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Static Force-Deflection Properties of Automobile Steering Components

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16. Abstract

This report provides the static force-deflection test results for 28 steering columns and 24 steering wheels used in domestic and import passenger cars from model years 1975 to 1985. The steering columns and wheels tested include approximately 90 percent of the domestic and import passenger vehicles from model years 1975 to 1981. Steering component testing was conducted at the Army Materials and Mechanics Research Center, Watertown, MA. The test procedure and the processing of the test results to generate data files for use in the National Highway Traffic Safety Administration's Passenger/Driver Simulation (PADS) model are described. Loads for all tests were applied at a rate of one inch per minute.

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The steering component test program documented here was performed under Program Plan Agreement HS-76 with the National Highway Traffic Safety Administration (NHTSA). Steering component testing was conducted at the Army Materials and Mechanics Research Center, Watertown, MA. Test data were processed to generate data files for use in the Passenger/Driver Simulation (PADS) model. These data files reside in NHTSA's VAX-11/780 computer system.

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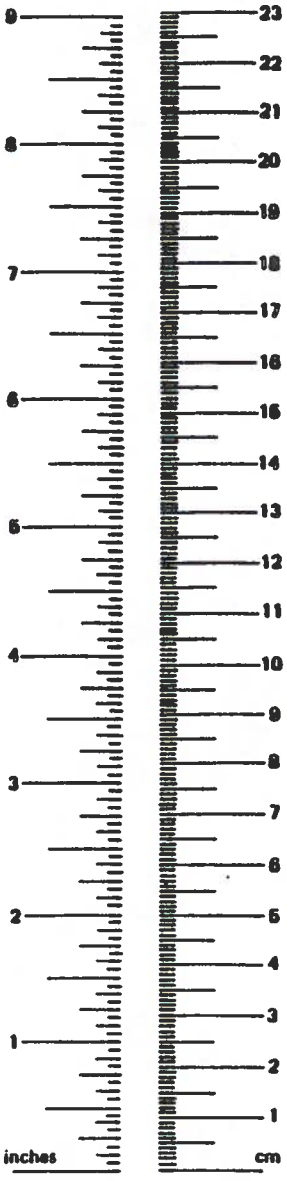
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

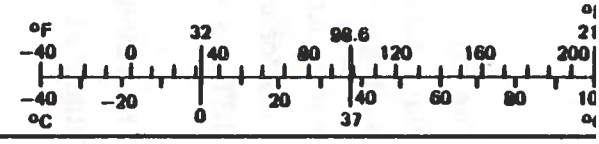
hen You Know	Multiply by	To Find	Symbol
LENGTH			
inches	*2.5	centimeters	cm
feet	30	centimeters	cm
yards	0.9	meters	m
miles	1.6	kilometers	km
AREA			
square inches	6.5	square centimeters	cm^2
square feet	0.09	square meters	m^2
square yards	0.8	square meters	m^2
square miles	2.6	square kilometers	km^2
acres	0.4	hectares	ha
MASS (weight)			
ounces	28	grams	g
pounds	0.45	kilograms	kg
short tons (2000 lb)	0.9	tonnes	t
VOLUME			
teaspoons	5	milliliters	ml
tablespoons	15	milliliters	ml
fluid ounces	30	milliliters	ml
cups	0.24	liters	l
pints	0.47	liters	l
quarts	0.96	liters	l
gallons	3.8	liters	l
cubic feet	0.03	cubic meters	m^3
cubic yards	0.76	cubic meters	m^3
TEMPERATURE (exact)			
Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

(exactly). For other exact conversions and more detail tables see 286, Units of Weight and Measures. Price $2.25 SD Catalog



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbo
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
MASS (weight)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
VOLUME				
ml	milliliters	0.03	fluid ounces	fl o
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	36	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



Section		Page
1.	INTRODUCTION	1
2.	GENERAL DESCRIPTION OF THE STEERING COMPONENT TEST PROGRAM	3
	2.1 Program Overview	3
	2.2 General Description of Steering Components	3
	2.3 PADS Steering Assembly Data Requirements	6
	2.4 Cross-Reference Table for Steering Columns and Wheels	12
3.	COLUMN FORCE-DEFLECTION TESTS	14
4.	WHEEL FORCE-DEFLECTION TESTS	17
APPENDIX A - STEERING COLUMN AND STEERING WHEEL INDEX		A-1
APPENDIX B - COLUMN FACT SHEETS		B-1
APPENDIX C - WHEEL FACT SHEETS		C-1
APPENDIX D - CONVERSION OF TEST RESULTS TO PADS DATA		D-1
APPENDIX E - PADS COLUMN FORCE-DEFLECTION DATA		E-1
APPENDIX F - PADS WHEEL FORCE-DEFLECTION DATA		F-1
REFERENCES		R-1

Figure		Page
2-1	STEERING WHEEL DEFORMATION MODES	5
2-2	TYPICAL STEERING COLUMN	5
2-3	STEERING ASSEMBLY ENERGY ABSORPTION SCHEMATIC	6
2-4	STEERING WHEEL LOADING AND TEST SCHEMATIC	7
3-1	STEERING COLUMN TEST SET-UP	14
3-2	STEERING COLUMN TEST WITH SIDE-LOAD (TYPICAL)	15
3-3	PADS STEERING COLUMN DIMENSIONS	16
4-1	STEERING WHEEL TESTS	18
4-2	STEERING WHEEL RADIAL BOTTOM TEST (TYPICAL)	19
4-3	STEERING WHEEL PARAXIAL BOTTOM TEST (TYPICAL)	20
4-4	PADS STEERING WHEEL DIMENSIONS	21

LIST OF TABLES

Table		Page
1-1	SUMMARY OF VEHICLES' STEERING COMPONENTS TESTED	2
2-1	FORCE-DEFLECTION DATA MEASURED BY STATIC TESTS	8
2-2	PADS STEERING COLUMN FILE DEFINITIONS	9
2-3	PADS STEERING WHEEL FILE DEFINITIONS	9
2-4	PADS STEERING COLUMN DATA FILE (SAMPLE)	10
2-5	PADS STEERING WHEEL DATA FILE (SAMPLE)	11
2-6	SUMMARY OF STEERING COMPONENTS TESTED	13
3-1	STEERING COLUMNS TESTED AND PRINCIPAL USAGE	16
4-1	STEERING WHEELS TESTED AND PRINCIPAL USAGE	17

1. INTRODUCTION

The objective of this project was to obtain and document the static force-deflection properties of selected passenger car steering wheels and columns. These force-deflection properties are essential inputs to the occupant impact simulation model Passenger-Driver Simulation (PADS).

The data obtained from this test program include:

- Steering column axial force-deflection (with and without side-load)
- Steering wheel paraxial bottom force-deflection
- Steering wheel paraxial top force-deflection
- Steering wheel radial bottom force-deflection
- Steering wheel hub crush force-deflection
- Steering wheel crush force-deflection
- Steering wheel torque-rotation (with respect to the column).

The steering columns and wheels tested represent about 90 percent of those used in domestic and import passenger vehicles from 1975 to 1981 model years. Table 1-1 shows the steering columns and wheels selected for the static testing.

Load-deflection tests were conducted at the Army Materials and Mechanics Research Center (AMMRC), Watertown, MA. The wheels were tested on a 20,000 lb. MTS testing machine and the column tests were made on a 250,000 lb. MTS testing machine. On both machines, the loads were applied at a rate of one inch per minute. The load-deflections of the wheels and load-strokes of the columns were recorded.

VEHICLE	STEERING COLUMN	STEERING WHEEL
1980 CONCORD	Column Shift	4-spoke
1976 DART/VALIANT	Column Shift	3-spoke
1976-80 ASPEN/VOLARE	Column Shift	2-spoke, 3-spoke
1976-80 LeBARON, FURY, etc.	Column Shift	2-spoke
1978-83 OMNI/HORIZON	Column Shift	4-spoke
1975-80 PINTO/BOBCAT	Floor Shift	2-spoke, 3-spoke
1978-80 FAIRMONT/ZEPHYR	Floor Shift	2-spoke
1979-81 MUSTANG/CAPRI	Floor Shift	2-spoke, 3-spoke, 4-spoke
1975-78 FORD LTD/MERCURY	Column Shift	2-spoke
1979-81 FORD LTD/MERCURY	Column Shift	4-spoke
1975-80 GRANADA/MONARCH	Column Shift	2-spoke, 3-spoke
1980-81 THUNDERBIRD	Floor Shift	4-spoke
1978-81 MALIBU, etc.	Column Shift	2-spoke
1977-81 CAPRICE, DELTA 88, etc.	Column Shift	2-spoke
1980-81 CITATION	Column Shift	2-spoke
1978-80 MONZA	Floor Shift	2-spoke
1979 NOVA	Column Shift	2-spoke
1976-81 CHEVETTE	Floor Shift	2-spoke
1979-81 CAMARO	Floor Shift	4-spoke
1980 LeMANS	Column Shift	3-spoke
1980 DeVILLE	Column Shift	2-spoke
1980 DATSUN	Floor Shift	2-spoke
1980 COROLLA	Floor Shift	2-spoke
1980 SUBARU	Floor Shift	4-spoke
1980 HONDA	Floor Shift	2-spoke
1980 RABBIT	Floor Shift	2-spoke
1983 CONCORD	Column Shift	4-spoke
1983 CELEBRITY	Column Shift	2-spoke
1983 ACCORD	Floor Shift	4-spoke
1983 FUEGO	Floor Shift	2-spoke
1985 DeVILLE	Column Shift	(not tested)

2.1 PROGRAM OVERVIEW

The steering component test program consisted of the following steps:

a. Plan the steering wheel and column testing program to meet the input requirements of the occupant simulation model (PADS).*[1,2]

b. Identify and acquire the steering wheels and columns for testing.

c. Design and fabricate the fixtures for the tests and prepare the wheels and columns for testing.

d. Conduct the static force-deflection tests and make pre-test and post-test wheel and column measurements.

e. Prepare the force-deflection test results for PADS.

2.2 GENERAL DESCRIPTION OF STEERING COMPONENTS

The wheels tested were of two, three and four-spoke designs. Most were of a two-spoke design in which the spokes connected the hub to the lower half of the wheel. The three-spoke wheels had two horizontal spokes and one vertical spoke joining the bottom of the wheel. The four-spoke wheels had two spokes connecting to each side of the wheel. All the wheels contained the horn-activating switch and various padding and trim attachments.

Four identical wheels were required for the five tests of each wheel group. One wheel of each wheel group, with the horn and trim in place, was used for the wheel hub load-deflection test. Since the wheel rim and spokes were not damaged in this test, this wheel was available for one of the other wheel tests.

*The Reference Section appears at the end of this report.

The spokes increased the deflection resistance of the rim in that part of the wheel where they were attached to the rim. In the tests with the two- and three-spoke wheels, the upper part of the wheel rim deflected more easily than the lower wheel rim. In no tests did any wheel rim or spoke structure fracture during the tests. The tests included wheels that deflected to a maximum deflection of seven inches. In some cases, the plastic covering the rim or spokes cracked, leaving sharp edges.

As shown in Figure 2-1, the wheel-bending deflection can be separated into two components: (1) deflection of only the rim, and (2) rotation of the rim caused by deflection of the spokes. Since PADS requires that the wheel displacement be defined only as rim deflection, a computer program was devised to separate the rim deflection from the rotation (see Appendix A).

A typical steering column contains: (a) the upper steering shaft, (b) the transmission shifting mechanism in column-shift design, (c) the switching and wiring for lights, wiper, and cruise control, (d) the bracket attaching the column to the dash and (in most cars) a flange attaching the column to the firewall (see Figure 2-2), and (e) in most vehicles, an energy-absorbing device (EAD) built into the steering column. Several different types of EADs have been produced by the manufacturers. In many vehicles, the steering column bracket is attached to the dash by shear capsules which are bolted to the dash. The shear capsules are designed to allow the column to move forward only, in order to prevent rearward intrusion of the column and the wheel. In addition, in most vehicles, the upper steering shaft is designed in two sections to allow the lower part to slide (telescope) into the upper part.* This design also prevents rearward motion of the steering wheel and column when a force is applied to the front of the steering linkage. The telescoping sections are held in normal use by two plastic shear-pins.

---

*The upper steering shaft is attached to the steering gear by a lower shaft, and in some vehicles, by an intermediate shaft. Depending on the alignment, and whether the vehicle is front-wheel drive, flexible couplings are used. In some vehicles the lower or intermediate shaft is of a "telescoping" design to prevent rearward intrusion of the upper shaft and steering wheel.

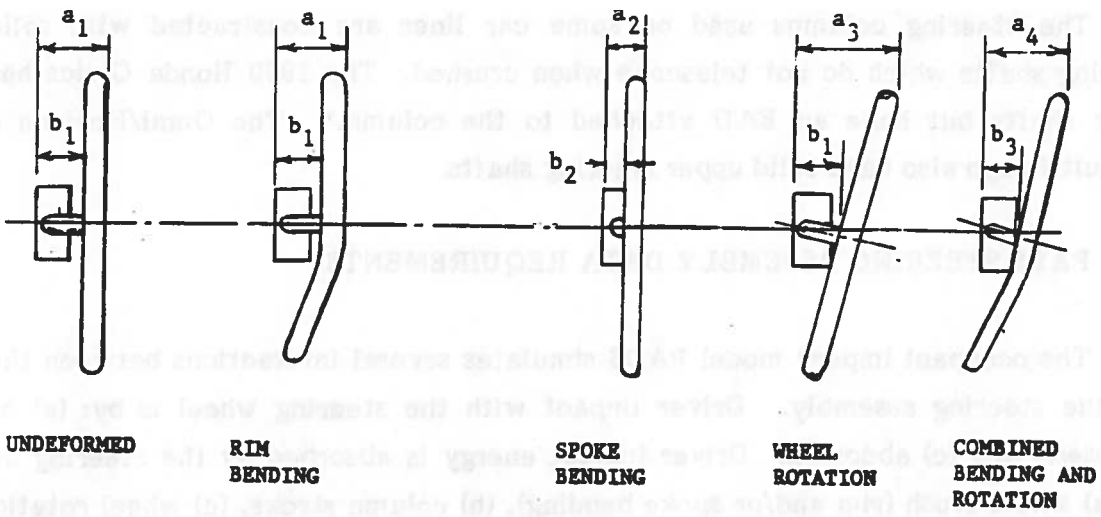
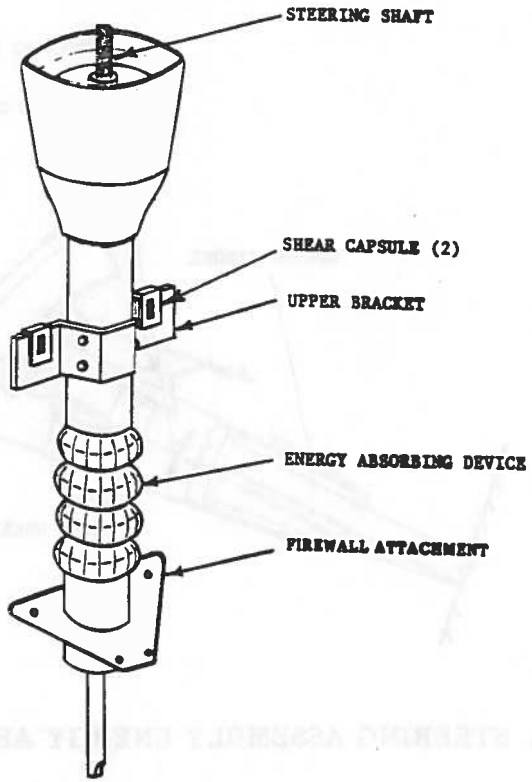


FIGURE 2-1. STEERING WHEEL DEFORMATION MODES



The steering columns used on some car lines are constructed with solid upper steering shafts which do not telescope when crushed. The 1980 Honda Civics have solid upper shafts but have an EAD attached to the column.* The Omni/Horizon and the Renault Fuego also have solid upper steering shafts.

2.3 PADS STEERING ASSEMBLY DATA REQUIREMENTS

The occupant impact model PADS simulates several interactions between the driver and the steering assembly. Driver impact with the steering wheel is by: (a) head, (b) shoulders, and (c) abdomen. Driver impact energy is absorbed by the steering assembly by: (a) wheel crush (rim and/or spoke bending), (b) column stroke, (c) wheel rotation (with respect to the column), and (d) column rotation. These energy-absorbing means are shown schematically in Figure 2-3. The relationship between the occupant body segments and the steering assembly and the corresponding wheel tests is shown in Figure 2-4.

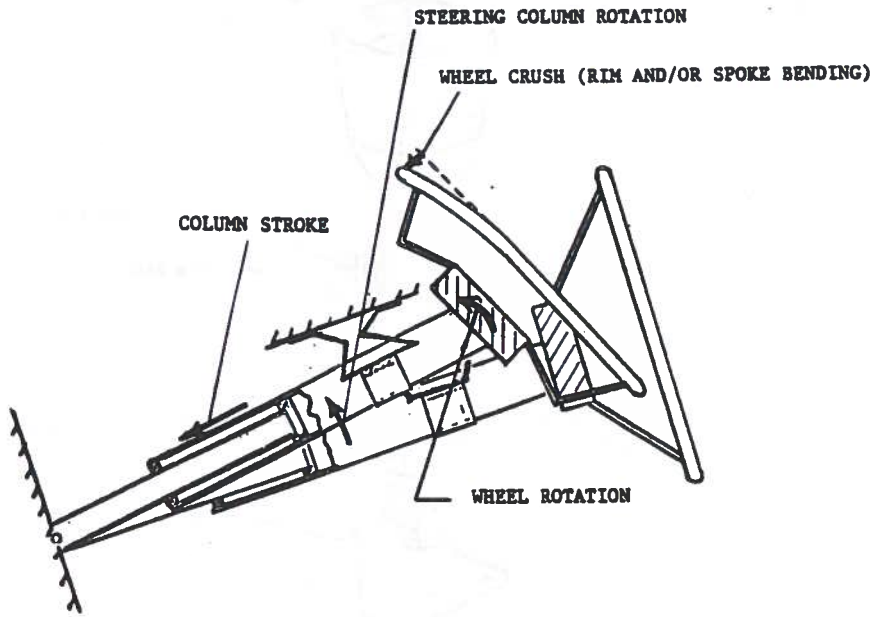
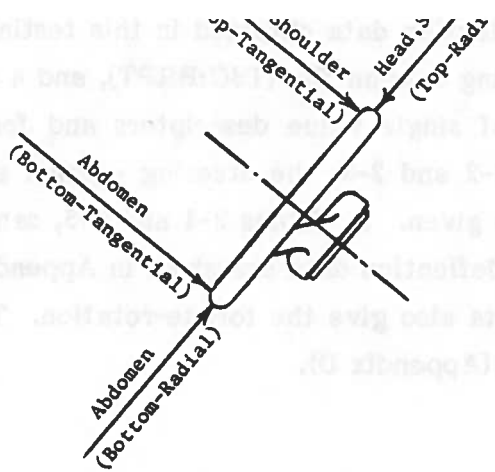
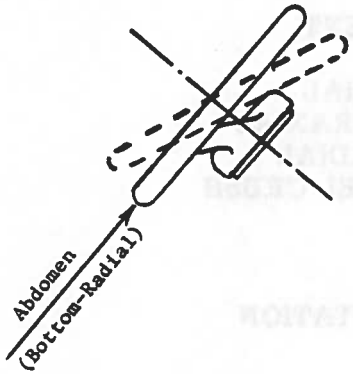


FIGURE 2-3. STEERING ASSEMBLY ENERGY ABSORPTION SCHEMATIC

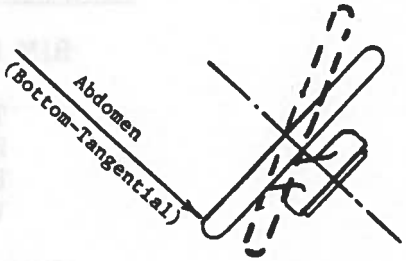
*The 1983 Honda Accord column had a telescoping upper steering shaft which allowed



ROTATION

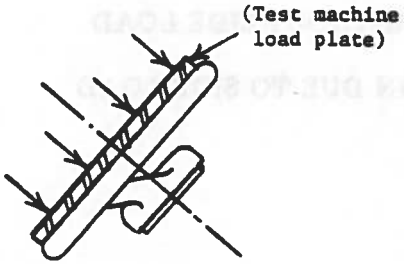


POSITIVE WHEEL ROTATION

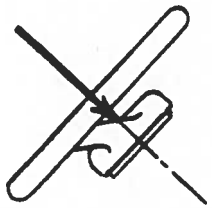


NEGATIVE WHEEL ROTATION

CRUSH



WHOLE WHEEL CRUSH



HUB CRUSH

Table 2-1 shows the force-deflection data obtained in this testing program. These data reside in two data files: a steering column file (TSC:BRPT), and a steering wheel file (TSC:CRPT). Each file consists of single value descriptors and force-deflection and torque-rotation arrays. In Tables 2-2 and 2-3, the steering column and steering wheel PADS file descriptor definitions are given. In Tables 2-4 and 2-5, samples of file print-outs are shown. Plots of the force-deflection data are given in Appendix E (columns) and Appendix F (wheels). The wheel data also give the torque-rotation. The wheel data are adjusted to show rim deflection only (Appendix D).

TABLE 2-1 FORCE-DEFLECTION DATA MEASURED BY STATIC TESTS

WHEEL TESTS

RIM DISPLACEMENT

TOP, PARAXIAL
BOTTOM, PARAXIAL
BOTTOM, RADIAL
WHOLE WHEEL CRUSH

RIM ROTATION

POSITIVE ROTATION

HUB CRUSH

COLUMN TESTS

AXIAL, WITHOUT SIDE LOAD

FRICTION DUE TO SIDE LOAD

Column File	[PCFGB.DAT]	
KEY	minn where m is manufacturer number, nn is sequential number assigned by TSC measurements program.	
B01	Distance from column pivot point to column CG	(RCOL)
B02	Column dimension, firewall to shear capsule (type 1 only) zero for type 2	(LFWZ)
B03	Column dimension, wheel pivot to shear capsule (type 1) or to firewall (type 2)	(LSCZ)
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)
B05	Column dimension, wheel pivot point to fwd col bearing	(LBFZ)
B06	Column weight (stroking components)	(WC)
B07	Column coefficient of friction (telescoping parts)	(MU)
B08	Damping factor for steering column	(PDFSC)
B09	Strain rate factor applied to steering wheel and column bracketry	(WHSRF)
B01A	Column torque/rotation upward	(COLRP)
B02A	Column torque/rotation downward	(COLRN)
B03A	Column enery absorber force/stroke	(COL)

TABLE 2-3. PADS STEERING WHEEL FILE DEFINITIONS

Wheel File	[PCFGC.DAT]	
KEY	msnn where m is manufacturer number, s is number of spokes (2,3,4), nn is sequence number assigned by TSC testing program	
C01	Wheel weight	(WWH)
C02	Wheel pitching moment of inertia	(WIN)
C03	Distance from wheel pivot point to aft surface of wheel rim	(XRIM)
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)
C05	Radius of wheel rim	(RIMRAD)
C06	Fraction of maximum lower rim deflections which remains as permanent set	(PSFLR)
C07	Fraction of maximum upper rim deflections which remains as permanent set	(PSFUR)
C01A	Positive wheel torque/rotation with respect to the column	(WHRP)
C02A	Negative wheel torque/rotation with respect to the column	(WHRN)
C03A	Rim tangential force/deflection due to shoulder impact	(FSHT)
C04A	Rim radial force/deflection due to shoulder impact	(FSHR)
C05A	Rim tangential force/deflection due to head impact	(FHRT)
C06A	Rim radial force/deflection due to head impact	(FHRR)
C07A	Rim tangential force/deflection due to abdomen impact	

Column XXXX

25.400	B02:	15.800	B03:	14.250	B04:	29.400	B05:	33.300	B06:	6.890
0.069	B08:	9.100	B09:	1.370					

Type: 1

-10.000	0.000	2.100	4.200	6.700	8.600	9.900	19.300	24.500	
0.000	0.000	5000.000	6500.000	9000.000	10000.000	10000.000	10000.000	50000.000	
-10.000	0.000	10.000							
0.000	0.000	500000.000							
-10.000	0.000	0.060	0.200	0.290	0.340	0.380	0.450	0.750	0.800
1.190	1.230	1.940	2.040	2.230	2.250	4.000	5.000		
0.000	0.000	67.990	914.910	1069.980	1009.150	1040.160	924.450	920.870	746.720
669.180	650.100	635.790	597.610	566.600	552.290	577.340	600.000		

Column XXXX

12.240	B02:	14.370	B03:	13.250	B04:	15.250	B05:	19.250	B06:	6.130
0.023	B08:	12.400	B09:	1.370					

Type: 1

-10.000	0.000	2.100	4.200	6.700	8.600	9.900	19.300	24.500	
0.000	0.000	5000.000	6500.000	9000.000	10000.000	10000.000	10000.000	50000.000	
-10.000	0.000	10.000							
0.000	0.000	500000.000							
-10.000	0.000	0.300	0.330	1.410	1.790	1.830	1.950	2.130	2.540
2.560	2.680	2.770	3.780	4.140	4.430	4.950	5.300	5.740	5.830
0.000	0.000	1005.760	137.600	58.790	1103.340	507.880	596.700	549.170	934.460
616.720	963.230	430.330	1109.590	748.070	754.320	990.750	693.030	1506.140	1650.000

5.700	C02:	0.220	C03:	5.600	C04:	1.380	C05:	7.500	C06: 0.690
0.910									
.000	0.000	0.020	0.050	0.080	0.200	0.550	1.260	2.030	3.560
.530	7.620	12.060	18.400	23.770	28.820	29.820	30.000		
.000	0.000	72.660	436.310	882.130	1329.860	1789.300	2286.570	2563.310	2837.880
.950	2651.040	2314.470	1936.960	1724.850	1445.960	1379.790	4396.590		
.000	0.000	0.590	1.270	2.260	3.940	7.310	9.610	9.770	10.330
.930									
.000	0.000	345.620	701.470	1065.680	1433.920	1853.160	2107.570	2277.440	2644.990
.570									
.000	0.000	0.390	0.620	1.040	1.830	2.030	2.040	2.050	2.080
.100									
.000	0.000	120.000	181.800	243.900	293.400	293.700	308.400	341.100	355.500
.400									
.000	0.000	0.250	0.500	0.750	1.000	1.250	1.500	1.750	1.880
.000	0.000	538.000	841.000	984.000	1073.000	1139.000	1174.000	1196.000	1212.000
.000	0.000	0.390	0.620	1.040	1.830	2.030	2.040	2.050	2.080
.100									
.000	0.000	120.000	181.800	243.900	293.400	293.700	308.400	341.100	355.500
.400									
.000	0.000	0.250	0.500	0.750	1.000	1.250	1.500	1.750	1.880
.000	0.000	433.000	677.000	793.000	864.000	917.000	946.000	963.000	976.000
.000	0.000	0.170	0.330	0.510	0.850	1.500	1.890	1.910	1.960
.000	0.000	49.300	99.330	149.360	197.680	247.960	277.000	345.830	390.000
.000	0.000	0.040	0.160	0.230	0.300	0.360	0.410	0.480	0.510
.590	0.640								
.000	0.000	14.870	16.360	98.140	198.270	297.890	397.030	497.890	547.210
.400	547.710								
.000	0.000	0.140	0.180	0.440	0.490	0.560	0.640	0.700	0.750
.840	1.420	1.940	2.660	3.020	3.120				
.000	0.000	57.740	97.560	1000.490	1097.050	1198.590	1297.650	1329.000	1326.520
.640	999.990	803.870	602.780	521.650	665.000				
000	0.000	0.140	0.410	0.530	0.680	0.780	0.870	0.900	1.020
200	1.250	1.420	1.540						
000	0.000	44.830	327.890	493.120	683.960	749.280	753.120	685.240	639.130
760	573.810	630.160	748.000						

The data presented in this report are the characteristics of 21 wheel designs and 10 column designs. Because there is a significant commonality of parts across models and model years, the designs were coded and a cross-reference table was developed in order to access the test results by car model and year. Table 2-6 lists the code designation assigned to indicate a structurally unique component. The code is a four-digit number. The first digit names the manufacturer; the second digit designates whether the item is a column (1) or a wheel (2, 3 or 4-spoke); the third and fourth digits give a sequential group number for a wheel or column structural type of that manufacturer. The manufacturer code designations (first digit) are:

1.XXX	American Motors	
2.XXX	Chrysler	
3.XXX	Ford	
4.XXX	General Motors	
5.XXX	Datsun	
6.XXX	Honda	
7.XXX	Subaru	
8.XXX	Toyota	
9.XXX	Volkswagen	
9.5XX	Renault Column	(Note: Renault and Volkswagen both
9.25X	Renault Wheel	use the same first digit.)

The commonality of parts was established over the model years from 1975 to 1981 by identifying all the manufacturer's parts numbers for the steering columns and steering wheels with similar structural characteristics to those of the tested components. In identifying these columns and wheels, the following assumptions were made:

a. Wheel color and trim options do not significantly alter wheel structural characteristics.

b. The wheel tilt and adjustable column options and transmission shift type do not significantly alter column energy absorbing characteristics.

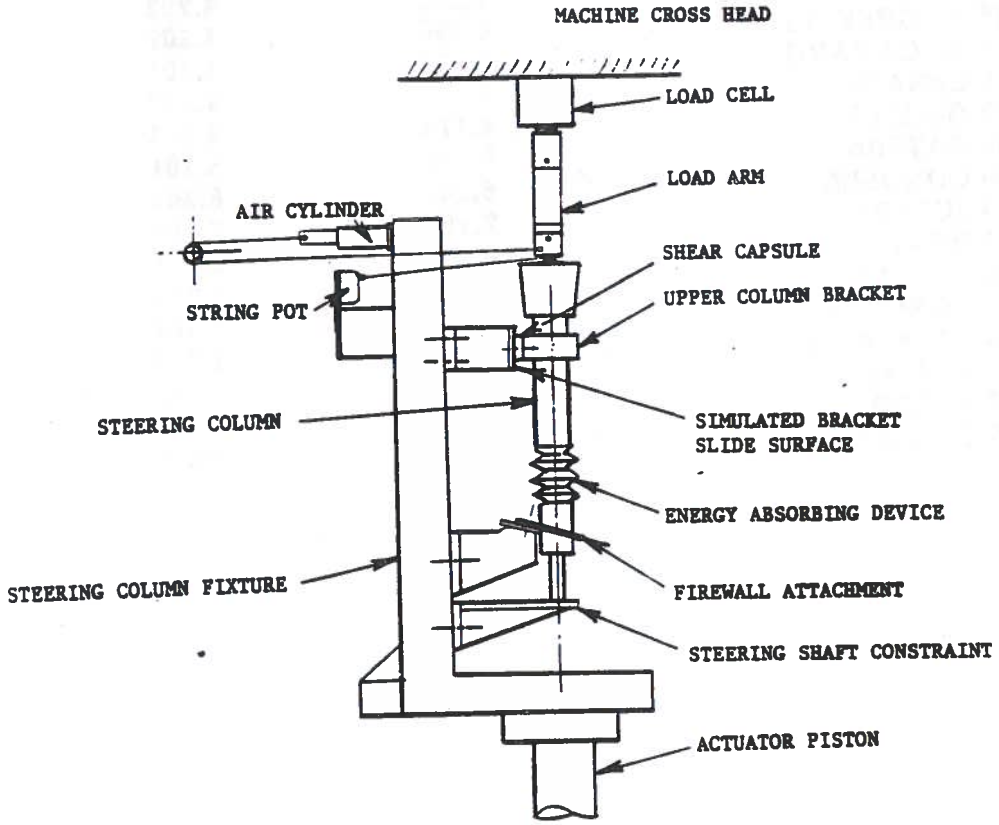
Appendix A lists the standard or optional steering columns and wheels in the top 90

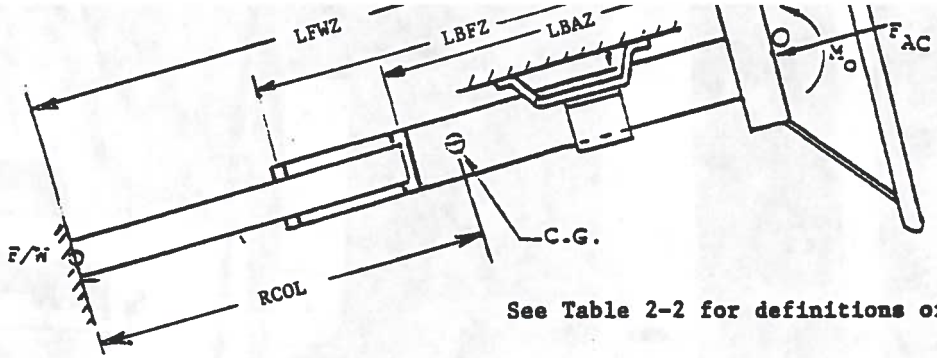
STEERING COMPONENTS TESTED

MODEL YEAR AND VEHICLE	STEERING COLUMN CODE NUMBER	STEERING WHEEL CODE NUMBER
1980 CONCORD	1.103	1.403
1976 DART/VALIANT	2.107	2.301
1976-80 ASPEN/VOLARE	2.101	2.201
1976-80 LeBARON, FURY, etc.	2.101	2.201
1978-83 OMNI/HORIZON	2.109	2.402
1975-80 PINTO/BOBCAT	3.106	3.202
1978-80 FAIRMONT/ZEPHYR	3.112	3.203
1979-81 MUSTANG/CAPRI	3.112	3.203
1975-78 FORD LTD/MERCURY	3.101	3.201
1979-81 FORD LTD/MERCURY	3.111	3.303
1975-80 GRANADA/MONARCH	3.107	3.303
1980-81 THUNDERBIRD	3.112	3.403
1978-81 MALIBU, etc.	4.104	4.202
1977-81 CAPRICE, DELTA 88, etc.	4.110	4.204
1980-81 CITATION	4.165	4.202
1978-80 MONZA	4.144	4.202
1979 NOVA	4.165	4.202
1976-81 CHEVETTE	4.156	4.207
1979-81 CAMARO	4.135	4.401
1980 LeMANS	4.104	4.307
1980 DeVILLE	4.116	4.206
1980 DATSUN	5.101	5.201
1980 COROLLA	8.102	8.204
1980 SUBARU	7.101	7.401
1980 HONDA	6.101	6.201
1980 RABBIT	9.107	9.205
1983 CONCORD	1.104	1.404
1983 CELEBRITY	4.120	4.212
1983 ACCORD	6.102	6.402
1983 FUEGO	9.501	9.251
1985 DeVILLE	4.170	not tested

3. COLUMN FORCE-DEFLECTION TESTS

The column static force-deflection tests were conducted on a 250,000 lb. MTS testing machine. The loading rate was one inch per minute, and the maximum stroking distance of the machine was ten inches. Most of the columns tested had an axial resistance of under 2,000 lbs. and an axial stroke of approximately six inches. Two column tests were made for most column designs.* In the first test only the axial load was applied, while in the second test a 250 pounds side force perpendicular to the column was applied. The purpose of the second test was to derive a friction factor for the column. The general layout of the tests is shown schematically in Figure 3-1. A photograph of a General Motors column installed in the testing fixture is shown in Figure 3-2. Except for those columns which possessed solid upper steering shafts, the lower end of the steering shaft was constrained. Figure 3-3 shows the column dimensions. Table 3-1 lists all of the column group types tested and shows the principal car models in which they were used.





See Table 2-2 for definitions of terms.

FIGURE 3-3. PADS STEERING COLUMN DIMENSIONS

TABLE 3-1. STEERING COLUMNS TESTED AND PRINCIPAL USAGE

GROUP NO.	PRINCIPAL USAGE
1.103	1980 CONCORD
1.104	1983 CONCORD
2.101	1976-80 ASPEN,VOLARE
2.107	1976 DART/VALIANT
2.109	1978-83 OMNI/HORIZON
2.114	1978-79 CHAMP
3.101	1975-76 TORINO, THUNDERBIRD
3.106	1975-80 PINTO
3.107	1975-80 GRANADA
3.111	1980-83 FORD LTD (FULL SIZE)
3.112	1980-83 MUSTANG, FAIRMONT, etc.
4.101	1975-76 MALIBU, CENTURY, etc.
4.104	1979-81 CENTURY, CUTLASS
4.110	1979-81 LeSABRE, CAPRICE, etc.
4.116	1980-83 DeVILLE
4.120	1982-83 CELEBRITY, CUTLASS, etc.
4.135	1979-81 CAMARO
4.144	1978-80 SKYHAWK, SUNBIRD
4.156	1979-81 CHEVETTE
4.165	1979-80 SKYLARK, etc.
4.170	1985 DeVILLE
5.101	1980 DATSUN
6.101	1980 CIVIC
6.102	1983 ACCORD
7.101	1980 SUBARU
8.102	1980 COROLLA
9.107	1978-81 RABBIT
9.501	1983 FUEGO

The wheel static force-deflection tests were conducted on a 20,000 lb. MTS testing machine. The loading rate was one inch per minute. For each wheel type, five wheel tests were made (Figure 4-1). Figure 4-2 shows the test set-up for the radial bottom test. Figure 4-3 shows the load-arm and the string-potentiometers arrangement in the paraxial bottom test. In the paraxial and radial tests loads were applied until either the wheel deflected and struck the fixture or the load-arm made contact with the wheel hub. Figure 4-4 gives the location of wheel dimensions. The measurements of the wheel dimensions and weights were made prior to the testing. The permanent deflection of the wheel was measured after the testing. Table 4-1 lists all of the wheel group types tested and shows the principal car models in which they were used. Wheel Fact Sheets are presented in Appendix C.

TABLE 4-1. STEERING WHEELS TESTED AND PRINCIPAL USAGE

GROUP NO.	PRINCIPAL USAGE
1.403	1979-81 CONCORD
1.404	1983 CONCORD
2.201	1976-80 ASPEN/VOLARE
2.301	1975-76 DART/VALIANT
2.402	1978-83 OMNI/HORIZON
3.201	1975-78 FORD LTD (FULL SIZE), TORINO
3.202	1975-80 PINTO
3.203	1979-82 MUSTANG, FAIRMONT
3.303	1980 GRANADA, PINTO
3.403	1979-82 FORD LTD (FULL SIZE), FAIRMONT
4.202	1977-81 MALIBU
4.204	1977-81 CUTLASS, LESABRE
4.206	1979-81 DEVILLE
4.207	1976-81 CHEVETTE
4.212	1983-84 CELEBRITY
4.307	1975-81 PONTIAC
4.401	1975-81 CAMARO
5.201	1980 DATSUN
6.201	1980 CIVIC
6.202	1983 ACCORD
7.401	1980 SUBARU
8.204	1975-83 COROLLA
9.205	1975-81 RABBIT
9.251	1983 FUEGO

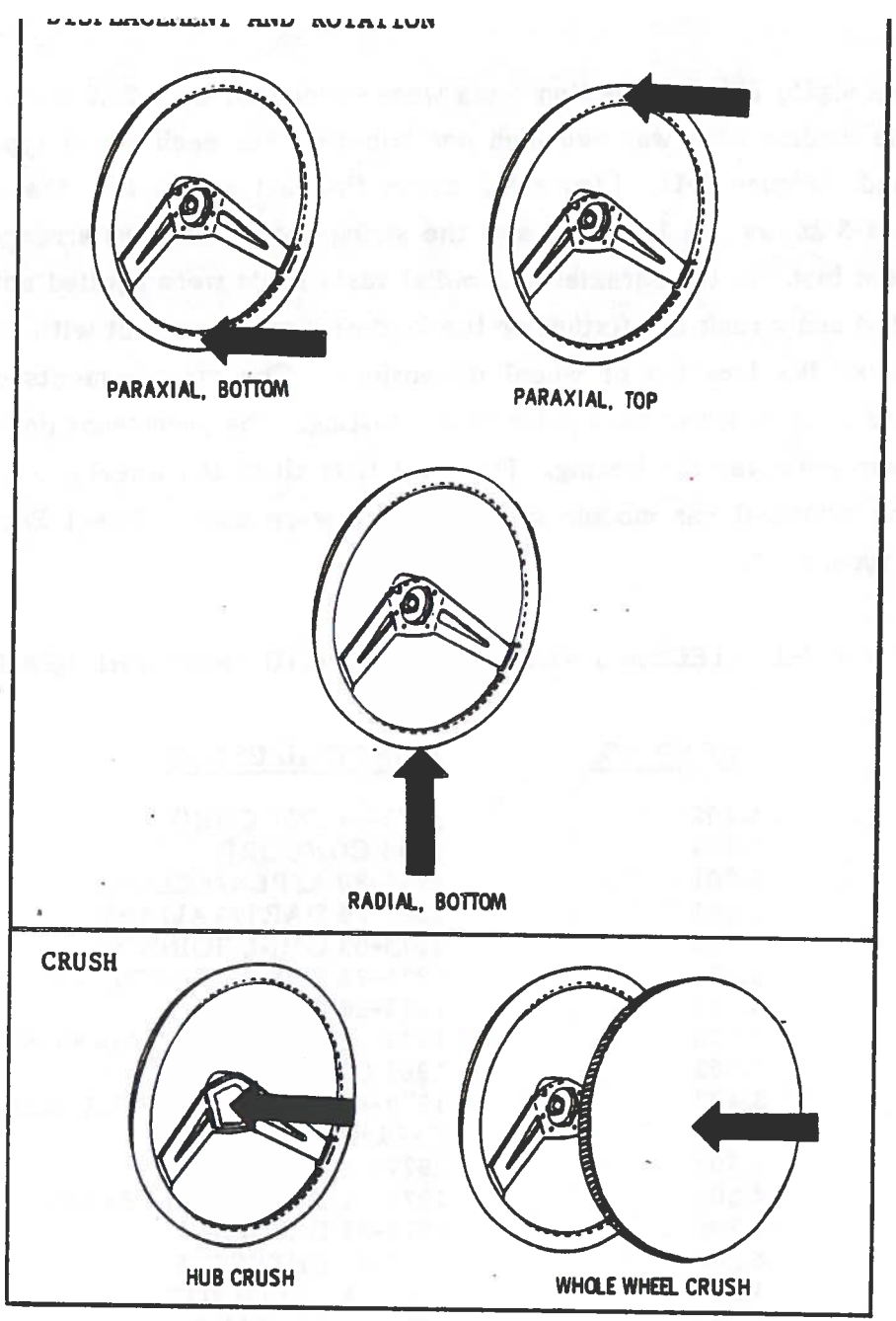


FIGURE 4-1. STEERING WHEEL TESTS

FIGURE 4.2 STEERING WHEEL RADIAL BOTTOM TEST (TYPICAL)

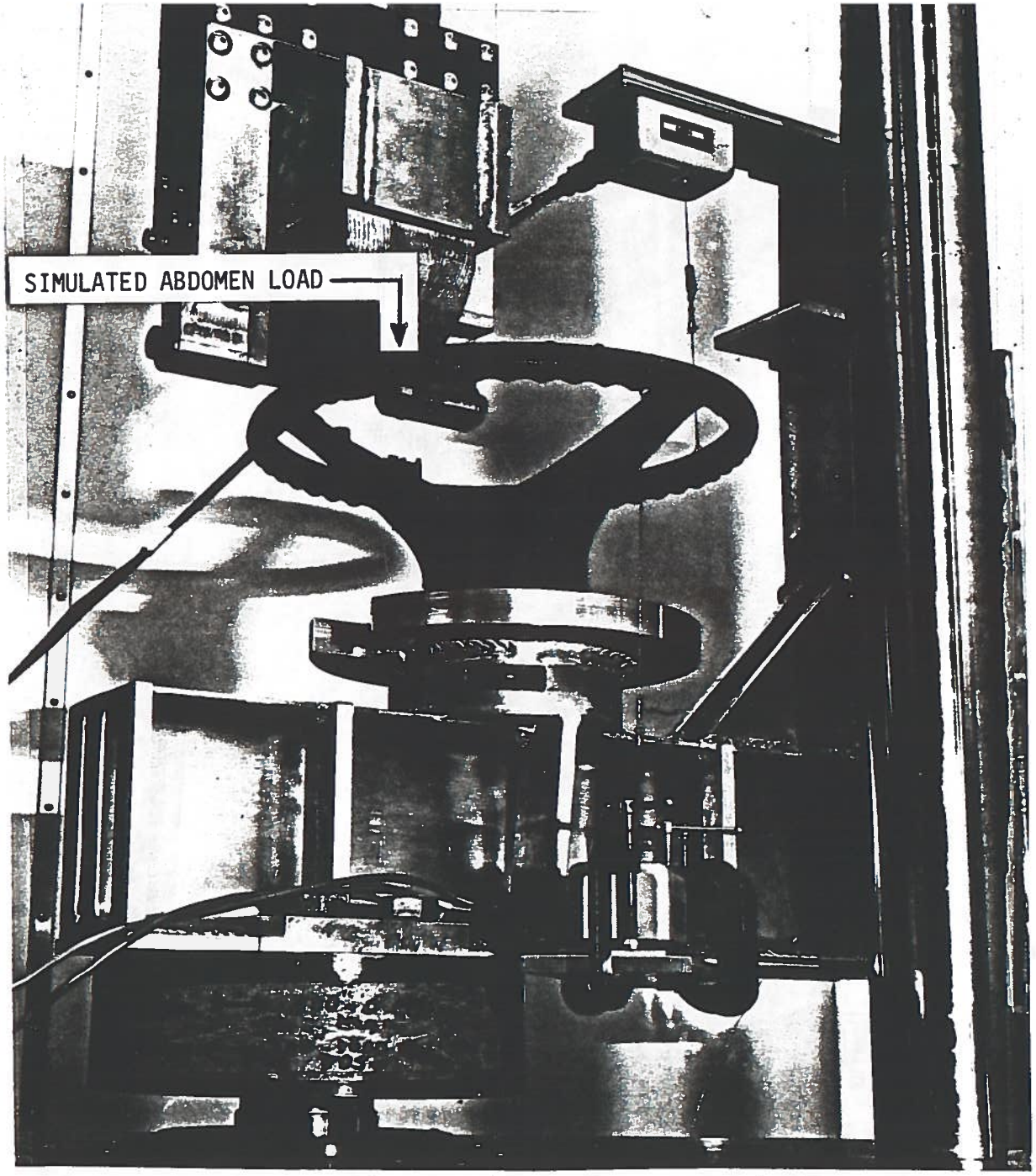
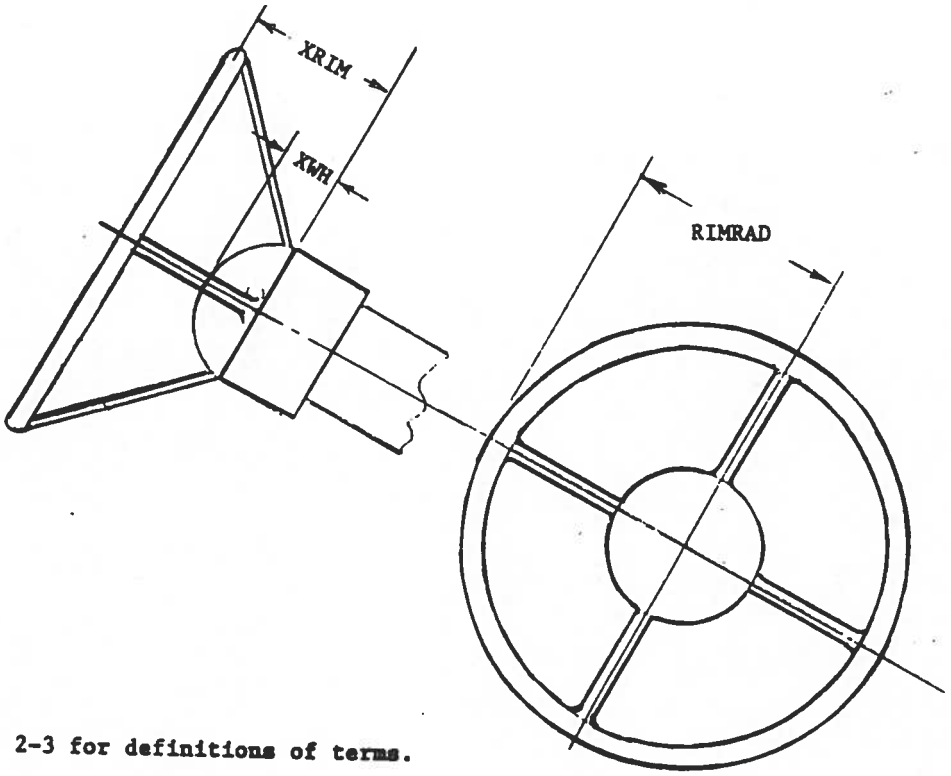


FIGURE 4.3 STEERING WHEEL PARAXIAL BOTTOM TEST (TYPICAL)



See Table 2-3 for definitions of terms.

FIGURE 4-4. PADS STEERING WHEEL DIMENSIONS

APPENDIX A

STEERING COLUMN AND STEERING WHEEL INDEX

(AMERICAN MOTORS, CHRYSLER)

VEHICLE MAKE/MODEL	MODEL YEAR 1975	1976	1977	1978	1979	1980	1981	1982	1983
AMERICAN MOTORS									
Concord						1.103 1.403			1.104 1.404
CHRYSLER									
LeBaron			2.101 2.201	2.101 2.201	2.101 2.201 2.202	2.102 2.201 2.202	2.102 2.203	2.102	2.102
			2.301	2.301	2.301	2.301 2.302	2.205 2.302	2.205	2.205
Cordoba	2.104	2.103 2.201 2.202	2.103 2.201 2.202	2.103 2.201 2.202	2.103 2.201 2.202	2.101 2.201 2.202	2.101 2.203	2.101	2.101
	2.301	2.302 2.303	2.302 2.303	2.301	2.301	2.301 2.302	2.205 2.302	2.205 2.401	2.205 2.401
Imperial	2.105 2.301 2.302						2.101 2.205	2.101 2.205	2.101 2.205

(CHRYSLER)									
VEHICLE	MODEL YEAR								
MAKE/MODEL	1975	1976	1977	1978	1979	1980	1981	1982	1983
DODGE									
Dart	2.106	2.107							
	2.301	2.301							
	2.302	2.302							
Aspen		2.101	2.101	2.101	2.101	2.101			
		2.201	2.201	2.201	2.201	2.201			
					2.202	2.202			
		2.301	2.301	2.301	2.301	2.301			
				2.302	2.302	2.302			
		2.304	2.304	2.304					
Coronet, Charger	2.104	2.103	2.103	2.103	2.103				
		2.201	2.201	2.201	2.201				
	2.301			2.301	2.301				
	2.302	2.302	2.302						
		2.304	2.304						
Omni				2.109	2.109	2.109	2.109	2.109	2.109
				2.110	2.110	2.110	2.110	2.110	2.110
				2.201	2.201				
				2.202	2.202				
						2.301			
						2.303	2.303	2.303	
				2.307	2.307				
				2.402	2.402	2.402	2.402	2.402	2.402
Colt	2.111	2.111	2.111	2.111	2.111	2.111			
	2.113	2.113	2.113	2.113	2.113	2.113			
	2.206	2.206	2.206	2.206					
					2.207	2.207			
	2.305	2.305	2.305	2.305	2.305	2.305			

(CHRYSLER)

VEHICLE MAKE/MODEL	MODEL YEAR 1975	1976	1977	1978	1979	1980	1981	1982	1983
PLYMOUTH									
Volare		2.101	2.101	2.101	2.101	2.101			
		2.201	2.201	2.201	2.201	2.201			
					2.202	2.202			
		2.301	2.301	2.301	2.301	2.301			
				2.302	2.302	2.302			
		2.304	2.304	2.304					
Horizon				2.109	2.109	2.109	2.109	2.109	2.109
				2.110	2.110	2.110	2.110	2.110	2.110
				2.201	2.201				
				2.202	2.202				
				2.301	2.301	2.301			
						2.303	2.303	2.303	
				2.402	2.402	2.402	2.402	2.402	2.402
Fury	2.104	2.103	2.103	2.103					
			2.108	2.108					
		2.201	2.201	2.201					
	2.301	2.301	2.301	2.301					
		2.304	2.304						
Valiant	2.106	2.107							
	2.301	2.301							
	2.302	2.302							
Champ				2.114	2.114				
				2.207	2.207				

(FORD)									
VEHICLE	MODEL YEAR								
MAKE/MODEL	1975	1976	1977	1978	1979	1980	1981	1982	1983
FORD Full Size	3.101 3.201	3.101 3.201	3.101 3.201	3.101 3.201	3.110 3.403	3.111 3.403	3.111 3.403	3.111 3.403	3.111 3.403
Torino	3.105 3.201	3.105 3.201							
Mustang	3.106 3.201	3.106 3.201	3.106 3.201 3.301	3.106 3.201 3.301	3.108 3.203 3.302 3.403	3.112 3.202 3.302 3.403	3.112 3.203 3.302 3.403	3.112 3.203 3.302 3.401 3.403	3.112 3.303 3.402 3.404
Granada	3.107 3.201	3.107 3.201	3.107 3.201 3.302	3.107 3.201 3.301	3.107 3.201 3.301	3.107 3.201 3.303	3.112 3.302 3.403	3.112 3.302 3.403	
Pinto	3.106 3.201 3.202	3.106 3.201 3.202	3.106 3.201 3.202 3.301	3.106 3.201 3.202 3.301	3.106 3.201 3.202 3.301	3.106 3.201 3.202 3.303			
Fairmont				3.108 3.203 3.302	3.108 3.203 3.302 3.403	3.112 3.203 3.302 3.403	3.112 3.203 3.403	3.112 3.203 3.403	3.112 3.204 3.404

(FORD)									
VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Thunderbird	3.105 3.201	3.105 3.201	3.105 3.201 3.301	3.105 3.201 3.301	3.105 3.201	3.112 3.403	3.112 3.403	3.112 3.403	3.112 3.404
LINCOLN-MERCURY Mercury, Full Size	3.101 3.201	3.101 3.201	3.101 3.201	3.101 3.201	3.110 3.403	3.111 3.403	3.111 3.403	3.111 3.403	3.111 3.403
Montego	3.105 3.201	3.105 3.201							
Lincoln	3.103 3.201	3.103 3.109 3.201	3.109 3.201	3.109 3.201	3.109 3.201	3.111 3.403	3.111 3.403	3.111 3.403	3.111 3.404
Monarch	3.107 3.201	3.107 3.201	3.107 3.201 3.301	3.107 3.201 3.301	3.107 3.201 3.301	3.107 3.201 3.303			
Capri	3.102 3.205	3.102 3.205	3.102 3.205	3.102 3.205	3.108 3.302 3.403	3.112 3.302 3.403	3.112 3.302 3.403	3.112 3.302 3.403	3.112 3.303 3.404
Bobcat	3.104 3.201	3.104 3.201	3.104 3.201 3.202 3.301	3.104 3.201 3.202 3.301	3.106 3.201 3.301	3.106 3.201 3.303			

(FORD)									
VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Zephyr				3.108 3.203 3.302	3.108 3.203 3.302 3.403	3.112 3.203 3.302 3.403	3.112 3.203 3.403	3.112 3.203 3.403	3.112 3.204 3.404

(GENERAL MOTORS)									
VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
BUICK Century		4.101 4.201 4.301	4.102 4.201 4.202 4.301	4.103 4.204	4.104 4.204	4.101 4.204 4.206	4.104 4.204 4.205		
Regal		4.101 4.201 4.301	4.102 4.201 4.202 4.301	4.103 4.204	4.104 4.204	4.104 4.204 4.206	4.104 4.204 4.205		
LeSabre		4.107 4.201 4.203 4.301 4.303	4.108 4.201 4.203 4.202 4.301 4.303	4.108 4.204 4.303	4.110 4.204 4.303	4.110 4.204 4.205 4.206	4.110 4.204 4.205		
Electra		4.107 4.203 4.301 4.303	4.108 4.203 4.301 4.303	4.108 4.204 4.303	4.110 4.204 4.303	4.110 4.204 4.205 4.206	4.110 4.204 4.205		

(GENERAL MOTORS)

VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Riviera		4.107	4.108	4.108					
				4.124	4.124	4.124			
					4.125	4.125	4.125		
							4.129		
		4.203	4.203						
				4.204	4.204				
					4.205	4.205	4.205		
		4.301	4.301						
		4.303	4.303	4.303	4.303				
Skyhawk		4.142	4.143	4.144	4.114	4.114			
		4.201	4.201						
			4.202						
				4.204	4.204	4.204			
				4.401	4.401	4.401			
Skylark		4.161	4.162						
			4.163	4.164	4.165	4.165	4.166		
		4.201	4.201						
		4.203	4.203						
			4.202						
			4.204	4.204	4.204	4.204			
					4.206	4.206			

(GENERAL MOTORS)									
VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
CADILLAC DeVille	4.303	4.112 4.303	4.113 4.205	4.114 4.205	4.115 4.206	4.116 4.206	4.116 4.117 4.206		
Fleetwood	4.303	4.112 4.303	4.113 4.205	4.114 4.205	4.115 4.206	4.116 4.206	4.116 4.117 4.206		
Eldorado	4.303	4.119 4.303	4.121 4.205	4.123 4.205	4.126 4.206	4.127 4.206	4.127 4.206		
Seville	4.303	4.148 4.149 4.303	4.150 4.205	4.151 4.205	4.152 4.206	4.127 4.206	4.127 4.206		

VEHICLE MAKE/MODEL	(GENERAL MOTORS) MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
CHEVROLET Malibu	4.101 4.201	4.101 4.201 4.401	4.102 4.201 4.202 4.401	4.103 4.201 4.202	4.104 4.202	4.104 4.202	4.104 4.202		
Full Size	4.106 4.201	4.106 4.201	4.108 4.201 4.202	4.108 4.201 4.202	4.110 4.202	4.110 4.202	4.110 4.202		
Camaro	4.131 4.132 4.401	4.131 4.132 4.401	4.131 4.401	4.133 4.134 4.401	4.135 4.401	4.135 4.401	4.135 4.137 4.401		
Monza	4.140 4.201	4.140 4.142 4.201 4.207	4.140 4.143 4.201 4.202 4.207	4.144 4.202 4.207	4.144 4.202 4.207	4.144 4.202 4.207			
Vega	4.140 4.201	4.140 4.201	4.140 4.201 4.202						
Chevette		4.153 4.207	4.153 4.154 4.207	4.155 4.207	4.156 4.207	4.156 4.207	4.156 4.207		
Nova	4.159 4.201 4.401	4.160 4.201 4.401	4.162 4.201	4.164 4.202					
Citation						4.165 4.202 4.206	4.166 4.202 4.206		
Monte Carlo	4.101 4.201	4.101 4.201	4.102 4.201 4.202	4.103 4.201 4.202	4.104 4.202	4.104 4.202	4.104 4.202		

(GENERAL MOTORS)

VEHICLE MAKE/MODEL	MODEL YEAR 1975	1976	1977	1978	1979	1980	1981	1982	1983
OLDSMOBILE Cutlass	4.101	4.101 4.201 4.203	4.102 4.201 4.202 4.203 4.204 4.402	4.103 4.204 4.209 4.402	4.101 4.204 4.209 	4.104 4.204 4.306 	4.104 4.204 4.306 		
Delta 88		4.107 4.203	4.108 4.202 4.203 4.305 4.402	4.108 4.109 4.204 4.209 4.305 4.402	4.110 4.204 4.209 4.305 	4.110 4.204 4.210 4.306	4.110 4.204 4.210 4.306		
Ninety-Eight		4.107 4.203 4.305	4.108 4.203 4.305	4.108 4.109 4.204 4.305	4.110 4.204 4.305	4.110 4.204 4.210 	4.110 4.204 4.210 		
Toronado		4.118 4.203 4.305	4.120 4.203 4.305	4.124 4.122 4.204 4.305	4.124 4.125 4.204 4.305	4.124 4.125 4.204 4.210 	 4.125 4.128 4.204 4.210 		

(GENERAL MOTORS)

VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Starfire	4.140 4.201	4.140 4.142 4.201 4.402	4.140 4.143 4.202 4.402	4.144 4.204 4.402	4.144 4.204 4.402	4.144 4.204 4.402			
Omega		4.160 4.201 4.203	4.162 4.201 4.202 4.203 4.402	4.164 4.204 4.209 4.402	4.165 4.204 4.209	4.165 4.204 4.209 4.306	4.166 4.204 4.306		

(GENERAL MOTORS)									
VEHICLE	MODEL YEAR								
MAKE/MODEL	1975	1976	1977	1978	1979	1980	1981	1982	1983
PONTIAC									
LeMans		4.101	4.102	4.103	4.104	4.104	4.104		
	4.211	4.211							
	4.307	4.307	4.307	4.307	4.307	4.307	4.307		
	4.308	4.308	4.308	4.308	4.308	4.308	4.308		
Full Size		4.107	4.108	4.108	4.110	4.110	4.110		
	4.211	4.211							
	4.307	4.307	4.307	4.307	4.307	4.307	4.307		
				4.308	4.308	4.308	4.308		
Firebird		4.131	4.131	4.133	4.136	4.136	4.136		
		4.132		4.134			4.138		
	4.211	4.211							
	4.307	4.307	4.307	4.307	4.307	4.307	4.307		
		4.308	4.308	4.308	4.308	4.308	4.308		
				4.309	4.309	4.309	4.309		
Gran Prix		4.101	4.102	4.103	4.104	4.104	4.104		
	4.211	4.211							
	4.307	4.307	4.307	4.307	4.307	4.307	4.307		
		4.308	4.308	4.308	4.308	4.308	4.308		
Astre	4.140	4.140	4.140						
			4.141						
	4.211	4.211							
	4.307	4.307	4.307						
		4.308	4.308						
Sunbird		4.142	4.143	4.144	4.144	4.144			
		4.211							
		4.307	4.307	4.307	4.307	4.307			
	-	4.308	4.308	4.308	4.308	4.308			
T1000							4.156		
							4.207		

(GENERAL MOTORS)

VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Ventura	4.159 4.211 4.307 4.308	4.160 4.211 4.307 4.308	4.162 4.307 4.308						
Phoenix			4.164 4.307 4.308	4.165 4.307 4.308	4.165 4.307 4.308	4.165 4.307 4.308	4.166 4.307 4.308		

(IMPORT)

VEHICLE MAKE/MODEL	MODEL YEAR 1975	1976	1977	1978	1979	1980	1981	1982	1983
DATSUN Model 210						5.101 5.201			
HONDA Civic						6.101 6.201			
Accord									6.102 6.402
SUBARU GL						7.101 7.401			
TOYOTA Celica Coupe			8.110	8.110 8.307 8.402 8.404	8.110 8.305 8.402	8.110 8.306 8.402 8.403	8.110 8.107 8.208 8.306 8.403	8.107 8.208 8.306 8.403	8.107 8.208 8.306
Celica Liftback	8.112 8.113 8.307 8.404	8.113 8.307 8.404	8.113 8.110 8.307 8.305 8.404 8.402	8.110 8.307 8.305 8.402	8.110 8.307 8.306 8.402 8.403	8.110 8.307 8.306 8.403	8.110 8.107 8.208 8.307 8.306 8.403	8.107 8.208 8.306 8.306	8.107 8.208 8.306
Celica Supra					8.110 8.403	8.110 8.403	8.110 8.107 8.208 8.403	8.107 8.208	8.107 8.208

(IMPORT)

VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Celica Hardtop	8.112 8.113 8.307 8.404	8.113 8.307 8.404	8.113 8.307 8.404						
Corolla Sedan	8.103 8.204 8.205 8.302	8.103 8.204 8.302	8.103 8.204 8.302	8.103 8.204	8.103 8.102 8.204	8.102 8.204	8.102 8.204 8.201	8.102 8.101 8.204 8.201	8.101 8.204 8.201
Corolla Coupe	 8.301 8.401	8.103 8.301 8.401	8.103 8.301 8.401	8.103 8.301 8.401	8.103 8.102 8.203 8.301 8.401	8.102 8.203 	8.102 8.203 8.201 	8.102 8.101 8.201 8.202 	8.101 8.201 8.202
Corolla Hardtop	8.103 8.204 8.205 	8.103 8.204 8.301 8.401	8.103 8.204 8.301 8.401	8.103 8.204 8.301 8.401	8.103 8.102 8.204 8.301 8.401	8.102 8.204 	8.102 8.204 8.201 	8.102 8.101 8.204 8.201 8.202	7.101 8.204 8.202
Corolla Liftback	 – 	8.103 8.301	8.103 8.301	8.103 8.301	8.103 8.102 8.203 8.301	8.102 8.203 	8.102 8.203 8.201 	8.102 8.101 8.201 8.202 	8.101 8.201 8.202

(IMPORT)

VEHICLE MAKE/MODEL	MODEL YEAR								
	1975	1976	1977	1978	1979	1980	1981	1982	1983
Corolla Station Wagon	8.103 8.204 8.205 8.302	8.103 8.204 8.302	8.103 8.204 8.302	8.103 8.204	8.103 8.102 8.204	8.102 8.204	8.102 8.204 8.201	8.102 8.101 8.204 8.201 8.202	8.101 8.204 8.201 8.202
VOLKSWAGEN Beetle	9.103 9.203	9.103 9.203	9.103 9.203	9.103 9.203					
Super Beetle	9.104 9.105 9.203	9.104 9.105 9.203	9.104 9.105 9.203	9.104 9.105 9.203					
Rabbit (Import)	9.106 9.204 9.302	9.107 9.205 9.302	9.107 9.205 9.302	9.107 9.205 9.302	9.107 9.205 9.302				
Rabbit (Domestic)					9.107 9.205 9.212	9.107 9.205 9.212	9.107 9.205 9.212		
Sirocco	9.106 9.205 9.301	9.106 9.205 9.301	9.106 9.205 9.302	9.106 9.205 9.302	9.106 9.205 9.302	9.106 9.205 9.302	9.106 9.205 9.302		
RENAULT Fuego (Column) Fuego (Wheel)									9.501 9.251

APPENDIX B
COLUMN FACT SHEETS

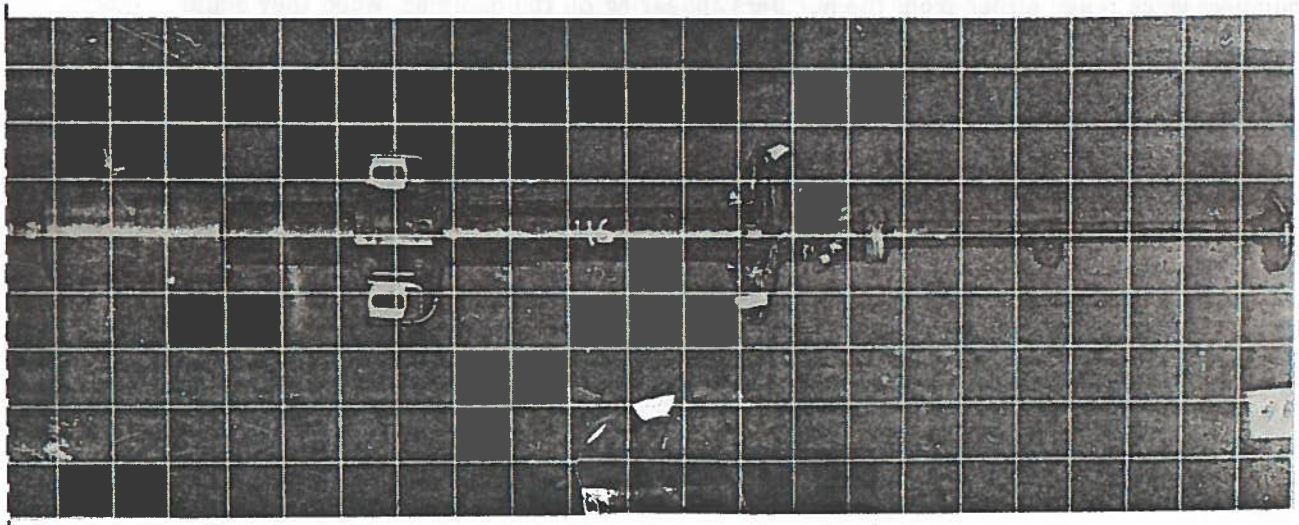
The fact sheets for each steering column group contain: (a) the vehicles on which this column group were used, (b) the manufacturer's part number, (c) an illustration, when available, (d) the steering column's physical measurements, and (e) the static load-deflection test results. The vehicle usage listing in the fact sheets identifies all the vehicles and model years that the particular column was used. The steering column part numbers were taken either from the numbers appearing on the columns, when they could be identified, or from the manufacturer's parts catalog. The column characteristics include the dimensions. The column dimensions are shown in Figure 3-3.

The column test results are presented as load-deflection traces, one for a pure axial load and one for the combined axial and side load. For the column types, where just one column could be procured, only the axial load test was run.

COLUMN GROUP NO: 1.103

STEERING COLUMN FACT SHEET

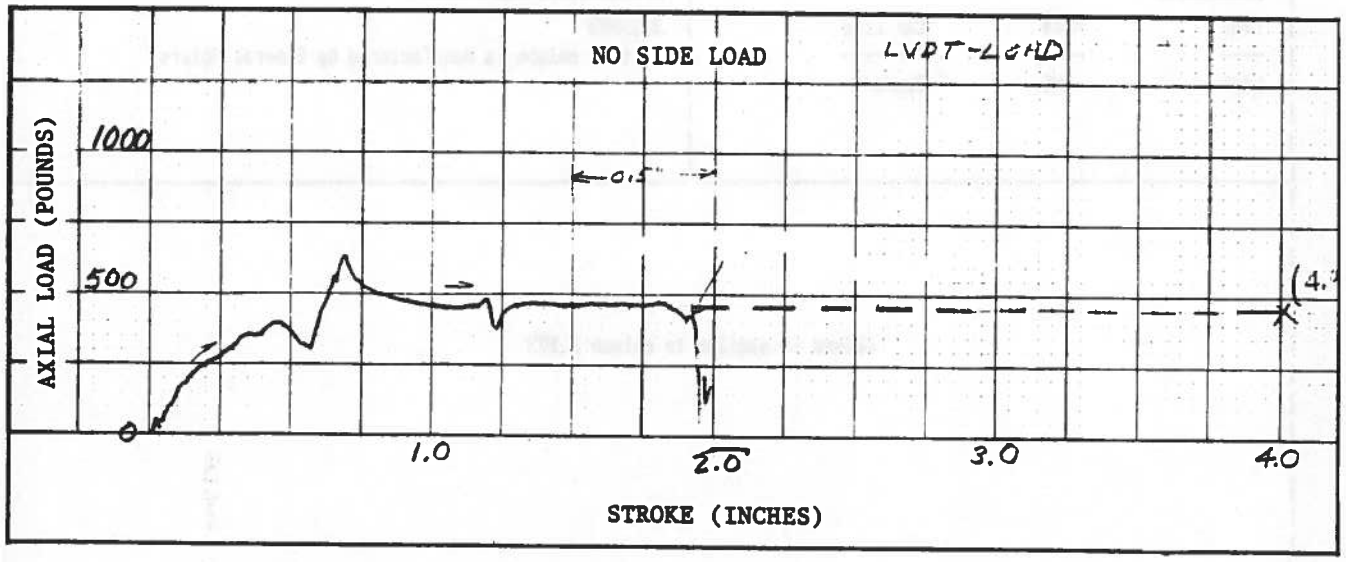
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	3250558
1980	AMC	Concord	(this column is manufactured by General Motors)

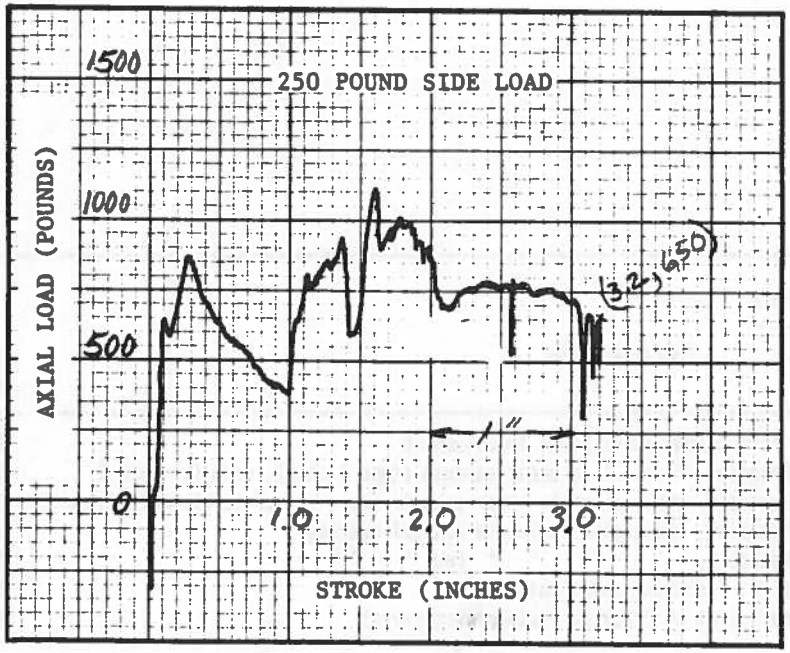


Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	25.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.8	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.25	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	29.4	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	33.0	in.
B06	Column weight (stroking components)	(WZ)	6.89	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.62	

COLUMN GROUP NO. 1.103





COLUMN GROUP NO. 1.104

STEERING COLUMN FACT SHEET

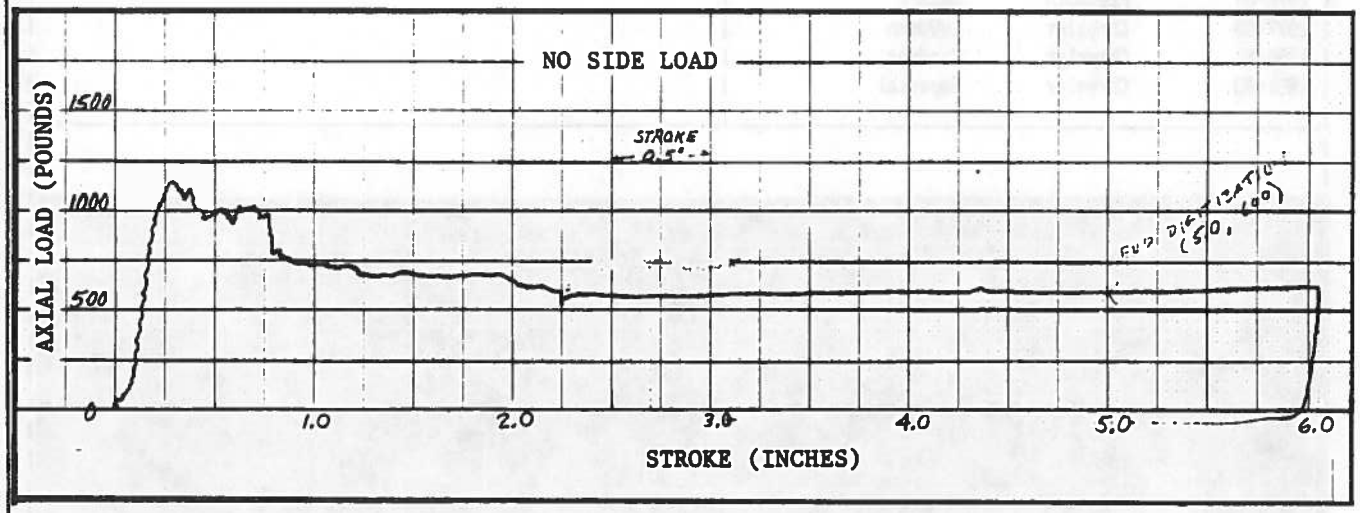
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	3239883
1983	AMC	Concord	(this column is manufactured by General Motors)

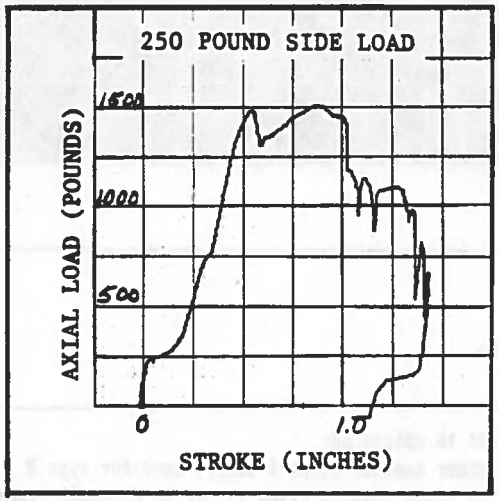
Column is similar to column 1.103

Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	25.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.8	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.25	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	29.4	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	33.0	in.
B06	Column weight (stroking components)	(WZ)	6.89	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.62	

COLUMN GROUP NO. 1.104

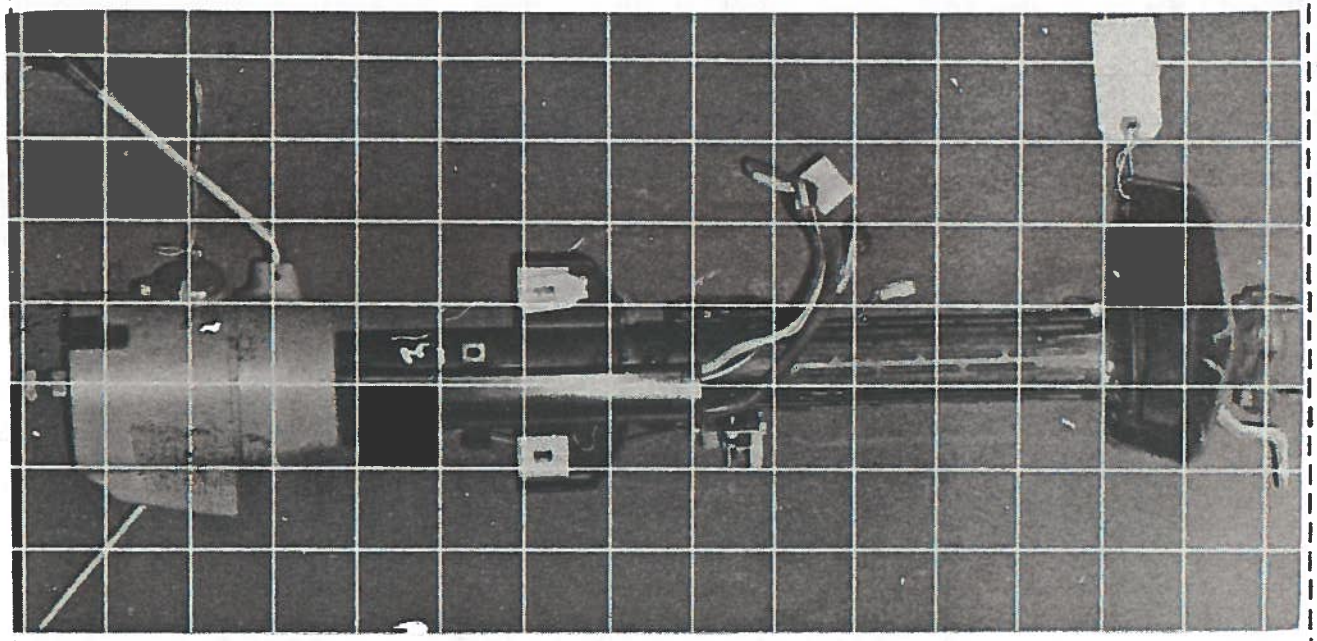




COLUMN GROUP NO. 2.101

STEERING COLUMN FACT SHEET

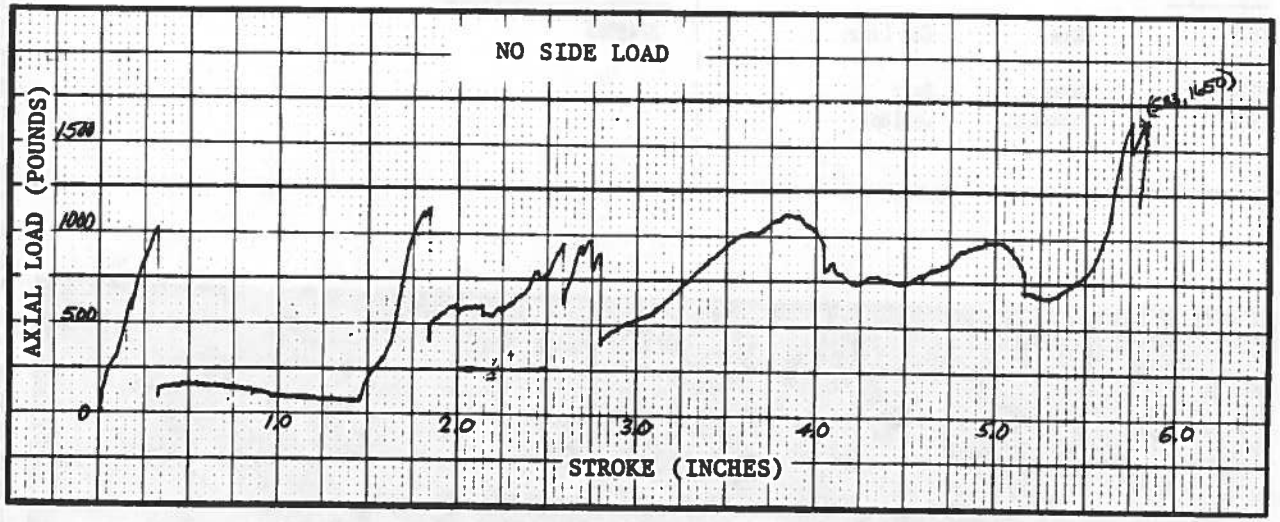
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	4019495
1976-80	Dodge	Aspen	
1976-80	Plymouth	Volare	
1977-83	Chrysler	LeBaron	
1980-83	Chrysler	Cordoba	
1981-83	Chrysler	Imperial	

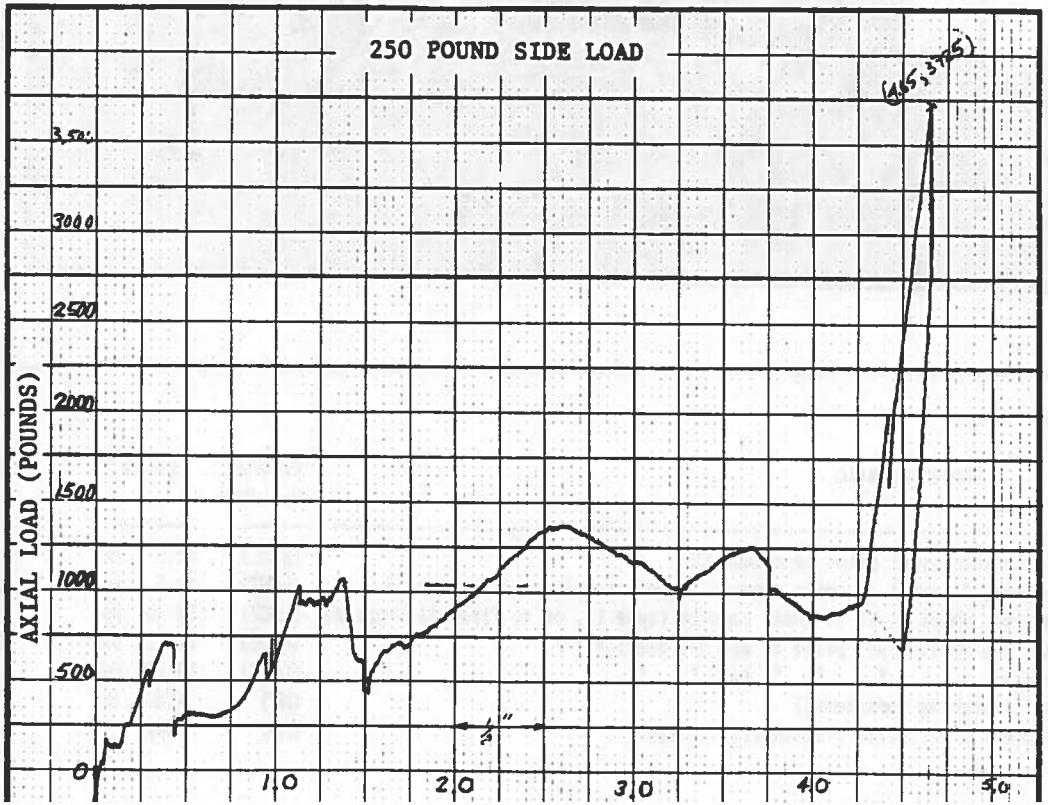


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	12.24 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	14.37 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.25 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	19.25 in.
B06	Column weight (stroking components)	(WZ)	6.13 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.21

COLUMN GROUP NO. 2.101





COLUMN GROUP NO. 2.107

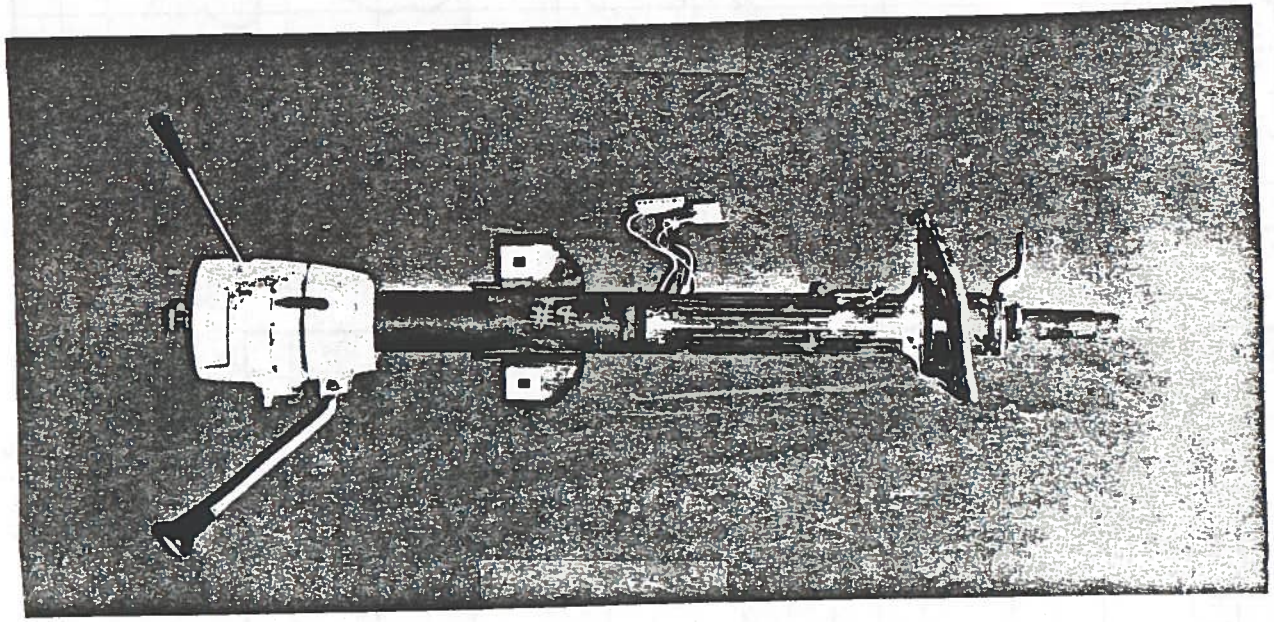
STEERING COLUMN FACT SHEET

Vehicle Use

Year	Make	Car Line
1976	Dodge	Dart
1976	Plymouth	Valiant

Manufacturer's Part No.

