UM-HSRI-PF-74-3

LABORATORY SHEAR FORCE COMPARISON OF 7.00 x 16.00 MILITARY NDCC TIRE WITH TWO CONVENTIONAL TIRES.

Final Report

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INTRODUCTION

This report presents the results obtained from a laboratory tire force and moment measurement program. The measurements were conducted by the Highway Safety Research Institute of The University of Michigan for the U.S. Army Tank Automotive Command (TACOM). The overall purpose of this study is to provide TACOM with tire data to be used in vehicle simulations.

Free-rolling lateral force and aligning moment produced by three different tires were measured on the HSRI flat bed device shown in Figure 1 and described in Appendix II. The tires tested were a military 7.00 x 16 NDCC (manufactured by Firestone) and two conventional mud and snow tires--a Goodyear Suburbanite GR78-15 (radial) and Firestone Town and Country G78-15. The test conditions are shown in Table 1. The test results are contained in Appendix I, both in graphical and tabular form as (a) lateral force and aligning moment versus slip angle at constant load and inflation pressure for a family of inclination angles and as (b) lateral force and aligning moment versus inclination angle at specific slip angles of 0°, 4°, and 11° and constant inflation pressure for a family of vertical loads.

The graphs and tables contain the words "steer angle" and "camber angle." As defined in SAE J670c Vehicle Dynamics Terminology, these terms should be, respectively, "slip angle" and "inclination angle." The latter terminology is used in the body of the report.

TABLE 1. TEST CONDITIONS

Loads-lbs. \ Slip Angle Deg	Camber Angles Deg. - 0, 2, 4, 5, 6						
	0	1	2	4	6	9	11
500	x	x	x	x	x	x	x
800	x	x	x	x	x	x	x
1100	x	x	x	x	x	x	*
1400	x	x	x	x	x	x	*

*Slip angles of 12° for 1100 and 1400 lbs. loads

Inflation pressures - Psi

G-78 x 15.00 commercial tires = 16, 24

7.00 x 16.00 military tire = 20, 25

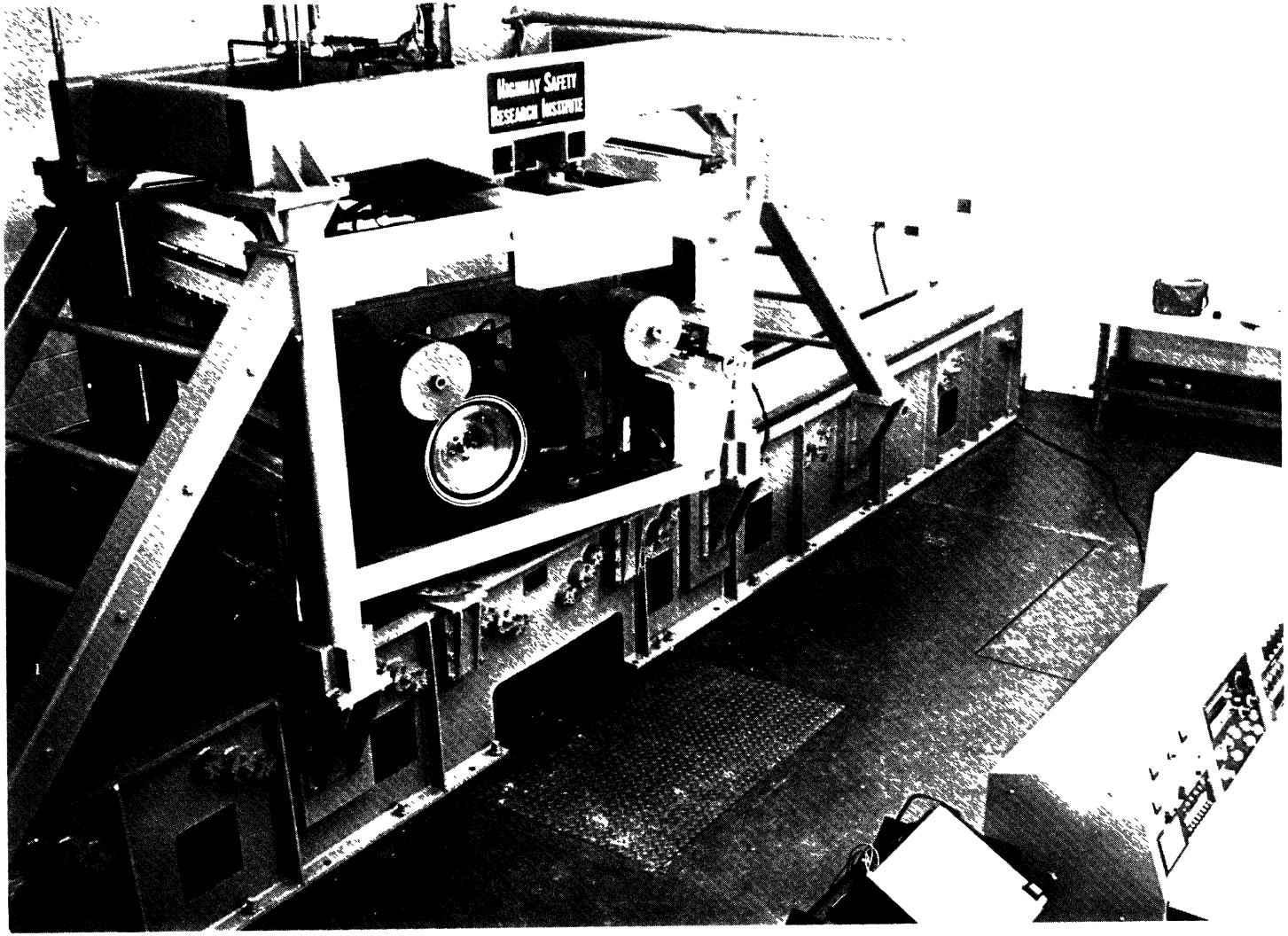


Figure 1. Flat Bed Tire Tester

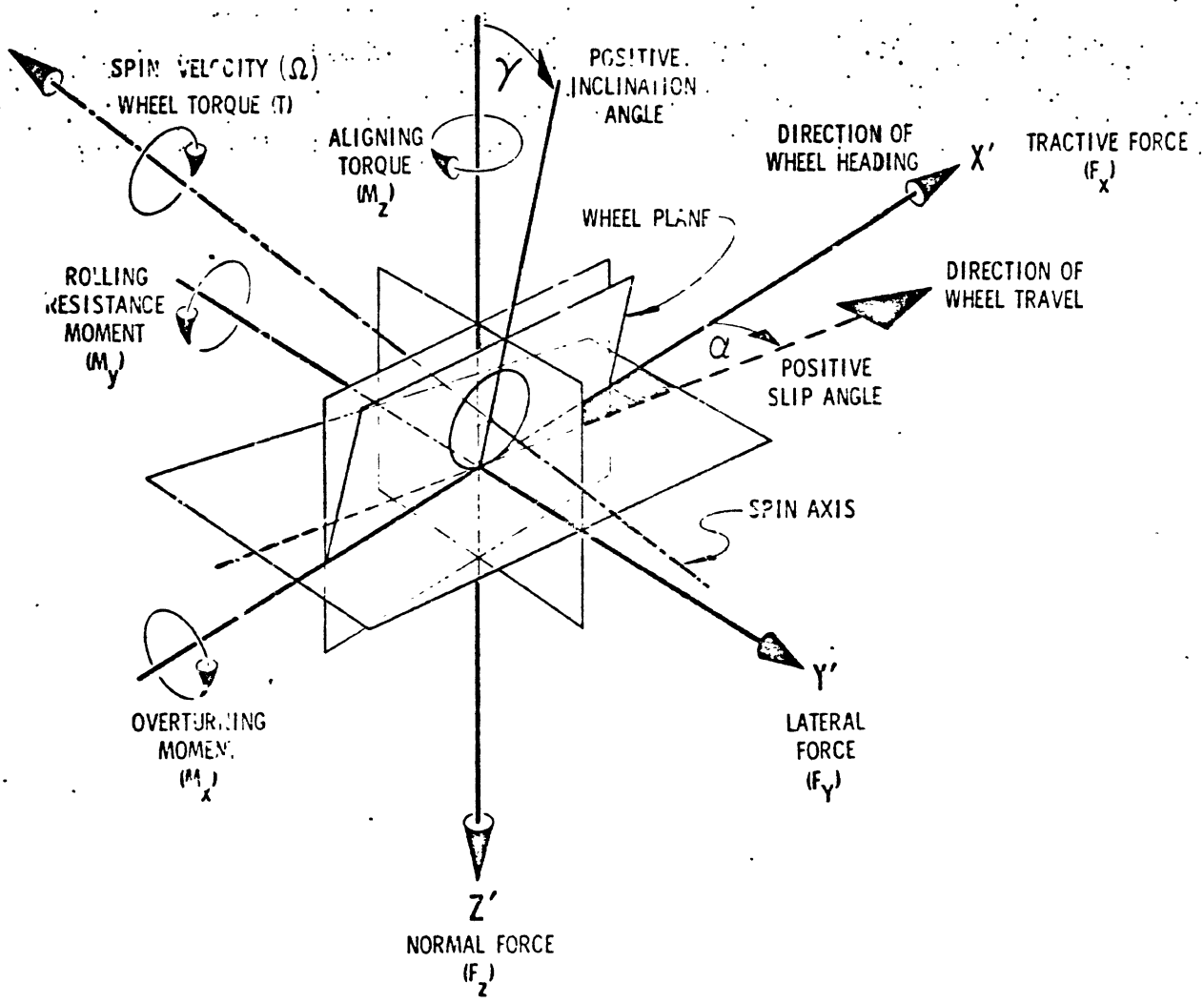


Figure 2.

SAE Tire Axis System

TEST PROCEDURES

Each tire was received in new condition and run on the flat bed machine at ± 6° slip angle at 1000 lbs load for 400 feet to remove mold lubricants and rubber protuberances from the tread. The basic test sequence consisted of locking the tire into a particular orientation (combination of slip angle and camber angle), and gathering force and moment data at each load and inflation pressure before the tire orientation was changed to the next increment.

All slip angles and inclination angles were SAE positive. The SAE tire axis system is shown in Figure 2. This combination of positive slip angle and positive inclination angle results generally (but not always) in a lateral force that is reduced from the lateral force produced by slip angle alone. The combination of positive slip angle and negative inclination angle, which generally produces lateral forces greater than those produced by slip angle alone, is not realistic for conventional four-wheeled vehicles, but rather is typical of motorcycle operation in which the vehicle's vertical axis tilts toward the center of path curvature.

Each value of lateral force and aligning moment tabulated in Appendix I is the average of two individual values--one produced by a clockwise rotation of the tire and one produced by a counterclockwise rotation. For μ at positive slip and inclination angle, the vehicular operating condition being simulated is a left turn with the tire mounted either serial-side-in (CW rotation) or serial-side-out (CCW rotation).

DISCUSSION OF DATA

It is anticipated that the data presented in Appendix I will be used directly in vehicle simulations and that tire-to-tire comparisons at specific operating conditions will not be of primary interest. Nevertheless, such comparisons are useful for demonstrating major features of the data and serve to give interested readers a measure of how the military tire compares to conventional types without requiring a search through the mass of data presented in Appendix I. Accordingly, the following three sub-sections contain tire-to-tire comparisons for the three basic operating conditions--slip angle alone, inclination angle alone, and combined slip and inclination.

TIRE RESPONSE TO SLIP ANGLE IN THE ABSENCE OF INCLINATION ANGLE

A tire parameter of significance to small disturbance directional behavior is the cornering stiffness, C_α, defined as the initial slope of the lateral force versus slip angle curve:

$$C_\alpha = \left.\frac{dF}{d\alpha}\right|_{\alpha=0}$$

Utilizing the lateral force data at 0° and 1° slip angle, the following values of C_α, in pounds per degree, were computed for the 24 or 25 psi case.

TABLE 2. COMPARISON OF C_α VALUES

		Load			
	psi	500	800	1100	1400
GR78-15	24	94.8	142.8	169.5	176.1
NDCC	25	105.8	136.7	146.4	151.9
G78-15	24	105.0	134.0	134.4	130.0

Except at the lightest load, the radial ply tire exhibits significantly higher cornering stiffness than do the other two tires;

the NDCC tire shows greater C_α at 1100 and 1400 than does the G78-15. The lower inflation pressures of 16 and 20 psi are too widely separated to allow meaningful comparison of the data taken at these pressures.

While the data at small slip angles is useful for establishing the cornering stiffness of the tire, data at large slip angles provides a measure of the ultimate cornering capability of a tire. At the higher slip angles of 9°, 11°, and 12° the NDCC tire provides significantly greater lateral force than either conventional tire as is shown in Table 3. These slip angles, however, are much greater than those imposed on the tire in routine driving, and are usually called for only in accident avoidance maneuvers.

TABLE 3. COMPARISON OF LATERAL FORCE AT HIGHER SLIP ANGLES; 1100 and 1400 LBS LOAD

		Slip Angle			
		9°		12°	
		Load			
	psi	1100	1400	1100	1400
NDCC	25	862	942	1028	1117
GR78-15	24	742	865	789	955
GR78-15	24	758	877	835	983

The NDCC and GR78-15 tires exhibit nearly identical aligning moment characteristics. The values of aligning moment produced by these tires are significantly greater than those produced by the G78-15.

TIRE RESPONSE TO INCLINATION ANGLE IN THE ABSENCE OF SLIP ANGLE

Analogous to cornering stiffness, inclination stiffness, C_γ, is defined as

$$C_\gamma = \left.\frac{dF}{d\gamma}\right|_{\gamma=0}$$

Utilizing lateral force data at 0° and 2° inclination angle, the following values of C_γ, in pounds per degree, were computed at 24 or 25 psi.

TABLE 4. COMPARISON OF C_γ VALUES

		Load			
	psi	500	800	1100	1400
GR78-15	24	7.5	10.0	13.0	16.0
NDCC	25	7.0	12.4	17.0	19.5
G78-15	24	13.0	18.5	20.0	20.0

The inclination stiffness of the radial tire is lower than that of the other two tires tested by about 30%.

At higher inclination angles, the radial ply tire continues to be the least influenced, displaying significantly less lateral force due to inclination angle than the other two tires, as shown in Table 5.

TABLE 5. COMPARISON OF LATERAL FORCE AT HIGHER INCLINATION ANGLES; 1100 1400 LB LOAD

		Inclination Angle			
		5°		6°	
		Load			
	psi	1100	1400	1100	1400
GR78-15	24	70	84	81	99
NDCC	25	95	112	124	139
G78-15	24	104	114	105	138

The aligning moment response of the NDCC and GR78-15 tires as inclination angle increases is negligible. The aligning moment versus inclination angle characteristics for these two tires are nearly horizontal, having a slope of much less than 1 ft lb per degree. The same is true of the G78-15 at 16 psi, but at 24 psi inflation the characteristics take on slopes of up to 4 ft lbs per degree.

TIRE RESPONSE TO COMBINED SLIP ANGLE AND INCLINATION ANGLE

At slip angles less than 6° (positive) all three tires exhibit a progressive reduction in lateral force as the inclination angle is increased from zero. This result is to be expected since the direction of lateral force due to a positive inclination angle is oppositely directed to the lateral force produced by a positive slip angle. However, at 6° slip angle, the lateral force versus slip angle curves for the radial and the NDCC tire show that the application of positive inclination angle actually causes the lateral force to increase relative to the zero-inclination angle condition. This result is quite unexpected and implies that the application of inclination angle to these two tires operating at high slip angles increases the amount of rubber in contact with the road and available for lateral deformation.

Visual inspection of the shoulder regions of the tires adds support to this hypothesis. The GR78-15 and NDCC tires have round shoulders which would facilitate the contact of shoulder and sidewall rubber with the road under conditions of tire inclination, thereby adding to the area of tire-road contact. The G78-15, however, has a square shoulder that would not allow shoulder and sidewall rubber to meet the road when inclination angle is applied; and, indeed, the data shows that the G78-15 produces the more expected pattern of lateral force reduction as inclination angle increases.

The aligning moment values produced by combined slip and inclination angles are much greater in all cases than those produced by slip angle alone. The increase in peak aligning moment due to 2° inclination range from 20% to 70%.

APPENDIX I.

Part A: Firestone NDCC Tire 7.00-16

INITIAL TIRE BIAS

TIRE: FIRESTONE [illegible]

RIM: 6 x 4.5

INFLATION: 20 PSI

STEER ANGLE= 0

CAMBER ANBLE= 0

VERTICAL LOAD	F_y	M_z
[illegible]	16.7	.9
[illegible]	[illegible]	2.5
[illegible]	18.3	3.8
[illegible]	[illegible]	5.1

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE [illegible] 7.00×16.00

RIM: 16.00 × 4.5

INFLATION: 20 psi

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
900	[illegible]	204.7	[illegible]	377.1	473.8	[illegible]	--
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	--
1100	[illegible]	283.6	454.0	[illegible]	532.1	--	762.7
1400	[illegible]	283.1	457.7	644.1	532.8	--	965.9

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	103.1	205.9	355.0	441.4	543.5	518.3	—
800	[illegible]	[illegible]	[illegible]	[illegible]	766.3	842.1	—
1100	[illegible]	[illegible]	[illegible]	625.1	859.3	—	1013.4
1400	[illegible]	182.8	[illegible]	597.4	805.3	—	967.2

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: 16 × 4.5

INFLATION: 20 PSI

CAMBER ANGLE: 4°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	8	11	12
500	84.3	131.5	333.5	429.6	533.7	580.0	—
800	70.6	[illegible]	405.0	[illegible]	750.5	[illegible]	—
1100	42.8	102.6	394.6	[illegible]	828.8	—	770.4
1400	17.4	134.8	347.8	554.3	775.9	—	753.0

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone [illegible] 7 x 8.00

RIM: 16 x 4.5

INFLATION: 20 PSI

CAMBER ANGLE: 5°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	67.9	179.8	329.4	[illegible]	[illegible]	57[illegible]	–
800	47.9	188.6	3[illegible].5	[illegible]	7[illegible].2	835.9	–
1100	[illegible]	[illegible]	371.6	571.6	816.7	–	979.7
1400	2.3	[illegible]	323.5	[illegible]	766.8	–	945.4

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

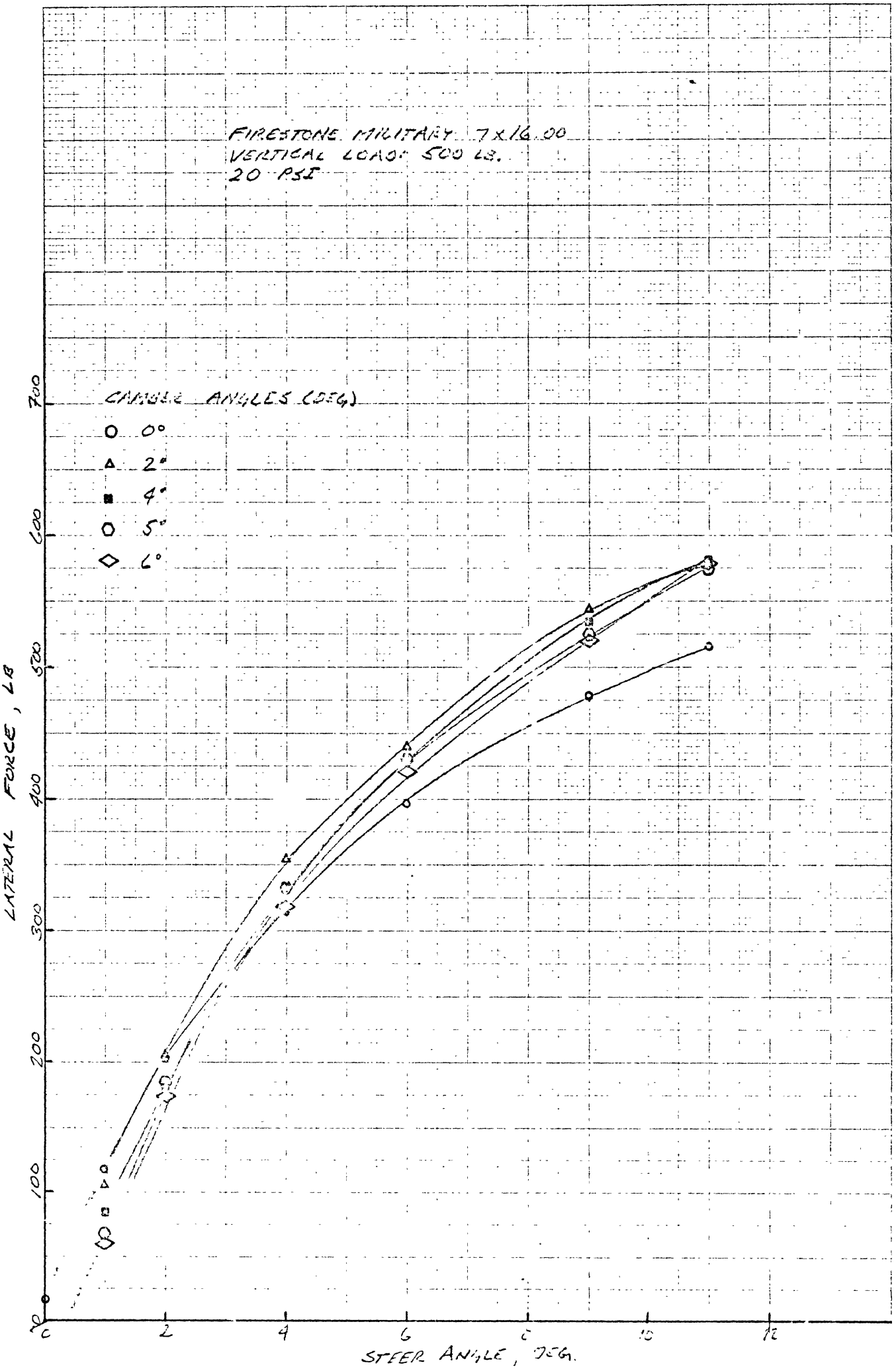
TIRE: FIRESTONE MILITARY 7.00-16

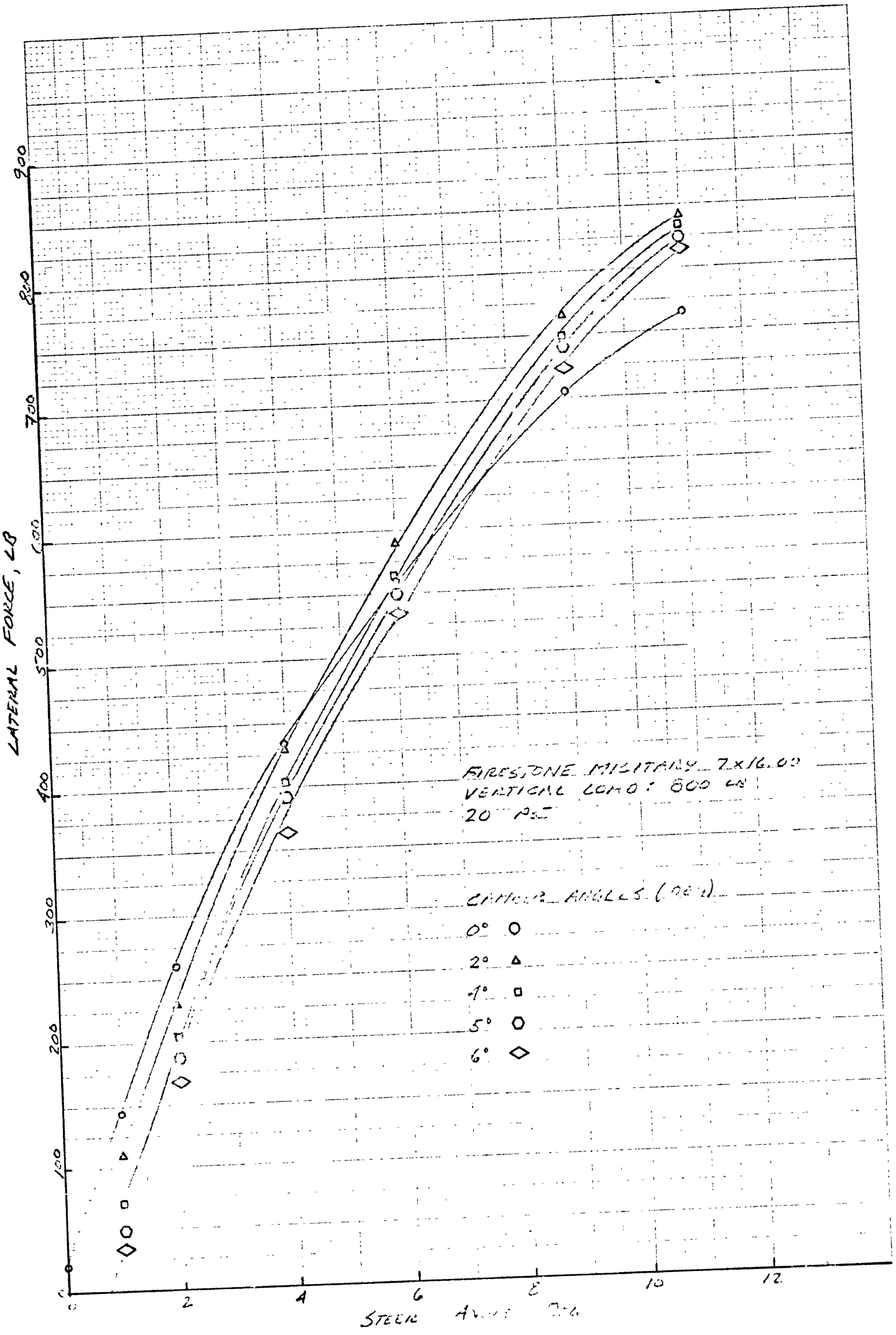
RIM: 16 x 4.5

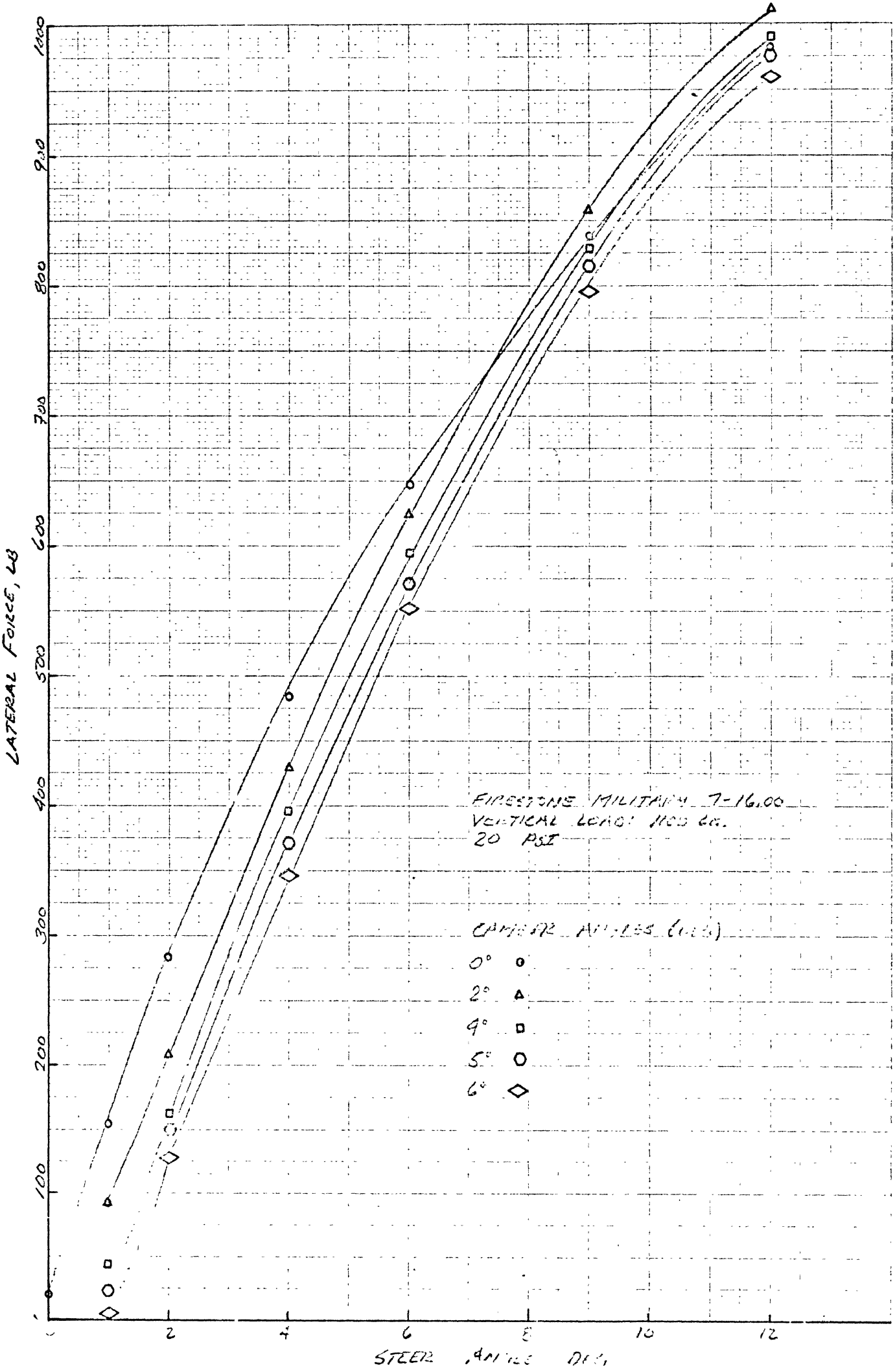
INFLATION: 20 PSI

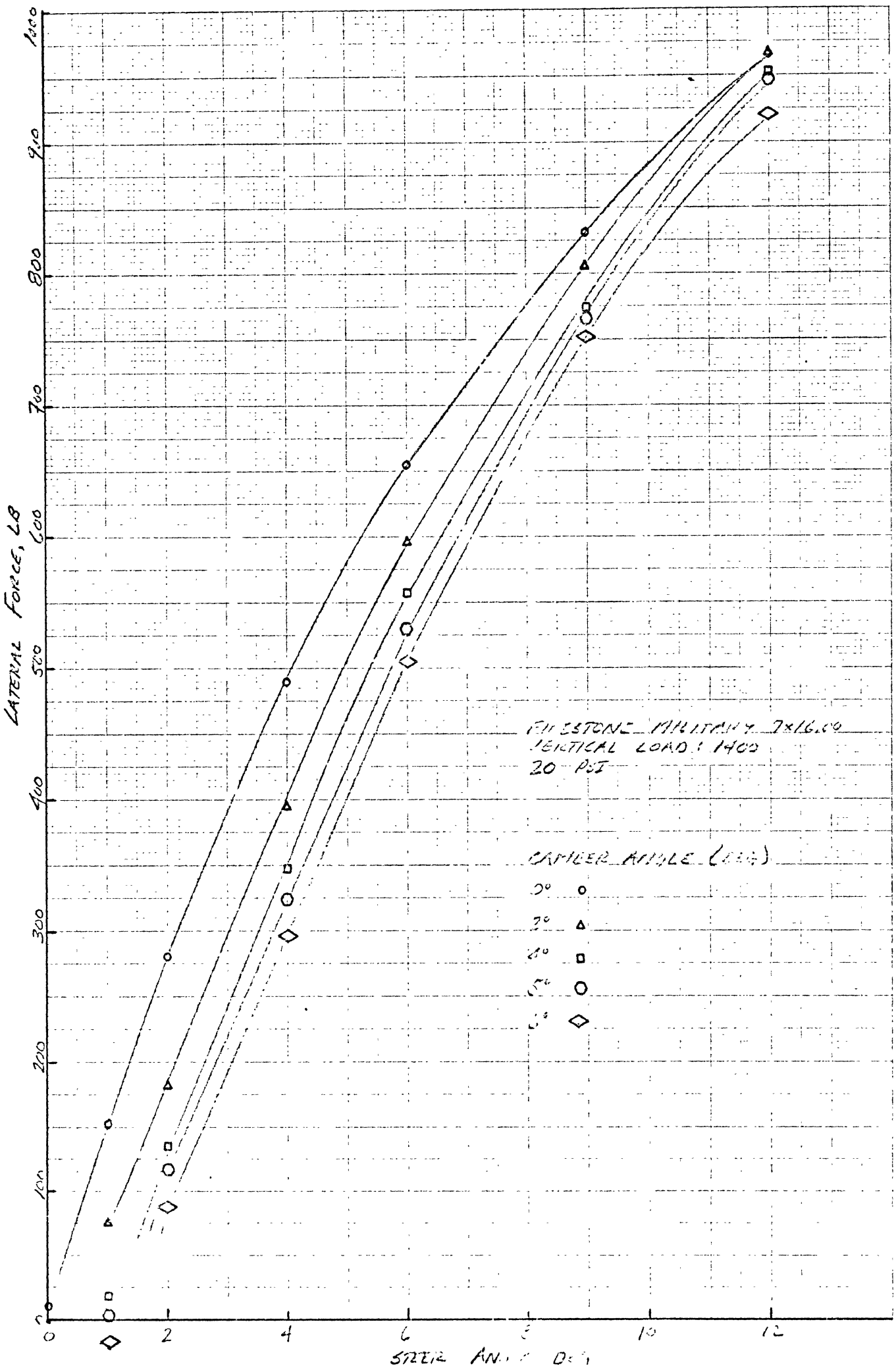
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	60.2	173.3	316.0	4[illegible]	521.9	5[illegible]9.1	
800	32.0	163.4	3[illegible]	[illegible]	[illegible]	816.2	
1100	5.5	127.5	346.0	[illegible]52.2	[illegible]	--	961.7
1400	-19.9	87.5	296.9	[illegible]	[illegible]	--	920.0


FIRESTONE MILITARY 7.00 x 16
VERTICAL LOAD: 500 LB.
20 PSI
CAMBER ANGLES (DEG.)
0°
2°
4°
5°
6°
LATERAL FORCE, LB
STEER ANGLE, DEG.
0
100
200
300
400
500
600
700
0
2
4
6
8
10
12


LATERAL FORCE, LB
900
800
700
600
500
400
300
200
100
0
2
4
6
8
10
12
FIRESTONE MILITARY 7.00-16.00
VERTICAL LOAD: 800 LB
20 PSI
CAMBER ANGLES (DEG)
0° ○
2° △
4° □
5° ○
6° ◇




LATERAL FORCE, LB
1000
900
800
700
600
500
400
300
200
100
0
0
2
4
6
8
10
12
FIRESTONE MILITARY 7×16.00
VERTICAL LOAD: 1400
20 PSI
CAMBER ANGLE (DEG)
0°
2°
4°
6°
8°

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone Nylon 7x16.00

RIM: 16.0[illegible] 4.5

INFLATION: 20 [illegible]

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	[illegible]	1.6	[illegible]	-6.6	-
800	[illegible]	25.0	[illegible]	[illegible]	[illegible]	-0.7	-
1100	[illegible]	45.1	54.4	50.4	[illegible]	-	+23.5
1400	[illegible]	63.5	71.1	70.5	87.5	-	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] 7×16.00

RIM: 16 × 4.5

INFLATION: 20 PSI

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	13.2	15.4	15.1	9.9	-2.4	-2.1	-
800	23.4	34.5	45.5	37.2	17.5	9.1	-
1100	33.6	55.5	84.9	86.6	59.8	-	37.1
1400	45.6	75.5	121.8	136.1	133.6	-	117.0

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone Phantom 7x16.5

RIM: 16 x 5.5

INFLATION: 2.0 psi

CAMBER ANGLE: 4°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	.1	15.6	13.7	7.7	-1.5	-2.8	—
800	26.1	39.0	27.7	30.6	23.0	13.6	—
1100	41.5	61.5	53.6	50.7	43.2	—	53.1
1400	47.8	83.1	129.4	131.0	133.8	—	116.5

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone Military 7×16.00

RIM: 16 × 4.5

INFLATION: 20 PSI

CAMBER ANGLE: 5°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	16.2	17.4	[illegible]	2.3	-0.7	-2.4	–
800	18.1	[illegible]	51.3	[illegible]	75.3	13.0	–
1100	[illegible]	[illegible]	[illegible]	[illegible]	73.1	–	45.3
1400	[illegible]	[illegible]	130.5	143.6	143.5	–	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

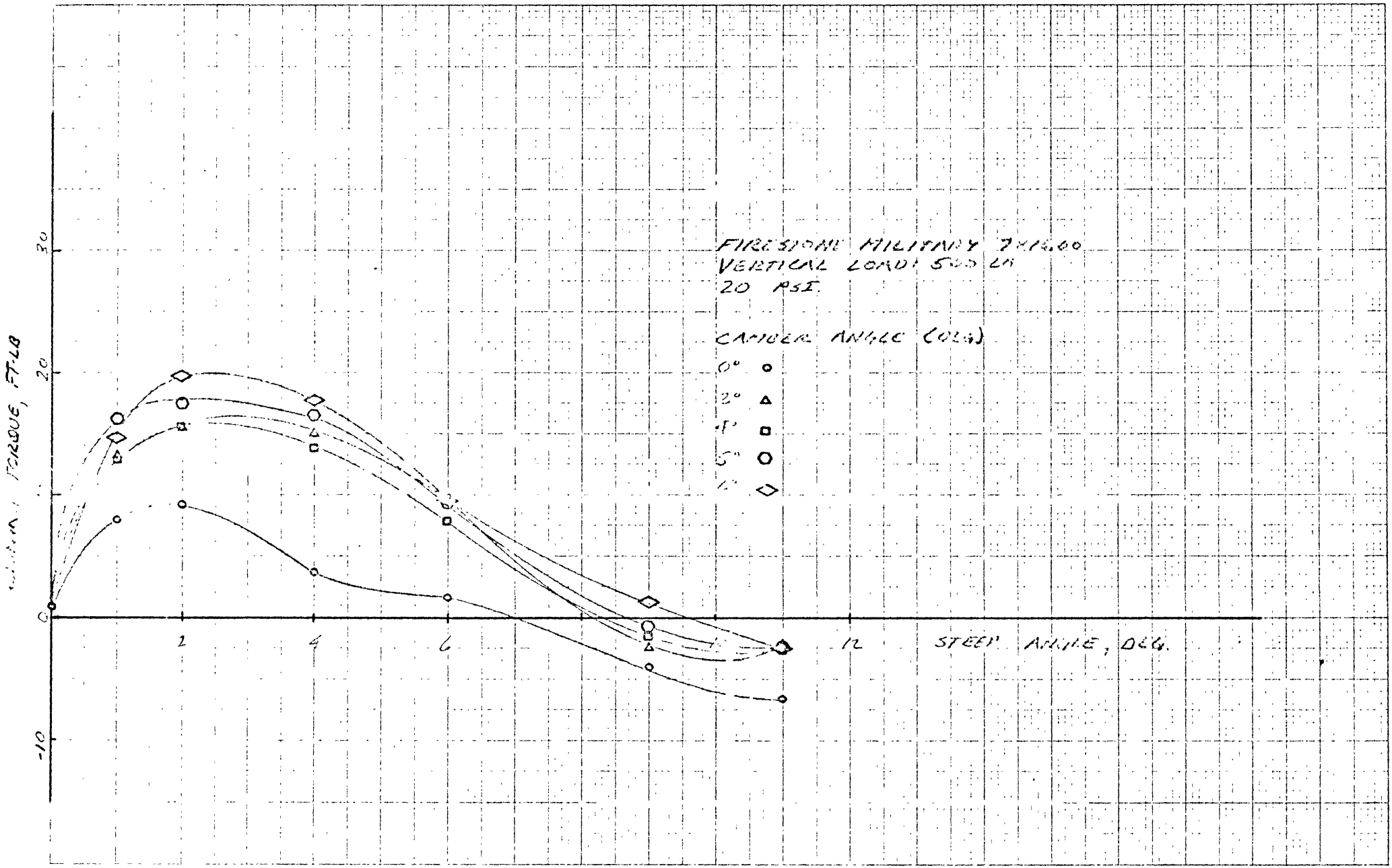
TIRE: FIRESTONE MILITARY 7.00-16

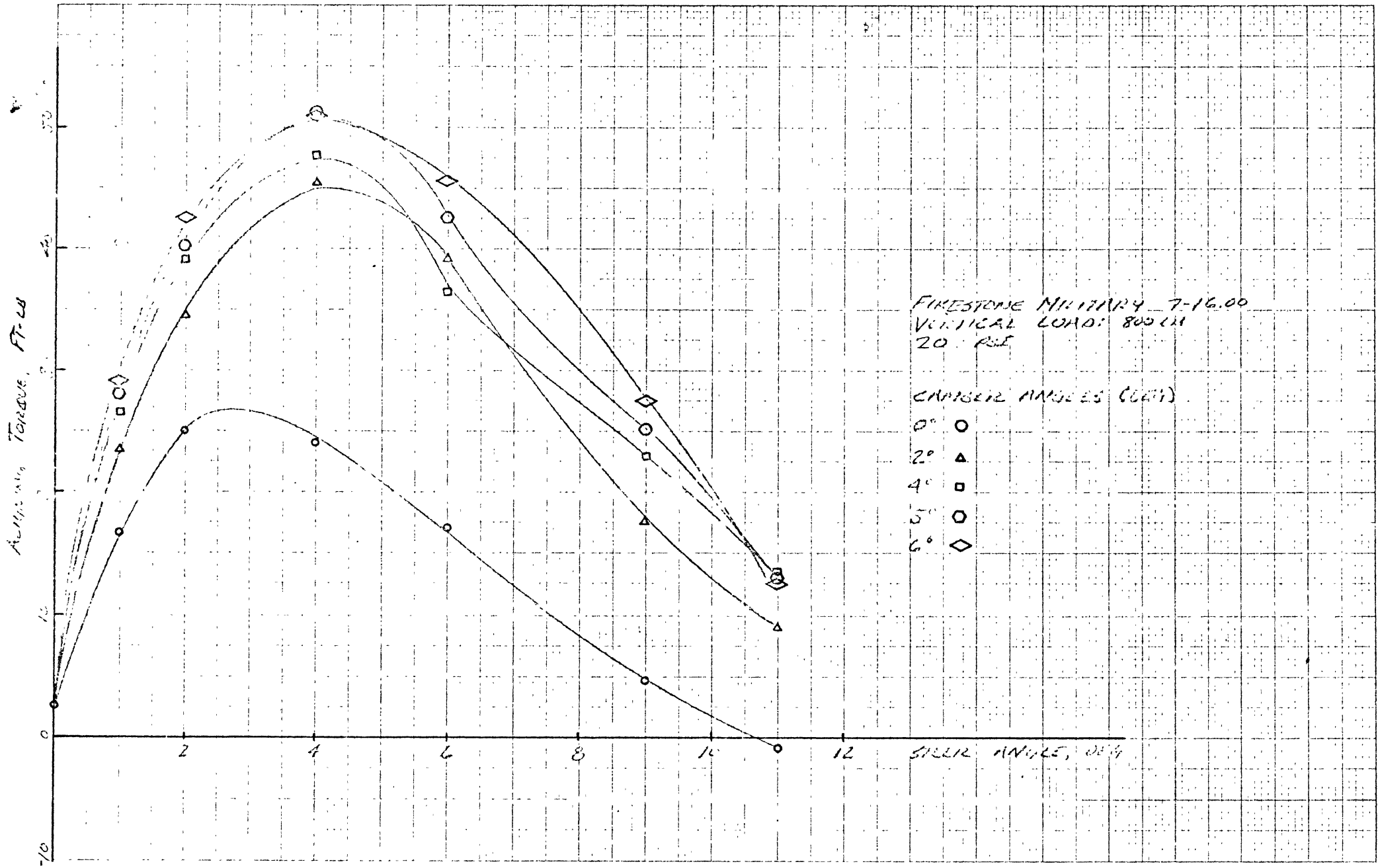
RIM: 16 x 4.5

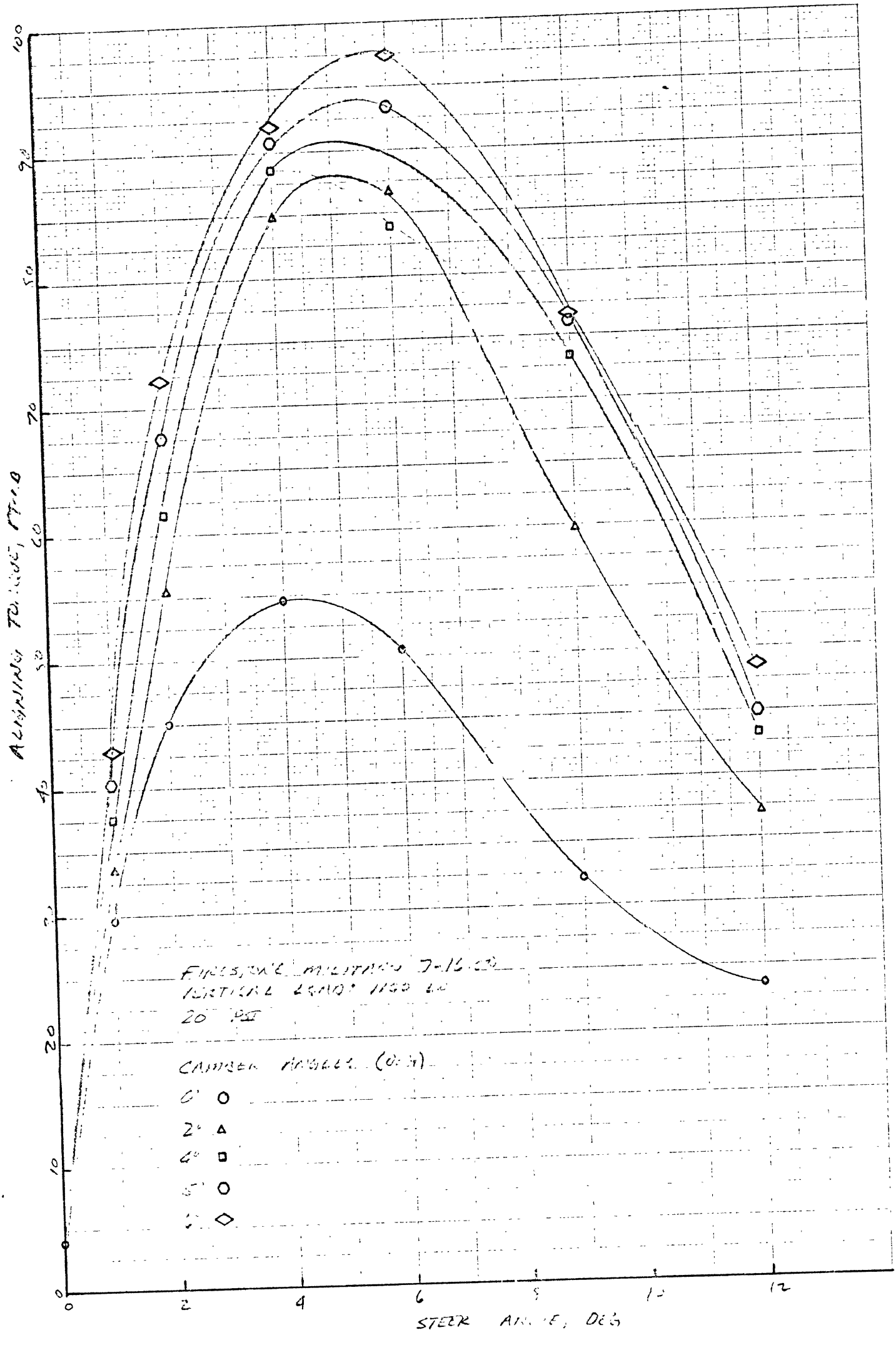
INFLATION: 20 PSI

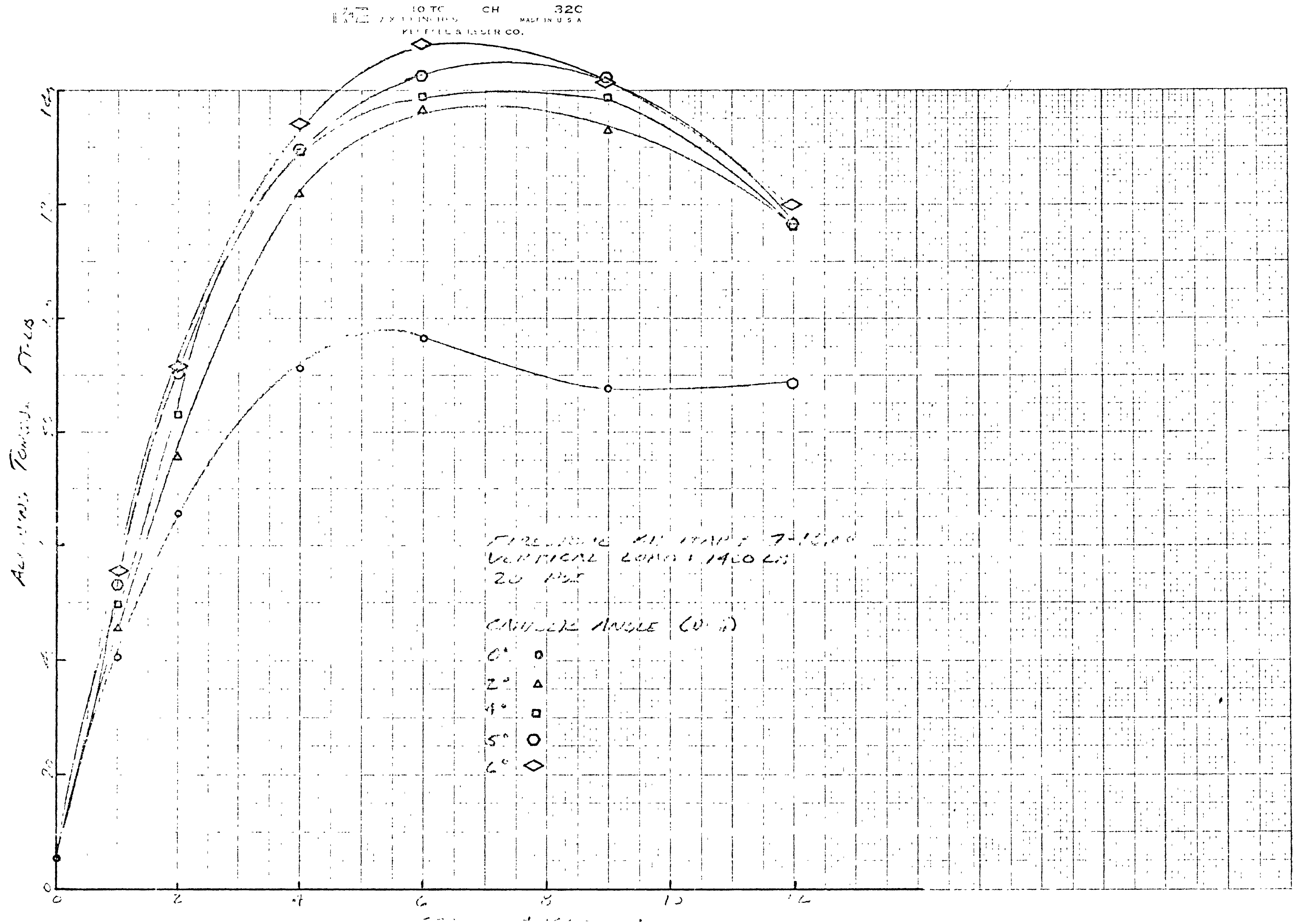
CAMBER ANGLE: 0°

VERTICAL LOAD(LBS)	ALIGNING TORQUE (LB-FT) @ INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	14.5	19.7	17.9	9.8	1.3	-2.6	-
800	29.2	42.7	41.2	31.4	27.5	12.4	-
1100	47.7	73.1	91.9	97.4	76.8	-	48.6
1400	55.6	77.0	134.2	151.6	142.0	-	120.5






