TABLE OF CONTENTS

VOLUME 3

10.00 - 20 G

L. DYNAMOMETER

*Reference Q Refers to the Tires on the Attached Sheet

R. TABULATED DATA

11.00 R 20 H

I. TABULATED DATA

12.00 - 20 G

12.00 - 20 H

Vertical Load
Inflation Pressure
Circumferential Stiffness
Vertical Spring Rate
Highway Tread

12 R 22.5 H

15.00 - 22.5 H

TABLE 1. TEST TIRES

TIRE NO.	MANUFACTURER	% OF MARKET*	MODEL	CARCASS TYPE	TREAD TYPE
1a&b	Goodyear	20%	Unisteel-2	Radial	Rib
2a&b	Goodyear		Himiler Special	Bias	Rib
3a&b	Goodyear		Custom Quiet Drive	Bias	Rib
4a&b	Goodyear		SuperHiMiler	Bias	Rib
5a&b	Goodyear		Custom Hi-Miler	Bias	Rib
6a&b	Firestone	18%	Power Drive	Bias	Lug
7a&b	Firestone		Transteel	Radial	Rib
8a&b	Firestone		Long Hauler	Bias	Rib
9a&b	Firestone		Super All Traction	Bias	Lug
10a&b	Kelly-Springfield	6.5%	Registered Armor-Trac	Bias	Rib
11a&b	Kelly-Springfield		Registered Drive Trac	Bias	Lug
12a&b	General	6.1%	GQT	Bias	Rib
13a&b	General		QCL	Bias	Lug
14a&b	Michelin	6.0%	XZA	Radial	Rib
15a&b	Michelin		XZZ	Radial	Rib
16a&b	Uniroyal	5.2%	Fleetmaster Triple Tread	Bias	Rib
17a&b	Uniroyal		Fleetmaster Superlug	Bias	Lug
18a&b	B.F. Goodrich	5.0%	Extra Miler XL	Bias	Rib
19a&b	B.F. Goodrich		Traction Express Custom	Bias	Lug
20a&b	Sears	4.6%	Plus Mileage Rib	Bias	Rib
21a&b	Sears		Silent Trac	Bias	Lug
22a&b	Armstrong	4.5%	SD-200	Bias	Rib
24a&b	Dayton	2%	Thorobred Premium ESD	Bias	Rib
26a&b	Recap		Uniroyal Fleet Carrier	Bias	Rib

*Tire Review Magazine

PLY RATING AND TIRE SIZE

The ply rating designates the load range for which a particular size tire is designed. Load limits for various sizes at specific inflation pressures up to the design pressure are tabulated according to empirical formulae. The ply rating is a measure of the strength of the tire carcass and does not necessarily indicate the actual number of plies.

The tire pairs listed in Table 1 were tested on design width precision rims at the indicated pressures and loads which are near the design values specified for these tires used as singles and duals. The higher rated tire of each pair is generally used as a dual. The 20 in tires that were tested all have the tread pattern shown in Fig. 6B. The tread pattern of the 11.00-22 tires (Fig. 2A) is similar. Table 2 lists the measured mechanical properties and illustrates the differences which may be found in tires which are similar in all respects, except for ply rating.

The differences seen in Table 2 are slight and possibly influenced by tire nonuniformity and/or measurement precision. There is remarkably little change in the properties of the 11.00-22 tires, the largest set tested for differences due to ply rating. The slight increase in test pressure (see Table 1) may be responsible for the increases in vertical spring rate. It is of interest to note that the vertical spring rate measured for the 10.00-20 tire with the G rating was less than that obtained for the F load rating. However, the lateral force generating ability did increase with increased load rating as evidenced by the

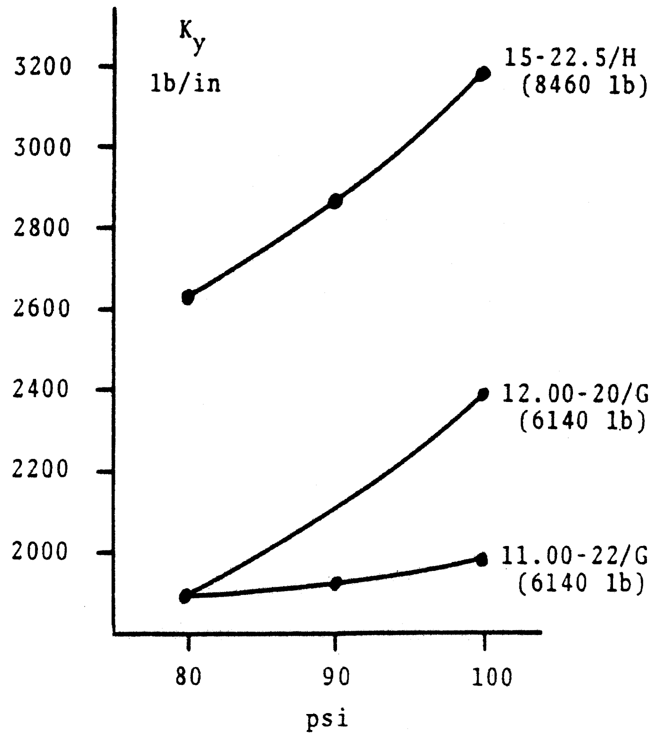


Fig. 4 - Lateral spring rate K_y versus inflation pressure for tires shown in Figs. 2A-2C

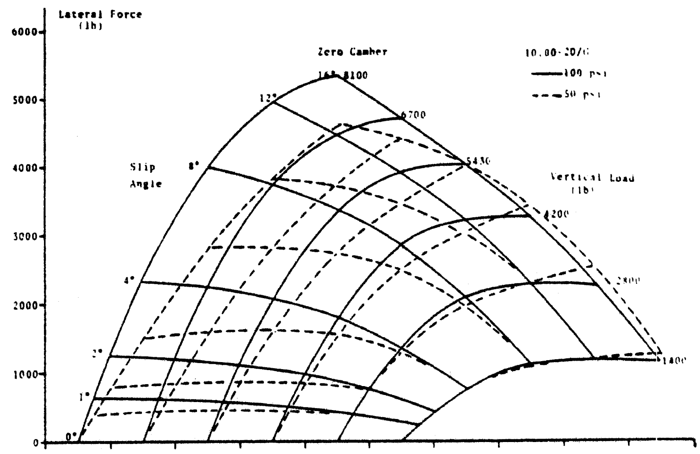
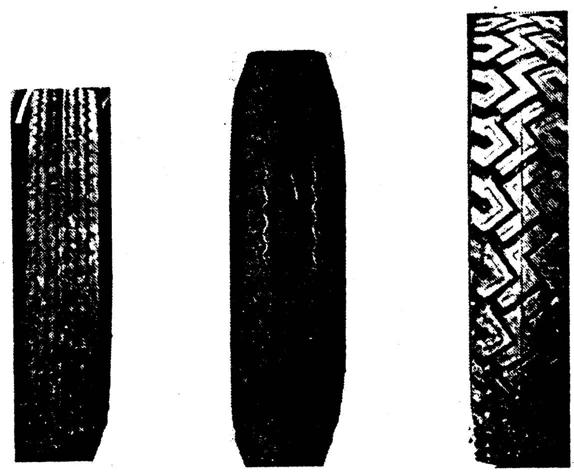


Fig. 5 - Lateral force versus slip angle and vertical load on 10.00-20/G tire at rated pressure (100 psi) and at 50 psi



	(a) Rib-type I	(b) Rib-type II	(c) Open Tread	
C_s	46000	42000	28000	lb/unit slip
C_α	508.2	523.4	516.0	lb/deg
C_γ	56.7	69.0	39.9	lb/deg
K_y	1477	1618	1291	lb/in
K_z	5032	4700	4500	lb/in

Fig. 6 - Measured mechanical properties of 10.00-20/F nylon tire in three tread patterns. A-rib-type I; B-rib-type II; C-open tread

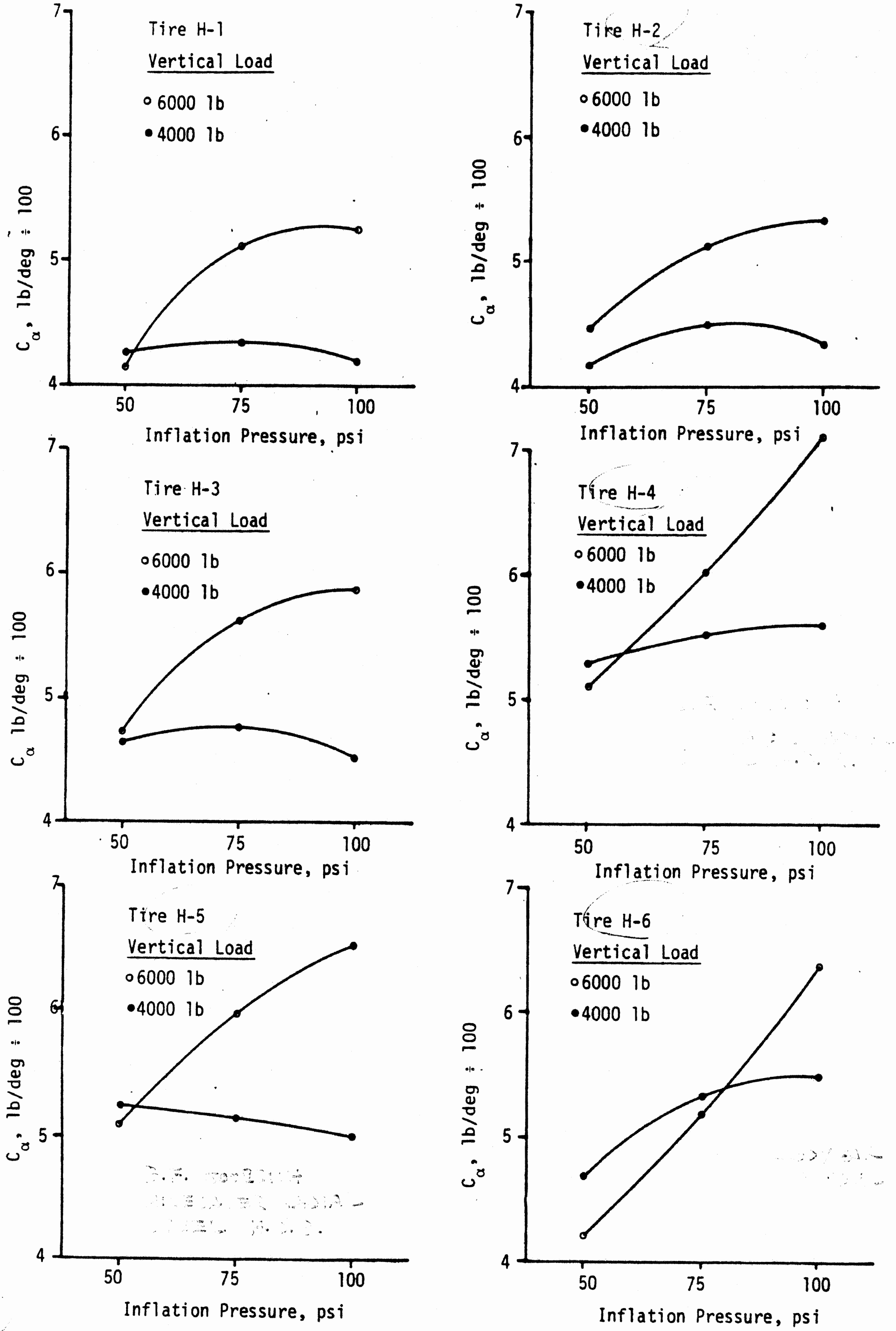
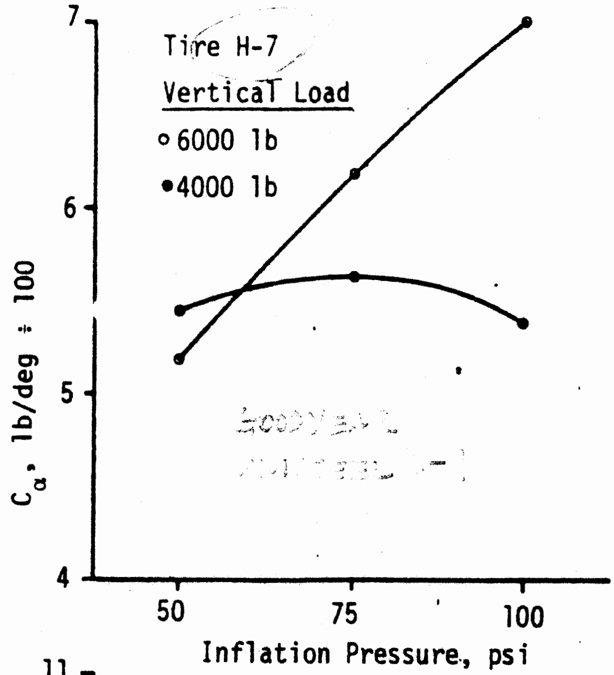
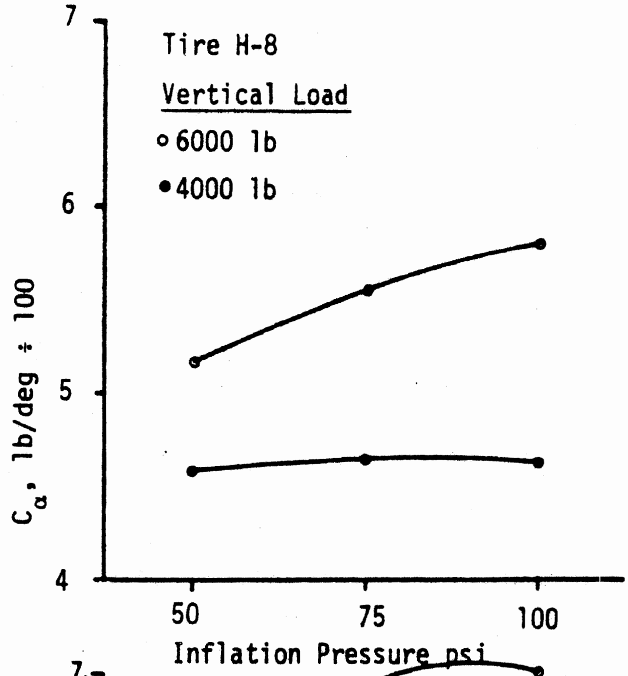
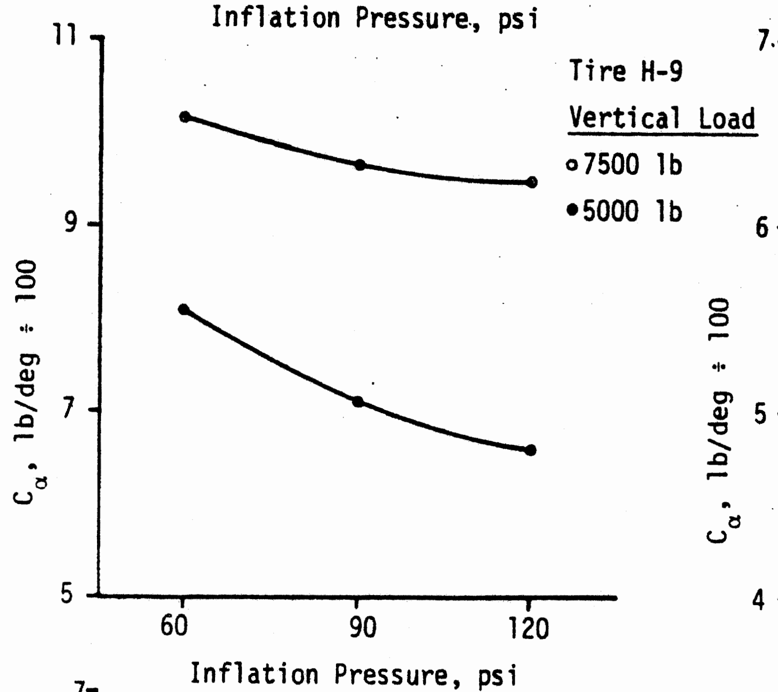
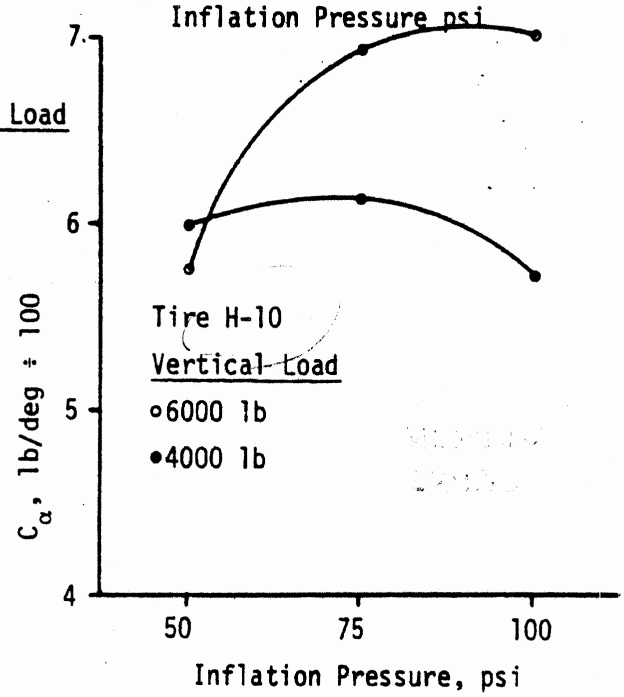


Figure 3.9 The effects of inflation pressure on cornering stiffness: heavy truck tires









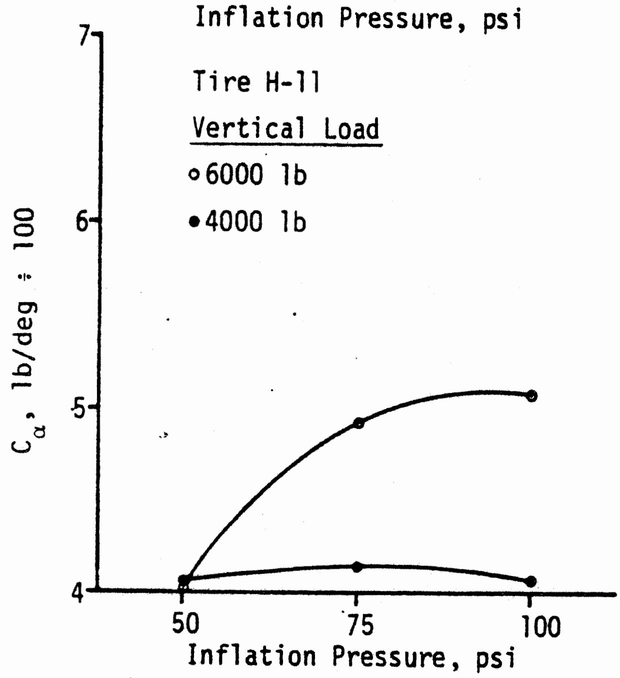


Figure 3. 10 The effects of inflation pressure on cornering stiffness: heavy truck tires (cont.).

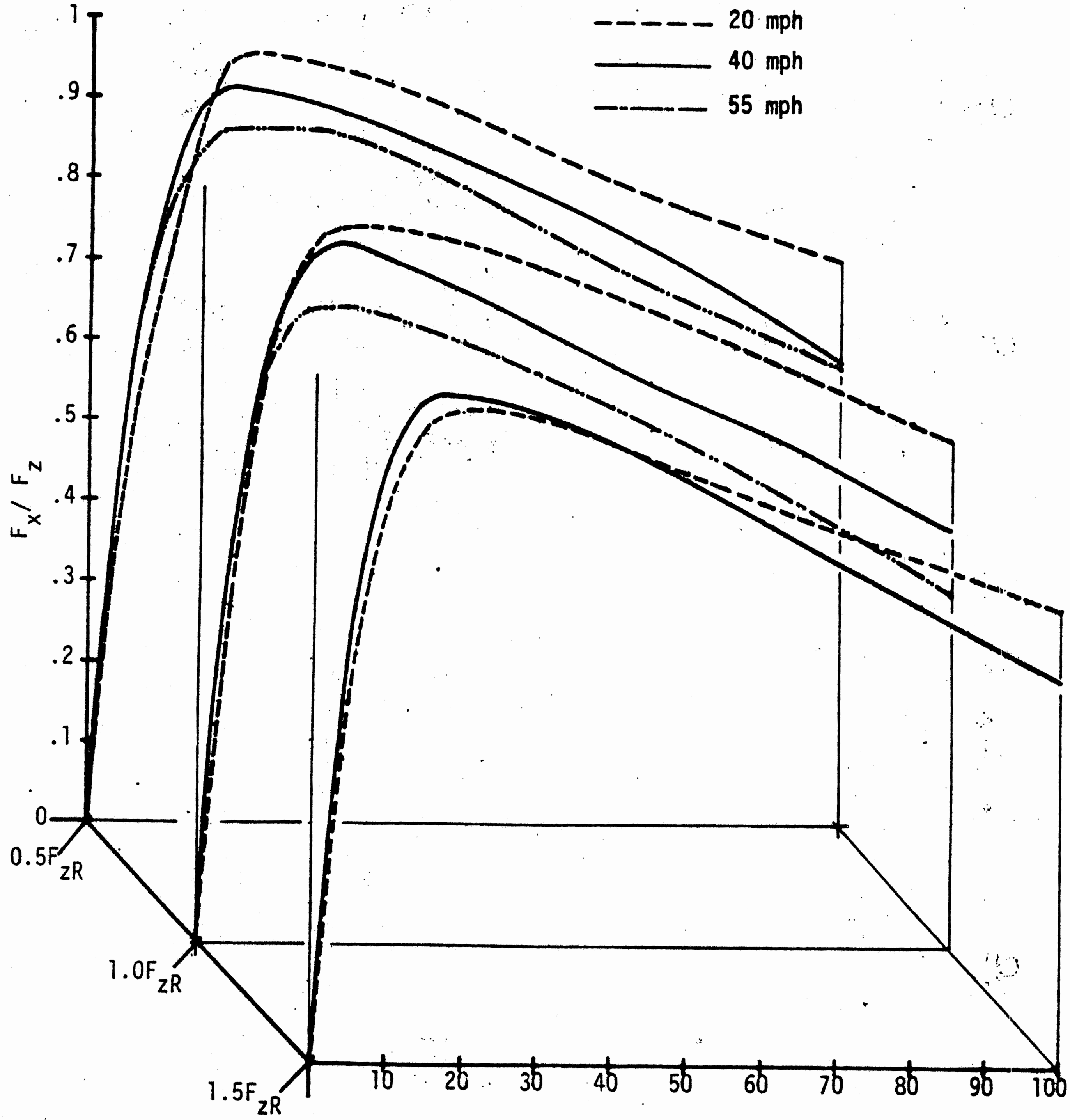


Figure 3.15. Family of μ-slip curves measured for a Goodyear Unisteel R-1 tire, size 10.00 R 20/G, on dry concrete.

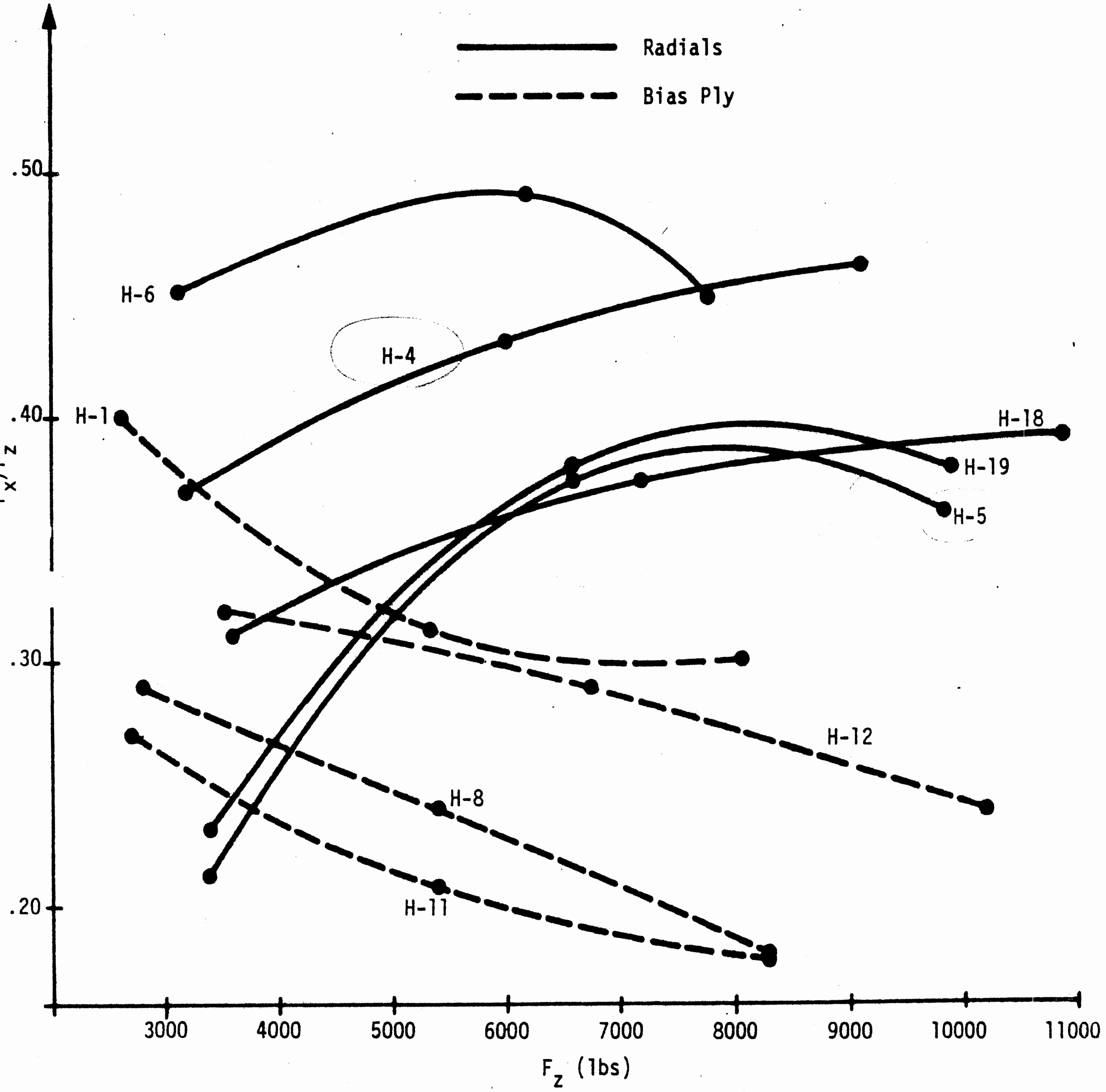


Figure 3.17. The load sensitivity of F_x/F_z values measured at 4% slip for heavy tires of radial and bias-ply construction (tires are identified by code numbers previously listed in Table 3-1).

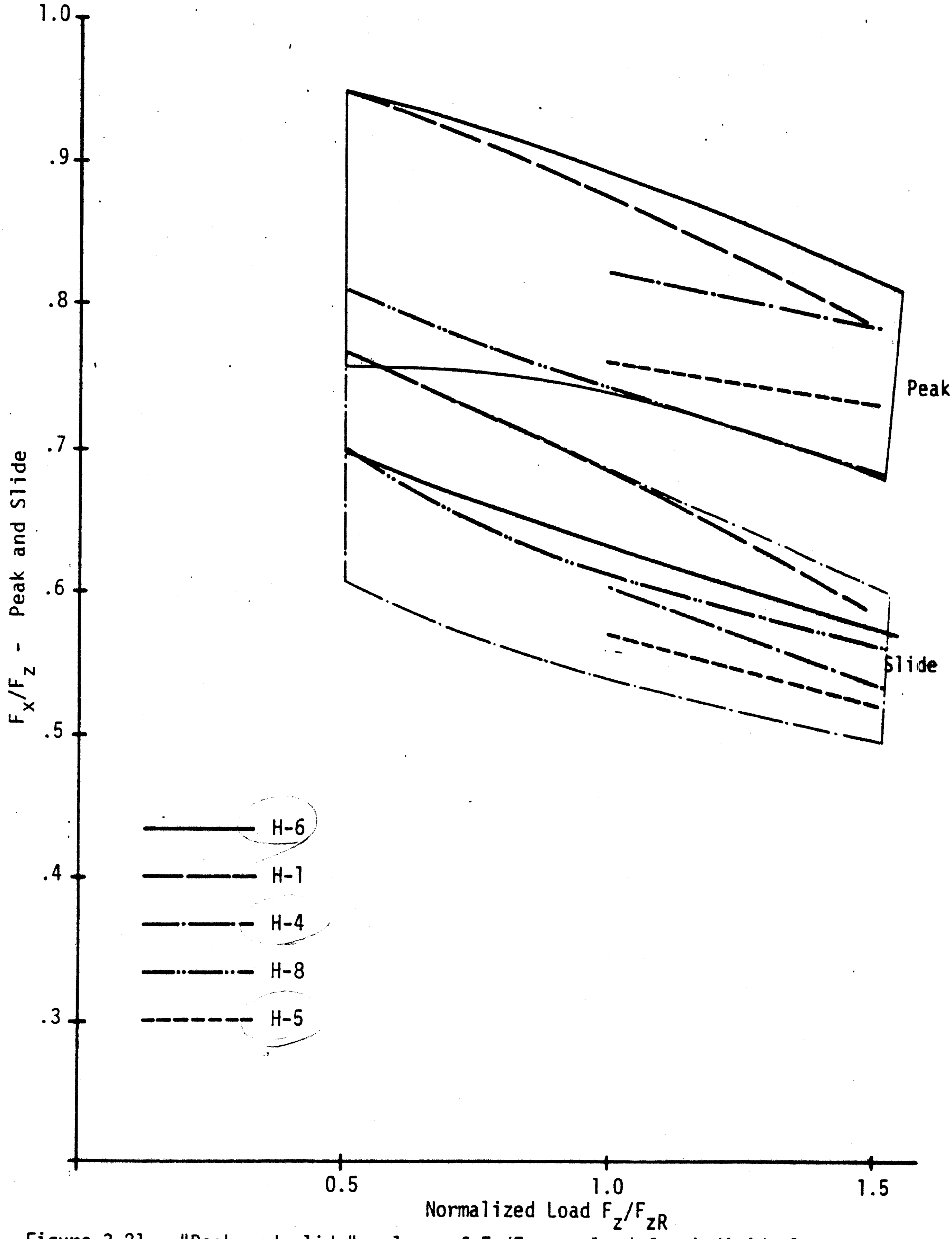


Figure 3.21. "Peak and slide" values of F_x/F_z vs. load for individual truck tires—superimposed within the envelope of data taken on eight truck and bus tires at 20 mph (for code number identifications, see Table 3-1).

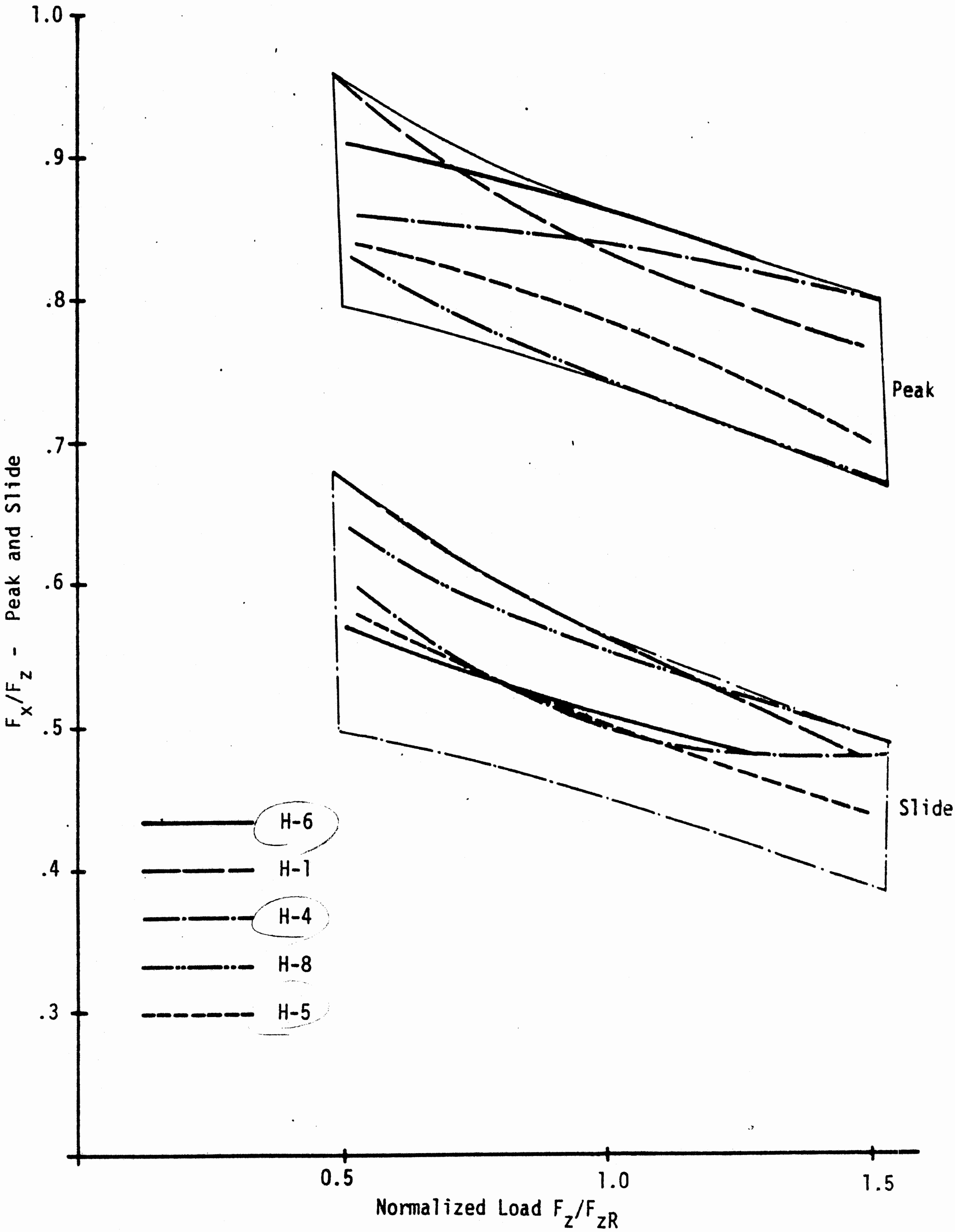


Figure 3.22. "Peak and slide" values of F_x/F_z vs. load for individual truck tires—superimposed within the envelope of data taken on eight truck and bus tires at 40 mph (for code number identifications, see Table 3-1).

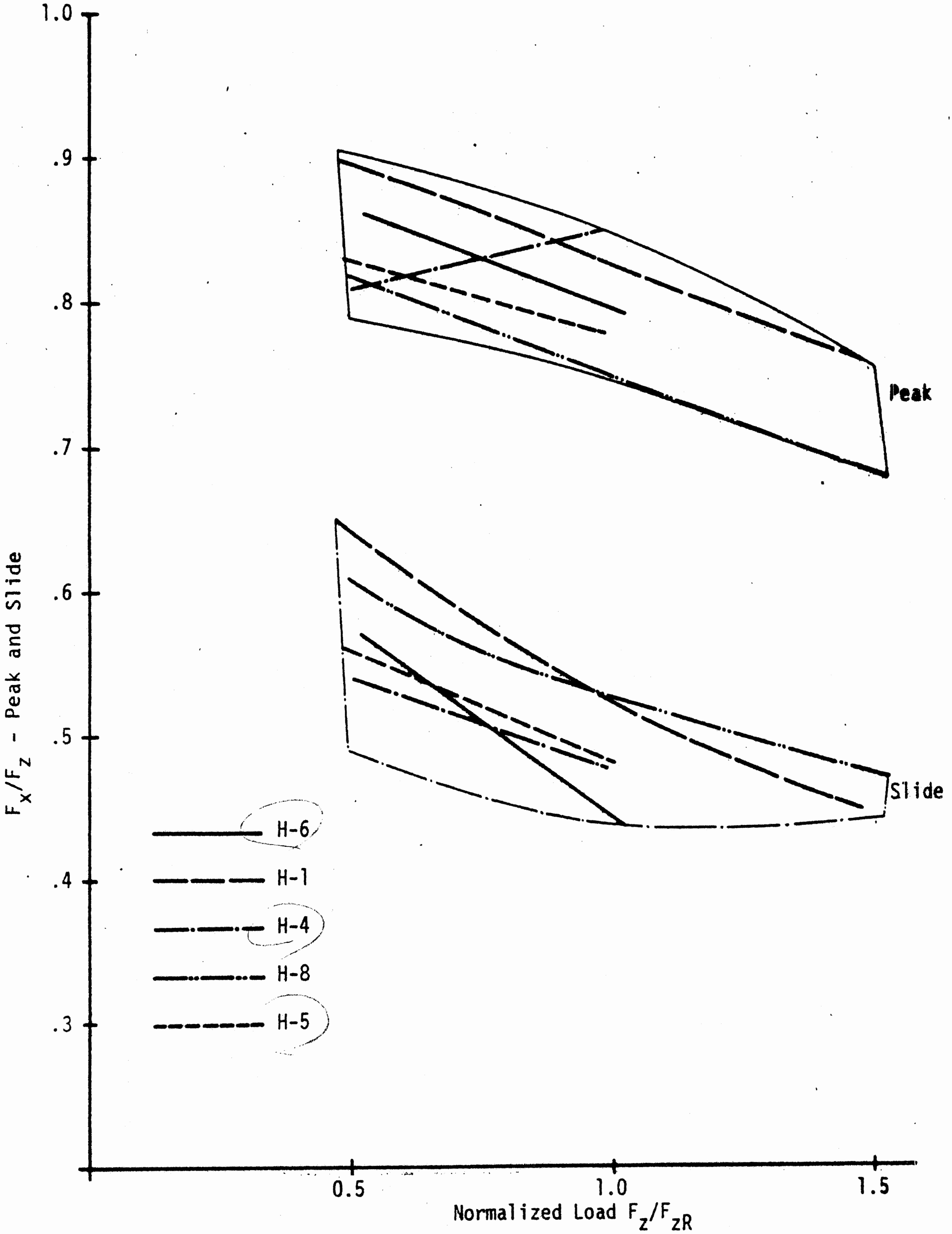


Figure 3.23. "Peak and slide" values of F_X/F_Z vs. load for individual truck tires—superimposed within the envelope of data taken on eight truck and bus tires at 55 mph (for code number identifications, see Table 3-1).

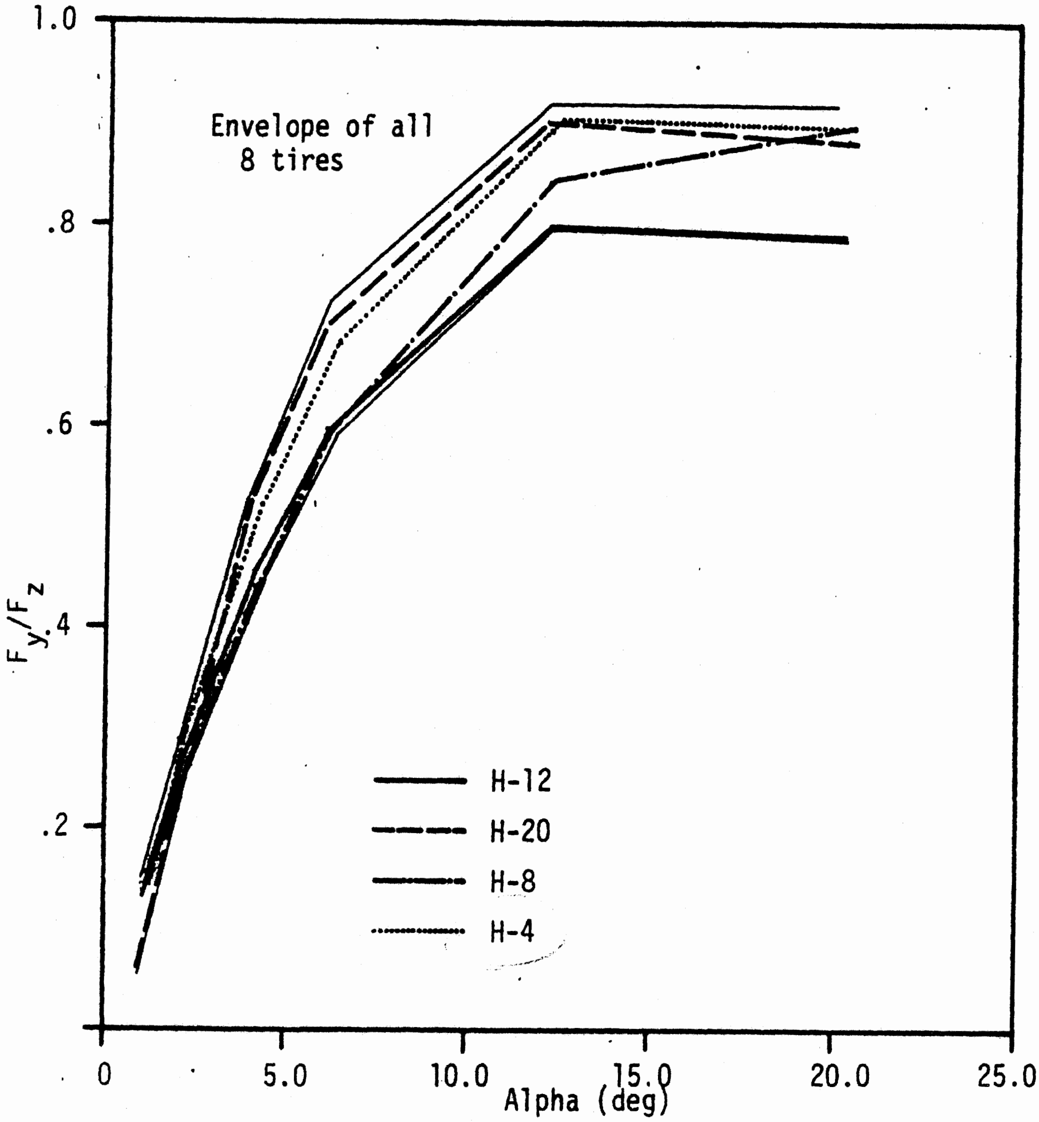


Figure 3.24. Lateral force measurements of heavy truck and bus tires at 20 mph and 0.5 x rated load.

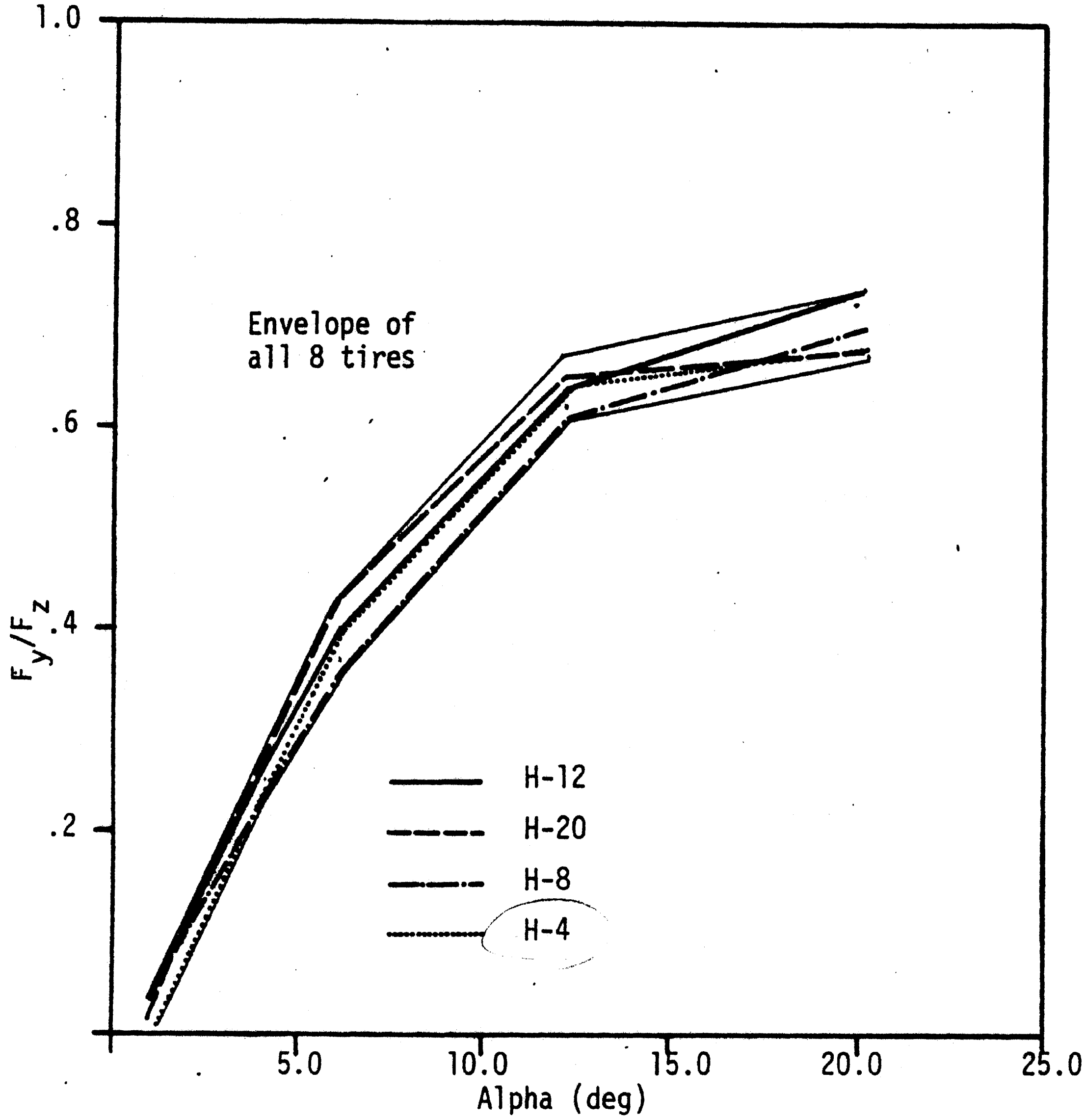


Figure 3.25. Lateral force measurements of heavy truck and bus tires at 20 mph, 1.5 x rated load.

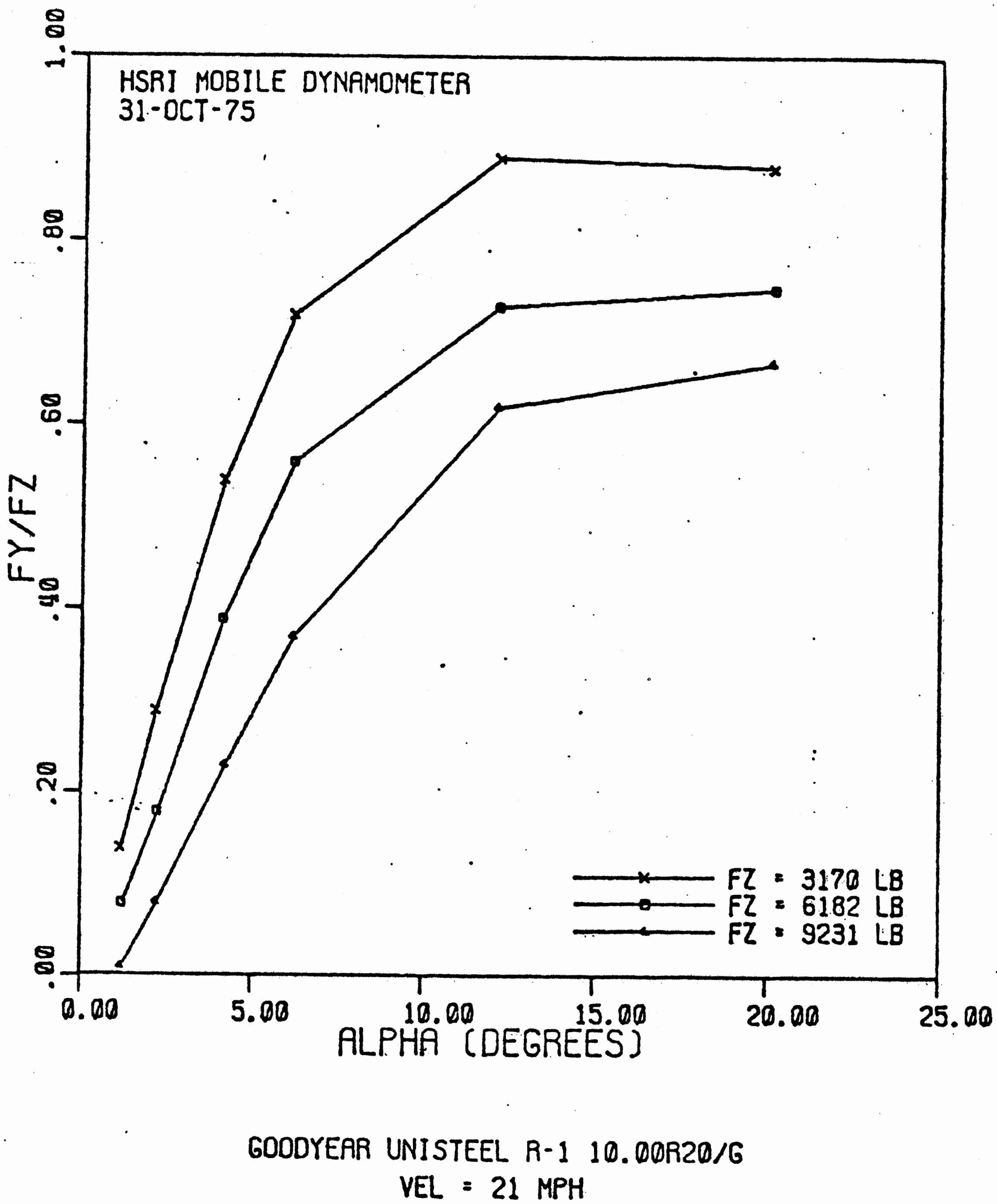


Figure 3.26. Typical array of (F_y/F_z vs. α) curves covering the load range from $0.5F_{zR}$ to $1.5\ F_{zR}$.

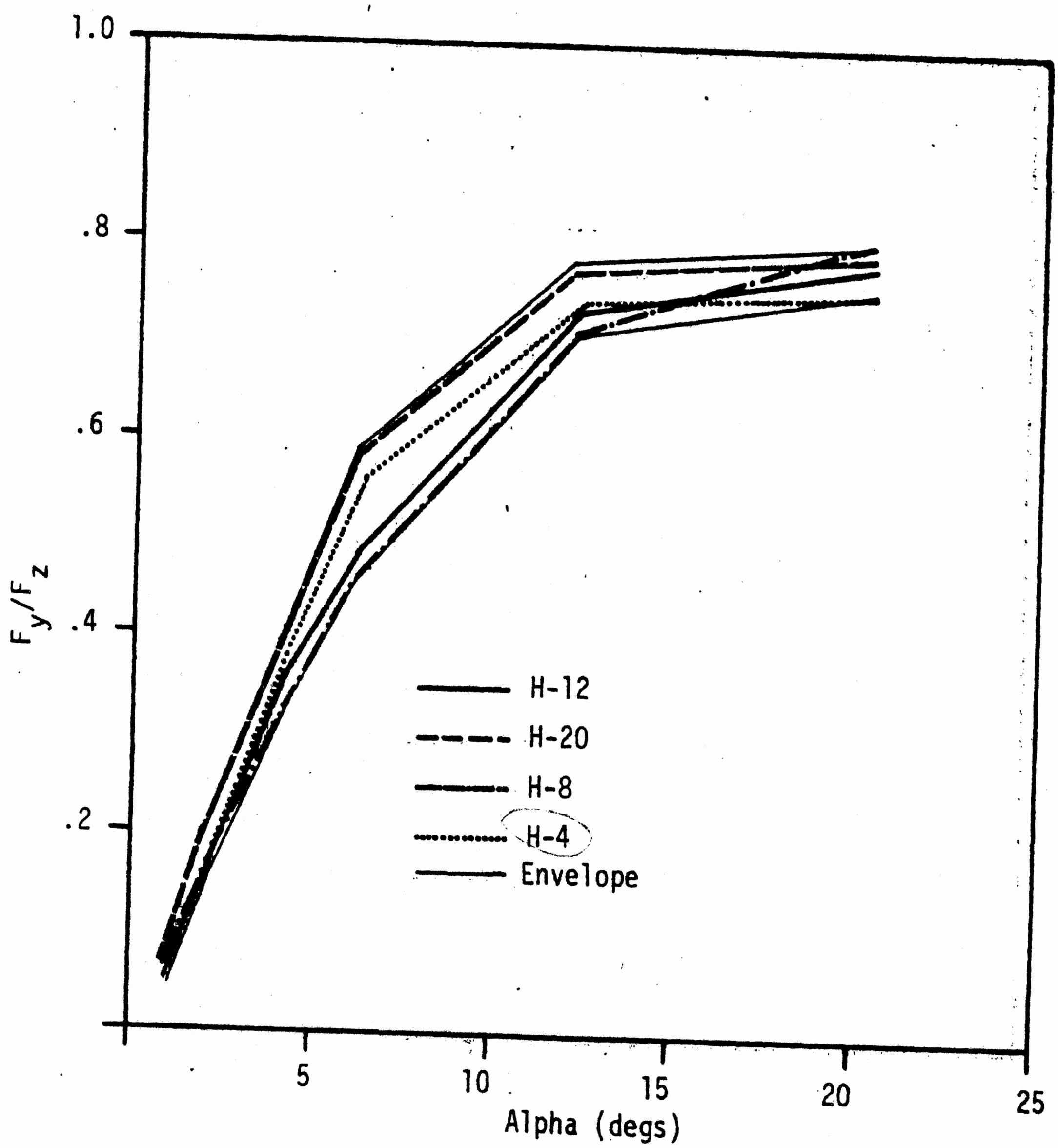


Figure 3.27. Envelope and specific examples of (F_y/F_z vs. α) measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 20 mph.

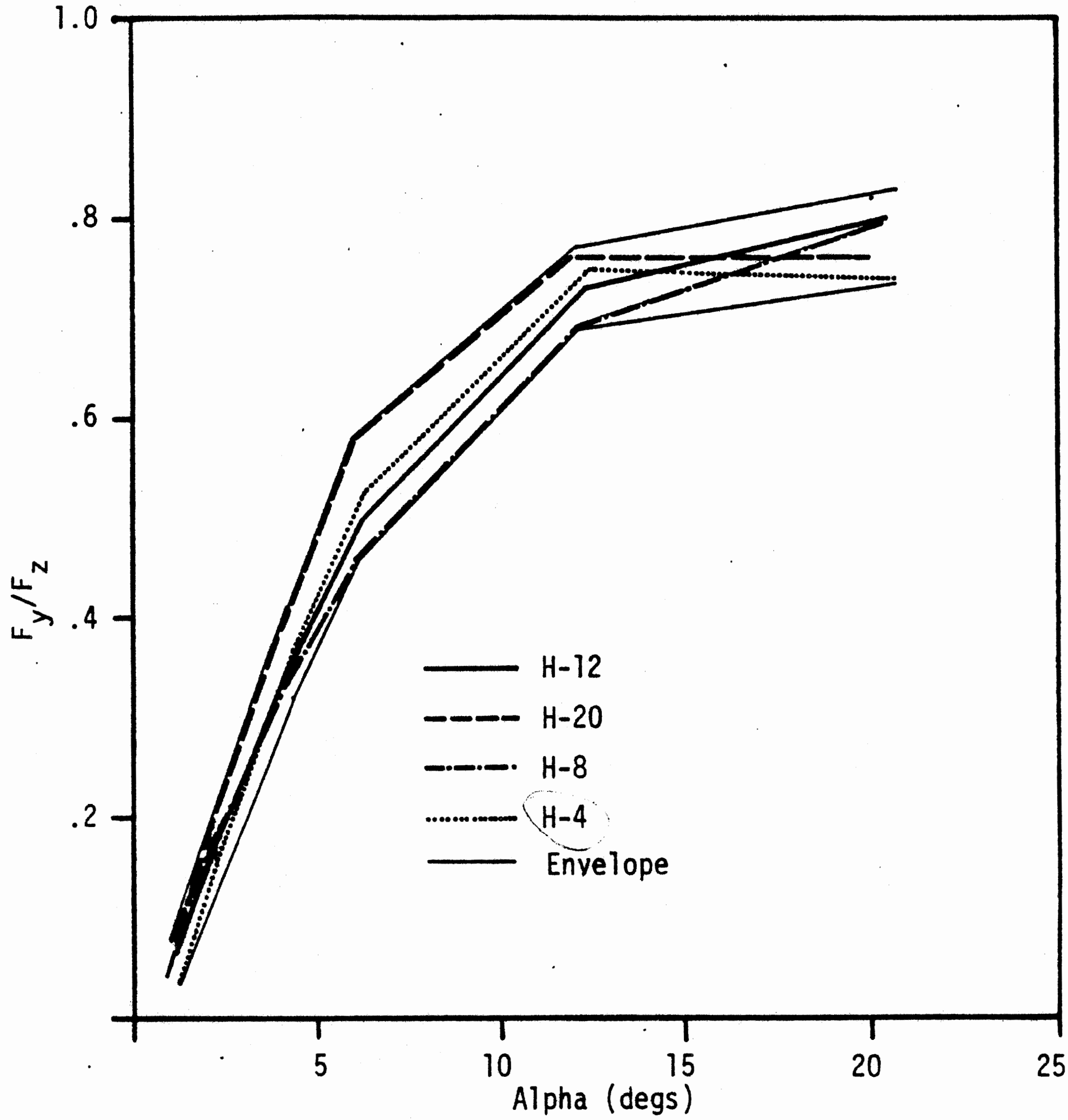


Figure 3.28. Envelope and specific examples of (F_y/F_z vs. α) measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 40 mph.

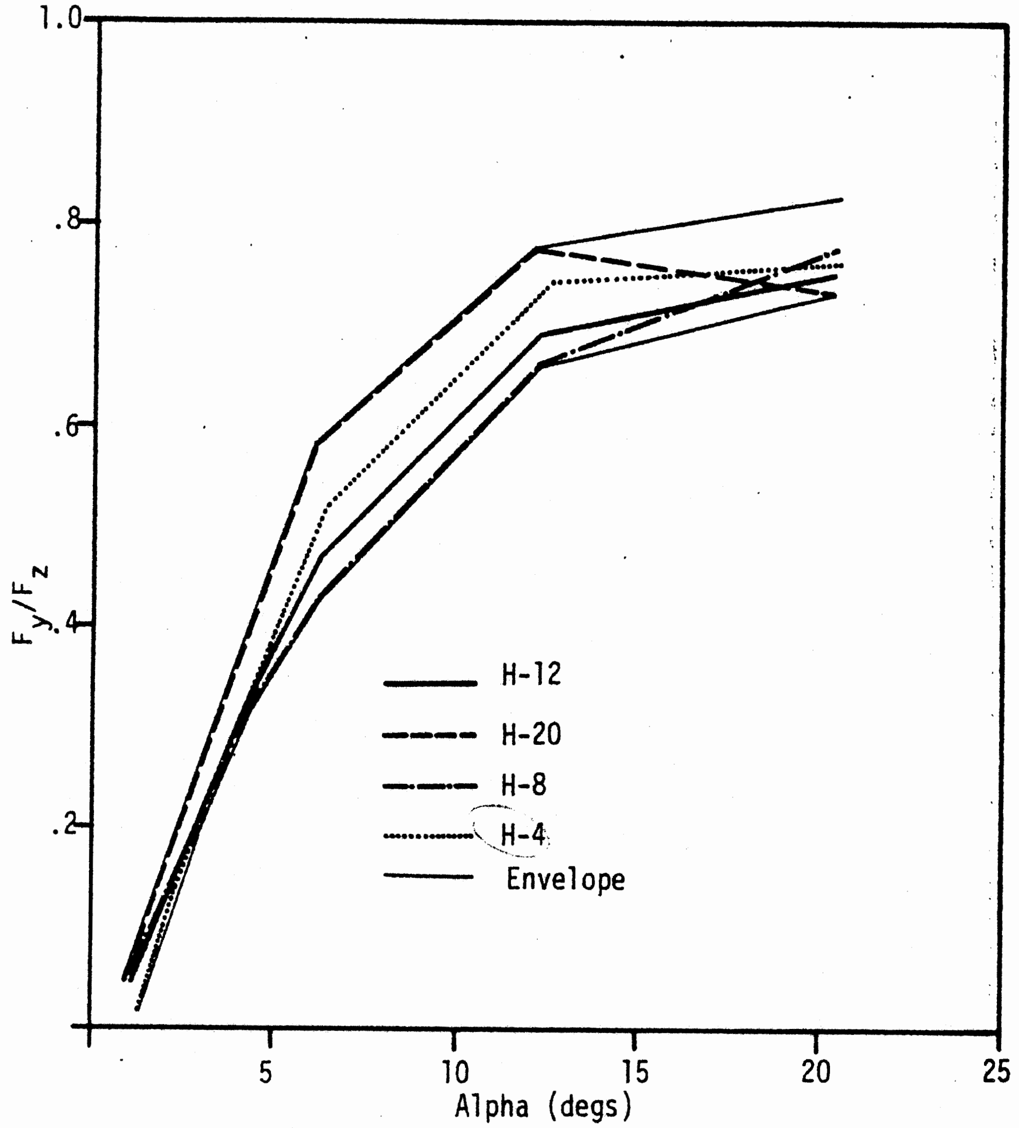


Figure 3.29. Envelope and specific examples of (F_y/F_z vs. α measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 55 mph.

UNIROY FLEETMASTER TRIPLE TREAD 10.00X20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-41.6	-294.7	228.9	-503.8	458.1	-860.8	818.4	-1278.9	1266.9	-1462.4	1492.0	-1614.3	1616.3
100.0	4000.0	-61.5	-490.1	381.2	-863.4	749.1	-1480.4	1398.0	-2278.7	2259.3	-2690.3	2716.4	-3036.9	3020.8
100.0	6000.0	-77.7	-605.0	469.5	-1088.9	962.6	-1916.2	1788.4	-3021.1	3005.0	-3671.7	3701.4	-4201.3	4202.1
100.0	8000.0	-94.1	-696.9	509.3	-1231.0	1087.5	-2157.1	2052.9	-3556.8	3515.5	-4467.5	4476.0	-5155.6	5149.2
75.0	4000.0	-67.2	-511.6	388.7	-890.1	792.0	-1533.3	1476.3	-2395.2	2376.0			-3077.1	3123.5
75.0	6000.0	-68.9	-581.0	442.9	-1054.3	940.7	-1869.5	1756.2	-3043.4	2996.2			-4001.1	4216.6
50.0	4000.0	-42.6	-461.2	373.8	-868.1	760.6	-1511.8	1417.8	-2320.9	2314.3			-3107.4	3107.7
50.0	6000.0	-51.9	-495.5	391.3	-904.9	811.0	-1675.6	1579.2	-2759.9	2733.9			-4189.2	3976.9

4

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	0.4	21.2	-26.3	36.4	-40.1	47.8	-58.6	36.5	-46.3	17.3	-29.2	6.5	-19.0
100.0	4000.0	2.7	64.7	-56.8	106.2	-103.7	148.5	-155.9	138.6	-152.9	89.5	-102.9	66.7	-68.0
100.0	6000.0	10.3	105.7	-87.7	177.8	-166.1	265.1	-268.4	273.8	-279.9	196.9	-216.6	144.1	-147.0
100.0	8000.0	12.2	142.8	-119.6	247.2	-228.6	378.2	-377.6	924.9	-430.8	335.3	-362.1	253.9	-252.4
75.0	4000.0	7.6	73.7	-75.0	138.9	-125.5	178.5	-188.9	164.5	-181.9			59.2	-72.8
75.0	6000.0	8.7	114.5	-104.6	202.1	-194.3	310.5	-314.2	333.5	-340.1			168.5	-167.9
50.0	4000.0	6.2	87.9	-81.3	152.0	-147.5	216.8	-225.5	199.4	-213.3			73.4	-92.2
50.0	6000.0	11.1	130.7	-124.1	248.1	-231.0	366.9	-374.5	397.9	-405.1			188.8	-208.6

B. F. ( )RICH MILSAVER HDR 10.00R20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-80.3	-372.6	224.1	-571.6	478.1	-905.7	865.4	-1309.3	1371.8	-1606.7	1596.4	-1722.5	1654.5
100.0	4000.0	-169.9	-710.6	410.5	-1157.2	894.6	-1786.4	1688.7	-2533.9	2584.4	-2925.4	2972.1	-3116.1	3152.3
100.0	6000.0	-220.6	-902.4	518.9	-1514.4	1147.4	-2409.1	2232.1	-3495.4	3468.8	-4063.7	4054.7	-4272.0	4225.3
100.0	8000.0	-217.2	-982.7	544.2	-1651.2	1229.7	-2729.0	2529.2	-4205.0	4047.9	-4823.6	4861.4	-5187.9	5158.7
75.0	4000.0	-156.0	-710.2	395.3	-1126.6	927.6	-1898.0	1752.1	-2653.4	2606.6			-3081.9	3191.6
75.0	6000.0	-190.0	-773.7	429.2	-1328.4	1017.2	-2283.7	2079.0	-3375.4	3297.5			-4039.1	4139.4
50.0	4000.0	-167.8	-689.6	367.7	-1167.5	886.4	-1898.0	1758.2	-2534.0	2533.2			-3025.8	3021.5
50.0	6000.0	-168.1	-667.0	352.6	-1145.4	855.3	-2024.0	1792.3	-3008.3	2935.9			-3912.3	3939.2

6 ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	6.0	24.8	-21.7	34.8	-34.3	38.8	-51.9	20.4	-46.5	9.4	-26.2	-1.2	-4.3
100.0	4000.0	26.9	87.7	-59.8	125.4	-115.7	147.9	-160.6	105.2	-157.7	77.8	-103.2	67.4	-63.9
100.0	6000.0	37.1	156.1	-99.9	235.0	-208.8	289.4	-309.3	233.1	-306.8	190.1	-205.8	156.9	-119.2
100.0	8000.0	52.9	225.7	-147.3	347.6	-302.4		-482.9	401.8	-442.6	299.8	-343.1	197.6	-205.8
75.0	4000.0	-25.6	43.8	-77.5	169.2	-161.9	220.7	-238.7	156.2	-185.2			49.2	-66.2
75.0	6000.0	-43.8	66.1	-130.5	307.3	-267.6	427.4	-434.5	332.6	-361.2			109.6	-136.4
50.0	4000.0	-36.9	54.8	-100.9	240.7	-204.5	259.1	-287.3	181.0	-213.5			38.9	-73.1
50.0	6000.0	-57.3	80.1	-152.7	396.1	-314.6	519.0	-545.7	416.5	-452.8			143.3	-174.3

B. F. GC ICH MILESAVER HDB 10.00R20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-63.7	-297.6	197.3	-510.7	426.6	-832.7	762.5	-1272.4	1241.5	-1500.2	1494.9	-1579.6	1576.0
100.0	4000.0	-154.8	-633.8	370.1	-1045.6	814.4	-1641.7	1510.4	-2379.6	2340.3	-2717.1	2722.2	-2825.8	2858.5
100.0	6000.0	-191.0	-831.8	472.5	-1377.4	1048.2	-2239.9	2030.4	-3271.2	3222.6	-3734.1	3752.6	-3903.8	3929.2
100.0	8000.0	-215.5	-897.7	507.0	-1551.8	1163.8	-2599.9	2340.3	-3943.5	3867.3	-4541.4	4502.8	-4822.4	4802.7
75.0	4000.0	-153.1	-649.8	377.2	-1111.8	848.6	-1742.5	1621.3	-2438.7	2425.6			-2852.5	2878.5
75.0	6000.0	-180.9	-772.3	421.7	-1297.2	974.8	-2193.8	1985.4	-3208.3	3168.2			-3879.9	3876.7
50.0	4000.0	-156.6	-684.7	363.5	-1156.9	852.3	-1803.5	1661.3	-2439.9	2436.7			-2823.5	2828.8
50.0	6000.0	-167.0	-668.0	349.7	-1184.1	891.3		1805.3	-2970.6	2901.5			-3689.2	3689.1

7 ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	5.1	25.4	-19.6	32.2	-35.2	41.1	-49.7	33.6	-35.1	9.1	-25.9	5.3	-8.1
100.0	4000.0	20.3	75.0	-47.3	107.1	-97.7	134.1	-143.5	102.8	-110.0	45.8	-73.8	9.3	-30.2
100.0	6000.0	35.1	133.6	-83.6	198.7	-172.1	258.5	-270.5	216.1	-225.7	122.5	-158.4	49.5	-71.8
100.0	8000.0	55.6	195.2	-114.3	302.8	-277.0	410.0	-416.5	361.6	-381.2	223.5	-255.6	110.4	-133.9
75.0	4000.0	22.3	100.1	-67.8	149.9	-130.1	177.8	-233.3	121.1	-144.4			8.7	-32.0
75.0	6000.0	37.8	167.4	105.0	266.2	-221.5	343.9	-442.8	273.4	-302.3			63.4	-106.5
50.0	4000.0	28.6	130.0	-84.6	195.0	-170.7	269.4	-192.5	141.1	-165.1			20.9	-40.7
50.0	6000.0	39.8	209.3	-128.1	336.9	-268.6		-355.1	340.3	-367.3			116.1	-143.7

GOODY UNISTEEL R-1 10.00R20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-12.6	-402.8	362.6	-686.3	662.9	-1131.0	1054.4	-1608.7	1553.0	-1840.8	1850.0	-1961.1	1937.0
100.0	4000.0	-15.4	-535.0	565.5	-1074.9	1053.9	-1897.6	1825.1	-2787.8	2729.6	-3217.2	3188.2	-3377.4	3391.3
100.0	6000.0	4.7	-643.2	633.4	-1197.2	1210.2	-2270.9	2191.5	-3639.8	3561.1	-4247.5	4192.3	-4488.2	4499.0
100.0	8000.0	11.3	-635.8	630.7	-1203.9	1211.4	-2326.8	2275.1	-4042.7	4026.9	-4940.5	4896.9	-5328.7	5363.3
75.0	4000.0	-3.9	-541.2	525.9	-1031.7	1004.7	-1862.6	1853.2	-2841.9	2789.3			-3362.5	3313.1
75.0	6000.0	-4.5	-520.6	518.2	-1039.0	1010.7	-2012.2	1975.9	-3374.0	3365.4			-4332.6	4270.7
50.0	4000.0	8.0	-478.2	459.9	-911.2	916.2	-1777.4	1741.8	-2679.6	2678.9			-3223.3	3122.4
50.0	6000.0	-2.5	-425.8	417.6	-807.9	802.2	-1626.1		-2915.2	2962.2			-4029.6	3946.3

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-1.4	33.4	-36.8	57.0	-61.6	66.6	-68.8	47.1	-43.9	28.8	-34.4	16.8	-17.4
100.0	4000.0	-1.9		-103.9	160.9	-162.6	210.1	-212.4	180.6	-155.4	117.0	-116.8	72.5	-61.7
100.0	6000.0	-6.7	148.1	-166.9	270.1	-284.3	397.6	-401.9	363.2	-326.5	247.8	-248.4	155.6	-142.0
100.0	8000.0	-14.6	191.0	-224.1	373.1	-388.6	596.0	-601.4	612.8	-582.3	423.6	-425.9	265.1	-260.9
75.0	4000.0	-9.0	112.7	-124.5	193.8	-197.1	265.2	-268.1	207.4	-212.6			67.5	-61.0
75.0	6000.0	-11.7	167.4	-184.9	306.0	-319.5	488.5	-488.4	449.9	-455.3			171.7	-153.1
50.0	4000.0	-8.9	137.9	-150.4	237.7	-256.2	327.9	-338.1	250.0	-231.4			92.4	-75.1
50.0	6000.0	-15.6	183.3	-211.5	355.7	380.0	594.6	-611.7	557.6	-533.7			208.2	-203.3

GOODYEA NISTEEL L-1 10.00R20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-12.6	-301.6	264.9	-539.2	519.5	-937.2	904.9	-1452.6	1415.6	-1721.4	1708.4	-1885.4	1850.6
100.0	4000.0	-3.1	-549.4	520.3	-1004.2	994.0	-1783.5	1716.9	-2683.5	2637.8	-3052.5	3045.3	-3296.6	3241.4
100.0	6000.0	4.3	-705.4	694.7	-1302.8	1299.6	-2376.4	2310.3	-3618.9	3586.5	-4188.3	4149.3	-4498.4	4445.8
100.0	8000.0	12.4	-746.3	747.4	-1437.3	1453.2	-2703.6	2660.5	-4311.5	4262.5	-5064.8	5035.9	-5553.9	5514.5
75.0	4000.0	2.3	-556.1	571.3	-1069.4	1042.0	-1892.5	1886.2	-2799.0	2740.6			-3357.0	3311.9
75.0	6000.0	17.2	-596.3	644.0	-1223.2	1255.7	-2297.8	2290.1	-3598.3	3564.8			-4433.6	4349.8
50.0	4000.0	16.9	-522.0	572.0	-1052.4	1091.8	-1939.4	1914.9	-2759.6	2723.6			-3279.8	3232.5
50.0	6000.0	33.8	-472.6	566.8	-1037.5	1120.9	-2085.3	2126.4	-3382.3	3326.9			-4236.4	4157.8

6 ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-3.7	22.3	-28.0	36.3	-44.4	53.5	-58.1	50.2	-46.9	29.2	-23.2	16.4	-11.6
100.0	4000.0	-3.7	66.3	-80.6	120.0	-128.5	177.2	-173.0	166.1	-134.9	95.1	-76.7	51.9	-25.4
100.0	6000.0	-8.6	112.1	-132.0	212.5	-222.7	331.1	-317.6	319.7	265.6	185.3	-150.9	118.2	-67.8
100.0	8000.0	-11.5	161.2	-186.7	308.2	-320.4	503.3	-484.8	516.3	-435.5	335.6	-272.6	252.7	-164.0
75.0	4000.0	-7.4	8350.5	-102.5	156.6	-160.5	226.0	-222.4	200.4	-161.1			76.1	-28.2
75.0	6000.0	-10.9	83.9	-160.7	261.6	-270.4	407.1	-391.8	380.1	-311.9			159.2	-93.3
50.0	4000.0	-10.3	99.6	-128.4	194.0	-205.7	255.6	-257.5	214.9	-155.3			84.8	-37.3
50.0	6000.0	-18.2	140.0	-194.4	312.0	-340.1	501.8	-480.4	437.1	-368.0			193.1	-127.7

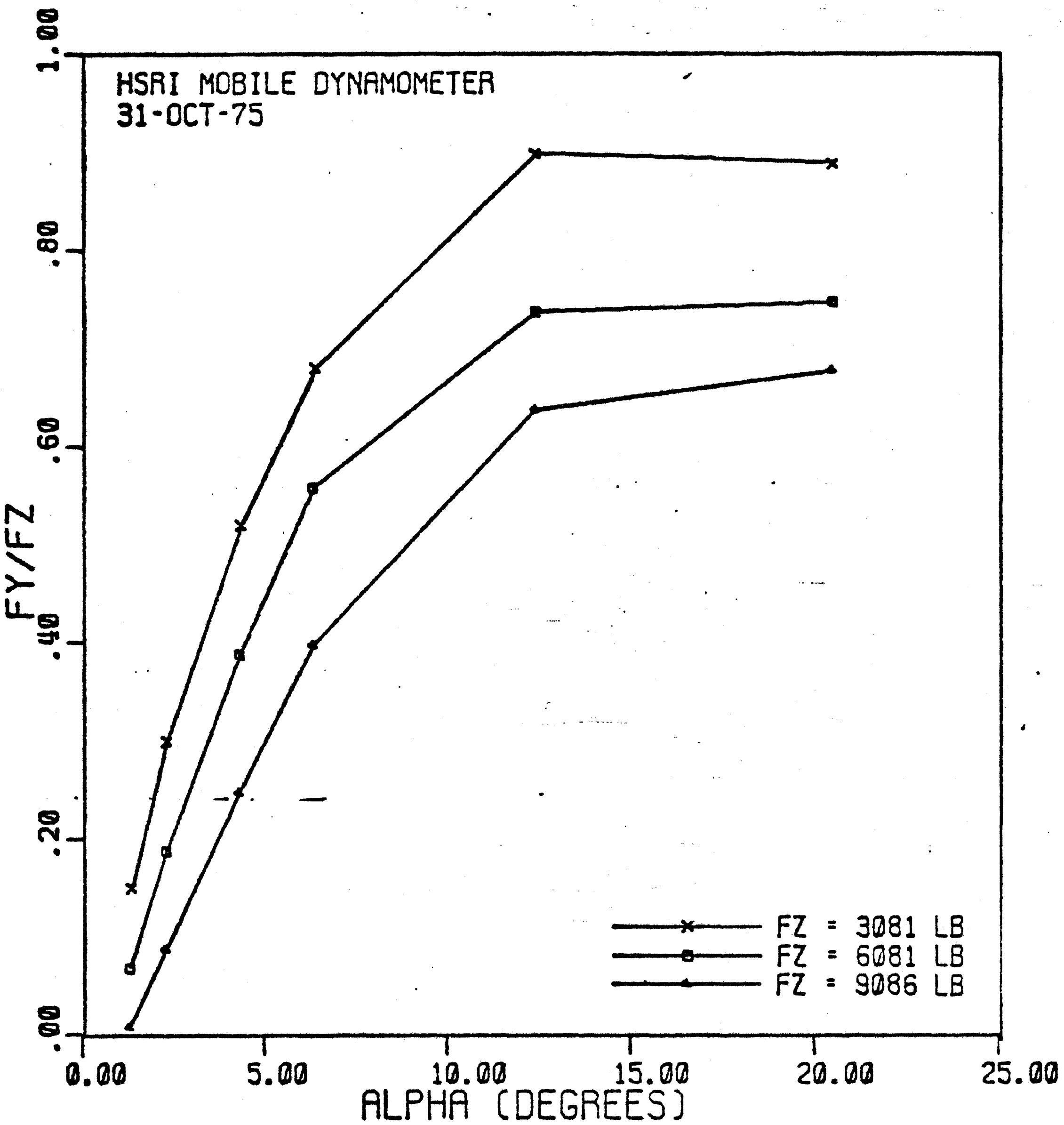
MICHE   RADIAL 18.00R20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

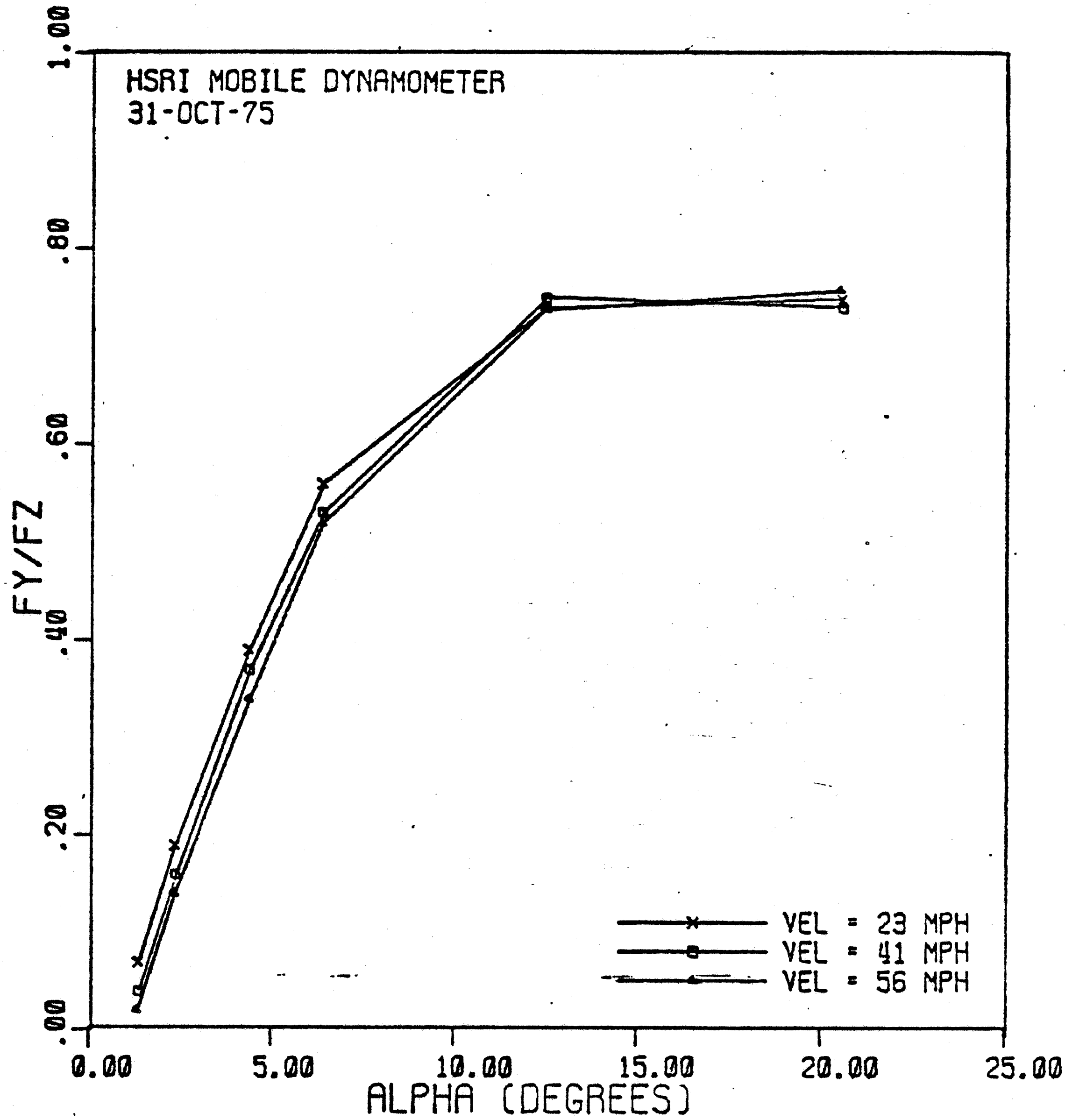
PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-15.1	-309.6	295.9	-576.4	547.3	-1023.4	972.1	-1626.9	1501.7	-1821.9	1717.6	-1858.1	1667.0
100.0	4000.0	-5.0	-576.8	565.6	-1093.7	1081.1	-1952.7	1879.1	-2856.9	2765.5	-3175.8	3136.3	-3259.7	2934.1
100.0	6000.0	5.1	-696.3	705.8	-1380.2	1366.0	-2512.4	2449.2	-3715.9	3640.0	-4208.7	4152.6	-4330.2	3907.8
100.0	8000.0	2.8	-759.3	736.7	-1500.6	1453.5	-2801.4	2712.3	-4218.5	4162.4	-5000.0	4944.8	-5178.8	4770.5
75.0	4000.0	-3.1	-617.4	613.5	-1197.6	1165.3	-2081.6	2091.7	-2881.0	2739.8			-3315.0	3207.4
75.0	6000.0	-1.1	-704.4	681.0	-1359.0	1325.8	-2538.0	2443.7	-3605.7	3535.6			-4397.2	4286.3
50.0	4000.0	-4.3	-616.4	580.7	-1179.0	1156.5	-2073.0	1995.5	-2754.7	2713.6			-3250.2	3158.8
50.0	6000.0	-15.5	-604.0	550.2	-1194.4	1126.6	-2205.4	2089.4	-3238.8	3188.5			-4170.8	4069.3

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	0.4	29.6	-28.9	48.0	-50.6	69.1	-70.9	65.9	-64.1	34.4	-33.0	11.6	-4.6
100.0	4000.0	-5.4	83.3	-92.8	146.1	-151.5	219.5	-218.1	188.8	-183.1	110.6	-104.5	39.4	-23.3
100.0	6000.0	-9.0	135.7	-154.1	250.0	-267.0	383.9	-391.6	345.6	-349.4	218.2	-215.0	93.5	-59.6
100.0	8000.0	-11.6	187.5	-212.0	361.5	-379.7	571.2	-589.8	554.6	-563.7		-375.3	168.1	-127.0
75.0	4000.0	-12.0	98.0	-114.5	179.0	-191.0	231.9	-244.1	192.6	-168.1			67.0	-49.9
75.0	6000.0	-14.8	158.0	-186.7	306.9	-328.1	430.4	-453.7	373.6	-363.6			151.0	-138.6
50.0	4000.0	-14.1	121.6	-147.2	222.6	-243.9	268.1	-297.3	223.8	-190.7			71.8	-63.2
50.0	6000.0	-17.8	185.2	-224.5	361.5	-396.9	509.8	-552.6	459.3	-433.8			173.6	180.9

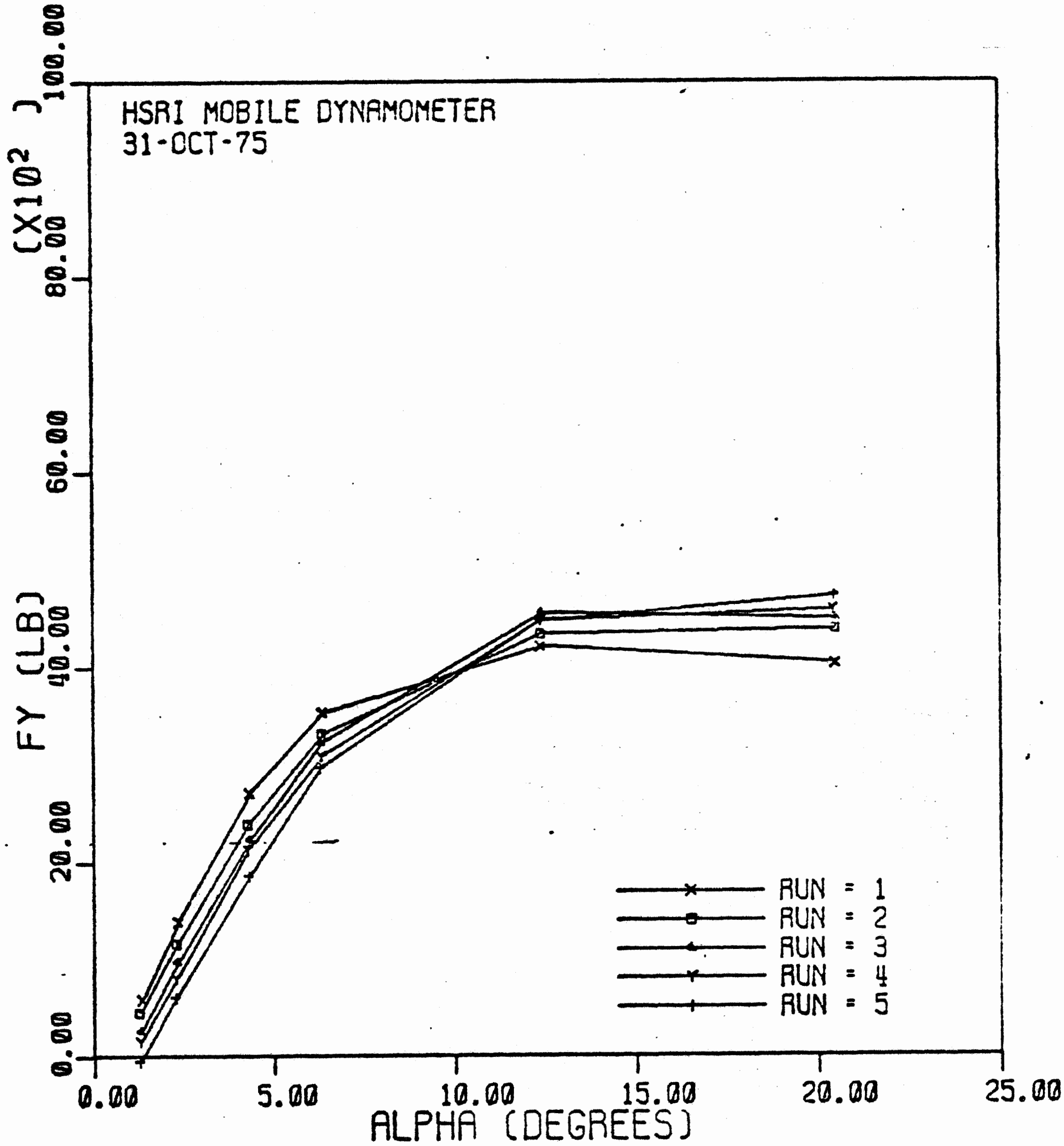


B. F. GOODRICH MILESAVER RADIAL STEEL HDR 10.00R20/G
VEL = 22 MPH

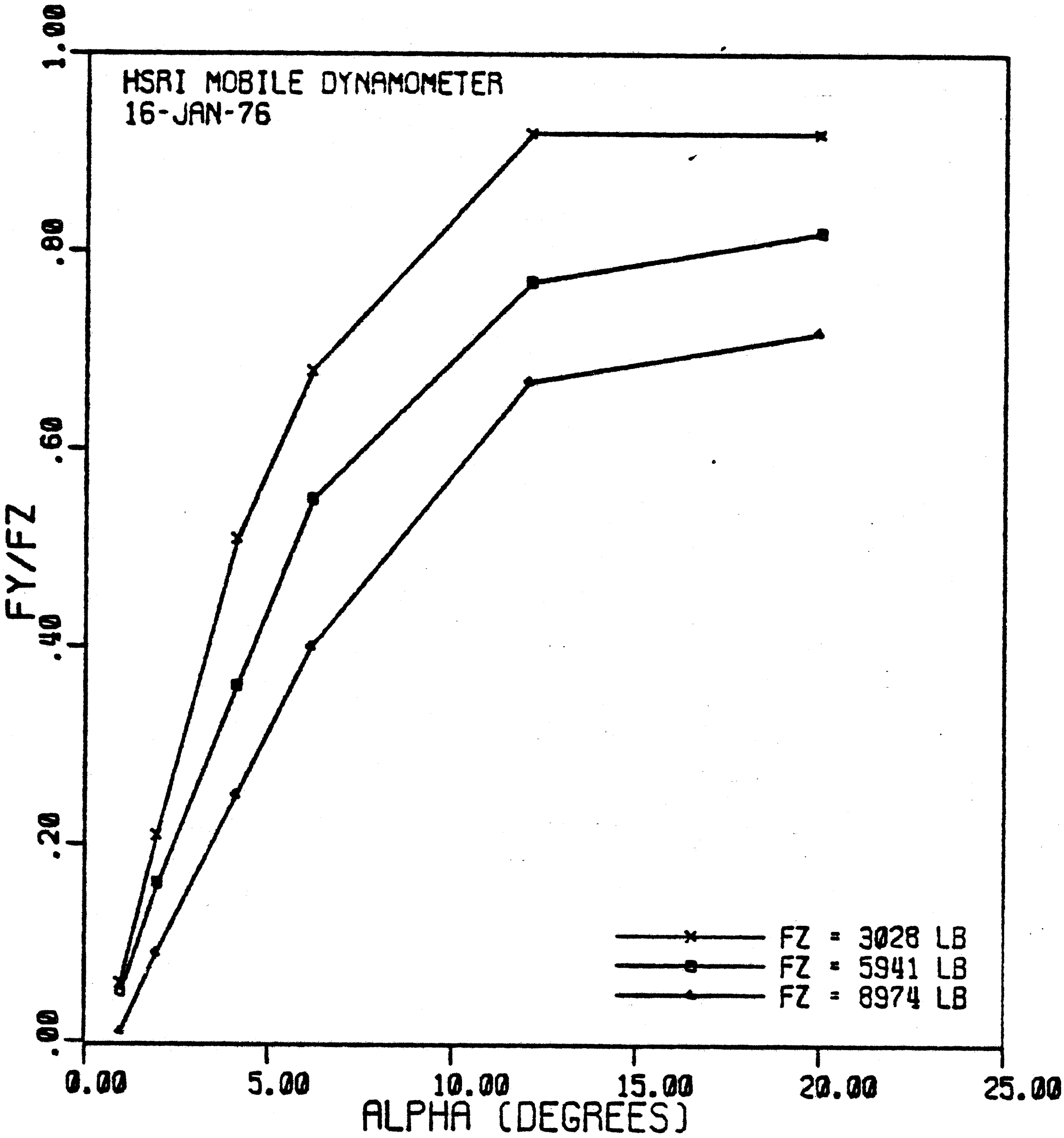


B. F. GOODRICH MILESAVER RADIAL STEEL HDR 10.00R20/G
FZ = 6080 LB

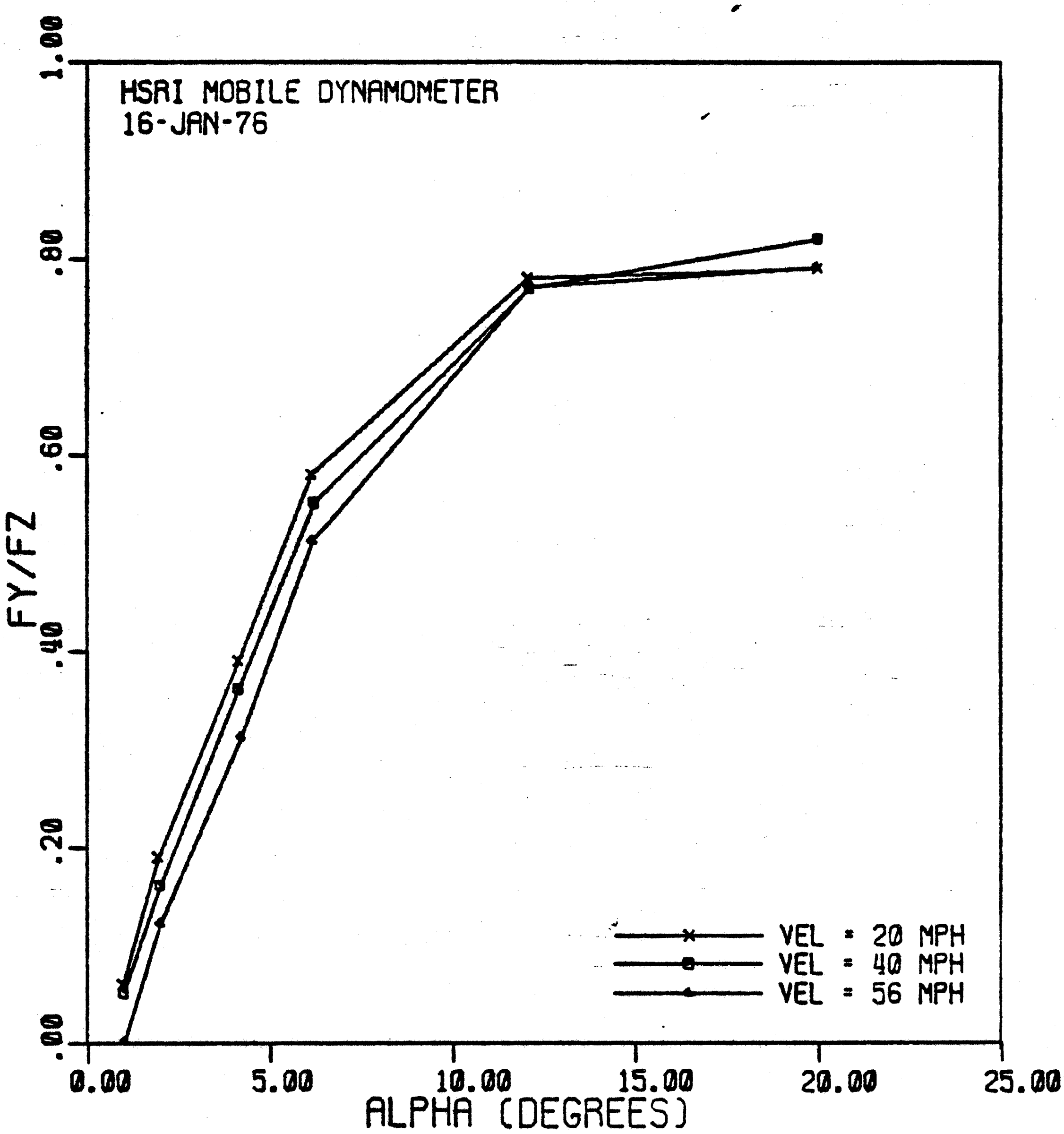
r



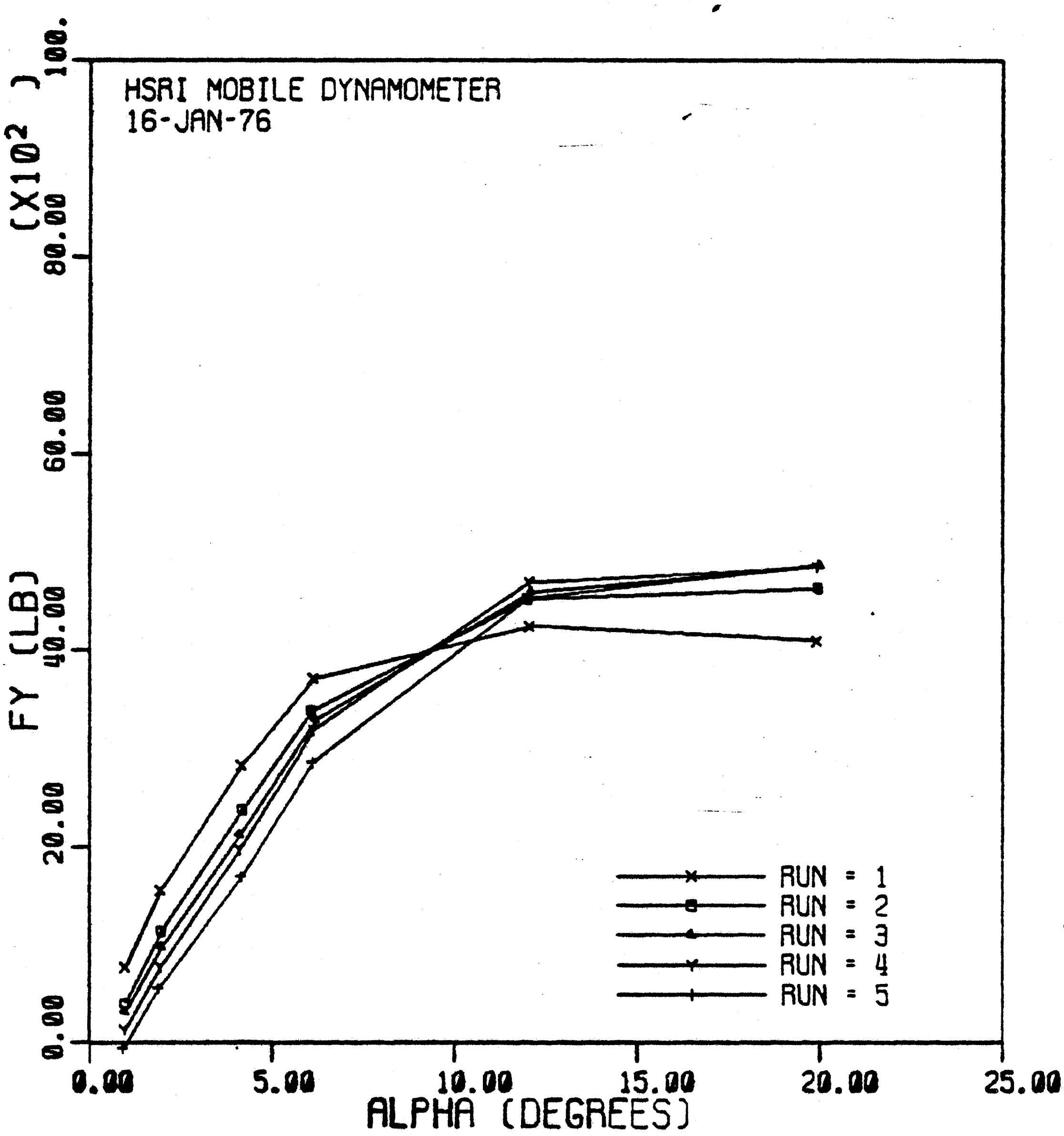
B. F. GOODRICH MILESAVER RADIAL STEEL HDR 10.00R20/G
FZ = 6063 LB VEL = 41 MPH



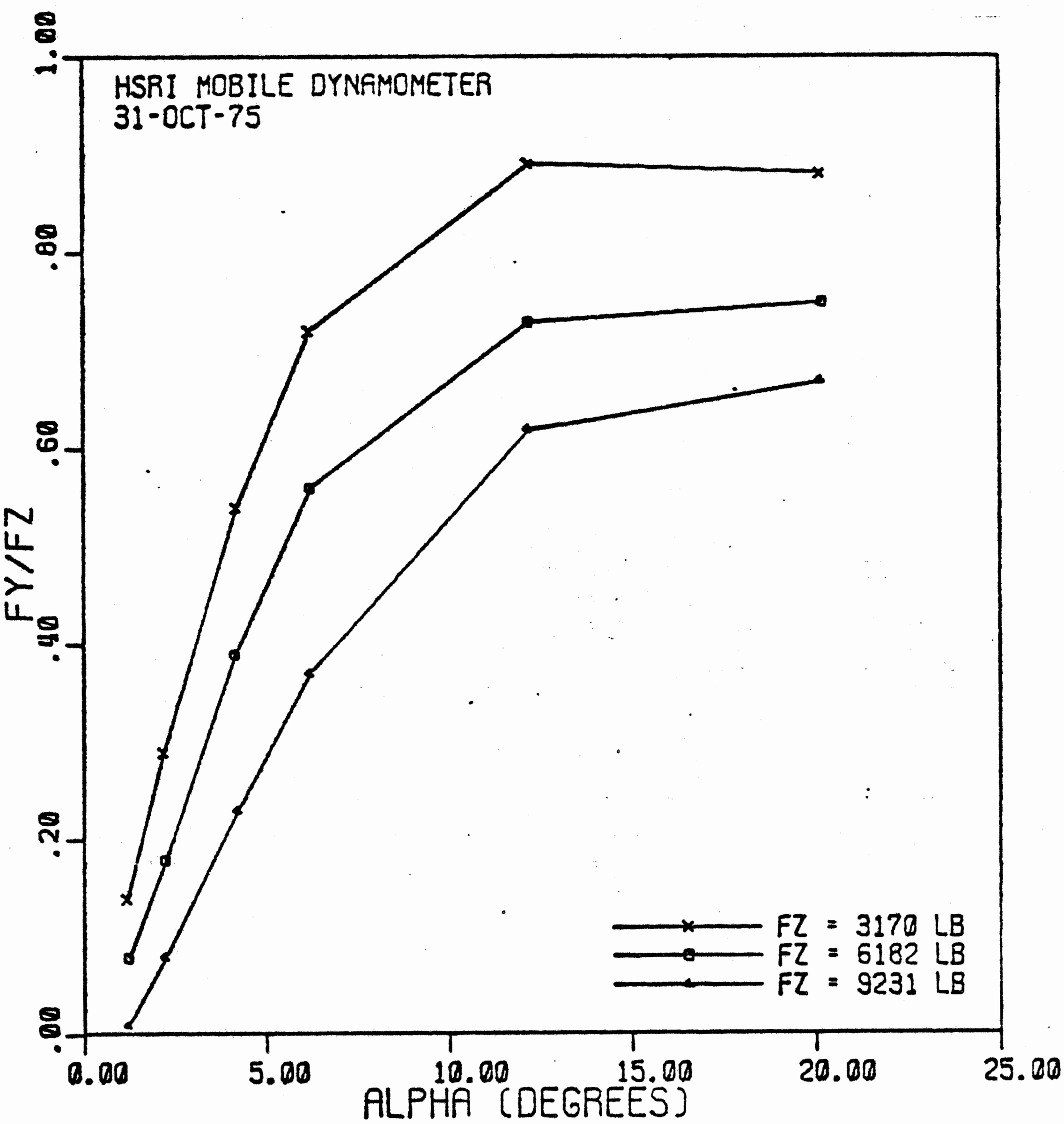
BFG MILESAVER RADIAL HDB 10.00R20/G
VEL = 40 MPH



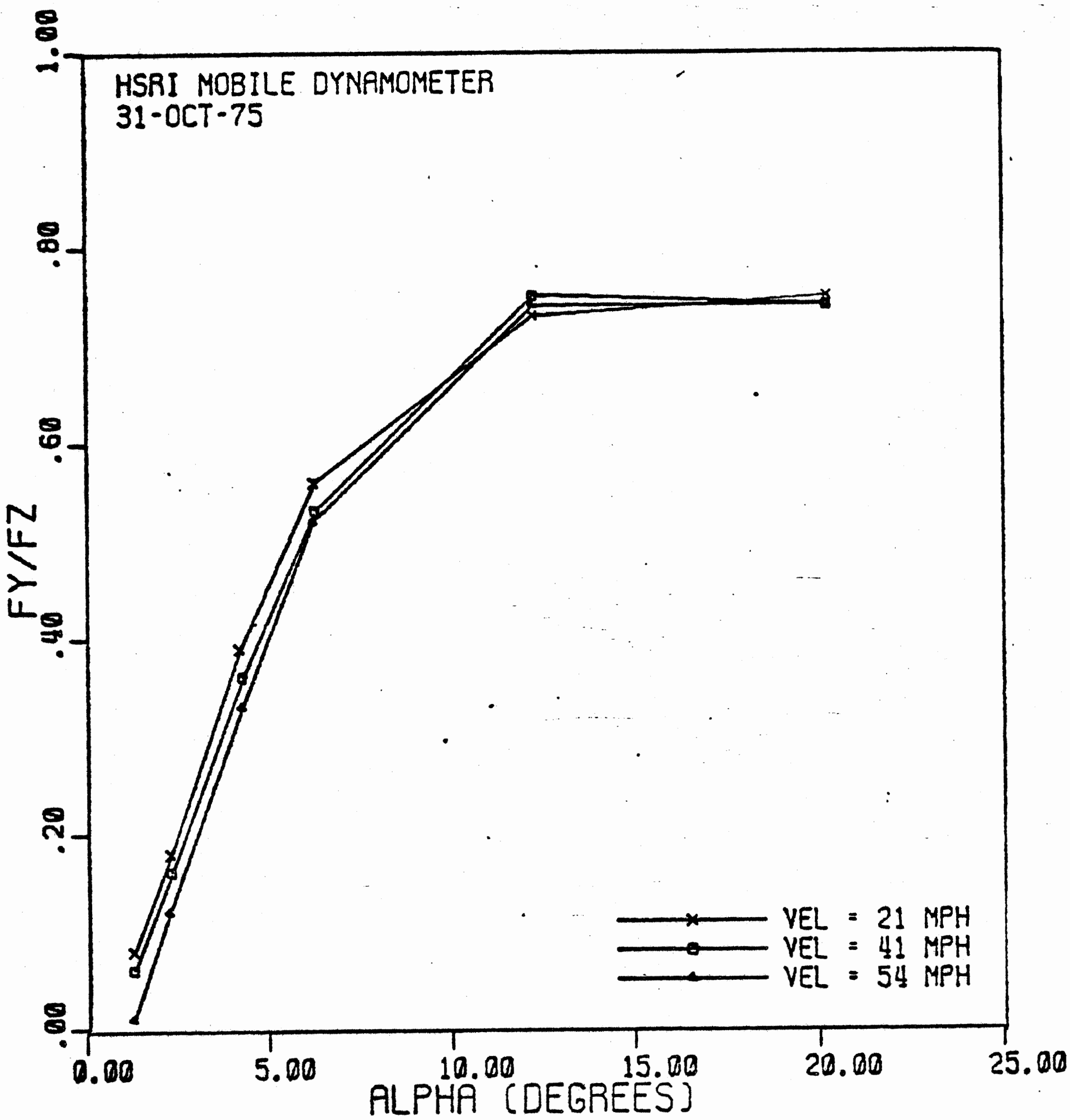
BFG MILESAVER RADIAL HDB 10.00R20/G
FZ = 5943 LB



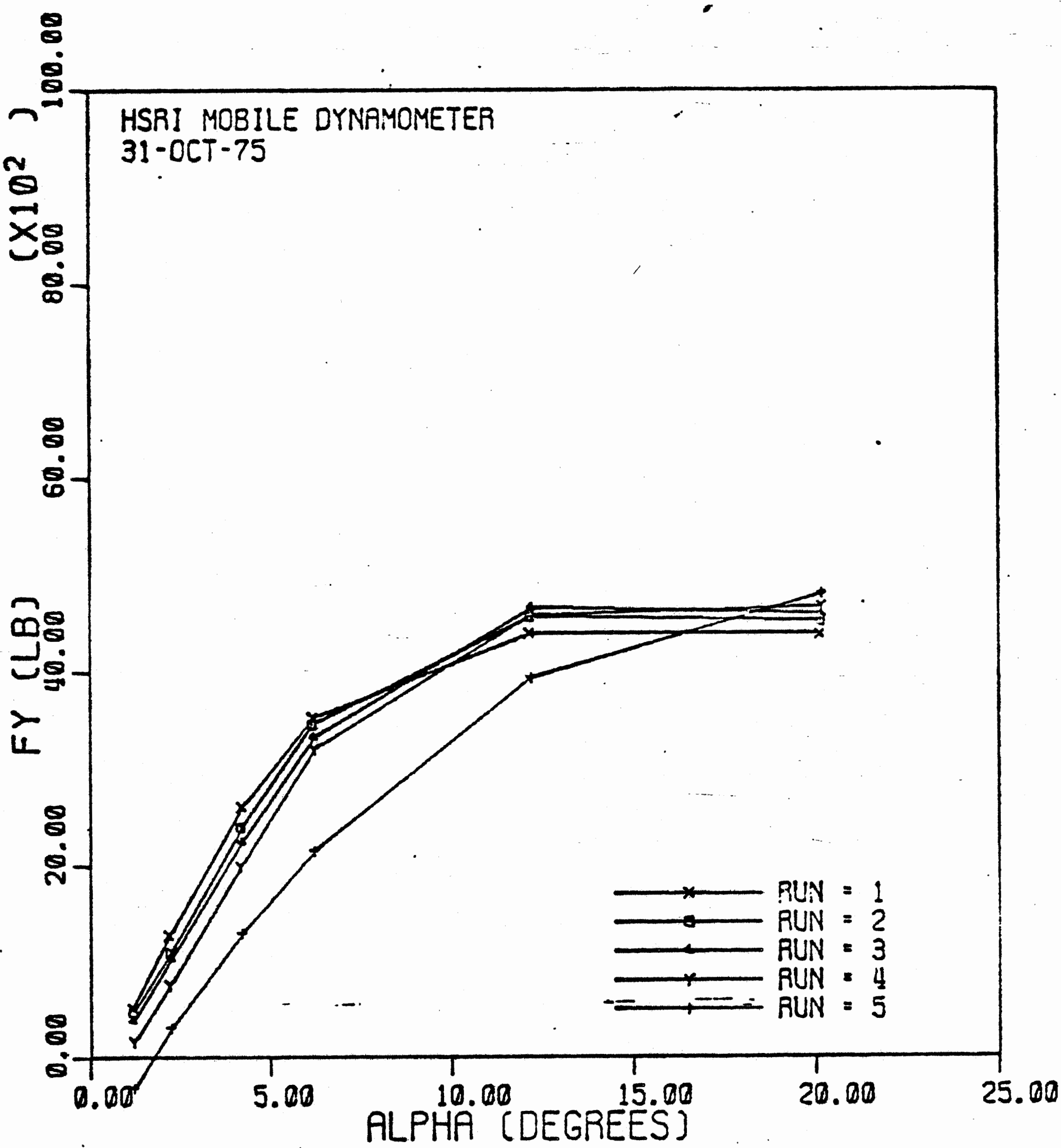
BFG MILESAVER RADIAL HDB 10.00R20/G
FZ = 5944 LB VEL = 40 MPH



GOODYEAR UNISTEEL R-1 10.00R20/G
VEL = 21 MPH



GOODYEAR UNISTEEL A-1 10.00R20/G
FZ = 6243 LB

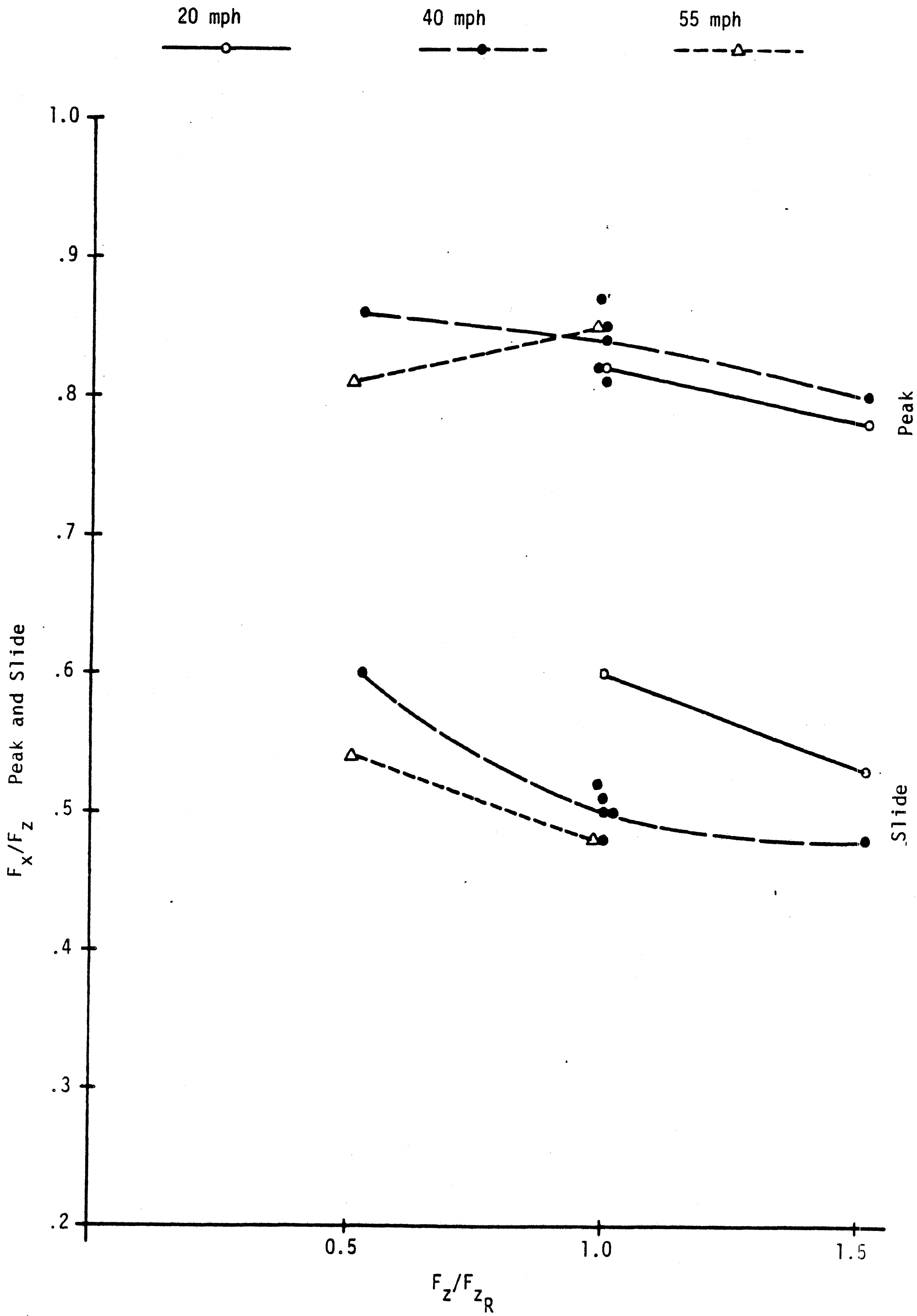


GOODYEAR UNISTEEL R-1 10.00R20/G
FZ = 6255 LB VEL = 41 MPH

Measurements on each of eight tire specimens are provided in the following tabular and graphic forms, presenting, first, a summary of the peak and slide values of F_x/F_z at all load and velocity conditions. Next, each tire's run-by-run traction performance is represented in both tables and print-plots of F_x/F_z (labeled "MUX") versus longitudinal slip.

The following heavy tires are represented in this data set.

Tire Code	Manufacturer	Model	Size
H-1	Uniroyal	Triple Tread	10.00 x 20F
H-4	B.F. Goodrich	Milesaver Radial H.D.R.	10.00 R 20G
H-5	B.F. Goodrich	Milesaver Radial H.D.B.	10.00 R 20G
H-6	Goodyear	Unisteel R-1	10.00 R 20G
H-8	Firestone	Power Drive	10.00 x 20F
H-12	Firestone	Commercial Mileage	12.5 x 22.5G
H-18	Michelin	Radial XZA	11 R 20H
H-19	Michelin	Radial XZA	11 R 22.5H



Summary - B.F. Goodrich Milesaver Radial - 10 R 20G

** A-D FILE 198 N. FILE 101 TEST SAMPLE209 **

AVERAGE OF FILE 198 FOR 6 RECORDS. BFG MILESAVER RADIAL HDR 10.0R-20/G (DANA)

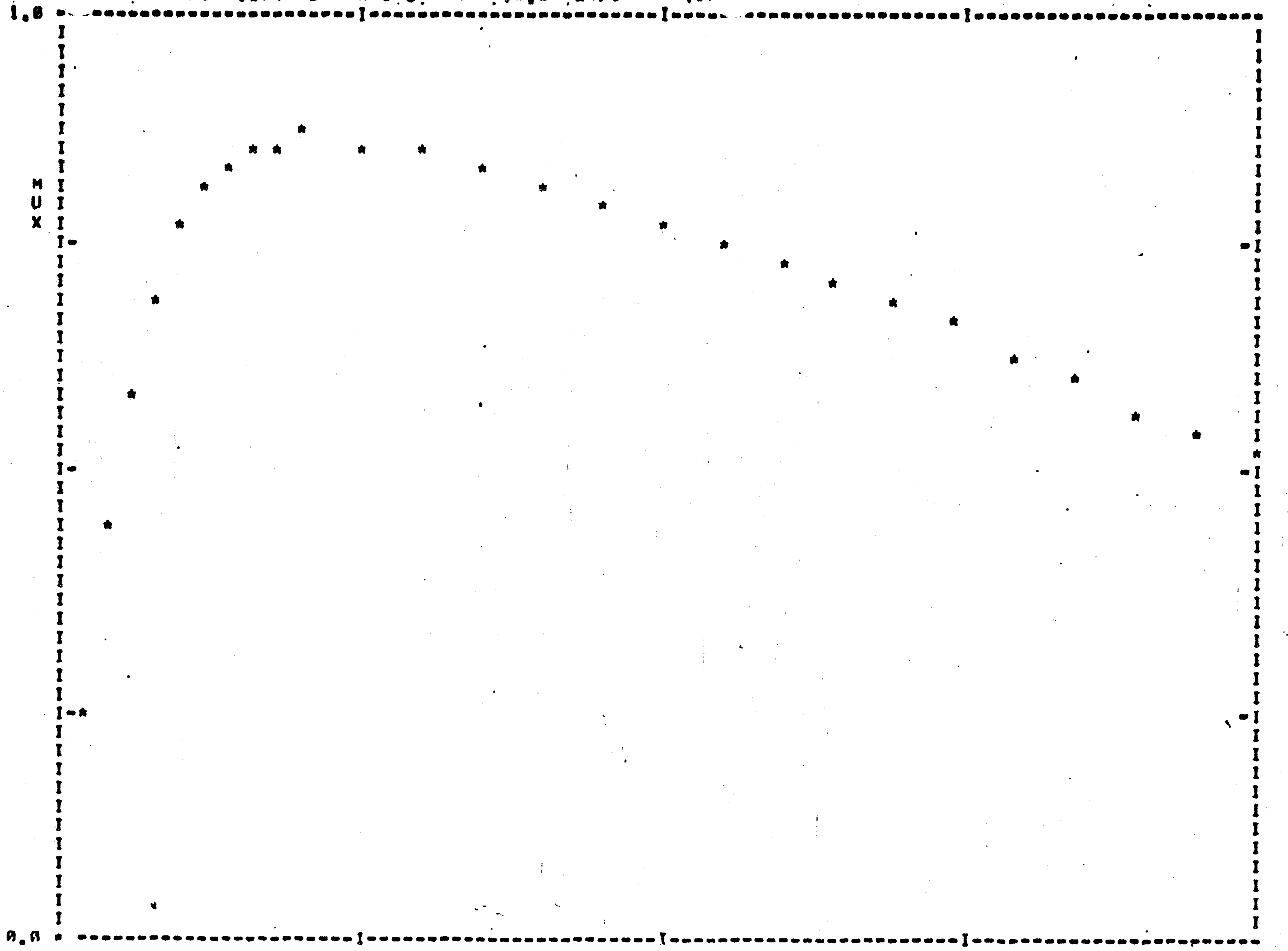
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.25	31571.0	1592.6
0.04	0.45	56716.5	2699.3
0.06	0.59	74884.6	3557.3
0.08	0.70	87991.8	4161.4
0.10	0.77	97344.6	4566.4
0.12	0.81	104014.1	4823.0
0.14	0.84	108925.1	4981.1
0.16	0.86	112696.0	5072.1
0.18	0.87	115526.2	5115.6
0.20	0.87	117592.6	5121.7
0.25	0.87	121764.0	5083.7
0.30	0.86	125462.8	5015.8
0.35	0.84	128775.6	4926.3
0.40	0.83	131891.5	4822.5
0.45	0.81	134940.8	4702.1
0.50	0.78	137430.2	4570.1
0.55	0.76	138425.8	4433.2
0.60	0.74	136937.4	4298.6
0.65	0.72	132362.7	4166.2
0.70	0.69	125262.3	4027.2
0.75	0.67	115499.3	3877.5
0.80	0.64	103306.6	3723.2
0.85	0.61	96893.6	3568.8
0.90	0.58	84361.7	3417.7
0.95	0.55	71982.1	3292.6
1.00	0.52	62958.3	3272.5

TOAV = 62958.3 LOAD = 5954.5 VEL = 40.0 MPH.

MUPEAK = 0.87 MULOCK = 0.52 RATIO = 1.66

316

BFG MILESAVER RADIAL HDR 10.0R-20/G (D)



FZ = 5954.5 VFL = 40.0 MULOCK = 0.52 MUPEAK = 0.87 RATIO = 1.66 A-D FILE 198 NWFILE 101 SAMPLE 209

** A-D FILE 200 . FILE 103 TEST SAMPLE 211 **

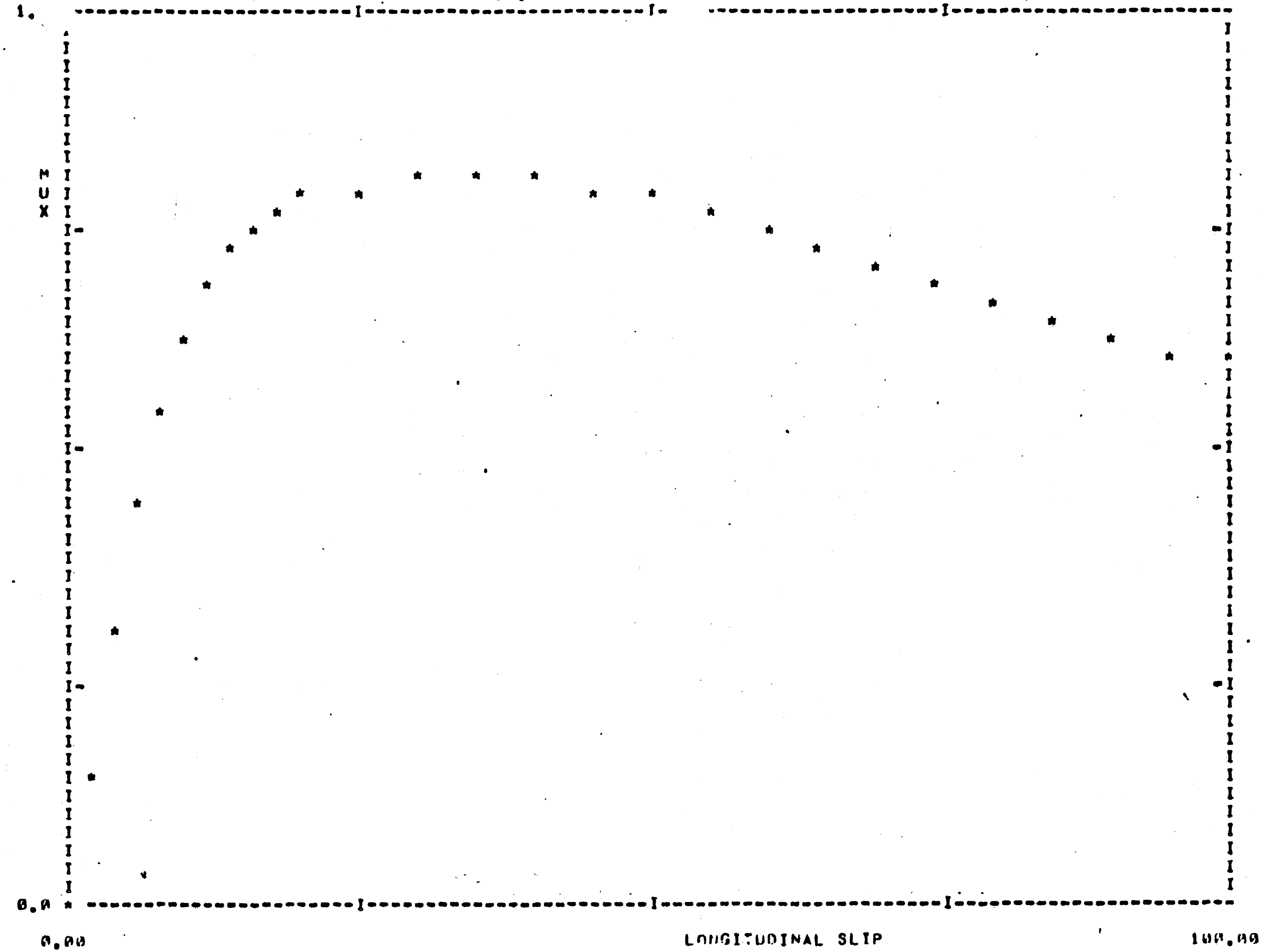
AVERAGE OF FILE 200 FOR 6 RECORDS. BFG MILESAVER RADIAL HDR 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.15	17702.0	905.0
0.04	0.31	38789.3	1886.1
0.06	0.45	56839.2	2730.0
0.08	0.56	70440.6	3371.1
0.10	0.64	80219.3	3826.5
0.12	0.69	87356.2	4146.2
0.14	0.73	92794.0	4377.5
0.16	0.76	97140.3	4538.9
0.18	0.78	100782.5	4650.2
0.20	0.79	103718.0	4712.3
0.25	0.81	109915.0	4792.0
0.30	0.81	115634.3	4831.0
0.35	0.82	120894.6	4828.8
0.40	0.81	125230.2	4800.0
0.45	0.80	128034.2	4752.6
0.50	0.79	128365.5	4693.2
0.55	0.78	126422.5	4618.5
0.60	0.77	122736.8	4524.6
0.65	0.75	117398.4	4433.6
0.70	0.72	110359.6	4266.3
0.75	0.70	102201.2	4131.0
0.80	0.68	94599.5	4010.3
0.85	0.66	88351.8	3898.0
0.90	0.64	82548.3	3788.8
0.95	0.62	77308.6	3682.4
1.00	0.60	72916.7	3580.0

TQAV = 72916.7 LOAD = 6021.2 VEL = 20.0 MPH

MUPEAK = 0.82 MULOCK = 0.60 RATIO = 1.35

BFG MILESAVER RADIAL HDR 10.0R-20/G NA)



FZ = 6021.2 VEL = 20.0 MULOCK = 0.60 MUPEAK = 0.82 RATIO = 1.35 A-D FILE 200 NWFILE 103 SAMPLE 211

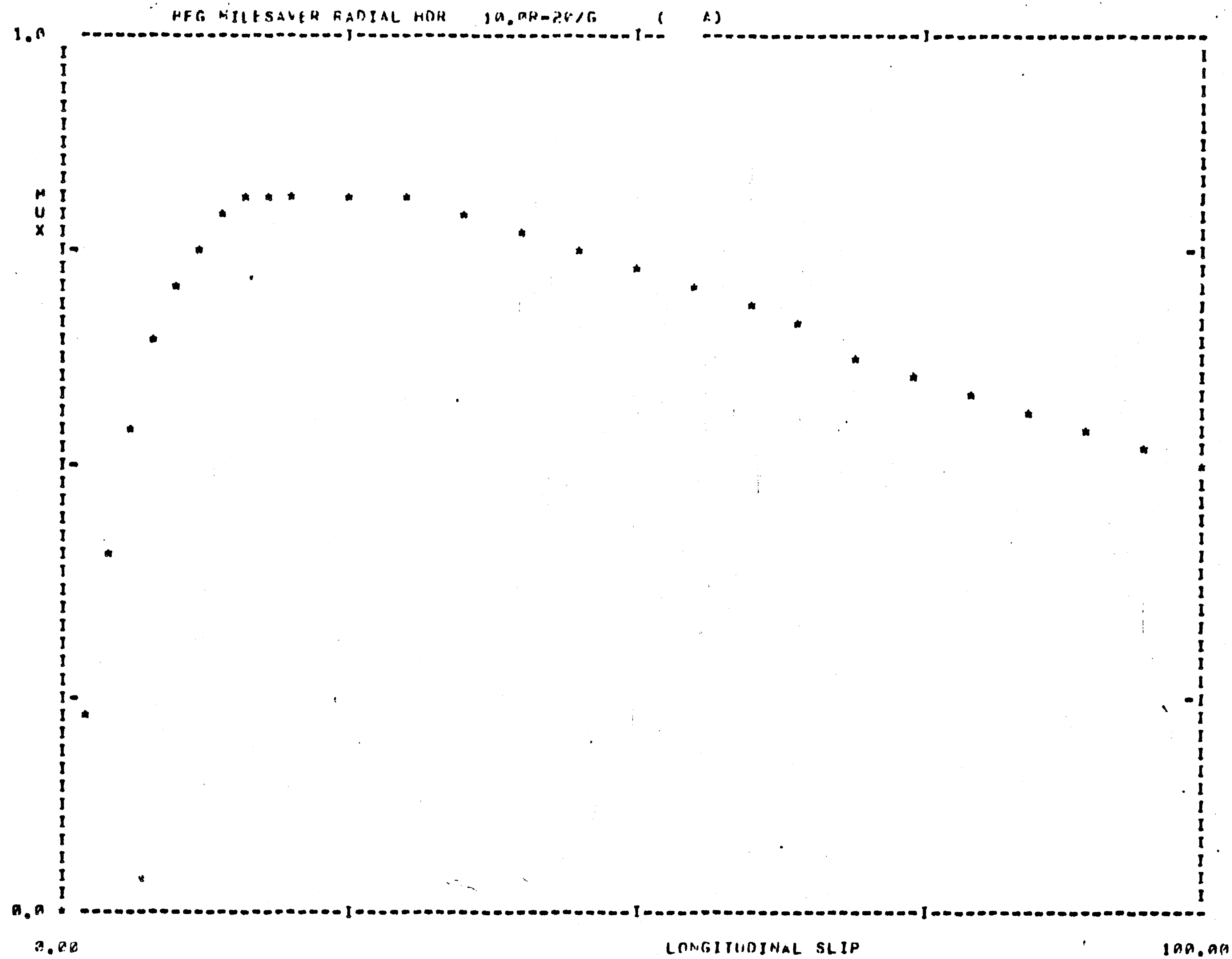
** A-D FILE 201 NEW FILE 100 TEST SAMPLE212 **

AVERAGE OF FILE 201 FOR 6 RECORDS. BFG MILESAVER RADIAL HDR 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	27294.2	1338.2
0.04	0.42	52779.7	2523.2
0.06	0.56	70669.3	3339.7
0.08	0.65	83724.4	3908.6
0.10	0.72	93043.9	4296.0
0.12	0.76	99804.5	4554.1
0.14	0.79	104942.7	4721.0
0.16	0.81	108965.6	4822.5
0.18	0.82	112163.6	4875.6
0.20	0.82	114657.2	4884.2
0.25	0.82	119791.2	4841.1
0.30	0.81	124325.1	4769.2
0.35	0.80	128381.9	4678.0
0.40	0.78	132103.7	4567.1
0.45	0.76	135372.9	4437.0
0.50	0.74	137349.9	4295.9
0.55	0.72	137360.7	4149.7
0.60	0.69	134195.5	4006.5
0.65	0.67	127933.1	3659.8
0.70	0.64	119349.9	3705.0
0.75	0.62	108316.9	3546.3
0.80	0.59	95495.[illegible]	3399.6
0.85	0.57	84018.4	3273.8
0.90	0.55	74848.4	3158.4
0.95	0.53	66903.7	3046.3
1.00	0.51	60666.7	2937.5

TOAV = 60666.7 LOAD = 5982.3 VEL = 40.0 MPH.

MUPEAK = 0.82 MULOCK = 0.51 RATIO = 1.62



FZ = 5982.3 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.82 RATIO = 1.62 A-D FILE 201 NWFILE 104 SAMPLE 212

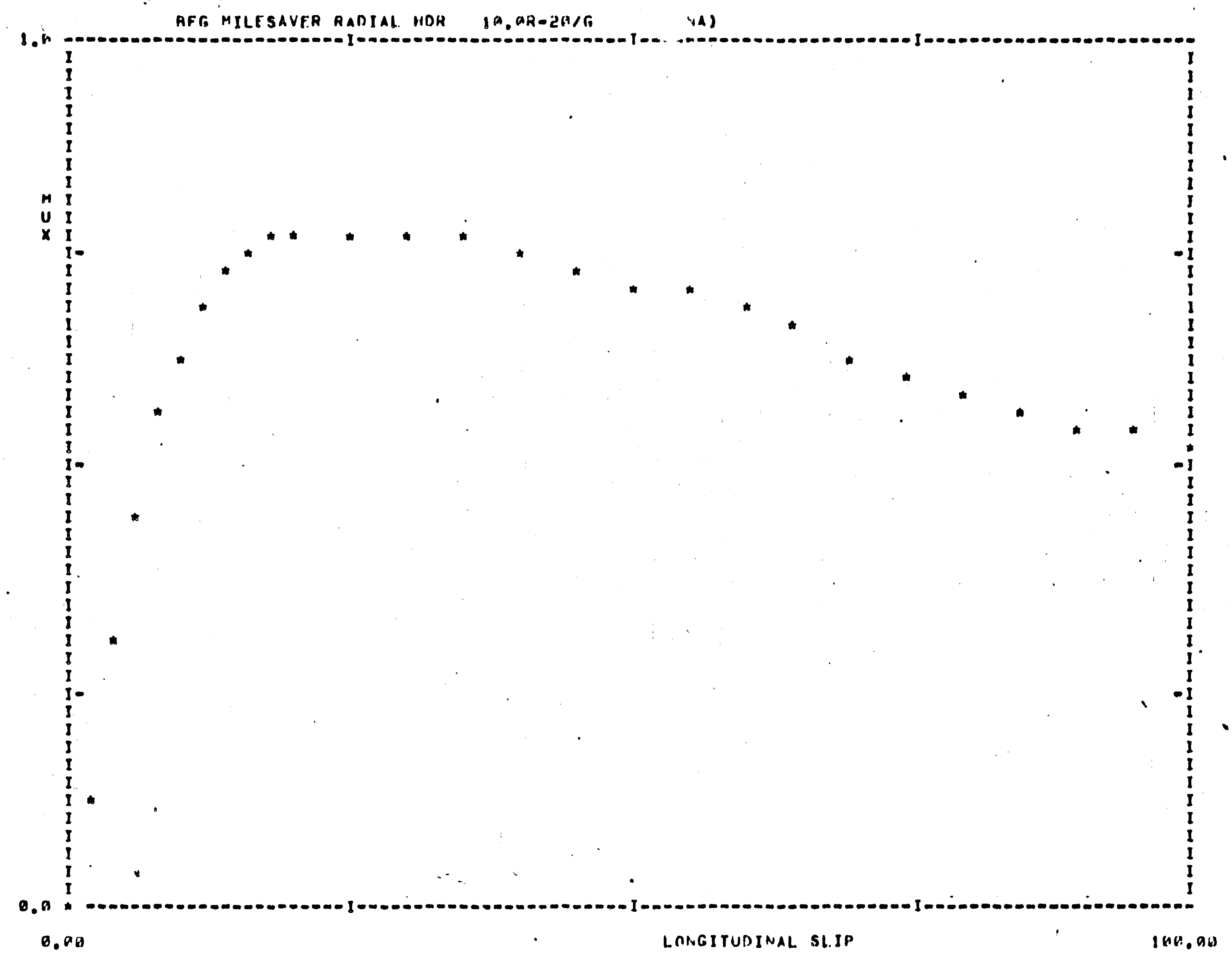
** A-D FILE 202 NEW : 105 TEST SAMPLE213 **

AVERAGE OF FILE 202 FOR 5 RECORDS. BFG MILESAVER RADIAL HDR 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.12	19341.4	1092.0
0.04	0.30	53452.4	2709.5
0.06	0.45	81028.0	4056.2
0.08	0.57	101813.5	5060.5
0.10	0.64	116156.5	5740.0
0.12	0.70	125768.3	6187.3
0.14	0.73	132341.2	6478.1
0.16	0.75	137017.0	6665.1
0.18	0.77	140415.5	6771.1
0.20	0.77	142867.9	6813.3
0.25	0.78	147856.9	6622.2
0.30	0.78	152315.9	6781.9
0.35	0.77	156269.3	6700.7
0.40	0.76	159019.6	6585.4
0.45	0.74	159732.6	6451.7
0.50	0.73	158364.4	6308.0
0.55	0.71	154292.2	6147.7
0.60	0.69	148467.5	5966.7
0.65	0.67	141472.6	5774.1
0.70	0.64	133124.3	5571.6
0.75	0.62	123821.6	5383.2
0.80	0.60	115338.1	5209.2
0.85	0.58	108358.6	5045.1
0.90	0.56	101999.3	4896.4
0.95	0.54	96332.6	4732.5
1.00	0.53	91675.0	4585.5

TOAV = 91675.0 LOAD = 9145.9 VEL = 20.0 MPH.

MUPEAK = 0.78 MULOCK = 0.53 RATIO = 1.48



FZ = 9145.9 VEL = 20.0 MULOCK = 0.53 MUPEAK = 0.78 RATIO = 1.48 A-D FILE 202 NWFILE 105 SAMPLE 213

** A-D FILE 203   NEW FILE 106   TEST SAMPLE214 **

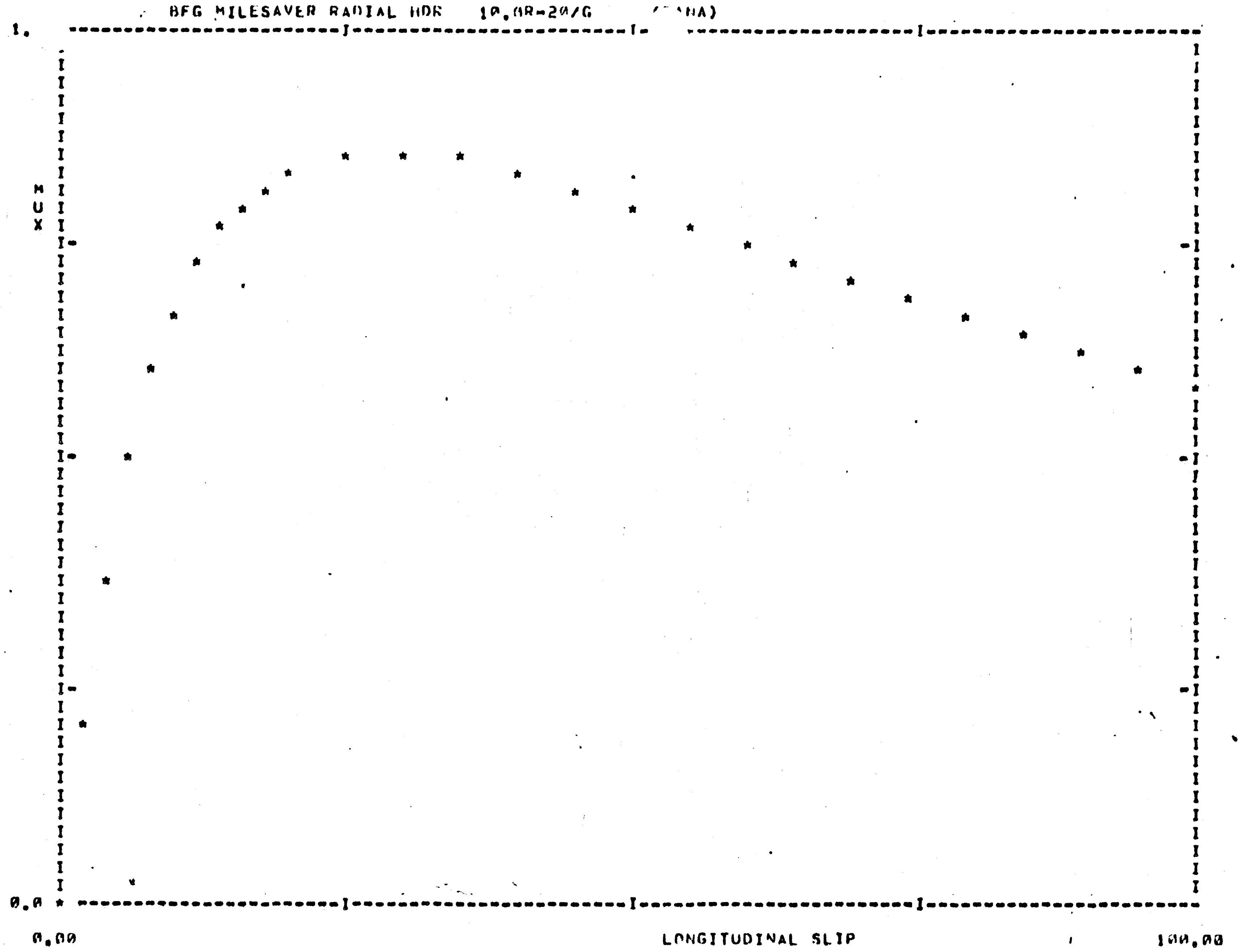
AVERAGE OF FILE 203 FOR 5 RECORDS.   BFG MILESAVER RADIAL HDR   10.0R-20/G   (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	15291.2	659.3
0.04	0.37	28549.3	1200.2
0.06	0.51	39264.0	1641.1
0.08	0.61	47965.8	1980.1
0.10	0.69	54911.2	2219.4
0.12	0.74	60669.8	2392.9
0.14	0.78	65347.0	2514.6
0.16	0.81	69332.8	2601.4
0.18	0.83	72626.7	2660.2
0.20	0.84	75388.1	2693.6
0.25	0.85	81664.8	2736.7
0.30	0.86	87591.6	2744.5
0.35	0.85	93382.4	2722.5
0.40	0.84	99031.3	2669.8
0.45	0.82	104116.7	2599.6
0.50	0.80	107744.3	2520.6
0.55	0.78	108289.0	2442.0
0.60	0.76	105407.2	2371.0
0.65	0.74	99866.1	2304.7
0.70	0.72	91415.6	2233.2
0.75	0.70	80737.9	2149.3
0.80	0.67	68877.5	2062.2
0.85	0.65	58586.9	1991.8
0.90	0.63	50702.5	1932.7
0.95	0.61	44115.1	1870.5
1.00	0.60	39250.0	1830.0

TQAV = 39050.0   LOAD = 3199.7   VEL = 40.0 MPH.

MUPEAK = 0.86   MULOCK = 0.60   RATIO = 1.44

324



FZ = 3199.7 VEL = 40.0 MULOCK = 0.60 MUPEAK = 0.86 RATIO = 1.40 A-D FILE 203 NWFILE 106 SAMPLE 214

** A-D FILE 204 IEW FILE 107 TEST SAMPLE215 **

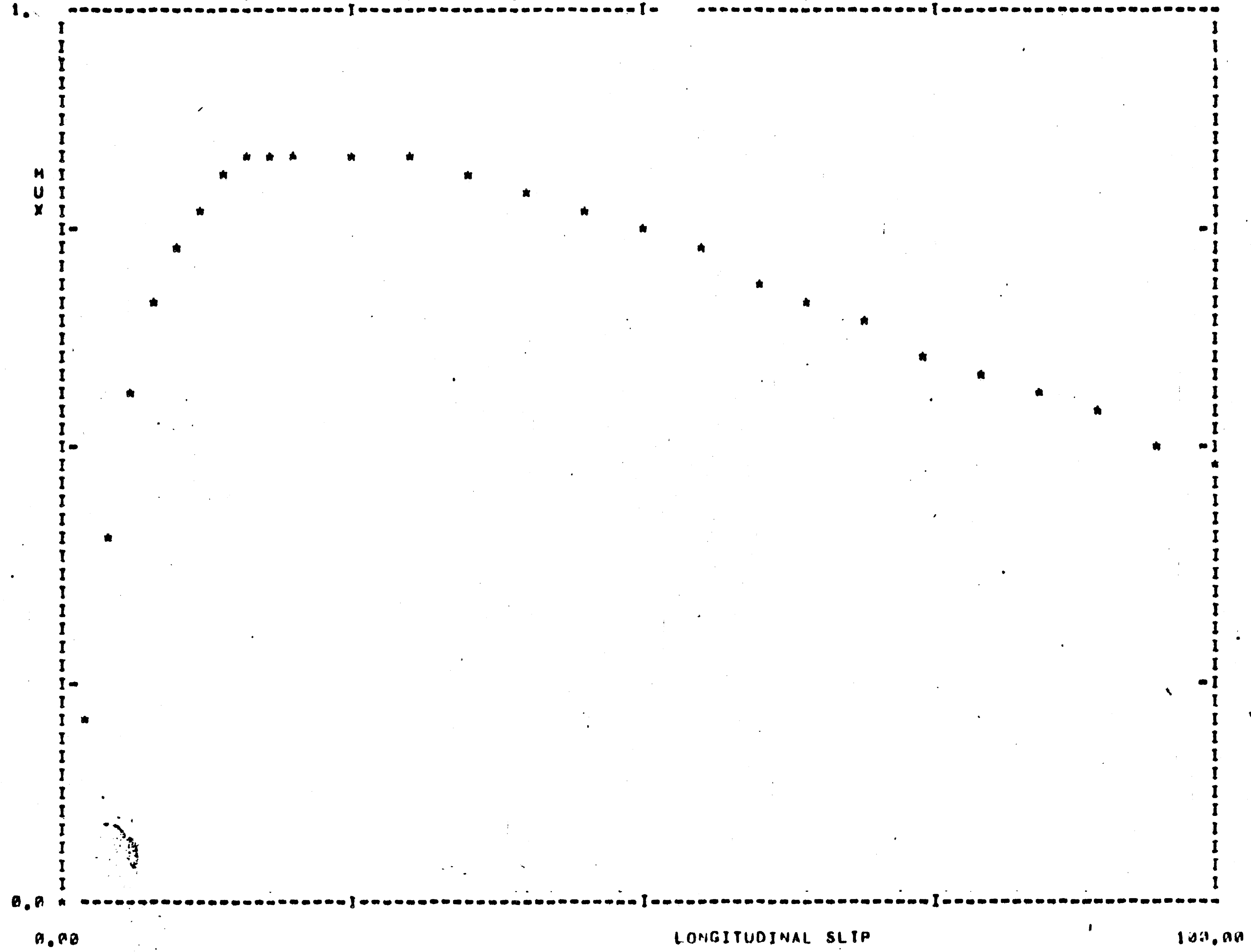
AVERAGE OF FILE 204 FOR 5 RECORDS. BFG MILESAVER RADIAL HDR 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	23146.5	1182.3
0.04	0.42	51940.0	2503.5
0.06	0.57	71723.4	3411.9
0.08	0.67	85802.7	4038.0
0.10	0.74	95848.7	4467.1
0.12	0.79	102821.3	4745.9
0.14	0.82	107874.0	4922.6
0.16	0.84	111885.7	5039.9
0.18	0.85	115116.6	5096.8
0.20	0.85	117663.8	5101.5
0.25	0.84	122842.9	5053.2
0.30	0.83	127300.0	4980.0
0.35	0.82	131259.8	4888.4
0.40	0.80	134747.3	4777.0
0.45	0.78	137775.7	4639.2
0.50	0.75	139903.1	4486.4
0.55	0.73	140058.1	4326.9
0.60	0.70	136349.9	4165.4
0.65	0.68	129685.1	4000.1
0.70	0.65	121289.5	3829.4
0.75	0.62	110637.4	3652.6
0.80	0.59	97488.0	3485.7
0.85	0.57	84584.2	3339.0
0.90	0.54	74694.9	3200.1
0.95	0.52	66391.1	3061.1
1.00	0.50	59850.0	2920.5

TQAV = 59850.0 LOAD = 6031.6 VEL = 40.0 MPH.

MUPEAK = 0.85 MULOCK = 0.50 RATIO = 1.71

PFG MILESAVER RADIAL HDR 10.00-20/G NA)



FZ = 6031.6 VEL = 40.0 MULOCK = 0.50 MUPEAK = 0.85 RATIO = 1.71 A-D FILE 204 NWFILE 107 SAMPLE 215

** A-D FILE 208 NEW FILE 108 TEST SAMPLE216 **

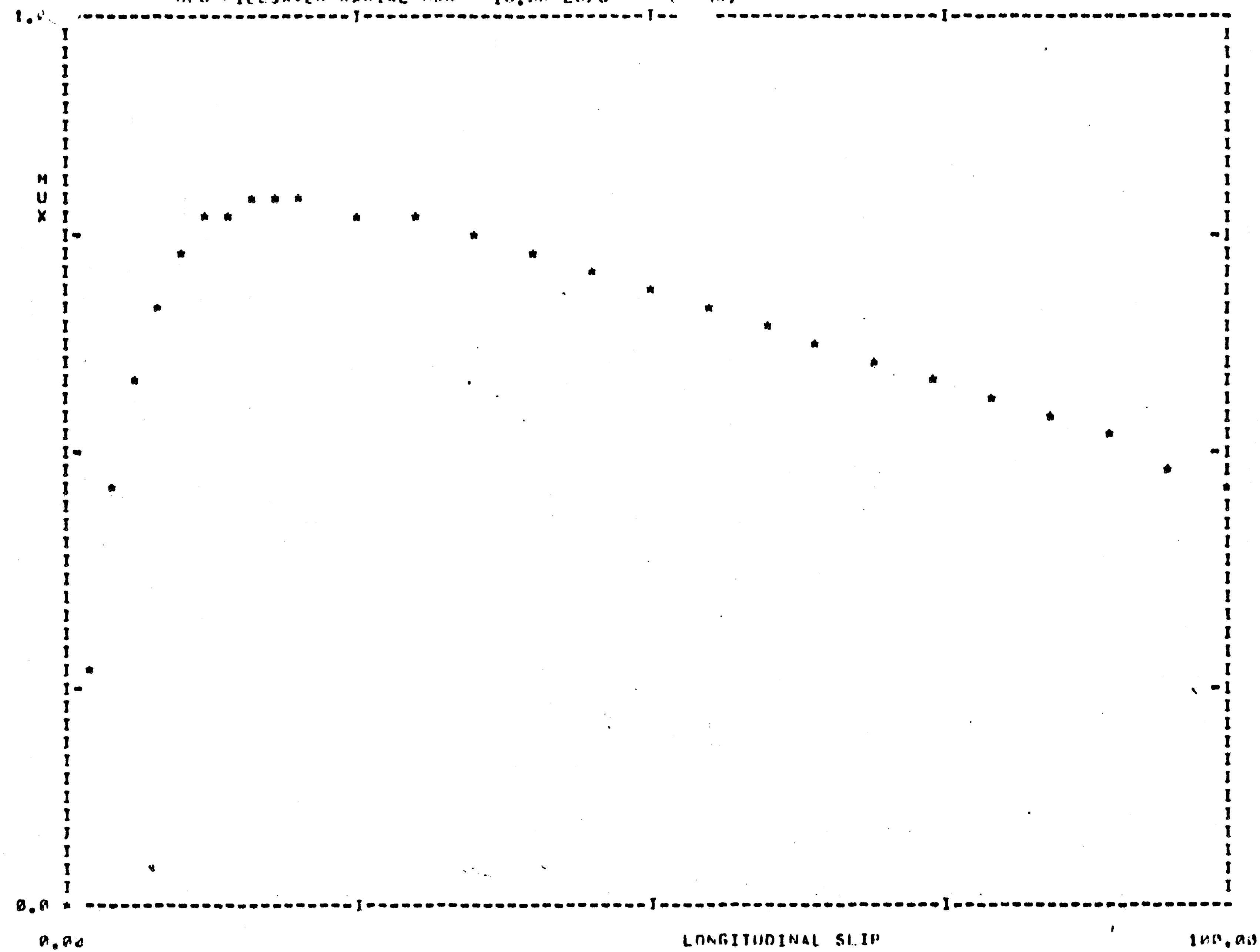
AVERAGE OF FILE 208 FOR 5 RECORDS, BFG MILESAVER RADIAL HDR 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.27	50792.4	2505.1
0.04	0.46	84755.3	4176.9
0.06	0.59	107136.6	5278.8
0.08	0.68	122724.7	6037.9
0.10	0.74	132904.8	6509.9
0.12	0.77	139390.9	6775.6
0.14	0.79	143568.1	6909.7
0.16	0.79	146417.5	6968.8
0.18	0.80	148356.5	6980.4
0.20	0.80	149623.5	6953.6
0.25	0.78	151988.2	6839.3
0.30	0.77	154009.0	6704.6
0.35	0.75	155729.9	6558.7
0.40	0.73	157180.6	6409.3
0.45	0.72	158384.3	6255.2
0.50	0.70	159273.0	6095.3
0.55	0.68	159328.6	5929.7
0.60	0.66	158002.4	5760.5
0.65	0.64	154643.0	5587.4
0.70	0.62	148147.3	5408.2
0.75	0.59	138917.0	5216.7
0.80	0.57	127496.7	5017.7
0.85	0.55	115637.3	4823.0
0.90	0.52	[illegible]	4634.0
0.95	0.50	[illegible]	4447.3
1.00	0.46	85925.0	4263.0

TQAV = 85925.0 LOAD = 9121.8 VEL = 40.0 MPH.

MUPEAK = 0.80 MULOCK = 0.48 RATIO = 1.66

BFG MILESAVER RADIAL HDH 10.00R-20/G (A)



FZ = 9121.8 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.80 RATIO = 1.66 A-D FILE 208 NWFILE 108 SAMPLE 216

329

** A-D FILE 209 NEW FILE 109 TEST SAMPLE217 **

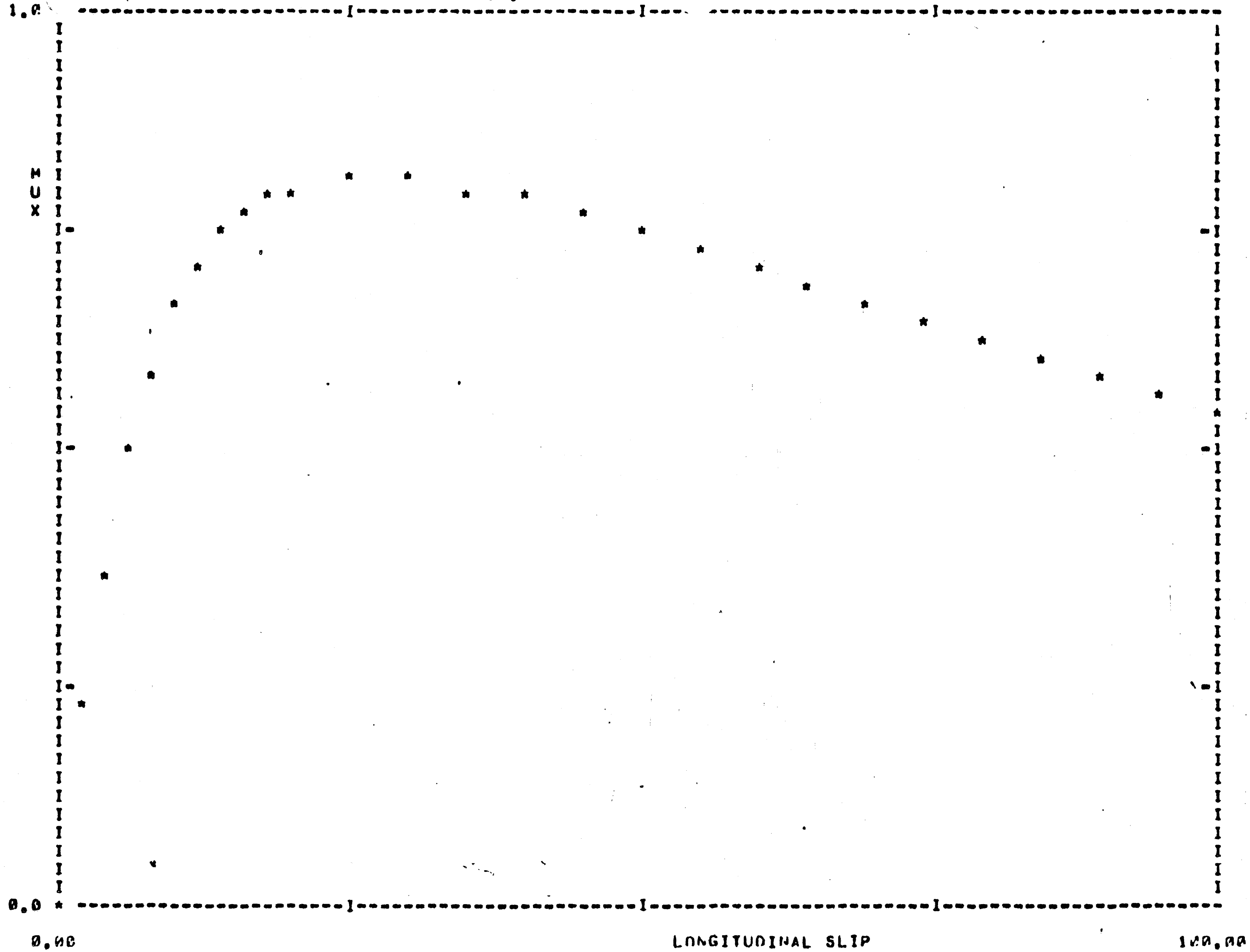
AVERAGE OF FILE 209 FOR 5 RECORDS. BFG MILESAVER RADIAL HDR 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	15148.7	662.0
0.04	0.38	28969.9	1156.8
0.06	0.51	38513.6	1536.8
0.08	0.60	46883.5	1819.1
0.10	0.67	53612.5	2022.6
0.12	0.72	59171.8	2166.9
0.14	0.75	63780.1	2265.1
0.16	0.78	67780.6	2332.7
0.18	0.79	71259.2	2376.2
0.20	0.80	74255.4	2396.2
0.25	0.81	80912.9	2405.0
0.30	0.81	87165.0	2392.9
0.35	0.80	92819.5	2366.4
0.40	0.79	98226.9	2326.6
0.45	0.78	103463.4	2274.8
0.50	0.76	108168.9	2215.5
0.55	0.74	111542.0	2147.7
0.60	0.72	111820.0	2078.4
0.65	0.70	108117.6	2015.5
0.70	0.68	100457.1	1957.3
0.75	0.66	89369.1	1895.6
0.80	0.64	75284.8	1821.5
0.85	0.61	60579.2	1740.0
0.90	0.59	49669.0	1692.8
0.95	0.56	40889.1	1645.7
1.20	0.54	34500.0	1606.5

TQAV = 34500.0 LOAD = 3060.6 VEL = 55.0 MPH.

MUPEAK = 0.81 MULOCK = 0.54 RATIO = 1.49

BFG MILESAVER RADIAL HDR 10.0R-20/G (1 1)



FZ = 3060.6 VEL = 55.0 MULOCK = 0.54 MUPEAK = 0.81 RATIO = 1.49 A-D FILE 209 N-FILE 109 SAMPLE 217

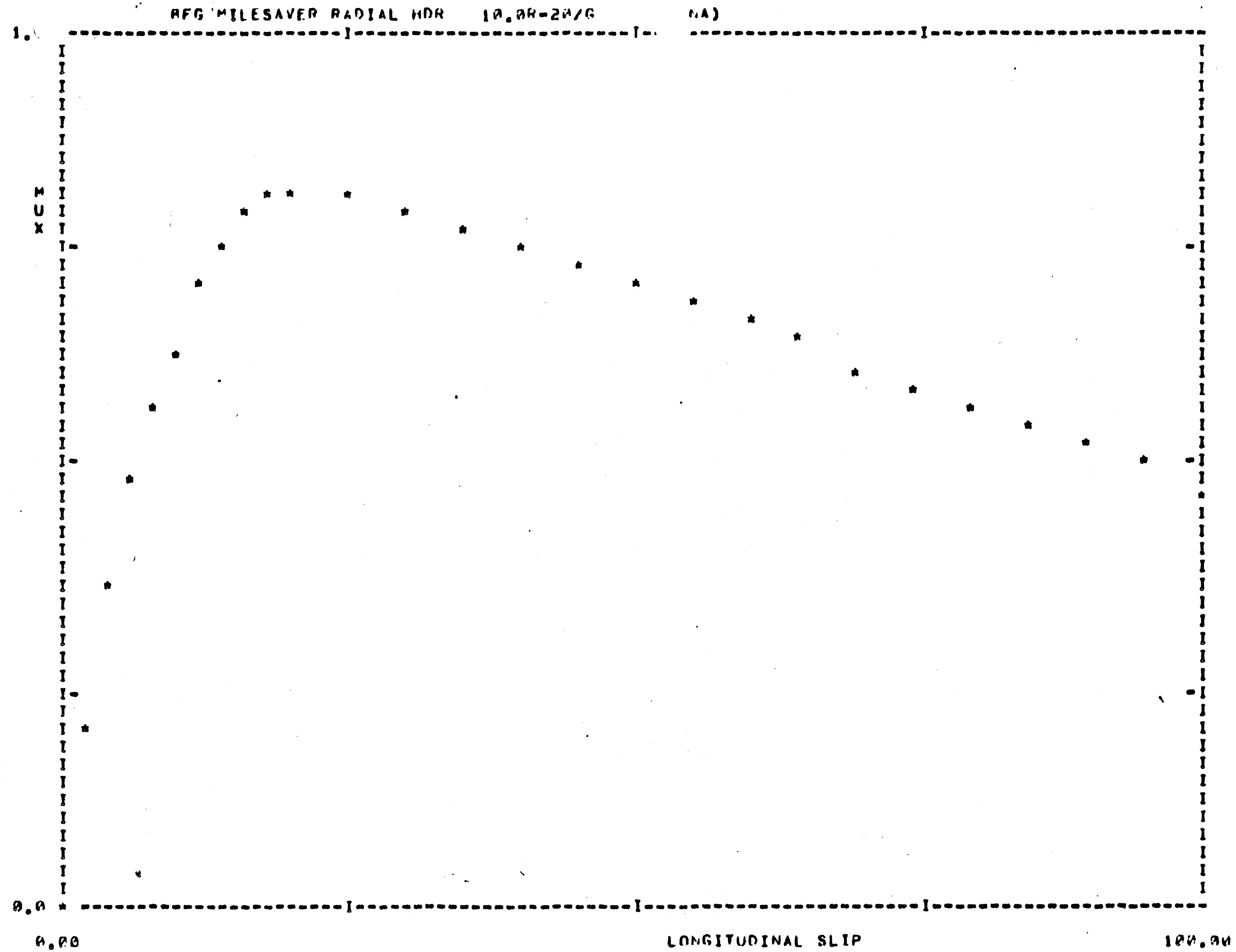
** A-D FILE 210 NEW FILE 119 TEST SAMPLE210 **

AVERAGE OF FILE 210 FOR 6 RECORDS. BFG MILESAVER RADIAL HDR 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	24586.1	1232.6
0.04	0.37	46693.9	2285.6
0.06	0.49	62164.9	3009.3
0.08	0.58	73266.2	3514.0
0.10	0.64	82850.8	3918.5
0.12	0.72	94374.1	4364.0
0.14	0.77	103040.1	4661.3
0.16	0.79	108941.5	4826.4
0.18	0.81	113149.6	4912.5
0.20	0.81	115983.3	4934.0
0.25	0.81	121413.4	4908.2
0.30	0.80	126156.2	4843.0
0.35	0.79	130513.8	4745.9
0.40	0.77	134679.3	4624.8
0.45	0.74	138251.3	4480.7
0.50	0.72	140370.2	4325.3
0.55	0.69	140419.6	4168.9
0.60	0.67	136620.6	4020.2
0.65	0.65	129501.2	3871.8
0.70	0.62	120141.3	3716.9
0.75	0.60	108702.7	3561.5
0.80	0.57	95516.2	3408.3
0.85	0.55	83564.5	3266.0
0.90	0.52	738[illegible]	313[illegible].2
0.95	0.5[illegible]	650[illegible]	2990.3
1.00	0.48	58718.3	2863.7

TRAV = 58708.3 LOAD = 6141.0 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.48 RATIO = 1.70



FZ = 6141.0 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.81 RATIO = 1.70 A-D FILE 210 NWFILE 110 SAMPLE 210

** A-D FILE 211   2W FILE 11   TEST SAMPLE219 **

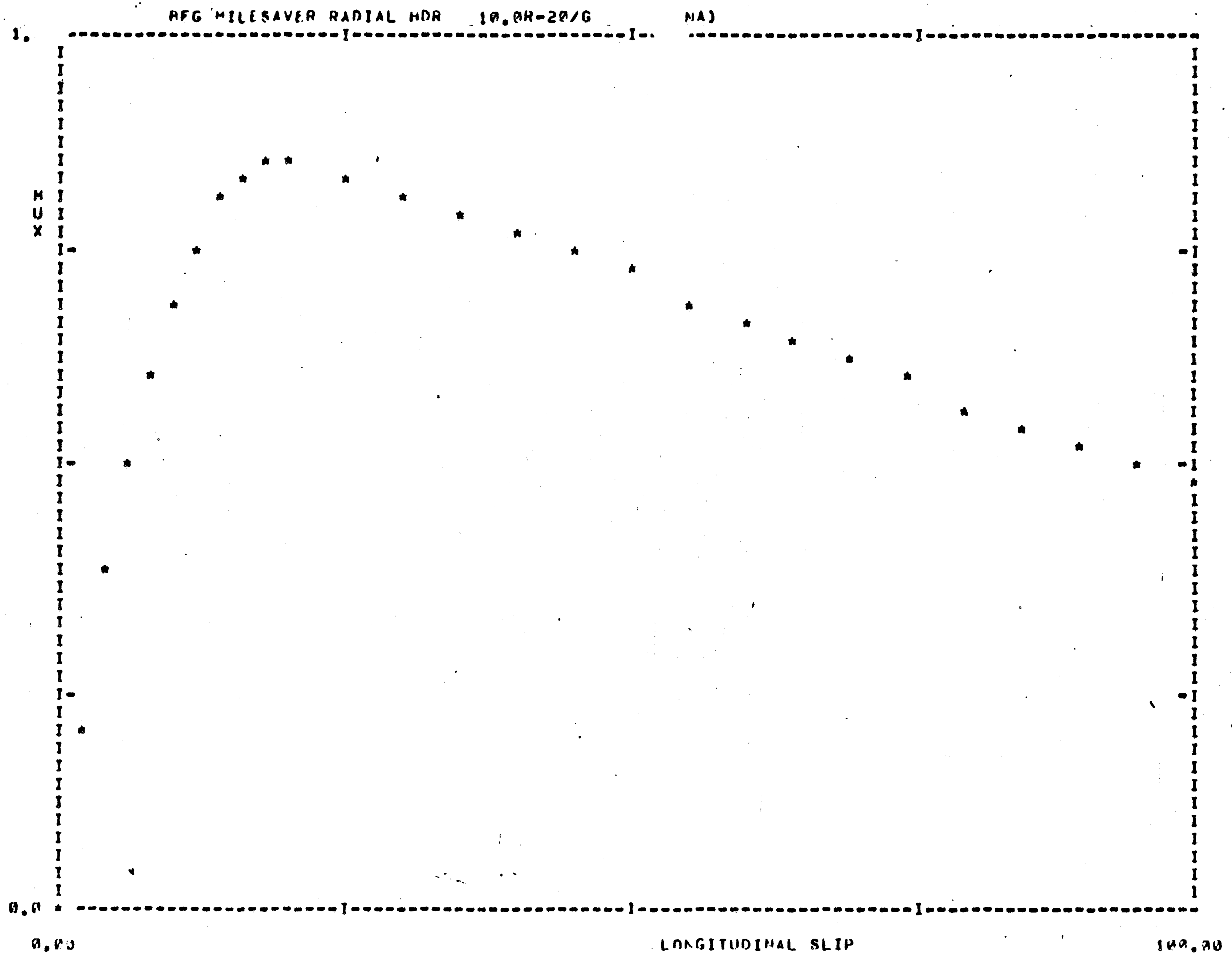
AVERAGE OF FILE 211 FOR 6 RECORDS,   BFG MILESAVER RADIAL HDR   10.0R-22/G   (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	26889.4	1276.3
0.04	0.38	48481.4	2303.1
0.06	0.51	64198.1	3040.1
0.08	0.61	75890.2	3584.3
0.10	0.69	85759.5	4022.5
0.12	0.76	96711.4	4453.1
0.14	0.81	104871.7	4735.9
0.16	0.84	110422.0	4688.0
0.18	0.85	114383.4	4951.1
0.20	0.85	117036.7	4946.8
0.25	0.84	122047.7	4874.9
0.30	0.82	126231.4	4778.7
0.35	0.80	129892.8	4666.1
0.40	0.78	133343.1	4542.4
0.45	0.75	136778.2	4406.2
0.50	0.73	139993.6	4260.9
0.55	0.70	142356.8	4113.2
0.60	0.68	142404.0	3960.3
0.65	0.65	138271.6	3836.8
0.70	0.63	130478.2	3707.8
0.75	0.61	119602.0	3566.2
0.80	0.58	105571.0	3420.0
0.85	0.55	90239.5	3274.2
0.90	0.53	78262.7	3135.8
0.95	0.51	67578.1	2999.2
1.00	0.48	58916.7	2863.7

TQAV = 58916.7   LOAD = 6031.5   VEL = 55.0 MPH.

MUPEAK = 0.85   MULOCK = 0.48   RATIO = 1.76

334



FZ = 6031.5 VEL = 55.0 MULOCK = 0.48 MUPEAK = 0.85 RATIO = 1.76 A-D FILE 211 NWFILE 111 SAMPLE 219

** A-D FILE 213   6 FILE 112   TEST SAMPLE221 **

AVERAGE OF FILE 213 FOR 6 RECORDS.   BFG MILESAVER RADIAL HDR 10.00-20/G (DANA)

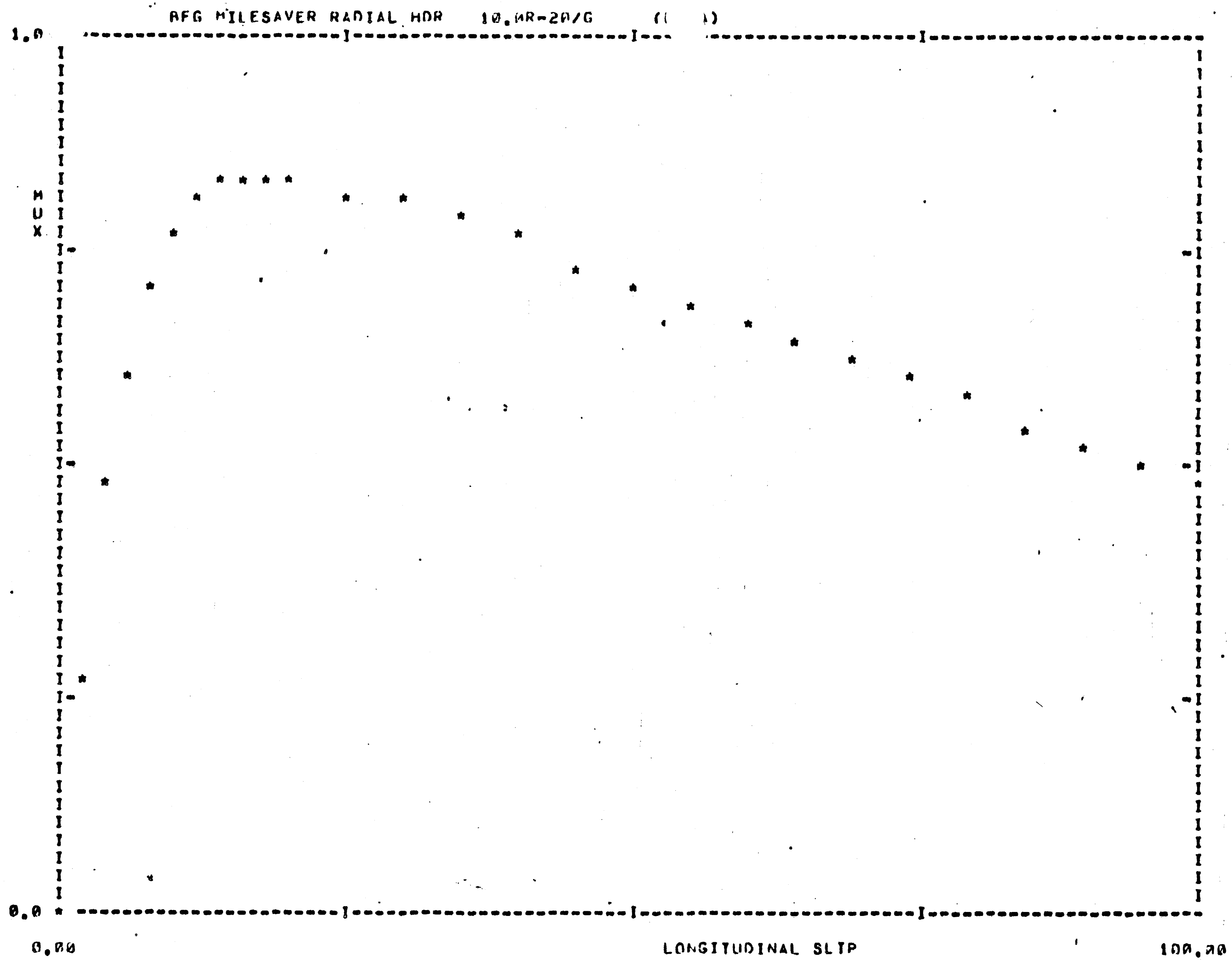
TQAV = 62000.0   LOAD = 6084.3   VEL = 40.0 MPH.

MUPEAK = 0.84   MULOCK = 0.50   RATIO = 1.69

SLIP	MUX	TORQUE	FX
0.00	0.20	0.0	0.0
0.02	0.27	34405.4	1659.1
0.04	0.48	60968.6	2950.8
0.06	0.62	78666.6	3796.2
0.08	0.72	90772.0	4354.1
0.10	0.78	99027.1	4703.7
0.12	0.81	104862.7	4905.0
0.14	0.83	109114.4	5006.7
0.16	0.84	112197.3	5050.0
0.18	0.84	114273.6	5056.4
0.20	0.84	115609.0	5034.8
0.25	0.83	118389.3	4937.8
0.30	0.81	120930.7	4821.1
0.35	0.79	123267.3	4693.1
0.40	0.77	125364.6	4560.1
0.45	0.75	127216.3	4421.9
0.50	0.72	128605.8	4279.3
0.55	0.70	128902.6	4138.0
0.60	0.68	127569.4	4002.9
0.65	0.66	123794.6	3874.2
0.70	0.63	117064.8	3747.0
0.75	0.61	108814.0	3611.0
0.80	0.59	97337.0	3470.4
0.85	0.56	87003.6	3337.3
0.90	0.54	77896.9	3211.7
0.95	0.52	69515.5	3[illegible].6
1.00	0.50	62000.0	2975.0

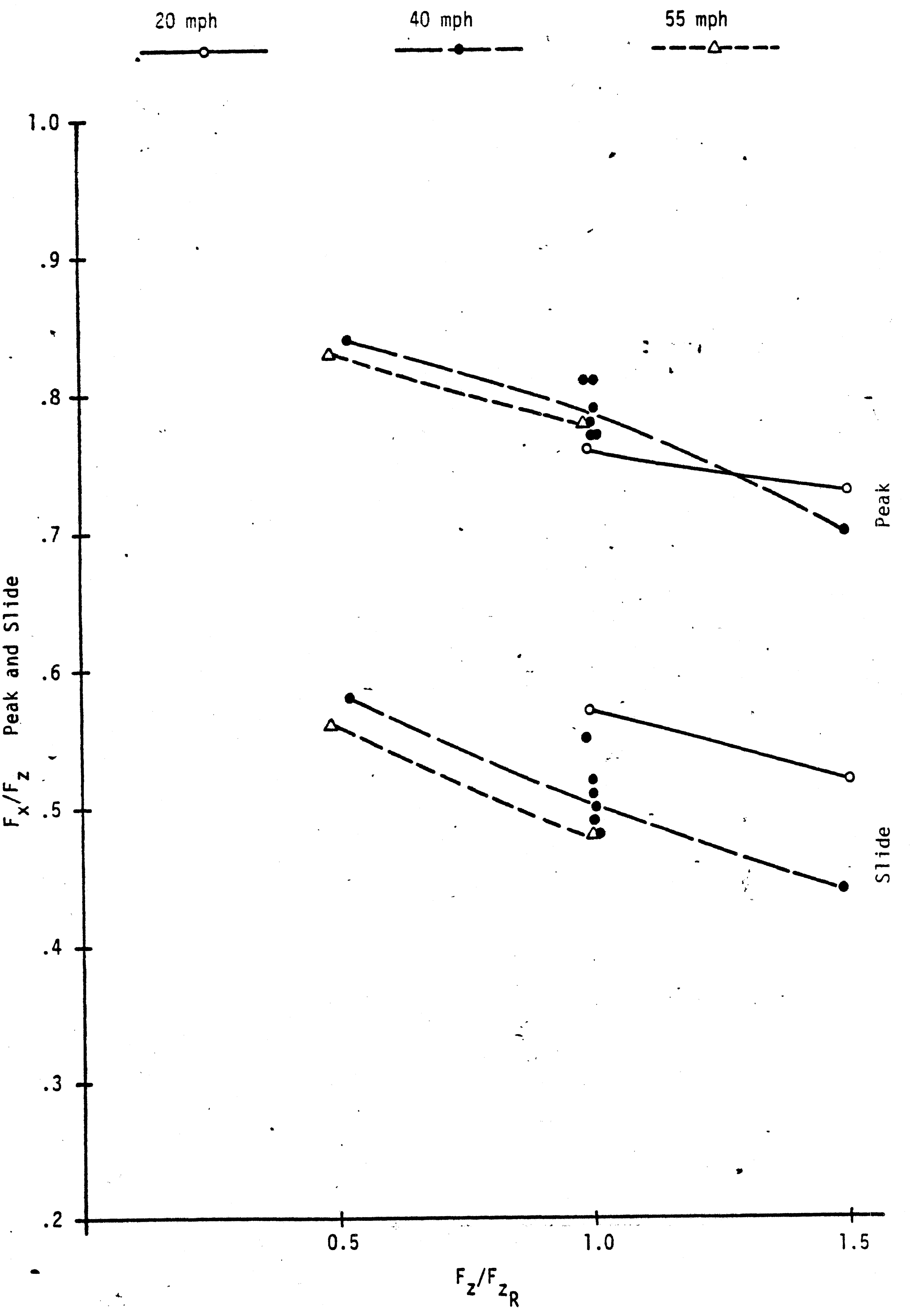
336

-53-



FZ = 6084.3 VEL = 40.0 MULOCK = 0.50 MUPEAK = 0.84 RATIO = 1.69 A-D FILE 213 NWFILE 112 SAMPLE 221

337



Summary - B.F. Goodrich Milesaver Radial - 10 R x 20G

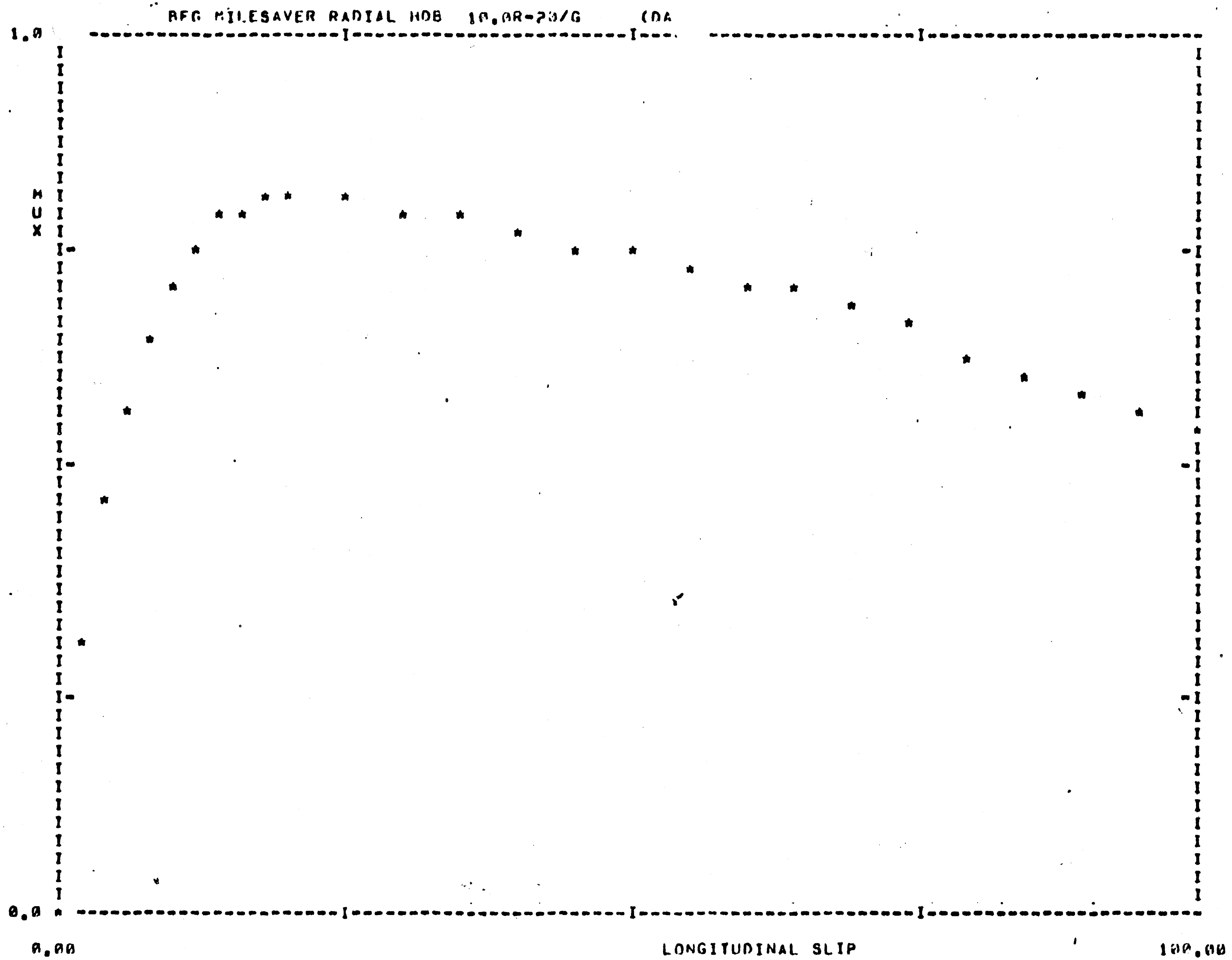
** A-D FILE 151 NEW FILE 36 TEST SAMPLE183 **

AVERAGE OF FILE 151 FOR 2 RECORDS. BFG MILESAVER RADIAL HDB 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.30	38256.5	1974.0
0.04	0.46	61002.0	3067.4
0.06	0.58	75814.8	3780.4
0.08	0.66	86621.4	4294.0
0.10	0.72	94431.6	4658.6
0.12	0.76	99917.9	4908.4
0.14	0.79	103800.0	5071.8
0.16	0.80	106992.6	5160.4
0.18	0.81	109029.9	5210.8
0.20	0.81	110020.1	5221.4
0.25	0.81	111871.1	5200.9
0.30	0.80	113384.6	5163.3
0.35	0.79	114953.3	5103.4
0.40	0.77	116245.5	5035.5
0.45	0.76	116930.9	4972.3
0.50	0.75	117168.7	4911.5
0.55	0.74	117409.8	4839.7
0.60	0.72	117725.9	4749.7
0.65	0.71	117786.6	4646.1
0.70	0.69	116925.7	4531.2
0.75	0.67	114450.5	4394.7
0.80	0.64	109473.2	4236.6
0.85	0.62	101565.2	4063.2
0.90	0.59	92469.8	3882.3
0.95	0.57	82992.7	3700.2
1.00	0.55	73125.0	3517.5

TQAV = 73125.0 LOAD = 6534.8 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.55 RATIO = 1.49



FZ = 6534.8 VEL = 40.0 MULOCK = 0.55 MUPEAK = 0.81 RATIO = 1.49 A-D FILE 151 NWFILE 76 SAMPLE 183

** A-D FILE 152 NEW FILE 77 TEST SAMPLE183 **

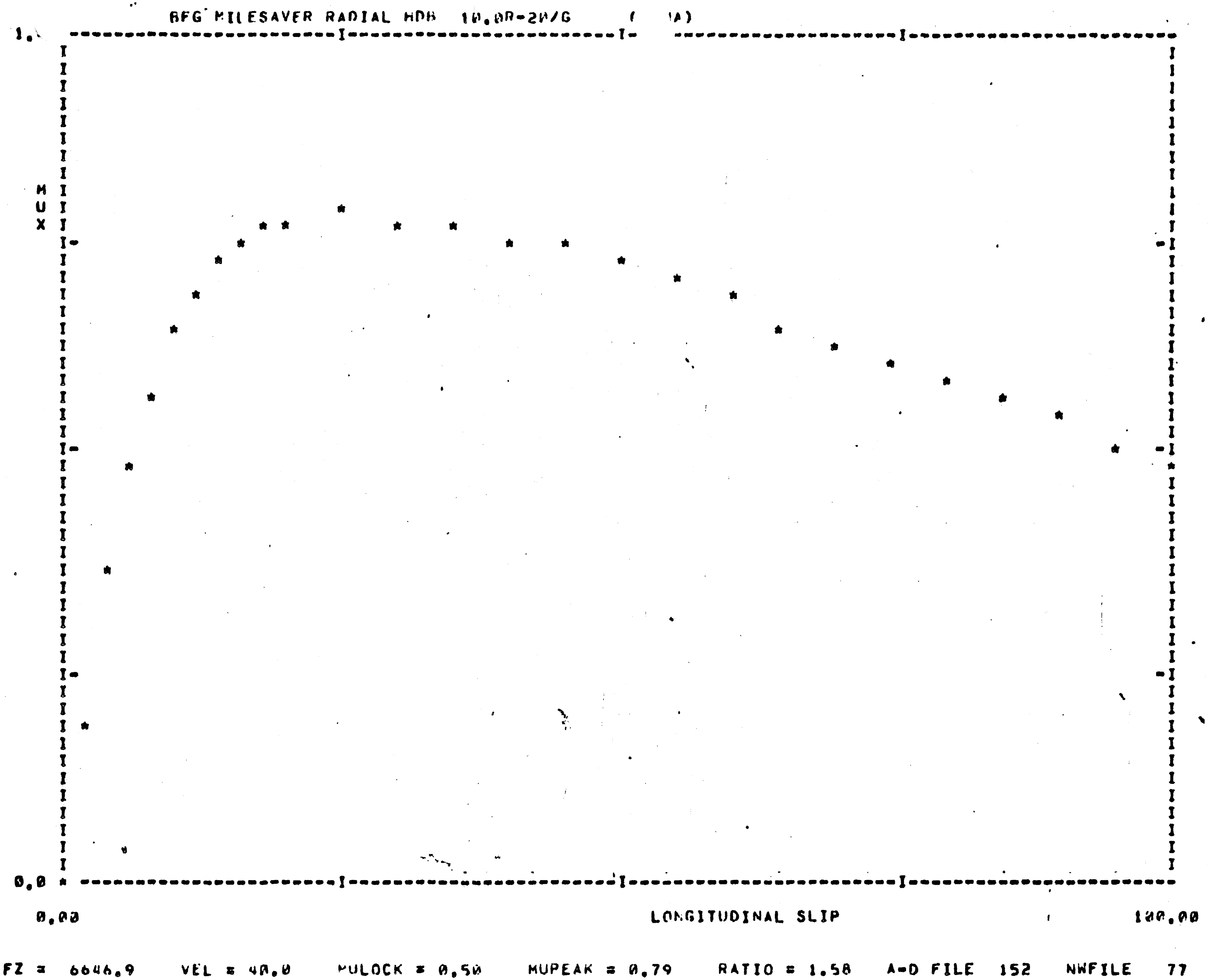
AVERAGE OF FILE 152 FOR 6 RECORDS. BFG MILESAVER RADIAL HDB 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	24372.3	1247.1
0.04	0.36	48911.1	2369.7
0.06	0.49	66678.5	3178.5
0.08	0.58	80010.2	3775.3
0.10	0.65	89957.9	4213.4
0.12	0.70	97343.5	4526.8
0.14	0.74	102989.5	4742.5
0.16	0.76	107441.4	4889.9
0.18	0.78	110954.0	4982.7
0.20	0.78	113539.6	5021.8
0.25	0.79	118373.4	5039.9
0.30	0.79	122462.4	5018.6
0.35	0.78	126062.8	4961.6
0.40	0.77	129394.1	4875.5
0.45	0.75	132541.2	4766.1
0.50	0.73	135106.4	4639.8
0.55	0.71	136037.2	4543.6
0.60	0.69	134826.3	4366.3
0.65	0.66	131140.4	4230.5
0.70	0.64	124275.2	4088.8
0.75	0.62	114605.2	3934.1
0.80	0.59	102700.5	3772.2
0.85	0.57	90441.2	3614.1
0.90	0.54	80740.7	3465.6
0.95	0.52	72263.4	3319.6
1.00	0.50	65125.0	3176.2

TQAV = 65125.0 LOAD = 6646.9 VEL = 40.0 MPH.

