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National Highway Traffic Safety Administration

DOT HS 808 252

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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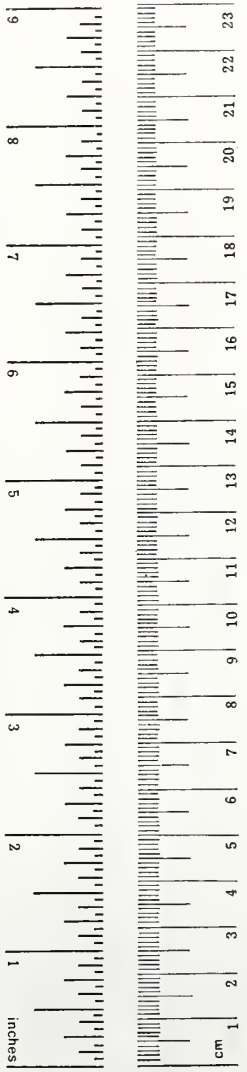
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

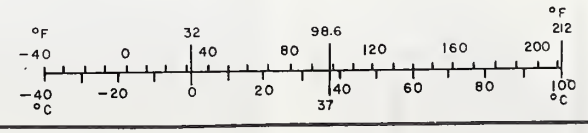
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
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

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		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 oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	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



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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 ANGLE[1] (DEG): 180

IMPACT VELOCITY[2] (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 unibelt	Three-point unibelt

NUMBER OF DATA CHANNELS: 10

NUMBER OF CAMERAS: HIGH-SPEED 7 REAL-TIME 1

[1]With respect to tow track centerline.
[2]Speed trap measurement (± .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? No[1]
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:

RCLW[1] = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (1431 KGS.)

VCW[1] = VEHICLE CAPACITY WEIGHT (392 KGS.)

DSC[1] = DESIGNATED SEATING CAPACITY (5)

RCLW[1]= VCW - 68 (DSC) = 52 KGS.

TARGET TEST WEIGHT = UDW + RCLW[1]+ (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)

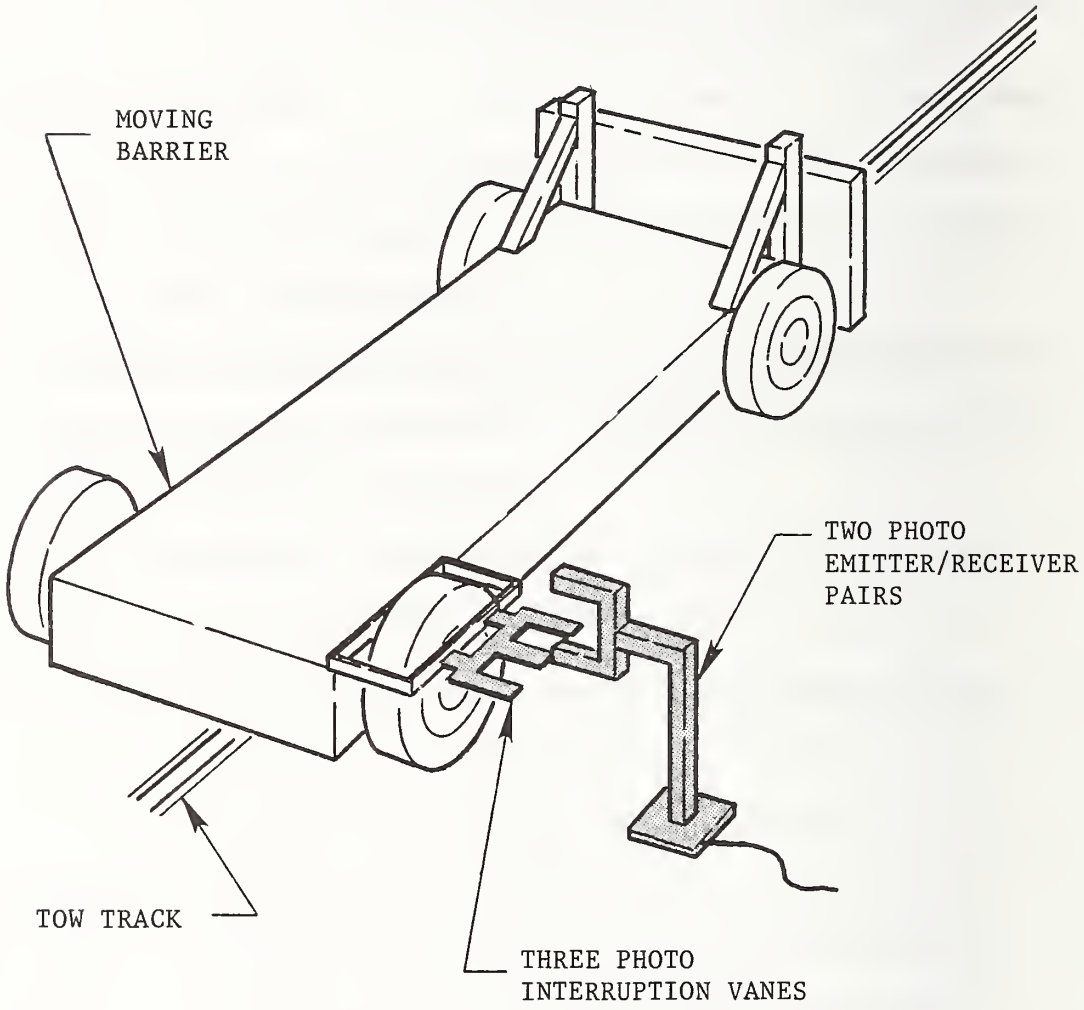
DISTANCE FROM VEHICLE TO BARRIER: ENTERING VELOCITY TRAP = 356 MM.

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	NA	NA
CHEST	NA	NA
ABDOMEN	NA	NA
LEFT KNEE	NA	NA
RIGHT KNEE	NA	NA

DOOR OPENING:

	LEFT	RIGHT
FRONT	Opened easily	Opened easily
REAR	Difficult	Difficult

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	Both back seats failed	No
REAR	No	No

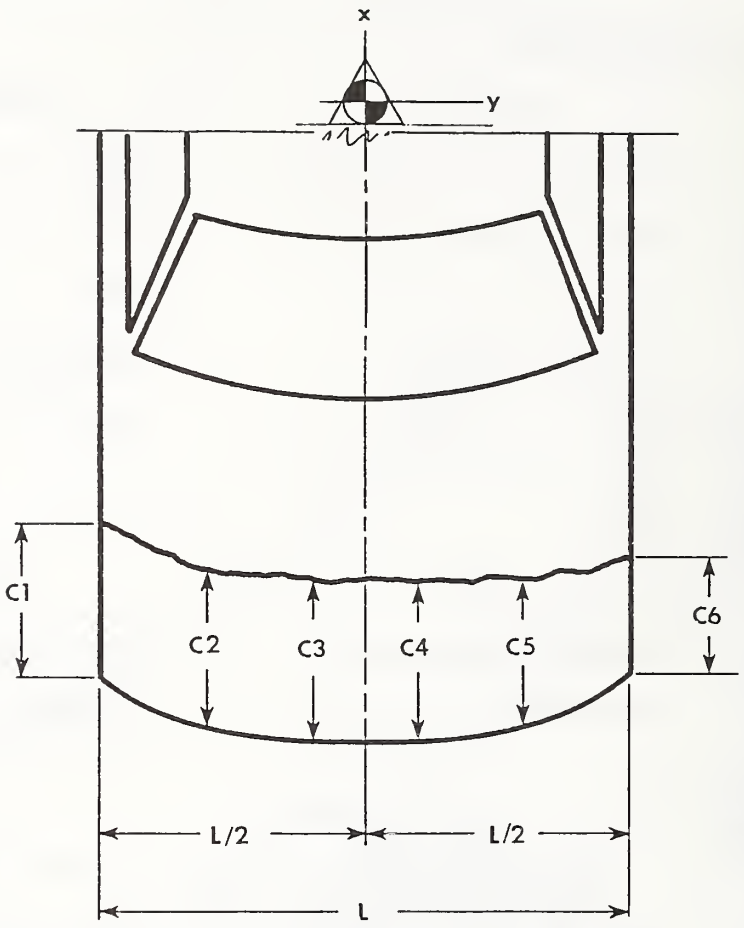
GLAZING DAMAGE:

The rear window shattered during the crash

OTHER NOTABLE IMPACT EFFECTS:

None

FIGURE 2 VEHICLE CRUSH

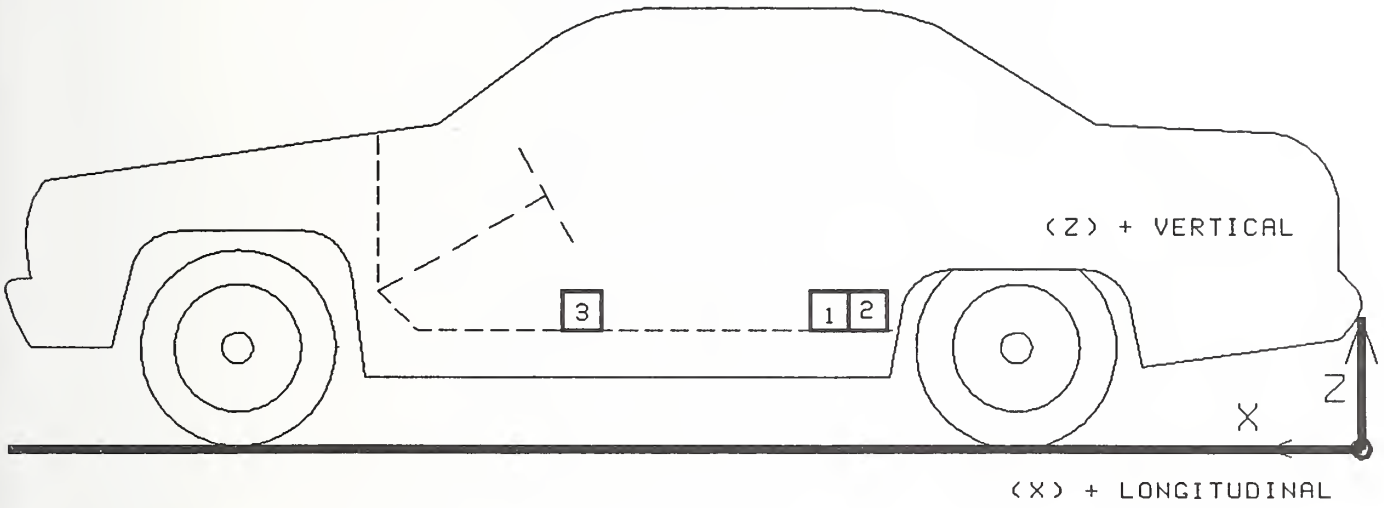


NOTES: L is pre-test length of contact surface.
C1 through C6 are spaced equally apart.
CL is vehicle centerline.
All measurements are in millimeters.

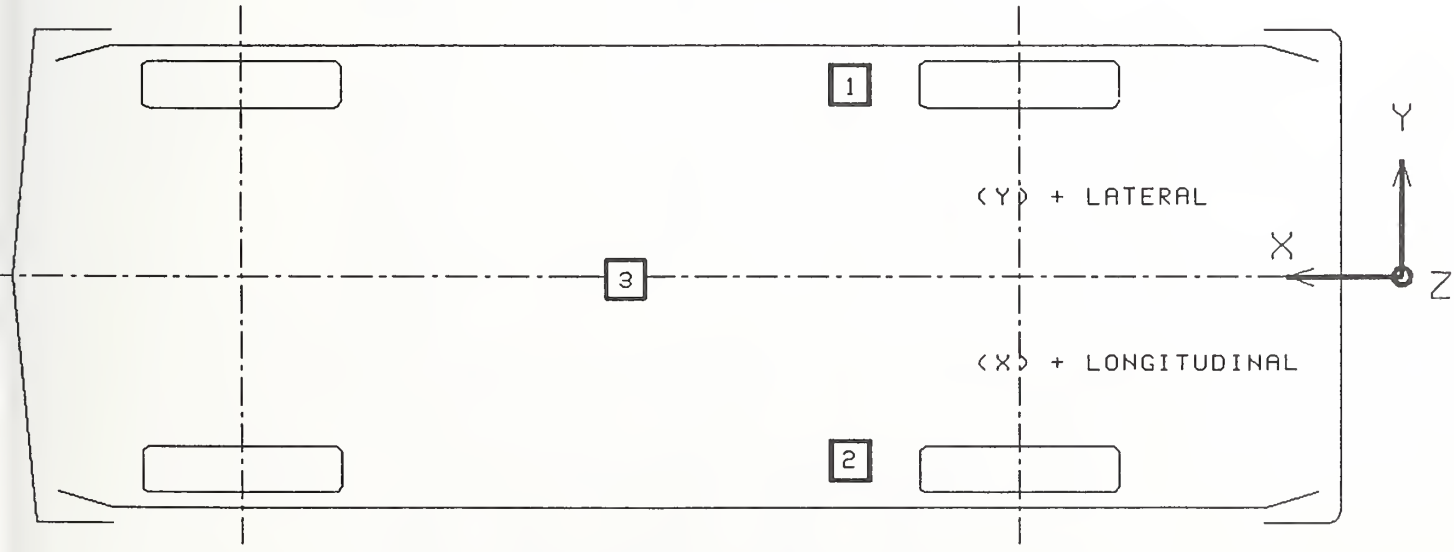
Vehicle Plymouth Acclaim 4-door sedan

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

FIGURE 3 VEHICLE ACCELEROMETER PLACEMENT



SIDE VIEW



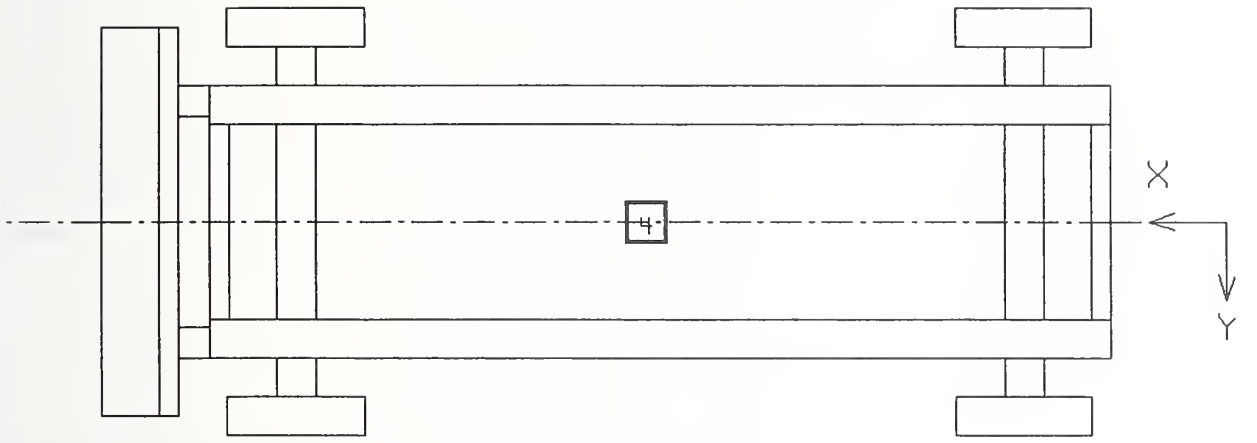
BOTTOM VIEW

TABLE 5 VEHICLE ACCELEROMETERS LOCATIONS AND DATA SUMMARY

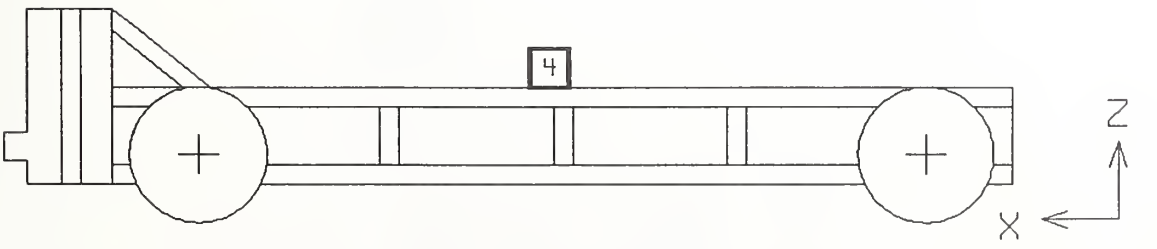
TEST NUMBER: 940706 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
1 LEFT REAR SILL	1698 mm	724 mm	352 mm				
LONGITUDINAL				15.1 g	@ 45.2 ms	1.9 g	@ 140.6 ms
VERTICAL				8.7 g	@ 46.6 ms	9.2 g	@ 12.6 ms
2 RIGHT REAR SILL	1698 mm	-724 mm	352 mm				
LONGITUDINAL				13.9 g	@ 45.0 ms	2.8 g	@ 20.6 ms
VERICAL				8.9 g	@ 32.2 ms	7.3 g	@ 42.4 ms
3 VEHICLE CENTER OF GRAVITY	2643 mm	0 mm	384 mm				
LONGITUDINAL				14.2 g	@ 43.3 ms	1.6 g	@ 138.1 ms
LATERAL				4.1 g	@ 61.7 ms	1.2 g	@ 32.2 ms
VERTICAL				9.7 g	@ 31.0 ms	6.5 g	@ 111.8 ms
RESULTANT				14.3 g	@ 43.2 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 6 MOVING BARRIER ACCELEROMETER LOCATIONS AND DATA SUMMARY

TEST NUMBER: 940706 No. LOCATION	X	Y	Z	POSITIVE DIRECTION		NEGATIVE DIRECTION	
4 BARRIER CENTER OF GRAVITY	2830 mm	0 mm	265 mm				
LONGITUDINAL				0.8 g	@ 19.7 ms	11.7 g	@ 12.3 ms
LATERAL				16.3 g	@ 19.4 ms	4.3 g	@ 23.5 ms
VERTICAL				22.8 g	@ 17.0 ms	14.4 g	@ 33.7 ms
RESULTANT				23.9 g	@ 17.0 ms		

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

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)	Temperaturees (° 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

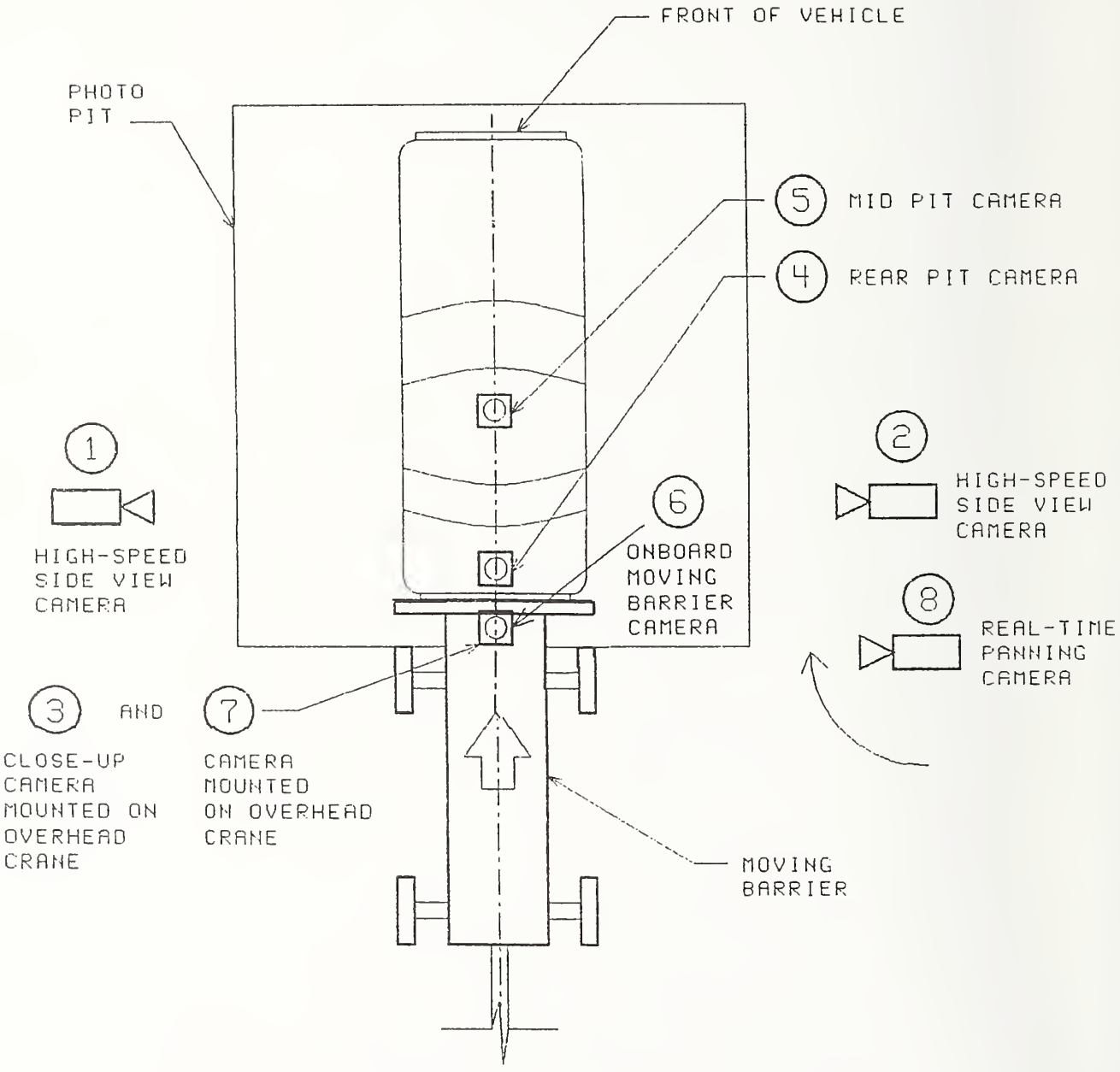


TABLE 8 MOTION PICTURE CAMERA INFORMATION

CAMERA NUMBER	LOCATION	TYPE	LENS (MM)	SPEED (FPS)	PURPOSE OF CAMERA DATA
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