ALIGNING TORQUE, FT-LB
STEER ANGLE, DEG
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12
CAMBER ANGLES (DEG)
0° O
2° △
4° □
5° O
6° ◇


10 TO CH 32C
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.
Adjusted Torque Ft-Lb
0
20
40
80
120
140
0
2
4
6
8
10
12
Firestone Ag Tractor
Vertical Load 1400 Lb
20 PSI
Camber Angle
0°
2°
4°
5°
6°

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE [illegible] 7.00

RIM: 5 x 4.5

INFLATION: 30 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-19.4	-35.?	-[illegible]	-57.8
800	-2[illegible].4	-59.?	-7[illegible].3	-[illegible]3.0
1100	-31.9	-7[illegible].5	-[illegible]	-[illegible]5.7
1400	-[illegible]	-97.0	-[illegible]	-[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone [illegible] 7x2.50

RIM: [illegible] 4.5

INFLATION: 20 psi

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	355.0	[illegible]	329.4	[illegible]
800	431.4	405.0	[illegible]	[illegible]
1100	431.7	[illegible]	[illegible]	346.0
1400	[illegible]	[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

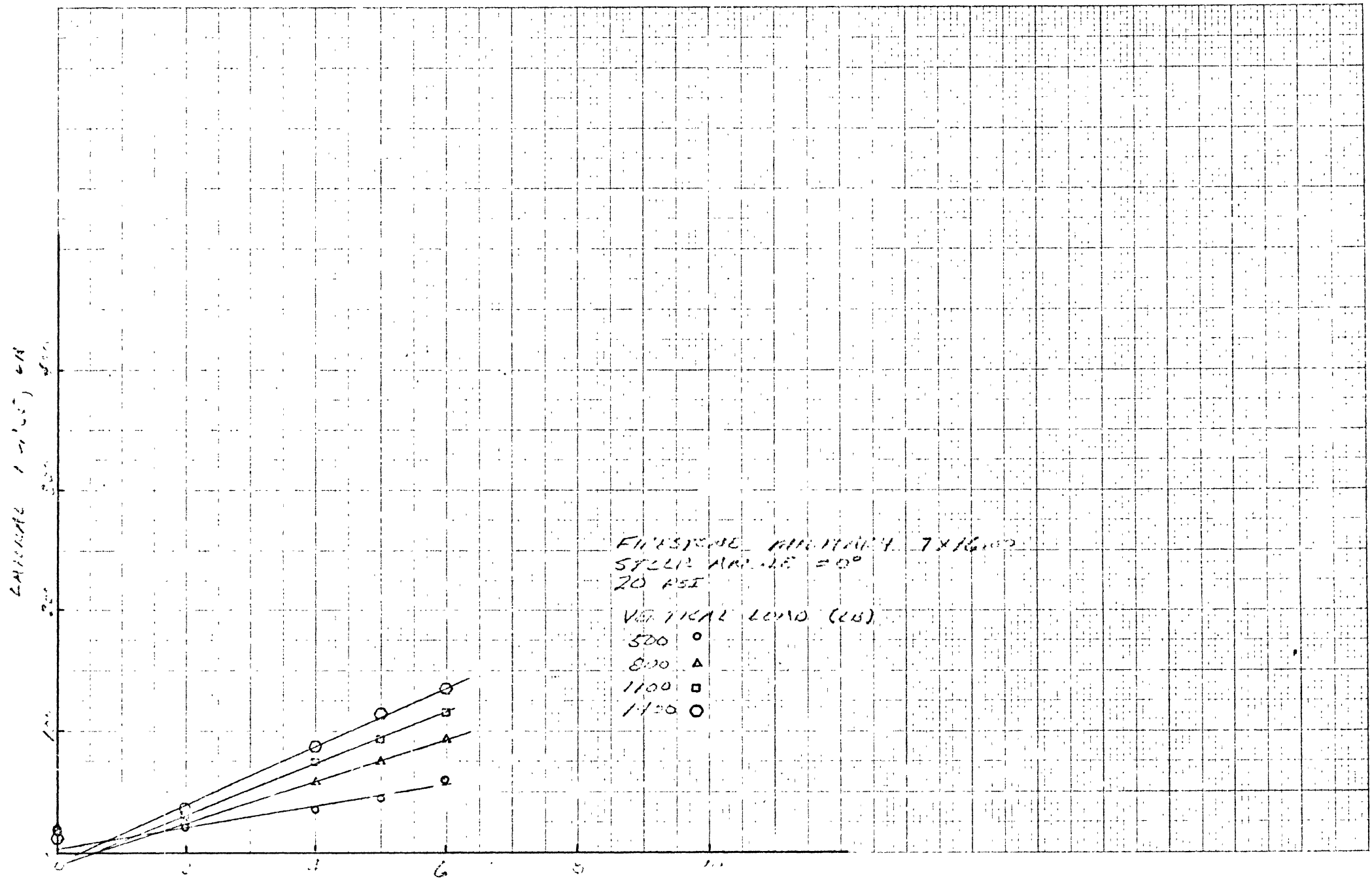
TIRE: Firestone Military 7x16.00

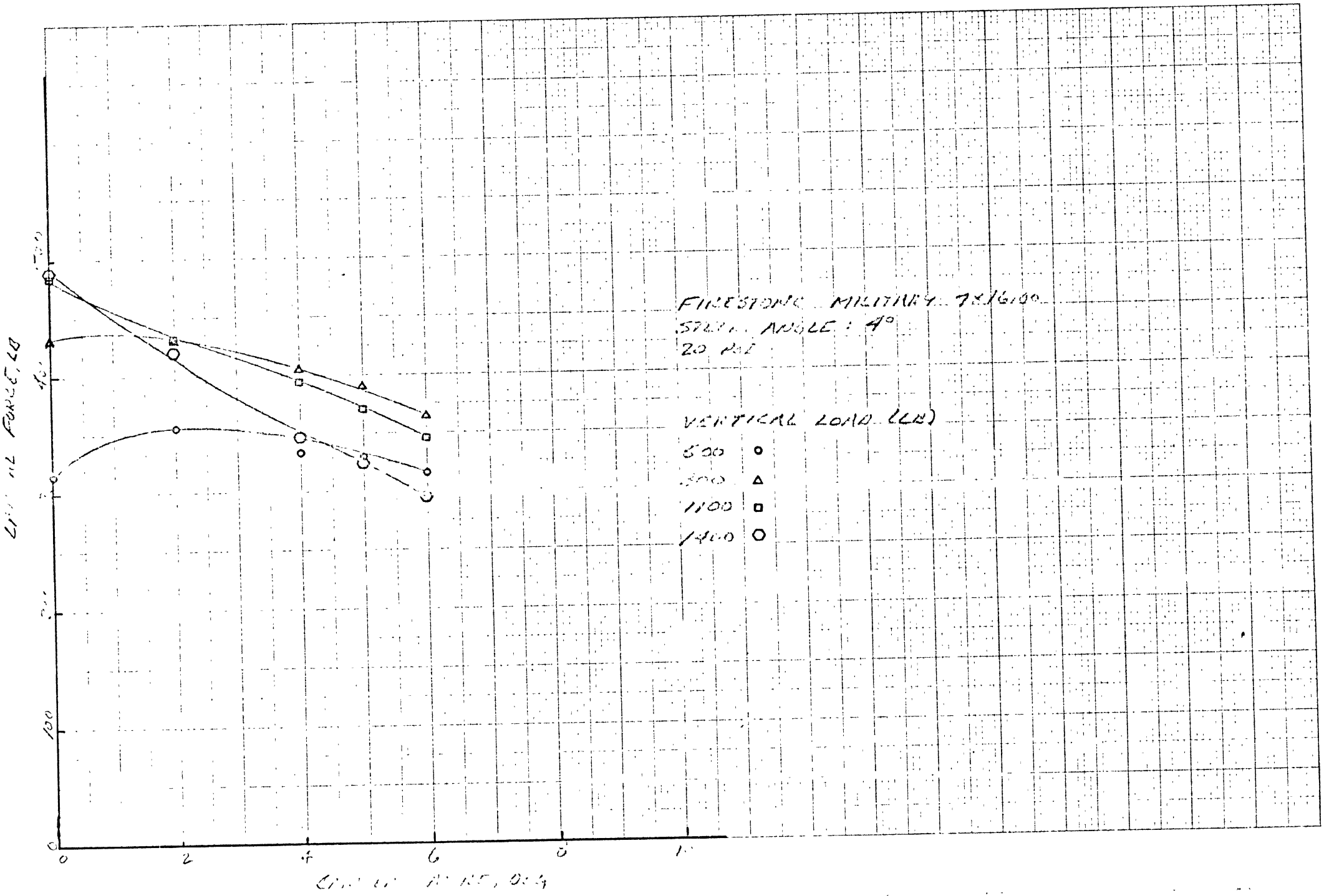
RIM: 16 x 4.5

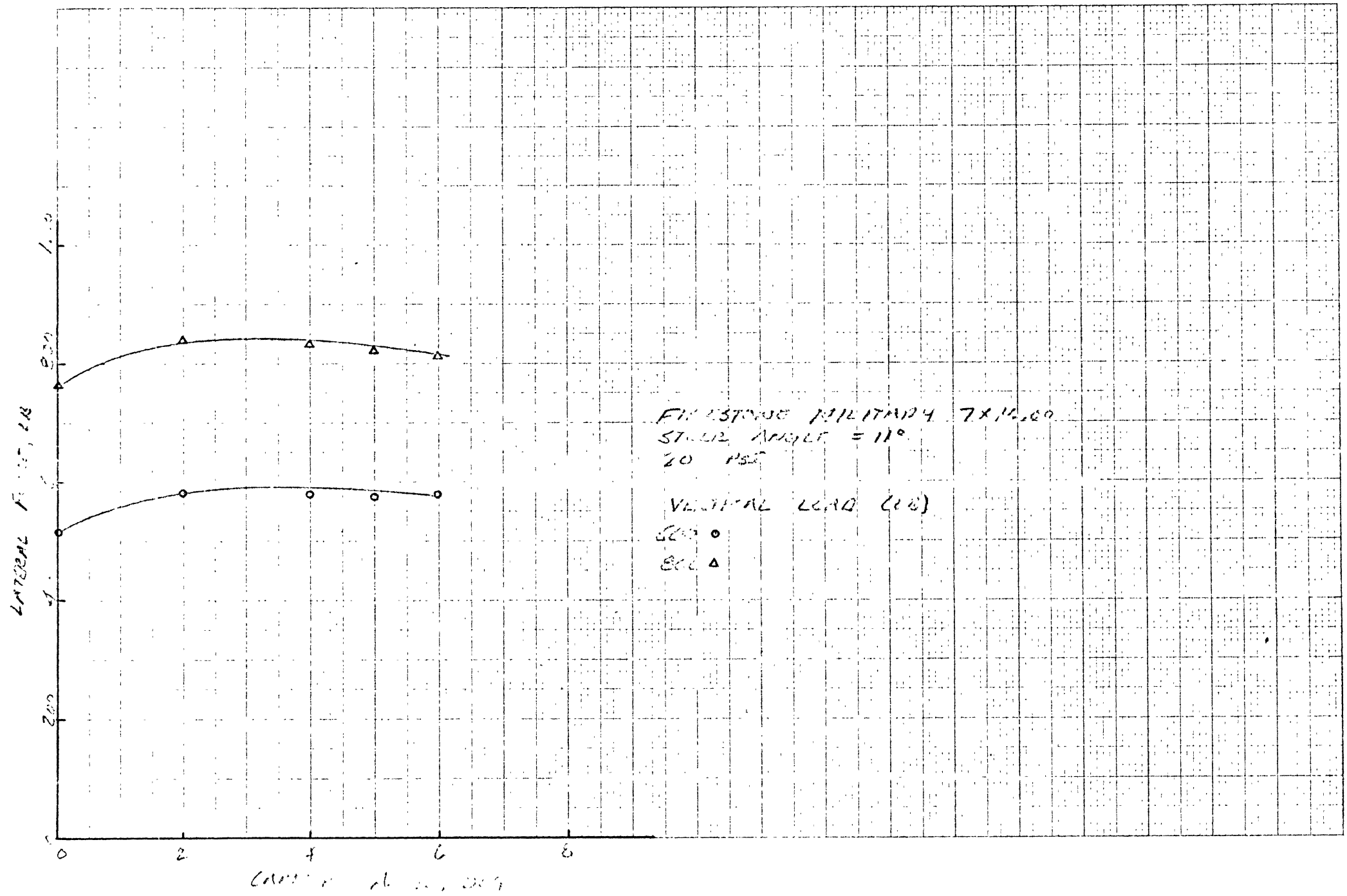
INFLATION: 30 PSI

STEER ANGLE: 11°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	578.3	580.0	574.4	579.1
800	[illegible]	[illegible]	[illegible]	816.2
1100	–	–	–	–
1400	–	–	–	–







ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone Champion, 7x16-10

RIM: 16 x 4.5"

INFLATION: 20 psi

STEER ANGLE: 11°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-2.1	-2.8	-2.4	-2.6
800	9.1	13.6	13.0	12.4
1100	-	-	-	-
1400	-	-	-	-

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone Nylon, 7×16.00

RIM: 16×4.5"

INFLATION: 20 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	1.3	1.3	-1.6	1.0
800	2.9	4.4	2.4	3.3
1100	4.2	3.4	2.9	4.5
1400	5.3	5.1	5.4	5.4

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone [illegible] 7 x [illegible]

RIM: 16 x 4.5

INFLATION: 20 [illegible]

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	15.1	13.7	16.5	17.9
800	45.5	47.7	51.3	51.2
1100	[illegible]	[illegible]	90.7	91.9
1400	123.9	129.4	130.5	134.2

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

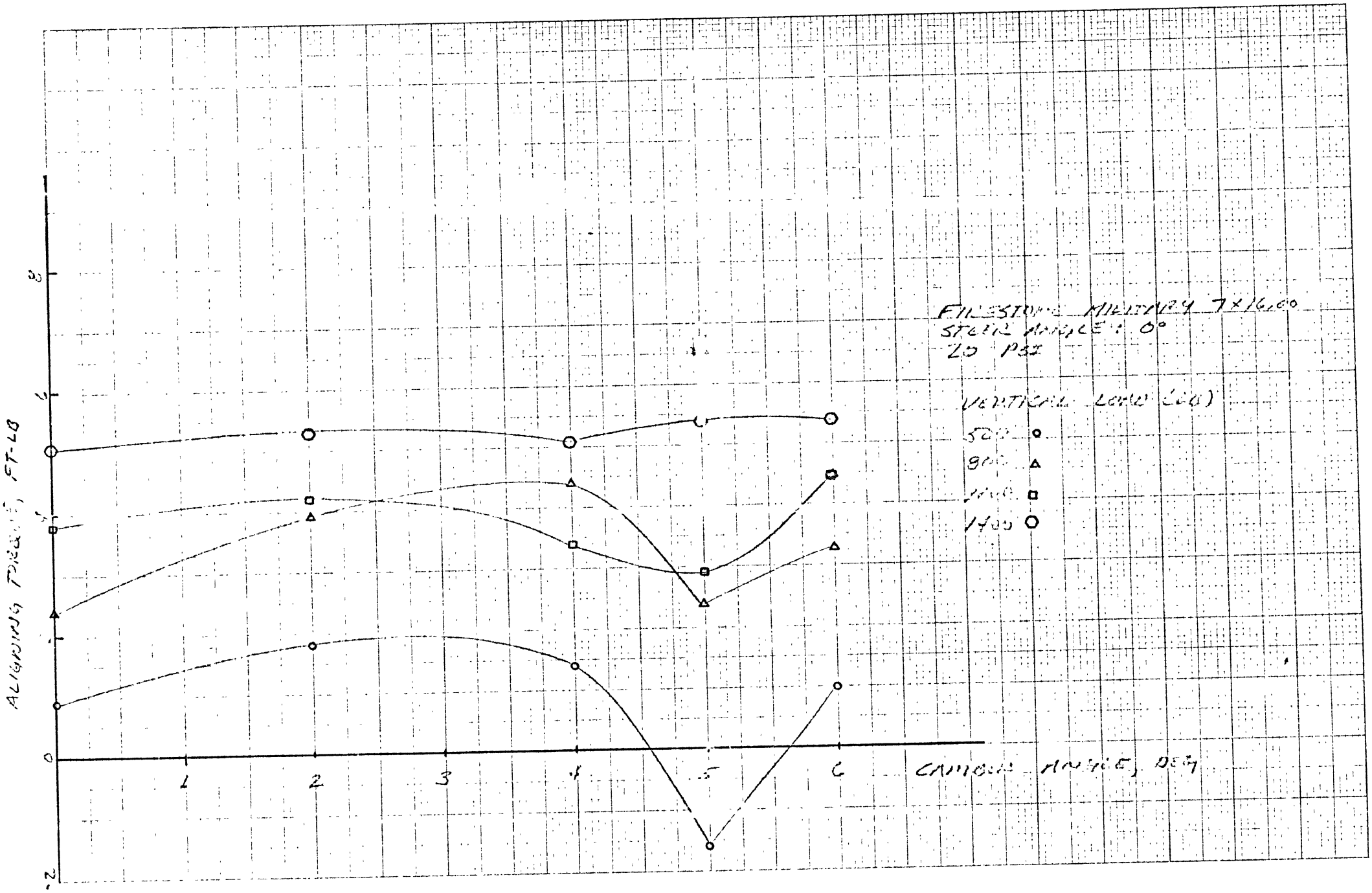
TIRE: Firestone Marathon 7x16.00

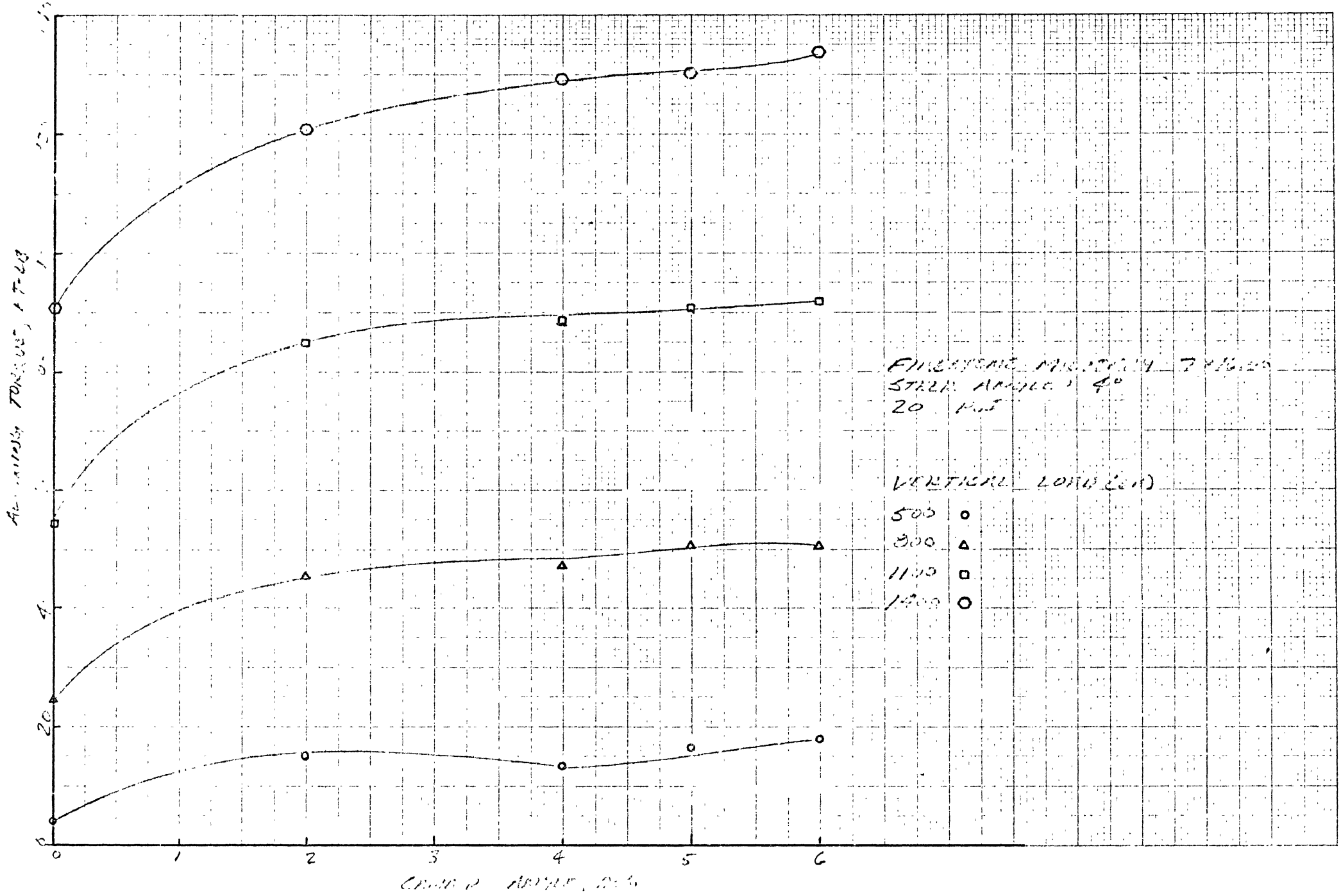
RIM: 16 x 5.5

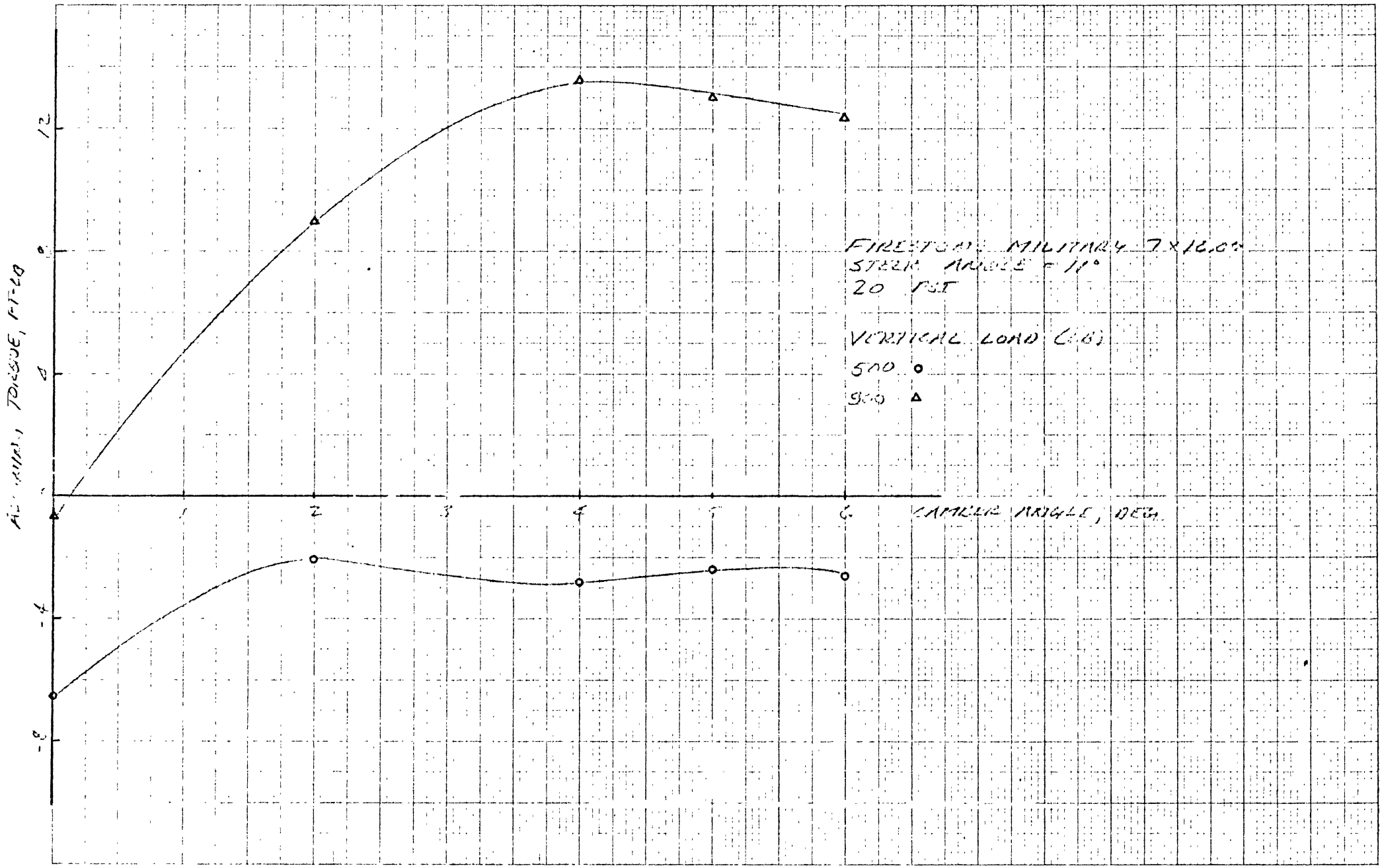
INFLATION: 20 PSI

STEER ANGLE: 11°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-2.1	-2.8	-2.4	-2.3
800	9.1	13.6	13.0	13.4
1100	-	-	-	-
1400	-	-	-	-







INITIAL TIRE BIAS

TIRE: FIRESTONE [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE= 0

CAMBER ANBLE= 0

VERTICAL LOAD	F_y	M_z
500	11.3	1.1
[illegible]	16.3	3.2
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] 7.00 x 16.00

RIM: 16.00 x 4.5

INFLATION: [illegible]

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	207.8	317.5	[illegible]	472.0	[illegible]	-
800	[illegible]	271.1	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	300.1	[illegible]	682.1	830.7	-	1047.0
1400	[illegible]	[illegible]	[illegible]	779.8	957.8	-	1132.5

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] Michelin 7.10-15

RIM: 16.00 x 4.5

INFLATION: 25 PSI

CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	354.1	[illegible]	[illegible]	542.7	—
800	[illegible]	254.2	472.6	[illegible]	[illegible]	837.0	—
1100	[illegible]	240.2	443.8	[illegible]	930.3	—	1026.7
1400	[illegible]	[illegible]	426.1	633.2	957.9	—	1151.1

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	83.3	174.0	[illegible]	[illegible]	536.1	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	770.3	[illegible]	-
1100	[illegible]	207.7	461.5	[illegible]	898.4	-	[illegible]
1400	[illegible]	178.7	431.7	[illegible]	925.8	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: 13 × 4.5

INFLATION: [illegible]

CAMBER ANGLE: 5°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	183.3	334.2	433.8	530.0	567.3	–
800	[illegible]	217.6	421.7	501.1	761.3	852.7	–
1100	[illegible]	194.3	433.8	641.7	888.4	–	1043.6
1400	[illegible]	150.9	400.1	627.8	718.0	–	1106.5

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

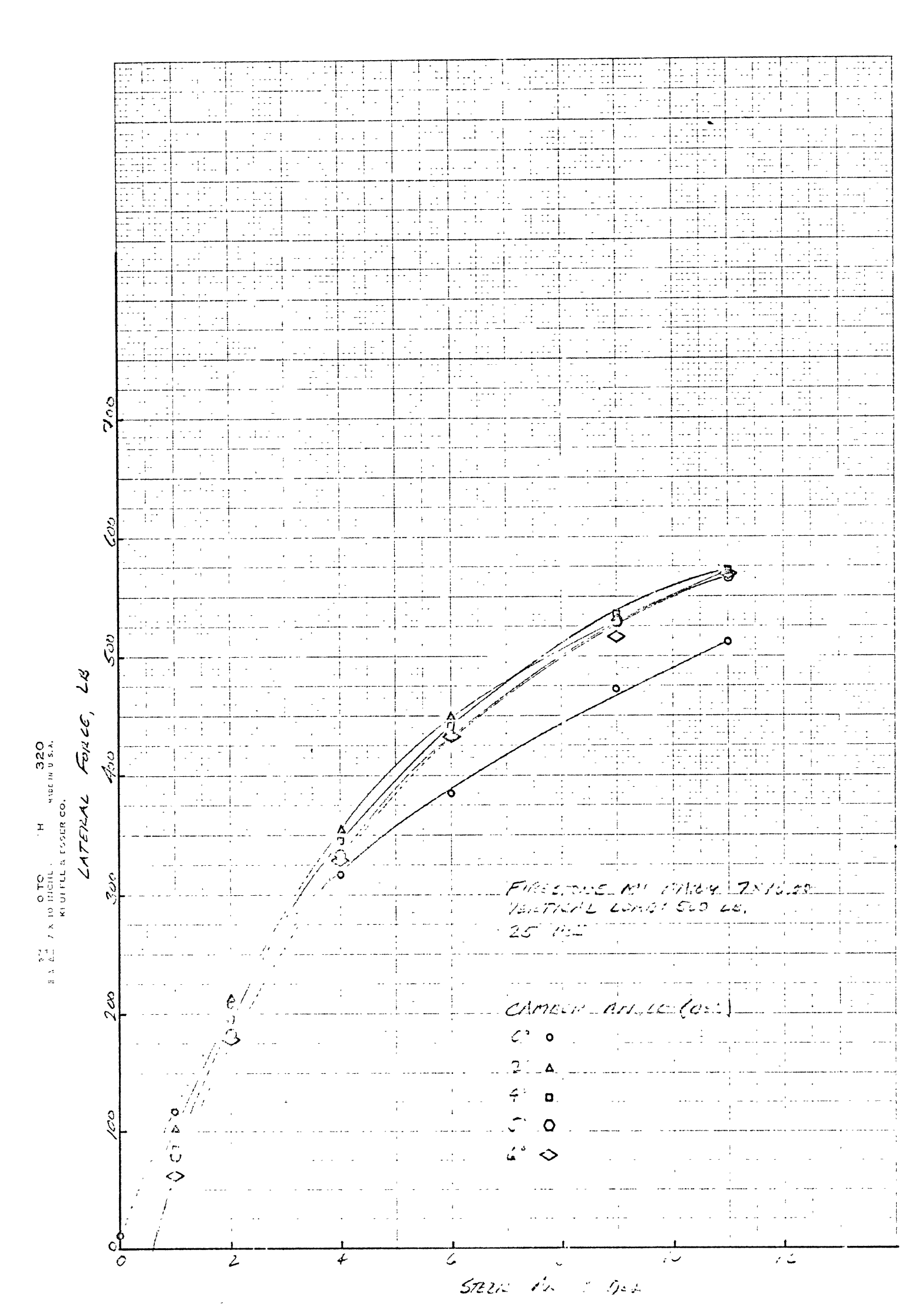
TIRE: [illegible]

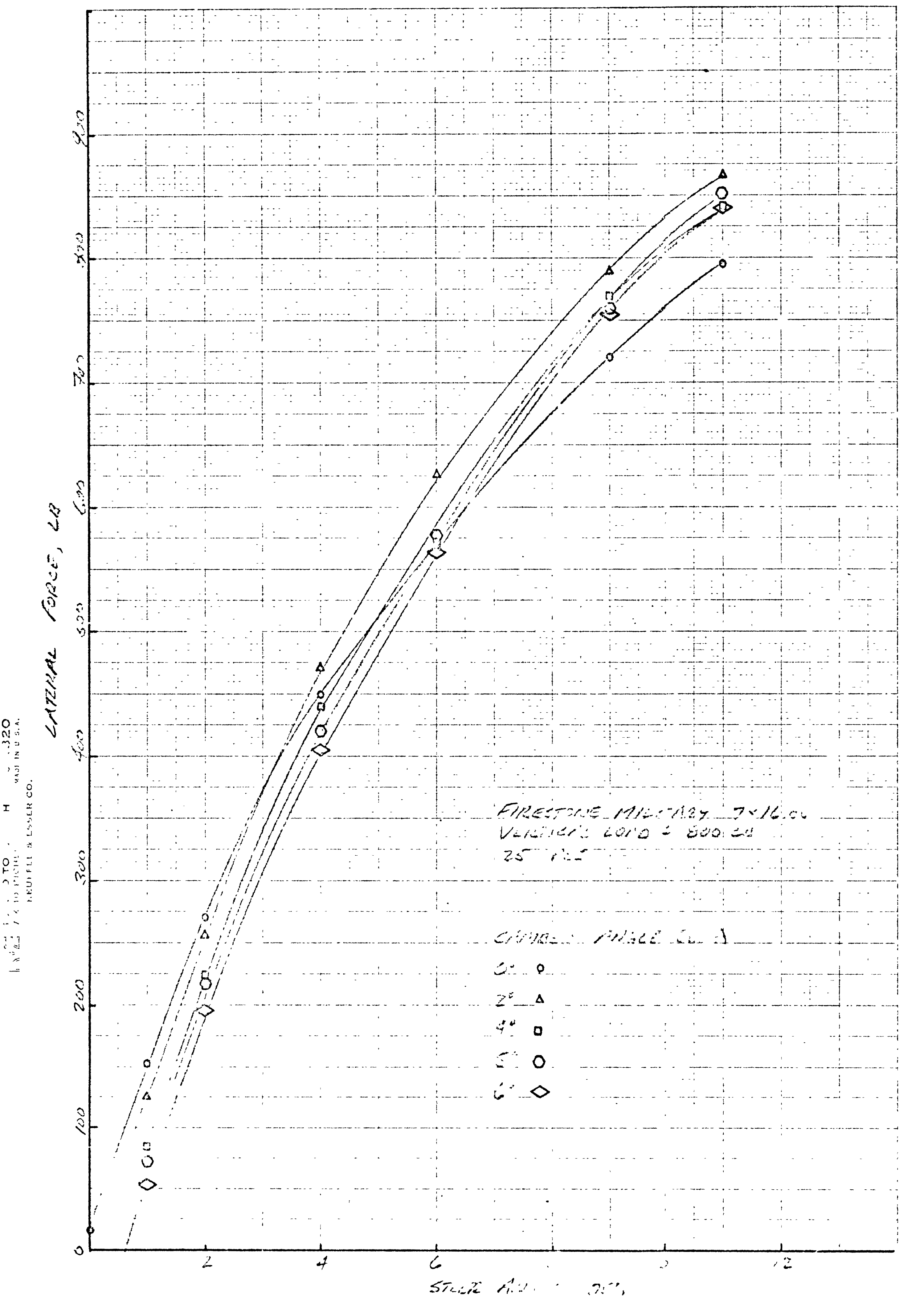
RIM: 16 x 4.5

INFLATION: 25 psi

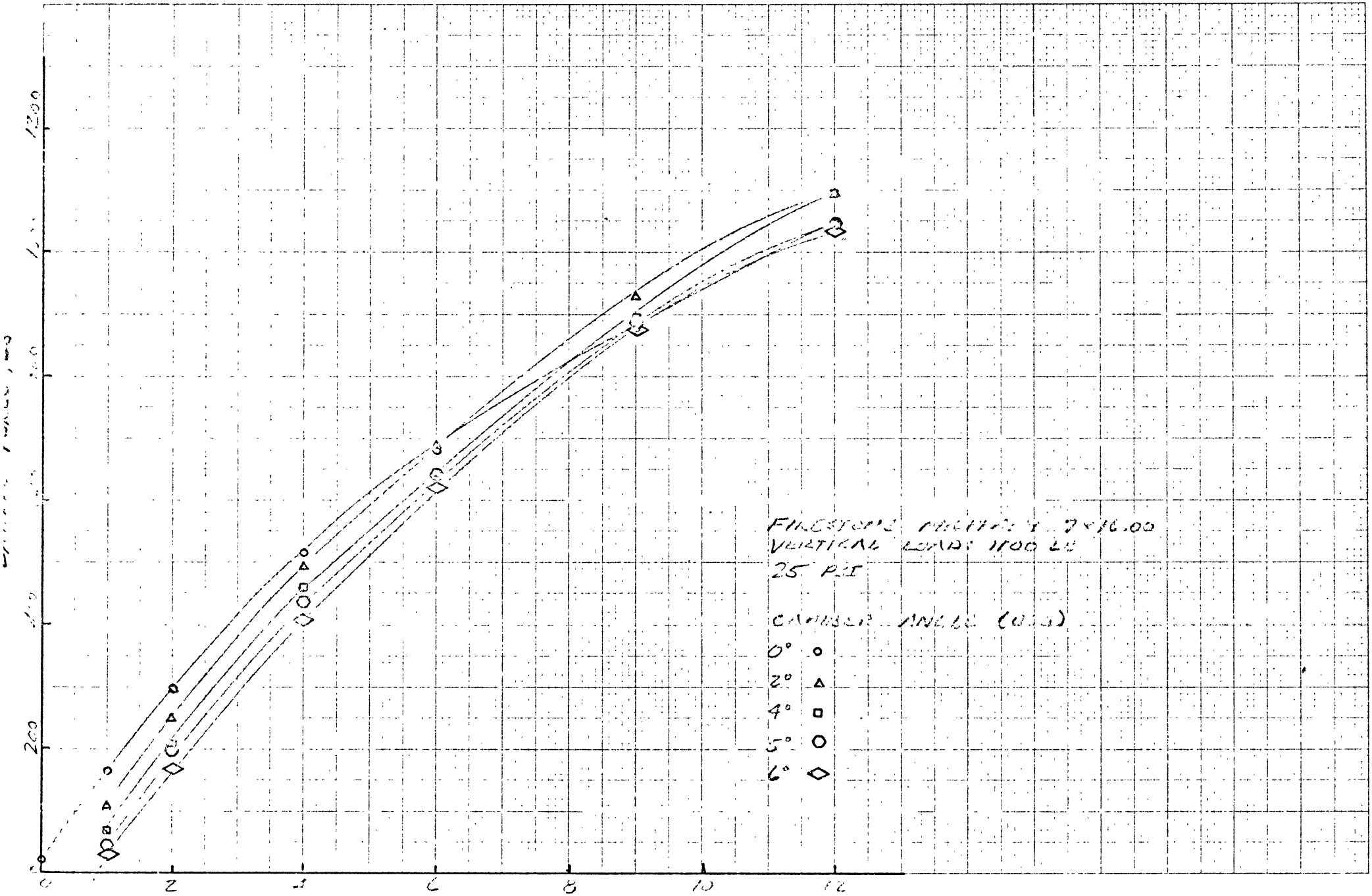
CAMBER ANGLE: 0°

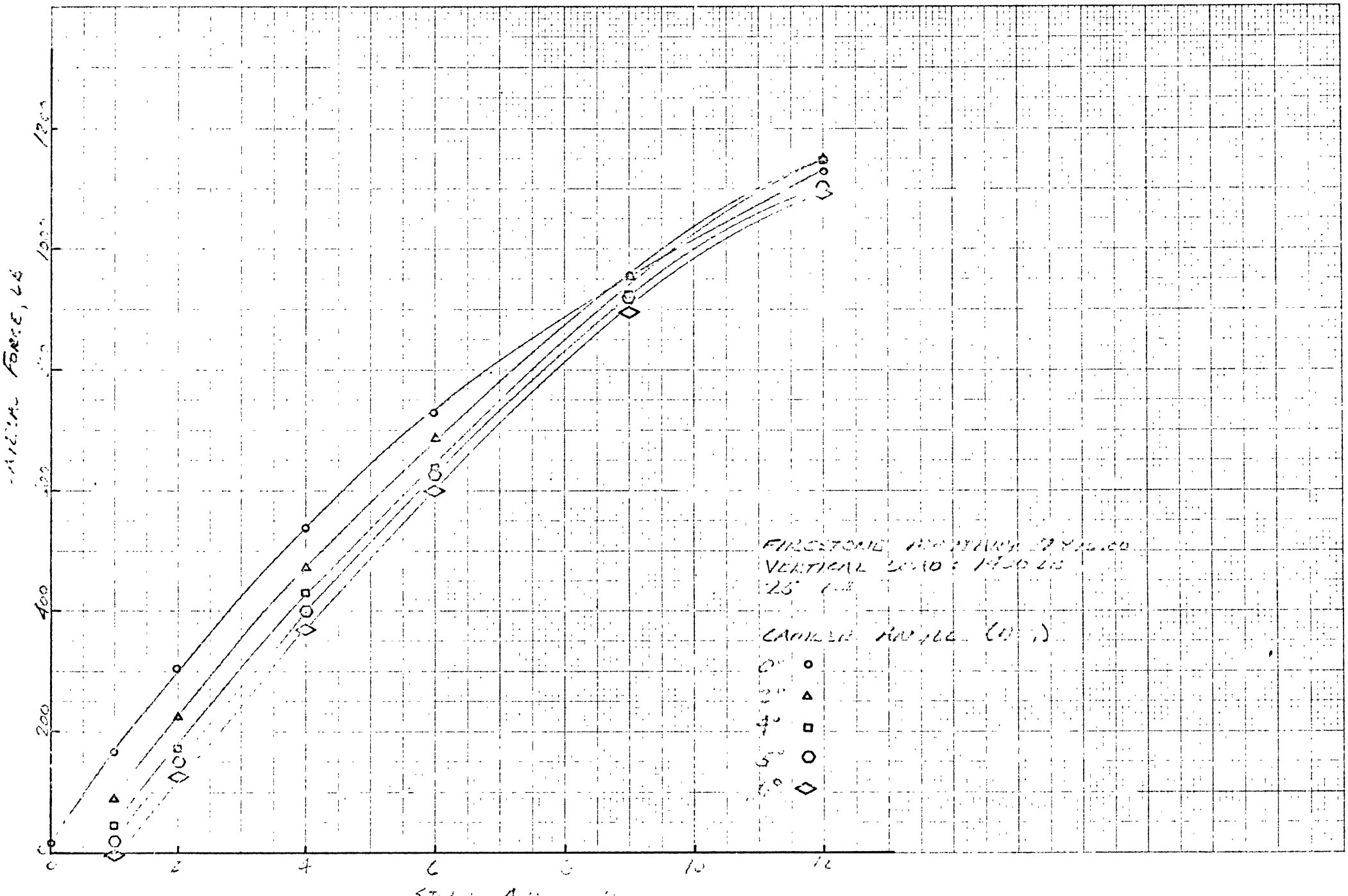
VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	61.1	173.9	350.1	432.4	516.1	568.1	-
800	[illegible]	[illegible]	[illegible]	[illegible]	755.2	840.7	-
1100	[illegible]	163.7	403.6	621.4	873.9	-	1035.7
1400	0.3	170.1	373.0	600.2	818.7	-	1073.9


LATERAL FORCE, LB
0
100
200
300
400
500
600
700
0
2
4
6
CAMBER ANGLE (DEG.)
0° o
2° Δ
4° □
5° O
6° ◇



LATERAL FORCE, LB
0
100
200
300
400
500
600
700
800
900
2
4
6
12
FIRESTONE MILITARY 7×16.00
VERTICAL LOAD = 800 LB
25 PSI
CAMBER ANGLE (DEG)
0°
2°
4°
6°





ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: 25 [illegible]

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	3.6	[illegible]	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	+10.4
1400	[illegible]	[illegible]	81.0	83.2	[illegible]	-	+51.6

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] 7x16.00

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	8.3	14.4	11.2	5.2	-1.9	-4.8	-
800	19.2	31.8	38.1	32.3	15.3	6.0	-
1100	31.6	51.6	74.3	74.3	52.8	-	24.9
1400	42.0	70.9	110.9	122.7	104.9	-	79.5

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] Military [illegible]
RIM: 16 x 4.5
INFLATION: 25 PSI
CAMBER ANGLE: +0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	11.3	13.0	12.5	3.3	1.3	-2.3	-
800	27.3	31.7	41.6	27.8	16.9	7.5	-
1100	34.0	55.7	74.7	72.4	55.7	-	25.2
1400	41.6	76.5	113.2	128.4	110.1	-	77.1