MUPEAK = 0.79 MULOCK = 0.50 RATIO = 1.58

342


BFG MILESAVER RADIAL HDB 10.00-20/G (A)
1.
MUX
0.0
0.00
LONGITUDINAL SLIP
100.00
FZ = 6646.9 VEL = 40.0 MULOCK = 0.50 MUPEAK = 0.79 RATIO = 1.58 A-D FILE 152 NWFILE 77 SAMPLE 183

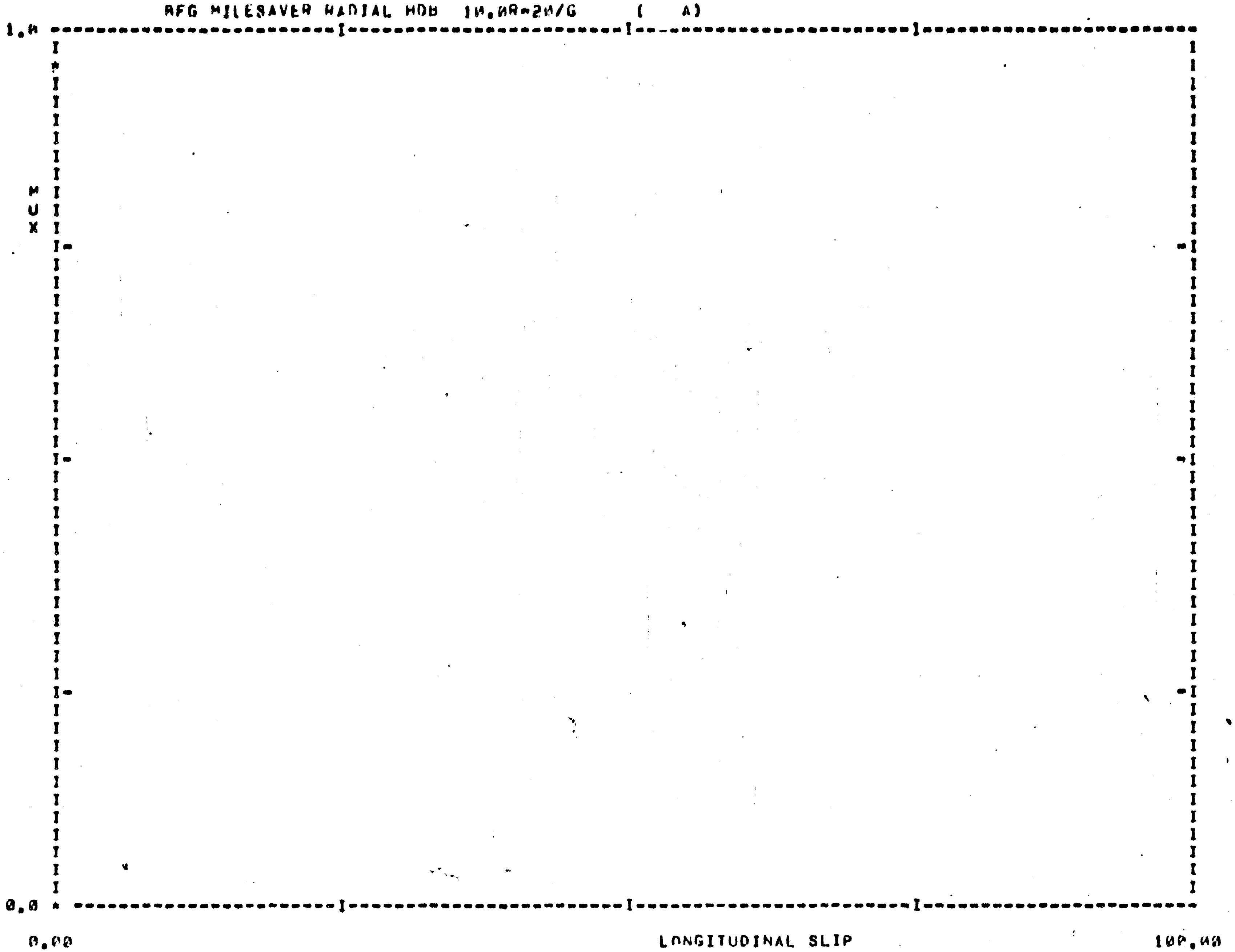
** A-D FILE 153 NEW FILE 79 TEST SAMPLE184 **

AVERAGE OF FILE 153 FOR 0 RECORDS. BFG MILESAVER RADIAL HDB 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.00	0.00	0.0	0.0
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.97	120.7	7.2
0.00	0.00	0.0	0.0

TQAV = 0.0 LOAD = 0.0 VEL = 40.0 MPH.

MUPEAK = 0.97 MULOCK = 0.00 RATIO =-9.00



FZ = 0.0 VFL = 40.0 MULOCK = 0.00 MUPEAK = 0.97 RATIO =-9.00 A-D FILE 153 NWFILE 78 SAMPLE 184

345

** A-D FILE 154 NEW FILE 79? TEST SAMPLE185 **

AVERAGE OF FILE 154 FOR 5 RECORDS. BFG MILESAVER RADIAL HDB 10.00-20/G (DANA)

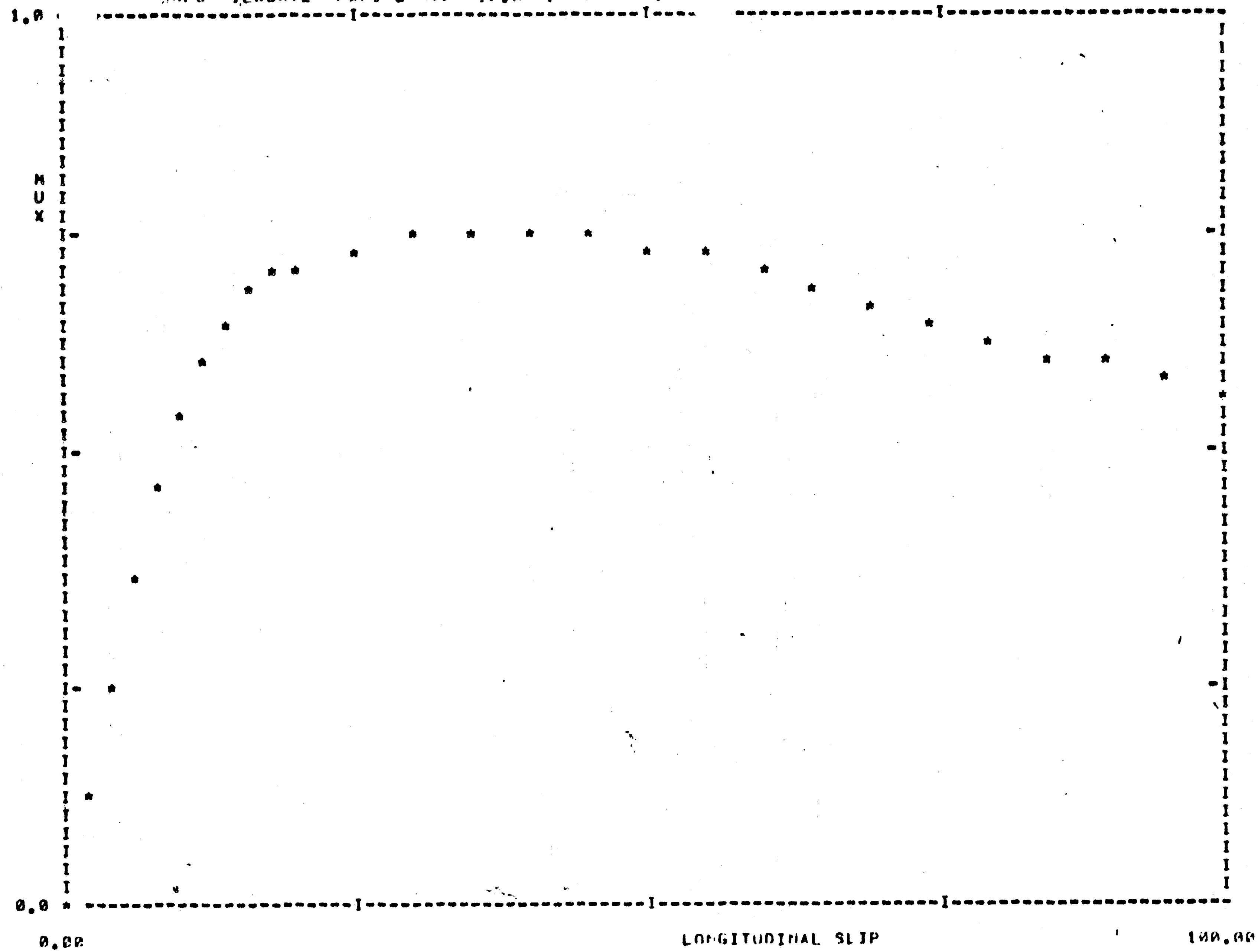
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.13	14884.3	816.3
0.04	0.26	33311.9	1654.7
0.06	0.38	50205.0	2435.8
0.08	0.48	64047.8	3086.0
0.10	0.56	74511.0	3575.2
0.12	0.61	82526.3	3937.6
0.14	0.66	88902.8	4207.6
0.16	0.69	93950.4	4401.2
0.18	0.71	98055.7	4541.8
0.20	0.72	101266.7	4630.1
0.25	0.74	107999.0	4765.5
0.30	0.76	114174.0	4845.3
0.35	0.76	119841.3	4870.4
0.40	0.76	124374.5	4852.4
0.45	0.75	126999.4	4808.6
0.50	0.74	127617.2	4750.7
0.55	0.73	125895.2	4678.7
0.60	0.72	122720.3	4593.7
0.65	0.70	117420.1	4485.4
0.70	0.68	110964.4	4341.2
0.75	0.66	101694.0	4238.2
0.80	0.64	94384.5	4121.5
0.85	0.62	88328.9	4007.8
0.90	0.61	82811.0	3896.5
0.95	0.59	77979.5	3796.0
1.00	0.57	74175.0	3679.5

TQAV = 74175.0 LOAD = 6567.9 VEL = 20.0 MPH.

MUPEAK = 0.76 MULOCK = 0.57 RATIO = 1.33

346

BFG MILESAVER RADIAL HDB 10.0R-20/G (DAN



FZ = 6567.9 VEL = 20.0 MULOCK = 0.57 MUPEAK = 0.76 RATIO = 1.33 A-D FILE 154 NWFILE 79 SAMPLE 185

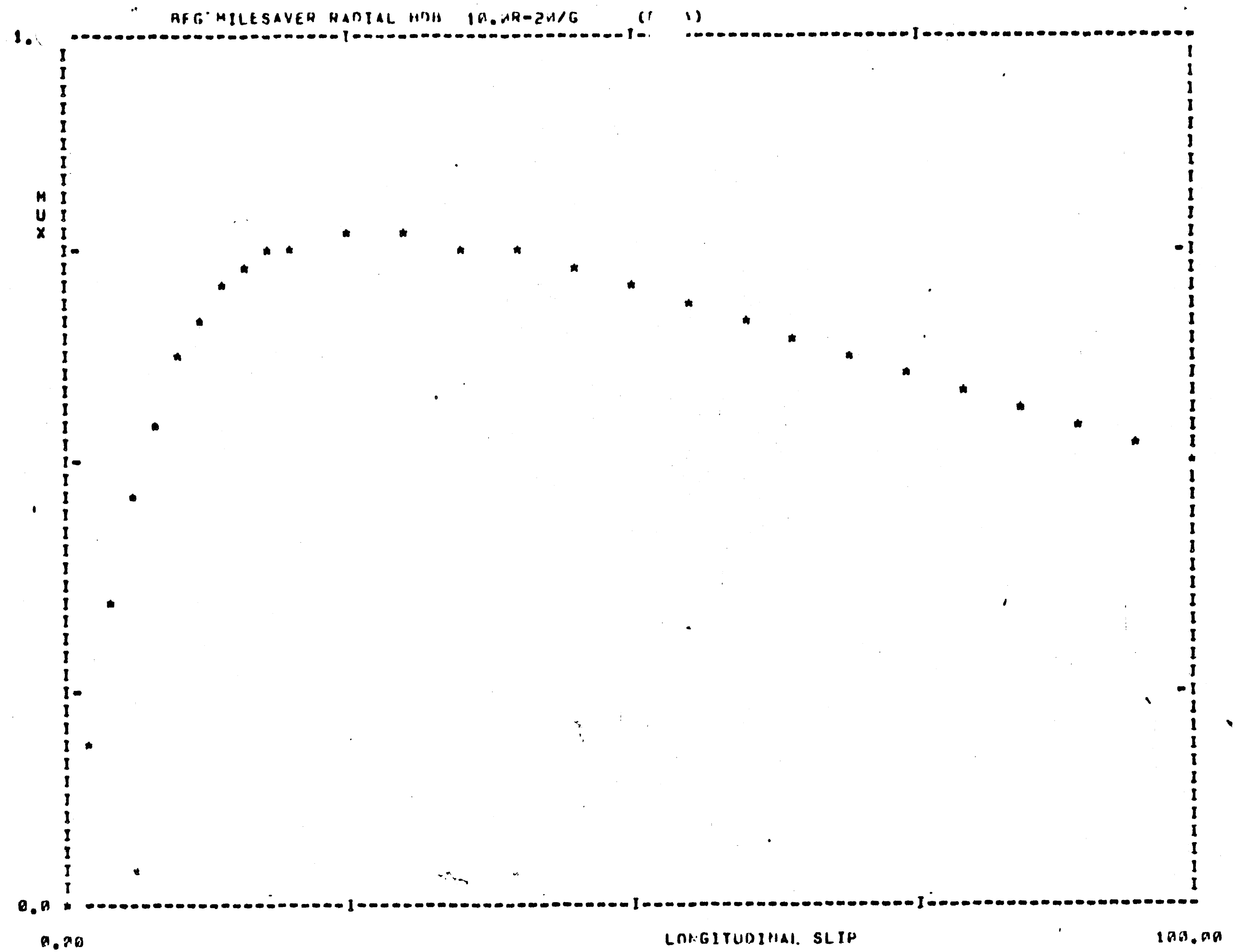
** A-D FILE 155 NEW FILE 80 TEST SAMPLE186 **

AVERAGE OF FILE 155 FOR 6 RECORDS. BFG MILESAVER RADIAL HDB 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	24420.2	1243.6
0.04	0.35	48335.0	2326.7
0.06	0.47	65858.6	3129.4
0.08	0.56	79209.2	3720.9
0.10	0.63	89425.7	4149.4
0.12	0.68	97228.2	4454.6
0.14	0.71	103170.1	4666.1
0.16	0.74	107803.6	4815.0
0.18	0.75	111528.1	4912.6
0.20	0.76	114437.4	4961.7
0.25	0.77	120445.8	4995.0
0.30	0.77	125793.2	4986.1
0.35	0.77	130591.6	4935.8
0.40	0.76	135036.3	4852.5
0.45	0.74	139092.4	4748.1
0.50	0.72	141946.2	4624.5
0.55	0.70	142294.5	4495.0
0.60	0.68	144308.5	4368.5
0.65	0.66	134741.9	4239.3
0.70	0.64	126261.7	4131.9
0.75	0.62	115366.7	3954.5
0.80	0.60	103041.1	3811.6
0.85	0.58	92215.5	3684.6
0.90	0.56	83139.3	3566.1
0.95	0.54	75142.5	3451.7
1.00	0.52	68500.0	3342.5

TOAV = 68500.0 LOAD = 6640.6 VEL = 40.0 MPH.

MUPEAK = 0.77 MULOCK = 0.52 RATIO = 1.49



FZ = 6648.6 VEL = 40.0 MULOCK = 0.52 MUPEAK = 0.77 RATIO = 1.49 A-D FILE 155 NNFILE 80 SAMPLE 186

** A-D FILE 156 NEW FILE 81 TEST SAMPLE187 **

AVERAGE OF FILE 156 FOR 5 RECORDS. BFG MILESAVER RADIAL HDB 10.00R-20/G (DANA)

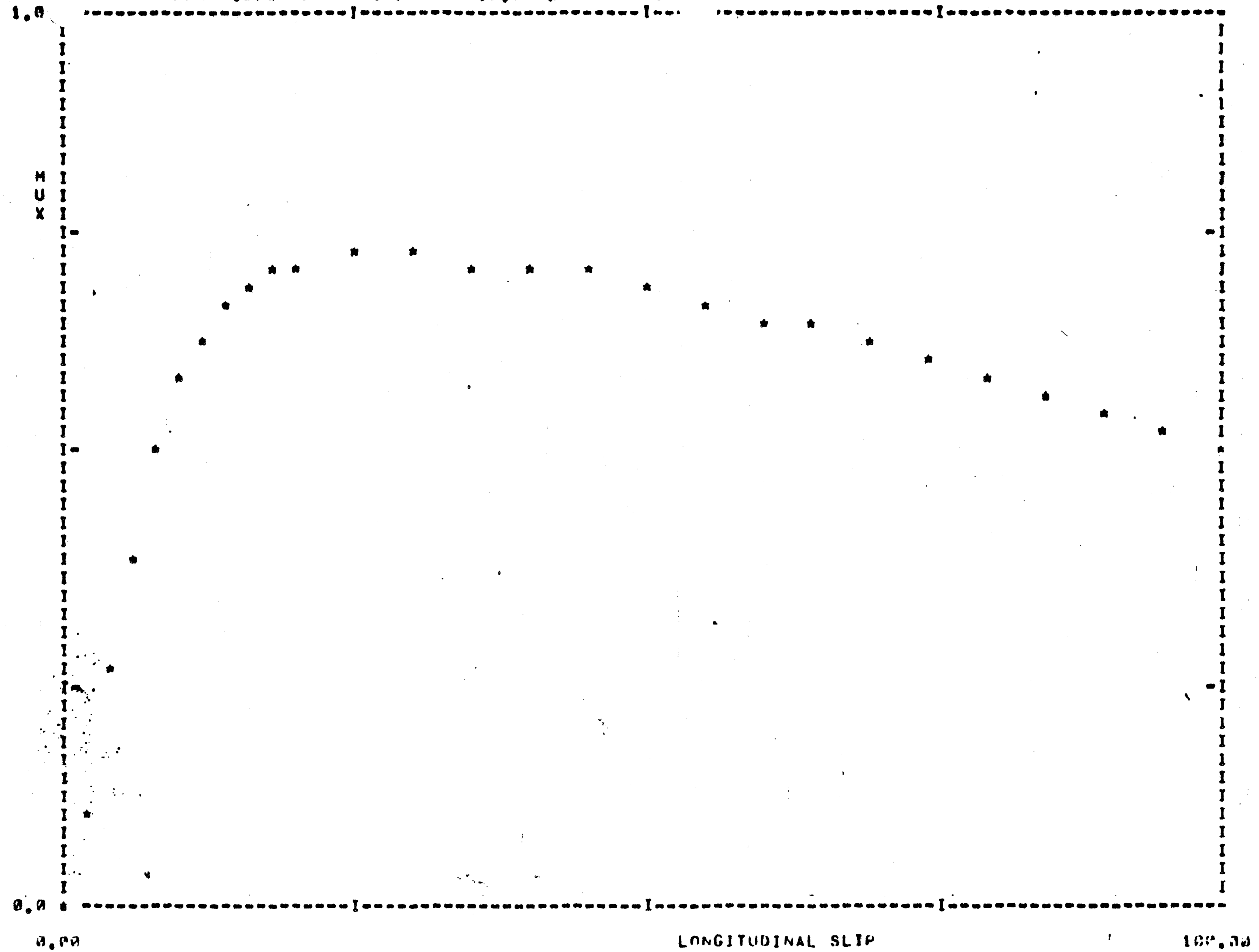
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.10	18217.9	1007.9
0.04	0.26	50161.3	2527.1
0.06	0.40	78389.1	3902.7
0.08	0.51	100230.9	4965.2
0.10	0.59	115743.5	5709.4
0.12	0.64	126409.1	6198.1
0.14	0.67	133760.9	6514.0
0.16	0.70	139023.0	6725.5
0.18	0.71	142819.7	6857.7
0.20	0.72	145346.6	6922.9
0.25	0.73	150348.7	6987.3
0.30	0.73	154831.9	6997.8
0.35	0.73	158985.4	6960.5
0.40	0.72	162314.8	6874.4
0.45	0.71	164077.9	6756.4
0.50	0.69	164321.5	6624.6
0.55	0.68	161591.1	6480.2
0.60	0.66	156531.4	6321.1
0.65	0.65	149869.2	6149.9
0.70	0.63	141520.1	5960.2
0.75	0.61	132400.6	5769.7
0.80	0.59	123961.1	5587.2
0.85	0.57	116642.9	5411.1
0.90	0.55	109873.1	5234.2
0.95	0.53	103662.6	[illegible]
1.00	0.52	98225.0	[illegible]

TQAV = 98225.0 LOAD = 9925.8 VEL = 20.0 MPH.

MUPEAK = 0.73 MULOCK = 0.52 RATIO = 1.41

350

BFG MILESAVER RADIAL HDH 10,0R=20/G (D)



FZ = 9925.8 VEL = 20.4 MULOCK = 0.52 MUPEAK = 0.73 RATIO = 1.41 A-D FILE 156 N-FILE 81 SAMPLE 187

** A-D FILE 157 EM FILE 82 TEST SAMPLE188 **

AVERAGE OF FILE 157 FOR 4 RECORDS. BFG MILFSAVER RADIAL HDB 10.00-20/G (DANA)

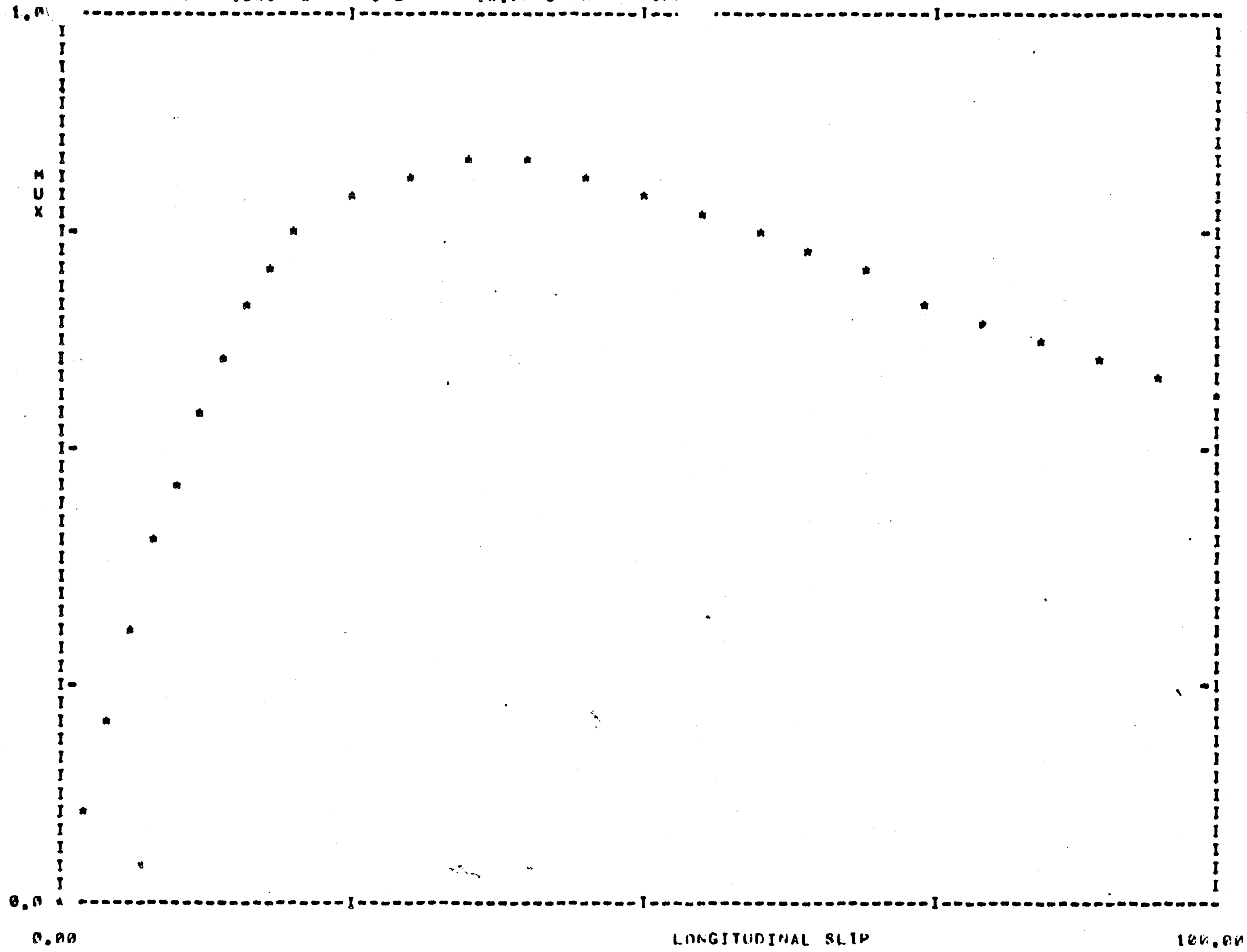
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.11	8555.1	368.1
0.04	0.21	17182.1	720.8
0.06	0.32	25306.6	1046.9
0.08	0.41	32500.7	1336.8
0.10	0.48	38747.9	1577.3
0.12	0.55	44370.5	1778.1
0.14	0.60	54142.6	1968.2
0.16	0.67	56337.4	2175.6
0.18	0.72	62132.0	2351.4
0.20	0.75	66526.7	2454.7
0.25	0.80	75178.6	2608.5
0.30	0.83	82544.6	2793.0
0.35	0.84	89114.8	2749.0
0.40	0.84	95318.3	2747.5
0.45	0.82	100968.6	2707.6
0.50	0.80	105113.1	2641.7
0.55	0.78	106507.9	2565.6
0.60	0.75	104696.4	2491.6
0.65	0.73	100092.4	2421.7
0.70	0.71	92515.[illegible]	2353.8
0.75	0.68	82530.5	2279.4
0.80	0.66	70734.5	22[illegible].2
0.85	0.64	59660.7	2120.7
0.90	0.62	51868.3	2070.7
0.95	0.6[illegible]	45643.7	2[illegible]16.9
1.00	0.58	41093.8	1966.9

TQAV = 41093.8 LOAD = 3493.9 VEL = 40.0 MPH.

MUPEAK = 0.84 MULOCK = 0.58 RATIO = 1.44

352

BFG MILESAVER RADIAL HDB 10.00R-20/G (D)



FZ = 3453.5 VEL = 40.0 MULOCK = 0.58 MUPEAK = 0.84 RATIO = 1.44 A-D FILE 157 MFILE 62 SAMPLE 180

353

** A-D FILE 158 EW FILE 83 TEST SAMPLE189 **

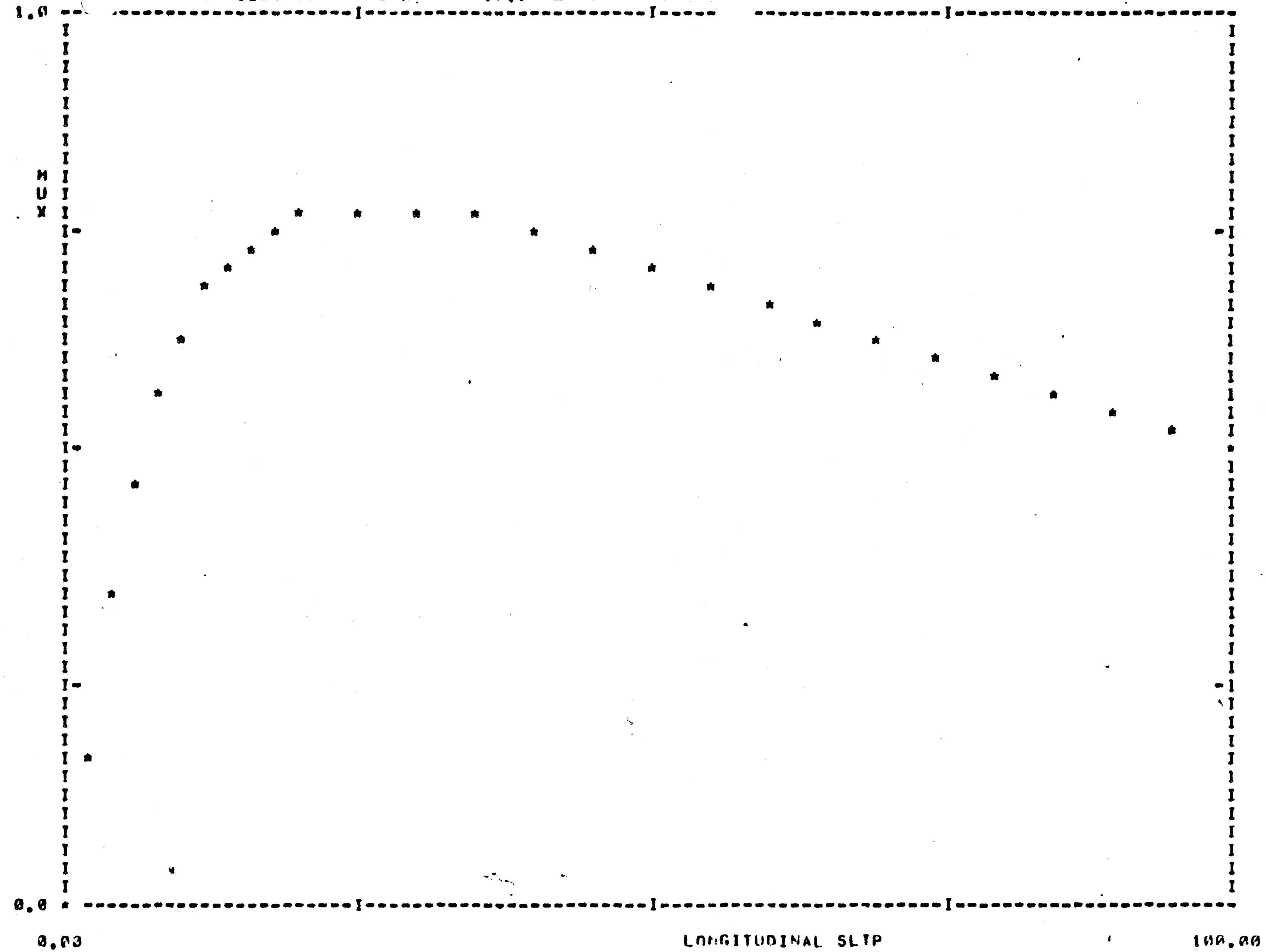
AVERAGE OF FILE 158 FOR 5 RECORDS. BFG MILESAVER RADIAL HDB 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
2.02	0.16	20660.4	1092.4
0.04	0.34	46845.0	2282.3
0.06	0.47	65803.8	3147.5
0.08	0.57	79717.8	3785.2
0.10	0.64	90127.2	4233.8
0.12	0.69	98018.3	4543.3
0.14	0.72	104150.7	4756.7
0.16	0.75	108908.7	4901.3
0.18	0.76	112545.8	4993.6
0.20	0.77	115268.2	5041.0
0.25	0.78	120964.0	5078.3
0.30	0.78	126124.8	5061.0
0.35	0.77	130984.6	4997.1
0.40	0.76	135634.7	4898.8
0.45	0.74	139673.4	4777.1
0.50	0.72	142345.0	4640.2
0.55	0.70	142718.0	4500.2
0.60	0.68	139744.3	4364.6
0.65	0.66	133824.9	4220.2
0.70	0.64	125239.5	4081.7
0.75	0.61	114351.1	3920.3
0.80	0.59	101985.0	3761.2
0.85	0.57	91118.4	3622.7
0.90	0.55	81965.0	3498.6
0.95	0.53	73916.5	333[illegible].7
1.00	0.51	67275.0	327[illegible].0

TQAV = 67275.0 LOAD = 6611.7 VEL = 40.0 MPH.

MUPEAK = 0.78 MULOCK = 0.51 RATIO = 1.53

HFG MILESAVER RADIAL HDB 10.00-20/G (DANA



FZ = 6611.7 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.78 RATIO = 1.53 A-D FILE 158 NWFILE 83 SAMPLE 189

355

** A-D FILE 162   TR FILE 80   TEST SAMPLE 190 **

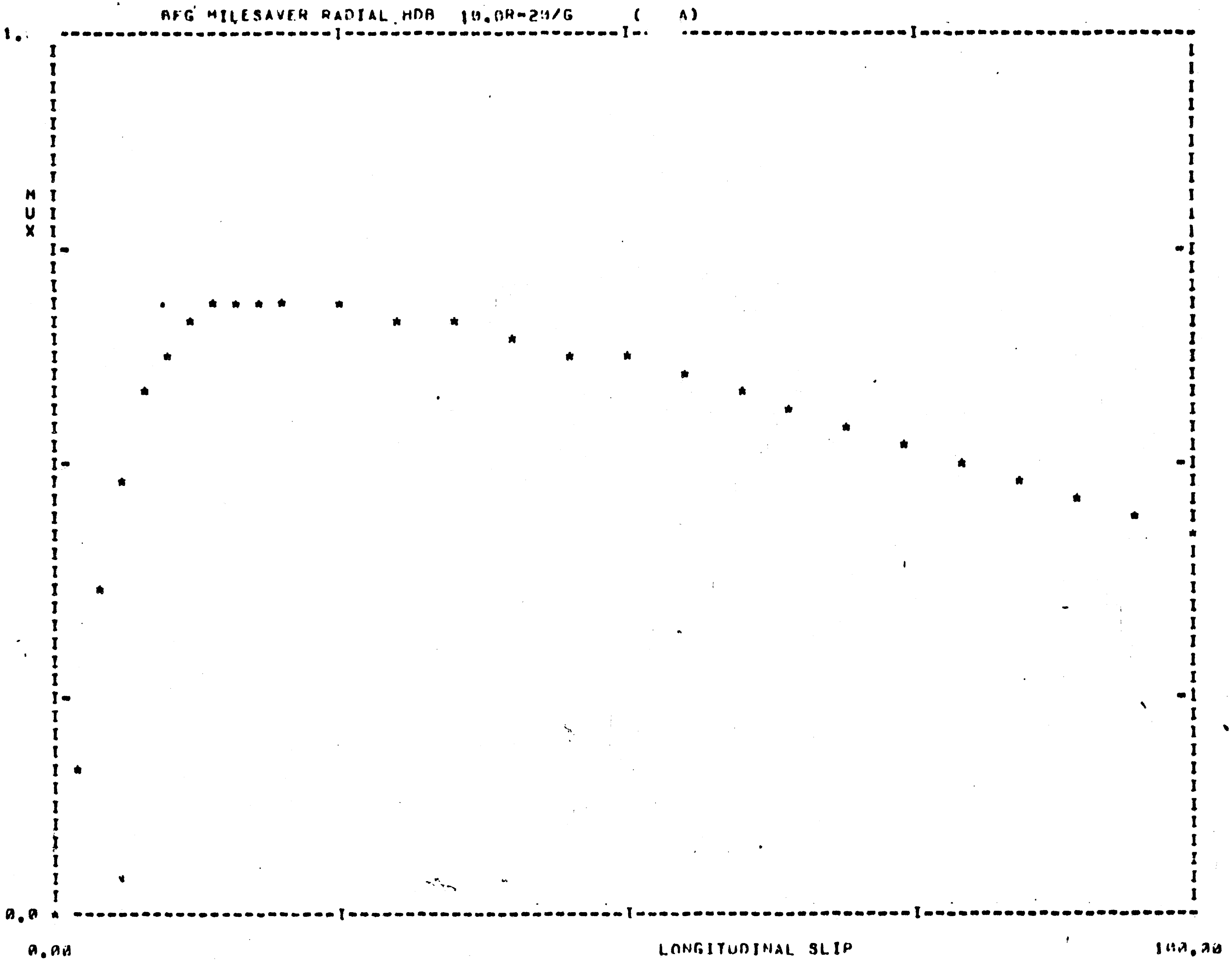
AVERAGE OF FILE 162 FOR 5 RECORDS.   BFG MILESAVER RADIAL HDB 10.00-20/6 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	31991.1	1632.5
0.04	0.36	70873.6	3540.3
0.06	0.50	97785.3	4859.5
0.08	0.59	115685.1	5723.5
0.10	0.64	127050.0	6236.2
0.12	0.67	134167.6	6507.7
0.14	0.69	138633.8	6640.3
0.16	0.70	141651.2	6708.3
0.18	0.70	143806.3	6722.2
0.20	0.70	145182.5	6700.4
0.25	0.69	147588.8	6615.2
0.30	0.68	149577.6	6511.4
0.35	0.67	151419.5	6388.2
0.40	0.66	153229.6	6250.2
0.45	0.64	154994.4	6102.1
0.50	0.63	156543.7	5944.6
0.55	0.61	156917.7	5778.6
0.60	0.59	154910.8	5612.1
0.65	0.58	150578.5	5446.0
0.70	0.56	144353.8	5274.6
0.75	0.54	135140.7	5087.3
0.80	0.52	123546.4	4884.4
0.85	0.49	111012.5	4694.0
0.90	0.47	101163.0	4522.1
0.95	0.45	91797.0	4328.2
1.00	0.44	83325.0	4162.5

TQAV = 83325.0   LOAD = 9876.9   VEL = 40.0 MPH.

MUPEAK = 0.70   MULOCK = 0.44   RATIO = 1.61

356



FZ = 9876.9 VEL = 40.0 MULOCK = 0.44 MUPEAK = 0.70 RATIO = 1.61 A-D FILE 162 NWFILE 64 SAMPLE 190

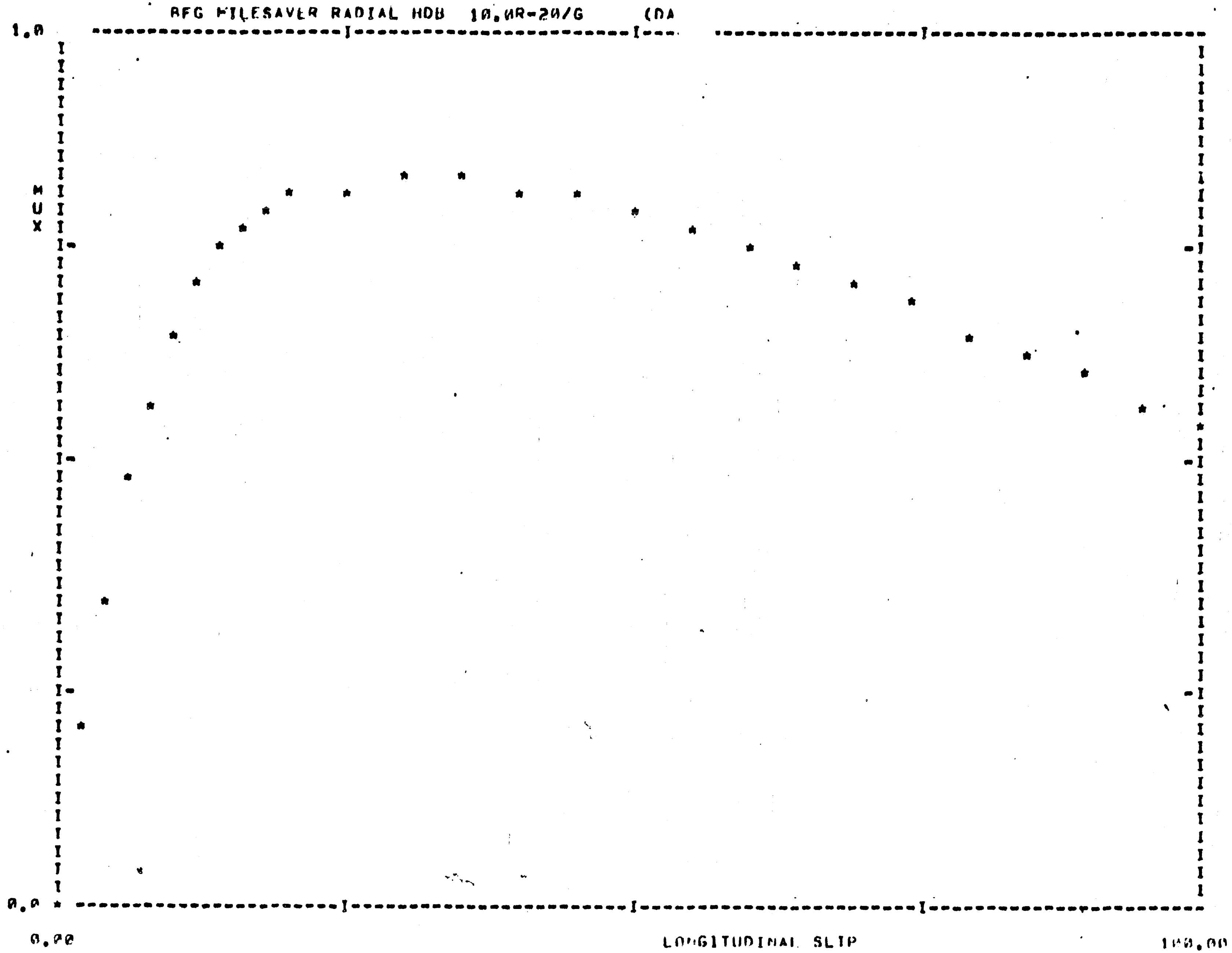
** A-D FILE 163 FILE 85 TEST SAMPLE191 **

AVERAGE OF FILE 163 FOR 6 RECORDS. BFG MILESAVER RADIAL HUB 10.WR-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	13996.9	629.7
0.04	0.35	26758.5	1138.0
0.06	0.48	37696.8	1552.5
0.08	0.58	46563.7	1882.3
0.10	0.66	53678.8	2133.0
0.12	0.71	59523.7	2313.9
0.14	0.75	64549.4	2443.3
0.16	0.78	68777.7	2535.8
0.18	0.80	72407.9	2599.7
0.20	0.81	75414.2	2635.7
0.25	0.83	81741.8	2678.5
0.30	0.83	87463.7	2694.9
0.35	0.83	92843.2	2691.4
0.40	0.83	98095.1	2667.6
0.45	0.81	103373.4	2620.1
0.50	0.80	108414.2	2557.0
0.55	0.77	112371.1	2483.6
0.60	0.75	113045.4	2409.8
0.65	0.73	109578.2	2345.2
0.70	0.71	102362.1	2281.7
0.75	0.69	91926.9	2208.6
0.80	0.66	78722.5	2119.4
0.85	0.63	64531.1	2022.7
0.90	0.60	53441.5	1937.8
0.95	0.58	44141.8	1858.2
1.00	0.56	36854.2	1783.7

TUAV = 36854.2 LOAD = 3213.7 VEL = 55.0 MPH.

MUPEAK = 0.83 MULOCK = 0.56 RATIO = 1.50



FZ = 3213.7 VEL = 55.0 MULOCK = 0.56 MUPEAK = 0.83 RATIO = 1.50 A-D FILE 163 NAFILE 85 SAMPLE 191

359

** A-D FILE 164   NEW FILE 86   TEST SAMPLE192 **

AVERAGE OF FILE 164 FOR 5 RECORDS.   BFG MILESAVER RADIAL HDB 10.0R-20/G (DANA)

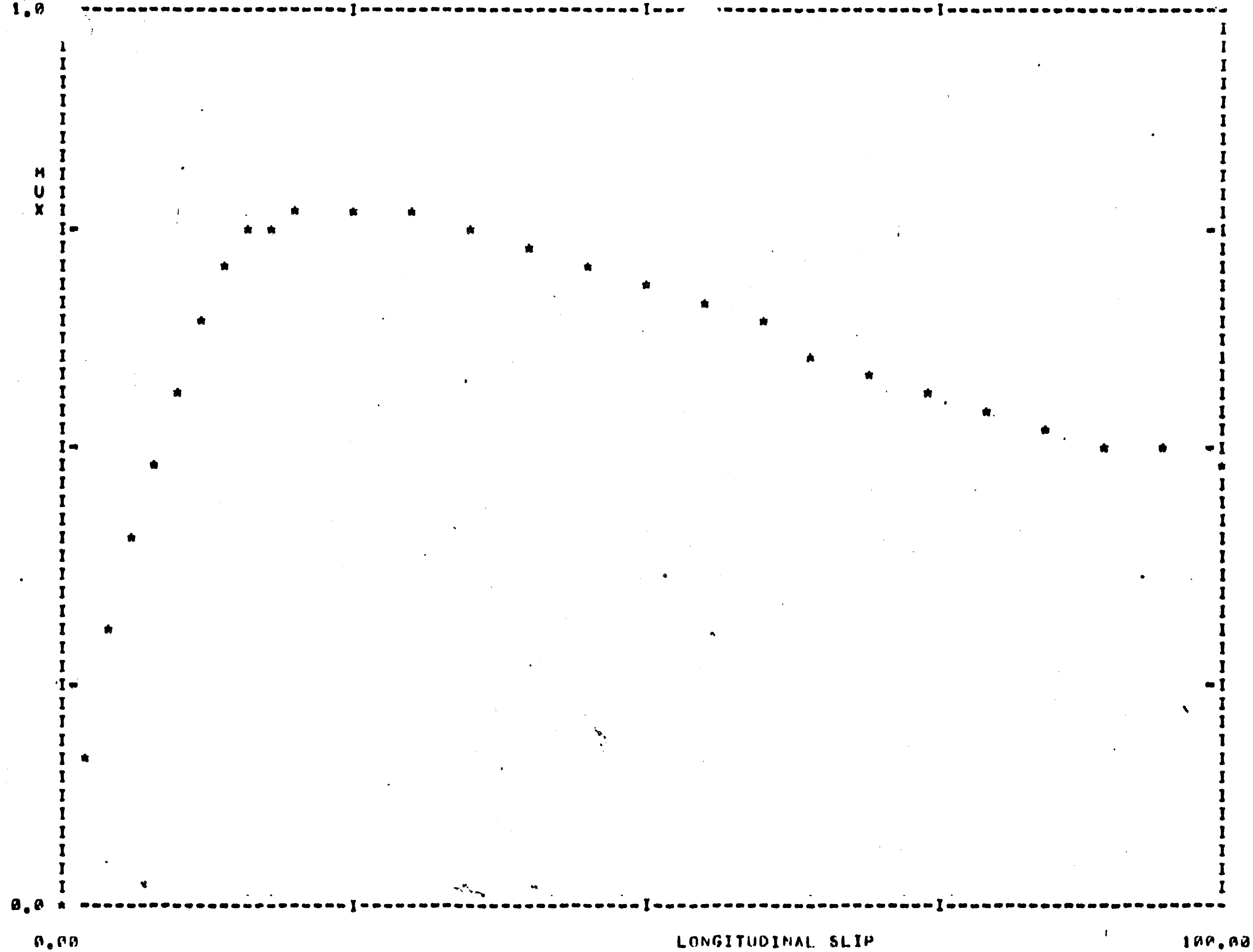
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	21048.2	1095.1
0.04	0.30	41232.9	2024.8
0.06	0.41	56182.2	2731.1
0.08	0.50	67611.6	3274.5
0.10	0.57	78035.6	3749.3
0.12	0.65	91068.0	4301.5
0.14	0.71	100916.5	4690.1
0.16	0.75	107468.7	4909.5
0.18	0.77	112022.1	5024.0
0.20	0.77	114971.0	5058.4
0.25	0.77	120503.2	5049.3
0.30	0.77	125352.7	4992.3
0.35	0.76	129841.8	4896.2
0.40	0.74	134066.3	4770.5
0.45	0.72	137771.6	4627.3
0.50	0.69	139969.4	4467.7
0.55	0.67	139582.0	4305.5
0.60	0.65	136572.4	4148.0
0.65	0.62	129901.8	3997.0
0.70	0.60	120470.1	3843.0
0.75	0.58	108941.1	3690.9
0.80	0.56	96078.6	3553.0
0.85	0.54	84686.6	3432.1
0.90	0.52	76001.2	3319.9
0.95	0.50	68673.1	3211.2
1.00	0.49	62875.0	3106.5

TQAV = 62875.0   LOAD = 6620.1   VEL = 40.0 MPH.

MUPEAK = 0.77   MULOCK = 0.49   RATIO = 1.59

360

BFG MILESAVER RADIAL HDB 10.0R-20/G (DANA)



FZ = 6620.1 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.77 RATIO = 1.59 A-D FILE 164 NWFILE 86 SAMPLE 192

361

** A-D FILE 165 NEW FILE 87 TEST SAMPLE193 **

AVERAGE OF FILE 165 FOR 6 RECORDS. BFG MILESAVER RADIAL HDB 10.00-20/G (DANA)

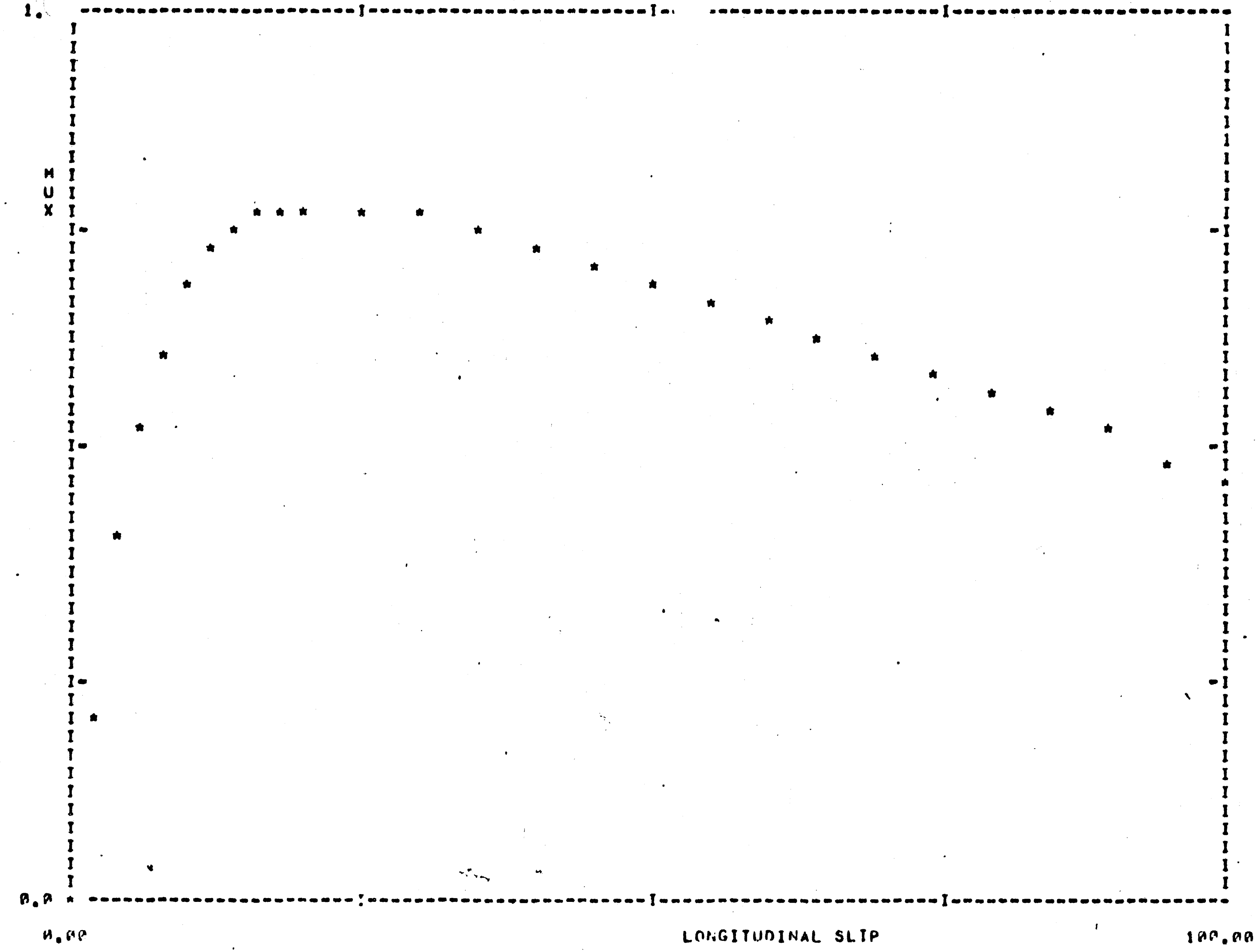
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	28226.0	1391.4
0.04	0.40	55181.9	2673.8
0.06	0.53	73649.3	3529.9
0.08	0.62	86785.1	4114.4
0.10	0.69	96044.8	4504.7
0.12	0.73	102761.5	4758.8
0.14	0.75	107760.6	4916.2
0.16	0.77	111555.7	5008.1
0.18	0.78	114494.9	5056.1
0.20	0.78	116614.8	5061.6
0.25	0.78	120634.3	5023.1
0.30	0.77	124152.1	4957.1
0.35	0.76	127315.0	4860.5
0.40	0.74	130256.4	4762.8
0.45	0.72	132981.7	4646.2
0.50	0.70	135533.2	4515.5
0.55	0.68	137591.9	4374.3
0.60	0.66	138079.9	4230.1
0.65	0.64	135709.6	4090.2
0.70	0.62	133058.7	3953.2
0.75	0.59	120779.6	3811.7
0.80	0.57	108376.9	3663.2
0.85	0.55	94378.7	3518.7
0.90	0.52	82459.3	3383.1
0.95	0.50	72003.4	3250.4
1.00	0.48	63291.7	3120.0

TQAV = 63291.7 LOAD = 6606.1 VEL = 55.0 MPH.

MUPEAK = 0.78 MULOCK = 0.48 RATIO = 1.64

362

PFG MILESAVER RADIAL HDB 10.00-20/G ( )



FZ = 6606.1 VEL = 55.0 MULOCK = 0.48 MUPEAK = 0.78 RATIO = 1.64 A-D FILE 165 NWFILE 87 SAMPLE 193

** A-D FILE 167   W FILE 88   TEST SAMPLE195 **

AVERAGE OF FILE 167 FOR 6 RECORDS.   BFG MILESAVER RADIAL HDB 10.0R-20/G (DANA)

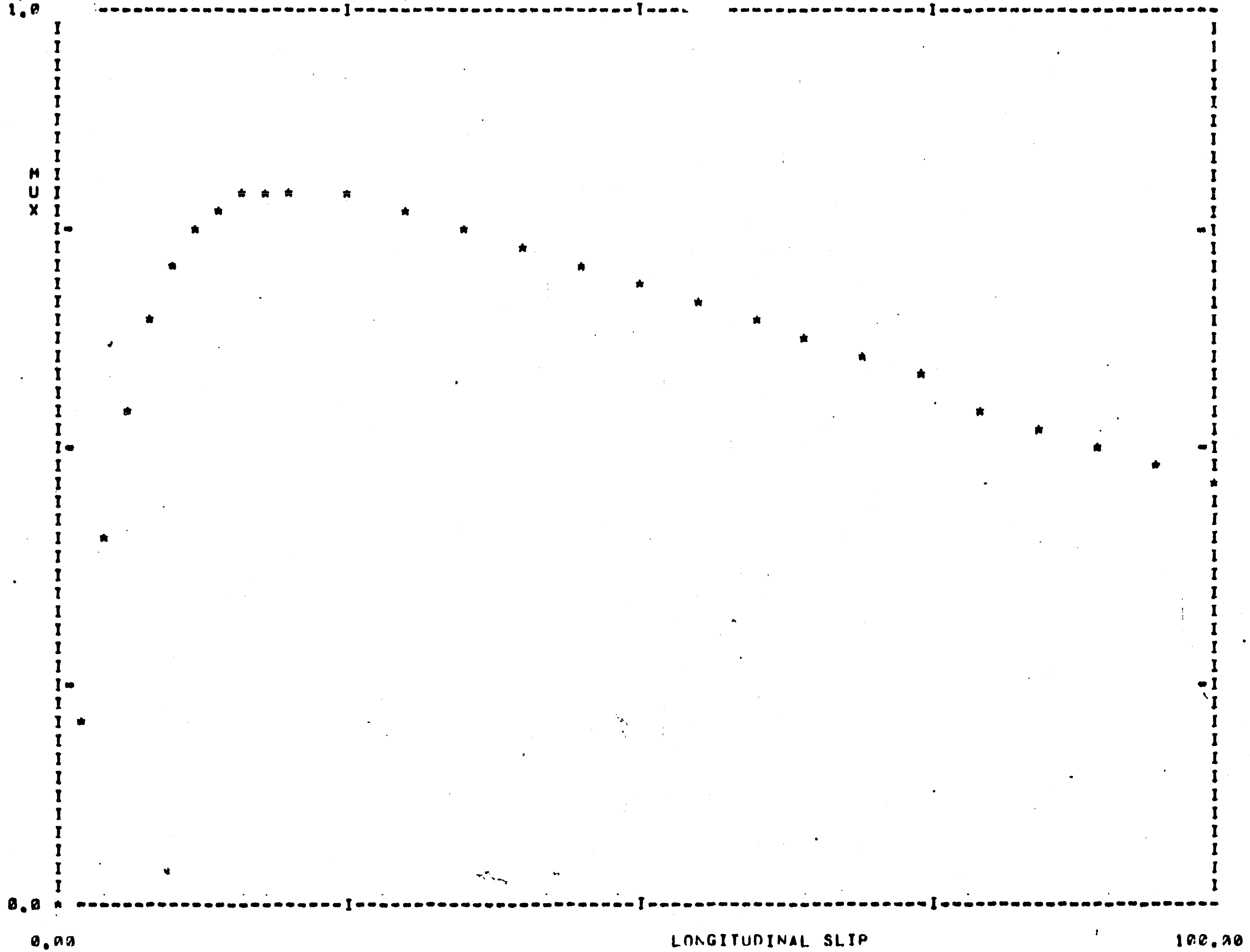
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	29403.7	1426.9
0.04	0.41	56315.3	2742.7
0.06	0.56	75165.5	3678.9
0.08	0.65	88787.1	4319.8
0.10	0.72	98181.0	4722.7
0.12	0.76	104523.0	4973.4
0.14	0.78	108917.2	5129.2
0.16	0.80	112099.2	5220.9
0.18	0.80	114456.7	5266.3
0.20	0.81	116181.6	5268.5
0.25	0.80	119665.5	5207.6
0.30	0.78	122482.2	5121.7
0.35	0.76	124769.1	5017.6
0.40	0.75	126555.2	4900.0
0.45	0.73	127898.0	4771.7
0.50	0.70	128860.6	4632.5
0.55	0.68	129031.4	4483.9
0.60	0.66	127729.8	4330.7
0.65	0.63	124630.6	4173.0
0.70	0.61	119089.7	4014.5
0.75	0.59	111100.6	3854.3
0.80	0.56	100819.4	3697.1
0.85	0.54	89601.0	3553.0
0.90	0.52	80299.3	3416.6
0.95	0.50	72019.7	3282.4
1.00	0.48	64833.3	3156.0

TQAV = 64833.3   LOAD = 6665.4   VEL = 40.0 MPH.

MUPEAK = 0.81   MULOCK = 0.48   RATIO = 1.68

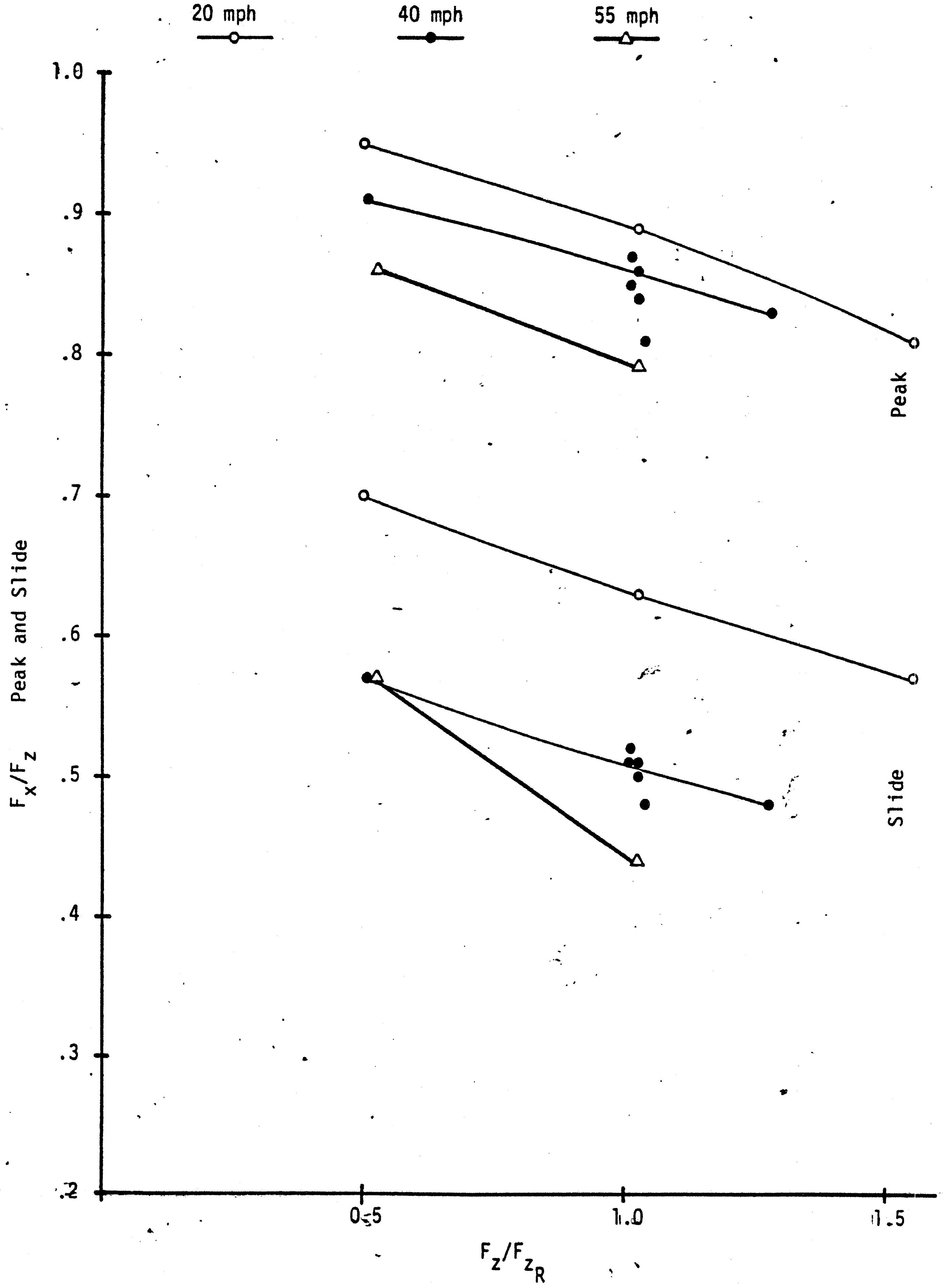
364

BFG MILESAVER RADIAL HDB 10.0R-20/G (DA



FZ = 6665.4 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.81 RATIO = 1.68 A-D FILE 167 NNFILE 88 SAMPLE 195

365



Summary - Goodyear Unisteel R-1 - 10 R 20G

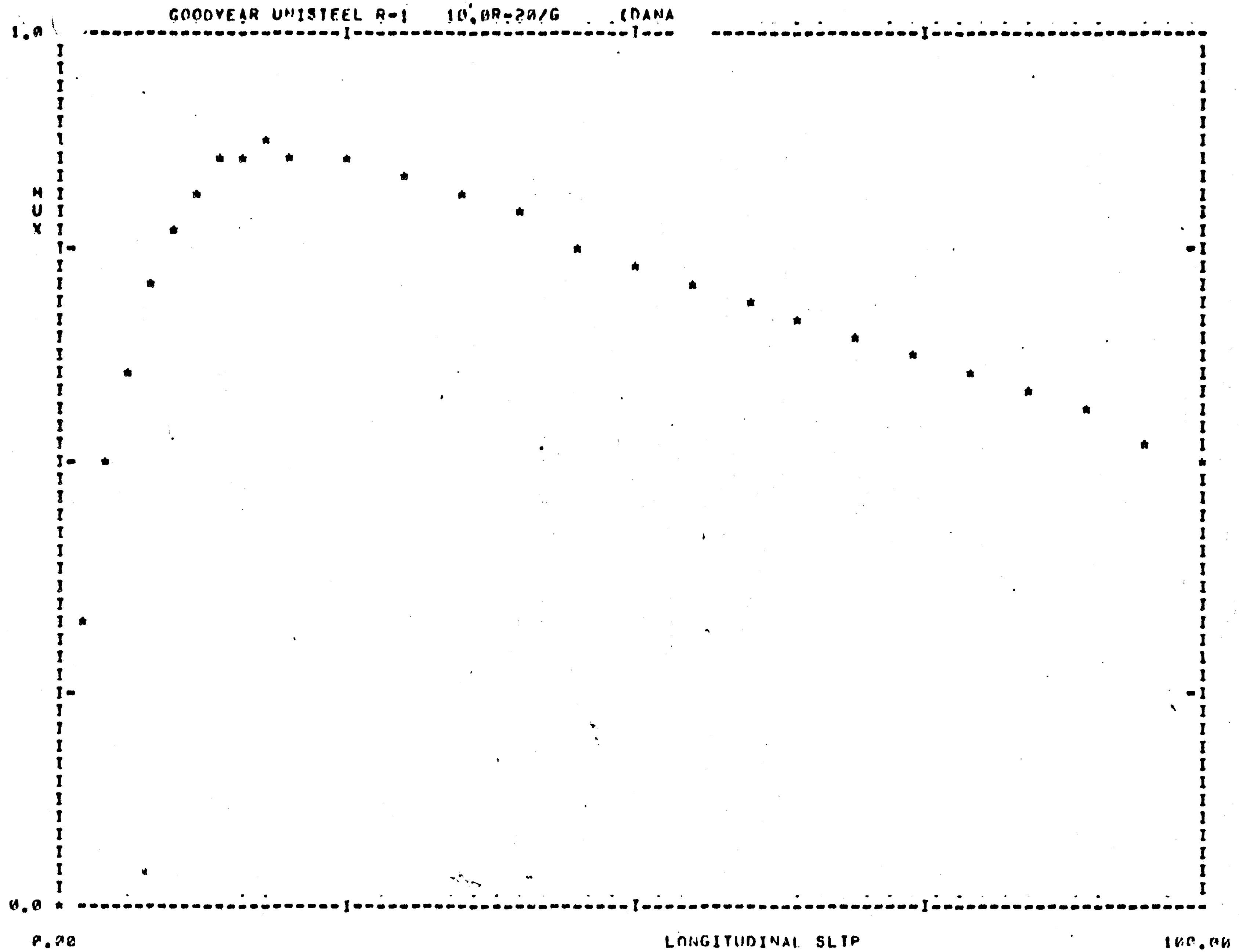
** A-D FILE 4 . FILE 1 TEST SAMPLE106 **

AVERAGE OF FILE 4 FOR 3 RECORDS. GOODYEAR UNISTEEL R-1 10.00-20/G (LANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.34	41041.2	2074.1
0.04	0.50	61354.5	3094.1
0.06	0.62	75809.7	3805.9
0.08	0.71	86318.2	4301.4
0.10	0.77	94255.8	4664.4
0.12	0.82	100062.8	4945.1
0.14	0.85	104297.3	5111.9
0.16	0.86	107967.7	5195.8
0.18	0.87	106719.6	5234.9
0.20	0.87	109741.3	5219.8
0.25	0.85	111221.5	5125.0
0.30	0.83	112166.1	5017.6
0.35	0.81	112886.2	4901.4
0.40	0.79	113489.9	4782.1
0.45	0.77	114339.5	4662.9
0.50	0.75	114561.9	4540.1
0.55	0.72	114997.7	4412.2
0.60	0.70	115186.4	4277.7
0.65	0.68	114661.9	4138.4
0.70	0.66	112302.5	4002.2
0.75	0.64	107139.3	3871.4
0.80	0.61	99191.5	3736.0
0.85	0.59	90164.6	3596.3
0.90	0.57	81162.9	3447.5
0.95	0.54	72348.3	3297.6
1.00	0.52	63708.3	3147.5

TQAV = 63708.3 LOAD = 6141.6 VEL = 40.0 MPH.

MUPEAK = 0.87 MULOCK = 0.52 RATIO = 1.68



FZ = 6141.6 VEL = 40.0 MULOCK = 0.52 MUPEAK = 0.87 RATIO = 1.68 A-D FILE 4 NWFILE 1 SAMPLE 106

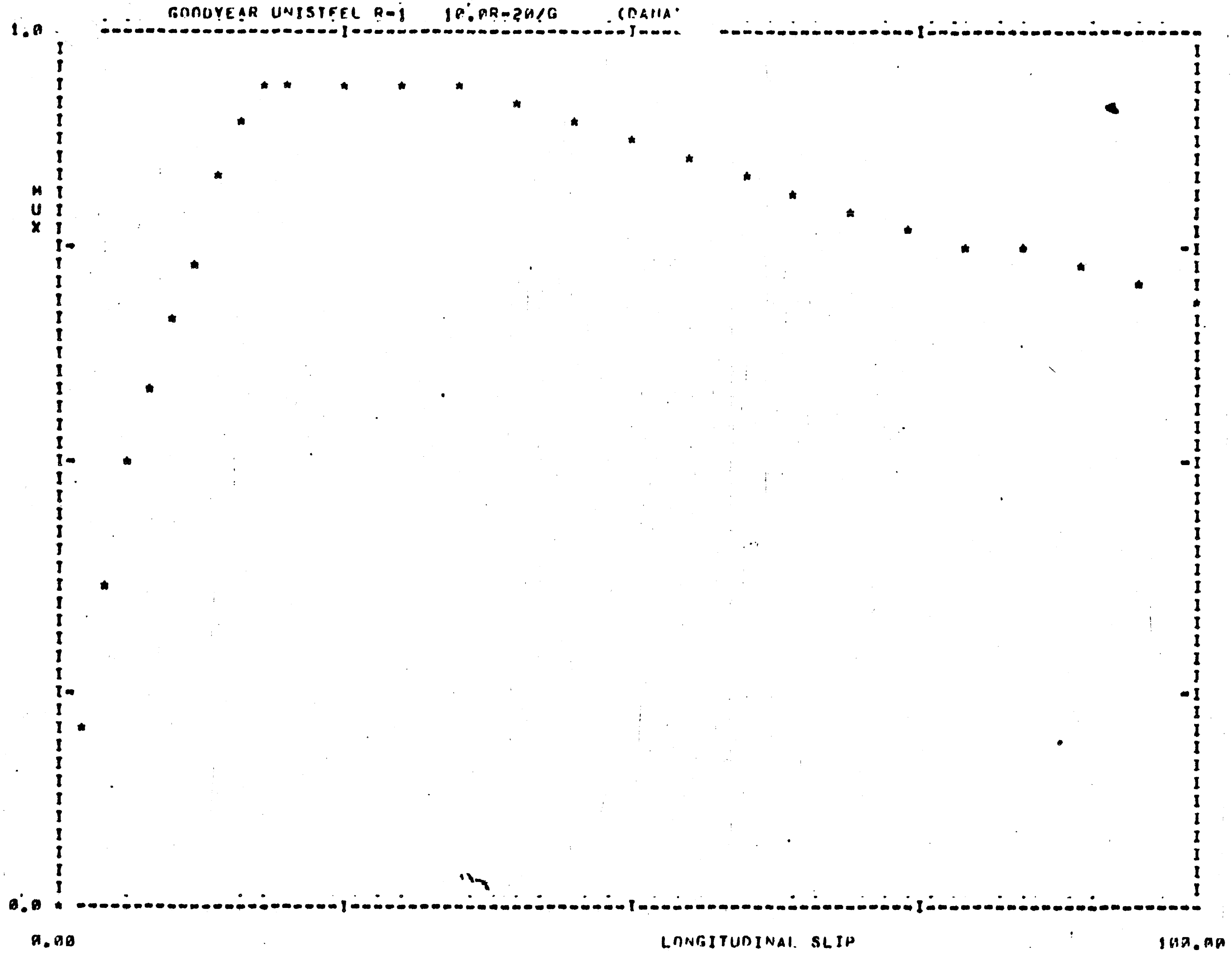
** A-D FILE 5 FILE 2 TEST SAMPLE1V7 **

AVERAGE OF FILE- 5 FOR 6 RECORDS. GOODYEAR UNISTEEL R-1 10.00-20/G (UANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	14372.0	693.4
0.04	0.38	26259.6	1274.8
0.06	0.51	35323.2	1717.5
0.08	0.60	42074.0	2038.8
0.10	0.67	46719.5	2259.8
0.12	0.74	50568.1	2440.1
0.14	0.83	55601.9	2648.3
0.16	0.90	59494.0	2787.1
0.18	0.94	62156.2	2862.4
0.20	0.95	63838.7	2879.0
0.25	0.95	66828.0	2876.0
0.30	0.94	69245.8	2857.6
0.35	0.93	71235.3	2829.2
0.40	0.92	73320.6	2792.3
0.45	0.90	74716.0	2745.5
0.50	0.88	76072.5	2689.1
0.55	0.86	76567.6	2625.6
0.60	0.84	75827.1	2560.7
0.65	0.82	73649.3	2498.1
0.70	0.80	70072.6	2437.9
0.75	0.78	65487.8	2380.7
0.80	0.76	60425.7	2328.9
0.85	0.75	55906.1	2277.9
0.90	0.73	51605.3	2227.3
0.95	0.71	47536.8	2177.4
1.00	0.70	43812.5	2128.7

TQAV = 43812.5 LOAD = 3026.4 VEL = 20.0 MPH.

MUPEAK = 0.95 MULOCK = 0.70 RATIO = 1.36



FZ = 3026.4 VEL = 20.0 MULOCK = 0.70 MUPEAK = 0.95 RATIO = 1.36 A-D FILE 5 NWFILE 2 SAMPLE 107

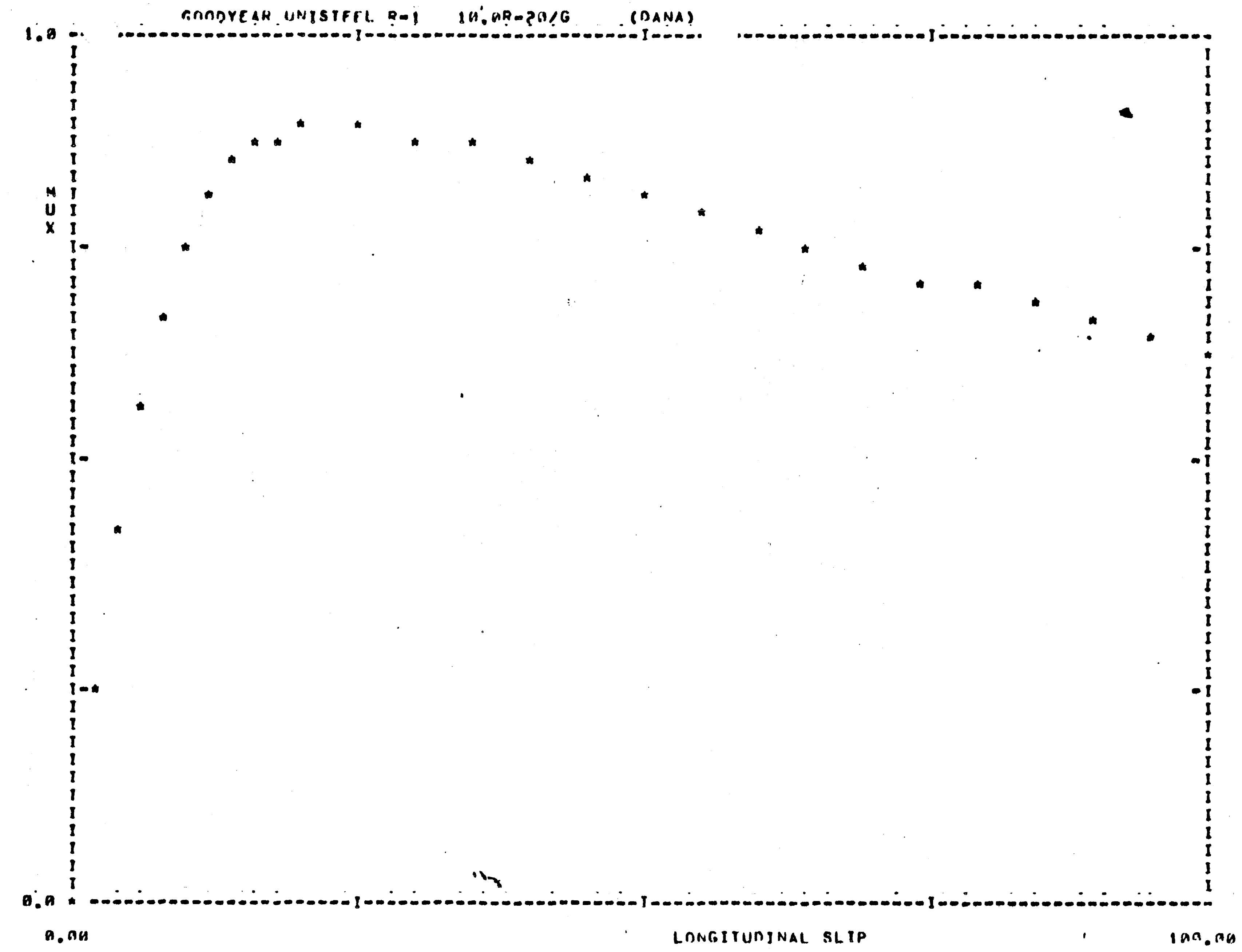
** A-D FILE 6 NE ILE 3 TEST SAMPLE 10A **

AVERAGE OF FILE 6 FOR 6 RECORDS. GOODYEAR UNISTEEL R-1 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.24	29941.3	1513.6
0.04	0.42	52203.6	2625.7
0.06	0.57	69592.8	3502.8
0.08	0.68	83063.1	4175.8
0.10	0.76	93105.6	4655.1
0.12	0.82	100173.4	4988.0
0.14	0.86	105219.9	5204.3
0.16	0.88	108754.5	5334.2
0.18	0.89	111147.5	5406.1
0.20	0.89	112559.0	5427.2
0.25	0.89	114935.9	5419.3
0.30	0.88	116830.9	5378.9
0.35	0.87	118420.4	5313.0
0.40	0.86	119794.1	5230.5
0.45	0.84	120908.3	5131.0
0.50	0.82	121519.3	5019.4
0.55	0.81	121068.8	4904.1
0.60	0.79	119407.2	4788.6
0.65	0.77	115824.8	4671.8
0.70	0.75	110877.1	4549.3
0.75	0.73	105016.0	4422.4
0.80	0.71	99379.1	4305.5
0.85	0.69	93794.8	4192.0
0.90	0.67	88267.1	4080.5
0.95	0.65	82985.9	3972.2
1.00	0.63	77729.2	3868.7

TQAV = 77729.2 LOAD = 6214.2 VEL = 20.0 MPH.

MUPEAK = 0.89 MULOCK = 0.63 RATIO = 1.41



FZ = 6214.2 VEL = 20.0 MULOCK = 0.63 MUPEAK = 0.89 RATIO = 1.41 A-D FILE 6 NWFILE 3 SAMPLE 100

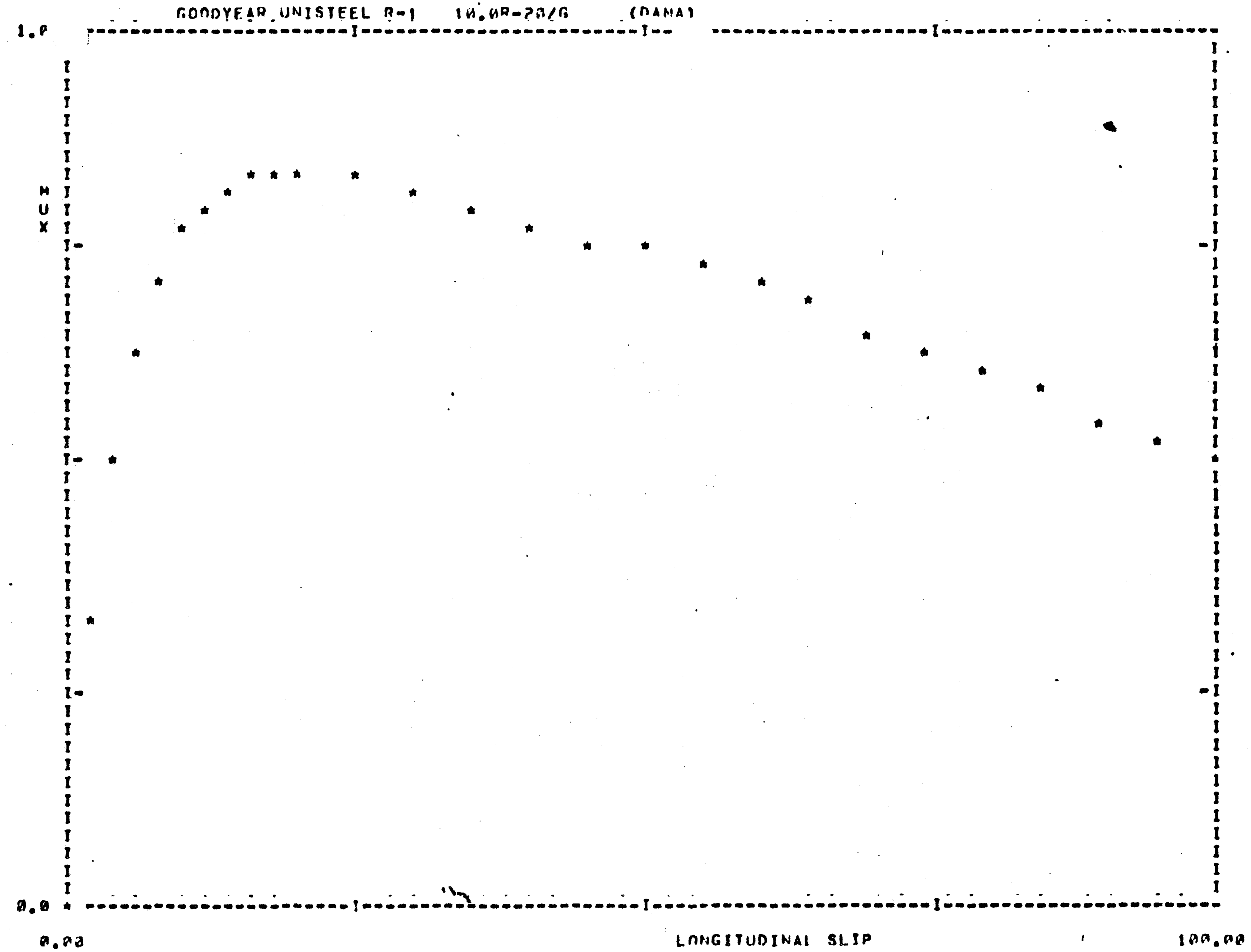
** A-D FILE 7   W FILE 8   TEST SAMPLE109 **

AVERAGE OF FILE 7 FOR 6 RECORDS.   GOODYEAR UNISTEEL R-1   10.00-20/G   (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.33	41048.4	2059.5
0.04	0.51	62810.3	3148.4
0.06	0.63	77615.0	3865.5
0.08	0.71	88432.9	4373.1
0.10	0.77	96085.0	4716.2
0.12	0.80	101577.1	4918.9
0.14	0.82	105425.6	5024.3
0.16	0.84	108053.5	5071.8
0.18	0.84	109931.7	5083.6
0.20	0.84	111154.2	5065.0
0.25	0.83	113704.3	4983.7
0.30	0.82	115874.4	4890.6
0.35	0.80	117631.9	4793.6
0.40	0.78	119077.0	4693.7
0.45	0.77	120288.2	4590.0
0.50	0.75	121303.9	4482.9
0.55	0.73	122085.2	4367.0
0.60	0.71	122445.3	4241.6
0.65	0.69	120245.9	4112.9
0.70	0.66	115970.0	3983.8
0.75	0.64	108096.1	3848.3
0.80	0.62	99479.7	3700.3
0.85	0.59	88991.5	3546.5
0.90	0.56	79477.3	3393.9
0.95	0.54	70629.7	3243.5
1.00	0.51	62562.5	3096.5

TQAV = 62562.5   LOAD = 6188.1   VEL = 40.0 MPH.

MUPEAK = 0.84   MULOCK = 0.51   RATIO = 1.64



FZ = 6188.1 VFL = 40.0 MULOCK = 0.51 MUPEAK = 0.84 RATIO = 1.64 A-D FILE 7 N-FILE 4 SAMPLE 109

375

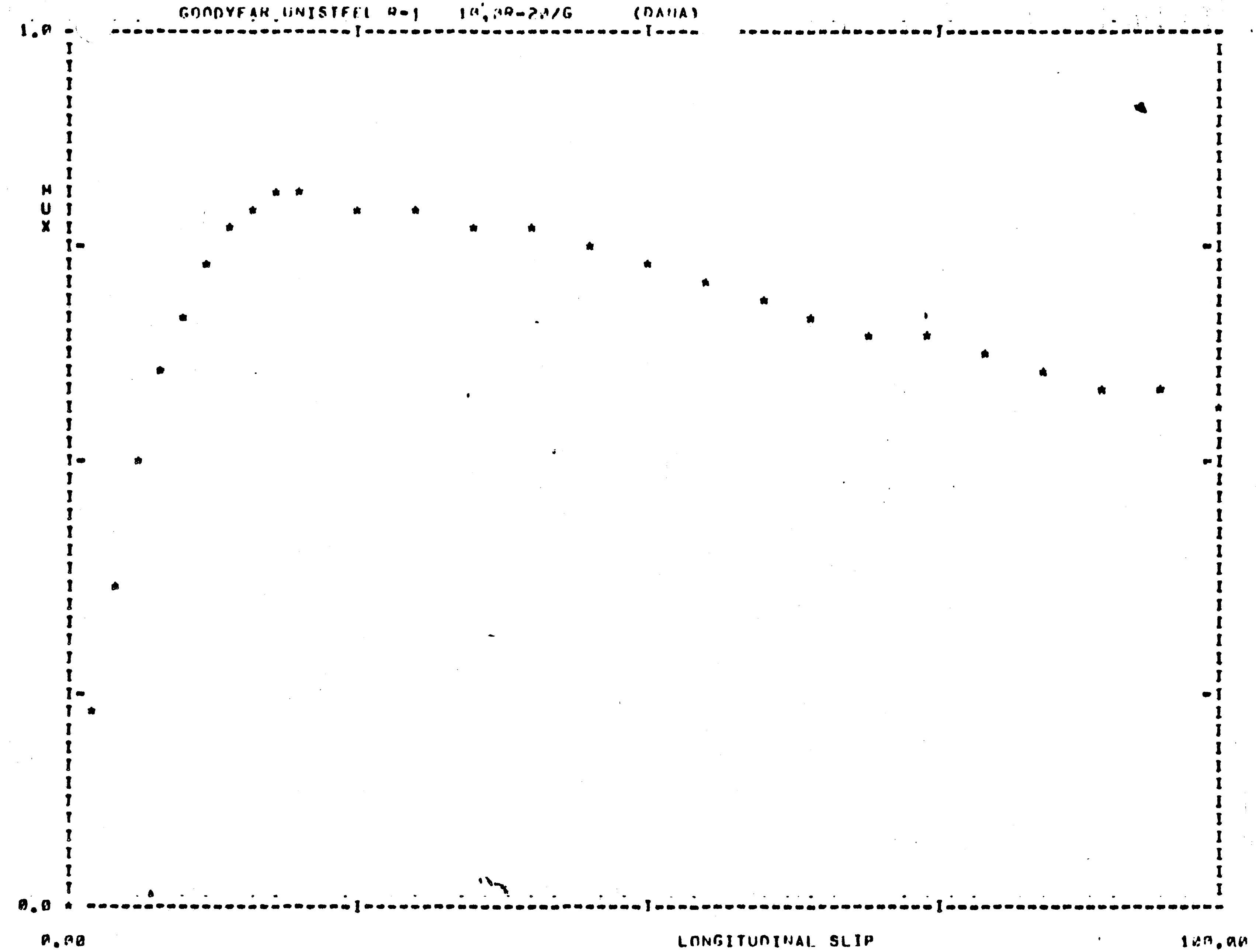
** A-D FILE 0 NEW FILE 1-5 TEST SAMPLE110 **

AVERAGE OF FILE 0 FOR 4 RECORDS. GOODYEAR UNISTEEL R=1 10.00-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	40016.4	2034.3
0.04	0.38	68289.6	3471.0
0.06	0.51	91424.6	4646.0
0.08	0.61	109249.3	5550.9
0.10	0.69	122646.0	6220.0
0.12	0.74	132581.7	6710.4
0.14	0.78	139559.2	7057.9
0.16	0.80	144155.7	7264.0
0.18	0.81	147066.9	7362.6
0.20	0.81	148475.3	7372.7
0.25	0.81	150415.0	7326.7
0.30	0.80	151776.6	7246.6
0.35	0.79	152777.6	7137.0
0.40	0.77	153475.8	7005.9
0.45	0.75	153795.2	6858.3
0.50	0.74	153461.9	6699.5
0.55	0.72	152064.5	6535.7
0.60	0.70	149608.8	6371.7
0.65	0.68	145288.2	6211.3
0.70	0.66	139599.6	6058.2
0.75	0.65	133897.8	5913.4
0.80	0.63	128131.6	5770.2
0.85	0.62	122282.3	5626.8
0.90	0.60	116459.4	5484.8
0.95	0.58	110732.7	5345.6
1.00	0.57	105187.5	5210.6

TQAV = 105187.5 LOAD = 9353.9 VEL = 20.0 MPH.

MUPEAK = 0.81 MULOCK = 0.57 RATIO = 1.43



FZ = 9353.9 VEL = 20.0 MULOCK = 0.57 MUPEAK = 0.81 RATIO = 1.43 A-D FILE 8 NAFILE 5 SAMPLE 110

** A-D FILE 9 EW FILE TEST SAMPLE111 **

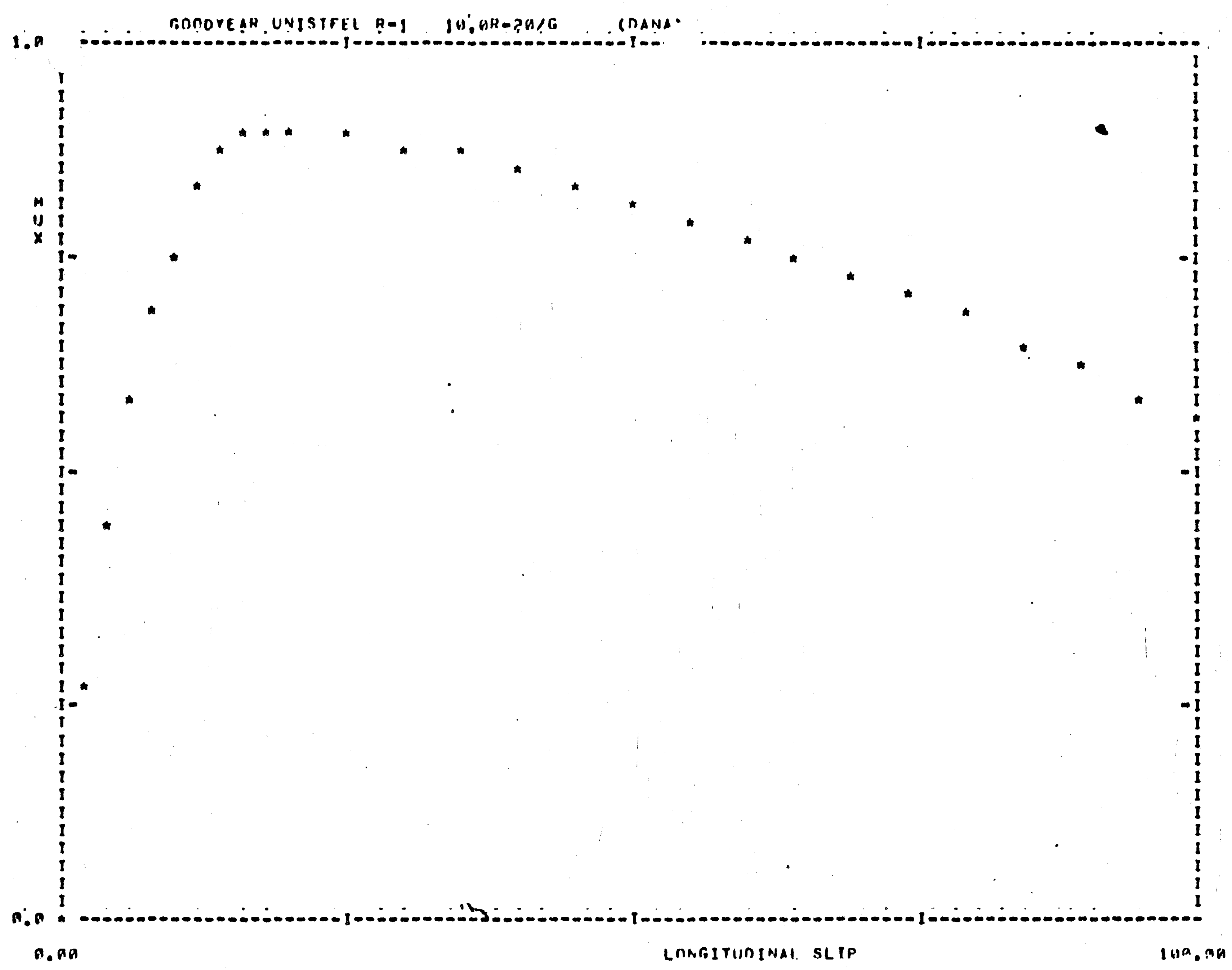
AVERAGE OF FILE 9 FOR 6 RECORDS. GOODYEAR UNISTEEL R-1 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.26	17031.8	808.5
0.04	0.45	28525.6	1370.0
0.06	0.59	37003.7	1788.3
0.08	0.69	43229.3	2087.7
0.10	0.76	48515.6	2308.6
0.12	0.83	54437.4	2524.5
0.14	0.88	58839.0	2657.8
0.16	0.90	61994.5	2727.5
0.18	0.91	64459.2	2754.6
0.20	0.91	66306.7	2748.5
0.25	0.90	69550.4	2724.4
0.30	0.89	72110.6	2699.5
0.35	0.88	74311.0	2668.3
0.40	0.86	76407.6	2625.7
0.45	0.84	78524.6	2573.3
0.50	0.82	80545.6	2517.6
0.55	0.80	82353.3	2460.5
0.60	0.78	83660.3	2406.7
0.65	0.76	83504.6	2342.3
0.70	0.74	80768.2	2284.9
0.75	0.72	[illegible]	2216.2
0.80	0.69	68097.3	2126.6
0.85	0.66	59388.9	2028.3
0.90	0.63	51219.5	1936.8
0.95	0.60	43444.8	1849.9
1.00	0.57	36333.3	1760.8

TQAV = 36333.3 LOAD = 3079.1 VEL = 40.0 MPH.

MUPEAK = 0.91 MULOCK = 0.57 RATIO = 1.58

378



FZ = 3079.1 VFL = 40.0 MULOCK = 0.57 MUPEAK = 0.91 RATIO = 1.58 A-D FILE 9 N.FILE 6 SAMPLE 111

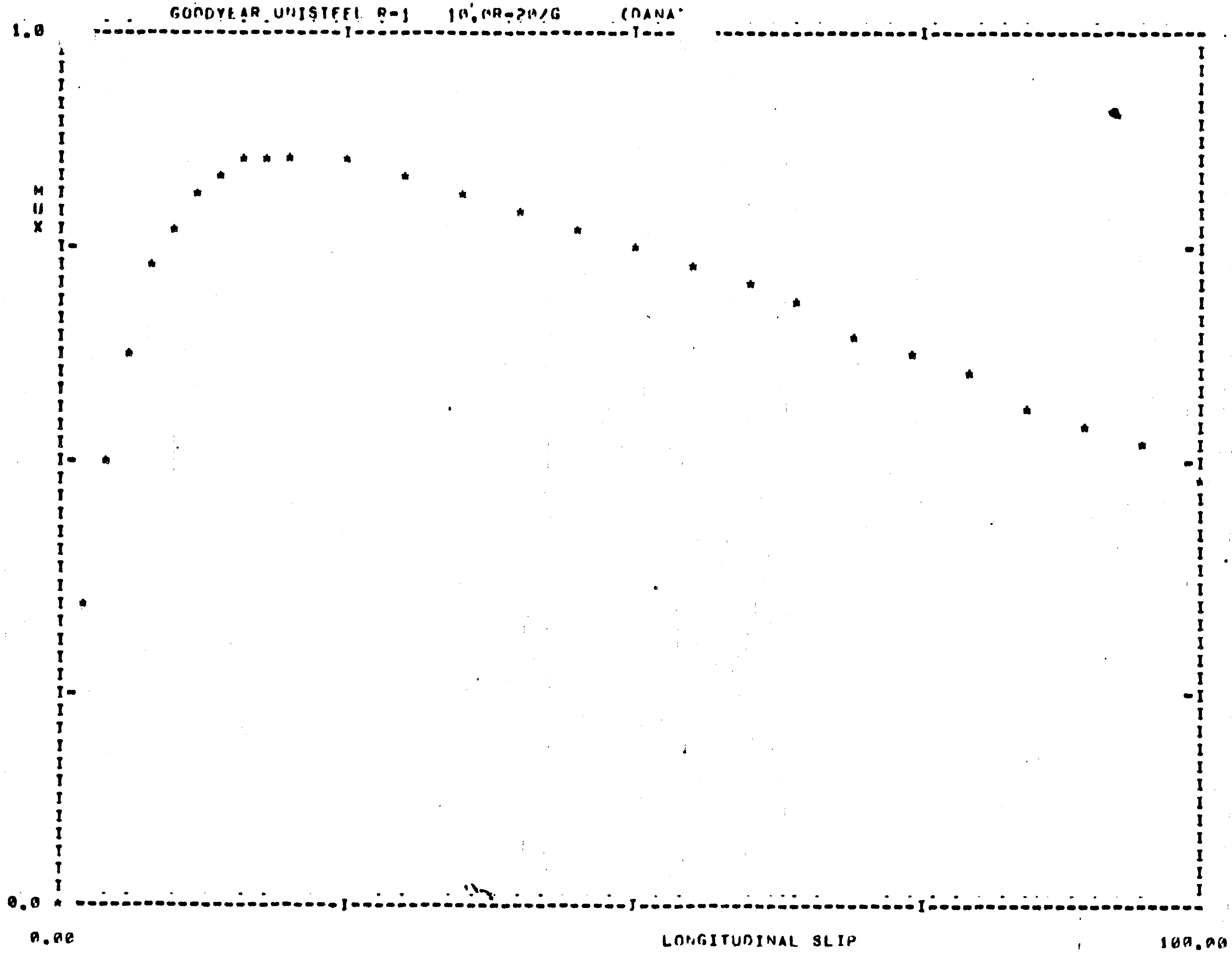
** A-D FILE 10 NEW FILE 7p TEST SAMPLE112 **

AVERAGE OF FILE 10 FOR 6 RECORDS. GOODYEAR UNISTEEL R-1 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.34	41269.4	2093.0
0.04	0.52	63809.1	3218.1
0.06	0.64	79397.1	3976.6
0.08	0.73	90261.5	4487.8
0.10	0.78	97874.1	4823.8
0.12	0.82	103153.8	5043.5
0.14	0.84	107980.4	5170.4
0.16	0.85	109895.8	5239.8
0.18	0.86	111910.2	5273.1
0.20	0.86	113242.4	5271.7
0.25	0.85	115725.4	5212.0
0.30	0.84	117860.3	5126.5
0.35	0.83	119722.5	5023.6
0.40	0.81	121419.1	4907.0
0.45	0.79	122922.4	4776.3
0.50	0.76	124198.4	4632.4
0.55	0.74	124911.3	4477.6
0.60	0.71	124265.4	4317.8
0.65	0.69	121704.2	4159.9
0.70	0.66	116386.8	4006.1
0.75	0.63	108445.4	3849.0
0.80	0.61	98246.7	3681.9
0.85	0.58	87405.9	3513.6
0.90	0.55	77994.2	3357.4
0.95	0.53	69345.7	3206.3
1.00	0.50	61520.8	3060.0

TQAV = 61520.8 LOAD = 6208.2 VEL = 40.0 MPH.

MUPEAK = 0.86 MULOCK = 0.50 RATIO = 1.72



FZ = 6200.2 VFL = 40.0 MULOCK = 0.50 MUPEAK = 0.86 RATIO = 1.72 A-D FILE 10 N-FILE 7 SAMPLE 112

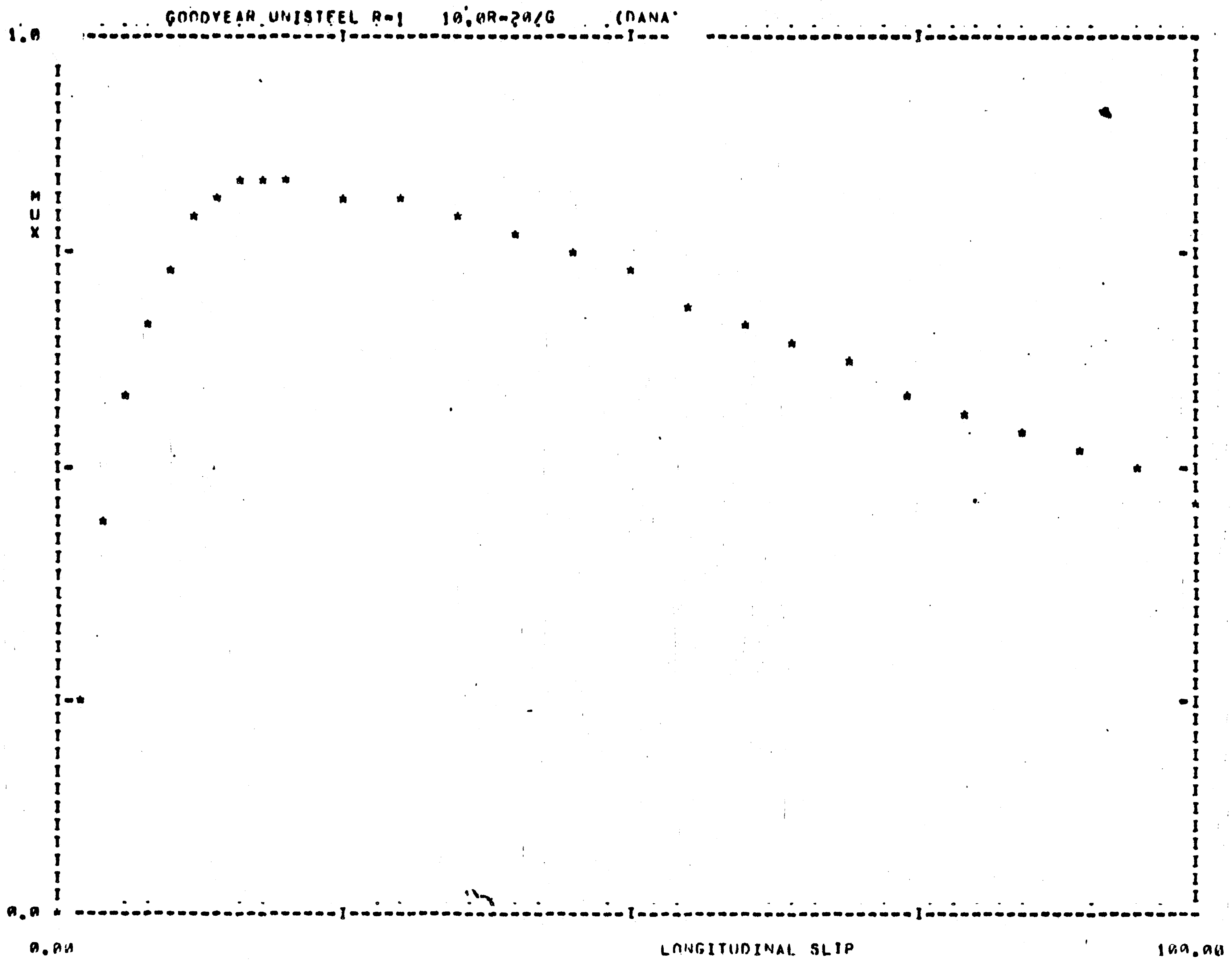
** A-D FILE 14 W FILE 8 TEST SAMPLE113 **

AVERAGE OF FILE 14 FOR 7 RECORDS. GOODYEAR UNISTEEL R-1 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.26	39850.9	1907.1
0.04	0.45	70546.3	3598.8
0.06	0.59	90667.4	4498.0
0.08	0.68	104842.1	5177.4
0.10	0.74	114865.5	5640.8
0.12	0.79	121629.9	5956.4
0.14	0.82	126437.9	6155.1
0.16	0.83	130014.5	6260.8
0.18	0.83	132712.7	6308.1
0.20	0.83	134575.8	6307.7
0.25	0.82	138263.9	6237.7
0.30	0.81	141537.5	6133.8
0.35	0.79	144480.7	6003.8
0.40	0.77	147159.0	5854.0
0.45	0.75	149468.3	5686.3
0.50	0.73	150621.7	5503.2
0.55	0.70	149920.4	5312.2
0.60	0.68	147417.9	5118.0
0.65	0.65	141741.2	4926.0
0.70	0.63	133012.1	4732.9
0.75	0.60	121996.6	4529.0
0.80	0.57	109717.2	4326.2
0.85	0.55	98617.2	4137.5
0.90	0.53	89014.5	3961.7
0.95	0.50	80343.6	3791.6
1.00	0.48	72839.3	3627.9

TQAV = 72839.3 LOAD = 7735.6 VFL = 40.0 MPH.

MUPEAK = 0.83 MULOCK = 0.48 RATIO = 1.74



FZ = 7735.6 VFL = 40.3 MULOCK = 0.48 MUPEAK = 0.83 RATIO = 1.74 A-D FILE 14 NWFILE 8 SAMPLE 113

** A-D FILE 15 * FILE 9 TEST SAMPLE110 **

AVERAGE OF FILE 15 FOR 4 RECORDS. GOODYEAR UNISTEEL R-1 10.0R-20/G (DANA)

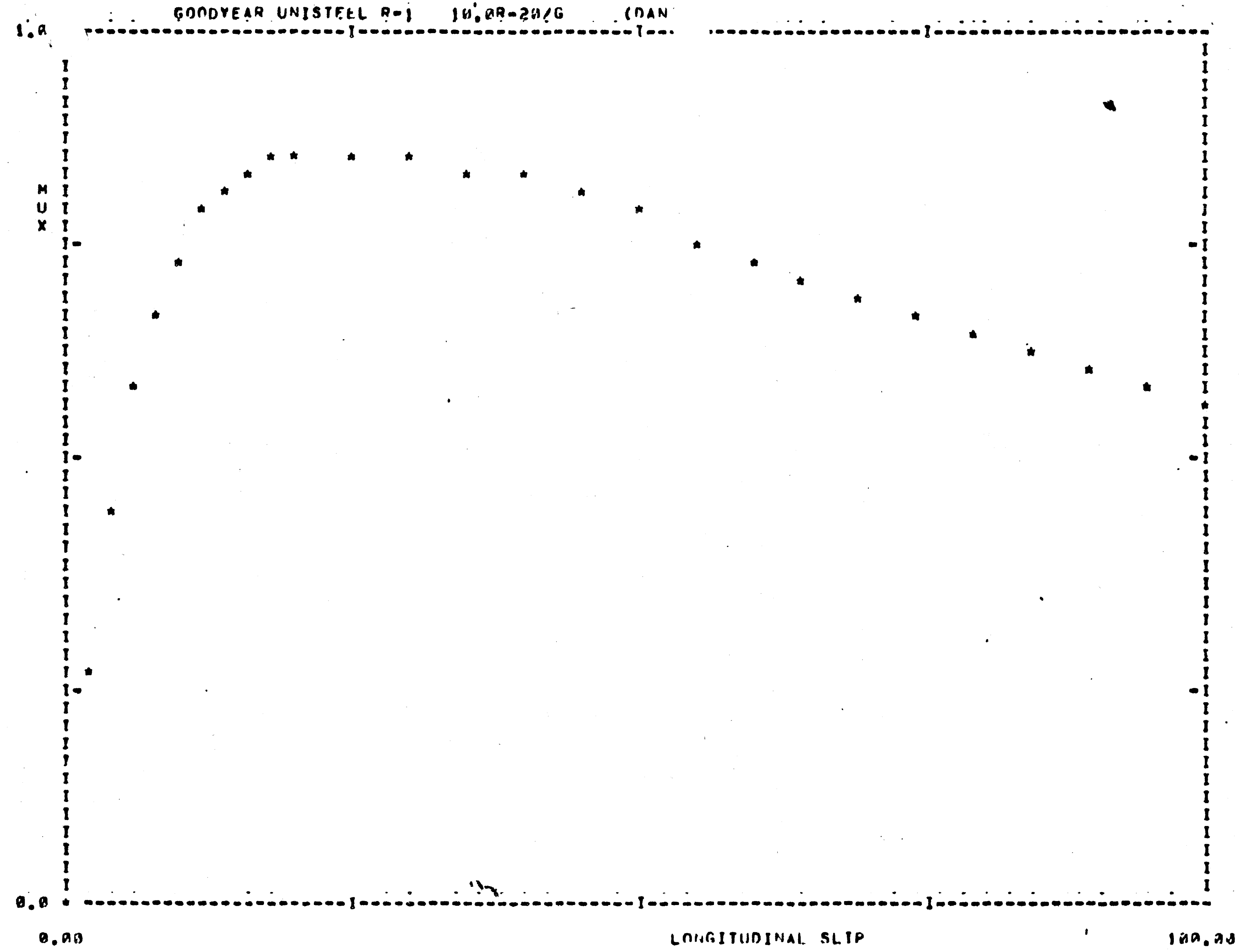
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.28	19907.9	889.6
0.04	0.46	32875.3	1455.1
0.06	0.59	42878.4	1857.1
0.08	0.68	52627.3	2145.1
0.10	0.75	56645.6	2355.6
0.12	0.80	61509.3	2507.6
0.14	0.83	65493.0	2606.8
0.16	0.85	68929.6	2672.4
0.18	0.86	72028.8	2707.5
0.20	0.86	74708.3	2716.5
0.25	0.86	80369.5	2708.2
0.30	0.86	85495.0	2687.0
0.35	0.85	90343.0	2652.9
0.40	0.83	95113.1	2606.9
0.45	0.81	99814.1	2550.1
0.50	0.79	104023.1	2477.5
0.55	0.76	106566.2	2394.7
0.60	0.74	106917.1	2312.9
0.65	0.71	104686.3	2235.9
0.70	0.69	98015.3	2171.0
0.75	0.67	87846.7	2105.0
0.80	0.65	75267.7	2032.2
0.85	0.63	61726.6	1961.3
0.90	0.61	51718.0	1897.5
0.95	0.59	43415.0	1836.3
1.00	0.57	36937.5	1777.5

TQAV = 36937.5 LOAD = 3169.3 VEL = 55.0 MPH.

MUPEAK = 0.86 MULOCK = 0.57 RATIO = 1.53

384

-98-



FZ = 3169.3 VEL = 55.0 MULOCK = 0.57 MUPEAK = 0.86 RATIO = 1.53 A-D FILE 15 NWFILE 9 SAMPLE 114

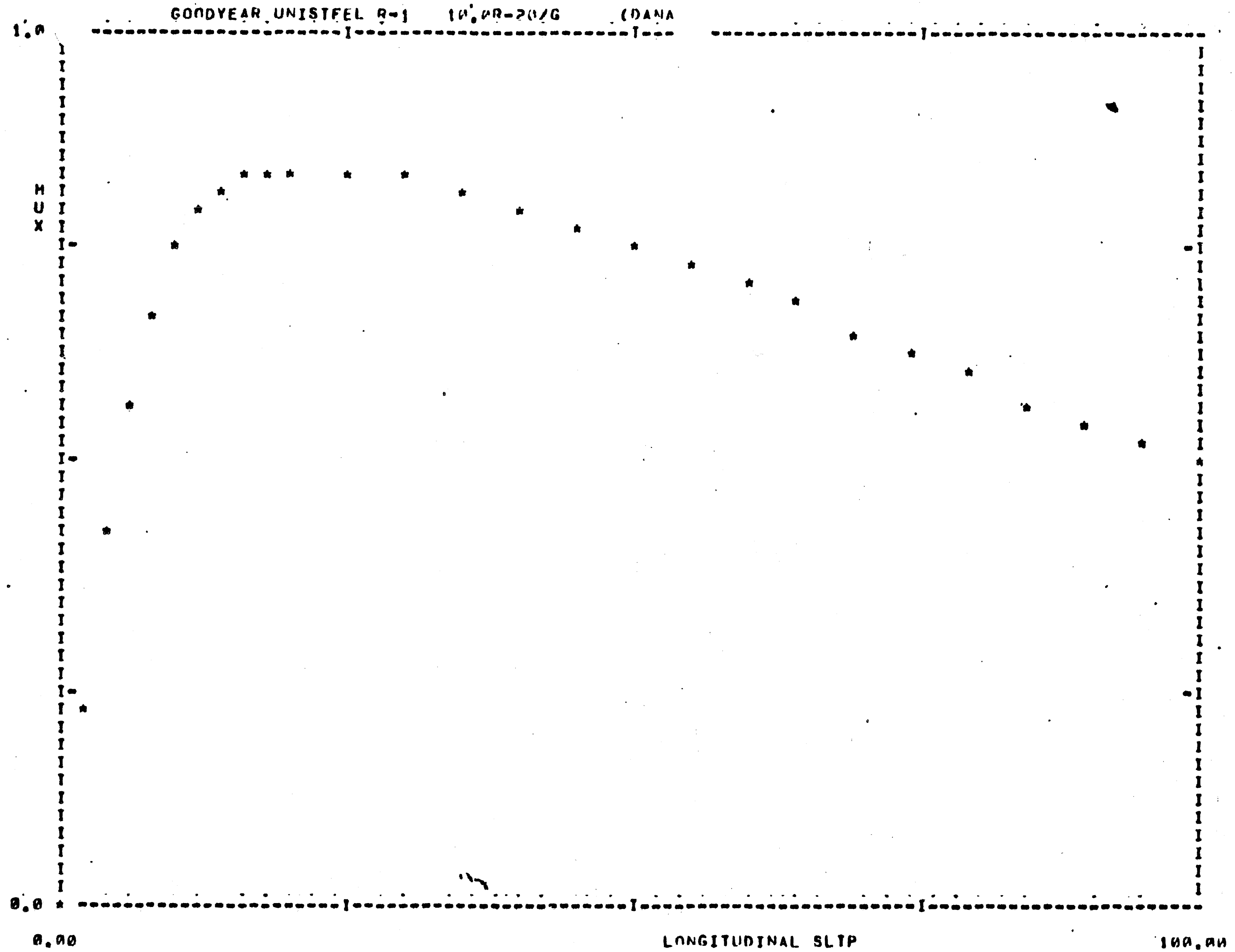
** A-D FILE 16 NEW FILE 10 TEST SAMPLE11S **

AVERAGE OF FILE 16 FOR 5 RECORDS. GOODYEAR UNISTEEL R-1 10.0H-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	27159.1	1356.0
0.04	0.44	55036.1	2698.5
0.06	0.58	73663.5	3593.1
0.08	0.68	86670.3	4187.7
0.10	0.75	95790.1	4622.6
0.12	0.79	102426.1	4878.7
0.14	0.82	107308.4	5047.3
0.16	0.84	111042.8	5144.5
0.18	0.85	114018.1	5199.0
0.20	0.85	116231.9	5214.4
0.25	0.84	120946.4	5194.9
0.30	0.84	125324.1	5143.2
0.35	0.82	129465.7	5058.0
0.40	0.80	133331.1	4948.4
0.45	0.78	136708.9	4819.8
0.50	0.76	138451.9	4674.0
0.55	0.74	138062.3	4525.0
0.60	0.71	135653.0	4376.0
0.65	0.69	129578.6	4227.3
0.70	0.66	121009.4	4066.6
0.75	0.63	110327.1	3890.4
0.80	0.61	98157.5	3714.8
0.85	0.58	86967.3	3556.3
0.90	0.56	77590.2	3424.3
0.95	0.53	69350.7	3254.7
1.00	0.51	62475.0	3108.0

TQAV = 62475.0 LOAD = 6141.3 VEL = 40.0 MPH.

MUPEAK = 0.85 MULOCK = 0.51 RATIO = 1.67



FZ = 6141.3 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.85 RATIO = 1.67 A-D FILE 16 NWFILE 10 SAMPLE 115

387

** A-D FILE 17 NEW FILE 17 TEST SAMPLE116 **

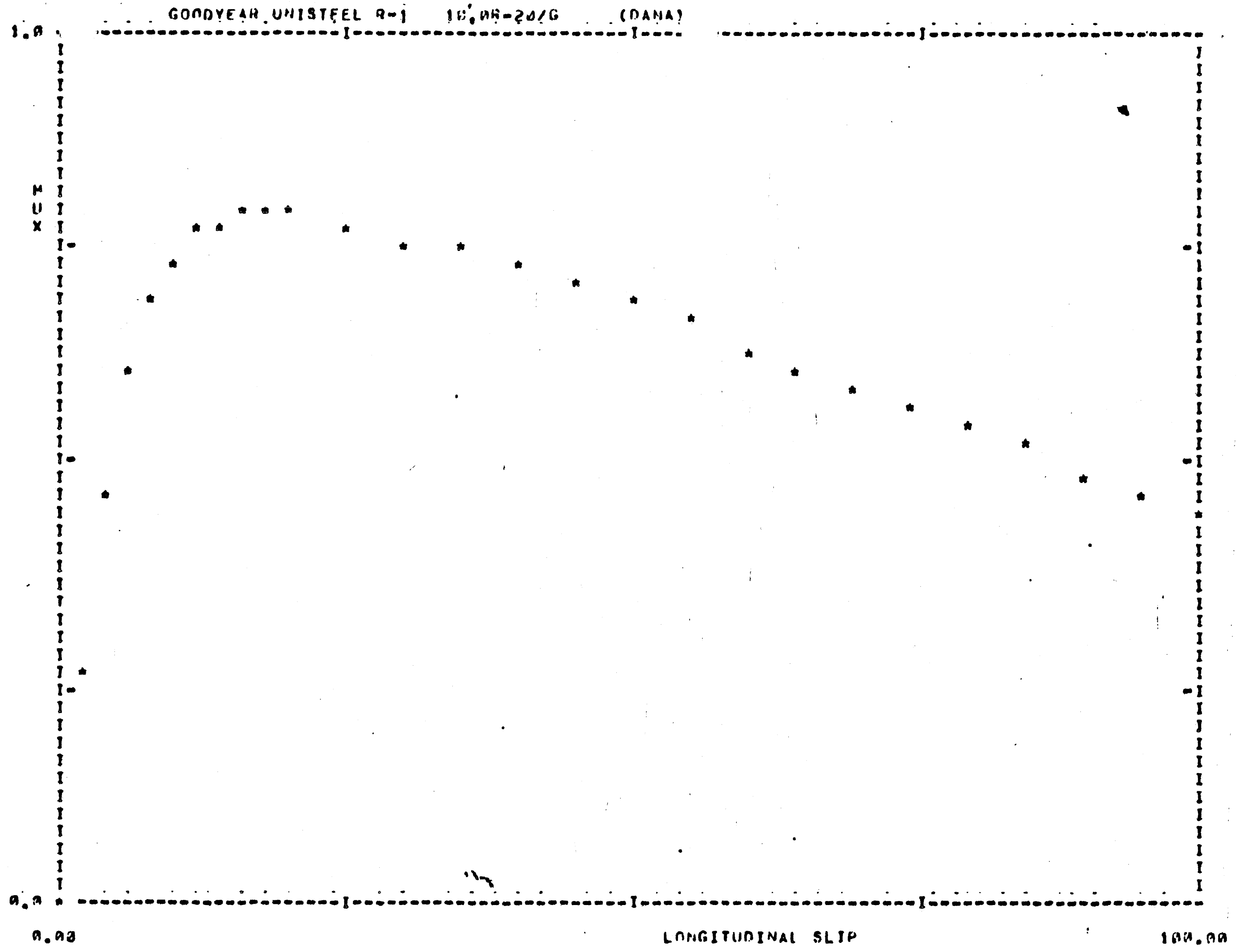
AVERAGE OF FILE 17 FOR 6 RECORDS. GOODYEAR UNISTEEL R-1 10.0R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.27	34479.8	1703.7
0.04	0.48	60171.9	2954.3
0.06	0.61	77003.6	3746.7
0.08	0.69	88405.2	4250.1
0.10	0.74	95998.5	4548.6
0.12	0.77	100966.0	4717.7
0.14	0.79	104314.5	4805.0
0.16	0.79	106787.2	4835.3
0.18	0.79	108835.9	4829.6
0.20	0.79	110487.7	4799.1
0.25	0.78	113882.4	4709.2
0.30	0.76	116924.2	4612.1
0.35	0.75	119799.6	4506.7
0.40	0.73	122656.7	4393.0
0.45	0.71	125545.1	4274.2
0.50	0.69	128334.2	4146.7
0.55	0.67	130409.9	4012.0
0.60	0.64	130643.6	3876.6
0.65	0.62	128180.0	3746.1
0.70	0.60	121985.8	3620.8
0.75	0.58	112315.7	3485.7
0.80	0.55	99836.6	3332.6
0.85	0.52	86196.3	3172.6
0.90	0.50	74873.5	3019.9
0.95	0.47	64707.0	2870.8
1.00	0.44	55729.2	2725.0

TQAV = 55729.2 LOAD = 6202.0 VEL = 55.0 MPH.

MUPEAK = 0.79 MULOCK = 0.44 RATIO = 1.79

388



FZ = 6202.0 VEL = 55.0 MULOCK = 0.44 MUPEAK = 0.79 RATIO = 1.79 A-D FILE 17 N-FILE 11 SAMPLE 116

** A-D FILE 18 NEW FILE 12 TEST SAMPLE117 **

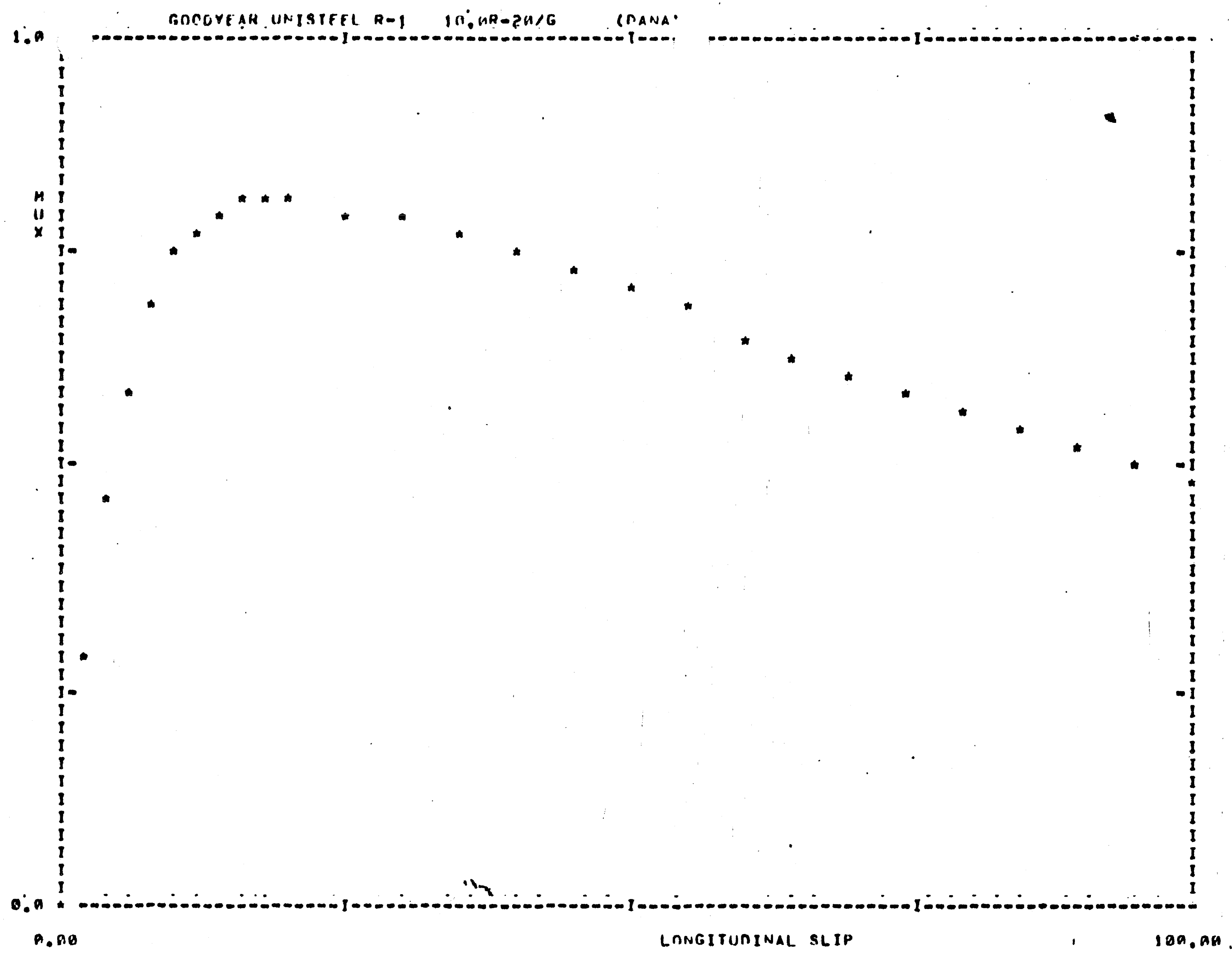
AVERAGE OF FILE 18 FOR 5 RECORDS. GOODYEAR UNISTEEL R-1 10.00R-20/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.28	36096.9	1770.8
0.04	0.46	60504.1	2950.8
0.06	0.60	78301.6	3802.5
0.08	0.69	90385.8	4372.7
0.10	0.75	98507.5	4720.4
0.12	0.78	104115.6	4914.7
0.14	0.80	108092.3	5014.7
0.16	0.81	111100.6	5062.8
0.18	0.81	113421.3	5077.7
0.20	0.81	115156.4	5068.1
0.25	0.81	118879.7	5007.1
0.30	0.79	122296.8	4920.0
0.35	0.78	125356.9	4807.2
0.40	0.76	127920.9	4678.3
0.45	0.73	129937.8	4540.4
0.50	0.71	131100.2	4395.4
0.55	0.69	130356.7	4250.3
0.60	0.66	127541.9	4107.7
0.65	0.64	122732.4	3969.3
0.70	0.62	115225.1	3830.1
0.75	0.59	105453.6	3678.2
0.80	0.57	94657.9	3520.9
0.85	0.55	85332.8	3379.1
0.90	0.52	76148.8	3244.9
0.95	0.50	67863.8	3116.5
1.00	0.48	60000.0	2995.5

TQAV = 60400.0 LOAD = 6288.9 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.48 RATIO = 1.69

390



FZ = 6285.9 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.81 RATIO = 1.69 A-D FILE 18 NWFILE 12 SAMPLE 117

2.0 RESEARCH METHODOLOGY

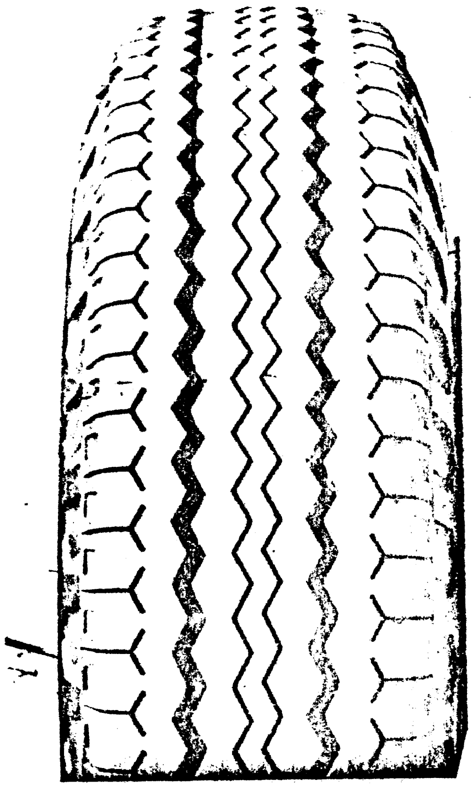
The methodologies employed in this study addressed the characterization of two diverse aspects of tire behavior. Measurements were conducted to describe both the noise and traction performance qualities of a sample of six truck tires, under conditions which were seen as relevant to the respective noise and traction interests arising from environmental and safety issues. With regard to noise generation, measurements were made according to an existing standard practice, recommended by the Society of Automotive Engineers. Traction measurements were conducted according to procedures developed at HSRI, since a standardized methodology has yet to be established.

2.1 Tire Sample

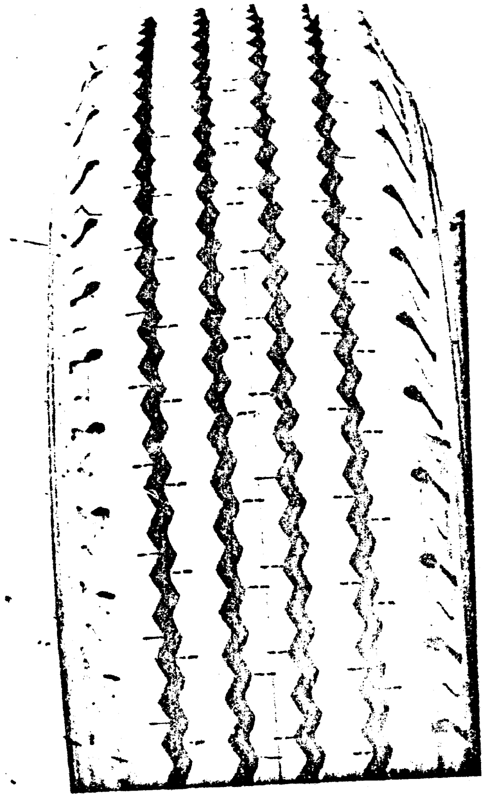
Six radial-ply heavy truck tires, identified below, were selected to conduct the noise and traction experiments. All tires were size 10.00 x 20/G, where the "G" designation indicates a Tire and Rim Association (T&RA) rated load of 6040 lbs at a cold inflation pressure of 105 psi. The test sample, as illustrated in Figures 1a and 1b, contains three tires with "circumferential rib"-type tread patterns and three tires configured with tread patterns of either the "cross lug" or "aggressive rib" varieties.

Sample of Radial-Ply Tires

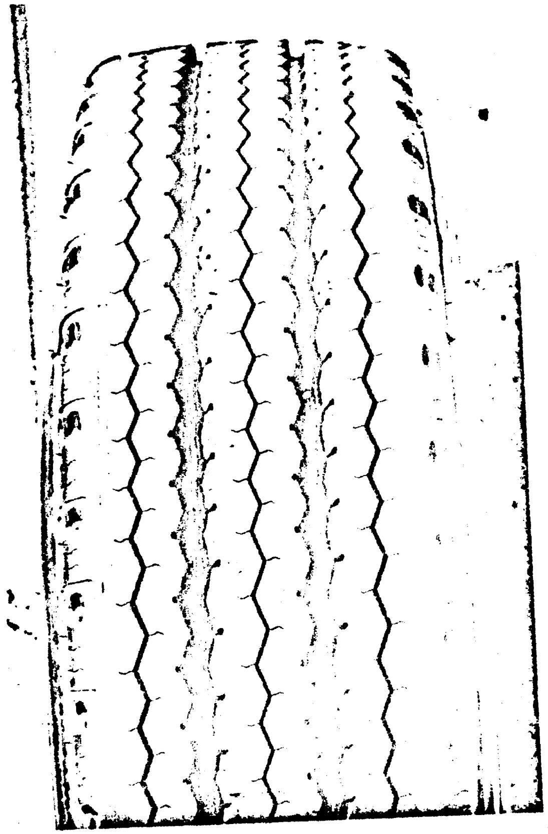
Firestone Transteel Goodyear Unisteel R-1 Michelin XZA	Rib Tread
Firestone Transteel Traction Goodyear Unisteel L-1	Lug Tread
Michelin XZZ	Aggressive Rib



Firestone Transteel

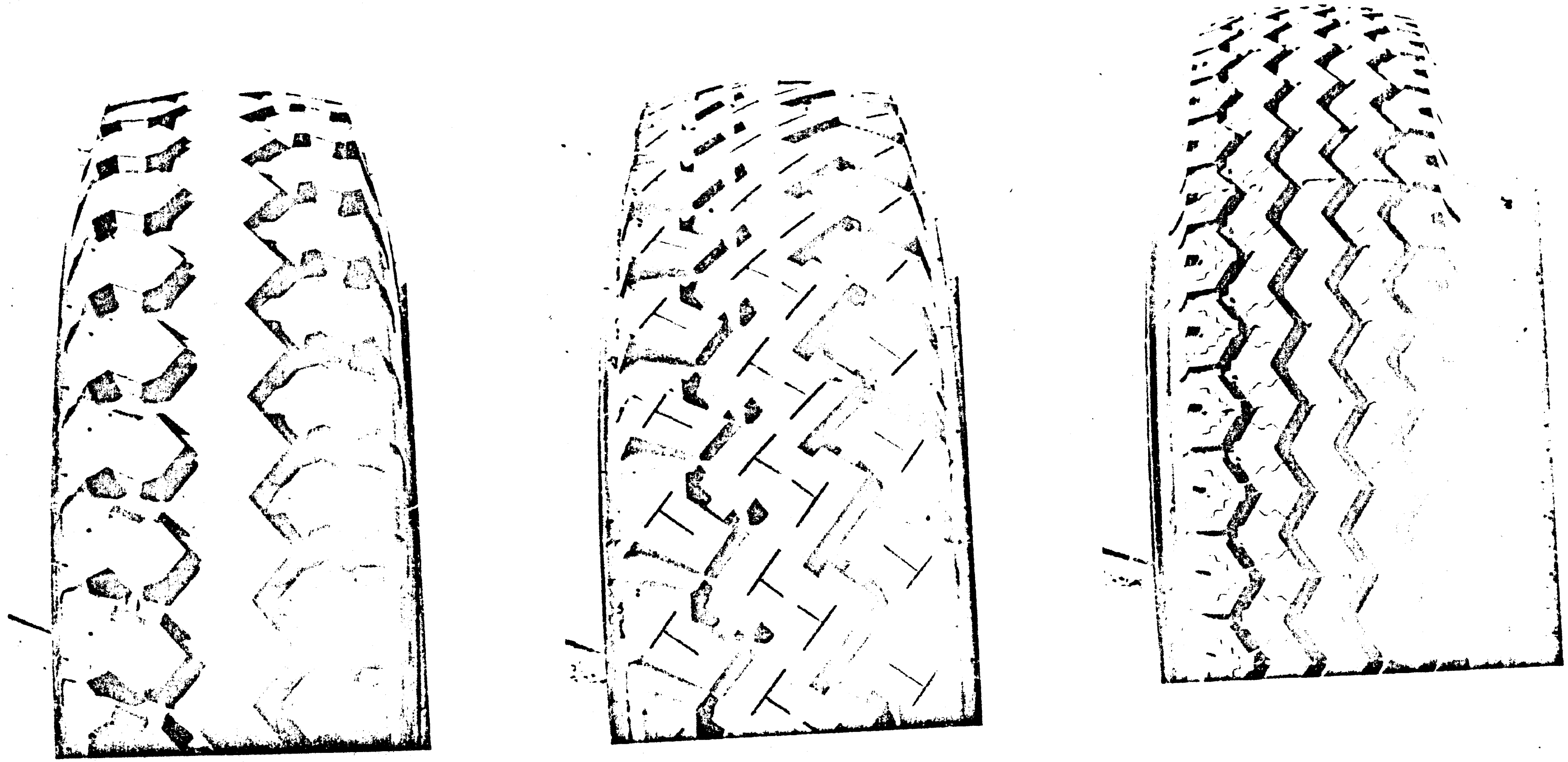


Goodyear Unisteel R-1



Michelin XZA

Figure 1a. Photos of rib-type tread patterns represented in the tire sample.

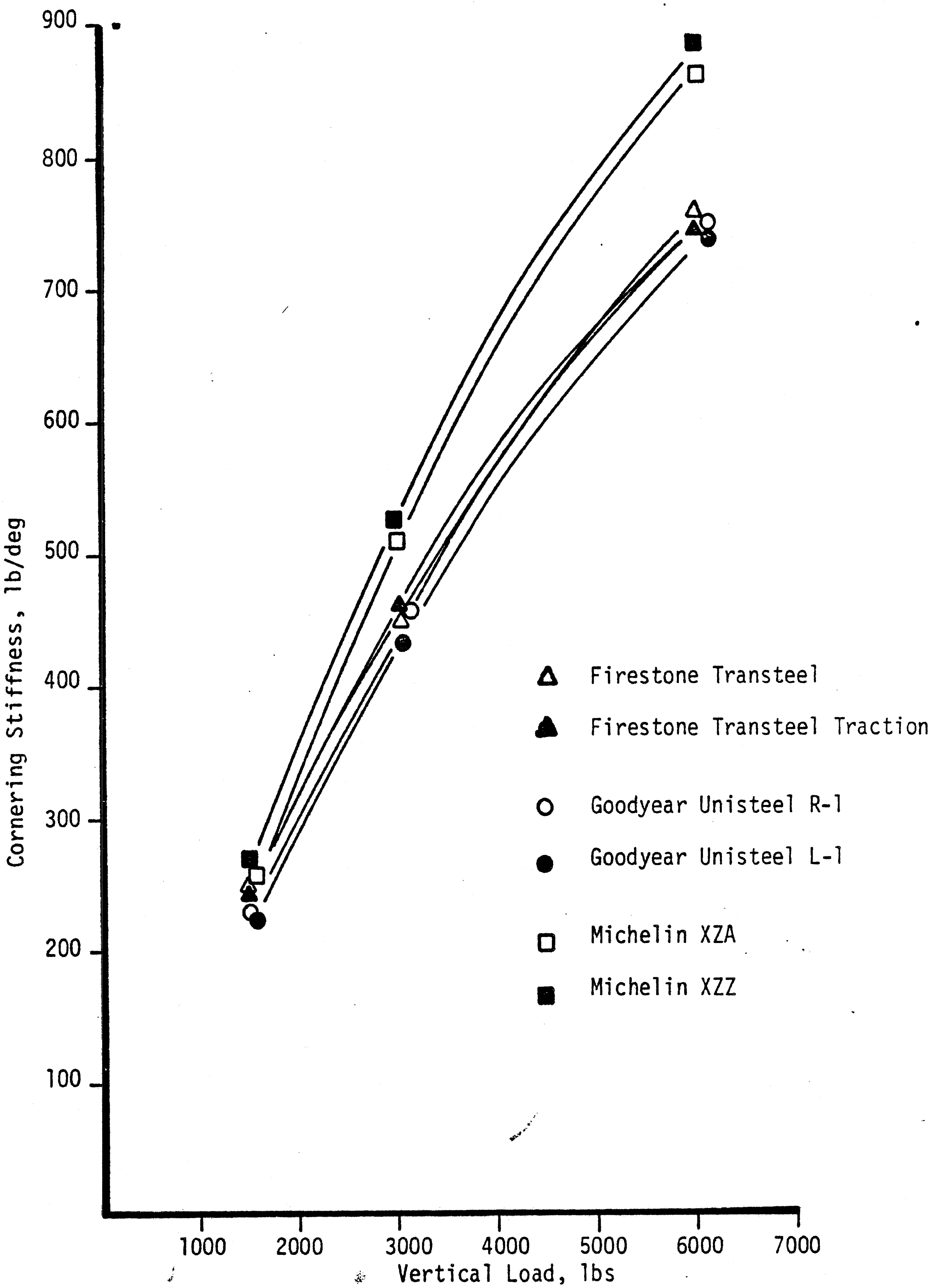


Firestone Transteel Traction

Goodyear Unisteel L-1

Michelin XZZ

Figure 1b. Photos of (2) lug-type and (1) aggressive-type tread patterns represented in the tire sample.



900
800
700
600
500
400
300
200
100
Cornering Stiffness, lb/deg
1000
2000
3000
4000
5000
6000
7000
Vertical Load, lbs
Firestone Transteel
Firestone Transteel Traction
Goodyear Unisteel R-1
Goodyear Unisteel L-1
Michelin XZA
Michelin XZZ

Figure 3

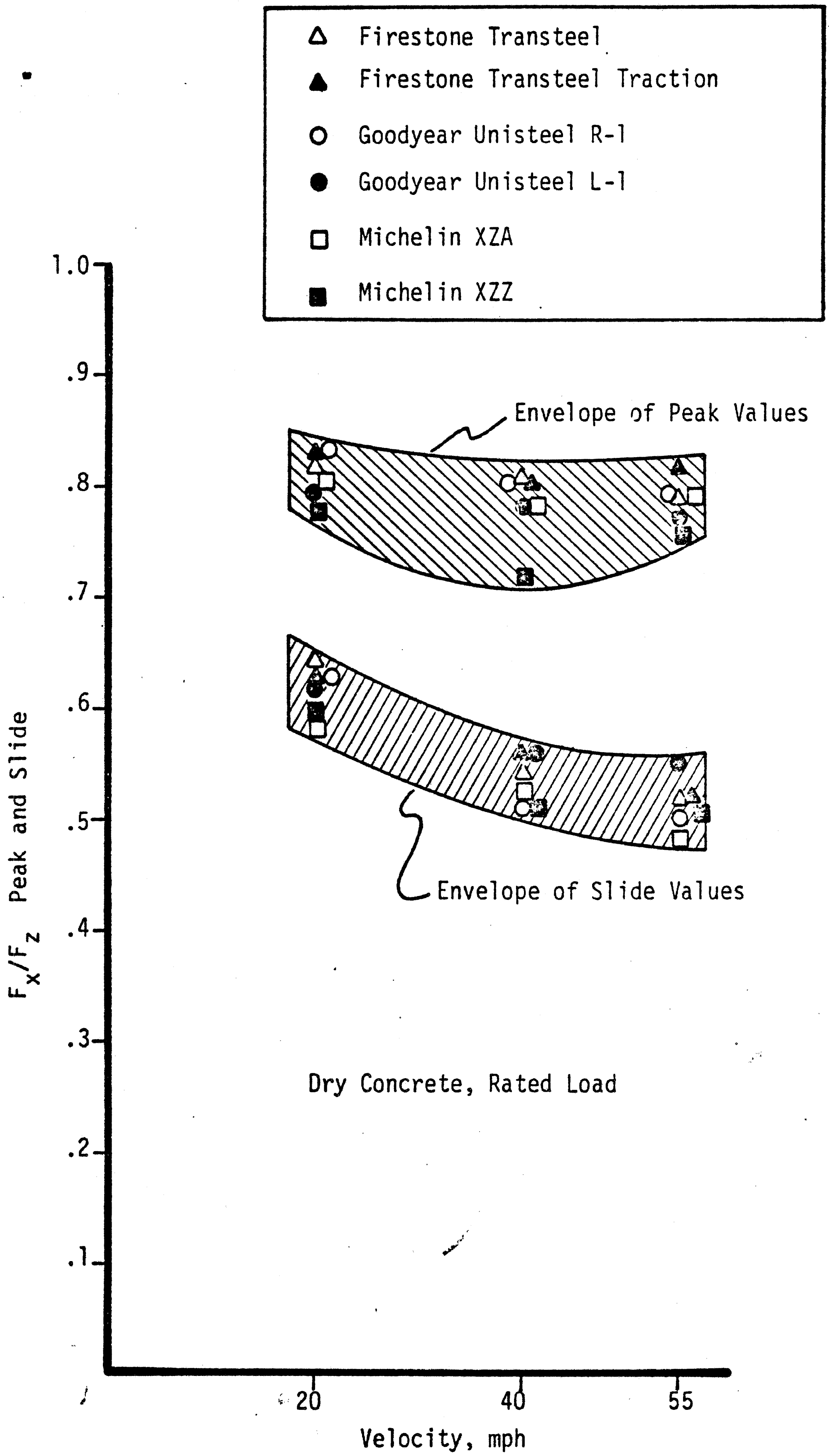

Firestone Transteel
Firestone Transteel Traction
Goodyear Unisteel R-1
Goodyear Unisteel L-1
Michelin XZA
Michelin XZZ
Envelope of Peak Values
Envelope of Slide Values
Dry Concrete, Rated Load
F_x/F_z Peak and Slide
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
20
40
55
Velocity, mph

Figure 4

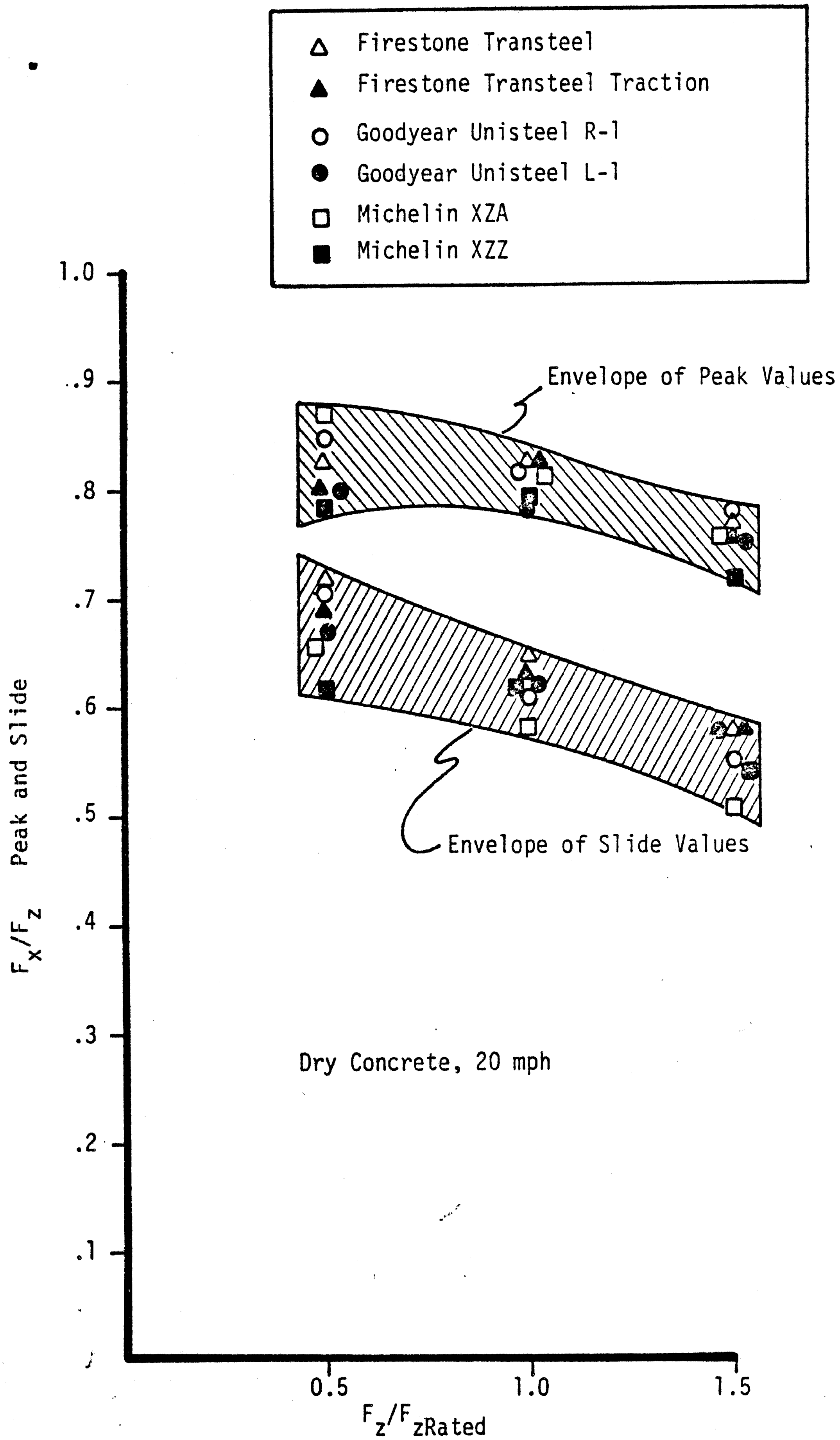

Firestone Transteel
Firestone Transteel Traction
Goodyear Unisteel R-1
Goodyear Unisteel L-1
Michelin XZA
Michelin XZZ
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
F_x/F_z Peak and Slide
Envelope of Peak Values
Envelope of Slide Values
Dry Concrete, 20 mph
0.5
1.0
1.5
F_z/F_{zRated}

Figure 5

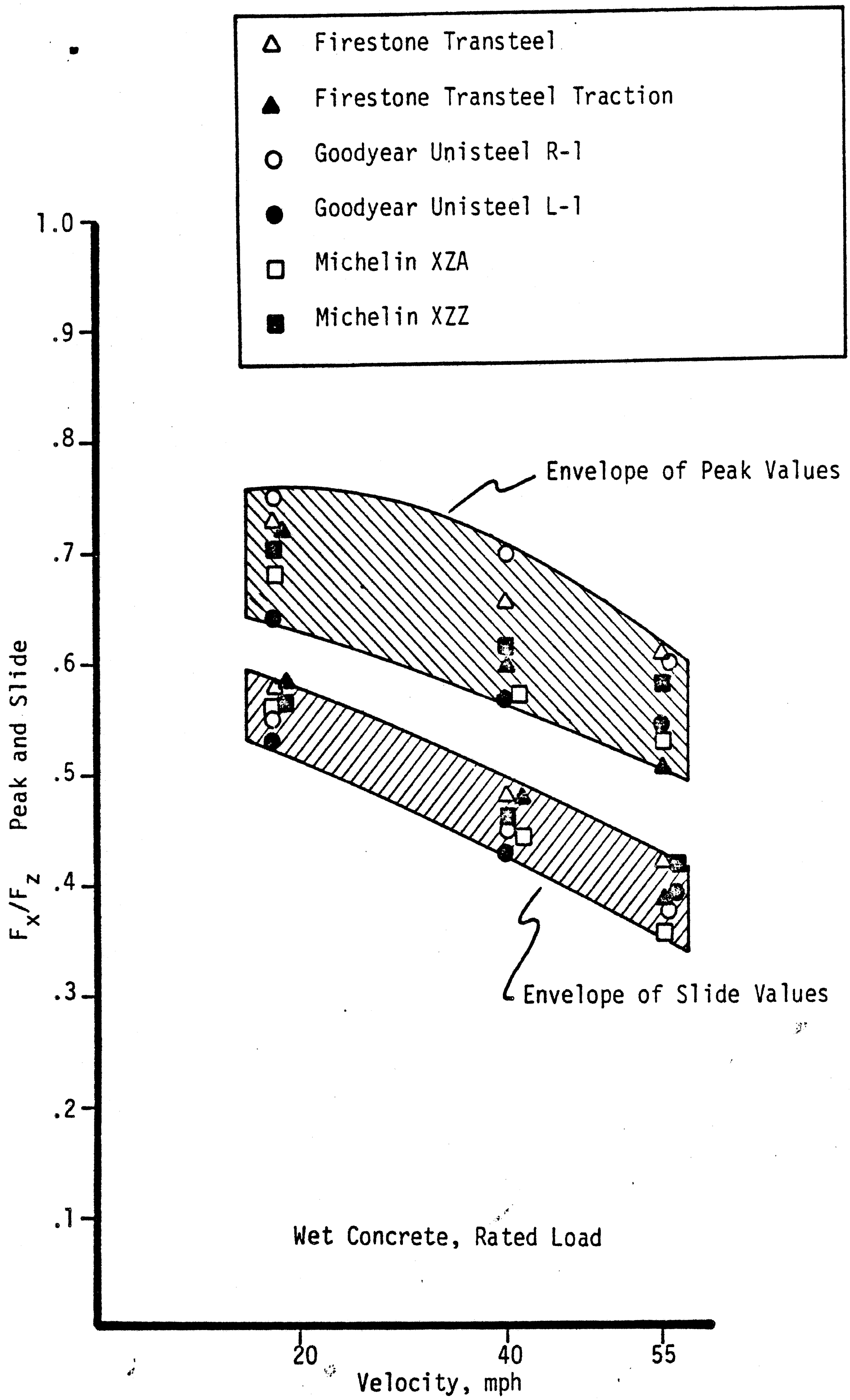

Firestone Transteel
Firestone Transteel Traction
Goodyear Unisteel R-1
Goodyear Unisteel L-1
Michelin XZA
Michelin XZZ
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
F_x/F_z Peak and Slide
Envelope of Peak Values
Envelope of Slide Values
Wet Concrete, Rated Load
20
40
55
Velocity, mph

Figure 6

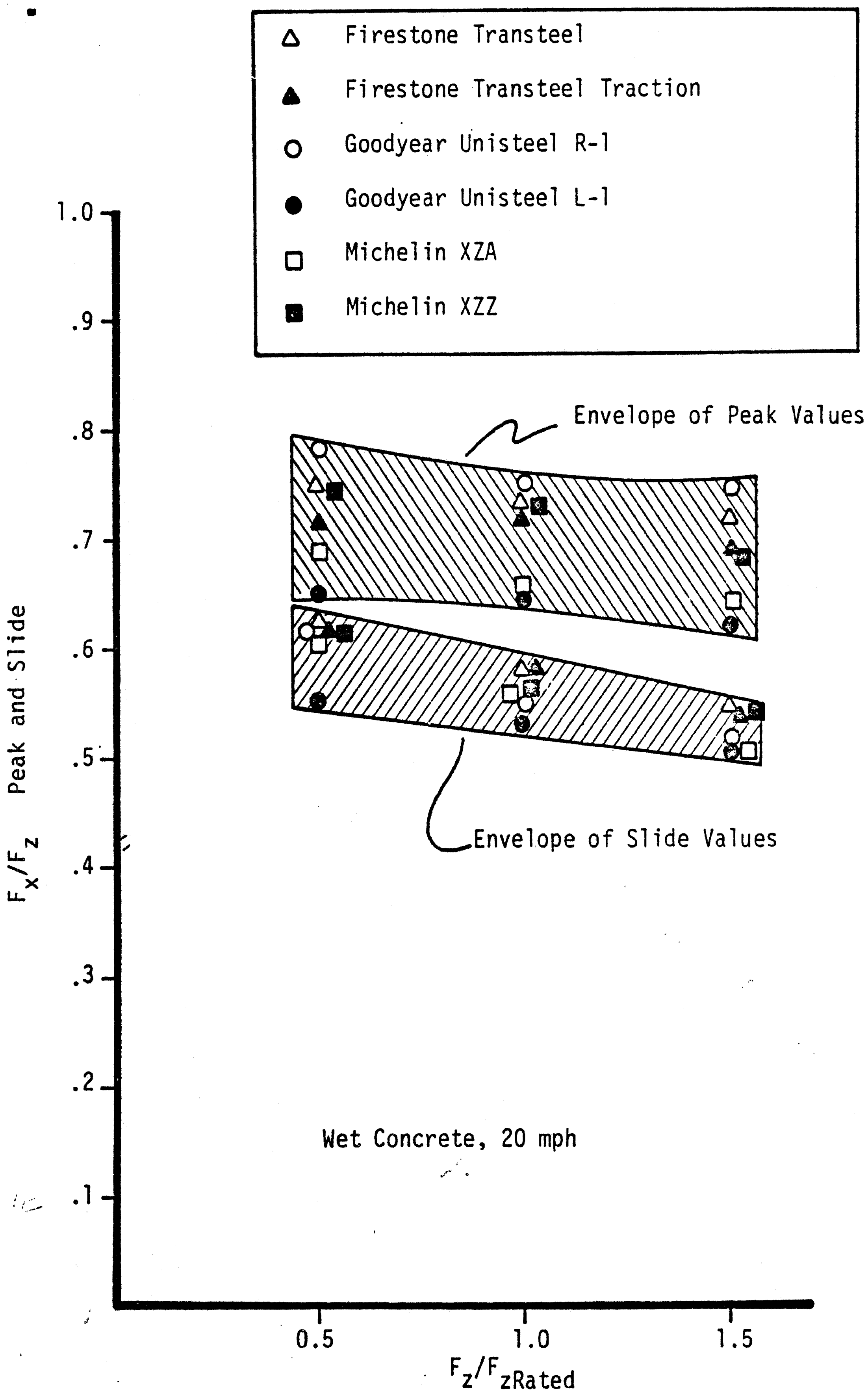

Firestone Transteel
Firestone Transteel Traction
Goodyear Unisteel R-1
Goodyear Unisteel L-1
Michelin XZA
Michelin XZZ
Envelope of Peak Values
Envelope of Slide Values
Wet Concrete, 20 mph
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
F_x/F_z Peak and Slide
0.5
1.0
1.5
F_z/F_{zRated}

Figure 7

it should be noted, by the substantial degree of "mixing" which occurs among rib and lug data—quite in contrast with data taken on the similarly-limited sample of bias tires [2] which showed virtually no mixing and a 23% spread in average (F_x/F_z) peak values on wet concrete.

Regarding "slide" traction values, the data taken on wet and dry concrete display virtually no significant rib/lug distinctions in the case of the radial truck tire. This observation again contrasts radials with bias-ply tires, the latter of which showed an average 16% lower slide traction performance of lug tires on wet concrete.

In summary of longitudinal traction measurements, radial-ply truck tires, as represented in this sample, are not seen to be significantly discriminated, according to tread type, by the gathered peak and slide traction values. As a note regarding the statistical quality of the longitudinal traction measurements, the data obtained in the three repeat runs for each tire and surface are shown in Table 2. The tabulated data show that relatively good repeatability was obtained, with a typical standard deviation of approximately .012 for either peak or slide traction coefficients on both surfaces.

3.4 Mobile Traction Results - Lateral

Tests were conducted on the lateral traction dynamometer to permit examination of the friction-limited lateral force behavior of the six-tire sample. Data resulting from these tests were reduced to the plotted format of Figures 8 through 11. These data indicate the basic sensitivity of the F_y/F_z versus α relationship to velocity and vertical load under the two subject surface conditions. As with longitudinal traction measurements, the tire exhibits a steeply rising (elastic) behavior followed by a friction-determined saturation. In the case of lateral traction, the angular slip range of interest is limited to about α = 20°, thereby eliminating any need

Table 2. Peak and Slide Values of F_X/F_Z Obtained from three (3) Repeated Runs on Each Tire.

