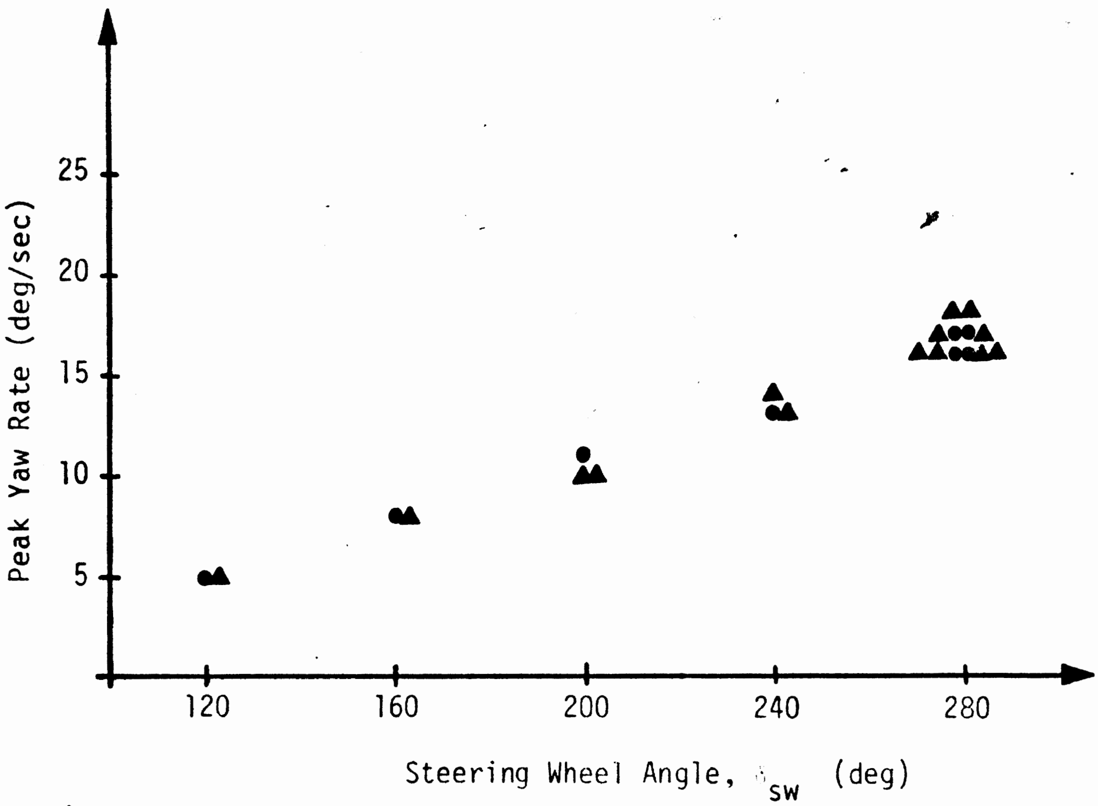


Figure E.33. Heavy truck: unloaded, trapezoidal steer runs at 30 mph.

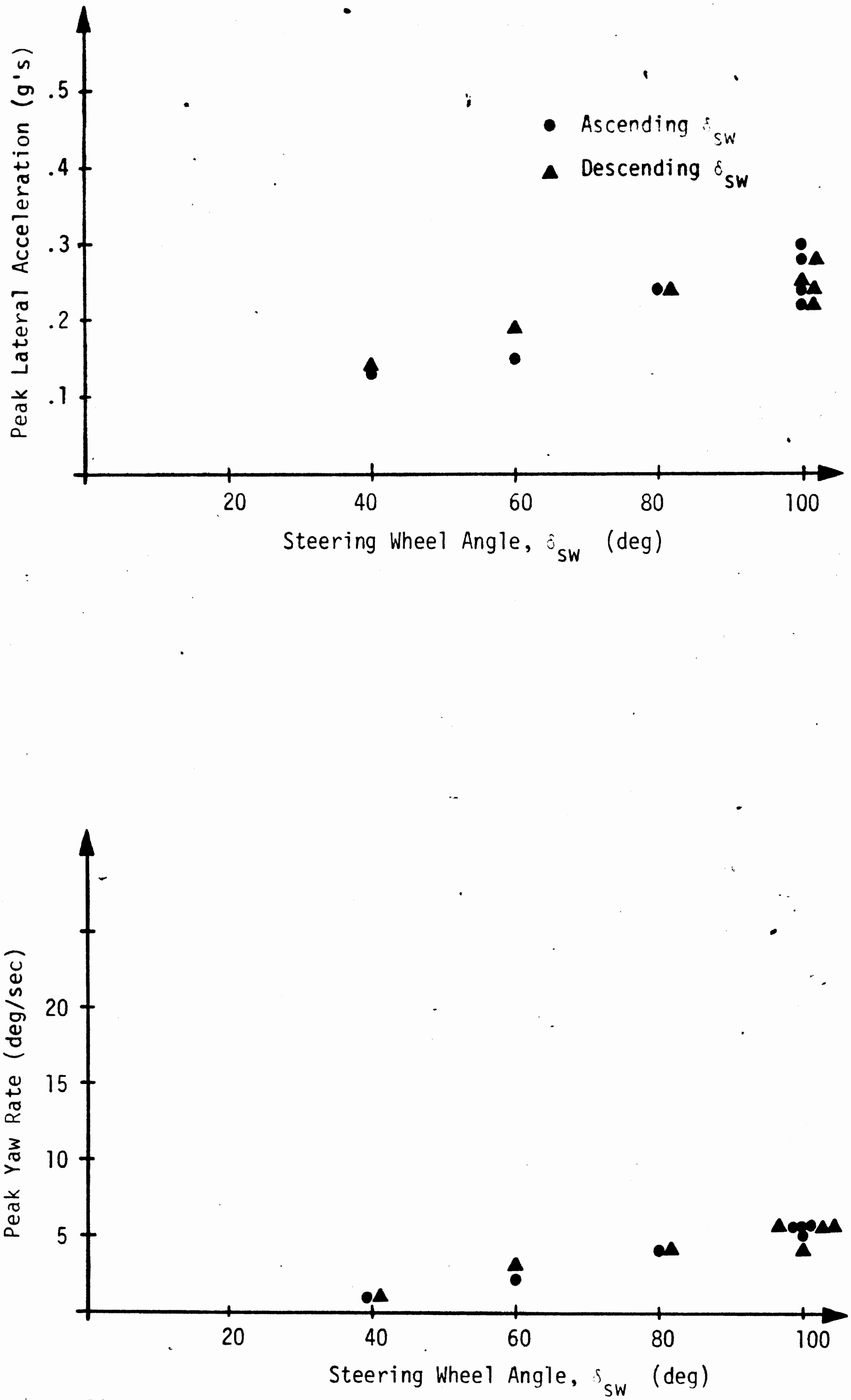


Figure E.34. Heavy truck: unloaded, trapezoidal steer runs at 50 mph.

E.4 Tabular Presentation of Vehicle Test Data

Tables indicate the following test conditions and response measures:

1) Loaded/unloaded state

2) Maneuver type, coded as follows

Code No.	Maneuver
1	Straight-line braking
2	Braking in a turn
3	Sinusoidal steer
4a	Trapezoidal steer, step-fronted input
4b	Trapezoidal steer, ramp-fronted input

3) Test velocity (mph)

4) Steering wheel displacement amplitude (deg)

5) Period of sinusoidal steering inputs

6) Brake input level (% of input level needed to lock all wheels on any one axle)

7) $A_{x_{ave}}$, average value of longitudinal acceleration during a braking test (g's).

8) $A_{y_{peak}}$, peak value of lateral acceleration (g's). (In sinusoidal steer experiments, the peak values achieved at both polarities of accelerations.)

9) r_{peak}, peak value of yaw rate (deg/sec). (In sinusoidal steer, both polarity peaks are listed.)

10) T_{inf}, the time (seconds) at which the lateral acceleration time history crosses back through zero—measured with respect to initiation of steering—in a sinusoidal steer maneuver.

Data presented for the light van and heavy truck indicate the installed tires by model and size. Pickup truck tests are identified by a code indicating tire installations as shown below.

Test Code	Front Tires	Rear Tires
TC-12	L1	L1
TC-13	L13	L13
TC-14	L16	L16
TC-15	L1	L9

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE: VAN — TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75x16.5 [illegible] — TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75x16.5 [illegible]

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
1-05	NO	1	40	0	—	20	0.12	—	—	—	
1-07	NO	1	40	0	—	20	0.15	—	—	—	
1-08	NO	1	40	0	—	40	0.20	—	—	—	
1-09	NO	1	40	0	—	[illegible]	0.13	—	—	—	
1-12	NO	1	41	[illegible]	—	[illegible]	0.45	—	—	—	
1-13	NO	1	40	0	—	60	0.45	—	—	—	
1-14	NO	1	40	0	—	80	0.55	-.10	L8	—	RR LOCK-UP @ END
1-15	NO	1	40	0	—	80	0.55	-.20	L10	—	LOCK-UP @ END
1-20	NO	1	[illegible]3	[illegible]	—	40	0.20	—	—	—	FRONT ONLY
1-21	NO	1	28	[illegible]	—	[illegible]	0.20	—	—	—	FRONT ONLY
1-22	NO	1	[illegible]3	[illegible]	—	[illegible]	[illegible]	—	—	—	REAR ONLY
1-23	NO	1	[illegible]3	[illegible]	—	[illegible]	[illegible]	—	—	—	REAR ONLY
2-06	NO	2	30	90L	—	[illegible]	0.18	0.25	10	—	
2-07	NO	2	[illegible]	110R	—	30	[illegible]	0.22	10	—	
2-08	NO	2	[illegible]	[illegible]	—	[illegible]	[illegible]	0.22	10	—	COMP. STOP, NO LOCK
2-09	NO	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]	04	—	
2-10	NO	2	[illegible]	[illegible]	—	[illegible]	0.30	0.25	11	—	

← WET | DRY →

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 1E TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 1E

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/sec	$T_{INF.}$ SEC.	
2-11	NO	2	30	110R	–	[illegible]	.30	.35	21	–	RR LOCK-UP
2-12	NO	2	30	110R	–	50	.53	.18	10	–	NO LOCK-UP
3-05	NO	3	30	64L	2		[illegible]	L.13/R.08	L15/R10	1.2	
3-06	NO	3	30	96R	2	–	.07	R.17/L.16	R8/L7	1.1	
3-07	NO	3	30	128R	2	–	.08	R.20/L.25	R10/L12	1.1	
3-08	NO	3	30	128[illegible]	2	–	.05	R.20/L.25	R10/L12	1.1	
3-09	NO	3	30	128L	2	–	.07	L.25/R.20	L11/R10	1.1	
3-10	NO	3	30	128L	2	–	.05	L.25/R.20	L11/R10	1.1	
3-11	NO	3	30	64L	3	–	.07	L.15/R.10	L6/R4	1.5	
3-12	NO	3	30	96R	3	–	[illegible]	R.20/L.20	R8/L9	1.6	
3-13	NO	3	30	128R	3	–	[illegible]	R.23/L.15	R10/L12	1.6	
3-14	NO	3	30	128[illegible]	3	–	[illegible]	R.25/L.15	R11/L12	1.6	
3-[illegible]	NO	3	30	128L	3	–	[illegible]	L.25/R.20	L11/R12	1.5	
3-17	NO	3	[illegible]	128[illegible]	3	–	[illegible]	[illegible]	[illegible]/R11	1.5	
4-06	NO	2	55	75[illegible]	–	40					NO Ay
4-0[illegible]	NO	2	55	75	–	50	.18	.48	12	—	
[illegible]-0[illegible]	NO	2	[illegible]	75	–	60	.20	.45	13	—	

WET

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN — TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75×16.5 1E — TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75×16.5 1E

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
4-08	NO	2	54	75L	—	60	.35	.68	18	—	LEFT REAR LOCK
4-09	NO	2	55	75L	—	60	.38	.65	19	—	" " "
4-10	NO	2	50	90R	—	60	.35	.63	21	—	" " "
4-11	NO	2	50	90R	—	60	.35	.65	20	—	
5-05	NO	3	30	64L	2	—	.05	L.15/R.10	L6/R4	1.1	
5-06	NO	3	28	128R	2	—	.05	R.15/L.25	R10/L12	1.0	
5-07	NO	3	30	128L	2	—	.05	L.27/R.20	L14/R9	1.1	
5-08	NO	3	30	192L	2	—	.05	L.40/R.30	L19/R16	1.1	
5-09	NO	3	28	192L	2	—	.05	L.40/R.30	L19/R15	1.1	
5-10	NO	3	30	192R	2	—	.05	R.30/L.35	R15/L19	1.1	
5-11	NO	3	30	192R	2	—	.05	R.35/L.37	R15/L18	1.0	T_2 POT NON-LINEAR
5-12	NO	3	28	64L		—					T_2 POT NON-LINEAR
5-13	NO	3	28	128L	3	—	.05	L.30/R.20	L14/R10	1.5	
5-14	NO	3	28	192L	3	—	.07	L.42/R.32	L19/R17	1.5	
5-15	NO	3	28	192L	3	—	.05	L.42/R.30	L20/R16	1.4	
5-16	NO	3	28	192R	3	—	.05	R.35/L.40	R18/L19	1.5	
5-17	NO	3	28	192R	3	—	.07	R.35/L.30	R18/L19	1.5	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN

TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
5-18	NO	3	50	32L	2	–	.07	L.10/R.07	L3/R2	1.1
5-19	NO	3	50	64L	2	–	.07	L.25/R.17	L7/R6	1.1
5-20	NO	3	50	96L	2	–	.08	L.35/R.25	L13/R10	1.2
5-21	NO	3	50	96L	2	–	.08	L.35/R.25	L12/R10	1.3
5-22	NO	3	50	96R	2	–	.07	R.27/L.35	R10/L12	1.1
5-23	NO	3	50	96R	2	–	.07	R.25/L.35	R10/L12	1.2
5-24	NO	3	50	32L	3	–	.07	L.15/R.08	L4/R2	1.5
5-25	NO	3	50	64L	3	–	.07	L.30/R.20	L9/R6	1.5
5-26	NO	3	50	96L	3	–	.06	L.42/R.36	L12/R9	1.8
5-27	NO	3	50	96L	3	–	.07	L.40/R.30	L12/R10	1.8
5-28	NO	3	50	96R	3	–	.06	R.30/L.40	R10/L12	1.7
5-29	NO	3	50	96R	3	–	.07	R.30/L.40	R10/L12	1.7
6-05	NO	4a	50	128L	–	–	.07	.32	13	–
6-06	NO	4a	50	128[illegible]	–	–	[illegible]	.3[illegible]	13	–
6-07	NO	4a	50	128[illegible]	–	–	.07	.25	11	–
6-0[illegible]	NO	4a	[illegible]	128[illegible]	–	–	.07	.2[illegible]	12	–
6-0[illegible]	NO	4a	50	48L	–	–	.06	.2[illegible]	6	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN   TIRES, FRONT: GOODYEAR CUSTOM HIMILER 8.75X16.5 IE   TIRES, REAR: GOODYEAR CUSTOM HIMILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
6-10	NO	4a	50	48L	–	–	.05	.25	6	–
6-11	NO	4a	50	48R	–	–	.07	.15	4	–
6-12	NO	4a	50	48R	–	–	.07	.15	4	–
6-13	NO	4b	50	96L	–	–	.05	.25	10	–
6-14	NO	4b	30	128L	–	–	.05	.30	14	–
6-15	NO	4b	30	160L	–	–	.07	.40	18	–
6-16	NO	4b	30	192L	–	–	.07	.45	19	–
6-17	NO	4b	30	224L	–	–	.06	.53	22	–
6-18	NO	4b	30	224L	–	–	.06	.53	21	–
6-19	NO	4b	30	224R	–	–	.05	.45	21	–
6-20	NO	4b	30	224R	–	–	.05	.48	22	–
6-21	NO	4b	50	32L	–	–	.07	.15	4	–
6-22	NO	4b	50	48L	–	–	.07	.23	6	–
6-23	NO	4b	50	64L	–	–	.07	.30	8	–
6-25	NO	4b	50	80L	–	–	.07	.37	10	–
6-26	NO	4b	50	80L	–	–	.07	.37	9	–
6-27	NO	4b	50	80R	–	–	.08	.30	9	–
6-28	NO	4b	50	80R	–	–	.08	.30	8	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN   TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE   TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{sw} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/sec	$T_{INF.}$ SEC.
7-05	NO	46	30	224R	–	–	.06	.45	22	–
7-06	NO	46	30	224R	–	–	.10	.45	22	–
7-07	NO	46	30	224L	–	–	.07	.55	22	–
7-08	NO	46	30	224L	–	–	.05	.53	22	–
7-09	NO	46	30	192L	–	–	.06	.45	19	–
7-10	NO	46	30	160L	–	–	.05	.35	15	–
7-11	NO	46	30	128L	–	–	.05	.30	12	–
7-12	NO	46	30	96L	–	–	.05	.22	9	–
7-13	NO	46	50	80R	–	–	.03	.30	9	–
7-14	NO	46	50	80R	–	–	.07	.32	9	–
7-15	NO	46	50	80L	–	–	.06	.37	9	–
7-16	NO	46	50	[illegible]0L	–	–	.03	.33	10	–
7-17	NO	46	50	64L	–	–	.07	.20	5	–
7-18	NO	46	50	[illegible]	–	–	.06	.22	6	–
7-19	NO	46	50	32L	–	–	.06	.15	3	–
8-05	YES	1	40	–	–	20	.13	–	–	–
8-06	YES	1	40	–	–	20	.12	–	–	–

DR

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
8-07	YES	1	40	—	—	40	.25	—	—	—	
8-08	YES	1	40	—	—	40	.25	—	—	—	
8-09	YES	1	40	—	—	60	.45	R.05	R3	—	
8-10	YES	1	40	—	—	60	.40	R.06	R3	—	
8-12	YES	1	40	—	—	80	.60	R.08	R4	—	
8-13	YES	1	40	—	—	80	.65	R.10	R6	—	
8-14	YES	1	40	—	—	100	.70	R.30	R31	—	R.R. LOCK, 45° R SPIN
8-15	YES	1	40	—	—	100	.75	R.45	R40+	—	R.R. LOCK, 45° R SPIN
8-20	YES	1	40	—	—	50					FRONT ONLY
8-21	YES	1	40	—	—	50					FRONT ONLY
8-22	YES	1	40	—	—	50					REAR ONLY
8-23	YES	1	40	—	—	50					REAR ONLY
9-07	YES	2	50	80L	—	40	.30	.40	11	—	
9-08	YES	2	50	80L	—	50	.37	.45	14	—	
9-09	YES	2	50	80L	—	60	.45	.50	19	—	
9-10	YES	2	50	80L	—	70	.50	.60	23	—	LR LOCK
9-11	YES	2	50	80L	—	70	.50	.60	22	—	LR LOCK

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN   TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE   TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IH

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
9-12	YES	2	50	85R	-	70	.45	.55	24	-	RR LOCK
9-13	YES	2	50	85R	-	70	.45	.55	24	-	RR LOCK
10-09	YES	3	30	64L	2	-	.05	L.15/R.08	L15/R10	1.1	
10-10	YES	3	30	128L	2	-	.05	L.25/R.20	L12/R10	1.1	
10-11	YES	3	30	192L	2	-	.05	L.35/R.30	L18/R18	1.1	
10-12	YES	3	30	192L	2	-	.05	L.35/R.30	L17/R17	1.1	
10-13	YES	3	30	192R	2	-	.05	R.30/L.35	R17/L17	1.1	
10-14	YES	3	30	192R	2	-	.06	R.30/L.35	R17/L18	1.1	
10-15	YES	3	30	64L	3	-	.05	L.15/R.08	L5/R8	1.6	END OSC. ROLL
10-16	YES	3	30	128L	3	-	.05	L.27/R.22	L2/R4	1.5	
10-17	YES	3	30	192L	3	-	.06	L.40/R.35	L18/R17	1.6	
10-18	YES	3	30	192L	3	-	.05	L.42/R.33	L6/R7	1.6	
10-19	YES	3	30	192R	3	-	.05	R.35/L.40	R18/L18	1.6	
10-20	YES	3	30	192R	3	-	.05	R.35/L.37	R18/L18	1.6	
11-21	YES	3	50	[illegible]L	2	-	.05	L.10/R.10	L3/R3	1.0	
11-22	YES	3	50	64L	2	-	.05	L.20/R.15	L7/R7	1.2	
11-23	YES	3	50	96L	2	-	.07	L.30/R.25	L10/R10	1.2	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN

TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
11-24	YES	3	50	96L	2	–	.06	L.30/R.25	L11/R11	1.2
11-25	YES	3	50	96R	2	–	.07	R.25/L.30	R10/L9	1.2
11-26	YES	3	50	96R	2	–	.07	R.25/L.30	R9/L12	1.2
11-27	YES	3	50	32L	3	–	.06	L.12/R.07	L3/R2	1.5
11-28	YES	3	50	64L	3	–	.07	L.28/R.19	L7/R6	1.6
11-29	YES	3	50	96L	3	–	.05	L.35/R.32	L11/R11	1.8
11-30	YES	3	50	96L	3	–	.05	L.35/R.35	L11/R11	1.7
11-31	YES	3	50	96R	3	–	.05	R.30/L.35	R10/L12	1.7
11-32	YES	3	50	96R	3	–	.06	R.30/L.42	R10/L11	1.7
12-05	YES	4a	30	128L	–	–	.06	.30	13	–
12-06	YES	4a	30	128L	–	–	.05	.30	13	–
12-07	YES	4a	30	128R	–	–	.05	.25	11	–
12-08	YES	4a	30	128R	–	–	.05	.25	12	–
12-09	YES	4a	50	48L	–	–	.06	.23	6	–
12-10	YES	4a	50	48L	–	–	.06	.22	5	–
12-11	YES	4a	50	48R	–	–	.06	.17	4	–
12-12	YES	4a	50	48[illegible]	–	–	.05	.20	5	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN

TIRES, FRONT: GOODYEAR CUSTOM HI MILLER 8.75x16.5 IE TIRES, REAR: GOODYEAR CUSTOM HI MILLER 8.75x16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{sw} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
12-13	YES	4b	30	96L	–	–	.05	.21	9	–
12-14	YES	4a	30	128L	–	–	.05	.30	13	–
12-15	YES	4a	30	160L	–	–	.05	.38	16	–
12-16	YES	4a	30	192L	–	–	.05	.45	19	–
12-17	YES	4a	30	224L	–	–	.07	.55	24	–
12-18	YES	4a	30	224L	–	–	.06	.55	23	–
12-19	YES	4a	30	224R	–	–	.07	.48	24	–
12-20	YES	4a	30	224R	–	–	.08	.50	24	–
13-21	YES	4a	50	32L	–	–	.05	.13	2	–
13-23	YES	4a	50	48L	–	–	.06	.20	5	–
13-24	YES	4a	50	64L	–	–	.05	.30	8	–
13-25	YES	4a	50	80L	–	–	.06	.37	10	–
13-26	YES	4a	50	80L	–	–	.07	.40	11	–
13-27	YES	4a	50	80R	–	–	.07	.30	8	–
13-28	YES	4a	50	80R	–	–	.07	.30	8	–
14-05	YES	7a	30	[illegible]	–	–	[illegible]	[illegible]	26	–
14-06	YES	7a	[illegible]	[illegible]	–	–	[illegible]	[illegible]	26	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN

TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

TIRES, REAR: GOODYEAR CUSTOM HI MILER 8.75X16.5 IE

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
14-07	YES	4a	30	224L	–	–	.08	.62	27	–
14-08	YES	4a	30	224L	–	–	.08	.62	27	–
14-09	YES	4a	30	192L	–	–	.07	.53	22	–
14-10	YES	4a	30	160L	–	–	.05	.45	18	–
14-11	YES	4a	30	128L	–	–	.05	.35	14	–
14-12	YES	4a	30	96L	–	–	.05	.27	11	–
14-14	YES	4a	50	80R	–	–	.10	.35	10	–
14-15	YES	4a	50	80R	–	–	.07	.30	8	–
14-17	YES	4a	50	80L	–	–	.05	.45	12	–
14-18	YES	4a	50	80L	–	–	.05	.45	12	–
14-19	YES	4a	50	64L	–	–	.05	.30	8	–
14-20	YES	4a	50	48L	–	–	.05	.27	6	–
14-21	YES	4a	50	32L	–	–	.06	.18	3	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN — TIRES, FRONT: GOODYEAR CUSTOM HI MILER 8.75x16.5 1E — TIRES, REAR: FIRESTONE TOWN & COUNTRY TRUCK

