

3145

**1999 Saturn SL1
into an IIHS 40% Left Offset Deformable Barrier
TRC Test Number: 990830-3**

**Prepared by:
Transportation Research Center Inc.
10820 State Route 347
East Liberty, OH 43319**

**Final Report
August - October 1999**

**Prepared For:
Vehicle Research and Test Center
P. O. Box 37
East Liberty, OH 43319**

Notice

Transportation Research Center Inc. does not endorse or certify products of manufacturers. The manufacturer's name appears solely to identify the test article. Transportation Research Center Inc. assumes no liability for the report or use thereof. It is responsible for the facts and the accuracy of the data presented herein. This report does not constitute a standard, specification, or regulation.

This publication is distributed by the U. S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Table of Contents

<u>Section</u>	<u>Description</u>	<u>Page</u>
1.0	Purpose and Test Procedure	1-1
2.0	35 mph IIHS 40% Left ODB Impact Test Summary	2-1
3.0	FMVSS 208 Data	3-1
4.0	Vehicle, Occupant, Barrier, and Camera Measurements	4-1
Appendix A	Photographs	A-1
Appendix B	Data Plots	B-1
Appendix C	Dummy Certification Information	C-1
Appendix D	Miscellaneous Test Information	D-1

List of Tables

<u>Number</u>	<u>Description</u>	<u>Page</u>
1	Crash Test Summary	2-4
2	Test Vehicle Information	2-6
3	Post-Impact Data	2-9
4	Vehicle Accelerometer Locations and Data Summary	2-13
5	Dummy Injury Criteria	3-2
6	Impacted Vehicle Measurements	4-3
7	Dummy Measurement Data for Front Seat Occupants	4-6
8	Motion Picture Camera Locations	4-8
9	Deformable Barrier Face Profiles	4-15

List of Figures

<u>Number</u>	<u>Description</u>	<u>Page</u>
1	Impact Velocity Measurement System	2-10
2	Accident Investigation Division Data for 35 mph IIHS 40% Left ODB Impact	2-11
3	Vehicle Accelerometer Placement	2-12
4	Pre-Test and Post-Test Measurement Points	4-2
5	Vehicle Target Locations	4-4
6	Dummy Measurement Locations for Front Seat Occupants	4-5
7	Camera Positions	4-7
8	Deformable Barrier Face Profiles	4-9

List of Photographs

<u>Description</u>	<u>Figure</u>
Pre-Test Front View	A-1
Post-Test Front View	A-2
Pre-Test Left Side View	A-3
Post-Test Left Side View	A-4
Pre-Test Left Rear Three-Quarter View	A-5
Post-Test Left Rear Three-Quarter View	A-6
Pre-Test Rear View	A-7
Post-Test Rear View	A-8
Pre-Test Right Side View	A-9
Post-Test Right Side View	A-10
Pre-Test Right Front Three-Quarter View	A-11
Post-Test Right Front Three-Quarter View	A-12
Pre-Test Overhead View	A-13
Post-Test Overhead View	A-14
Pre-Test Overhead Close-Up View	A-15
Post-Test Overhead Close-Up View	A-16
Pre-Test Front Underbody View	A-17
Post-Test Front Underbody View	A-18
Pre-Test Rear Underbody View	A-19
Post-Test Rear Underbody View	A-20
Pre-Test Engine Compartment View	A-21
Post-Test Engine Compartment View	A-22
Pre-Test Windshield - View 1	A-23
Post-Test Windshield - View 1	A-24
Pre-Test Windshield - View 2	A-25
Post-Test Windshield - View 2	A-26
Pre-Test Driver Dummy Windshield View	A-27
Post-Test Driver Dummy Windshield View	A-28

List of Photographs, Cont'd.

<u>Description</u>	<u>Figure</u>
Pre-Test Passenger Dummy Windshield View	A-29
Post-Test Passenger Dummy Windshield View	A-30
Pre-Test Driver Dummy Position - View 1	A-31
Post-Test Driver Dummy Position - View 1	A-32
Pre-Test Driver Dummy Position - View 2	A-33
Post-Test Driver Dummy Position - View 2	A-34
Pre-Test Driver Dummy Position - View 3	A-35
Post-Test Driver Dummy Position - View 3	A-36
Pre-Test Passenger Dummy Position - View 1	A-37
Post-Test Passenger Dummy Position - View 1	A-38
Pre-Test Passenger Dummy Position - View 2	A-39
Post-Test Passenger Dummy Position - View 2	A-40
Pre-Test Passenger Dummy Position - View 3	A-41
Post-Test Passenger Dummy Position - View 3	A-42
Post-Test Driver Dummy View	A-43
Post-Test Driver Dummy Head Contact - View 1	A-44
Post-Test Driver Dummy Head Contact - View 2	A-45
Post-Test Driver Dummy Head Contact - View 3	A-46
Post-Test Driver Dummy Head Contact - View 4	A-47
Post-Test Driver Dummy Knee Contact - View 1	A-48
Post-Test Driver Dummy Knee Contact - View 2	A-49
Post-Test Driver Footwell Deformation View	A-50
Post-Test Passenger Dummy View	A-51
Post-Test Passenger Dummy Head Contact - View 1	A-52
Post-Test Passenger Dummy Head Contact - View 2	A-53
Post-Test Passenger Dummy Knee Contact - View 1	A-54
Post-Test Passenger Dummy Knee Contact - View 2	A-55
Post-Test Passenger Footwell Deformation View	A-56

List of Photographs, Cont'd.

<u>Description</u>	<u>Figure</u>
Pre-Test Vehicle Certification Label View	A-57
Pre-Test Vehicle Tire Information Label View	A-58
Post-Test Barrier Front View	A-59
Post-Test Barrier Left Side View	A-60
Post-Test Barrier Right Side View	A-61
Impact Event	A-62

Section 1.0

Purpose and Test Procedure

Purpose and Test Summary

This 35 mph IIHS 40% left offset deformable barrier impact test has as the main objective to investigate both vehicle and occupant dynamics during an IIHS 40% left offset deformable barrier test. A secondary objective is to gather information on depowered airbags.

This test was conducted with a 1999 Saturn SL1 that impacted an IIHS 40% left offset deformable barrier. The test vehicle contained two instrumented Hybrid III 5th percentile adult female dummies.

Section 2.0

35 mph IIHS 40% Left ODB Impact Test Summary

Test Procedure

This test was conducted per VRTC personnel's instructions. Data was obtained relative to FMVSS 208, "Occupant Crash Protection," performance.

The test vehicle was instrumented with twelve (12) accelerometers to measure longitudinal, lateral, and vertical axis accelerations and two (2) inductive pickup switches to measure the driver and passenger airbag fire times. The vehicle's specified impact velocity range was 55.5 to 57.1kph. The vehicle impacted an IIHS 40% left offset deformable barrier.

The test vehicle contained two (2) Hybrid III 5th percentile adult female anthropomorphic test devices (dummies). The dummies were positioned in the front outboard designated seating positions according to the FMVSS 208 laboratory seating procedure.

Both dummies were instrumented with head and chest accelerometers to measure longitudinal, lateral, and vertical accelerations; chest deflection potentiometers; left and right femur load cells to measure axial forces; and upper neck load cells to measure forces and moments.

The fifty-four (54) data channels were digitally sampled at 12,500 samples per second and processed per Sections 11.13 through 11.15 of the Laboratory Test Procedure.

The crash event was recorded by one (1) real-time panning motion picture camera and fifteen (15) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The vehicle and occupant data are summarized in Section 2.0. The FMVSS 208 data are presented in Section 3.0. The vehicle, occupant, barrier, and camera measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the dummy and vehicle data plots. Appendix C contains the dummy certification information. Appendix D contains the miscellaneous test information.

Test Results Summary

This IIHS 40% left offset deformable barrier test was conducted at TRC on August 30, 1999.

The test vehicle, a 1999 Saturn SL1, was equipped with airbags at the driver's and right front passenger's seating positions. The vehicle's test weight was 1187.1 kilograms. The vehicle's impact speed was 56.3 kph. The vehicle's maximum static crush was 587 millimeters.

The driver's 15-millisecond HIC was 99 and its 36-millisecond HIC was 210. The driver's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 33.6 g. The driver's chest deflection was 55.1 millimeters. The driver's left and right femur maximum compressive forces were 3612 N and 999, respectively. The driver's tibia indices were as follows: upper left leg 0.26, upper right leg 0.18, lower left leg 1.02, lower right leg 0.21.

The right front passenger's 15-millisecond HIC was 45 and its 36-millisecond HIC was 83. The right front passenger's chest maximum resultant acceleration with three (3) milliseconds minimum duration was 24.0 g. The passenger's chest deflection was 5.7 millimeters. The right front passenger's left and right femur maximum compressive forces were 3701 N and 3171 N, respectively.

