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**National Highway
Traffic Safety
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August 1994

Final Report

Final Report of 1991 Plymouth Acclaim Rear Impact CNG Fuel Tank Integrity

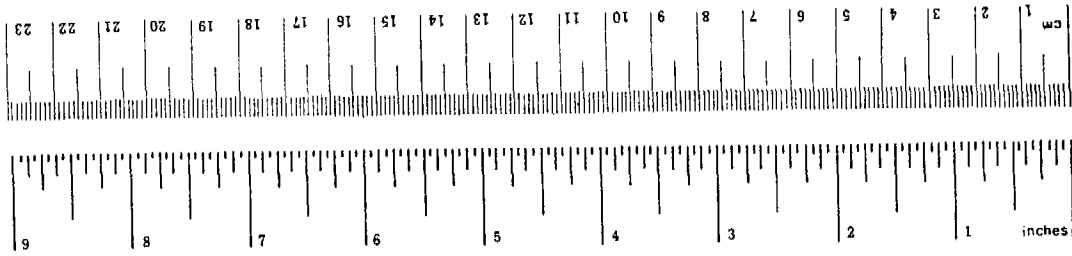
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16. Abstract A gasoline-powered vehicle was converted to operate as a dual fueled (gasoline/CNG) vehicle. The conversion met the minimum standards of National Fire Protection Association Procedure Number 52 (NFPA 52). The purpose of this test was to evaluate the suitability of NFPA 52 for ensuring adequate safety in vehicles converted to CNG after first sale. This 48 kph rear impact was conducted at Transportation Research Center Inc. on July 6, 1994. The subject vehicle, a 1991 Plymouth Acclaim 4-door sedan, VIN 1P3XA46K7MF666206, was tested according to the rear impact test procedures prescribed in FMVSS 303. The actual impact speed was 49.3 kph. In the hour following the impact, a pressure drop of 132 kPa was recorded, which is well within the requirements specified in FMVSS 303 for OEM vehicles.					
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures			Approximate Conversions from Metric Measures					
Symbol	When You Know	Multiply by	To Find	Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH								
in	inches	*2.5	centimeters	mm	millimeters	0.04	inches	in
ft	feet	30	centimeters	cm	centimeters	0.4	inches	in
yd	yards	0.9	meters	m	meters	3.3	feet	ft
mi	miles	1.6	kilometers	km	kilometers	1.1	yards	yd
						0.6	miles	mi
AREA								
in ²	square inches	6.5	square centimeters	cm ²	square centimeters	0.16	square inches	in ²
ft ²	square feet	0.09	square meters	m ²	square meters	1.2	square yards	yd ²
yd ²	square yards	0.8	square meters	m ²	square kilometers	0.4	square miles	mi ²
mi ²	square miles	2.6	square kilometers	km ²	square kilometers	2.5	acres	ac
	acres	0.4	hectares	ha	hectares (10,000 m ²)			
MASS (weight)								
oz	ounces	28	grams	g	grams	0.035	ounces	oz
lb	pounds	0.45	kilograms	kg	kilograms	2.2	pounds	lb
	short tons	0.9	tonnes	t	tonnes (1000 kg)	1.1	short tons	st
	(2000 lb)							
VOLUME								
tsp	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces	fl oz
Tbsp	tablespoons	15	milliliters	ml	liters	2.1	pints	pt
fl oz	fluid ounces	30	milliliters	ml	liters	1.06	quarts	qt
c	cups	0.24	liters	l	liters	0.26	gallons	gal
pt	pints	0.47	liters	l	cubic meters	35	cubic feet	ft ³
qt	quarts	0.95	liters	l	cubic meters	1.3	cubic yards	yd ³
gal	gallons	3.8	liters	l				
ft ³	cubic feet	0.03	cubic meters	m ³				
yd ³	cubic yards	0.76	cubic meters	m ³				
TEMPERATURE (exact)								
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



*1 in = 2.54 exactly. For other chart conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price \$2.25, SD Catalog No. C1310286.

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SECTION 1.0

PURPOSE AND TEST PROCEDURE

PURPOSE

This 48 kph moving barrier rear impact test was conducted for Vehicle Research and Test Center by Transportation Research Center Inc. (TRC). The purpose of this test was to evaluate the suitability of National Fire Protection Association Procedure Number 52 (NFPA 52) for ensuring adequate safety in vehicles converted to CNG after first sale. The subject vehicle for this test was a 1991 Plymouth Acclaim 4-door sedan.

TEST PROCEDURE

This test was conducted in accordance with the applicable portions of NHTSA's Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure No. TP-301-00, with the addition of vehicle accelerometers. Data was obtained relative to fuel system integrity.

The test vehicle was instrumented with seven (7) accelerometers to measure longitudinal, lateral, and vertical axis accelerations, two (2) thermocouples to measure tank and ambient temperatures, and a pressure transducer to measure fuel system pressure. The moving barrier was instrumented with three (3) accelerometers to measure longitudinal, lateral, and vertical axis accelerations. The moving barrier impacted the test vehicle's rear in the specified impact velocity range of 47.5 to 49.1 kph.

The test vehicle contained two (2) uninstrumented Part 572 B 50th percentile adult anthropomorphic test devices (dummies) positioned in the front outboard designated seating positions. The fuel system was filled with nitrogen gas at 20,648 kPa at 21° C.

The ten (10) acceleration data channels were multiplexed and recorded on a 14-track tape drive. The acceleration data was digitally sampled at 12500 samples per second and processed according to SAE J211 OCT88. The pressure and temperature data was recorded by a Fluke 2625A Data Logger. The data logger sampled the data at 2.7 sec/sample.

The crash event was recorded by one (1) real-time panning motion picture camera and seven (7) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The rear impact data are presented in Section 2.0. The camera information is presented in Section 3.0. Appendix A contains the still photographic prints. Appendix B contains the vehicle and moving barrier data plots. Appendix C contains miscellaneous test information.

SECTION 2.0

REAR IMPACT TEST SUMMARY

TEST RESULTS SUMMARY

This rear impact moving barrier test was conducted at TRC on July 6, 1994.

The test vehicle, a 1991 Plymouth Acclaim 4-door sedan, appeared to comply with the proposed performance requirements of FMVSS 303 in the rear moving barrier impact mode. The pressure transducer recorded a pressure drop of 132 kPa during the one-hour period immediately following the impact.

The test vehicle was equipped with a 2.5-liter transverse engine, automatic transmission, power steering, and power brakes. The vehicle's test weight was 1633 kilograms. The vehicle's maximum static crush was 460 millimeters. The moving barrier's test weight was 1822 kilograms. The moving barrier's impact speed was 49.2 kph.

TABLE 1 CRASH TEST SUMMARY

TEST TYPE: Rear Moving Barrier Impact

TEST DATE: 07/06/94 TEST TIME: 1409 AMBIENT TEMP. (°C): 35

VEHICLE: 1991 Plymouth Acclaim 4-door sedan

VEHICLE TEST WEIGHT (KGS.): 1634

MOVING BARRIER TEST WEIGHT (KGS.): 1822

IMPACT ANGLE¹ (DEG): 180

IMPACT VELOCITY² (KPH): PRIMARY = 49.2 SECONDARY = 49.2

MAXIMUM STATIC CRUSH (MM): 460

DUMMIES:	Driver	Passenger
TYPE:	Part 572 B	Part 572 B
LOCATION:	Left front	Right front
RESTRAINT:	Three-point unbelt	Three-point unbelt
NUMBER OF DATA CHANNELS:	10	
NUMBER OF CAMERAS:	HIGH-SPEED 7	REAL-TIME 1

¹With respect to tow track centerline.

²Speed trap measurement ($\pm .05$ mph accuracy)

TABLE 2 TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: Chrysler Corporation

MAKE/MODEL: Plymouth/Acclaim

VIN: 1P3XA46K7MF666206

BODY STYLE: 4-door sedan

MODEL YEAR: 1991

COLOR: Tan

ENGINE DATA: TYPE: Transverse CYLINDERS: 4 DISPLACEMENT: 2.5 liters

TRANSMISSION DATA: 3 SPEED, MANUAL, X AUTOMATIC, X FWD, RWD, 4WD

DATE VEHICLE RECEIVED: 06/30/94

ODOMETER READING: 67,442

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	Yes
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	Yes
POWER SEATS	No	TILTING STEERING WHEEL	Yes
POWER WINDOWS	No	TELESCOPING STEERING WHEEL	No
TINTED GLASS	Yes	AIR CONDITIONING	Yes
RADIO	Yes	ANTI-SKID BRAKE	No
CLOCK	Yes	REAR WINDOW DEFROSTER	Yes
OTHER	None		

REMARKS:

1. IS THE VEHICLE STOCK THROUGHOUT? No¹
2. DOES VEHICLE SHOW EVIDENCE OF PRIOR ACCIDENT HISTORY? No
3. DOES VEHICLE SHOW ANY SIGNIFICANT CORROSION? No
4. CONDITION OF THE FRONT/REAR BUMPER AND FRAME: Good

CERTIFICATION DATA FROM VEHICLE'S LABEL:

VEHICLE MANUFACTURED BY: Chrysler Corporation

DATE OF MANUFACTURE: 04/91

VIN: 1P3XA46K7MF666206

GVWR: 1845 KGS.

GAWR: FRONT: 1009 KGS.

REAR: 858 KGS.

¹ The vehicle was modified to operate on compressed natural gas.

TABLE 2 TEST VEHICLE INFORMATION, CONT'D.

TIRES ON VEHICLE (MFR., LINE, SIZE): MasterCraft, P185/70R14

TIRE PRESSURE WITH MAXIMUM CAPACITY VEHICLE LOAD: FRONT: 240 kPa
REAR: 240 kPa

SPARE TIRE (MFR., LINE, SIZE): Temp Goodyear, T125/70D14

TYPE OF SEATS: FRONT: Bucket
REAR: Bench

TYPE OF FRONT SEAT BACKS: Manually adjustable

WHEELBASE: 2629 millimeters

LOCATION OF LABEL STATING TIRE & CAPACITY DATA:

The label was located on the driver's door.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE: P185/70R14

RECOMMENDED COLD TIRE PRESSURE: FRONT: 240 KPa; REAR: 240 KPa

DESIGNATED SEATING CAPACITY: 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT: 392 KGS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN MILLIMETERS):

DELIVERED ATTITUDE: LF 691; RF 695; LR 656; RR 651

PRE-TEST ATTITUDE: LF 643; RF 640; LR 632; RR 638

POST-TEST ATTITUDE: LF 689; RF 660; LR 824; RR 768

TABLE 2 TEST VEHICLE INFORMATION, CONT'D.

WEIGHT OF TEST VEHICLE AS RECEIVED (WITH MAXIMUM FLUIDS):

RIGHT FRONT	404 KGS.	RIGHT REAR	300 KGS.
LEFT FRONT	426 KGS.	LEFT REAR	300 KGS.
TOTAL FRONT WEIGHT	830 KGS.	(58.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	600 KGS.	(42.0% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT 1430 KGS.			

CALCULATION OF TEST VEHICLE'S TARGET TEST WEIGHT:

RCLW¹ = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (1431 KGS.)

VCW¹ = VEHICLE CAPACITY WEIGHT (392 KGS.)

DSC¹ = DESIGNATED SEATING CAPACITY (5)

RCLW¹ = VCW - 68 (DSC) = 52 KGS.

TARGET TEST WEIGHT = UDW + RCLW¹ + (NO. OF HYBRID II DUMMIES X 74 KGS./DUMMY)

TARGET TEST WEIGHT = 1430 + 52 + 148 = 1630 KGS.

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 55 KGS. OF CARGO WEIGHT:

RIGHT FRONT	452 KGS.	RIGHT REAR	347 KGS.
LEFT FRONT	509 KGS.	LEFT REAR	325 KGS.
TOTAL FRONT WEIGHT	961 KGS.	(58.8% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	672 KGS.	(41.2% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	1633 KGS.	(0.2% OVER TARGET TEST WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE: 0 KGS.

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: None

CG = 1082 MILLIMETERS REARWARD OF FRONT WHEEL CENTERLINE

¹ Cargo weight for multipurpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 136 kilograms, whichever is less.

TABLE 3 POST-IMPACT DATA

TEST NUMBER: 940706

TEST DATE: 07/06/94

TEST TIME: 1409

TEST TYPE: Rear Moving Barrier Impact

IMPACT ANGLE: 180°

AMBIENT TEMPERATURE AT IMPACT AREA: 35° C

IMPACT VELOCITY: PRIMARY = 49.2 KPH

SECONDARY = 49.2 KPH

(SPECIFIED RANGE = 47.5 TO 49.1 KPH)

DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 356 MM.

EXITING VELOCITY TRAP = 51 MM.

TEST VEHICLE STATIC CRUSH (ALL MEASUREMENTS ARE IN MILLIMETERS):

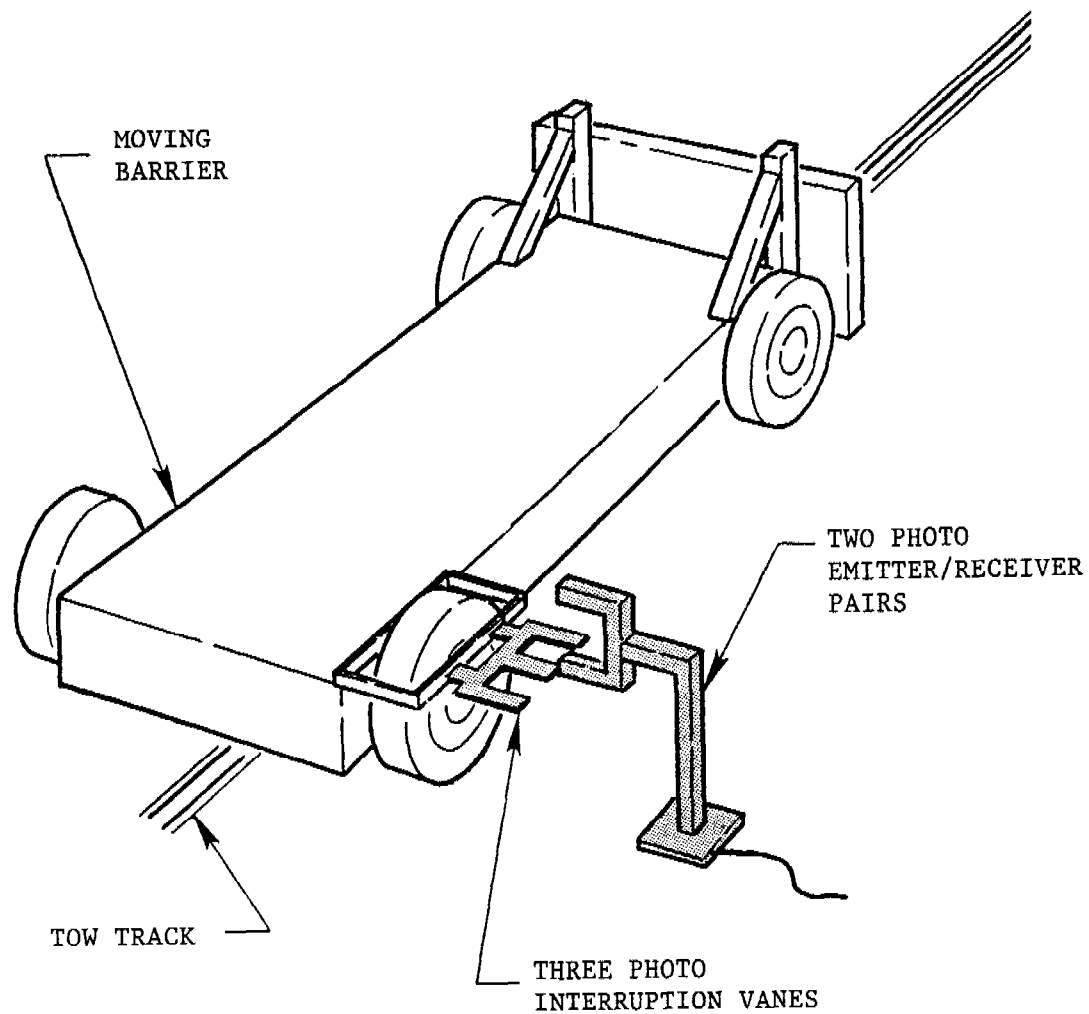
OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: L 4613; C 4625; R 4602

POST-TEST: L 4232; C 4270; R 4239

TOTAL CRUSH: L 381; C 355; R 363

AVERAGE CRUSH: 366

FIGURE 1 IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane clears emitter/receiver 51 millimeters before impact.

The vanes have 356-millimeter spacing.

TABLE 4 POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS:

	DRIVER	PASSENGER
HEAD	<u>NA</u>	<u>NA</u>
CHEST	<u>NA</u>	<u>NA</u>
ABDOMEN	<u>NA</u>	<u>NA</u>
LEFT KNEE	<u>NA</u>	<u>NA</u>
RIGHT KNEE	<u>NA</u>	<u>NA</u>

DOOR OPENING:

	LEFT	RIGHT
FRONT	<u>Opened easily</u>	<u>Opened easily</u>
REAR	<u>Difficult</u>	<u>Difficult</u>

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	<u>Both back seats failed</u>	<u>No</u>
REAR	<u>No</u>	<u>No</u>

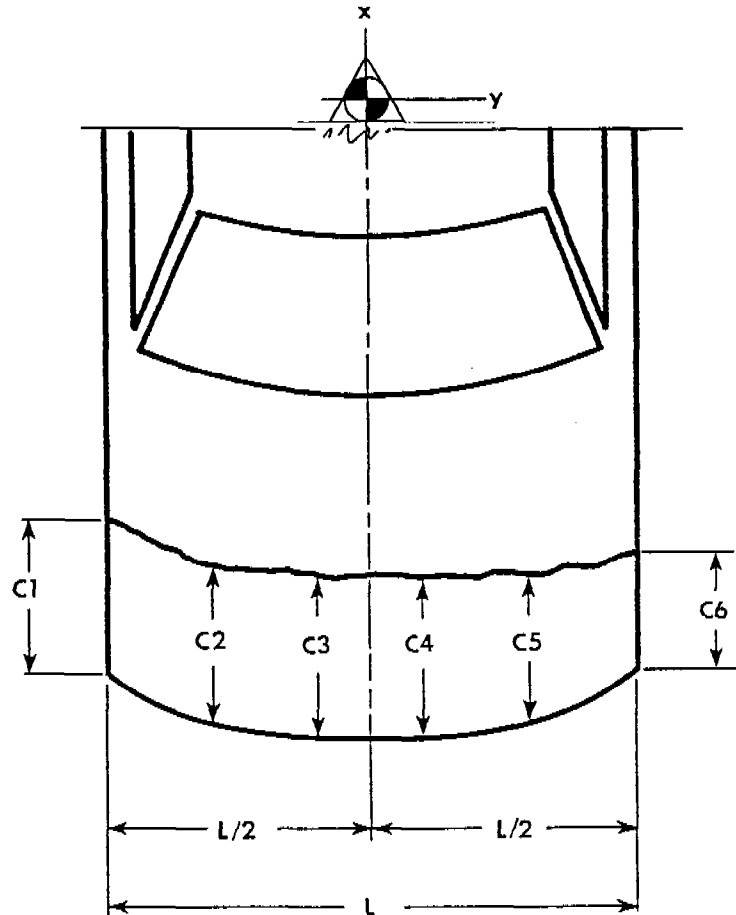
GLAZING DAMAGE:

The rear window shattered during the crash

OTHER NOTABLE IMPACT EFFECTS:

None

FIGURE 2 VEHICLE CRUSH

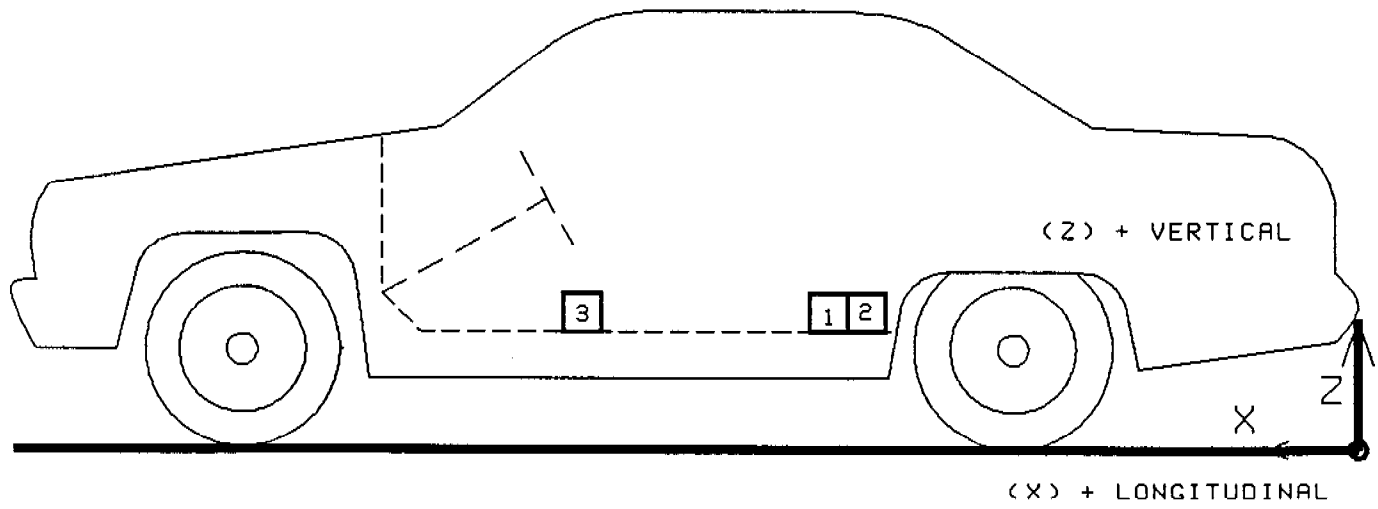


NOTES: L is pre-test length of contact surface.
 C1 through C6 are spaced equally apart.
 CL is vehicle centerline.
 All measurements are in millimeters.

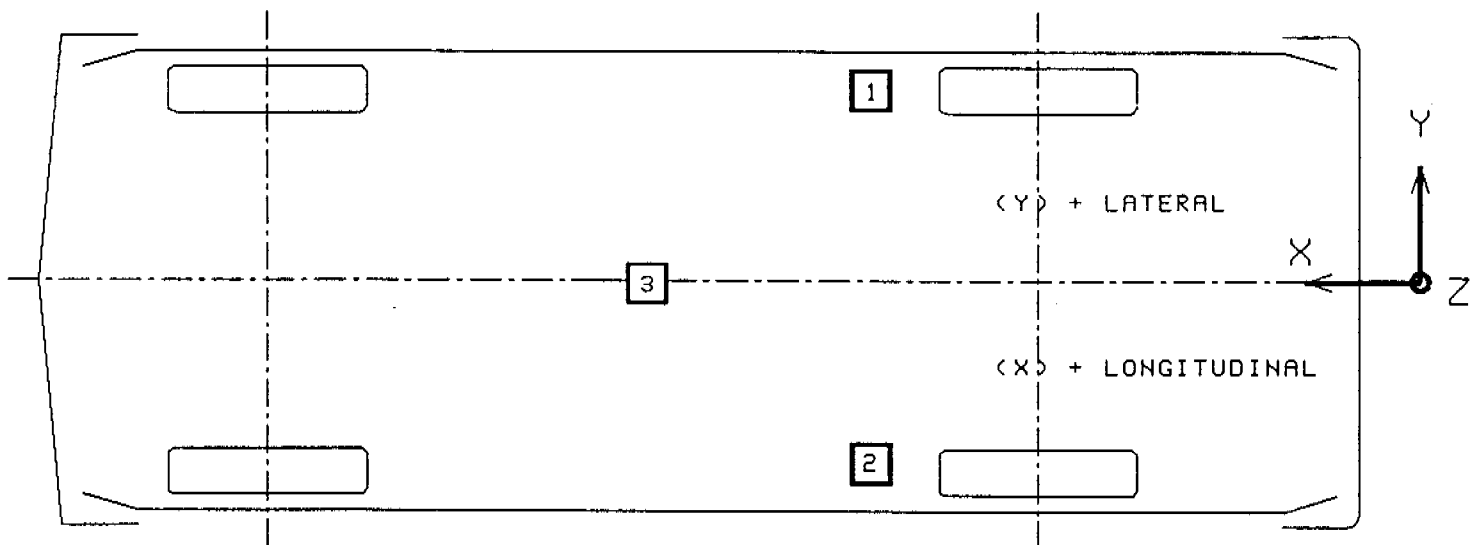
Vehicle Plymouth Acclaim 4-door sedan

	PRE-TEST	POST-TEST	CRUSH
L	<u>1422</u>		
C1	<u>4613</u>	C1 <u>4232</u>	C1 <u>381</u>
C2	<u>4623</u>	C2 <u>4214</u>	C2 <u>409</u>
C3	<u>4623</u>	C3 <u>4163</u>	C3 <u>460</u>
C4	<u>4623</u>	C4 <u>4194</u>	C4 <u>429</u>
C5	<u>4618</u>	C5 <u>4211</u>	C5 <u>407</u>
C6	<u>4602</u>	C6 <u>4239</u>	C6 <u>363</u>
CL	<u>4625</u>	CL <u>4270</u>	CL <u>355</u>