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
15-05	NO	2	50	60L	–	40	.15	.37	9	–	
15-06	NO	2	50	60L	–	50	.20	.37	9	–	
15-07	NO	2	50	60L	–	60	.25	.40	12	–	
15-08	NO	2	50	60L	–	70	.33	.52	17	–	NO LOCK, δ_{SW} STRANGE
15-09	NO	2	50	60L	–	80	.38	.47	18	–	" " " "
15-10	NO	2	50	60L	–	90	.42	.47	19	–	ALMOST LOCK
15-11	NO	2	50	60L	–	90	.43	.67	37	–	DEF. LOCK, 180° SPIN OUT
15-12	NO	2	50	60R	–	70	.35	.68	34+ (OFF SCALE)	–	DEF. LOCK, 180° SPINOUT
15-13	NO	2	50	60R	–	60	.27	.75	34+ (OFF SCALE)	–	" " " "
16-05	YES	3	30	[illegible]	2	–	.05	L.12/R.10	L6/R5	1.20	
16-06	YES	3	30	[illegible]	2	–	[illegible]	L.25/R.22	L12/R12	1.20	
16-07	YES	3	[illegible]	192L	2	–	.05	L.35/R.32	L20/R21	1.20	
16-08	YES	3	30	192L	2	–	[illegible]	L.35/R.30	L20/R[illegible]	1.20	
16-09	YES	3	30	[illegible]	2	–	.07	R.35/L.33	R22/L19	1.25	
16-10	[illegible]	[illegible]	30	[illegible]	2	–	.06	R.35/L.33	R22/L19	1.20	
16-11	[illegible]	[illegible]	[illegible]	64L	[illegible]	–	[illegible]	L.12/R.10	L5/R6	1.6	
16-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	–	.06	L.27/R.25	L13/R14	1.70	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE: VAN — TIRES, FRONT: GOODYEAR CUSTOM HI MILER — TIRES, REAR: FIRESTONE TOWN & COUNTRY TRUCK

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
16-13	YES	3	30	192 L	3	–	.08	L.42/R.37	L21/R21	1.80	
16-14	YES	3	30	192 L	3	–	.07	L.40/R.37	L20/R22	1.75	
16-15	YES	3	30	192 R	3	–	.08	R.40/L.38	R23/L20	1.80	
16-16	YES	3	30	192 L		–		R.40/L.40	R22/L20		TAPE ON TOO LATE
16-17	YES	3	50	32 L	2	–	.07	L.12/R.10	L4/R3	1.20	
16-18	YES	3	50	64 L	2	–	[illegible]	L.20/R.18	L7/R9	1.30	
16-20	YES	3	50	96 L?	2	–	.08	L.30/R.27	L11/R13	1.30	STEERED RT ? (DATA SHOWS LEFT)
16-21	YES	3	[illegible]	96 R	2	–	.08	R.30/L.28	R13/L12	1.40	
16-22	YES	3	[illegible]	96 R	2	–	[illegible]	R.32/L.24	R13/L12	1.40	
17-23	YES	3	50	32 L	3	–	[illegible]	L.13/R.12	L3/R3	1.80	
17-24	YES	3	50	64 L	3	–	[illegible]	L.25/R.23	L8/R9	1.80	
17-25	YES	3	50	96 L	4	–	.10	L.40/R.37	L15/R14	2.10	END CUT OFF
17-26	YES	3	[illegible]	96 L	4	–	.06	L.43/R.35	L15/R14	2.10	" "
17-27	YES	3	50	96 R	3	–	.05	R.42/L.35	R15/L14	2.00	
17-28	YES	3	50	96 R	3	–	[illegible]	R.40/L.38	R15/L15	2.10	
18-05	YES	4a	[illegible]	128 L	–	–	.05	.33	14	–	
18-06	YES	4a	50	128 L	–	–	.05	.35	15	–	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE VAN TIRES, FRONT: GOODYEAR CUSTOM HI MILER TIRES, REAR: FIRESTONE TOWN & COUNTRY TRUCK

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
18-07	YES	4a	30	128R	—	—	.07	.33	15	—
18-08	YES	4a	30	128R	—	—	.07	.35	16	—
18-09	YES	4a	50	48L	—	—	.08	.25	6	—
18-10	YES	4a	50	48L	—	—	.08	.27	7	—
18-11	YES	4a	50	48R	—	—	.07	.28	7	—
18-12	YES	4a	50	48L	—	—	.07	.28	7	—
18-13	YES	4a	30	96L	—	—	.07	.25	9	—
18-14	YES	4a	30	128L	—	—	.06	.32	13	—
18-16	YES	4a	30	160L	—	—	.07	.46	19	—
18-17	YES	4a	30	192L	—	—	.07	.53	23	—
18-18	YES	4a	30	224L	—	—	.08	.62	30	—
18-19	YES	4a	30	224L	—	—	.07	.63	30	—
18-20	YES	4a	30	224R	—	—	.08	.60	32	—
18-21	YES	4a	30	224R	—	—	.08	.59	31	—
19-22	YES	4a	50	32L	—	—	.07	.12	2	—
19-23	YES	4a	50	48L	—	—	.08	.23	5	—
19-24	YES	4a	50	64L	—	—	.06	.39	10	—

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 15 OF

VEHICLE VAN | TIRES, FRONT: GOODYEAR CUSTOM HI MILER | TIRES, REAR: FIRESTONE TOWN & COUNTRY TRUCK

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
19-25	YES	4a	50	80L	-	-	.10	.60	13	-	
19-26	YES	4a	50	80L	-	-	.08	.63	20	-	
19-27	YES	4a	50	80R	-	-	.03	.75	35+	-	120° SPIN

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 1 OF

VEHICLE PICK-UP TC 12 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
31-05	No	1	40	–	–	20	.15		–	–	no stop
31-06	No	1	40	–		20	.15			–	no stop
31-07	No	1	40	–		40	.5			–	almost stop
31-08	No	1	40	–	–	40	.25		–	–	
31-09	No	1	40	–		60	.31		–	–	vehicle stopped
31-10	No	1	40	–		60	.40		–	–	
31-11	No	1	40	–		80	.55		–	–	
31-12	No	1	40	–		80	.9		–	–	
31-13	No	1	40	–		100	.7	.16	0	–	R. R. lockup
31-14	No	1	40	–		100	.70	.17	0	–	R. R. lockup
32-07	No	2	30	75 L	–	20	.10	.2	4	–	Wet
32-09	No	2	30	75 L	–	30	.20	.24	4	–	
32-10	No	2	30	75 L	–	40	.29	.22	5	–	
32-11	No	2	30	75 L	–	50	.35	.25	7	–	LR lockup!
32-12	No	2	30	75 L	–	50	.33	.26	7	–	"
33-23	No	2	30	65	–	50	.35	.22	13	–	RR lockup
33-24	No	2	30	60	–	50	.37	.24	13	–	"
33-05	No	3	30	55 L	2	30	.09	.13L/.15R	4L/8R	1.1 *	Wet sine
33-06	No	3	30	75 L	2	–	.10	.17L/.20R	6L/10.5R	1.2	
33-07	No	3	30	95 L	2	–	.08	.23L/.22R	9.5L/13R	1.2	
33-08	No	3	30	95 L	2	–	.08	.22L/.24R	9.5L/13R	1.1	
33-09	No	3	30	95	2	–	.10	.21/.22L	13R/14	1.2	
33-10	No	3	30	95		–	.08	.24/.22	13R/11L		start too late
33-12	No	3	30	55 L	4	–	.10	.15L/.14R	4.5L/7R	2.0	
34-16	No	3	30	75 L	4	–	.12	.22/.14R	9L/R	2.3	
34-17	No	3	30	95 L	4	–	.12	.26L/.17R	12L/10.5R	2.3	P
34-18	No	3	30	95	4	–	.12	.21L/.21	12L/11R	2.3	SFW2 cut again
34-	No	3	30	95	4	–	.11	.22R/.22L	13R/L	2.3	P
	No	3	30	9	4		.11	.23/.22	12R/L		TAPE LINE

*using Ay trace

DRY — WET — WET

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE *PICK-UP* TC 12 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
35-05	No	2	50	55L	-	40	.29	.4[illegible]	10	-	Dry
35-06	No	2	50	55L	-	50	.34	.4[illegible]	12	-	
35-07	No	2	50	55L	-	60	.40	.[illegible]2	18	-	LR [illegible]
35-08	No	2	50	55L	-	70	.46	.53	18	-	R [illegible]
35-09	No	2	50	55L	-	70	.46	.50	19	-	
35-10	No	2	50	62[illegible]	-	70	.48	.52	19	-	RR
35-[illegible]	No	2	50	[illegible]	-	70	.48	.56	20	-	"
36-05	No	3	30	55L	2	-	.07	.20L/.0[illegible]	7L/4R	1.3	Dry
36-06	No	3	30	95L	2	-	.06	.25L/.20	12L/10R	1.3	"
36-07	No	3	30	135L	2	-	.10	.35L/.30	18L/15R	1.3	
36-08	No	3	30	135L	2	-	.08	.35L/.2[illegible]	20L/15R	1.3	
36-09	No	3	30	135R	-	-	.10	.2[illegible]/.32L	16R/16L	-	Data / Te[illegible]
36-10	No	3	30	135R	2	-	.07	.2[illegible]R/.33	14R/17L	1.3	[illegible]
36-11	No	3	30	55L	4	-	.07	.15L/.12	5L/6R	-	Data st[illegible]
36-12	No	3	30	95L	4	-	.07	.25L/.22	11L/11R	2.[illegible]	
36-13	No	3	30	135L	4	-	.10	.38L/.3[illegible]	17L/16R	2.3	
36-14	No	3	30	135L	4	-	.10	.3[illegible]L/.3[illegible]	17L/15R	2.2	
36-15	No	3	30	135R	4	-	.10	.3[illegible]R/.3[illegible]	16R/12L	2.2	
36-16	No	3	30	135R	4	-	.10	.3[illegible]/.3[illegible]	18R/17L	2.3	
36-17	No	3	35	35L	4	-	.13	.22L/.0[illegible]R	7L/[illegible]R	1.[illegible]	
36-18	No	3	35	55L	4	-	.10	.3[illegible]L/.1[illegible]	10L/6R	1.[illegible]	
36-20	No	3	35	75L	4	-	.1[illegible]	.4[illegible]/.2[illegible]	12L/[illegible]R	1.6	
36-21	No	3	35	75L	4	-	.13	.4[illegible]/.2[illegible]	14L/10R	1.[illegible]	
36-[illegible]	No	3	35	75[illegible]	4	-	.13	.2[illegible]/.4L	9R/14L	1.[illegible]	
37-[illegible]	No	3	35	35L	4	-	.12	.3[illegible]/.10	6L/[illegible]R	2.6	
37-27	No	3	35	55L	4	-	.10	.4[illegible]/.18	11L/[illegible]R	2.7	
37-28	No	3	35	75L	4	-	.12	.5[illegible]/.2[illegible]	13L/[illegible]R	2.3	P
37-29	No	3	35	75L	4	-	.13	.5[illegible]/.2[illegible]	15L/[illegible]R	2.3	
37-[illegible]	No	3	35	75R	4	-	.12	.3[illegible]/.4[illegible]L	9R/15L	2.3	P
[illegible]	[illegible]	[illegible]	[illegible]	7[illegible]	[illegible]	-	.13	.2[illegible]/.4[illegible]	[illegible]R/15L	2.4	

chick report [illegible] 25-40 [illegible] 50 mph [illegible] tire psi [illegible]

← DRY

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 3 OF

VEHICLE *Pick-up* *TC/2* TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/sec	T INF. SEC.	
38-05	No	4a	30	95L	-	-	.08	.30	12	-	
38-06	No	4a	30	95L	-	-	.08	.3[illegible]	13	-	
38-07	No	4a	30	95R	-	-	.08	.25	10	-	
38-08	No	4a	30	95R	-	-	.08	.25	11	-	
38-09	No	4a	50	45L	-	-	.10	.40	8	-	
38-10	No	4a	50	45L	-	-	.12	.38	8	-	
38-12	No	4a	50	45R	-	-	.10	.15	4	-	
38-13	No	4a	50	45R	-	-	.08	.15	4	-	
38-14	No	4b	30	75L	-	-	.08	.25	10	-	
38-15	No	4b	30	95L	-	-	.08	.32	12	-	
38-16	No	4b	30	115L	-	-	.10	.38	16	-	
38-17	No	4b	30	135L	-	-	.10	.45	19	-	
38-18	No	4b	30	155L	-	-	.10	.50	22	-	
38-19	No	4b	30	155L	-	-	.08	.50	22	-	
38-21	No	4b	30	155R	-	-	.10	.40	19	-	
38-22	No	4b	30	155R	-	-	.10	.40	20	-	
39-24	No	4b	50	[illegible]L	-	-	.12	.30	5	-	
39-25	No	4b	50	45L	-	-	.13	.4[illegible]	9	-	
39-2[illegible]	No	4b	50	55L	-	-	.13	.47	10	-	
39-27	No	4b	50	[illegible]5L	-	-	.13	.52	14	-	
39-29	No	4b	50	[illegible]L	-	-	.12	.6[illegible]	15	-	
39-[illegible]	No	4b	50	[illegible]5R	-	-	.15	.3[illegible]	8	-	
39-[illegible]	No	4b	50	[illegible]R	-	-	.15	.25	6	-	

← DRY →

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 4 OF

VEHICLE *PICK-UP TC/3* TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
40-13	N	2	30	70L	–	20	.14	.25	8	–	Wet T Le... Steer post SFW Gist...
4?-14	N	2	30	70L	–	30	.18	.20	8	–	
4?-15	N	2	30	70L	–	[illegible]	.28	.20	8	–	
4?-16	N	2	30	70L	–	[illegible]	.32	.20	9	–	N Vock...
4?-17	N	2	30	70L	–	50	.32	.22	9	–	
4?-13	N	2	30	75R	–	50	.40	.20	.10	–	RR ½ P P
4?-11	N	2	30	75R	–	50	.35	.20	1.0	–	"
41-05	N	3	30	55L	2	–	.0?	.13L/.1?R	?L/4?	1.2	
41-06	N	3	[illegible]	75L	2	–	.05	.?L/.?R	9L/8?	1.4	
41-07	N	3	[illegible]	95L	2	–	.05	.3?L/.?R	13L/12?	1.3	
41-08	N	3	[illegible]	95L	2	–	.05	.?L/.?R	1?L/12R	1.1	
41-09	N	3	[illegible]	95R	2	–	.05	.?R/.?L	12R/14L	1.2	
41-10	N	3	[illegible]	95R	2	–	.05	.2?R/.32L	12R/12L	1.1	
41-11	N	3	[illegible]	55L	4	–	.04	.2?L/.?R	6L/5?	2.2	
41-12	N	3	[illegible]	75L	4	–	.0?	.?L/.5?	?L/8R	2.1	
41-13	N	3	[illegible]	95L	4	–	.0?	.33L/.?R	14L/11?	2.2	P
41-14	N	3	[illegible]	95L	4	–	.0?	.?2L/.5R	1?L/12?	2.2	
41-15	N	3	[illegible]	95R	4	–	.0?	.?/.7L	12R/12?	2.2	P
41-16	N	3	[illegible]	[illegible]	4	–	.0?	.?R/.?L	1?R/12?	2.2	
42-05	N	2	30	??L	–	40	.3?	.4	10	–	Dry
42-06	N	2	[illegible]	??L	–	40	.3?	.4	9	–	
42-07	N	2	[illegible]	??L	–	40	.32	[illegible]	9	–	
42-08	N	2	[illegible]	??L	–	50	.4?	[illegible]	11	–	Veh. ST ...ed
42-09	N	2	[illegible]	??L	–	60	.5?	.5	14	–	LR ½ P
42-10	N	2	[illegible]	??L	–	60	.5?	[illegible]	14	–	"
42-11	N	2	[illegible]	??R	–	60	.52	.3	13	–	RR ½ ...
42-12	N	2	[illegible]	??R	–	60	.55	.3	13	–	"
4?-??	N	3	[illegible]	9?L	2	–	.0?	.?4L/.?R	7L/7?	1.4	
[illegible]	[illegible]	[illegible]	[illegible]	9?L	2	–	.0	.?4L/.?R	14L/12	1.5	
[illegible]	[illegible]	[illegible]	[illegible]	1??L	2	–	[illegible]	.?L/.?R	1?L/17	1.1	
[illegible]	[illegible]	[illegible]	[illegible]	1??L	?	–	.0	.44/.?	?/16?	1.1	
[illegible]	[illegible]	[illegible]	[illegible]	13?R	?	–	.0	.4?/.?	1?R/17L	1.1	
[illegible]	[illegible]	[illegible]	[illegible]	13?R	2	–	.0?	.3R/.?L	1?R/16L	1.1	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE Pick-up TC 13 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
43-11	No	2	30	[illegible] L	4	–	0.0	.15L/[illegible]R	7L/7R	2.2	
43-12	No	[illegible]	[illegible]	95L	4	–	.05	.3L/[illegible]R	1[illegible]L/12R	2.1	
43-14	No	[illegible]	[illegible]	135L	4	–	.05	.4L/[illegible]R	1[illegible]L/15[illegible]	2.2	~10° Left after test
43-15	No	3	30	135L	4	–	.03	.4[illegible]/.5[illegible]	1[illegible]/16R	2.2	"
43-16	No	3	30	13[illegible]R	4	–	.04	.45R/.5L	1[illegible]/16L	2.2	"
43-17	No	3	[illegible]	135R	4	–	.05	.4R/[illegible]L	1[illegible]R/16L	2.2	"
43-1[illegible]	No	[illegible]	50	35L	3	–	.05	.20L/[illegible]R	[illegible]L/[illegible]	1.4	~15° "
43-1[illegible]	No	[illegible]	50	5[illegible]L	3	–	.07	.33L/[illegible]R	[illegible]L/14R	1.5	"
43-20	No	[illegible]	50	75L	3	–	.07	.45L/[illegible]R	[illegible]L/17R	1.3	"
43-21	No	[illegible]	[illegible]	7[illegible]L	3	–	.08	.4[illegible]L/.4[illegible]R	[illegible]/12R	1.4	"
43-22	No	[illegible]	50	7[illegible]R	3	–	.08	.40R/.4[illegible]L	1[illegible]R/12L	1.3	
43-23	No	[illegible]	[illegible]	7[illegible]R	3	–	.08	.40R/[illegible]L	14R/12L	1.3	
44-2[illegible]	No	2	[illegible]	3[illegible]L	4	–	.07	.2[illegible]L/[illegible]R	[illegible]L/14[illegible]	2.4	
44-2[illegible]	No	2	[illegible]	5[illegible]L	4	–	.07	.4L/[illegible]R	[illegible]/9[illegible]	2.5	
44-2[illegible]	No	2	[illegible]	7[illegible]L	4	–	.10	[illegible]L/[illegible]R	1[illegible]L/12R	2.6	P
44-2[illegible]	[illegible]	2	[illegible]	7[illegible]L	4	–	.0[illegible]	.5[illegible]L/[illegible]R	1[illegible]L/12R	2.5	
44-2[illegible]	No	[illegible]	50	7[illegible]R	4	–	.07	.4[illegible]R/[illegible]L	1[illegible]R/12L	2.4	P
44-2[illegible]	No	[illegible]	[illegible]	72R	4	–	.0[illegible]	.4[illegible]R/[illegible]L	1[illegible]R/12L	2.4	
45-0[illegible]	No	4[illegible]	[illegible]	[illegible]L	–	–	.05	.38	10	–	used post ... for Ay ...
45-0[illegible]	No	[illegible]	[illegible]	95L	–	–	.05	.38	10	–	
45-07	No	[illegible]	30	95R	–	–	.07	.35	20	–	
45-[illegible]	No	[illegible]	[illegible]	[illegible]R	–	–	.0[illegible]	.35	15	–	
45-0[illegible]	No	[illegible]	[illegible]	4[illegible]L	–	–	.0[illegible]	.48	10	–	
45-[illegible]	No	4	[illegible]	4[illegible]L	–	–	.10	.50	10	–	... in ...
45-1[illegible]	No	[illegible]	50	4[illegible]R	–	–	.10	.45	10	–	
45-12	[illegible]	[illegible]	[illegible]	4[illegible]R	–	–	.12	.45	10	–	... too
45-1[illegible]	[illegible]	4b	[illegible]	7[illegible]L	–	–	.0[illegible]	.27	5	–	
45-1[illegible]	[illegible]	4b	[illegible]	9[illegible]L	–	–	.0[illegible]	.2[illegible]	10	–	
45-15	[illegible]	[illegible]	[illegible]	11[illegible]L	–	–	.05	.42	15	–	
4[illegible]-1[illegible]	[illegible]	[illegible]	[illegible]	13[illegible]	–	–	.0[illegible]	.47	25	–	
4[illegible]-1[illegible]	No	[illegible]	[illegible]	15[illegible]L	–	–	.0[illegible]	.55	[illegible]5	–	
4[illegible]-1[illegible]	No	[illegible]	[illegible]	1[illegible]L	–	–	.0[illegible]	.55	[illegible]5	–	
45-1[illegible]	No	[illegible]	[illegible]	15[illegible]R	–	–	.0[illegible]	.55	[illegible]5	–	
45-2[illegible]	No	[illegible]	[illegible]	155R	–	–	.0[illegible]	.55	[illegible]5	–	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 6 OF

VEHICLE PICK-UP TC 13 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
4[illegible]-21	No	[illegible]	50	35L	–	–	.0[illegible]	.35	[illegible]	–	tape to late to [illegible] in [illegible]
4[illegible]-22	No	[illegible]	50	45L	–	–	.10	.4[illegible]	5	–	
4[illegible]-2[illegible]	No	46	50	55L	–	–	.12	.5[illegible]	10	–	
46-21	No	46	50	65L	–	–	.10	.6[illegible]	15	–	
46-2[illegible]	N[illegible]	46	50	65L	–	–	.12	.6[illegible]	15	–	
4[illegible]-2[illegible]	N[illegible]	46	50	65R	–	–	.12	.55	20	–	
4[illegible]-27	N[illegible]	[illegible]	50	65R	–	–	.15	.55	20	–	

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TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 7 OF

VEHICLE PICK-UP TC B TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
46-05	No	2	50	45L	–	40	.30	.5	5	–	[illegible] (? all)
46-06	No	2	50	45L		50	.35	.7	5	–	r-di[illegible] Cam
46-07	No	2	50	45L		60	.45	.40	10	–	prev[illegible]
46-08	No	2	50	45L		70	.53	.50	12	–	LR Lockup
46-09	No	2	50	40L		70	.55	.45	10	–	
46-10	No	2	50	50R		70	.55	.50	20	–	RR "
46-11	No	2	50	50R		70	.55	.45	20	–	"
47-05	No	3	30	55L	2	–	.05	.13L/.10R	0L/[illegible]R	–	DATA LATE
47-06	No	3	30	95L	2	–	.05	.2[illegible]L/.22R	10L/[illegible]R	1.2	
47-07	No	3	30	135L	2	–	.05	.3[illegible]/.28	12L/[illegible]R	1.2	
47-08	No	3	30	135L	2	–	.07	.3[illegible]/.[illegible]	15L/[illegible]	1.3	
47-09	No	3	30	135R	2	–	.07	.3[illegible]/.3[illegible]	20R/[illegible]L	1.2	
47-10	No	3	30	135R	2	–	.08	[illegible]/.2[illegible]L	20R/[illegible]5L	1.2	
47-12	No	3	30	55L	2	–	.05	.12L/.1[illegible]	0L/[illegible]R	2.3	
47-13	No	3	30	95L	2	–	.05	.20L/.15	10L/[illegible]R	2.3	
47-14	No	3	30	135L	2	–	.07	.2[illegible]/.2[illegible]	20L/[illegible]R	2.3	
47-15	No	3	30	135L	2	–	.08	[illegible]/.2[illegible]	15L/[illegible]R	2.2	
47-16	No	3	30	135R	2	–	.08	.3[illegible]/.3[illegible]L	22[illegible]/[illegible]5L	2.2	
47-17	No	3	30	135R	2	–	.08	.2[illegible]/.3[illegible]L	20[illegible]/[illegible]L	2.3	
47-18	No	3	50	35L	2	–	.10	.15L/.14	0L/[illegible]R	1.3	
47-19	No	3	50	55L	2	–	.10	.2[illegible]/.2[illegible]	5L/[illegible]R	1.4	
47-20	No	3	50	75L	2	–	.10	.3[illegible]L/.[illegible]	[illegible]L/[illegible]R	1.4	
47-21	No	3	50	75L	2	–	.13	.3[illegible]L/.[illegible]	[illegible]L/[illegible]R	1.3	
47-22	No	3	50	75R	2	–	.13	.3[illegible]/.[illegible]	12R/[illegible]L	1.4	
47-23	No	3	50	75R	2	–	.10	.3[illegible]/.3[illegible]	10R/[illegible]L	1.3	
48-24	No	3	50	35L	1	–	10	.1[illegible]/.1[illegible]	0[illegible]/[illegible]	2.2	
48-25	No	3	50	55L	1	–	10	.[illegible]/.2[illegible]	5L/[illegible]	2.2	
48-26	No	3	50	75L	1	–	12	.[illegible]/.[illegible]	10L/[illegible]R	2.4	
48-27	No	3	50	75L	1	–	12	.4/.39	10L/[illegible]R	2.3	
48-28	No	3	50	75R	1	–	10	.4/.4	15R/[illegible]L	2.3	
48-29	No	3	50	75R	1	–	10	.4/.4	15R/[illegible]L	2.4	