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone Marathon 7.00-15
RIM: 16 x 5.5
INFLATION: 25 PSI
CAMBER ANGLE: 5°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	13.6	14.8	14.5	7.0	-0.4	-1.2	-
800	24.2	23.3	42.8	33.4	17.5	10.3	-
1100	37.3	42.3	79.3	77.1	52.8	-	30.7
1400	49.8	61.9	117.5	128.2	113.3	-	36.1

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

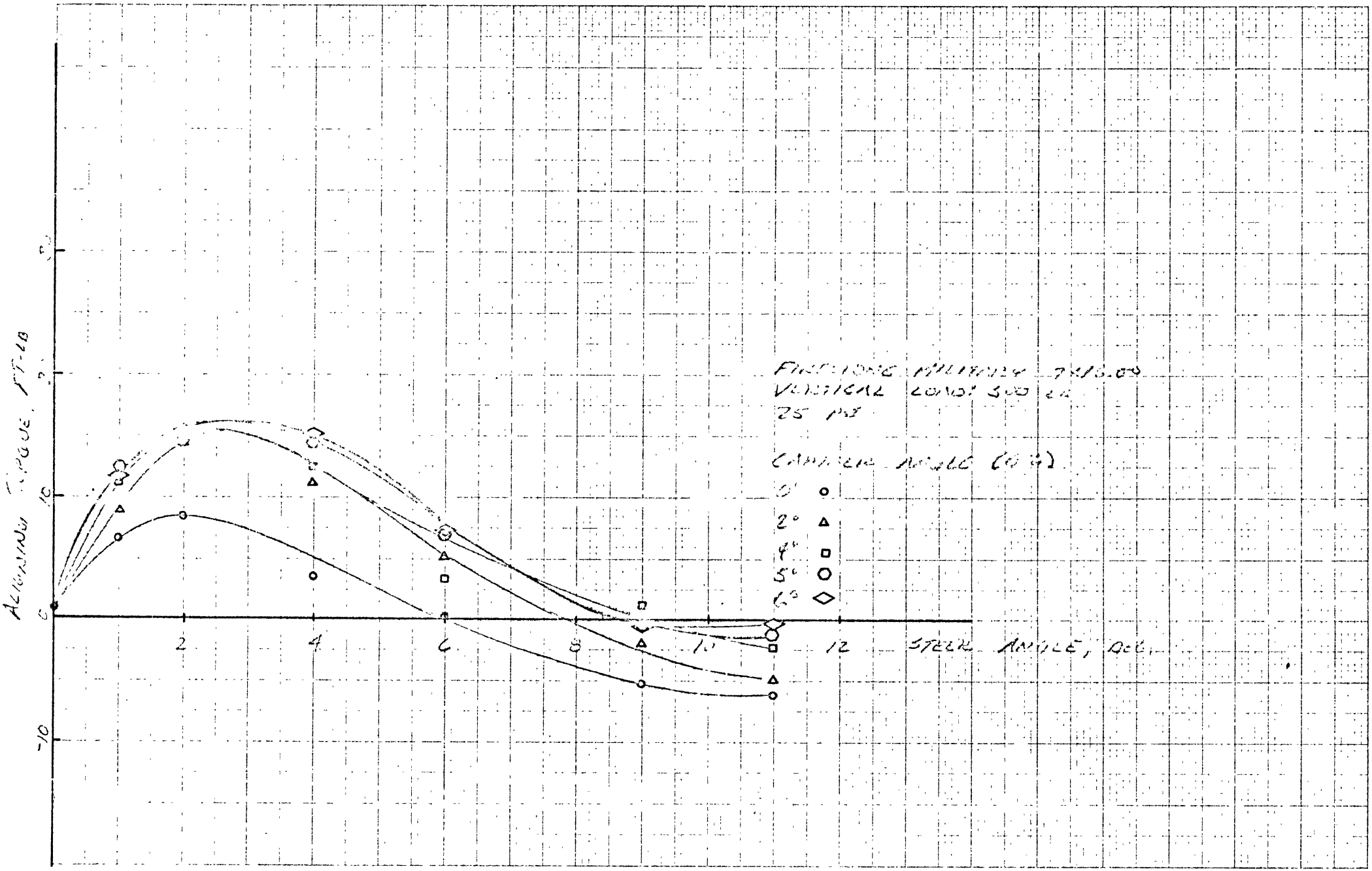
TIRE: [illegible] 7.00-16.00

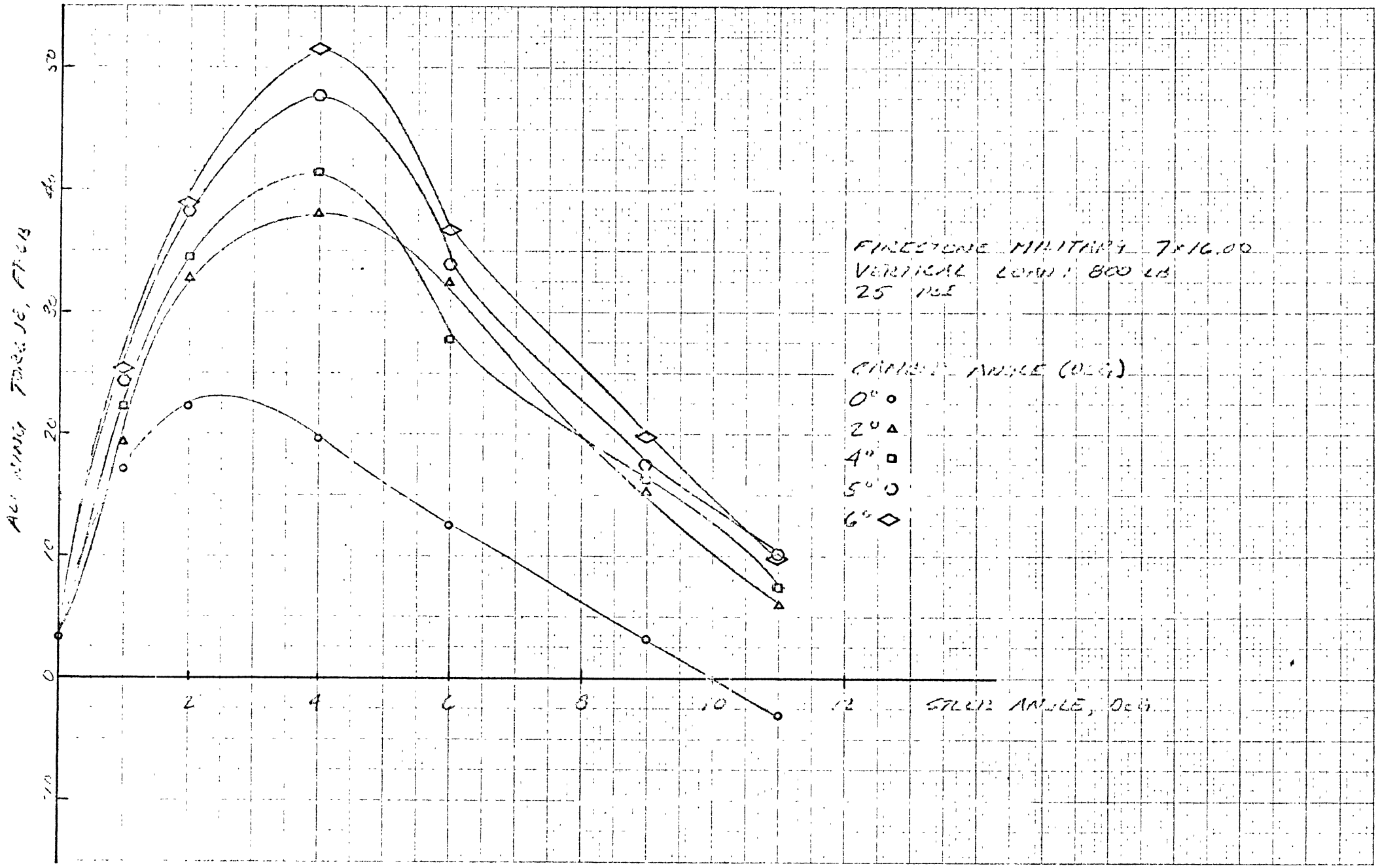
RIM: 16 x 4.5

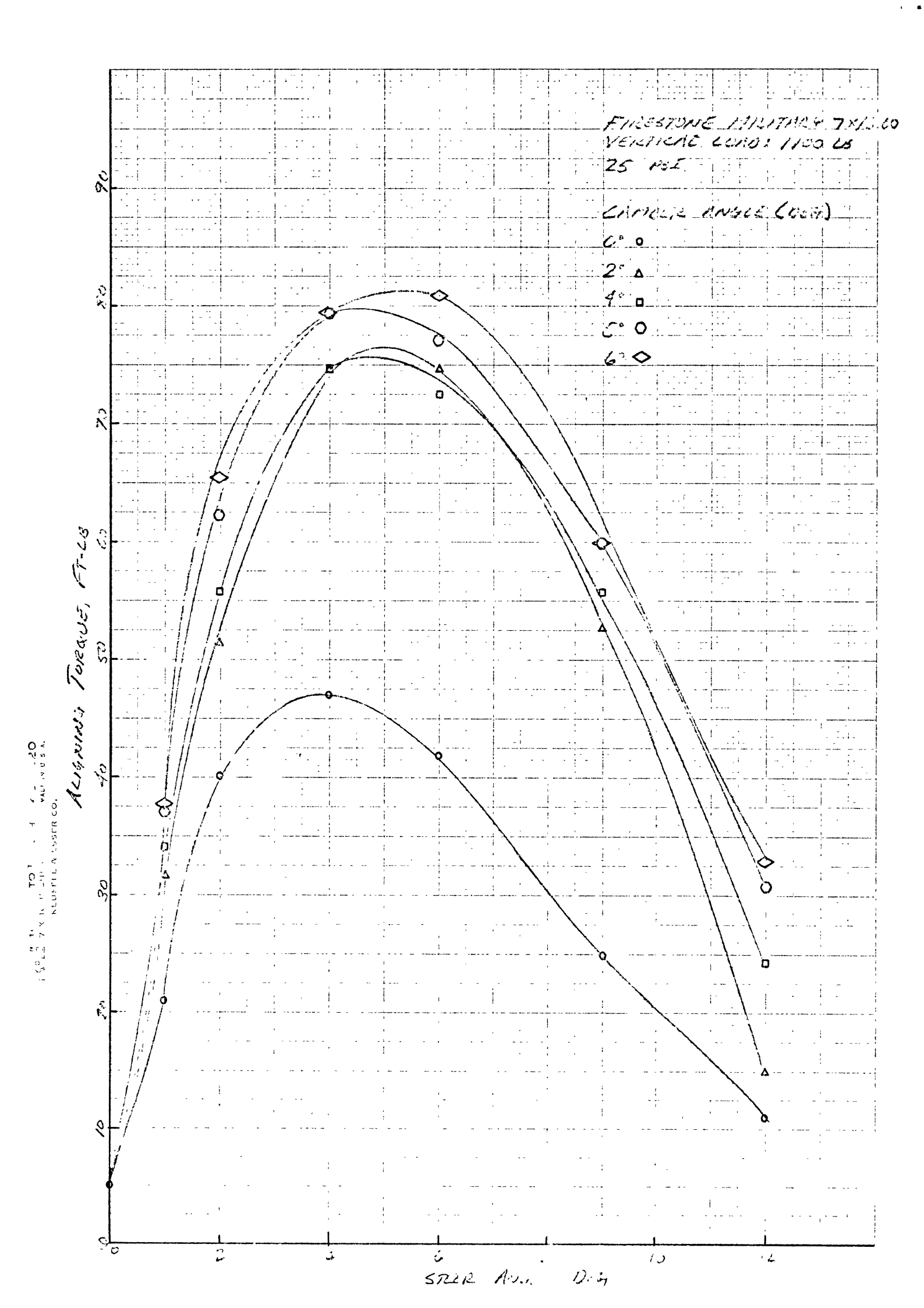
INFLATION: 25 PSI

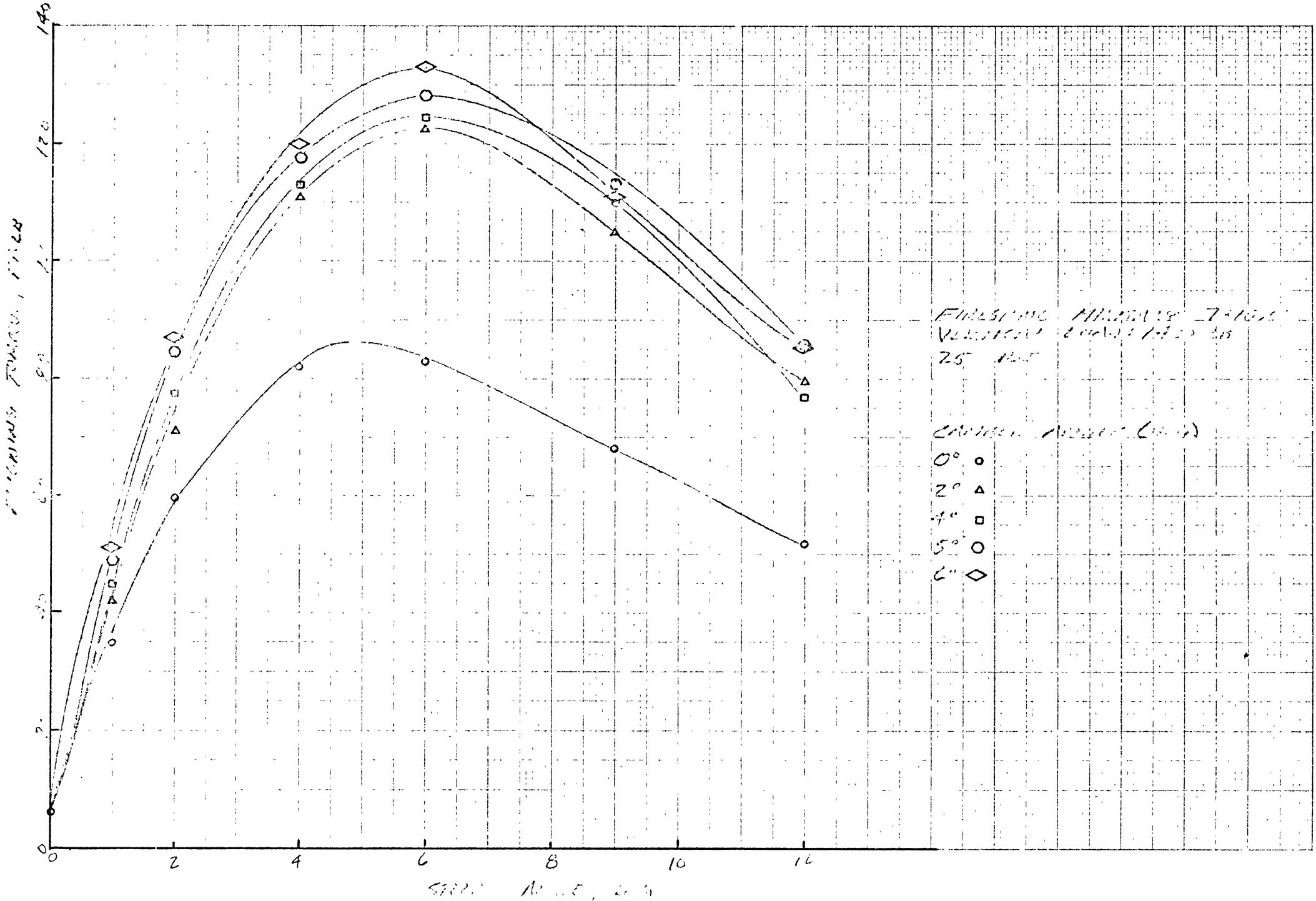
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	11.6	15.6	15.3	[illegible]	-0.5	-2.0	—
800	25.4	37.0	51.2	36.7	[illegible]	9.7	—
1100	37.7	65.3	79.4	80.9	51.9	—	33.1
1400	51.1	87.6	120.2	134.1	111.4	—	85.7






FIRESTONE MILITARY 7.50-20
VERTICAL LOAD: 1100 LB
25 MPH
CAMBER ANGLE (LOAD)
0° o
2° Δ
4° □
5° O
6° ◇
ALIGNING TORQUE, FT-LB
STEER ANG. DEG
0
10
20
30
40
50
60
70
80
90
2
4
6
8
10
12



LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	[illegible]	-31.4	-39.3	[illegible]
800	[illegible]	-62.2	-76.1	[illegible]
1100	[illegible]	-72.5	-97.3	[illegible]
1400	[illegible]	-36.1	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: 16 x 9.5

INFLATION: 25 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	359.2	344.0	334.2	320.6
800	472.6	460.5	421.7	401.3
1100	494.8	461.5	433.8	403.6
1400	476.1	431.7	400.1	378.0

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

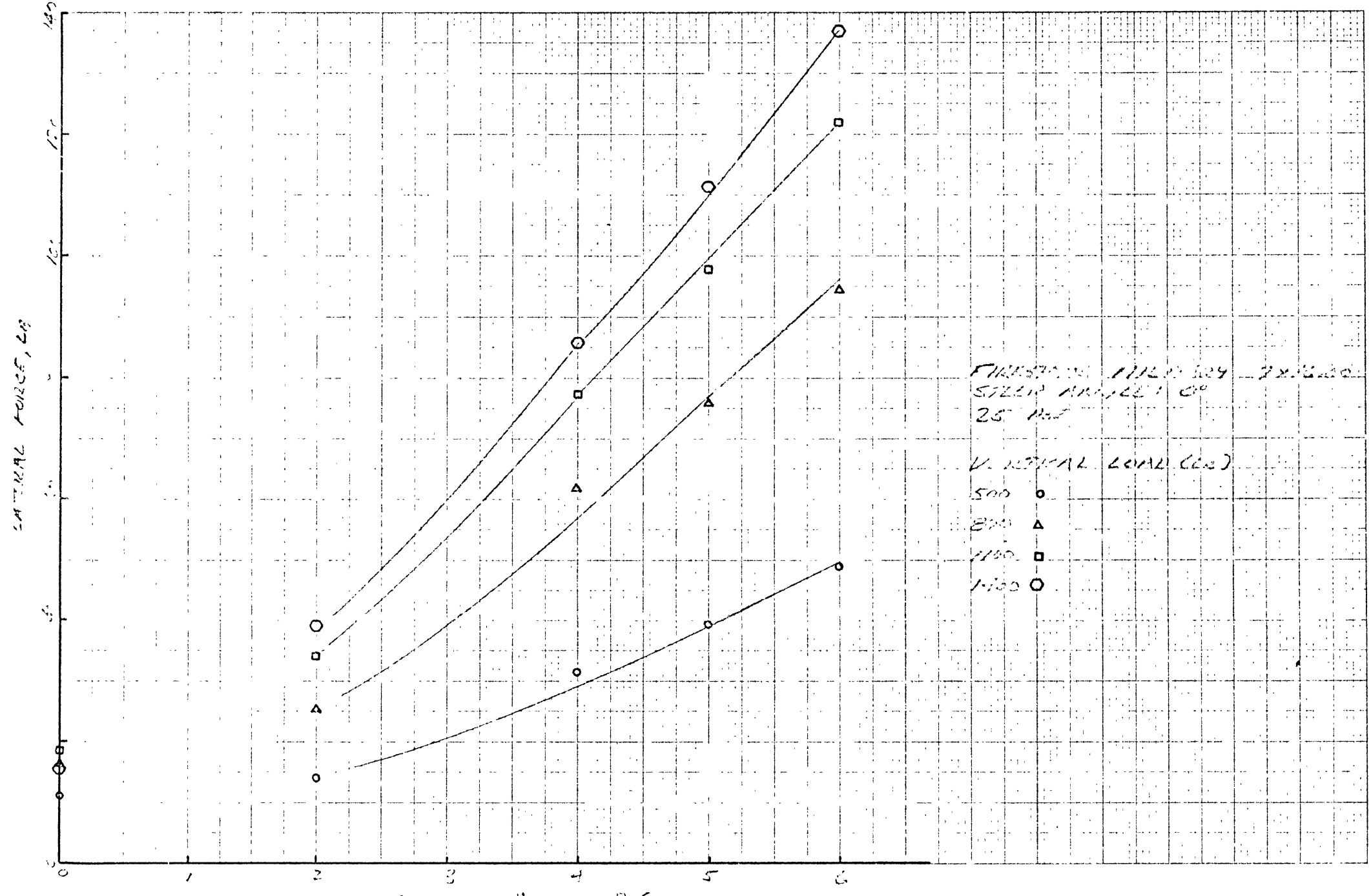
TIRE: [illegible]

RIM: [illegible]

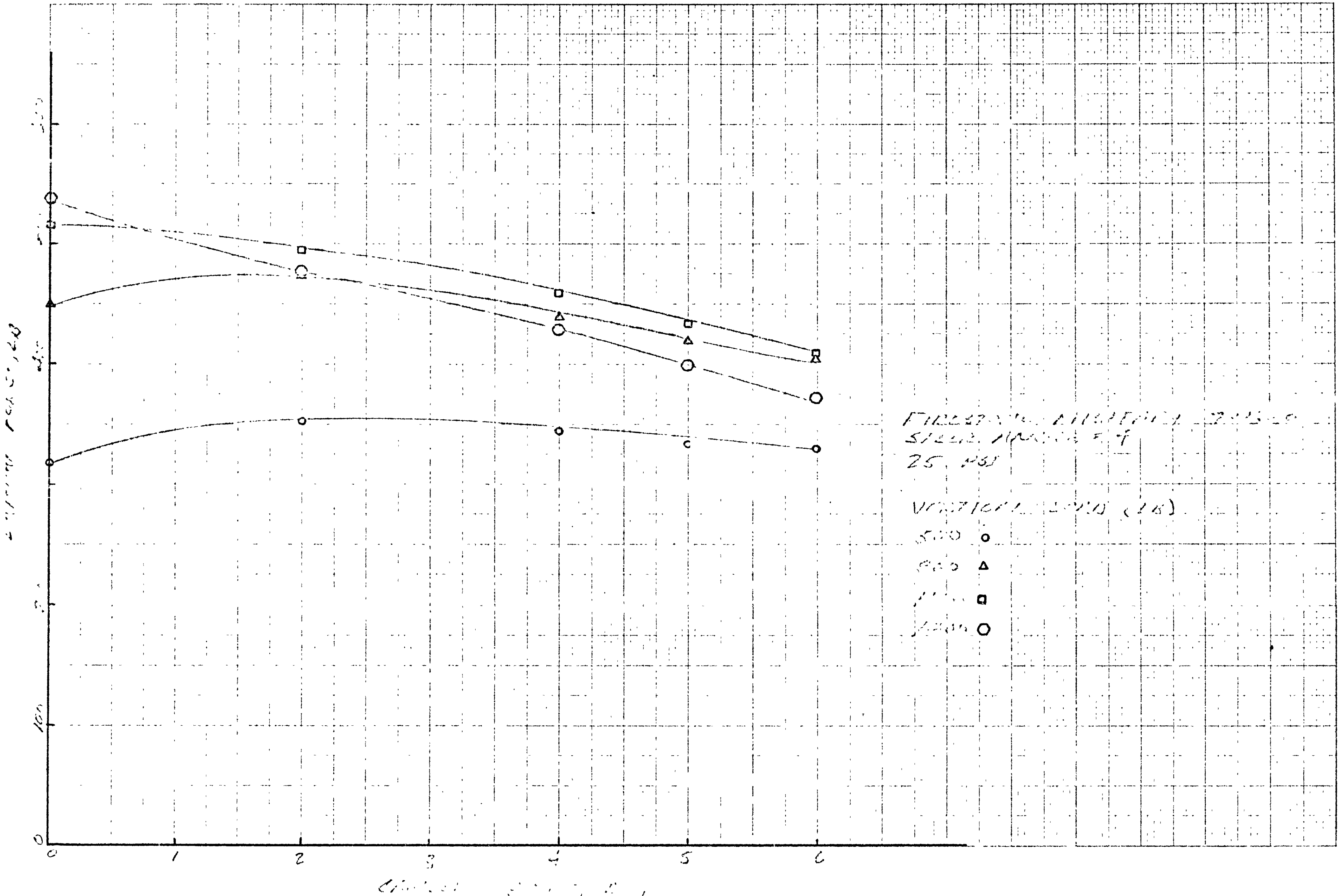
INFLATION: [illegible]

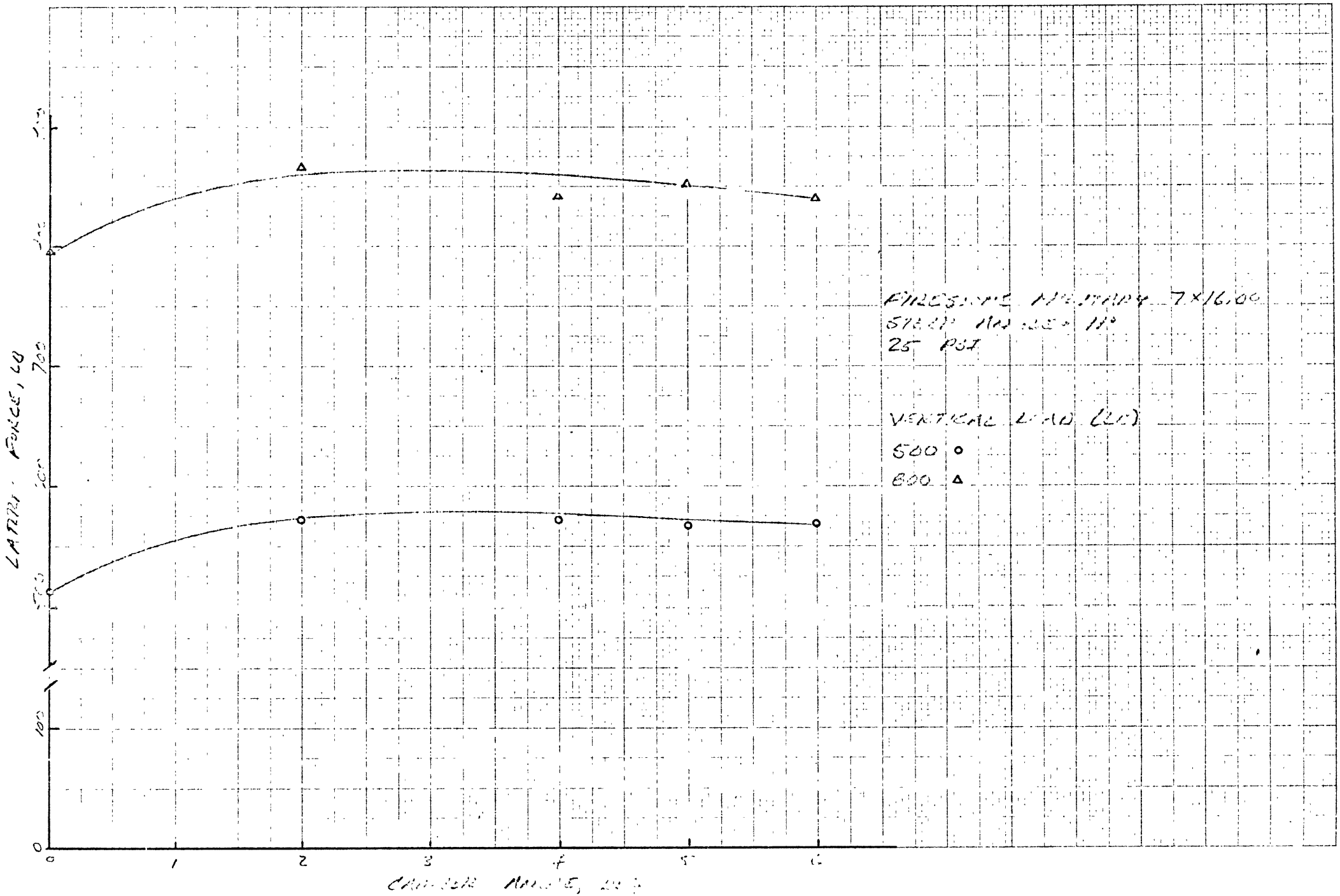
STEER ANGLE: [illegible]

VERTICAL LOAD LB.	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	[illegible]	[illegible]	[illegible]	[illegible]
800	[illegible]	[illegible]	[illegible]	[illegible]
1100	-	-	-	-
1400	-	-	-	-



KEUFFEL & ESSER CO.
MADE IN U.S.A.





ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: 0°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	1.4	3.1	1.7	1.0
800	1.2	1.4	2.3	-0.3
1100	2.6	3.4	3.1	5.0
1400	4.0	5.1	4.4	5.2

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone, [illegible]

RIM: 16 x 4.5

INFLATION: [illegible] PSI

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	11.2	12.5	15.5	15.?
800	[illegible]	41.6	47.3	51.6
1100	[illegible].3	72.7	79.3	[illegible]
1400	[illegible]	112.7	117.5	120.2

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

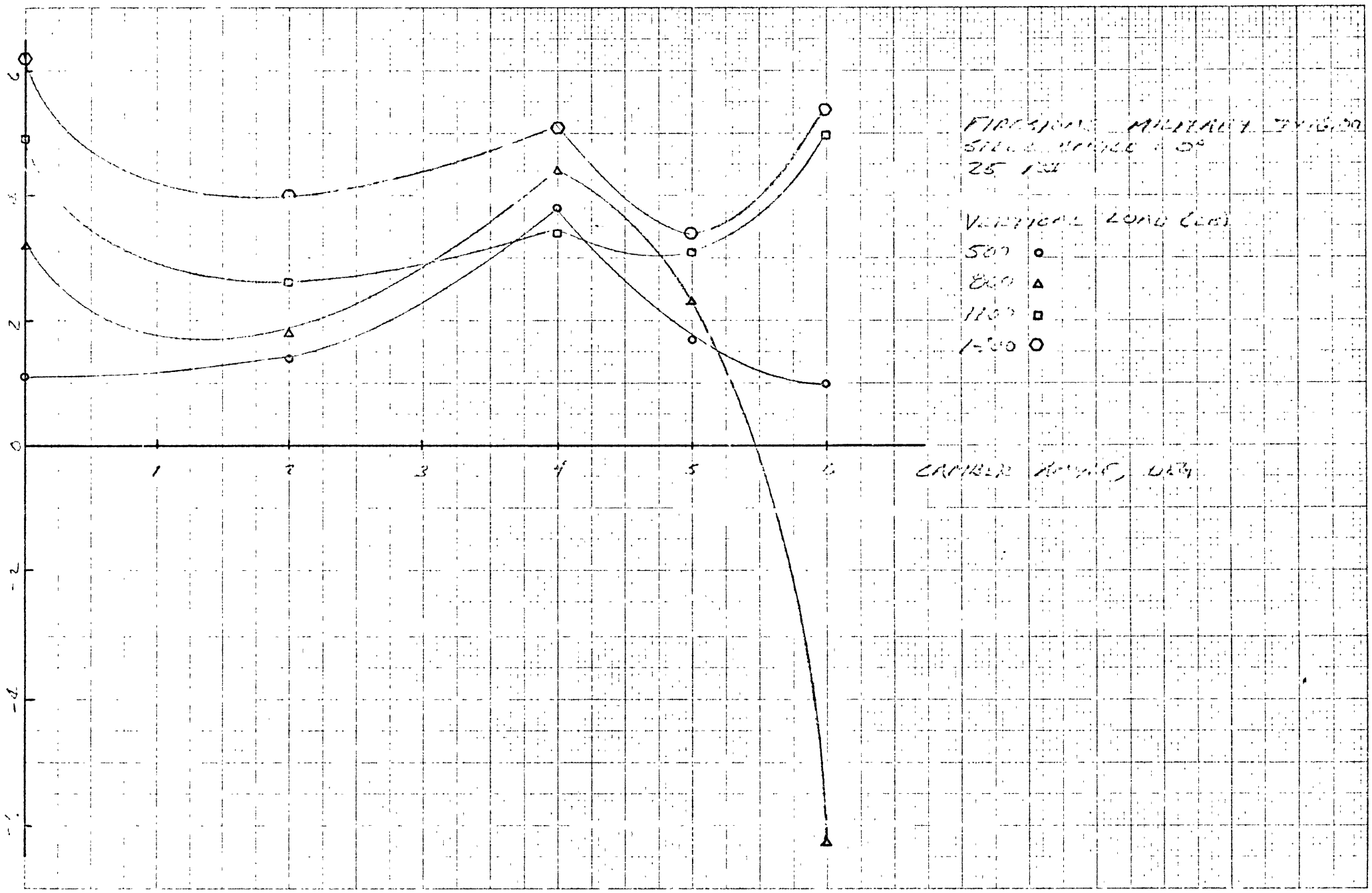
TIRE: Firestone Milemaker 7x16.00

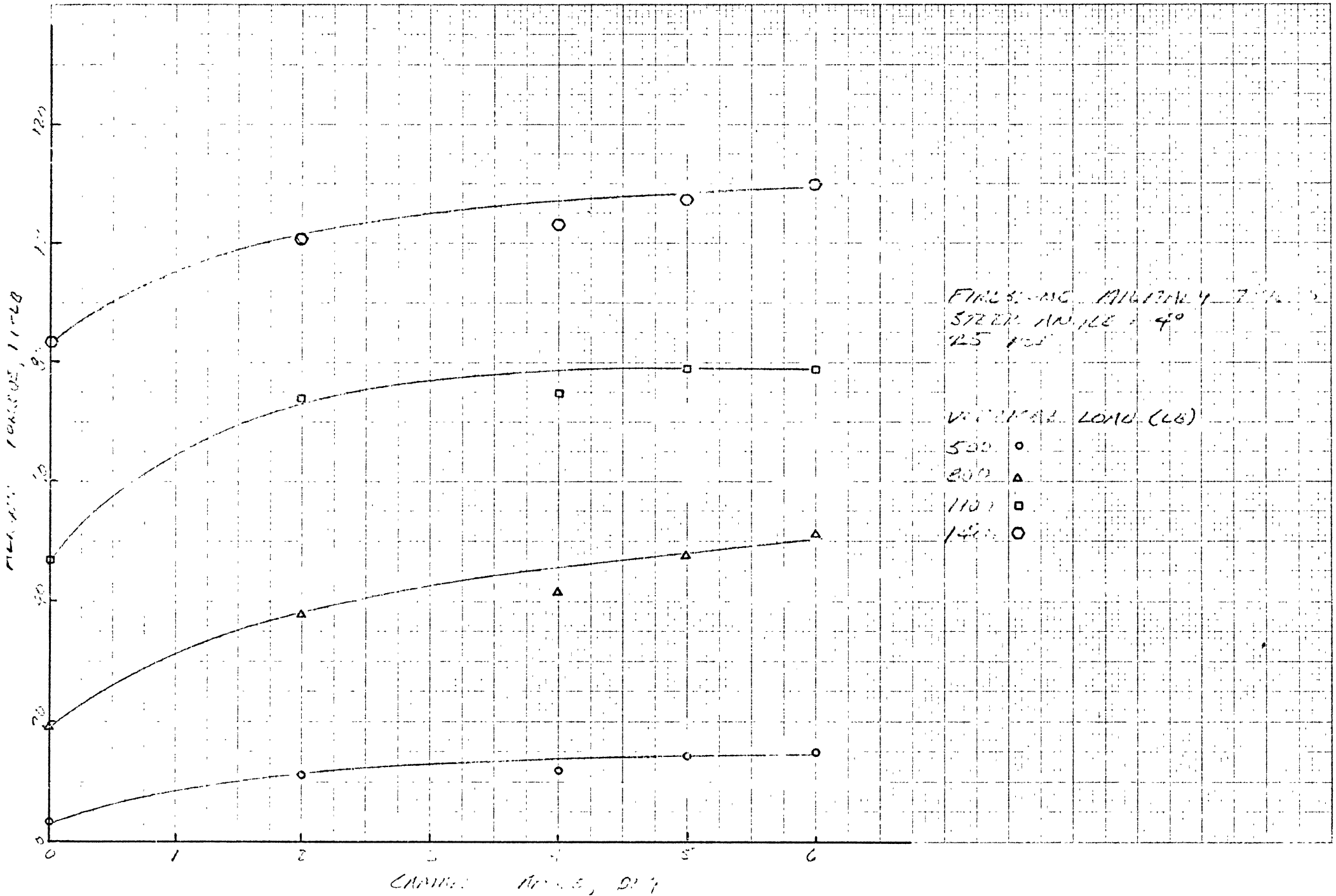
RIM: 16 x 5.5

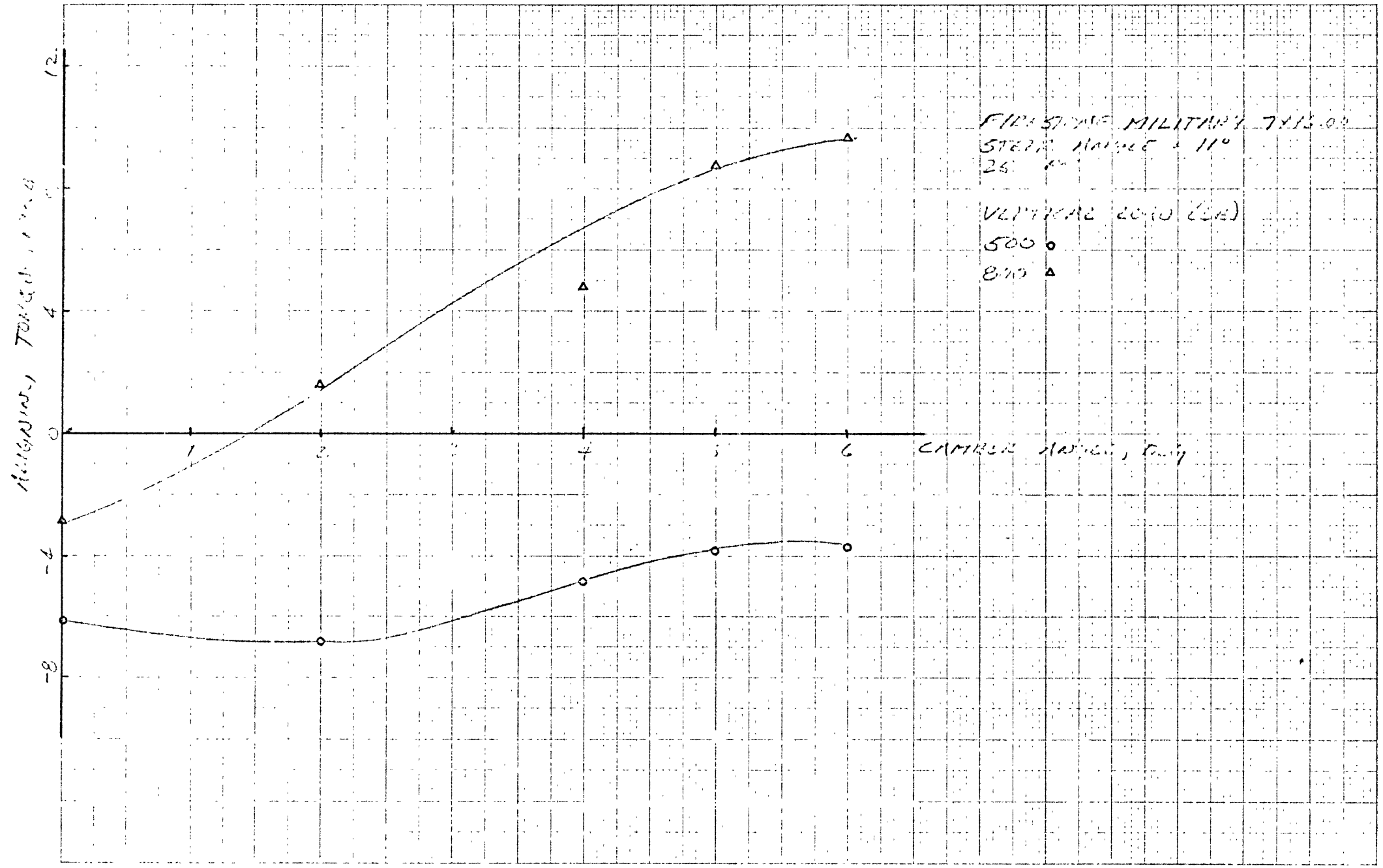
INFLATION: 25 psi

STEER ANGLE: 0°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-6.8	-4.2	-3.8	-3.7
800	1.6	4.8	7.2	9.7 ✓
1100	-	-	-	-
1400	-	-	-	-







APPENDIX I.