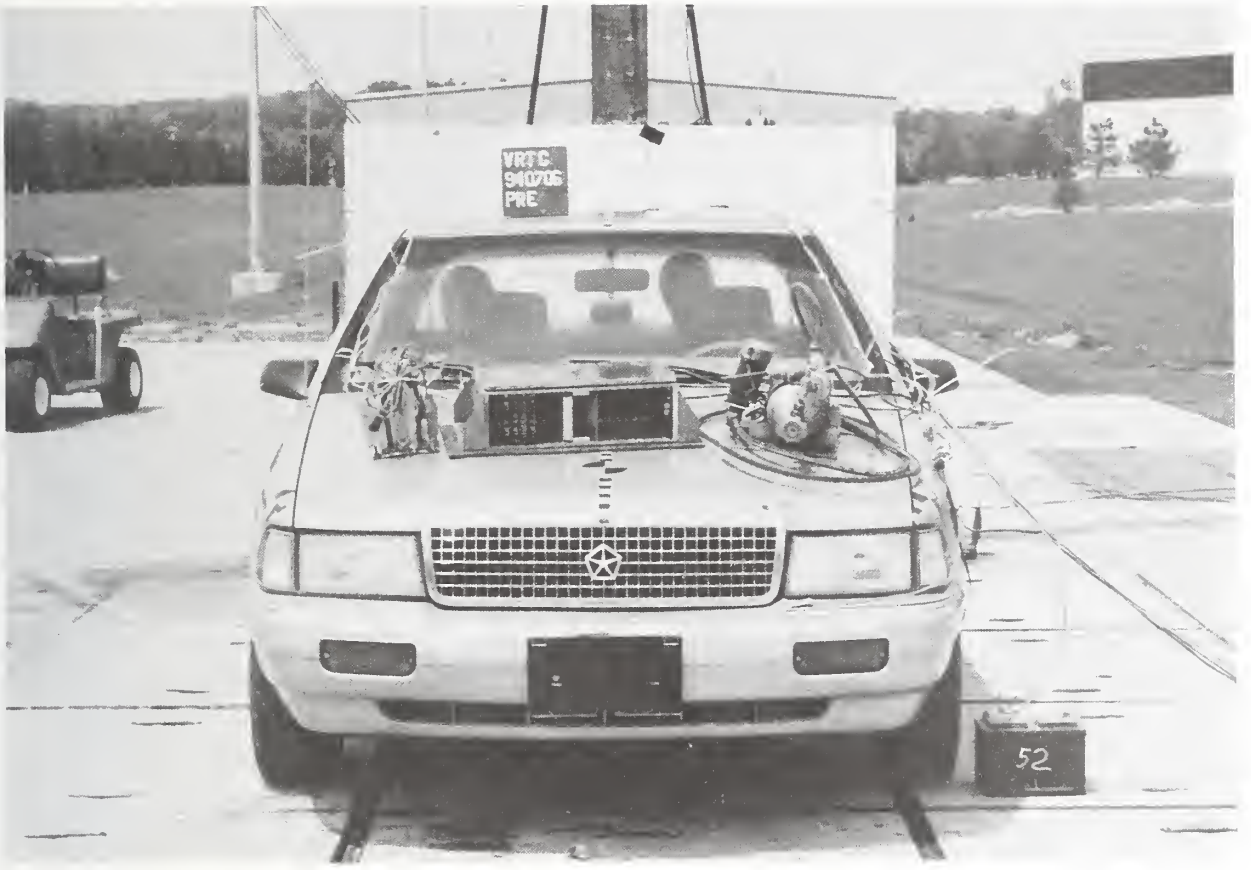


Figure A-1. PRE-TEST FRONT VIEW

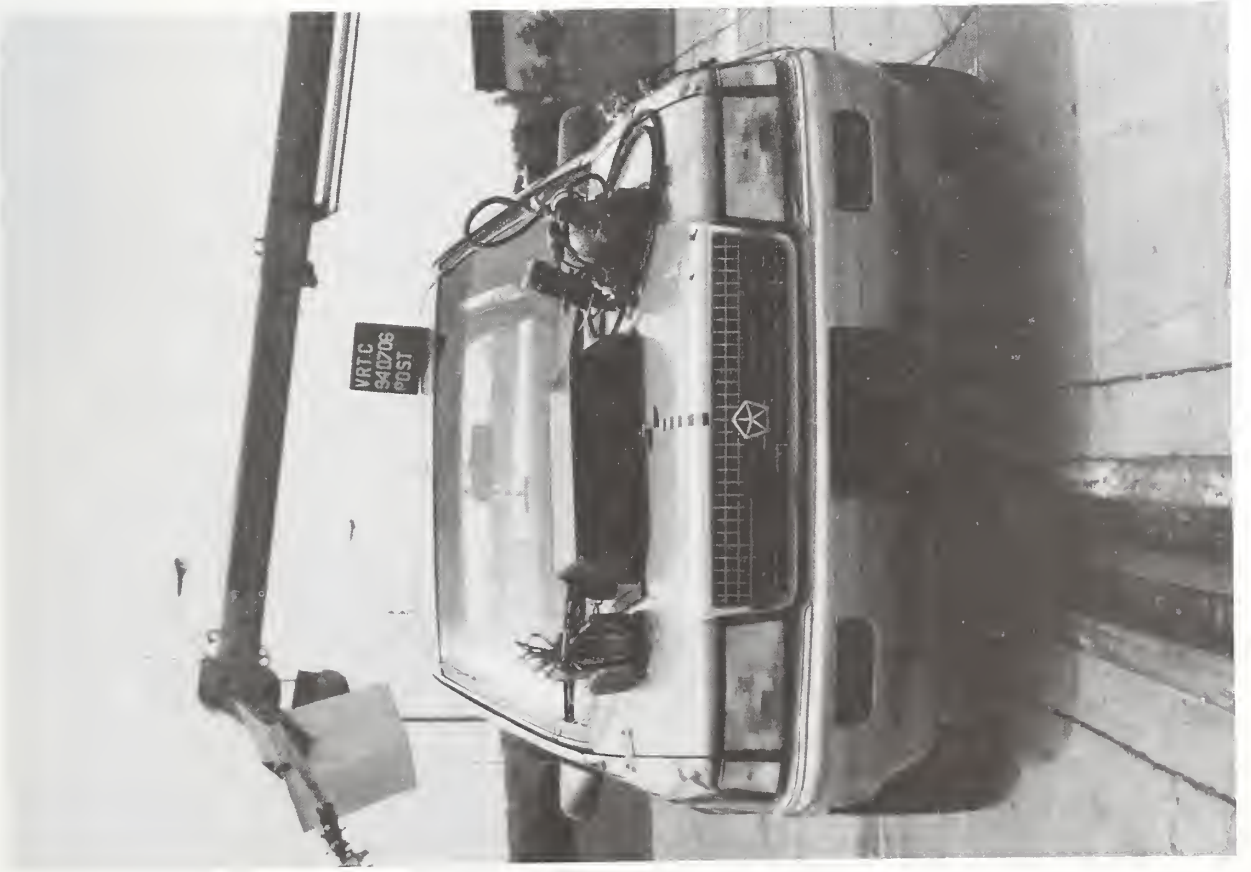


Figure A-2. POST-TEST FRONT VIEW

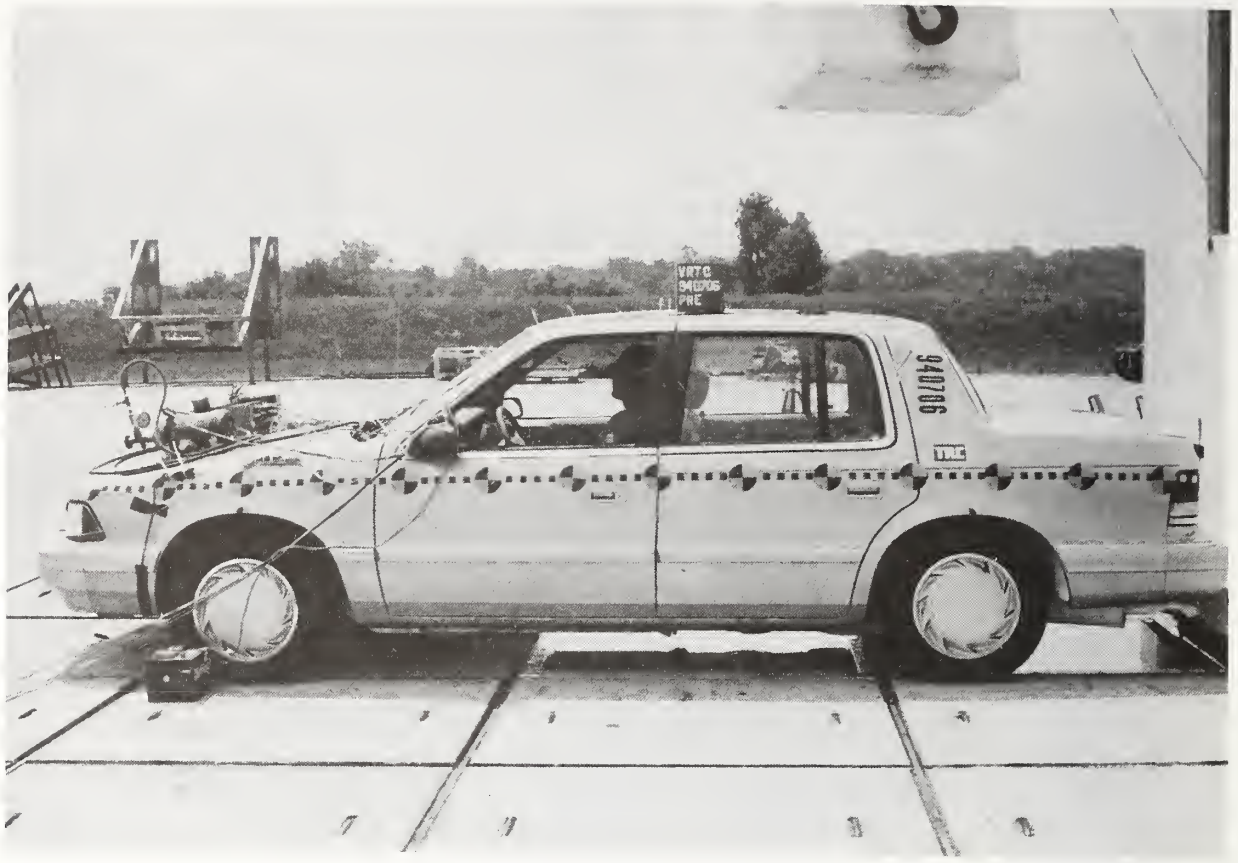


Figure A-3. PRE-TEST LEFT SIDE VIEW

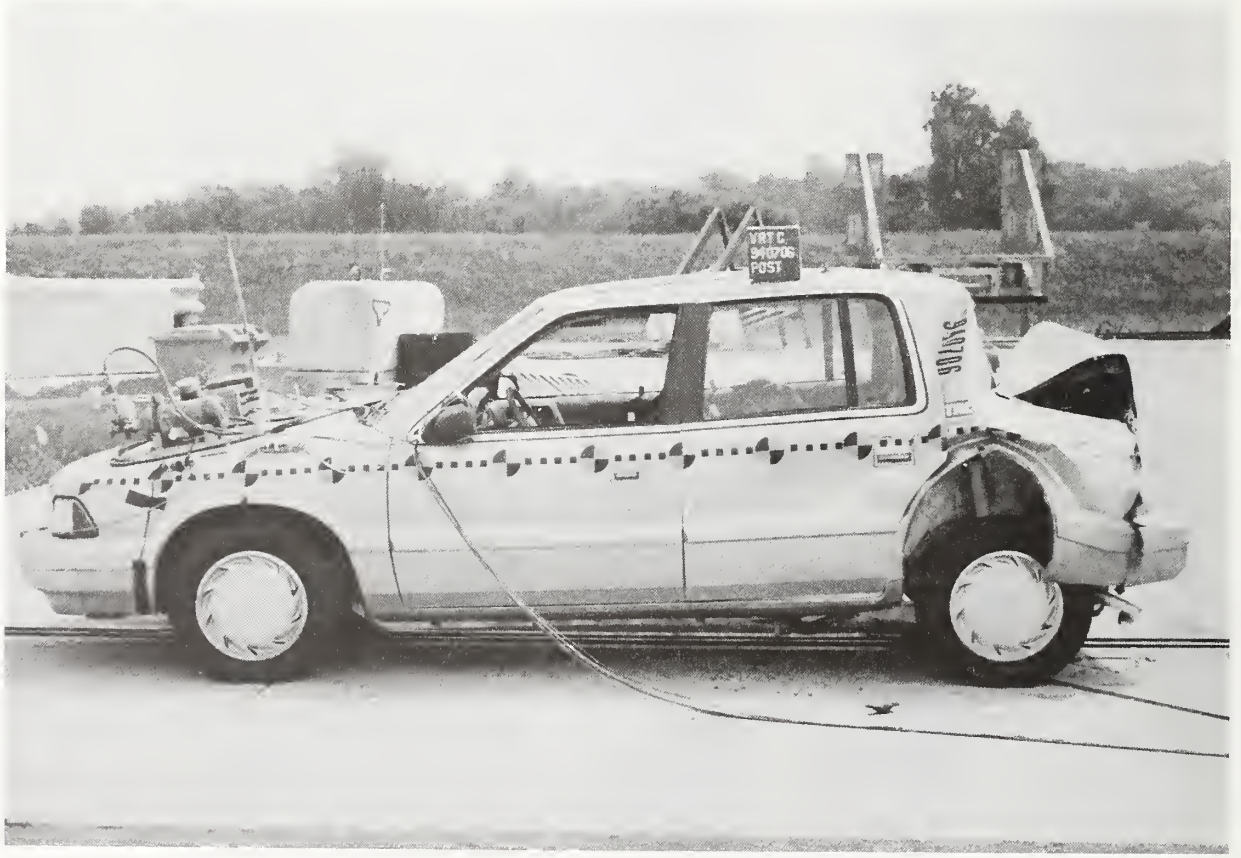


Figure A-4. POST-TEST LEFT SIDE VIEW

Figure A-5. PRE-TEST REAR VIEW

Figure A-6. PRE-TEST RIGHT SIDE VIEW

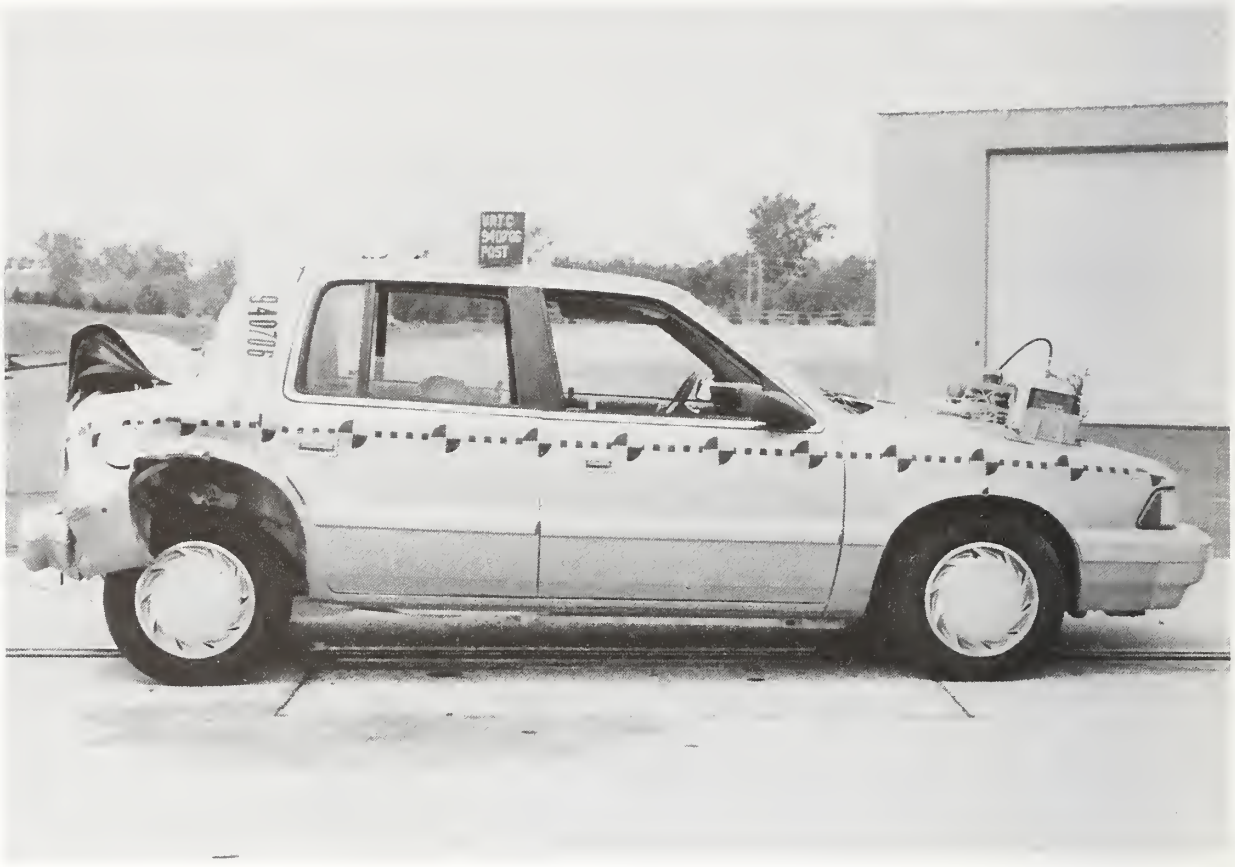


Figure A-7. POST-TEST RIGHT SIDE VIEW

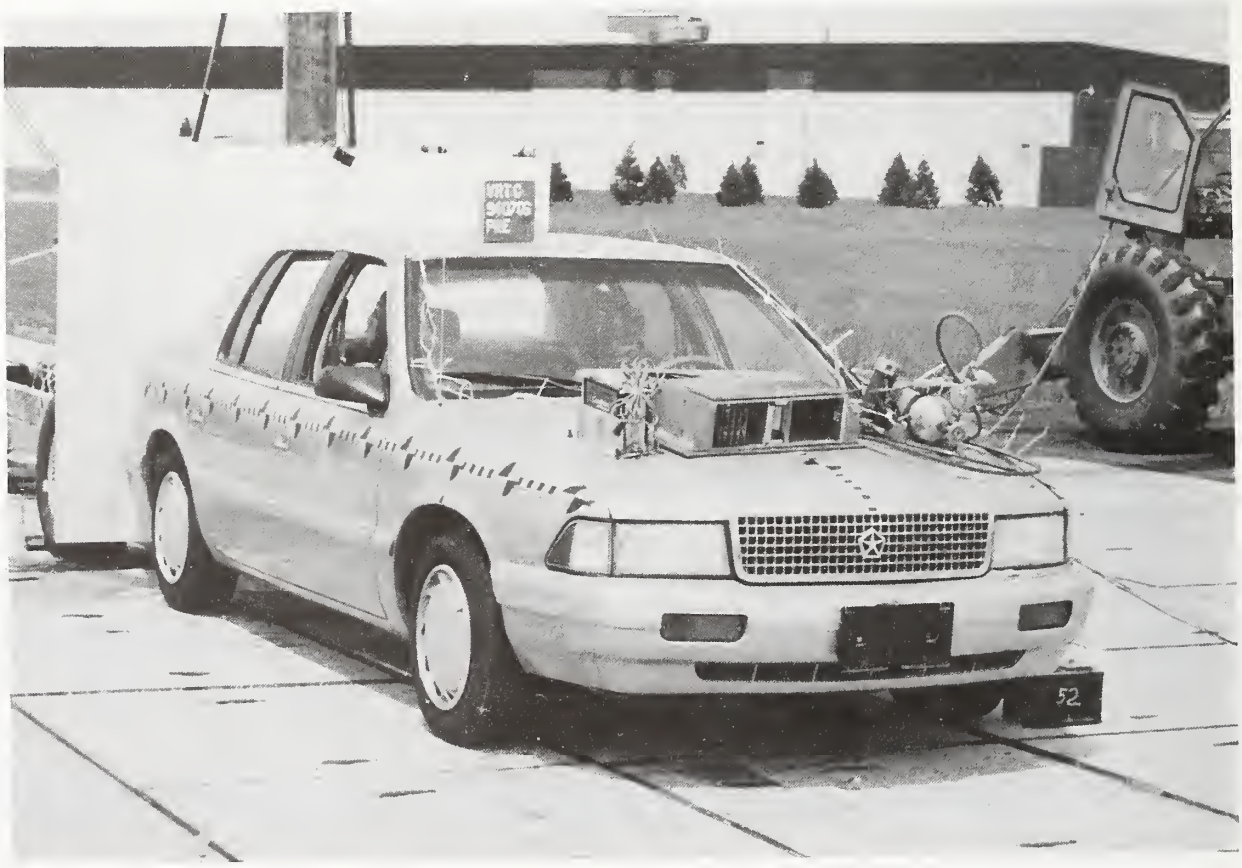


Figure A-8. PRE-TEST RIGHT FRONT THREE-QUARTER VIEW

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

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

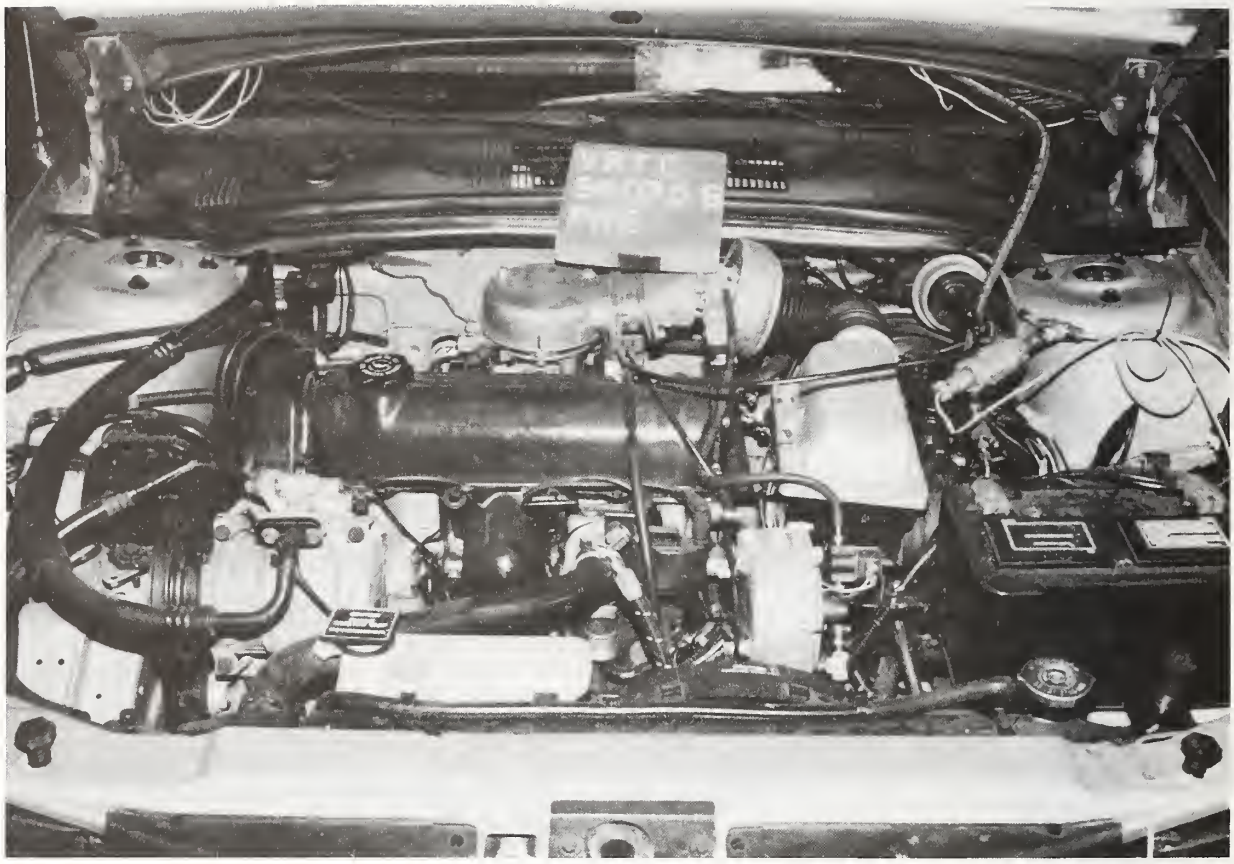


Figure A-11. PRE-TEST ENGINE COMPARTMENT VIEW

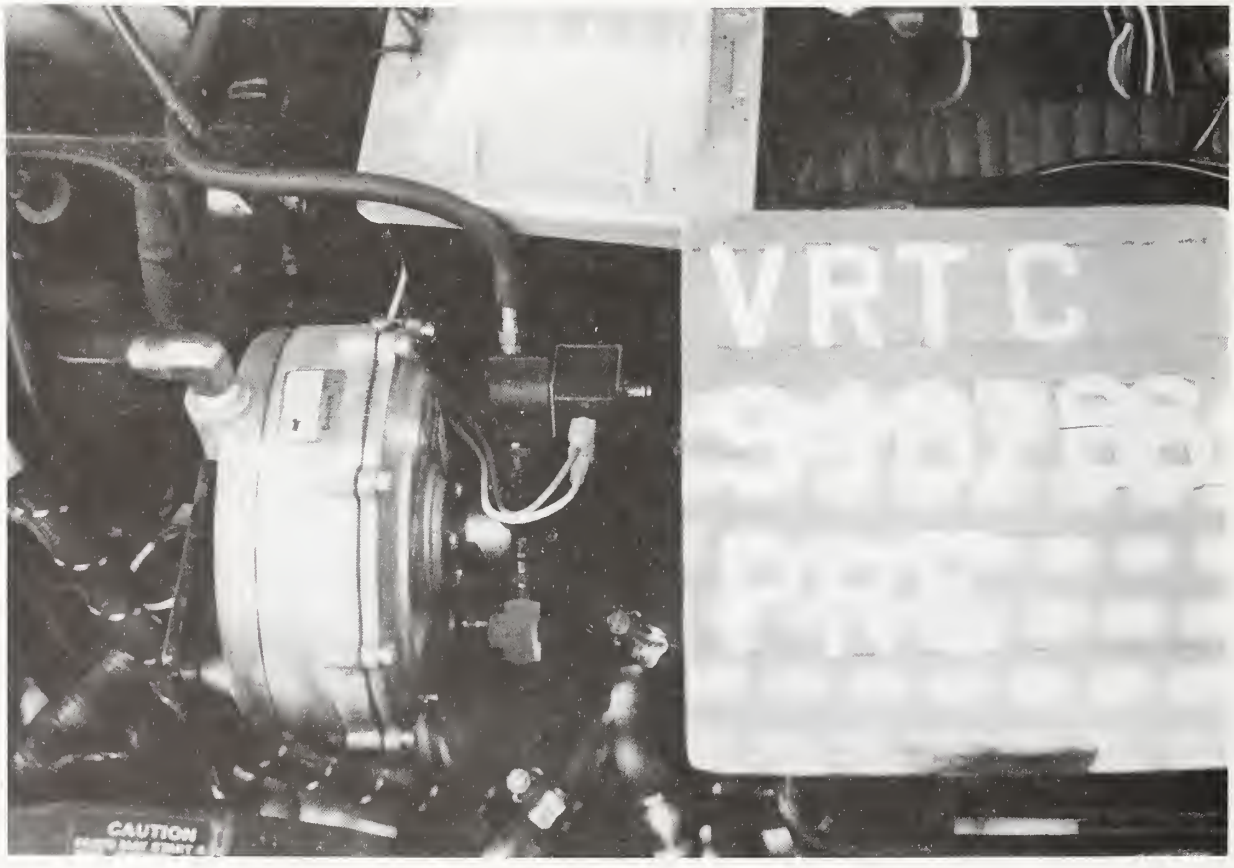


Figure A-12. PRE-TEST FUEL PRESSURE REGULATOR VIEW

Figure A-13. PRE-TEST FUEL FILLER VIEW