		Dry (Repeat Number) 1	Dry 2	Dry 3	Dry Ave.	Dry Std. Dev. $1 \times \sigma$	Wet (Repeat Number) 1	Wet 2	Wet 3	Wet Ave.	Wet Std. Dev. $1 \times \sigma$
Firestone Transteel	Peak	.82	.81	.84	.823	.012	.75	.73	.72	.733	.012
	Slide	.65	.65	.63	.643	.009	.58	.58	.57	.577	.005
Firestone Transteel Traction	Peak	.85	.82	.81	.827	.017	.73	.72	.70	.717	.012
	Slide	.65	.63	.62	.633	.012	.58	.58	.57	.577	.005
Goodyear Unisteel R-1	Peak	.83	.80	.84	.833	.017	.74	.75	.76	.750	.008
	Slide	.61	.59	.62	.607	.012	.55	.55	.56	.553	.005
Goodyear Unisteel L-1	Peak	.78	.78	.81	.790	.014	.67	.61	.64	.640	.025
	Slide	.62	.62	.62	.620	.000	.54	.52	.53	.530	.008
Michelin XZA	Peak	.82	.82	.81	.817	.005	.68	.64	.67	.663	.017
	Slide	.57	.59	.58	.580	.008	.56	.55	.56	.557	.005
Michelin XZZ	Peak	.79	.73	.78	.767	.026	.74	.70	.69	.710	.022
	Slide	.62	.59	.59	.600	.014	.60	.56	.56	.573	.019

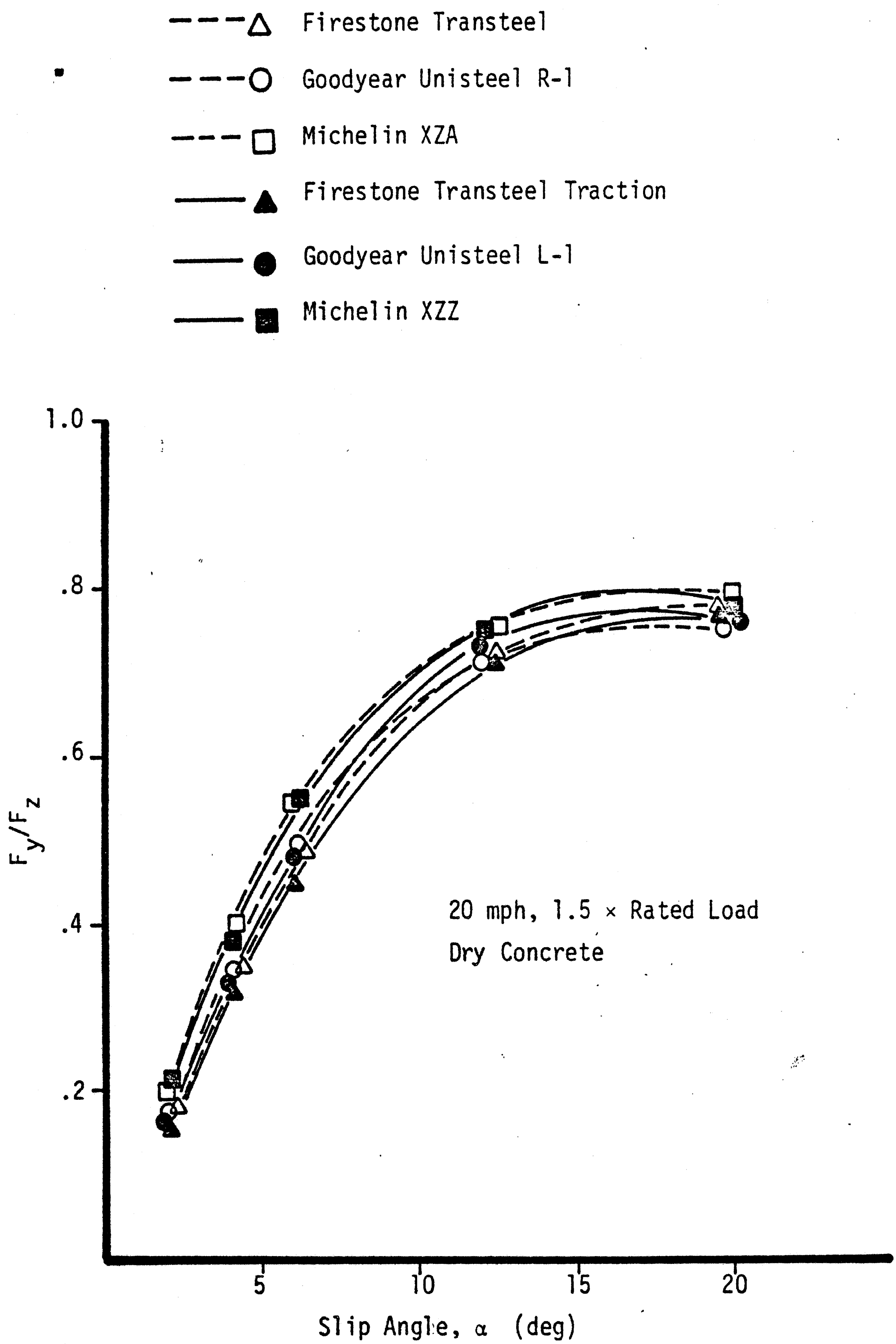

Firestone Transteel
Goodyear Unisteel R-1
Michelin XZA
Firestone Transteel Traction
Goodyear Unisteel L-1
Michelin XZZ
1.0
.8
.6
.4
.2
F_y/F_z
20 mph, 1.5 × Rated Load
Dry Concrete
5
10
15
20
Slip Angle, α (deg)

Figure 8

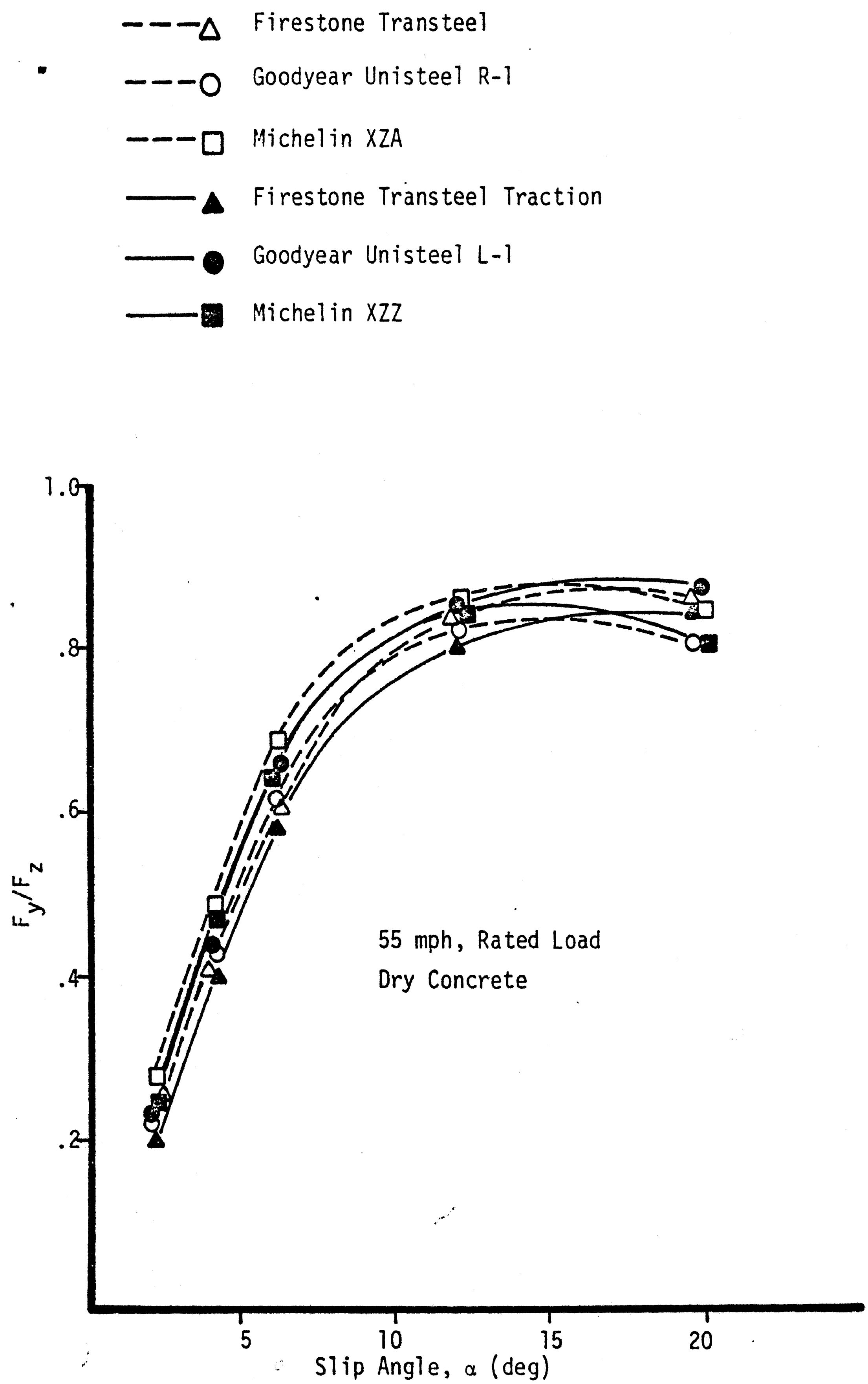
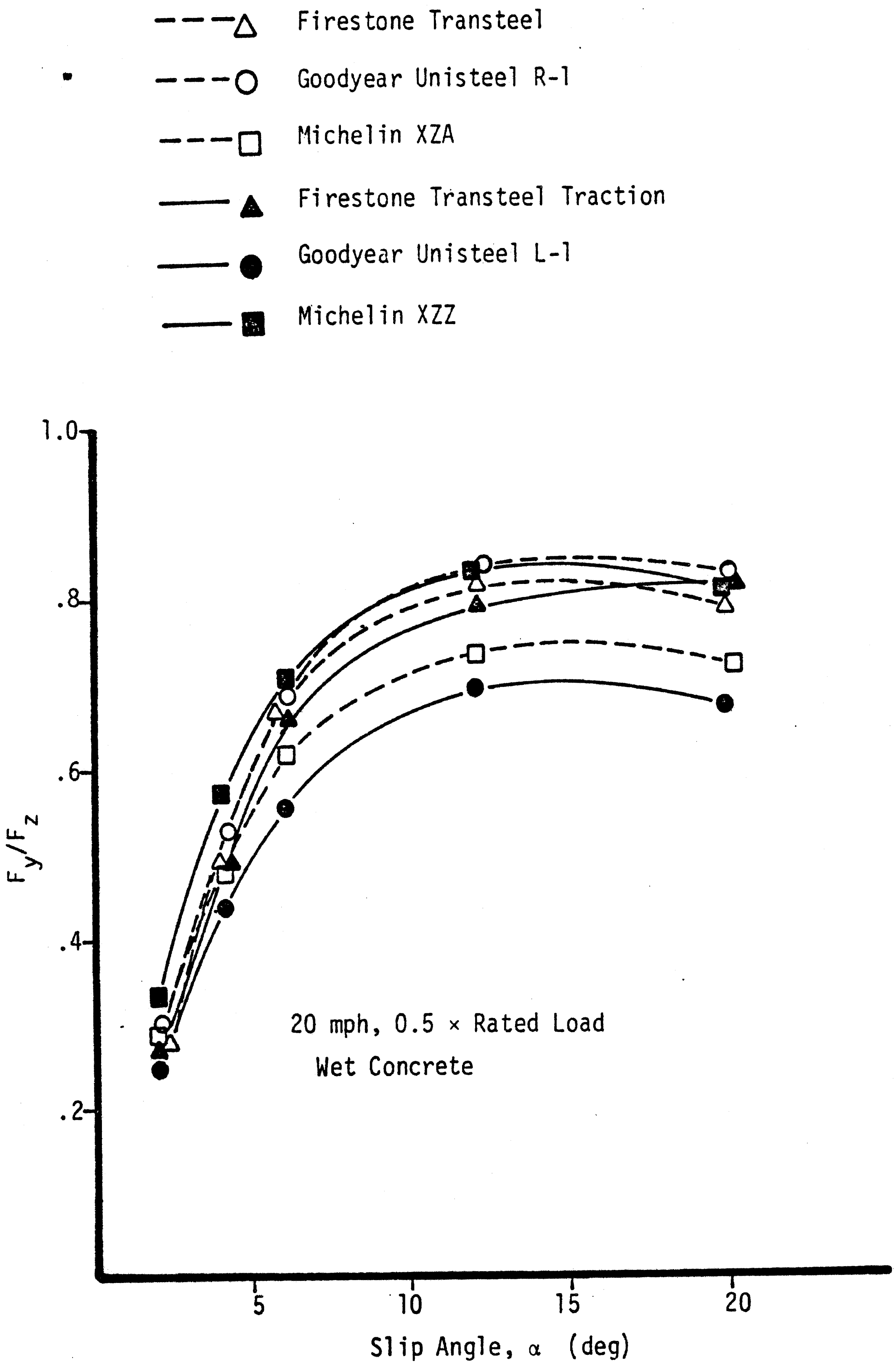

Firestone Transteel
Goodyear Unisteel R-1
Michelin XZA
Firestone Transteel Traction
Goodyear Unisteel L-1
Michelin XZZ
1.0
.8
.6
.4
.2
F_y/F_z
55 mph, Rated Load
Dry Concrete
5
10
15
20
Slip Angle, α (deg)

Figure 9



Firestone Transteel
Goodyear Unisteel R-1
Michelin XZA
Firestone Transteel Traction
Goodyear Unisteel L-1
Michelin XZZ
1.0
.8
.6
.4
.2
F_y/F_z
20 mph, 0.5 × Rated Load
Wet Concrete
5
10
15
20
Slip Angle, α (deg)

Figure 10

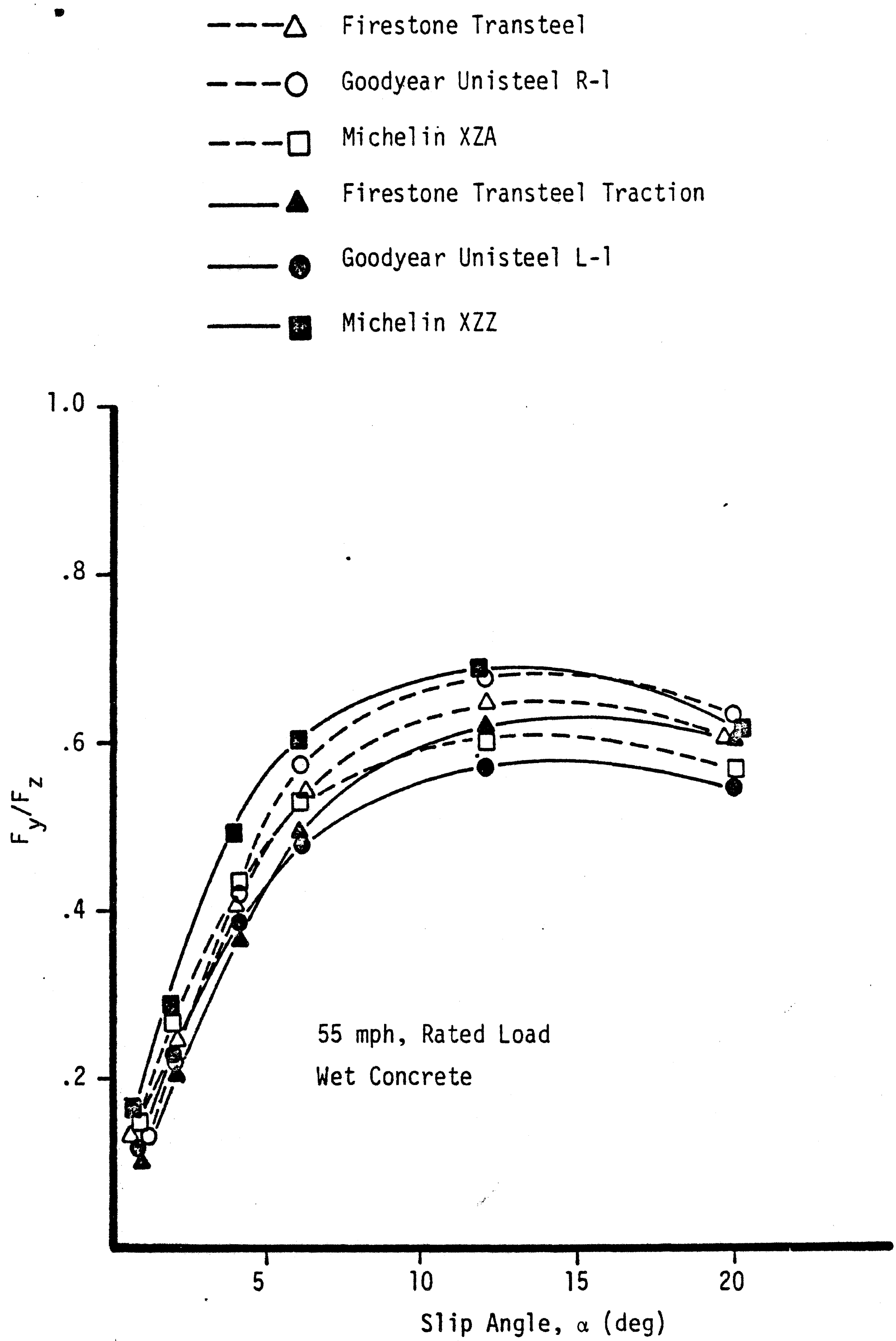
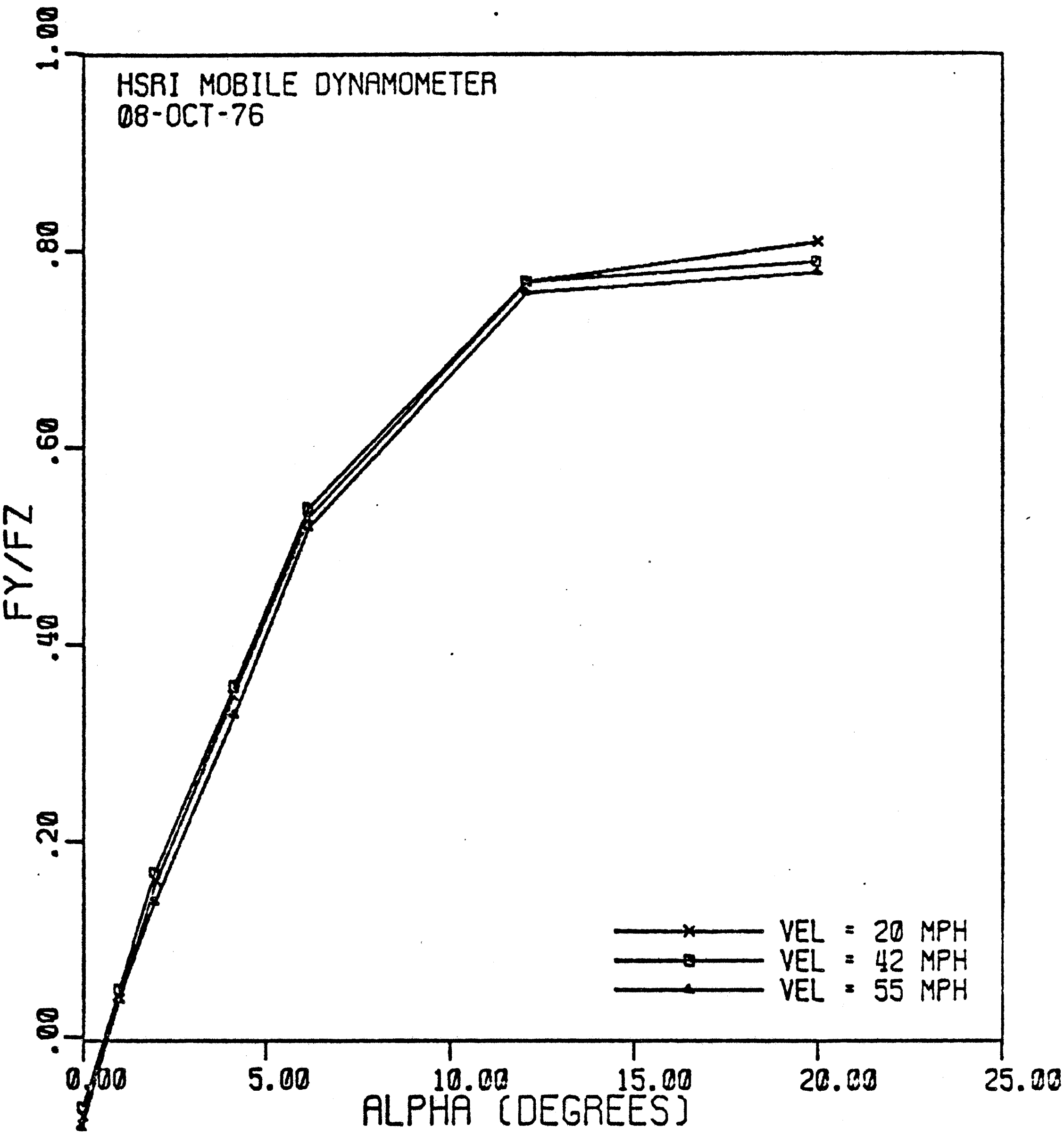

Firestone Transteel
Goodyear Unisteel R-1
Michelin XZA
Firestone Transteel Traction
Goodyear Unisteel L-1
Michelin XZZ
1.0
.8
.6
.4
.2
F_y/F_z
55 mph, Rated Load
Wet Concrete
5
10
15
20
Slip Angle, α (deg)

Figure 11

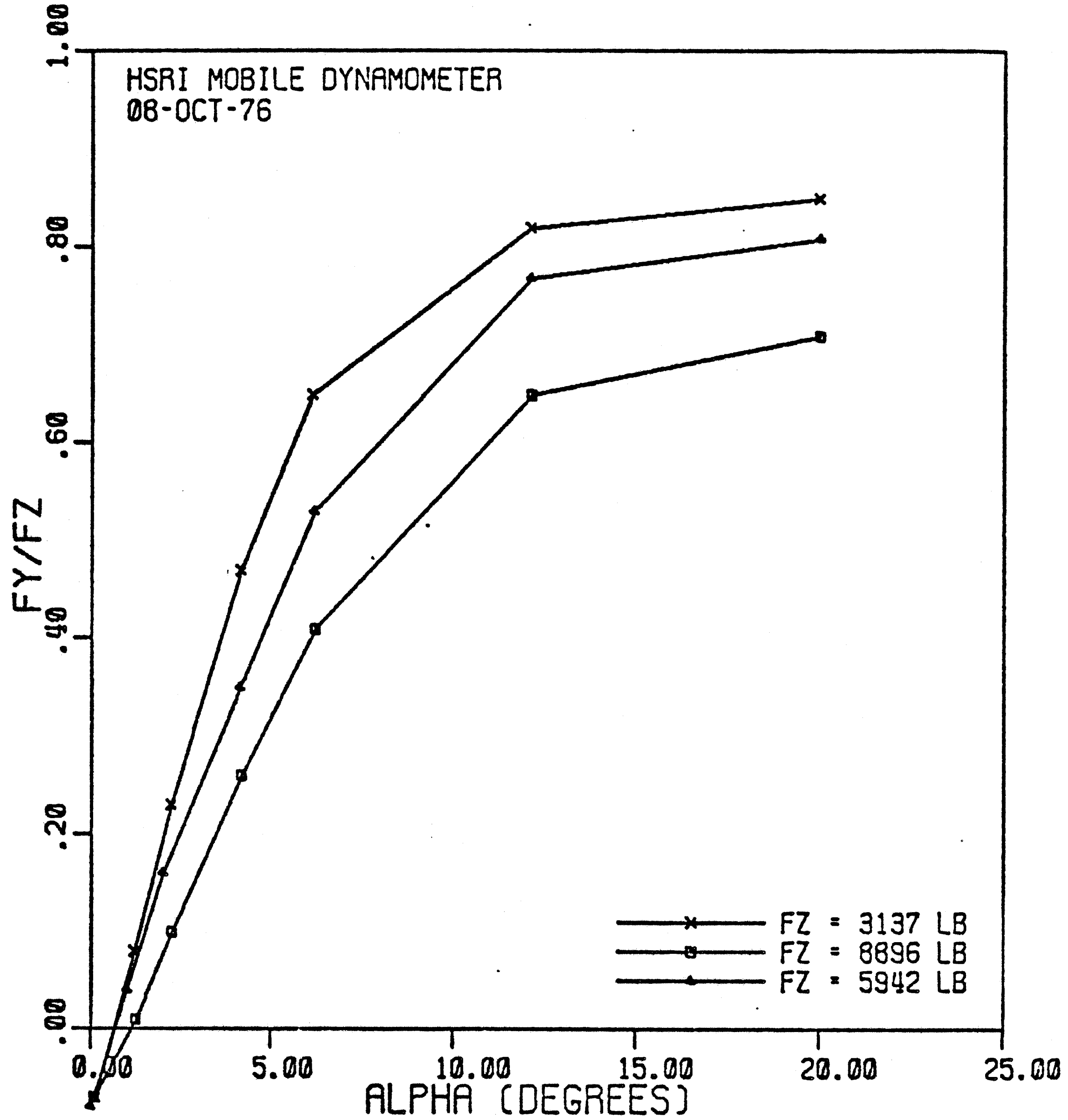
NOISE-TRACTION STUDY, RADIAL TIRES

Tire Test Code	Manufacturer	Model
ONA/B-13-C-Date	Firestone	Transteel
ONA/B-14-C-Date	Firestone	Transteel Traction
ONA/B-15-C-Date	Goodyear	Unisteel R-1
ONA/B-16-C-Date	Goodyear	Unisteel L-1
ONA/B-17-C-Date	Michelin	XZA
ONA/B-18-C-Date	Michelin	XZZ
ONA/B-19-D-Date	Firestone	Transteel
ONA/B-20-D-Date	Firestone	Transteel Traction
ONA/B-21-D-Date	Goodyear	Unisteel R-1
ONA/B-22-D-Date	Goodyear	Unisteel L-1
ONA/B-23-D-Date	Michelin	XZA
ONA/B-24-D-Date	Michelin	XZZ

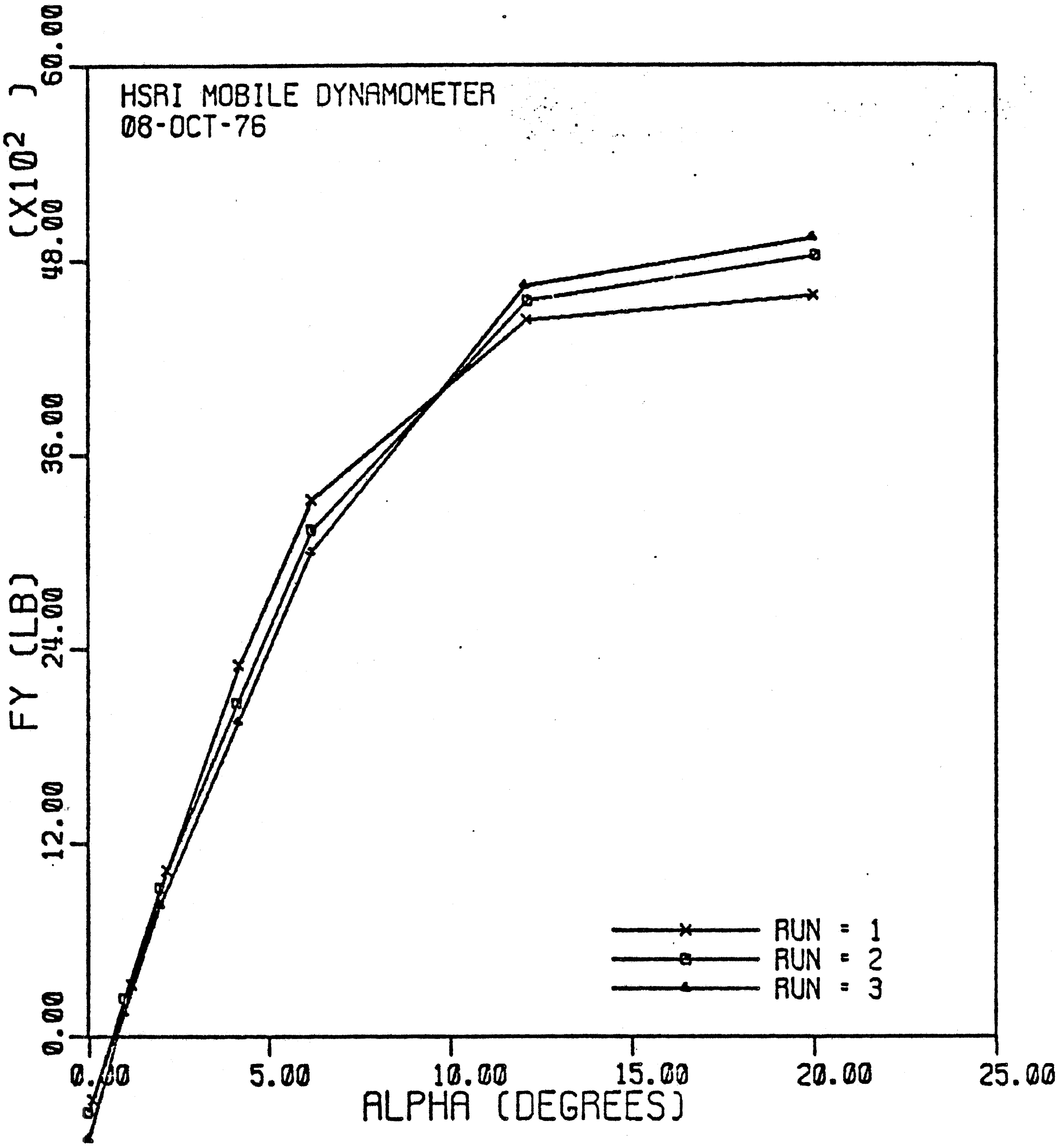


ONA/B-13-C-B/23 DRY CONCRETE (DANA)
FZ = 6019 LB

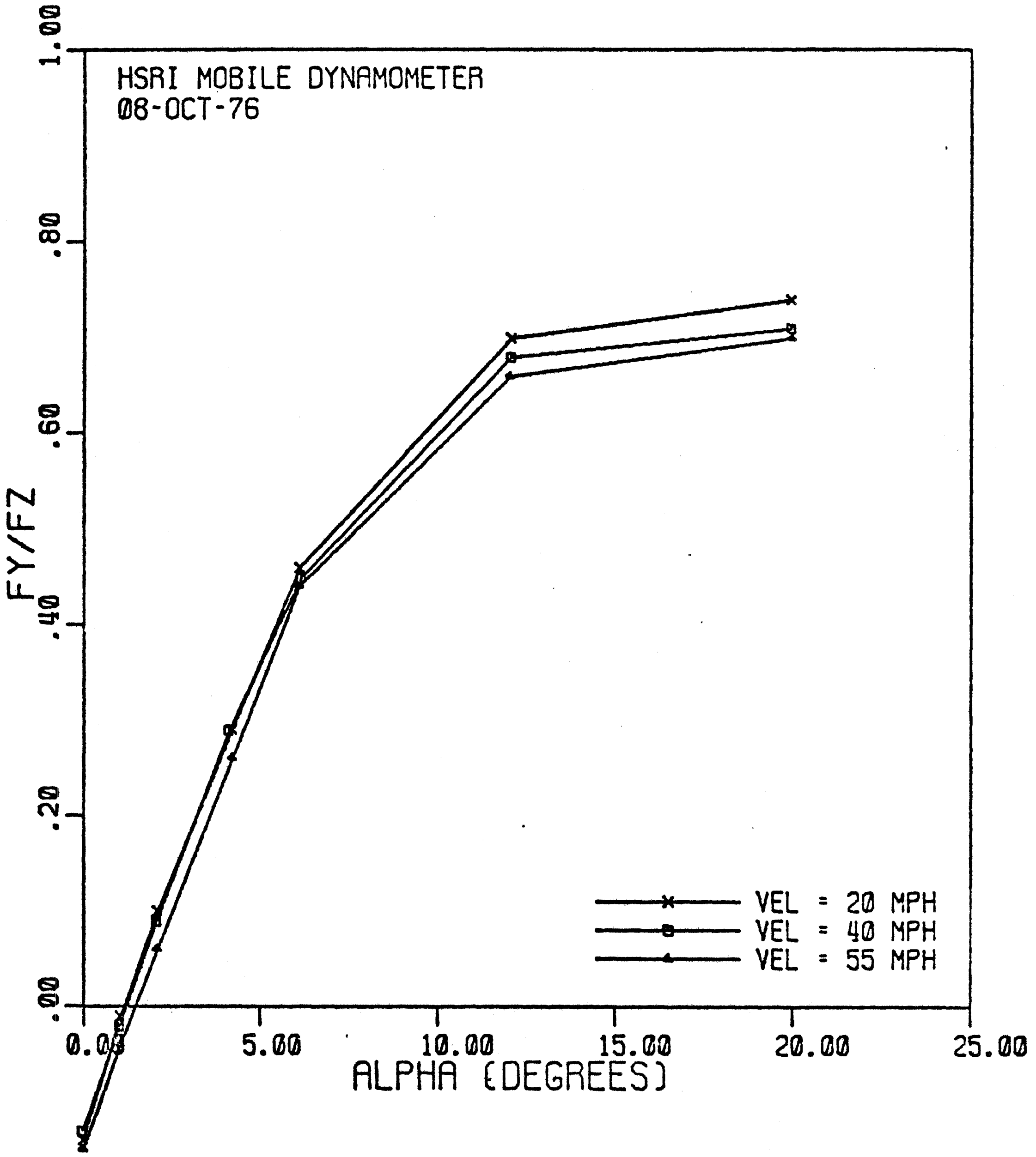
FIRESTONE TRANSTEEL



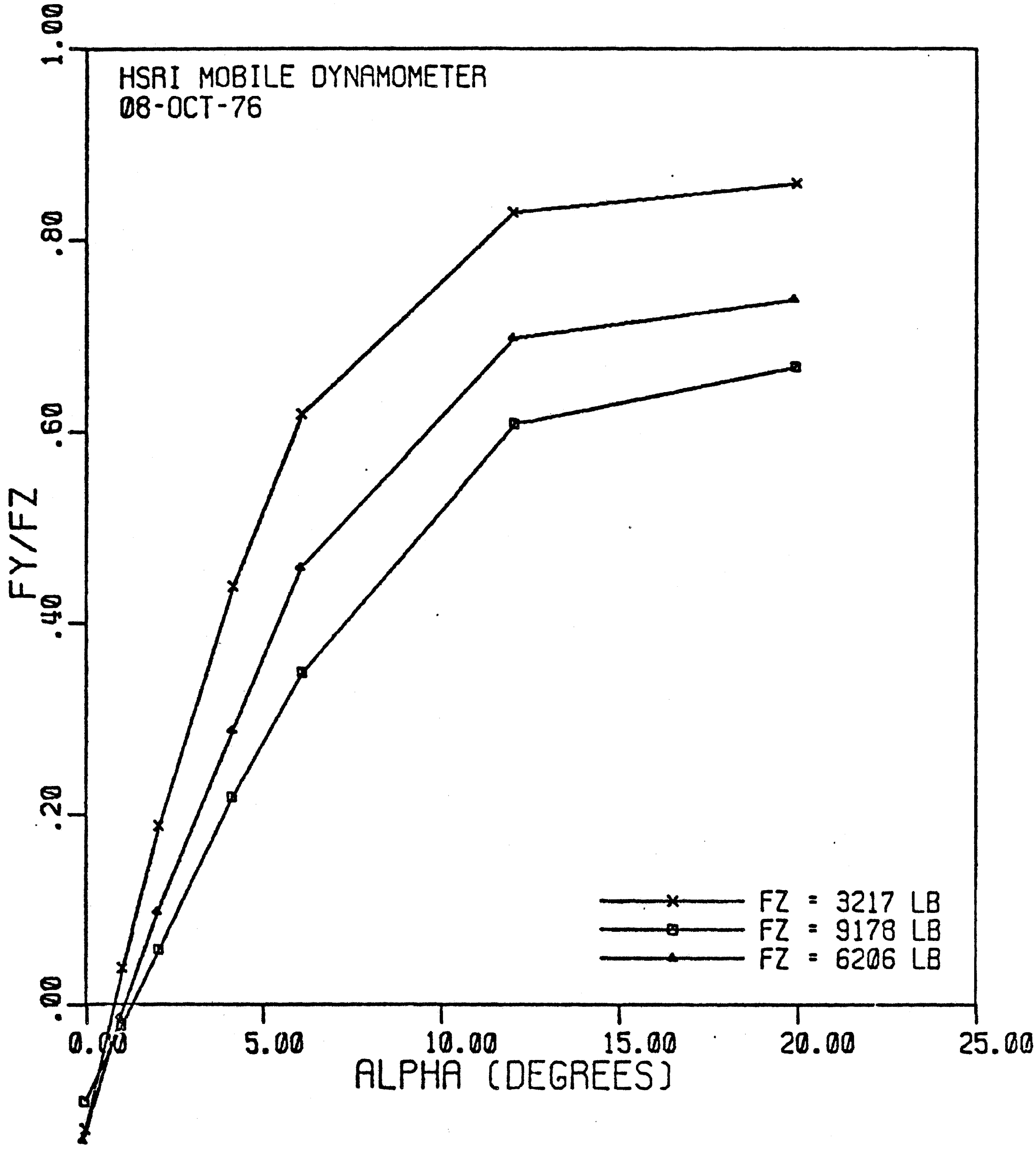
ONA/B-13-C-B/23 DRY CONCRETE (DANA)
VEL = 20 MPH



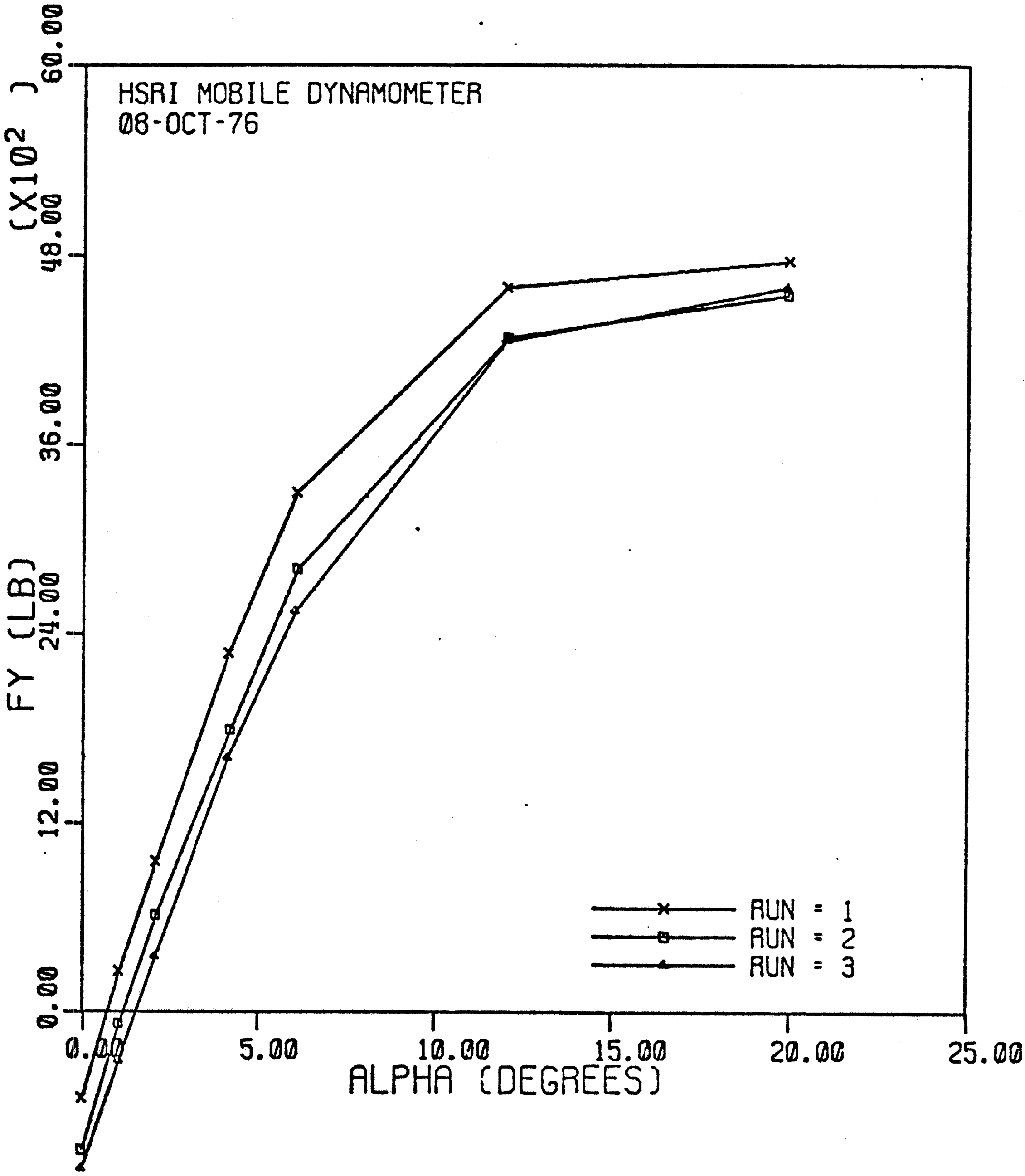
ONA/B-13-C-B/23 DRY CONCRETE (DANA)
FZ = 6014 LB VEL = 20 MPH



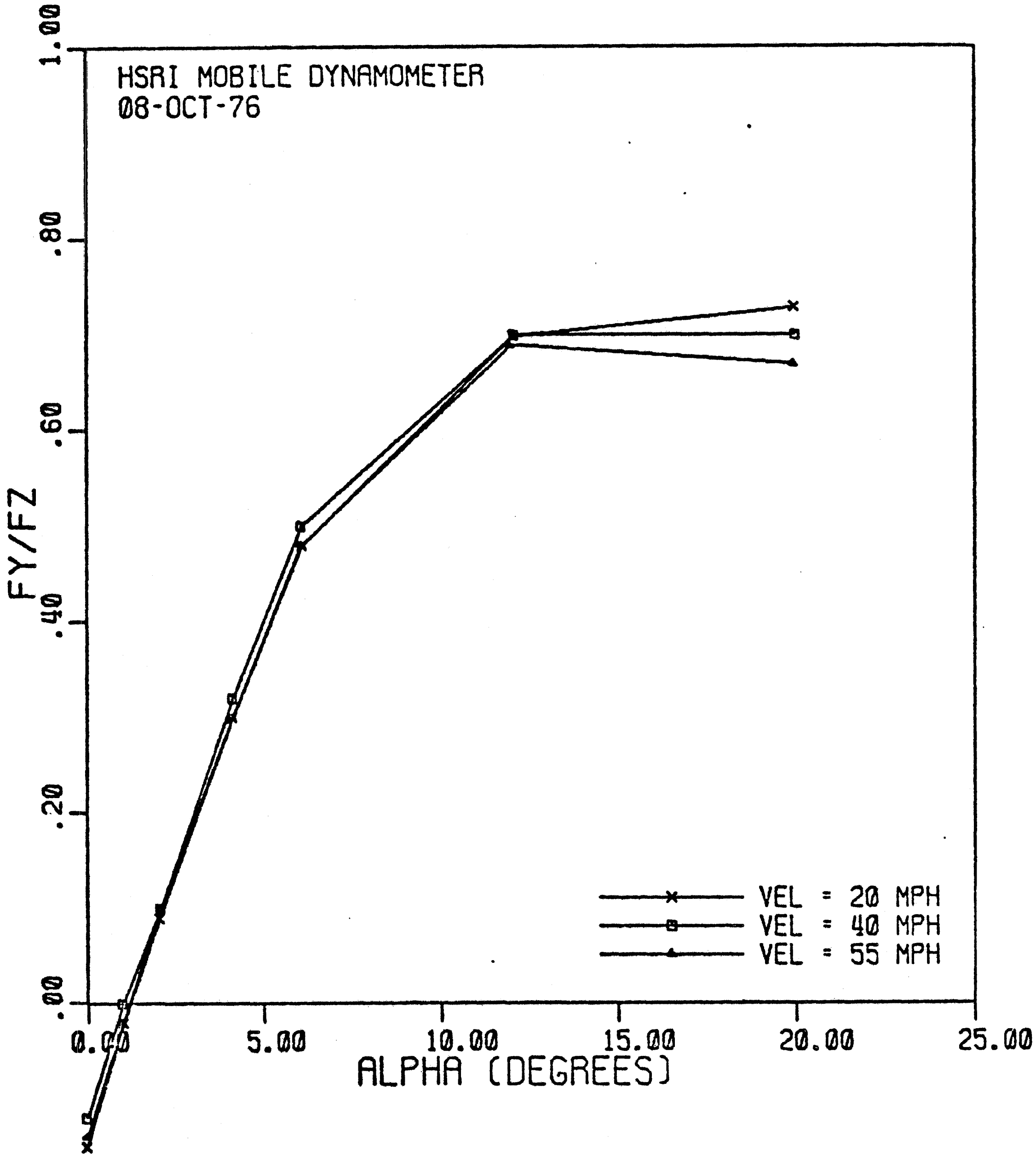
ONA/B-14-C-8/23 DRY CONCRETE (DANA)
FZ = 6304 LB



ONA/B-14-C-8/23 DRY CONCRETE (DANA)
VEL = 20 MPH

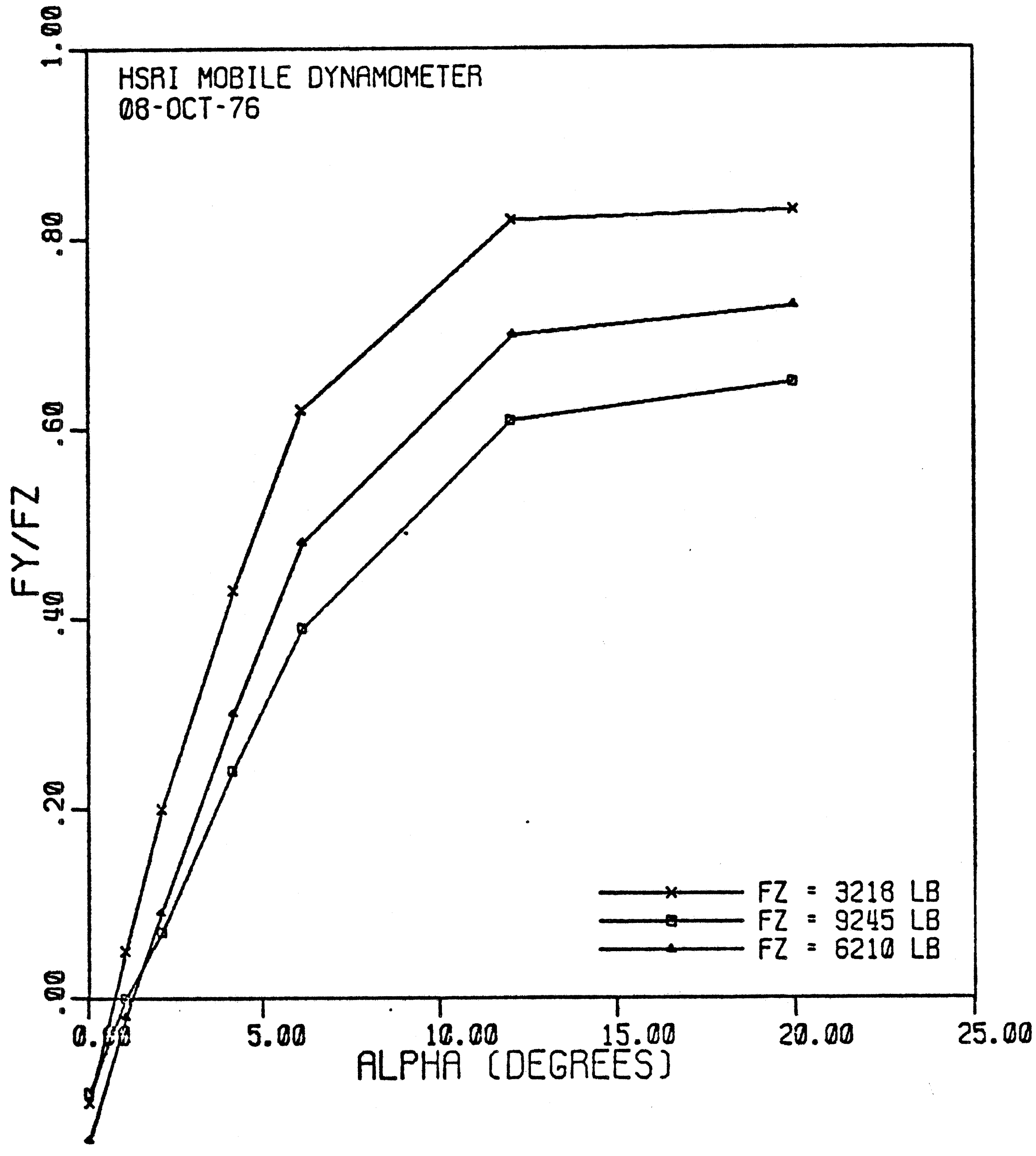


ONA/B-14-C-8/23 DRY CONCRETE (DANA)
FZ = 6228 LB VEL = 20 MPH



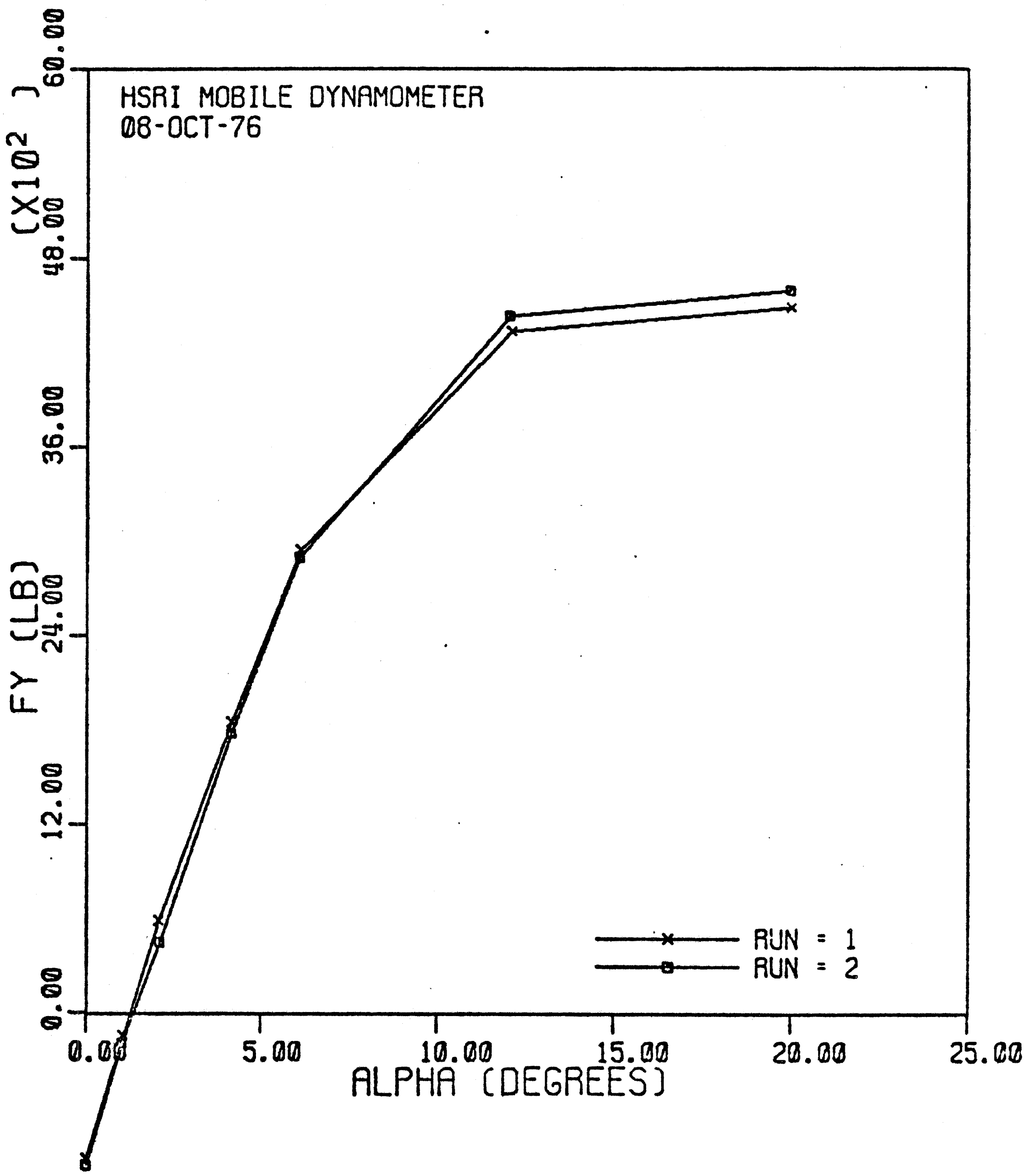
ONA/B-15-C-8/23 DRY CONCRETE (DANA)

FZ = 6287 LB



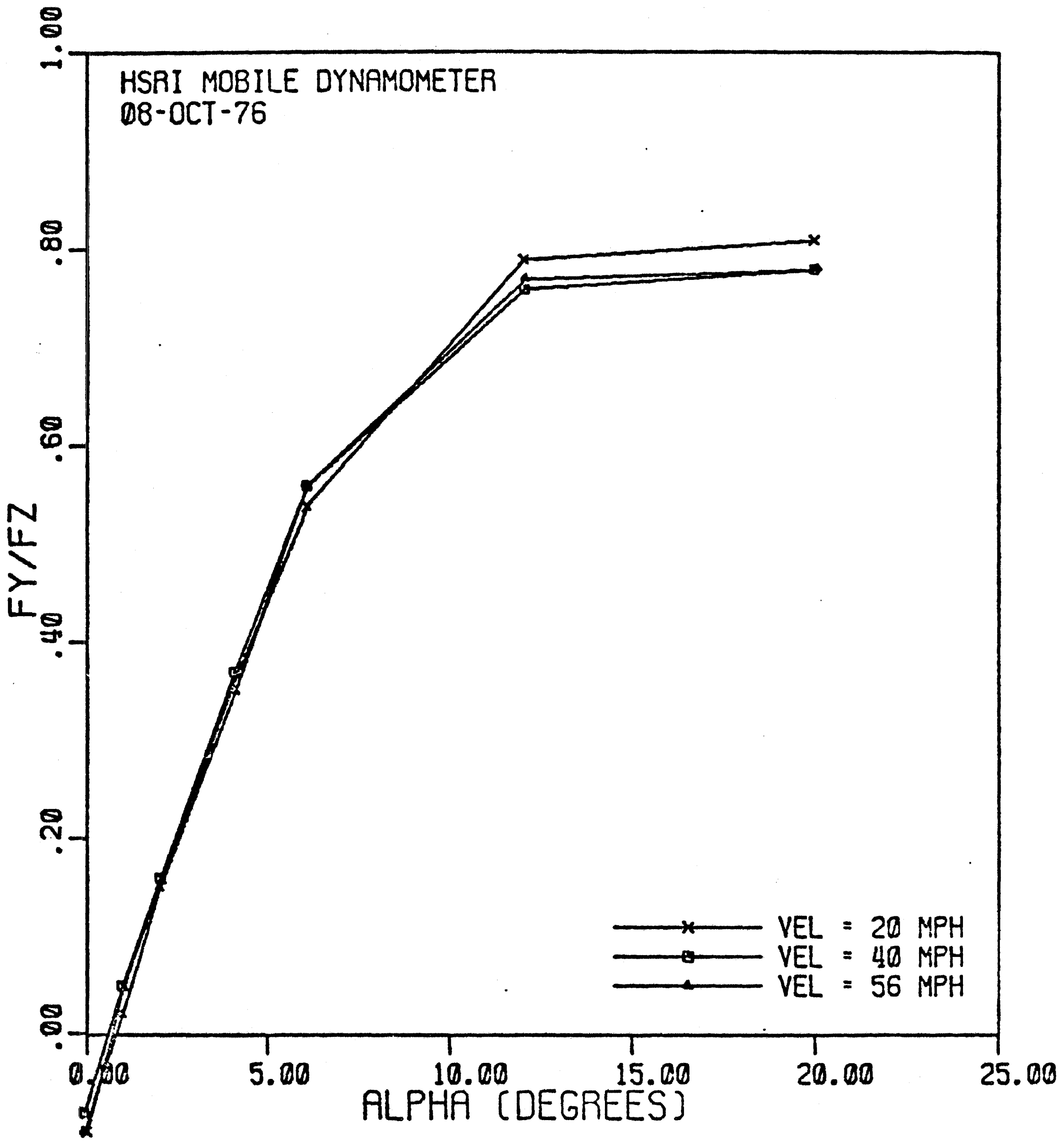
ONA/B-15-C-8/23 DRY CONCRETE (DANA)
VEL = 20 MPH

GOODYEAR [illegible]



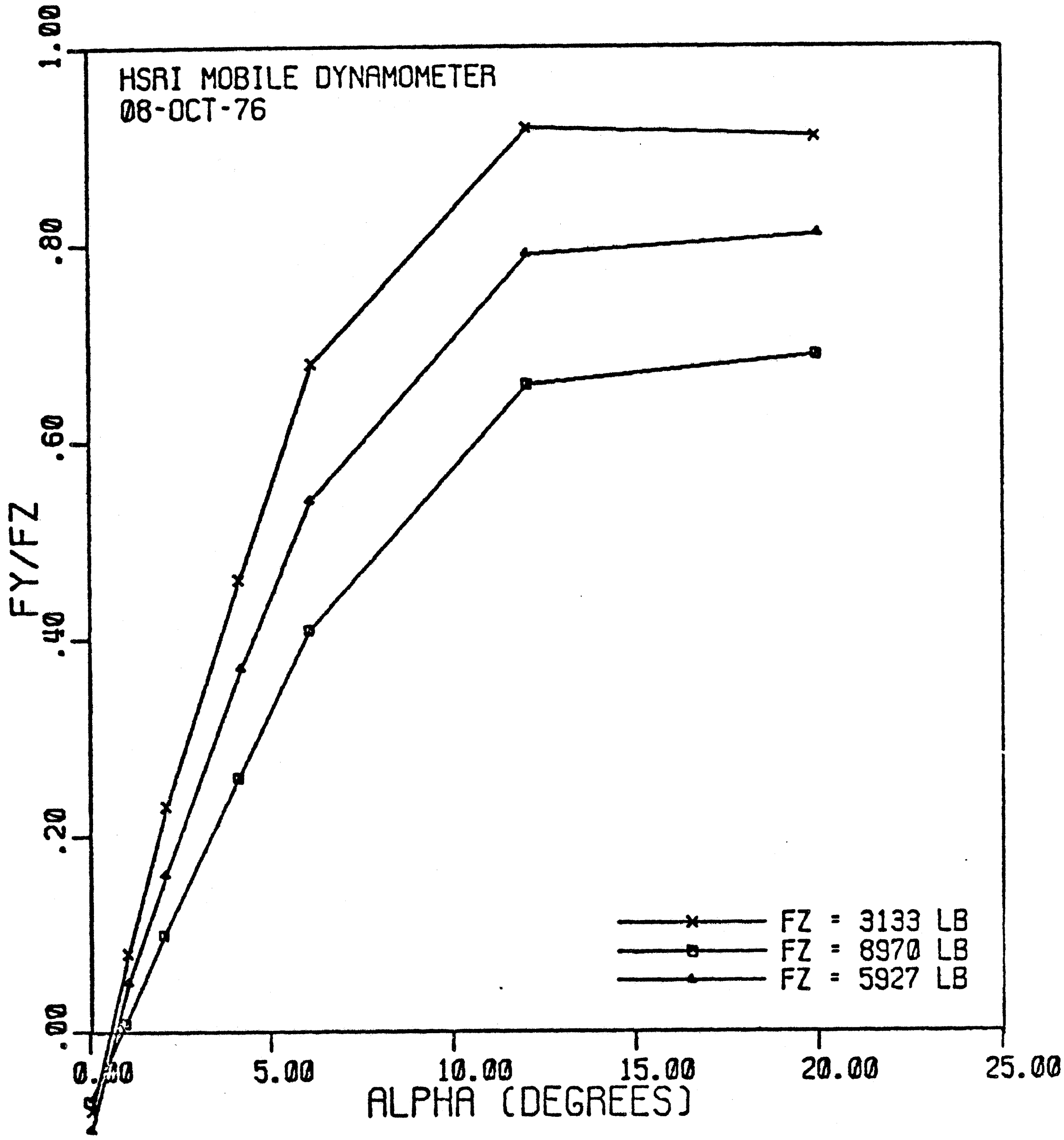
ONA/B-15-C-8/23 DRY CONCRETE (DANA)
FZ = 6256 LB VEL = 20 MPH

GOODYEAR UNISTEEL [-1]

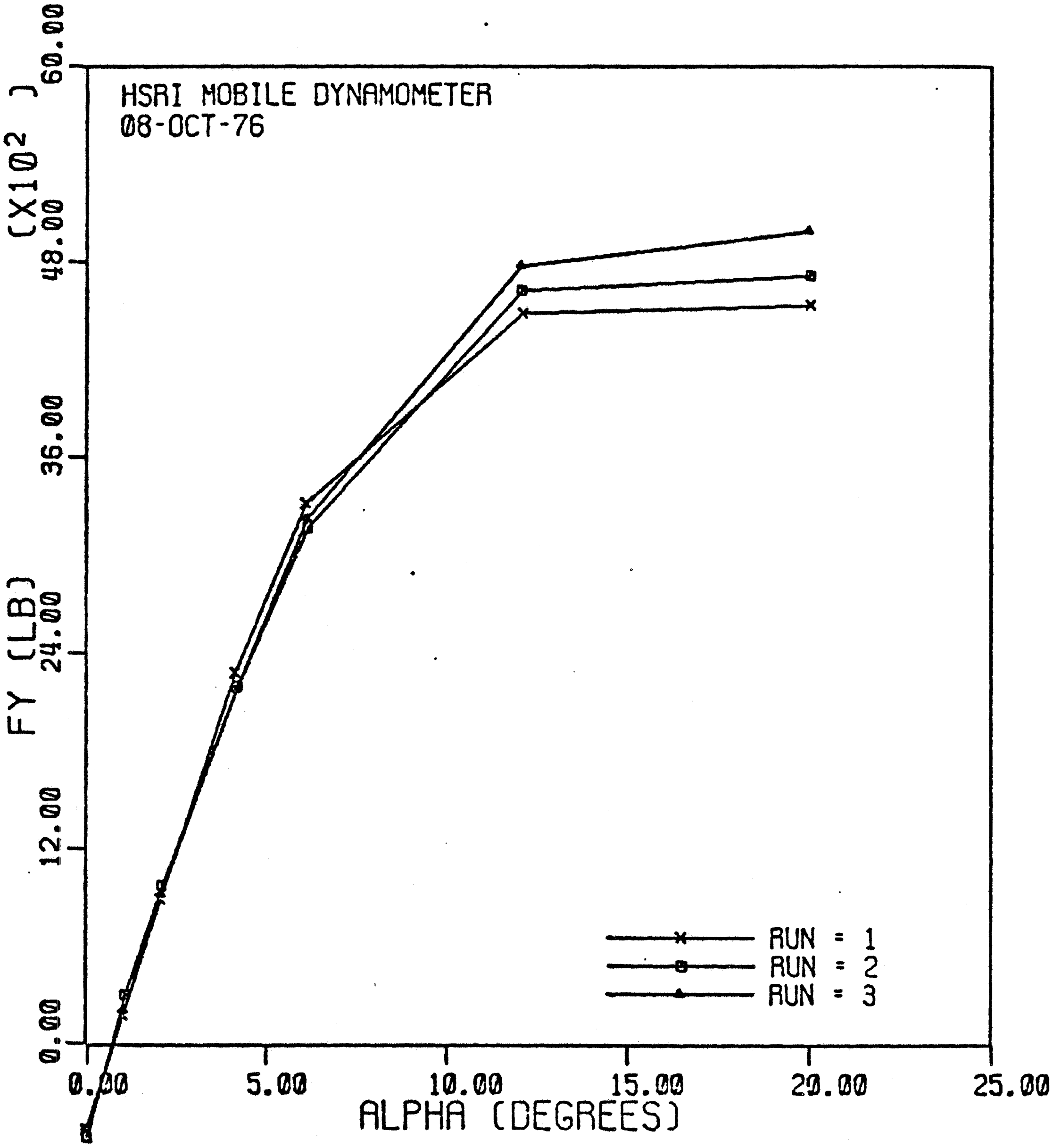


ONA/B-16-C-8/23 DRY CONCRETE (DANA)
FZ = 5941 LB

GOODYEAR ... TEST ...

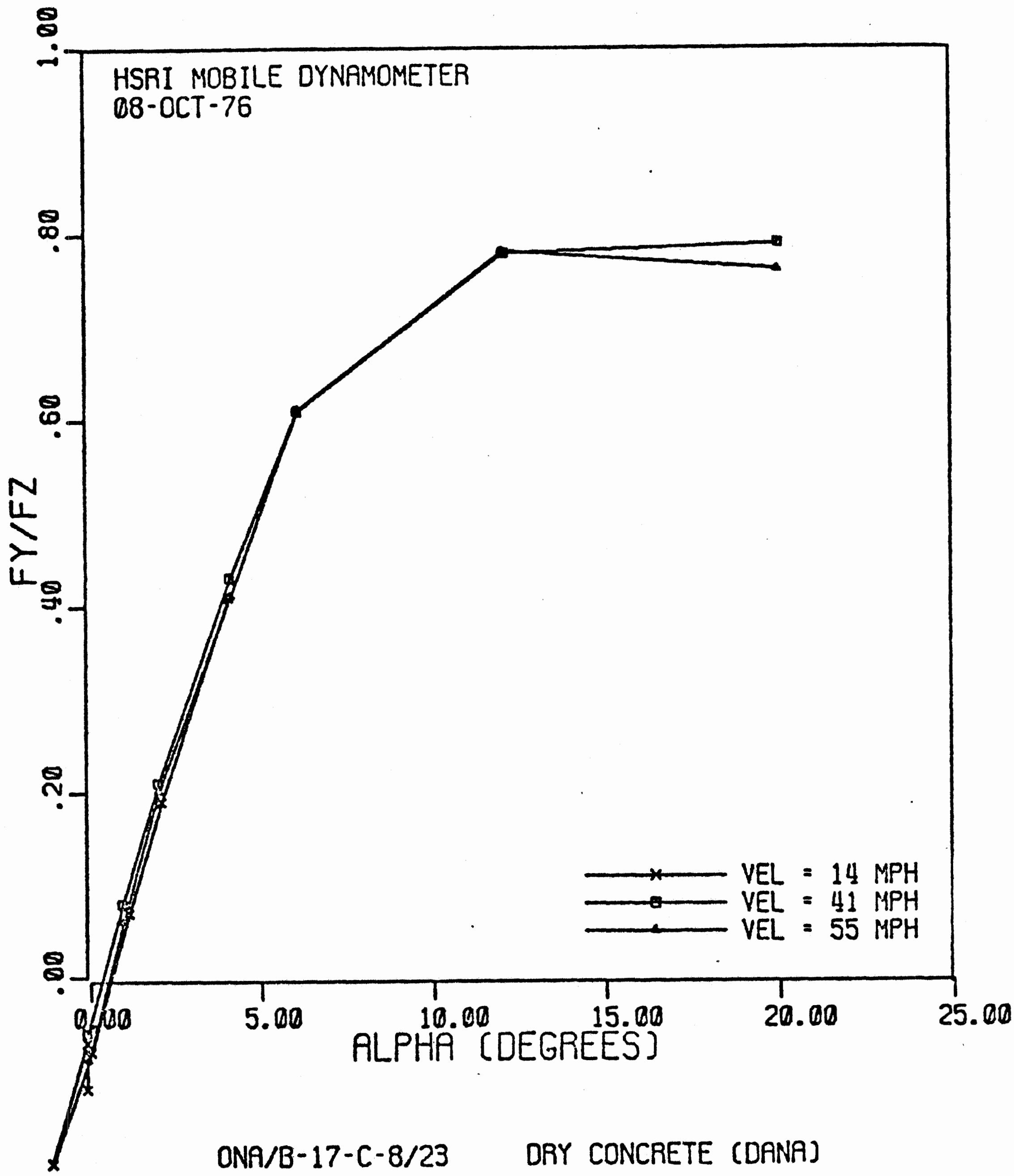


ONA/B-16-C-8/23 DRY CONCRETE (DANA)
VEL = 21 MPH

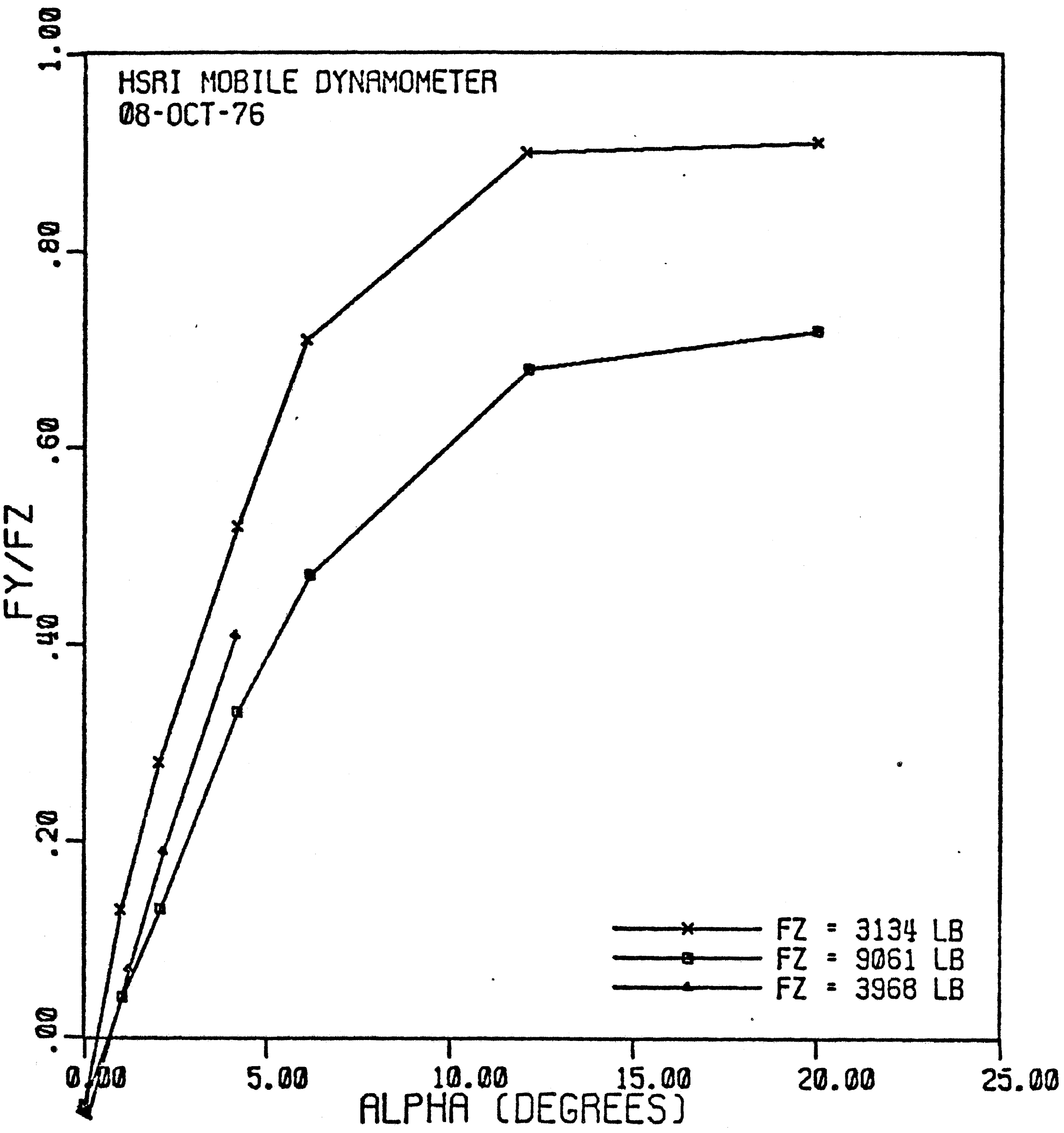


ONA/B-16-C-8/23 DRY CONCRETE (DANA)
FZ = 5964 LB VEL = 14 MPH

GOODYEAR

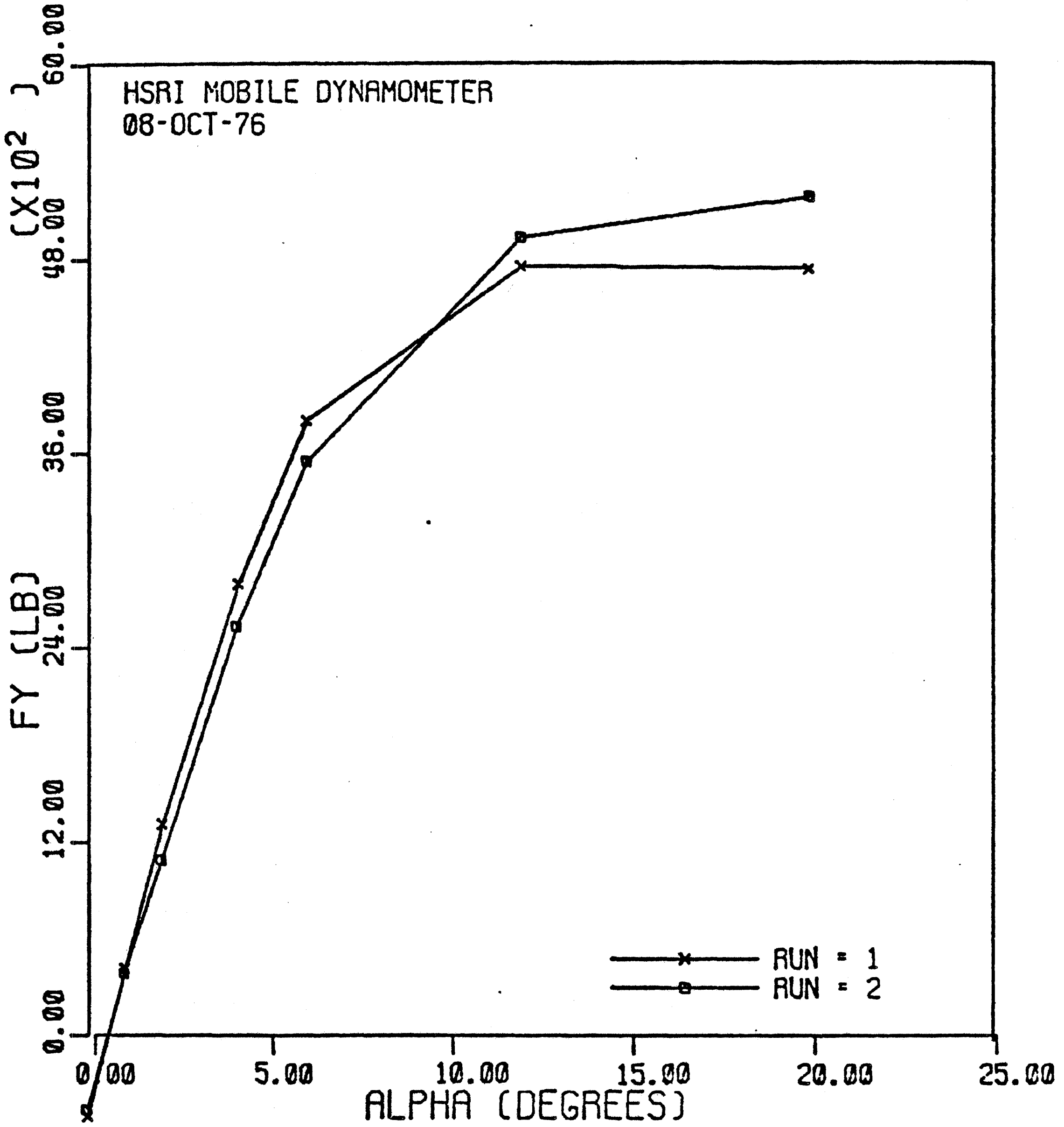


ONA/B-17-C-8/23 DRY CONCRETE (DANA)
FZ = 5445 LB

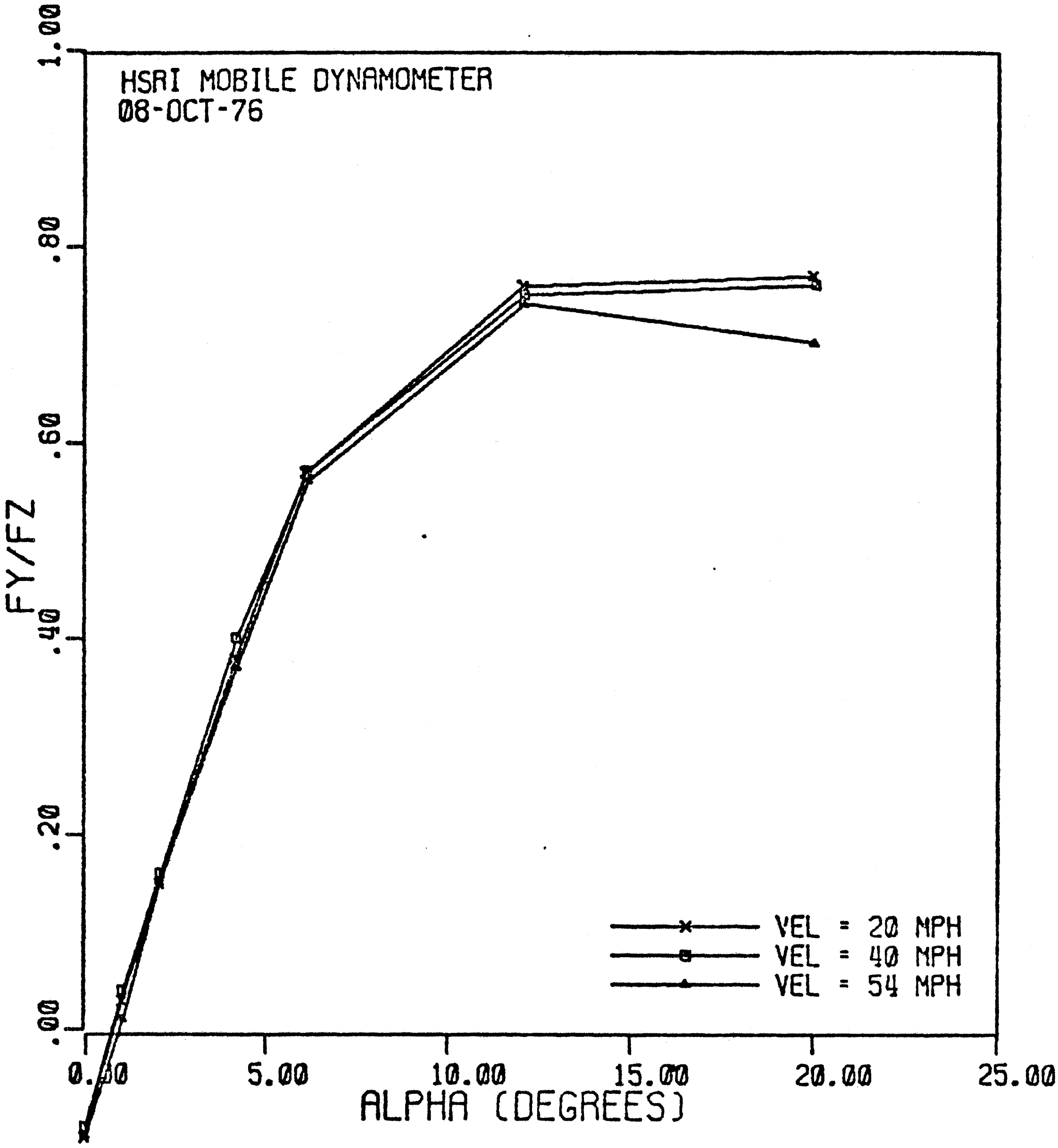


ONA/B-17-C-8/23 DRY CONCRETE (DANA)

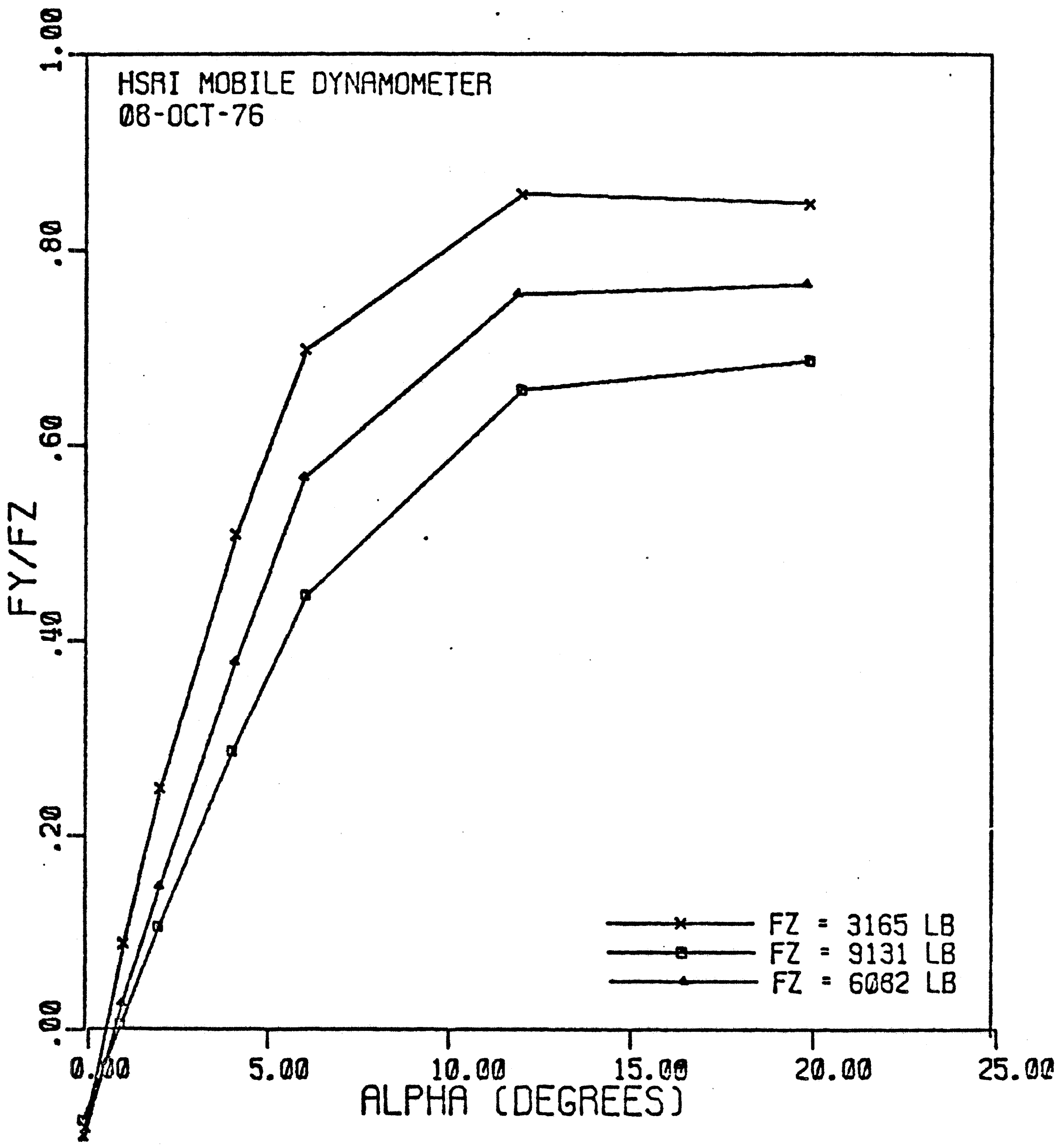
VEL = 18 MPH



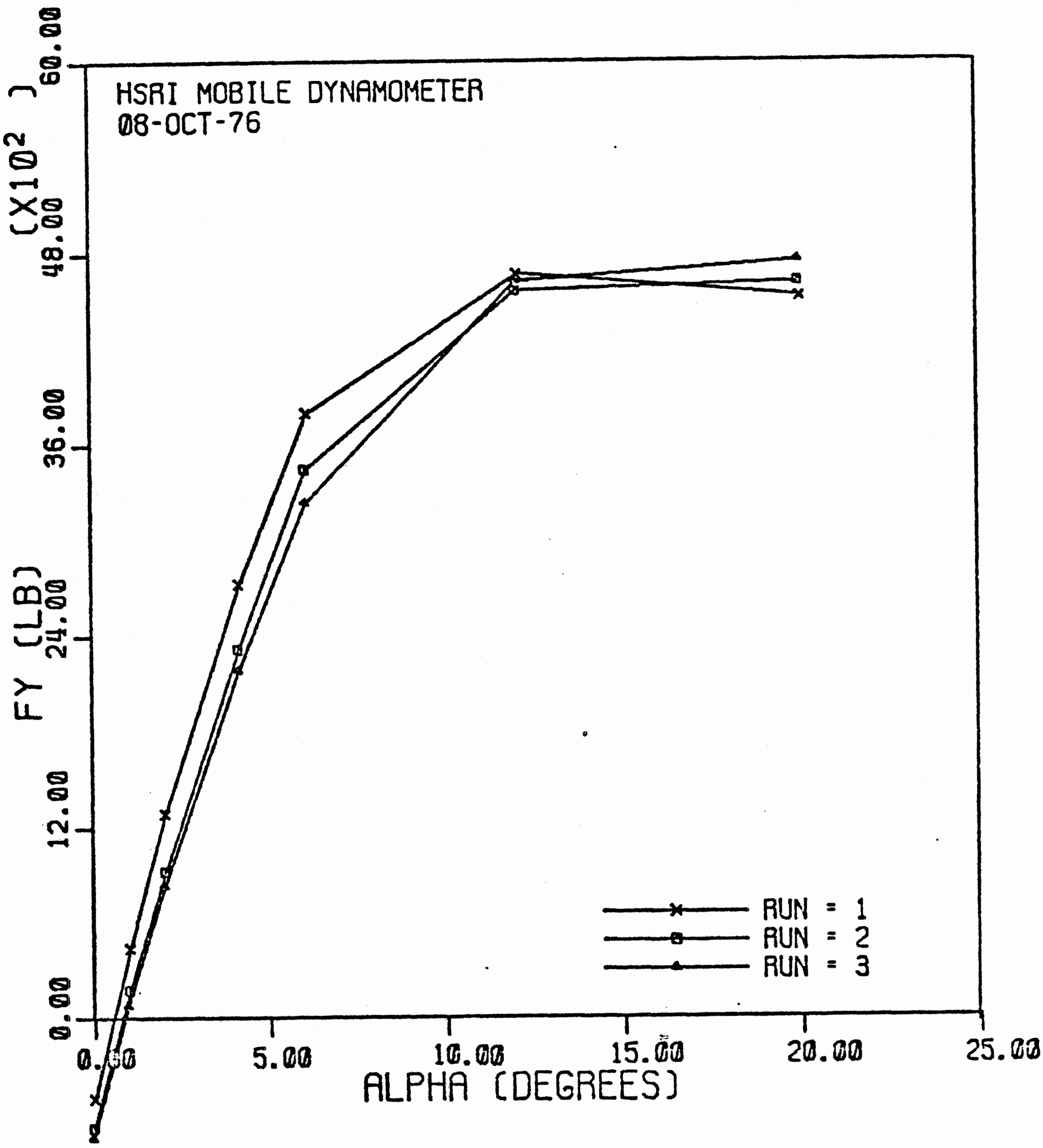
ONA/B-17-C-8/23 DRY CONCRETE (DANA)
FZ = 6130 LB VEL = 20 MPH



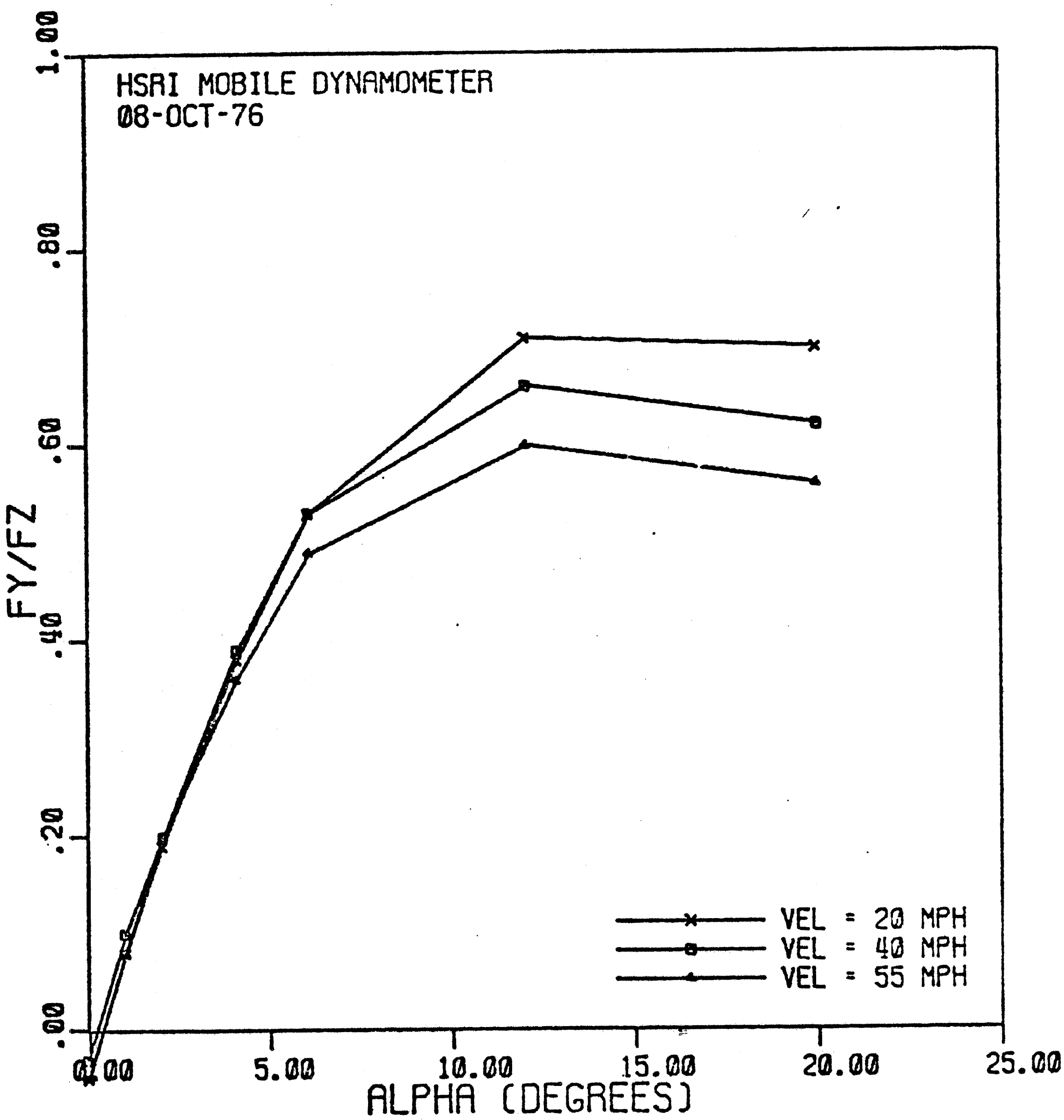
ONA/B-18-C-8/23 DRY CONCRETE (DANA)
FZ = 6184 LB



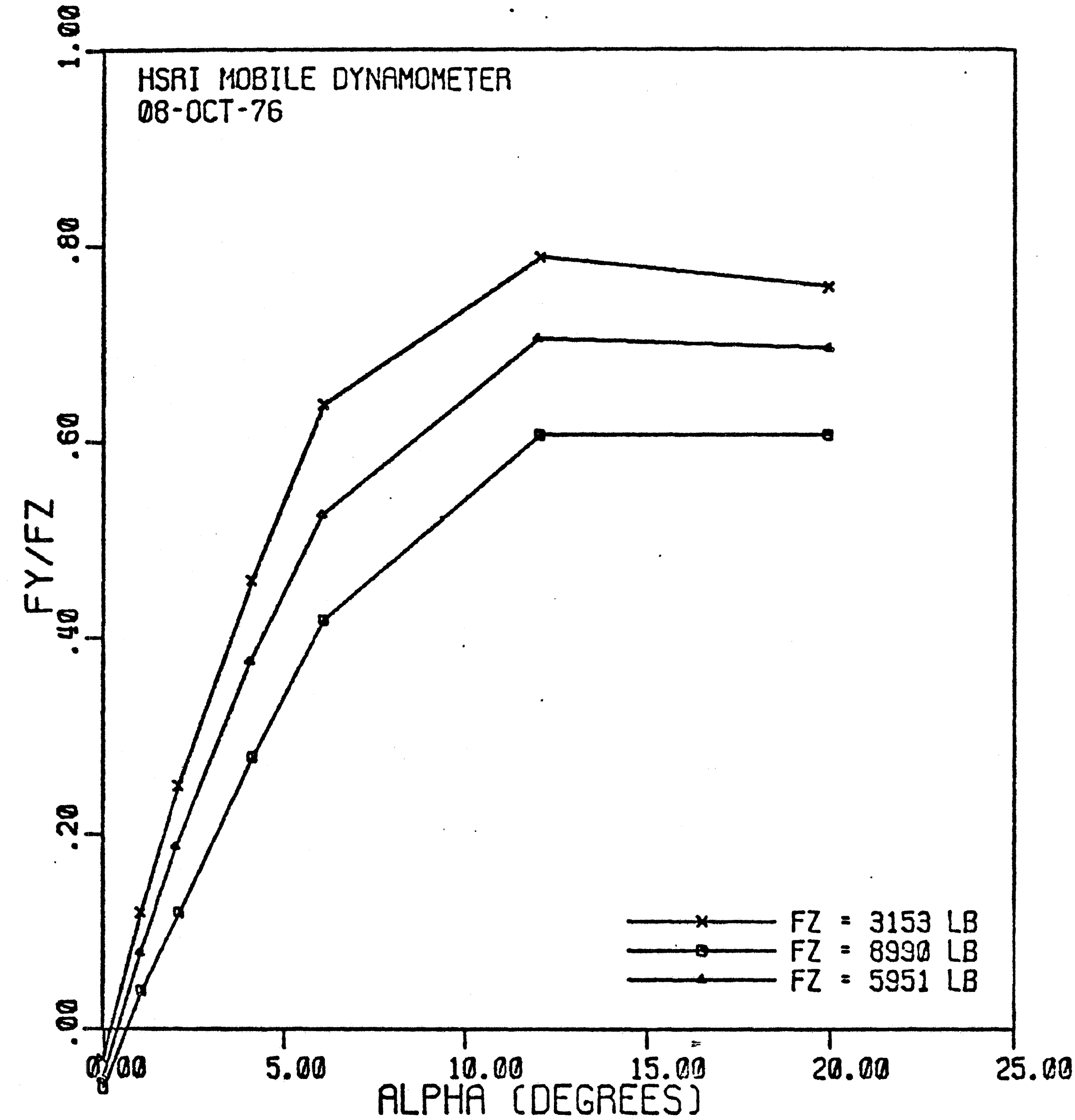
ONA/B-18-C-8/23 DRY CONCRETE (DANA)
VEL = 20 MPH



ONA/B-18-C-8/23 DRY CONCRETE (DANA)
FZ = 6153 LB VEL = 20 MPH

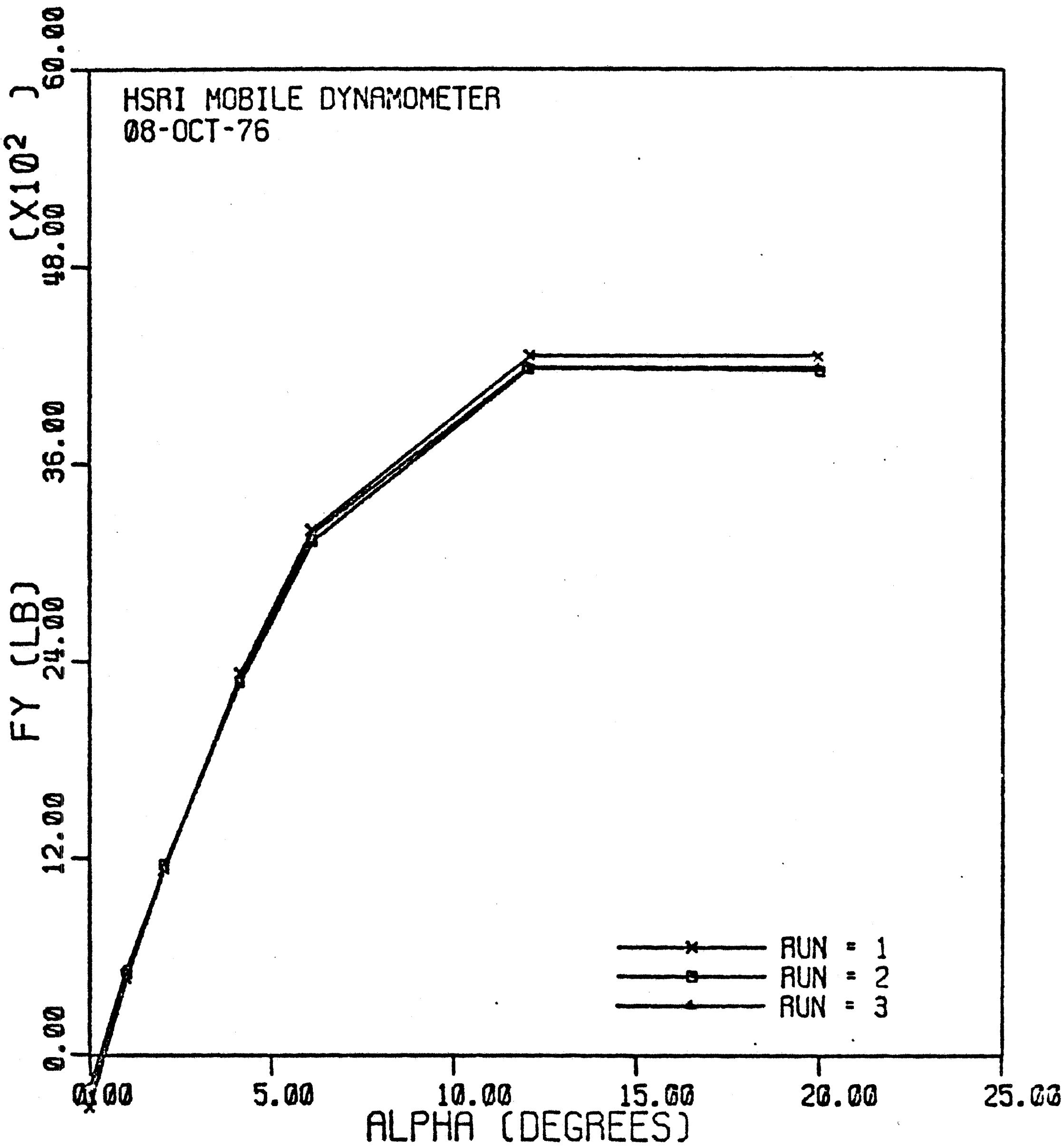


ONA/B-19-D-8/25 WET CONCRETE (DANA)
FZ = 6003 LB

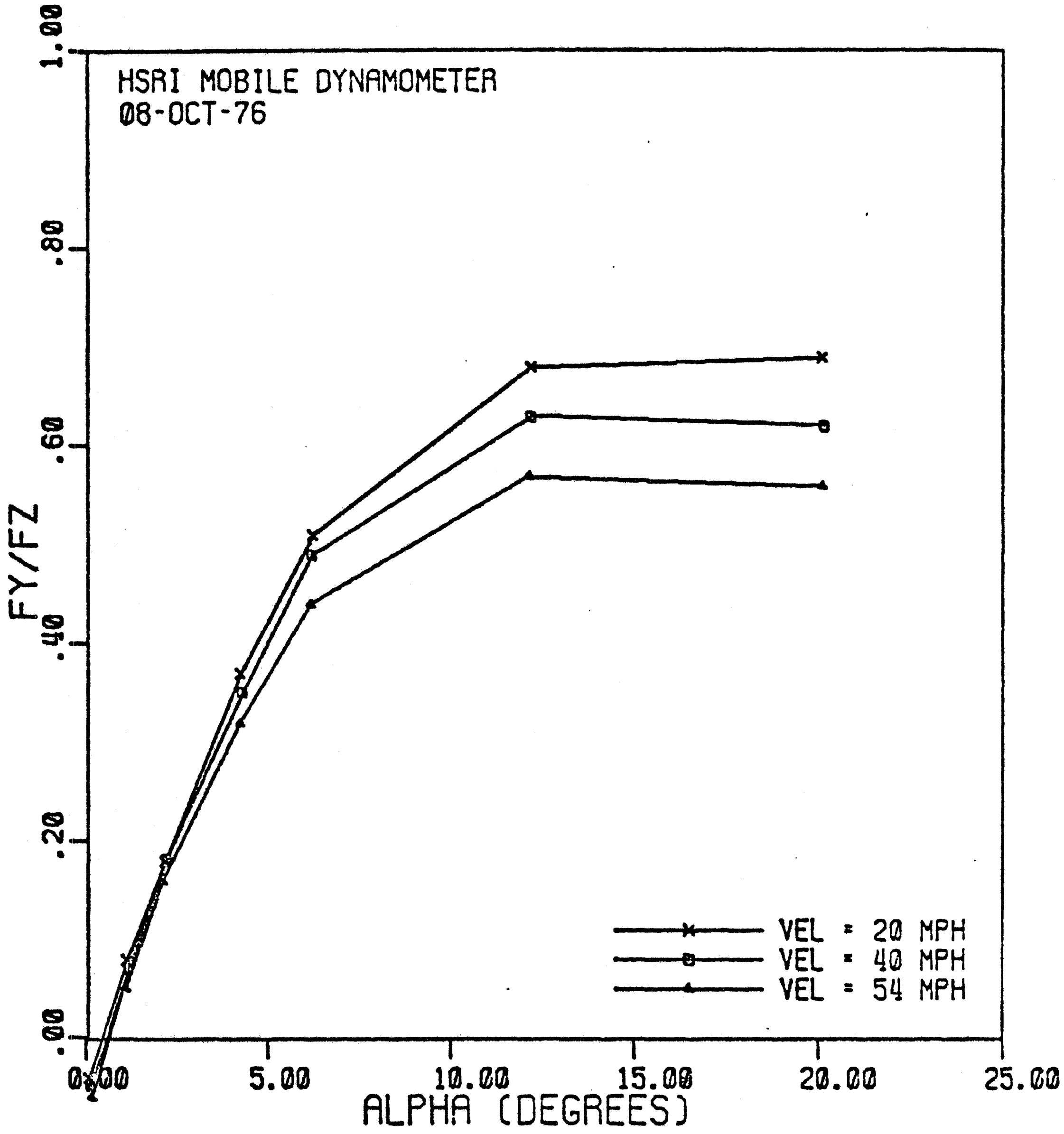


ONA/B-19-D-8/25 WET CONCRETE (DANA)

VEL = 20 MPH

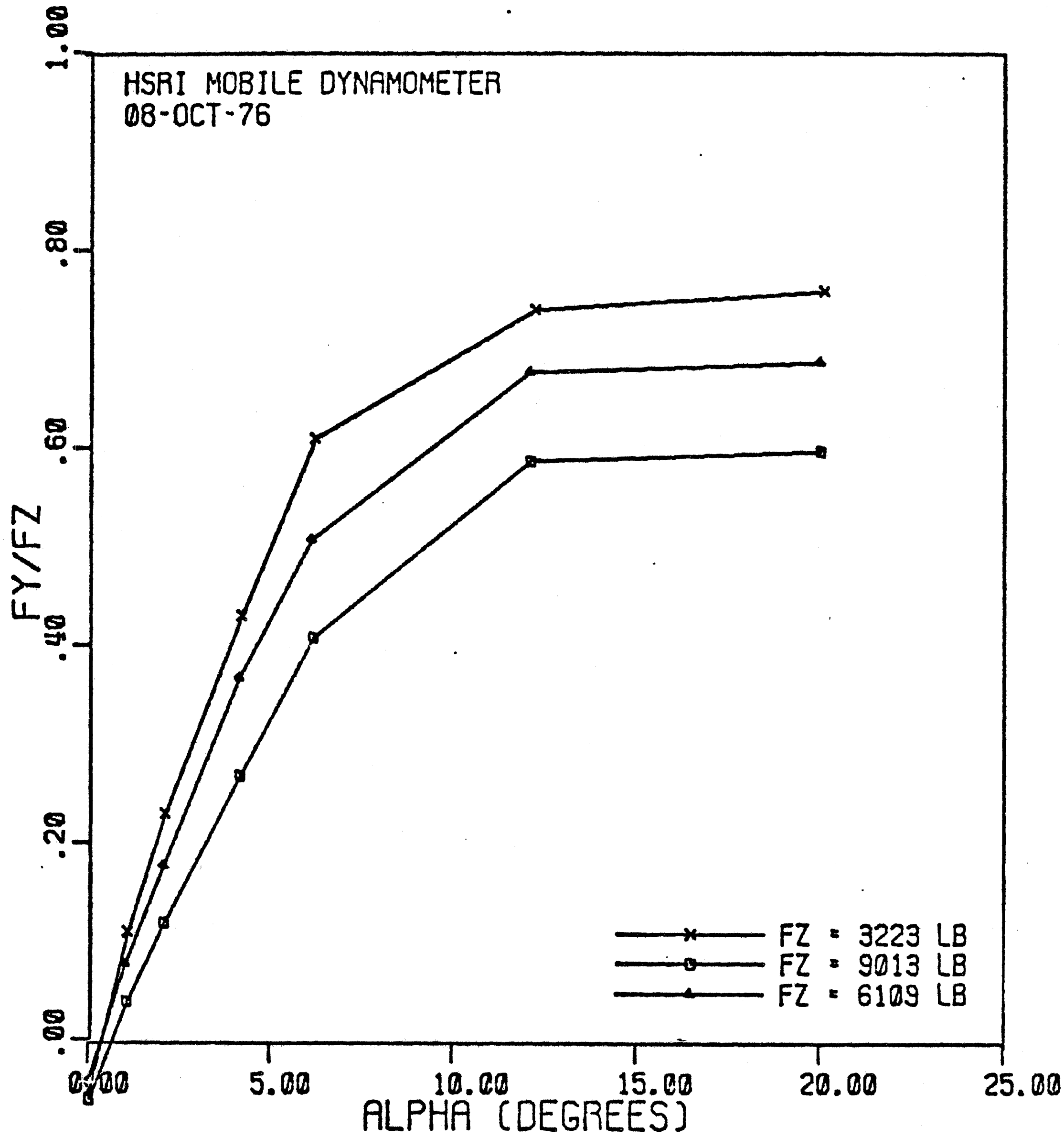


ONA/B-19-D-8/25 WET CONCRETE (DANA)
FZ = 5973 LB VEL = 20 MPH

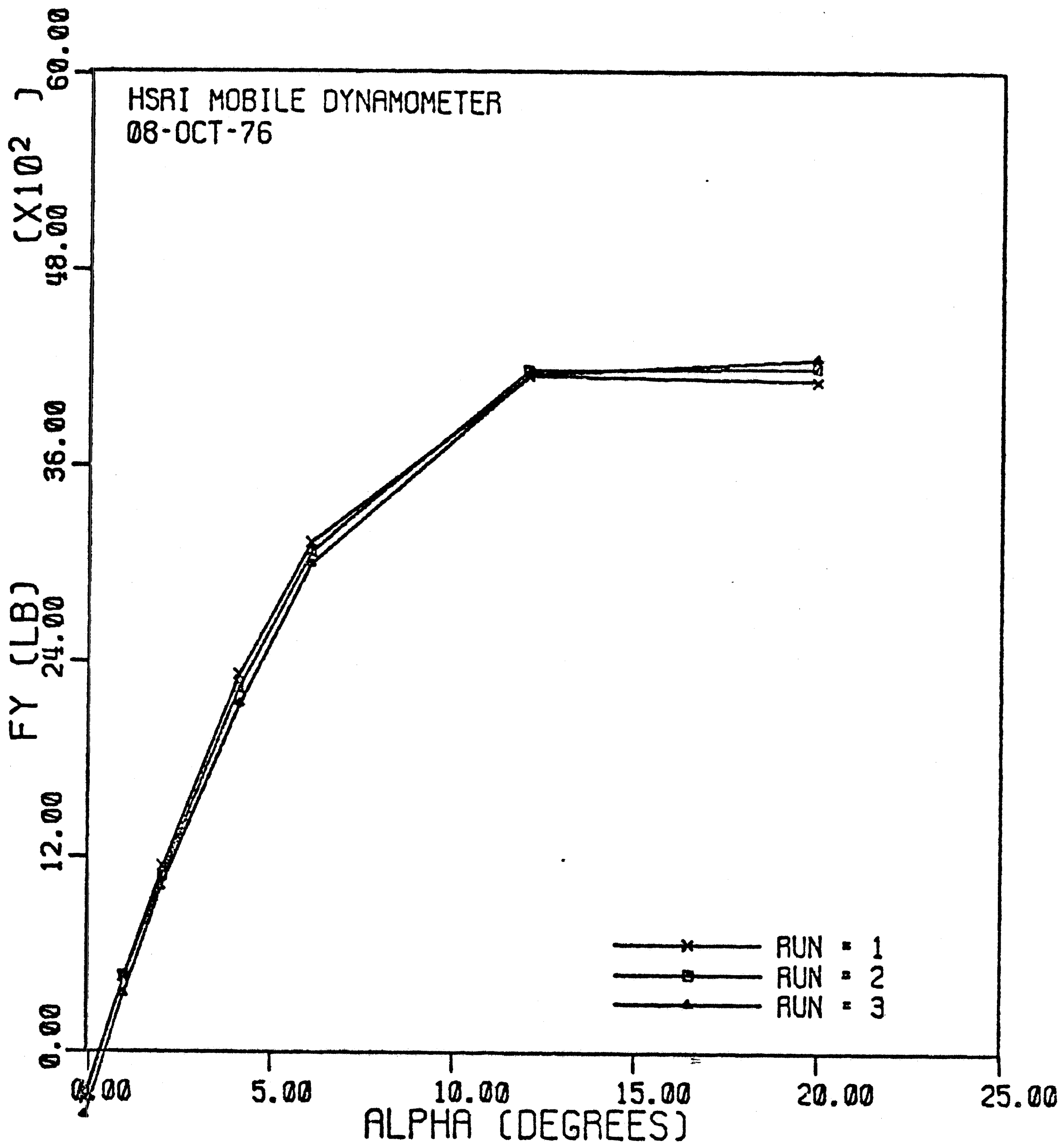


ONA/B-20-D-8/25 WET CONCRETE (DANA)

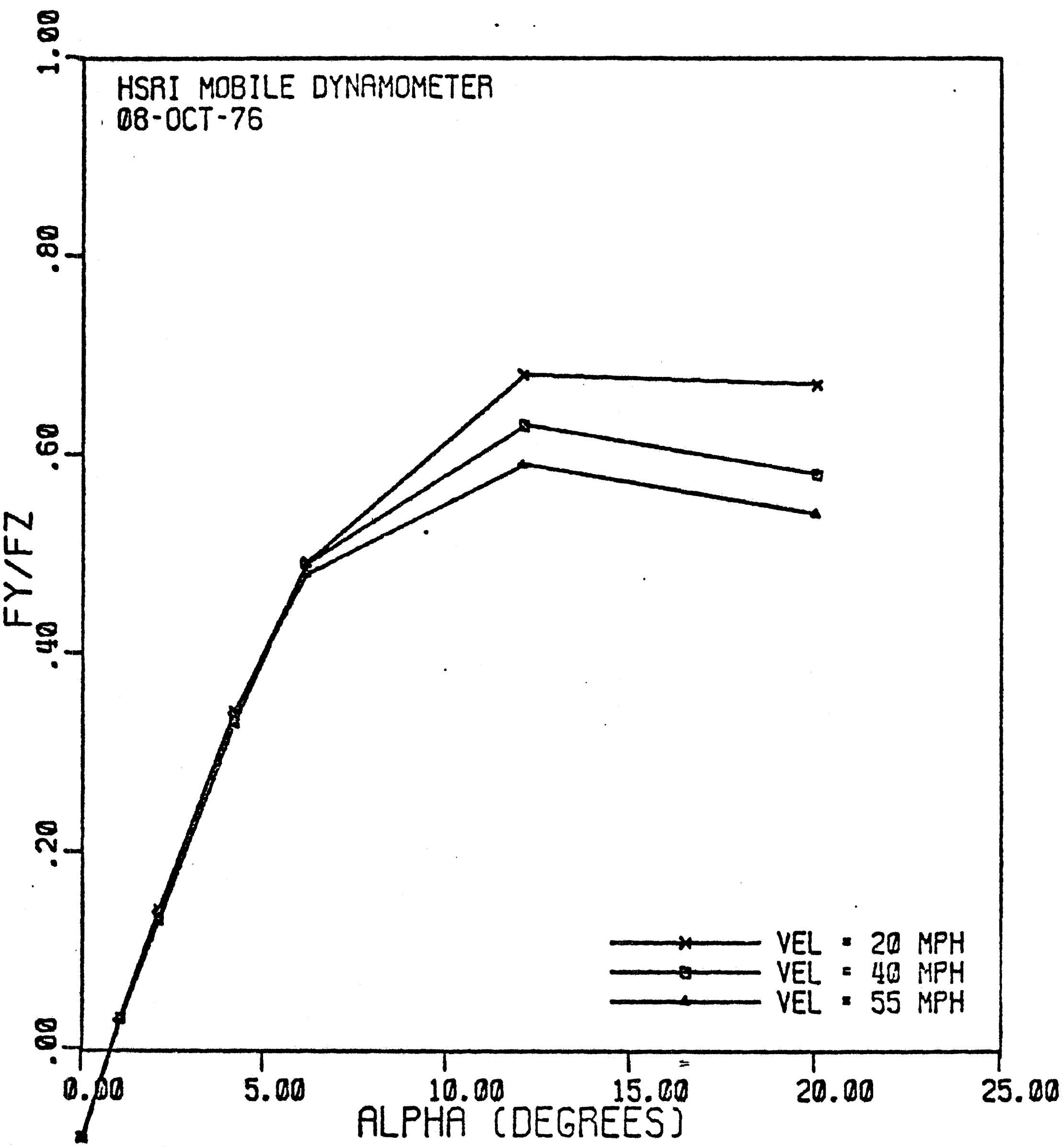
FZ = 6171 LB



ONA/B-20-D-8/25 WET CONCRETE (DANA)
VEL = 20 MPH

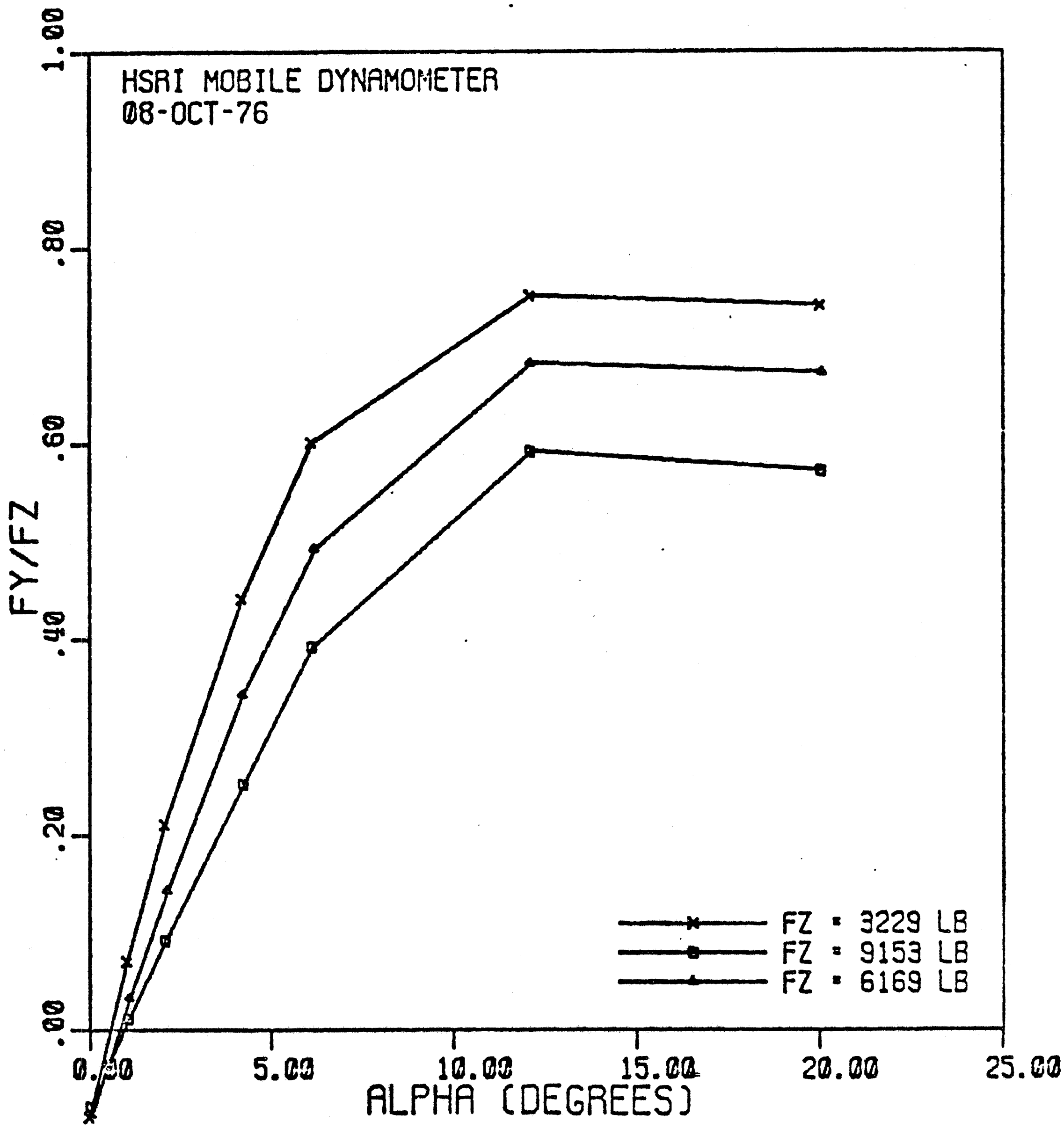


ONA/B-20-D-8/25 WET CONCRETE (DANA)
FZ = 6137 LB VEL = 20 MPH



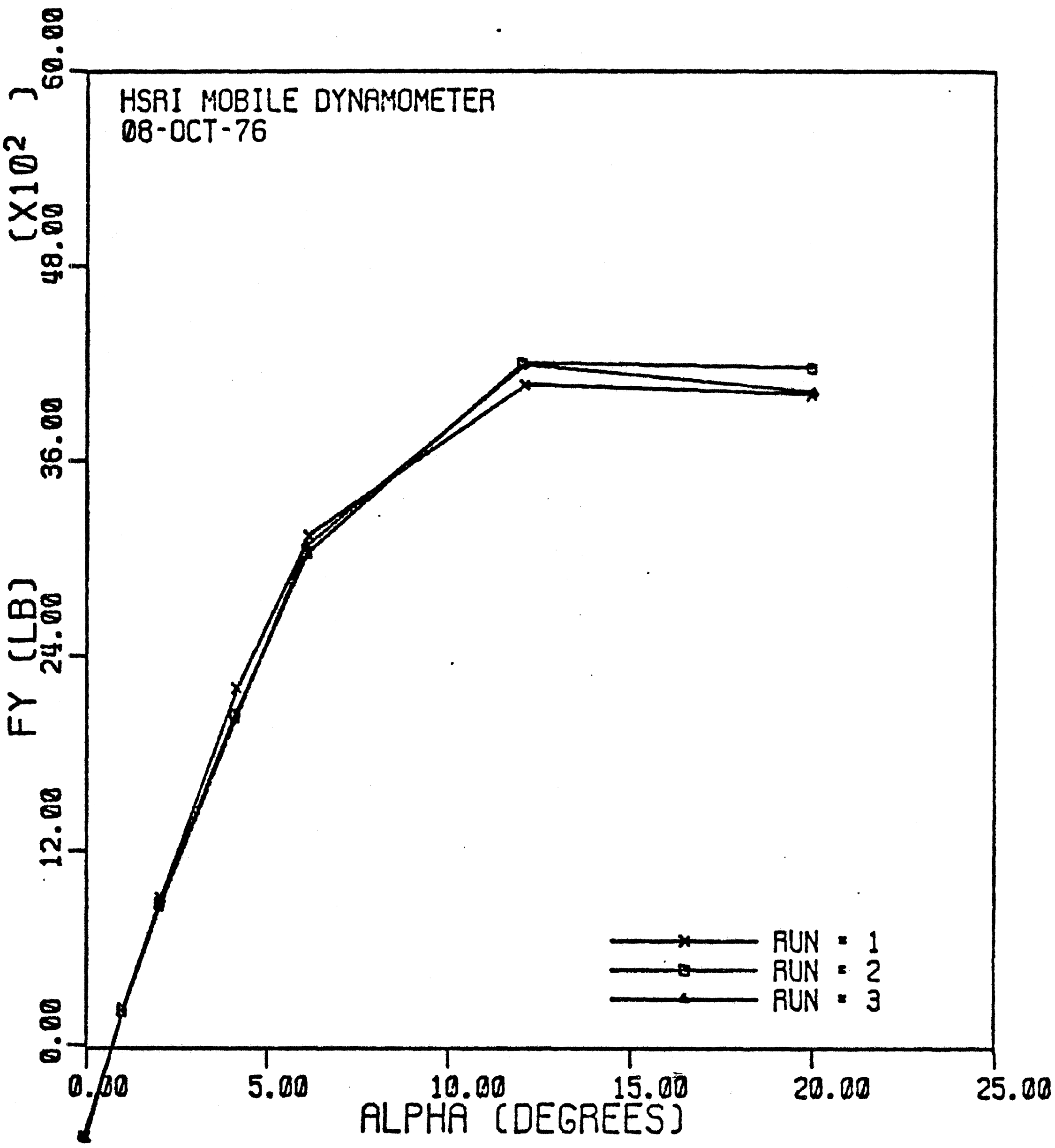
ONA/B-21-D-8/25 WET CONCRETE (DANA)
FZ = 6248 LB

GOODYEAR



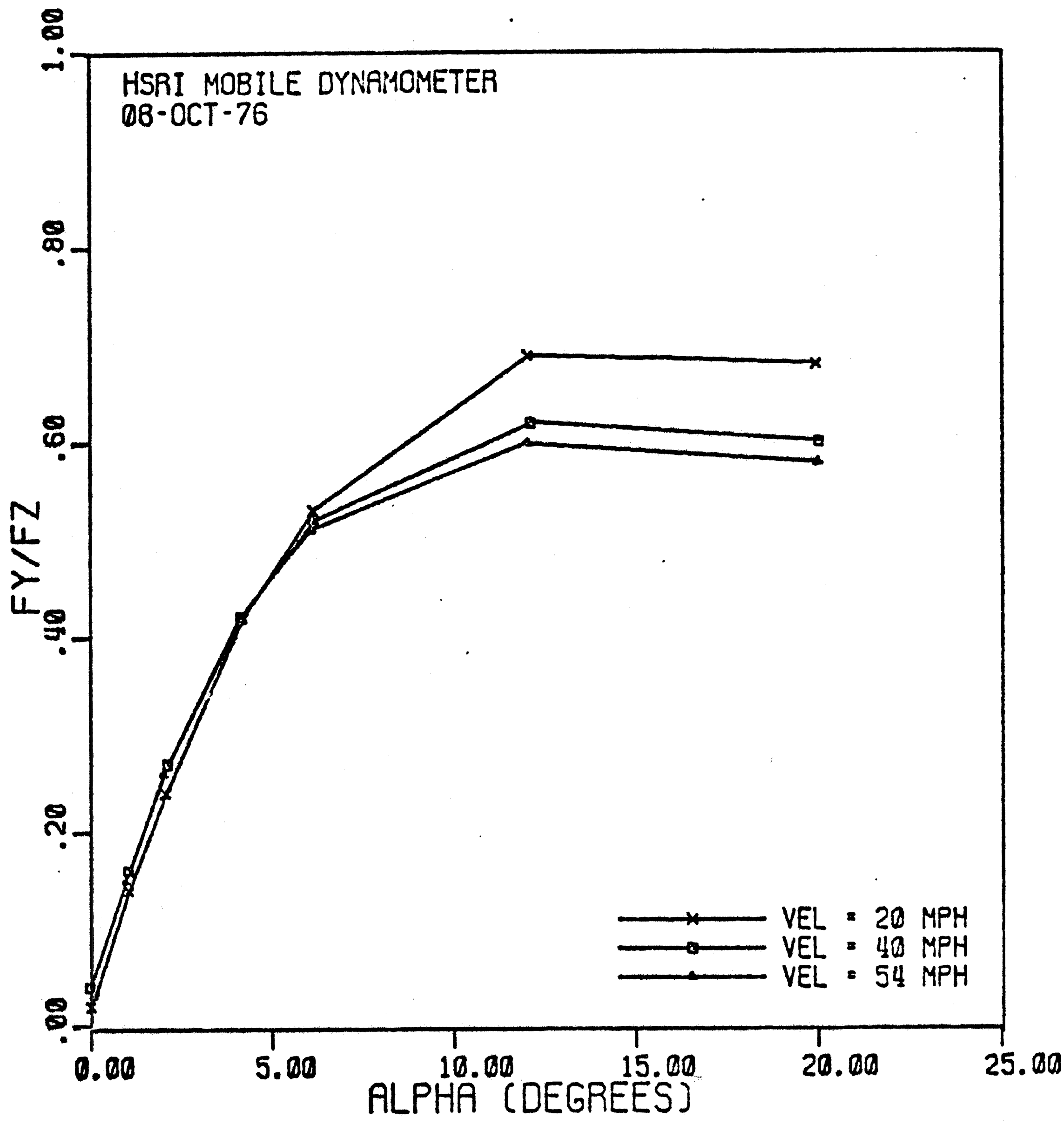
ONA/B-21-D-8/25 WET CONCRETE (DANA)
VEL = 20 MPH

GOODYEAR STEEL L-1

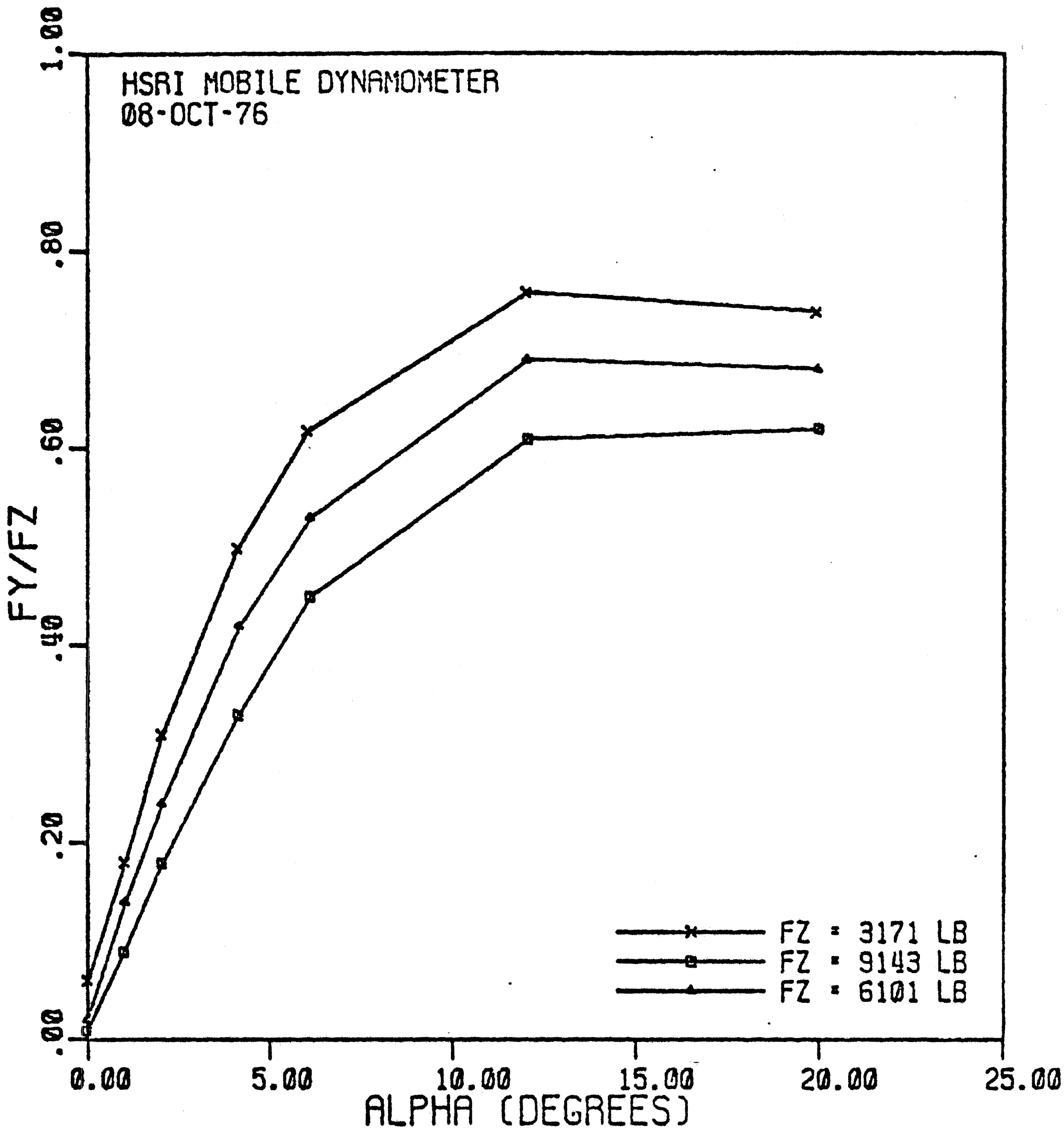


ONA/B-21-D-8/25 WET CONCRETE (DANA)
FZ = 6173 LB VEL = 20 MPH

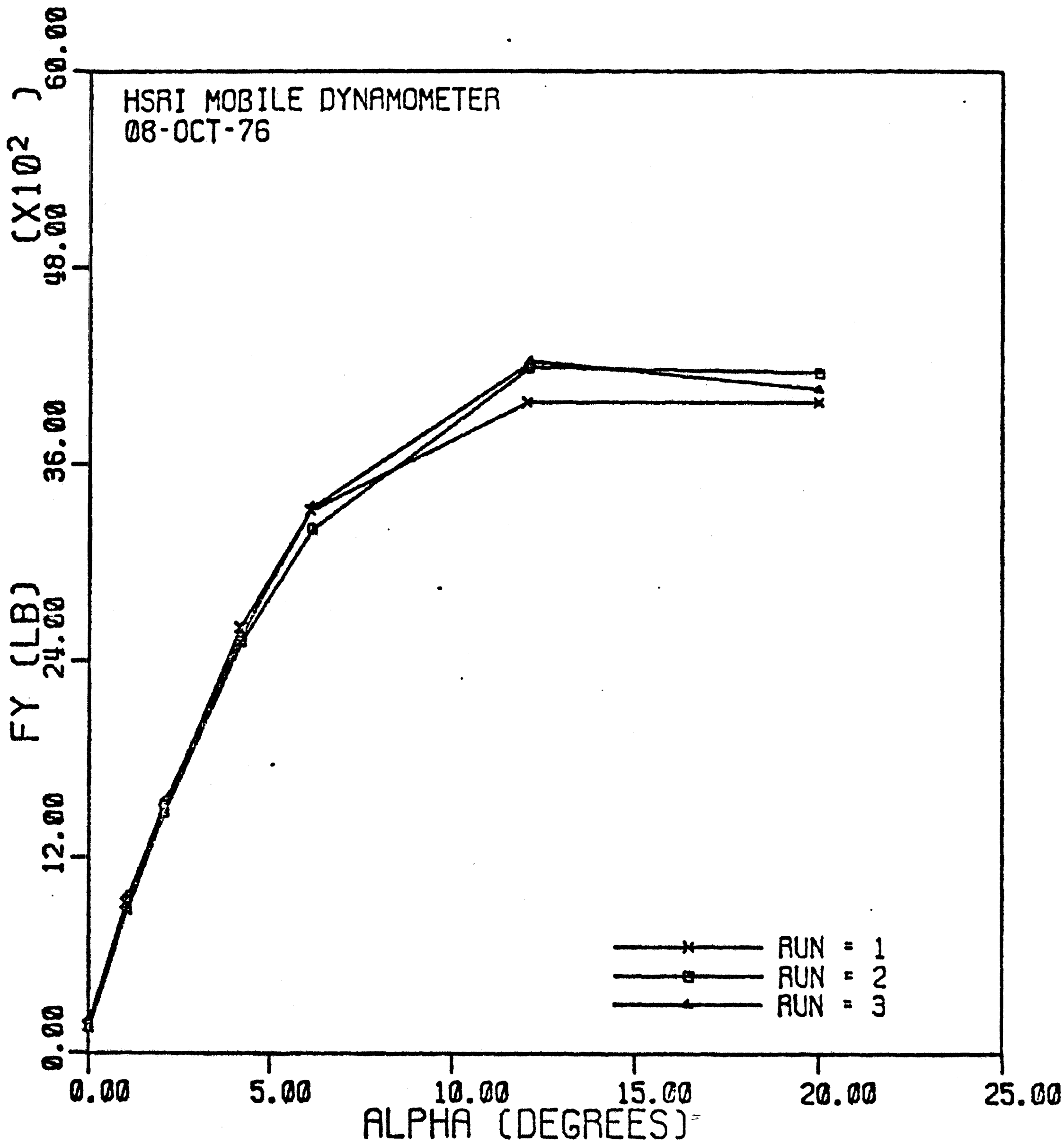
GOODYEAR ... STEEL ... -1



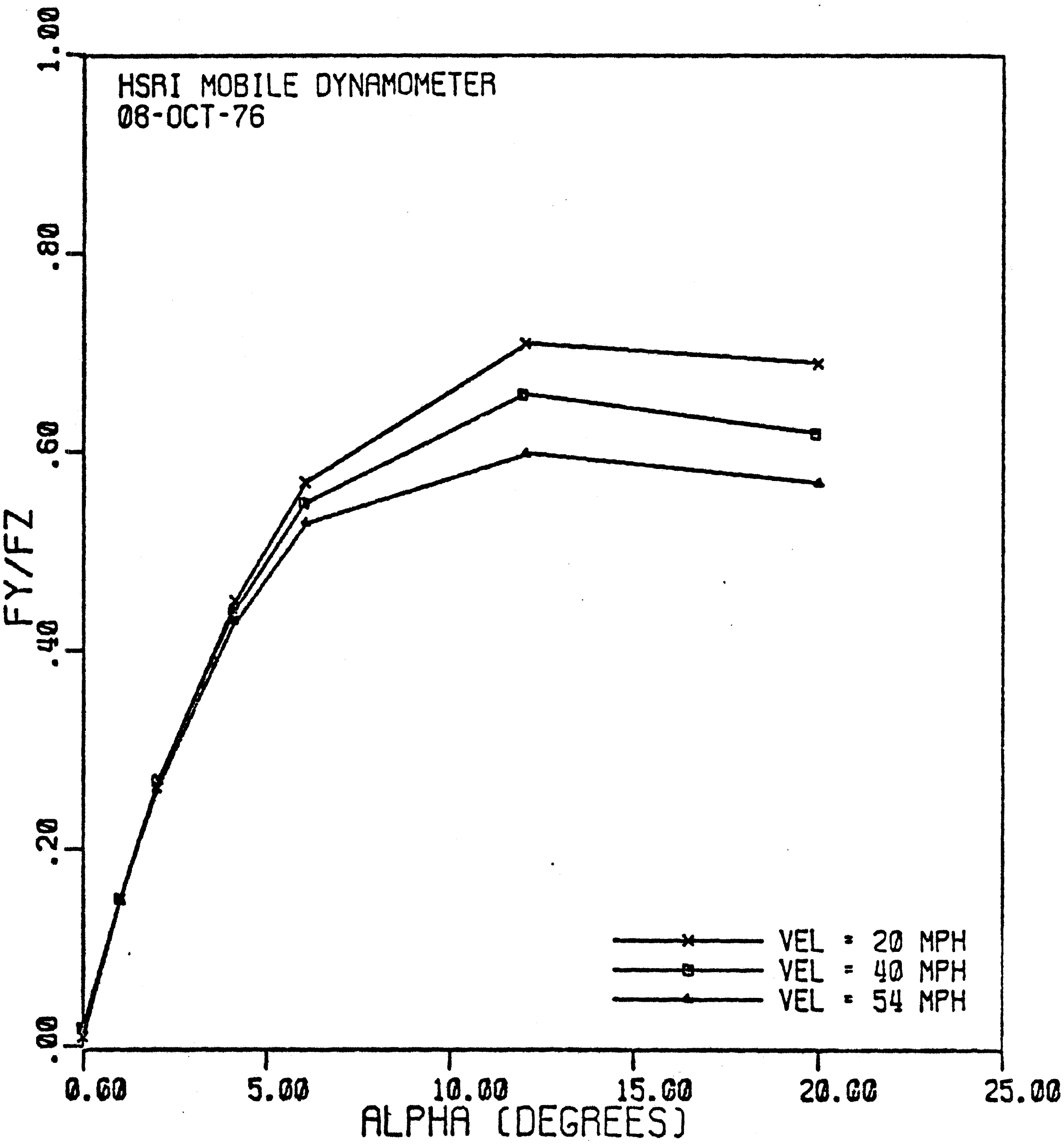
ONA/B-22-D-8/30 WET CONCRETE (DANA)
FZ = 6130 LB



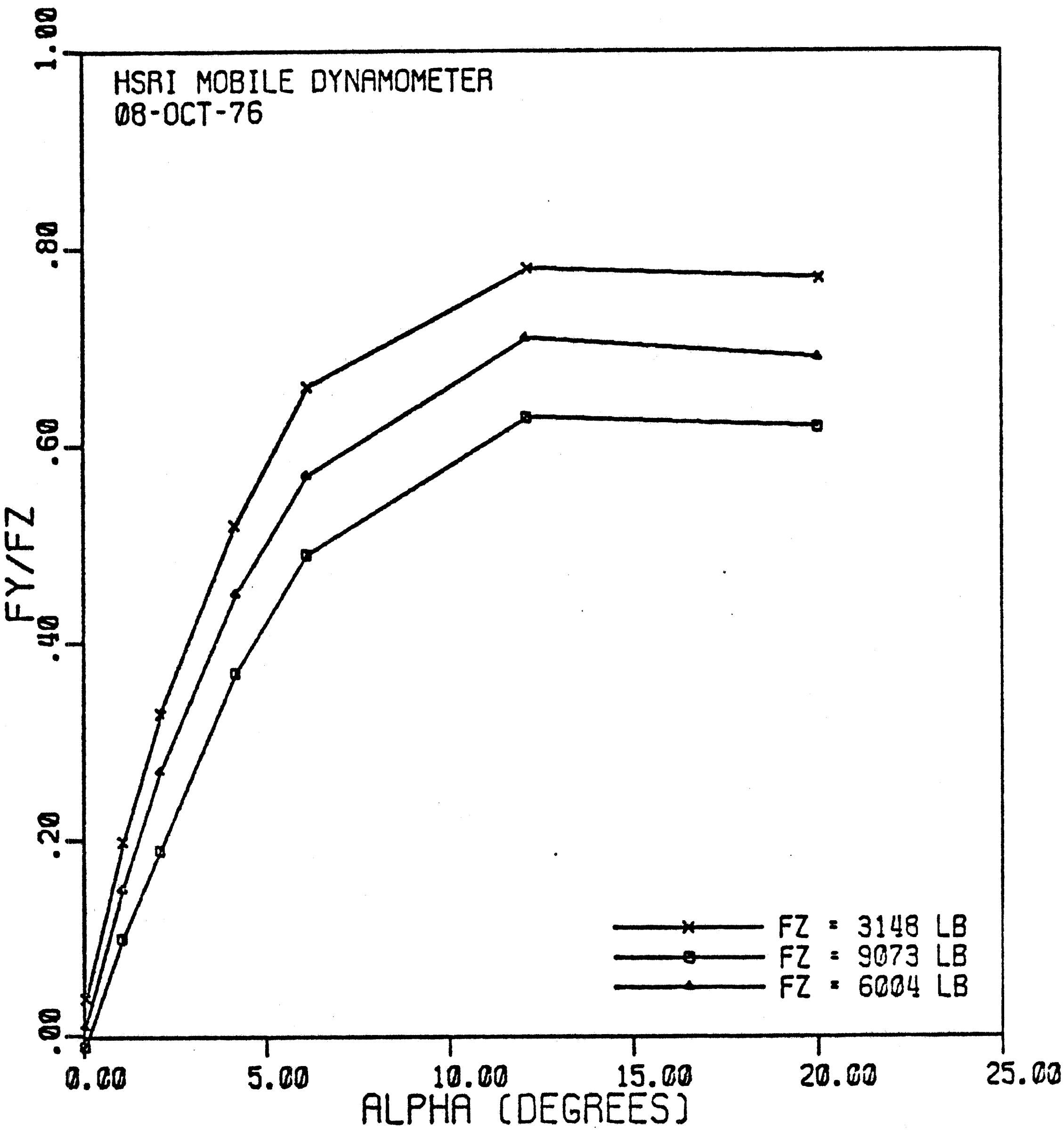
ONA/B-22-D-8/30 WET CONCRETE (DANA)
VEL = 20 MPH



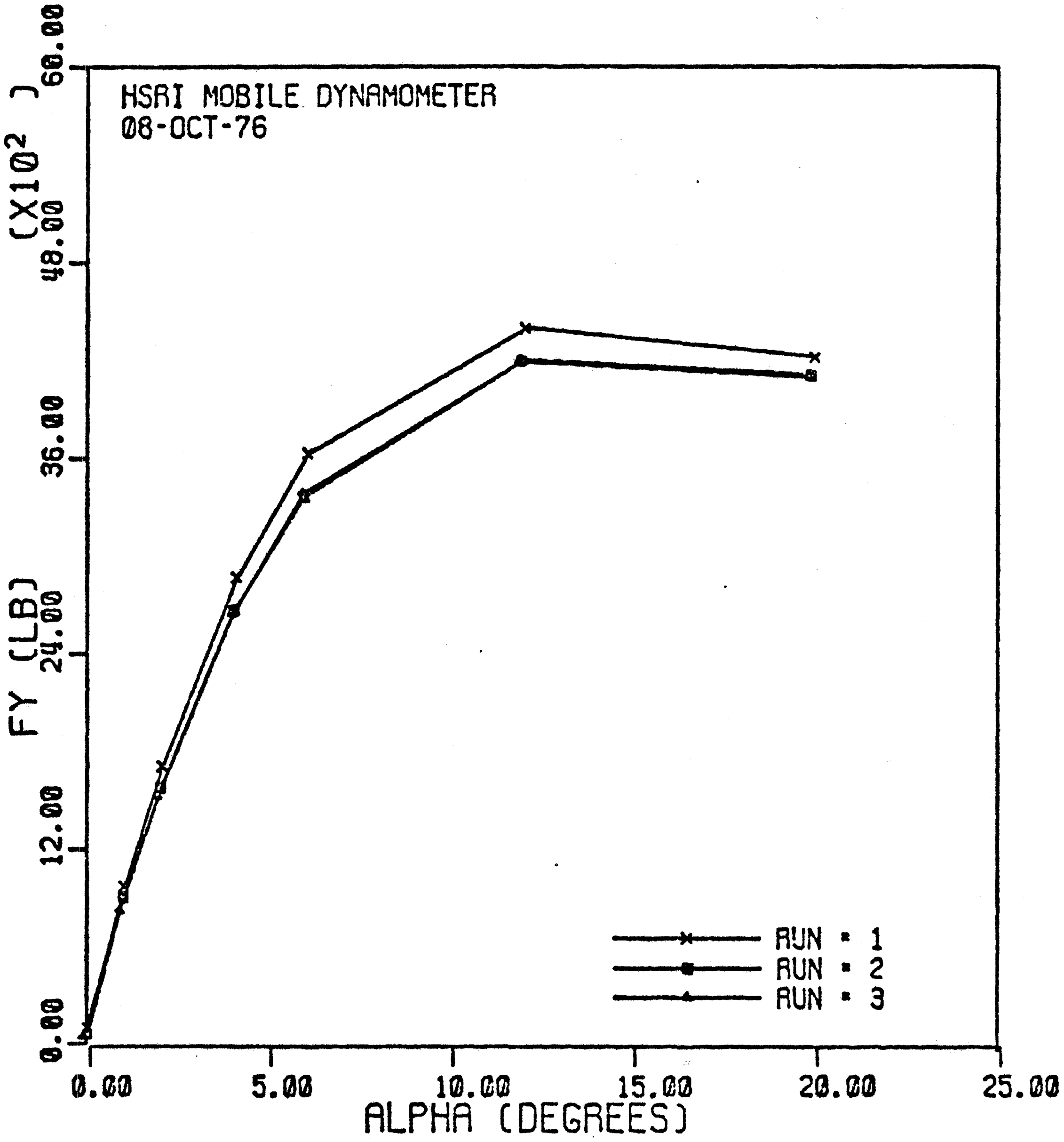
ONA/B-22-D-8/30 WET CONCRETE (DANA)
FZ = 6053 LB VEL = 20 MPH



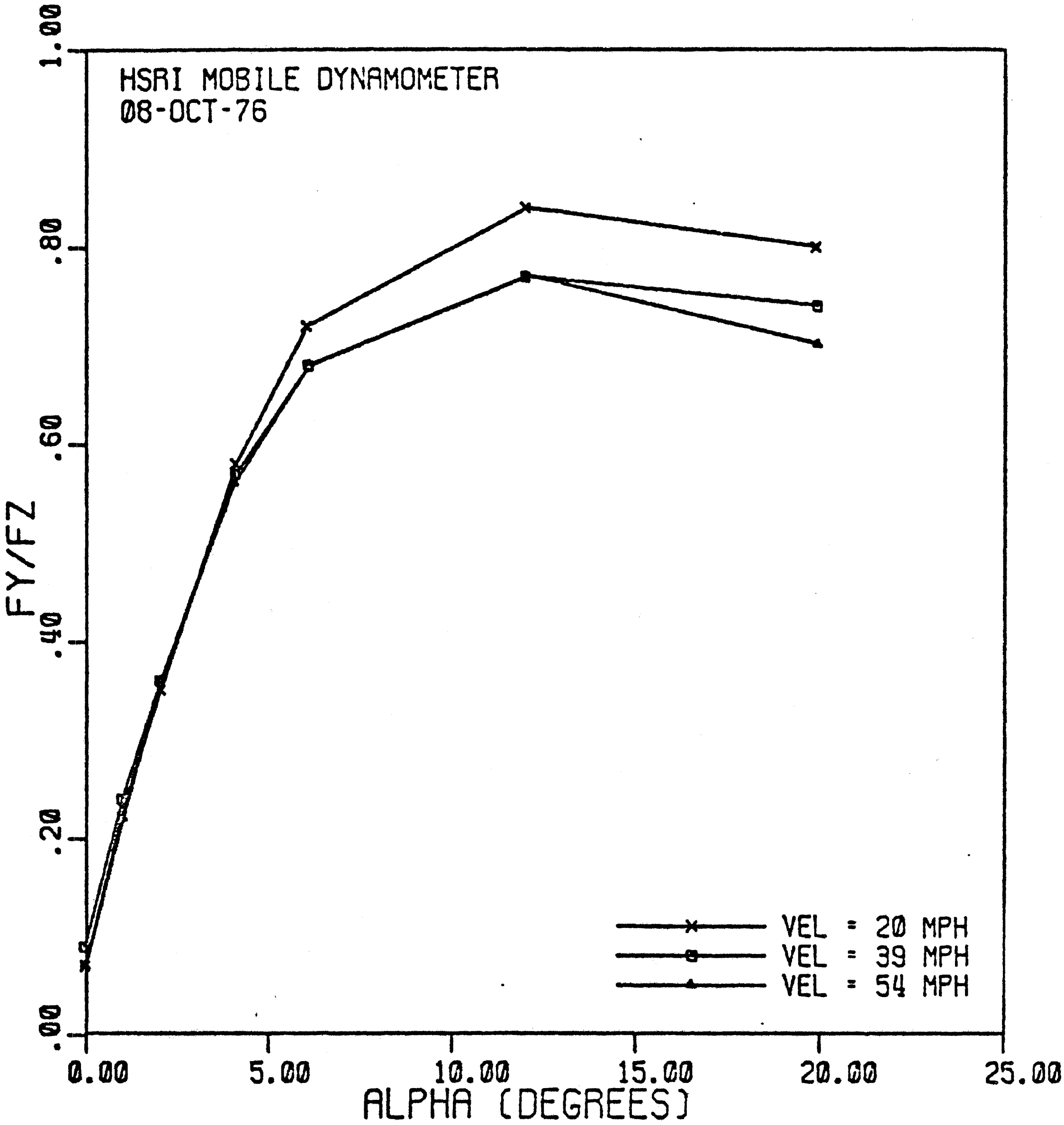
ONA/B-23-D-8/30 WET CONCRETE (DANA)
FZ = 6022 LB



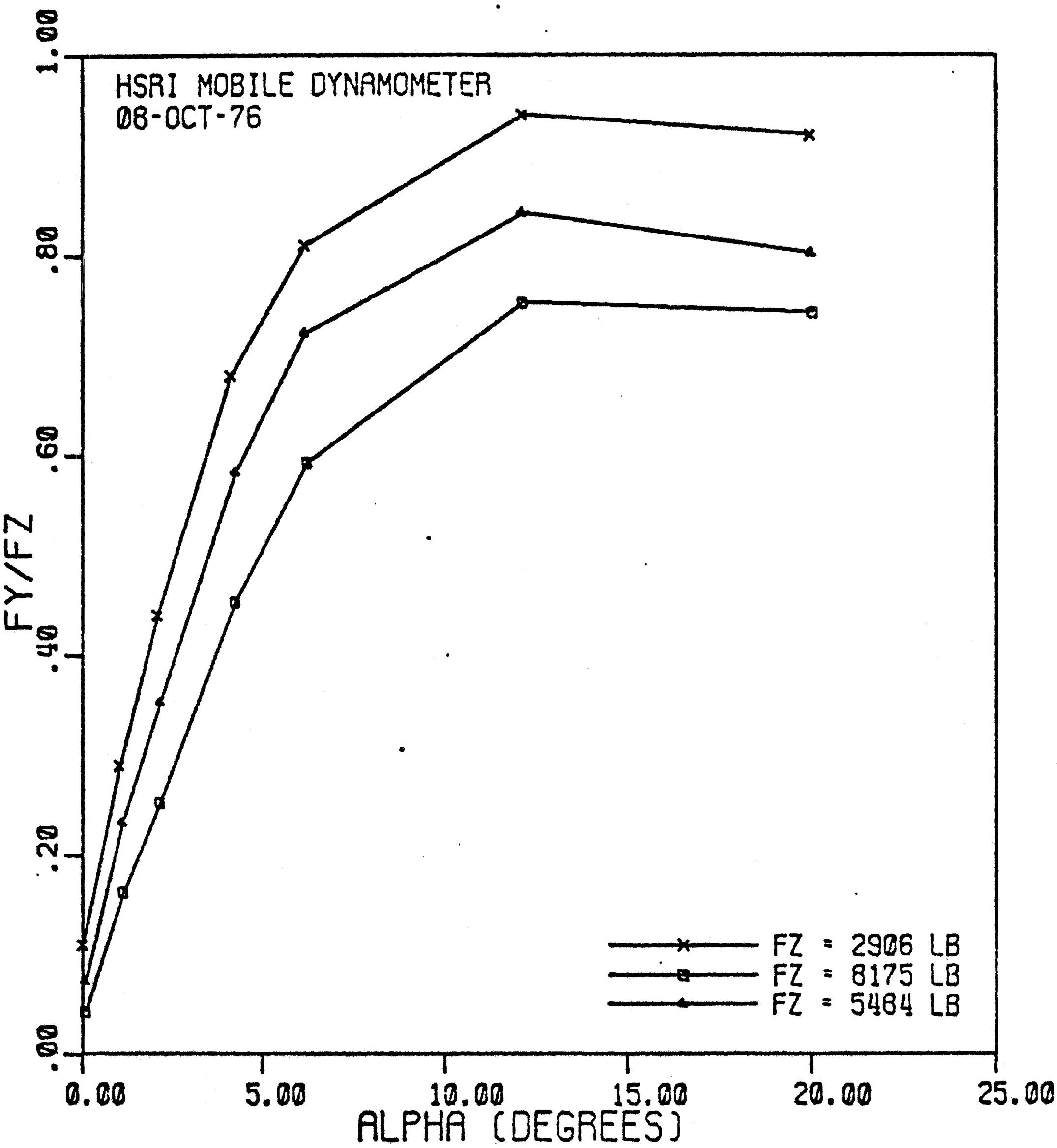
ONA/B-23-D-8/30 WET CONCRETE (DANA)
VEL = 13 MPH



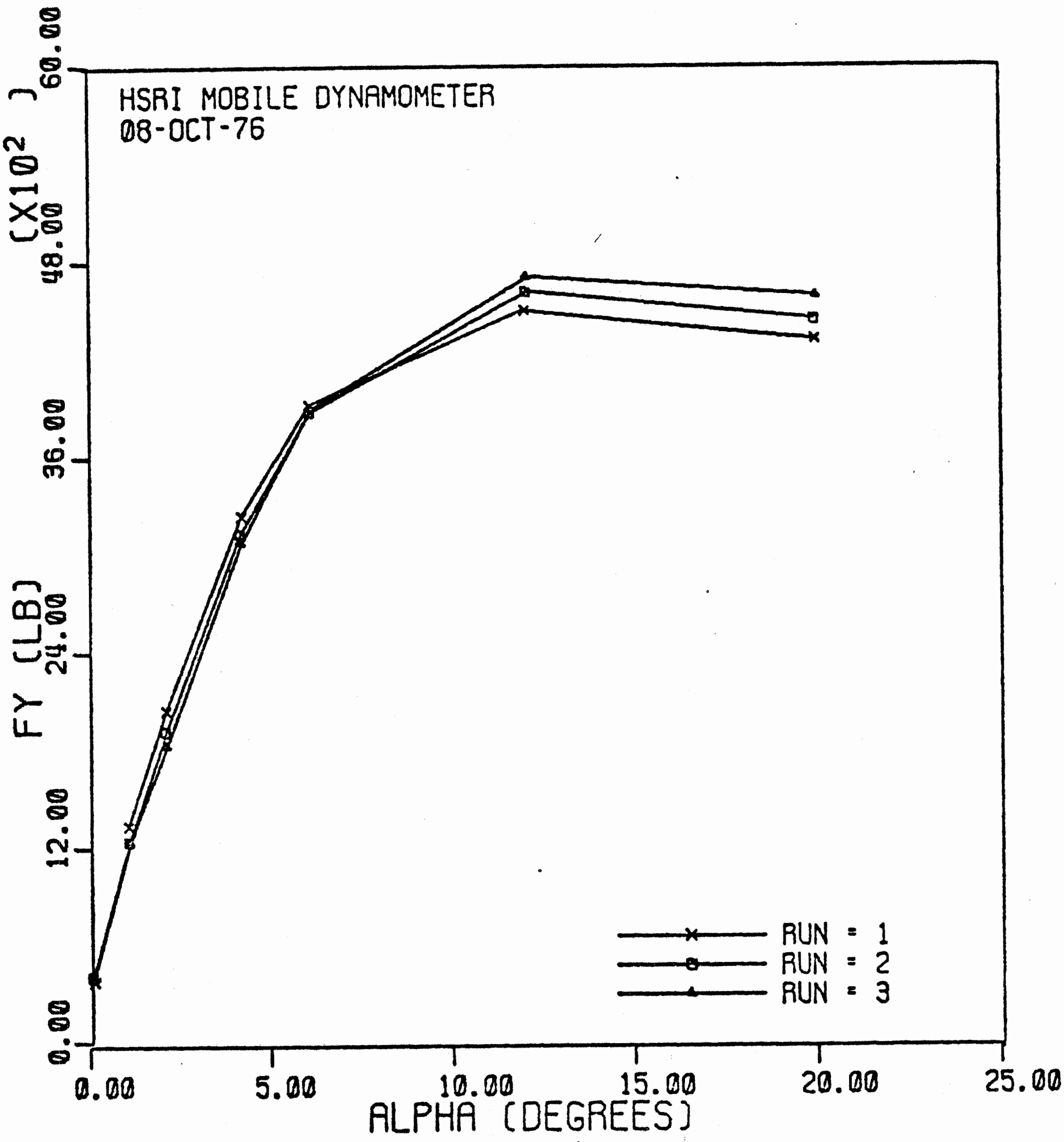
ONA/B-23-D-8/30 WET CONCRETE (DANA)
FZ = 6006 LB VEL = 13 MPH



ONA/B-24-D-8/30 WET CONCRETE (DANA)
FZ = 5515 LB



ONA/B-24-D-8/30 WET CONCRETE (DANA)
VEL = 20 MPH



ONA/B-24-D-8/30 WET CONCRETE (DANA)
FZ = 5494 LB VEL = 19 MPH

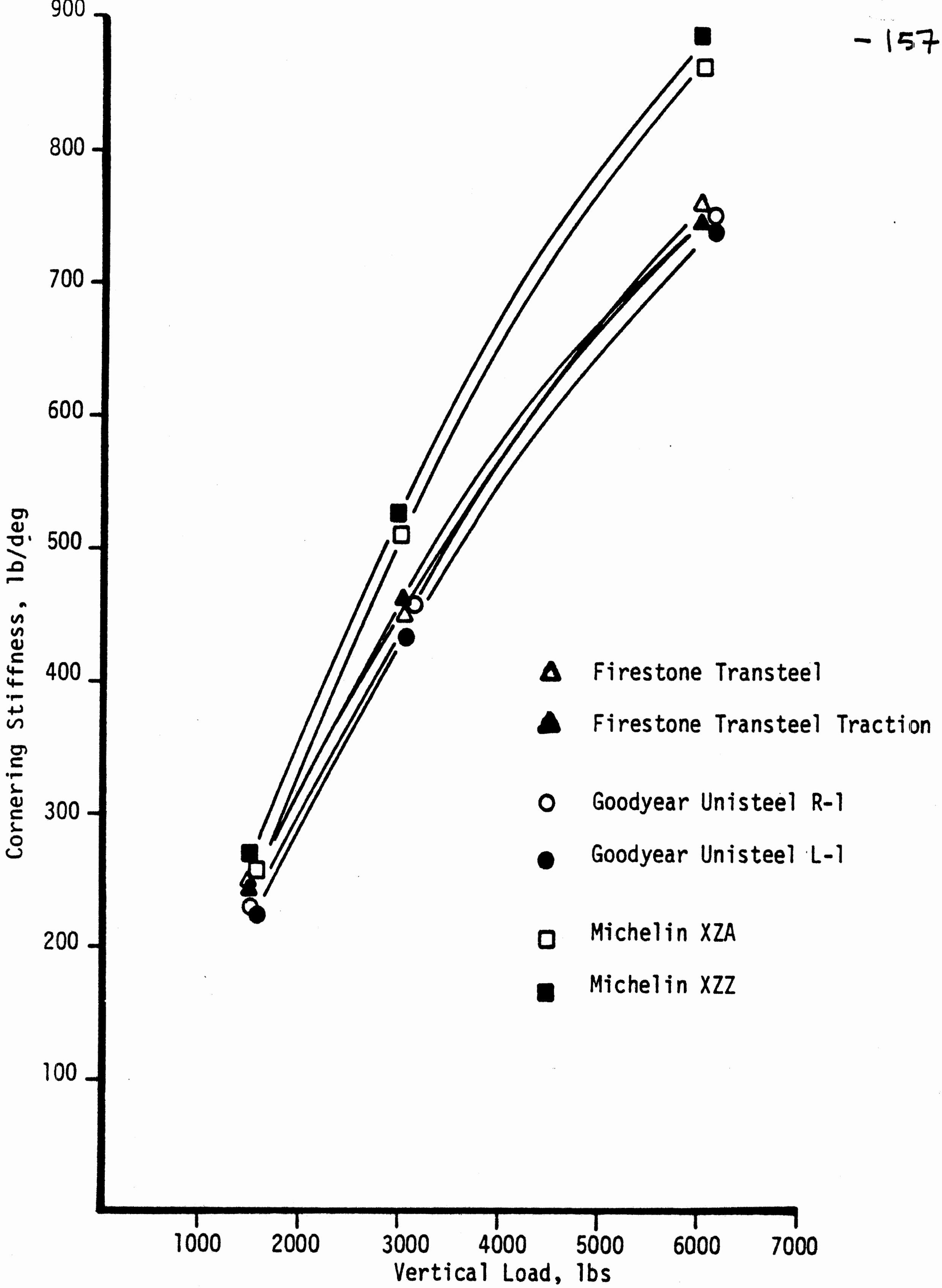


Figure 9. Cornering stiffness, C_α, as influenced by vertical load, F_z, for the radial ply tires.

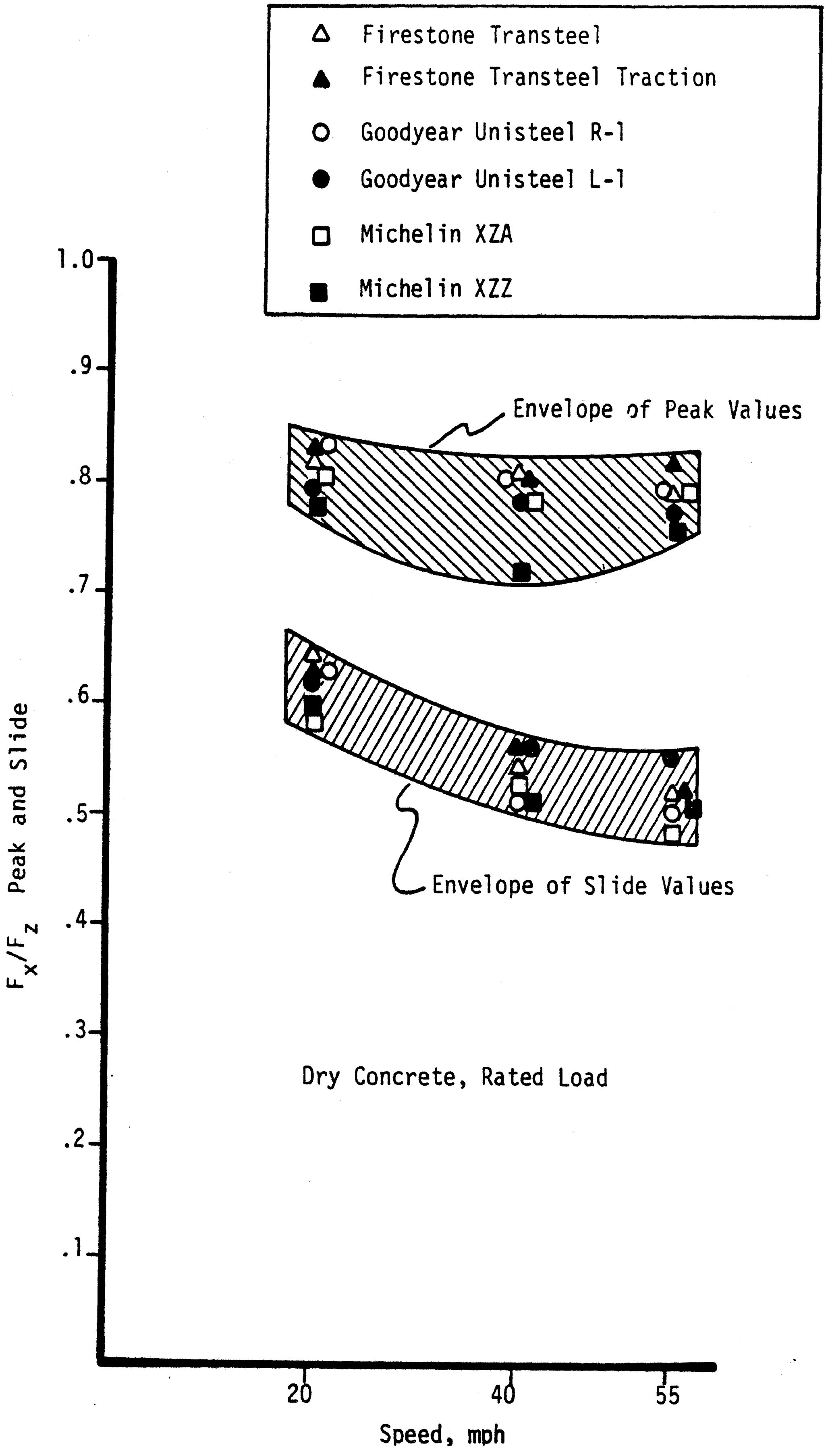


Figure 13. Peak and slide values versus speed for radial tires at rated load on dry concrete.

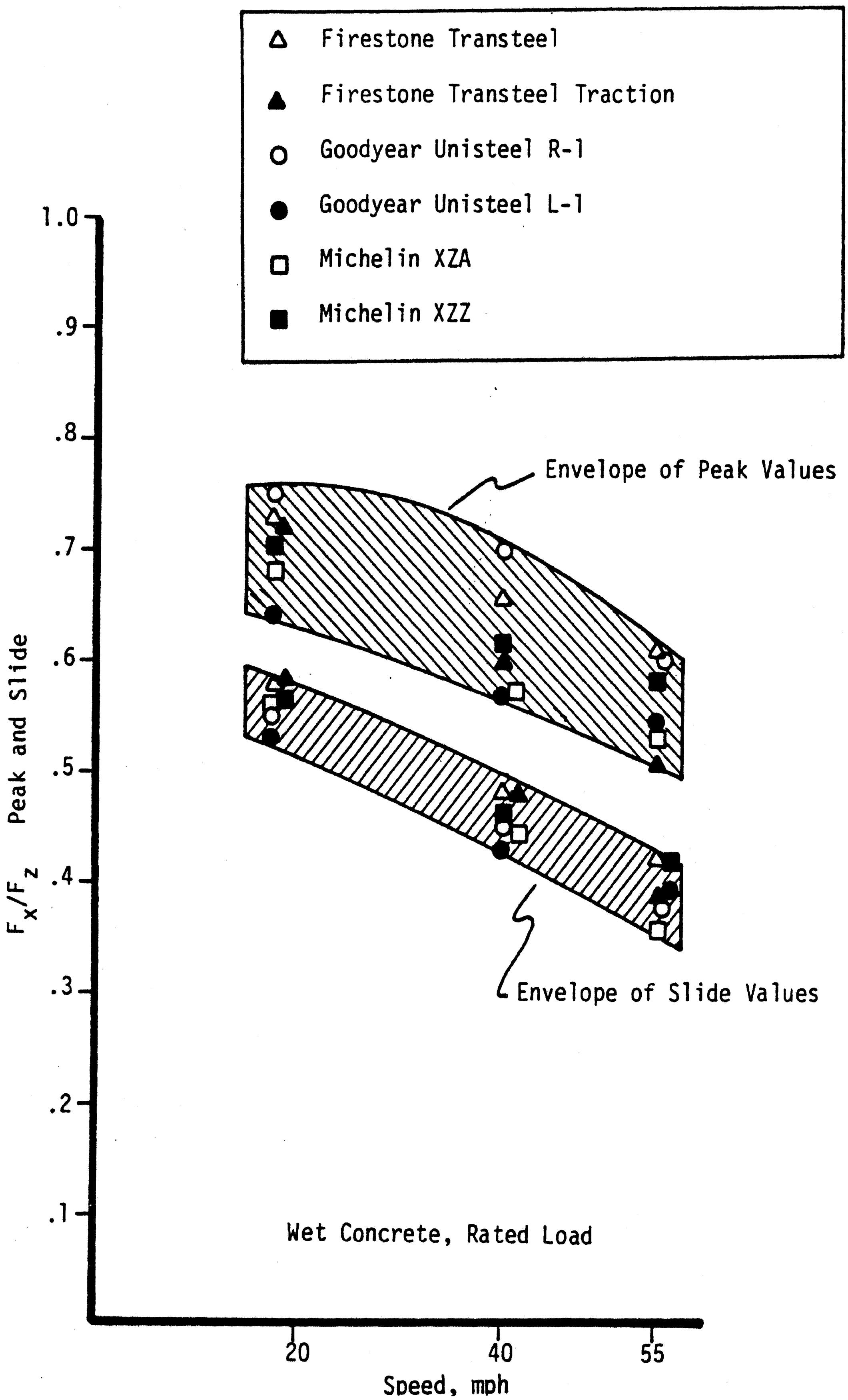


Figure 15. Peak and slide values versus speed for radial tires at rated load on wet concrete.

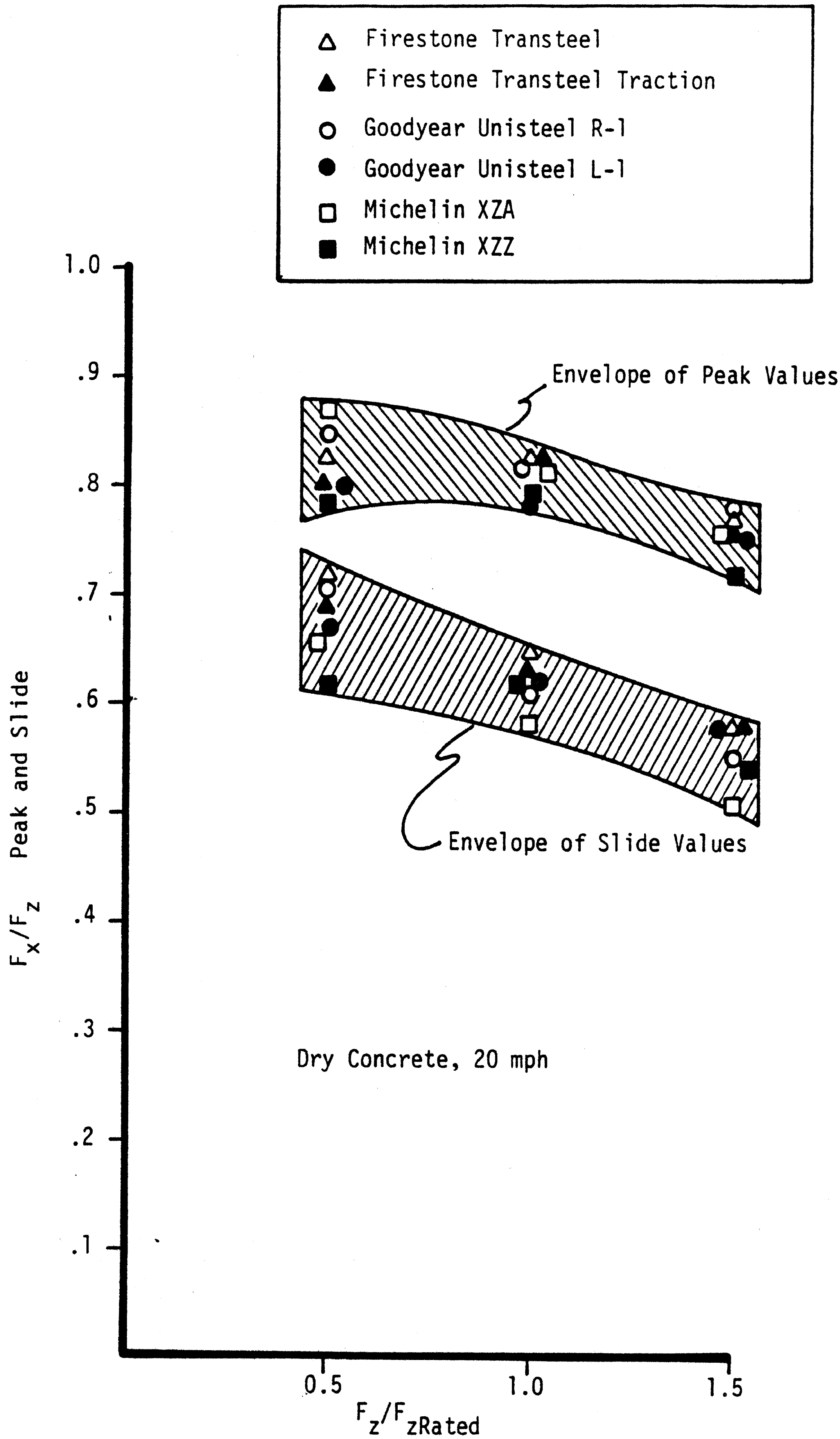


Figure 17. Peak and slide values versus load for radial tires at 20 mph on dry concrete.

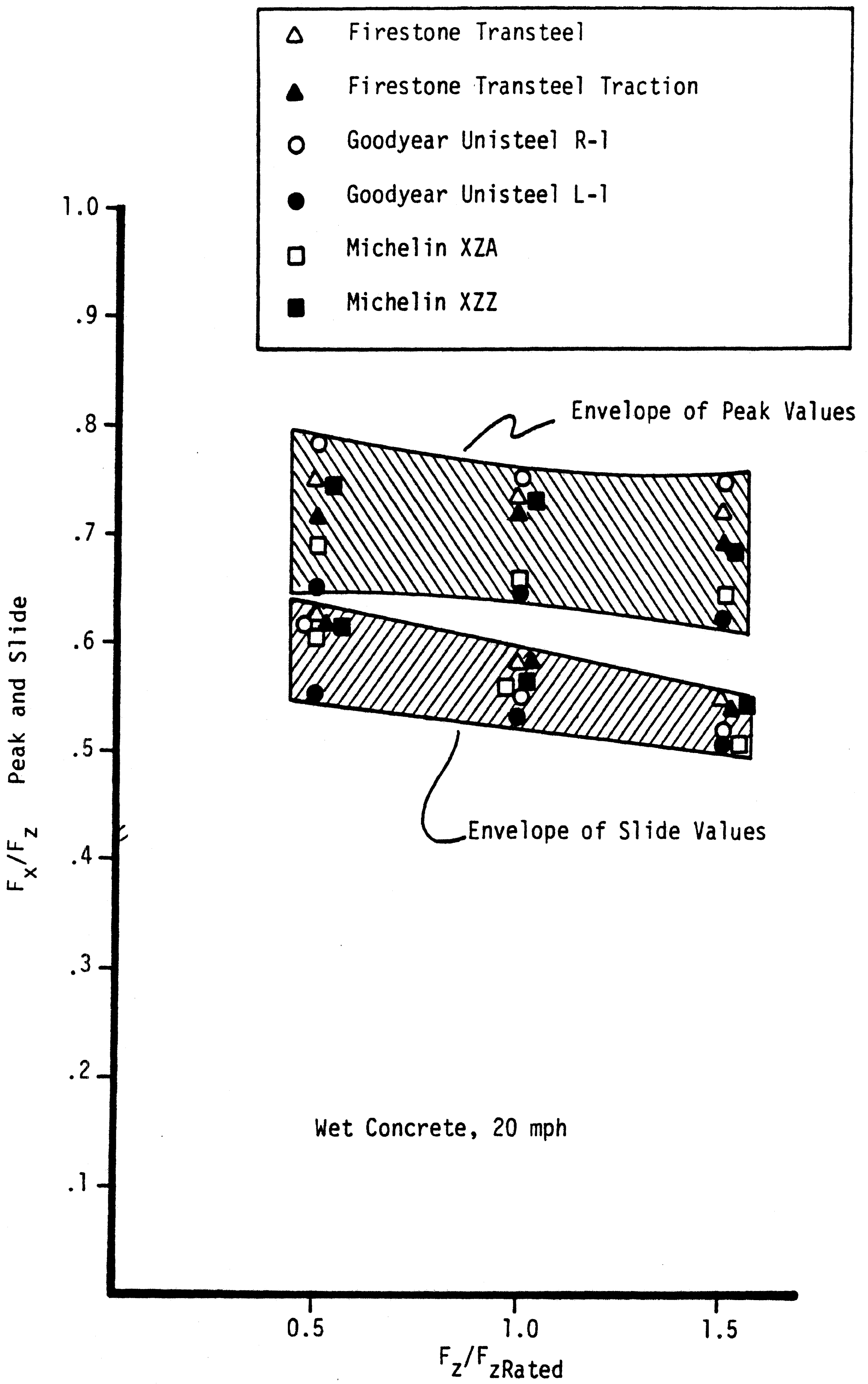


Figure 19. Peak and slide values versus load for radial tires at 20 mph on wet concrete.

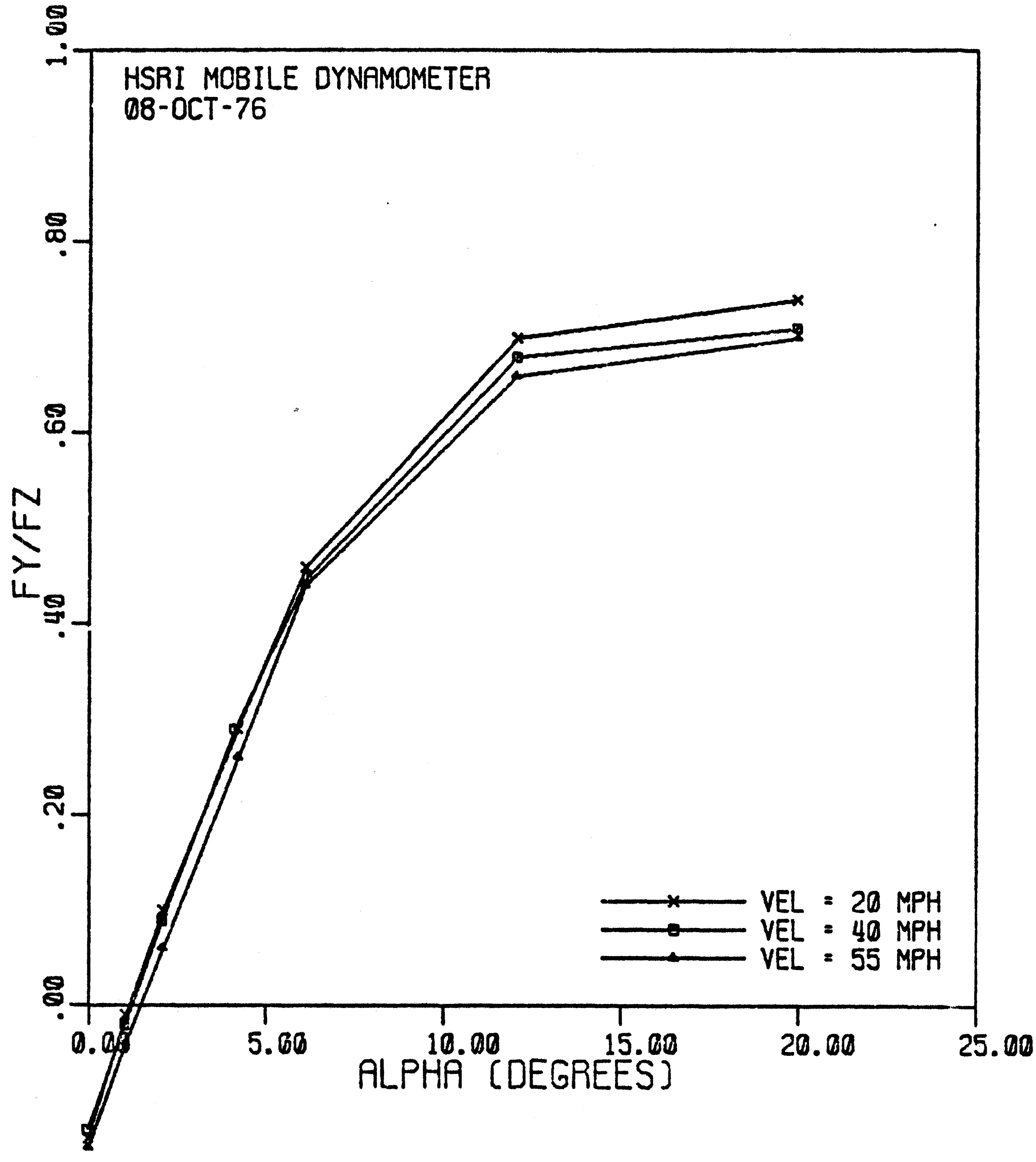


Figure C-37. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a dry Portland cement concrete surface. Tire load was 6304 pounds.

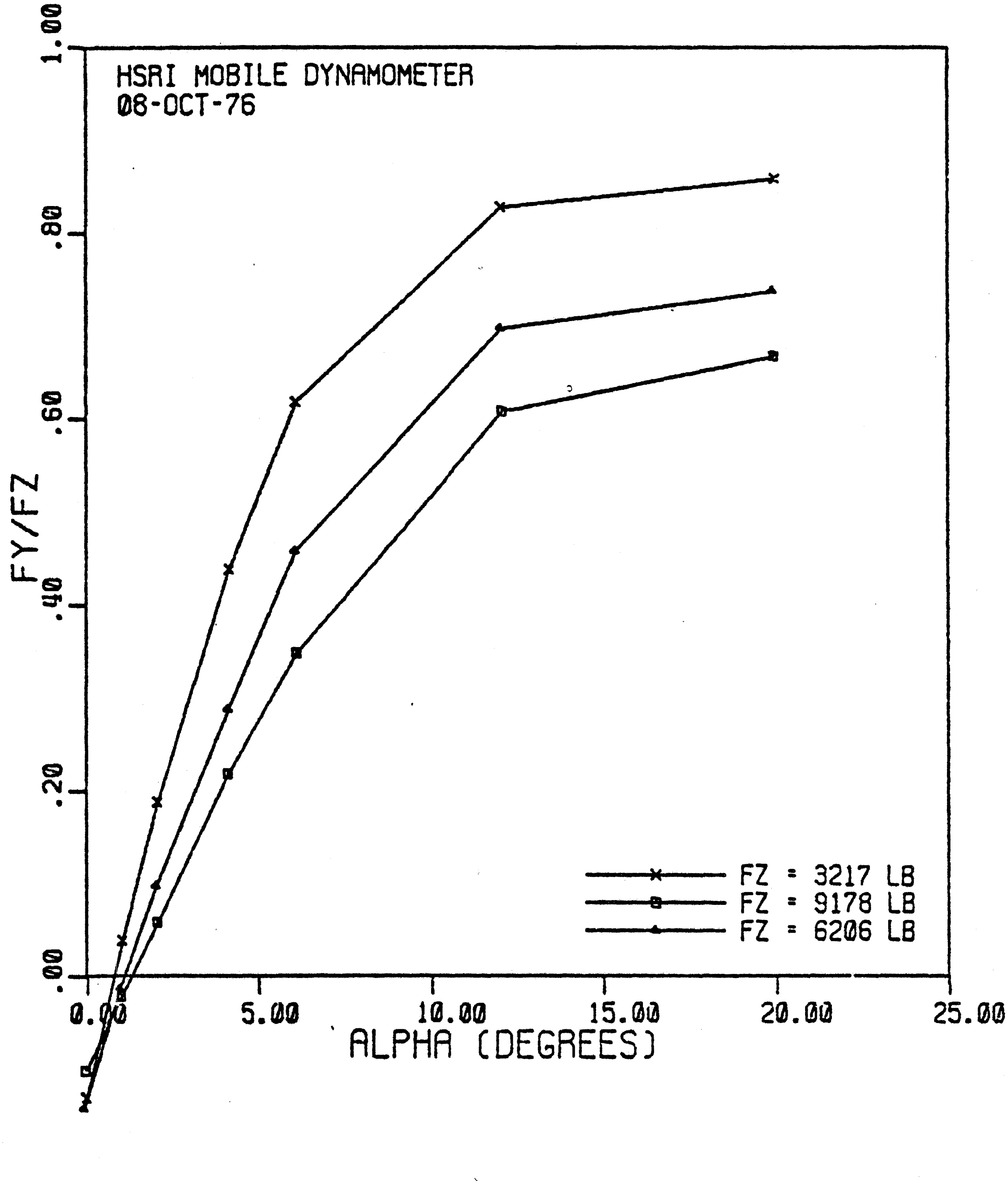


Figure C-38. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

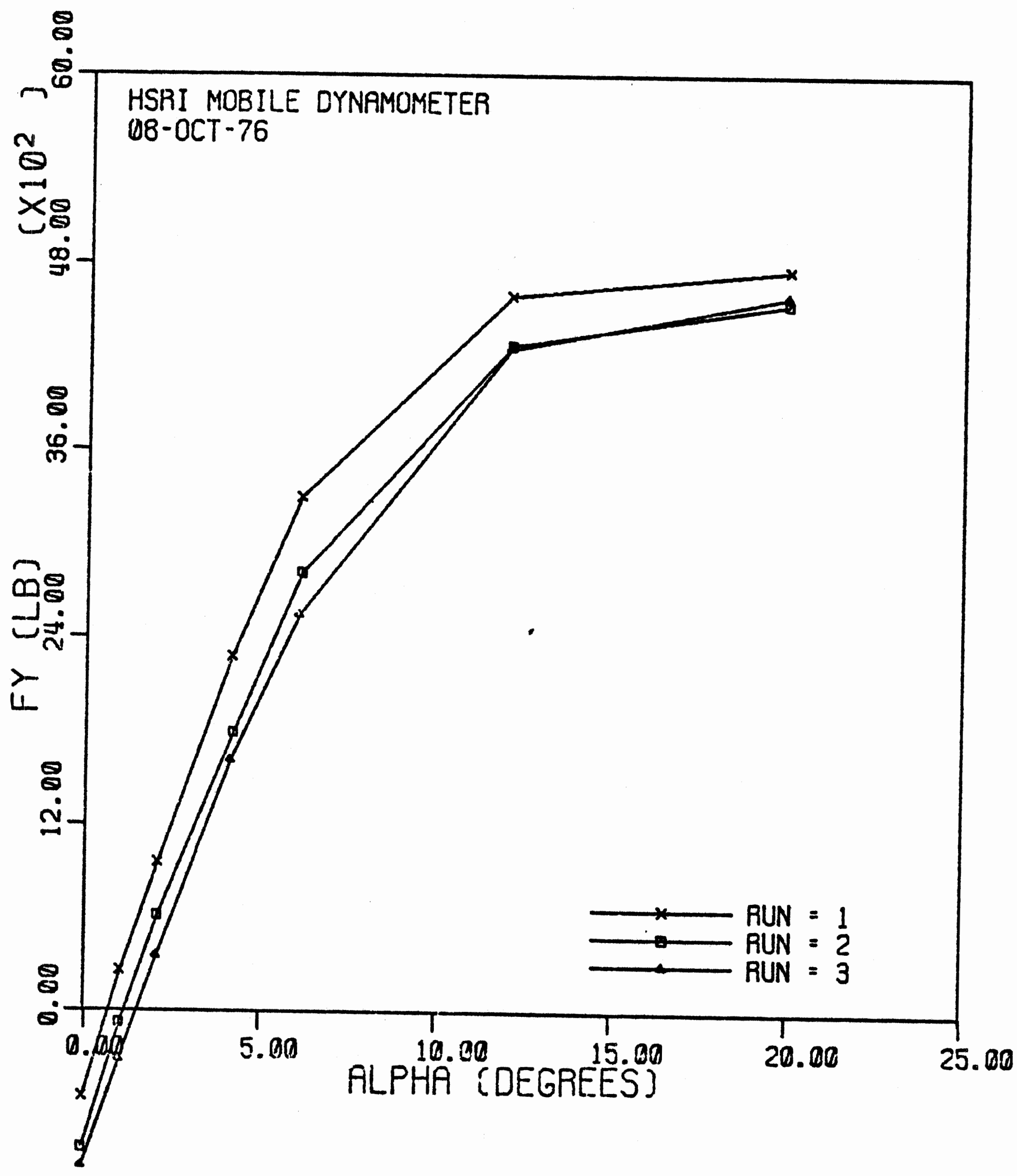


Figure C-39. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a dry Portland cement concrete surface.

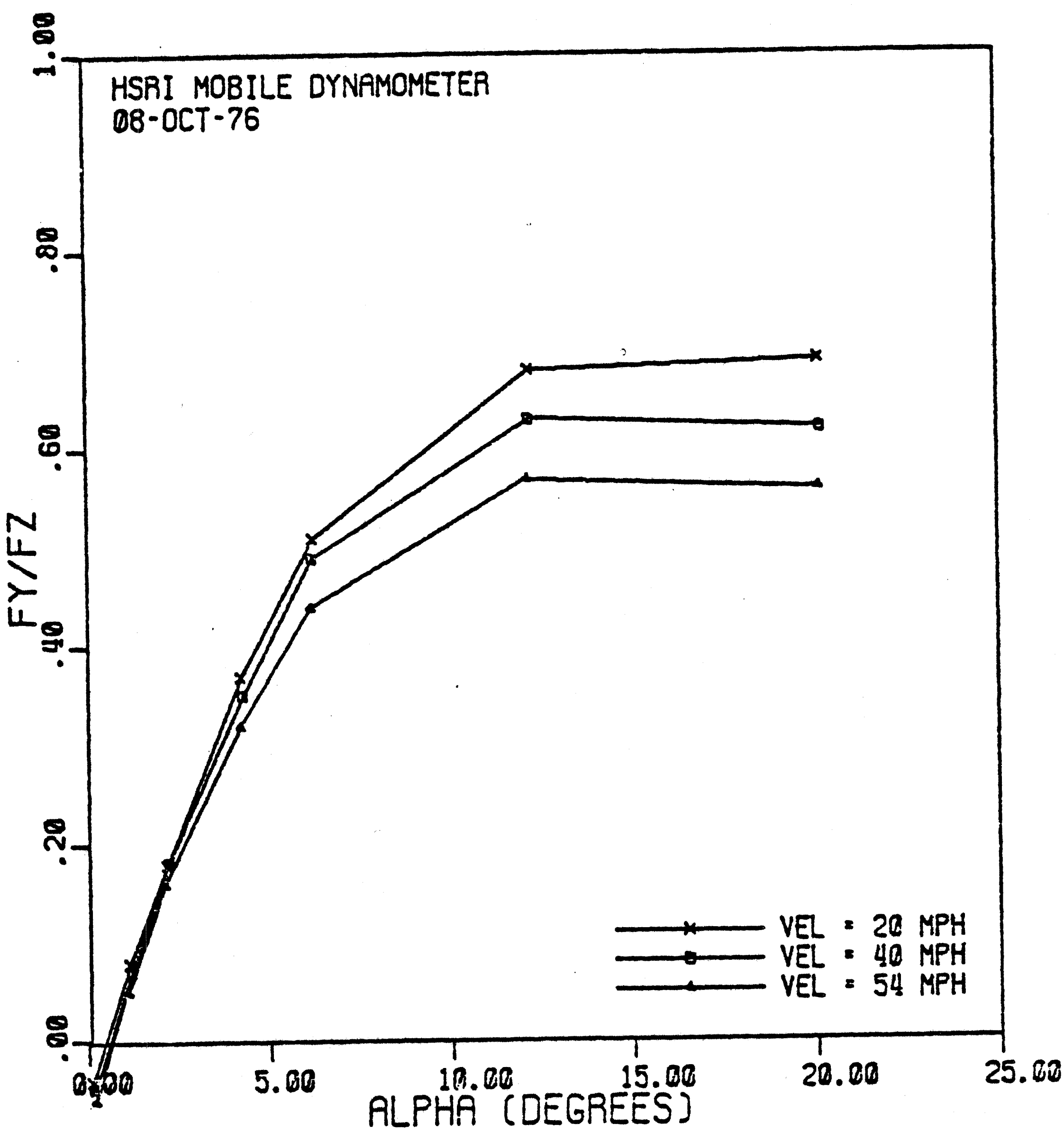


Figure C-40. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a wet Portland cement concrete surface. Tire load was 6171 pounds.

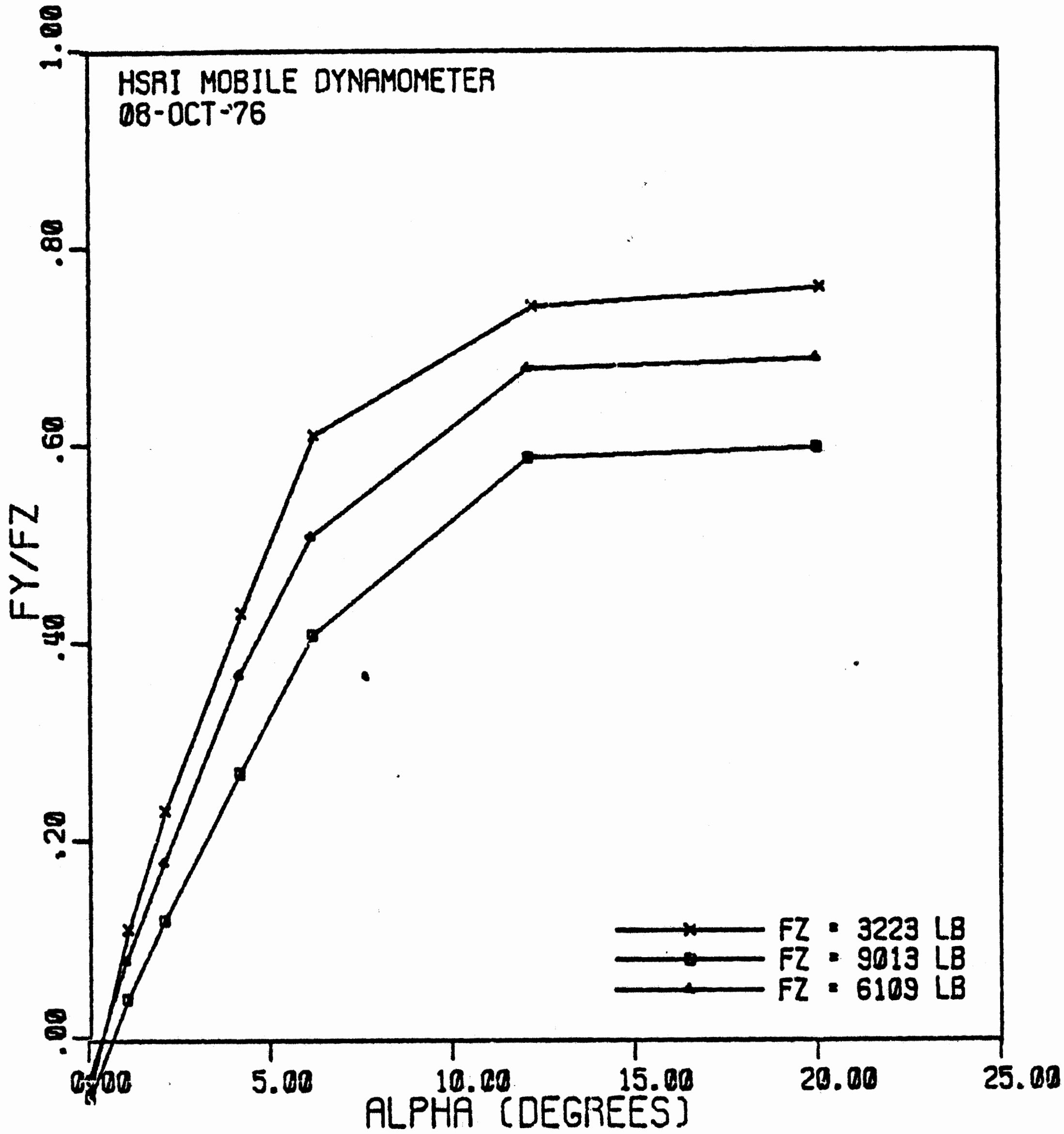


Figure C-41. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

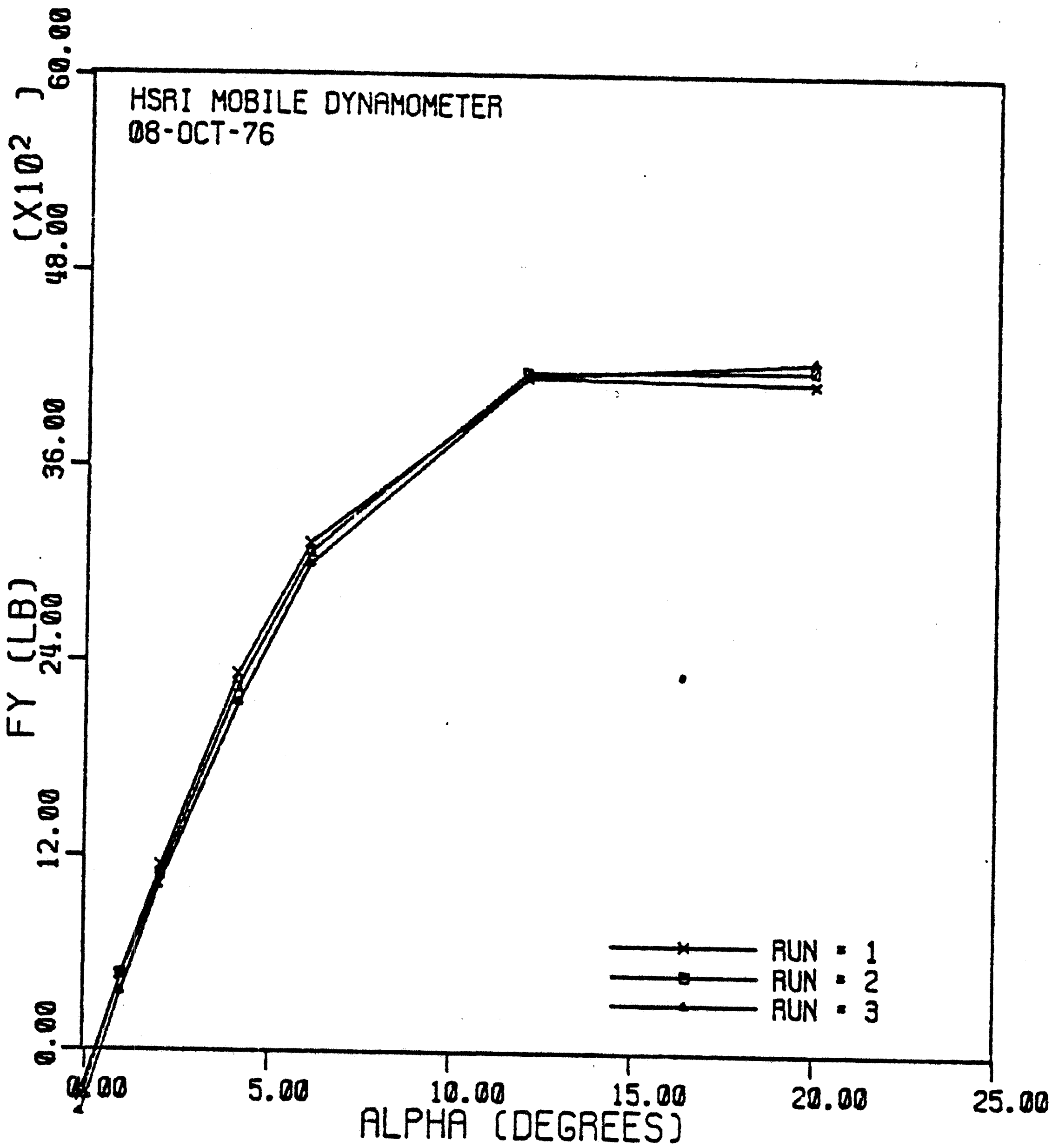


Figure C-42. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Firestone Transteel Traction tires were tested on a wet Portland cement concrete surface.

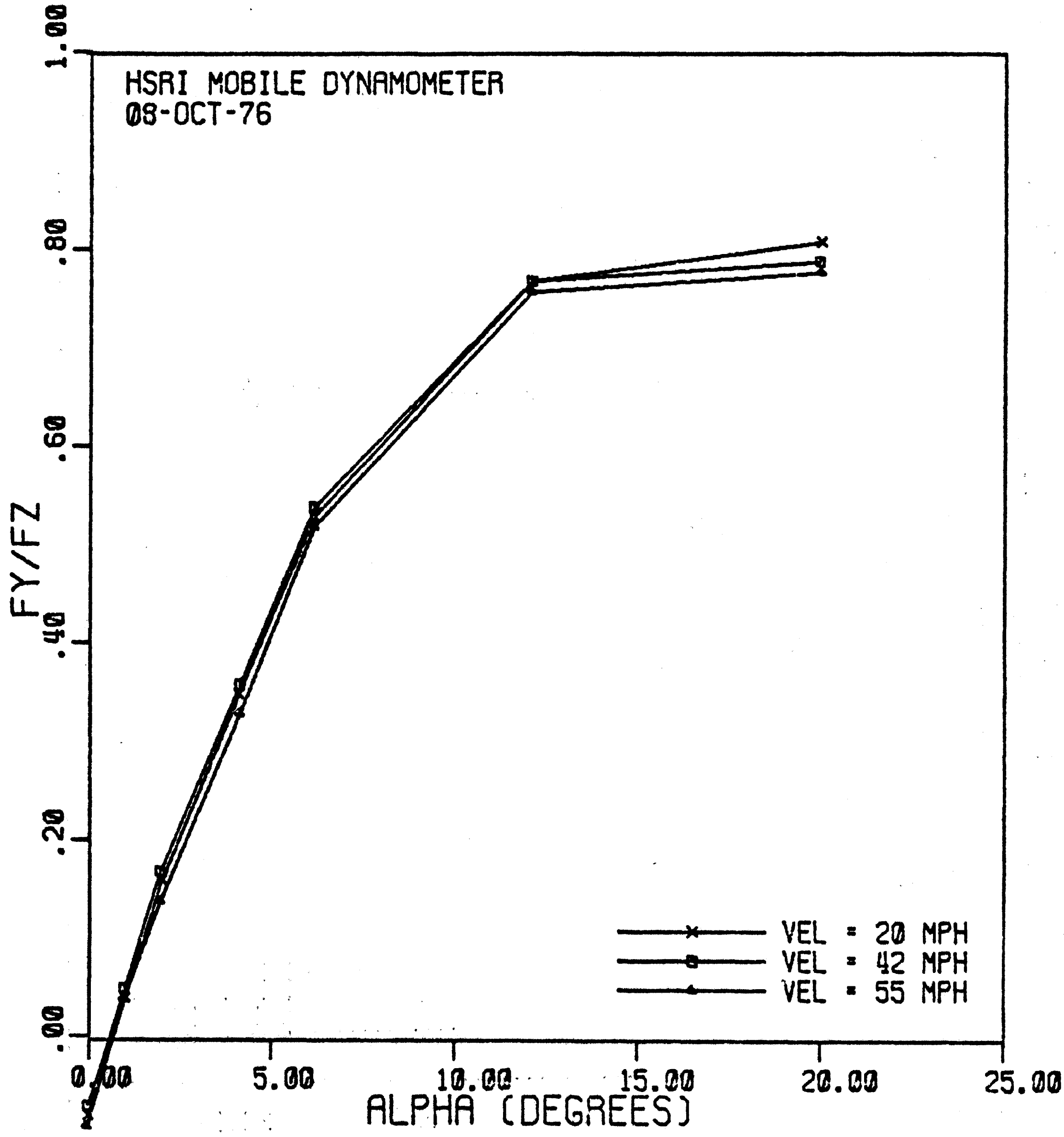


Figure C-43. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a dry Portland cement concrete surface. Tire load was 6019 pounds.

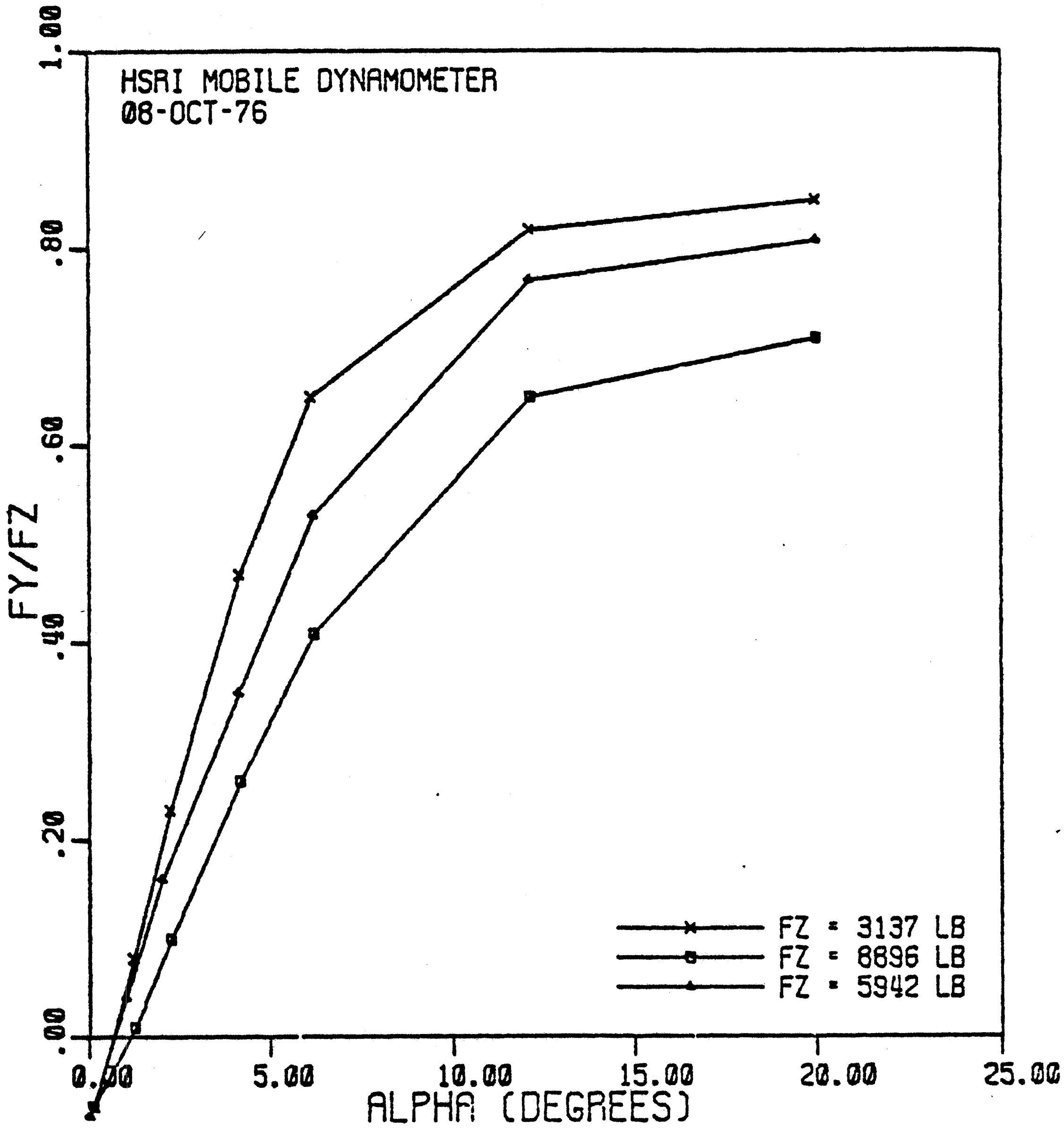


Figure C-44. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

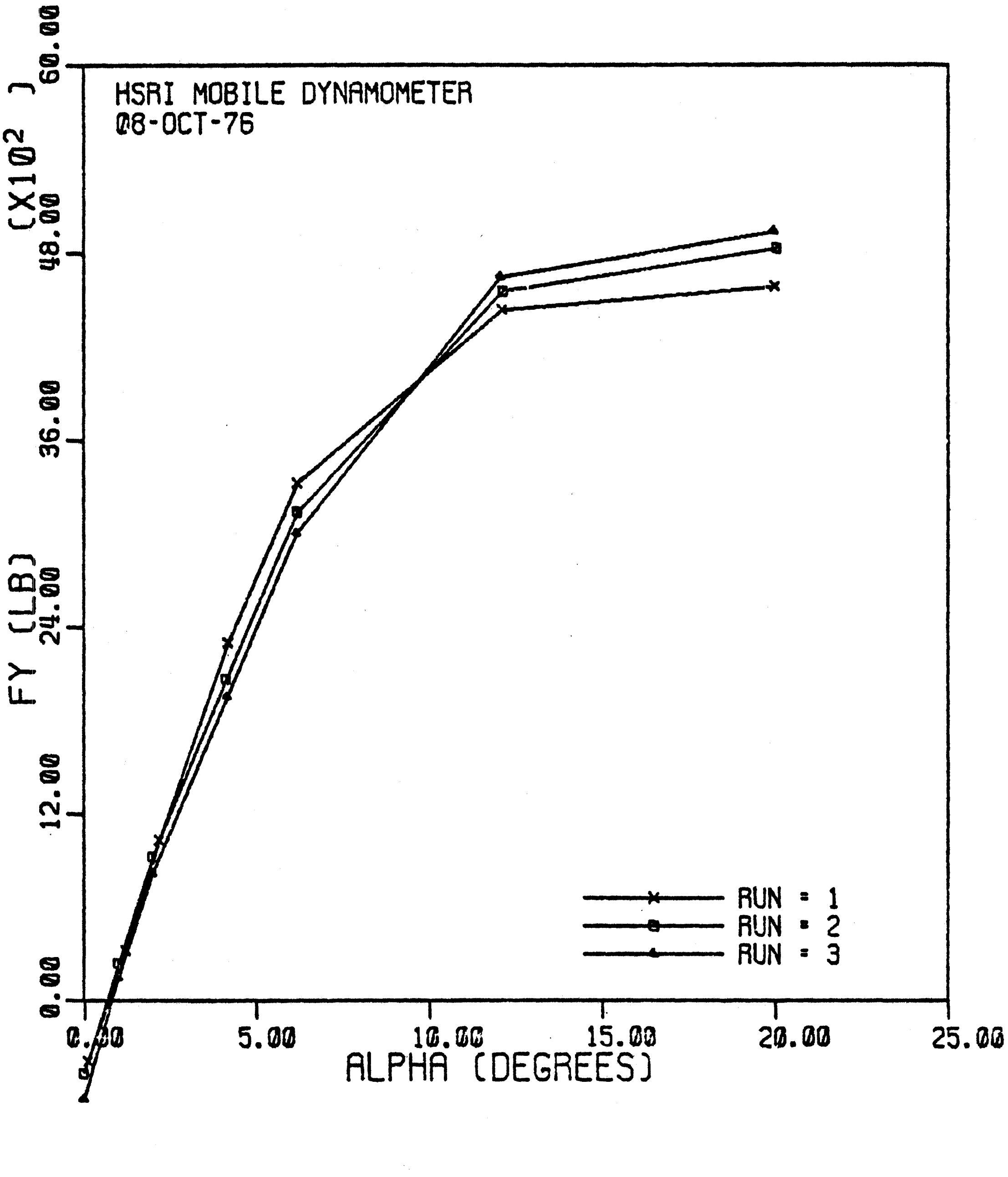


Figure C-45. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a dry Portland cement concrete surface.