Table 1 Crash Test Summary

Test type:	IIHS 40% Left Offset Deformable Barrier Impact
Test date:	08/30/99
Test time:	2400
Ambient temperature at impact area:	21° C
Vehicle year/make/ model/body style:	1999/Saturn/SL1/Sedan
Vehicle test weight:	1187.1 kg
Impact angle ¹ :	0°
Impact velocity ² :	
Primary:	56.3 kph
Secondary:	56.3 kph
Maximum static crush:	587 mm
Average rebound:	N/A
Number of cameras:	
Real-time:	1
High-speed:	15
Door opening data:	
Left-front:	Hard
Right-front:	Easy

¹ With respect to tow track centerline.

² Speed trap measurement ($\pm .08$ km/h accuracy)

Table 1. Crash Test Summary, Cont'd.

Dummies:	<u>Driver #289</u>	<u>Passenger #369</u>
Type:	Hybrid III 5 th percentile adult female	Hybrid III 5 th percentile adult female
Location:	Left front	Right front
Restraint:	Airbag	Airbag
Number of data channels:	25	15
Front seat data:		
Seat track failure:	None	None
Seat back failure:	None	None
Visible dummy contact points:		
Head:	Airbag, Window sill Corner of headrest	Airbag, Instrument panel
Chest:	Airbag	Airbag
Abdomen:	None	None
Left knee:	Instrument panel	Instrument panel
Right knee:	Instrument panel	Instrument panel

Table 2 Test Vehicle Information

Vehicle year/make/
model/body style: 1999/Saturn/SL1/Sedan

Color: Green

VIN: 1G8ZG5286XZ131551

Engine data:

Placement: Transverse/Lateral

Cylinders: 4

Displacement: 1.9 liters

Transmission data: 5 speed, X manual, ___ automatic, X overdrive

Final drive: X fwd, ___ rwd, ___ 4wd

Date vehicle received: N/A

Odometer reading: 10,500 miles

Dealer's name and address: N/A

Accessories:

Power steering	Yes	Automatic transmission	No
Power brakes	Yes	Automatic speed control	No
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
Power door locks	Yes	Other:	None

Certification data from vehicle's label:

Vehicle manufactured by: Saturn Corporation

Date of manufacture: 08/98

VIN: 1G8ZG5286XZ131551

GVWR: 3259 lb.

GAWR: Front: 1651 lb.

Rear: 1608 lb.

Table 2 Test Vehicle Information, Cont'd.

Size of tires on vehicle: P175/70R14
Spare tire: Space Saver
Type of front seats: Bucket

Tire & capacity data from vehicle's label:

Recommended tire size: P175/70R14

Recommended cold tire pressure:

Front: 30 psi

Rear: 26 psi

Designated Seating Capacity:

Front 2

Rear 3

Total 5

Vehicle Capacity Weight: 849 lb.

Test vehicle attitudes:

Delivered attitude: LF: 665 mm RF: 667 mm LR: 674 mm RR: 668 mm

Fully loaded attitude: LF: 657 mm RF: 665 mm LR: 642 mm RR: 647 mm

Pre-test attitude: LF: 646 mm RF: 652 mm LR: 646 mm RR: 644 mm

Post-test attitude: LF: N/A mm RF: 649 mm LR: 585 mm RR: 695 mm

Table 2 Test Vehicle Information, Cont'd.

Weight of test vehicle as received (with maximum fluids):

Right front	317.5 kg	Right rear	211.8 kg
Left front	318.4 kg	Left rear	204.1 kg
Total front weight	635.9 kg	(60.5% of total vehicle weight)	
Total rear weight	415.9 kg	(39.5% of total vehicle weight)	
Total delivered weight	1051.8 kg		

Calculation of test vehicle's target test weight:

RCLW¹ = Rated Cargo and Luggage Weight

UDW = Unloaded Delivered Weight (1051.8 kg)

DSC² = Designated Seating Capacity (5)

RCLW¹ = 44.9 kg

Target test weight = UDW + RCLW + (number of Hybrid III Dummies x 47.6 kg per dummy)

Target test weight = 1051.8 + 44.9 + 95.2 = 1191.9 kg

Weight of test vehicle with required dummies and 44.9 kg of cargo weight:

Right front	331.1 kg	Right rear	253.6 kg
Left front	348.4 kg	Left rear	254.0 kg
Total front weight	679.5 kg	(57.2% of total vehicle weight)	
Total rear weight	507.6 kg	(42.8% of total vehicle weight)	
Total test weight	1187.1 kg	(0.4% under target test weight)	

Weight of ballast secured in vehicle: None

Components removed to meet target test weight: Rear seat, rear taillights, rear package shelf, rear seat belts, passenger rear interior door panel, C-pillar trim panels, and muffler.

CG rearward of front wheel centerline: 1485 mm

Vehicle Wheelbase: 2595 mm

¹ Cargo weight for multi-purpose passenger vehicles, trucks, and buses is the vehicle's calculated cargo and luggage weight or 136.1 kg, whichever is less.

² The designated seating capacity is determined by counting the number of seat belts installed in the vehicle.

Table 3 Post-Impact Data

Test number: 990830-3
Test date: 08/30/99
Test time: 2400
Test type: IIHS 40% Left Offset Deformable Barrier Impact
Impact angle: 0°
Ambient temperature
at impact area: 22° C
Temperature in
occupant compartment: 21° C
Impact velocity:
Primary: 56.3 kph
Secondary: 56.3 kph
Specified range: 55.5 to 57.1kph

Distance from vehicle to barrier:

Entering velocity trap: 356 mm
Exiting velocity trap: 51 mm

Test vehicle static crush:

Overall length of test vehicle:

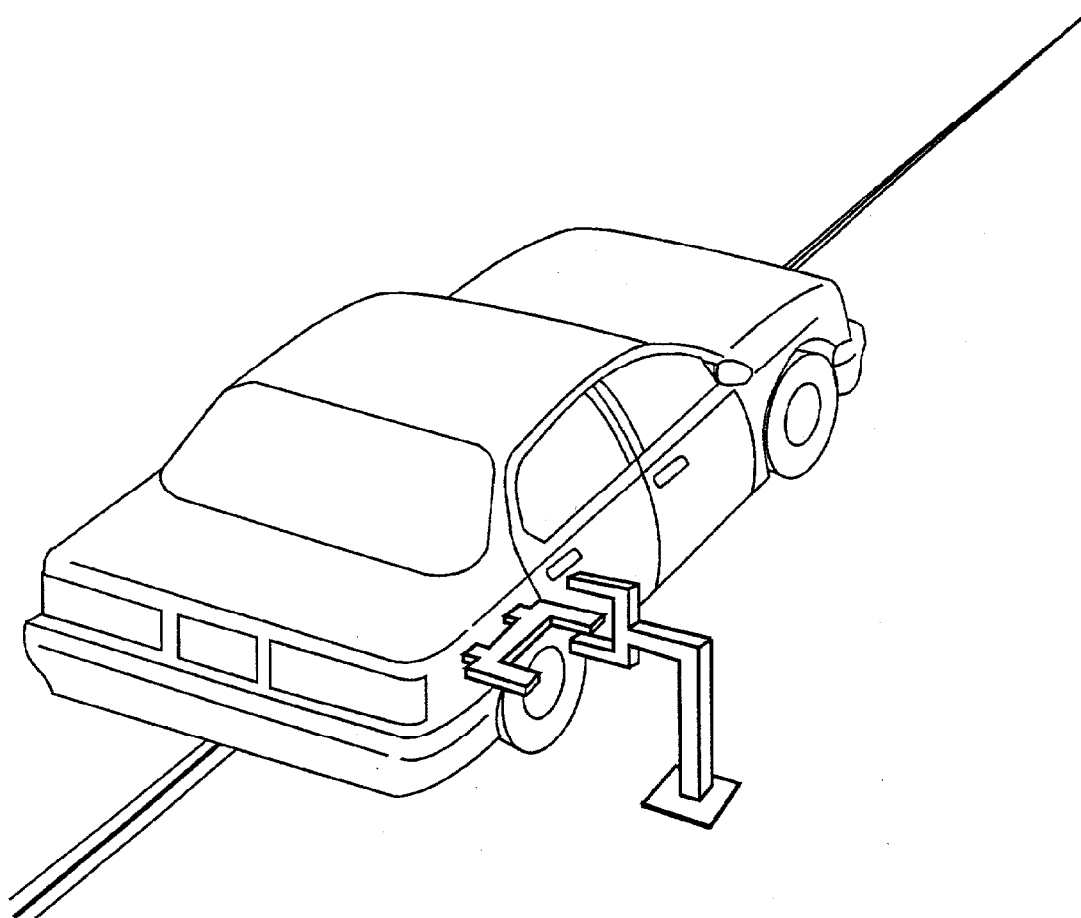
Pre-test:	L: 4341 mm	C: 4557 mm	R: 4339 mm
Post-test:	L: 3754 mm	C: 4232 mm	R: 4471 mm
Total crush:	L: 587 mm	C: 325 mm	R: -132 mm
Average crush:	260 mm		

Test vehicle rebound from IIHS 40% left offset deformable barrier:

Distance from test vehicle to barrier:

Post-test:	L: N/A	C: N/A	R: N/A
Average rebound:	N/A		

Figure 1 Impact Velocity Measurement System



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

The vanes have 305-millimeter spacing.