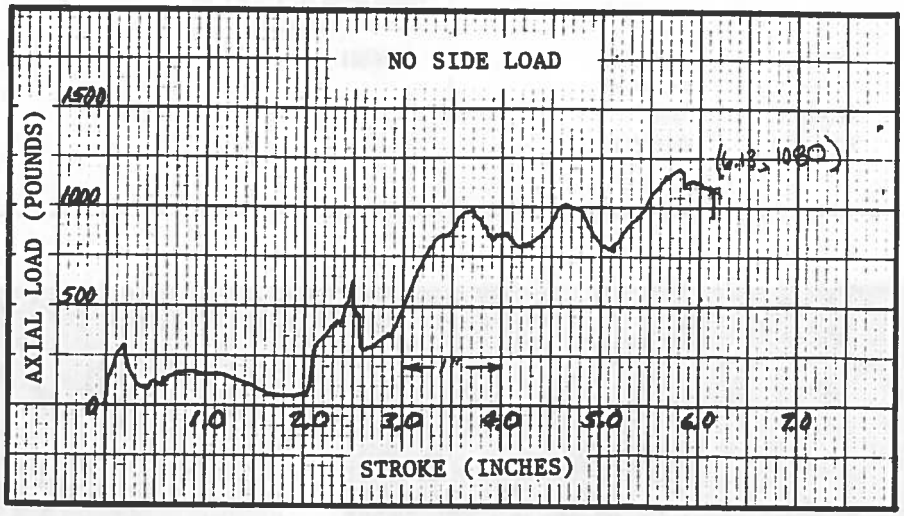
3748905

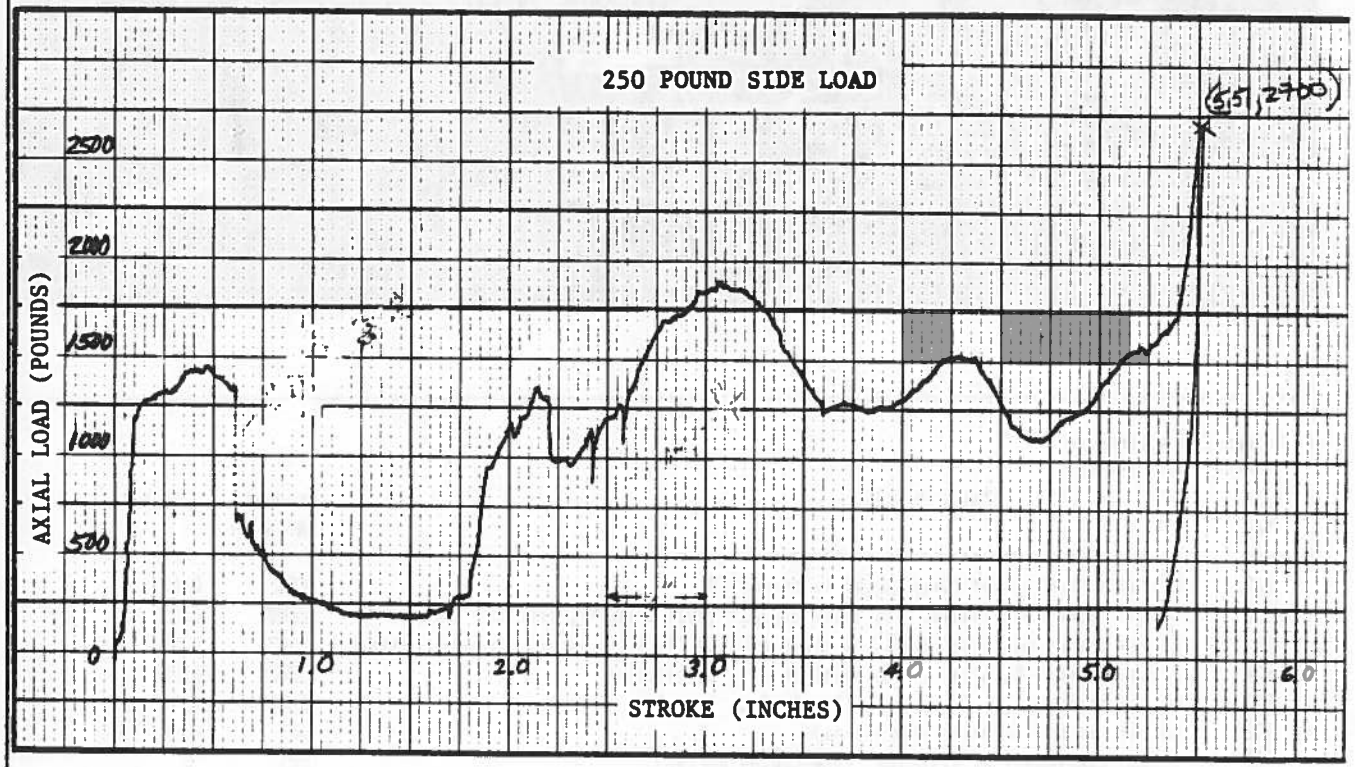


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	11.0 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	13.5 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	14.75 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	18.75 in.
B06	Column weight (stroking components)	(WZ)	6.64 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.47

COLUMN GROUP NO. 2.107

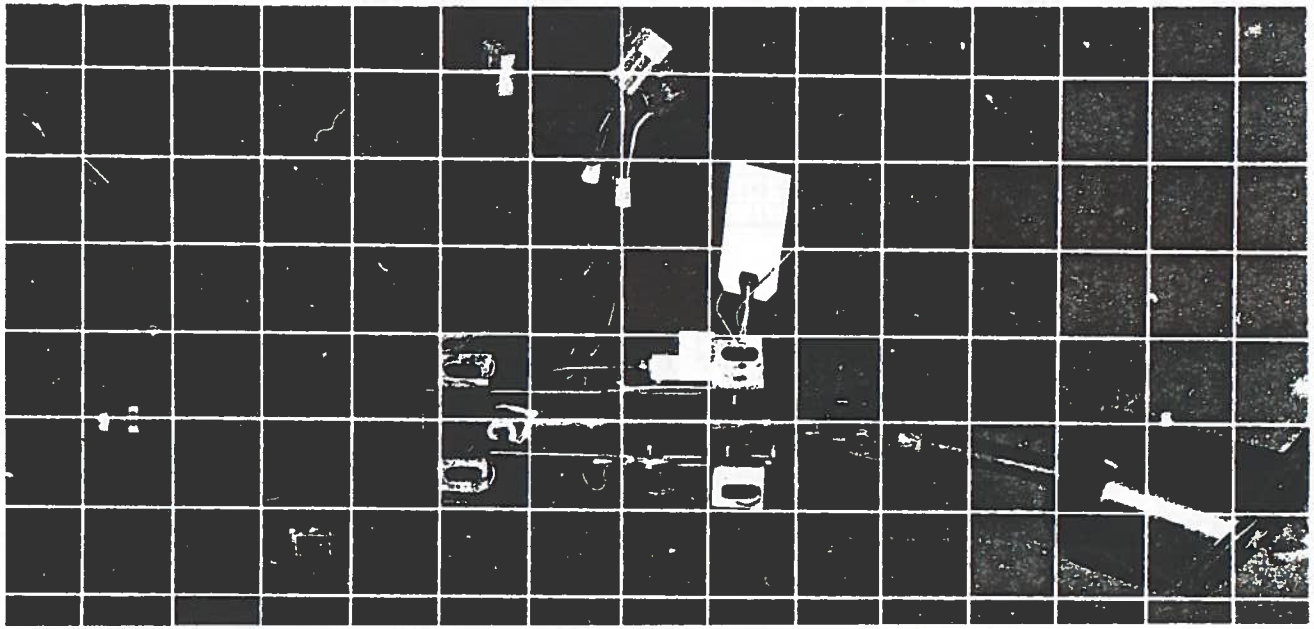




COLUMN GROUP NO. 2.109

STEERING COLUMN FACT SHEET

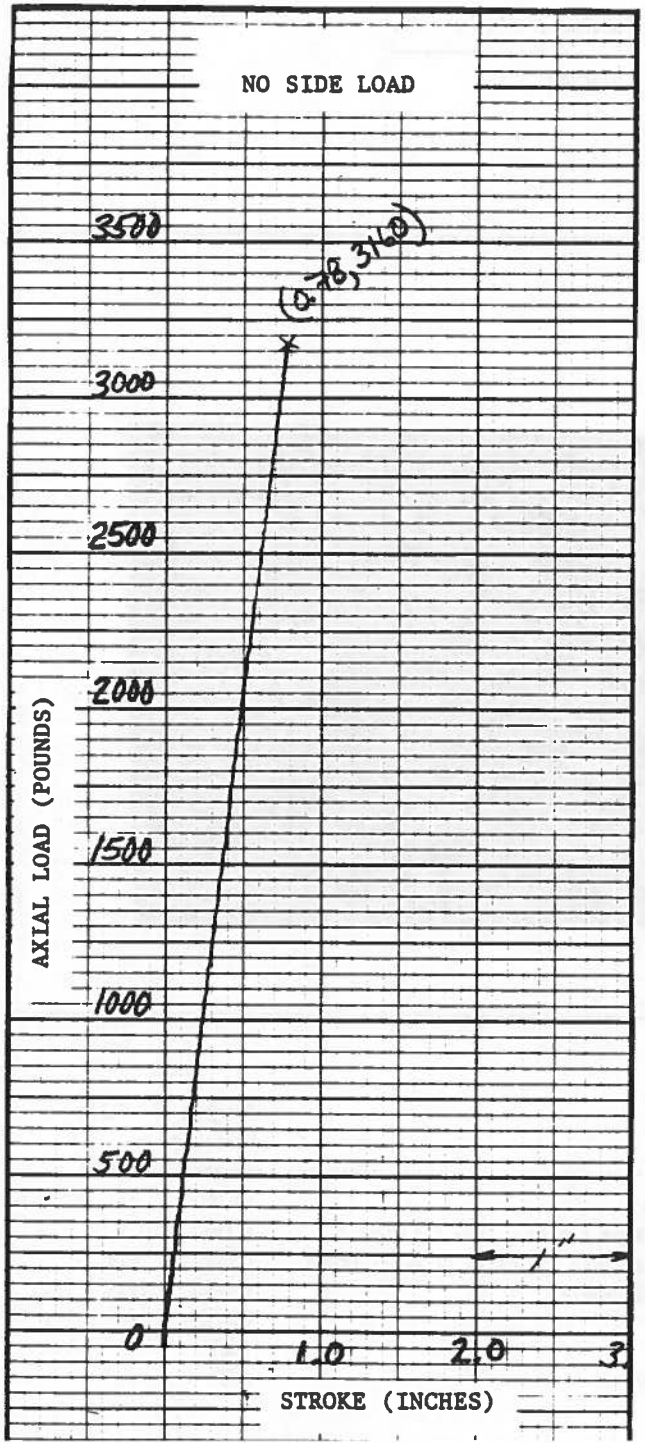
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	5206801
1978-83	Dodge	Omni	
1978-83	Plymouth	Horizon	

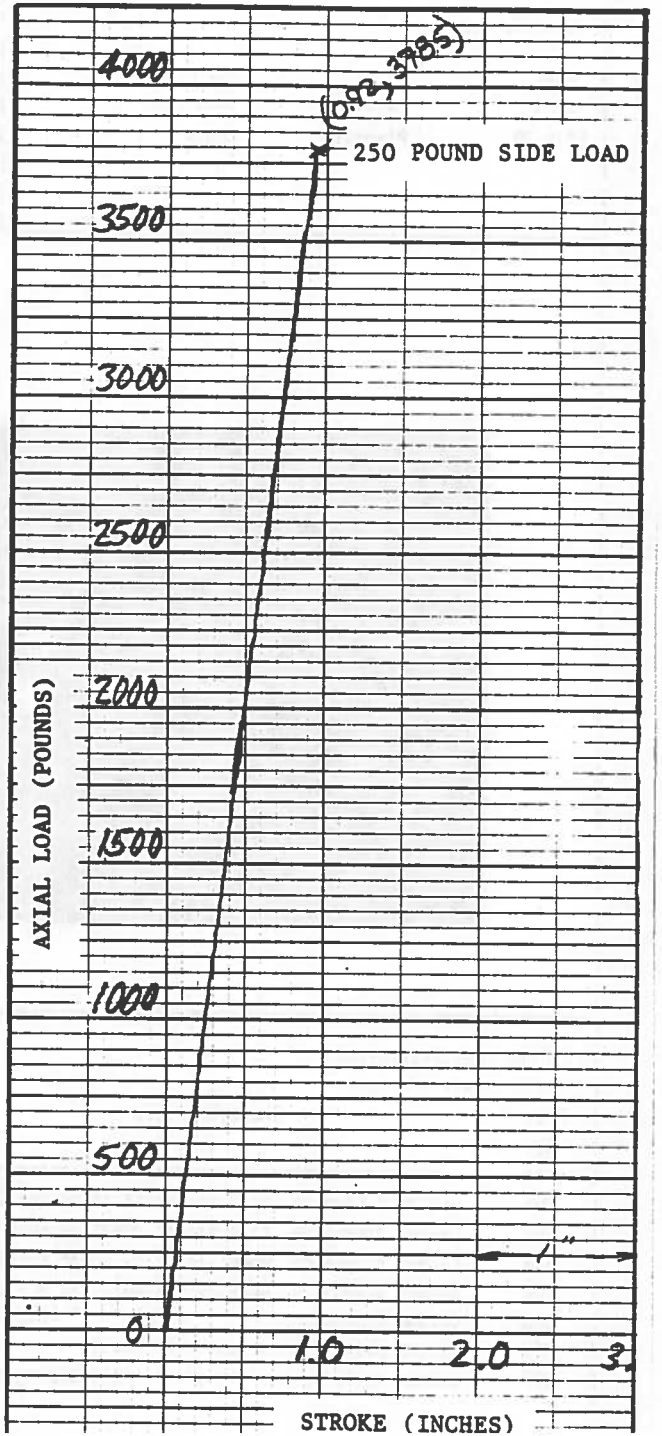


Column Characteristics

File Key	Characteristic	Program Variable	Value
801	Distance from column pivot point to column CG	(RCOL)	6.13 in.
802	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	6.63 in.
803	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	8.75 in.
804	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	10.75 in.
805	Column dimension, " " " " fwd " "	(LBFZ)	14.75 in.
806	Column weight (stroking components)	(WZ)	4.35 lb.
807	Column coeficient of friction (telescoping parts)	(MU)	0

COLUMN GROUP NO. 2.109

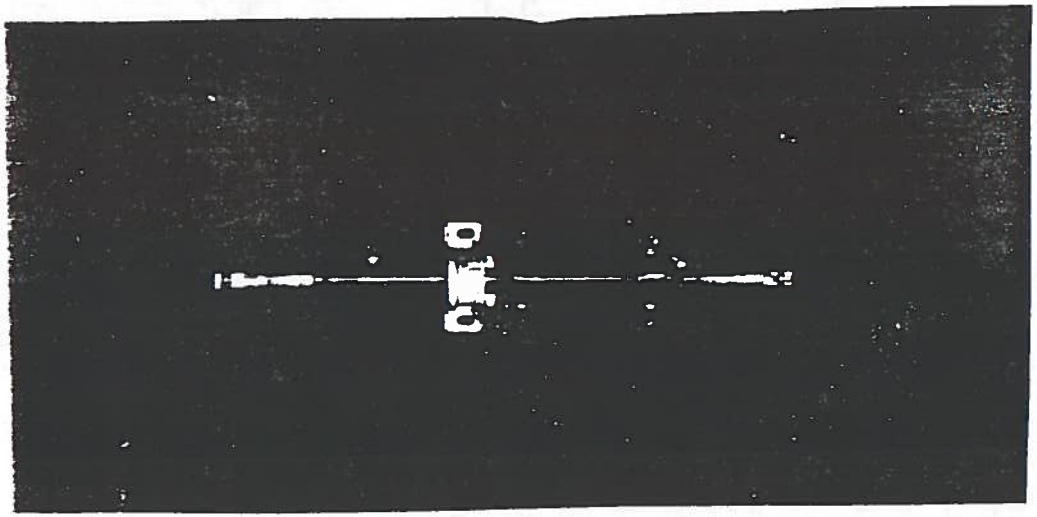




COLUMN GROUP NO. 2.114

STEERING COLUMN FACT SHEET

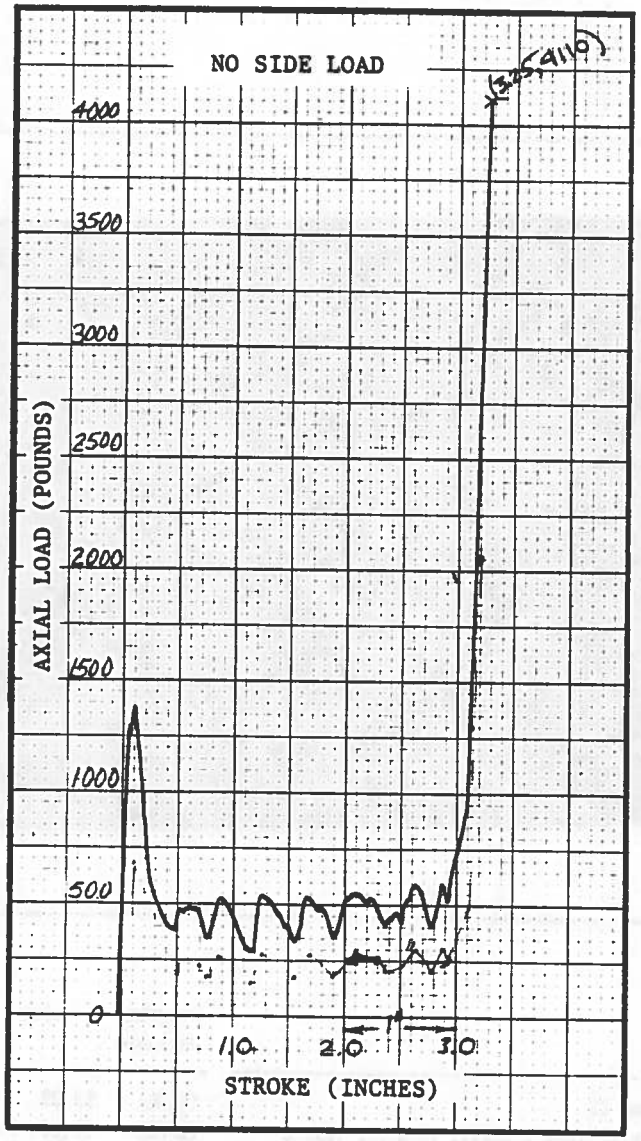
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1978-79	Plymouth	Champ	273618E

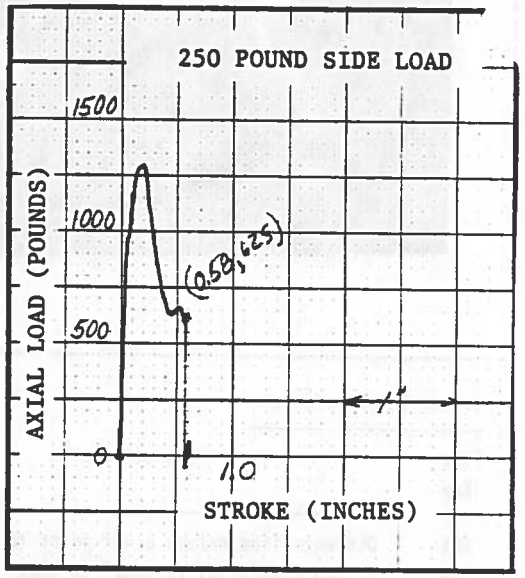


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	6.1
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	7.1
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	10.4
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	12.4 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	16.4 in.
B06	Column weight (stroking components)	(WZ)	3.4
B07	Column coeficient of friction (telescoping parts)	(MU)	0.4

COLUMN GROUP NO. 2.114

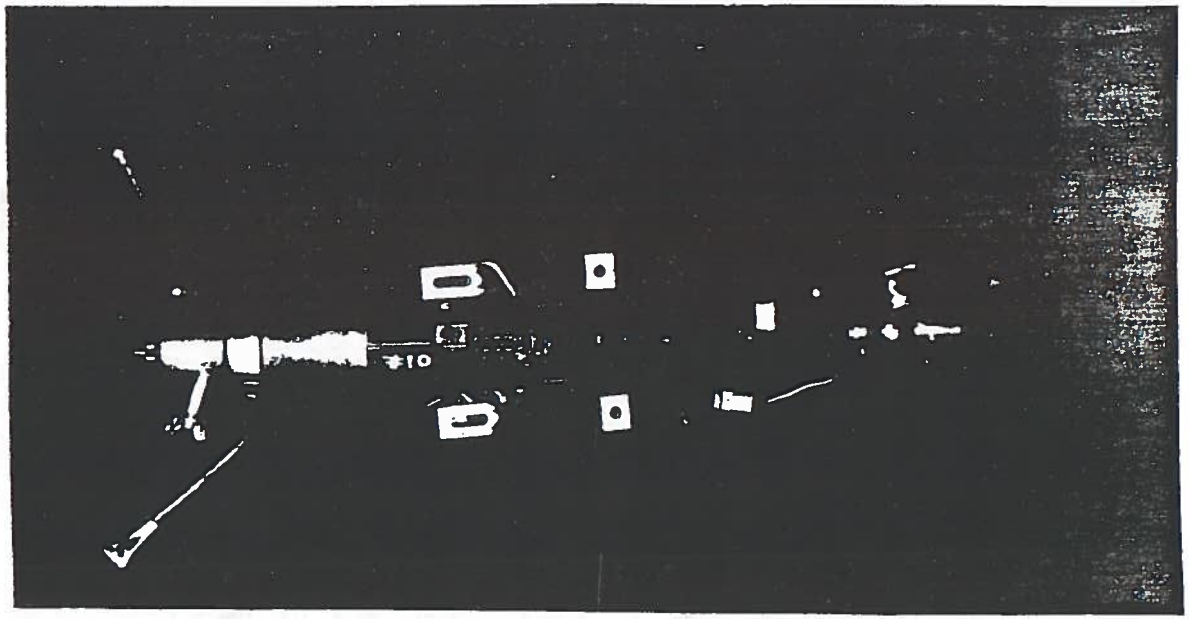




COLUMN GROUP NO. 3.101

STEERING COLUMN FACT SHEET

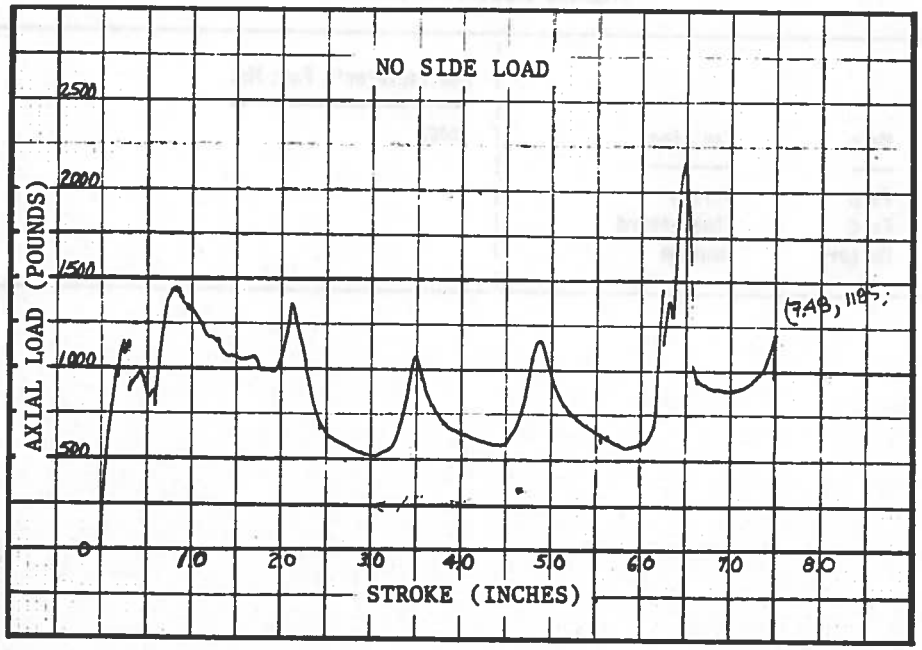
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	D3AZ, D4AZ
1975-78	Ford	Full Size (LTD)	
1975-78	Mercury	Full Size (Marquis)	

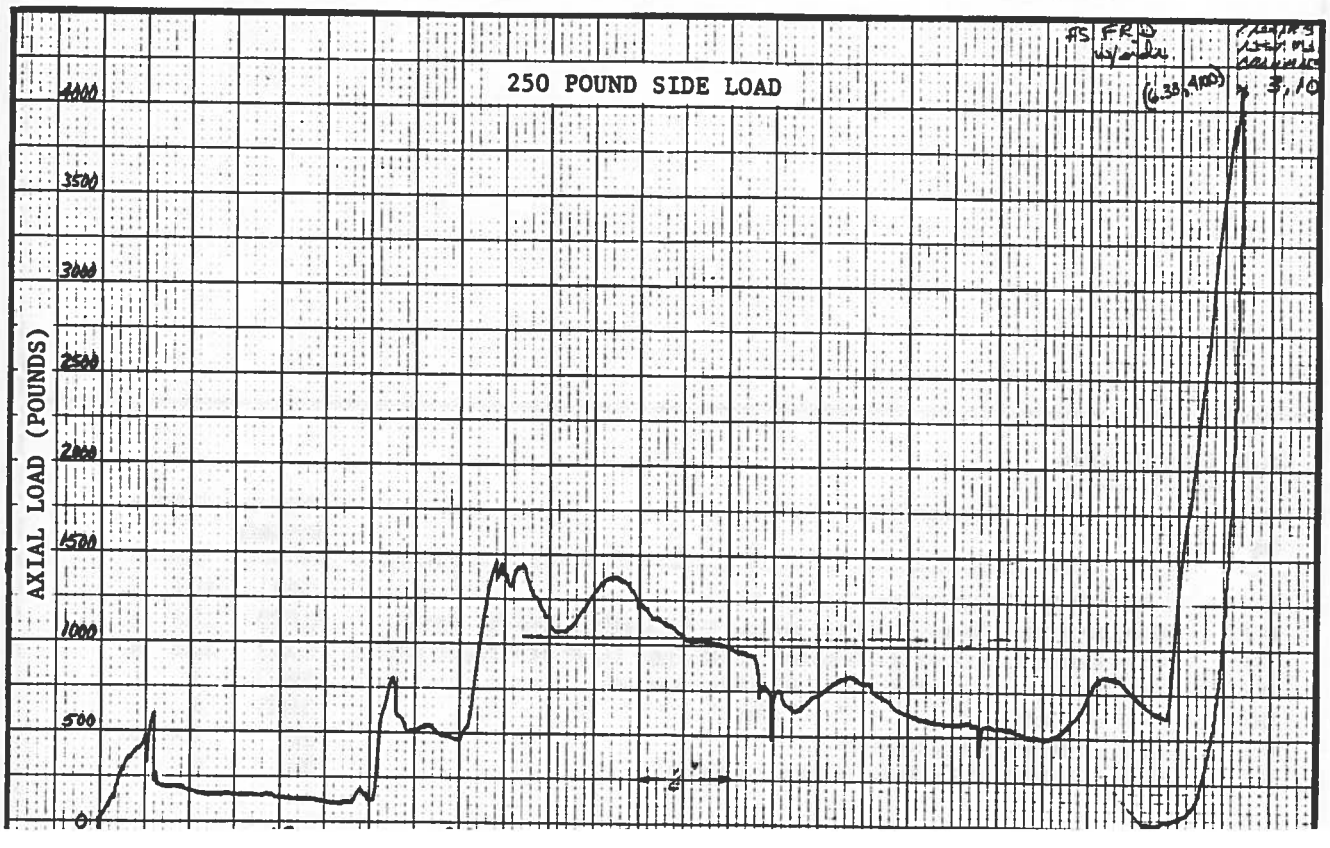


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	13.38 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.63 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.0 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.0 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	19.0 in.
B06	Column weight (stroking components)	(WZ)	8.46 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0

COLUMN GROUP NO. 3.101





COLUMN GROUP NO. 3.105

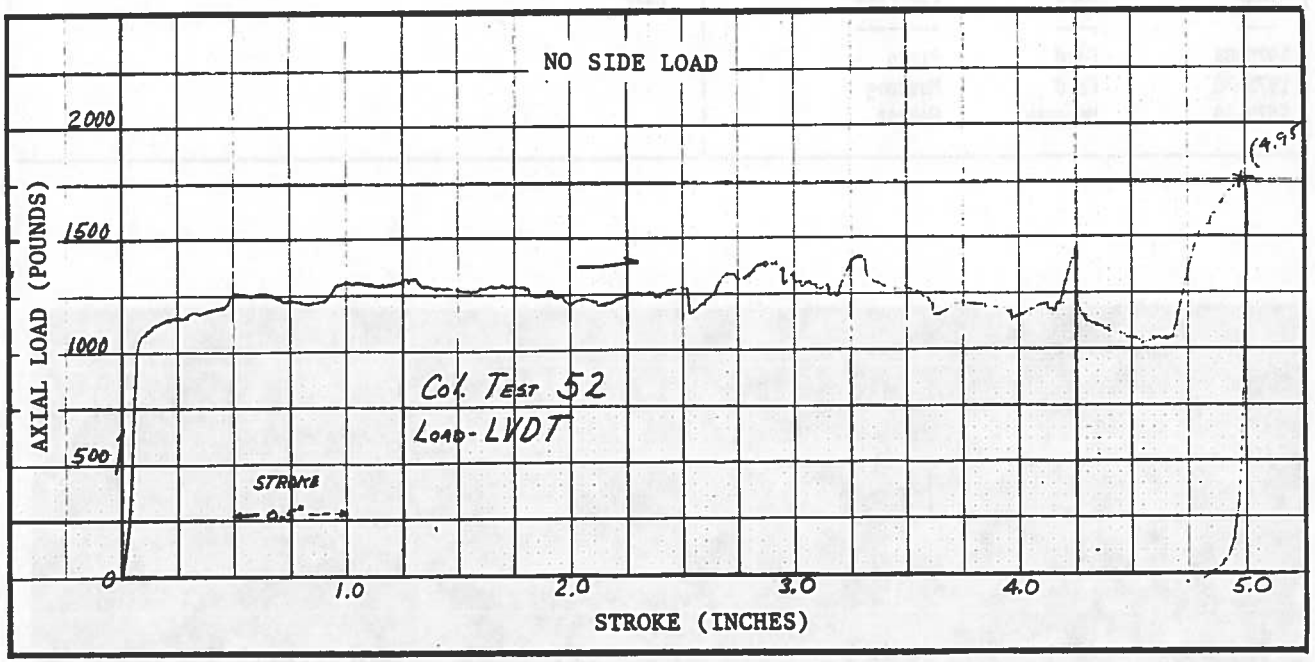
STEERING COLUMN FACT SHEET

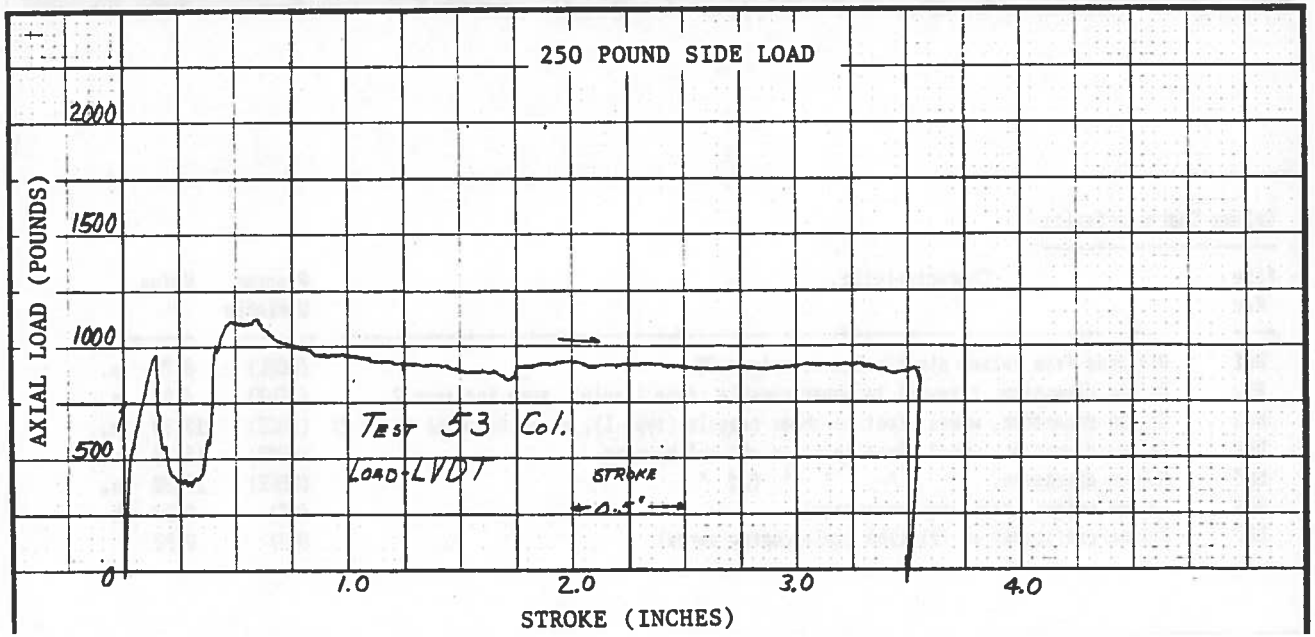
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-76	Ford	Torino	D40Z
1975-79	Ford	Thunderbird	
1975-76	Mercury	Montego	

Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	12.0 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	13.9 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.5 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	0
B05	Column dimension, " " " " fwd " "	(LBFZ)	0
B06	Column weight (stroking components)	(WZ)	6.4 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0

COLUMN GROUP NO. 3.105

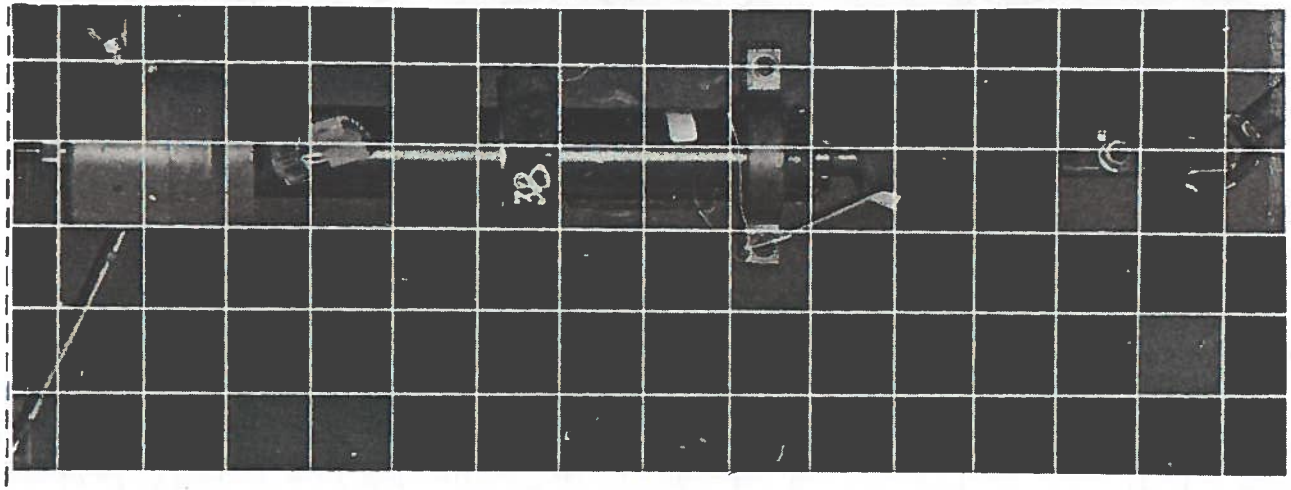




COLUMN GROUP NO. 3.106

STEERING COLUMN FACT SHEET

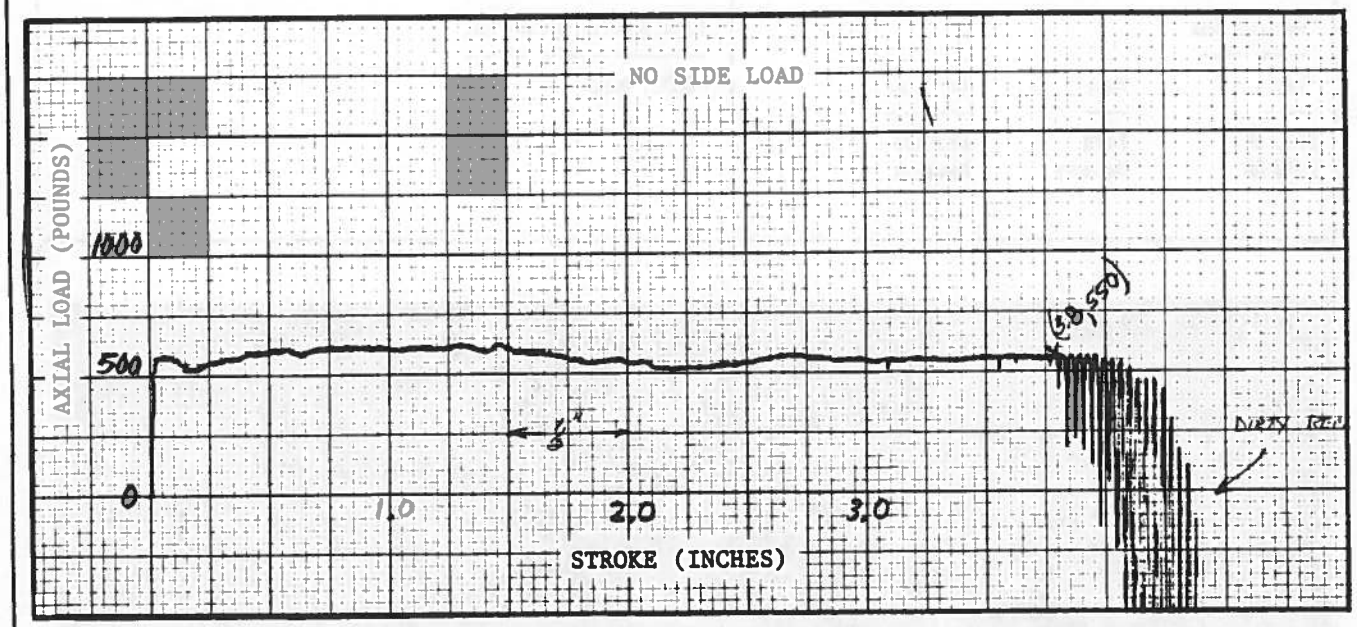
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	D4ZZ
1975-80	Ford	Pinto	
1975-78	Ford	Mustang	
1979-80	Mercury	Bobcat	

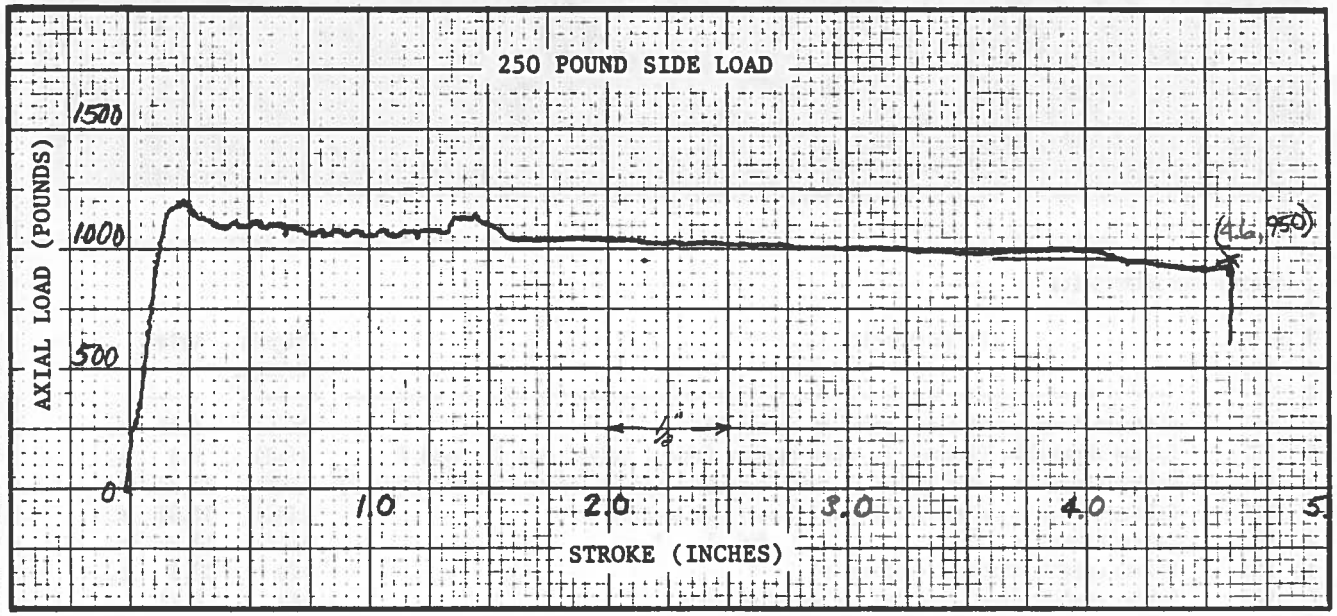


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	8.75 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	6.0 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.38 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.38 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	19.38 in.
B06	Column weight (stroking components)	(WZ)	8.27 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.82

COLUMN GROUP NO. 3.106

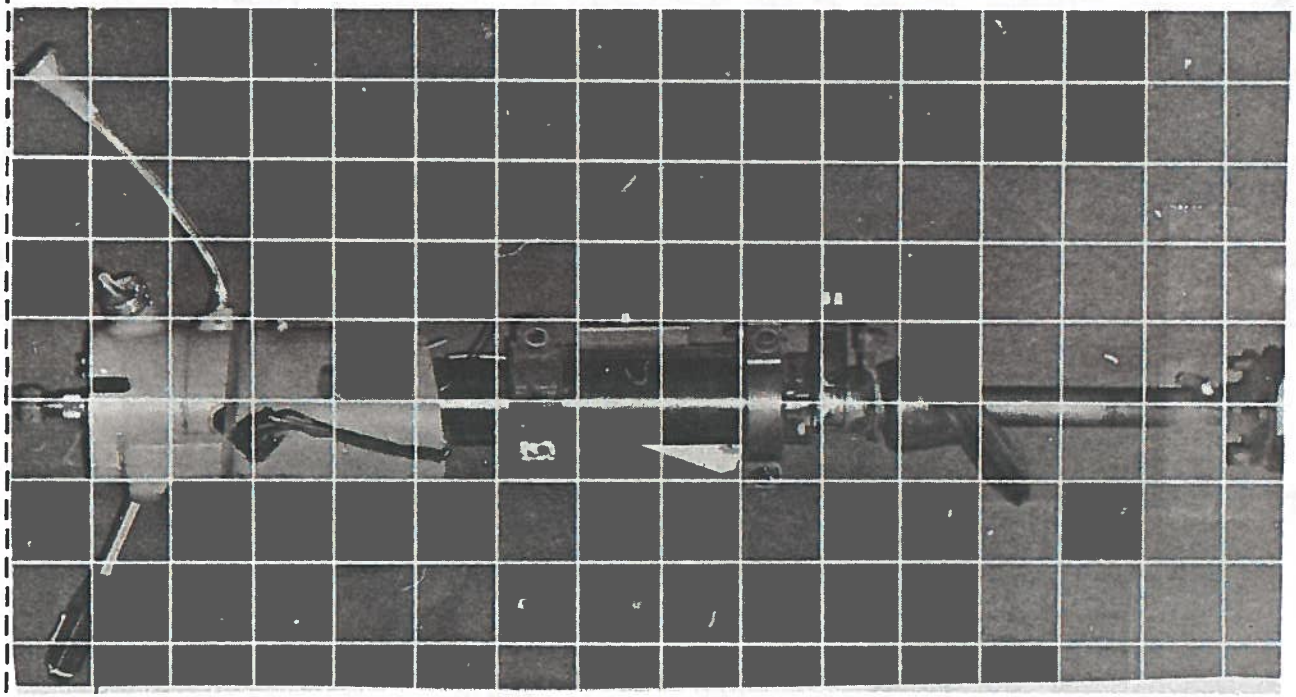




COLUMN GROUP NO. 3.107

STEERING COLUMN FACT SHEET

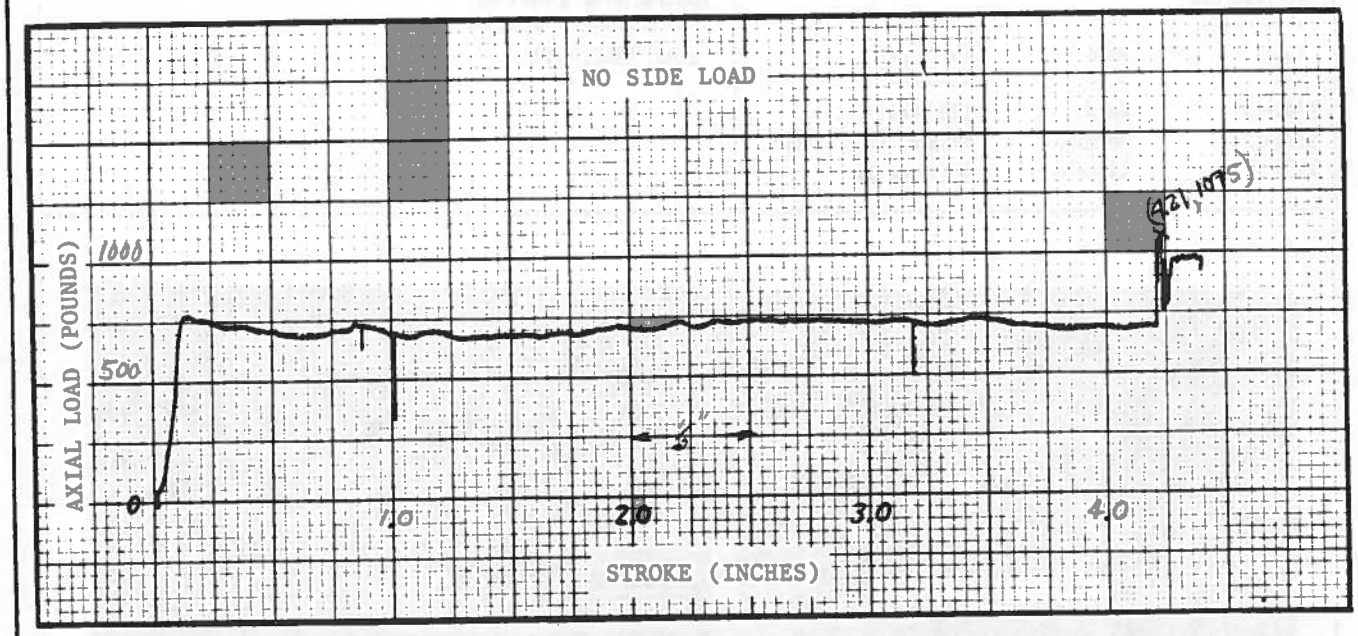
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	D5DZ, D6DZ
1975-80	Ford	Granada	
1975-80	Mercury	Monarch	

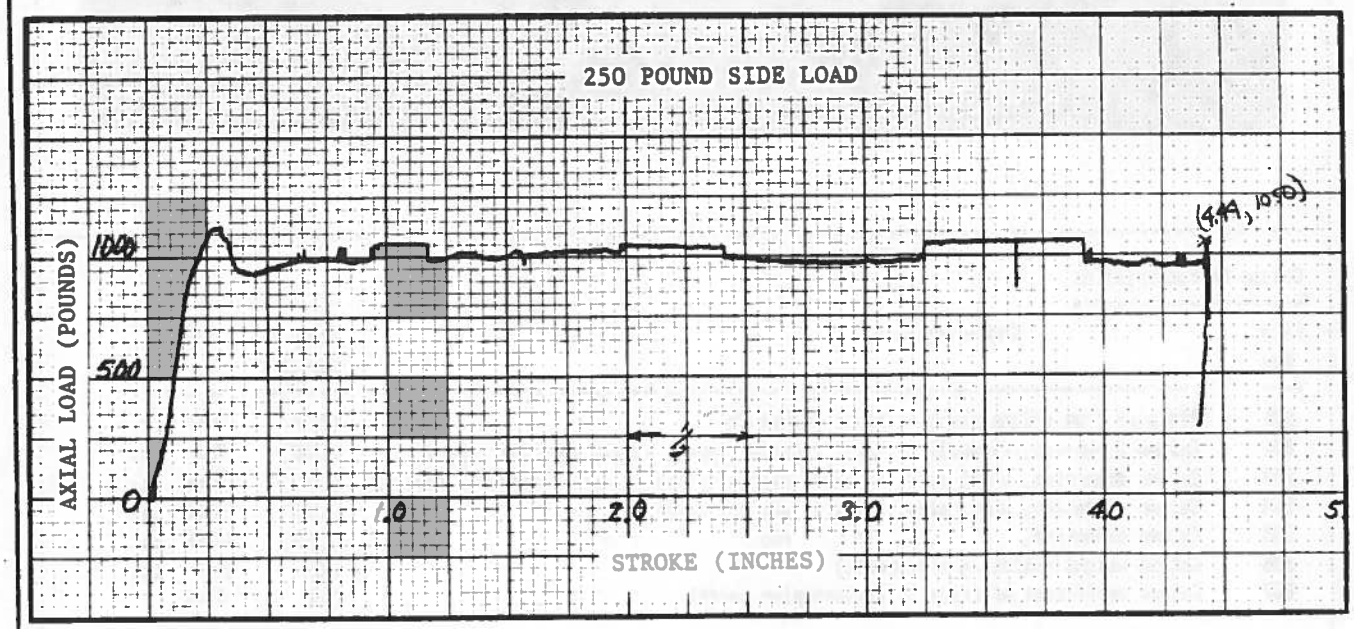


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	6.88 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	6.0 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.38 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.38 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	19.38 in.
B06	Column weight (stroking components)	(WZ)	12.8 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.33

COLUMN GROUP NO. 3.107





COLUMN GROUP NO. 3.111

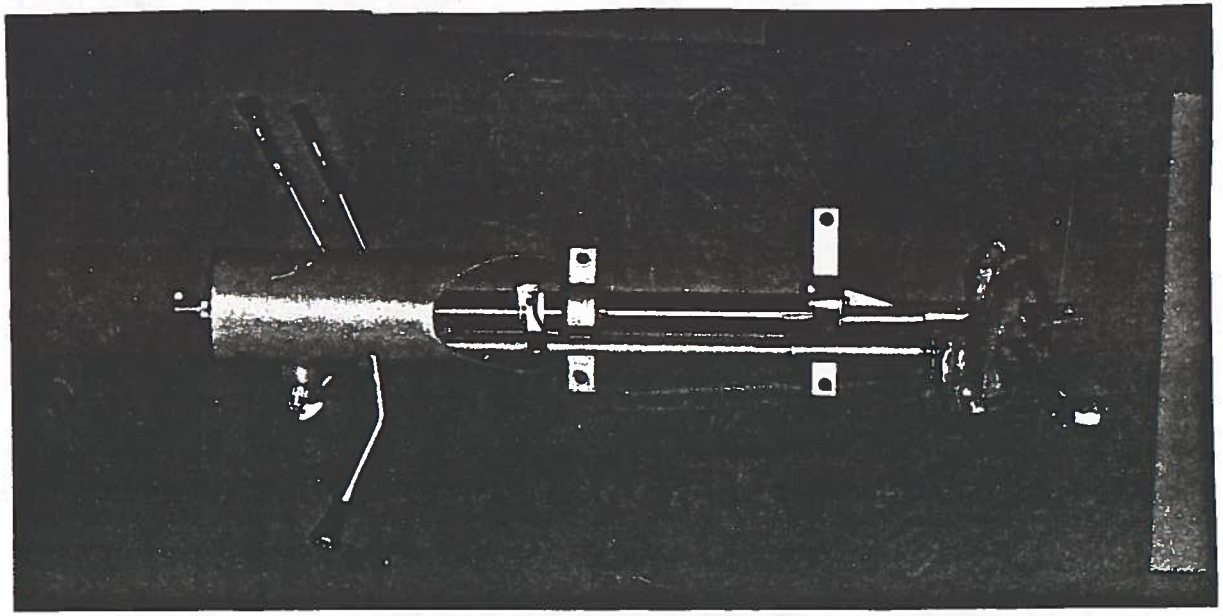
STEERING COLUMN FACT SHEET

Vehicle Use

Year	Make	Car Line
1980-83	Ford	LTD (Full Size)
1980-83	Mercury	Monarch (Full Size)
1980-83	Lincoln	Continental

Manufacturer's Part No.

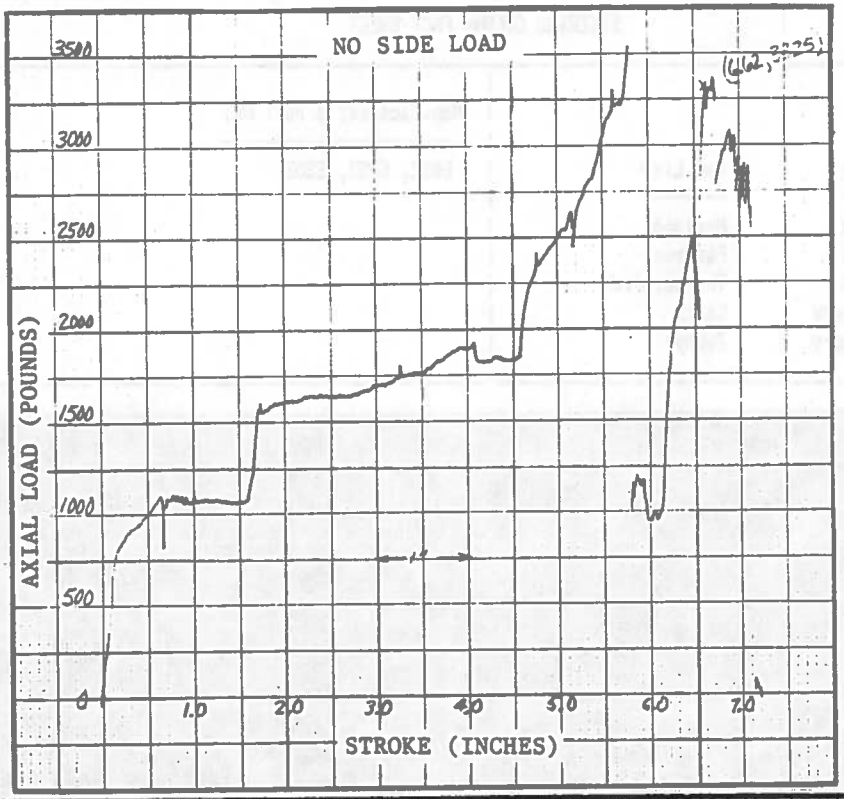
E0AZ, E2AZ, E2LY

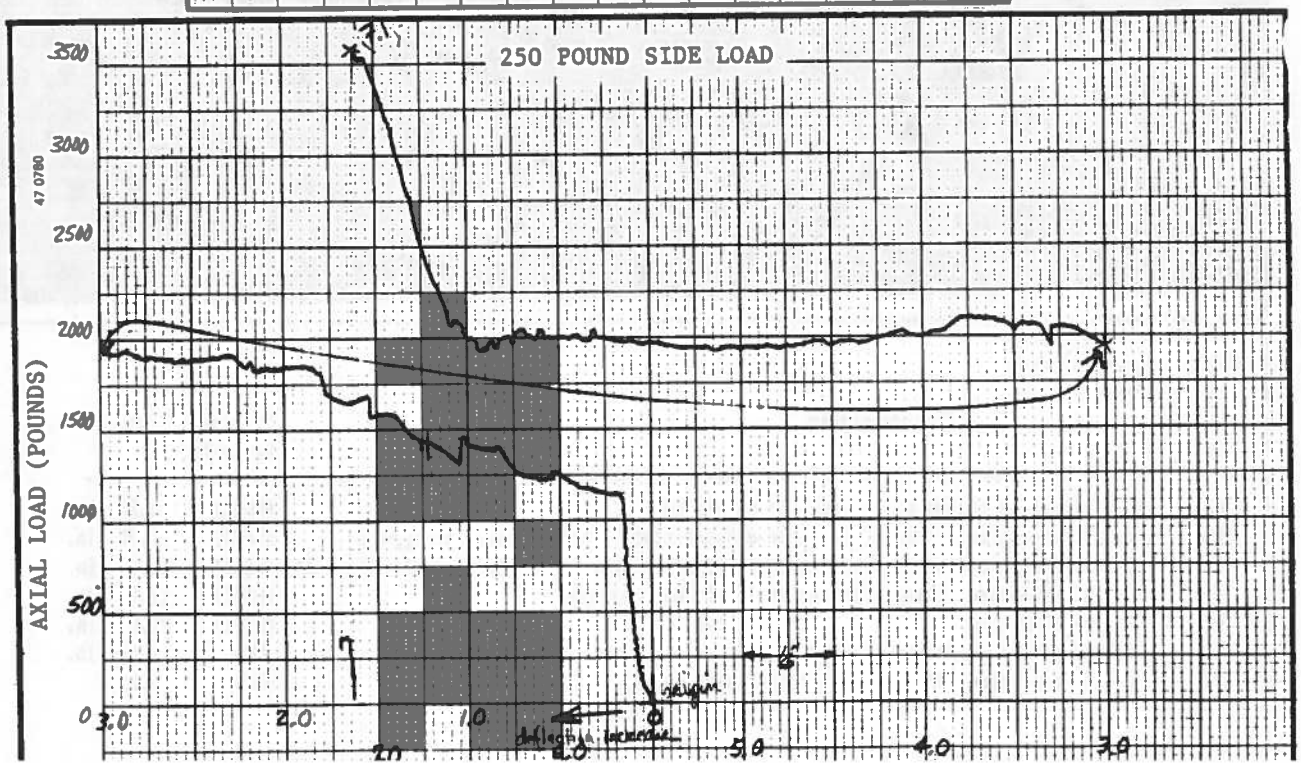


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	8.88 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	8.5 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	12.88 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	14.88 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	18.88 in.
B06	Column weight (stroking components)	(WZ)	10.5 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.49

COLUMN GROUP NO. 3.111





COLUMN GROUP NO. 3.112

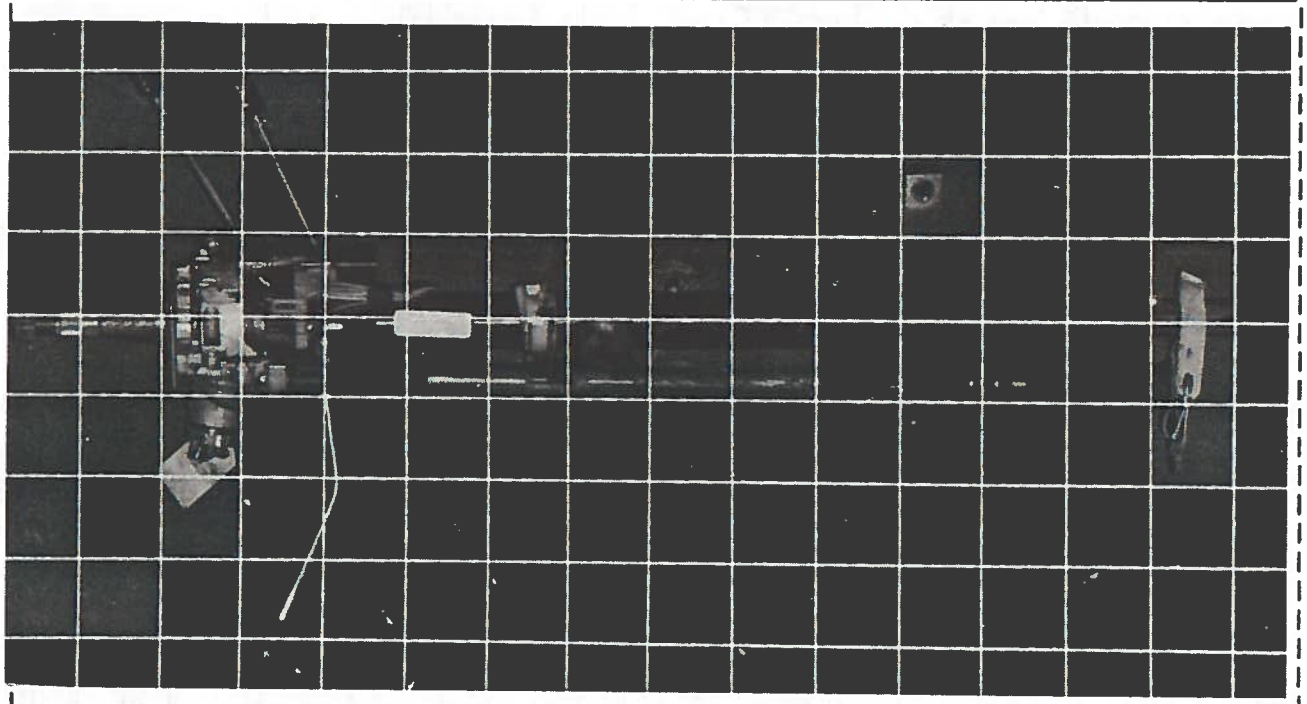
STEERING COLUMN FACT SHEET

Vehicle Use

Year	Make	Car Line
1980-83	Ford	Mustang
1980-83	Ford	Fairmont
1980-83	Ford	Thunderbird
1980-83	Mercury	Capri
1980-83	Mercury	Zephyr

Manufacturer's Part No.

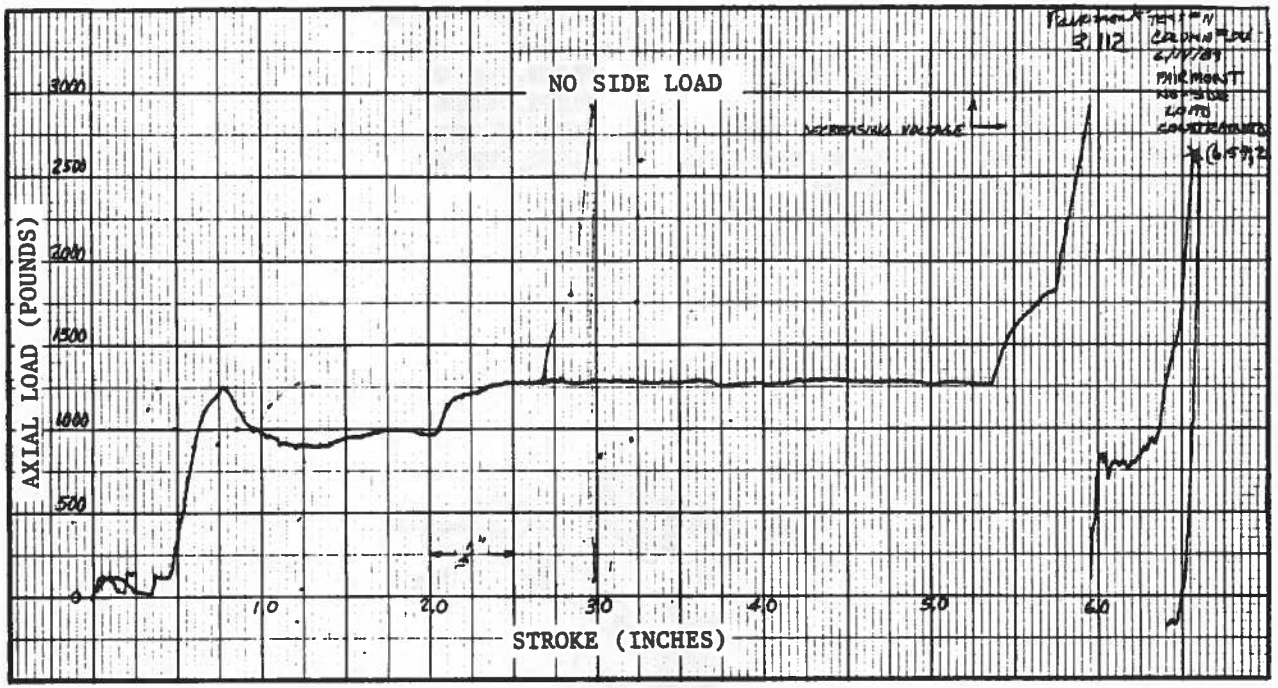
E0SZ, E2SZ, E30Z

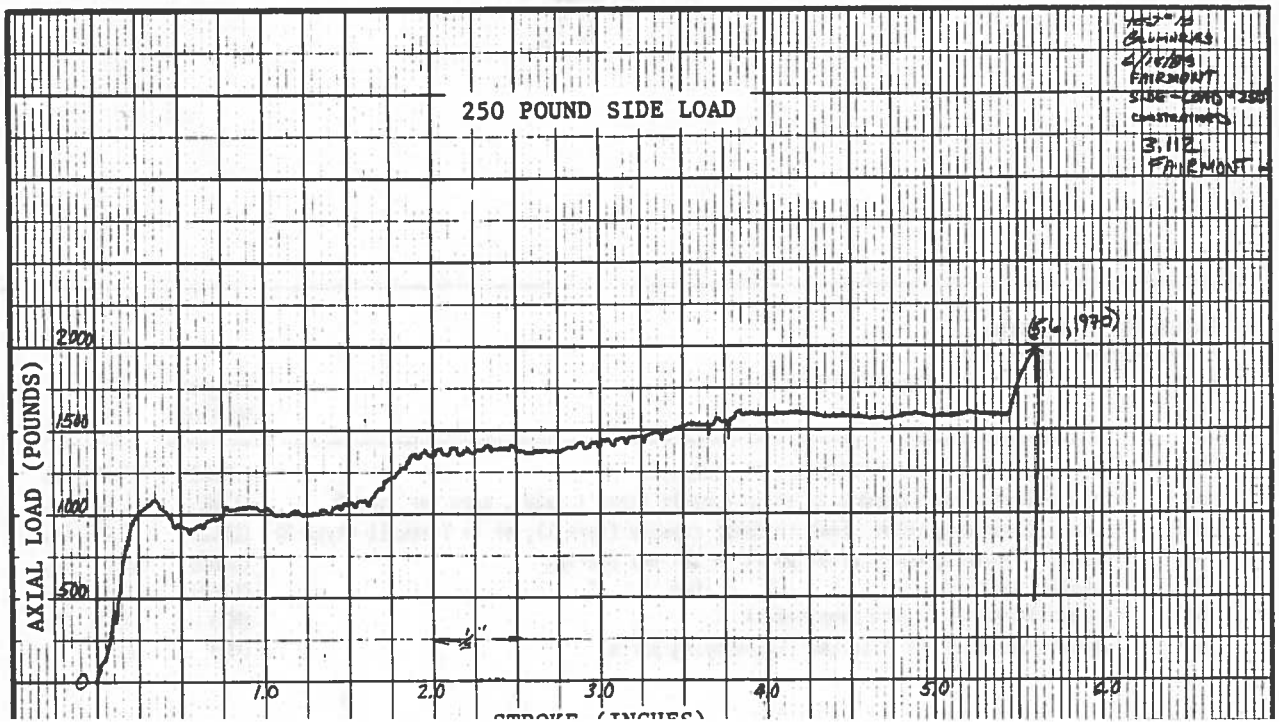


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	9.13 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	6.75 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	15.0 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	17.0 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	21.0 in.
B06	Column weight (stroking components)	(WZ)	7.12 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.23

COLUMN GROUP NO. 3.112

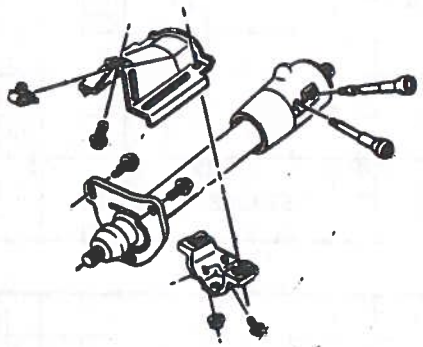




COLUMN GROUP NO. 4.101

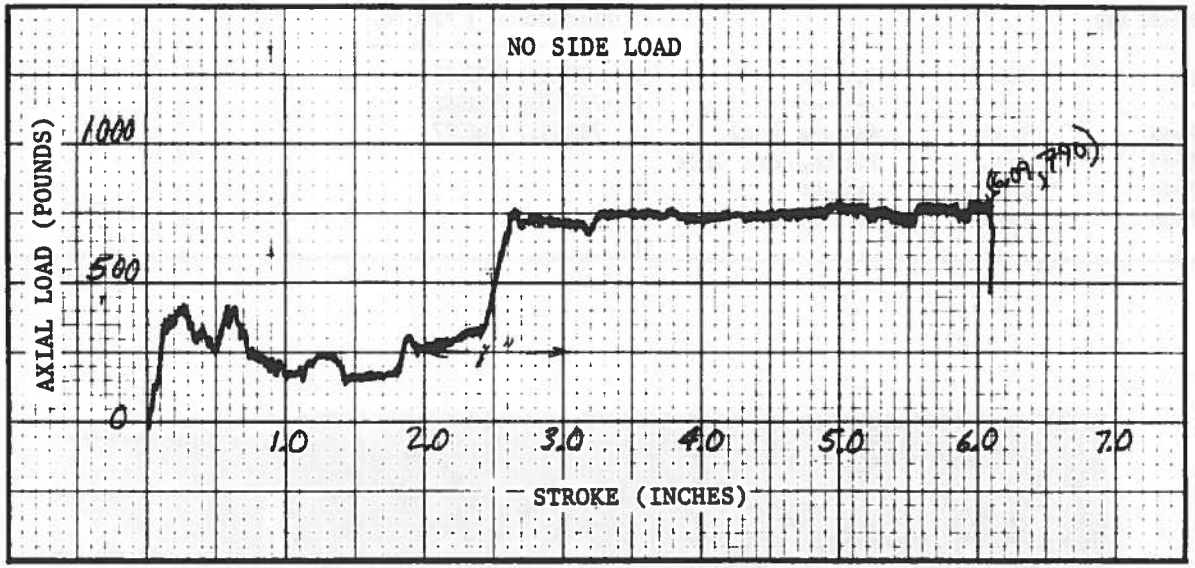
STEERING COLUMN FACT SHEET

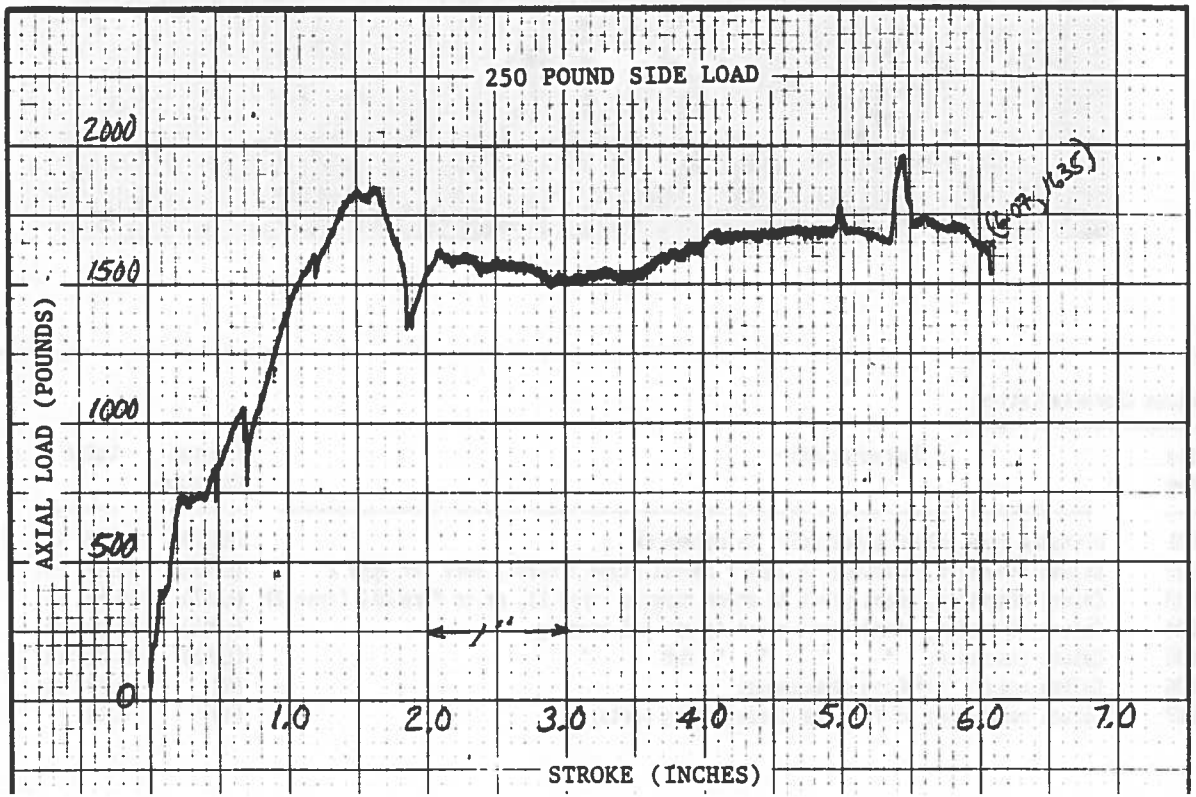
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1976	Buick	Century, Regal	7818830, 7881840
1975-76	Chev.	Malibu, Monte Carlo	7818872, 7818896
1975-76	Olds.	Cutlass	7818906, 7818928
1976	Pontiac	Lemans, Grand Prix	7818932, 7819763



Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	12.38 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	11.25 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	8.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.38 in.
B05	Column dimension, [illegible] fwd [illegible]	(LBFZ)	17.38 in.
B06	Column weight (stroking components)	(WZ)	5.25 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.4

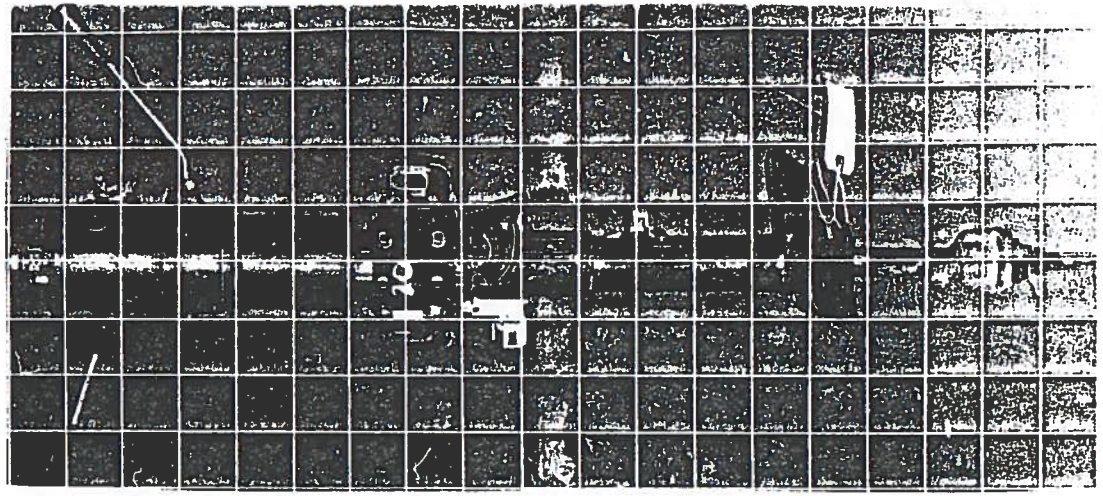

NO SIDE LOAD
AXIAL LOAD (POUNDS)
1000
500
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
STROKE (INCHES)


250 POUND SIDE LOAD
AXIAL LOAD (POUNDS)
2000
1500
1000
500
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
STROKE (INCHES)

COLUMN GROUP NO. 4.104

STEERING COLUMN FACT SHEET

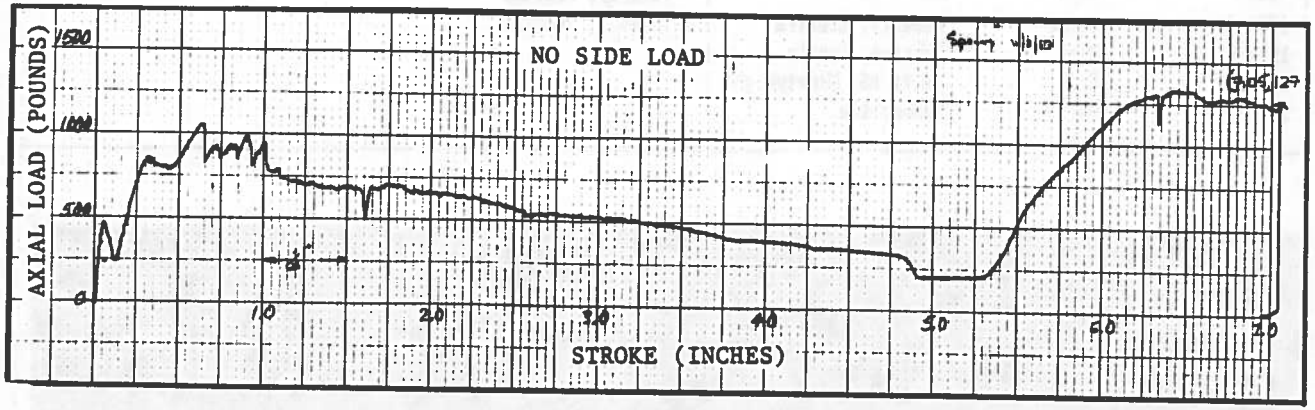
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	7830864, 7830870
1979-81	Buick	Century, Regal	7831058, 7831062
1979-81	Chev.	Malibu, Monte Carlo	7836111, 7836377
1979-81	Olds.	Cutlass	
1979-81	Pont.	Le Mans, Grand Prix	

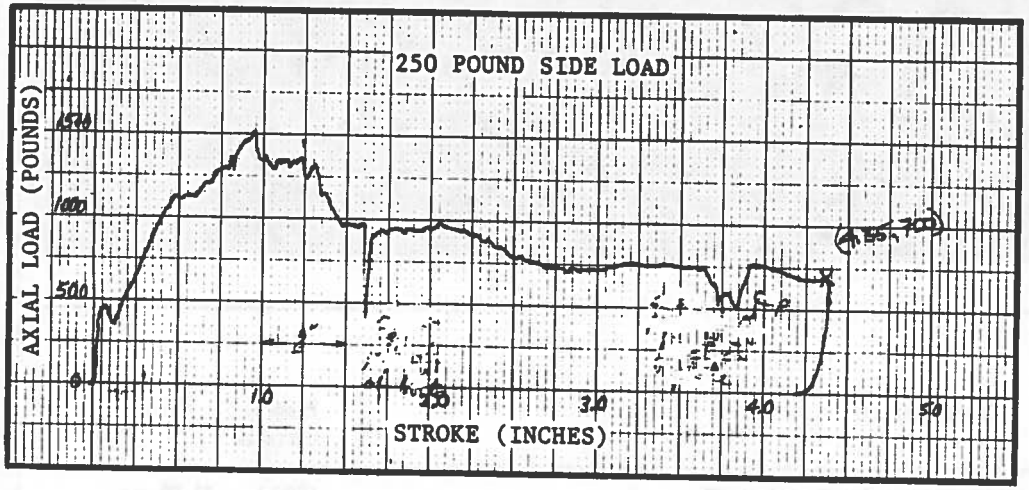


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	14.62 in.
B02	Column dimension, firewall to sheare capsul (type 1 only), zero for type 2	(LFWZ)	19.37 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.62 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	17.25 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	21.25 in.
B06	Column weight (stroking components)	(WZ)	6.79 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.34

COLUMN GROUP NO. 4.104

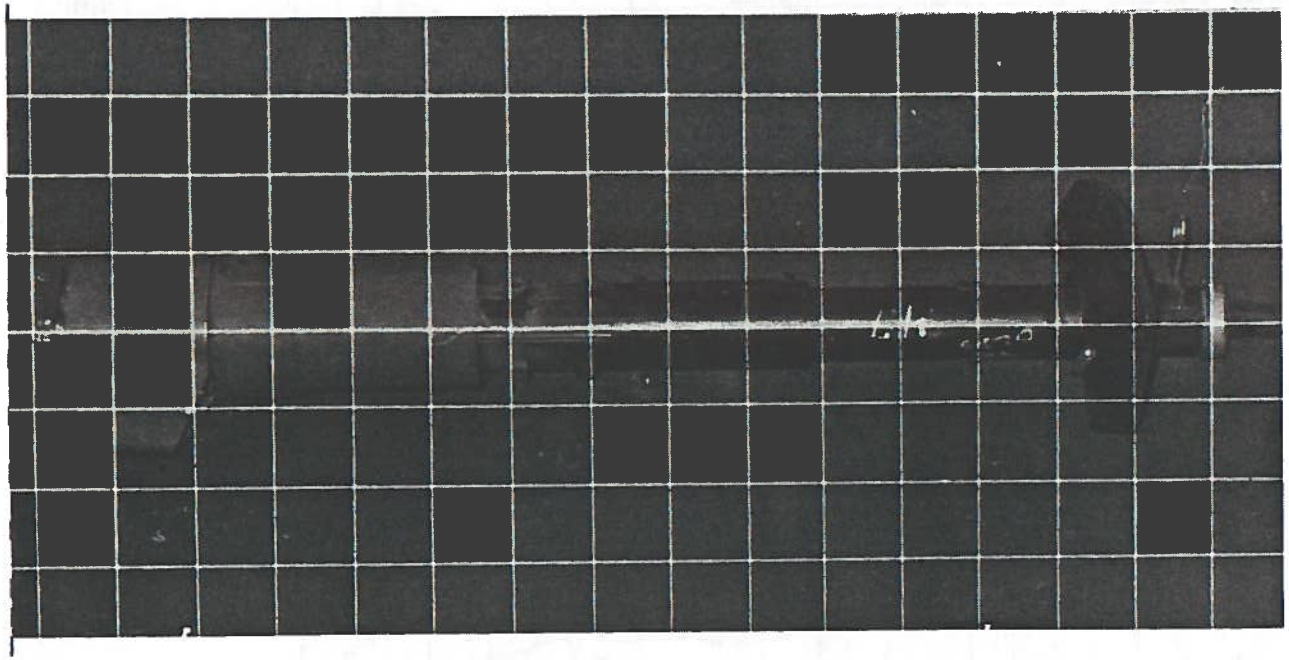




COLUMN GROUP NO. 4.110

STEERING COLUMN FACT SHEET

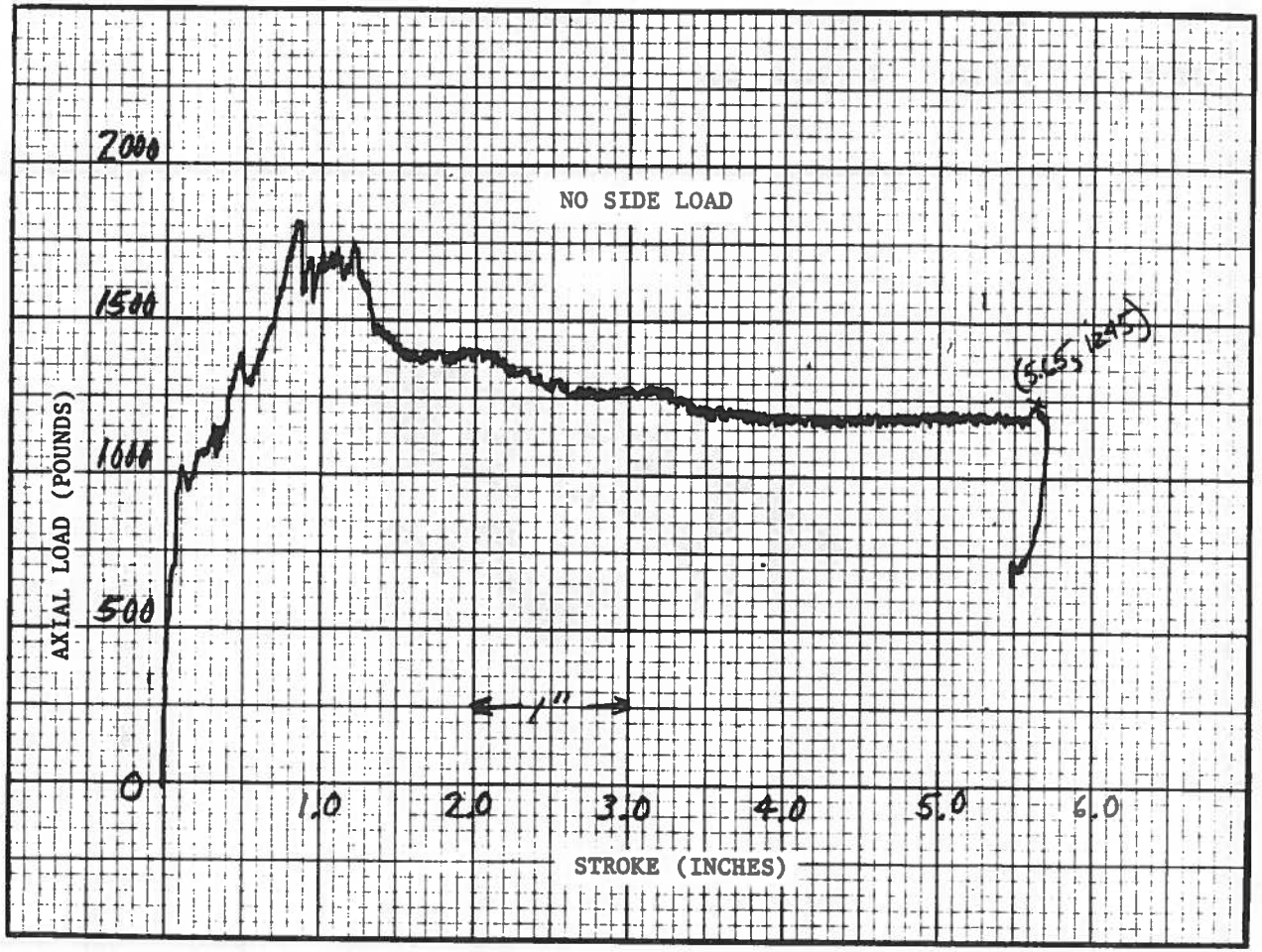
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	7830866, 7831064
1979-81	Buick	LeSabre, Elextra	7831219, 7832458
1979-81	Chev.	Caprice, Impala	7836005, 7836116
1979-81	Olds.	Delta 88, Ninetyeight	
1979-81	Pont.	Bonneville	



Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	11.25 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	12.5 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.75 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	17.12 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	21.25 in.
B06	Column weight (stroking components)	(WZ)	6.83 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0

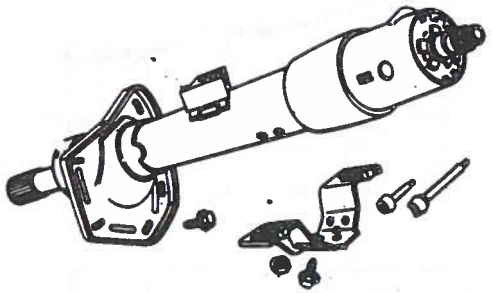
COLUMN GROUP NO. 4.110



COLUMN GROUP NO. 4.116

STEERING COLUMN FACT SHEET

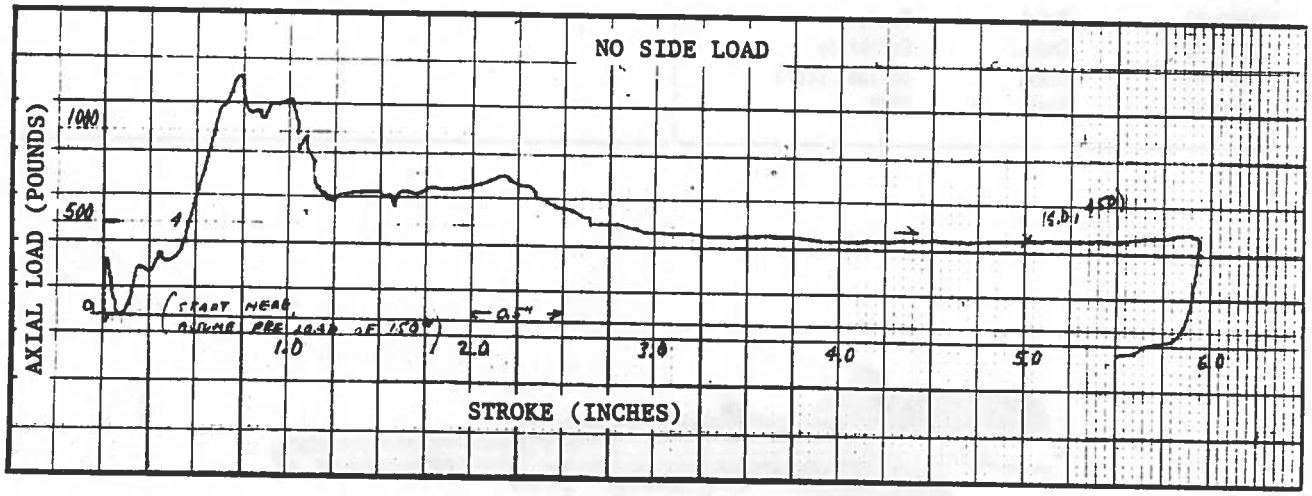
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980-83	Cadillac	DeVille, Fleetwood	7833252, 7836004



Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	23.0	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.5	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.75	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	21.0	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	23.0	in.
B06	Column weight (stroking components)	(WZ)	5.25	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	

COLUMN GROUP NO. 4.116



COLUMN GROUP NO. 4.120

STEERING COLUMN FACT SHEET

Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1982-83	Buick	Century	7837301
1982-83	Chev.	Celebrity	
1982-83	Olds.	Cutlass Ciera	
1982-83	Pont.	6000	

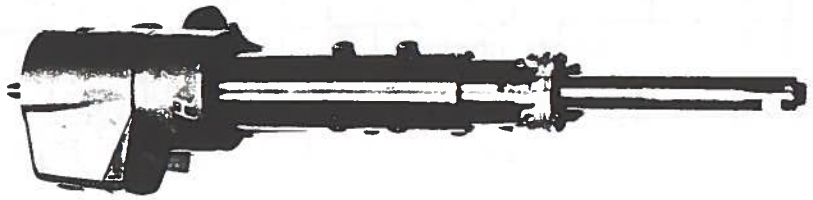
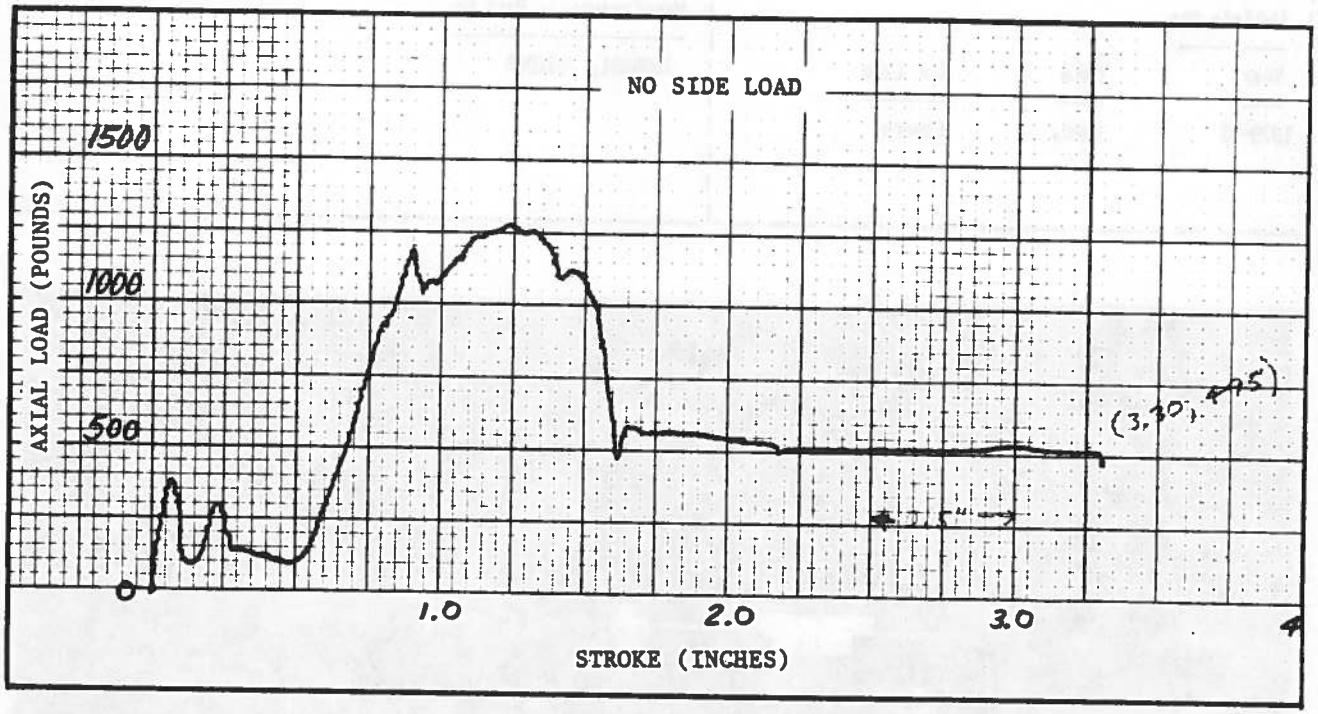


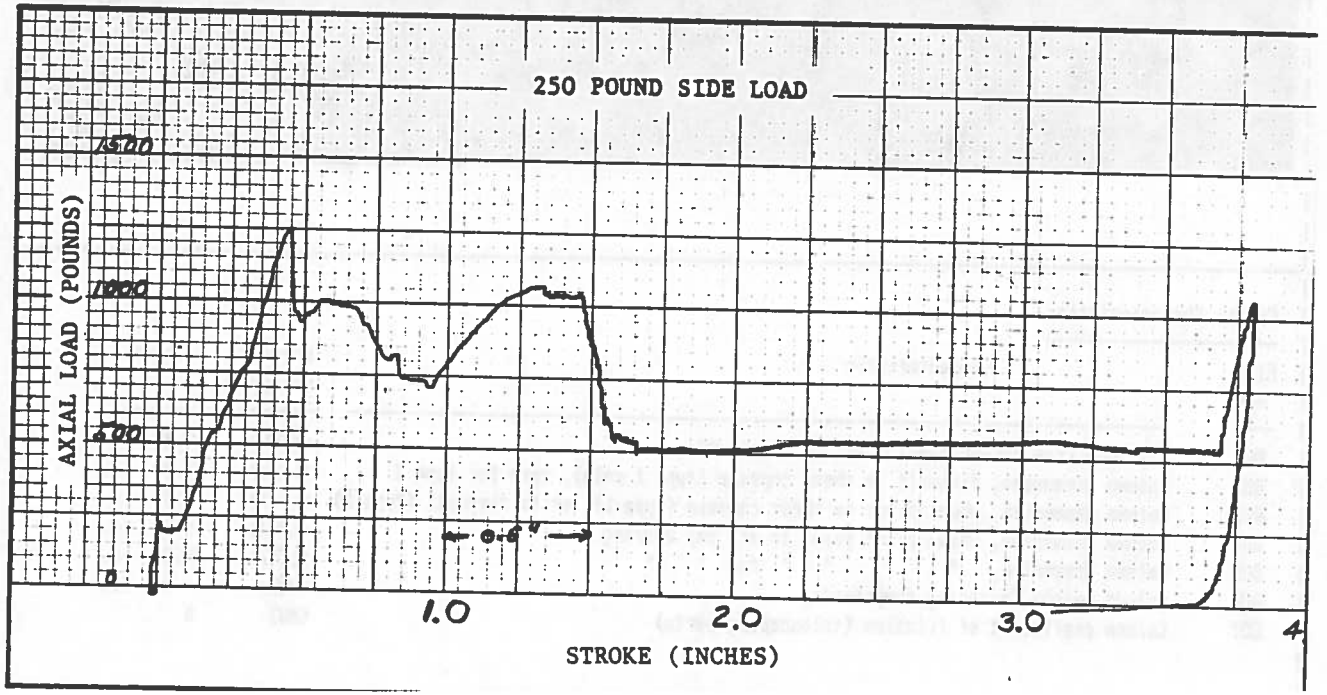
Illustration shows column with approx. 3.5 in. crush after load/deflection test.

Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	14.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	8.2	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	12.5	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	18.8	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	20.8	in.
B06	Column weight (stroking components)	(WZ)	4.6	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	

COLUMN GROUP NO. 4.120

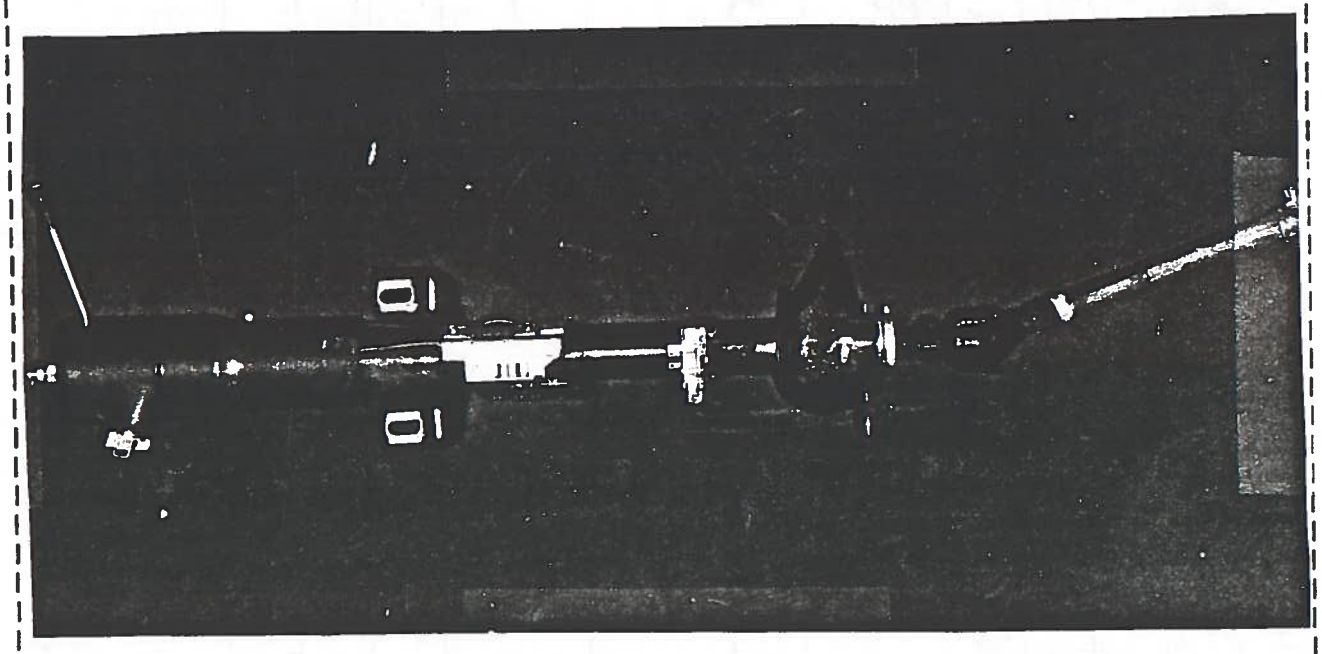




COLUMN GROUP NO. 4.135

STEERING COLUMN FACT SHEET

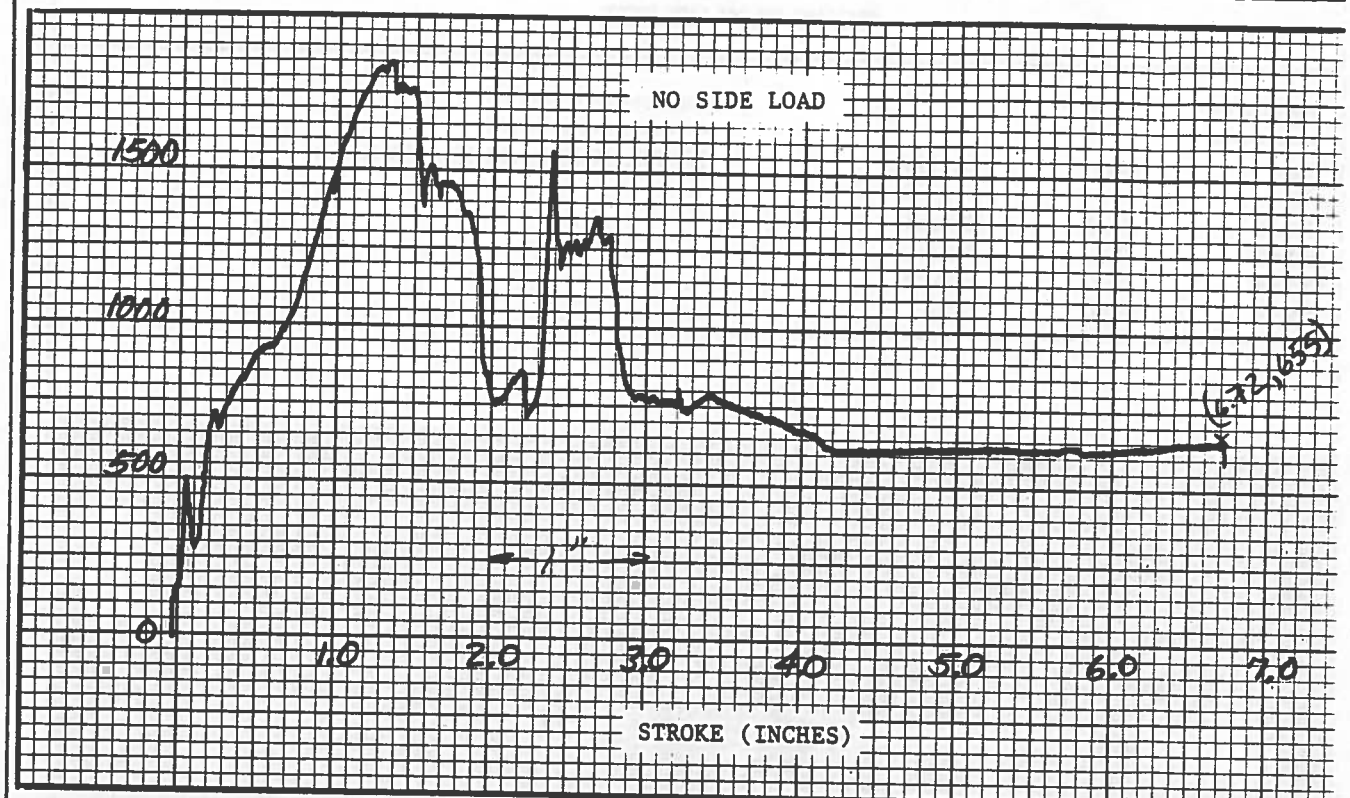
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	7830881, 7831069
1979-81	Chev.	Camaro	

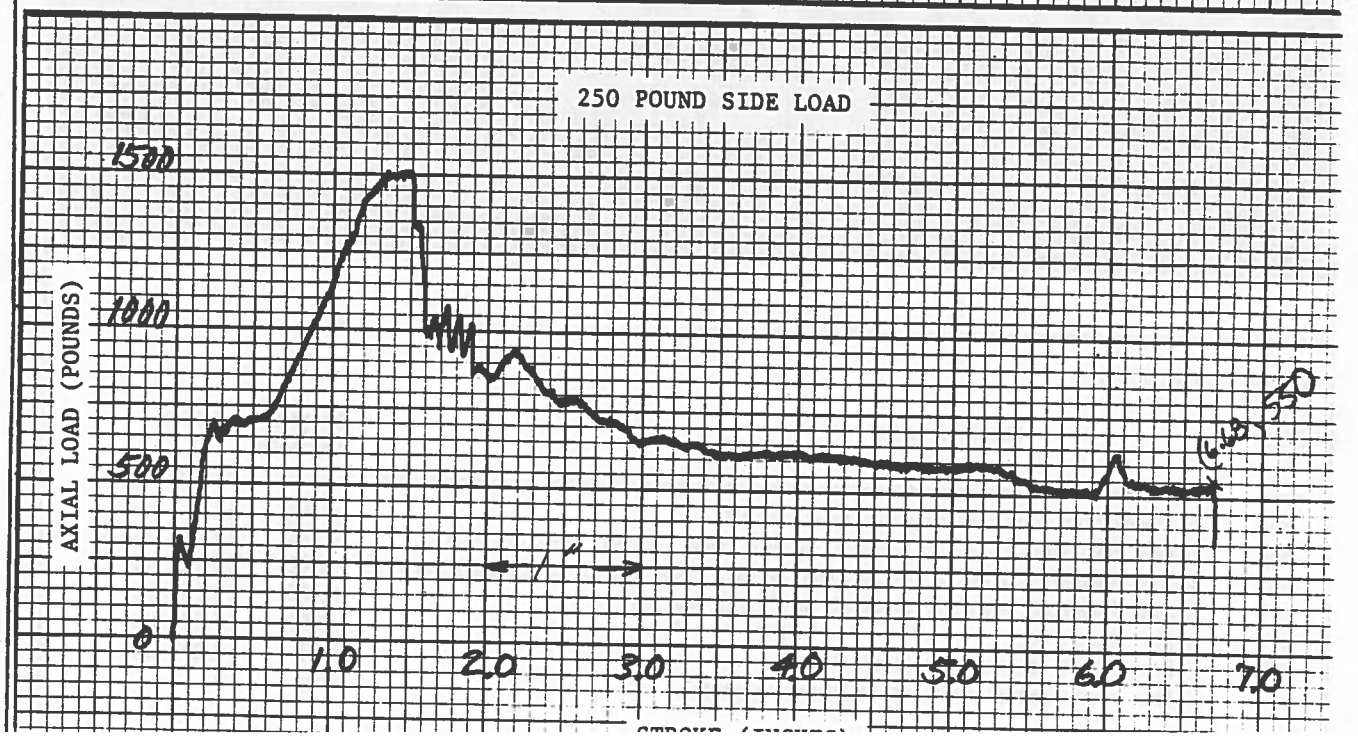


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	14.81 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	13.56 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	14.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	16.5 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	20.5 in.
B06	Column weight (stroking components)	(WZ)	7.56 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0

COLUMN GROUP NO. 4.135





COLUMN GROUP NO. 4.144

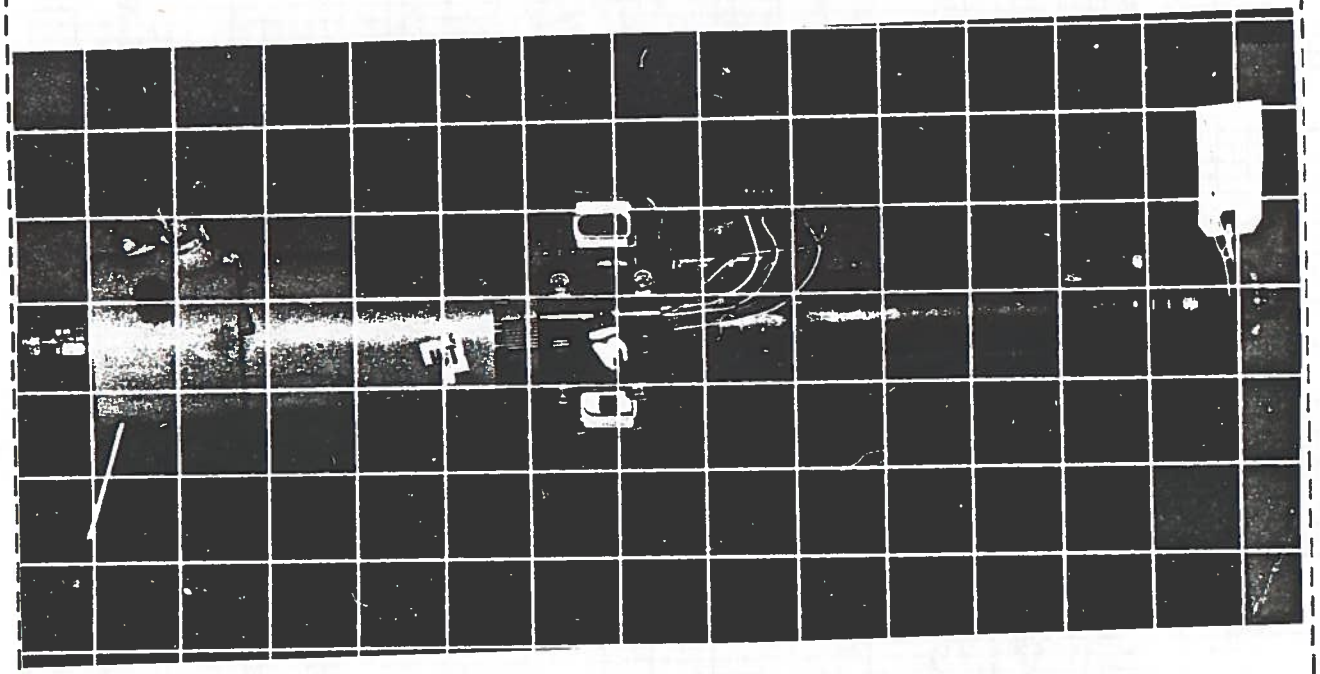
STEERING COLUMN FACT SHEET

Vehicle Use

Year	Make	Car Line
1978-80	Buick	Skyhawk
1978-80	Olds.	Starfire
1978-80	Pont.	Sunbird
1978-80	Chev.	Monza

Manufacturer's Part No.