FIGURE 3 VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



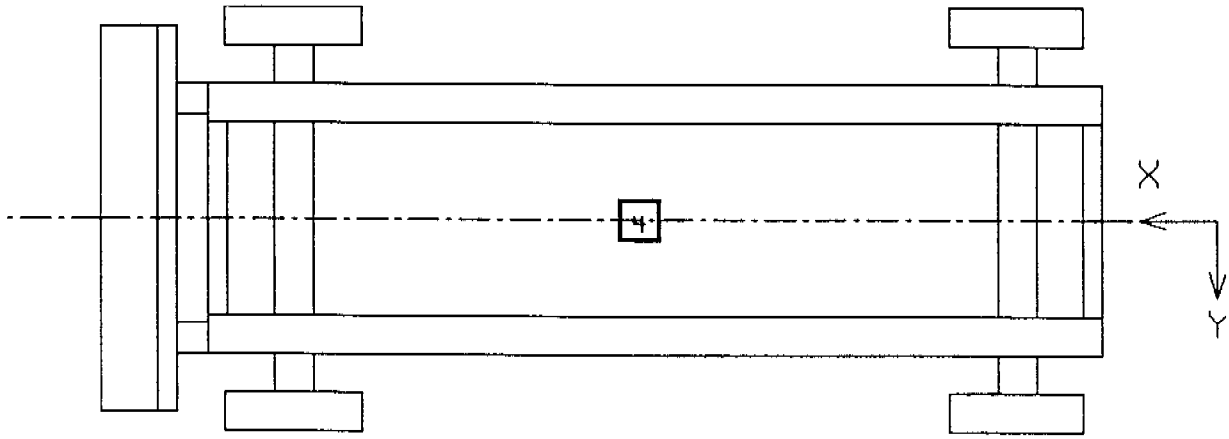
BOTTOM VIEW

TABLE 5 VEHICLE ACCELEROMETERS LOCATIONS AND DATA SUMMARY

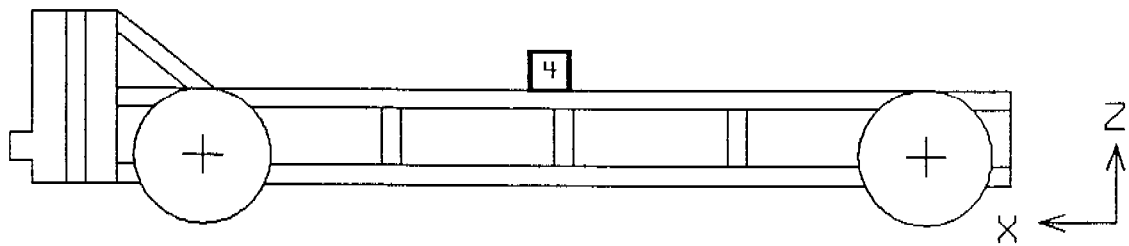
TEST NUMBER: 940706				POSITIVE		NEGATIVE	
No. LOCATION	X	Y	Z	DIRECTION	DIRECTION	DIRECTION	DIRECTION
1 LEFT REAR SILL LONGITUDINAL VERTICAL	1698 mm	724 mm	352 mm	15.1 g @ 45.2 ms 8.7 g @ 46.6 ms	1.9 g @ 140.6 ms 9.2 g @ 12.6 ms		
2 RIGHT REAR SILL LONGITUDINAL VERTICAL	1698 mm	-724 mm	352 mm	13.9 g @ 45.0 ms 8.9 g @ 32.2 ms	2.8 g @ 20.6 ms 7.3 g @ 42.4 ms		
3 VEHICLE CENTER OF GRAVITY LONGITUDINAL LATERAL VERTICAL RESULTANT	2643 mm	0 mm	384 mm	14.2 g @ 43.3 ms 4.1 g @ 61.7 ms 9.7 g @ 31.0 ms 14.3 g @ 43.2 ms	1.6 g @ 138.1 ms 1.2 g @ 32.2 ms 6.5 g @ 111.8 ms		

REFERENCE: X: + FORWARD FROM REAR BUMPER
 Y: + LEFTWARD FROM VEHICLE CENTERLINE
 Z: + UPWARD FROM GROUND LEVEL

FIGURE 4 MOVING BARRIER ACCELEROMETER PLACEMENT



TOP VIEW



SIDE VIEW

TABLE 7 FUEL SYSTEM DATA

MAKE/MODEL: Plymouth/Acclaim
FUEL SYSTEM CAPACITY: 62.1 LITERS
RATED SERVICE PRESSURE: 20,684 kPa AT 21° C

Actual Test Pressures and Temperatures:

Time following impact (sec)	Tank pressure (kPa)	Temperatures (° C)	
		Inside trunk	Outside Ambient
0	20,643	39.9	33.4
900	20,628	35.1	35.2
1800	20,600	35.4	35.1
2700	20,555	34.8	35.2
3600	20,511	35.5	35.2

TEST GAS TYPE: NITROGEN

DETAILS OF FUEL SYSTEM: The fuel tank was located in the trunk. The fuel filler neck was located at the left front corner of the engine compartment. The fuel lines ran along the right underbody to the engine compartment.

FUEL INJECTION: Yes

DOES ELECTRIC FUEL PUMP OPERATE WITH IGNITION SWITCH "ON" AND THE ENGINE NOT OPERATING? No

SECTION 3.0

CAMERA INFORMATION

FIGURE 5 CAMERA POSITIONS

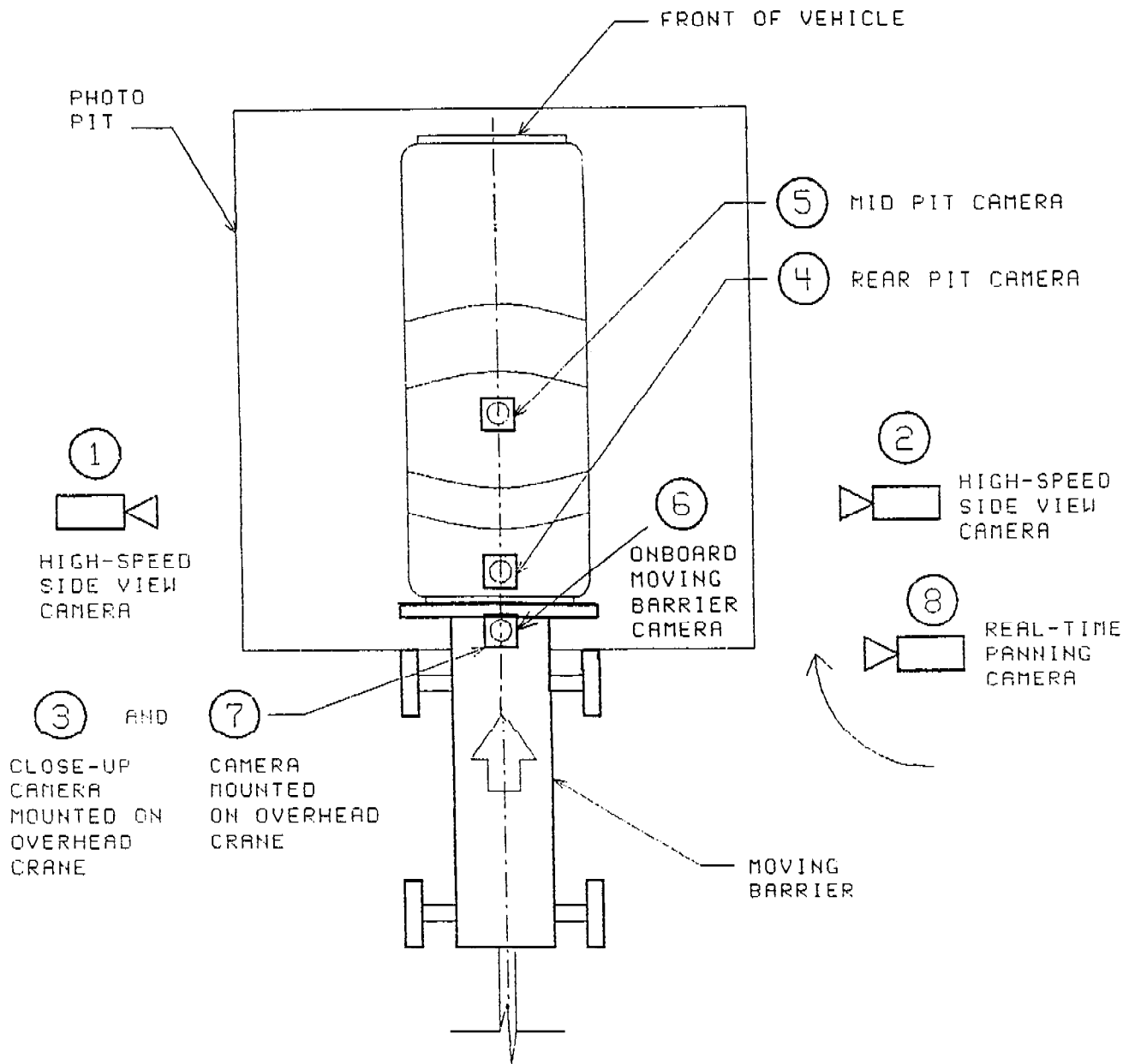


TABLE 8 MOTION PICTURE CAMERA INFORMATION

<u>CAMERA NUMBER</u>	<u>LOCATION</u>	<u>TYPE</u>	<u>LENS (MM)</u>	<u>SPEED (FPS)</u>	<u>PURPOSE OF CAMERA DATA</u>
1	Left wide	Photosonic	13	995	Vehicle crush
2	Right wide	Photosonic	13	1000	Vehicle crush
3	Overhead tight	Photosonic	25	1000	Vehicle crush
4	Pit - rear	Photosonic	17	820	Vehicle crush
5	Pit - tight	Photosonic	35	800	Vehicle crush
6	Onboard Mvg. Bar.	Photosonic	13	998	Vehicle crush
7	Overhead wide	Photosonic	8.5	992	Vehicle crush
8	Right panning	Beaulieu	12-120	24	Real-time panning