Figure 2 Accident Investigation Division Data for 35 mph IIHS 40% Left ODB Impact

Test date: August 30, 1999
 Vehicle year/make/
 model/body style: 1999/Saturn/SL1/Sedan
 VIN: 1G8ZG5286XZ131551
 Build date: 08/98
 Test weight: 1187.1 kg
 Vehicle wheelbase: 2595 mm
 Maximum width: 1689 mm
 Front overhang: 973 mm

Collision Deformation
 Classification (CDC) Code: 12FDAW6

Crush depth
 measurements:

C1: 587 mm
 C2: 529 mm
 C3: 400 mm
 C4: 187 mm
 C5: 55 mm
 C6: -132 mm

Midpoint of damage: D: Vehicle Longitudinal Centerline

Length of damaged
 region: L: 1525 mm

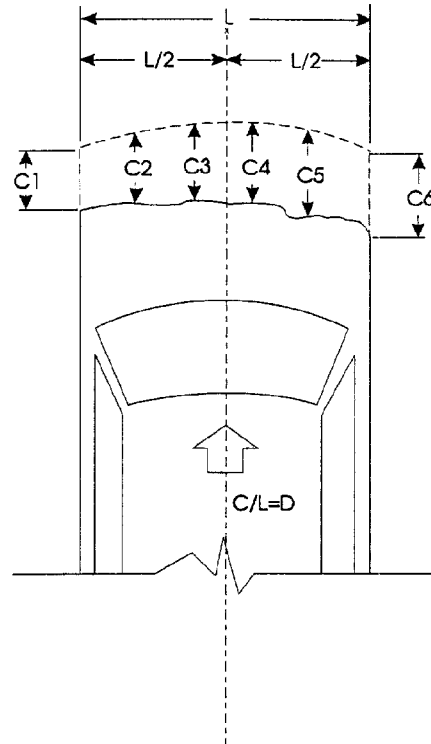
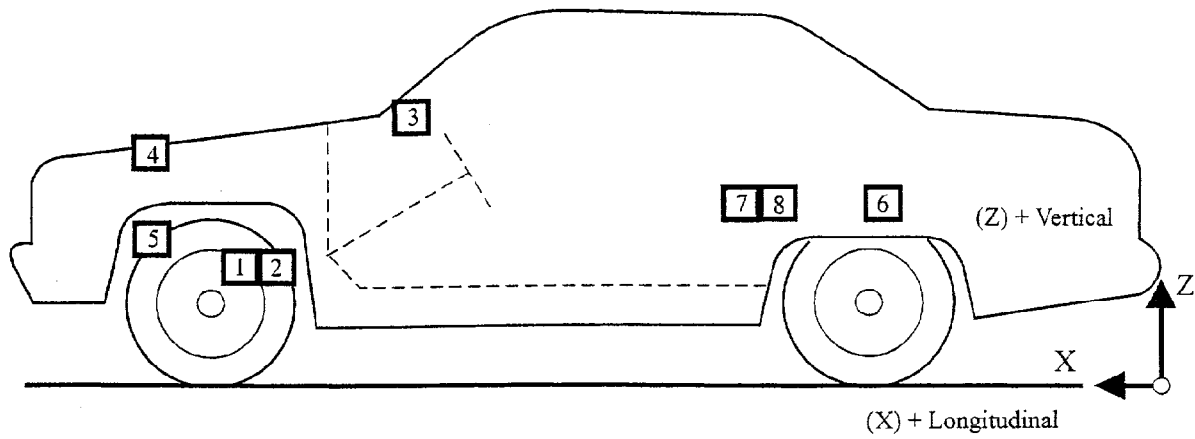
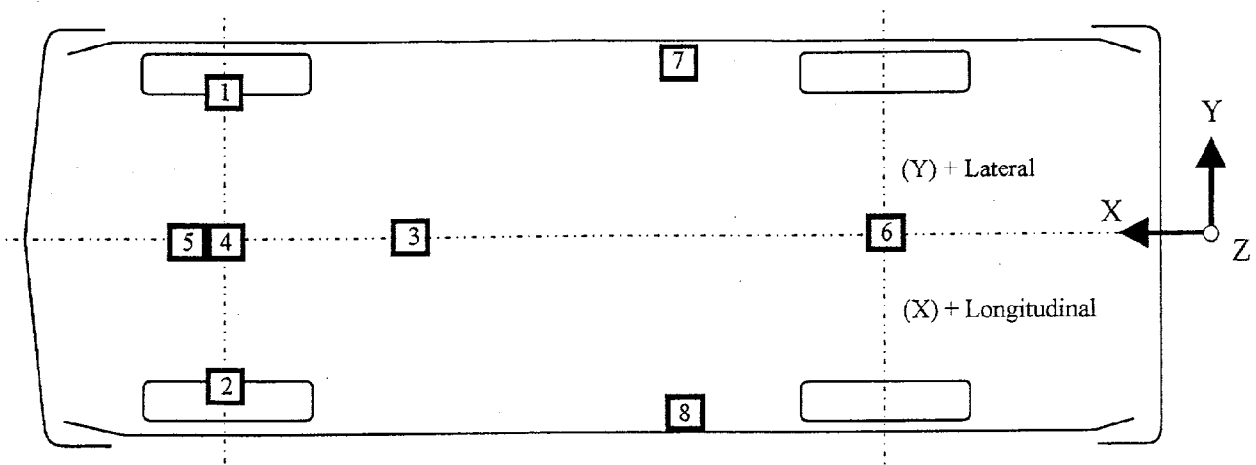


Figure 3 Vehicle Accelerometer Placement



Side View



Bottom View

Table 4 Vehicle Accelerometer Locations and Data Summary

TEST NUMBER: 990830-3						POSITIVE	Negative
No. LOCATION	X	Y	Z	DIRECTION			DIRECTION
1 LEFT BRAKE CALIPER	PRE 3534 mm	625 mm	291 mm				
	POST 3510 mm	601 mm	316 mm				
LONGITUDINAL				26.4 g	@ 73.4 ms	68.7 g	@ 61.3 ms
2 RIGHT BRAKE CALIPER	PRE 3534 mm	625 mm	288 mm				
	POST 3682 mm	741 mm	305 mm				
LONGITUDINAL				7.5 g	@ 176.4 ms	54.6 g	@ 94.2 ms
3 INSTRUMENT PANEL	PRE 3050 mm	0 mm	837 mm				
CENTER	POST 2992 mm	21 mm	790 mm				
LONGITUDINAL				40.2 g	@ 42.8 ms	37.5 g	@ 33.4 ms
LATERAL				10.0 g	@ 34.3 ms	14.8 g	@ 30.7 ms
4 ENGINE TOP	PRE 3701 mm	170 mm	797 mm				
	POST 3626 mm	151 mm	778 mm				
LONGITUDINAL				6.0 g	@ 48.0 ms	26.9 g	@ 83.8 ms
5 ENGINE BOTTOM	PRE 365 mm	130 mm	163 mm				
	POST 3560 mm	111 mm	157 mm				
LONGITUDINAL				2.0 g	@ 201.4 ms	21.1 g	@ 26.6 ms

Table 4 Vehicle Accelerometer Locations and Data Summary, Cont'd.