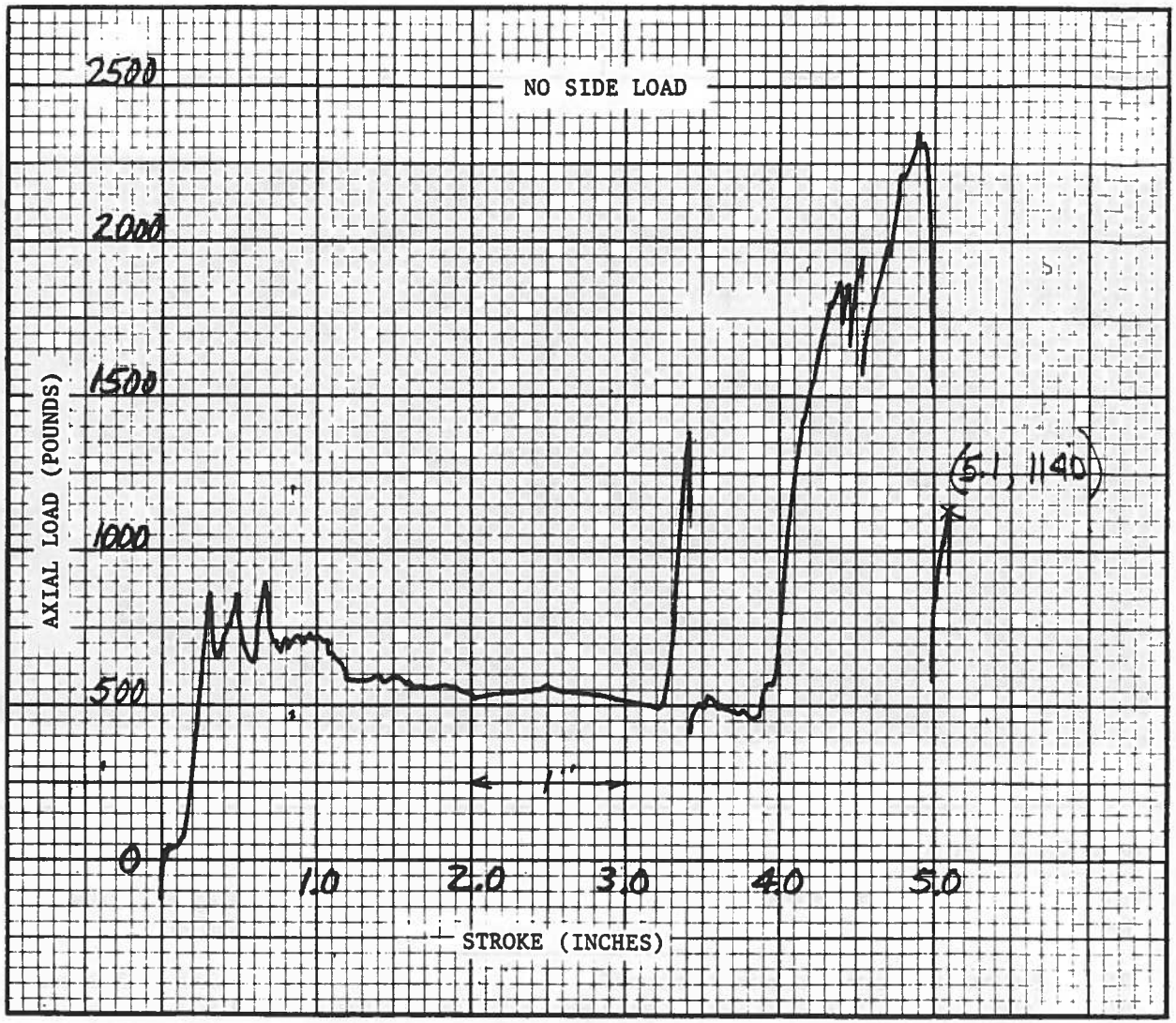
7828747, 7830875, 7834020, 7830413



Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	15.62 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.25 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	15.12 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	13.25 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	17.88 in.
B06	Column weight (stroking components)	(WZ)	5.25 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0

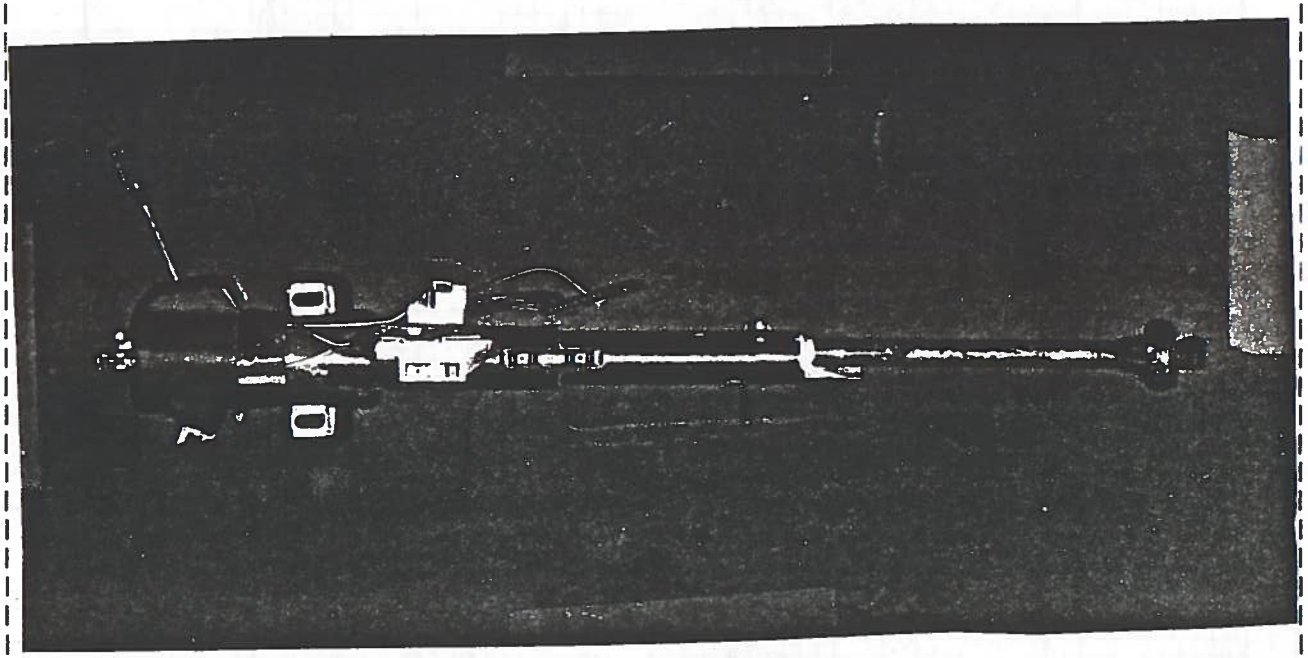
COLUMN GROUP NO. 4.144



COLUMN GROUP NO. 4.156

STEERING COLUMN FACT SHEET

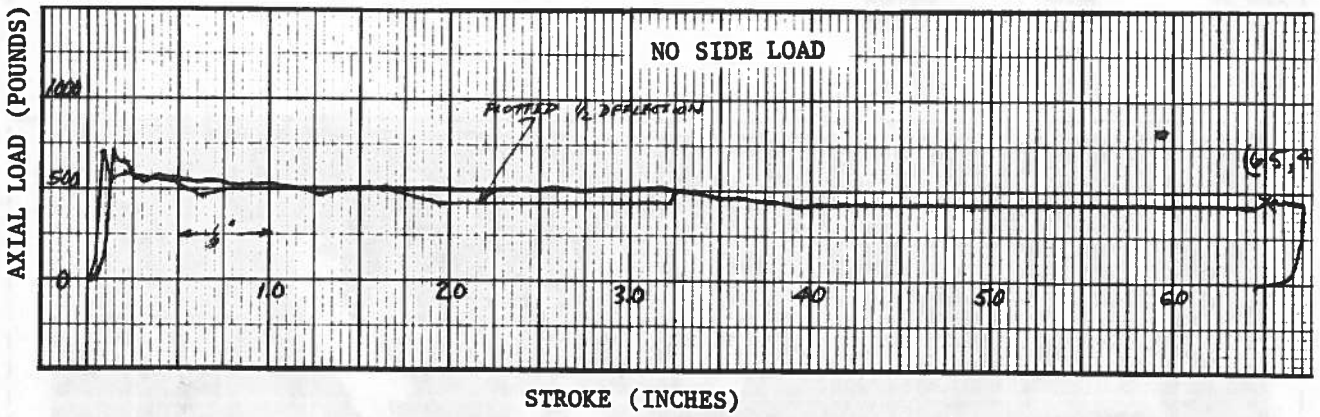
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	7830893, 7838251
1979-81	Chev.	Chevette	
1981	Pont.	T1000	

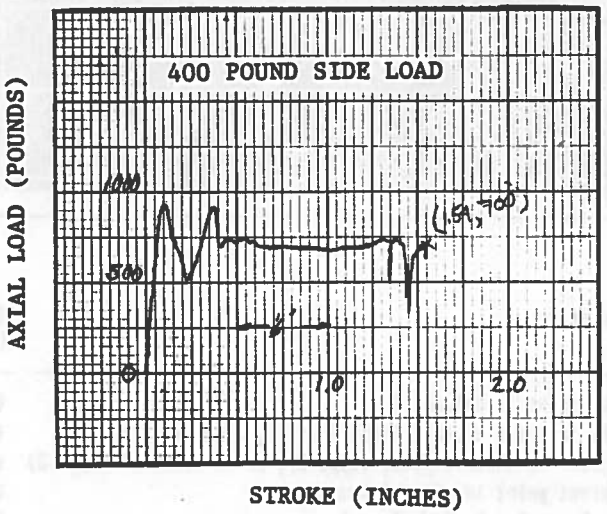


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	12.38 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	11.25 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	8.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.38 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	17.38 in.
B06	Column weight (stroking components)	(WZ)	5.25 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.4

COLUMN GROUP NO. 4156





COLUMN GROUP NO. 4.165

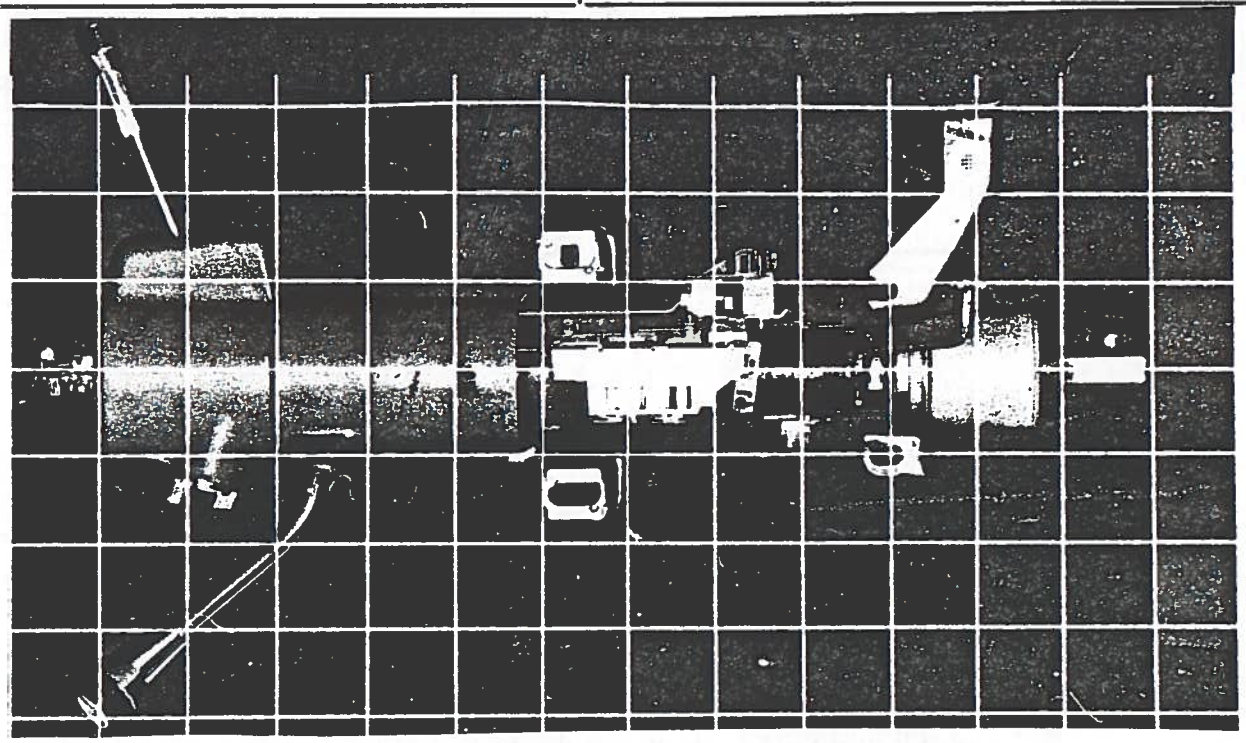
STEERING COLUMN FACT SHEET

Vehicle Use

Year	Make	Car Line
1980-85	Buick	Skylark
1980-85	Chev.	Citation
1970-85	Pont.	Phoenix
1980-85	Olds.	Omega

Manufacturer's Part No.

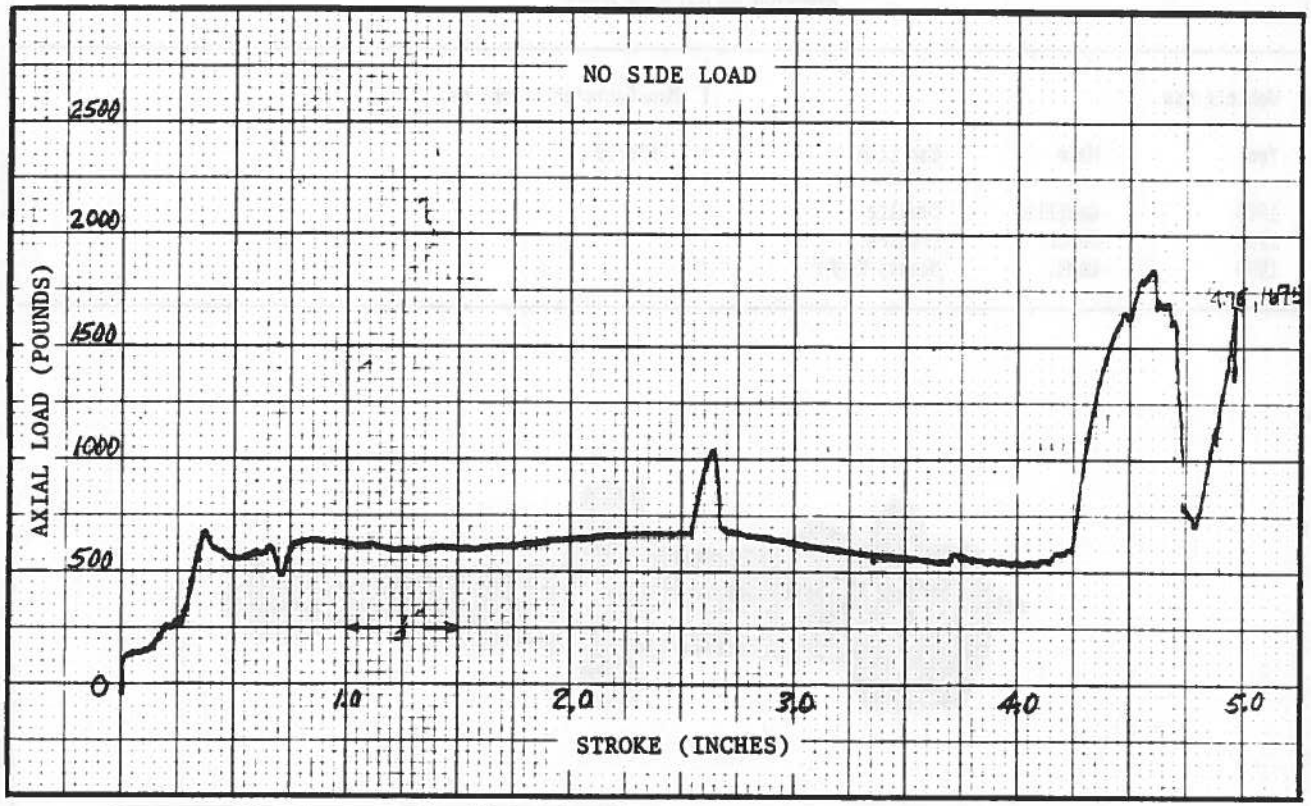
7830012, 7830038
7830887, 7835248

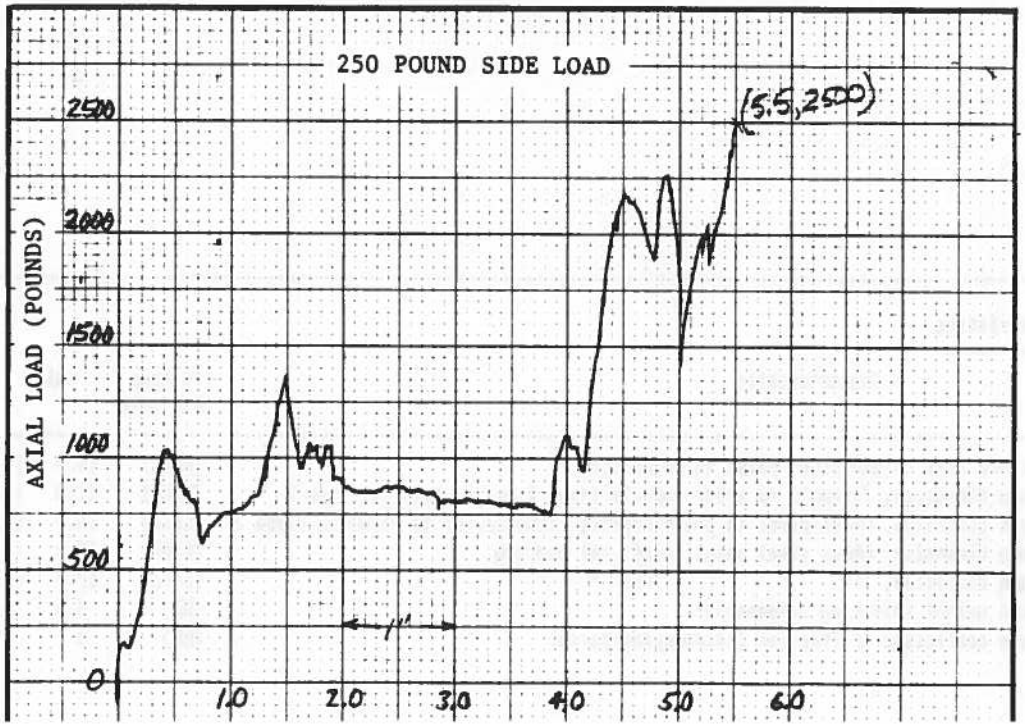


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	8.25 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	7.38 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	12.0 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	13.0 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	15.0 in.
B06	Column weight (stroking components)	(WZ)	4.0 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.39

COLUMN GROUP NO. 4.165

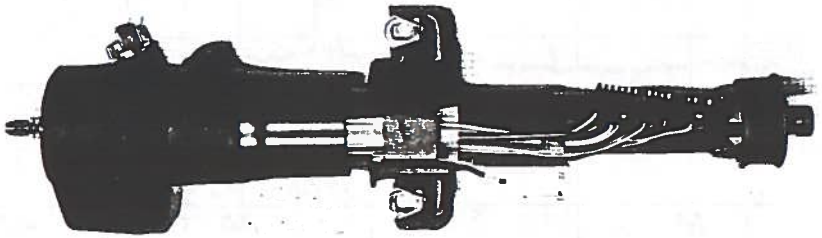




COLUMN GROUP NO. 4.170

STEERING COLUMN FACT SHEET

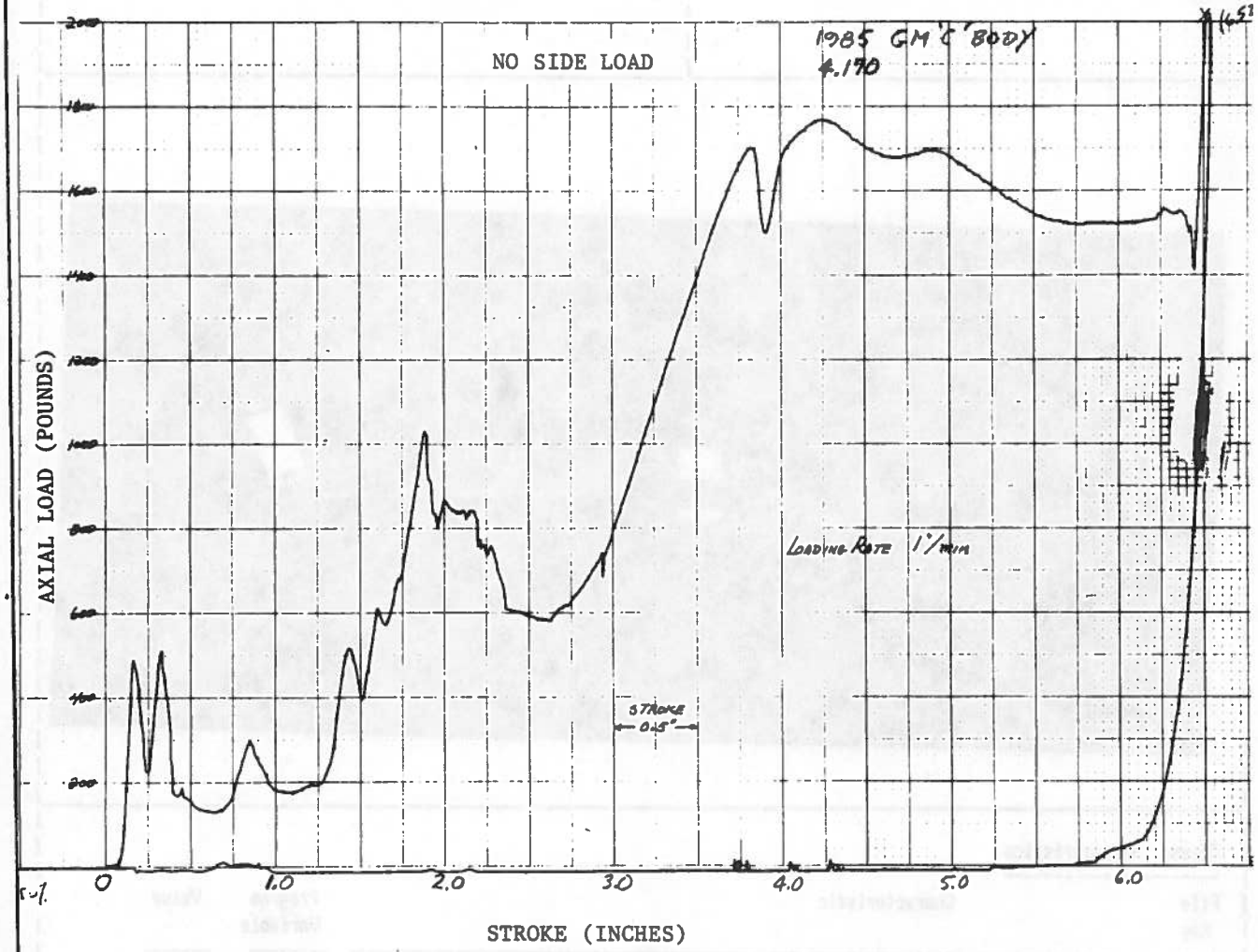
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	7838799
1985	Cadillac	DeVille	
1985	Buick	Electra	
1985	Olds.	Ninety Eight	



Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	14.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	11.8	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	13.0	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.0	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	17.5	in.
B06	Column weight (stroking components)	(WZ)	5.9	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	

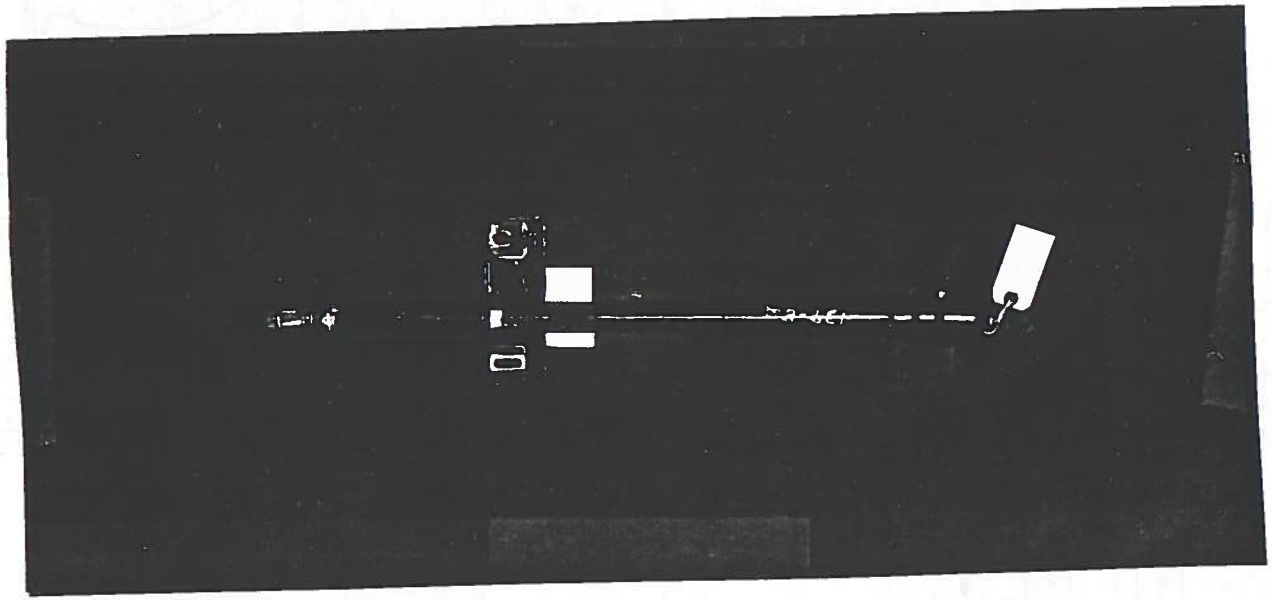
COLUMN GROUP NO. 4.170



COLUMN GROUP NO. 5.101

STEERING COLUMN FACT SHEET

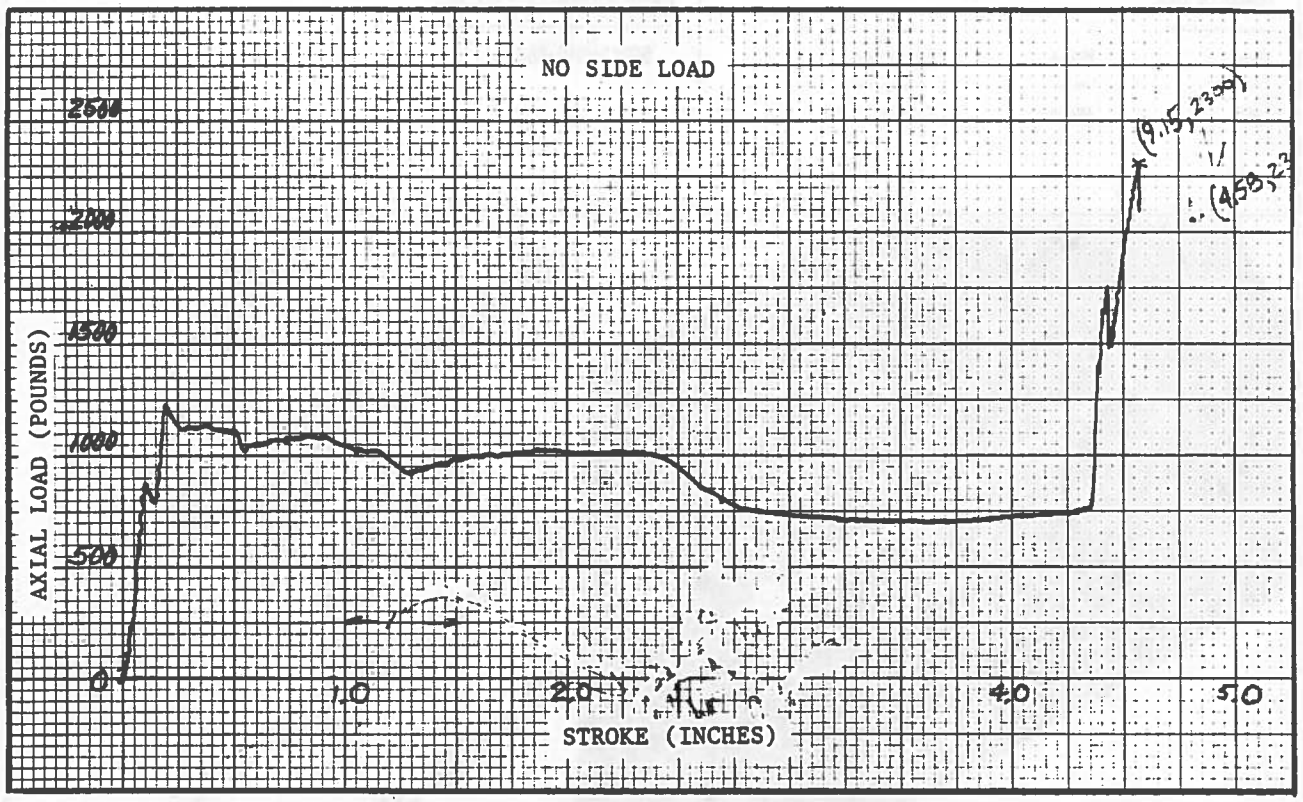
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980	Datsun	Model 210	0327/139-82, 1127/196-82

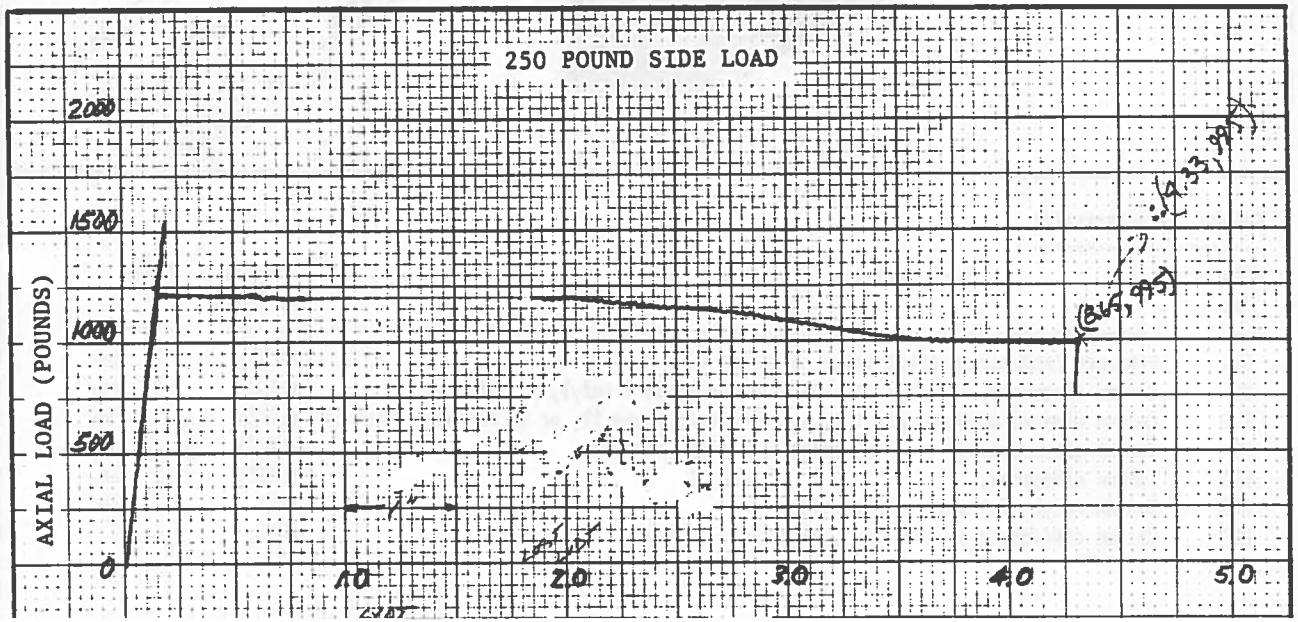


Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	10.1	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	18.7	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	9.3	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	16.1	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	18.6	in.
B06	Column weight (stroking components)	(WZ)	4.2	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	

COLUMN GROUP NO. 5.101

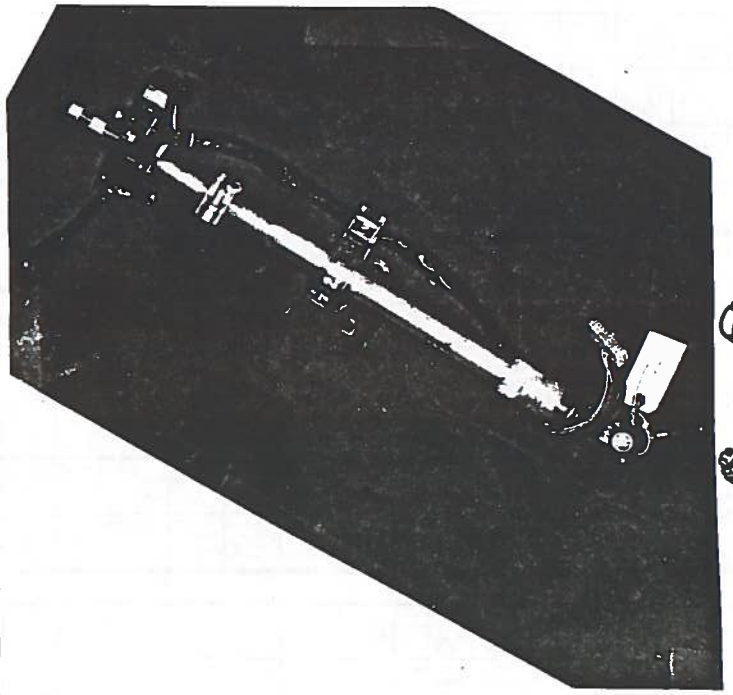


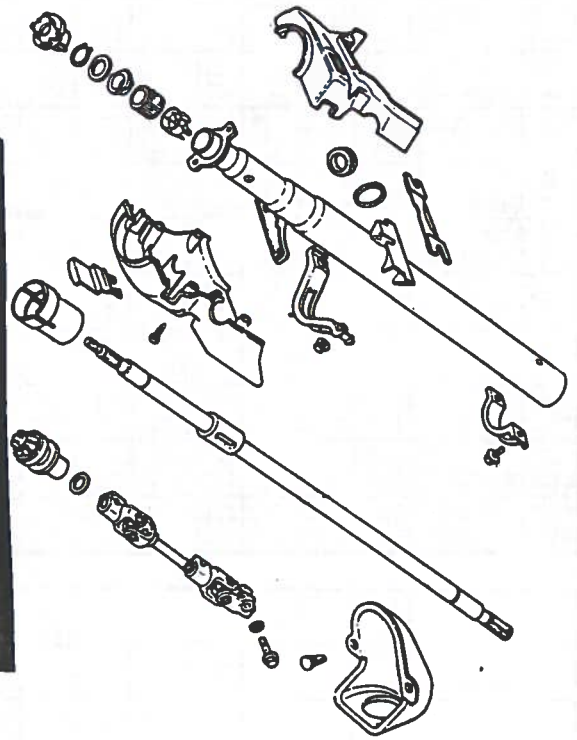


COLUMN GROUP NO. 6.101

STEERING COLUMN FACT SHEET

Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980	Honda	Civic	53210-SA0-000

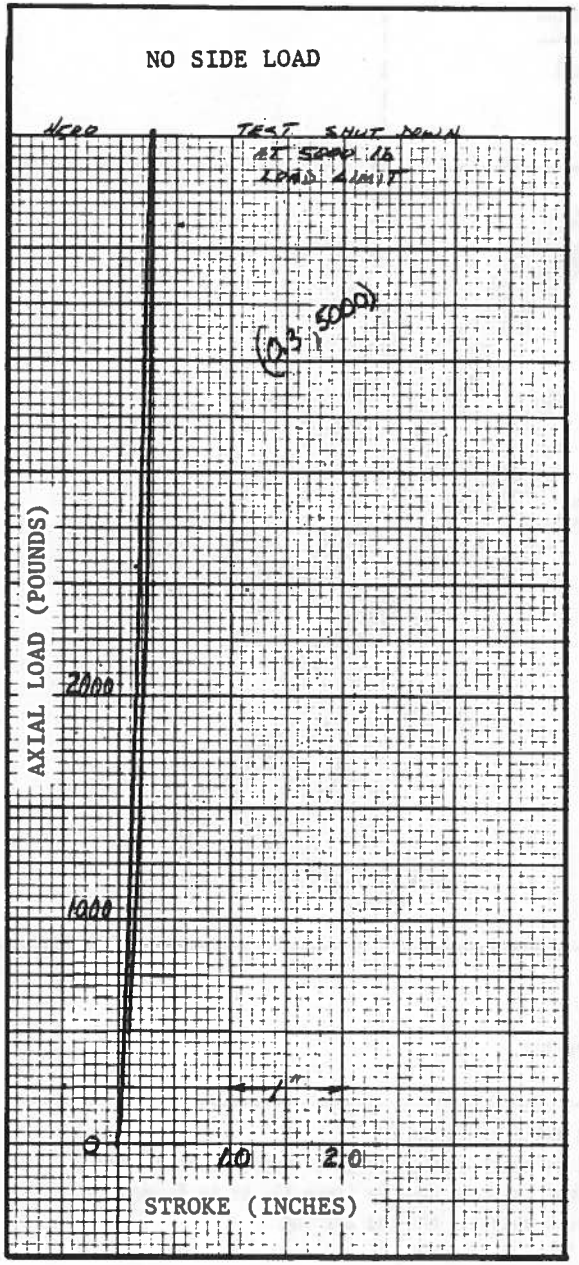




Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	9.1	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	8.5	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	12.5	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	14.5	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	18.5	in.
B06	Column weight (stroking components)	(WZ)	3.8	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	

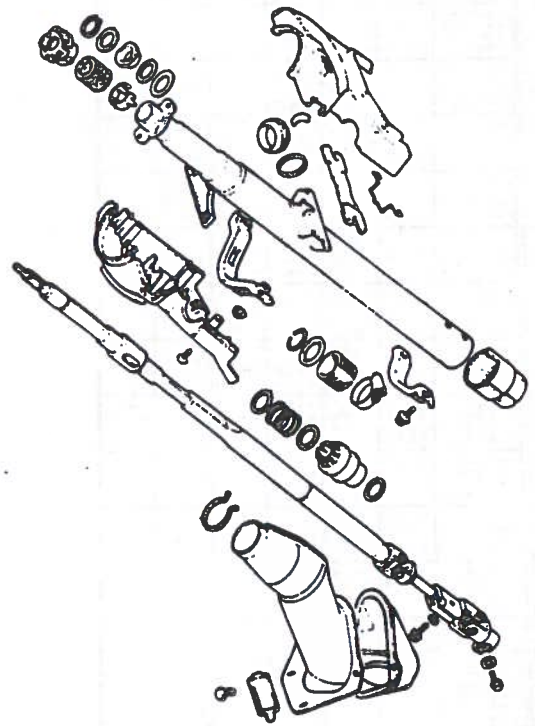
COLUMN GROUP NO. 6.101



COLUMN GROUP NO. 6.102

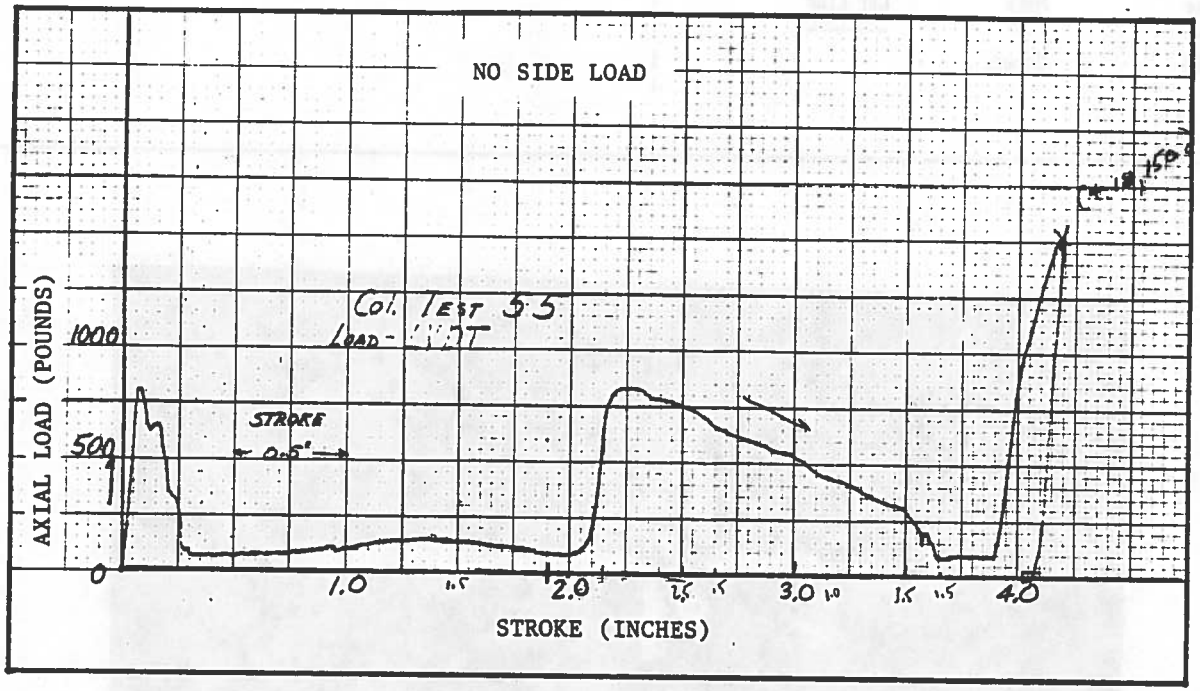
STEERING COLUMN FACT SHEET

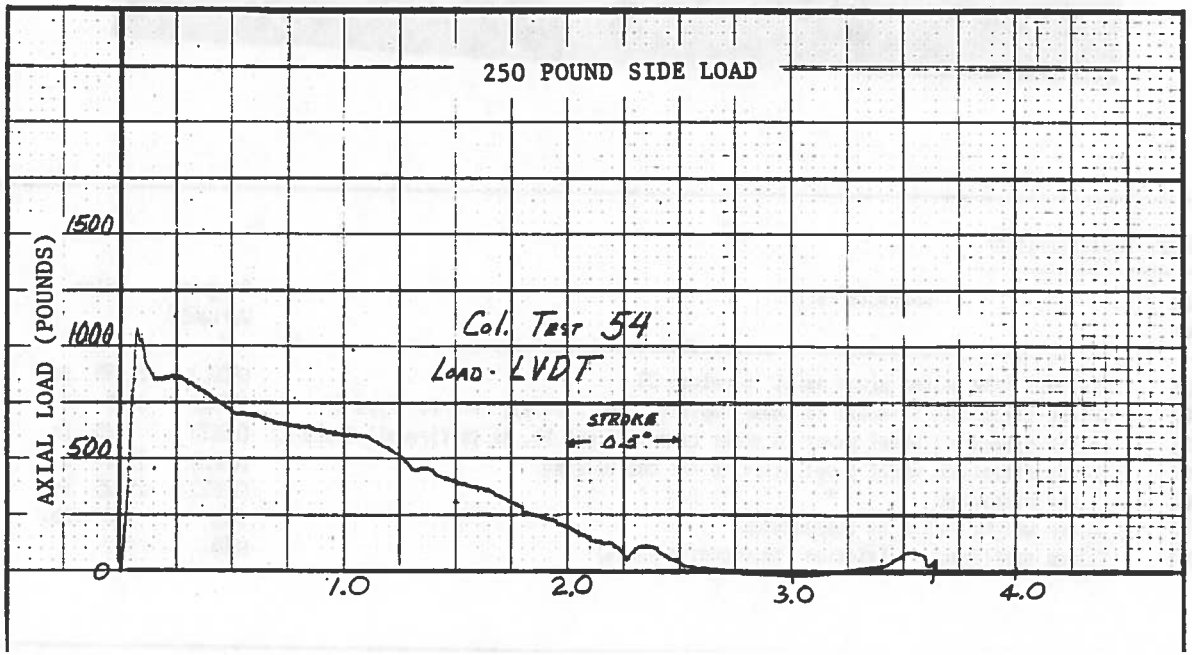
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1983	Honda	Accord	



Column Characteristics

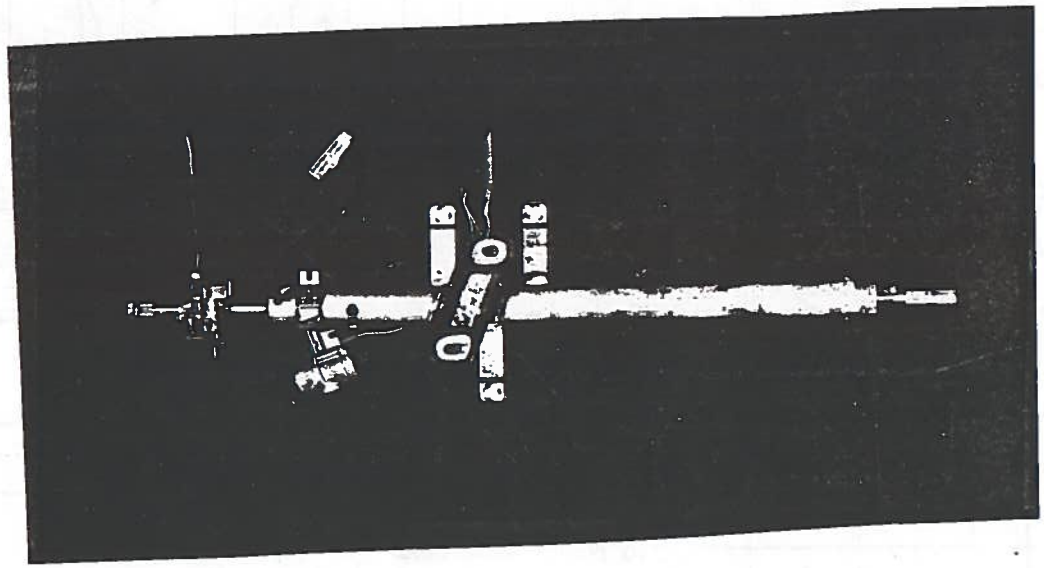
File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	9.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	8.5	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	12.7	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	14.7	in.
B05	Column dimension, ▫ ▫ ▫ ▫ fwd ▫ ▫	(LBFZ)	18.7	in.
B06	Column weight (stroking components)	(WZ)	3.8	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0	


NO SIDE LOAD
Col. Test 53
Load - LVDT
STROKE
← 0.5" →
AXIAL LOAD (POUNDS)
1000
500
0
1.0
2.0
3.0
4.0
STROKE (INCHES)


250 POUND SIDE LOAD
Col. Test 54
Load - LVDT
STROKE
← 0.5" →
AXIAL LOAD (POUNDS)
1500
1000
500
0
1.0
2.0
3.0
4.0

STEERING COLUMN FACT SHEET

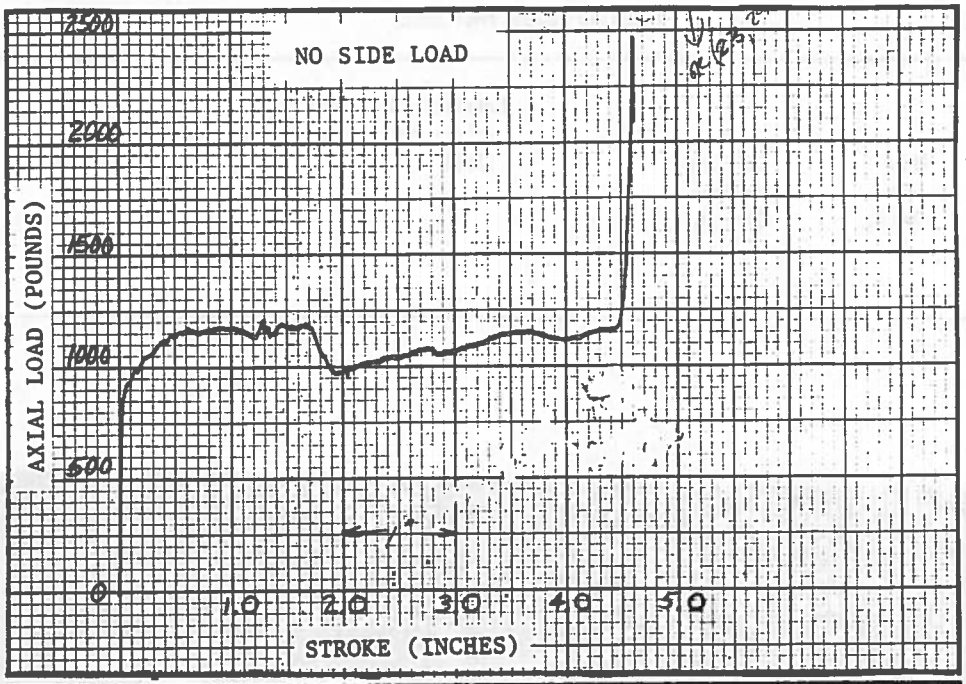
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980	Subaru		

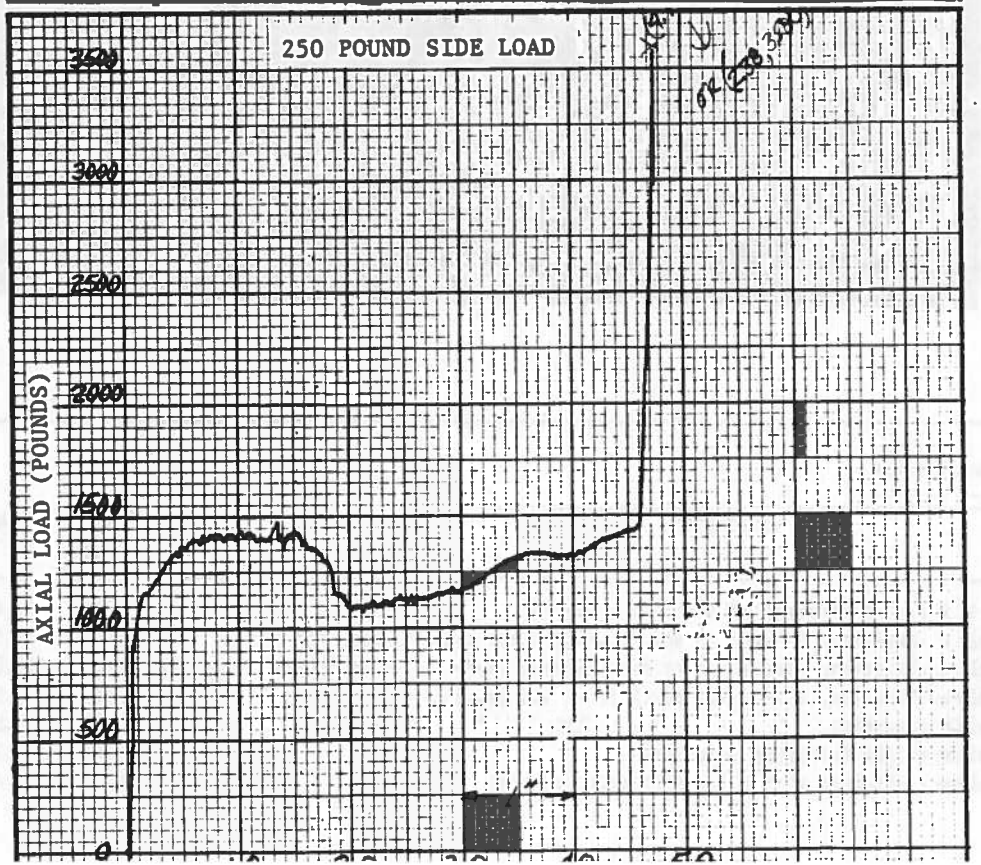


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	11.25 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.5 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	9.25 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	11.25 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	15.25 in.
B06	Column weight (stroking components)	(WZ)	1.6 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.2

COLUMN GROUP NO. 7.101

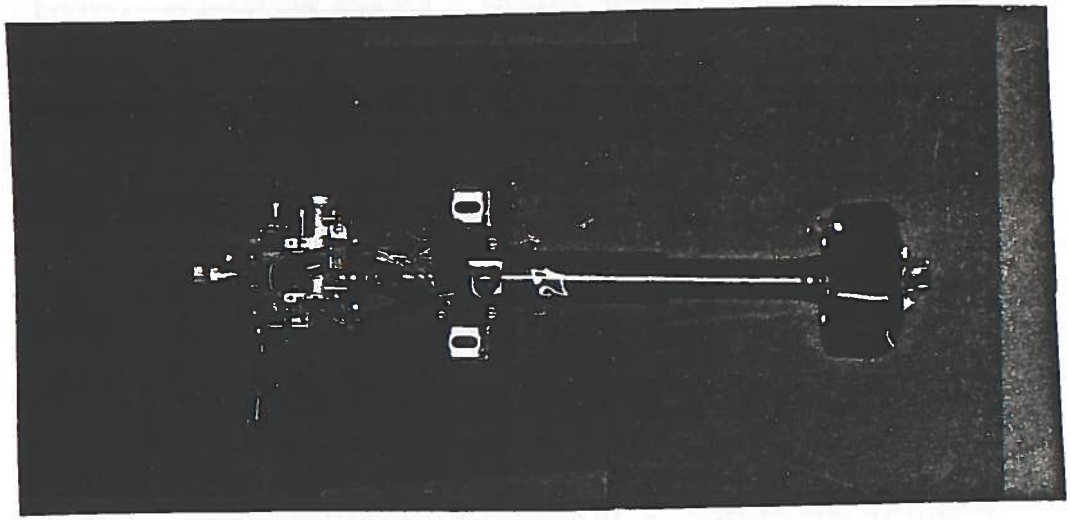




COLUMN GROUP NO. 8.102

STEERING COLUMN FACT SHEET

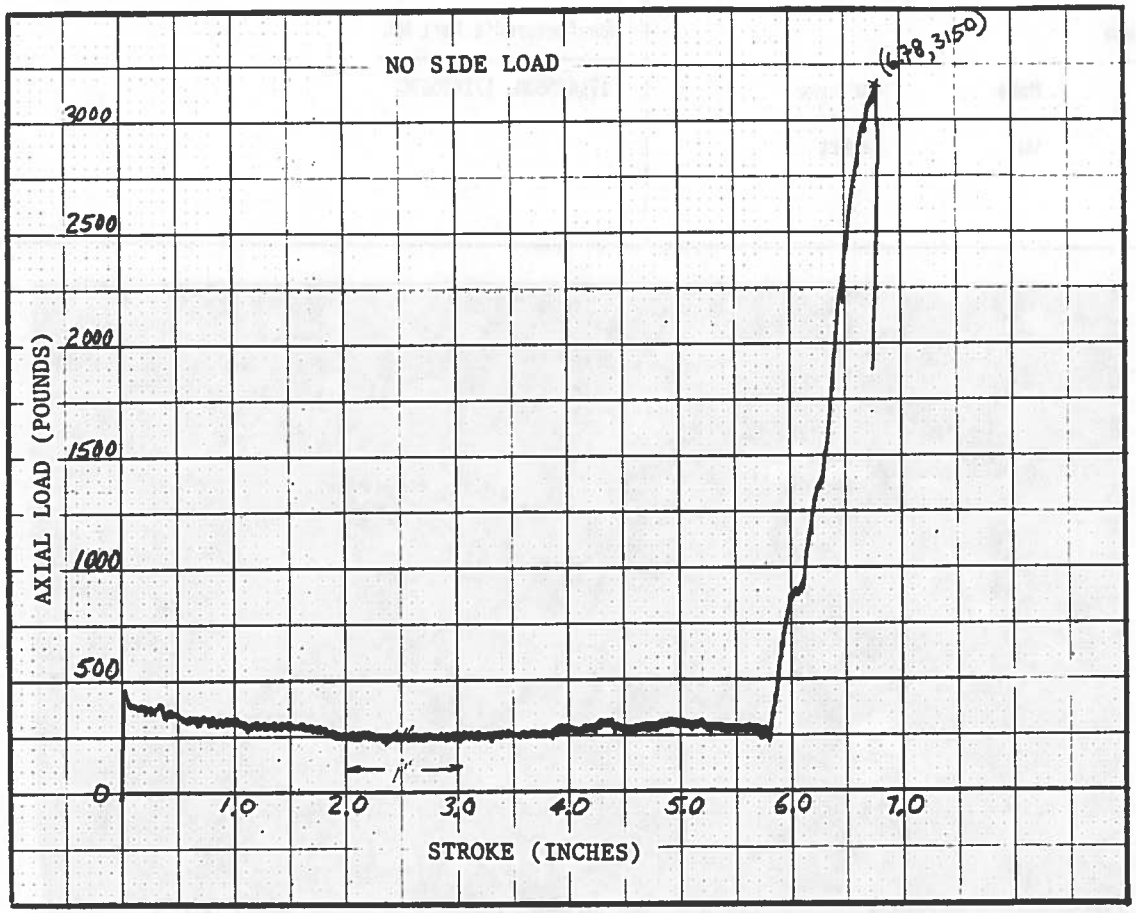
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980	Toyota	Corolla	12080

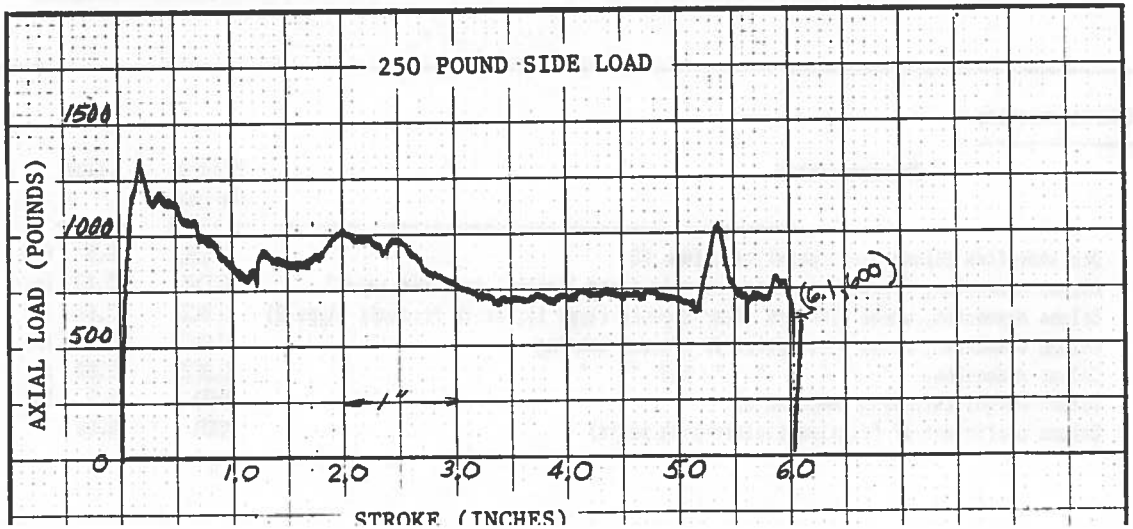


Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	13.4	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	15.5	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	11.0	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	15.5	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	18.5	in.
B06	Column weight (stroking components)	(WZ)	4.7	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	1.4	

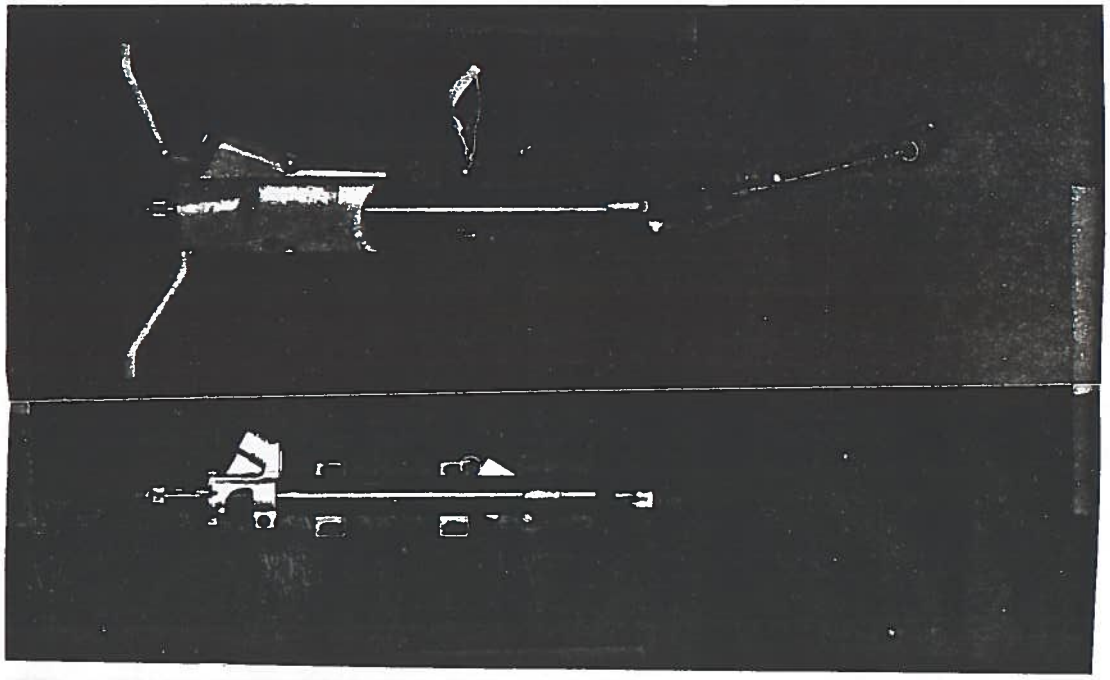
COLUMN GROUP NO. 8.102





STEERING COLUMN FACT SHEET

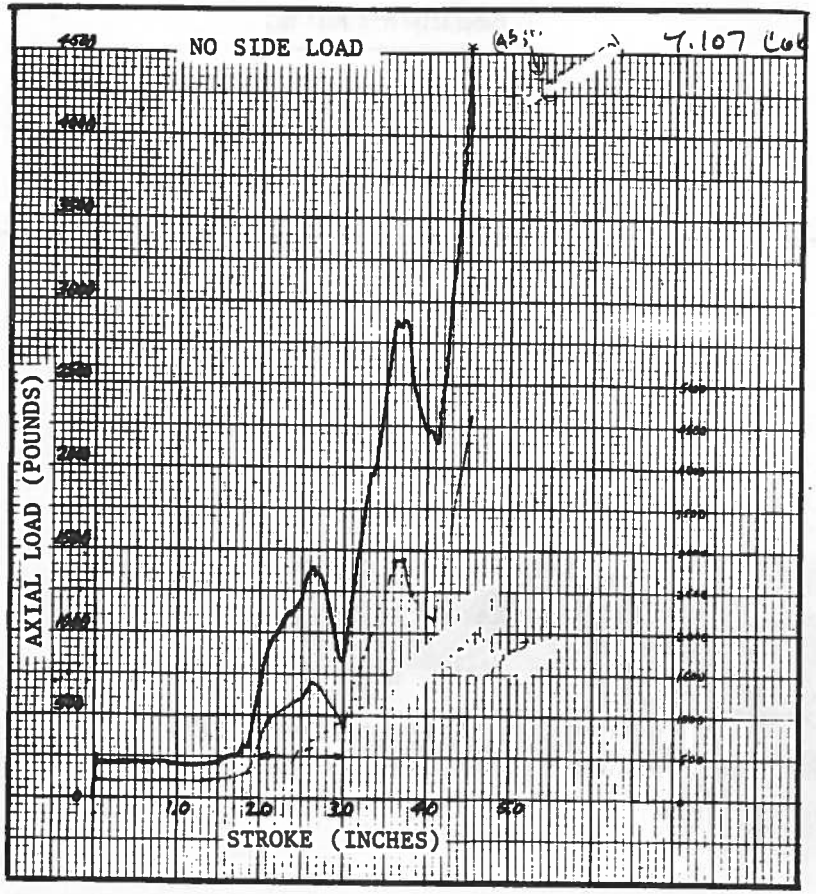
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	17149503A, 17149563C
1978-81	Vw	Rabbit	

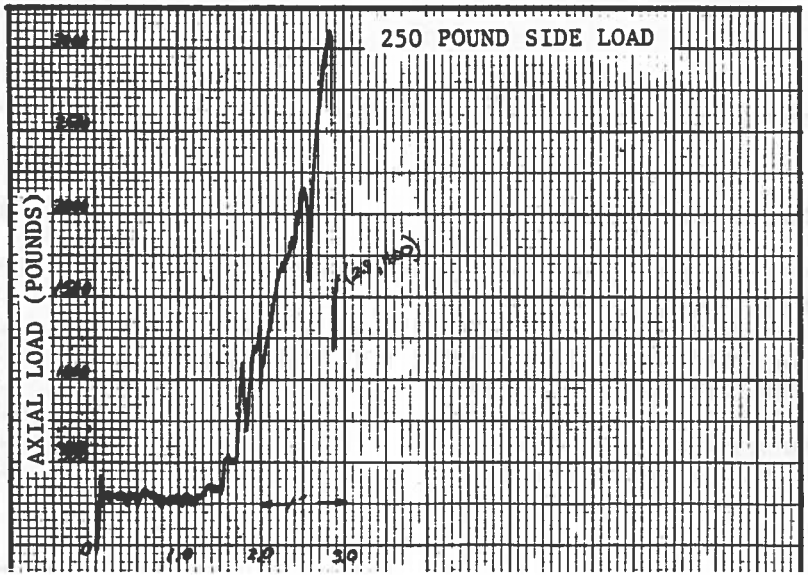


Column Characteristics

File Key	Characteristic	Program Variable	Value
B01	Distance from column pivot point to column CG	(RCOL)	2.5 in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	5.13 in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	7.62 in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	9.62 in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	13.62 in.
B06	Column weight (stroking components)	(WZ)	1.2 lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.36

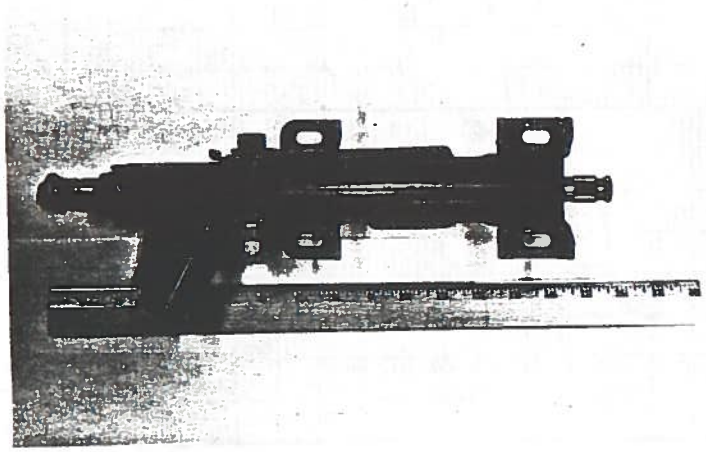
COLUMN GROUP NO. 9.107





STEERING COLUMN FACT SHEET

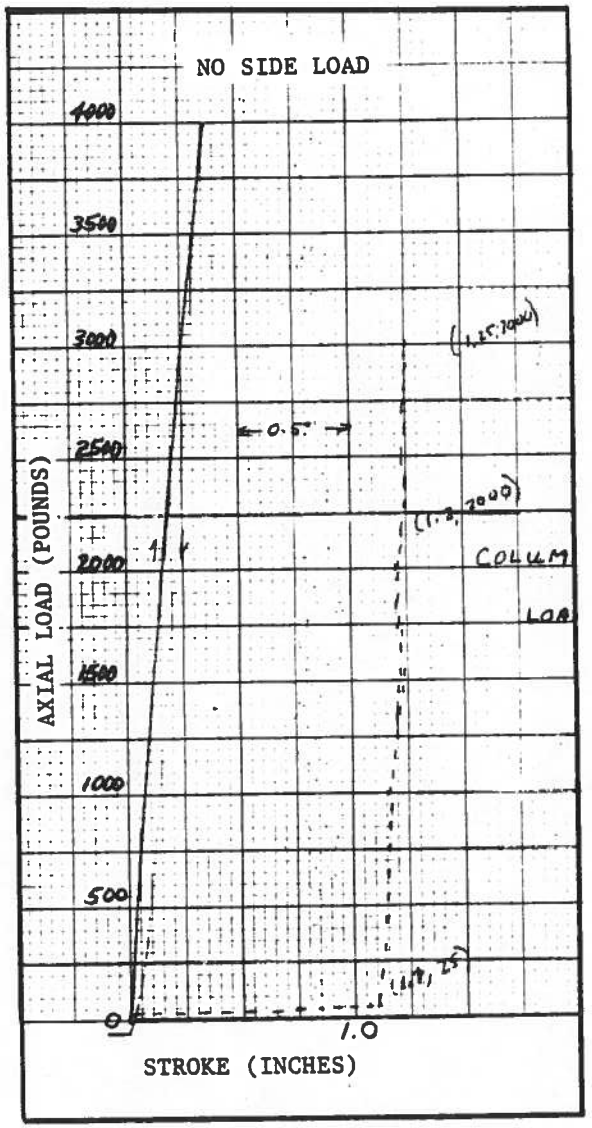
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1983	Renault	Fuego	

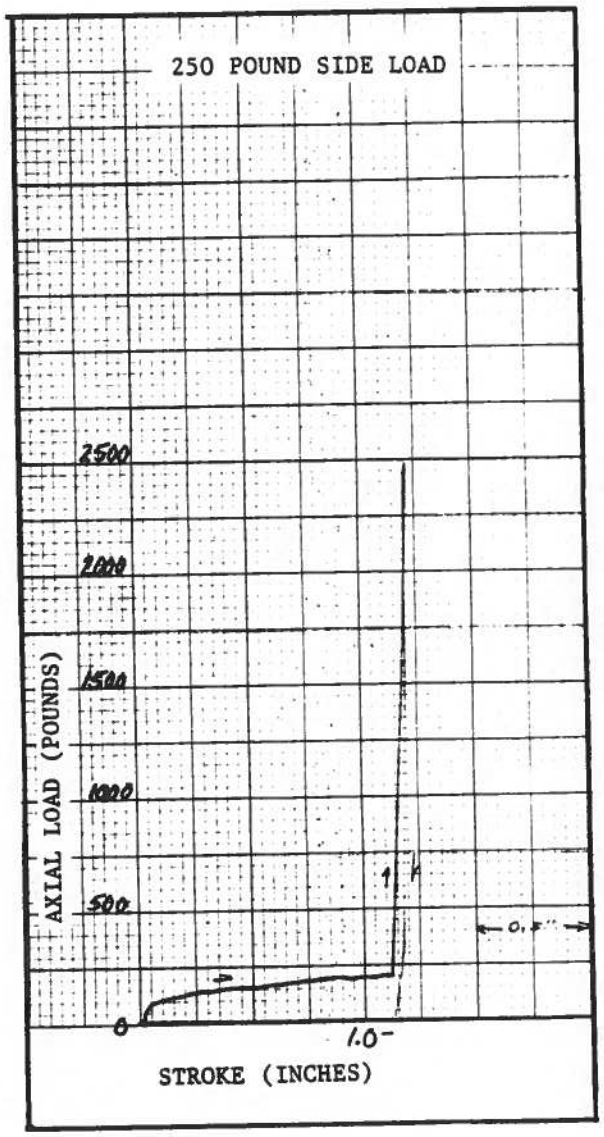


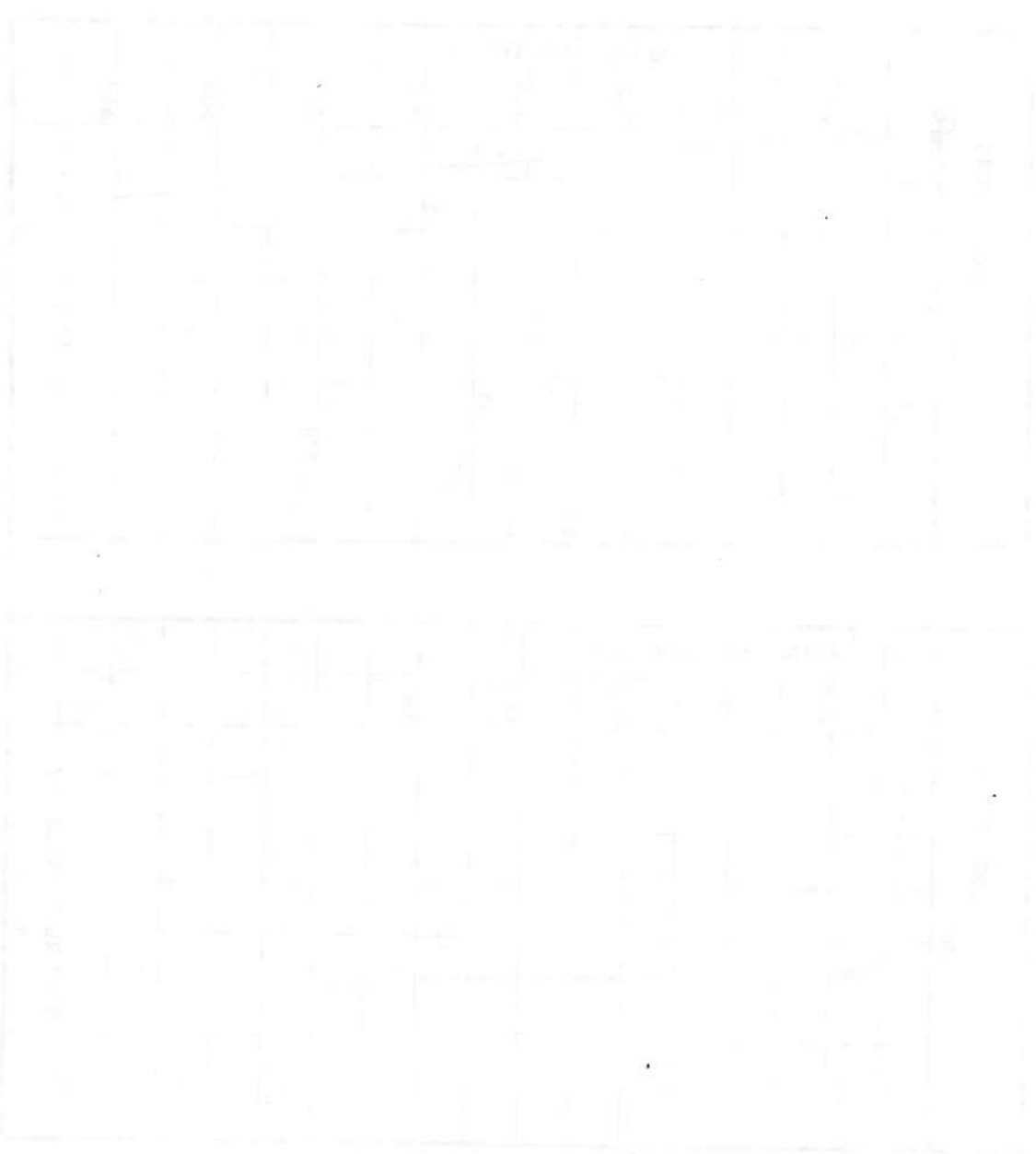
Column Characteristics

File Key	Characteristic	Program Variable	Value	
B01	Distance from column pivot point to column CG	(RCOL)	7.8	in.
B02	Column dimension, firewall to shear capsule (type 1 only), zero for type 2	(LFWZ)	9.1	in.
B03	Column dimension, wheel pivot to shear capsule (type 1), or to firewall (type 2)	(LSCZ)	7.5	in.
B04	Column dimension, wheel pivot point to aft col bearing	(LBAZ)	9.5	in.
B05	Column dimension, " " " " fwd " "	(LBFZ)	13.5	in.
B06	Column weight (stroking components)	(WZ)	2.64	lb.
B07	Column coeficient of friction (telescoping parts)	(MU)	0.59	

COLUMN GROUP NO. 9.501







APPENDIX C
WHEEL FACT SHEETS

The fact sheets for each steering wheel group contain: (a) vehicles on which this wheel group was used, (b) manufacturer's part numbers, (c) an illustration, when available, from the manufacturer's parts catalog, (d) the physical measurements of the wheels, and (e) the static load-deflection test results.

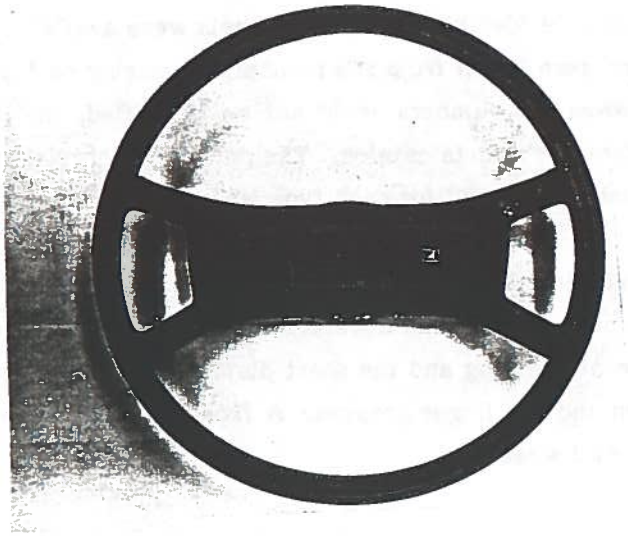
The vehicle usage listing in the fact sheets identifies all vehicles and model years that the particular wheel was used. The usage listing does not indicate that all vehicles of the particular type and model year were equipped with the wheel shown here. In some cases, optional trim and substitute "deluxe" or "sport" wheels were available options. The steering wheel part numbers were taken from the numbers appearing on the wheels when they could be identified. When the numbers could not be identified, the parts numbers were taken from the manufacturer's parts catalog. The parts numbers listing attempts to identify all the numbers which were found for each type wheel group.

The location of wheel dimensions is shown in Figure 4-4. In some cases, the dimensions are the average measurements of several wheels. In all instances, the wheel rim dimension is an average of the long and the short diameters of the rim cross-section which is oval in cross-section and has finger grooves. A fixed value of the wheel pitching moment of inertia is used for all wheels.

The test results are presented as load-deflection traces for paraxial bottom, paraxial top, radial bottom, hub crush and whole wheel crush tests.

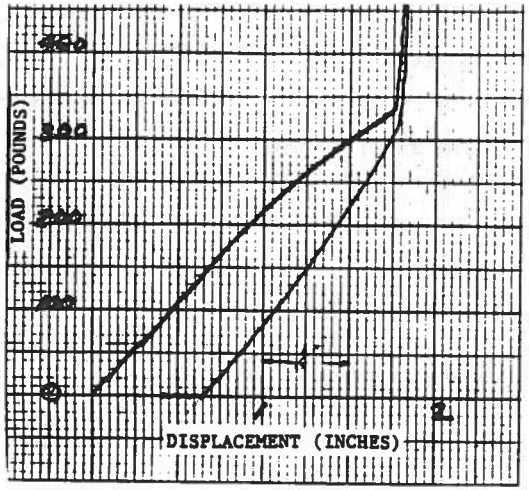
STEERING WHEEL FACT SHEET

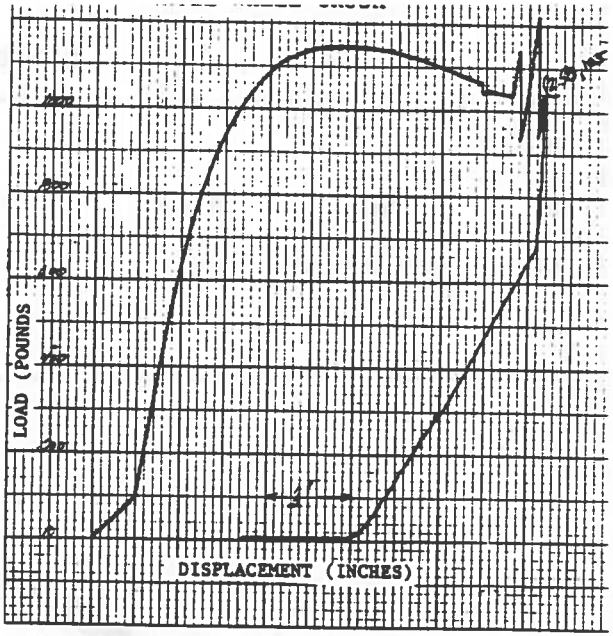
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1979-81	American Motors	Concord	41939 A

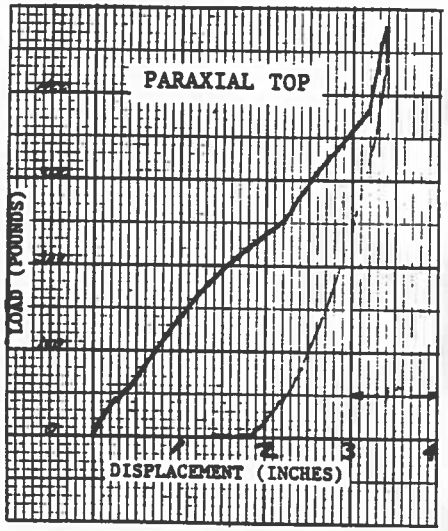


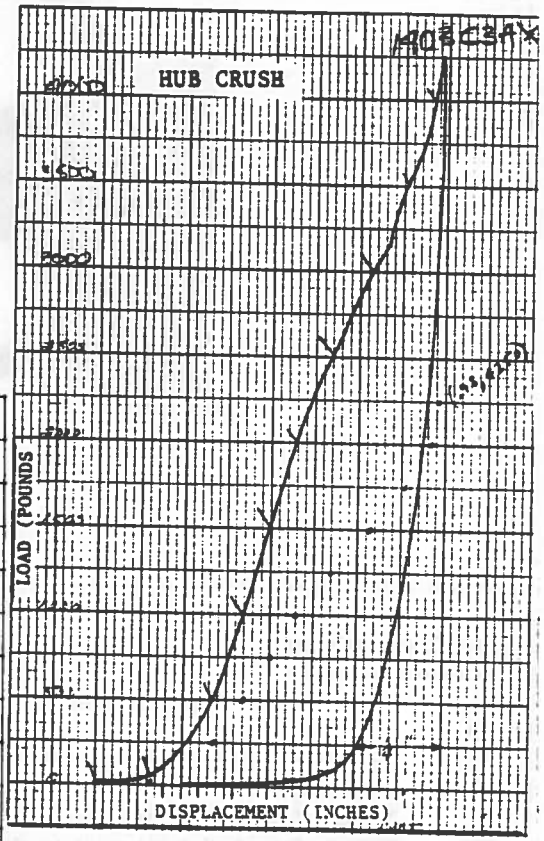
Wheel Characteristics

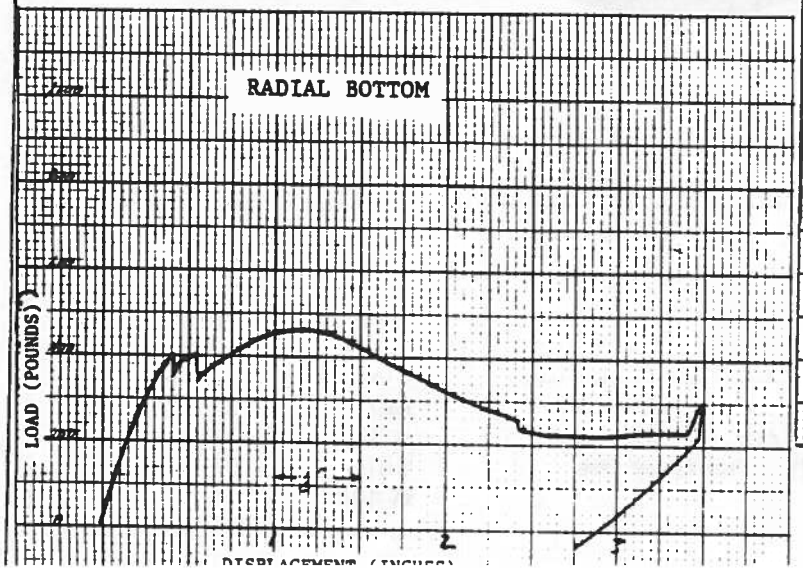
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.2 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.12 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.81 in.
C05	Radious of wheel rim	(RIMRAD)	7.53 in.
	Thickness of wheel rim		0.77 in.


LOAD (POUNDS)
DISPLACEMENT (INCHES)


LOAD (POUNDS
DISPLACEMENT (INCHES)

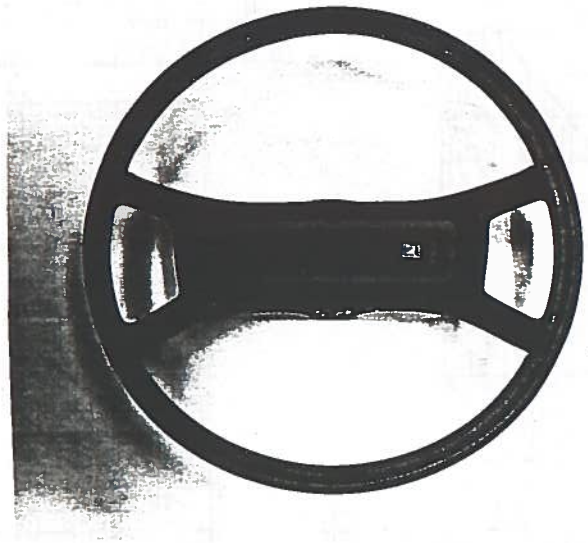

PARAXIAL TOP
LOAD (POUNDS)
DISPLACEMENT (INCHES)


HUB CRUSH
LOAD (POUNDS
DISPLACEMENT (INCHES)


RADIAL BOTTOM
LOAD (POUNDS)

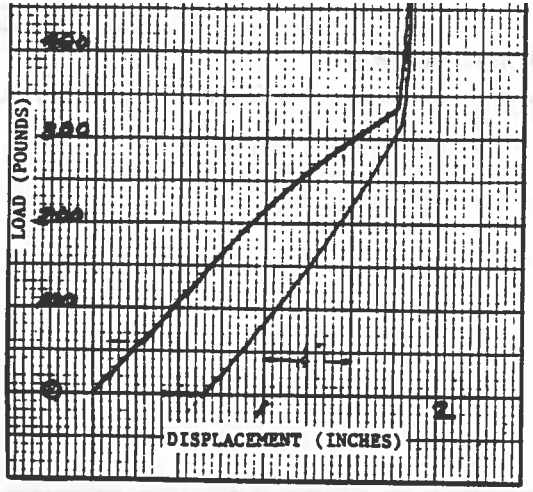
STEERING WHEEL FACT SHEET

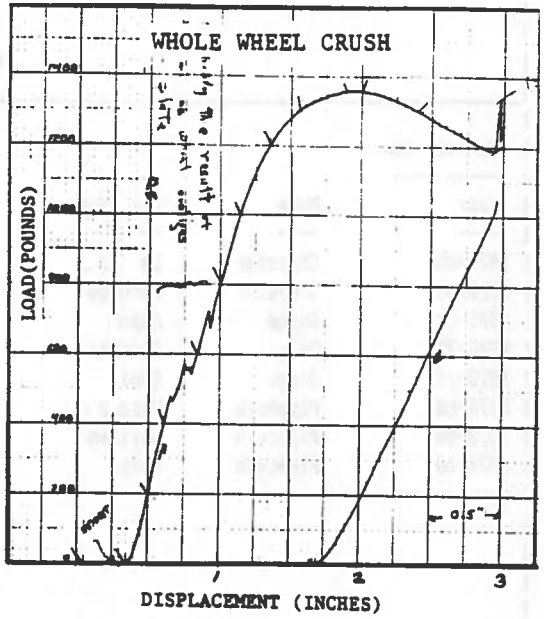
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1983	American Motors	Concord	3251219-10280R

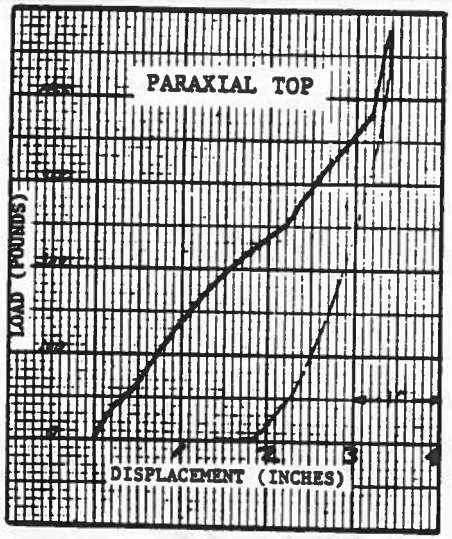


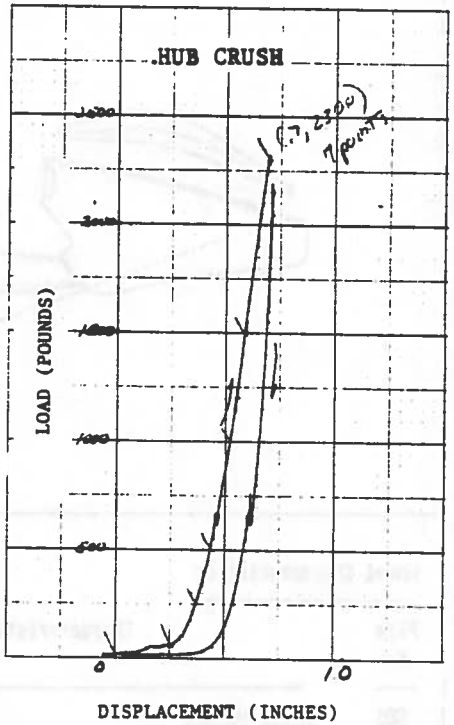
Wheel Characteristics

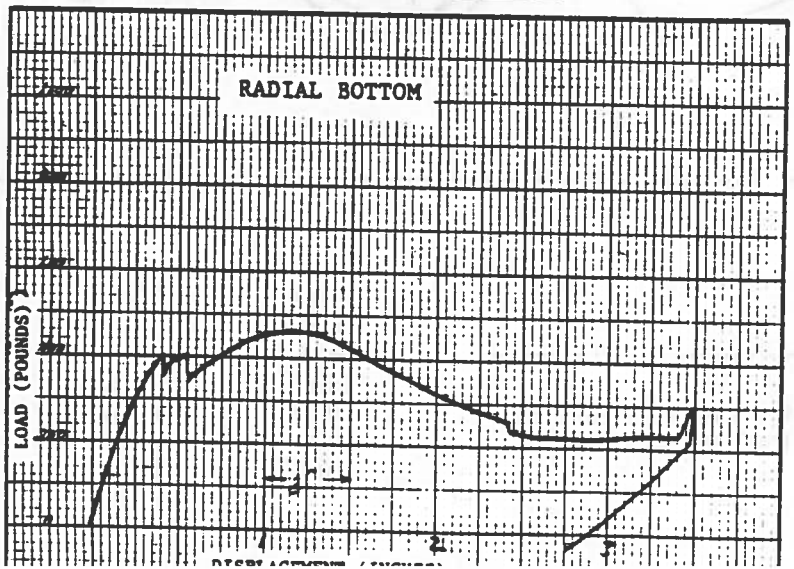
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.2 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.12 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.8 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		0.77 in.


LOAD (POUNDS)
DISPLACEMENT (INCHES)


WHOLE WHEEL CRUSH
LOAD(POUNDS)
DISPLACEMENT (INCHES)

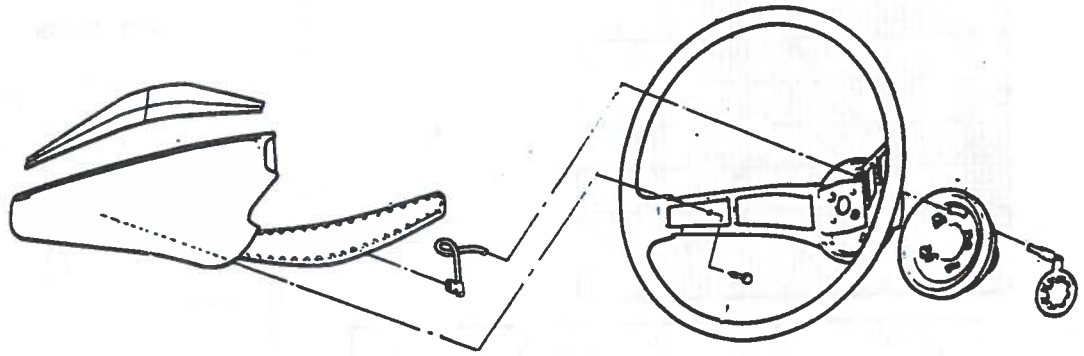

PARAXIAL TOP
LOAD (POUNDS)
DISPLACEMENT (INCHES)


HUB CRUSH
LOAD (POUNDS)
DISPLACEMENT (INCHES)


RADIAL BOTTOM
LOAD (POUNDS)

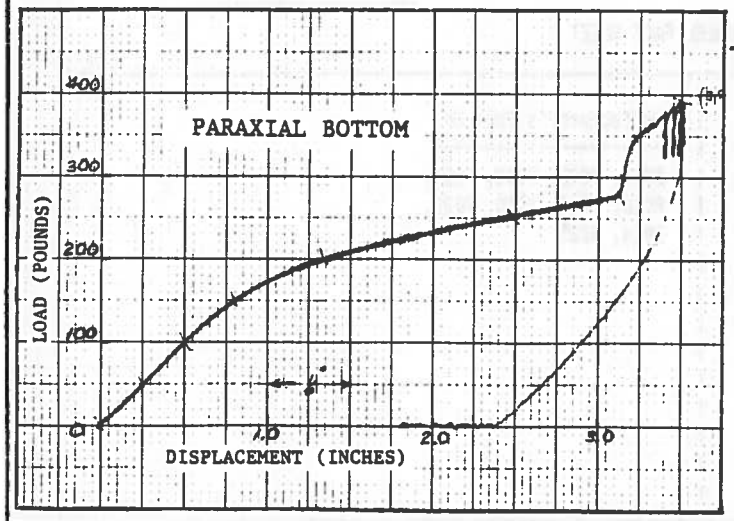
STEERING WHEEL FACT SHEET

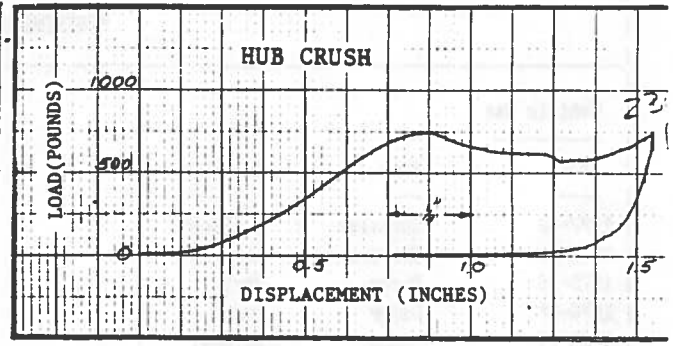
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	P011, P015, P022
1977-80	Chrysler	Le Baron	
1976-80	Chrysler	Cordoba	
1976-80	Dodge	Aspen	
1976-79	Dodge	Coronet	
1978-79	Dodge	Omni	
1976-80	Plymouth	Volare	
1978-80	Plymouth	Horizon	
1976-80	Plymouth	Fury	

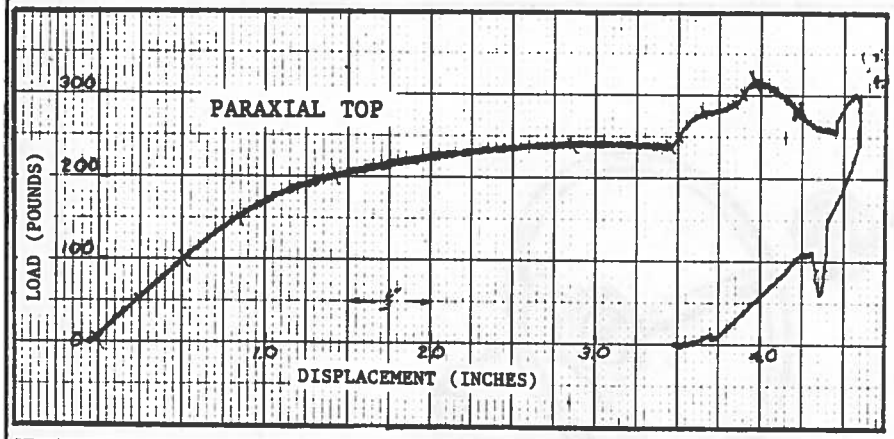


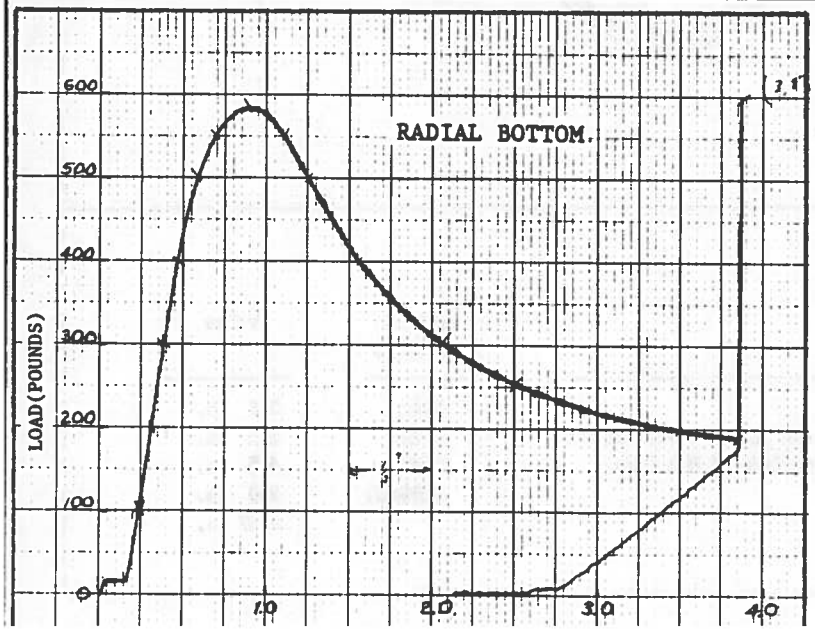
Wheel Characteristics

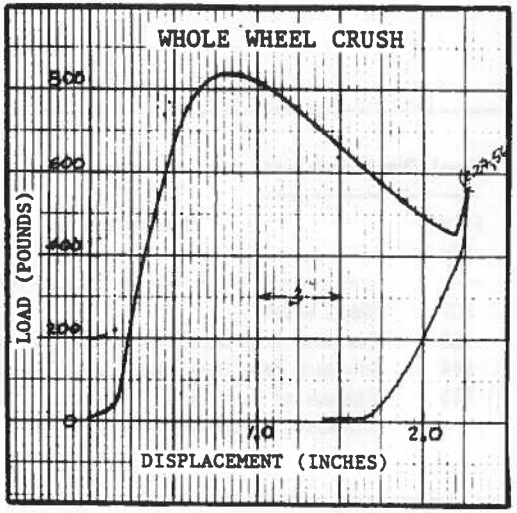
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.7 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.6 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	4.1 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		1.1 in.


PARAXIAL BOTTOM
LOAD (POUNDS)
400
300
200
100
0
1.0
2.0
5.0
DISPLACEMENT (INCHES)


HUB CRUSH
LOAD (POUNDS)
1000
500
0
0.5
1.0
1.5
DISPLACEMENT (INCHES)

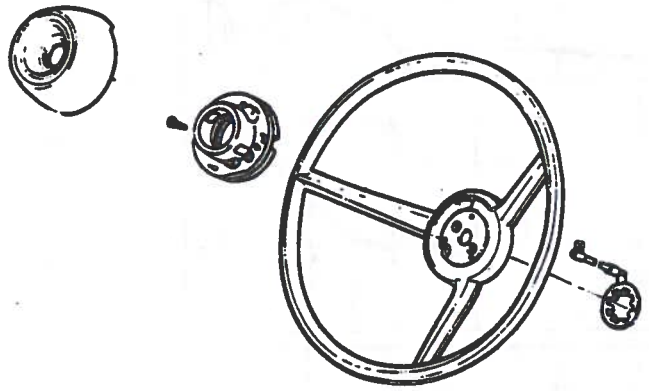

PARAXIAL TOP
LOAD (POUNDS)
300
200
100
0
1.0
2.0
3.0
4.0
DISPLACEMENT (INCHES)


RADIAL BOTTOM.
LOAD (POUNDS)
600
500
400
300
200
100
0
1.0
2.0
3.0
4.0


WHOLE WHEEL CRUSH
LOAD (POUNDS)
800
600
400
200
0
1.0
2.0
DISPLACEMENT (INCHES)

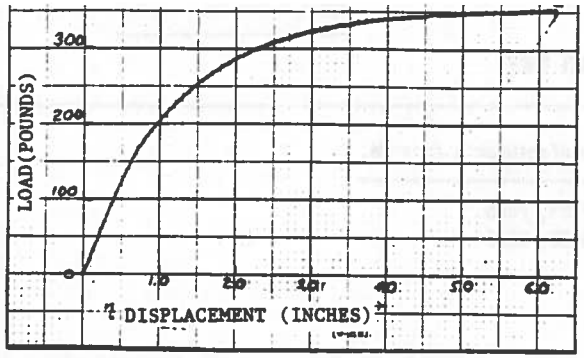
STEERING WHEEL FACT SHEET

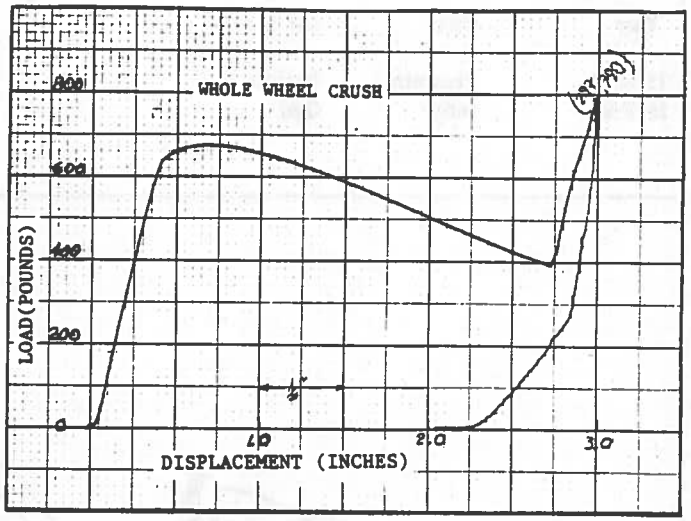
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	P001, P002, P003, P004, P010, P014, P015, P021, P014, 4025
1977-80	Chrysler	Le Baron	
1975-80	Chrysler	Cordoba	
1975-76	Dodge	Dart	
1976-80	Dodge	Aspen	
1975-79	Dodge	Coronet	
1978-80	Dodge	Omni	
1976-80	Plymouth	Volare	
1976-80	Plymouth	Horizon	
1975-78	Plymouth	Fury	
1975-76	Plymouth	Valiant	

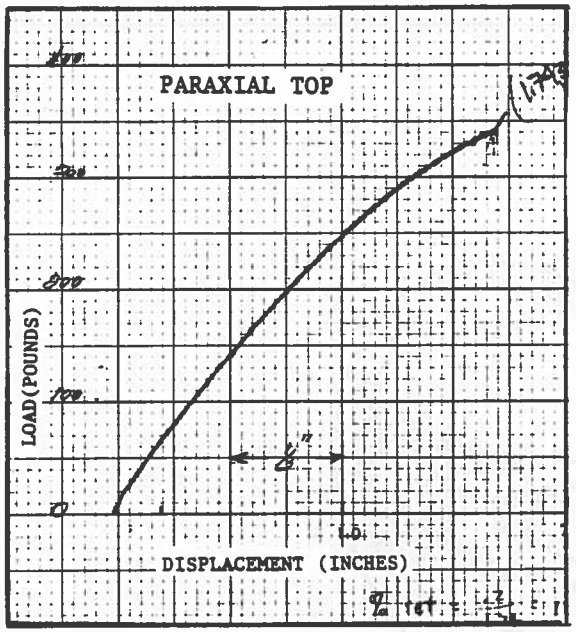


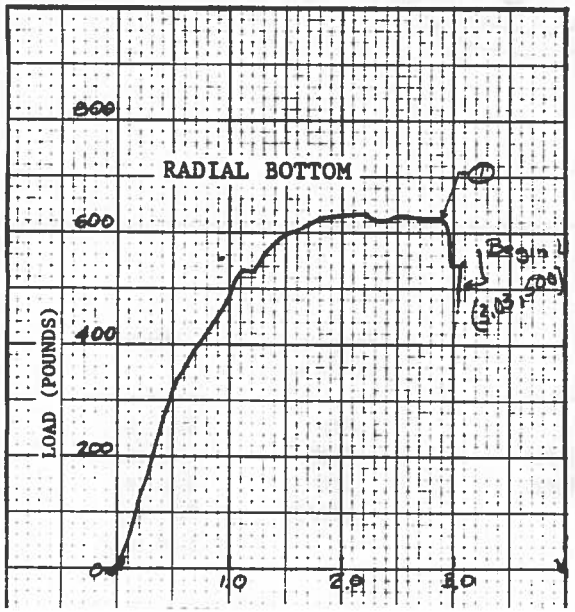
Wheel Characteristics

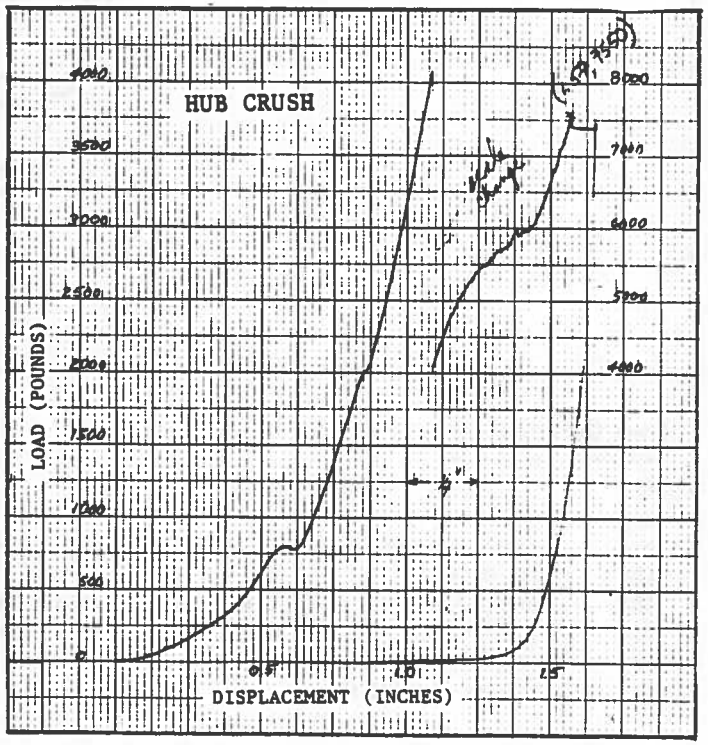
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.0 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.5 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	4.5 in.
C05	Radious of wheel rim	(RIMRAD)	8.0 in.
	Thickness of wheel rim		0.67 in.