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TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 8 OF

VEHICLE PICK-UP TC 13 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
49-05	No	4a	30	95L	-	-	.05	.35	5	-	Data [illegible] late
49-06	No	4a	30	95L	-	-	.05	.35	10	-	
49-07	No	4a	30	95R	-	-	.07	.35	15	-	ditto
49-08	No	4a	30	95R	-	-	.08	.35	15	-	not a
49-09	No	4a	50	45L	-	-	.10	.38	5	-	
49-10	No	4a	50	45L	-	-	.10	.38	5	-	[illegible] scale
49-11	No	4a	50	45R	-	-	.10	.37	10	-	
49-12	No	4a	50	45R	-	-	.10	.38	10	-	from [illegible] page
49-13	No	4b	30	75L	-	-	.05	.25	5	-	
49-14	No	4b	30	95L	-	-	.07	.32	10	-	
49-15	No	4b	30	115L	-	-	.07	.40	15	-	
49-16	No	4b	30	135L	-	-	.10	.45	20	-	
49-17	No	4b	30	155L	-	-	.10	.50	20	-	
49-18	No	4b	30	155L	-	-	.12	.50	22	-	
49-19	No	4b	30	155R	-	-	.10	.45	25	-	
49-20	No	4b	30	155R	-	-	.10	.50	30	-	
49-21	No	4b	50	35L	-	-	.10	.30	0	-	
49-22	No	4b	50	45L	-	-	.12	.35	5	-	
49-23	No	4b	50	55L	-	-	.14	.4[illegible]	8	-	
49-24	No	4b	50	65L	-	-	.1[illegible]	.52	10	-	
49-25	No	4b	50	65L	-	-	.1[illegible]	.55	15	-	
49-26	No	4b	50	65R	-	-	.1[illegible]	.45	15	-	
49-27	No	4b	50	[illegible]	-	-	[illegible]	.4[illegible]	12	-	

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TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 9 OF

VEHICLE *PICK-UP* *TC 15* TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
50-05	No	2	50	4 L	–	[illegible]	.25	–	–	–	TAPE ON LATE
50-06	No	2	50	4 L	–	[illegible]	.30	.47	16	–	
50-07	No	2	50	4 L	–	60	[illegible]	.52	19	–	LR [illegible]
50-[illegible]	No	2	50	4 L	–	60	[illegible]	.50	19	–	
50-[illegible]	No	2	50	45R	–	60	.40	.50	20	–	RR
50-[illegible]	No	2	50	45R	–	60	.45	.47	19	–	
51-05	No	3	30	55L	2	–	.06	L.14/R.10	L4/R4	1.2	
51-06	No	3	30	95L	2	–	.06	L.25/R.20	L10/R9	1.2	TAPE ON LATE
51-07	No	3	30	135L	–	–	.07	–	–/R15	–	TAPE ON LATE
51-[illegible]	N	3	30	135L	–	–	–	–	–/R15	–	
51-[illegible]	N	3	30	135R	2	–	.07	R.30/L.35	R15/L14	1.1	
51-[illegible]	N	3	30	135R	2	–	.05	R.30/L.35	R15/L16	1.1	
51-[illegible]	A	3	30	55L	4	–	.06	L.17/R.10	L4/R4	2.3	
51-[illegible]	A	3	30	95L	4	–	.05	L.30/R.20	L11/R10	2.2	
51-[illegible]	A	3	30	135L	–	–	.05	–/R.30	–/R15	–	TAPE ON LATE
51-[illegible]	No	3	30	135L	4	–	[illegible]	L.40/R.33	L16/R15	2.2	
51-[illegible]	N	3	30	135R	4	–	.05	R.35/L.35	R17/L14	2.1	
51-[illegible]	N	3	30	135R	4	–	.05	R.35/L.33	R17/L14	–	TAPE ON LATE
51-[illegible]	A	3	50	35L	2	–	.10	L.15/R.13	L6/R6	1.2	
51-17	A	3	50	55L	2	–	.08	L.25/R.20	L9/R9	–	LATE
51-[illegible]	[illegible]	3	50	75L	2	–	.10	L.33/R.30	L10/R11	1.3	
51-[illegible]	[illegible]	3	50	75L	2	–	.12	L.35/R.30	L11/R11	1.3	
51-[illegible]	[illegible]	3	50	75R	2	–	.10	R.30/L.28	11/L9	1.3	
51-[illegible]	[illegible]	3	50	75R	2	–	.10	R.28/L.32	9/L10	1.2	
52-[illegible]	N	3	50	35L	4	–	[illegible]	L.20/R.17	L3/R3	2.3	
52-[illegible]	[illegible]	3	50	55L	4	–	[illegible]	L.33/R.25	L7/R6	2.4	
52-[illegible]	[illegible]	3	50	75L	–	–	.07	–/R.35	–/R11	–	LATE
52-[illegible]	[illegible]	3	[illegible]	95L (?)	4	–	.10	L.45/R.40	L12/R10	2.4	
52-[illegible]	[illegible]	3	[illegible]	75R (?)	–	–	–	–	–	–	LATE
52-[illegible]	[illegible]	3	[illegible]	[illegible]	4	–	.10	R.10/L.37	L12/L9 (?)	2.2	

A142/ (?)

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE *PICK-UP TC/5* TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
53-05	No	4a	30	95L	-	-	.05	.35	12	-	
[illegible]	No	4a	30	95L	-	-	.07	.34	13	-	
[illegible]	No	4a	30	95R	-	-	.05	.28	11	-	
[illegible]	No	4a	30	95R	-	-	.05	.30	11	-	
[illegible]	No	4a	50	45L	-	-	.12	.40	10	-	
[illegible]	No	4a ?	50	45L	-	-	.08	.40	—	-	TAPE ON DATE
[illegible]	No	4a ?	50	45R	-	-	.10	.32	7	-	
[illegible]	[illegible]	4a	50	45R	-	-	.10	.33	7	-	
[illegible]	[illegible]	4b	30	75L	-	-	.06	.25	9	-	
[illegible]	[illegible]	4b	30	95L	-	-	.05	.32	12	-	
[illegible]	[illegible]	4b	30	115L	-	-	.06	.33	14	-	
[illegible]	[illegible]	4b	30	135L	-	-	-	—	—	-	TAPE ON LATE
[illegible]	[illegible]	4b	30	155L	-	-	.03	.45	20	-	
[illegible]	[illegible]	4b	30	155L	-	-	.07	.47	21	-	
[illegible]	[illegible]	4b	30	155R	-	-	.07	.45	21	-	
[illegible]	[illegible]	4b	30	155R	-	-	.08	.45	22	-	
[illegible]	[illegible]	4b	50	[illegible]L	-	-	.10	.30	5	-	
[illegible]	[illegible]	4b	50	45L	-	-	.10	.37	8	-	
[illegible]	[illegible]	4b	50	45L	-	-	.10	.41	10	-	
[illegible]	Yes	4b	50	[illegible]L	-	-	.12	.52	12	-	TAPE ON LATE
53-25	Yes	4b	50	45L	-	-	.10	.52	13	-	
53-27	Yes	4b	50	45[illegible]	-	-	.13	.45	11	-	
[illegible]	Yes	4b	50	[illegible]	-	-	.13	.45	11	-	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 11 OF

VEHICLE *PICK-UP TC/2* TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T INF. SEC.	
54-05	Yes	1	40	–	–	20	.15	–	–	–	
54-0[illegible]	Yes	1	40	–	–	20	.15	–	–	–	
54-07	Yes	1	40	–	–	40	.35	.05	1	–	
54-[illegible]	Yes	1	40	–	–	40	.35	.03	1	–	
54-[illegible]	Yes	1	40	–	–	60	.55	.05	2	–	
54-[illegible]	Yes	1	40	–	–	60	.60	.05	2	–	
54-11	Yes	1	40	–	–	80	.75	.05	2	–	
54-12	Yes	1	40	–	–	80	.75	.05	2	–	
54-13	Yes	1	40	–	–	100	.80	.10	4	–	Rears [illegible] lockup (P)
54-14	Yes	1	40	–	–	100	.85	.17	9	–	" "
55-05	Yes	2	50	35L	–	40	.40	.50	14	–	
55-0[illegible]	Yes	2	50	35L	–	50	.40	[illegible]	40++	–	LR lock – spin out ~90° P
55-07	Yes	2	50	[illegible]L	–	50	.45	[illegible]	40++	–	" "
55-0[illegible]	Yes	2	50	35R	–	50	[illegible]	[illegible]	10	–	No lock
55-0[illegible]	Yes	2	50	[illegible]	–	50	[illegible]	[illegible]	8	–	" P

DRY

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE *PICK-UP TC/2* TIRES, FRONT: TIRES, REAR: *OE*

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/sec	$T_{INF.}$ SEC.	
56-05	Yes	3	30	55L	2	—	.05	L.13/R.12	L [illegible]/R6	1.1	
56-[illegible]	Yes	3	30	95L	2	—	.05	L.23/R.20	L10/R11	1.2	
56-07	Yes	3	30	135L	2	—	.07	L.33/R.30	L16/R16	1.2	
56-0[illegible]	Yes	3	[illegible]	135L	2	—	.08	L.35/R.32	L16/R17	1.2	
56-[illegible]	Yes	3	[illegible]	135R	2	—	.07	R.32/L.30	R16/L16	—	TAPE ON LATE
56-1[illegible]	Yes	[illegible]	[illegible]	135R	2	—	.07	— L.30	R —/L15	—	" " "
56-1[illegible]	Yes	[illegible]	[illegible]	55L	4	—	.06	L.15/R.13	L4/R6	2.2	
56-1[illegible]	Yes	[illegible]	[illegible]	95L	4	—	.06	L.28/R.23	L10/R11	2.3	
56-[illegible]	Yes	[illegible]	[illegible]	135L	4	—	.07	L.40/R.35	L18/R18	—	TAPE ON LATE
56-1[illegible]	Yes	[illegible]	[illegible]	135L	—	—	—	—	—	—	NG
56-15	Yes	[illegible]	[illegible]	135R	4	—	.07	R.38/L.35	R20/L16	2.3	
56-16	Yes	[illegible]	[illegible]	135R	4	—	.06	R.40/L.35	R20/L16	2.2	
56-17	Yes	3	50	55L	2	—	.08	L.13/R.12	L2/R4	1.3	
56-1[illegible]	Yes	3	50	55L	2	—	.08	L.25/R.20	L6/R9	1.3	
56-[illegible]	Yes	3	[illegible]	75L	2	—	.10	L.35/R.30	L10/R14	1.4	
56-[illegible]	Yes	[illegible]	[illegible]	75L	2	—	.13	L.35/R.30	L11/R14	1.4	
56-[illegible]	Yes	3	[illegible]	75R	—	—	—	—	—	—	NO DATA
56-[illegible]	Yes	[illegible]	[illegible]	75R	—	—	.13	— L.28	— /L11	—	TAPE ON LATE
57-[illegible]	Yes	3	50	55L	4	—	.10	L.20/R.18	L3/R6	2.2	
57-2[illegible]	Yes	3	[illegible]	55L	4	—	.08	L.35/R.32	L3/R10	2.4	~5° Right @ End. P
57-[illegible]	Yes	3	[illegible]	75L	—	—	.08	— /R.40	— /R15	—	Slight overst. @ start P
57-[illegible]	Yes	3	[illegible]	75L	4	—	.10	L.50/R.45	L15/R15	2.5	" " " 2nd 1/2
57-[illegible]	Yes	3	[illegible]	75R	4	—	.12	R.18/L.30	R15/L14	2.4	Overst. @ 2nd 1/2 P
57-[illegible]	Yes	3	[illegible]	75R	4	—	.12	R.15/L.45	R15/L14	2.4	"

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE *PICK-UP TC 12* TIRES, FRONT: TIRES, REAR: *OE*

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
58-05	Yes	4a	30	95L	–		.07	.37	14	–	
58-06	Yes	4a	30	95L	–	–	.07	.37	14	–	
58-07	Yes	4a	30	95R	–	–	.05	.35	17	–	
58-08	Yes	4a	30	95R	–	–	.05	.35	16	–	
58-09	Yes	4a	50	45L	–	–	.13	.55	14	–	
58-10	Yes	4a	50	45L	–	–	.13	.58	14	–	
58-11	Yes	4a	50	45R	–	–	.12	.45	14	–	
58-12	Yes	4a	50	45R	–	–	.13	.45	13	–	–
58-13	Yes	4b	30	75L	–	–	.06	.25	10	–	
58-14	Yes	4b	30	95L	–	–	.06	.35	14	–	
58-15	Yes	4b	[illegible]	115L	–	–	–	–	–	–	MISSING
58-16	Yes	4b	[illegible]	135L	–	–	.01	.42	17	–	
58-17	Yes	4b	[illegible]	155L	–	–	–	–	–	–	N.G.
58-18	Yes	4b	[illegible]	155L	–	–	.10	.55	24	–	
58-19	Yes	4b	[illegible]	155R	–	–	.10	.55	26	–	
58-20	Yes	4b	[illegible]	155R	–	–	.12	.53	26	–	
58-21	Yes	4b	50	35L	–	–	.10	.35	6	–	
58-22	Yes	4b	70	45L	–	–	.10	.55	12	–	
58-23	Yes	4b	[illegible]	55L	–	–	.10	.85+	38+	–	Rear slides P
58-24	Yes	4b	[illegible]	55L	–	–	[illegible]	[illegible]+	38+	–	" "
58-25	Yes	4b	[illegible]	59R	–	–	[illegible]	.55	16	–	
58-26	Yes	4b	[illegible]	55R	–	–	[illegible]	.57	17	–	No slide P

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 14 OF

VEHICLE PICK-UP TC13 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δsw DEG.	STEER PERIOD SEC.	BRAKE INPUT %	Ax AVERAGE g's	Ay PEAK g's	r PEAK °/sec	T INF. SEC.	
59.-05	Yes	2	50	30L	—	40	.32	.30	8	—	
59.-06	Yes	2	50	30L	—	50	.40	.45	12	—	LATE TAPE
59.-07	Yes	2	50	30L	—	60	—	—	—	—	Lockup LR
59.-0[illegible]	Yes	2	50	30L	—	[illegible]	.52	.60	30	—	" "
59.-[illegible]	Yes	2	50	42R	—	[illegible]	—	—	—	—	" RR
59.-[illegible]	Yes	2	[illegible]	42R	—	[illegible]	.55	45	13	—	No "
59.-[illegible]	Yes	2	50	42R	—	[illegible]	.55	.45	18	—	" "
60-05	Yes	3	30	55L	2	—	.05	L.17/R.17	L 4/R 6	1.1	Dry
60-06	Yes	3	30	95L	2	—	.05	L.30/R.25	L 11/R12	1.1	
60-07	Yes	3	30	135L	2	—	.07	L.40/R.35	L 18/R18	1.1	
60-[illegible]	Yes	3	30	135L	—	—	—	—	—	—	NG
60-[illegible]	[illegible]	3	[illegible]	135R	2	—	.07	R.35/L.40	R 18/L18	1.1	
60-[illegible]	[illegible]	3	[illegible]	135[illegible]	2	—	.07	R.35/L.44	R 19/L1[illegible]	1.1	
60-[illegible]	Yes	3	30	55L	4	—	.04	L.20/R.15	L 4/R 5	2.3	
60-[illegible]	Yes	3	30	95L	4	—	.05	L.32/R.25	L 11/R 11	2.1	
60-[illegible]	Yes	3	30	135L	4	—	.05	L.46/R.38	L 19/R 18	2.1	
60-14	Yes	3	30	135L	4	—	.0[illegible]	L.46/R.37	L 19/R [illegible]	2.3	
60-15	Yes	3	30	135R	—	—	—	—	—	—	NG
60-16	Ye[illegible]	3	30	135[illegible]	4	—	.05	R.40/L.40	R 16/L20	2.1	
60-17	Ye[illegible]	3	50	35L	2	—	.05	L.20/R.20	L 3/R 4	1.1	
6[illegible]	Ye[illegible]	3	[illegible]	55L	2	—	.07	L.33/R.28	L 8/R 8	1.2	
6[illegible]	Ye[illegible]	3	50	75L	2	—	.08	L.45 R.35	L 13/R 12	1.3	
[illegible]	Y[illegible]	3	50	75L	2	—	.08	L.45 R.40	L 13/R 1[illegible]	—	TAPE ON LATE
6[illegible]-21	Y	3	50	75R	2	—	.08	R.40/L.43	R 13/L 14	1.3	
[illegible]-22	Y	3	[illegible]	75[illegible]	2	—	.08	R.40/L.40	R 12/L 13	1.3	
61-23	Yes	3	50	35L	4	—	.07	L.25/R.20	L 2/R 3	2.0	
61-24	Yes	3	50	55L	4	—	.07	L.40/R.35	L 10/R 8	2.3	
6[illegible]-[illegible]	Y[illegible]	3	50	75[illegible]	4	—	.13	L.60/R.40	L 16/R 12	2.5	
[illegible]	Y[illegible]	3	50	75[illegible]	4	—	.0[illegible]	L.58/R.47	L 15/R 13	2.5	
[illegible]	Y[illegible]	3	50	75[illegible]	4	—	.0[illegible]	R.50/L.50	R 14/L [illegible]	2.[illegible]	
61-2[illegible]	Y[illegible]	3	50	75R	4	—	.1[illegible]	R.50/L.50	R 14/L 1[illegible]	2.[illegible]	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 15 OF

VEHICLE *PICK-UP* TC 13 TIRES, FRONT: TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T INF. SEC.	
62-05	No ?	4a	30	95L	-	-	.05	.37	14	-	
62-07		4a	30	95L	-	-	.05	.37	13	-	
62-08		4a	30	95R	-	-	.05	—	—	-	TAPE ON LATE
6[illegible]-09		4a	30	95R	-	-	.05	.33	17	-	
[illegible]-12		4a	50	45L	-	-	.08	.55	10	-	
[illegible]-11		4a	50	45L	-	-	.10	.50	11	-	
[illegible]-12		4a	50	45R	-	-	.10	.45	12	-	
[illegible]-13		4a	50	45R	-	-	.15	.50	12	-	
[illegible]-14		4b	30	75L	-	-	.05	.30	10	-	
62-15		4b	30	95L	-	-	.05	.37	13	-	
6[illegible]		4b	30	115L	-	-	.05	.45	17	-	
6[illegible]		4b	30	135L	-	-	.08	.55	21	-	
62-[illegible]		4b	30	155L	-	-	.07	.60	25	-	
[illegible]		4b	30	155L	-	-	.07	.60	25	-	
[illegible]		4b	30	155R	-	-	.10	.55	26	-	
6[illegible]		4b	30	155R	-	-	.10	.53	27	-	
62-22	No ?	4b	50	35L	-	-	.08	.35	7	-	
63-23		4b	50	45L	-	-	.08	.47	10	-	
6[illegible]-24		4b	50	55L	-	-	.10	.65	15	-	
6[illegible]-25		4b	50	65L	-	-	[illegible]	.80++	40++	-	Spin out
[illegible]	—	—	60	65L	-	-	—	—	—	-	FG Turned itself off
[illegible]-27		4b	60	65L	-	-	[illegible]	.80++	40++	-	Spin out
[illegible]-28		4b	50	65R	-	-	.17	.65	18	-	No spin
[illegible]-29		4b	50	65[illegible]	-	-	.18	.65	19	-	" "

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

SHEET 16 OF

VEHICLE PICK-UP TIRES, FRONT: 12 TIRES, REAR:

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
64-27	Yes	1	28	–	–	50	.20	–	–	–	Front only
64-28	Yes	1	28	–	–	50	.25	–	–	–	
64-29	Yes	1	28	–	–	50	.23	–	–	–	Rear only
64-30	Yes	1	28	–	–	50	.25	–	–	–	
64-32	Yes	1	28	–	–	50	.15	–	–	–	
64-33	Yes	1	28	–	–	50	.17	–	–	–	
64-34	Yes	1	28	–	–	50	.20	–	–	–	Rear only
64-35	Yes	1	28	–	–	50	.20	–	–	–	
						A +475° +1000°					

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK TIRES, FRONT: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00x20/F TIRES, REAR: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00x20/F

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_x AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
20-05	NO	1	40	—	—	20				—	NG
20-06	NO	1	40	—	—	20	.12			—	DATA NOISY
20-07	NO	1	40	—	—	40	.18			—	
20-08	NO	1	40	—	—	40	.15			—	
20-09	NO	1	40	—	—	60	.24			—	
20-10	NO	1	40	—	—	60	.23			—	
20-11	NO	1	40	—	—	80	.33			—	
20-12	NO	1	40	—	—	80	.32			—	
20-13	NO	1	40	—	—	100	.40			—	NO LOCK
20-14	NO	1	40	—	—	100+	.42			—	" "
20-15	NO	1	40	—	—	100+	.12			—	LOCK @ END OF RUN
20-16	NO	1	40	—	—	100+	.14			—	" " "
20-17	NO	1	40	—	—	100+	.14			—	" " " "
20-18	NO	1	40	—	—	100+	.13			—	LOCK RR
20-19	NO	1	40	—	—	100+	.42			—	(NOT 100%)
20-20	NO	1	40	—	—	50	.13			—	FRONT ONLY
20-21	NO	1	40	—	—	50	.10			—	" "
20-22	NO	1	40	—	—	50	.17			—	REAR ONLY
20-23	NO	1	40	—	—	50	.18			—	" "

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE

TIRES, FRONT: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F TIRES, REAR: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
21-09	NO	2	30	170L	–	20	.10	.20	8	–	
21-11	NO	2	30	170L		30	.11	.28	14	–	
21-12	NO	2	30	170L	–	40	.16	.44	43+	–	REAR LOCK, 180° SPIN
21-15	NO	2	30	170R	–	40	.18	.37	41+	–	" "
22-05	NO	3	30	80L	2	–	.05	L.12/R.10	L4/R4	1.0	WET
22-06	NO	3	30	120L	2	–	.06	L.17/R.13	L5/R6	1.0	
22-07	NO	3	30	160L	2	–	.05	L.20/R.16	L7/R8	1.1	
22-08	NO	3	30	160L	2	–	.07	L.16/R.18	L6/R8	1.1	
22-09	NO	3	30	160R	2	–	.04	R.11/L.16	R9/L7	1.1	
22-10	NO	3	30	160R	2	–	.04	R.14/L.20	R9/L7	1.1	
22-11	NO	3	30	80L	4	–	.05	L.[illegible]/R.08	L3/R4	2.0	STEER TRACES MOVED
22-12	NO	3	30	120L	4	–	.05	L.18/R.15	L6/R6	2.1	
22-13	NO	3	30	160L	[illegible]	–	.05	L.[illegible]/R.20	L8/R8	2.0	STEER LOCK O.K.
22-14	NO	3	30	160L	[illegible]	–	.05	L.[illegible]/R.[illegible]	L7/R9	2.1	
22-15	NO	3	30	160R	[illegible]	–	.04	R.20/L.22	R9/L8	2.2	
22-16	NO	3	30	160R	4	–	.05	R.[illegible]/L.20	R9/L7	2.2	
23-09	NO	2	[illegible]	160L		40	.25	.50	15	–	
23-10	NO	2	50	160[illegible]		50	.26	.50	16	–	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK **TIRES, FRONT:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00x20/F **TIRES, REAR:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00x20/F

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
23-11	NO	2	50	180L		60	.29	.53	15	–	INSIDE LOCK
23-12	NO	2	50	180L	–	70	.30	.53	15	–	" "
23-13	NO	2	50	180L	–	70	.30	.55	16	–	" "
23-14	NO	2	50	180R	–	70	.30	.45	16	–	" "
23-15	NO	2	50	180R	–	70	.30	.48	16	–	" "
24-05	NO	3	30	80L	2	–	0	L.13/R.08	L3/R4	1.0	
24-06	NO	3	30	160L	2	–	0	L.18/R.17	L7/R9	1.0	
24-07	NO	3	30	240L	2	–	0	L.30/R.27	L14/R14	1.0	
24-08	NO	3	30	240L	2	–	.02	L.32/R.27	L13/R13	1.1	
24-09	NO	3	30	240R	2	–	.02	R.21/L.32	R13/L14	1.1	
24-10	NO	3	30	240R	2	–	.22	R.[illegible]/L.31	R14/L13	1.0	
24-11	NO	3	30	80L	4	–	0	L.12/R.09	L3/R4	2.0	
24-12	NO	3	30	160L	4	–	0	L.23/R.20	L8/R9	2.1	
24-13	NO	3	30	240L	4	–	.02	L.35/R.23	L13/R14	2.1	
24-14	NO	3	30	240L	4	–	.02	L.29/R.27	L14/R14	2.1	
24-15	NO	3	30	240R	4	–	.02	R.20/L.32	R14/L14	2.1	
24-16	NO	3	30	240R	[illegible]	–	.02	R.30/L.35	R14/L14	2.1	
24-17	NO	3	50	40L	2	–	.03	L.12/R.10	L1/R3	1.0	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK TIRES, FRONT: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F TIRES, REAR: UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.	
24-18	NO	3	50	80L	2	–	.04	L.22/R.15	L4/R6	1.2	
24-19	NO	3	50	120L	2	–	.03	L.28/R.24	L8/R8	1.1	
24-20	NO	3	50	120L	2	–	.06	L.30/R.24	L8/R8	1.2	
24-21	NO	3	50	120R	2	–	.05	R.22/L.28	R8/L8	1.2	
24-22	NO	3	50	120R	2	–	.05	R.23/L.28	R8/L8	1.1	
25-23	NO	3	50	40L	4	–	.03	L.10/R.08	L2/R2	2.0	
25-24	NO	3	50	80L	4	–	.03	L.22/R.18	L4/R5	?	DATA LATE
25-25	NO	3	50	120L	4	–	.05	L.30/R.28	L7/R8	2.1	
25-26	NO	3	50	120L	4	–	.05	L.33/R.25	L7/R6	2.1	
25-27	NO	3	50	120R	4	–	.04	R.25/L.30	R6/L7	2.1	
25-28	NO	3	50	120R	4	–	.04	R.25/L.30	R7/L7	2.4	
26-05	NO	4a	30	160L	–	–	.03	.25	9	–	
26-06	NO	4a	30	160L	–	–	.02	.23	8	–	
26-07	NO	4a	30	160R	–	–	.02	.20	9	–	
26-08	NO	4a	30	160R	–	–	.03	.21	9	–	
26-09	NO	4a	50	60L	–	–	.05	.18	3	–	
26-10	NO	4a	50	60L	–	–	.05	.19	3	–	
26-11	NO	4a	50	60R	–	–	.05	.13	4	–	
26-12	NO	4a	50	60R	–	–	.05	.15	4	–	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK   **TIRES, FRONT:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F   **TIRES, REAR:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F.