TEST NUMBER: 990830-3						POSITIVE			NEGATIVE
No. LOCATION	X	Y	Z			DIRECTION			DIRECTION
6 REAR VEHICLE CENTERLINE LATERAL VERTICAL	PRE 290 mm	5 mm	478 mm						
	POST 290 mm	5 mm	500 mm						
				10.2 g	@	33.4 ms	3.8 g	@	240.6 ms
				12.5 g	@	26.8 ms	12.0 g	@	95.2 ms
7 LEFT REAR SEAT LONGITUDINAL LATERAL	PRE 1732 mm	450 mm	262 mm						
	POST 1732 mm	450 mm	215 mm						
				2.1 g	@	23.4 ms	24.5 g	@	92.4 ms
				8.3 g	@	94.4 ms	1.9 g	@	236.9 ms
8 RIGHT REAR SEAT LONGITUDINAL LATERAL	PRE 1732 mm	450 mm	255 mm						
	POST 1732 mm	450 mm	264 mm						
				3.5 g	@	24.1 ms	18.9 g	@	103.9 ms
				6.4 g	@	91.4 ms	4.0 g	@	151.9 ms

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

Section 3.0

FMVSS 208 Data

Table 5 Dummy Injury Criteria

	<u>Maximum Acceleration</u>						
	Head				Chest		
	X	Y	Z	R	X	Y	Z
Driver	-31.3 g	9.3 g	43.7 g	45.9 g	-33.8 g	12.0 g	-13.4 g
Passenger	-24.6 g	8.5 g	13.9 g	25.4 g	-24.2 g	6.0 g	12.3 g

	<u>Maximum Femur Compressive Force</u>	
	Left Femur	Right Femur
Driver	3612 N	999 N
Passenger	3701 N	3171 N

	<u>15-millisecond Head Injury Criteria¹</u>		
	HIC	Time t ₁	Time t ₂
Driver	99	86.6 ms	101.7 ms
Passenger	45	104.8 ms	119.8 ms

	<u>36-millisecond Head Injury Criteria¹</u>		
	HIC	Time t ₁	Time t ₂
Driver	210	65.4 ms	101.4 ms
Passenger	83	95.3 ms	131.3 ms

	<u>Chest Maximum Resultant Acceleration²</u>		
	Acceleration	Time t ₁	Time t ₂
Driver	33.6 g	96.0 ms	99.0 ms
Passenger	24.0 g	91.8 ms	94.9 ms

	<u>Maximum Chest Deflection</u>
Driver	55.1 mm
Passenger	5.7 mm

¹ As defined in FMVSS No. 208

² Defined as equal to or exceeding 0.003 sec. duration

Dummy Kinematic Summary

Driver Dummy

Upon impact, the driver dummy translated forward on the seat impacting both knees into the instrument panel. The dummy's head and chest impacted the airbag. The driver dummy shifted to the left as the dummy's torso twisted to the right, and the dummy's left shoulder contacted the driver's side inside door panel. The top of the dummy's head extended out the window, and the left side of the dummy's head grazed the windowsill. The driver dummy rebounded back toward the center of the car. The back of the dummy's head hit the outside corner of the driver's seat headrest as the dummy came to rest in the driver's seat. The driver dummy came to rest seated in the driver's seat, leaning from the waist to the left.

Right Front Passenger Dummy

Upon impact, the right front passenger dummy translated forward impacting both knees into the instrument panel. The dummy's head and chest impacted the airbag, and the dummy's torso shifted to the left as the dummy's head faced to the right. The left side of the dummy's head contacted the instrument panel. The passenger dummy rebounded rearward into the passenger seat. The dummy came to rest seated upright in the passenger's seat. The dummy's head was bent slightly forward, and the dummy's torso was angled slightly to the right.

Section 4.0

Vehicle, Occupant, Barrier, and Camera Measurements

Figure 4 Pre-test and Post-test Measurement Points

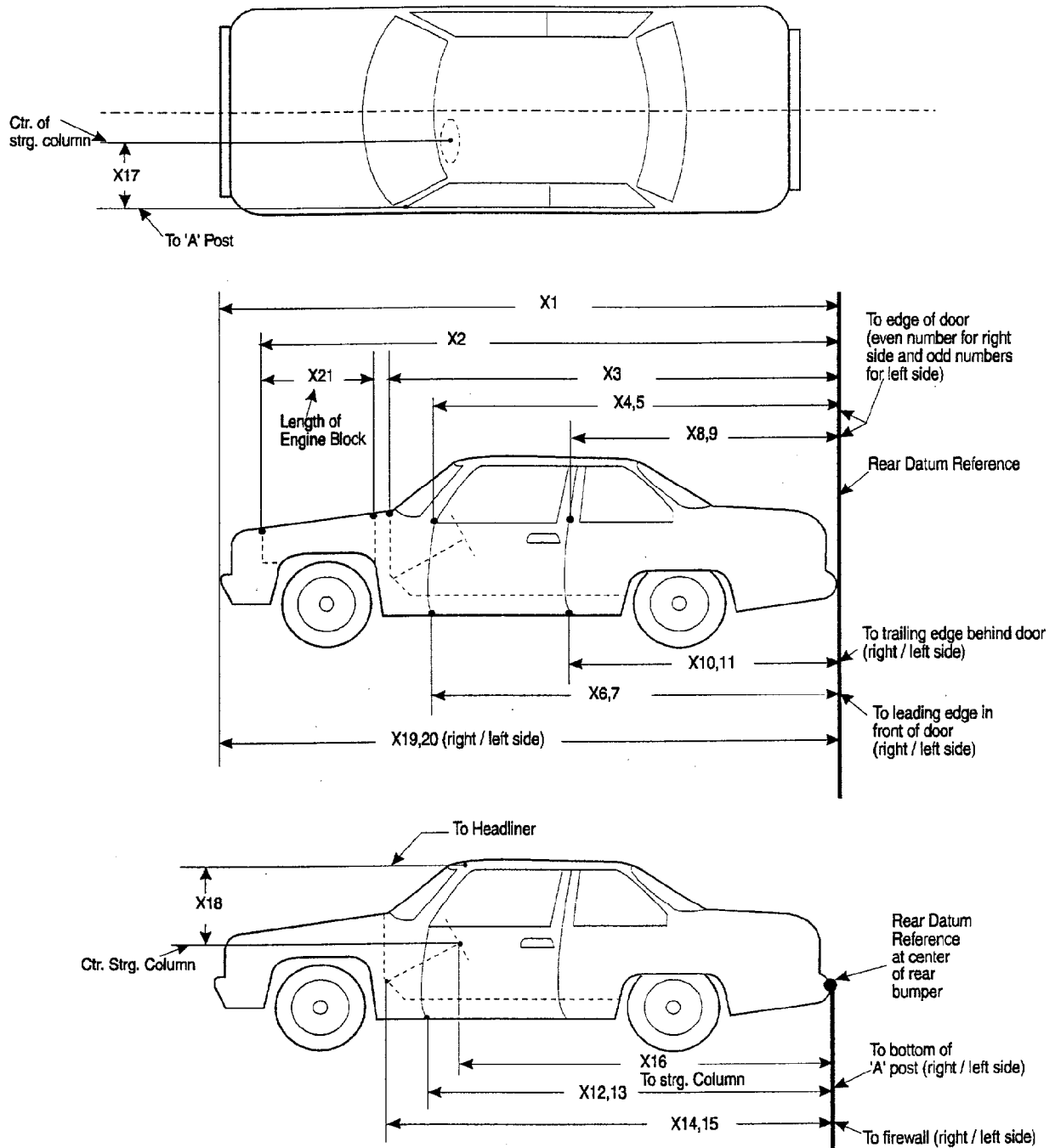


Table 6 Impacted Vehicle Measurements

Vehicle year/make/model/body style: 1999/Saturn/SL1/Sedan

Test Number: 990830-3

No.	Type of measurement	Pre-Test	Post-Test	Difference
X1	Total Length of Veh. at Centerline	4557	4232	325
X2	Rear Surface of Veh. to Front of Engine Block	3819	3759	60
X3	Rear Surface of Veh. to Firewall	3478	3432	46
X4	Rear Surface of Veh. to Upper Leading Edge of Right Door	3036	3030	6
X5	Rear Surface of Veh. to Upper Leading Edge of Left Door	3039	3015	24
X6	Rear Surface of Veh. to Lower Leading Edge of Right Door	3019	3011	8
X7	Rear Surface of Veh. to Lower Leading Edge of Left Door	3021	3006	15
X8	Rear Surface of Veh. to Upper Trailing Edge of Right Door	2078	2071	7
X9	Rear Surface of Veh. to Upper Trailing Edge of Left Door	2075	2064	11
X10	Rear Surface of Veh. to Lower Trailing Edge of Right Door	2093	2086	7
X11	Rear Surface of Veh. to Lower Trailing Edge of Left Door	2096	2077	19
X12	Rear Surface of Veh. to Bottom of " A " Post on Right Side	3019	3010	9
X13	Rear Surface of Veh. to Bottom of " A " Post on Left Side	3021	2932	89
X14	Rear Surface of Veh. to Firewall--Right Side	3393	3396	-3
X15	Rear Surface of Vehicle to Firewall --Left Side	3393	3235	158
X16	Rear Surface of Veh. to Steering Wheel Center	2625	2562	63
X17	Center of Steering Column to " A " Post	310	306	4
X18	Center of Steering Column to Headliner	425	444	-19
X19	Rear Surface of Veh. to Right Side of Front Bumper	4339	4471	-132
X20	Rear Surface of Veh. to Left Side of Front Bumper	4341	3754	587
X21	Length of Engine Block	415	415	0