LOAD (POUNDS)
300
200
100
0
1.0
2.0
3.0
4.0
5.0
6.0
DISPLACEMENT (INCHES)


WHOLE WHEEL CRUSH
LOAD (POUNDS)
600
400
200
0
1.0
2.0
3.0
DISPLACEMENT (INCHES)


PARAXIAL TOP
LOAD (POUNDS)
800
600
400
200
0
1.0
DISPLACEMENT (INCHES)

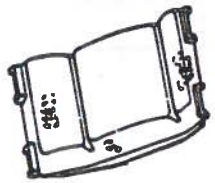

RADIAL BOTTOM
LOAD (POUNDS)
800
600
400
200
0
1.0
2.0
3.0

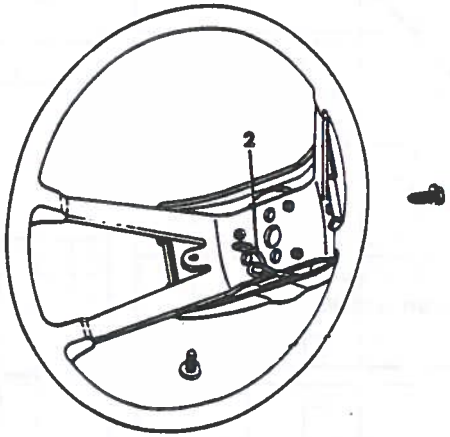

HUB CRUSH
LOAD (POUNDS)
4000
3500
3000
2500
2000
1500
1000
500
0
0.5
1.0
1.5
DISPLACEMENT (INCHES)

WHEEL GROUP NO. 2.402

STEERING WHEEL FACT SHEET

Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1978-83	Plymouth	Horizon	P059, P065
1978-83	Dodge	Omni	4188, 5026

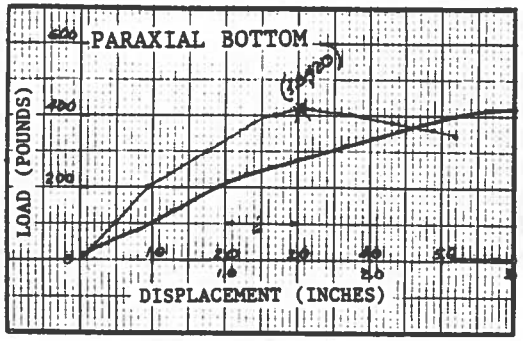


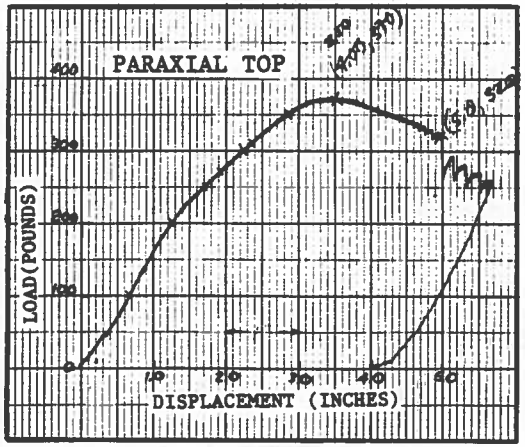


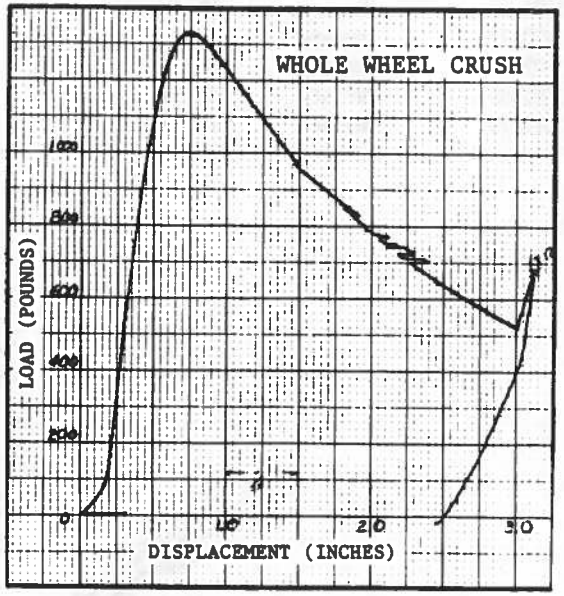
Wheel Characteristics

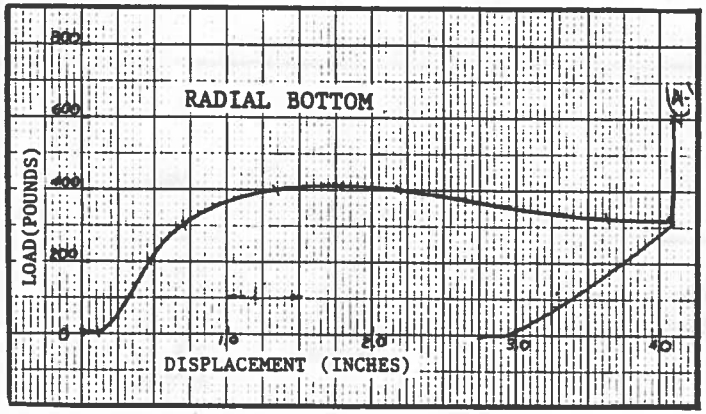
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.14 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	6.63 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.6 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		1.04 in.

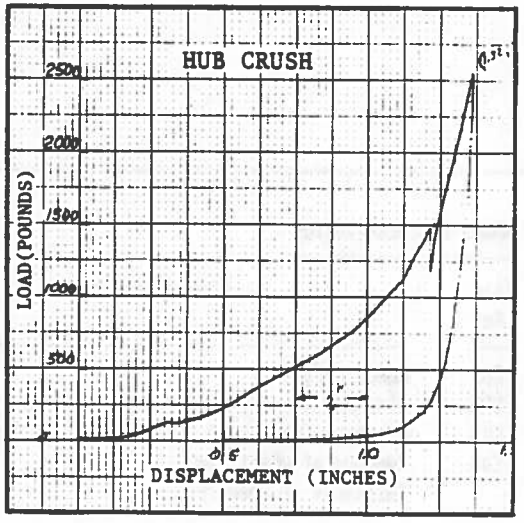
WHEEL GROUP NO. 2.402











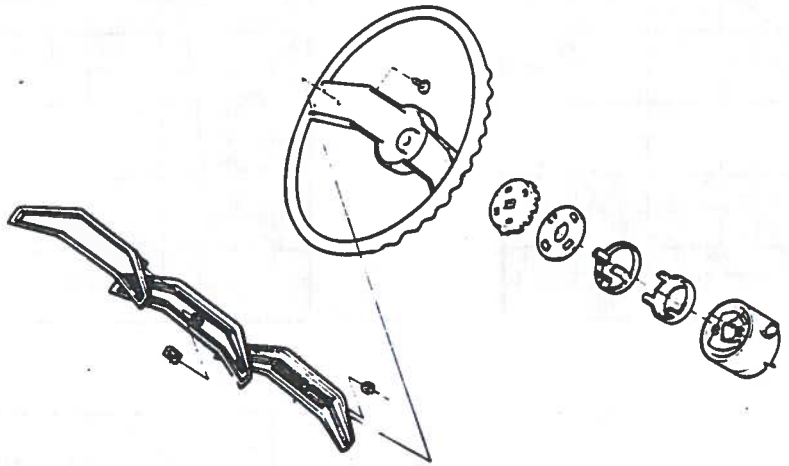
STEERING WHEEL FACT SHEET

Vehicle Use

Year	Make	Car Line
1975-76	Ford	Torino
1975-78	Ford	LTD
1975-78	Ford	Mustang
1975-80	Ford	Grenada
1975-80	Ford	Pinto
1975-79	Ford	Thunderbird
1975-78	Mercury	Marquis
1975-77	Mercury	Montego
1975-80	Mercury	Monarch
1975-80	Mercury	Bobcat
1975-79	Mercury	Continental

Manufacturer's Part No.

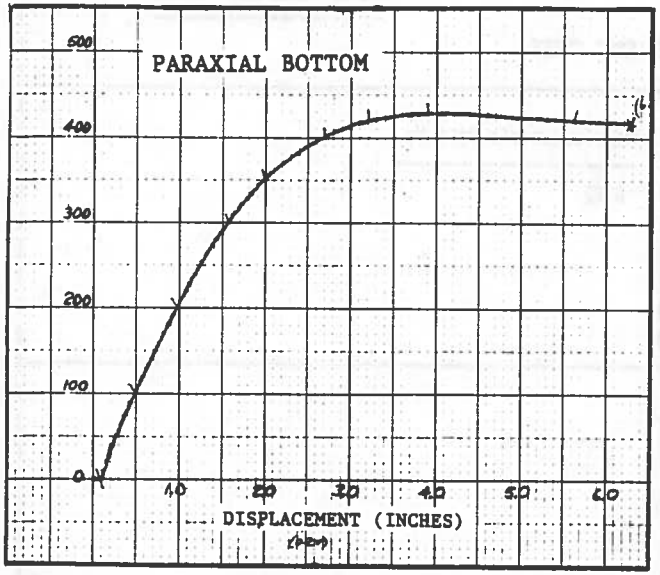
D5AV, D5AZ, D50Y, D50Z
D5SY, D5SZ, D6AY, D6AZ
D60Z, D74Y, D7AY, D7AZ
D70Z, D84Y, D8LY, D8AZ
D8FZ, D80Z, D94Y, D9LY
D9VY, E04Y, E0DZ, E0FZ

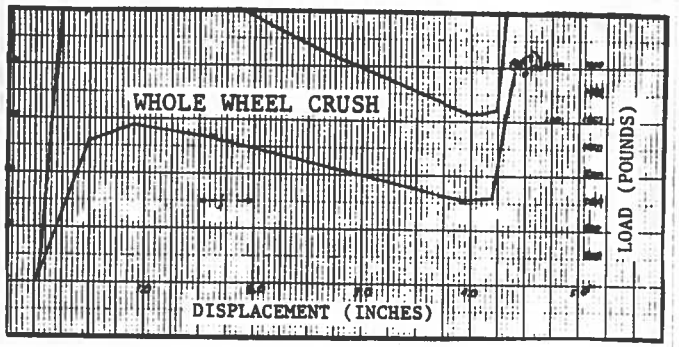


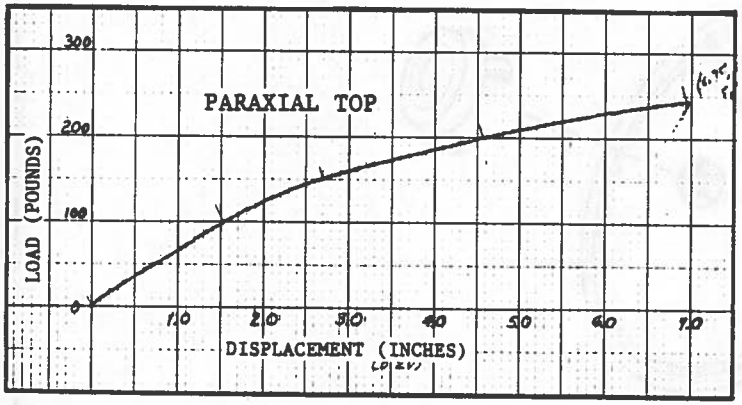
Wheel Characteristics

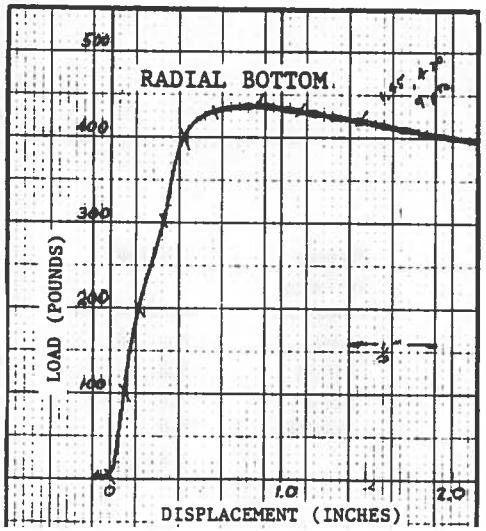
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.3 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.62 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	4.0 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		0.75 in.

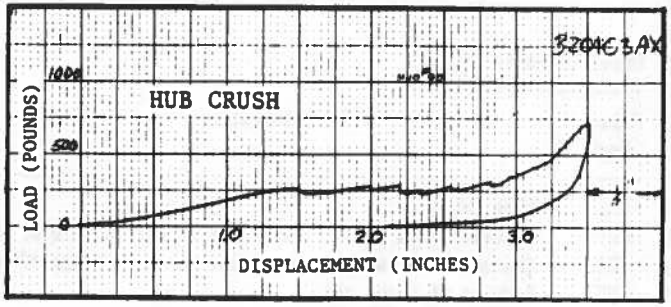
WHEEL GROUP NO. 3.201





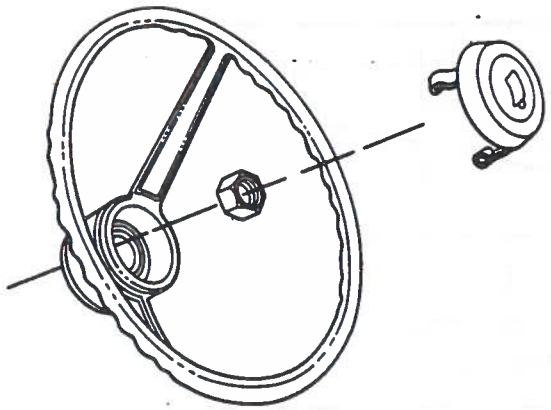






STEERING WHEEL FACT SHEET

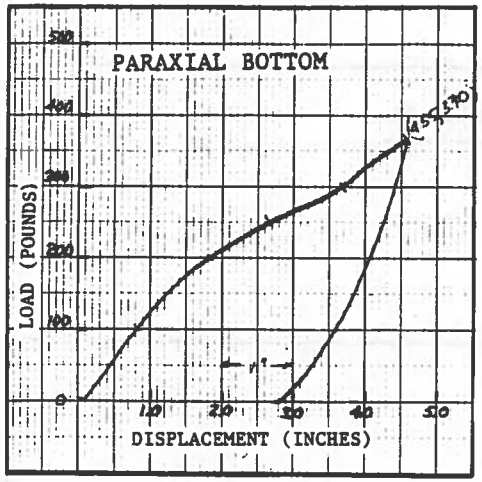
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-80	Ford	Pinto	D7FZ

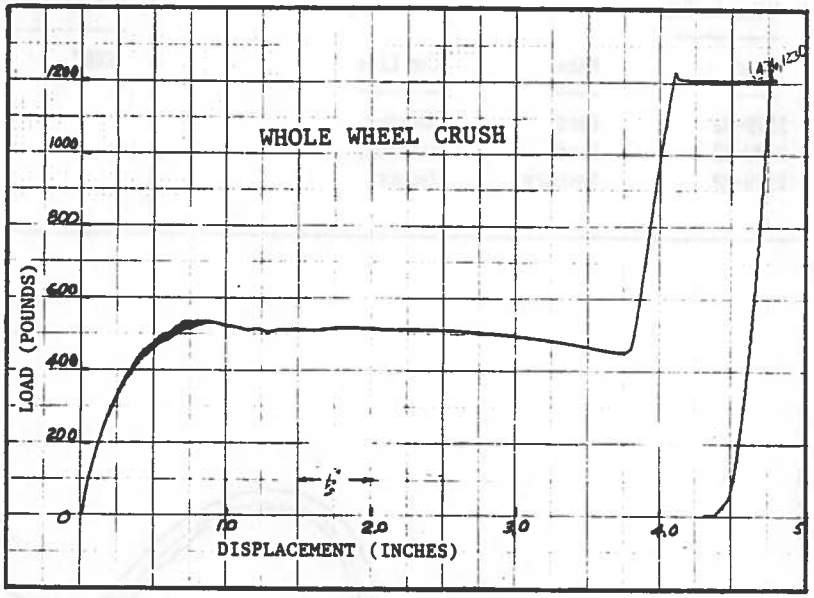


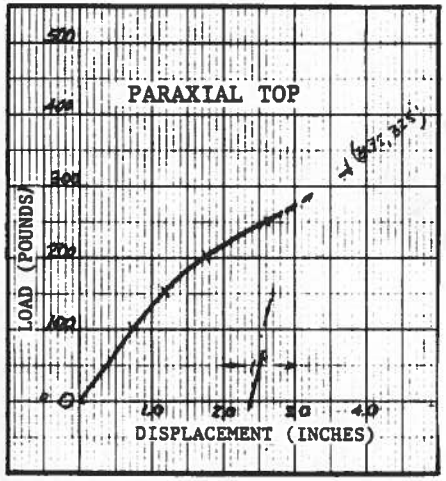
Wheel Characteristics

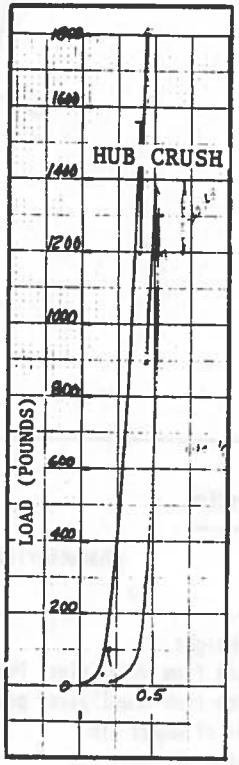
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.0 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.6 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	4.0 in.
C05	Radious of wheel rim	(RIMRAD)	15.0 in.
	Thickness of wheel rim		1.0 in.

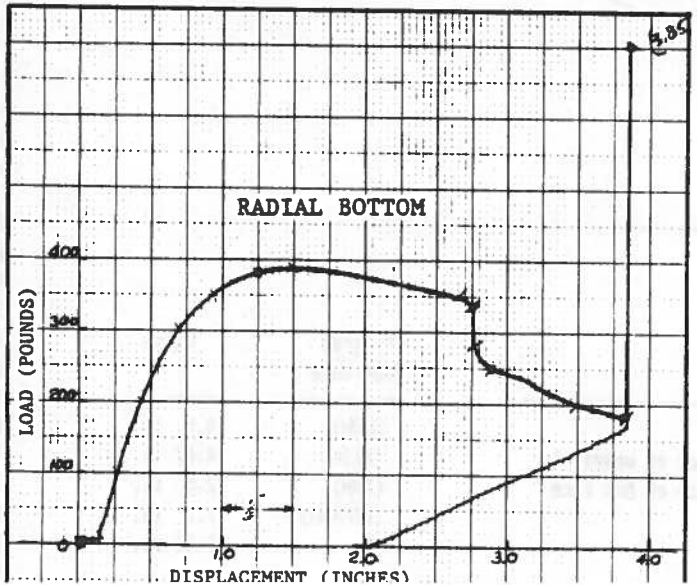
WHEEL GROUP NO. 3.202











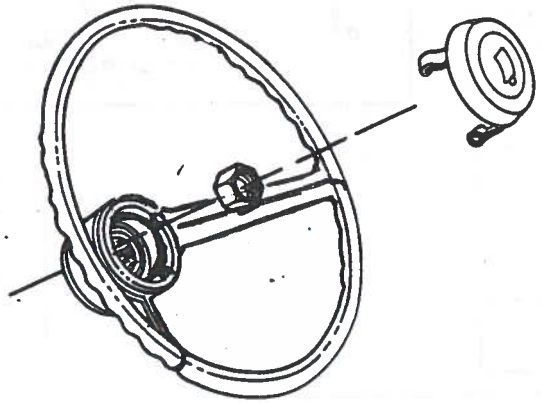
STEERING WHEEL FACT SHEET

Vehicle Use

Year	Make	Car Line
1979-82	Ford	Mustang
1978-82	Ford	Fairmont
1978-82	Mercury	Zephyr

Manufacturer's Part No.

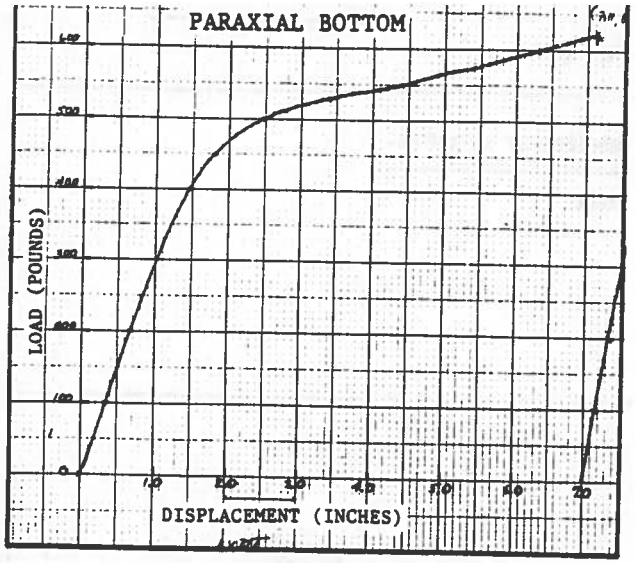
D88C

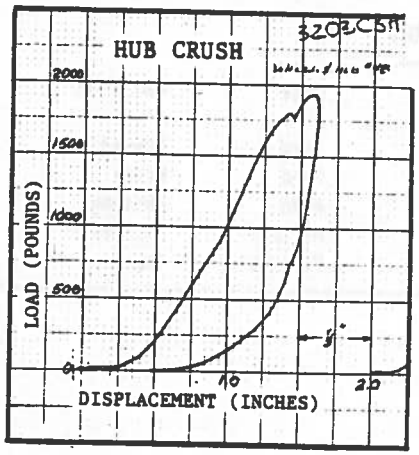


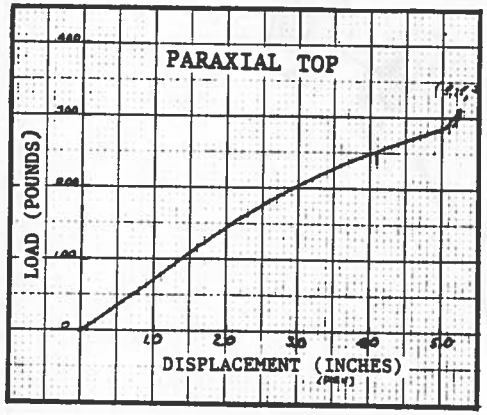
Wheel Characteristics

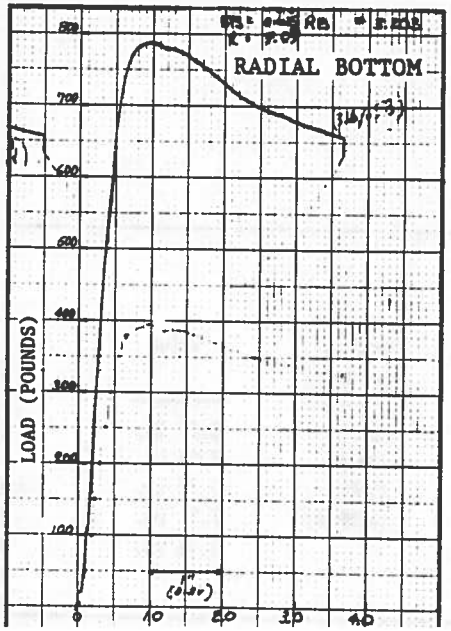
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.9 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.67 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.5 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		0.83 in.

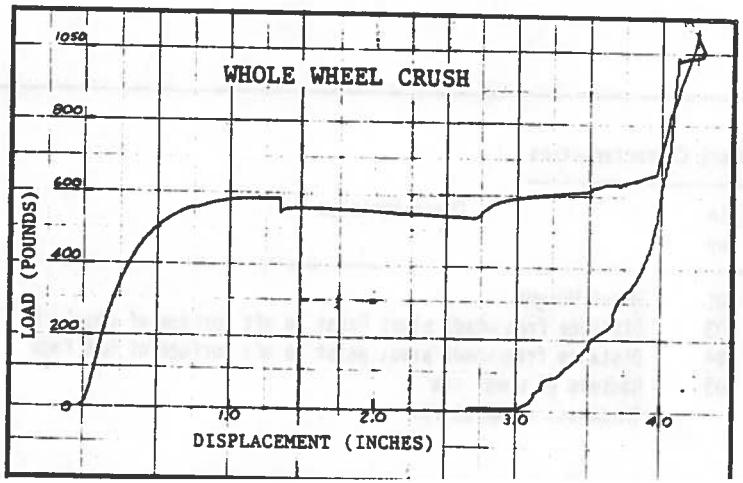
WHEEL GROUP NO. 3.203











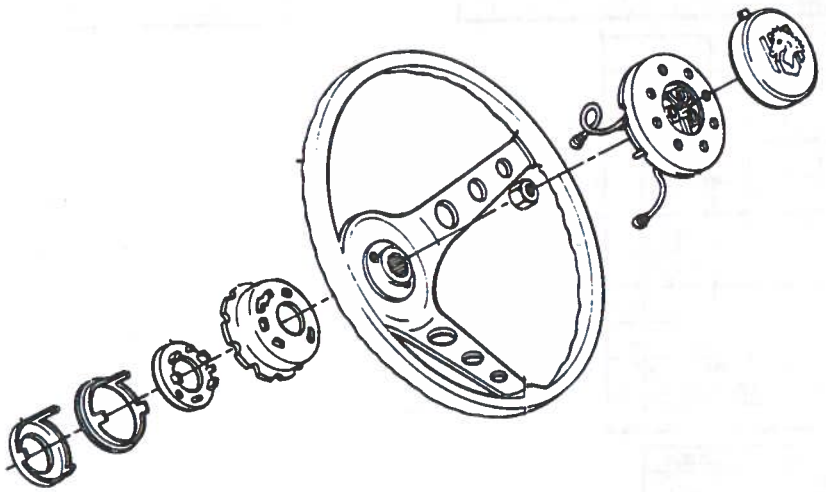
STEERING WHEEL FACT SHEET

Vehicle Use

Year	Make	Car Line
1980	Ford	Grenad
1980	Ford	Pinto
1983	Ford	Mustang
1980	Mercury	Mercury
1983	Mercury	Capri

Manufacturer's Part No.

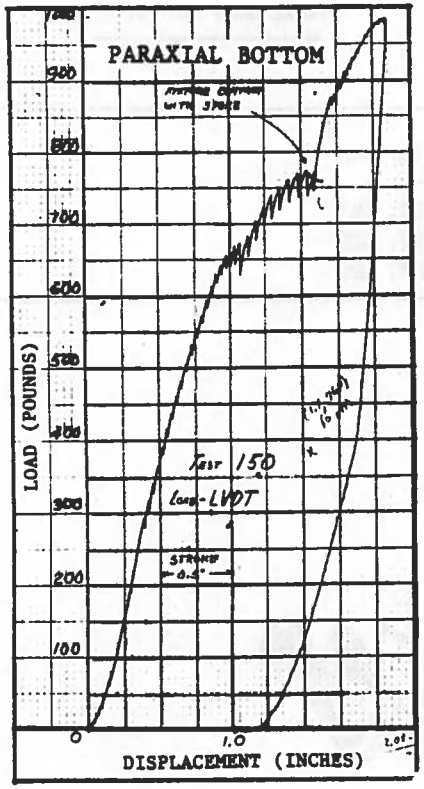
E00Z

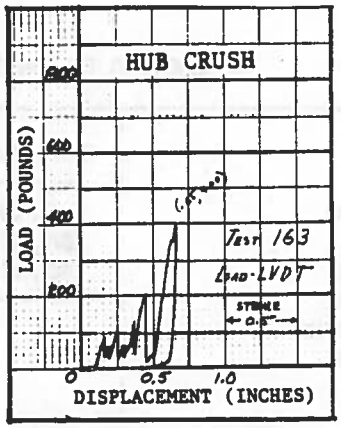


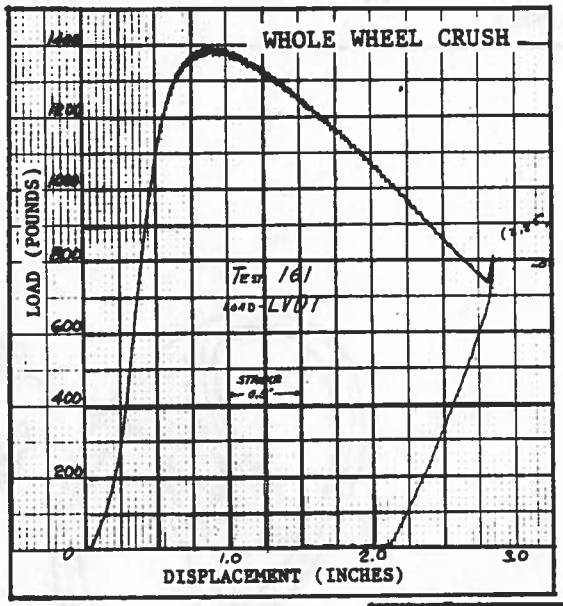
Wheel Characteristics

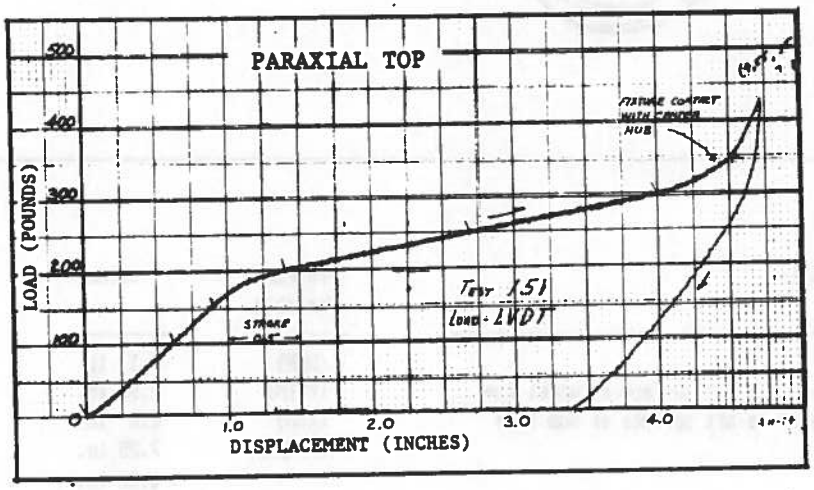
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.5 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.56 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XHH)	2.75 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		1.06 in.

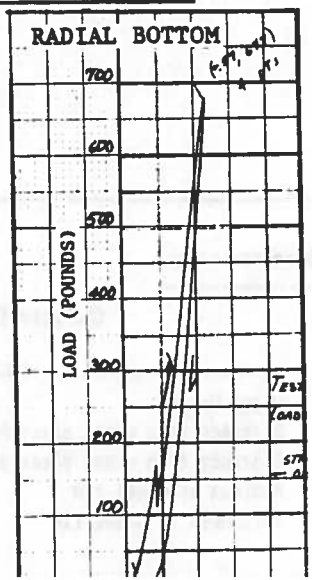
WHEEL GROUP NO. 3.303











WHEEL GROUP NO. 3.403

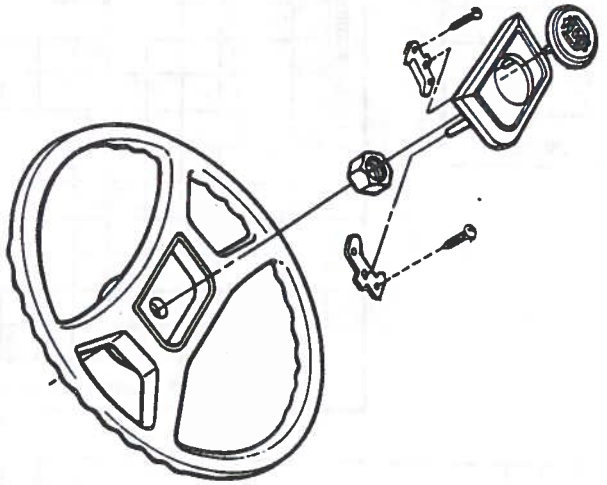
STEERING WHEEL FACT SHEET

Vehicle Use

Year	Make	Car Line
1979-83	Ford	LTD
1979-82	Ford	Mustang
1979-82	Ford	Fairmont
1980-82	Ford	Thunderbird
1979-83	Mercury	Marquis
1979-82	Mercury	Capris
1979-82	Mercury	Zephyr
1980-82	Lincoln	

Manufacturer's Part No.

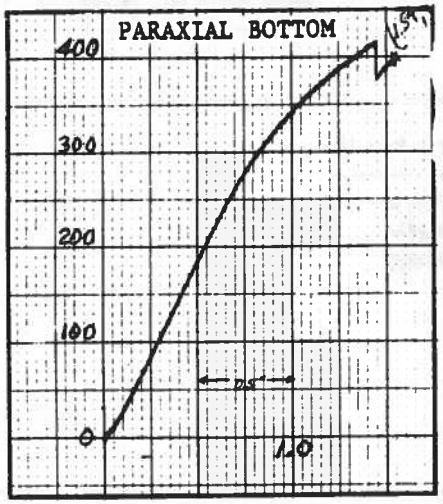
D9AZ, D9BZ, D9ZZ, E0LY
E0VY, E0AZ, E0BZ, E0SZ
E0ZZ, E1LY, E1VY, E1AZ

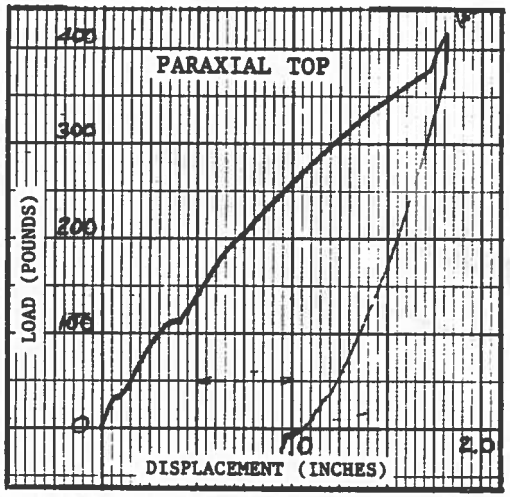


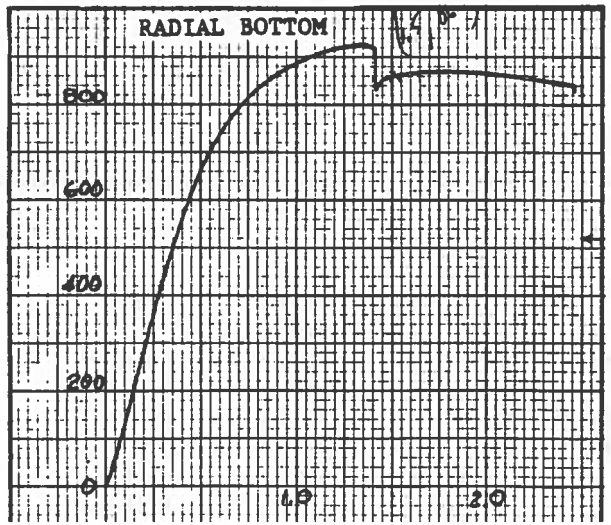
Wheel Characteristics

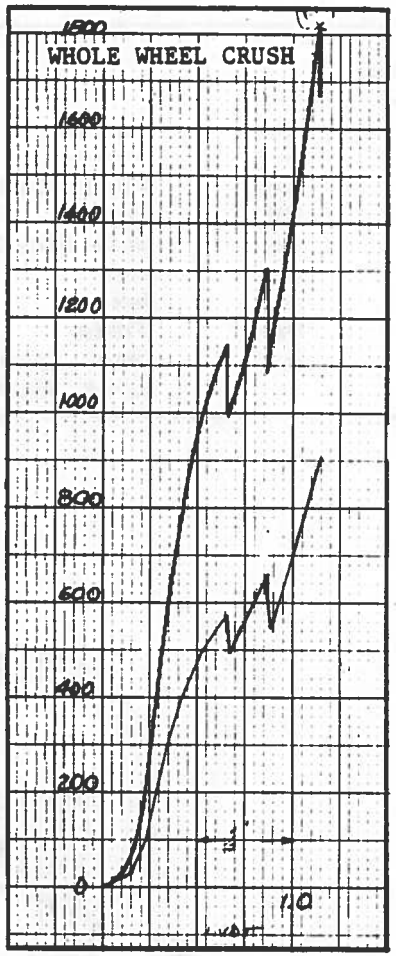
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.1 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	2.95 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.0 in.
C05	Radious of wheel rim	(RIMRAD)	7.25 in.
	Thickness of wheel rim		0.82 in.

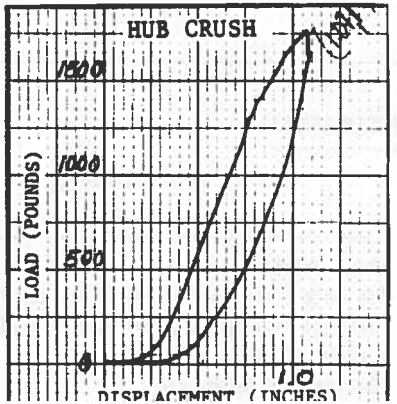
WHEEL GROUP NO. 3.403







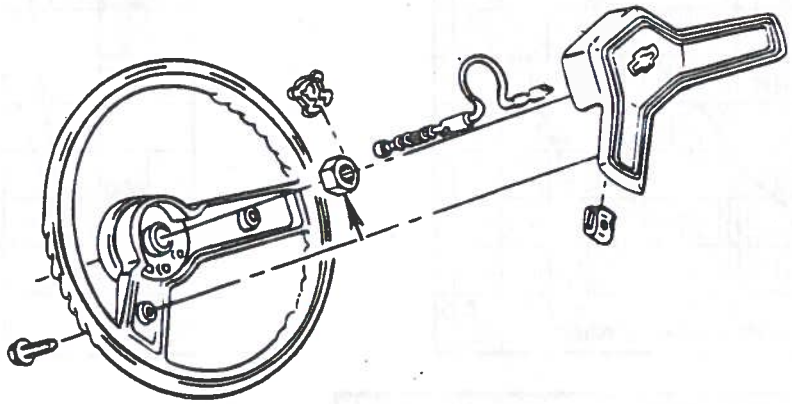




WHEEL GROUP NO 4.202

STEERING WHEEL FACT SHEET

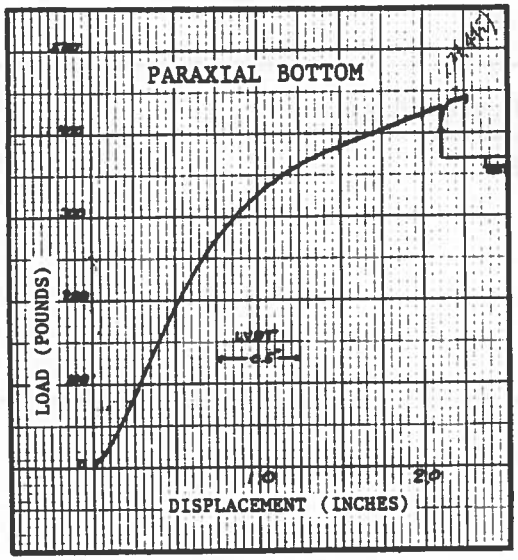
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	9754887, 9759464
			9761003, 9761084
1977	Olds.	Delta 88, Starfire	9763897, 9764992
1977-78	Olds	Omega	
1977-81	Chev.	Impala, Monte Carlo, Malibu	
1977-80	Chev.	Monza	
1978-79	Chev.	Nova	
1980-81	Chev.	Citation	
1977	Buick	Century, LeSabre, Regal Skyhawk, Skylark	

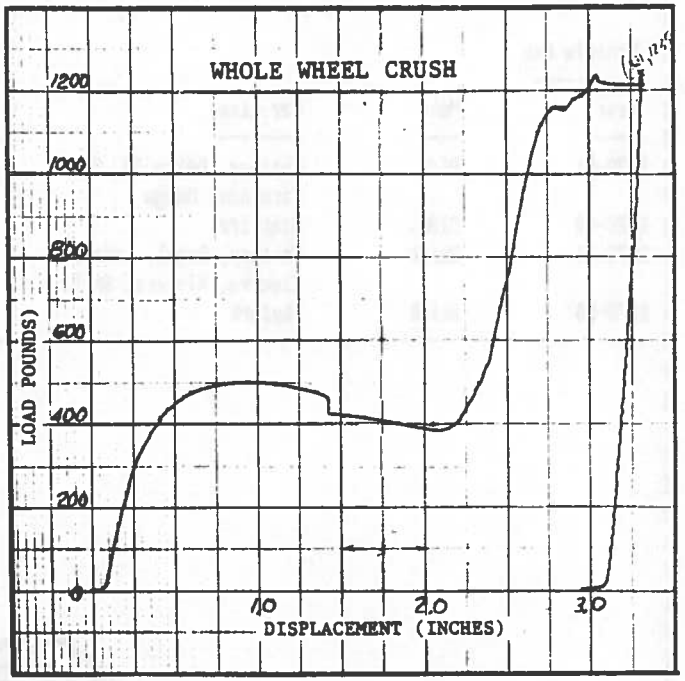


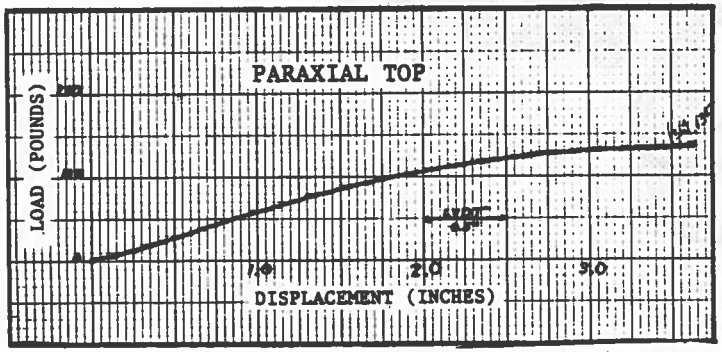
Wheel Characteristics

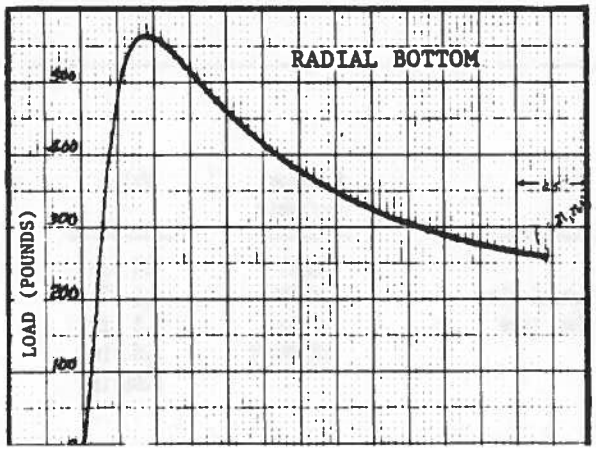
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	6.75 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.12 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.5 in.
C05	Radious of wheel rim	(RIMRAD)	7.62 in.
	Thickness of wheel rim		0.82 in.

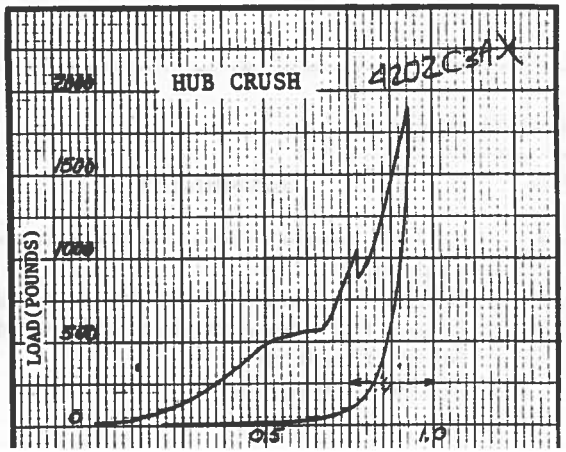
WHEEL GROUP NO. 4.202





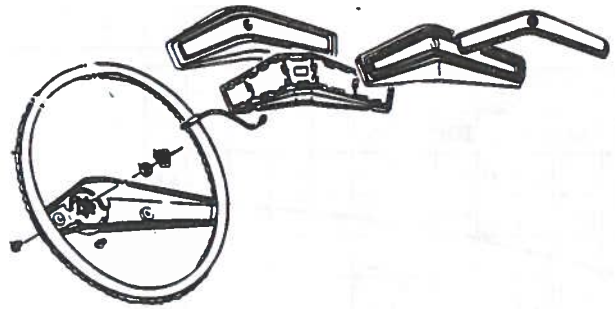






STEERING WHEEL FACT SHEET

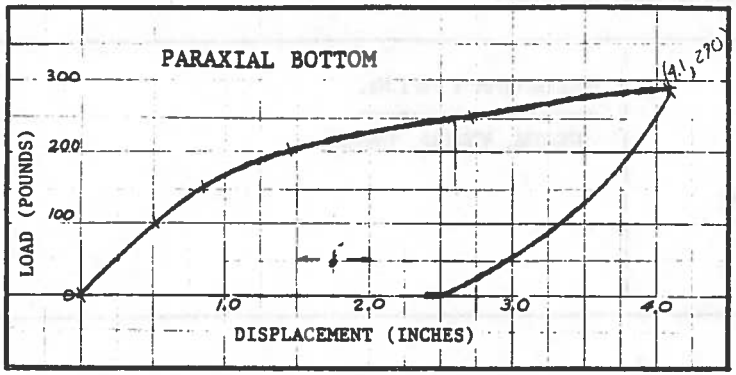
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	9762752
1978-81	Olds.	Cutlass, Delta 88, 98 Toronado, Omega	
1978-80	Olds.	Starfire	
1978-81	Buick	Century, Regal, LeSabre Electra, Riviera, Skylark	
1978-80	Buick	Skylark	

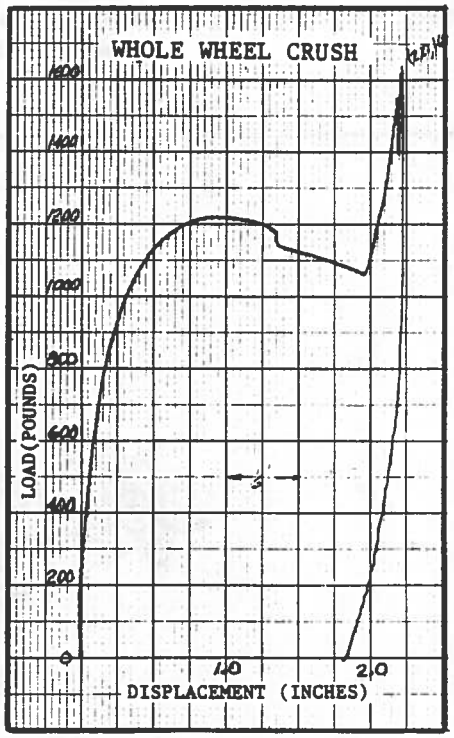


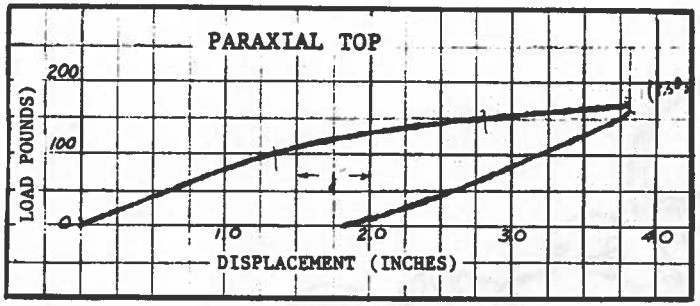
Wheel Characteristics

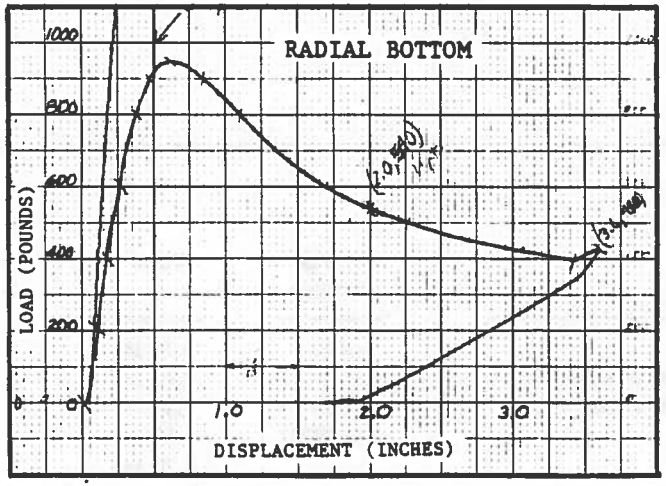
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	6.0 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.1 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	1.1 in.
C05	Radious of wheel rim	(RIMRAD)	7.6 in.
	Thickness of wheel rim		1.06 in.

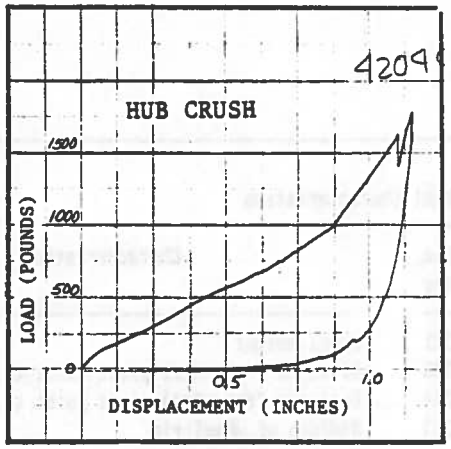
WHEEL GROUP NO. 4.204





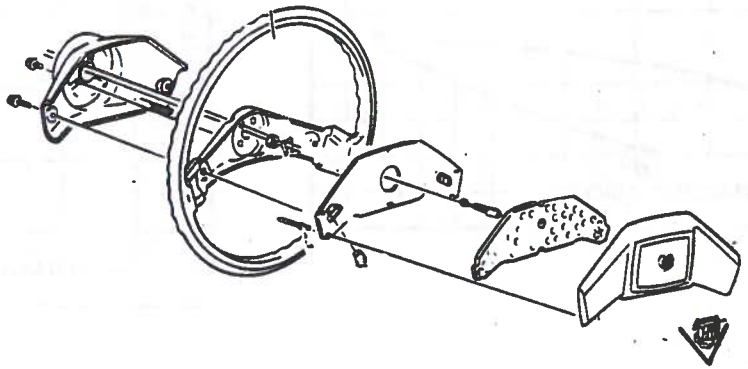






STEERING WHEEL FACT SHEET

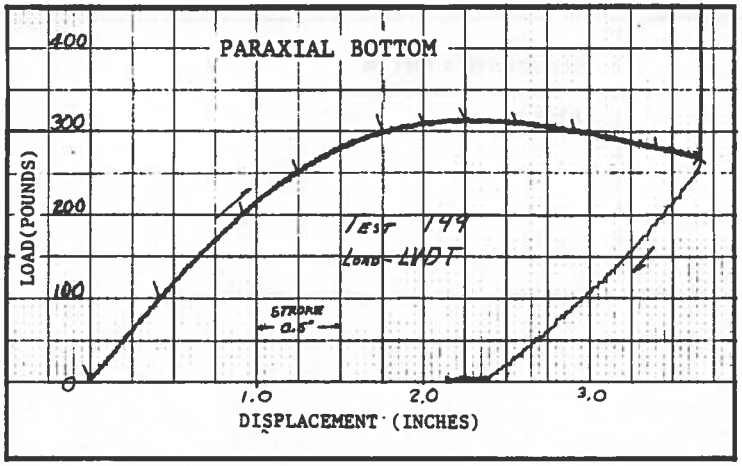
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1979-81	Cadillac	DeVille, Fleetwood Seville, Eldorado	9764036, 9764042, 9765325

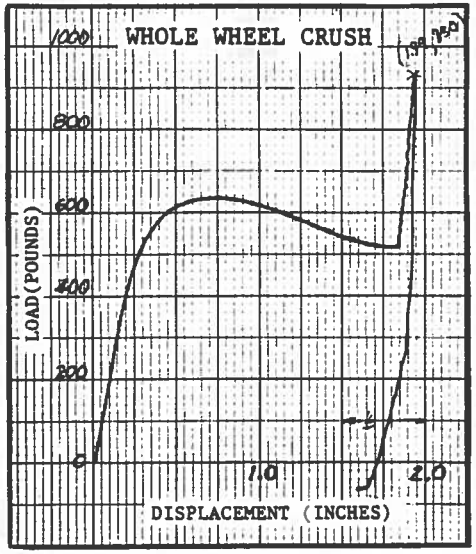


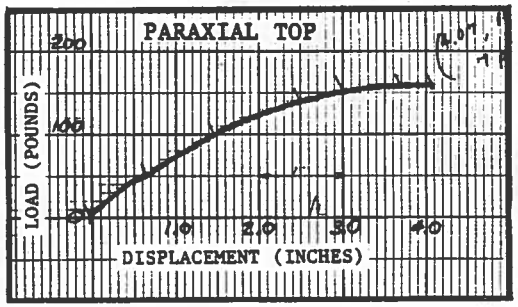
Wheel Characteristics

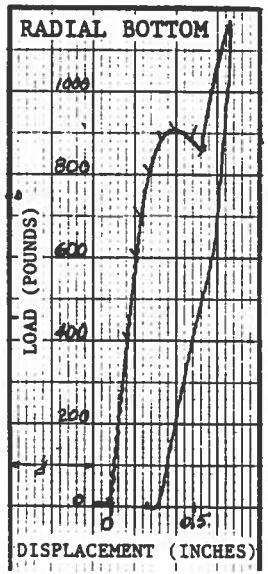
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.94 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.25 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.56 in.
C05	Radious of wheel rim	(RIMRAD)	7.69 in.
	Thickness of wheel rim		0.75 in.

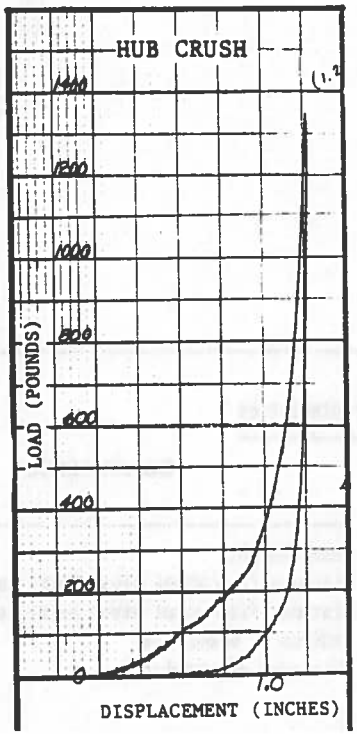
WHEEL GROUP NO. 4.206







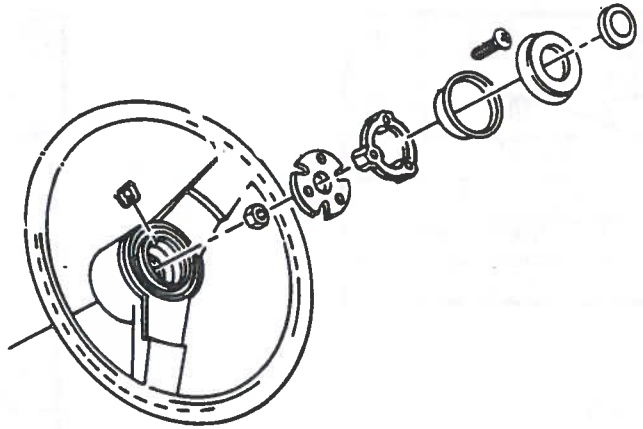




WHEEL GROUP NO. 4.207

STEERING WHEEL FACT SHEET

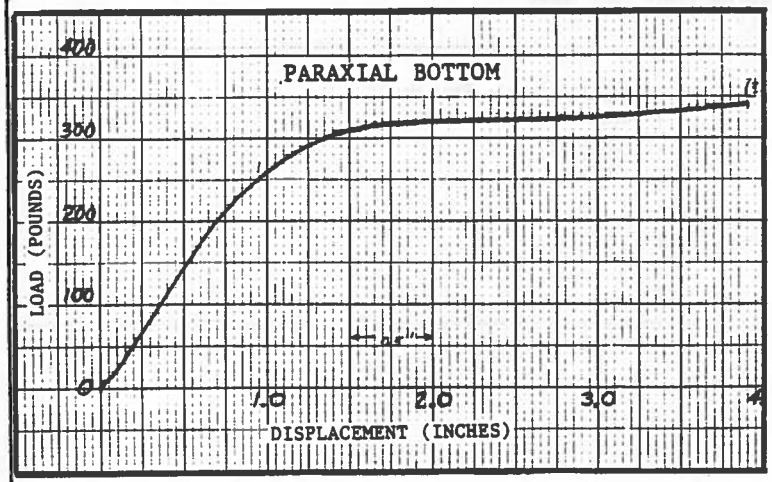
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1976-81	Chev.	Chevette	9758175
1981	Pontiac	T1000	

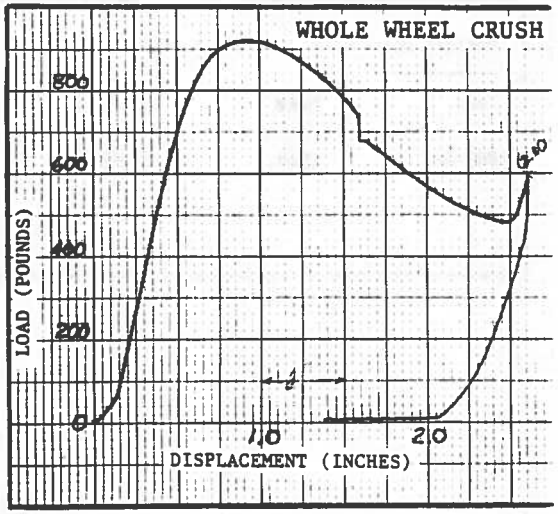


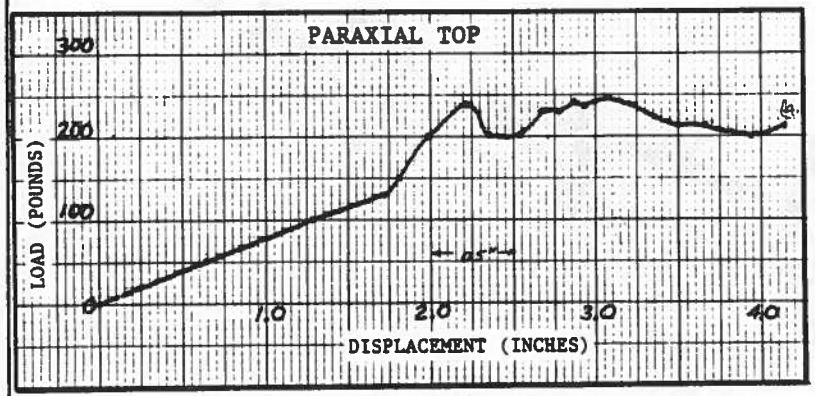
Wheel Characteristics

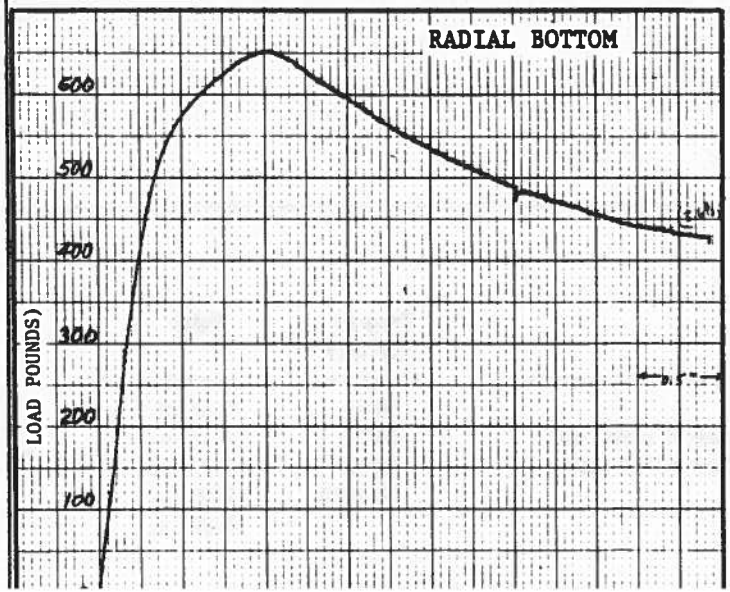
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.4 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.12 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.77 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		0.81 in.

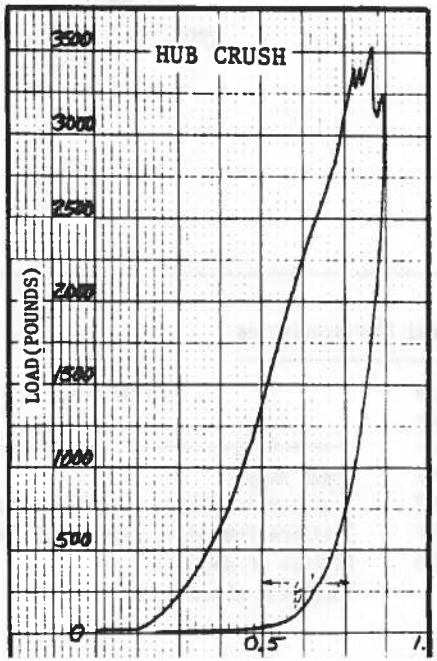
WHEEL GROUP NO. 4.207







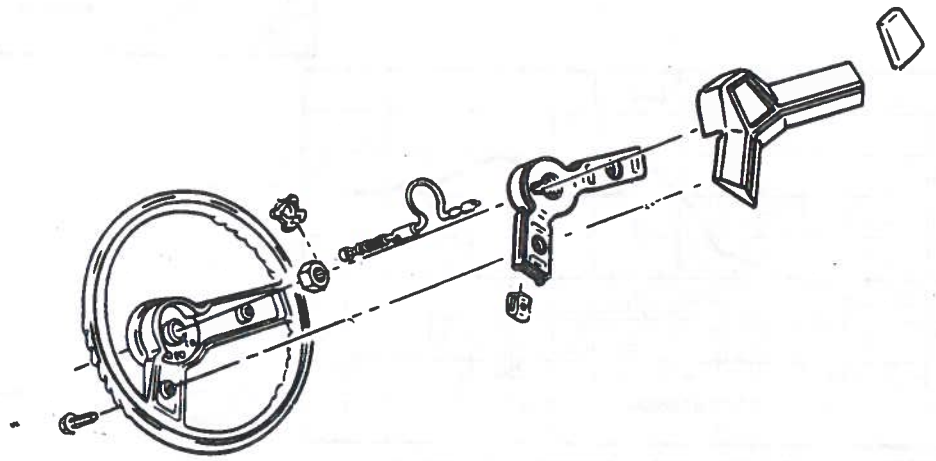




WHEEL GROUP NO. 9.212

STEERING WHEEL FACT SHEET

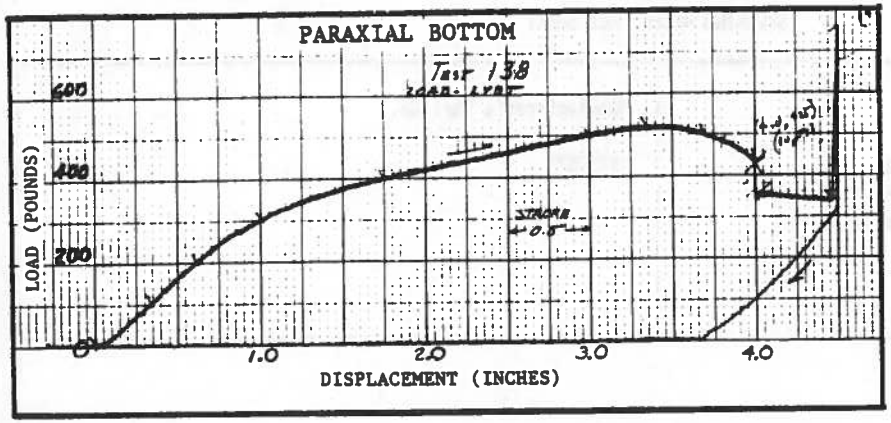
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	9761084
1983-84	Chev.	Celebrity	

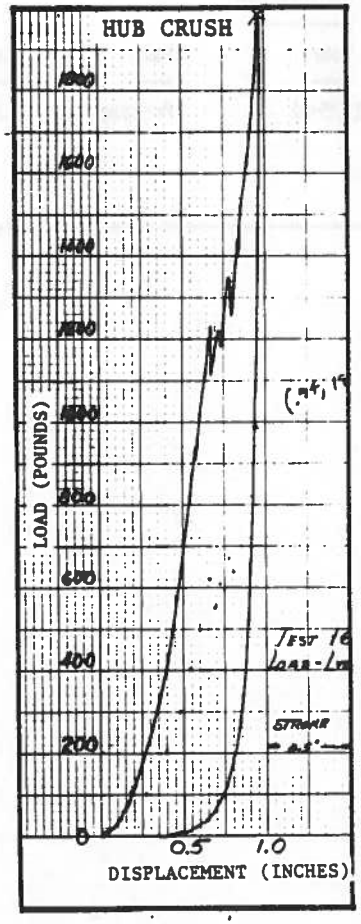


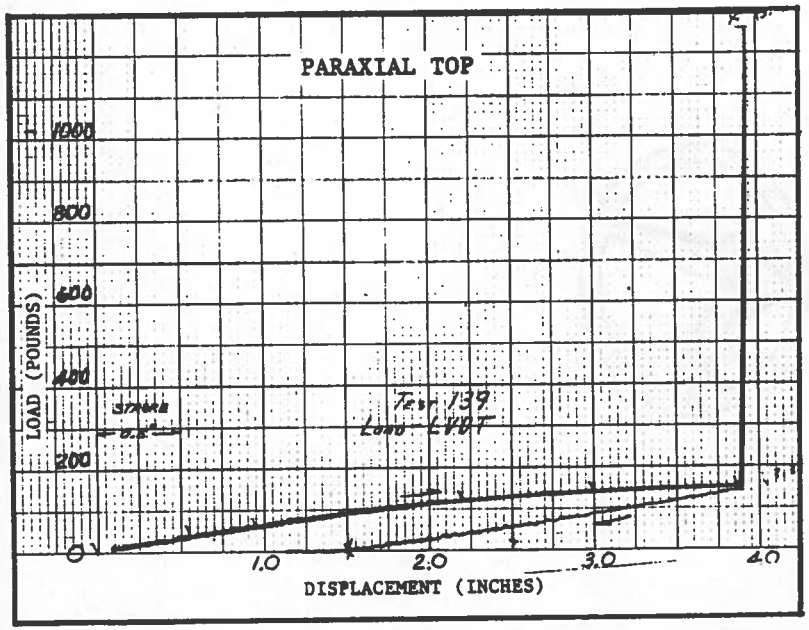
Wheel Characteristics

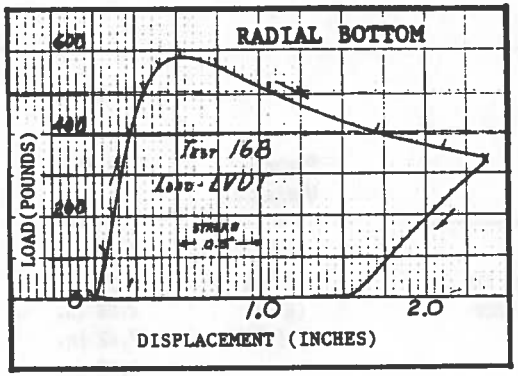
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.67 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.12 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.0 in.
C05	Radious of wheel rim	(RIMRAD)	7.58 in.
	Thickness of wheel rim		0.88 in.

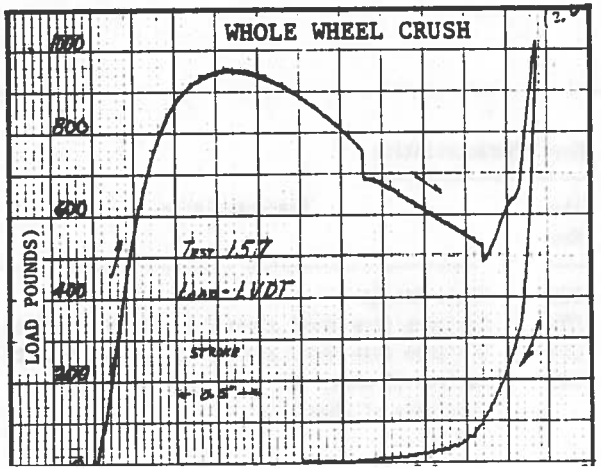
WHEEL GROUP NO. 4.212







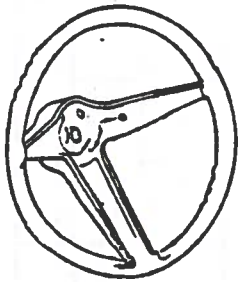




WHEEL GROUP NO. 4.307

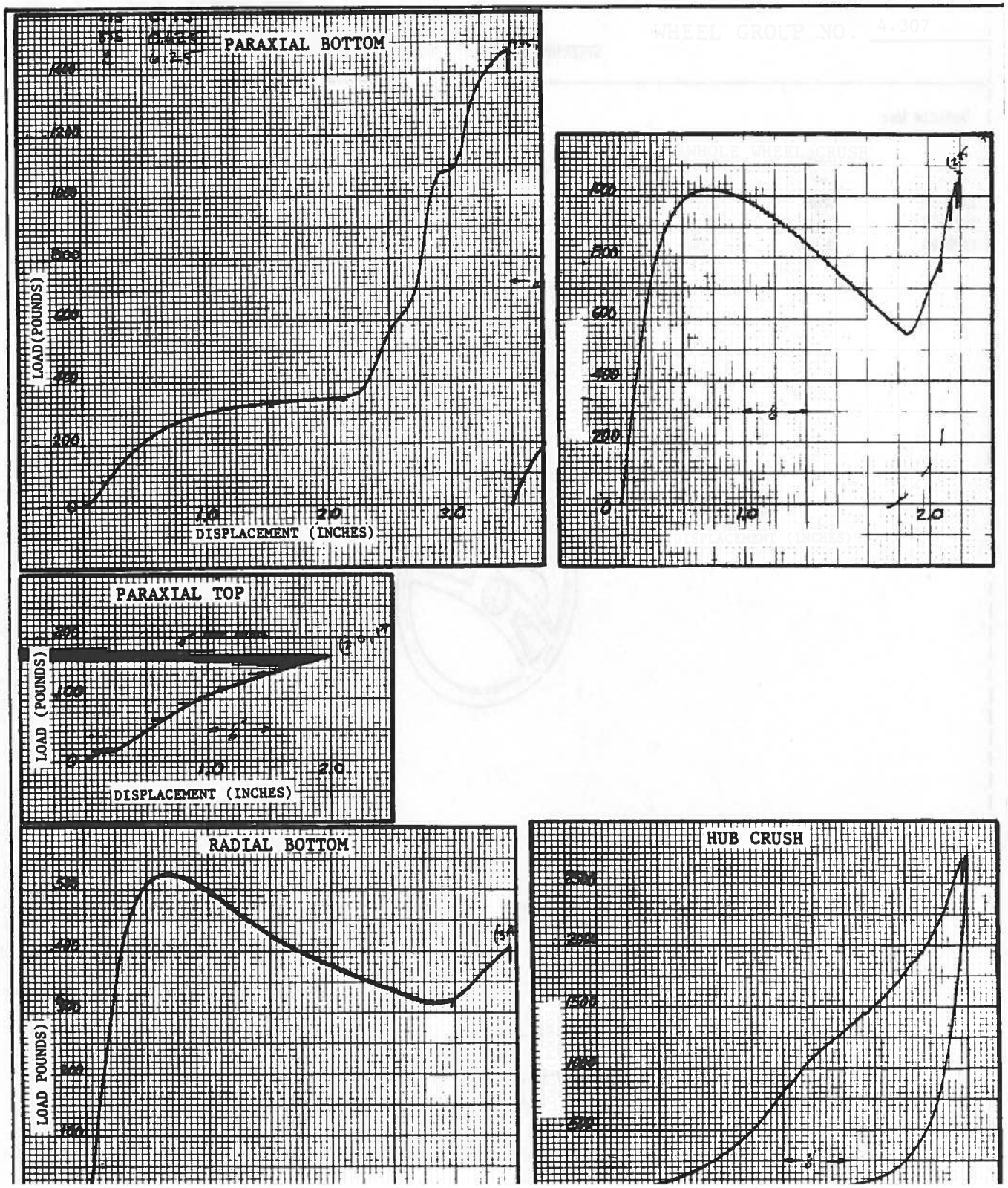
STEERING WHEEL FACT SHEET

Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-81	Pontiac	All-except T1000	9757575



Wheel Characteristics

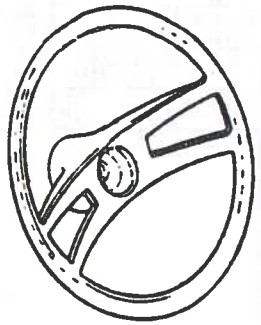
File Key	Characteristic	Program Variable	Value
C01	Wheel Height	(WHH)	5.75 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.5 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XHH)	2.88 in.
C05	Radious of wheel rim	(RIMRAD)	7.62 in.
	Thickness of wheel rim		0.73 in.


PARAXIAL BOTTOM
LOAD (POUNDS)
DISPLACEMENT (INCHES)
1.0
2.0
3.0
PARAXIAL TOP
LOAD (POUNDS)
DISPLACEMENT (INCHES)
1.0
2.0
RADIAL BOTTOM
LOAD POUNDS)
HUB CRUSH

WHEEL GROUP NO. 4.401

STEERING WHEEL FACT SHEET

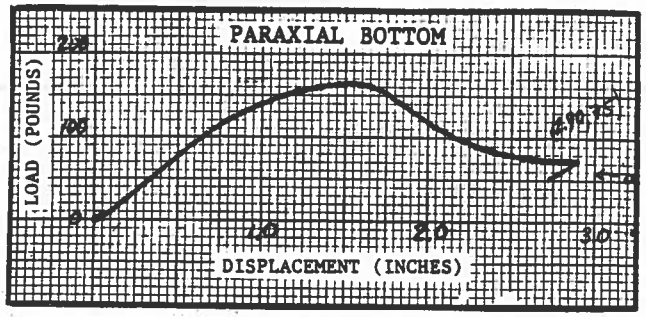
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-81	Chev.	Camaro	9752585
1975-76	Chev.	Nova	
1978-80	Buick	Skyhawk	

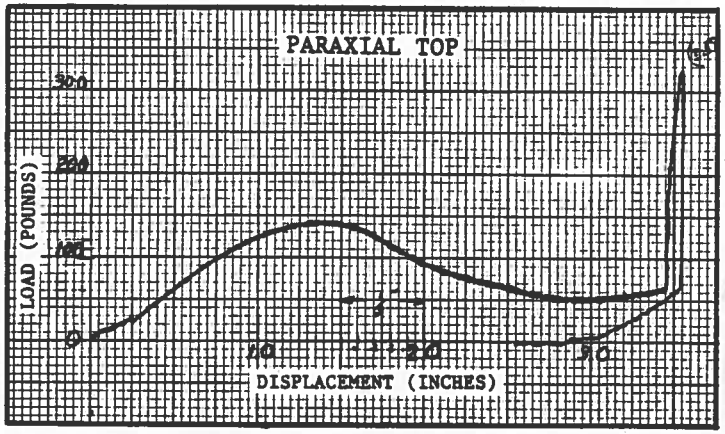


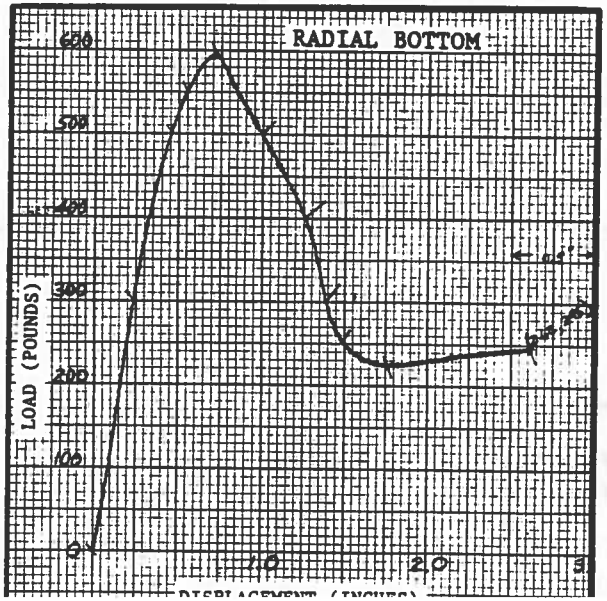
Wheel Characteristics

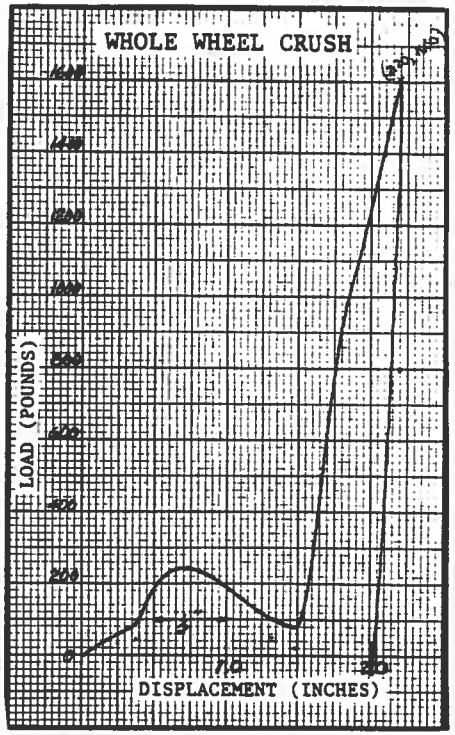
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	5.3 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.8 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.88 in.
C05	Radious of wheel rim	(RIMRAD)	7.28 in.
	Thickness of wheel rim		0.90 in.

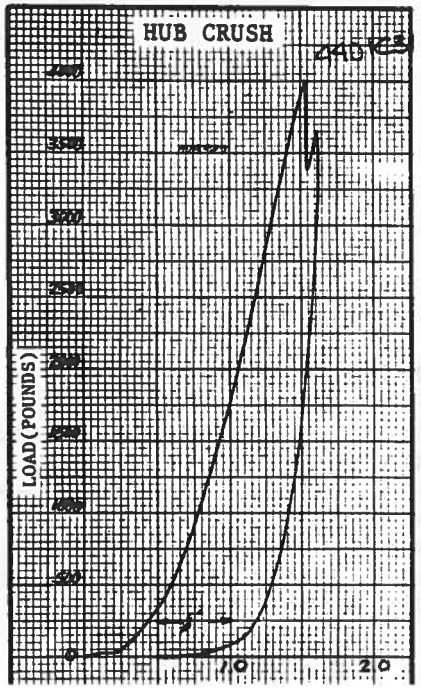
WHEEL GROUP NO. 4.401







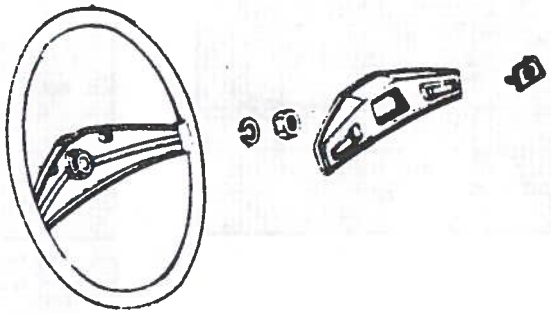




WHEEL GROUP NO. 5.201

STEERING WHEEL FACT SHEET

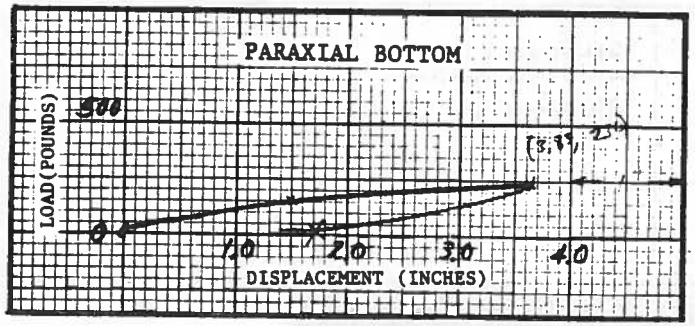
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	48400 - H9100
1980	Datsun	Model 210	

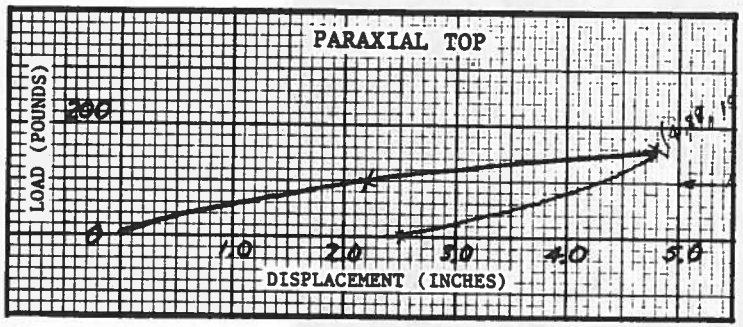


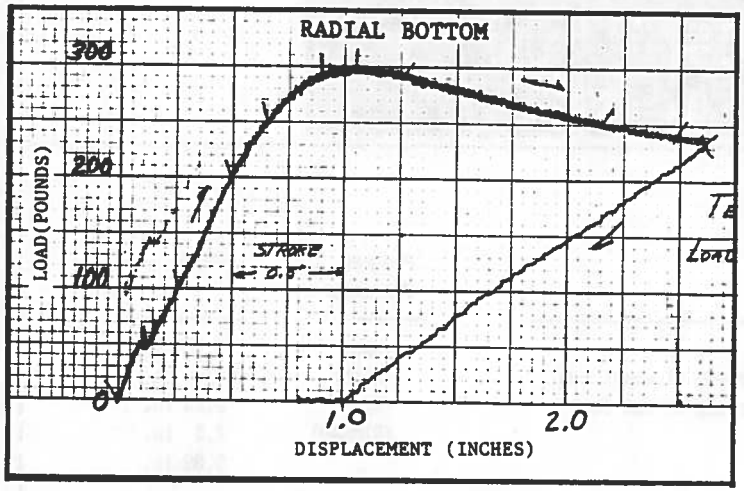
Wheel Characteristics

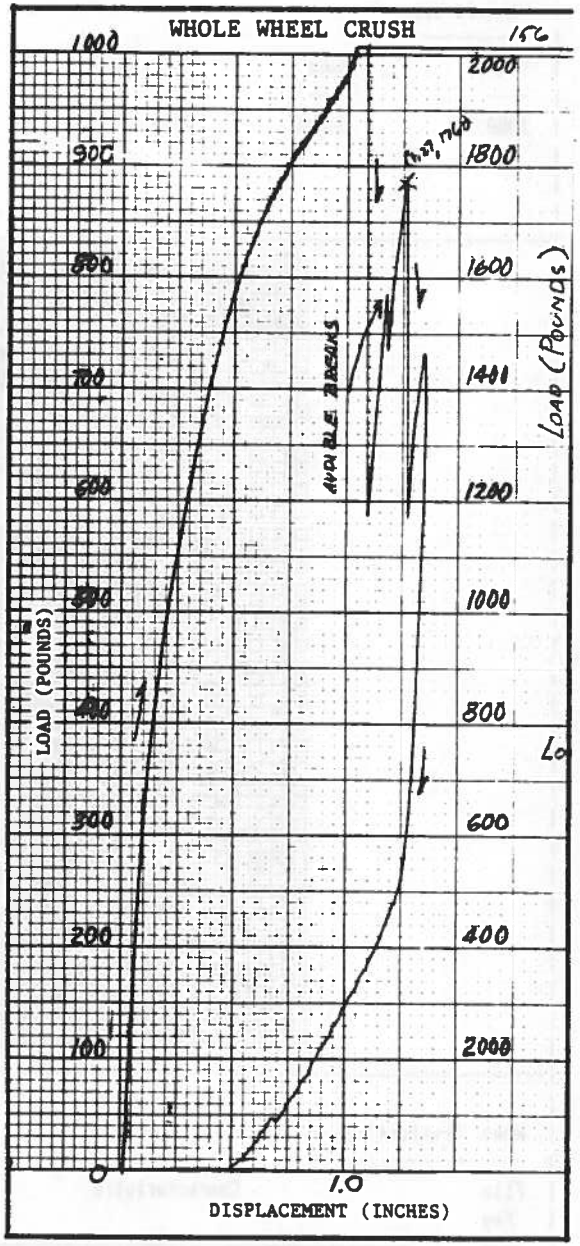
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	3.0 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.25 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.12 in.
C05	Radious of wheel rim	(RIMRAD)	7.46 in.
	Thickness of wheel rim		0.88 in.

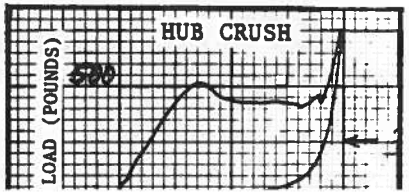
WHEEL GROUP NO. 5.201











WHEEL GROUP NO. 6.201

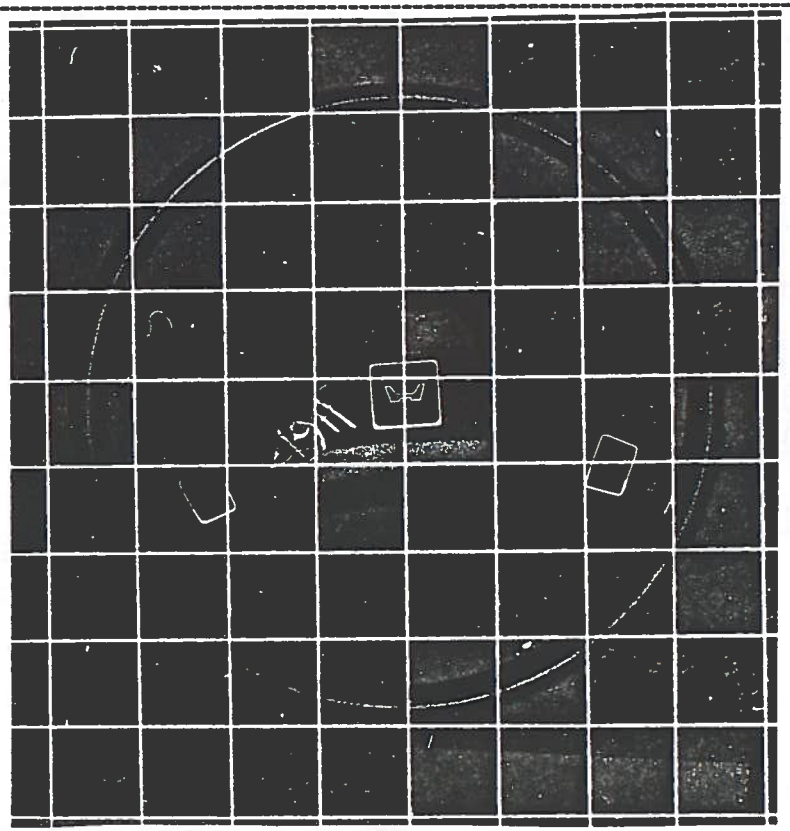
STEERING WHEEL FACT SHEET

Vehicle Use

Year	Make	Car Line
1980	Honda	Civic

Manufacturer's Part No.

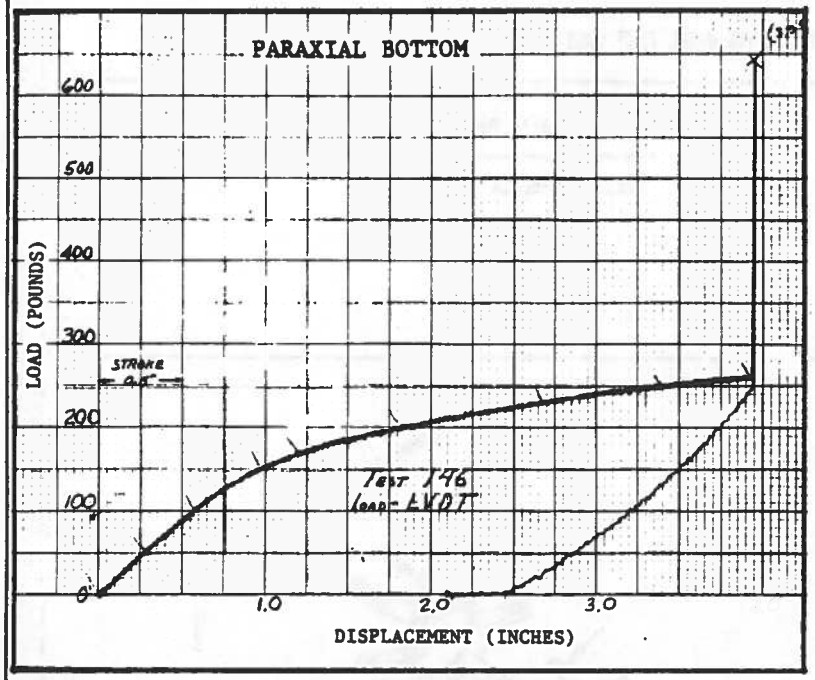
53110-SA0-672ZA

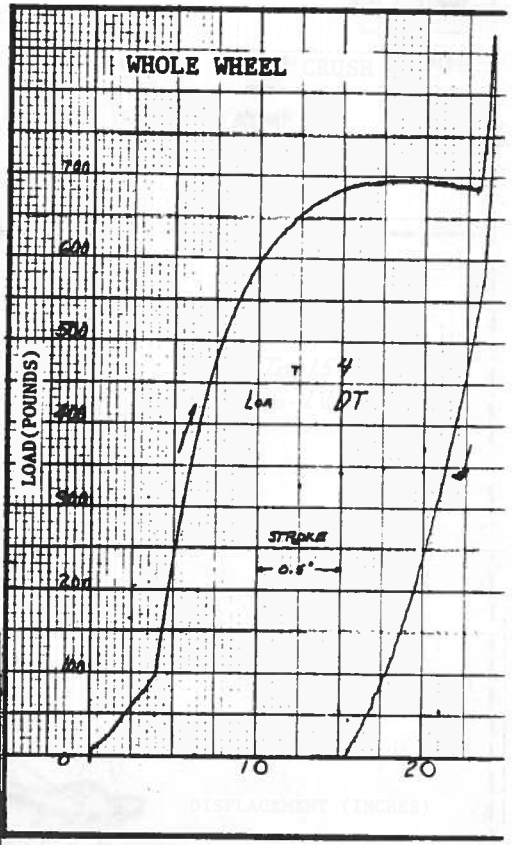


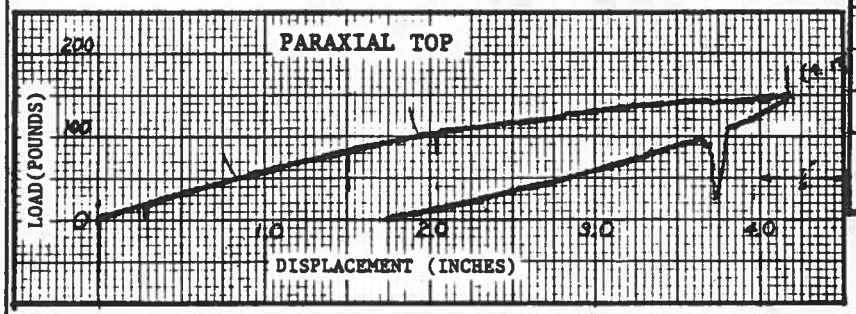
Wheel Characteristics

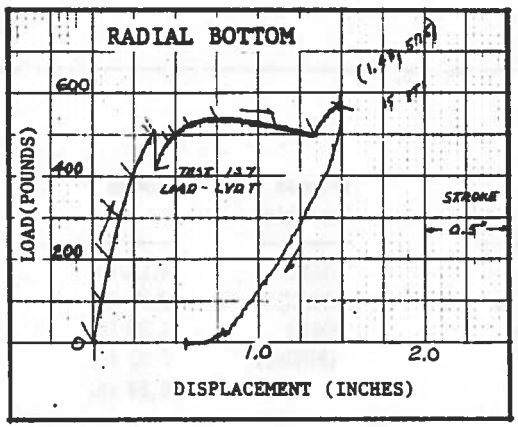
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.25 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.88 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.25 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		0.88 in.

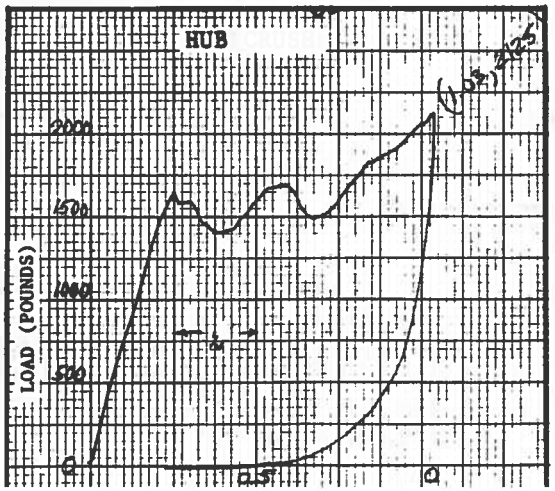
WHEEL GROUP NO. 6.201







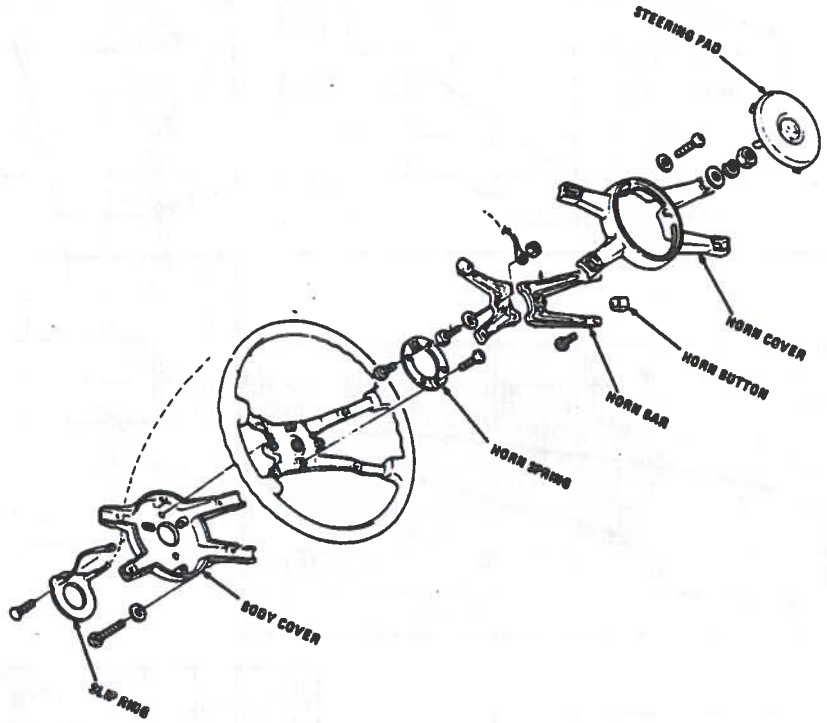




WHEEL GROUP NO. 6.402

STEERING WHEEL FACT SHEET

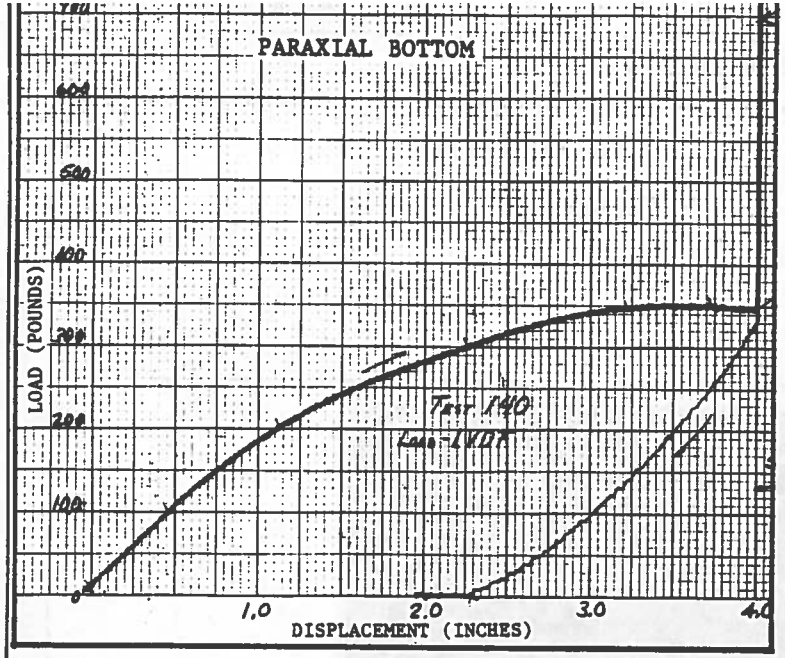
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1983	Honda	Accord	53110-SA5-023ZC

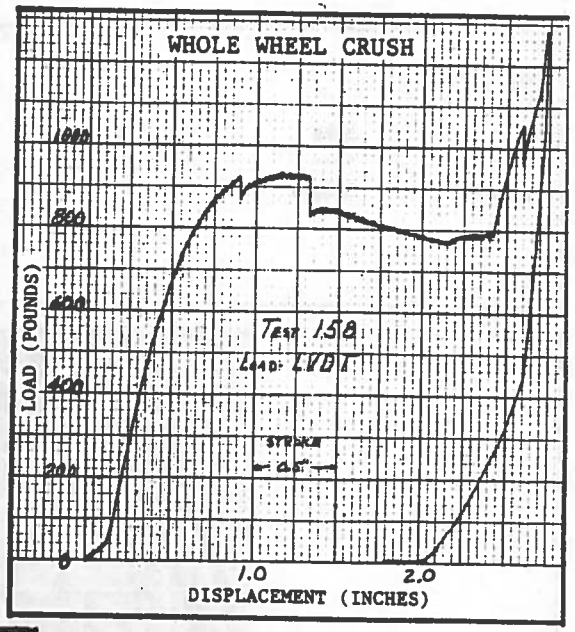


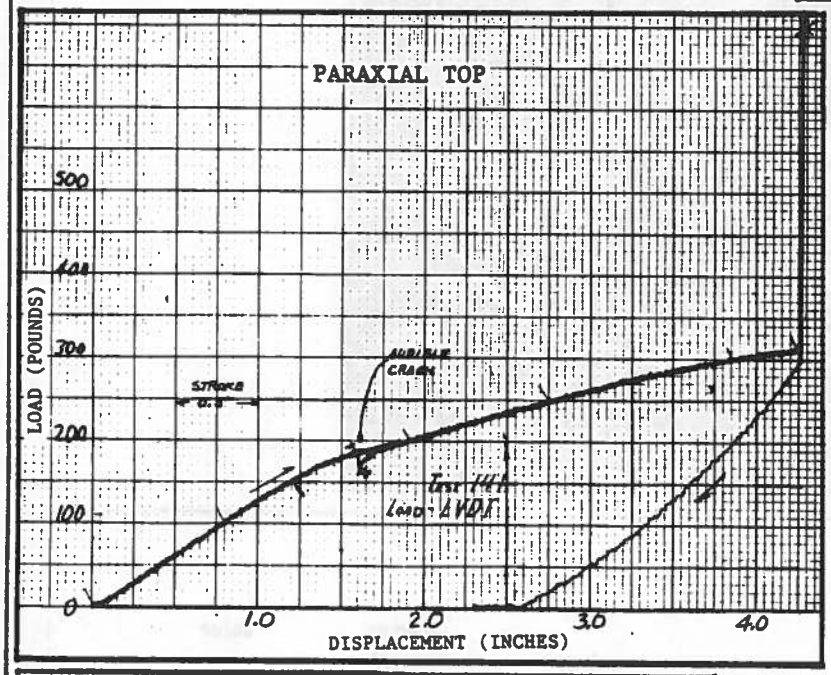
Wheel Characteristics

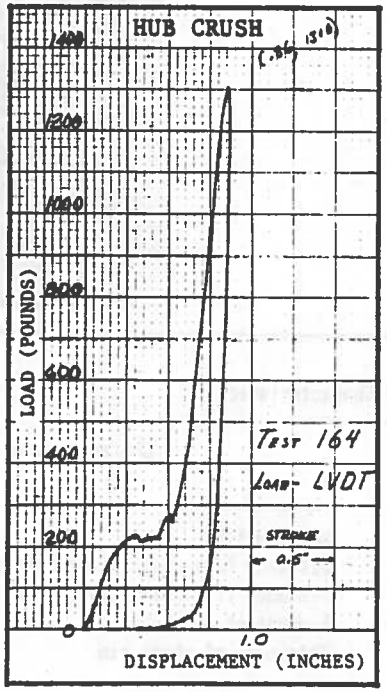
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.23 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.75 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.25 in.
C05	Radious of wheel rim	(RIMRAD)	7.53 in.
	Thickness of wheel rim		0.88 in.