APPENDIX A

PHOTOGRAPHS



Figure A-1. PRE-TEST FRONT VIEW

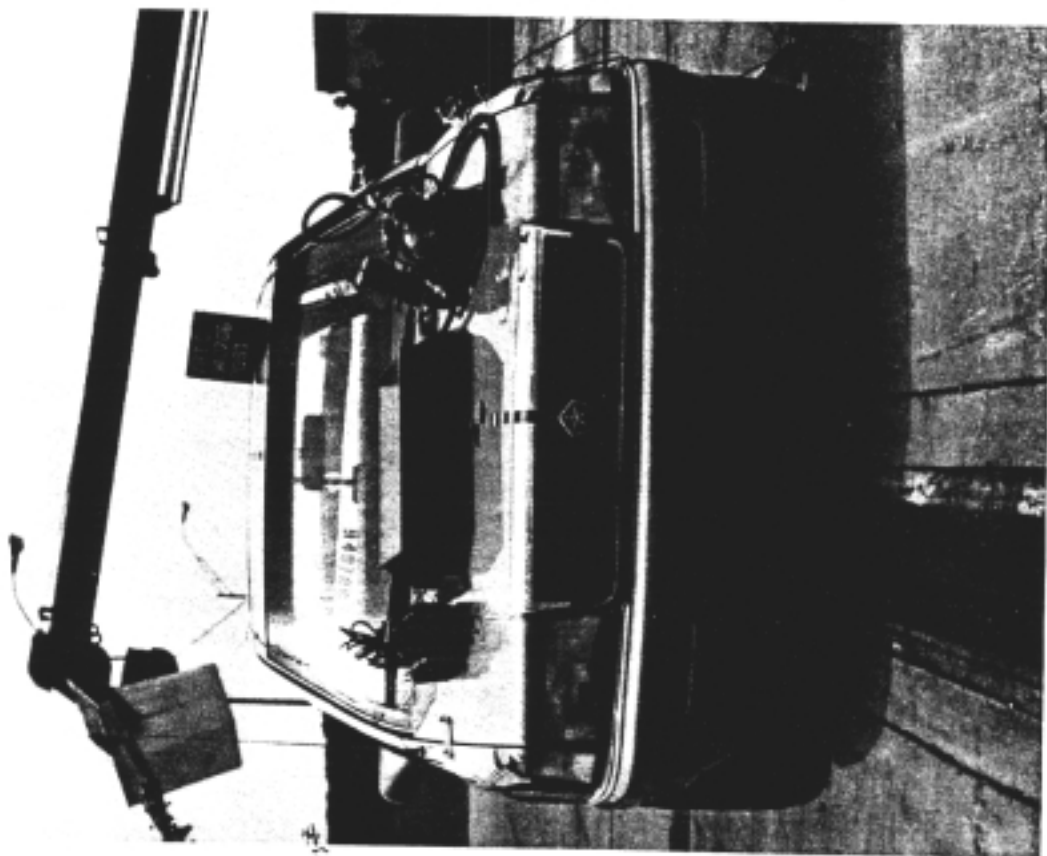


Figure A-2. POST-TEST FRONT VIEW

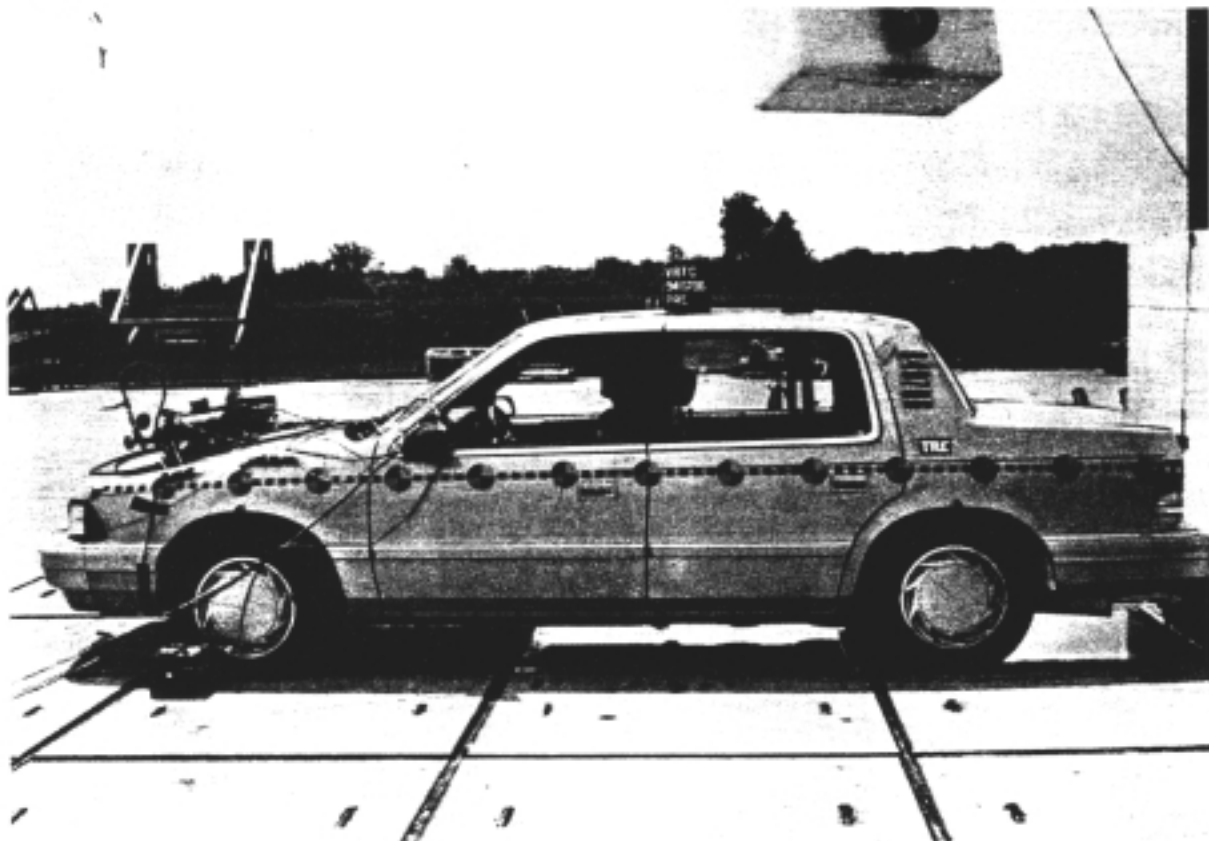


Figure A-3. PRE-TEST LEFT SIDE VIEW

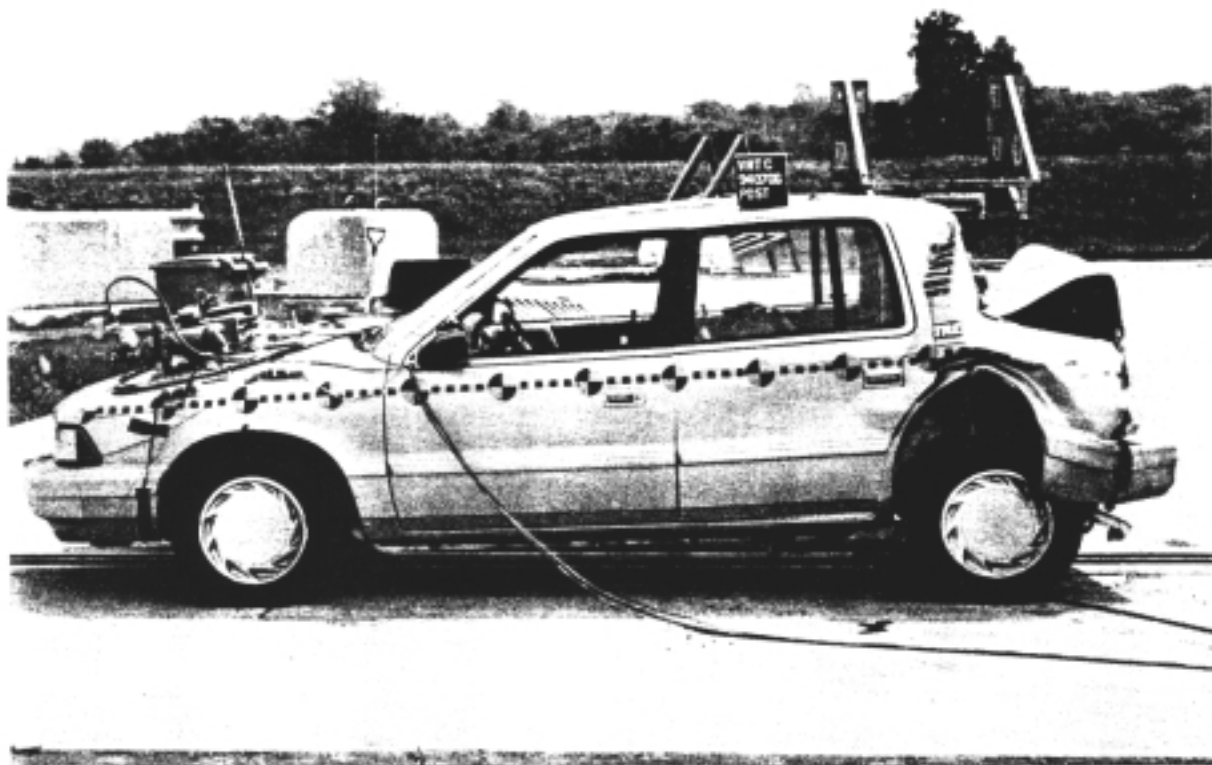


Figure A-4. POST-TEST LEFT SIDE VIEW



Figure A-5. PRE-TEST REAR VIEW



Figure A-6. PRE-TEST RIGHT SIDE VIEW

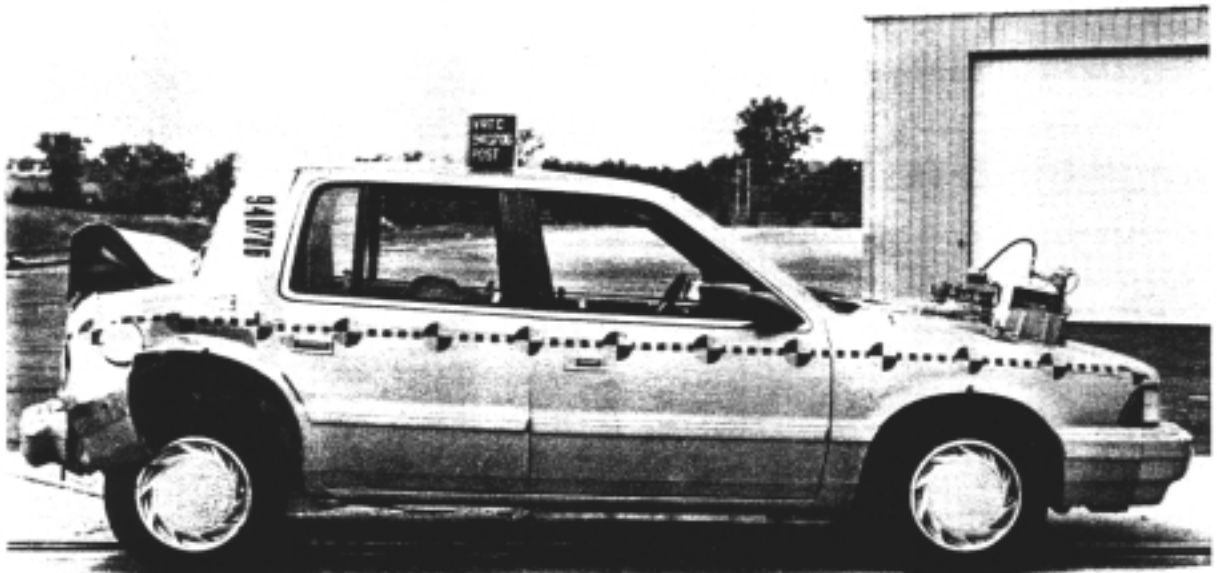


Figure A-7. POST-TEST RIGHT SIDE VIEW



Figure A-8. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW



Figure A-9. POST-TEST RIGHT FRONT THREE-QUARTER VIEW



Figure A-10. PRE-TEST LEFT REAR THREE-QUARTER VIEW

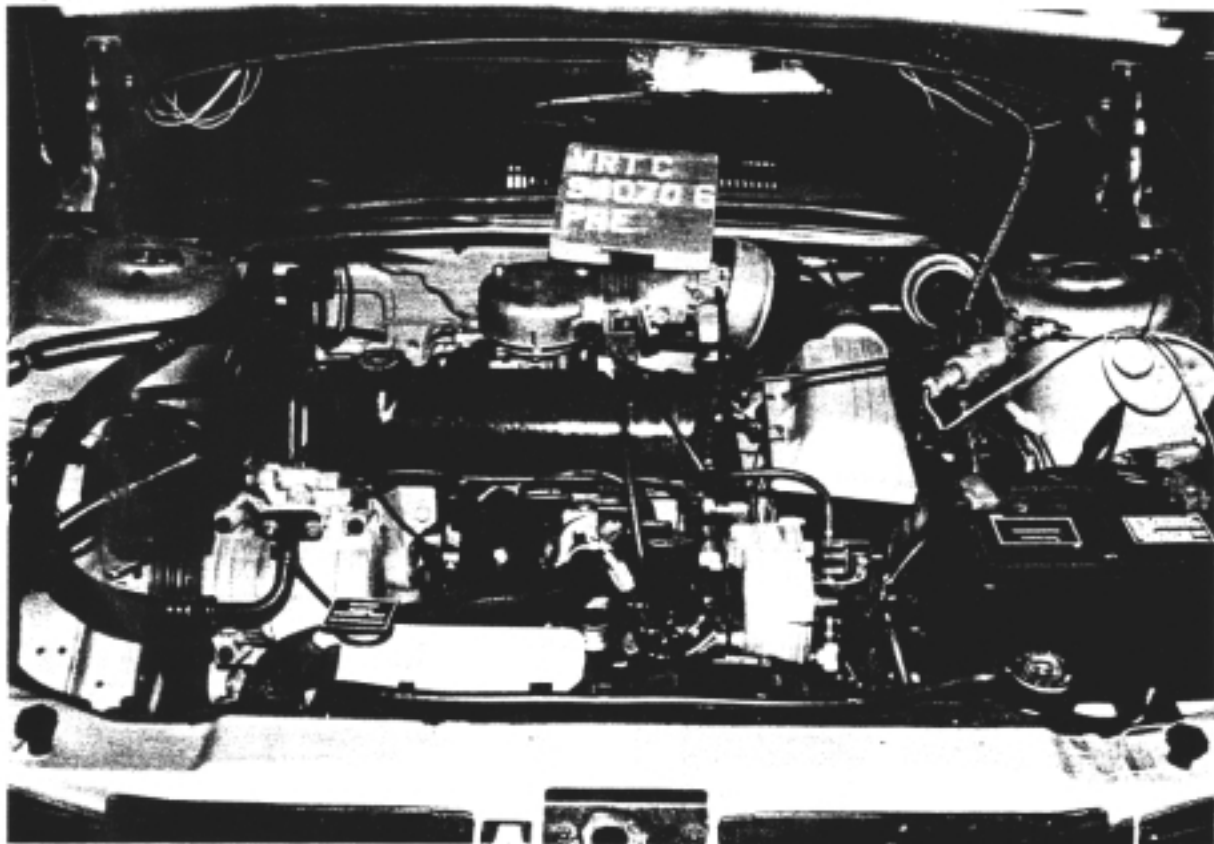


Figure A-11. PRE-TEST ENGINE COMPARTMENT VIEW

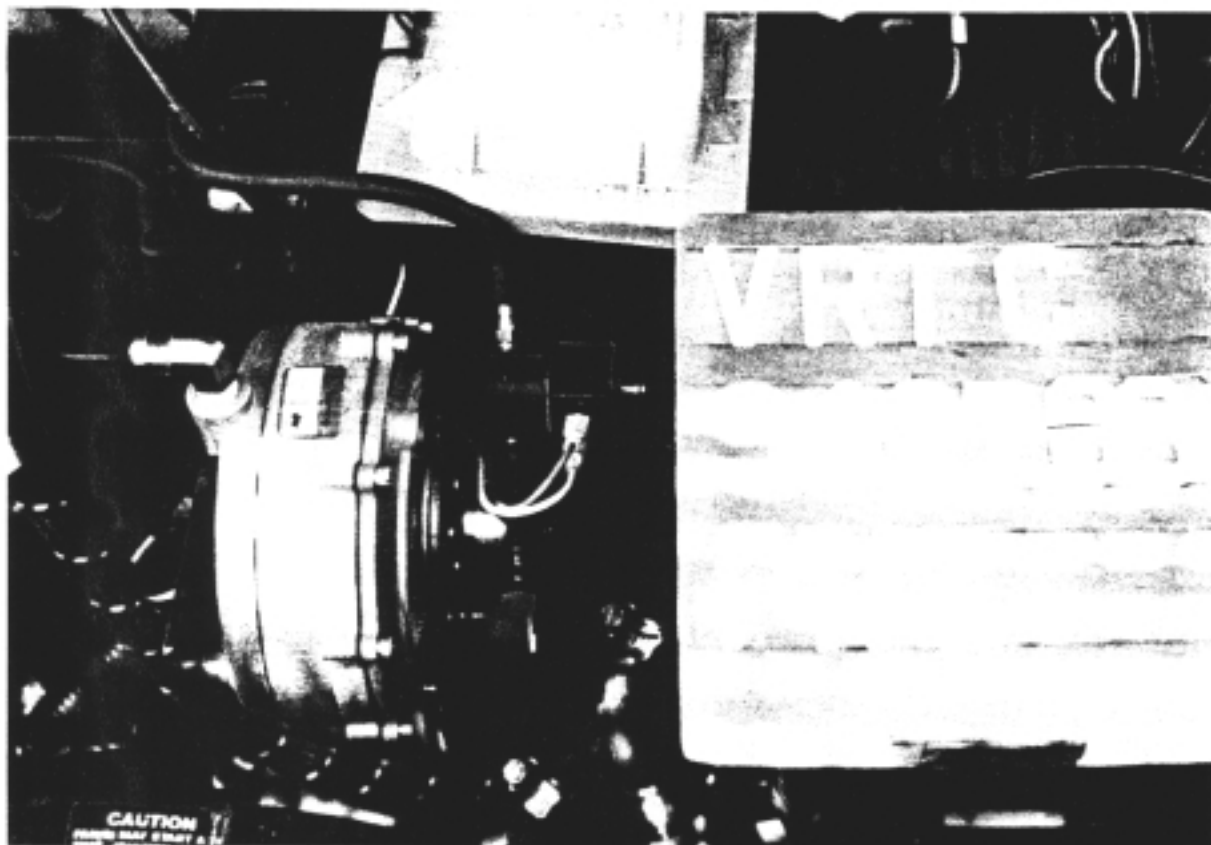


Figure A-12. PRE-TEST FUEL PRESSURE REGULATOR VIEW



Figure A-13. PRE-TEST FUEL FILLER VIEW

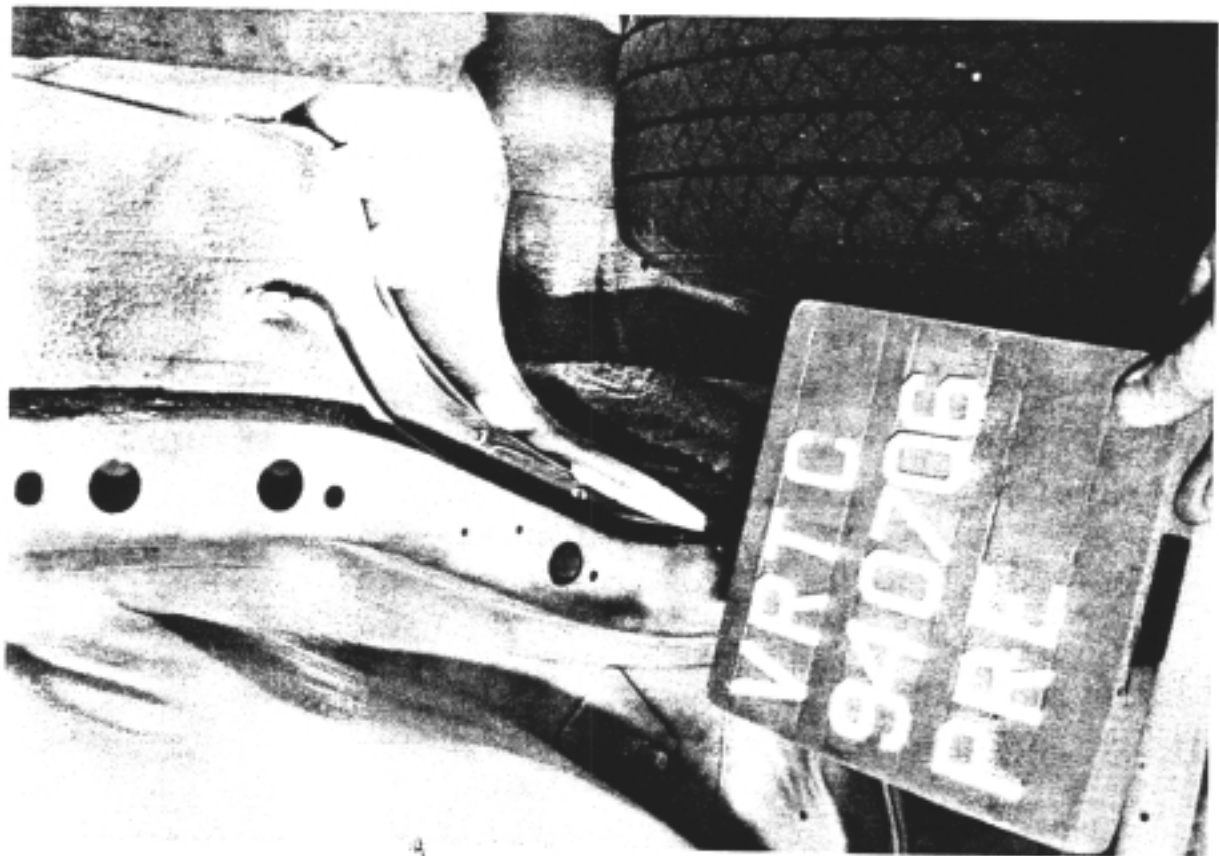


Figure A-14. PRE-TEST FUEL LINES - VIEW 1

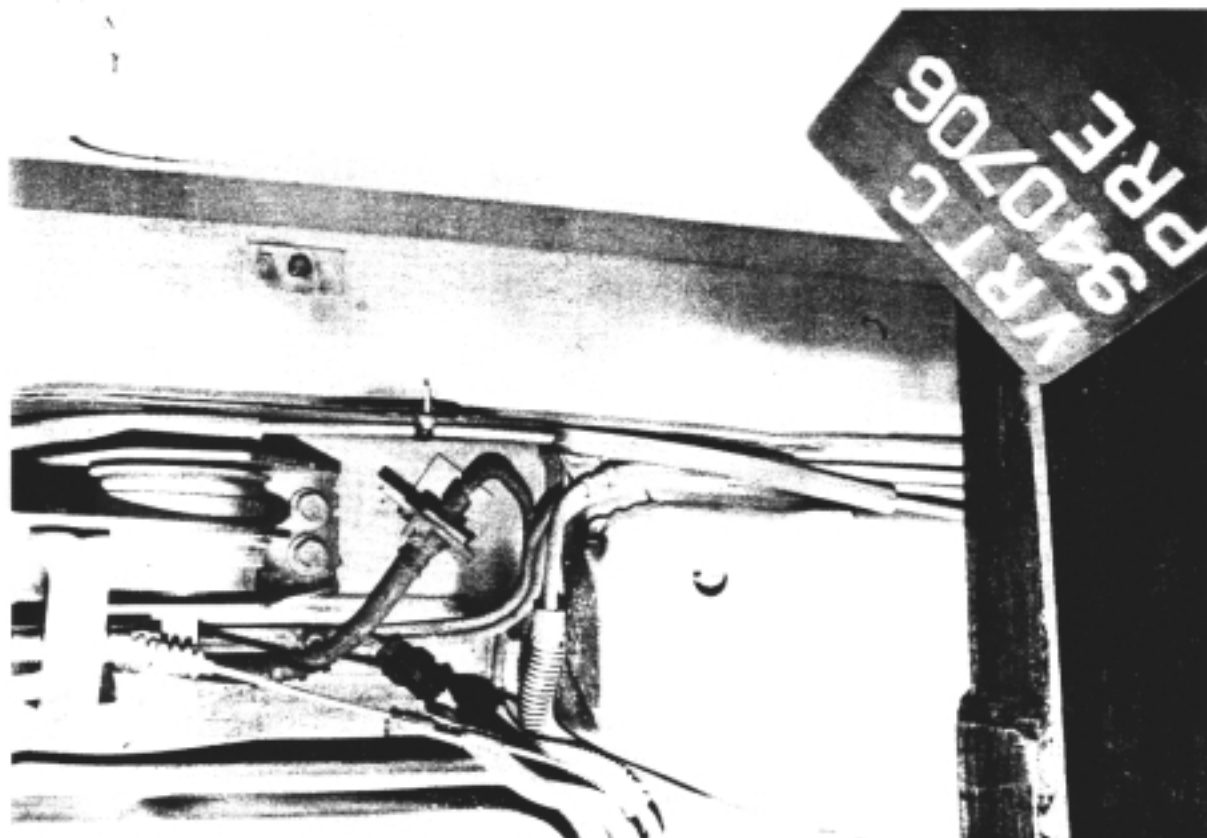


Figure A-15. PRE-TEST FUEL LINES - VIEW 2



Figure A-16. PRE-TEST FUEL LINES - VIEW 3

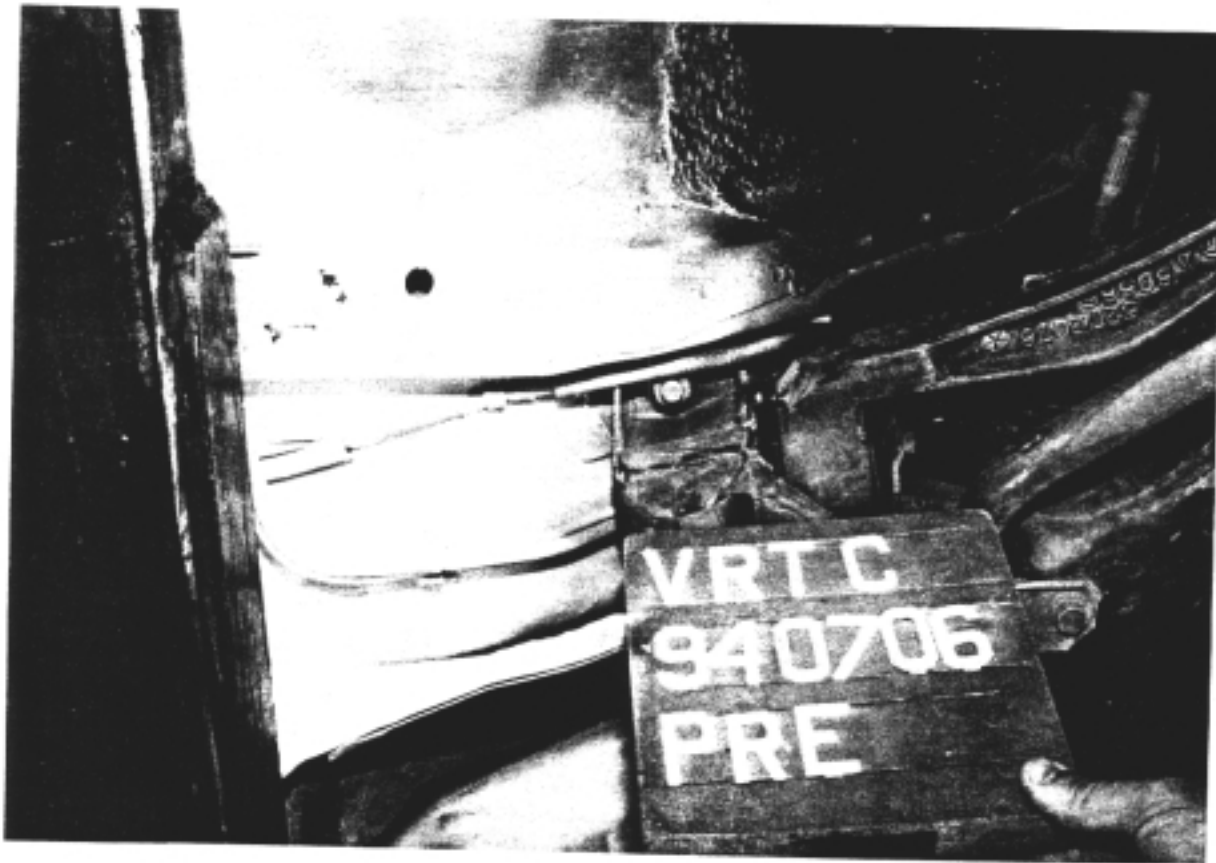


Figure A-17. PRE-TEST FUEL LINES - VIEW 4

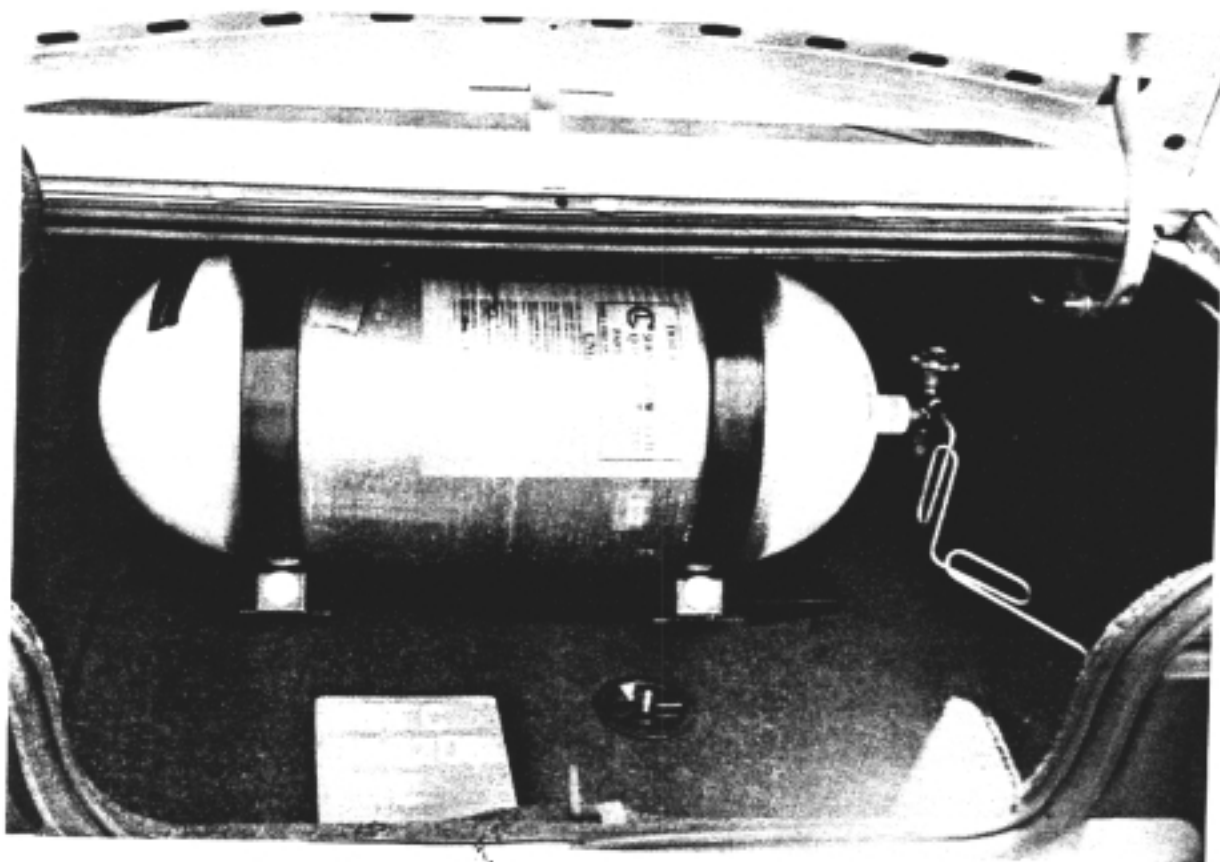


Figure A-18. PRE-TEST FUEL TANK VIEW

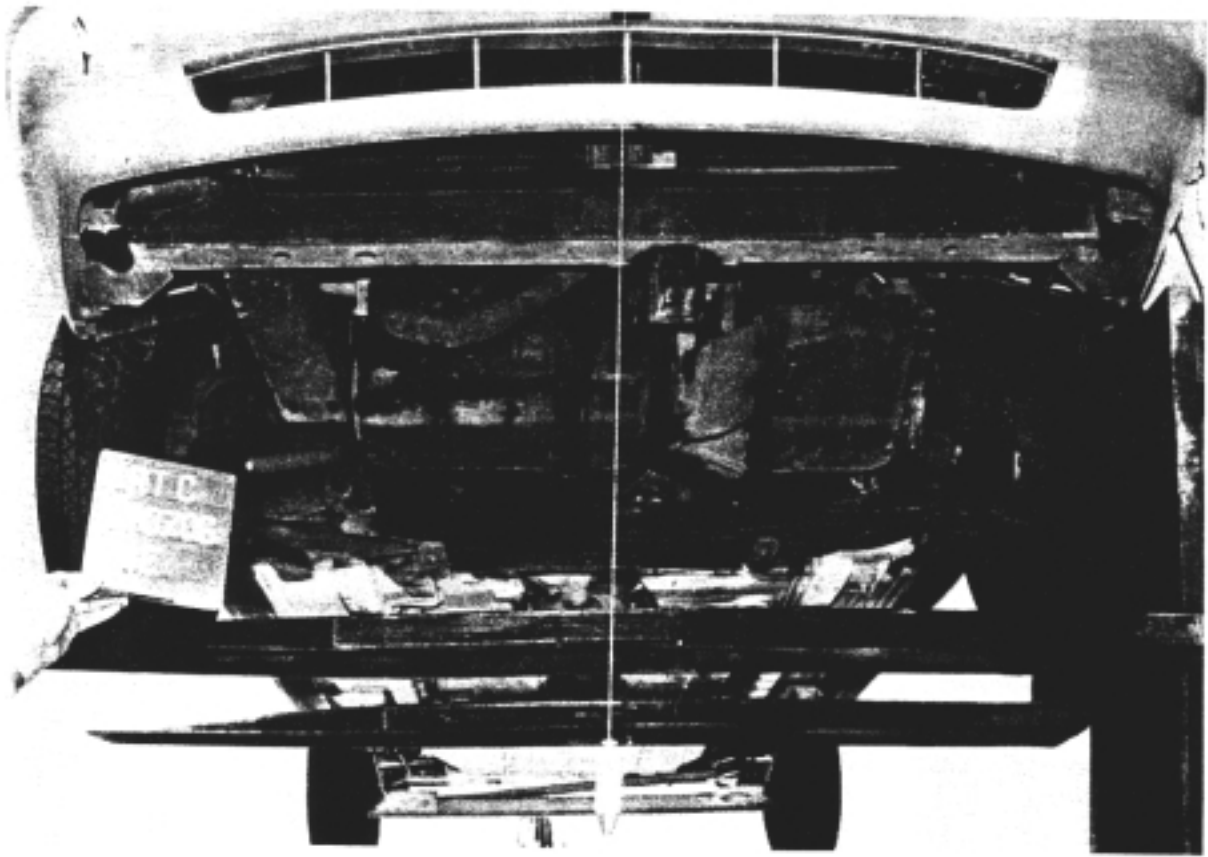


Figure A-19. PRE-TEST FRONT UNDERBODY VIEW

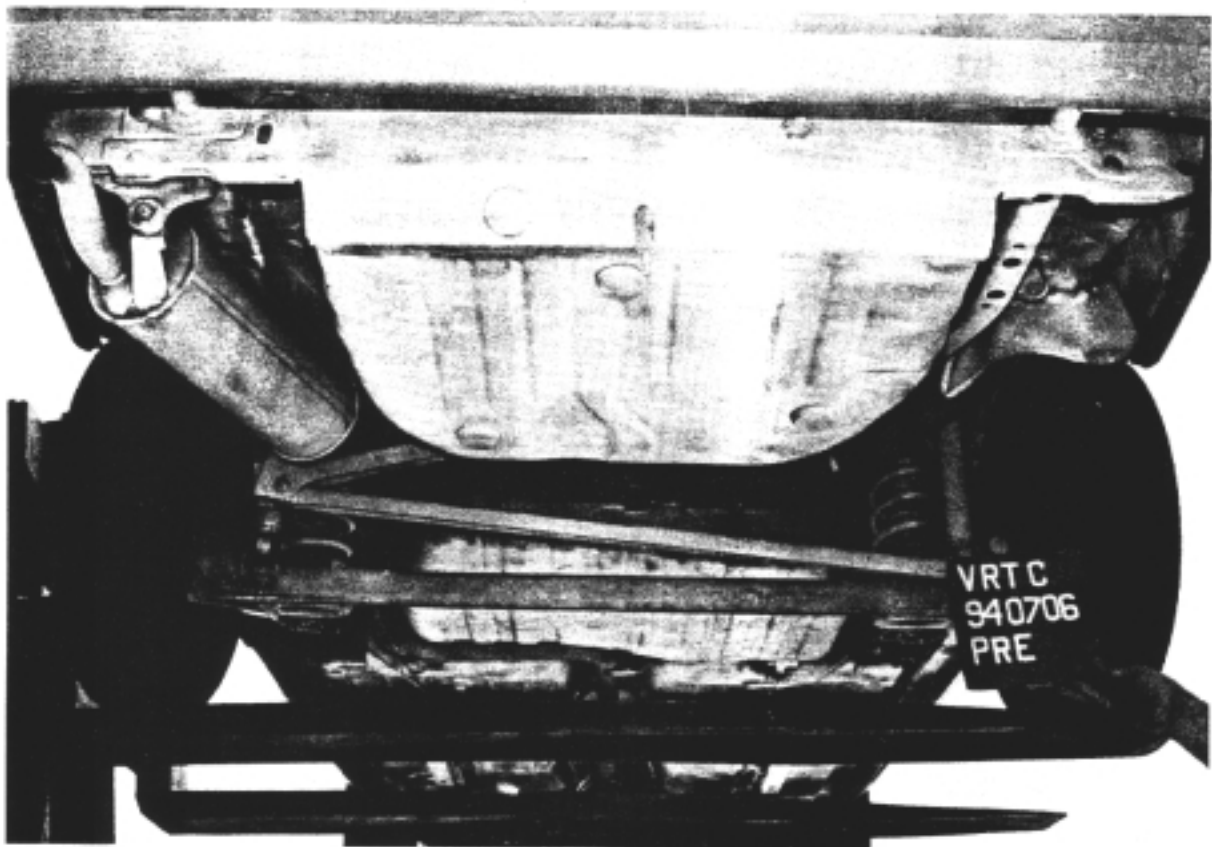
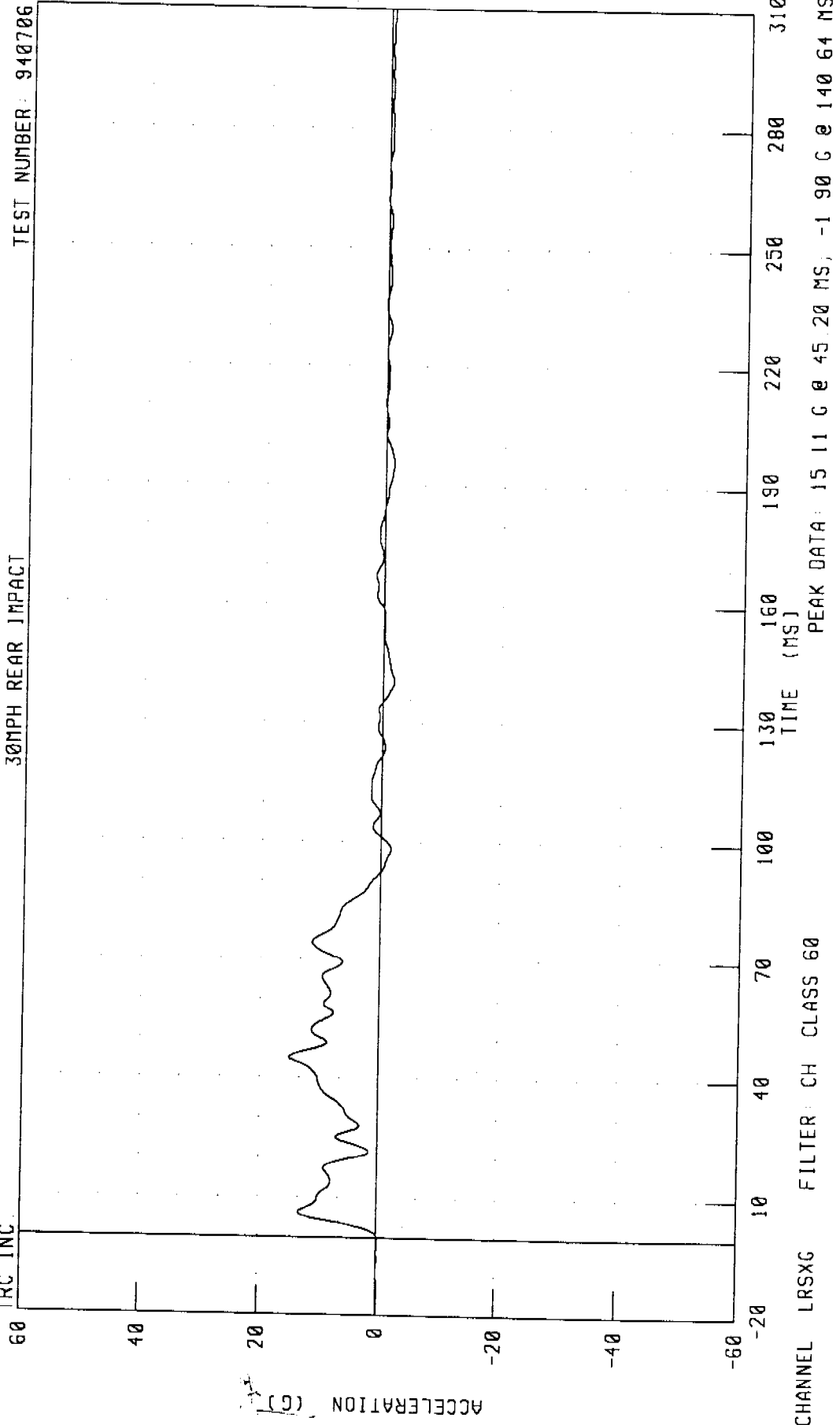