Figure 5 Vehicle Target Locations

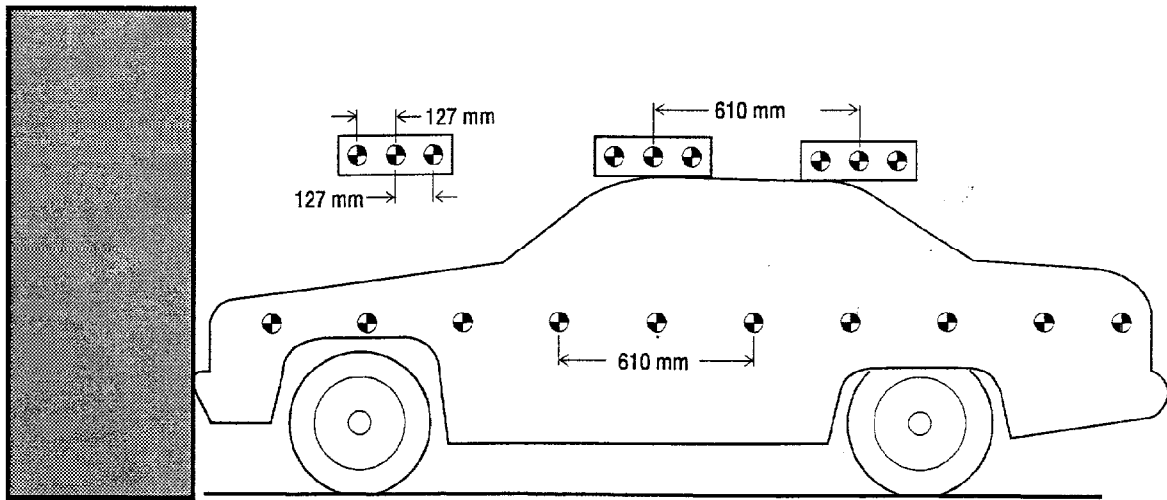


Figure 6 Dummy Measurement Locations for Front Seat Occupants

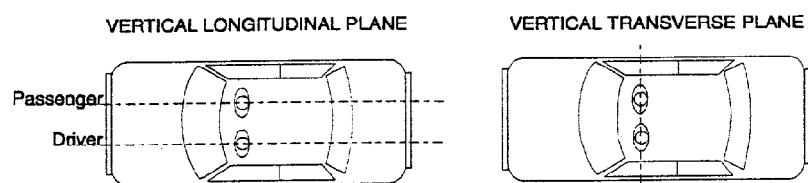
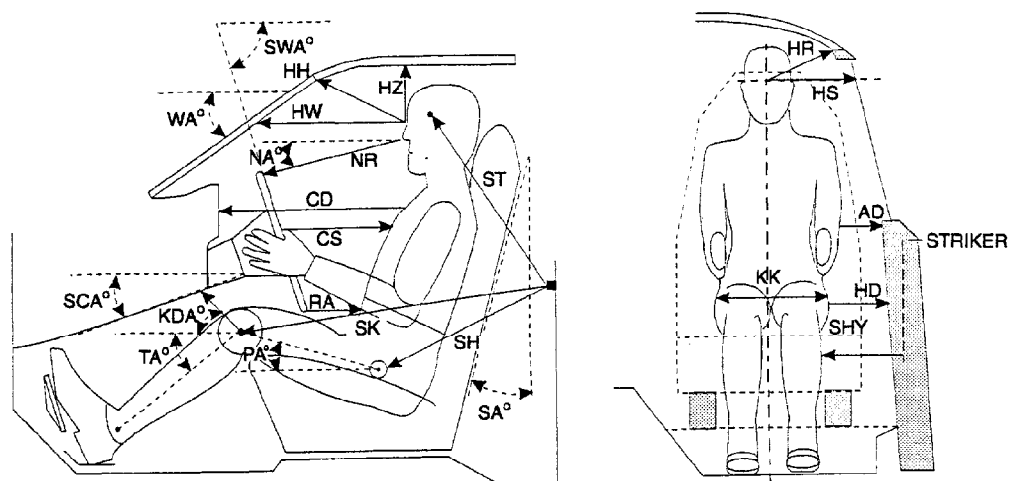


Table 7 Dummy Measurement Data For Front Seat Occupants

Designation	Type of Measurement	Driver (Serial #289)	Passenger (Serial #369)
WA	Windshield angle	25.7°	25.7°
SWA	Steering wheel angle	70.7°	N/A
SCA	Steering column angle	19.3°	N/A
SA	Seat back angle	17.1°	19.3°
HZ	Head to roof	196 mm	224 mm
HH	Head to header	262 mm	292 mm
HW	Head to windshield	550 mm	596 mm
HR	Head to side header	225 mm	245 mm
NR	Nose to rim	259 mm	N/A
NA	Nose to rim angle	9.3°	N/A
CD	Chest to dash	424 mm	403 mm
CS	Steering wheel to chest	234 mm	N/A
RA	Rim to abdomen	120 mm	N/A
KDL	Left knee to dash	151 mm	126 mm
KDR	Right knee to dash	148 mm	132 mm
KDA	Outboard knee to dash angle	31.4°	25.5°
PA	Pelvic angle	20.1°	22.3°
TA	Tibial angle	37.8°	53.6°
KK	Knee to knee	221 mm	223 mm
ST ¹	Striker to head	459 mm	439 mm
	Striker to head angle	-66.8°	-64.0°
SK	Striker to knee	617 mm	594 mm
	Striker to knee angle	-6.1°	4.1°
SH	Striker to H-point	329 mm	298 mm
	Striker to H-point angle	25.5°	32.0°
SHY	Striker to H-point (Y-direction)	232 mm	238 mm
HS	Head to side window	335 mm	368 mm
HD	H-point to door	150 mm	152 mm
AD	Arm to door	145 mm	165 mm

The seat back angle (SA°) is measured relative to vertical, all other angles are measured relative to horizontal.

¹ A negative angle indicates the measurement point was above the striker.