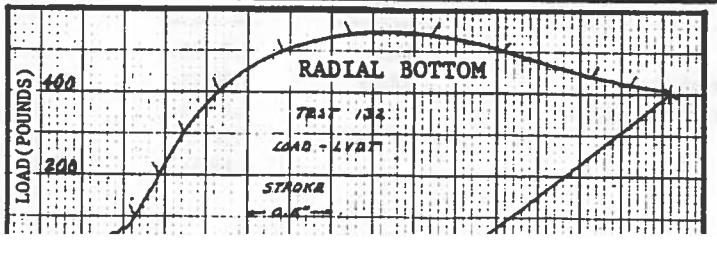
WHEEL GROUP NO. 6.402







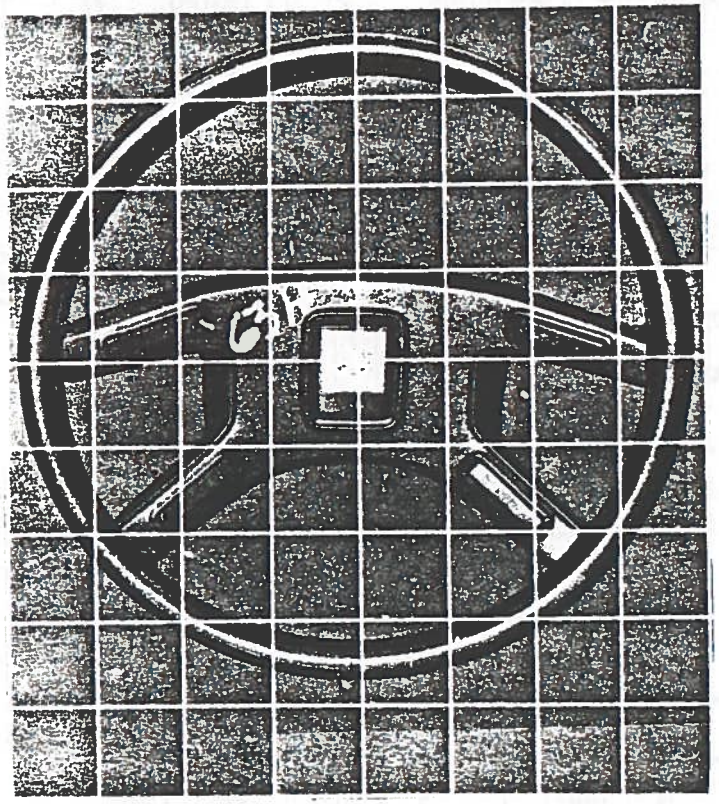




WHEEL GROUP NO. 7.402

STEERING WHEEL FACT SHEET

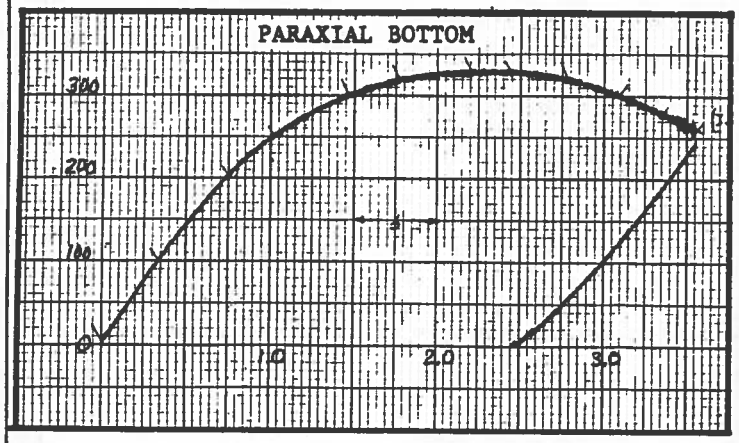
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1980	Subaru		65420-02162A1

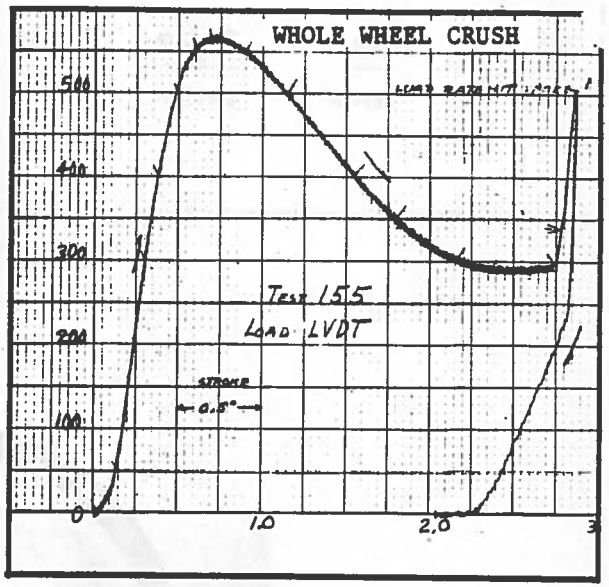


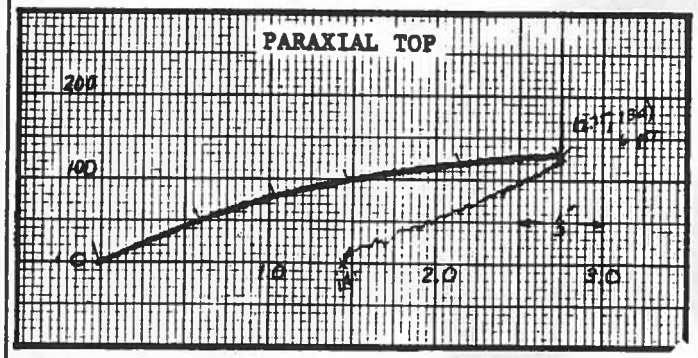
Wheel Characteristics

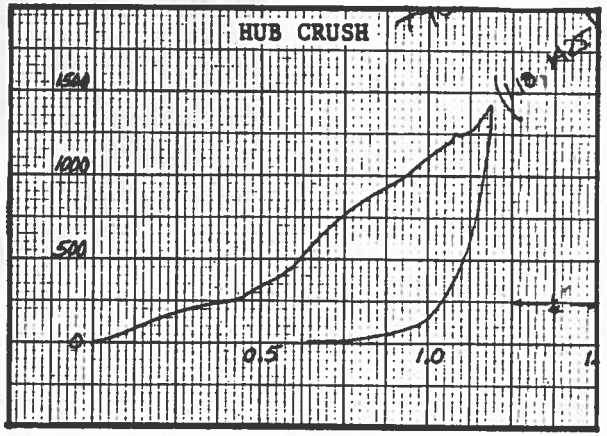
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.9 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.88 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.5 in.
C05	Radious of wheel rim	(RIMRAD)	7.56 in.
	Thickness of wheel rim		0.88 in.

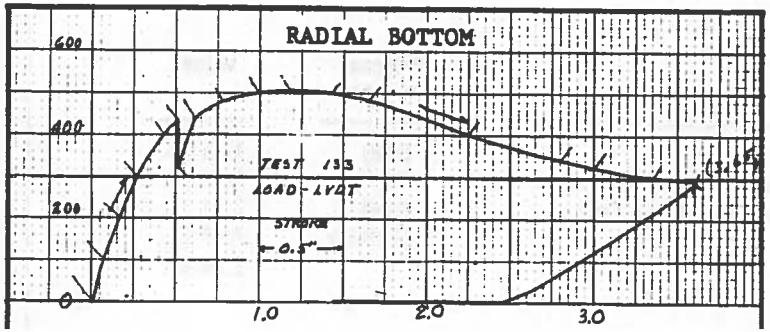
WHEEL GROUP NO. 7.401











WHEEL GROUP NO. 8.204

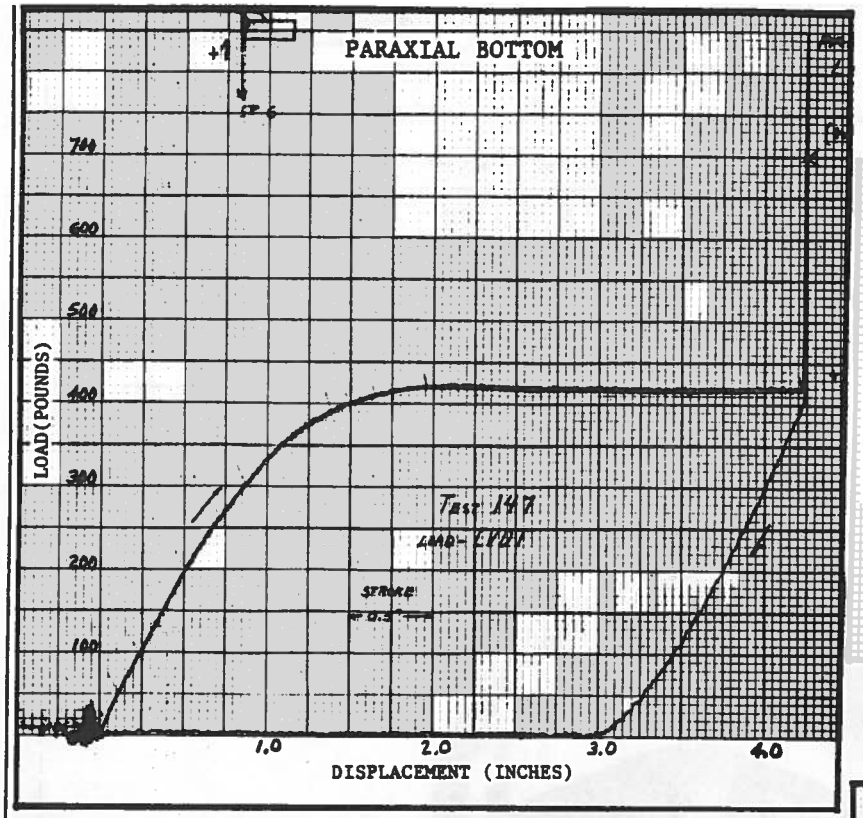
STEERING WHEEL FACT SHEET

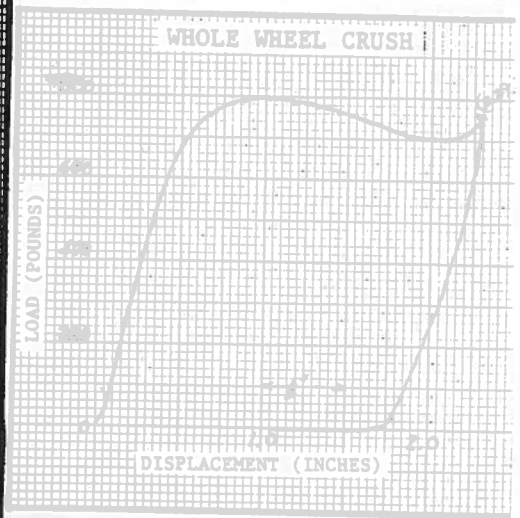
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-83	Toyota	Corolla	45102-12150

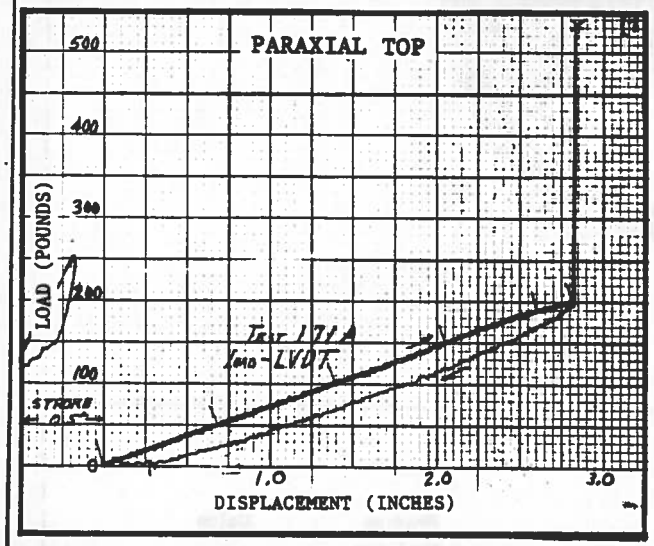
Wheel Characteristics

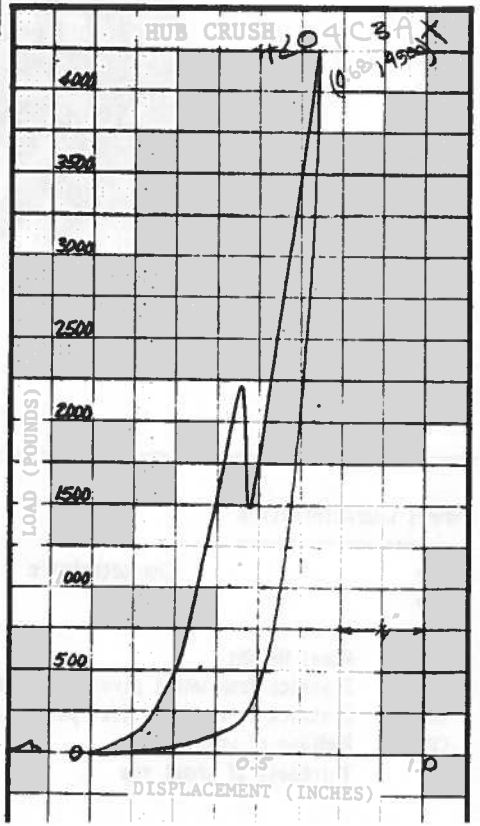
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.75 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	3.88 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	2.94 in.
C05	Radious of wheel rim	(RIMRAD)	7.44 in.
	Thickness of wheel rim		1.04 in.

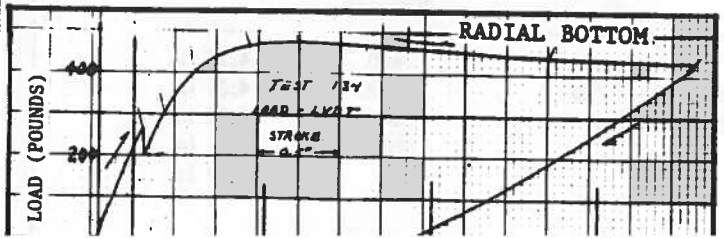
WHEEL GROUP NO. 8.204







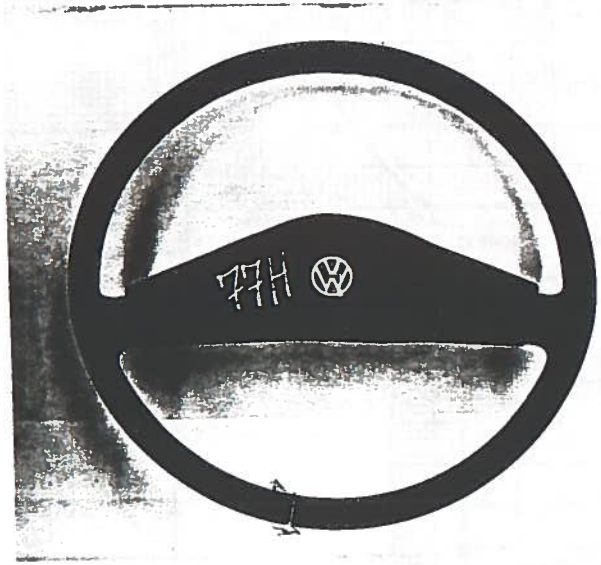




WHEEL GROUP NO. 9.205

STEERING WHEEL FACT SHEET

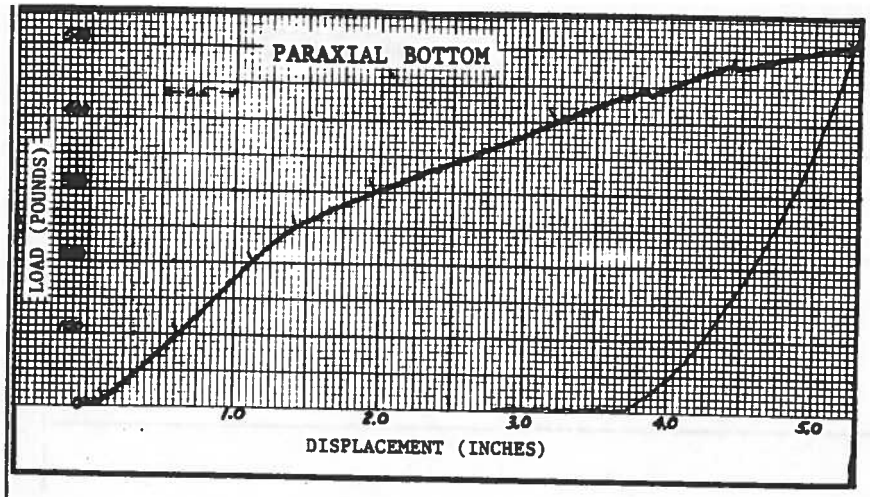
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1975-81	VW	Rabbit, Sirocco	171419091, 171419655

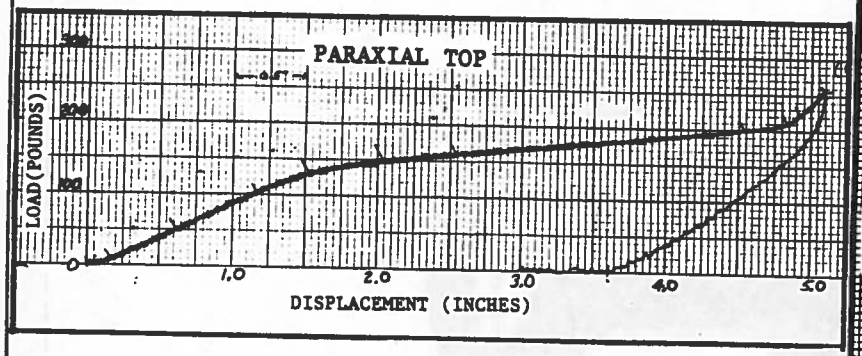


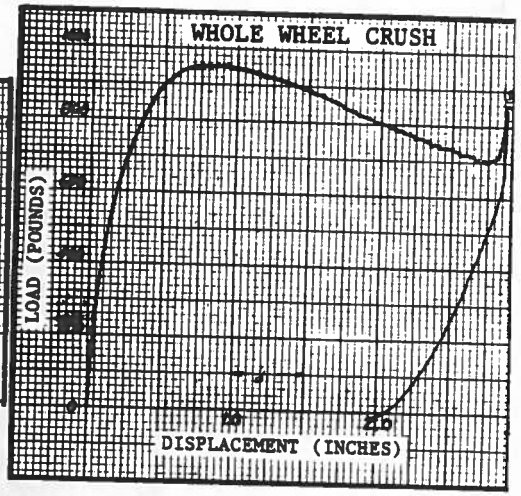
Wheel Characteristics

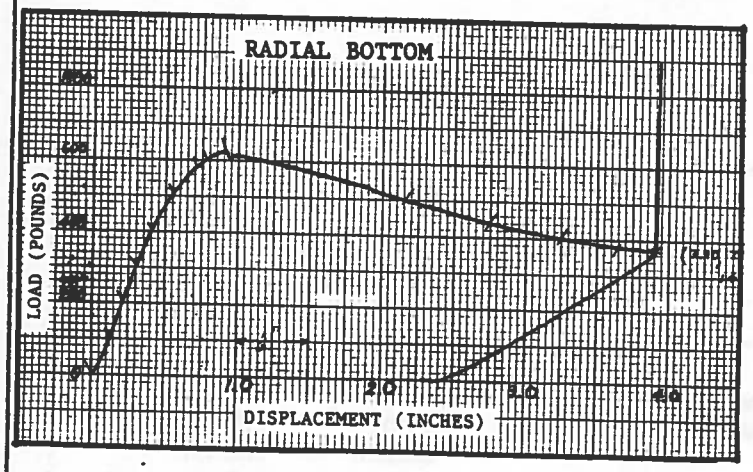
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.75 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	4.25 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	4.25 in.
C05	Radious of wheel rim	(RIMRAD)	7.5 in.
	Thickness of wheel rim		1.12 in.

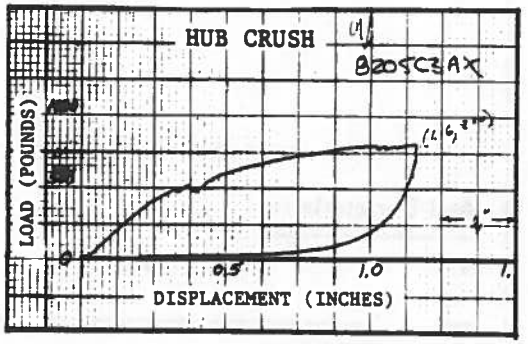
WHEEL GROUP NO. 9.205







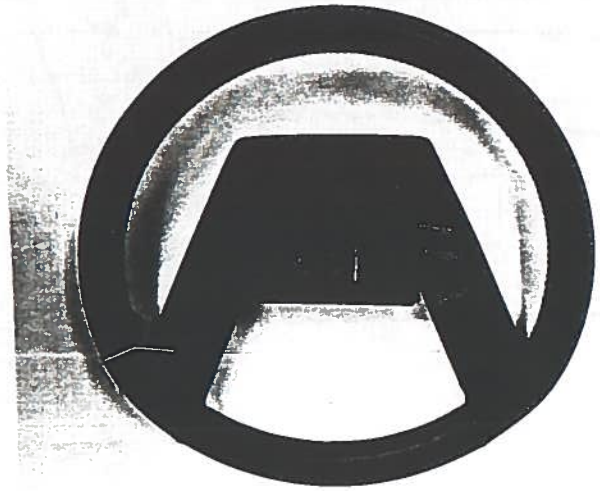




WHEEL GROUP NO. 9.251

STEERING WHEEL FACT SHEET

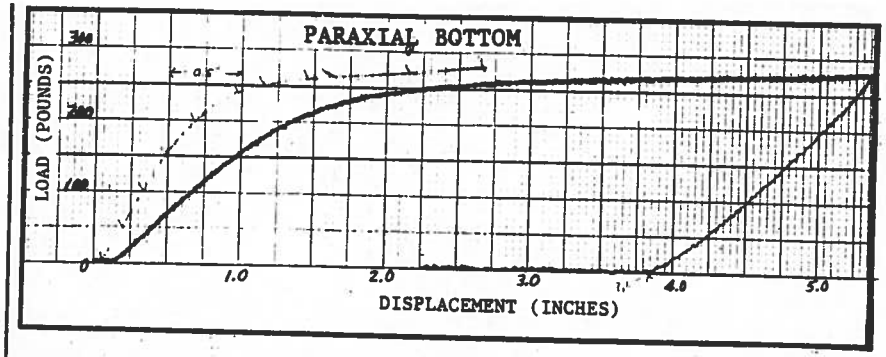
Vehicle Use			Manufacturer's Part No.
Year	Make	Car Line	
1983	Renault	Fuego	7704003762

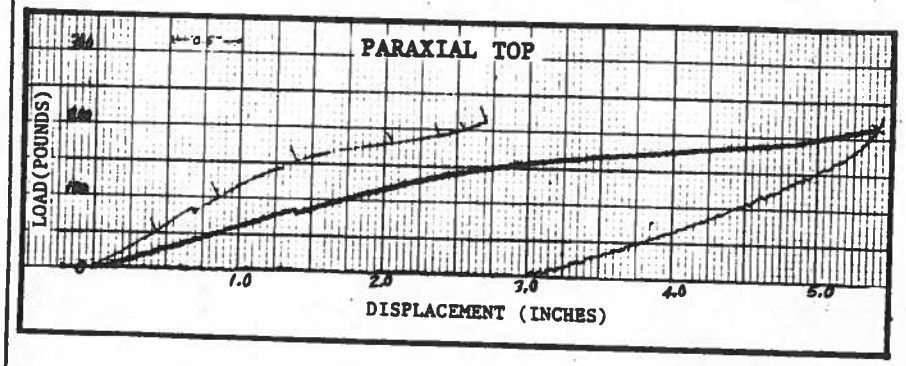


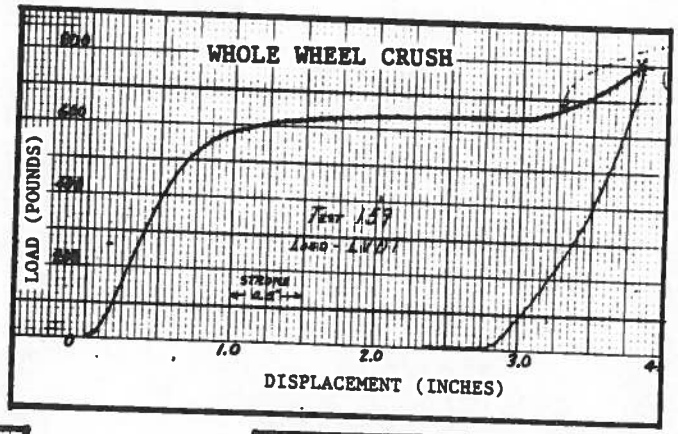
Wheel Characteristics

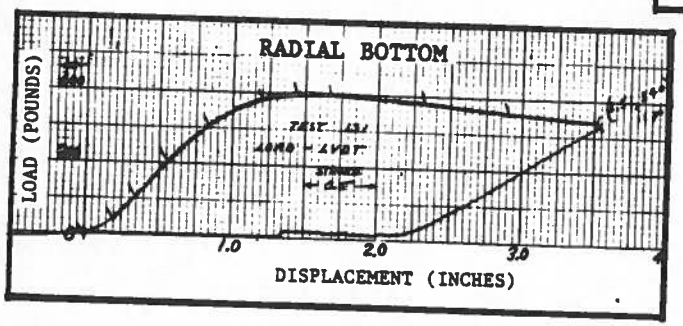
File Key	Characteristic	Program Variable	Value
C01	Wheel Weight	(WWH)	4.34 lb.
C03	Distance from wheel pivot Point to aft surface of wheel rim	(XRIM)	5.31 in.
C04	Distance from wheel pivot point to aft surface of hub face	(XWH)	3.62 in.
C05	Radious of wheel rim	(RIMRAD)	7.72 in.
	Thickness of wheel rim		1.25 in.

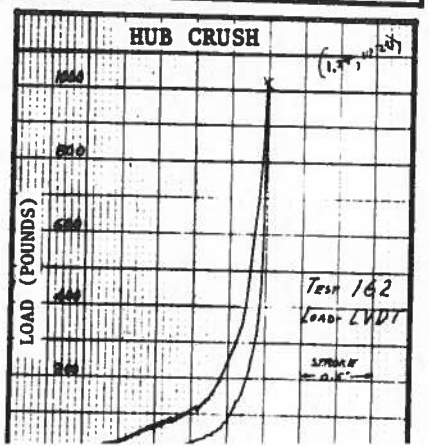
WHEEL GROUP NO. 9.251











APPENDIX D
CONVERSION OF TEST RESULTS TO PADS DATA

Each of the six rim displacement characteristics required by PADS (see Table D-1) is defined to be a structural mode which includes only local rim deflection in the vicinity of the load. The two wheel rotation characteristics are defined as structural modes in which the plane defined by the rim rotates without deforming or translating. Whole wheel crush is rim translation with respect to the hub with no local rim deflection.

TABLE D-1. FORCE-DEFLECTION CHARACTERISTICS REQUIRED BY PADS

PADS CODING SYMBOL	ARRAY DESCRIPTION
CO1A	Positive wheel rotation/torque with respect to column
CO2A	Negative wheel rotation/torque with respect to column
CO3A*(1)	Rim tangential displacement/force due to shoulder impact
CO4A*(2)	Rim radial displacement/force due to shoulder impact
CO5A	Rim tangential displacement/force due to head impact
CO6A*(2)	Rim radial displacement/force due to head impact
CO7A	Rim tangential displacement/force due to abdomen impact
CO8A	Rim radial displacement/force due to abdomen impact
CO9A	Whole wheel crush/force
C10A	Hub crush/force due to chest impact

*Data not produced by TSC steering component test program.
(1) Shoulder tangential displacement/force assumed equal to head tangential force displacement.
(2) Default values used (Reference 3).

Since the paraxial and radial wheel tests were performed with no constraint on the rim, the test results contain a combination of wheel rotation and local rim deflection (wheel crush with respect to the hub was also possible but was not detected in any of these tests).

To establish the amount of rotation present in each of these tests, the rim was instrumented with stringpots at the two locations indicated in Figures D-1a and b. Little or no local deflection occurs between these points since they are located away from the point of load application. The stringpots measure deflection parallel to the centerline of the hub. This point is a distance "B" from the centerline of the hub and a distance "A" from the undeflected rim plane as indicated in Figure D-2.

Rotation is given by

$$(1) \qquad \theta = \sin^{-1}\left(\frac{|S1| + |S2|}{D}\right)$$

where S1 and S2 are the stringpot deflections and D is the distance between the stringpots. Local deflection is the difference between the total deflection measured in the test at the point of load application (and in the direction of load application) less the calculated deflection that results from wheel rotation. For negative rotation, the calculated wheel deflection parallel to the hub centerline is

$$(2) \qquad \Delta_A = A - C\cos(\phi + \theta)$$

$$\text{where } \phi = \tan^{-1}\left[\frac{R - B}{A}\right]$$

$$C = \left[A^2 + (R-B)^2\right]^{1/2}$$

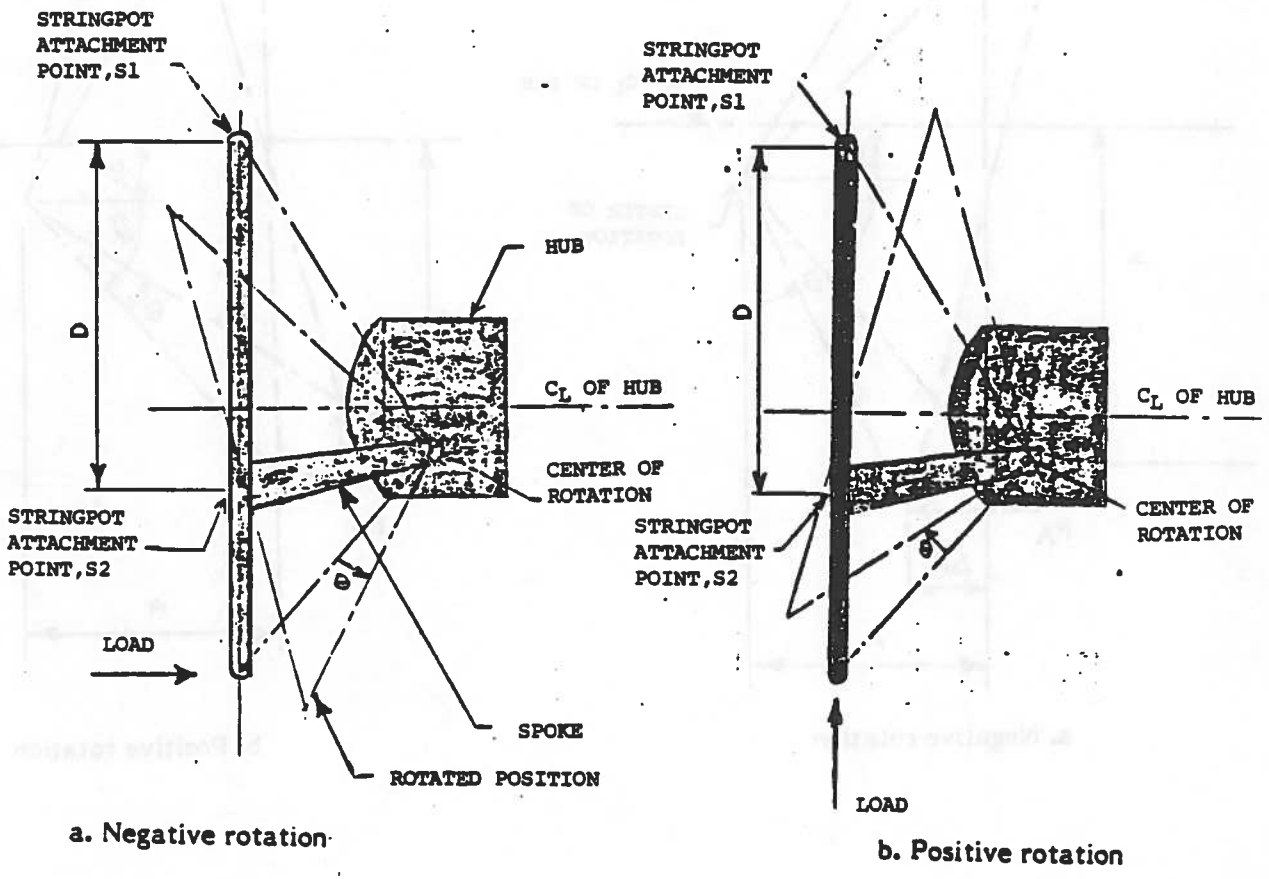


FIGURE D-1. DIAGRAM OF WHEEL ROTATIONAL MODES

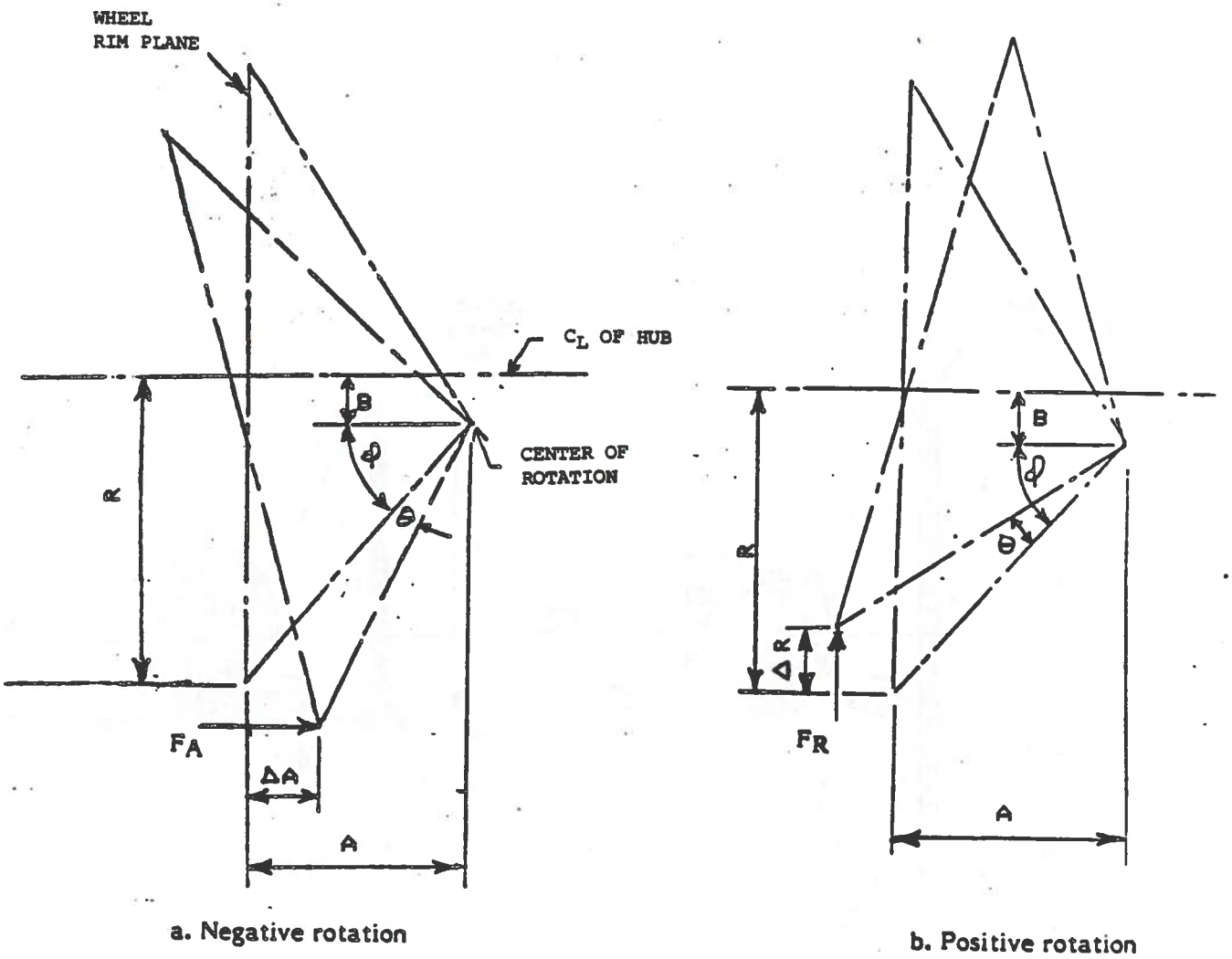


FIGURE D-2. DEFINITION OF WHEEL ROTATION VARIABLES

and all variables are defined in Figure D-2a. For positive rotation the calculated wheel deflection in the direction of the undeformed rim plane is

(3) $\Delta_R = (R-B) - C \sin(\phi - \theta)$

where all variables are defined in Figure D-2b.

The moments corresponding to the rotations are given by

Negative:

(4) $M_n = F_A \cdot C \sin(\phi + \theta)$

Positive:

(5) $M_p = F_R \cdot C \cos(\phi - \theta)$

where F is the load measured in the particular test.

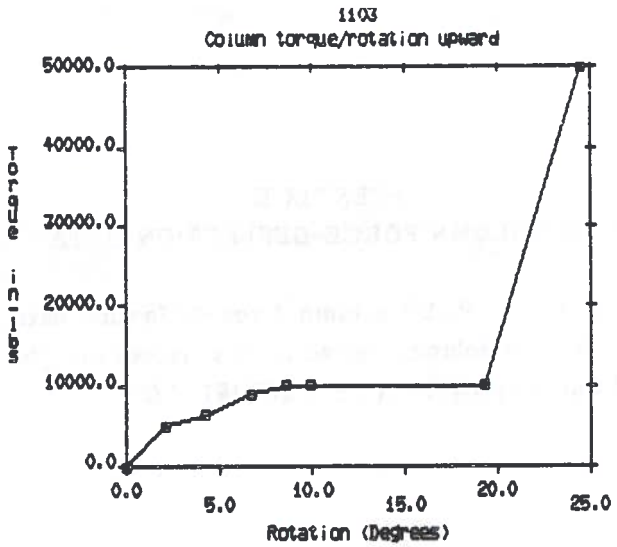
Equation (1) also applies in calculating rotation induced by the paraxial, top load where the stringpots are repositioned to the rim portion below the spokes.

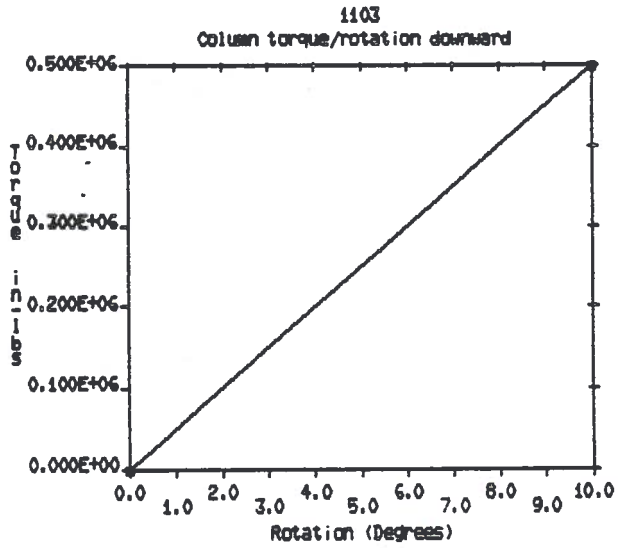
Equations (1) to (5) were programmed on the TSC DEC-10 computer in conjunction with the digitization routine so that analog test measurements could be digitized and transformed to PADS input format on the NHTSA's VAX-11/780 computer. A digitizing tablet connected to a computer terminal was used to aid in transforming graphical plots of the test results into digitized data. A Fortran program (DIGTST) was used for this operation.

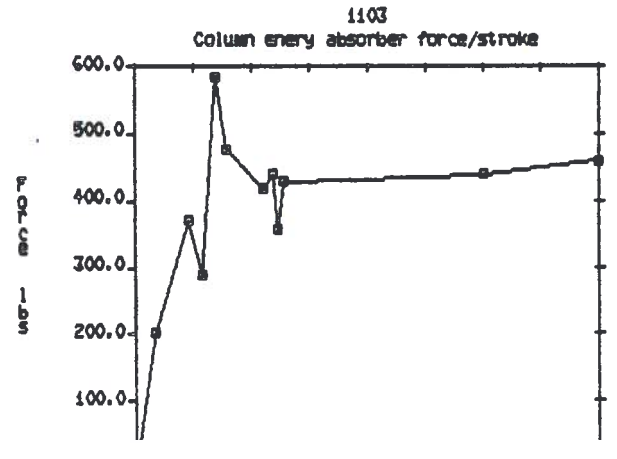
Test results for whole wheel and hub crush only require digitization in order to become PADS input. A simpler form of the program (DIGI) is used to digitize this data.

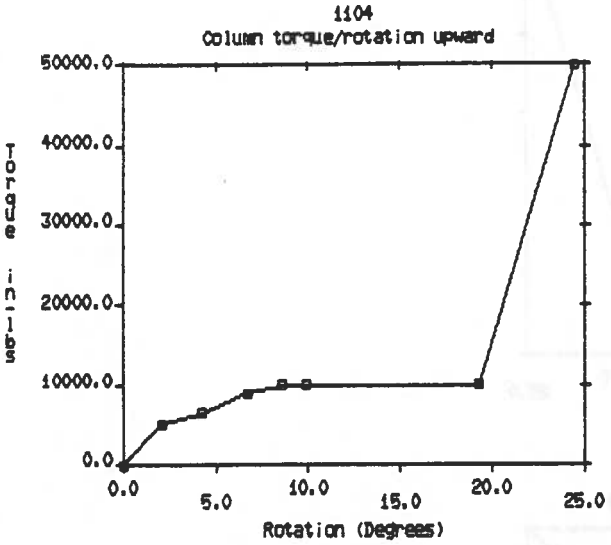
APPENDIX E
PADS COLUMN FORCE-DEFLECTION DATA

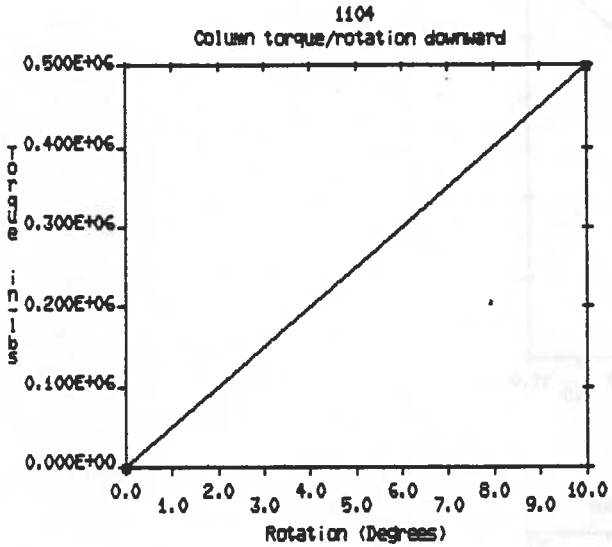
Graphical print-outs of the PADS column force-deflection data from the steering column file (TSC:BRPT) for the columns tested in this project are given in this appendix. The plots are obtained from the program [TSCPROG]FDPLOT.

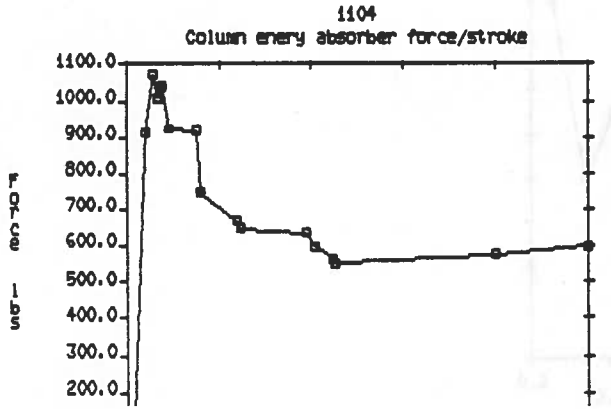

1103
Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

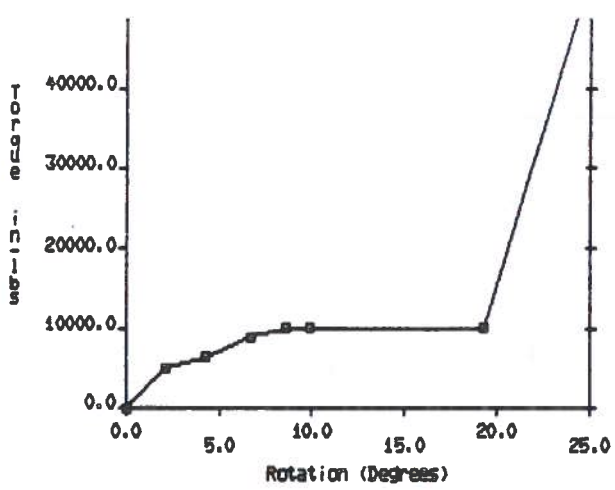

1103
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

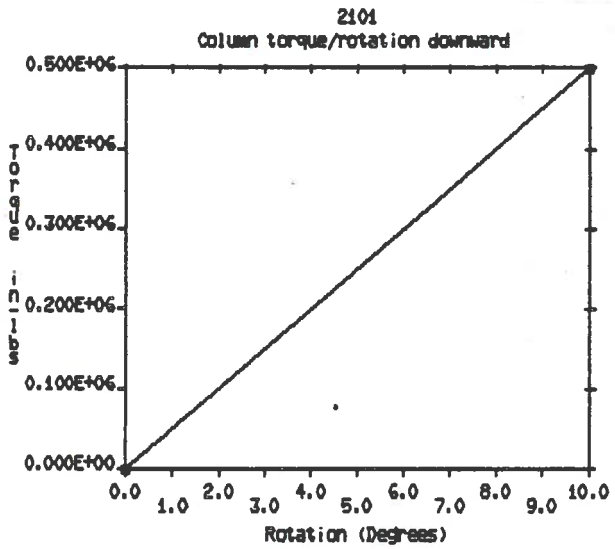

1103
Column enery absorber force/stroke
600.0
500.0
400.0
300.0
200.0
100.0
Force - lbs

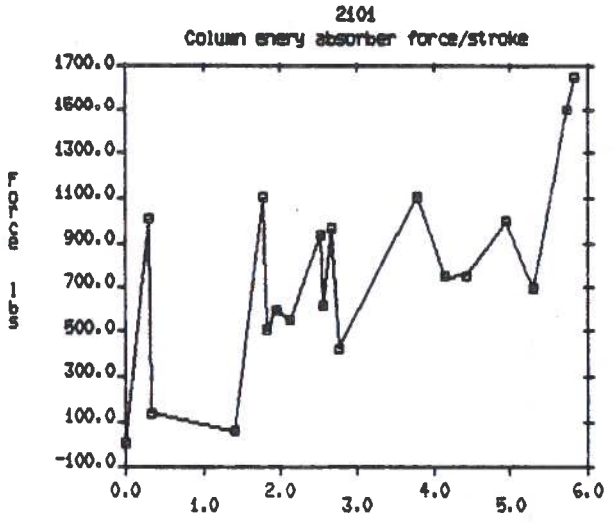

1104
Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

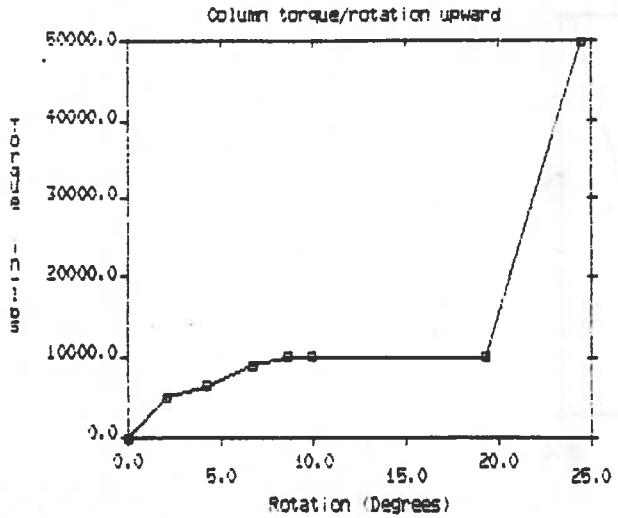

1104
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)


1104
Column enery absorber force/stroke
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
Force - lbs

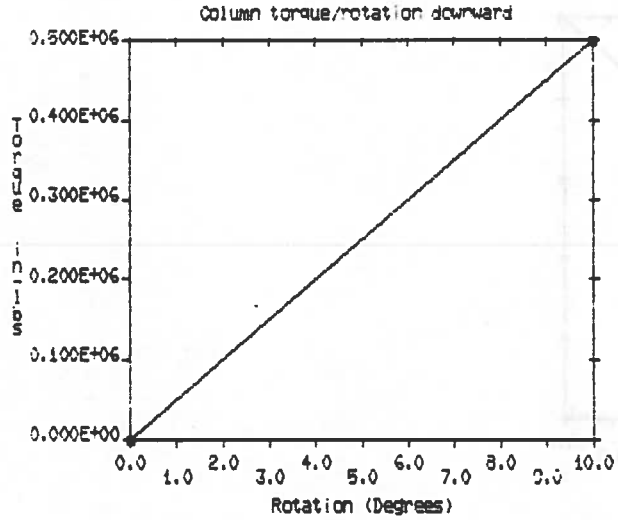

Torque - in-lbs
40000.0
30000.0
20000.0
10000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


2101
Column torque/rotation downward
Torque - in-lbs
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

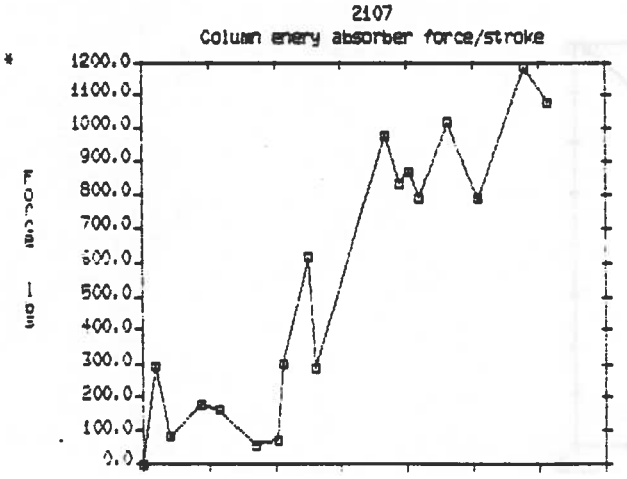

2101
Column enery absorber force/stroke
Force - lbs
1700.0
1600.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0

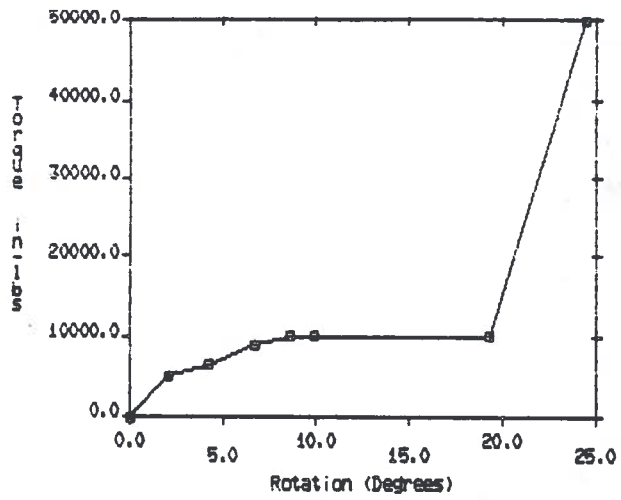

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

2107

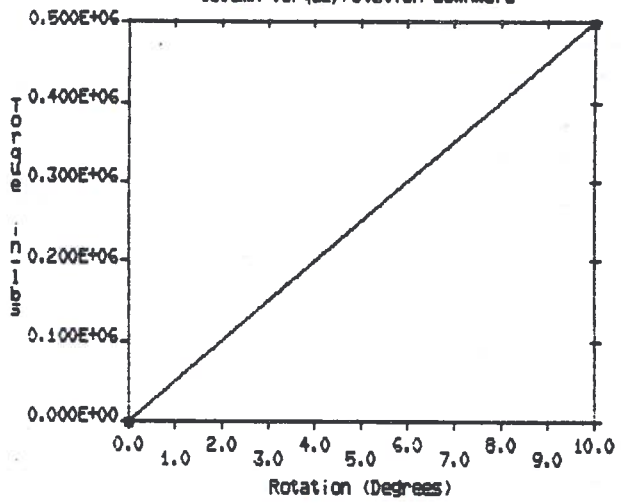

Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

2107

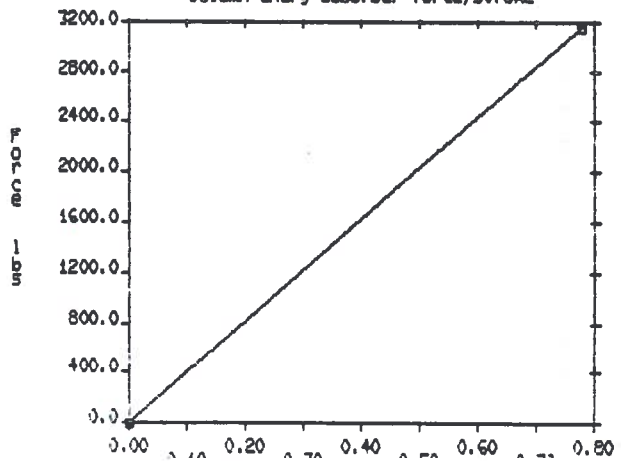

Column enery absorber force/stroke
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs

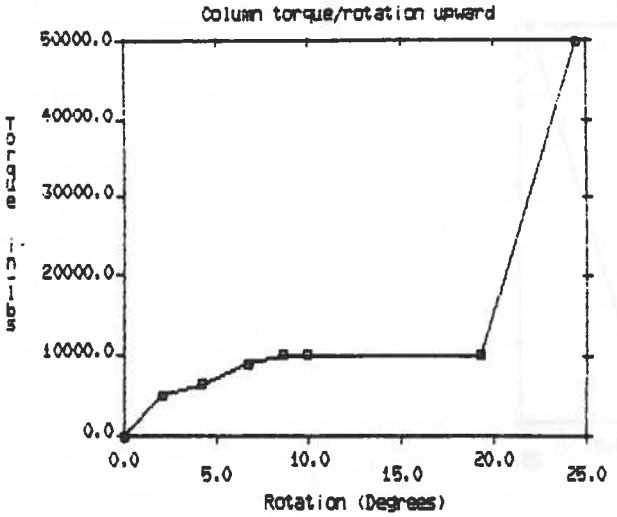


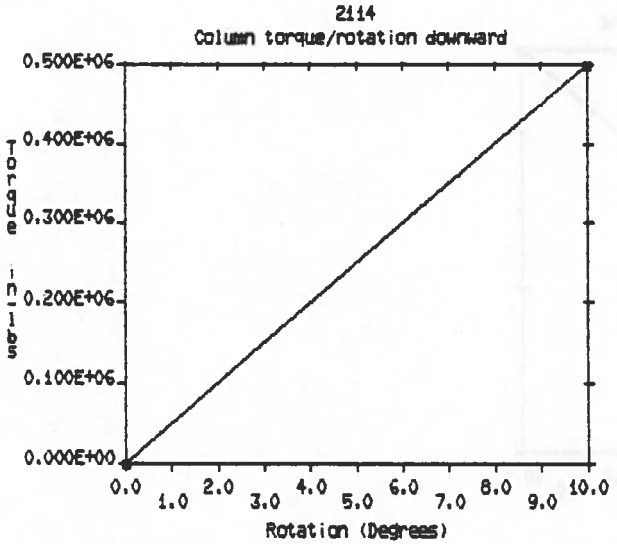
2109
Column torque/rotation downward

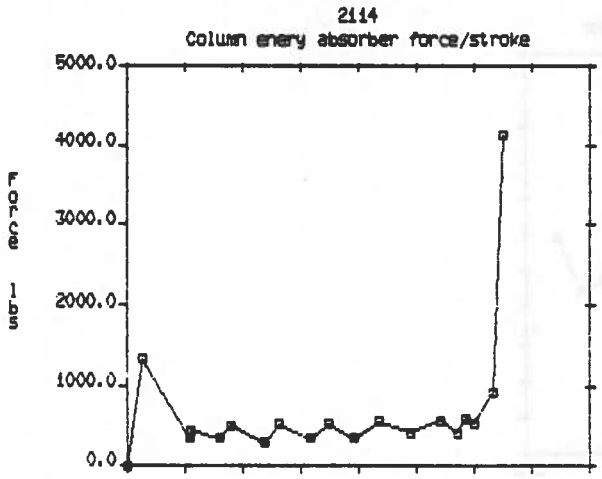


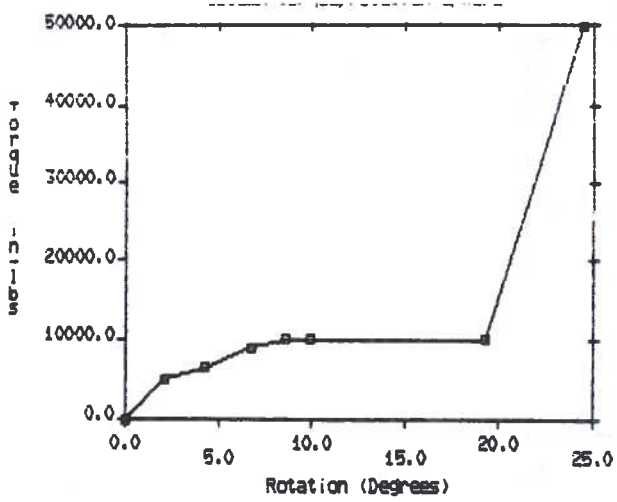
2109
Column enery absorber force/stroke



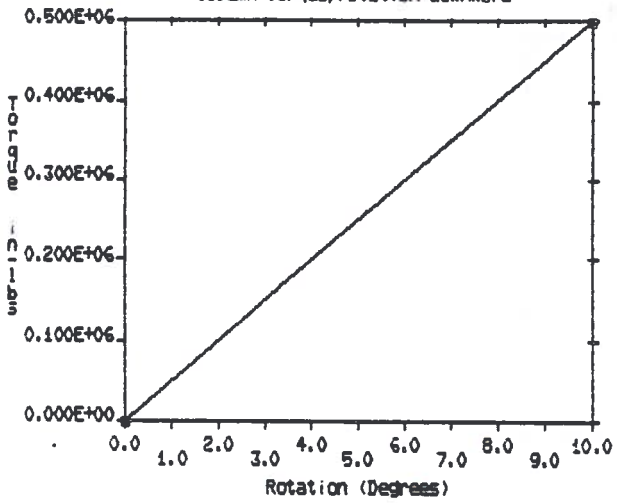

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


2114
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

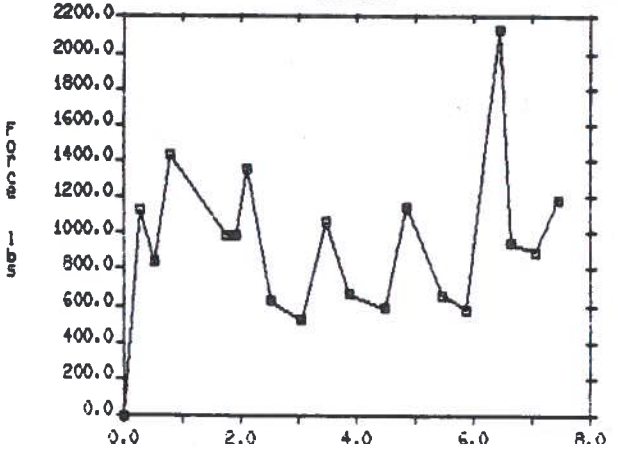

2114
Column enery absorber force/stroke
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
Force - lbs

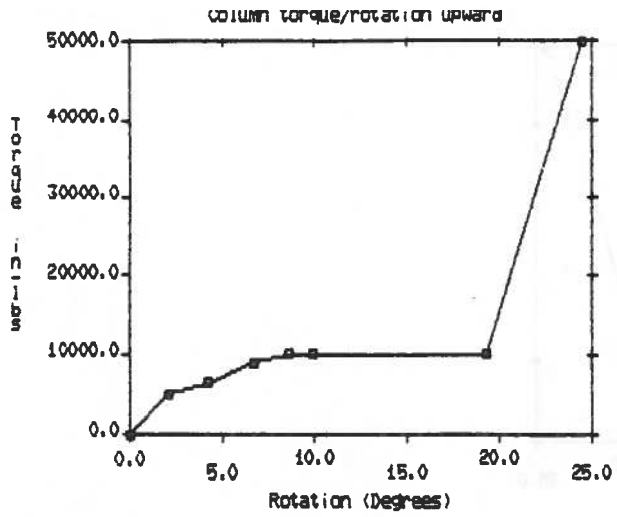


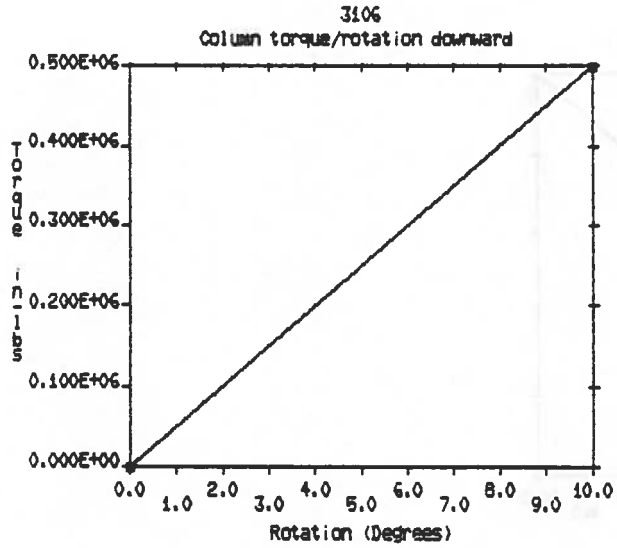
3101
Column torque/rotation downward

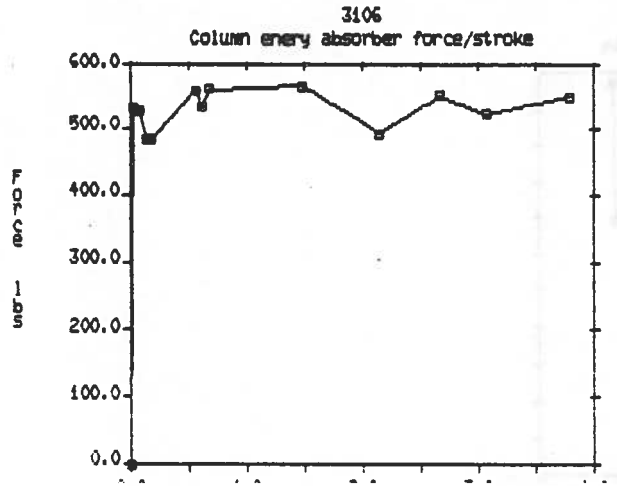


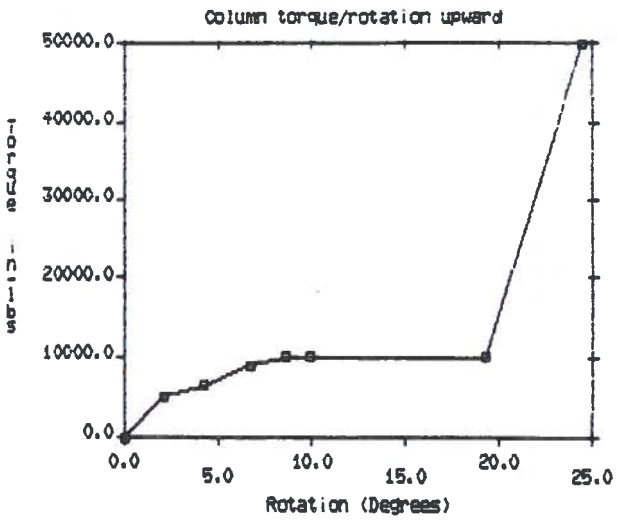
3101
Column enery absorber force/stroke

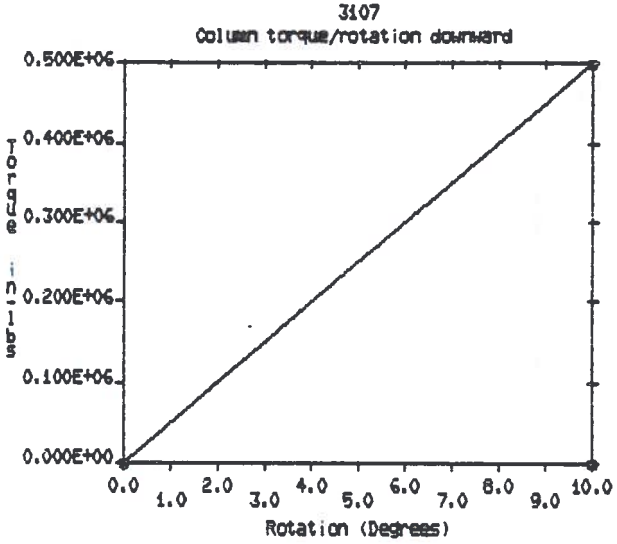


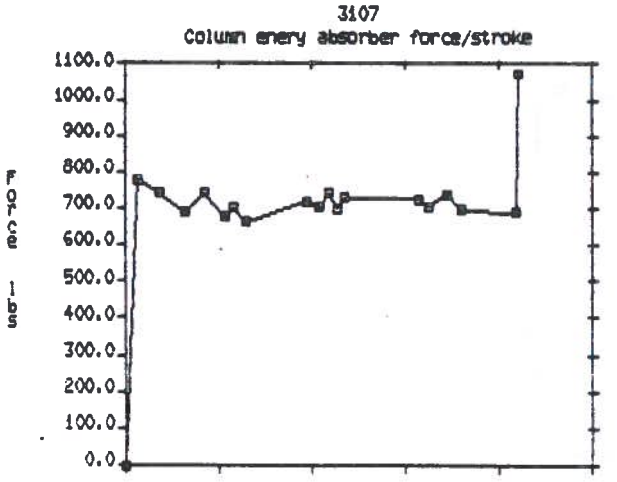

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

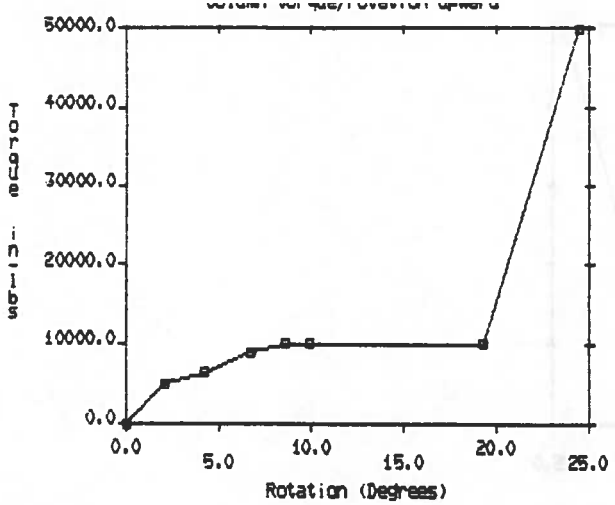

3106
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)


3106
Column enery absorber force/stroke
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs

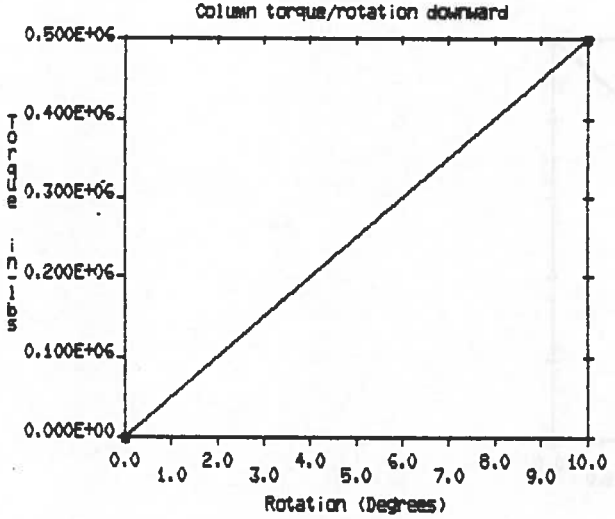

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


3107
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

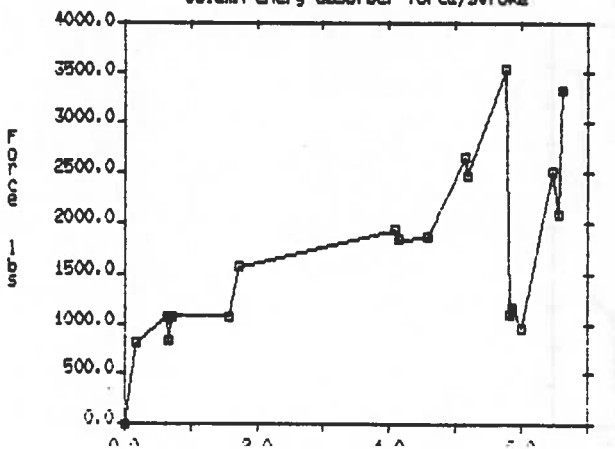

3107
Column enery absorber force/stroke
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs

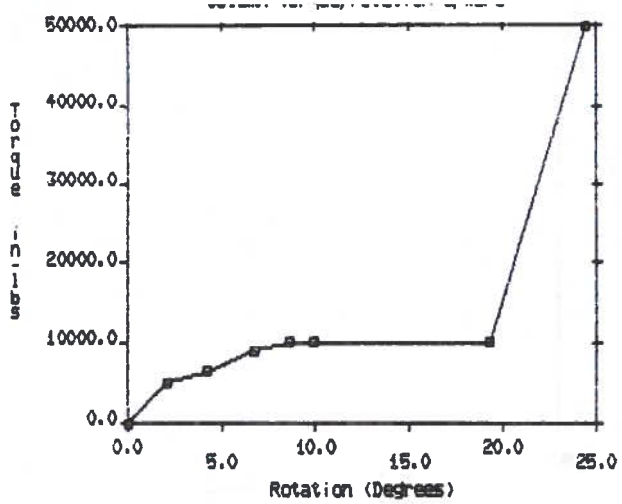


3111
Column torque/rotation downward

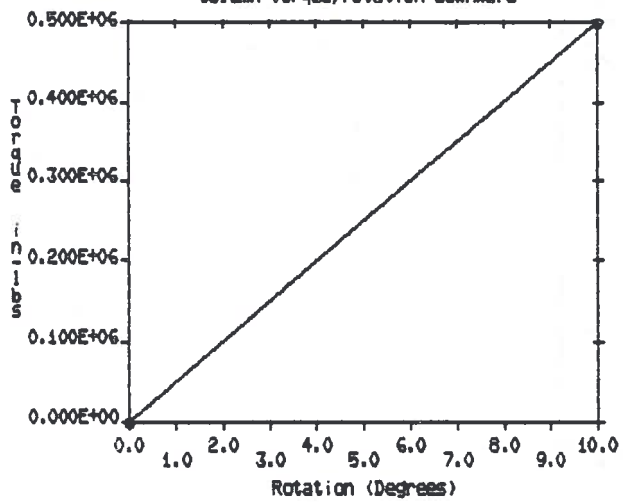


3111
Column enery absorber force/stroke

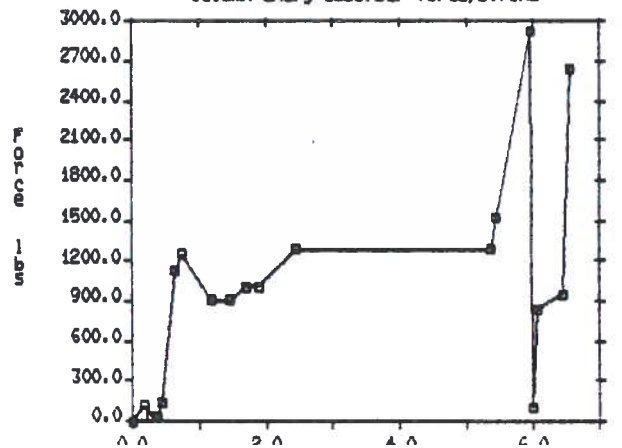


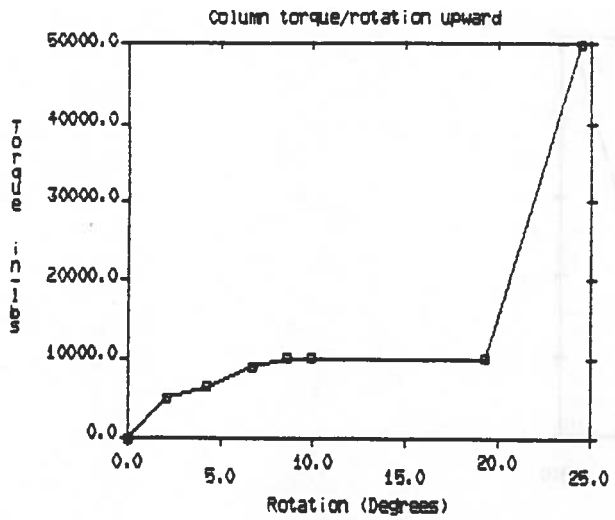


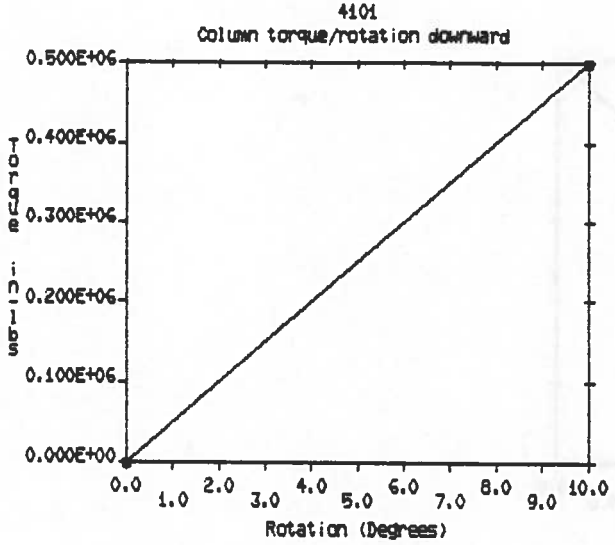
3112
Column torque/rotation downward

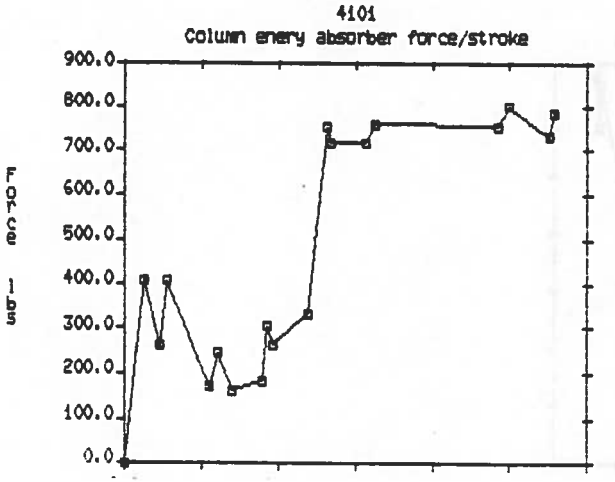


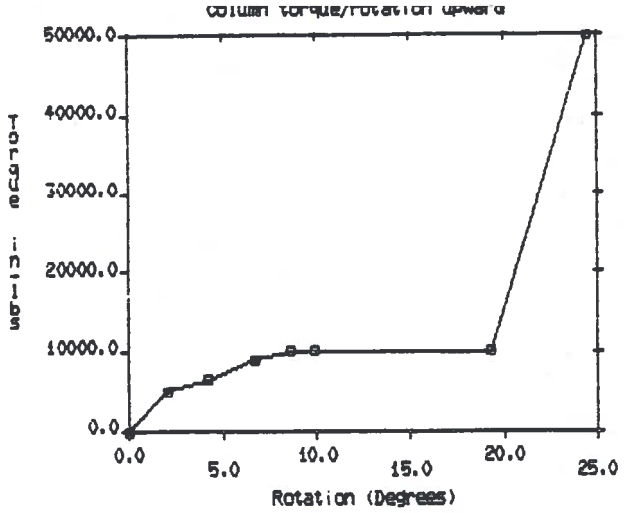
3112
Column enery absorber force/stroke

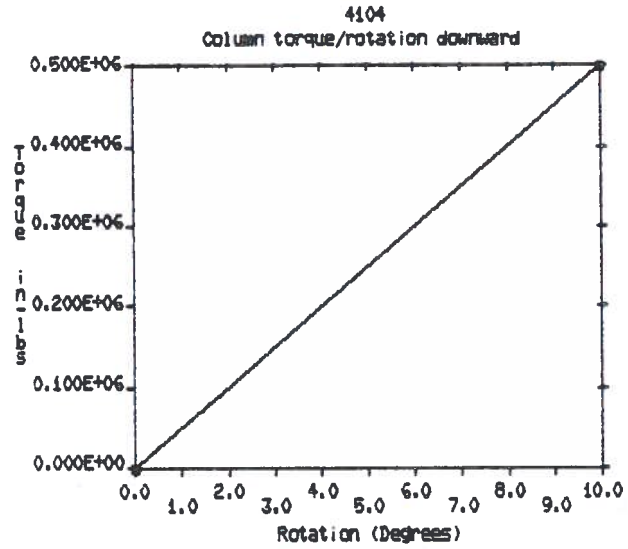


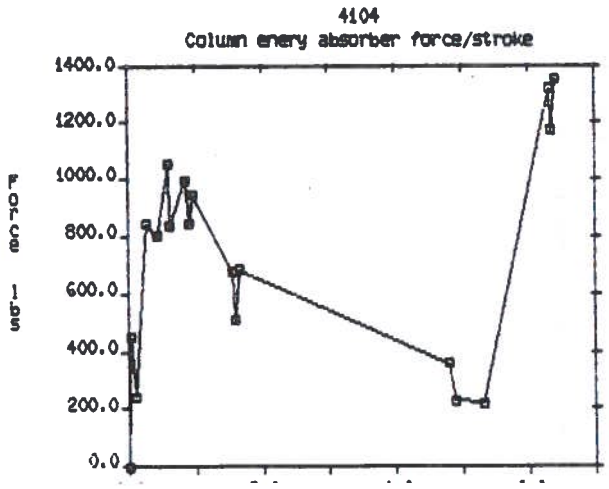

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

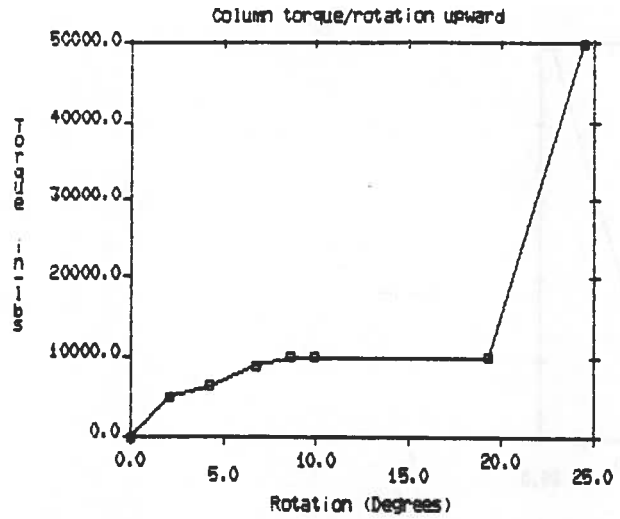

4101
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)


4101
Column enery absorber force/stroke
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs

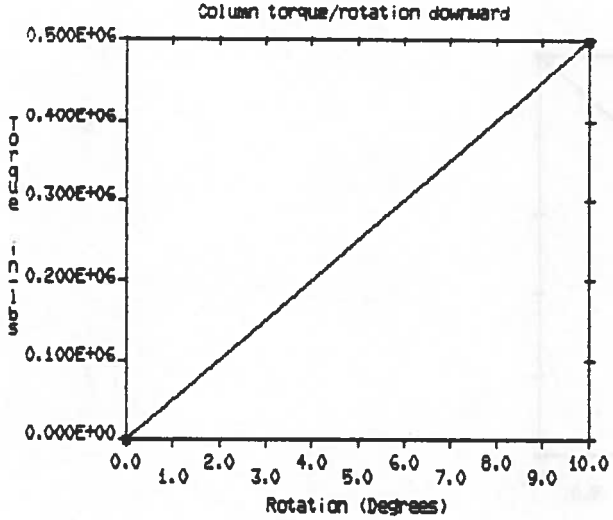

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


4104
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

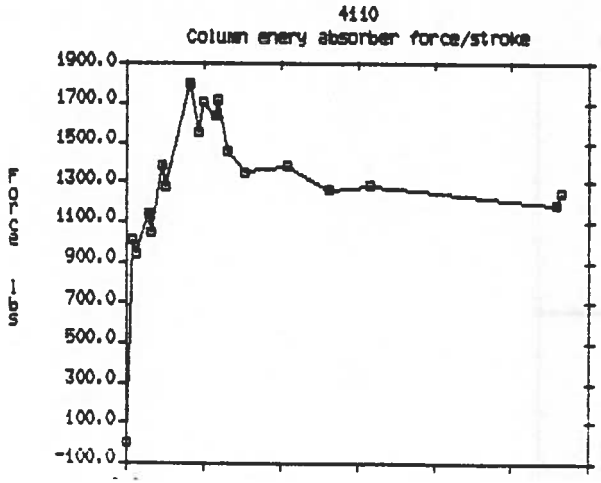

4104
Column enery absorber force/stroke
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Force - lbs

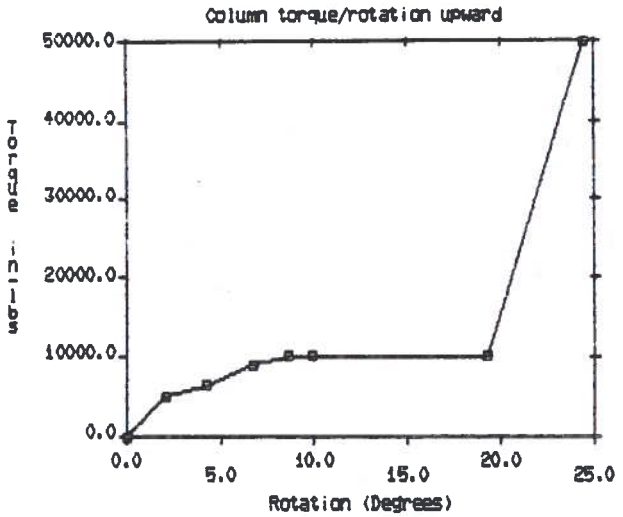

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

4110

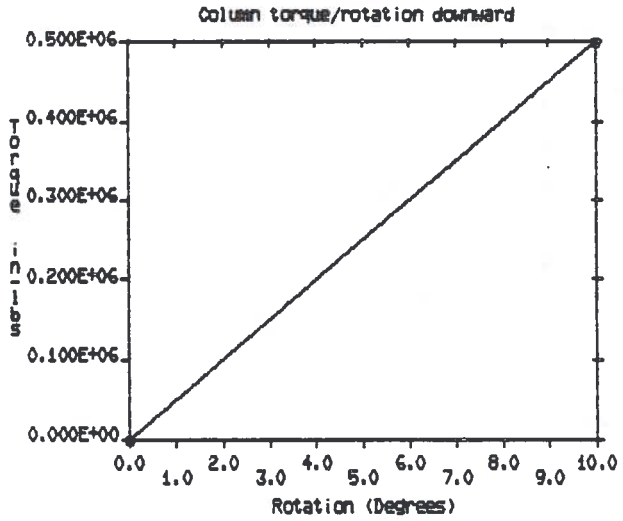

Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

4110

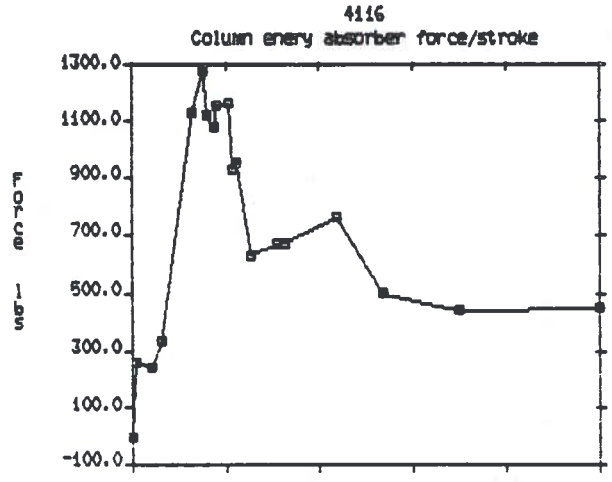

Column enery absorber force/stroke
1900.0
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
Force - lbs

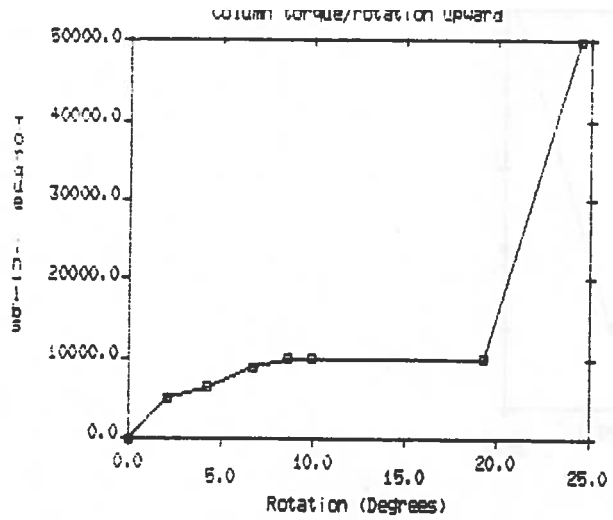

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

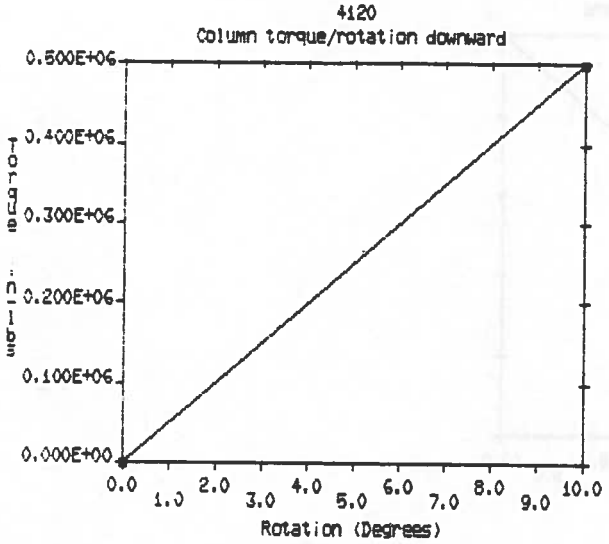
4116

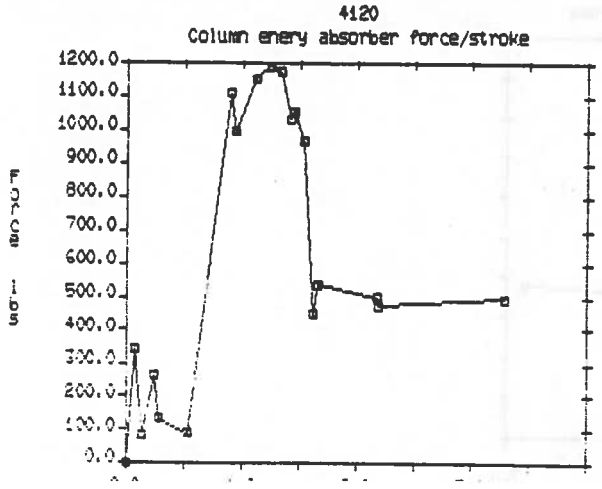

Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

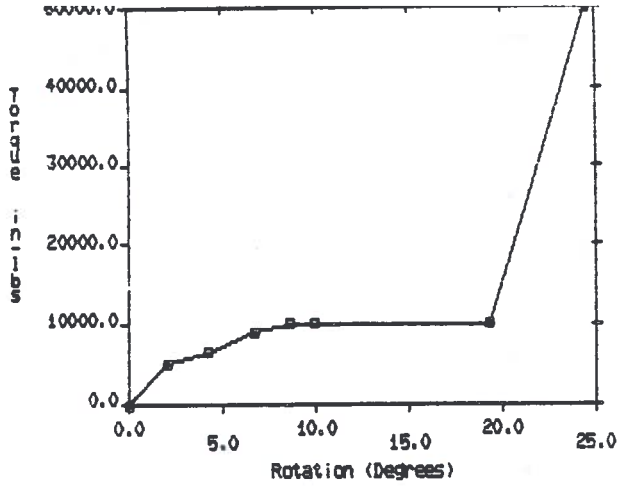
4116


Column enery absorber force/stroke
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
Force - lbs

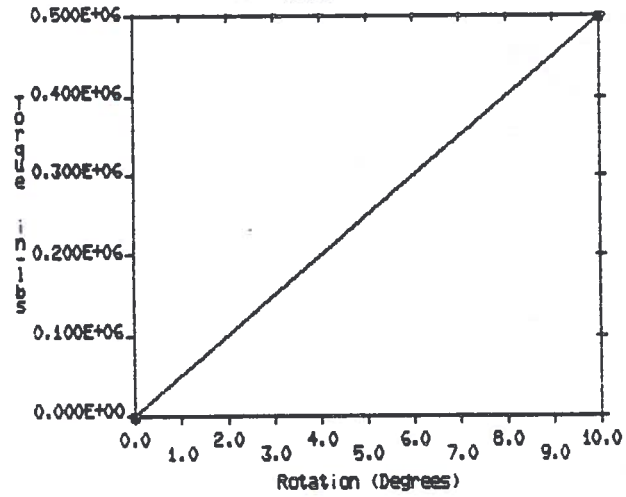

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


4120
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

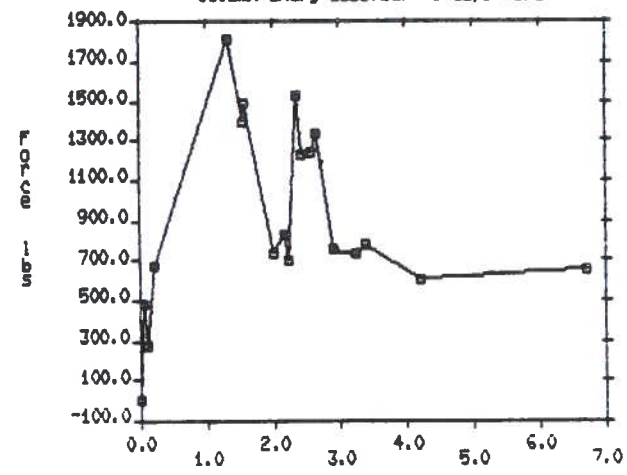

4120
Column enery absorber force/stroke
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

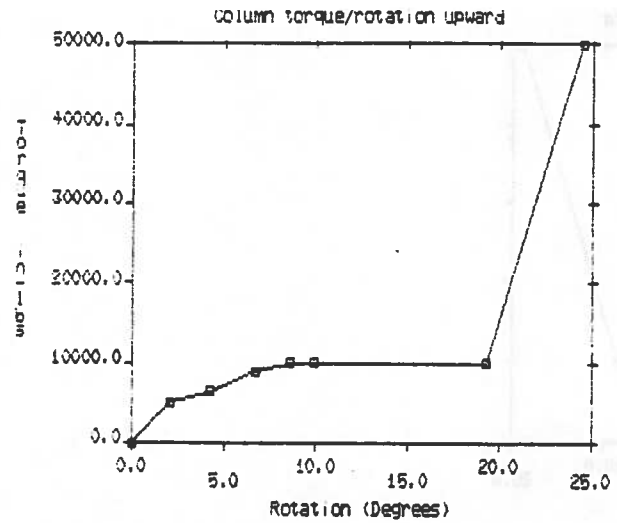


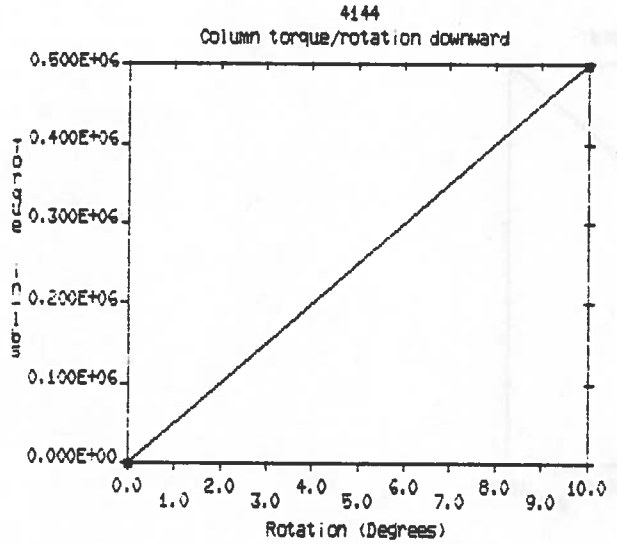
4135
Column torque/rotation downward

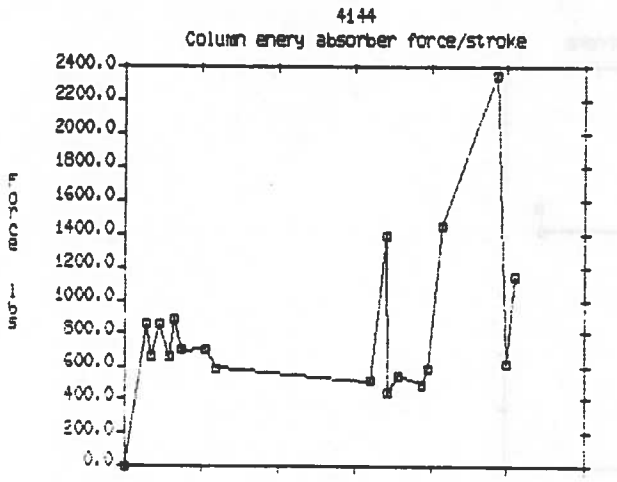


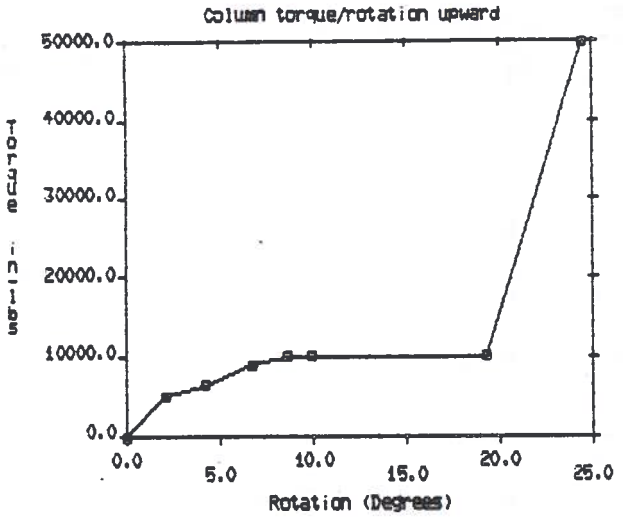
4135
Column enery absorber force/stroke



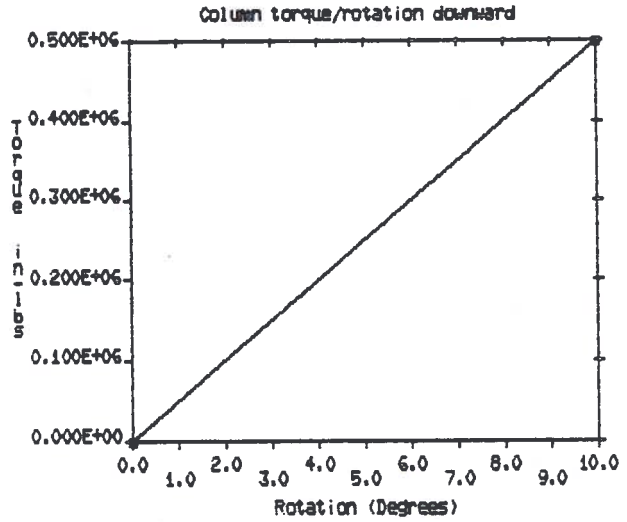

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - in-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