Figure A-20. PRE-TEST REAR UNDERBODY VIEW

APPENDIX B

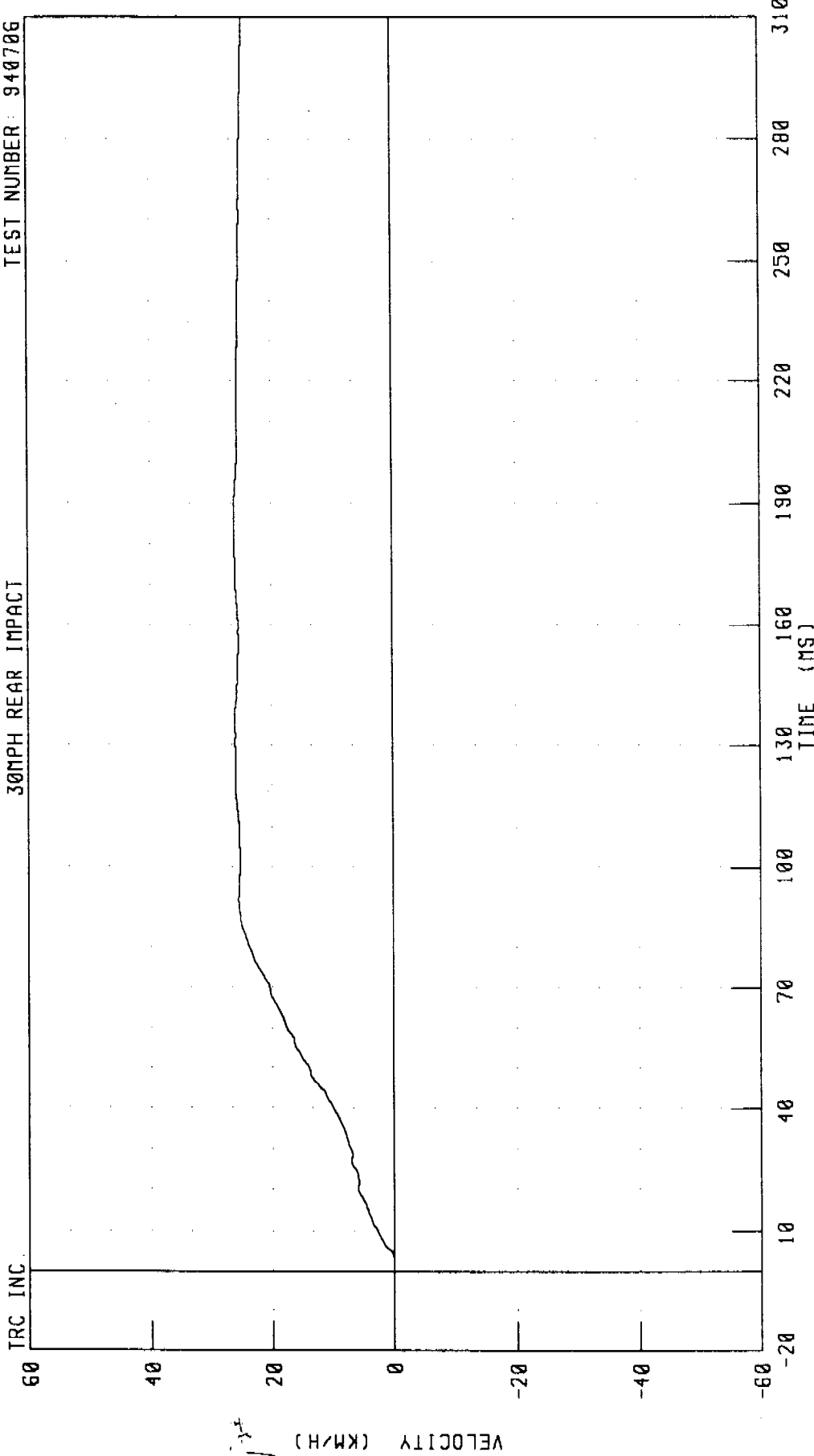
DATA PLOTS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL X-AXIS ACCELERATION
30MPH REAR IMPACT



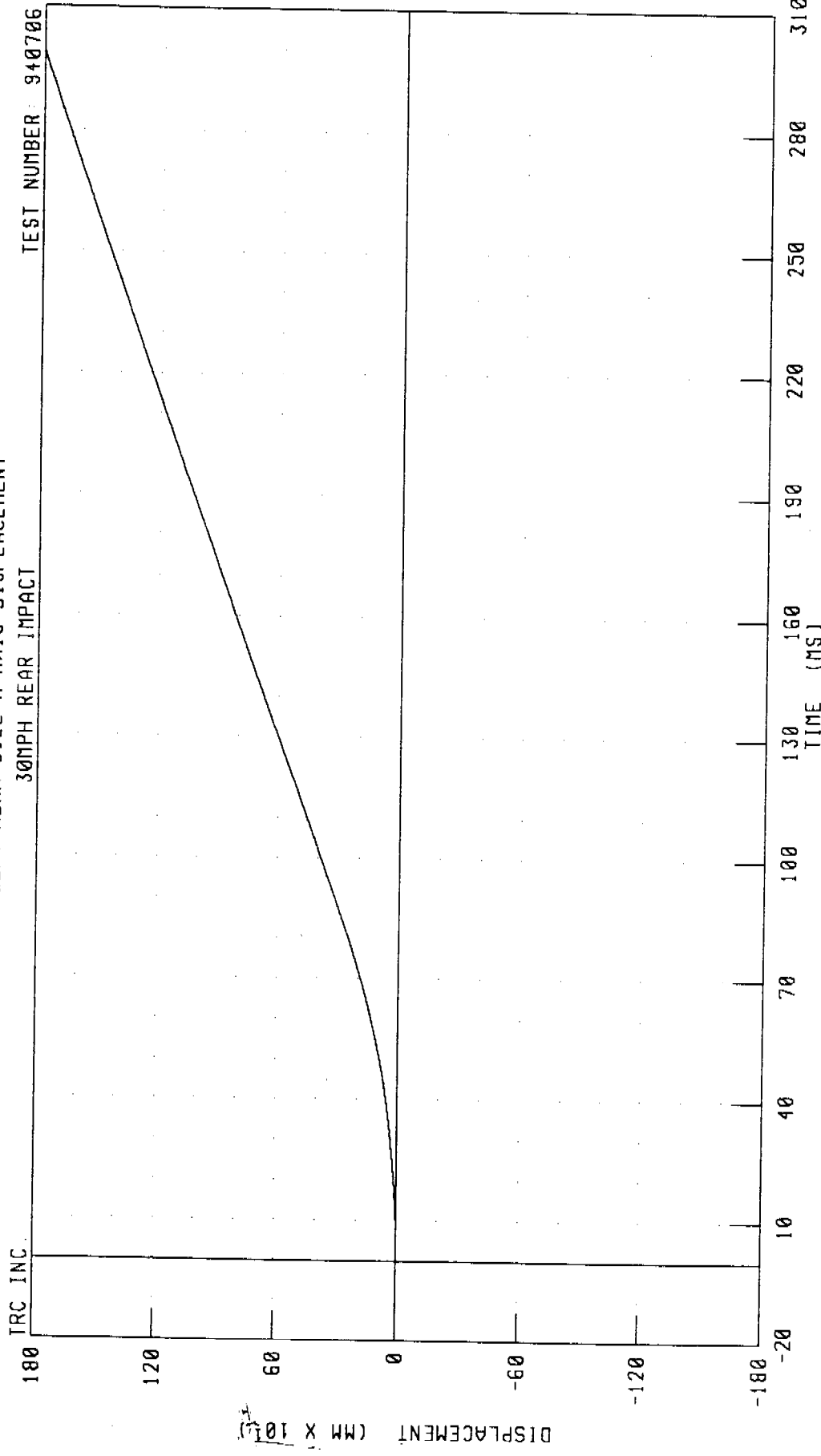
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL X-AXIS VELOCITY
30MPH REAR IMPACT

TEST NUMBER: 940706



CHANNEL: LRSXV FILTER: CH. CLASS 180 PEAK DATA: 26.14 KM/H @ 185.20 MS, 0.00 KM/H @ 0.00 MS

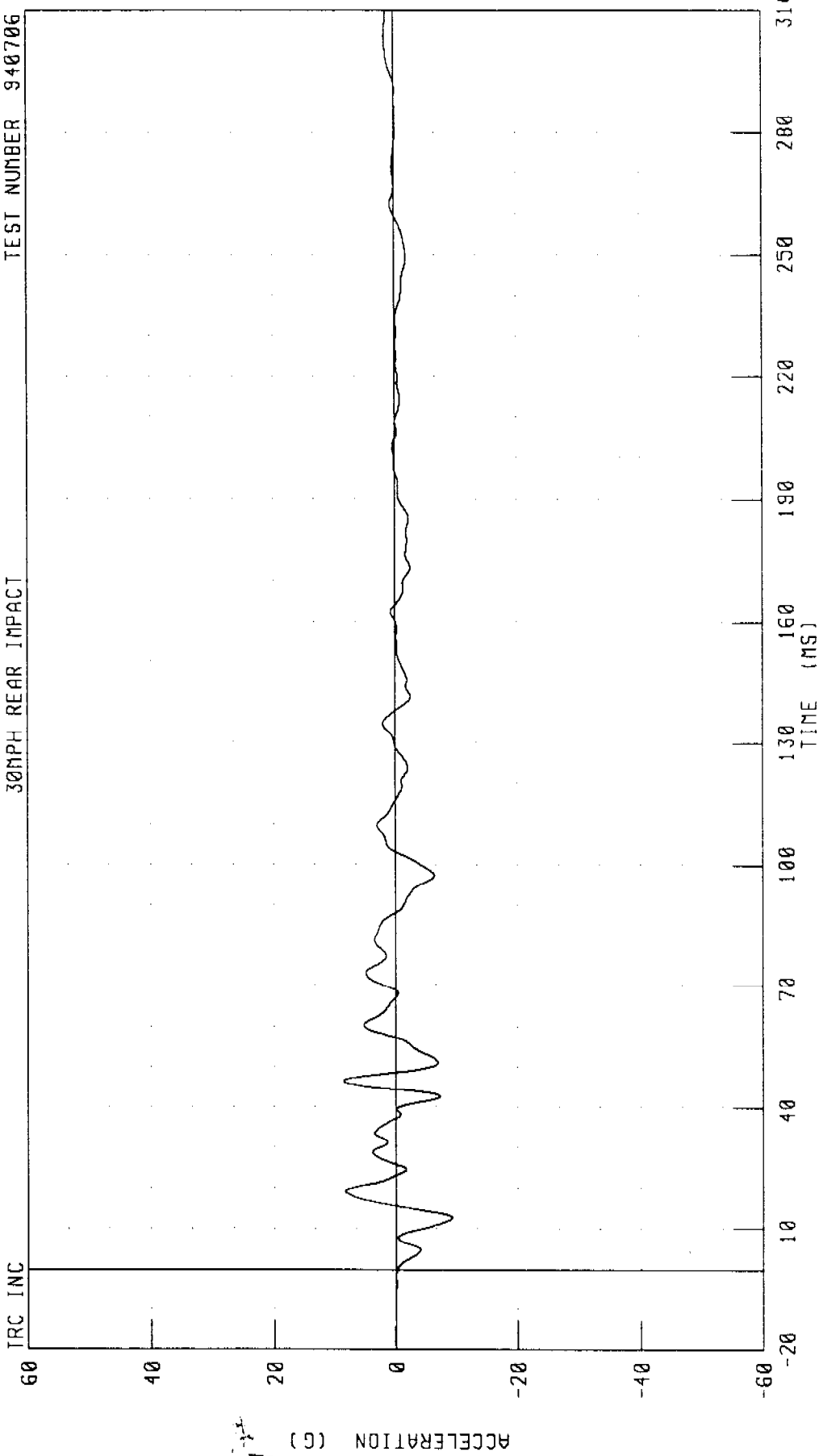
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL X-AXIS DISPLACEMENT
30MPH REAR IMPACT



CHANNEL LRSXD FILTER: CH CLASS 180
PEAK DATA 1872.92 MM @ 310.00 MS, 0.00 MM @ 0.00 MS

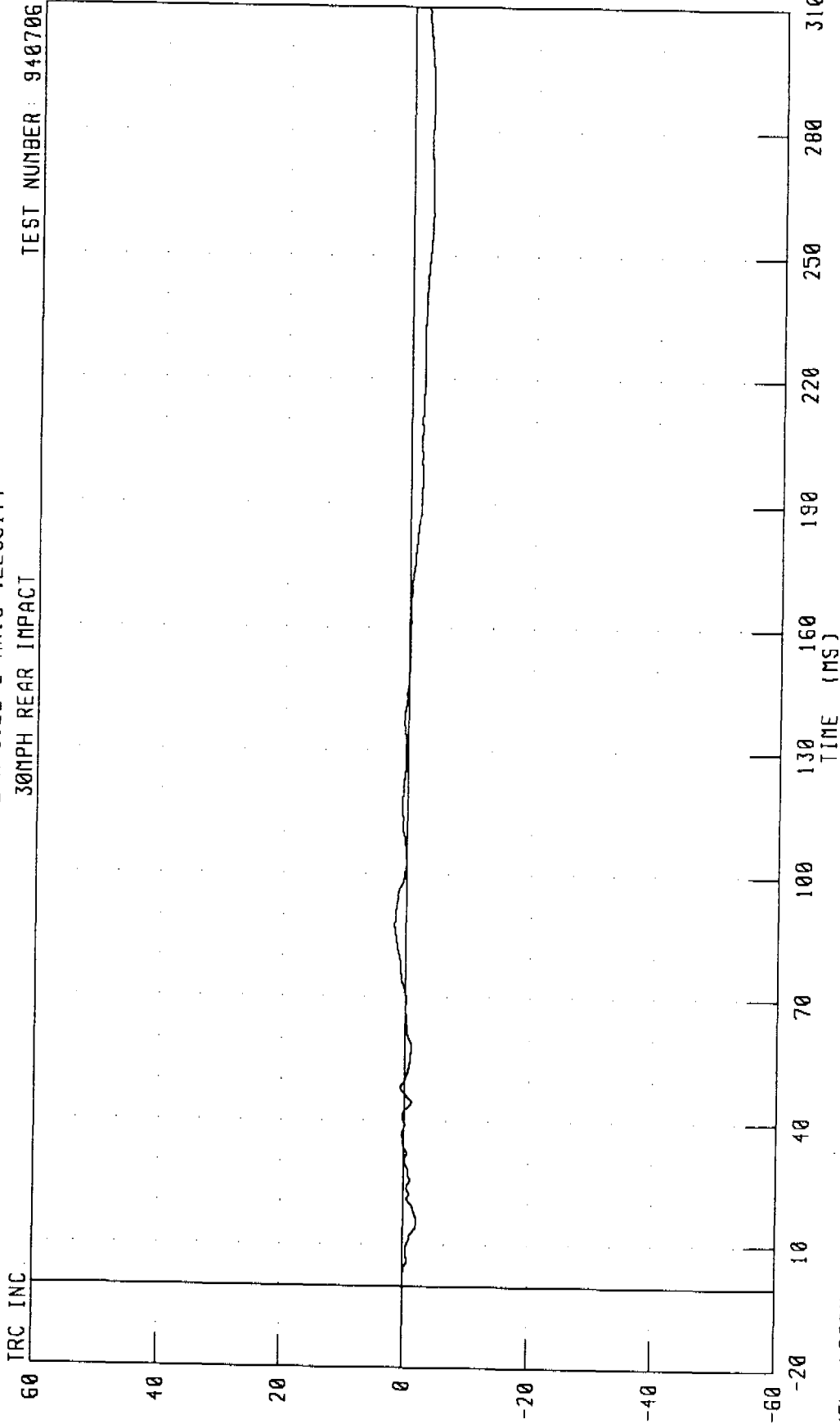
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL Z-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER 940706



CHANNEL LRSZG FILTER CH CLASS 60 PEAK DATA 8 67 G @ 12.64 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL Z-AXIS VELOCITY
30MPH REAR IMPACT



TRC INC

TEST NUMBER: 940706

VELOCITY (KM/H)

TIME (MS)

PEAK DATA: 1.81 KM/H @ 87.76 MS, -3.13 KM/H @ 259.76 MS

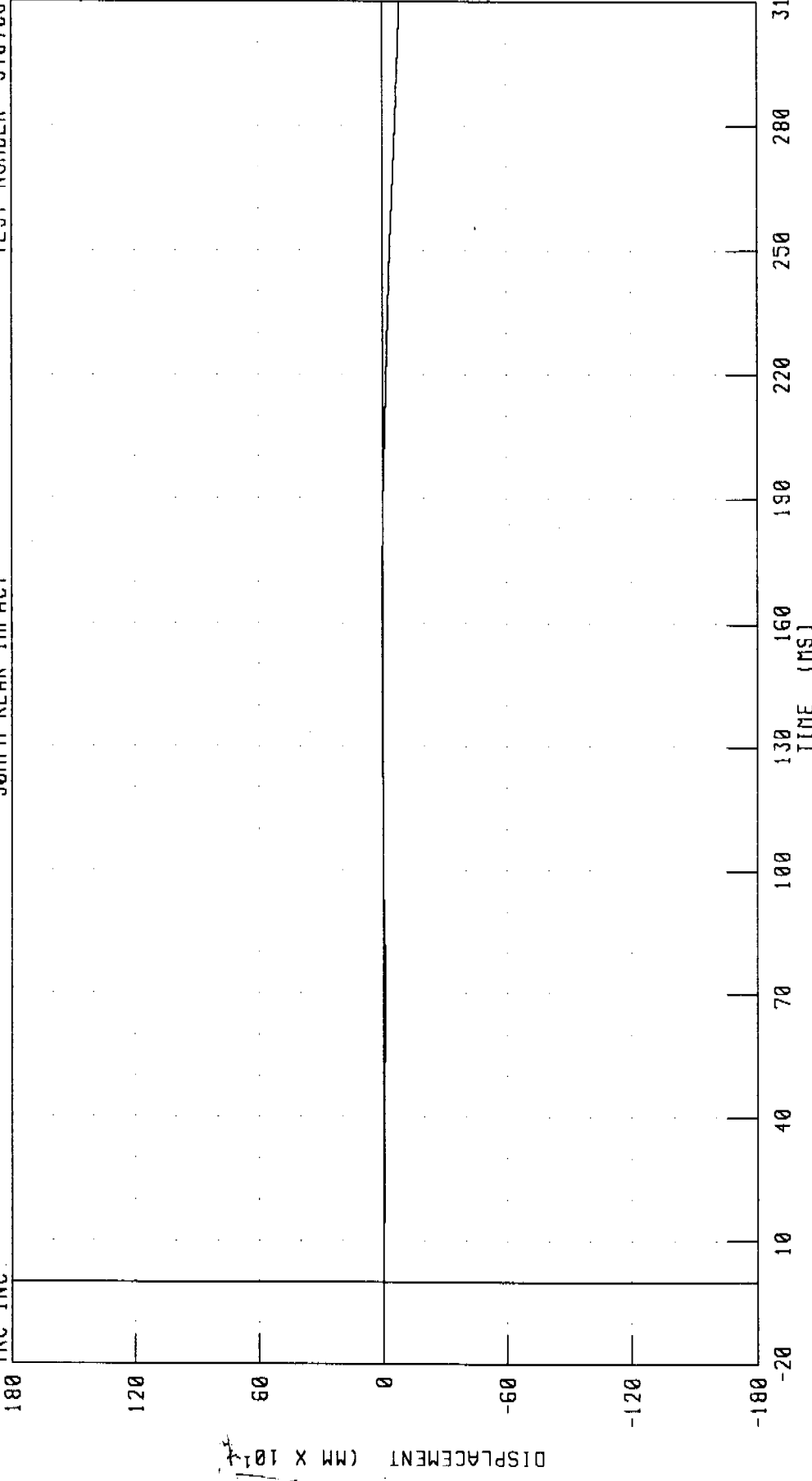
CHANNEL LRSZV FILTER: CH. CLASS 180

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
LEFT REAR SILL Z-AXIS DISPLACEMENT

TEST NUMBER: 940706

30MPH REAR IMPACT

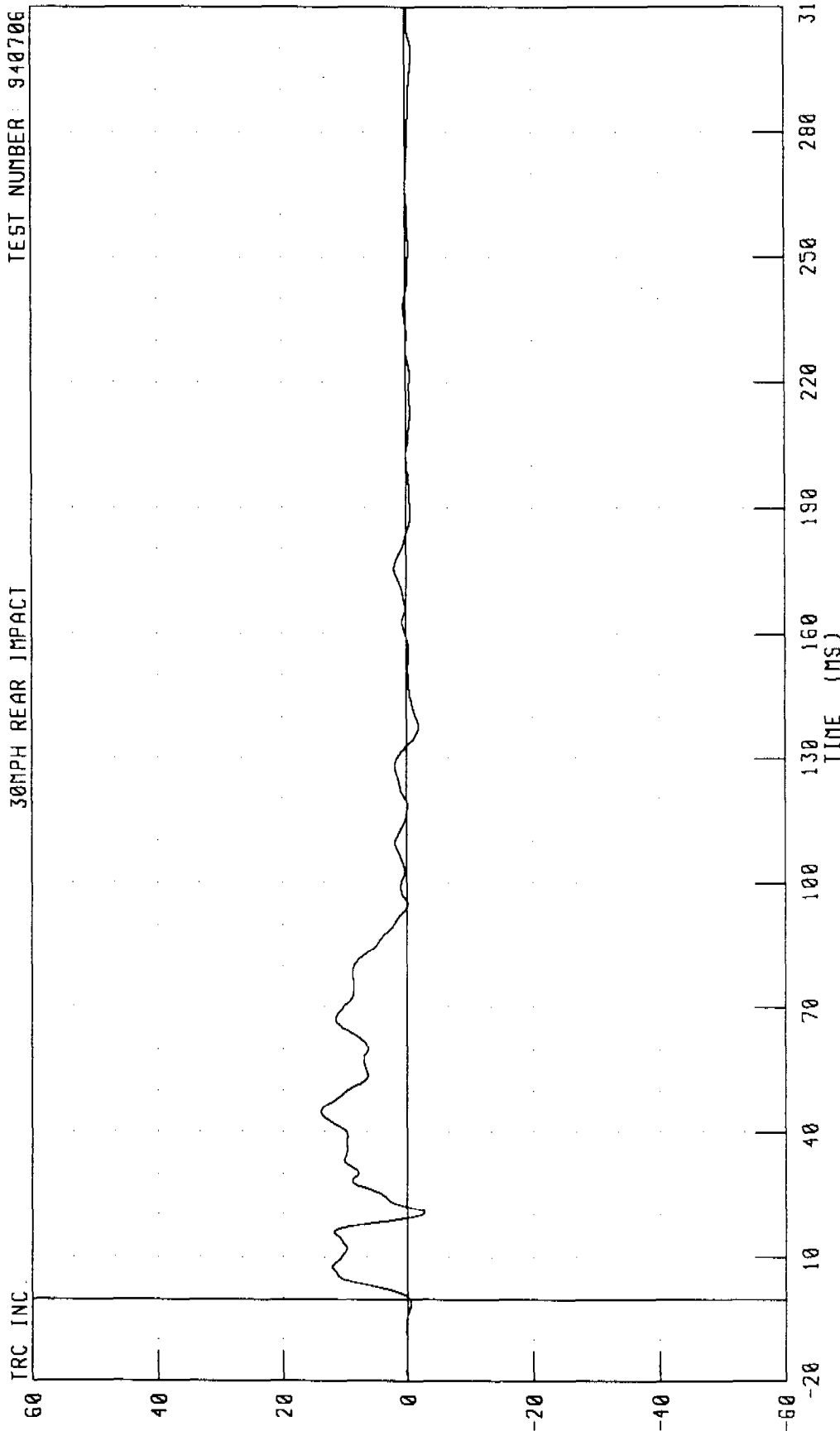
TRC INC.