Figure 7 Camera Positions

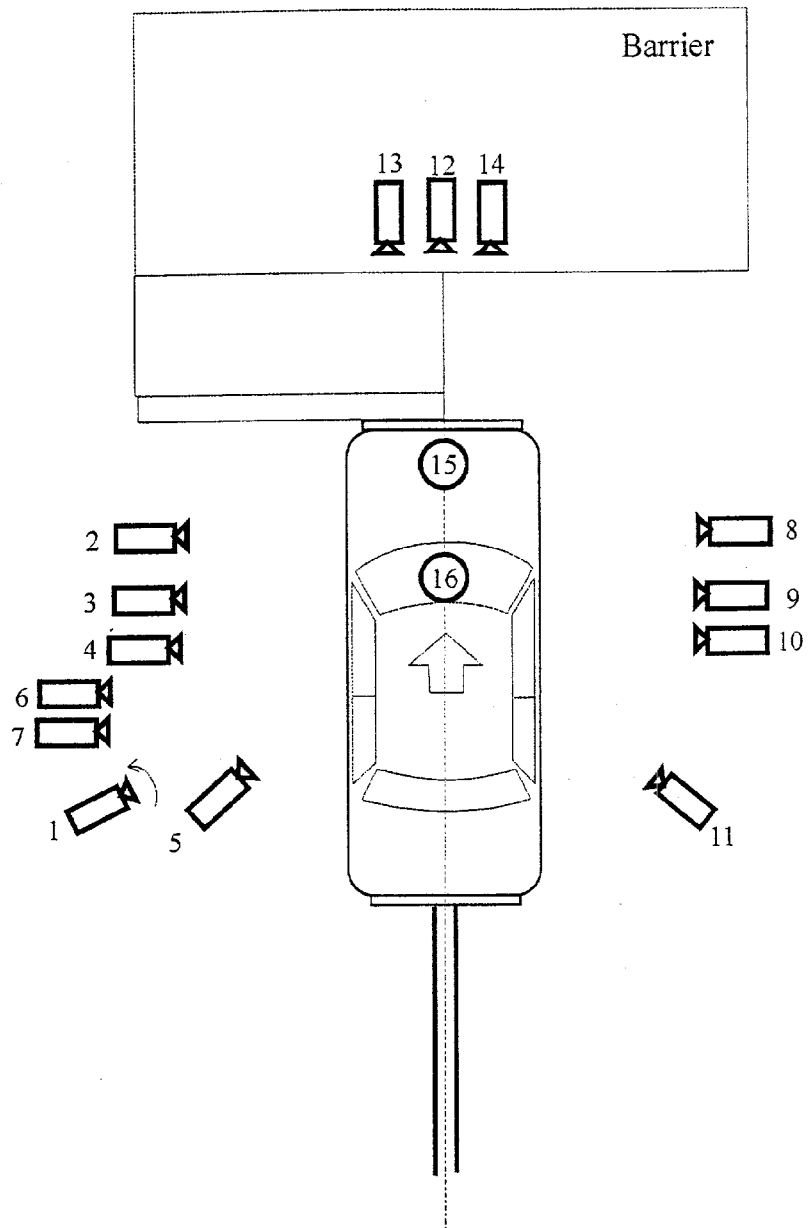


Table 8 Motion Picture Camera Locations

Vehicle year/make/model/body style: 1999/Saturn/SL1/Sedan

Test number: 990830-3

Camera Number	View	Camera Positions ¹			Camera Angle ²	Film Plane to Head Target	Camera Lens	Film Speed
		X	Y	Z				
1	Real-time panning	N/A	N/A	N/A	N/A	N/A	16 mm	24 frames/s
2	Left vehicle crush	6200 mm	765 mm	830 mm	0°	N/A	25 mm	997 frames/s
3	Left windshield intrusion	7250 mm	995 mm	1220 mm	0°	7010 mm	50 mm	985 frames/s
4	Driver kinematics	7250 mm	1580 mm	1470 mm	-3.6°	6950 mm	25 mm	1007 frames/s
5	Driver kinematics angled	2175 mm	3350 mm	1950 mm	-22°	2000 mm	25 mm	1072 frames/s
6	Steering column upper	7440 mm	2690 mm	2580 mm	-14.1°	7040 mm	25 mm	997 frames/s
7	Steering column lower	7440 mm	2690 mm	1624 mm	-6.3°	6930 mm	25 mm	997 frames/s
8	Right wide	8400 mm	-2435 mm	939 mm	0°	7040 mm	13 mm	1005 frames/s
9	Right windshield intrusion	7400 mm	-1080 mm	1210 mm	0°	7150 mm	50 mm	987 frames/s
10	Passenger kinematics	1800 mm	-3540 mm	1470 mm	-5.3°	6950 mm	25 mm	1012 frames/s
11	Passenger kinematics angled	7300 mm	-540 mm	1975 mm	-22.4°	2160 mm	25 mm	1005 frames/s
12	Windshield front view	0 mm	390 mm	2300 mm	-36.4°	3950 mm	8.5 mm	985 frames/s
13	Driver - front view	-380 mm	390 mm	2300 mm	-30°	3950 mm	25 mm	955 frames/s
14	Passenger - front view	-345 mm	390 mm	2300 mm	-31.3°	3950 mm	25 mm	1000 frames/s
15	Overhead - tight	0 mm	1960 mm	5700 mm	90°	N/A	25 mm	1007 frames/s
16	Overhead - wide	0 mm	2290 mm	5700 mm	90°	N/A	13 mm	1000 frames/s
	Real-time documentation	N/A	N/A	N/A	N/A	N/A	12-120 mm	24 frames/s