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

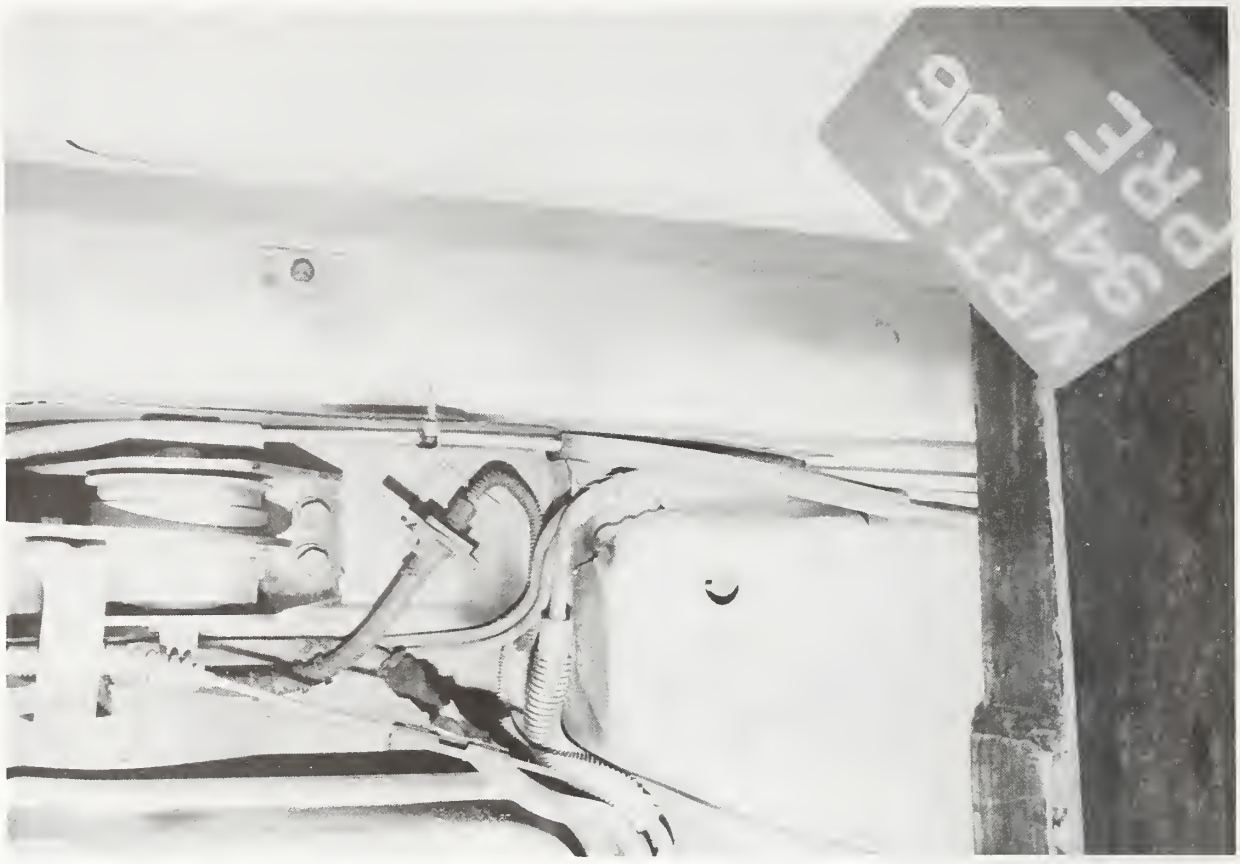


Figure A-15. PRE-TEST FUEL LINES - VIEW 2

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

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

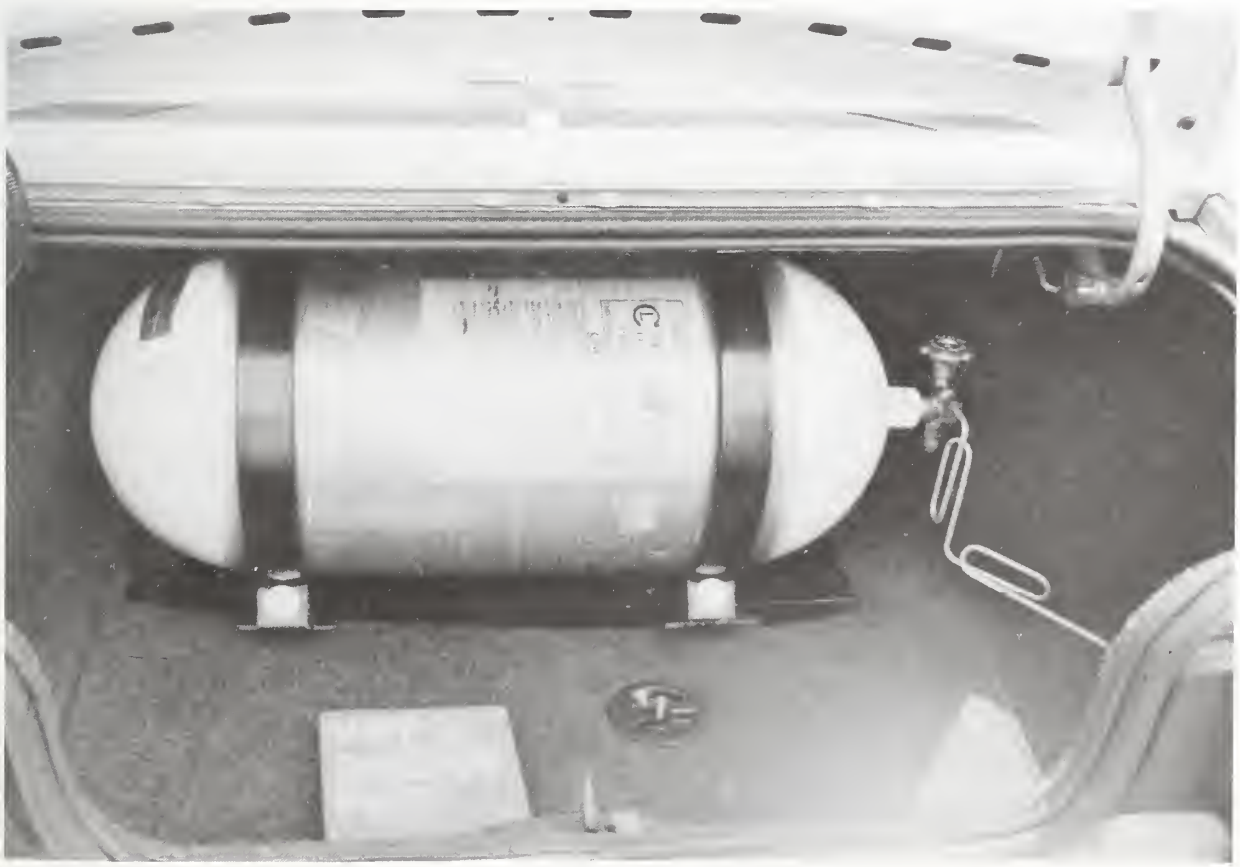


Figure A-18. PRE-TEST FUEL TANK VIEW

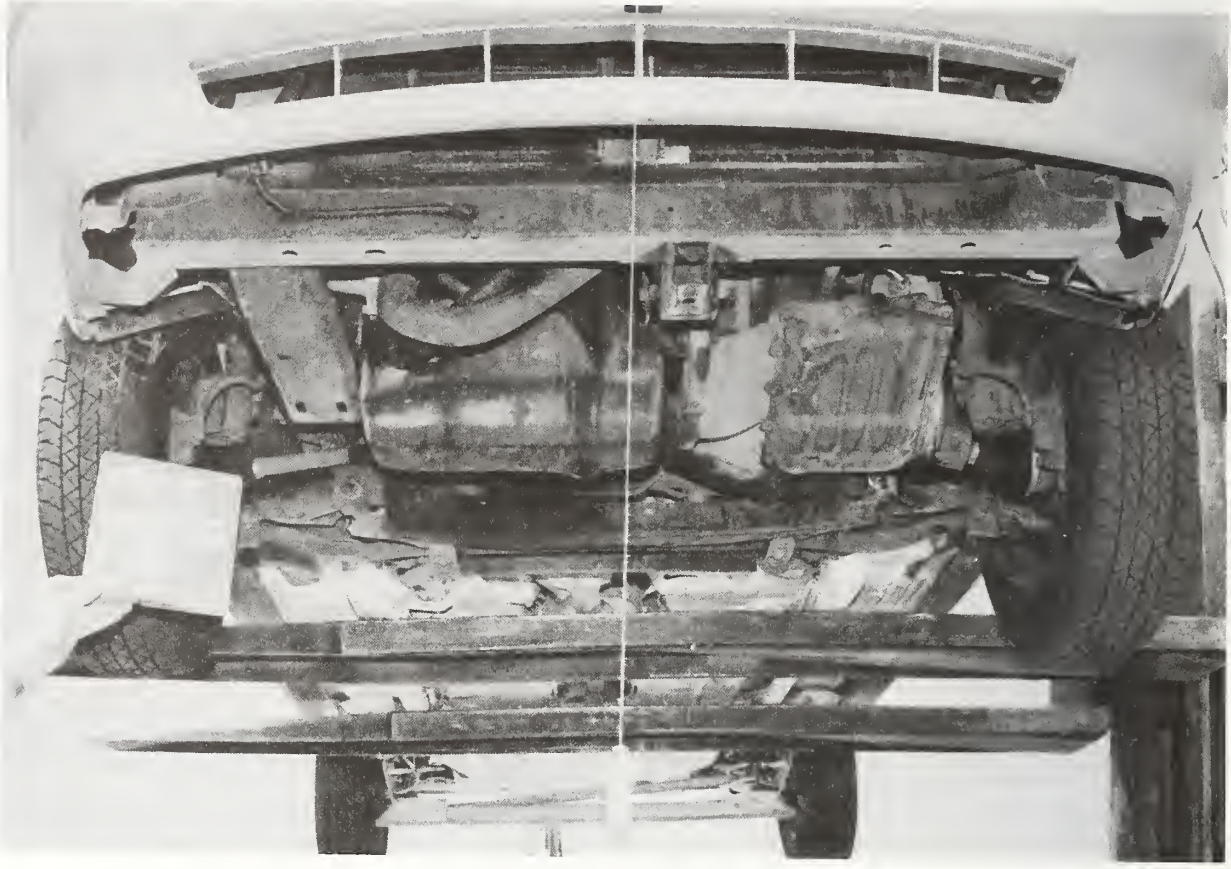


Figure A-19. PRE-TEST FRONT UNDERBODY VIEW

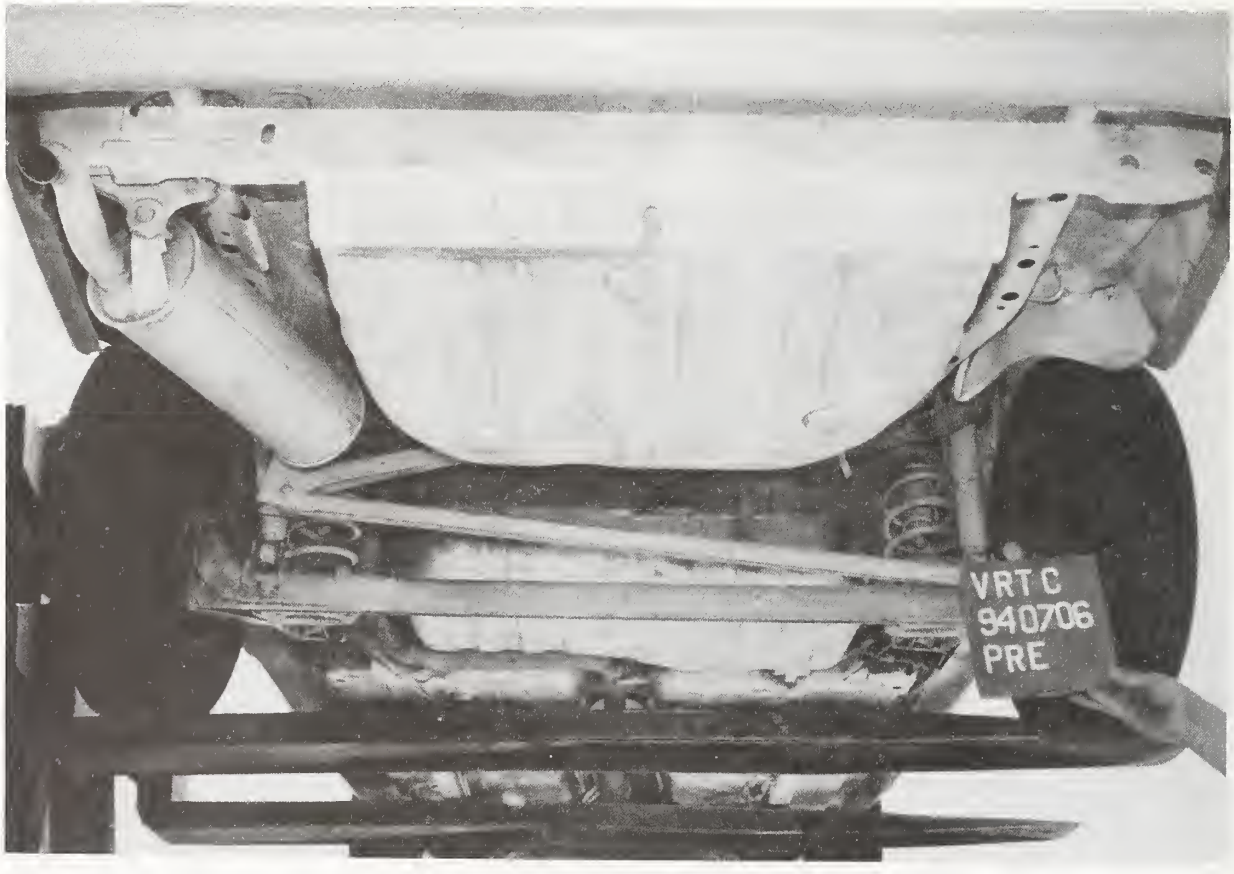


Figure A-20. PRE-TEST REAR UNDERBODY VIEW

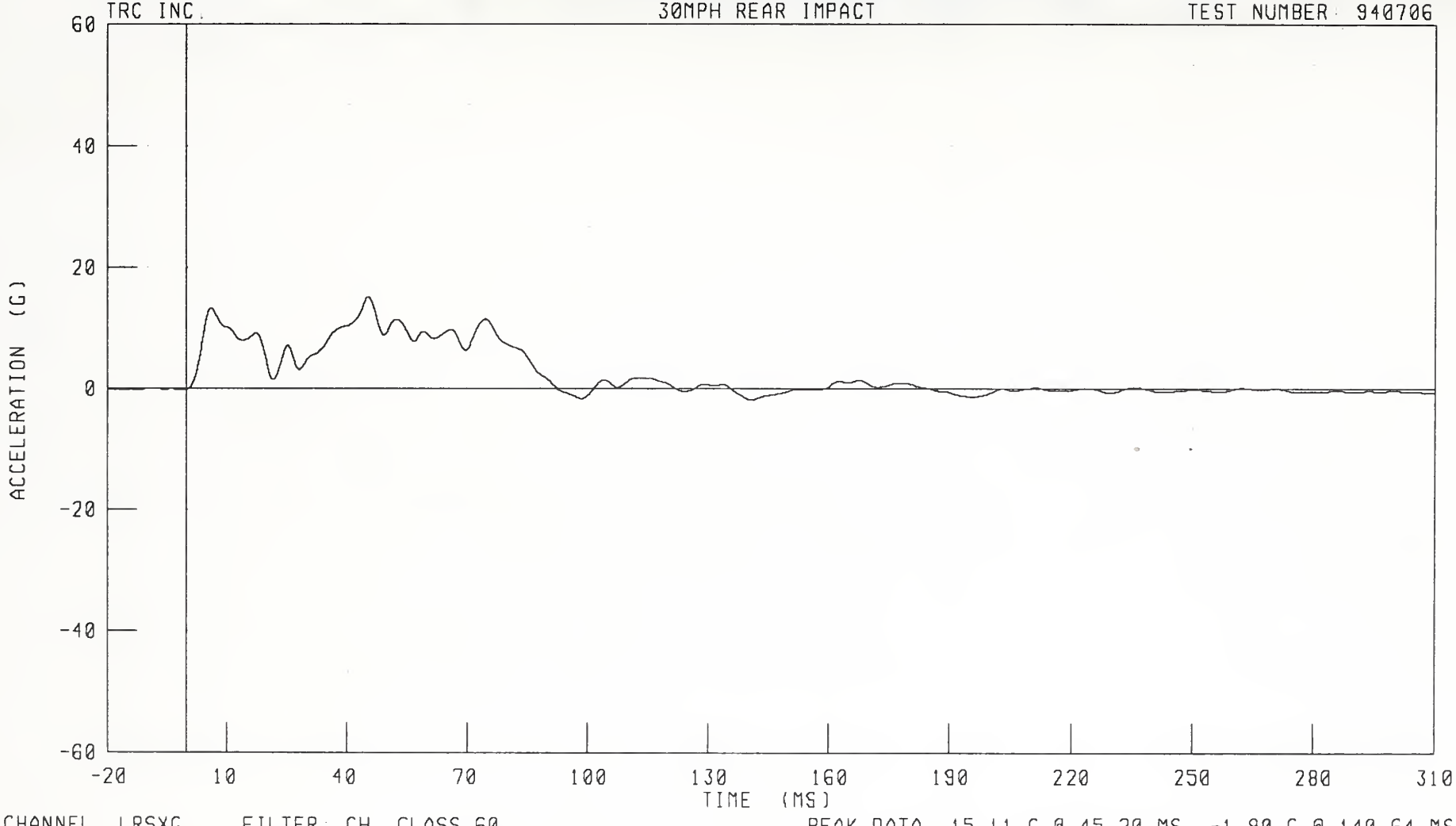
APPENDIX B

DATA PLOTS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM

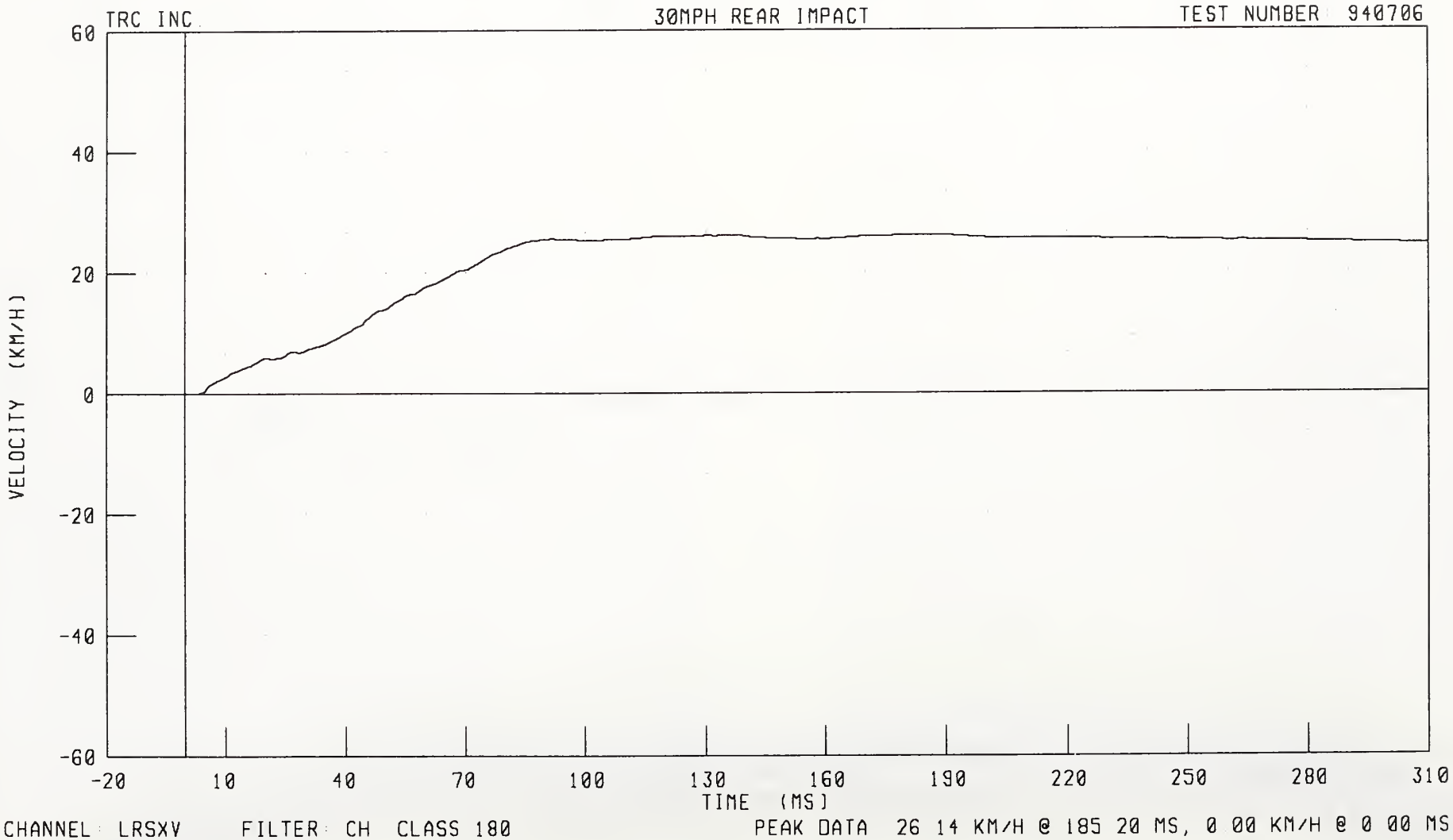
LEFT REAR SILL X-AXIS ACCELERATION

TRC INC. 30MPH REAR IMPACT TEST NUMBER: 940706



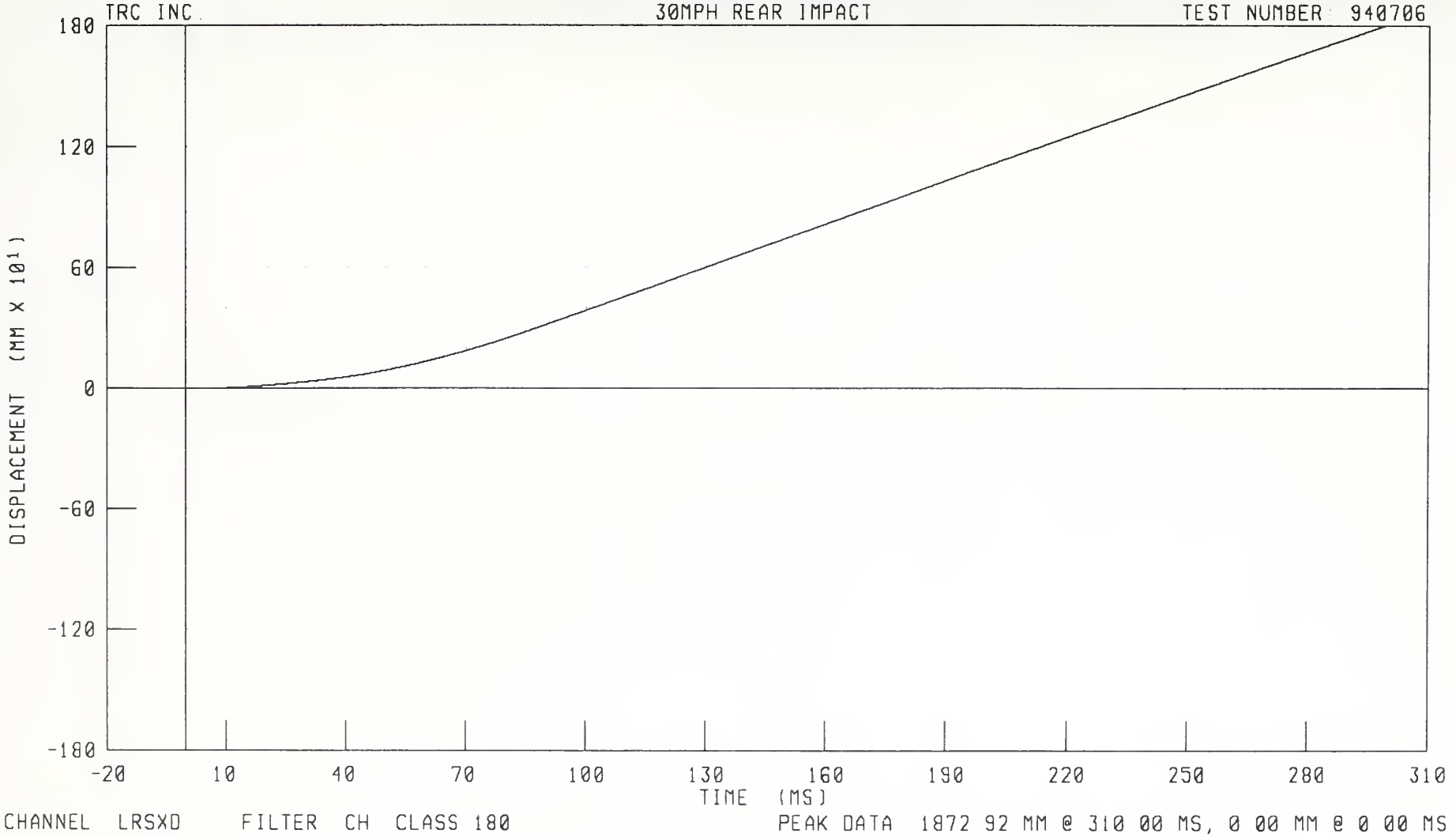
CHANNEL LRSXG FILTER: CH CLASS 60 PEAK DATA 15 11 G @ 45 20 MS, -1 90 G @ 140 64 MS