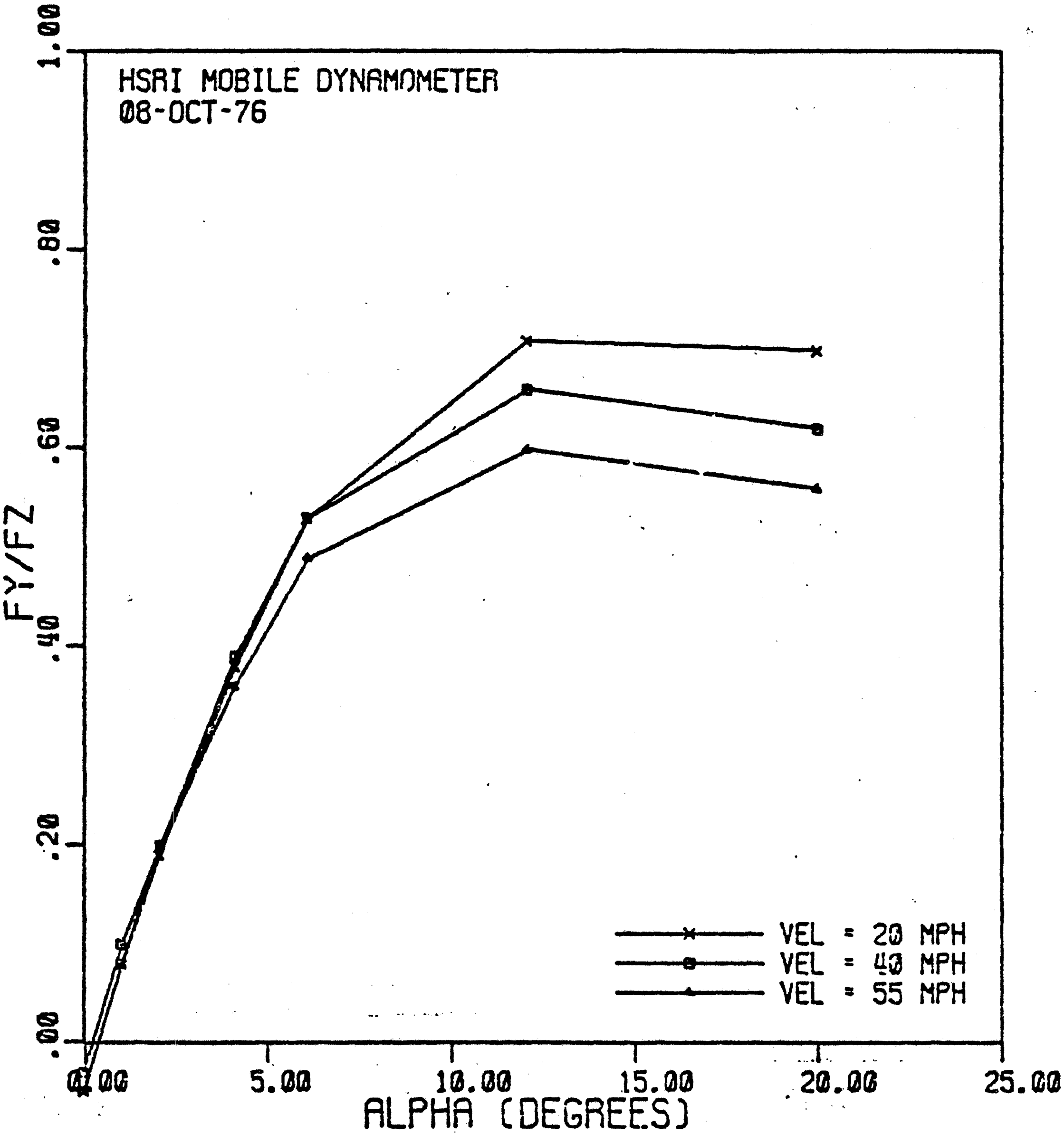


Figure C-46. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a wet Portland cement concrete surface. Tire load was 6003 pounds.

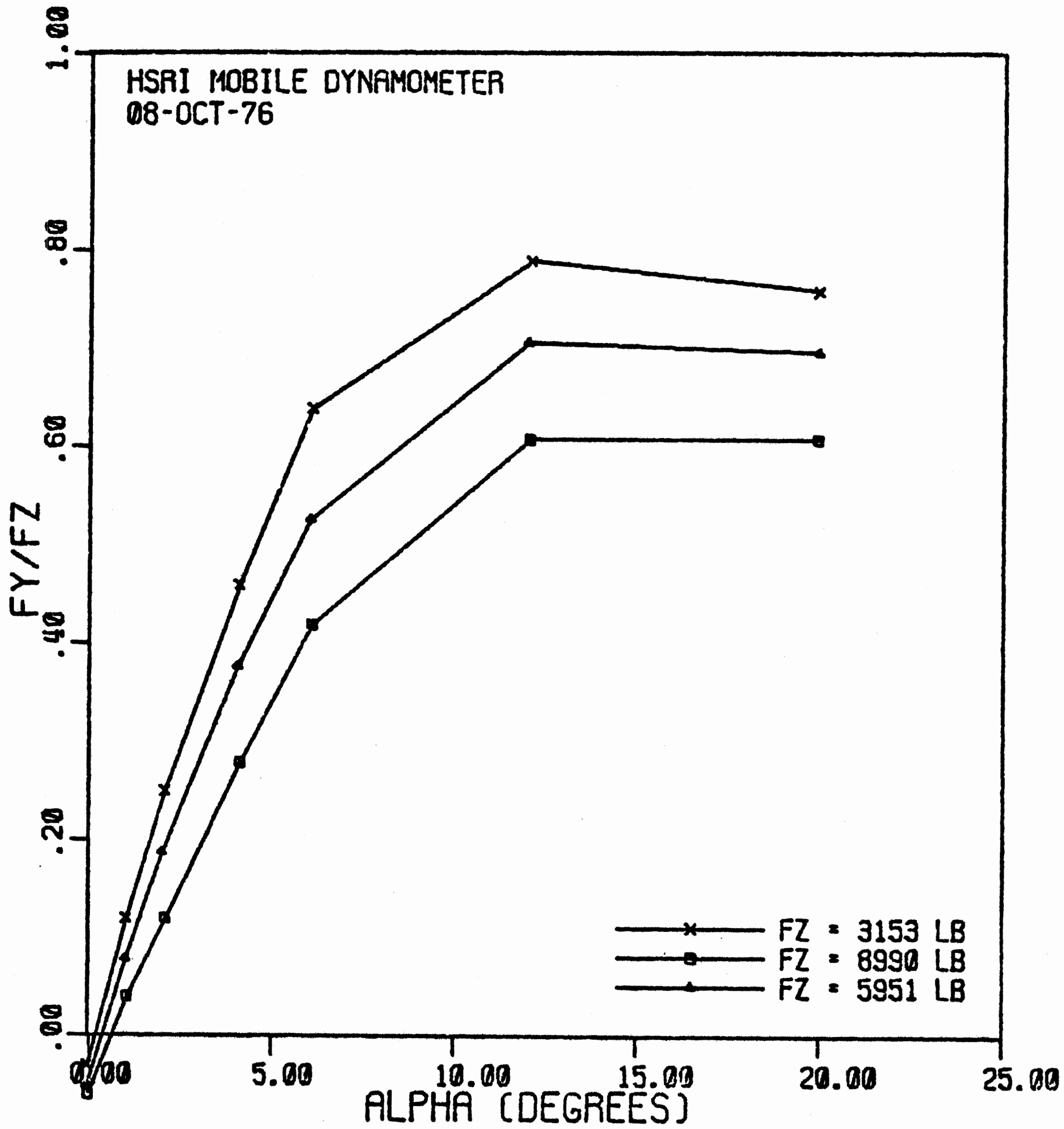


Figure C-47. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

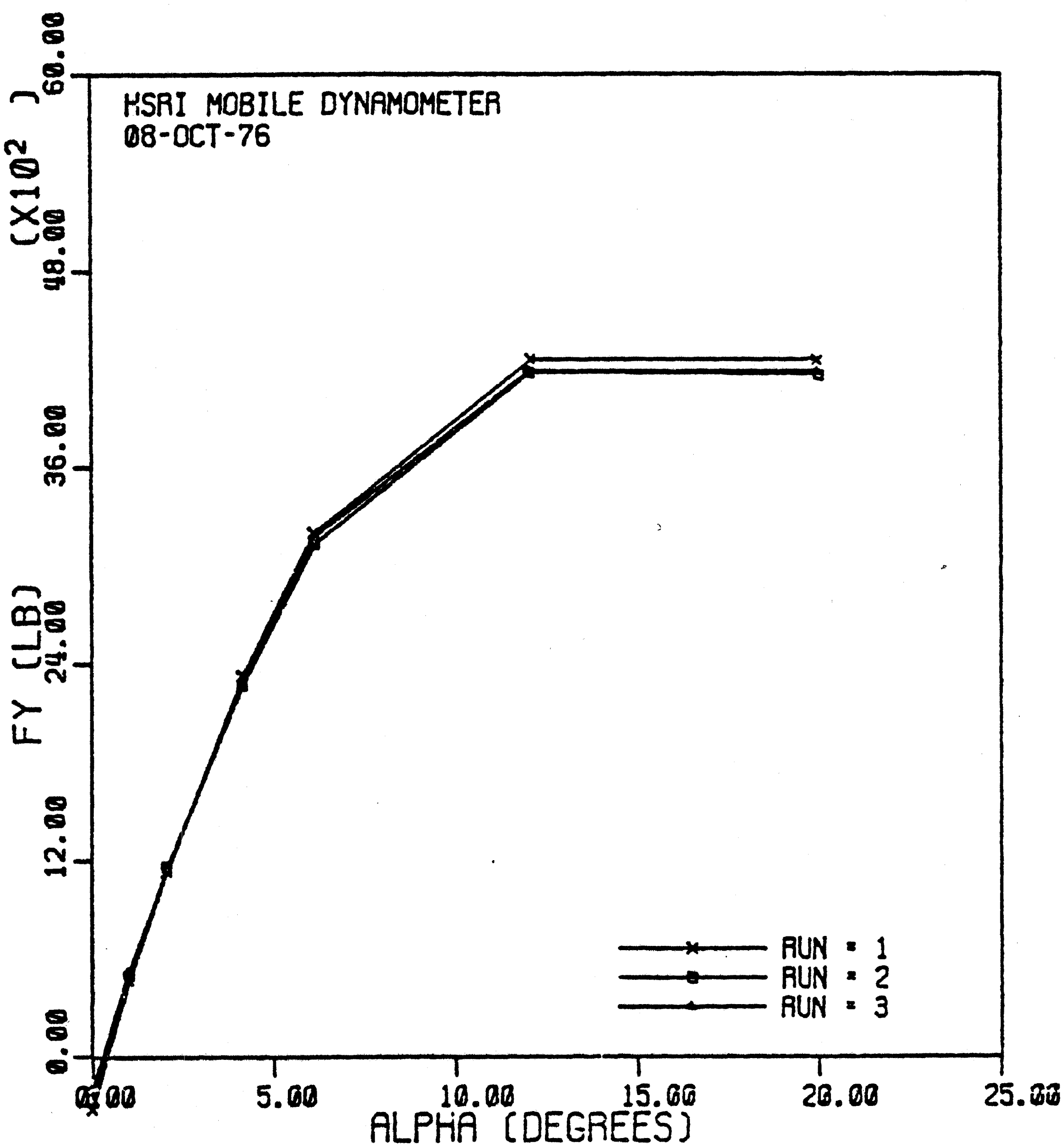


Figure C-48. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Firestone Transteel tires were tested on a wet Portland cement concrete surface.

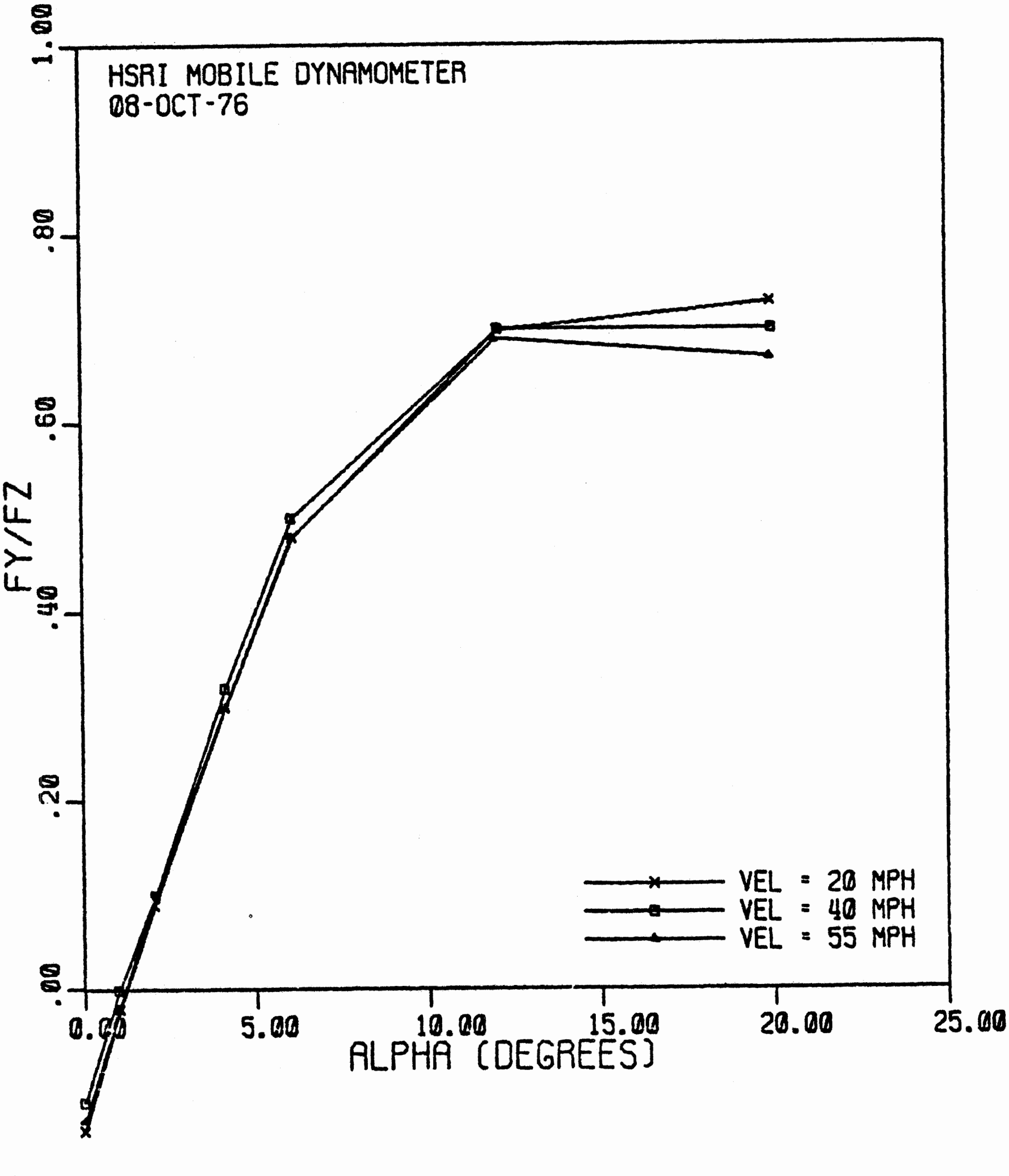


Figure C-49. Normalized later force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a dry Portland cement concrete surface. Tire load was 6287 pounds.

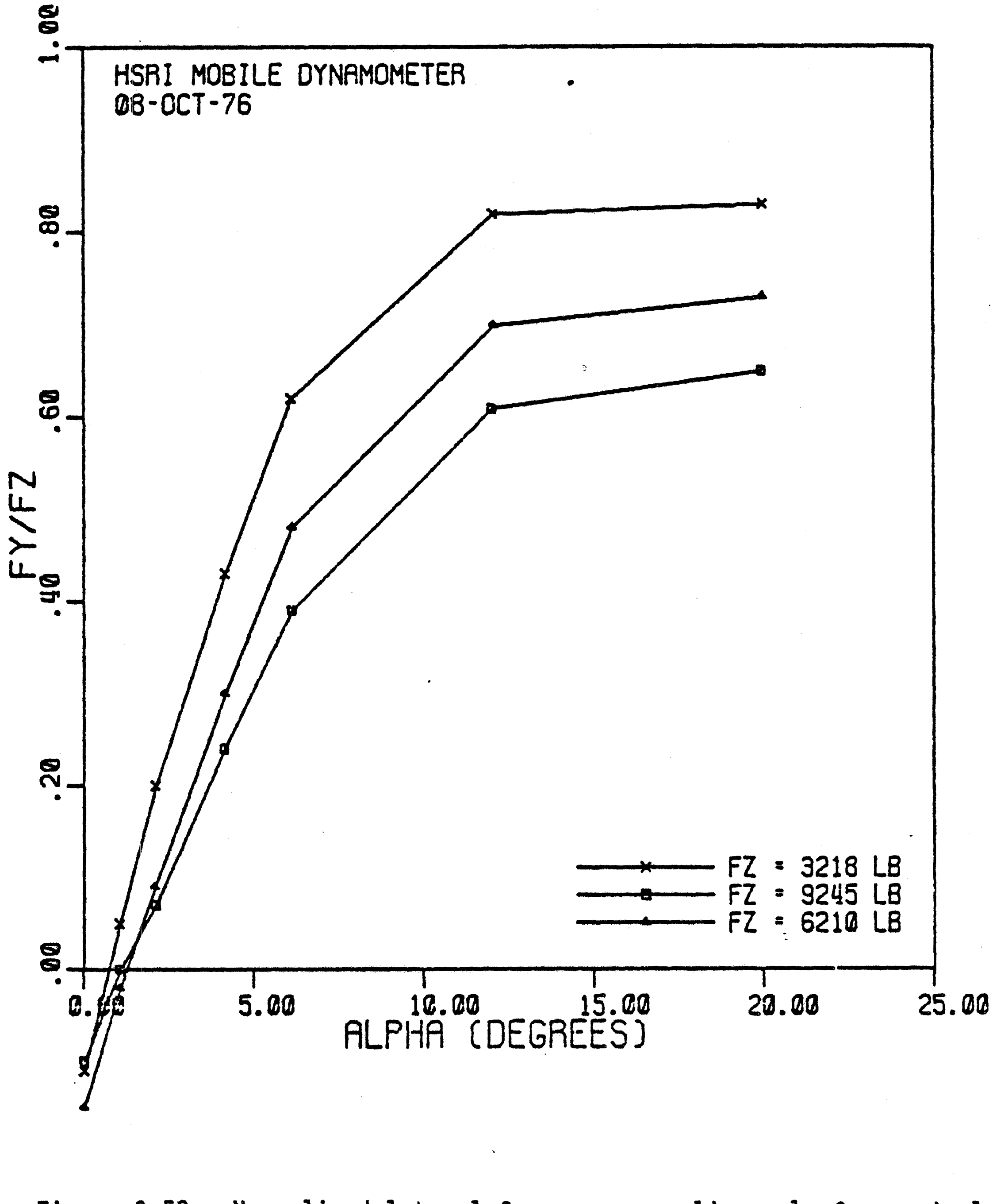


Figure C-50. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

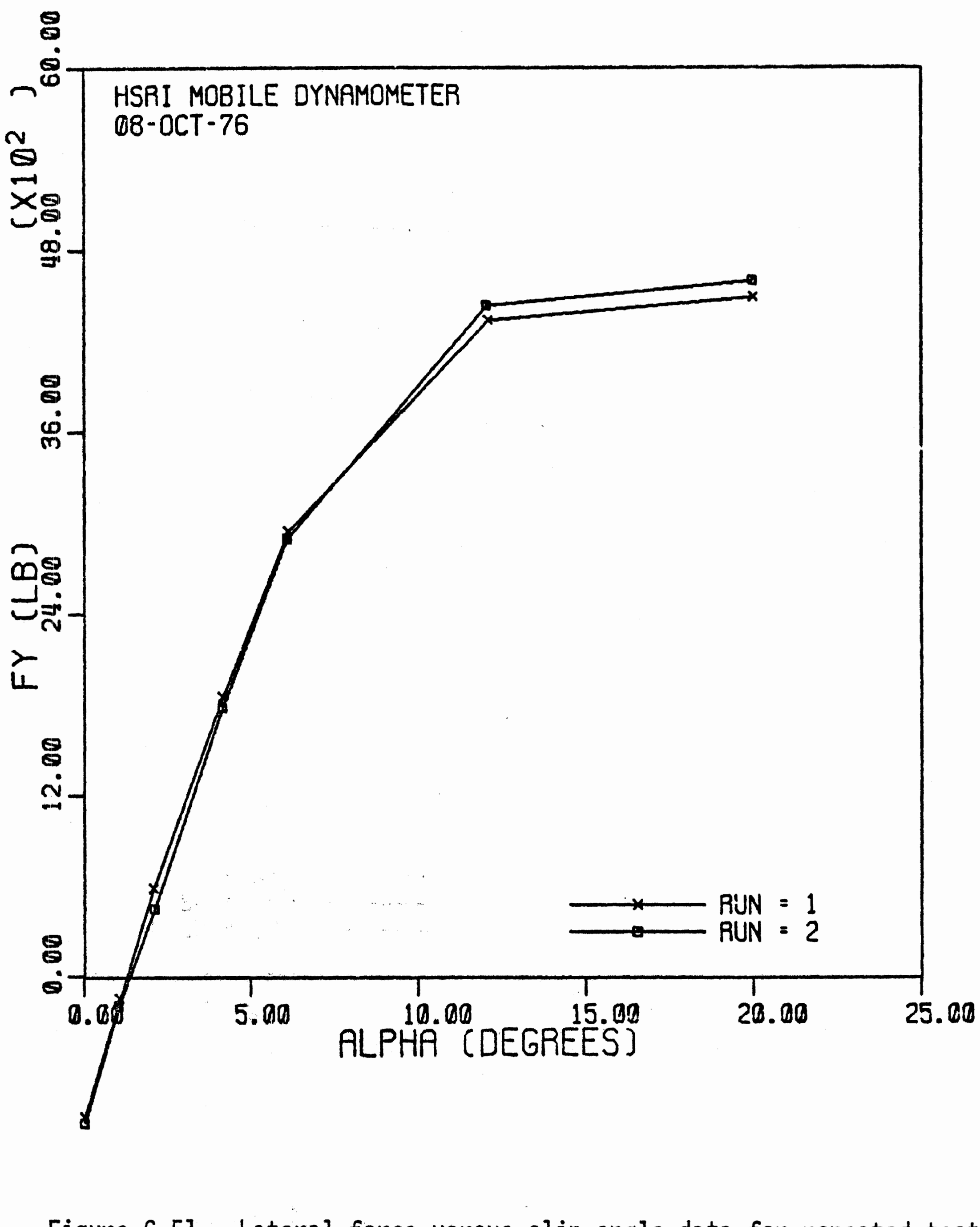


Figure C-51. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a dry Portland cement concrete surface.

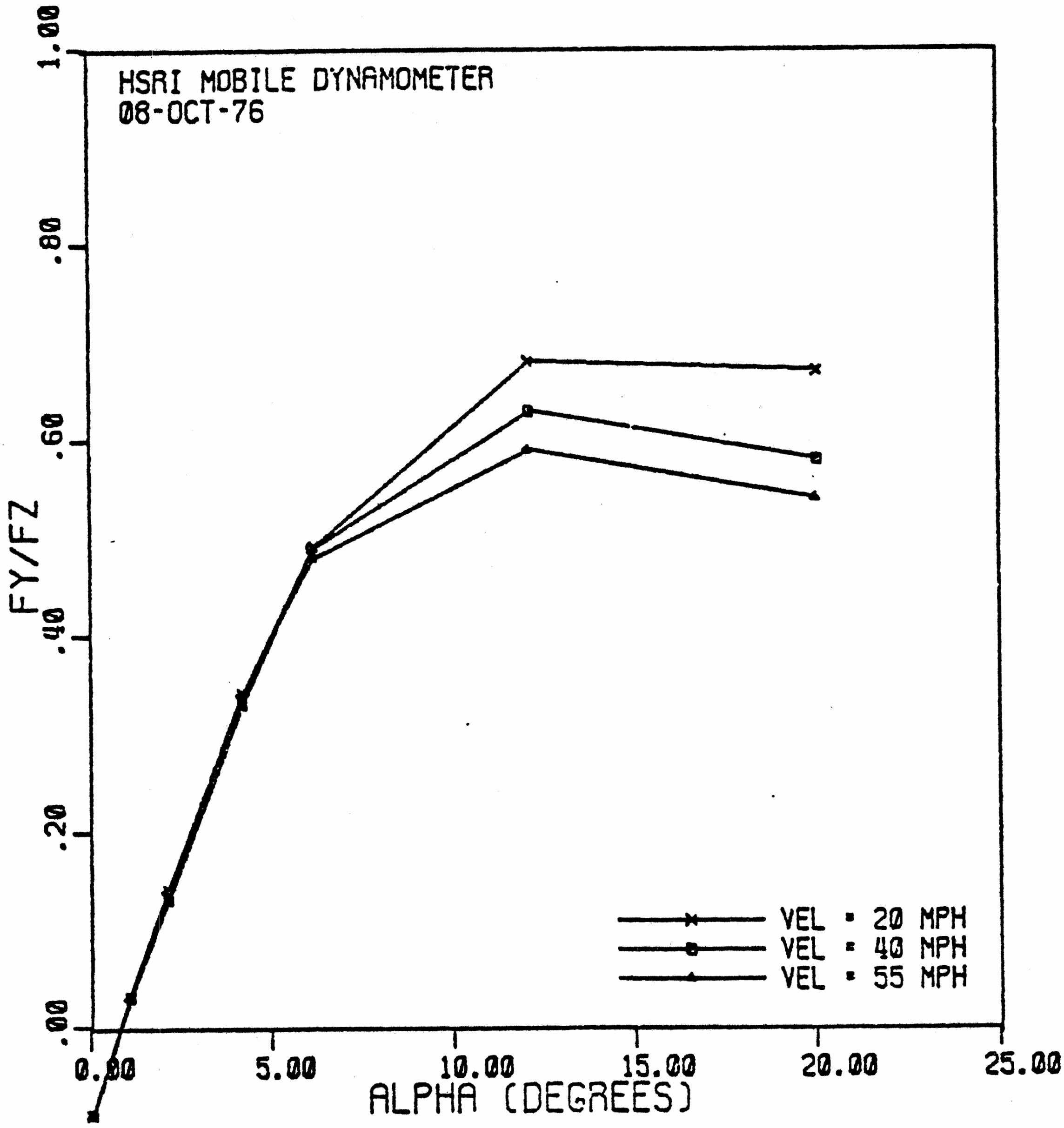


Figure C-52. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a wet Portland cement concrete surface. Tire load was 6248 pounds.

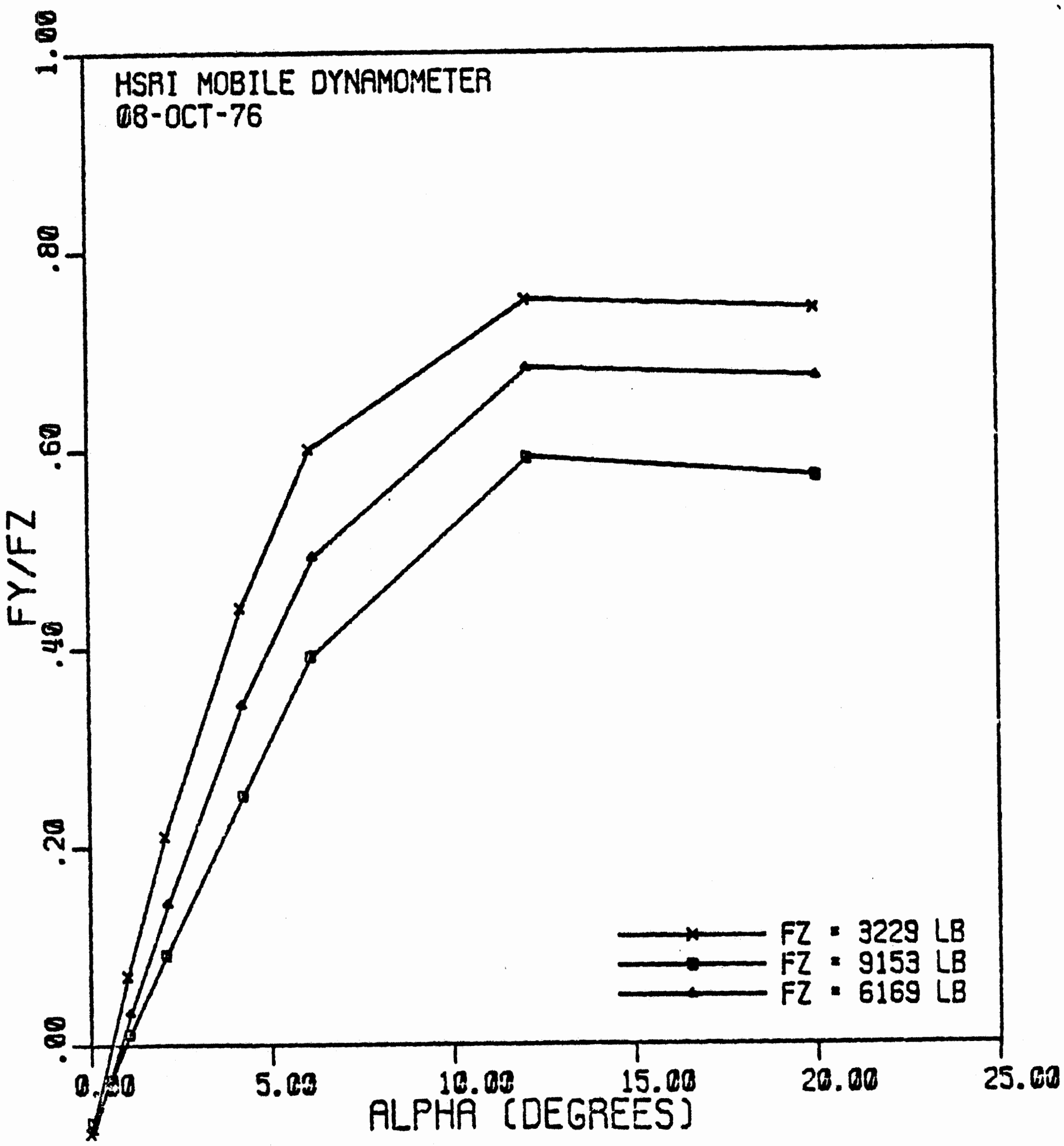


Figure C-53. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

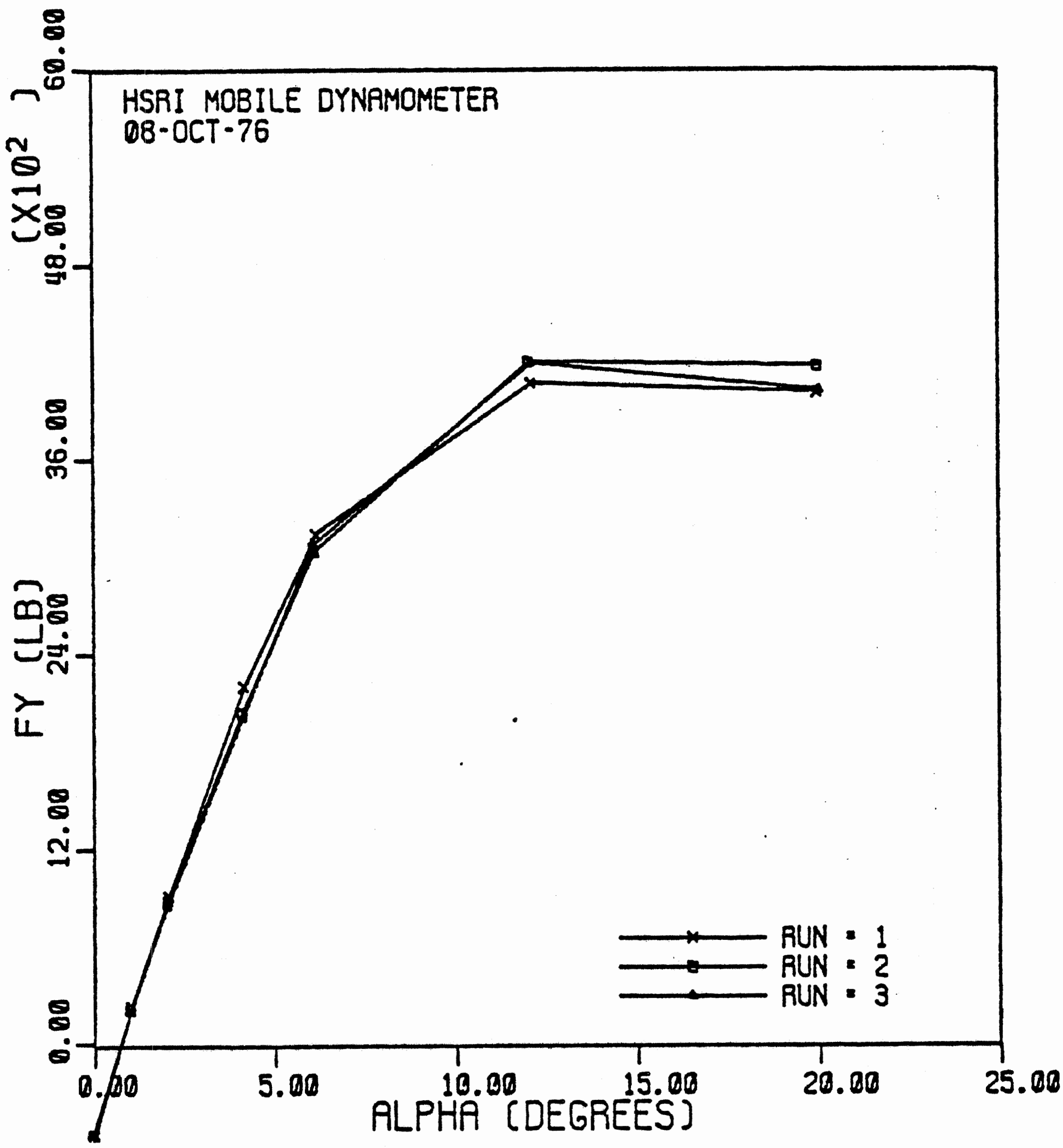


Figure C-54. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Goodyear Unisteel R-1 tires were tested on a wet Portland cement concrete surface.

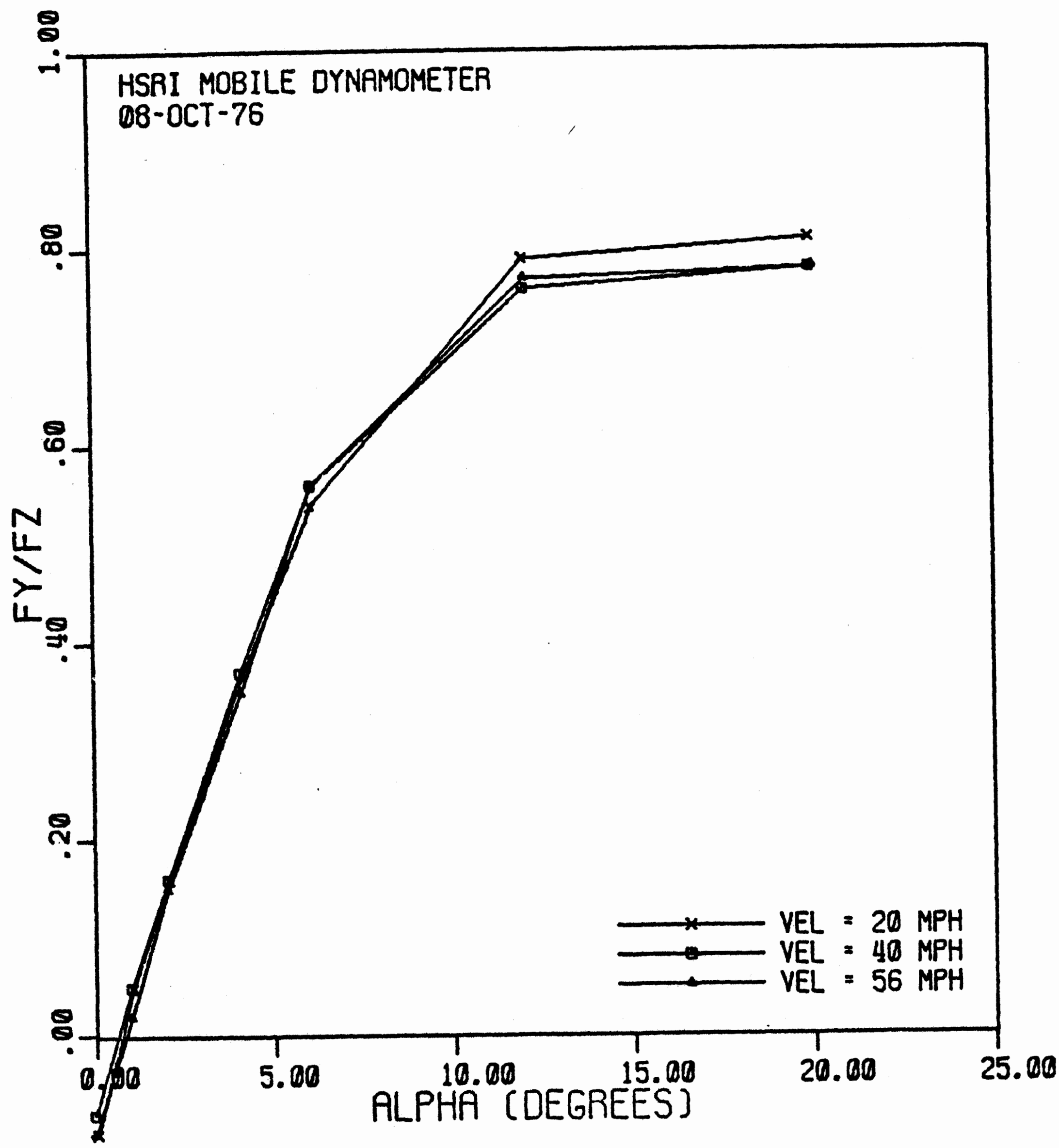


Figure C-55. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a dry Portland cement concrete surface. Tire load was 5941 pounds.

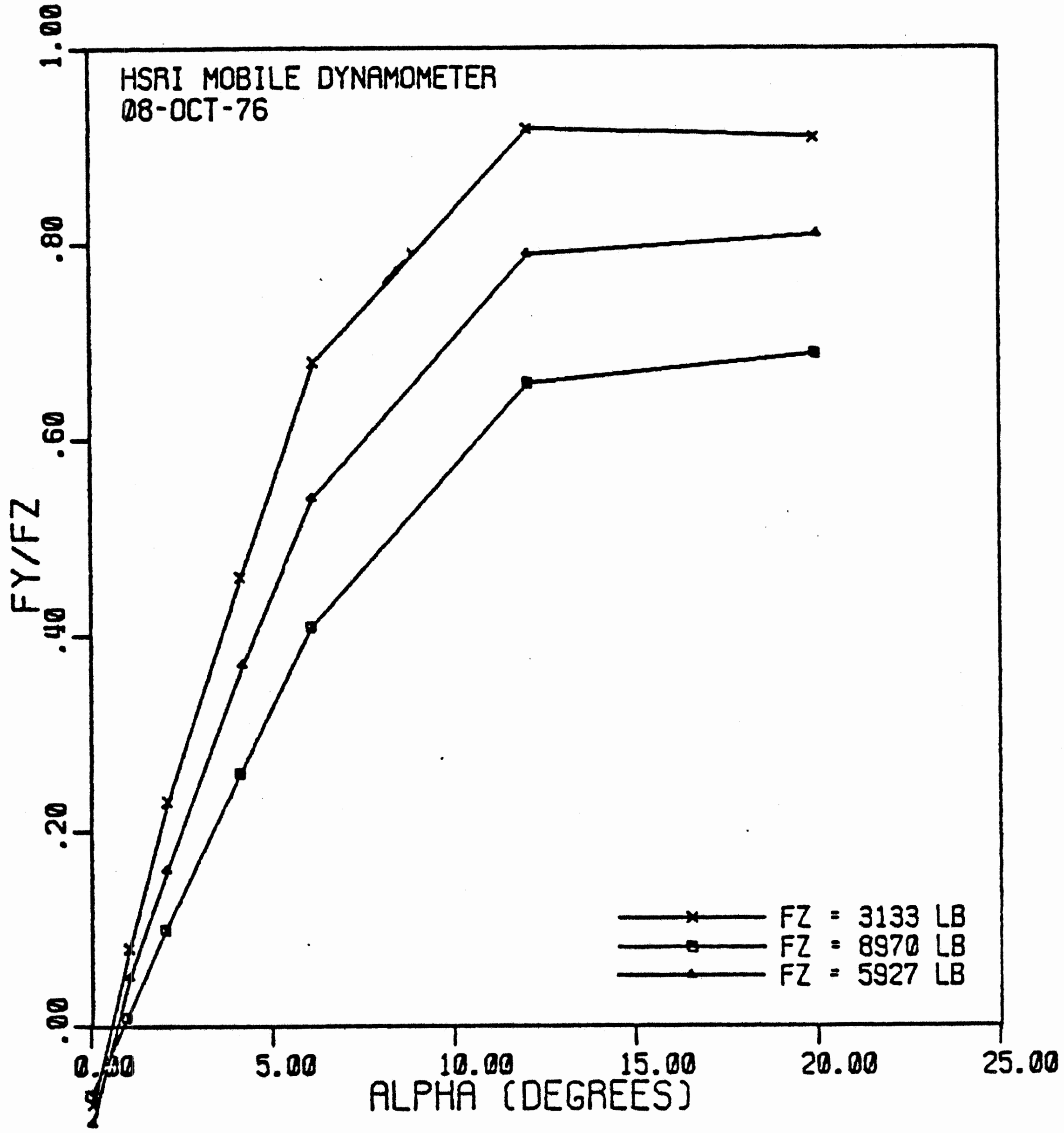


Figure C-56. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

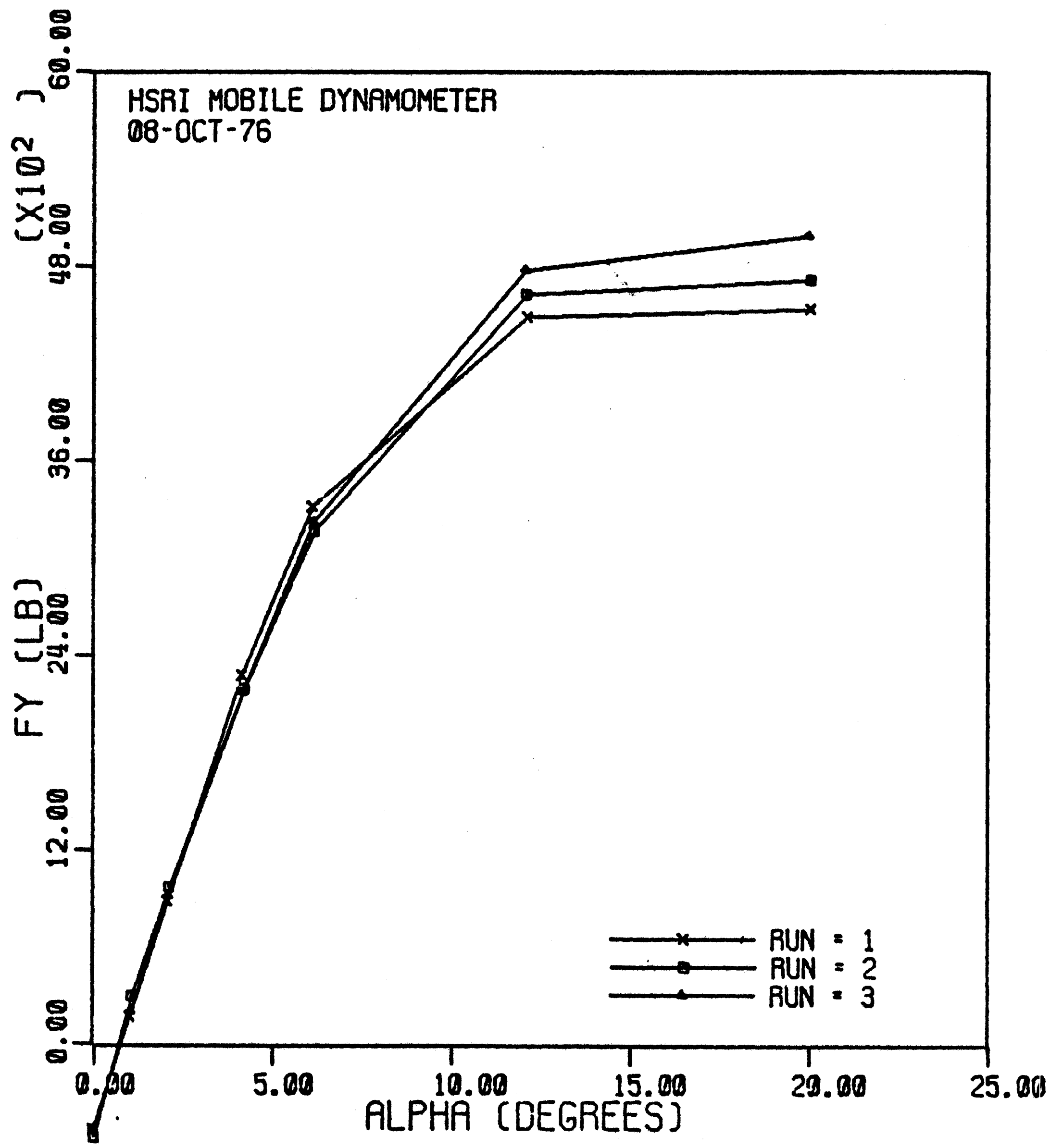


Figure C-57. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a dry Portland cement concrete surface.

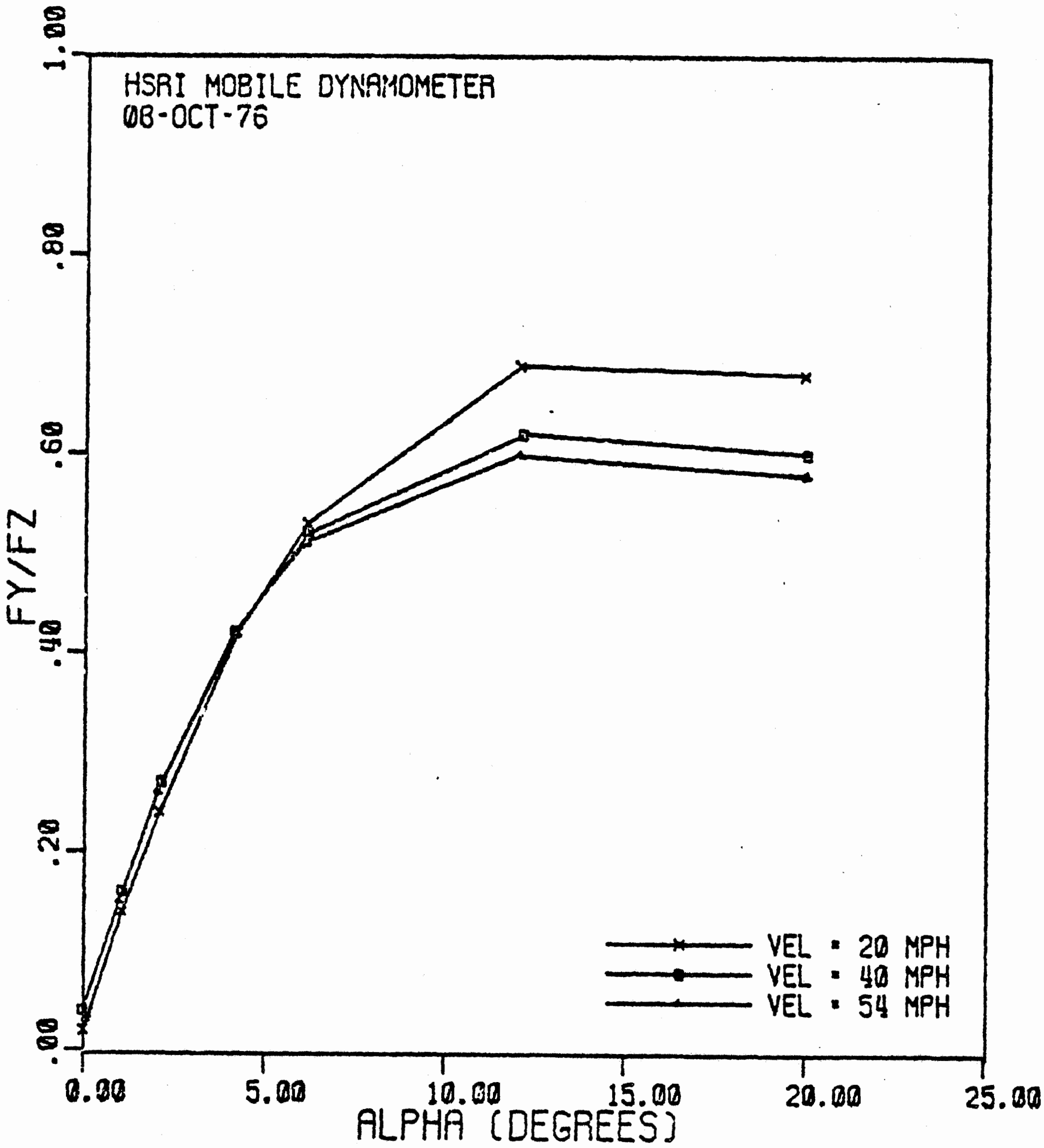


Figure C-58. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a wet Portland cement concrete surface. Tire load was 6130 pounds.

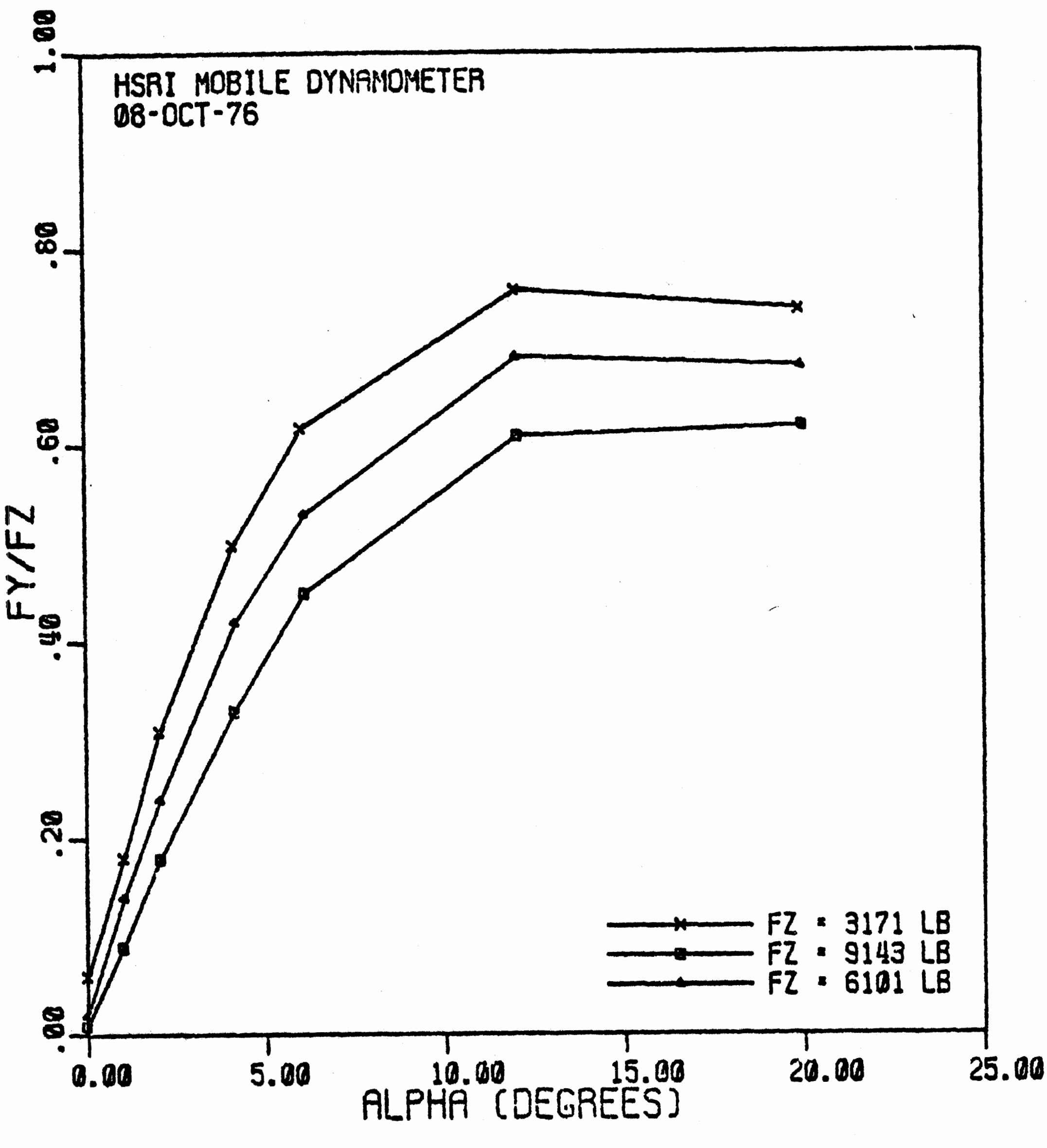


Figure C-59. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

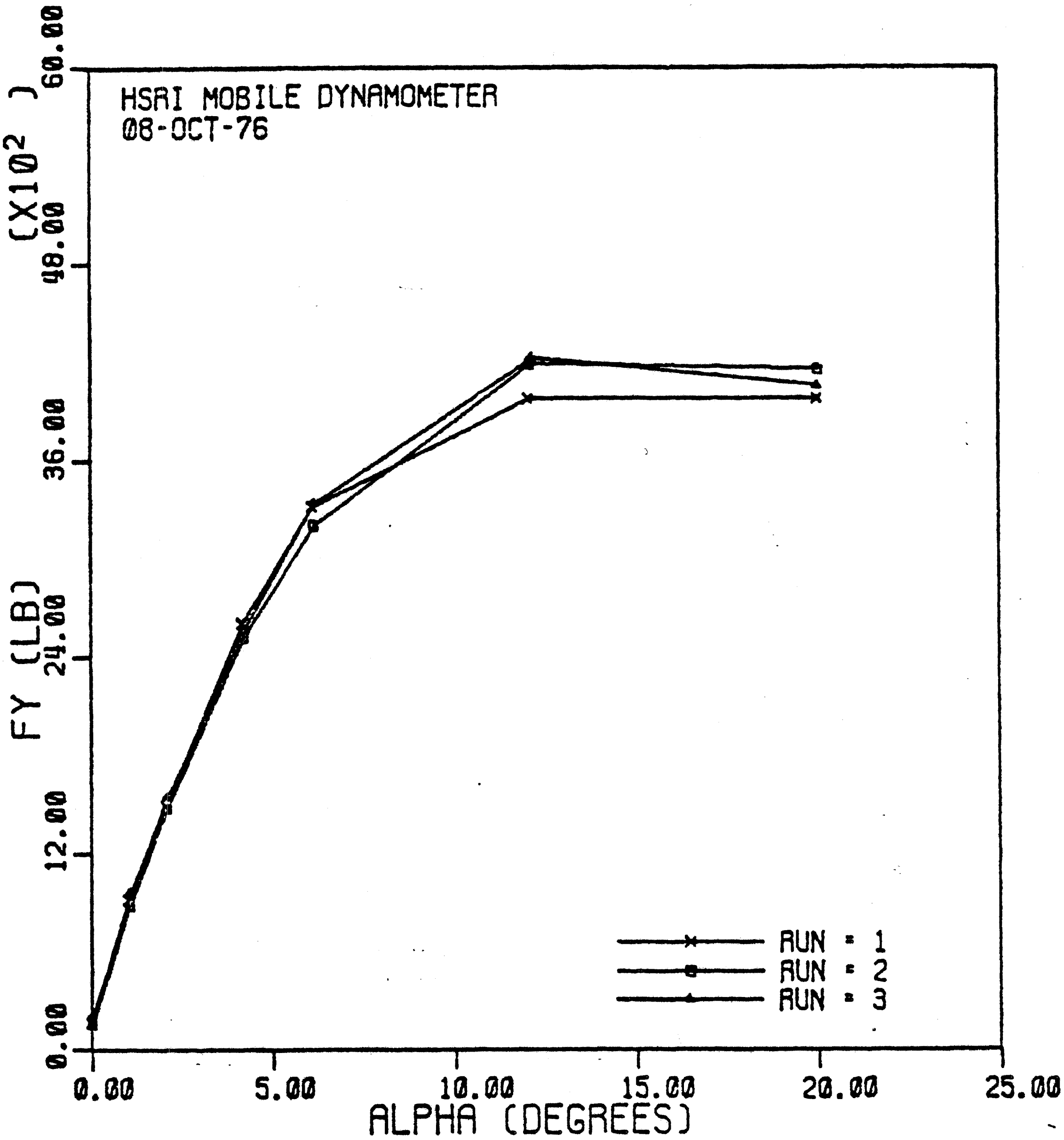


Figure C-60. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Goodyear Unisteel L-1 tires were tested on a wet Portland cement concrete surface.

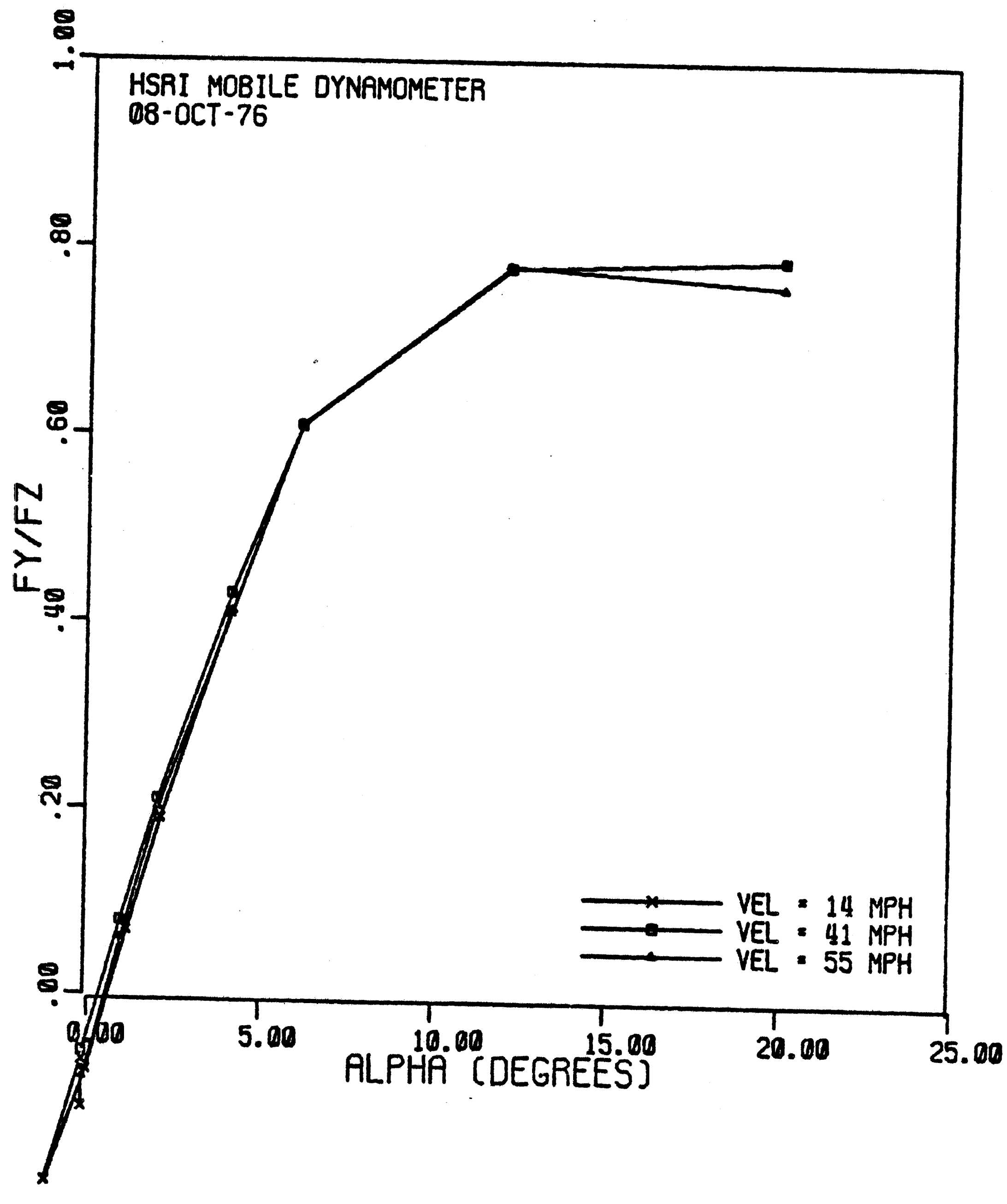


Figure C-61. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface. Tire load was 5445 pounds.

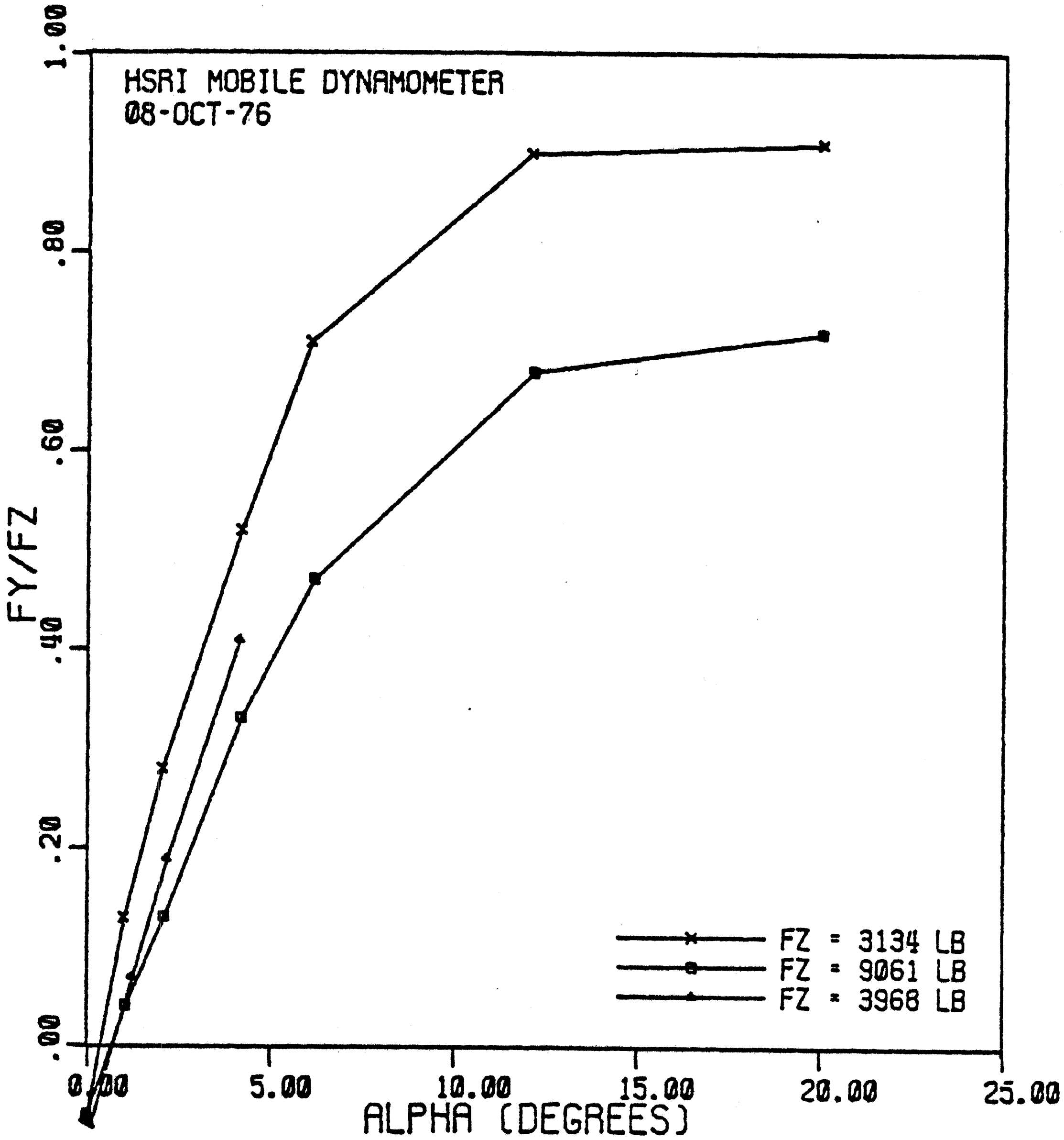


Figure C-62. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

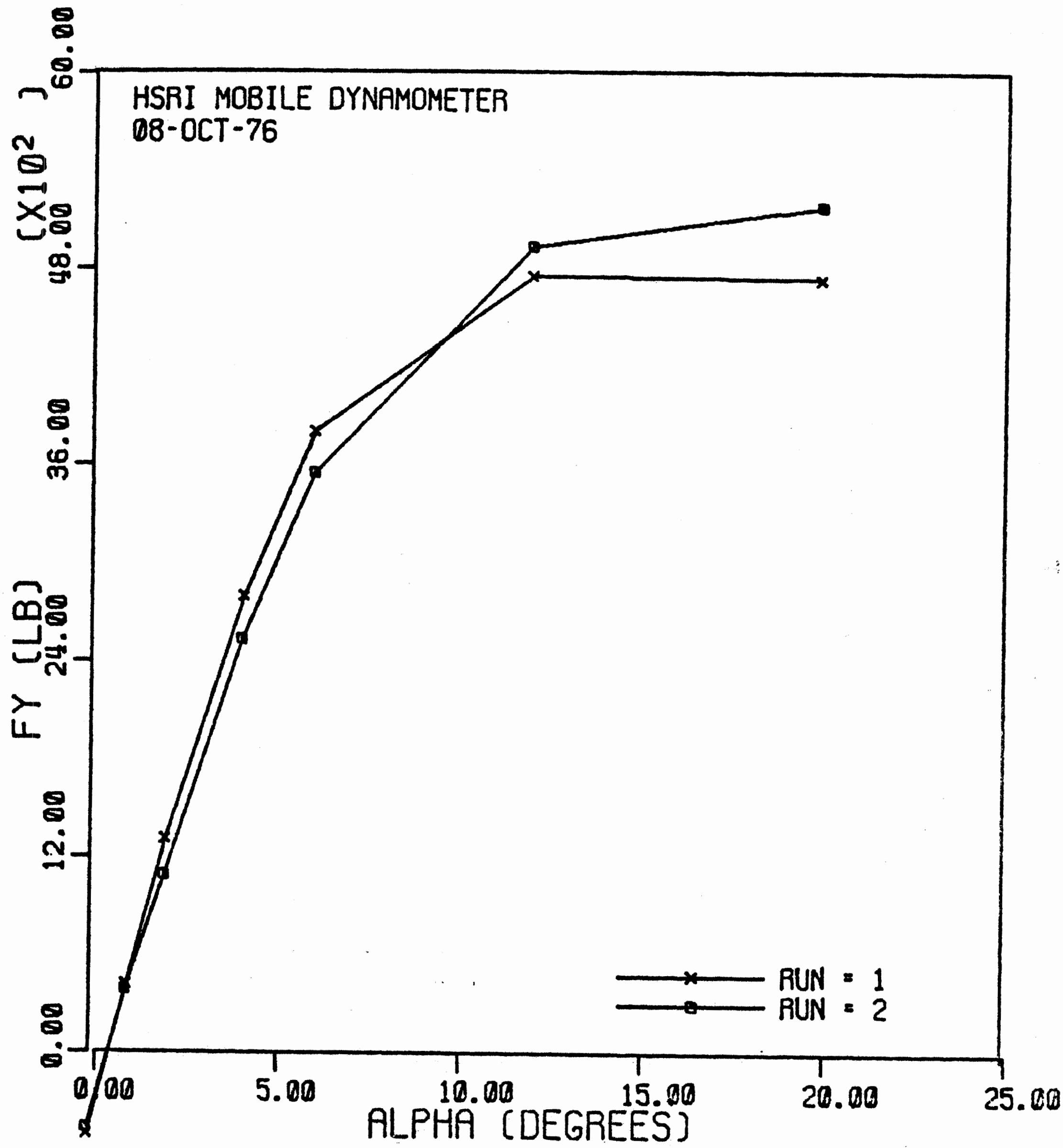


Figure C-63. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface.

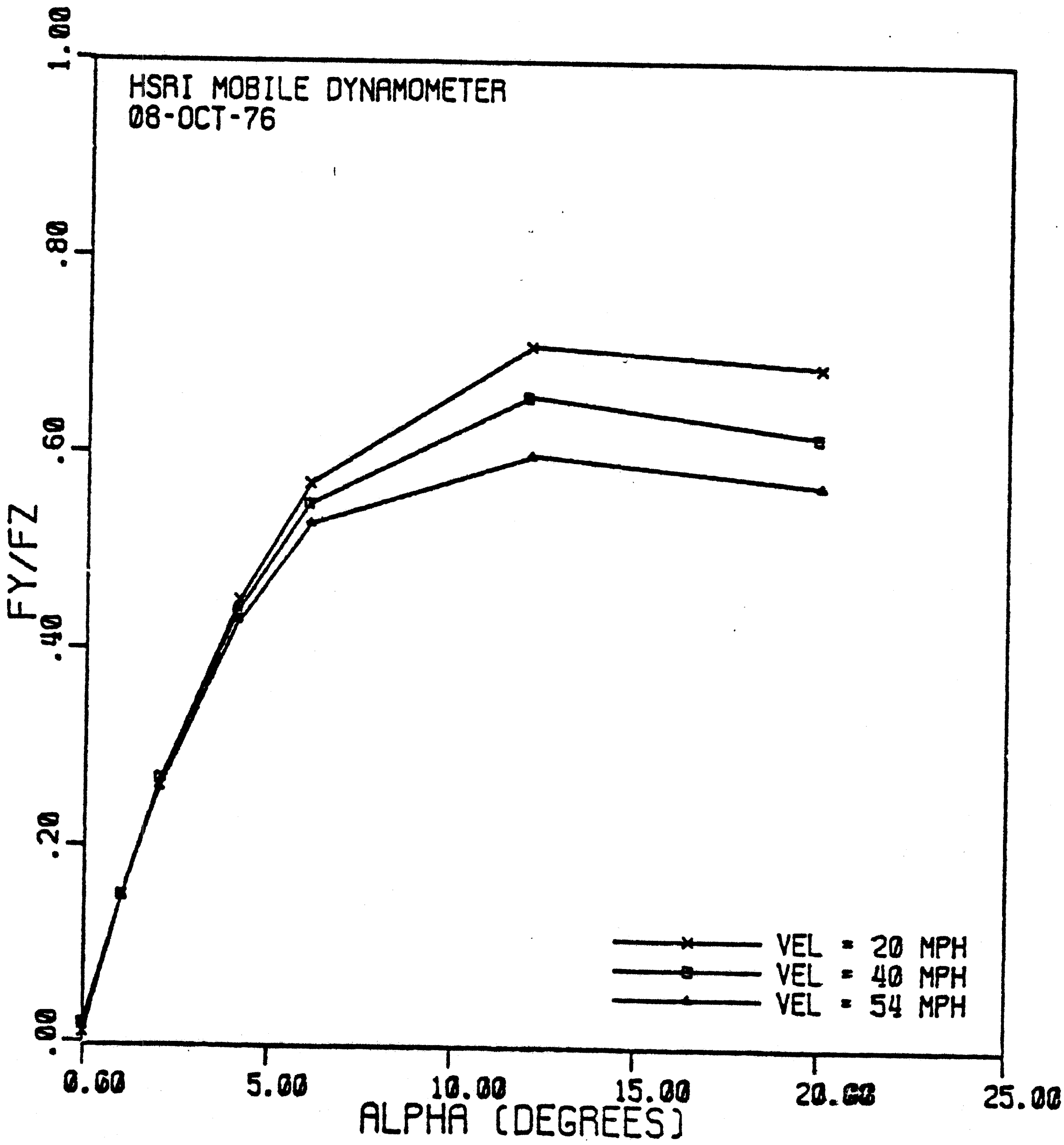


Figure C-64. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface. Tire load was 6022 pounds.

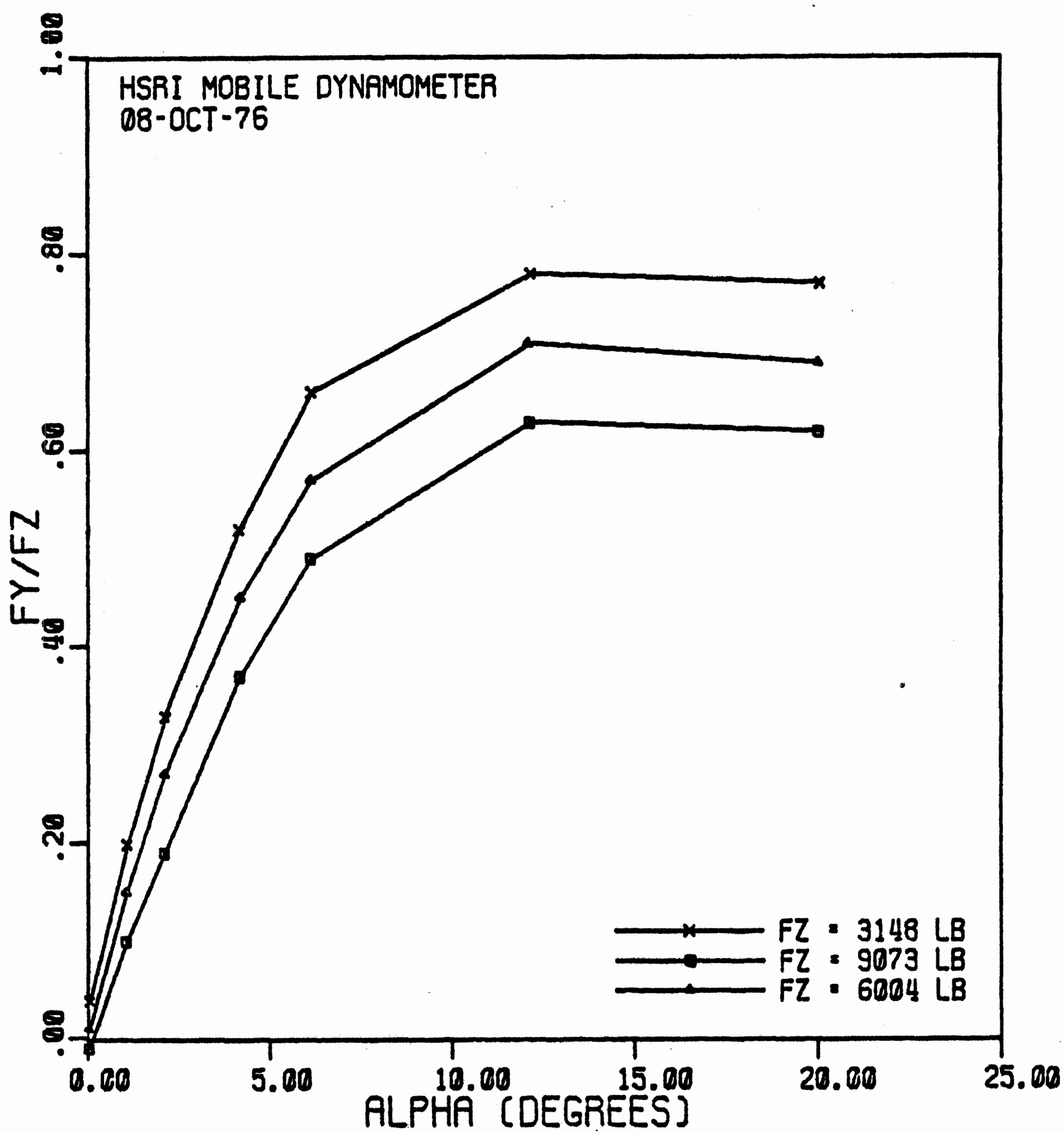


Figure C-65. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

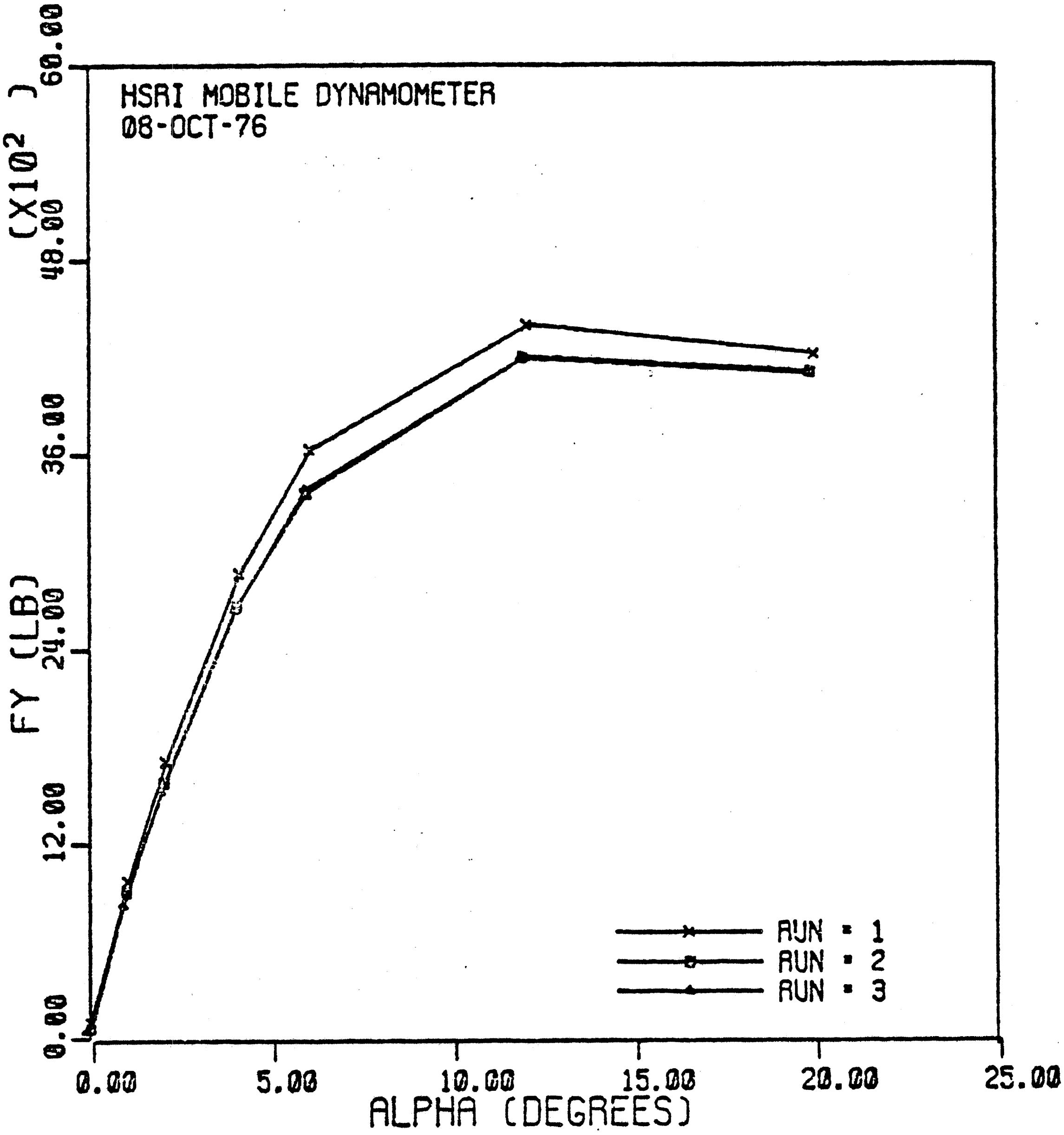


Figure C-66. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface.

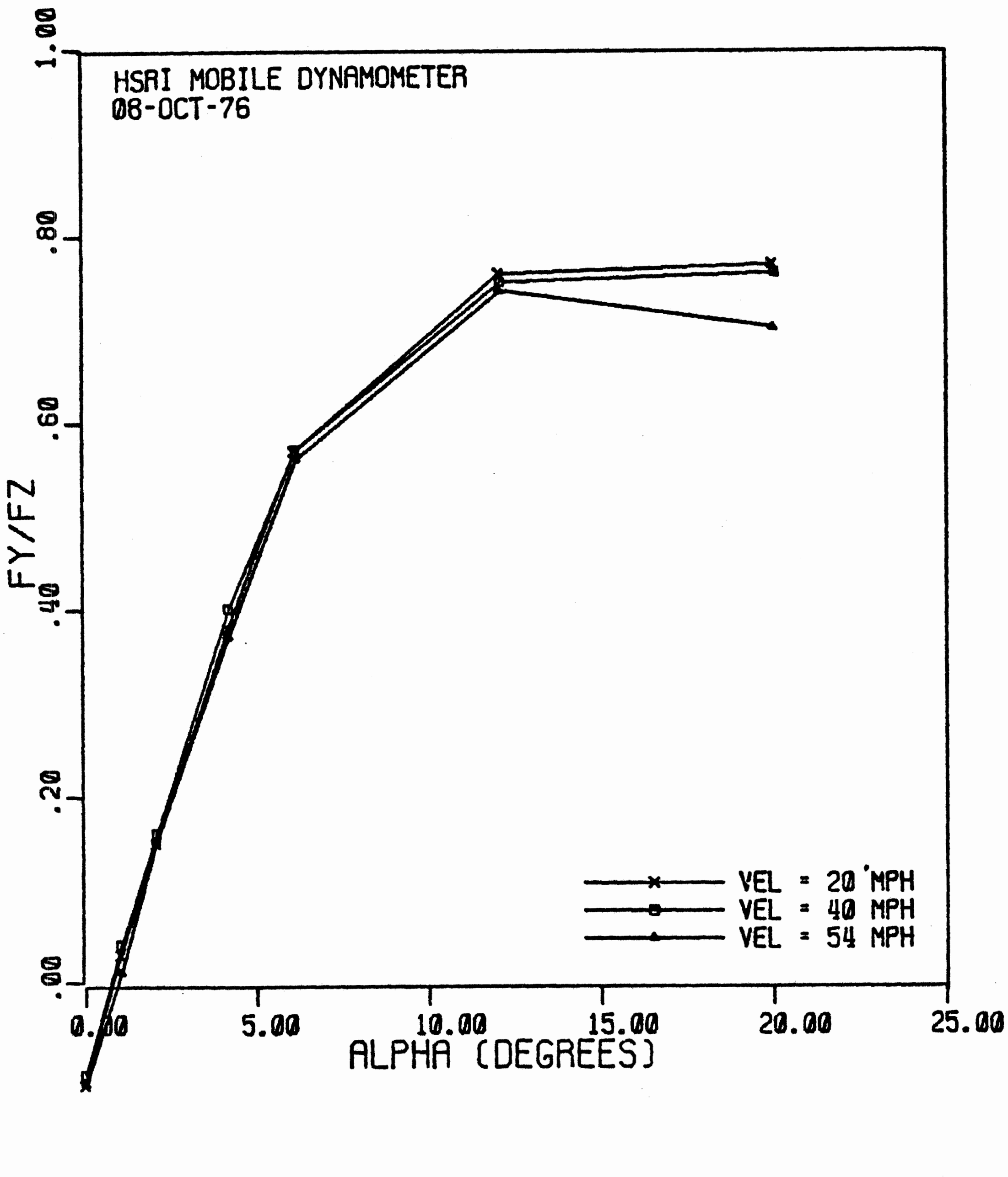


Figure C-67. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface. Tire load was 6184 pounds.

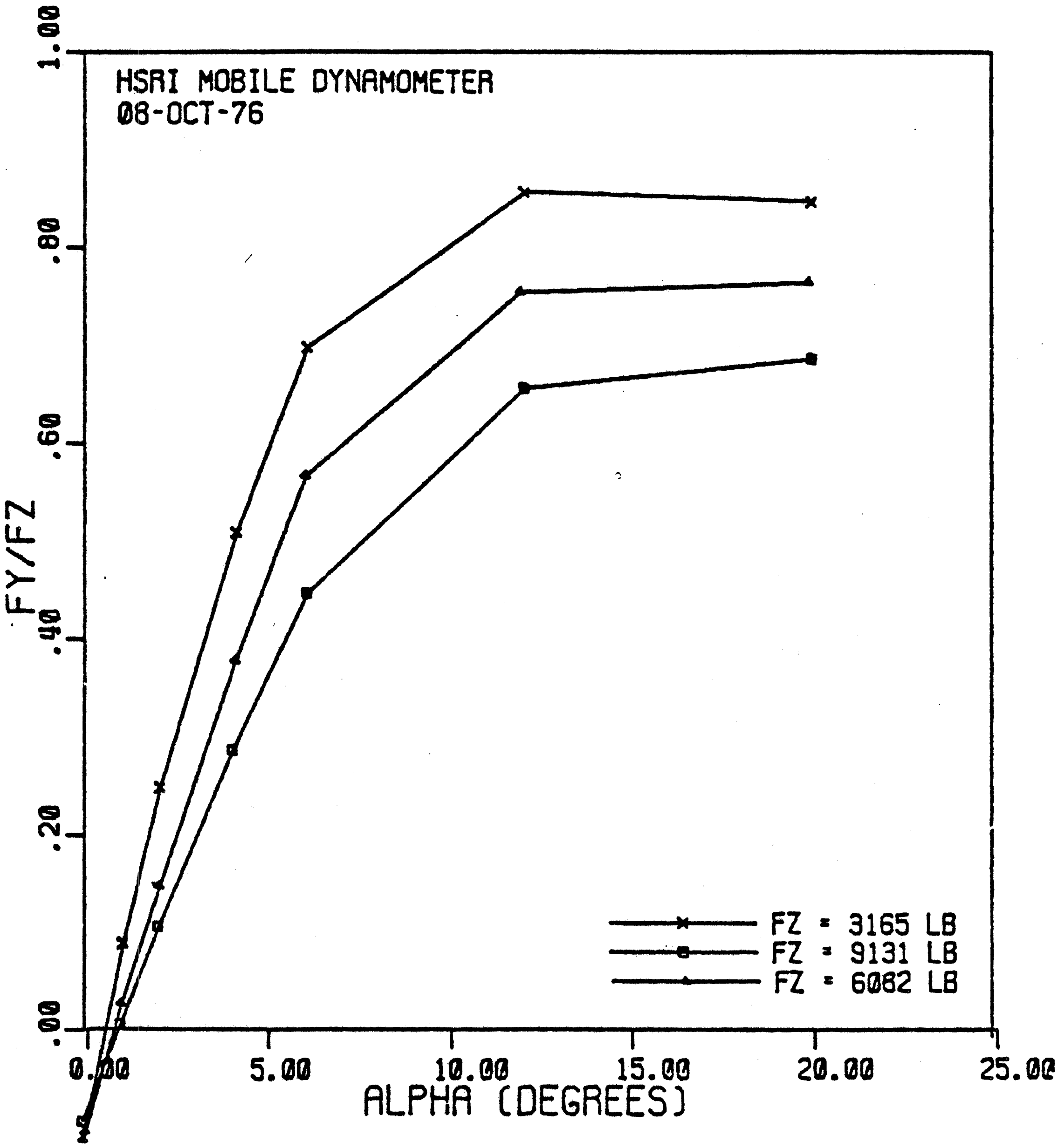


Figure C-68. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface. Nominal vehicle speed was 20 mph.

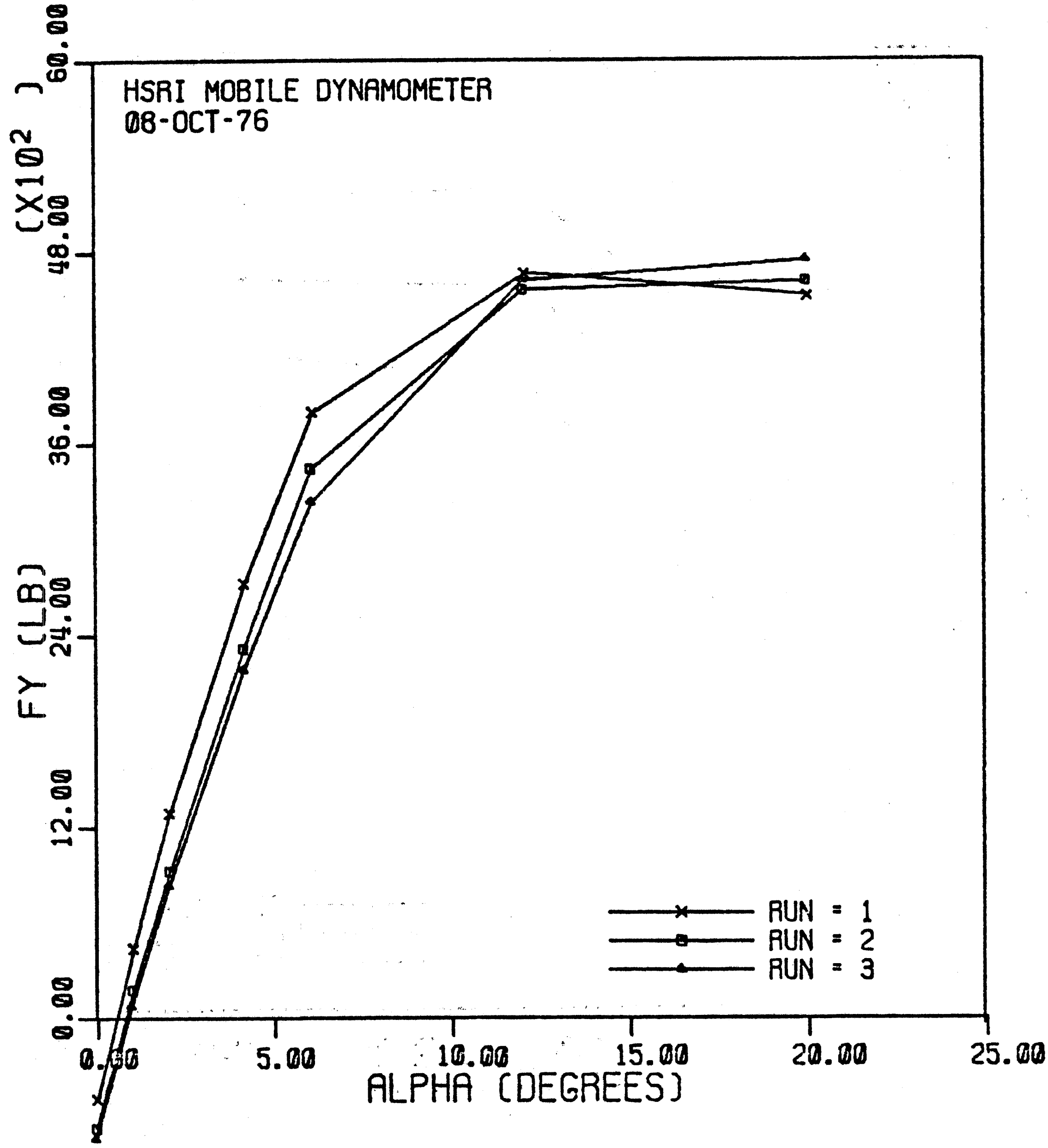


Figure C-69. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a dry Portland cement concrete surface.

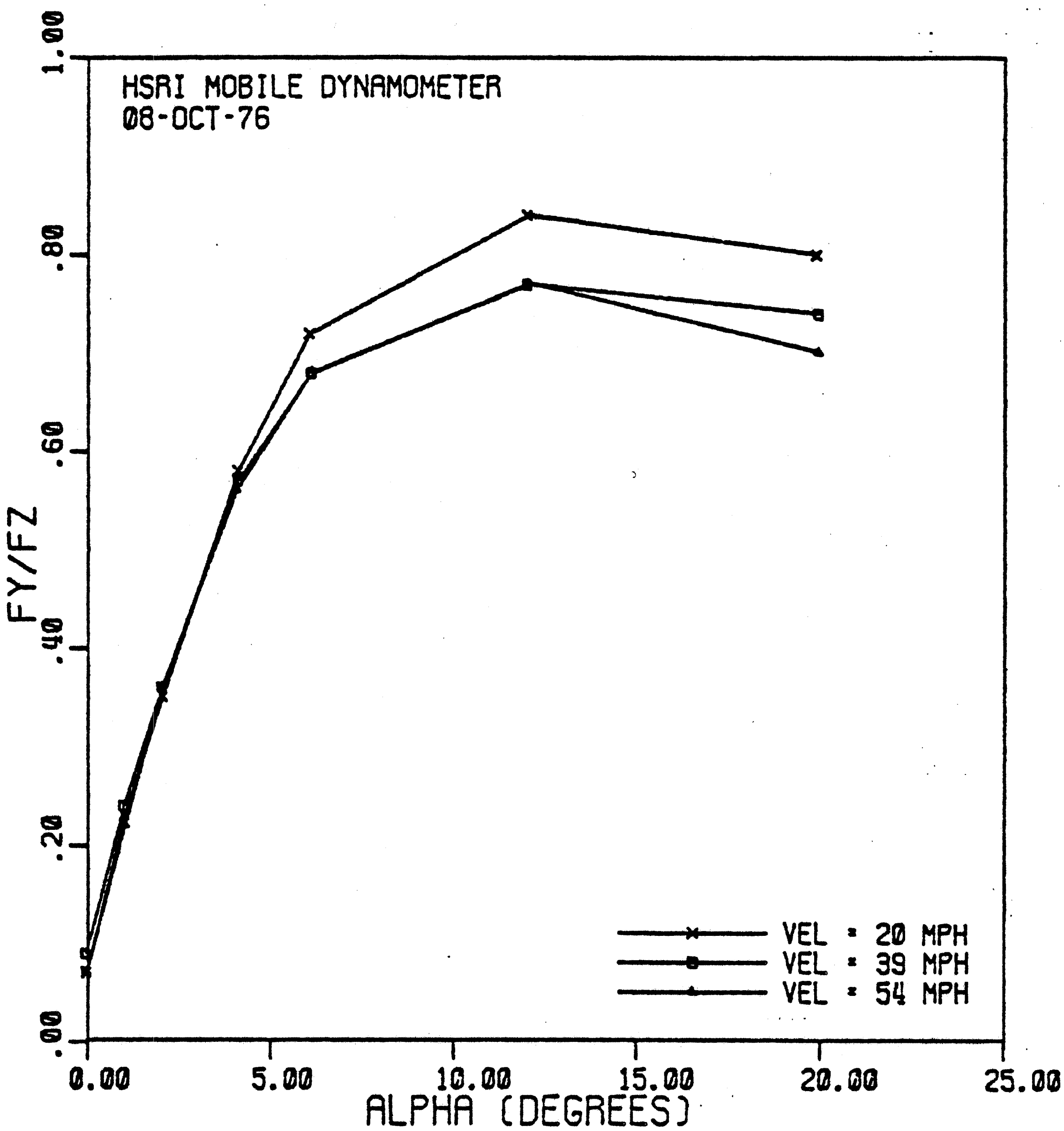


Figure C-70. Normalized lateral force versus slip angle data at nominal vehicle speeds of 20, 40 and 55 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface. Tire load was 5515 pounds.

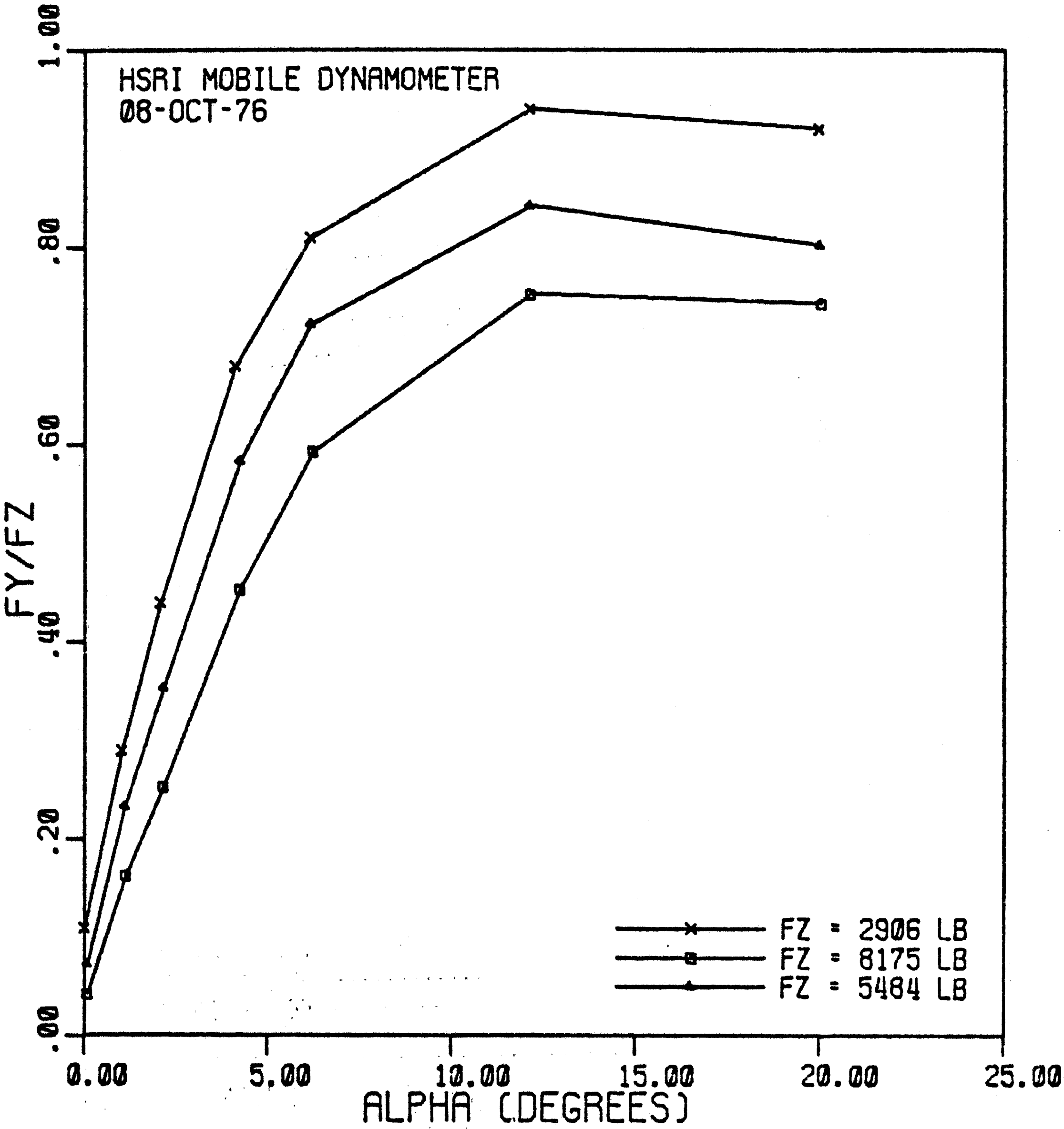


Figure C-71. Normalized lateral force versus slip angle for nominal tire loads of 0.5, 1.0, and 1.5 times T&RA rated load. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface. Nominal vehicle speed was 20 mph.

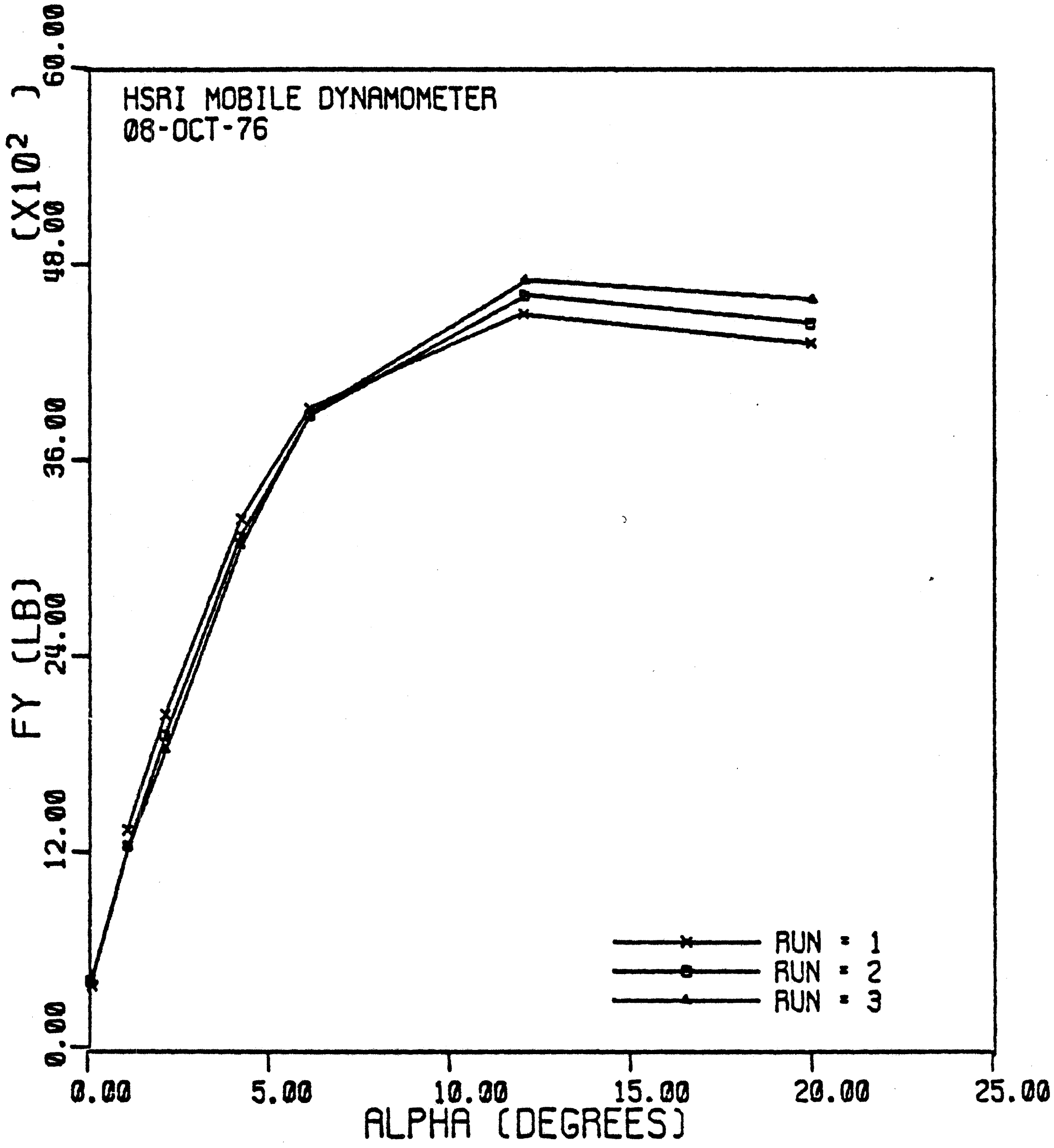


Figure C-72. Lateral force versus slip angle data for repeated tests at rated load and a vehicle speed of 20 mph. The radial, 10:00R20, load range G, Michelin XZZ tires were tested on a wet Portland cement concrete surface.

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2. TEST TIRES

The tire sample was chosen to be representative of the entire truck tire population, that is, representative in construction, brand and popularity. The number of tires of each brand selected for the test sample was based on the market penetration of the sales of that brand, and the relative number of tires of the three major types (bias ply, ribbed tread; bias ply, lug tread; and radial ply, ribbed tread) was based on the relative popularity of the types. Table 1 lists the test tires and identifies their type.

All of the tires were of the 10.00 x 20 size and they were mounted on the proper rim recommended by the Tire & Rim Association. They were inflated to the maximum pressure (85 psi for bias ply tires and 90 psi for radial ply tires) and loaded to a nominal 4,620 lbs.

Each tire was warmed-up by traveling about six miles at 50 miles per hour immediately before being tested. Each tire was also broken-in by six brake applications of one second lock-up duration during the warm-up. The whole group of tires were tested in braking and then retested later in cornering as a group.

3. SURFACES

Two pavements very much like the Uniform Tire Quality Grading traction pads at San Angelo, Texas were used. The surfaces were located at the Transportation Research Center of Ohio. One surface was a hot mixed bituminous asphalt pavement with a nominal ASTM E274-70 skid number of 60. The other surface was a polished Portland cement concrete pavement with a nominal ASTM E274-70 skid number of 35.

TABLE 1. TEST TIRES

TIRE NO.	MANUFACTURER	% OF MARKET*	MODEL	CARCASS TYPE	TREAD TYPE
1a&b	Goodyear	20%	Unisteel-2	Radial	Rib
2a&b	Goodyear		Himiler Special	Bias	Rib
3a&b	Goodyear		Custom Quiet Drive	Bias	Rib
4a&b	Goodyear		SuperHiMiler	Bias	Rib
5a&b	Goodyear		Custom Hi-Miler	Bias	Rib
6a&b	Firestone	18%	Power Drive	Bias	Lug
7a&b	Firestone		Transteel	Radial	Rib
8a&b	Firestone		Long Hauler	Bias	Rib
9a&b	Firestone		Super All Traction	Bias	Lug
10a&b	Kelly-Springfield	6.5%	Registered Armor Trac	Bias	Rib
11a&b	Kelly-Springfield		Registered Drive Trac	Bias	Lug
12a&b	General	6.1%	GQT	Bias	Rib
13a&b	General		QCL	Bias	Lug
14a&b	Michelin	6.0%	XZA	Radial	Rib
15a&b	Michelin		XZZ	Radial	Rib
16a&b	Uniroyal	5.2%	Fleetmaster Triple Tread	Bias	Rib
17a&b	Uniroyal		Fleetmaster Superlug	Bias	Lug
18a&b	B.F. Goodrich	5.0%	Extra Miler XL	Bias	Rib
19a&b	B.F. Goodrich		Traction Express Custom	Bias	Lug
20a&b	Sears	4.6%	Plus Mileage Rib	Bias	Rib
21a&b	Sears		Silent Trac	Bias	Lug
22a&b	Armstrong	4.5%	SD-200	Bias	Rib
24a&b	Dayton	2%	Thorobred Premium ESD	Bias	Rib
26a&b	Recap		Uniroyal Fleet Carrier	Bias	Rib

**Tire Review* Magazine

TABLE 2

TRUCK TIRE TRACTION FORCE COEFFICIENTS ON CONCRETE CORRECTED FOR SURFACE WEAR

TIRE TYPE	TIRE NO.	μ_{xs} Slide				μ_{xp} Peak				μ_{yp} Peak lateral			
		40 mph		55 mph		40 mph		55 mph		40 mph		55 mph	
		avg	s	avg	s	avg	s	avg	s	avg	s	avg	s
	2A	.245	.026	.200	.010	.362	.069	.311	.054	.381	.025	.336	.000
	2B	.222	.031	.186	.019	.337	.021	.308	.016	.376	.022	.333	.019
	4A	.221	.018	.182	.012	.325	.040	.290	.043	.430	.028	.385	.024
	4B	.211	.021	.187	.022	.308	.034	.261	.021	.404	.021	.369	.019
	5A	.264	.024	.211	.021	.347	.028	.303	.025	.371	.023	.325	.017
	5B	.247	.033	.208	.028	.343	.039	.304	.021	.392	.020	.343	.030
	8A	.222	.021	.186	.011	.324	.039	.282	.034	.362	.015	.300	.022
B	8B	.232	.017	.194	.021	.332	.029	.272	.036	.352	.028	.301	.006
I	10A	.266	.011	.209	.012	.350	.029	.305	.025	.396	.018	.368	.015
A	10B	.266	.042	.224	.016	.362	.039	.317	.025	.382	.022	.342	.021
S	12A	.201	.022	.161	.017	.276	.029	.232	.014	.397	.029	.386	.054
	12B	.218	.026	.173	.021	.292	.010	.245	.010	.404	.029	.375	.034
R	16A	.245	.037	.196	.017	.343	.038	.276	.030	.382	.034	.350	.018
I	16B	.238	.024	.217	.018	.353	.043	.310	.040	.400	.025	.371	.012
B	18A	.250	.026	.200	.012	.347	.039	.272	.033	.381	.018	.342	.013
	18B	.239	.025	.198	.016	.352	.045	.302	.030	.395	.024	.360	.020
	20A	.251	.021	.232	.012	.371	.028	.326	.022	.383	.024	.351	.020
	20B	.263	.021	.230	.015	.370	.043	.326	.025	.394	.019	.367	.029
	22A	.228	.013	.222	.027	.358	.029	.290	.041	.393	.028	.342	.017
	22B	.253	.030	.221	.024	.354	.028	.292	.017	.382	.021	.305	.020
	24A	.235	.022	.200	.024	.317	.028	.216	.024	.347	.021	.304	.015
	24B	.251	.032	.208	.021	.344	.023	.287	.011	.363	.019	.320	.016
	3A	.224	.033	.193	.032	.331	.030	.285	.019	.362	.015	.317	.026
	3B	.231	.019	.204	.022	.330	.024	.295	.018	.363	.023	.299	.012
	6A	.229	.027	.203	.024	.301	.021	.285	.023	.365	.032	.316	.015
	6B	.204	.014	.185	.020	.293	.027	.266	.025	.353	.024	.329	.018
B	9A	.226	.012	.179	.024	.320	.036	.260	.044	.361	.022	.298	.023
I	9B	.233	.028	.196	.024	.322	.016	.297	.050	.371	.039	.328	.024
A	11A	.224	.026	.185	.026	.325	.028	.286	.039	.406	.026	.359	.027
S	11B	.214	.018	.202	.028	.335	.032	.291	.040	.415	.034	.374	.051
	13A	.176	.022	.127	.007	.224	.029	.176	.013	.318	.023	.306	.085
L	13B	.167	.013	.138	.027	.224	.025	.216	.032	.316	.024	.274	.025
U	17A	.220	.026	.194	.018	.289	.029	.251	.013	.326	.040	.286	.021
G	17B	.245	.021	.195	.017	.328	.033	.291	.020	.323	.056	.284	.018
	19A	.236	.018	.197	.024	.311	.026	.267	.020	.407	.045	.361	.021
	19B	.239	.012	.189	.022	.310	.029	.250	.018	.386	.035	.323	.020
	21A	.248	.021	.211	.032	.345	.021	.309	.023	.387	.013	.332	.024
	21B	.238	.019	.208	.037	.315	.029	.282	.029	.390	.013	.336	.029
	1A	.235	.015	.180	.012	.352	.037	.338	.055	.416	.026	.392	.016
R	1B	.230	.032	.176	.022	.361	.035	.316	.033	.407	.022	.376	.012
A	7A	.211	.023	.170	.015	.276	.041	.234	.043	.391	.023	.366	.024
D	7B	.212	.022	.167	.033	.290	.037	.240	.039	.361	.050	.314	.026
	14A	.220	.014	.155	.010	.302	.039	.244	.026	.395	.033	.363	.009
R	14B	.217	.017	.175	.010	.296	.037	.244	.019	.407	.021	.369	.031
I	15A	.243	.019	.199	.023	.329	.027	.285	.027	.422	.041	.376	.030
B	15B	.224	.031	.190	.016	.311	.018	.282	.019	.429	.036	.410	.045
RE	26A	.184	.029	.153	.013	.235	.024	.194	.011	.370	.017	.262	.025
CAP	26B	.171	.011	.152	.022	.235	.024	.216	.039	.366	.016	.297	.015

TABLE 3

TRUCK TIRE TRACTION FORCE COEFFICIENTS ON ASPHALT CORRECTED FOR SURFACE WEAR

TIRE TYPE	TIRE NO.	μ_{xs} 40 mph avg	μ_{xs} 40 mph s	μ_{xs} 55 mph avg	μ_{xs} 55 mph s	μ_{xp} 40 mph avg	μ_{xp} 40 mph s	μ_{xp} 55 mph avg	μ_{xp} 55 mph s	μ_{yp} 40 mph avg	μ_{yp} 40 mph s	μ_{yp} 55 mph avg	μ_{yp} 55 mph s
	2A	.538	.026	.462	.024	.784	.023	.718	.036	.620	.023	.572	.033
	2B	.481	.015	.417	.019	.745	.040	.684	.051	.651	.018	.589	.021
	4A	.521	.024	.444	.033	.778	.032	.729	.030	.612	.018	.597	.023
	4B	.506	.020	.462	.021	.738	.068	.770	.027	.620	.014	.586	.019
	5A	.612	.017	.461	.046	.779	.021	.682	.034	.666	.034	.620	.020
	5B	.507	.020	.487	.029	.769	.014	.692	.031	.631	.017	.611	.022
	8A	.474	.017	.421	.026	.674	.033	.604	.052	.613	.018	.554	.012
B	8B	.747	.040	.403	.026	.676	.025	.619	.034	.615	.021	.578	.030
I	10A	.500	.036	.465	.026	.745	.039	.684	.018	.655	.023	.624	.022
A	10B	.514	.015	.451	.047	.735	.022	.680	.048	.648	.018	.604	.031
S	12A	.552	.034	.445	.034	.784	.022	.726	.025	.657	.024	.611	.014
	12B	.519	.026	.461	.034	.754	.026	.721	.042	.675	.008	.610	.031
R	16A	.538	.026	.437	.021	.710	.054	.666	.036	.670	.020	.608	.018
I	16B	.524	.022	.451	.042	.731	.027	.663	.012	.662	.019	.591	.015
B	18A	.519	.030	.482	.036	.817	.055	.770	.020	.648	.027	.557	.018
	18B	.544	.044	.463	.037	.797	.047	.606	.040	.662	.032	.582	.014
	20A	.585	.008	.479	.017	.791	.012	.640	.021	.623	.016	.574	.008
	20B	.576	.044	.453	.052	.742	.027	.633	.043	.604	.021	.548	.015
	22A	.475	.032	.419	.014	.760	.031	.660	.037	.573	.023	.518	.015
	22B	.471	.018	.411	.023	.728	.038	.642	.036	.653	.027	.609	.023
	24A	.518	.013	.459	.031	.679	.038	.640	.036	.665	.016	.611	.018
	24B	.552	.018	.485	.028	.721	.031	.574	.017	.700	.023	.644	.004
	3A	.560	.006	.479	.024	.744	.031	.654	.024	.635	.015	.581	.911
	3B	.556	.025	.471	.024	.745	.026	.669	.016	.681	.016	.585	.012
	6A	.461	.031	.416	.026	.614	.031	.587	.029	.642	.023	.633	.019
	6B	.398	.082	.405	.025	.567	.046	.603	.029	.643	.021	.599	.025
B	9A	.562	.022	.437	.025	.697	.032	.657	.018	.688	.008	.663	.008
I	9B	.501	.059	.431	.008	.679	.031	.677	.021	.709	.014	.704	.008
A	11A	.471	.018	.403	.023	.610	.034	.590	.016	.710	.031	.649	.021
S	11B	.478	.016	.404	.018	.611	.027	.586	.019	.678	.014	.635	.014
	13A	.458	.027	.402	.045	.642	.031	.611	.037	----	----	.587	.020
L	13B	.435	.025	.366	.023	.643	.043	.584	.022	.620	.019	.593	.012
U	17A	.423	.022	.401	.020	.555	.024	.581	.045	.622	.016	.557	.008
G	17B	.415	.016	.396	.017	.535	.030	.590	.037	.579	.012	.538	.024
	19A	.540	.024	.443	.014	.720	.022	.641	.023	.636	.022	.518	.022
	19B	.483	.021	.431	.024	.670	.029	.622	.030	.660	.026	.582	.016
	21A	.516	.025	.442	.012	.716	.020	.680	.017	.618	.013	.601	.010
	21B	.512	.016	.454	.029	.708	.056	.696	.012	.632	.021	.583	.022
	1A	.437	.031	.387	.020	.730	.027	.681	.022	.604	.022	.582	.029
R	1B	.422	.022	.393	.031	.722	.040	.657	.032	.585	.015	.573	.021
A	7A	.445	.026	.393	.015	.694	.027	.631	.025	.613	.020	.563	.030
D	7B	.475	.020	.410	.027	.694	.031	.658	.024	.613	.010	.582	.020
	14A	.473	.016	.419	.019	.713	.052	.679	.043	.640	.005	.597	.012
R	14B	.474	.020	.410	.027	.646	.051	.604	.036	.661	.015	.613	.012
I	15A	.443	.020	.404	.019	.736	.014	.684	.053	.690	.013	.652	.029
B	15B	.448	.023	.390	.030	.747	.014	.712	.031	.762	.052	.689	.039
RE	26A	.505	.025	.424	.029	.847	.041	.756	.024	.815	.024	.738	.039
CAP	26B	.485	.018	.454	.026	.848	.032	.766	.037	.780	.019	.696	.024

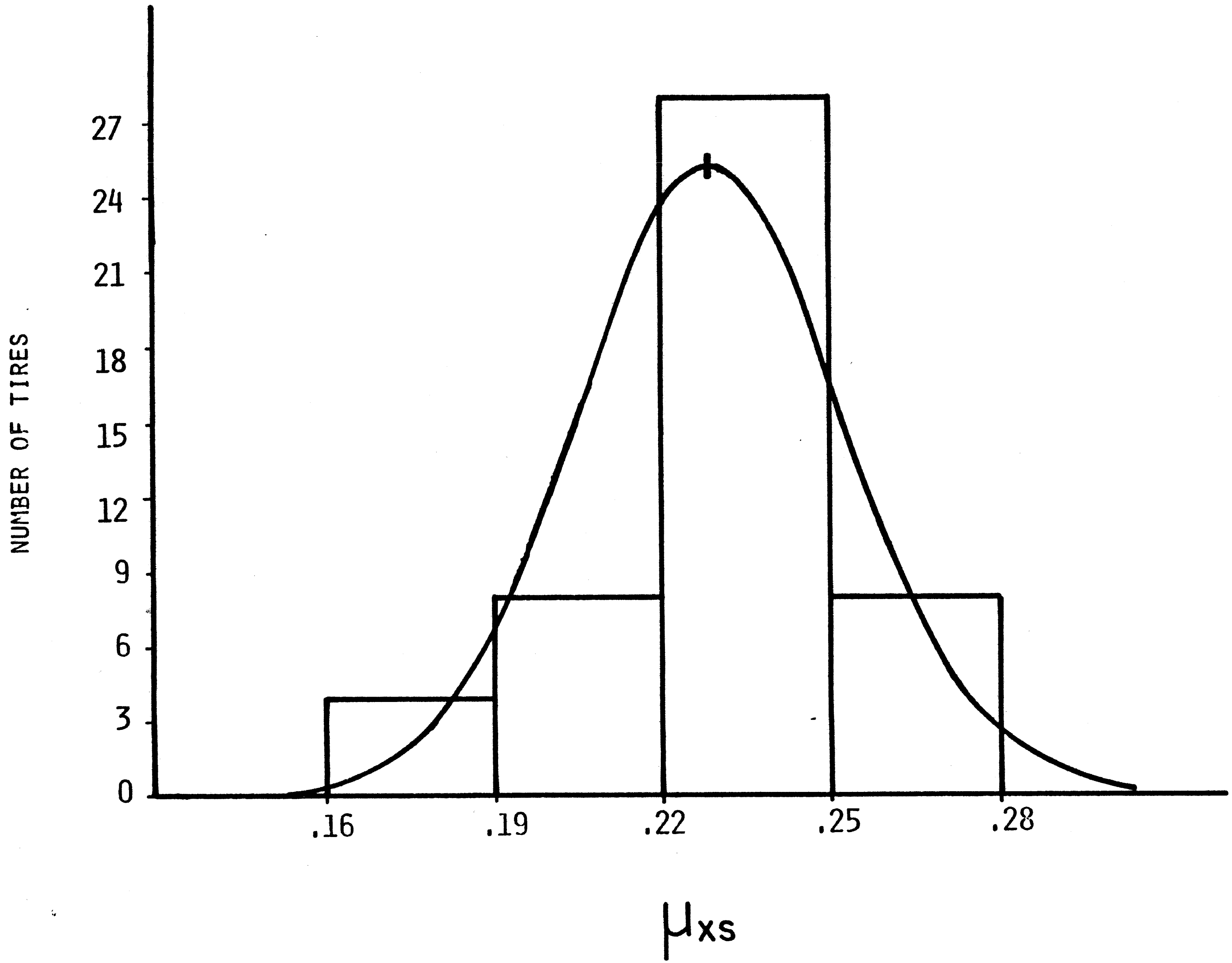

Fig. 14
Histogram of Test Sample Distribution for Locked Wheel Braking Coefficient (μ_{xs}) at 40 MPH on Concrete and a Prediction of the Population Distribution

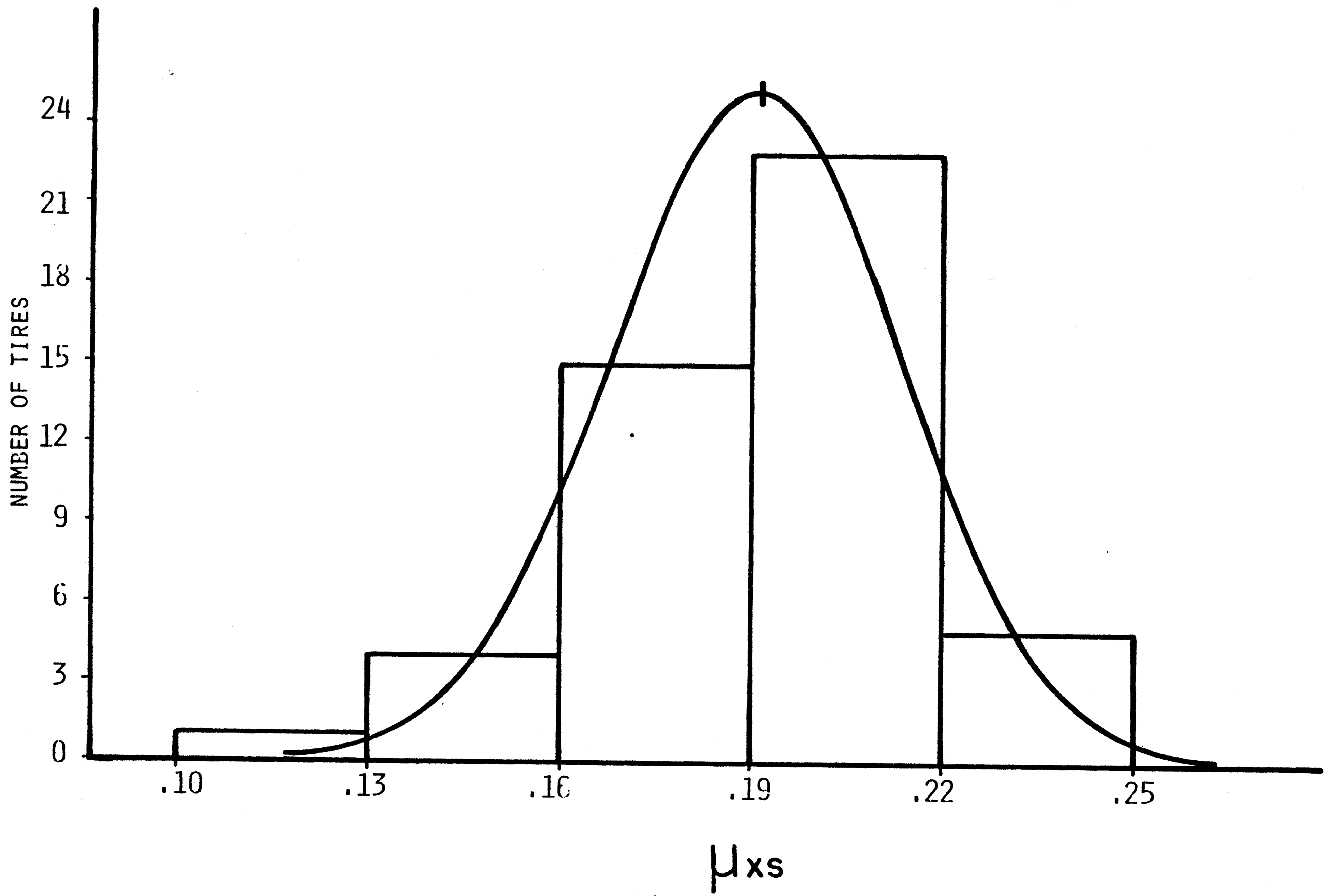

Fig. 15

Histogram of the Test Sample Distribution for Locked Wheel Braking Coefficient (μ_{xs}) at 55 MPH on Concrete and a Prediction of the Population Distribution

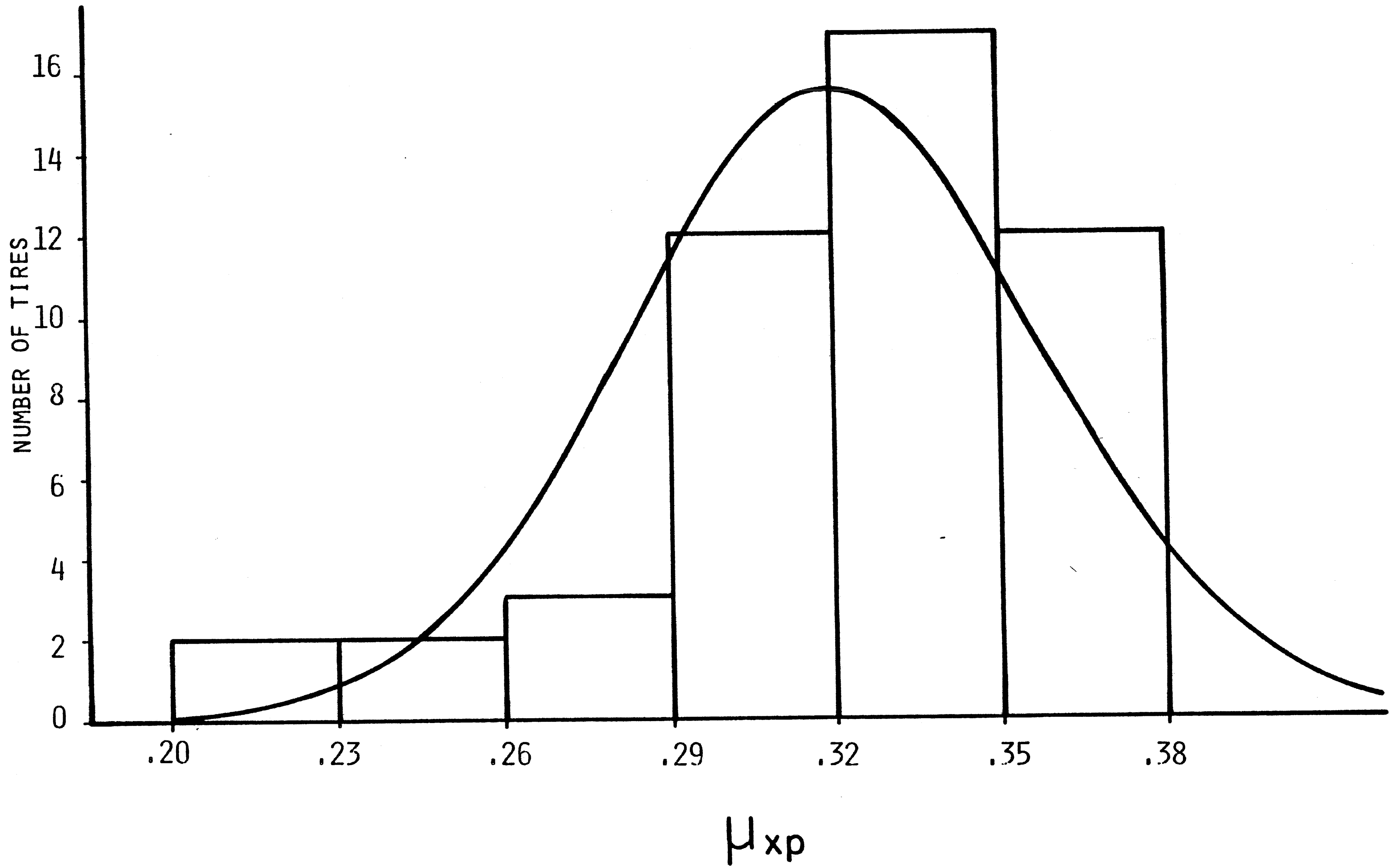

Fig. 16

Histogram of the Test Sample Distribution for Peak Braking Force Coefficient (μ_{xp}) at 40 MPH on Concrete and a Prediction of the Population Distribution

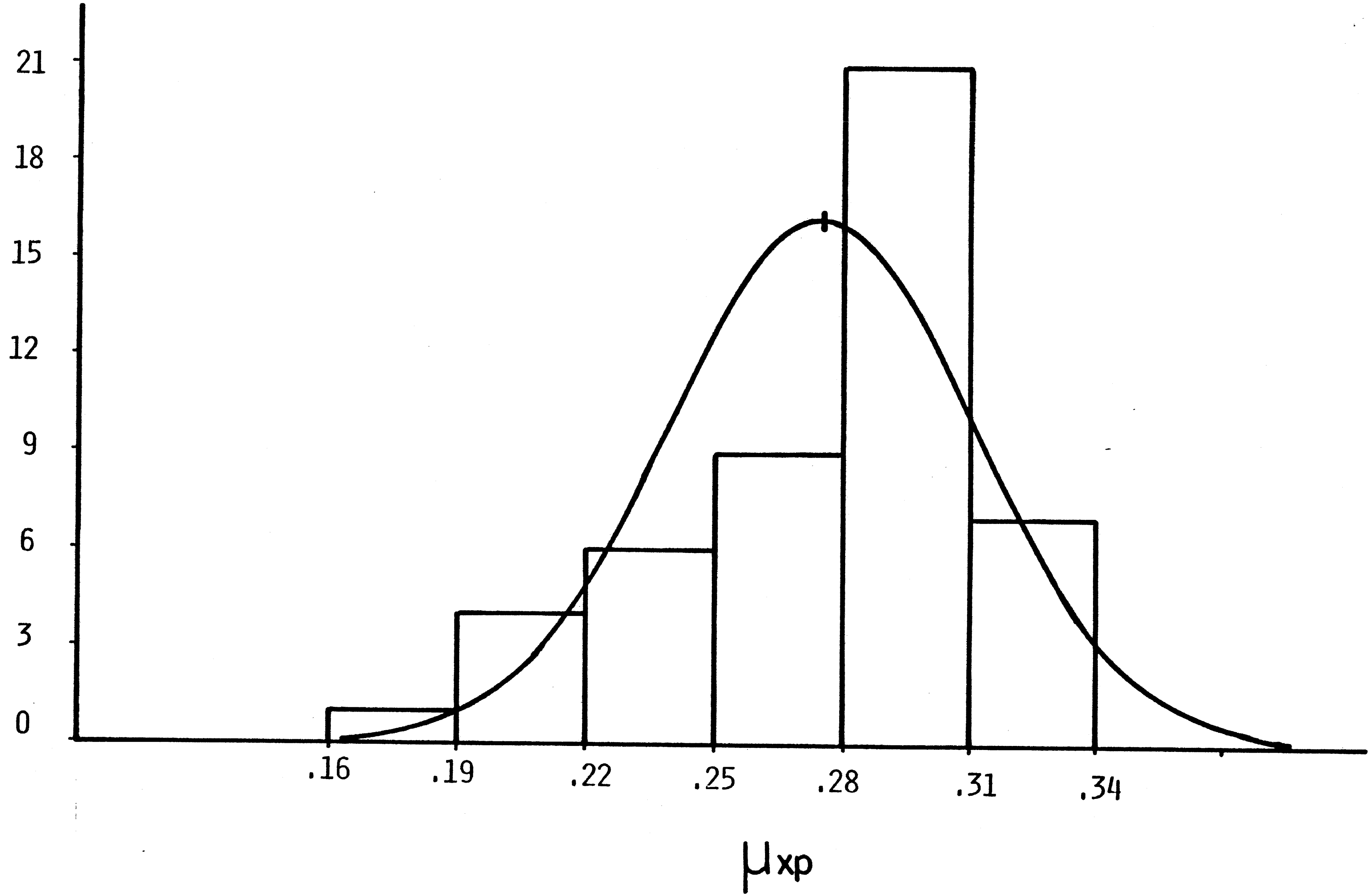

Fig. 17
Histogram of the Test Sample Distribution for Peak Braking Force Coefficient (μ_{xp}) at 55 MPH on Concrete and a Prediction of the Population Distribution

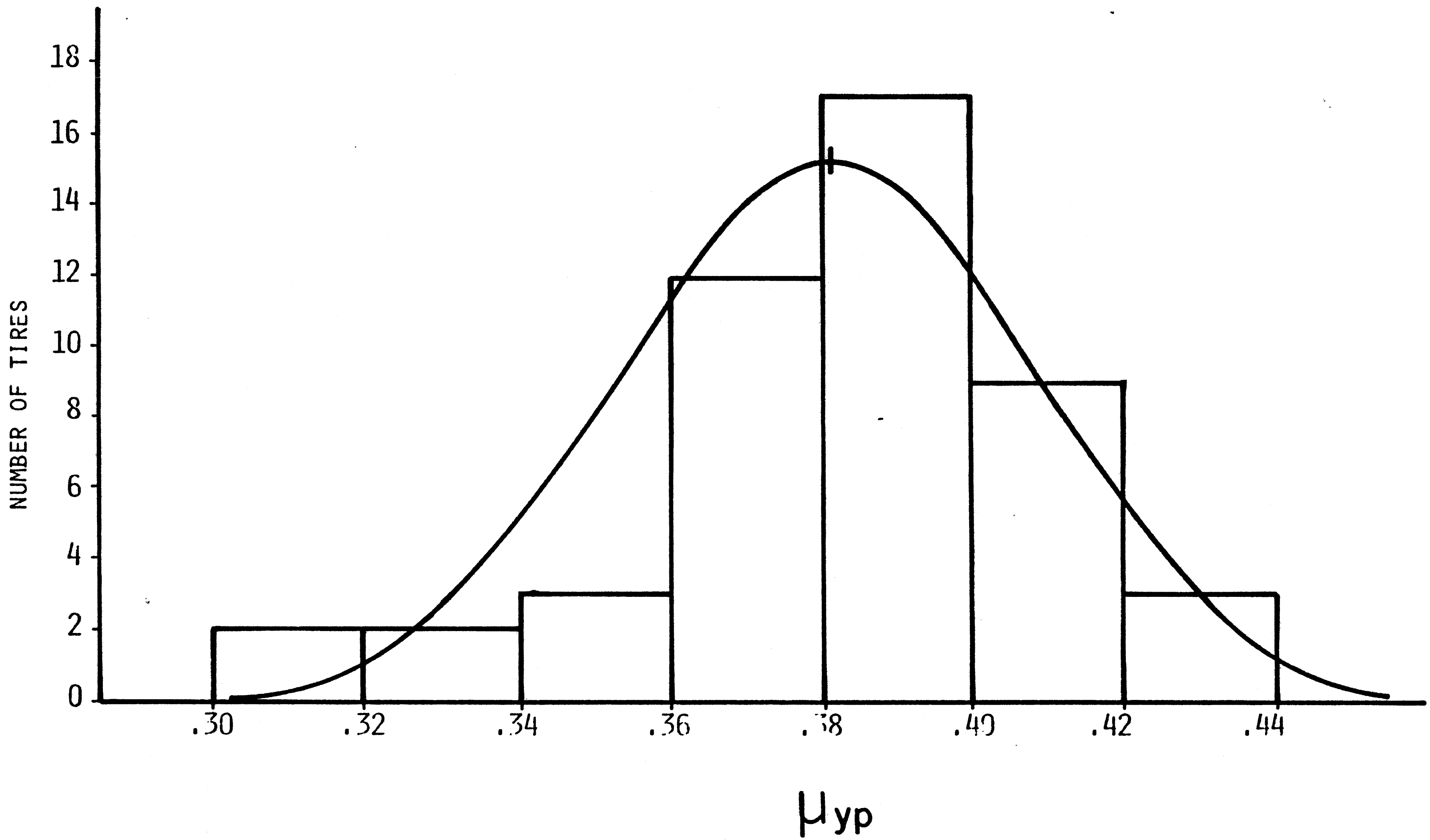

Fig. 18

Histogram of the Test Sample Distribution for Peak Lateral Force Coefficient (μ_{yp}) at 40 MPH on Concrete and a Prediction of the Population Distribution

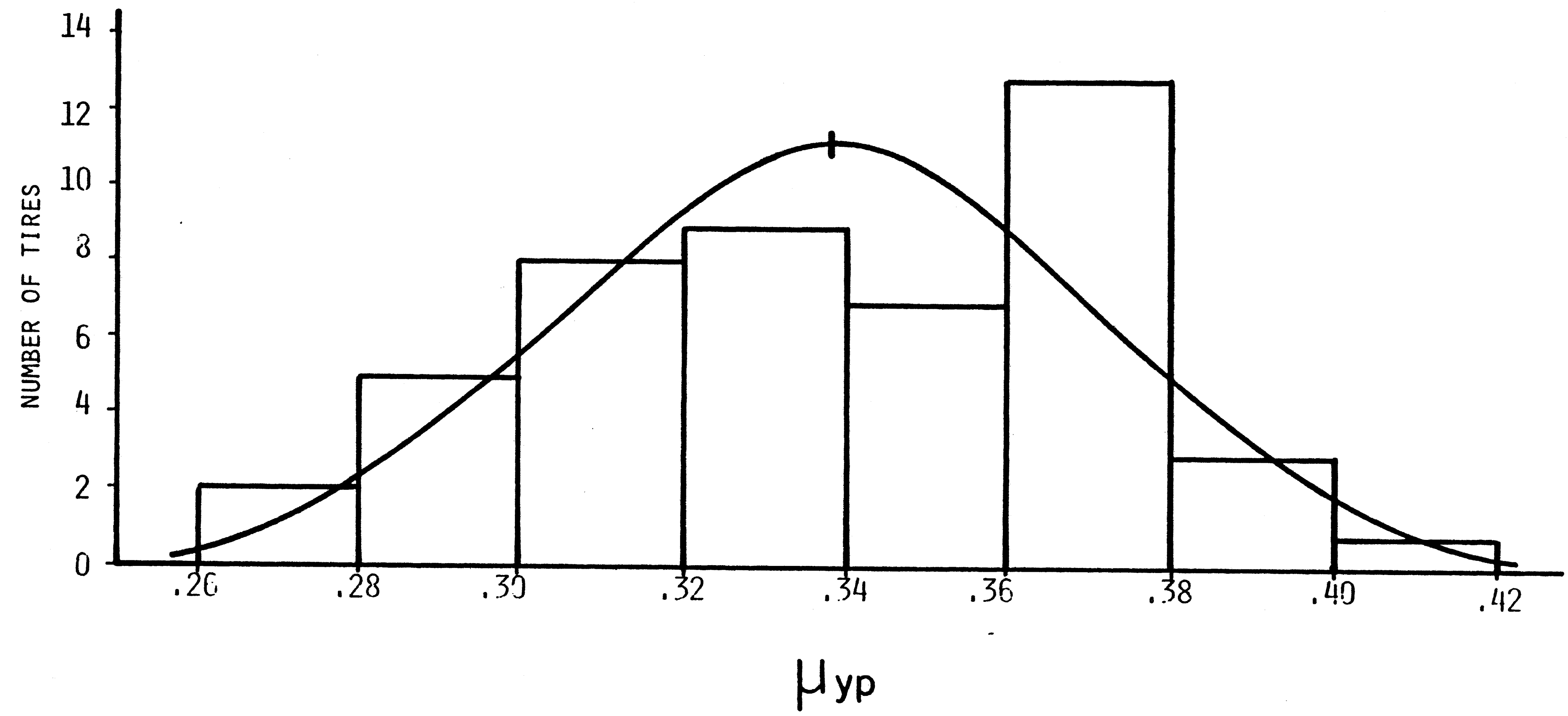

Fig. 19

Histogram of the Test Sample Distribution for Peak Lateral Force Coefficient (μ_{yp}) at 55 MPH on Concrete and a Prediction of the Population Distribution

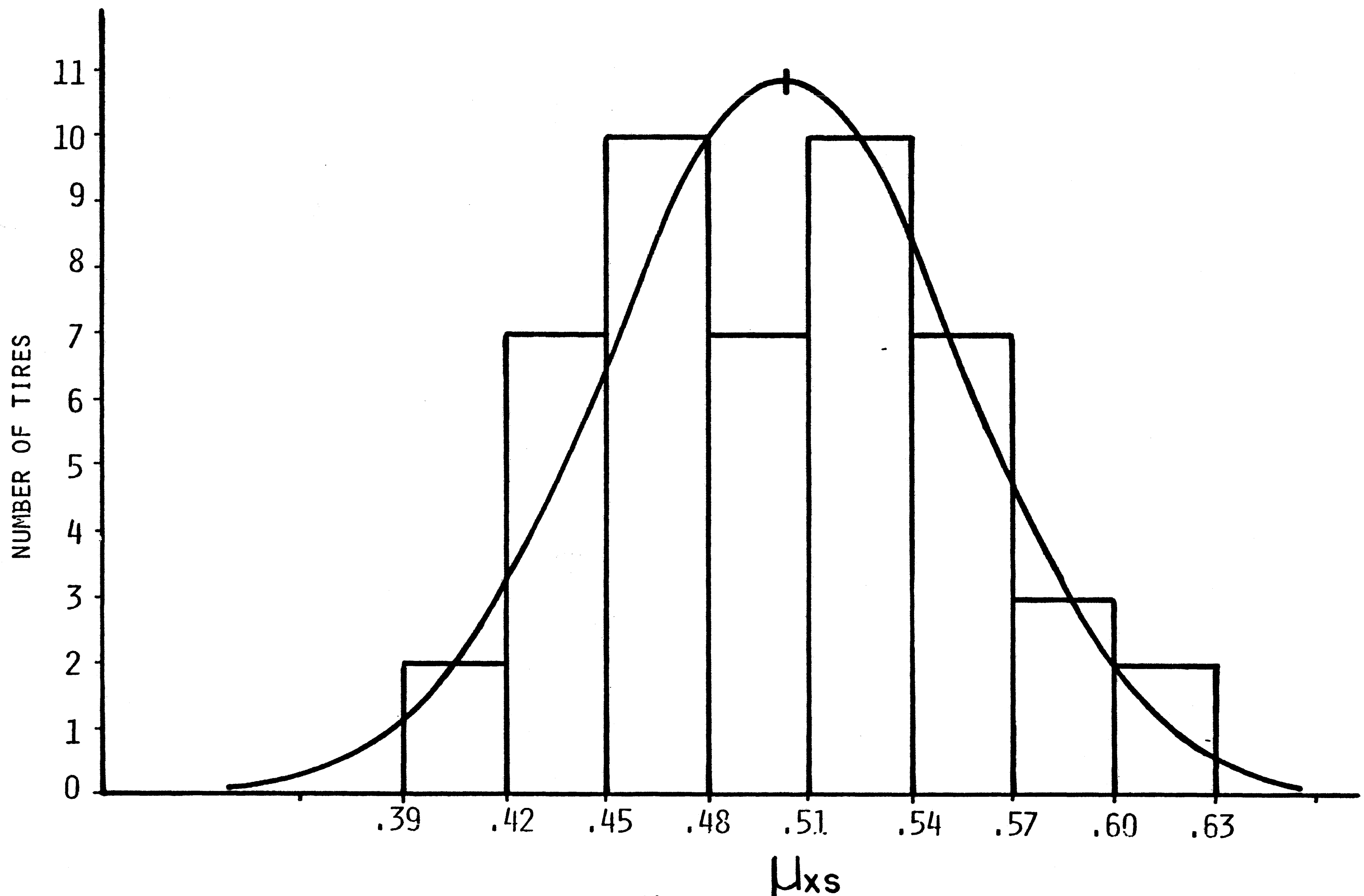

Fig. 20

Histogram of Test Sample Distribution for Locked Wheel Braking Coefficient (μ_{xs}) at 40 MPH on Asphalt and a Prediction of the Population Distribution

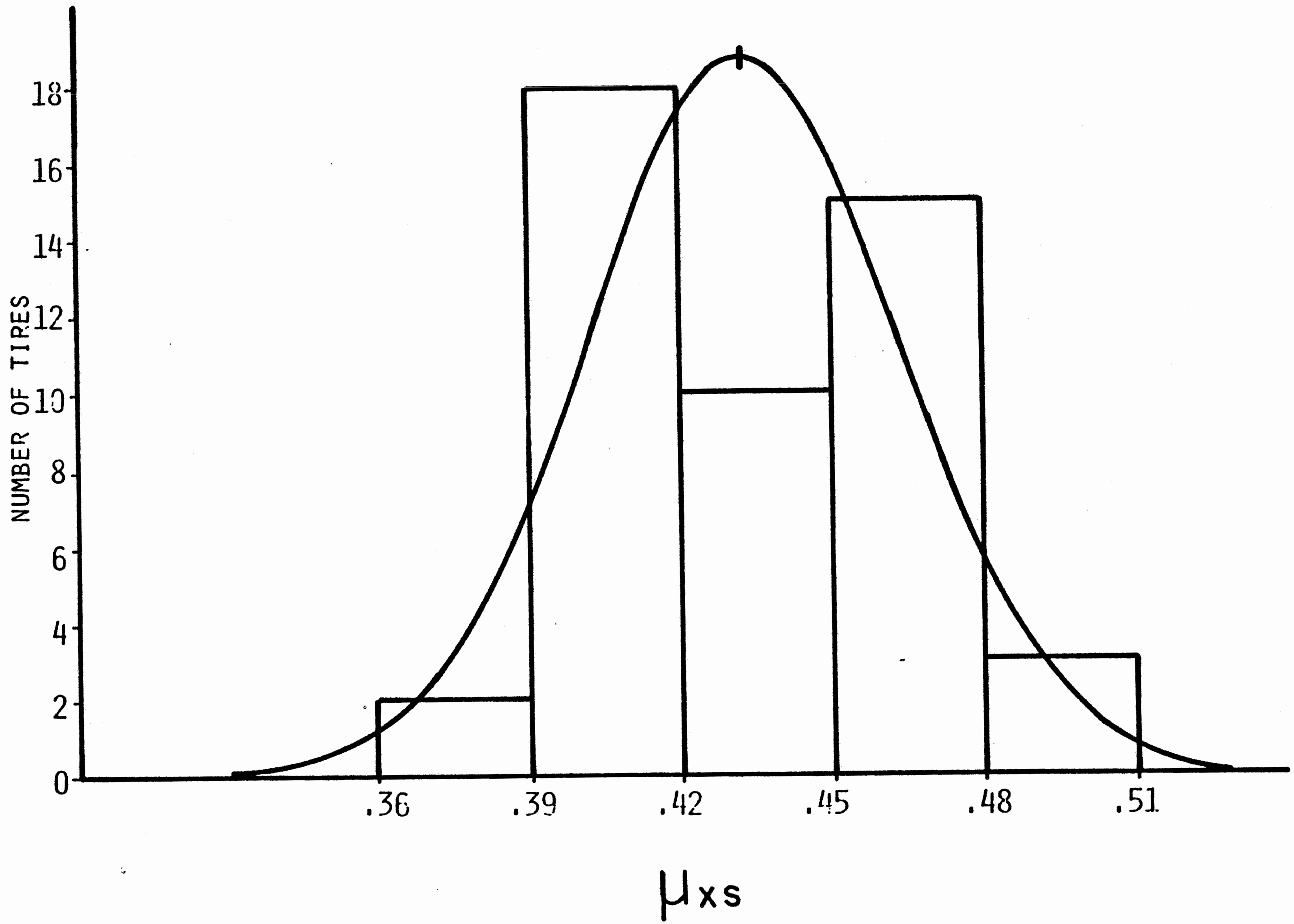

Fig. 21
Histogram of Test Sample Distribution for Locked Wheel Force Coefficient (μ_{xs}) at 55 MPH on Asphalt and a Prediction of the Population Distribution

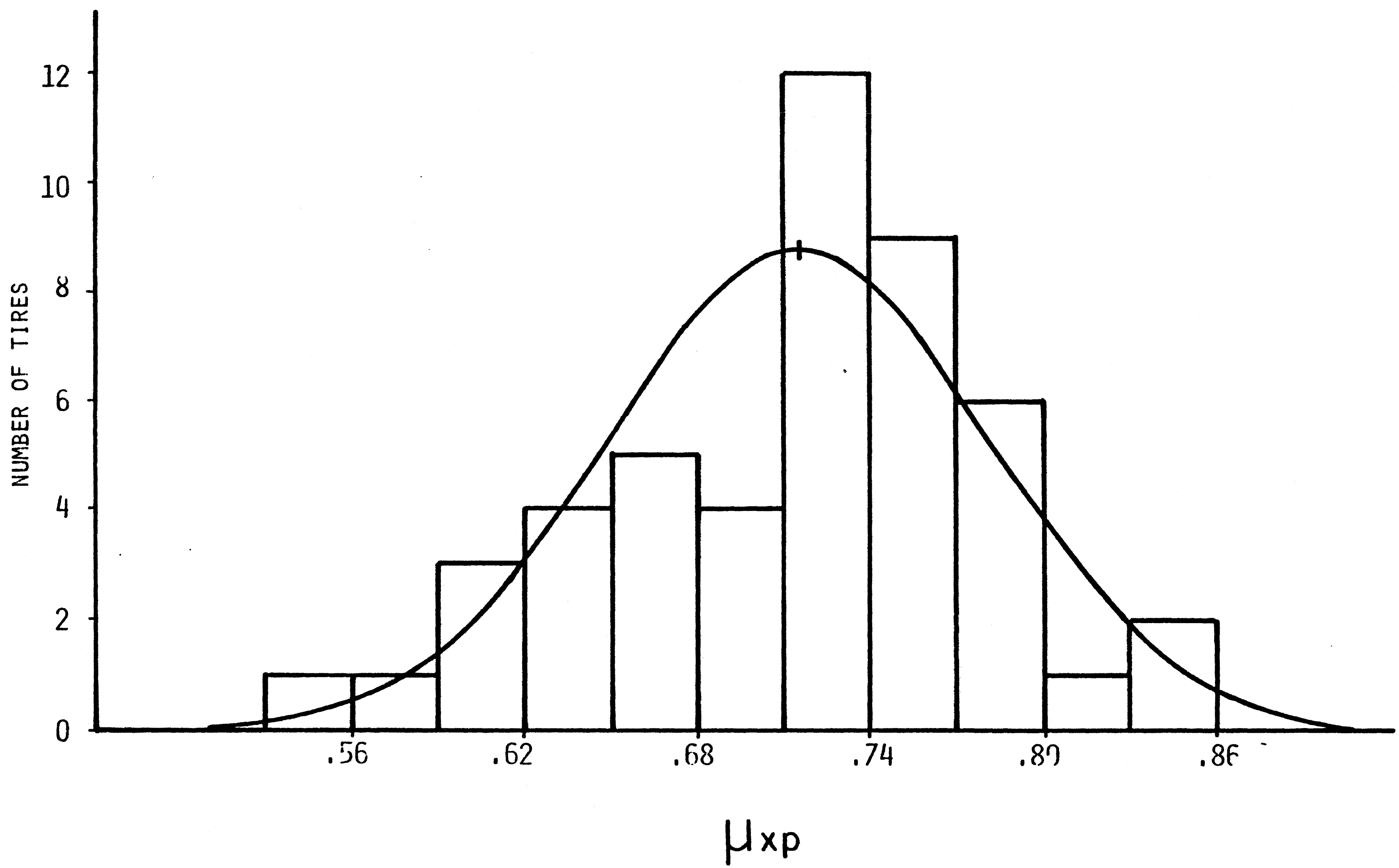

Fig. 22
Histogram of Test Sample Distribution for Peak Braking Force Coefficients (μ_{xp}) at 40 MPH on Asphalt and a Prediction of the Population Distribution

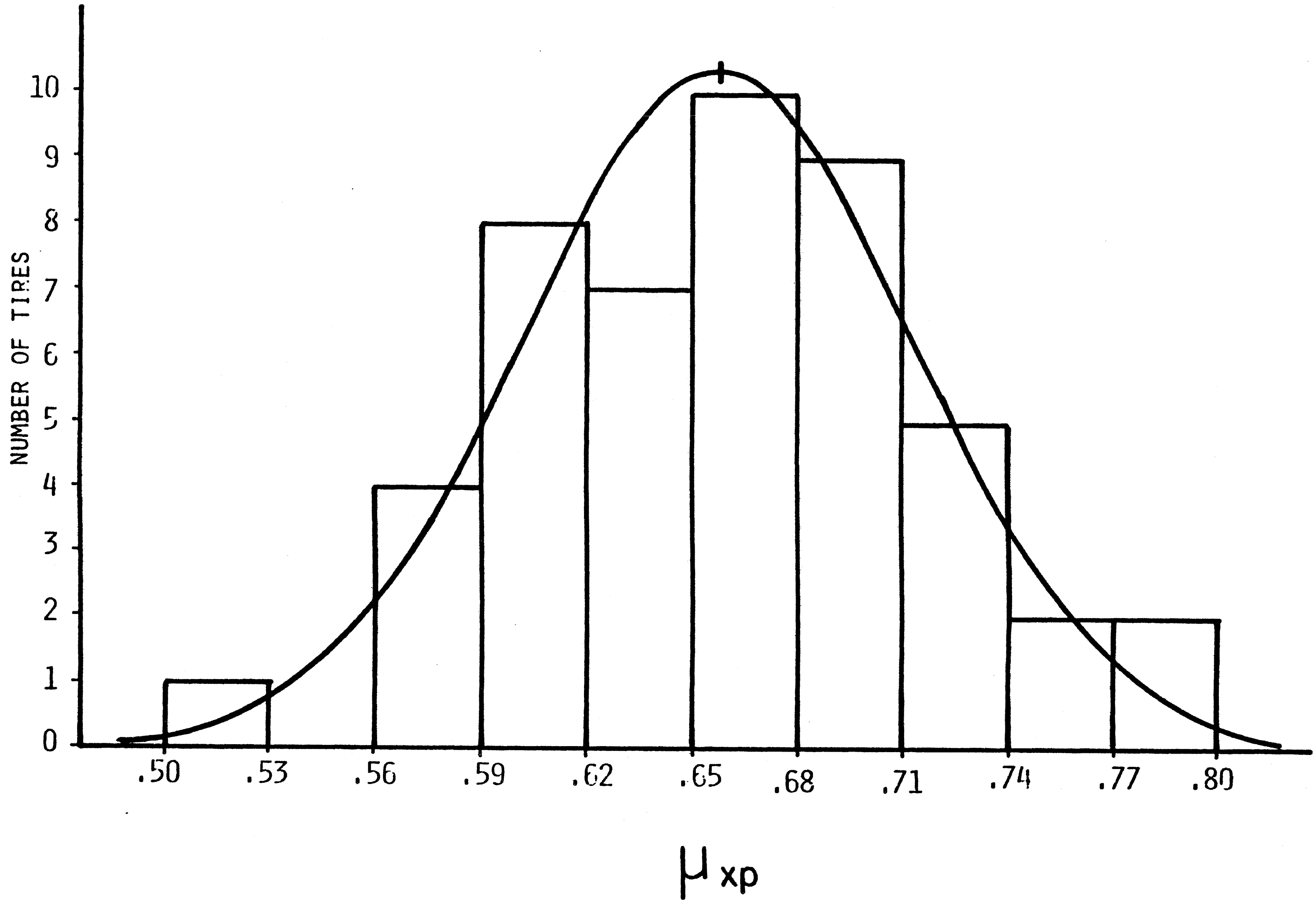

Fig. 23
Histogram of Test Sample Distribution for Peak Braking Force Coefficient (μ_{xp}) at 55 MPH on Asphalt and a Prediction of the Population Distribution

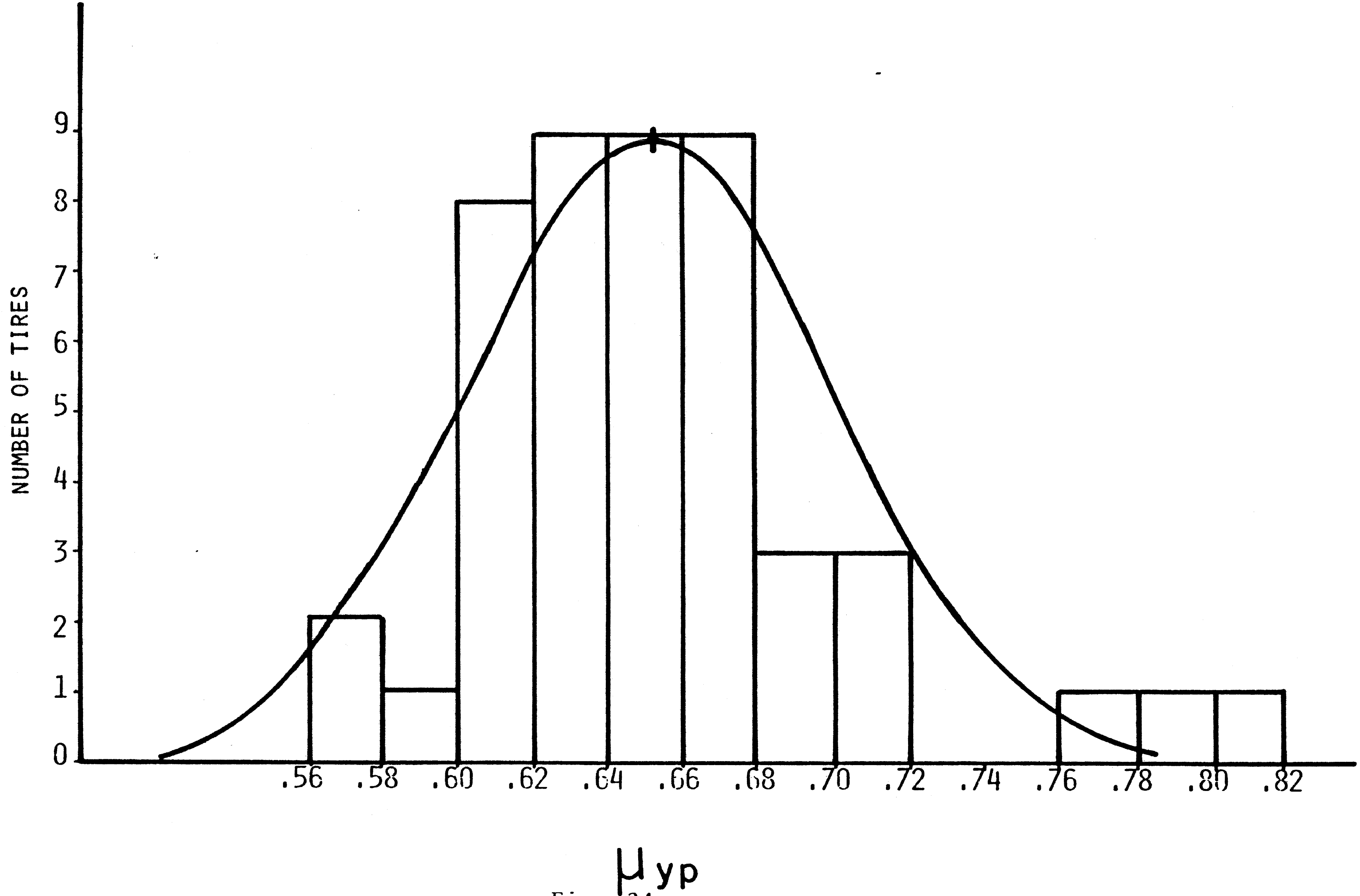

Fig. 24

Histogram of Test Sample Distribution for Peak Lateral Force Coefficient (μ_{yp}) at 40 MPH on Asphalt and a Prediction of the Population Distribution

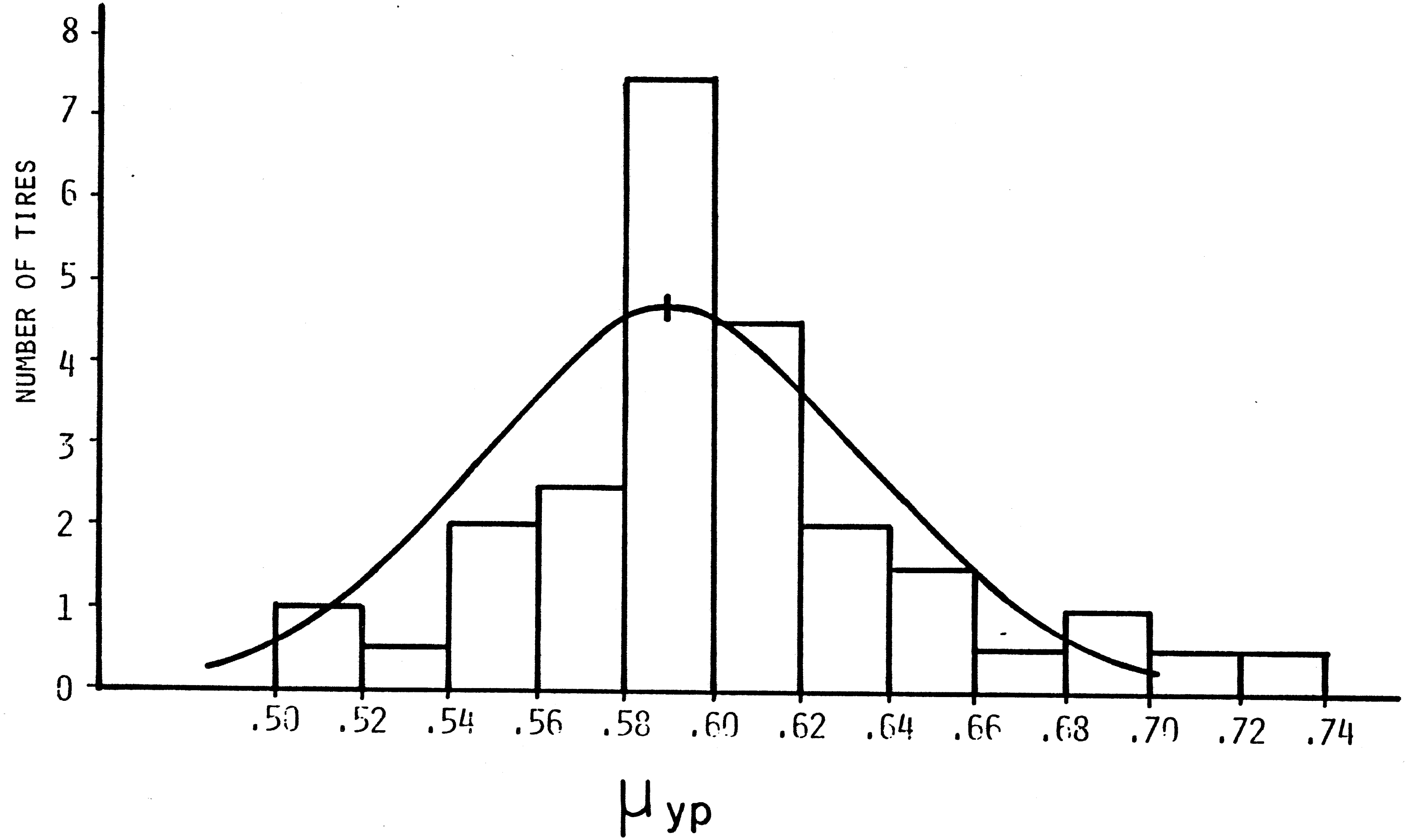

Fig. 25

Histogram of Test Sample Distribution for Peak Lateral Force Coefficient (μ_{yp}) at 55 MPH on Asphalt and a Prediction of the Population Distribution

TABLE 4. SAMPLE MEAN AND STANDARD DEVIATION FOR EACH TRACTION PROPERTY AT EACH SPEED AND SURFACE

Property Mean & Standard Deviation	Asphalt		Concrete	
	40 mph	55 mph	40 mph	55 mph
$\bar{\mu}_{xs}$	0.497	0.433	0.229	0.191
s	0.048	0.031	0.023	0.023
$\bar{\mu}_{xp}$	0.716	0.660	0.320	0.276
s	0.065	0.053	0.037	0.036
$\bar{\mu}_{yp}$	0.652	0.602	0.381	0.339
s	0.048	0.045	0.027	0.034

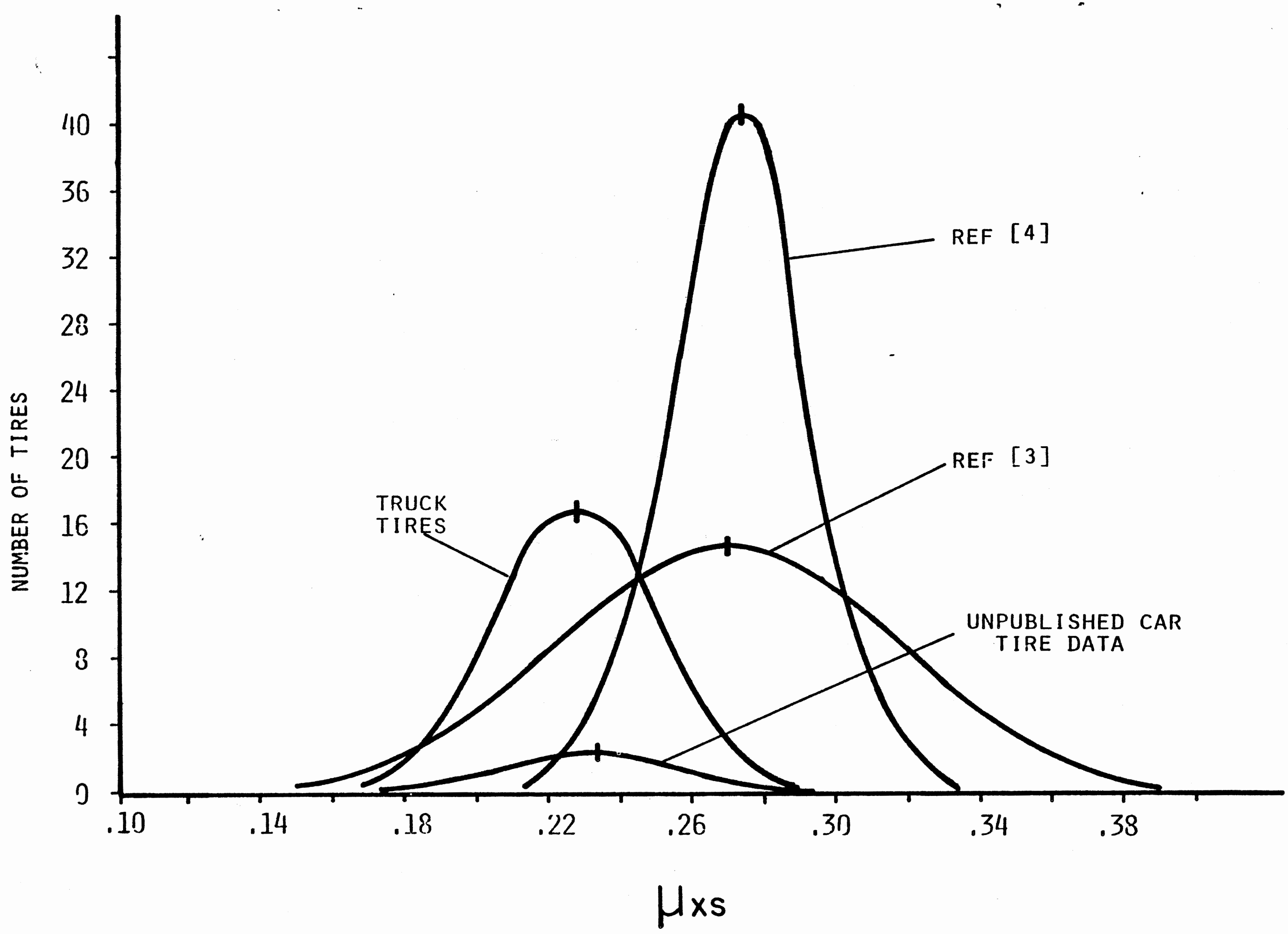

Fig. 26

Comparison of Locked Wheel Braking Force Coefficient (μ_{xs}) for Truck Tire and Car Tire Populations on Concrete

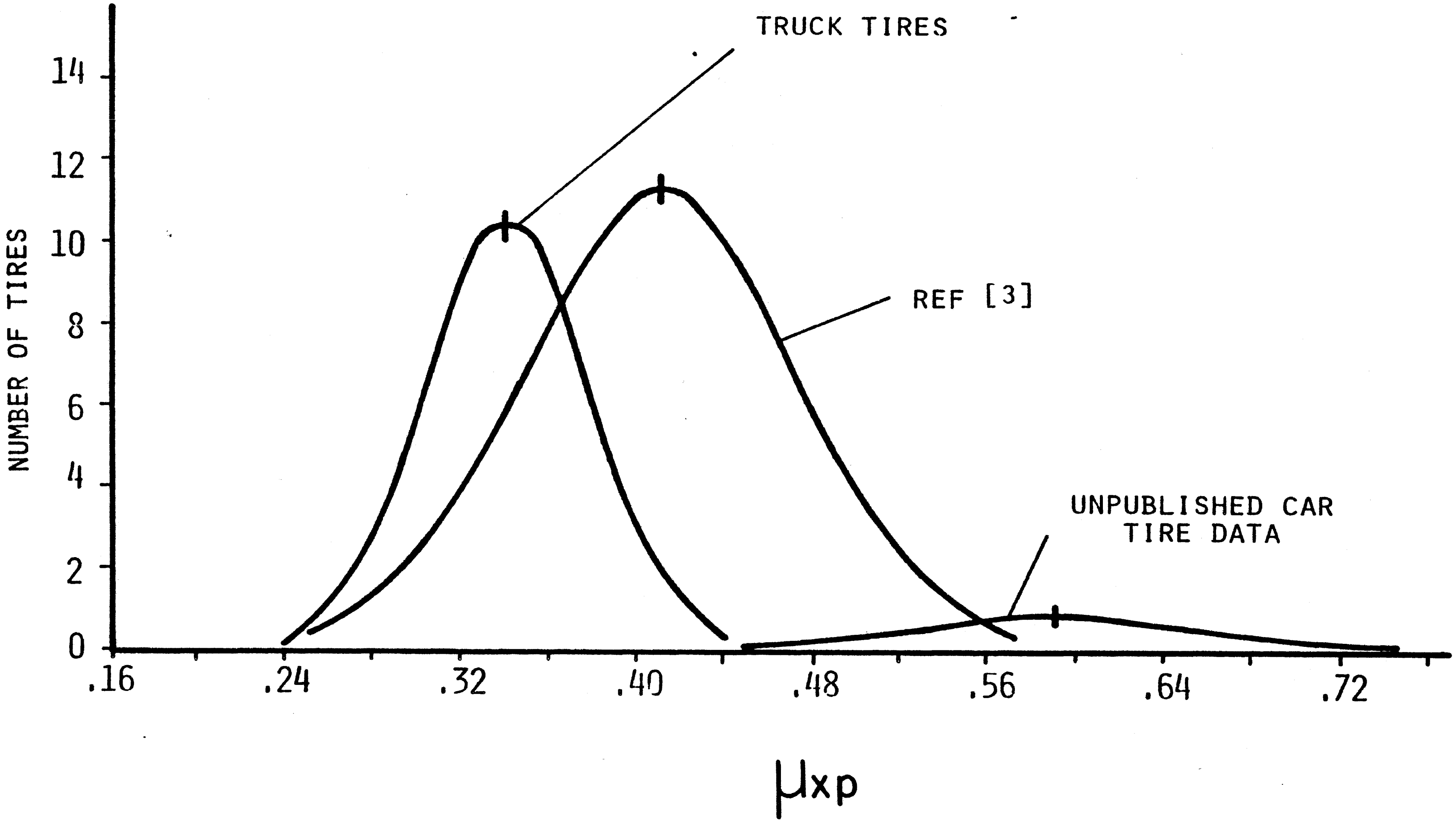

Fig. 27
Comparison of Peak Braking Force Coefficient (μ_{xp}) for Truck Tire and Car Tire Populations on Concrete

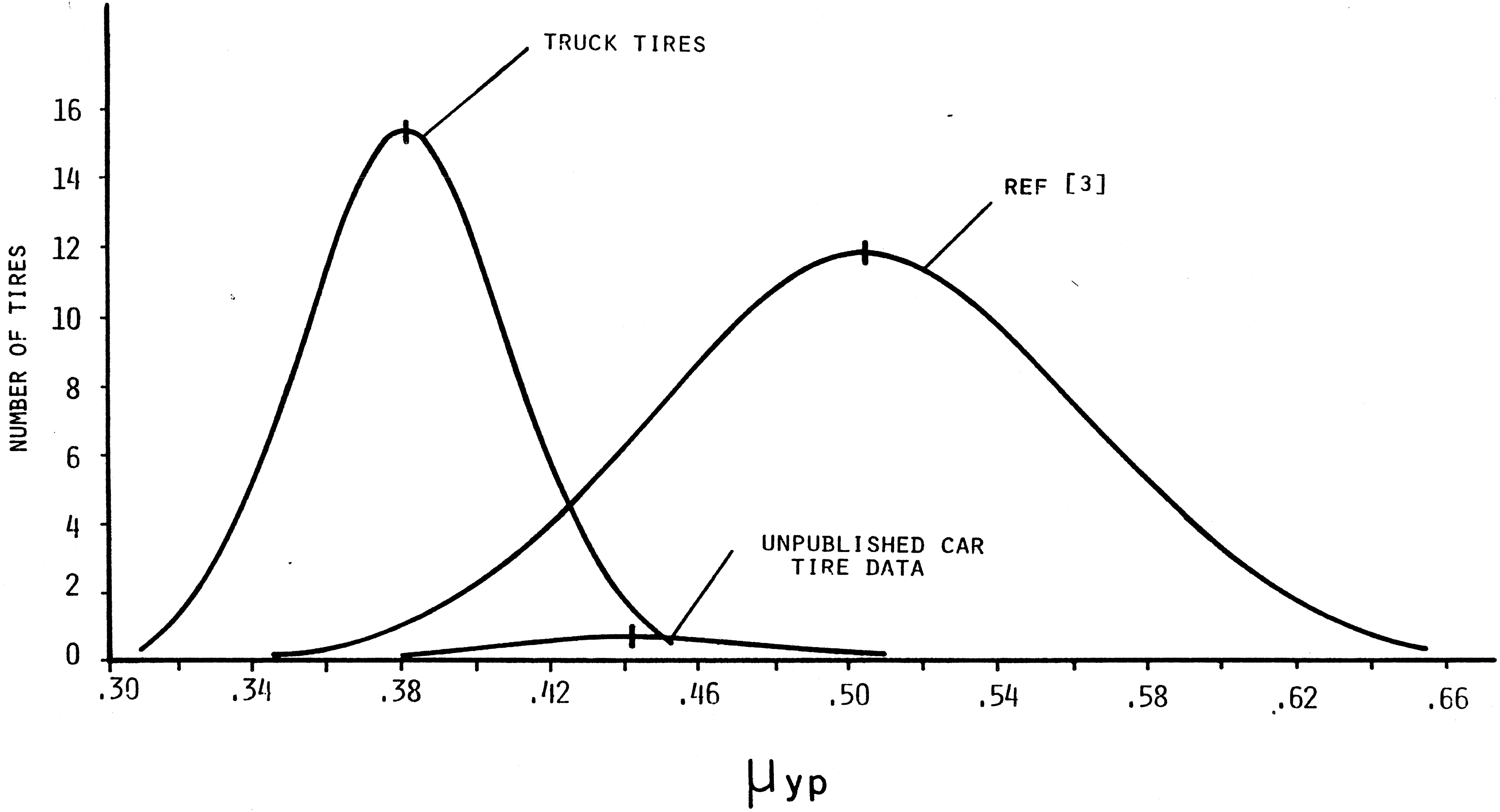

Fig. 28
Comparison of Peak Lateral Force Coefficient (μ_{yp}) for Truck Tire and Car Tire Populations on Concrete

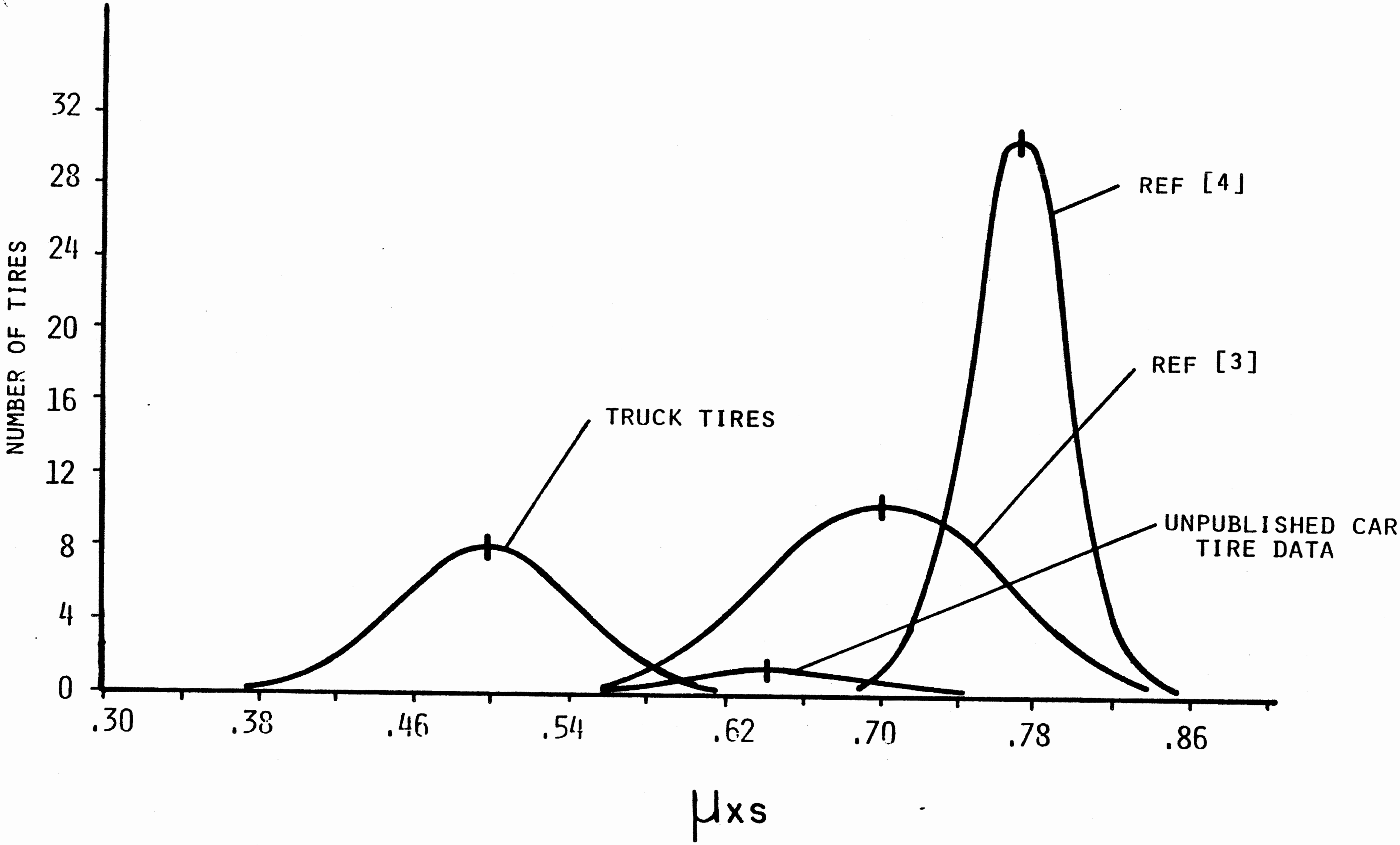

Fig. 29
Comparison of Locked Wheel Braking Force Coefficient (μ_{xs}) for Truck Tire and Car Tire Populations on Asphalt

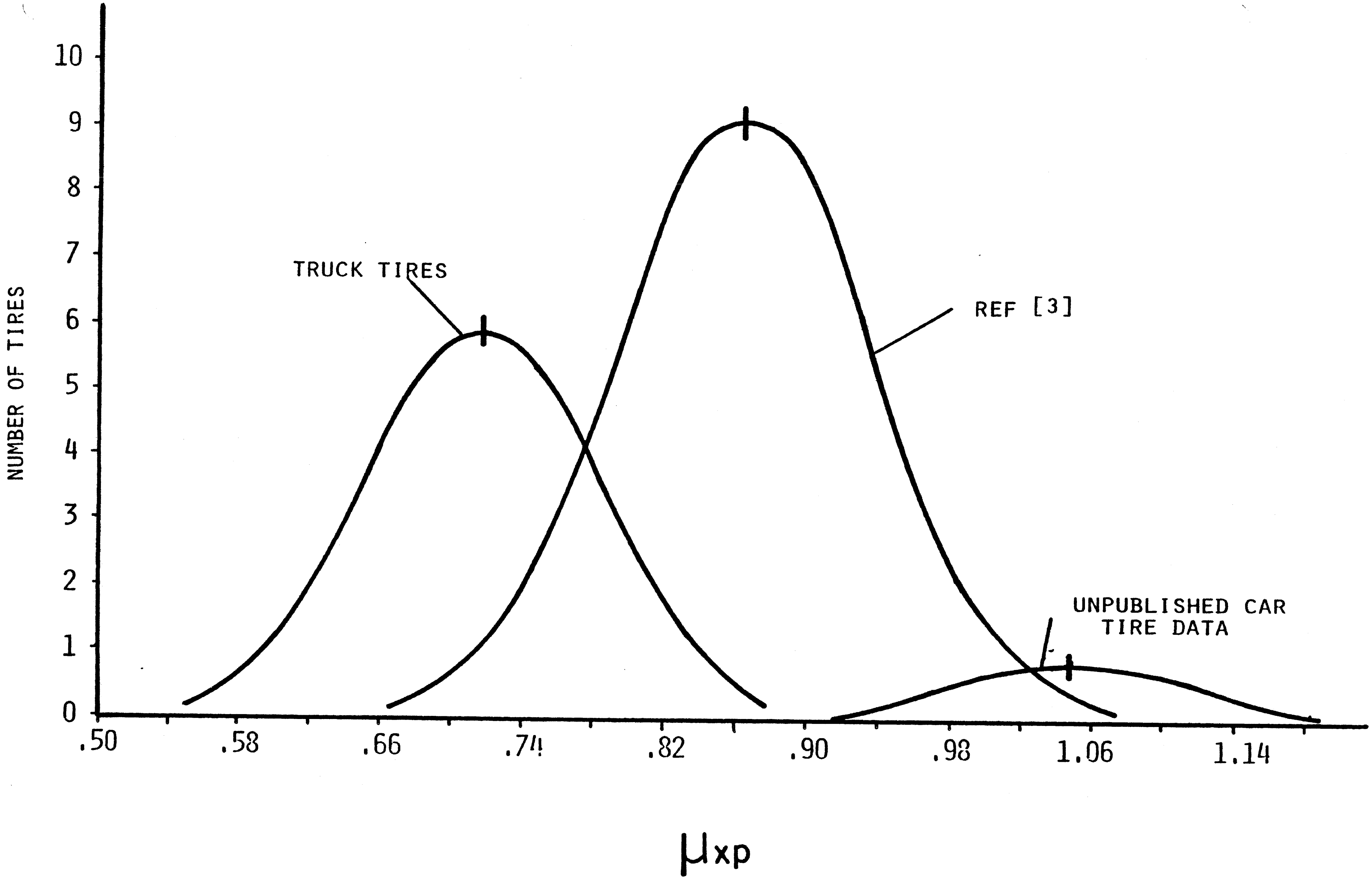

Fig. 30

Comparison of Peak Braking Force Coefficient (μ_{xp}) for Truck Tire and Car Tire Populations on Asphalt

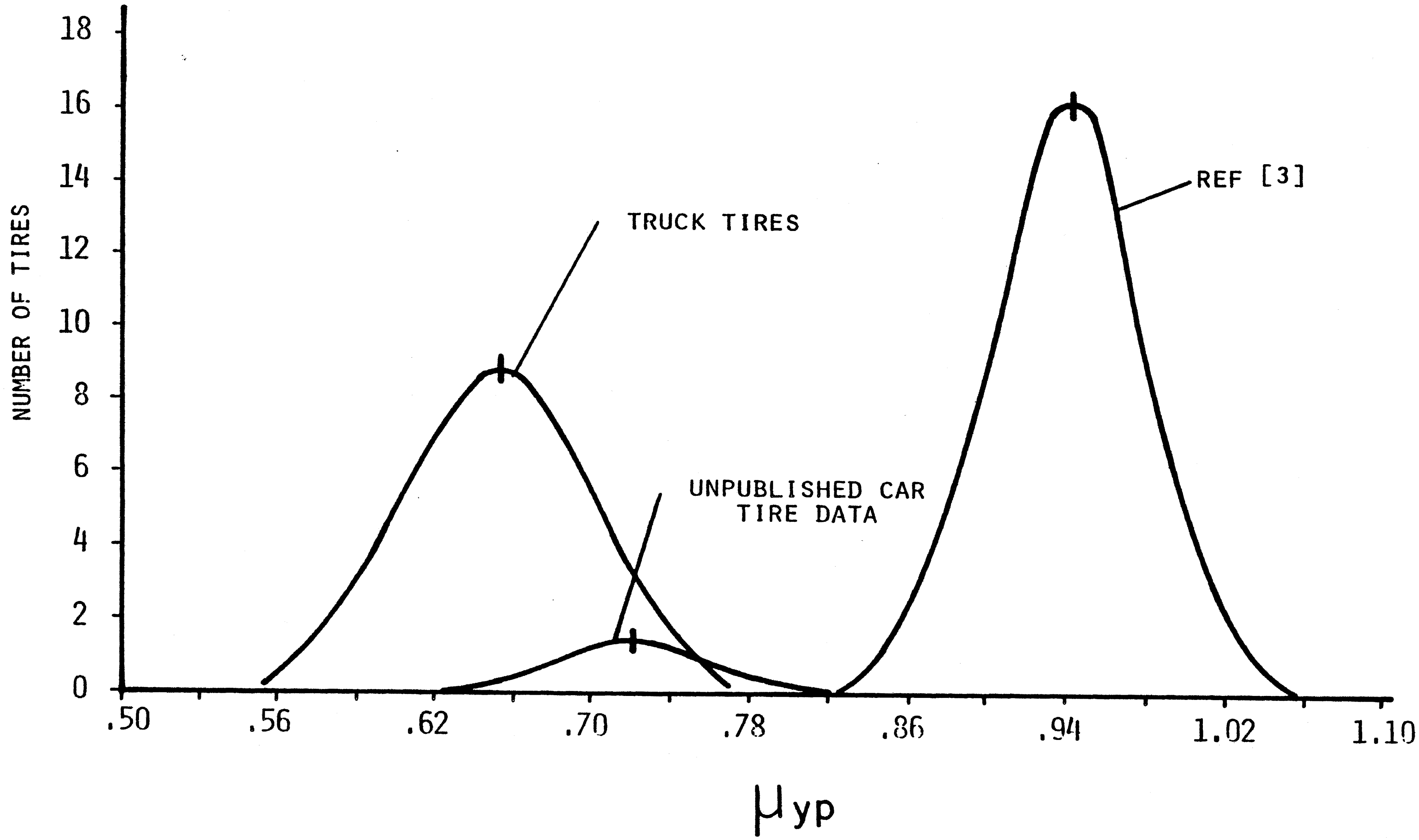

Fig. 31
Comparison of Peak Lateral Force Coefficient (μ_{yp}) for Truck Tire and Car Tire Populations on Asphalt

TABLE 4. SAMPLE MEAN AND STANDARD DEVIATION FOR EACH TRACTION PROPERTY AT EACH SPEED AND SURFACE

Property Mean & Standard Deviation	Asphalt		Concrete	
	40 mph	55 mph	40 mph	55 mph
$\bar{\mu}_{xs}$	0.497	0.433	0.229	0.191
s	0.048	0.031	0.023	0.023
$\bar{\mu}_{xp}$	0.716	0.660	0.320	0.276
s	0.065	0.053	0.037	0.036
$\bar{\mu}_{yp}$	0.652	0.602	0.381	0.339
s	0.048	0.045	0.027	0.034

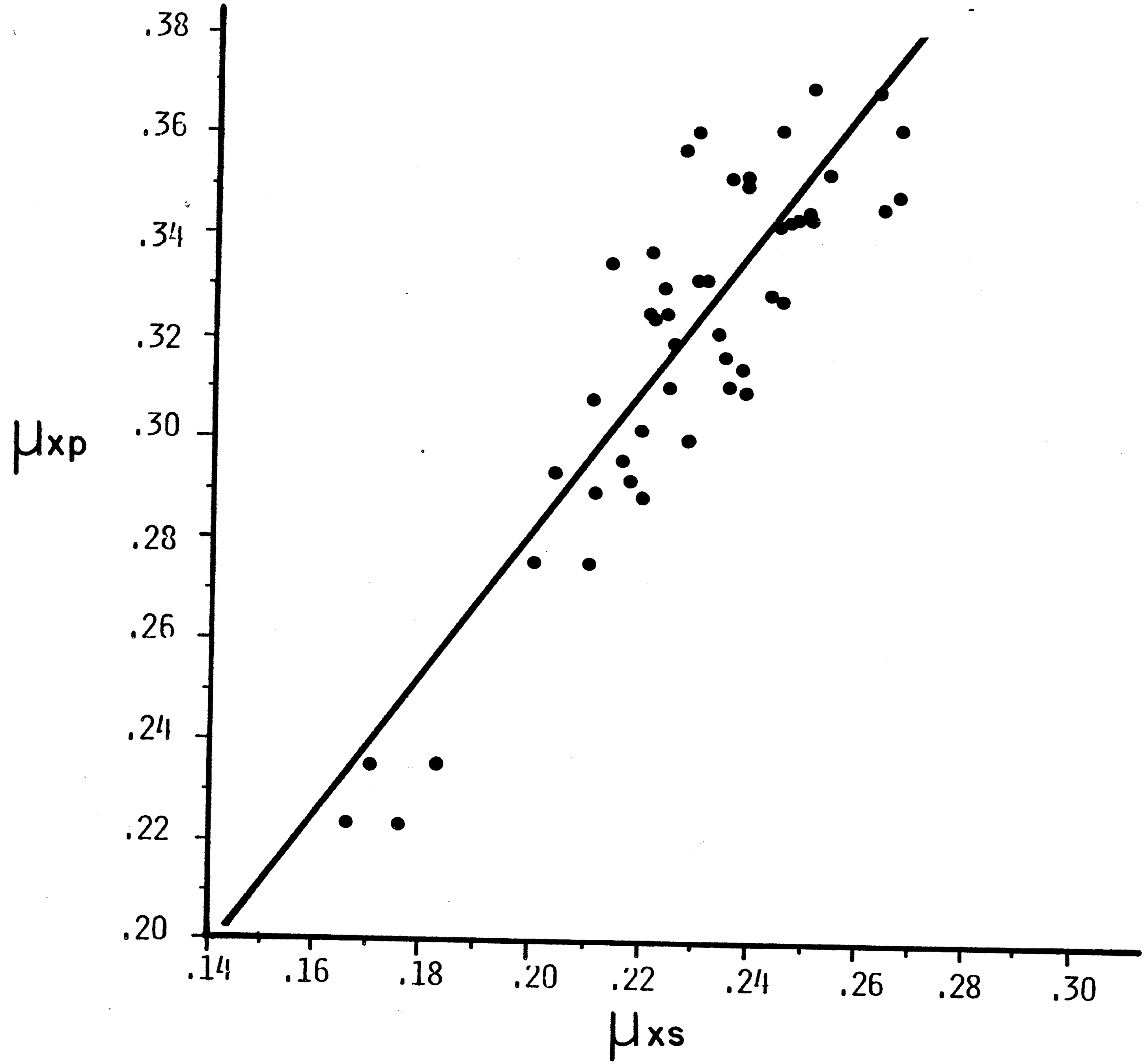

Fig. 32

Linear Regression Line Relating the Peak Braking Force Coefficient (μ_{xp}) and the Locked Wheel Braking Force Coefficient (μ_{xs}) Measurement on Concrete at 40 MPH

TABLE 5. CORRELATION BETWEEN TRACTION PROPERTIES

COMPARISON	ASPHALT		CONCRETE	
	40 mph	55 mph	40 mph	55 mph
μ_{xs} vs. μ_{xp}	.563	.400	.876	.720
μ_{xs} vs. μ_{yp}	. 20	. 05	.005	.057
μ_{yp} vs. μ_{xp}	-. 23	. 06	.405	.285

Tire: Highway Tread 10-20/G (New) Rim: 20x7.50

LATERAL SOURCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1400	50	261	472	795	1099	1210	1304
	85	252	449	706	1027	1159	1342
	100	210	416	759	1120	1195	1152
2800	50	405	757	1323	1991	2291	2548
	85	444	771	1282	1945	2253	2613
	100	366	727	1356	2083	2294	2242
4200	50	451	859	1562	2510	3033	3459
	85	536	991	1708	2666	3171	3725
	100	479	958	1809	2859	3247	3275
5430	50	447	861	1630	2768	3471	4043
	85	589	1117	1966	3147	3833	4520
	100	552	1102	2068	3374	3932	4034
6700	50	427	833	1572	2848	3733	4447
	85	605	1171	2136	3533	4377	5197
	100	603	1182	2257	3747	4494	4710
100	50	414	806	1507	2806	3825	4609
	85	611	1193	2233	3813	4838	5785
	100	631	1244	2325	4000	4967	5353
9200	50	405	790	1433	2672	3803	4500
	85	611	1189	2217	3927	--	--
	100	640	1258	2229	4083	5070	--

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1400	50	21	36	41	18	3	2
	85	21	32	35	21	7	1
	100	17	29	40	30	8	0
2800	50	58	100	134	101	55	27
	85	56	89	104	82	45	25
	100	42	79	119	97	45	11
4200	50	92	166	246	223	145	93
	85	91	150	196	174	113	72
	100	72	137	217	203	112	49
430	50	124	223	350	350	258	183
	85	118	200	278	272	186	131
	100	97	188	302	313	191	88

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD (Continued)

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
6700	50	161	283	451	522	407	310
	85	148	253	365	383	278	208
	100	120	234	403	443	289	143
8100	50	183	342	561	715	606	406
	85	180	311	463	515	406	311
	100	146	295	471	595	418	222
9200	50	209	395	647	868	768	--
	85	205	353	537	632	--	--
	100	168	335	594	727	468	--

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
5430	50	50,000	2857
	85		4363
	100		5532

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18

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-22.6	-331.4	298.9	-616.2	576.5	-1046.6	999.5	-1493.8	1375.0	-1598.8	1572.7	-1713.1	1644.0
100.0	4000.0	-12.5	-576.4	550.5	-1101.0	1058.0	-1947.3	1878.1	-2710.1	2673.2	-2919.5	2878.1	-3054.1	2958.6
100.0	6000.0	13.6	-652.9	642.6	-1284.1	1250.9	-2391.0	2314.7	-3453.5	3380.4	-3835.7	3787.6	-4020.5	3922.7
100.0	8000.0	19.7	-664.2	652.6	-1267.7	1281.6	-2480.4	2435.8	-3842.2	3777.5	-4499.6	4473.4	-4798.3	4700.1
75.0	4000.0	-1.8	-608.3	560.4	-1128.0	1071.4	-2012.6	1928.3	-2782.1	2666.3			-3179.0	3102.5
75.0	6000.0	14.7	-607.3	609.6	-1202.4	1200.7	-2280.8	2228.1	-3419.3	3280.9			-4145.2	4082.0
50.0	4000.0	3.0	544.9	541.3	-1025.9	1060.9	1924.0	1863.8	-2627.8	2591.0			-3131.0	2937.0
50.0	6000.0	15.9		562.1	-1007.7	1050.8	-1941.7	1921.7	-3083.8	2966.3			-4028.2	3855.5

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-4.5	37.4	-37.4	54.0	-58.8	64.4	-78.0	47.5	-36.2	20.1	-26.6	8.7	-6.3
100.0	4000.0	-2.2	104.6	-113.3	187.0	-189.3	252.3	-257.0	169.2	-164.4	76.7	-82.5	41.9	-33.6
100.0	6000.0	-1.1	174.5	-180.2	315.9	-317.3	467.3	-471.7	325.9	-319.2	166.1	-167.0	73.5	-80.3
100.0	8000.0	-2.2	229.6	-238.8	436.8	-442.5	682.5	-686.4	545.9	-538.7	297.3	-309.4	130.7	-135.7
75.0	4000.0	-3.4	121.1	-124.4	212.9	-214.8	285.1	-283.2	178.6	-168.7			29.3	-32.7
75.0	6000.0	-6.3	187.8	-202.4	350.5	-361.5	514.1	-518.3	376.7	-366.4			99.9	-111.5
50.0	4000.0	-7.9	145.3	-155.9	271.3	-272.0	341.6	-340.4	192.1	-200.6			27.9	-35.9
50.0	6000.0	-16.9	204.6	-242.5	418.5	-427.5	606.5	-605.0	438.9	-429.8			136.7	-145.3

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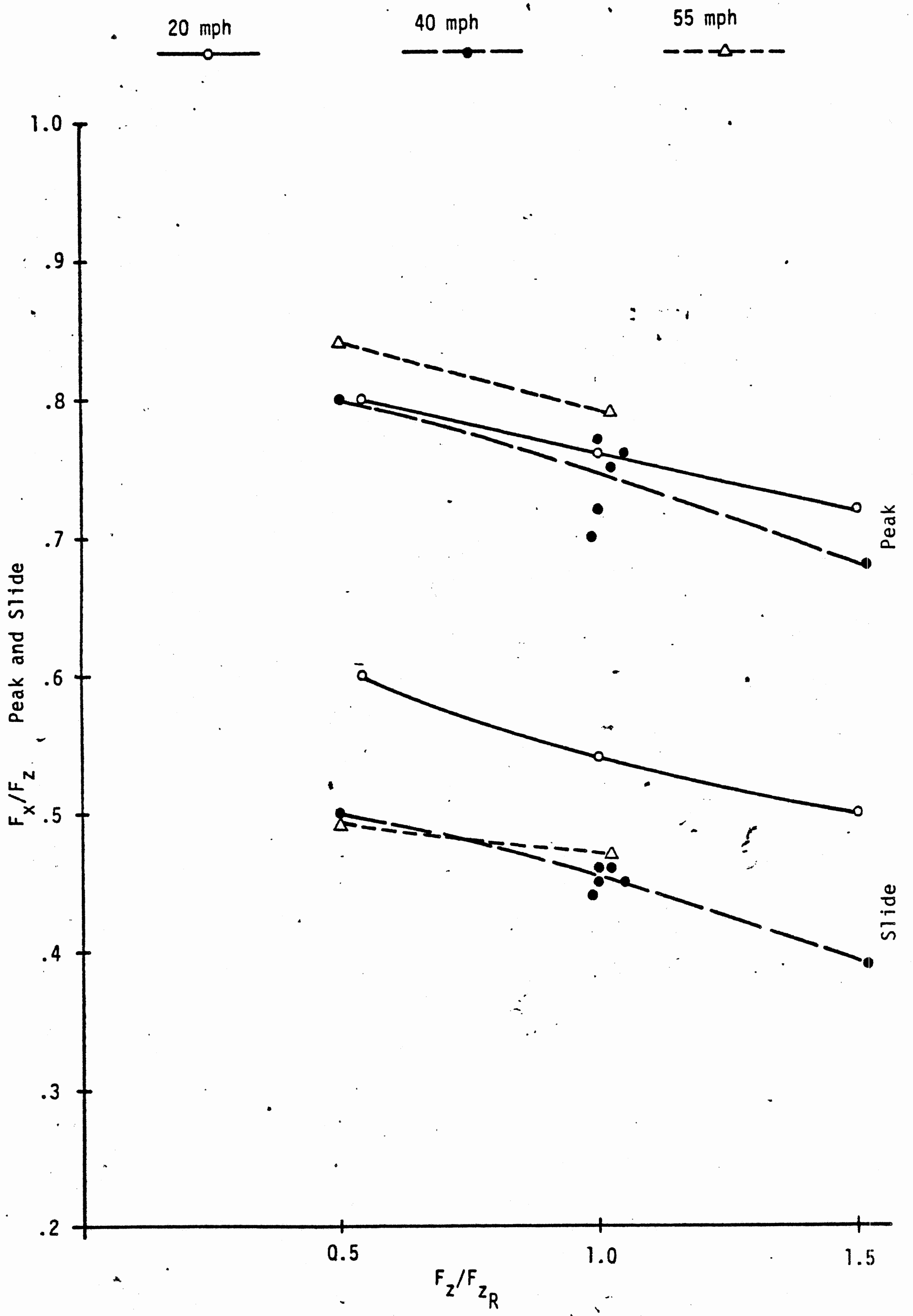
LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-10.7	-321.9	278.9	-569.2	531.1	-908.6	936.2	-1540.1	1479.5	-1760.0	1691.0	-1911.0	1797.7
100.0	4000.0	6.2	-581.8	589.4	-1083.8	1084.9	-1913.4	1833.8	-2880.0	2803.2	-3318.0	3238.0	-3533.0	3415.6
100.0	6000.0	19.5	-743.3	798.7	-1455.7	1464.3	-2630.1	2542.0	-3951.0	3859.2	-4475.0	4368.0	-4715.0	4615.3
100.0	8000.0	20.3	-823.8	875.8	-1688.9	1668.0	-3113.8	3016.6	-4692.0	4640.4	-5399.0	5293.0	-5668.0	5587.4
75.0	4000.0	7.2	-612.0	645.9	-1206.3	1181.3	-2040.6	1998.1	-2805.6	2683.7			-3458.2	3068.8
75.0	6000.0	29.7	-734.1	784.4	-1478.7	1500.7		2632.0	-3723.4	3617.0			-4561.9	4148.8
50.0	4000.0	18.3	-607.6	647.4	-1231.3	1226.9	-2062.3	2015.3	-2733.5	2622.7			-3195.1	3202.7
50.0	6000.0	21.1	-672.6	708.1	-1394.7	1392.3	-2582.9	2511.0	-3449.4	3437.8			-4242.8	4291.2

20

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-3.6	-23.8	-26.1	40.6	-43.3	54.8	-53.6	44.4	-39.9	12.3	-27.4	8.5	-6.6
100.0	4000.0	-8.8	71.2	-80.1	124.0	-131.6	175.6	-170.8	164.2	-147.5	104.8	-94.6	48.0	-40.3
100.0	6000.0	-13.0	123.5	-139.8	223.2	-234.4	331.8	-326.4	321.5	-299.2	227.1	-202.7	116.9	-106.9
100.0	8000.0	-16.8	178.2	-202.3	327.3	-350.6	510.8	504.9	495.5	475.5	364.0	-343.6	187.0	-185.9
75.0	4000.0	-11.0	81.4	-103.1	150.7	-161.0	184.7	-186.0	139.6	-121.0			39.9	-26.8
75.0	6000.0	-20.9	136.5	-176.0	266.6	-289.3		-359.5	294.6	-273.7			119.8	-122.1
50.0	4000.0	-17.4	96.1	-125.5	182.2	-196.7	198.5	-206.6	167.1	-133.3			47.6	-19.5
50.0	6000.0	-30.9	155.1	-212.3	314.8	-348.7	394.0	-419.1	358.1	-302.6			142.7	-99.7



Summary - Michelin Radial XZA - 11 R 20H

** A-D FILE 124 W FILE 64 TEST SAMPLE170 **

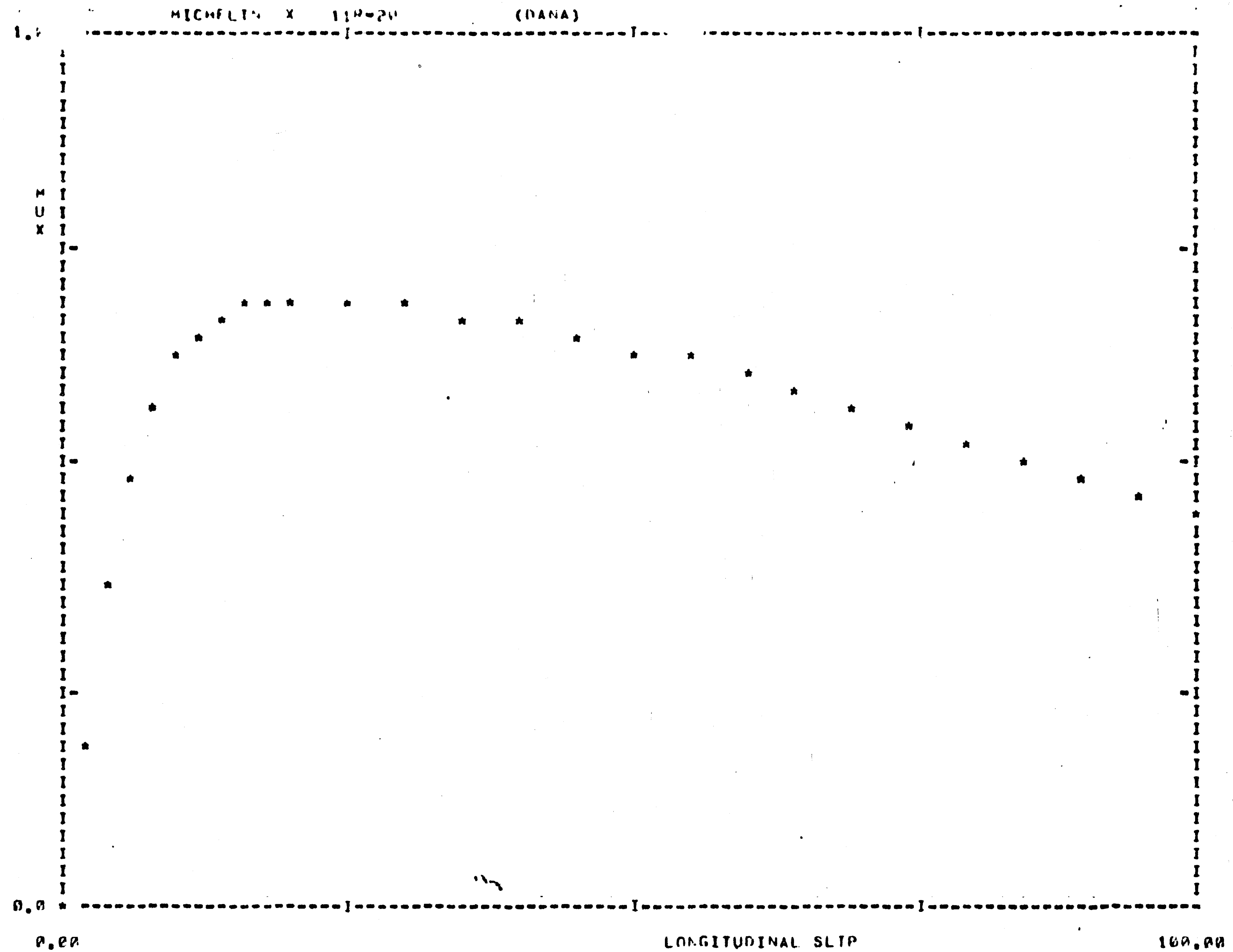
AVERAGE OF FILE 124 FOR 5 RECORDS, MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	29133.3	1384.4
0.04	0.37	56237.6	2629.3
0.06	0.49	74919.6	3489.1
0.08	0.57	88798.9	4073.8
0.10	0.65	97423.3	4449.4
0.12	0.66	104141.3	4684.3
0.14	0.68	108947.4	4816.2
0.16	0.69	112541.2	4884.4
0.18	0.70	115414.4	4914.2
0.20	0.70	117461.4	4910.4
0.25	0.70	121701.3	4860.3
0.30	0.69	125454.6	4793.1
0.35	0.68	128755.2	4713.4
0.40	0.67	131816.5	4621.2
0.45	0.66	134901.6	4512.0
0.50	0.64	137929.4	4389.9
0.55	0.62	140247.7	4263.4
0.60	0.61	140387.7	4136.7
0.65	0.59	136625.7	4019.3
0.70	0.57	129316.2	3901.7
0.75	0.56	118917.8	3769.7
0.80	0.53	106266.5	3624.6
0.85	0.51	93534.6	3481.9
0.90	0.49	82413.4	3338.0
0.95	0.47	72399.3	3195.0
1.00	0.44	63750.0	3054.0

TOAV = 63750.0 LOAD = 7102.1 VEL = 40.0 MPH.