¹ +X: Film plane forward of barrier face

+Y: Film plane to left of monorail centerline

+Z: Film plane above ground level

² +Angle: Film plane angled upward from horizontal plane

Figure 8 Deformable Barrier Face Profile 1-11

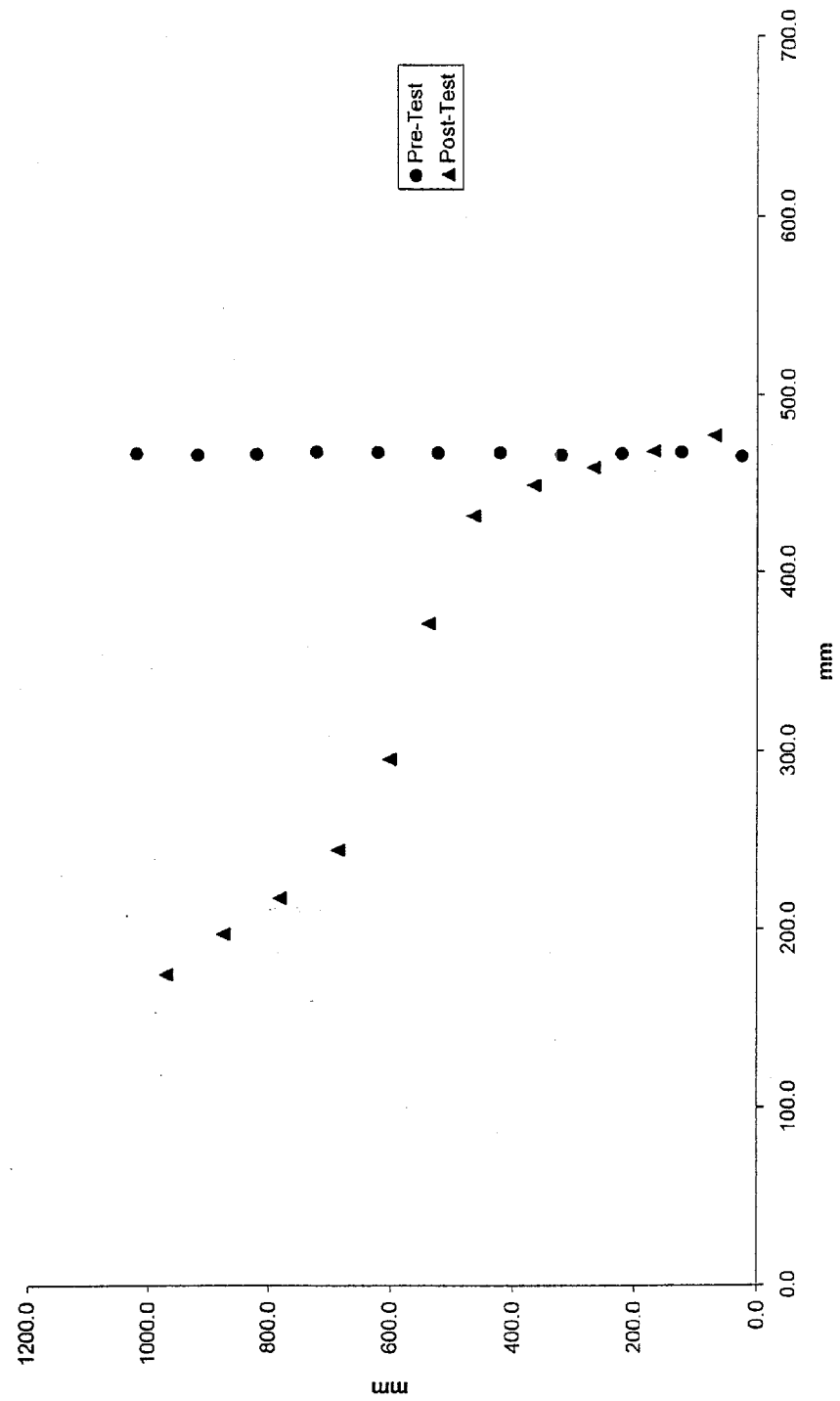


Figure 8 Deformable Barrier Face Profile 12-22

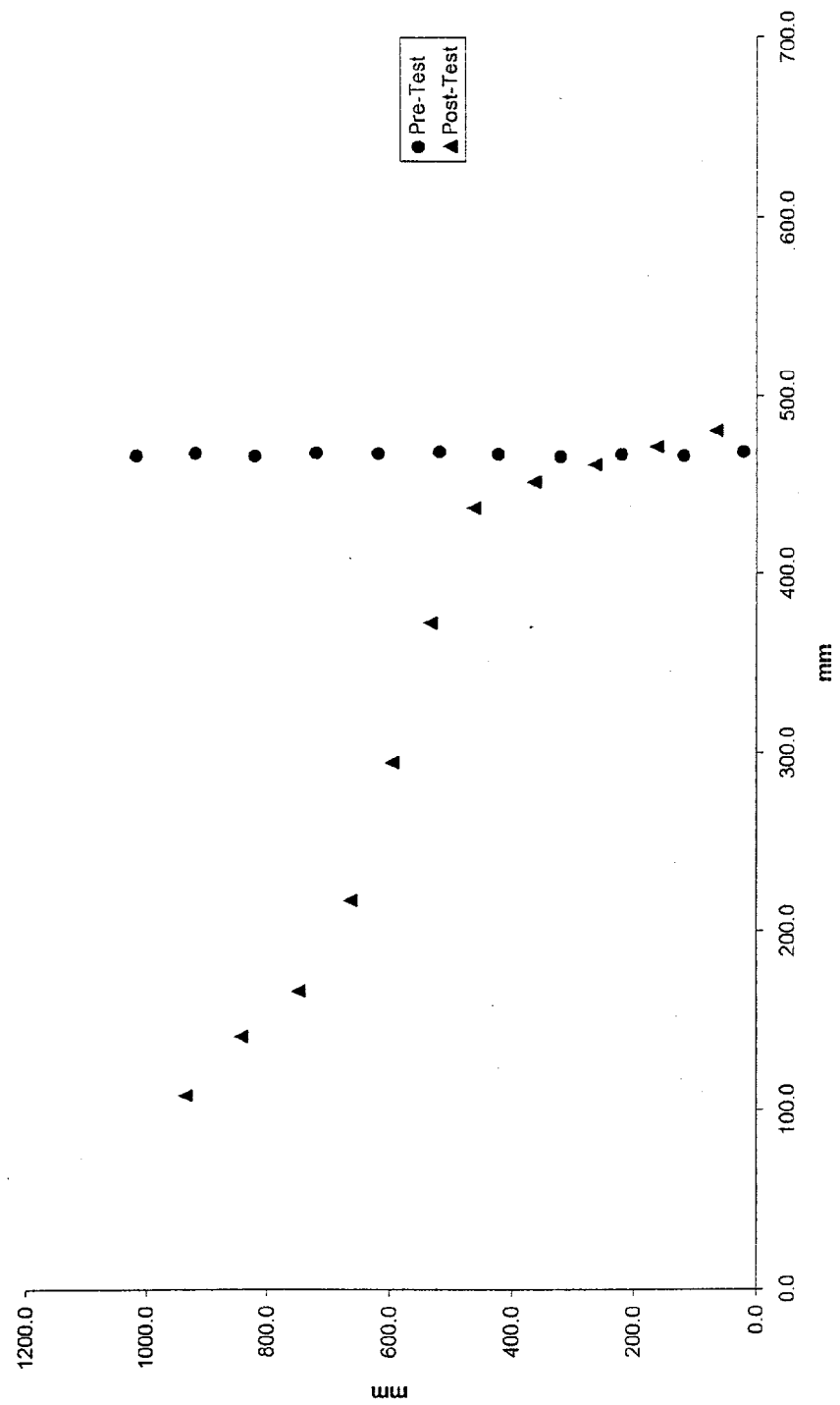


Figure 8 Deformable Barrier Face Profile 23-33

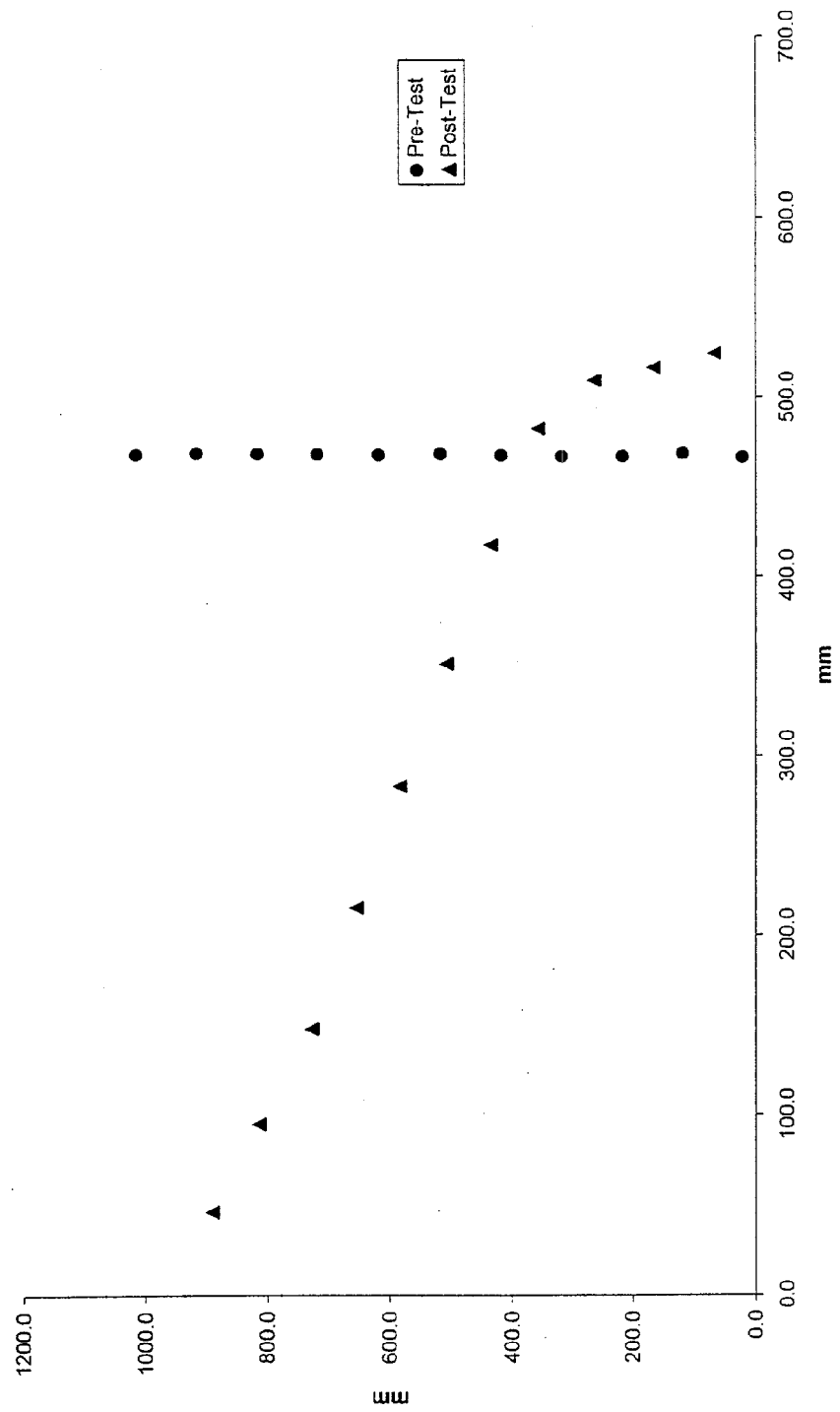


Figure 8 Deformable Barrier Face Profile 34-44