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T INF. SEC.	
26-13	NO	4b	30	120 L	—	—	[illegible]	.13	5	—	ASCEND
26-14	NO	4b	30	160 L	—	—	.02	[illegible]	8	—	
26-15	NO	4b	30	200 L	—	—	.02	.30	11	—	
26-16	NO	4b	30	240 L	—	—	.03	.34	13	—	
26-17	NO	4b	30	260 L	—	—	.03	.42	16	—	
26-18	NO	4b	30	280 L	—	—	.04	.41	16	—	
26-19	NO	4b	30	280 R	—	—	.05	.45	17	—	
26-20	NO	4b	30	280 R	—	—	.04	.44	17	—	
26-21	NO	4b	50	40 L	—	—	.05	.13	1	—	
26-22	NO	4b	50	60 L	—	—	.04	.15	2	—	
26-23	NO	4b	50	80 L	—	—	.04	.24	4	—	
26-24	NO	4b	50	100 L	—	—	.04	.30	5	—	
27-25	NO	4b	50	100 L	—	—	.06	.28	6	—	
27-2[illegible]	NO	4b	50	100 R	—	—	.07	[illegible]	6	—	
27-30	NO	4b	[illegible]	100 R	—	—	.07	.22	6	—	RECORDER ON LATE
28-05	NO	4b	30	280 R	—	—	.05	.33	17	—	DECSEND
28-06	NO	4b	30	280 R	—	—	.07	.34	18	—	
28-07	NO	4b	30	28[illegible]	—	—	.07	.40	16	—	

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK **TIRES, FRONT:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F **TIRES, REAR:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F

RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	$T_{INF.}$ SEC.
28-08	NO	4b	30	280L	–	–	.03	.45	18	–
28-09	NO	4b	30	240L	–	–	.05	.35	13	–
28-10	NO	4b	30	200L	–	–	.06	.30	10	–
29-15	NO	4b	30	280R	–	–	.06	.34	16	–
29-16	NO	4b	30	280R	–	–	.08	.35	16	–
29-17	NO	4b	30	280L	–	–	.07	.40	17	–
29-18	NO	4b	30	280L	–	–	.07	.38	16	–
29-19	NO	4b	30	240L	–	–	.05	.34	14	–
29-20	NO	4b	30	200L	–	–	.06	.29	10	–
29-21	NO	4b	30	160L	–	–	.06	.23	8	–
29-22	NO	4b	30	120L	–	–	.06	.20	5	–
29-23	NO	4b	50	100R	–	–	.07	.22	6	–
29-24	NO	4b	50	100R	–	–	.07	.24	6	–
29-25	NO	4b	50	100L	–	–	.07	.25	4	–
29-26	NO	4b	50	100L	–	–	.06	.23	6	–
29-27	NO	4b	50	80L	–	–	.07	.24	4	–
29-28	NO	4b	50	60L	–	–	.05	.19	3	–
29-29	NO	4b	50	40L	–	–	.05	.14	1	–

TTI-HSRI-DOT VEHICLE HANDLING DATA SUMMARY

VEHICLE HEAVY TRUCK **TIRES, FRONT:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F **TIRES, REAR:** UNIROYAL FLEETMASTER TRIPLE TREAD 10.00X20/F

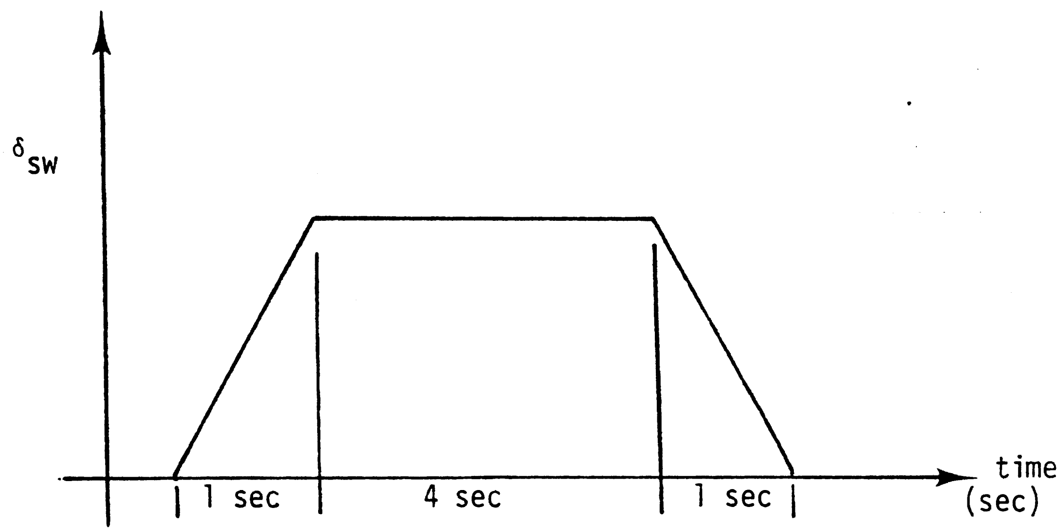
RUN NO.	LOADED YES/NO	MANEUVER TYPE NO.	V MPH	δ_{SW} DEG.	STEER PERIOD SEC.	BRAKE INPUT %	A_X AVERAGE g's	A_Y PEAK g's	r PEAK °/SEC	T_{INF} SEC.	
30-05	YES	1	40	—	—	20	.13	.02	0	—	NO LOCK UP
30-06	YES	1	40	—	—	20	.13	.05	0	—	
30-07	YES	1	40	—	—	40	.25	.05	0	—	
30-08	YES	1	40	—	—	40	.25	.07	0	—	
30-09	YES	1	40	—	—	60	.32	.08	1	—	
30-10	YES	1	40	—	—	60	.32	.08	1	—	
30-11	YES	1	40	—	—	80	.40	.08	1	—	COMP. STOP PULLED TO LEFT
30-12	YES	1	40	—	—	80	.45	.13	0	—	PULLED TO LEFT
30-13	YES	1	40	—	—	100	.45	.15	1	—	
30-14	YES	1	40	—	—	100	.44	.13	1	—	
30-19	YES	1	40	—	—	50	.15	.08	0	—	FRONT BREAK ONLY
30-20	YES	1	40	—	—	50	.13	.08	0	—	" " "
30-21	YES	1	40	—	—	50	.20	.13	0	—	REAR BREAK ONLY
30-22	YES	1	40	—	—	50	.20	.10	0	—	" " "

APPENDIX F

APL SIMULATION RESULTS

This appendix presents listings of the condensed metrics [1] describing the results of simulated trapezoidal and sinusoidal steer maneuvers conducted on the various test vehicles.

The results from three classes of tests: Trapezoidal steer, Sinusoidal steer 1 and Sinusoidal steer 2, are presented. Trapezoidal steer tests employed a steering wheel angle input of the following form:



For Sinusoidal steer 1, an sine wave steering wheel angle input of a 2-second period is used for all vehicles. Sinusoidal steer 2 employes a 3-second period for the two lighter vehicles and a 4-second period for the two heavy vehicles.

The title for each page of data indicates the vehicle and its loading condition, the initial velocity of the test maneuver, and a tire code, which in combination with Table F.1 indicates the tires used on the vehicle.

A dictionary of metric definitions appears in Table F.2.

Table F.1. Tire Codes*

Heavy Bus:

- HB0: Tire H12 on all wheels
- HB1: Tire H18 on all wheels
- HB2: Tire H19 on all wheels

Heavy Truck:

- HT1: Tire H1 on all wheels
- HT2: Tire H4 on all wheels
- HT3: Tire H6 on all wheels

Light Van:

- E0: Tire L2 on all wheels (75 psi)
- E1: Tire L10 on all wheels
- E2: Tire L15 on all wheels
- E3: Tire L2 on all wheels (45 psi front, 75 psi rear)
- E4: Tire L2 on front wheels (45 psi) and L11 on rear wheels

Pickup Truck

- F0: Tire L1 on all wheels
- F1: Tire L16 on all wheels
- F2: Tire L13 on all wheels
- F3: Tire L1 on all wheels (45 psi front, 75 psi rear)

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*Tires identified as per codings presented in Table 3.1. Recommended inflation pressures except as indicated.

Table F.2. Dictionary of Metrics for Simulated Trapezoidal and Sinusoidal Steer Maneuvers.

Trapezoidal Steer

STR4:	Maximum steering wheel angle (deg)
BETAMX:	Maximum absolute sideslip angle during the 2-second time period (t), beginning at the time of steering input (rad.)
BETDMX:	Maximum absolute value of the rate of change of sideslip angle during the time period t (rad/sec).
CUVRAT:	Average path curvature ratios = $(1/R)_{av}/(1/R)_o$

where

$$\left(\frac{1}{R}\right)_{av} = \frac{1}{2}\int_{t_4}^{t_4+2} \left(\frac{1}{R}\right) dt \cong \frac{1}{2s_f} \sum_{i=1}^{2s_f} \left(\frac{1}{R}\right)_i$$

$$\left(\frac{1}{R}\right)_o = \left.\frac{1}{R}\right|_{t_4} \cong \left(\frac{1}{R}\right)_i \; , \quad i=0$$

and

t_4 is the time of the steering input

t_4+1 is the time 2 seconds after the steering input

$\left(\frac{1}{R}\right)_{av}$ is the average path curvature over the above defined interval $[t_4, t_4+1]$

$\left(\frac{1}{R}\right)_o$ is the path curvature at t_o.

Table F.2 (Cont.)

AYMAX:	Maximum lateral acceleration over the entire maneuver time interval (g's).
RMAX:	Maximum yaw rate over the entire maneuver time interval (rad/sec).
PHIMAX:	Maximum roll angle over the entire maneuver time interval (deg).

Sinusoidal Steer

STR5:	Maximum steering wheel angle (deg).
AYMAX:	Maximum lateral acceleration over the entire maneuver time interval (g's).
DEL:	Lateral deviation of the vehicle position from the "desired" 12-ft lane change at the completion of the maneuver (ft).
BETAMAX:	Maximum absolute value of sideslip angle during the time period t (rad).
DELPSI:	Vehicle heading angle at the completion of the maneuver (rad).
UIN:	Initial velocity (mph).
PHIMAX:	Maximum roll angle over the entire maneuver time interval (deg).

HEAVY BUS SIMULATION RESULTS

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
180.	0.580E-02	0.118E-01	0.275	0.264	0.194	3.35
240.	0.108E-01	0.181E-01	0.358	0.348	0.259	4.35
300.	0.172E-01	0.262E-01	0.436	0.423	0.322	5.27
360.	0.248E-01	0.348E-01	0.508	0.493	0.386	6.14
420.	0.329E-01	0.469E-01	0.573	0.549	0.437	6.78
480.	0.400E-01	0.575E-01	0.631	0.637	0.494	7.50

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.118	9.76	0.593E-02	0.475E-02	30.0	2.12
240.	0.219	7.71	0.151E-01	0.750E-02	30.0	3.95
360.	0.307	5.96	0.271E-01	0.118E-01	30.0	5.39
480.	0.370	4.86	0.400E-01	0.166E-01	30.0	6.40
600.	0.413	4.98	0.504E-01	0.201E-01	30.0	6.95
720.	0.438	5.13	0.561E-01	0.214E-01	30.0	7.06
840.	0.453	5.25	0.596E-01	0.226E-01	30.0	7.08

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.153	8.79	0.553E-02	0.665E-02	30.0	2.04
240.	0.285	17.6	0.161E-01	0.100E-01	30.0	3.75
360.	0.394	27.0	0.326E-01	0.187E-01	30.0	5.11
480.	0.481	34.6	0.529E-01	0.311E-01	30.0	6.14
480.	0.481	34.6	0.530E-01	0.311E-01	30.0	6.15
550.	0.521	37.8	0.649E-01	0.382E-01	30.0	6.74

Figure F.1. Unloaded heavy bus, $V_o = 30$ mph, Tire code: HBO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.175E-01	0.162E-01	0.645E-01	0.211	0.940E-01	2.65
90.0	0.284E-01	0.253E-01	0.936E-01	0.319	0.143	3.96
120.	0.406E-01	0.351E-01	0.120	0.423	0.193	5.21
150.	0.538E-01	0.457E-01	0.145	0.520	0.246	6.38
180.	0.679E-01	0.570E-01	0.167	0.607	0.290	7.21
210.	0.825E-01	0.687E-01	0.187	0.645	0.335	12.3

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.105	9.63	0.120E-01	0.369E-02	50.0	1.75
120.	0.195	7.44	0.256E-01	0.382E-02	50.0	3.27
180.	0.271	5.58	0.407E-01	0.194E-02	50.0	4.54
240.	0.334	5.92	0.567E-01	-0.284E-02	50.0	5.57
300.	0.383	6.64	0.729E-01	-0.107E-01	50.0	6.38
360.	0.420	7.25	0.874E-01	-0.246E-01	50.0	7.01
420.	0.453	7.62	0.988E-01	-0.464E-01	50.0	7.46
480.	0.476	7.79	0.108	-0.731E-01	50.0	7.75

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.160	10.6	0.165E-01	0.696E-02	50.0	2.06
120.	0.298	21.6	0.388E-01	0.795E-02	50.0	3.82
180.	0.413	33.5	0.675E-01	0.829E-02	50.0	5.60
240.	0.501	44.8	0.102	0.127E-01	50.0	7.35
300.	0.589	54.5	0.141	0.115E-01	50.0	8.82
360.	0.638	61.9	0.180	0.316E-01	50.0	9.02
420.	0.658	65.8	0.209	0.124E-01	50.0	10.3
480.	0.843	67.3	0.231	-0.647E-01	50.0	11.1

Figure F.2. Unloaded heavy bus, V_o = 50 mph, tire code: HBO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
180.	0.315E-02	0.642E-02	0.255	0.230	0.168	3.71
240.	0.418E-02	0.100E-01	0.333	0.301	0.222	4.84
300.	0.998E-02	0.175E-01	0.403	0.364	0.272	5.89
360.	0.178E-01	0.269E-01	0.468	0.421	0.321	6.81
420.	0.268E-01	0.393E-01	0.528	0.473	0.367	7.71
480.	0.346E-01	0.509E-01	0.584	0.531	0.409	8.46

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.127	9.98	0.386E-02	0.371E-02	30.0	2.82
240.	0.228	8.03	0.561E-02	0.597E-02	30.0	4.96
360.	0.305	6.32	0.147E-01	0.784E-02	30.0	6.78
480.	0.360	4.94	0.260E-01	0.777E-02	30.0	8.20
540.	0.387	4.62	0.343E-01	0.801E-02	30.0	8.80

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.142	7.98	0.316E-02	0.542E-02	30.0	2.46
240.	0.271	15.1	0.624E-02	0.648E-02	30.0	4.57
360.	0.374	23.4	0.189E-01	0.108E-01	30.0	6.15
480.	0.455	30.6	0.383E-01	0.183E-01	30.0	7.63
540.	0.485	33.4	0.460E-01	0.192E-01	30.0	8.34

Figure F.3. Loaded heavy bus, V_o = 30 mph, tire code: HBO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.119E-01	0.116E-01	0.551E-01	0.154	0.689E-01	2.44
90.0	0.200E-01	0.184E-01	0.808E-01	0.232	0.104	3.70
120.	0.298E-01	0.261E-01	0.105	0.304	0.139	4.86
150.	0.409E-01	0.349E-01	0.127	0.369	0.172	5.91
180.	0.534E-01	0.451E-01	0.147	0.430	0.204	6.98
210.	0.671E-01	0.564E-01	0.165	0.483	0.235	7.85

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.998E-01	10.1	0.889E-02	0.186E-02	50.0	1.98
120.	0.188	8.29	0.200E-01	0.201E-02	50.0	3.86
180.	0.261	6.54	0.339E-01	0.876E-04	50.0	5.42
240.	0.313	5.11	0.495E-01	-0.717E-02	50.0	6.69
300.	0.350	5.47	0.651E-01	-0.206E-01	50.0	7.73

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.133	8.50	0.111E-01	0.337E-02	50.0	2.21
120.	0.257	15.4	0.272E-01	0.375E-02	50.0	4.12
180.	0.363	24.3	0.493E-01	0.112E-02	50.0	6.07
240.	0.454	32.8	0.773E-01	-0.714E-02	50.0	8.09
300.	0.583	40.3	0.117	-0.475E-01	50.0	9.88

Figure F.4. Loaded heavy bus, V_o = 50 mph, tire code: HBO

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
180.	0.416E-02	0.952E-02	0.283	0.265	0.193	3.36
240.	0.645E-02	0.143E-01	0.368	0.347	0.256	4.36
300.	0.115E-01	0.212E-01	0.448	0.422	0.318	5.30
360.	0.178E-01	0.297E-01	0.522	0.491	0.380	6.09
420.	0.251E-01	0.404E-01	0.589	0.548	0.431	6.78
480.	0.312E-01	0.509E-01	0.650	0.618	0.492	7.65
550.	0.391E-01	0.695E-01	0.709	0.655	0.543	12.3

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.123	9.71	0.476E-02	0.479E-02	30.0	2.24
240.	0.229	7.64	0.124E-01	0.764E-02	30.0	4.13
360.	0.319	5.84	0.229E-01	0.127E-01	30.0	5.63
480.	0.386	4.79	0.349E-01	0.194E-01	30.0	6.70
540.	0.411	4.88	0.401E-01	0.222E-01	30.0	7.06

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.157	8.74	0.415E-02	0.662E-02	30.0	2.12
240.	0.294	17.7	0.123E-01	0.995E-02	30.0	3.90
360.	0.405	27.1	0.256E-01	0.183E-01	30.0	5.25
480.	0.495	34.9	0.432E-01	0.309E-01	30.0	6.21
540.	0.531	37.8	0.528E-01	0.379E-01	30.0	6.67

Figure F.5. Unloaded heavy bus, V_o = 30 mph, tire code: HB1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.158E-01	0.149E-01	0.676E-01	0.211	0.935E-01	2.63
90.0	0.257E-01	0.234E-01	0.979E-01	0.314	0.140	3.90
120.	0.368E-01	0.320E-01	0.126	0.413	0.187	5.10
150.	0.488E-01	0.416E-01	0.151	0.510	0.237	6.24
180.	0.620E-01	0.520E-01	0.175	0.587	0.276	7.11
210.	0.758E-01	0.618E-01	0.195	0.656	0.333	12.5

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.112	9.56	0.113E-01	0.335E-02	50.0	1.87
120.	0.207	7.33	0.240E-01	0.287E-02	50.0	3.48
180.	0.288	5.44	0.381E-01	0.160E-03	50.0	4.81
240.	0.353	5.82	0.534E-01	-0.554E-02	50.0	5.89
300.	0.401	6.59	0.691E-01	-0.140E-01	50.0	6.74

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.166	10.6	0.149E-01	0.648E-02	50.0	2.14
120.	0.307	21.6	0.347E-01	0.685E-02	50.0	3.93
180.	0.425	33.4	0.601E-01	0.608E-02	50.0	5.71
240.	0.516	44.5	0.916E-01	0.663E-02	50.0	7.48
300.	0.591	54.5	0.130	-0.444E-02	50.0	9.14

Figure F.6. Unloaded heavy bus, V_o = 50 mph, tire code: HB1.