4144
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - in-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

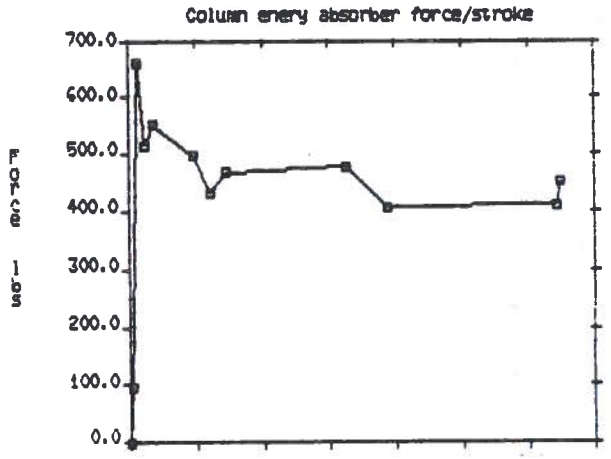

4144
Column enery absorber force/stroke
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Load - lbs

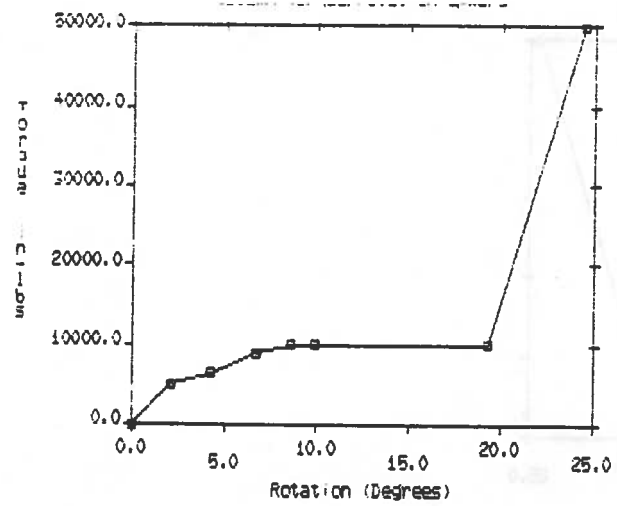

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

4156

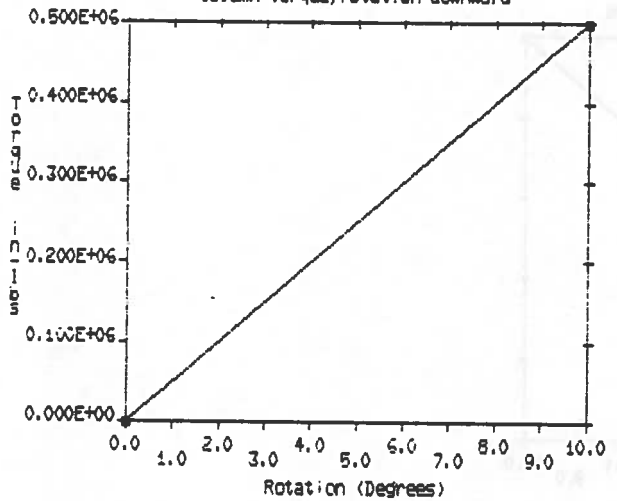

Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

4156

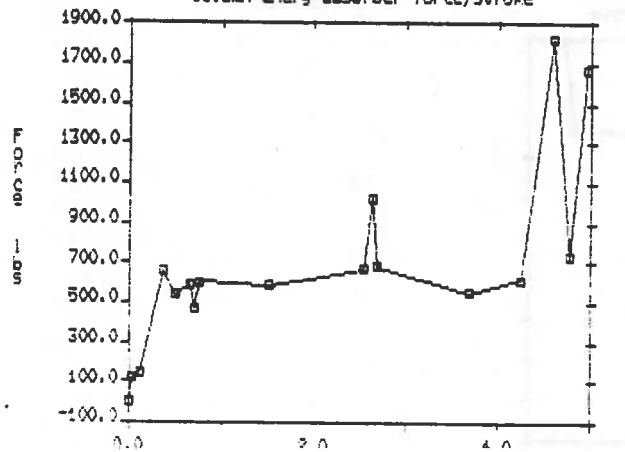

Column enery absorber force/stroke
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs

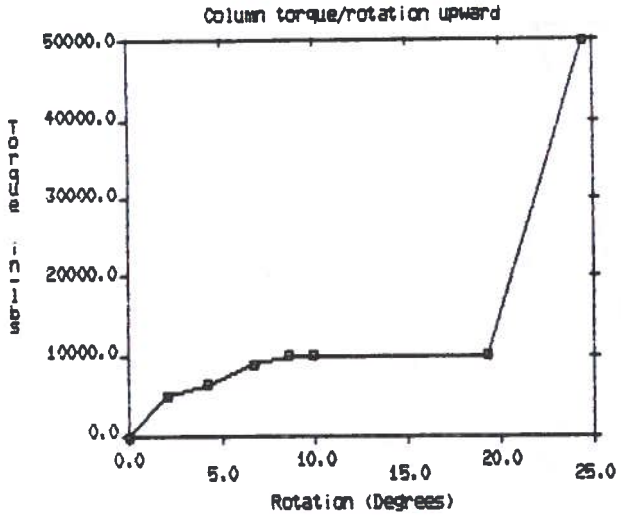


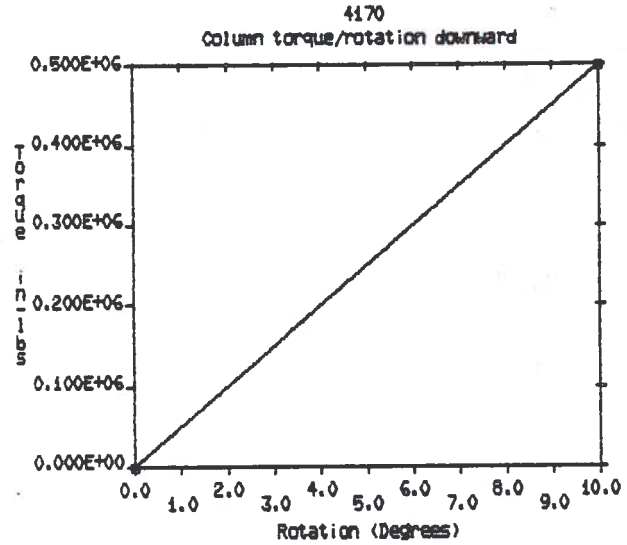
4165
Column torque/rotation downward

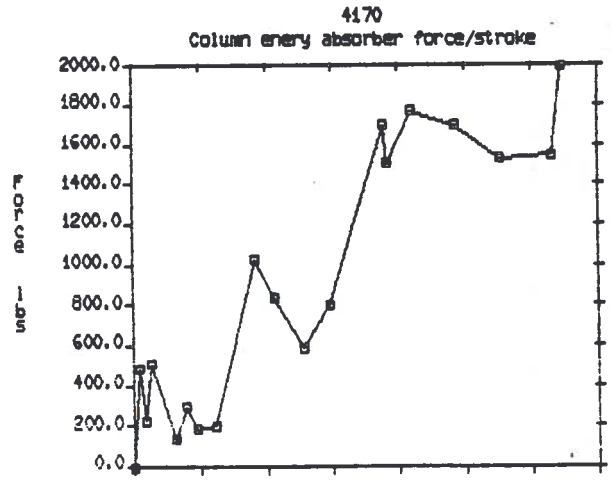


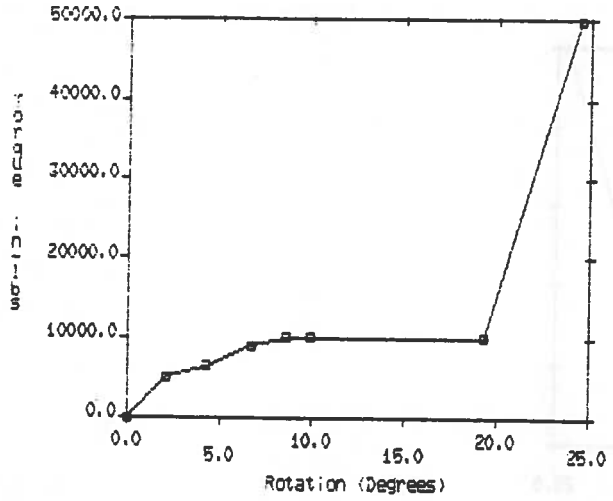
4165
Column enery absorber force/stroke

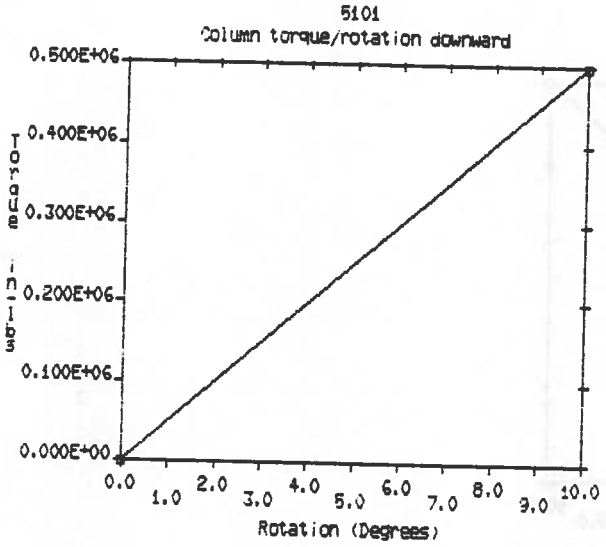


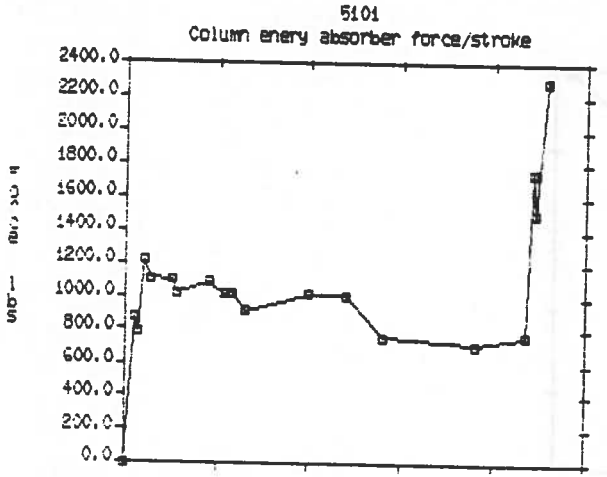

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins-lbs
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

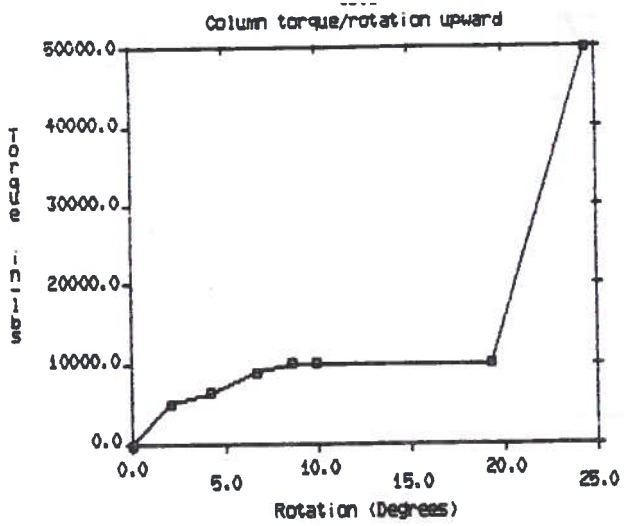

4170
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins-lbs
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)


4170
Column enery absorber force/stroke
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Force - lbs

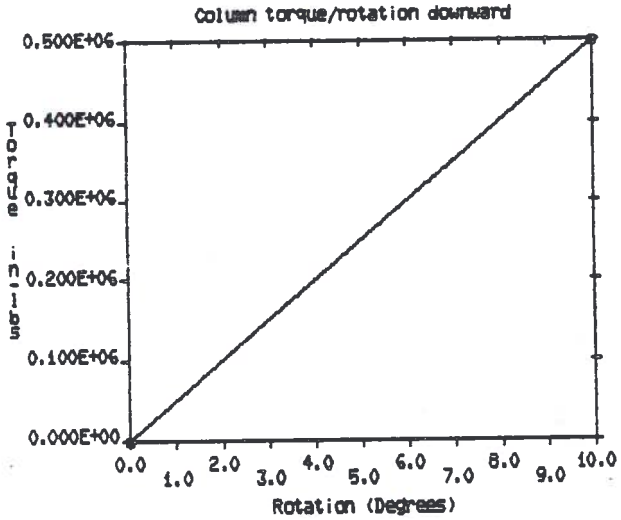

50000.0
40000.0
30000.0
20000.0
10000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


5101
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

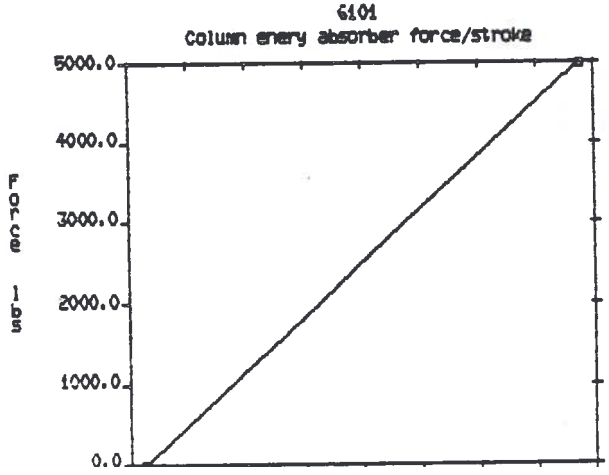

5101
Column enery absorber force/stroke
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0

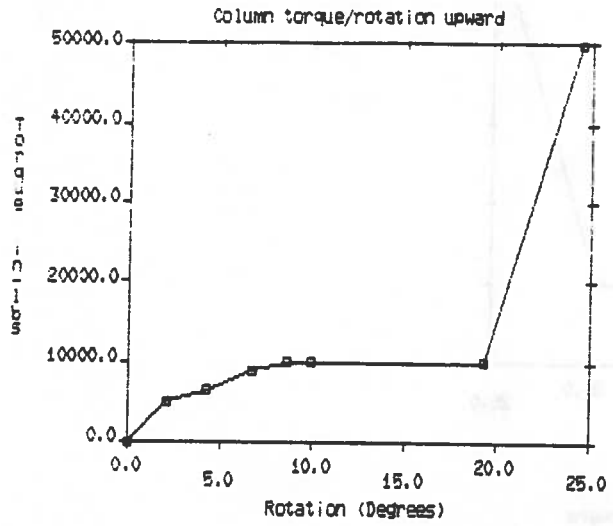

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
Torque - ins
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

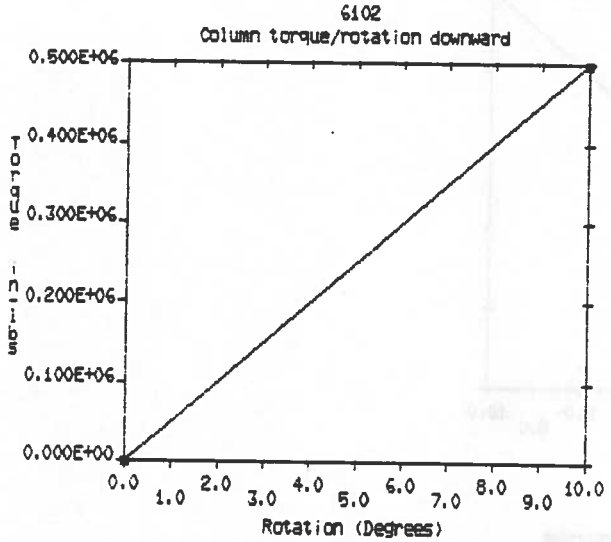
6101

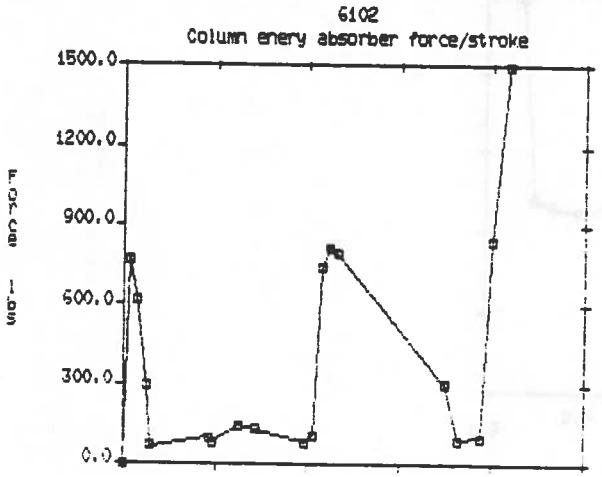

Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
Torque - ins
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

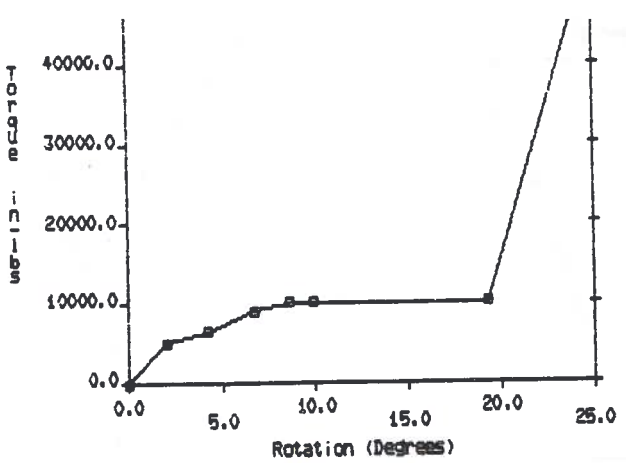
6101


Column enery absorber force/stroke
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
Force - lbs

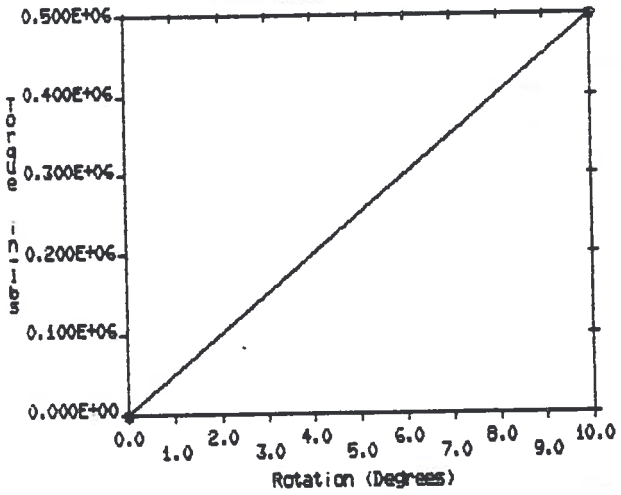

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)


6102
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

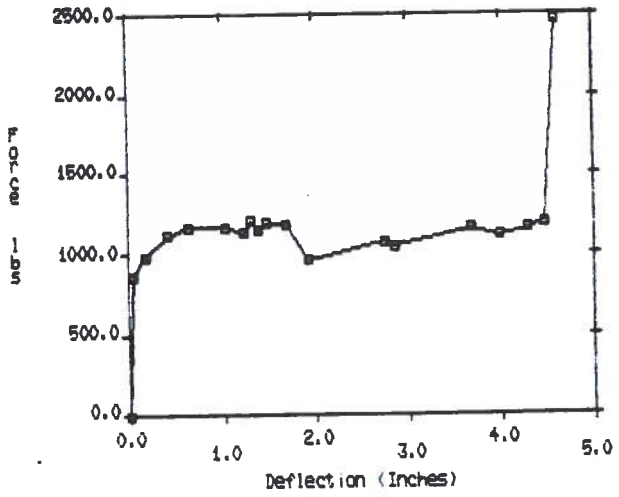

6102
Column enery absorber force/stroke
1500.0
1200.0
900.0
600.0
300.0
0.0

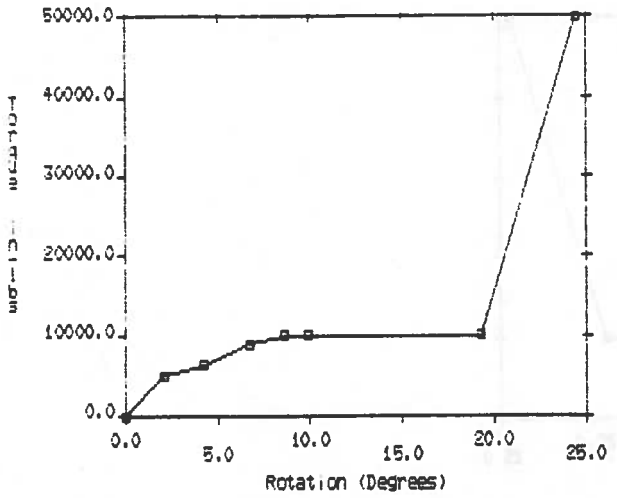


7101
Column torque/rotation downward

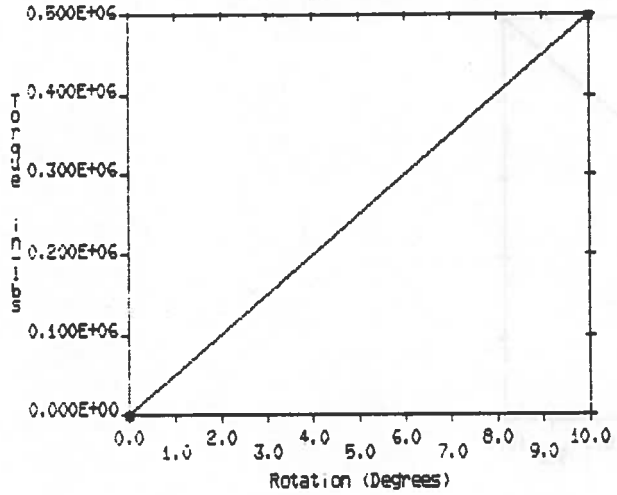


7101
Column enery absorber force/stroke

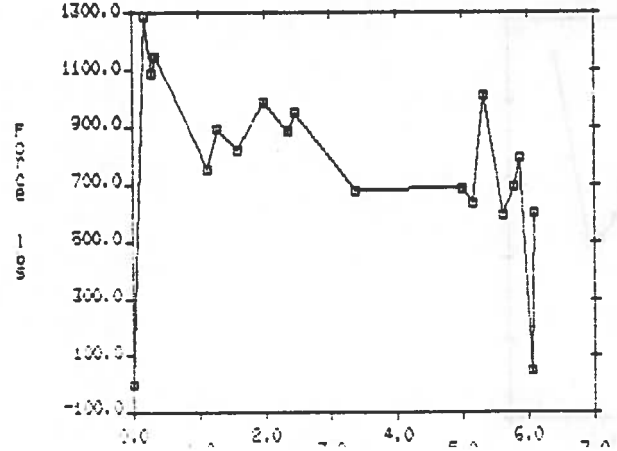


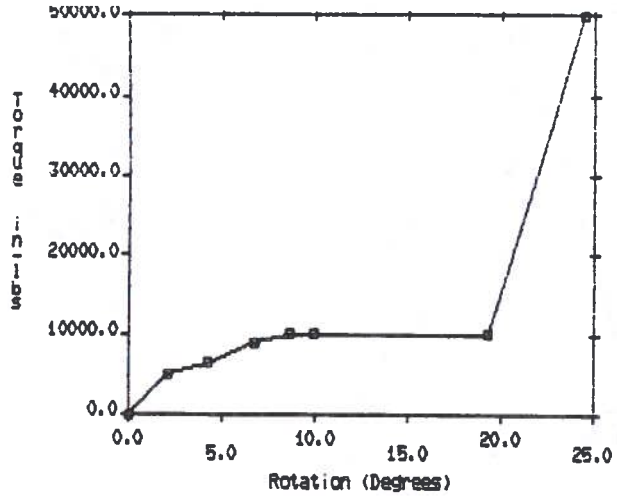


8102
Column torque/rotation downward

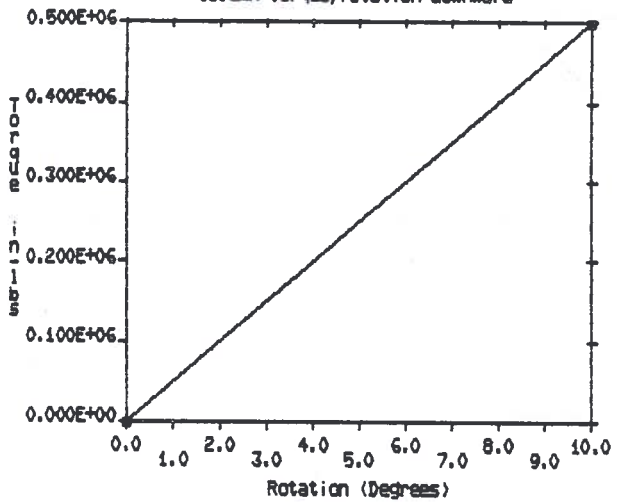


8102
Column enery absorber force/stroke

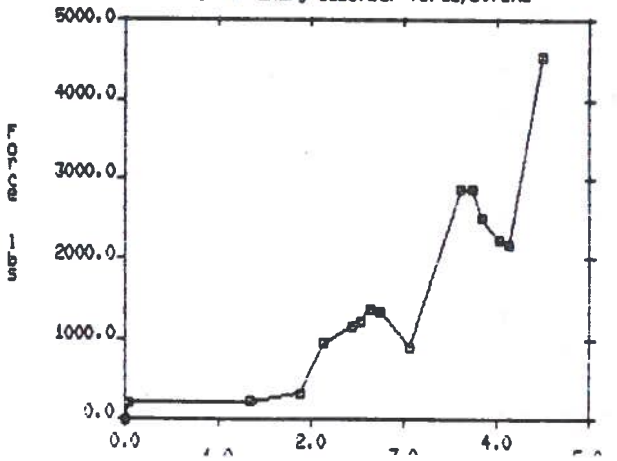


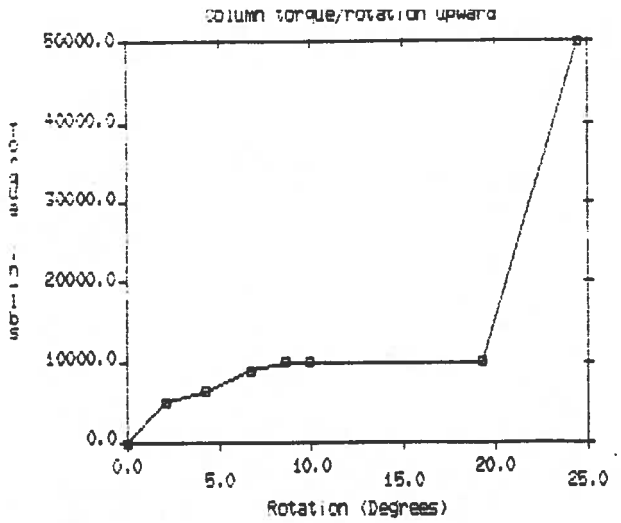


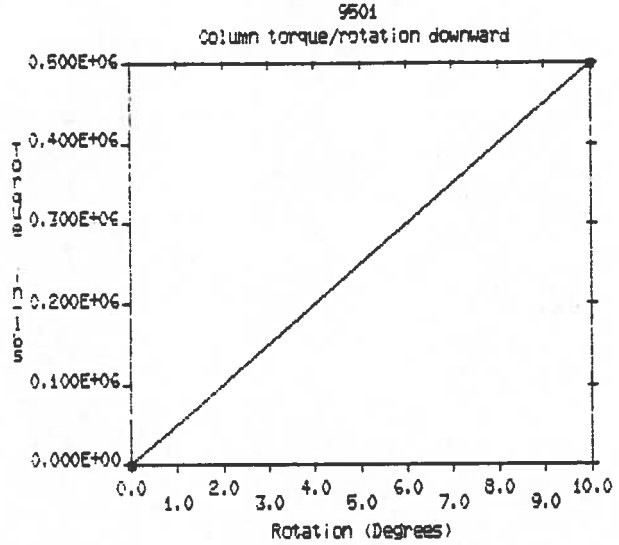
9107
Column torque/rotation downward

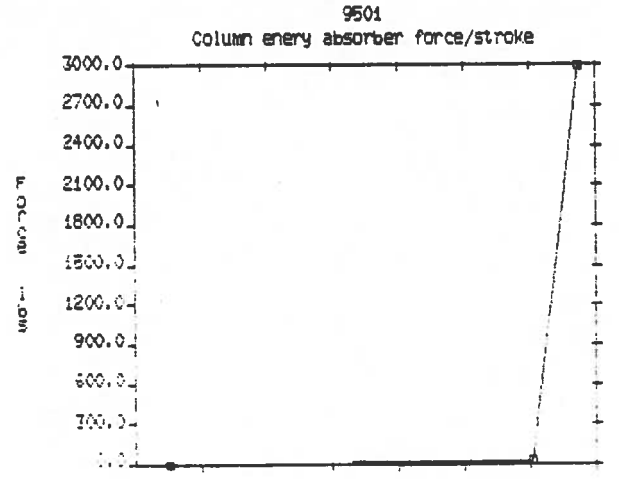


9107
Column enery absorber force/stroke



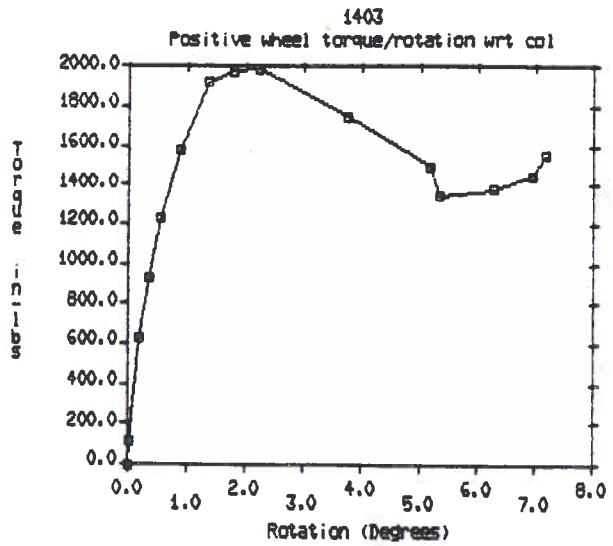

Column torque/rotation upward
50000.0
40000.0
30000.0
20000.0
10000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Rotation (Degrees)

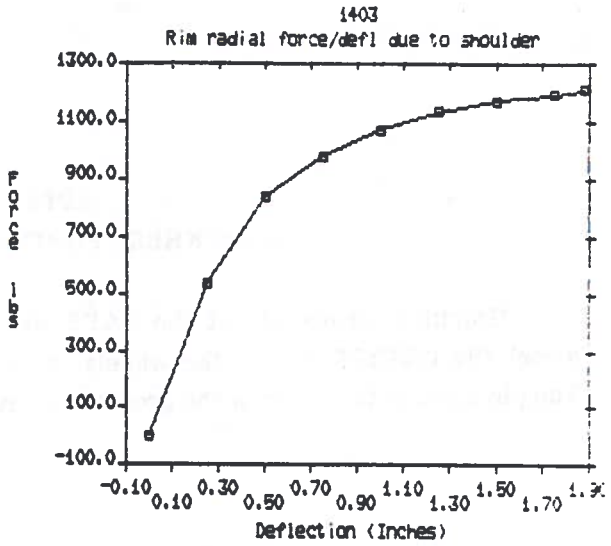

9501
Column torque/rotation downward
0.500E+06
0.400E+06
0.300E+06
0.200E+06
0.100E+06
0.000E+00
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

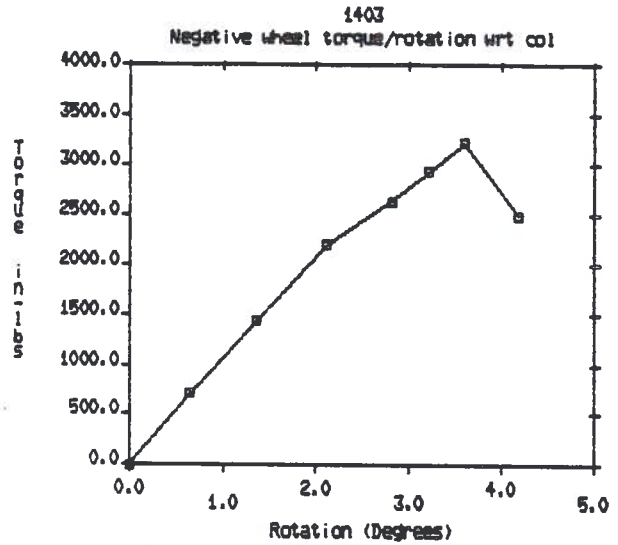

9501
Column enery absorber force/stroke
3000.0
2700.0
2400.0
2100.0
1800.0
1500.0
1200.0
900.0
600.0
300.0

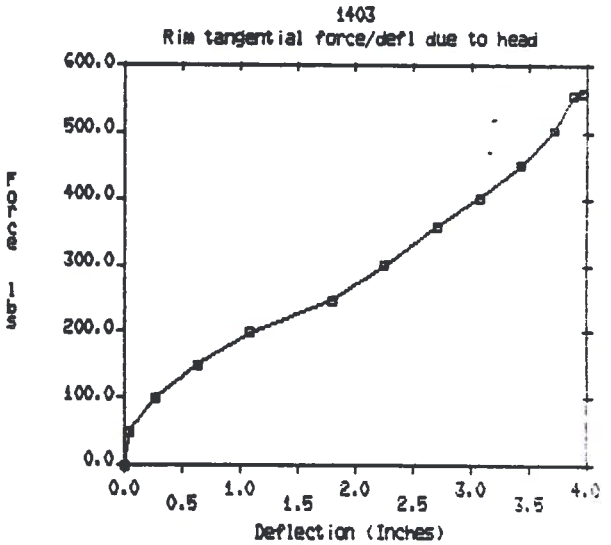
APPENDIX F
PADS WHEEL FORCE-DEFLECTION DATA

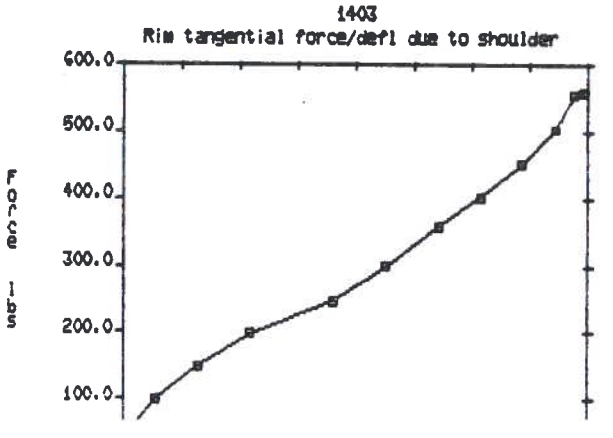
Graphical print-outs of the PADS wheel force-deflection data from the steering wheel file (TSC:CRPT) for the wheels tested in this project are given in this appendix. The plots are obtained from the program [TSCPROG]FDPLOT.

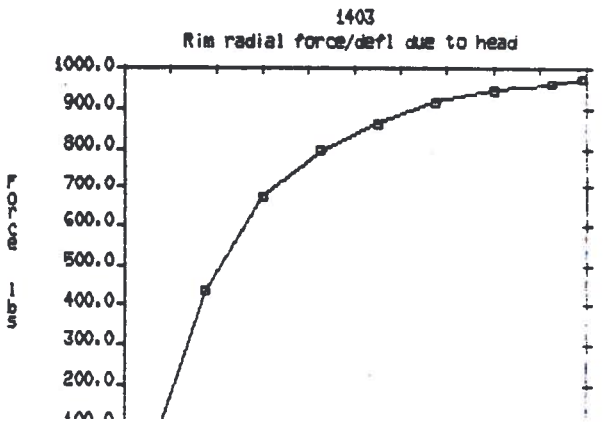

1403
Positive wheel torque/rotation wrt col
Torque - in-lbs
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Rotation (Degrees)

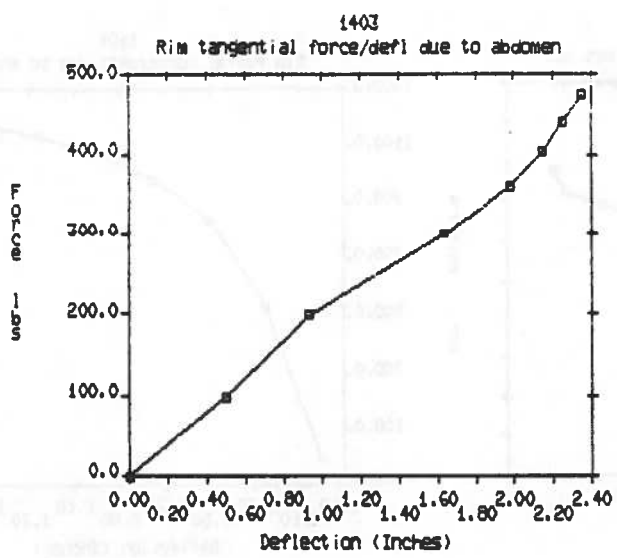

1403
Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

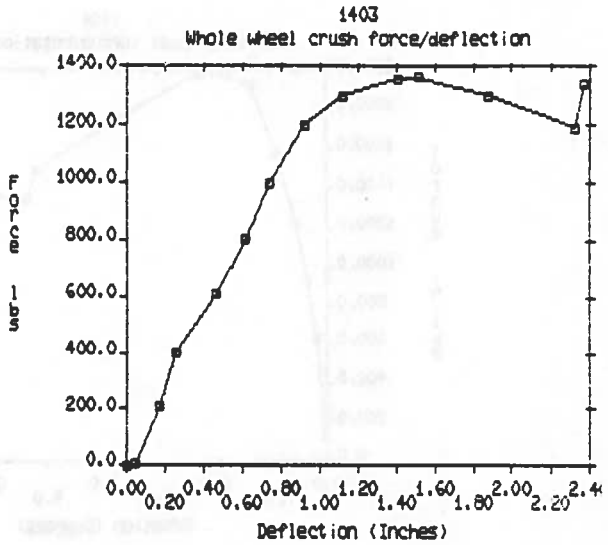

1403
Negative wheel torque/rotation wrt col
Torque - in-lbs
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Rotation (Degrees)

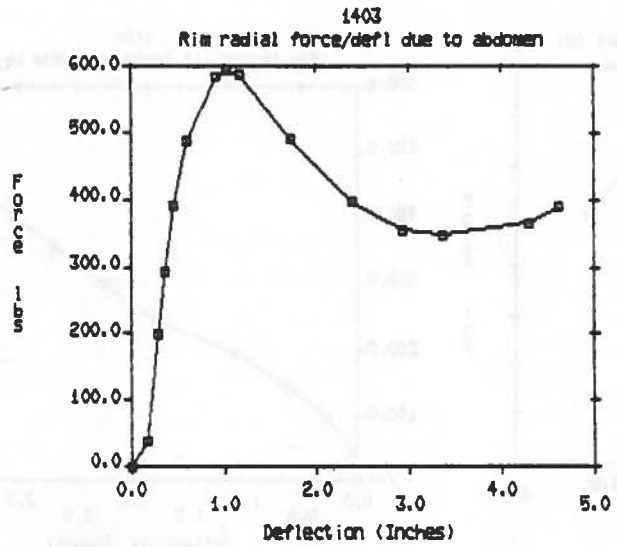

1403
Rim tangential force/defl due to head
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Deflection (Inches)

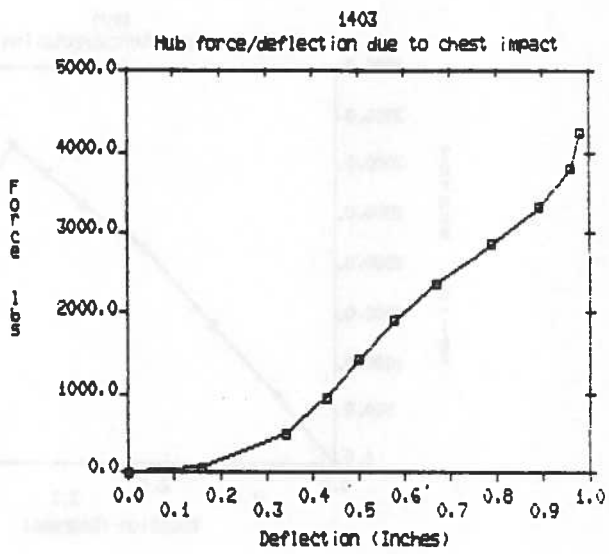

1403
Rim tangential force/defl due to shoulder
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0

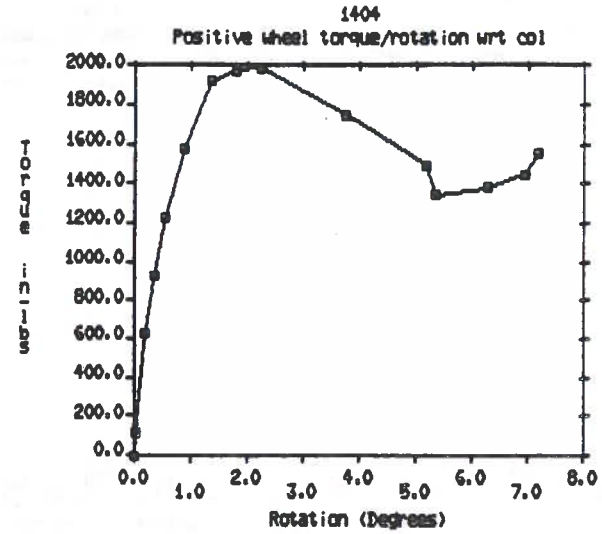

1403
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0

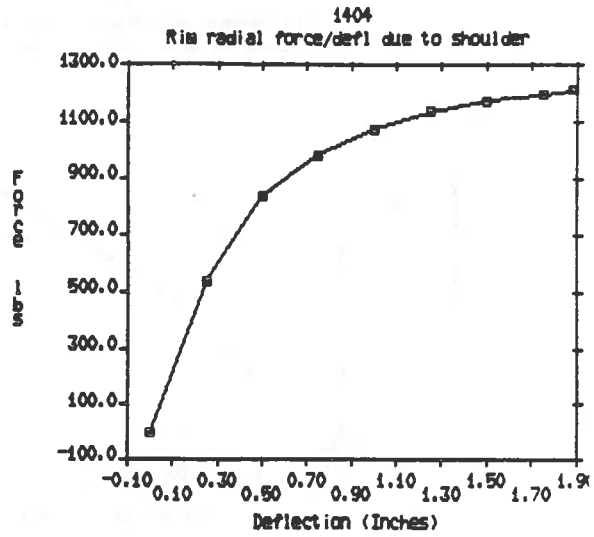

1403
Rim tangential force/defl due to abdomen
Force lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20 2.40
Deflection (Inches)

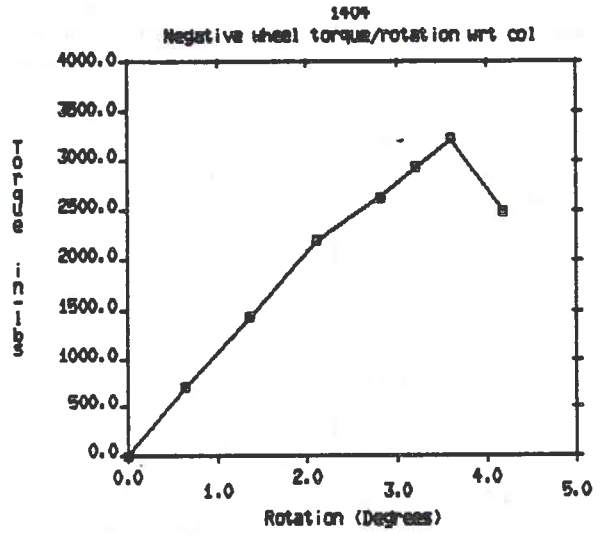

1403
Whole wheel crush force/deflection
Force lbs
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20
Deflection (Inches)

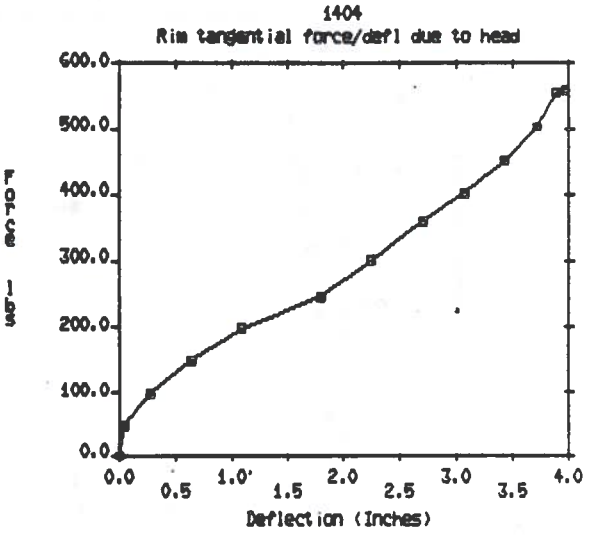

1403
Rim radial force/defl due to abdomen
Force lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0
Deflection (Inches)

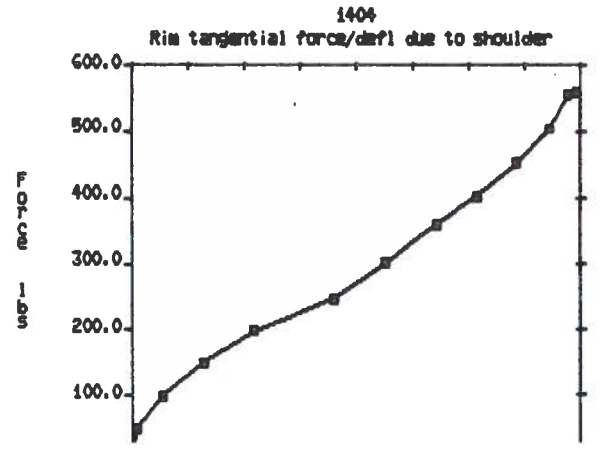

1403
Hub force/deflection due to chest impact
Force lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Deflection (Inches)

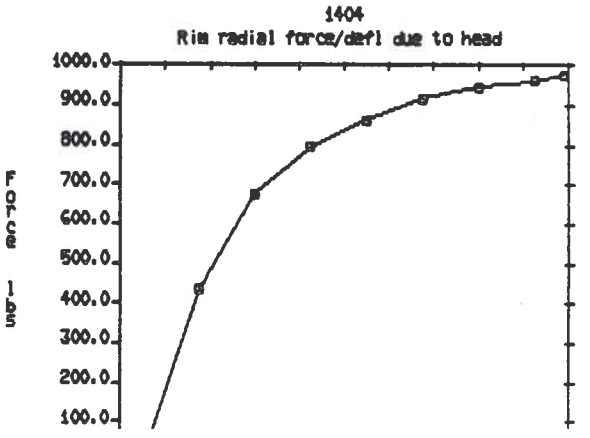

1404
Positive wheel torque/rotation wrt col
Torque - ins-lbs
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
Rotation (Degrees)

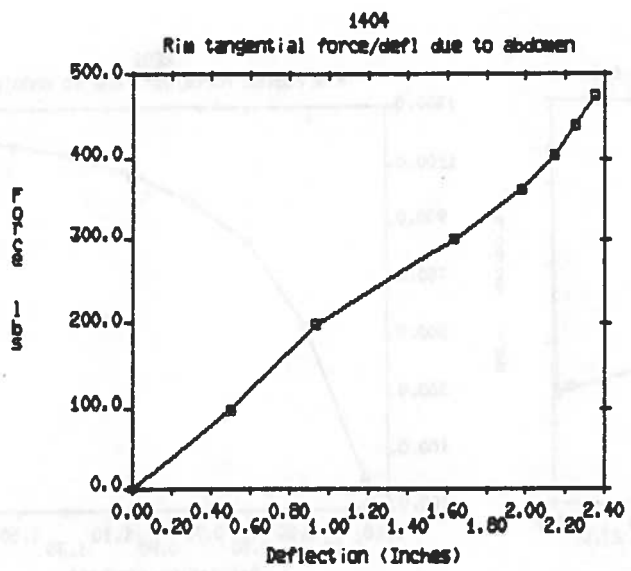

1404
Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

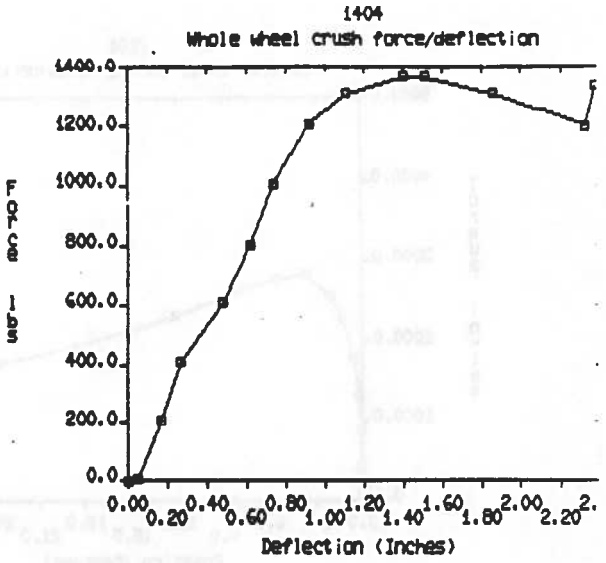

1404
Negative wheel torque/rotation wrt col
Torque - ins-lbs
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Rotation (Degrees)

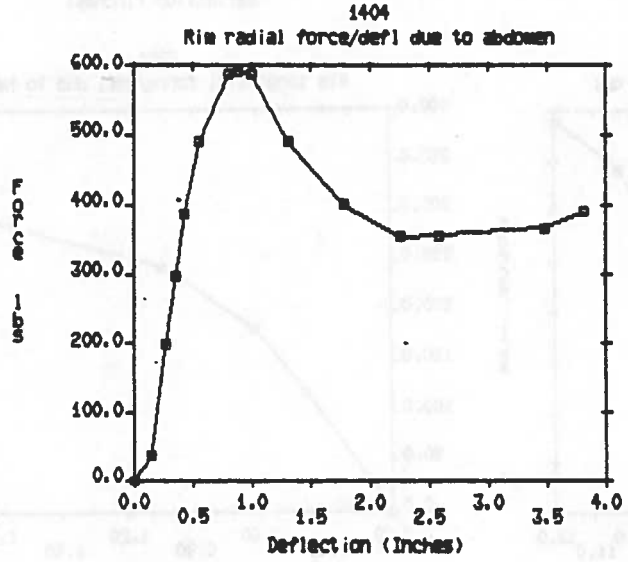

1404
Rim tangential force/defl due to head
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Deflection (Inches)

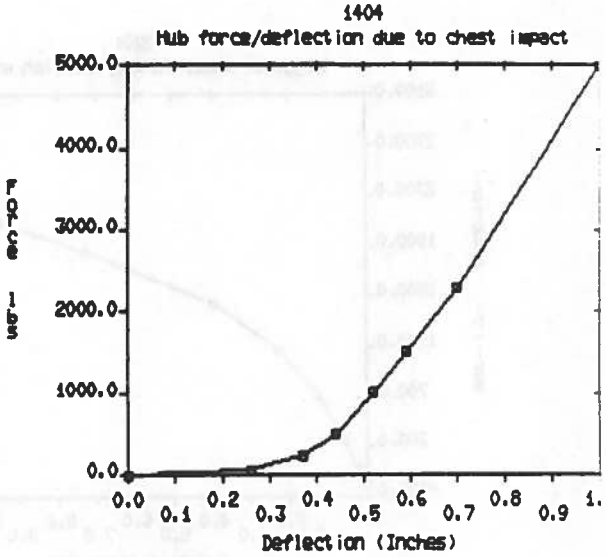

1404
Rim tangential force/defl due to shoulder
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0

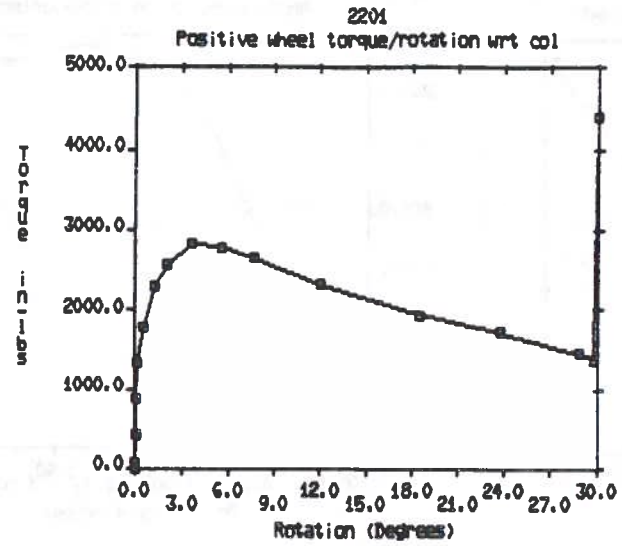

1404
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

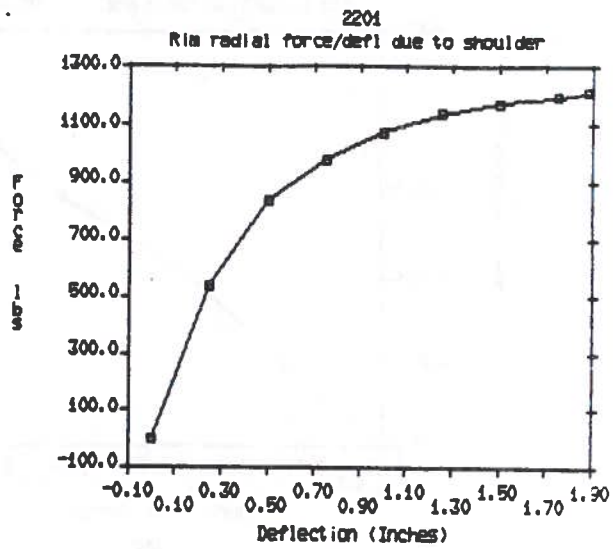

1404
Rim tangential force/defl due to abdomen
Force - lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20 2.40
Deflection (Inches)

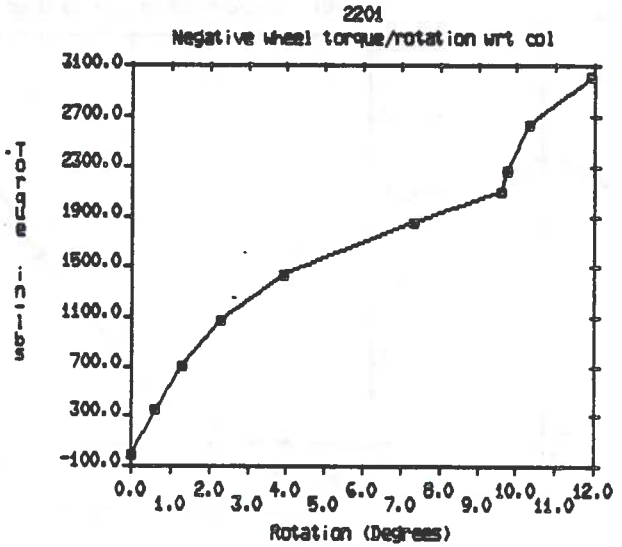

1404
Whole wheel crush force/deflection
Force - lbs
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20
Deflection (Inches)

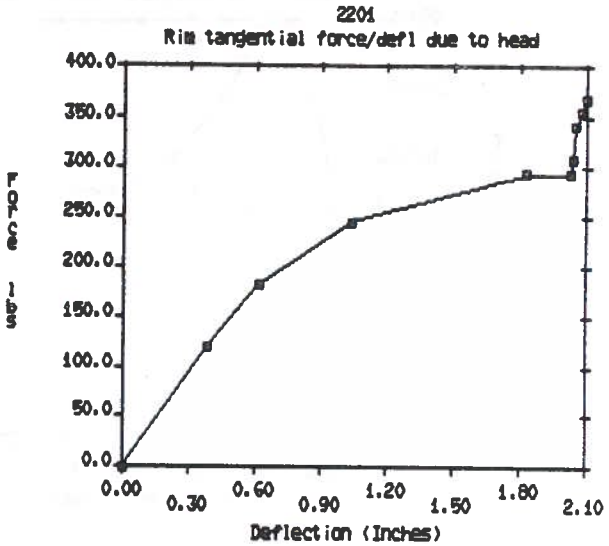

1404
Rim radial force/defl due to abdomen
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

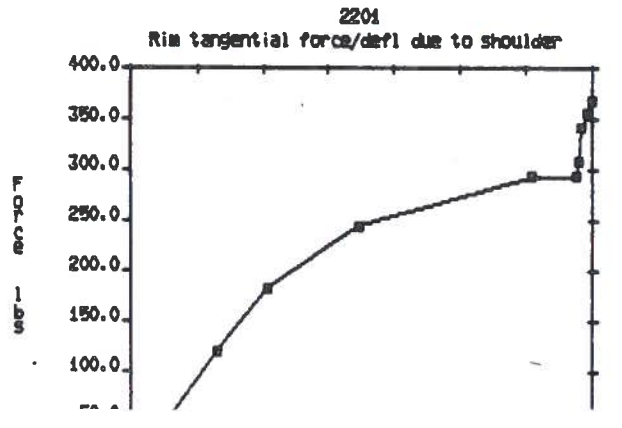

1404
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
Deflection (Inches)

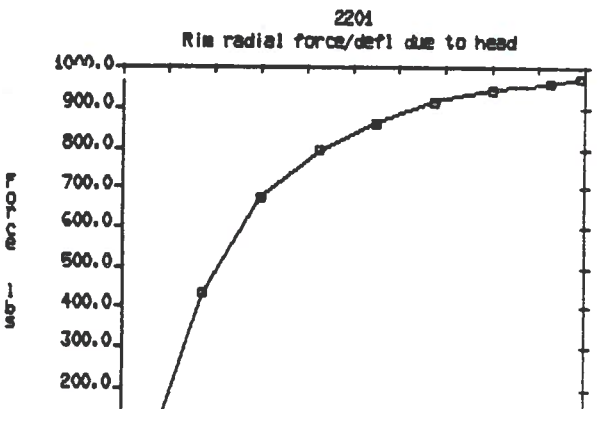

2201
Positive wheel torque/rotation wrt col
Torque - in-lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0 3.0 6.0 9.0 12.0 15.0 18.0 21.0 24.0 27.0 30.0
Rotation (Degrees)


2201
Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90
Deflection (Inches)


2201
Negative wheel torque/rotation wrt col
Torque - in-lbs
3100.0
2700.0
2300.0
1900.0
1500.0
1100.0
700.0
300.0
-100.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
Rotation (Degrees)

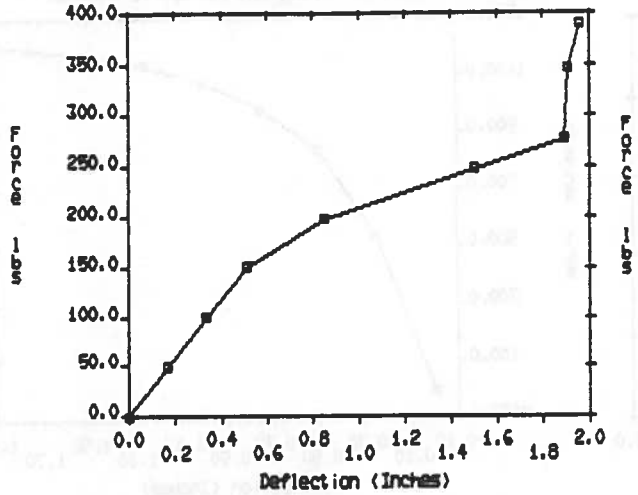

2201
Rim tangential force/defl due to head
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00 0.30 0.60 0.90 1.20 1.50 1.80 2.10
Deflection (Inches)


2201
Rim tangential force/defl due to shoulder
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0

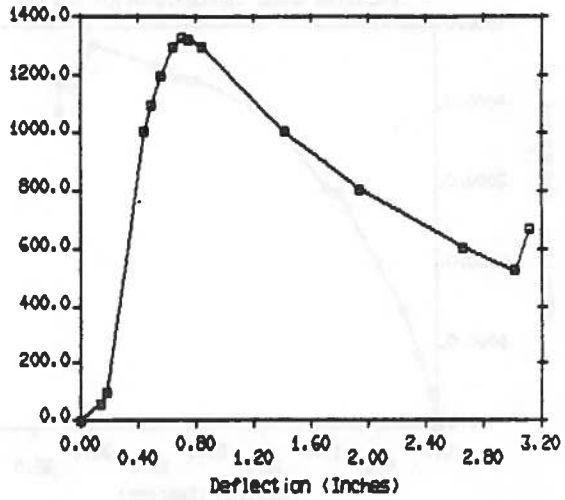

2201
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0

2201

Rim tangential force/defl due to abdomen

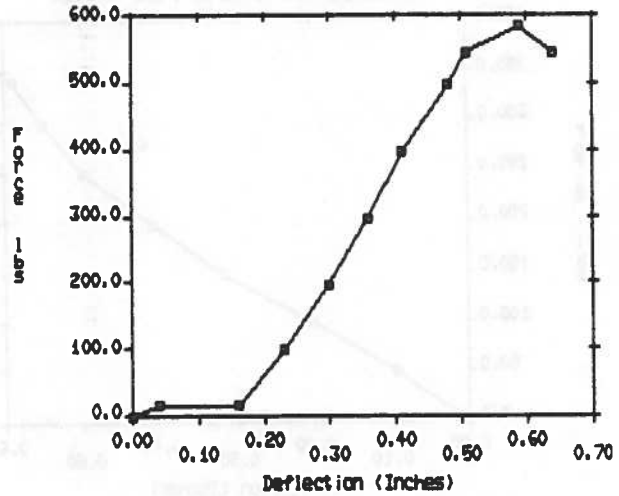


Whole wheel crush force/deflection



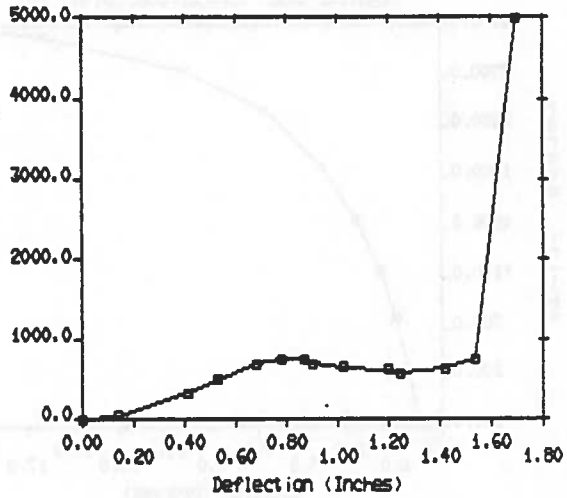
2201

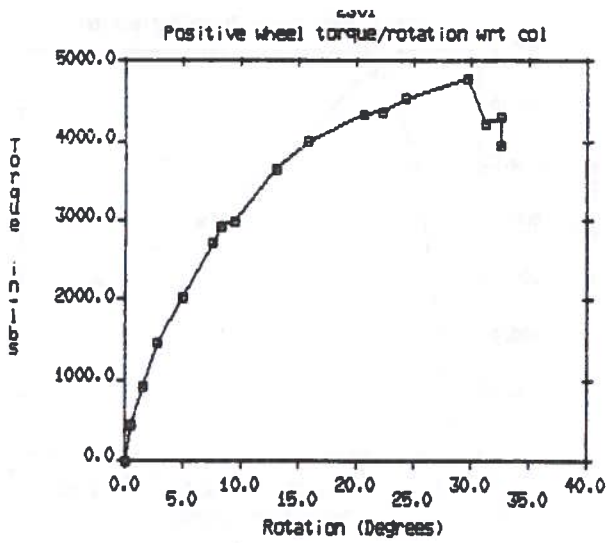
Rim radial force/defl due to abdomen

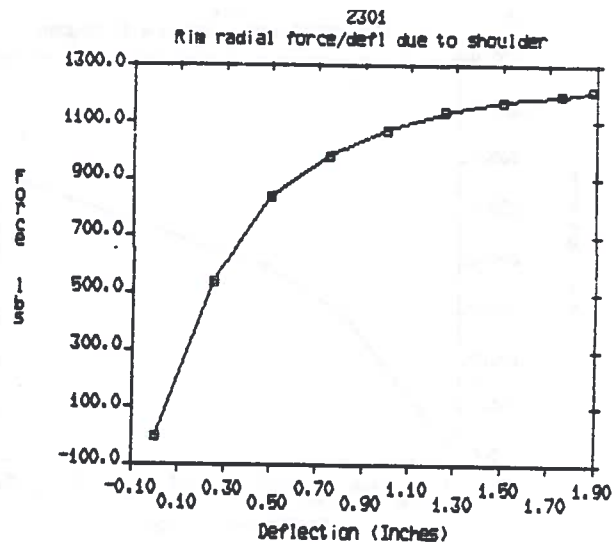


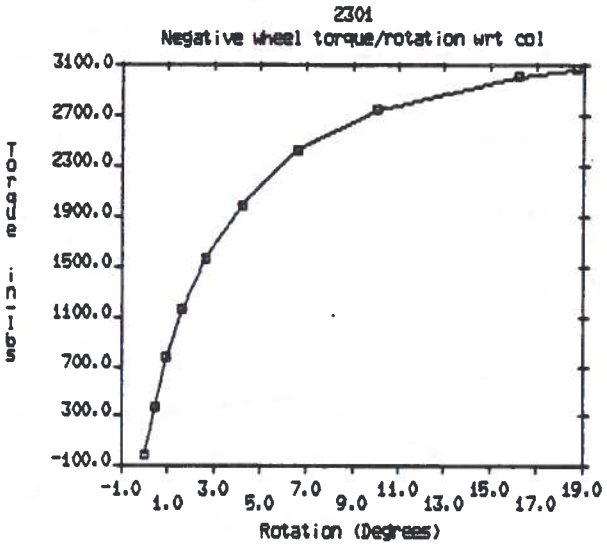
2201

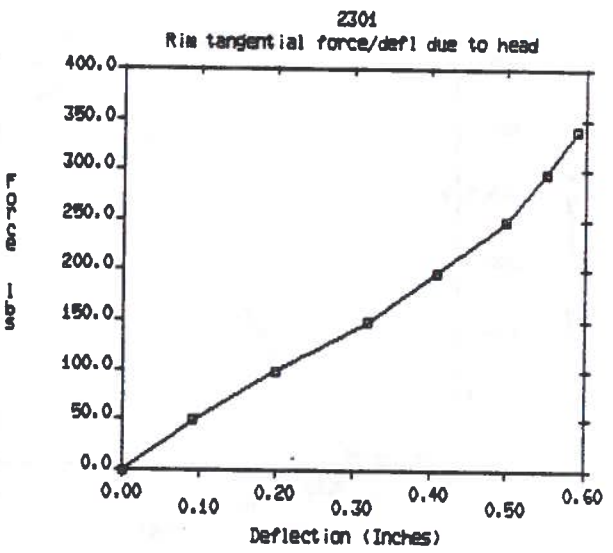
Hub force/deflection due to chest impact

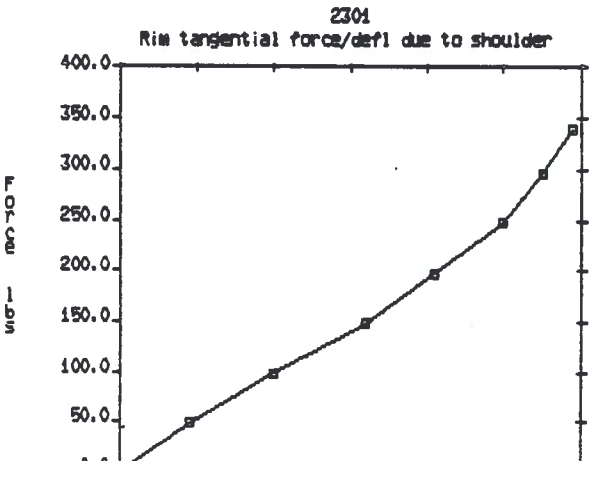


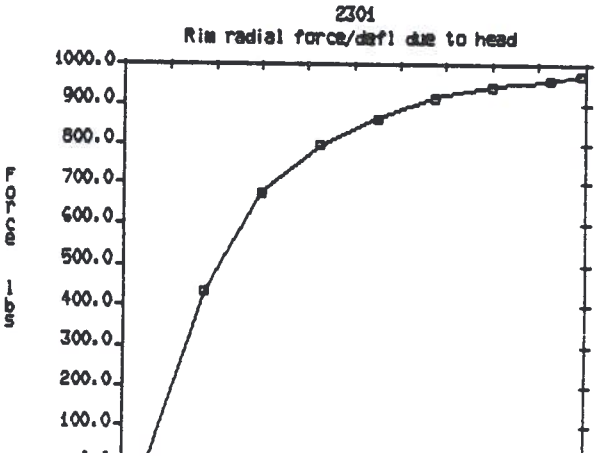

Z301
Positive wheel torque/rotation wrt col
Torque - in-lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Rotation (Degrees)

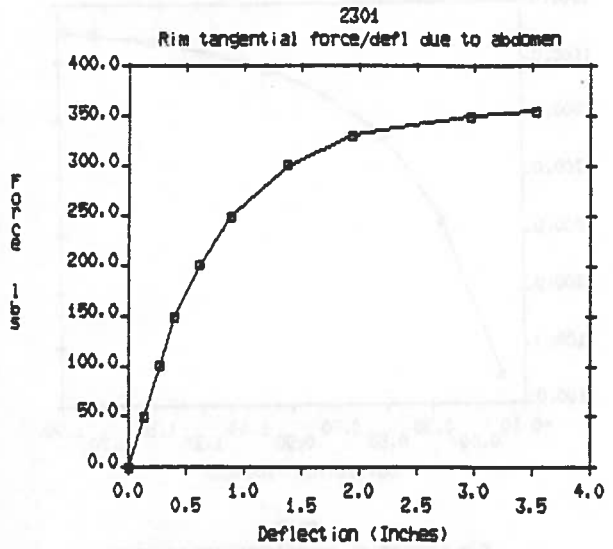

Z301
Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

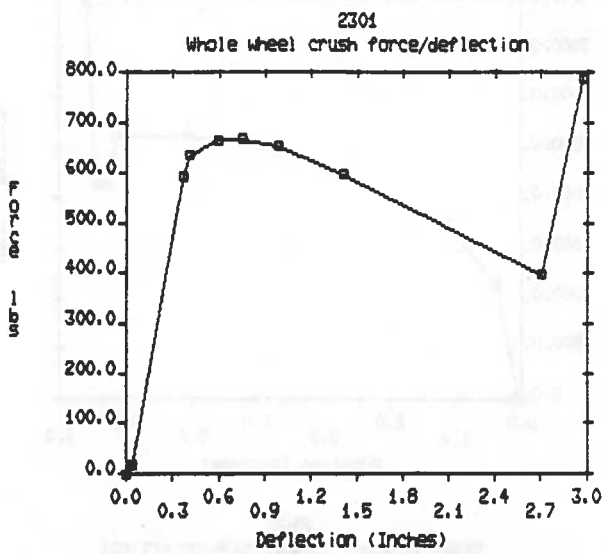

Z301
Negative wheel torque/rotation wrt col
Torque - in-lbs
3100.0
2700.0
2300.0
1900.0
1500.0
1100.0
700.0
300.0
-100.0
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
17.0
19.0
Rotation (Degrees)

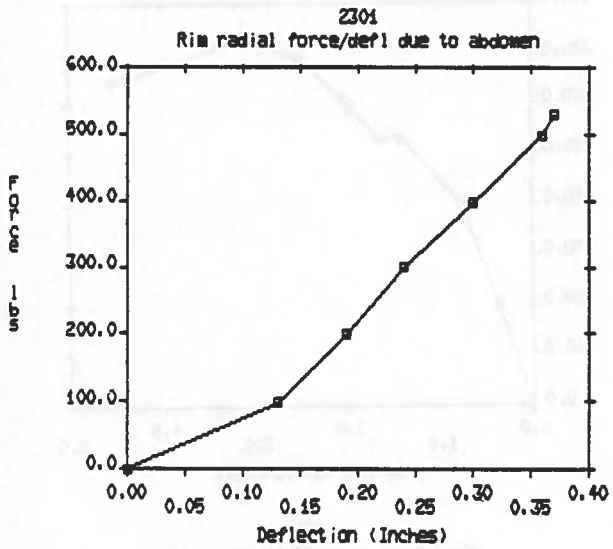

Z301
Rim tangential force/defl due to head
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Deflection (Inches)

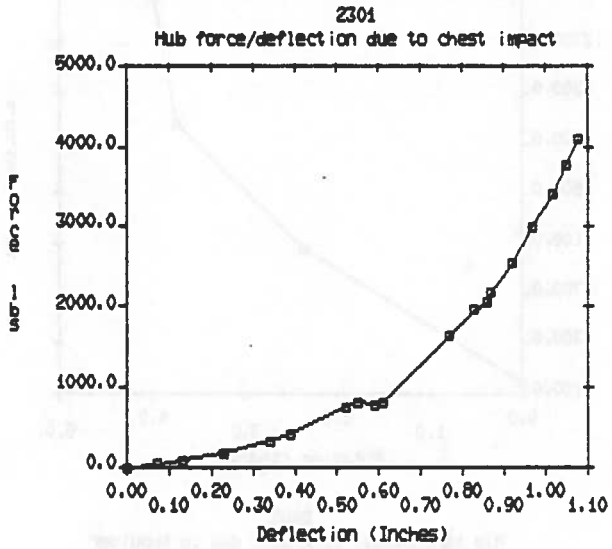

Z301
Rim tangential force/defl due to shoulder
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0

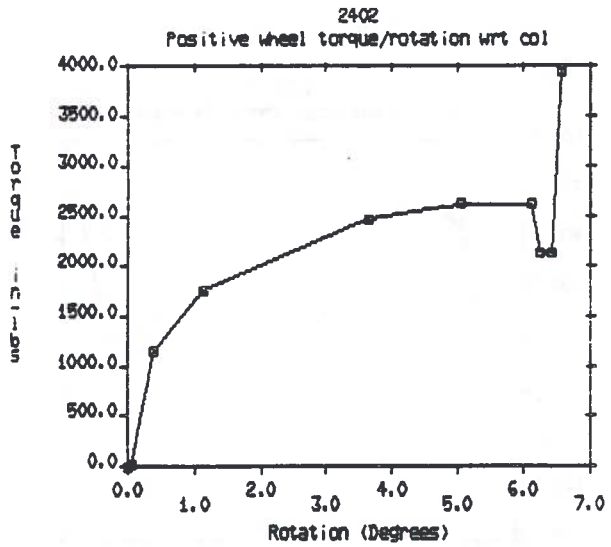

Z301
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

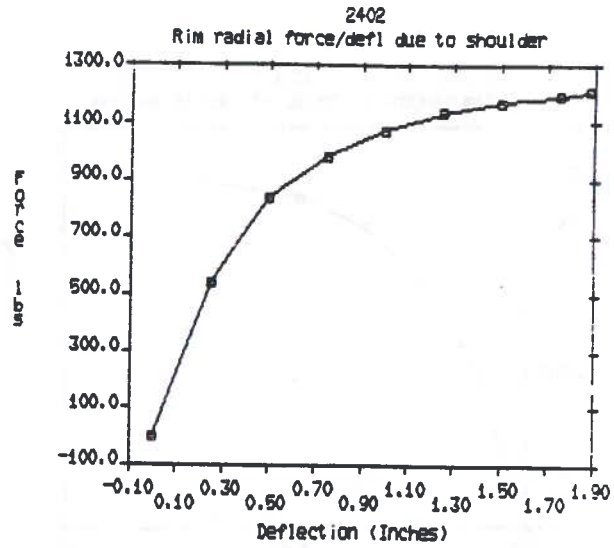

2301
Rim tangential force/defl due to abdomen
Force lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

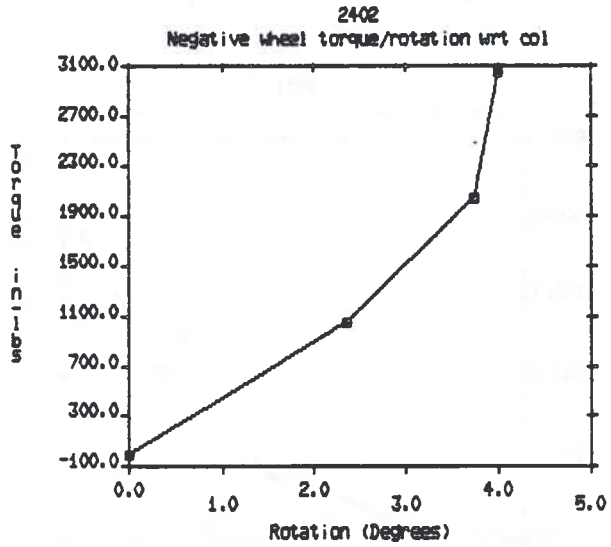

2301
Whole wheel crush force/deflection
Force lbs
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.3 0.6 0.9 1.2 1.5 1.8 2.1 2.4 2.7 3.0
Deflection (Inches)

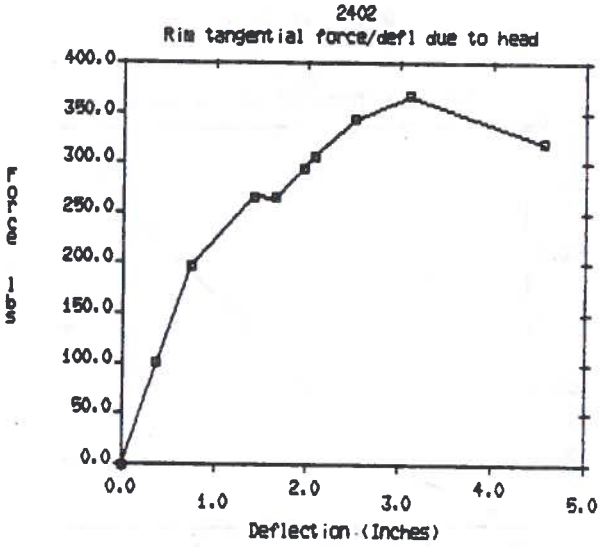

2301
Rim radial force/defl due to abdomen
Force lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40
Deflection (Inches)

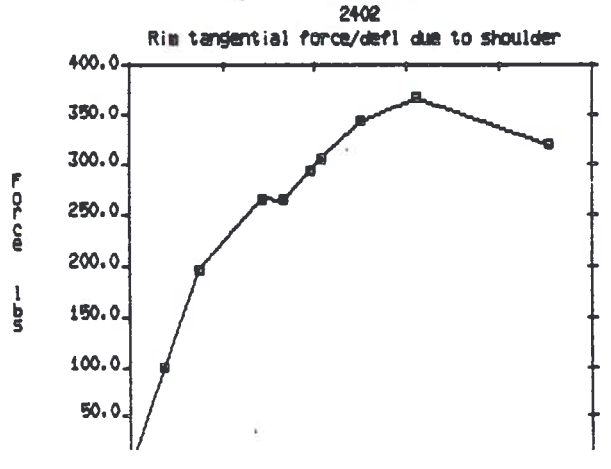

2301
Hub force/deflection due to chest impact
Force lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00 1.10
Deflection (Inches)

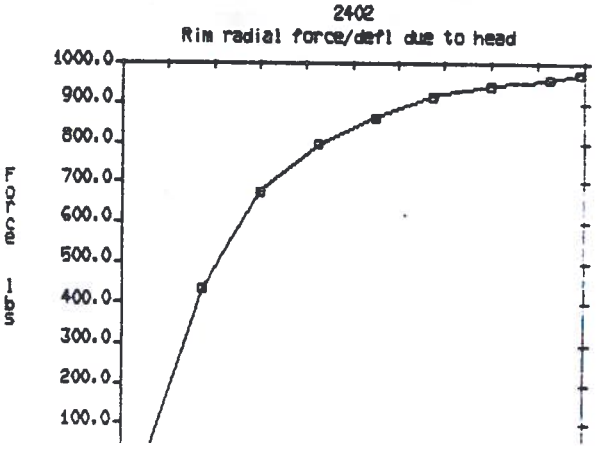

2402
Positive wheel torque/rotation wrt col
Torque - in-lbs
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Rotation (Degrees)

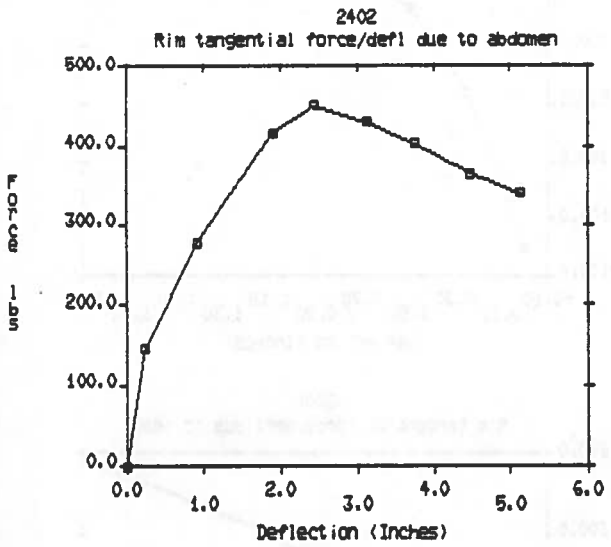

2402
Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

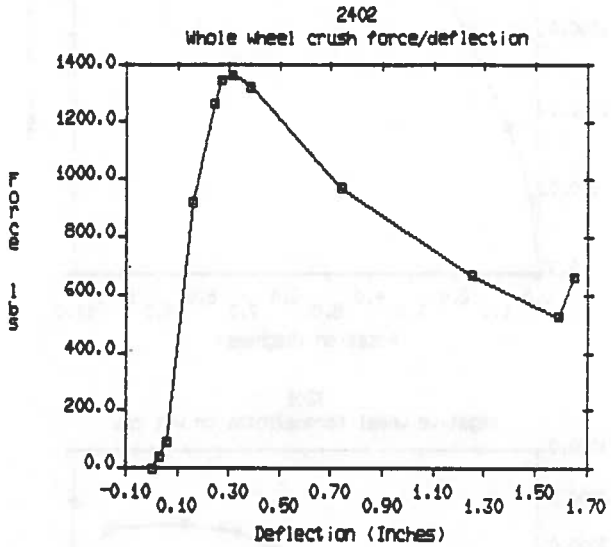

2402
Negative wheel torque/rotation wrt col
Torque - in-lbs
3100.0
2700.0
2300.0
1900.0
1500.0
1100.0
700.0
300.0
-100.0
0.0
1.0
2.0
3.0
4.0
5.0
Rotation (Degrees)

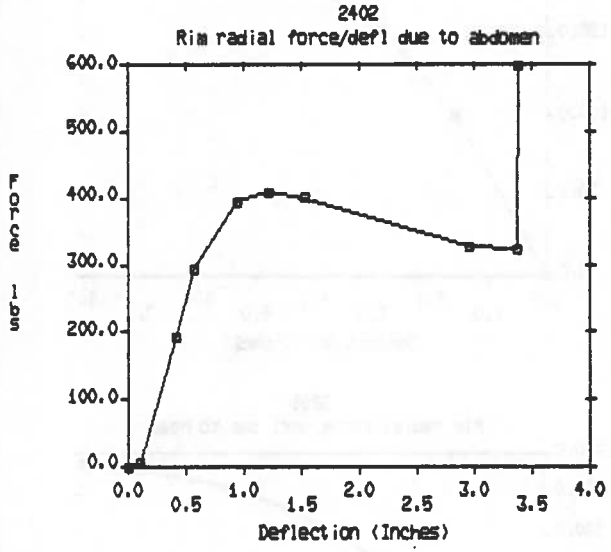

2402
Rim tangential force/defl due to head
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

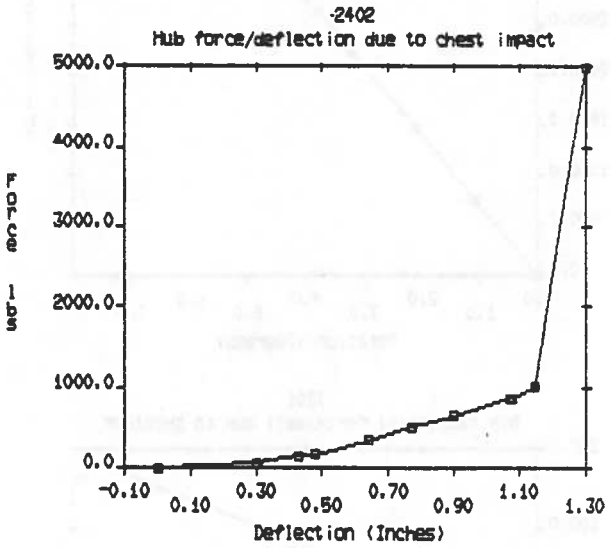

2402
Rim tangential force/defl due to shoulder
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0

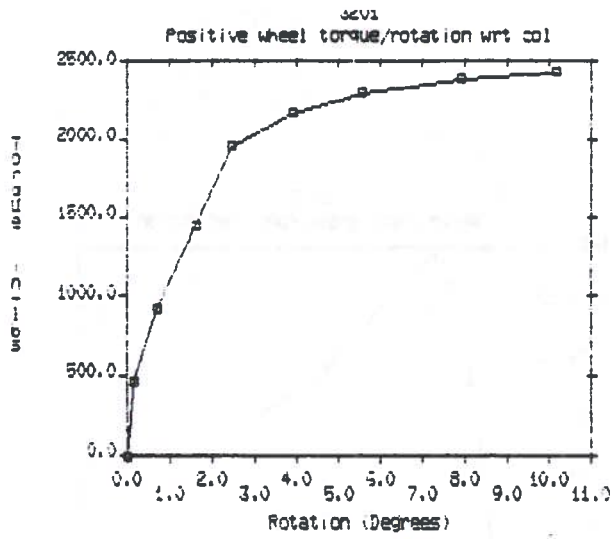

2402
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

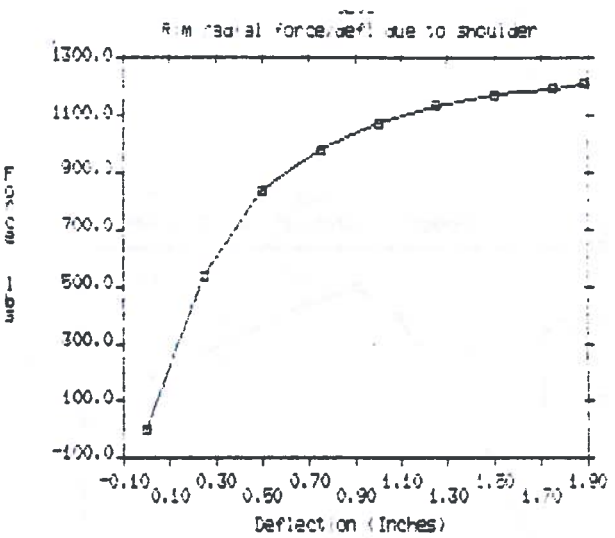

2402
Rim tangential force/defl due to abdomen
Force lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Deflection (Inches)

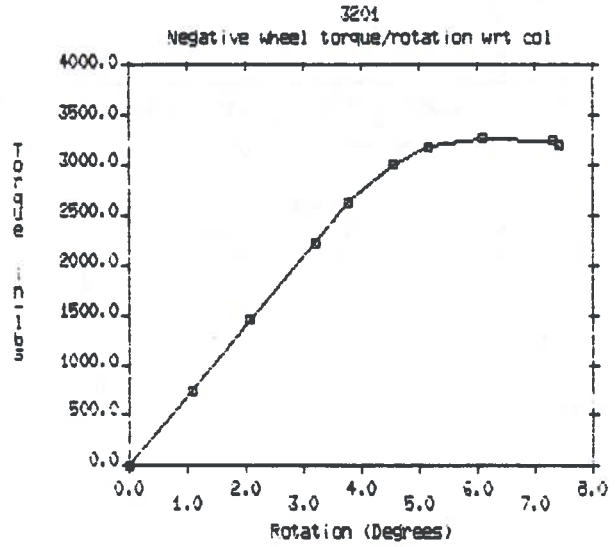

2402
Whole wheel crush force/deflection
Force lbs
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

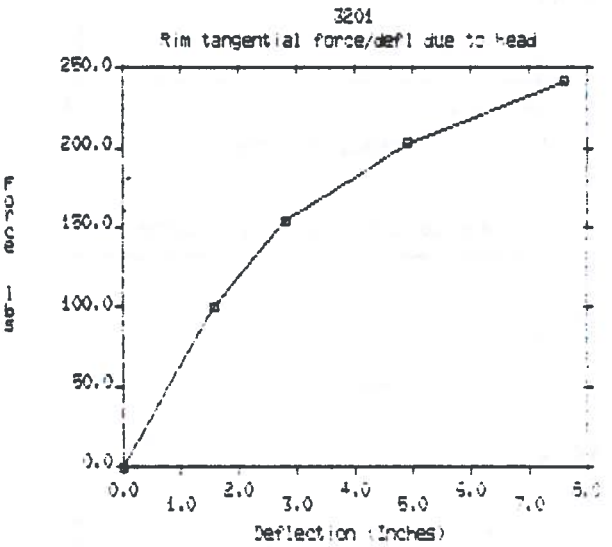

2402
Rim radial force/defl due to abdomen
Force lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Deflection (Inches)

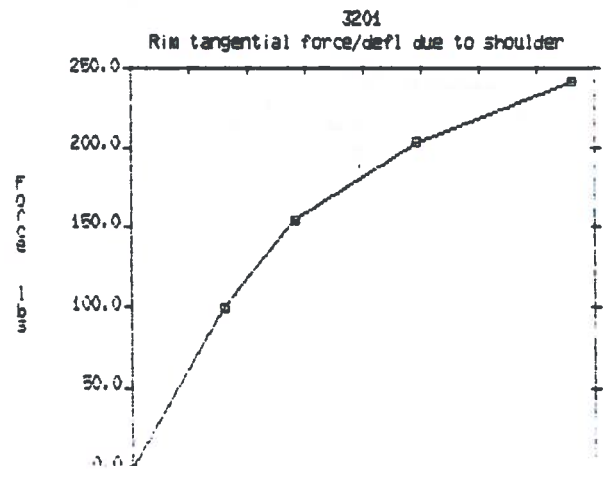

2402
Hub force/deflection due to chest impact
Force lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

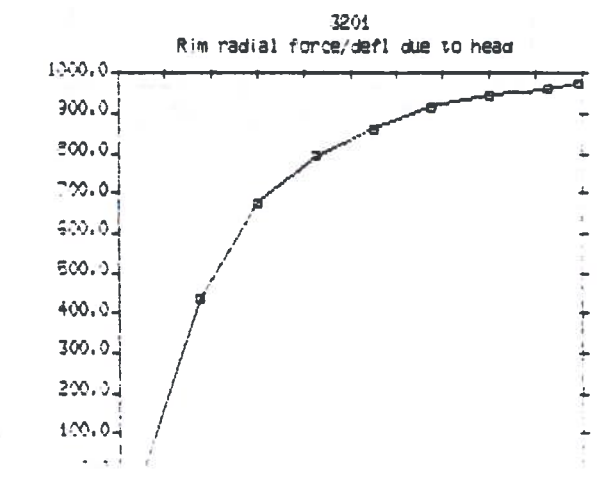

3201
Positive wheel torque/rotation wrt col
Torque - in-lbs
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0
Rotation (Degrees)

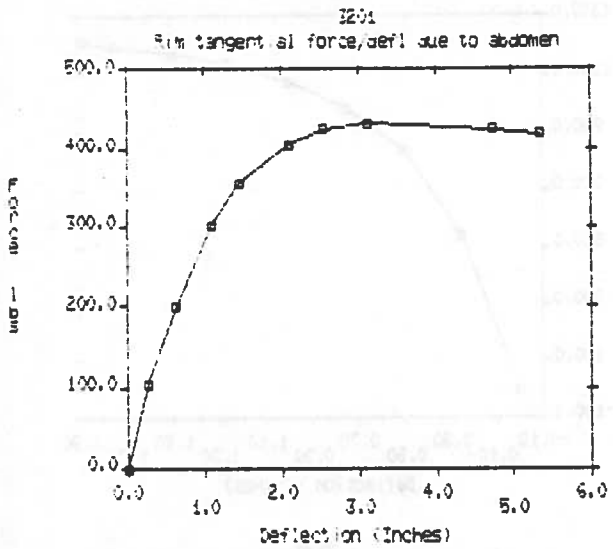

Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90
Deflection (Inches)

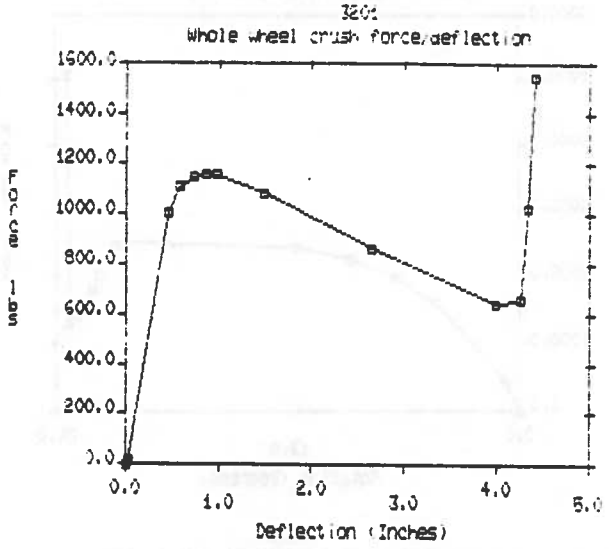

3201
Negative wheel torque/rotation wrt col
Torque - in-lbs
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
Rotation (Degrees)

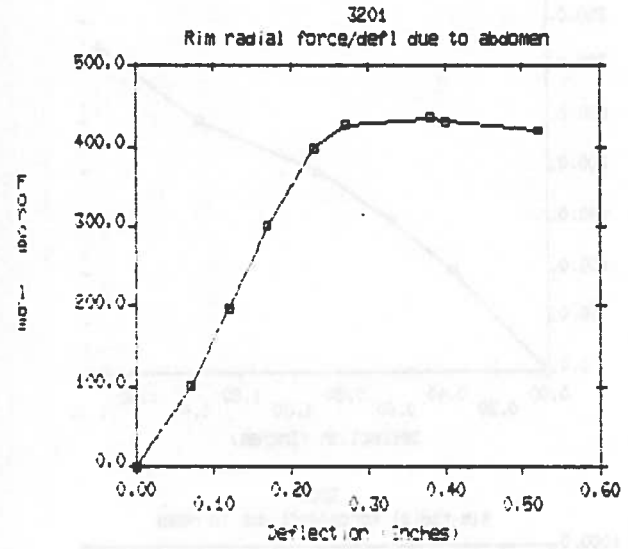

3201
Rim tangential force/defl due to head
Force - lbs
250.0
200.0
150.0
100.0
50.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0
Deflection (Inches)

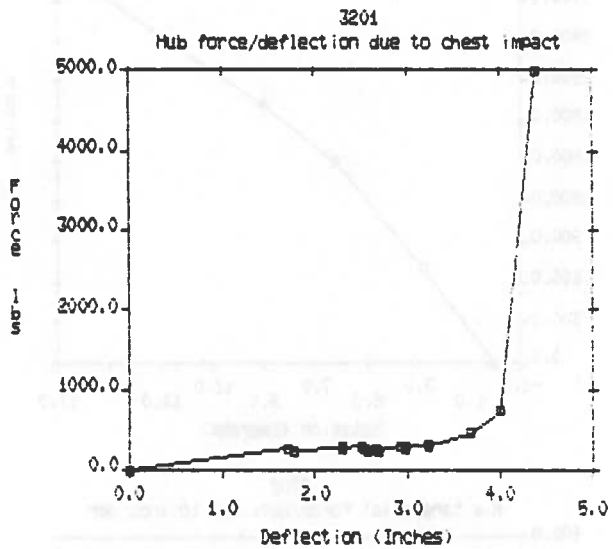

3201
Rim tangential force/defl due to shoulder
Force - lbs
250.0
200.0
150.0
100.0
50.0
0.0

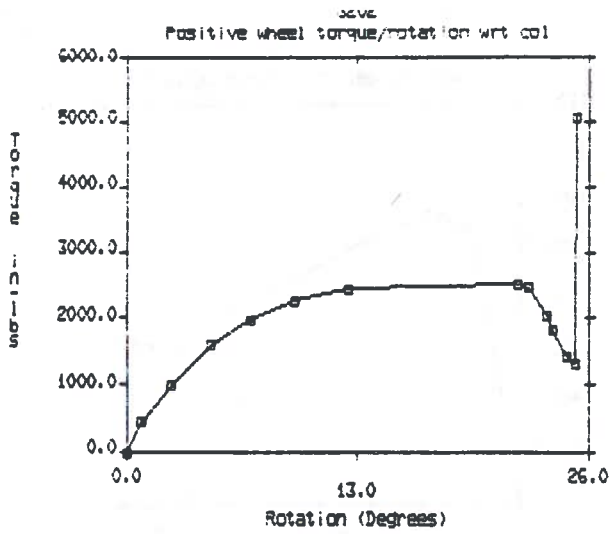

3201
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

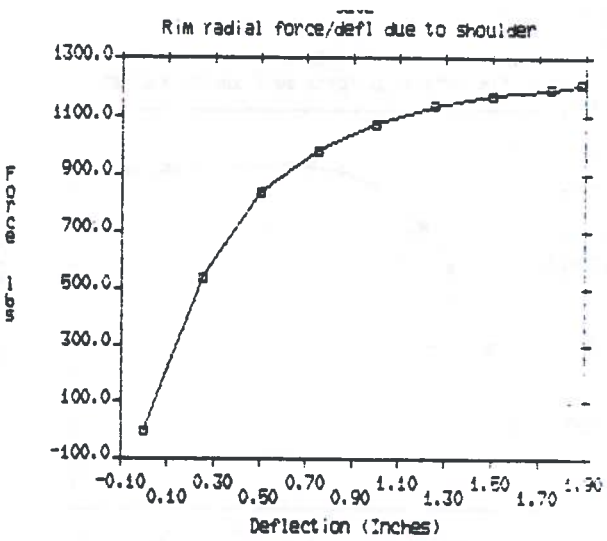

3201
Rim tangential force/defl due to abdomen
Force - lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Deflection (Inches)

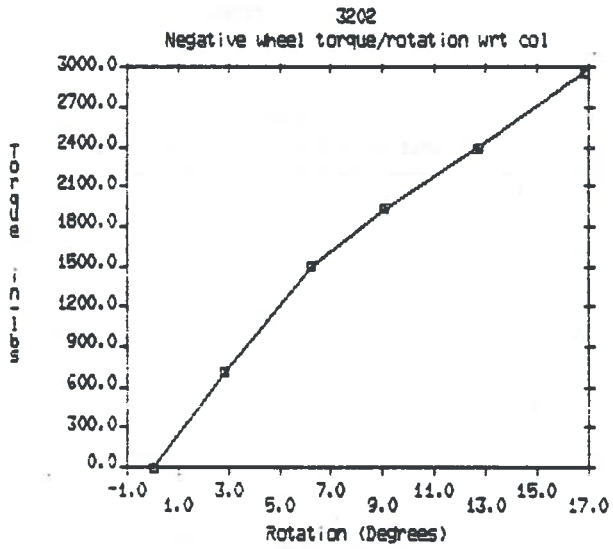

3201
Whole wheel crush force/deflection
Force - lbs
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

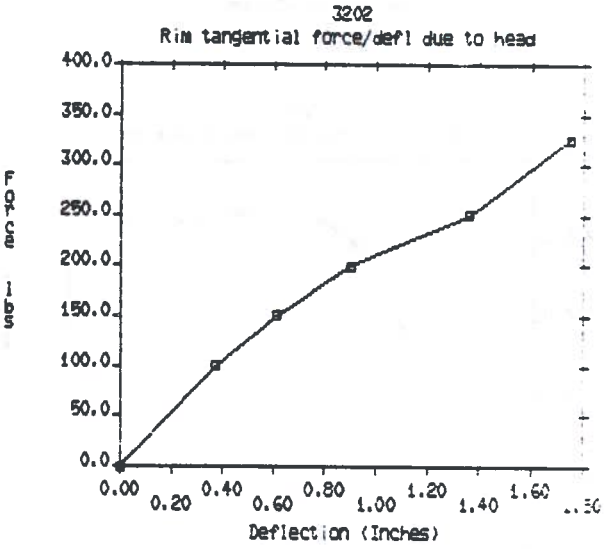

3201
Rim radial force/defl due to abdomen
Force - lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Deflection (Inches)