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



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

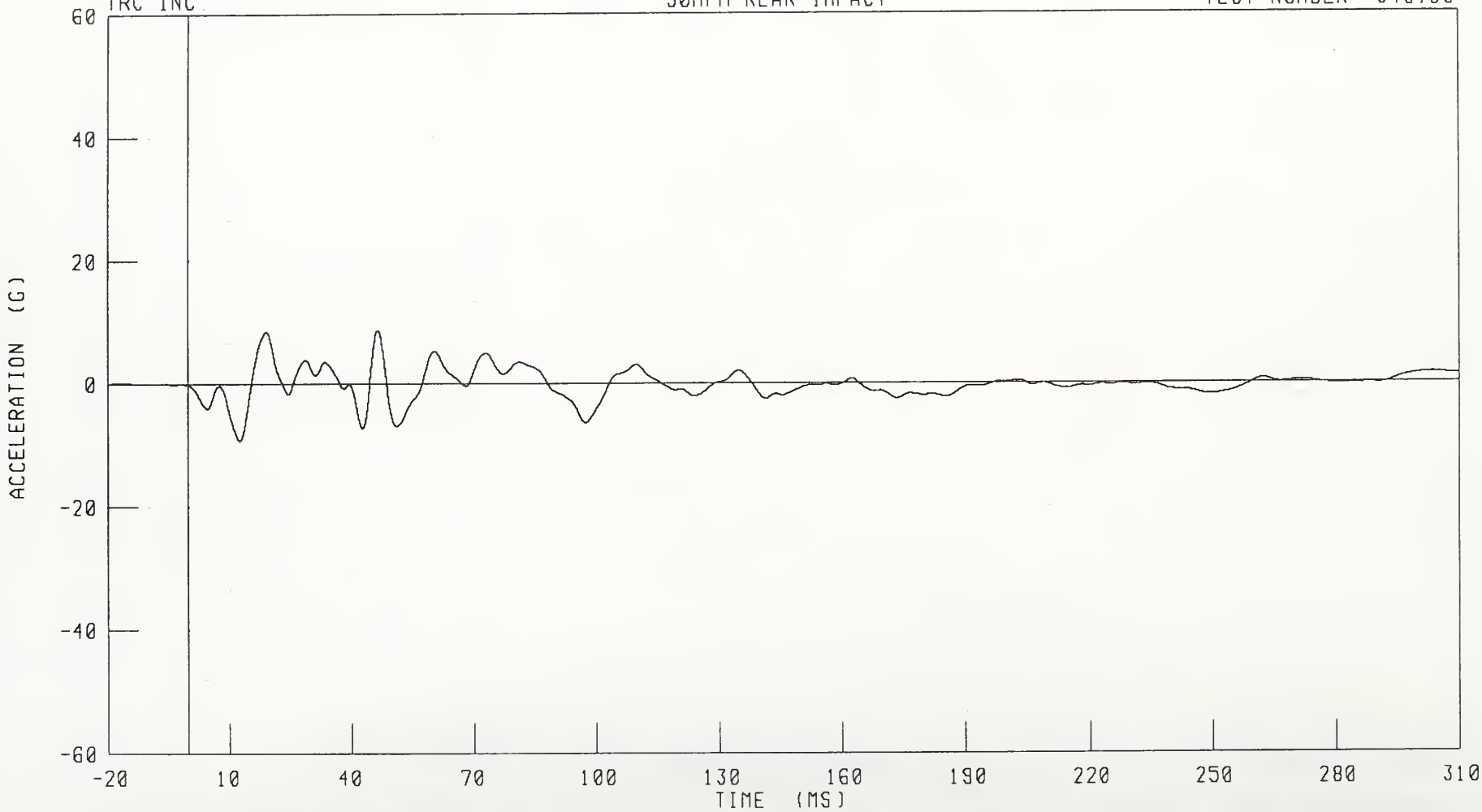


CHANNEL LRSXD FILTER CH CLASS 180 PEAK DATA 1872 92 MM @ 310 00 MS, 0 00 MM @ 0 00 MS

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

TRC INC

TEST NUMBER 940706



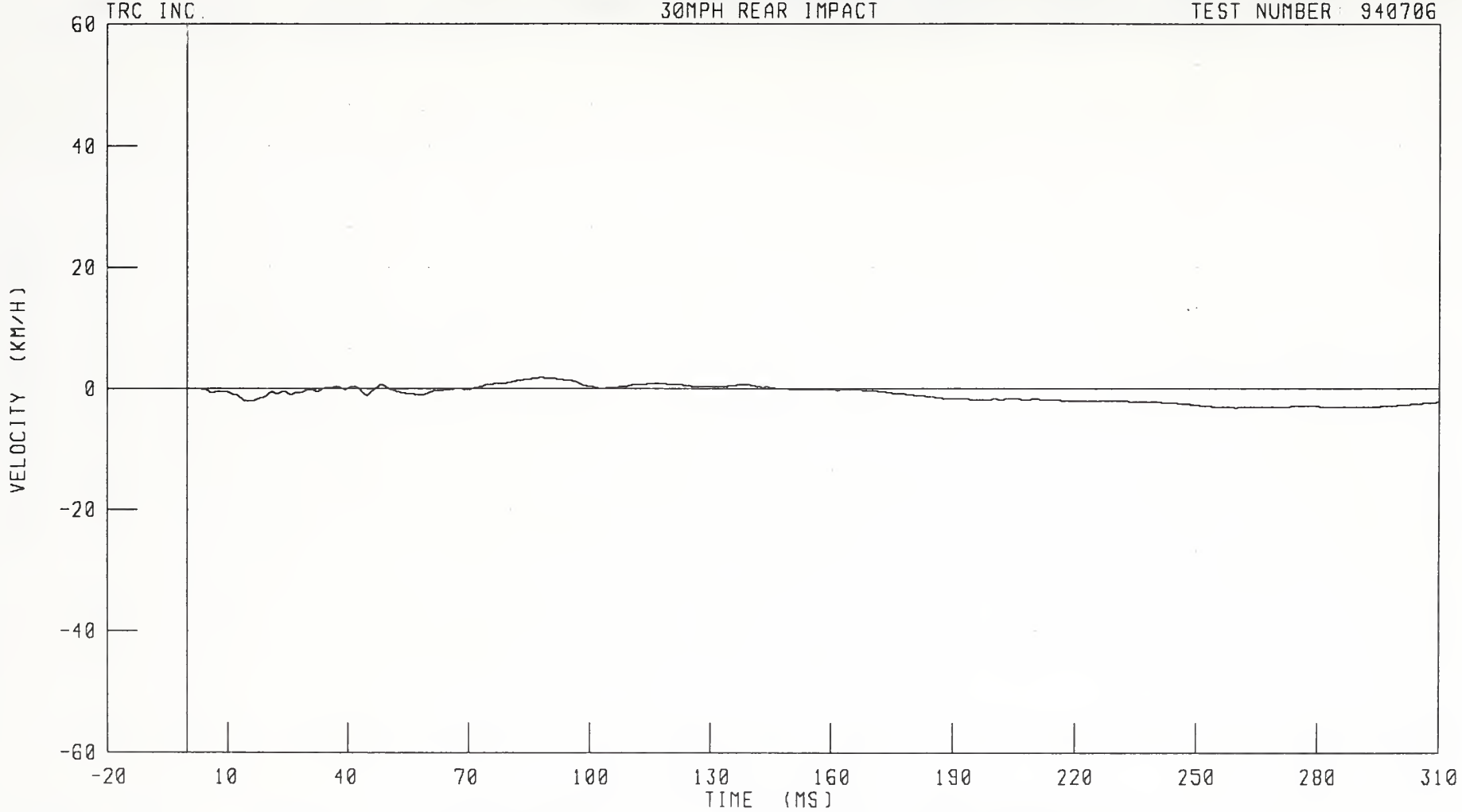
CHANNEL LRSZG FILTER CH CLASS 60

PEAK DATA 8 67 G @ 46 56 MS, -9 25 G @ 12 64 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM

LEFT REAR SILL Z-AXIS VELOCITY

TRC INC. 30MPH REAR IMPACT TEST NUMBER: 940706

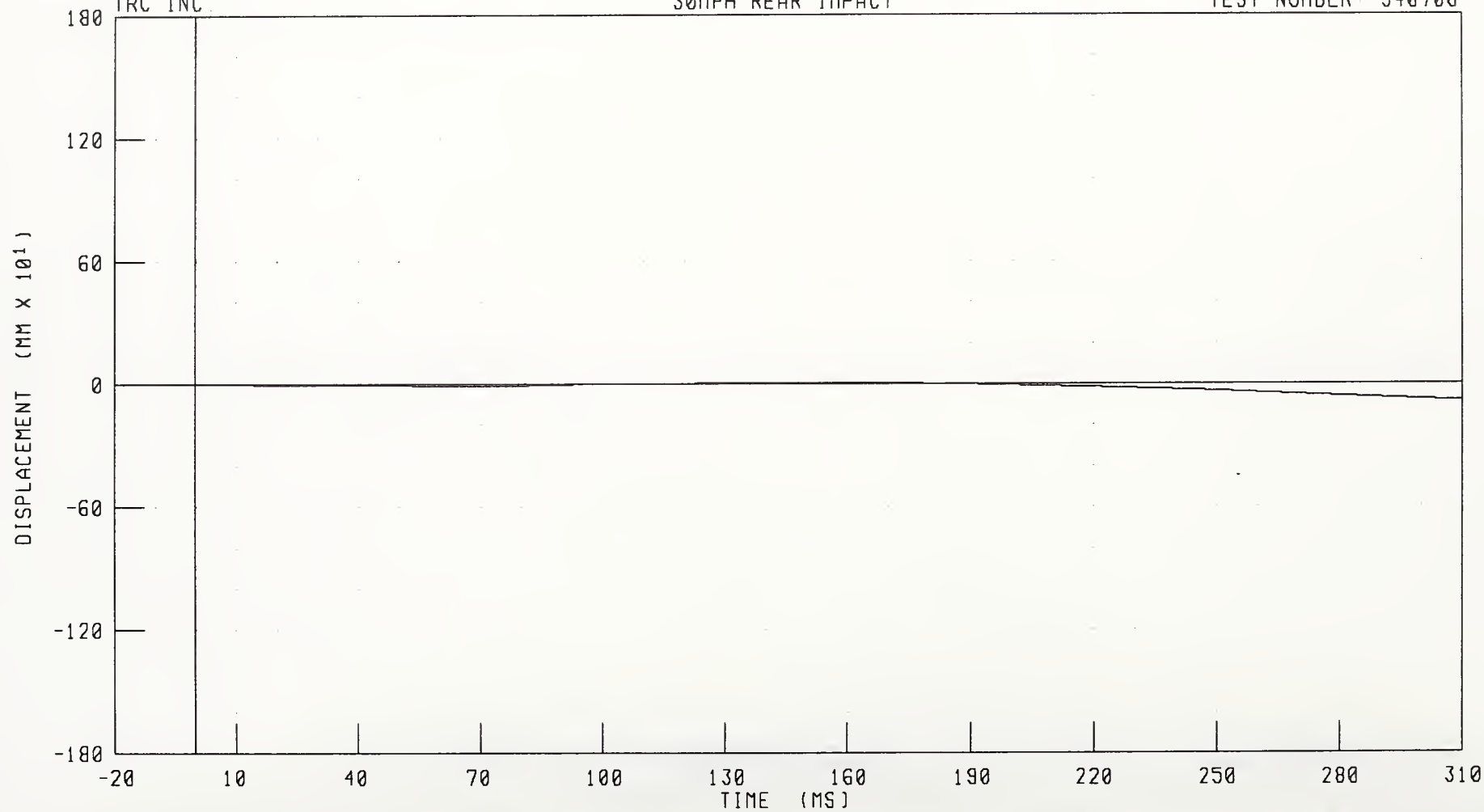


CHANNEL LRSZV FILTER CH CLASS 180 PEAK DATA 1 81 KM/H @ 87 76 MS, -3 13 KM/H @ 259 76 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM

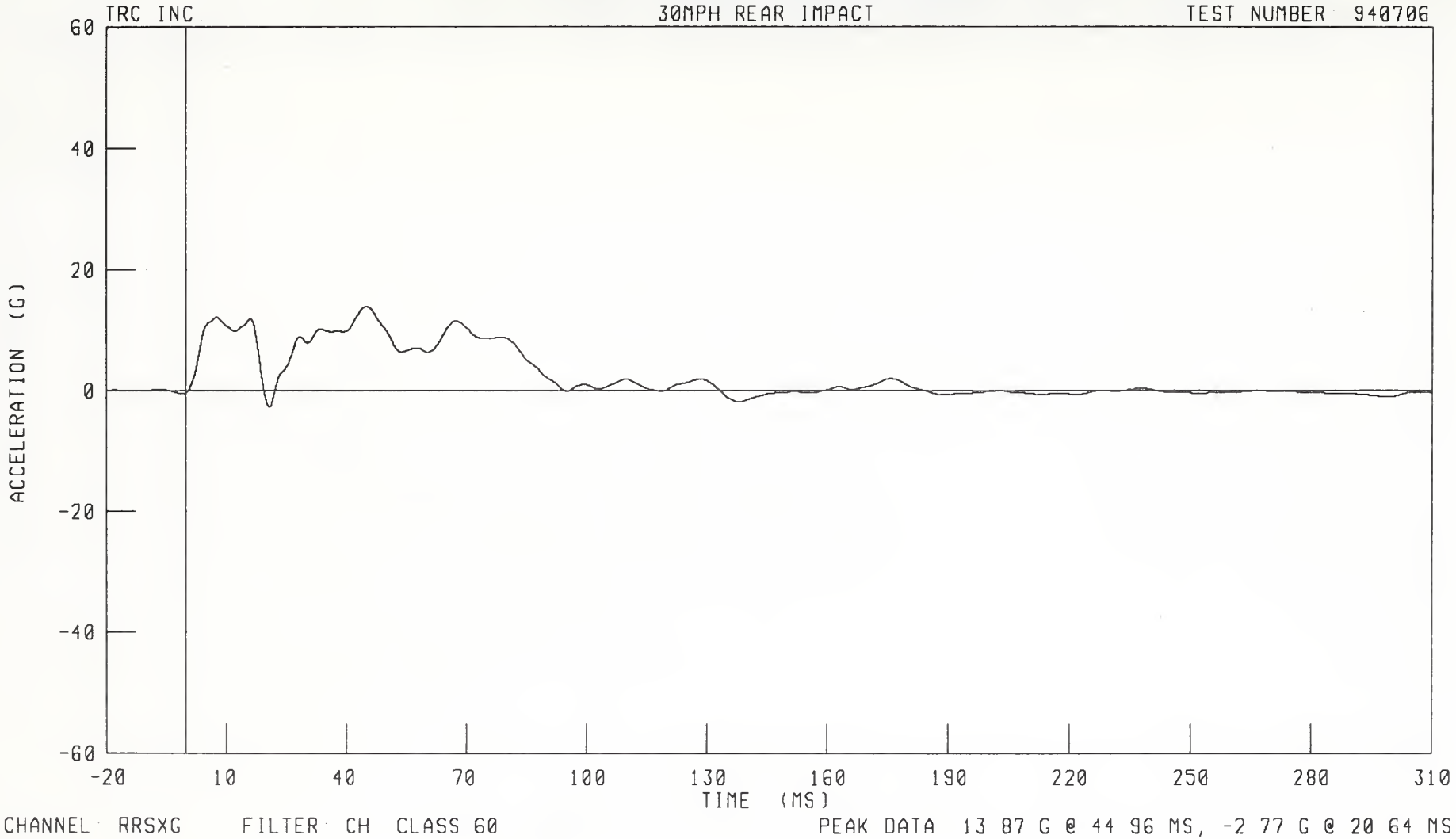
LEFT REAR SILL Z-AXIS DISPLACEMENT

TRC INC 30MPH REAR IMPACT TEST NUMBER 940706



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

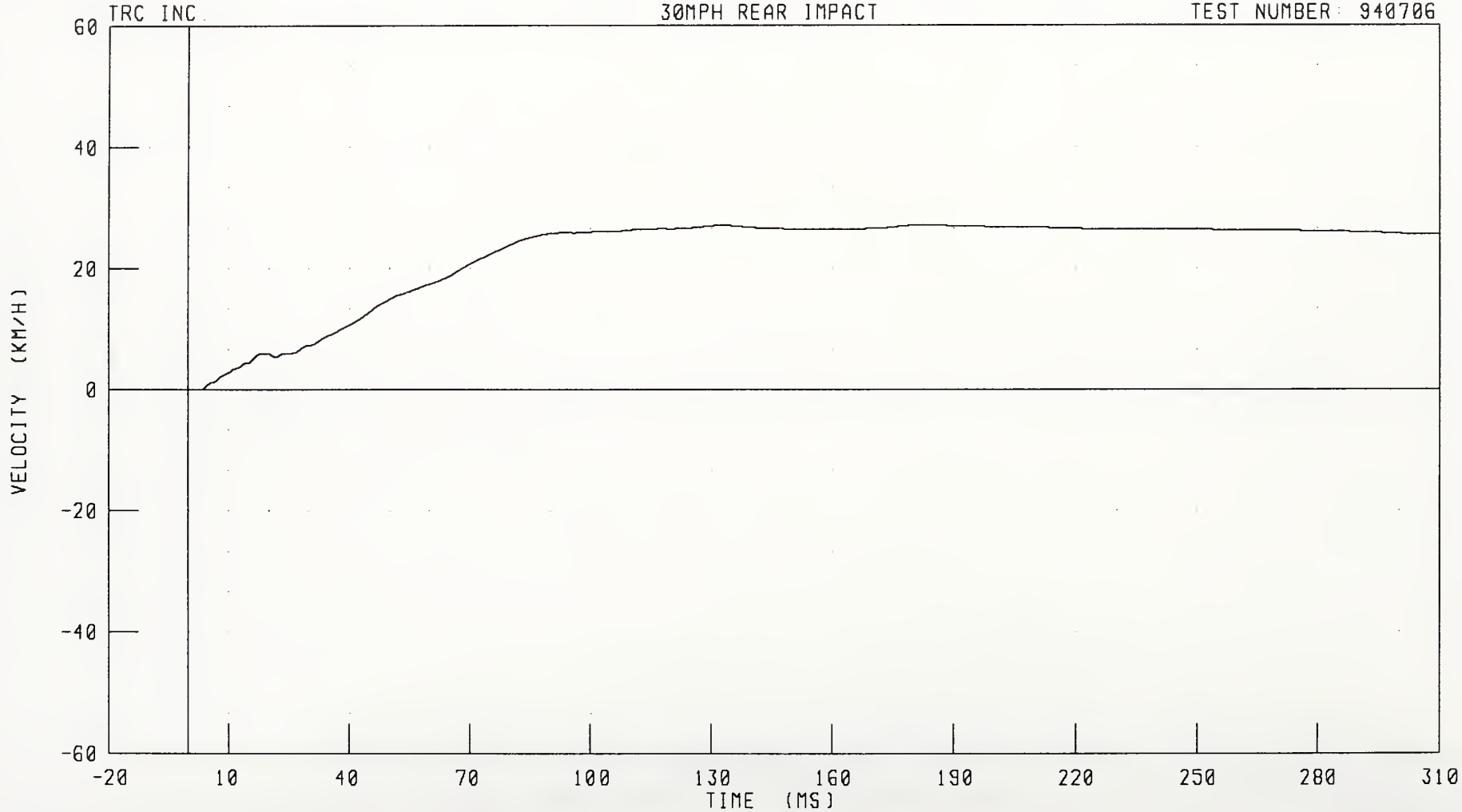
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS ACCELERATION