Trapezoidal Steer

STR4..(	1) BETAMX(	1) BETDMX(	1) CUVRAT(	1) AYMAX.(	1) RMAX..(	1) PHIMAX(1)
180.	0.528E-02	0.831E-02	0.262	0.226	0.166	3.65
240.	0.574E-02	0.866E-02	0.340	0.295	0.219	4.75
300.	0.593E-02	0.141E-01	0.412	0.357	0.268	5.77
360.	0.978E-02	0.223E-01	0.477	0.412	0.313	6.67
420.	0.164E-01	0.325E-01	0.537	0.460	0.355	7.51
480.	0.212E-01	0.418E-01	0.593	0.505	0.390	8.32

Sinusoidal Steer 1

STR5..(	1) AYMAX.(	1) DEL...(	1) BETAMX(	1) DELPSI(	1) UIN...(	1) PHIMAX(1)
120.	0.141	9.99	0.577E-02	0.184E-02	30.0	3.13
240.	0.236	8.03	0.682E-02	0.442E-02	30.0	5.42
360.	0.312	6.34	0.107E-01	0.670E-02	30.0	6.96
480.	0.368	4.99	0.197E-01	0.753E-02	30.0	8.36
540.	0.396	4.54	0.281E-01	0.877E-02	30.0	8.94

Sinusoidal Steer 2

STR5..(	1) AYMAX.(	1) DEL...(	1) BETAMX(	1) DELPSI(	1) UIN...(	1) PHIMAX(1)
120.	0.145	7.78	0.453E-02	0.228E-02	30.0	2.53
240.	0.273	14.8	0.790E-02	0.381E-02	30.0	4.67
360.	0.376	22.9	0.121E-01	0.848E-02	30.0	6.25
480.	0.458	29.7	0.267E-01	0.150E-01	30.0	7.55
540.	0.486	32.3	0.315E-01	0.146E-01	30.0	8.17

Figure F.7. Loaded heavy bus, V_o = 30 mph, tire code: HB1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.958E-02	0.964E-02	0.572E-01	0.152	0.684E-01	2.41
90.0	0.166E-01	0.156E-01	0.839E-01	0.229	0.103	3.66
120.	0.257E-01	0.226E-01	0.108	0.300	0.137	4.80
150.	0.360E-01	0.309E-01	0.131	0.362	0.168	5.83
180.	0.470E-01	0.4[illegible]E-01	0.150	0.415	0.198	6.68

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.106	10.1	0.783E-02	0.173E-03	50.0	2.13
120.	0.199	8.25	0.181E-01	-0.886E-04	50.0	4.10
180.	0.270	6.53	0.314E-01	-0.327E-02	50.0	5.67
240.	0.321	5.07	0.461E-01	-0.116E-01	50.0	6.94
300.	0.362	5.20	0.606E-01	-0.260E-01	50.0	7.97

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.138	8.37	0.925E-02	0.229E-02	50.0	2.29
120.	0.262	15.4	0.236E-01	0.265E-02	50.0	4.21
180.	0.371	24.1	0.437E-01	0.137E-03	50.0	6.15
240.	0.459	32.0	0.672E-01	-0.483E-02	50.0	8.07
300.	0.552	38.4	0.968E-01	-0.330E-01	50.0	9.73

Figure F.8. Loaded heavy bus, V_o = 50 mph, tire code: HB1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
180.	0.663E-02	0.124E-01	0.271	0.262	0.193	3.31
240.	0.116E-01	0.184E-01	0.352	0.343	0.255	4.29
300.	0.177E-01	0.264E-01	0.427	0.416	0.316	5.18
360.	0.250E-01	0.344E-01	0.497	0.483	0.377	6.01
420.	0.331E-01	0.449E-01	0.560	0.539	0.429	6.64
480.	0.406E-01	0.573E-01	0.617	0.607	0.482	7.25
540.	0.467E-01	0.641E-01	0.667	0.642	0.530	10.2

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.115	9.79	0.641E-02	0.466E-02	30.0	2.07
240.	0.214	7.78	0.157E-01	0.738E-02	30.0	3.85
360.	0.298	6.06	0.274E-01	0.112E-01	30.0	5.25
480.	0.363	4.90	0.397E-01	0.162E-01	30.0	6.26
600.	0.406	5.00	0.502E-01	0.200E-01	30.0	6.84

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.150	8.77	0.602E-02	0.653E-02	30.0	2.00
240.	0.280	17.3	0.168E-01	0.955E-02	30.0	3.66
360.	0.386	26.5	0.326E-01	0.171E-01	30.0	4.98
480.	0.471	33.9	0.521E-01	0.279E-01	30.0	6.01
600.	0.532	38.8	0.716E-01	0.374E-01	30.0	6.95

Figure F.9. Unloaded heavy bus, V_o = 30 mph, tire code: HB2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.178E-01	0.164E-01	0.632E-01	0.207	0.920E-01	2.59
120.	0.404E-01	0.351E-01	0.117	0.408	0.186	5.02
180.	0.664E-01	0.563E-01	0.163	0.573	0.276	7.02
240.	0.946E-01	0.801E-01	0.200	0.744	0.384	13.0
300.	0.122	0.115	0.228	0.872	0.438	13.0
360.	0.147	0.140	0.249	0.823	0.454	13.1

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.102	9.68	0.122E-01	0.317E-02	50.0	1.69
120.	0.189	7.56	0.257E-01	0.281E-02	50.0	3.16
180.	0.263	5.66	0.403E-01	0.292E-03	50.0	4.38
240.	0.325	5.81	0.557E-01	-0.513E-02	50.0	5.40
300.	0.373	6.46	0.712E-01	-0.136E-01	50.0	6.20
360.	0.409	7.07	0.860E-01	-0.260E-01	50.0	6.83
420.	0.441	7.47	0.976E-01	-0.454E-01	50.0	7.29
480.	0.468	7.67	0.107	-0.712E-01	50.0	7.60
540.	0.486	7.73	0.115	-0.971E-01	50.0	7.79

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.157	10.5	0.168E-01	0.641E-02	50.0	2.02
120.	0.291	20.9	0.386E-01	0.670E-02	50.0	3.70
180.	0.402	32.3	0.657E-01	0.510E-02	50.0	5.40
240.	0.487	43.2	0.998E-01	0.774E-02	50.0	7.07
300.	0.555	52.5	0.136	-0.667E-02	50.0	8.60
360.	0.643	60.9	0.186	0.465E-01	50.0	9.34
420.	0.711	66.2	0.227	0.868E-01	50.0	9.78
480.	0.729	68.5	0.252	0.855E-01	50.0	10.7

Figure F.10. Unloaded heavy bus, V_o = 50 mph, tire code: HB2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
180.	0.296E-02	0.607E-02	0.251	0.227	0.166	3.66
240.	0.568E-02	0.113E-01	0.326	0.296	0.219	4.76
300.	0.119E-01	0.195E-01	0.394	0.358	0.268	5.77
360.	0.194E-01	0.278E-01	0.455	0.410	0.313	6.63
420.	0.276E-01	0.388E-01	0.512	0.457	0.355	7.42
480.	0.345E-01	0.504E-01	0.564	0.497	0.390	8.22

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.124	10.0	0.361E-02	0.354E-02	30.0	2.73
240.	0.222	8.11	0.569E-02	0.560E-02	30.0	4.81
360.	0.296	6.47	0.158E-01	0.705E-02	30.0	6.55
480.	0.349	5.17	0.269E-01	0.690E-02	30.0	7.87
600.	0.394	4.65	0.391E-01	0.607E-02	30.0	8.81

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
120.	0.140	7.97	0.306E-02	0.497E-02	30.0	2.40
240.	0.264	14.8	0.735E-02	0.615E-02	30.0	4.44
360.	0.363	22.8	0.207E-01	0.971E-02	30.0	5.93
480.	0.441	29.5	0.381E-01	0.138E-01	30.0	7.35
600.	0.495	34.1	0.500E-01	0.122E-01	30.0	8.42

Figure F.11. Loaded heavy bus, V_o = 30 mph, tire ccde: HB2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.121E-01	0.118E-01	0.541E-01	0.152	0.680E-01	2.40
90.0	0.202E-01	0.186E-01	0.793E-01	0.227	0.102	3.63
120.	0.303E-01	0.264E-01	0.102	0.297	0.136	4.73
150.	0.416E-01	0.357E-01	0.123	0.359	0.168	5.75
180.	0.536E-01	0.457E-01	0.142	0.414	0.198	6.66
210.	0.662E-01	0.561E-01	0.159	0.460	0.225	7.47

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.977E-01	10.2	0.898E-02	0.182E-02	50.0	1.93
120.	0.183	8.36	0.202E-01	0.182E-02	50.0	3.75
180.	0.251	6.70	0.340E-01	-0.112E-02	50.0	5.22
240.	0.302	5.26	0.491E-01	-0.885E-02	50.0	6.43
300.	0.340	5.34	0.643E-01	-0.221E-01	50.0	7.41

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.131	8.50	0.113E-01	0.350E-02	50.0	2.15
120.	0.250	15.1	0.277E-01	0.352E-02	50.0	3.99
180.	0.352	23.6	0.499E-01	0.221E-03	50.0	5.91
240.	0.439	31.4	0.764E-01	-0.940E-02	50.0	7.75
300.	0.574	37.8	0.114	-0.506E-01	50.0	9.36

Figure F.12. Loaded heavy bus, V_0 = 50 mph, tire code: HB2.

Blank

HEAVY TRUCK SIMULATION RESULTS

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.971E-02	0.126E-01	0.231	0.182	0.133	0.576
120.	0.125E-01	0.159E-01	0.306	0.241	0.177	0.763
150.	0.151E-01	0.196E-01	0.381	0.300	0.221	0.946
180.	0.175E-01	0.231E-01	0.455	0.358	0.265	1.13
210.	0.197E-01	0.271E-01	0.529	0.415	0.309	1.30
240.	0.216E-01	0.305E-01	0.601	0.472	0.354	1.48
270.	0.232E-01	0.342E-01	0.673	0.536	0.409	1.68
300.	0.245E-01	0.380E-01	0.745	0.593	0.459	1.86

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.108	10.3	0.703E-02	0.139E-02	30.0
120.	0.211	8.64	0.137E-01	0.155E-02	30.0
180.	0.310	7.02	0.203E-01	0.166E-02	30.0
240.	0.401	5.47	0.267E-01	0.177E-02	30.0
300.	0.483	4.02	0.332E-01	0.167E-02	30.0

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.115	10.8	0.661E-02	0.230E-02	30.0
120.	0.224	6.27	0.126E-01	0.254E-02	30.0
180.	0.330	7.57	0.181E-01	0.388E-02	30.0
240.	0.427	10.8	0.236E-01	0.745E-02	30.0
300.	0.512	14.1	0.286E-01	0.686E-02	30.0

Figure F.13. Unloaded heavy truck, V_o = 30 mph, tire code: HT1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.518E-02	0.704E-02	0.488E-01	0.117	0.527E-01	0.368
45.0	0.832E-02	0.111E-01	0.730E-01	0.176	0.794E-01	0.556
60.0	0.117E-01	0.155E-01	0.965E-01	0.232	0.106	0.733
75.0	0.157E-01	0.201E-01	0.120	0.289	0.133	0.911
90.0	0.201E-01	0.251E-01	0.143	0.348	0.159	1.09
105.	0.253E-01	0.306E-01	0.166	0.404	0.186	1.27

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.892E-01	10.5	0.584E-02	-0.582E-03	50.0
60.0	0.175	8.97	0.123E-01	-0.506E-03	50.0
90.0	0.257	7.47	0.195E-01	-0.555E-03	50.0
120.	0.335	5.99	0.279E-01	-0.119E-02	50.0
150.	0.408	4.54	0.374E-01	-0.251E-02	50.0

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.103	[illegible]	0.562E-02	-0.401E-03	50.0
60.0	0.201	7.09	0.121E-01	-0.131E-03	50.0
90.0	0.298	7.49	0.198E-01	0.186E-03	50.0
120.	0.389	10.5	0.291E-01	0.170E-03	50.0
150.	0.470	13.8	0.413E-01	-0.910E-03	50.0

Figure F.14. Unloaded heavy truck, V_o` = 50 mph, tire code: HT1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.185E-01	0.195E-01	0.222	0.216	0.159	3.09
120.	0.298E-01	0.288E-01	0.292	0.296	0.221	4.22
150.	0.456E-01	0.406E-01	0.359	0.364	0.295	5.45
180.	0.659E-01	0.555E-01	0.425	0.477	0.386	6.69
210.	0.909E-01	0.721E-01	0.466	0.558	0.472	7.62
240.	0.122	0.971E-01	0.542	0.598	0.544	13.9

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.101	10.2	0.103E-01	0.692E-02	30.0
120.	0.193	8.46	0.228E-01	0.476E-02	30.0
180.	0.293	6.79	0.395E-01	-0.660E-02	30.0
240.	0.361	4.97	0.608E-01	-0.165E-01	30.0
300.	0.417	5.75	0.877E-01	-0.173E-01	30.0

Sinusoidal Steer 2

STR5..(1)	...MAX.(1)	DEL...(1)	...TAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.127	8.41	0.105E-01	0.122E-01	30.0
120.	0.247	14.4	0.265E-01	0.130E-01	30.0
180.	0.359	23.4	0.543E-01	0.907E-02	30.0
240.	0.463	34.2	0.102	0.350E-01	30.0
300.	0.545	44.6	0.173	0.149	30.0

Figure F.15. Loaded heavy truck, V_o = 30 mph, tire code: HT1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.174E-01	0.160E-01	0.505E-01	0.156	0.698E-01	2.23
45.0	0.295E-01	0.254E-01	0.741E-01	0.253	0.116	3.56
60.0	0.451E-01	0.362E-01	0.970E-01	0.382	0.189	5.36
75.0	0.648E-01	0.465E-01	0.119	[illegible]	0.315	7.55
90.0	0.884E-01	0.656E-01	0.139	0.627	0.405	15.0
105.	0.116	0.990E-01	0.158	0.640	0.429	15.1

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.936E-01	10.2	0.130E-01	0.501E-02	50.0
60.0	0.177	8.42	0.276E-01	0.654E-02	50.0
90.0	0.253	8.63	0.450E-01	-0.140E-02	50.0
120.	0.325	5.88	0.671E-01	0.674E-03	50.0
150.	0.392	7.66	0.952E-01	0.344E-01	50.0

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.128	9.04	0.161E-01	0.939E-02	50.0
60.0	0.252	16.4	0.386E-01	0.108E-01	50.0
90.0	0.375	28.7	0.762E-01	-0.483E-02	50.0
120.	0.496	46.6	0.148	0.183	50.0
150.	0.595	67.3	0.263	0.733	50.0

Figure F.16. Loaded heavy truck, V_o = 50 mph, tire code: HT1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.108E-01	0.151E-01	0.258	0.204	0.149	0.649
120.	0.139E-01	0.173E-01	0.343	0.273	0.200	0.862
150.	0.167E-01	0.221E-01	0.428	[illegible]	0.250	1.07
180.	0.192E-01	0.260E-01	0.510	0.404	0.299	1.27
210.	0.212E-01	0.304E-01	0.590	0.465	0.347	1.46
240.	0.231E-01	0.342E-01	0.668	0.524	0.394	1.64
270.	0.246E-01	0.382E-01	0.743	0.575	0.437	1.79
300.	0.258E-01	0.420E-01	0.813	0.619	0.480	2.84
330.	0.268E-01	0.461E-01	0.875	0.654	0.521	4.72
360.	0.277E-01	0.500E-01	0.932	0.676	0.555	6.29

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.120	10.1	0.793E-02	0.186E-02	30.0
120.	0.235	8.21	0.153E-01	0.210E-02	30.0
180.	0.345	6.38	0.225E-01	0.250E-02	30.0
240.	0.442	4.68	0.295E-01	0.246E-02	30.0
300.	0.528	4.20	0.364E-01	0.229E-02	30.0

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
60.0	0.128	10.3	0.747E-02	0.277E-02	30.0
120.	0.251	5.76	0.142E-01	0.340E-02	30.0
180.	0.369	8.79	0.201E-01	0.463E-02	30.0
240.	0.471	12.5	0.256E-01	0.628E-02	30.0
300.	0.562	16.2	0.312E-01	0.938E-02	30.0

Figure F.17. Unloaded heavy truck, V_o = 30 mph, tire code: HT2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.646E-02	0.895E-02	0.587E-01	0.147	0.642E-01	0.457
45.0	0.106E-01	0.134E-01	0.882E-01	0.219	0.978E-01	0.694
60.0	0.157E-01	0.189E-01	0.117	0.296	0.132	0.938
75.0	0.213E-01	0.254E-01	0.146	0.369	0.166	1.17
90.0	0.276E-01	0.326E-01	0.173	0.436	0.198	1.37
105.	0.349E-01	0.397E-01	0.199	0.499	0.229	1.57
120.	0.427E-01	0.466E-01	0.223	0.558	0.259	1.75
135.	0.498E-01	0.545E-01	0.246	0.605	0.288	1.97

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.106	10.1	0.660E-02	0.757E-03	50.0
60.0	0.209	8.20	0.142E-01	0.118E-02	50.0
90.0	0.306	6.28	0.230E-01	0.156E-02	50.0
120.	0.395	4.53	0.331E-01	-0.346E-03	50.0
150.	0.473	5.22	0.443E-01	-0.304E-02	50.0

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)
30.0	0.125	10.2	0.658E-02	0.173E-02	50.0
60.0	0.246	6.55	0.149E-01	0.182E-02	50.0
90.0	0.363	10.0	0.253E-01	0.273E-02	50.0
120.	0.464	14.1	0.375E-01	0.205E-02	50.0
150.	0.551	18.2	0.519E-01	-0.715E-03	50.0

Figure F.18. Unloaded heavy truck, V_o = 50 mph, tire code: HT2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.105E-01	0.124E-01	0.234	0.215	0.158	3.10
120.	0.196E-01	0.200E-01	0.312	0.301	0.224	4.32
150.	0.341E-01	0.323E-01	0.387	0.398	0.303	5.67
180.	0.543E-01	0.479E-01	0.460	0.493	0.394	6.93
210.	0.805E-01	0.659E-01	0.528	0.570	0.466	7.80
240.	0.111	0.926E-01	0.590	0.601	0.537	15.1
270.	0.142	0.124	0.646	0.615	0.577	15.1
300.	0.174	0.156	0.694	0.624	0.612	15.1

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	[illegible]	[illegible]	[illegible]	0.642E-02	30.0	1.10
120.	0.230	8.39	0.165E-01	0.118E-02	30.0	2.51
180.	0.349	6.53	0.354E-01	-0.118E-01	30.0	4.95
240.	0.421	4.74	0.582E-01	-0.209E-01	30.0	6.89
300.	0.482	6.05	0.832E-01	-0.194E-01	30.0	8.04

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.131	8.22	0.653E-02	0.110E-01	30.0	1.60
120.	0.258	14.5	0.177E-01	0.113E-01	30.0	3.21
180.	0.384	24.5	0.436E-01	0.728E-02	30.0	5.10
240.	0.492	30.3	0.926E-01	0.373E-01	30.0	6.73
300.	0.578	46.9	0.158	0.144	30.0	8.33

Figure F.19. Loaded heavy truck, V_o = 30 mph, tire code: HT2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.122E-01	0.123E-01	0.536E-01	0.152	0.674E-01	2.17
45.0	0.214E-01	0.196E-01	0.799E-01	0.258	0.118	3.65
60.0	0.369E-01	0.281E-01	0.106	0.420	0.210	5.92
75.0	0.581E-01	0.418E-01	0.132	0.593	0.337	8.62
90.0	0.841E-01	0.705E-01	0.155	0.625	0.392	15.0
105.	0.115	0.112	0.177	0.631	0.415	15.1

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
30.0	0.103	10.1	0.112E-01	0.467E-02	50.0	1.06
60.0	0.201	8.35	0.239E-01	0.182E-02	50.0	2.11
90.0	0.302	6.28	0.404E-01	-0.117E-01	50.0	4.21
120.	0.377	6.21	0.654E-01	-0.561E-02	50.0	5.78
150.	0.448	9.03	0.985E-01	0.660E-01	50.0	5.99

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
30.0	0.133	8.73	0.120E-01	0.798E-02	50.0	1.64
60.0	0.268	16.6	0.307E-01	0.602E-02	50.0	3.40
90.0	0.425	32.0	0.754E-01	-0.319E-01	50.0	5.86
120.	0.554	56.3	0.157	0.271	50.0	7.40
150.	0.622	6.82	0.264	0.768	50.0	15.1

Figure F.20. Loaded heavy truck, V_o = 50 mph, tire code: HT2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.112E-01	0.129E-01	0.243	0.193	0.139	0.606
120.	0.145E-01	0.170E-01	0.324	0.255	0.186	0.809
150.	0.176E-01	0.213E-01	0.405	0.319	0.234	1.01
180.	0.203E-01	0.254E-01	0.483	0.380	0.279	1.19
210.	0.227E-01	0.311E-01	0.560	0.438	0.324	1.37
240.	0.247E-01	0.335E-01	0.634	0.494	0.368	1.54
270.	0.265E-01	0.374E-01	0.706	0.545	0.410	1.70
300.	0.280E-01	0.414E-01	0.774	0.591	0.446	1.84
330.	0.292E-01	0.454E-01	0.837	0.625	0.486	3.12
360.	0.302E-01	0.494E-01	0.894	0.653	0.517	4.58

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)
60.0	0.115	10.2	0.793E-02	0.180E-02
120.	0.226	8.45	0.154E-01	0.228E-02
180.	0.332	6.70	0.222E-01	0.289E-02
240	[illegible]	[illegible]	0.267E-01	0.311E-02
300.	0.511	3.94	0.350E-01	0.308E-02

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)
60.0	0.120	10.6	0.761E-02	0.278E-02
120.	0.238	5.76	0.146E-01	0.333E-02
180.	0.353	8.06	0.208E-01	0.419E-02
240.	0.454	11.5	0.262E-01	0.555E-02
300.	0.542	14.9	0.315E-01	0.793E-02

Figure F.21. Unloaded heavy truck, V_o = 30 mph, tire code: HT3.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.456E-02	0.823E-02	0.522E-01	0.131	0.555E-01	0.393
45.0	0.746E-02	0.108E-01	0.786E-01	0.189	0.846E-01	0.599
60.0	0.109E-01	0.148E-01	0.105	0.257	0.114	0.812
75.0	0.150E-01	0.200E-01	0.132	0.322	0.145	1.02
90.0	0.194E-01	0.257E-01	0.157	0.382	0.174	1.20
105.	0.242E-01	0.312E-01	0.181	0.440	0.202	1.38
120.	0.296E-01	0.369E-01	0.204	0.493	0.228	1.55
135.	0.354E-01	0.430E-01	0.226	0.543	0.254	1.70

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)
30.0	0.966E-01	10.4	0.522E-02	0.566E-03
60.0	0.192	8.67	0.113E-01	0.149E-02
90.0	0.285	6.96	0.185E-01	0.187E-02
120.	0.371	5.32	0.269E-01	0.131E-02
150.	0.447	4.51	0.359E-01	-0.392E-03

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)
30.0	0.109	10.9	0.488E-02	0.148E-02
60.0	0.220	6.26	0.111E-01	0.241E-02
90.0	0.331	8.40	0.191E-01	0.260E-02
120.	0.427	11.8	0.280E-01	0.232E-02
150.	0.512	15.3	0.384E-01	0.213E-02

Figure F.22. Unloaded heavy truck, V_O = 50 mph, tire code: HT3.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
90.0	0.897E-02	0.103E-01	0.211	0.188	0.138	2.70
120.	0.150E-01	0.154E-01	0.281	0.263	0.194	3.77
150.	0.264E-01	0.268E-01	0.353	0.347	0.271	4.98
180.	0.430E-01	0.400E-01	0.422	0.432	0.354	6.17
210.	0.638E-01	0.558E-01	0.487	0.509	0.411	7.13
240.	0.896E-01	0.746E-01	0.547	0.569	0.469	7.81
270.	0.118	0.994E-01	0.601	0.596	0.544	15.1
300.	0.147	0.128	0.649	0.609	0.582	15.0

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL....(1)	BETAMX(1)	[illegible] 1)	UIN...(1)	PHIMAX(1)
60.0	[illegible]	10.3	0.697E-02	0.822E-02	30.0	0.999
120.	0.204	6.73	0.160E-01	0.652E-02	30.0	2.04
180.	0.324	7.09	0.302E-01	-0.436E-02	30.0	4.38
240.	0.398	5.22	0.525E-01	-0.137E-01	30.0	6.46
300.	0.476	5.33	0.758E-01	-0.165E-01	30.0	7.75

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL....(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
60.0	0.117	9.15	0.576E-02	0.152E-01	30.0	1.43
120.	0.233	12.7	0.144E-01	0.182E-01	30.0	2.87
180.	0.350	21.0	0.348E-01	0.586E-02	30.0	4.56
240.	0.454	31.3	0.728E-01	0.144E-01	30.0	6.22
300.	0.534	41.4	0.150	0.690E-01	30.0	7.76

Figure F.23. Loaded heavy truck, V_o = 30 mph, tire code: HT3.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
30.0	0.974E-02	0.980E-02	0.450E-01	0.118	0.525E-01	1.70
45.0	0.155E-01	0.155E-01	0.670E-01	0.180	0.803E-01	2.59
[illegible]	0.248E-01	0.227E-01	0.898E-01	0.279	0.127	3.95
75.0	0.394E-01	0.298E-01	0.113	0.413	0.2[illegible]3	5.82
90.0	0.591E-01	0.426E-01	0.136	0.538	0.291	7.42
105.	0.820E-01	0.611E-01	0.156	0.602	0.372	11.8

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL....(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
30.0	0.859E-01	10.5	0.987E-02	0.445E-02	50.0	0.886
60.0	0.172	9.05	0.209E-01	0.429E-02	50.0	1.76
90.0	0.281	7.58	0.357E-01	-0.789E-02	50.0	3.63
120.	0.354	5.56	0.555E-01	-0.207E-01	50.0	5.55
150.	0.409	6.30	0.766E-01	-0.176E-01	50.0	6.81

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL....(1)	[illegible]	[illegible] 1)	UIN...(1)	PHIMAX(1)
30.0	0.107	10.2	0.967E-02	0.642E-02	50.0	1.31
60.0	0.217	12.1	0.220E-01	0.954E-02	50.0	2.70
90.0	0.357	21.5	0.509E-01	-0.165E-01	50.0	4.78
120.	0.463	36.5	0.106	-0.662E-01	50.0	6.71
150.	0.557	54.7	0.172	0.109	50.0	7.99

Figure F.24. Loaded heavy truck, $V_o \doteq 50$ mph, tire code: HT3.