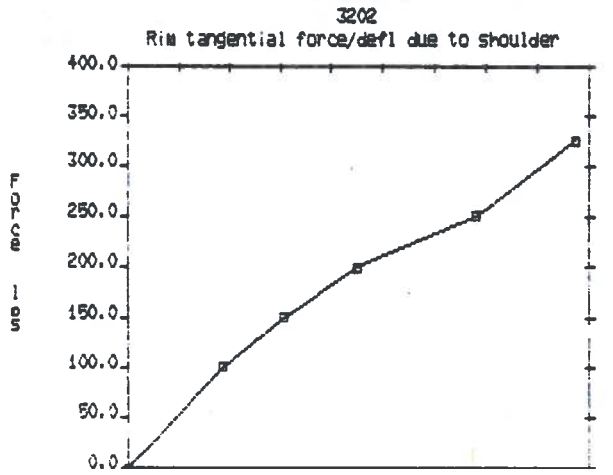

3201
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

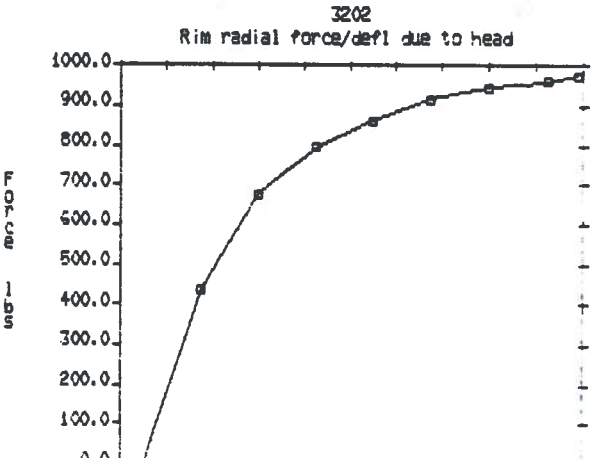

3202
Positive wheel torque/rotation wrt col
Torque - in-lbs
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
13.0
26.0
Rotation (Degrees)

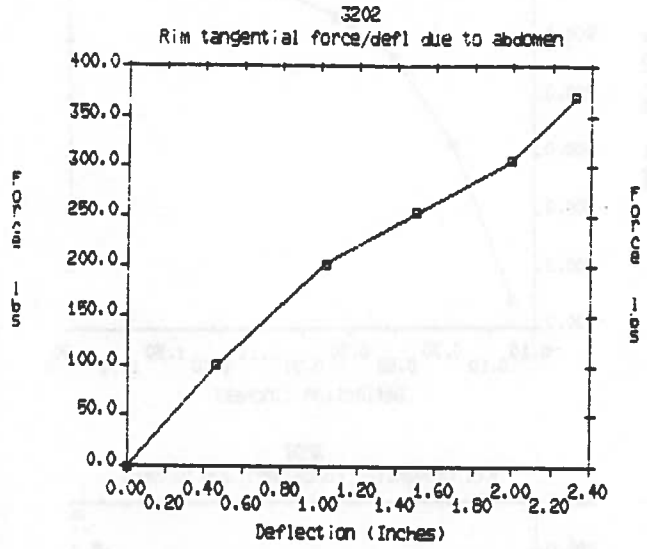

Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

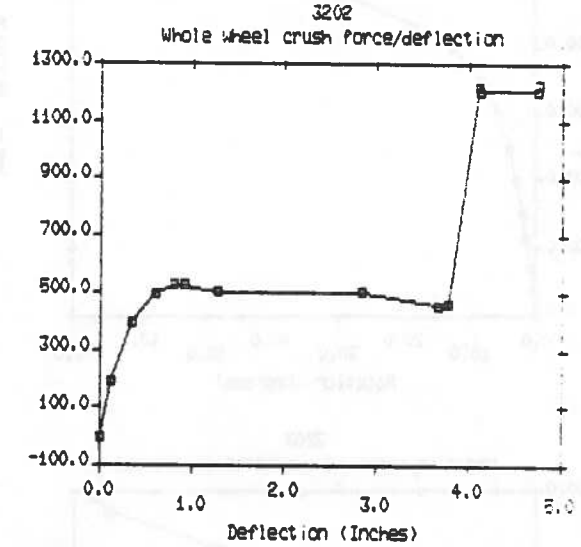

3202
Negative wheel torque/rotation wrt col
Torque - in-lbs
3000.0
2700.0
2400.0
2100.0
1800.0
1500.0
1200.0
900.0
600.0
300.0
0.0
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
17.0
Rotation (Degrees)

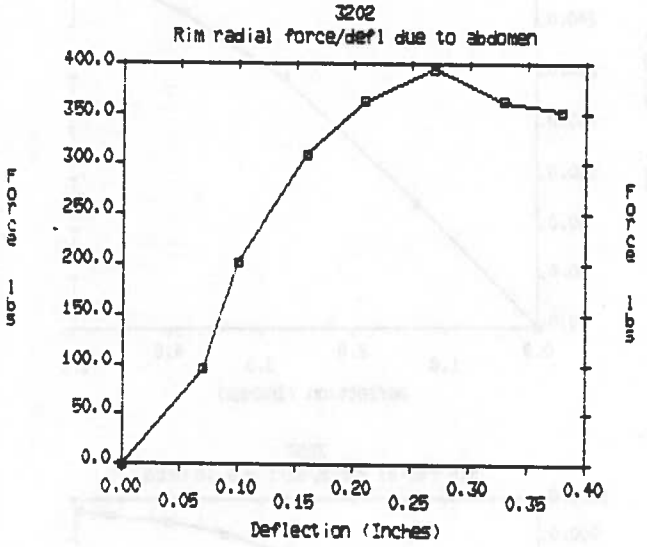

3202
Rim tangential force/defl due to head
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Deflection (Inches)

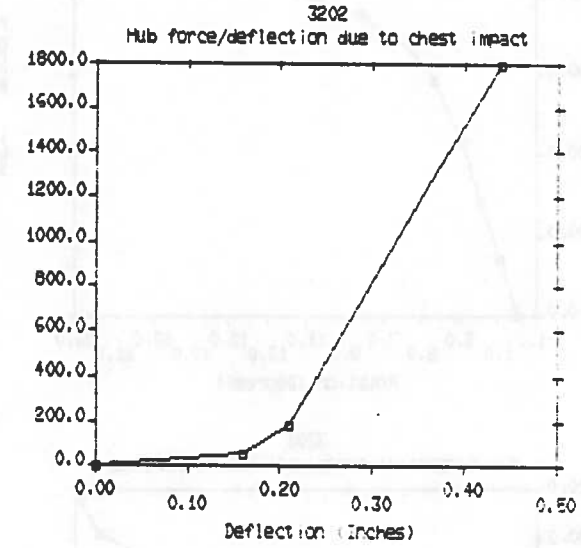

3202
Rim tangential force/defl due to shoulder
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0

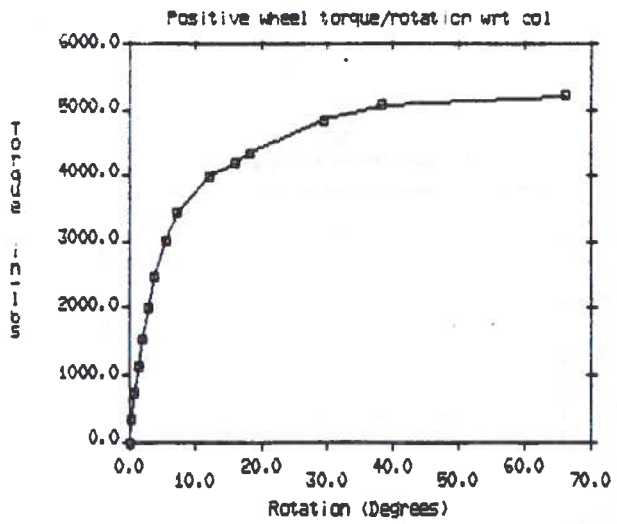

3202
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

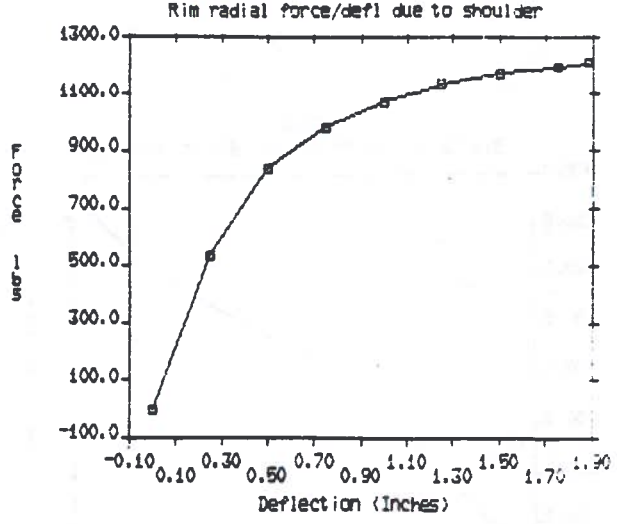

3202
Rim tangential force/defl due to abdomen
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20 2.40
Deflection (Inches)

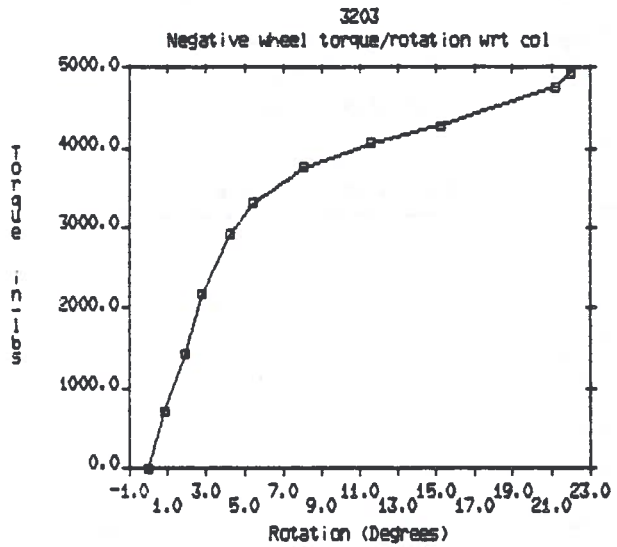

3202
Whole wheel crush force/deflection
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0 1.0 2.0 3.0 4.0 5.0
Deflection (Inches)

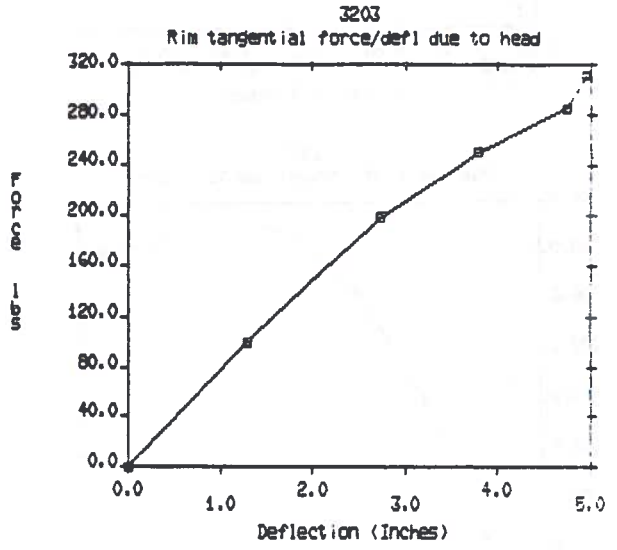

3202
Rim radial force/defl due to abdomen
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40
Deflection (Inches)

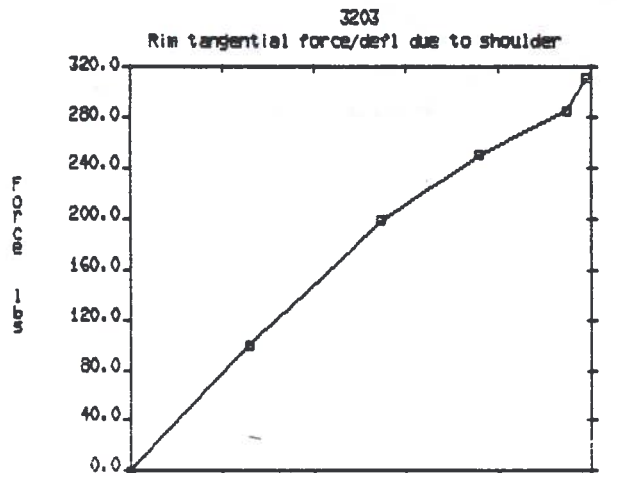

3202
Hub force/deflection due to chest impact
Force - lbs
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.00 0.10 0.20 0.30 0.40 0.50
Deflection (Inches)

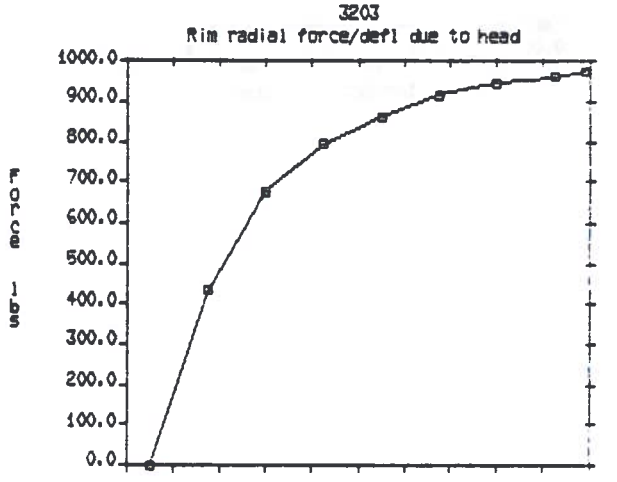

Positive wheel torque/rotation wrt col
Torque - in-lbs
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Rotation (Degrees)

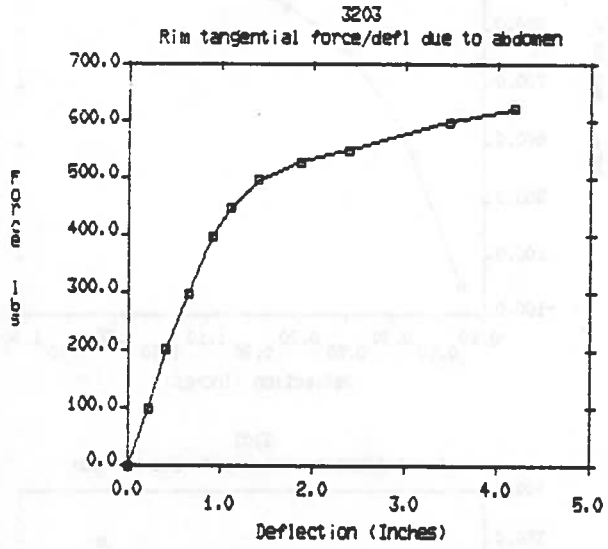

Rim radial force/defl due to shoulder
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

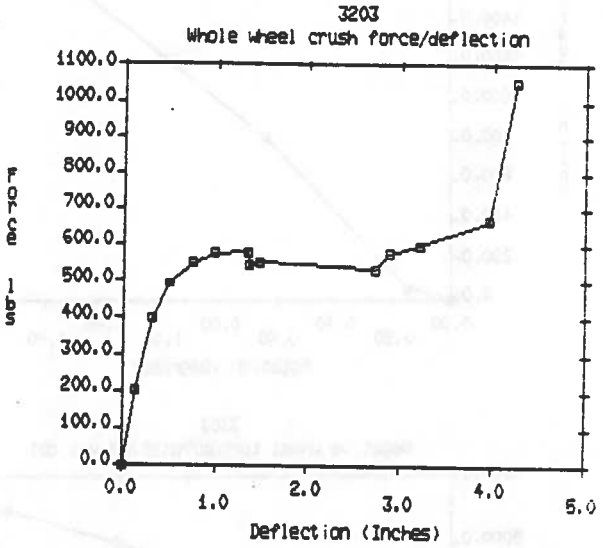

3203
Negative wheel torque/rotation wrt col
Torque - in-lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
17.0
19.0
21.0
23.0
Rotation (Degrees)

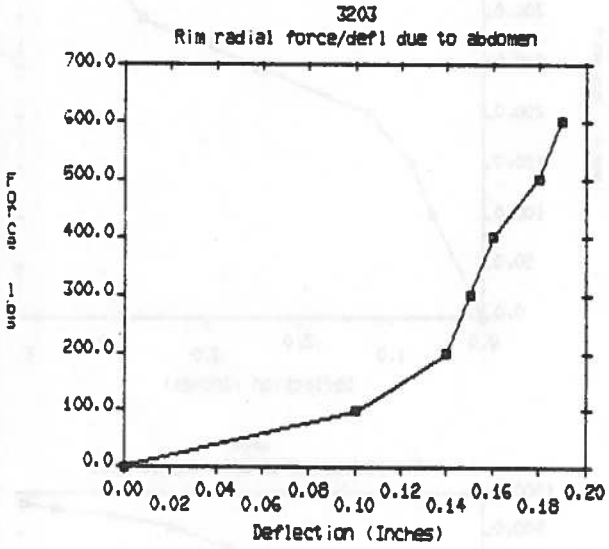

3203
Rim tangential force/defl due to head
Force - lbs
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

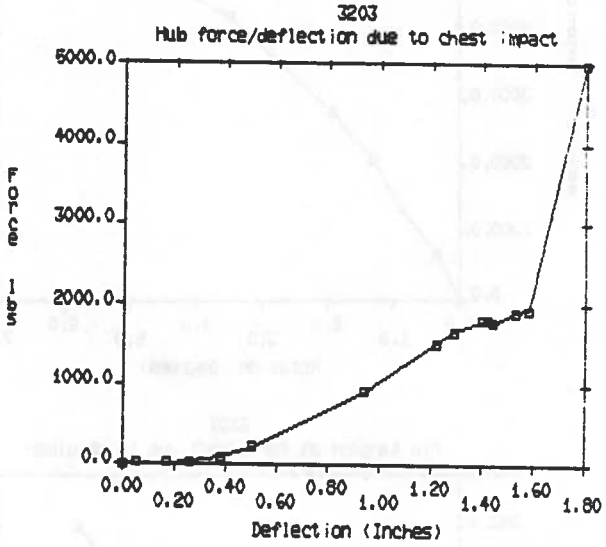

3203
Rim tangential force/defl due to shoulder
Force - lbs
320.0
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0

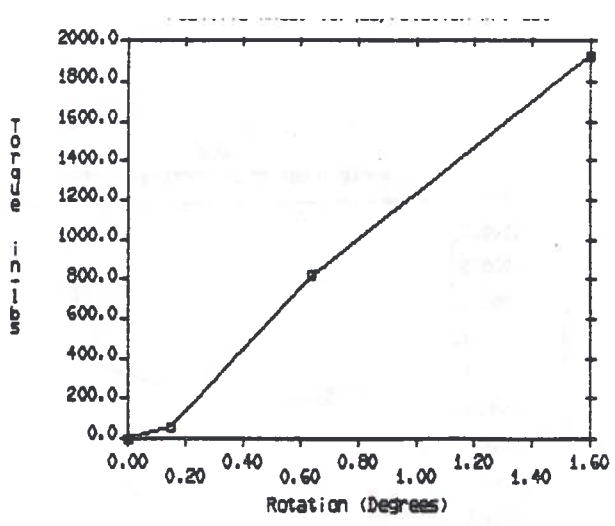

3203
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

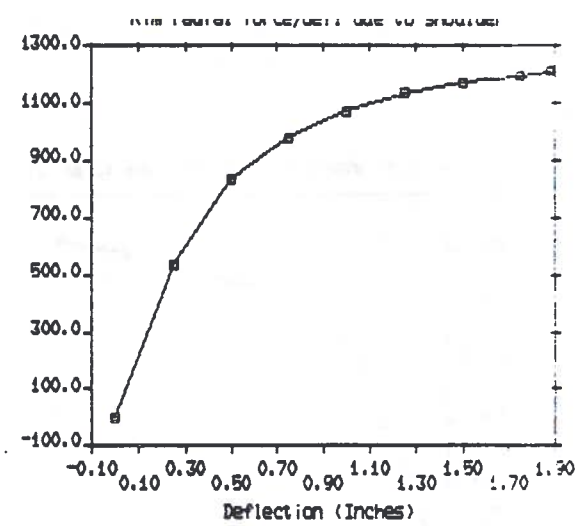

3203
Rim tangential force/defl due to abdomen
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

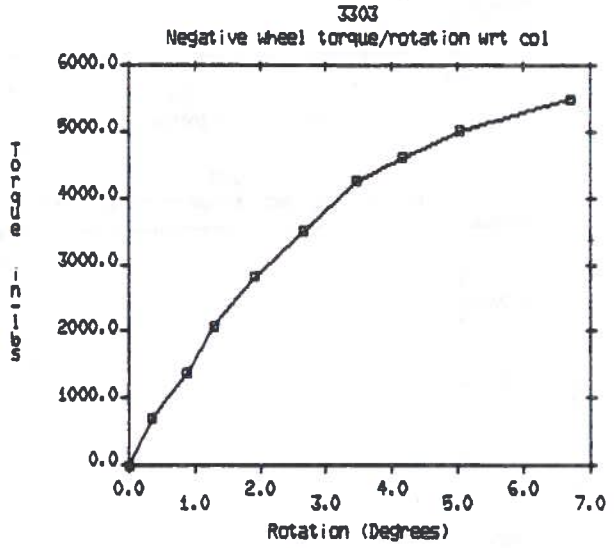

3203
Whole wheel crush force/deflection
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

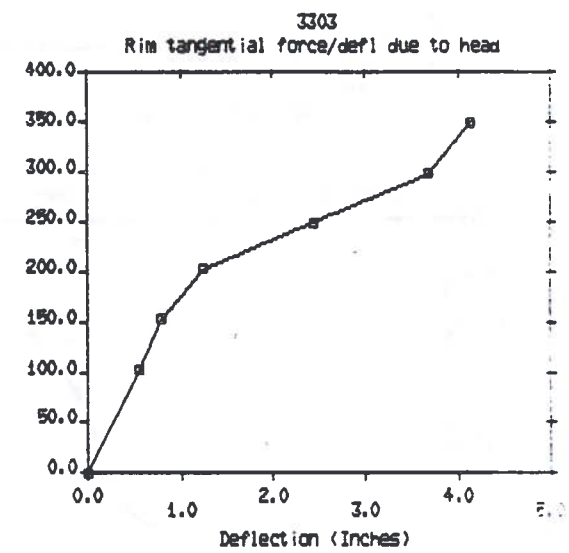

3203
Rim radial force/defl due to abdomen
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Force - lbs
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Deflection (Inches)

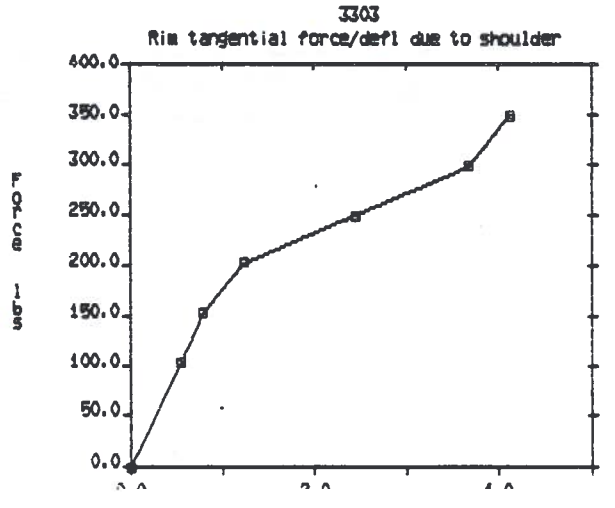

3203
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
Force - lbs
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
Deflection (Inches)

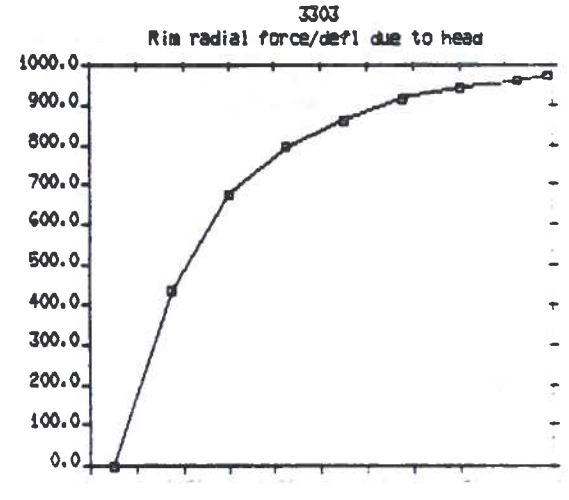

Torque - ins-lbs
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Rotation (Degrees)

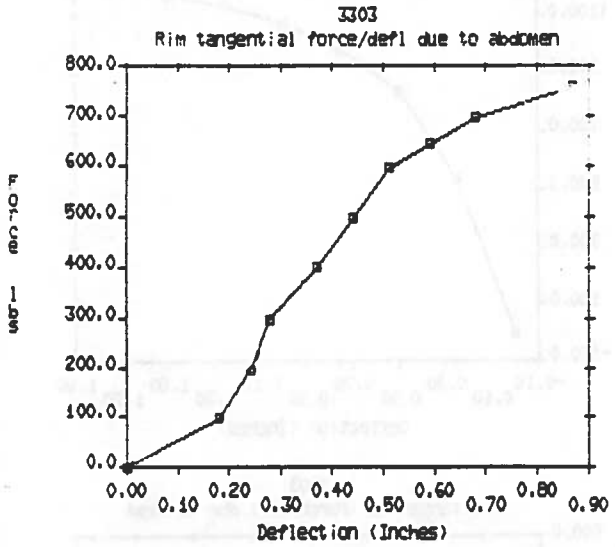

Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

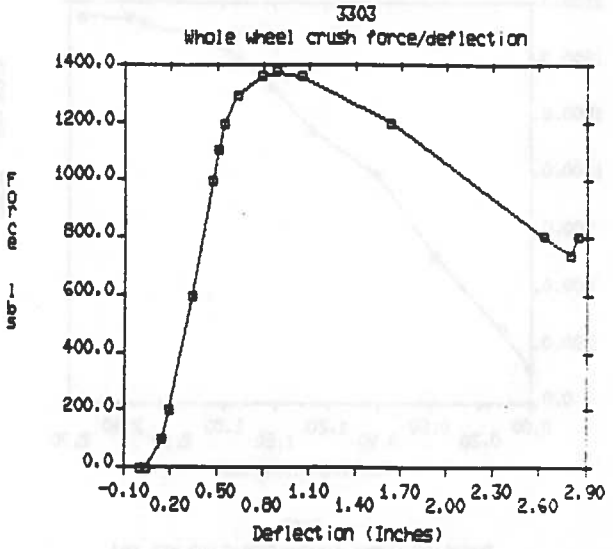

3303
Negative wheel torque/rotation wrt col
Torque - ins-lbs
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Rotation (Degrees)

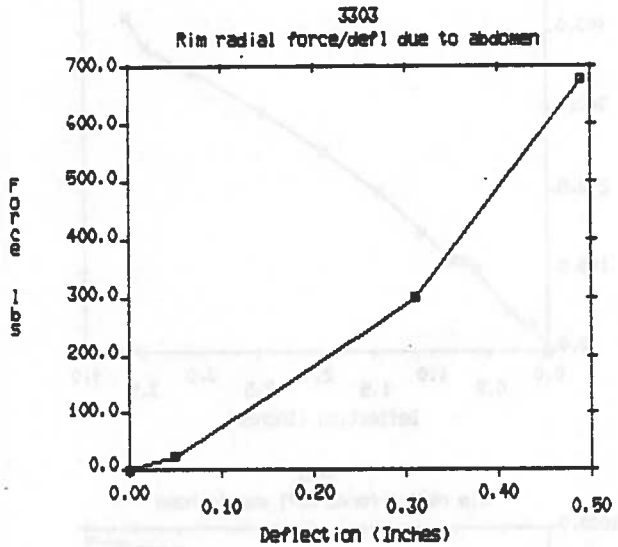

3303
Rim tangential force/defl due to head
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.0
1.0
2.0
3.0
4.0
Deflection (Inches)

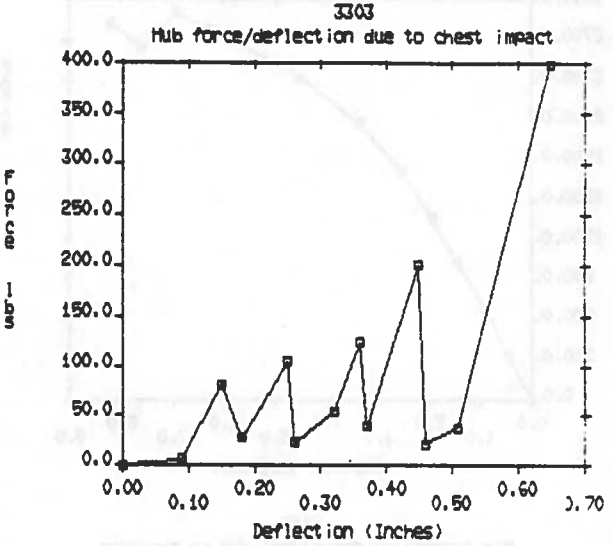

3303
Rim tangential force/defl due to shoulder
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0

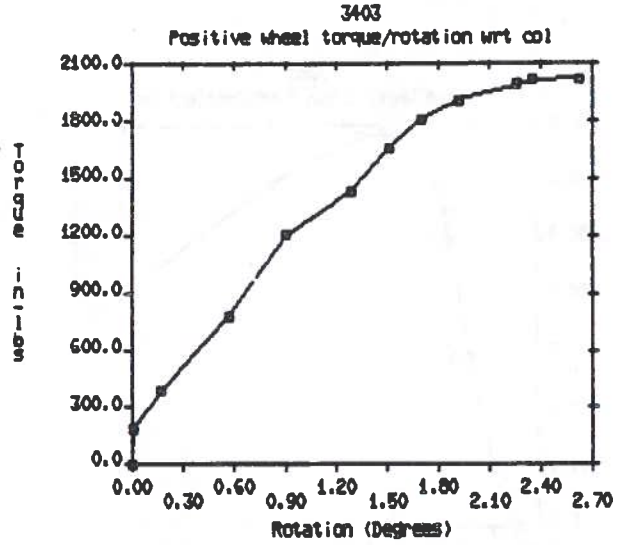

3303
Rim radial force/defl due to head
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

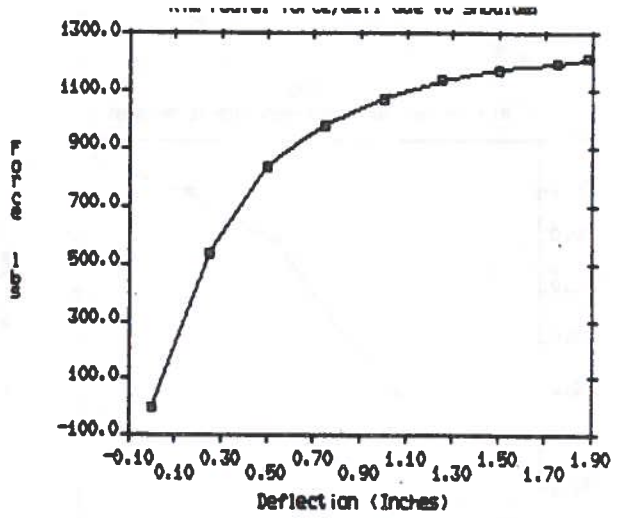

3303
Rim tangential force/defl due to abdomen
Force - lbs
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Deflection (Inches)

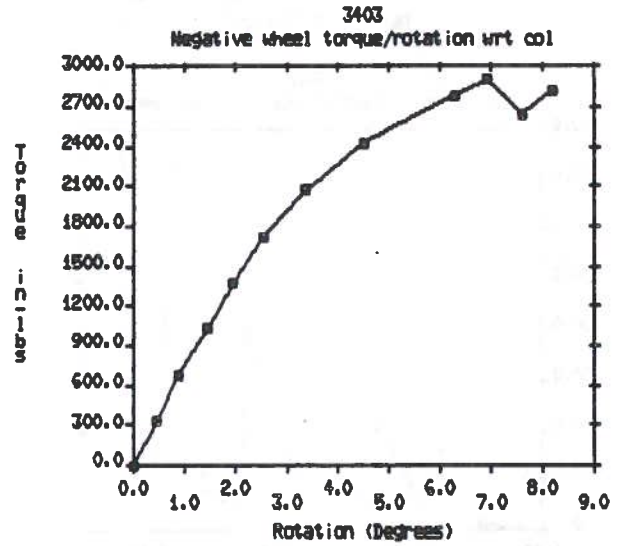

3303
Whole wheel crush force/deflection
Force - lbs
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-0.10
0.20
0.50
0.80
1.10
1.40
1.70
2.00
2.30
2.60
2.90
Deflection (Inches)

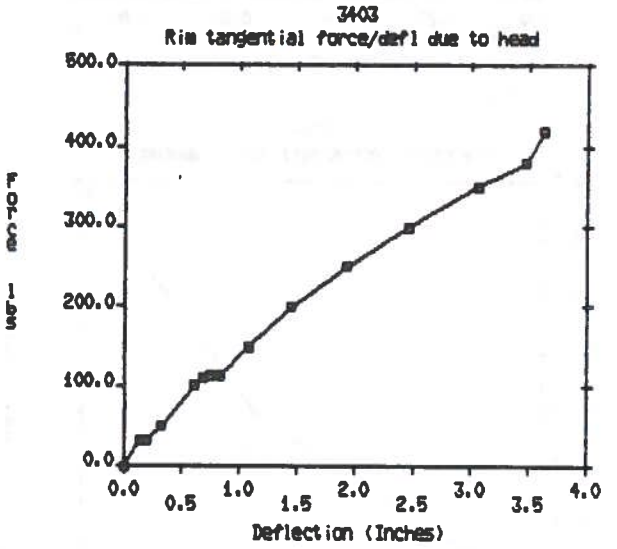

3303
Rim radial force/defl due to abdomen
Force - lbs
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
Deflection (Inches)

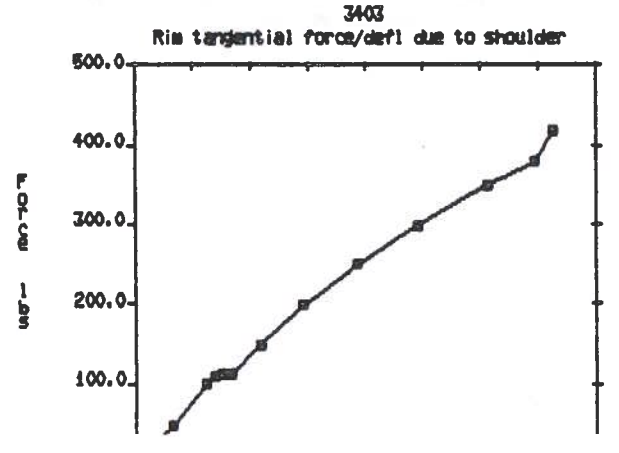

3303
Hub force/deflection due to chest impact
Force - lbs
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Deflection (Inches)

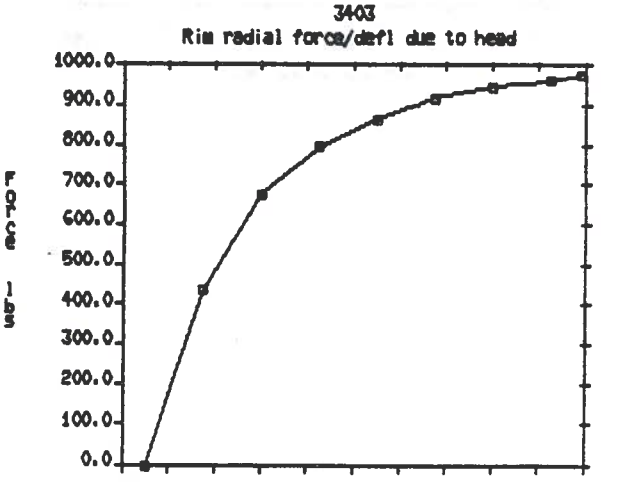

3403
Positive wheel torque/rotation wrt col
Torque - in-lbs
2100.0
1800.0
1500.0
1200.0
900.0
600.0
300.0
0.0
0.00 0.30 0.60 0.90 1.20 1.50 1.80 2.10 2.40 2.70
Rotation (Degrees)

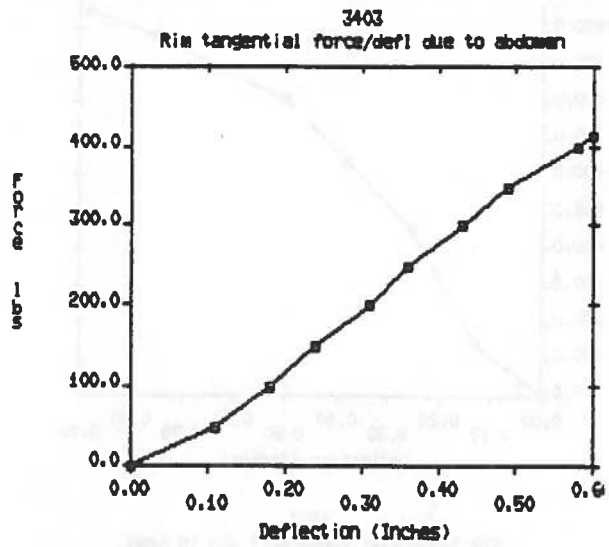

1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90
Deflection (Inches)

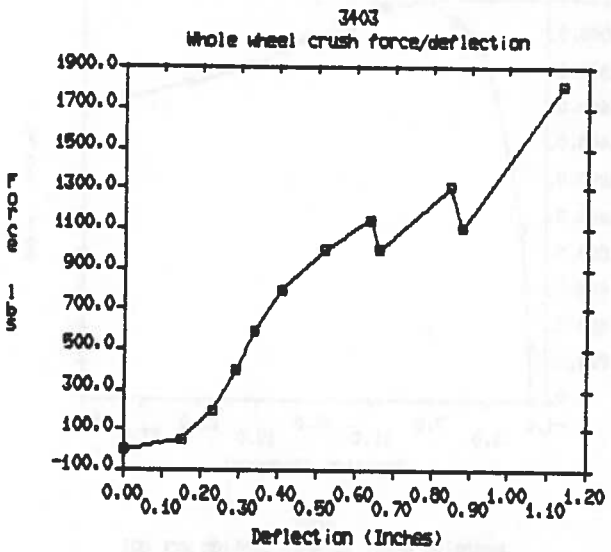

3403
Negative wheel torque/rotation wrt col
Torque - in-lbs
3000.0
2700.0
2400.0
2100.0
1800.0
1500.0
1200.0
900.0
600.0
300.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
Rotation (Degrees)

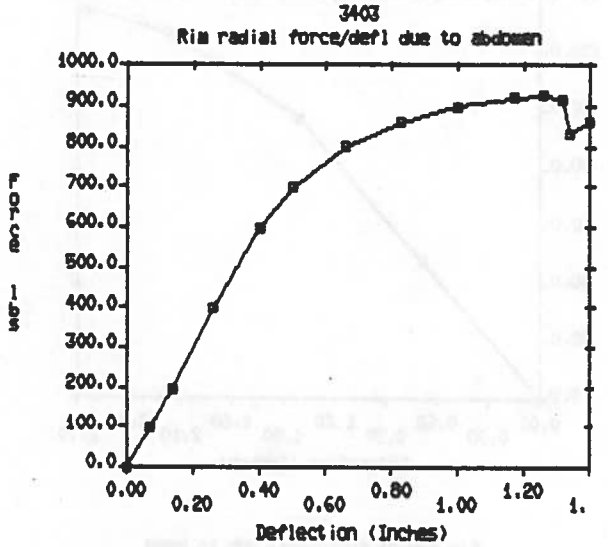

3403
Rim tangential force/defl due to head
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

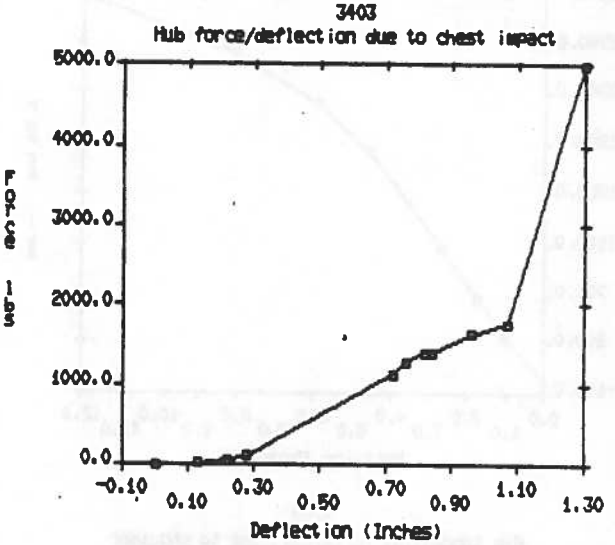

3403
Rim tangential force/defl due to shoulder
500.0
400.0
300.0
200.0
100.0

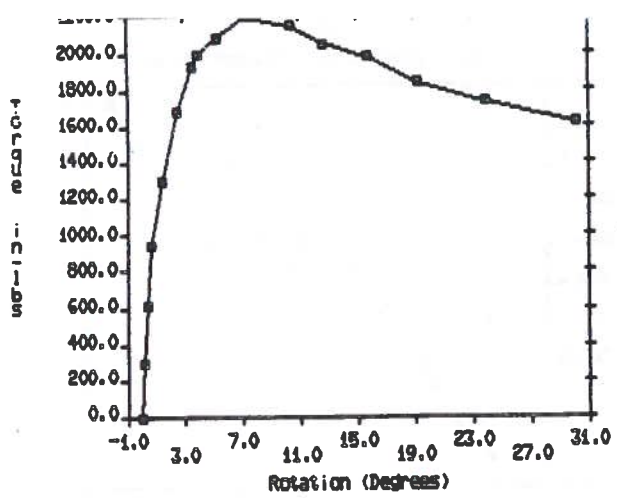

3403
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

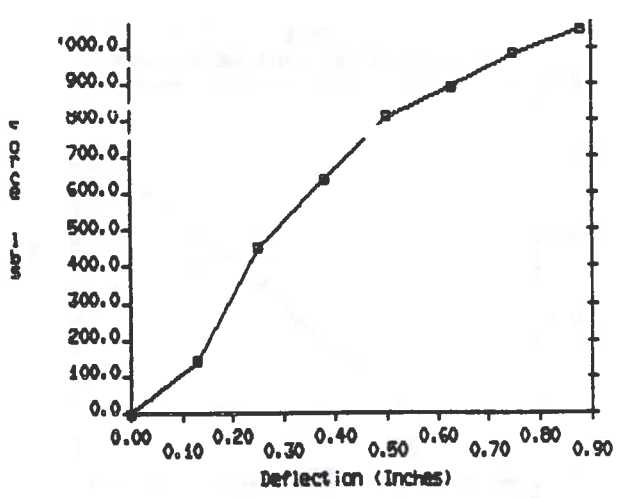

3403
Rim tangential force/defl due to abdomen
Force - lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
Deflection (Inches)

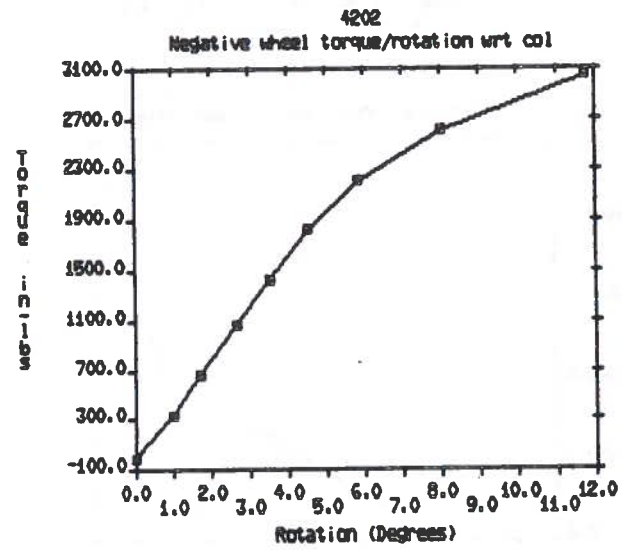

3403
Whole wheel crush force/deflection
Force - lbs
1900.0
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.10
1.20
Deflection (Inches)

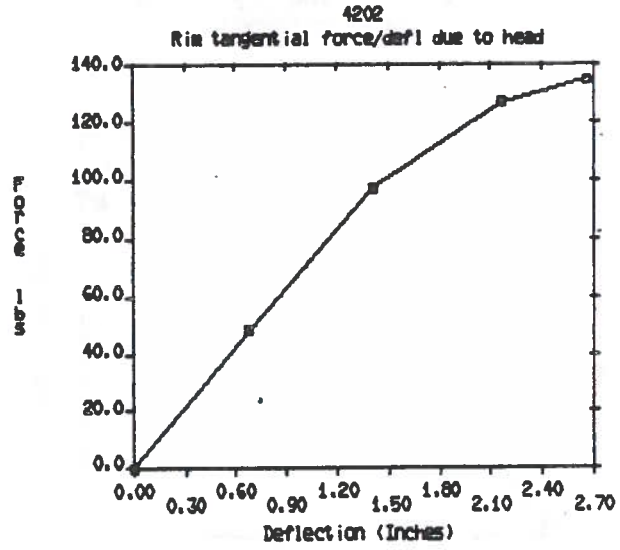

3403
Rim radial force/defl due to abdomen
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Deflection (Inches)

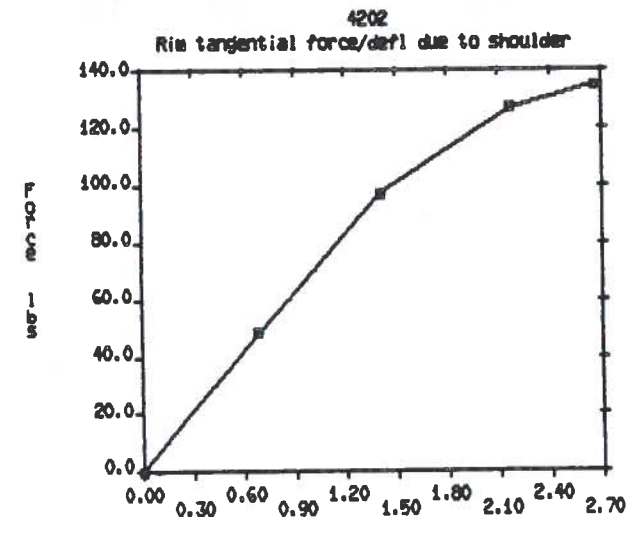

3403
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

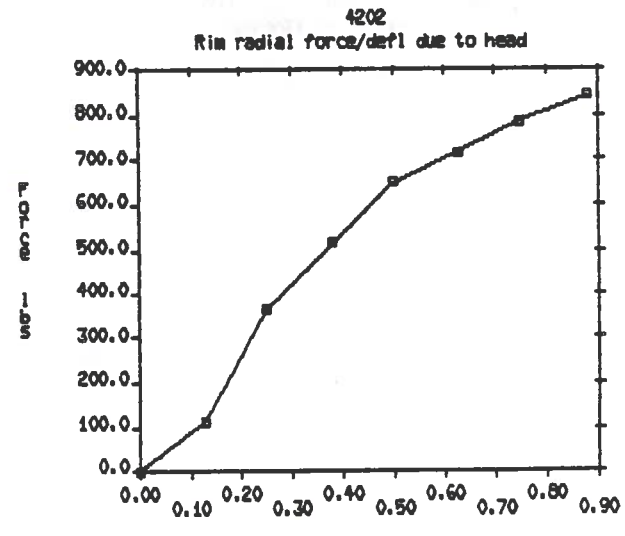

Torque - in-lbs
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-1.0
3.0
7.0
11.0
15.0
19.0
23.0
27.0
31.0
Rotation (Degrees)

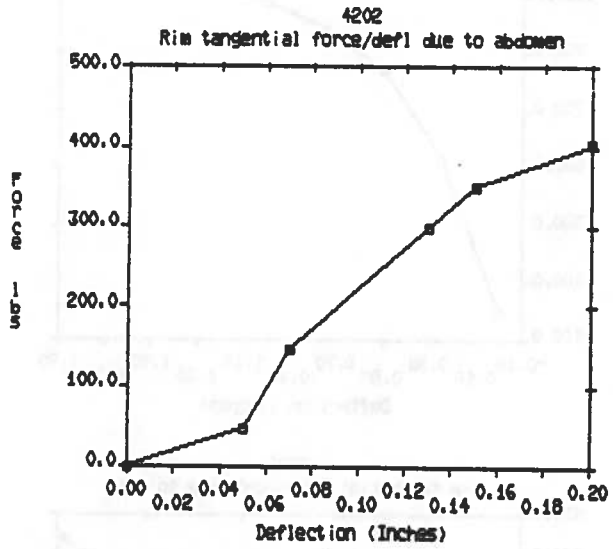

Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Deflection (Inches)

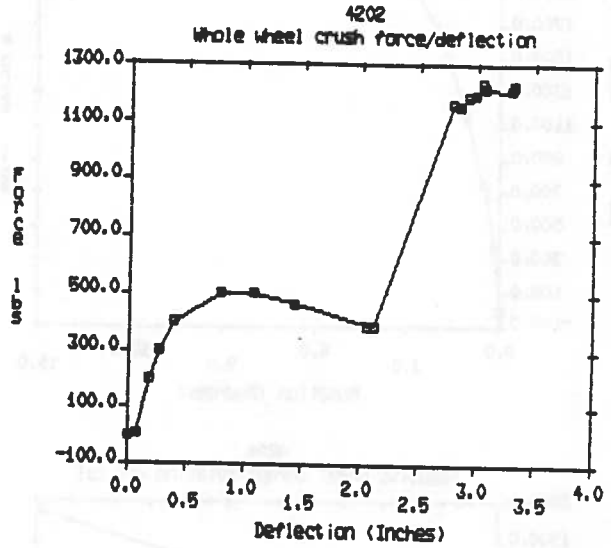

4202
Negative wheel torque/rotation wrt col
Torque - in-lbs
3100.0
2700.0
2300.0
1900.0
1500.0
1100.0
700.0
300.0
-100.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
Rotation (Degrees)

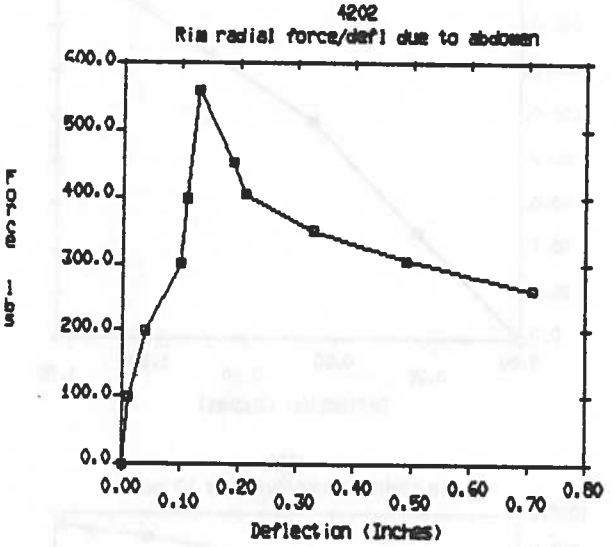

4202
Rim tangential force/defl due to head
Force - lbs
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
1.80
2.10
2.40
2.70
Deflection (Inches)

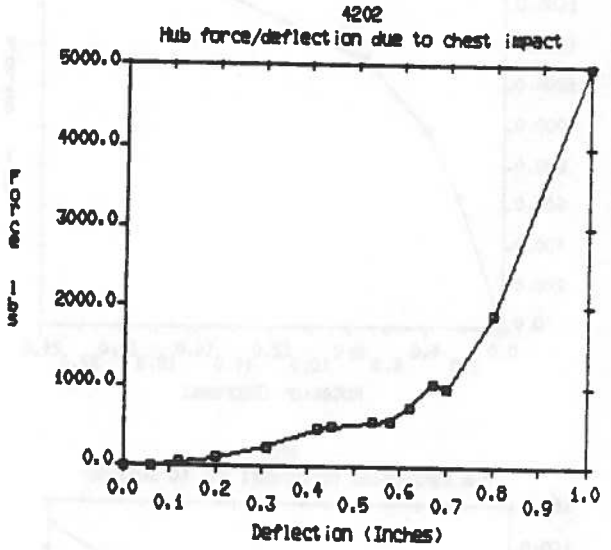

4202
Rim tangential force/defl due to shoulder
Force - lbs
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
1.80
2.10
2.40
2.70

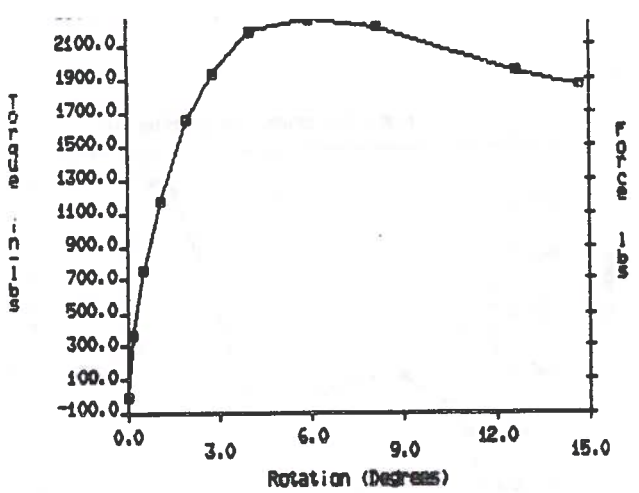

4202
Rim radial force/defl due to head
Force - lbs
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90

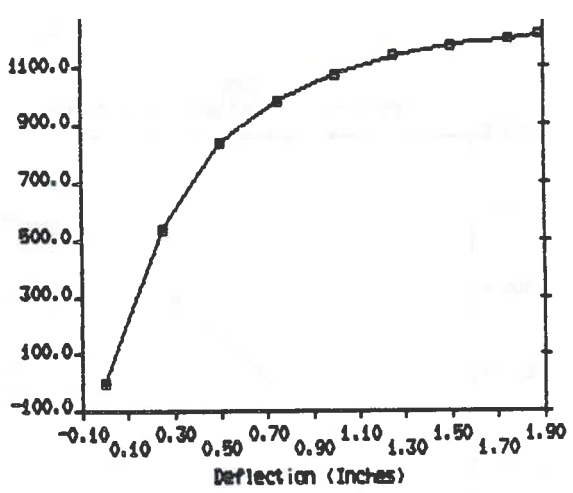

4202
Rim tangential force/defl due to abdomen
Force - lbs
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20
Deflection (Inches)

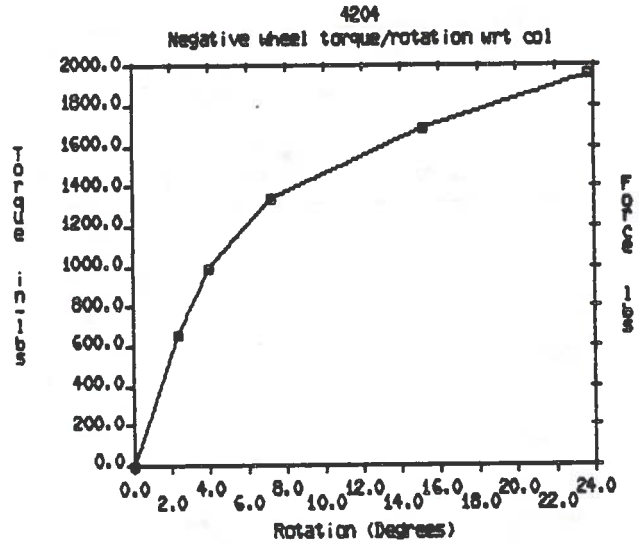

4202
Whole wheel crush force/deflection
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

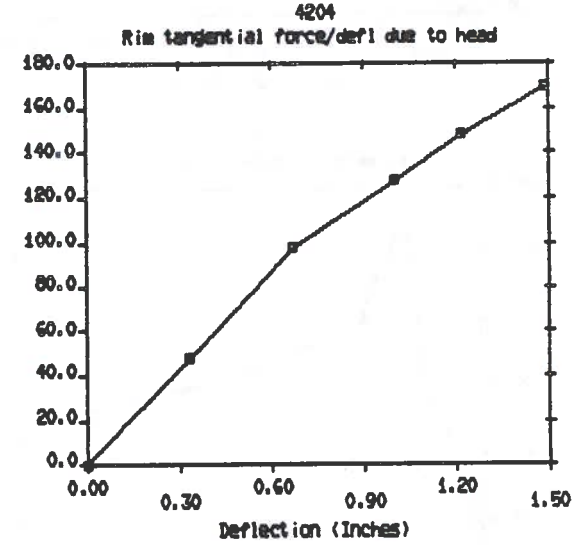

4202
Rim radial force/defl due to abdomen
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80
Deflection (Inches)

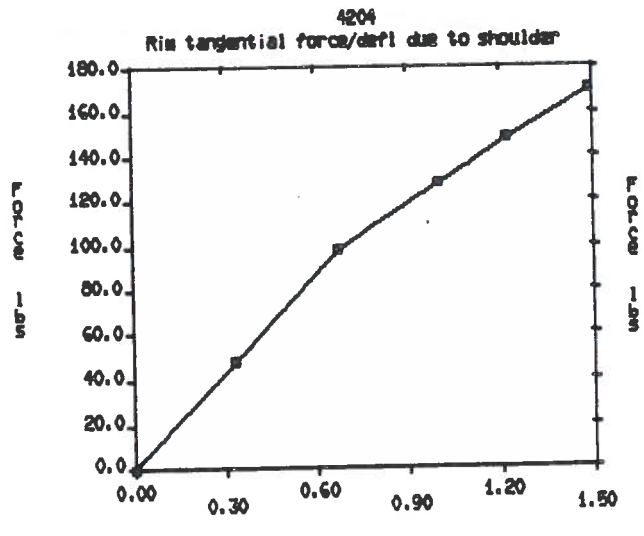

4202
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Deflection (Inches)

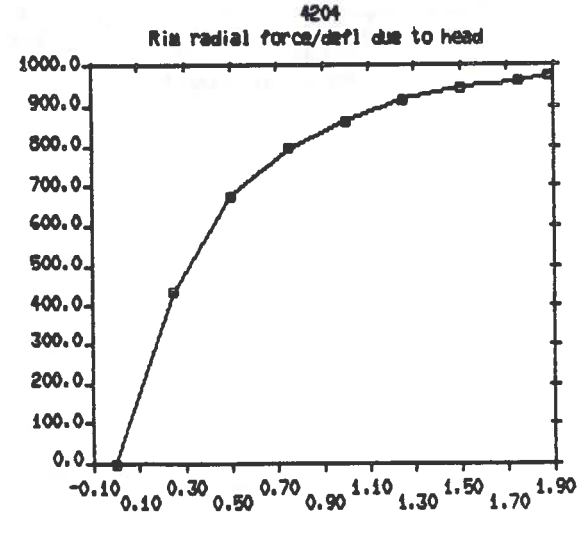

2100.0
1900.0
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0
3.0
6.0
9.0
12.0
15.0
Rotation (Degrees)

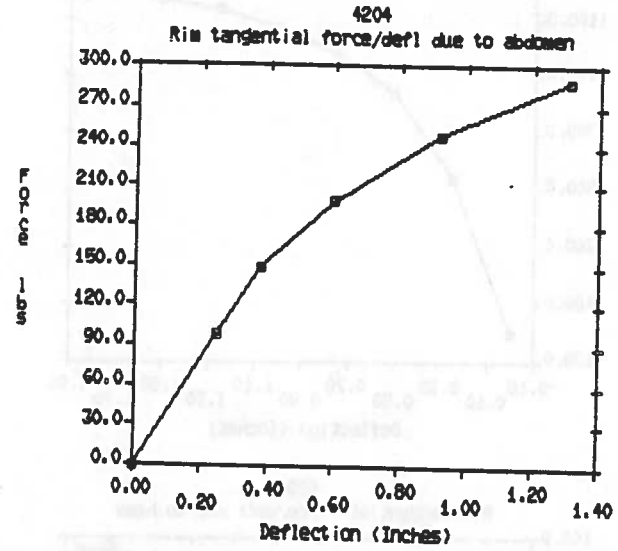

1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

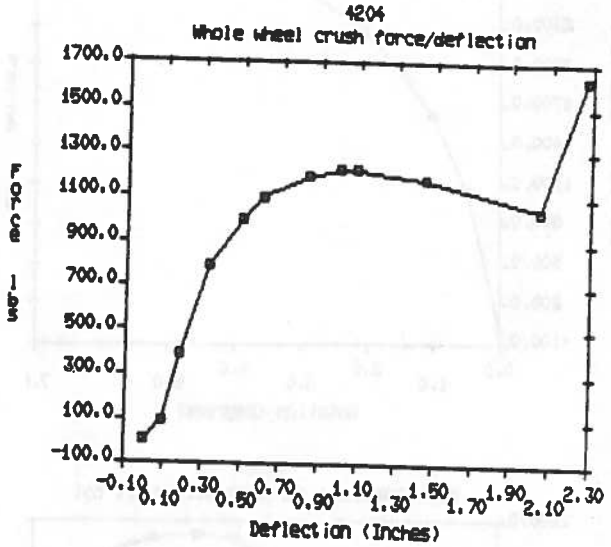

4204
Negative wheel torque/rotation wrt col
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
Rotation (Degrees)

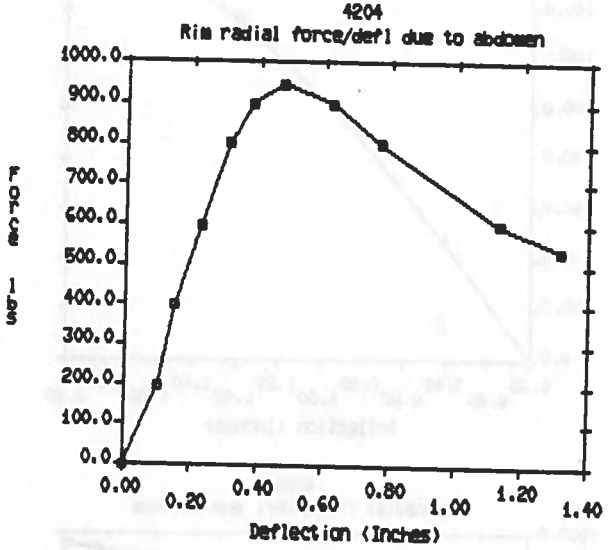

4204
Rim tangential force/defl due to head
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
Deflection (Inches)

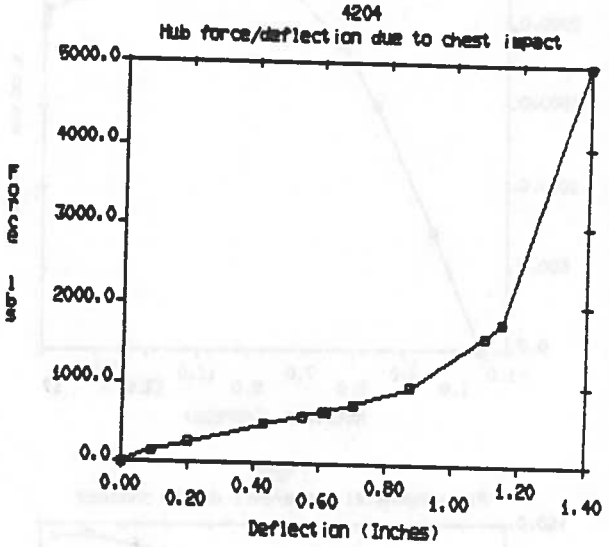

4204
Rim tangential force/defl due to shoulder
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50

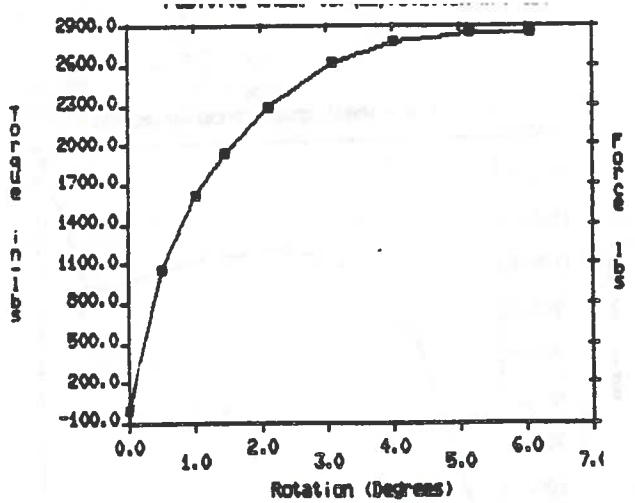

4204
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90

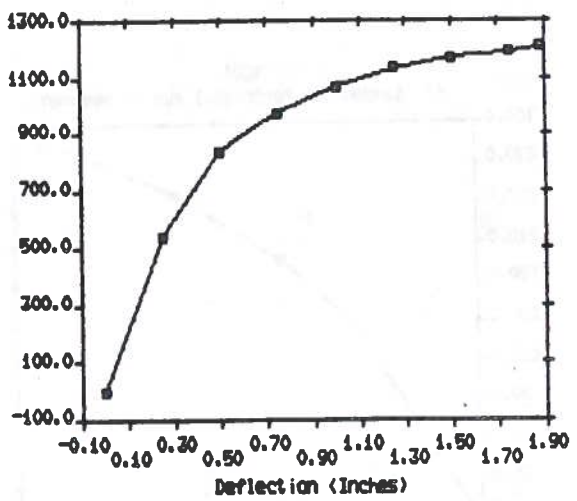

4204
Rim tangential force/defl due to abdomen
Force - lbs
300.0
270.0
240.0
210.0
180.0
150.0
120.0
90.0
60.0
30.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

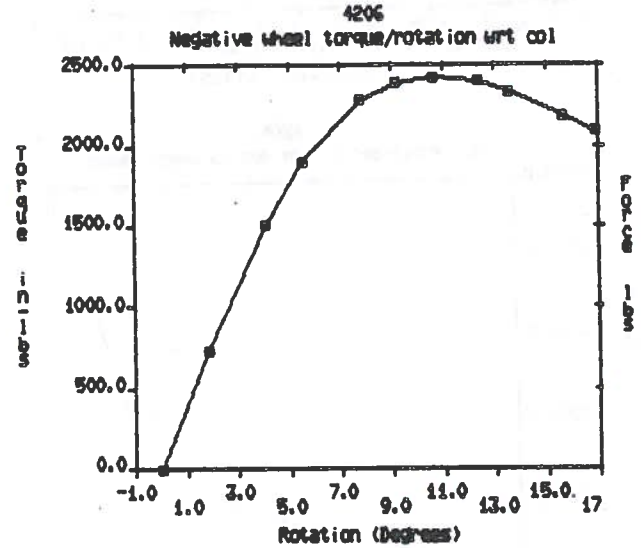

4204
Whole wheel crush force/deflection
Force - lbs
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
2.10
2.30
Deflection (Inches)

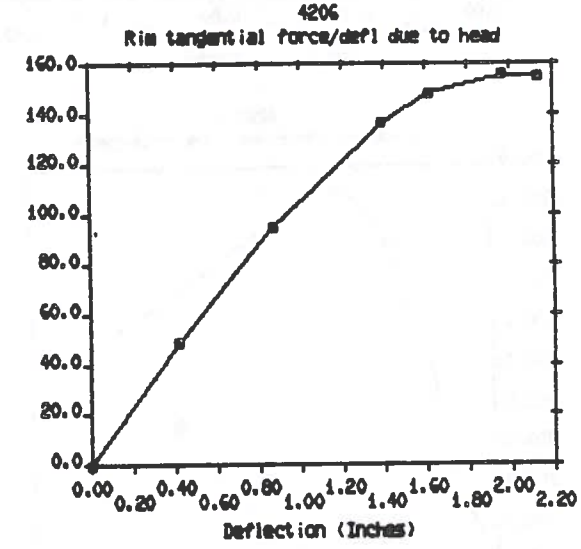

4204
Rim radial force/defl due to abdomen
Force - lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

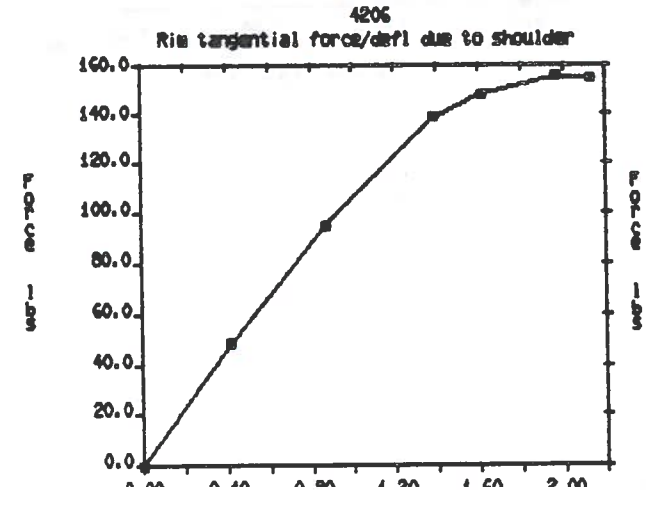

4204
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

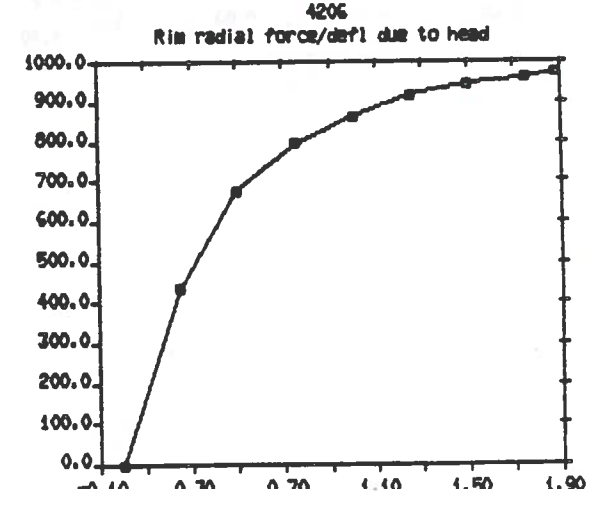

Torque - in-lbs
Force - lbs
Rotation (Degrees)

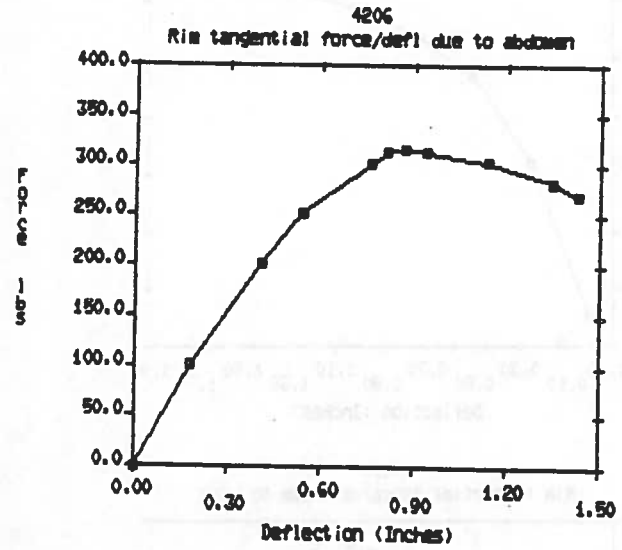

Force - lbs
Deflection (Inches)

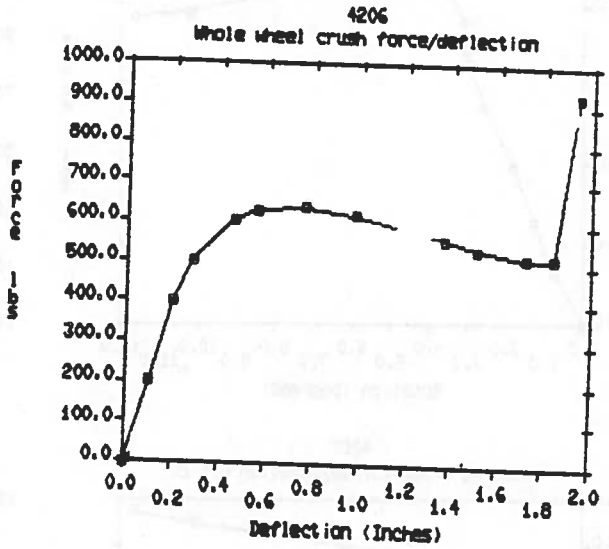

4206
Negative wheel torque/rotation wrt COI
Torque - in-lbs
Force - lbs
Rotation (Degrees)

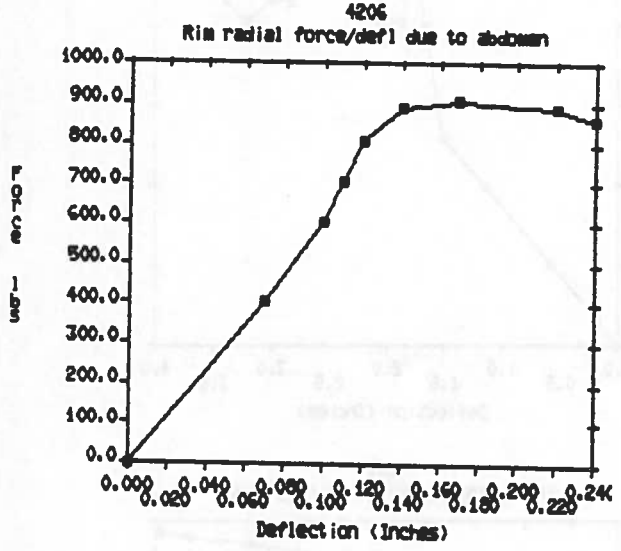

4206
Rim tangential force/defl due to head
Force - lbs
Deflection (Inches)

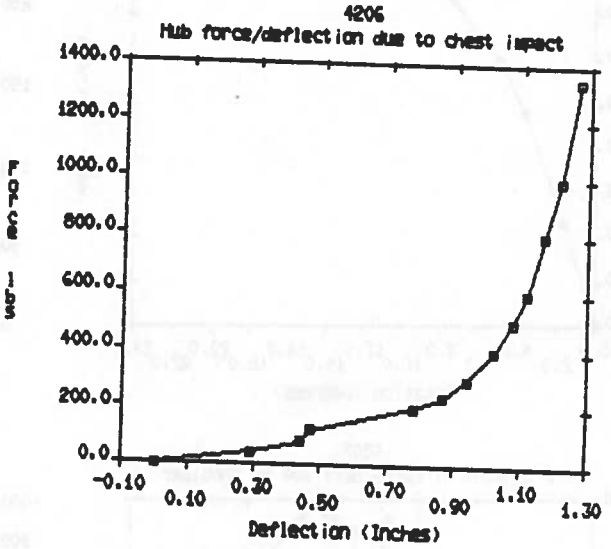

4206
Rim tangential force/defl due to shoulder
Force - lbs

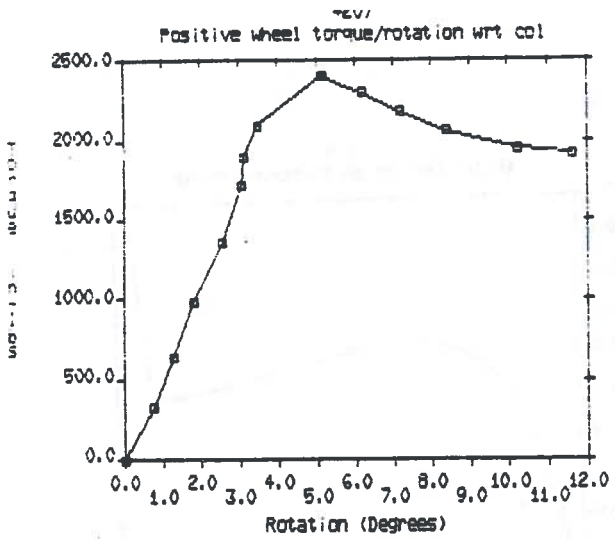

4206
Rim radial force/defl due to head
Force - lbs

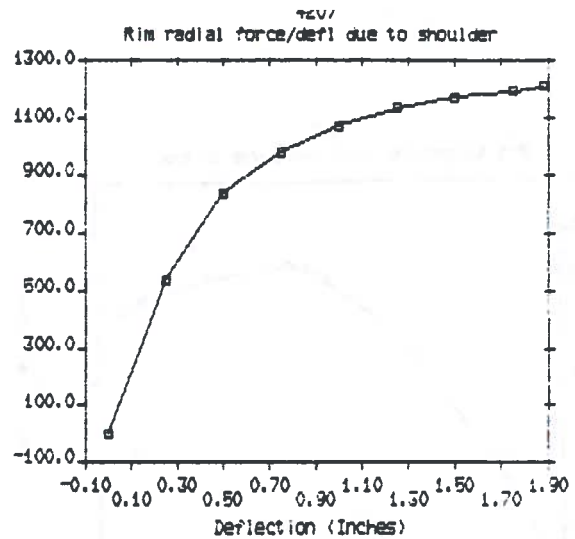

4206
Rim tangential force/defl due to abdomen
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
Deflection (Inches)

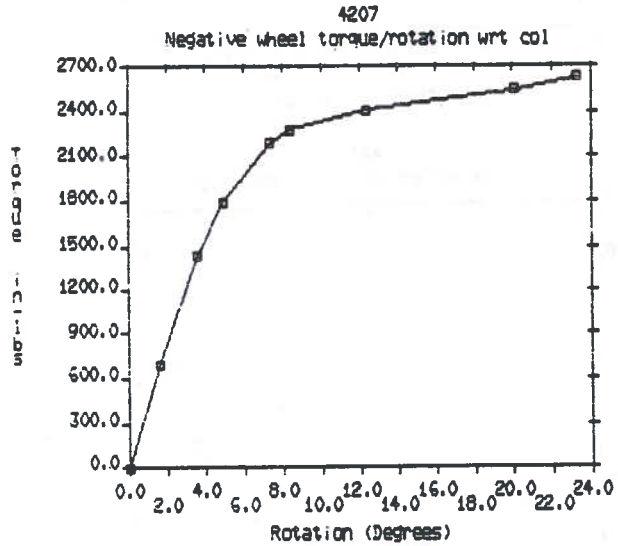

4206
Whole wheel crush force/deflection
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Deflection (Inches)

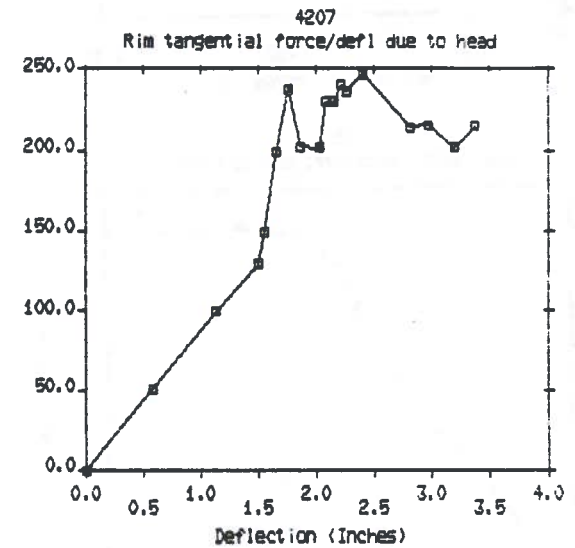

4206
Rim radial force/defl due to abdomen
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.000
0.020
0.040
0.060
0.080
0.100
0.120
0.140
0.160
0.180
0.200
0.220
0.24
Deflection (Inches)

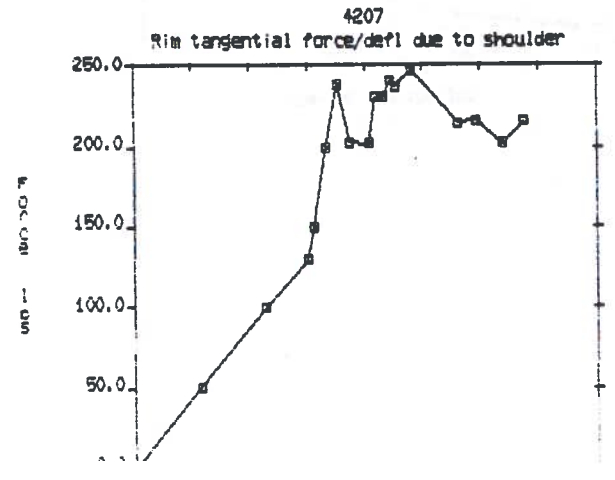

4206
Hub force/deflection due to chest impact
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

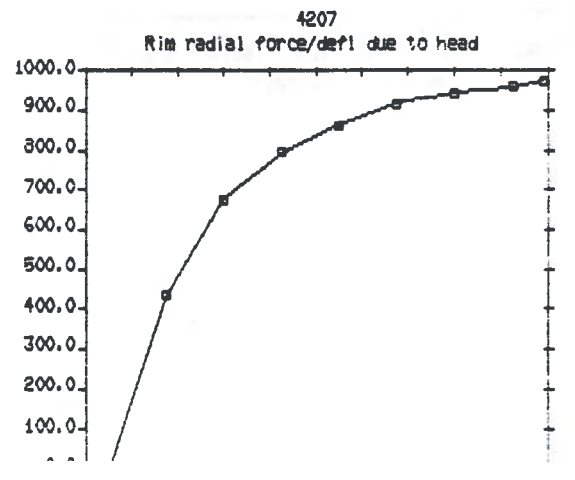

4207
Positive wheel torque/rotation wrt col
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
Rotation (Degrees)

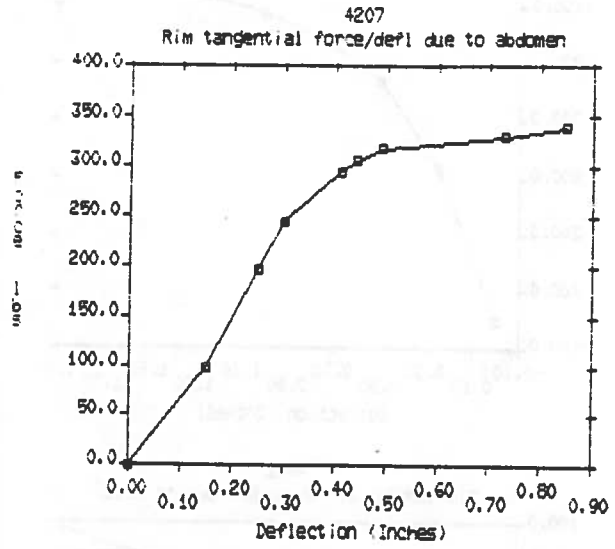

4207
Rim radial force/defl due to shoulder
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90
Deflection (Inches)

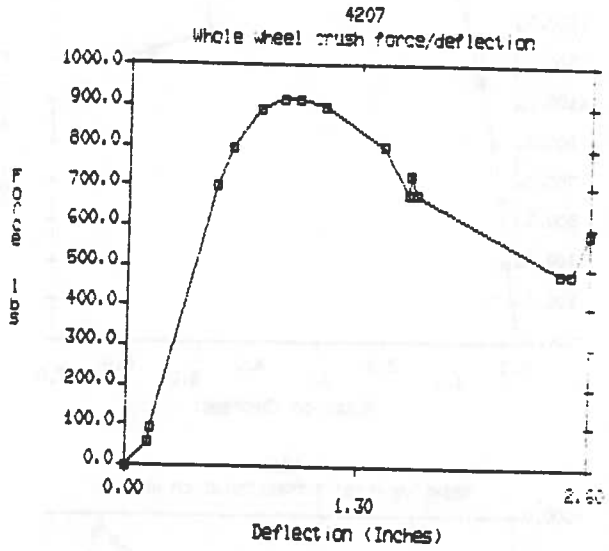

4207
Negative wheel torque/rotation wrt col
2700.0
2400.0
2100.0
1800.0
1500.0
1200.0
900.0
600.0
300.0
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0
Rotation (Degrees)

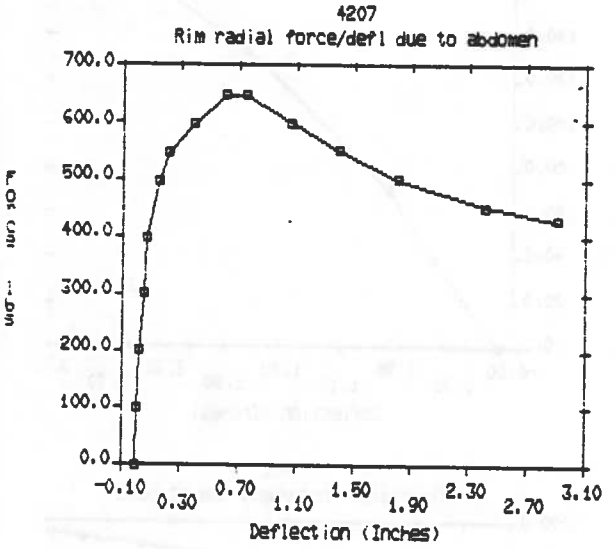

4207
Rim tangential force/defl due to head
250.0
200.0
150.0
100.0
50.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

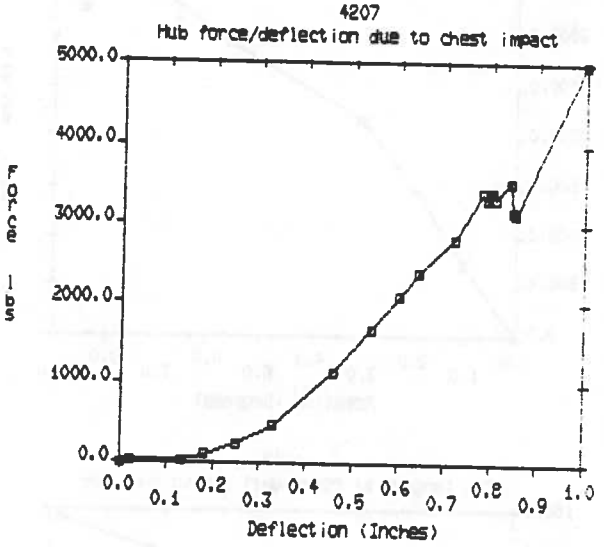

4207
Rim tangential force/defl due to shoulder
250.0
200.0
150.0
100.0
50.0

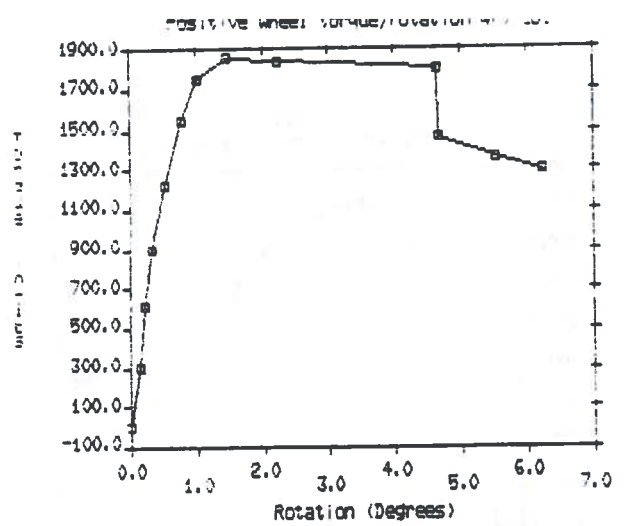

4207
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

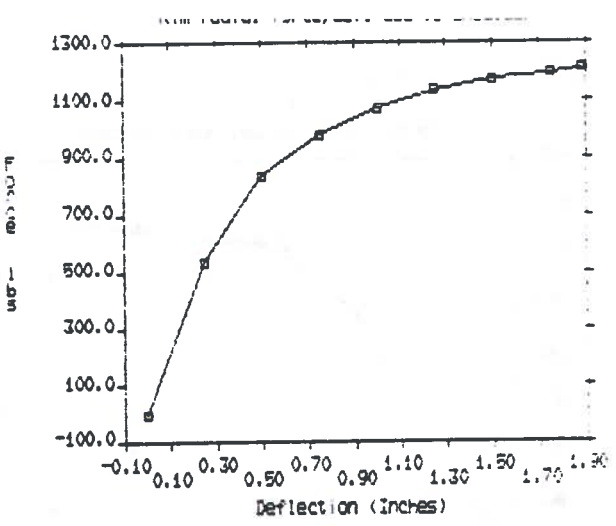

4207
Rim tangential force/defl due to abdomen
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Deflection (Inches)

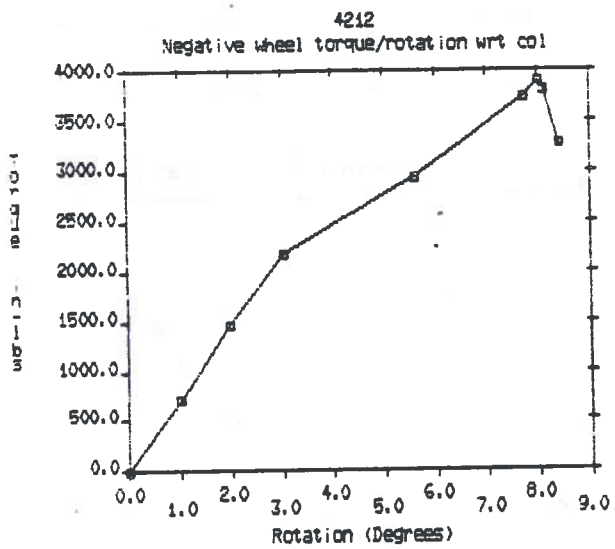

4207
Whole wheel crush force/deflection
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
1.30
Deflection (Inches)

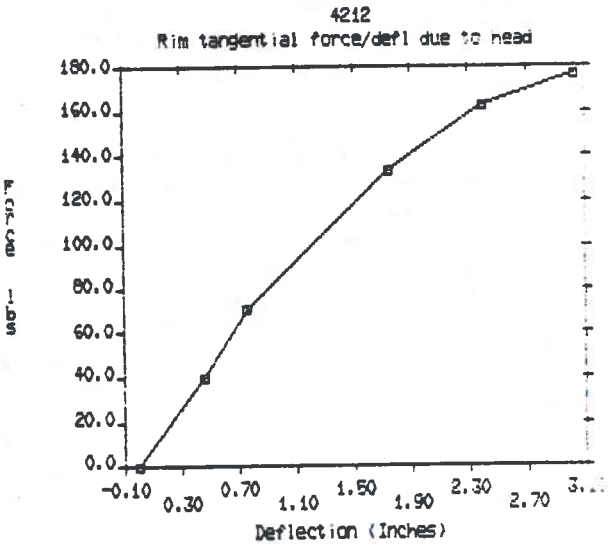

4207
Rim radial force/defl due to abdomen
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10
0.30
0.70
1.10
1.50
1.90
2.30
2.70
3.10
Deflection (Inches)

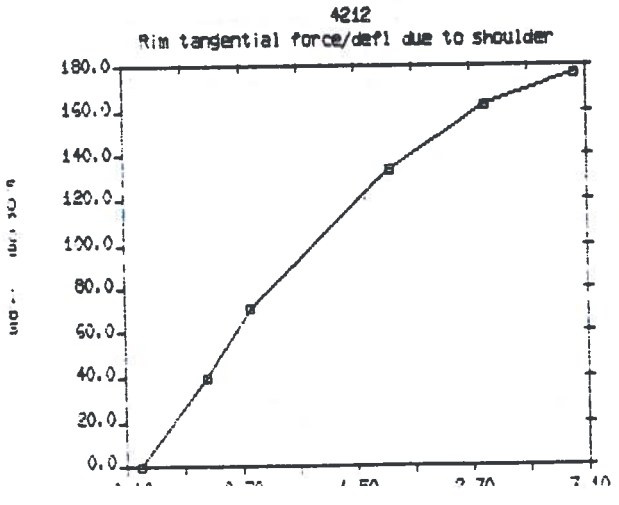

4207
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Deflection (Inches)

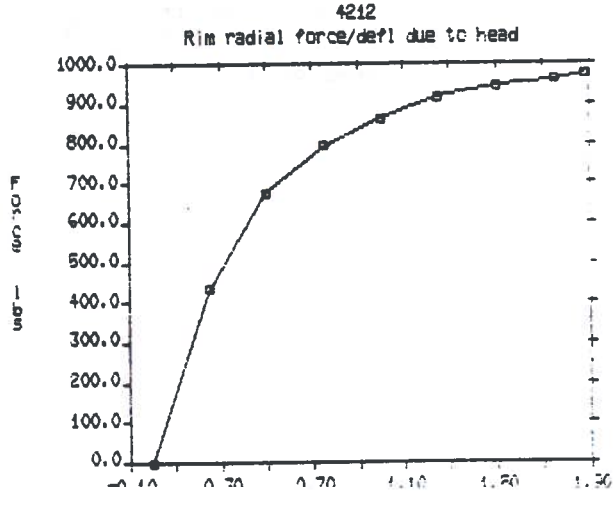

1900.0
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Rotation (Degrees)

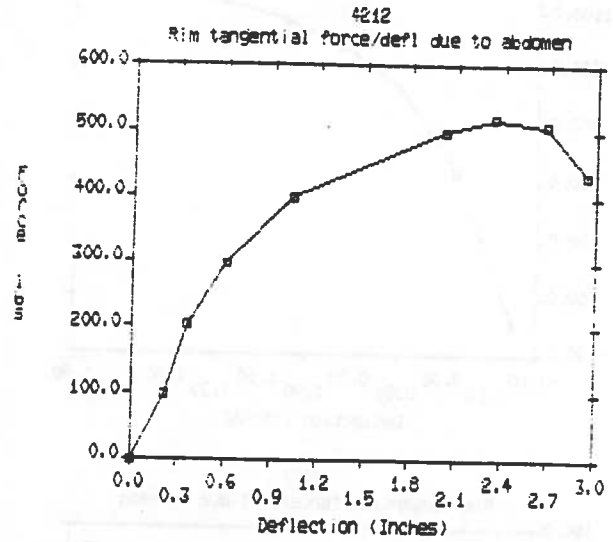

1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

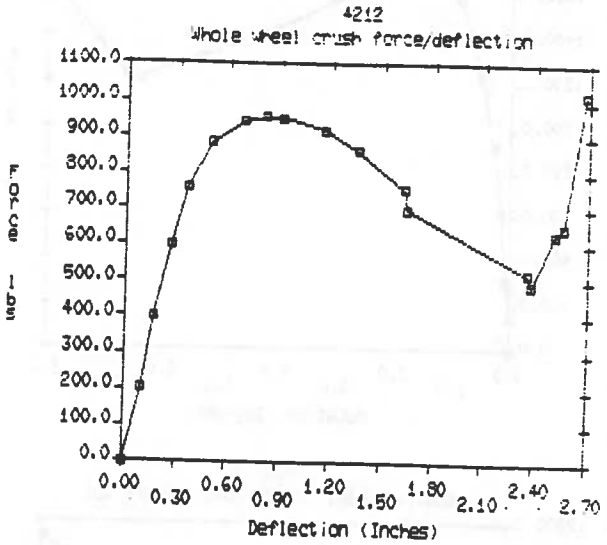

4212
Negative wheel torque/rotation wrt col
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
Rotation (Degrees)

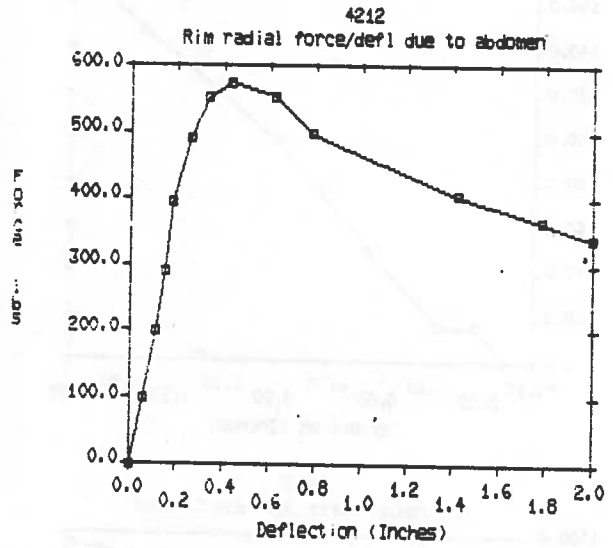

4212
Rim tangential force/defl due to head
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-0.10
0.30
0.70
1.10
1.50
1.90
2.30
2.70
Deflection (Inches)

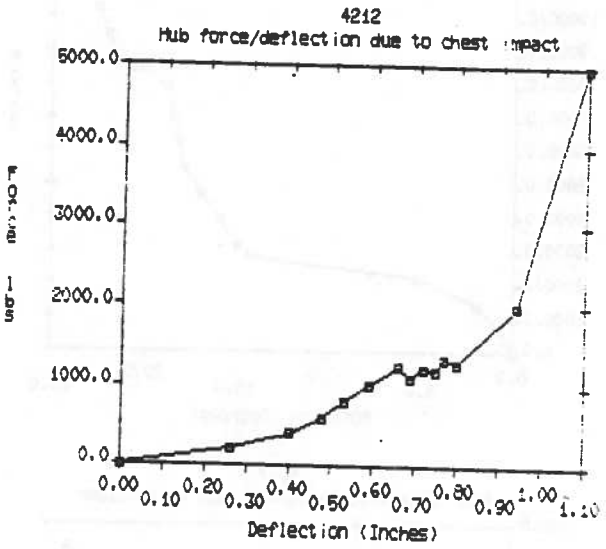

4212
Rim tangential force/defl due to shoulder
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0

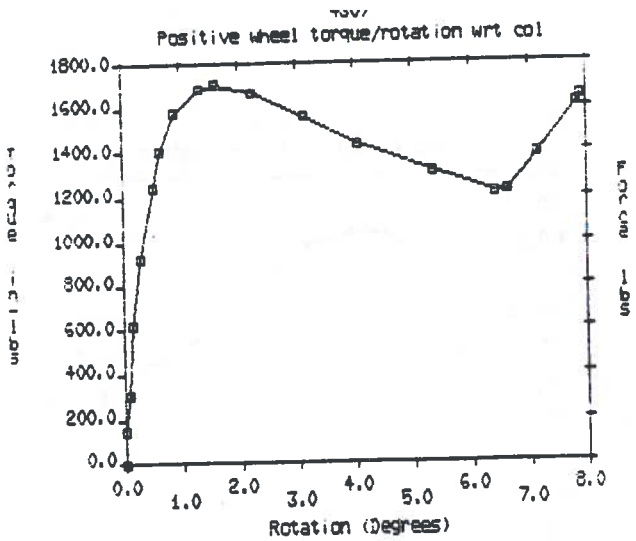

4212
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

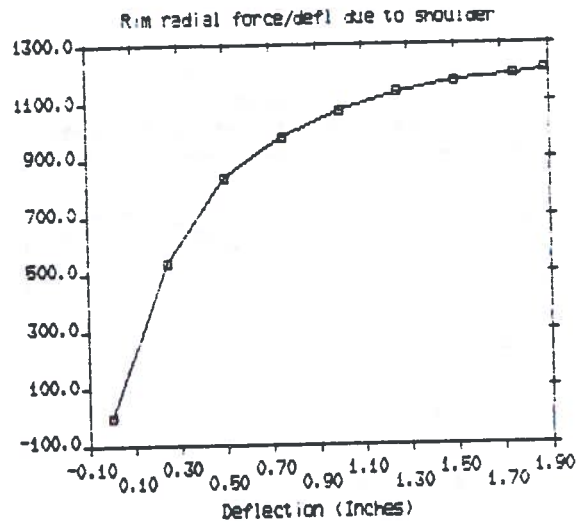

4212
Rim tangential force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.3 0.6 0.9 1.2 1.5 1.8 2.1 2.4 2.7 3.0
Deflection (Inches)

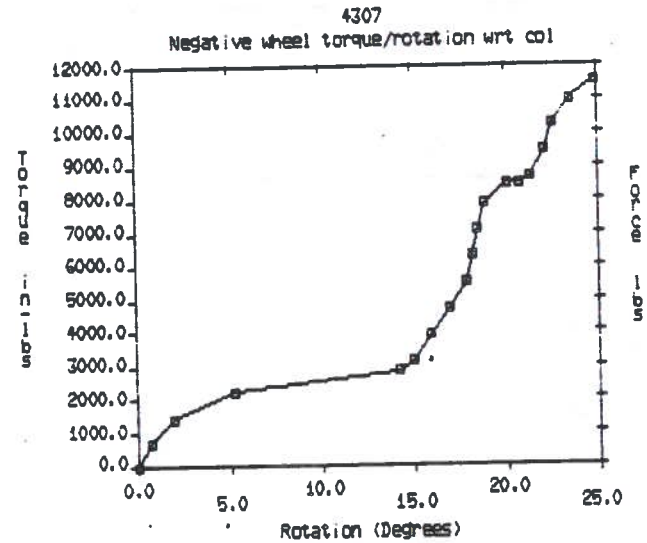

4212
Whole wheel crush force/deflection
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.30 0.60 0.90 1.20 1.50 1.80 2.10 2.40 2.70
Deflection (Inches)

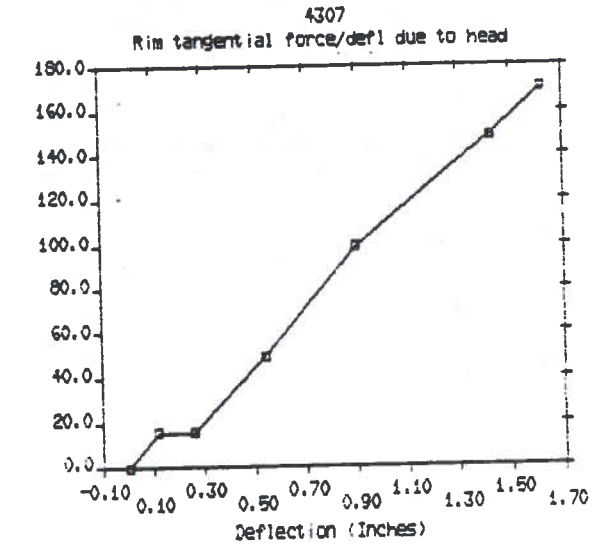

4212
Rim radial force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0
Deflection (Inches)

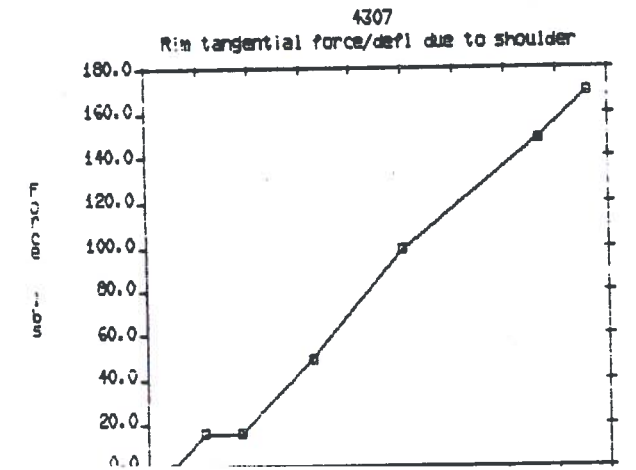

4212
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00 1.10
Deflection (Inches)

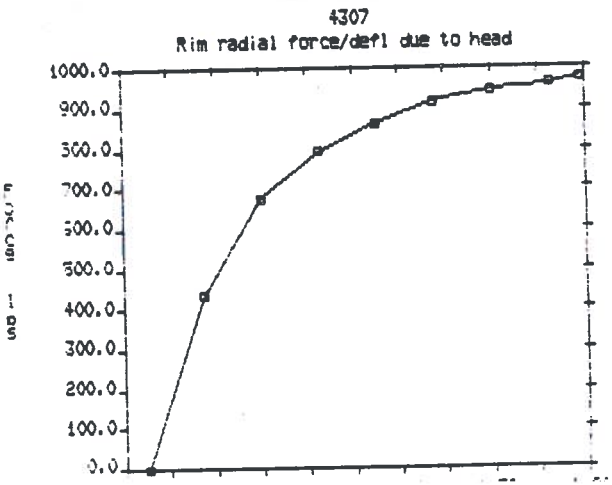

4307
Positive wheel torque/rotation wrt col
Torque - in-lbs
Rotation (Degrees)


Rim radial force/defl due to shoulder
Force - lbs
Deflection (Inches)


4307
Negative wheel torque/rotation wrt col
Torque - in-lbs
Rotation (Degrees)


4307
Rim tangential force/defl due to head
Force - lbs
Deflection (Inches)


4307
Rim tangential force/defl due to shoulder
Force - lbs

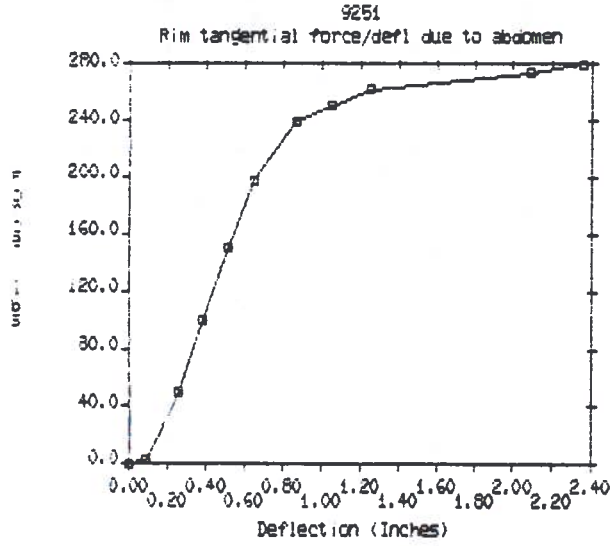

4307
Rim radial force/defl due to head
Force - lbs

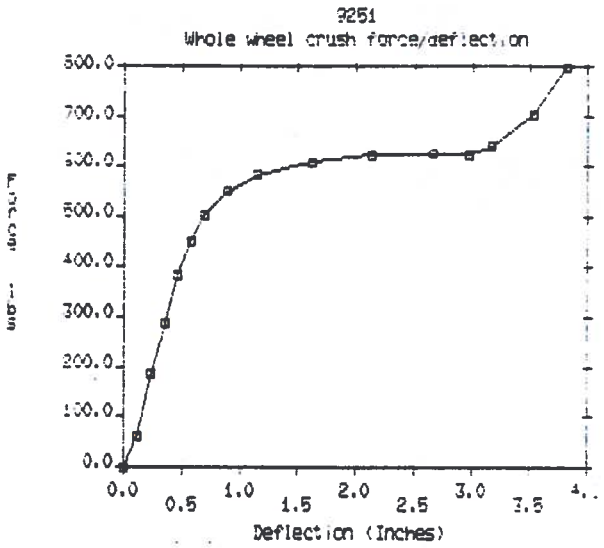
REFERENCES

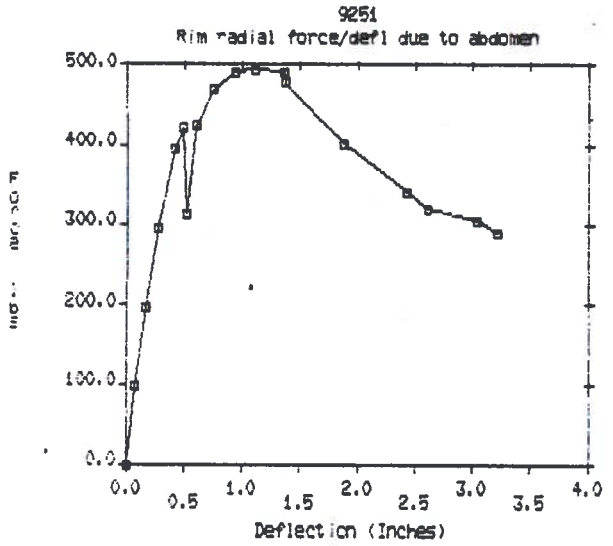
1. M. T. McGrath and D. J. Segal, "The Development and Use of the PADS (Passenger/Driver Simulation) Computer Program," MGA Research Corporation, Buffalo, New York, March 1984.