Part B: Goodyear Suburbanite Radial GR78-15

INITIAL TIRE BIAS

TIRE: Goodyear Suburbanite [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE = 0
CAMBER ANBLE = 0

VERICAL LOAD	F_y	M_z
[illegible]	27.7	2.7
[illegible]	35.7	6.3
[illegible]	37.5	7.3
[illegible]	[illegible]	12.3

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	124.7	193.5	[illegible]	[illegible]	[illegible]	[illegible]	-
800	166.9	270.6	[illegible]	490.0	[illegible]	[illegible]	-
1100	175.3	295.9	761.5	580.8	719.4		787.7
1400	165.8	291.0	770.8	607.1	790.2	-	914.5

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Su[illegible] GR 78-15
RIM: 15x6.00
INFLATION: 16 [illegible]
CAMBER ANGLE: 2°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED STEER ANGLE (DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	256.[illegible]	363.[illegible]	415.7	[illegible].8	—
800	[illegible]	[illegible].6	393.5	[illegible]	[illegible].6	[illegible]	—
1100	147.5	[illegible]	[illegible]	[illegible].1	739.2	—	[illegible].8
1400	[illegible].6	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible].3

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: 15 x 6.00
INFLATION: [illegible]
CAMBER ANGLE: 0

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	92.0	[illegible]	[illegible]	338.7	441.2	473.2	-
800	115.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	119.0	[illegible]	[illegible]	536.0	710.2		807.0
1400	[illegible]	[illegible]	368.3	[illegible]	[illegible]		[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear [illegible]

RIM: 15 × 6.00

INFLATION: 16 PSI

CAMBER ANGLE: 5°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED STEER ANGLE (DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	266.9	[illegible]	[illegible]	420.0	-
800	[illegible]	[illegible]	[illegible]	[illegible]	391.7	673.1	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	694.7	—	[illegible]
1400	[illegible]	[illegible]	[illegible]	523.[illegible]	737.7	—	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

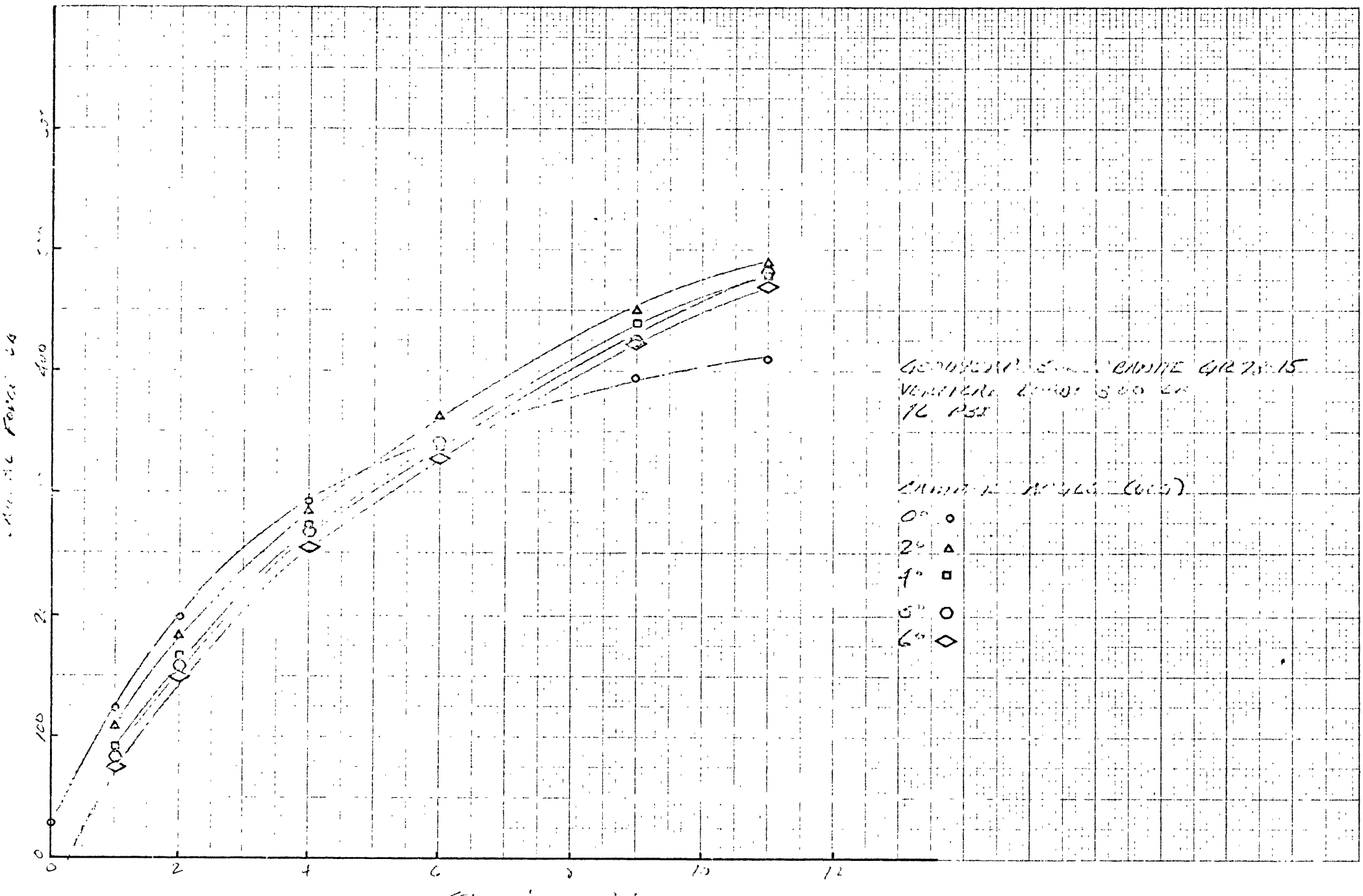
TIRE: Goodyear Suburban 6.70-15

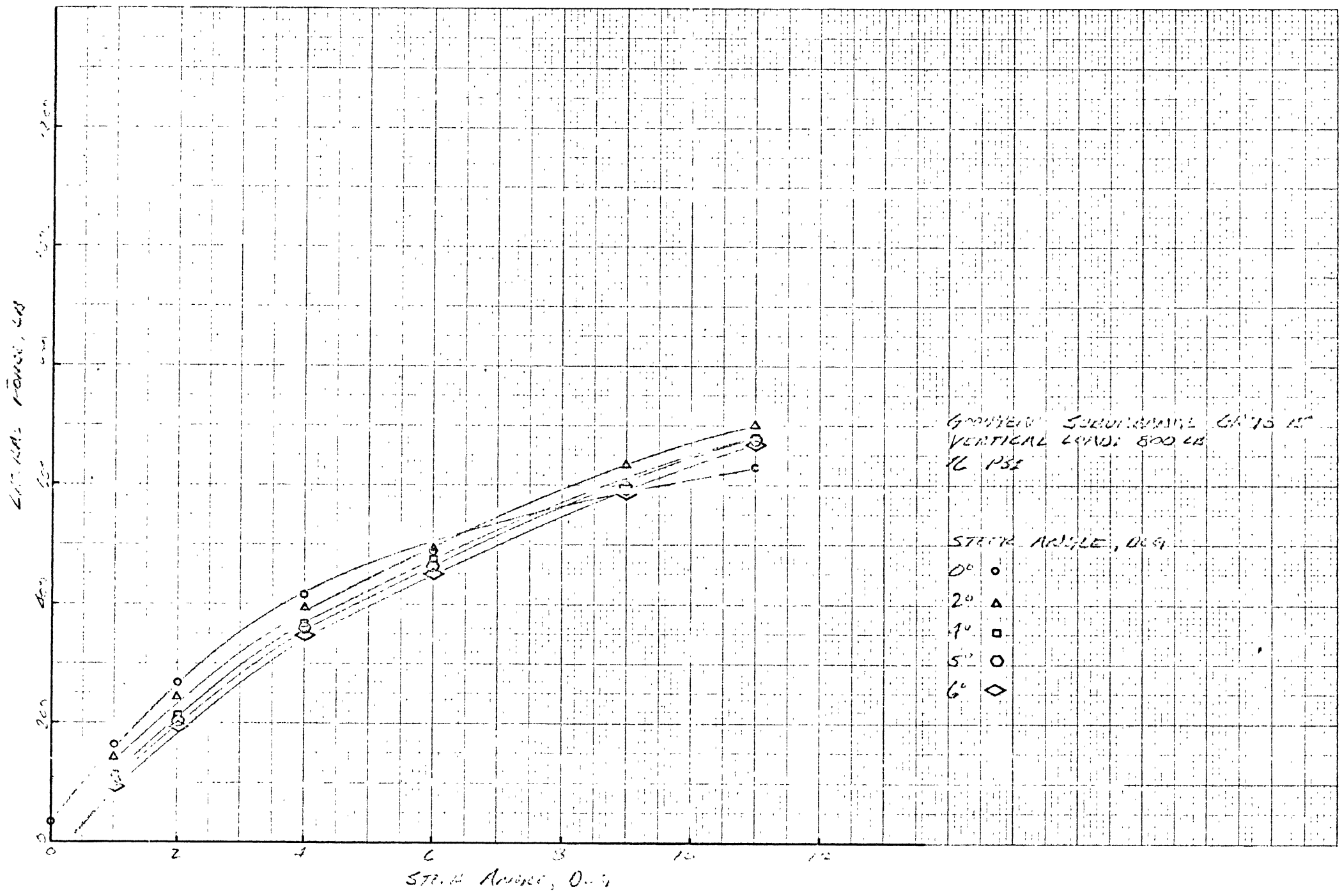
RIM: 15 x 6.00

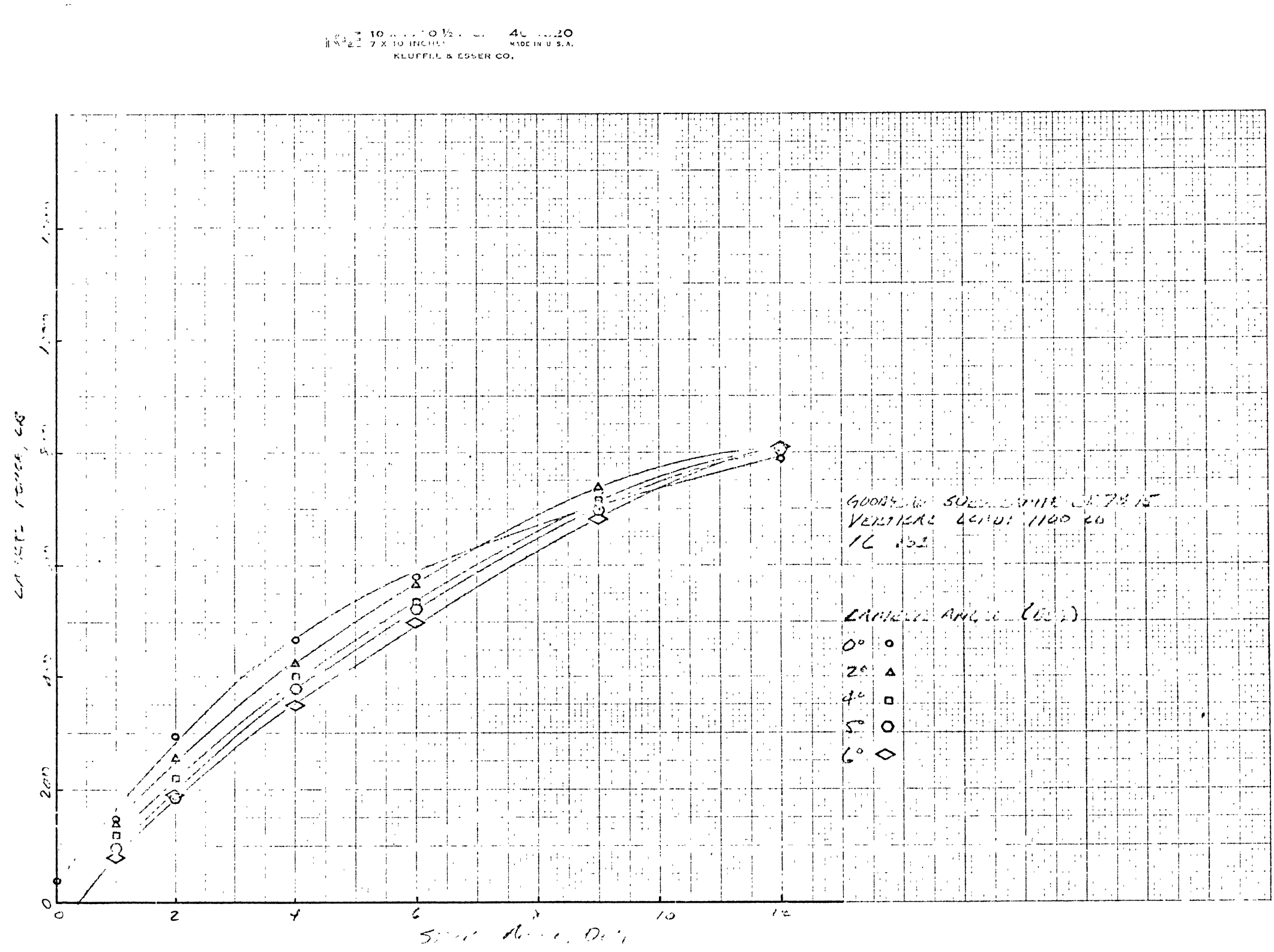
INFLATION: 16 PSI

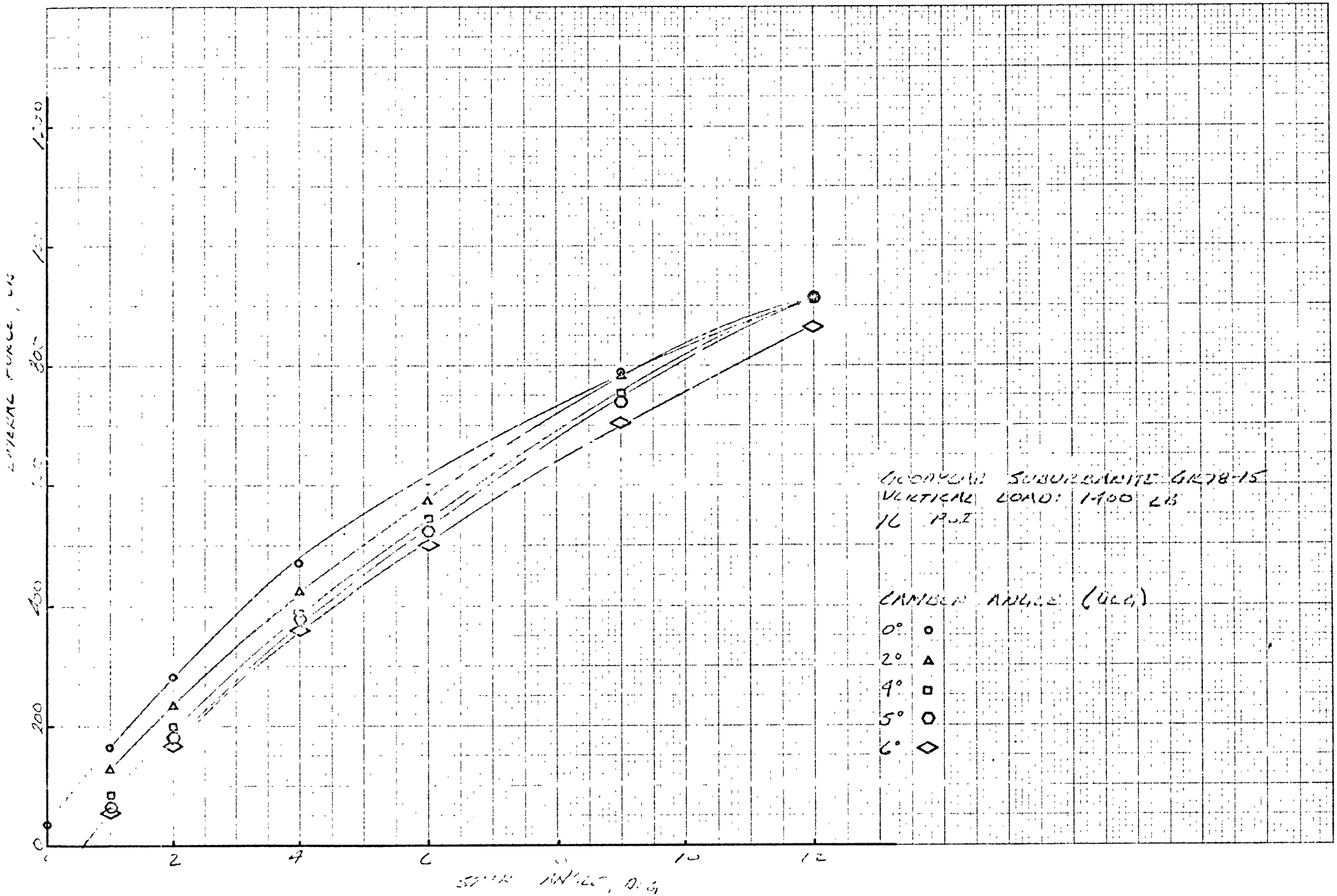
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	3	4	6	9	11	12
500	75.1	[illegible]	255.5	317.8	373.5	[illegible]	—
800	71.6	[illegible]	[illegible]	[illegible]	[illegible]	665.[illegible]	—
1100	[illegible]	[illegible]	375.9	500.7	[illegible]	—	809.7
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	865.3









ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suregrip 5.60-15
RIM: 15 x 6.00
INFLATION: 16 PSI
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	10.5	11.1	10.4	4.2	2.2	-0.2	-
800	28.5	30.1	31.9	26.2	19.8	13.0	-
1100	36.9	52.3	63.2	61.1	51.8	-	28.2
1400	49.1	78.3	94.4	103.0	93.2	-	53.5

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite 6.00-15

RIM: 15 x 6.00

INFLATION: 16 PSI

CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	13.4	/	15.5	1..	11.2	6.1	-
800	..5		/	..	1.3	37.9	-
1100	.1.1		..	82.2	80.1	-	52.6
1400	..		..	..	122.5		86.7

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	15.6		17.8	15.	13.5	9.6	-
800	11.3	?	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]		[illegible]	[illegible]	[illegible]	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

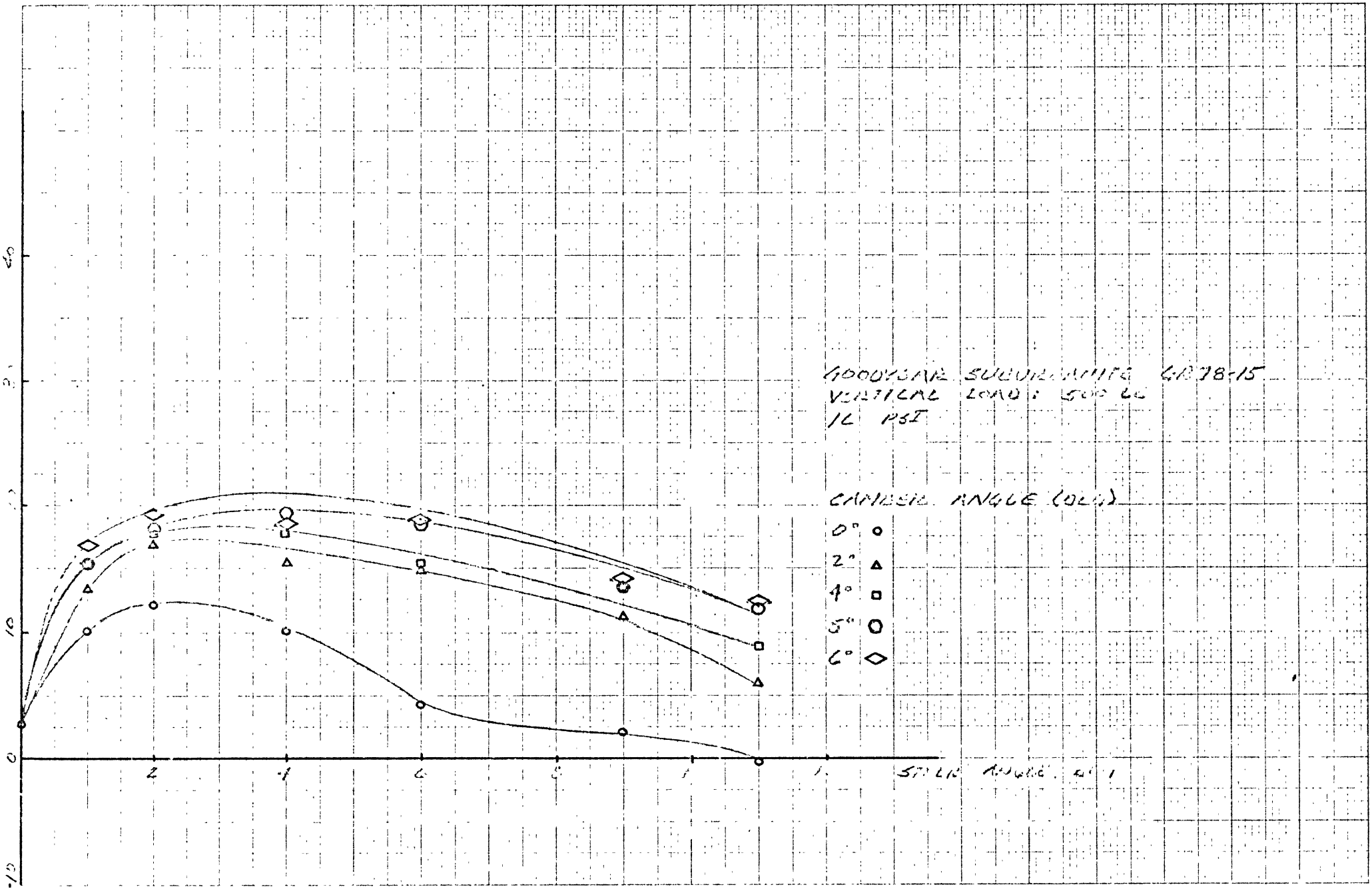
TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 5°

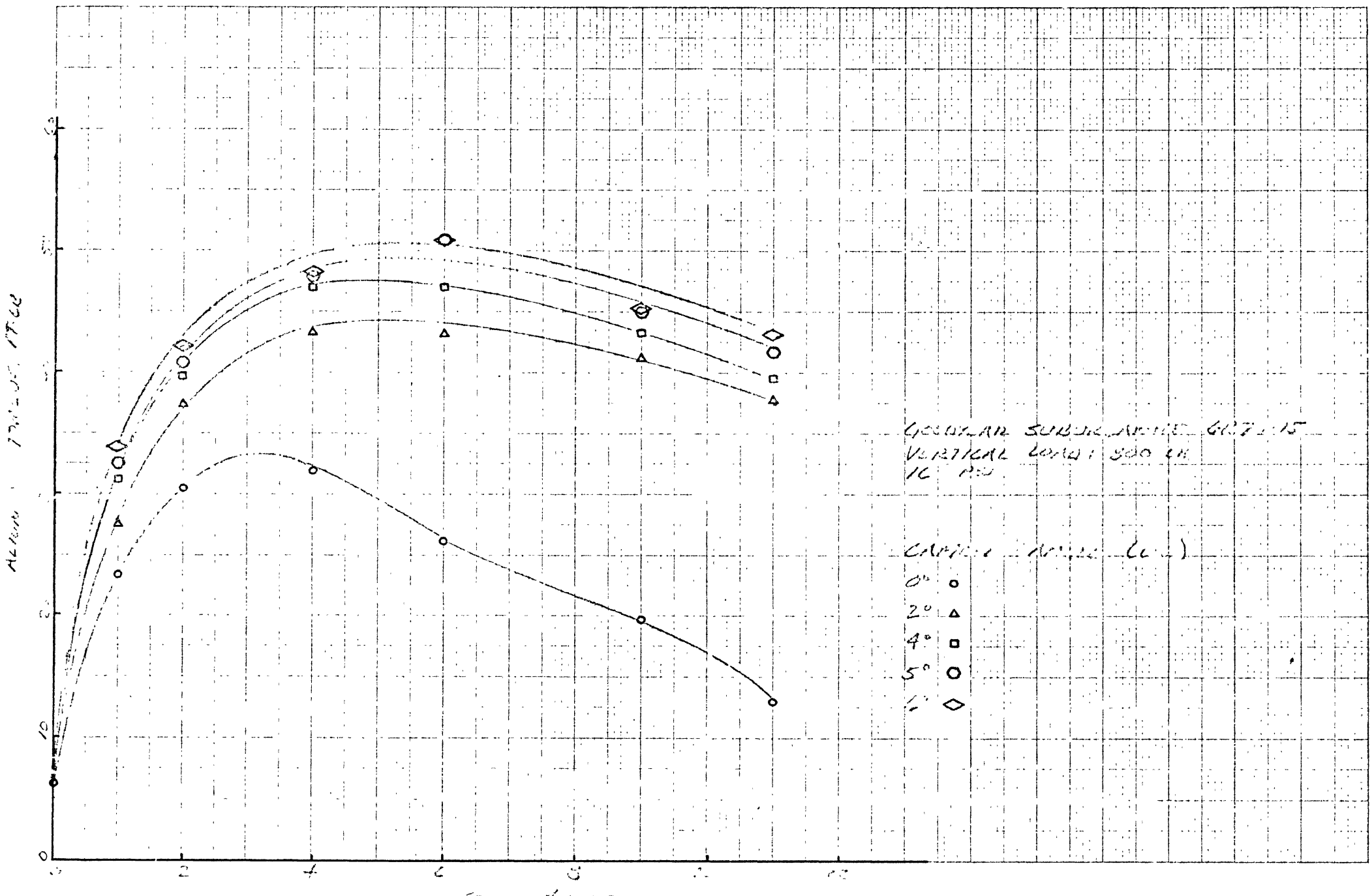
VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]

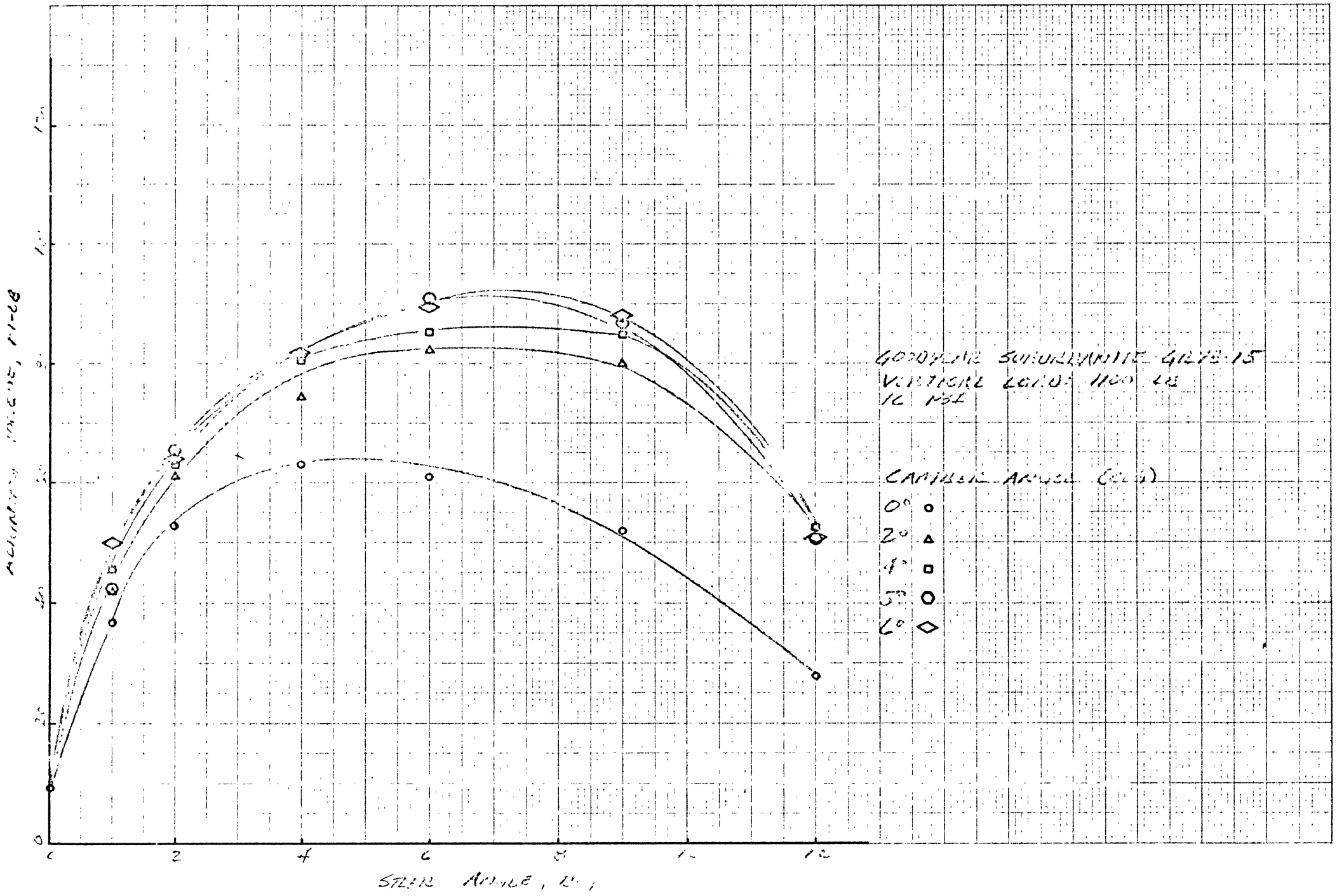
ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

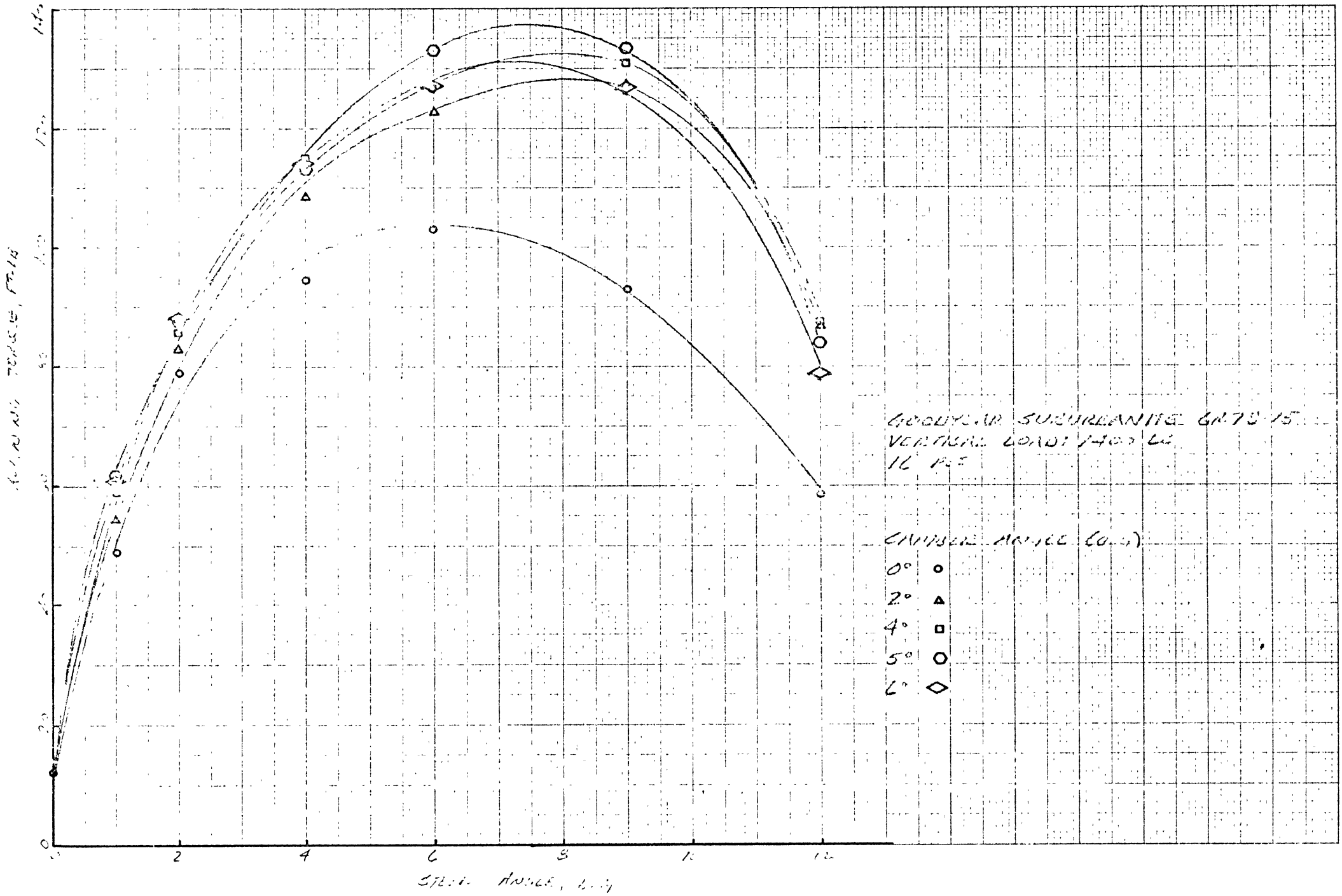
TIRE: Goodyear Suburbanite [illegible] 78-15
RIM: 15 x 6.00
INFLATION: [illegible] PSI
CAMBER ANGLE: 6°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE (DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	18.5	[illegible]	[illegible]	12.[illegible]	—
800	[illegible]	[illegible]	[illegible]	50.[illegible]	45.2	45.3	—
1100	[illegible]	[illegible]	[illegible]1.4	[illegible]	88.2		50.[illegible]
1400	[illegible]	[illegible]	114.5	121.8	126.3	—	[illegible]









LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Goodyear [illegible]

RIM: [illegible]

INFLATION: 16 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-15.3	[illegible]	-37.9	[illegible]
800	-20.4	-39.7	[illegible]	[illegible]
1100	[illegible]	-53.1	-66.6	[illegible]
1400	[illegible]	-68.6	[illegible]	-101.1

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite [illegible]

RIM: 15 x 6.00

INFLATION: [illegible]

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	286.1	272.7	[illegible]	[illegible]
800	[illegible]	367.5	[illegible]	[illegible]
1100	428.1	[illegible]	[illegible]	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

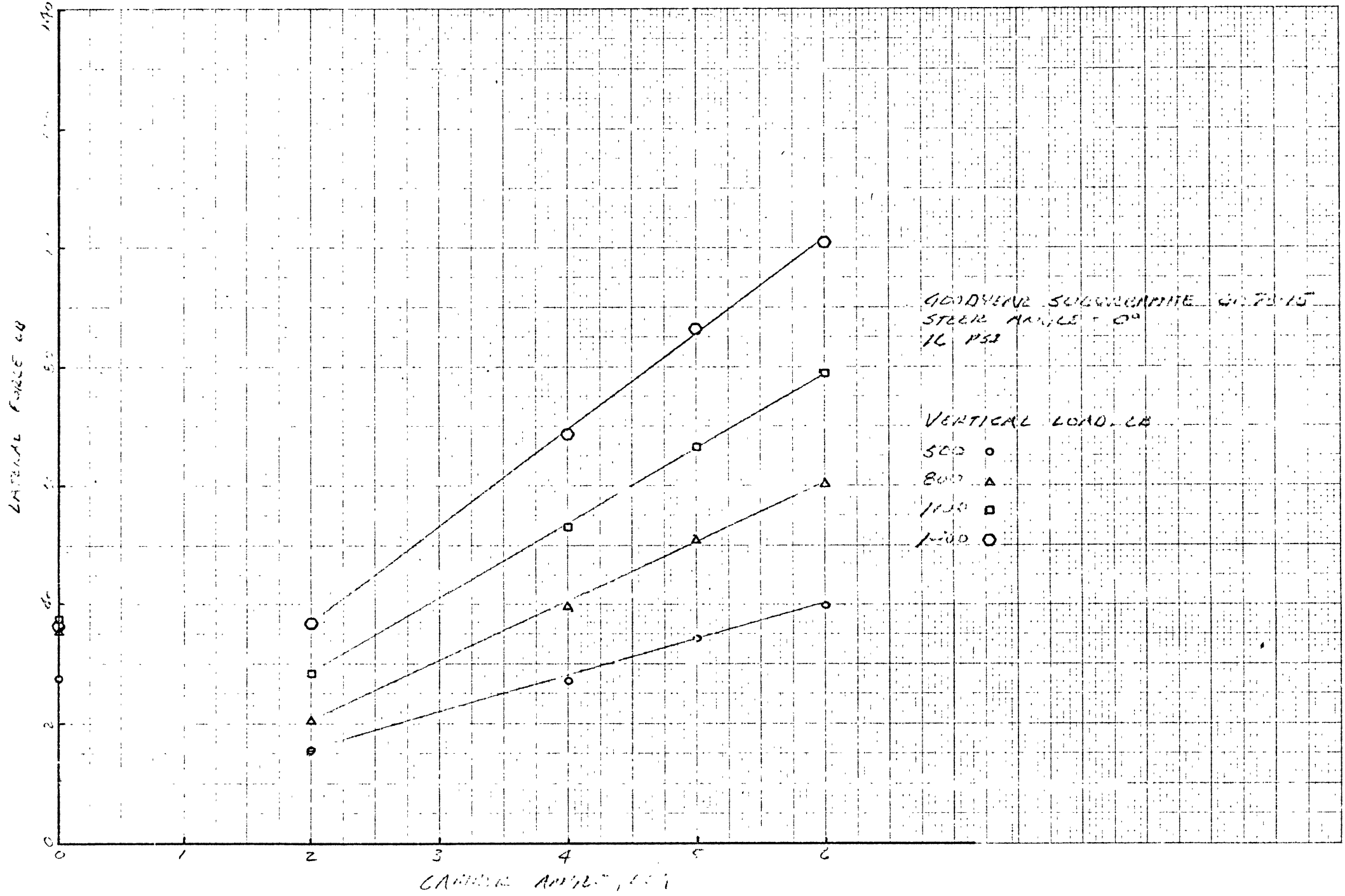
TIRE: Goodyear Suregrip SC 8-15

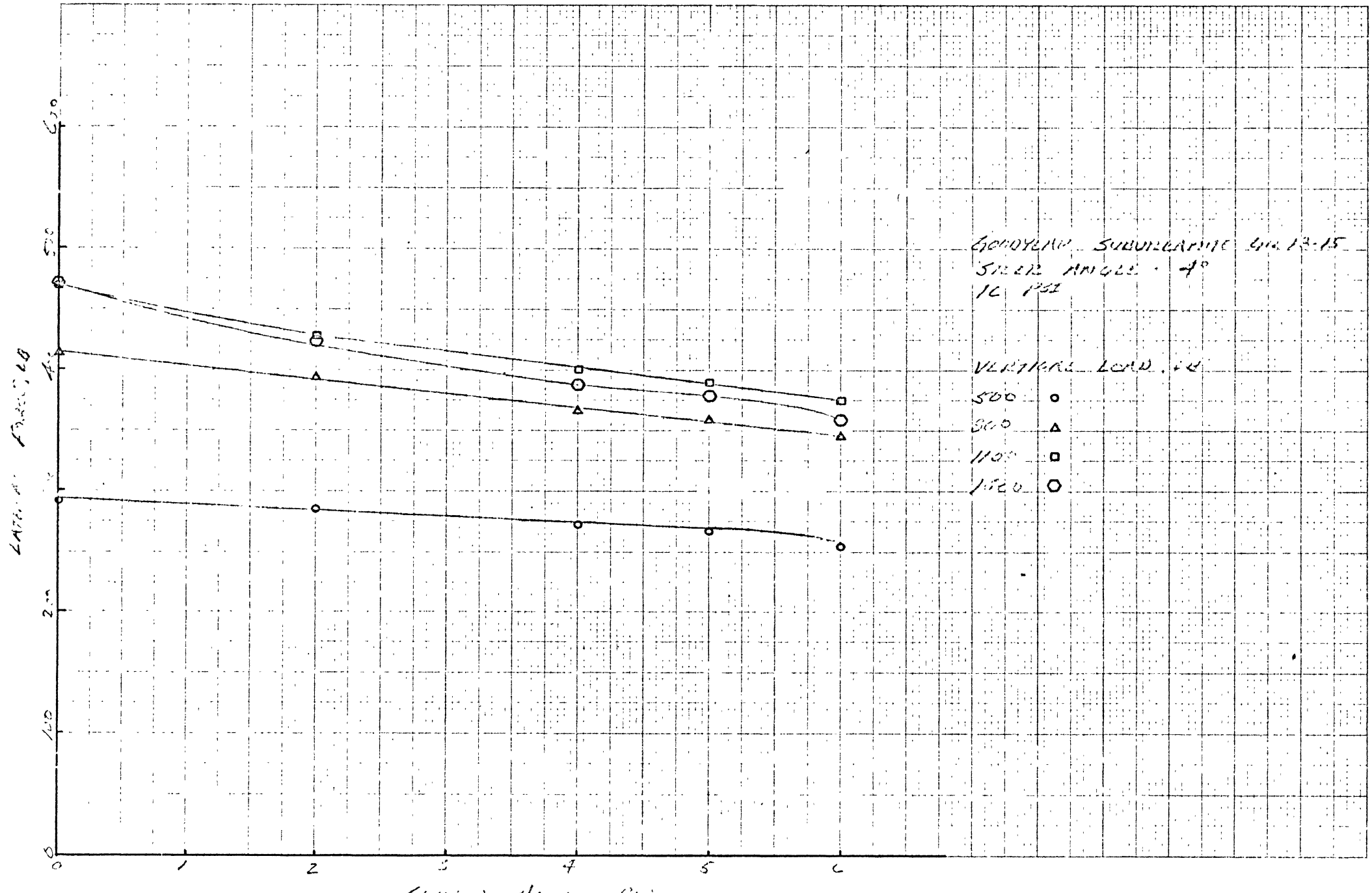
RIM: 5 x 6.5 J

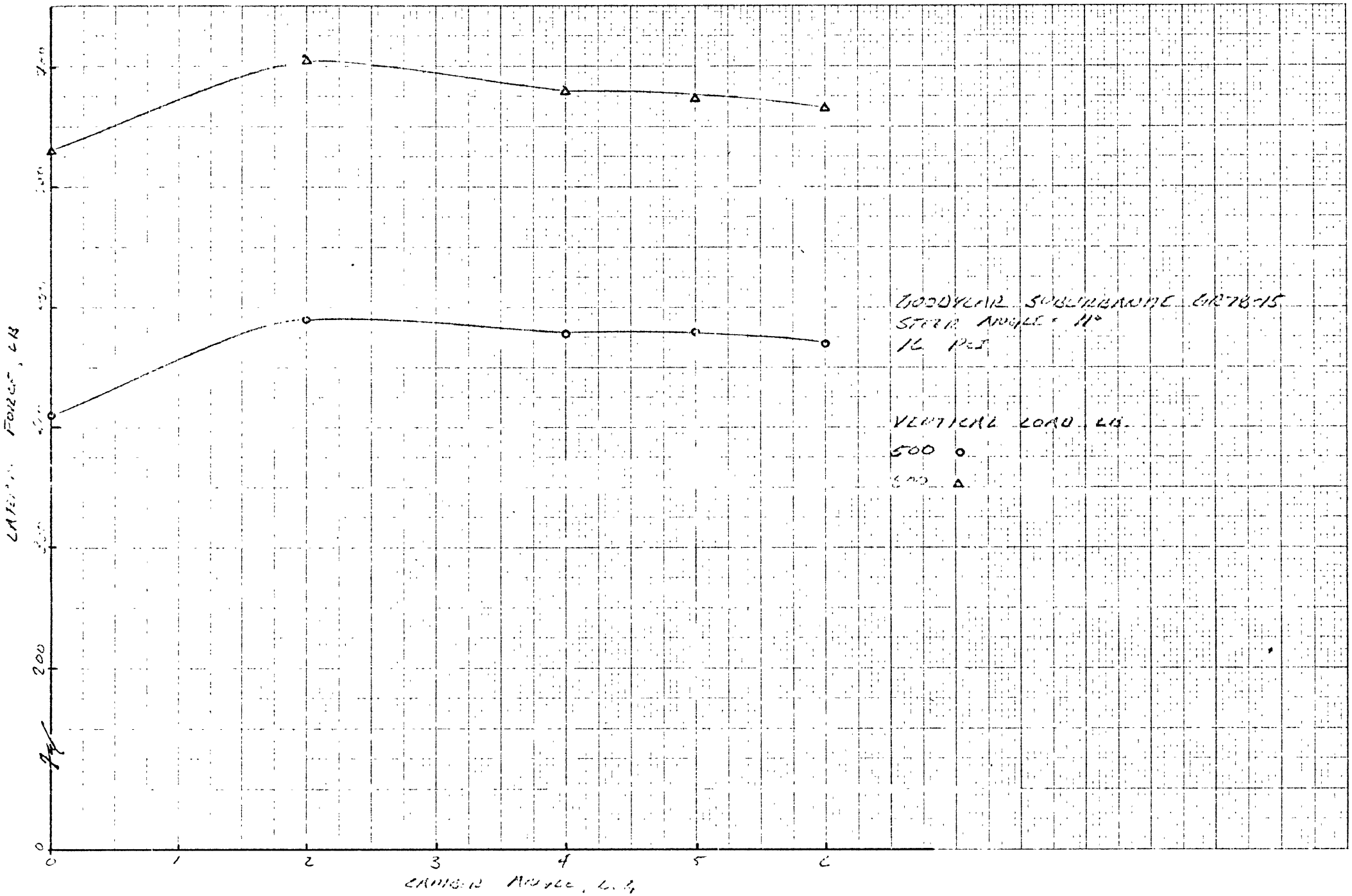
INFLATION: 16 psi

STEER ANGLE: 11°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	491.5	478.2	450.2	440.1
800	702.1	681.3	673.1	665.5
1100	-	-	-	-
1400	-	-	-	-







ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite Cord 13.15

RIM: 15 x 6.00

INFLATION: 16 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	3.8	3.1	3.5	2.7
800	6.7	6.8	6.9	5.2
1100	9.5	9.8	9.5	8.5
1400	12.6	12.5	12.8	10.9

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite GR 78-15

RIM: 15 x 6.00

INFLATION: [illegible]

STEER ANGLE: 4°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	15.5	17.8	17.6	18.5
800	[illegible]	46.8	[illegible]	[illegible]
1100	[illegible]	80.5	81.5	82.4
1400	[illegible]	[illegible]	113.0	117.5

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

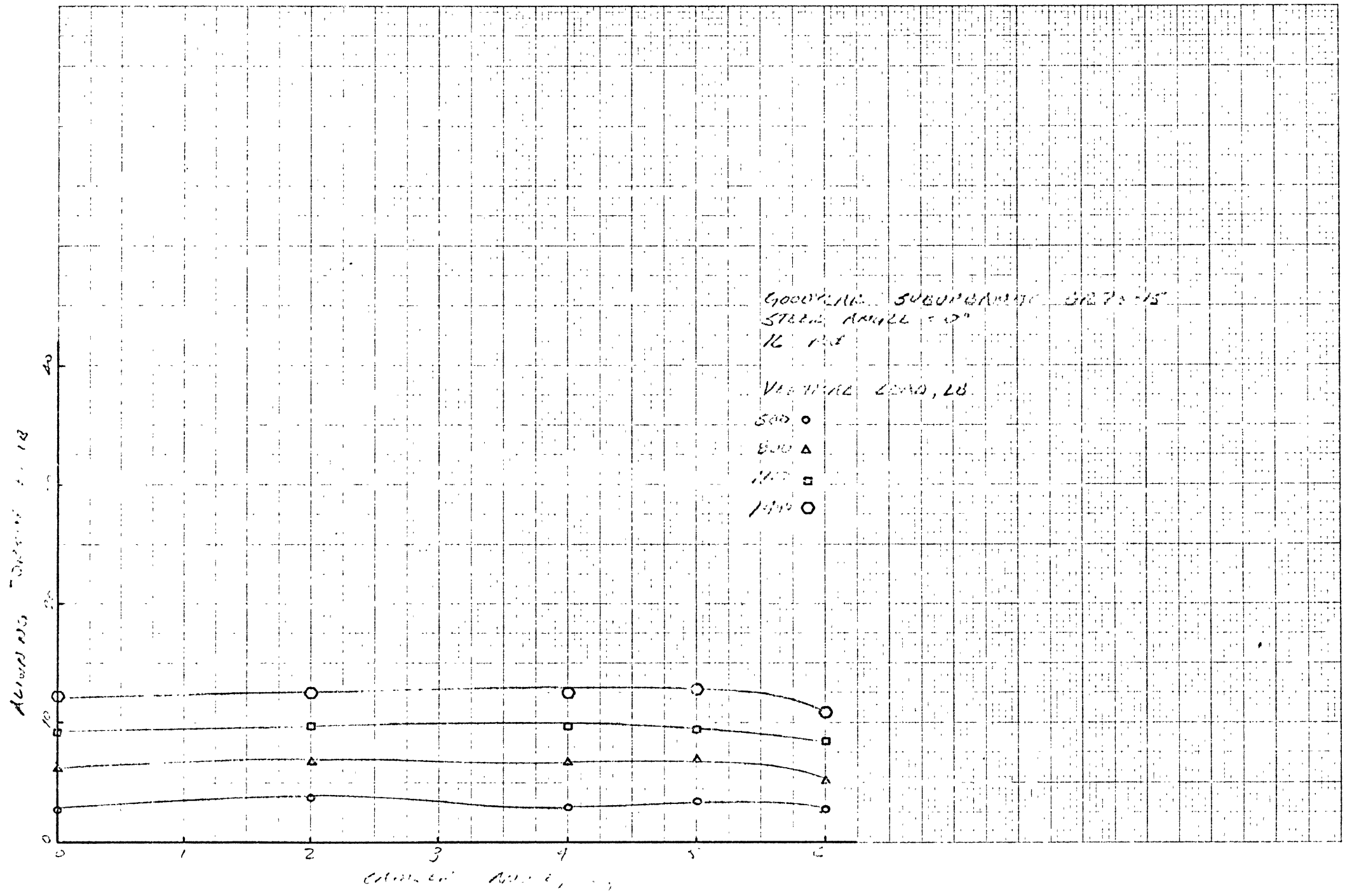
TIRE: Goodyear Suregrip GR 78-15

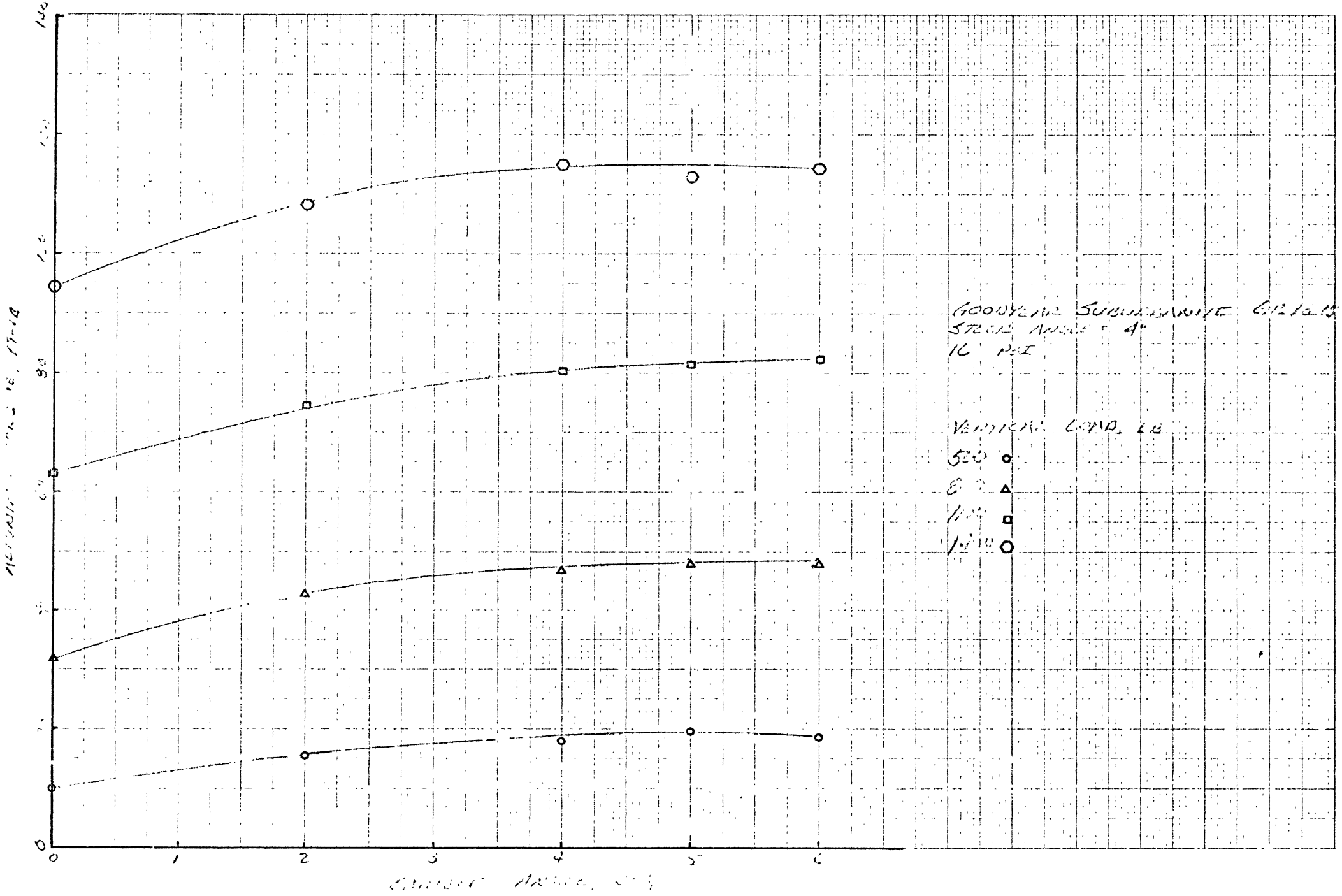
RIM: 15 x 6.50

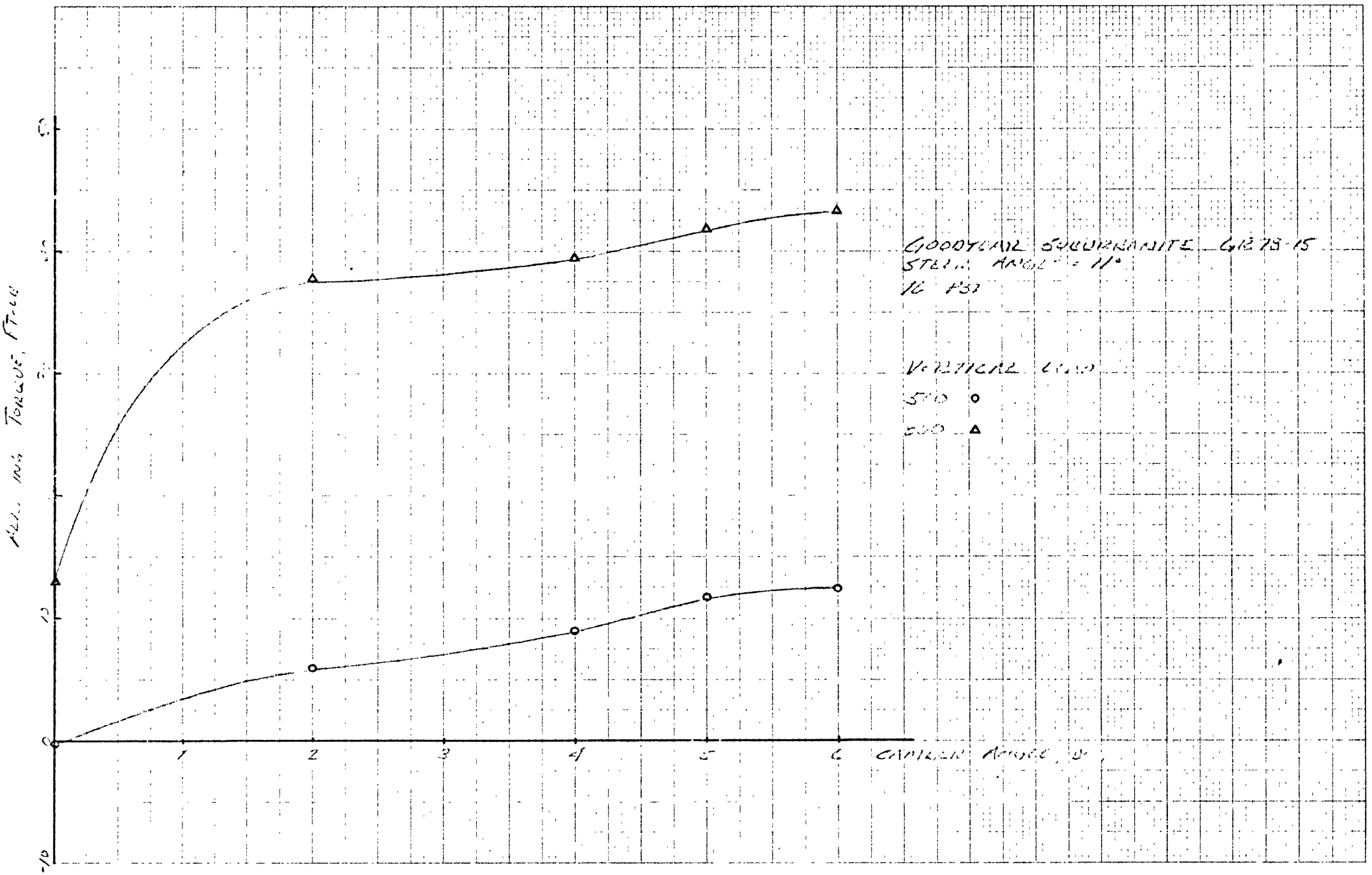
INFLATION: 16 PSI

STEER ANGLE: 1/2°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	6.1	9.0	11.7	12.4
800	37.9	39.4	41.8	43.3
1100	-	-	-	-
1400	-	-	-	-