LIGHT VAN SIMULATION RESULTS

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.909E-02	0.175E-01	0.181	0.177	0.130	1.62
88.9	0.143E-01	0.232E-01	0.266	0.254	0.188	2.43
111.	0.202E-01	0.281E-01	0.348	0.325	0.242	3.16
133.	0.277E-01	0.328E-01	0.428	0.396	0.298	3.85
156.	0.371E-01	0.393E-01	0.507	0.465	0.354	4.52
178.	0.484E-01	0.492E-01	0.583	0.534	0.412	5.17
200.	0.629E-01	0.619E-01	0.656	0.608	0.484	5.83
222.	0.822E-01	0.760E-01	0.727	0.700	0.618	6.58

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.646E-01	11.0	0.487E-02	0.732E-02	30.0	0.237
88.9	0.174	8.85	0.129E-01	0.265E-01	30.0	1.56
133.	0.282	6.85	0.225E-01	0.455E-01	30.0	3.01
178.	0.377	4.92	0.347E-01	0.497E-01	30.0	4.17
222.	0.460	5.23	0.499E-01	0.493E-01	30.0	5.12

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]E-02	30.0	0.319
88.9	0.211	7.16	0.140E-01	0.500E-01	30.0	1.76
133.	0.329	8.54	0.253E-01	0.562E-01	30.0	3.08
178.	0.428	12.6	0.407E-01	0.610E-01	30.0	4.17
222.	0.523	16.8	0.614E-01	0.690E-01	30.0	5.18

Figure F. 25. Unloaded light van, V_o = 30 mph, tire code: EO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.401E-02	0.769E-02	0.781E-02	0.442E-01	0.297E-01	0.341
33.3	0.153E-01	0.205E-01	0.371E-01	0.148	0.657E-01	1.23
44.4	0.268E-01	0.334E-01	0.669E-01	0.251	0.112	2.29
55.5	0.394E-01	0.454E-01	0.964E-01	0.341	0.153	3.25
66.7	0.531E-01	0.557E-01	0.124	0.435	0.197	4.19
77.8	0.686E-01	0.661E-01	0.151	0.542	0.251	5.16

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.365E-01	12.2	0.414E-02	-0.889E-02	50.0	0.108
44.4	0.121	10.1	0.178E-01	0.366E-01	50.0	0.785
66.7	0.221	8.00	0.321E-01	0.435E-01	50.0	2.27
88.9	0.316	5.80	0.491E-01	0.480E-01	50.0	3.33
111.	0.400	5.71	0.678E-01	0.512E-01	50.0	4.17

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.322E-01	15.8	0.437E-02	-0.112E-01	50.0	0.134
44.4	0.188	10.9	0.231E-01	0.153E-01	50.0	1.51
66.7	0.313	6.93	0.430E-01	0.210E-01	50.0	2.84
88.9	0.421	11.4	0.661E-01	0.199E-01	50.0	4.05
111.	0.510	17.0	0.927E-01	0.148E-01	50.0	5.18

Figure F.26. Unloaded light van, V_o = 50 mph, tire code: EO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.148E-01	0.272E-01	0.162	0.174	0.121	2.91
88.9	0.191E-01	0.341E-01	0.238	0.239	0.170	4.14
111.	0.245E-01	0.411E-01	0.312	0.306	0.221	5.24
133.	0.348E-01	0.470E-01	0.387	0.376	0.280	6.21
156.	0.503E-01	0.526E-01	0.462	0.458	0.349	7.23
178.	0.728E-01	0.727E-01	0.536	0.589	0.503	8.89
200.	0.103	0.948E-01	0.608	0.725	1.91	10.6
222.	0.143	0.146	0.675	0.728	1.96	10.6

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.658E-01	11.1	0.939E-02	0.516E-02	30.0	0.546
88.9	0.200	9.02	0.223E-01	0.246E-01	30.0	3.97
133.	0.314	7.18	0.315E-01	0.379E-01	30.0	6.20
178.	0.401	5.30	0.454E-01	0.362E-01	30.0	7.66
222.	0.462	5.56	0.709E-01	0.426E-01	30.0	8.83

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.909E-01	13.2	0.976E-02	0.125E-02	30.0	1.10
88.9	0.215	7.82	0.200E-01	0.175E-01	30.0	3.88
133.	0.322	8.04	0.323E-01	0.392E-01	30.0	5.87
178.	0.425	12.0	0.542E-01	0.432E-01	30.0	7.59
222.	0.536	17.4	0.883E-01	0.623E-01	30.0	9.42

Figure F.27. Loaded light van, V_o = 30 mph, tire code: E0.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.707E-02	0.112E-01	0.304E-02	0.599E-01	0.421E-01	0.661
33.3	0.183E-01	0.302E-01	0.317E-01	0.149	0.683E-01	2.33
44.4	0.263E-01	0.451E-01	0.591E-01	0.221	0.104	3.80
55.5	0.350E-01	0.563E-01	0.854E-01	0.295	0.135	5.06
66.7	0.485E-01	0.663E-01	0.110	0.384	0.173	6.33
77.8	0.687E-01	0.745E-01	0.135	0.721	0.796	10.2
88.9	0.965E-01	0.820E-01	0.160	0.735	1.79	10.7
100.	0.132	0.139	0.184	0.731	1.79	10.7

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.546E-01	12.3	0.707E-02	-0.692E-02	50.0	0.301
44.4	0.152	10.2	0.250E-01	0.249E-01	50.0	2.96
66.7	0.279	[illegible]	[illegible]	0.292E-01	50.0	5.68
88.9	0.364	6.44	0.535E-01	0.371E-01	50.0	7.19
111.	0.416	5.72	0.727E-01	0.469E-01	50.0	8.06

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.646E-01	16.3	0.938E-02	-0.163E-01	50.0	0.409
44.4	0.214	11.4	0.252E-01	-0.697E-02	50.0	3.93
66.7	0.312	6.33	0.408E-01	0.357E-02	50.0	5.91
88.9	0.464	10.0	0.776E-01	-0.955E-02	50.0	7.74
111.	0.591	17.1	0.131	-0.127	50.0	10.2

Figure F.28. Loaded light van, V_o = 50 mph, tire code: EO

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.514E-02	0.143E-01	0.188	0.176	0.129	1.64
88.9	0.861E-02	0.170E-01	0.277	0.255	0.188	2.48
111.	0.131E-01	0.204E-01	0.364	0.330	0.245	3.24
133.	0.190E-01	0.249E-01	0.450	0.405	0.303	3.95
156.	0.272E-01	0.306E-01	0.534	0.479	0.364	4.65
178.	0.387E-01	0.427E-01	0.616	0.558	0.432	5.39
200.	0.560E-01	0.574E-01	0.696	0.666	0.567	6.29
222.	0.814E-01	0.762E-01	0.771	0.755	1.36	7.19

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.715E-01	11.1	0.367E-02	0.115E-02	30.0	0.240
88.9	0.193	8.80	0.925E-02	0.192E-01	30.0	1.88
133.	0.309	6.69	0.169E-01	0.384E-01	30.0	3.51
178.	0.410	4.70	0.275E-01	0.373E-01	30.0	4.80
222.	0.500	5.36	0.432E-01	0.454E-01	30.0	5.86

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.833E-01	13.1	0.365E-02	0.161E-02	30.0	0.333
88.9	0.222	7.10	0.939E-02	0.199E-01	30.0	1.88
133.	0.348	8.61	0.184E-01	0.417E-01	30.0	3.31
178.	0.455	12.9	0.322E-01	0.485E-01	30.0	4.48
222.	0.554	17.9	0.541E-01	0.694E-01	30.0	5.67

Figure F.29. Unloaded light van, V_o = 30 mph, tire code: E1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.339E-02	0.783E-02	0.748E-02	0.447E-01	0.258E-01	0.341
33.3	0.127E-01	0.193E-01	0.396E-01	0.149	0.658E-01	1.26
44.4	0.224E-01	0.309E-01	0.718E-01	0.252	0.112	2.34
55.5	0.337E-01	0.406E-01	0.104	0.353	0.157	3.38
66.7	0.468E-01	0.500E-01	0.135	0.460	0.208	4.43
77.8	0.625E-01	0.593E-01	0.164	0.616	0.310	5.78
88.9	0.823E-01	0.689E-01	0.192	0.761	0.975	7.15
100.	0.108	0.944E-01	0.218	0.761	1.18	7.25

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.373E-01	12.3	0.328E-02	-0.896E-02	50.0	0.117
44.4	0.148	10.2	0.163E-01	0.174E-01	50.0	1.21
66.7	0.259	7.92	0.295E-01	0.264E-01	50.0	2.81
88.9	0.352	5.55	0.451E-01	0.348E-01	50.0	4.03
111.	0.444	5.73	0.644E-01	0.403E-01	50.0	5.00

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.306E-01	16.0	0.333E-02	-0.109E-01	50.0	0.133
44.4	0.193	10.7	0.188E-01	0.108E-02	50.0	1.53
66.7	0.334	7.01	0.372E-01	0.911E-02	50.0	3.02
88.9	0.453	12.2	0.598E-01	0.143E-01	50.0	4.42
111.	0.555	19.1	0.911E-01	0.731E-02	50.0	5.84

Figure F.30. Unloaded light van, V_o = 50 mph, tire code: E1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.106E-01	0.199E-01	0.175	0.173	0.119	2.86
88.9	0.142E-01	0.254E-01	0.256	0.243	0.172	4.19
111.	0.194E-01	0.310E-01	0.337	0.315	0.232	5.41
133.	0.327E-01	0.352E-01	0.421	0.411	0.309	6.62
156.	0.533E-01	0.562E-01	0.506	0.538	0.434	8.27
178.	0.839E-01	0.810E-01	0.586	0.678	1.77	10.2
200.	0.127	0.147	0.658	0.680	1.81	10.2

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.733E-01	[illegible]	[illegible]E-02	0.449E-02	30.0	0.778
88.9	0.219	9.01	0.192E-01	0.140E-01	30.0	4.47
133.	0.348	7.09	0.288E-01	0.212E-01	30.0	6.78
178.	0.437	4.86	0.431E-01	0.297E-01	30.0	8.41
222.	0.489	6.14	0.734E-01	0.546E-01	30.0	9.58

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
44.4	0.926E-01	13.2	0.711E-02	-0.324E-02	30.0	1.14
88.9	0.222	7.76	0.151E-01	0.360E-02	30.0	3.98
133.	0.338	8.23	0.280E-01	0.275E-01	30.0	6.16
178.	0.461	13.2	0.530E-01	0.395E-01	30.0	8.21
222.	0.571	20.4	0.103	0.111	30.0	10.4

Figure F.31. Loaded light van, V_o = 30 mph, tire code: E1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.493E-02	0.936E-02	0.765E-02	0.492E-01	0.307E-01	0.557
33.3	0.140E-01	0.249E-01	0.384E-01	0.143	0.642E-01	2.19
44.4	0.209E-01	0.371E-01	0.674E-01	0.219	0.983E-01	3.75
55.5	0.302E-01	0.468E-01	0.965E-01	0.309	0.136	5.33
66.7	0.501E-01	0.546E-01	0.126	0.673	0.719	9.88
77.8	0.787E-01	0.718E-01	0.155	0.685	1.67	10.2

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.410E-01	12.2	0.485E-02	-0.131E-01	50.0	0.217
44.4	0.183	10.3	0.226E-01	-0.118E-02	50.0	3.72
66.7	0.325	8.46	0.366E-01	0.485E-02	50.0	6.44
88.9	0.416	6.03	0.537E-01	0.188E-01	50.0	8.08
111.	0.463	6.22	0.787E-01	0.336E-01	50.0	9.22

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
22.2	0.377E-01	15.7	0.563E-02	-0.137E-01	50.0	0.269
44.4	0.203	11.0	0.199E-01	-0.120E-01	50.0	3.75
66.7	0.338	6.21	0.371E-01	-0.140E-01	50.0	6.30
88.9	0.531	11.9	0.921E-01	-0.620E-01	50.0	9.10
111.	0.577	30.7	0.155	0.289	50.0	10.4

Figure F.32. Loaded light van, V_o = 50 mph, tire code: E1.

Trapeozidal Steer - 30 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.551E-02	0.149E-01	0.194	0.178	0.117	2.91
88.9	0.708E-02	0.161E-01	0.278	0.249	0.171	4.28
111.	0.867E-02	0.203E-01	0.364	0.319	0.231	5.52
133.	0.156E-01	0.229E-01	0.459	0.414	0.305	6.61
156.	0.347E-01	0.421E-01	0.556	0.556	0.433	8.59

Trapezoidal Steer - 50 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.249E-02	0.797E-02	0.178E-01	0.481E-01	0.202E-01	0.628
33.3	0.938E-02	0.227E-01	0.492E-01	0.145	0.632E-01	2.16
44.4	0.144E-01	0.306E-01	0.783E-01	0.229	0.957E-01	4.02
55.5	0.185E-01	0.339E-01	0.111	0.315	0.134	5.39
66.7	0.377E-01	0.360E-01	0.147	0.693	1.14	9.97
77.8	0.732E-01	0.883E-01	0.183	0.691	1.67	10.2

Figure F.33. Loaded light van, tire code: E2.

Trapezoidal Steer - 30 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.129E-01	0.242E-01	0.181	0.186	0.129	2.95
88.9	0.169E-01	0.290E-01	0.264	0.258	0.186	4.29
111.	0.250E-01	0.342E-01	0.344	0.339	0.247	5.67
133.	0.399E-01	0.407E-01	0.429	0.428	0.321	6.78
156.	0.583E-01	0.627E-01	0.515	0.530	0.416	8.10
178.	0.856E-01	0.835E-01	0.596	0.703	0.742	9.98

Trapezoidal Steer - 50 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.653E-02	0.125E-01	0.958E-02	0.667E-01	0.321E-01	0.595
33.3	0.174E-01	0.298E-01	0.425E-01	0.166	0.726E-01	2.63
44.4	0.261E-01	0.370E-01	0.710E-01	0.254	0.110	4.12
55.5	0.399E-01	0.516E-01	0.102	0.401	0.182	6.25
66.7	0.611E-01	0.616E-01	0.133	0.786	1.25	11.9

Figure F.34. Loaded light van, tire code: E3.

Trapezoidal Steer - 30 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
66.7	0.184E-01	0.296E-01	0.193	0.212	0.154	3.43
88.9	0.297E-01	0.392E-01	0.283	0.310	0.228	5.11
111.	0.503E-01	0.461E-01	0.373	0.460	0.367	7.02
133.	0.809E-01	0.737E-01	0.464	0.711	2.48	10.2

Trapezoidal Steer - 50 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
22.2	0.862E-02	0.145E-01	0.932E-02	0.984E-01	0.478E-01	1.05
33.3	0.259E-01	0.332E-01	0.452E-01	0.244	0.111	3.81
44.4	0.460E-01	0.542E-01	0.804E-01	0.718	1.43	10.2

Figure F.35. Loaded light van, tire code: E4.

PICKUP TRUCK SIMULATION RESULTS

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)	UIN...(1)
60.0	0.275E-02	0.907E-02	0.275	0.230	0.169	1.73	30.0
80.0	0.437E-02	0.124E-01	0.362	0.304	0.225	2.41	30.0
100.	0.821E-02	0.174E-01	0.448	0.377	0.282	3.01	30.0
120.	0.138E-01	0.279E-01	0.533	0.453	0.339	3.59	30.0
140.	0.215E-01	0.382E-01	0.615	0.523	0.399	4.16	30.0
160.	0.318E-01	0.469E-01	0.693	0.591	0.460	4.69	30.0

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.124	9.94	0.572E-02	-0.418E-03	30.0	0.483
80.0	0.244	7.94	0.106E-01	0.177E-02	30.0	2.09
120.	0.352	5.99	0.170E-01	0.226E-02	30.0	3.19
160.	0.443	4.27	0.266E-01	0.149E-02	30.0	4.03
200.	0.517	5.11	0.397E-01	0.107E-02	30.0	4.71

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.143	9.80	0.405E-02	0.107E-04	30.0	0.679
80.0	0.270	6.47	0.824E-02	0.283E-02	30.0	1.99
120.	0.383	10.2	0.157E-01	0.515E-02	30.0	3.10
160.	0.489	14.5	0.287E-01	0.112E-01	30.0	3.92
200.	0.574	18.9	0.484E-01	0.257E-01	30.0	4.74

Figure F.36. Unloaded pickup truck, V_o = 30 mph, tire code: FO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)	UIN...(1)
20.0	0.146E-01	0.160E-01	0.692E-01	0.192	0.844E-01	1.31	50.0
30.0	0.231E-01	0.239E-01	0.101	0.286	0.126	2.17	50.0
40.0	0.335E-01	0.302E-01	0.133	0.381	0.170	3.02	50.0
50.0	0.460E-01	0.388E-01	0.163	0.486	0.220	3.83	50.0
60.0	0.610E-01	0.497E-01	0.191	0.606	0.286	4.74	50.0
70.0	0.791E-01	0.648E-01	0.218	0.775	0.543	6.08	50.0

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.125	9.69	0.116E-01	-0.201E-02	50.0	0.405
40.0	0.239	7.36	0.235E-01	0.224E-02	50.0	1.87
60.0	0.340	5.08	0.375E-01	0.176E-02	50.0	2.90
80.0	0.423	5.86	0.545E-01	0.243E-02	50.0	3.62
100.	0.492	7.64	0.744E-01	0.768E-02	50.0	4.24

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.157	8.98	0.131E-01	-0.179E-03	50.0	0.844
40.0	0.289	8.45	0.275E-01	0.186E-02	50.0	2.17
60.0	0.414	13.6	0.468E-01	0.352E-02	50.0	3.24
80.0	0.524	20.0	0.729E-01	0.114E-01	50.0	4.23
100.	0.613	27.7	0.109	0.550E-01	50.0	4.87

Figure F.37. Unloaded pickup truck, V_o = 50 mph, tire code: FO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.234E-01	0.250E-01	0.286	0.280	0.208	2.75
80.0	0.354E-01	0.349E-01	0.377	0.376	0.283	3.74
100.	0.518E-01	0.486E-01	0.465	0.482	0.373	4.83
120.	0.731E-01	0.626E-01	0.549	0.605	0.504	6.03
140.	0.995E-01	0.795E-01	0.627	0.719	0.838	7.31
160.	0.131	0.114	0.699	0.747	1.40	7.71

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.123	9.71	0.111E-01	-0.812E-03	30.0	0.887
80.0	0.239	7.39	0.257E-01	-0.202E-02	30.0	2.38
120.	0.336	5.12	0.435E-01	0.177E-04	30.0	3.57
160.	0.417	5.69	0.661E-01	0.730E-02	30.0	4.58
200.	0.494	7.25	0.938E-01	0.250E-01	30.0	5.44

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.148	9.04	0.123E-01	-0.634E-03	30.0	1.16
80.0	0.285	8.33	0.295E-01	0.922E-03	30.0	2.81
120.	0.409	13.4	0.541E-01	0.125E-01	30.0	4.11
160.	0.516	19.5	0.912E-01	0.561E-01	30.0	5.18
200.	0.603	26.3	0.145	0.183	30.0	6.04

Figure F.38. Loaded pickup truck, V_o = 30 mph, tire code: F0.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.335E-01	0.276E-01	0.772E-01	0.341	0.159	3.27
30.0	0.557E-01	0.430E-01	0.114	0.678	0.418	6.71
40.0	0.830E-01	0.669E-01	0.147	0.749	0.961	7.68
50.0	0.116	0.112	0.178	0.753	1.18	7.81

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.136	8.91	0.188E-01	0.712E-02	50.0	0.986
40.0	0.258	6.10	0.418E-01	0.245E-01	50.0	2.58
60.0	0.367	7.80	0.687E-01	0.692E-01	50.0	3.74
80.0	0.464	11.2	0.103	0.178	50.0	4.72
100.	0.541	15.5	0.145	0.365	50.0	5.56

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.181	7.94	0.248E-01	0.100E-01	50.0	1.60
40.0	0.358	15.2	0.586E-01	0.508E-01	50.0	3.46
60.0	0.510	27.5	0.112	0.262	50.0	5.02
80.0	0.748	42.3	0.897	1.97	50.0	7.78
100.	0.750	26.2	496.	2.51	50.0	7.78

Figure F.39. Loaded pickup truck, V_o = 50 mph, tire code: FO.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.354E-02	0.100E-01	0.284	0.230	0.169	1.77
80.0	0.428E-02	0.139E-01	0.375	0.305	0.225	2.46
100.	0.514E-02	0.260E-01	0.464	0.380	0.280	3.05
120.	0.581E-02	0.201E-01	0.552	0.447	0.335	3.59
140.	0.643E-02	0.255E-01	0.639	0.518	0.390	4.12
160.	0.112E-01	0.313E-01	0.723	0.586	0.448	4.65
180.	0.221E-01	0.399E-01	0.805	0.662	0.521	5.24

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.130	9.90	0.485E-02	0.347E-03	30.0	0.614
80.0	0.263	7.85	0.719E-02	0.269E-02	30.0	2.30
120.	0.378	5.86	0.108E-01	0.297E-02	30.0	3.48
160.	0.480	4.15	0.174E-01	0.351E-02	30.0	4.40
200.	0.562	5.05	0.264E-01	0.443E-02	30.0	5.18

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.148	9.73	0.365E-02	0.702E-03	30.0	0.730
80.0	0.281	6.39	0.602E-02	0.312E-02	30.0	2.11
120.	0.399	10.1	0.872E-02	0.505E-02	30.0	3.28
160.	0.512	14.4	0.152E-01	0.103E-01	30.0	4.19
200.	0.608	18.9	0.286E-01	0.233E-01	30.0	4.95

Figure F. 40. Unloaded pickup truck, V_o = 30 mph, tire code: F1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.115E-01	0.133E-01	0.728E-01	0.190	0.838E-01	1.32
30.0	0.184E-01	0.199E-01	0.108	0.286	0.126	2.19
40.0	0.265E-01	0.247E-01	0.142	0.378	0.168	3.03
50.0	0.352E-01	0.322E-01	0.174	0.466	0.208	3.74
60.0	0.460E-01	0.404E-01	0.204	0.560	0.254	4.47
70.0	0.604E-01	0.527E-01	0.233	0.726	0.373	5.73

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.134	9.63	0.999E-02	-0.609E-03	50.0	0.617
40.0	0.258	7.25	0.200E-01	0.227E-02	50.0	2.21
60.0	0.374	4.91	0.319E-01	0.207E-02	50.0	3.32
80.0	0.466	5.66	0.460E-01	0.523E-03	50.0	4.20
100.	0.541	7.38	0.631E-01	0.109E-02	50.0	4.92

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.165	8.84	0.106E-01	0.820E-03	50.0	0.930
40.0	0.307	8.39	0.227E-01	0.232E-02	50.0	2.35
60.0	0.437	13.4	0.374E-01	0.319E-02	50.0	3.45
80.0	0.555	19.4	0.573E-01	0.661E-02	50.0	4.49
100.	0.651	27.2	0.905E-01	0.351E-01	50.0	5.40

Figure F.41. Unloaded pickup truck, V_o = 50 mph, tire code: F1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.177E-01	0.204E-01	0.298	0.276	0.205	2.73
80.0	0.273E-01	0.290E-01	0.394	0.372	0.278	3.73
100.	0.412E-01	0.409E-01	0.488	0.477	0.364	4.79
120.	0.608E-01	0.550E-01	0.580	0.603	0.486	6.05
140.	0.868E-01	0.705E-01	0.667	0.752	0.977	7.68
160.	0.120	0.111	0.748	0.778	1.56	8.04

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.130	9.70	0.917E-02	-0.182E-02	30.0	1.06
80.0	0.256	7.30	0.215E-01	-0.222E-02	30.0	2.67
120.	0.361	4.96	0.372E-01	0.576E-04	30.0	3.90
160.	0.448	5.67	0.585E-01	0.798E-02	30.0	5.01
200.	0.534	7.48	0.865E-01	0.290E-01	30.0	5.96

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.153	8.99	0.964E-02	-0.121E-02	30.0	1.24
80.0	0.298	8.20	0.236E-01	0.607E-03	30.0	2.96
120.	0.432	13.4	0.451E-01	0.110E-01	30.0	4.37
160.	0.548	19.9	0.804E-01	0.531E-01	30.0	5.55
200.	0.645	27.8	0.138	0.203	30.0	6.52

Figure F.42. Loaded pickup truck, V_o = 30 mph, tire code: F1.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.297E-01	0.253E-01	0.832E-01	0.333	0.151	3.16
30.0	0.502E-01	0.392E-01	0.123	0.705	0.431	7.02
40.0	0.777E-01	0.644E-01	0.161	0.783	1.14	8.05
50.0	0.113	0.118	0.195	0.782	1.40	8.11
60.0	0.156	0.193	0.225	0.784	1.40	8.14
70.0	0.204	0.277	0.249	0.782	1.40	8.10