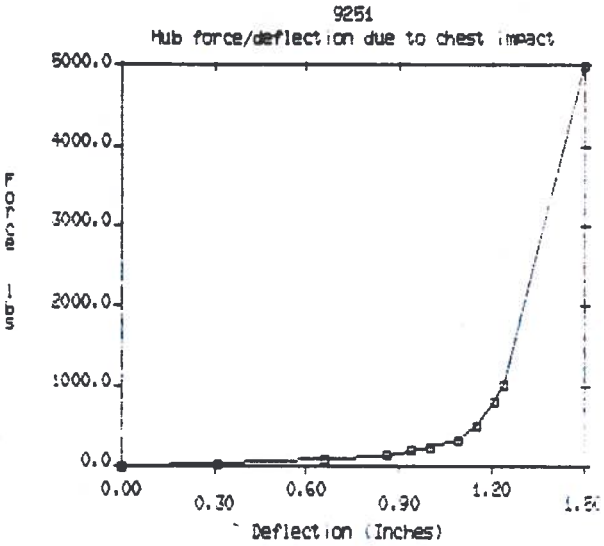
2. D. G. Griffith and D. J. Segal, "PADS 2 User's Manual," MGA Research Corporation, Buffalo, New York, October 1984.

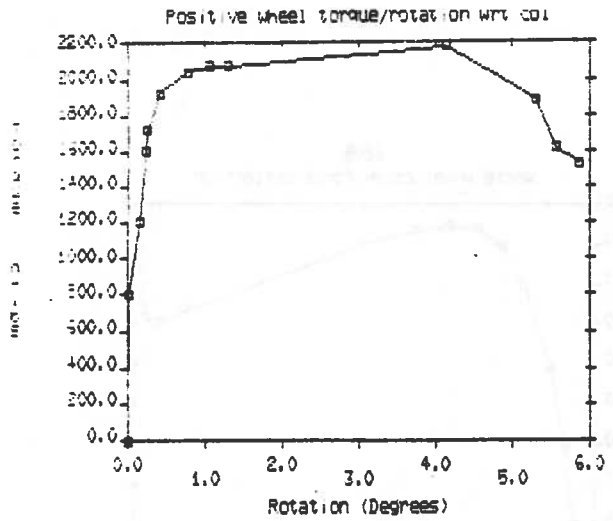
3. "SCORES 2 User's Manual," Fitzpatrick Engineering, Warsaw, Indiana, July 15, 1983.

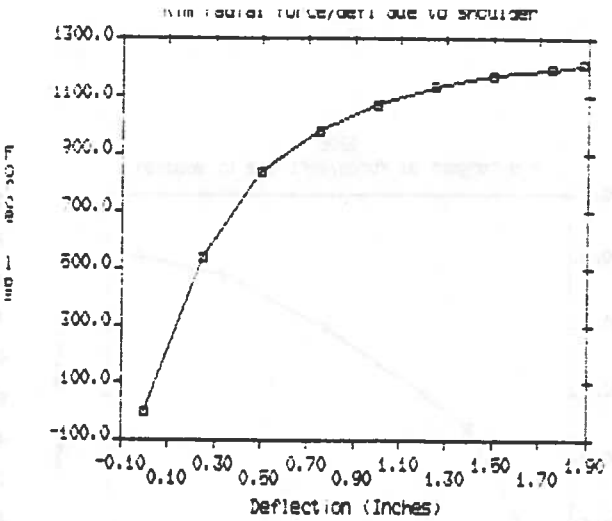

9251
Rim tangential force/defl due to abdomen
280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20 2.40
Deflection (Inches)

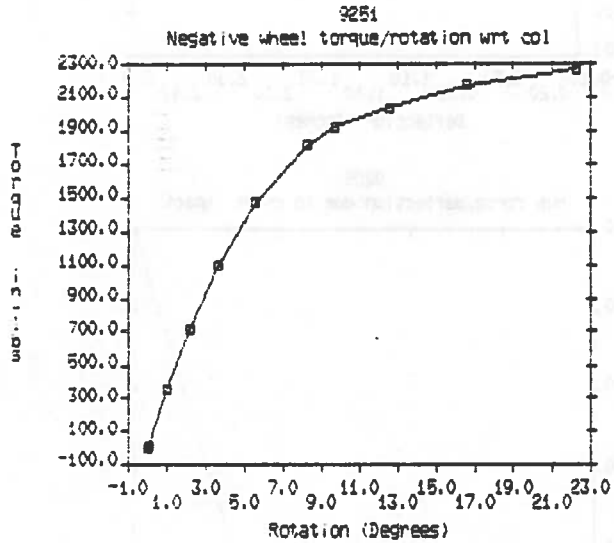

9251
Whole wheel crush force/deflection
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
Deflection (Inches)

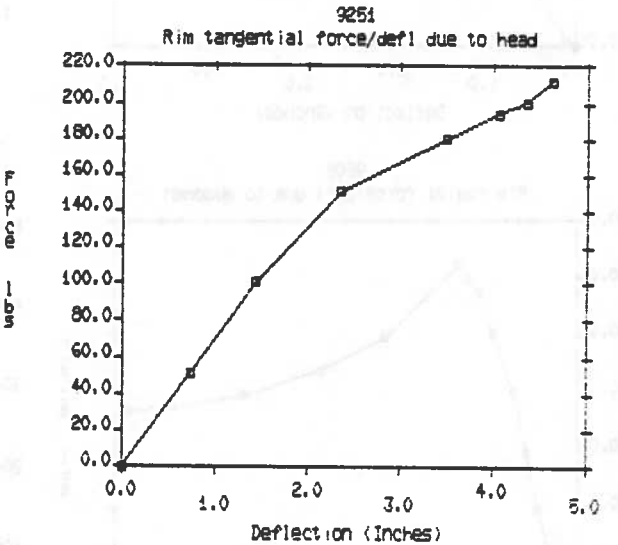

9251
Rim radial force/defl due to abdomen
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

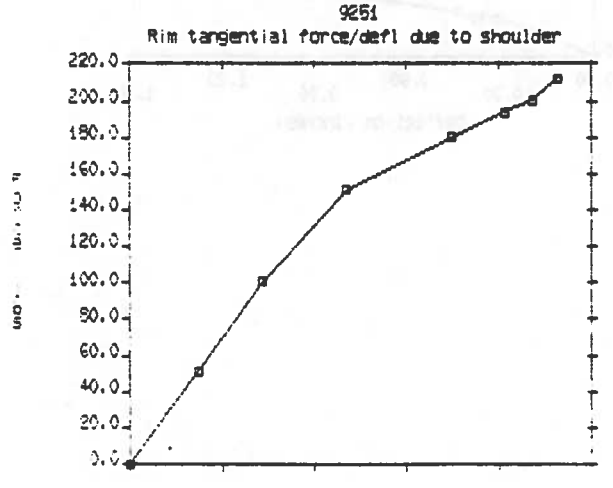

9251
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00 0.30 0.60 0.90 1.20
Deflection (Inches)

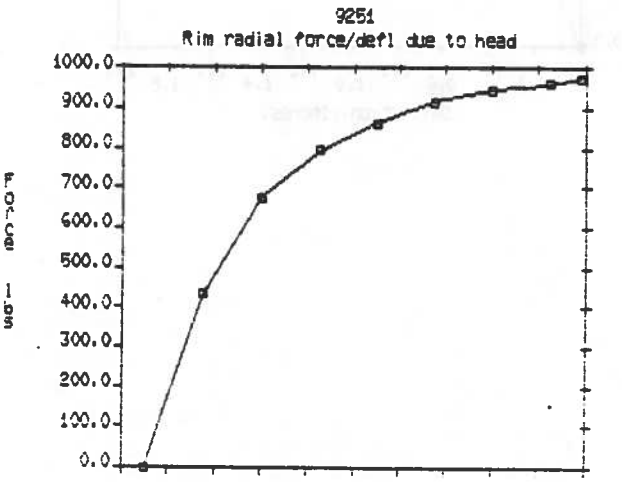

Positive wheel torque/rotation wrt col
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Rotation (Degrees)

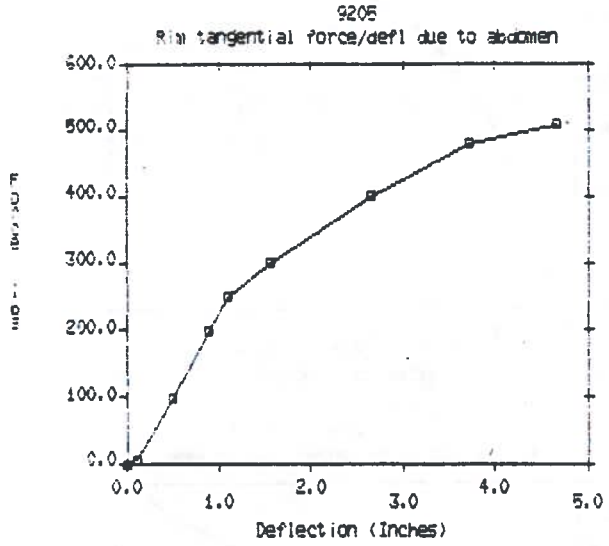

1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

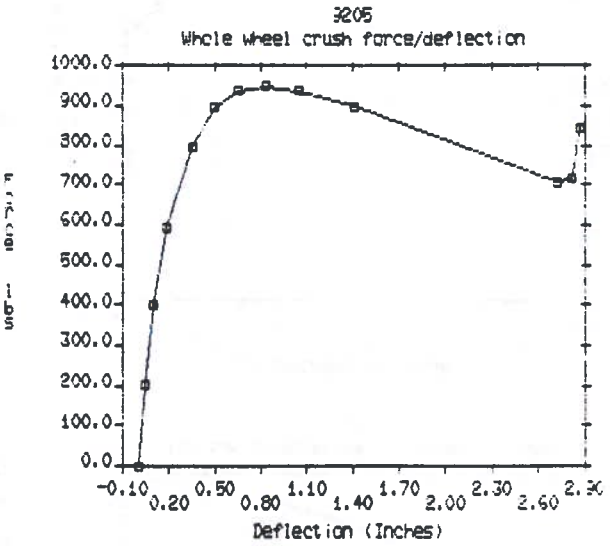

9251
Negative wheel torque/rotation wrt col
2300.0
2100.0
1900.0
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
17.0
19.0
21.0
23.0
Rotation (Degrees)

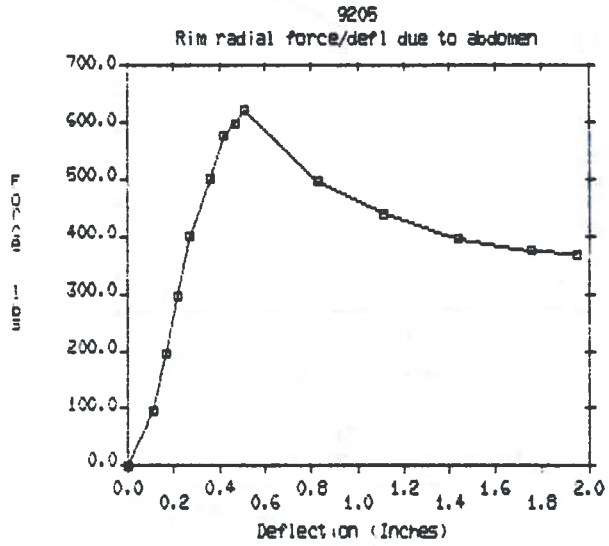

9251
Rim tangential force/defl due to head
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

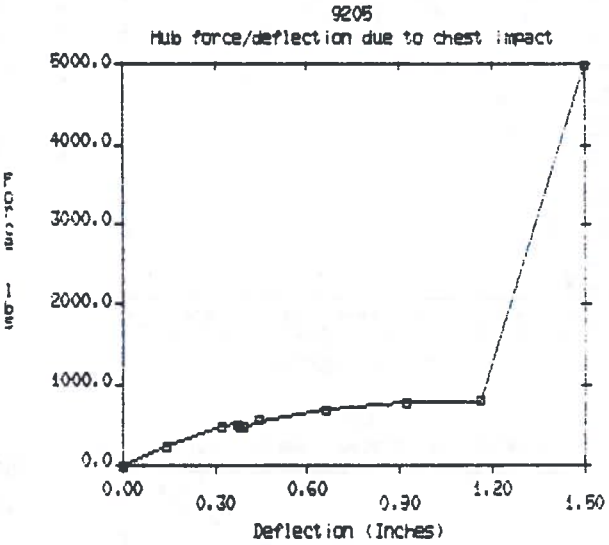

9251
Rim tangential force/defl due to shoulder
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0

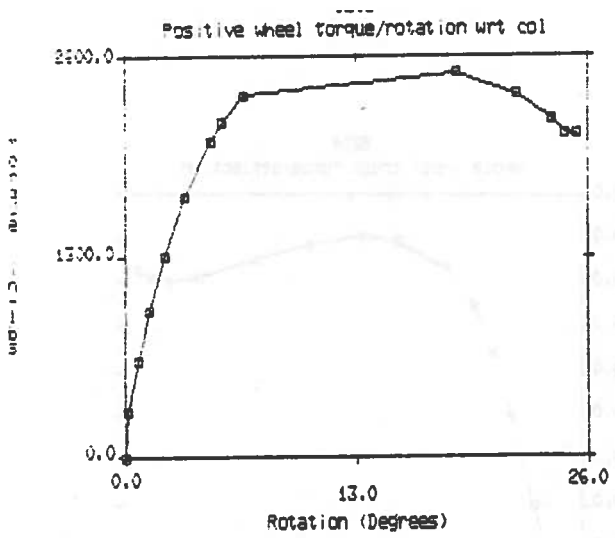

9251
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

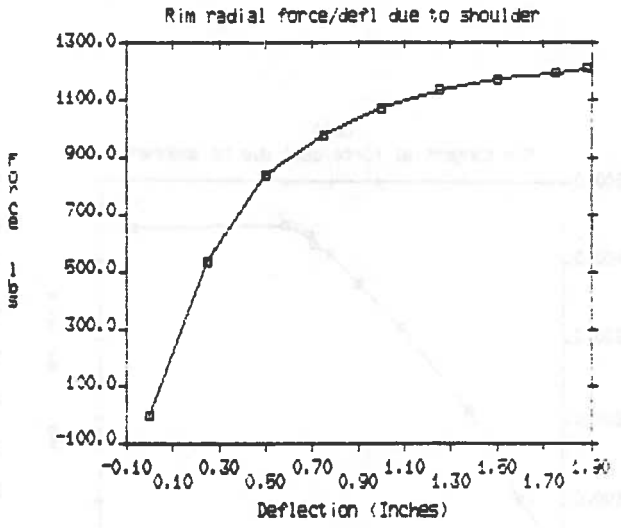

9205
Rim tangential force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

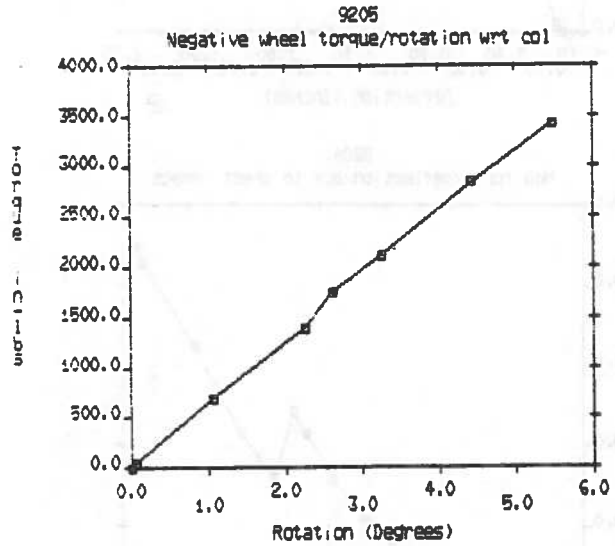

9205
Whole wheel crush force/deflection
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10
0.20
0.50
0.80
1.10
1.40
1.70
2.00
2.30
2.60
2.90
Deflection (Inches)

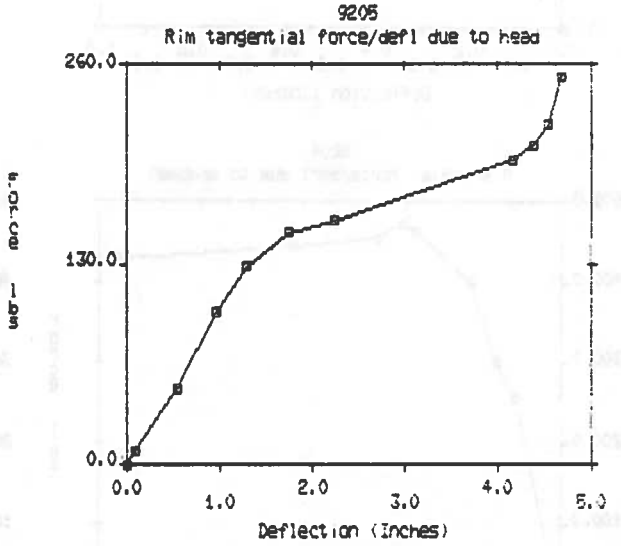

9205
Rim radial force/defl due to abdomen
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Deflection (Inches)

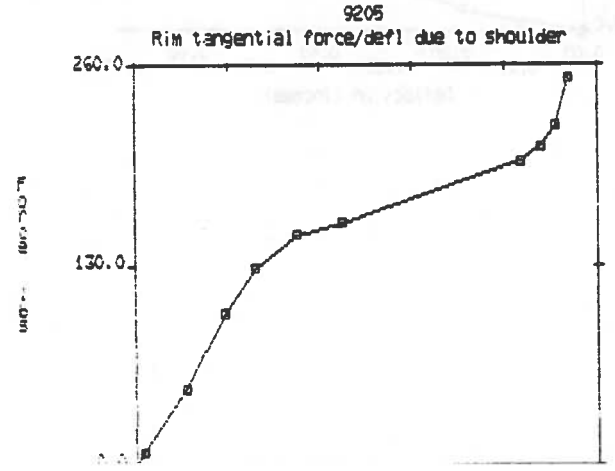

9205
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
Deflection (Inches)

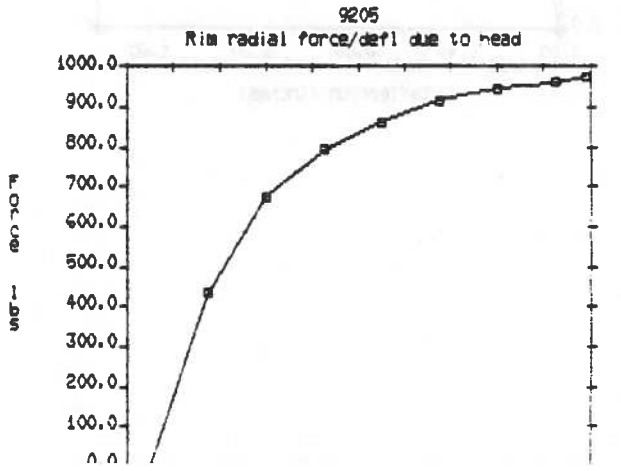

Positive wheel torque/rotation wrt col
2600.0
1300.0
0.0
0.0
13.0
26.0
Rotation (Degrees)

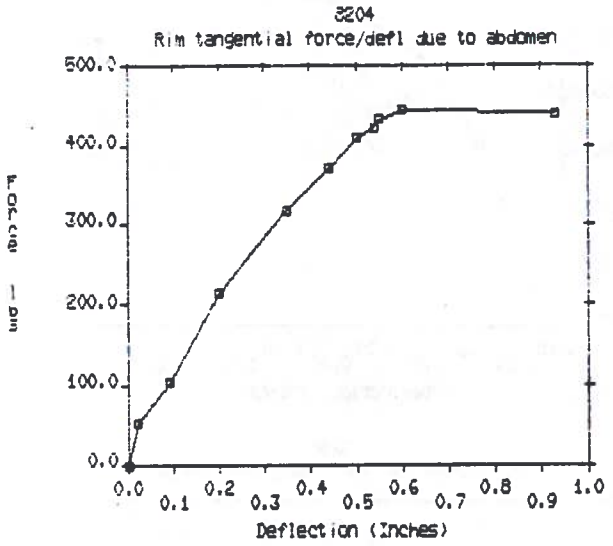

Rim radial force/defl due to shoulder
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
Deflection (Inches)

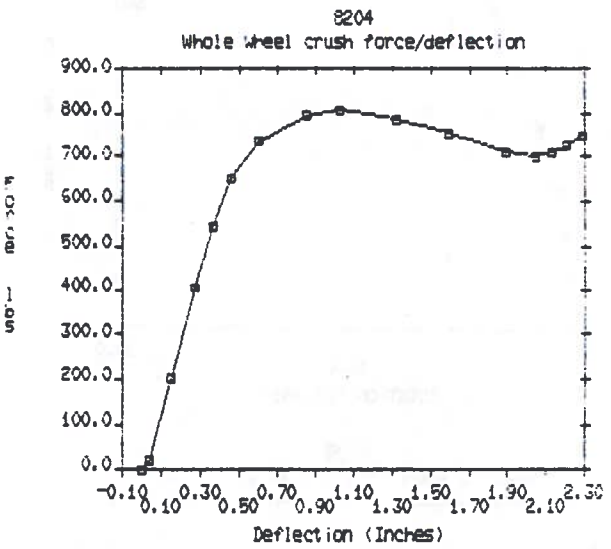

9205
Negative wheel torque/rotation wrt col
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Rotation (Degrees)

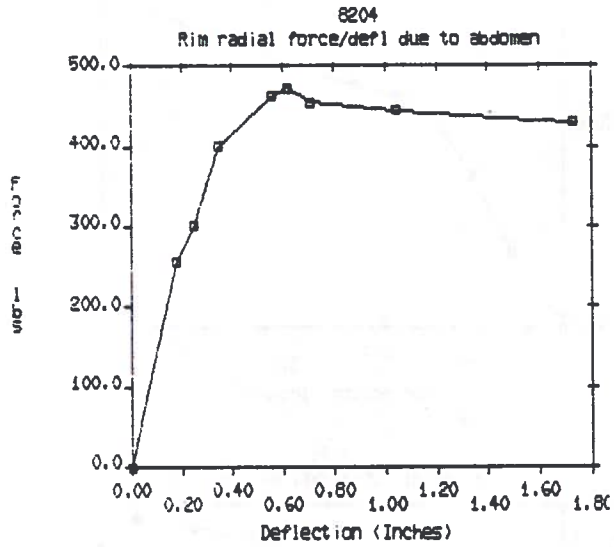

9205
Rim tangential force/defl due to head
260.0
130.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
Deflection (Inches)

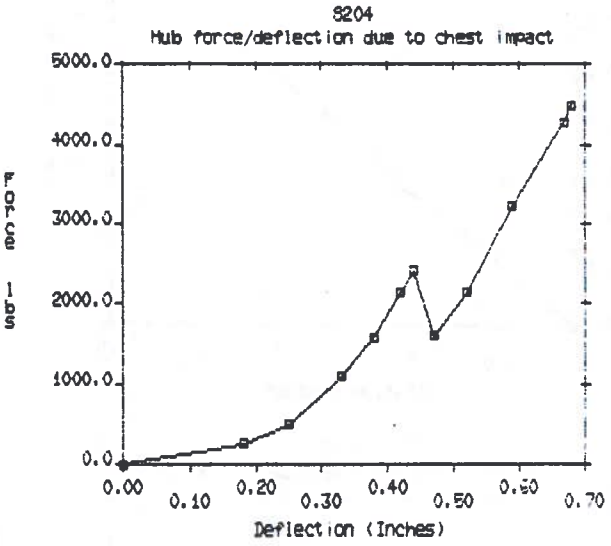

9205
Rim tangential force/defl due to shoulder
260.0
130.0

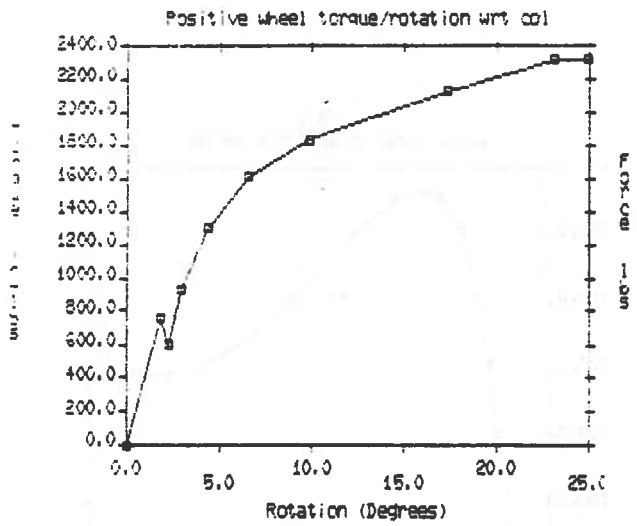

9205
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0

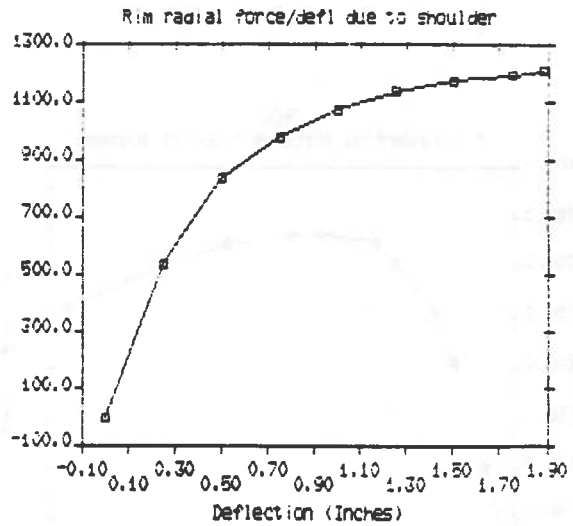

8204
Rim tangential force/defl due to abdomen
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Deflection (Inches)

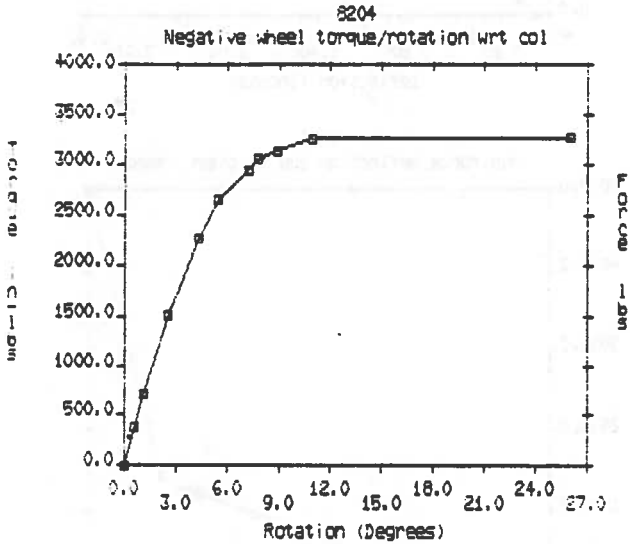

8204
Whole Wheel crush force/deflection
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90 2.10 2.30
Deflection (Inches)

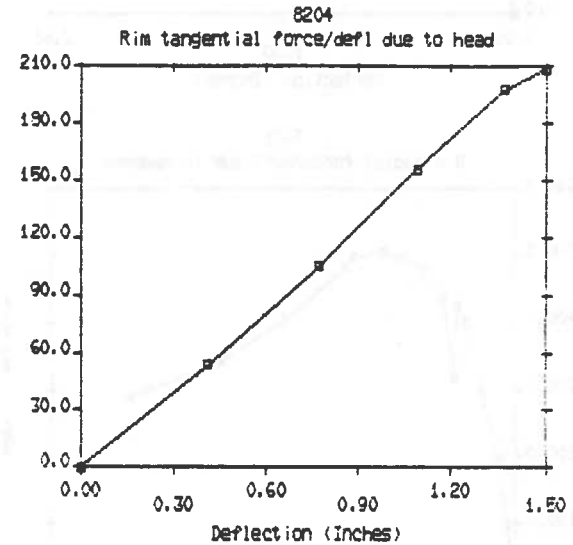

8204
Rim radial force/defl due to abdomen
500.0
400.0
300.0
200.0
100.0
0.0
0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Deflection (Inches)

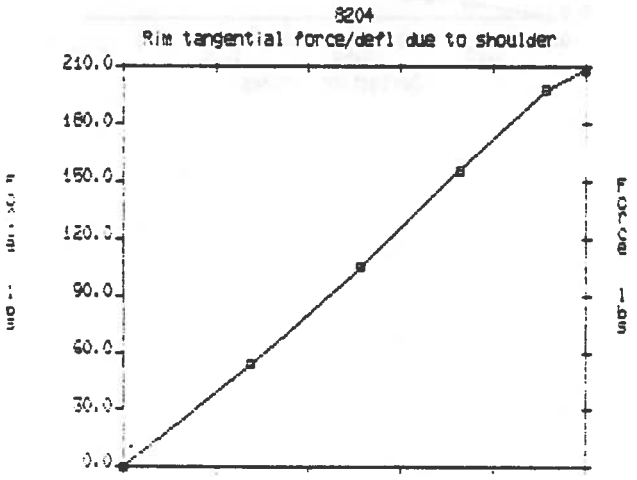

8204
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70
Deflection (Inches)

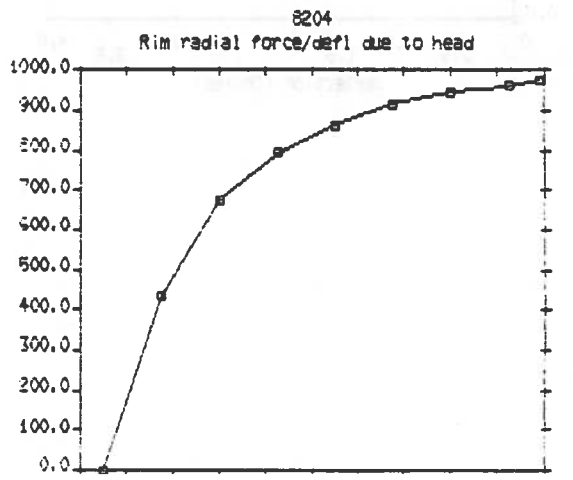

Positive wheel torque/rotation wrt col
2400.0
2200.0
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
5.0
10.0
15.0
20.0
Rotation (Degrees)

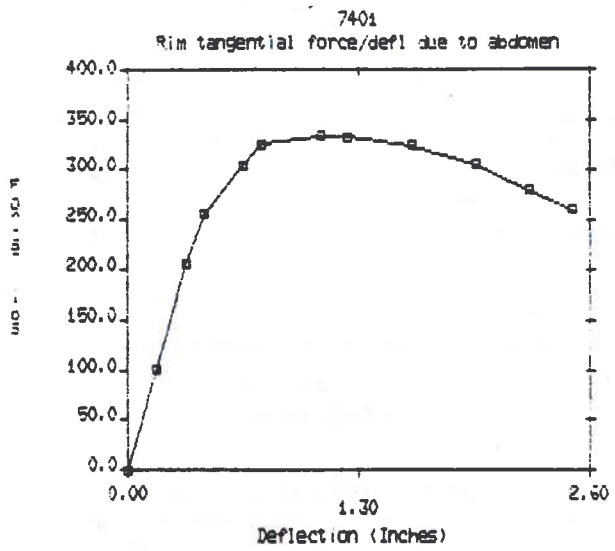

Rim radial force/defl due to shoulder
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

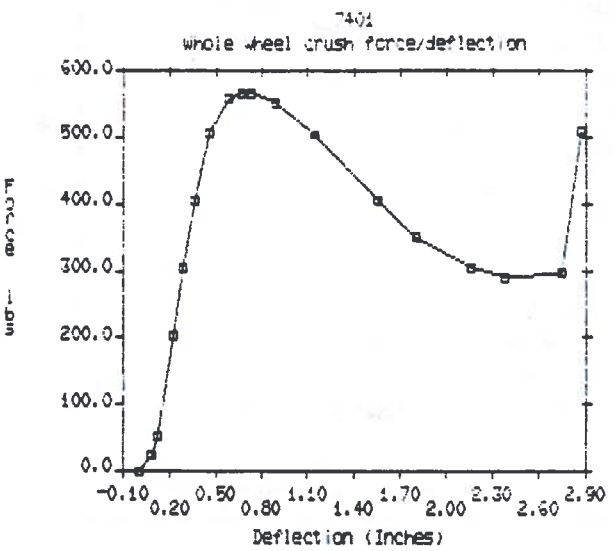

8204
Negative wheel torque/rotation wrt col
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
3.0
6.0
9.0
12.0
15.0
18.0
21.0
24.0
Rotation (Degrees)

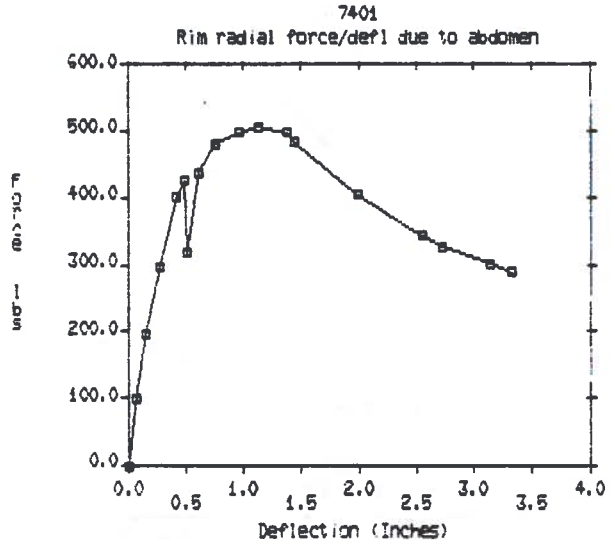

8204
Rim tangential force/defl due to head
210.0
180.0
150.0
120.0
90.0
60.0
30.0
0.0
0.00
0.30
0.60
0.90
1.20
1.50
Deflection (Inches)

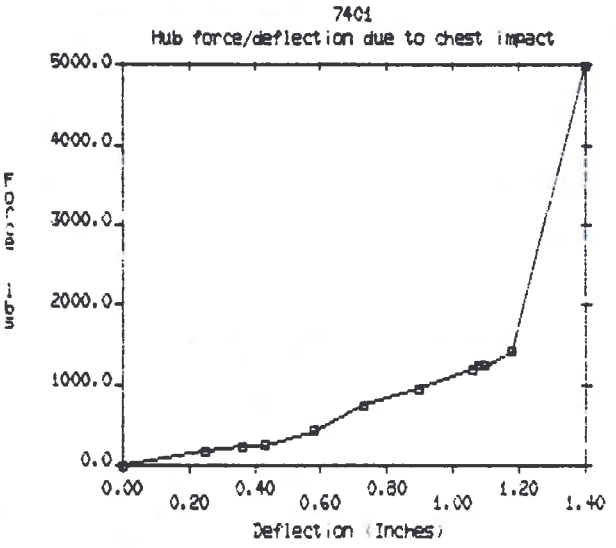

8204
Rim tangential force/defl due to shoulder
210.0
180.0
150.0
120.0
90.0
60.0
30.0
0.0

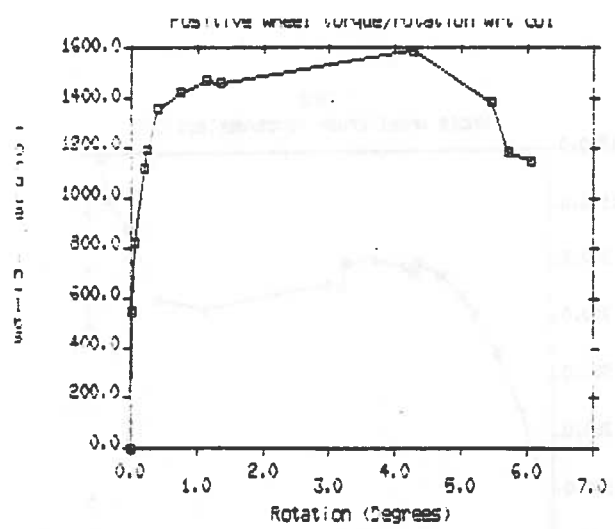

8204
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

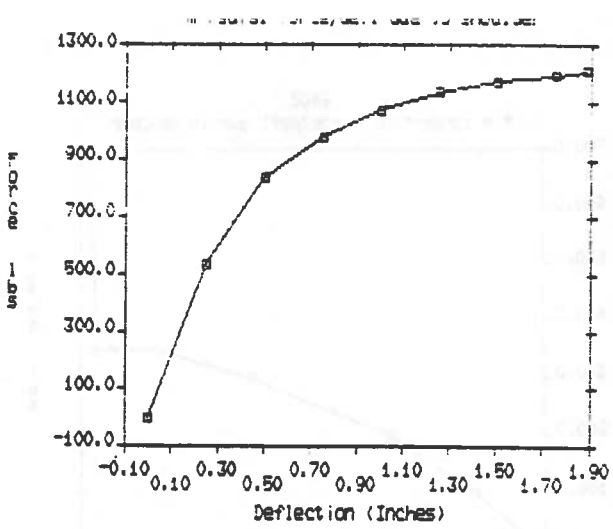

7401
Rim tangential force/defl due to abdomen
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
0.00
1.30
2.60
Deflection (Inches)

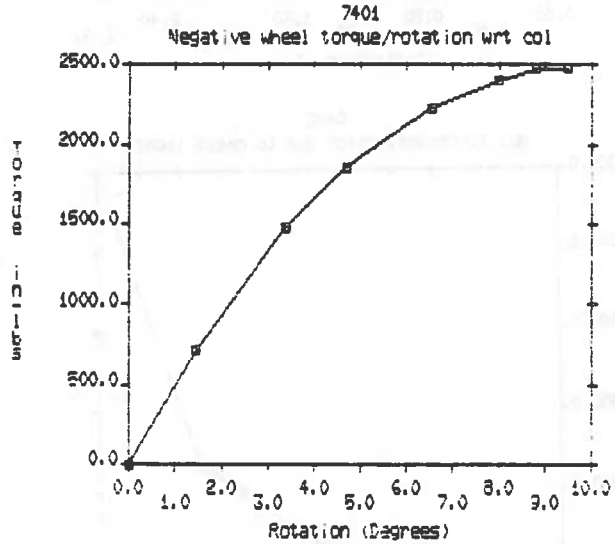

7401
Whole wheel crush force/deflection
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10
0.20
0.50
0.80
1.10
1.40
1.70
2.00
2.30
2.60
2.90
Deflection (Inches)

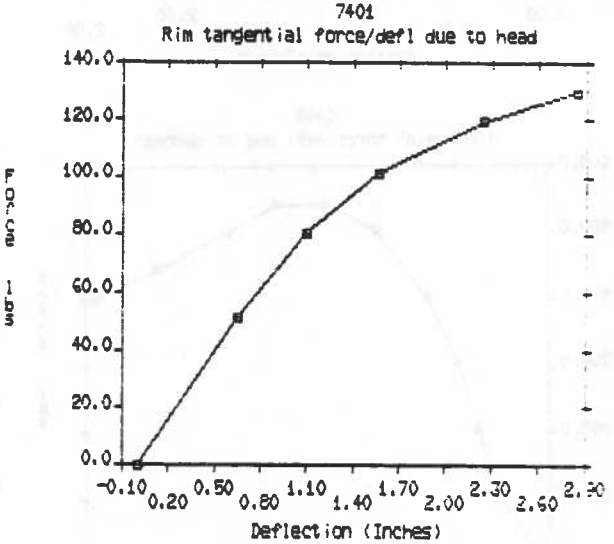

7401
Rim radial force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Deflection (Inches)

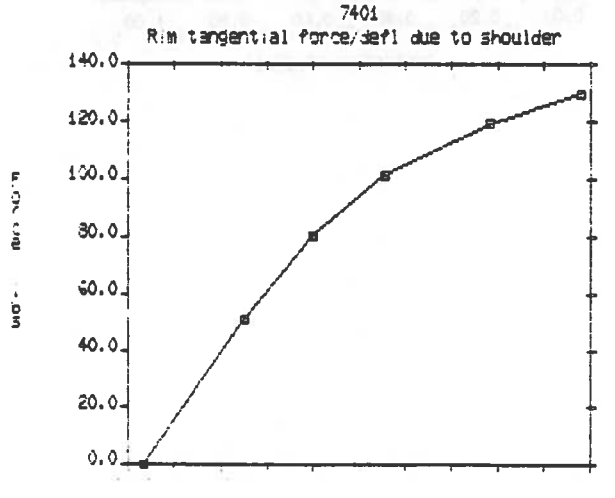

7401
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

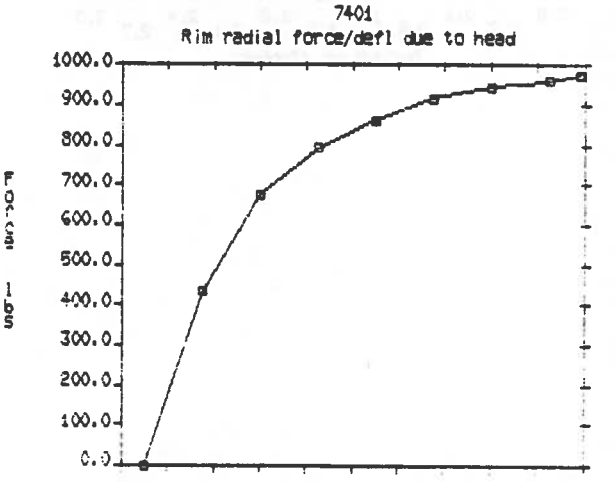

1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
Rotation (Degrees)

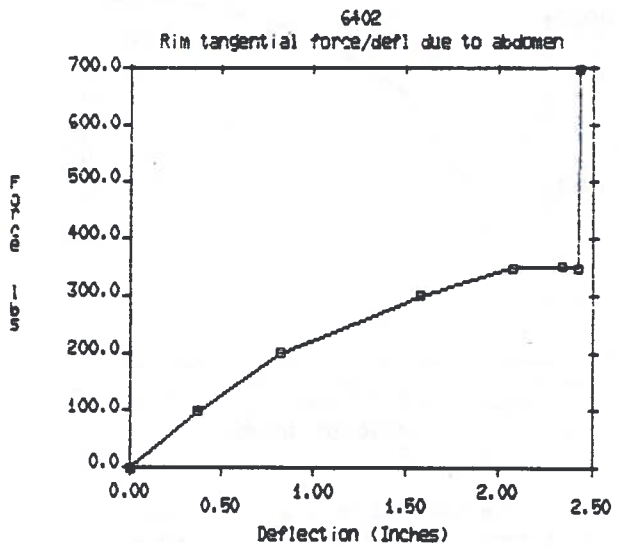

1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

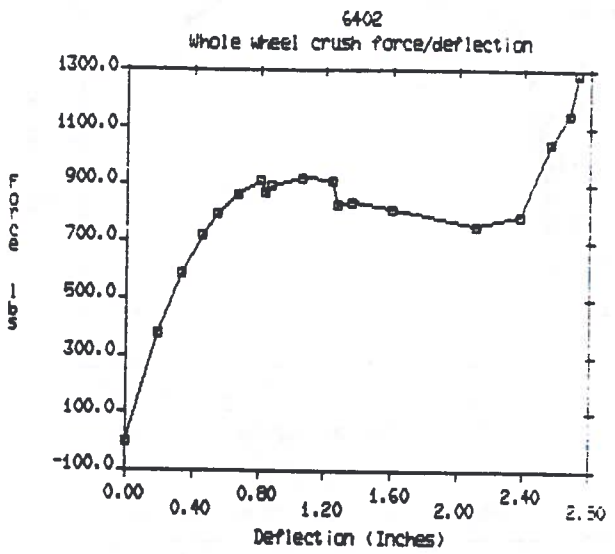

7401
Negative wheel torque/rotation wrt col
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Rotation (Degrees)

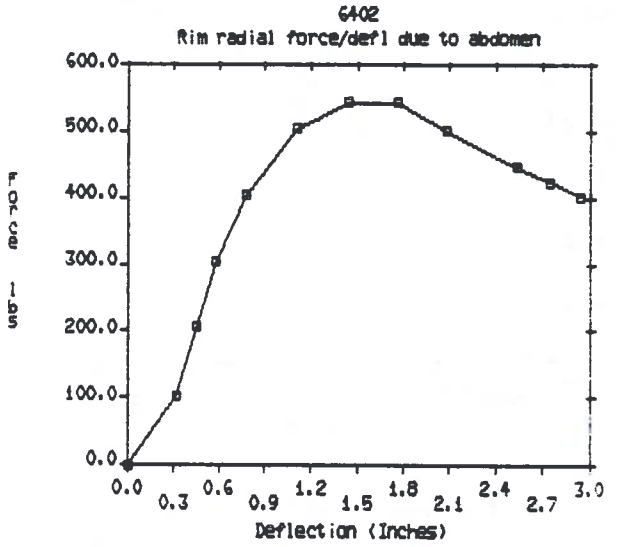

7401
Rim tangential force/defl due to head
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-0.10
0.20
0.50
0.80
1.10
1.40
1.70
2.00
2.30
Deflection (Inches)

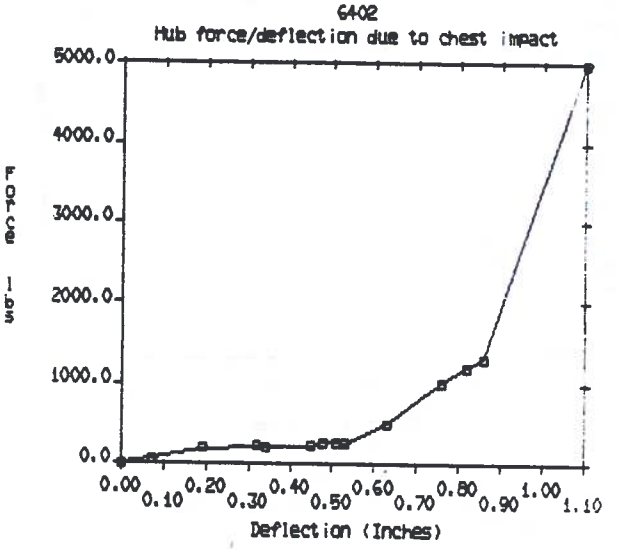

7401
Rim tangential force/defl due to shoulder
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0

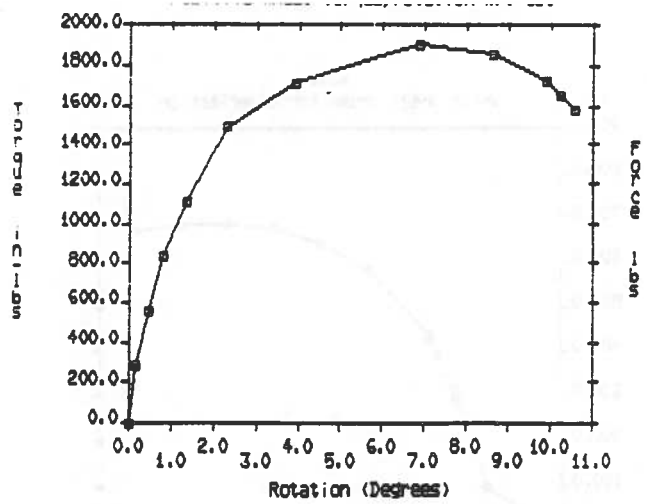

7401
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

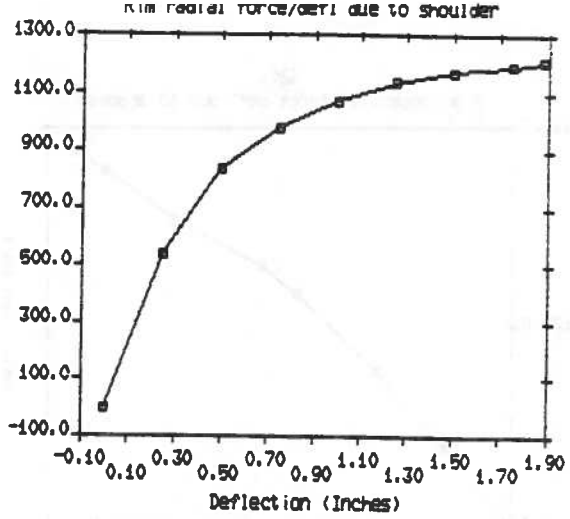

6402
Rim tangential force/defl due to abdomen
Force - lbs
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.50
1.00
1.50
2.00
2.50
Deflection (Inches)

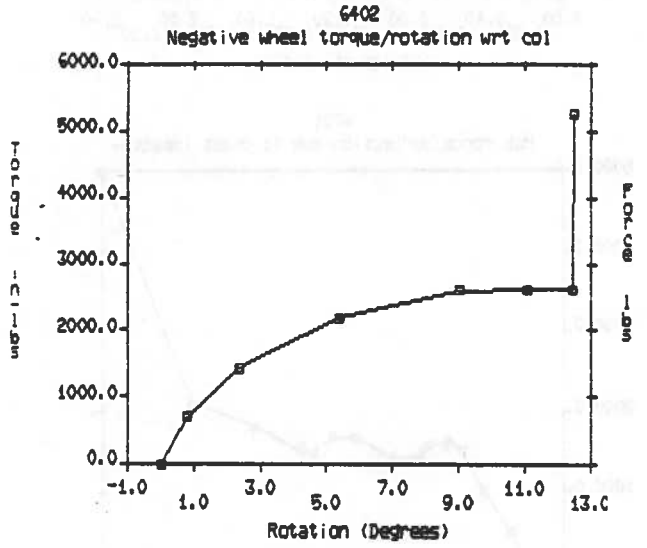

6402
Whole wheel crush force/deflection
Force - lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.00
0.40
0.80
1.20
1.60
2.00
2.40
2.50
Deflection (Inches)

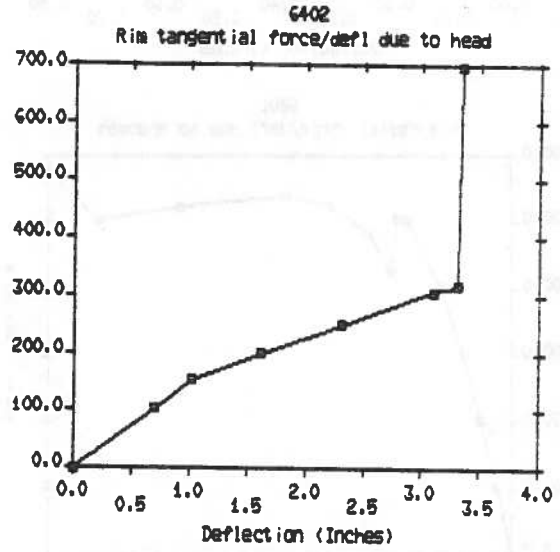

6402
Rim radial force/defl due to abdomen
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
Deflection (Inches)

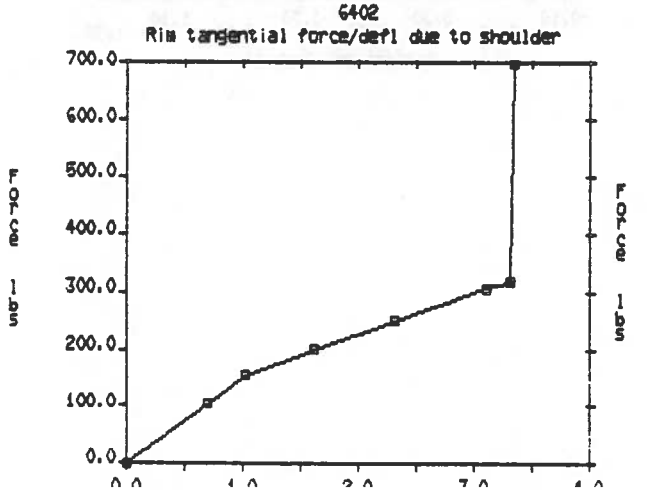

6402
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
1.10
Deflection (Inches)

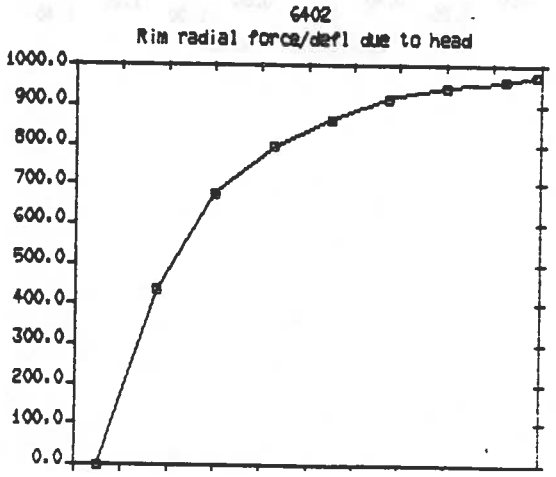

Torque - in-lbs
Force - lbs
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0
Rotation (Degrees)

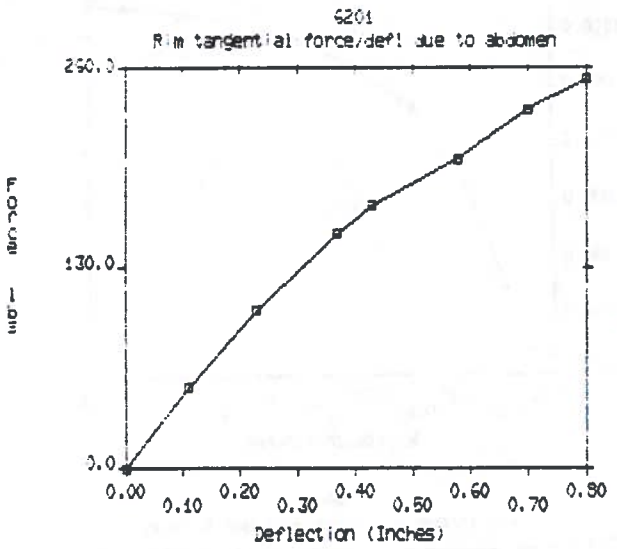

Rim radial force/defl due to shoulder
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70 1.90
Deflection (Inches)

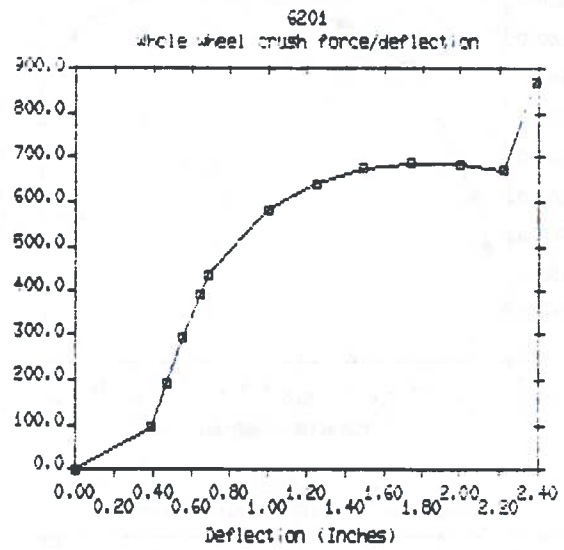

6402
Negative wheel torque/rotation wrt col
Torque - in-lbs
Force - lbs
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-1.0 1.0 3.0 5.0 7.0 9.0 11.0 13.0
Rotation (Degrees)

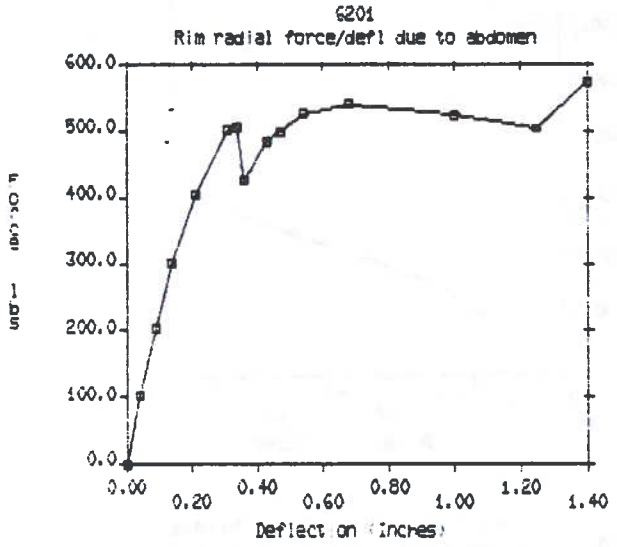

6402
Rim tangential force/defl due to head
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Deflection (Inches)

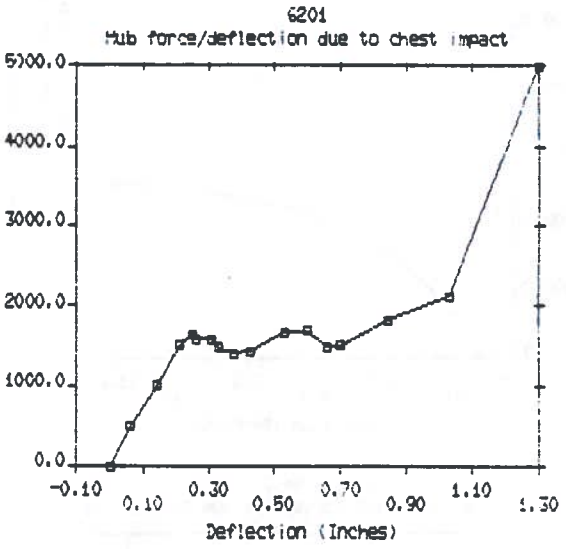

6402
Rim tangential force/defl due to shoulder
Force - lbs
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

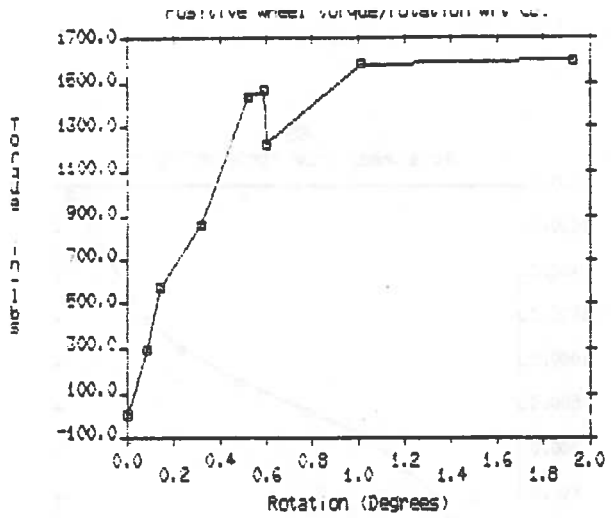

6402
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

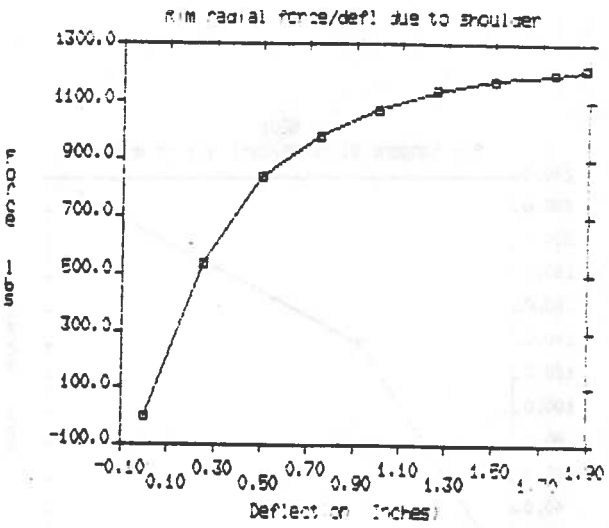

6201
Rim tangential force/defl due to abdomen
Force - lbs
260.0
130.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
Deflection (Inches)

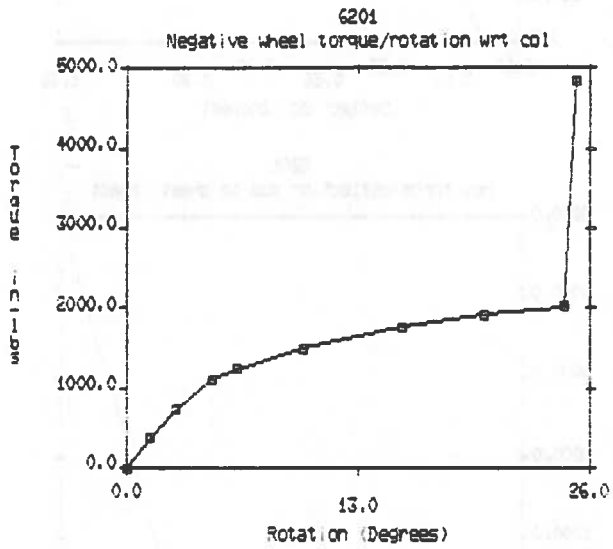

6201
Whole Wheel Crush force/deflection
Force - lbs
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
2.20
2.40
Deflection (Inches)

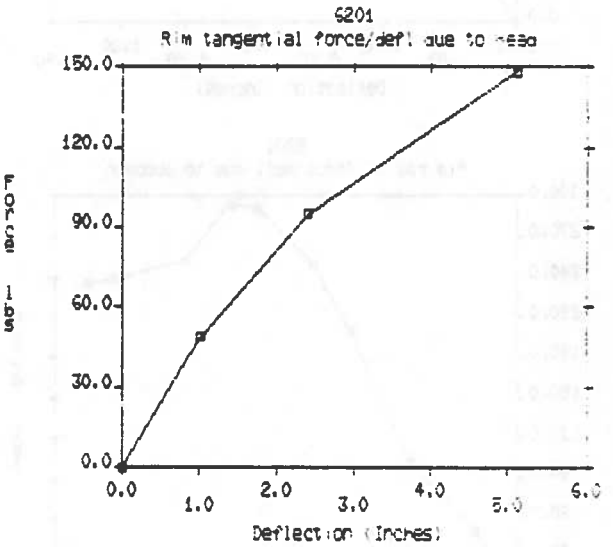

6201
Rim radial force/defl due to abdomen
Force - lbs
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

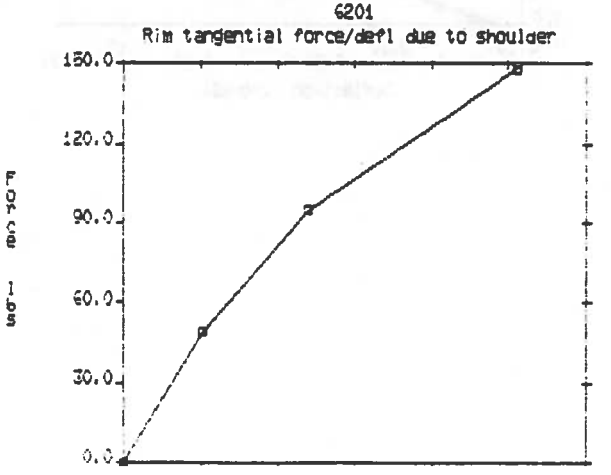

6201
Hub force/deflection due to chest impact
Force - lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

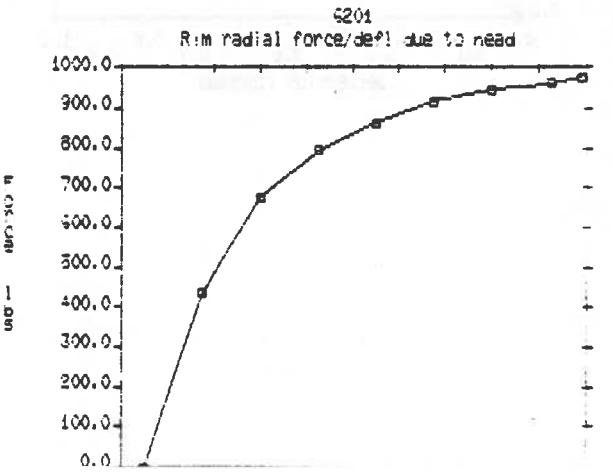

Positive wheel torque/rotation wrt col
Torque - Lbs
1700.0
1500.0
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Rotation (Degrees)

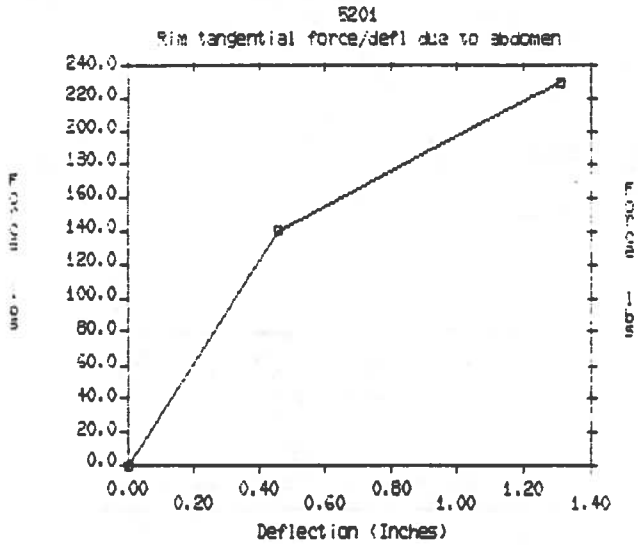

Rim radial force/defl due to shoulder
Load - Lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.90
Deflection (Inches)

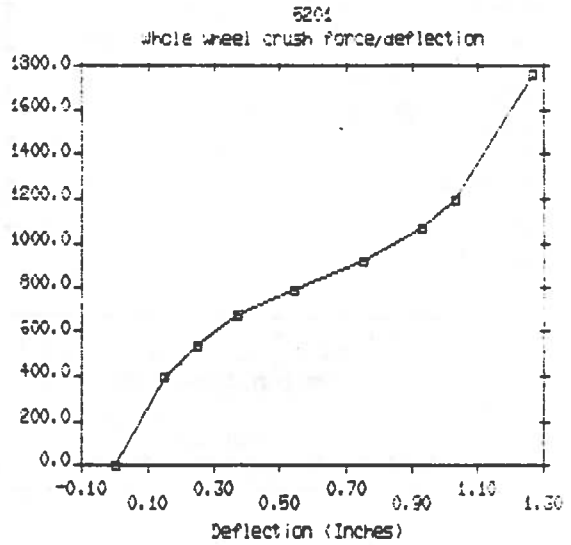

6201
Negative wheel torque/rotation wrt col
Torque - Lbs
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
13.0
26.0
Rotation (Degrees)

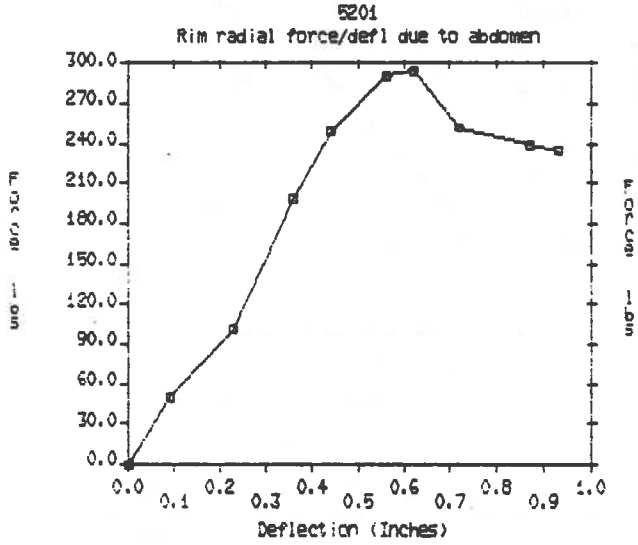

6201
Rim tangential force/defl due to shoulder
Load - Lbs
150.0
120.0
90.0
60.0
30.0
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
Deflection (Inches)

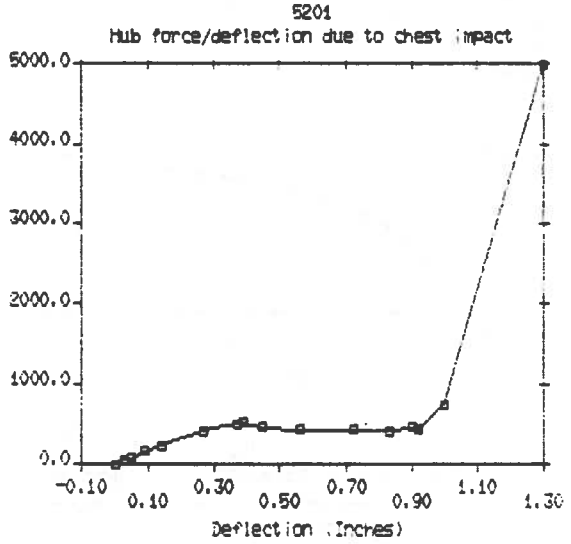

6201
Rim tangential force/defl due to shoulder
Load - Lbs
150.0
120.0
90.0
60.0
30.0
0.0

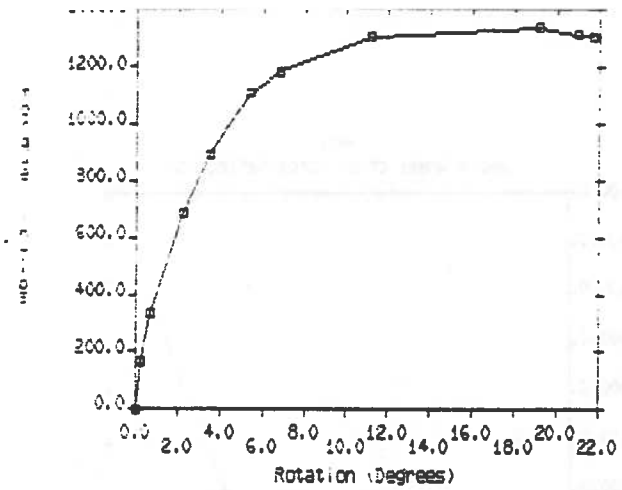

6201
Rim radial force/defl due to head
Load - Lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0

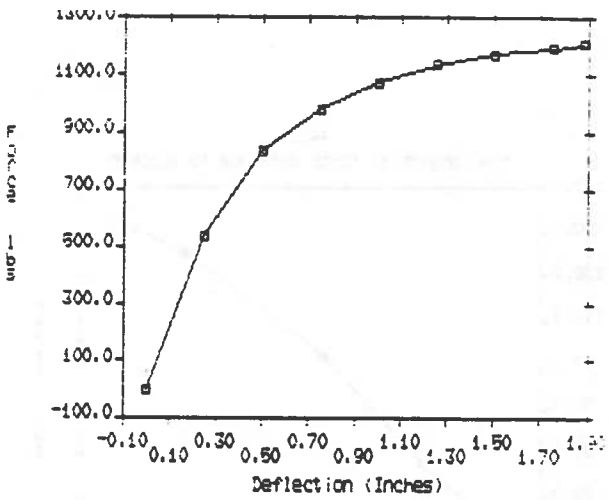

5201
Rim tangential force/defl due to abdomen
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

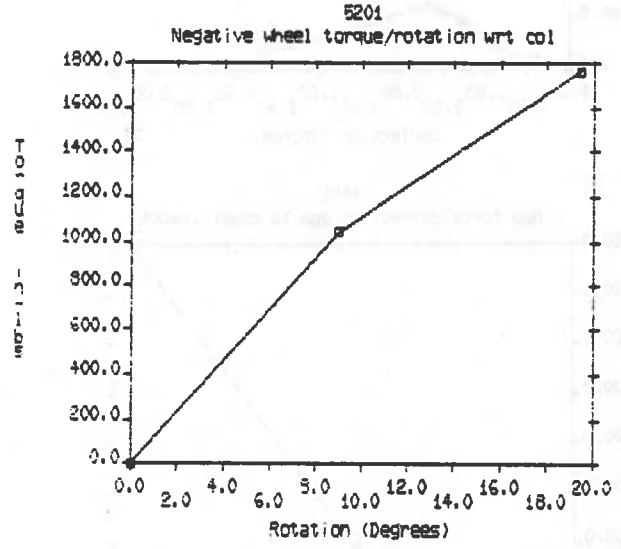

5201
Whole wheel crush force/deflection
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

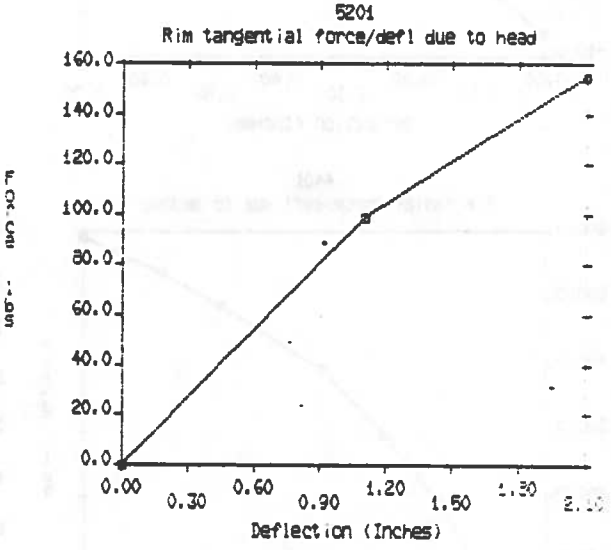

5201
Rim radial force/defl due to abdomen
300.0
270.0
240.0
210.0
180.0
150.0
120.0
90.0
60.0
30.0
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Deflection (Inches)

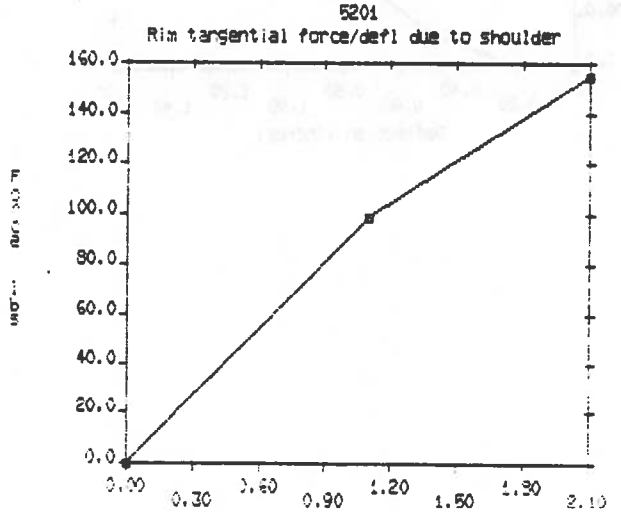

5201
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
Deflection (Inches)

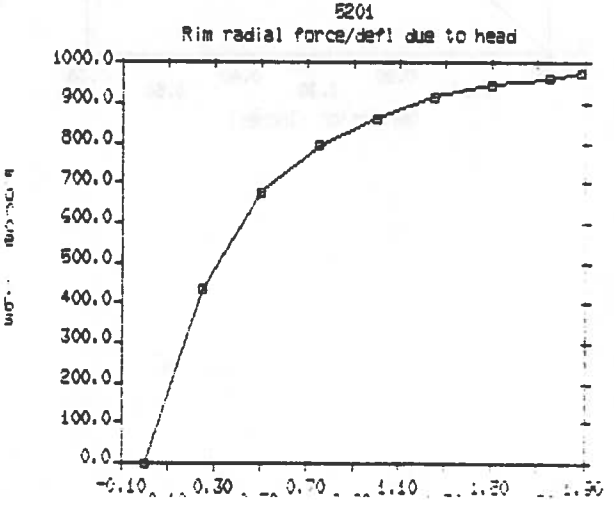

1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0
Rotation (Degrees)

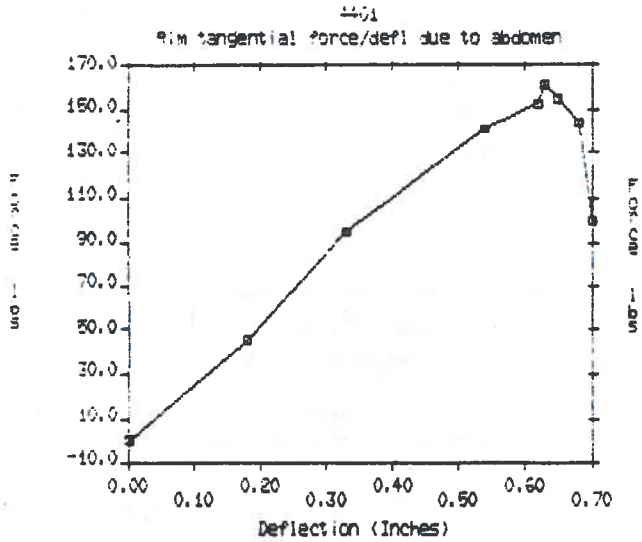

1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10 0.10 0.30 0.50 0.70 0.90 1.10 1.30 1.50 1.70
Deflection (Inches)

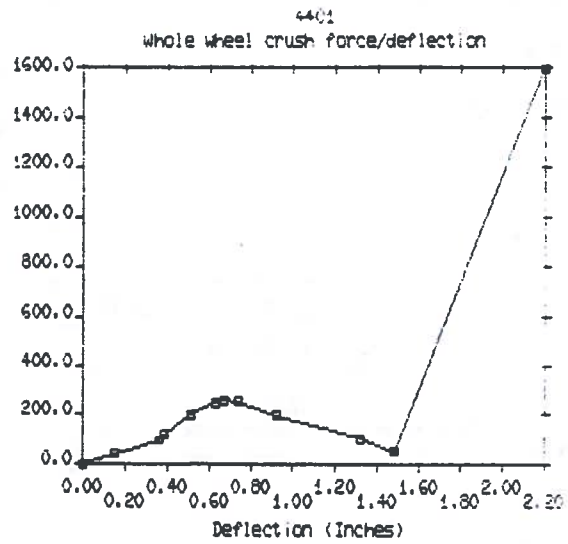

5201
Negative wheel torque/rotation wrt col
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0
Rotation (Degrees)

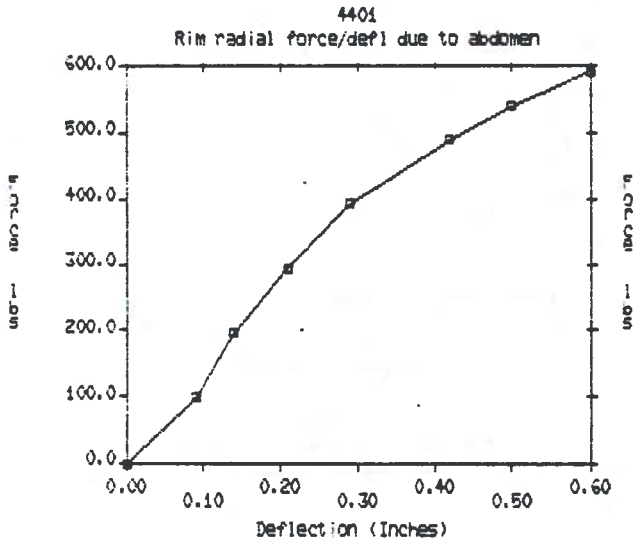

5201
Rim tangential force/defl due to head
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00 0.30 0.60 0.90 1.20 1.50 1.80
Deflection (Inches)

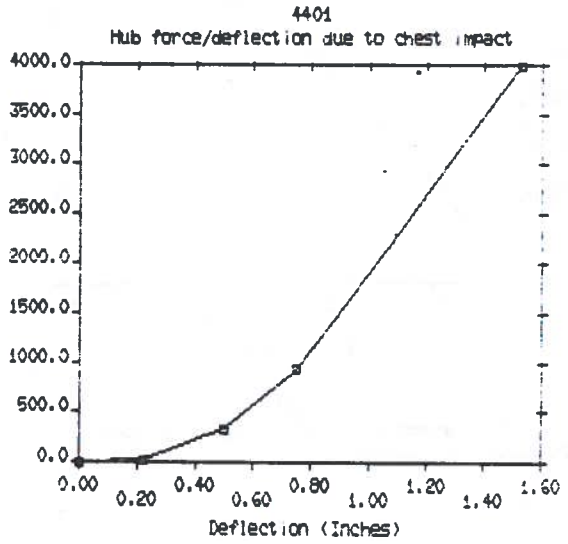

5201
Rim tangential force/defl due to shoulder
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00 0.30 0.60 0.90 1.20 1.50 1.80

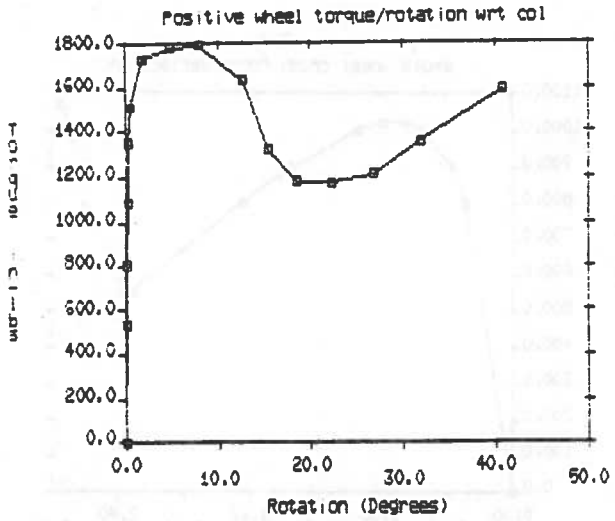

5201
Rim radial force/defl due to head
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
-0.10 0.30 0.70 1.10

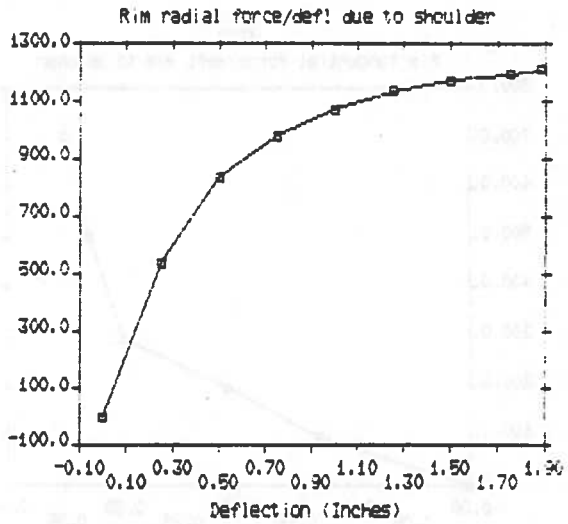

4401
Rim tangential force/defl due to abdomen
170.0
150.0
130.0
110.0
90.0
70.0
50.0
30.0
10.0
-10.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Deflection (Inches)

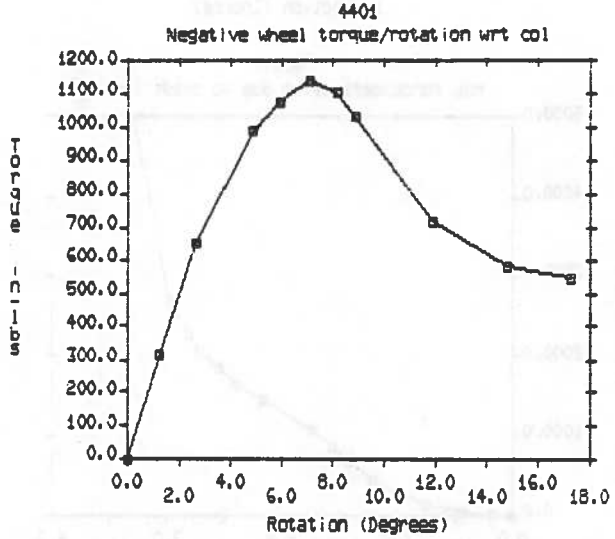

4401
Whole wheel crush force/deflection
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
Deflection (Inches)

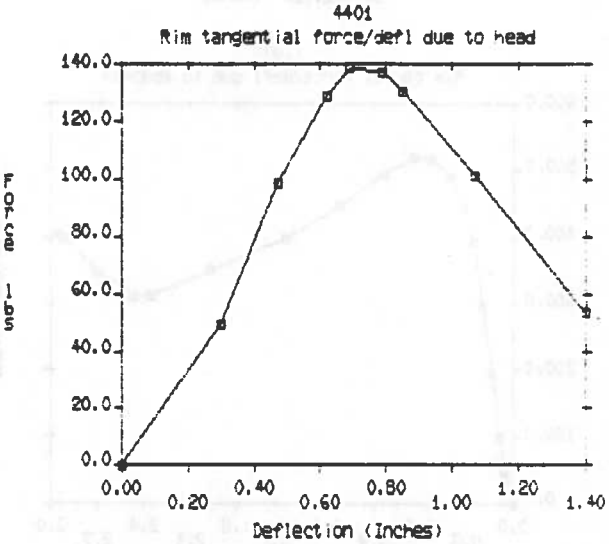

4401
Rim radial force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
Deflection (Inches)

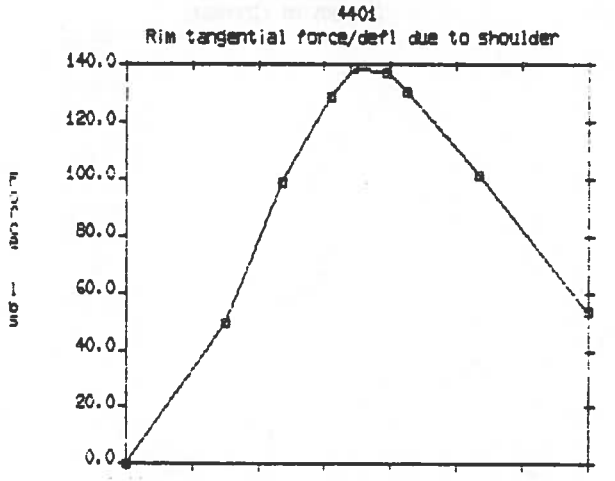

4401
Hub force/deflection due to chest impact
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
Deflection (Inches)

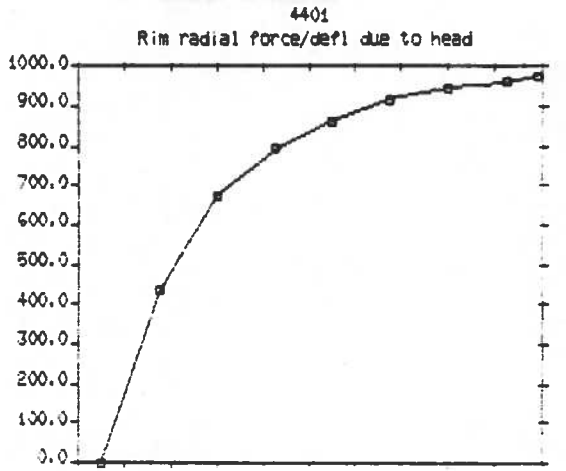

Positive wheel torque/rotation wrt col
Torque - Lbs-Ft
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
0.0
10.0
20.0
30.0
40.0
50.0
Rotation (Degrees)

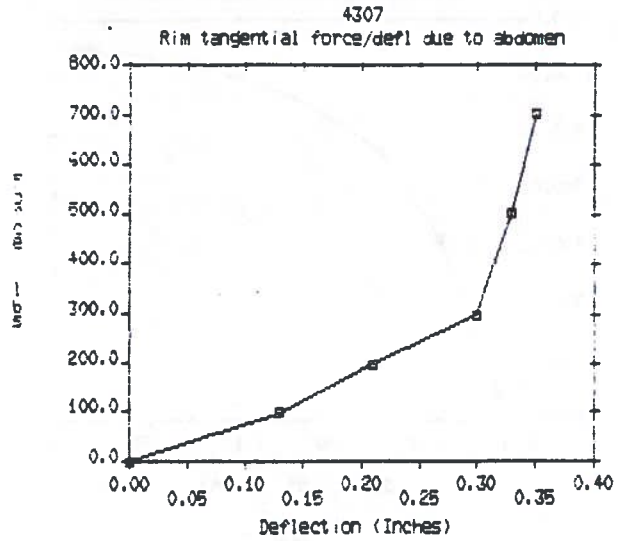

Rim radial force/defl due to shoulder
Force - Lbs
1300.0
1100.0
900.0
700.0
500.0
300.0
100.0
-100.0
-0.10
0.10
0.30
0.50
0.70
0.90
1.10
1.30
1.50
1.70
1.90
Deflection (Inches)

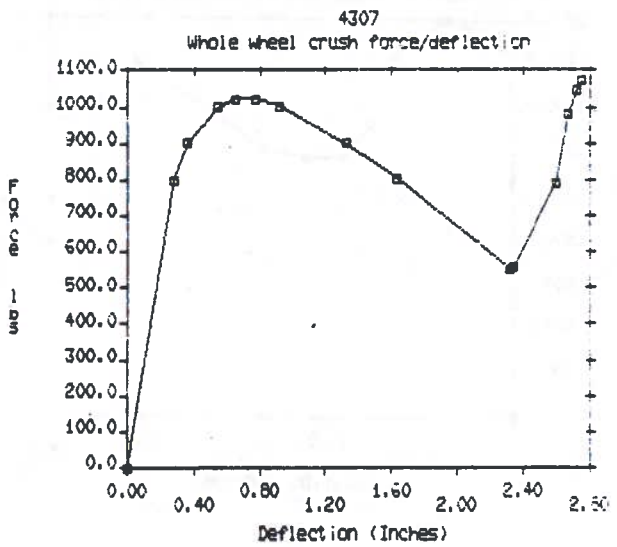

4401
Negative wheel torque/rotation wrt col
Torque - Lbs-Ft
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
Rotation (Degrees)

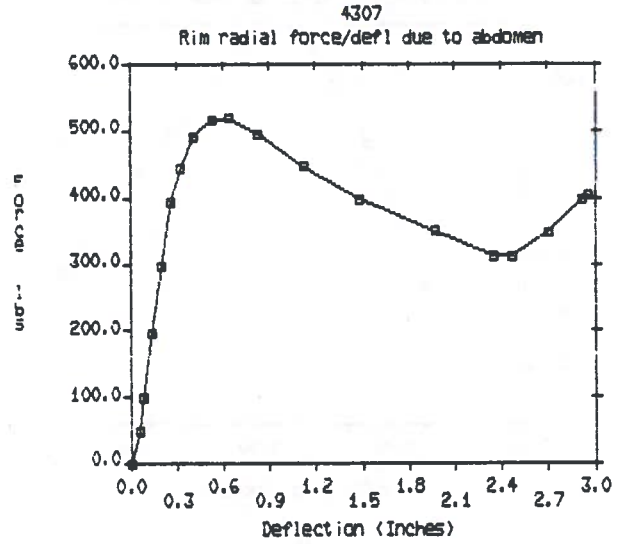

4401
Rim tangential force/defl due to head
Force - Lbs
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Deflection (Inches)

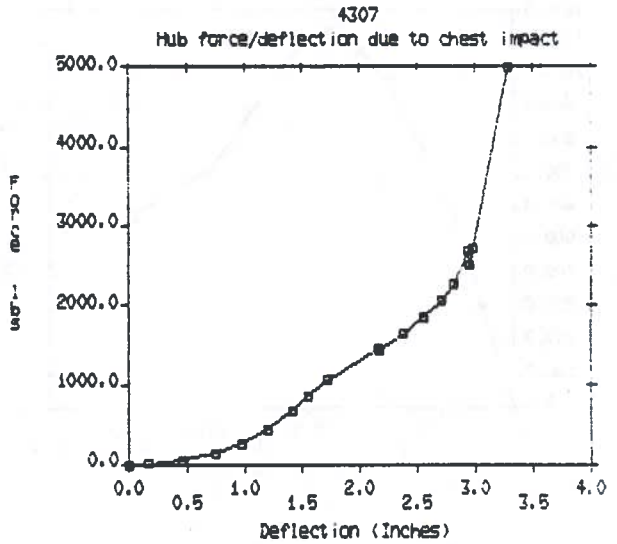

4401
Rim tangential force/defl due to shoulder
Force - Lbs
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0


4401
Rim radial force/defl due to head
Force - Lbs
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0


4307
Rim tangential force/defl due to abdomen
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Deflection (Inches)


4307
Whole wheel crush force/deflection
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.00
0.40
0.80
1.20
1.60
2.00
2.40
Deflection (Inches)


4307
Rim radial force/defl due to abdomen
600.0
500.0
400.0
300.0
200.0
100.0
0.0
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
Deflection (Inches)


4307
Hub force/deflection due to chest impact
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Deflection (Inches)