MUPEAK = 0.70 MULOCK = 0.44 RATIO = 1.58

450



FZ = 7102.1 VEL = 40.0 MULOCK = 0.44 MUPEAK = 0.70 RATIO = 1.58 A-D FILE 124 N*FILE 64 SAMPLE 170

451

** A-D FILE 125 TH FILE 65 TEST SAMPLE171 **

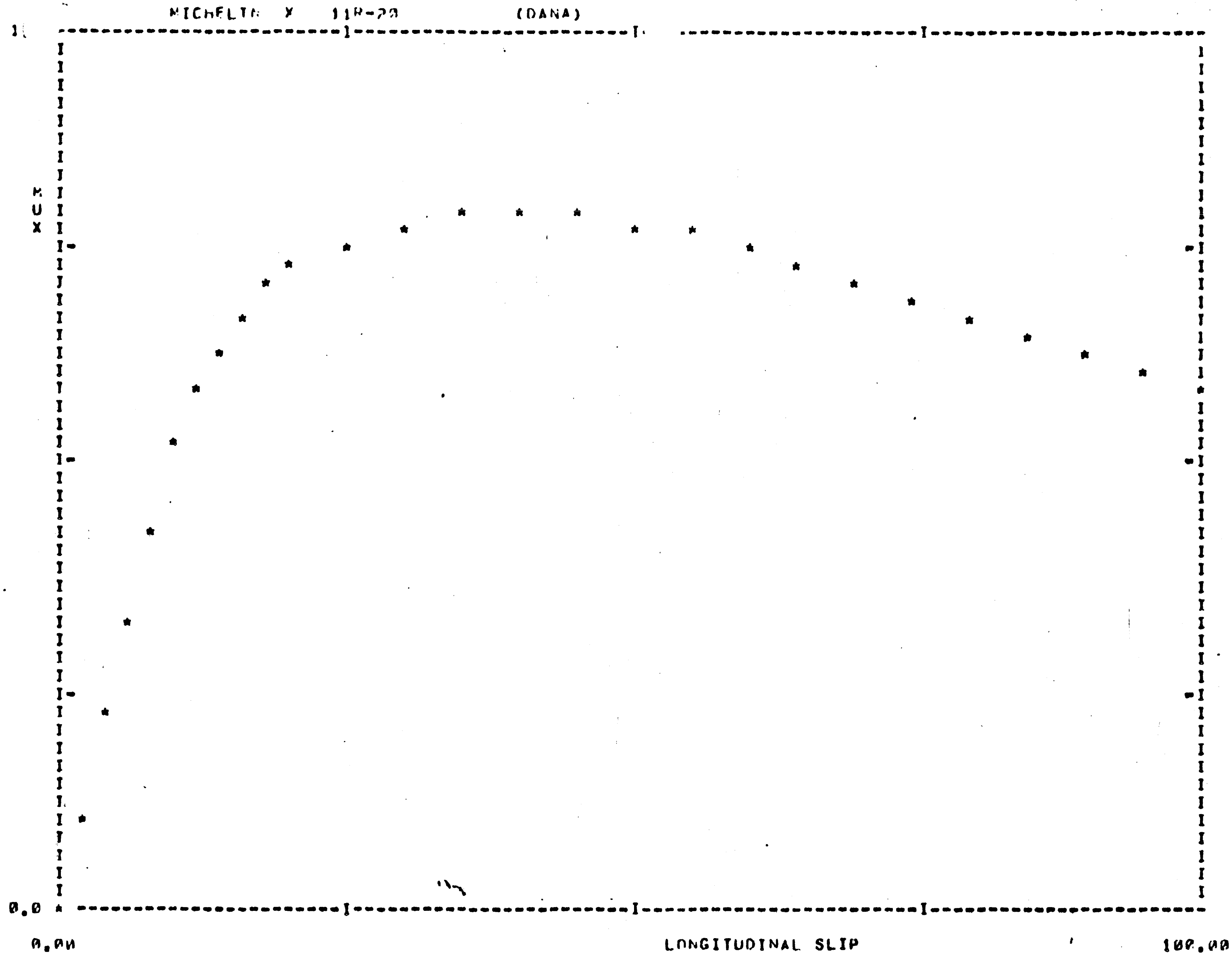
AVERAGE OF FILE 125 FOR 1 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.11	9901.7	432.4
0.04	0.22	20105.8	875.3
0.06	0.34	30066.1	1319.8
0.08	0.44	39020.9	1725.3
0.10	0.53	46814.7	2058.2
0.12	0.59	53403.2	2349.1
0.14	0.64	59251.7	2513.6
0.16	0.68	64041.3	2656.8
0.18	0.71	68362.9	2774.5
0.20	0.73	71723.2	2851.4
0.25	0.76	78475.6	2975.6
0.30	0.78	84751.2	3062.7
0.35	0.80	90779.1	3122.1
0.40	0.80	96226.8	3128.6
0.45	0.79	100301.6	3101.2
0.50	0.78	103031.5	3062.0
0.55	0.77	101808.7	3007.6
0.60	0.75	97836.2	2942.0
0.65	0.73	92790.0	2870.9
0.70	0.71	85911.6	2791.8
0.75	0.70	77467.6	2718.0
0.80	0.68	69972.8	2654.0
0.85	0.66	62689.9	2582.2
0.90	0.64	57414.0	2505.9
0.95	0.62	53[illegible]25.2	2423.7
1.00	0.61	49875.0	2332.5

TQAV = 49875.0 LOAD = 3902.0 VEL = 20.0 MPH.

MUPEAK = 0.80 MULOCK = 0.60 RATIO = 1.34

452



FZ = 3992.0 VFL = 20.0 MULOCK = 0.60 MUPEAK = 0.80 RATIO = 1.34 A-D FILE 125 NWFILE 65 SAMPLE 171

** A-D FILE 126 NEW FILE 66 TEST SAMPLE172 **

AVERAGE OF FILE 126 FOR 5 RECORDS. MICHELIN X 11R-20 (DANA)

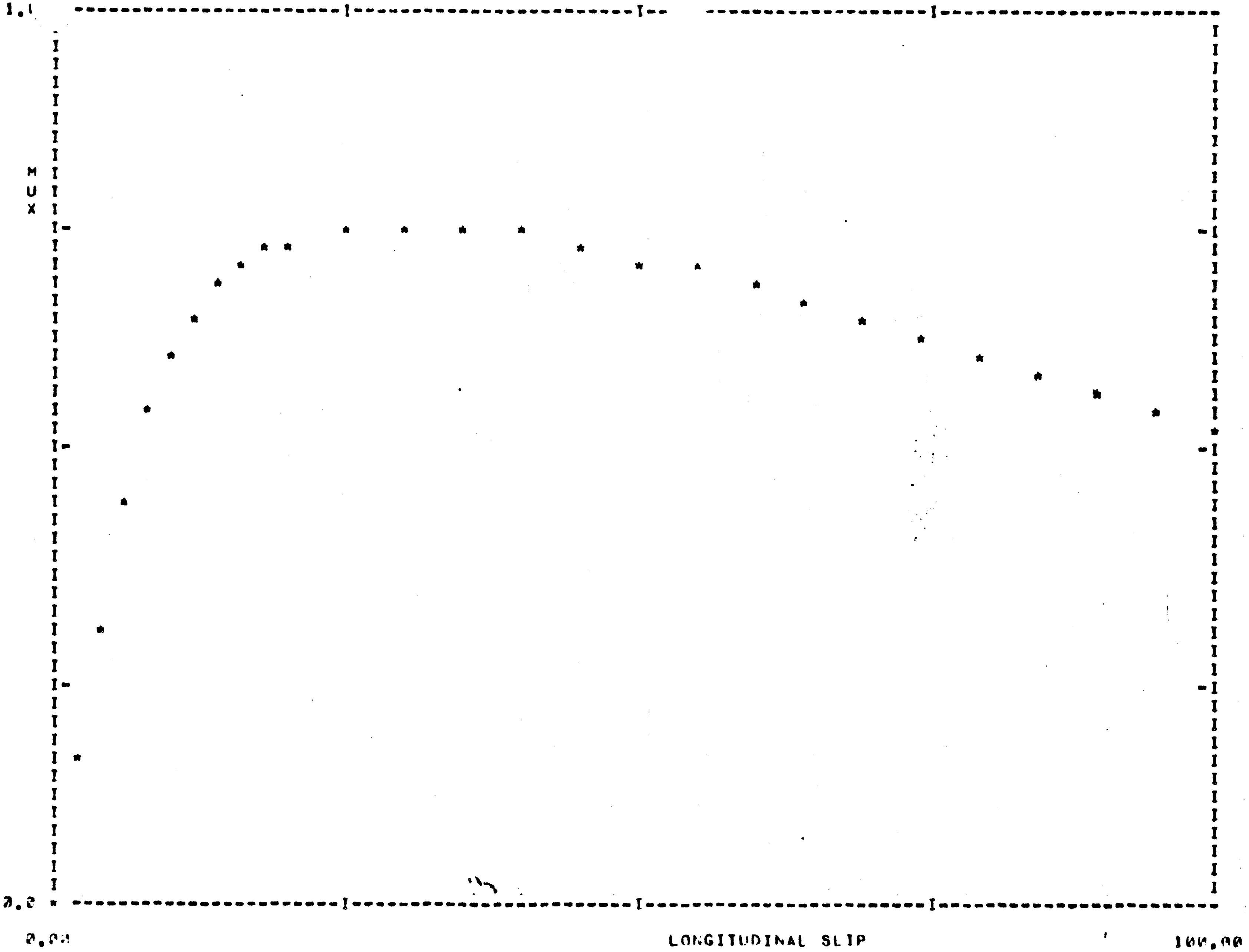
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	22313.8	1119.6
0.04	0.32	47225.9	2273.1
0.06	0.45	66941.9	3205.3
0.08	0.55	82181.4	3939.8
0.10	0.62	93349.6	4409.9
0.12	0.66	101393.6	4754.0
0.14	0.70	107155.9	4984.5
0.16	0.72	111312.8	5137.0
0.18	0.74	114600.6	5241.6
0.20	0.74	117079.9	5298.0
0.25	0.75	122316.8	5352.8
0.30	0.76	127198.7	5363.3
0.35	0.75	131891.8	5334.5
0.40	0.75	136194.5	5269.0
0.45	0.74	139349.4	5181.5
0.50	0.72	140911.8	5085.3
0.55	0.71	139662.0	4984.8
0.60	0.70	1354[illegible]6.1	4877.7
0.65	0.68	129574.2	4759.0
0.70	0.66	121914.3	4615.9
0.75	0.64	113164.6	4461.1
0.80	0.62	105026.5	4315.0
0.85	0.6[illegible]	97426.6	4175.6
0.90	0.58	90129.3	4039.6
0.95	0.56	83252.3	39[illegible]7.9
1.00	0.54	77000.0	3783.0

TQAV = 77000.0 LOAD = 7214.5 VFL = 20.0 MPH.

MUPEAK = 0.76 MULOCK = 0.54 RATIO = 1.40

454

MICHELIN X 11R-20 (DANA)



FZ = 7214.5 VEL = 20.0 MULOCK = 0.54 MUPEAK = 0.76 RATIO = 1.40 A-D FILE 126 NWFILE 66 SAMPLE 172

455

** A-D FILE 127 NEW FILE 67 TEST SAMPLE173 **

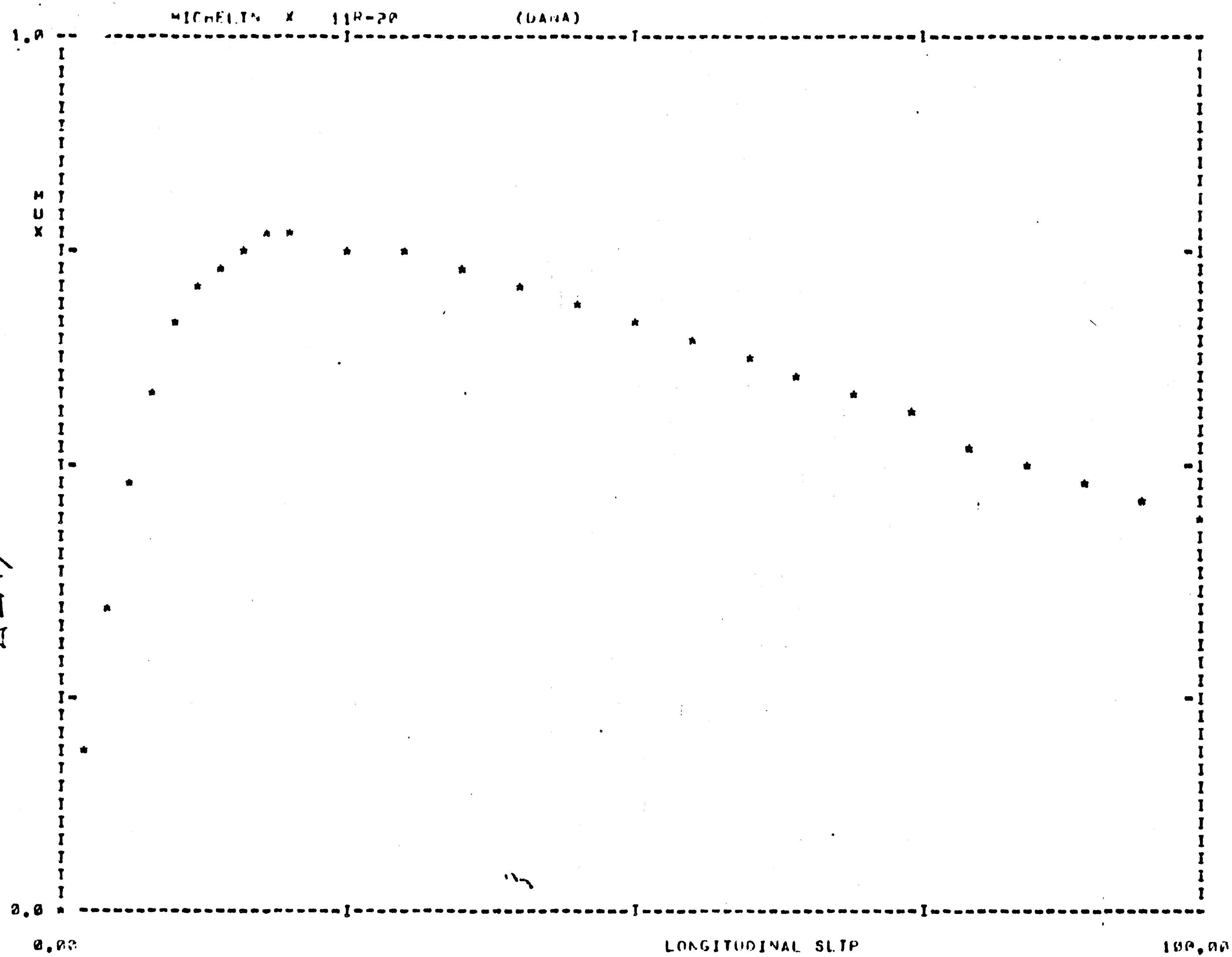
AVERAGE OF FILE 127 FOR 6 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	28642.9	1325.3
0.04	0.35	54686.7	2549.7
0.06	0.49	75681.0	3532.9
0.08	0.59	91388.7	4250.5
0.10	0.67	102717.2	4742.2
0.12	0.71	110659.6	5061.0
0.14	0.74	116233.1	5258.1
0.16	0.76	120383.4	5374.1
0.18	0.77	123551.3	5435.6
0.20	0.77	125927.2	5443.5
0.25	0.77	130574.2	5389.8
0.30	0.76	134606.1	5304.2
0.35	0.74	138086.1	5197.4
0.40	0.72	141202.1	5073.8
0.45	0.70	144189.9	4932.3
0.50	0.68	146897.5	4777.0
0.55	0.66	148648.9	4609.2
0.60	0.63	147926.1	4439.9
0.65	0.61	143059.0	4278.8
0.70	0.59	134735.2	4110.3
0.75	0.57	123274.2	3947.8
0.80	0.54	109369.6	3769.1
0.85	0.52	95014.3	3598.4
0.90	0.49	83615.6	3440.3
0.95	0.47	737[illegible]1.1	3286.0
1.00	0.45	65354.2	3155.[illegible]

TQAV = 65354.2 LOAD = 7230.9 VEL = 40.0 MPH.

MUPEAK = 0.77 MULOCK = 0.45 RATIO = 1.72

456



FZ = 7232.9 VFL = 40.0 MULOCK = 0.45 MUPEAK = 0.77 RATIO = 1.72 A-D FILE 127 NWFILE 67 SAMPLE 173

457

** A-D FILE 128 NEW FILE 68 TEST SAMPLE174 **

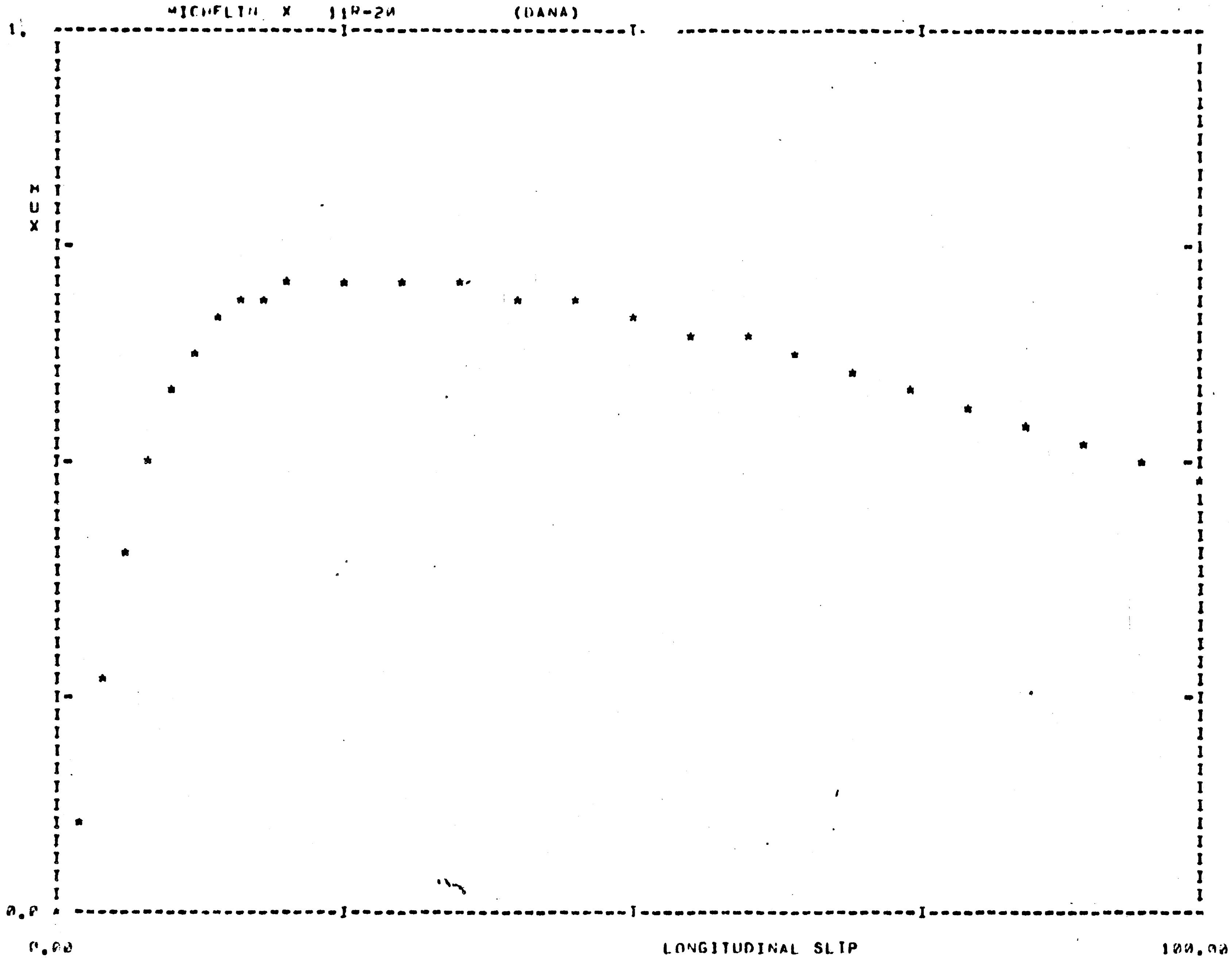
AVERAGE OF FILE 128 FOR 6 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.11	22773.4	1177.1
0.04	0.26	57045.5	2798.7
0.06	0.40	88974.9	4341.0
0.08	0.51	112843.3	5489.6
0.10	0.59	129207.2	6267.4
0.12	0.64	140046.6	6777.9
0.14	0.67	147396.8	7107.7
0.16	0.69	152633.2	7313.1
0.18	0.71	156310.9	7430.7
0.20	0.71	158700.0	7480.2
0.25	0.72	163985.4	7510.5
0.30	0.72	166758.2	7489.0
0.35	0.71	169943.0	7421.9
0.40	0.70	172747.8	7321.0
0.45	0.69	174845.9	719[illegible].1
0.50	0.68	175351.7	7035.6
0.55	0.66	173823.9	6869.6
0.60	0.65	169953.9	6695.3
0.65	0.63	163353.7	6514.3
0.70	0.61	154952.7	6324.9
0.75	0.59	145[illegible].7	6125.0
0.80	0.57	135386.6	5924.7
0.85	0.55	126818.7	5732.1
0.90	0.54	118826.7	5542.4
0.95	.52	111329.2	535[illegible].7
1.00	0.50	1[illegible]4541.7	517[illegible]

TQAV = 104541.7 LOAD = 10014.4 VEL = 20.0 MPH.

MUPEAK = 0.72 MULOCK = 0.50 RATIO = 1.44

458



FZ = 10814.4 VEL = 20.0 MULOCK = 0.50 MUPEAK = 0.72 RATIO = 1.44 A-D FILE 128 N-FILE 68 SAMPLE 174

** A-D FILE 129 — W FILE 69 — TEST SAMPLE175 **

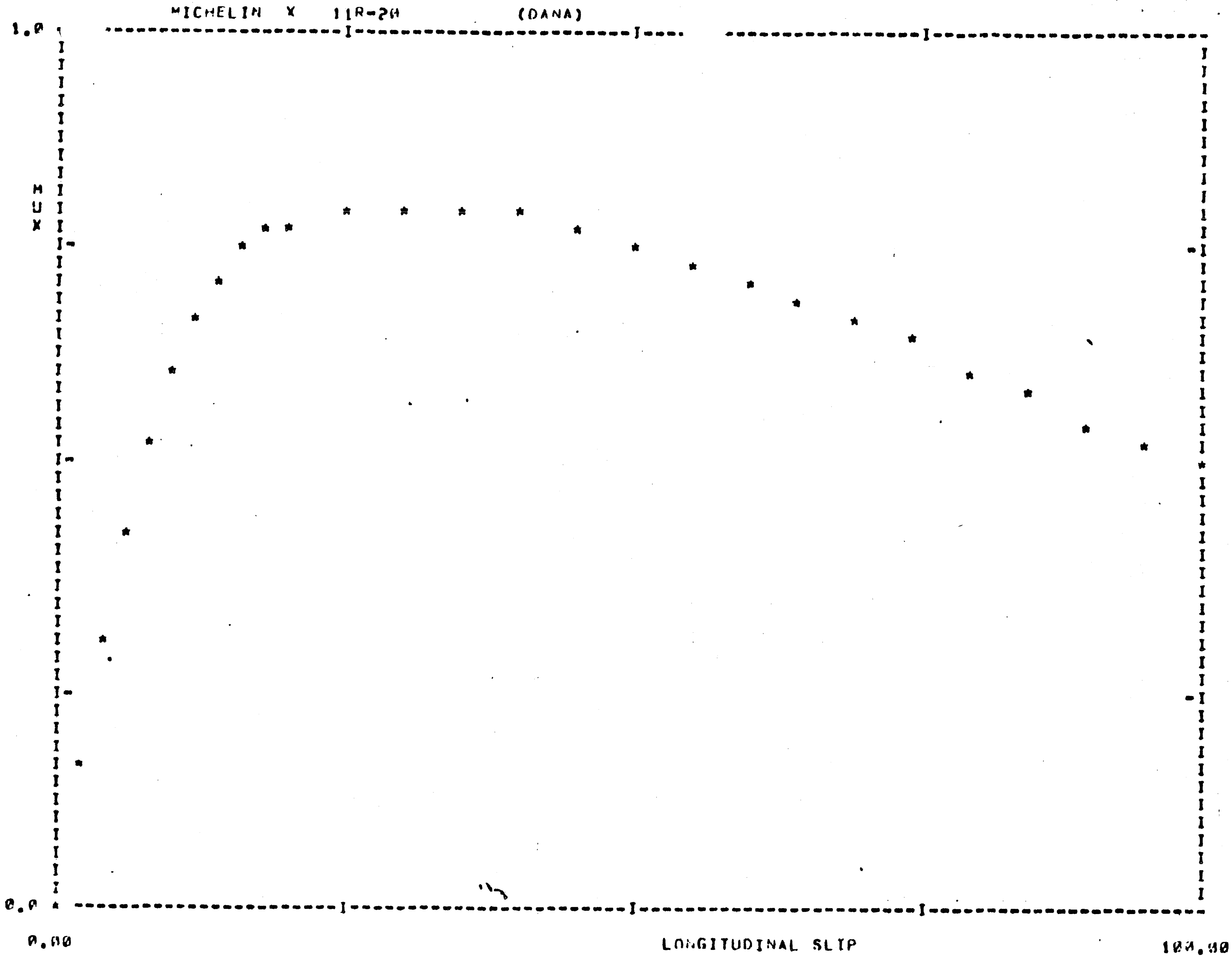
AVERAGE OF FILE 129 FOR 4 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	14163.1	596.6
0.04	0.31	27225.9	1125.0
0.06	0.43	39012.3	1578.9
0.08	0.54	48821.4	1944.3
0.10	0.61	56524.2	2221.0
0.12	0.67	62657.8	2429.5
0.14	0.72	67967.1	2598.7
0.16	0.75	72294.5	2712.0
0.18	0.77	76117.2	2791.8
0.20	0.78	79379.2	2837.8
0.25	0.80	86458.4	2892.1
0.30	0.80	92934.5	2913.0
0.35	0.80	96897.9	2906.0
0.40	0.79	104488.6	2878.9
0.45	0.78	109673.4	2834.0
0.50	0.76	113929.9	2766.0
0.55	0.74	116461.7	2691.0
0.60	0.72	115852.4	2607.0
0.65	0.70	111349.7	2524.7
0.70	0.67	103371.8	2440.7
0.75	0.65	92336.4	2346.3
0.80	0.62	79279.1	2239.5
0.85	0.59	66476.1	2134.2
0.90	0.56	55888.6	2032.5
0.95	0.53	46749.2	1929.0
1.00	0.50	39375.0	1824.4

TQAV = 39375.0 LOAD = 3641.0 VEL = 40.0 MPH.

MUPEAK = 0.80 MULOCK = 0.50 RATIO = 1.59

460



FZ = 3641.8 VEL = 40.0 MULOCK = 0.50 MUPEAK = 0.80 RATIO = 1.59 A-D FILE 129 NWFILE 69 SAMPLE 175

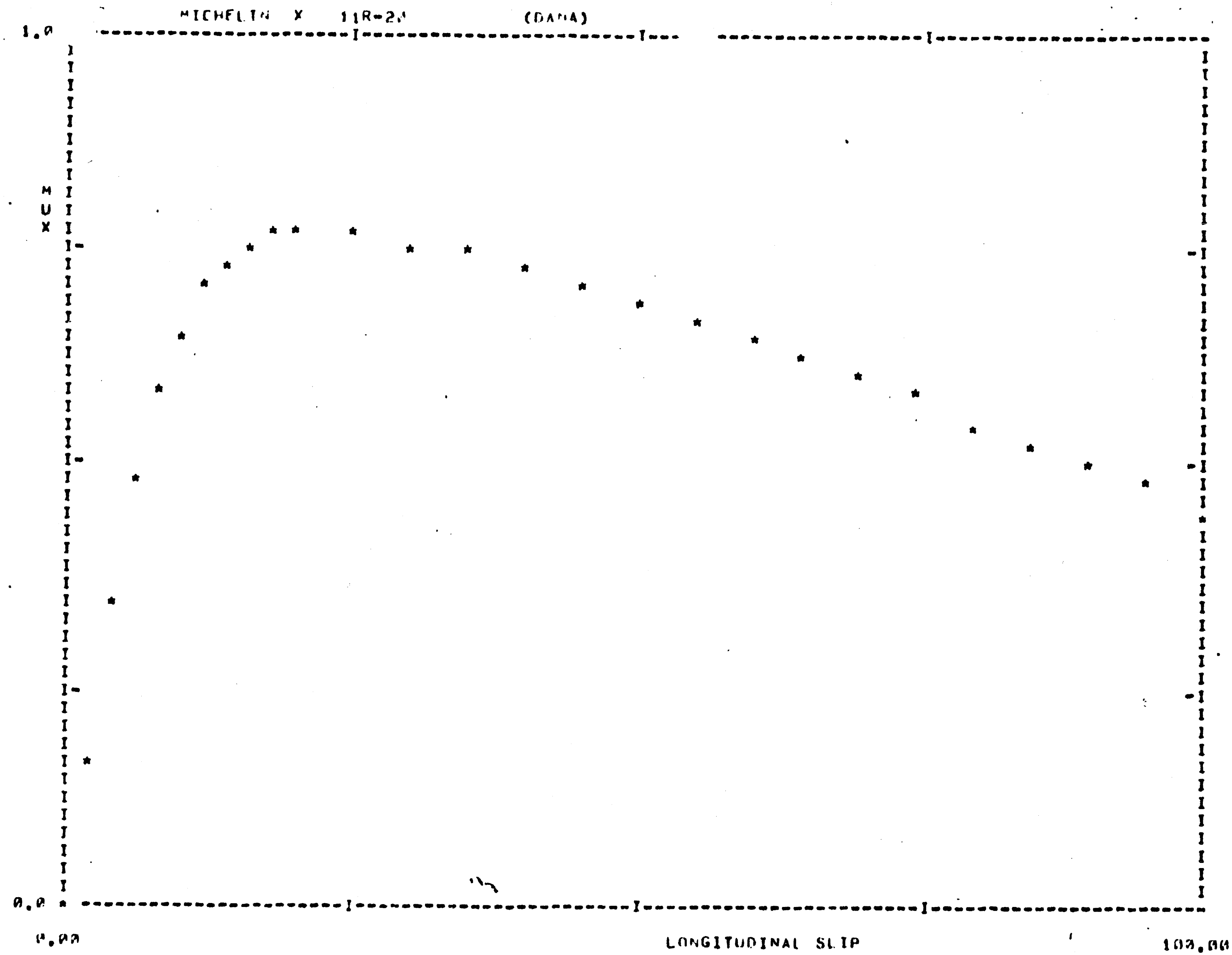
** A-D FILE 130 .EW FILE 70 TEST SAMPLE176 **

AVERAGE OF FILE 130 FOR 6 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	25366.1	1175.0
0.04	0.35	54449.7	2533.6
0.06	0.49	76304.0	3552.3
0.08	0.59	92315.3	4272.8
0.10	0.66	103832.2	4752.7
0.12	0.71	111088.2	5066.2
0.14	0.74	117698.7	5272.2
0.16	0.76	122158.4	5404.9
0.18	0.77	125718.5	5479.4
0.20	0.77	128464.0	5499.0
0.25	0.77	133818.9	5477.4
0.30	0.76	138277.7	5420.0
0.35	0.75	142062.0	5335.6
0.40	0.74	145497.1	5226.8
0.45	0.72	148752.0	5096.9
0.50	0.70	151563.3	4945.0
0.55	0.68	152920.6	4777.7
0.60	0.65	151398.0	4611.2
0.65	0.63	146629.7	4451.1
0.70	0.61	138640.0	4290.5
0.75	0.59	127165.4	4118.9
0.80	0.56	113297.9	3935.6
0.85	0.53	99116.6	3756.5
0.90	0.51	87400.6	3586.8
0.95	[illegible]	76991.2	[illegible]
1.00	0.46	68083.3	3235.0

TQAV = 68083.3 LOAD = 7238.9 VEL = 40.0 MPH.

MUPEAK = 0.77 MULOCK = 0.46 RATIO = 1.68



FZ = 7238.9 VEL = 40.0 MULOCK = 0.46 MUPEAK = 0.77 RATIO = 1.68 A-D FILE 130 N-FILE 70 SAMPLE 176

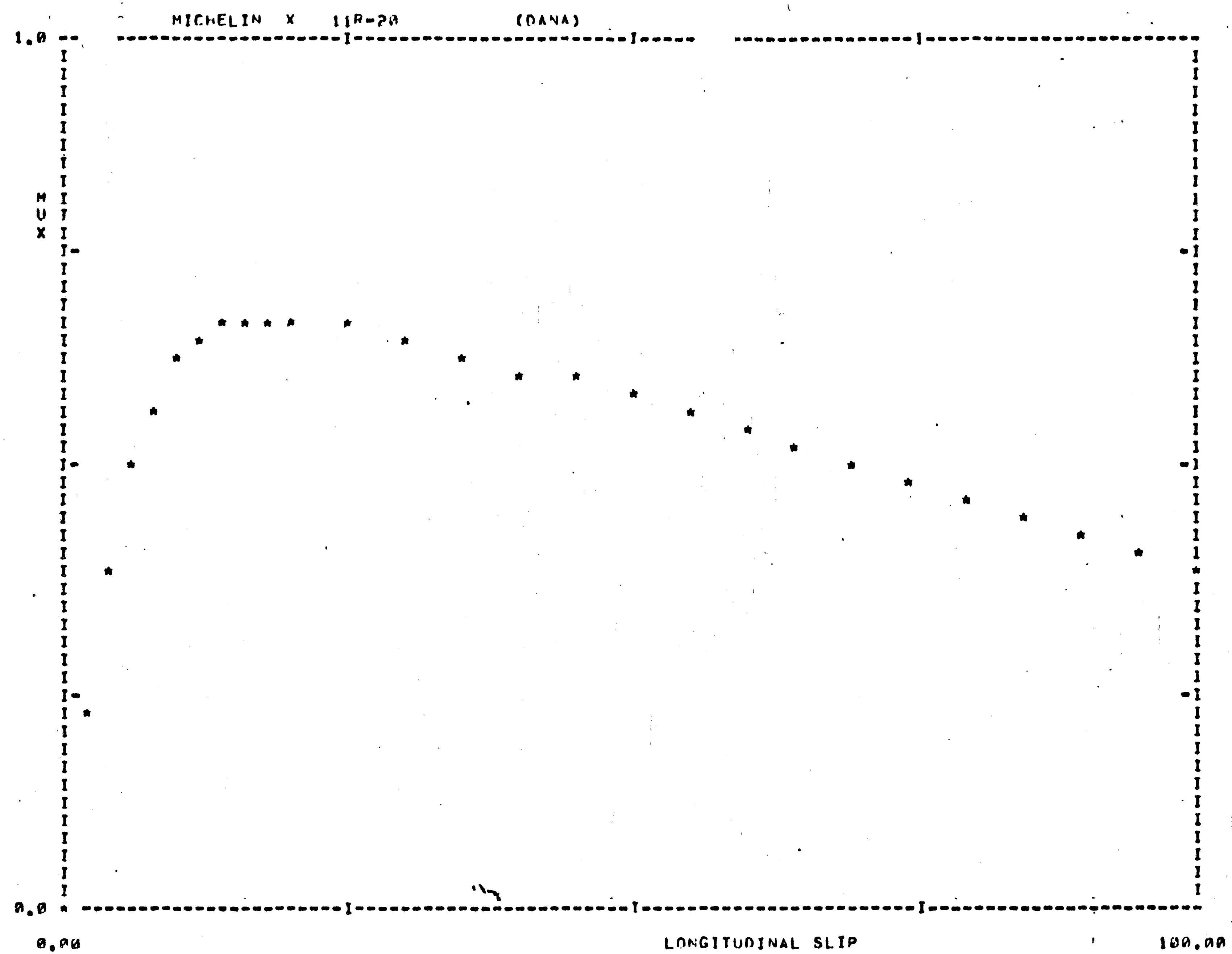
** A-D FILE 134   NEW FILE 71   TEST SAMPLE177 **

AVERAGE OF FILE 134 FOR 4 RECORDS.   MICHELIN X 11R-20   (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	50602.4	2397.3
0.04	0.39	87214.1	4192.7
0.06	0.50	111660.9	5374.5
0.08	0.58	127580.4	6145.9
0.10	0.63	137905.3	6624.4
0.12	0.65	144696.4	6909.8
0.14	0.67	149188.1	7074.1
0.16	0.68	152300.2	7146.0
0.18	0.68	154301.8	7162.7
0.20	0.68	155333.8	7139.0
0.25	0.67	157474.5	7014.6
0.30	0.65	159209.8	6867.9
0.35	0.64	160364.8	6718.3
0.40	0.62	161044.1	6573.0
0.45	0.61	161519.0	6425.4
0.50	0.59	161970.5	6260.5
0.55	0.58	162404.7	6095.4
0.60	0.56	162173.6	5906.5
0.65	0.54	160272.9	5710.9
0.70	0.52	155993.2	5514.6
0.75	0.50	147[illegible].9	5318.3
0.80	0.48	136[illegible]63.8	51[illegible]6.4
0.85	0.46	122390.0	4872.8
0.90	0.43	109563.0	4634.5
0.95	0.41	97345.8	4395.8
1.00	0.39	85812.5	4156.9

TQAV = 85812.5   LOAD = 10931.8   VEL = 40.0 MPH.

MUPEAK = 0.68   MULOCK = 0.39   RATIO = 1.75



FZ = 10931.8 VEL = 40.0 MULOCK = 0.39 MUPEAK = 0.68 RATIO = 1.75 A-D FILE 134 NWFILE 71 SAMPLE 177

** A-D FILE 135 · FILE 72 TEST SAMPLE178 **

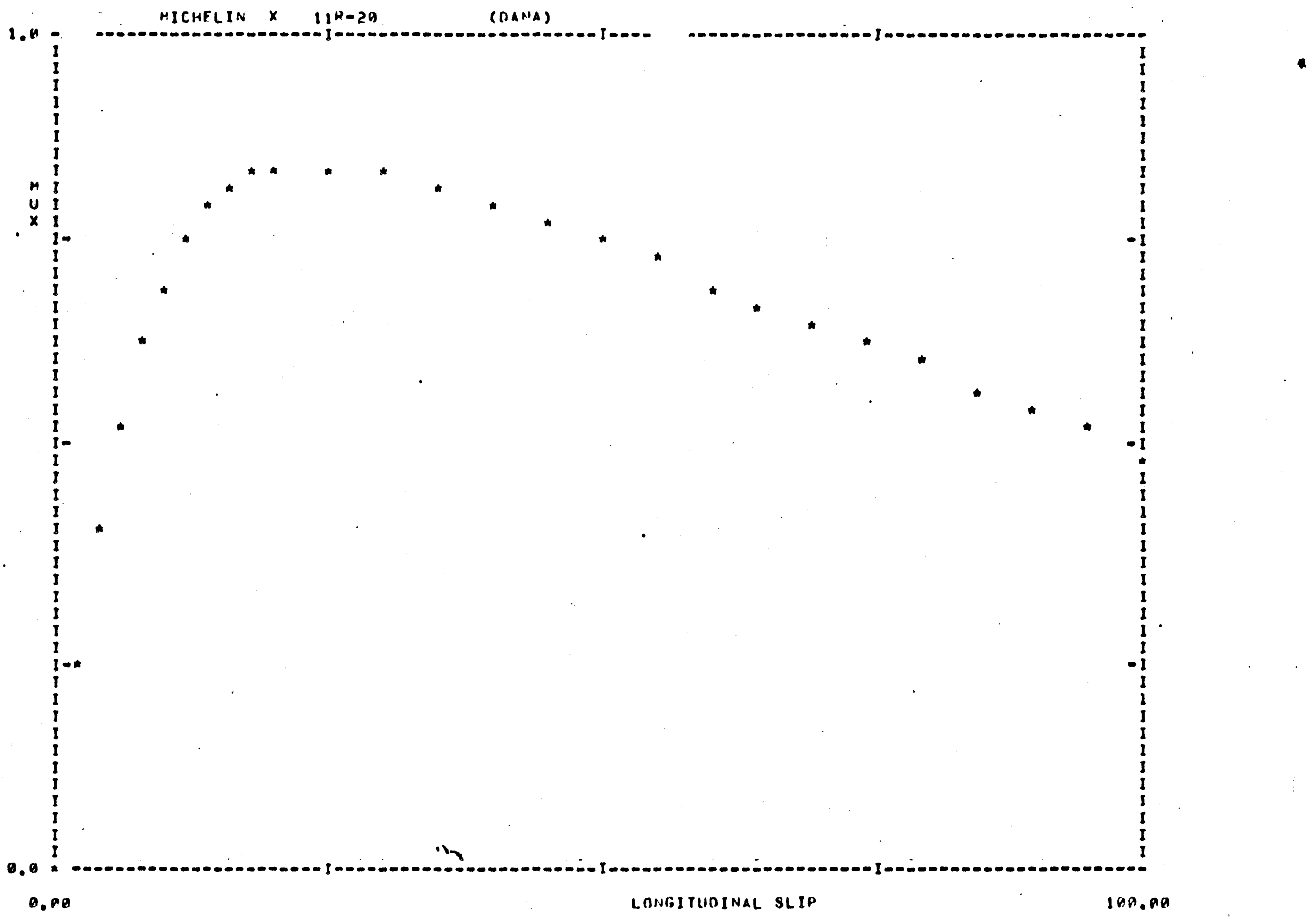
AVERAGE OF FILE 135 FOR 5 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.24	23271.6	946.6
0.04	0.40	38028.0	1556.6
0.06	0.53	49412.8	2030.0
0.08	0.63	58602.7	2402.5
0.10	0.70	66234.0	2679.8
0.12	0.76	72474.6	2872.4
0.14	0.79	77401.1	3001.5
0.16	0.82	81309.3	3086.7
0.18	0.83	84489.4	3139.0
0.20	0.84	87051.0	3158.7
0.25	0.84	92838.3	3145.1
0.30	0.83	98273.3	3098.5
0.35	0.81	103308.4	3030.7
0.40	0.79	107953.9	2955.2
0.45	0.77	112278.2	2881.6
0.50	0.75	116380.6	2806.3
0.55	0.73	120206.2	2722.7
0.60	0.70	122695.4	2633.8
0.65	0.68	121963.7	2544.8
0.70	0.65	117022.3	2461.4
0.75	0.63	1073[illegible].5	2380.5
0.80	0.61	932[illegible].2	2292.0
0.85	0.58	76479.6	2192.5
0.90	0.55	61658.1	2090.0
0.95	0.52	491[illegible].7	1976.1
1.00	0.49	398[illegible]	1851.0

TQAV = 39800.0 LOAD = 3829.0 VEL = 55.0 MPH.

MUPEAK = 0.84 MULOCK = 0.49 RATIO = 1.72

466



FZ = 3829.0 VEL = 55.0 MULOCK = 0.49 MUPEAK = 0.84 RATIO = 1.72 A-D FILE 135 NWFILE 72 SAMPLE 178

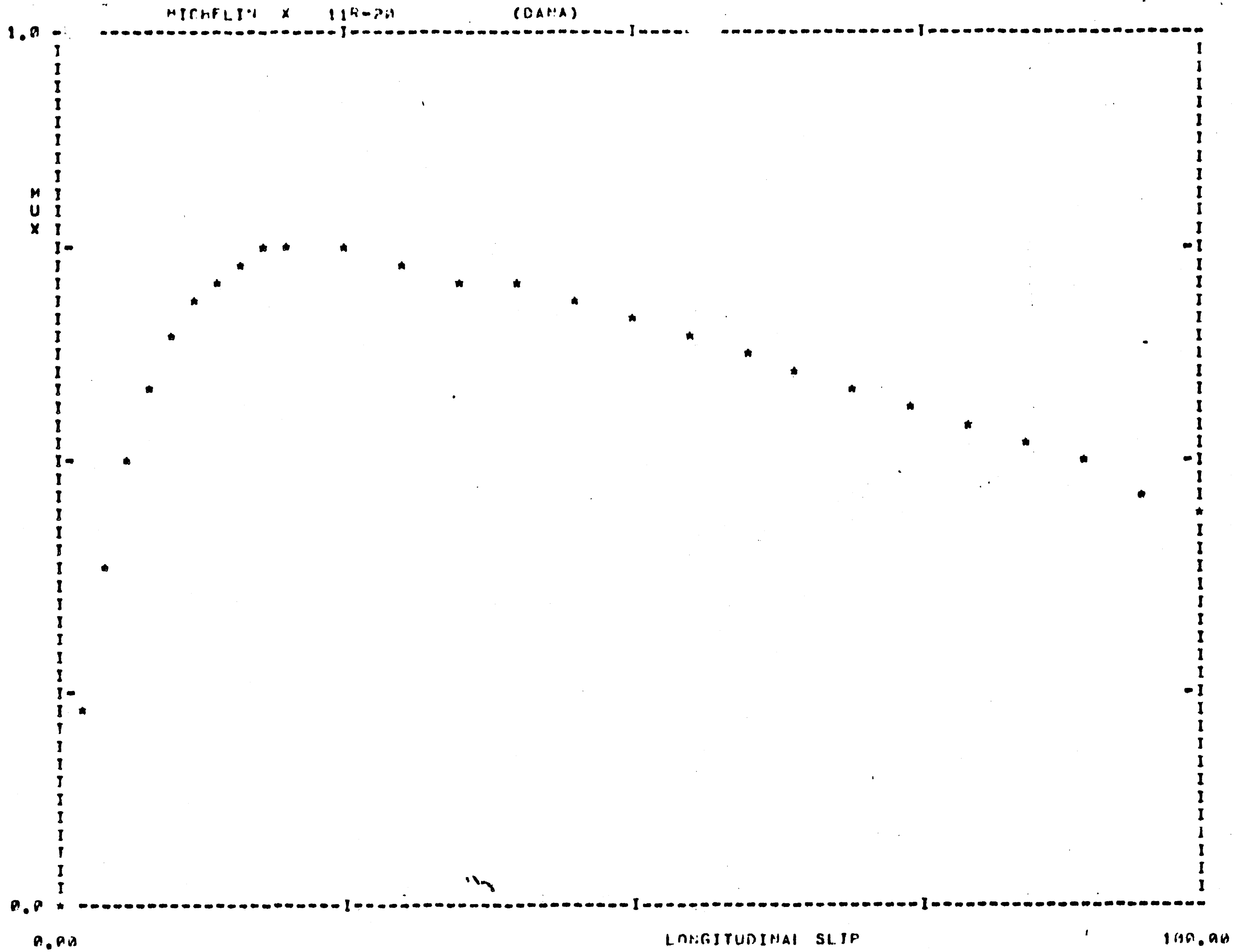
** A-D FILE 136 NEW FILE 73 TEST SAMPLE179 **

AVERAGE OF FILE 136 FOR 5 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	35950.3	1657.5
0.04	0.40	61657.3	2917.4
0.06	0.51	79672.9	3759.9
0.08	0.60	92600.1	4350.4
0.10	0.66	102149.7	4747.6
0.12	0.69	109114.7	5009.1
0.14	0.72	114160.1	5182.8
0.16	0.74	117958.7	5297.1
0.18	0.75	121030.1	5370.1
0.20	0.75	123444.4	5383.3
0.25	0.75	128444.9	5343.6
0.30	0.74	132706.2	5273.8
0.35	0.73	136359.5	5188.9
0.40	0.71	139629.0	5092.7
0.45	0.70	142554.0	4982.9
0.50	0.68	145045.2	4854.3
0.55	0.66	146675.4	4710.1
0.60	0.64	146749.7	4557.7
0.65	0.61	143377.0	4405.7
0.70	0.59	135733.7	4257.3
0.75	0.57	124997.8	4099.8
0.80	0.55	111988.1	3933.3
0.85	0.52	98379.1	3772.8
0.90	0.50	87290.4	3619.4
0.95	0.48	77438.8	3468.4
1.00	0.46	68875.0	3319.5

TQAV = 68875.0 LOAD = 7382.0 VEL = 40.0 MPH.

MUPEAK = 0.75 MULOCK = 0.46 RATIO = 1.64



FZ = 7382.0 VEL = 40.0 MULOCK = 0.46 MUPEAK = 0.75 RATIO = 1.64 A-D FILE 136 NWFILE 73 SAMPLE 179

** A-D FILE 137 NEW FILE 7/4 TEST SAMPLE180 **

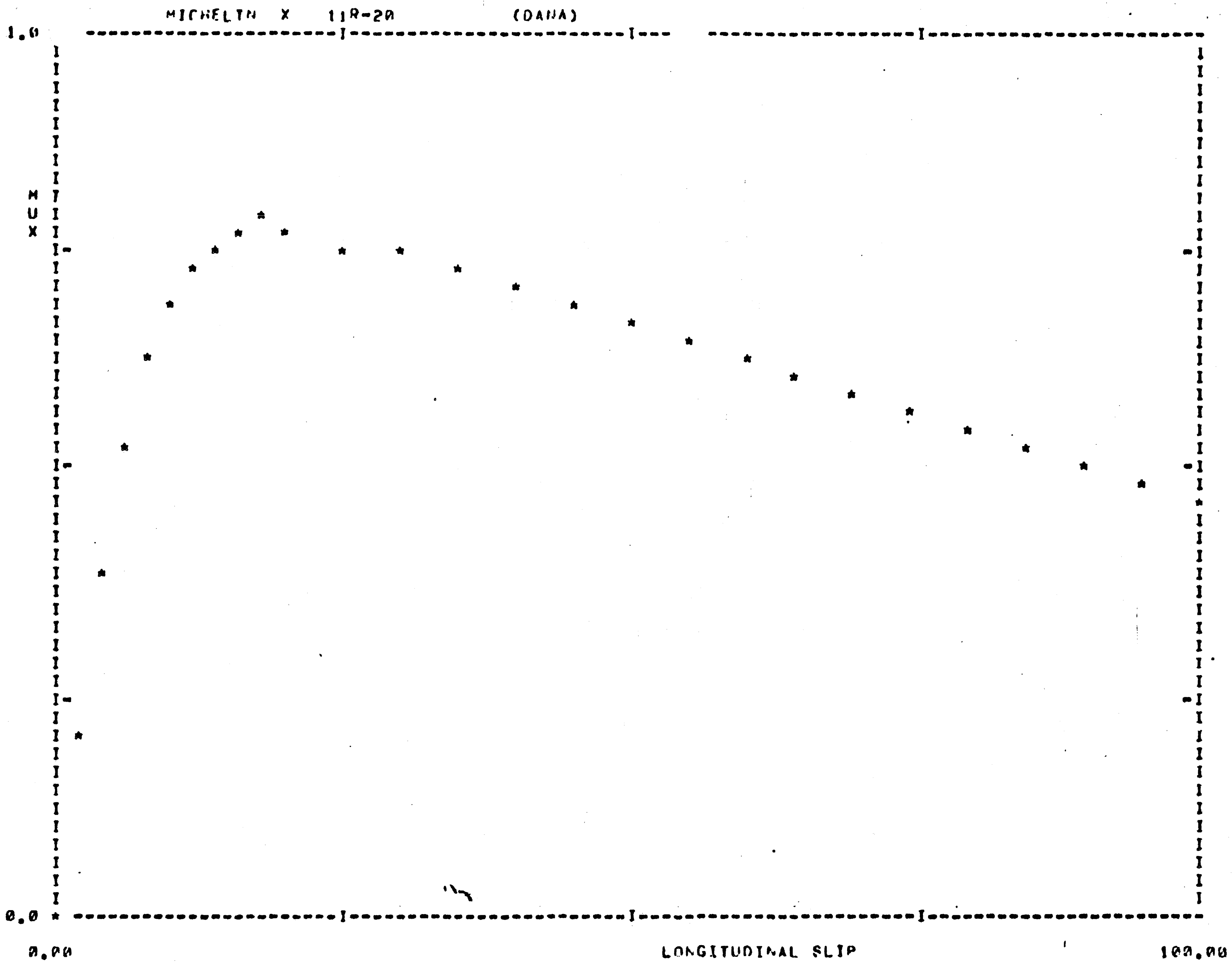
AVERAGE OF FILE 137 FOR 5 RECORDS. MICHELIN X 11R-20 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	31850.9	1489.5
0.04	0.39	61253.1	2890.9
0.06	0.53	82128.4	3874.2
0.08	0.63	96989.9	4553.8
0.10	0.69	107630.4	5028.1
0.12	0.74	115197.2	5313.7
0.14	0.77	120384.2	5512.4
0.16	0.78	123894.0	5623.8
0.18	0.79	126481.2	5662.4
0.20	0.78	128356.8	5628.8
0.25	0.77	131582.6	5509.8
0.30	0.75	134366.6	5387.8
0.35	0.73	137118.5	5260.2
0.40	0.71	139928.9	5125.3
0.45	0.69	142719.2	4986.9
0.50	0.67	145350.9	4849.6
0.55	0.66	147780.1	4711.5
0.60	0.64	149522.8	4572.9
0.65	0.62	149171.0	4432.6
0.70	0.60	145172.7	4292.6
0.75	0.58	136963.7	4147.4
0.80	0.56	124296.8	3990.3
0.85	0.54	109045.6	3828.1
0.90	0.51	95281.6	3678.9
0.95	0.49	82615.7	3535.4
1.00	0.47	71225.0	3397.5

TQAV = 71225.0 LOAD = 7353.8 VEL = 55.0 MPH.

MUPEAK = 0.79 MULOCK = 0.47 RATIO = 1.67

470



FZ = 7353.0 VEL = 55.0 MULOCK = 0.47 MUPEAK = 0.79 RATIO = 1.67 A-D FILE 137 NWFILE 74 SAMPLE 180

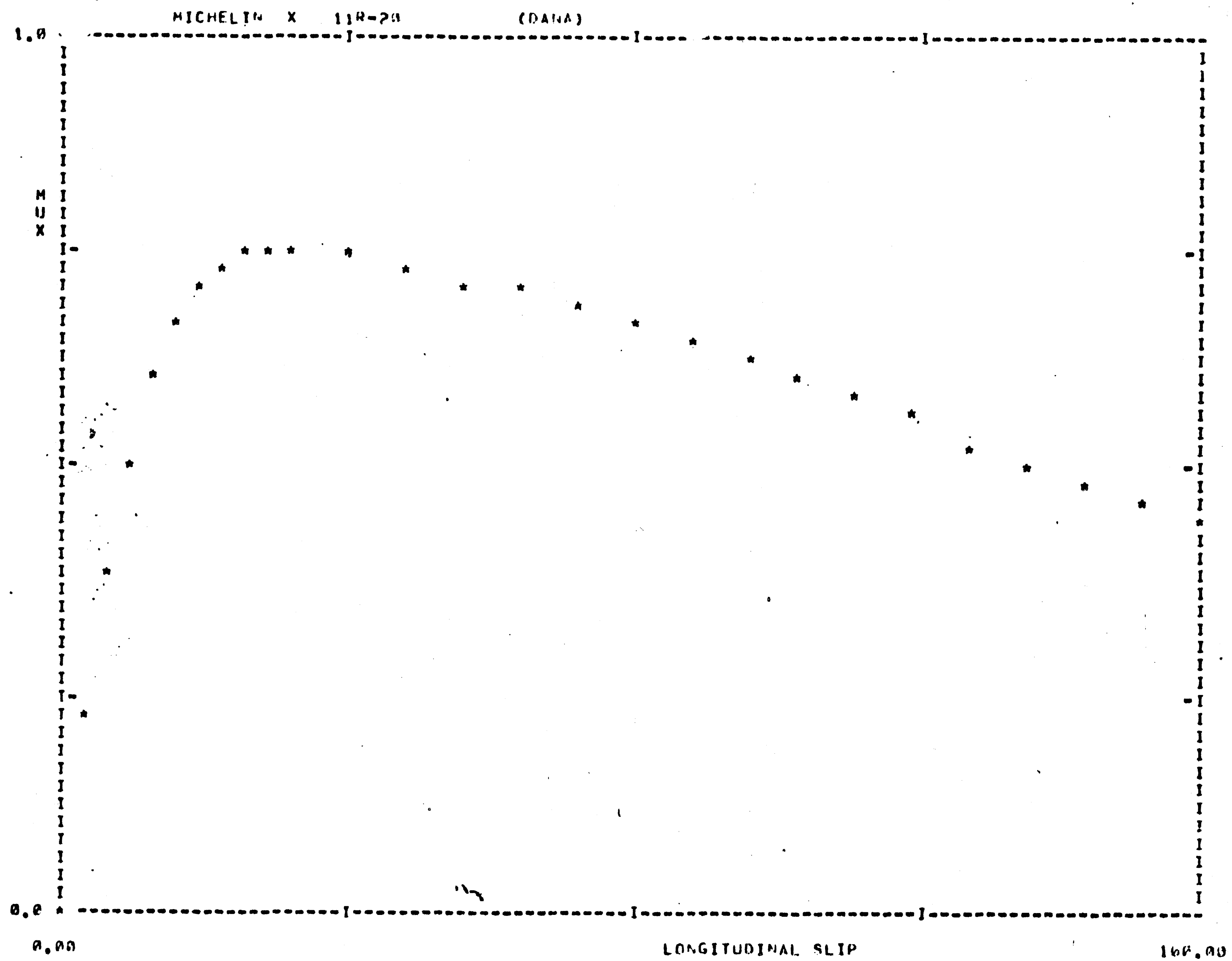
** A-D FILE 139 * FILE 75 TEST SAMPLE182 **

AVERAGE OF FILE 139 FOR 5 RECORDS. MICHELIN X 11R-20 (DANA)

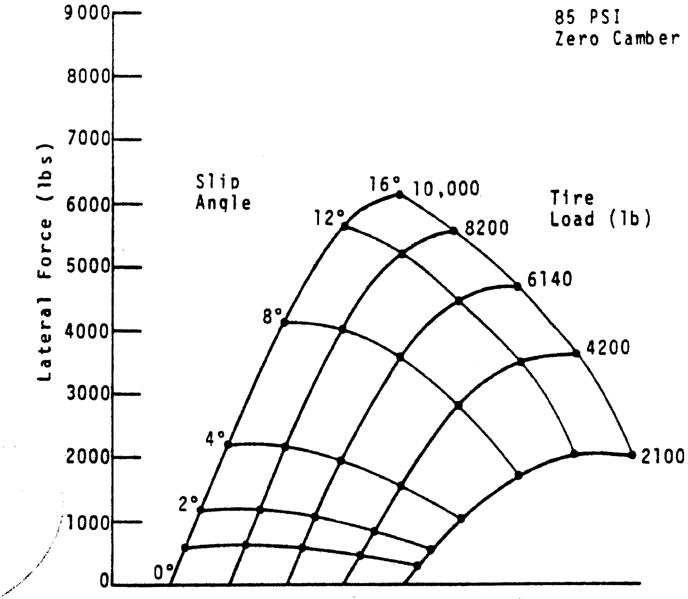
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.22	34729.9	1652.9
0.04	0.40	62446.0	2969.7
0.06	0.52	81455.7	3869.9
0.08	0.61	95230.2	4510.5
0.10	0.67	105202.7	4944.0
0.12	0.71	112273.5	5222.2
0.14	0.74	117430.2	5388.4
0.16	0.75	121386.3	5476.8
0.18	0.75	124445.9	5513.0
0.20	0.76	126642.3	5506.7
0.25	0.75	130603.0	5446.9
0.30	0.74	133864.8	5361.6
0.35	0.72	136686.5	5253.8
0.40	0.71	139203.2	5130.8
0.45	0.69	141348.6	5000.2
0.50	0.67	143048.5	4863.9
0.55	0.65	143885.9	4721.4
0.60	0.63	142982.8	4576.5
0.65	0.61	139688.2	4433.6
0.70	0.59	133115.4	4287.4
0.75	0.57	1237[illegible].7	4139.7
0.80	0.54	112147.3	3950.0
0.85	0.52	100096.3	3789.4
0.90	0.49	88852.4	3627.4
0.95	0.47	76308.4	3471.9
1.00	0.45	68675.0	3325.5

TQAV = 68675.0 LOAD = 7528.4 VEL = 40.0 MPH.

MUPEAK = 0.76 MULOCK = 0.45 RATIO = 1.68



FZ = 7528.4 VEL = 40.0 MULOCK = 0.45 MUPEAK = 0.76 RATIO = 1.68 A-D FILE 139 NWFILE 75 SAMPLE 182



A

Load 6140 lb.

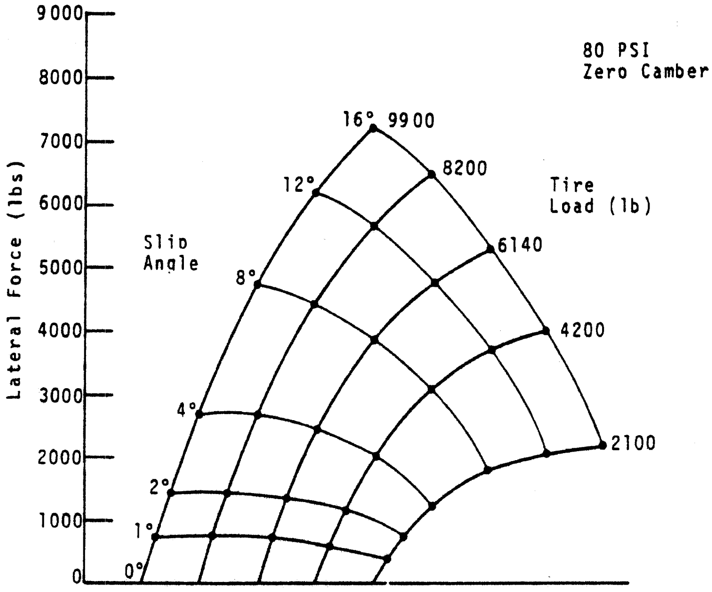
C_s 51,000 lb/unit slip

C_α 536.9 lb/deg

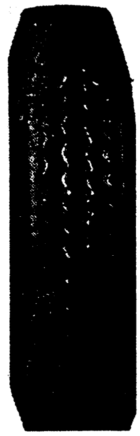
C_γ 62.8 lb/deg

K_y 1910 lb/in

K_z 5850 lb/in



B



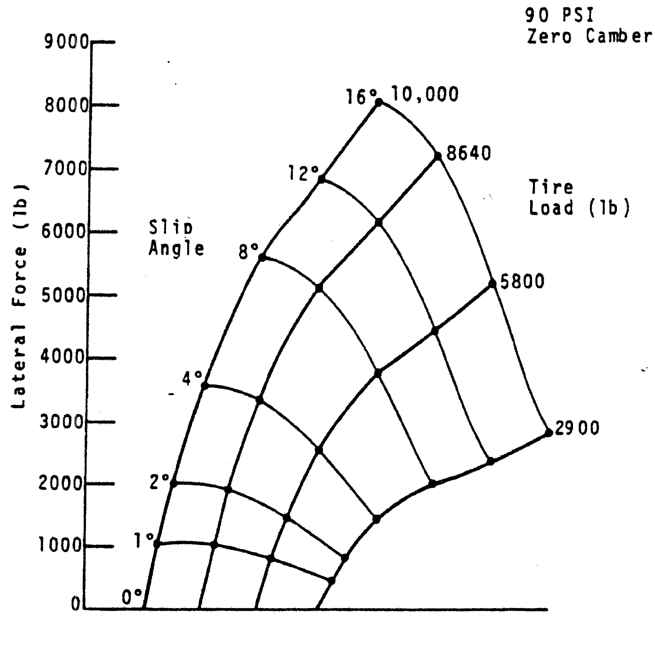
Load 6140 lb.

C_s 60,000 lb/unit Slip

C_α 700.8 lb/deg

C_γ 101.6 lb/deg

K_y 1900 lb/in



C

Load 8640 lb.

C_s 85,000 lb/unit slip

C_α 1014.7 lb/deg

C_γ 162.0 lb/deg

K_y 2860 lb/in

K_z 5420 lb/in

Fig. 2 - Measured mechanical properties of three different tires. A-11.00-22/G; B-12.00-20/G; C-15-22.5/H

profile become very pronounced, especially in the sidewall area, and cause a reduction in spring rate. It should be noted that the maximum value of lateral spring rate occurs near the design load for each tire tested.

The vertical load-deflection data are remarkably linear for a broad range of tire loads (Fig. 1). Fig. 1 suggests that it is reasonable to consider the tire as a linear vertical spring with spring rate, K_z, defined as the average slope of the load-deflection plot.

INFLATION PRESSURE

Increasing inflation pressure reverses the deformation caused by vertical load. Although a decrease in contact length accompanies an increase in inflation pressure, the dominant effects of increased pressure are reduced curvature in the sidewall and a generally stiffened carcass structure. The net result is a lateral spring rate that increases with inflation pressure, as is demonstrated by Fig. 4; these data being obtained on the three tires shown in Figs. 2A-2C. As may be expected, the effect of increasing the pressure is more pronounced at the higher loads which cause large distortions in the meridian profile.

The cornering stiffness, C_α, exhibits similar pressure sensitivity at higher vertical loads. Fig. 5 compares the lateral force versus slip angle and vertical load exhibited by a 10.00-20/G tire (Fig. 6B) at rated inflation pressure (100 psi) and at 50 psi. As can be anticipated from lateral spring rate behavior measured for these three different tires (Fig. 4), cornering stiffness increases with inflation pressure at higher loads.

The apparent similarity between K_y and C_α is due to the definition of K_y as the lateral stiffness of a standing tire measured at, effectively, a 0 deg slip angle while C_α is defined to measure the stiffness of the rolling tire in generating lateral force at very small slip angles. However, the contact region deformation associated with tire traction is considerably more complicated than the deformation associated with the measurement of K_y. As no rational basis exists for the correlation of these values, they are treated as independent mechanical properties.

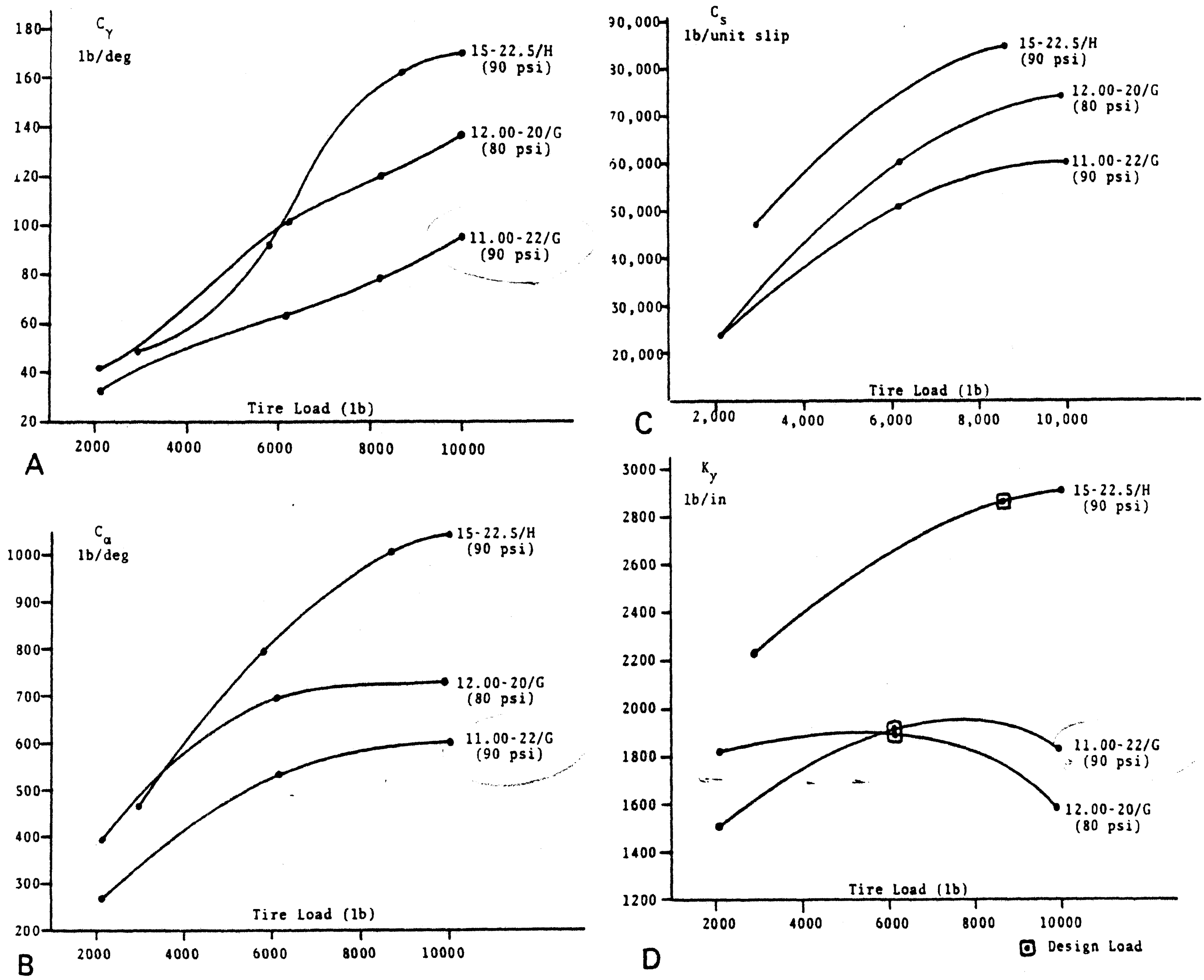


Fig. 3 - Variation of mechanical properties with tire load for tires shown in Figs. 2A-2C. A-camber stiffness versus tire load; B-cornering stiffness versus tire load; C-circumferential stiffness versus tire load; D-lateral spring rate versus tire load

loads, the tire behaves (laterally) like a softening spring. The lateral spring rate is the slope through the origin of the lateral load-deflection curve.

TRACTION STIFFNESS (C_α, C_γ, C_s) - The following three properties are defined to characterize the mechanical behavior of a rolling tire operated at very small slip and camber angles and for very light application of braking or driving power.

Cornering Stiffness

$$C_\alpha = \left.\frac{dF_y}{d\alpha}\right|_{\alpha=0} \qquad (1)$$

Camber Stiffness

$$C_\gamma = \left.\frac{dF_y}{d\gamma}\right|_{\gamma=0} \qquad (2)$$

Circumferential Stiffness

$$C_s = \left.\frac{dF_x}{ds}\right|_{s=0} \qquad (3)$$

where:

α = slip angle
γ = camber angle
s = circumferential slip parameter

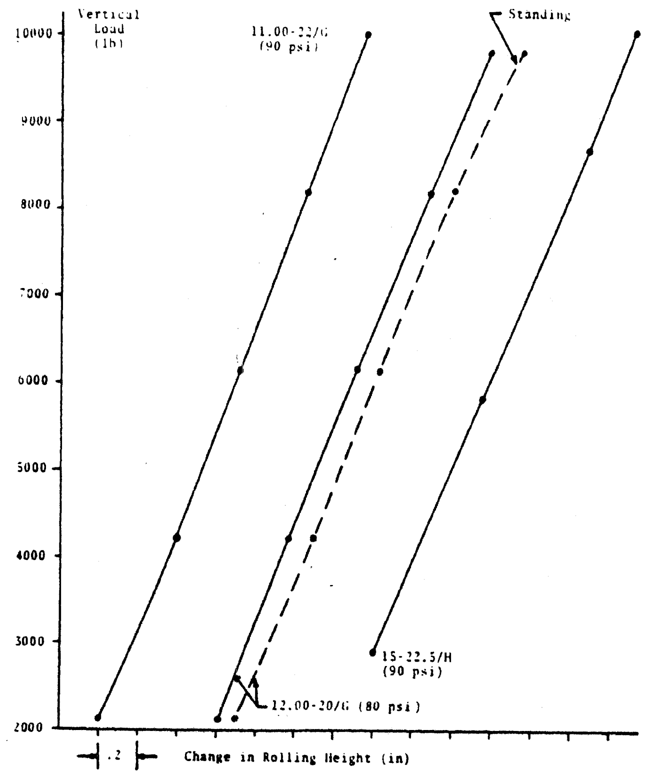


Fig. 1 - Vertical load versus change in low-speed rolling height of tires shown in Figs. 2A-2C

$$s \begin{cases} = 1 \text{ locked wheel} \\ = 0 \text{ free rolling (light braking: } s < 0.05) \\ < 0 \text{ driving} \end{cases}$$

F_x = longitudinal traction force (depends primarily on s)
F_y = lateral traction force (depends on both α and γ)

Graphically, the traction stiffness is the slope taken through the origin of the traction force (F_x or F_y) versus a particular operating variable (α, γ, or s) curve. These stiffnesses measure the initial rise of traction force and have no direct relation to peak values. However, a tire with higher traction stiffness will usually develop higher peak traction force. The usefulness of these definitions depends on linear behavior for small values of the operating variables. Examination of the following truck tire data will show this linearity to be a reasonable assumption.

GENERAL BEHAVIOR

Figs. 2A-2C describe three truck tires chosen to exhibit a broad range of traction stiffness properties*. The mechanical properties listed below each tire were measured at rated load and pressure. The carpet plots of lateral force versus slip angle and vertical load show the variation in lateral force obtained and indicate how the cornering stiffness, C_α, is related to slip angle and load. Although C_α measures only the initial rise of lateral force with slip angle for a particular tire load, the rise is similar at other tire loads. It appears that a tire showing higher cornering stiffness will develop more lateral force than a lower stiffness tire operated at the same slip angle and vertical load.

TIRE LOAD

The operating variable having the greatest influence on traction stiffness is tire load. The influence of tire load derives from the extreme deformation which a tire undergoes in the contact region. Specifically, the meridian and circumference profiles, intersecting at the center of contact, are substantially altered in dimension and curvature as tire load is increased. The camber, cornering, and circumferential stiffnesses, being indirectly influenced by lateral and longitudinal tire stiffness, are consequently dependent on structural geometry, and are seen to increase with test load for the tires diagrammed in Figs. 3A-3D.

Particularly affected by sidewall deformation is the lateral spring rate, K_y. Fig. 3D illustrates the variation of K_y with tire load for the three tires shown in Figs. 2A-2C. Increasing load on the tire from far below the design value results mainly in an increased contact length with some change in the meridian profile. The increased contact length causes an increase in lateral stiffness. At higher loads, the changes in tire

*The tires are representative of the 14 different truck tire sizes tested for this program.

PLY RATING AND TIRE SIZE

The ply rating designates the load range for which a particu- size tire is designed. Load limits for various sizes at specific inflation pressures up to the design pressure are tabulated according to empirical formulae. The ply rating is a measure of the strength of the tire carcass and does not necessarily indicate the actual number of plies.

The tire pairs listed in Table 1 were tested on design width precision rims at the indicated pressures and loads which are near the design values specified for these tires used as singles and duals. The higher rated tire of each pair is generally used as a dual. The 20 in tires that were tested all have the tread pattern shown in Fig. 6B. The tread pattern of the 11.00-22 tires (Fig. 2A) is similar. Table 2 lists the measured mechanical properties and illustrates the differences which may be found in tires which are similar in all respects, except for ply rating.

The differences seen in Table 2 are slight and possibly influenced by tire nonuniformity and/or measurement precision. There is remarkably little change in the properties of the 11.00-22 tires, the largest set tested for differences due to ply rating. The slight increase in test pressure (see Table 1) may be responsible for the increases in vertical spring rate. It is of interest to note that the vertical spring rate measured for the 10.00-20 tire with the G rating was less than that obtained for the F load rating. However, the lateral force generating ability did increase with increased load rating as evidenced by the

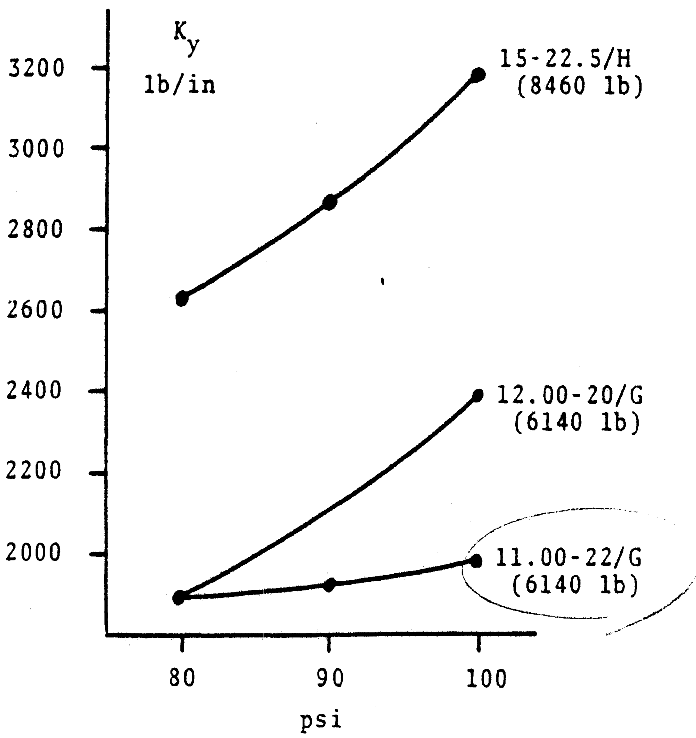


Fig. 4 - Lateral spring rate K_y versus inflation pressure for tires shown in Figs. 2A-2C

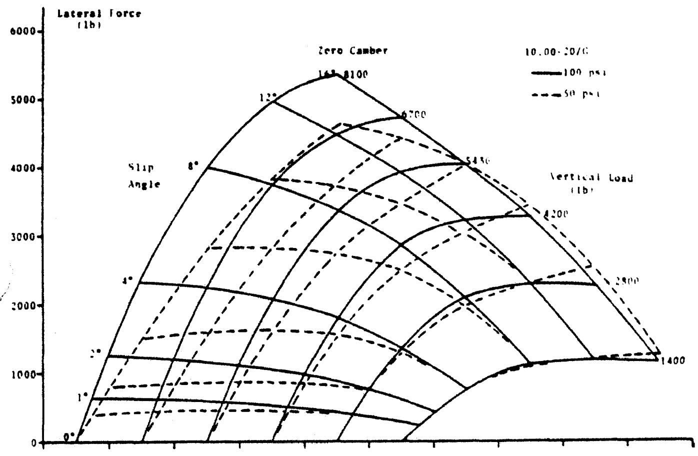
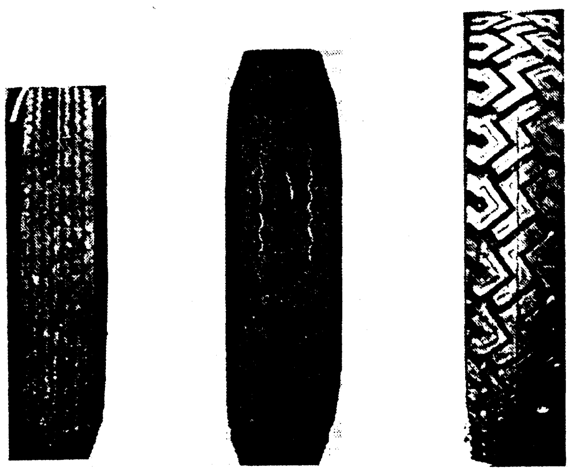


Fig. 5 - Lateral force versus slip angle and vertical load on 10.00-20/G tire at rated pressure (100 psi) and at 50 psi



	(a) Rib-type I	(b) Rib-type II	(c) Open Tread	
C_s	46000	42000	28000	lb/unit slip
r	508.2	523.4	516.0	lb/deg
	56.7	69.0	39.9	lb/deg
K_y	1477	1618	1291	lb/in
K_z	5032	4700	4500	lb/in

Fig. 6 - Measured mechanical properties of 10.00-20/F nylon tire in three tread patterns. A-rib-type I; B-rib-type II; C-open tread

measured increase in C_α and by the carpet plot comparison given in Fig. 7.

Fig. 7 represents the extreme in force variation found in this study of ply rating and tire size. More tests are needed to establish firmly the trends evident in Table 2.

TREAD PATTERN INFLUENCE

It is widely recognized that the tread pattern is a very important factor in wet traction performance. However, it also appears that pattern influence is noticeable in the data from low-speed dry-traction flat bed tests. Fig. 6 shows the three 10.00-20/F nylon tires, similar except for tread design, that were tested in this study. Listed beneath the tires are the five basic mechanical properties defined earlier. The values shown were measured at rated inflation pressure, 85 psi, and rated load, 5430 lb.

From an examination of the data, it appears that tread design has little influence on the tire spring rates K_y and K_z. The cornering stiffness, C_α, was affected very little although the open tread did generate slightly higher lateral force at higher slip angles than the rib-type pattern (see comparison presented in Fig. 8). The camber stiffness, C_γ, was substantially changed by the tread pattern. In Fig. 9, it is seen that the open tread generated considerably less lateral force (or camber thrust) than the rib-type pattern.

The marked decrease in longitudinal stiffness, C_s (Fig. 6), is a result of increased tread compliance*. It would be of considerable interest to compare the peak braking traction of the rib-type and open tread tires. Although the force measuring equipment employed in these tests was incapable of responding to a longitudinal slip much above s = 0.04**, the higher initial slope (indicated by the measured C_s) of the F_x

*This is to be expected in the open pattern which has approximately twice the void area of the closed rib-type pattern.

**Far below that required for peak braking force generation.

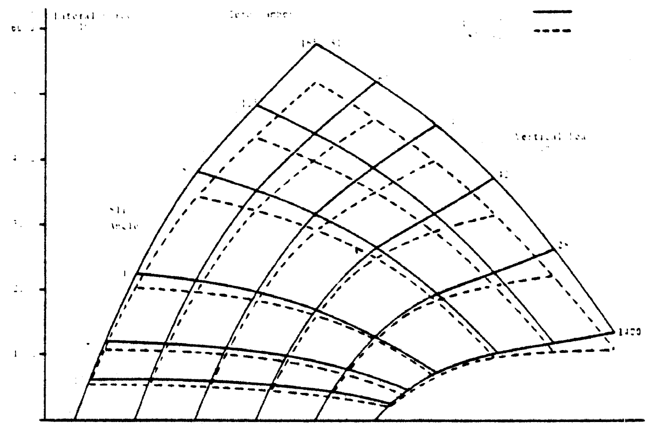


Fig. 7 - Comparison of lateral force versus slip angle and vertical load on 10.00-20 tires with ply ratings F and G

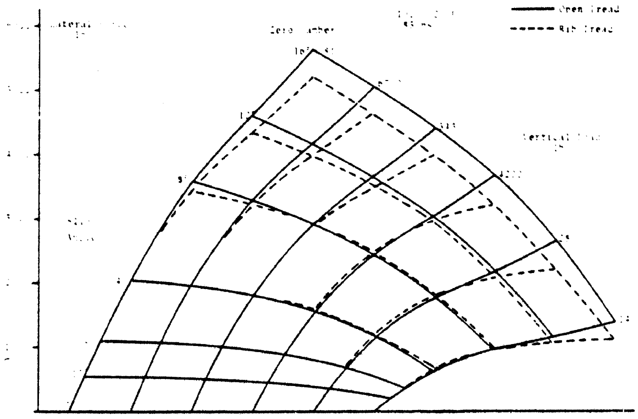


Fig. 8 - Lateral force versus slip angle and vertical load on open and rib-type II tread patterns

Table 1 - Tires Tested to Determine Influence of Ply Rating and Tire Size on Mechanical Properties

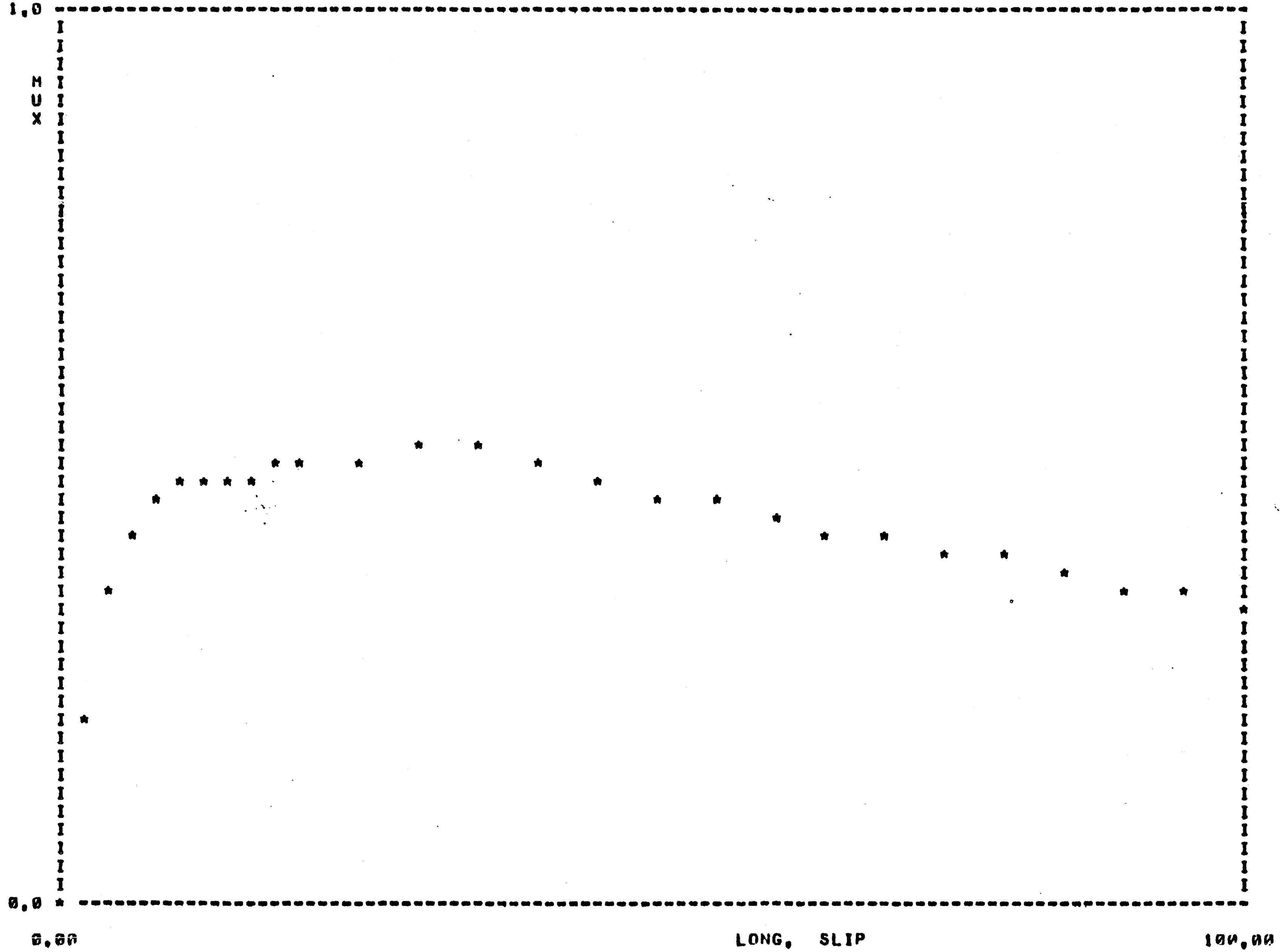
Tire Size and Rating	Test Pressure, psi	Test Load, lb
9.00-20/E	80	4160
9.00-20/F	85	4250
10.00-20/F	85	5430
10.00-20/G	85	5430
11.00-22/F	85	6290
11.00-22/G	90	6140

Table 2 - Measured Mechanical Properties for Three Sets of Two Tires Which Differ Only in Ply Rating

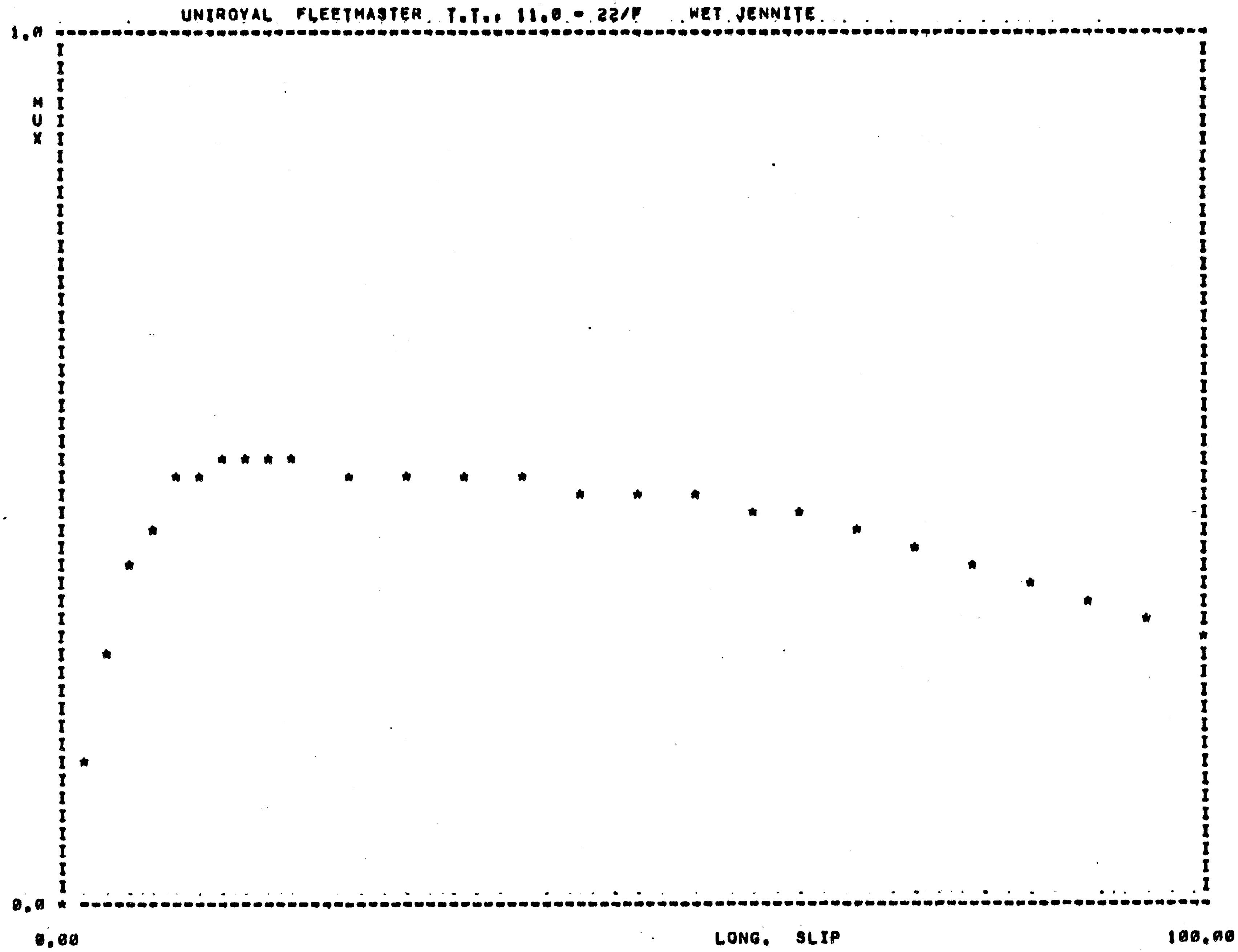
Tire	9.00-20		10.00-20		11.00-22	
Rating	E	F	F	G	F	G
C_s, lb/unit slip	41,000	41,000	42,000	50,000	47,000	51,000
C_α, lb/deg	466.1	479.4	523.4	588.8	542.7	536.9
C_γ, lb/deg	59.6	64.4	69.0	74.6	63.3	62.8
K_y, lb/in	1,673	1,889	1,618	1,482	2,116	1,909
K_z, lb/in	3,824	4,122	4,700	4,363	5,578	5,850

fil

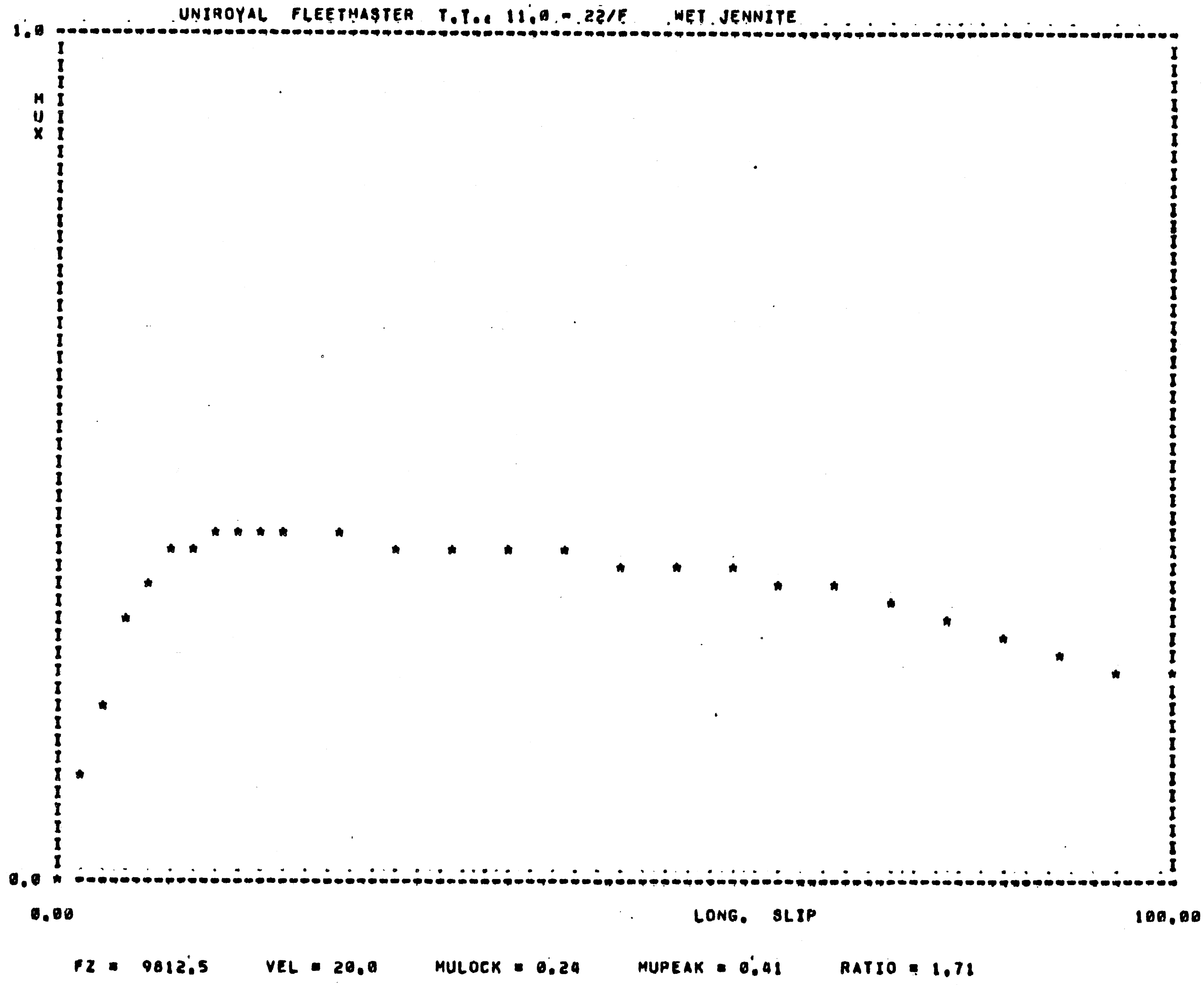
UNIROYAL FLEETMASTER T.T., 11.0 - 22/F WET JENNITE



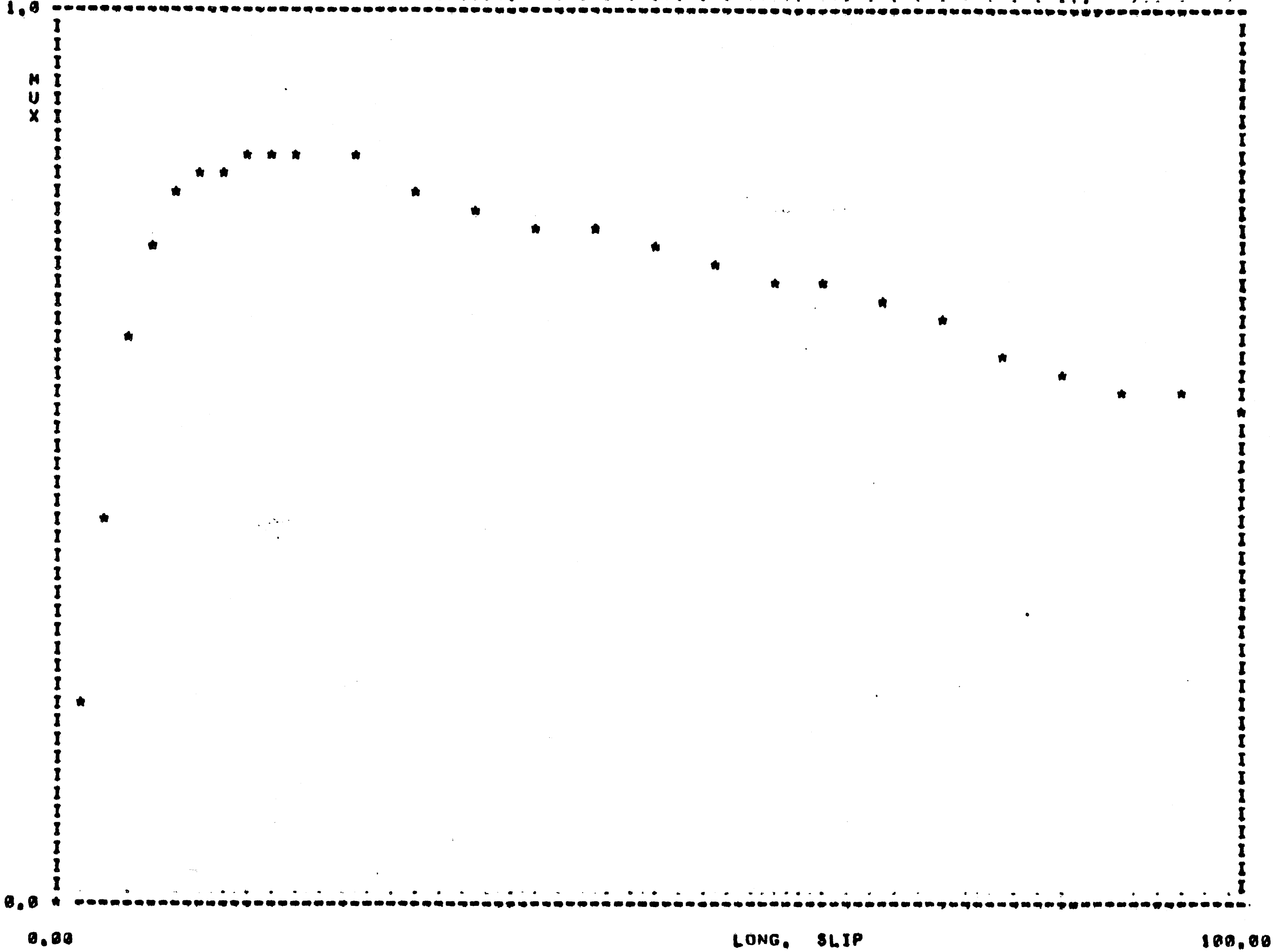
FZ = 3240.1 VEL = 20. MUPUK = .50 MULOCK = .33 RATIO = 1.54



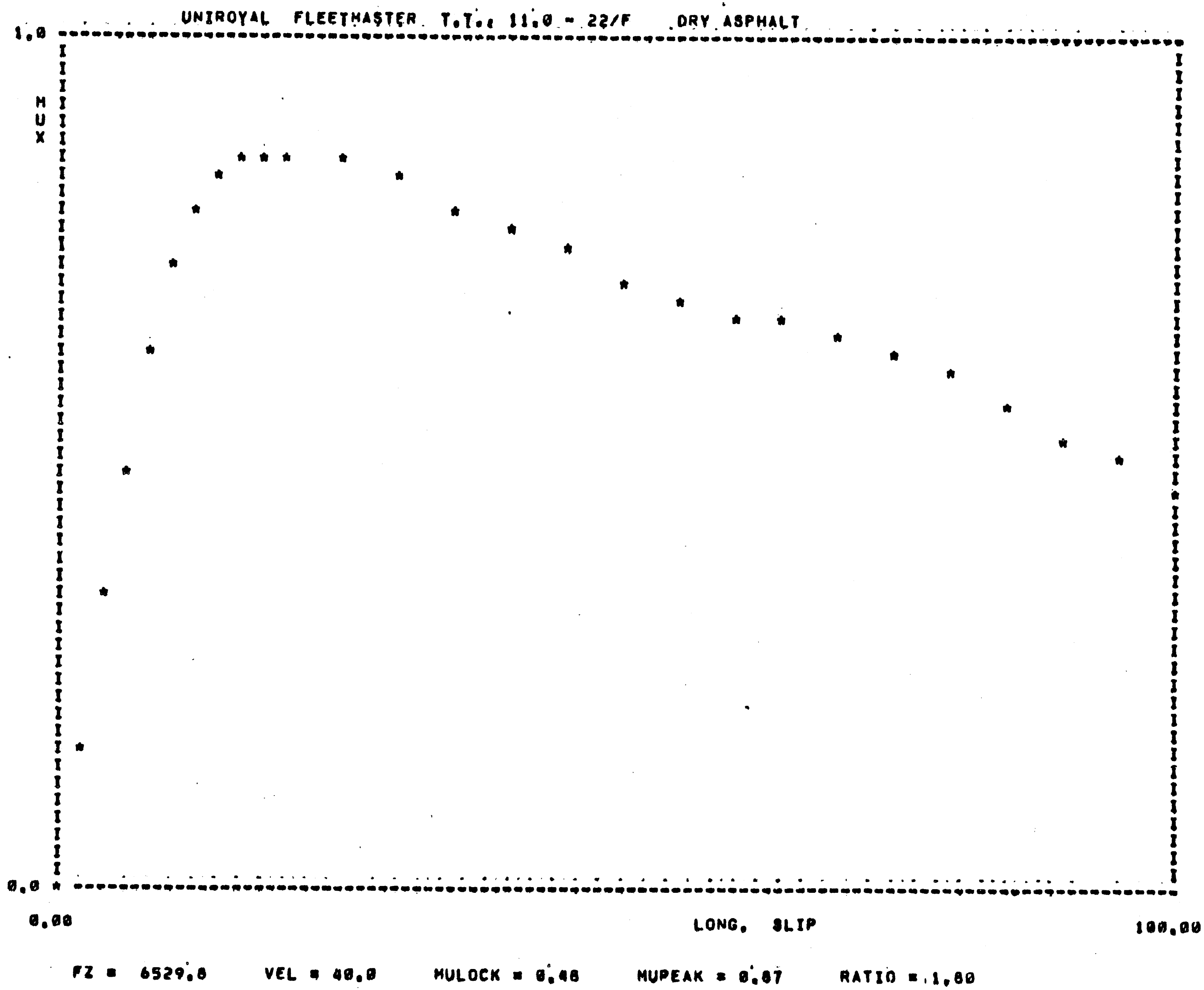
FZ = 6542.0 VEL = 20.0 MULOCK = 0.30 MUPEAK = 0.51 RATIO = 1.66

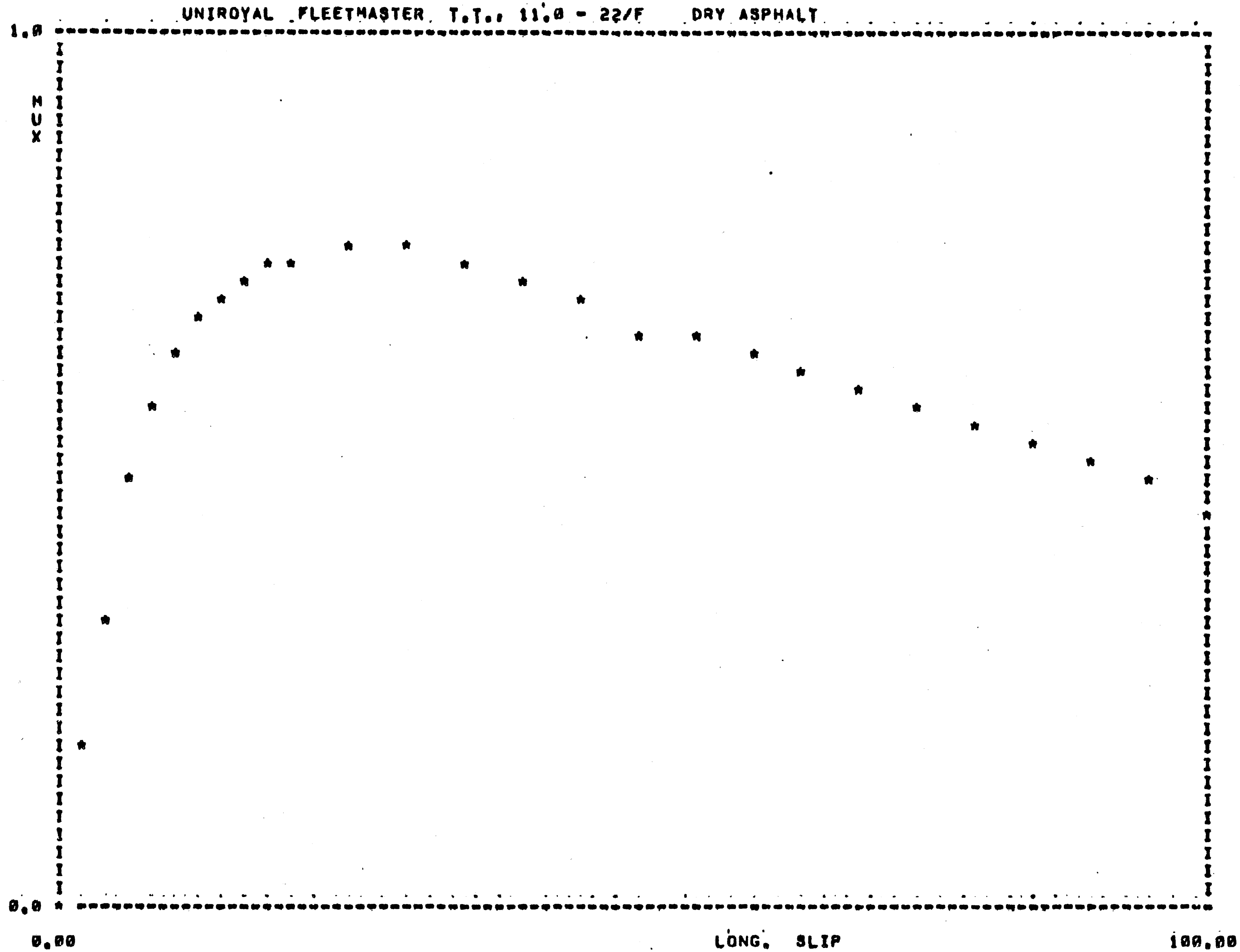

UNIROYAL FLEETMASTER T.T.: 11.0 - 22/F WET JENNITE
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 9812.5 VEL = 20.0 MULOCK = 0.24 MUPEAK = 0.41 RATIO = 1.71

UNIROYAL FLEETMASTER T.T., 11.0 - 22/F DRY ASPHALT



FZ = 3431.5 VEL = 40.0 MULOCK = 0.55 MUPEAK = 0.85 RATIO = 1.53


UNIROYAL FLEETMASTER T.T., 11.0 - 22/F DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 6529.8 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.87 RATIO = 1.80



FZ = 8344.3 VEL = 60.0 MULOCK = 0.46 MUPEAK = 0.76 RATIO = 1.66

Tire: Highway Tread 11-22/F Rim: 22x8.0

LATERAL FORCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	85	268	508	903	1428	2003	2269
4200	85	434	832	1535	2584	3456	4020
6290	85	543	1034	1916	3310	4474	5308
8200	85	571	1122	2091	3718	5073	6155
9900	85	573	1140	2162	3932	5351	6706

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	85	31	51	73	73	54	22
4200	85	76	133	205	230	204	131
6290	85	120	215	345	420	400	274
8200	85	156	290	478	607	613	448
9900	85	183	356	598	784	838	639

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
2100	85	21,000	
6290	85	47,000	5578
9800	85	48,000	

Tire: Highway Tread 11-22/G Rim: 22x8.50

LATERAL FORCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	90	265	497	973	1636	2017	1927
4200	90	435	828	1550	2807	3510	3577
6140	90	537	1036	1979	3517	4497	4669
8200	90	587	1148	2189	4028	5245	5572
10000	90	601	1183	2236	4163	5633	6137

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	90	28	46	77	75	46	-5
4200	90	72	124	210	243	183	80
6140	90	112	199	350	428	342	174
8200	90	152	280	509	646	551	271
10000	90	185	345	652	853	766	429

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
2100	90	23,000	
6140	90	51,000	5852
10000	90	60,000	

2.2 DATA MEASUREMENT AND PROCESSING PROCEDURES

2.2.1 TIRE PREPARATION. Truck tires were prepared for testing through the maintenance of certain practices intended to assure consistency of test conditions as well as representativeness of measured traction performance. All tires were mounted on their respective Tire & Rim Association-recommended rims (disc wheels).

The inflation pressure of each tire was maintained at a representative "hot" inflation level which had been identified in prior testing as the equilibrium value which accompanies operation at 60 mph and rated load, following "cold" inflation to the T&RA-recommended value. The maintained "hot" inflation pressure values are shown for each sample in Table 4.

Table 4.

Tire Sample	Size	Code	T&RA-Recommended "Cold" Inflation	Maintained "Hot" Inflation
Firestone Transport 1	10.00x20/F	FT10	85 psi	100 psi
Goodyear Super Hi Miler	10.00x20/F	GyS10	85	100
General Power Jet	10.00x20/F	GℓJ10	85	100
Goodyear Super Hi Miler	11x22.5/F	GyS11	90	100
Firestone Transport 1	12.00x20/H	FT12	105	120
Uniroyal Unimaster Rib	15x22.5/H	UU15	100	115

Each tire was "broken-in," on the test machine, for a distance of approximately 10 miles, and at a velocity of 40 mph, followed by the execution of six preliminary "lockup cycles" for purposes of removing any surface contaminants remaining from the tire molding process.

It has been rationalized that customary preparations employed in passenger car tire testing, such as utilization of a 100-mile free-rolling break-in practice, are most likely inappropriate for preparation of heavy truck tire samples, given that the slip energy experienced in a single lockup far exceeds the accumulated work history encountered during the free-rolling practice. Accordingly, the initial application of six lockup cycles was seen as a more satisfactory method for assuring that the sample experiences the necessary transition in tread surface conditions prior to data-taking. It would appear from data which are presented later that the tires examined in this sample did indeed exhibit a quite stable traction performance over the sequence of test runs, following the indicated break-in procedure. The <u>need</u> for such a break-in practice, however, has not been explored.

2.2.2 TRACTION MEASUREMENT PROCEDURE. The basic lockup cycle, which was applied six times in succession at each condition of velocity and vertical load, involved a controlled-onset brake torque application followed by an automatic brake release, as diagrammed in Figure 10. By means of an appropriate throttling valve setting, the flow of air into the chambers of a dual-wedge drum brake was controlled to provide a gradual approach toward the peak force condition, thus increasing the quantity of data gathered in the vicinity of the peak longitudinal force. The locked-wheel condition is constrained to approximately 150 milliseconds duration to minimize the load variations that derive from "flat-spotting," as reported previously [1, 2]. Throughout the brake application sequence an attempt is made to maintain the

The C_s parameter is characteristically influenced by vertical load because of the increasing length of the tire-road contact patch with increased load. In the data presented, the load range is sufficiently broad that the C_s versus F_z relationship is seen to stiffen markedly at the higher load level. As expected, however, C_s has been found to be unaffected by variations in velocity as was illustrated in the normalized data curves of Figure 14.

The "μ-slip" data (such as shown in Figure 14) has been reduced further to yield numeric characterizations of F_x/F_z at the peak of the curve and at the 100% slip (or "slide") point. These peak and slide characterizations are utilized, in large measure, to illustrate the basic findings of the study.

Let us examine, first, the variation in performance measured for the six-tire sample at the BADC (asphalt) facility. Figure 16 summarizes the sample's traction sensitivity to normalized vertical load, i.e., $F_Z/F_{z(rated)}$. On recognizing that the tire sample included four "F"-rated tires (open symbols) and two "H"-rated tires (closed symbols) we note that the traction data produced by the tires having a common load-range rating are rather tightly grouped, especially with regard to peak values. It is surprising, however, that the size 15x22.5/H wide base single tire (code UU15) provides such a small increment in normalized traction when the load is reduced from the rated value (8460 lbs) to 0.4 of the rated value (3380 lbs). This performance suggests, for example, that the wide base single is less suitable for operation at lower loads than tires which are rated in the lower load range. As shown in Figure 17, with vertical load (non-normalized) plotted on the axis of abscissa, the wide base tire provides a reduced tractive performance (compared to 10.00x20/F's) when the value of F_z is below about 8000 lbs. Thus the notion that one can "tire-up" to resolve stopping performance deficiencies in heavy trucks may not be a universal axiom.

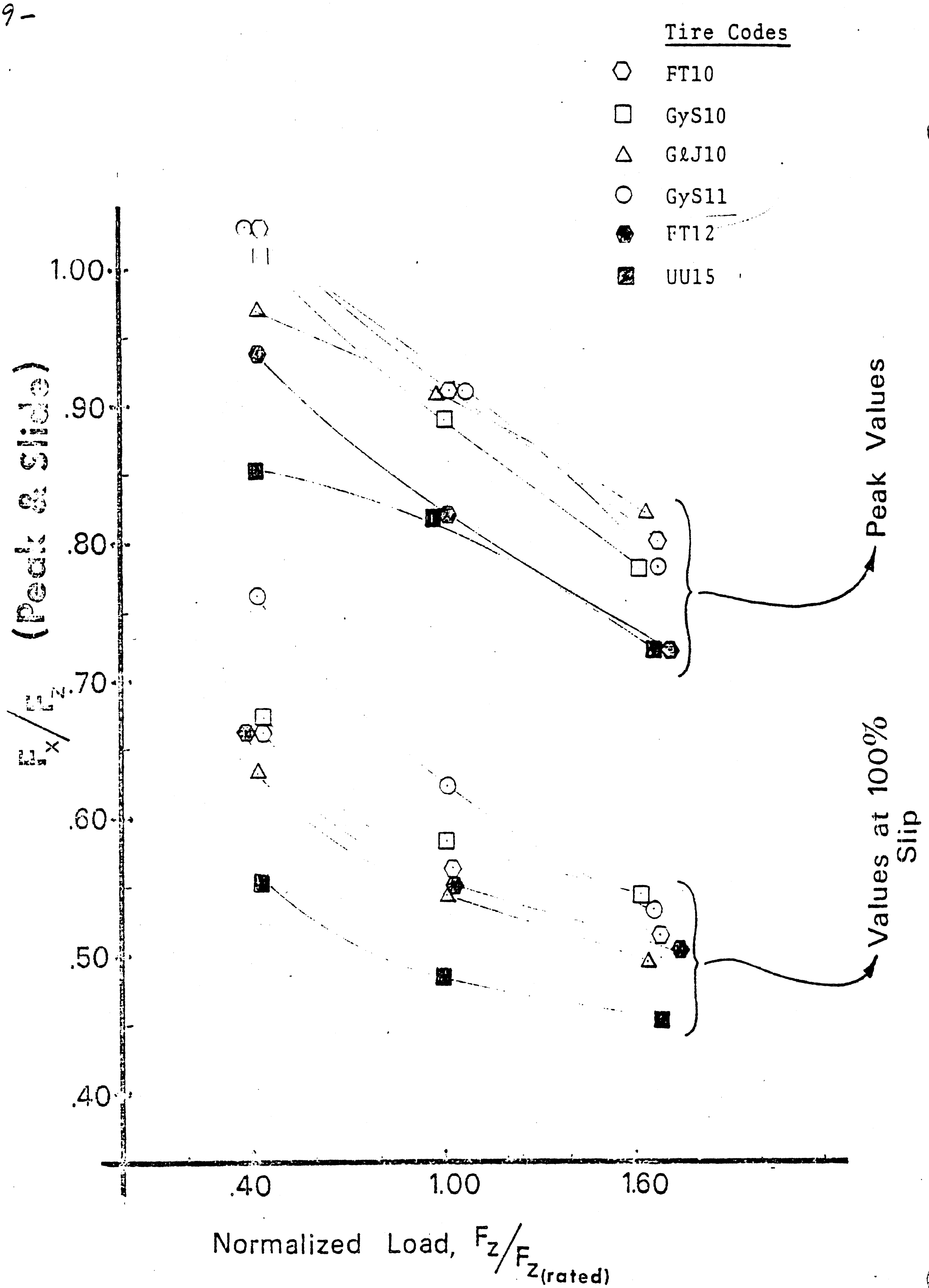


Figure 16. Normalized load sensitivity in the peak and slide traction of the six-tire sample (on BADC's asphalt).

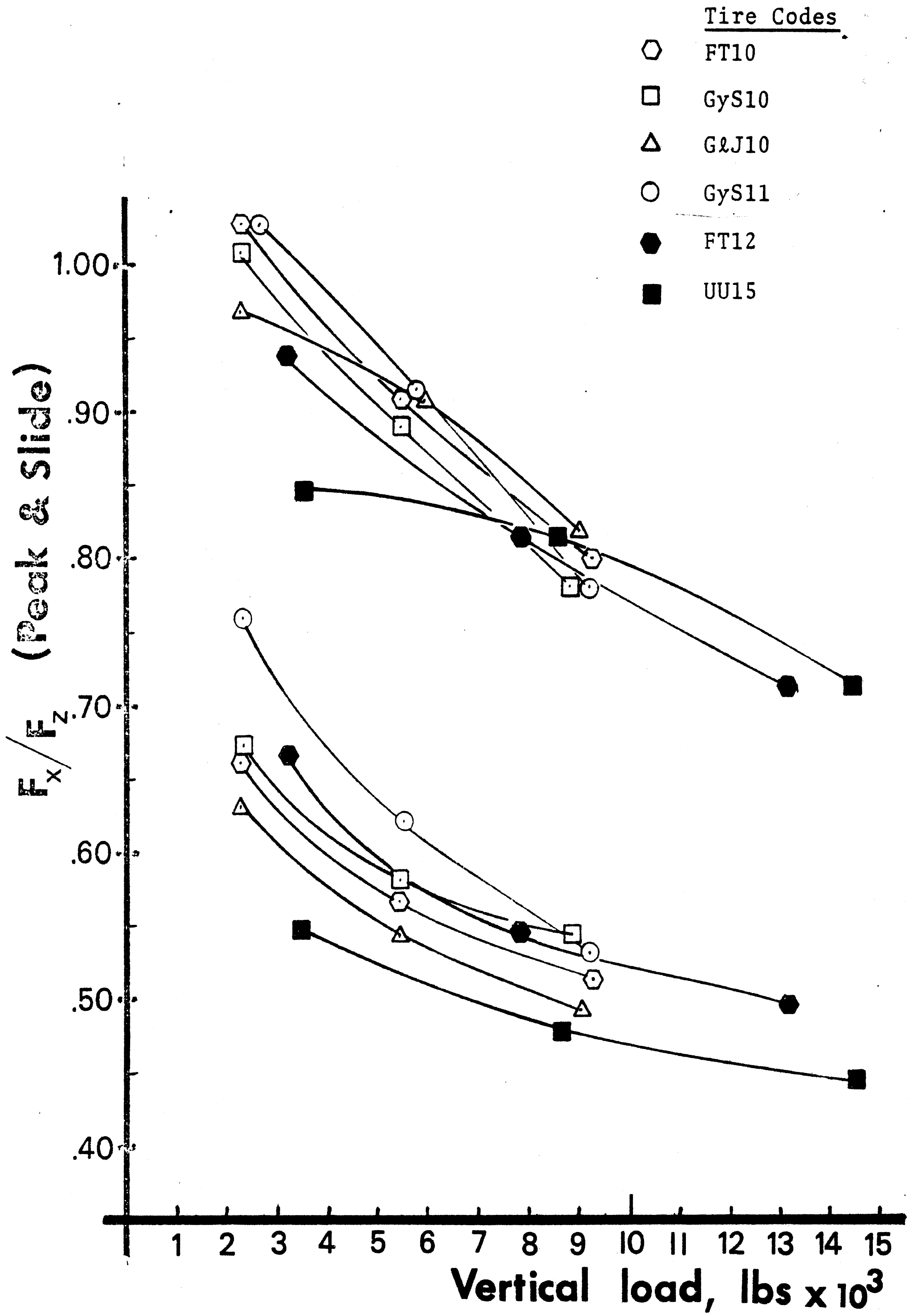


Figure 17. Load sensitivity (non-normalized abscissa) in the peak and slide traction of the six-tire sample (on BADC asphalt).

Figure 18 illustrates the influence of velocity on the normalized traction behavior of the six-tire sample as measured on the asphalt track at the BADC facility. The data show a rather narrow band within the respective peak measurements and slide measurements across the tire sample, with consistent gross trends exhibited in all cases except, perhaps, in the case of the peak measurements describing the performance of the Goodyear 11x22.5/F (tubeless) tire (code GyS11). Data from this tire are seen to rise from a value of 0.85 to 0.92 over the 3- to 10-mph velocity increment while the same tire in a tube-type version (10.00x20/F, code GyS10) stays virtually constant at .93-.94. The data in Figure 18 again place the H-rated tires (codes FT12 and UU15) at the lower boundary of performance for these experiments in which each tire was operated at its rated load.

To characterize the repeatability of the data presented in Figures 16 through 18, the data obtained in the check runs are plotted, for each tire, in Figure 19. Data points are presented, left to right, in the order in which they were gathered. Below each group of peak and slide data presented in Figure 19 for each tire, the standard deviation of the measures is printed. In general, the indicated repeatabilities are of considerably higher quality than is observed, say, in peak readings gathered using ASTM skid trailers. In addition to the observed repeatability, it is gratifying to observe that the test process is causing no monotonic trend in peak/slide characteristics as a function of work history. Thus we conclude that each tire sample was behaving in a stable fashion throughout the sequence of test runs.

These results, as obtained by testing a selected sample of tires on the asphalt surface at the BADC facility generally confirm the measurements reported earlier, except insofar as absolute values of traction are concerned. Also,

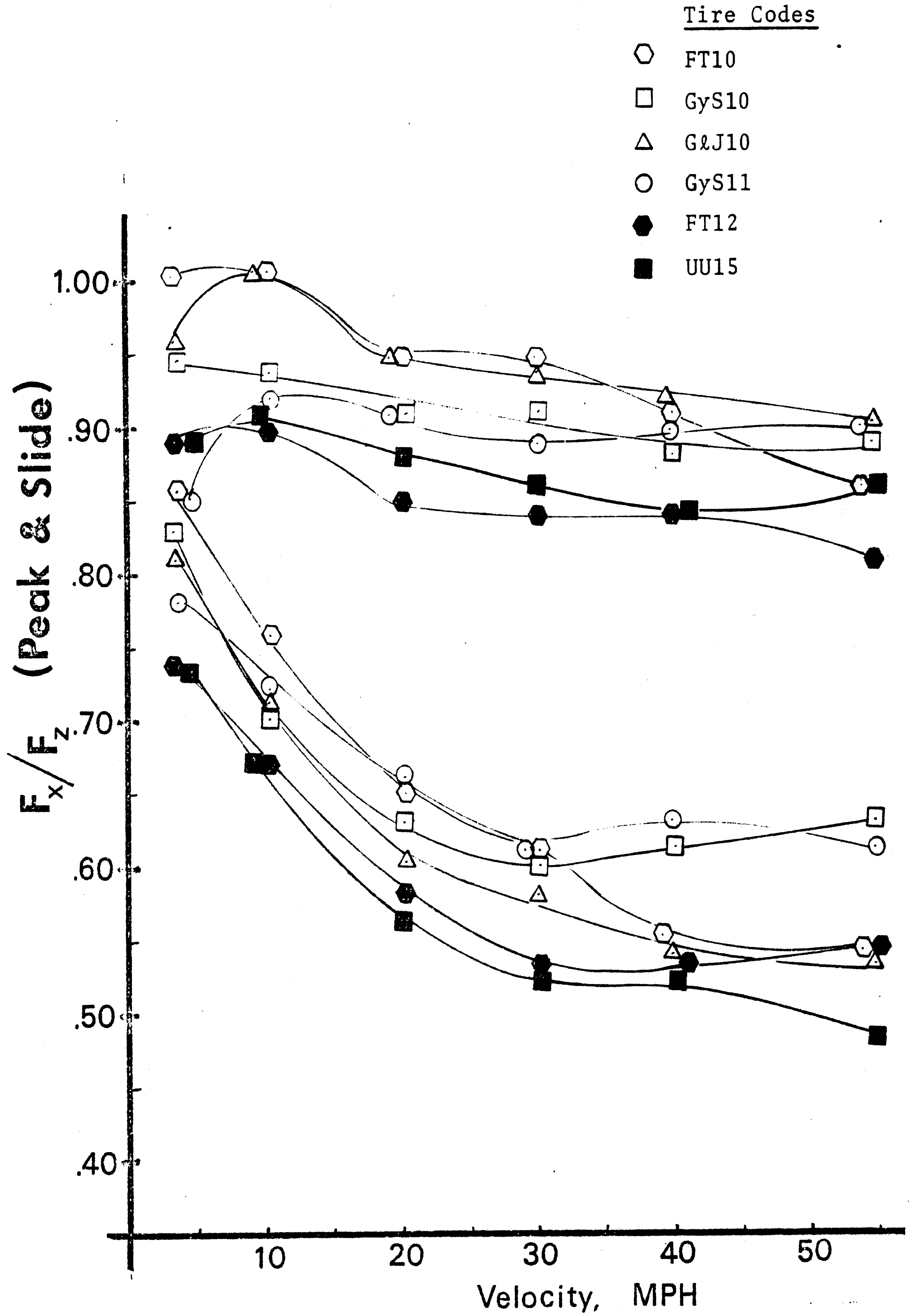


Figure 18. Velocity sensitivity of the peak and slide traction values for the six-tire sample (on BADC asphalt).

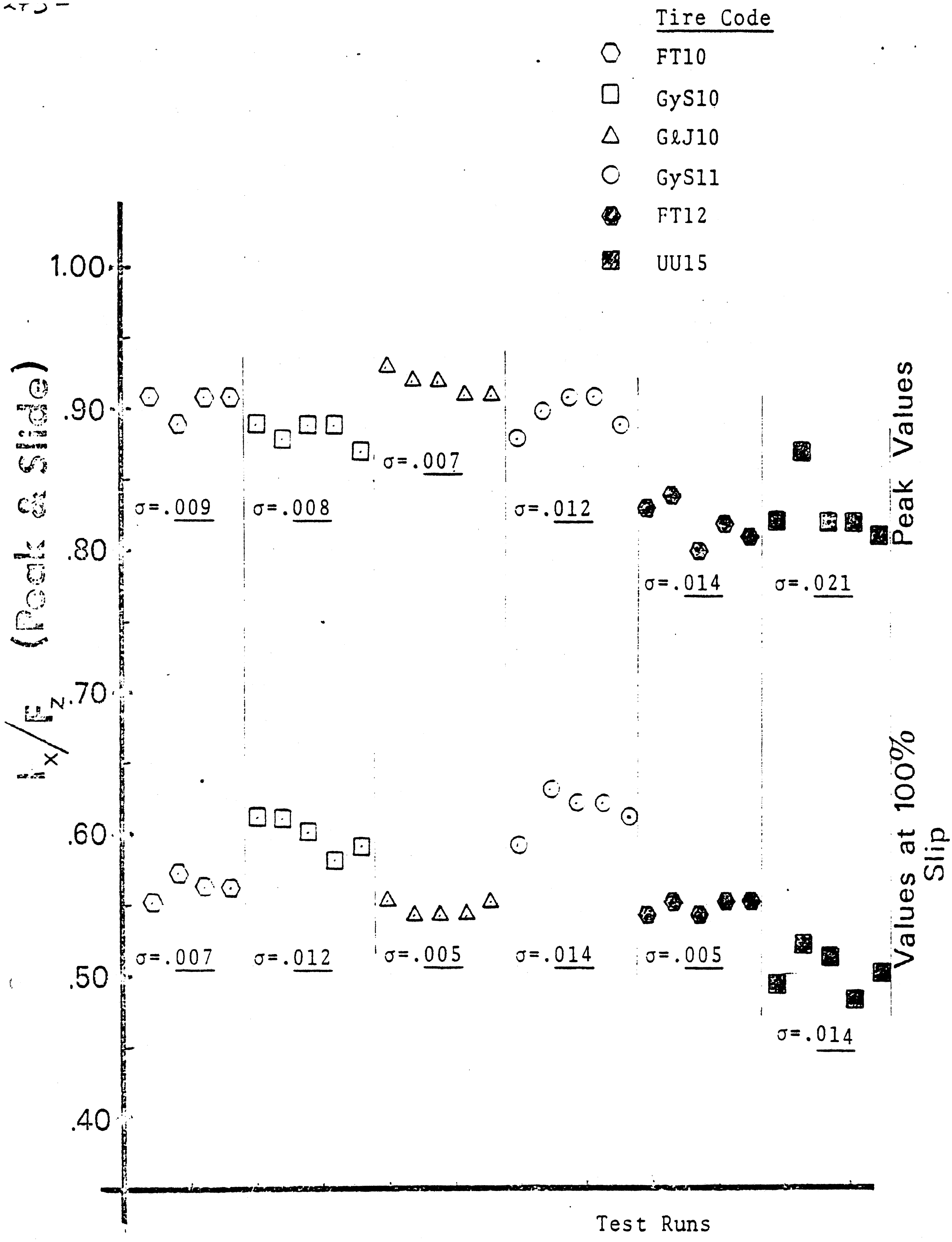


Figure 19. Peak and slide traction measures deriving from repeat runs of each of the six tires tested on the asphalt track at BADC.

GOODYEAR SUPER HI MILER, 11 x 22.5/F, BADC ASPHALT

** A-D FILE 222 NEW FILE 91 TEST SAMPLE401 **

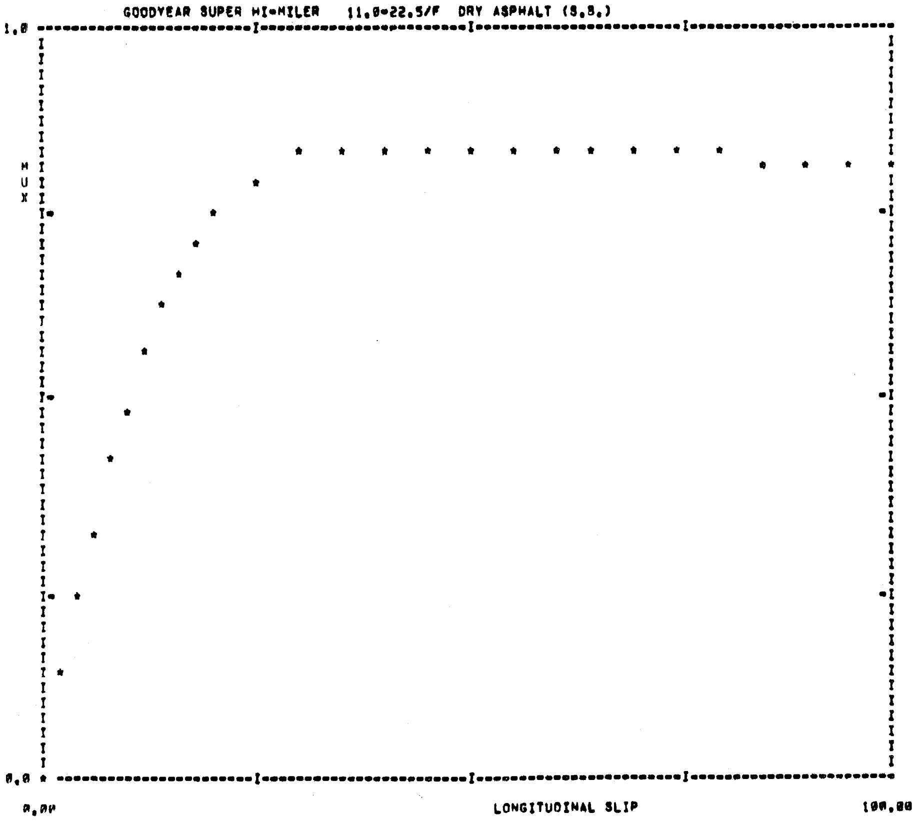
AVERAGE OF FILE 222 FOR 6 RECORDS. GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.S.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.15	13577.0	809.4
0.04	0.24	23875.2	1315.9
0.06	0.33	33481.6	1800.5
0.08	0.42	43761.9	2317.2
0.10	0.50	53092.1	2749.6
0.12	0.57	60786.6	3137.1
0.14	0.64	66595.2	3456.0
0.16	0.68	71306.4	3705.6
0.18	0.72	75447.4	3904.1
0.20	0.75	78881.4	4050.4
0.25	0.80	85376.2	4290.6
0.30	0.83	90047.1	4465.4
0.35	0.84	91095.7	4531.9
0.40	0.85	92377.3	4545.6
0.45	0.85	92420.4	4501.0
0.50	0.85	92294.9	4531.4
0.55	0.84	92098.2	4517.0
0.60	0.84	91846.4	4502.7
0.65	0.84	91583.2	4486.9
0.70	0.84	91310.2	4470.6
0.75	0.83	91032.4	4454.2
0.80	0.83	90752.1	4437.7
0.85	0.83	90470.6	4421.1
0.90	0.82	90105.3	4402.2
0.95	0.82	89573.3	4370.4
1.00	0.82	88791.7	4347.5

TQAV = 88791.7 LOAD = 5505.2 VEL = 3.0 MPH.

MUPEAK = 0.85 MULOCK = 0.82 RATIO = 1.04

GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.S.)



FZ = 5505.2 VEL = 3.0 MULOCK = 0.82 MUPEAK = 0.85 RATIO = 1.04 A-D FILE 222 NWFILE 91 SAMPLE 401

** A-D FILE 223 NEW FILE 92 TEST SAMPLE002 **

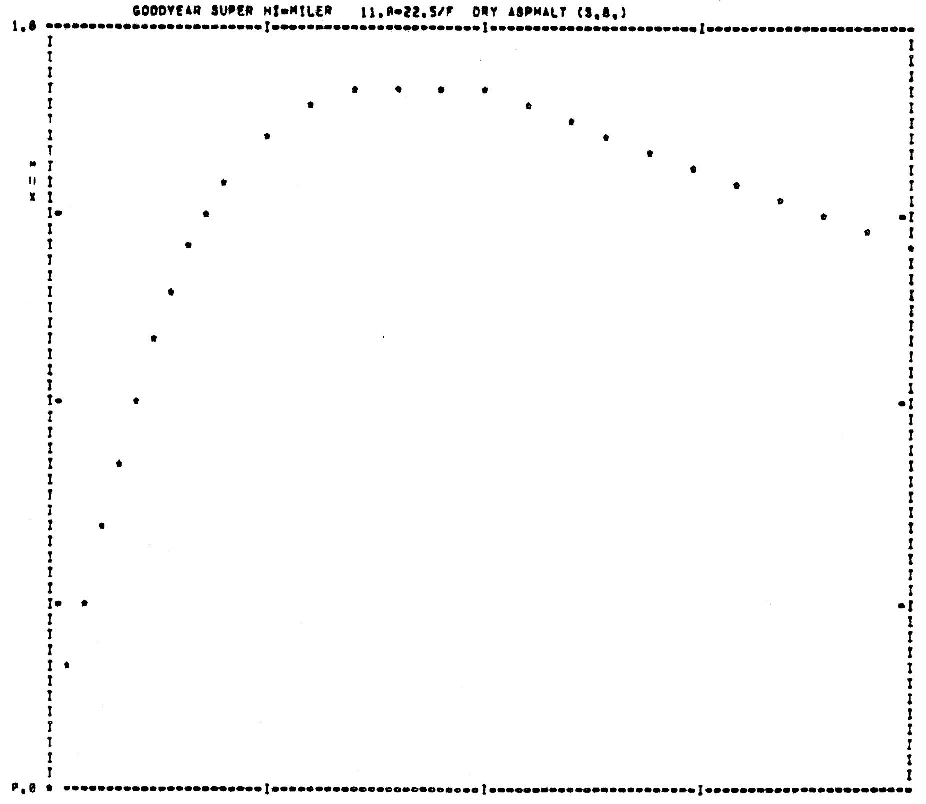
AVERAGE OF FILE 223 FOR 5 RECORDS. GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	14354.6	857.5
0.04	0.25	25985.7	1401.4
0.06	0.35	36421.0	1908.9
0.08	0.44	46356.1	2404.0
0.10	0.52	55374.9	2829.3
0.12	0.59	62704.4	3210.1
0.14	0.66	69556.8	3536.3
0.16	0.71	76251.1	3816.1
0.18	0.76	81785.6	4081.9
0.20	0.81	85707.7	4290.7
0.25	0.86	93142.8	4567.3
0.30	0.90	98970.9	4720.6
0.35	0.91	103521.3	4791.3
0.40	0.92	107199.9	4800.7
0.45	0.92	110119.2	4790.4
0.50	0.91	111674.4	4750.1
0.55	0.90	111396.9	4690.6
0.60	0.88	108337.2	4606.1
0.65	0.86	100151.0	4503.9
0.70	0.80	100156.5	4402.0
0.75	0.82	96439.2	4302.2
0.80	0.80	92878.7	4203.6
0.85	0.79	89398.5	4105.6
0.90	0.77	85554.1	4004.7
0.95	0.74	80918.4	3897.2
1.00	0.72	75075.0	3780.0

TOAV = 75075.0 LOAD = 5098.9 VEL = 10.0 MPH.

MUPEAK = 0.92 MULOCK = 0.72 RATIO = 1.28

GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)



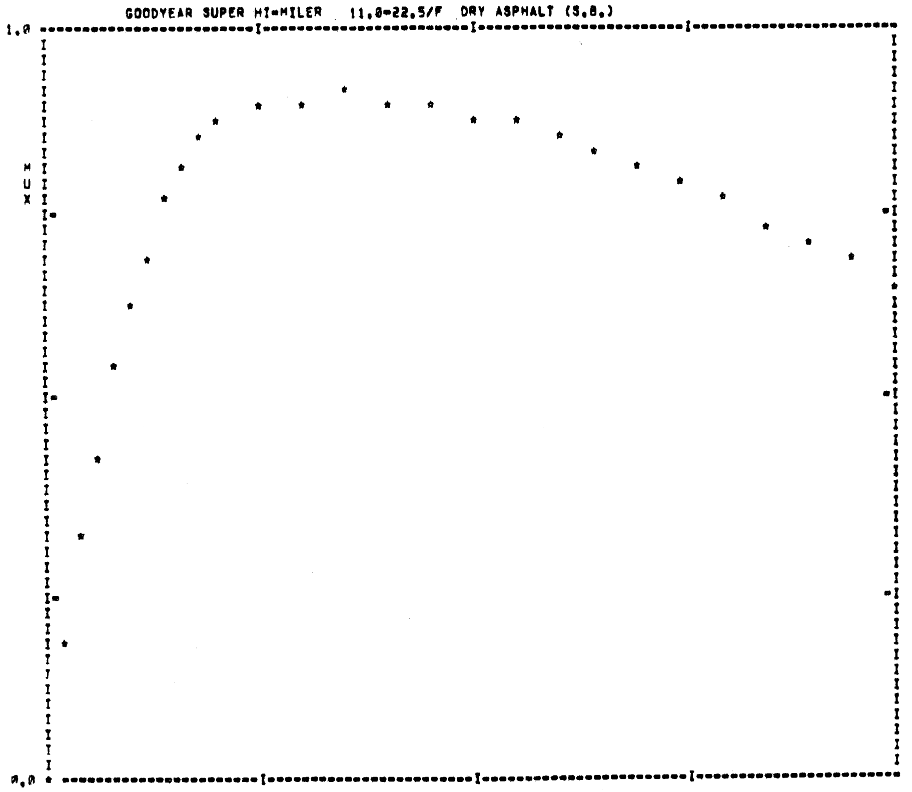
FZ = 5098.9 VEL = 10.0 MULOCK = 0.72 MUPEAK = 0.92 RATIO = 1.28 A-D FILE 223 NWFILE 92 SAMPLE 402

** A-D FILE 224 NEW FILE 93 TEST SAMPLE403 **

AVERAGE OF FILE 224 FOR 5 RECORDS, GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX	
0.00	0.00	0.0	0.0	
0.02	0.18	17242.1	970.6	
0.04	0.32	31912.4	1742.2	
0.06	0.44	44935.0	2379.4	
0.08	0.54	56468.2	2927.2	
0.10	0.63	66097.6	3389.7	
0.12	0.71	74436.3	3779.3	
0.14	0.77	81800.5	4107.5	
0.16	0.82	87224.0	4381.9	
0.18	0.86	91375.9	4579.7	TQAV = 69825.0 LOAD = 5492.0 VEL = 20.0 MPH.
0.20	0.88	94898.9	4668.3	
0.25	0.90	100776.7	4765.9	MUPEAK = 0.91 MULOCK = 0.66 RATIO = 1.37
0.30	0.91	104846.0	4812.6	
0.35	0.91	107695.5	4821.9	
0.40	0.91	110100.2	4796.9	
0.45	0.90	112581.8	4749.6	
0.50	0.89	115382.9	4688.6	
0.55	0.87	118422.4	4614.5	
0.60	0.86	120864.1	4528.5	
0.65	0.84	121212.5	4433.0	
0.70	0.82	119554.5	4330.2	
0.75	0.79	113476.4	4210.7	
0.80	0.77	105222.6	4080.4	
0.85	0.75	96808.8	3949.2	
0.90	0.72	88224.3	3816.4	
0.95	0.69	79067.9	3679.7	
1.00	0.66	69825.0	3537.0	

GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)



FZ = 5492.0 VEL = 20.0 MULOCK = 0.66 MUPEAK = 0.91 RATIO = 1.37 A-D FILE 224 NWFILE 93 SAMPLE 403

** A-D FILE 225   NEW FILE 94   TEST SAMPLE### **

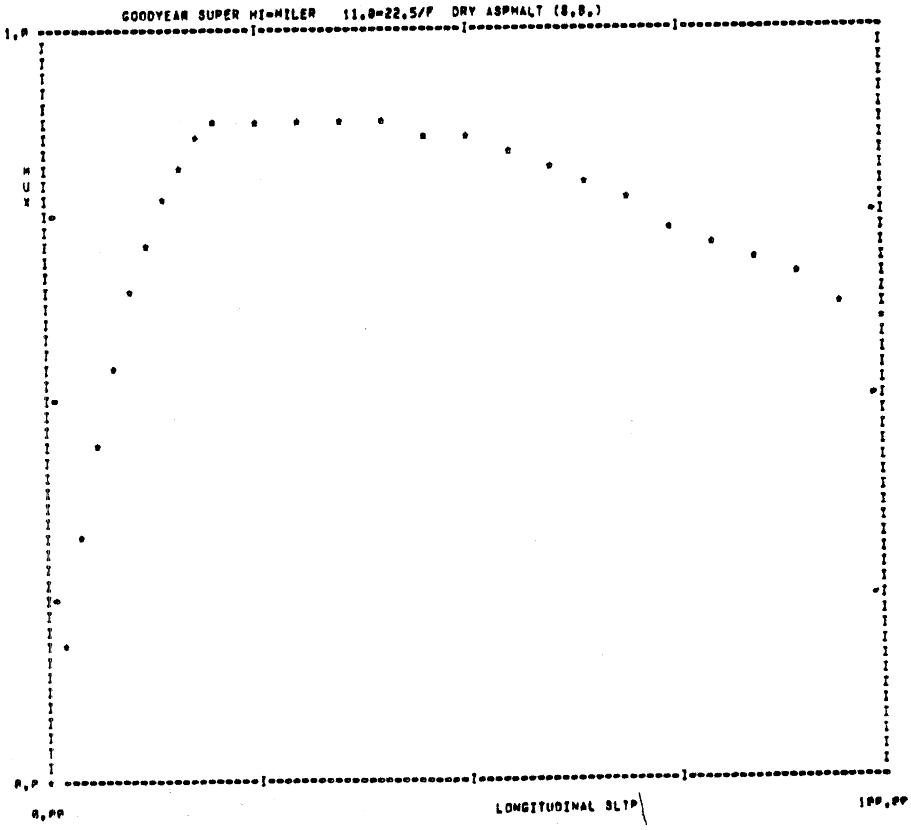
AVERAGE OF FILE 225 FOR 6 RECORDS.   GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (0.0.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	10671.9	1076.0
0.04	0.34	34349.9	1864.0
0.06	0.46	47120.0	2506.0
0.08	0.56	58745.0	3063.6
0.10	0.65	69436.1	3549.2
0.12	0.73	70282.9	3976.9
0.14	0.78	85591.3	4297.2
0.16	0.82	91400.4	4517.5
0.18	0.86	95858.5	4671.1
0.20	0.87	98658.0	4746.0
0.25	0.88	104082.7	4795.4
0.30	0.89	108165.7	4780.0
0.35	0.88	111132.9	4758.2
0.40	0.88	113404.4	4691.6
0.45	0.86	115232.3	4616.0
0.50	0.85	117157.5	4528.3
0.55	0.83	119351.2	4432.1
0.60	0.81	121583.9	4329.1
0.65	0.79	122641.5	4219.9
0.70	0.77	121081.9	4101.5
0.75	0.75	116259.4	3980.2
0.80	0.72	108283.2	3848.5
0.85	0.69	97740.7	3703.4
0.90	0.67	86512.1	3554.4
0.95	0.64	74862.9	3402.5
1.00	0.61	62645.4	3246.3

TOAV = 62645.8   LOAD = 5521.3   VEL = 30.0 MPH.

MUPEAK = 0.89   MULOCK = 0.61   RATIO = 1.46

GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (0.0.)



FZ = 5521.3   VEL = 30.0   MULOCK = 0.61   MUPEAK = 0.89   RATIO = 1.46   A-D FILE 225   NWFILE 94   SAMPLE 4##

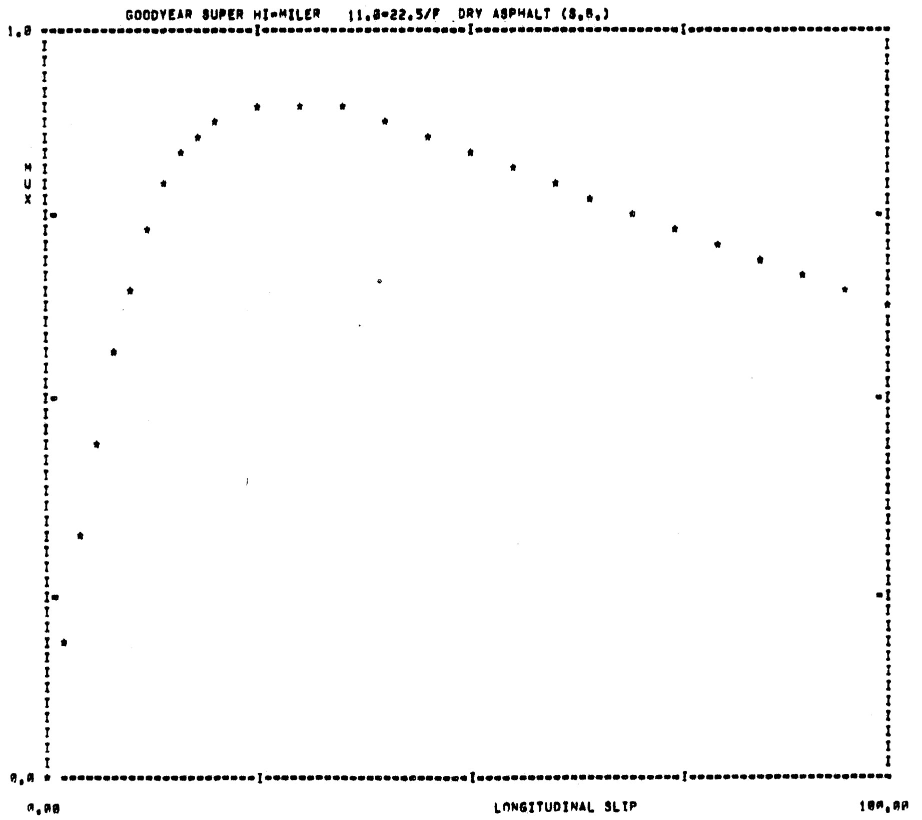
** A-D FILE 226 NEW FILE 95 TEST SAMPLE405 **

AVERAGE OF FILE 226 FOR 6 RECORDS, GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	19001.5	991.5
0.04	0.33	34649.0	1797.8
0.06	0.46	48101.6	2495.0
0.08	0.57	60002.8	3080.8
0.10	0.66	69942.3	3543.7
0.12	0.73	77917.4	3915.1
0.14	0.79	84587.7	4215.3
0.16	0.83	90669.4	4444.1
0.18	0.87	95593.2	4608.4
0.20	0.88	98846.3	4689.7
0.25	0.90	104442.5	4751.6
0.30	0.90	108688.3	4751.7
0.35	0.89	111837.1	4709.6
0.40	0.88	114411.5	4638.2
0.45	0.87	116741.6	4552.1
0.50	0.85	118849.3	4456.3
0.55	0.83	121104.9	4346.1
0.60	0.80	123565.9	4232.3
0.65	0.78	125486.7	4123.3
0.70	0.76	125416.6	4021.3
0.75	0.74	122910.6	3923.4
0.80	0.73	116239.8	3824.8
0.85	0.70	103800.6	3716.3
0.90	0.68	90097.3	3600.7
0.95	0.66	76484.1	3483.0
1.00	0.63	63125.0	3363.8

TQAV = 63125.0 LOAD = 5501.1 VEL = 40.0 MPH.

MUPEAK = 0.90 MULOCK = 0.63 RATIO = 1.42



FZ = 5501.1 VEL = 40.0 MULOCK = 0.63 MUPEAK = 0.90 RATIO = 1.42 A-D FILE 226 NWFILE 95 SAMPLE 405

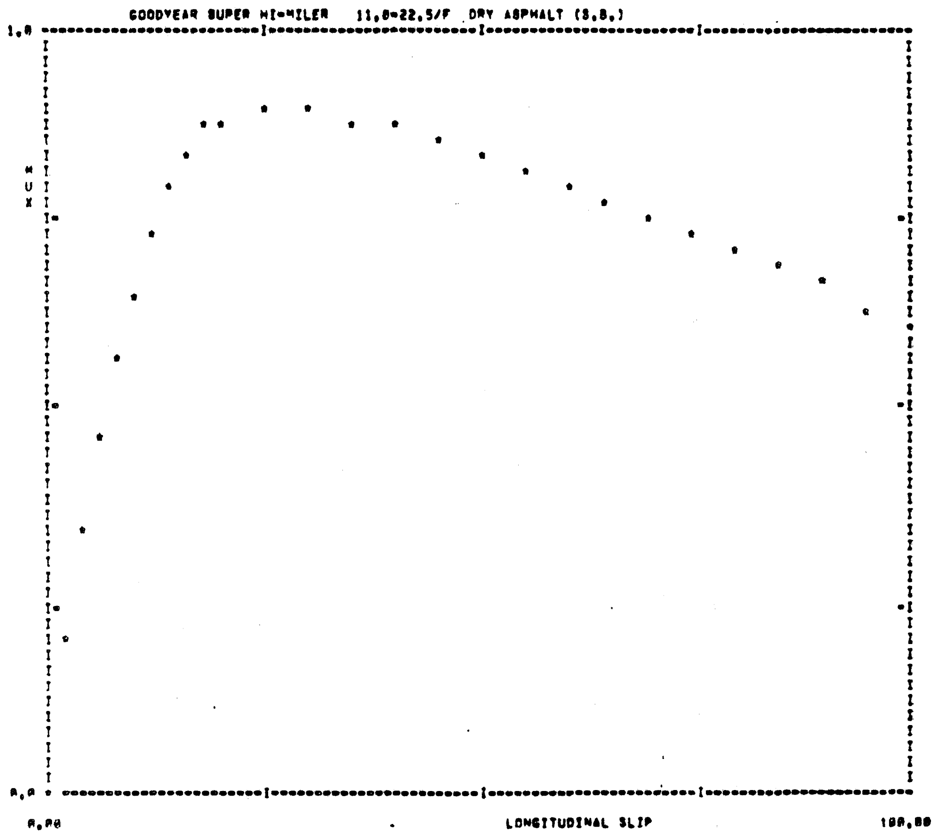
** A-D FILE 227   NEW FILE 96   TEST SAMPLE006 **

AVERAGE OF FILE 227 FOR 6 RECORDS.   GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	20677.0	1104.6
0.04	0.35	36656.3	1920.4
0.06	0.47	50473.5	2592.5
0.08	0.57	62788.3	3154.7
0.10	0.66	72096.0	3624.2
0.12	0.74	81407.0	4000.6
0.14	0.80	89873.0	4306.3
0.16	0.84	95691.4	4531.2
0.18	0.87	100845.1	4694.3
0.20	0.89	104421.1	4776.6
0.25	0.90	111371.7	4830.3
0.30	0.89	117047.9	4819.3
0.35	0.89	121510.0	4771.6
0.40	0.88	125032.5	4703.7
0.45	0.86	128084.1	4621.2
0.50	0.84	130922.9	4524.9
0.55	0.82	133031.6	4414.9
0.60	0.80	136032.9	4301.6
0.65	0.78	139779.5	4184.7
0.70	0.76	141804.5	4067.1
0.75	0.74	137873.2	3955.3
0.80	0.71	128501.3	3843.8
0.85	0.69	112941.7	3721.9
0.90	0.67	95409.9	3580.9
0.95	0.64	78127.7	3431.3
1.00	0.61	61562.5	3272.5

TQAV = 61562.5   LOAD = 5622.2   VEL = 55.0 MPH.

MUPEAK = 0.90   MULOCK = 0.61   RATIO = 1.48



FZ = 5622.2   VEL = 55.0   MULOCK = 0.61   MUPEAK = 0.90   RATIO = 1.48   A-D FILE 227   NWFILE 96   SAMPLE 006

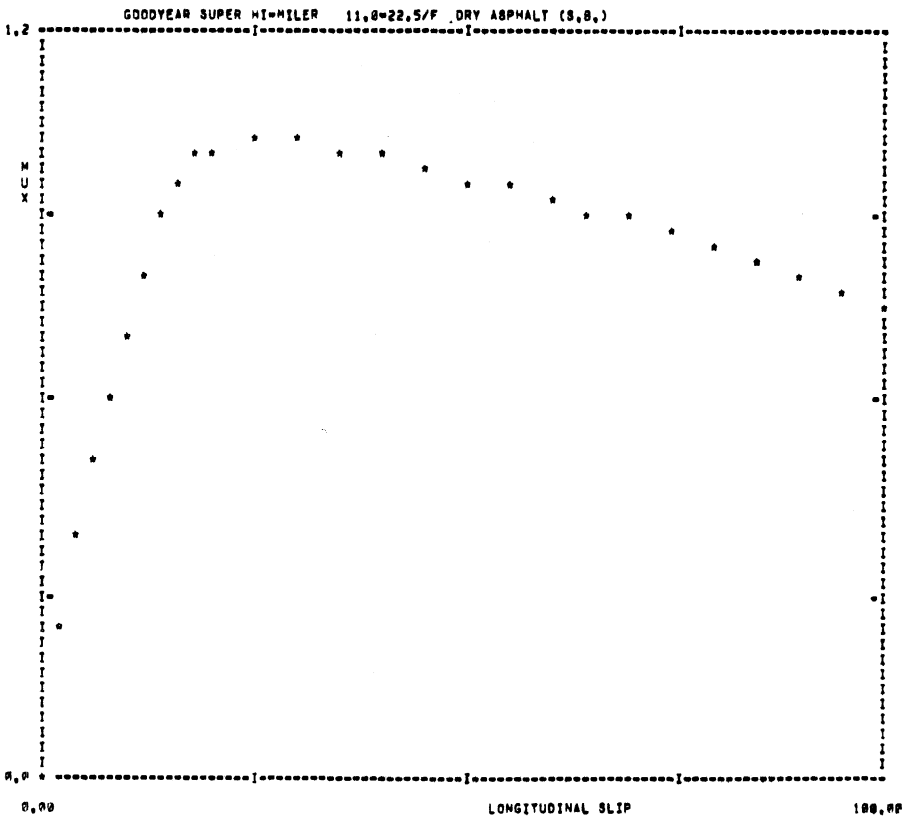
** A-D FILE 232 NEW FILE 98 TEST SAMPLE408 **

AVERAGE OF FILE 232 FOR 6 RECORDS. GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.25	9812.3	549.0
0.04	0.39	16534.4	852.0
0.06	0.51	22656.1	1116.6
0.08	0.61	27857.7	1334.9
0.10	0.71	32380.8	1539.2
0.12	0.82	37658.0	1761.7
0.14	0.90	41977.6	1940.0
0.16	0.96	45587.2	2062.9
0.18	1.00	48485.3	2137.6
0.20	1.02	50687.0	2170.2
0.25	1.03	54379.0	2195.9
0.30	1.03	57656.8	2186.4
0.35	1.01	60622.9	2154.8
0.40	1.00	63270.2	2113.2
0.45	0.98	65735.3	2067.9
0.50	0.96	68062.5	2024.5
0.55	0.95	70395.7	1980.5
0.60	0.93	72773.4	1938.3
0.65	0.92	75397.5	1900.3
0.70	0.90	77507.0	1864.6
0.75	0.89	77481.4	1831.6
0.80	0.87	73720.9	1796.1
0.85	0.85	65191.6	1749.0
0.90	0.82	54373.7	1699.3
0.95	0.79	42869.4	1647.9
1.00	0.76	30687.5	1593.8

TQAV = 30687.5 LOAD = 2226.6 VEL = 40.0 MPH.

MUPEAK = 1.03 MULOCK = 0.76 RATIO = 1.35



FZ = 2226.6 VEL = 40.0 MULOCK = 0.76 MUPEAK = 1.03 RATIO = 1.35 A-D FILE 232 NWFILE 98 SAMPLE 408

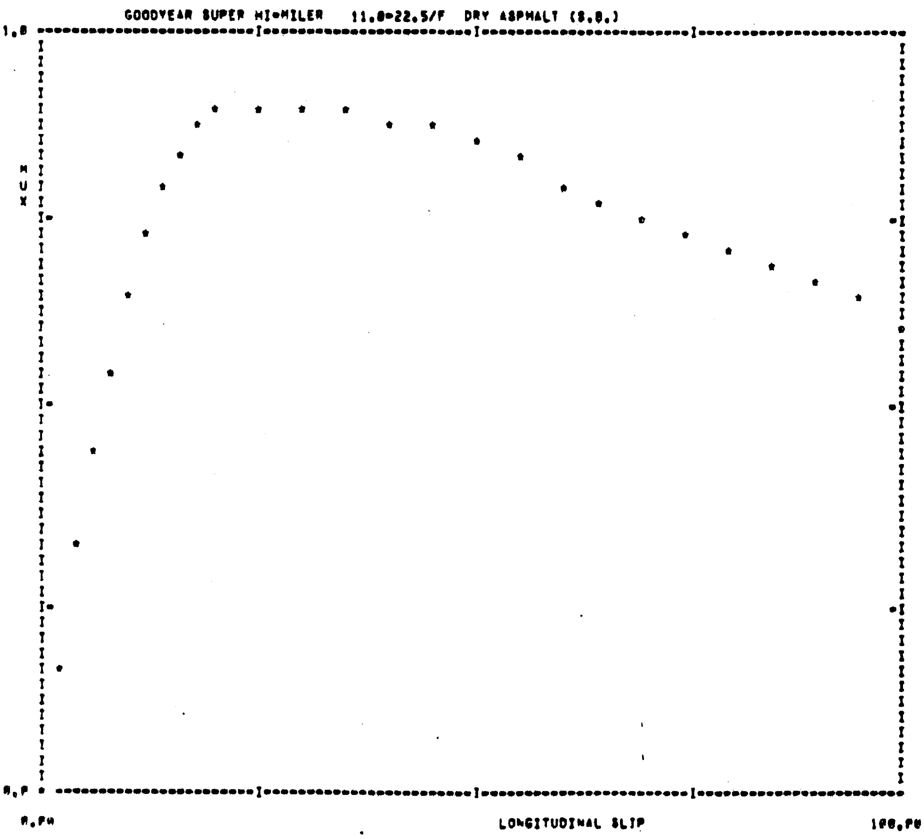
** A-D FILE 233 NEW FILE 09 TEST SAMPLE409 **

AVERAGE OF FILE 233 FOR 5 RECORDS. GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	10034.0	945.0
0.04	0.32	34227.5	1769.3
0.06	0.44	47557.0	2424.4
0.08	0.55	59010.6	2993.3
0.10	0.65	69292.5	3462.6
0.12	0.73	77516.3	3870.7
0.14	0.80	85022.0	4180.1
0.16	0.85	91073.1	4427.7
0.18	0.88	95290.0	4599.7
0.20	0.90	98477.3	4676.3
0.25	0.91	105004.2	4713.7
0.30	0.90	109943.6	4697.0
0.35	0.90	113220.1	4652.9
0.40	0.89	115457.2	4592.9
0.45	0.87	117262.2	4520.6
0.50	0.85	119104.1	4426.6
0.55	0.83	121331.1	4317.0
0.60	0.81	123700.0	4190.7
0.65	0.78	126102.3	4079.1
0.70	0.76	126901.6	3963.1
0.75	0.74	124034.6	3853.6
0.80	0.72	116026.1	3740.4
0.85	0.69	104710.5	3640.6
0.90	0.67	91237.1	3531.4
0.95	0.65	77712.7	3420.6
1.00	0.62	64300.0	3307.5

TQAV = 64300.0 LOAD = 5517.0 VEL = 40.0 MPH.