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.147	8.82	0.173E-01	0.444E-02	50.0	1.17
40.0	0.282	5.89	0.389E-01	0.164E-01	50.0	2.87
60.0	0.403	7.93	0.655E-01	0.588E-01	50.0	4.15
80.0	0.511	12.0	0.101	0.182	50.0	5.27
100.	0.596	17.8	0.152	0.446	50.0	6.18

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.194	7.73	0.223E-01	0.655E-02	50.0	1.72
40.0	0.382	15.3	0.533E-01	0.374E-01	50.0	3.73
60.0	0.553	29.6	0.108	0.266	50.0	5.47
80.0	0.781	36.4	0.965E 04	2.67	50.0	8.11
100.	0.780	18.8	358.	2.42	50.0	8.13

Figure F.43. Loaded pickup truck, V_o = 50 mph, tire code: F1

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.378E-02	0.110E-01	0.293	0.238	0.175	1.84
80.0	0.476E-02	0.142E-01	0.387	0.316	0.233	2.54
100.	0.566E-02	0.182E-01	0.480	0.390	0.290	3.14
120.	0.644E-02	0.210E-01	0.570	0.462	0.345	3.68
140.	0.712E-02	0.261E-01	0.658	0.530	0.401	4.21
160.	0.100E-01	0.310E-01	0.743	0.598	0.457	4.73
180.	0.199E-01	0.384E-01	0.826	0.670	0.526	5.29

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.135	9.82	0.483E-02	0.116E-02	30.0	0.684
80.0	0.272	7.70	0.744E-02	0.300E-02	30.0	2.40
120.	0.391	5.65	0.109E-01	0.299E-02	30.0	3.59
160.	0.494	4.22	0.179E-01	0.331E-02	30.0	4.52
200.	0.579	5.22	0.271E-01	0.425E-02	30.0	5.31

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.153	9.53	0.383E-02	0.104E-02	30.0	0.783
80.0	0.289	6.59	0.624E-02	0.348E-02	30.0	2.20
120.	0.410	10.6	0.938E-02	0.564E-02	30.0	3.37
160.	0.526	15.0	0.155E-01	0.110E-01	30.0	4.28
200.	0.620	19.5	0.283E-01	0.237E-01	30.0	5.05

Figure F.44. Unloaded pickup truck, V_o = 30 mph, tire code: F2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.120E-01	0.142E-01	0.776E-01	0.207	0.904E-01	1.45
30.0	0.198E-01	0.199E-01	0.115	0.312	0.138	2.42
40.0	0.284E-01	0.256E-01	0.150	0.406	0.181	3.25
50.0	0.375E-01	0.344E-01	0.184	0.498	0.223	3.98
60.0	0.488E-01	0.446E-01	0.215	0.596	0.271	4.73
70.0	0.637E-01	0.567E-01	0.245	0.797	0.462	6.26

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.142	9.45	0.101E-01	0.137E-03	50.0	0.728
40.0	0.274	6.88	0.209E-01	0.284E-02	50.0	2.35
60.0	0.393	4.85	0.336E-01	0.233E-02	50.0	3.47
80.0	0.486	6.16	0.483E-01	0.852E-03	50.0	4.34
100.	0.561	8.06	0.660E-01	0.235E-02	50.0	5.04

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.174	8.37	0.110E-01	0.117E-02	50.0	1.02
40.0	0.324	9.20	0.241E-01	0.313E-02	50.0	2.52
60.0	0.462	14.7	0.394E-01	0.399E-02	50.0	3.63
80.0	0.580	21.0	0.601E-01	0.850E-02	50.0	4.70
100.	0.673	29.4	0.947E-01	0.464E-01	50.0	5.60

Figure F.45. Unloaded pickup truck, V_o = 50 mph, tire code: F2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.137E-01	0.169E-01	0.300	0.270	0.199	2.67
80.0	0.215E-01	0.250E-01	0.396	0.360	0.269	3.62
100.	0.331E-01	0.356E-01	0.492	0.458	0.347	4.61
120.	0.499E-01	0.484E-01	0.584	0.569	0.444	5.70
140.	0.725E-01	0.623E-01	0.674	0.718	0.645	7.15
160.	0.102	0.866E-01	0.758	0.794	1.52	8.16

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.134	9.68	0.754E-02	-0.191E-02	30.0	1.16
80.0	0.264	7.34	0.182E-01	-0.259E-02	30.0	2.84
120.	0.370	5.03	0.322E-01	-0.112E-02	30.0	4.15
160.	0.460	5.45	0.517E-01	0.371E-02	30.0	5.25
200.	0.544	7.19	0.778E-01	0.181E-01	30.0	6.11

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
40.0	0.155	9.06	0.761E-02	-0.173E-02	30.0	1.27
80.0	0.301	7.95	0.193E-01	0.120E-03	30.0	2.99
120.	0.436	13.0	0.381E-01	0.809E-02	30.0	4.40
160.	0.553	19.2	0.692E-01	0.390E-01	30.0	5.60
200.	0.655	26.6	0.120	0.146	30.0	6.60

Figure F.46. Loaded pickup truck, V_o = 30 mph, tire code: F2.

Trapezoidal Steer

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.254E-01	0.227E-01	0.841E-01	0.302	0.136	2.87
30.0	0.435E-01	0.352E-01	0.125	0.531	0.258	5.26
40.0	0.679E-01	0.523E-01	0.163	0.799	1.02	8.15
50.0	0.100	0.966E-01	0.198	0.799	1.35	8.27

Sinusoidal Steer 1

STR5..(1)	AYMAX.(1)	DE[illegible] 1)	[illegible] 1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.151	8.87	0.156E-01	0.205E-02	50.0	1.24
40.0	0.290	5.70	0.356E-01	0.834E-02	50.0	2.95
60.0	0.412	7.51	0.603E-01	0.400E-01	50.0	4.25
80.0	0.524	11.4	0.937E-01	0.138	50.0	5.38
100.	0.607	17.1	0.141	0.367	50.0	6.30

Sinusoidal Steer 2

STR5..(1)	AYMAX.(1)	DEL...(1)	BETAMX(1)	DELPSI(1)	UIN...(1)	PHIMAX(1)
20.0	0.192	7.40	0.196E-01	0.297E-02	50.0	1.73
40.0	0.381	14.3	0.47[illegible]	0.204E-01	50.0	3.73
60.0	0.550	27.1	0.945E-01	0.167	50.0	5.40
80.0	0.797	46.0	6.32	2.68	50.0	8.27
100.	0.795	20.4	365.	2.46	50.0	8.23

Figure F.47. Loaded pickup truck, V_o = 50 mph, tire code: F2.

Trapezoidal Steer - 30 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
60.0	0.253E-01	0.280E-01	0.302	0.302	0.223	2.81
80.0	0.388E-01	0.385E-01	0.397	0.407	0.306	3.95
100.	0.577E-01	0.529E-01	0.489	0.531	0.419	5.20
120.	0.826E-01	0.669E-01	0.577	0.683	0.653	6.88
140.	0.114	0.955E-01	0.658	0.762	1.38	7.75
160.	0.151	0.152	0.732	0.756	1.49	7.72

Trapezoidal Steer - 50 mph

STR4..(1)	BETAMX(1)	BETDMX(1)	CUVRAT(1)	AYMAX.(1)	RMAX..(1)	PHIMAX(1)
20.0	0.388E-01	0.316E-01	0.851E-01	0.452	0.217	4.37
30.0	0.652E-01	0.492E-01	0.125	0.752	0.870	7.60
40.0	0.987E-01	0.948E-01	0.161	0.762	1.18	7.83
50.0	0.0	0.0	0.0	0.529E-02	0.426E-03	0.202E-01
60.0	0.0	0.0	0.0	0.563E-02	0.891E-03	0.345E-01
70.0	0.255E-03	0.202E-02	0.419E-04	0.903E-02	0.192E-02	0.435E-01

Figure F.48. Loaded pickup truck, tire code: F3.

APPENDIX G

A ROLLOVER INCIDENT WHICH OCCURRED DURING TESTING OF A HEAVY TRUCK

On May 30, 1975, a heavily loaded straight truck rolled over during the conduct of vehicle dynamics experiments at the facilities of the Texas Transportation Institute (TTI). The incident was unexpected, unplanned for, and involved the injury of a test driver. This document is intended to provide answers to a series of questions regarding the event itself, as well as regarding the significance of this experience to NHTSA-sponsored research.

The questions to be addressed are as follows:

1) What was the nature of the experiment which was being attempted?

2) What actually occurred in the course of that experiment?

3) From a mechanistic point of view, why did the rollover anomaly occur?

4) What lessons are to be learned from this experience?

In responding to these questions, the writer wishes to be as informative as our current state of knowledge on the matter permits, and to establish an understanding of the overall event which will promote practices that prevent recurrence of any similar situation in the future.

1) <u>What was the nature of the experiment which was being attempted?</u>

The test vehicle, shown in Figure G-1, was a White Road Boss, two-axle truck, outfitted with a hybrid driver/automatic control system. The vehicle was being employed in a series of

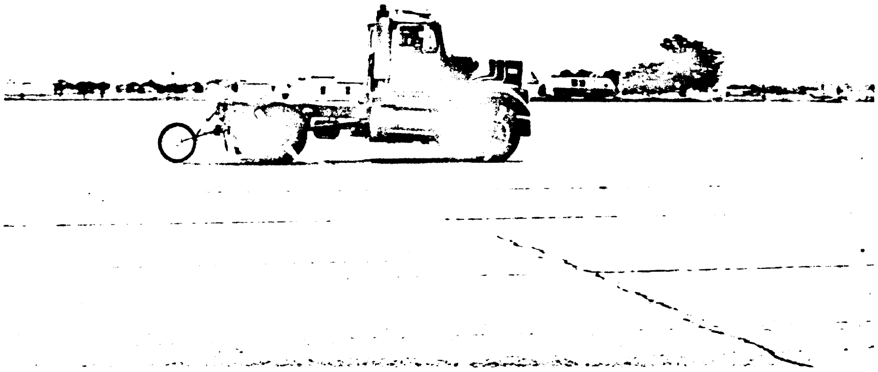


Figure G.1. White Road Boss test vehicle (unladen).

experiments, designed to be sublimit in nature, which were primarily intended as a means to validate a computerized simulation.

The test procedure was based upon the methods employed in a previous NHTSA-sponsored study entitled "Analysis of Truck and Bus Handling" [1]. These procedures applied automatically-controlled test techniques to commercial vehicles by way of a hybrid scheme of driver control and pre-programmed servo control. The severity of turning maneuvers was constrained, in concern for heavy vehicle rollover, but no steps were taken to assure the prevention of a rollover should a constrained level experiment become inadvertently unconstrained.

These procedures and test practices were applied, without significant modification, in the current study. Calculations were made to predict the limits of lateral acceleration beyond which rollover would occur and vehicle test levels were prescribed with an accordingly large margin of safety.

The particular experiment being conducted at the time of the subject incident involved a set of steering-only maneuvers as a preliminary to combined steering/braking tests. The purpose of the preliminary test was to determine that steer angle value at which a steady turn of .35 g lateral acceleration (A_y) level would be attained, at a test speed of 50 mph. The test is conducted by first establishing a straight-line path at a speed slightly above 50 mph, whereupon the driver shifts the transmission into neutral and presses a button initiating automatic control. When the truck has slowed to exactly 50 mph, the steering servo motor becomes clutched through a drive pulley to the steering shaft and the stored steering function begins. The steering waveshape is a trapezoidal time history with an initial ramp function followed by a sustained steering level. The steady steering level is incremented in successive test runs in search of the value needed to attain the .35 g condition.

In the tests being conducted here, the test vehicle was fully loaded to approximately its gross vehicle weight rating of 30,000 lbs. As shown in Figure G.2, the weights consisted of three cast concrete sections which were mounted directly to the vehicle's frame rails, giving a composite c.g. height in the vicinity of 48 inches.

2) <u>What actually occurred in the course of the previously defined experiments?</u>

A sequence of left-hand-turning runs was conducted in which the steering wheel displacement was incremented from 100° amplitude to 120° and, finally, to 140°. At the 100° level, a 0.3 g A_y level was obtained. In two following runs with 120° applied, a 0.3 g level was again obtained, but, due to the noisy character of the signal output from the truck-mounted accelerometer, the lack of an acceleration response commensurate with the 20° steering increment was merely considered a resolution problem. In the following run, with 140° now programmed as the steering level, the vehicle elicited a diverging yaw response which concluded with the rollover of the vehicle. In the course of the roll transient, the first ground contact of the truck body was at the right roof edge and exhaust stack position followed by a thorough crushing of the roof structure and then another apparently airborne roll motion. Next, the left side wheels and driver's-side sheet metal hit the pavement, failing all frame cross-members and three out of four rear suspension spring attachments. The vehicle then slid along the pavement, remaining overturned onto the left side of the cab, as shown in Figure G.3.

Although one fuel tank parted from the vehicle and both tanks ruptured completely, no fire ensued.

The driver was extracted very quickly from the vehicle through the backlight, in fear of the prevailing fire hazard.

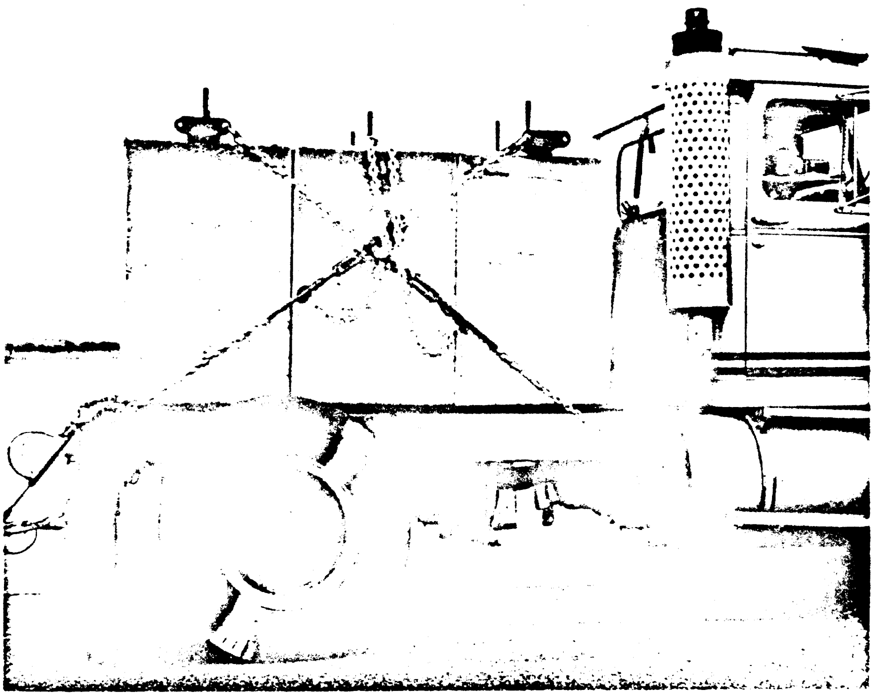


Figure G.2. Concrete loading weights.

Figure G.3. Final position of overturned test vehicle.

The minimization of the driver's injuries to include only a broken shoulder blade and minor lacerations is attributed in large measure to his having pulled himself down toward the floor, upon first realizing that rollover was imminent. The driver was restrained by a competition-type shoulder and lap harness and he wore a helmet which remained lodged in the deformed roof structure upon his removal.

3) From a mechanistic point of view, why did the rollover anomaly occur?

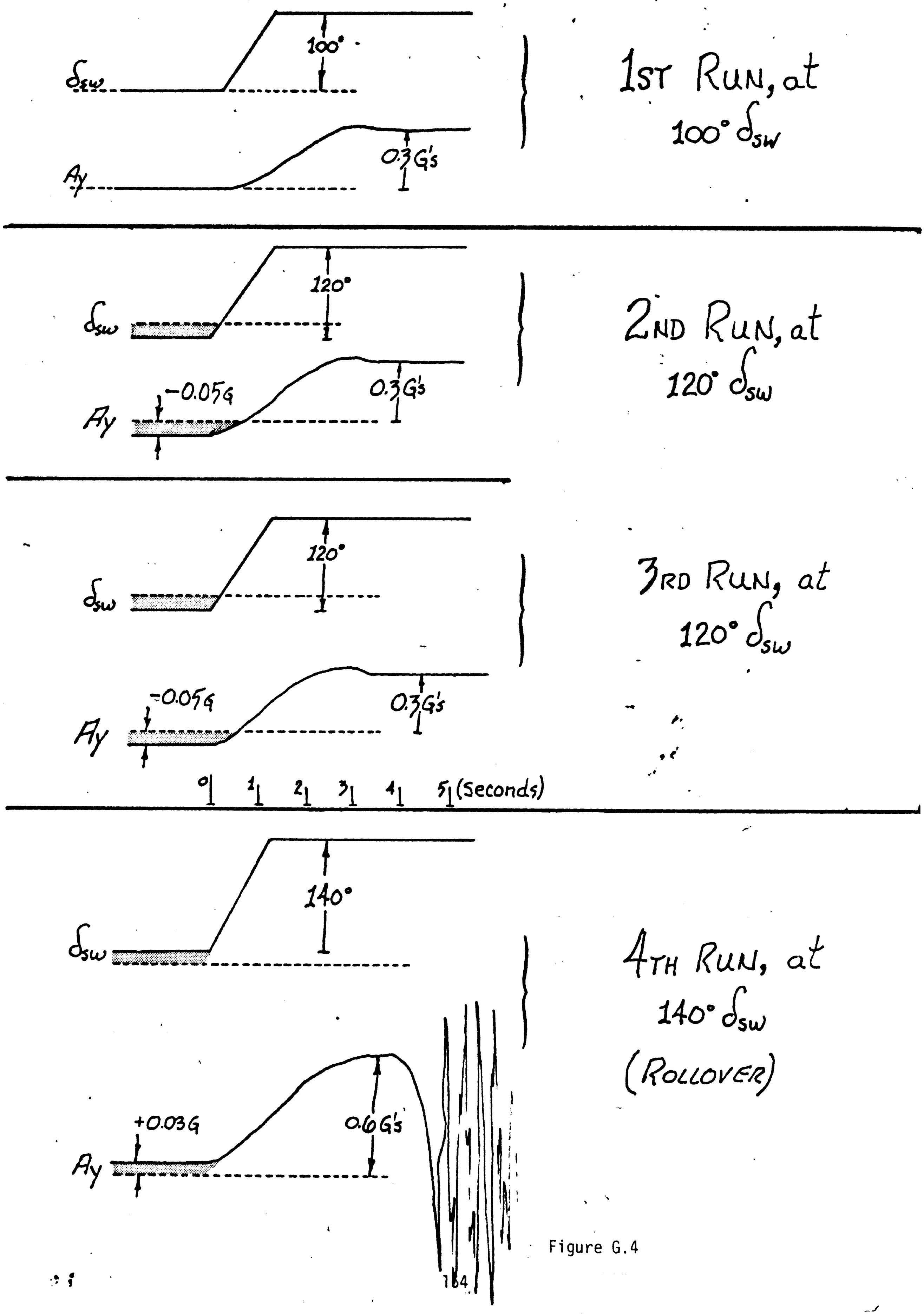
Since HSRI had calculated, simply on the basis of equilibrium roll moment considerations, that rollover would occur in the vicinity of 0.7 g's A_y, it is not surprising that the vehicle rolled over on TTI's dry asphalt test surface (whose dry skid number was 80). In the actual event, however, the rollover occurred at 0.6 g due to the failure of the outside front wheel rim which permitted an abrupt, and large, reduction in effective track width. Nevertheless, it is generally taken for granted that heavy trucks, with any commonly-elevated load configuration, will roll over on dry surfaces if subjected to a sufficiently large sideslip excursion. Thus the relevant question here is not so much "why did the truck roll over?" but rather "why did the truck become exposed to a condition in which rollover was inevitable?" The latter question can be condensed to an even more specific query which relates to the evidence of this incident; namely, "why did this truck elicit a yaw divergency in response to a steering input which was expected to yield a steady turn of 0.35 g A_y?"

The answer to this question has two parts. Firstly, due to an oversight in the conduct of the test sequence we should not have "expected" a .35 g level response to the final steering input of 140° amplitude. Rather, it would appear that we should have expected a response in the range of .40 to .45 g.

To explain the manner in which the effective input magnitudes became confused, consider the four sets of time histories in Figure G.4. This figure is reconstructed from A_y recordings and includes the presumed steering wheel displacements which were not being recorded during the preliminary setup tests. Since the steering input was generated through the automatic controller and since there is no evidence that the controller either misbehaved or was mis-programmed, it appears very likely that the steer inputs were as shown.

The significant feature of the Figure G.4 time histories is the existence of initial offsets in the measured A_y and presumably in steering wheel displacement, δ_{sw}. Offset in the "zero value" of δ_{sw} is possible in the hybridized driver/automatic system because the driver himself must establish zero steer just prior to initiating the automatic sequence in each test run. When the controller switches "on," the steering servo becomes clamped to the truck's steering shaft at whatever angular position the shaft happens to occupy at that instant. The controller then applies its programmed displacements in reference to that "zero" position. In the severe vibration environment presented in a truck such as that tested, it is not unlikely that the driver, distracted by his many chores, could have missed the intended zero position by the 20° or so needed to explain the A_y data shown in Figure G.4.

Thus, in Run No. 1, it would appear that a true 100° steering angle was applied since the "zero value" was virtually zero degrees. Upon observing that the A_y response provided only 0.3 g, the test operator then selected to conduct Runs No. 2 and 3 at a 120° setting on the automatic controller. These two runs, however, were coincidentally accompanied by zero steer offset values of sufficient magnitude, and consistent polarity, to effectively nullify the influence of the 20° increment in δ_{sw} which had been added relative to the 100° setting of Run No. 1. Accordingly, an A_y level of approximately 0.3 g was again observed in both Run No. 2 and No. 3.



1ST RUN, at
100° δ_{SW}
100°
δ_{SW}
0.3G's
Ay
2ND RUN, at
120° δ_{SW}
120°
δ_{SW}
-0.05G
0.3G's
Ay
3RD RUN, at
120° δ_{SW}
120°
δ_{SW}
-0.05G
0.3G's
Ay
0 1 2 3 4 5 (Seconds)
4TH RUN, at
140° δ_{SW}
(ROLLOVER)
140°
δ_{SW}
+0.03G
0.6G's
Ay

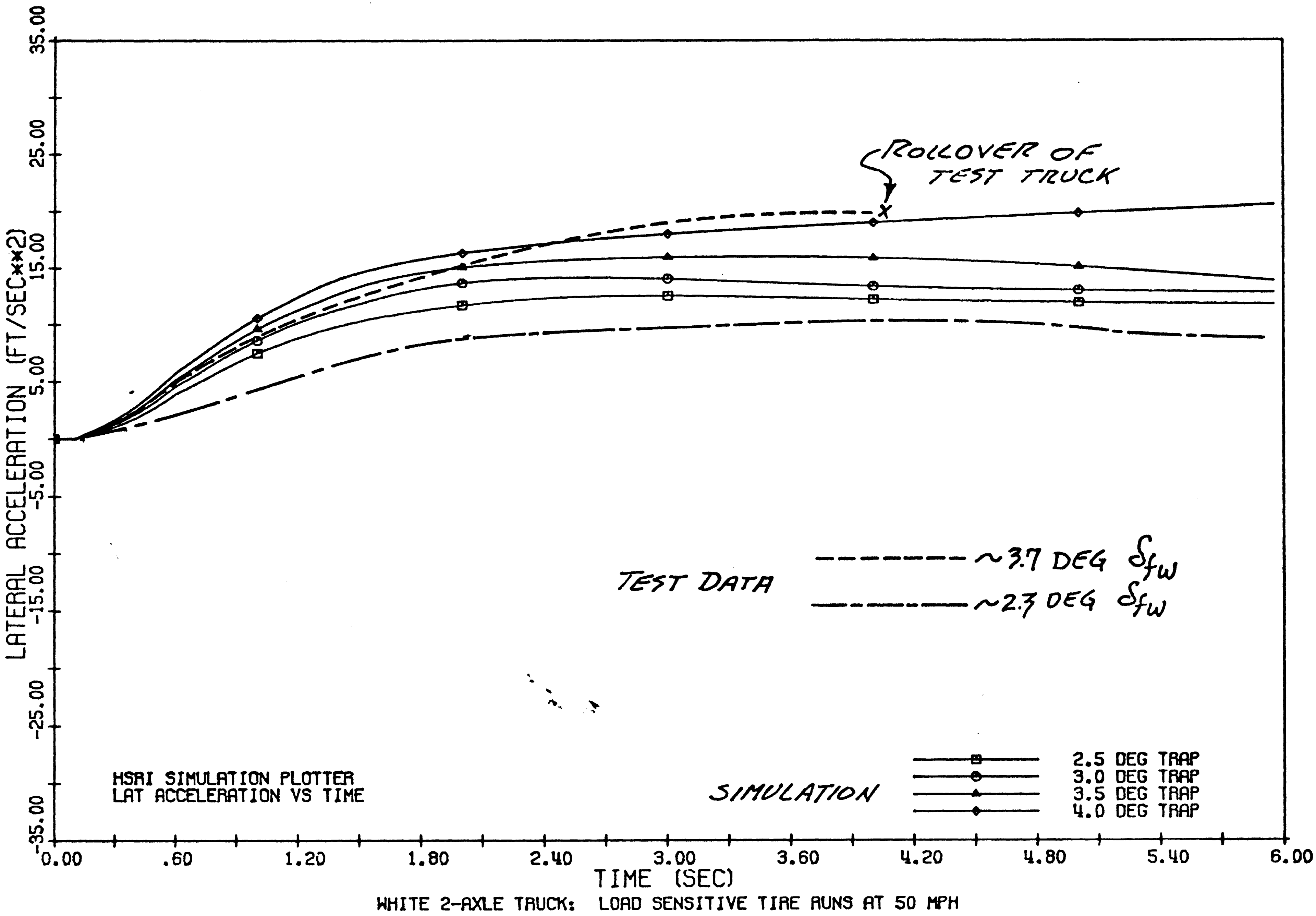
Figure G.4

in side force generation prior to the saturation or friction-limiting, of tires on the other axle.