CHANNEL: LRSZO FILTER: CH: CLASS 180
PEAK DATA 5 55 MM @ 147 60 MS, -82 97 MM @ 310 00 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

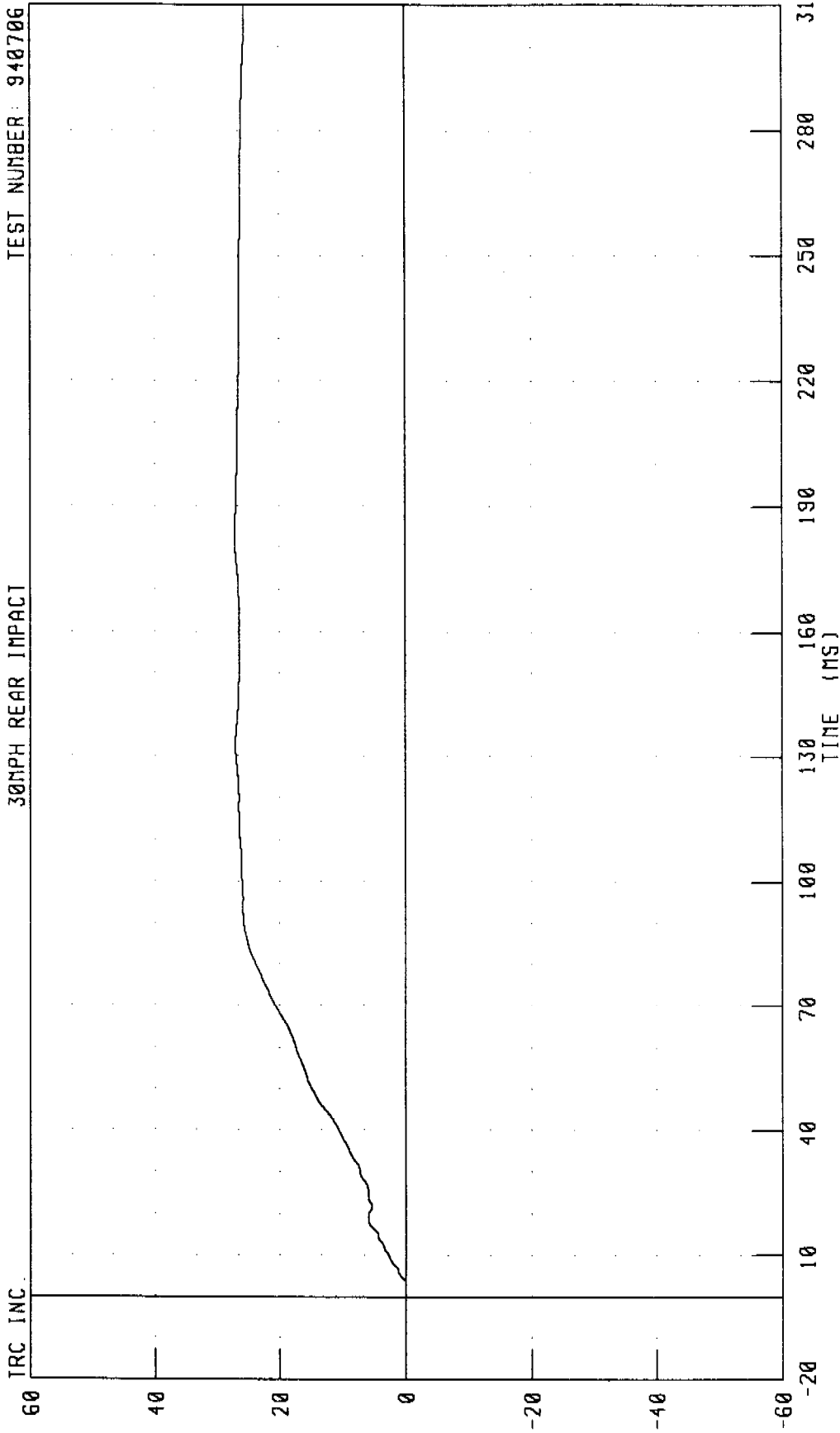


CHANNEL: RRSXG FILTER: CH CLASS 60

PEAK DATA: 13.87 G @ 44.96 MS, -2.77 G @ 20.64 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS VELOCITY
30MPH REAR IMPACT

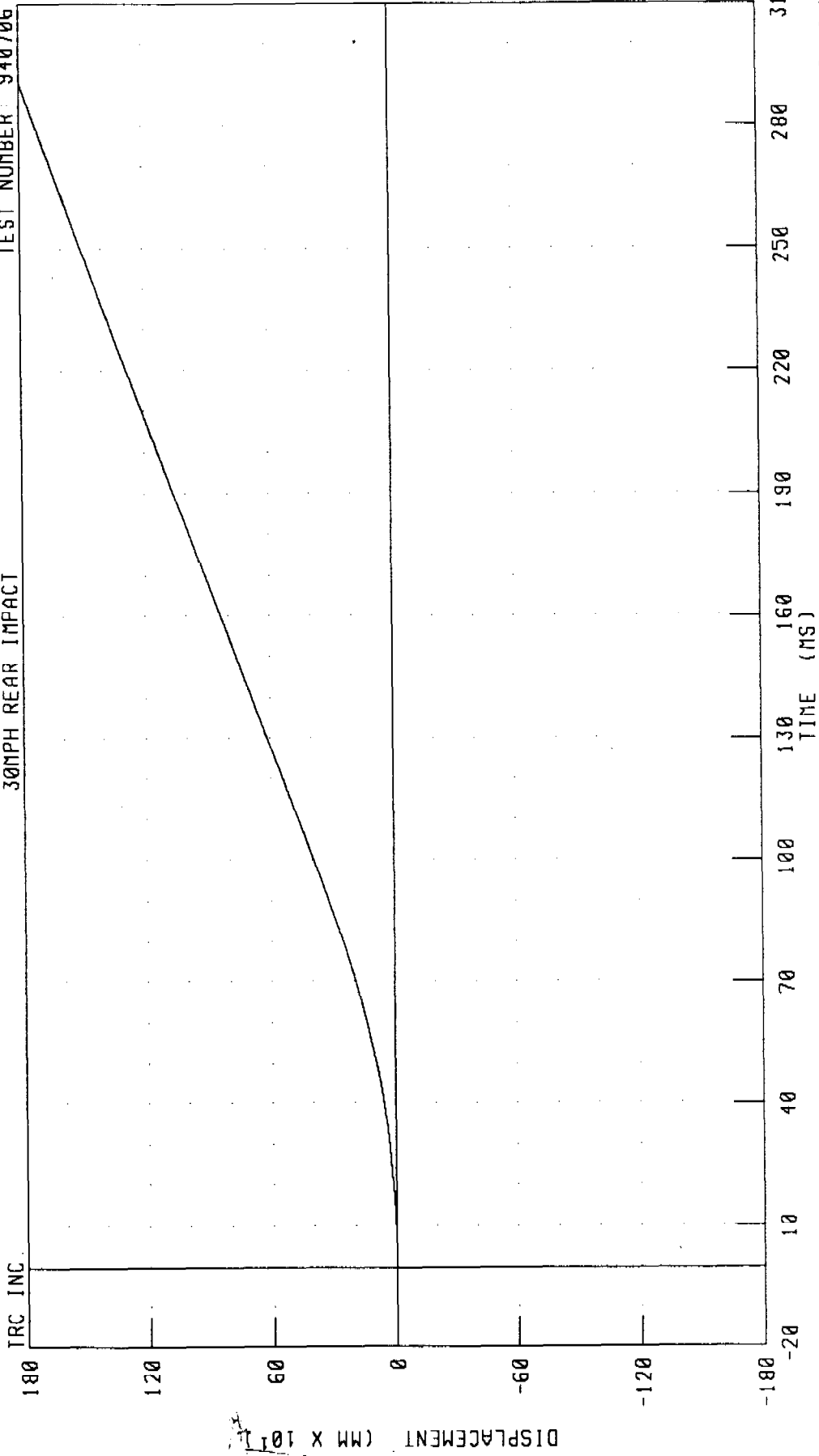
TRC INC. TEST NUMBER: 948706



CHANNEL: RRSXY FILTER: CH CLASS 180 PEAK DATA 27.10 KM/H @ 184.24 MS, -0.01 KM/H @ 1.68 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS DISPLACEMENT
30MPH REAR IMPACT

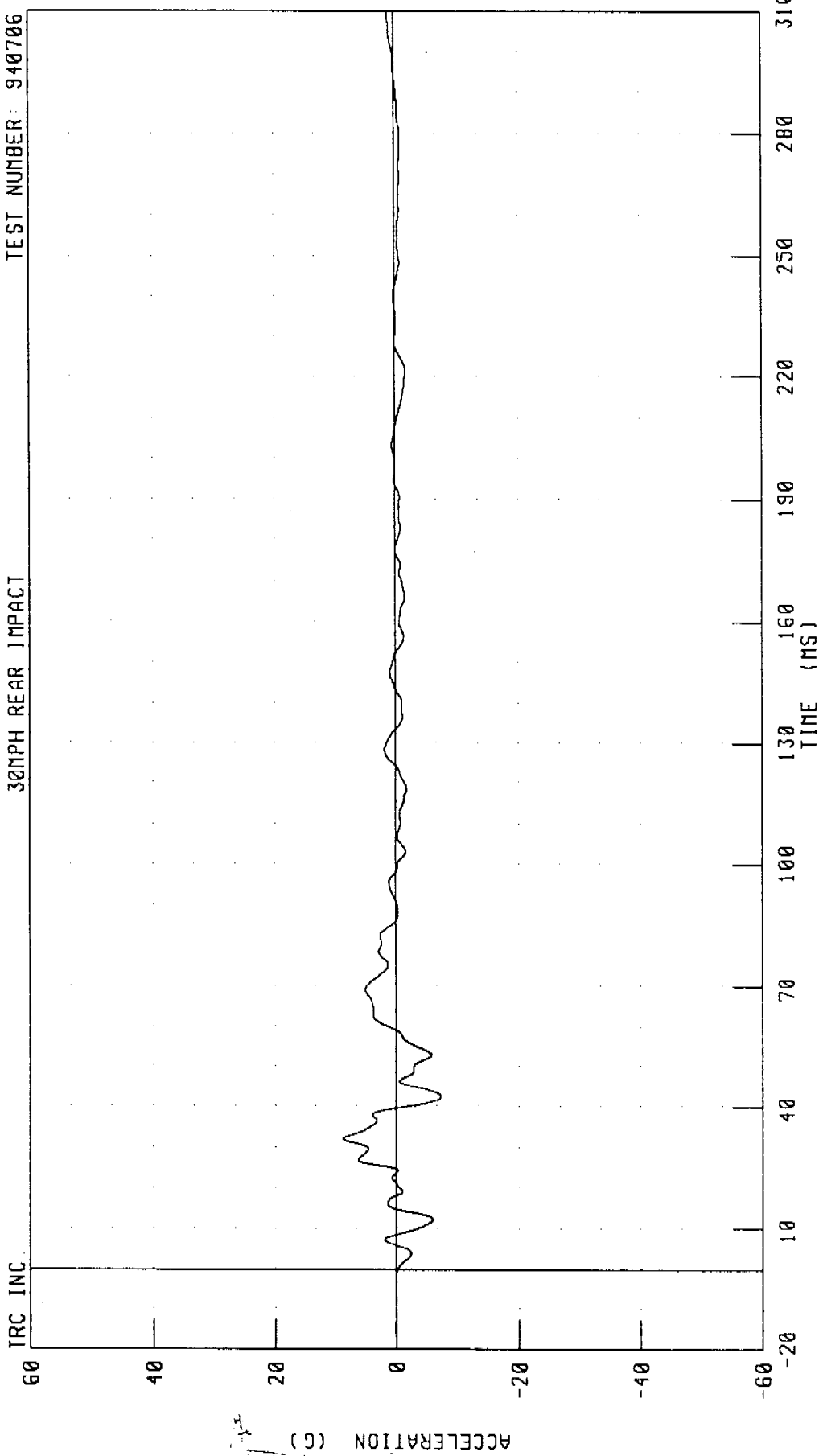
TEST NUMBER: 940706



CHANNEL: RRSXD FILTER: CH CLASS 180
PEAK DATA 1935.88 MM @ 310.00 MS, 0 00 MM @ 2 48 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL Z-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706



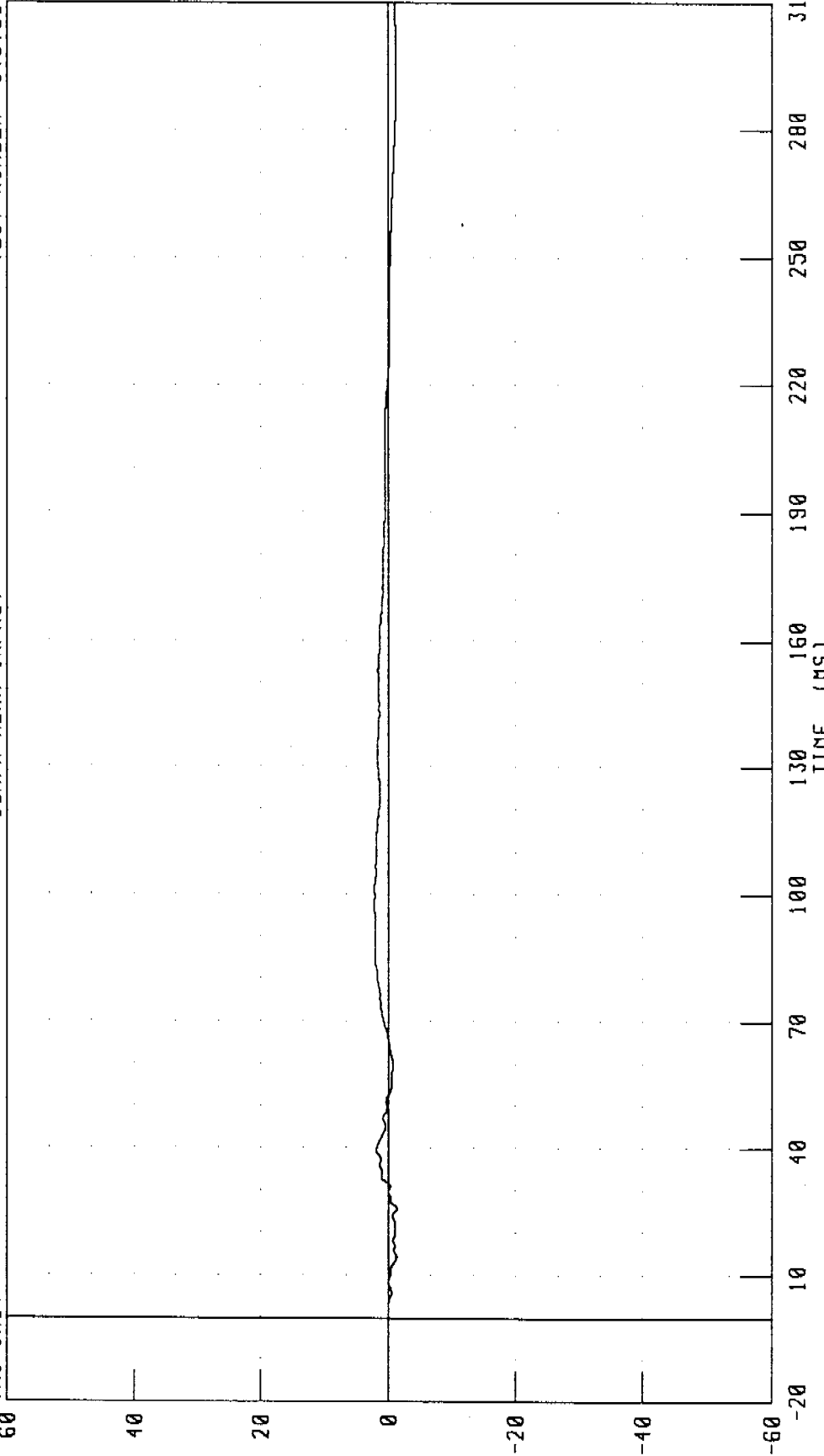
CHANNEL: RRSZG FILTER: CH. CLASS 60 PEAK DATA: 8 87 G @ 32 24 MS, -7 31 G @ 42 40 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL Z-AXIS VELOCITY

TEST NUMBER 940706

30MPH REAR IMPACT

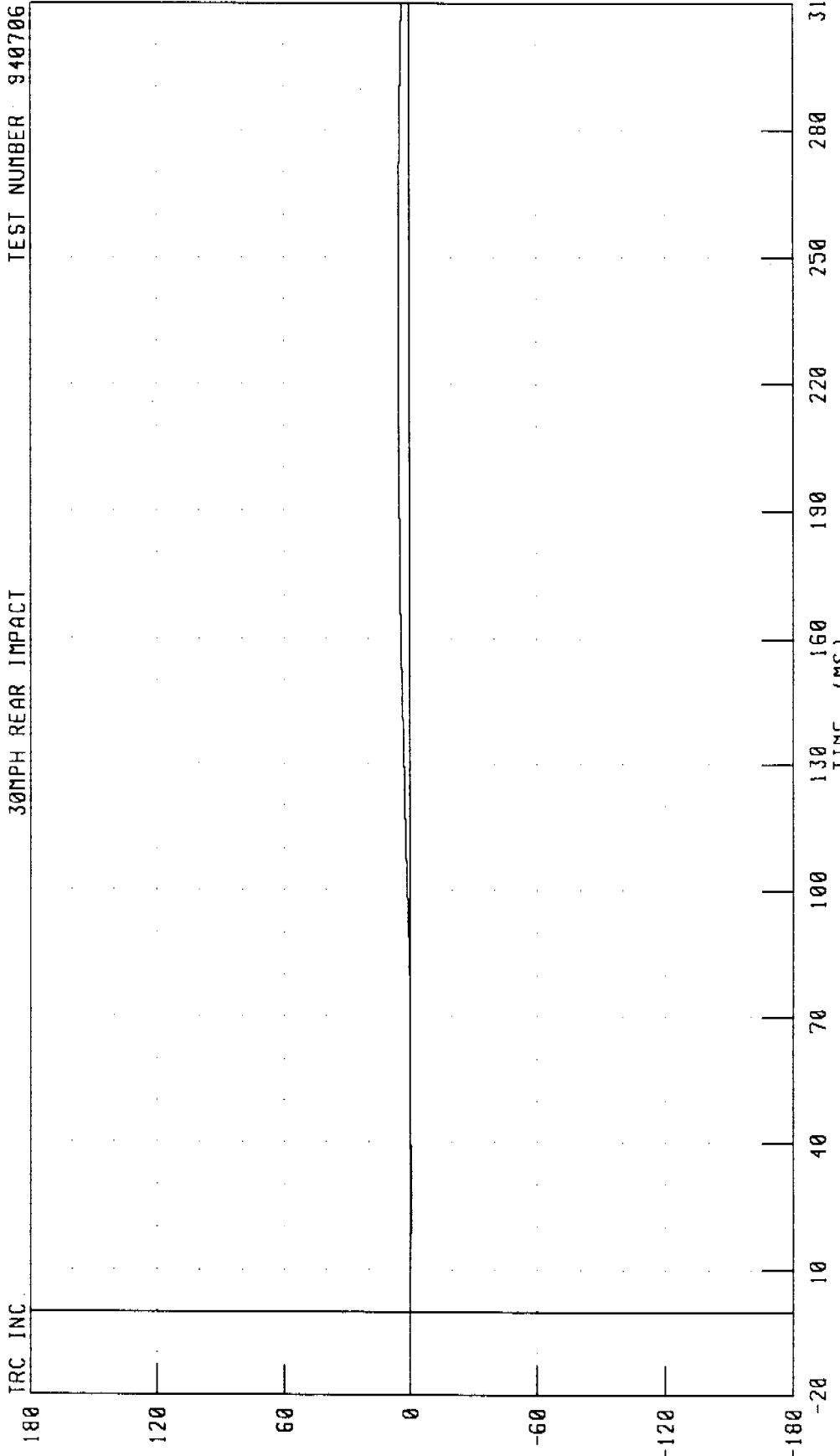
TRC INC.



CHANNEL: RRSZV FILTER: CH CLASS 180 PEAK DATA: 2.23 KM/H @ 97.28 MS, -1.39 KM/H @ 25.68 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL Z-AXIS DISPLACEMENT
30MPH REAR IMPACT

TEST NUMBER 940706



TRC INC.

DISPLACEMENT (MM X 10¹)

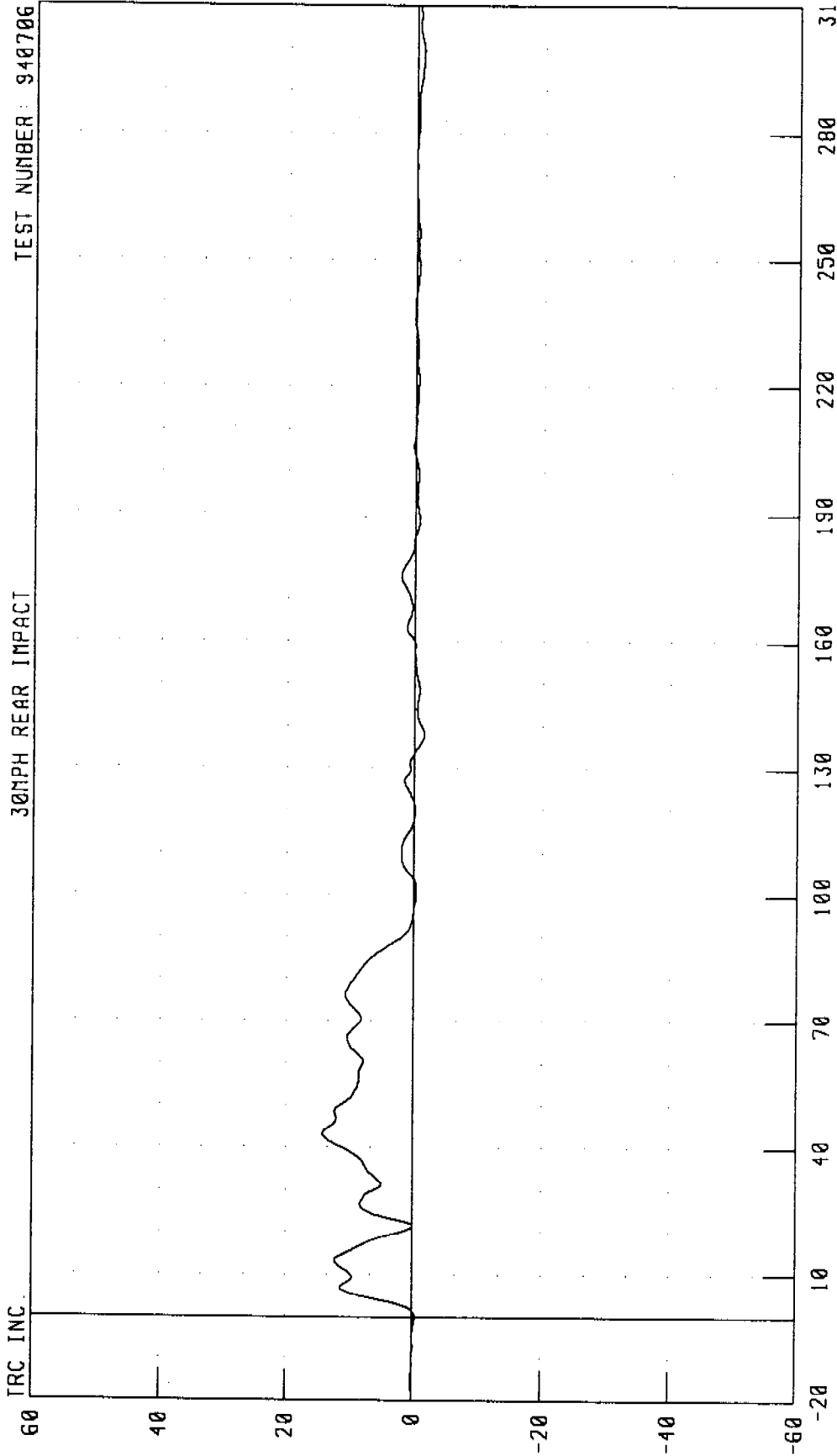
CHANNEL ARSZD FILTER: CH CLASS 180
TIME (MS) PEAK DATA 53 07 MM @ 222.96 MS, -4.75 MM @ 31.68 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY X-AXIS ACCELERATION

TEST NUMBER: 948706

30MPH REAR IMPACT

TRC INC.



CHANNEL VCGXG FILTER: CH. CLASS 60

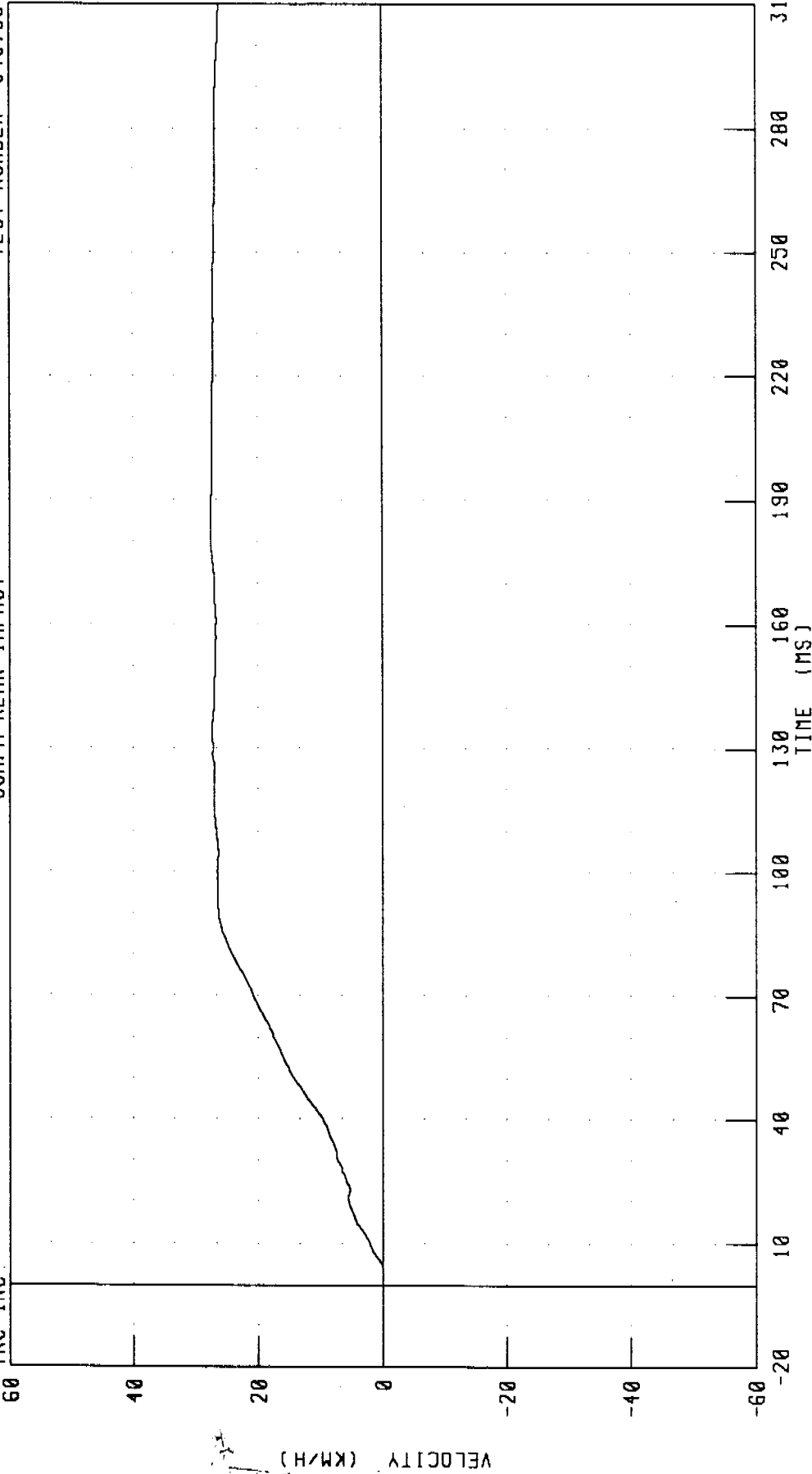
PEAK DATA 14.16 G @ 43.28 MS, -15.6 G @ 138.08 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY X-AXIS VELOCITY

TEST NUMBER: 940706

30MPH REAR IMPACT

TRC INC.