INITIAL TIRE BIAS

TIRE: Goodyear Suburbanite [illegible]

RIM: 15 x 6.00

INFIATION: [illegible]

STEER ANGLE= 0

CAMBER ANBLE= 0

VERICAL LOAD	F_y	M_z
500	21.1	2.3
600	35.9	5.5
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: 15 x 6.00
INFLATION: 24 PSI
CAMBER ANGLE: 2°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED STEER ANGLE (DEG)						
	1	2	4	6	9	11	12
500	101.1	[illegible]	230.0	311.8	461.7	512.3	-
800	154.1	246.6	[illegible]	[illegible]	693.1	760.2	-
1100	[illegible]	[illegible]	[illegible]	668.6	837.5	-	966
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	84.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	8	11	12
500	[illegible]	[illegible]	[illegible]	351.3	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	416.1
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

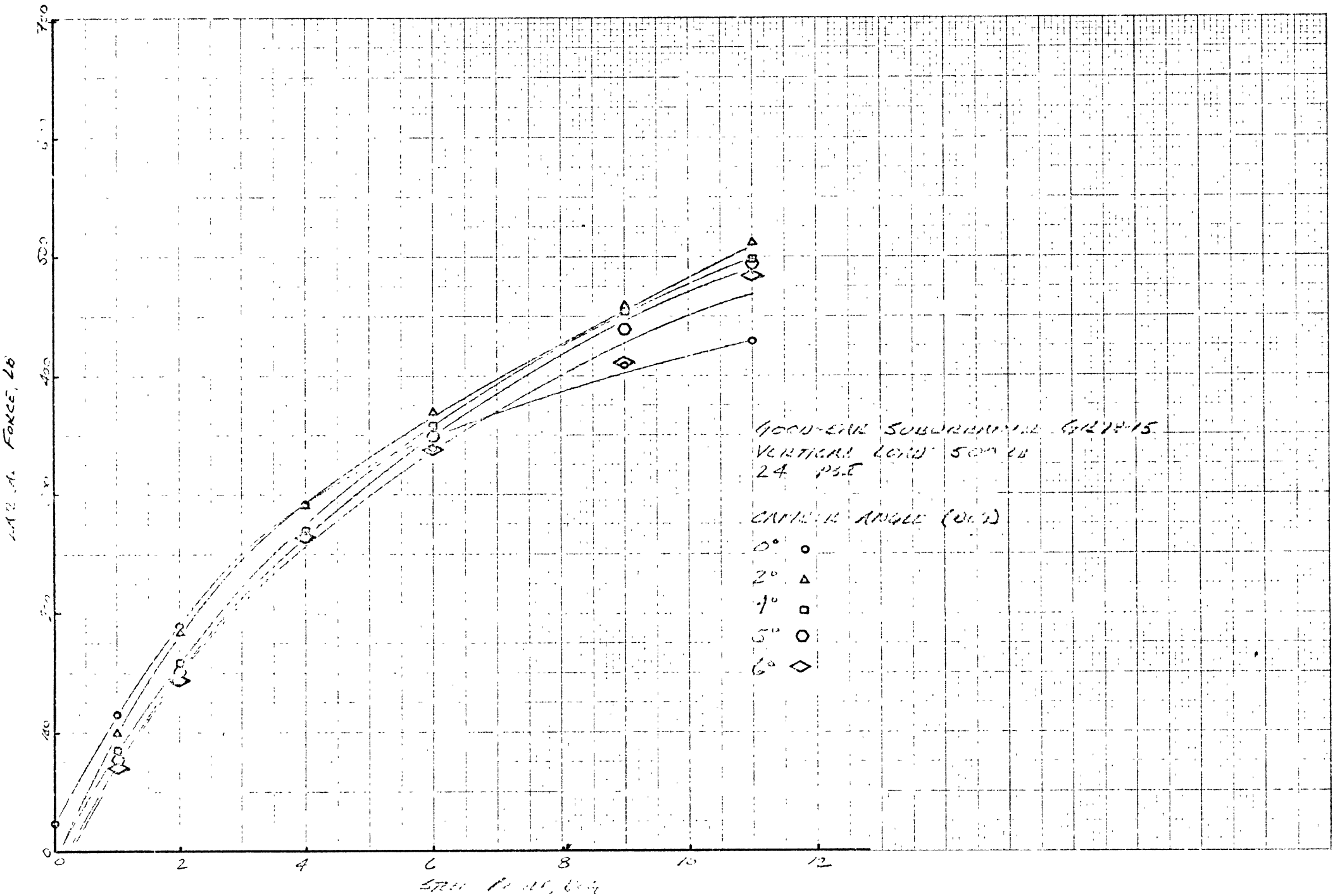
TIRE: [illegible]

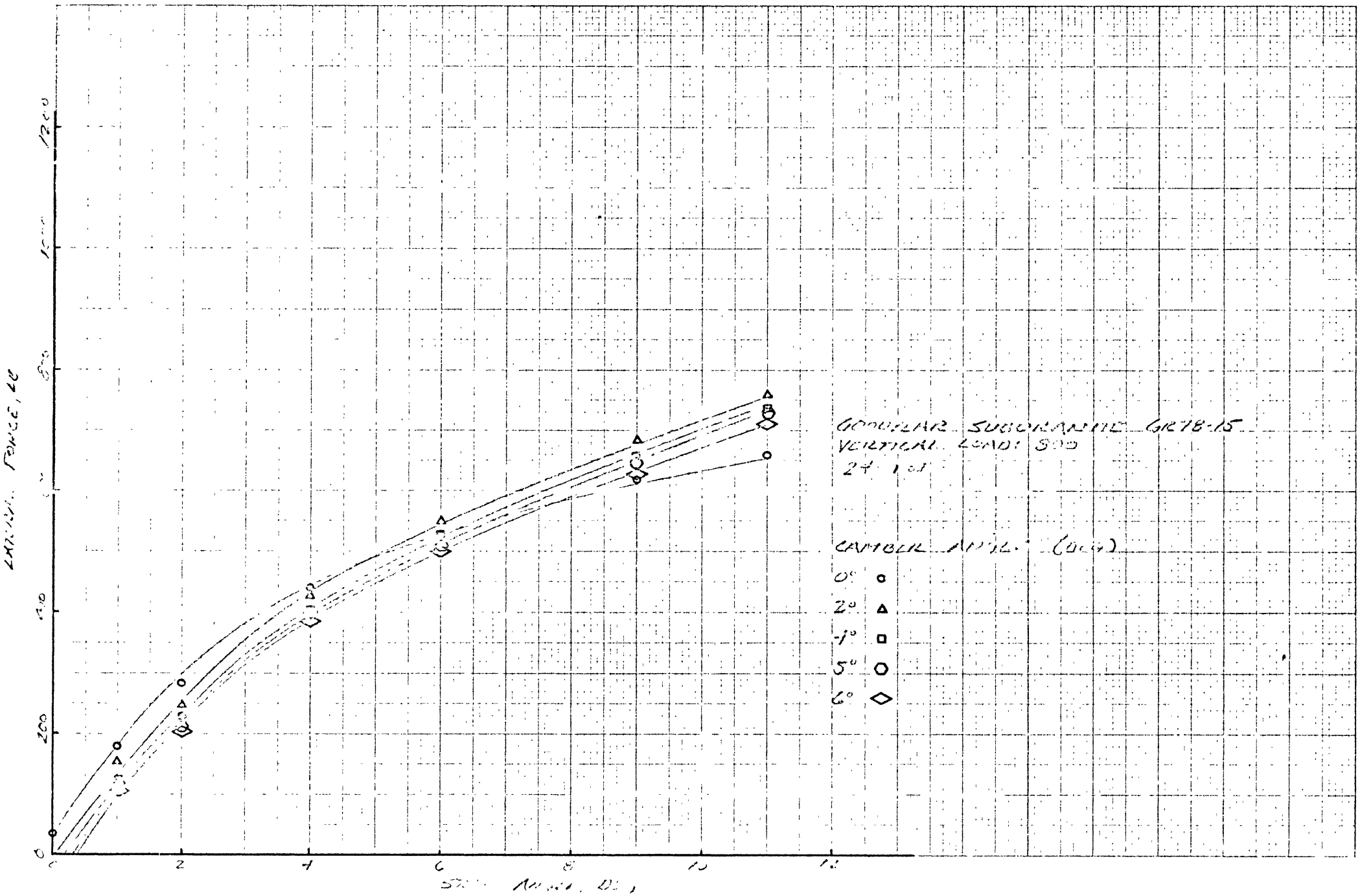
RIM: [illegible]

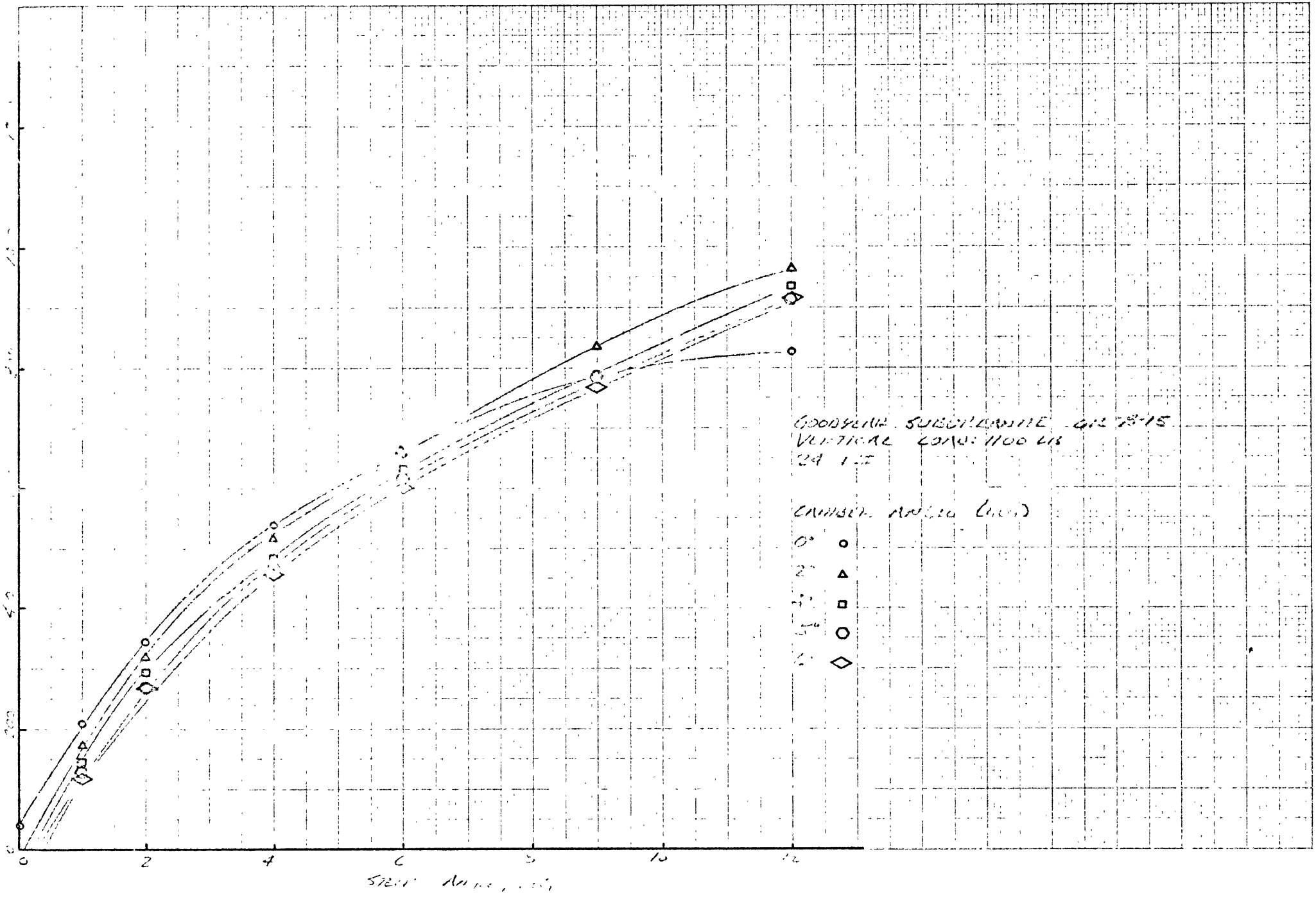
INFLATION: [illegible]

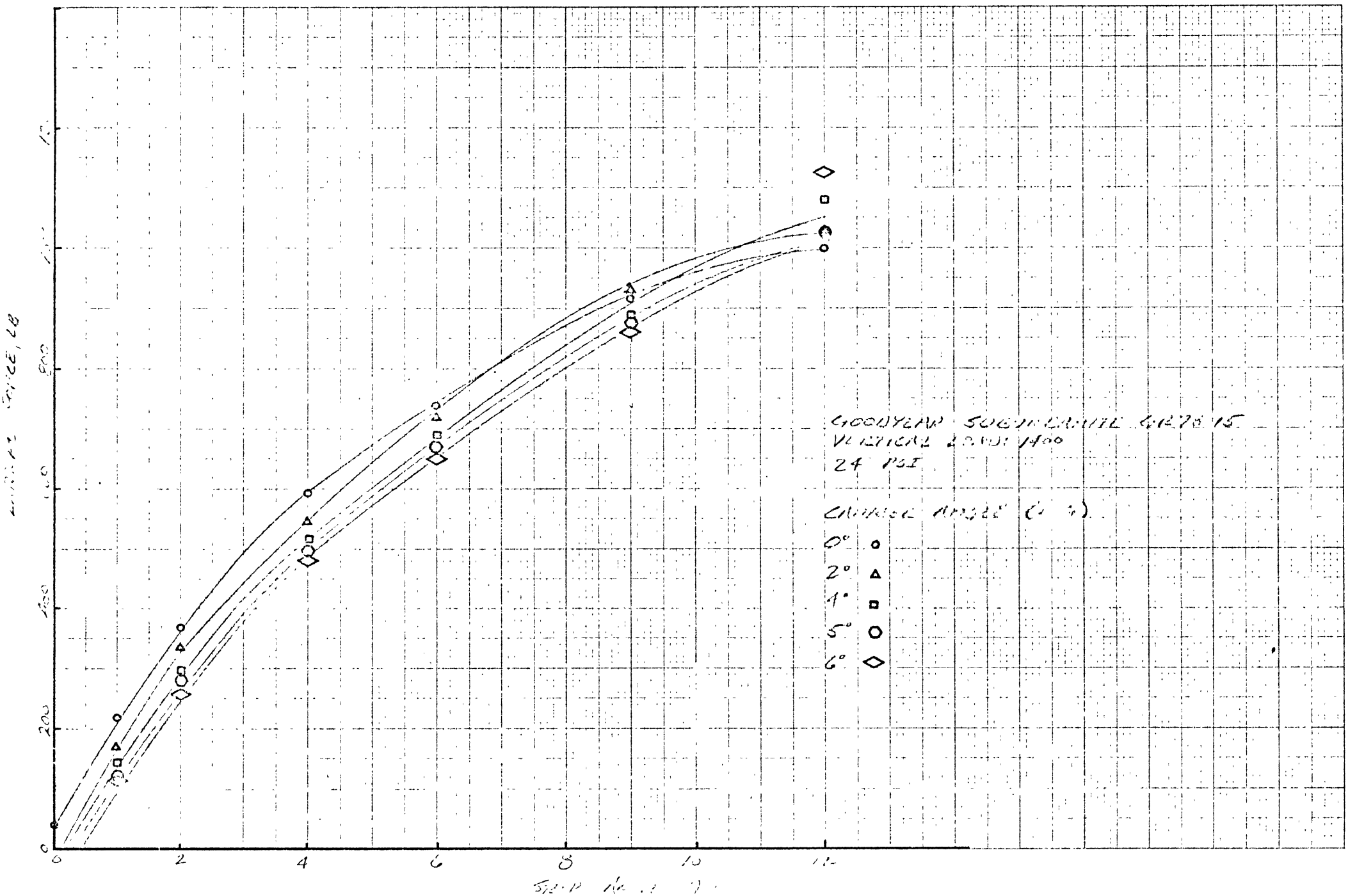
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	143.3	[illegible]	[illegible]	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	712.5	-
1100	[illegible]	[illegible]	[illegible]	610.6	770.1	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	861.5	-	[illegible]









ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite GR 78-15
RIM: 15 x 6.5 JJ
INFLATION: 24 PSI
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	6.3	8.1	6.7	5.3	0.8	-1.6	-
800	13.1	13.2	23.3	17.8	10.3	4.7	-
1100	27.7	32.1	47.1	42.7	30.3	-	12.9
1400	42.3	63.9	76.4	72.7	61.1	-	35.6

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) @ INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	[illegible]	10.6	[illegible]	[illegible]	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	40.7
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] 5.00-15

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	11.6	12.5	[illegible]	12.6	[illegible]	6.3	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	33.3
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

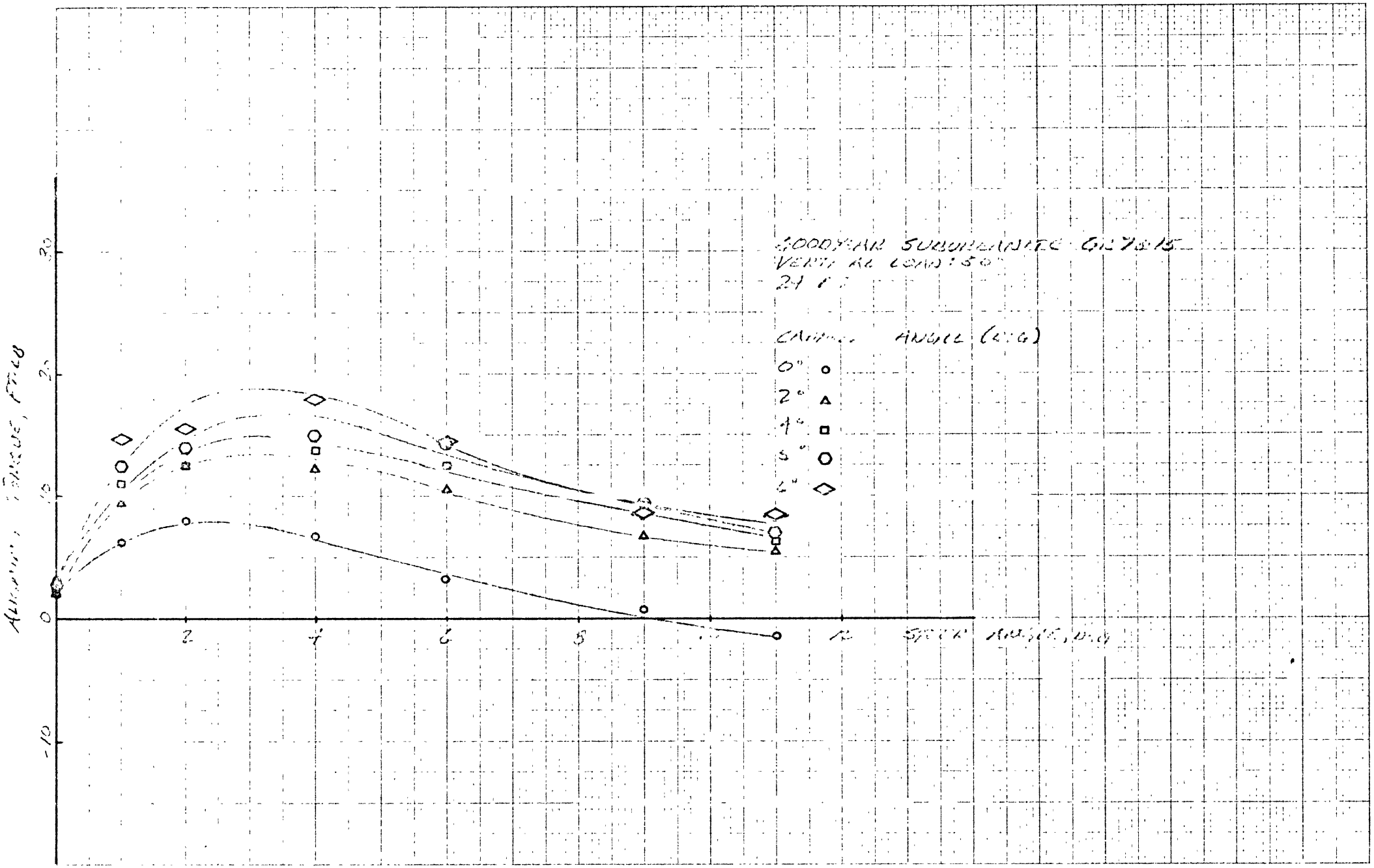
TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: [illegible]

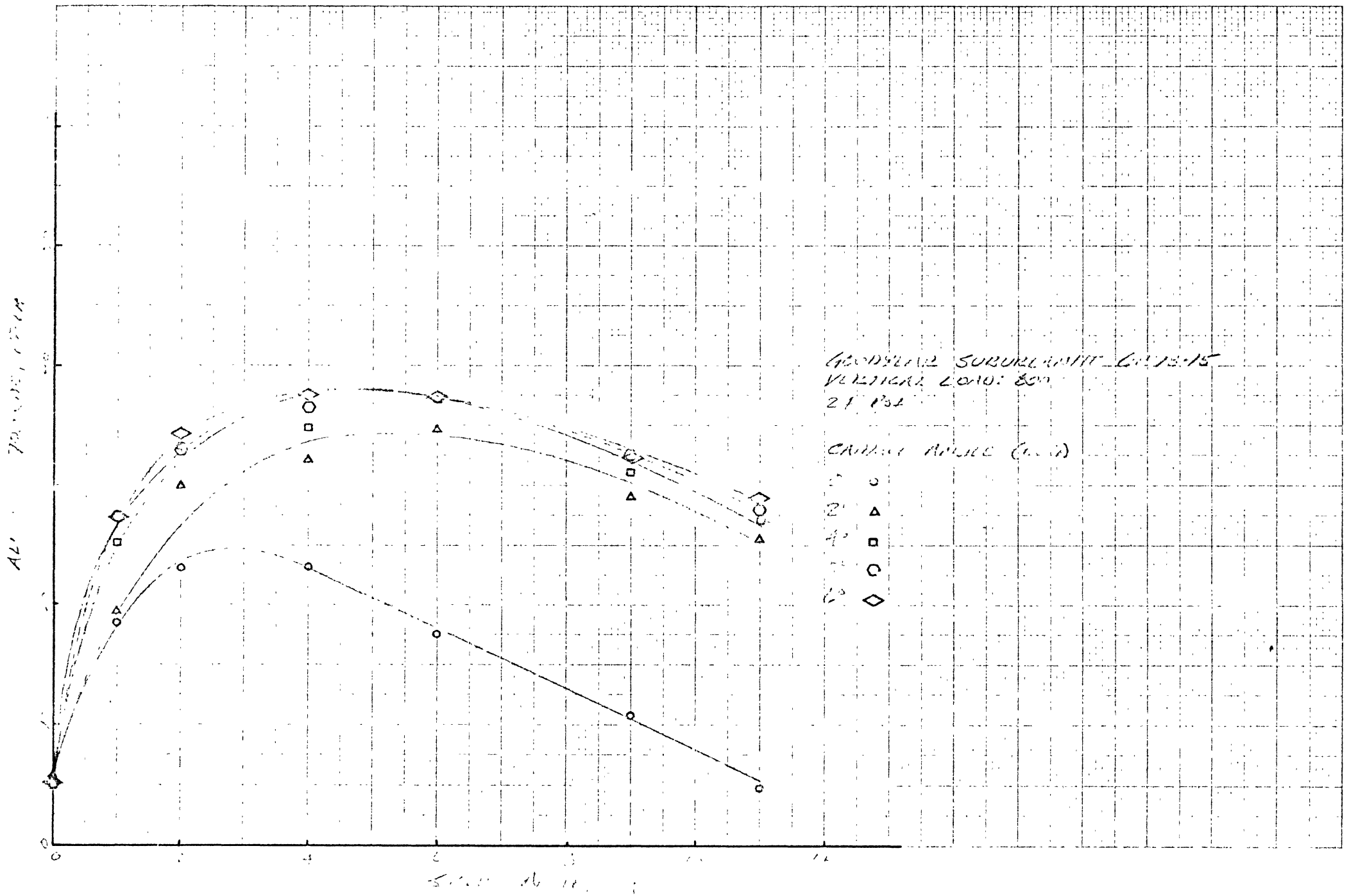
VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	111.2	[illegible]	[illegible]	[illegible]	6.9	-
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	[illegible]	48.2	43.5	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

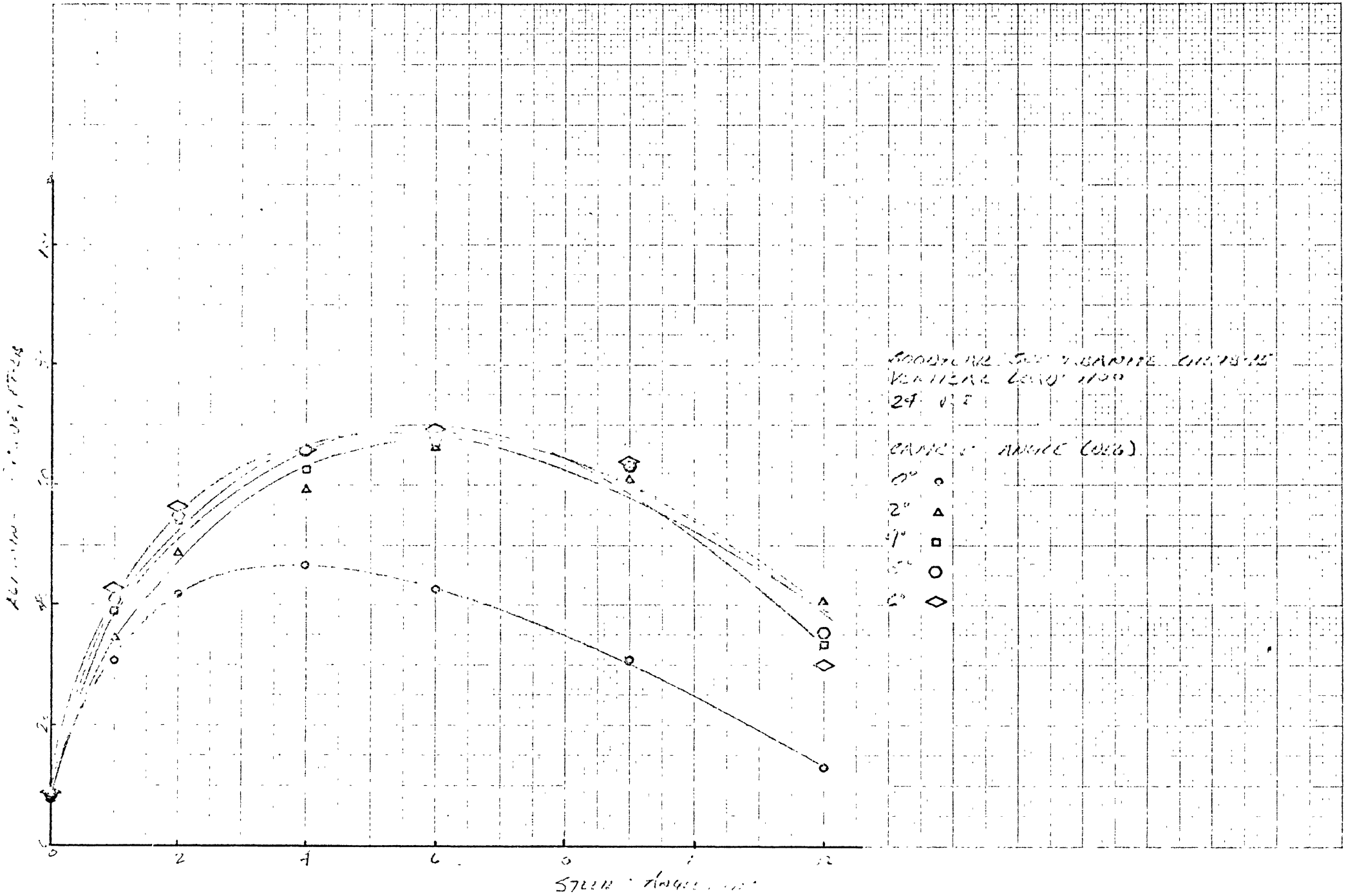
ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Goodyear Suburbanite GR 78-15
RIM: 15 x 6.50
INFLATION: 24 PSI
CAMBER ANGLE: 6°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) @ INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
900	14.7	15.6	18.1	[illegible]	5.6	3.2	-
900	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-
1100	[illegible]	[illegible]	69.9	60.6	69.1	-	30.4
1400	[illegible]	[illegible]	[illegible]	[illegible]	102.1	-	56.2







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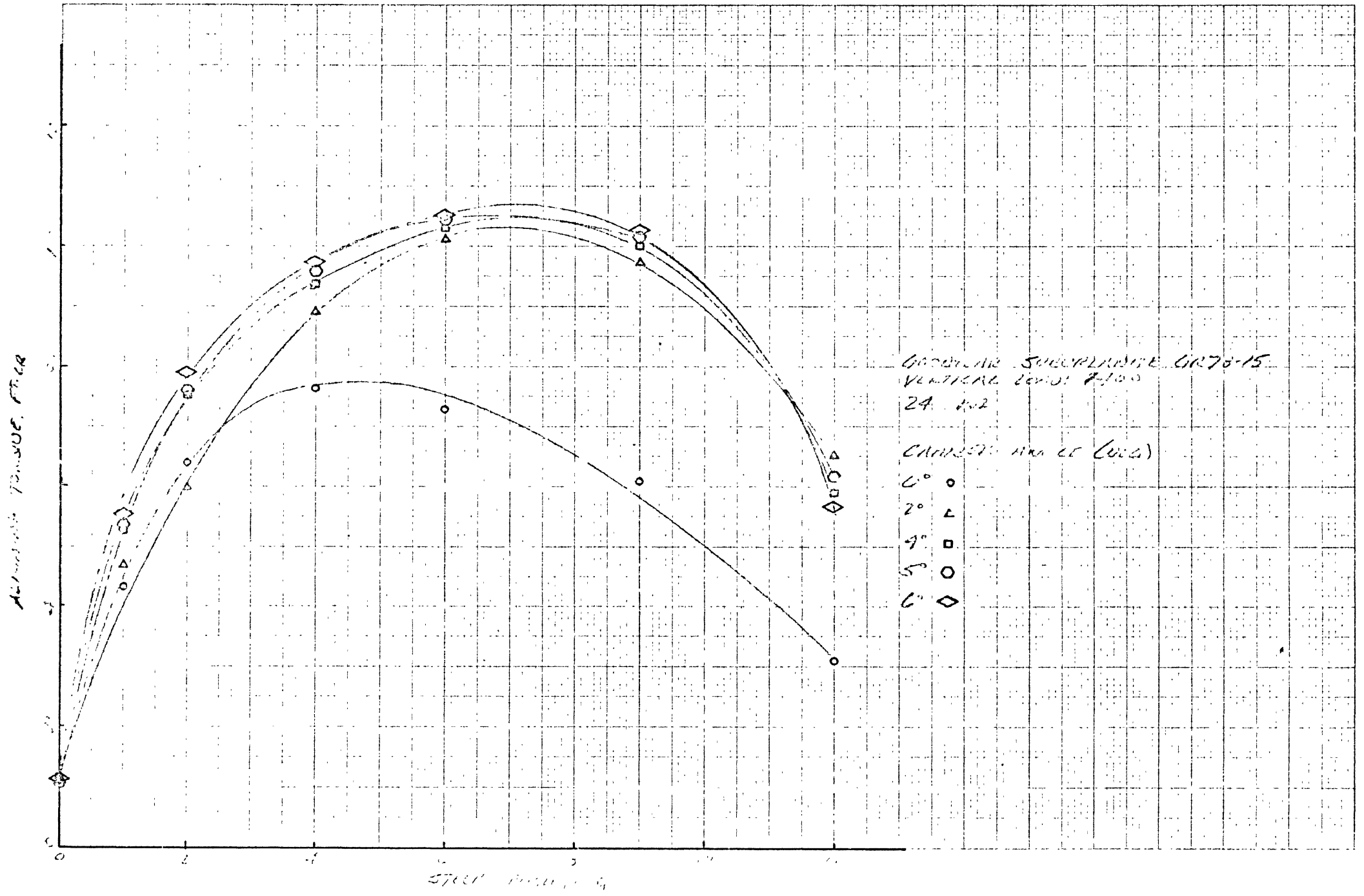


LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-15.1	[illegible]	[illegible]	[illegible]
800	[illegible]	[illegible]	[illegible]	[illegible]
1100	-26.5	[illegible]	[illegible]	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE:

RIM:

INFLATION:

STEER ANGLE:

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500				
800				
1100				
1400				

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

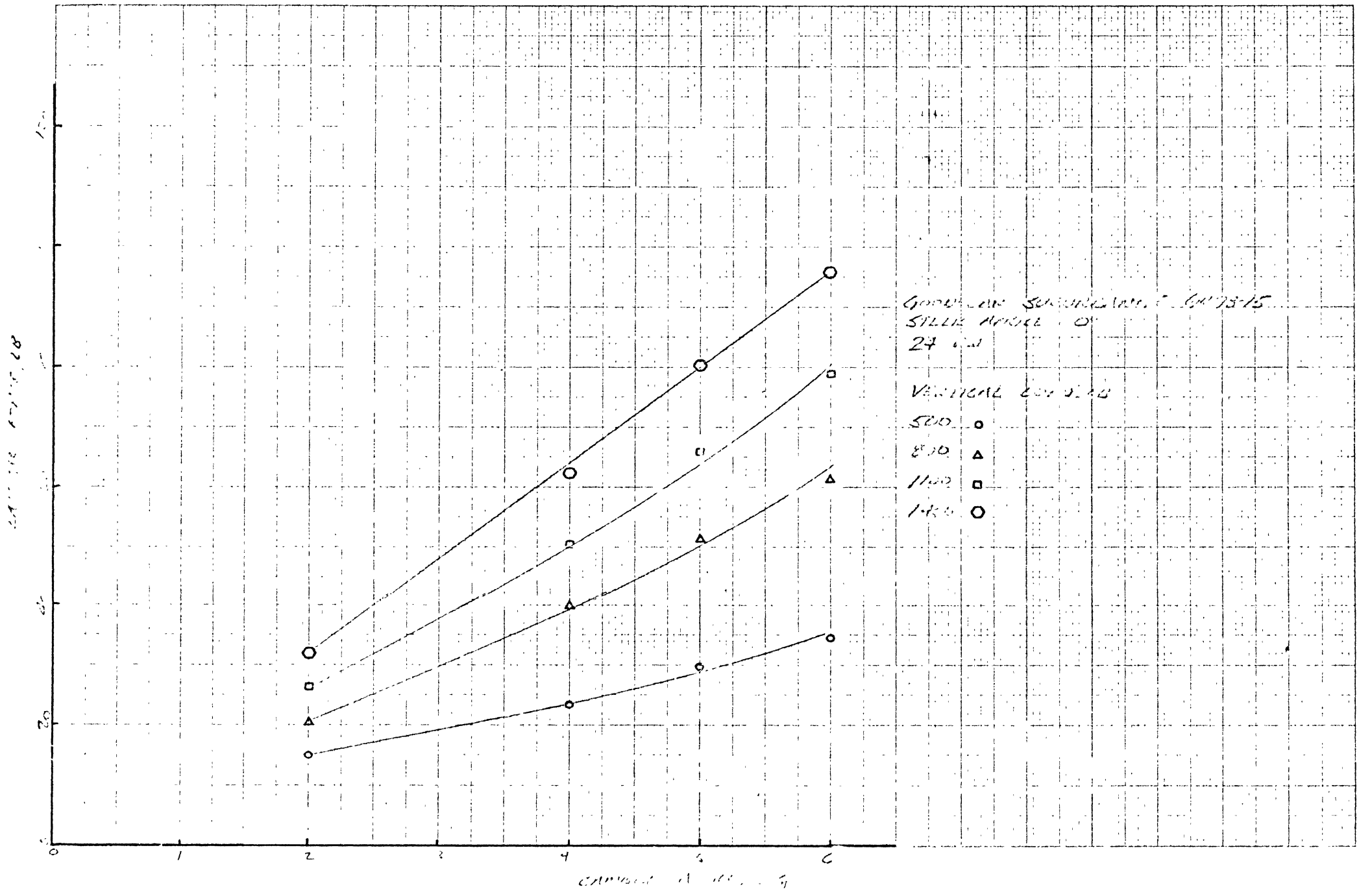
TIRE: [illegible] Suburban [illegible]

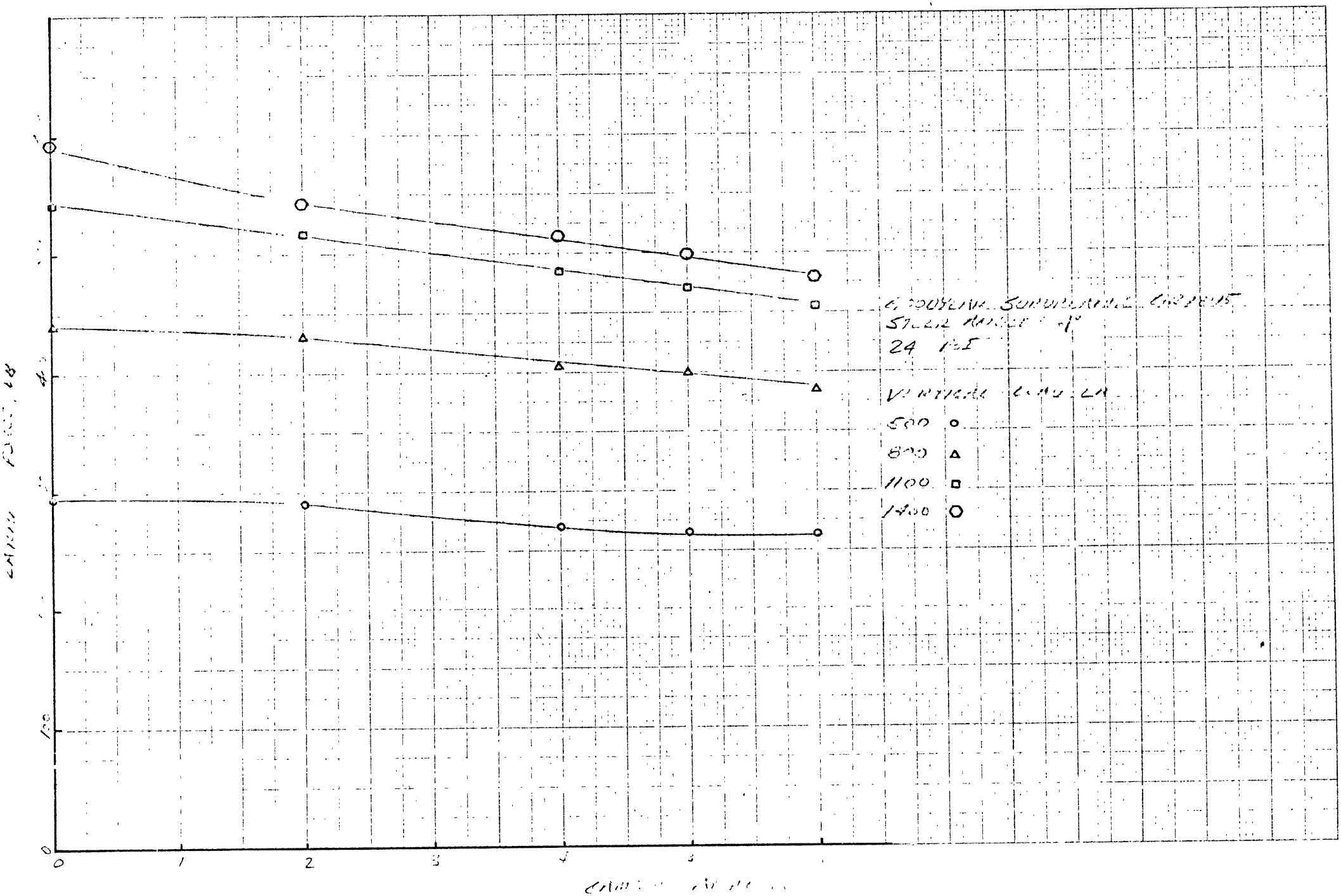
RIM: [illegible]

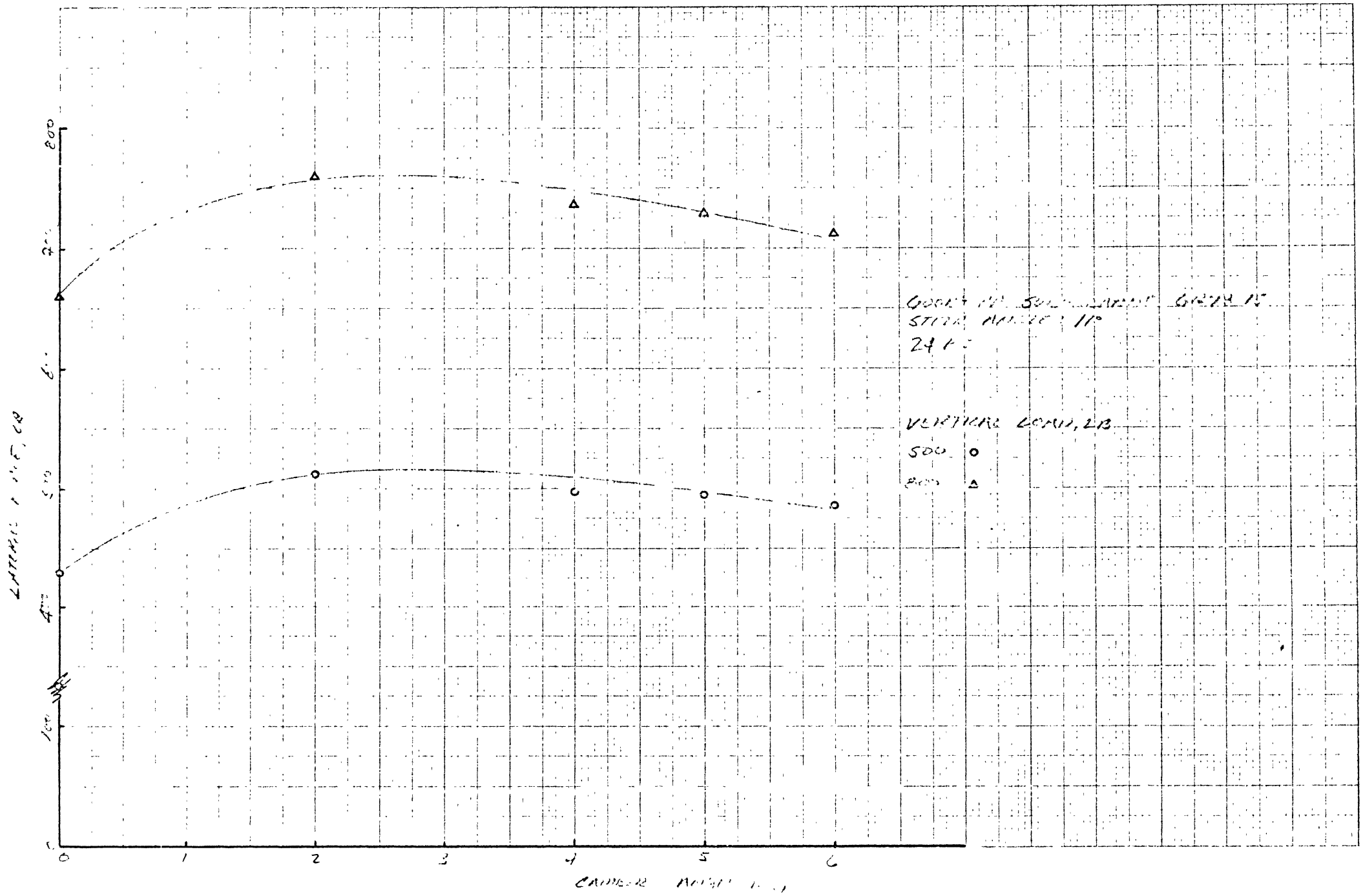
INFLATION: [illegible]