MUPEAK = 0.91 MULOCK = 0.62 RATIO = 1.46



FZ = 5517.0 VEL = 40.0 MULOCK = 0.62 MUPEAK = 0.91 RATIO = 1.46 A-D FILE 233 NWFILE 09 SAMPLE 409

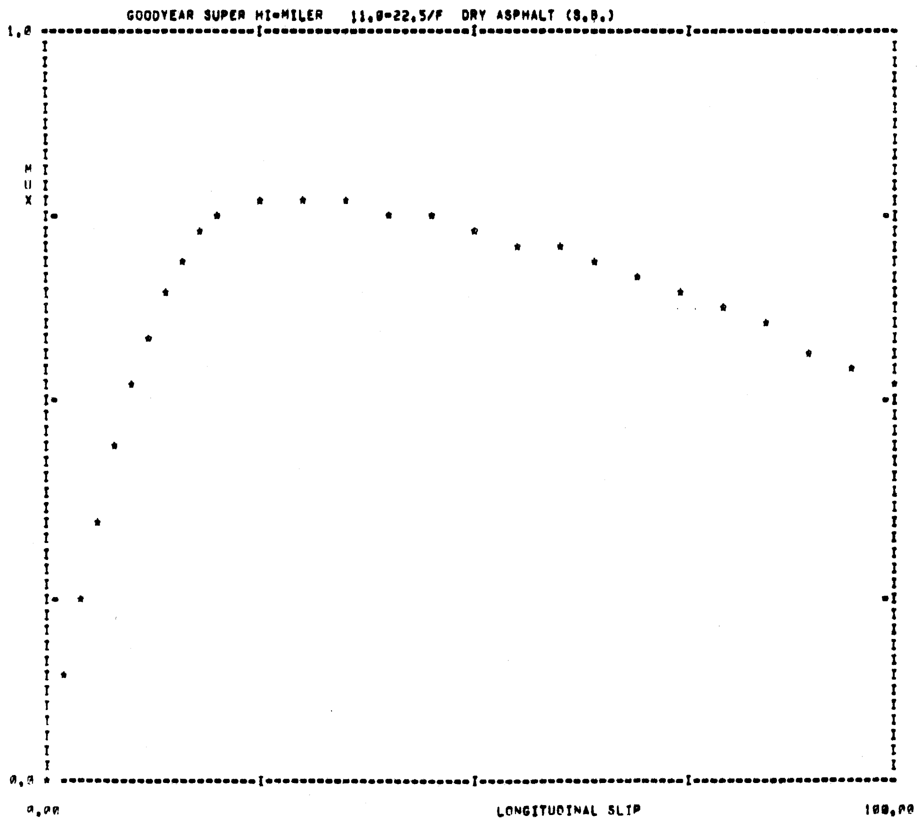
** A-D FILE 234 NEW FILE 100 TEST SAMPLE410 **

AVERAGE OF FILE 234 FOR 6 RECORDS, GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.14	23159.9	1287.4
0.04	0.25	42844.7	2270.5
0.06	0.35	60720.8	3210.4
0.08	0.45	77300.7	4036.1
0.10	0.53	91217.4	4717.5
0.12	0.59	103033.9	5280.4
0.14	0.65	113086.8	5755.0
0.16	0.70	121777.9	6136.9
0.18	0.73	129139.1	6416.0
0.20	0.75	133766.7	6574.8
0.25	0.78	141190.0	6737.5
0.30	0.78	147157.7	6777.1
0.35	0.78	151985.7	6731.3
0.40	0.77	155873.8	6639.5
0.45	0.75	159166.7	6522.0
0.50	0.74	161824.8	6393.3
0.55	0.72	164096.5	6258.3
0.60	0.71	166026.1	6119.2
0.65	0.69	166776.7	5974.1
0.70	0.67	164004.7	5822.3
0.75	0.65	157538.0	5660.7
0.80	0.63	146962.3	5482.4
0.85	0.61	132107.6	5282.0
0.90	0.58	116418.9	5059.5
0.95	0.55	100835.1	4828.8
1.00	0.53	85479.2	4590.0

TQAV = 85479.2 LOAD = 9173.7 VEL = 40.0 MPH.

MUPEAK = 0.78 MULOCK = 0.53 RATIO = 1.48



FZ = 9173.7 VEL = 40.0 MULOCK = 0.53 MUPEAK = 0.78 RATIO = 1.48 A-D FILE 234 NWFILE 100 SAMPLE 410

** A-D FILE 221 NEW FILE 90 TEST SAMPLE400 **

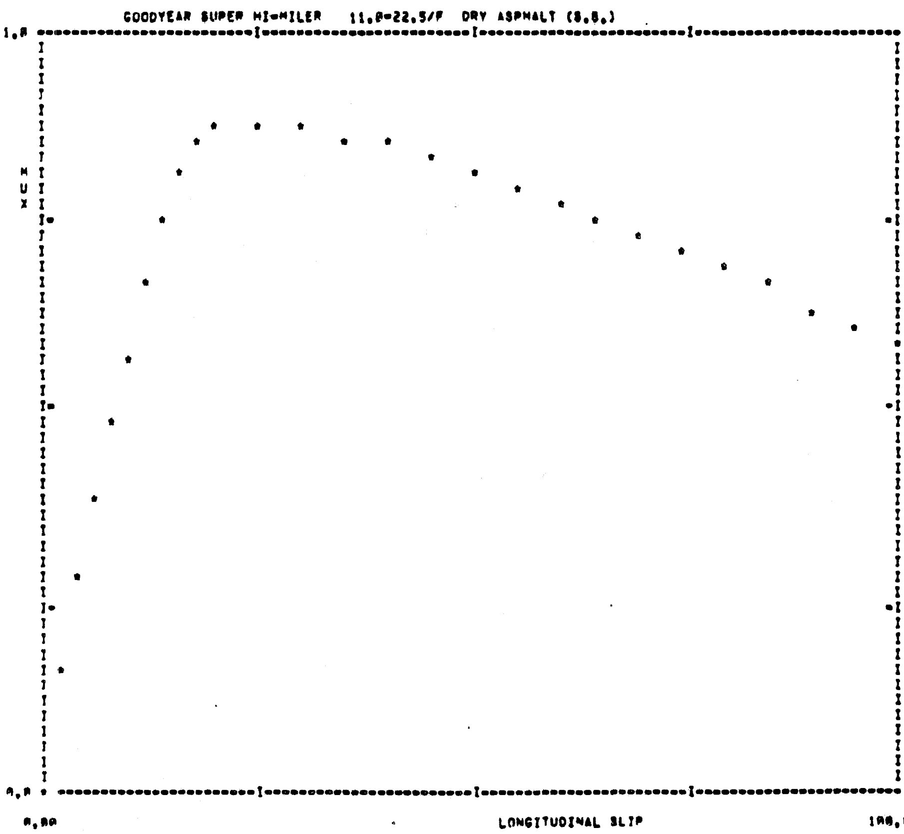
AVERAGE OF FILE 221 FOR 6 RECORDS. GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (0.0.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	13653.7	859.7
0.04	0.29	29501.2	1598.6
0.06	0.40	42335.6	2188.7
0.08	0.49	52075.6	2687.2
0.10	0.58	62760.4	3166.7
0.12	0.68	74257.6	3730.0
0.14	0.76	83874.1	4163.3
0.16	0.82	90399.8	4449.9
0.18	0.86	95309.6	4629.7
0.20	0.87	98551.7	4690.7
0.25	0.88	103353.9	4741.0
0.30	0.88	106599.5	4720.7
0.35	0.87	109166.9	4672.9
0.40	0.85	111505.4	4580.2
0.45	0.83	113602.4	4487.8
0.50	0.81	115507.3	4377.3
0.55	0.79	116992.9	4265.6
0.60	0.77	118349.5	4156.1
0.65	0.75	119647.0	4050.9
0.70	0.73	120251.1	3949.6
0.75	0.71	117930.8	3851.1
0.80	0.69	111674.9	3742.9
0.85	0.67	101341.4	3611.4
0.90	0.64	88563.2	3467.4
0.95	0.61	74945.2	3317.4
1.00	0.59	60479.2	3160.0

TOAV = 60479.2 LOAD = 5562.6 VEL = 40.0 MPH.

MUPEAK = 0.88 MULOCK = 0.59 RATIO = 1.50

Check Run #1



FZ = 5562.6 VEL = 40.0 MULOCK = 0.59 MUPEAK = 0.88 RATIO = 1.50 A-D FILE 221 NWFILE 90 SAMPLE 400

** A-D FILE 228 NEW FILE 97 TEST SAMPLE407 **

AVERAGE OF FILE 228 FOR 6 RECORDS, GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)

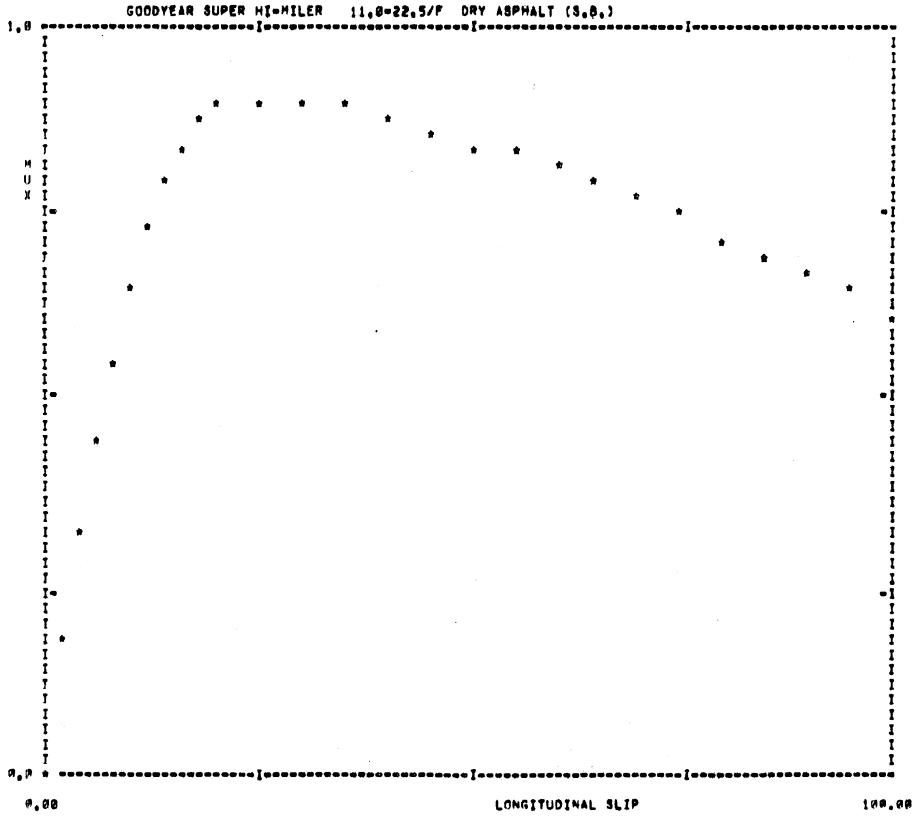
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	17909.5	998.7
0.04	0.33	34908.3	1815.3
0.06	0.45	47611.6	2457.6
0.08	0.56	58867.6	2991.7
0.10	0.65	68921.5	3456.1
0.12	0.73	77332.0	3865.0
0.14	0.80	85116.5	4190.9
0.16	0.85	91936.5	4433.8
0.18	0.88	97178.0	4680.7
0.20	0.90	100513.8	4682.4
0.25	0.91	106837.2	4748.1
0.30	0.91	112165.5	4741.2
0.35	0.90	116612.3	4688.7
0.40	0.88	120388.1	4612.1
0.45	0.87	123634.4	4521.4
0.50	0.85	126501.6	4425.7
0.55	0.83	129149.4	4333.1
0.60	0.81	131516.8	4237.9
0.65	0.79	132408.0	4140.4
0.70	0.77	130946.8	4040.6
0.75	0.75	125509.6	3934.8
0.80	0.73	116171.8	3814.1
0.85	0.70	102985.6	3681.1
0.90	0.67	89861.9	3549.9
0.95	0.65	75398.0	3419.9
1.00	0.62	62288.3	3291.2

TQAV = 62288.3 LOAD = 5491.5 VEL = 40.0 MPH.

MUPEAK = 0.91 MULOCK = 0.62 RATIO = 1.47

Check Run #3

GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (S.B.)



FZ = 5491.5 VEL = 40.0 MULOCK = 0.62 MUPEAK = 0.91 RATIO = 1.47 A-D FILE 228 NWFILE 97 SAMPLE 407

** A-D FILE 235 NEW FILE 101 TEST SAMPLE#11 **

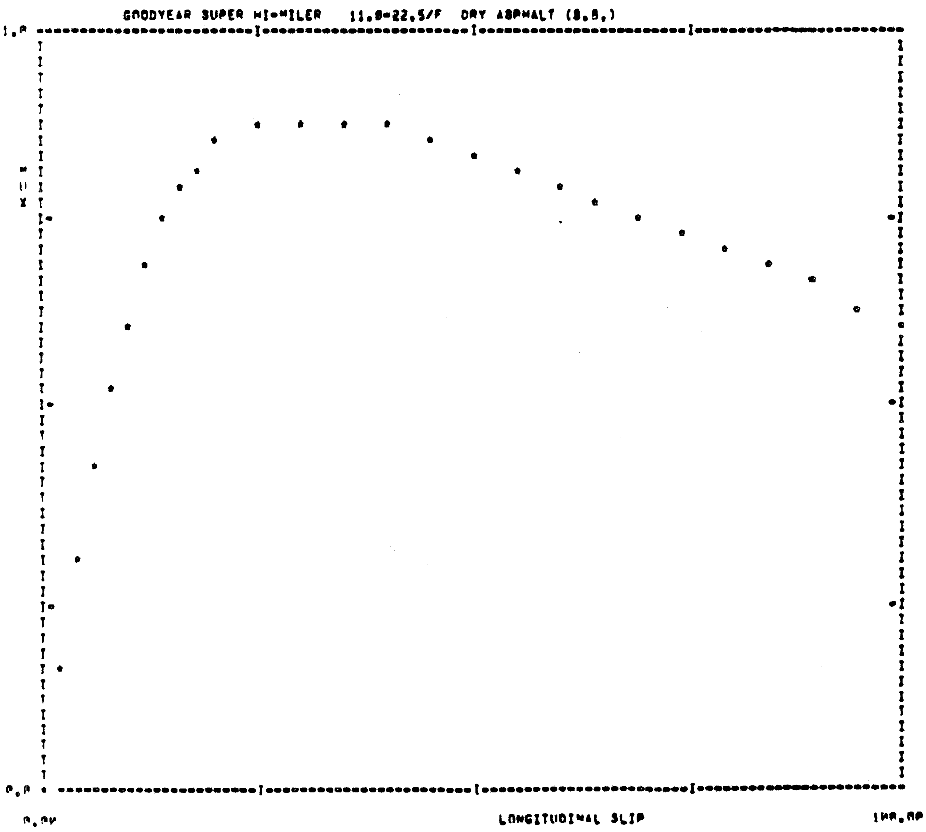
AVERAGE OF FILE 235 FOR 6 RECORDS, GOODYEAR SUPER HI-MILER 11.0-22.5/F DRY ASPHALT (8.0.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	16479.2	972.6
0.04	0.30	32451.1	1719.5
0.06	0.43	46585.0	2392.9
0.08	0.53	58989.3	2978.3
0.10	0.62	69198.1	3436.9
0.12	0.69	77243.0	3806.6
0.14	0.75	83915.0	4096.9
0.16	0.79	89996.0	4319.6
0.18	0.83	95198.9	4484.2
0.20	0.85	98932.7	4583.7
0.25	0.88	105786.9	4698.2
0.30	0.89	111160.3	4742.5
0.35	0.89	115777.2	4733.9
0.40	0.88	119711.0	4693.4
0.45	0.86	123218.9	4623.1
0.50	0.84	126572.5	4527.4
0.55	0.82	129930.2	4425.7
0.60	0.80	133116.0	4322.3
0.65	0.78	135235.4	4217.8
0.70	0.76	134157.6	4115.7
0.75	0.74	128079.9	4012.8
0.80	0.72	119884.4	3901.8
0.85	0.69	106198.0	3767.8
0.90	0.67	91419.2	3616.2
0.95	0.64	76901.0	3458.9
1.00	0.61	62916.7	3296.2

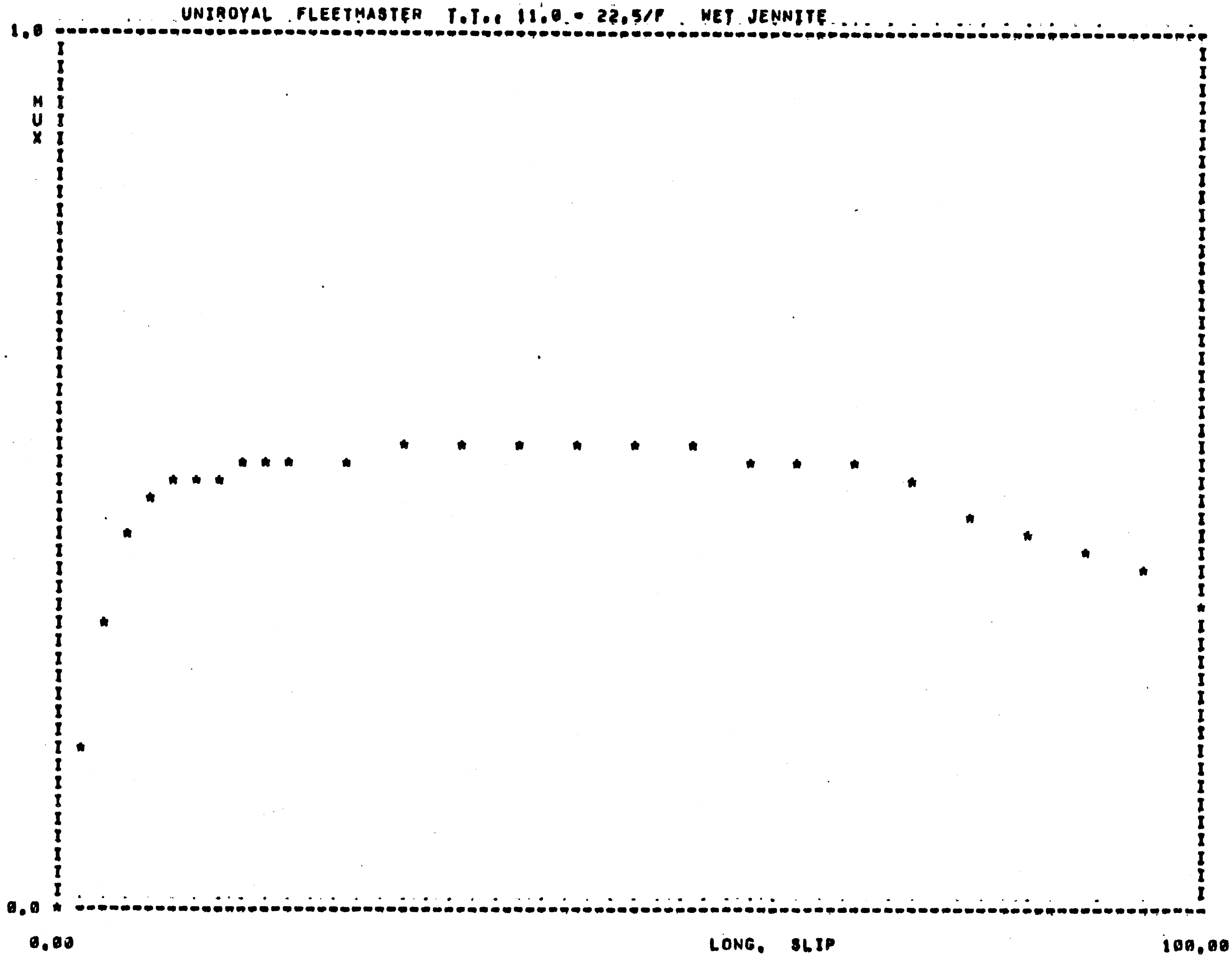
TDAV = 62916.7 LOAD = 5625.0 VEL = 40.0 MPH.

MUPEAK = 0.89 MULOCK = 0.61 RATIO = 1.46

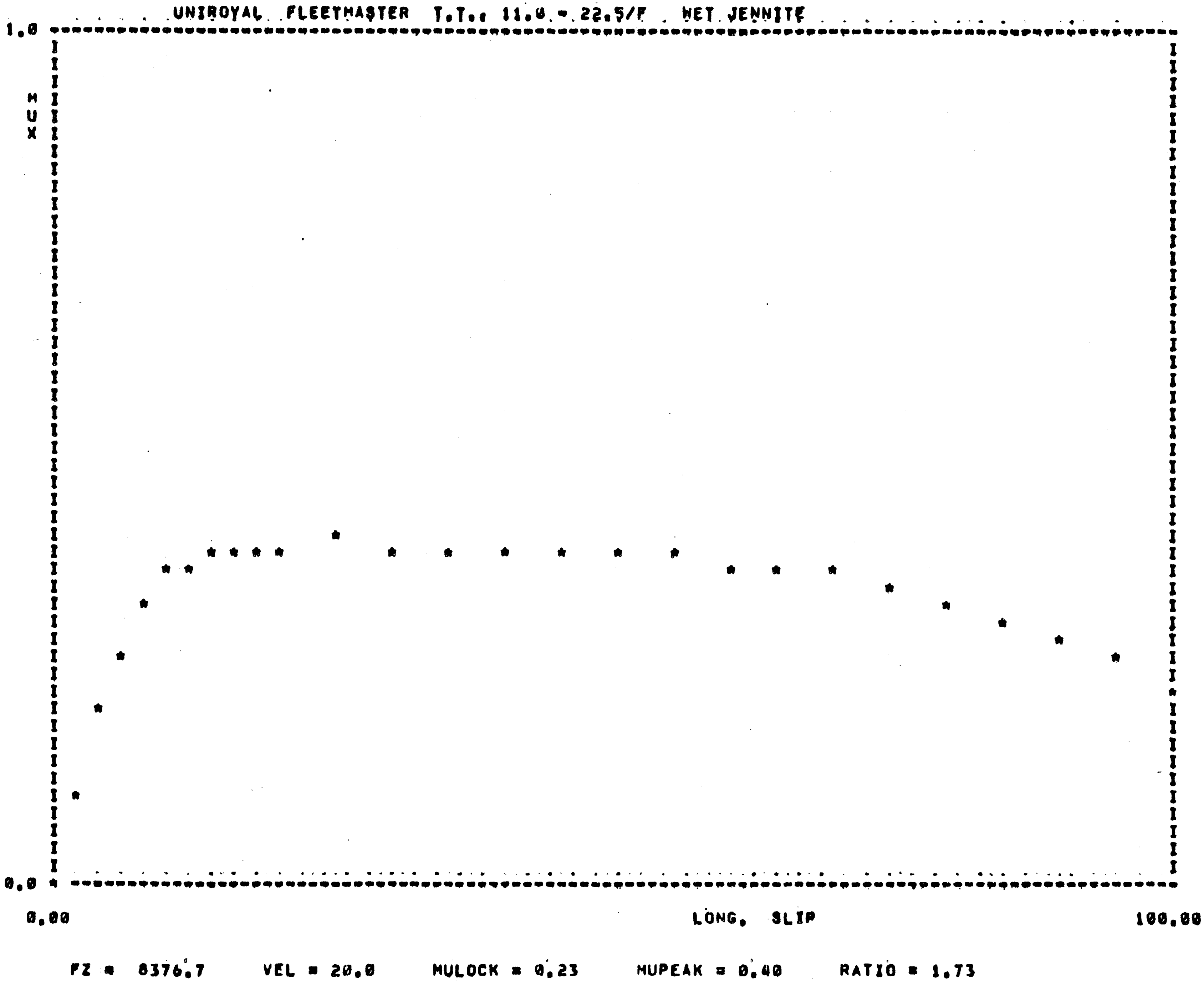
Check Run #5



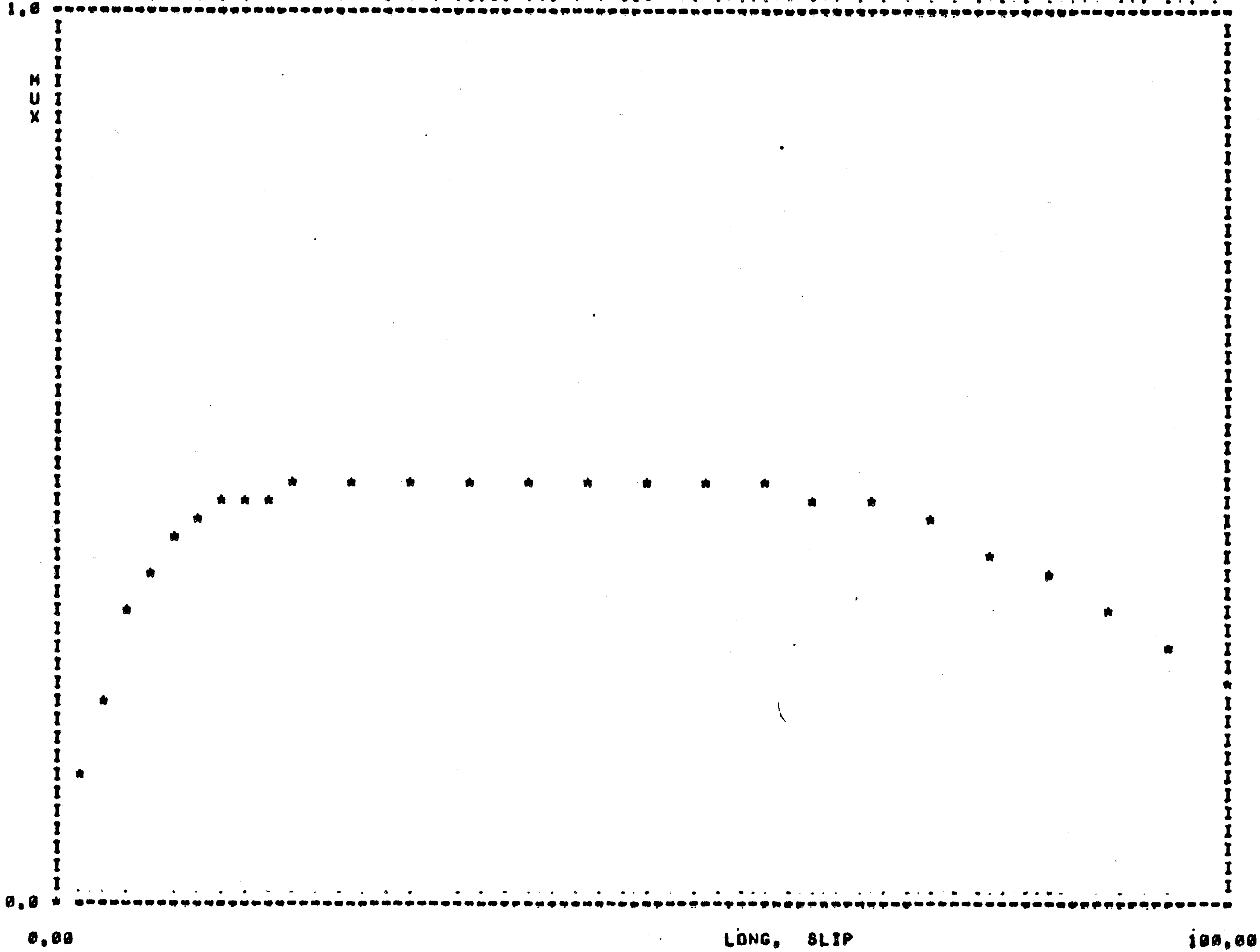
FZ = 5625.0 VEL = 40.0 MULOCK = 0.61 MUPEAK = 0.89 RATIO = 1.46 A-D FILE 235 NWFILE 101 SAMPLE 411



FZ = 2740.3 VEL = 20.0 MULOCK = 0.36 MUPEAK = 0.54 RATIO = 1.50

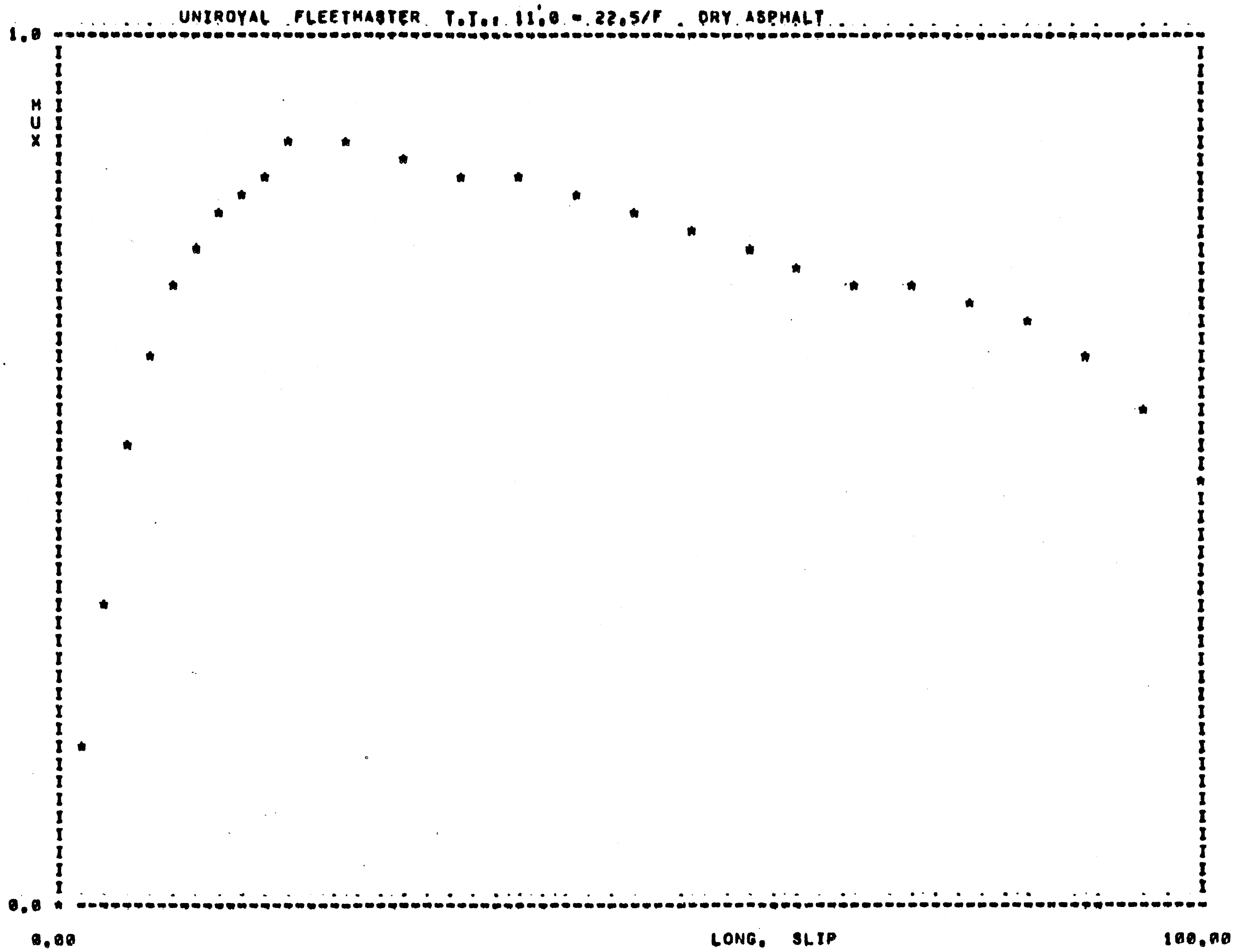

UNIROYAL FLEETMASTER T.T., 11.0 - 22.5/F . WET JENNITE
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 8376.7 VEL = 20.0 MULOCK = 0.23 MUPEAK = 0.40 RATIO = 1.73

UNIROYAL FLEETMASTER T.T., 11.0 - 22.5/F WET JENNITE

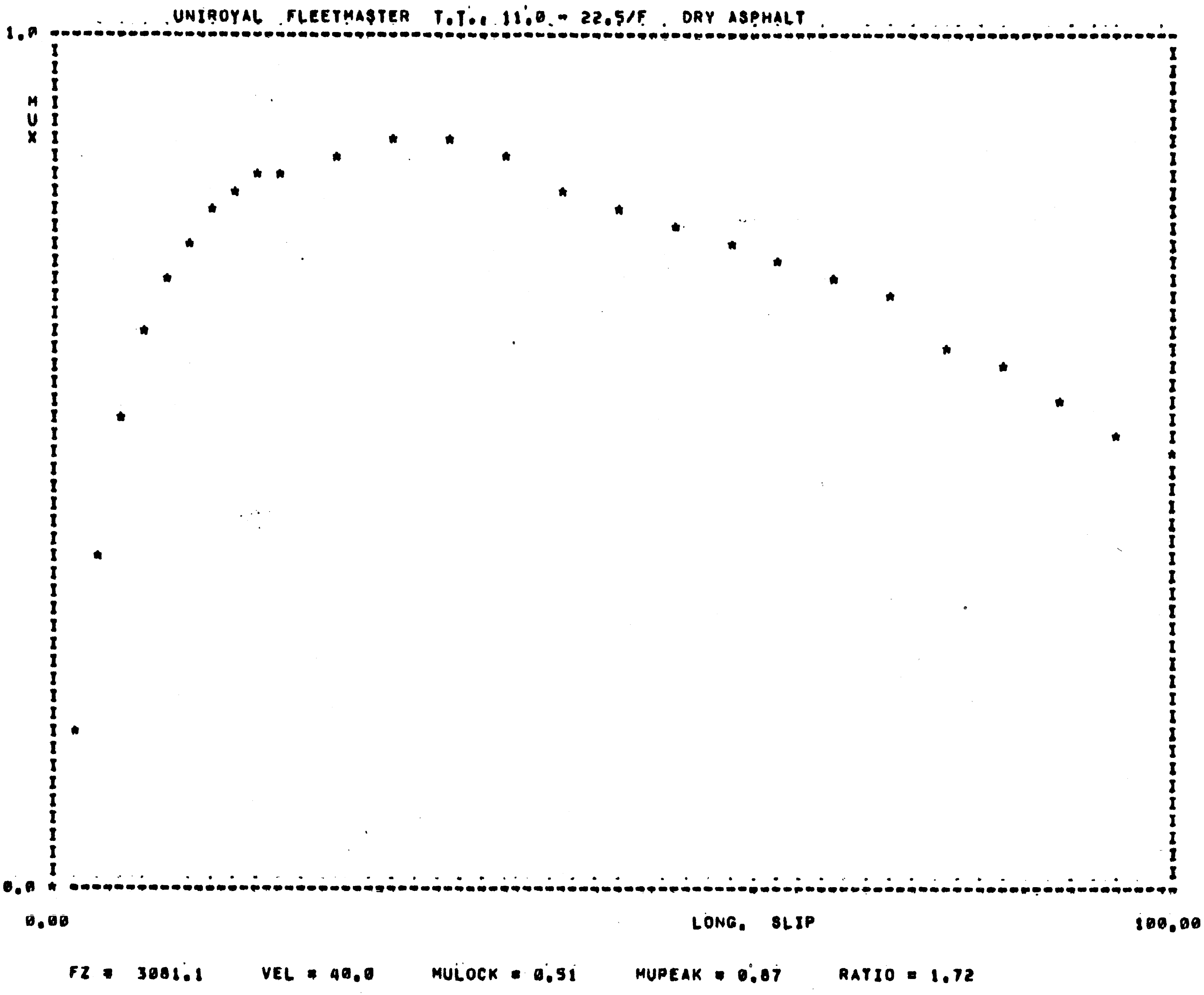


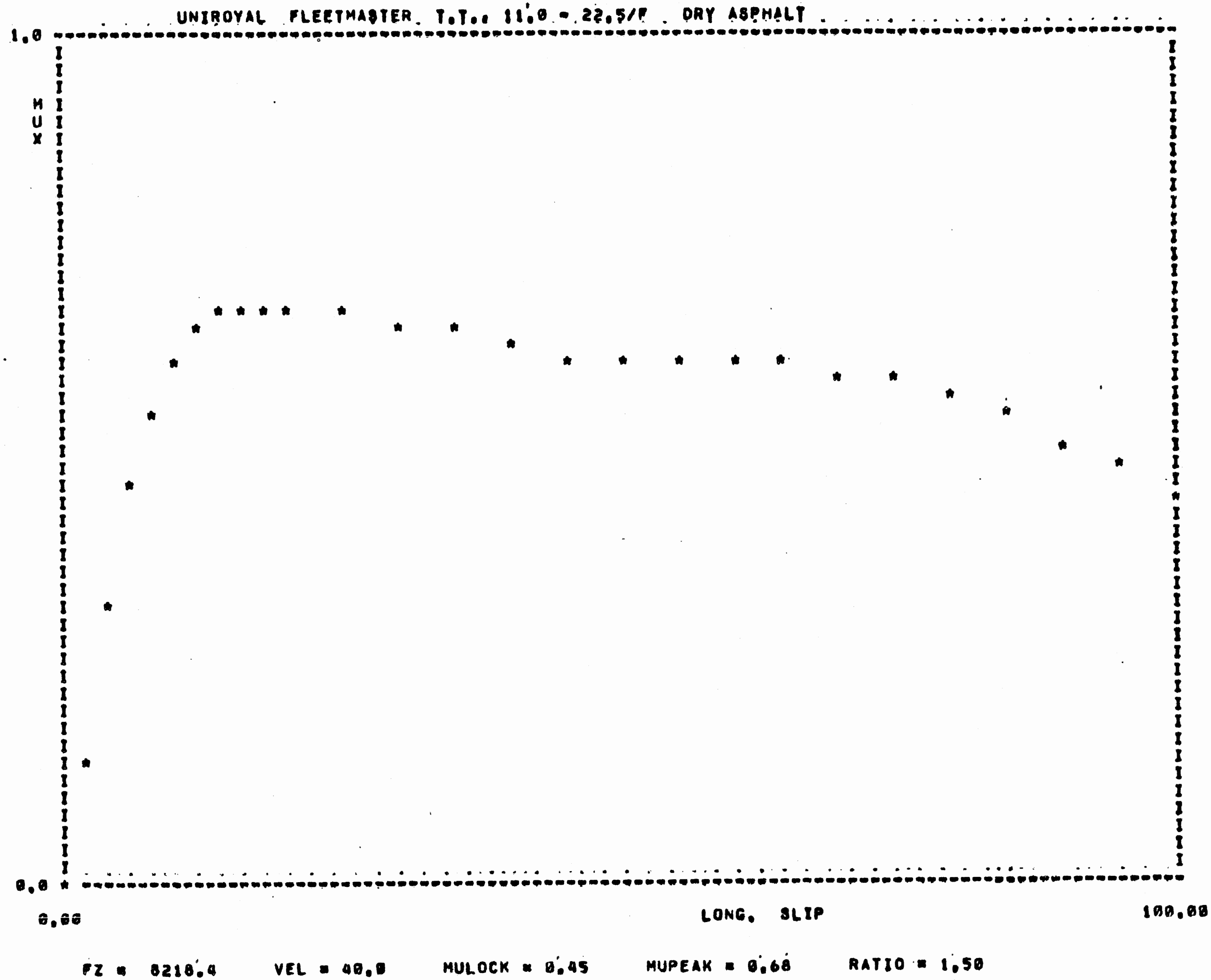
FZ = 5380.2 VEL = 20.0 MULOCK = 0.25 MUPEAK = 0.48 RATIO = 1.91

3



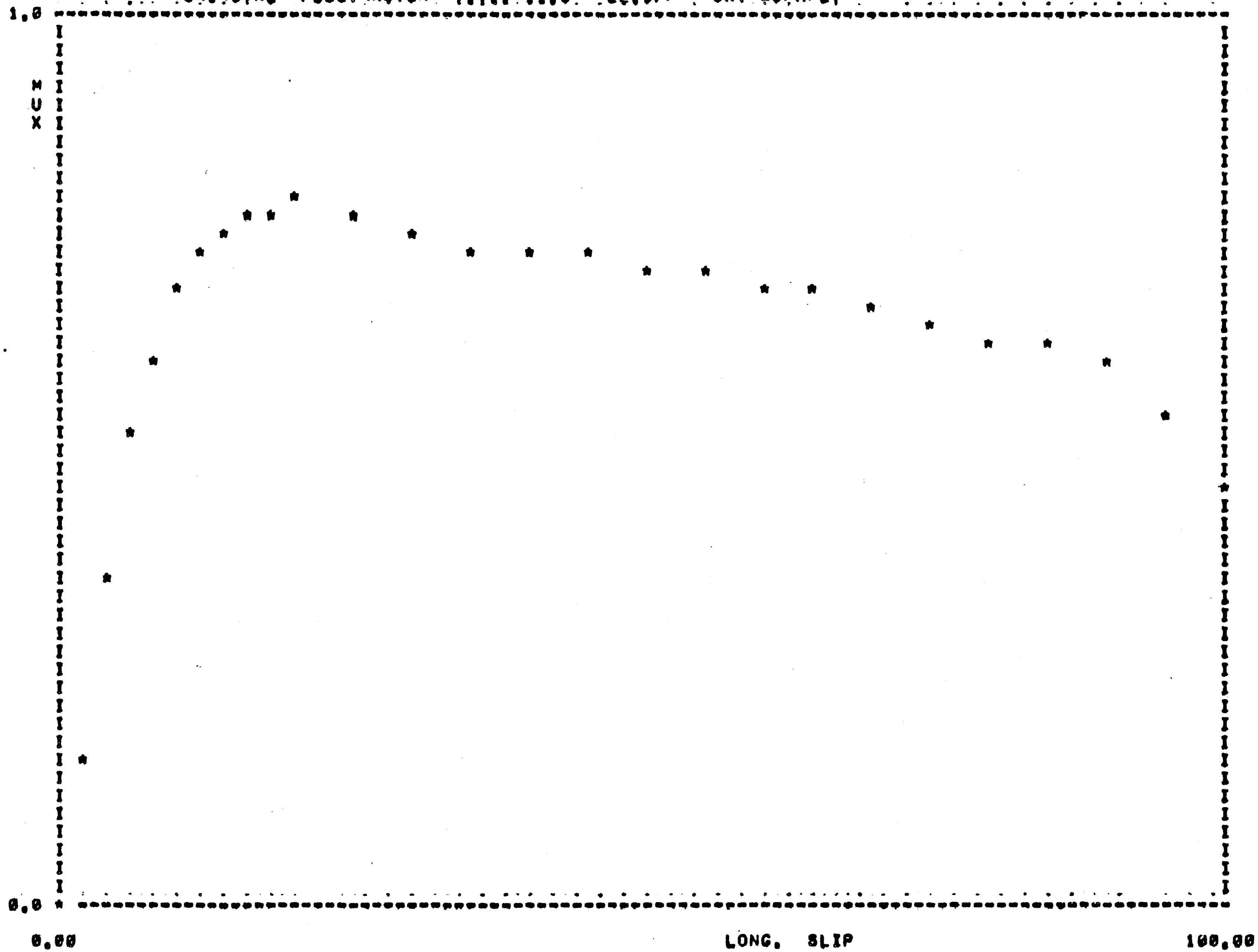
FZ = 5364.2 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.88 RATIO = 1.81


UNIROYAL FLEETMASTER T.T., 11.0 - 22.5/F . DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 3081.1 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.87 RATIO = 1.72


UNIROYAL FLEETMASTER T.T.: 11.0 - 22.5/F DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 8218.4 VEL = 40.0 MULOCK = 0.45 MUPEAK = 0.68 RATIO = 1.50

-292-

UNIROYAL FLEETMASTER T.T.. 11.0 - 22.5/F DRY ASPHALT



FZ = 5507.1 VEL = 60.0 MULOCK = 0.48 MUPEAK = 0.79 RATIO = 1.65

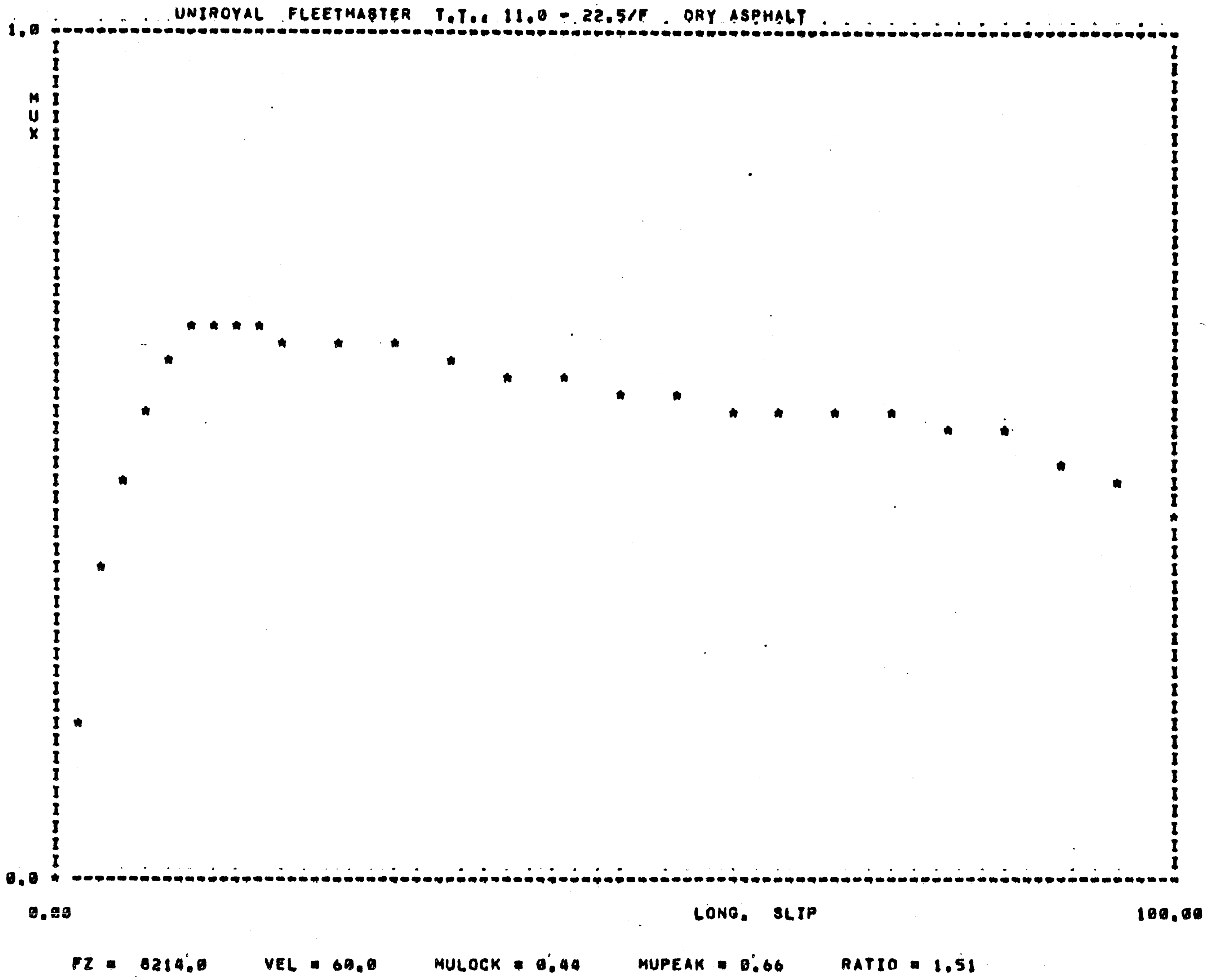

UNIROYAL FLEETMASTER T.T., 11.0 - 22.5/F . DRY ASPHALT
1.0
0.0
MUX
0.00
LONG. SLIP
100.00
FZ = 8214.0 VEL = 60.0 MULOCK = 0.44 MUPEAK = 0.66 RATIO = 1.51

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
[redacted]	[redacted]	[redacted]	[redacted]
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
[redacted]	[redacted]	[redacted]	[redacted]
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

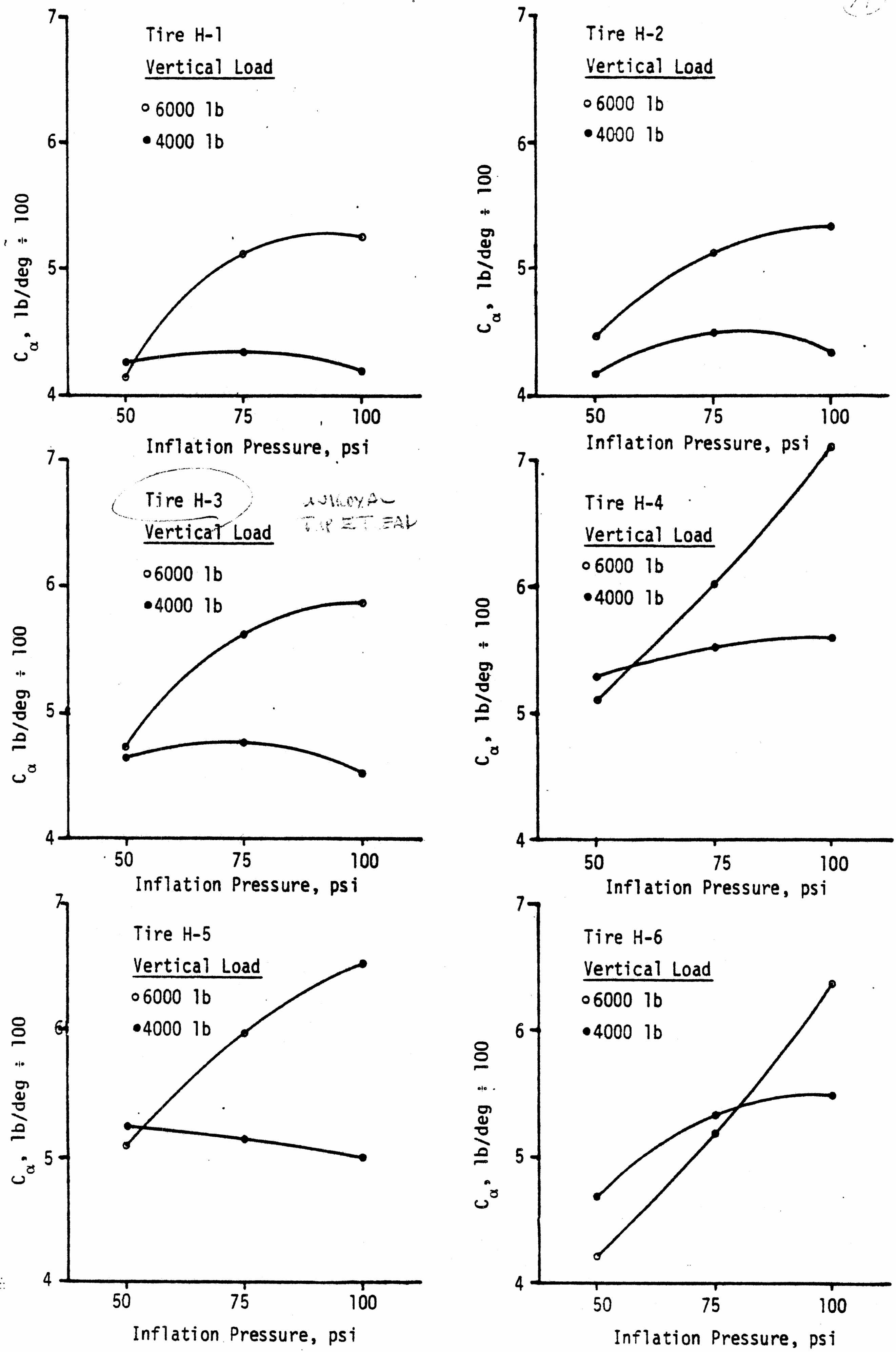


Figure 3.9 The effects of inflation pressure on cornering stiffness: heavy truck tires

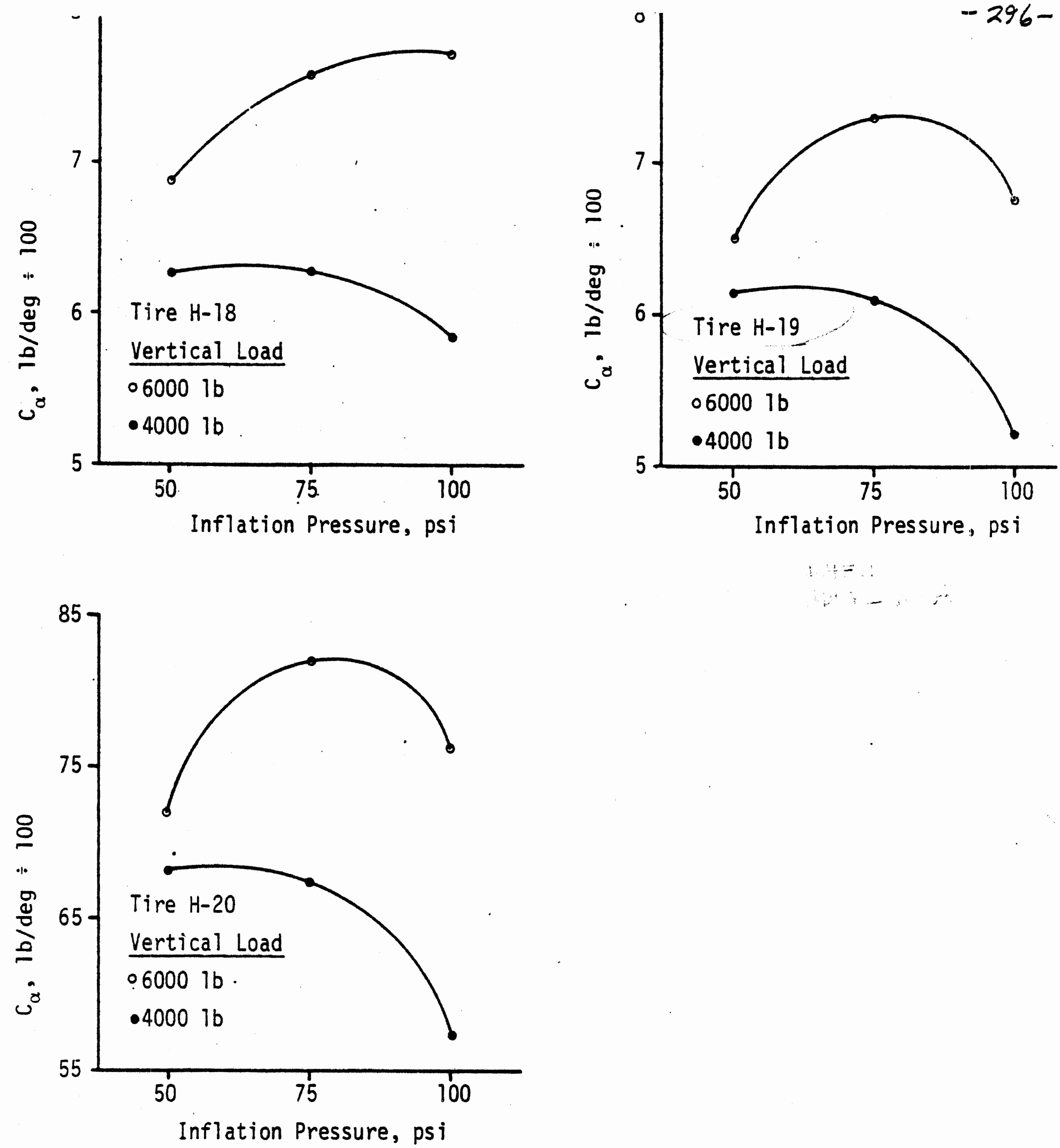


Figure 3.12 The effects of inflation pressure on cornering stiffness: heavy bus tires (cont.).

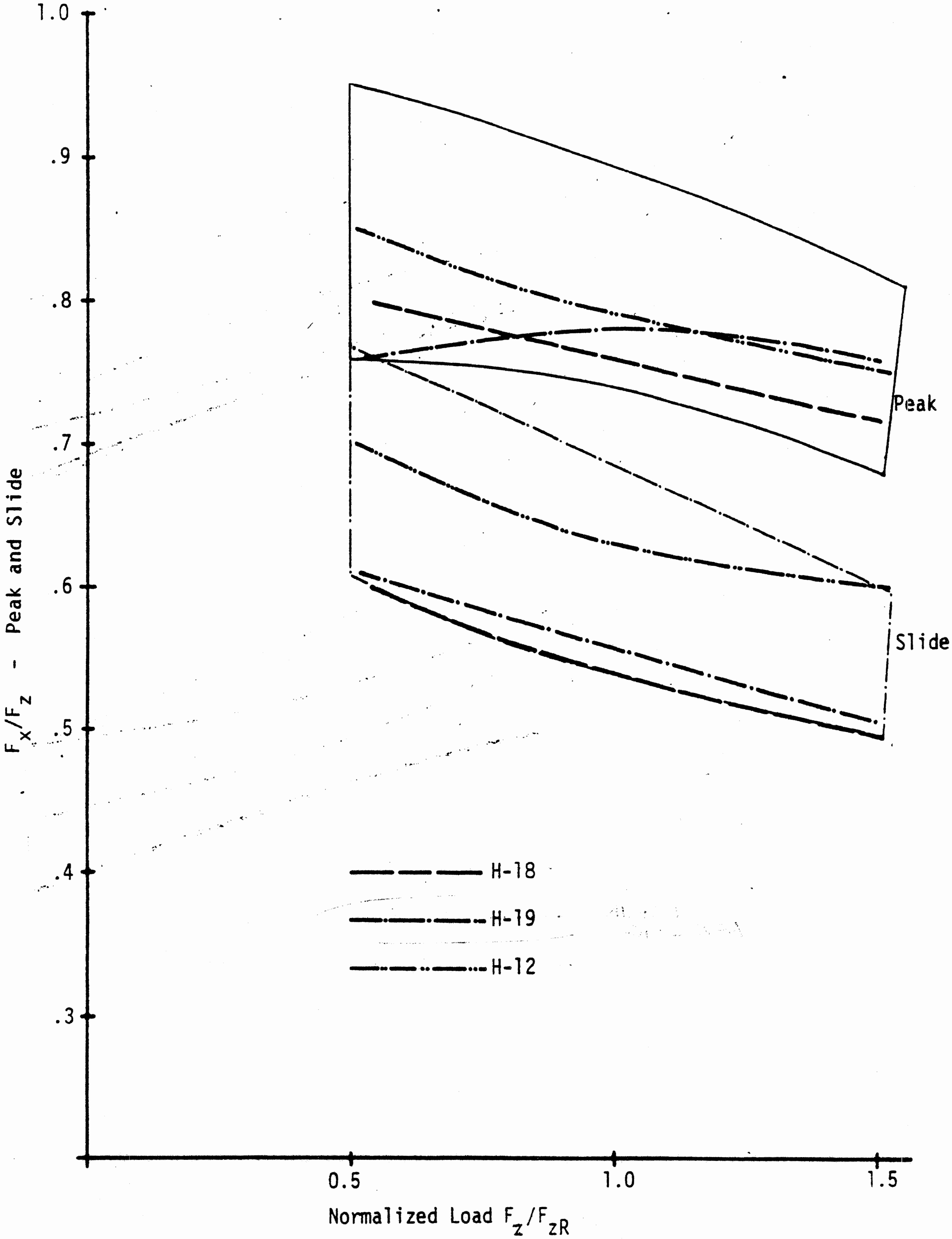


Figure 3.18. "Peak and slide" values of F_x/F_z vs. load for individual bus tires—superimposed within the envelope of data taken on eight truck and bus tires at 20 mph (for code identifications, see Table 3-1).

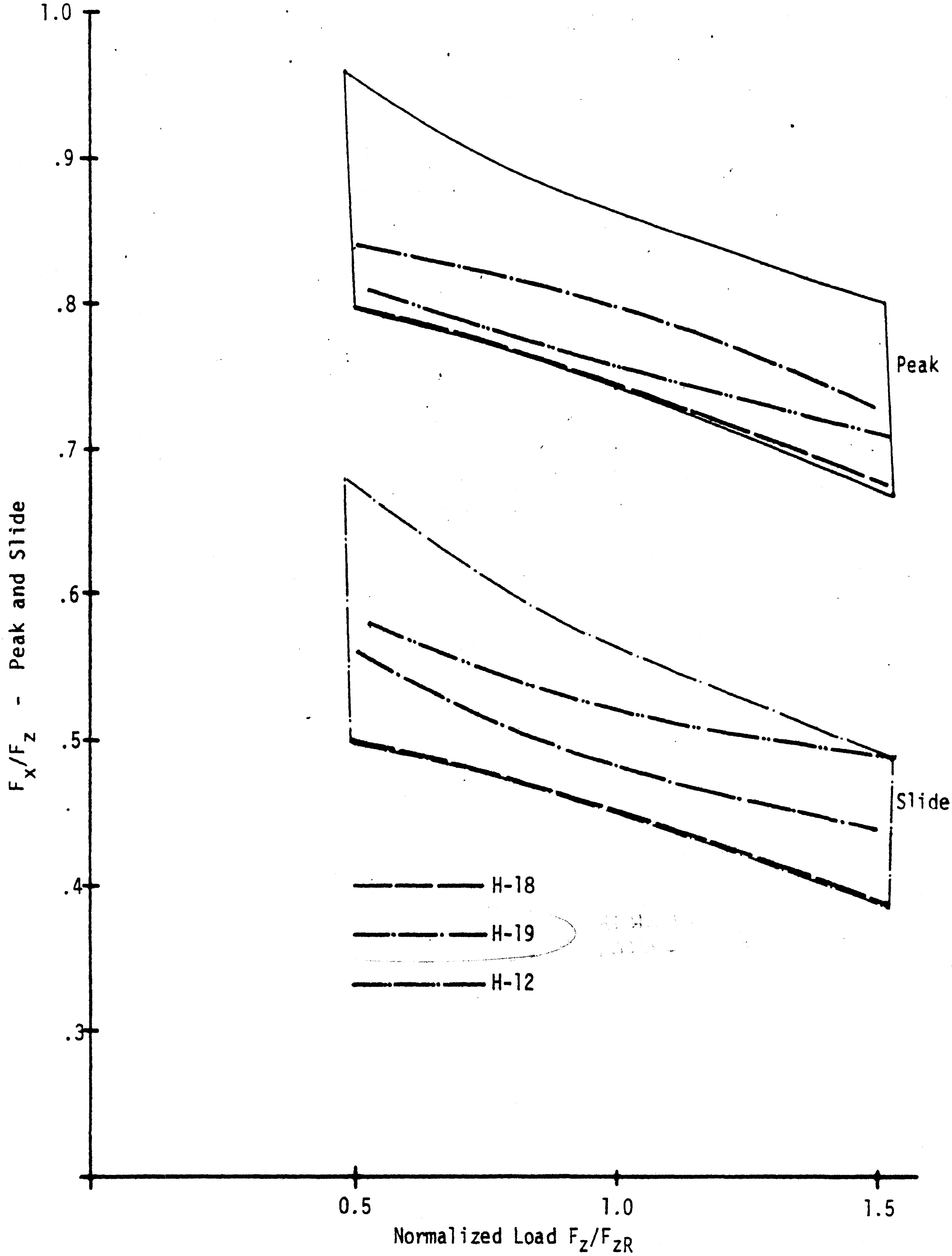


Figure 3.19. "Peak and slide" values of F_x/F_z vs. load for individual bus tires—superimposed within the envelope of data taken on eight truck and bus tires at 40 mph (for code identifications, see Table 3-1).

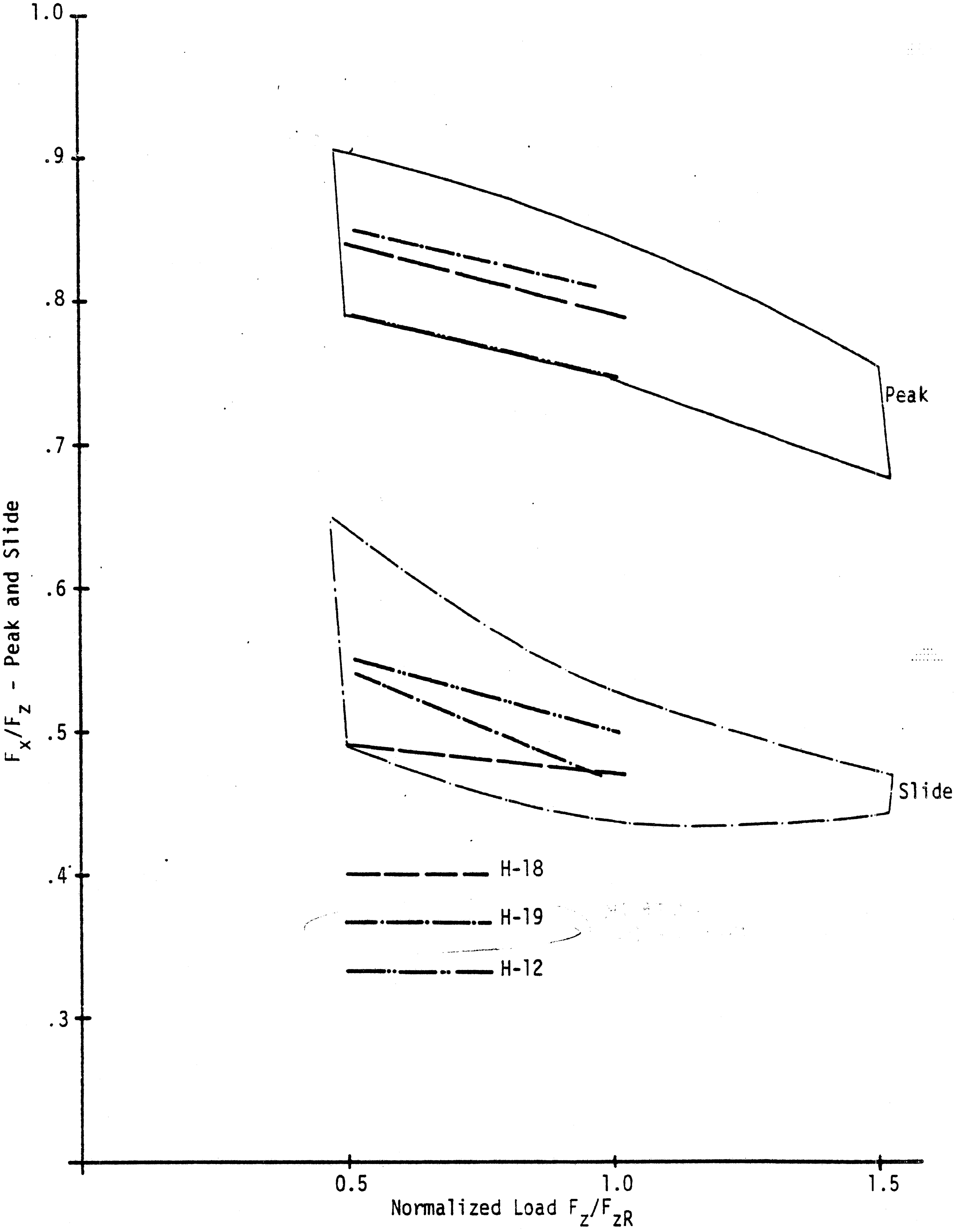


Figure 3.20. "Peak and slide" values of F_x/F_z vs. load for individual bus tires—superimposed within the envelope of data taken on eight truck and bus tires at 55 mph (for code identifications, see Table 3-1).

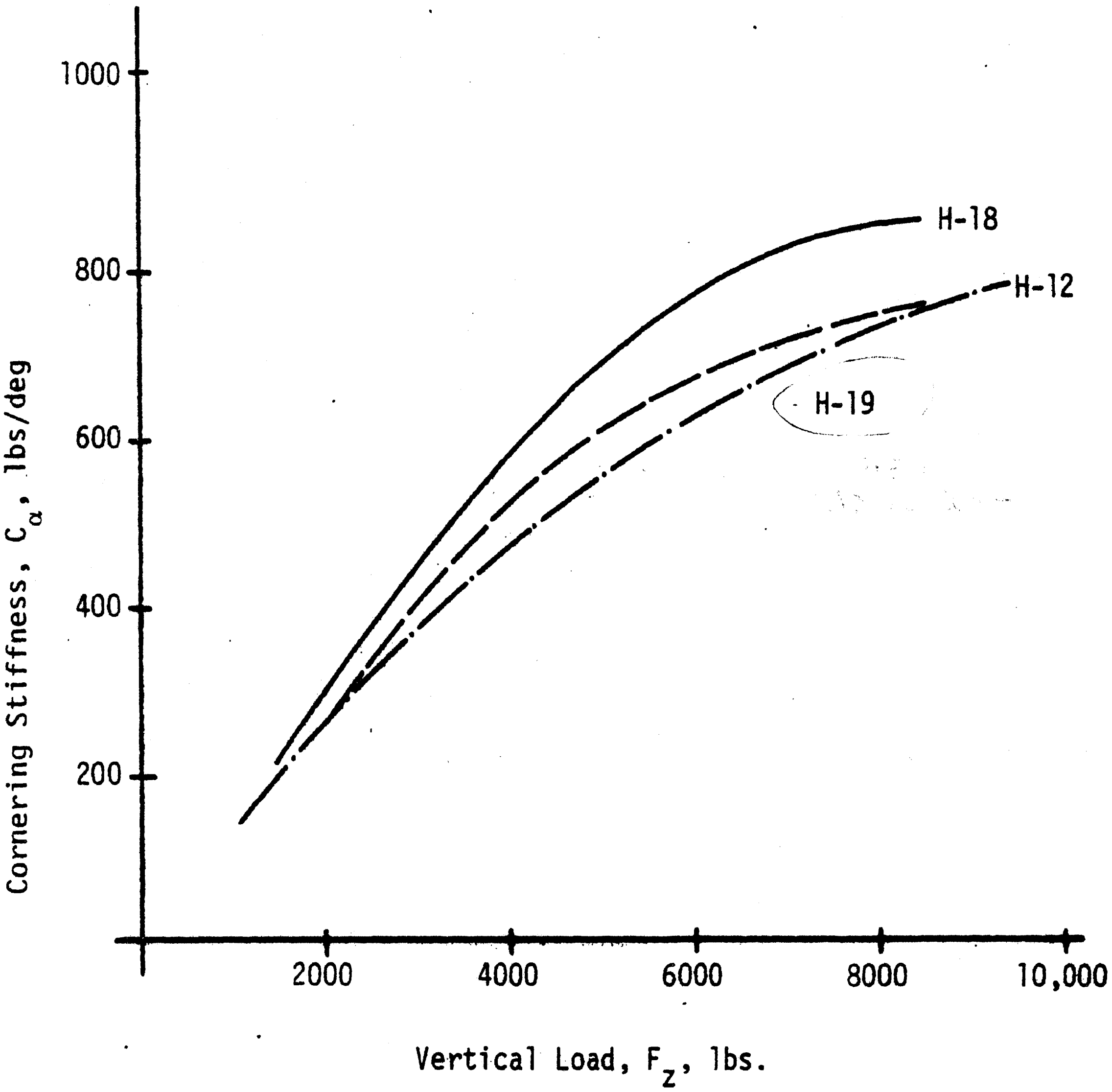


Figure 4.19. Load sensitivity of the cornering stiffness parameter for the three tires employed in intercity bus simulations.

UNIROY FLEETMASTER TRIPLETREAD 11.00X22.5 F

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-30.3	-313.2	239.1	-513.0	475.0	-861.3	830.0	-1264.3	1237.0	-1473.6	1513.5	-1592.5	1608.2
100.0	4000.0	-63.1	-507.8	398.9	-881.7	806.4	-1520.7	1446.7	-2300.7	2268.9	-2780.3	2844.3	-3079.2	3109.2
100.0	6000.0	-68.0	-657.0	518.4	-1150.5	1046.4	-2007.9	1900.2	-3114.5	3073.9	-3844.8	3915.2	-4304.4	4341.7
100.0	8000.0	-89.8	-752.3	594.1	-1325.5	1190.9	-2319.3	2189.6	-3733.6	3669.1	-4666.8	4744.2	-5314.2	5355.9
75.0	4000.0	-61.3	-530.4	426.6	-943.9	854.7	-1635.5	1574.0	-2500.3	2480.1			-3213.3	3236.6
75.0	6000.0	-69.9	-634.7	491.9	-1135.3	1021.7	-2005.6	1890.1	-3200.3	3155.9			-4420.3	4410.8
50.0	4000.0	-62.5	-530.2	397.6	-912.5	830.6	-1631.2	1537.6	-2432.3	2455.8			-3174.5	3168.2
50.0	6000.0	-81.6	-559.2	390.2	-976.8	847.0	-1763.0	1691.0	-2903.0	2948.8			-4190.4	4159.2

5 ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	1.5	28.8	-26.6	42.6	-42.2	48.0	-52.6	36.8	-40.1	17.3	-26.8	6.1	-14.0
100.0	4000.0	8.6	73.0	-59.3	113.3	-107.4	149.7	-156.9	130.6	-133.2	91.0	-107.9	58.7	-68.5
100.0	6000.0	12.8	115.7	-95.1	190.4	-176.6	269.8	-270.5	262.6	-262.7	197.1	-228.4	142.4	146.9
100.0	8000.0	18.8	161.3	-125.7	265.3	-243.4	392.2	-387.1	420.0	-413.6	333.0	-387.4	247.2	-253.7
75.0	4000.0	11.1	81.7	-75.0	140.9	-132.9	185.9	-190.5	163.9	-175.3			58.7	-69.7
75.0	6000.0	11.1	133.5	-110.4	223.1	-205.2	322.2	-323.7	331.8	-349.7			162.8	-177.0
50.0	4000.0	12.3	99.3	-82.5	168.8	-156.4	233.8	-228.5	201.7	-202.0			78.0	-87.3
50.0	6000.0	21.8	159.5	-174.5	272.9	-242.9	406.3	-389.8	423.1	-407.9			192.1	-212.6

I

MICHE.   RADIAL 11.00R22.5 H

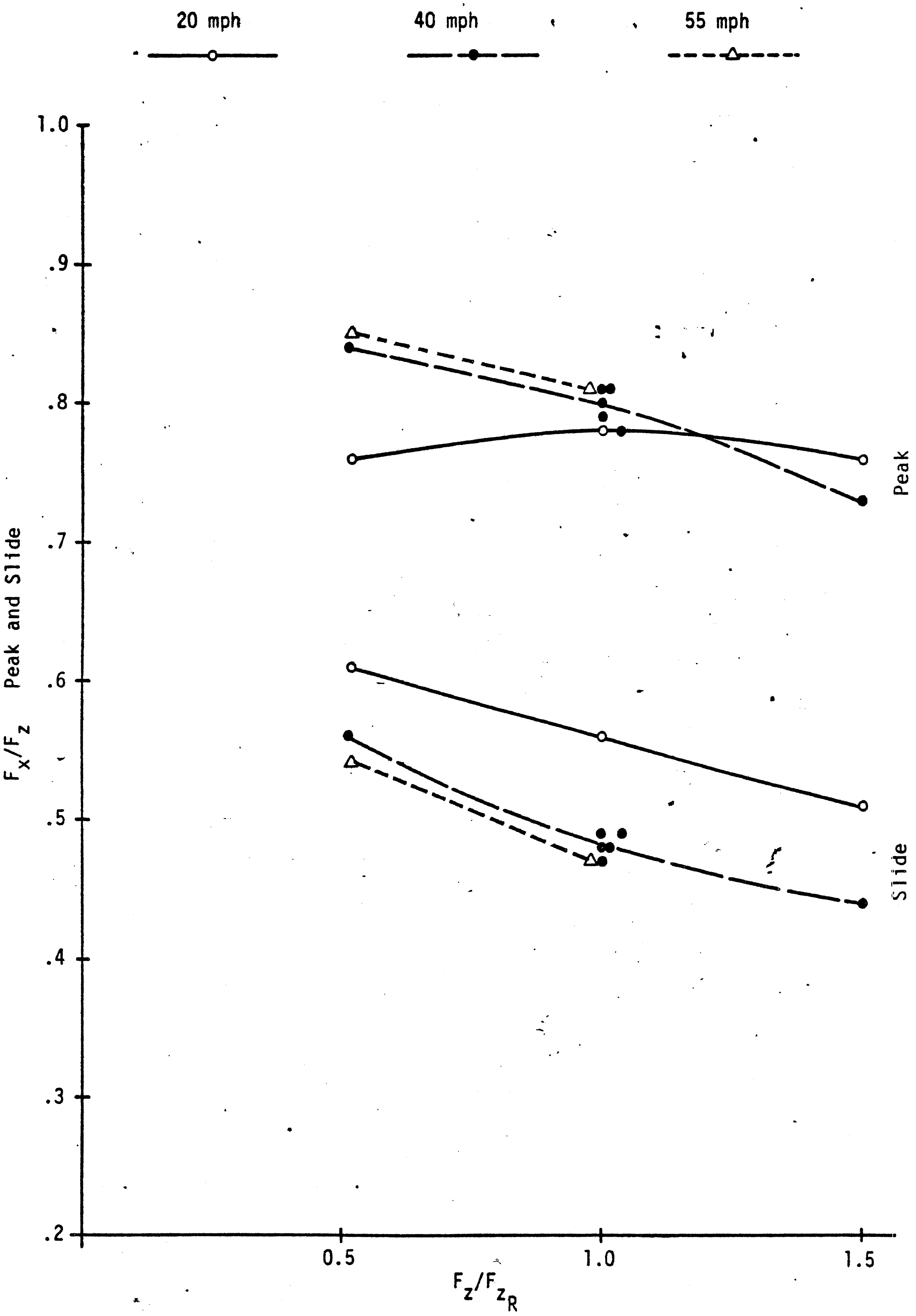
LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-9.1	-298.2	250.8	-511.8	493.3	-963.2	872.0	-1488.1	1401.2	-1675.3	1661.0	-1802.0	1753.0
100.0	4000.0	4.6	-528.5	514.7	-981.0	980.8	-1797.2	1732.8	-2773.9	2667.6	-3170.1	3065.0	-3407.0	3263.0
100.0	6000.0	14.1	-677.3	676.7	-1301.8	1312.0	-2423.2	2358.1	-3744.8	3669.3	-4310.4	4179.0	-4508.0	4295.0
100.0	8000.0	13.7	-739.4	766.7	-1467.6	1485.4	-2796.1	2737.4	-4468.0	4406.3	-5140.0	5019.0	-5301.0	5332.0
75.0	4000.0	10.4	-589.5	632.9	-1146.9	1142.3	-1975.9	1902.7	-2822.2	2742.9			-3331.7	3270.4
75.0	6000.0	15.5	-702.7	759.6	-1430.1	1419.9	-2552.7	2488.0	-3722.8	3634.9			-4518.6	4354.3
50.0	4000.0	12.7	-608.9	623.5	-1186.5	1202.5	-2054.3	1985.1	-2773.9	2699.8			-3279.1	3170.4
50.0	6000.0	12.1	-641.1	660.7	-1284.4	1303.3	-2470.3	2352.1	-3467.6	3372.4			-4358.2	4207.0

21

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-3.1	-25.4	-25.9	40.8	-43.0	55.6	-58.4	59.9	-55.0	30.8	-37.1	20.5	-13.3
100.0	4000.0	-7.1	66.1	-75.4	124.3	-129.6	178.6	-185.1	195.4	-172.7	124.3	-120.2	82.4	-64.1
100.0	6000.0	-10.1	116.4	-134.2	221.2	-229.6	336.1	-343.8	346.7	-341.6	262.0	-240.8	139.6	0.0
100.0	8000.0	-15.3	166.3	-193.4	324.0	-341.3	510.9	-533.8	536.3	-519.8	393.4	-374.0	217.1	-212.3
75.0	4000.0	-11.8	79.7	-98.3	151.0	-160.8	207.1	-210.4	175.4	-158.5			62.4	-51.6
75.0	6000.0	-19.5	134.7	-173.2	268.6	-291.9	388.0	-400.3	341.9	-321.9			162.9	-143.7
50.0	4000.0	-17.6	100.7	-133.6	198.0	-213.5	247.6	-255.3	200.3	-173.7			81.8	-71.8
50.0	6000.0	-27.9	160.2	-224.0	330.4	-374.2	475.7	-504.0	403.6	-401.2			197.6	-183.1



Summary - Michelin Radial XZA - 11 R 22.5H

** A-D FILE 174 NEW FILE 89 TEST SAMPLE196 **

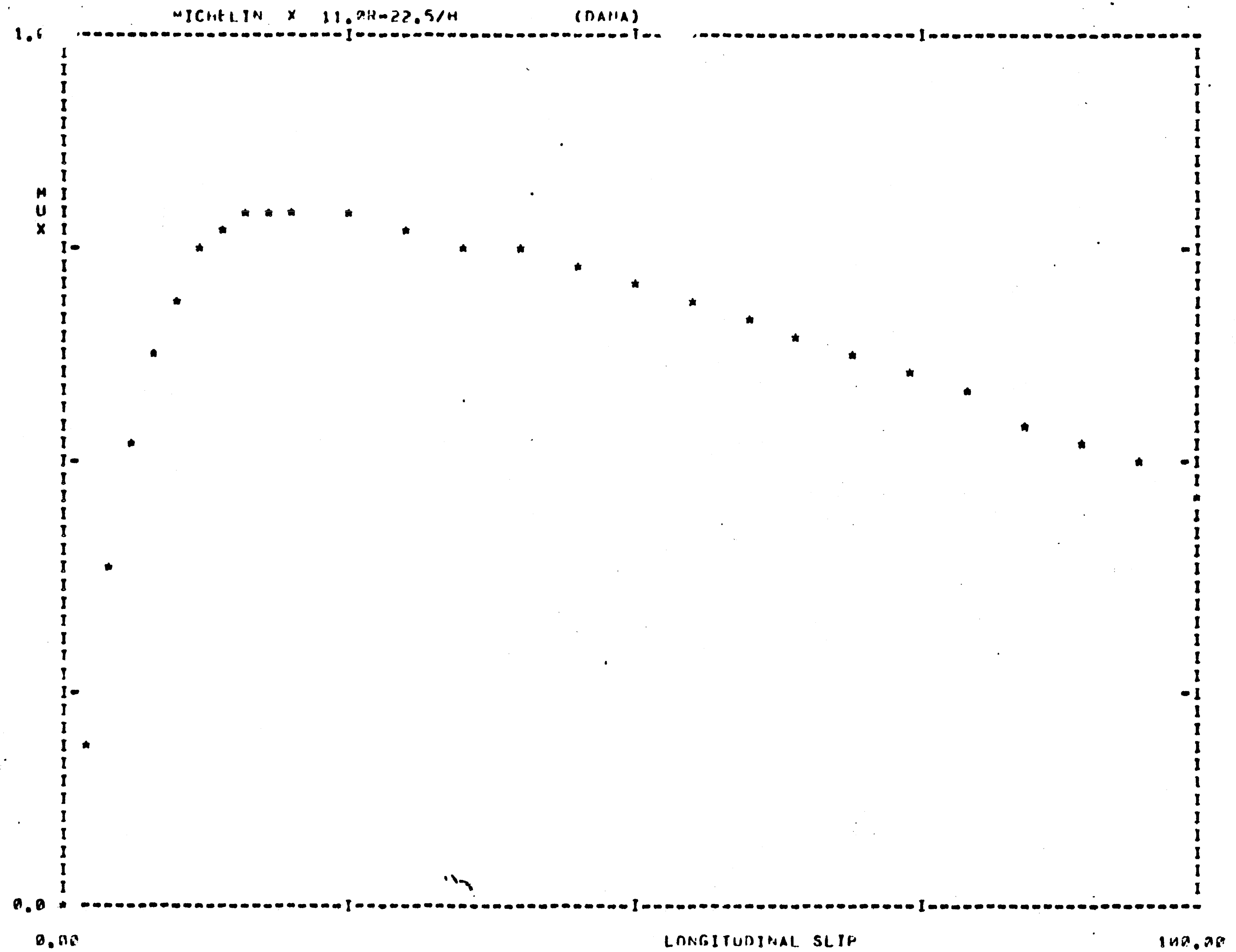
AVERAGE OF FILE 174 FOR 6 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	26460.6	1260.3
0.04	0.39	53085.5	2540.6
0.06	0.53	71993.3	3453.6
0.08	0.63	85448.9	4100.9
0.10	0.70	94997.2	4537.3
0.12	0.75	101844.3	4821.3
0.14	0.78	106441.3	4993.3
0.16	0.79	109684.8	5086.0
0.18	0.80	112022.4	5127.3
0.20	0.80	113527.0	5128.9
0.25	0.79	116203.4	5076.7
0.30	0.78	118394.8	4991.3
0.35	0.77	120173.3	4888.7
0.40	0.75	121622.6	4780.3
0.45	0.73	122792.6	4672.2
0.50	0.71	123022.3	4561.0
0.55	0.70	124589.1	4442.0
0.60	0.68	124588.5	4314.0
0.65	0.65	123150.1	4179.9
0.70	0.63	119151.2	4043.8
0.75	0.61	112267.8	3924.5
0.80	0.59	102837.6	3759.1
0.85	0.56	91697.9	3610.9
0.90	0.54	81445.7	3454.7
0.95	0.51	72139.4	3292.4
1.00	0.48	64062.5	3122.5

TQAV = 64062.5 LOAD = 6640.9 VEL = 40.0 MPH.

MUPEAK = 0.80 MULOCK = 0.48 RATIO = 1.67

477



FZ = 6640.9 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.80 RATIO = 1.67 A-D FILE 174 NKFILE 69 SAMPLE 196

** A-D FILE 175 NEW FILE 90 TEST SAMPLE197 **

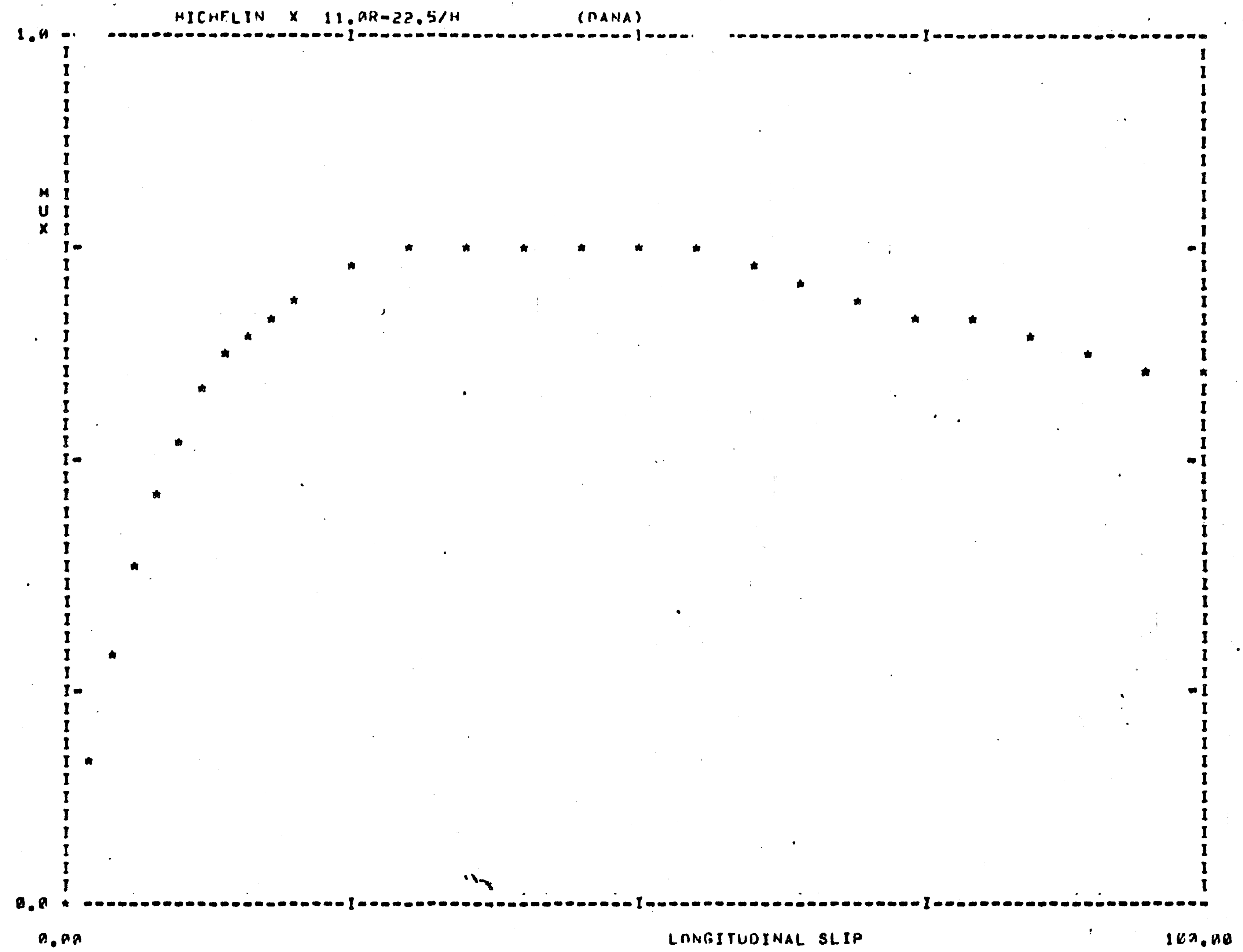
AVERAGE OF FILE 175 FOR 2 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.02	0.0	0.0
0.02	0.16	11633.4	566.2
0.04	0.29	22104.6	1029.8
0.06	0.39	30598.5	1373.7
0.08	0.47	37521.1	1652.4
0.10	0.54	43915.5	1877.9
0.12	0.59	47456.1	2059.6
0.14	0.63	51126.3	2200.5
0.16	0.66	54289.0	2312.4
0.18	0.68	57172.7	2395.9
0.20	0.70	59817.2	2454.0
0.25	0.73	66229.2	2557.7
0.30	0.75	72401.2	2620.0
0.35	0.76	78025.5	2638.4
0.40	0.76	82593.6	2636.1
0.45	0.76	85232.0	2622.0
0.50	0.76	85192.9	2604.0
0.55	0.75	83964.9	2579.7
0.60	0.74	80426.6	2537.6
0.65	0.72	75646.4	2476.9
0.70	0.70	70071.5	2408.5
0.75	0.68	63718.0	2335.2
0.80	0.67	58820.1	2279.4
0.85	0.65	54282.1	2227.6
0.90	0.64	49984.5	2178.0
0.95	0.62	46181.0	2133.4
1.00	0.61	43125.0	2096.2

TQAV = 43125.0 LOAD = 3423.8 VEL = 20.0 MPH.

MUPEAK = 0.76 MULOCK = 0.61 RATIO = 1.25

478



FZ = 3423.8 VEL = 20.0 MULOCK = 0.61 MUPEAK = 0.76 RATIO = 1.25 A-D FILE 175 NWFILE 90 SAMPLE 197

480

** A-D FILE 176 ! FILE 91 TEST SAMPLE198 **

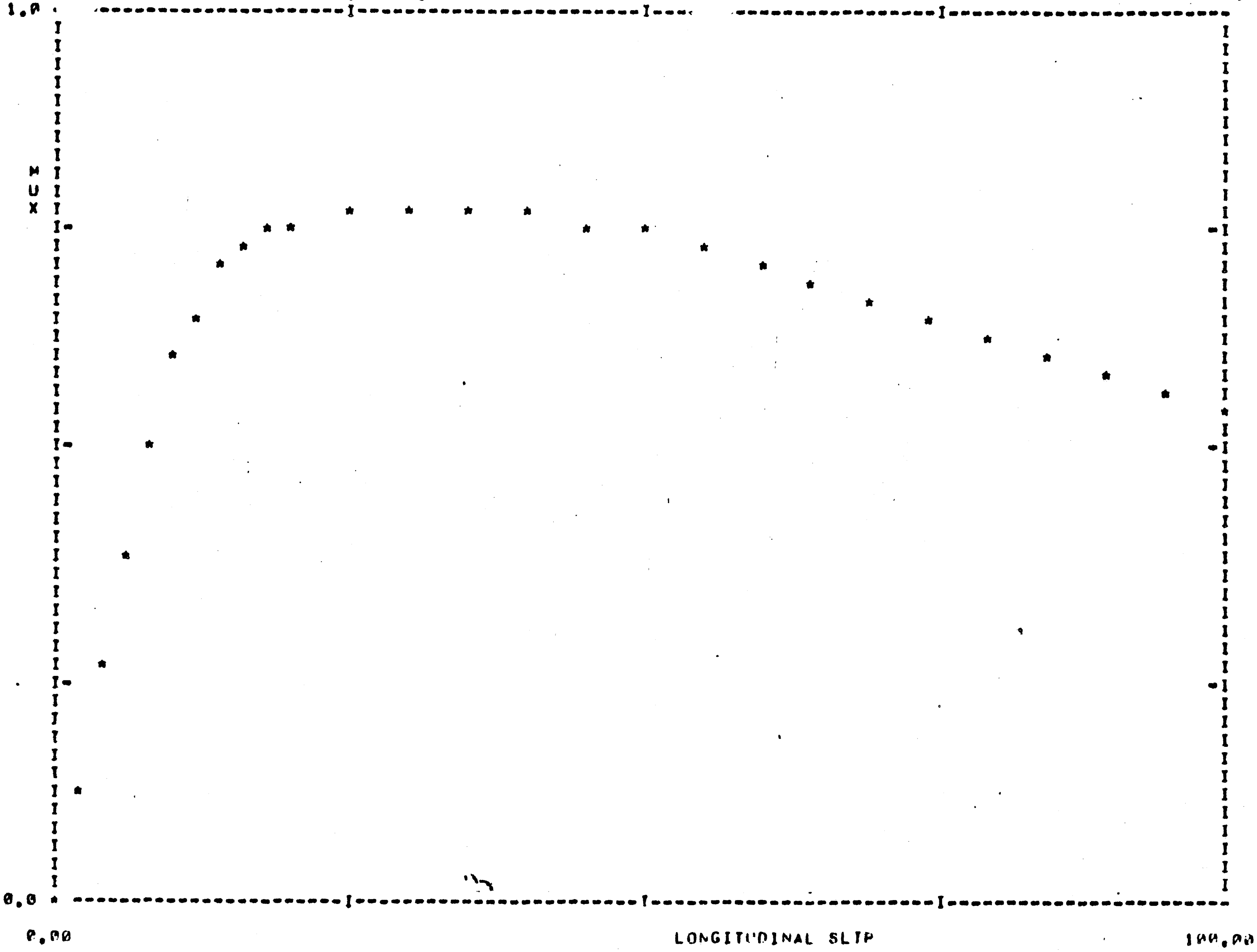
AVERAGE OF FILE 176 FOR 6 RECORDS, MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.12	14779.4	748.4
0.04	0.26	34365.0	1670.6
0.06	0.40	53051.2	2579.9
0.08	0.52	69296.1	3353.7
0.10	0.60	81335.1	3922.0
0.12	0.66	89875.5	4318.2
0.14	0.71	95890.8	4585.7
0.16	0.74	100429.6	4775.6
0.18	0.75	103919.2	4891.6
0.20	0.76	106546.1	4950.7
0.25	0.78	112019.8	5011.5
0.30	0.78	117060.2	5026.6
0.35	0.78	121660.7	5001.1
0.40	0.77	125439.7	4945.1
0.45	0.76	127822.9	4870.7
0.50	0.75	128174.3	4787.9
0.55	0.74	126074.6	4695.3
0.60	0.72	121999.4	4586.0
0.65	0.70	116522.9	4453.8
0.70	0.68	109669.2	4299.4
0.75	0.66	101457.[illegible]	4141.0
0.80	0.63	936[illegible].5	3998.5
0.85	0.61	87057.9	3868.1
0.90	0.60	81102.8	3742.0
0.95	0.58	75702.1	3622.[illegible]
1.00	0.56	71395.8	35[illegible]7.5

TQAV = 71395.8 LOAD = 6623.6 VEL = 20.0 MPH.

MUPEAK = 0.78 MULOCK = 0.56 RATIO = 1.39

MICHELIN X 11.00R-22.5/H (DANA)



FZ = 6623.8 VEL = 2?.? MULOCK = 0.56 MUPEAK = 0.78 RATIO = 1.39 A-D FILE 176 NWFILE 91 SAMPLE 198

** A-D FILE 177 NEW FILE 92 TEST SAMPLE199 **

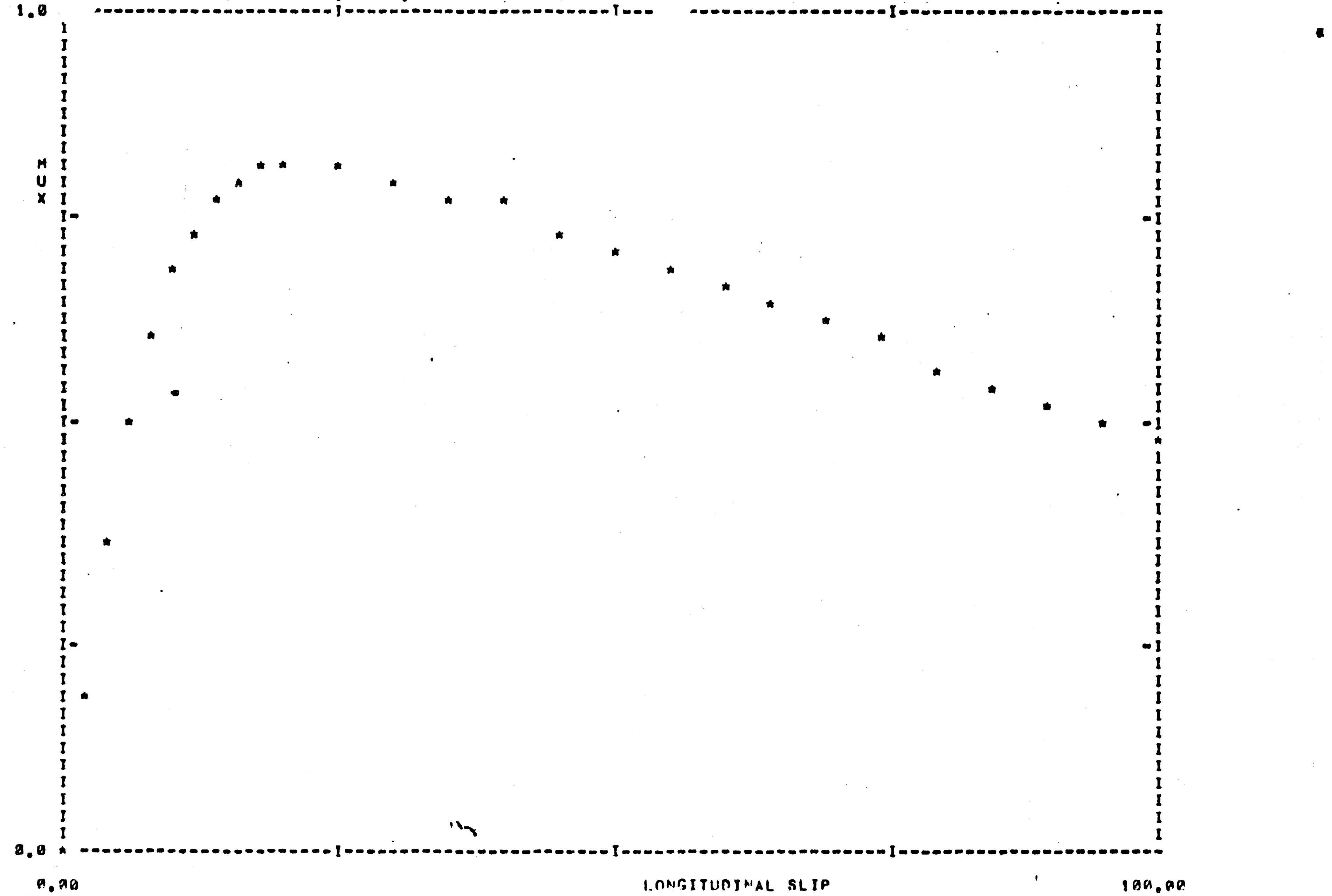
AVERAGE OF FILE 177 FOR 6 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	24619.3	1194.3
0.04	0.37	50487.4	2421.9
0.06	0.51	70184.8	3364.8
0.08	0.62	84733.5	4056.8
0.10	0.69	95288.5	4538.4
0.12	0.74	102908.5	4863.9
0.14	0.78	108361.1	5077.1
0.16	0.80	112375.5	5208.1
0.18	0.81	115390.2	5276.7
0.20	0.81	117434.0	5287.6
0.25	0.81	121322.9	5244.4
0.30	0.82	124569.8	5165.8
0.35	0.79	127341.6	5066.7
0.40	0.77	129839.9	4935.5
0.45	0.75	132151.7	4789.3
0.50	0.72	134035.9	4627.0
0.55	0.70	134676.7	4458.9
0.60	0.68	132769.2	4296.5
0.65	0.65	128124.5	4141.3
0.70	0.63	123836.0	3985.6
0.75	0.60	111244.3	3823.2
0.80	0.58	99470.7	3659.2
0.65	0.55	87169.2	3502.8
0.90	0.53	77846.3	3358.4
0.95	0.51	69926.4	3217.3
1.00	0.49	63437.5	3078.7

TQAV = 63437.5 LOAD = 6561.4 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.49 RATIO = 1.68

MICHELIN X 11.00R-22.5/H (DANA)



FZ = 6561.4 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.61 RATIO = 1.68 A-D FILE 177 NWFILE 92 SAMPLE 199

** A-D FILE 178 NEW FILE 93 TEST SAMPLE200 **

AVERAGE OF FILE 178 FOR 6 RECORDS. MICHELIN X 11.00-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.09	16003.9	864.0
0.04	0.26	50527.6	2550.9
0.06	0.42	82344.9	4128.9
0.08	0.55	105727.1	5288.1
0.10	0.63	121798.1	6065.4
0.12	0.69	132221.5	6563.8
0.14	0.72	138897.2	6873.3
0.16	0.74	143318.2	7065.3
0.18	0.76	146317.7	7173.7
0.20	0.76	148129.3	7210.9
0.25	0.76	151271.5	7208.2
0.30	0.76	153746.7	7155.7
0.35	0.75	155845.4	7064.6
0.40	0.74	157673.0	6943.8
0.45	0.72	158891.7	6798.7
0.50	0.71	159106.7	6641.4
0.55	0.69	157345.7	6474.7
0.60	0.67	153144.0	6301.0
0.65	0.65	147607.4	6120.3
0.70	0.63	140439.4	5921.4
0.75	0.61	131927.4	5713.1
0.80	0.59	123239.5	5515.1
0.85	0.57	115691.7	5320.5
0.90	0.55	108637.3	5146.6
0.95	0.53	102066.9	4969.5
1.00	0.51	96208.3	4798.8

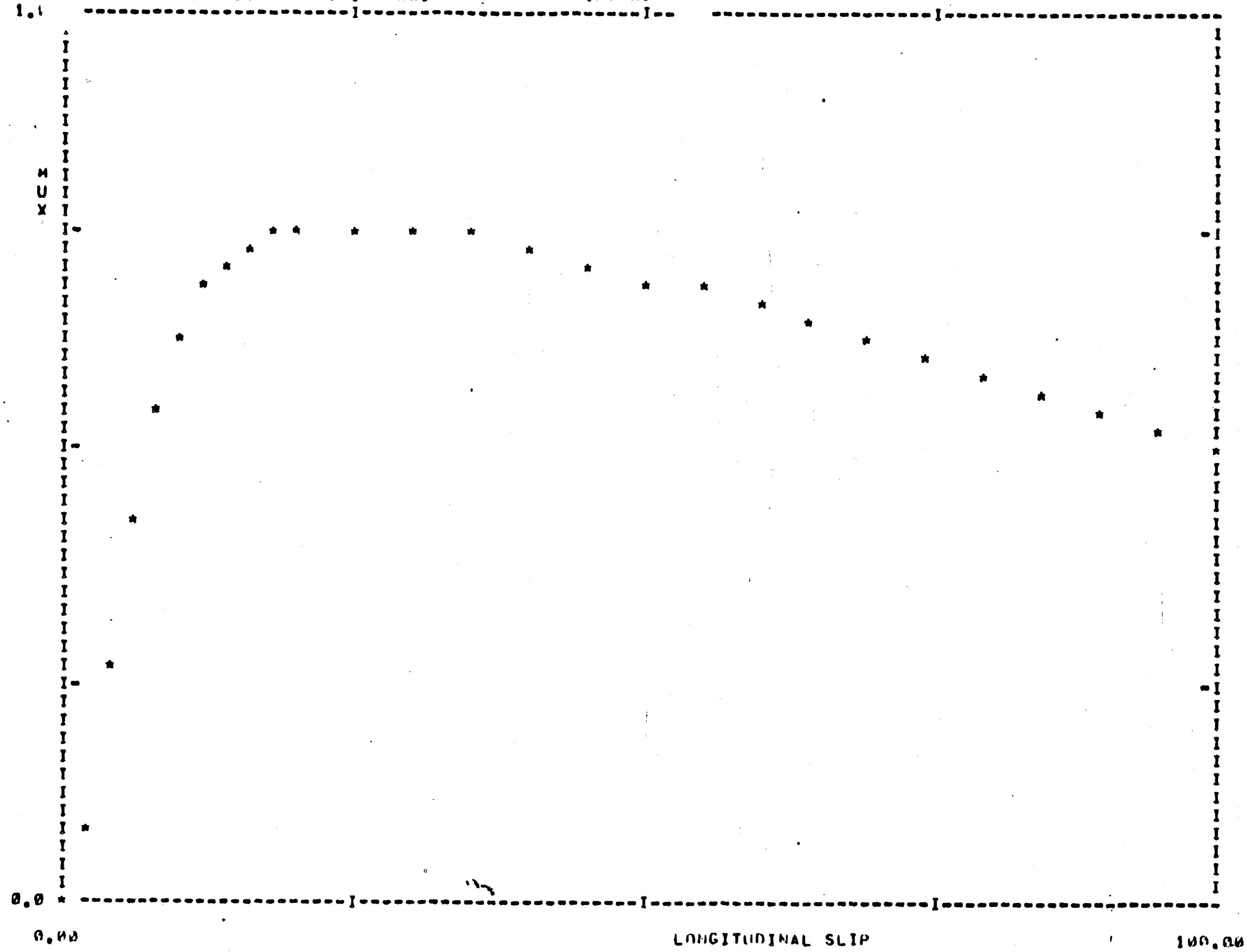
TQAV = 96208.3 LOAD = 9896.3 VEL = 20.0 MPH.

MUPEAK = 0.76 MULOCK = 0.51 RATIO = 1.51

484

-312-

MICHELIN X 11.0R-22.5/H (DANA)



FZ = 9896.3 VEL = 20.0 MULOCK = 0.51 MUPEAK = 0.76 RATIO = 1.51 A-D FILE 178 NWFILE 93 SAMPLE 200

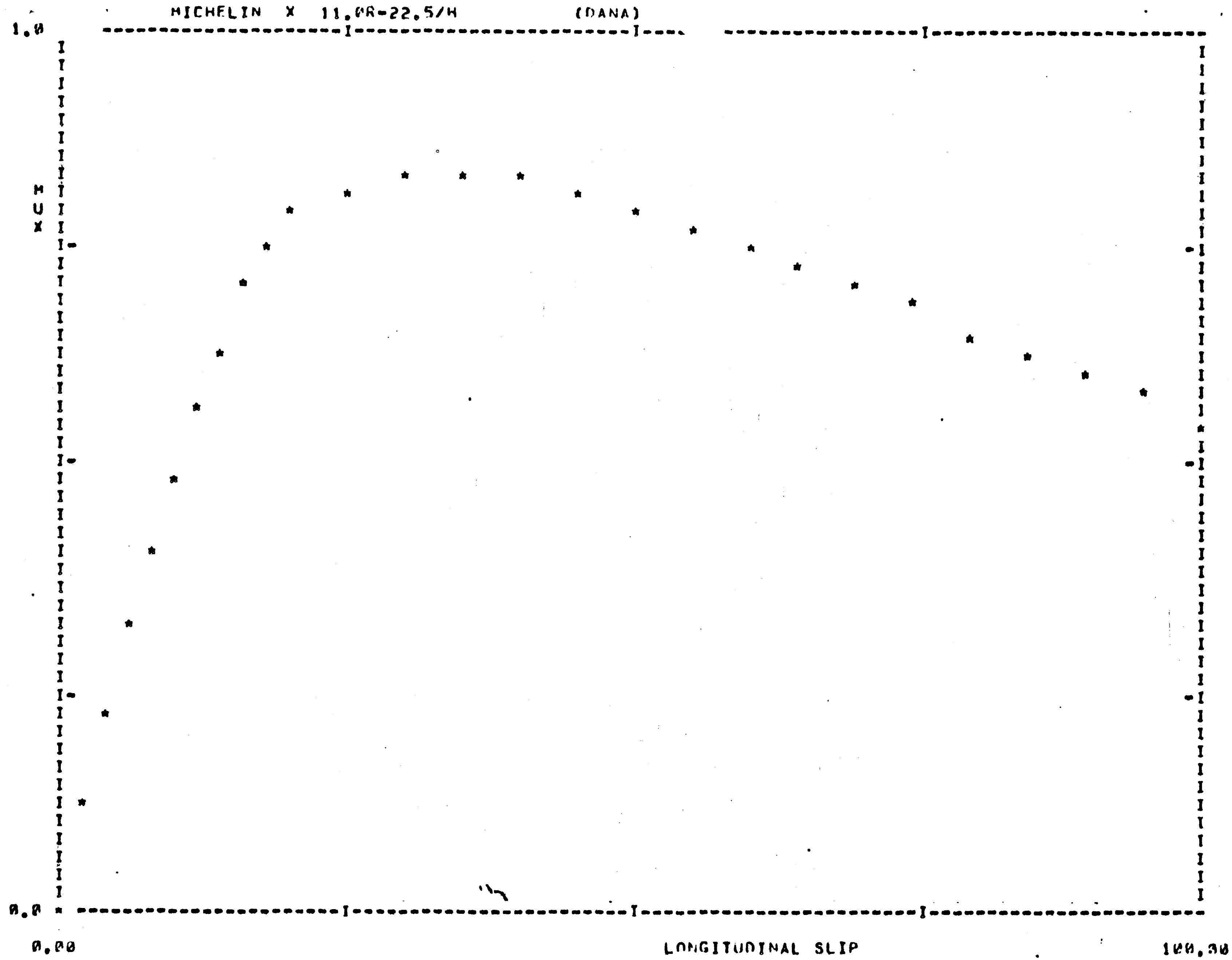
** A-D FILE 179 NE ILE 942 TEST SAMPLE201 **

AVERAGE OF FILE 179 FOR 6 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.12	8478.6	393.8
0.04	0.23	17200.8	767.2
0.06	0.33	25228.0	1111.8
0.08	0.42	32031.2	1405.7
0.10	0.49	38252.9	1658.1
0.12	0.57	45288.4	1914.3
0.14	0.64	52976.8	2169.0
0.16	0.71	60044.5	2390.4
0.18	0.76	65817.6	2553.5
0.20	0.79	69613.2	2638.1
0.25	0.82	76853.0	2744.7
0.30	0.84	83091.7	2799.4
0.35	0.84	86658.4	2803.0
0.40	0.84	93925.7	2768.1
0.45	0.82	98716.9	2710.3
0.50	0.80	102383.2	2638.4
0.55	0.78	103562.4	2563.1
0.60	0.76	101923.7	2493.4
0.65	0.74	97417.4	2420.0
0.70	0.72	89092.8	2344.0
0.75	0.69	80140.2	2252.8
0.80	0.66	69392.9	2156.7
0.85	0.63	59996.0	2073.4
0.90	0.61	51951.3	1995.8
0.95	0.59	44820.3	1922.4
1.00	0.56	38875.0	1855.0

TQAV = 38875.0 LOAD = 3404.3 VEL = 40.0 MPH.

MUPEAK = 0.84 MULOCK = 0.56 RATIO = 1.50



FZ = 3404.3 VEL = 40.0 MULOCK = 0.56 MUPEAK = 0.84 RATIO = 1.50 A-D FILE 179 NWFILE 94 SAMPLE 201

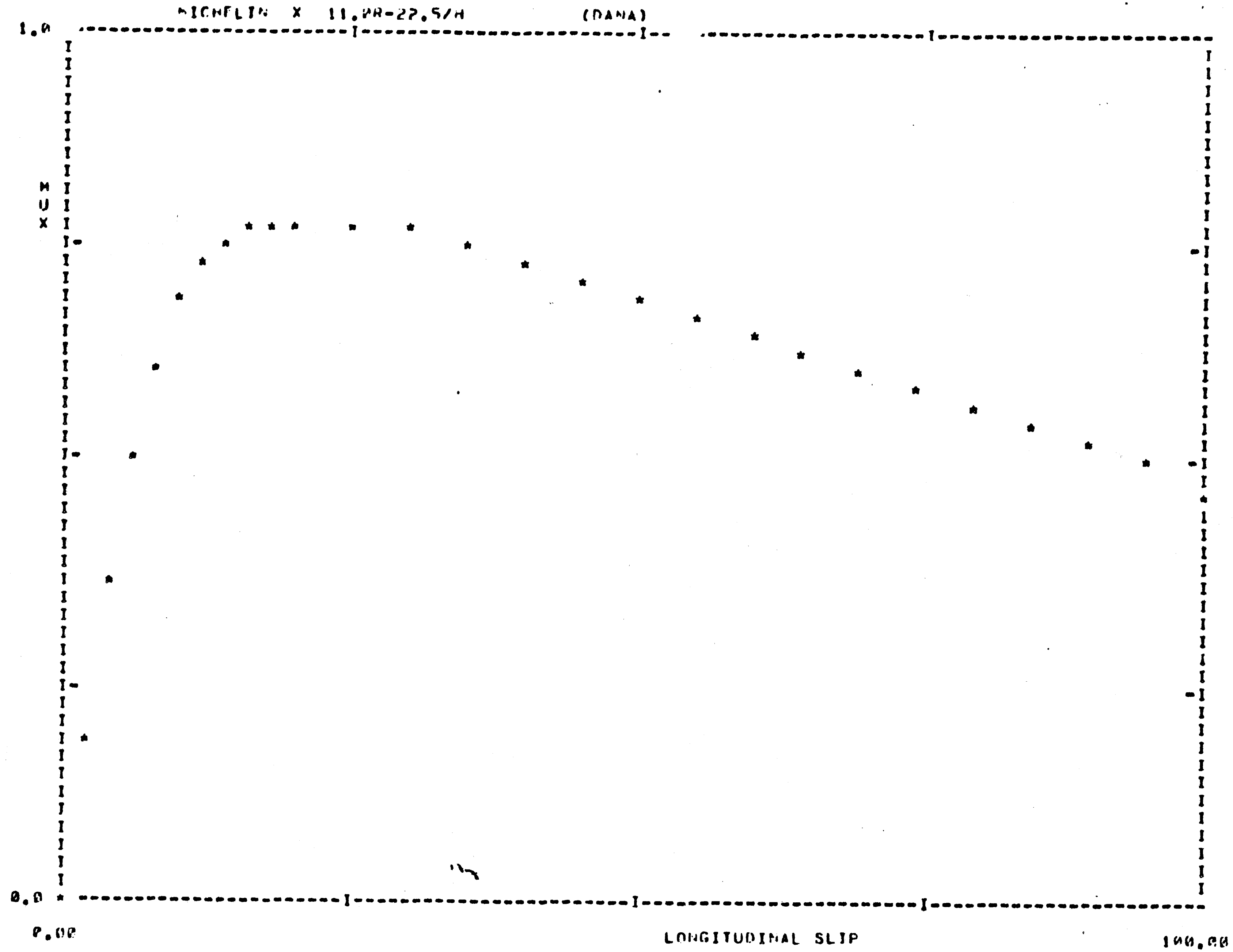
** A-D FILE 180 NEW FILE 952 TEST SAMPLE202 **

AVERAGE OF FILE 180 FOR 5 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	25638.5	1251.1
0.04	0.38	52290.7	2513.5
0.06	0.52	71350.8	3422.1
0.08	0.62	85209.7	4069.4
0.10	0.69	94950.4	4512.0
0.12	0.73	101755.4	4798.8
0.14	0.76	106705.3	4972.5
0.16	0.78	110579.4	5070.5
0.18	0.79	113730.5	5114.2
0.20	0.79	116059.6	5109.6
0.25	0.78	120242.4	5051.0
0.30	0.77	123650.1	4975.2
0.35	0.76	126546.3	4884.0
0.40	0.74	129170.0	4776.1
0.45	0.72	131682.2	4646.6
0.50	0.70	133617.0	4501.1
0.55	0.68	134121.0	4346.7
0.60	0.65	132636.3	4195.7
0.65	0.63	127806.1	4057.8
0.70	0.61	120616.1	3925.7
0.75	0.59	110941.5	3793.3
0.80	0.57	99230.4	36[illegible].5
0.85	0.55	87414.2	3519.9
0.90	0.53	77963.2	3376.2
0.95	0.5[illegible]	69716.7	32[illegible].0
1.00	0.48	62750.0	3081.0

TQAV = 62750.0 LOAD = 6626.0 VEL = 40.0 MPH.

MUPEAK = 0.79 MULOCK = 0.48 RATIO = 1.65



FZ = 6626.0 VFL = 40.0 MULOCK = 0.48 MUPEAK = 0.79 RATIO = 1.65 A-D FILE 180 NNFILE 95 SAMPLE 202

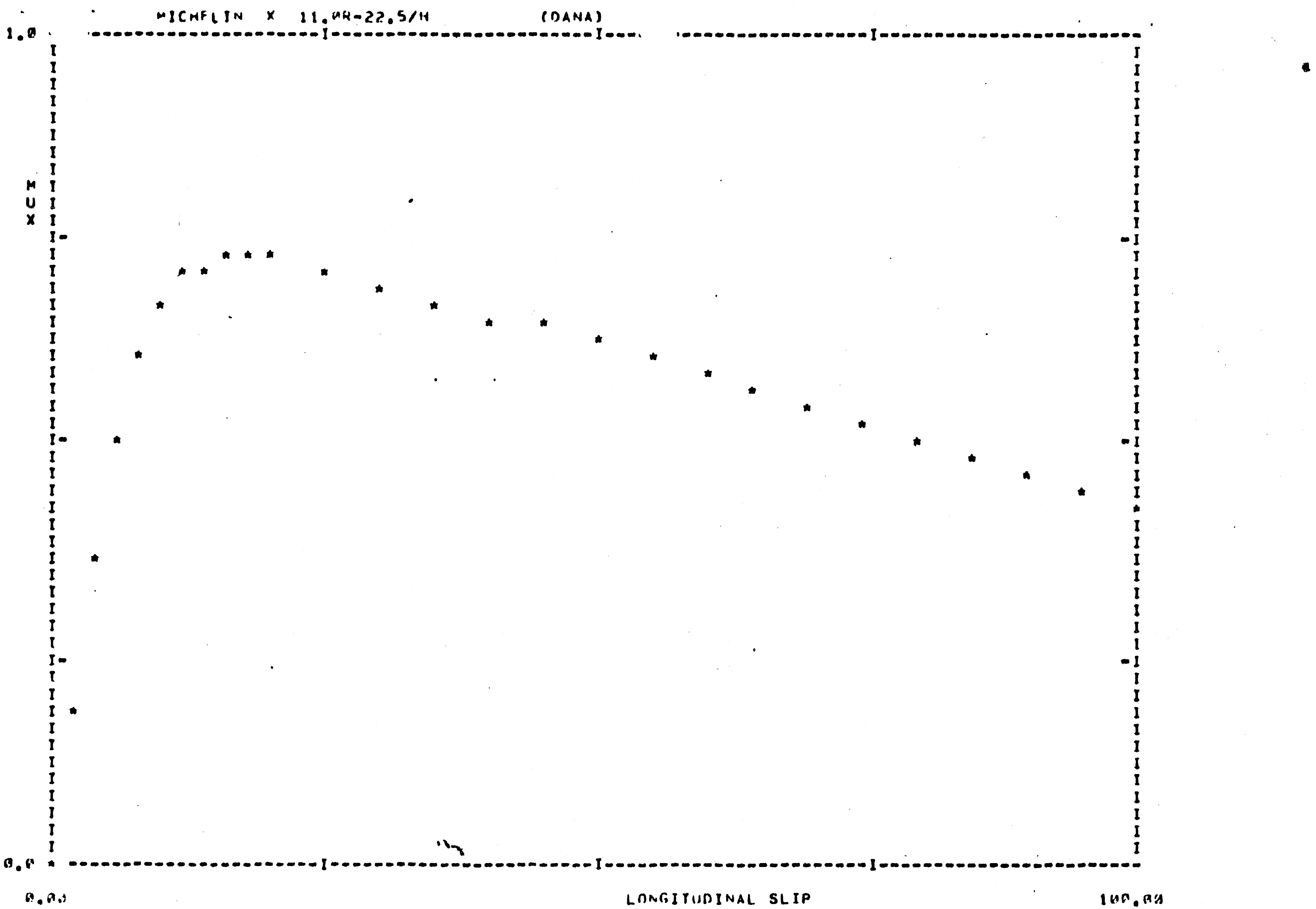
** A-D FILE 184   W FILE 96   TEST SAMPLE203 **

AVERAGE OF FILE 184 FOR 5 RECORDS.   MICHELIN X 11.0R-22.5/H   (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	34204.1	1776.5
0.04	0.38	73477.1	3725.5
0.06	0.51	98736.8	4983.6
0.08	0.61	116354.1	5857.7
0.10	0.67	128439.0	6443.1
0.12	0.71	136244.2	6787.2
0.14	0.72	140998.2	6965.4
0.16	0.73	143720.5	7050.7
0.18	0.73	145354.3	7075.4
0.20	0.73	146424.7	7035.5
0.25	0.71	148386.3	6879.0
0.30	0.70	149860.0	6712.0
0.35	0.68	150929.9	6542.3
0.40	0.66	151743.2	6370.8
0.45	0.65	152421.9	6193.2
0.50	0.63	152927.1	6001.2
0.55	0.61	152589.1	5797.2
0.60	0.59	150686.7	5592.0
0.65	0.56	146720.2	5394.8
0.70	0.55	140219.0	5209.8
0.75	0.53	131130.3	5032.3
0.80	0.51	120483.7	4858.0
0.85	0.49	110161.0	4691.5
0.90	0.47	100766.6	4526.4
0.95	0.46	91966.1	4362.9
1.00	0.44	83900.0	4211.5

TQAV = 83900.0   LOAD = 9929.0   VEL = 40.0 MPH.

MUPEAK = 0.73   MULOCK = 0.44   RATIO = 1.67



FZ = 9929.8 VEL = 40.? MULOCK = 0.44 MUPEAK = 0.73 RATIO = 1.67 A-D FILE 184 NWFILE 96 SAMPLE 203

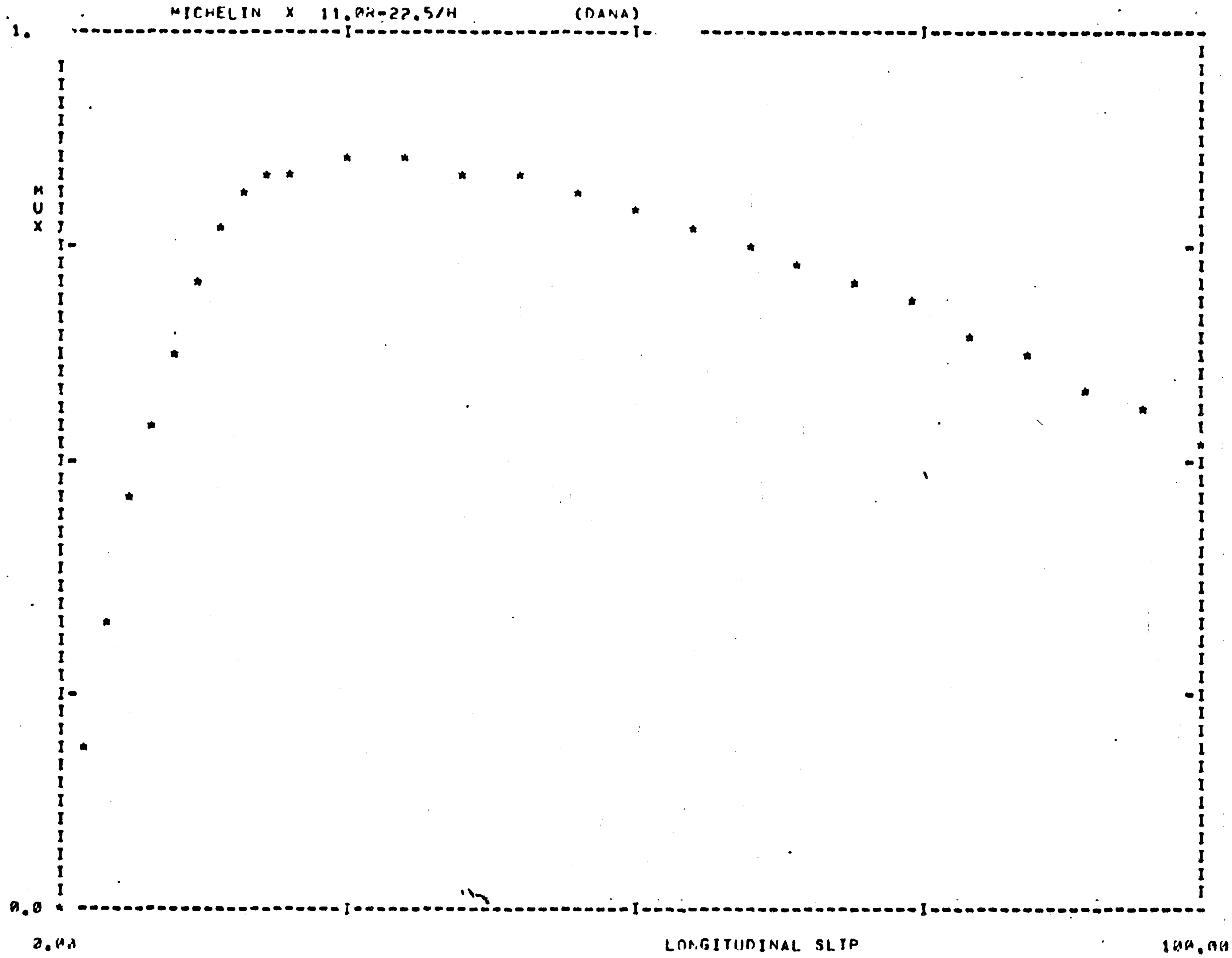
** A-D FILE 185 FM FILE 97 TEST SAMPLE200 **

AVERAGE OF FILE 185 FOR 6 RECORDS. MICHELIN X 11.00-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	14160.8	617.0
0.04	0.34	26508.3	1160.7
0.06	0.46	36398.7	1592.7
0.08	0.56	44360.4	1916.2
0.10	0.64	51451.8	2181.3
0.12	0.72	59344.8	2458.7
0.14	0.78	65575.2	2655.2
0.16	0.81	70139.1	2775.4
0.18	0.84	73655.6	2843.6
0.20	0.84	76306.2	2869.1
0.25	0.85	81847.9	2882.1
0.30	0.85	86729.3	2873.9
0.35	0.85	91094.2	2850.0
0.40	0.84	95219.2	2815.2
0.45	0.82	99325.4	2765.4
0.50	0.80	103440.7	2700.0
0.55	0.78	107027.5	2623.1
0.60	0.76	108795.1	2538.8
0.65	0.73	107768.5	2457.9
0.70	0.71	102959.1	2384.8
0.75	0.69	93992.8	2300.2
0.80	0.66	81698.4	2215.5
0.85	0.63	67666.6	2113.7
0.90	0.60	56143.1	2015.2
0.95	0.57	46176.2	1916.3
1.00	0.54	38020.8	1822.5

TQAV = 38020.8 LOAD = 3444.4 VEL = 55.0 MPH.

MUPEAK = 0.85 MULOCK = 0.54 RATIO = 1.58



FZ = 3444.4 VFL = 55.0 MULOCK = 0.54 MUPEAK = 0.85 RATIO = 1.58 A-D FILE 185 NWFILE 97 SAMPLE 204

492

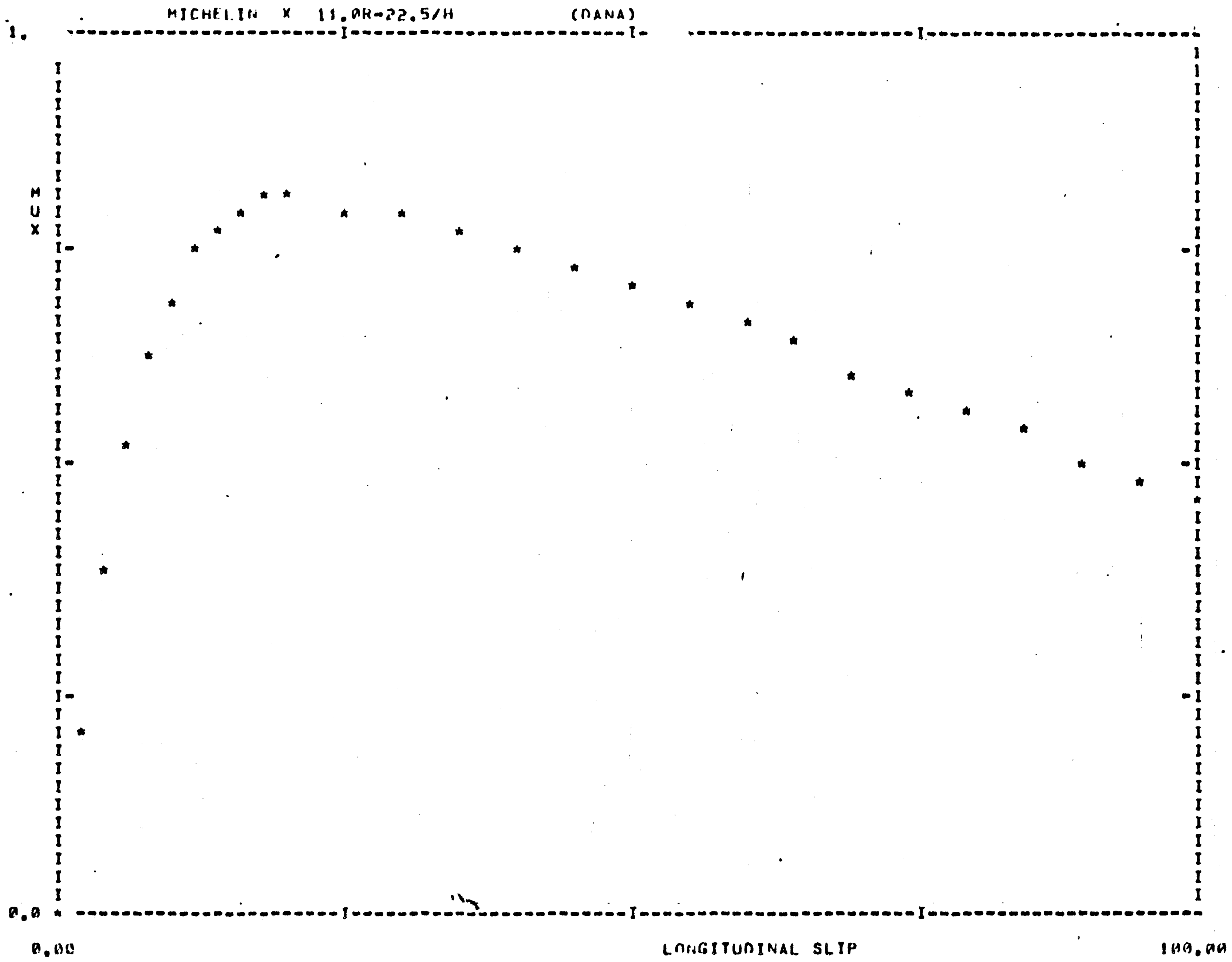
** A-D FILE 186 · FILE 98 TEST SAMPLE205 **

AVERAGE OF FILE 186 FOR 6 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

TQAV = 63000.0 LOAD = 6641.0 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.47 RATIO = 1.72

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	27717.2	1340.3
0.04	0.38	51678.5	2520.7
0.06	0.52	70411.3	3433.1
0.08	0.63	84491.5	4094.8
0.10	0.70	94533.8	4546.6
0.12	0.75	101538.3	4844.2
0.14	0.78	106589.3	5024.3
0.16	0.80	110438.4	5125.5
0.18	0.81	113440.0	5177.7
0.20	0.81	115572.3	5184.6
0.25	0.81	119760.5	5148.2
0.30	0.80	123467.5	5086.8
0.35	0.78	126924.6	4987.2
0.40	0.76	130241.9	4871.4
0.45	0.74	133389.0	4733.2
0.50	0.72	135835.3	4591.3
0.55	0.69	136771.8	4426.7
0.60	0.67	134819.7	4275.9
0.65	0.65	129800.3	4132.0
0.70	0.62	121987.1	3984.1
0.75	0.60	111792.6	3822.5
0.80	0.57	99761.4	3657.4
0.85	0.54	88965.3	3505.8
0.90	0.52	78564.7	3361.2
0.95	0.50	72173.3	3219.5
1.00	0.47	[illegible]	3081.3



FZ = 6641.0 VEL = 40.0 MULOCK = 0.47 MUPEAK = 0.81 RATIO = 1.72 A-D FILE 186 NWFILE 9A SAMPLE 205

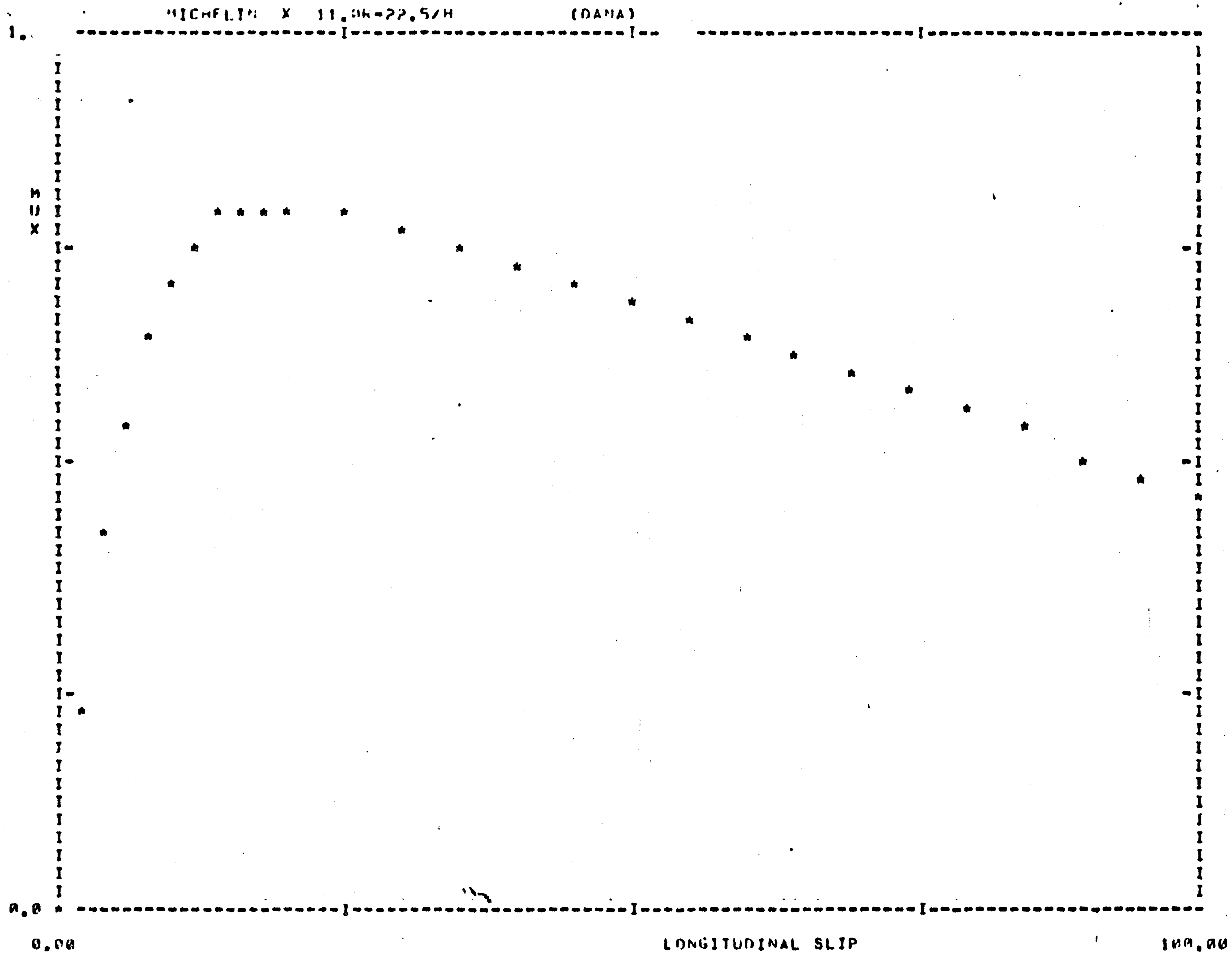
** A-D FILE 187 NEW FILE 99 TEST SAMPLE206 **

AVERAGE OF FILE 187 FOR 6 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.22	0.23	31223.7	1511.2
0.04	0.42	57149.3	2786.6
0.06	0.56	75742.2	3685.1
0.08	0.66	88998.2	4326.6
0.10	0.72	98238.3	4754.4
0.12	0.77	104632.9	5012.4
0.14	0.79	109146.2	5161.8
0.16	0.80	112416.1	5240.6
0.18	0.81	114914.7	5267.7
0.20	0.81	116584.3	5247.8
0.25	0.79	119680.0	5154.4
0.30	0.78	122456.3	5045.6
0.35	0.76	125172.9	4928.1
0.40	0.74	127933.7	4804.4
0.45	0.72	130805.3	4675.8
0.50	0.70	133643.0	4540.3
0.55	0.68	136087.0	4398.0
0.60	0.66	137276.4	4253.7
0.65	0.64	136236.0	4111.4
0.70	0.62	131564.8	3974.9
0.75	0.59	122911.8	3834.8
0.80	0.57	110626.7	3681.3
0.85	0.55	96271.1	3520.0
0.90	0.52	83489.0	3361.3
0.95	0.49	71955.0	3291.0
1.00	0.47	61937.5	3038.0

TQAV = 61937.5 LOAD = 6640.7 VEL = 55.0 MPH.

MUPEAK = 0.81 MULOCK = 0.47 RATIO = 1.73



FZ = 6640.7 VEL = 55.0 MULOCK = 0.47 MUPEAK = 0.81 RATIO = 1.73 A-D FILE 187 NWFILE 99 SAMPLE 206

** A-D FILE 189 CH FILE 100 TEST SAMPLE208 **

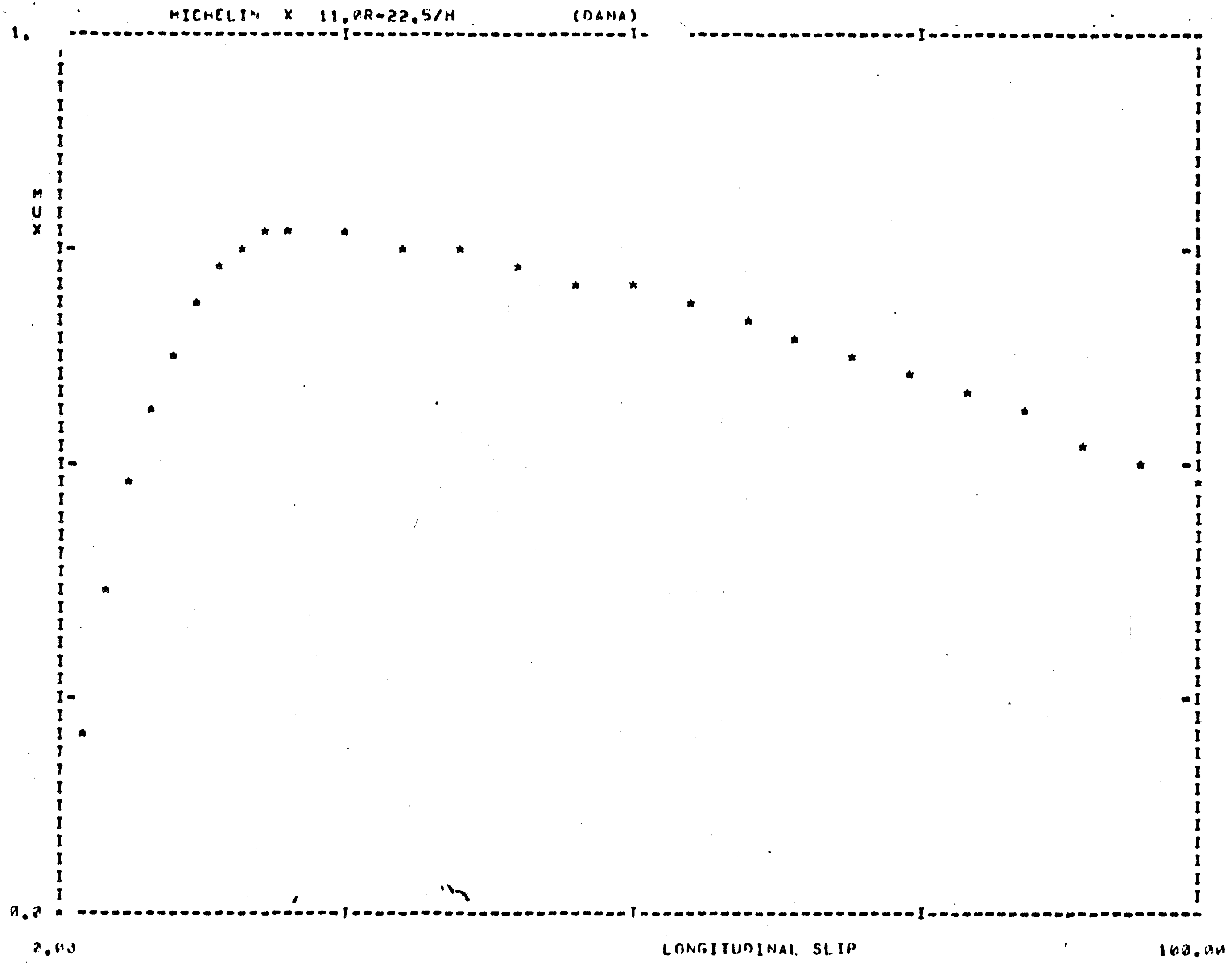
AVERAGE OF FILE 189 FOR 7 RECORDS. MICHELIN X 11.0R-22.5/H (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	28397.4	1398.0
0.04	0.36	49910.9	2456.7
0.06	0.48	65882.2	3249.9
0.08	0.57	77710.2	3813.7
0.10	0.63	87227.1	4240.1
0.12	0.70	97166.2	4665.6
0.14	0.74	104166.9	4942.5
0.16	0.76	108661.3	5089.7
0.18	0.77	111663.3	5156.9
0.20	0.78	113527.9	5163.3
0.25	0.77	117022.8	5118.9
0.30	0.76	119939.6	5053.0
0.35	0.75	122396.2	4976.4
0.40	0.74	124512.7	4893.7
0.45	0.72	126399.7	4800.0
0.50	0.71	128067.9	4693.7
0.55	0.69	129136.5	4574.6
0.60	0.67	126837.4	4447.6
0.65	0.65	126517.3	4318.7
0.70	0.63	121779.5	4191.4
0.75	0.61	114230.4	4059.7
0.80	0.59	104388.8	3916.6
0.85	0.57	93651.9	3765.8
0.90	0.54	84164.1	3612.2
0.95	0.52	74999.1	3458.5
1.00	0.49	66410.7	3305.4

TOAV = 66410.7 LOAD = 6841.7 VEL = 40.0 MPH.

MUPFAK = 0.78 MULOCK = 0.49 RATIO = 1.57

497



FZ = 6841.7 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.78 RATIO = 1.57 A-D FILE 189 NWFILE 100 SAMPLE 208

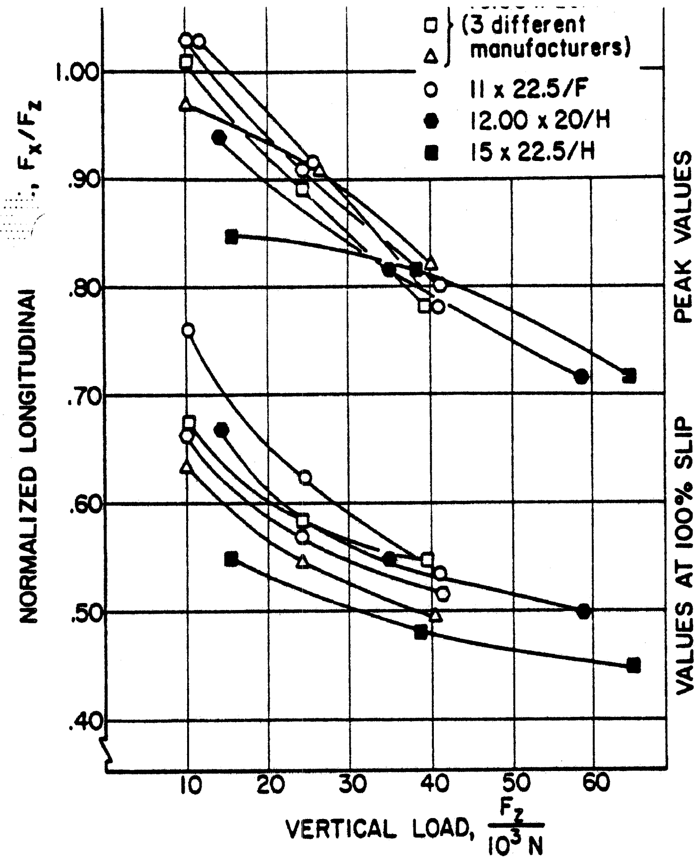


Fig. 3: Load sensitivity in the peak and slide traction of a six-tire sample on dry asphalt. All tests run at 64 km/h.

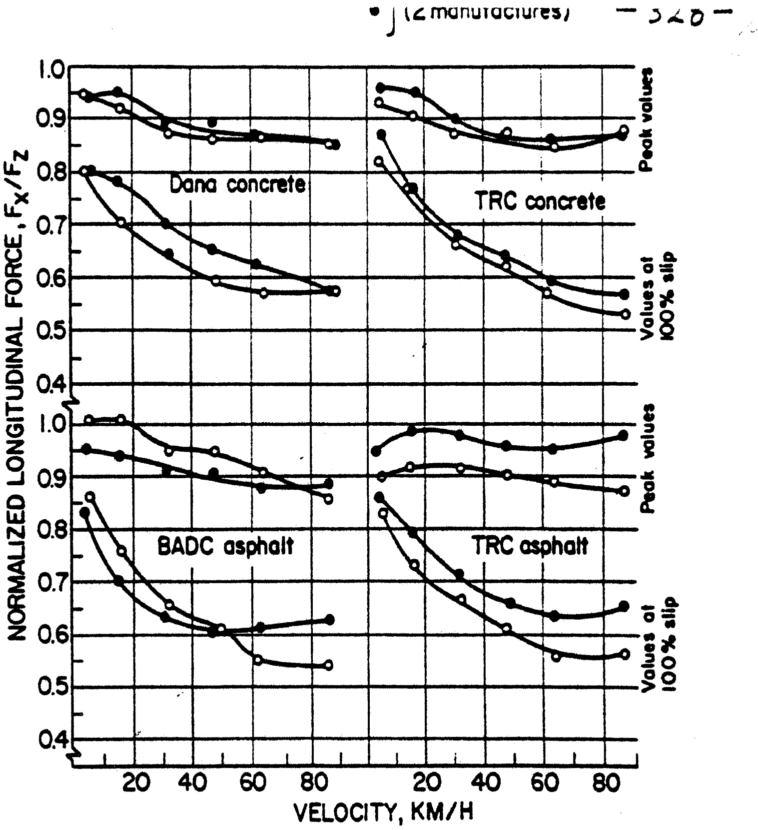
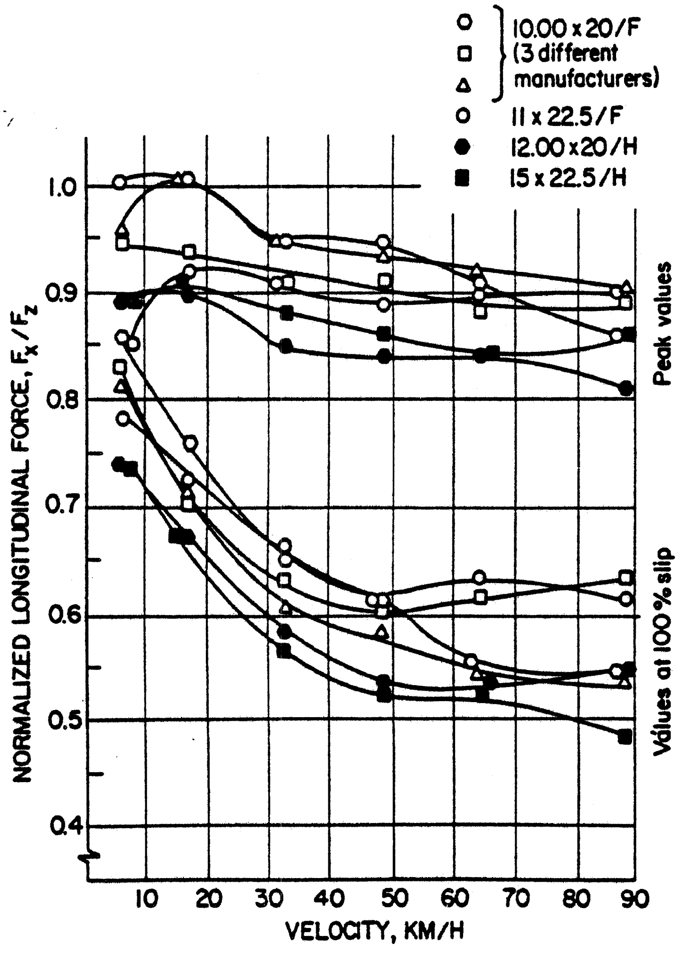


Fig. 5: The differing influence of pavement surface on the velocity sensitivities of two tires.



4: Velocity sensitivity of the peak and slide traction values for a six-tire sample on dry asphalt. All tires operated at their respective T & RA rated load.

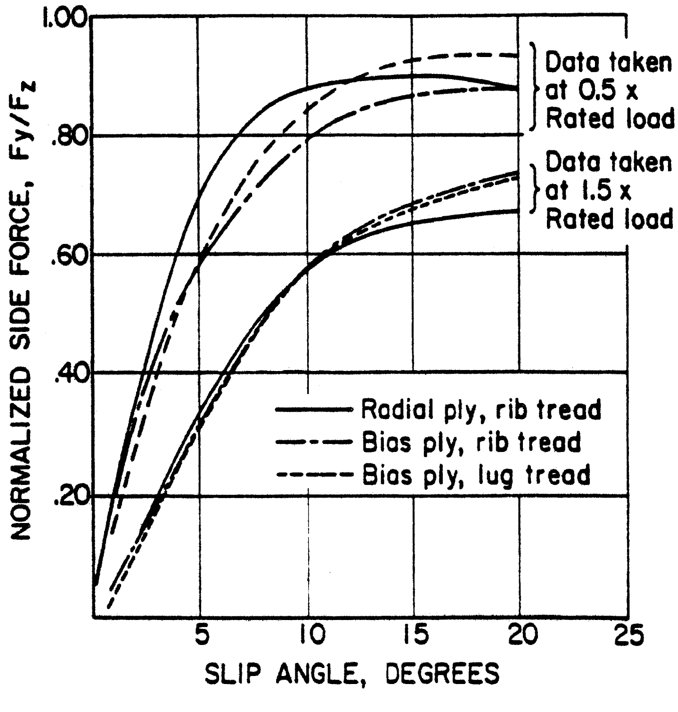


Fig. 6: Typical load sensitivities in the side force response of a sample of 10.00 x 20 tires tested at 32 km/h on a dry concrete surface.

Tire: Highway Tread 11-22.5/F Rim: 22.5x8.25

LATERAL FORCE vs. SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1800	85	197	427	752	1250	1547	1605
3600	85	395	748	1352	2302	2876	3086
5430	85	504	973	1773	3065	3867	4317
7200	85	570	1102	2023	3591	4605	5310
8700	85	625	1159	2166	3883	5047	5930

ALIGNING TORQUE vs. SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1800	85	18	36	48	45	27	10
3600	85	59	101	146	157	125	74
5430	85	96	171	261	310	269	178
7200	85	130	235	374	481	442	315
8700	85	159	293	479	640	623	452

CIRCUMFERENTIAL STIFFNESS vs. SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
1800	85	18,000	
5430	85	56,000	5700
8700	85	46,000	

B. F. GOO 'ICH INTERCITY MILEAGE 11.50X20 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-6.7	-303.2	218.0	-491.1	436.5	-814.0	741.1	-1202.2	1159.1	-1343.1	1414.4	-1474.2	1443.2
100.0	4000.0	-52.3	-508.7	397.0	-899.7	803.6	-1533.9	1442.8	-2277.1	2238.4	-2616.7	2686.9	-2889.3	2863.5
100.0	6000.0	-72.7	-666.4	524.6	-1202.2	1067.6	-2076.7	1950.7	-3133.8	3095.1	-3752.5	3775.2	-4120.8	4076.0
100.0	8000.0	-83.8	-755.2	598.2	-1399.9	1224.6	-2437.5	2276.5	-3909.6	3758.4	-4680.8	4702.8	-5218.4	5158.2
75.0	4000.0	-77.4	-568.3	444.7	-1010.1	879.7	-1666.3	1577.7	-2307.2	2252.6			-2848.2	2959.2
75.0	6000.0	-87.3	-713.6	553.7	-1272.0	1094.6	-2139.1	1988.4	-3174.0	3046.3			-4027.6	4118.0
50.0	4000.0	-78.4	-607.3	461.9	-1039.1	920.5	-1721.2	1587.6	-2381.8	2343.8			-2982.5	3056.2
50.0	6000.0	-97.3	-715.0	520.7	1247.7	1093.6	-2112.4	1945.1	-3165.5	3063.5			-4147.1	4185.8

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-2.1	18.6	-27.2	36.4	-42.5	47.5	-53.3	31.5	-33.6	4.6	-15.0	-8.2	-1.0
100.0	4000.0	8.2	76.1	-65.4	119.3	-114.5	160.0	-159.9	124.8	-137.0	59.0	-81.6	21.1	-33.4
100.0	6000.0	14.6	130.4	-103.6	208.7	-195.9	292.5	-287.5	244.5	-263.3	153.0	-183.3	82.6	-97.3
100.0	8000.0	22.1	178.8	-144.7*	295.6	275.8	431.8	-428.1	425.6	-426.4	271.1	-321.1	163.4	-177.6
75.0	4000.0	14.8	95.1	-80.0	151.7	-138.7	173.5	-183.0	107.5	-121.4			4.1	-24.9
75.0	6000.0	21.1	154.9	-125.6	250.8	-231.9	327.9	-333.6	252.9	-267.1			48.6	-88.8
50.0	4000.0	19.0	117.6	-94.8	178.5	-171.2	203.6	-216.4	126.7	-137.0			11.3	-36.7
50.0	6000.0	26.9	183.9	-140.2	298.6	-271.5	379.6	-392.6	297.9	-312.6			57.4	-117.1

loads, the tire behaves (laterally) like a softening spring. The lateral spring rate is the slope through the origin of the lateral load-deflection curve.

TRACTION STIFFNESS (C_α, C_γ, C_s) - The following three properties are defined to characterize the mechanical behavior of a rolling tire operated at very small slip and camber angles and for very light application of braking or driving power.

Cornering Stiffness

$$C_\alpha = \left.\frac{dF_y}{d\alpha}\right|_{\alpha=0} \qquad (1)$$

Camber Stiffness

$$C_\gamma = \left.\frac{dF_y}{d\gamma}\right|_{\gamma=0} \qquad (2)$$

Circumferential Stiffness

$$C_s = \left.\frac{dF_x}{ds}\right|_{s=0} \qquad (3)$$

where:

α = slip angle
γ = camber angle
s = circumferential slip parameter

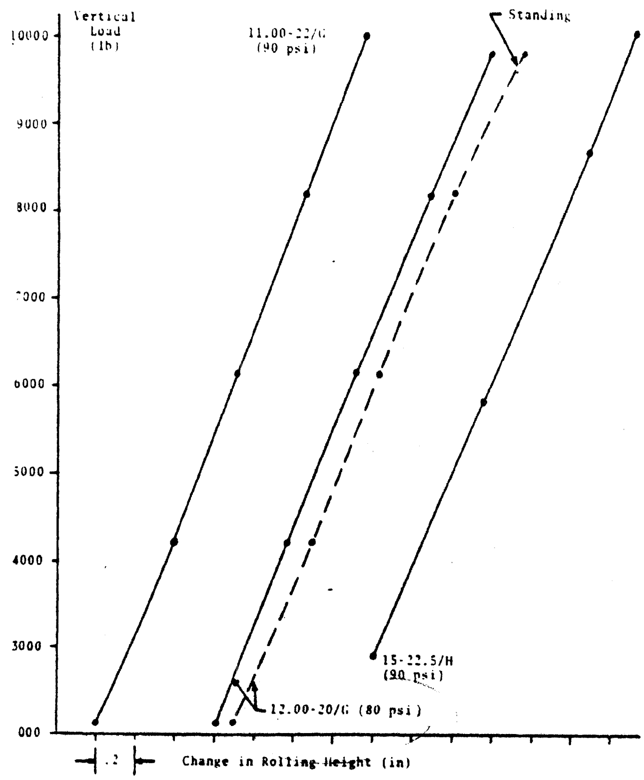


Fig. 1 - Vertical load versus change in low-speed rolling height of tires shown in Figs. 2A-2C

$$s \begin{cases} = 1 \text{ locked wheel} \\ = 0 \text{ free rolling (light braking: } s < 0.05) \\ < 0 \text{ driving} \end{cases}$$

F_x = longitudinal traction force (depends primarily on s)

F_y = lateral traction force (depends on both α and γ)

Graphically, the traction stiffness is the slope taken through the origin of the traction force (F_x or F_y) versus a particular operating variable (α, γ, or s) curve. These stiffnesses measure the initial rise of traction force and have no direct relation to peak values. However, a tire with higher traction stiffness will usually develop higher peak traction force. The usefulness of these definitions depends on linear behavior for small values of the operating variables. Examination of the following truck tire data will show this linearity to be a reasonable assumption.

GENERAL BEHAVIOR

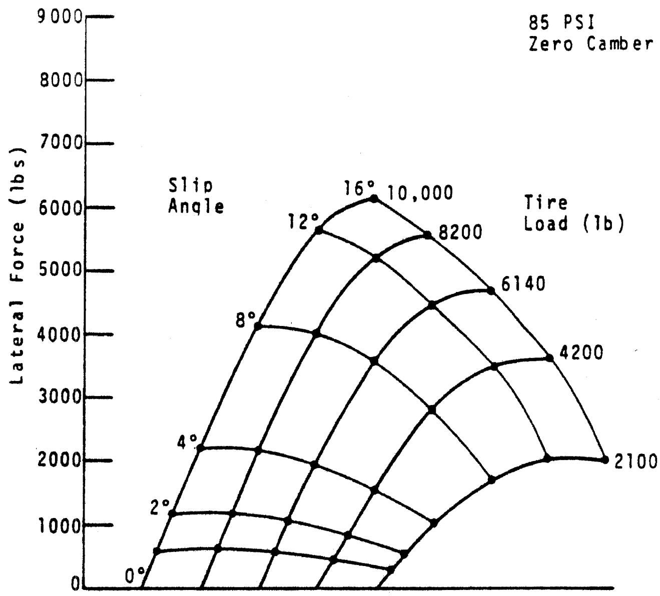
Figs. 2A-2C describe three truck tires chosen to exhibit a broad range of traction stiffness properties*. The mechanical properties listed below each tire were measured at rated load and pressure. The carpet plots of lateral force versus slip angle and vertical load show the variation in lateral force obtained and indicate how the cornering stiffness, C_α, is related to slip angle and load. Although C_α measures only the initial rise of lateral force with slip angle for a particular tire load, the rise is similar at other tire loads. It appears that a tire showing higher cornering stiffness will develop more lateral force than a lower stiffness tire operated at the same slip angle and vertical load.

TIRE LOAD

The operating variable having the greatest influence on traction stiffness is tire load. The influence of tire load derives from the extreme deformation which a tire undergoes in the contact region. Specifically, the meridian and circumference profiles, intersecting at the center of contact, are substantially altered in dimension and curvature as tire load is increased. The camber, cornering, and circumferential stiffnesses, being indirectly influenced by lateral and longitudinal tire stiffness, are consequently dependent on structural geometry, and are seen to increase with test load for the tires diagrammed in Figs. 3A-3D.

Particularly affected by sidewall deformation is the lateral spring rate, K_y. Fig. 3D illustrates the variation of K_y with tire load for the three tires shown in Figs. 2A-2C. Increasing load on the tire from far below the design value results mainly in an increased contact length with some change in the meridian profile. The increased contact length causes an increase in lateral stiffness. At higher loads, the changes in tire

*The tires are representative of the 14 different truck tire sizes tested for this program.



A

Load 6140 lb.

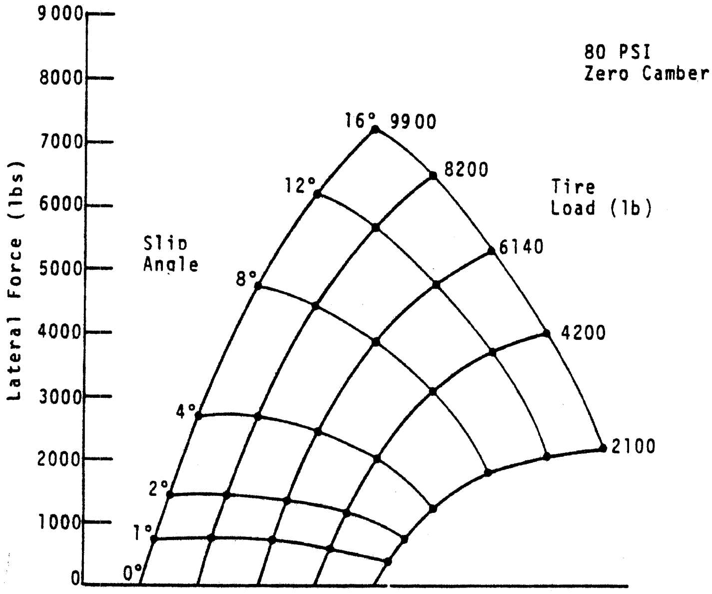
C_s 51,000 lb/unit slip

C_α 536.9 lb/deg

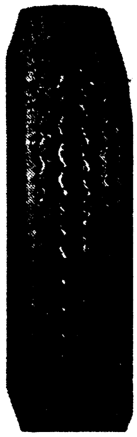
C_Y 62.8 lb/deg

K_y 1910 lb/in

K_z 5850 lb/in



B



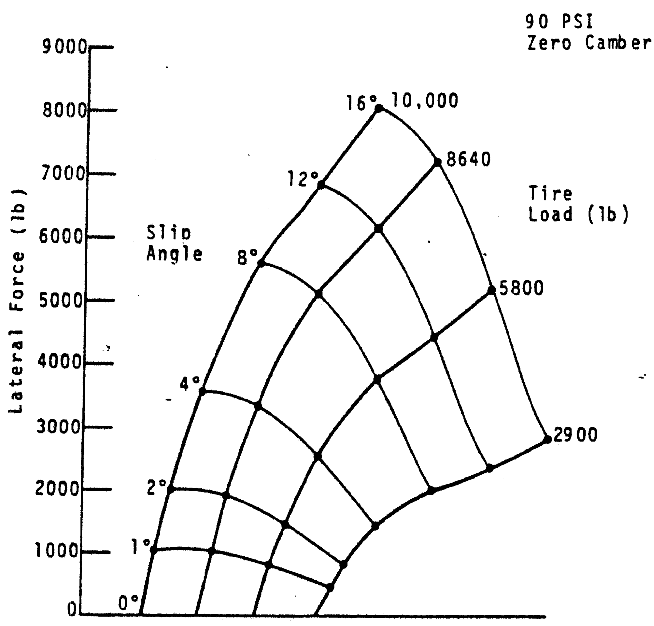
Load 6140 lb.

C_s 60,000 lb/unit Slip

C_α 700.8 lb/deg

C_Y 101.6 lb/deg

K_y 1900 lb/in



Load 8640 lb.

C_s 85,000 lb/unit slip

C_α 1014.7 lb/deg

C_Y 162.0 lb/deg

K_y 2860 lb/in

K_z 5420 lb/in

C

Fig. 2 - Measured mechanical properties of three different tires. A-11.00-22/G; B-12.00-20/G; C-15-22.5/H

profile become very pronounced, especially in the sidewall area, and cause a reduction in spring rate. It should be noted that the maximum value of lateral spring rate occurs near the design load for each tire tested.

The vertical load-deflection data are remarkably linear for a broad range of tire loads (Fig. 1). Fig. 1 suggests that it is reasonable to consider the tire as a linear vertical spring with spring rate, K_z, defined as the average slope of the load-deflection plot.

INFLATION PRESSURE

Increasing inflation pressure reverses the deformation caused by vertical load. Although a decrease in contact length accompanies an increase in inflation pressure, the dominant effects of increased pressure are reduced curvature in the sidewall and a generally stiffened carcass structure. The net result is a lateral spring rate that increases with inflation pressure, as is demonstrated by Fig. 4; these data being obtained on the three tires shown in Figs. 2A-2C. As may be expected, the effect of increasing the pressure is more pronounced at the higher loads which cause large distortions in the meridian profile.

The cornering stiffness, C_α, exhibits similar pressure sensitivity at higher vertical loads. Fig. 5 compares the lateral force versus slip angle and vertical load exhibited by a 10.00-20/G tire (Fig. 6B) at rated inflation pressure (100 psi) and at 50 psi. As can be anticipated from lateral spring rate behavior measured for these three different tires (Fig. 4), cornering stiffness increases with inflation pressure at higher loads.

The apparent similarity between K_y and C_α is due to the definition of K_y as the lateral stiffness of a standing tire measured at, effectively, a 0 deg slip angle while C_α is defined to measure the stiffness of the rolling tire in generating lateral force at very small slip angles. However, the contact region deformation associated with tire traction is considerably more complicated than the deformation associated with the measurement of K_y. As no rational basis exists for the correlation of these values, they are treated as independent mechanical properties.

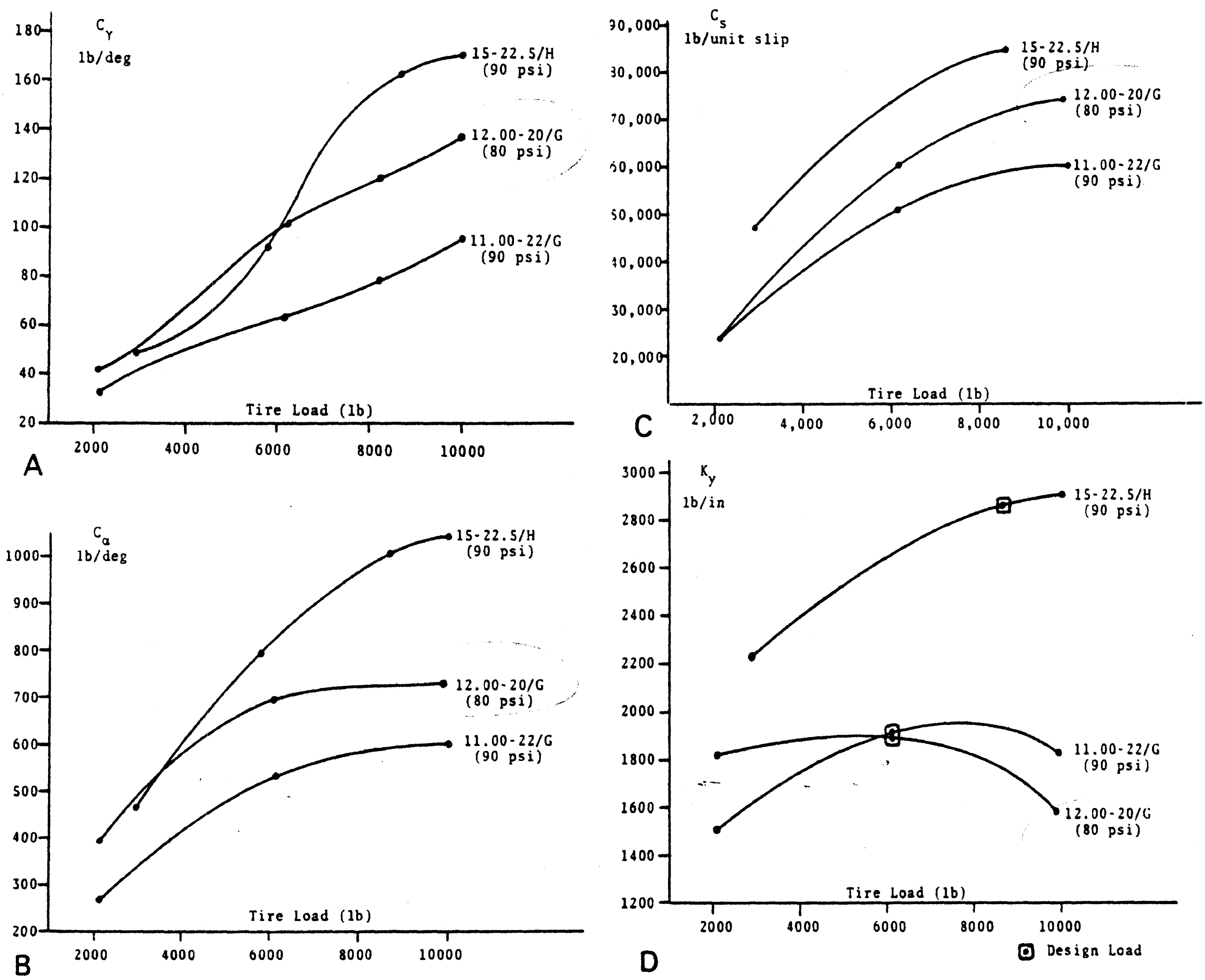


Fig. 3 - Variation of mechanical properties with tire load for tires shown in Figs. 2A-2C. A-camber stiffness versus tire load; B-cornering stiffness versus tire load; C-circumferential stiffness versus tire load; D-lateral spring rate versus tire load

PLY RATING AND TIRE SIZE

The ply rating designates the load range for which a particu- size tire is designed. Load limits for various sizes at specific inflation pressures up to the design pressure are tabulated according to empirical formulae. The ply rating is a measure of the strength of the tire carcass and does not necessarily indicate the actual number of plies.

The tire pairs listed in Table 1 were tested on design width precision rims at the indicated pressures and loads which are near the design values specified for these tires used as singles and duals. The higher rated tire of each pair is generally used as a dual. The 20 in tires that were tested all have the tread pattern shown in Fig. 6B. The tread pattern of the 11.00-22 tires (Fig. 2A) is similar. Table 2 lists the measured mechanical properties and illustrates the differences which may be found in tires which are similar in all respects, except for ply rating.

The differences seen in Table 2 are slight and possibly influenced by tire nonuniformity and/or measurement precision. There is remarkably little change in the properties of the 11.00-22 tires, the largest set tested for differences due to ply rating. The slight increase in test pressure (see Table 1) may be responsible for the increases in vertical spring rate. It is of interest to note that the vertical spring rate measured for the 10.00-20 tire with the G rating was less than that obtained for the F load rating. However, the lateral force generating ability did increase with increased load rating as evidenced by the

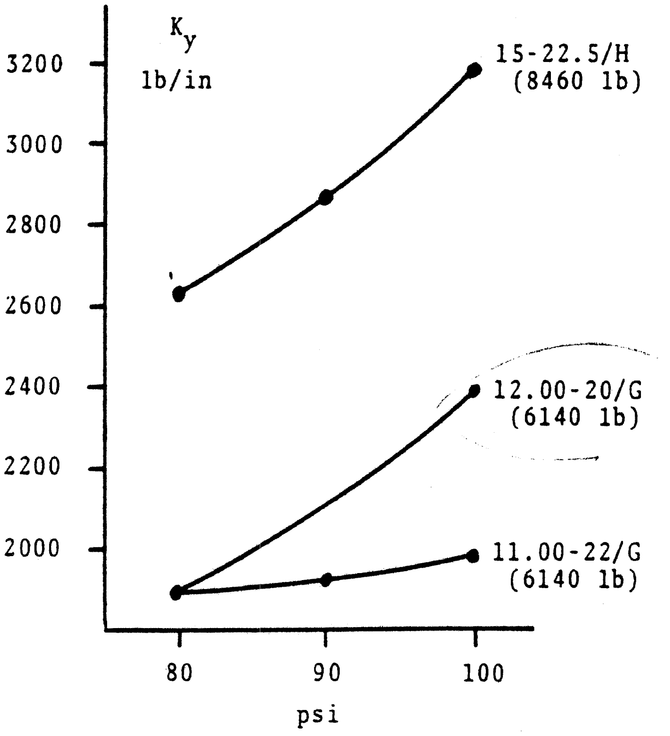


Fig. 4 - Lateral spring rate K_y versus inflation pressure for tires shown in Figs. 2A-2C

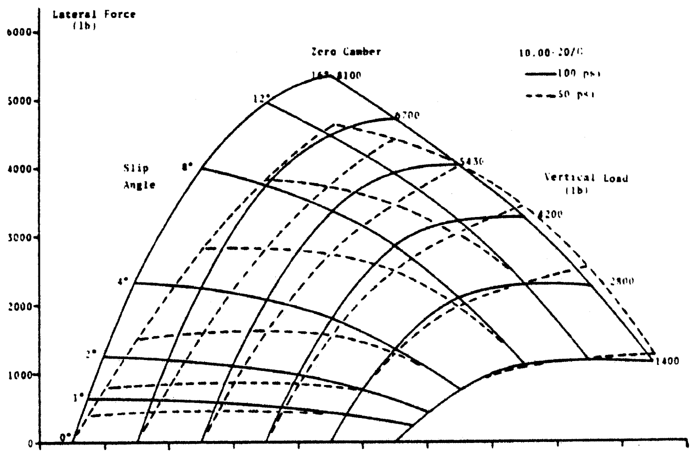
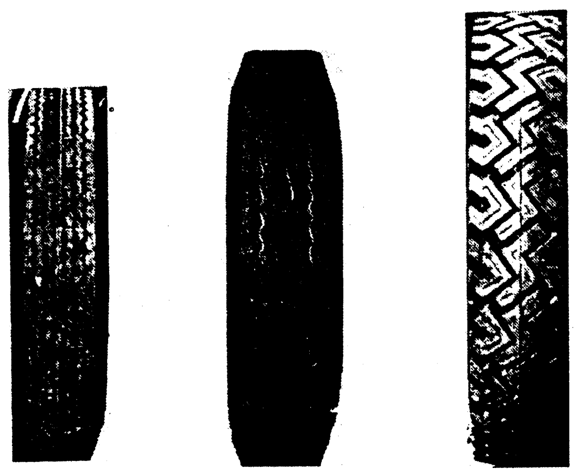


Fig. 5 - Lateral force versus slip angle and vertical load on 10.00-20/G tire at rated pressure (100 psi) and at 50 psi



	(a) Rib-type I	(b) Rib-type II	(c) Open Tread	
C_s	46000	42000	28000	lb/unit slip
[illegible]	508.2	523.4	516.0	lb/deg
[illegible]	56.7	69.0	39.9	lb/deg
K_y	1477	1618	1291	lb/in
K_z	5032	4700	4500	lb/in

Fig. 6 - Measured mechanical properties of 10.00-20/F nylon tire in three tread patterns. A-rib-type I; B-rib-type II; C-open tread

FIRESTONE TRANSPORT 110, 12 x 20/H, BADC ASPHALT

** A-D FILE 197 NEW FILE 79 TEST SAMPLE351 **

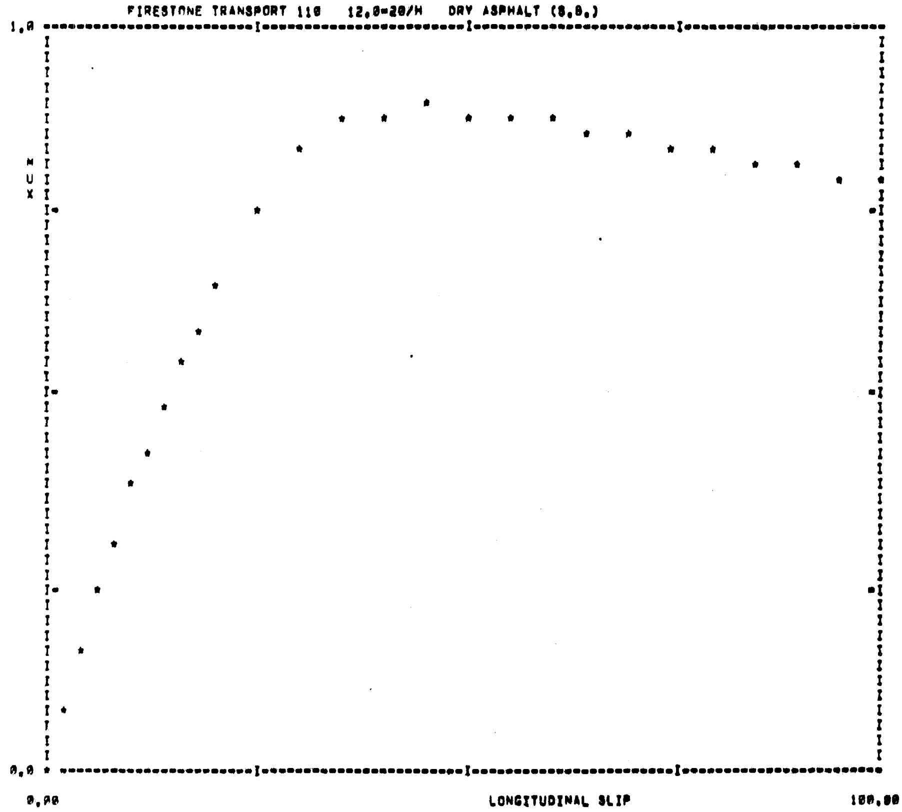
AVERAGE OF FILE 197 FOR 5 RECORDS, FIRESTONE TRANSPORT 110 12,0-20/H DRY ASPHALT (S,B,)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.07	11237.2	596.3
0.04	0.16	24839.6	1256.3
0.06	0.24	38869.9	1927.0
0.08	0.32	51598.8	2526.4
0.10	0.38	62238.1	3025.1
0.12	0.43	70849.9	3432.8
0.14	0.49	79085.9	3841.9
0.16	0.54	88946.3	4293.5
0.18	0.60	98778.9	4753.0
0.20	0.66	107715.9	5156.9
0.25	0.76	123794.7	5918.1
0.30	0.83	135876.7	6451.1
0.35	0.87	143123.2	6744.5
0.40	0.89	145587.9	6841.2
0.45	0.89	145957.2	6846.1
0.50	0.89	145454.7	6809.6
0.55	0.88	144534.0	6752.9
0.60	0.87	143405.9	6686.2
0.65	0.86	142174.4	6614.5
0.70	0.85	140891.1	6548.3
0.75	0.84	139581.9	6464.8
0.80	0.83	138259.9	6388.7
0.85	0.82	136931.4	6312.3
0.90	0.81	135526.3	6233.8
0.95	0.80	133973.5	6151.3
1.00	0.80	132200.0	6063.0

TQAV = 132200.0 LOAD = 7979.2 VEL = 3.0 MPH.

MUPEAK = 0.89 MULOCK = 0.80 RATIO = 1.12

FIRESTONE TRANSPORT 110 12,0-20/H DRY ASPHALT (S,B,)



FZ = 7979.2 VEL = 3.0 MULOCK = 0.80 MUPEAK = 0.89 RATIO = 1.12 A-D FILE 197 NWFILE 79 SAMPLE 351

** A-D FILE 190   NEW FILE 80   TEST SAMPLE352 **

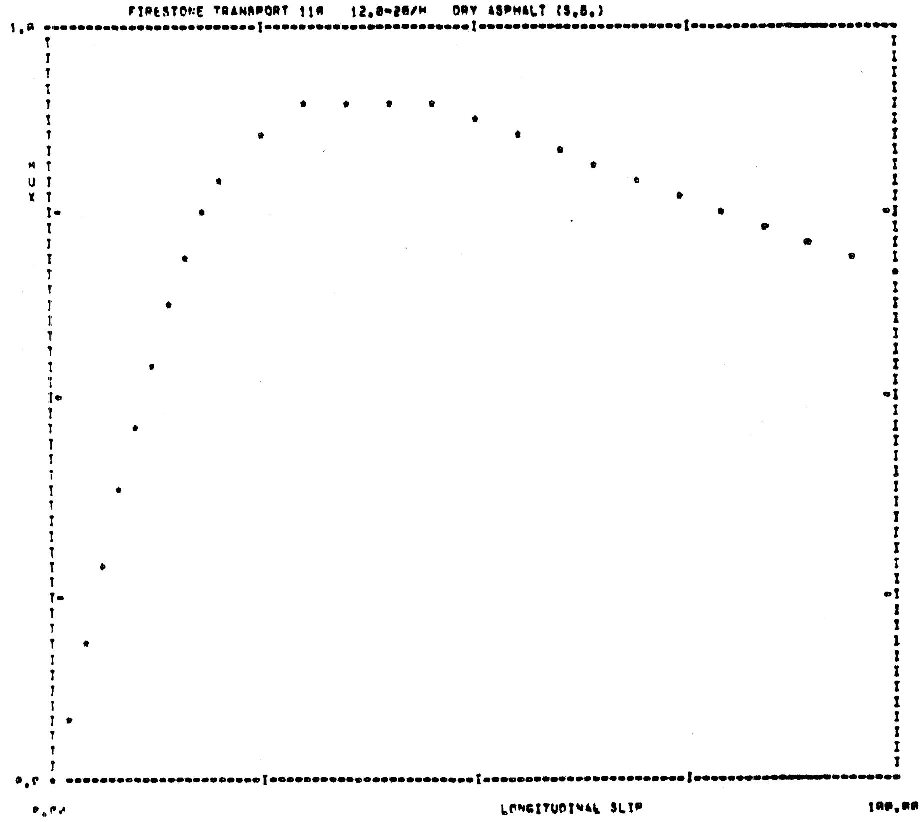
AVERAGE OF FILE 190 FOR 6 RECORDS,   FIRESTONE TRANSPORT 110 12.0-20/M DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.08	11728.0	660.6
0.04	0.18	29336.1	1451.2
0.06	0.29	46317.4	2288.7
0.08	0.38	61297.9	3014.5
0.10	0.46	74758.0	3640.7
0.12	0.54	88173.7	4270.1
0.14	0.63	101970.5	4896.9
0.16	0.70	113377.2	5432.5
0.18	0.76	122321.0	5851.1
0.20	0.80	128815.0	6138.7
0.25	0.86	139583.5	6555.3
0.30	0.89	147439.7	6774.5
0.35	0.90	153064.1	6858.1
0.40	0.90	157100.3	6841.0
0.45	0.90	160012.6	6789.0
0.50	0.89	160713.1	6784.3
0.55	0.87	157877.1	6575.1
0.60	0.85	152455.1	6416.6
0.65	0.83	146797.8	6254.1
0.70	0.81	141337.4	6092.4
0.75	0.78	136007.0	5931.6
0.80	0.76	130744.7	5771.1
0.85	0.74	125516.7	5610.9
0.90	0.72	119917.9	5446.6
0.95	0.69	113540.5	5273.9
1.00	0.67	106828.0	5088.7

TQAV = 106828.0   LOAD = 7974.1   VEL = 10.0 MPH,

MUPEAK = 0.90   MULOCK = 0.67   RATIO = 1.35

FIRESTONE TRANSPORT 110   12.0-20/M   DRY ASPHALT (S.B.)