CHANNEL RRSXG FILTER CH CLASS 60 PEAK DATA 13 87 G @ 44 96 MS, -2 77 G @ 20 64 MS

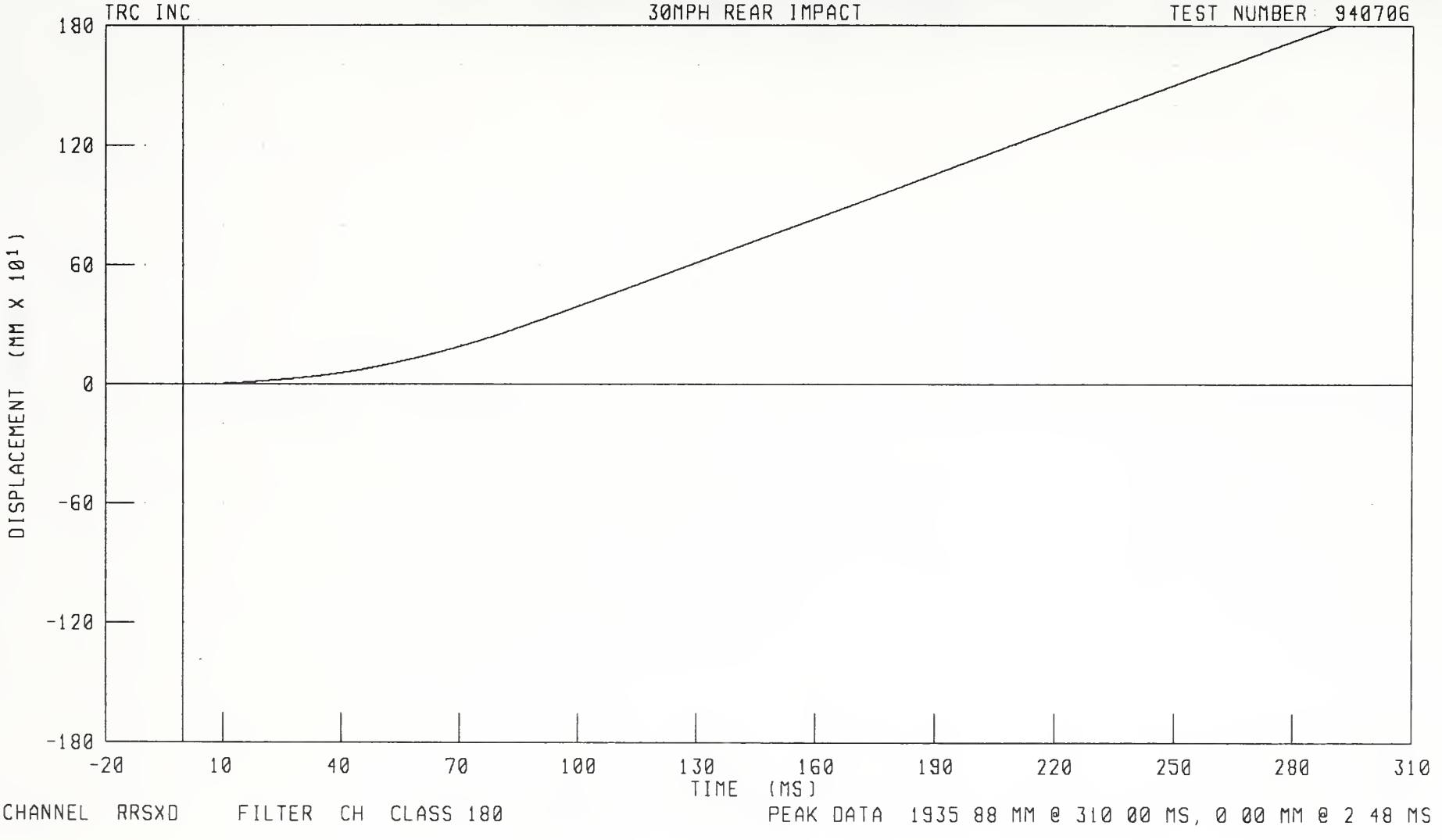
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS VELOCITY

TRC INC 30MPH REAR IMPACT TEST NUMBER: 940706



CHANNEL: RRSXV FILTER: CH. CLASS 180 PEAK DATA 27.10 KM/H @ 184.24 MS; -0.01 KM/H @ 1.68 MS

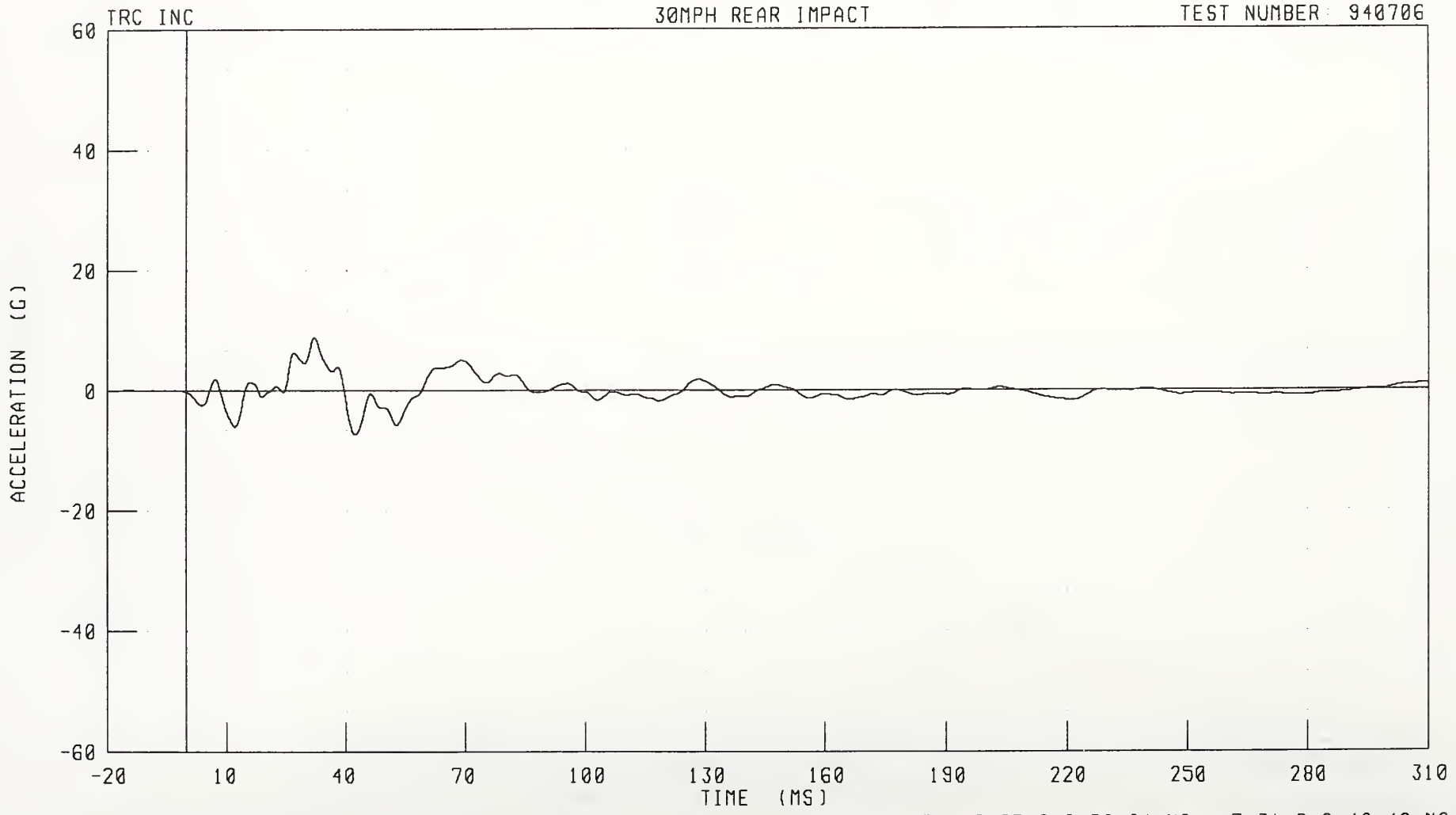
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
RIGHT REAR SILL X-AXIS DISPLACEMENT



CHANNEL RRSXD FILTER CH CLASS 180

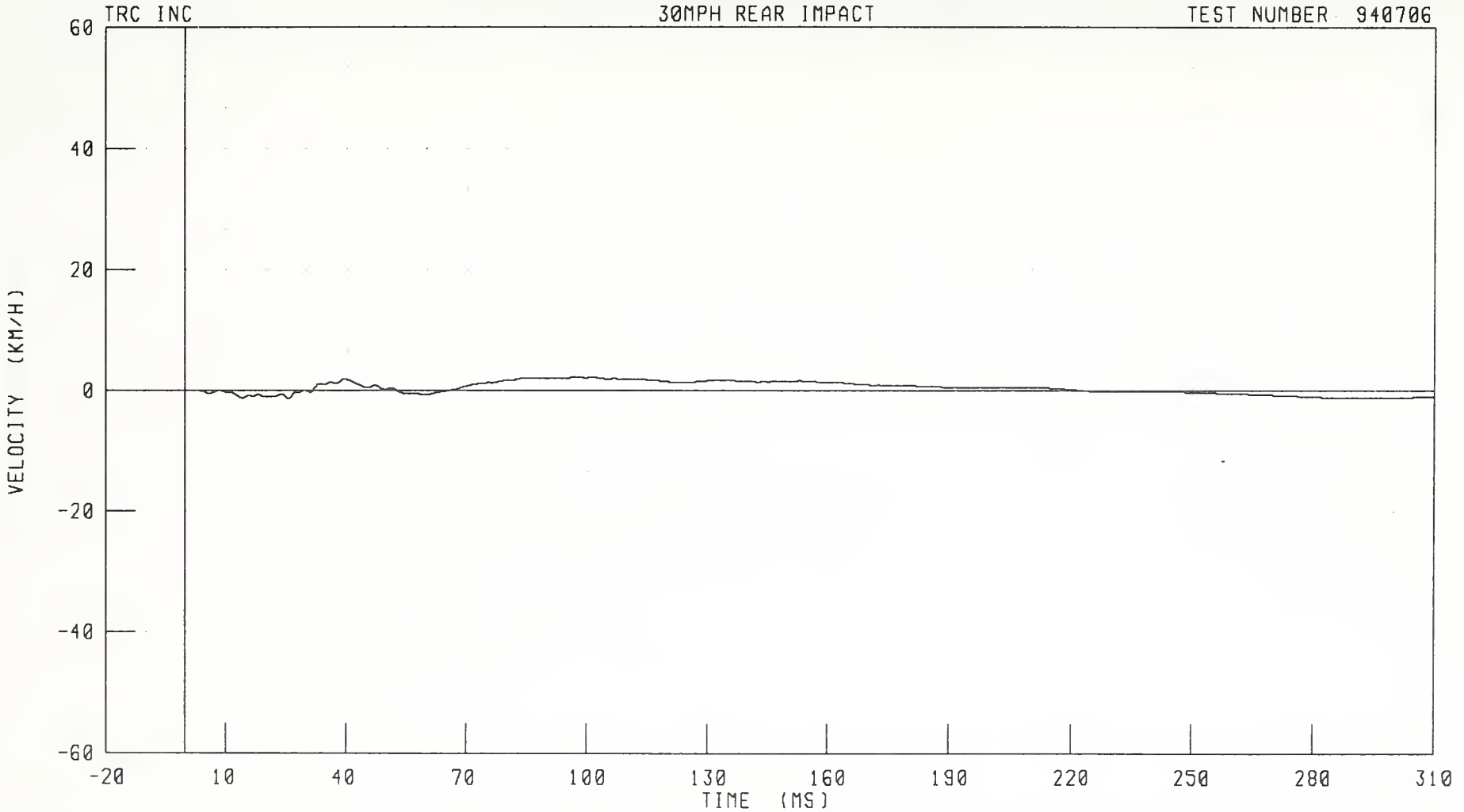
PEAK DATA 1935 88 MM @ 310 00 MS, 0 00 MM @ 2 48 MS

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



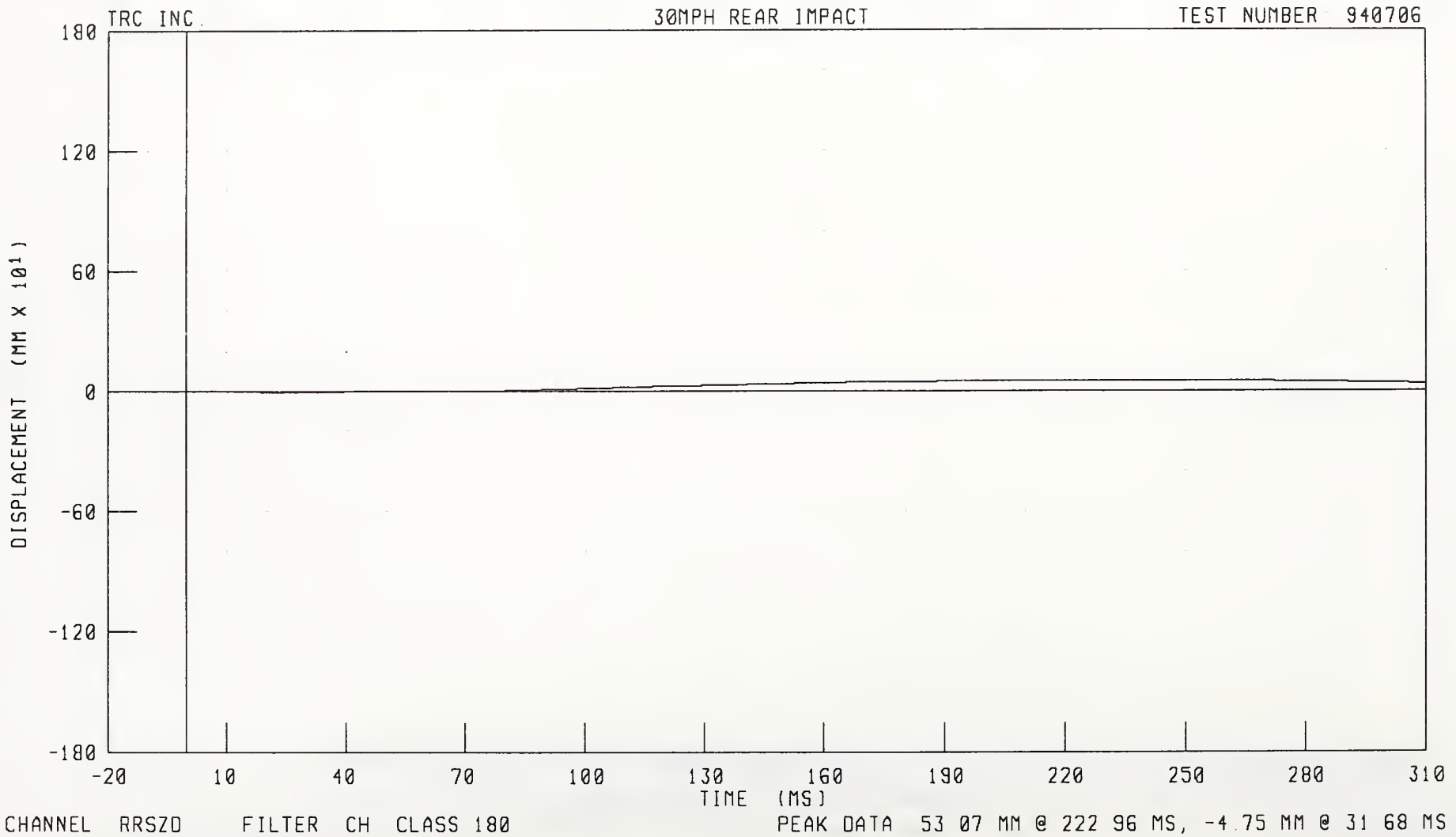
CHANNEL RRSZG FILTER CH CLASS 60 PEAK DATA 8 87 G @ 32 24 MS, -7 31 G @ 42 40 MS

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



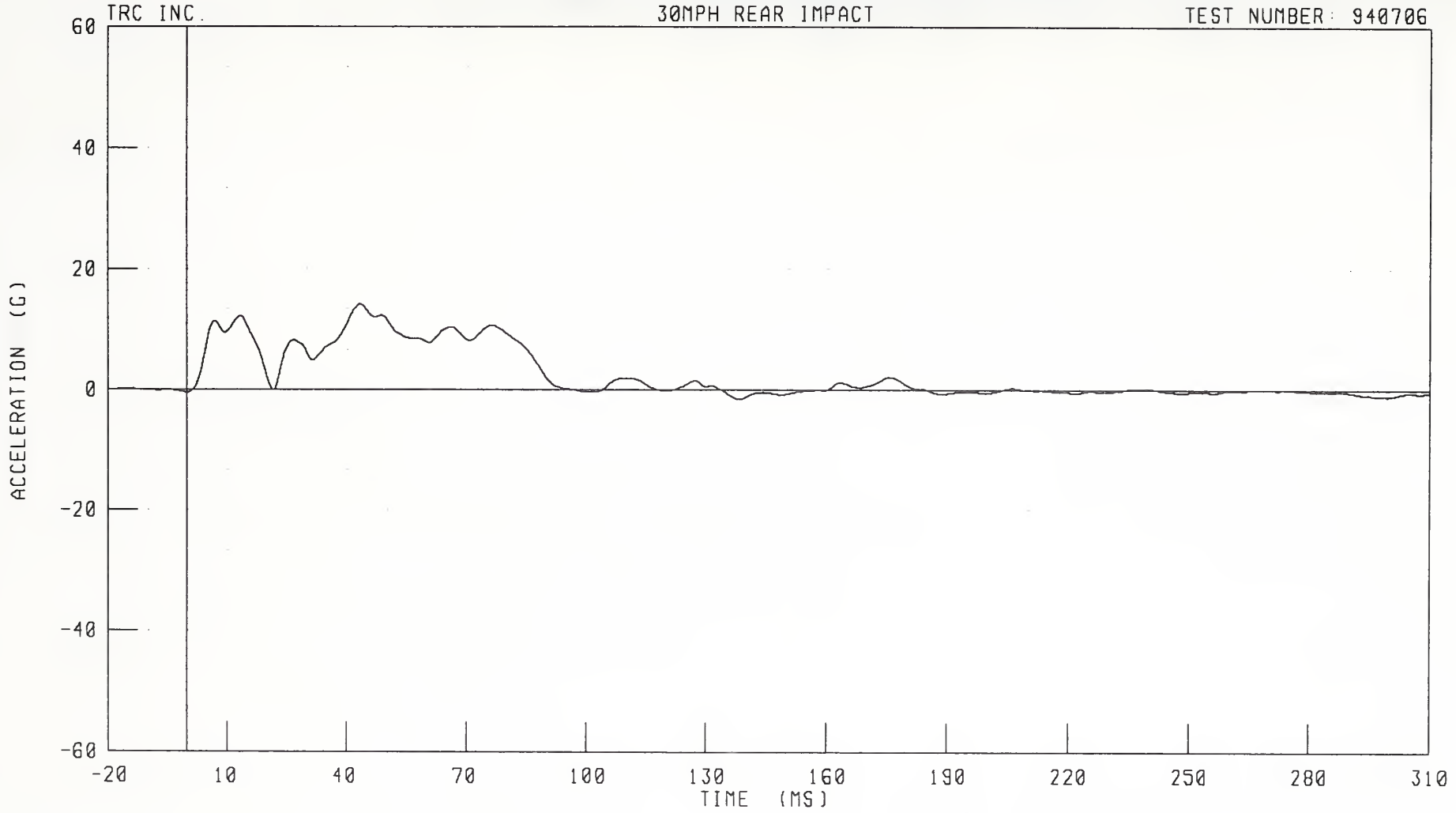
CHANNEL RRSZV FILTER CH CLASS 180 PEAK DATA 2 23 KM/H @ 97 28 MS, -1 39 KM/H @ 25 68 MS

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



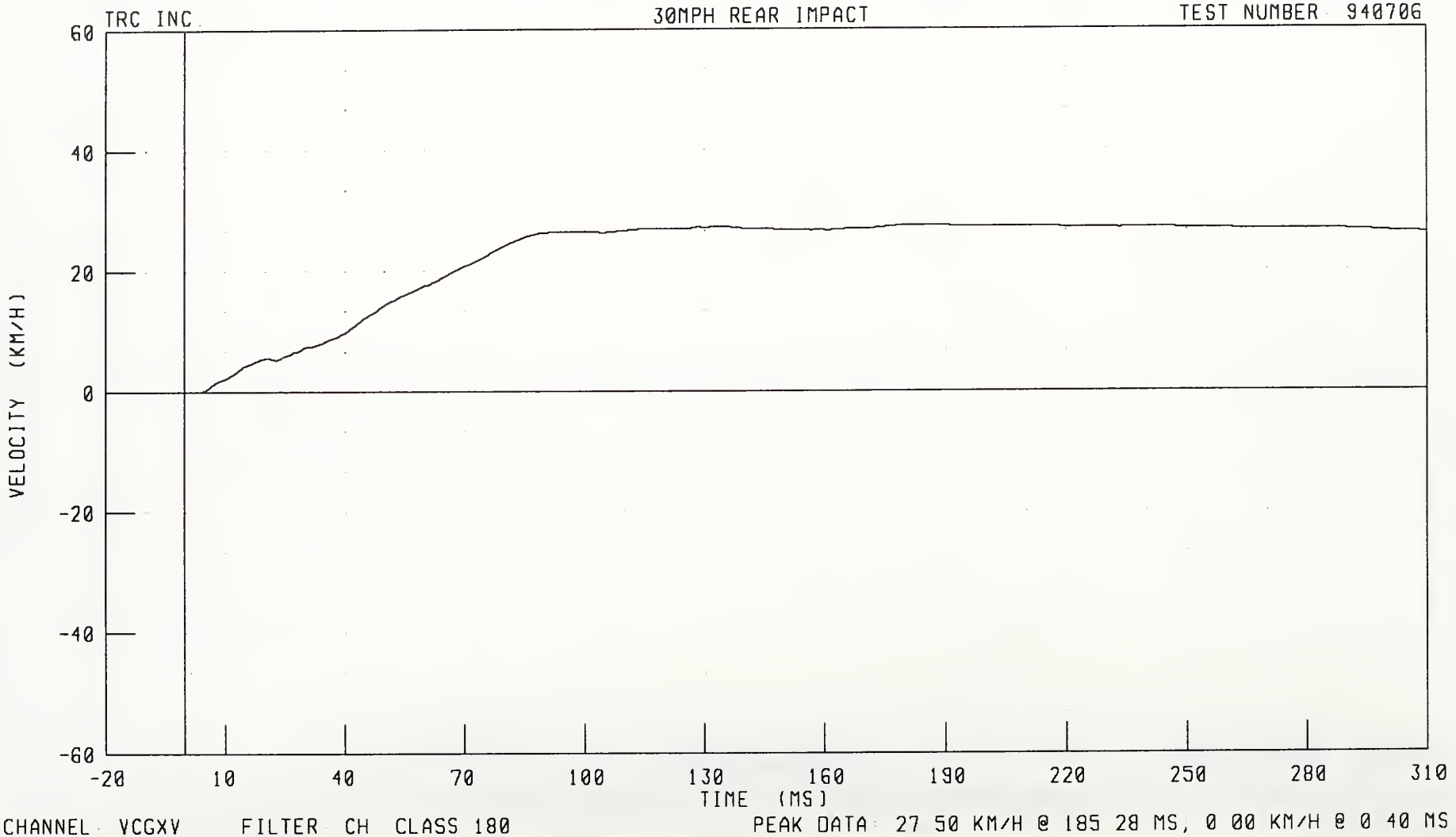
CHANNEL RRSZD FILTER CH CLASS 180 PEAK DATA 53 07 MM @ 222 96 MS, -4 75 MM @ 31 68 MS