In contrast, it appears that a heavy truck spinout can initiate when maneuvering severity exceeds an A_y of about 0.45 to 0.50 as illustrated by the simulated and experimentally-recorded A_y time histories of Figure G.5. The simulation runs cover a sequence of trapezoidal steering levels spanning the range of conditions which were tested. Beginning with the "2.5 DEG TRAP" (roughly equivalent to a run at 107° steering wheel angle) the simulated responses indicate convergent behavior up to the "4.0 DEG TRAP" condition. With a simulated 4.0° nominal input at the front wheels, the truck shows a diverging yaw behavior (Figure G.6) and slews to a 14-degree sideslip angle in four seconds (the point in time at which the test truck completely unloaded its inside wheels and initiated the rapid roll divergency).

In Figure G.5 the simulation results are compared with measured data from the 2.3 Deg (100° steering wheel amplitude) and 3.7 Deg (140° steering wheel amplitude) test runs which were discussed previously. Although the simulated vehicle shows less understeer than the test vehicle (comparing data from the roughly equivalent "2.5 DEG TRAP" and "2.3 DEG δ_{SW}" conditions), the abupt change in the simulated vehicle's behavior between the 3.5- and 4.0-DEG conditions basically confirms the divergency of the test run with nominally 3.7 DEG input at the front wheels. It would appear from the simulated sideslip and roll angle plots of Figures G.7 and G.8 that a heavily diverging sideslip response, with the simulated 4.0 DEG input, was definitely leading to a rollover.

The occurrence or non-occurrence of a simulated vehicle rollover is of little significance to this examination, however. Rather, the significant observations are related to the narrow regime of tire slip angles within which the vehicle is apparently stable. The simulated response to the 3.5 DEG input, for



35.00
25.00
15.00
5.00
-5.00
-15.00
-25.00
-35.00
LATERAL ACCELERATION (FT/SEC**2)
0.00
.60
1.20
1.80
2.40
3.00
3.60
4.20
4.80
5.40
6.00
TIME (SEC)
ROLLOVER OF TEST TRUCK
TEST DATA
~3.7 DEG δ_{fw}
~2.3 DEG δ_{fw}
SIMULATION
2.5 DEG TRAP
3.0 DEG TRAP
3.5 DEG TRAP
4.0 DEG TRAP
HSRI SIMULATION PLOTTER
LAT ACCELERATION VS TIME
WHITE 2-AXLE TRUCK: LOAD SENSITIVE TIRE RUNS AT 50 MPH

Figure G.5

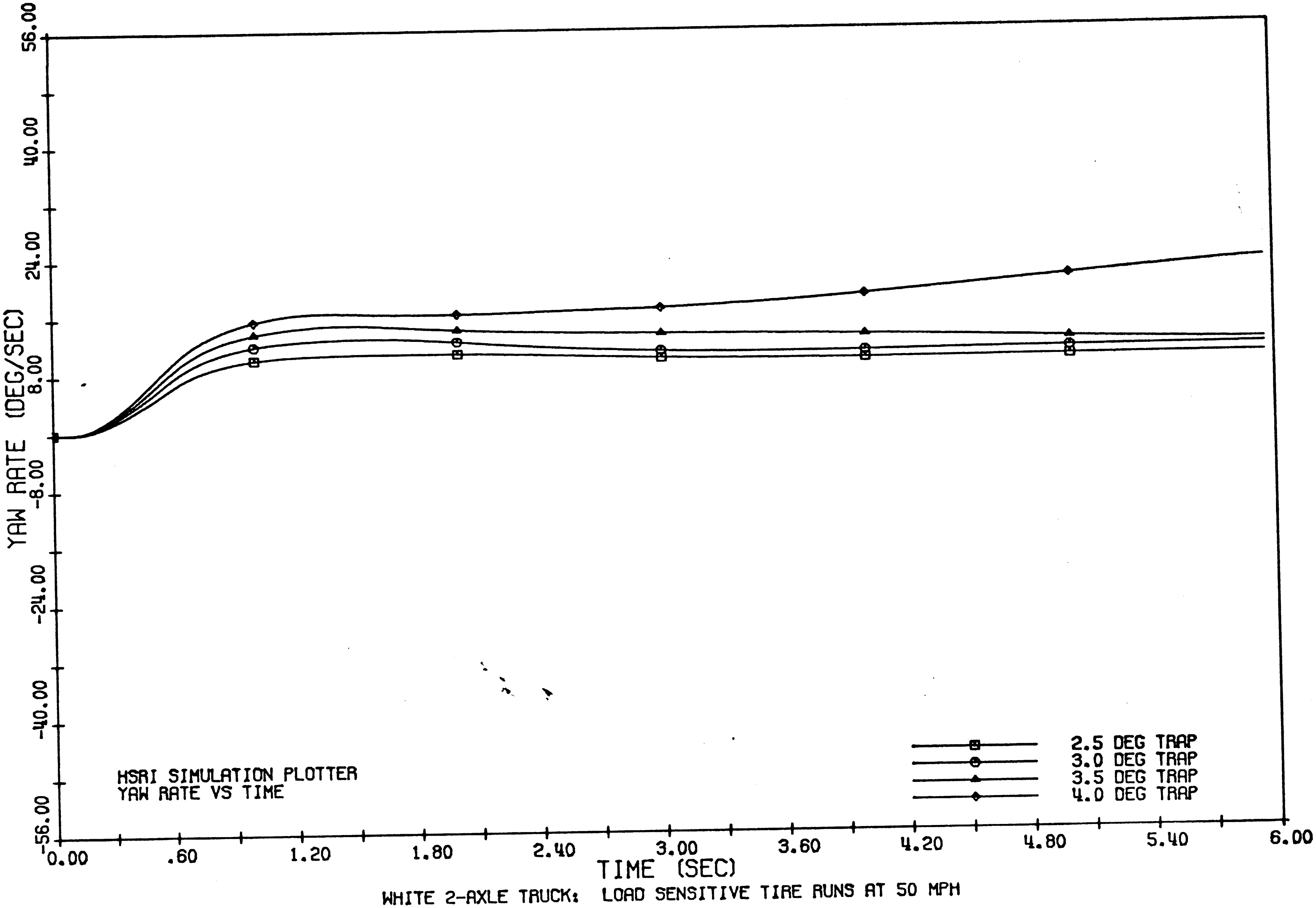
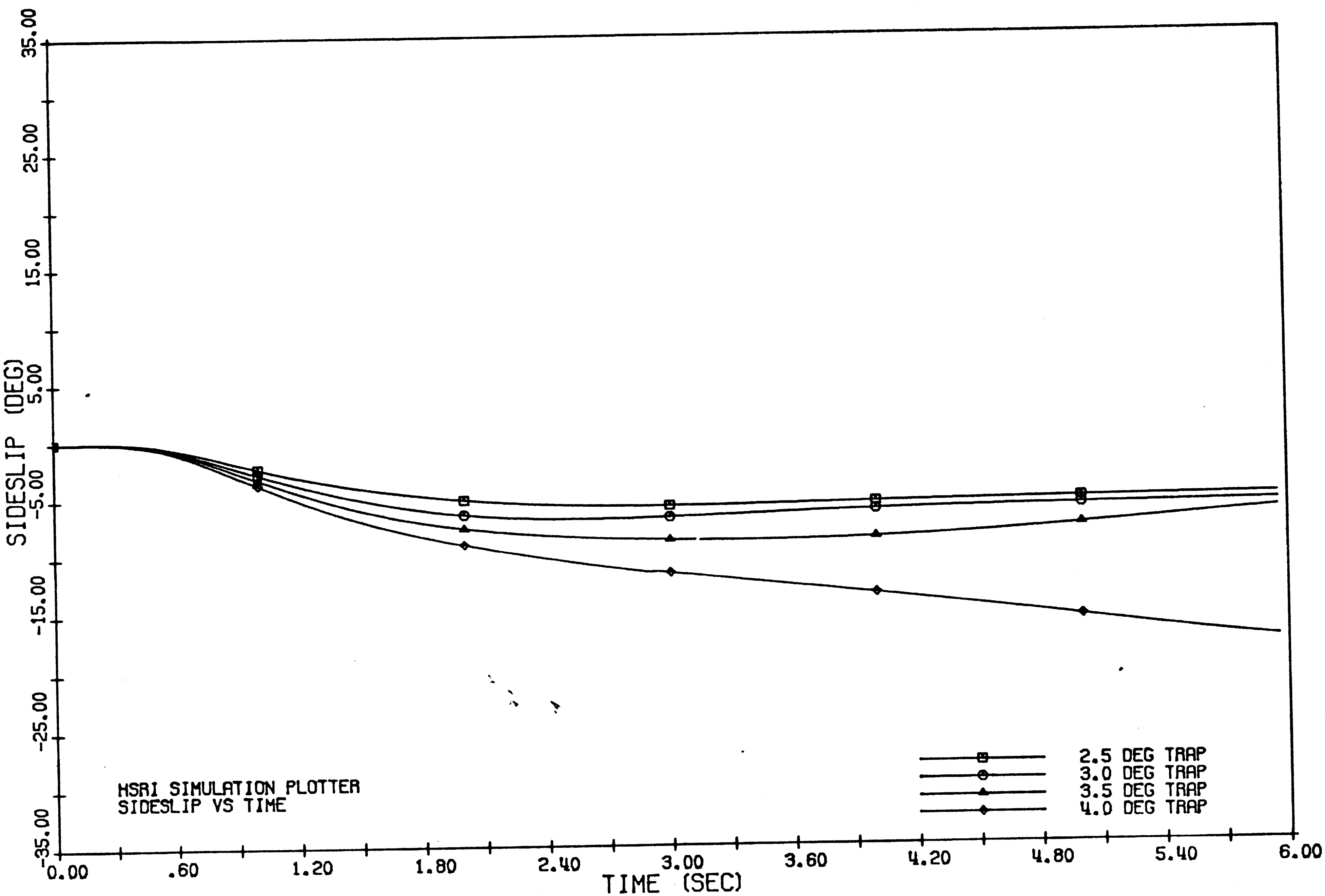

YAW RATE (DEG/SEC)
56.00
40.00
24.00
8.00
-8.00
-24.00
-40.00
-56.00
0.00
.60
1.20
1.80
2.40
3.00
3.60
4.20
4.80
5.40
6.00
TIME (SEC)
WHITE 2-AXLE TRUCK: LOAD SENSITIVE TIRE RUNS AT 50 MPH
HSRI SIMULATION PLOTTER
YAW RATE VS TIME
2.5 DEG TRAP
3.0 DEG TRAP
3.5 DEG TRAP
4.0 DEG TRAP

Figure G.6



WHITE 2-AXLE TRUCK: LOAD SENSITIVE TIRE RUNS AT 50 MPH

Figure G.7

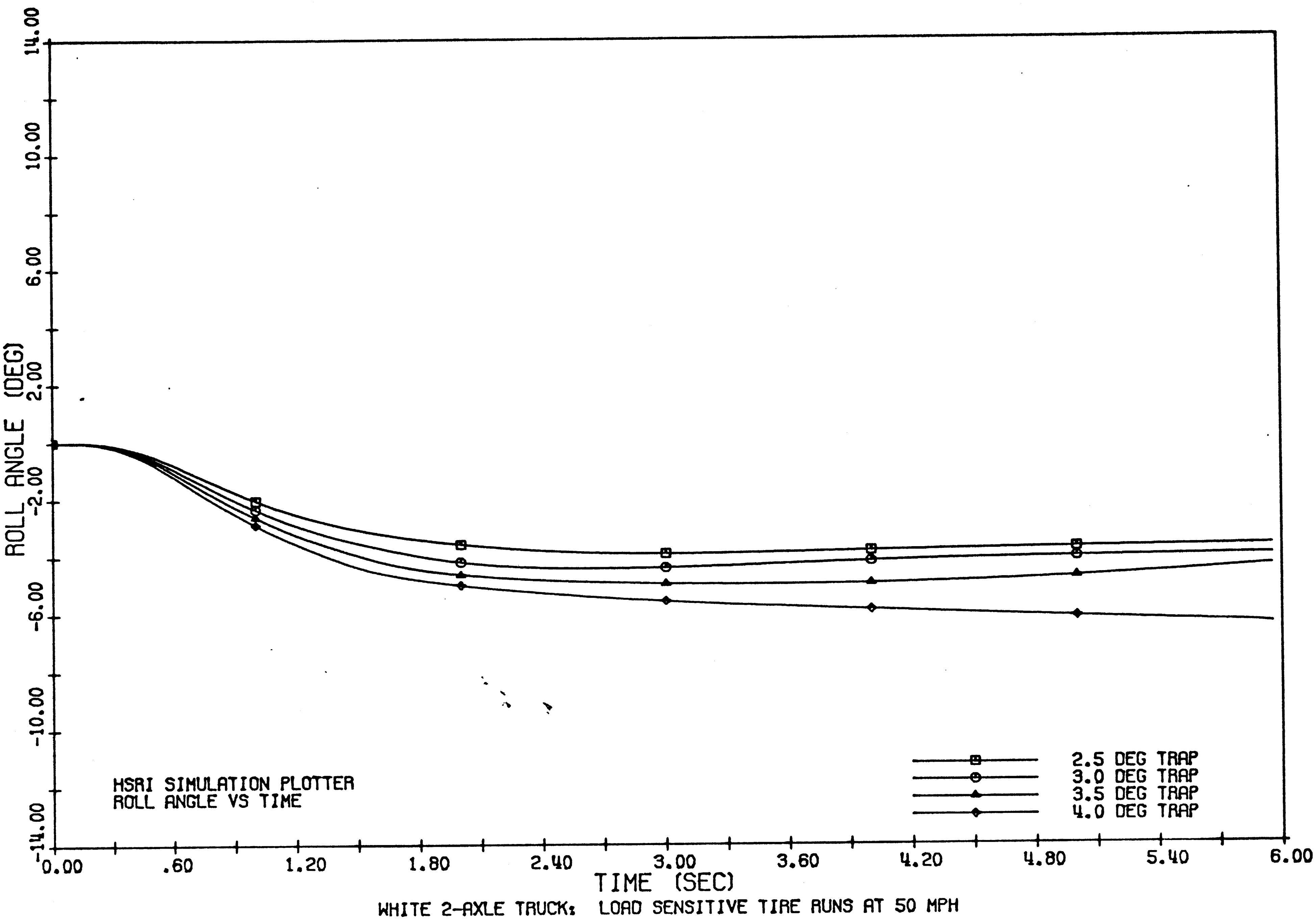

14.00
10.00
6.00
2.00
-2.00
-6.00
-10.00
-14.00
ROLL ANGLE (DEG)
HSRI SIMULATION PLOTTER
ROLL ANGLE VS TIME
2.5 DEG TRAP
3.0 DEG TRAP
3.5 DEG TRAP
4.0 DEG TRAP
0.00
.60
1.20
1.80
2.40
3.00
3.60
4.20
4.80
5.40
6.00
TIME (SEC)
WHITE 2-AXLE TRUCK: LOAD SENSITIVE TIRE RUNS AT 50 MPH

Figure G.8

example, shows that front and rear tires are operating at slip angles of 8 to 9°—and that beyond that level, in the 4.0 DEG run, the vehicle exhibits a yaw divergency. Referring to the carpet plot of Figure G.9 (describing the tires which were installed on the test truck), we see that the vehicle's more heavily loaded tires, which are running at 8000 lbs or so, are far from being side force saturated at an 8° slip angle. Thus the spinout anomaly occurs while effective front and rear lateral force rates (lb/deg slip angle) are still rather stiff. In examining this, it can be shown that the vehicle becomes destabilized by a classical mechanism which is explainable through linear vehicle mechanics. Namely, the vehicle arrives at a lateral acceleration level at which the prevailing velocity exceeds the critical speed of the system linearized about that operating point.

To demonstrate this linearized systems explanation we evaluated the lateral force rates for each tire of the vehicle under those conditions of slip angle and load which were computed by the major simulation in the 3.5 DEG TRAP run. Together with parameters describing the vehicle's mass, wheelbase, and longitudinal location of c.g., the critical speed of the (now oversteer) truck can be obtained through the relation:

$$V_c = \frac{L^2 C_{\alpha_r} C_{\alpha_f}}{m(C_{\alpha_f} a - C_{\alpha_r} b)}$$

where

V_c = critical speed

L = wheelbase

C_{α_r}, C_{α_f} = total cornering stiffness at rear (front) axle

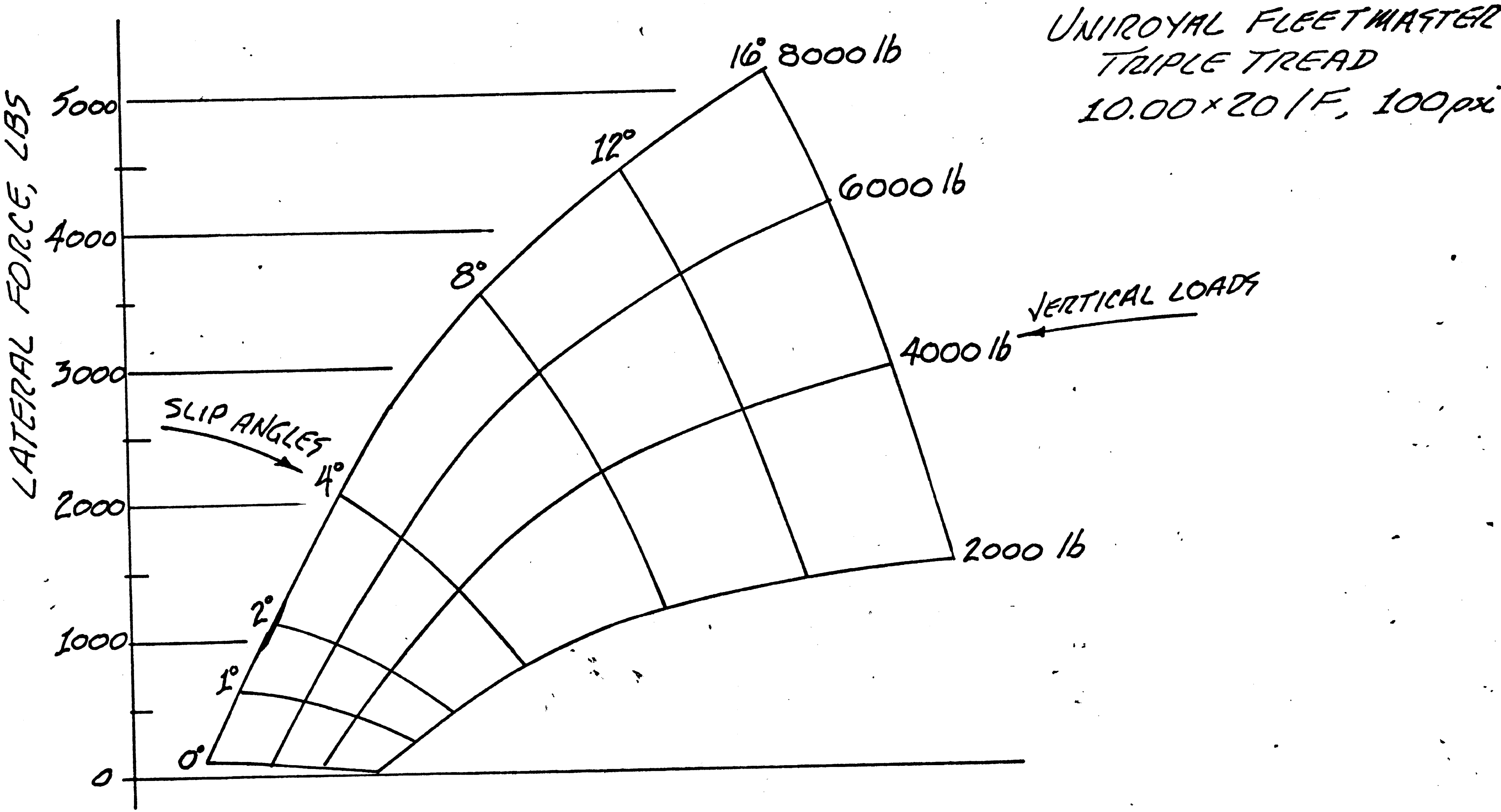

UNIROYAL FLEETMASTER
TRIPLE TREAD
10.00×20/F, 100psi
LATERAL FORCE, LBS
5000
4000
3000
2000
1000
0
SLIP ANGLES
0°
1°
2°
4°
8°
12°
16°
8000 lb
6000 lb
4000 lb
2000 lb
VERTICAL LOADS

Figure G.9

m = mass

a = position of c.g. aft of front axle

b = position of c.g. forward of rear axle

The solution of this expression yields a 75 ft/sec or 51.2 mph critical speed. Thus, it confirms our observation that at some steering level between the 3.5 DEG and 4.0 DEG run, the system exceeds a stability threshold, with its 50 mph test velocity, which instability is manifested by a small positive exponential time response. This slowly growing divergency, while contrasting with the abrupt spinout limits of some passenger cars, is unusual because it can be stimulated, as seen, in near proximity to the normal maneuvering range.

In summary, the truck rolled over because it entered a medium level turn, within which its yaw behavior was unstable. The instability was sustained long enough for the truck to accumulate a sideslip angle of about 25°, producing a tire side force-induced rolling moment sufficiently large, with the help of the outside front wheel failure, to initiate the rollover.

4) What lessons can be learned from this incident?

A variety of lessons would appear to be demonstrated by the scenario surrounding this incident. From a technical point of view, the heavy commercial vehicle clearly deserves to be treated with special care in vehicle dynamics experimentation. Indeed, this class of vehicles presents certain behavior characteristics which differ so markedly from passenger car properties that we need to "recalibrate" much of our thinking before planning truck measurement studies. Particularly in regard to mechanisms which determine load distribution around the vehicle's various tire positions, the heavy truck possesses certain first-order parametric sensitivities which are virtually insignificant in passenger cars.

More importantly than the mechanisms themselves, we must recognize our limited knowledge of the ways in which these mechanisms are influential in determining vehicle response. In the face of a very limited base of experience, it would appear that caution is the primary virtue. In the context of research into truck maneuvering dynamics, "caution" means that the full-scale experiment should never be used for exploring areas about which we have not already gained a considerable insight through simulation. In the current vacuum of technology concerning heavy truck directional response, the areas of "no considerable insight" far out-number those which are ripe for examination through testing.

With regard to full-scale experimentation, as it may be warranted and desirable in the future, it appears that either the total removal of the driver or his total protection, with anti-rollover outriggers, is the only prudent course. In addition, the reliability of either the fully automatically-controlled truck or the outrigger-protected truck, should be assessed through appropriate trial. While the automatic control of an automatic transmission-equipped truck would be straightforward, the formidable hazard posed by a runaway requires special consideration—and there have been at least two passenger car runaways in NHTSA-sponsored automatic control testing. Likewise, we must recognize that an outrigger which fails is worse than no outrigger at all since it may serve merely to pole-vault the vehicle from an increased altitude. Thus the assured performance of a heavy truck outrigger system must be demonstrated in an unoccupied vehicle prior to adoption for driver-controlled testing.