FZ = 7974.1   VEL = 10.0   MULOCK = 0.67   MUPEAK = 0.90   RATIO = 1.35   A-D FILE 190   NWFILE 80   SAMPLE 352

** A-D FILE 199 NEW FILE 81 TEST SAMPLE353 **

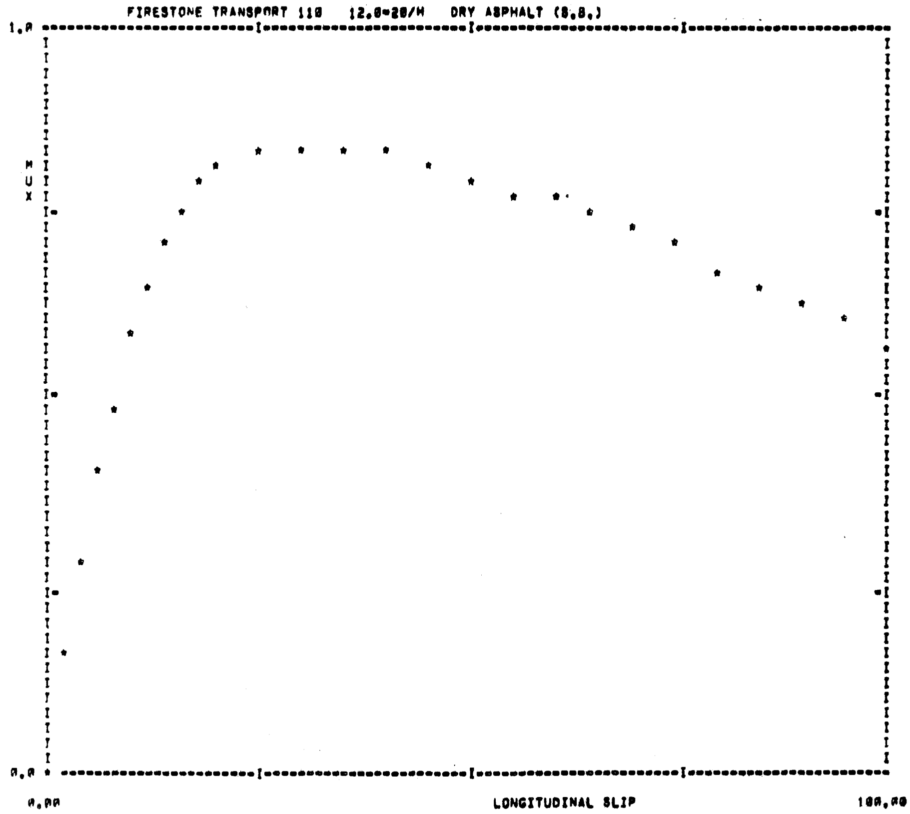
AVERAGE OF FILE 199 FOR 5 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	26770.2	1371.8
0.04	0.29	45870.3	2264.5
0.06	0.40	64262.1	3115.5
0.08	0.50	80629.4	3892.4
0.10	0.59	95020.7	4564.0
0.12	0.66	107400.7	5114.7
0.14	0.72	117485.6	5560.3
0.16	0.76	126179.3	5906.1
0.18	0.80	132870.0	6170.4
0.20	0.82	137498.7	6306.2
0.25	0.84	144545.5	6446.2
0.30	0.85	149215.5	6481.7
0.35	0.85	152305.0	6449.4
0.40	0.84	154675.6	6369.4
0.45	0.82	156809.2	6250.8
0.50	0.81	158807.0	6125.3
0.55	0.79	160725.6	5985.0
0.60	0.77	161841.3	5840.5
0.65	0.75	160935.4	5690.9
0.70	0.73	156733.0	5541.0
0.75	0.71	149864.0	5383.0
0.80	0.68	139219.3	5196.8
0.85	0.66	127952.2	5006.8
0.90	0.63	116430.5	4815.4
0.95	0.61	104172.1	4618.1
1.00	0.58	90775.0	4411.5

TQAV = 90775.0 LOAD = 7003.0 VEL = 20.0 MPH.

MUPEAK = 0.85 MULOCK = 0.58 RATIO = 1.47

FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)



FZ = 7003.0 VEL = 20.0 MULOCK = 0.58 MUPEAK = 0.85 RATIO = 1.47 A-D FILE 199 NWFILE 81 SAMPLE 353

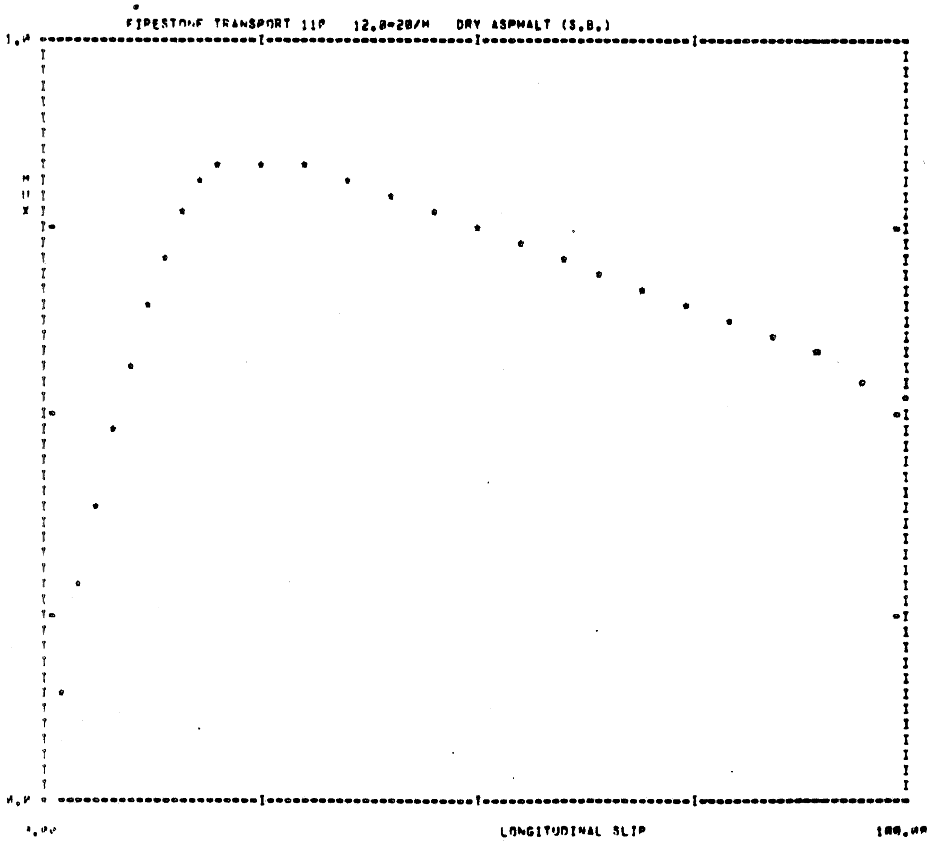
** A-D FILE 203 NEW FILE 02 TEST SAMPLE354 **

AVERAGE OF FILE 203 FOR 6 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/M DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.14	23276.2	1145.9
0.04	0.28	46274.5	2215.2
0.06	0.39	64724.5	3068.4
0.08	0.48	80066.5	3797.0
0.10	0.57	93879.0	4408.3
0.12	0.65	106637.8	5026.7
0.14	0.72	117043.2	5535.5
0.16	0.77	126108.4	5953.1
0.18	0.81	133960.4	6261.7
0.20	0.83	139548.0	6391.4
0.25	0.84	147599.4	6469.7
0.30	0.84	152882.5	6484.1
0.35	0.82	156596.8	6349.7
0.40	0.81	159565.3	6216.9
0.45	0.78	162014.2	6059.2
0.50	0.76	164116.2	5891.1
0.55	0.74	165872.3	5721.6
0.60	0.72	167051.2	5555.2
0.65	0.70	166713.5	5391.0
0.70	0.68	163045.9	5232.8
0.75	0.66	155567.5	5074.8
0.80	0.64	143631.5	4902.4
0.85	0.61	129501.3	4714.0
0.90	0.59	114711.0	4519.7
0.95	0.56	99602.8	4319.3
1.00	0.53	84083.3	4118.0

TQAV = 84083.3 LOAD = 8017.1 VEL = 30.0 MPH.

MUPEAK = 0.84 MULOCK = 0.53 RATIO = 1.58



FZ = 8017.1 VEL = 30.0 MULOCK = 0.53 MUPEAK = 0.84 RATIO = 1.58 A-D FILE 203 NWFILE 02 SAMPLE 354

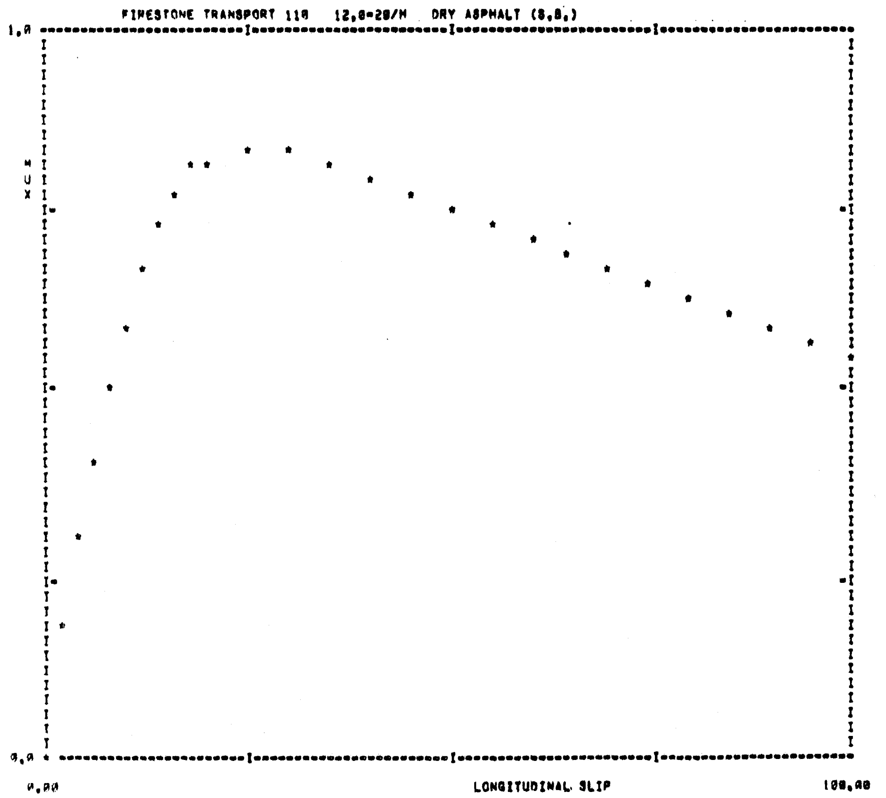
** A-D FILE 200 NEW FILE 83 ; TEST SAMPLE355 **

AVERAGE OF FILE 204 FOR 6 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/M DRY ASPHALT (8.8.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	29067.8	1471.6
0.04	0.30	49303.5	2370.1
0.06	0.41	67724.8	3225.6
0.08	0.51	83858.4	3961.2
0.10	0.60	97988.6	4642.1
0.12	0.67	110911.0	5292.2
0.14	0.73	121493.3	5648.8
0.16	0.78	129704.8	5992.8
0.18	0.81	135868.6	6220.6
0.20	0.83	140184.5	6325.9
0.25	0.84	146753.8	6367.5
0.30	0.83	151562.2	6306.8
0.35	0.82	155315.7	6185.5
0.40	0.80	158451.2	6038.6
0.45	0.78	161105.3	5881.4
0.50	0.76	163264.0	5721.8
0.55	0.74	164979.9	5557.4
0.60	0.72	166263.3	5395.9
0.65	0.70	166886.5	5241.2
0.70	0.68	165752.3	5086.7
0.75	0.66	160927.8	4932.6
0.80	0.63	151237.5	4775.9
0.85	0.61	136563.2	4617.7
0.90	0.59	119596.6	4460.7
0.95	0.57	101998.9	4306.4
1.00	0.55	83812.5	4156.2

TQAV = 83812.5 LOAD = 7928.0 VEL = 40.0 MPH.

MUPEAK = 0.84 MULOCK = 0.55 RATIO = 1.52



FZ = 7928.0 VEL = 40.0 MULOCK = 0.55 MUPEAK = 0.84 RATIO = 1.52 A-D FILE 204 NNFILE 83 SAMPLE 355

** A-D FILE 205 NEW FILE 84 TEST SAMPLE356 **

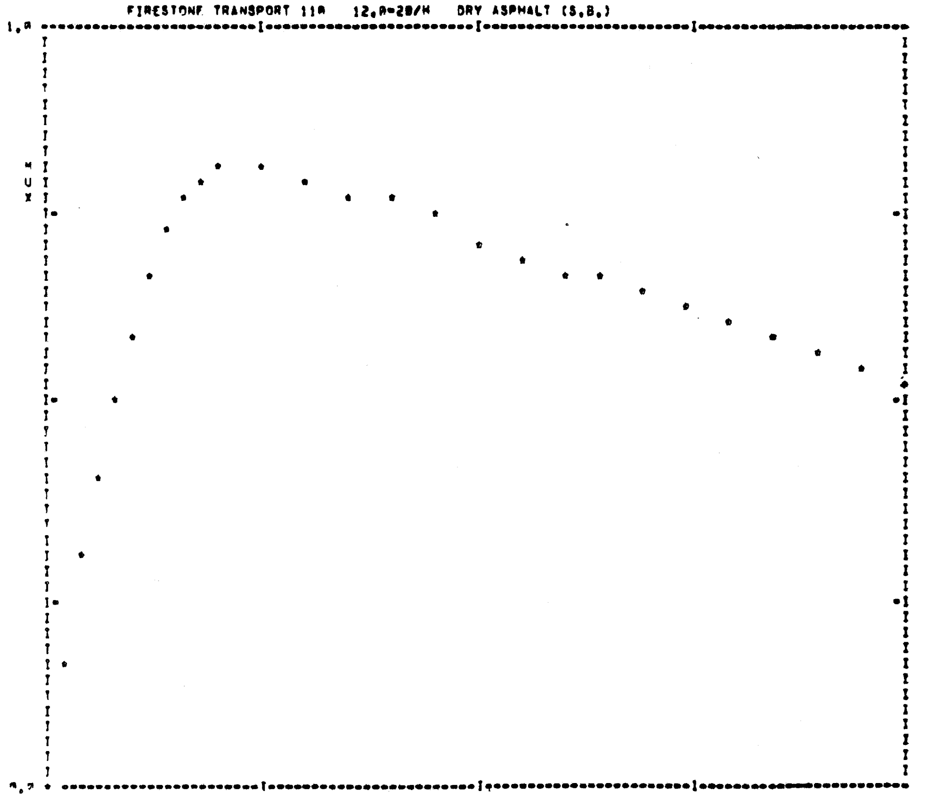
AVERAGE OF FILE 205 FOR 4 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	29941.0	1361.4
0.04	0.30	51355.7	2386.8
0.06	0.41	70582.6	3293.6
0.08	0.52	87711.9	4090.6
0.10	0.60	102439.0	4736.8
0.12	0.67	114160.6	5256.5
0.14	0.73	123446.0	5678.1
0.16	0.77	130723.2	5991.6
0.18	0.80	136022.0	6225.2
0.20	0.81	140145.1	6318.7
0.25	0.81	146692.2	6290.2
0.30	0.80	151196.0	6193.3
0.35	0.79	153843.3	6058.7
0.40	0.77	155851.3	5911.7
0.45	0.75	158158.2	5755.1
0.50	0.73	160850.7	5595.2
0.55	0.70	163621.2	5439.5
0.60	0.68	166258.7	5294.1
0.65	0.67	168423.8	5160.5
0.70	0.65	169757.5	5040.3
0.75	0.63	169284.7	4926.2
0.80	0.62	164218.9	4810.8
0.85	0.60	151333.6	4679.8
0.90	0.58	131418.7	4525.2
0.95	0.56	109491.5	4363.1
1.00	0.54	85968.7	4190.4

TQAV = 85968.7 LOAD = 8041.2 VEL = 55.0 MPH.

MUPEAK = 0.81 MULOCK = 0.54 RATIO = 1.51

FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)



FZ = 8041.2 VEL = 55.0 MULOCK = 0.54 MUPEAK = 0.81 RATIO = 1.51 A-D FILE 205 NFILE 84 SAMPLE 356

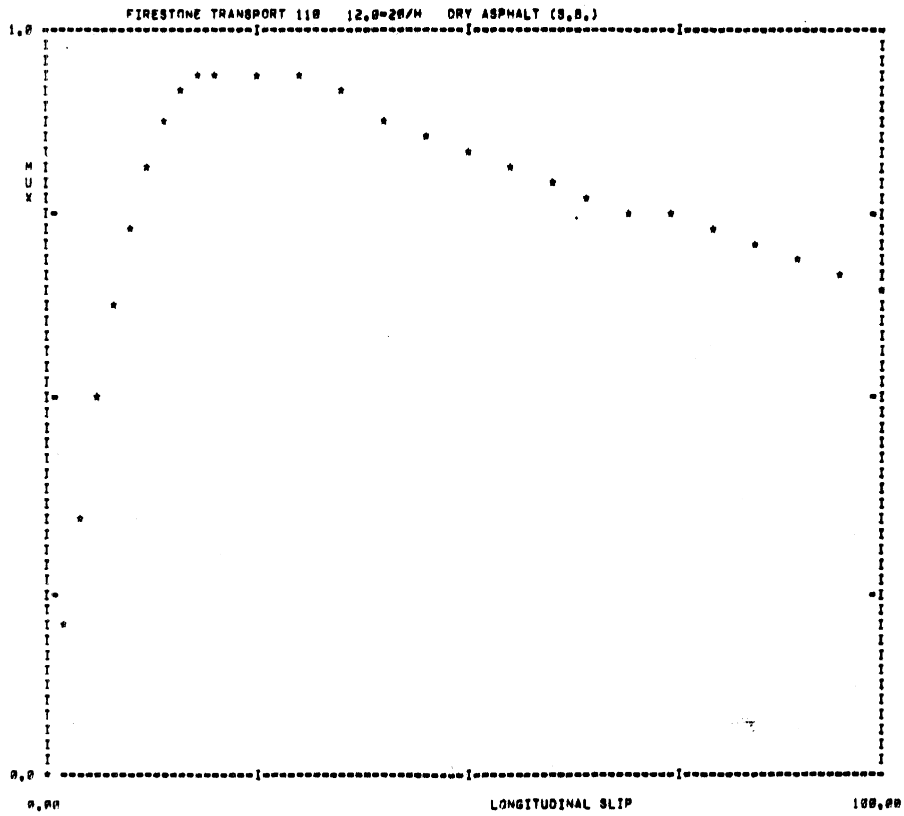
** A-D FILE 210   NEW FILE 86   TEST SAMPLE358 **

AVERAGE OF FILE 210 FOR 5 RECORDS,   FIRESTONE TRANSPORT 110   12.0-20/H   DRY ASPHALT (S.S.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.20	13434.7	647.8
0.04	0.35	23155.6	1111.6
0.06	0.50	34302.3	1610.2
0.08	0.64	44553.0	2044.5
0.10	0.75	52623.1	2397.5
0.12	0.83	58877.4	2656.2
0.14	0.88	64033.7	2822.1
0.16	0.91	68380.2	2919.6
0.18	0.93	71725.2	2972.4
0.20	0.94	74852.3	2982.7
0.25	0.94	78454.8	2957.7
0.30	0.93	81946.9	2909.2
0.35	0.92	84981.4	2841.4
0.40	0.89	87876.0	2760.6
0.45	0.86	90864.5	2678.9
0.50	0.84	94012.9	2597.2
0.55	0.81	97082.8	2520.2
0.60	0.79	99844.8	2449.7
0.65	0.77	102328.0	2386.6
0.70	0.76	103639.4	2339.9
0.75	0.75	101717.7	2297.7
0.80	0.73	94581.6	2253.7
0.85	0.71	83439.6	2208.5
0.90	0.70	69976.9	2144.3
0.95	0.68	55831.5	2086.1
1.00	0.66	41075.0	2025.0

TQAV = 41075.0   LOAD = 3259.7   VEL = 40.0 MPH.

MUPEAK = 0.94   MULOCK = 0.66   RATIO = 1.43



FZ = 3259.7   VEL = 40.0   MULOCK = 0.66   MUPEAK = 0.94   RATIO = 1.43   A-D FILE 210   NWFILE 86   SAMPLE 358

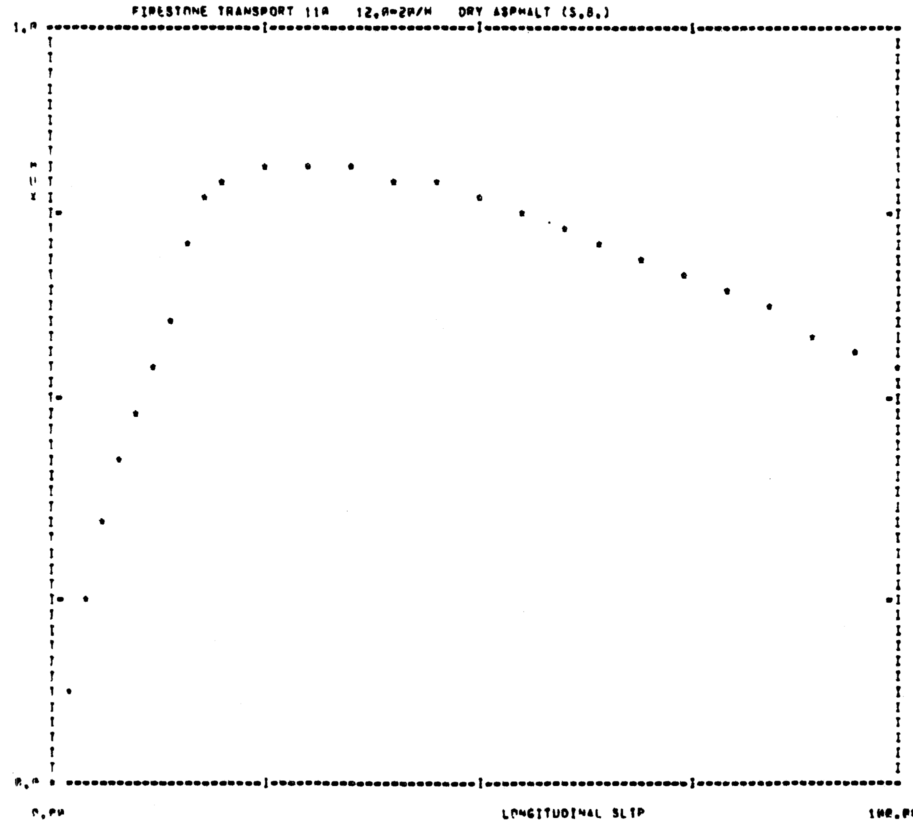
** A-D FILE 211   NEW FILE 87   TEST SAMPLE359 **

AVERAGE OF FILE 211 FOR 5 RECORDS.   FIRESTONE TRANSPORT 110   12.0-20/H   DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.13	21466.5	1074.2
0.04	0.25	40302.8	1956.3
0.06	0.34	55259.7	2682.2
0.08	0.43	68750.4	3337.8
0.10	0.50	80473.1	3879.8
0.12	0.56	90620.9	4323.9
0.14	0.62	101404.7	4808.4
0.16	0.71	116875.4	5497.5
0.18	0.78	120974.6	5983.5
0.20	0.80	135467.0	6150.1
0.25	0.82	146154.6	6245.1
0.30	0.82	153090.9	6229.1
0.35	0.82	159190.4	6160.6
0.40	0.81	163057.5	6062.9
0.45	0.79	165060.1	5951.6
0.50	0.78	168075.7	5823.0
0.55	0.76	170100.0	5677.4
0.60	0.74	171920.0	5528.8
0.65	0.72	172975.7	5362.9
0.70	0.69	171650.2	5203.3
0.75	0.67	166520.0	5044.8
0.80	0.65	156106.9	4890.7
0.85	0.63	140277.1	4730.6
0.90	0.60	122241.5	4569.5
0.95	0.58	103464.7	4406.5
1.00	0.55	83875.8	4240.5

TQAV = 83875.0   LOAD = 7969.1   VEL = 40.0 MPH.

MUPEAK = 0.82   MULOCK = 0.55   RATIO = 1.49



FZ = 7969.1   VEL = 40.0   MULOCK = 0.55   MUPEAK = 0.82   RATIO = 1.49   A-D FILE 211   N-FILE 87   SAMPLE 359

** A-D FILE 212 NEW FILE 88 TEST SAMPLE360 **

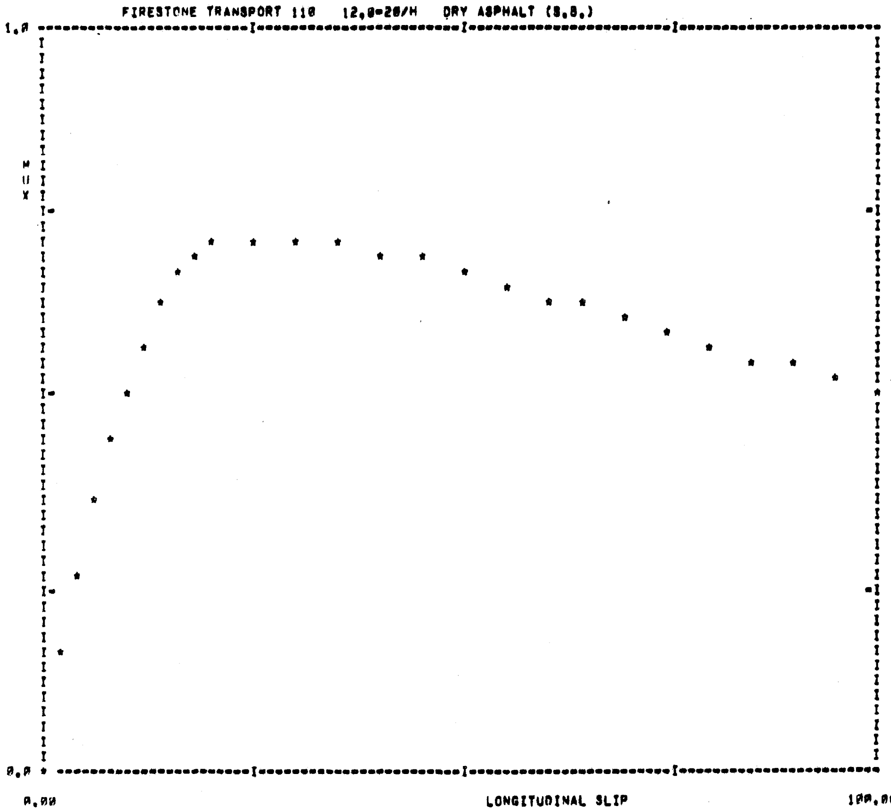
AVERAGE OF FILE 212 FOR 5 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	36648.6	2180.1
0.04	0.27	65108.4	3517.4
0.06	0.36	88930.9	4676.9
0.08	0.44	110728.3	5728.1
0.10	0.52	130920.0	6666.3
0.12	0.58	148928.6	7484.0
0.14	0.63	163082.2	8141.2
0.16	0.67	173037.8	8654.6
0.18	0.70	181594.1	8983.9
0.20	0.71	187205.4	9117.3
0.25	0.72	195996.1	9159.3
0.30	0.72	201941.1	9087.1
0.35	0.71	206182.2	8946.6
0.40	0.70	209489.3	8768.1
0.45	0.69	212424.4	8569.3
0.50	0.67	215072.0	8360.7
0.55	0.66	217254.7	8152.7
0.60	0.64	219019.0	7954.2
0.65	0.62	219579.7	7771.8
0.70	0.61	217204.7	7597.1
0.75	0.60	210324.7	7421.9
0.80	0.58	197365.1	7233.3
0.85	0.56	179209.3	7026.9
0.90	0.54	159488.3	6814.7
0.95	0.52	139291.8	6598.9
1.00	0.50	118550.0	6378.0

TQAV = 118550.0 LOAD = 13159.9 VEL = 40.0 MPH.

MUPEAK = 0.72 MULOCK = 0.50 RATIO = 1.43

FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)



FZ = 13159.9 VEL = 40.0 MULOCK = 0.50 MUPEAK = 0.72 RATIO = 1.43 A-D FILE 212 NNFILE 88 SAMPLE 360

** A-D FILE 196 NEW FILE 78 TEST SAMPLE350 **

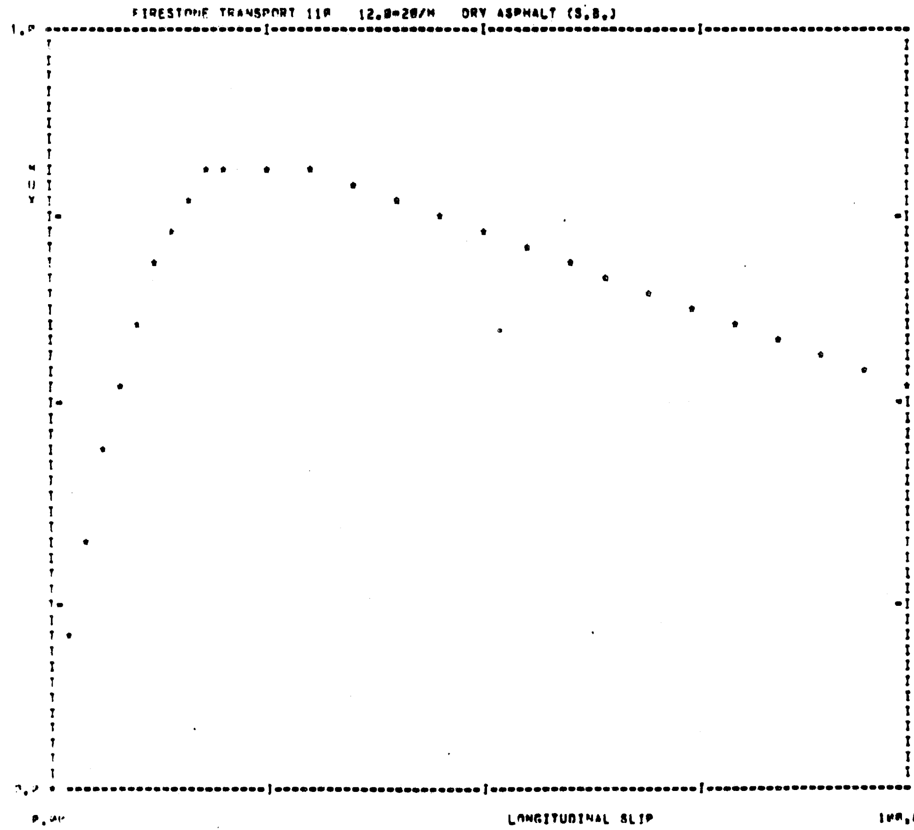
AVERAGE OF FILE 196 FOR 6 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	33862.7	1714.8
0.04	0.33	50437.1	2707.6
0.06	0.44	72406.7	3553.8
0.08	0.54	88116.8	4267.8
0.10	0.62	102333.5	4987.6
0.12	0.69	114265.6	5447.6
0.14	0.75	123184.0	5888.0
0.16	0.79	131154.7	6206.8
0.18	0.81	137084.0	6420.1
0.20	0.83	140983.2	6499.9
0.25	0.83	146294.1	6474.4
0.30	0.82	150631.7	6359.5
0.35	0.80	154020.3	6205.2
0.40	0.76	156549.6	6041.2
0.45	0.76	158252.0	5881.2
0.50	0.74	159398.9	5725.2
0.55	0.72	160252.3	5567.8
0.60	0.70	160953.4	5410.6
0.65	0.68	161547.3	5260.7
0.70	0.66	161089.6	5113.6
0.75	0.64	159281.4	4969.2
0.80	0.62	151648.0	4829.9
0.85	0.60	138069.5	4691.1
0.90	0.58	121255.8	4541.0
0.95	0.56	103231.0	4386.4
1.00	0.54	83895.8	4227.5

TDAV = 83895.8 LOAD = 8048.2 VEL = 40.0 MPH.

MUPEAK = 0.83 MULOCK = 0.54 RATIO = 1.54

Check Run #1



FZ = 8048.2 VEL = 40.0 MULOCK = 0.54 MUPEAK = 0.83 RATIO = 1.54 A-D FILE 196 NWFILE 78 SAMPLE 350

** A-D FILE 206 NEW FILE 85 TEST SAMPLE357 **

AVERAGE OF FILE 206 FOR 6 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

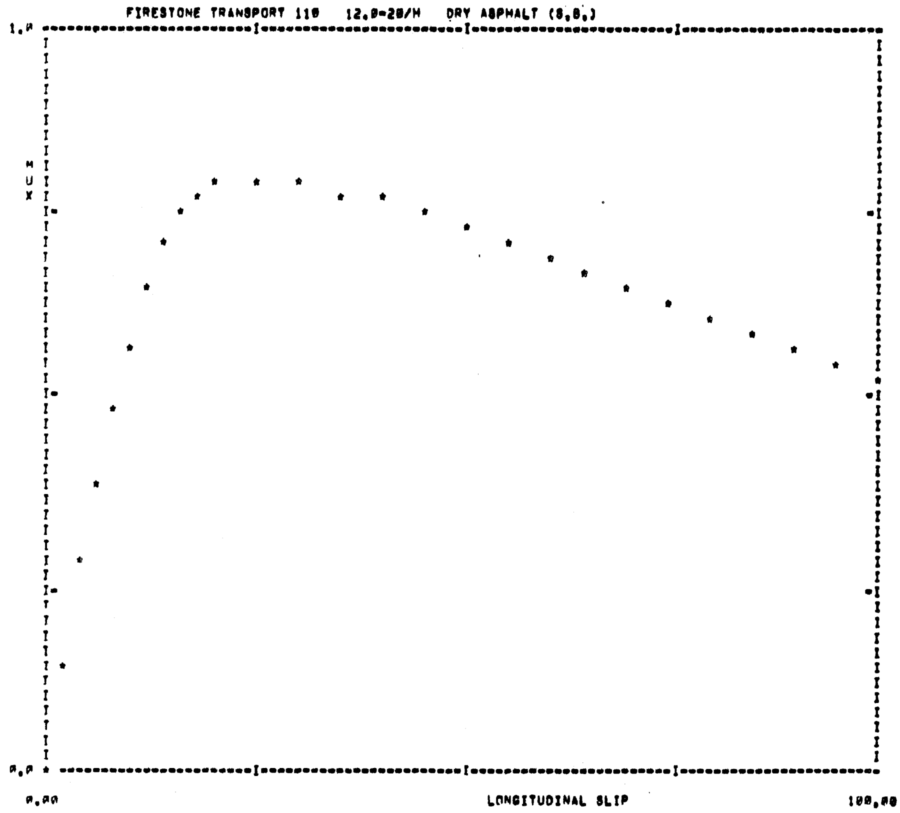
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.15	26801.7	1237.0
0.04	0.28	48451.8	2238.5
0.06	0.39	66594.2	3073.5
0.08	0.49	82933.5	3852.3
0.10	0.58	97394.7	4528.9
0.12	0.66	109900.6	5081.1
0.14	0.71	119756.4	5494.4
0.16	0.75	127433.9	5783.7
0.18	0.78	133494.6	5968.5
0.20	0.79	137785.3	6045.0
0.25	0.80	144612.4	6075.8
0.30	0.80	149464.1	6032.6
0.35	0.79	153130.0	5937.3
0.40	0.77	156236.7	5810.2
0.45	0.75	159047.0	5662.8
0.50	0.73	161373.9	5511.5
0.55	0.71	163334.6	5359.4
0.60	0.69	164824.6	5210.8
0.65	0.67	165513.2	5076.3
0.70	0.65	164921.0	4948.9
0.75	0.64	160606.3	4825.1
0.80	0.62	150788.8	4694.9
0.85	0.60	136789.2	4554.9
0.90	0.58	120554.1	4406.2
0.95	0.56	103409.9	4253.8
1.00	0.54	85250.0	4097.5

TQAV = 85250.0 LOAD = 7959.2 VEL = 40.0 MPH.

MUPEAK = 0.80 MULOCK = 0.54 RATIO = 1.50

Check Run #3

FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)



FZ = 7959.2 VEL = 40.0 MULOCK = 0.54 MUPEAK = 0.80 RATIO = 1.50 A-D FILE 206 NWFILE 85 SAMPLE 357

** A-D FILE 213 NEW FILE 09 TEST SAMPLE361 **

AVERAGE OF FILE 213 FOR 6 RECORDS. FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

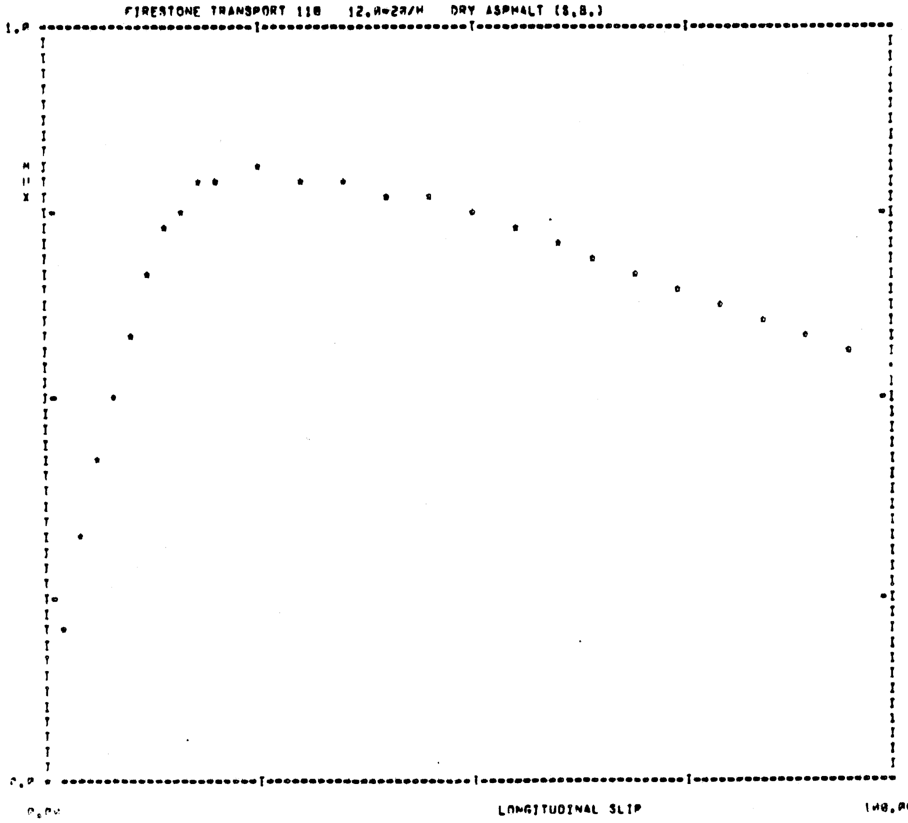
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	31294.5	1743.2
0.04	0.32	51111.7	2677.4
0.06	0.43	69072.3	3531.6
0.08	0.52	85240.0	4275.1
0.10	0.60	99637.2	4934.9
0.12	0.67	112924.4	5531.0
0.14	0.73	123629.0	5987.7
0.16	0.77	131423.1	6291.4
0.18	0.79	137056.8	6486.9
0.20	0.81	140971.4	6566.7
0.25	0.81	148391.0	6561.4
0.30	0.81	154166.7	6474.9
0.35	0.80	158642.7	6353.3
0.40	0.78	162223.3	6217.9
0.45	0.77	165117.1	6079.2
0.50	0.75	167037.4	5931.3
0.55	0.73	170320.8	5779.1
0.60	0.71	172461.1	5631.4
0.65	0.69	173710.1	5491.4
0.70	0.68	172814.0	5351.6
0.75	0.66	168000.1	5215.7
0.80	0.64	157117.6	5080.6
0.85	0.62	141156.3	4948.2
0.90	0.60	122037.1	4782.2
0.95	0.58	103977.9	4617.8
1.00	0.55	84708.3	4447.5

TQAV = 84708.3 LOAD = 8346.1 VEL = 40.0 MPH.

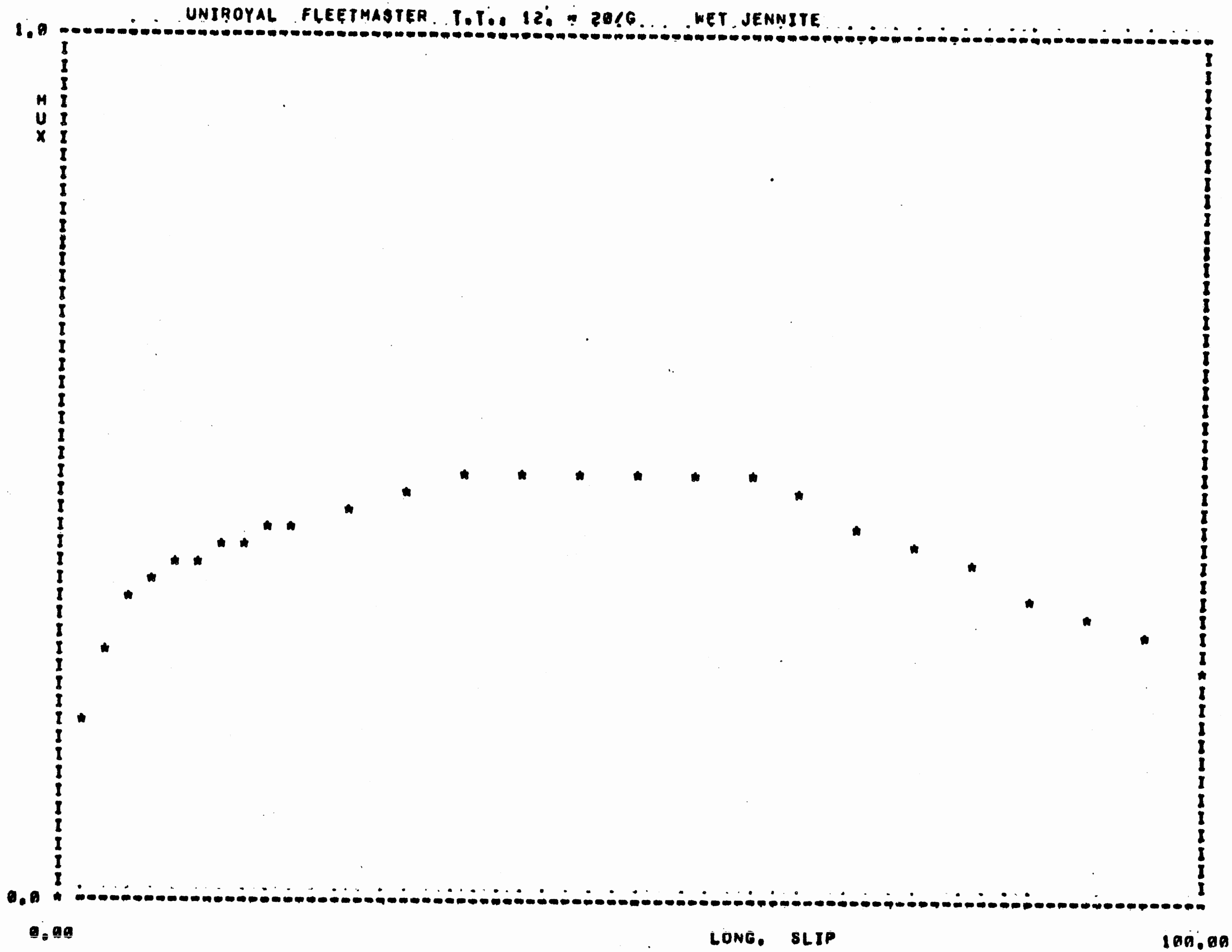
MUPEAK = 0.81 MULOCK = 0.55 RATIO = 1.47

Check Run #5

FIRESTONE TRANSPORT 110 12.0-20/H DRY ASPHALT (S.B.)

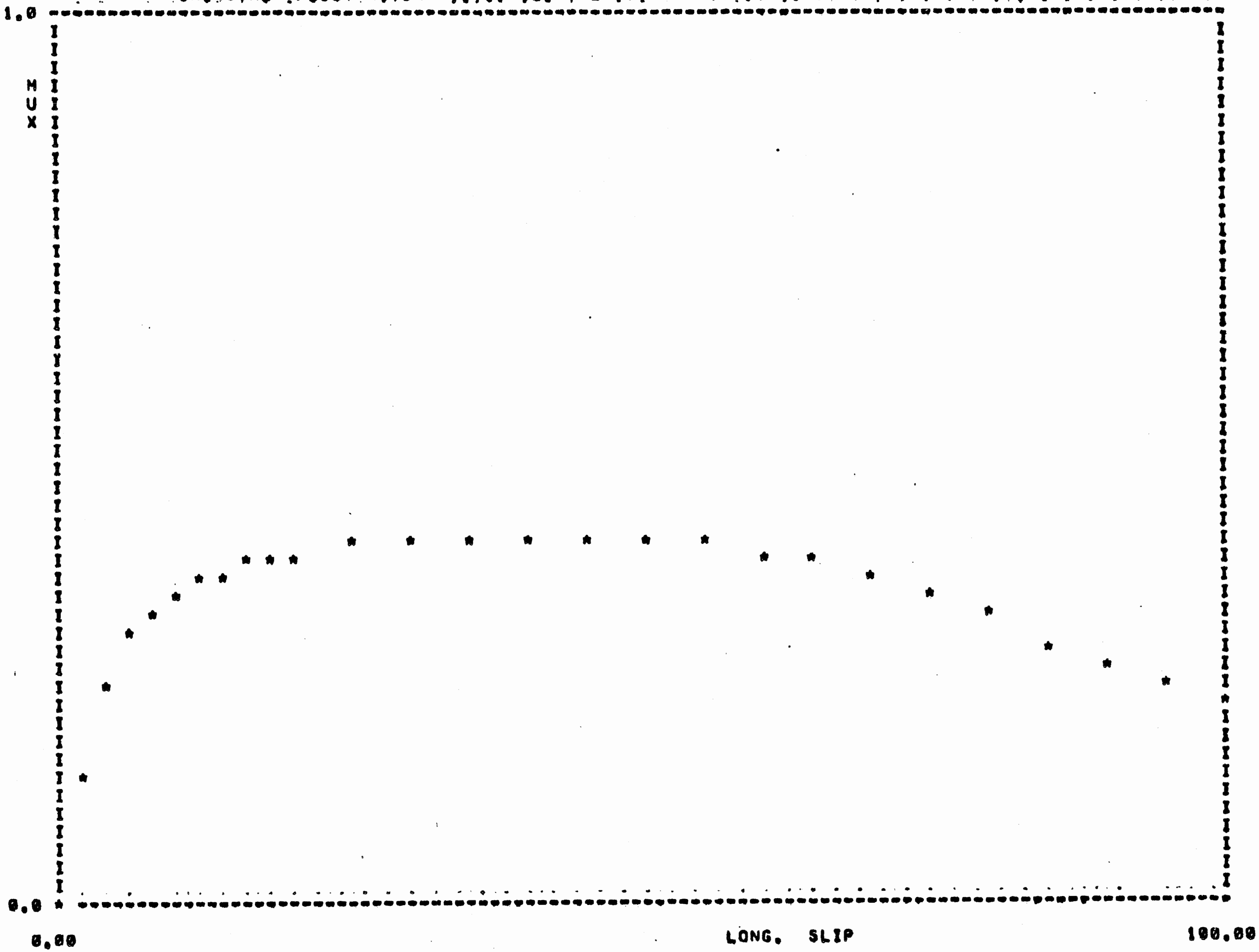


FZ = 8346.1 VEL = 40.0 MULOCK = 0.55 MUPEAK = 0.81 RATIO = 1.47 A-D FILE 213 NWFILE 09 SAMPLE 361



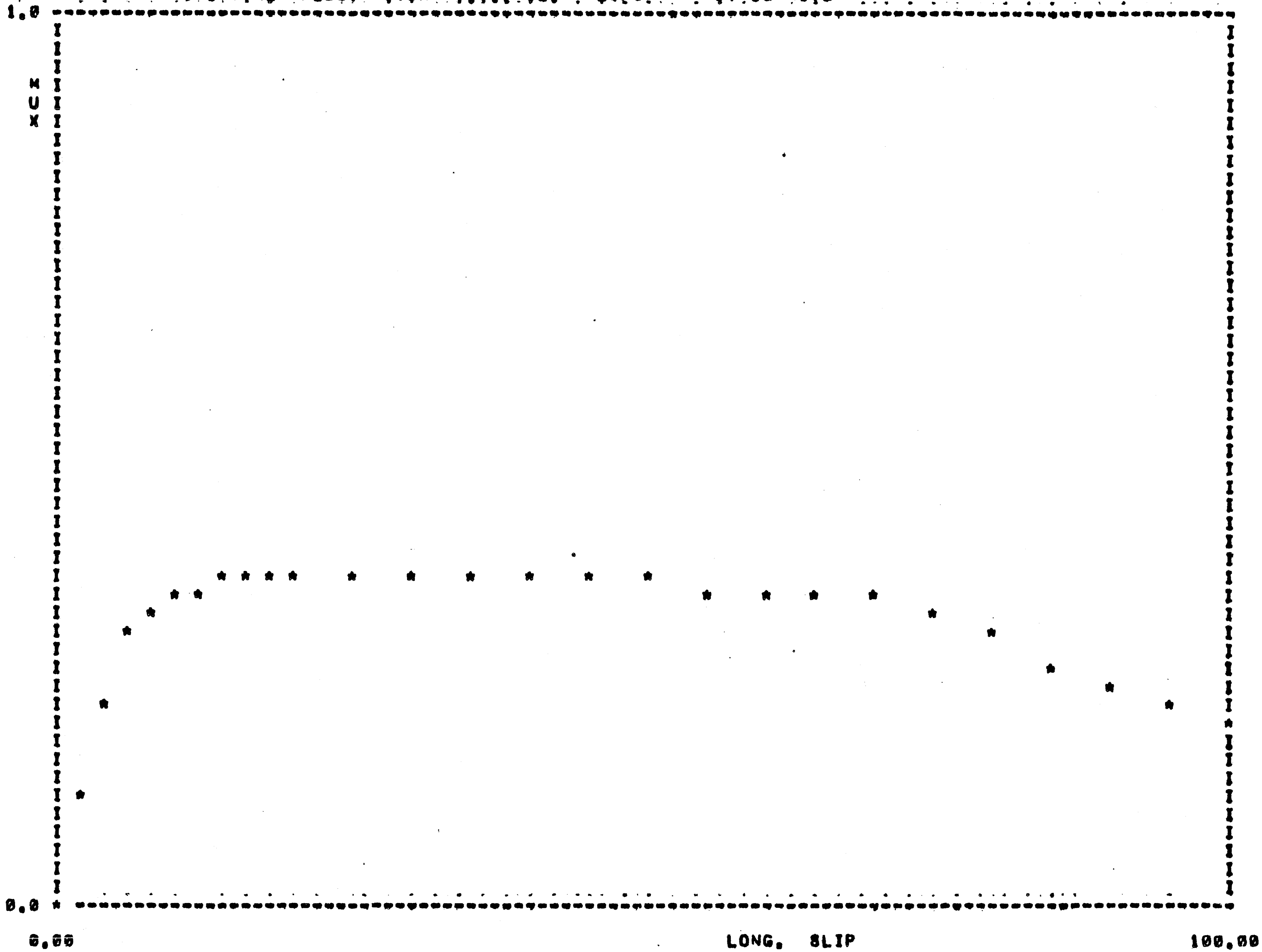
FZ = 3820.8 VEL = 20.0 MULOCK = 0.27 MUPEAK = 0.49 RATIO = 1.86

UNIROYAL FLEETMASTER T.T., 12. - 20/G. WET JENNITE

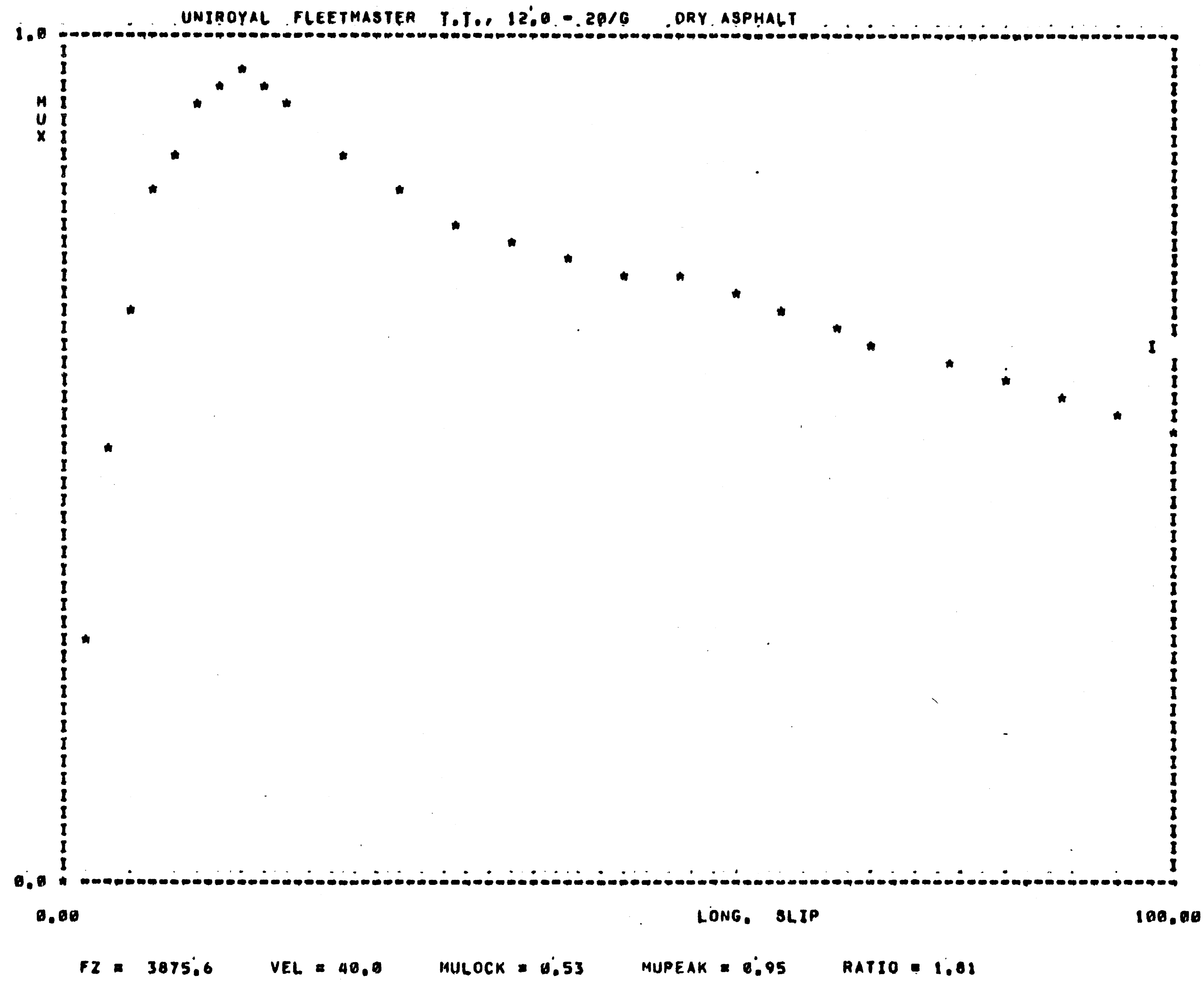


FZ = 7359.7 VEL = 20.0 MULOCK = 0.23 MUPEAK = 0.42 RATIO = 1.85

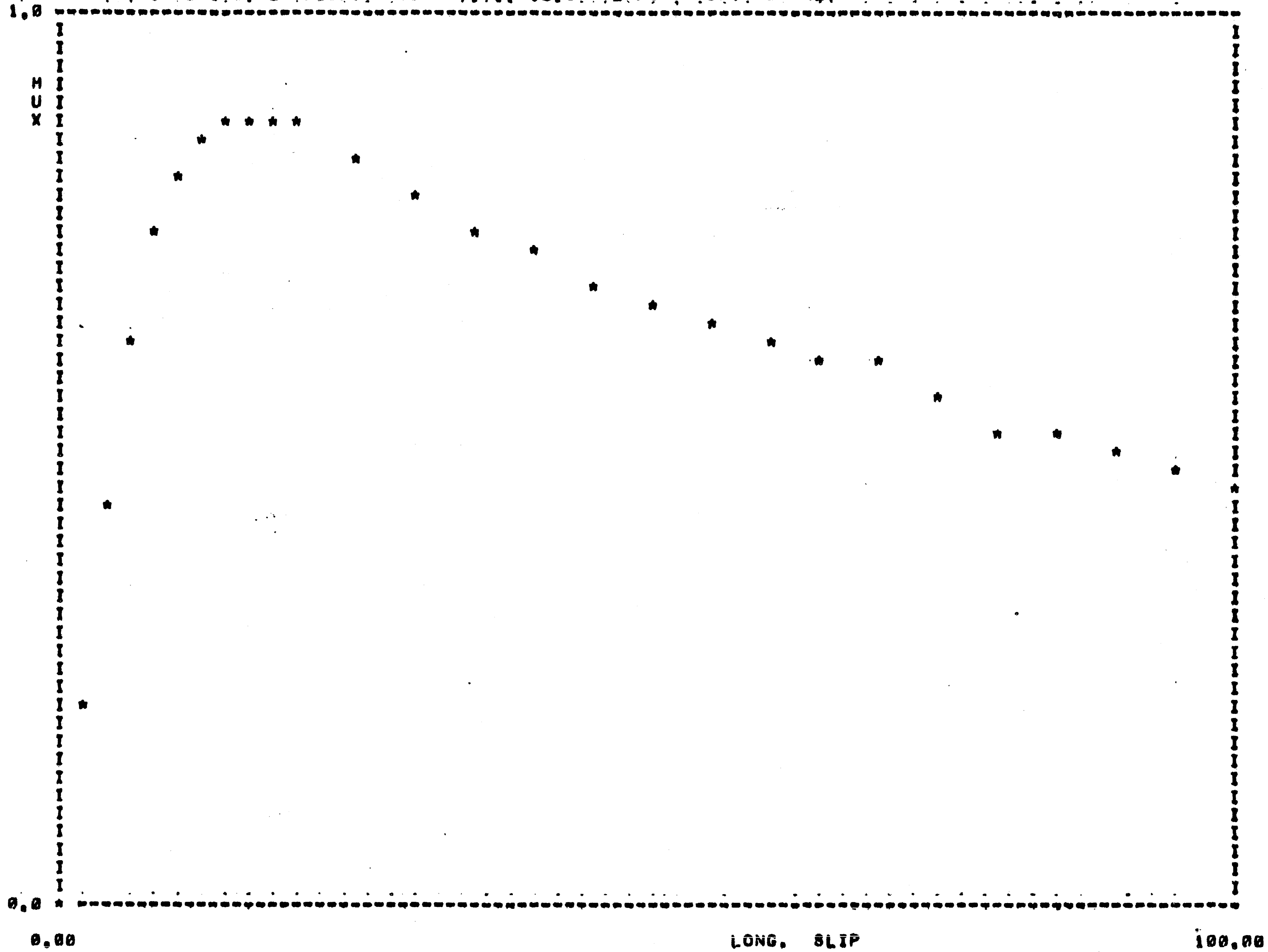
UNIROYAL FLEETMASTER T.T.: 12. = 20/G. WET JENNITE



FZ = 11246.5 VEL = 20.0 MULOCK = 0.20 MUPEAK = 0.37 RATIO = 1.86

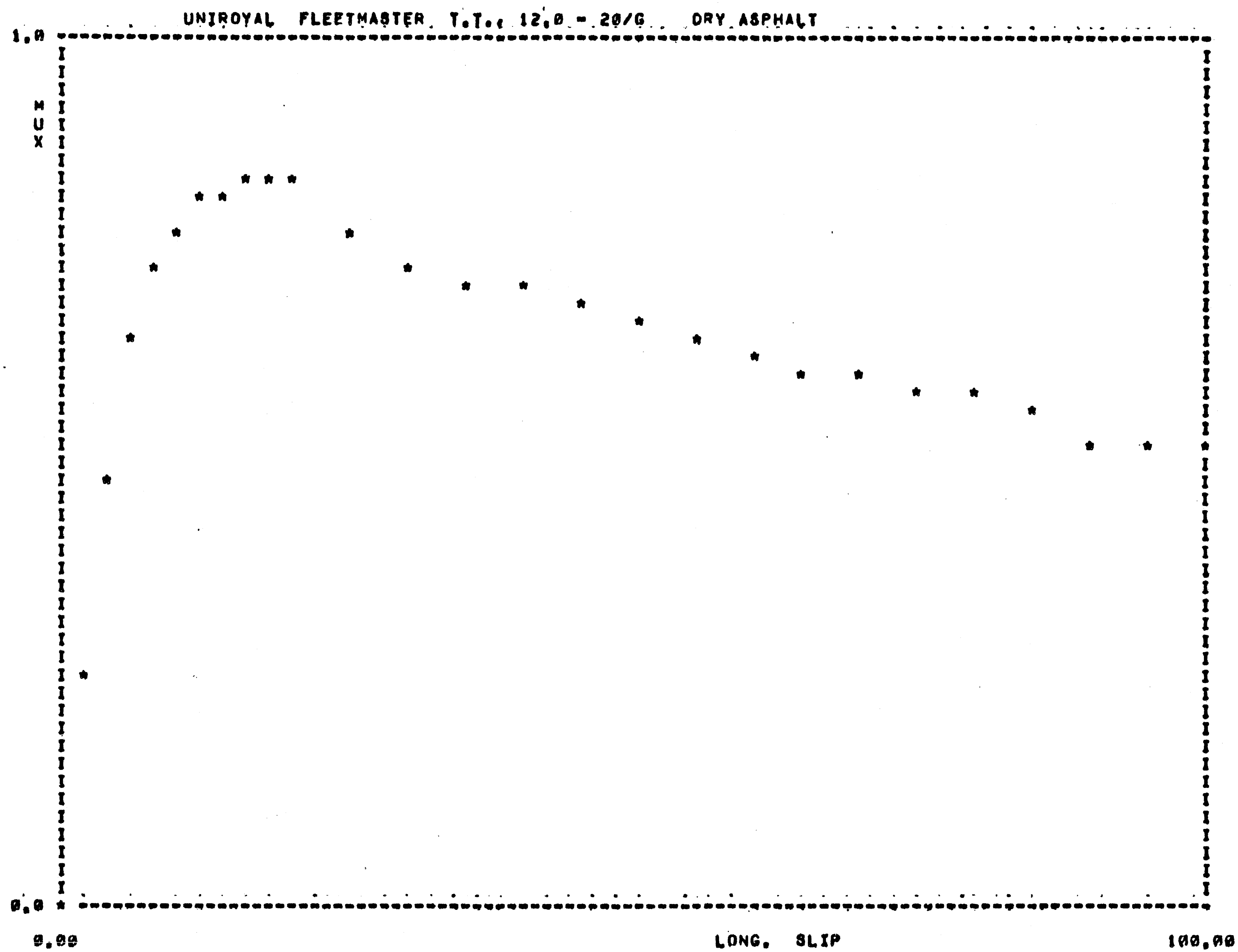

UNIROYAL FLEETMASTER T.T., 12.0 - 20/G DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 3875.6 VEL = 40.0 MULOCK = 0.53 MUPEAK = 0.95 RATIO = 1.81

UNIROYAL FLEETMASTER T.T., 12.0 - 20/G , DRY ASPHALT

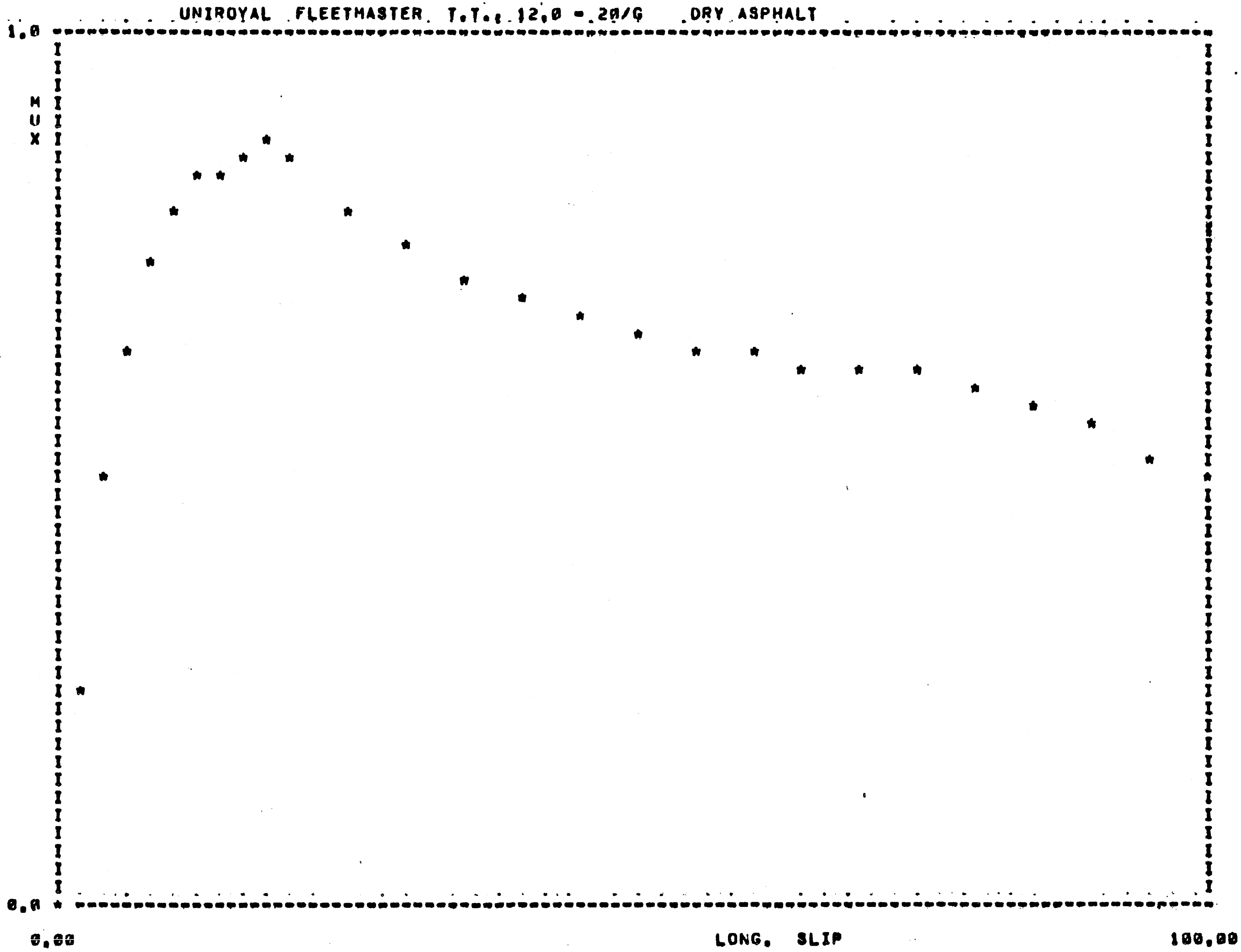


FZ = 5544.3 VEL = 40.0 MULOCK = 0.48 MUPEAK = 0.88 RATIO = 1.84

6



FZ = 3859.7 VEL = 60.0 MULOCK = 0.53 MUPEAK = 0.84 RATIO = 1.58



FZ = 5529.9 VEL = 60.0 MULOCK = .49 MUPEAK = .87 RATIO = 1.78

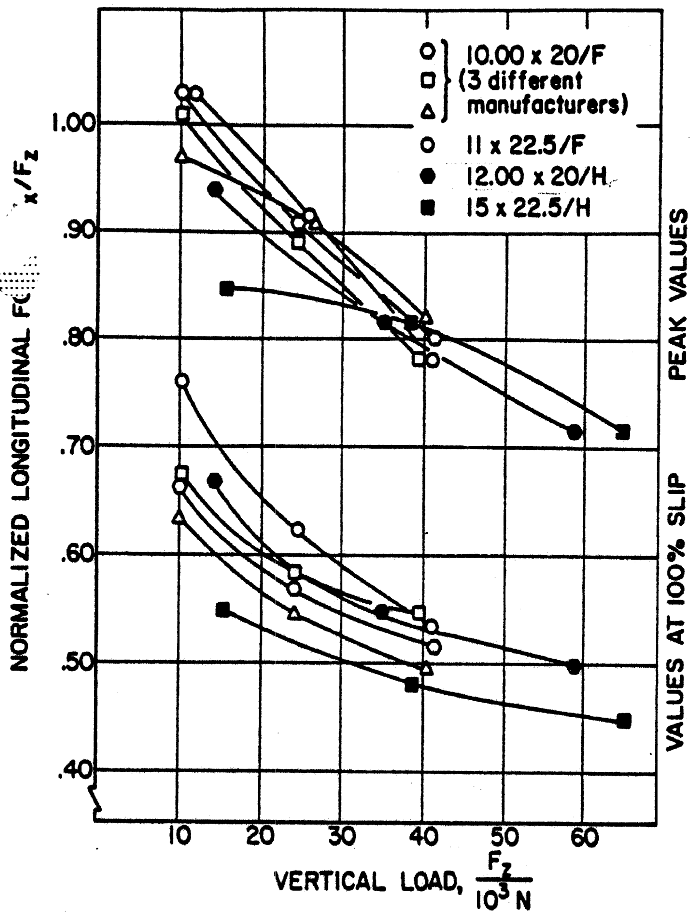


Fig. 3: Load sensitivity in the peak and slide traction of a six-tire sample on dry asphalt. All tests run at 64 km/h.

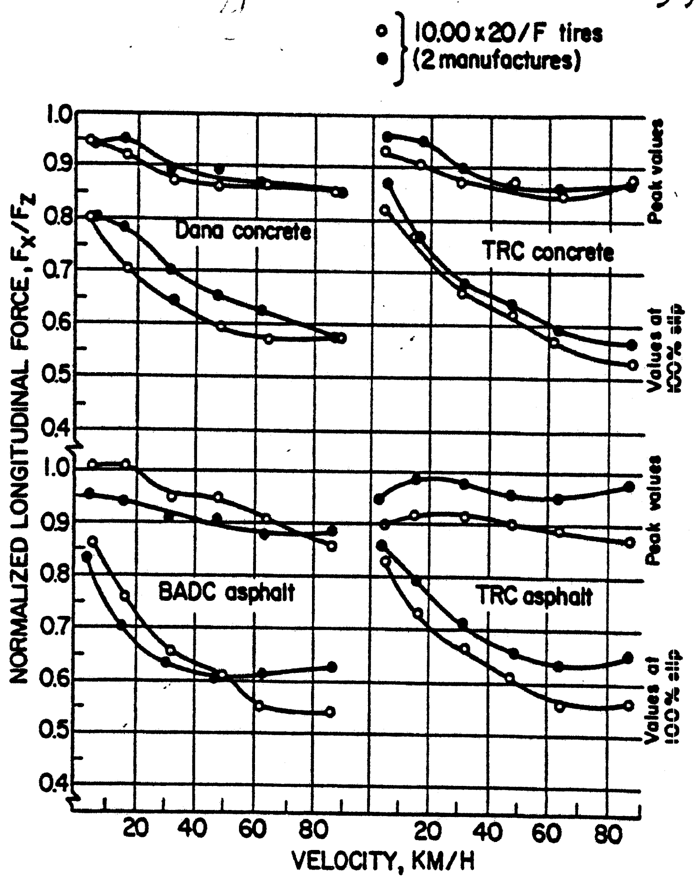


Fig. 5: The differing influence of pavement surface on the velocity sensitivities of two tires.

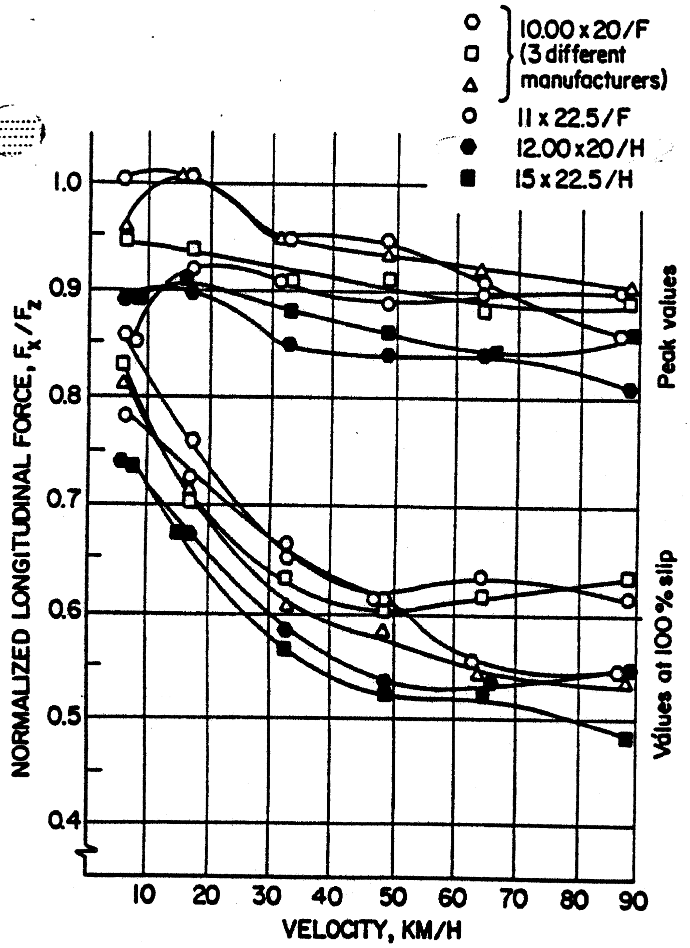


Fig. 4: Velocity sensitivity of the peak and slide traction values for a six-tire sample on dry asphalt. All tires operated at their respective T & RA rated load.

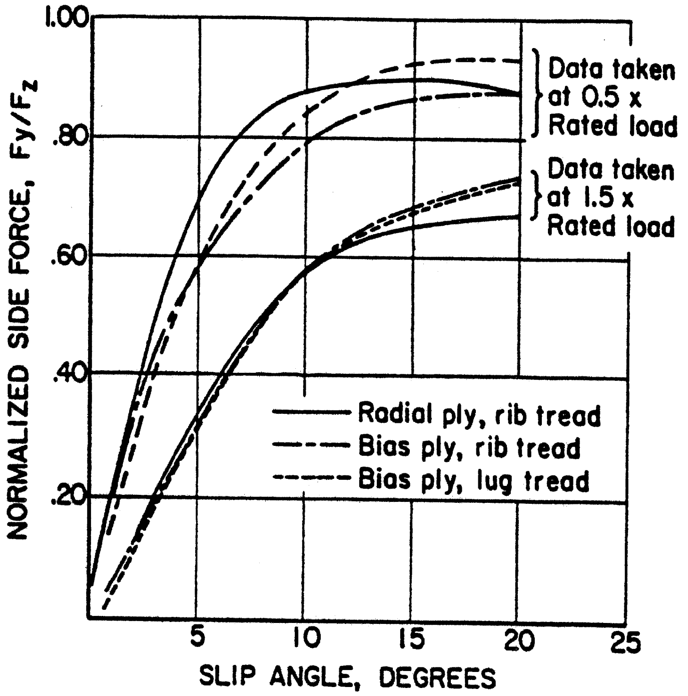


Fig. 6: Typical load sensitivities in the side force response of a sample of 10.00 x 20 tires tested at 32 km/h on a dry concrete surface.

Tire: Highway Tread 12-20/G Rim: 20x8.50

LATERAL FORCE vs. SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	80	391	741	1245	1746	2047	2189
4200	80	590	1144	2041	3063	3681	4002(?)
6140	80	701	1343	2438	3846	4763	5292
8200	80	721	1417	2671	4414	5675	6472
9900	80	729	1440	2672	4695	6195	7197

ALIGNING TORQUE vs. SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2100	80	48	82	104	76	42	16
4200	80	114	203	292	261	177	101
6140	80	170	309	471	467	338	204
8200	80	224	422	659	713	559	369
9900	80	272	512	795	930	770	528

CIRCUMFERENTIAL STIFFNESS vs. SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
2100	80	23,000	
6140	80	60,000	4800
9900	80	74,000	

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

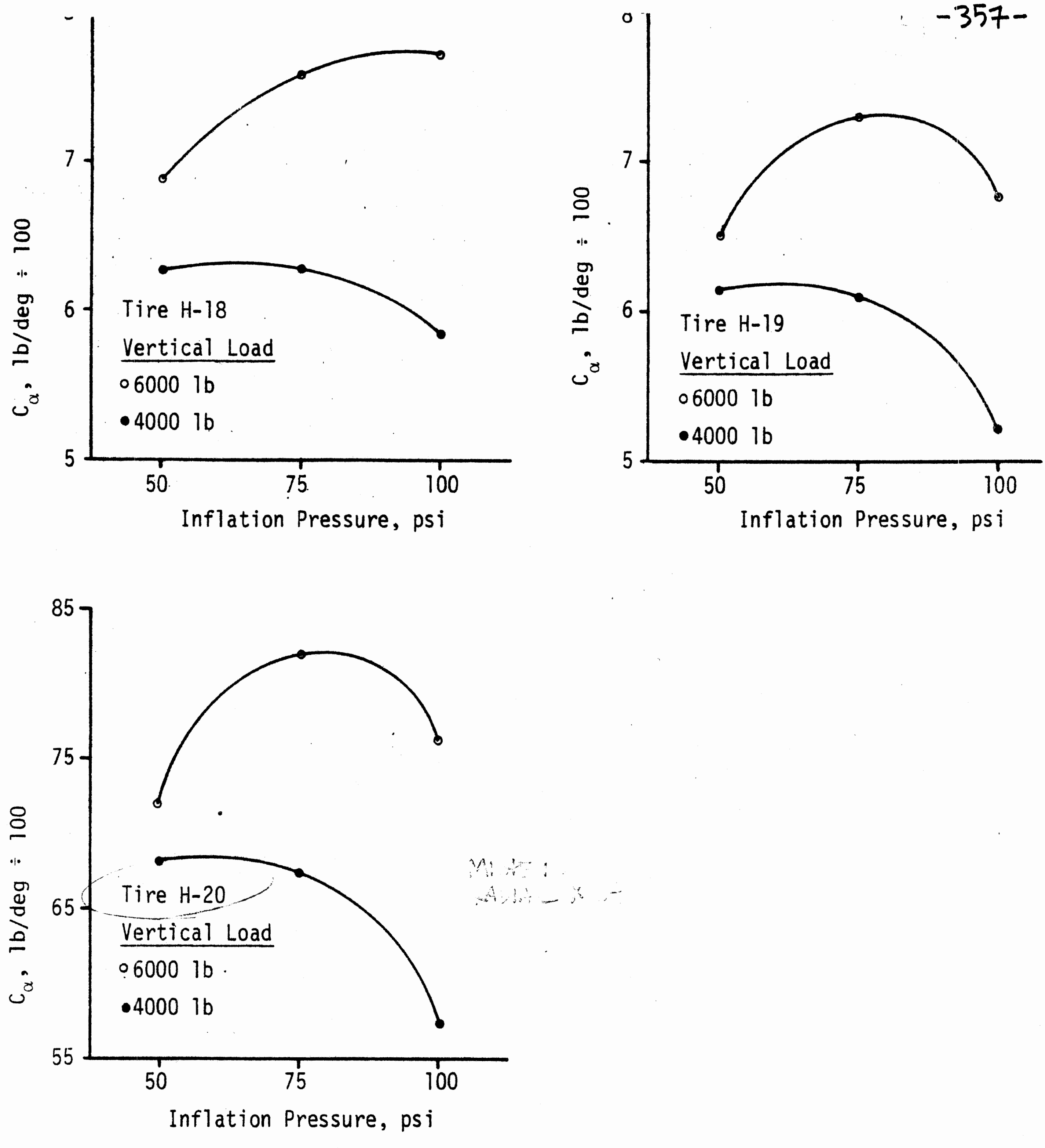


Figure 3.12 The effects of inflation pressure on cornering stiffness: heavy bus tires (cont.).

The data presented in these figures are remarkable in that they indicate that inflation pressure may have a profound effect, quantitatively and qualitatively, on the C_α behavior of these heavy tires. The heavy truck tires (H-1 through H-11) show an increase in C_α with inflation pressure when the tire is operated at the higher load (except for H-9, the wide base tire). At the lower load, behavior is mixed: C_α may rise, fall, or remain quite constant with inflation pressure. For the bus tires (H-12 through H-20) behavior is mixed at both loads. Despite this mix in behavior, it is universally true in this sample of heavy tires that at the higher inflation pressure, C_α is higher at the higher load. However, at reduced inflation pressure, the increase of C_α with load tends to reduce sharply, and, in many cases, at lower inflation pressure, C_α may actually fall with increasing load.

Figure 3.13 is a similar plot for the two light truck tires tested at reduced inflation pressures. At all but one point, C_α is seen to increase with decreasing inflation pressure. For tire L-1, the load sensitivity of C_α is rather independent of inflation pressure, but for L-2, this sensitivity decreases with inflation pressure.

The broad significance of the inflation sensitivity measurements is that light and heavy tires follow no simple rule in their cornering stiffness response to inflation pressure. In marked contrast to the case of passenger car tires, one must be cautious in applying "rules of thumb" relating cornering stiffness dependence upon inflation to the achievement of desirable vehicle understeer quality.

3.2 Mobile Tire Test Findings

3.2.1 Longitudinal Traction - Mobile Measurements. Dry pavement measurements of longitudinal traction performance were conducted on a sample of eight heavy truck tires. These data indicate traction properties which confirm and complement those reported earlier [8, 9]. The data were reduced to so-called

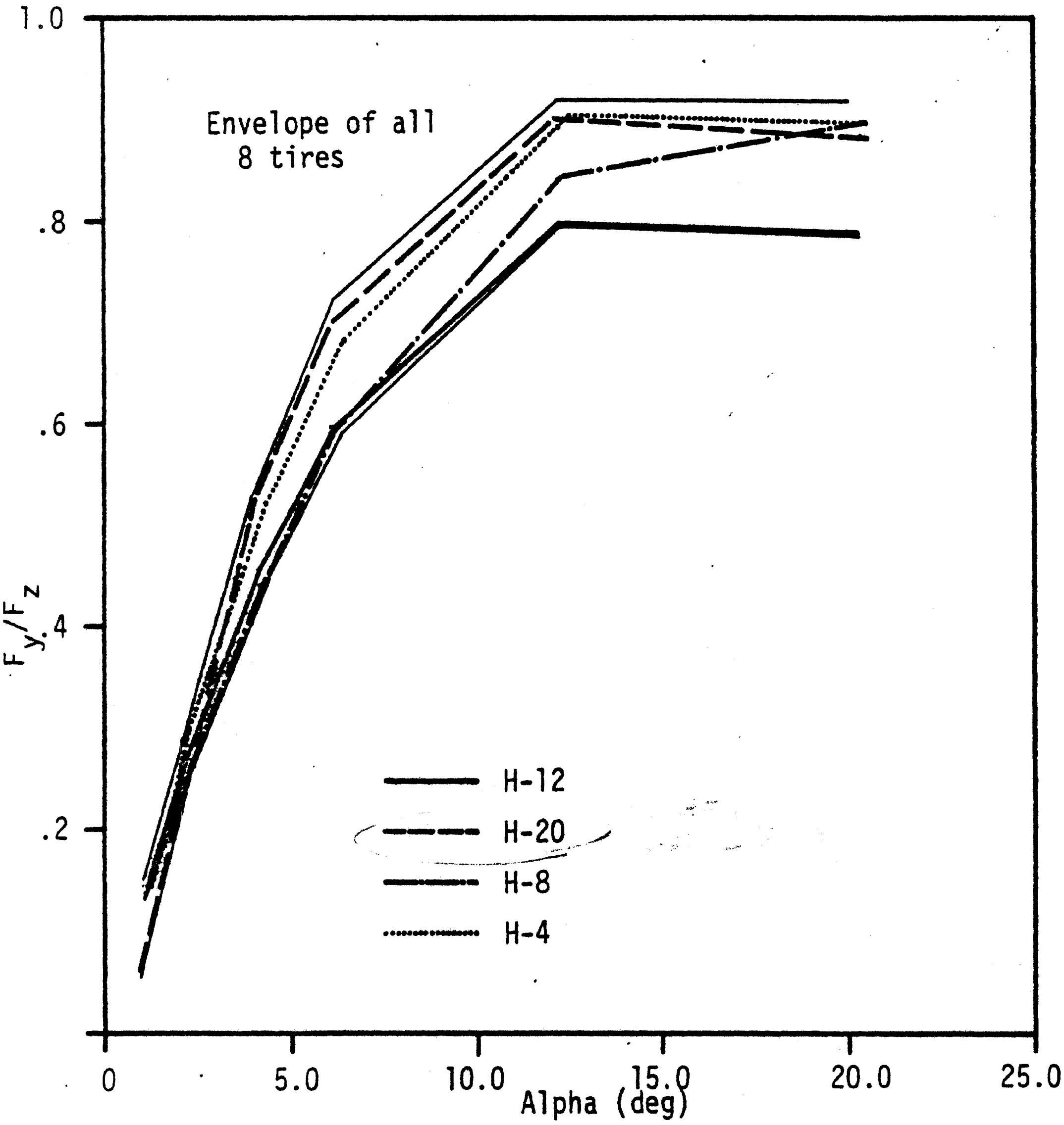


Figure 3.24. Lateral force measurements of heavy truck and bus tires at 20 mph and 0.5 x rated load.

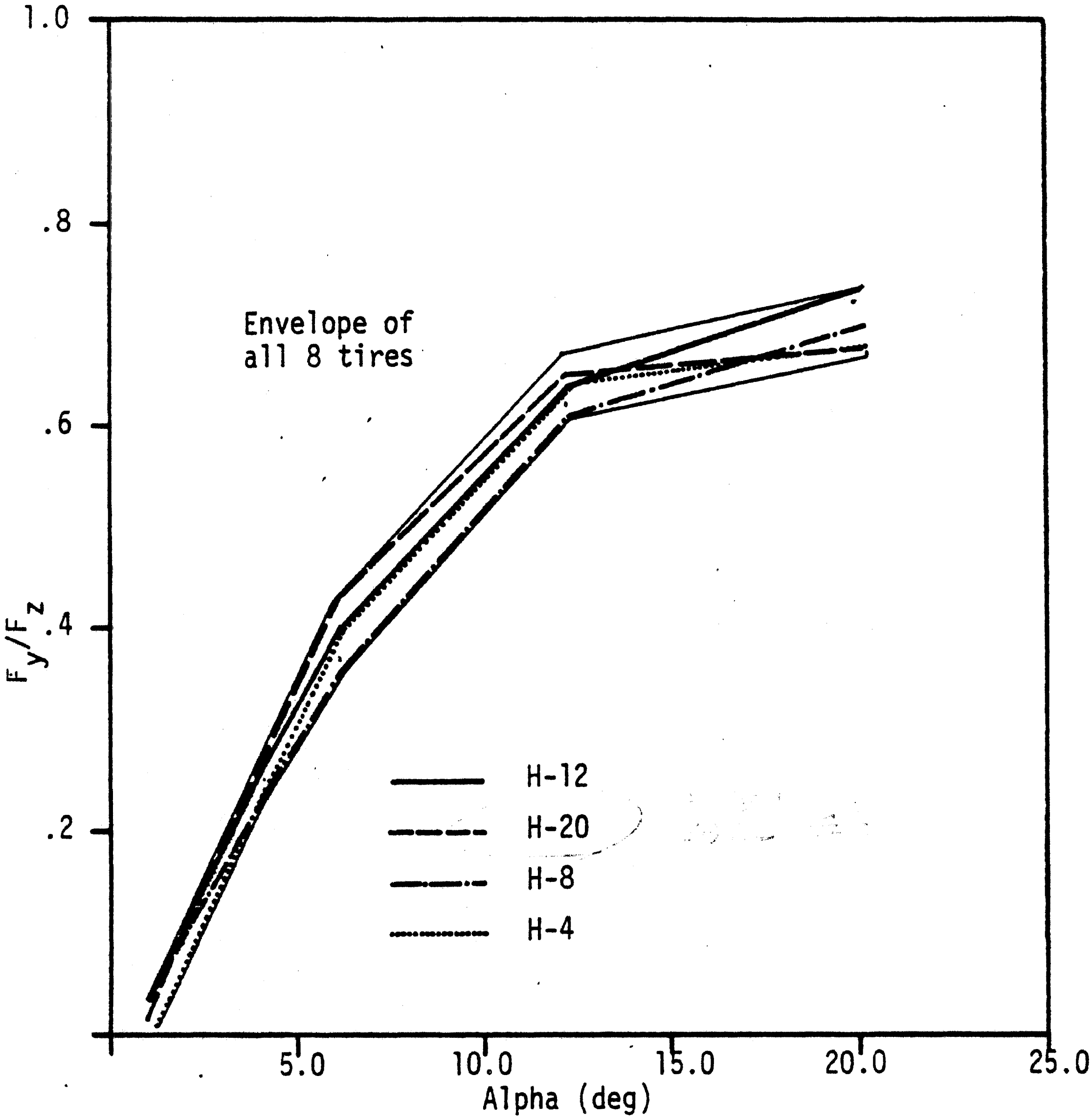


Figure 3.25. Lateral force measurements of heavy truck and bus tires at 20 mph, 1.5 x rated load.

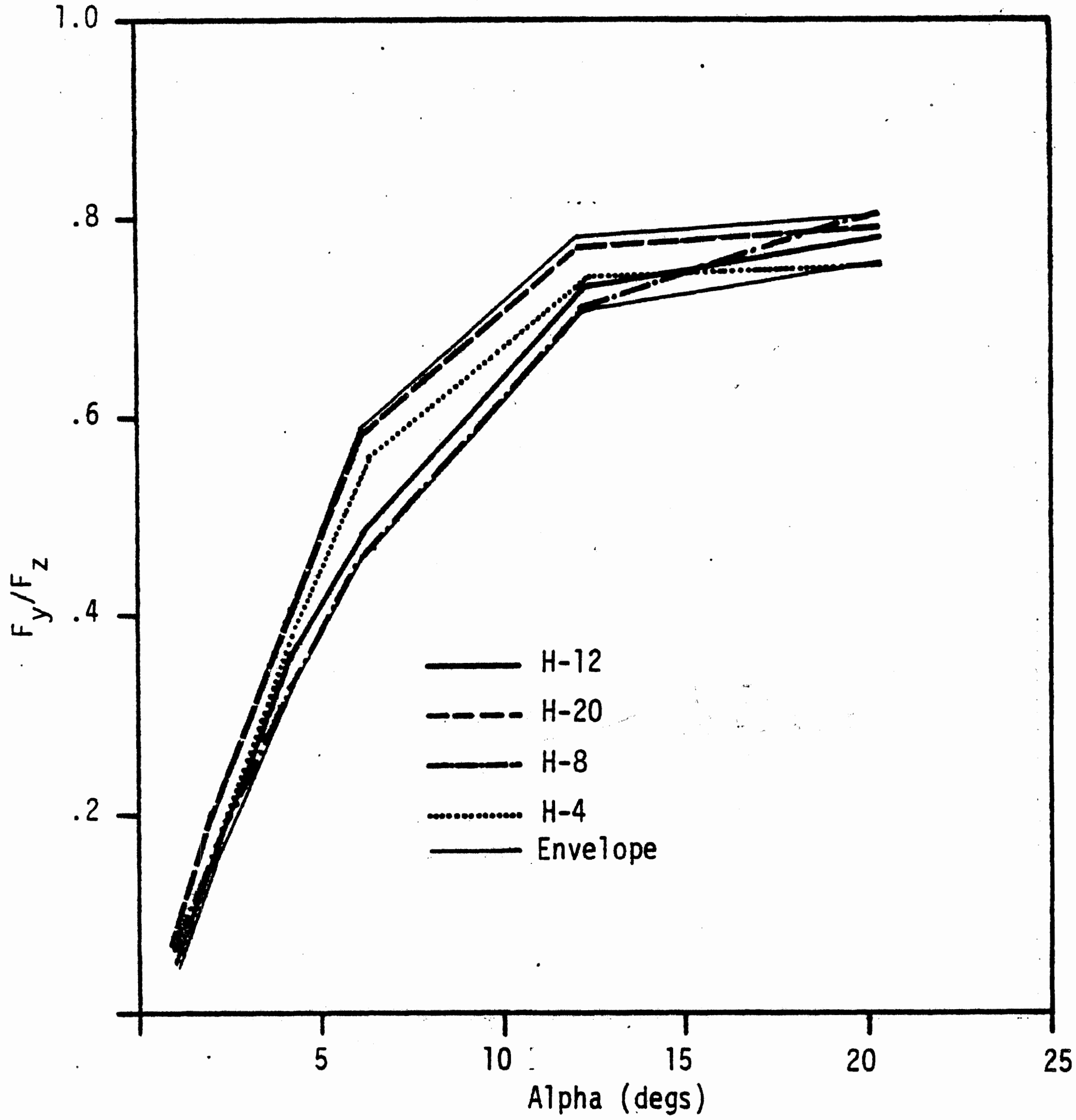


Figure 3.27. Envelope and specific examples of (F_y/F_z vs. α) measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 20 mph.

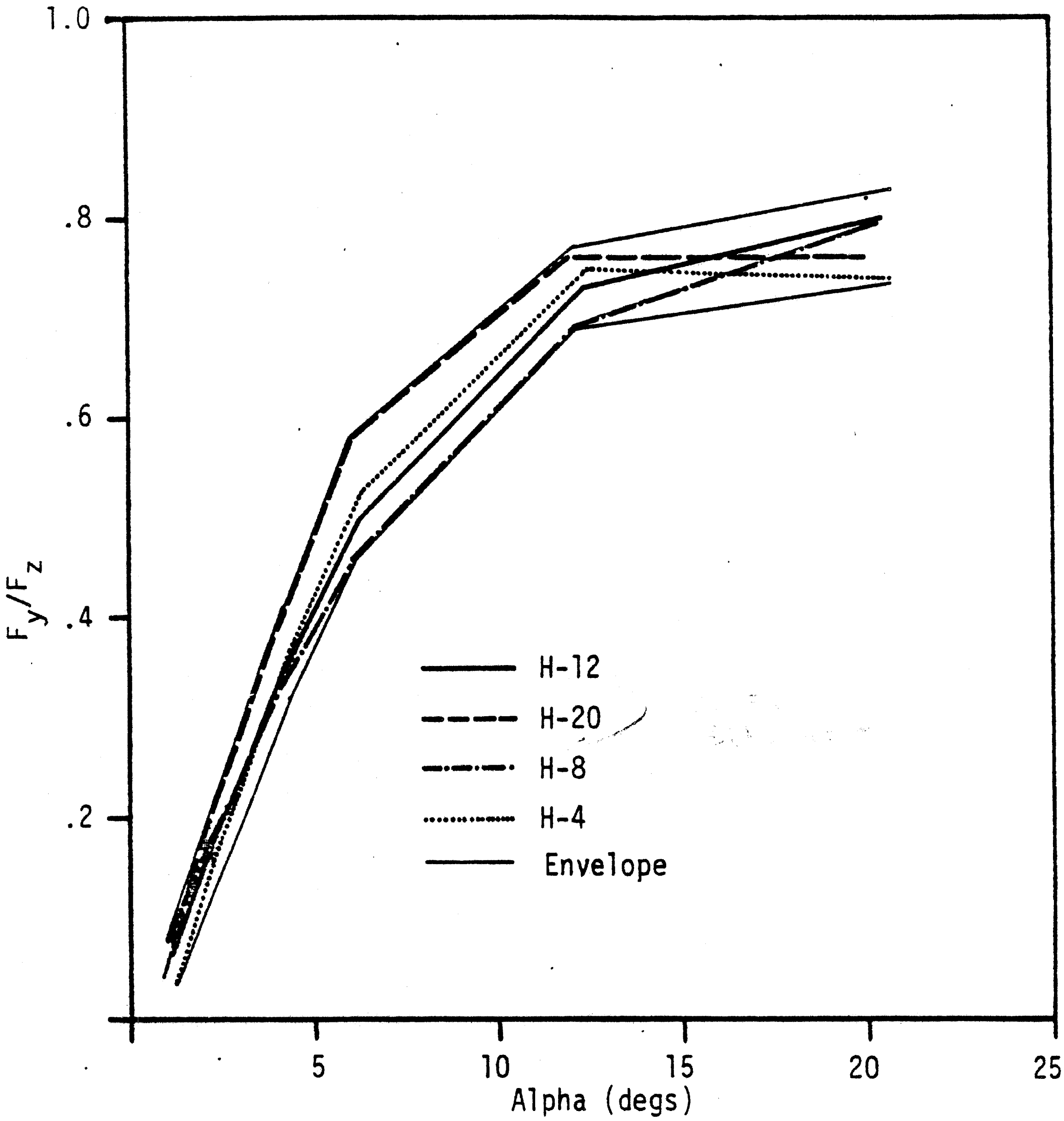


Figure 3.28. Envelope and specific examples of (F_y/F_z vs. α) measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 40 mph.

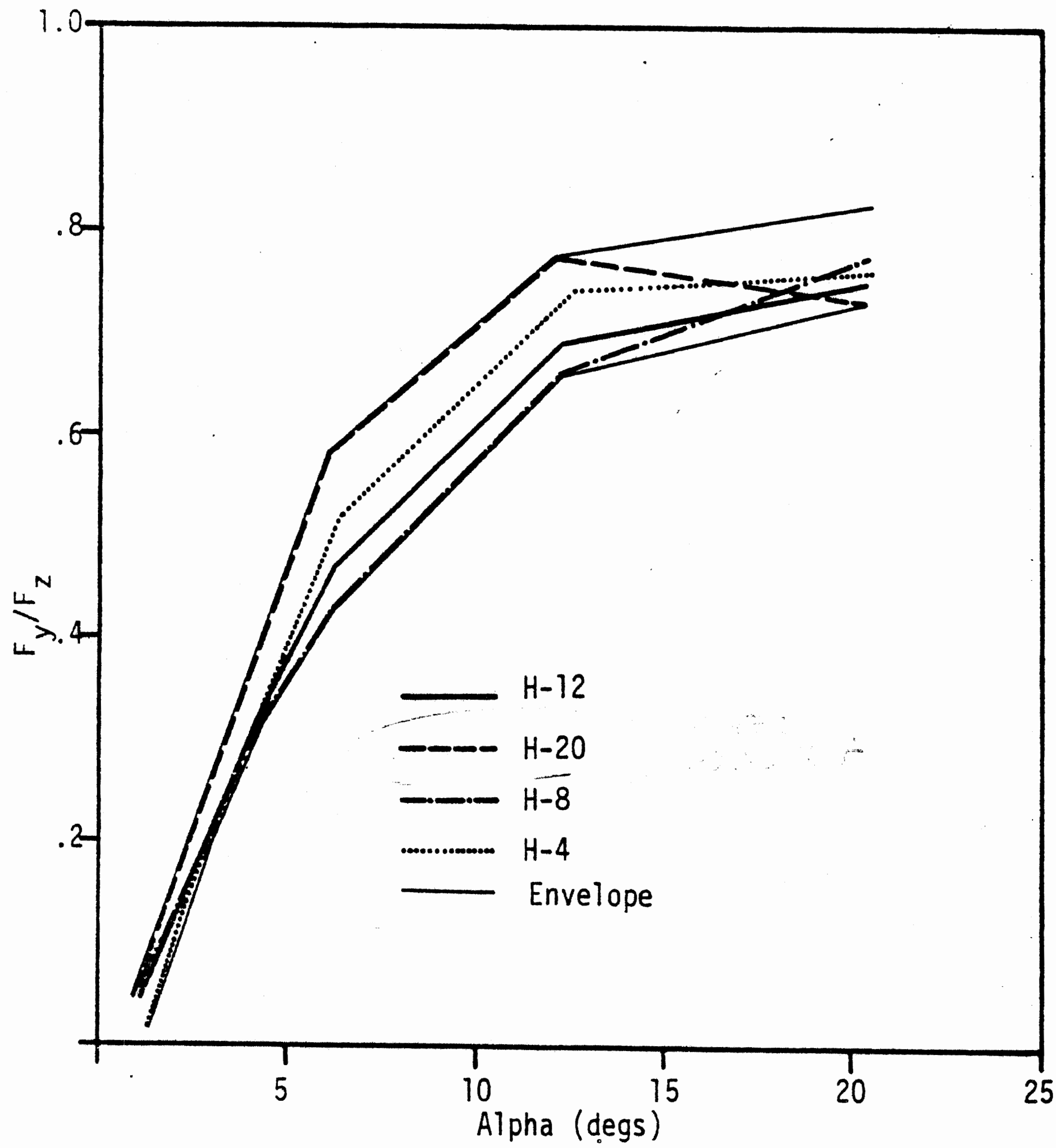
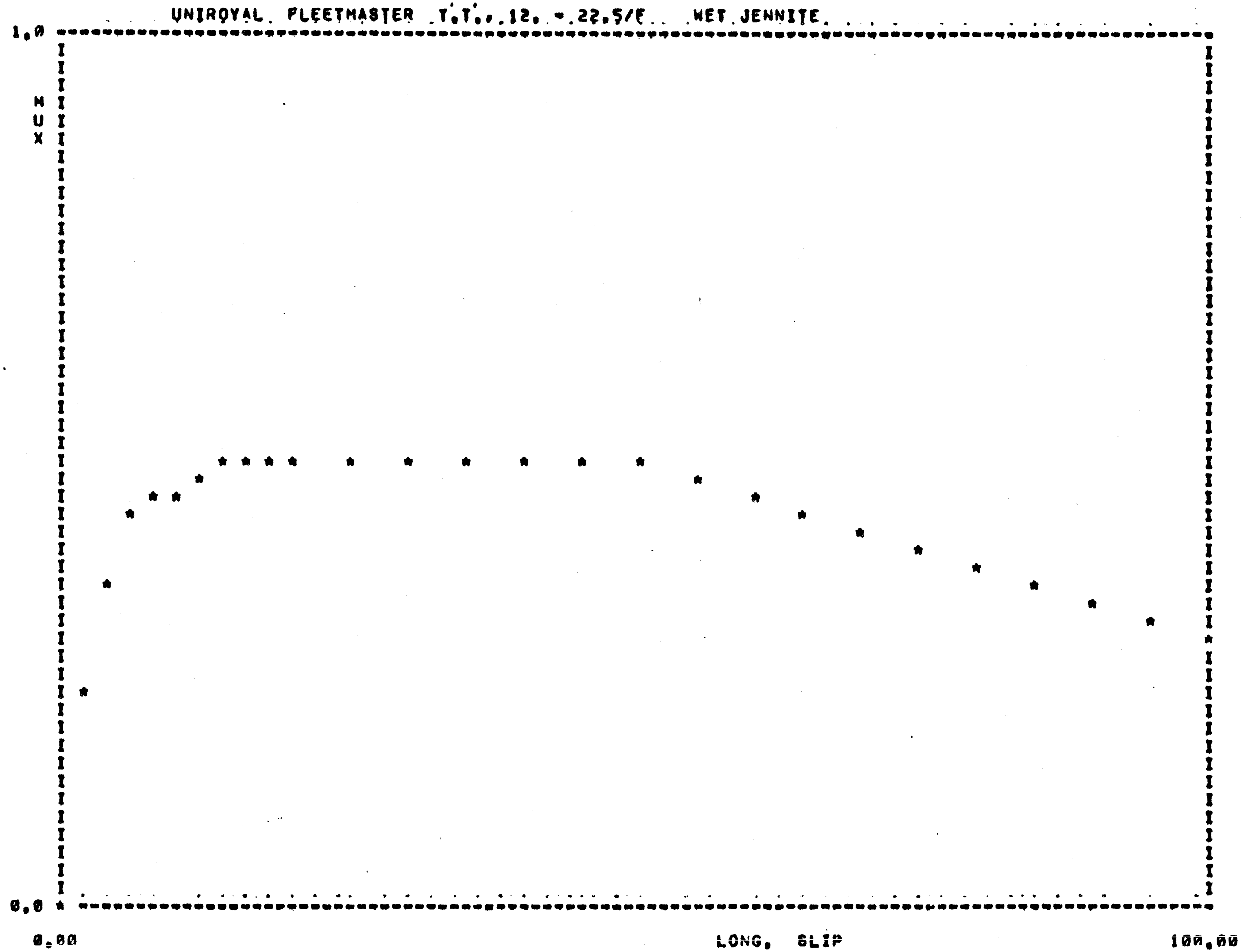
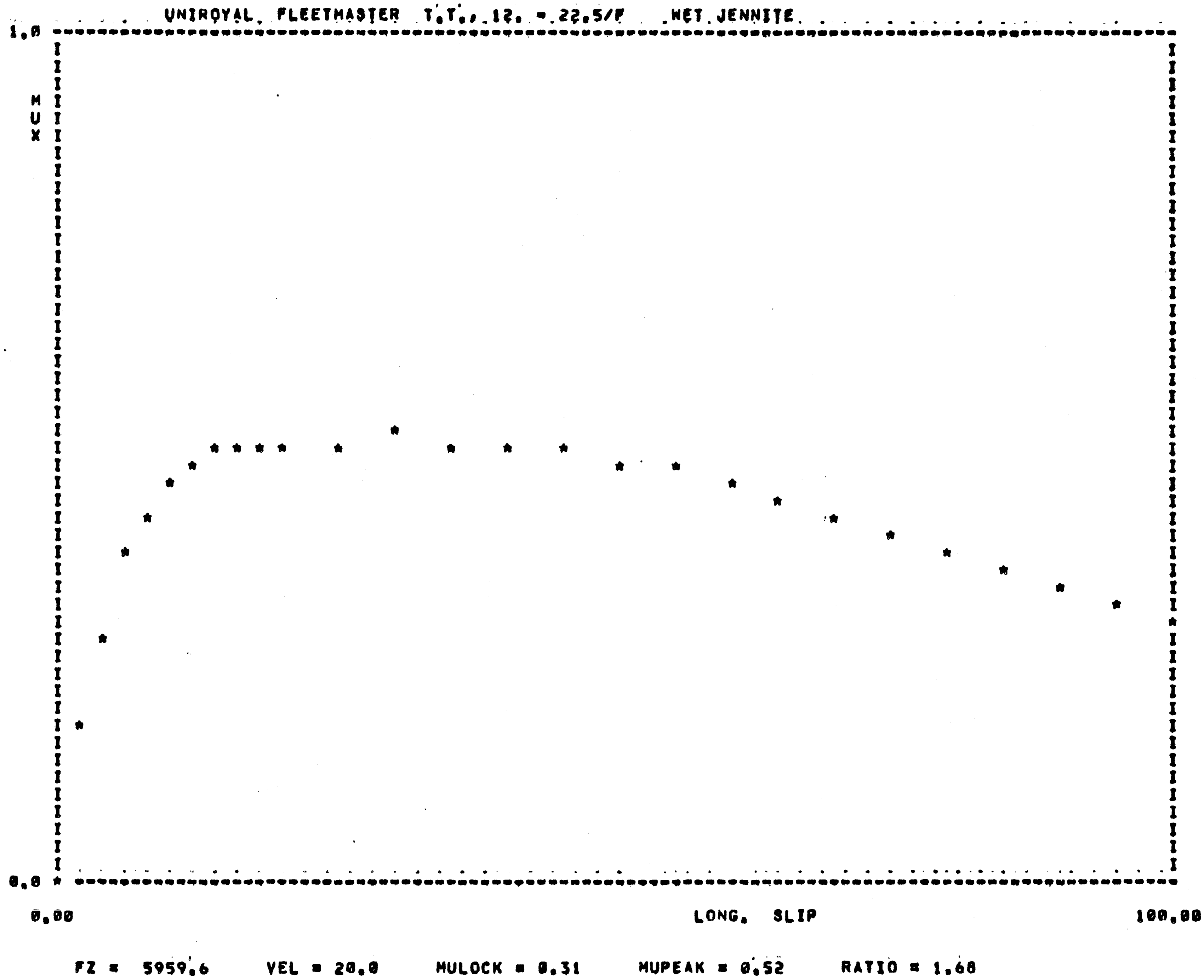


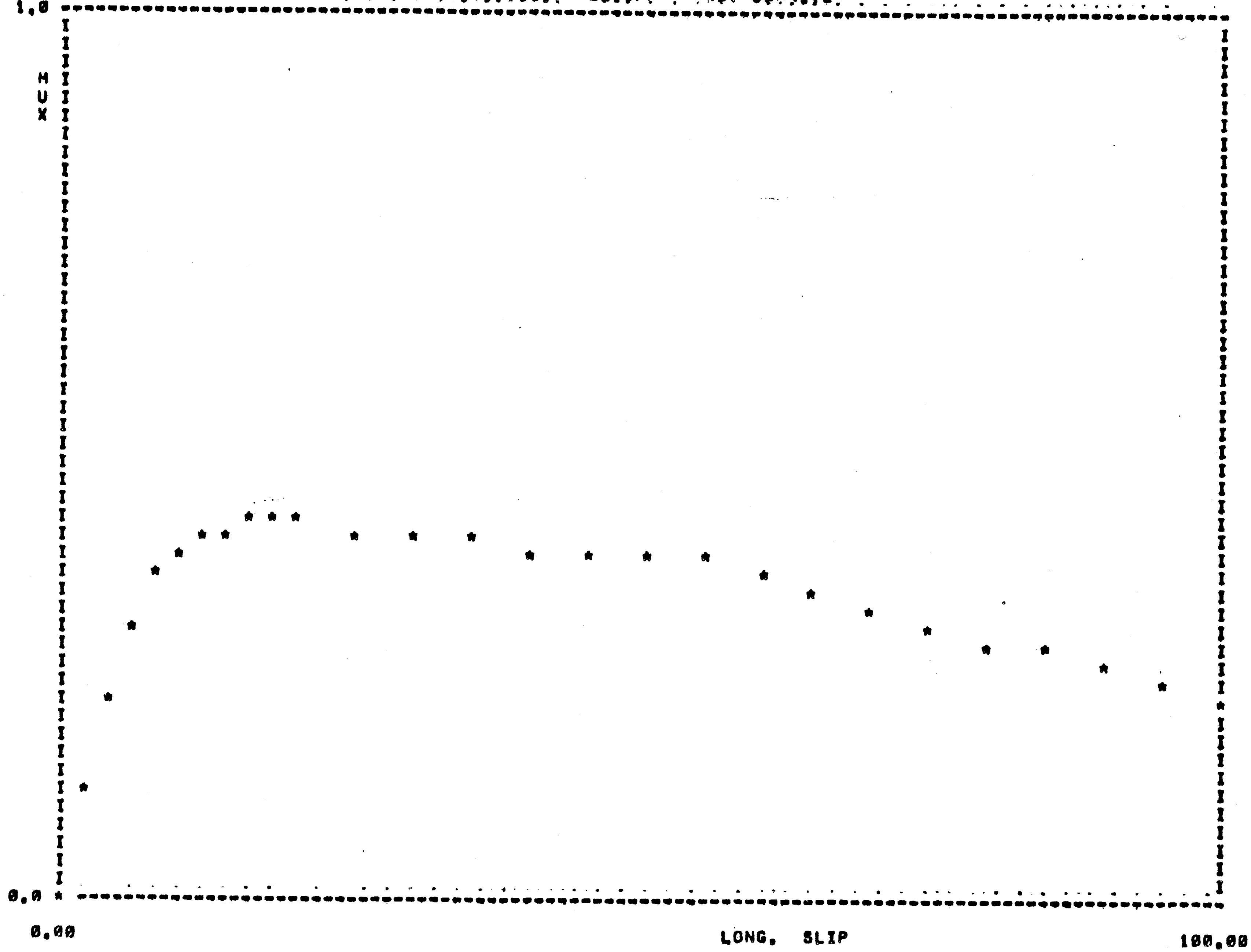
Figure 3.29. Envelope and specific examples of (F_y/F_z vs. α measurements taken for 8 heavy truck and bus tires at 1.0 F_{zR} and 55 mph.



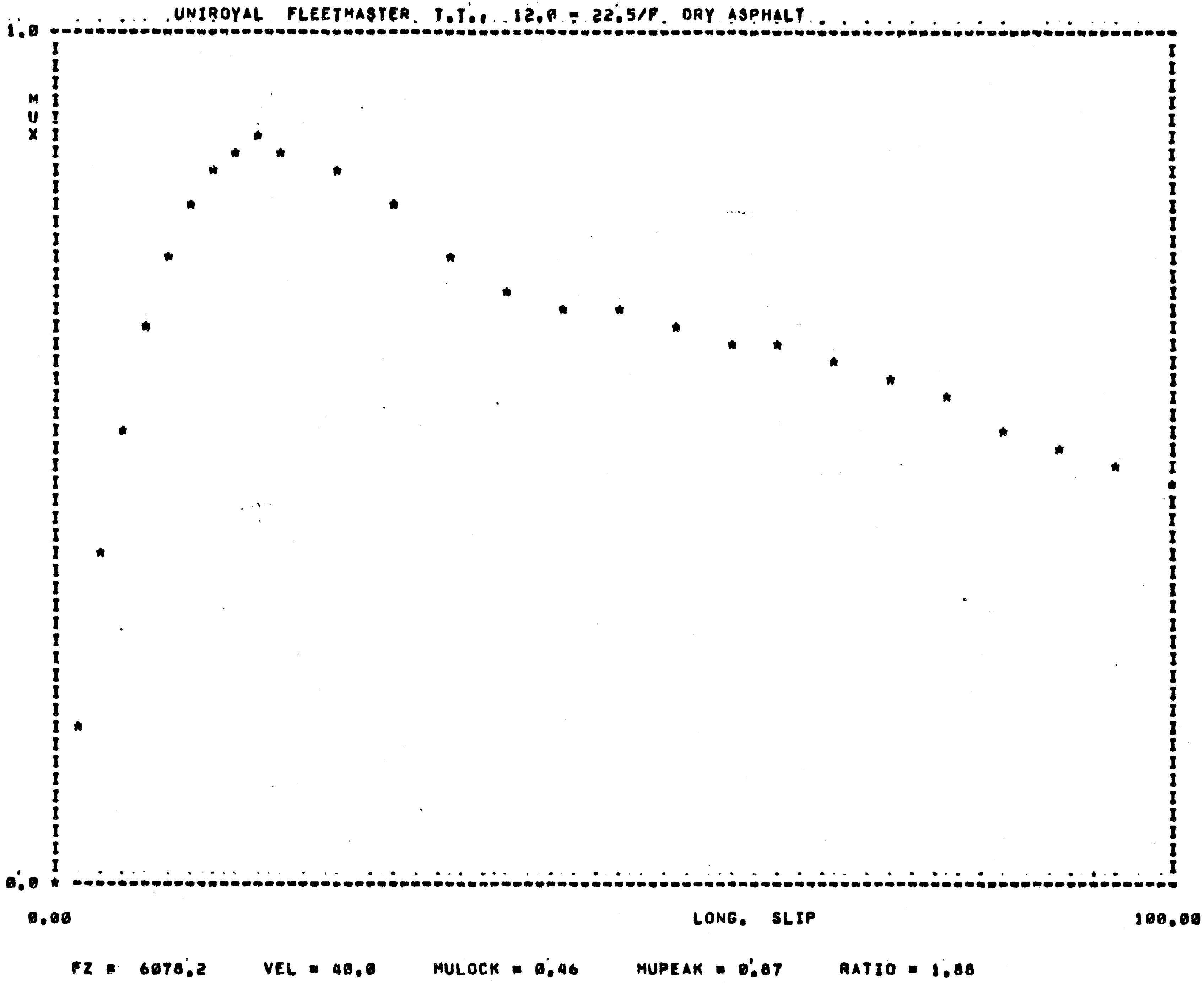
FZ = 3274.3 VEL = 20.0 MULOCK = 0.30 MUPEAK = 0.52 RATIO = 1.71

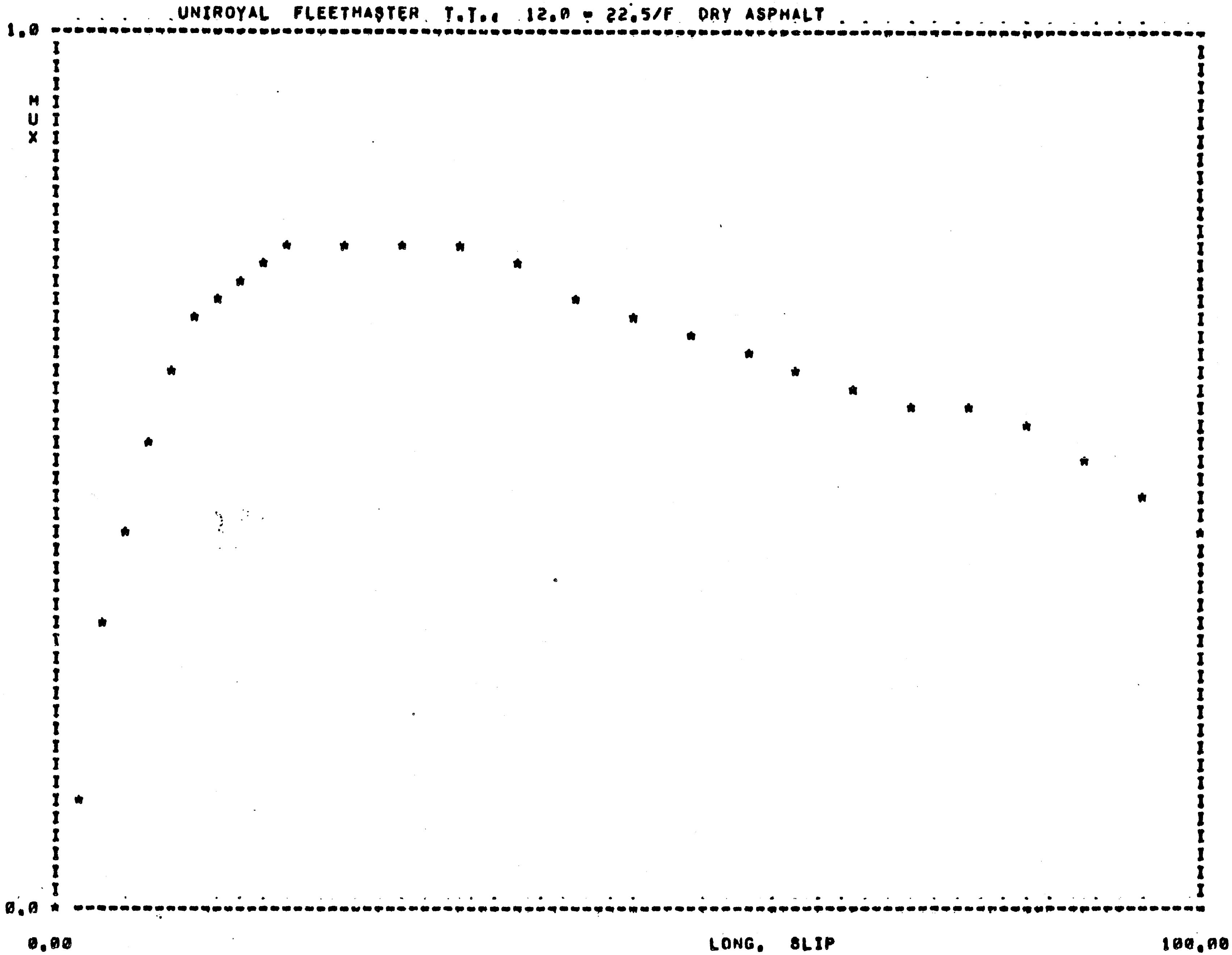

UNIROYAL, FLEETMASTER T.T., 12. - 22.5/F .WET JENNITE
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 5959.6 VEL = 20.0 MULOCK = 0.31 MUPEAK = 0.52 RATIO = 1.68

UNIROYAL FLEETMASTER T.T., 12. - 22.5/F WET JENNITE

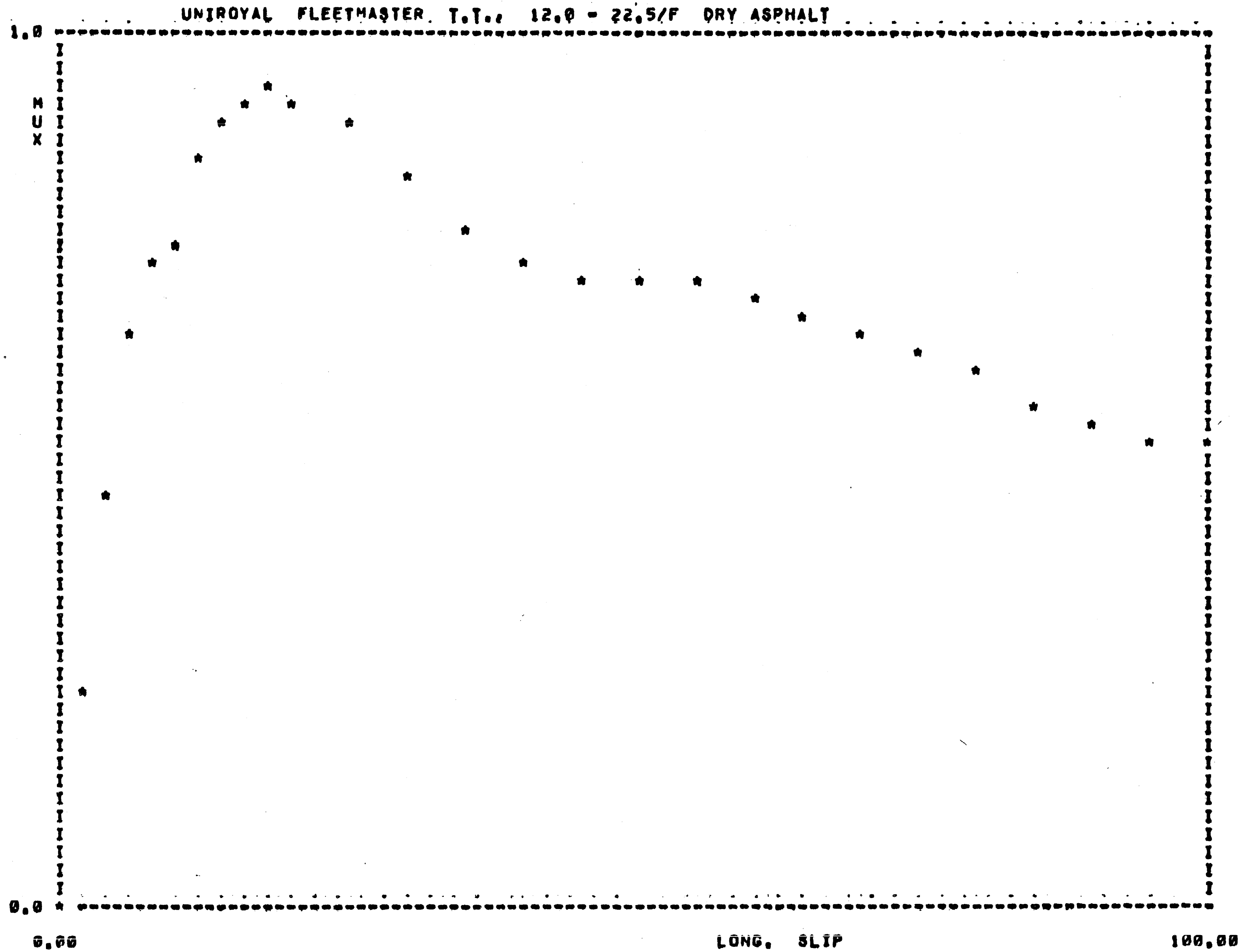


FZ = 9293.0 VEL = 20.0 MULOCK = 0.23 MUPEAK = 0.42 RATIO = 1.87

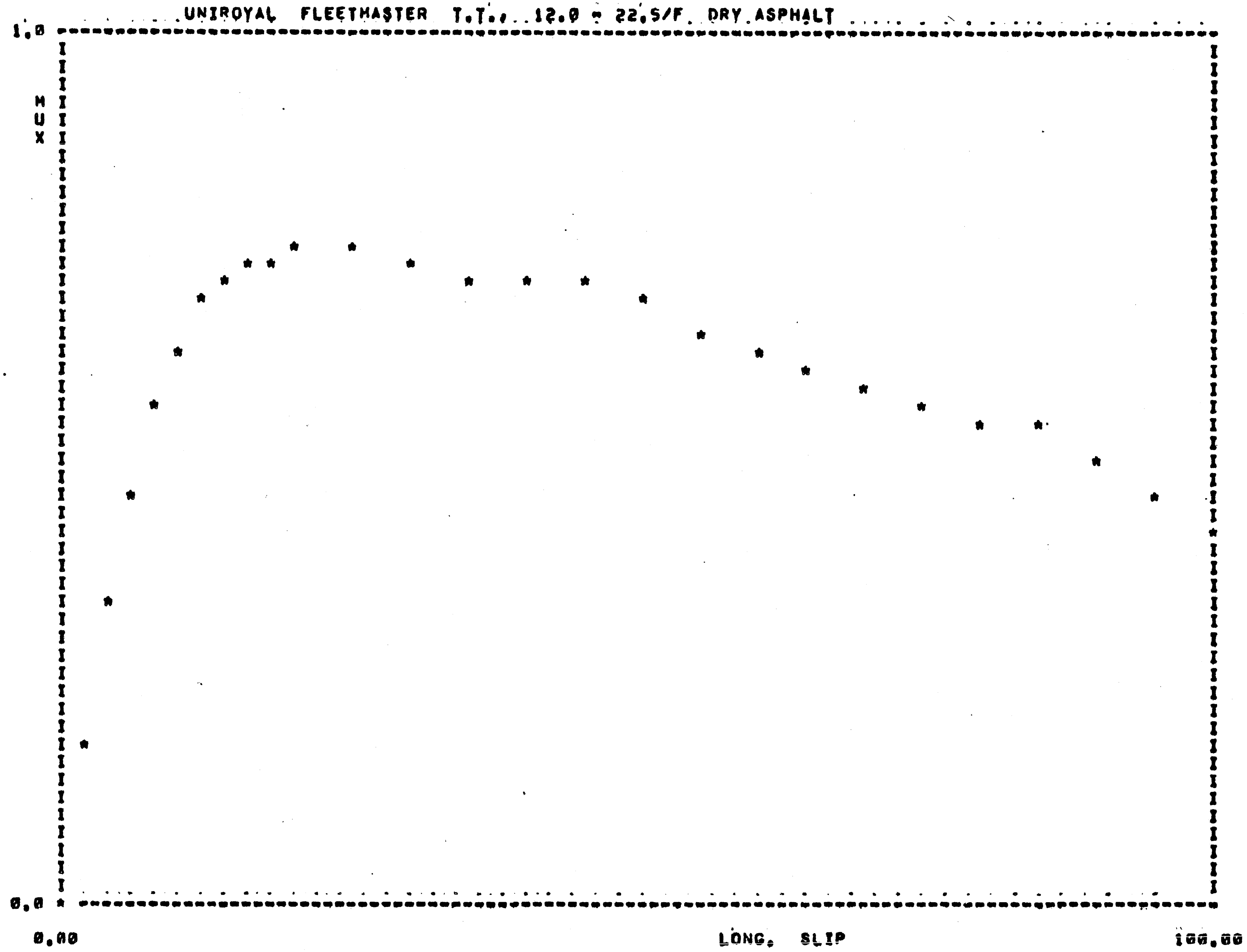

UNIROYAL FLEETMASTER T.T., 12.0 - 22.5/F. DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 6078.2
VEL = 40.0
MULOCK = 0.46
MUPEAK = 0.87
RATIO = 1.88



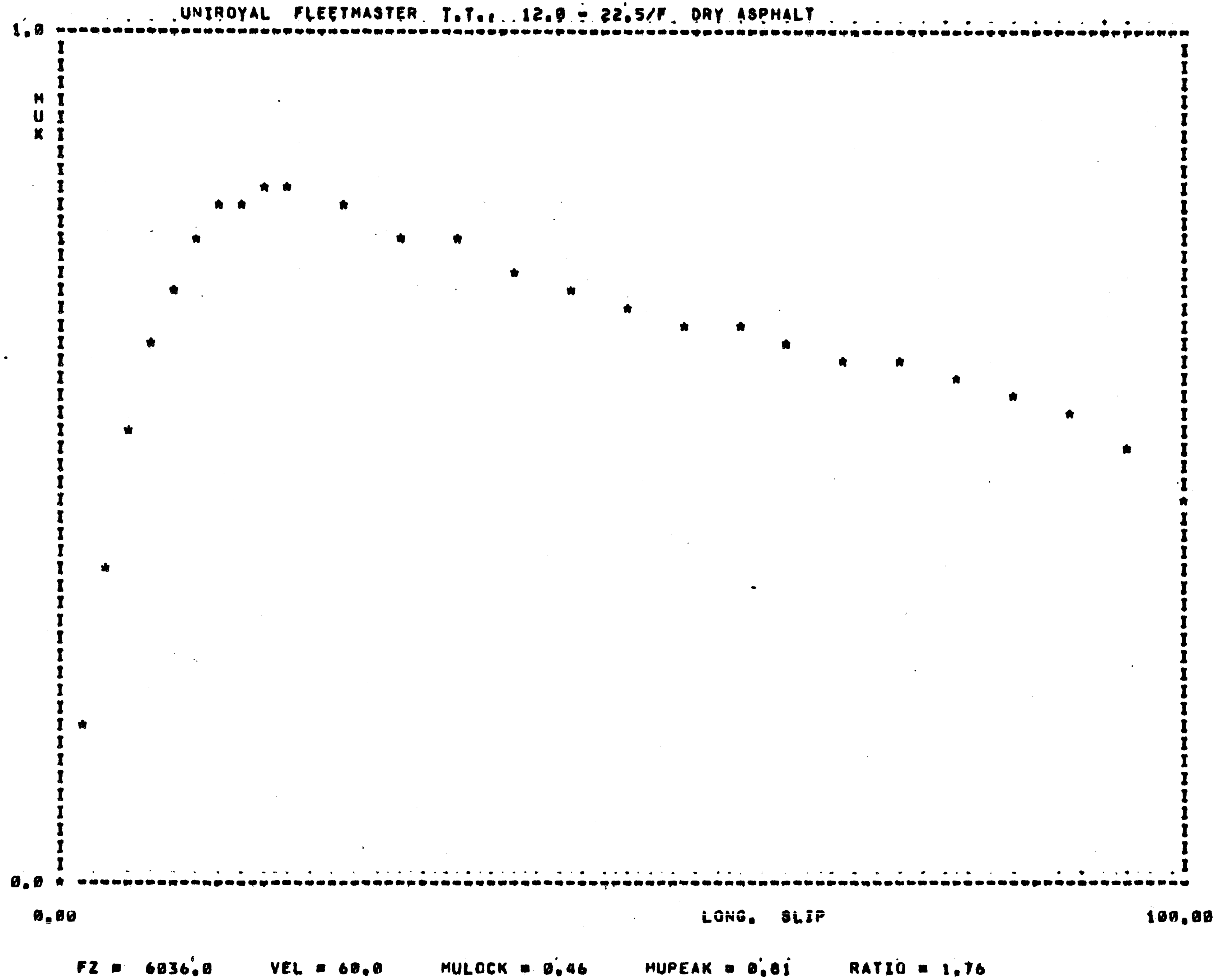
FZ = 7830.4 VEL = 40.0 MULOCK = 0.42 MUPEAK = 0.76 RATIO = 1.81



FZ = 3369.1 VEL = 60.0 MULOCK = 0.52 MUPEAK = 0.94 RATIO = 1.79



FZ = 7821.0 VEL = 60.0 MULOCK = 0.43 MUPEAK = 0.76 RATIO = 1.78


UNIROYAL FLEETMASTER T.T.. 12.0 - 22.5/F. DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 6036.0 VEL = 60.0 MULOCK = 0.46 MUPEAK = 0.81 RATIO = 1.76

Tire: Highway Tread 12-22.5/F   Rim: 22.5x8.50

LATERAL FORCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2000	85	313	581	1001	1472	1758	1796
4000	85	502	944	1718	2693	3262	3614(?)
5920	85	621	1132	2090(?)	3436(?)	4299	4682
8000	85	609	1186	2241	3915	5044	5770
10000	85	603	1168	2243	4083	5381	6367

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2000	85	35	55	67	40	14	-1
4000	85	89	153	212	180	117	31
5920	85	136	241	362	366	275	151
8000	85	179	331	530	605	520(?)	327(?)
10000	85	220	421	688	858	817	559

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
2000	85	20,000	
5920	85	58,000	4534
10000	85	57,000	

MICHELIN RADIAL 12 x 22.5 16 PLY

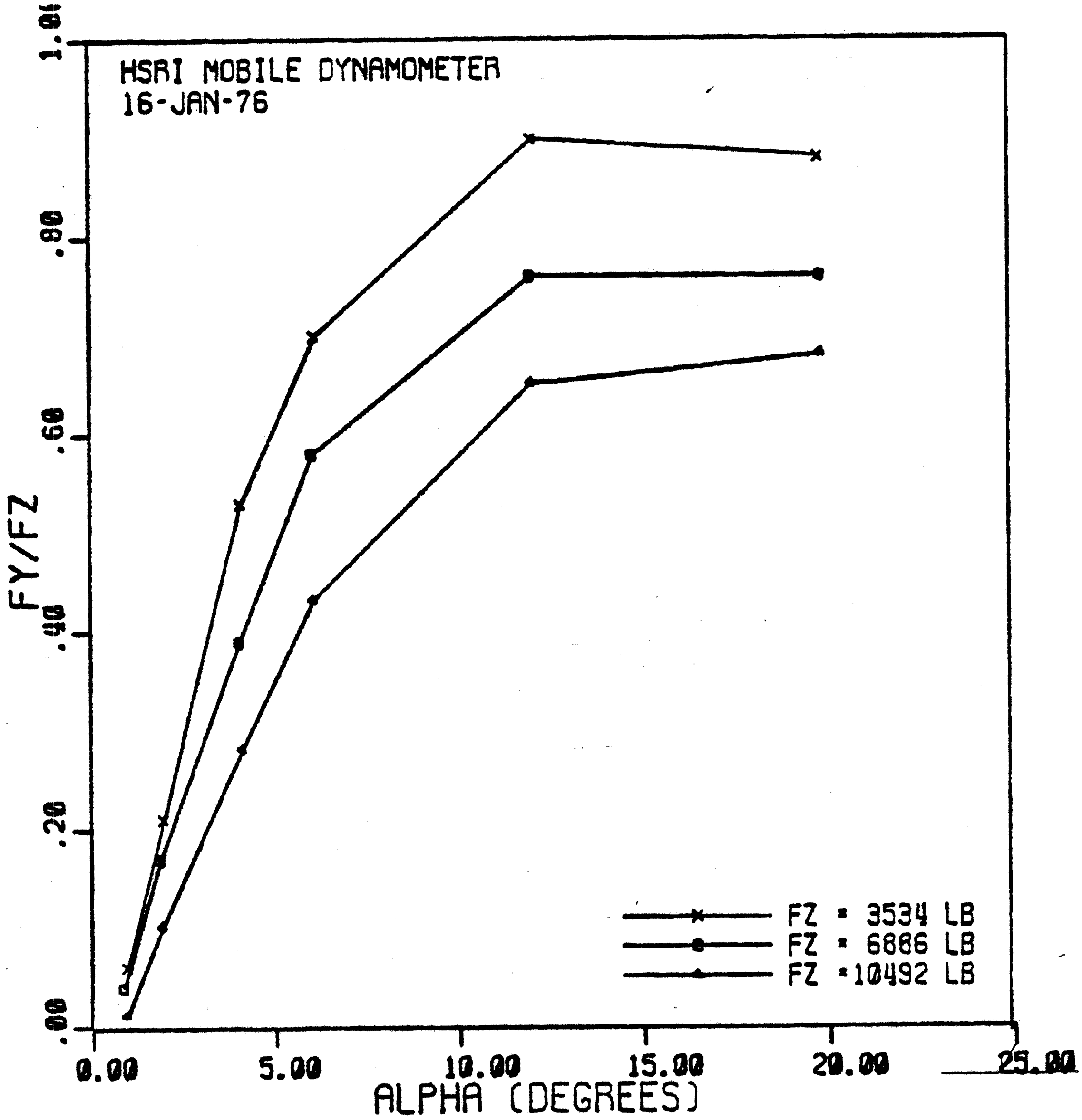
LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB), AND STEER ANGLE (DEG)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-12.8	-312.1	284.0	-572.7	531.8	-988.6	941.	-1592.3	1454.	-1793	1711	-1850	1798
100.0	4000.0	5.8	-576.1	576.5	-1086.	1046.8	-1937.5	1862.	-2917.5	2808.	-3323	3213	-3347	3306
100.0	6000.0	25.4	-749.1	776.8	-1461.6	1373.6	-2641.8	2571.	-3995.4	3889.	-4506	4329	-4565	4463
100.0	8000.0	23.9	-829.9	875.2	-1669.2	1658.	-3090.4	3036.	-4795.7	4721.	-5405	5217	-5436	5396
75.0	4000.0	18.8	-665.2	685.0	-1249.8	1223.8	-2118.	2070.9	-2937.5	2827.2			-3360.8	3270.4
75.0	6000.0	29.8	-804.4	836.8	-1570.8	1564.9	-2780.5	2730.5	-3927.5	3844.6			-4517.4	4392.2
50.0	4000.0	22.4	-680.4	683.6	-1282.5	1314.6	-2183.1	2124.4	-2901.8	2797.1			-3299.9	
50.0	6000.0	27.2	-713.1	726.7	-1413.1	1432.4	-2688.9	2604.1	-3702.1	3639.8			-4340.4	

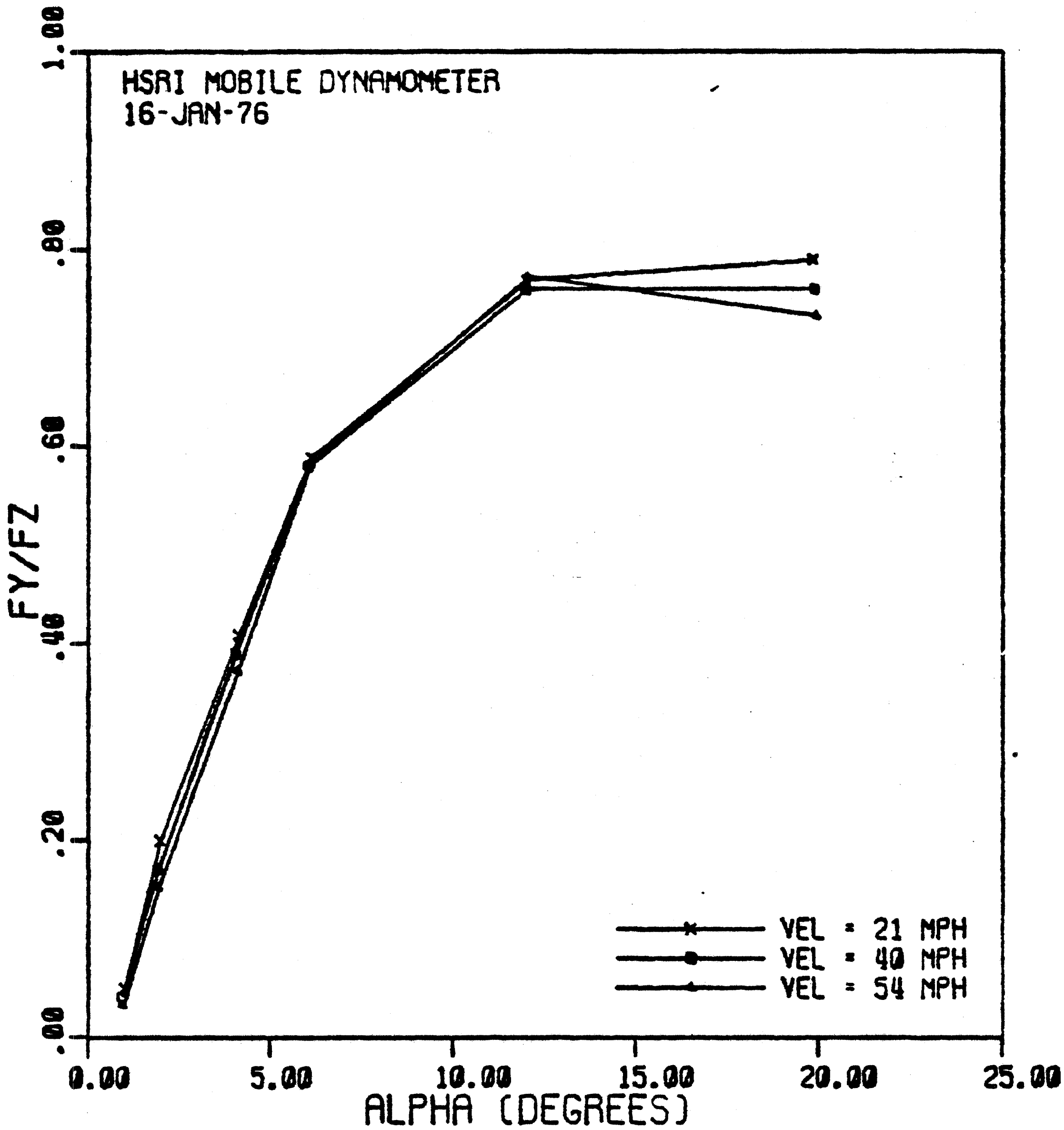
22

ALIGNING MOMENT (FT-LB) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB), AND STEER ANGLE (DEG)

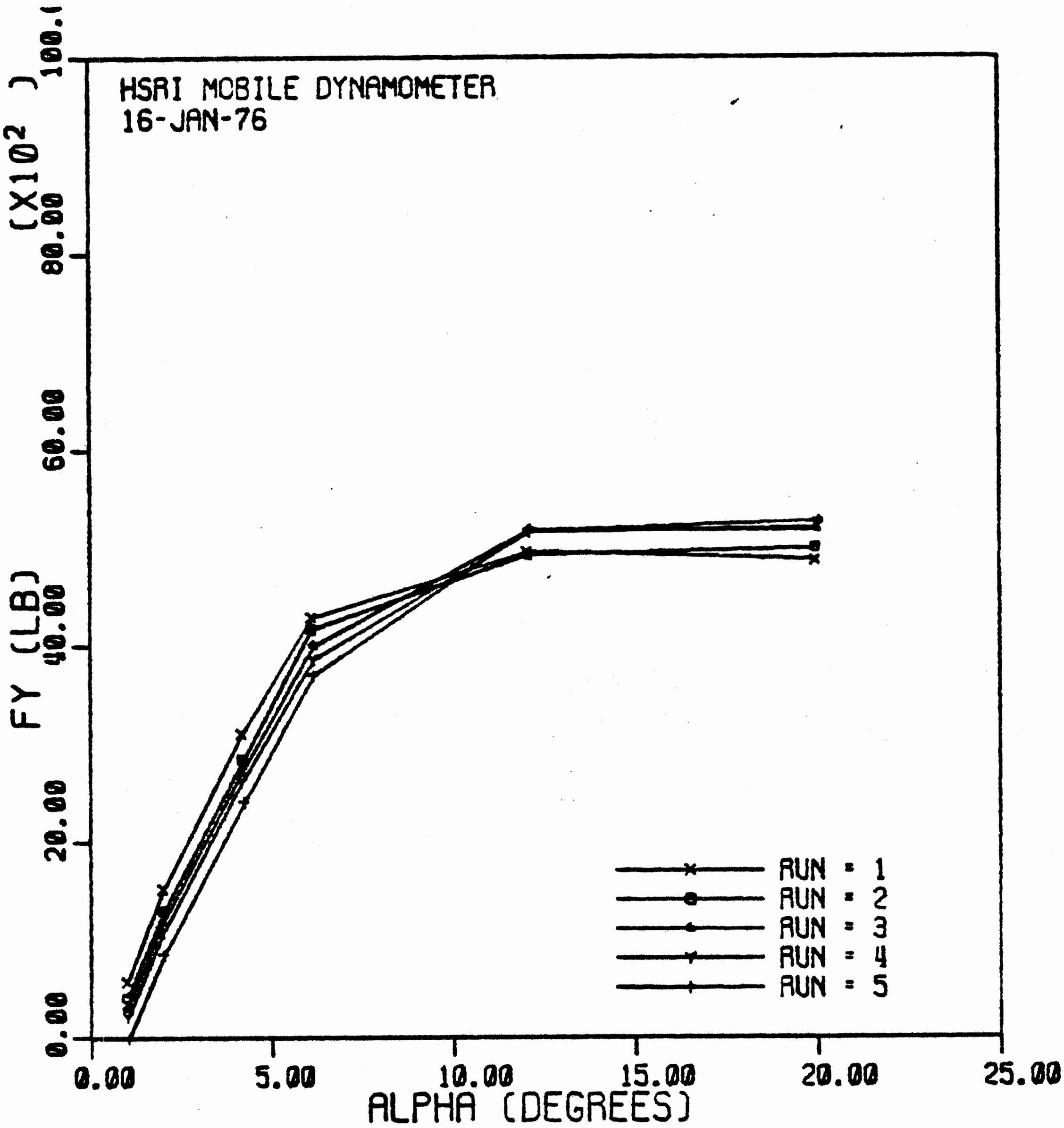
PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-3.85	21.9	-31.9	39.2	-42.6	54.3	-57.4	51.5	-46.9	25.7	-21.5	3.4	.2
100.0	4000.0	-7.06	73.7	-86.1	128.3	-132.6	185.1	-190.0	178.2	-163.9	99.7	-92.5	28.4	-14.1
100.0	6000.0	-13.6	126.1	-154.7	234	-236.0	349.7	-364.2	341.6	-326.8	209.6	-187.8	56.3	-47.8
100.0	8000.0	-18.86	176.1	-222.5	344.2	-370.9	504.9	-562.8	528.4	-515.7	326.9	-293.1	108.5	-112.2
75.0	4000.0	-12.1	84.7	-104.7	151.0	-166.6	205.5	-212.3	154.9	-146.1			35.4	-16.5
75.0	6000.0	-20.4	143.	-181.8	269.4	-308.3	389.4	-411.38	327.6	-313.5			114.1	-93.3
50.0	4000.0	-21.2	106.7	-144.1	197.1	-218.3	232.6	-249.7	189.6	-160.8			47.85	22.5
50.0	6000.0	-33.5	163.7	-237.5	331.6	-383.6	443.5	-506.1	375.4	-364.0			14.1	11.8



MICHELIN XZA 12.00R22.5/H
VEL = 40 MPH



MICHELIN XZA 12.00R22.5/H
FZ = 6843 LB



MICHELIN XZA 12.00R22.5/H
FZ = 6829 LB VEL = 40 MPH

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

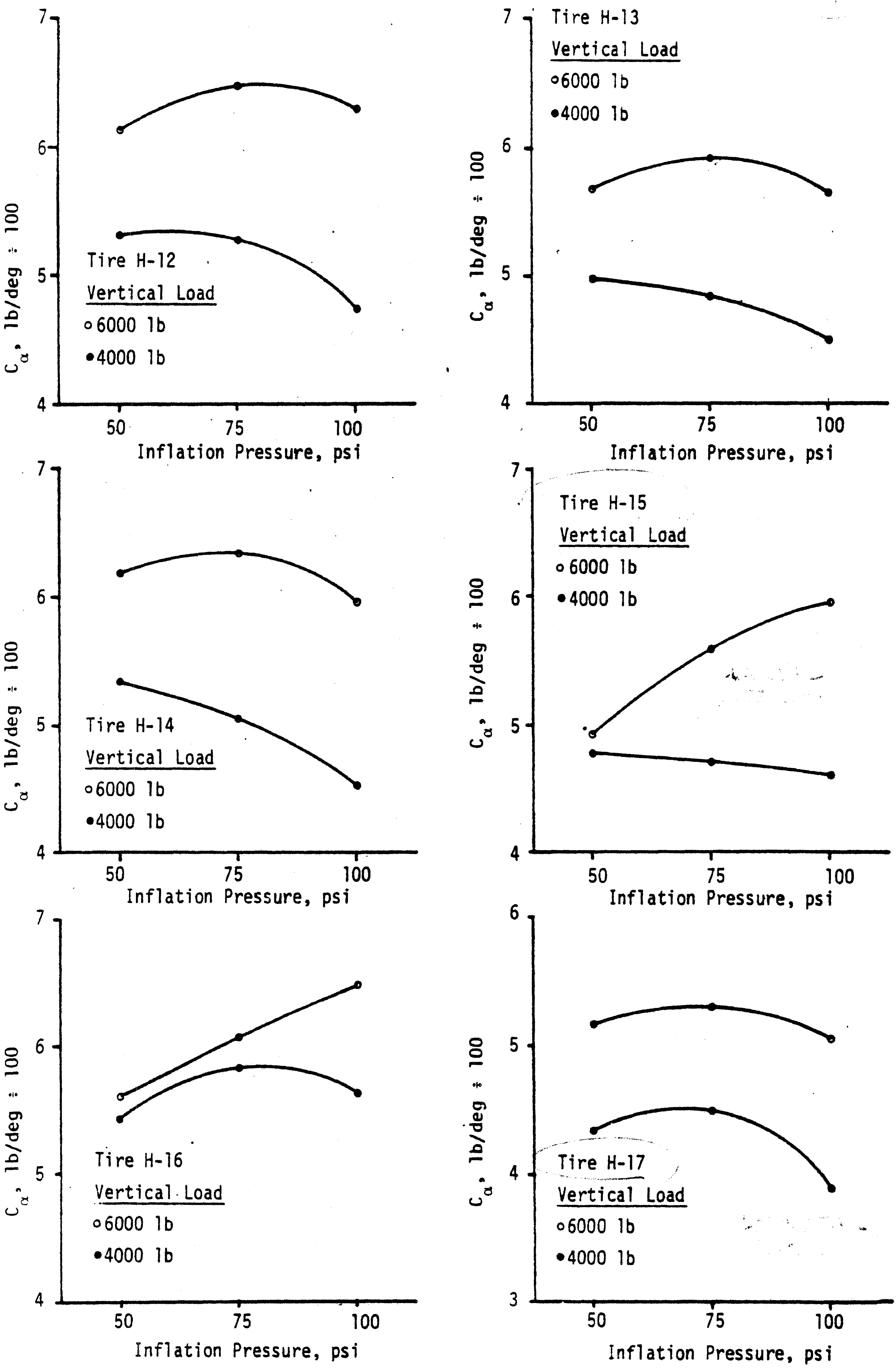


Figure 3.11 The effects of inflation pressure on cornering stiffness: heavy bus tires.

FIRESTO HIWAY MILEAGE 12.50X22.5 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-36.8	-297.2	233.8	-534.5	478.5	-872.8	839.2	-1296.1	1277.4	-1491.8	1518.0	-1562.4	1577.2
100.0	4000.0	-79.8	-545.2	401.7	-930.7	825.7	-1585.6	1488.4	-2397.1	2381.4	-2823.2	2839.0	-2994.6	3048.8
100.0	6000.0	-103.7	-720.5	539.3	-1258.7	1107.0	-2162.2	2036.8	-3343.6	3296.6	-3944.5	3939.0	-4215.6	4251.1
100.0	8000.0	-113.6	-850.9	613.5	-1503.2	1318.4	-2588.6	2420.8	-4058.0	4008.3	-4865.1	4856.1	-5256.5	5288.3
75.0	4000.0	-88.9	-599.5	458.2	-1046.4	916.5	-1750.0	1673.0	-2533.8	2543.2			-3119.5	3167.7
75.0	6000.0	-99.1	-740.6	557.9	-1320.5	1152.7	-2265.9	2142.5	-3402.4	3397.2			-4329.2	4355.2
50.0	4000.0	-89.9	-610.6	454.1	-1066.4	950.0	-1828.6	1714.3	-2589.5	2629.8			-3176.9	3082.5
50.0	6000.0	-84.4	-706.7	524.2	-1252.6	1099.1	-2223.6	2071.3	-3357.6	3397.5			-4327.7	4252.2

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	0.8	25.3	-22.7	39.1	-37.8	43.5	-47.8	28.0	-32.5	6.4	-18.6	-12.3	-1.4
100.0	4000.0	7.4	64.4	-55.3	102.0	-98.2	133.7	-137.1	109.7	-120.2	53.3	-67.4	2.5	-13.3
100.0	6000.0	16.3	115.8	-92.7	189.0	-173.5	256.4	-257.7	233.1	-238.9	124.0	-144.0	49.6	-49.2
100.0	8000.0	23.7	164.6	-125.7	269.3	-245.2	381.0	-382.9	382.2	-384.2	229.2	-259.1	118.4	-118.3
75.0	4000.0	6.0	79.8	-68.8	126.8	-131.2	163.3	-186.5	102.6	-124.4			-6.6	-9.1
75.0	6000.0	16.5	140.2	-113.2	222.7	-211.0	301.8	-314.9	235.5	-257.2			46.5	-54.2
50.0	4000.0	10.1	108.2	-89.9	153.8	-149.9	195.6	-216.3	127.3	-147.3			1.8	-1.7
50.0	6000.0	17.6	163.6	-135.6	269.2	-249.4	370.1	-384.6	287.1	-314.1			42.3	-62.2

14

I

B. F. ORICH INTERCITY MILEAGE 12.50X22.5 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-31.8	-288.0	238.8	-531.4	456.3	-847.8	808.3	-1217.4	1174.6	-1353.2	1338.4	-1465.1	1483.0
100.0	4000.0	-45.2	-493.2	406.0	-889.7	806.8	-1519.7	1436.9	-2173.8	2224.6	-2590.3	2618.2	-2862.5	2795.0
100.0	6000.0	-37.6	-610.7	517.0	-1130.5	1034.1	-1953.7	1868.9	-3005.7	2981.6	-3497.3	3600.5	-4079.5	3944.0
100.0	8000.0	-56.5	-691.2	587.8	-1266.3	1161.6	-2244.6	2145.1	-3664.5	3466.4	-4578.6	4434.5	-5084.2	4973.0
75.0	4000.0	-42.6	-523.1	445.6	-956.3	861.4	-1628.9	1555.9	-2354.1	2296.6			-2936.5	2908.0
75.0	6000.0	-46.2	-639.6	544.9	-1177.0	1063.7	-2012.9	1938.0	-3105.9	3017.2			-4059.3	4092.7
50.0	4000.0	-48.6	-550.5	448.4	-969.0	887.1	-1686.0	1560.6	-2361.6	2334.7			-3046.6	2912.2
50.0	6000.0	-43.6	-621.2	517.5	-949.9	1058.5	-1964.4	1843.8	-3007.5	2956.4			-4157.2	3978.8

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	0.5	27.3	-30.7	43.8	-45.5	48.3	-55.8	27.7	-33.5	7.1	-14.0	-4.7	0.2
100.0	4000.0	5.3	75.4	-68.4	121.8	-117.3	161.6	-161.5	111.4	-132.3	63.8	-78.7	31.1	-37.2
100.0	6000.0	7.9	122.2	-108.6	203.7	-195.7	282.9	-289.0	240.2	-267.6	151.6	-190.2	107.6	-116.1
100.0	8000.0	9.3	164.6	-145.7	283.4	-267.6	417.5	-418.0	436.1	-398.7	329.5	-343.7	211.4	-211.1
75.0	4000.0	4.6	90.1	-79.5	136.4	-136.1	172.9	-181.3	123.0	-128.9			35.8	-37.9
75.0	6000.0	6.8	136.1	-123.2	227.2	-214.0	317.6	-321.6	274.4	-287.4			103.0	-121.7
50.0	4000.0	8.8	103.5	-89.5	167.7	-163.4	211.4	-221.7	149.5	-146.8			39.1	-44.6
50.0	6000.0	9.3	159.4	-135.3	271.7	-247.6	379.0	-389.9	335.3	-335.4			115.7	-142.1

UNIROY- NTERCITY 12.50X22.5 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-28.7	-304.2	240.5	-500.7	456.2	-845.5	824.4	-1318.6	1264.4	-1482.5	1459.5	-1599.3	1507.8
100.0	4000.0	-61.3	-509.4	415.7	-887.3	806.5	-1548.4	1473.0	-2417.8	2345.1	-2815.1	2774.5	-2992.5	2912.4
100.0	6000.0	-66.4	-657.3	532.7	-1159.6	1076.1	-2053.6	1948.4	-3256.8	3154.8	-3865.0	3798.8	-4153.1	4056.7
100.0	8000.0	-73.1	-743.8	511.1	-1330.7	1220.0	-2381.0	2253.6	-3848.0	3740.4	-4702.2	4606.7	-5112.3	4993.6
75.0	4000.0	-47.7	-514.6	426.5	-971.3	839.2	-1668.7	1574.4	-2542.2	2507.0			-3287.9	3196.8
75.0	6000.0	-64.7	-613.1	509.0	-1201.8	1032.6	-2085.8	1980.4	-3325.3	3260.9			-4413.5	4299.1
50.0	4000.0	-62.6	-537.4	419.2	-978.5	845.1	-1690.4	1551.4	-2515.1	2490.2			-3316.5	3215.2
50.0	6000.0	-68.8	-552.4	434.1	-1050.4	916.2	-1906.5	1708.6	-3146.2	3078.7			-4338.1	4241.3

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	0.5	26.0	-27.1	42.3	-46.1	50.3	-57.4	38.6	-41.9	13.5	-23.7	-1.1	-6.1
100.0	4000.0	9.3	72.6	-64.9	115.8	-112.5	156.5	-164.1	142.5	-146.0	79.2	-89.3	26.5	-32.7
100.0	6000.0	17.8	129.0	-101.2	204.8	-1.9	289.8	-294.4	281.6	-238.1	169.1	-177.8	69.1	-79.1
100.0	8000.0	21.3	176.6	-147.7	292.4	-258.7	439.0	-432.9	442.6	-449.3	290.1	-302.3	137.6	-140.1
75.0	4000.0	8.7	109.6	-73.6	141.8	-163.2	231.7	-188.2	156.8	-191.3			-43.6	36.9
75.0	6000.0	17.2	178.3	-115.9	240.5	-263.1	416.2	-333.1	320.9	-394.6			-106.3	112.5
50.0	4000.0	16.4	88.4	-89.0	175.3	-133.6	184.7	-243.6	173.0	-166.6			-41.7	37.0
50.0	6000.0	29.3	143.5	-132.0	290.0	-221.1	337.4	-2124.6	384.4	-336.7			-126.0	97.1

17

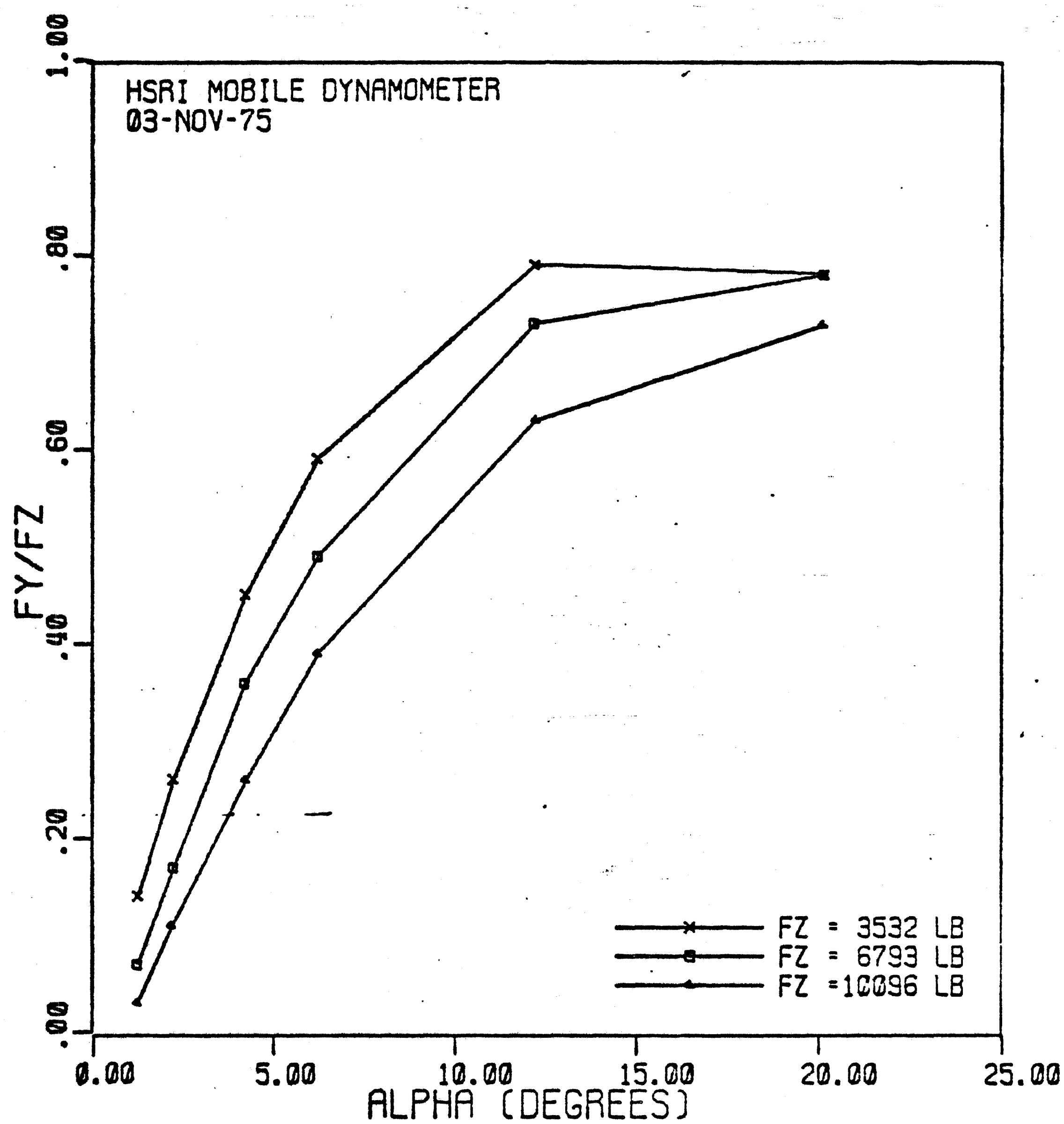
GOODYEAR TOM CRUISER 12.50X22.5 G

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

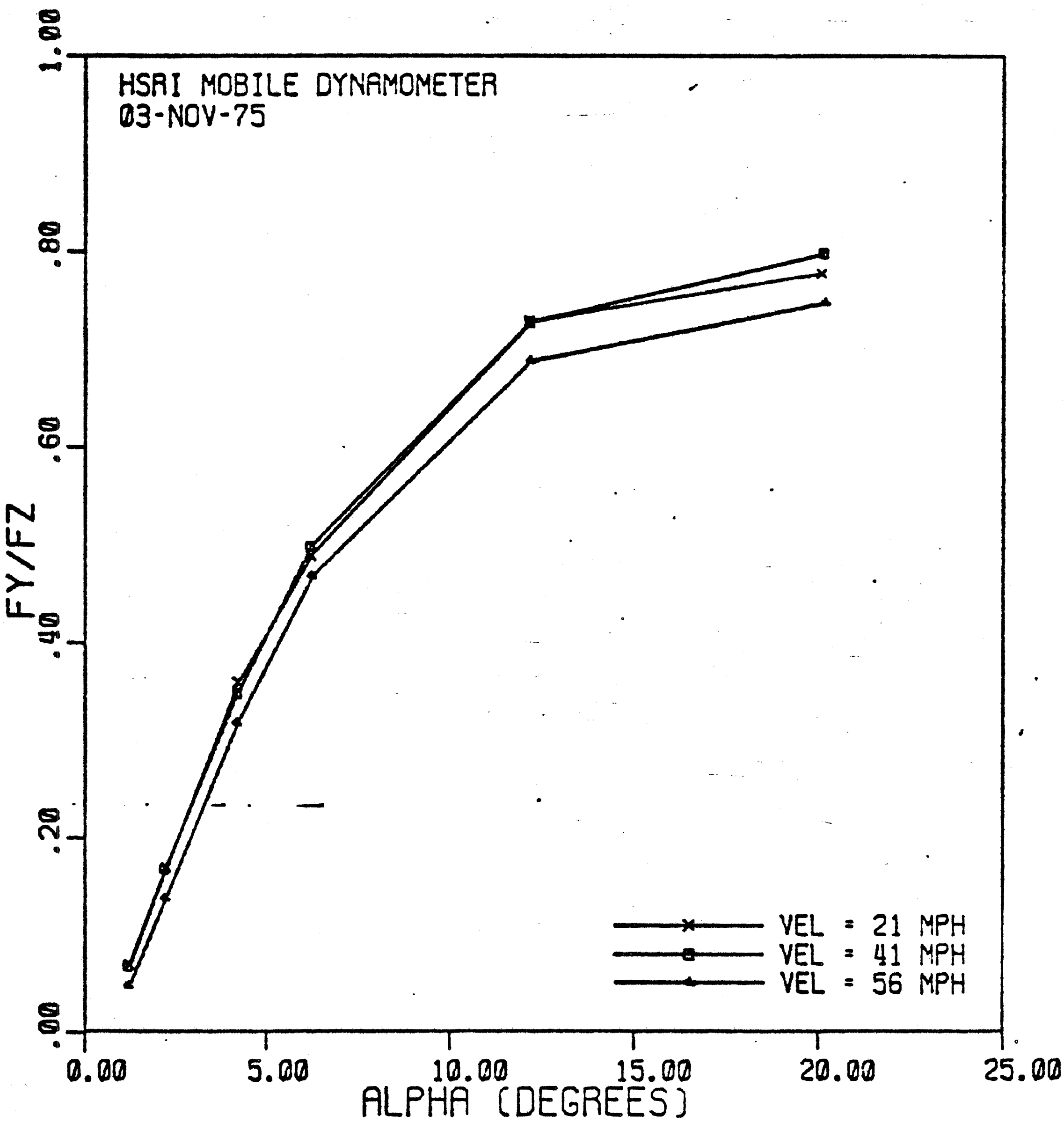
PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	20.4	-234.1	196.9	-434.2	408.4	-747.6	713.0	-1225.0	1148.7	-1468.0	1524.7	-1477.5	1341.9
100.0	4000.0	-7.2	-418.3	361.3	-797.1	751.0	-1413.3	1321.0	-2263.7	2191.4	-2751.5	2915.1	-2819.6	2617.1
100.0	6000.0	-39.6	-540.8	474.7	-1032.4	966.2	-1855.2	1767.8	-3116.4	2987.8	-3883.7	3995.2	-3938.3	3597.3
100.0	8000.0	-43.3	-624.6	559.5	-1198.7	1096.2	-2160.0	2073.3	-3682.0	3596.3	-4577.9	4577.9	-5025.4	4811.8
75.0	4000.0	-29.4	-491.6	410.0	-844.2	737.8	-1506.1	1436.1	-2386.3	2380.3			-3205.5	3133.9
75.0	6000.0	-37.8	-570.3	491.1	-1067.8	980.3	-1927.1	1841.0	-3127.5	3075.2			-4314.9	4292.2
50.0	4000.0	-38.2	-472.5	396.6	-856.2	795.7	-1601.9	1489.6	-2398.9	2443.6			-3211.0	3201.2
50.0	6000.0	-34.7	-549.4	486.2	-1067.5	978.9	-1881.6	1783.1	-3054.4	3093.9			-4378.9	4270.4

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

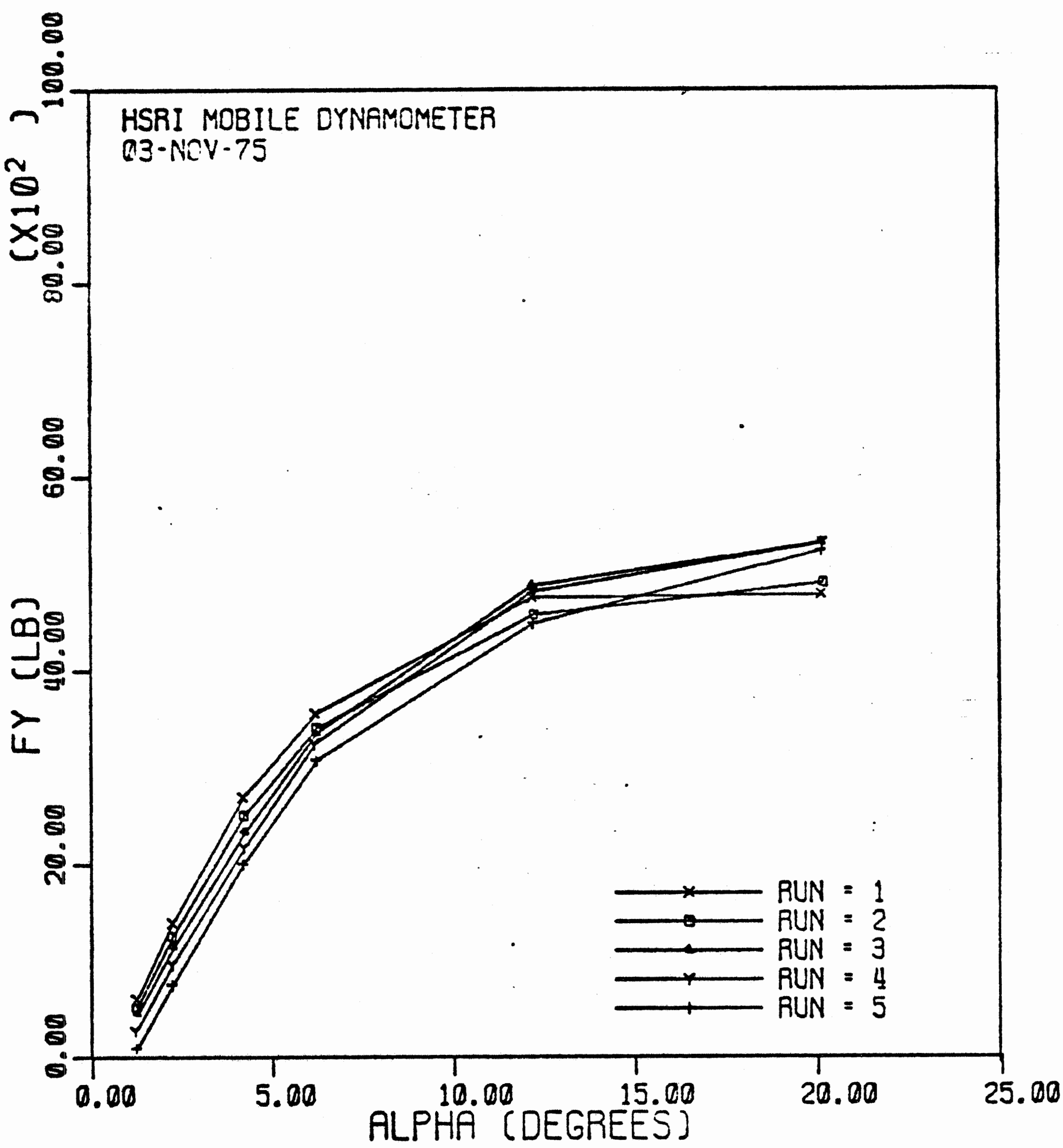
PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
100.0	2000.0	-1.0	26.1	-24.3	43.8	-40.9	53.1	-62.2	48.2	-59.6	30.8	-15.0	14.4	-39.8
100.0	4000.0	0.4	68.1	-58.6	116.0	-110.0	163.4	-162.9	170.1	-169.9	125.4	-119.0	73.8	-119.7
100.0	6000.0	9.3	109.1	-94.2	192.4	-180.9	287.0	-283.2	315.9	-317.6	241.3	-234.0	143.3	-150.8
100.0	8000.0	12.7	150.2	-130.7	270.8	-248.9	420.5	-410.8	492.8	-487.9	363.0	-374.4	-242.3	-239.2
75.0	4000.0	7.2	86.2	-74.8	136.7	-125.3	191.0	-194.9	190.0	-198.1			91.8	-108.8
75.0	6000.0	12.4	126.6	-109.5	230.4	-199.9	330.1	-332.8	364.2	-373.6			178.3	-192.6
50.0	4000.0	7.4	95.2	-83.3	163.9	-153.6	247.2	-237.9	228.5	-234.8			88.8	-107.5
50.0	6000.0	11.1	149.4	-131.8	265.7	-243.3	402.4	-406.0	443.6	-439.1			179.6	-207.8



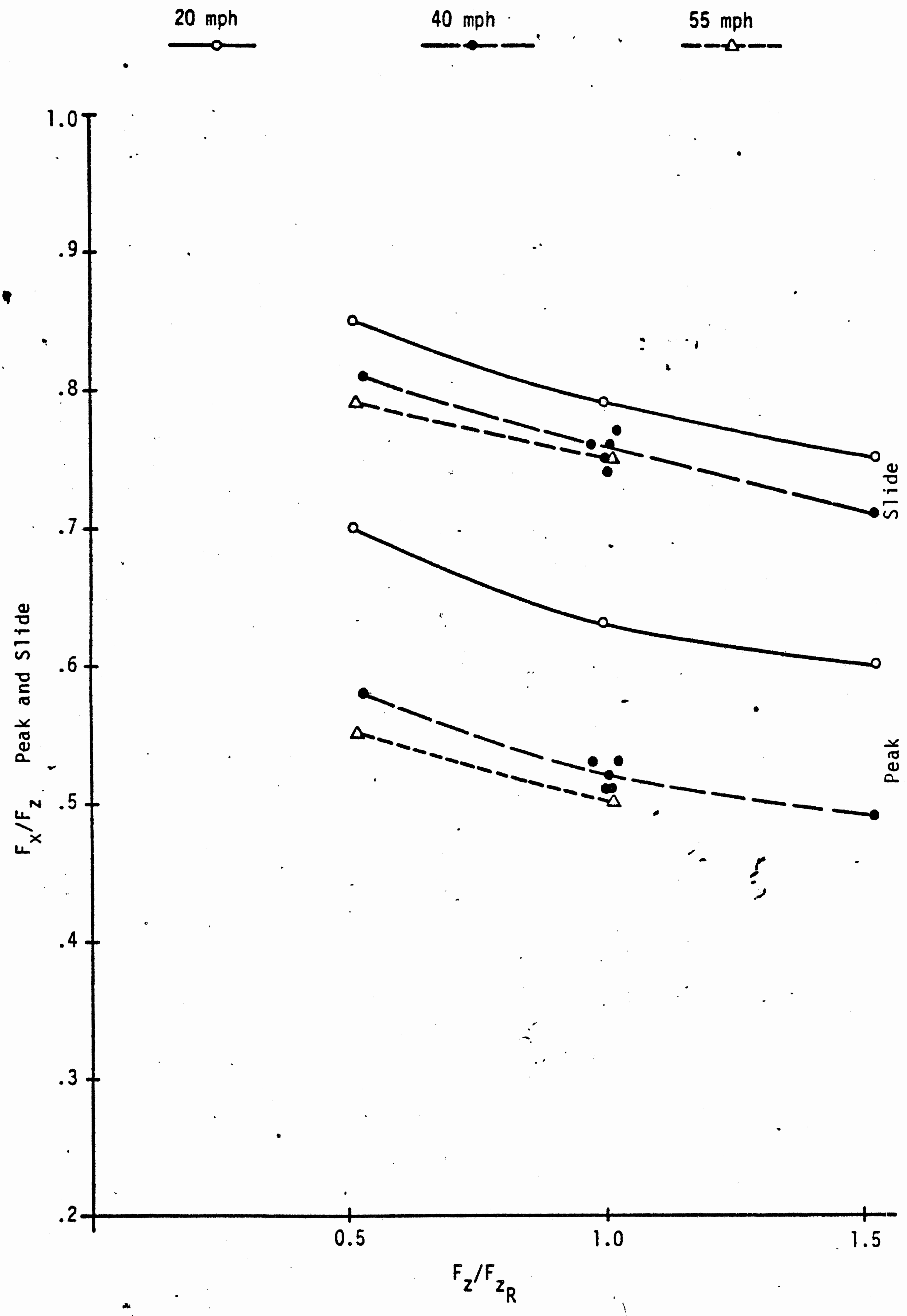
FIRESTONE COMMERCIAL MILEAGE 12.5X22.5/G
VEL = 21 MPH



FIRESTONE COMMERCIAL MILEAGE 12.5X22.5/G
FZ = 6804 LB



FIRESTONE COMMERCIAL MILEAGE 12.5X22.5/G
FZ = 6812 LB VEL = 41 MPH



Summary - Firestone Commercial Mileage - 12.5 x 22.5G

** A-D FILE 99 EW FILE 51 TEST SAMPLE157 **

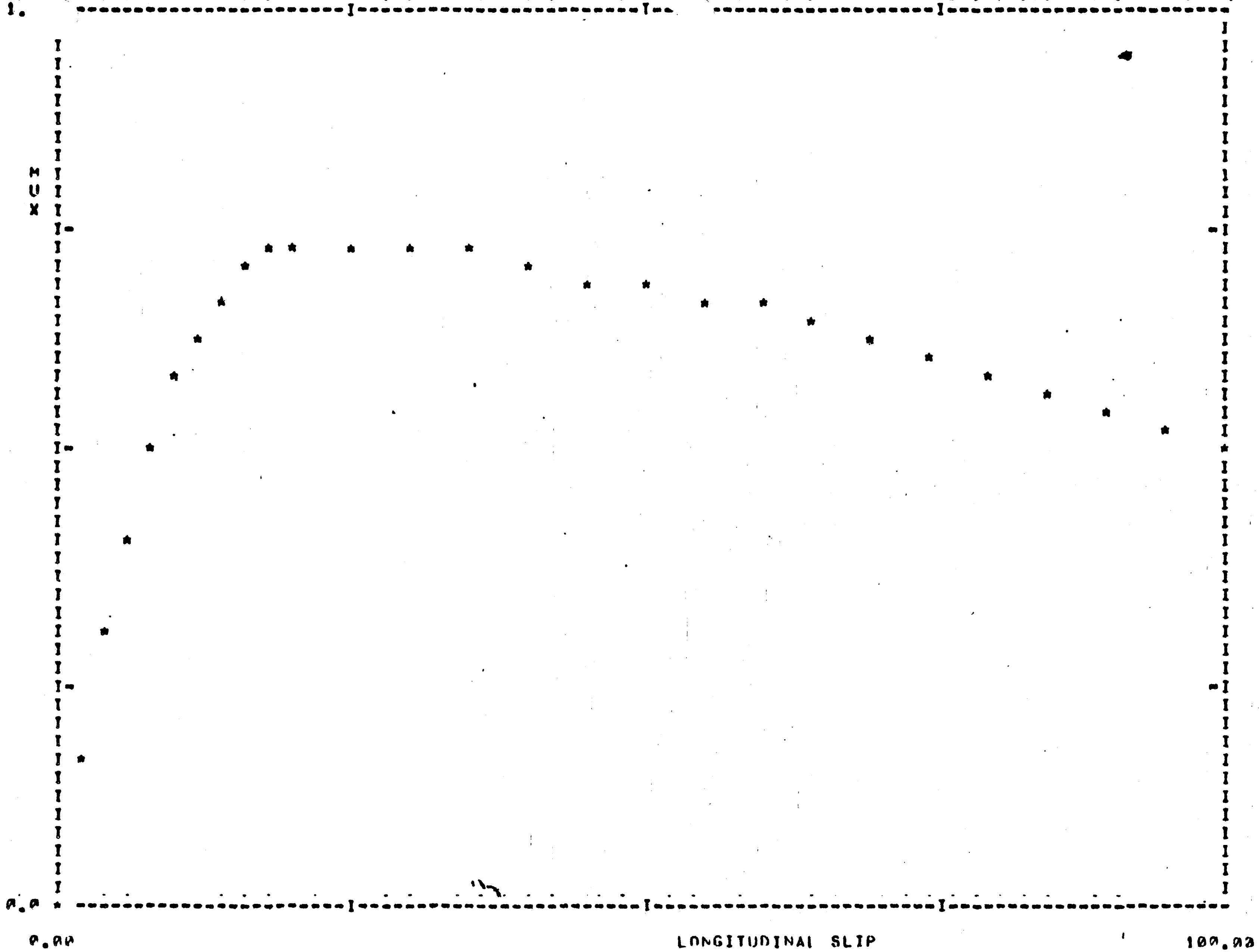
AVERAGE OF FILE 99 FOR 4 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	22458.8	1125.2
0.04	0.30	41848.3	2057.0
0.06	0.42	57533.5	2806.1
0.08	0.51	70673.4	3425.8
0.10	0.59	81009.6	3913.2
0.12	0.64	88963.4	4285.7
0.14	0.68	95126.5	4539.3
0.16	0.71	99552.6	4696.7
0.18	0.73	102377.6	4802.1
0.20	0.74	104259.3	4851.8
0.25	0.74	107760.5	4865.6
0.30	0.74	110601.9	4834.0
0.35	0.73	112931.4	4773.3
0.40	0.72	114782.3	4696.1
0.45	0.71	116176.6	4614.8
0.50	0.69	117268.5	4534.1
0.55	0.68	118229.9	4452.7
0.60	0.67	119077.3	4365.9
0.65	0.65	119278.0	4271.9
0.70	0.64	117776.5	4172.5
0.75	0.62	1138[illegible].4	4[illegible]67.7
0.80	0.60	107134.1	3953.1
0.85	0.58	98443.3	3827.6
0.90	0.56	89537.[illegible]	3791.[illegible]
[illegible].95	[illegible].51	9[illegible]737.3	3574.5
1.[illegible]	0.52	72[illegible]3.8	[illegible]4[illegible].1

TQAV = 72093.8 LOAD = 6776.3 VEL = 40.0 MPH.

MUPEAK = 0.74 MULOCK = 0.52 RATIO = 1.42

FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G DANA)



FZ = 6776.3 VFL = 40.0 MULOCK = 0.52 MUPEAK = 0.74 RATIO = 1.42 A-D FILE 99 NWFILE 51 SAMPLE 157

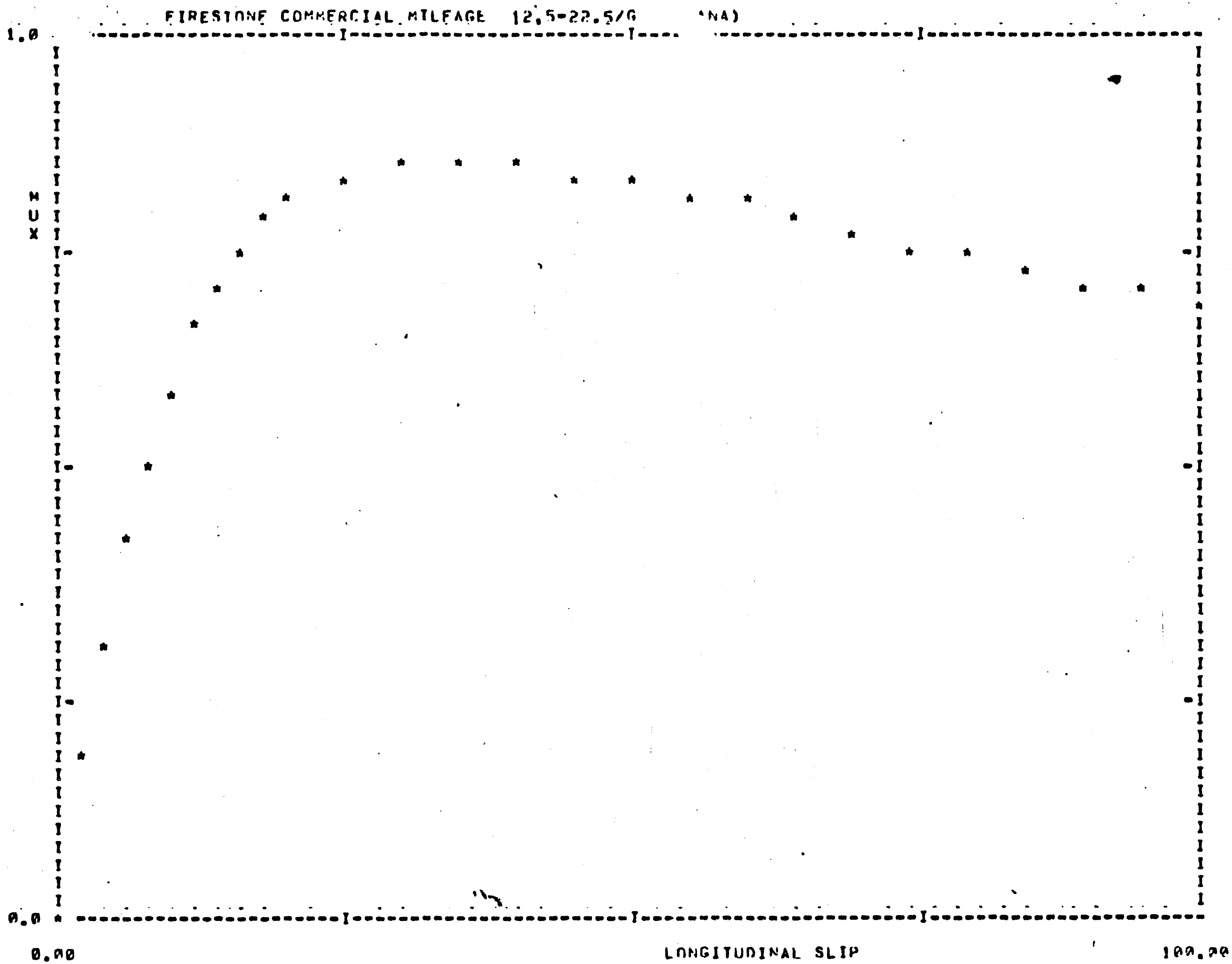
** A-D FILE 100 EX FILE 32 TEST SAMPLE15A **

AVERAGE OF FILE 100 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	13798.2	664.9
0.04	0.31	23692.8	1096.8
0.06	0.42	31936.5	1469.5
0.08	0.52	38947.7	1789.8
0.10	0.60	44948.9	2056.0
0.12	0.67	49909.7	2270.3
0.14	0.73	53957.7	2439.4
0.16	0.77	57187.6	2567.9
0.18	0.80	59767.9	2662.7
0.20	0.82	61746.9	2718.5
0.25	0.84	65902.5	2786.2
0.30	0.85	69596.1	2819.6
0.35	0.85	72902.8	2828.9
0.40	0.85	76067.9	2818.2
0.45	0.84	78917.8	2795.8
0.50	0.84	81278.4	2765.3
0.55	0.82	82271.7	2726.0
0.60	0.81	81696.4	2682.8
0.65	0.79	79944.6	2635.4
0.70	0.78	76767.5	2581.9
0.75	0.76	72198.4	2530.5
0.80	0.75	67183.7	2491.0
0.85	0.74	62676.0	2455.1
0.90	0.73	58404.7	2426.6
0.95	0.71	54388.0	2387.8
1.00	0.70	50750.0	2357.5

TQAV = 50750.0 LOAD = 3463.9 VEL = 20.0 MPH.