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	512.8	[illegible]	495.2	436.7
800	760.2	737.0	723.1	712.5
1100	-	-	-	-
1400	-	-	-	-







ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	2.0	[illegible]	[illegible]	[illegible]
800	[illegible]	[illegible]	[illegible]	[illegible]
1100	[illegible]	[illegible]	[illegible]	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: [illegible]

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	12.2	[illegible]	[illegible]	13.1
800	32.2	[illegible]	[illegible]	37.7
1100	[illegible]	[illegible]	[illegible]	65.4
1400	[illegible]	[illegible]	[illegible]	[illegible]

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

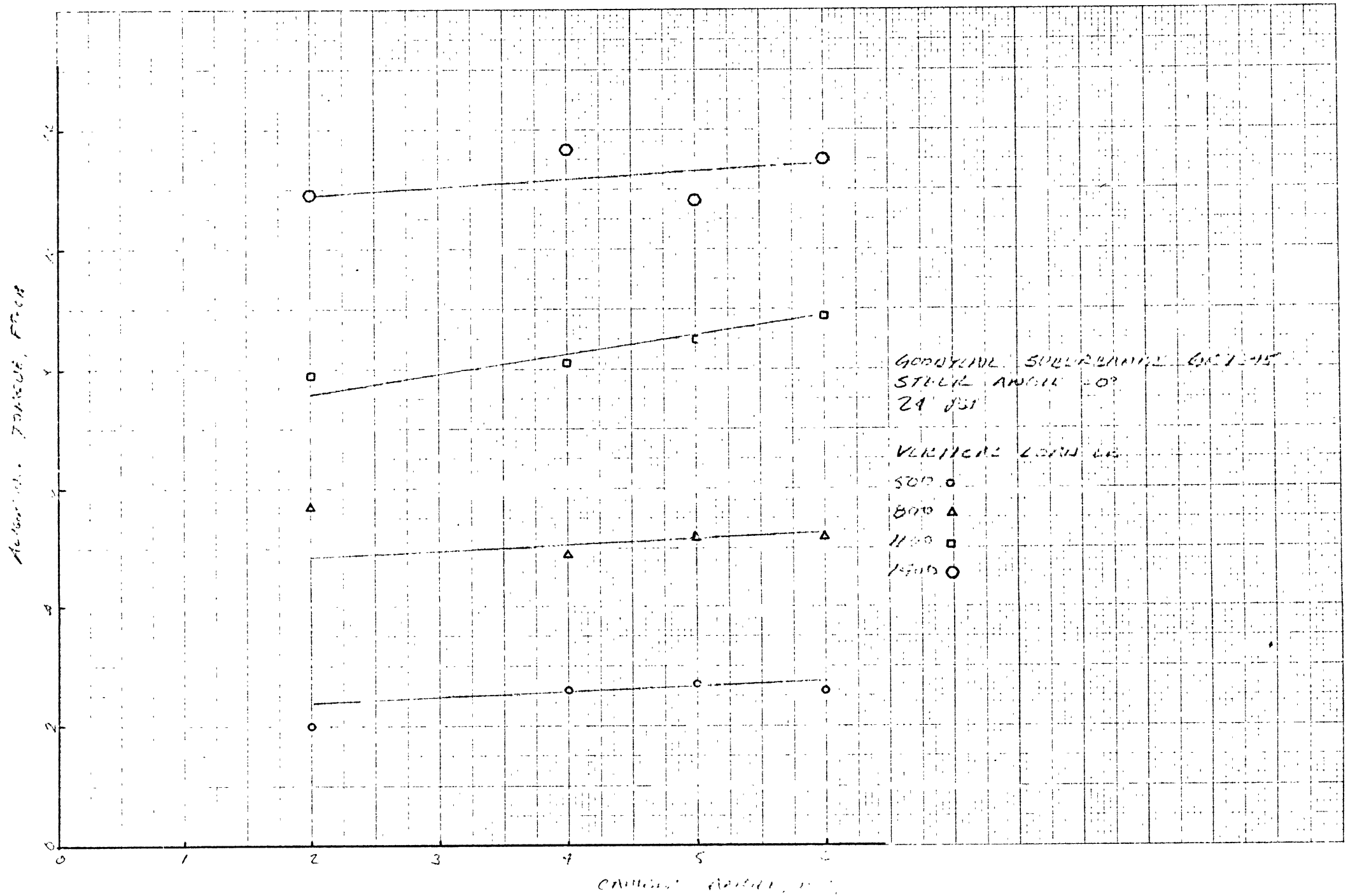
TIRE: Goodyear Suburbanite 6.00-15

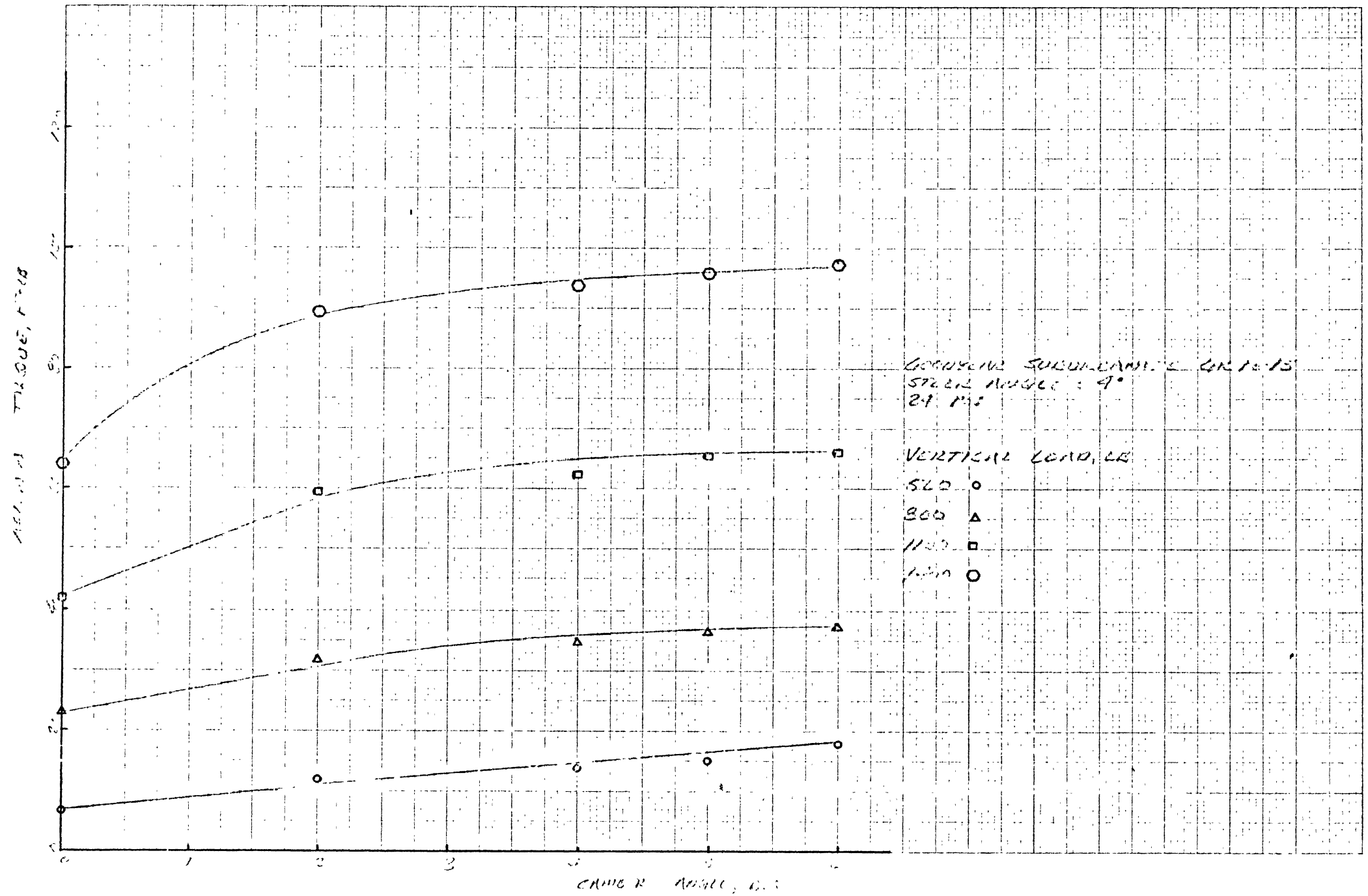
RIM: 15x6.00

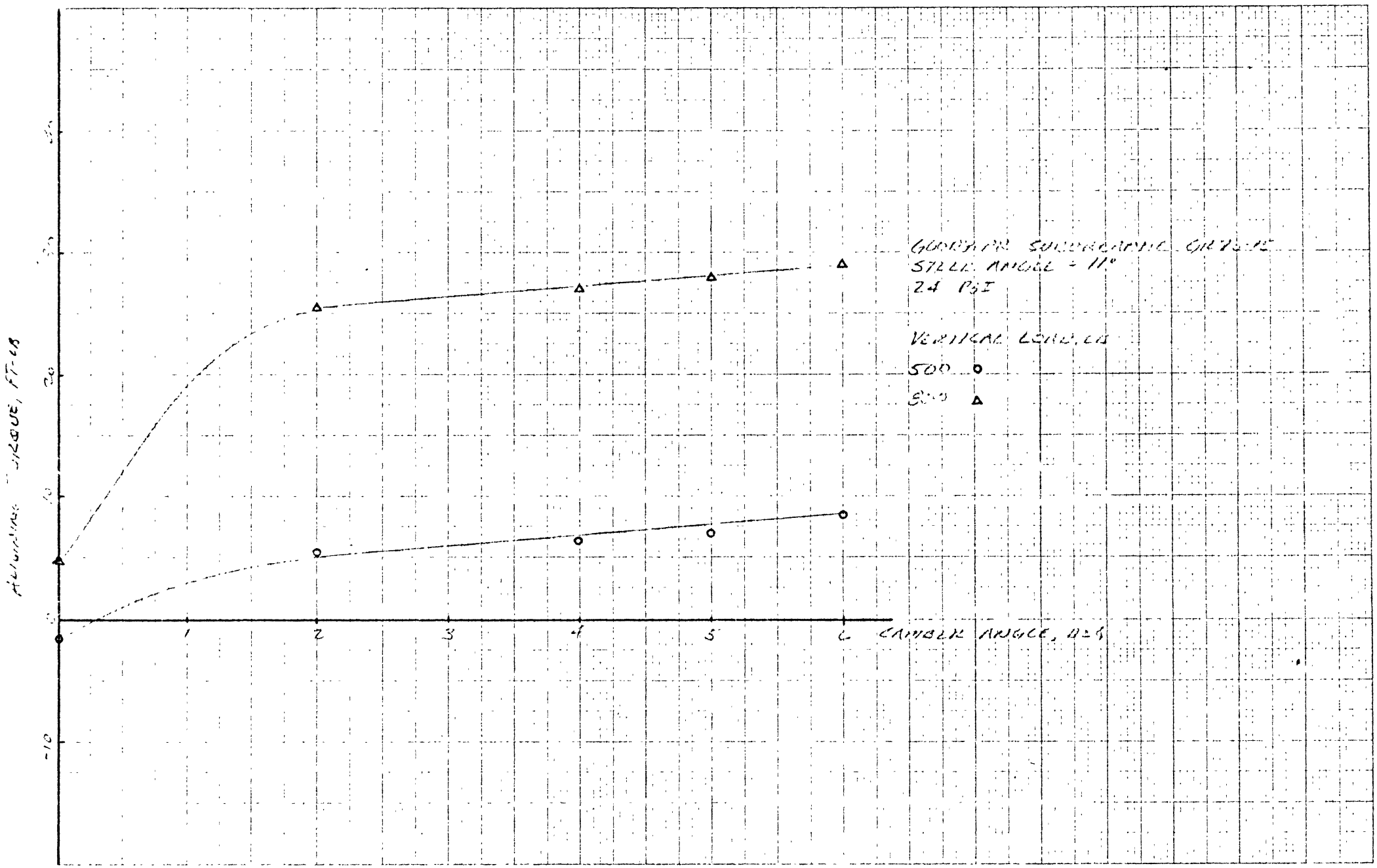
INFLATION: 24 psi

STEER ANGLE: 0°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	5.2	6.3	6.9	8.6
800	25.6	27.1	28.0	29.0
1100	-	-	-	-
1400	-	-	-	-







APPENDIX I.

Part C: Firestone Town & Country G78-15

INITIAL TIRE BIAS .

TIRE: FIRESTONE G 78-15

RIM: [illegible]

INFLATION: [illegible] PSI

STEER ANGLE= 0

CAMBER ANBLE= 0

VERTICAL LOAD	F_y	M_z
[illegible]	18.9	1.4
[illegible]	26.2	4.4
[illegible]	27.1	6.2
[illegible]	26.1	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible] 6.70×15

RIM: 15 × 4.50

INFLATION: 16 PSI

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	114.2	206.0	323.7	[illegible]	553.0	547.2	-
800	127.7	240.1	[illegible]	[illegible]	601.0	611.3	-
1100	125.3	239.3	[illegible]	588.5	723.0	-	806.6
1400	[illegible]	235.0	[illegible]	[illegible]	701.2	-	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	73.2	[illegible]	294.5	357.1	[illegible]	430.6	—
800	[illegible]	[illegible]	384.1	[illegible]	557.4	627.7	—
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	802.3
1400	[illegible]	[illegible]	514.5	[illegible]	737.9	—	884.2

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: [illegible]

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	[illegible]	[illegible]	[illegible]	330.3	[illegible]	[illegible]	—
800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	772.7
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE 6.73-15

RIM: 15 x 4.50

INFLATION: 12 PSI

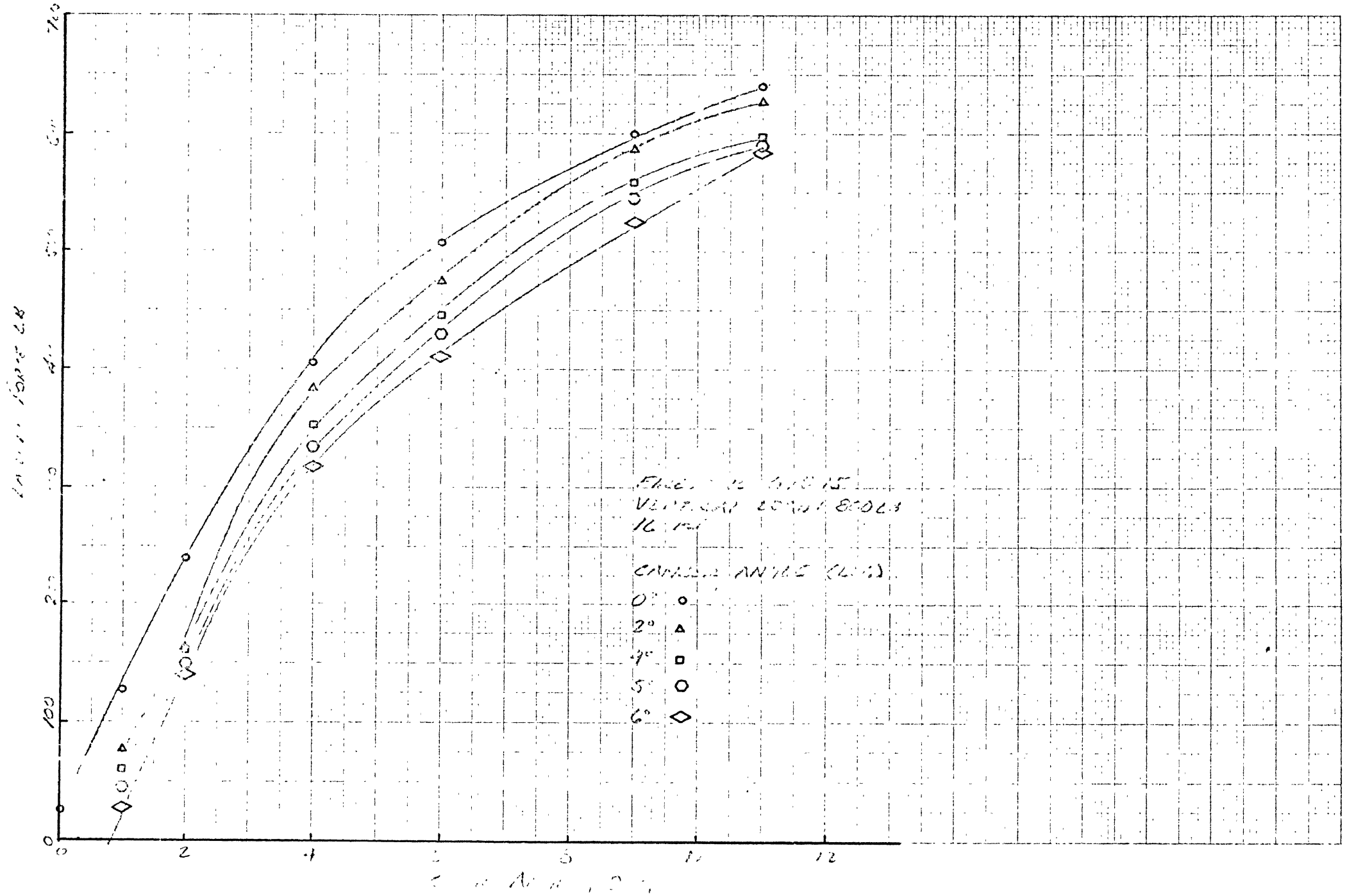
CAMBER ANGLE: 5°

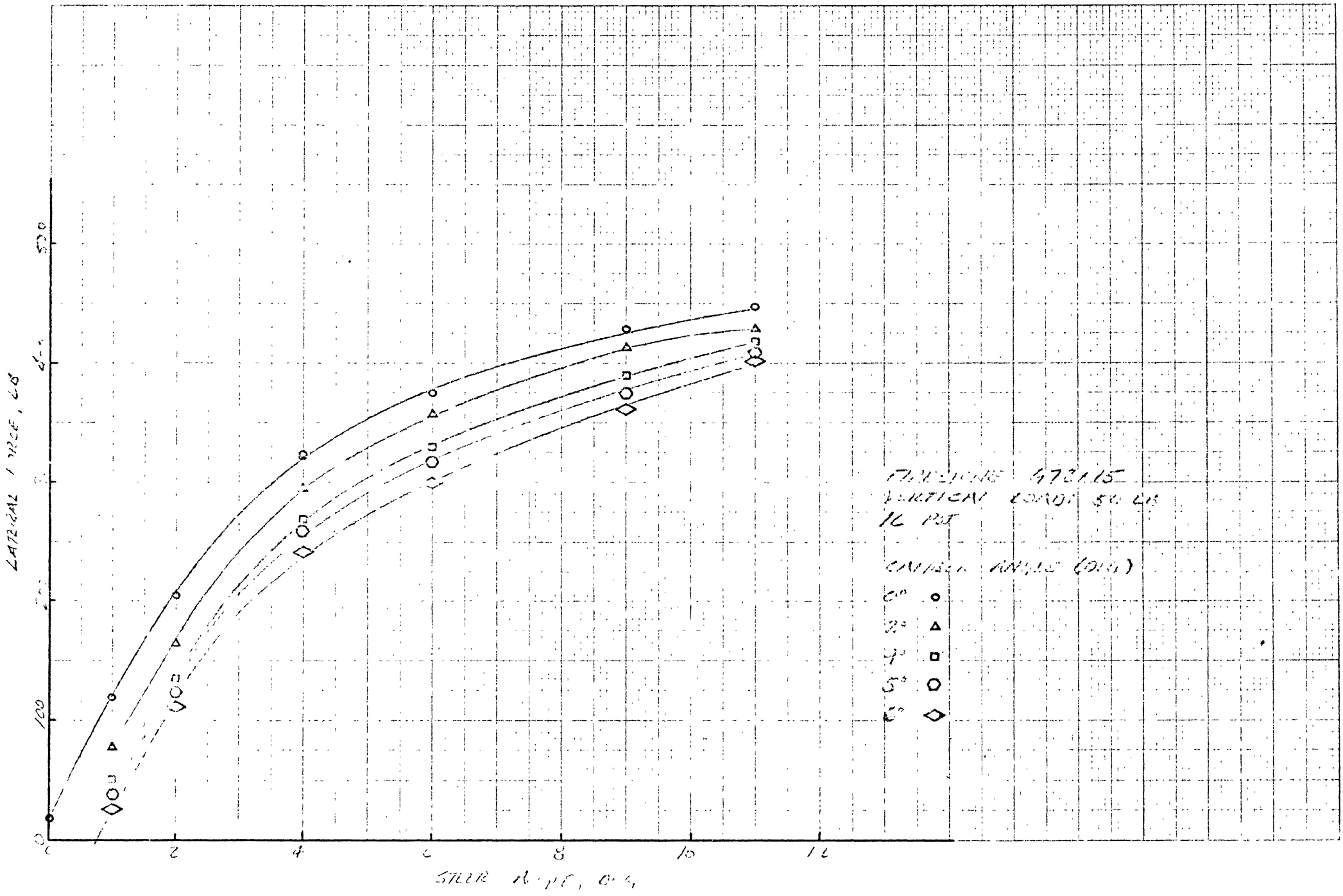
VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	37.4	123.2	259.[illegible]	318.5	375.7	[illegible]	—
800	41.4	[illegible]	[illegible]	431.7	544.2	578.0	—
1100	33.0	135.0	342.3	482.4	657.7	—	754.1
1400	16.2	105.[illegible]	[illegible]	467.[illegible]	683.0	—	832.6

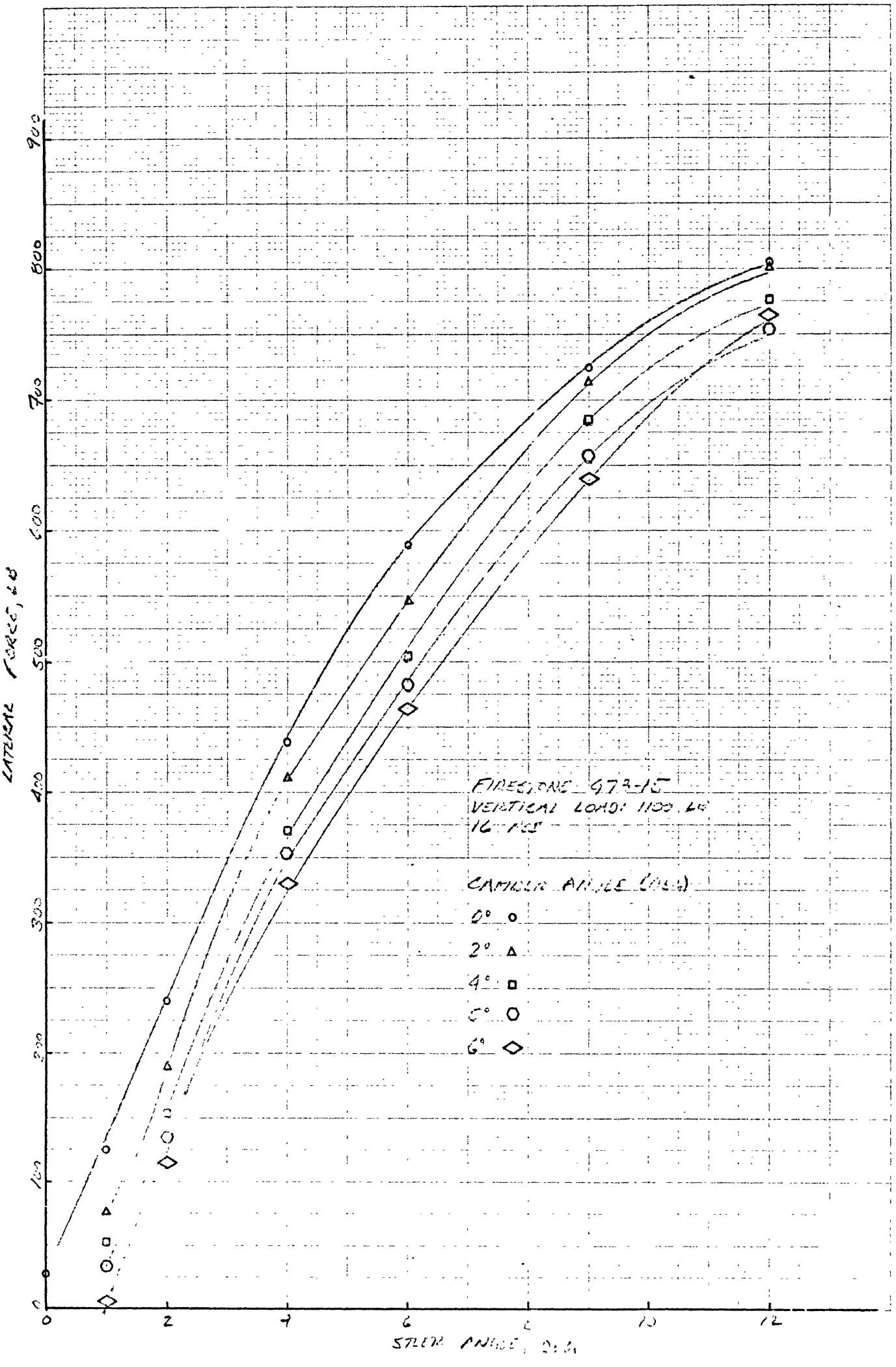
LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone [illegible]
RIM: 15 x 4.00
INFLATION: 16 PSI
CAMBER ANGLE: 6°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED STEER ANGLE (DEG)						
	1	2	4	6	9	11	12
500	26.4	112.2	241.2	298.2	362.5	402.3	–
800	27.2	148.5	317.1	411.4	324.7	[illegible]	–
1100	6.5	116.6	331.7	465.5	[illegible]	–	765.8
1400	-14.5	81.9	291.5	458.8	[illegible]	–	[illegible]







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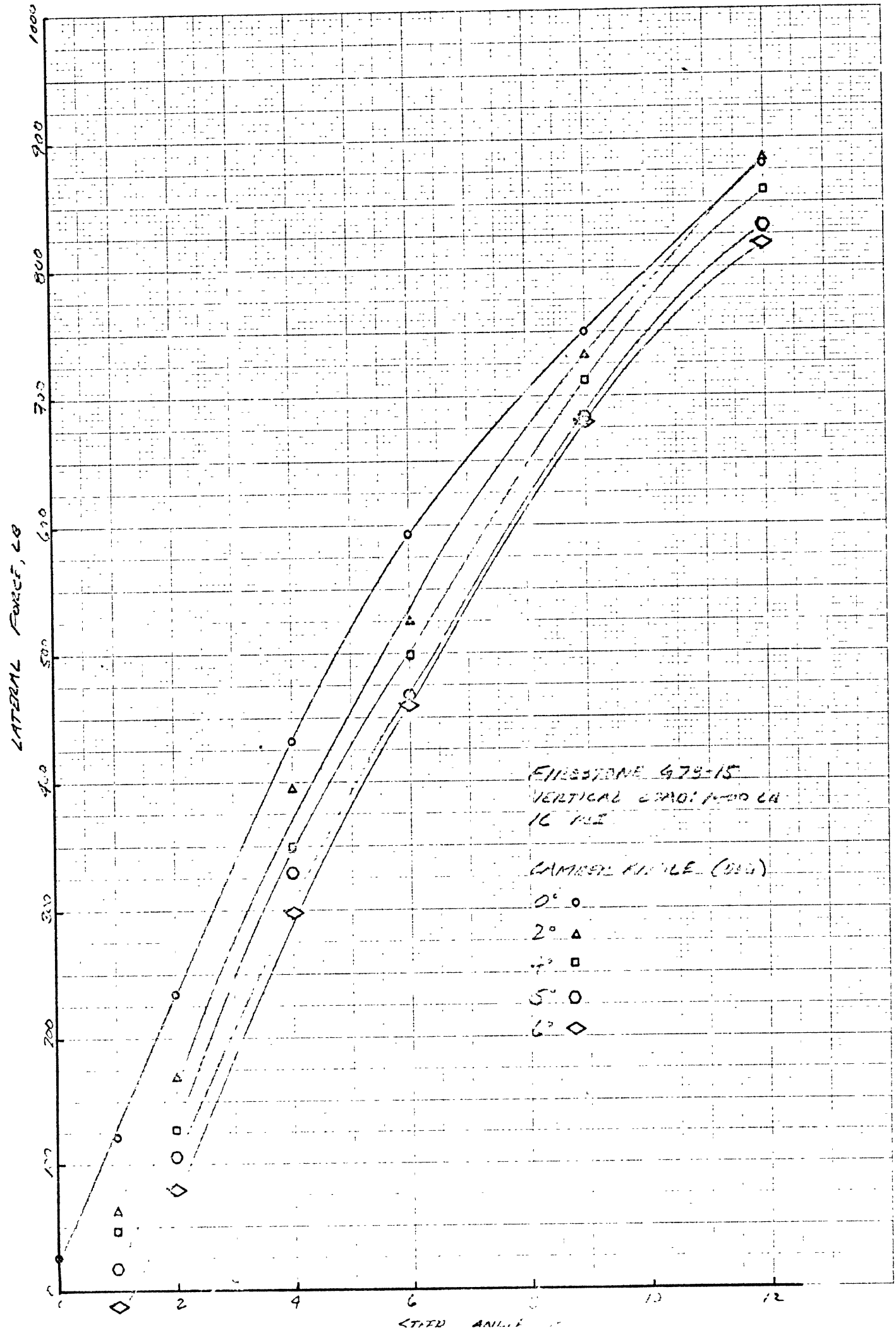


ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]
RIM: [illegible]
INFLATION: [illegible]
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500		9.2	[illegible]	2.6	-1.0	-2.9	
800	[illegible]	[illegible]	[illegible]	[illegible]	5.3	4.1	
1100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone 6.70-15

RIM: 15 x 5

INFLATION: [illegible]

CAMBER ANGLE: 3°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	3.9	[illegible]	[illegible]	7.5	[illegible]	2.1	—
800	14.7	[illegible]	[illegible]	[illegible]	[illegible]	3.5	—
1100	[illegible]	47.5	[illegible]	58.[illegible]	43.5	—	24.5
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE G 78-15

RIM: 15 × 4.5

INFLATION: 16 PSI

CAMBER ANGLE: 1°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	14.4	16.4	15.3	11.0	5.7	3.6	-
800	20.5	32.9	40.6	32.3	22.3	16.6	-
1100	31.4	57.4	73.9	65.2	49.5	-	32.1
1400	47.9	77.2	107.7	104.1	93.7	-	63.8

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE G 78-15

RIM: 5½ 4

INFLATION: 16 PSI

CAMBER ANGLE: 5°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	1.1	17.9	18.6	13.3	5.6	—	-
800	16.4	38.8	42.4	23.1	23.2	20.1	-
1100	21.2	61.9	76.8	71.0	51.8	-	34.9
1400	28.4	81.8	113.4	112.9	92.0	-	69.6

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

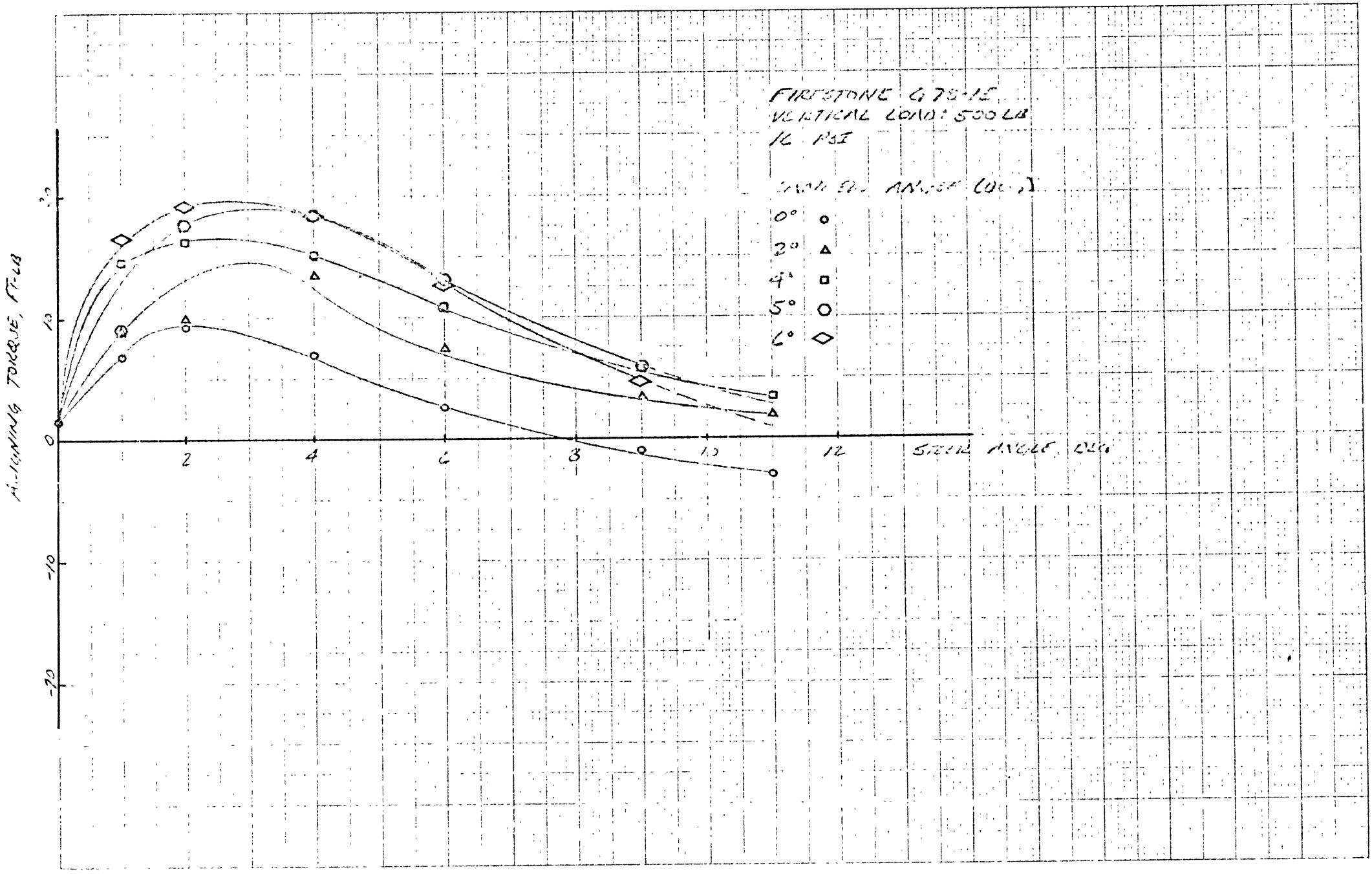
TIRE: FIRESTONE G 78-15

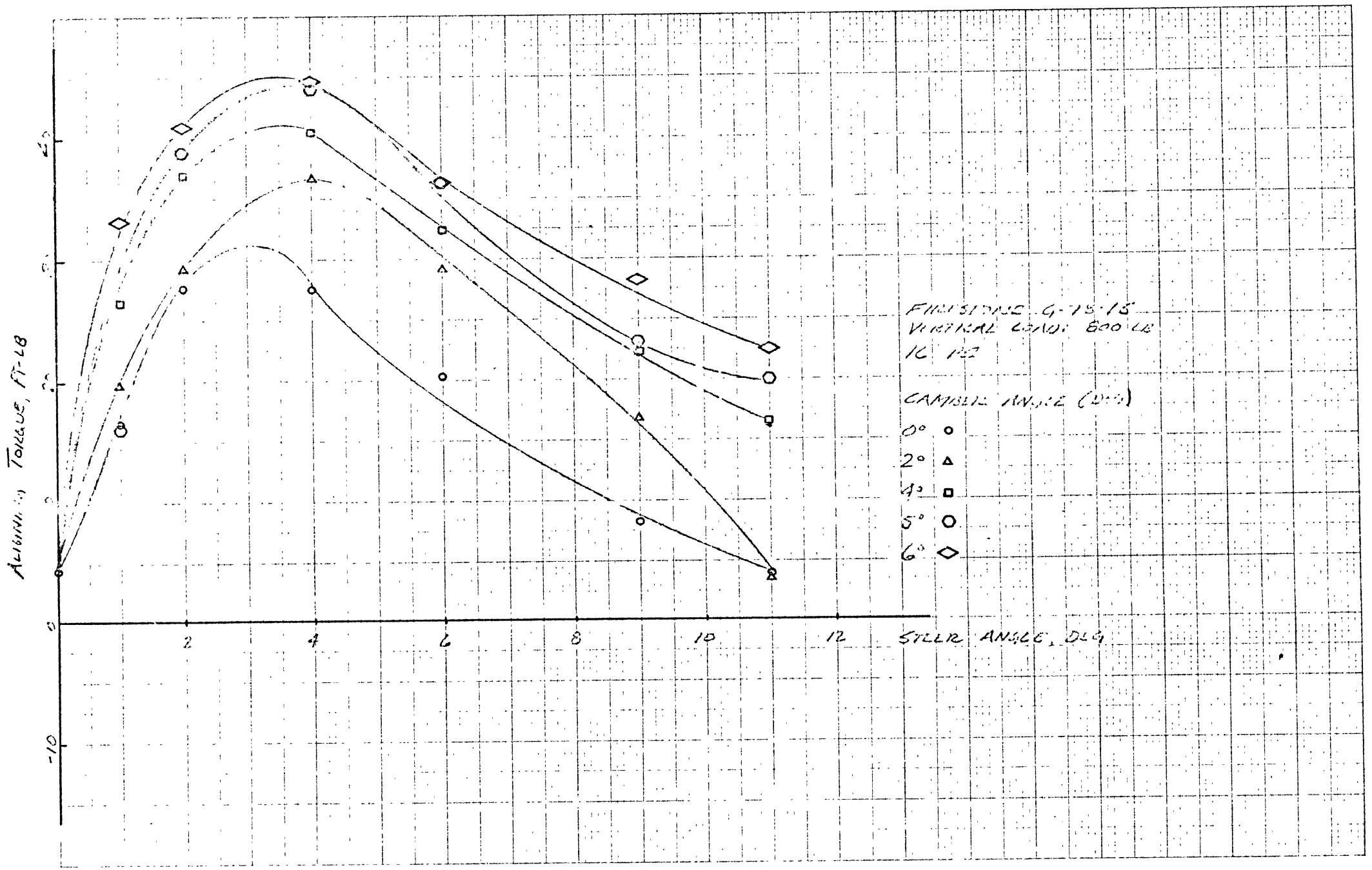
RIM: 15 x 7

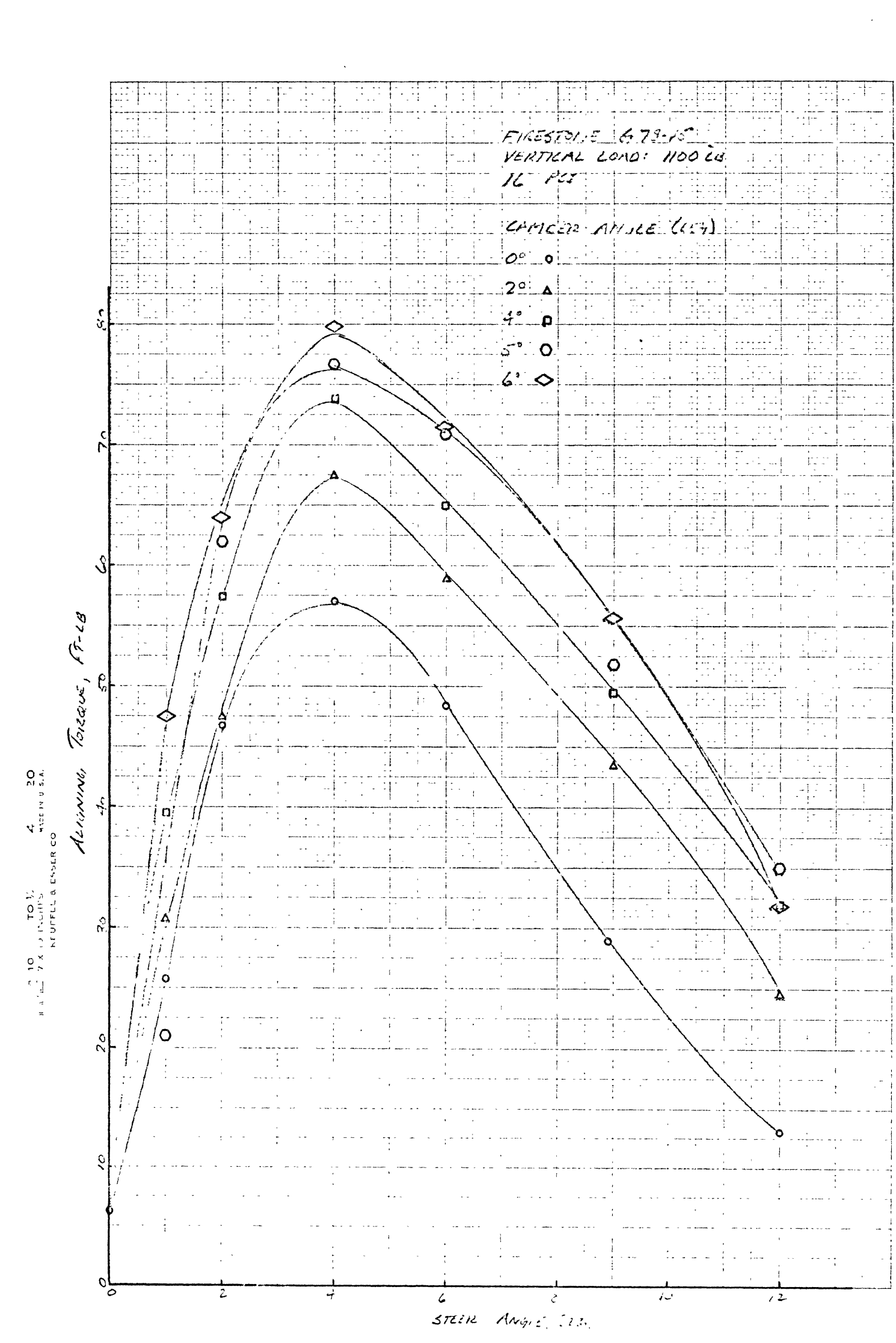
INFLATION: 26 PSI

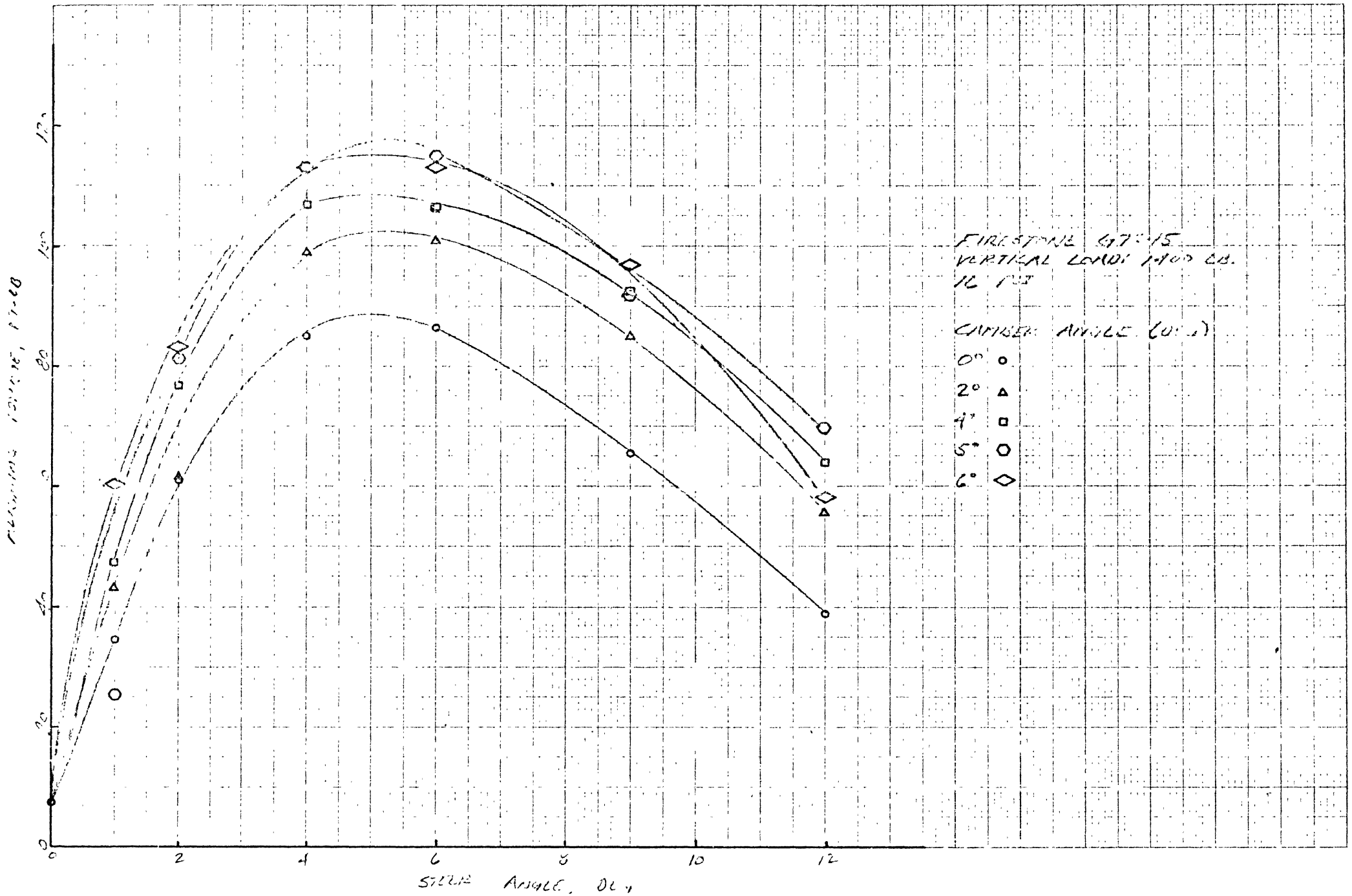
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	11.6	12.3	18.6	12.7	4.7	—	
800	33.2	40.9	41.7	36.4	27.7	22.4	—
1100	57.3	63.4	79.8	71.6	55.9	-	32.0
1400	60.2	83.5	113.4	113.1	92.1	—	57.9






FIRESTONE 670-15
VERTICAL LOAD: 1100 LB
16 PSI
CAMBER ANGLE (LFT)
0°
2°
4°
5°
6°
ALIGNING TORQUE, FT-LB
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12
STEER ANGLE (DEG)



LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone 6.70-15

RIM: 15 x 4

INFLATION: 26 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-37.2	-51.0	-60.3	-73.6
800	-31.0	-62.8	-80.7	-93.4
1100	-36.9	-71.8	-91.2	-104.5
1400	-30.2	-82.4	-107.2	-121.7

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone G 78-15

RIM: 15 x 7

INFLATION: 24 psi

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	294.5	[illegible]	[illegible]	241.2
800	364.5	[illegible]	[illegible]	312.1
1100	418.4	[illegible]	[illegible]	337.7
1400	[illegible]	[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