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



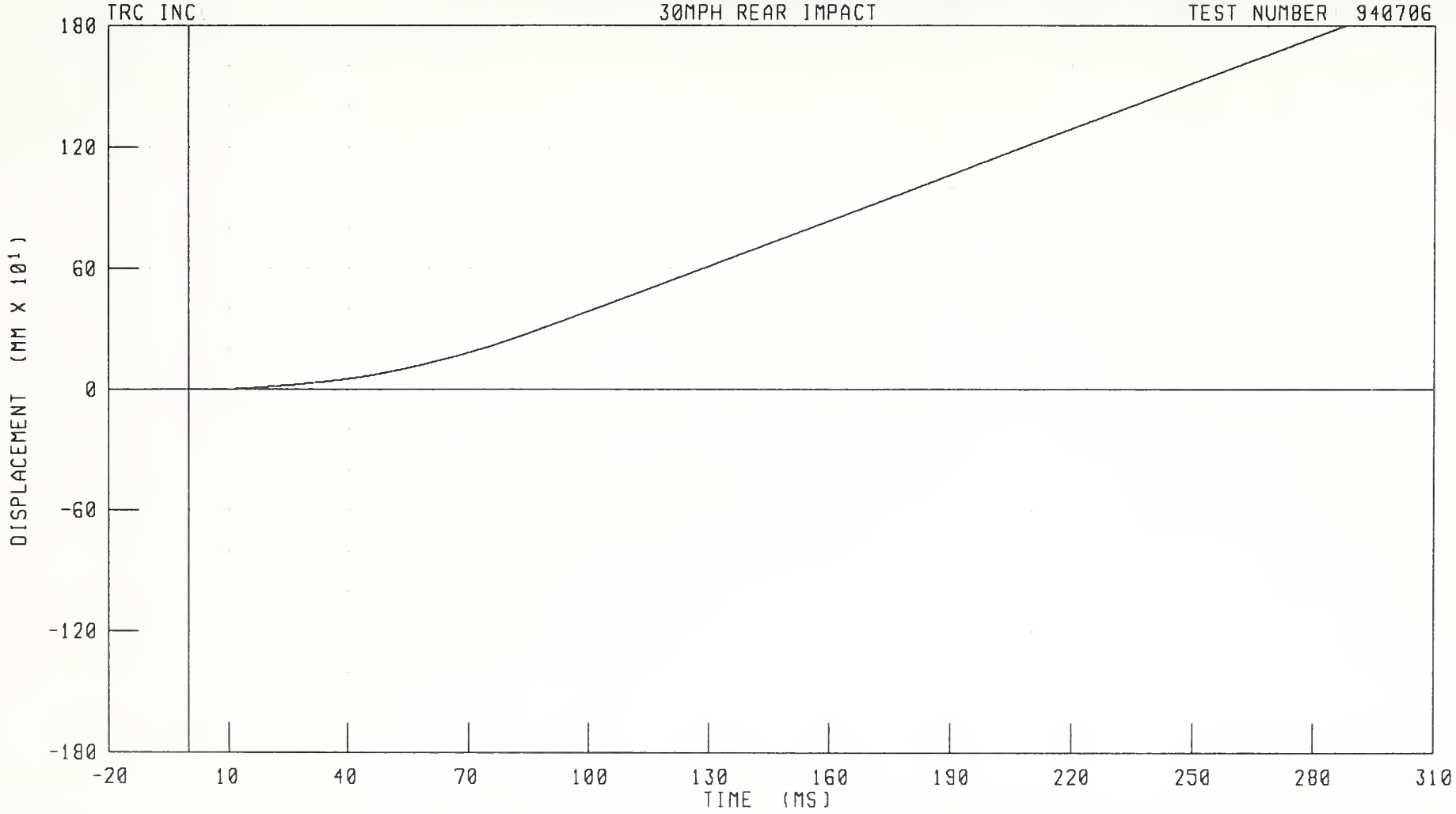
CHANNEL VCGXG FILTER CH CLASS 60 PEAK DATA 14 16 G @ 43 28 MS, -1 56 G @ 138 08 MS

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



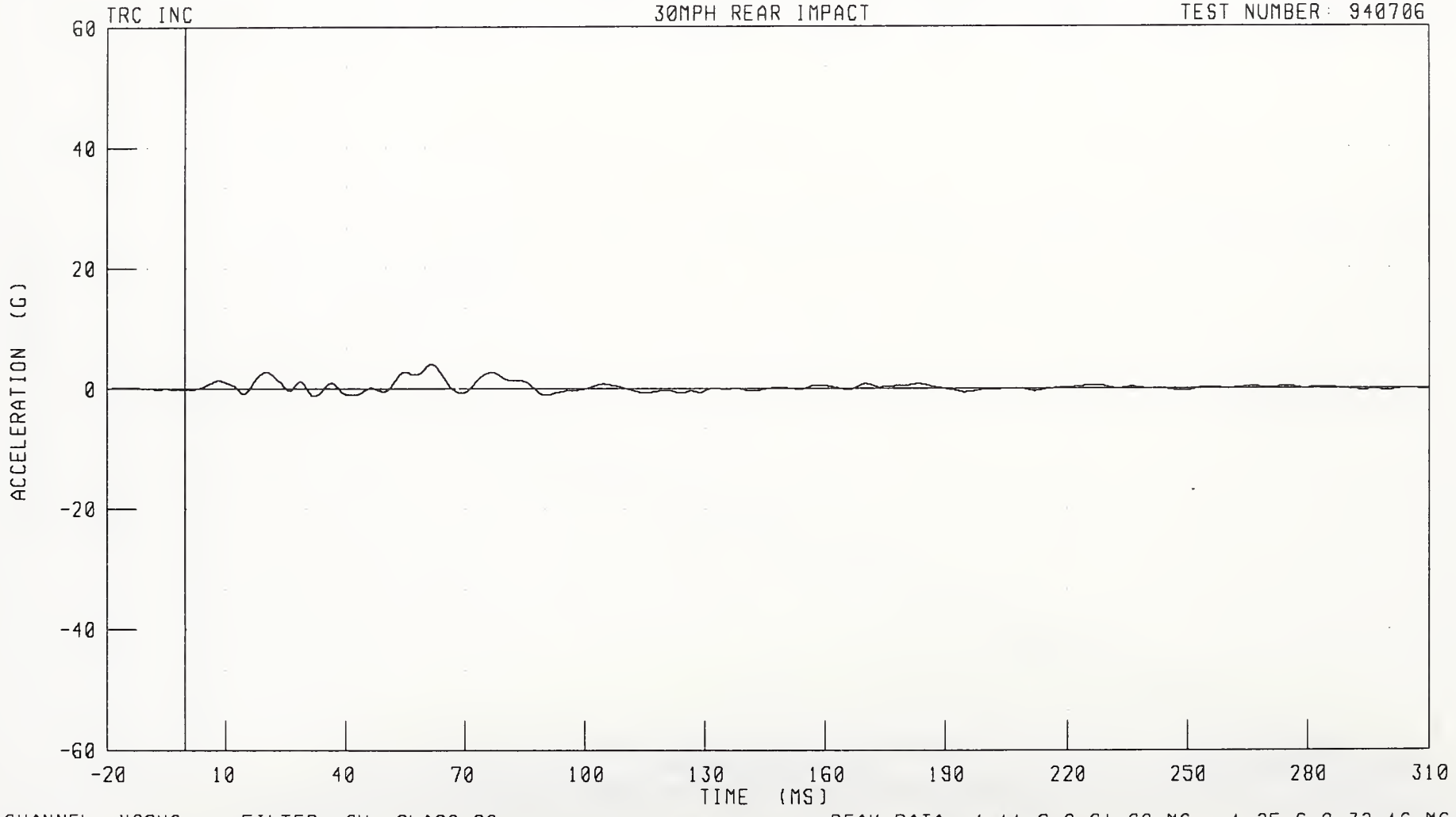
CHANNEL VCGXV FILTER CH CLASS 180 PEAK DATA 27 50 KM/H @ 185 28 MS, 0 00 KM/H @ 0 40 MS

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



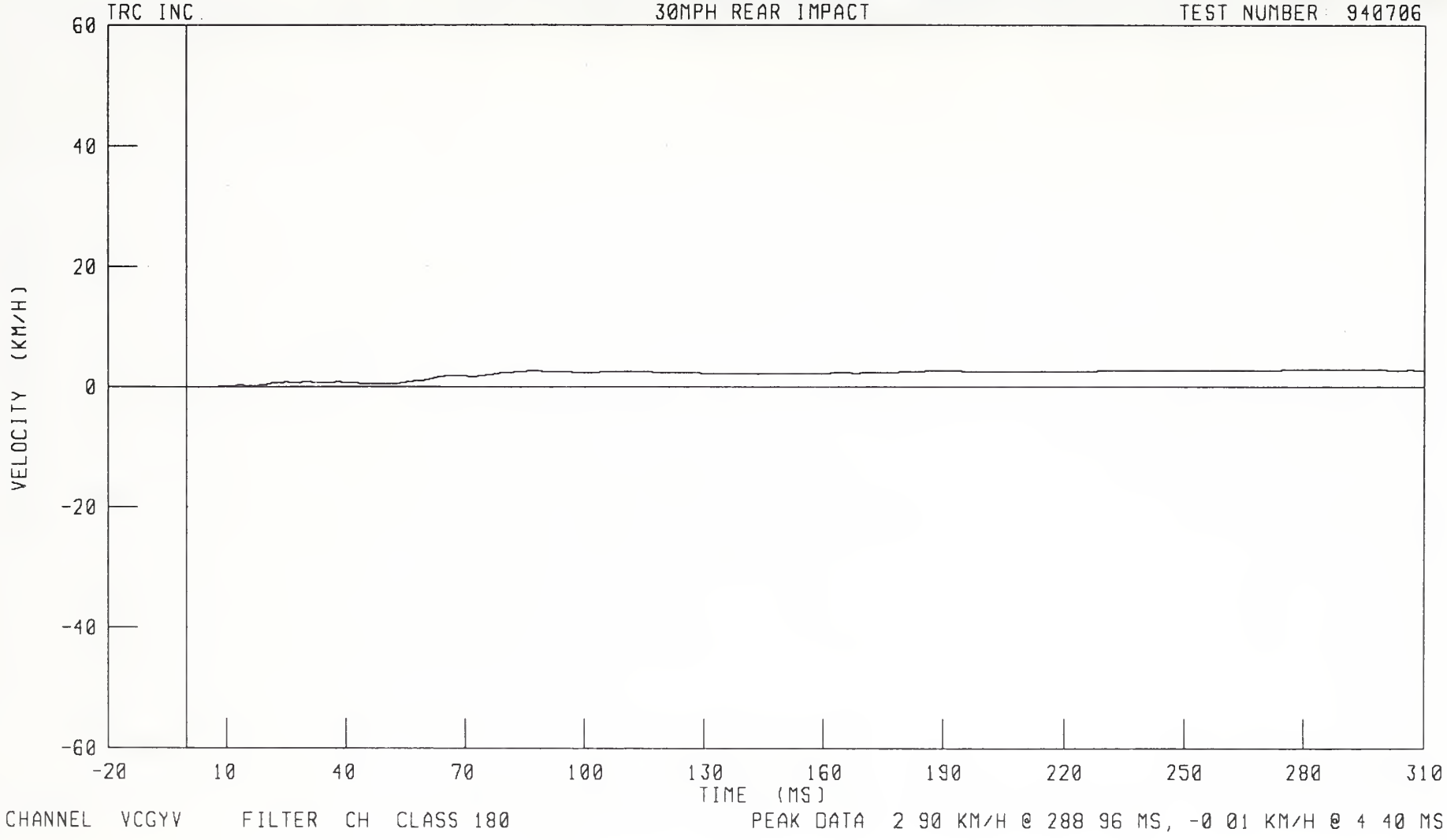
CHANNEL VCGXD FILTER CH CLASS 180 PEAK DATA 1960 52 MM @ 310 00 MS, 0 00 MM @ 0 88 MS

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



CHANNEL: VCGYG FILTER: CH CLASS 60 PEAK DATA: 4.11 G @ 61.68 MS, -1.25 G @ 32.16 MS

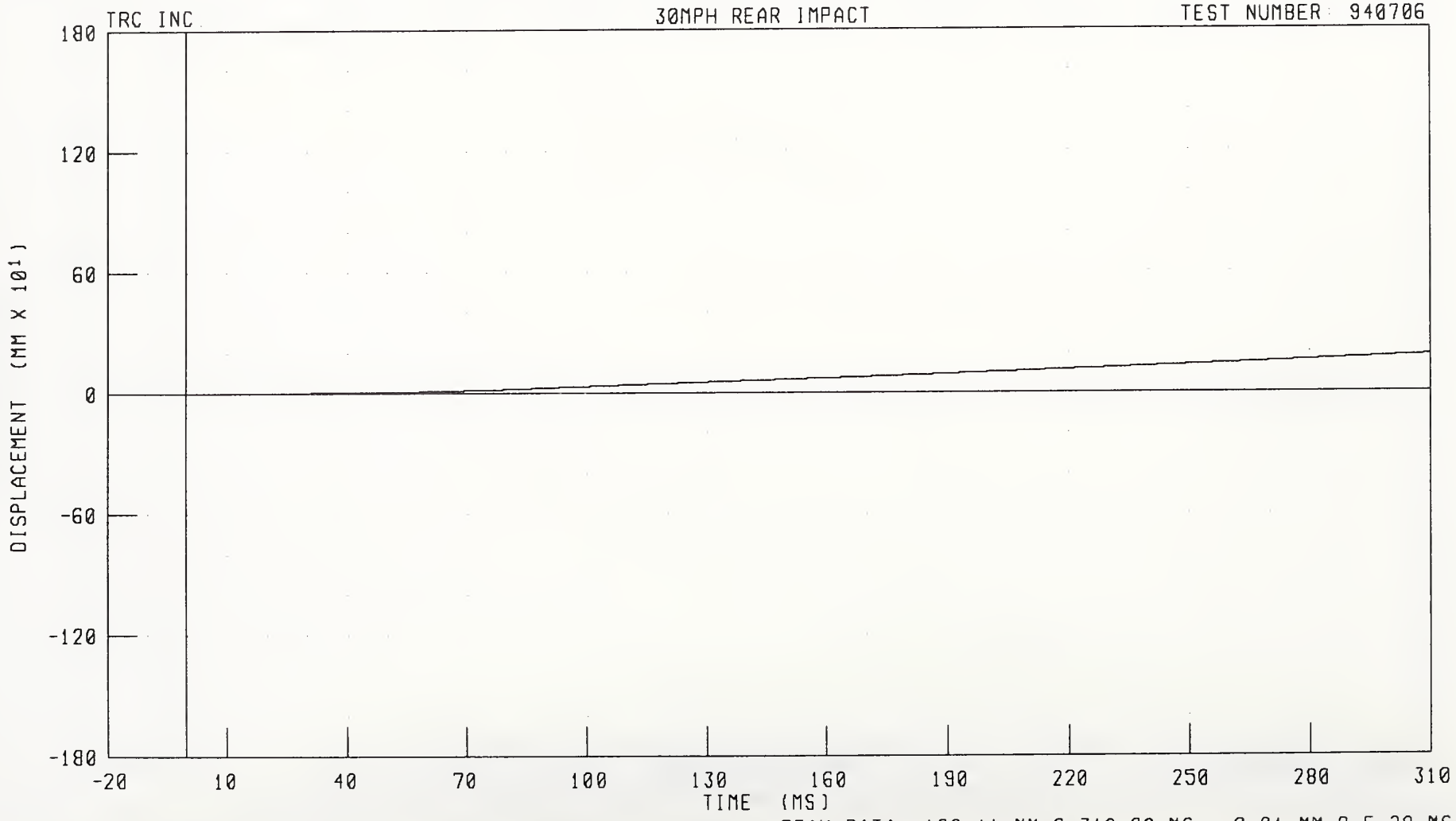
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
VEHICLE CENTER OF GRAVITY Y-AXIS VELOCITY



CHANNEL VCGYV FILTER CH CLASS 180

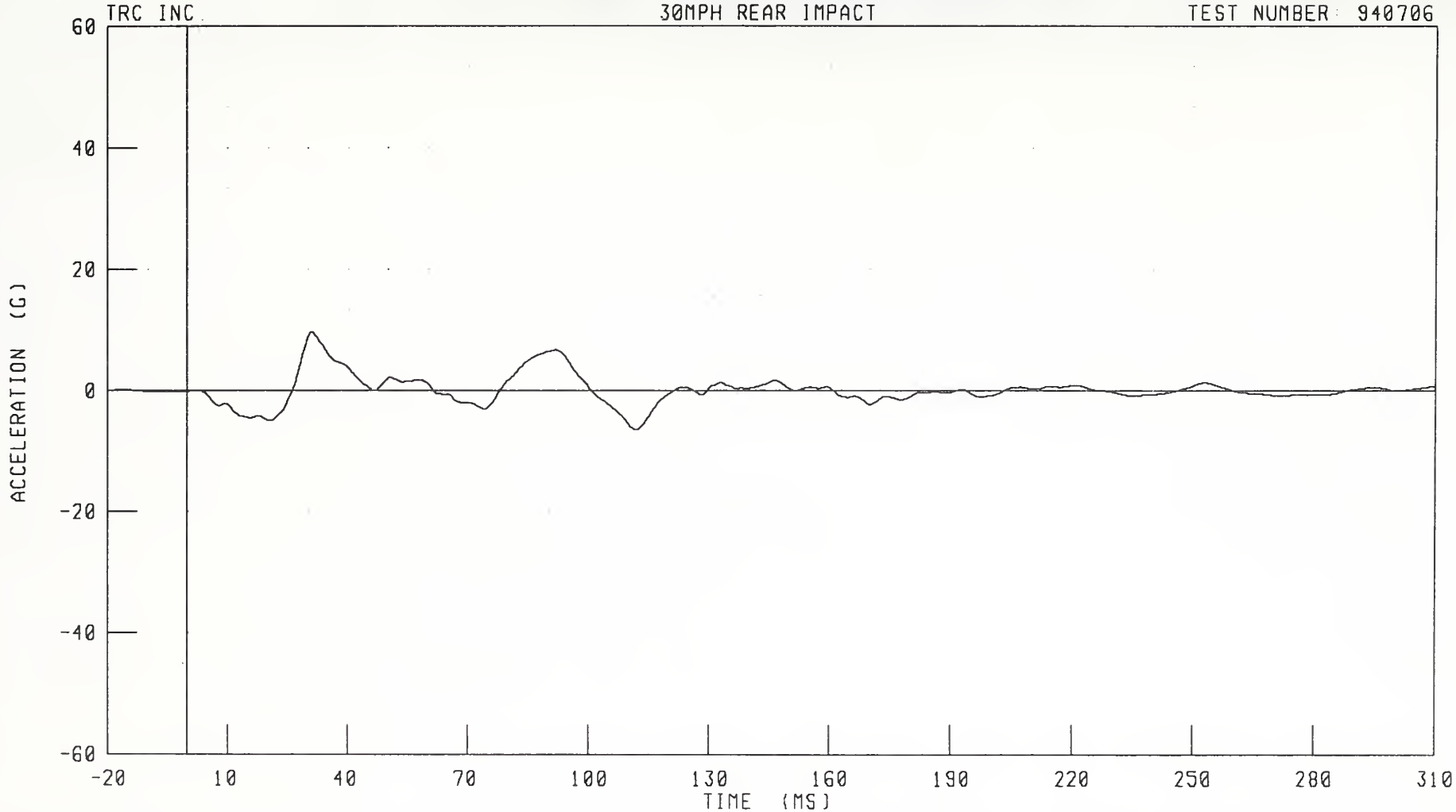
PEAK DATA 2 90 KM/H @ 288 96 MS, -0 01 KM/H @ 4 40 MS

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



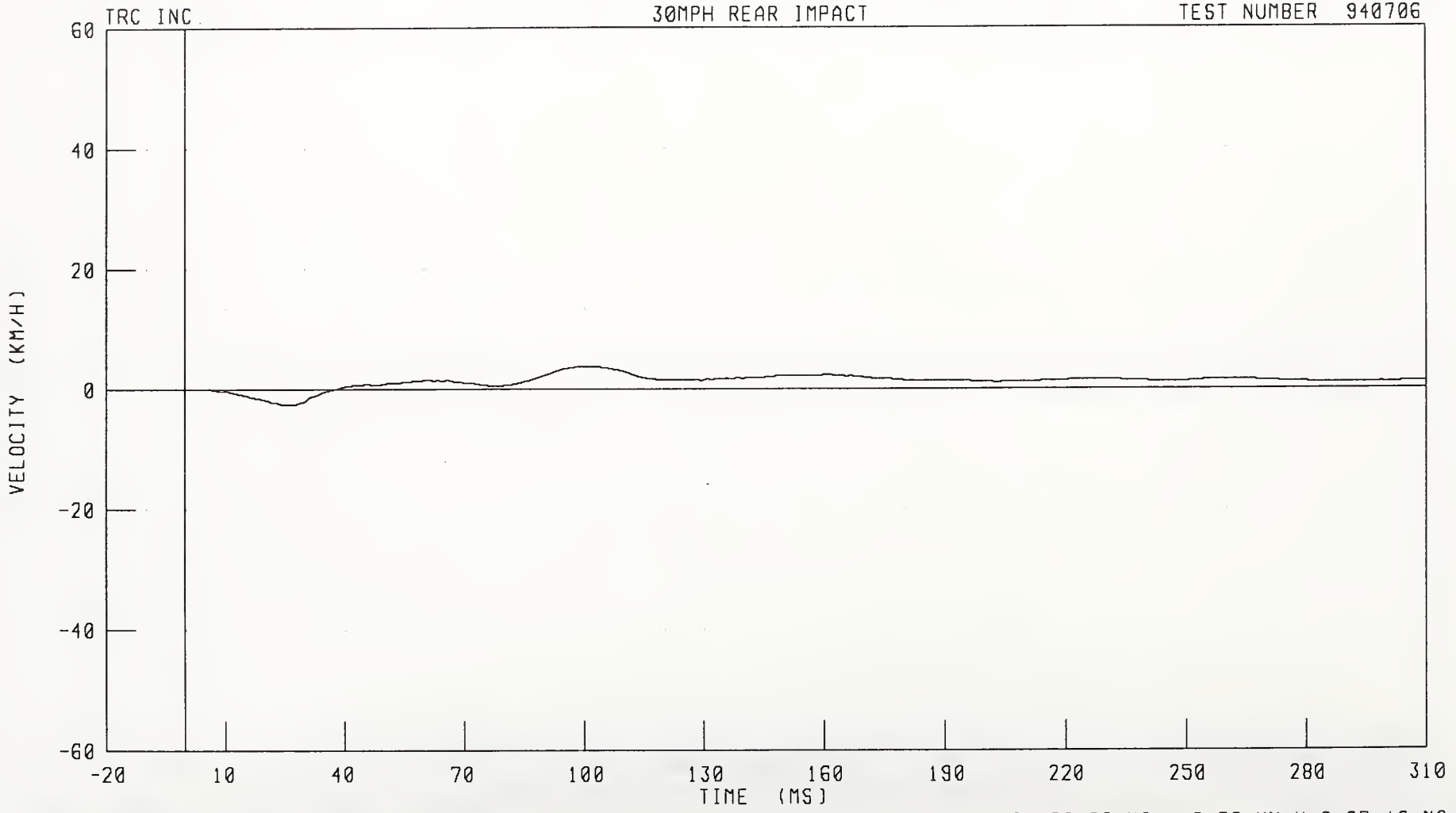
CHANNEL: VCGYD FILTER: CH CLASS 180 PEAK DATA: 182.11 MM @ 310.00 MS, -0.01 MM @ 5.28 MS

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



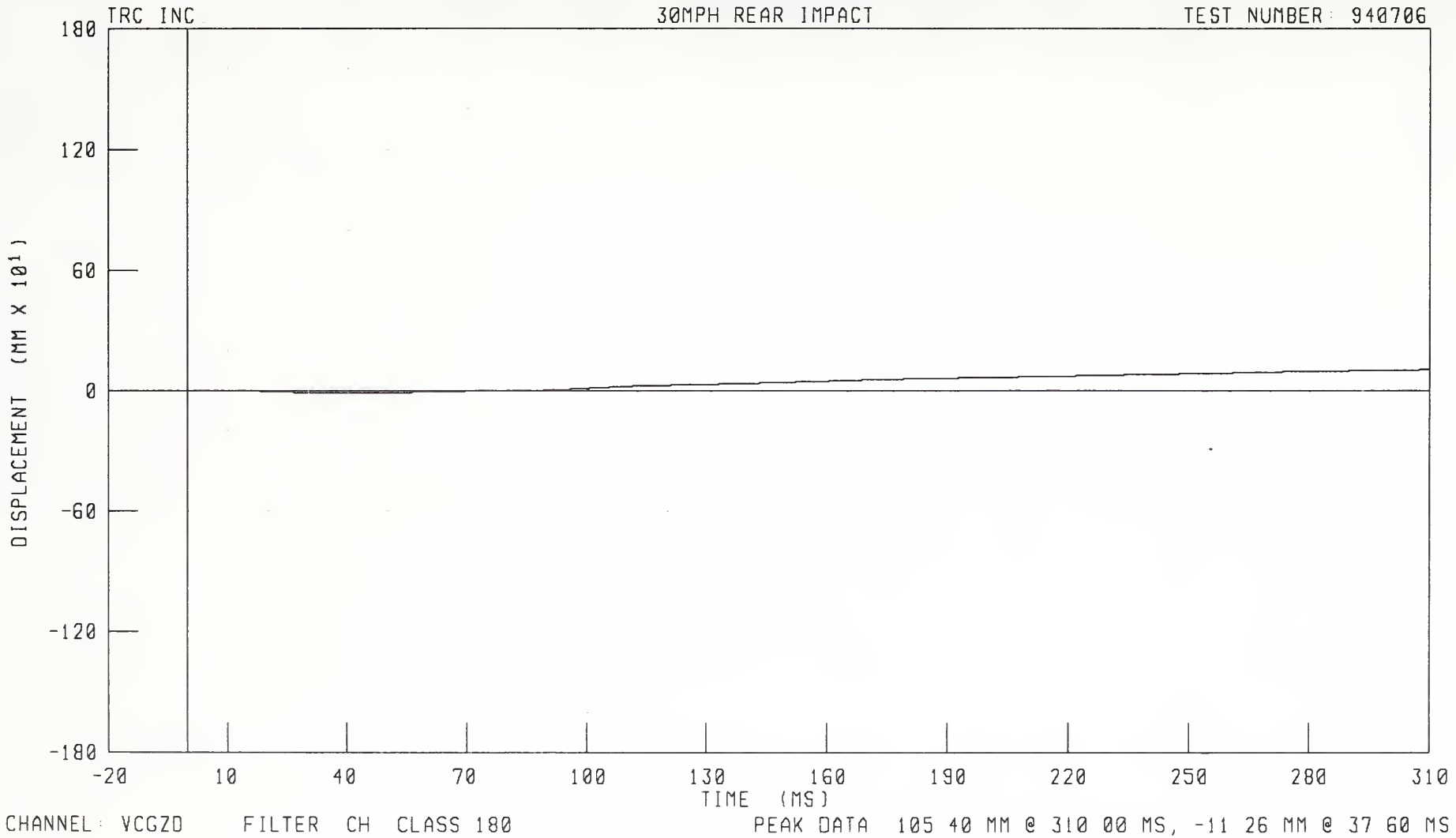
CHANNEL VCGZG FILTER CH CLASS 60 PEAK DATA 9 72 G @ 30 96 MS, -6 46 G @ 111 76 MS