MUPEAK = 0.85 MULOCK = 0.70 RATIO = 1.22



FZ = 3463.9 VEL = 20.0 MULOCK = 0.70 MUPEAK = 0.85 RATIO = 1.22 A-D FILE 100 NWFILE 52 SAMPLE 150

** A-D FILE 101 EW FILE 53 TEST SAMPLE159 **

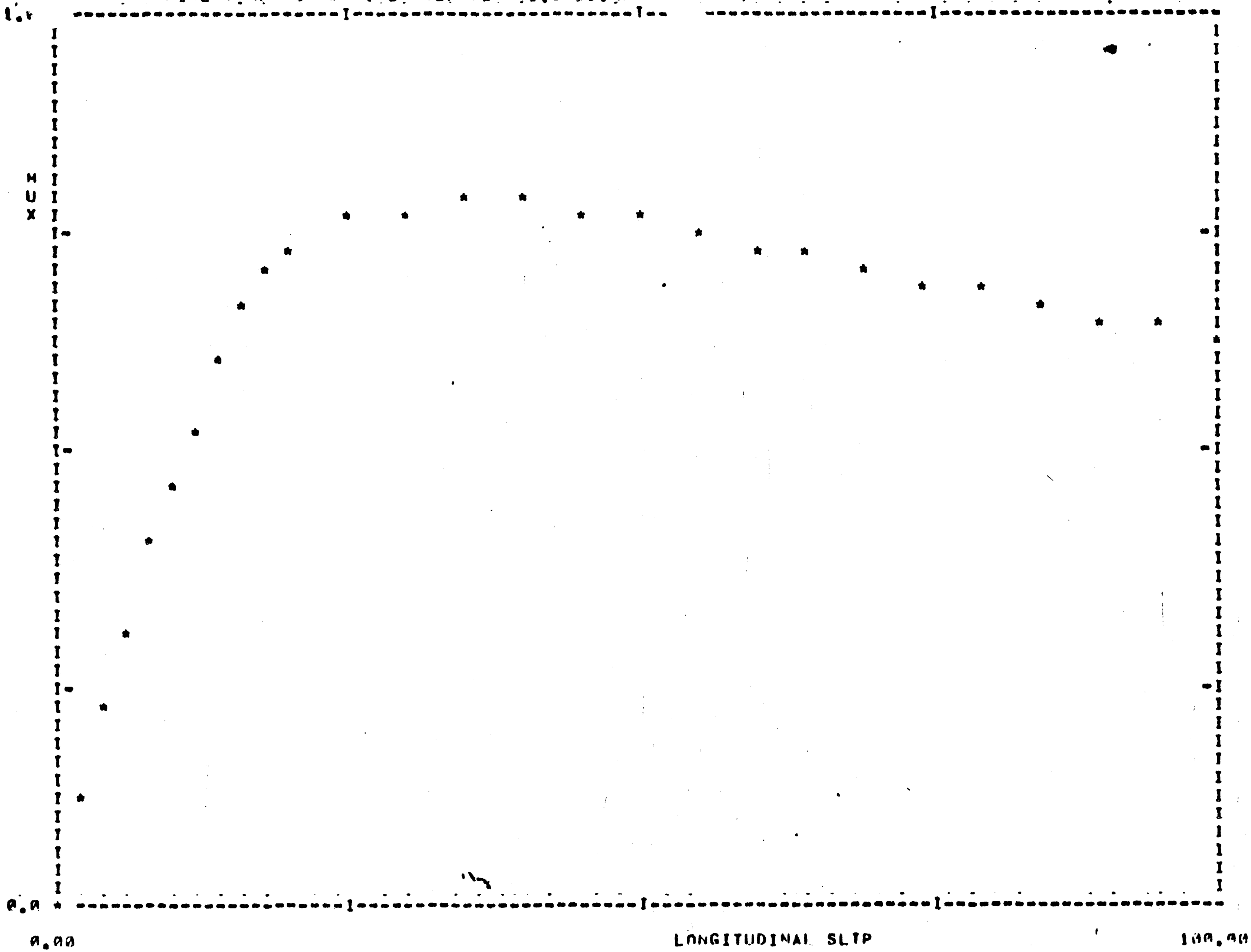
AVERAGE OF FILE 101 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5 (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.12	16370.2	825.5
0.04	0.22	29820.9	1474.7
0.06	0.32	42409.8	2089.6
0.08	0.40	53827.4	2645.8
0.10	0.47	63434.3	3105.3
0.12	0.54	72398.3	3531.9
0.14	0.62	83515.3	4041.8
0.16	0.68	92202.0	4429.9
0.18	0.72	98026.2	4689.1
0.20	0.75	101360.1	4829.2
0.25	0.77	107218.4	4991.2
0.30	0.79	111538.5	5072.7
0.35	0.79	114765.9	5103.6
0.40	0.79	117493.2	5098.4
0.45	0.78	120988.0	5063.0
0.50	0.77	122358.4	5005.8
0.55	0.76	123860.3	4933.3
0.60	0.75	123867.2	4849.9
0.65	0.73	121843.5	4763.9
0.70	0.72	118026.1	4676.0
0.75	0.70	112661.9	4589.3
0.80	0.69	106607.8	4503.1
0.85	0.68	100798.0	4412.7
0.90	0.66	95222.3	4320.1
0.95	0.65	89955.5	4226.4
1.00	0.63	85145.8	4131.3

TQAV = 85145.8 LOAD = 4684.3 VEL = 20.0 MPH.

MUPEAK = 0.79 MULOCK = 0.63 RATIO = 1.26

FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DATA)



FZ = 6684.3 VFL = 20.0 MULOCK = 0.63 MUPEAK = 0.79 RATIO = 1.26 A-D FILE 101 NNFILE . 53 SAMPLE 159

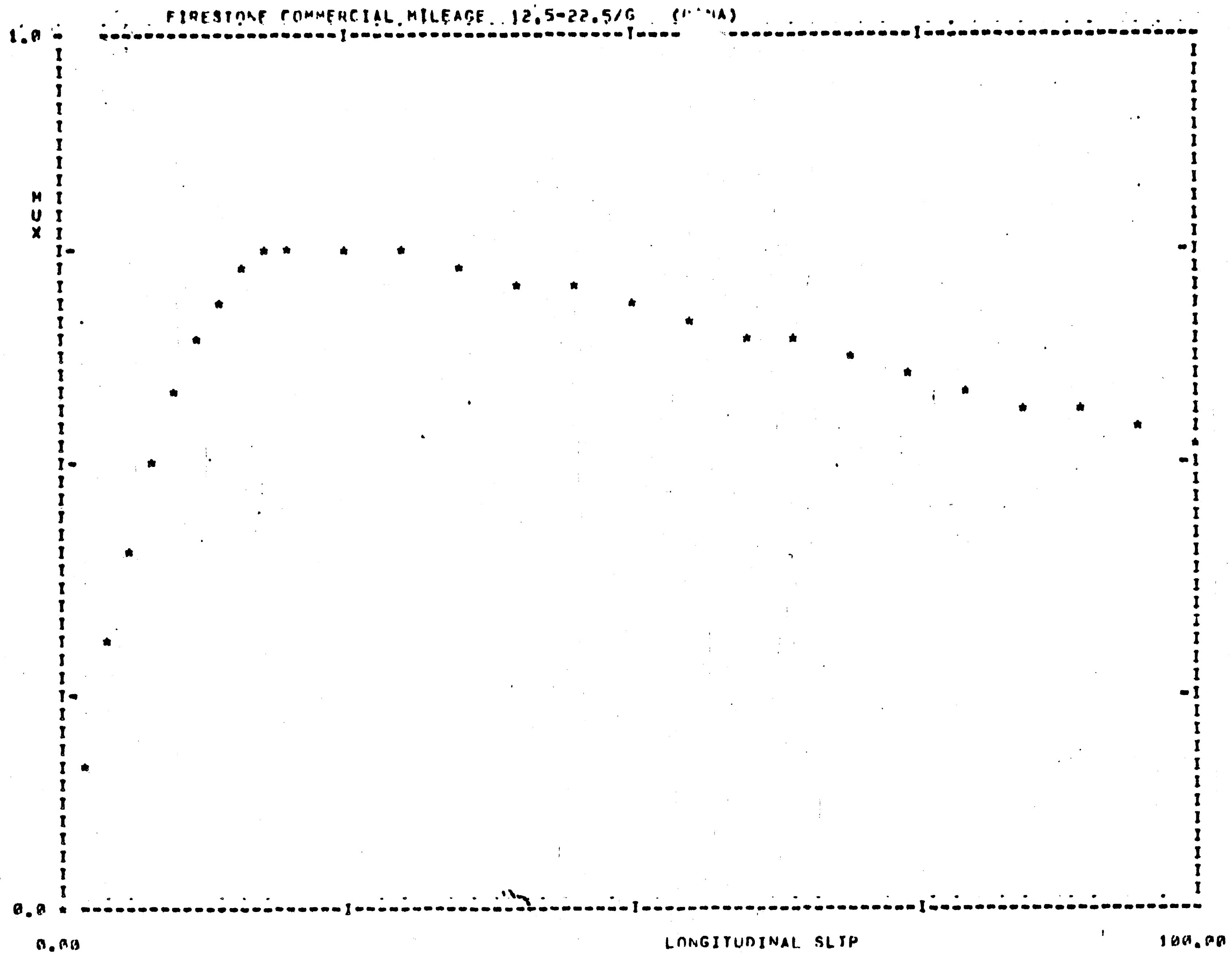
** A-D FILE 102 FW FILE 54. TEST SAMPLE160 **

AVERAGE OF FILE 102 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	21388.7	1110.6
0.04	0.30	40039.6	2000.5
0.06	0.42	56329.1	2780.3
0.08	0.52	69917.8	3429.8
0.10	0.60	80951.7	3948.2
0.12	0.66	89445.3	4343.4
0.14	0.70	96070.7	4641.0
0.16	0.73	101101.4	4869.4
0.18	0.75	105272.6	5022.7
0.20	0.76	107953.4	5083.4
0.25	0.76	111979.2	5086.4
0.30	0.75	114962.4	5018.6
0.35	0.74	117301.3	4911.7
0.40	0.72	119132.0	4794.8
0.45	0.71	120564.1	4681.3
0.50	0.69	121760.4	4569.6
0.55	0.68	122789.6	4454.2
0.60	0.66	123345.8	4330.4
0.65	0.65	122500.8	4200.0
0.70	0.63	119457.1	4065.1
0.75	0.61	113734.2	3928.7
0.80	0.60	104953.4	3792.6
0.85	0.58	94581.1	3666.2
0.90	0.56	85469.6	3553.2
0.95	0.55	77159.3	3446.0
1.00	0.53	69708.3	3345.0

TQAV = 69708.3 LOAD = 6553.7 VEL = 40.0 MPH.

MUPEAK = 0.76 MULOCK = 0.53 RATIO = 1.43



FZ = 6553.7 VFL = 40.0 MULOCK = 0.53 MUPEAK = 0.76 RATIO = 1.43 A-D FILE 102 NWFILE 54 SAMPLE 160

** A-D FILE 103 LW FILE 55 TEST SAMPLE160 **

AVERAGE OF FILE 103 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

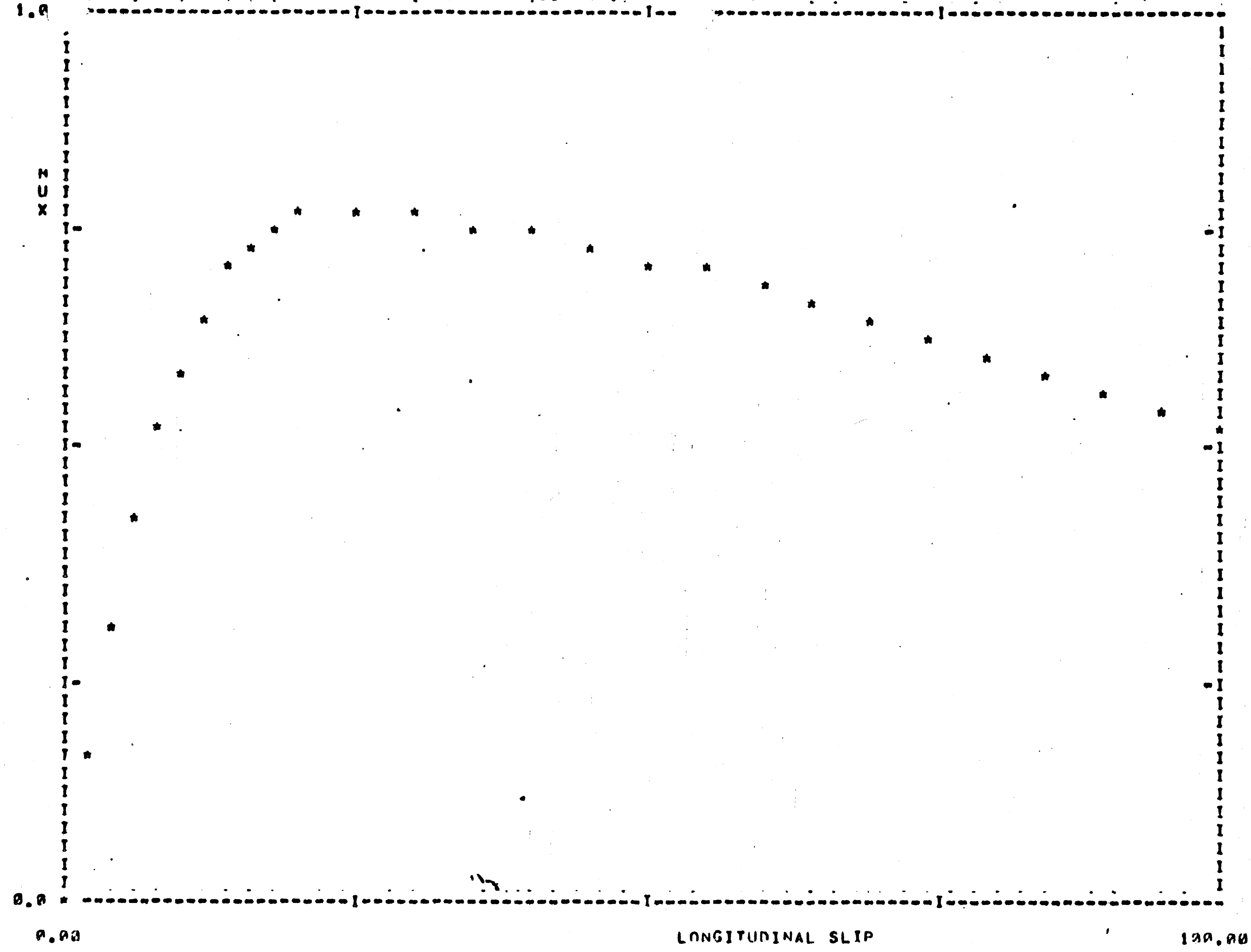
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	21624.5	1078.0
0.04	0.31	42030.3	2056.3
0.06	0.43	59004.7	2862.5
0.08	0.52	72749.3	3501.9
0.10	0.60	83397.7	3995.8
0.12	0.66	91741.6	4369.5
0.14	0.71	97924.0	4645.4
0.16	0.74	102636.4	4838.3
0.18	0.76	106219.0	4964.8
0.20	0.77	108770.7	5022.5
0.25	0.77	113064.6	5059.5
0.30	0.77	116450.5	5036.8
0.35	0.76	119092.0	4986.8
0.40	0.75	121211.0	4920.1
0.45	0.74	122963.4	4845.2
0.50	0.73	124560.2	4758.6
0.55	0.71	126133.3	4653.4
0.60	0.69	127272.6	4533.4
0.65	0.67	126857.9	4406.7
0.70	0.65	124332.9	4277.8
0.75	0.63	118757.6	4149.3
0.80	0.61	109972.7	4018.7
0.85	0.59	99359.3	3886.5
0.90	0.57	89844.5	3756.5
0.95	0.55	81104.4	3628.4
1.00	0.53	73250.0	3502.5

TQAV = 73250.0 LOAD = 4767.7 VEL = 40.0 MPH.

MUPEAK = 0.77 MULOCK = 0.53 RATIO = 1.46

430

FIRESTONE COMMERCIAL MILEAGE (12.5-22.5/G ANA)



FZ = 6767.7 VFL = 40.0 MULOCK = 0.53 MUPEAK = 0.77 RATIO = 1.46 A-D FILE 103 NWFILE 55 SAMPLE 160

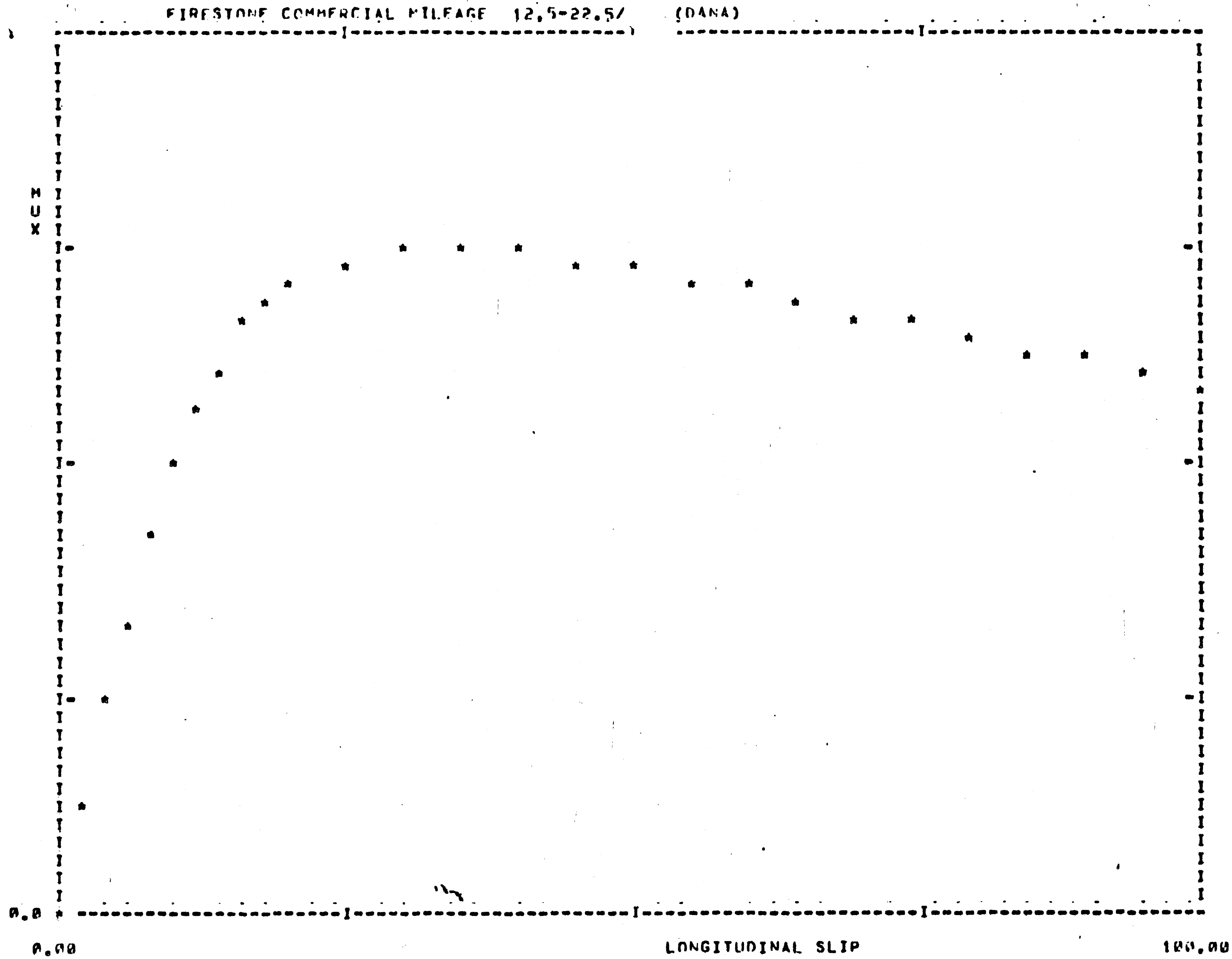
** A-D FILE 100 .. FILE 56 TEST SAMPLE161 **

AVERAGE OF FILE 100 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.13	26282.6	1326.9
0.04	0.24	48798.4	2463.0
0.06	0.34	67984.6	3411.4
0.08	0.43	85088.9	4268.0
0.10	0.50	100241.1	5022.2
0.12	0.57	112808.8	5654.4
0.14	0.62	122965.9	6165.1
0.16	0.67	131187.2	6565.1
0.18	0.70	137543.5	6853.3
0.20	0.72	141229.9	7014.4
0.25	0.74	147342.4	7201.7
0.30	0.75	151560.3	7281.4
0.35	0.75	154318.0	7292.1
0.40	0.75	156205.5	7258.1
0.45	0.75	157632.1	7189.6
0.50	0.74	158749.5	7095.3
0.55	0.72	159318.2	6981.5
0.60	0.71	158940.1	6857.7
0.65	0.70	156266.0	6727.0
0.70	0.68	153337.0	6592.7
0.75	0.67	148412.6	6160.4
0.80	0.66	143023.3	6335.8
0.85	0.64	137390.6	6213.3
0.90	0.63	131643.7	6091.6
0.95	0.62	125894.9	5970.8
1.00	0.60	120166.7	5851.2

TQAV = 120166.7 LOAD = 10234.7 VEL = 20.0 MPH.

MUPEAK = 0.75 MULOCK = 0.60 RATIO = 1.25



FZ = 10234.7 VFL = 20.0 MULOCK = 0.60 MUPEAK = 0.75 RATIO = 1.25 A-D FILE 104 NWFILE 56 SAMPLE 161

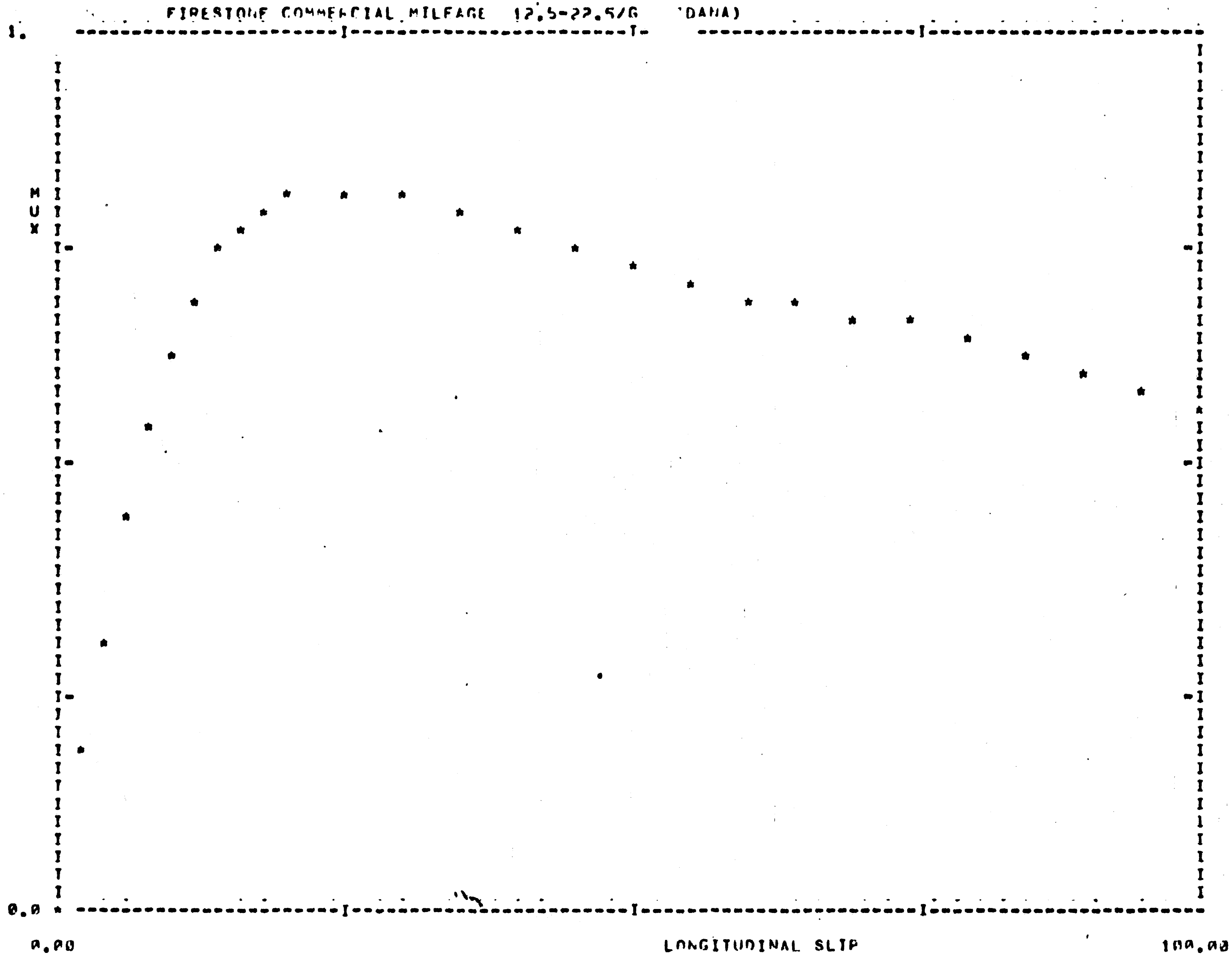
** A-D FILE 105 NEW FILE 57 TEST SAMPLE162 **

AVERAGE OF FILE 105 FOR 4 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	13495.0	629.3
0.04	0.32	24757.8	1114.9
0.06	0.44	34484.7	1545.7
0.08	0.55	42958.4	1918.6
0.10	0.64	49973.1	2215.0
0.12	0.70	55433.9	2447.5
0.14	0.75	59725.7	2618.1
0.16	0.79	63343.6	2733.5
0.18	0.81	66448.8	2802.0
0.20	0.81	68836.5	2822.7
0.25	0.81	73085.4	2827.3
0.30	0.81	76599.9	2808.9
0.35	0.80	79815.0	2765.8
0.40	0.79	83047.9	2701.0
0.45	0.77	86347.8	2623.4
0.50	0.74	89513.7	2539.3
0.55	0.72	92085.8	2458.3
0.60	0.70	93231.1	2389.3
0.65	0.69	91733.0	2336.3
0.70	0.68	87697.7	2291.5
0.75	0.67	81488.0	2242.0
0.80	0.65	73112.3	2181.8
0.85	0.63	63957.8	2117.5
0.90	0.61	56364.5	2061.0
0.95	0.60	46845.2	2000.0
1.00	0.58	42343.7	1961.3

TQAV = 42343.7 LOAD = 3558.7 VEL = 40.0 MPH.

MUPEAK = 0.81 MULOCK = 0.58 RATIO = 1.41



FZ = 3558.7 VFL = 40.0 MULOCK = 0.58 MUPEAK = 0.81 RATIO = 1.41 A-D FILE 105 NWFILE 57 SAMPLE 162

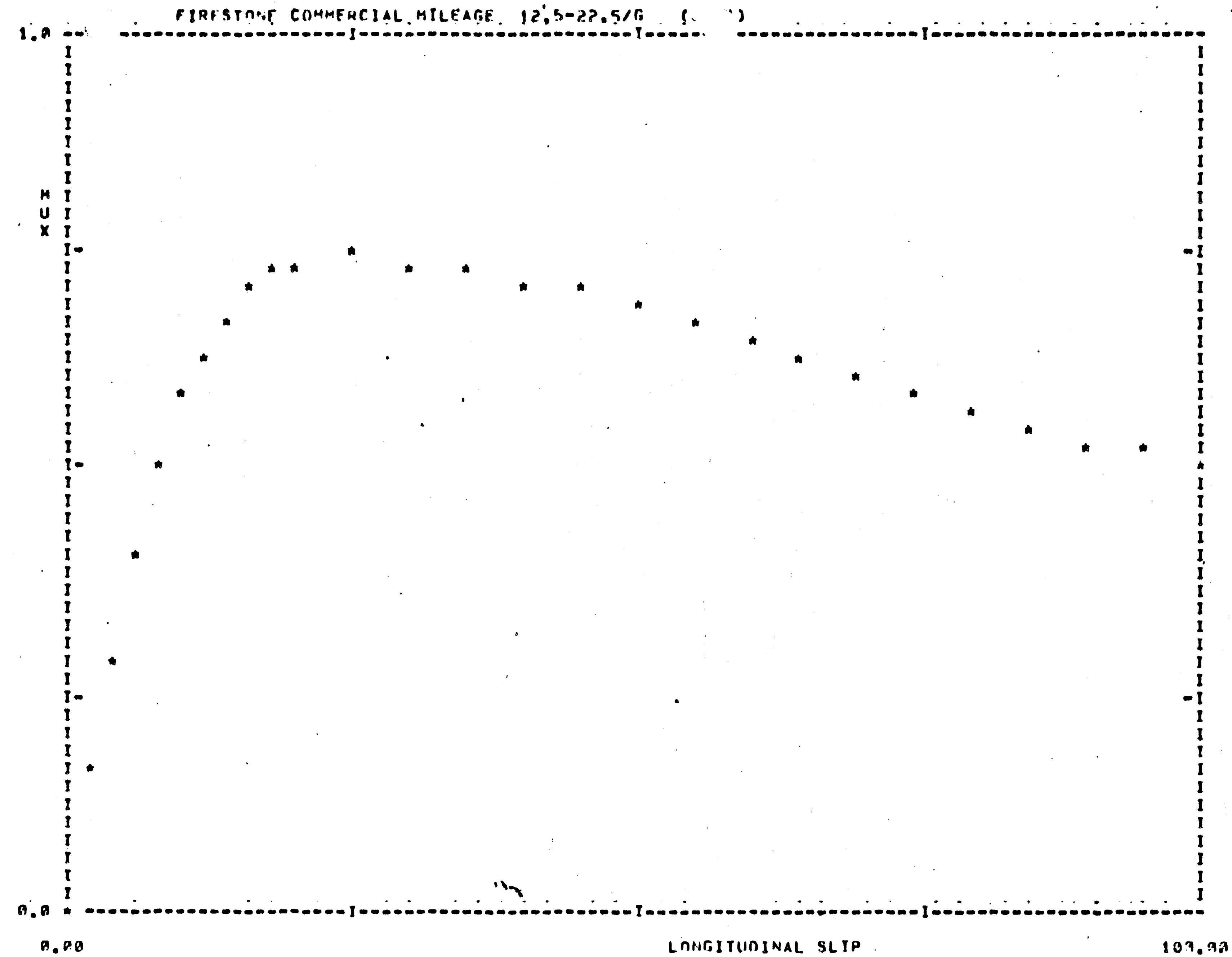
** A-D FILE 106 NEW FILE 58 TEST SAMPLE163 **

AVERAGE OF FILE 106 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	21537.7	1082.5
0.04	0.29	40470.6	1987.0
0.06	0.41	56821.9	2766.0
0.08	0.51	70376.9	3409.5
0.10	0.58	81232.9	3905.4
0.12	0.64	89292.1	4273.2
0.14	0.68	95577.7	4528.8
0.16	0.71	100434.6	4708.6
0.18	0.73	104068.8	4830.4
0.20	0.74	106564.7	4883.7
0.25	0.75	110909.5	4909.6
0.30	0.75	114328.5	4882.1
0.35	0.74	117038.4	4818.5
0.40	0.72	119304.4	4731.7
0.45	0.71	121372.7	4629.8
0.50	0.69	123359.6	4515.2
0.55	0.67	125103.5	4388.9
0.60	0.65	125828.0	4258.5
0.65	0.63	124457.2	4132.5
0.70	0.61	120325.8	4038.1
0.75	0.60	113458.0	3886.0
0.80	0.58	104359.8	3763.7
0.85	0.56	94607.6	3649.0
0.90	0.54	85741.6	3542.1
0.95	0.53	77468.0	3439.3
1.00	0.51	69895.8	3341.3

TQAV = 69895.8 LOAD = 6724.2 VEL = 40.0 MPH.

MUPEAK = 0.75 MULOCK = 0.51 RATIO = 1.47



FZ = 6724.2 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.75 RATIO = 1.47 A-D FILE 106 NWFILE 58 SAMPLE 163

** A-D FILE 110 , FILE 50 TEST SAMPLE160 **

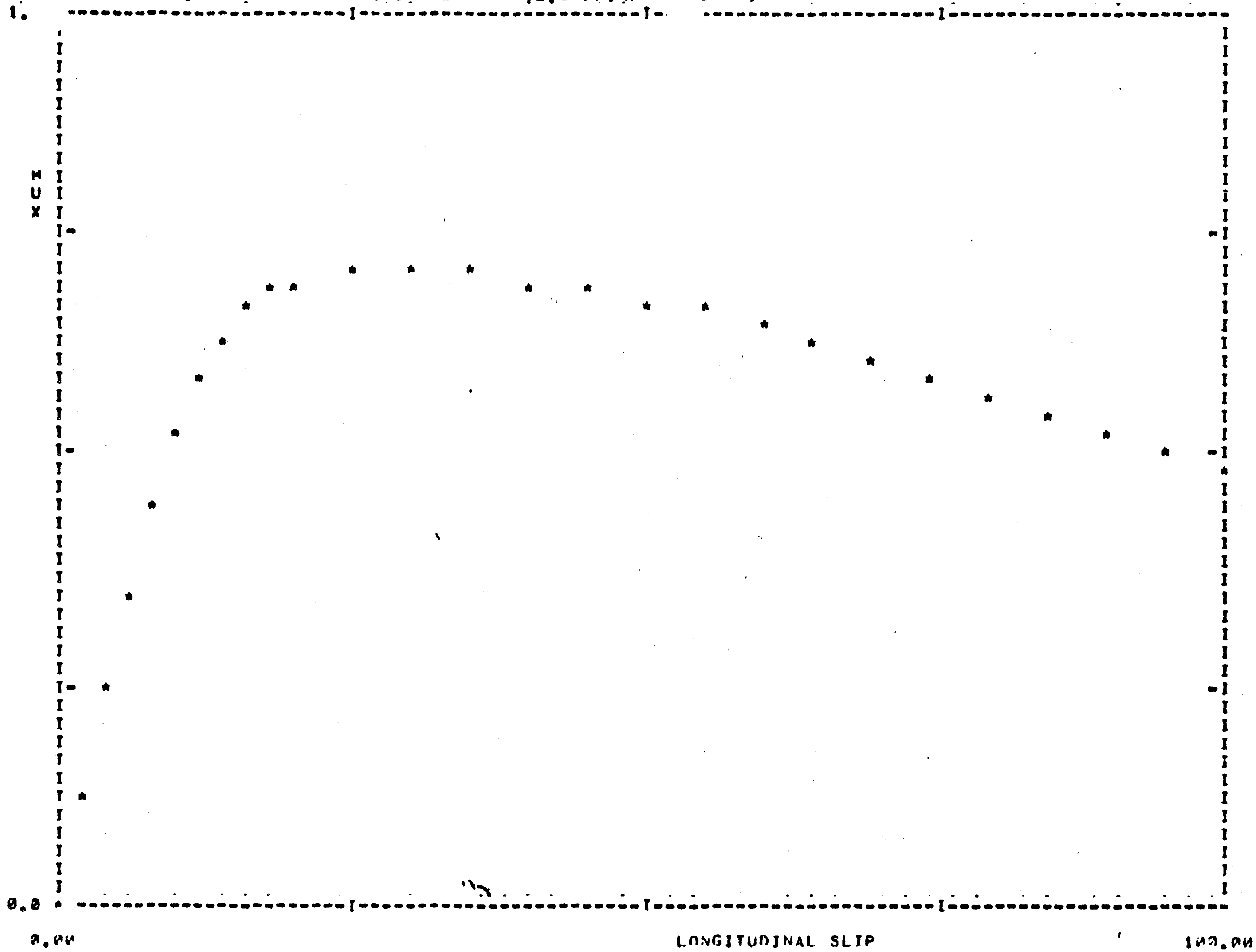
AVERAGE OF FILE 110 FOR 3 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.13	26453.9	1337.1
0.04	0.25	52228.0	2562.1
0.06	0.36	74090.6	3623.1
0.08	0.45	92631.2	4538.5
0.10	0.53	107906.0	5288.7
0.12	0.59	119792.0	5867.4
0.14	0.64	128758.7	6289.6
0.16	0.67	135189.7	6587.0
0.18	0.69	139641.9	6779.6
0.20	0.70	142378.6	6861.0
0.25	0.71	146286.0	6933.1
0.30	0.71	149123.9	6928.8
0.35	0.71	151096.5	6880.2
0.40	0.70	152246.5	6809.6
0.45	0.69	153093.2	6717.6
0.50	0.68	154099.8	6599.3
0.55	0.67	155266.8	6457.5
0.60	0.65	156447.3	6292.3
0.65	0.63	156594.2	6115.7
0.70	0.61	154102.7	5933.0
0.75	0.59	148292.5	5745.9
0.80	0.57	139025.0	5547.8
0.85	0.55	128985.1	5345.8
0.90	0.53	118065.2	5146.0
0.95	0.51	107525.7	4949.5
1.00	0.49	97375.0	4757.5

TQAV = 97375.0 LOAD = 10210.6 VEL = 40.0 MPH

MUPEAK = 0.71 MULOCK = 0.49 RATIO = 1.47

FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)



FZ = 10210.6 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.71 RATIO = 1.47 A-D FILE 110 NWFILE 59 SAMPLE 164

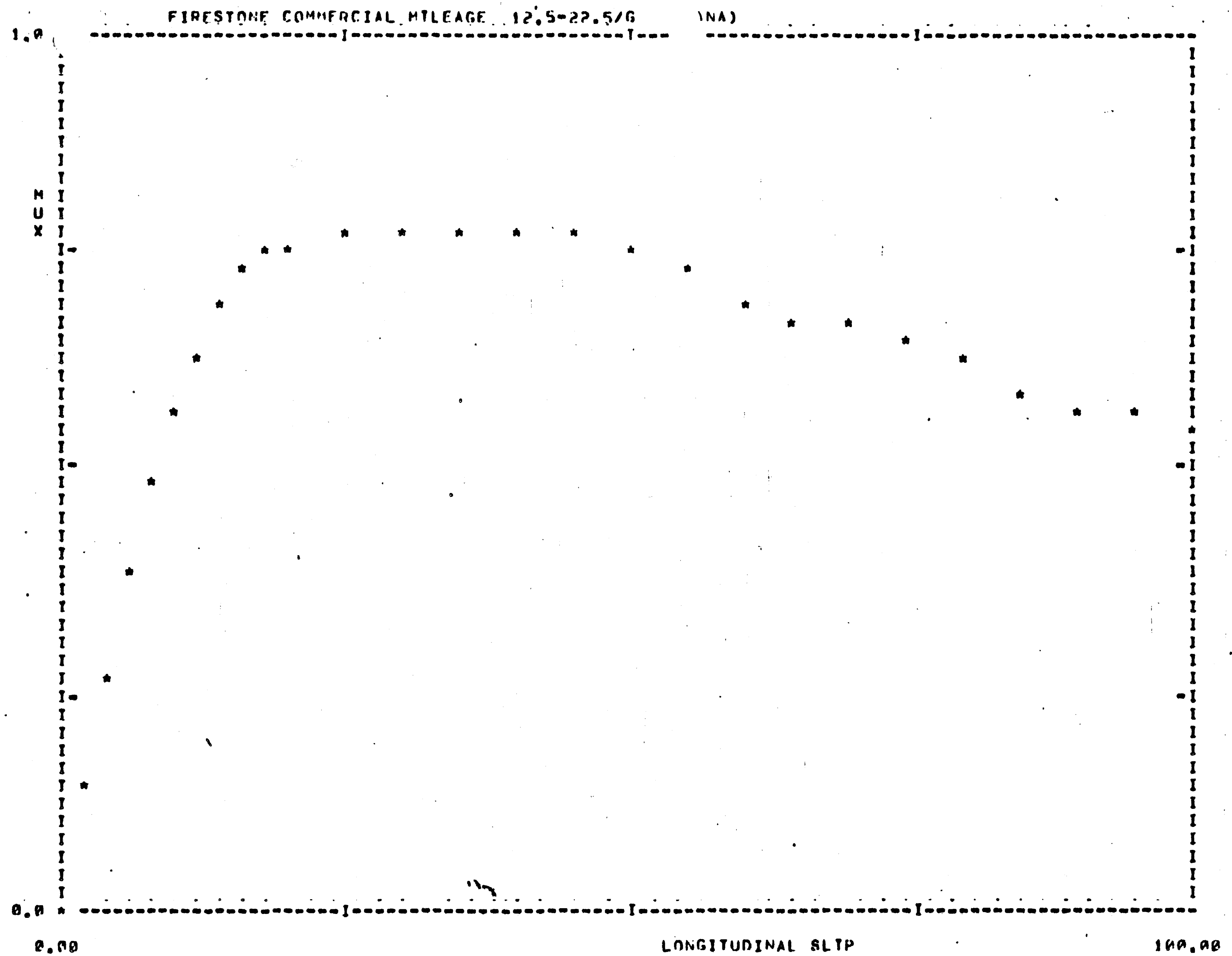
** A-D FILE 111 IN FILE 69 TEST SAMPLE165 **

AVERAGE OF FILE 111 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.14	12752.6	484.1
0.04	0.27	24499.7	952.1
0.06	0.39	34629.4	1371.0
0.08	0.49	43430.2	1718.0
0.10	0.57	50735.3	1990.8
0.12	0.64	56620.1	2204.9
0.14	0.69	61440.3	2371.3
0.16	0.73	65449.0	2493.6
0.18	0.75	68962.4	2573.6
0.20	0.77	71911.0	2611.0
0.25	0.78	78076.2	2650.0
0.30	0.79	83462.5	2661.0
0.35	0.79	88183.9	2652.3
0.40	0.78	92469.3	2628.4
0.45	0.77	96604.0	2585.1
0.50	0.75	100710.1	2522.4
0.55	0.73	104289.4	2445.6
0.60	0.71	106173.4	2367.2
0.65	0.68	105483.0	2292.8
0.70	0.67	101253.0	2229.8
0.75	0.65	93170.3	2169.2
0.80	0.63	81680.6	2099.5
0.85	0.62	68533.5	2022.8
0.90	0.58	57608.1	1955.8
0.95	0.56	47937.5	1899.6
1.00	0.55	39625.0	[illegible]

TQAV = 39625.0 LOAD = 3494.0 VFL = 55.0 MPH.

MUPEAK = 0.79 MULOCK = 0.55 RATIO = 1.44



FZ = 3494.8 VEL = 55.0 MULOCK = 0.55 MUPEAK = 0.79 RATIO = 1.44 A-D FILE 111 NWFILE 60 SAMPLE 165

7

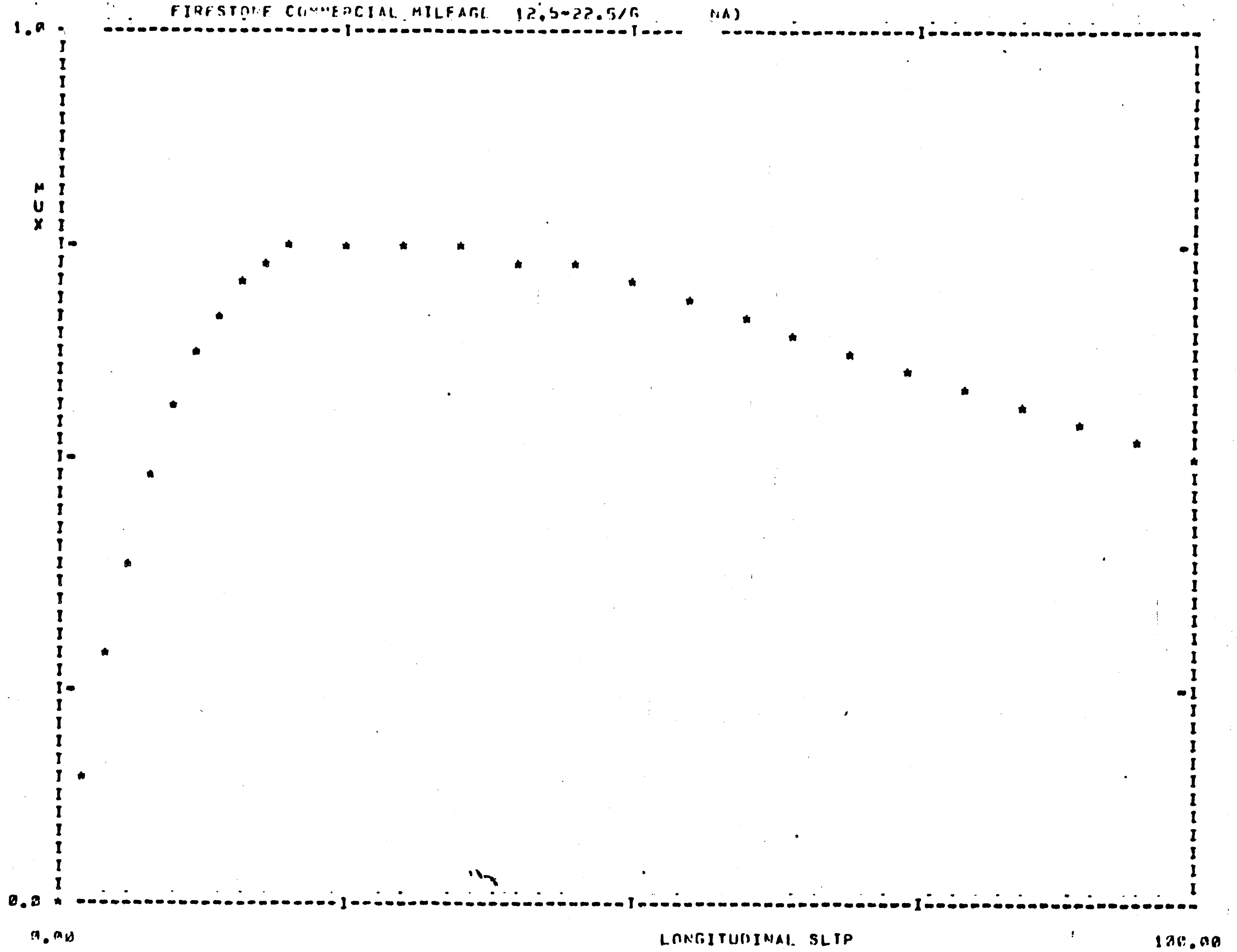
** A-D FILE 112 W FILE 62 TEST SAMPLE166 **

AVERAGE OF FILE 112 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.15	21406.5	1039.1
0.04	0.28	40044.9	1887.5
0.06	0.40	56221.1	2639.9
0.08	0.49	69528.1	3255.4
0.10	0.57	80407.5	3747.6
0.12	0.63	89118.5	4141.4
0.14	0.67	95990.6	4450.1
0.16	0.71	101490.6	4682.0
0.18	0.74	105929.3	4845.5
0.20	0.75	109232.0	4927.6
0.25	0.76	115161.1	5003.4
0.30	0.76	120093.2	5014.7
0.35	0.76	124423.5	4975.4
0.40	0.75	128434.2	4900.8
0.45	0.73	132169.7	4798.0
0.50	0.71	135258.3	4675.9
0.55	0.69	136762.0	4546.6
0.60	0.67	135906.3	4423.7
0.65	0.65	132505.9	4303.3
0.70	0.63	126367.0	4182.7
0.75	0.61	117659.5	4056.2
0.80	0.59	106806.8	3922.5
0.85	0.57	95873.6	3789.0
0.90	0.55	86323.2	3658.5
0.95	0.53	77593.5	3531.4
1.00	0.51	69812.5	3408.8

TQAV = 69812.5 LOAD = 6790.3 VEL = 40.0 MPH.

MUPEAK = 0.76 MULOCK = 0.51 RATIO = 1.49



FZ = 6790.3 VEL = 40.0 MULOCK = 0.51 MUPEAK = 0.76 RATIO = 1.49 A-D FILE 112 NWFILE 61 SAMPLE 166

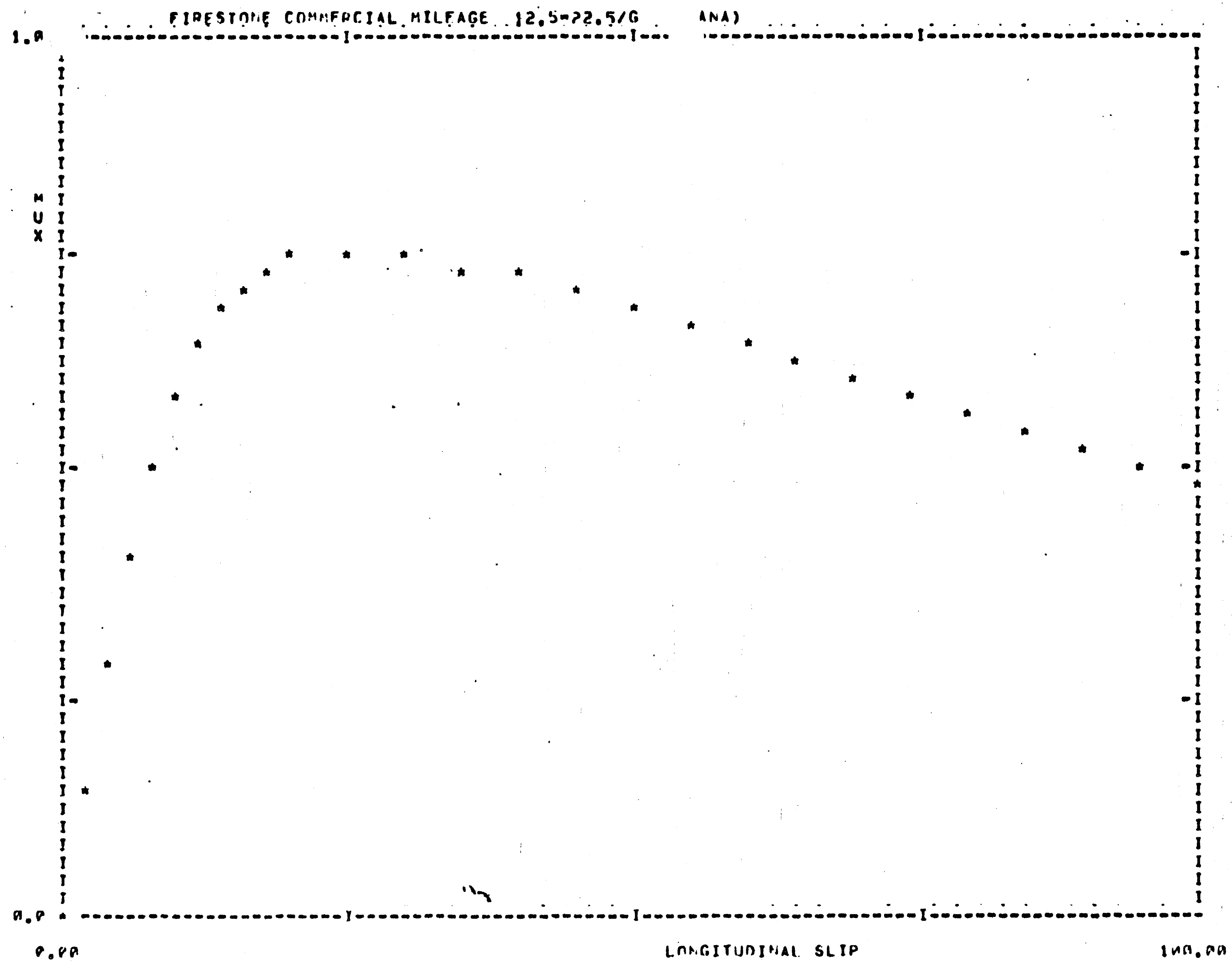
** A-D FILE 113 W FILE 62 TEST SAMPLE167 **

AVERAGE OF FILE 113 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

TQAV = 67270.0 LOAD = 4891.0 VEL = 55.0 MPH.

MUPEAK = 0.75 MULOCK = 0.50 RATIO = 1.52

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.15	21773.0	1035.1
0.04	0.29	42047.5	1967.6
0.06	0.41	59277.9	2770.8
0.08	0.51	73391.8	3423.8
0.10	0.59	84401.0	3931.3
0.12	0.65	92889.6	4304.5
0.14	0.69	99431.1	4569.8
0.16	0.72	104508.4	4748.5
0.18	0.74	108480.2	4857.6
0.20	0.75	111434.4	4891.5
0.25	0.75	117093.5	4883.6
0.30	0.75	121729.2	4835.2
0.35	0.74	125689.0	4760.5
0.40	0.73	129273.8	4671.1
0.45	0.71	132755.1	4569.0
0.50	0.69	136239.1	4454.2
0.55	0.67	139280.6	4327.1
0.60	0.65	140582.6	4200.2
0.65	0.63	139301.5	4076.3
0.70	0.62	134469.8	3959.3
0.75	0.60	125625.0	3844.4
0.80	0.58	113139.8	3724.0
0.85	0.56	98902.2	3600.5
0.90	0.54	87909.3	3483.7
0.95	0.52	76431.2	3377.2
1.0[illegible]	0.51	672[illegible]2.0	3260.0



FZ = 6801.0 VEL = 55.0 MULOCK = 0.50 MUPEAK = 0.75 RATIO = 1.52 A-D FILE 113 NWFILE 62 SAMPLE 167

** A-D FILE 115 NEW FILE 63 TEST SAMPLE169 **

AVERAGE OF FILE 115 FOR 6 RECORDS. FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (DANA)

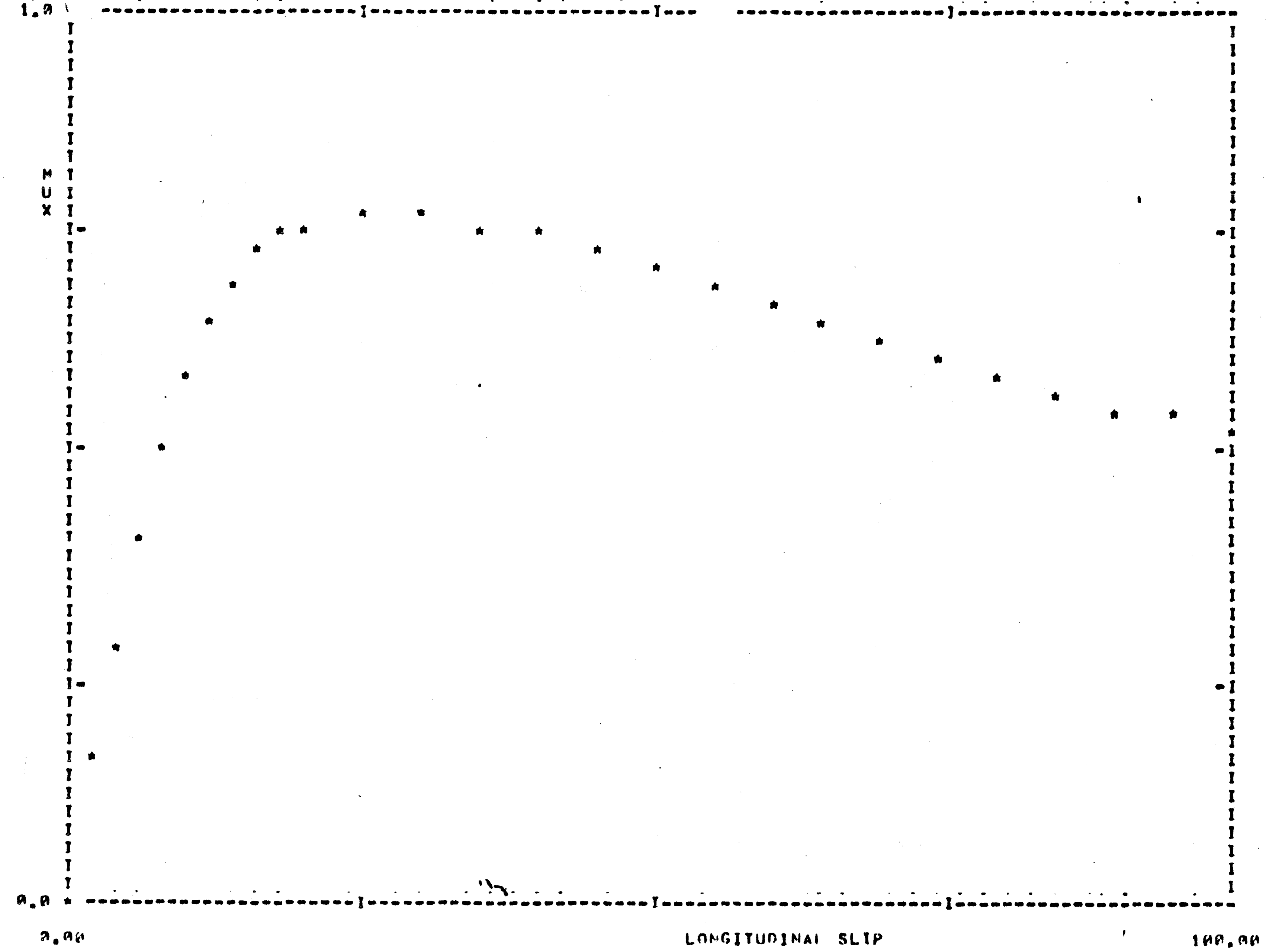
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	23939.2	1149.6
0.04	0.29	42113.6	2014.3
0.06	0.41	58499.8	2800.3
0.08	0.51	72703.4	3479.6
0.10	0.59	84352.8	4035.8
0.12	0.66	93851.4	4463.7
0.14	0.70	100975.3	4771.5
0.16	0.73	106353.8	4983.7
0.18	0.75	110329.8	5118.7
0.20	0.76	112864.5	5171.3
0.25	0.77	117337.6	5206.9
0.30	0.77	120983.0	5198.1
0.35	0.76	123958.9	5151.6
0.40	0.75	126199.9	5078.9
0.45	0.74	127802.4	4986.7
0.50	0.72	129095.1	4873.7
0.55	0.70	129962.4	4742.8
0.60	0.68	129885.2	4601.9
0.65	0.66	128139.3	4458.5
0.70	0.64	124142.6	4318.1
0.75	0.62	117[illegible]3.3	4177.3
0.80	0.60	108572.9	4037.3
0.85	0.58	96987.6	3907.7
0.90	0.56	90253.6	3783.7
0.95	0.55	82[illegible]17.1	3663.6
1.00	0.53	74333.3	35[illegible].6

TQAV = 74333.3 LOAD = 6898.4 VEL = 40.0 MPH.

MUPEAK = 0.77 MULOCK = 0.53 RATIO = 1.46

4446

FIRESTONE COMMERCIAL MILEAGE 12.5-22.5/G (NA)



FZ = 6898.4 VEL = 40.0 MULOCK = 0.53 MUPEAK = 0.77 RATIO = 1.46 A-D FILE 115 NWFILE 63 SAMPLE 169

Tire: Highway Tread 12.5-22.5/G Rim: 22.5x8.25

LATERAL FORCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1960	90	284	540	956	1344	1623	1770
3925	90	470	911	1653	2469	3042	3352
5890	90	593	1157	2117	3261	4121	4629
7850	90	649	1261	2370	3844	4945	5658
9800	90	666	1310	2420	4234	5558	6569

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
1960	90	31	54	77	58	34	13
3925	90	78	140	211	188	130	68
5890	90	126	230	363	353	263	157
7850	90	171	318	530	540	430	270
9800	90	219	417	697	760	636	429

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
1960	90	21,000	
5890	90	62,000	4785
9800	90	50,000	

loads, the tire behaves (laterally) like a softening spring. The lateral spring rate is the slope through the origin of the lateral load-deflection curve.

TRACTION STIFFNESS (C_α, C_γ, C_s) - The following three properties are defined to characterize the mechanical behavior of a rolling tire operated at very small slip and camber angles and for very light application of braking or driving power.

Cornering Stiffness

$$C_\alpha = \left.\frac{dF_y}{d\alpha}\right|_{\alpha=0} \tag{1}$$

Camber Stiffness

$$C_\gamma = \left.\frac{dF_y}{d\gamma}\right|_{\gamma=0} \tag{2}$$

Circumferential Stiffness

$$C_s = \left.\frac{dF_x}{ds}\right|_{s=0} \tag{3}$$

where:

α = slip angle
γ = camber angle
s = circumferential slip parameter

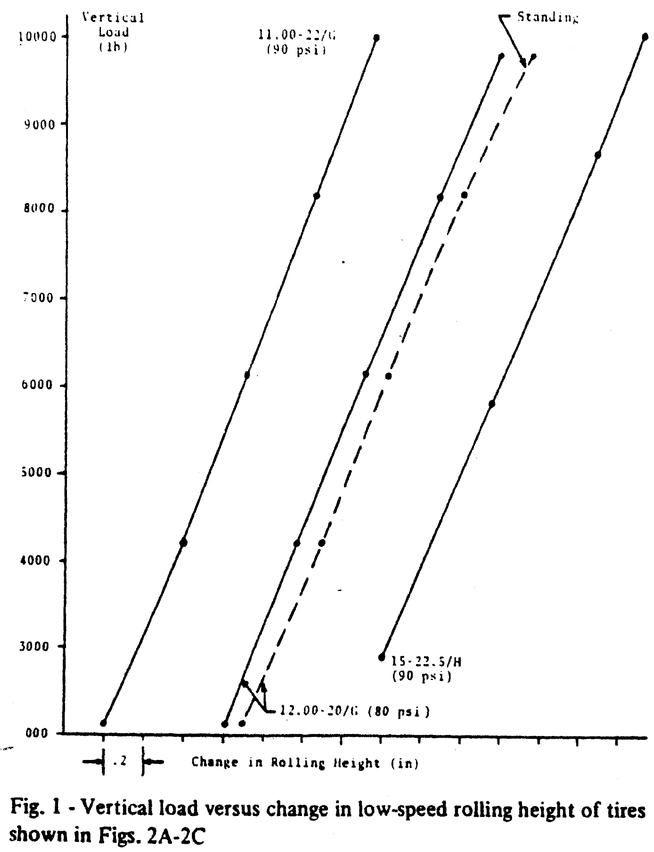


Fig. 1 - Vertical load versus change in low-speed rolling height of tires shown in Figs. 2A-2C

$$s \begin{cases} = 1 \text{ locked wheel} \\ = 0 \text{ free rolling (light braking: } s < 0.05) \\ < 0 \text{ driving} \end{cases}$$

F_x = longitudinal traction force (depends primarily on s)

F_y = lateral traction force (depends on both α and γ)

Graphically, the traction stiffness is the slope taken through the origin of the traction force (F_x or F_y) versus a particular operating variable (α, γ, or s) curve. These stiffnesses measure the initial rise of traction force and have no direct relation to peak values. However, a tire with higher traction stiffness will usually develop higher peak traction force. The usefulness of these definitions depends on linear behavior for small values of the operating variables. Examination of the following truck tire data will show this linearity to be a reasonable assumption.

GENERAL BEHAVIOR

Figs. 2A-2C describe three truck tires chosen to exhibit a broad range of traction stiffness properties*. The mechanical properties listed below each tire were measured at rated load and pressure. The carpet plots of lateral force versus slip angle and vertical load show the variation in lateral force obtained and indicate how the cornering stiffness, C_α, is related to slip angle and load. Although C_α measures only the initial rise of lateral force with slip angle for a particular tire load, the rise is similar at other tire loads. It appears that a tire showing higher cornering stiffness will develop more lateral force than a lower stiffness tire operated at the same slip angle and vertical load.

TIRE LOAD

The operating variable having the greatest influence on traction stiffness is tire load. The influence of tire load derives from the extreme deformation which a tire undergoes in the contact region. Specifically, the meridian and circumference profiles, intersecting at the center of contact, are substantially altered in dimension and curvature as tire load is increased. The camber, cornering, and circumferential stiffnesses, being indirectly influenced by lateral and longitudinal tire stiffness, are consequently dependent on structural geometry, and are seen to increase with test load for the tires diagrammed in Figs. 3A-3D.

Particularly affected by sidewall deformation is the lateral spring rate, K_y. Fig. 3D illustrates the variation of K_y with tire load for the three tires shown in Figs. 2A-2C. Increasing load on the tire from far below the design value results mainly in an increased contact length with some change in the meridian profile. The increased contact length causes an increase in lateral stiffness. At higher loads, the changes in tire

*The tires are representative of the 14 different truck tire sizes tested for this program.

3

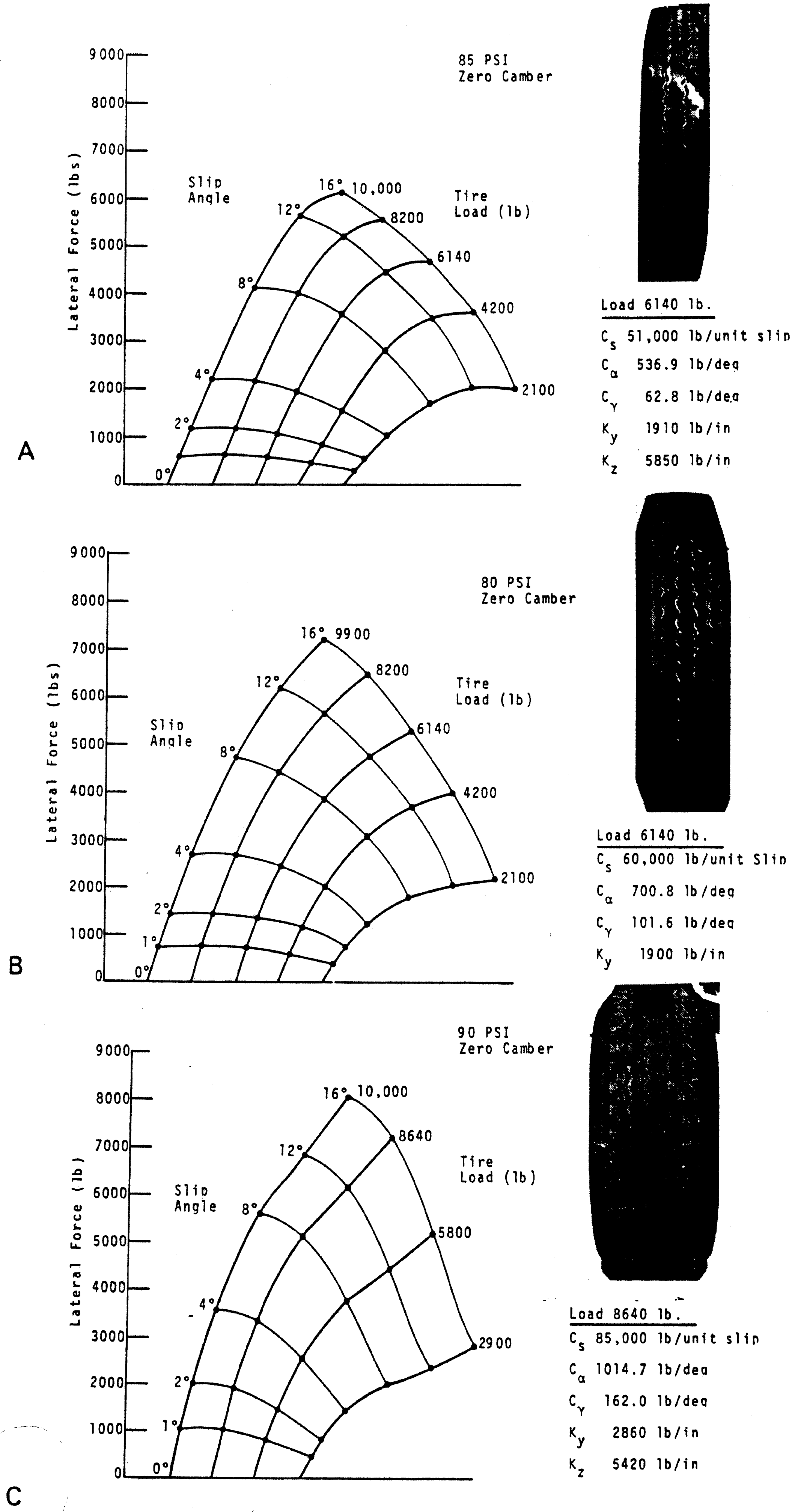


Fig. 2 - Measured mechanical properties of three different tires. A-11.00-22/G; B-12.00-20/G; C-15-22.5/H

profile become very pronounced, especially in the sidewall area, and cause a reduction in spring rate. It should be noted that the maximum value of lateral spring rate occurs near the design load for each tire tested.

The vertical load-deflection data are remarkably linear for a broad range of tire loads (Fig. 1). Fig. 1 suggests that it is reasonable to consider the tire as a linear vertical spring with spring rate, K_z, defined as the average slope of the load-deflection plot.

INFLATION PRESSURE

Increasing inflation pressure reverses the deformation caused by vertical load. Although a decrease in contact length accompanies an increase in inflation pressure, the dominant effects of increased pressure are reduced curvature in the sidewall and a generally stiffened carcass structure. The net result is a lateral spring rate that increases with inflation pressure, as is demonstrated by Fig. 4; these data being obtained on the three tires shown in Figs. 2A-2C. As may be expected, the effect of increasing the pressure is more pronounced at the higher loads which cause large distortions in the meridian profile.

The cornering stiffness, C_α, exhibits similar pressure sensitivity at higher vertical loads. Fig. 5 compares the lateral force versus slip angle and vertical load exhibited by a 10.00-20/G tire (Fig. 6B) at rated inflation pressure (100 psi) and at 50 psi. As can be anticipated from lateral spring rate behavior measured for these three different tires (Fig. 4), cornering stiffness increases with inflation pressure at higher loads.

The apparent similarity between K_y and C_α is due to the definition of K_y as the lateral stiffness of a standing tire measured at, effectively, a 0 deg slip angle while C_α is defined to measure the stiffness of the rolling tire in generating lateral force at very small slip angles. However, the contact region deformation associated with tire traction is considerably more complicated than the deformation associated with the measurement of K_y. As no rational basis exists for the correlation of these values, they are treated as independent mechanical properties.

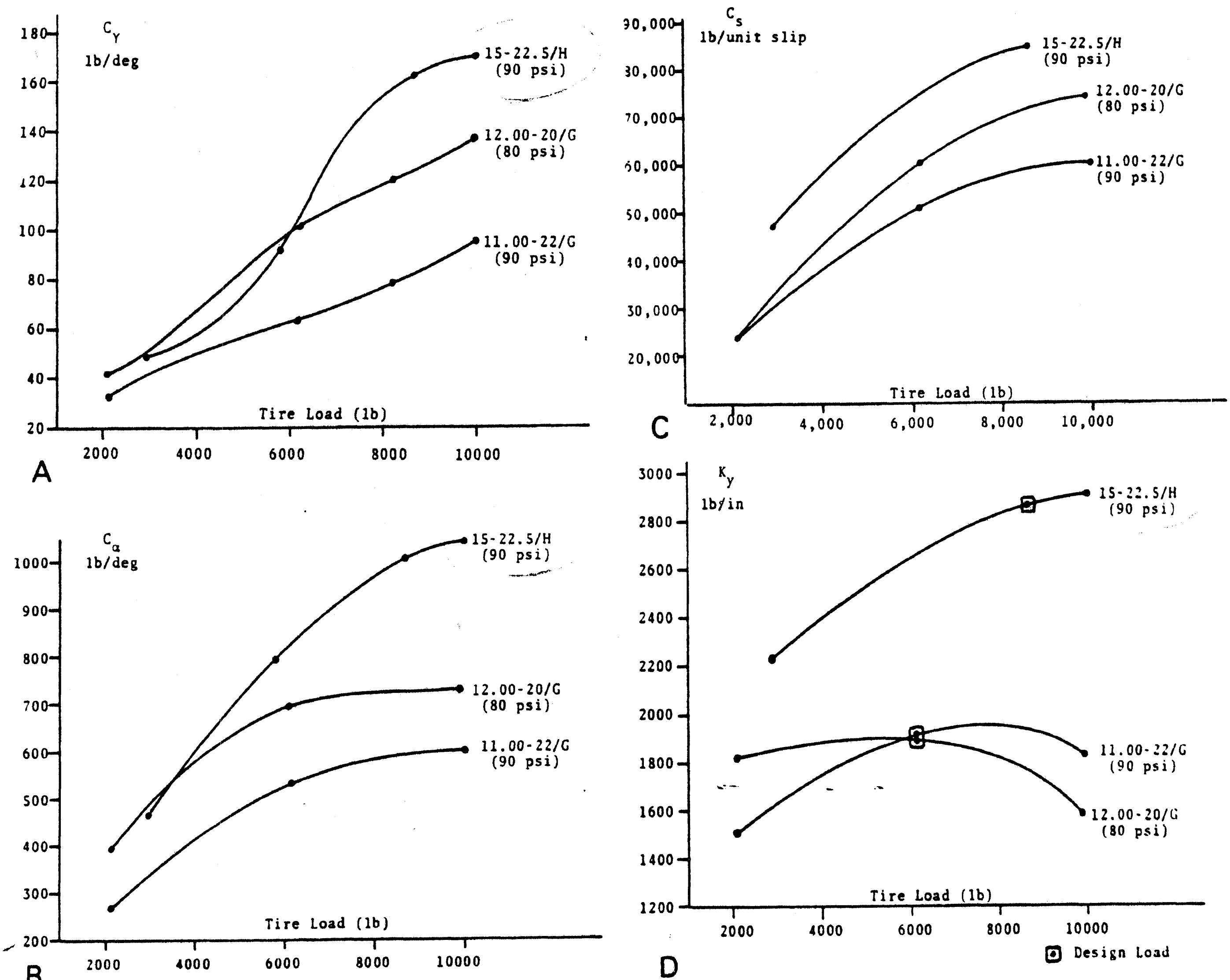


Fig. 3 - Variation of mechanical properties with tire load for tires shown in Figs. 2A-2C. A-camber stiffness versus tire load; B-cornering stiffness versus tire load; C-circumferential stiffness versus tire load; D-lateral spring rate versus tire load

PLY RATING AND TIRE SIZE

The ply rating designates the load range for which a particu- size tire is designed. Load limits for various sizes at specific inflation pressures up to the design pressure are tabulated according to empirical formulae. The ply rating is a measure of the strength of the tire carcass and does not necessarily indicate the actual number of plies.

The tire pairs listed in Table 1 were tested on design width precision rims at the indicated pressures and loads which are near the design values specified for these tires used as singles and duals. The higher rated tire of each pair is generally used as a dual. The 20 in tires that were tested all have the tread pattern shown in Fig. 6B. The tread pattern of the 11.00-22 tires (Fig. 2A) is similar. Table 2 lists the measured mechanical properties and illustrates the differences which may be found in tires which are similar in all respects, except for ply rating.

The differences seen in Table 2 are slight and possibly influenced by tire nonuniformity and/or measurement precision. There is remarkably little change in the properties of the 11.00-22 tires, the largest set tested for differences due to ply rating. The slight increase in test pressure (see Table 1) may be responsible for the increases in vertical spring rate. It is of interest to note that the vertical spring rate measured for the 10.00-20 tire with the G rating was less than that obtained for the F load rating. However, the lateral force generating ability did increase with increased load rating as evidenced by the

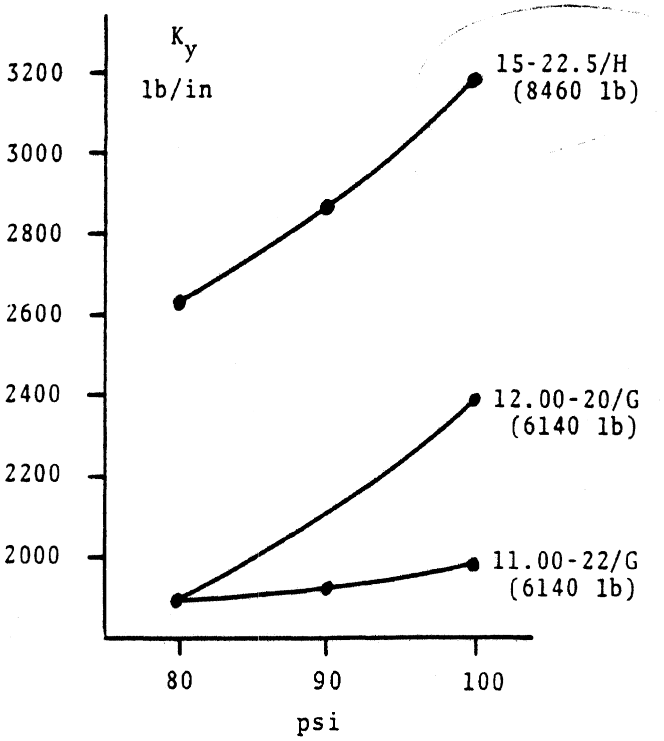


Fig. 4 - Lateral spring rate K_y versus inflation pressure for tires shown in Figs. 2A-2C

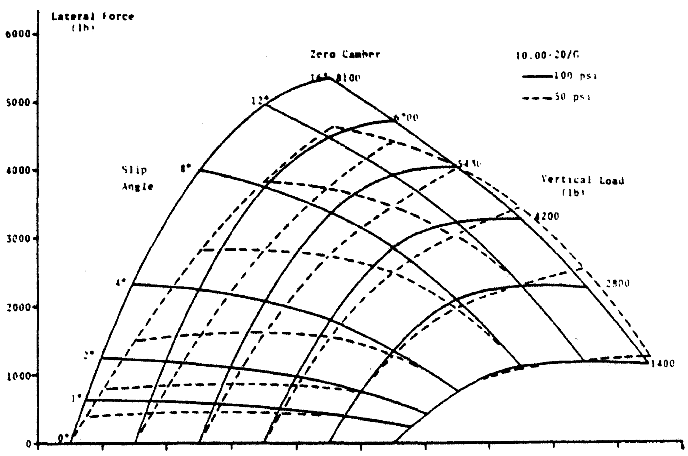
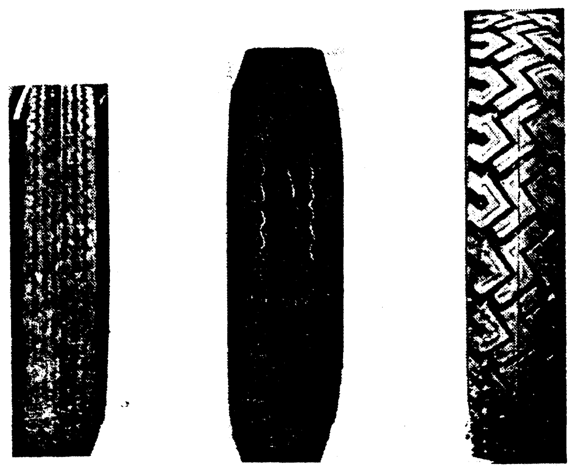


Fig. 5 - Lateral force versus slip angle and vertical load on 10.00-20/G tire at rated pressure (100 psi) and at 50 psi



	(a) Rib-type I	(b) Rib-type II	(c) Open Tread	
C_s	46000	42000	28000	lb/unit slip
[illegible]	508.2	523.4	516.0	lb/deg
[illegible]	56.7	69.0	39.9	lb/deg
K_y	1477	1618	1291	lb/in
K_z	5032	4700	4500	lb/in

Fig. 6 - Measured mechanical properties of 10.00-20/F nylon tire in three tread patterns. A-rib-type I; B-rib-type II; C-open tread

UNIROYAL UNIMASTER, 15 x 22.5/H, BADC ASPHALT

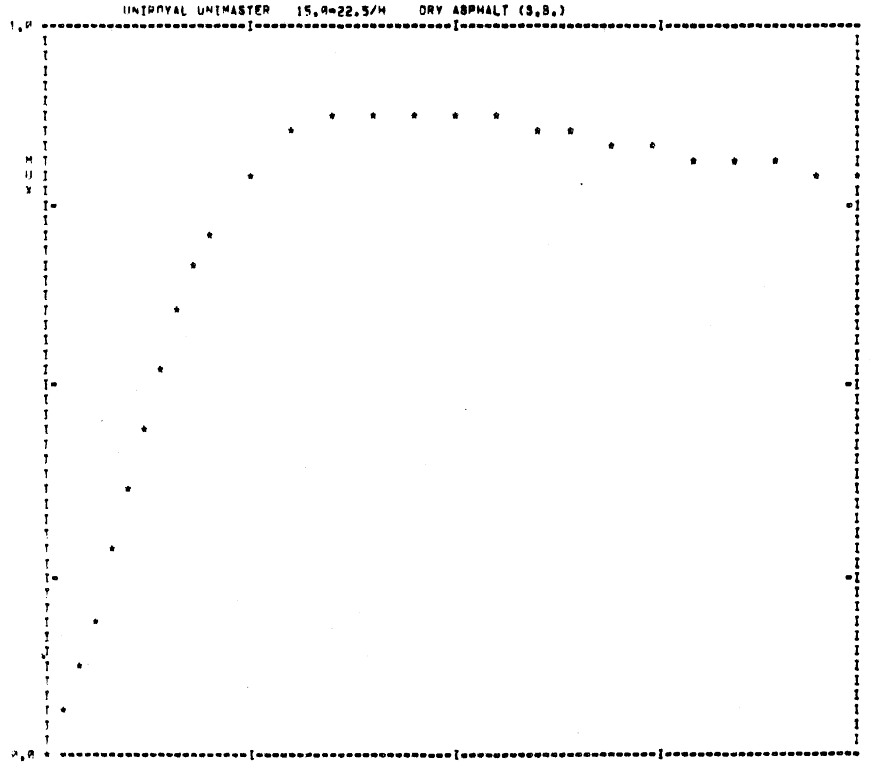
** A=D FILE 245 NEW FILE 103 TEST SAMPLE451 **

AVERAGE OF FILE 245 FOR 7 RECORDS. UNIROYAL UNIMASTER 15.0=22.5/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.06	8288.4	551.9
0.04	0.12	10057.6	1014.4
0.06	0.19	31622.2	1652.1
0.08	0.28	47990.6	2419.5
0.10	0.37	63099.0	3156.0
0.12	0.46	77721.9	3878.0
0.14	0.54	91404.4	4532.1
0.16	0.61	104069.0	5139.4
0.18	0.68	114610.7	5649.6
0.20	0.72	122276.1	6033.4
0.25	0.80	136099.5	6646.0
0.30	0.85	146116.2	7040.9
0.35	0.88	151254.1	7238.3
0.40	0.89	152429.5	7288.5
0.45	0.88	152034.9	7271.3
0.50	0.88	151021.3	7224.1
0.55	0.87	149714.0	7162.2
0.60	0.86	148263.4	7093.0
0.65	0.85	146739.9	7020.1
0.70	0.85	145180.2	6945.4
0.75	0.84	143602.5	6869.0
0.80	0.83	142015.7	6793.8
0.85	0.82	140424.5	6717.5
0.90	0.81	138715.1	6638.6
0.95	0.80	136772.9	6554.5
1.00	0.79	134482.1	6462.9

TQAV = 134482.1 LOAD = 8514.0 VEL = 3.0 MPH.

MUPEAK = 0.89 MULOCK = 0.79 RATIO = 1.12



FZ = 8514.0 VEL = 3.0 MULOCK = 0.79 MUPEAK = 0.89 RATIO = 1.12 A=D FILE 245 NWFILE 103 SAMPLE 451

** A-D FILE 246   NEW FILE 184   TEST SAMPLE452 **

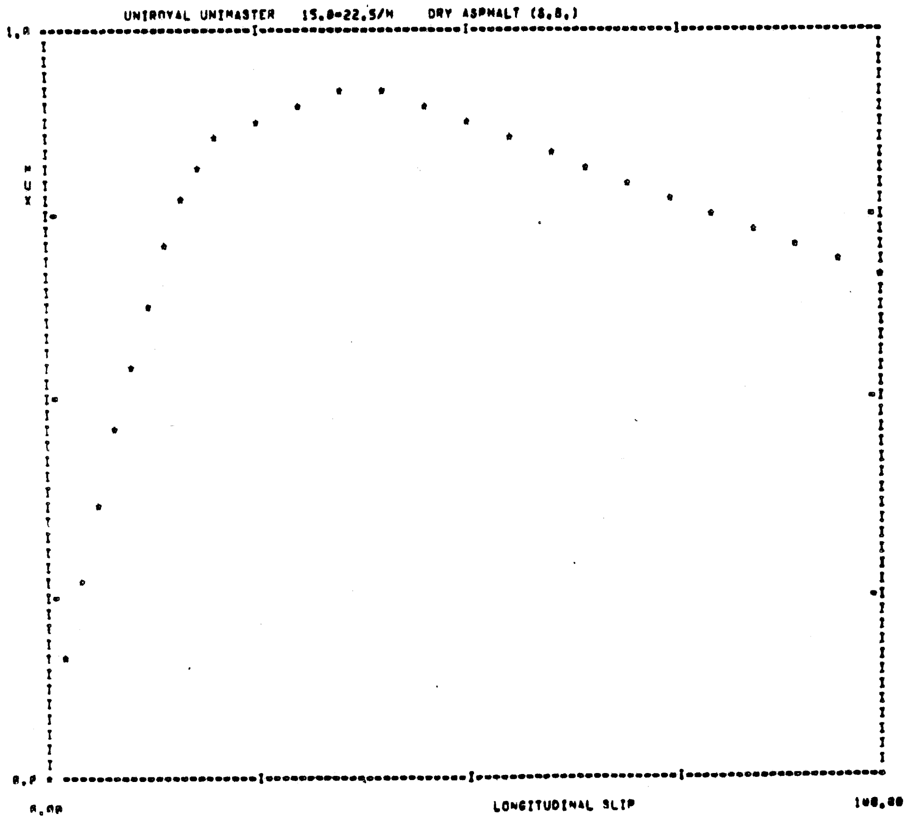
AVERAGE OF FILE 246 FOR 7 RECORDS.   UNIROYAL UNIMASTER 15.0-22.5/H   DRY ASPHALT (S.D.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	26697.4	1374.3
0.04	0.26	46270.7	2303.4
0.06	0.38	65950.0	3265.0
0.08	0.47	83160.9	4095.0
0.10	0.56	98444.4	4811.0
0.12	0.64	112235.9	5485.2
0.14	0.71	124780.8	6069.4
0.16	0.77	135254.0	6537.0
0.18	0.82	142952.1	6989.9
0.20	0.85	148051.0	7129.0
0.25	0.89	157458.3	7482.4
0.30	0.91	163921.0	7537.4
0.35	0.91	168711.6	7572.7
0.40	0.91	172532.0	7539.8
0.45	0.90	175547.7	7464.5
0.50	0.89	175928.5	7348.6
0.55	0.87	172408.3	7198.6
0.60	0.85	166321.3	7023.8
0.65	0.83	160082.4	6845.9
0.70	0.80	153960.1	6669.4
0.75	0.78	148091.5	6494.8
0.80	0.76	142313.4	6319.0
0.85	0.74	136580.8	6144.4
0.90	0.72	130289.7	5966.3
0.95	0.70	122843.4	5781.1
1.00	0.67	113660.7	5585.4

TQAV = 113660.7   LOAD = 8671.3   VEL = 10.0 MPH.

MUPEAK = 0.91   MULOCK = 0.67   RATIO = 1.36

UNIROYAL UNIMASTER 15.0-22.5/H   DRY ASPHALT (S.D.)



FZ = 8671.3   VEL = 10.0   MULOCK = 0.67   MUPEAK = 0.91   RATIO = 1.36   A-D FILE 246   NWFILE 184   SAMPLE 452

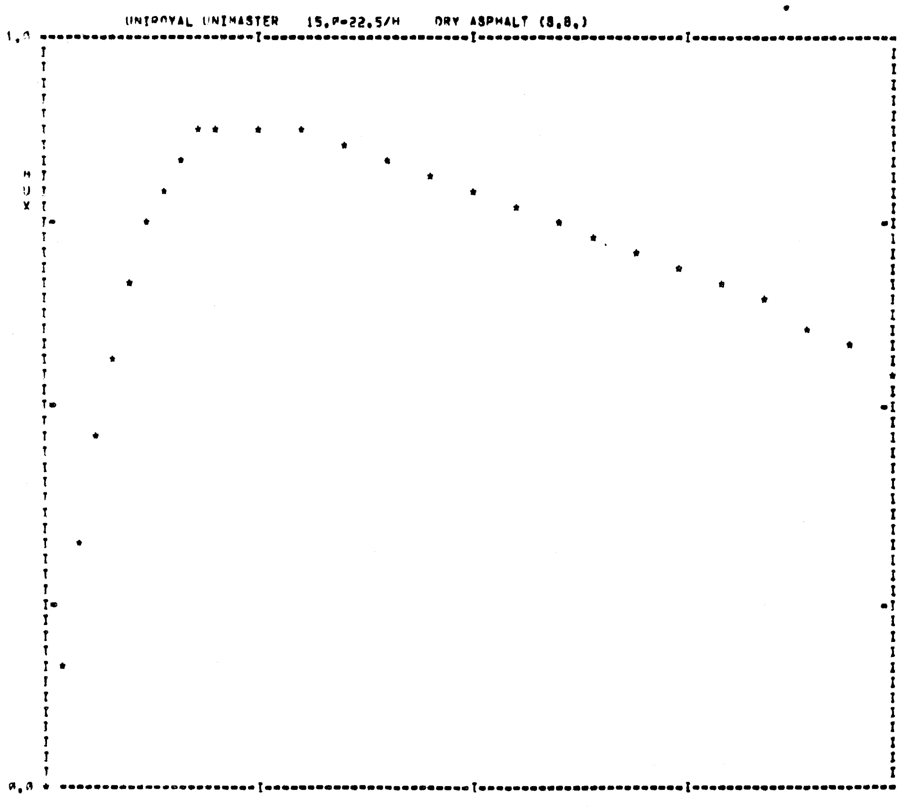
** A=D FILE 247 NEW FILE 105 TEST SAMPLE453 **

AVERAGE OF FILE 247 FOR 6 RECORDS, UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.8.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	28450.9	1495.3
0.04	0.34	57365.9	2888.6
0.06	0.47	80497.5	4013.1
0.08	0.58	99659.6	4925.4
0.10	0.67	115594.0	5677.9
0.12	0.75	129016.8	6311.2
0.14	0.81	139885.3	6757.8
0.16	0.85	147879.5	7068.6
0.18	0.87	153293.9	7263.3
0.20	0.88	156545.1	7327.2
0.25	0.88	162112.2	7321.1
0.30	0.87	166618.2	7246.6
0.35	0.86	170335.3	7133.8
0.40	0.84	173459.8	6992.4
0.45	0.82	176021.2	6843.3
0.50	0.81	178304.1	6685.2
0.55	0.79	179932.5	6523.3
0.60	0.77	179891.0	6359.5
0.65	0.75	175571.4	6190.5
0.70	0.72	168236.7	6014.4
0.75	0.70	158013.5	5819.2
0.80	0.67	145661.0	5608.1
0.85	0.65	132640.9	5389.4
0.90	0.62	119439.1	5167.3
0.95	0.59	106075.2	4938.3
1.00	0.56	92479.2	4698.7

TQAV = 92479.2 LOAD = 8664.3 VEL = 20.0 MPH.

MUPEAK = 0.88 MULOCK = 0.56 RATIO = 1.57



FZ = 8664.3 VEL = 20.0 MULOCK = 0.56 MUPEAK = 0.88 RATIO = 1.57 A=D FILE 247 NWFILE 105 SAMPLE 453

-421-

** A-D FILE 200 NEW FILE 106 TEST SAMPLE454 **

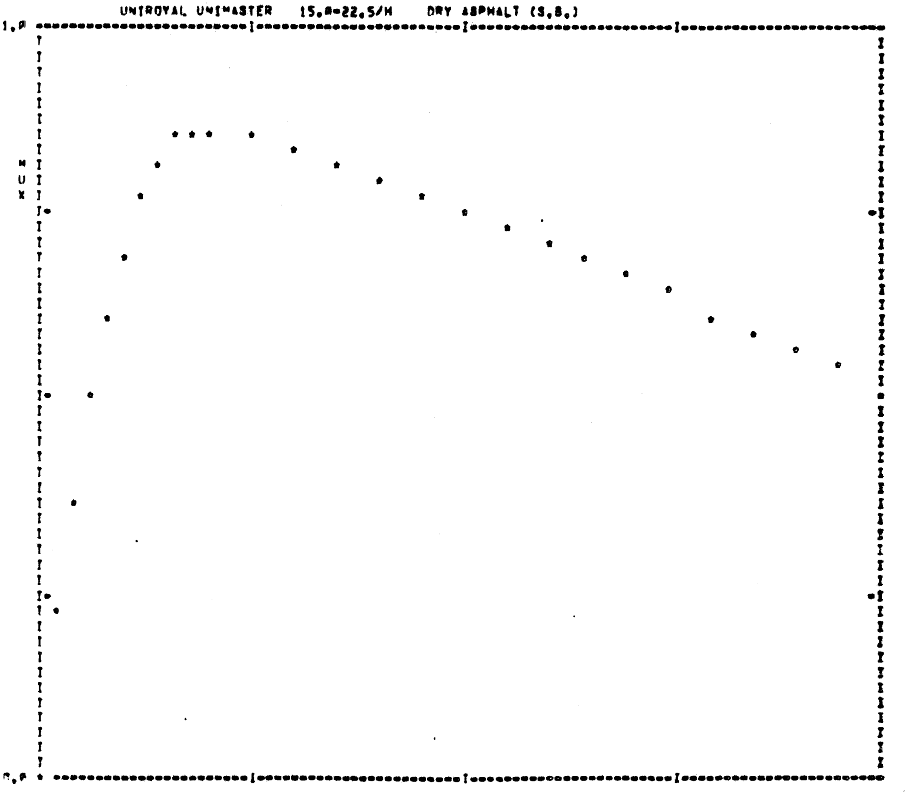
AVERAGE OF FILE 200 FOR 6 RECORDS. UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.23	40034.4	1991.7
0.04	0.38	66202.1	3304.6
0.06	0.50	88409.9	4356.4
0.08	0.61	107218.2	5240.4
0.10	0.70	123439.7	5986.6
0.12	0.78	135960.1	6578.3
0.14	0.82	144735.9	6986.7
0.16	0.85	151626.4	7237.6
0.18	0.86	156968.3	7352.7
0.20	0.86	160335.7	7345.5
0.25	0.85	165505.1	7219.8
0.30	0.83	169605.7	7062.8
0.35	0.81	173053.2	6891.6
0.40	0.79	175978.7	6708.5
0.45	0.77	178569.9	6519.2
0.50	0.75	180831.1	6331.9
0.55	0.73	182613.0	6140.2
0.60	0.71	183327.7	5960.2
0.65	0.69	181505.8	5791.1
0.70	0.67	175240.0	5617.5
0.75	0.65	164450.7	5444.8
0.80	0.62	150471.4	5261.7
0.85	0.60	134679.4	5064.5
0.90	0.58	118348.6	4862.4
0.95	0.55	102045.6	4656.2
1.00	0.52	85875.0	4443.7

TQAV = 85875.0 LOAD = 8702.5 VEL = 30.0 MPH.

MUPEAK = 0.86 MULOCK = 0.52 RATIO = 1.66

UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)



FZ = 8702.5 VEL = 30.0 MULOCK = 0.52 MUPEAK = 0.86 RATIO = 1.66 A-D FILE 200 NWFILE 106 SAMPLE 454

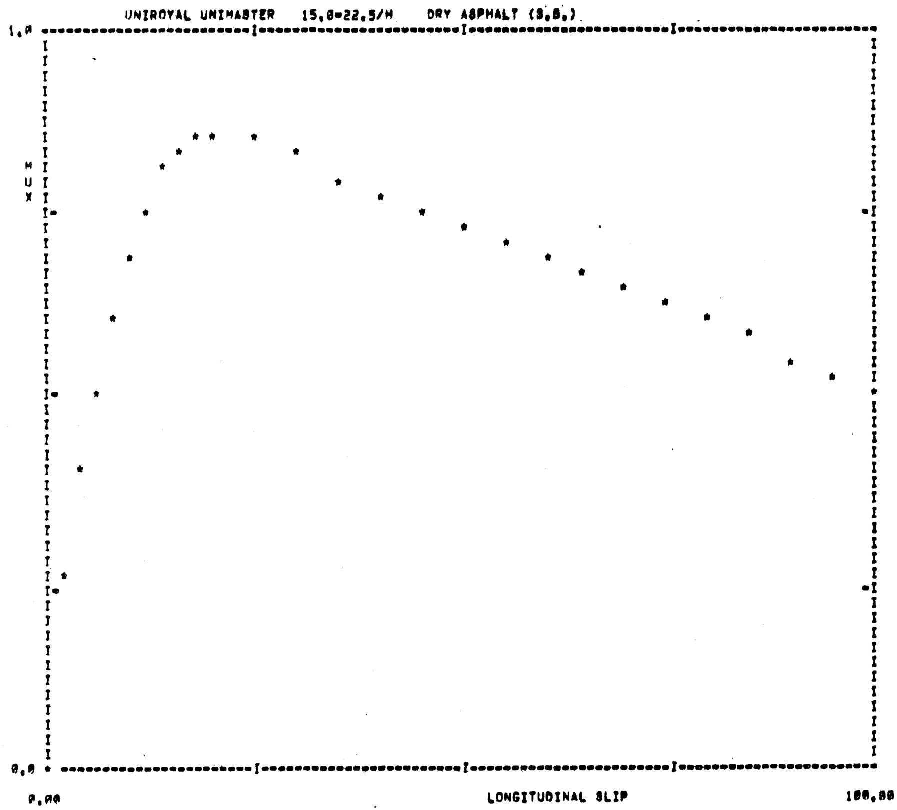
** A=D FILE 249 NEW FILE 107 / TEST SAMPLE455 **

AVERAGE OF FILE 249 FOR 6 RECORDS, UNIROYAL UNIMASTER 15.0=22.5/H DRY ASPHALT (8.8.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.27	46160.8	2367.3
0.04	0.40	69611.0	3455.8
0.06	0.52	98784.3	4468.2
0.08	0.61	107739.2	5279.8
0.10	0.70	121913.8	5923.2
0.12	0.76	132849.5	6406.8
0.14	0.81	141755.3	6777.4
0.16	0.85	148739.4	7070.8
0.18	0.87	154294.6	7239.7
0.20	0.87	157293.9	7262.5
0.25	0.85	161392.4	7154.9
0.30	0.83	164698.7	6983.0
0.35	0.81	167560.7	6780.5
0.40	0.78	169805.6	6571.7
0.45	0.76	171577.1	6364.7
0.50	0.74	172877.3	6167.1
0.55	0.72	173935.7	5977.0
0.60	0.69	174683.5	5794.2
0.65	0.67	174993.5	5612.9
0.70	0.65	173351.2	5431.6
0.75	0.63	168425.2	5249.9
0.80	0.61	157680.9	5061.7
0.85	0.58	141431.6	4878.6
0.90	0.56	123058.8	4679.1
0.95	0.54	103906.2	4488.1
1.00	0.52	83854.2	4297.5

TQAV = 83854.2 LOAD = 8587.6 VEL = 40.0 MPH.

MUPEAK = 0.87 MULOCK = 0.52 RATIO = 1.68



FZ = 8587.6 VEL = 40.0 MULOCK = 0.52 MUPEAK = 0.87 RATIO = 1.68 A=D FILE 249 NWFILE 107 SAMPLE 455

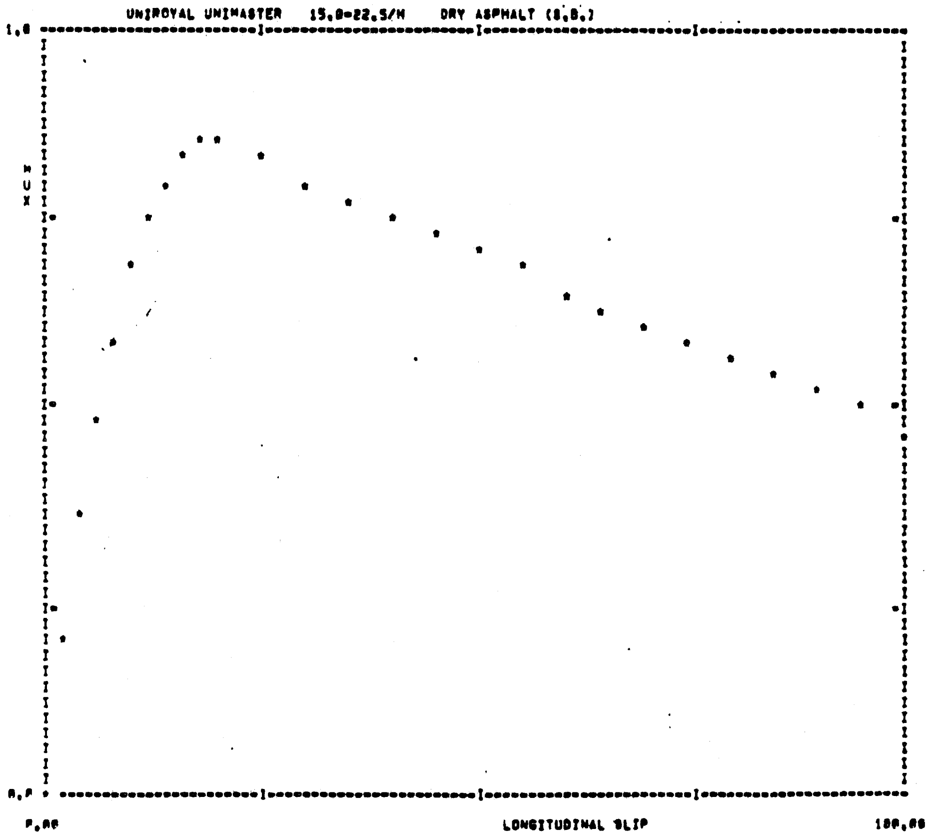
** A-D FILE 250 NEW FILE 100 , TEST SAMPLE456 **

AVERAGE OF FILE 250 FOR 5 RECORDS, UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.21	35974.0	1788.9
0.04	0.36	64637.0	3146.5
0.06	0.49	88509.9	4271.7
0.08	0.60	107968.7	5185.1
0.10	0.69	124111.9	5905.3
0.12	0.75	136219.3	6434.0
0.14	0.80	145374.3	6825.1
0.16	0.84	152505.6	7122.0
0.18	0.86	157999.9	7294.2
0.20	0.85	161478.9	7298.1
0.25	0.83	168016.4	7081.7
0.30	0.80	173103.6	6825.6
0.35	0.77	176657.3	6567.7
0.40	0.75	179168.7	6331.4
0.45	0.73	180873.0	6127.7
0.50	0.71	182361.9	5935.0
0.55	0.69	184218.0	5734.2
0.60	0.66	186371.7	5535.5
0.65	0.64	188448.0	5343.4
0.70	0.61	188938.1	5155.5
0.75	0.59	185465.2	4973.4
0.80	0.57	173930.1	4805.7
0.85	0.55	153831.1	4637.0
0.90	0.53	129700.9	4453.2
0.95	0.50	105055.1	4260.0
1.00	0.48	80325.0	4057.5

TQAV = 80325.0 LOAD = 8692.0 VEL = 55.0 MPH.

MUPEAK = 0.86 MULOCK = 0.48 RATIO = 1.00



FZ = 8692.0 VEL = 55.0 MULOCK = 0.48 MUPEAK = 0.86 RATIO = 1.80 A-D FILE 250 NWFILE 100 SAMPLE 456

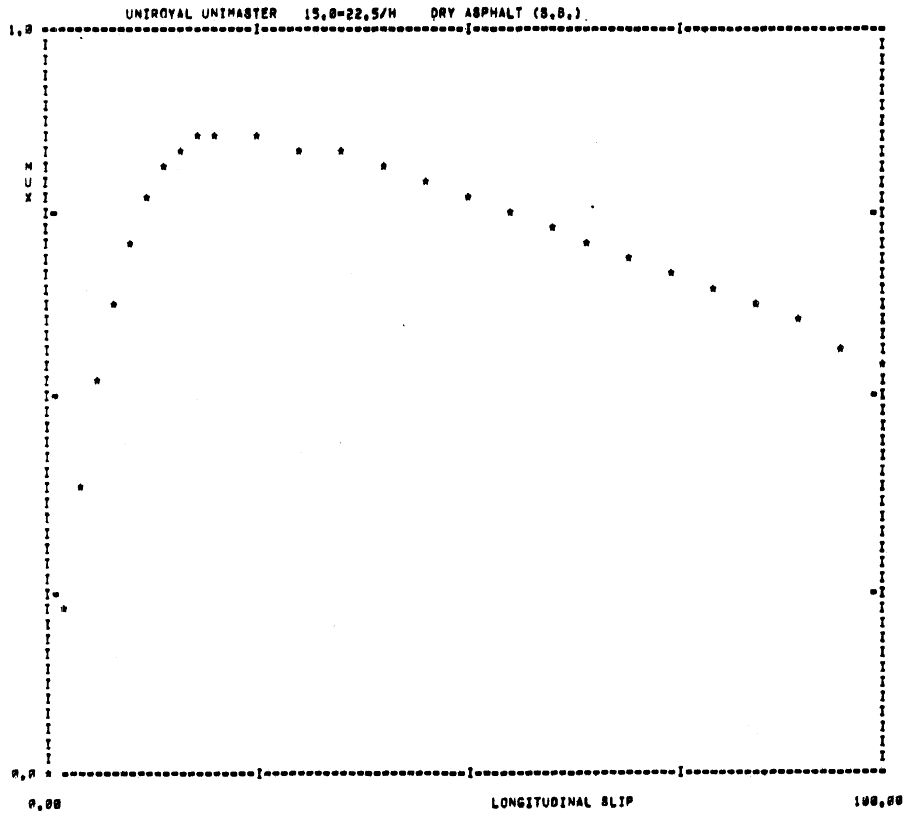
** A-D FILE 255 NEW FILE 110 TEST SAMPLE458 **

AVERAGE OF FILE 255 FOR 6 RECORDS, UNIROYAL UNIMASTER 15,0-22,5/H DRY ASPHALT (0,0,)

SLIP	MUX	TORQUE	FX
0,00	0,00	0,0	0,0
0,02	0,23	16880,4	825,7
0,04	0,39	30244,5	1399,4
0,06	0,53	41385,0	1880,9
0,08	0,64	50509,1	2269,1
0,10	0,72	57551,9	2552,0
0,12	0,78	62930,0	2741,1
0,14	0,81	67662,6	2856,7
0,16	0,84	71641,3	2919,3
0,18	0,85	74875,7	2949,1
0,20	0,85	77338,7	2950,3
0,25	0,85	82374,0	2921,1
0,30	0,84	86596,8	2873,7
0,35	0,83	90186,9	2812,0
0,40	0,81	93251,2	2744,1
0,45	0,80	96170,8	2680,2
0,50	0,78	99170,7	2620,3
0,55	0,76	102430,3	2555,5
0,60	0,74	105895,4	2485,6
0,65	0,72	109374,5	2416,5
0,70	0,70	111427,8	2348,7
0,75	0,68	109281,9	2279,5
0,80	0,66	101153,6	2210,9
0,85	0,64	88806,3	2134,7
0,90	0,61	72702,1	2051,8
0,95	0,58	56646,0	1965,4
1,00	0,55	39770,8	1875,0

TQAV = 39770,8 LOAD = 3515,0 VEL = 40,0 MPH,

MUPEAK = 0,85 MULOCK = 0,55 RATIO = 1,55



FZ = 3515,0 VEL = 40,0 MULOCK = 0,55 MUPEAK = 0,85 RATIO = 1,55 A-D FILE 255 NWFILE 110 SAMPLE 458

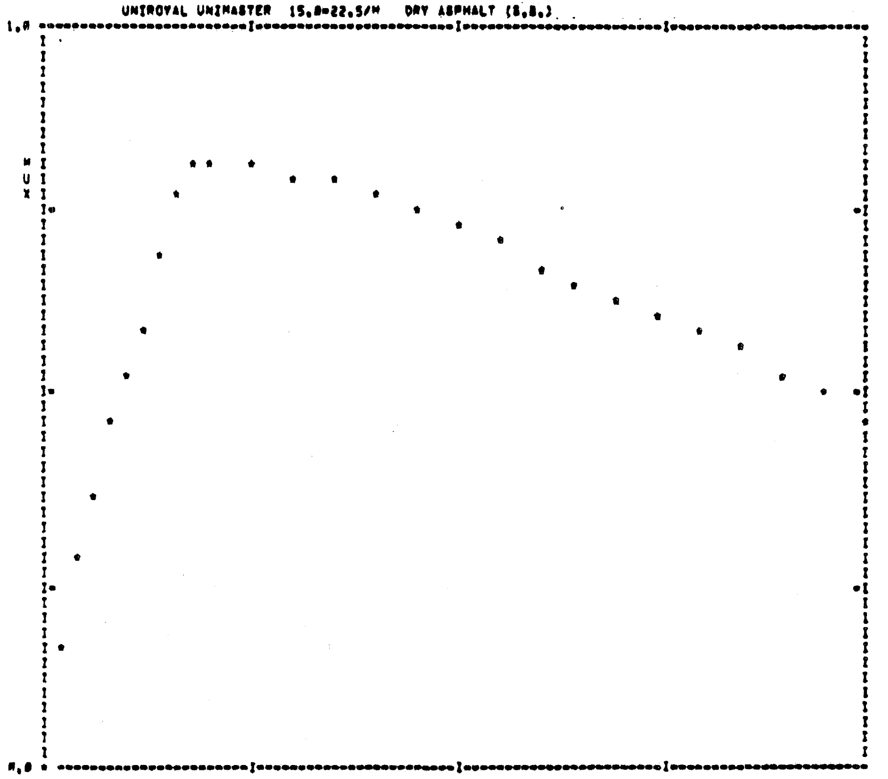
** A-D FILE 256   NEW FILE 111   TEST SAMPLE459 **

AVERAGE OF FILE 256 FOR 5 RECORDS.   UNIROYAL UNIMASTER 15.0-22.5/M DRY ASPHALT (S.D.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.16	20697.8	1394.0
0.04	0.28	50727.0	2419.1
0.06	0.38	60401.4	3218.2
0.08	0.46	83016.7	3932.8
0.10	0.54	95111.0	4508.1
0.12	0.60	100392.3	5052.3
0.14	0.70	126782.4	5815.1
0.16	0.77	140145.0	6303.2
0.18	0.81	146660.6	6705.0
0.20	0.82	153758.1	6782.7
0.25	0.81	162452.9	6750.3
0.30	0.80	168777.8	6667.9
0.35	0.79	173527.4	6544.0
0.40	0.77	177506.6	6399.2
0.45	0.75	181183.3	6231.5
0.50	0.73	184743.1	6050.0
0.55	0.71	188235.7	5865.0
0.60	0.68	190984.2	5673.6
0.65	0.66	191409.5	5475.5
0.70	0.64	187341.0	5277.9
0.75	0.61	177172.3	5081.3
0.80	0.59	160490.2	4877.9
0.85	0.56	140397.8	4665.4
0.90	0.54	119461.7	4441.3
0.95	0.51	98968.4	4209.8
1.00	0.48	79325.0	3969.0

TBAV = 79325.0   LOAD = 8519.3   VEL = 40.0 MPH.

MUPEAK = 0.82   MULOCK = 0.48   RATIO = 1.70



FZ = 8519.3   VEL = 40.0   MULOCK = 0.48   MUPEAK = 0.82   RATIO = 1.70   A-D FILE 256   NWFILE 111   SAMPLE 459

** A-D FILE 257 NEW FILE 110 TEST SAMPLE460 **

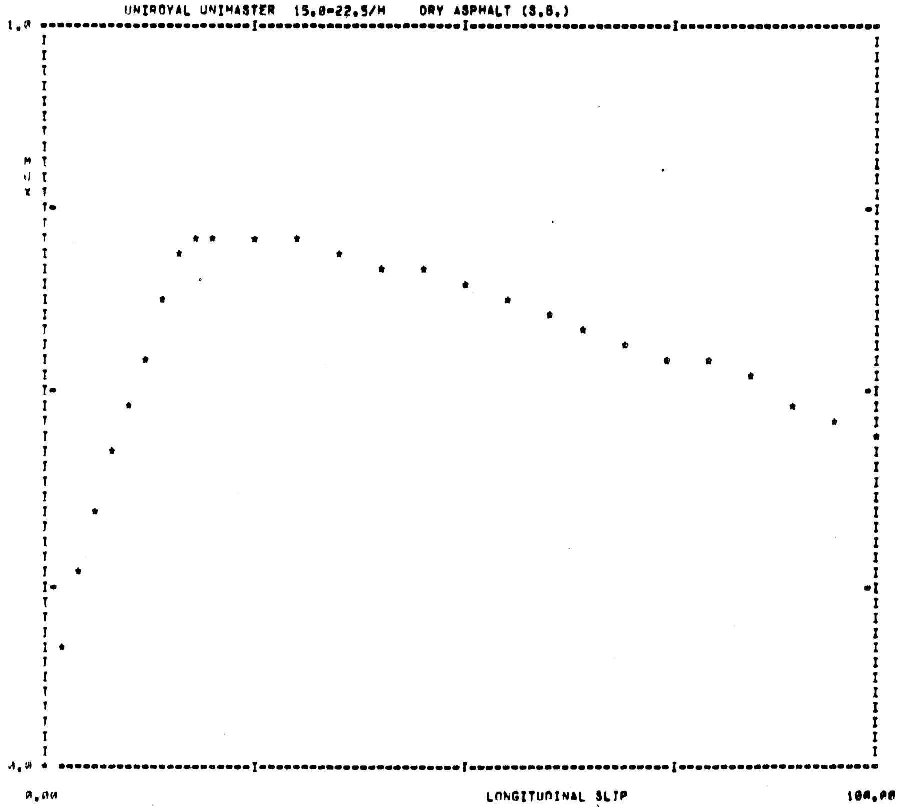
AVERAGE OF FILE 257 FOR 5 RECORDS. UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.17	44221.1	2550.1
0.04	0.27	72493.0	3987.4
0.06	0.36	96769.6	5096.9
0.08	0.43	117791.6	6131.2
0.10	0.49	134619.4	6975.6
0.12	0.55	151758.3	7806.8
0.14	0.63	176630.4	8949.9
0.16	0.69	196058.0	9791.4
0.18	0.71	207743.2	10221.2
0.20	0.72	213414.0	10293.2
0.25	0.72	221536.0	10208.8
0.30	0.71	227130.6	10048.4
0.35	0.69	231228.9	9848.3
0.40	0.68	234429.9	9631.6
0.45	0.67	237220.7	9405.4
0.50	0.65	240078.2	9166.7
0.55	0.63	242859.5	8926.5
0.60	0.62	244912.6	8683.4
0.65	0.60	244319.2	8436.9
0.70	0.58	238693.3	8188.4
0.75	0.56	227697.2	7937.6
0.80	0.54	211097.1	7679.5
0.85	0.52	187718.1	7399.0
0.90	0.50	163606.5	7082.5
0.95	0.48	140181.2	6749.5
1.00	0.45	117775.0	6399.0

TQAV = 117775.0 LOAD = 14557.8 VEL = 40.0 MPH.

MUPEAK = 0.72 MULOCK = 0.45 RATIO = 1.60

UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)



FZ = 14557.0 VEL = 40.0 MULOCK = 0.45 MUPEAK = 0.72 RATIO = 1.60 A-D FILE 257 NWFILE 112 SAMPLE 460

** A-D FILE 244 NEW FILE 102 TEST SAMPLE450 **

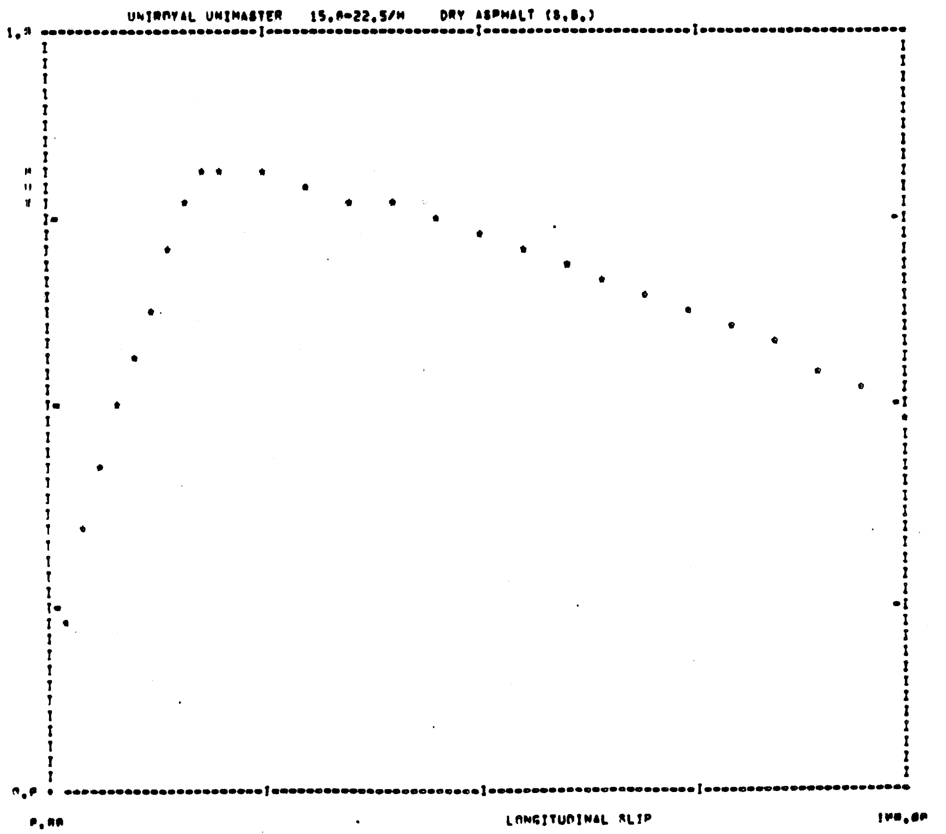
AVERAGE OF FILE 244 FOR 6 RECORDS. UNIROYAL UNIMASTER 15.0-22.5/H DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.23	38033.3	1970.4
0.04	0.34.	57468.4	2882.5
0.06	0.44	75164.8	3718.8
0.08	0.52	89437.3	4388.4
0.10	0.58	101226.9	4919.3
0.12	0.64	112773.8	5410.2
0.14	0.72	127201.4	6045.2
0.16	0.78	137826.7	6582.4
0.18	0.81	144636.5	6757.2
0.20	0.82	148212.6	6888.3
0.25	0.81	153490.7	6737.1
0.30	0.80	156798.8	6617.6
0.35	0.78	158835.7	6474.9
0.40	0.77	160093.2	6324.8
0.45	0.75	161084.7	6169.6
0.50	0.73	162402.4	6005.2
0.55	0.71	163990.8	5829.5
0.60	0.69	165763.3	5648.8
0.65	0.67	167516.0	5471.1
0.70	0.65	168186.8	5307.5
0.75	0.63	165379.6	5161.6
0.80	0.61	155559.9	5016.4
0.85	0.59	139411.7	4836.4
0.90	0.56	120833.6	4614.3
0.95	0.53	100674.6	4369.4
1.00	0.49	88187.5	4097.5

TOAV = 88187.5 LOAD = 8496.3 VEL = 40.0 MPH.

MUPEAK = 0.82 MULOCK = 0.49 RATIO = 1.66

Check Run #1



FZ = 8496.3 VEL = 40.0 MULOCK = 0.49 MUPEAK = 0.82 RATIO = 1.66 A-D FILE 244 NWFILE 102 SAMPLE 450

** A-D FILE 251   NEW FILE 109 ,   TEST SAMPLE457 **

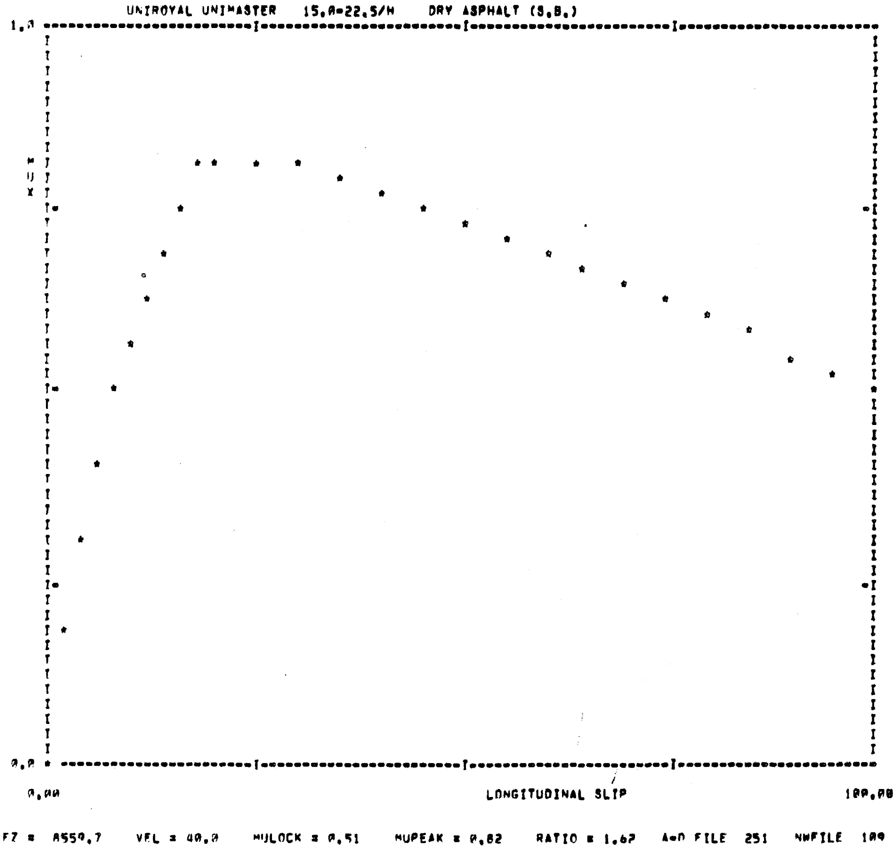
AVERAGE OF FILE 251 FOR 6 RECORDS.   UNIROYAL UNIMASTER 15.0-22.5/H   DRY ASPHALT (S.B.)

SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.18	25231.3	1595.6
0.04	0.31	40966.6	2686.2
0.06	0.41	52521.0	3555.5
0.08	0.50	61171.2	4300.7
0.10	0.58	66957.3	4903.0
0.12	0.64	65806.1	5342.4
0.14	0.69	63789.3	5746.6
0.16	0.76	98722.8	6296.7
0.18	0.81	127147.6	6653.7
0.20	0.82	138825.2	6749.0
0.25	0.82	153706.0	6739.0
0.30	0.81	163608.7	6645.6
0.35	0.79	170534.6	6515.2
0.40	0.78	175784.2	6364.2
0.45	0.75	179999.4	6200.2
0.50	0.73	183566.3	6026.0
0.55	0.71	186415.0	5856.2
0.60	0.69	188555.2	5686.9
0.65	0.67	188573.4	5524.4
0.70	0.65	184876.4	5366.0
0.75	0.63	176581.0	5205.7
0.80	0.61	161137.3	5032.3
0.85	0.59	142375.0	4843.7
0.90	0.56	122515.4	4647.0
0.95	0.54	102682.7	4447.1
1.00	0.51	82812.5	4240.0

TQAV = 82812.5 LOAD = 8559.7 VEL = 40.0 MPH.

MUPEAK = 0.82 MULOCK = 0.51 RATIO = 1.62

Check Run #3



FZ = 8559.7   VEL = 40.0   MULOCK = 0.51   MUPEAK = 0.82   RATIO = 1.62   A-D FILE 251   NWFILE 109   SAMPLE 457

** A-D FILE 261   NEW FILE 113   TEST SAMPLE461 **

AVERAGE OF FILE 261 FOR 5 RECORDS,   UNIROYAK UNIMASTER 15.0-22.5/H   DRY ASPHALT (S.B.)

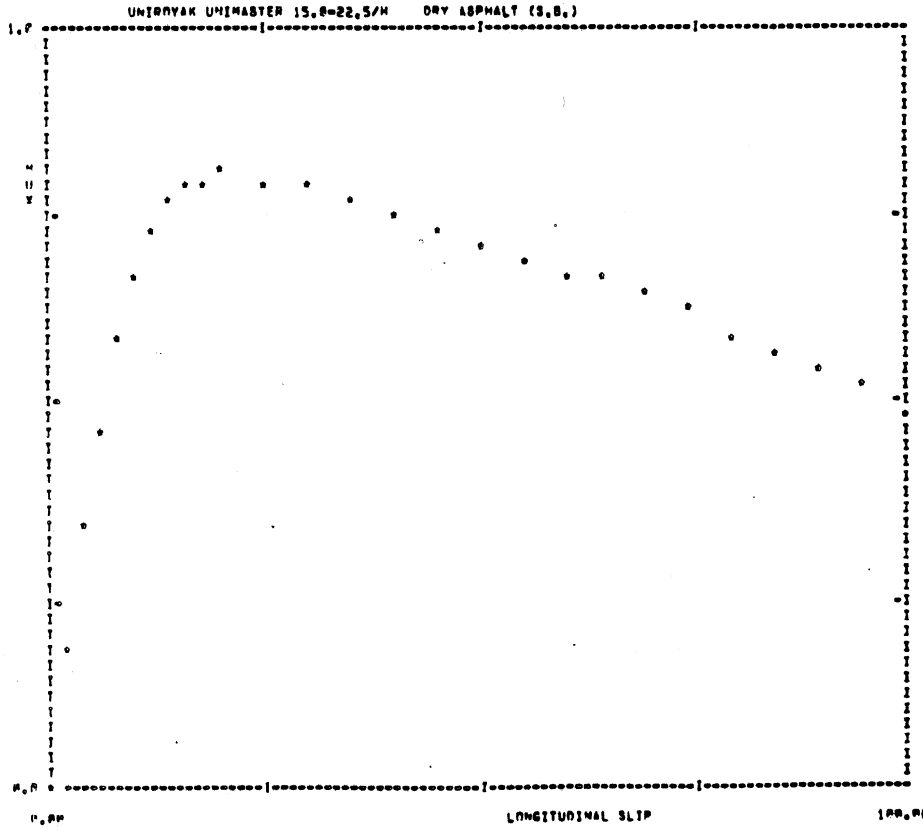
SLIP	MUX	TORQUE	FX
0.00	0.00	0.0	0.0
0.02	0.19	38631.5	1675.9
0.04	0.34	64958.9	2998.7
0.06	0.48	87797.9	4100.6
0.08	0.59	107092.5	5004.6
0.10	0.67	122467.6	5716.6
0.12	0.73	135105.6	6217.7
0.14	0.77	145089.2	6539.4
0.16	0.79	152170.6	6743.0
0.18	0.81	157369.0	6853.8
0.20	0.81	160990.4	6869.4
0.25	0.80	168044.7	6790.3
0.30	0.79	174055.7	6688.3
0.35	0.78	179371.3	6553.9
0.40	0.76	184120.9	6401.6
0.45	0.74	188511.0	6236.8
0.50	0.72	192655.5	6062.8
0.55	0.70	196407.5	5893.8
0.60	0.68	199107.1	5726.3
0.65	0.67	198210.4	5567.4
0.70	0.65	194013.4	5400.9
0.75	0.63	182992.1	5234.6
0.80	0.60	166402.5	5049.0
0.85	0.58	146054.2	4848.2
0.90	0.55	125386.1	4629.3
0.95	0.52	105276.2	4403.6
1.00	0.50	86025.0	4171.5

TQAV = 86025.0   LOAD = 8638.0   VEL = 40.0 MPH.

MUPEAK = 0.81   MULOCK = 0.50   RATIO = 1.63

Check Run #5

UNIROYAK UNIMASTER 15.0-22.5/H   DRY ASPHALT (S.B.)



FZ = 8638.0   VEL = 40.0   MULOCK = 0.50   MUPEAK = 0.81   RATIO = 1.63   A-D FILE 261   NWFILE 113   SAMPLE 461

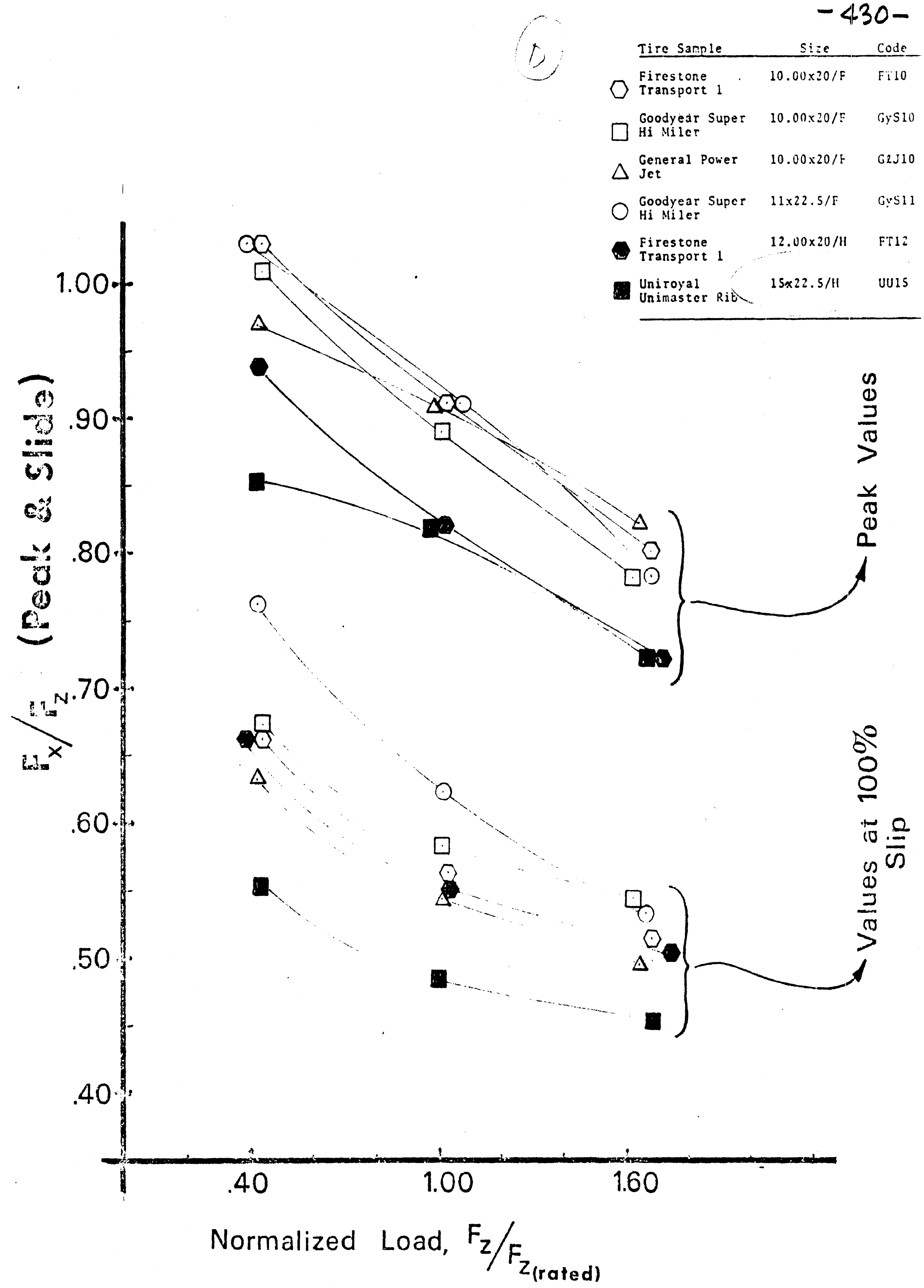


Figure 12. Normalized load sensitivity in the peak and slide traction of the six-tire sample (on BADC's asphalt).

with regard to peak values. It is surprising, however, that the size 15 x 22.5/H wide base single tire (code UU15) provides such a small increment in normalized traction when the load is reduced from the rated value (8460 lbs) to 0.4 of the rated value (3380 lbs). This performance suggests, for example, that the wide base single is less suitable for operation at lower loads than tires which are rated in the lower load range. As shown in Figure 13, with vertical load (non-normalized) plotted on the axis of abscissa, the wide base tire provides a reduced tractive performance (compared to 10.00 x 20/F's) when the value of F_z is below about 8000 lbs. Thus the notion that one can "tire-up" to resolve stopping performance deficiencies in heavy trucks may not be a universal axiom.

Figure 14 illustrates the influence of velocity on the normalized traction behavior of the six-tire sample as measured on the asphalt pavement. The data show a rather narrow band within the respective peak measurements and slide measurements across the tire sample, with consistent gross trends exhibited in all cases. The data in Figure 14 again place the H-rated tires (codes FT12 and UU15) at the lower boundary of performance for these experiments in which each tire was operated at its rated load.

To characterize the repeatability of the data presented in Figures 12 through 14, the data obtained from a set of five repeat runs which were interspersed within data runs for each tire are plotted in Figure 15. Each repeat run represents the average of six locking cycles conducted at 40 mph and the T & RA rated load on each tire. Data points are presented, left to right, in the order in which they were gathered. Below each

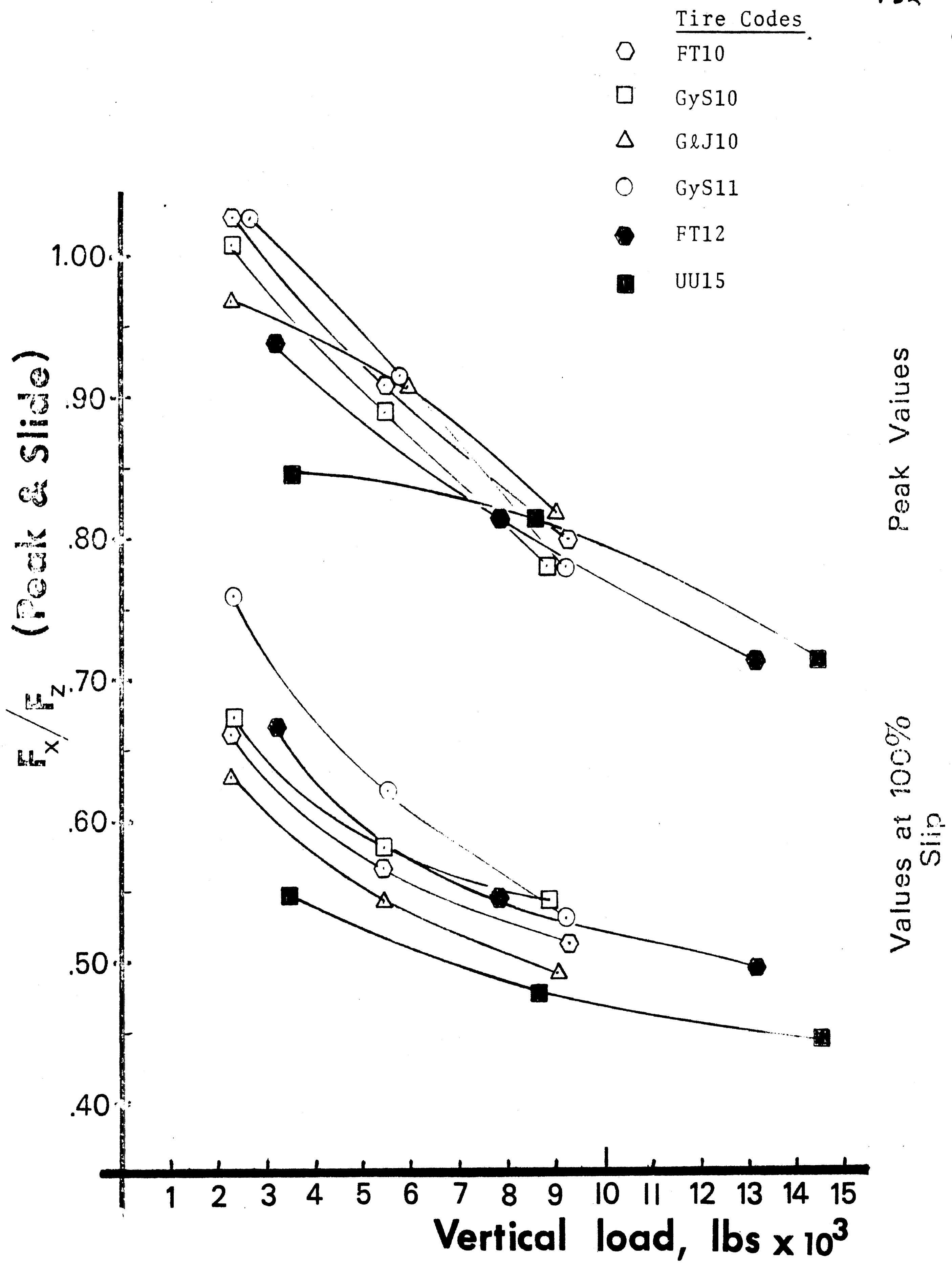


Figure 13. Load sensitivity (non-normalized abscissa) in the peak and slide traction of the six-tire sample (on BADC asphalt).

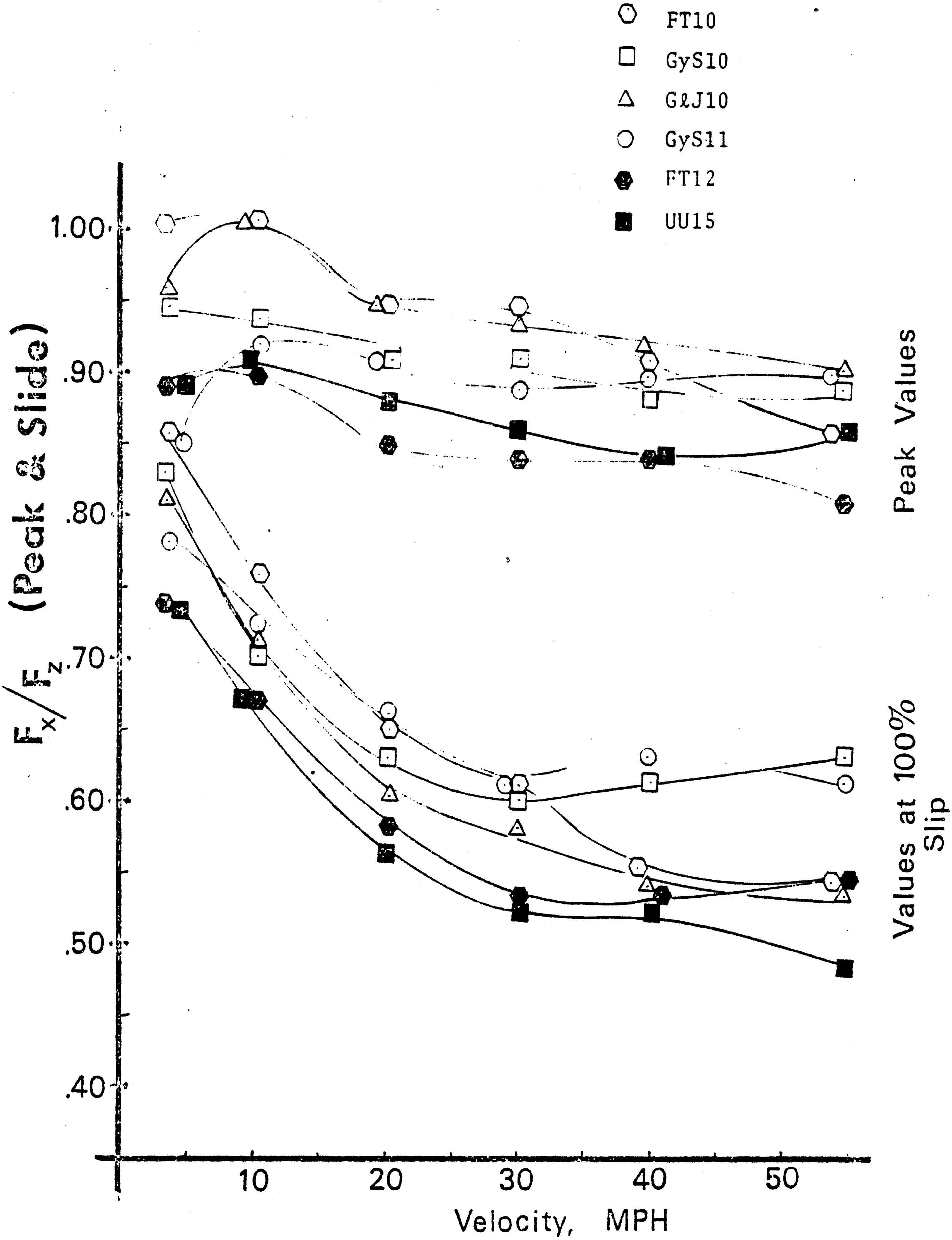


Figure 14. Velocity sensitivity of the peak and slide traction values for the six-tire sample (on BADC asphalt).

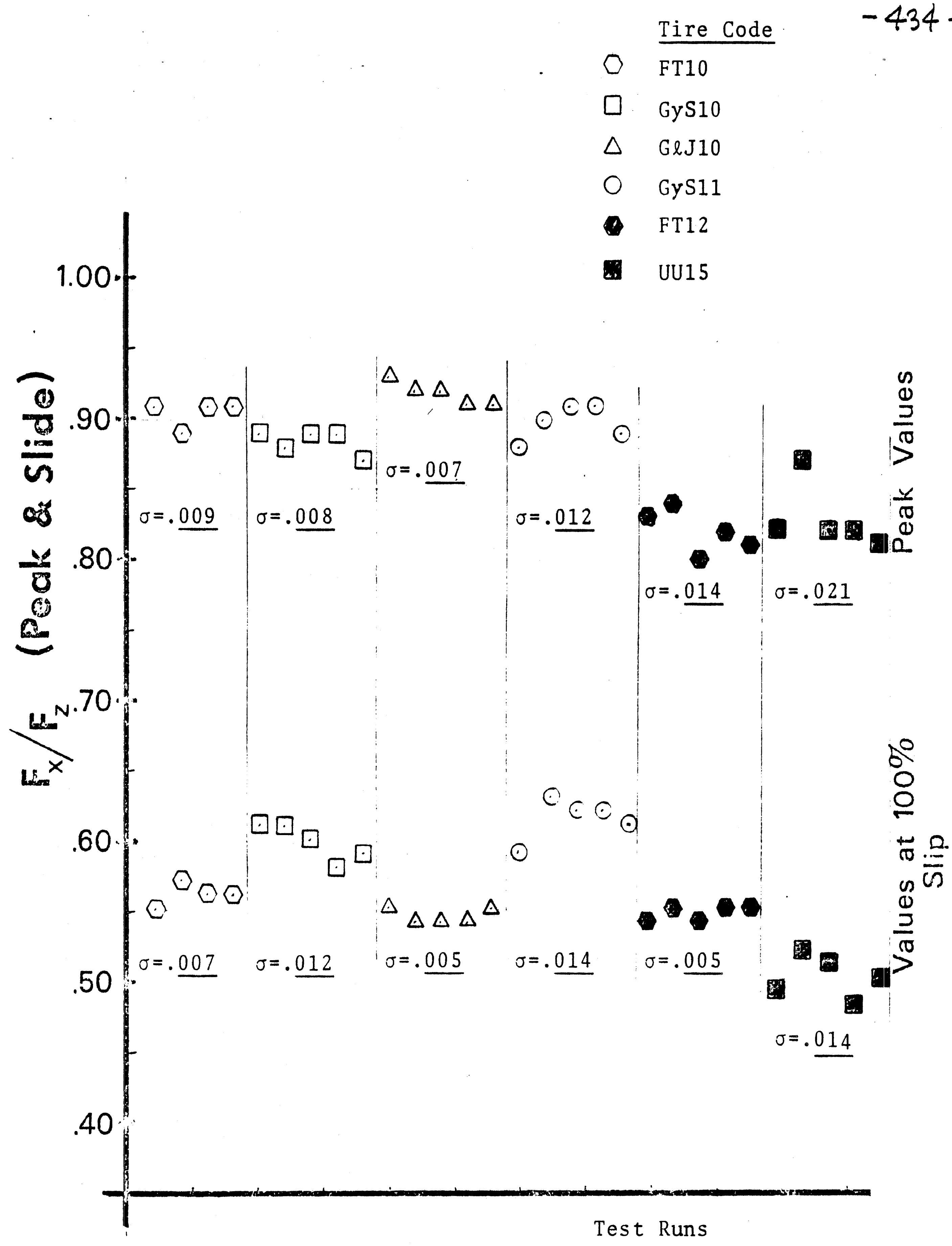


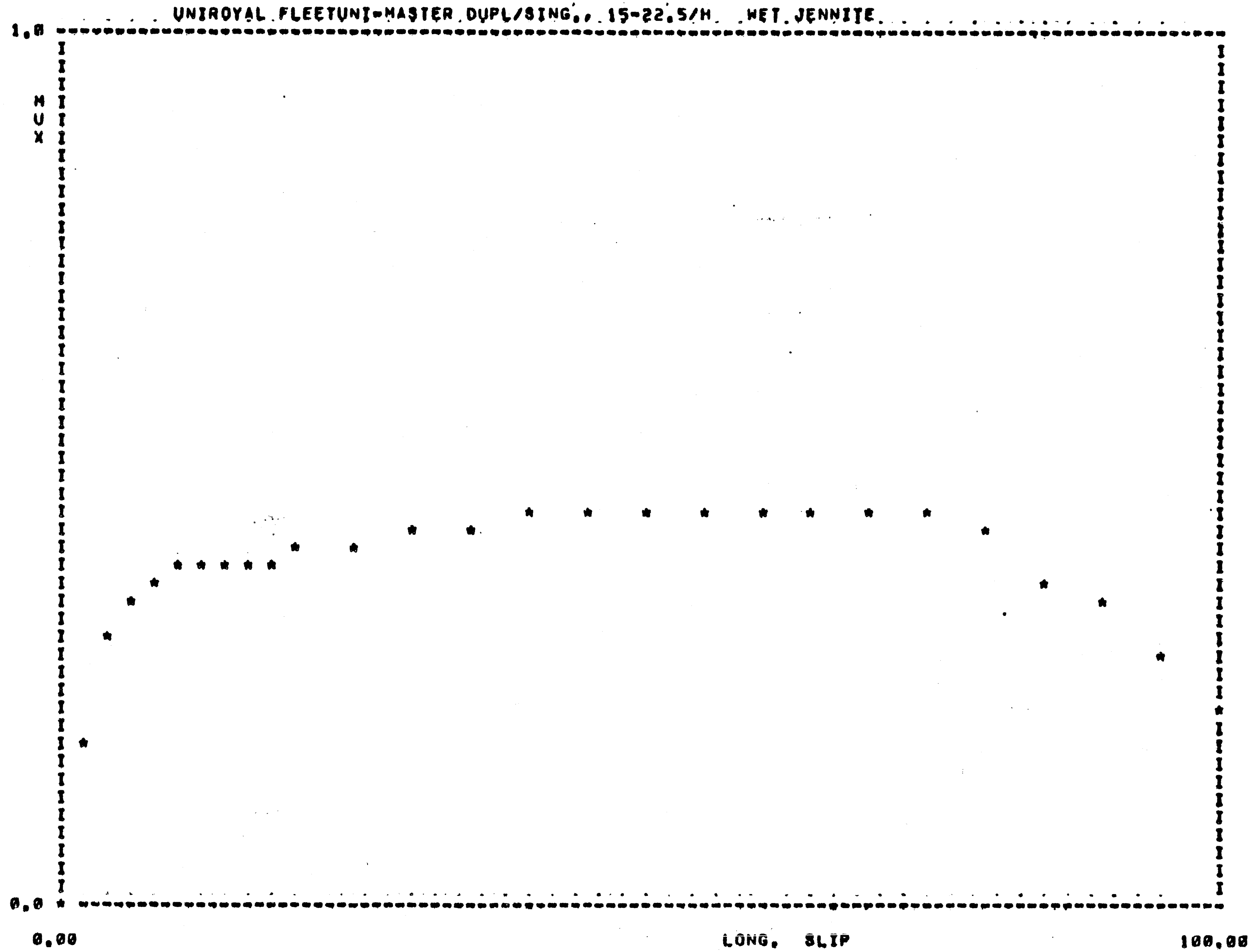
Figure 15. Peak and slide traction measures deriving from repeat runs of each of the six tires tested on the asphalt track at BADC.

group of peak and slide data presented in Figure 15 for each tire, the standard deviation of the measures is printed. In general, the indicated repeatabilities are of considerably higher quality than is observed, say, in peak readings gathered using ASTM skid trailers. In addition to the observed repeatability, it is most significant to note that the test process is causing no monotonic trend in peak/slide characteristics as a function of work history. Thus we have concluded that each tire sample was behaving in a stable fashion throughout the sequence of test runs.

To demonstrate the influence of pavement surface characteristics on peak and slide traction, results have been summarized as load and velocity sensitivities for a baseline tire tested on four different test surfaces. Figure 16 illustrates the extent to which the four pavement selections altered the load sensitivities of this tire. While there appears to be a changing rank among the surfaces in terms of the peak and slide traction values, the two asphalt surfaces which were examined generally provided higher peak traction performances than did two concrete surfaces.

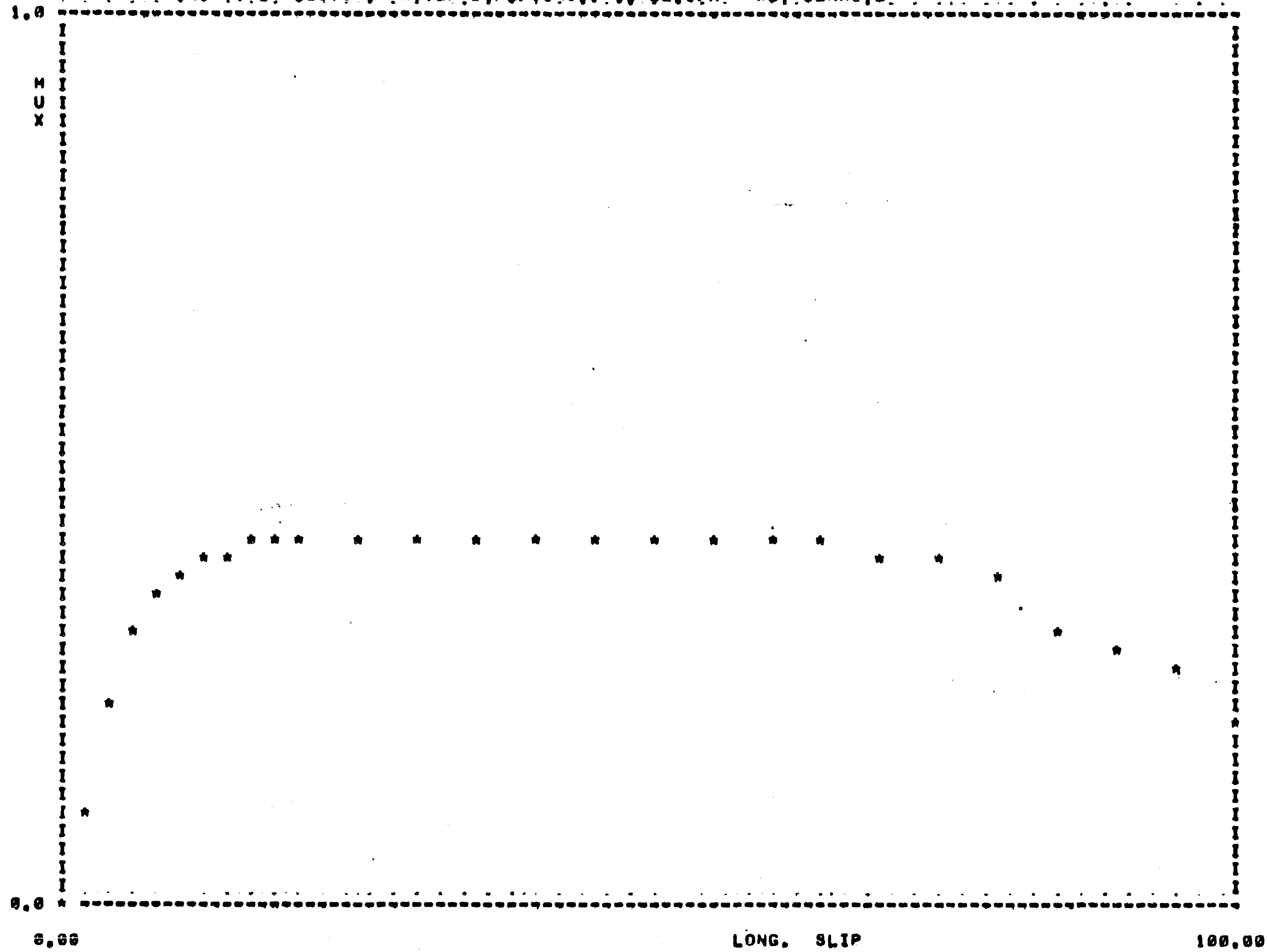
Figure 17 indicates the influence of the pavement differences on velocity sensitivity. Whereas previously reported measurements indicated a profound difference between peak traction performances on concrete and asphalt, these data show basically comparable trends among the two asphalt and two concrete surfaces.

To characterize the statistical repeatability of the data describing pavement influences, the "check run" values of peak and slide traction are plotted for each of two baseline tires in Figures 18 and 19. As before,



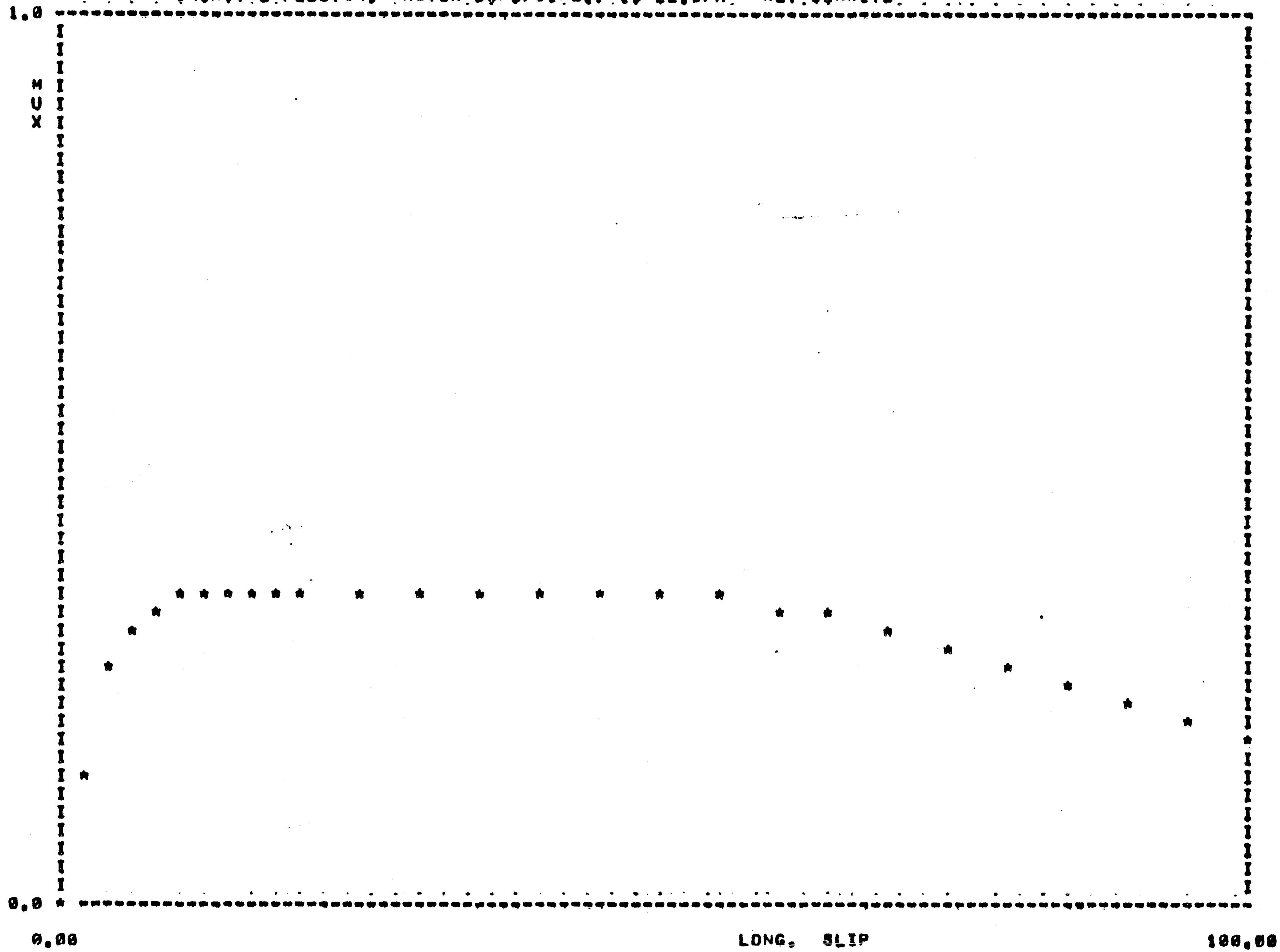
FZ = 4501.9 VEL = 20.0 MULOCK = 0.22 MUPEAK = 0.45 RATIO = 2.00

UNIROYAL FLEETUNI-MASTER DUPL/SING., 15-22.5/H. WET JENNITE

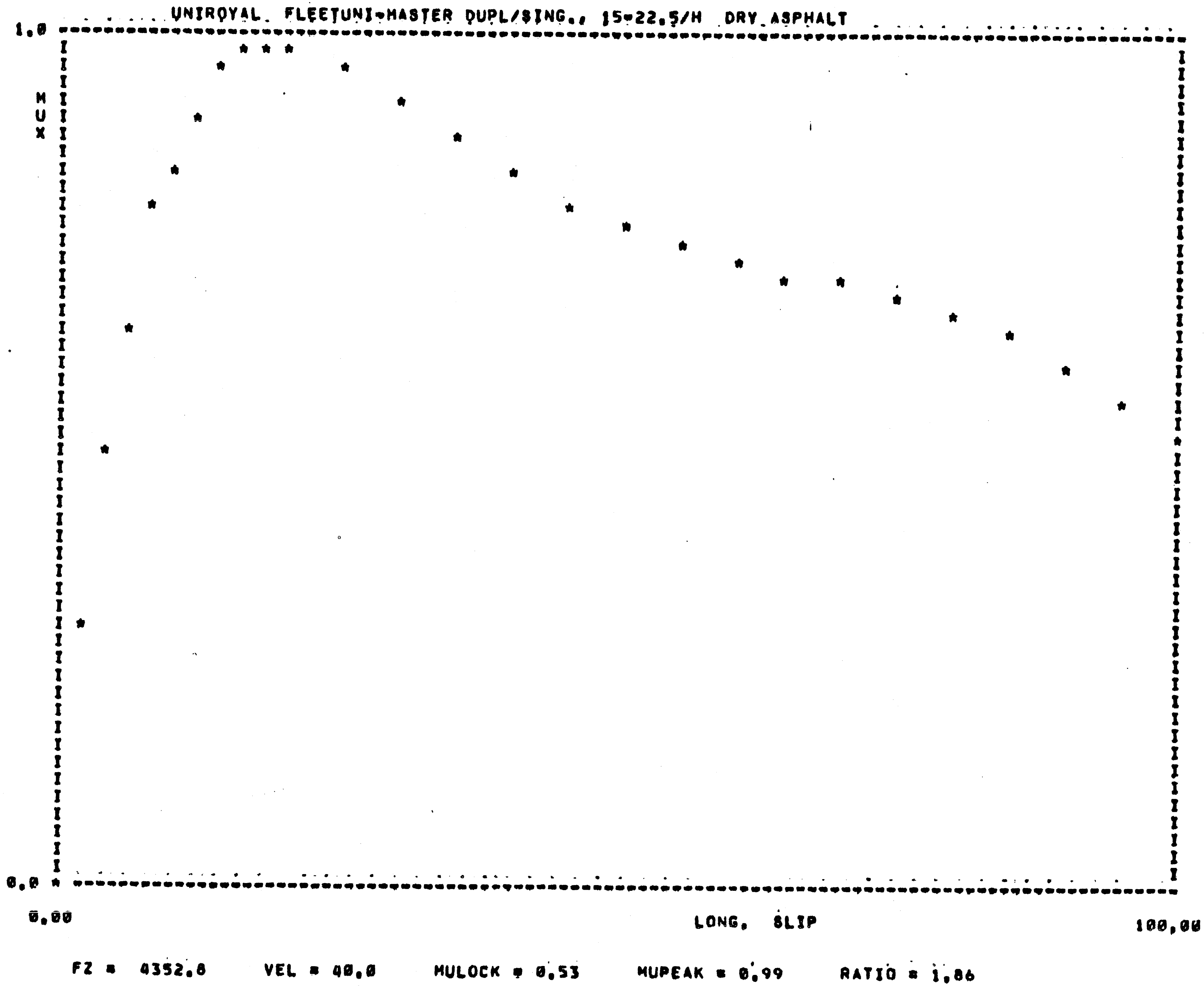


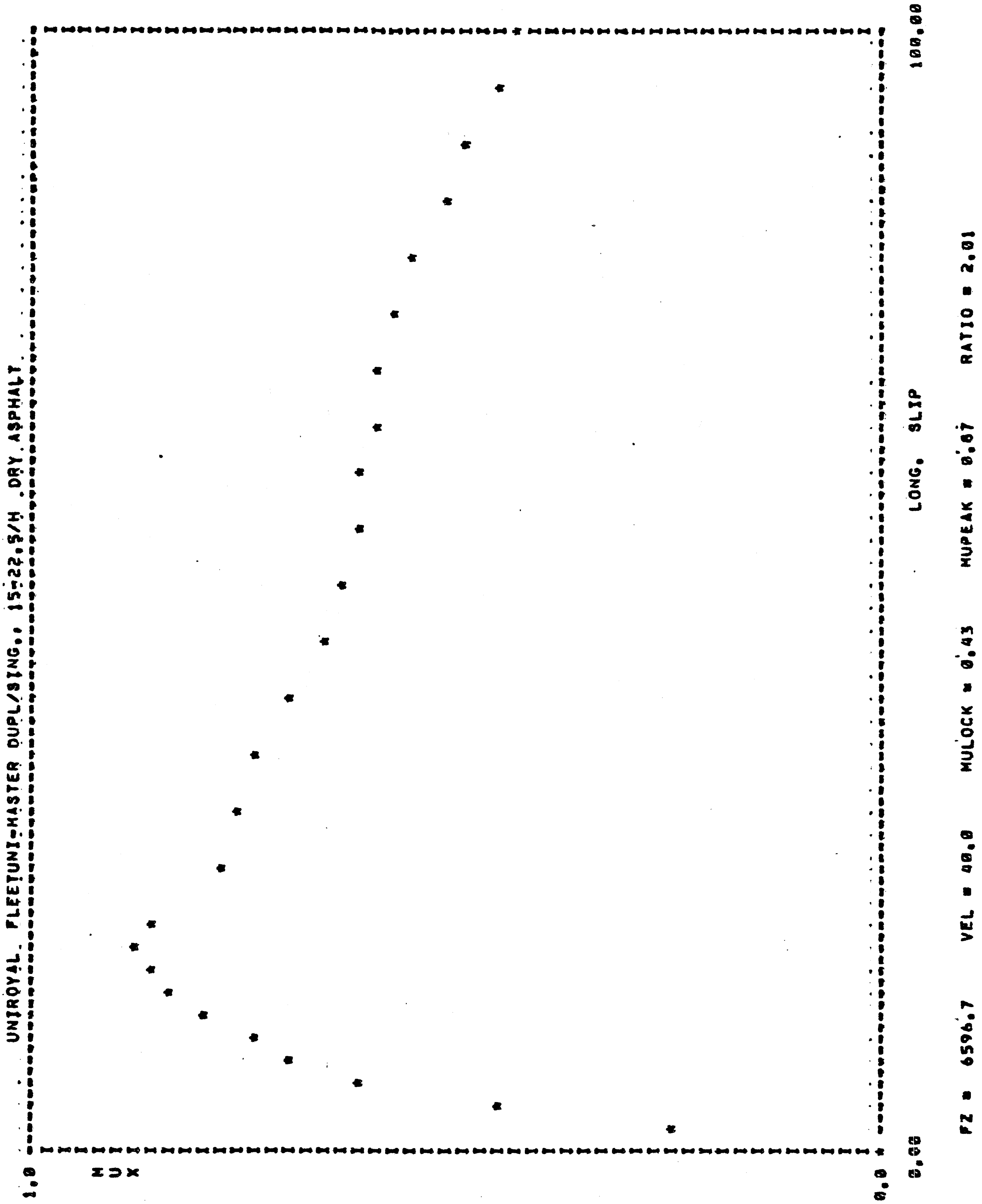
FZ = 8749.8 VEL = 20.0 MULOCK = 0.22 MUPEAK = 0.42 RATIO = 1.93

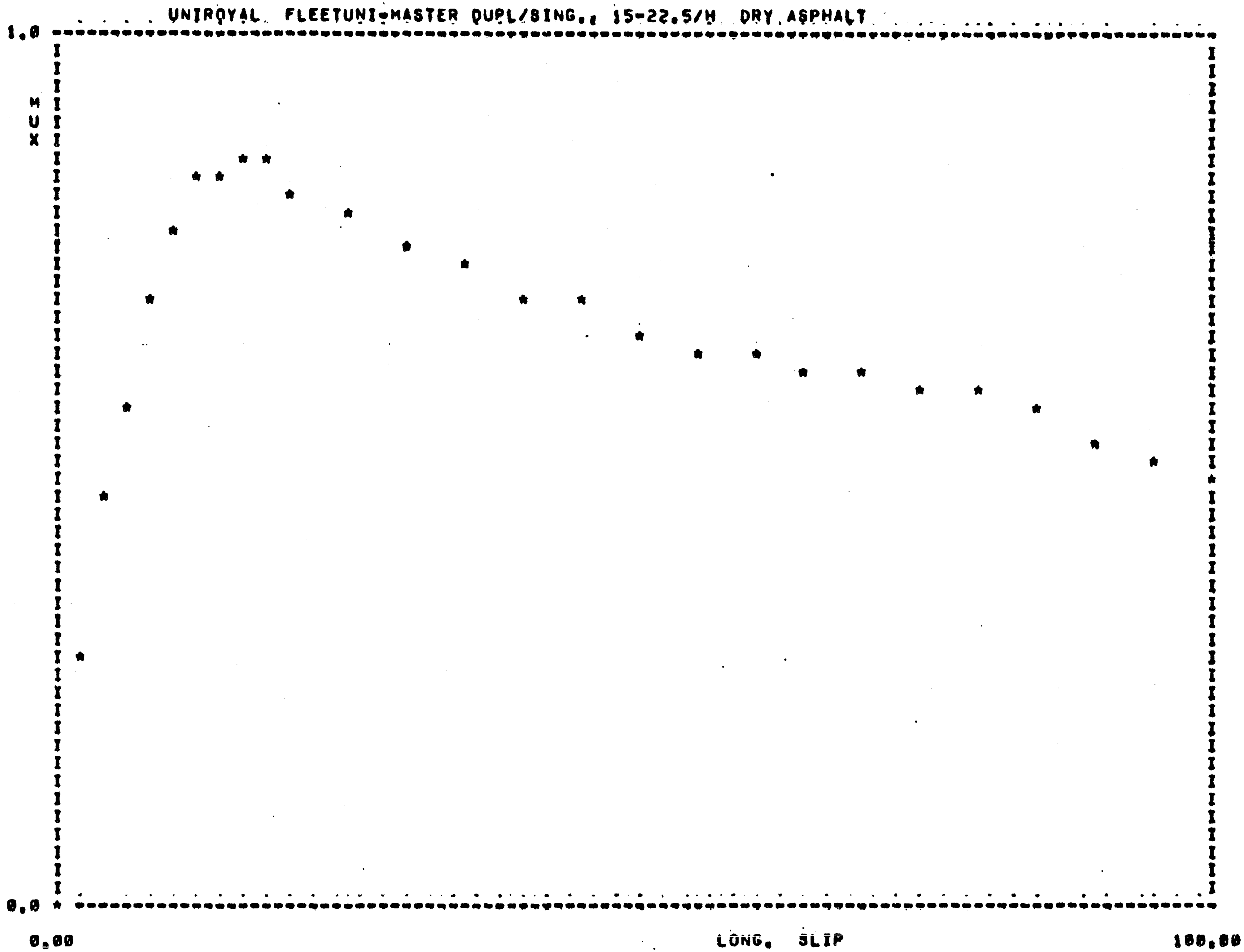
UNIROYAL FLEETUNI-MASTER DUPL/SING., 15-22.5/H. WET JENNITE



FZ = 13519.9 VEL = 20.0 MULOCK = 0.20 MUPEAK = 0.36 RATIO = 1.82


UNIROYAL FLEETUNI-MASTER DUPL/SING., 15-22.5/H DRY ASPHALT
1.0
MUX
0.0
0.00
LONG. SLIP
100.00
FZ = 4352.8 VEL = 40.0 MULOCK = 0.53 MUPEAK = 0.99 RATIO = 1.86


UNIROYAL. FLEETUNI-MASTER DUPL/SING., 15-22.5/H DRY ASPHALT
MUX
1.0
0.0
0.00
100.00
LONG. SLIP
FZ = 6596.7 VEL = 40.0 MULOCK = 0.43 MUPEAK = 0.67 RATIO = 2.01



FZ = 4414.2 VEL = 60.0 MULOCK = 0.49 MUPEAK = 0.86 RATIO = 1.76

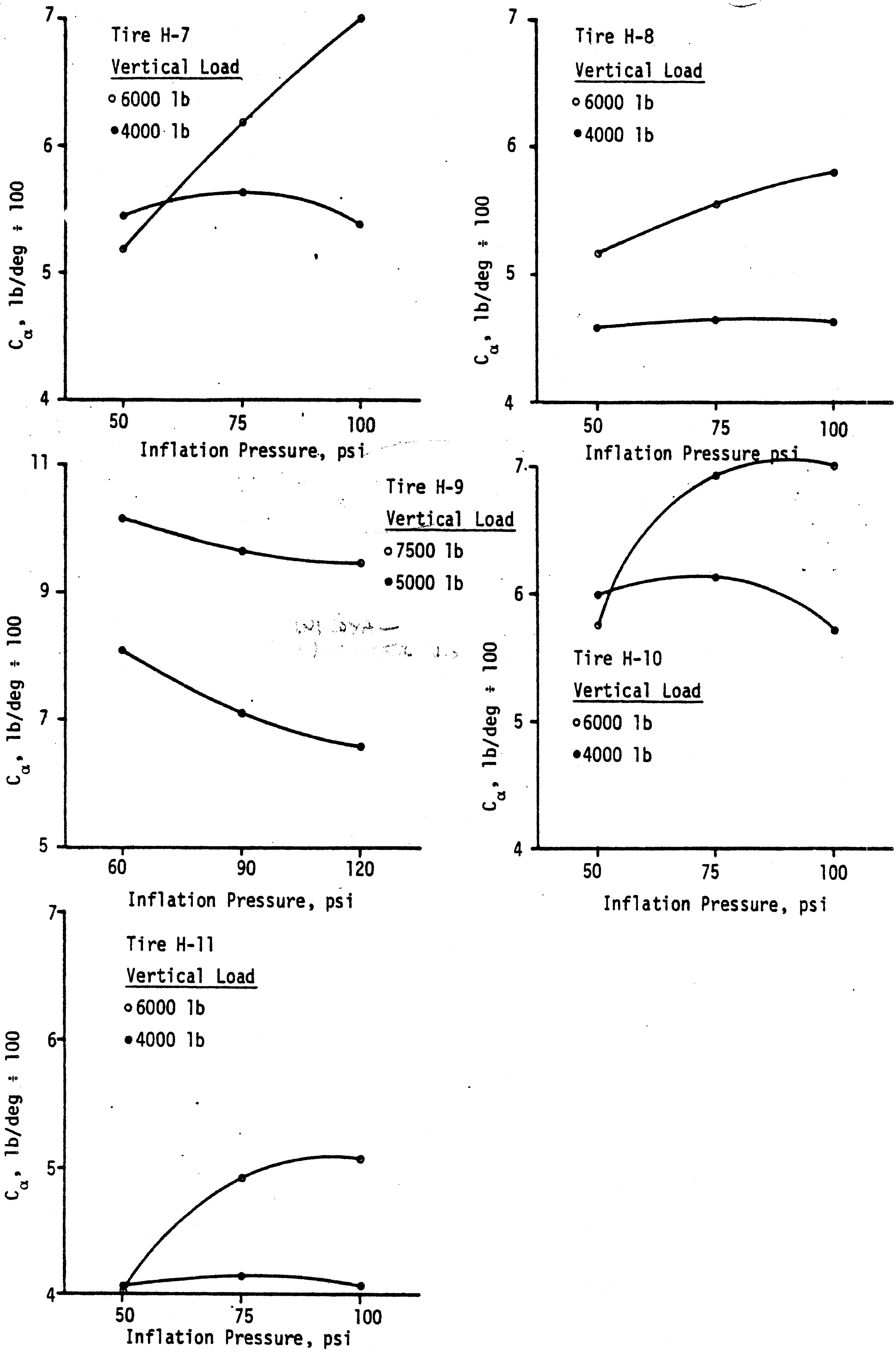


Figure 3. 10 The effects of inflation pressure on cornering stiffness: heavy truck tires (cont.).

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

UNIROYA' LEET-UNI-MASTER 15.00X22.5 H

LATERAL FORCE (LB.) AT INDICATED INFLATION PRESSURE (PSI.), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
120.0	2500.0	-45.1	-388.6	307.3	-642.6	589.8	-1068.3	1003.3	-1631.2	1541.7	-1910.2	1808.6	-1986.9	1997.8
120.0	5000.0	-98.8	-735.2	588.9	-1253.7	1135.8	-2072.9	1961.5	-3183.3	3059.4	-3747.6	3602.6	-3774.3	3848.8
120.0	7500.0	-136.6	-1065.4	825.1	-1803.0	1621.6	-3019.1	2869.3	-4622.4	4487.0	-5231.7	5209.7	-5462.5	5520.3
120.0	10000.0	-176.2	-1285.9	992.2	-2228.2	1995.3	-3806.7	3622.3	-5857.5	5747.1	-6631.8	6605.1	-6948.0	6991.1
90.0	5000.0	-100.6	-786.8	633.2	-1379.7	1253.1	-2338.5	2246.4	-3568.2	3269.0			-4049.9	3927.5
90.0	7500.0	-135.1	-1063.7	865.9	-1875.7	1707.5	-3254.5	3103.3	-4830.6	4707.3			-5724.0	5561.1
60.0	5000.0	-103.1	-899.1	724.0	-1574.9	1439.3	-2640.3	2520.0	-3712.4	3494.8			-4211.2	4102.6
60.0	7500.0	-124.2	-1123.5	904.9	-1975.0	1807.0	-3444.8	3280.1	-5008.2	4783.6			-5734.4	5670.0

11

ALIGNING MOMENT (FT.-LB.) AT INDICATED INFLATION PRESSURE (PSI), LOAD (LB.), AND STEER ANGLE (DEG.)

PSI	LOAD	0	+1	-1	+2	-2	+4	-4	+8	-8	+12	-12	+16	-16
120.0	2500.0	0.8	25.7	-27.5	38.3	-41.6	43.6	-48.5	36.5	-34.6	20.5	-14.0	4.9	2.7
120.0	5000.0	11.1	78.6	-71.8	117.8	-114.7	140.1	-148.6	130.0	-124.9	65.0	-65.3	9.4	-18.7
120.0	7500.0	18.4	154.8	-127.0	232.0	-218.6	295.4	-305.8	267.8	-250.1	154.0	-149.6	46.5	-49.1
120.0	10000.0	30.1	228.7	-186.4	537.4	-329.5	476.3	-489.6	437.6	-423.6	236.9	-241.9	85.6	0.0
90.0	5000.0	11.2	102.0	-91.6	157.8	-158.3	217.4	-198.3	155.6	-158.0			18.6	-28.9
90.0	7500.0	25.6	181.1	-158.1	298.9	-277.2	403.0	-403.6	321.0	-337.2			50.4	-69.0
60.0	5000.0	20.3	141.3	-123.5	224.3	-213.0	264.6	-276.1	162.1	-164.4			14.7	-29.1
60.0	7500.0	31.1	250.6	-206.8	400.6	-378.6	527.1	-531.6	366.9	-369.6			45.0	-69.2

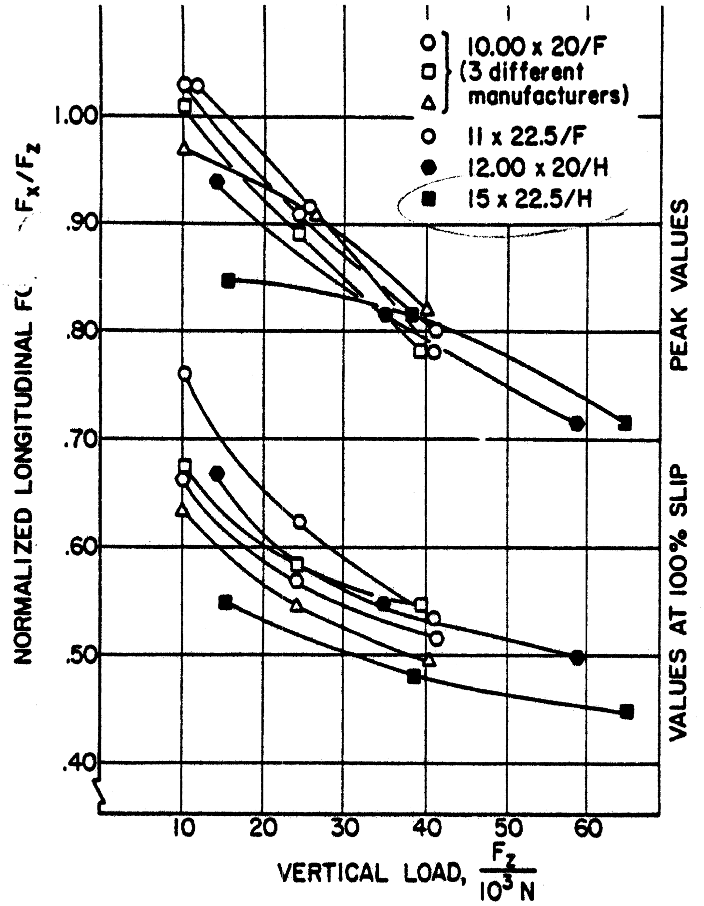


Fig. 3: Load sensitivity in the peak and slide traction of a six-tire sample on dry asphalt. All tests run at 64 km/h.

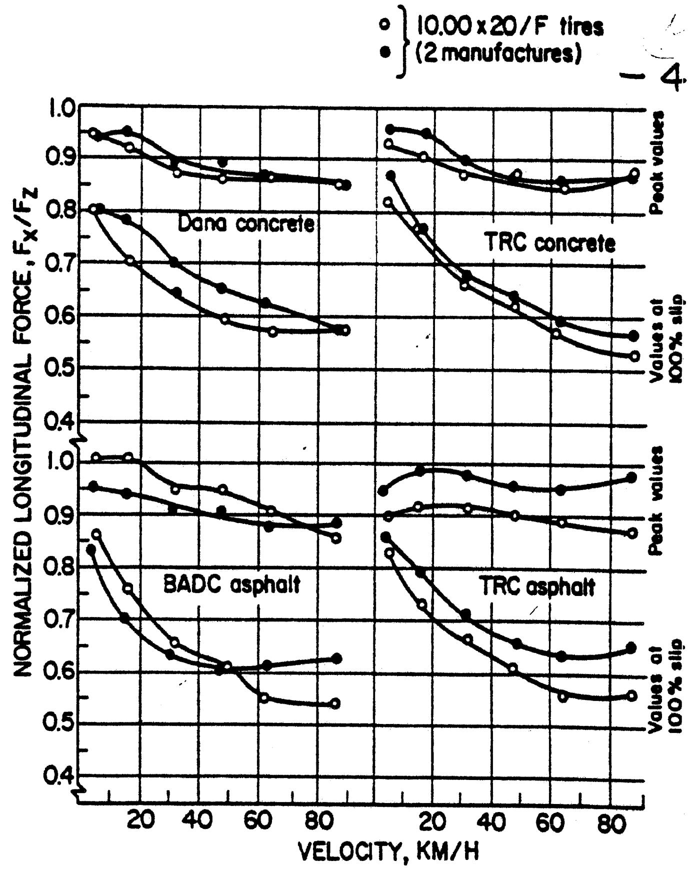


Fig. 5: The differing influence of pavement surface on the velocity sensitivities of two tires.

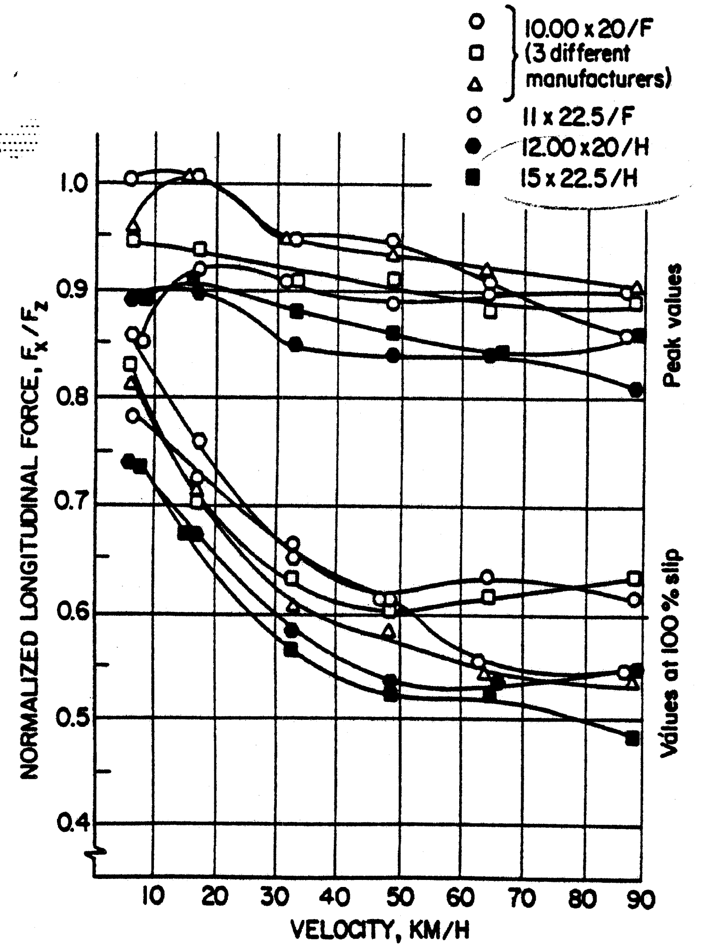


Fig. 4: Velocity sensitivity of the peak and slide traction values for a six-tire sample on dry asphalt. All tires operated at their respective T & RA rated load.

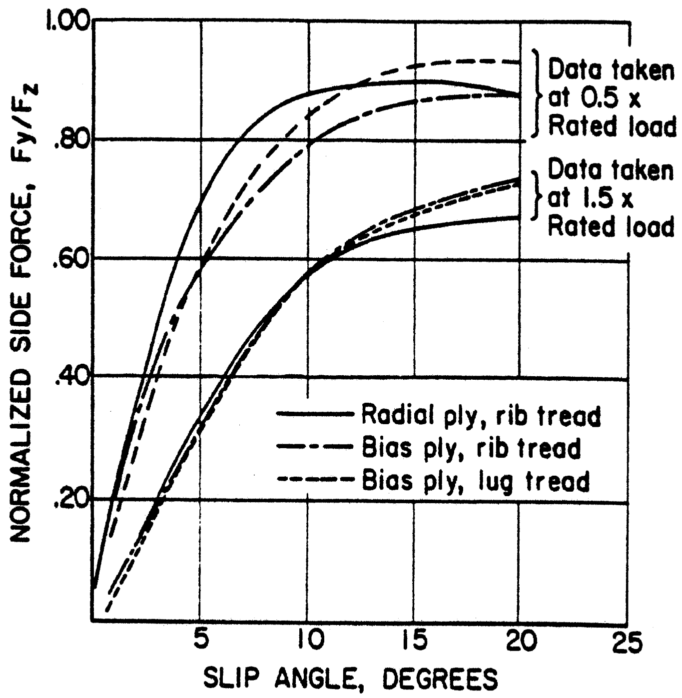


Fig. 6: Typical load sensitivities in the side force response of a sample of 10.00 x 20 tires tested at 32 km/h on a dry concrete surface.

Tire: Highway Tread 15-22.5/H Rim: 22.5x11.75

LATERAL FORCE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Lateral Force at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2900	90	461	850	1402	2027	2376	2772
5800	90	790	1488	2531	3791	4479	5256
8640	90	1015	1915	3368	5190	6195	7301
10000	90	1041	2012	3583	5628	6860	8119(?)

ALIGNING TORQUE vs SLIP ANGLE AND VERTICAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	Aligning Torque at Indicated Slip Angle (degs.)					
		1	2	4	8	12	16
2900	90	44	71	86	63	29	10
5800	90	124	208	276	223	131	78
8640	90	214	375	515	449	273	161
10000	90	251	449	632	571	347	215

CIRCUMFERENTIAL STIFFNESS vs SLIP ANGLE AND NORMAL LOAD

Vertical Load (lbs.)	Inflation Pressure (psi)	C_s (lbs.)	Vertical Spring Rate (lbs./in.)
2900	90	47,000	
8640	90	85,000	5420
10000	90	76,000	