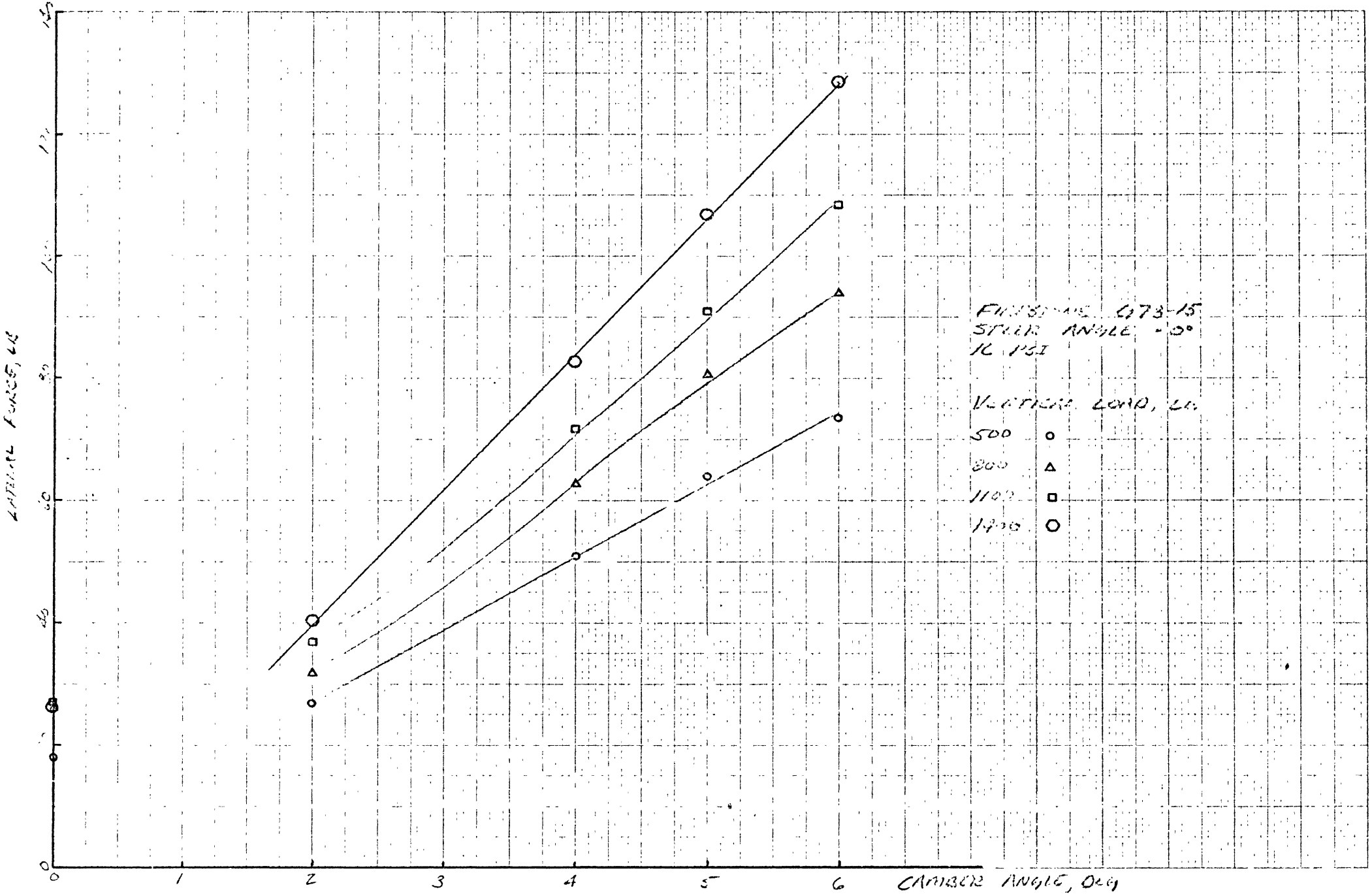
TIRE: Firestone G 7.50-15

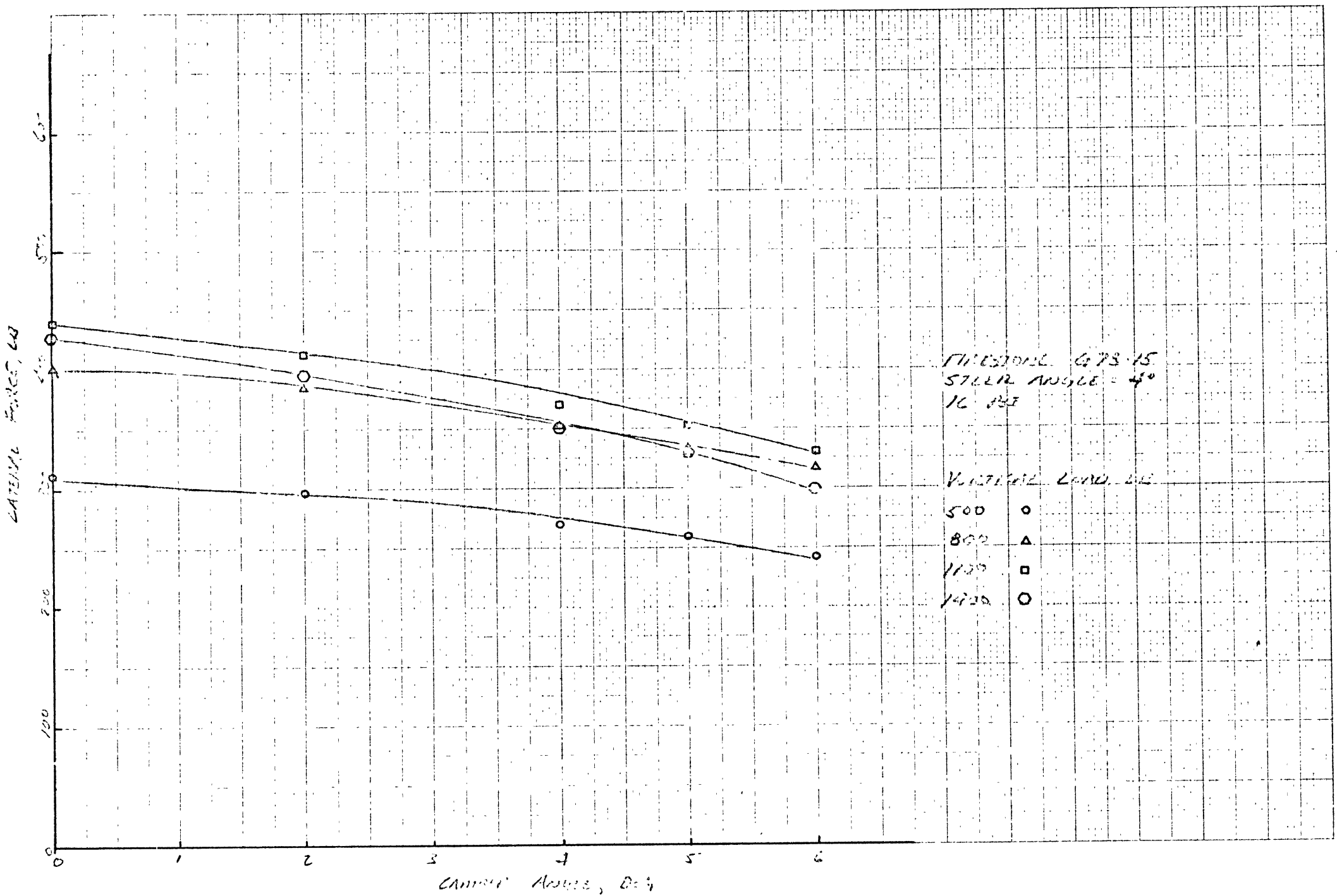
RIM: 15 x 5.50

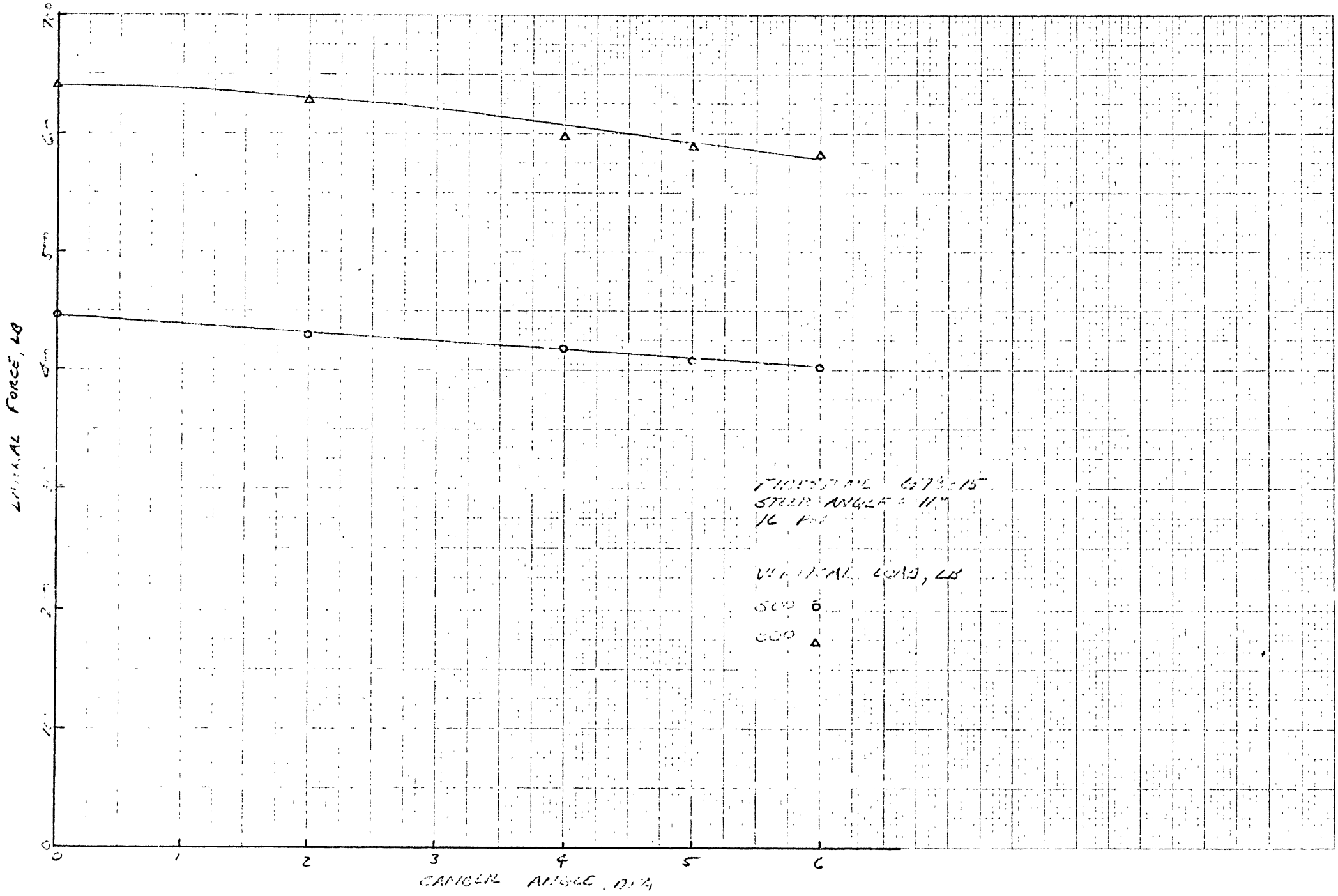
INFLATION: 16 PSI

STEER ANGLE: 11°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	430.6	418.1	409.0	402.3
800	627.7	597.6	587.0	582.5
1100	-	-	-	-
1400	-	-	-	-







ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: 0°

VERTICAL LOAD (Lb)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
[illegible]	0.7	1.7	-0.6	1.3
800	2.4	2.9	2.1	[illegible]
1100	3.7	4.5	4.3	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone G 78-15

RIM: 5 x 4.5

INFLATION: 16 psi

STEER ANGLE: 1°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	12.5	15.3	15.6	18.6
800	35.2	40.6	43.9	47.7
1100	62.5	73.0	76.8	74.8
1400	92.2	107.7	113.4	112.9

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone G 78-15

RIM: 15 x 7.00

INFLATION: 16 PSI

STEER ANGLE: 11°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	2.1	3.6	6.3	7.7
800	3.5	16.6	20.1	22.4
1100	-	-	-	-
1400	-	-	-	-

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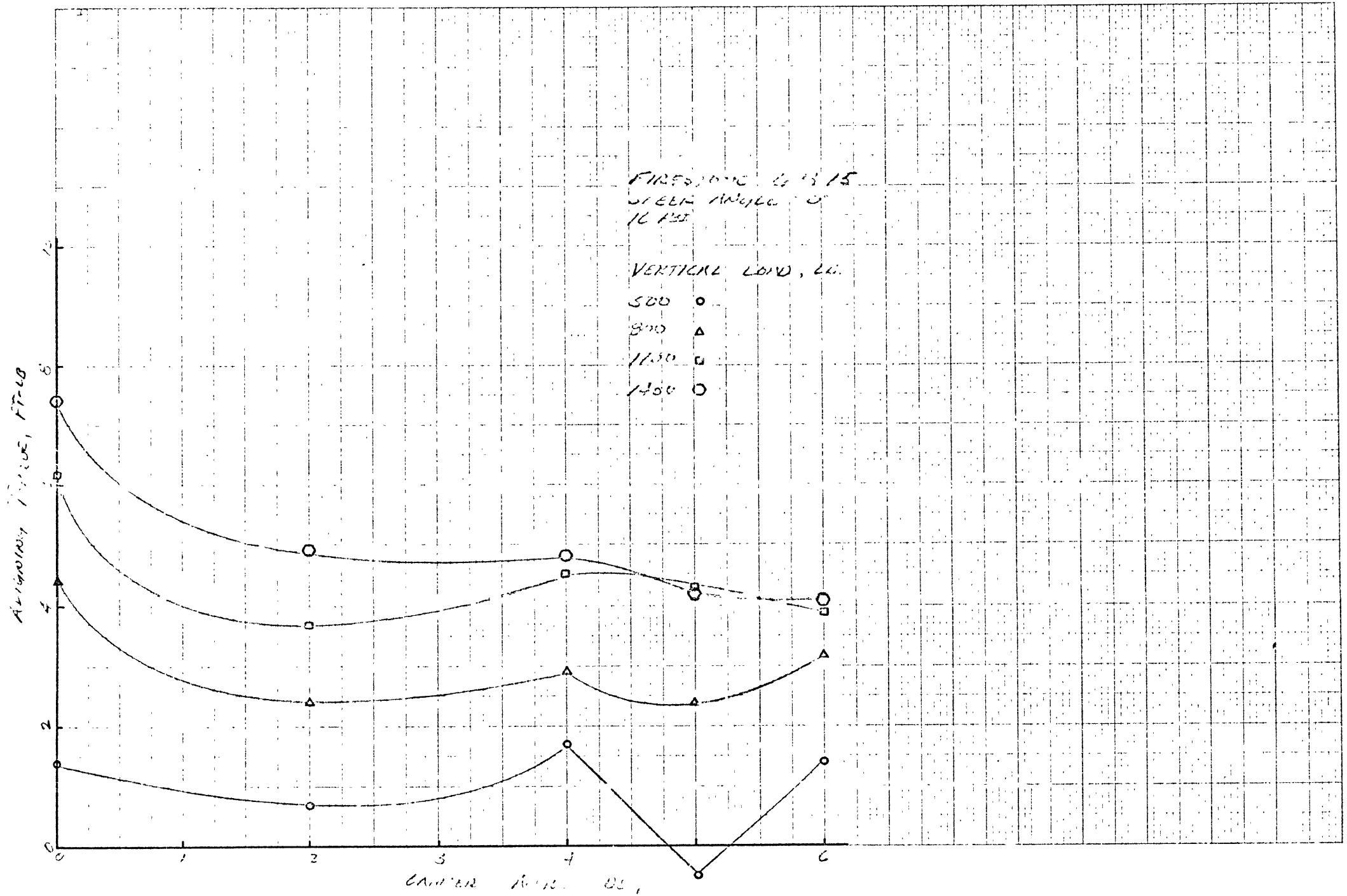
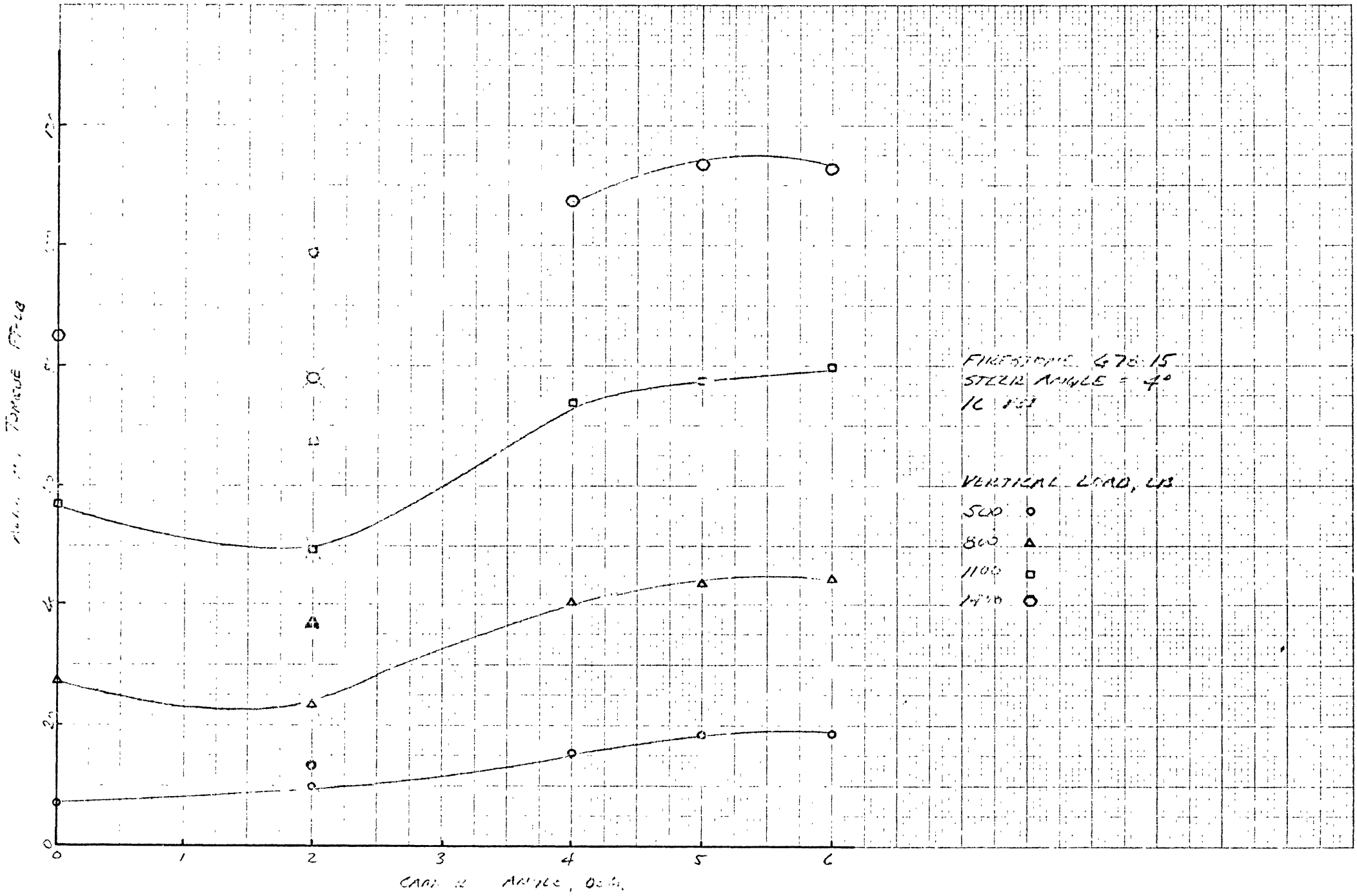
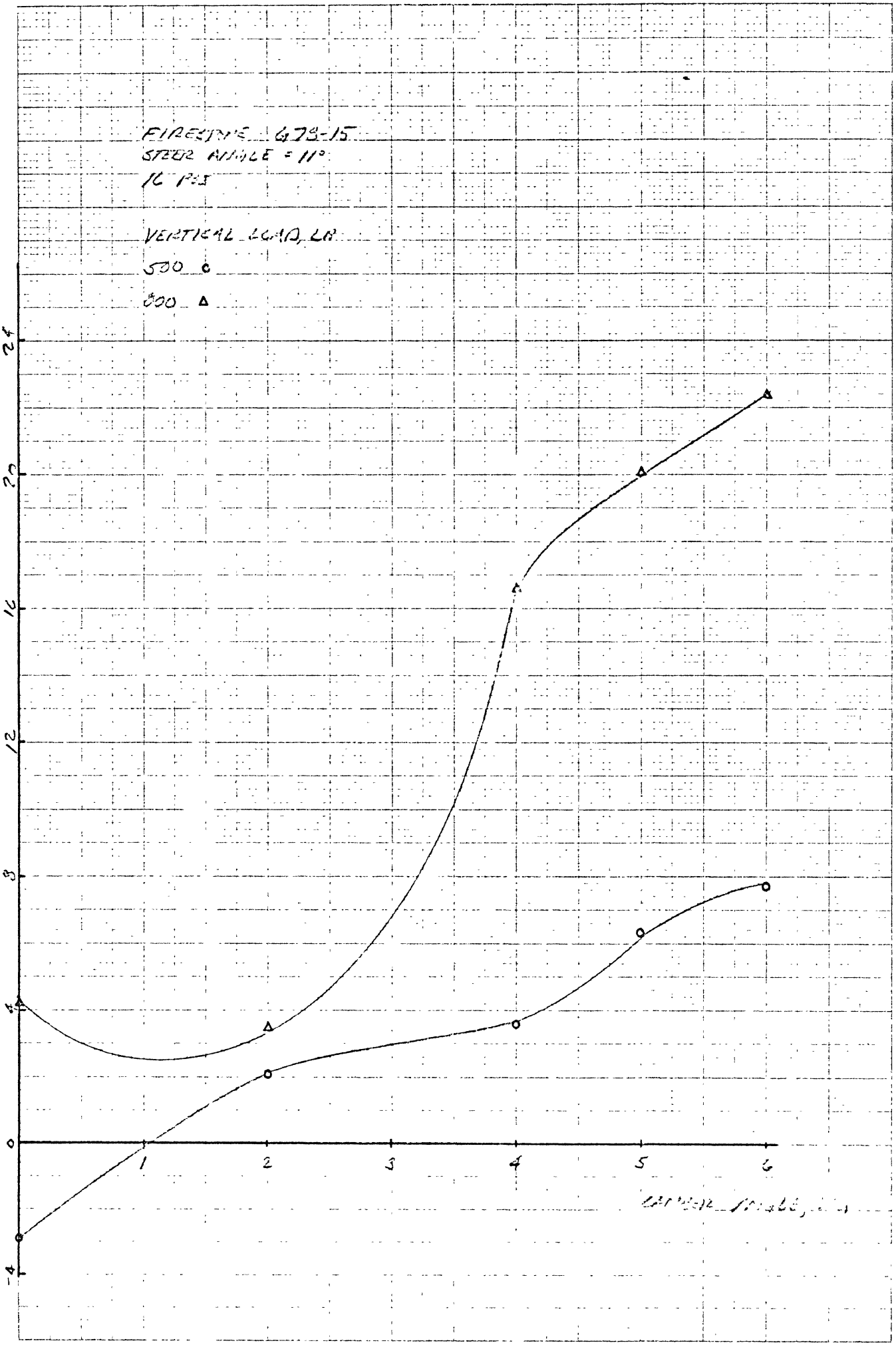





FIRESTONE 678-15
STEER ANGLE = 11°
16 PSI
VERTICAL LOAD, LB
500 ○
800 △
ALIGNING TORQUE, FT-LB
24
20
16
12
8
4
0
-4
1
2
3
4
5
6

INITIAL TIRE BIAS

TIRE: FIRESTONE G78-15

RIM: 15 x 7.00

INFLATION: 24 PSI

STEER ANGLE= 0

CAMBER ANBLE= 0

VERICAL LOAD	F_y	M_z
500	17.4	.9
800	25.1	2.1
1100	32.3	3.7
1400	32.6	5.2

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: 24 PSI

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	122.4	209.7	330.?	373.4	[illegible]	[illegible]	—
800	159.1	286.0	[illegible]	549.2	636.3	665.4	—
1100	166.7	310.2	532.0	663.2	790.3	—	867.4
1400	162.6	[illegible]	[illegible]	735.1	902.5	—	1015.9

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE G 78-15

RIM: 15 × 7.00

INFLATION: 24 PSI

CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	81.9	[illegible]	[illegible]	364.6	—	444.8	—
800	[illegible]	[illegible]	[illegible]	573.9	—	654.8	—
1100	[illegible]	[illegible]	503.6	631.9	794.0	—	855.5
1400	[illegible]	[illegible]	[illegible]	731.5	913.5	-	1030.5

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone G78-15

RIM: 15 x 5.50

INFLATION: 24 PSI

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	50.8	112.6	267.7	332.3	475.0	584.6	-
800	56.5	195.8	[illegible]	489	[illegible]	677.0	-
1100	51.6	218.3	458.2	595.0	[illegible]	-	830.8
1400	34.6	208.0	[illegible]	654.4	867.7	-	784.2

LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

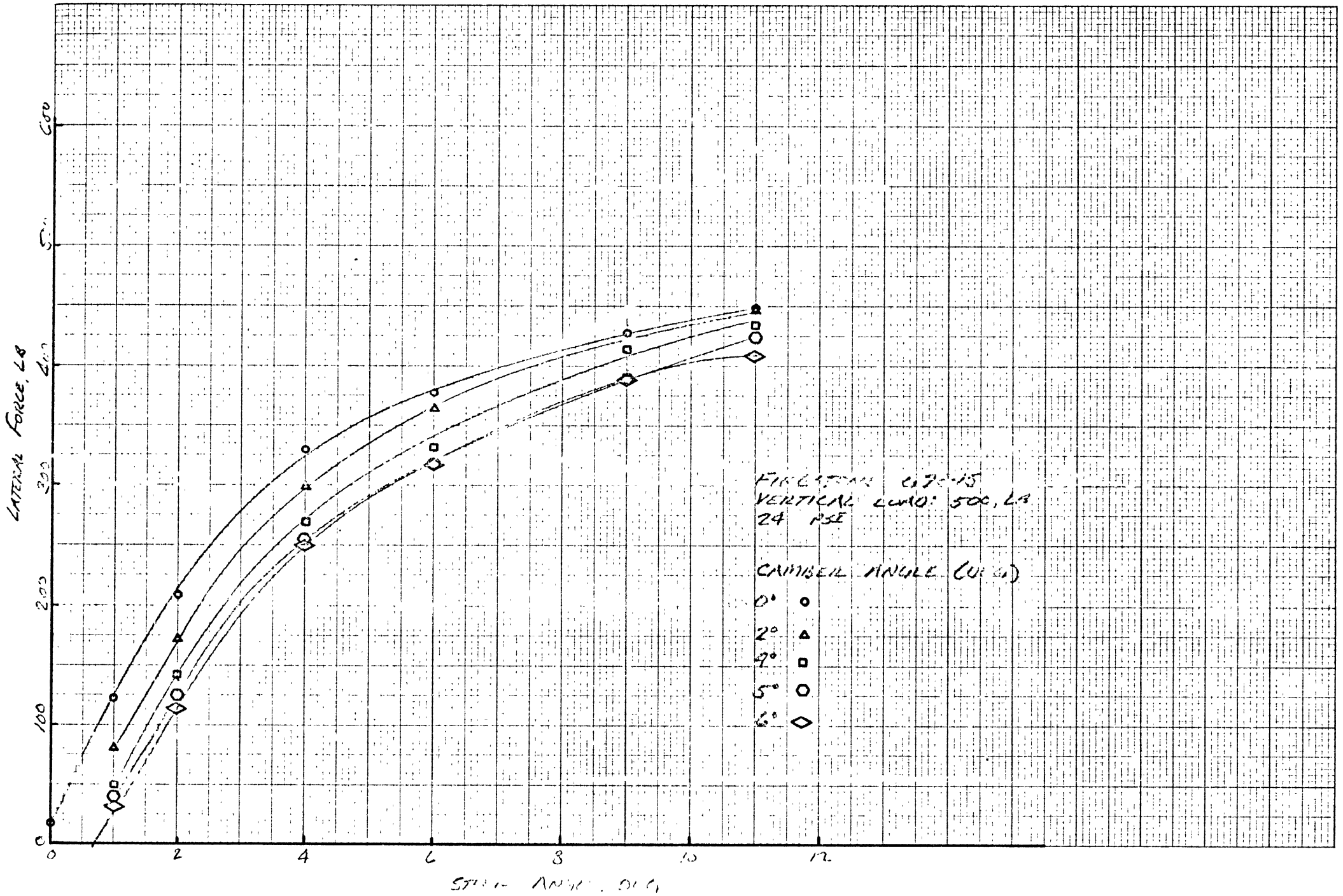
TIRE: FIRESTONE G78-15
RIM: 15 x 4.00
INFLATION: 24 PSI
CAMBER ANGLE: 5°

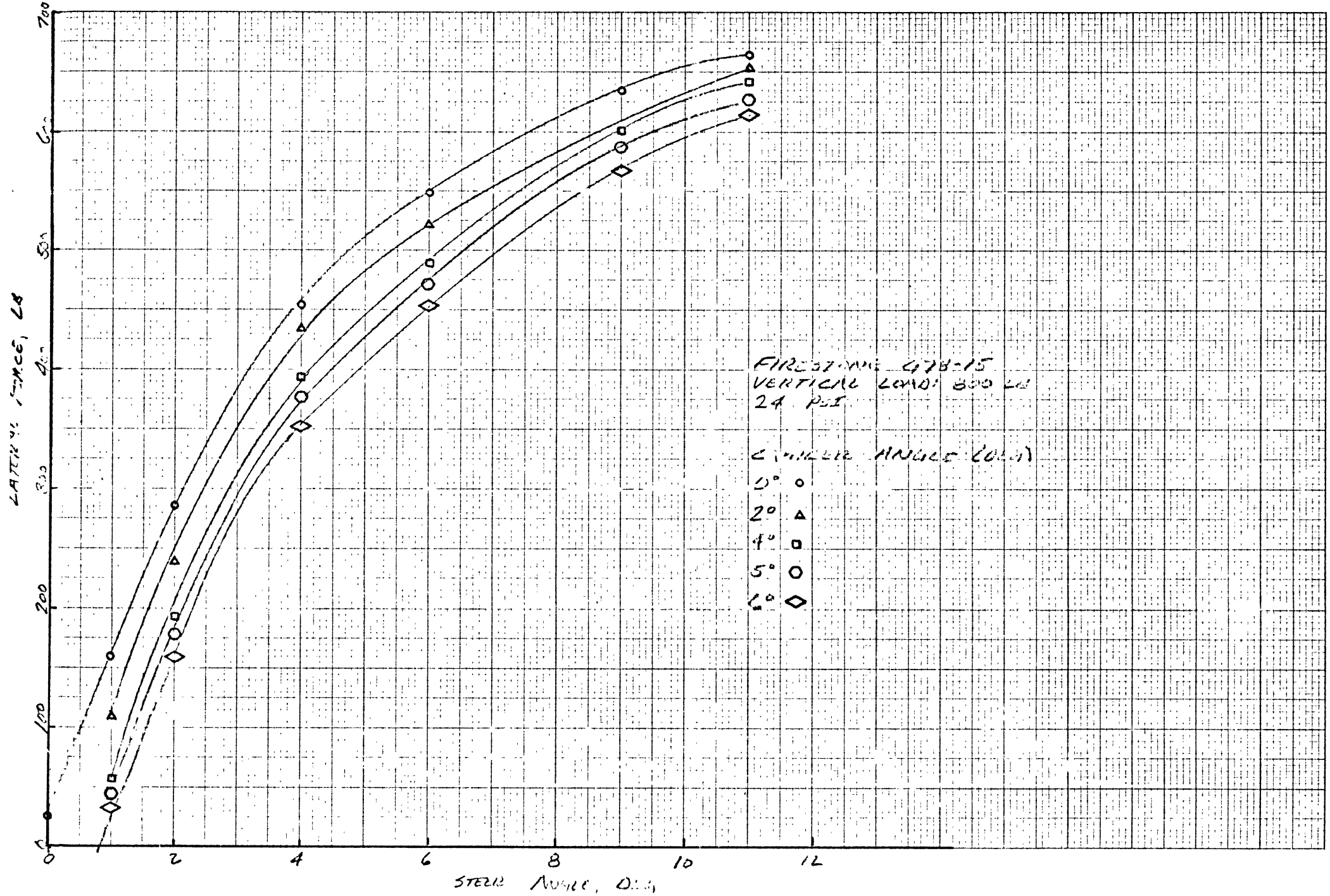
VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	41.0	[illegible]	256.4	318.2	389.5	425.9	—
800	45.4	177.7	378.3	472.6	587.3	628.2	—
1100	43.6	200.1	470.1	576.7	728.0	—	811.1
1400	25.5	[illegible]	955.2	631.5	836.9	—	965.1

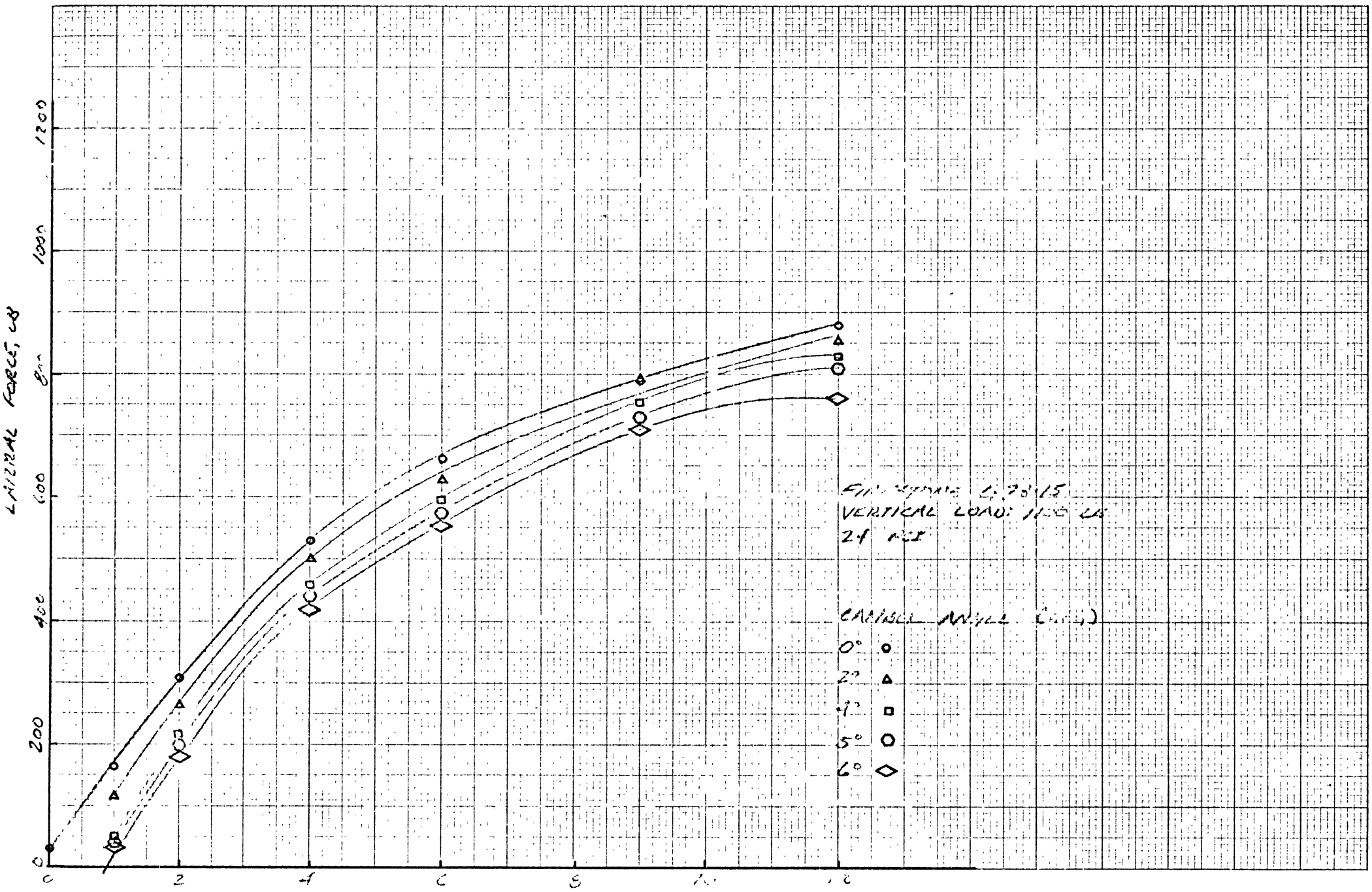
LATERAL FORCE VS. STEER ANGLE AND VERTICAL LOAD

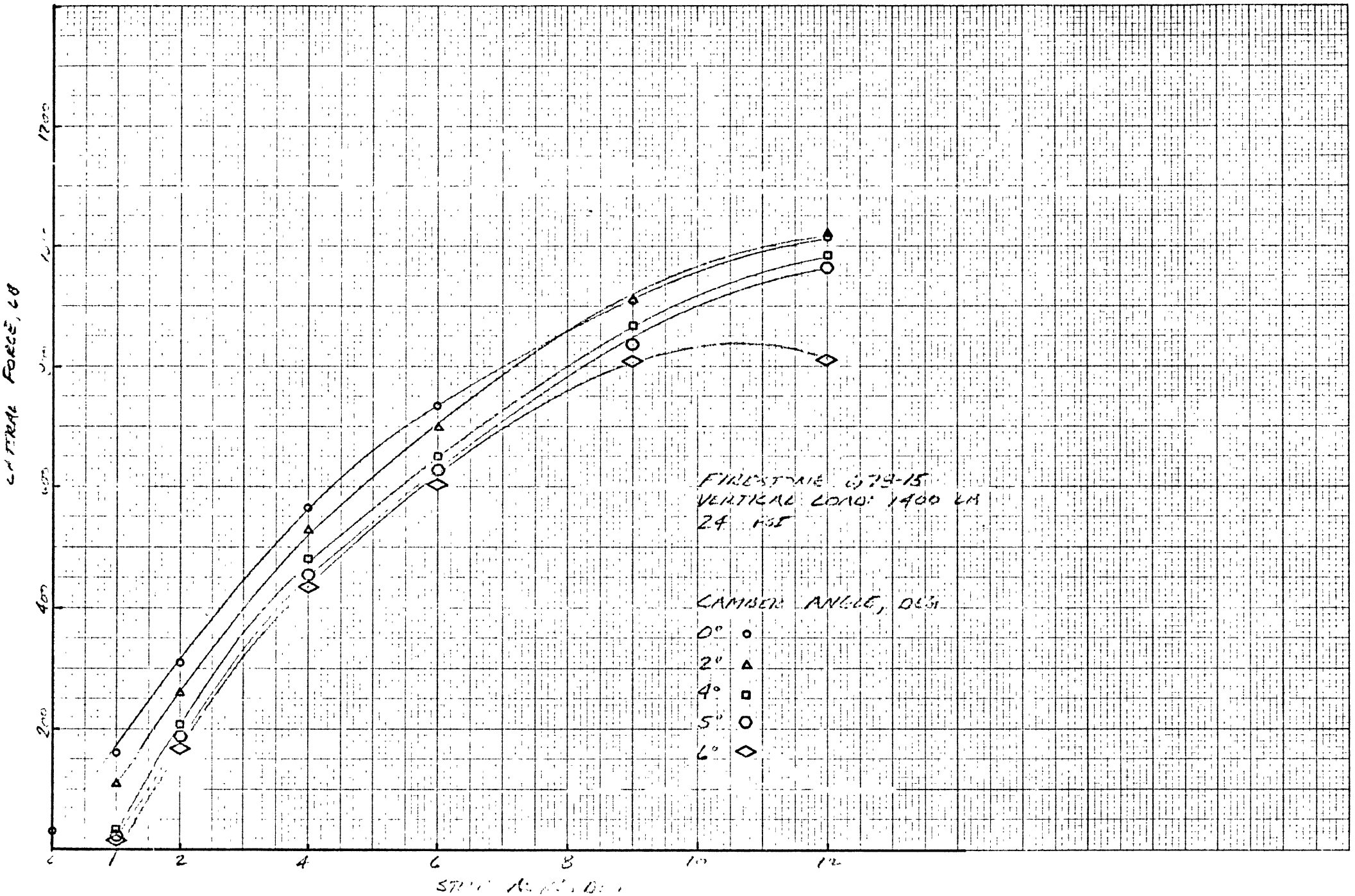
TIRE: Firestone G 78-15
RIM: 15 x 9.50
INFLATION: 24 PSI
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	LATERAL FORCE(LB) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	32.9	111.2	243.1	317.7	385.0	409.9	-
800	35.2	160.4	351.3	455.0	567.1	615.3	-
1100	36.4	178.3	419.8	554.5	711.2	-	762.0
1400	18.8	168.7	436.4	605.2	812.2	-	813.0









ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: 24 PSI

CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	5.5	7.3	[illegible]	[illegible]	-1.9	-3.1	-
800	12.6	23.5	[illegible]	[illegible]	[illegible]	+0.6	-
1100	23.1	27.8	[illegible]	[illegible]	16.1	-	3.1
1400	[illegible]	34.7	[illegible]	[illegible]	36.6	-	19.7

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

CAMBER ANGLE: 2°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	10.5	6.2	6.9	5.4	3.2	3.1	—
800	20.2	23.7	28.1	17.2	12.3	6.2	—
1100	30.3	38.3	51.3	38.4	29.2	—	15.5
1400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	34.5

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE 6.70-15

RIM: 5½ - 4.50

INFLATION: 24 PSI

CAMBER ANGLE: 4°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	12.9	13.5	14.1	7.6	4.3	4.5	-
800	27.3	29.7	31.7	22.1	15.3	13.1	-
1100	39.5	47.3	56.2	47.7	35.1	-	22.5
1400	46.1	66.4	87.1	79.1	61.9	-	45.3

ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

TIRE: Firestone 6.70-15

RIM: 4.5-4

INFLATION: 24 PSI

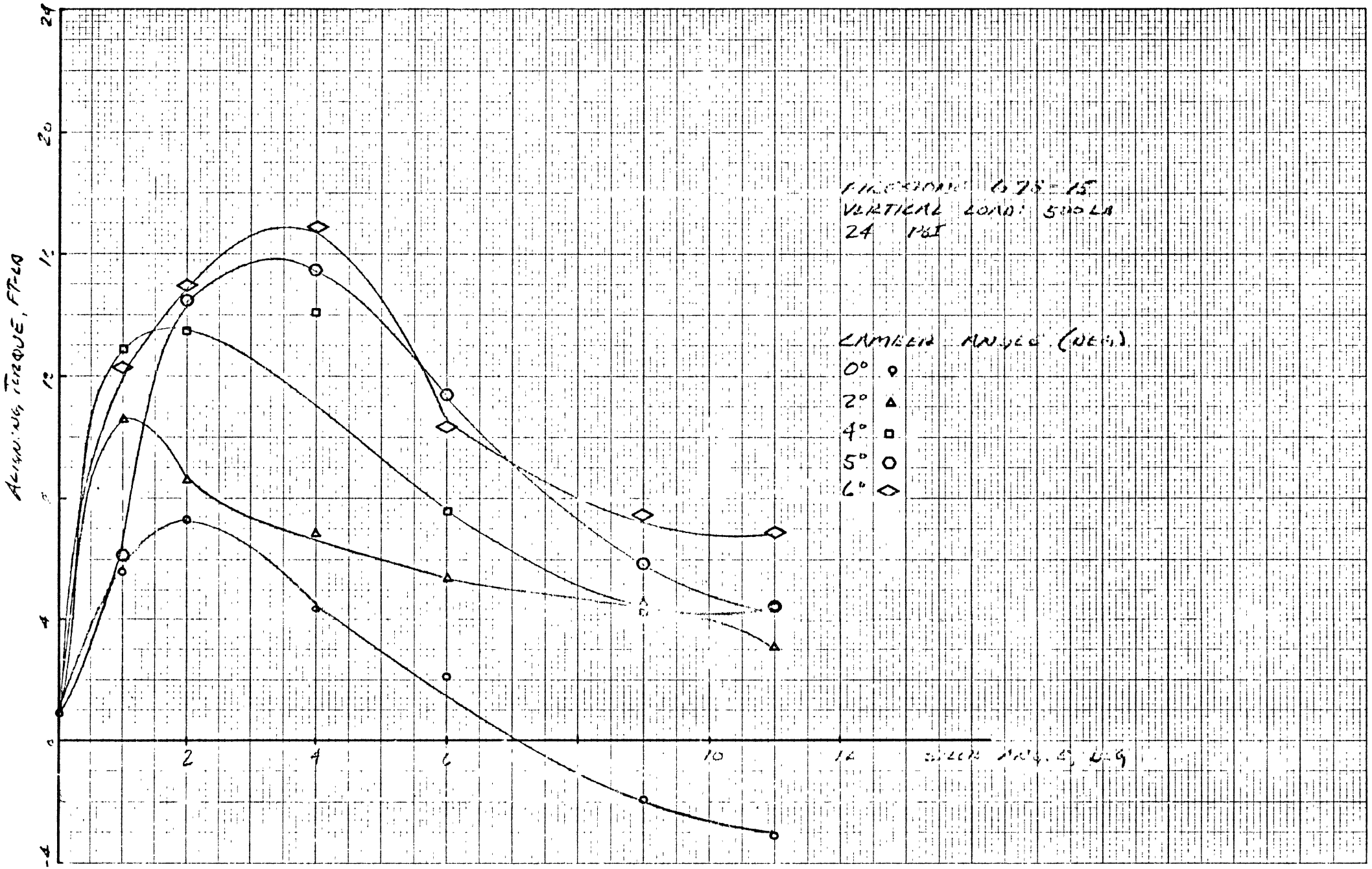
CAMBER ANGLE: 5°

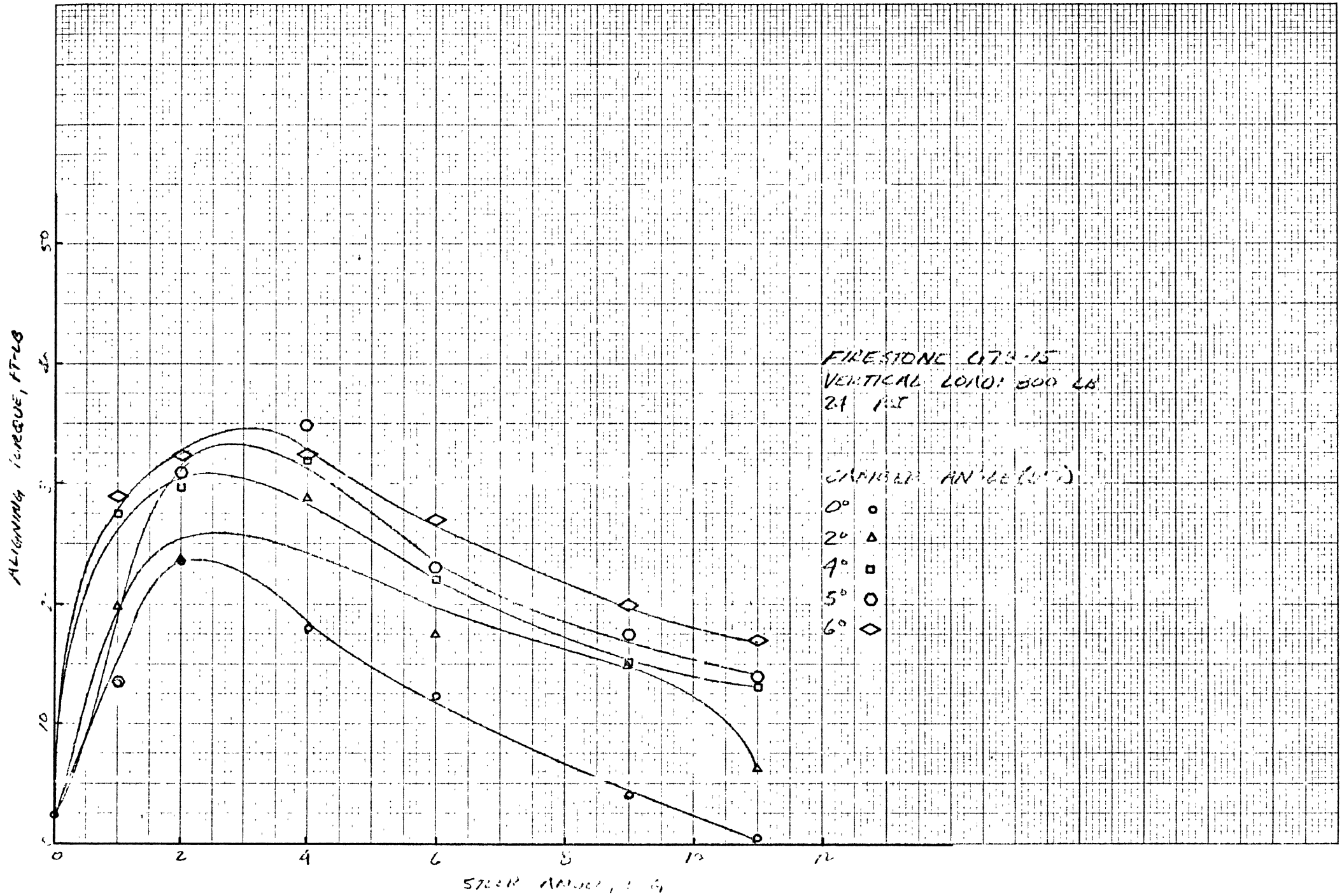
VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	6.2	10.5	15.1	11.4	5.9	4.5	-
800	13.4	21.0	31.9	23.1	17.6	13.9	-
1100	17.8	50.4	60.5	49.4	37.0	-	24.4
1400	23.1	71.1	90.8	81.3	64.2	-	45.2