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



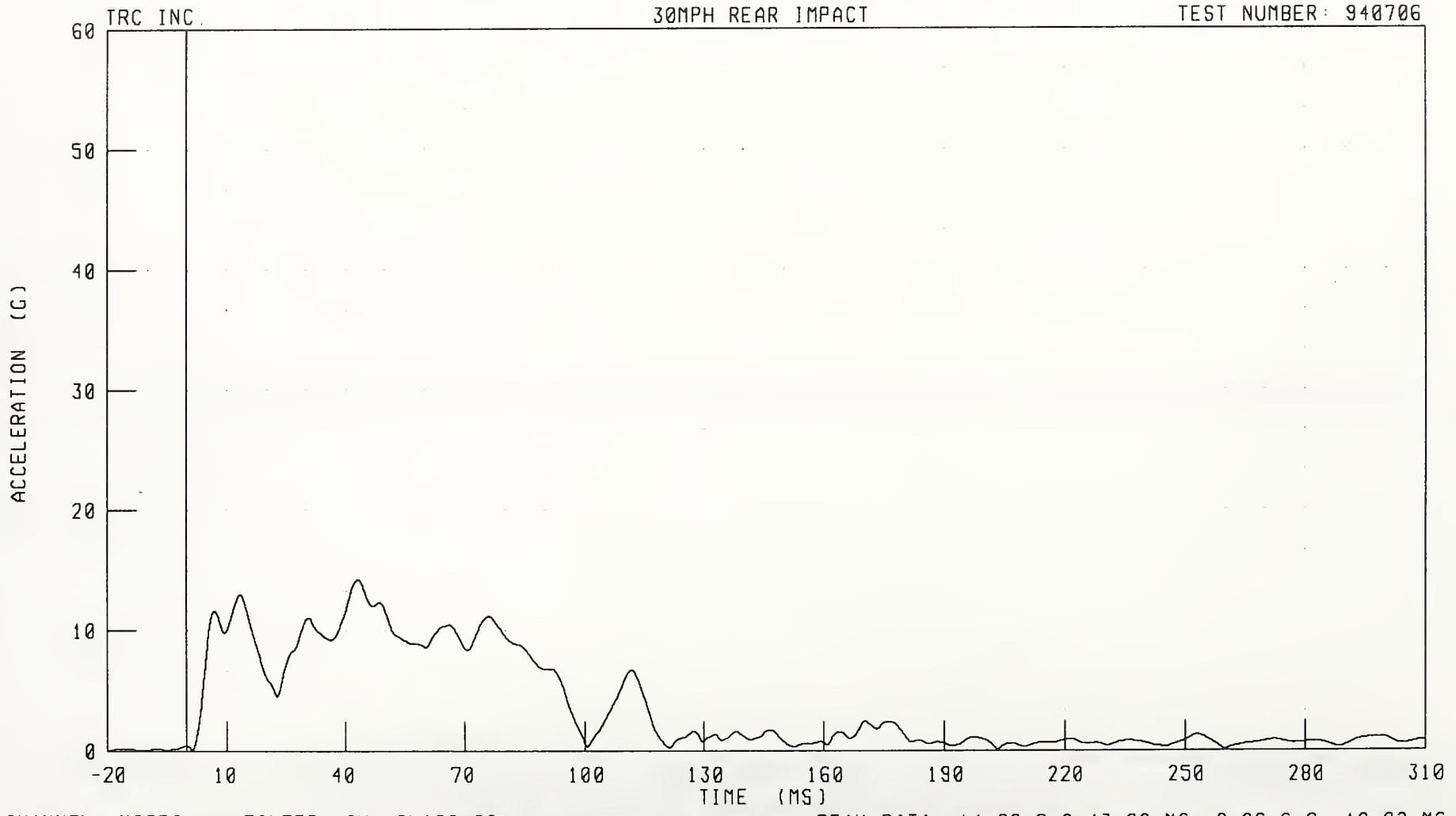
CHANNEL VCGZV FILTER CH CLASS 180 PEAK DATA 3 81 KM/H @ 100 00 MS, -2 56 KM/H @ 27 12 MS

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



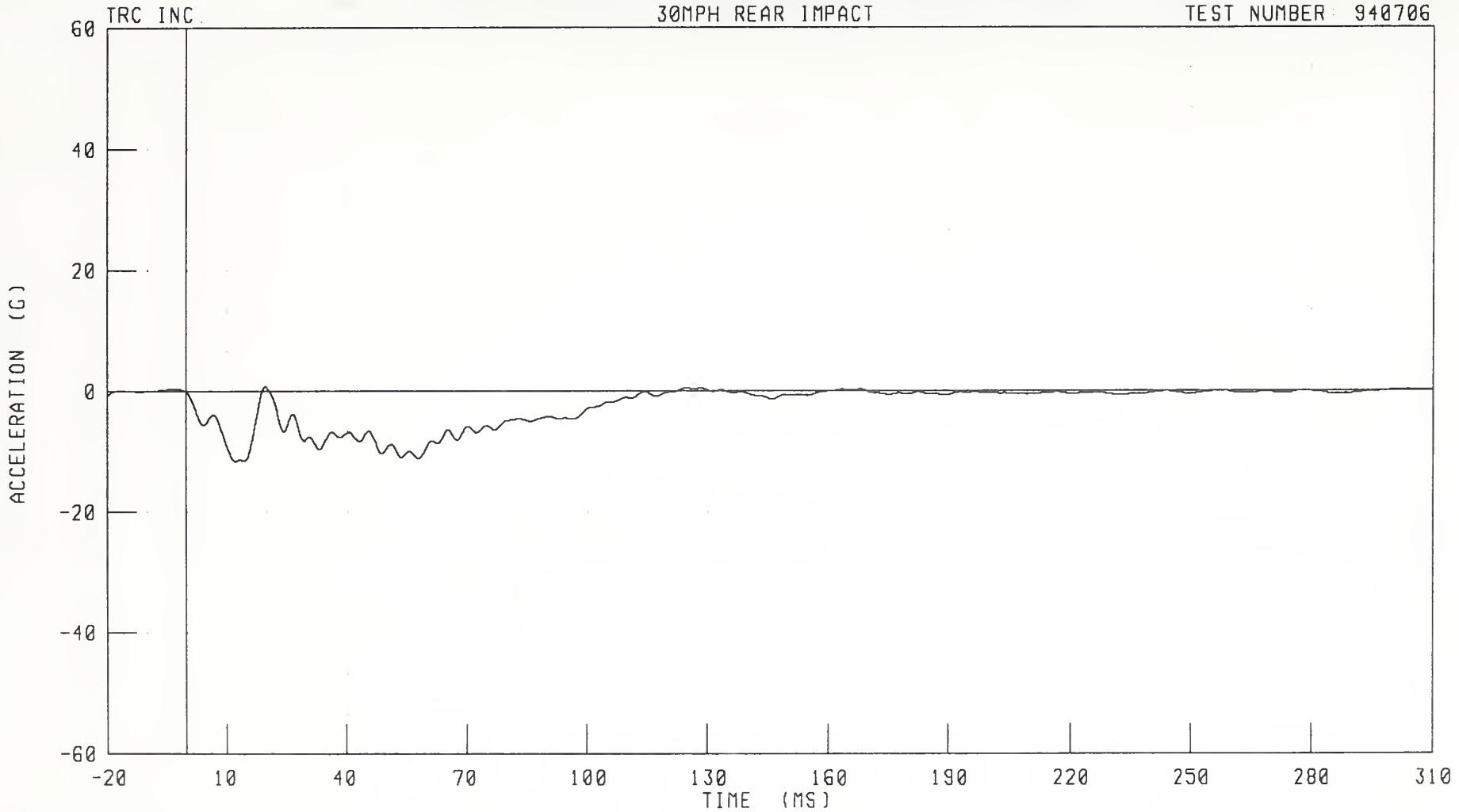
CHANNEL: VCGZD FILTER CH CLASS 180 PEAK DATA 105 40 MM @ 310 00 MS, -11 26 MM @ 37 60 MS

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



CHANNEL VCGRG FILTER: CH CLASS 60 PEAK DATA 14.26 G @ 43.20 MS, 0.06 G @ -19.92 MS

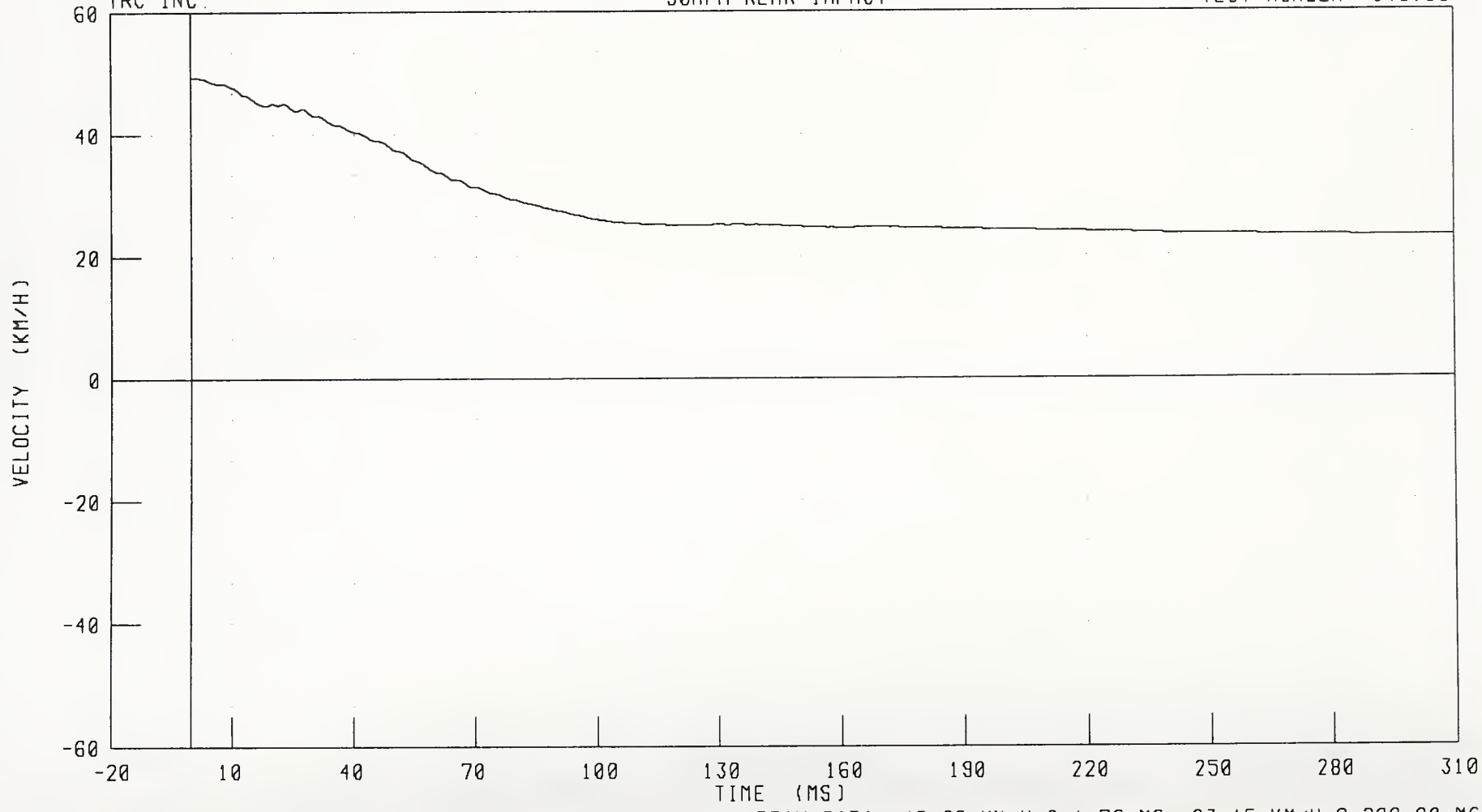
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY X-AXIS ACCELERATION



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

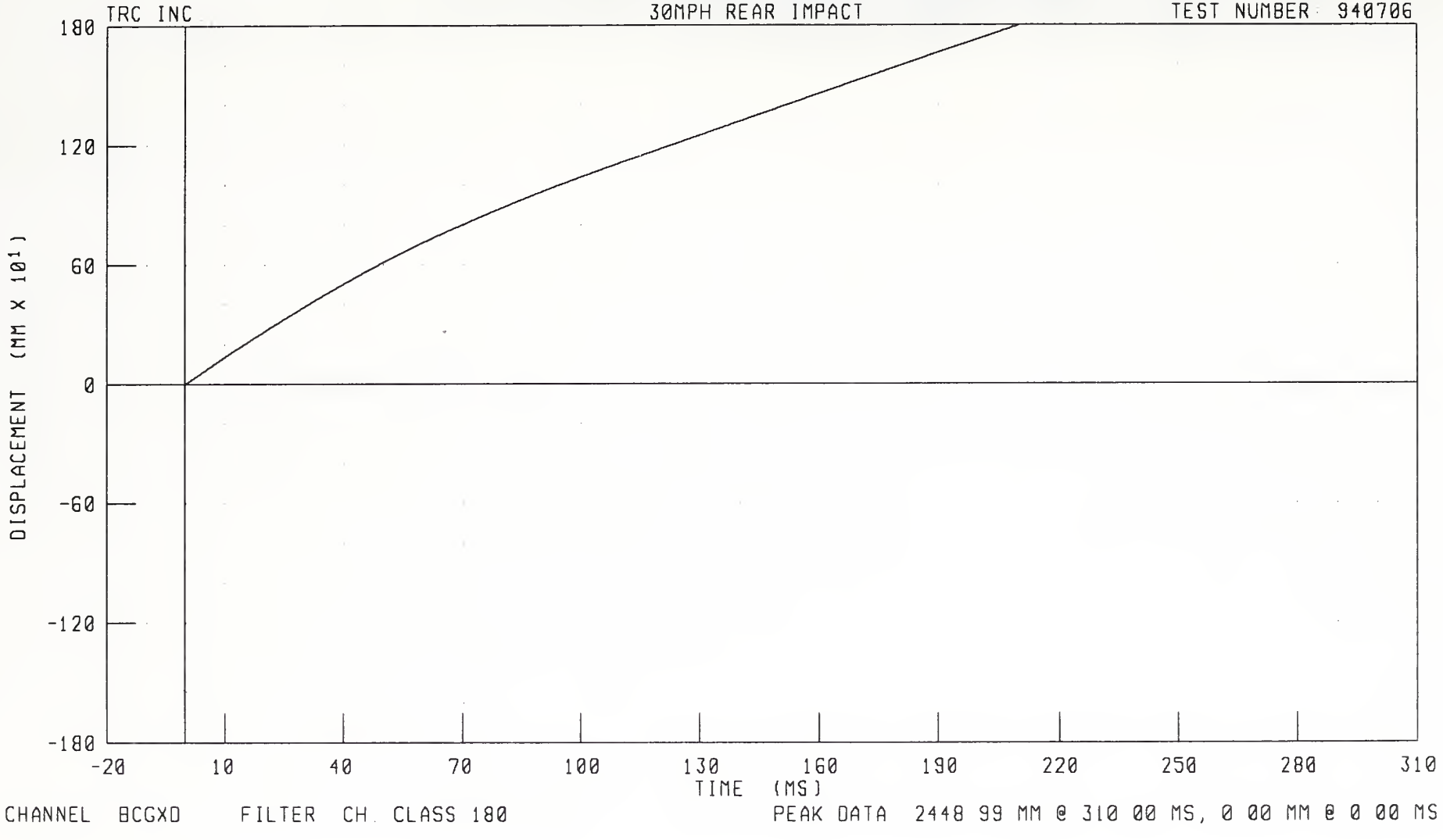
TRC INC. TEST NUMBER: 940706



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

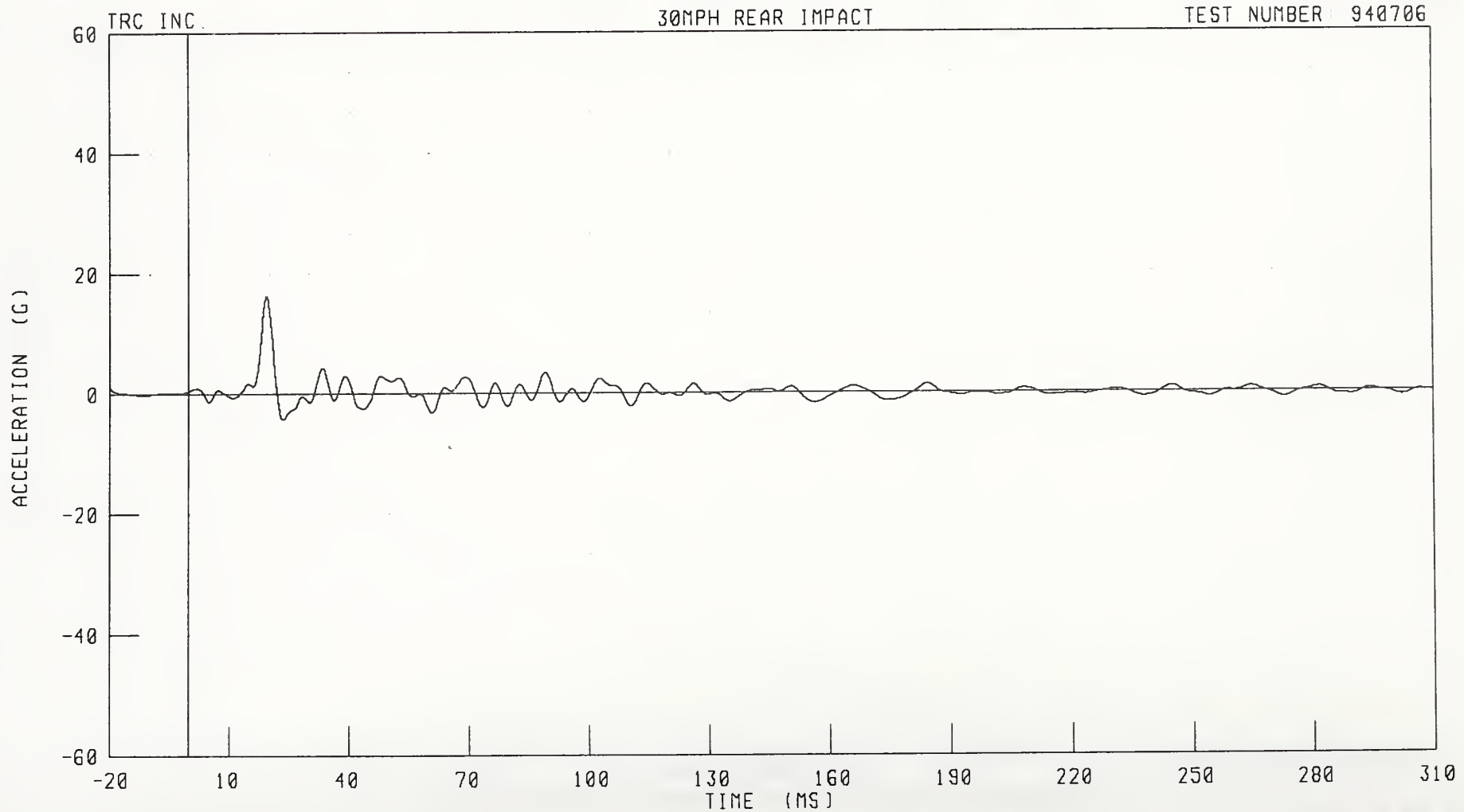
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM

MOVING BARRIER CENTER OF GRAVITY X-AXIS DISPLACEMENT



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

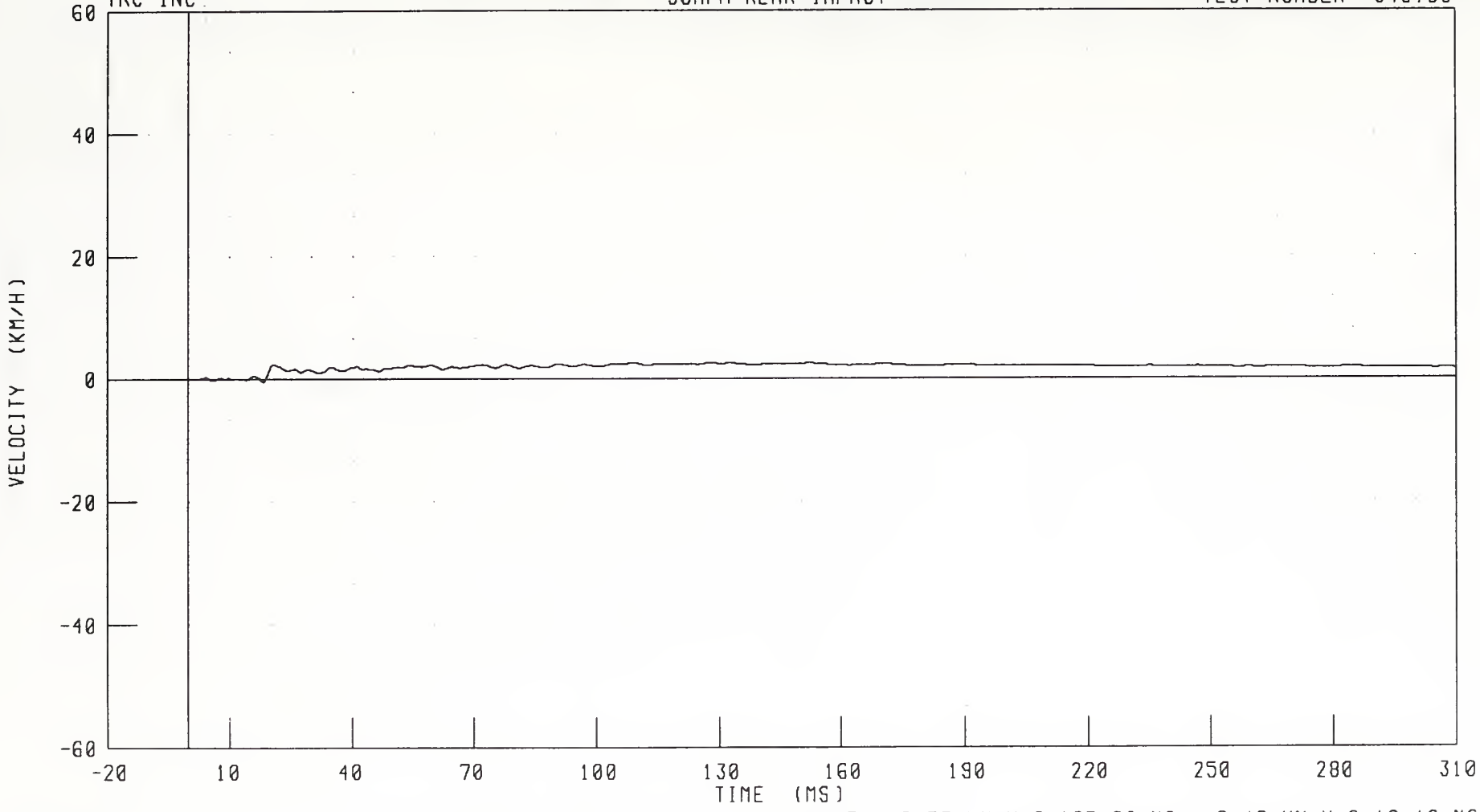


CHANNEL BCGYG FILTER CH CLASS 60

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

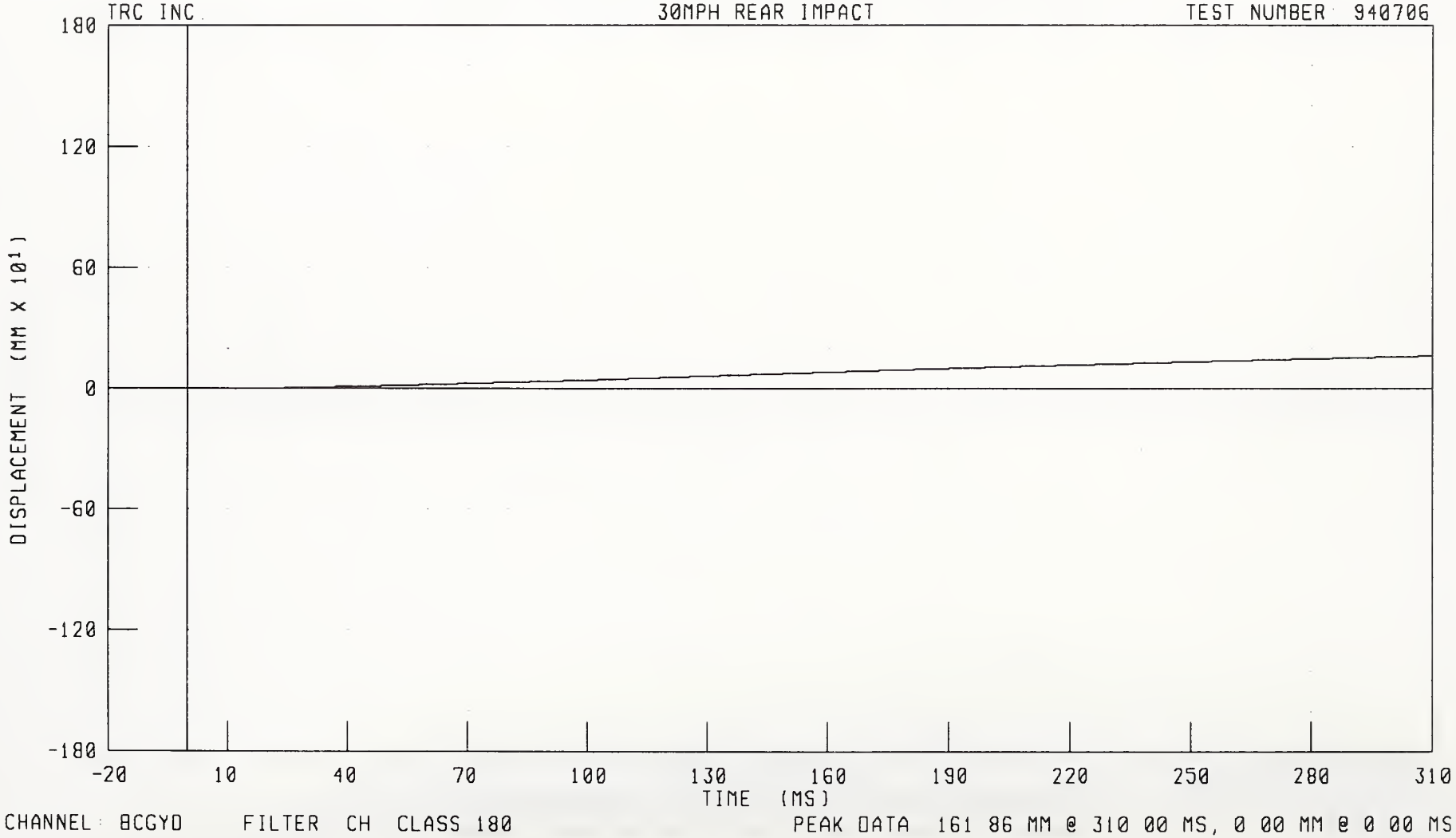
TRC INC 30MPH REAR IMPACT TEST NUMBER 940706



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

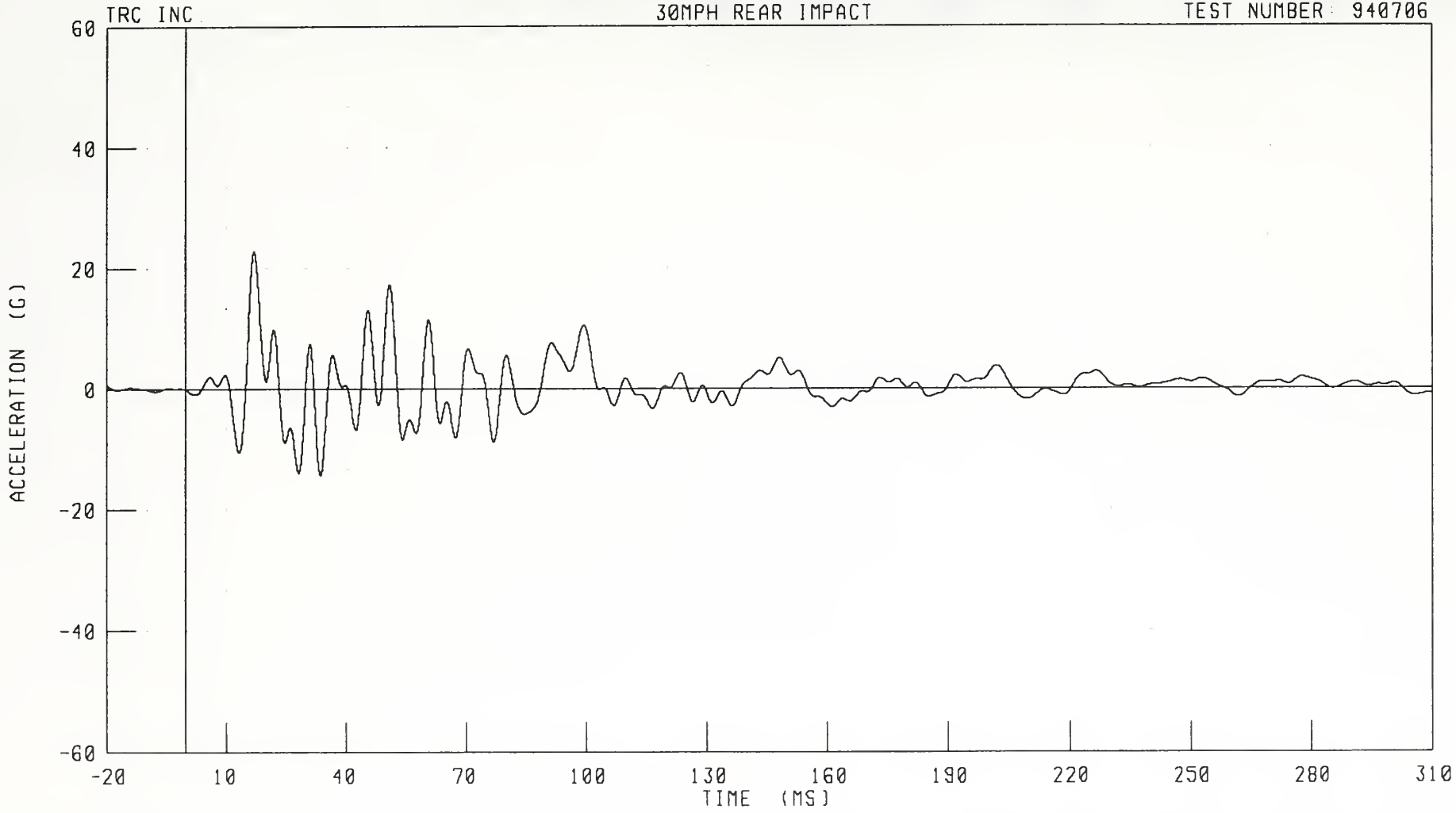
MOVING BARRIER CENTER OF GRAVITY Y-AXIS DISPLACEMENT



CHANNEL BCGYD FILTER CH CLASS 180 PEAK DATA 161 86 MM @ 310 00 MS, 0 00 MM @ 0 00 MS

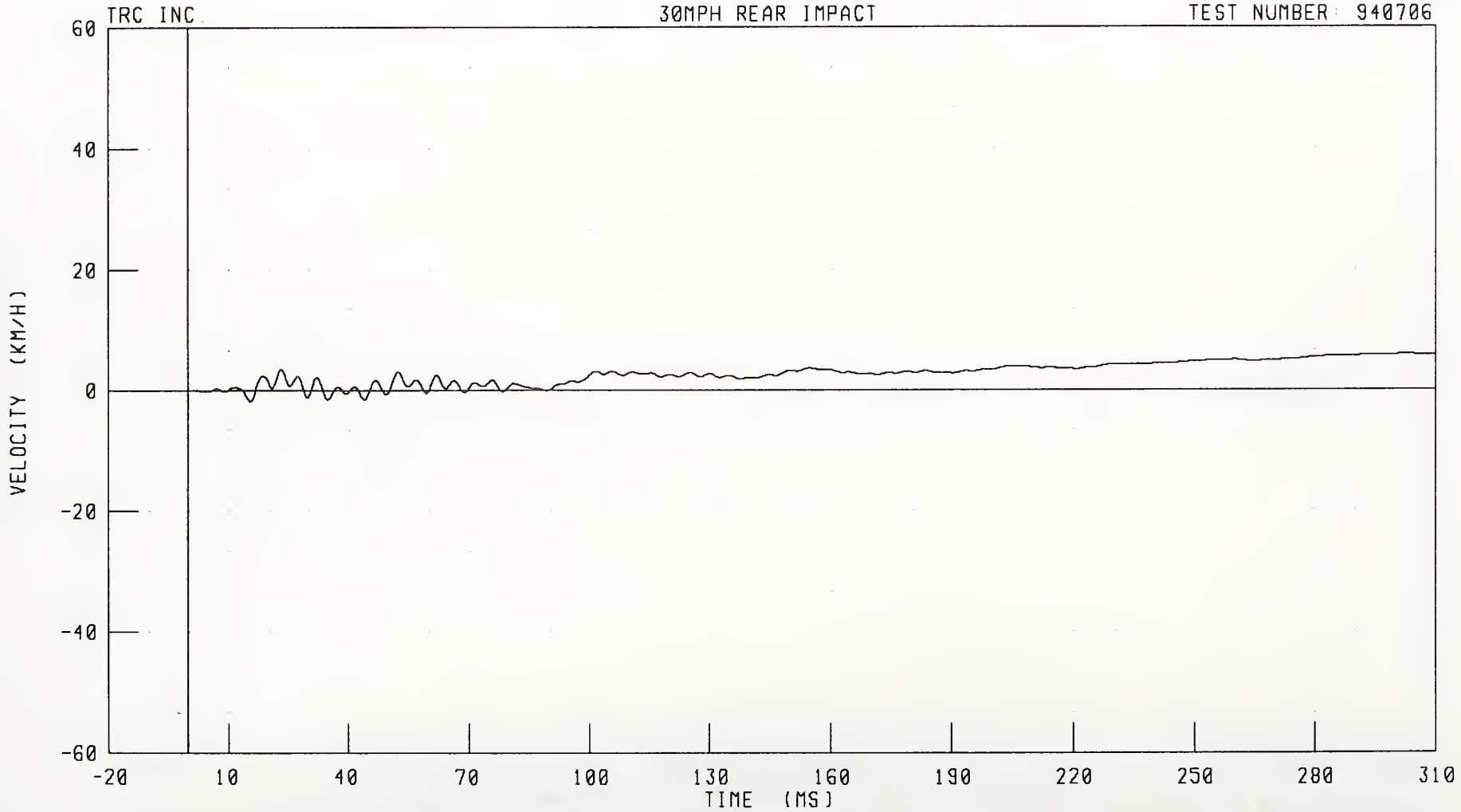
MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM
MOVING BARRIER CENTER OF GRAVITY Z-AXIS ACCELERATION

TRC INC 30MPH REAR IMPACT TEST NUMBER: 940706



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

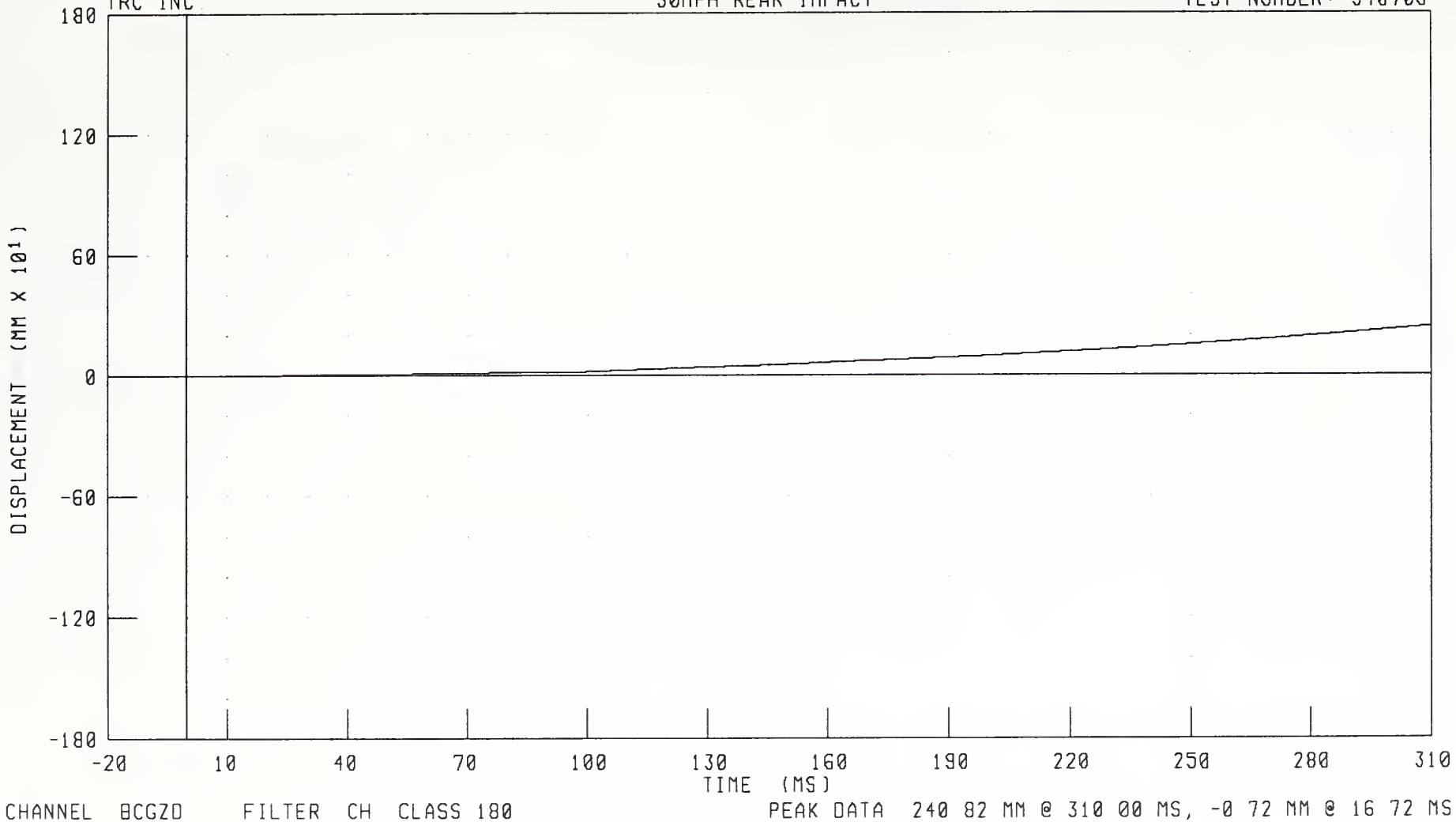


CHANNEL BCGZV FILTER CH CLASS 180 PEAK DATA 5 95 KM/H @ 302 32 MS, -1 84 KM/H @ 15 44 MS

MOVING BARRIER INTO REAR OF 1991 PLYMOUTH ACCLAIM

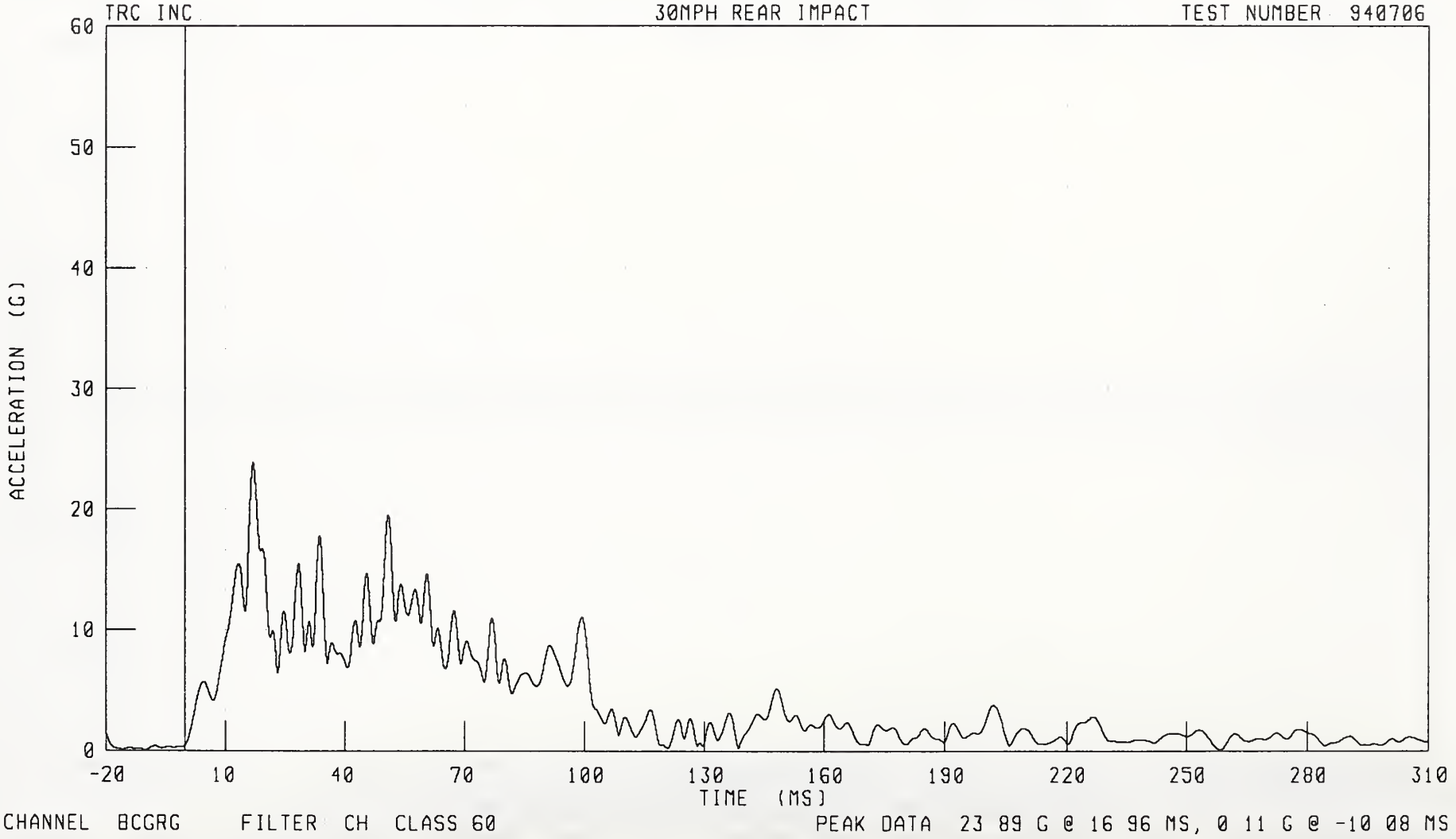
MOVING BARRIER CENTER OF GRAVITY Z-AXIS DISPLACEMENT

TRC INC 30MPH REAR IMPACT TEST NUMBER: 940706



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



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

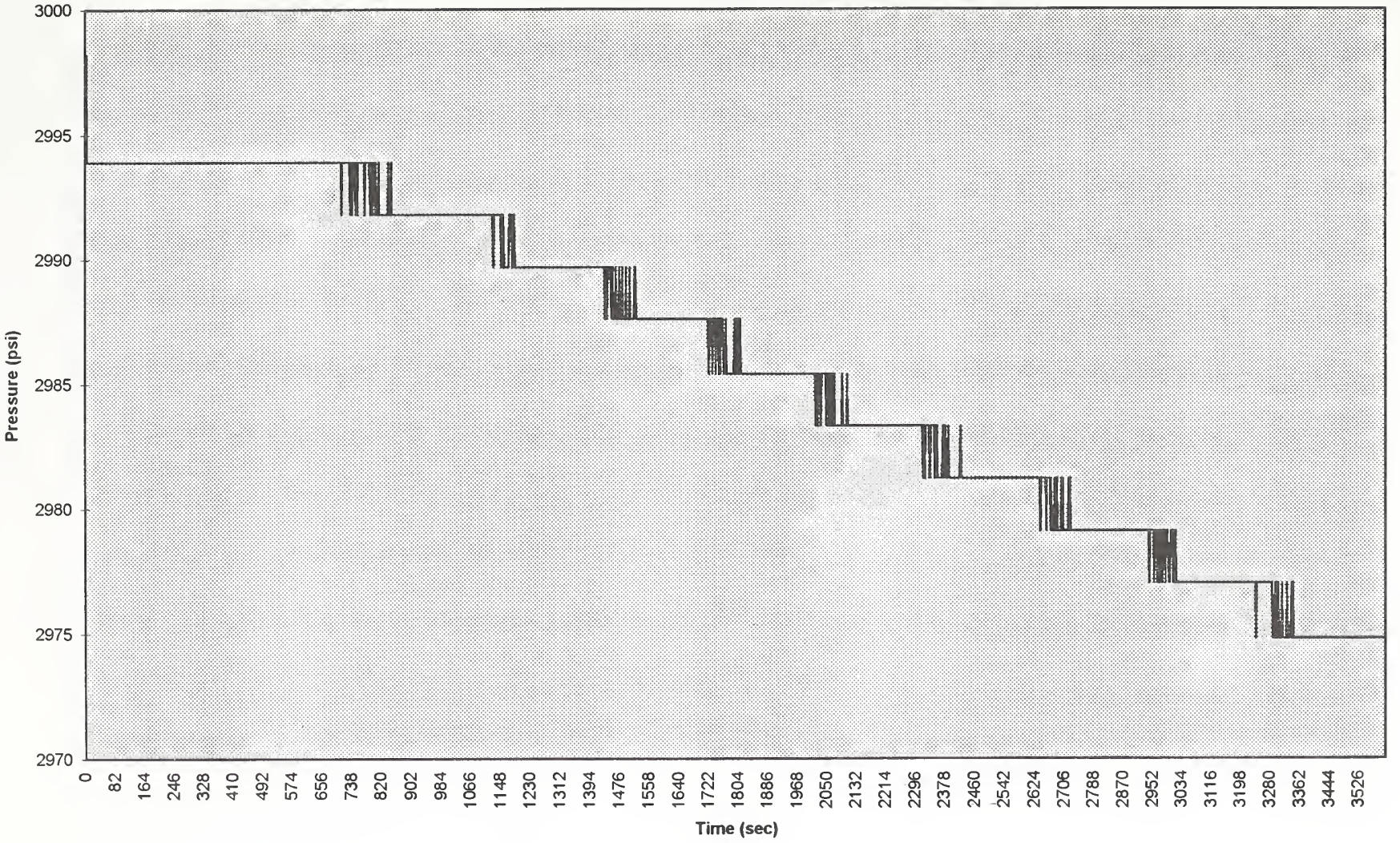
VEHICLE INSTRUMENTATION INFORMATION

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