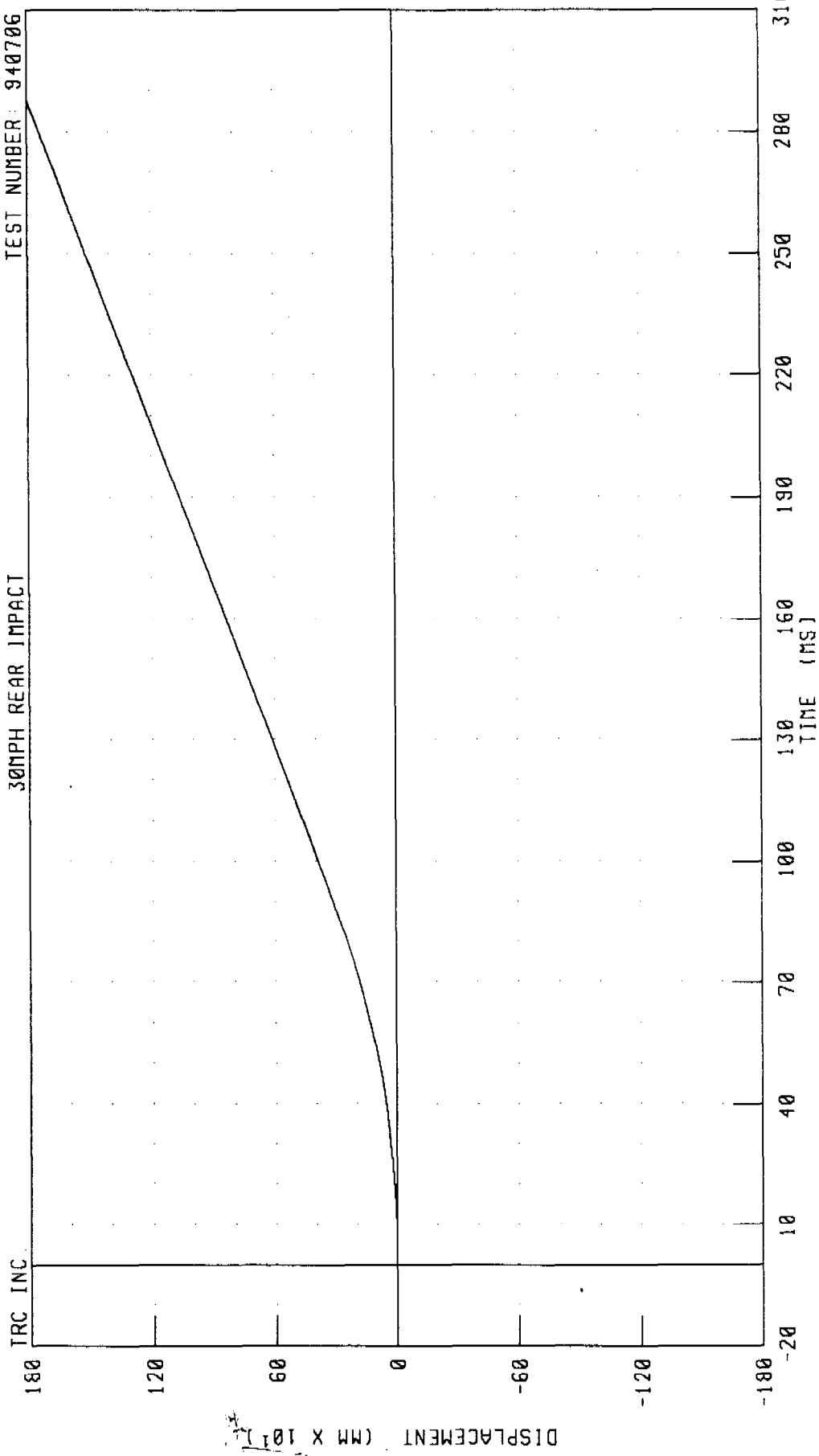


PEAK DATA: 27.50 KM/H @ 185.28 MS, 0.00 KM/H @ 0 40 NS

CHANNEL: YCGXV FILTER: CH CLASS 180

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY X-AXIS DISPLACEMENT
30MPH REAR IMPACT

TEST NUMBER: 940706



TRC INC

DISPLACEMENT (MM X 10¹)

TIME (MS)

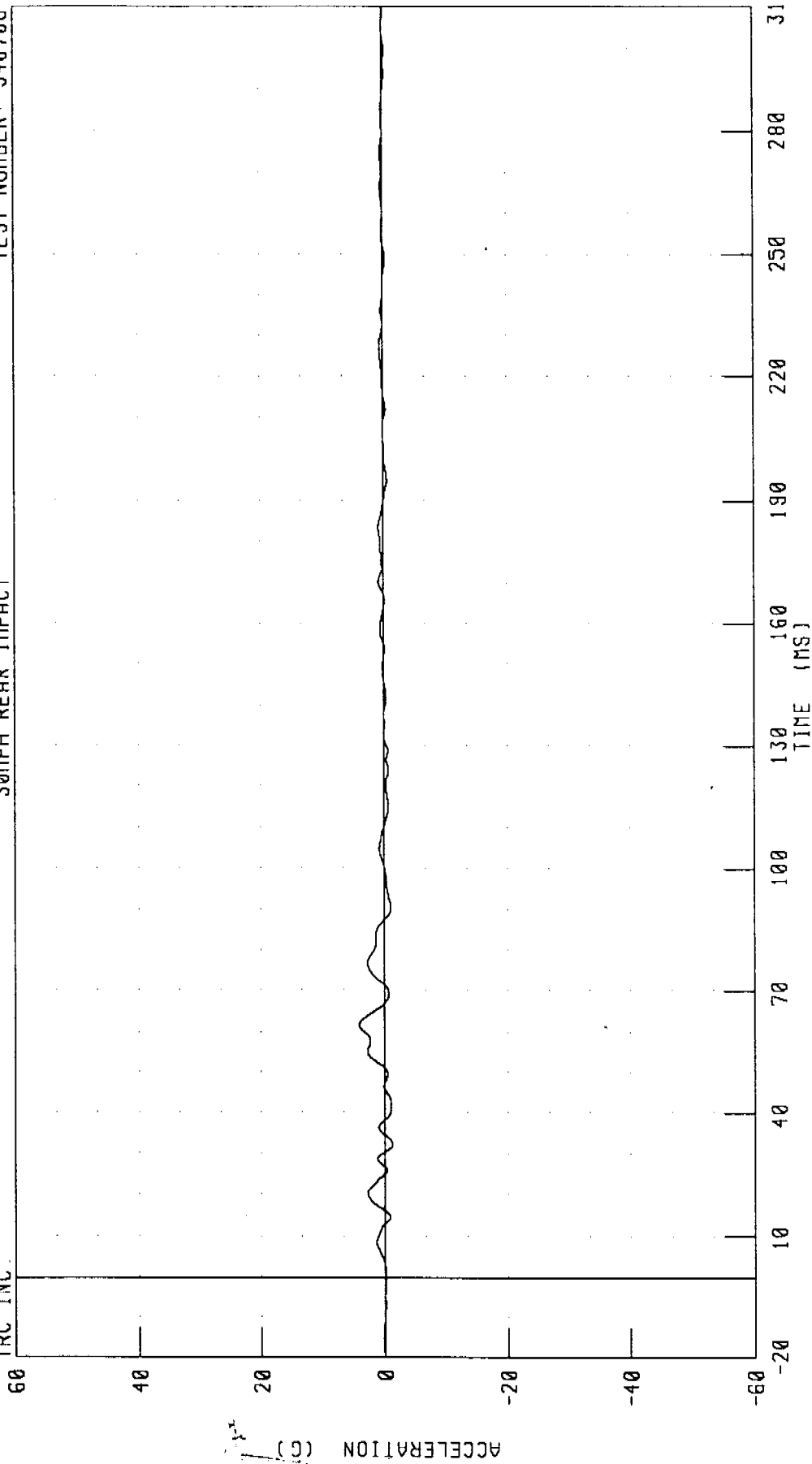
CHANNEL VCGXD FILTER: CH CLASS 180

PEAK DATA: 1960 52 MM @ 310 00 MS; 0.00 MM @ 0 88 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Y-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

TRC INC.



CHANNEL: VCGYG FILTER: CH CLASS 60

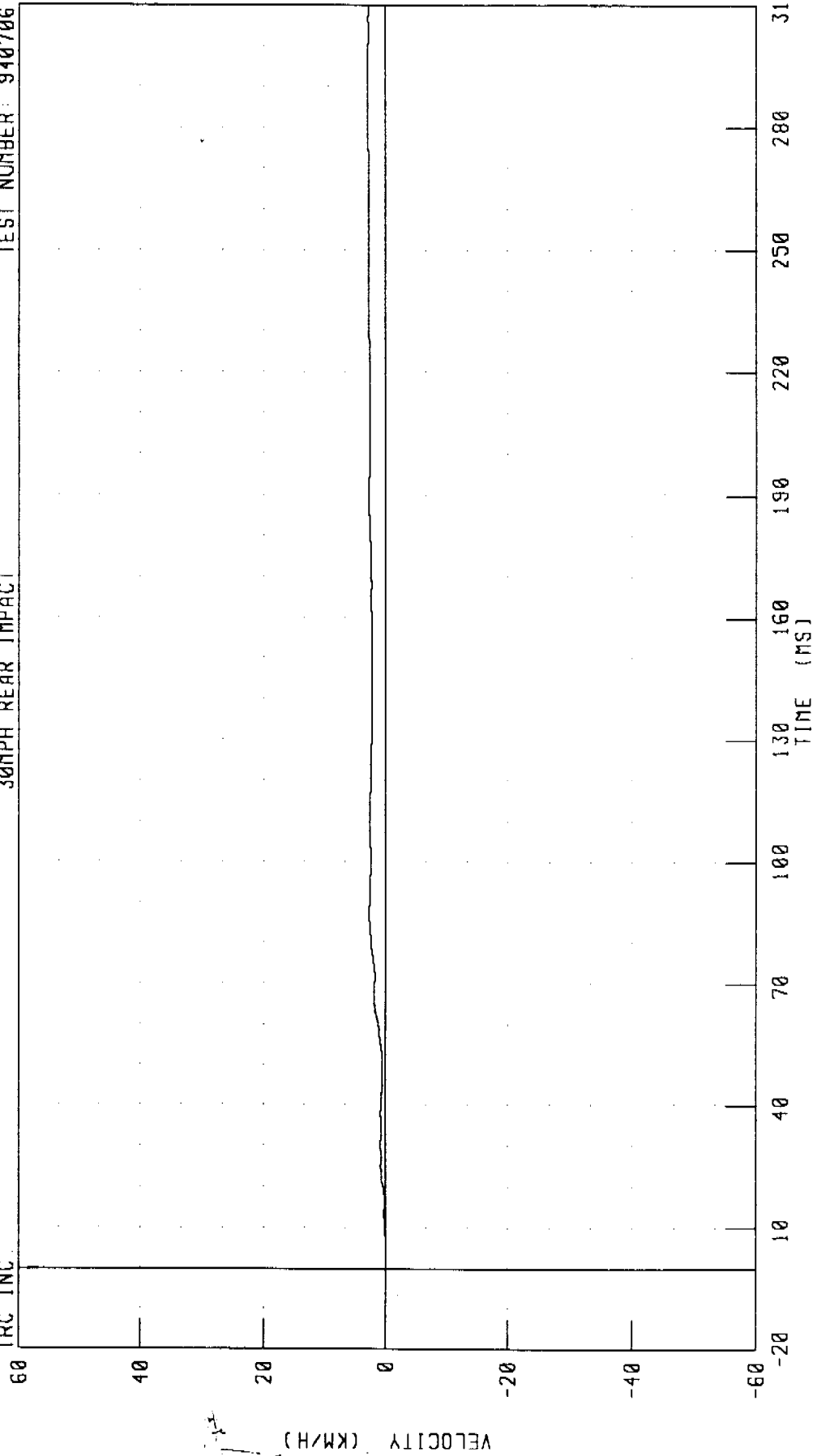
PEAK DATA: 4 11 G @ 61.68 MS, -1 25 G @ 32.16 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Y-AXIS VELOCITY

TEST NUMBER: 940706

30MPH REAR IMPACT

TRC INC

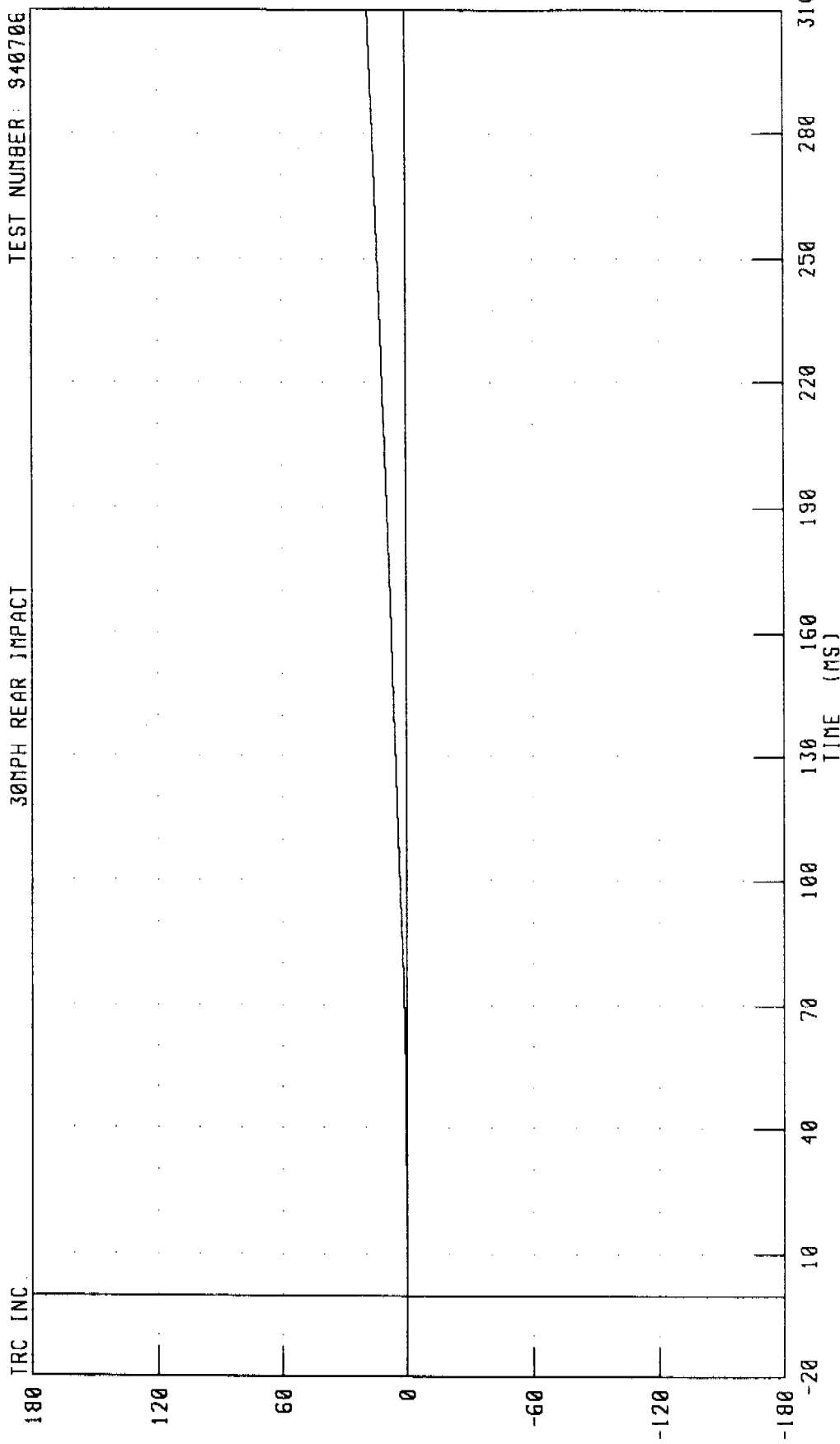


CHANNEL: YCGYV FILTER: CH. CLASS 180

PEAK DATA: 2.90 KM/H @ 288.96 MS; -0.01 KM/H @ 4.40 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Y-AXIS DISPLACEMENT
30MPH REAR IMPACT

TEST NUMBER: 940706



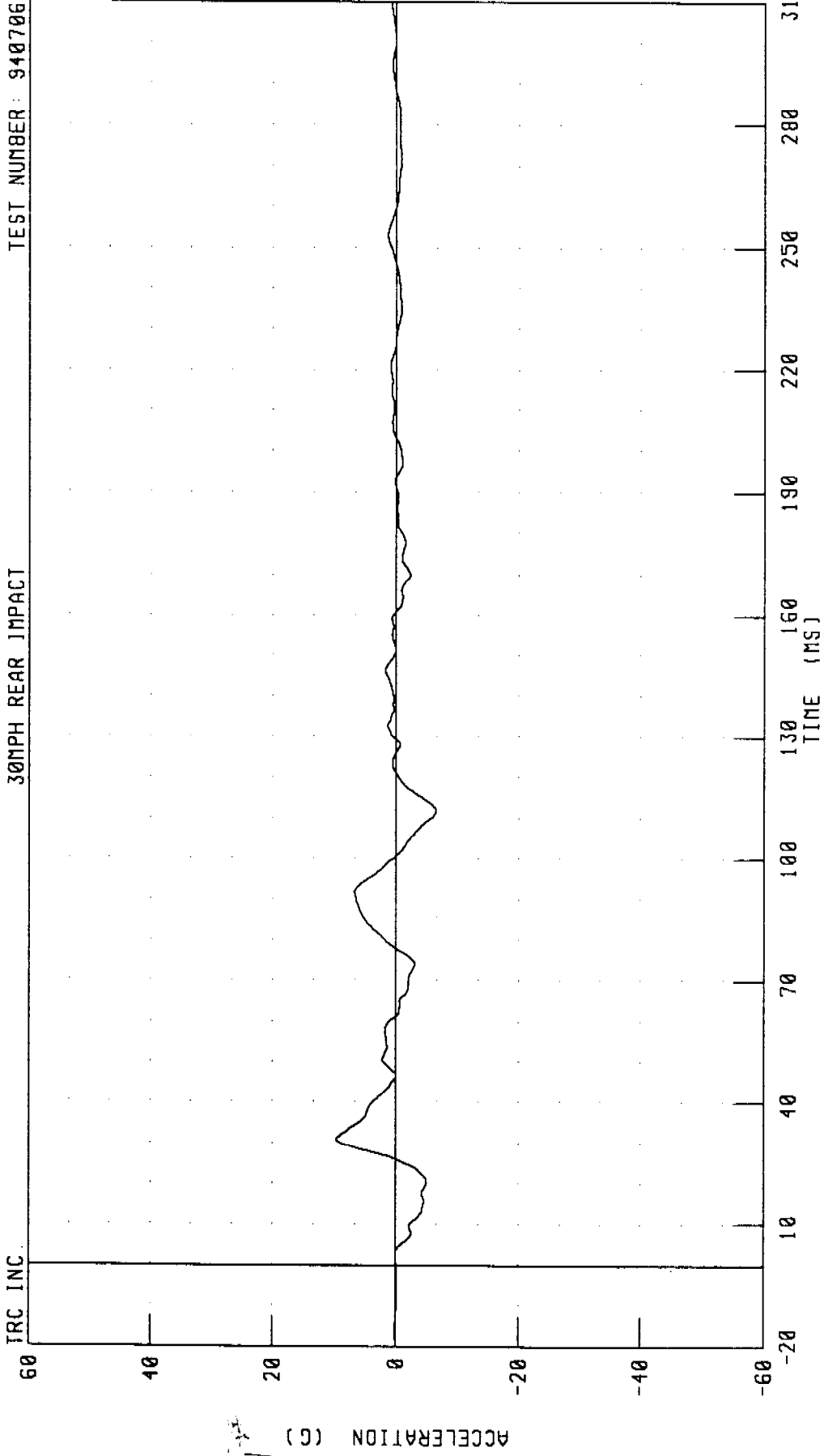
TRC INC.

DISPLACEMENT (CM X 10¹⁴)

CHANNEL: VCGYD FILTER: CH. CLASS 180
TIME (MS) PEAK DATA: 182.11 MS @ 310.00 MS; -0.01 MM @ 5.28 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Z-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

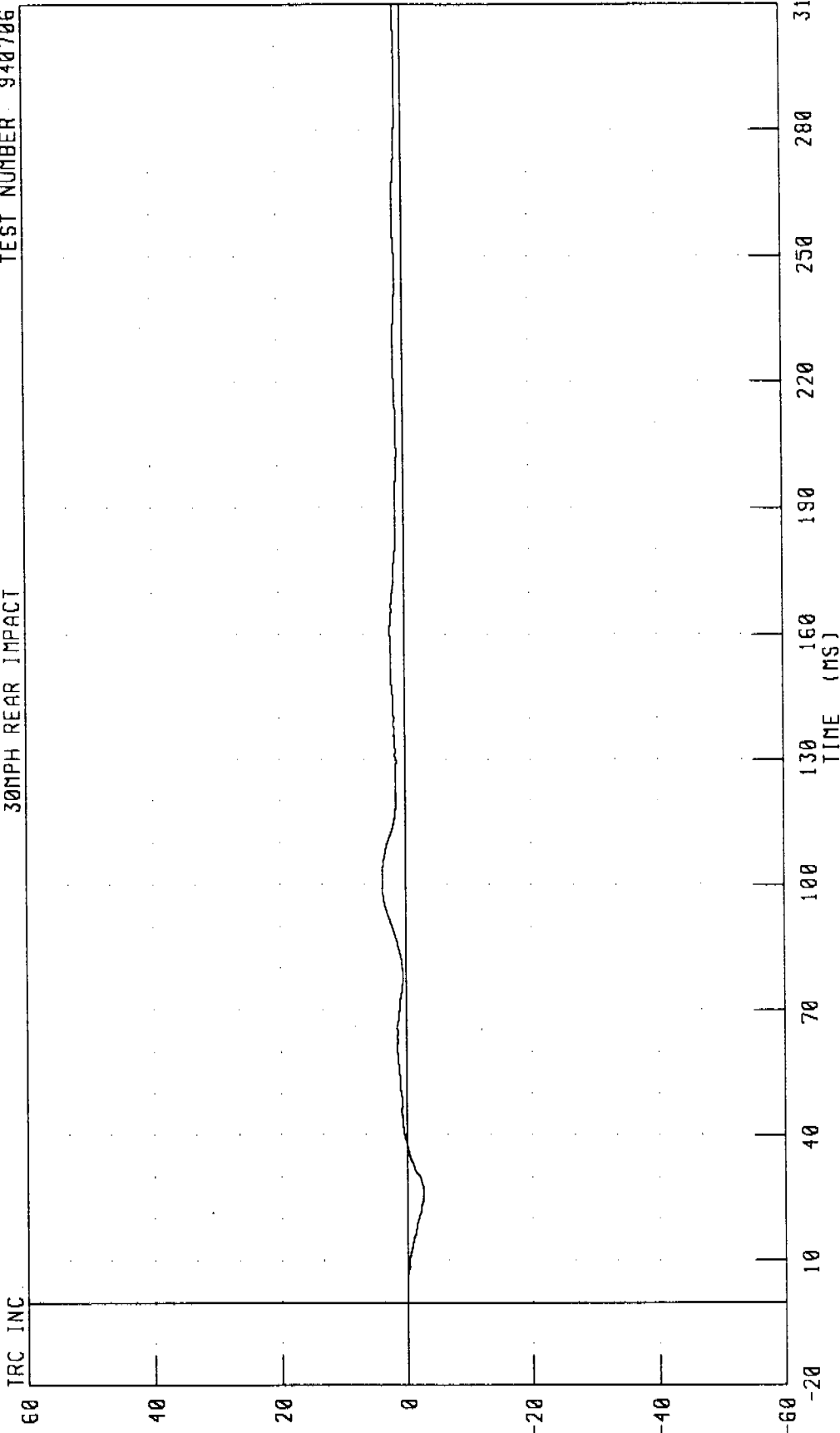


CHANNEL: VCGZG FILTER: CH CLASS 60

PEAK DATA: 9.72 G @ 30.96 MS, -6.46 G @ 111.76 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Z-AXIS VELOCITY
30MPH REAR IMPACT

TEST NUMBER 940706



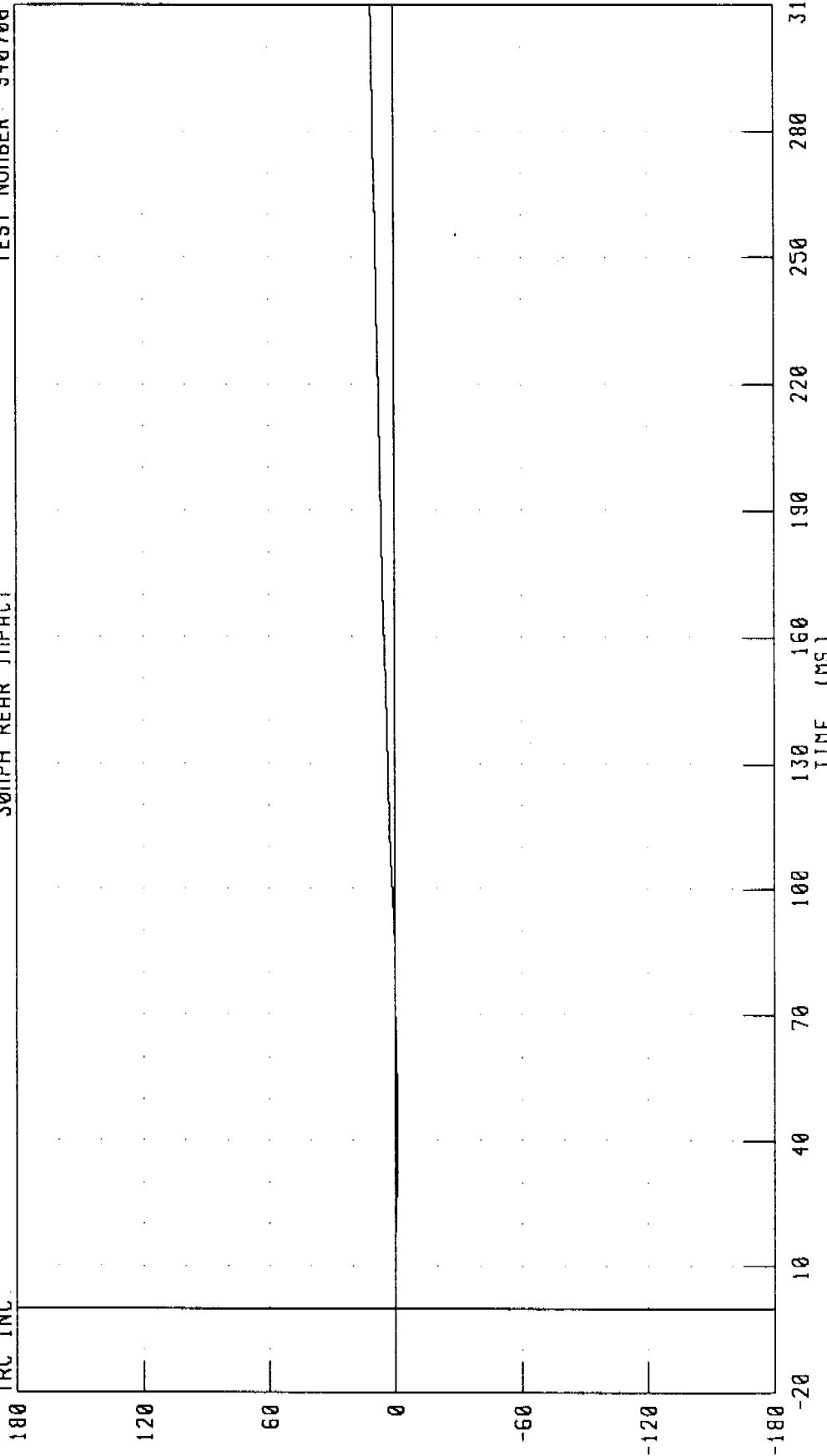
CHANNEL: VCGZV FILTER: CH. CLASS 180

PEAK DATA: 3.81 KM/H @ 100.00 MS; -2.56 KM/H @ 27.12 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Z-AXIS DISPLACEMENT
30MPH REAR IMPACT

TEST NUMBER: 940706

TRC INC.