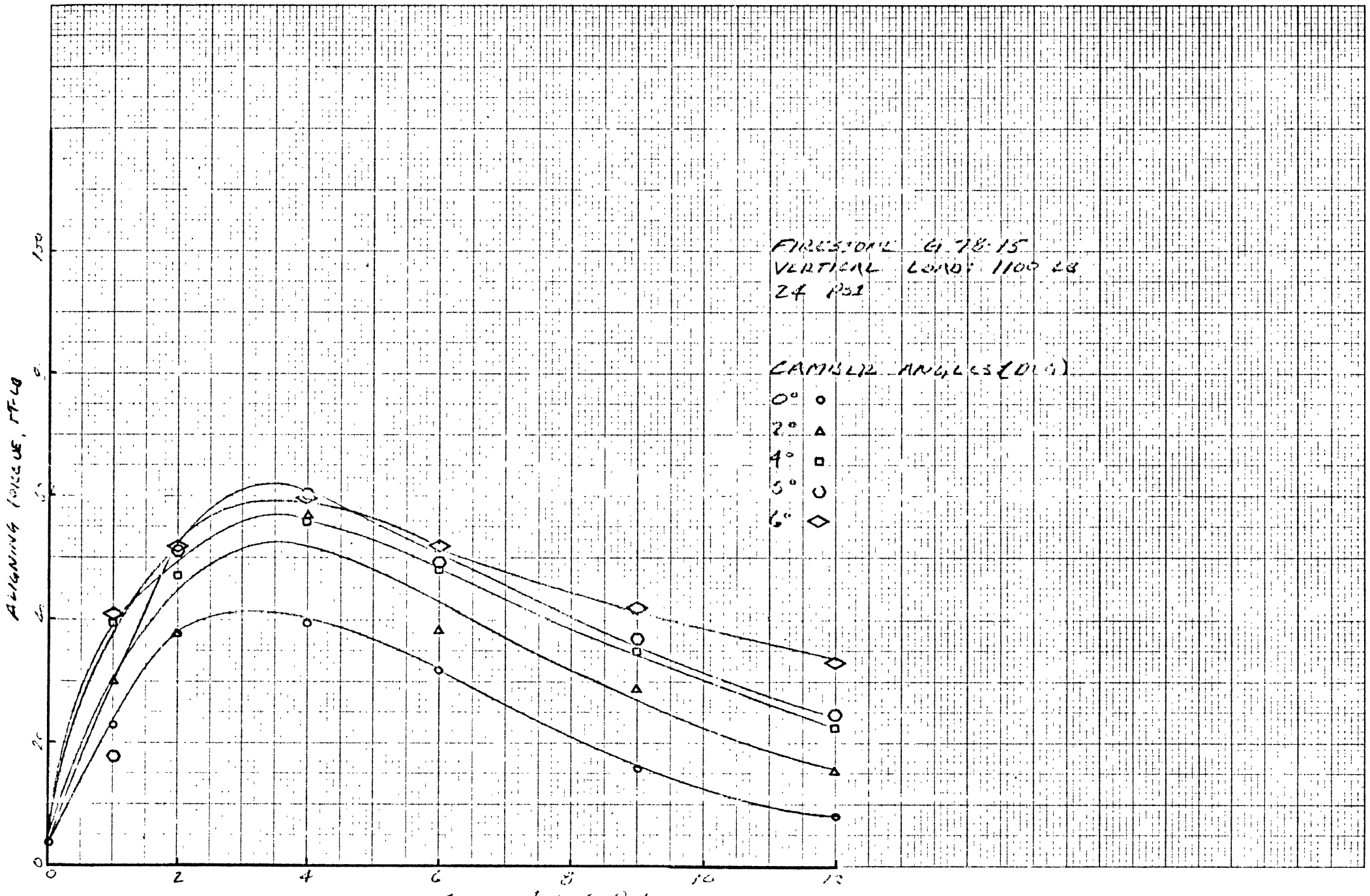
ALIGNING TORQUE VS. STEER ANGLE AND VERTICAL LOAD

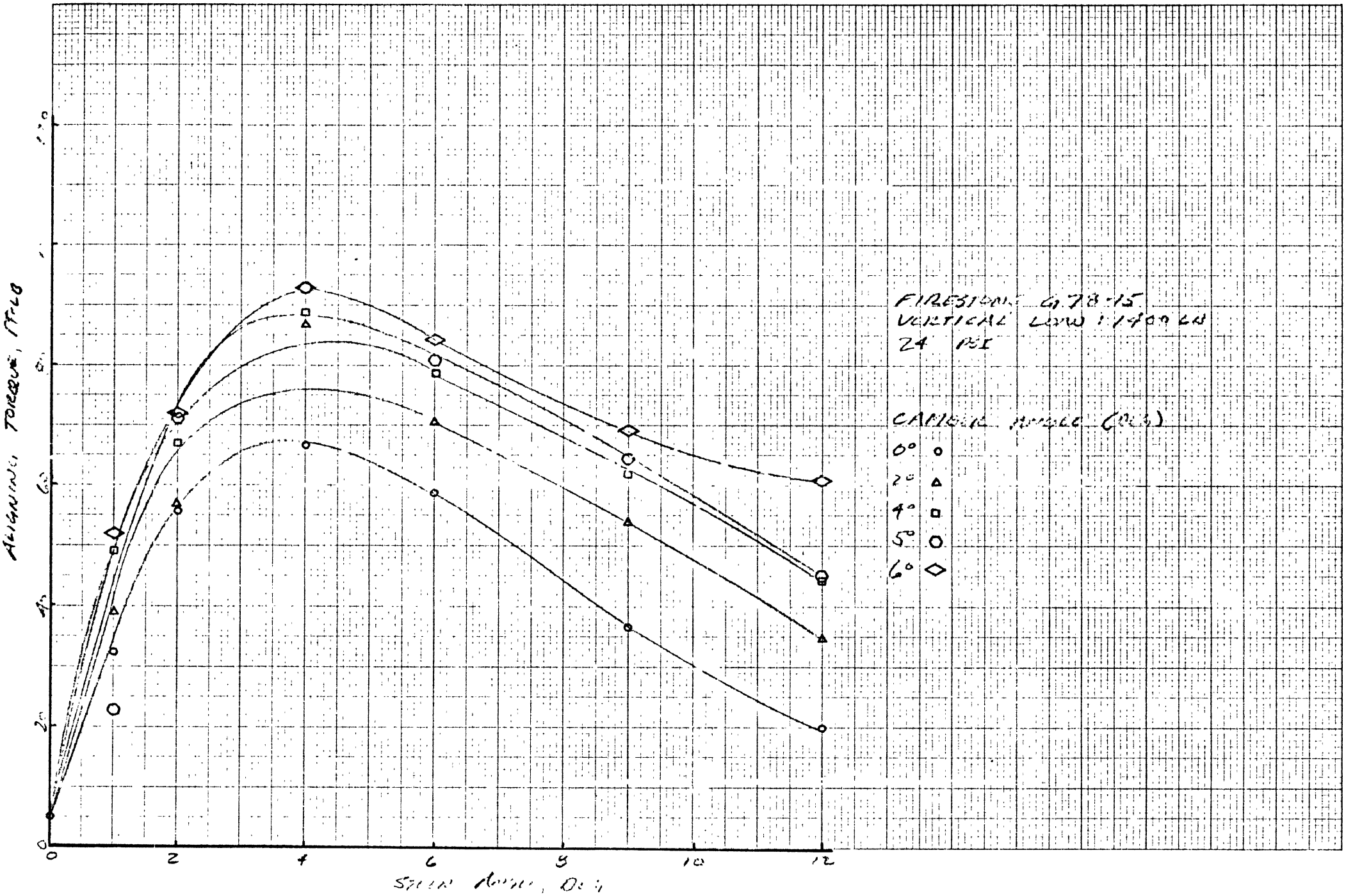
TIRE: Firestone G70-15
RIM: 15 x 4
INFLATION: 24 PSI
CAMBER ANGLE: 0°

VERTICAL LOAD(LB)	ALIGNING TORQUE (LB-FT) AT INDICATED STEER ANGLE(DEG)						
	1	2	4	6	9	11	12
500	12.3	15.0	16.9	10.4	7.5	6.9	-
800	29.1	32.6	32.2	27.0	20.6	16.9	-
1100	41.2	52.2	59.7	52.4	42.0	-	33.1
1400	52.3	72.3	73.5	84.4	69.4	-	60.9









LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: [illegible]

RIM: [illegible]

INFLATION: [illegible]

STEER ANGLE: 0

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	-26.8	-45.9	-55.0	-70.5
800	-37.3	-73.2	-89.1	-105
1100	-50.0	-81.6	-102.1	-113.9
1400	-50.2	-97.0	-109.5	-123.2

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE 6.70-15

RIM: 5.5

INFLATION: 30 PSI

STEER ANGLE: 0°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	300.7	2[illegible]	256.2	248.1
800	435.0	393.2	378.3	352.5
1100	[illegible]	[illegible]	[illegible]	[illegible]
1400	[illegible]	[illegible]	[illegible]	[illegible]

LATERAL FORCE VS. CAMBER ANGLE AND VERTICAL LOAD

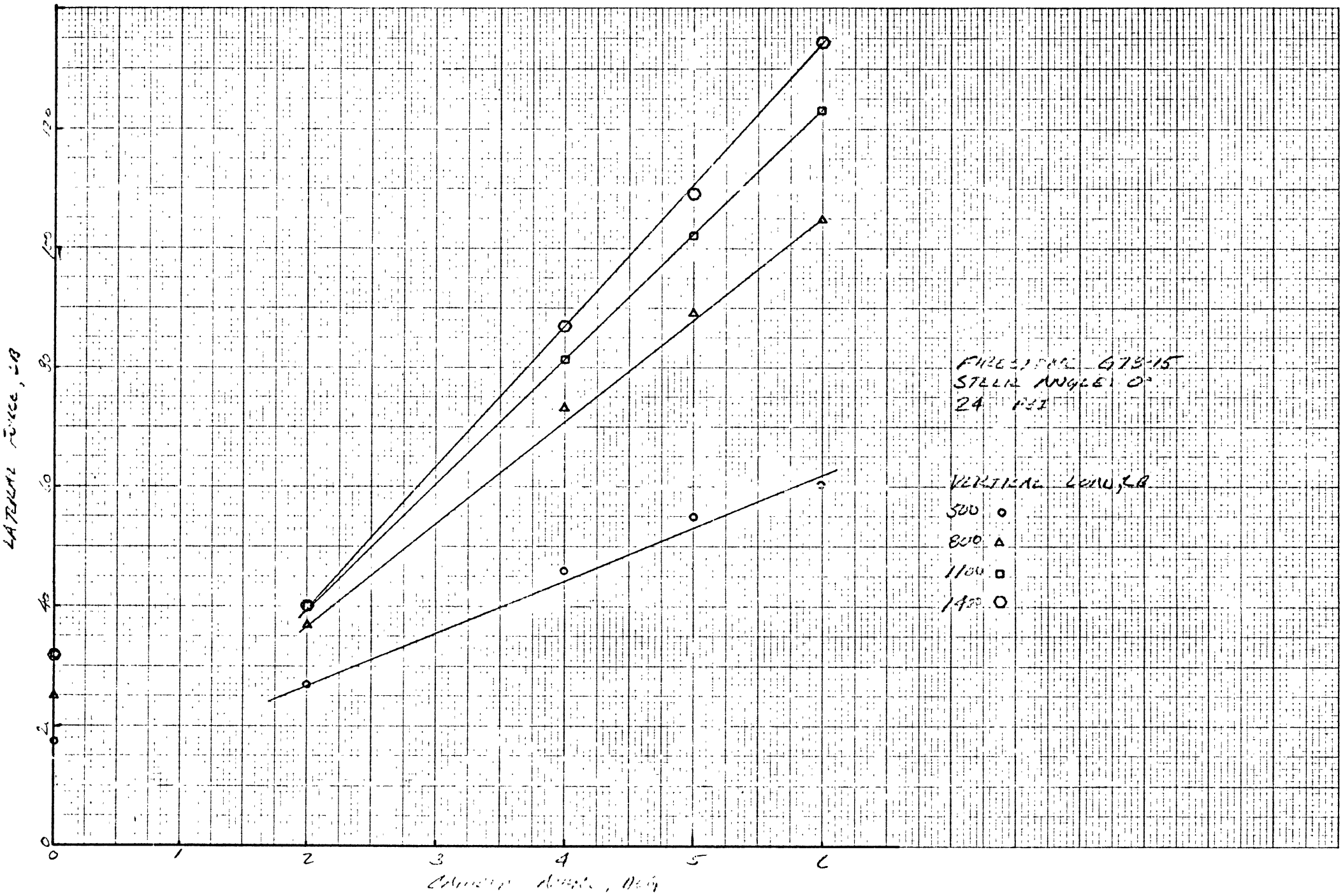
TIRE: Firestone G 78-15

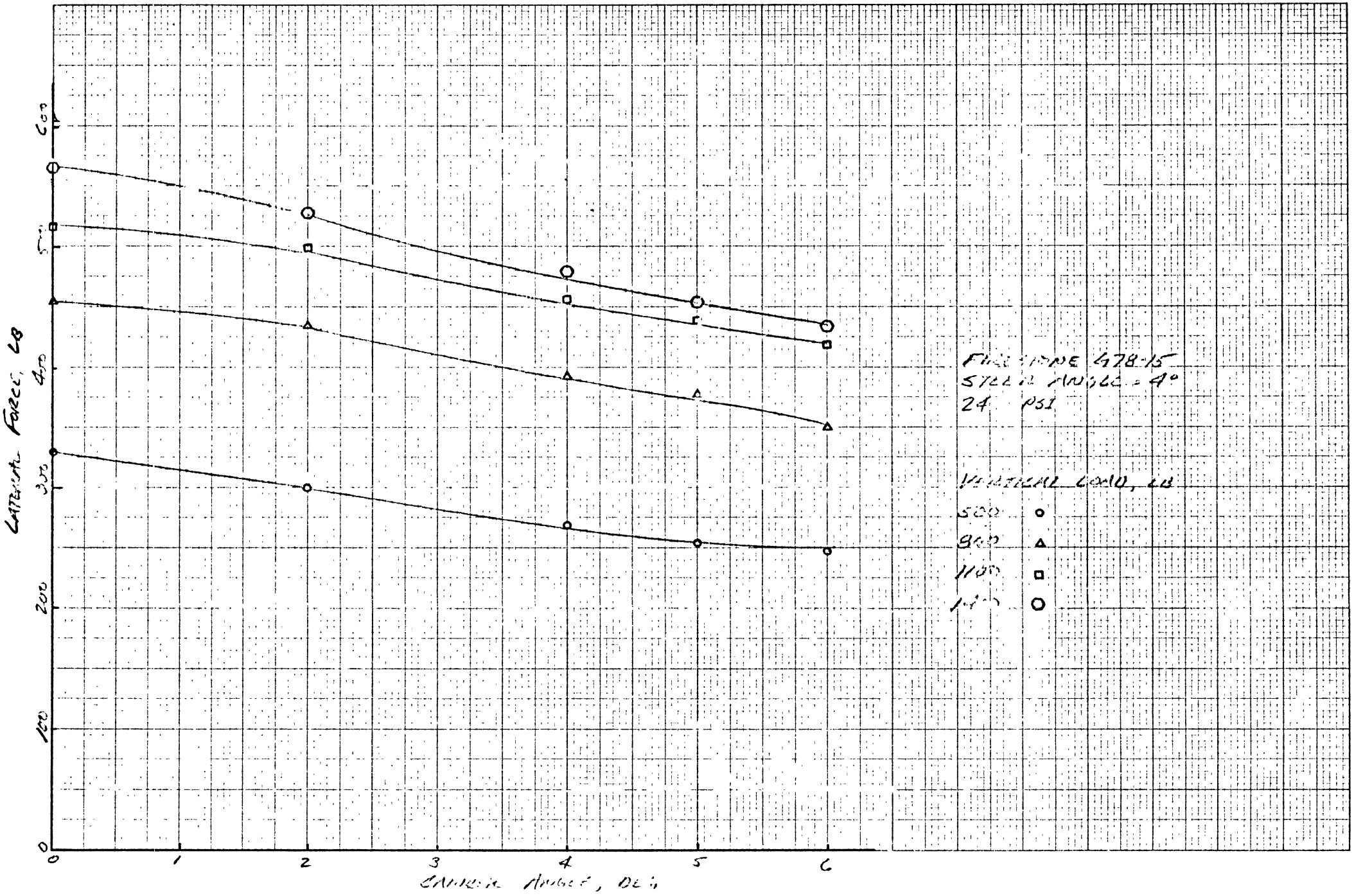
RIM: 15 x 4.00

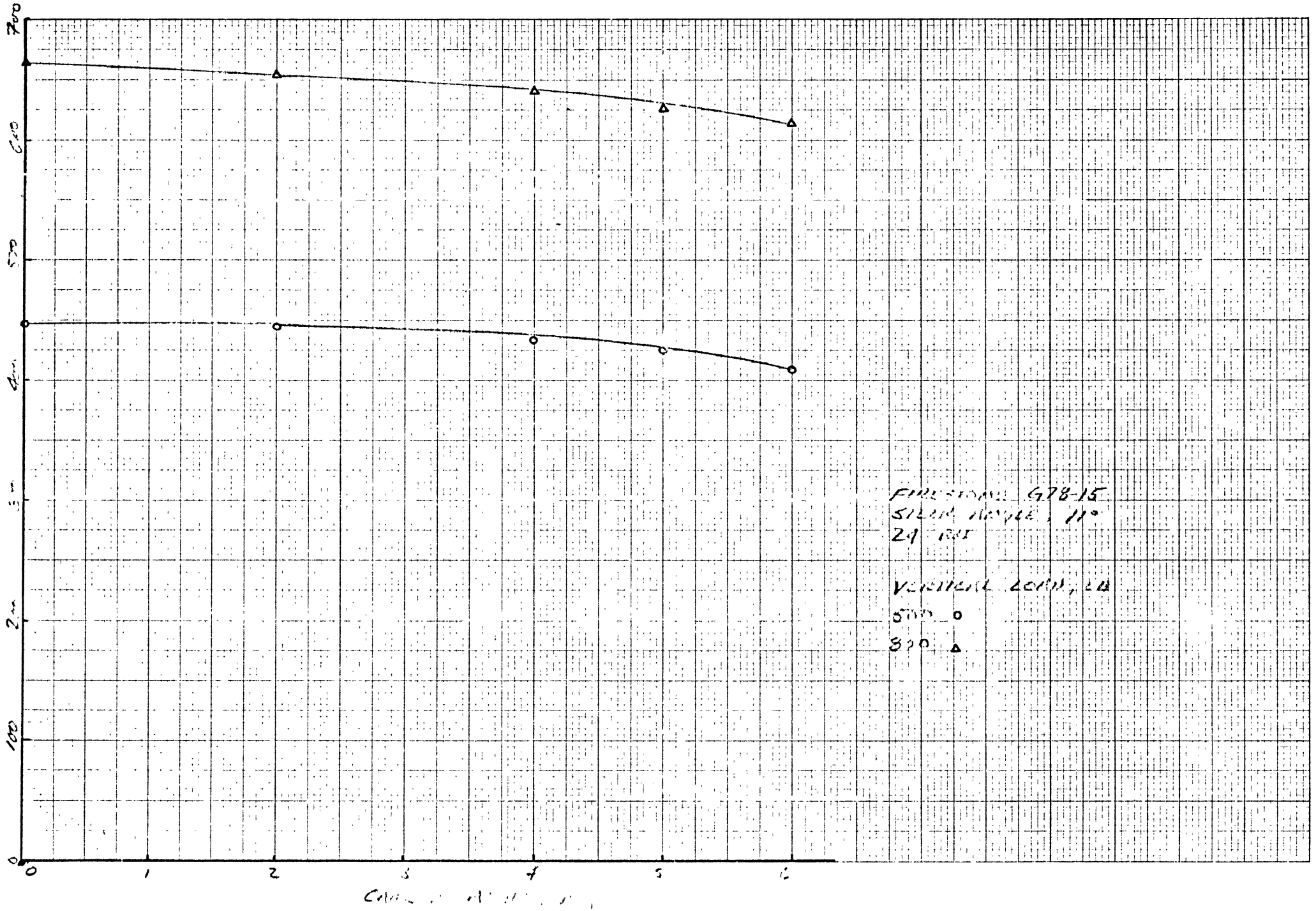
INFLATION: 20 PSI

STEER ANGLE: 11°

VERTICAL LOAD (LB)	LATERAL FORCE (LB) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	444.8	434.6	425.9	409.9
800	654.8	642.0	628.2	615.3
1100	-	-	-	-
1400	-	-	-	-







ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: Firestone G 78-15

RIM: 5½ 4

INFLATION: 24 PSI

STEER ANGLE: 0

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	4.6	6.2	7.7	7.5
800	7.0	12.0	14.2	15.9
1100	7.5	14.5	18.7	21.3
1400	7.5	16.4	20.0	22.1

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

TIRE: FIRESTONE G 78-15

RIM: 15 X 4.50

INFLATION: 24 PSI

STEER ANGLE: 4°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	6.9	14.1	15.4	16.9
800	23.4	31.9	34.3	32.2
1100	52.3	56.2	60.5	59.7
1400	86.6	89.1	92.8	92.5

ALIGNING TORQUE VS. CAMBER ANGLE AND VERTICAL LOAD

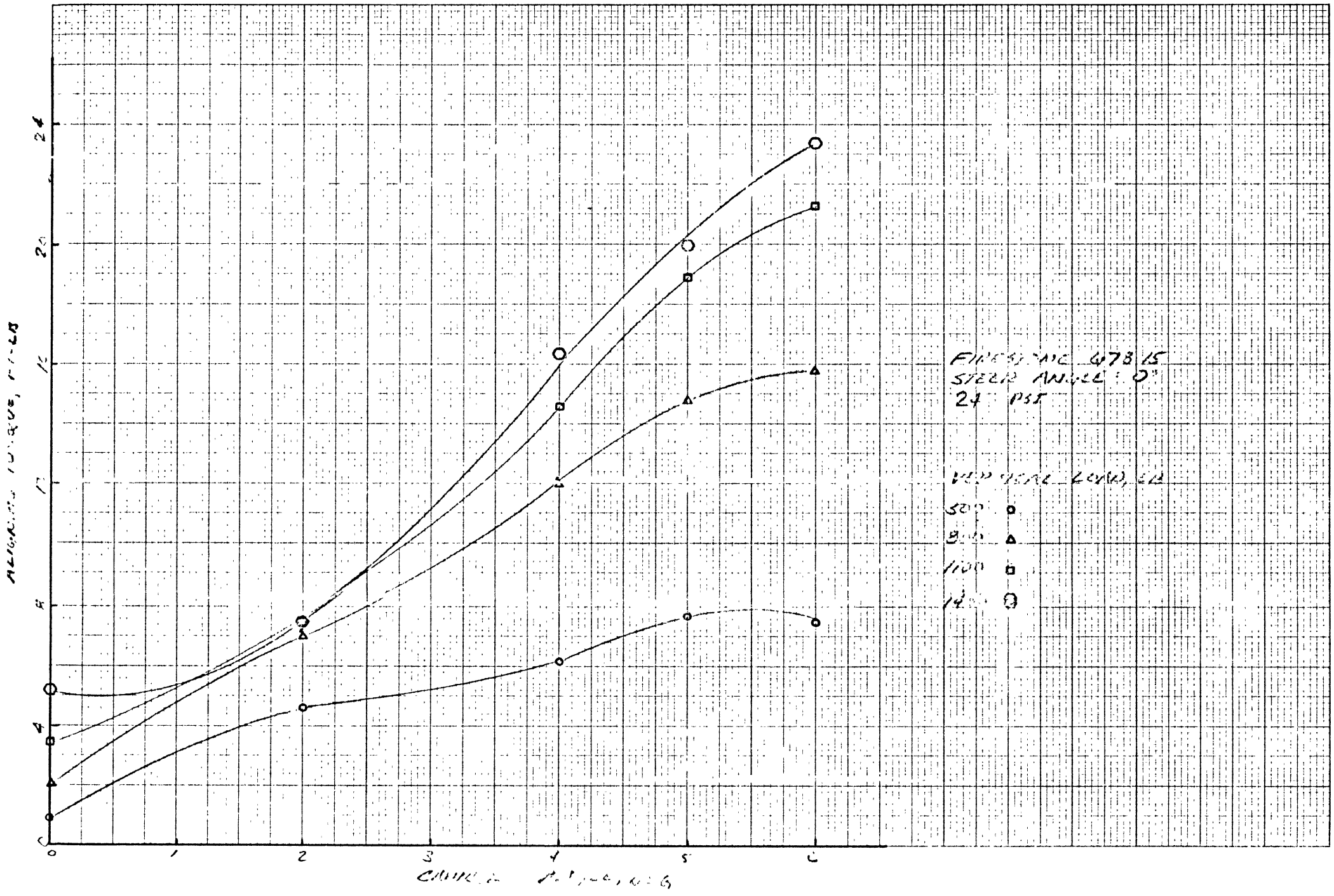
TIRE: FIRESTONE G78-15

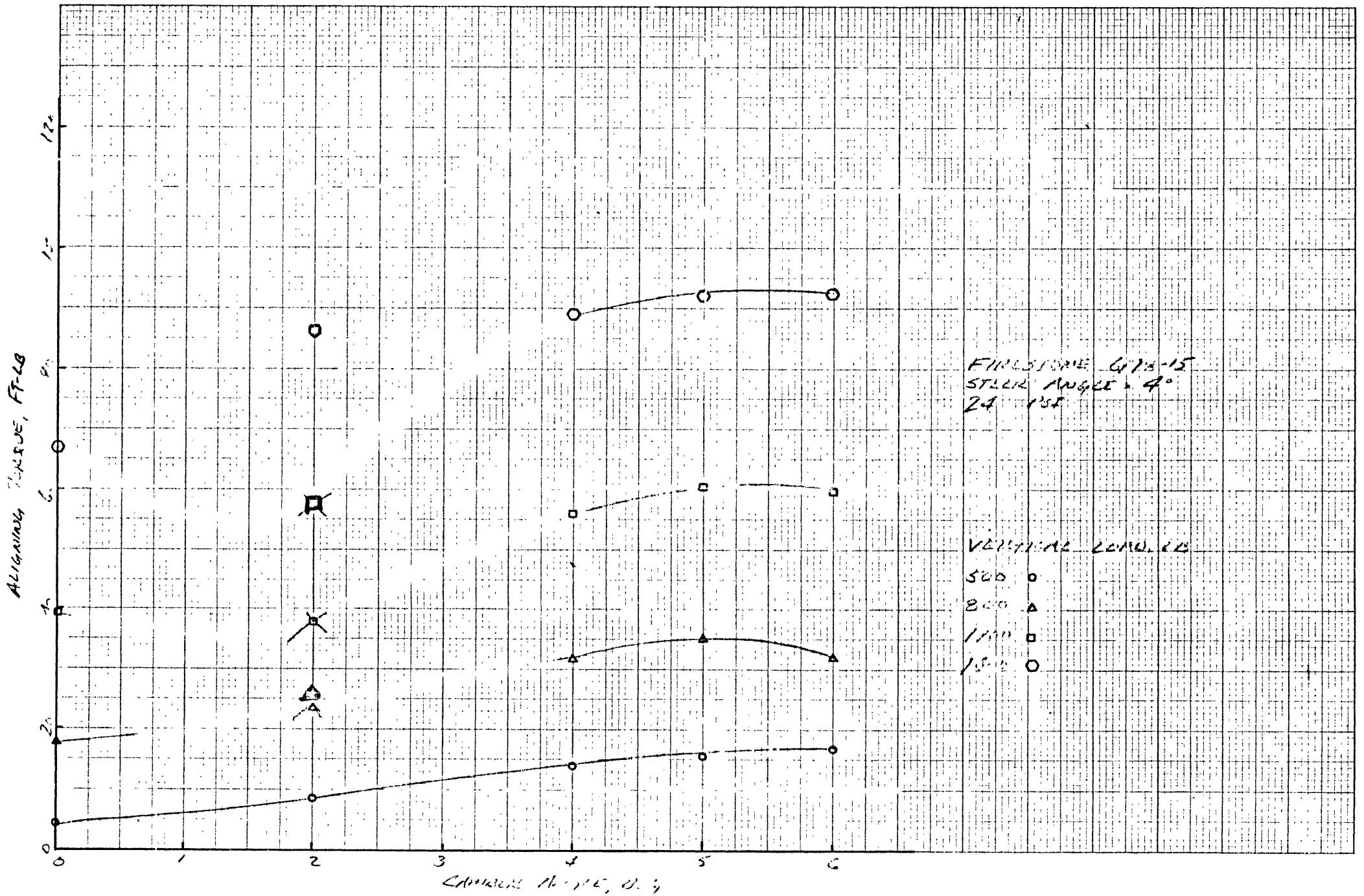
RIM: 15 x 7.00

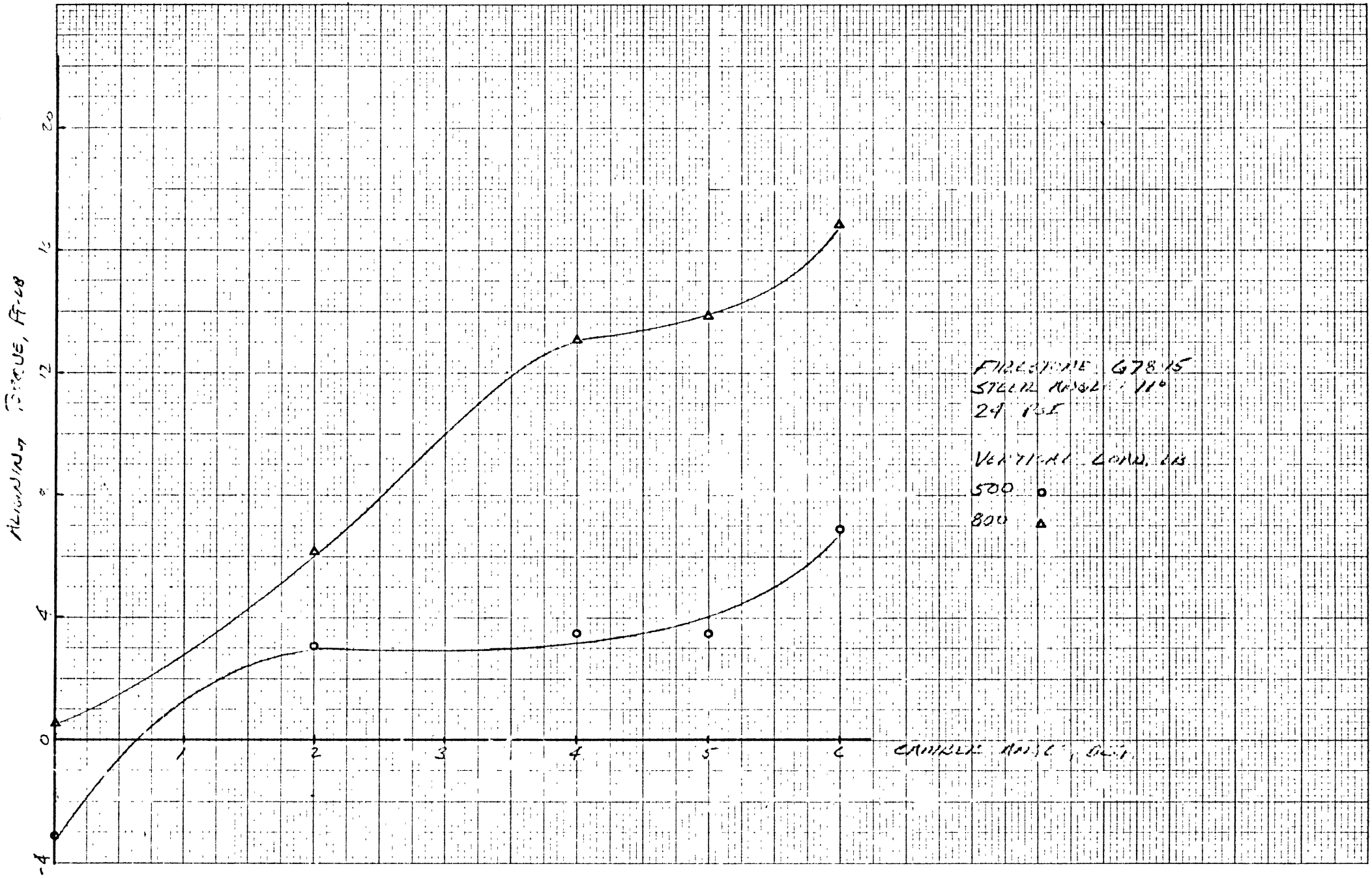
INFLATION: 24 PSI

STEER ANGLE: 1/2°

VERTICAL LOAD (LB)	ALIGNING TORQUE (LB-FT) AT INDICATED CAMBER ANGLE (DEG)			
	2	4	5	6
500	3.1	4.5	4.5	6.9
800	6.2	13.1	13.9	16.9
1100	-	-	-	-
1400	-	-	-	-







APPENDIX II

TEST EQUIPMENT

The HSRI flat bed tire tester provides precise laboratory measurements of the mechanical properties of standing, rolling, and slipping tires. It can accommodate tires up to 44 inches outside diameter with vertical loads to 10,000 lbs. The slip angle is adjustable in 1° increments from 0° to ±30° and in 15° increments on out to +90°. Camber angles can be varied from -10° to +20° in 1° increments. The test wheel is powered by a 13,000 ft-lb hydraulic system which is driven independently of the flat bed table to create longitudinal slip conditions.

The machine is instrumented to measure the three force and three moment components developed by the tire, in addition to test wheel drive torque (T), rolling height (R_h), and wheel angular velocity (ω). The positions of the six load cells used to measure the forces and moments are shown in Figure 3.

The bed surface is 100 grit* tungsten carbide bonded directly to the aluminum table with no intervening paper or glue. The bed velocity is 2.11 feet per second or 1.44 mph. Thus the flat bed machine is useful for exploring the small slip or "elastic" mechanical properties of tires, which are essentially speed independent, and for measuring the ultimate force and moment capabilities of tires at higher slip conditions. The magnitude of these large slip forces and moments may be lower at highway velocities.

DATA ACQUISITION

During a test, the analog output of the transducers is recorded continuously on a chart recorder and at discrete intervals is digitized onto magnetic tape. This periodic sampling of analog data, which is the main source of data acquisition, is

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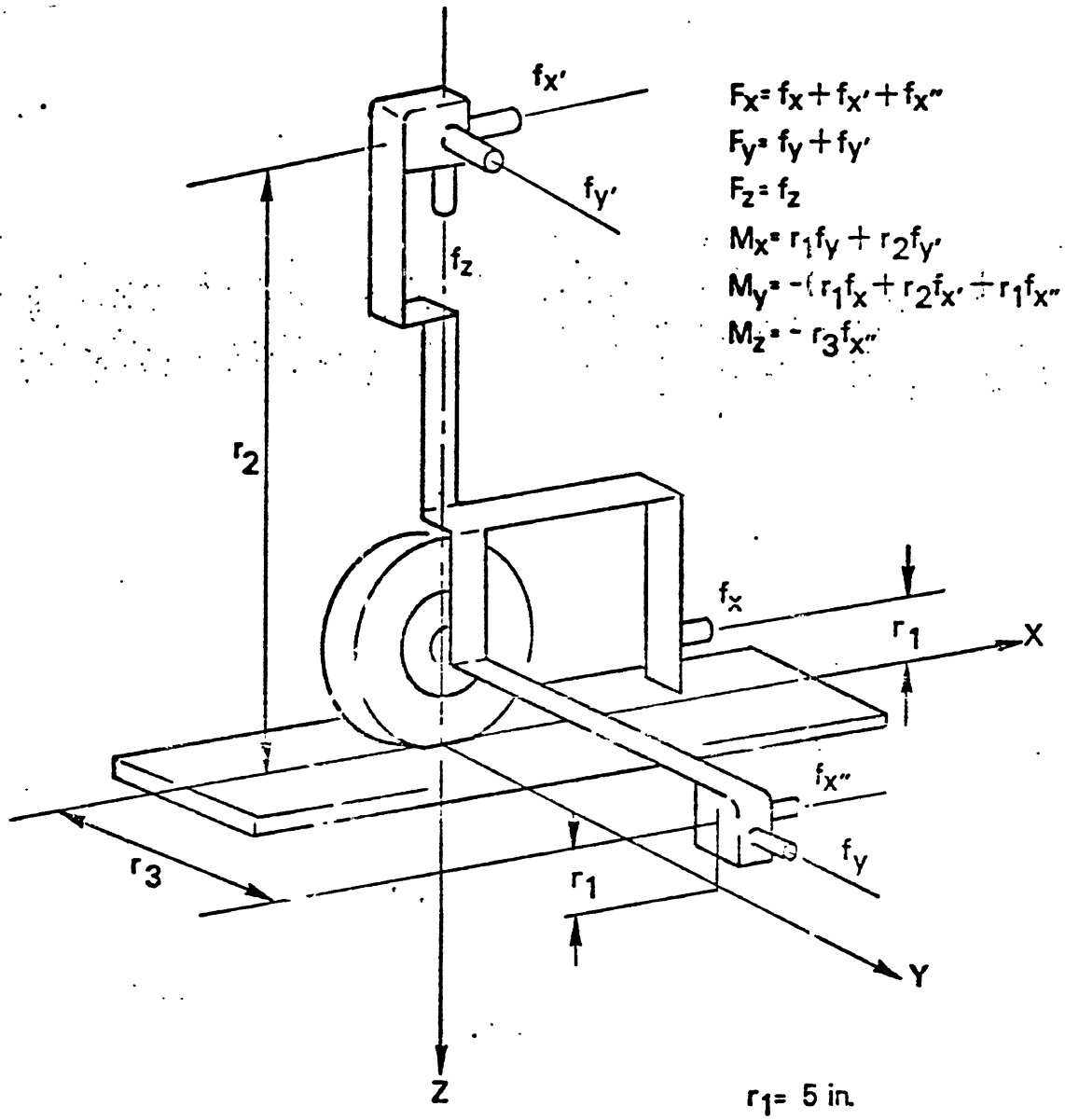
*100 grit = 100 particles per square inch.



$F_x = f_x + f_{x'} + f_{x''}$

$F_y = f_y + f_{y'}$

$F_z = f_z$

$M_x = r_1 f_y + r_2 f_{y'}$

$M_y = -(r_1 f_x + r_2 f_{x'} + r_1 f_{x''})$

$M_z = -r_3 f_{x''}$

$r_1 = 5$ in.

$r_2 = 75$ in.

$r_3 = 30$ in.

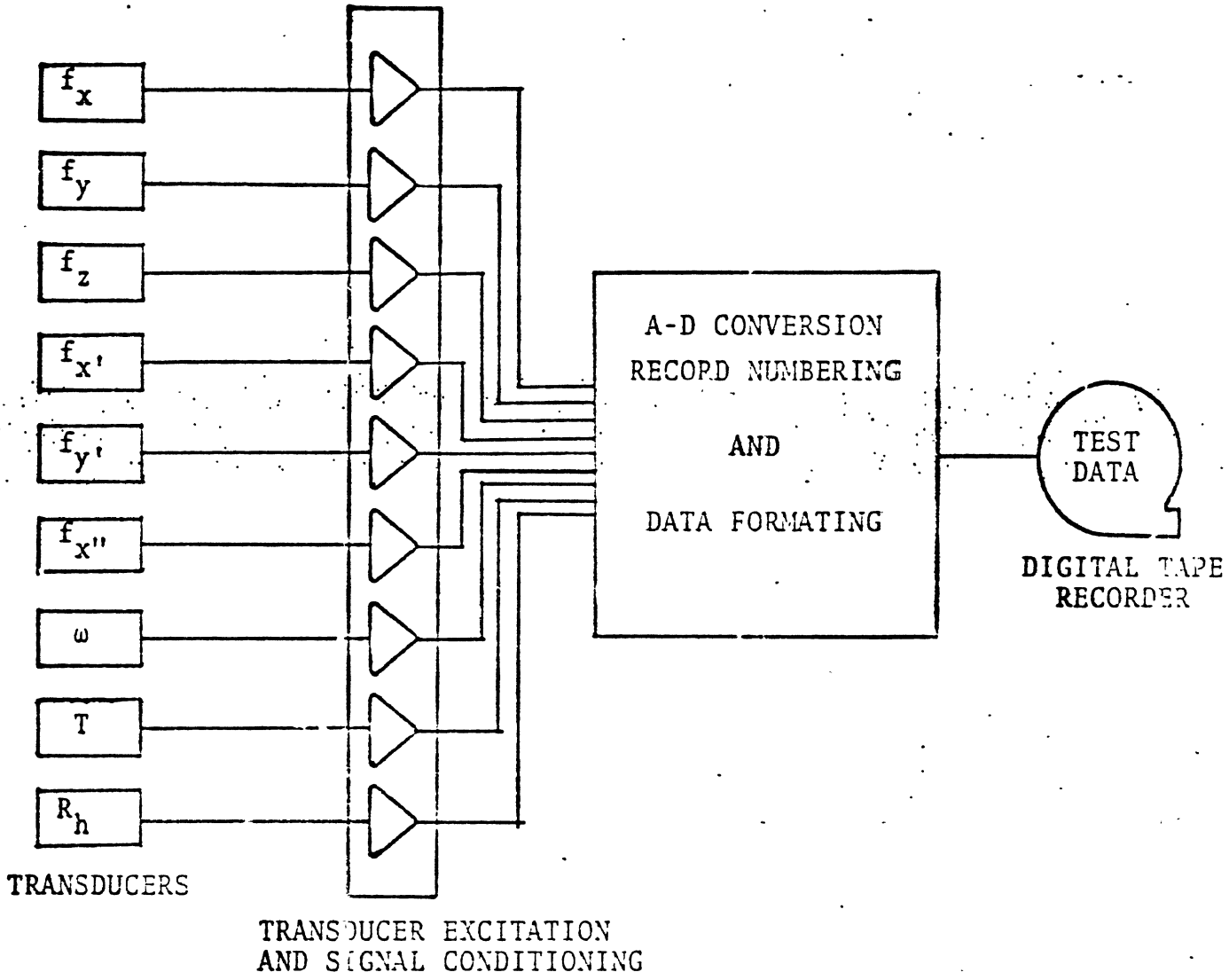
Figure 3.

done ten times during the constant velocity portion of a pass of the flat bed table. The samples are spaced in time to cover approximately one revolution of the test tire.

The samples of analog data are routed to a tape recorder interface unit which digitizes and formats the data for printing onto magnetic tape along with such information as slip angle, specified load, and test number. The digital tape (the end product of a test series) is processed on the HSRI PDP 11/45 digital computer. Here the data from the six load cells is multiplied by a 6 x 6 calibration matrix which provides the proper scale factors and removes interaction caused by test frame distortion. The ten samples obtained during a pass of the bed are now averaged. The result is a table of the forces and moments produced by the tire at each of the various test parameter combinations. The data processing to this point is illustrated in Figure 4.

The data listed in the table described above is put through a final processing to combine and average the two values of each force and moment which result from making both left and right passes of the roadbed.

REAL-TIME DATA ACQUISITION



FINAL PROCESSING BY IBM 1800

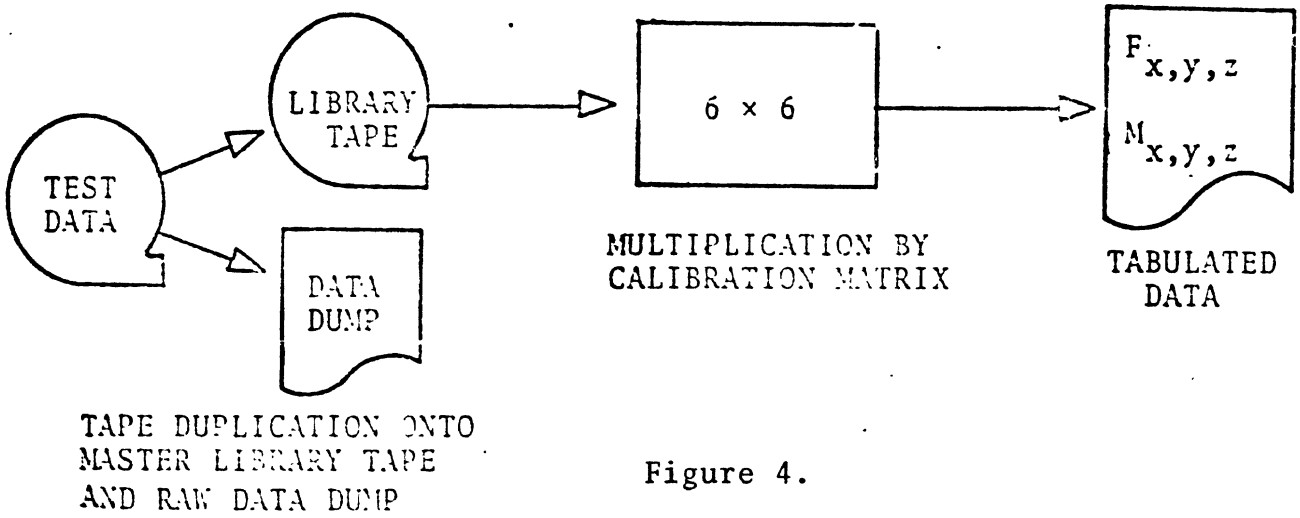


Figure 4.