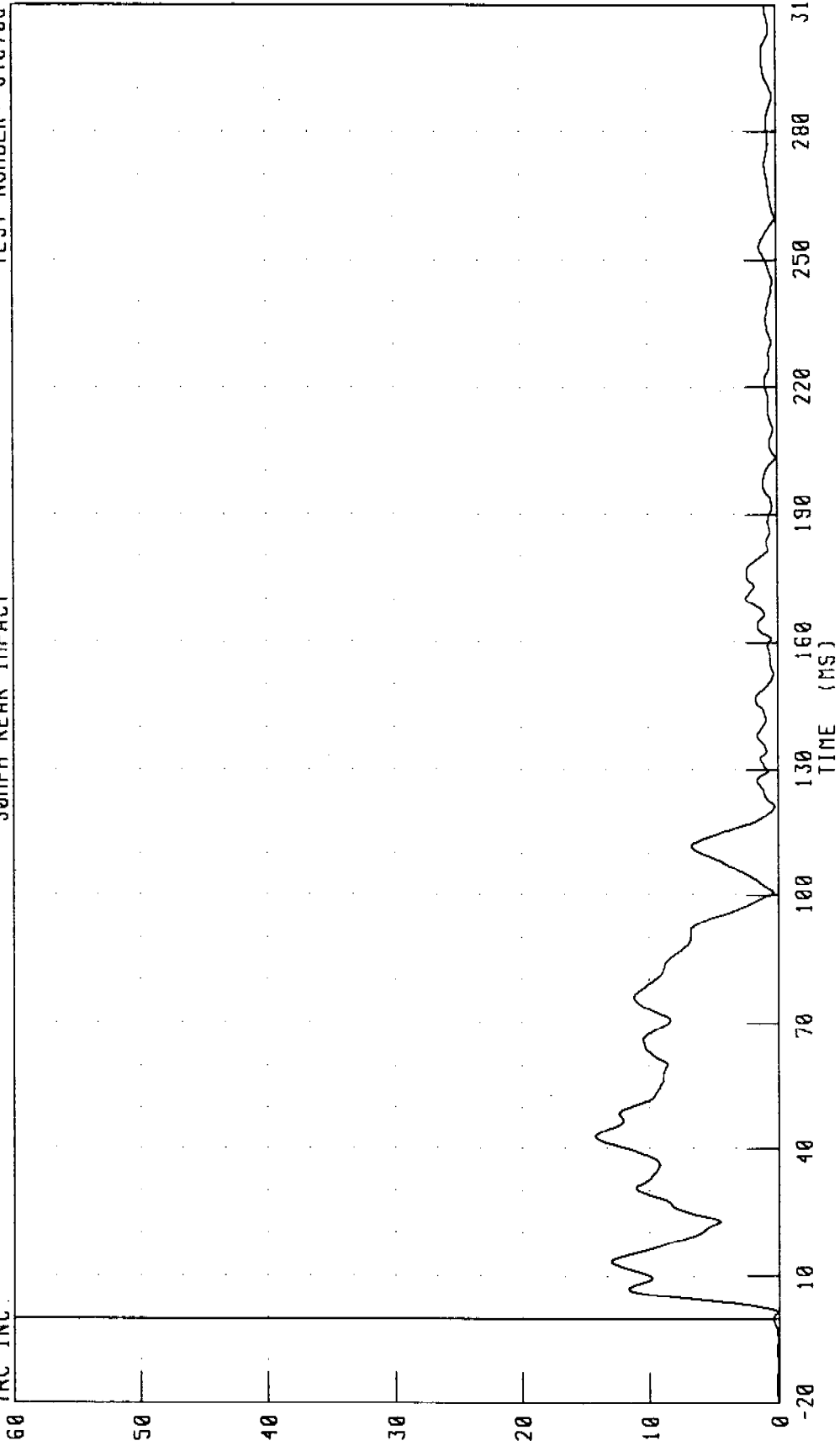
CHANNEL: VCGZD FILTER: CH CLASS 180

PEAK DATA: 105 40 MM @ 310.00 MS; -11 26 MM @ 37 60 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

IRC INC.

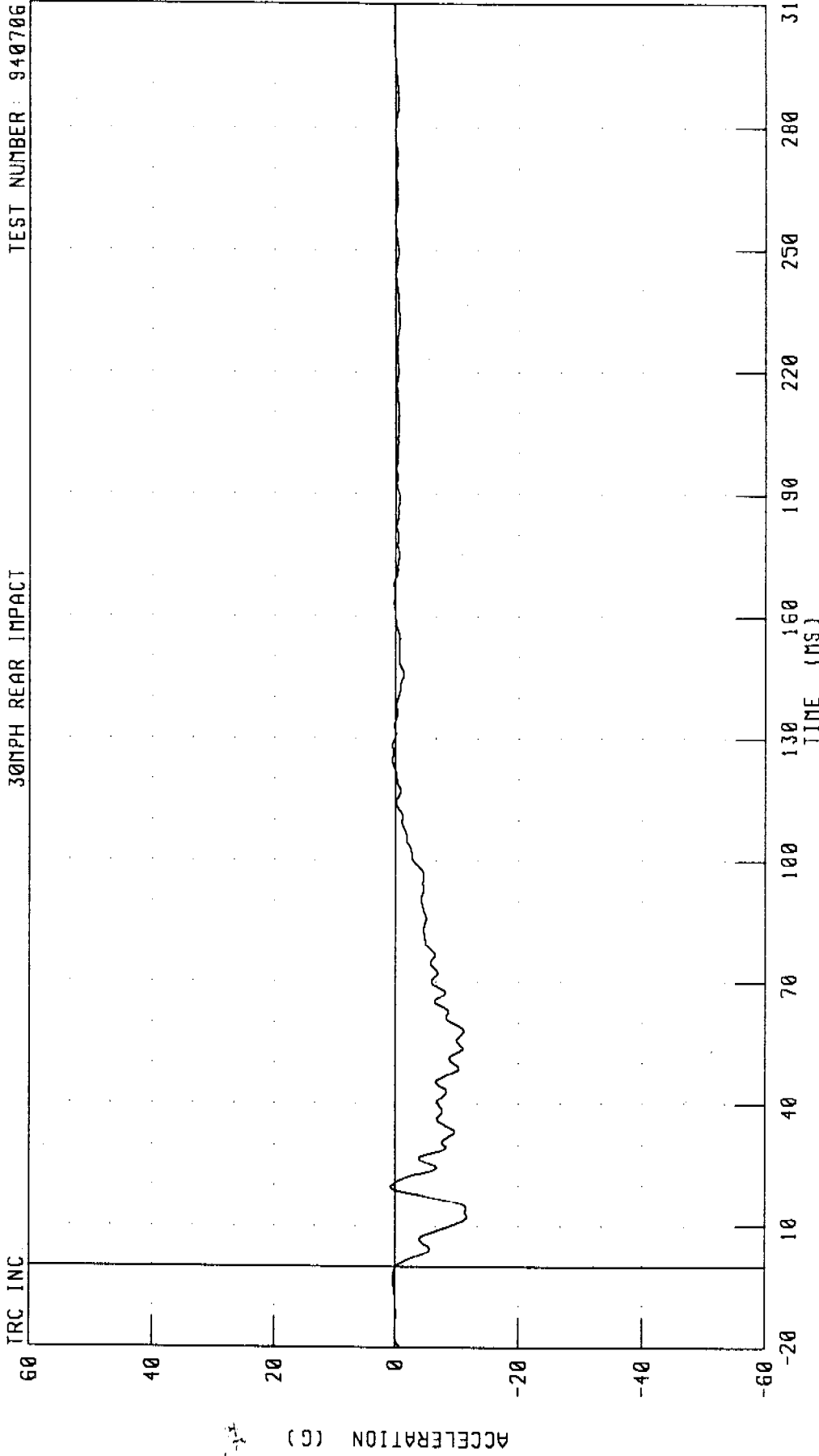


CHANNEL: VCGRG FILTER: CH. CLASS 60

PEAK DATA: 14.26 G @ 43.20 MS; 0.06 G @ -19.92 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY X-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

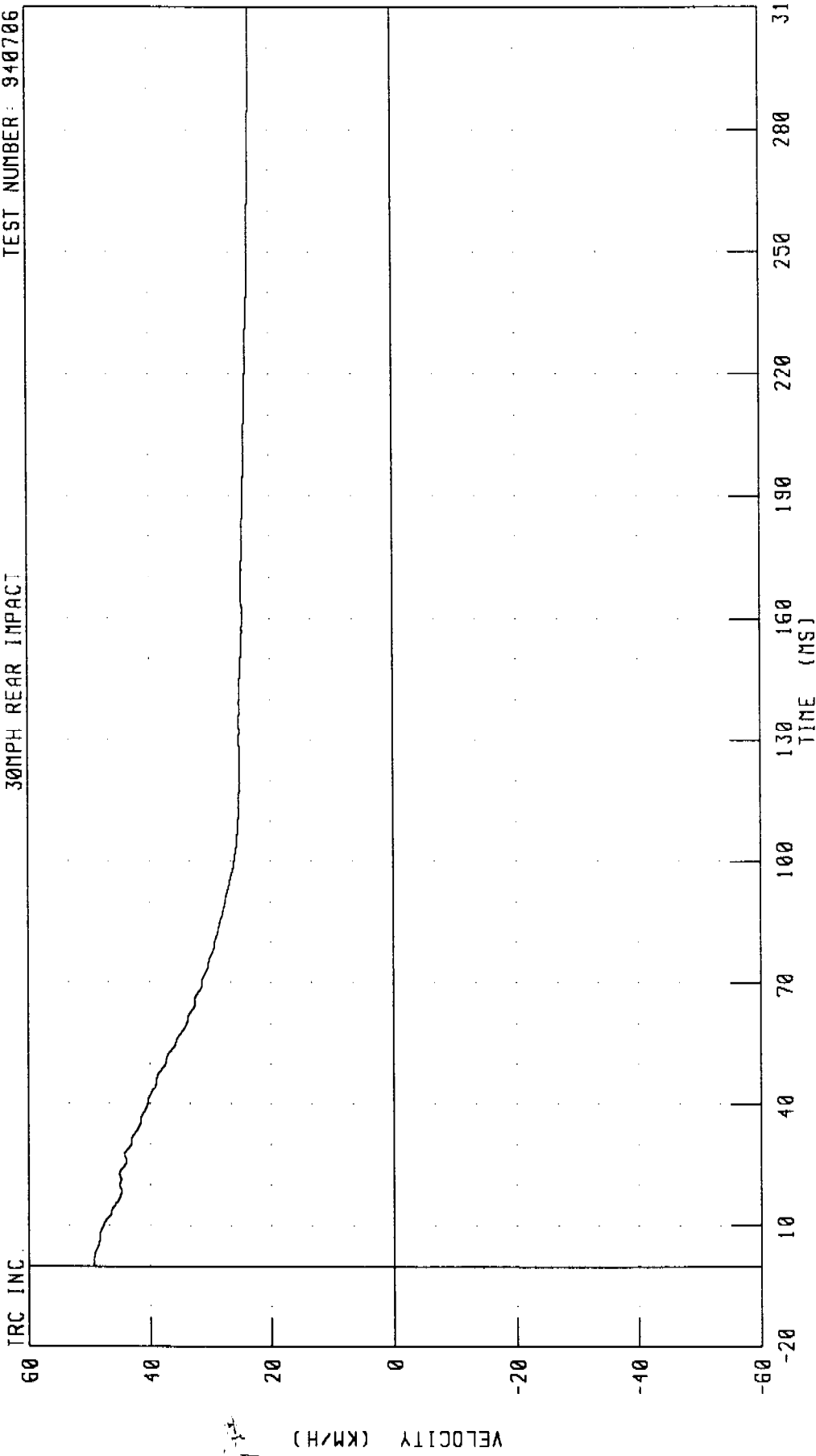


CHANNEL: BCGXG FILTER: CH. CLASS 60

PEAK DATA 0 78 G @ 19.68 MS, -11.69 G @ 12.32 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY X-AXIS VELOCITY
30MPH REAR IMPACT

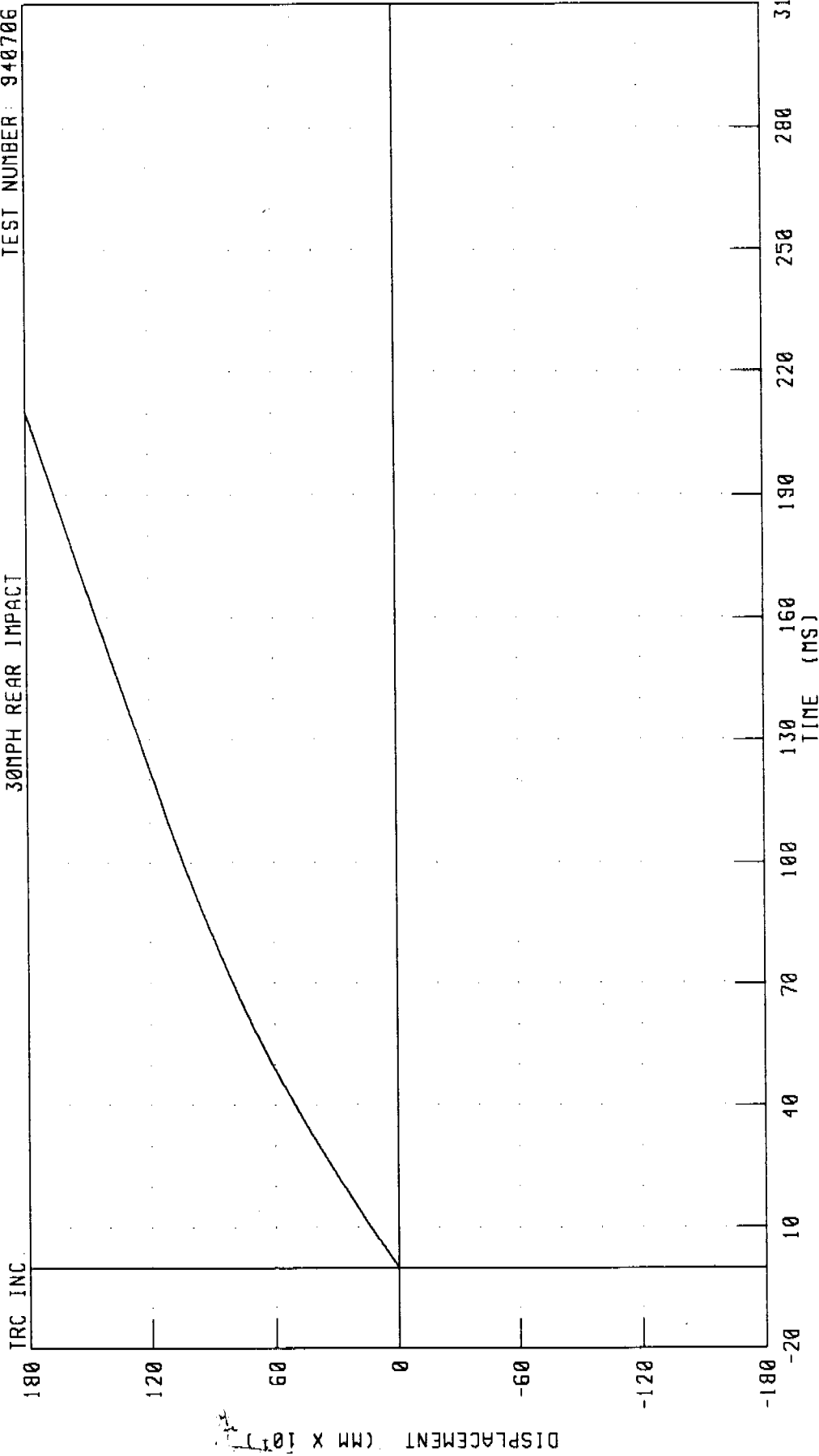
TEST NUMBER: 940706



CHANNEL: BCGXV FILTER: CH. CLASS 180 PEAK DATA 49 20 KM/H @ 1.76 MS; 23 15 KM/H @ 298 80 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY X-AXIS DISPLACEMENT
30MPH REAR IMPACT

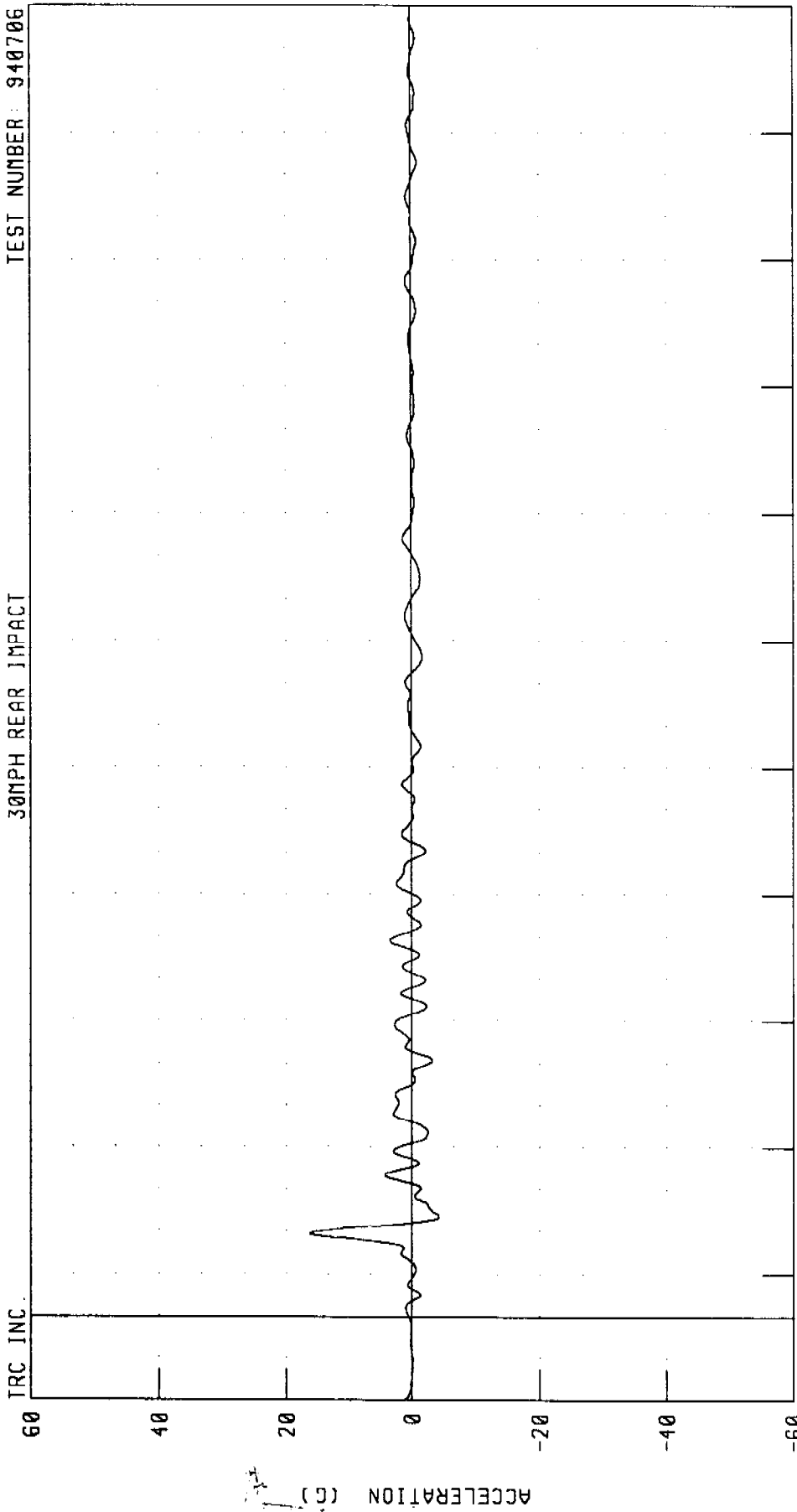
TEST NUMBER: 940706



CHANNEL: BCGXD FILTER CH: CLASS 180 PEAK DATA 2448 99 MM @ 310 00 MS, 0 00 MM @ 0 00 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Y-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

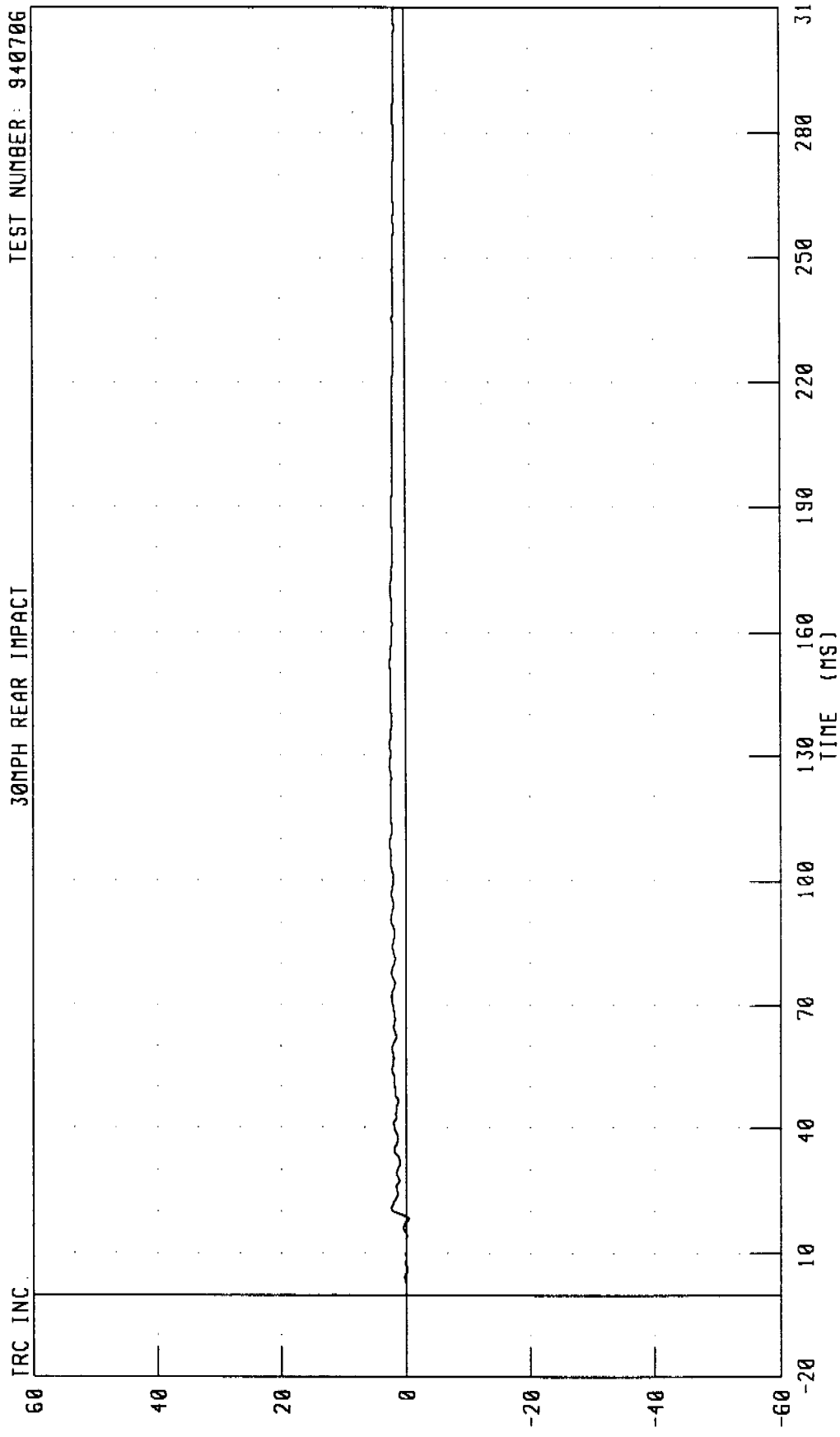


TRC INC. CHANNEL BCGYC FILTER CH. CLASS 60

PEAK DATA: 16.32 G @ 19.44 MS, -4.26 G @ 23.52 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Y-AXIS VELOCITY
30MPH REAR IMPACT

TEST NUMBER: 940706



TRC INC.

CHANNEL: BCGYV FILTER: CH. CLASS 180

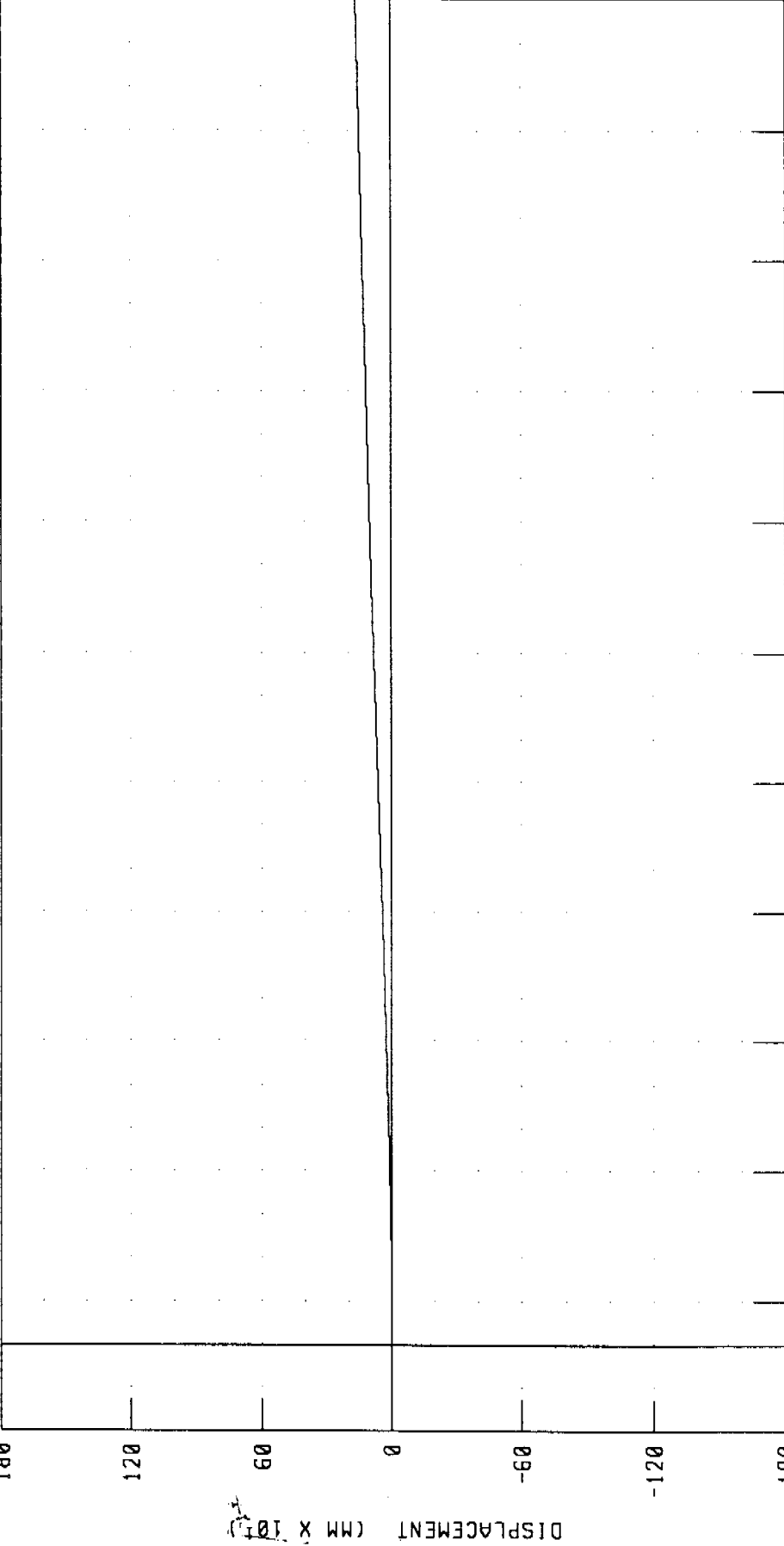
PEAK DATA 2 57 KM/H @ 127 68 MS, -0 42 KM/H @ 18 16 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Y-AXIS DISPLACEMENT

TRC INC

30MPH REAR IMPACT

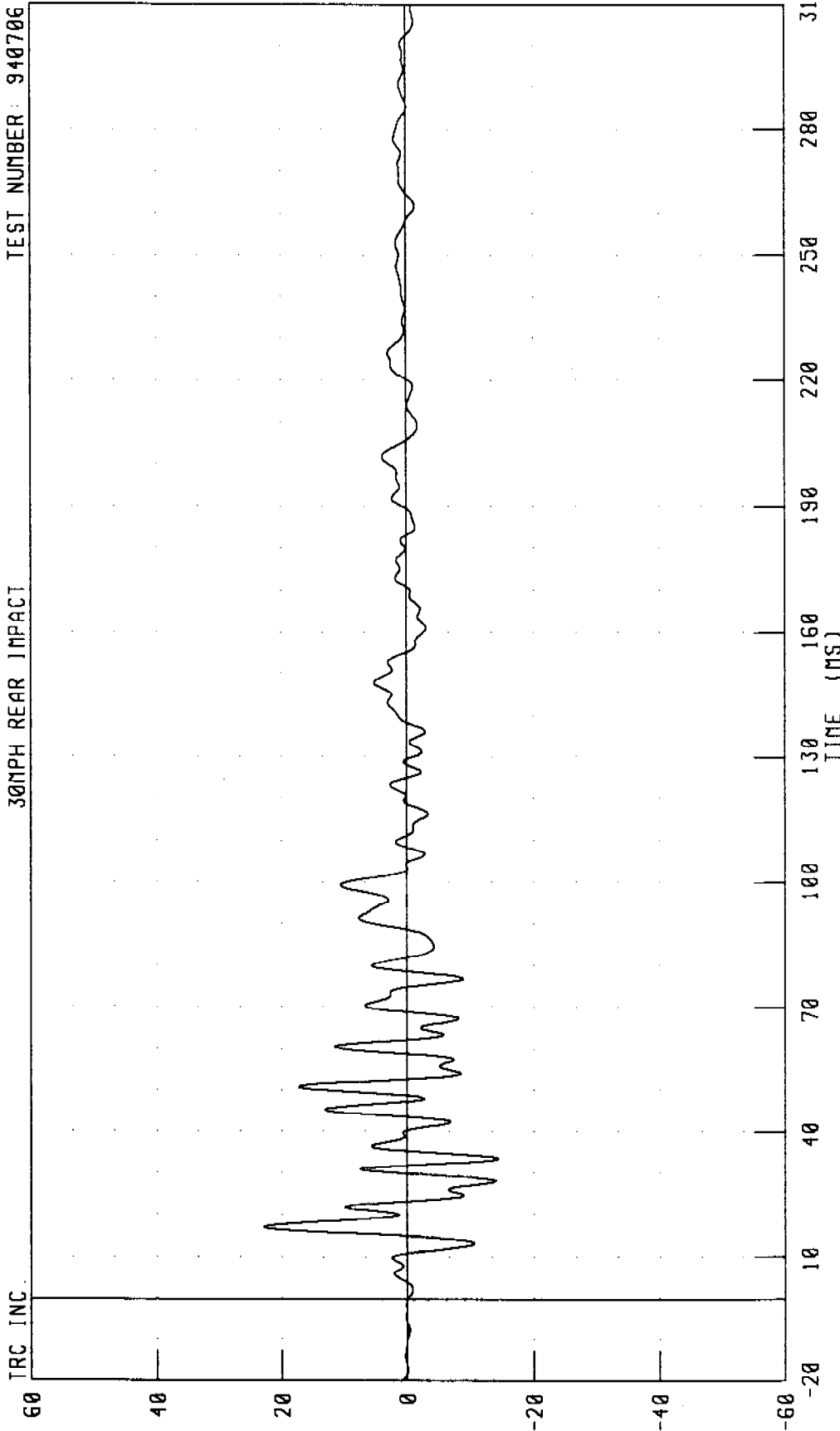
TEST NUMBER: 940706



CHANNEL: BCCYD FILTER: CH. CLASS 180
PEAK DATA 161.86 MM @ 310.00 MS, 0.00 MM @ 0.00 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Z-AXIS ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706

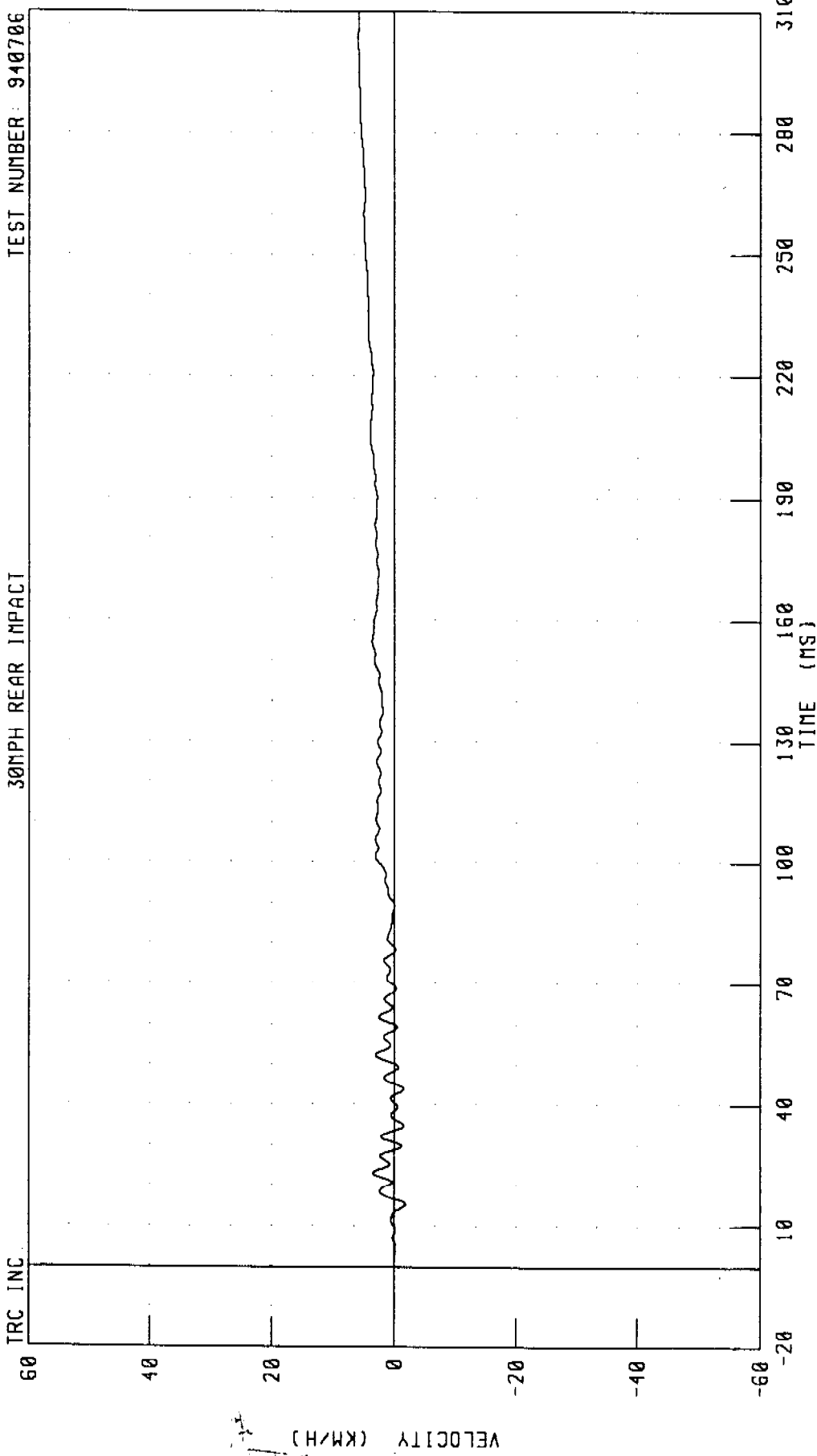


TRC INC.

CHANNEL: BCGZG FILTER: CH: CLASS 60 PEAK DATA: 22.85 G @ 16.96 MS, -14.37 G @ 33.68 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Z-AXIS VELOCITY
30MPH REAR IMPACT

TEST NUMBER: 940706

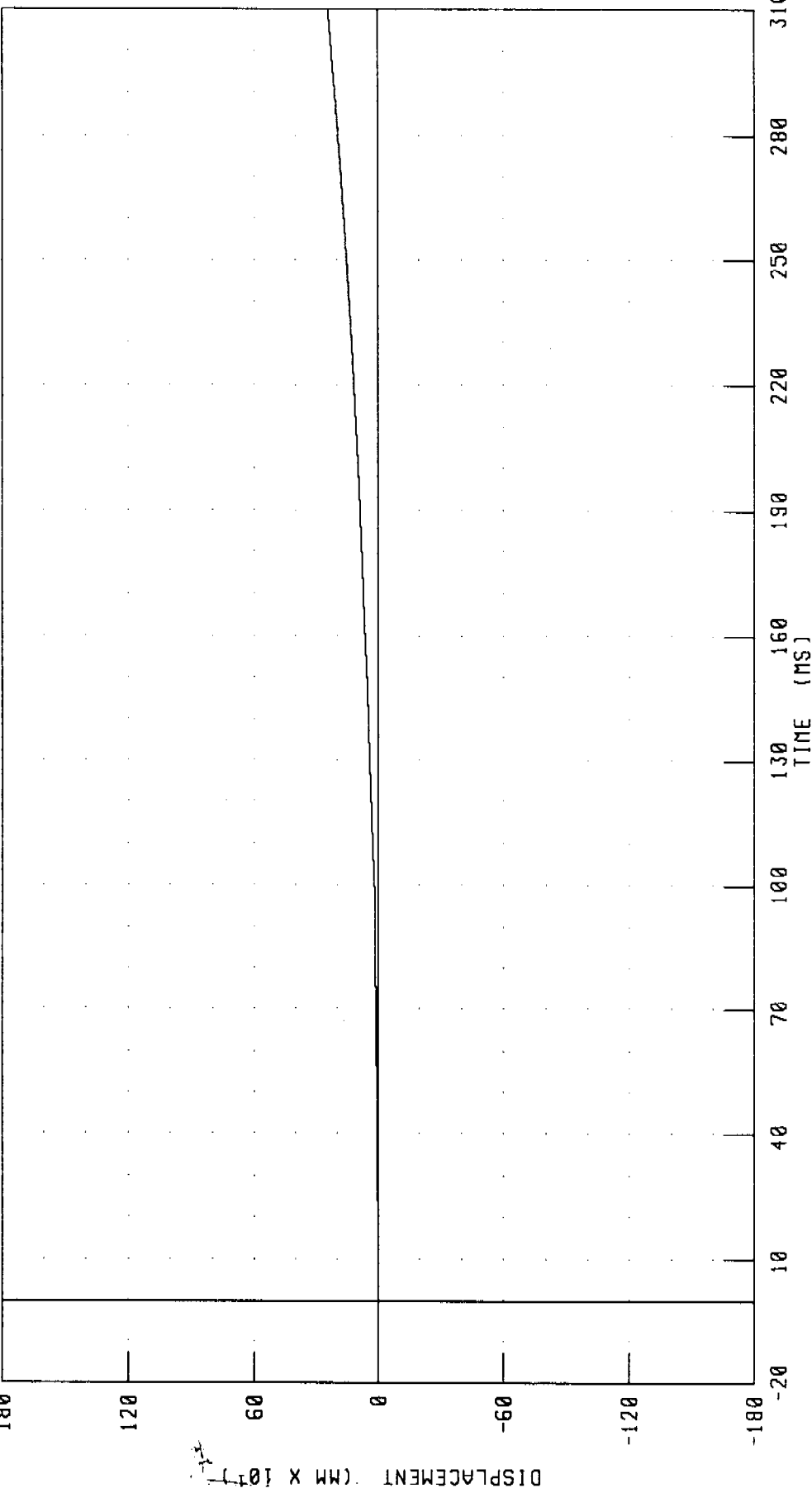


CHANNEL: BCGZV FILTER: CH CLASS 180 PEAK DATA 5 95 KM/H @ 302 32 MS, -1 84 KM/H @ 15.44 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Z-AXIS DISPLACEMENT
30MPH REAR IMPACT

TEST NUMBER: 940706

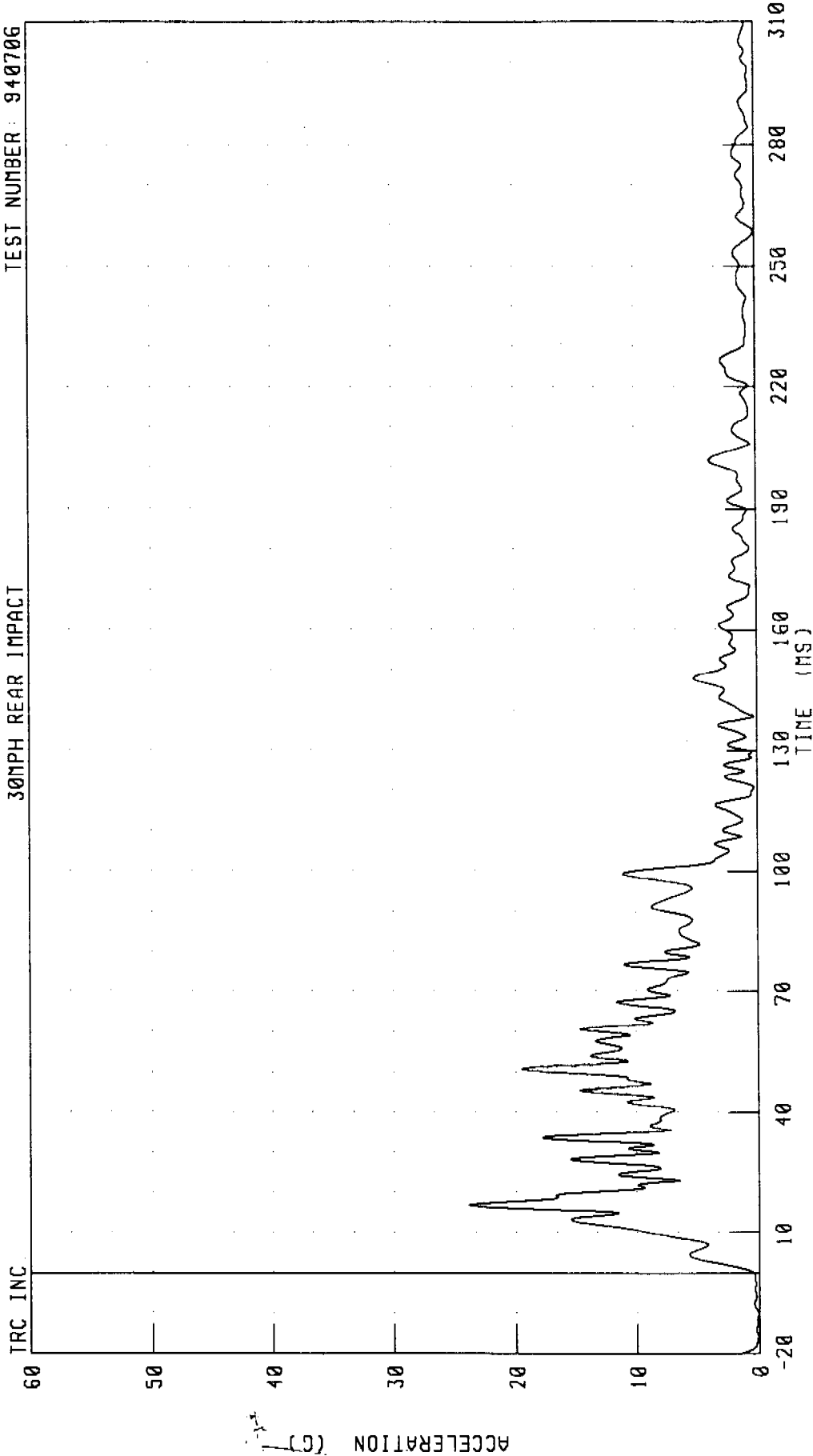
TRC INC.



CHANNEL BCGZD FILTER: CH. CLASS 180 PEAK DATA: 240.82 MM @ 310.00 MS, -0.72 MM @ 16.72 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY RESULTANT ACCELERATION
30MPH REAR IMPACT

TEST NUMBER: 940706



CHANNEL: BCGRG FILTER: CH CLASS 60 PEAK DATA: 23.89 G @ 16.96 MS; 0.11 G @ -10.08 MS

APPENDIX C

MISCELLANEOUS TEST INFORMATION

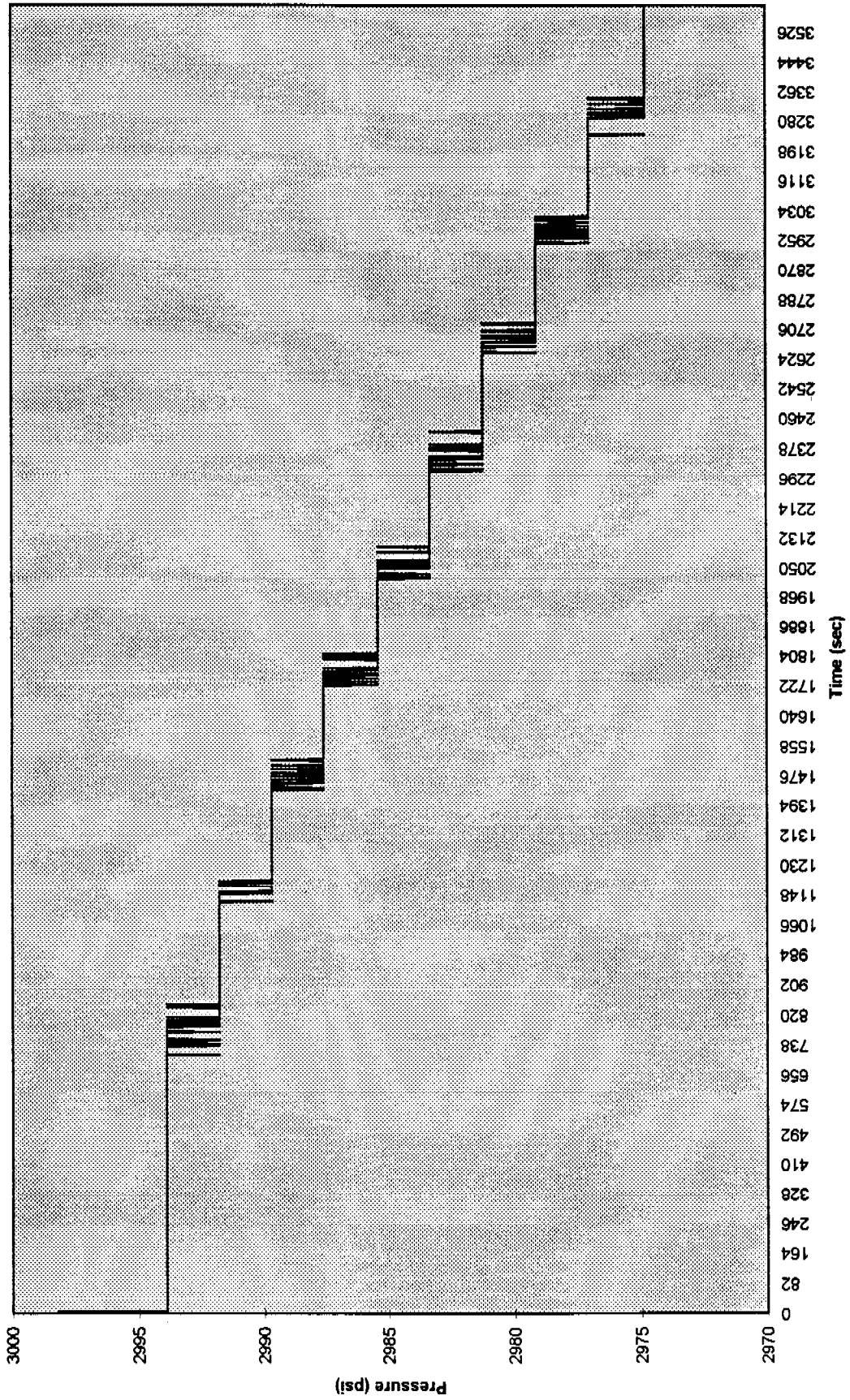
VEHICLE INSTRUMENTATION INFORMATION

NO.	LOCATION	AXIS	MFR.	MODEL	S/N	ORIENTATION (+ SENSING)
1	LEFT REAR SILL	X	ENDEVCO	7264	AGRF1	REAR
		Y	ENDEVCO	7264	AGRF7	UP
2	RIGHT REAR SILL	Y	ENDEVCO	7264	CJ75H	FRONT
		Y	ENDEVCO	7264	AGRG8	UP
3	CENTER OF GRAVITY	X	ENDEVCO	7264	DT96JT	FRONT
		Y	ENDEVCO	7264	AGRG5	LEFT
		Z	ENDEVCO	7264	CM27H	UP

MOVING BARRIER INSTRUMENTATION INFORMATION

NO.	LOCATION	AXIS	MFR.	MODEL	S/N	ORIENTATION (+ SENSING)
4	BARRIER CENTER OF GRAVITY	X	ENDEVCO	7264	DW34JC	FRONT
		Y	ENDEVCO	7264	CL98H	LEFT
		Z	ENDEVCO	7264	DR87J	UP

VRTC CNG TEST 7/6/94



VRTC CNG TEST 7/6/94