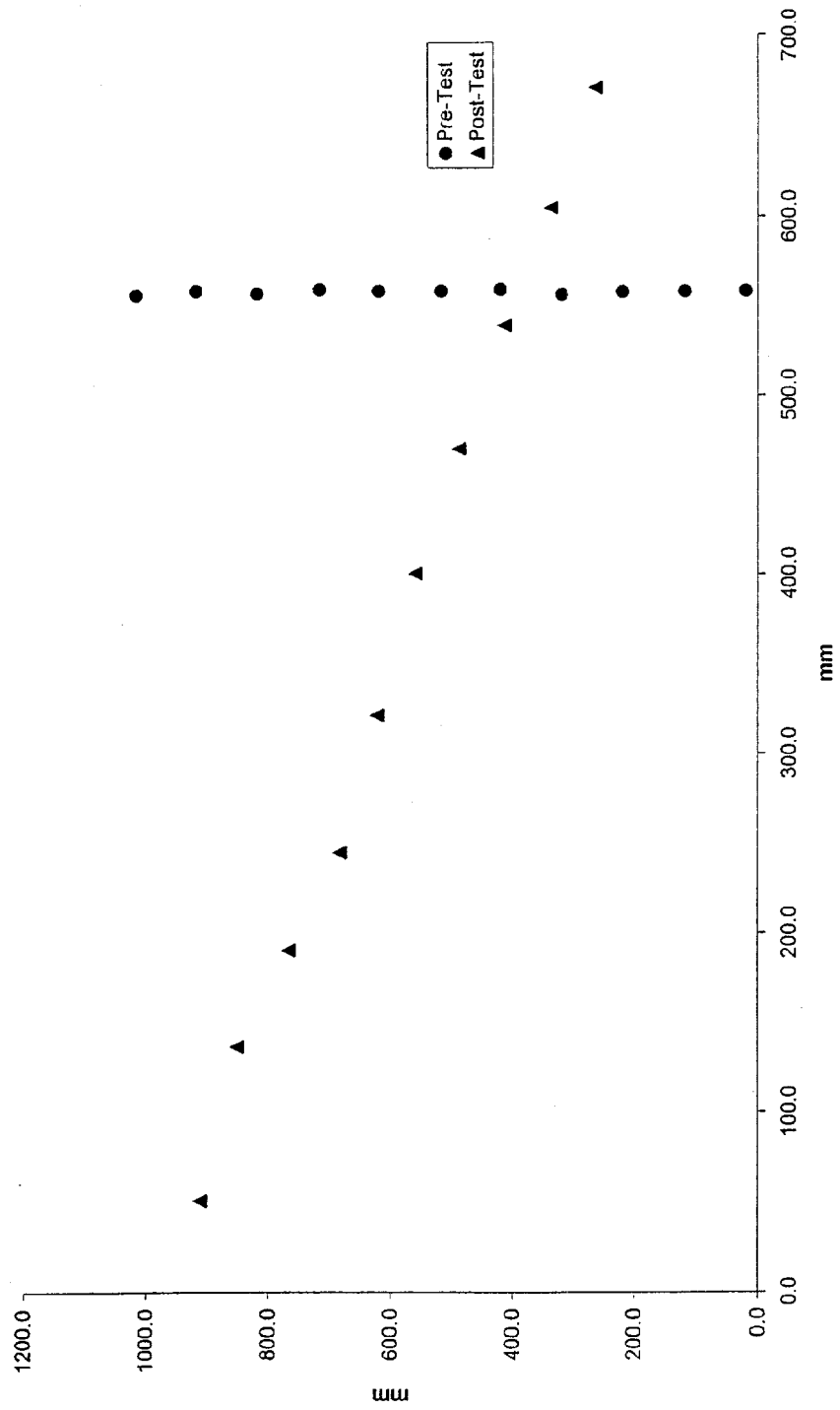


Figure 8 Deformable Barrier Face Profile 45-55

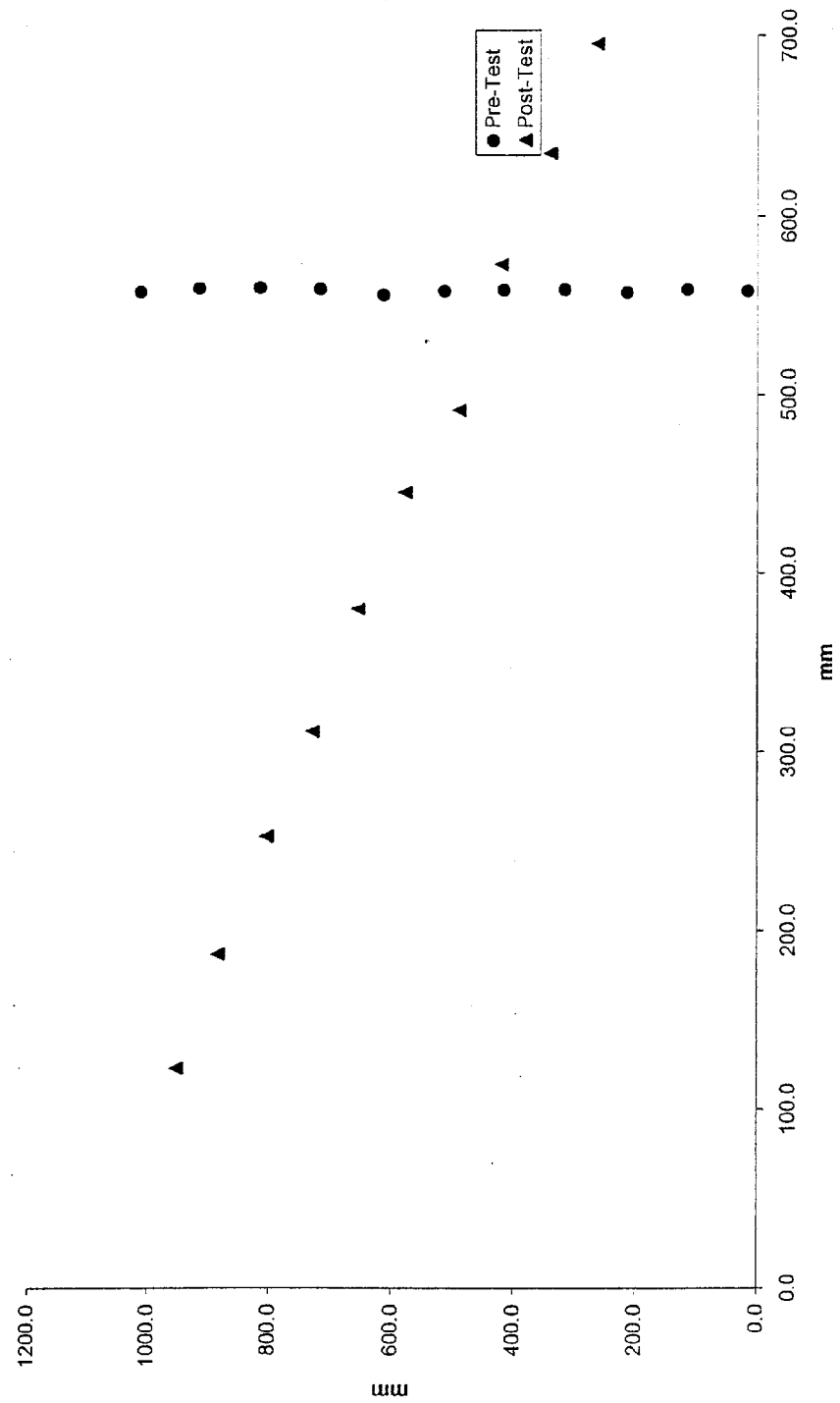


Figure 8 Deformable Barrier Face Profile 56-66

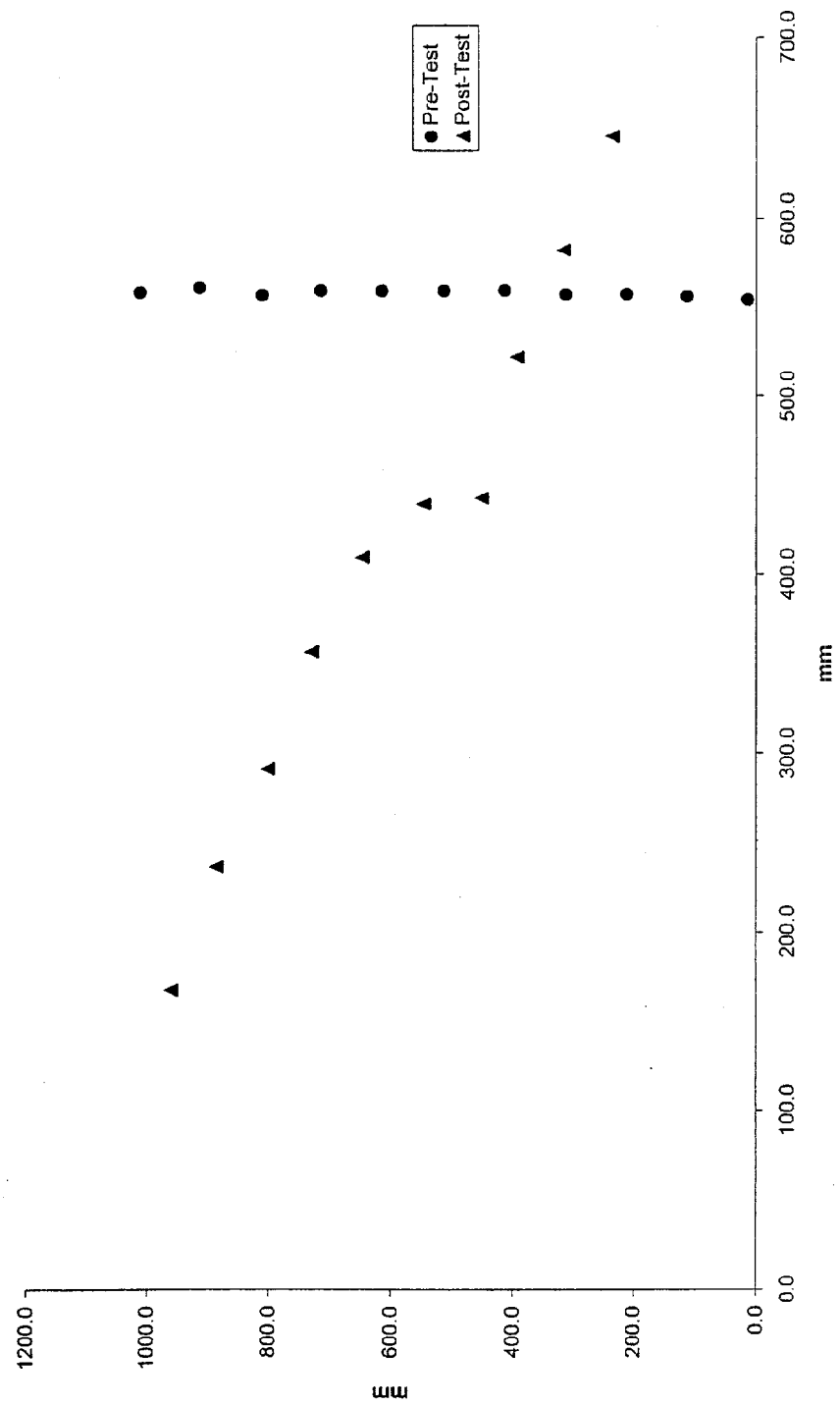


Table 9 Deformable Barrier Face Profile

Pre-Test				Post-Test				Difference			
Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm
1	465.7	25.4	661.2	1	476.9	72.1	671.6	1	-11.3	-46.8	-10.5
2	467.6	125.3	660.0	2	467.9	170.7	669.4	2	-0.3	-45.4	-9.4
3	466.8	223.5	656.9	3	458.7	269.5	664.3	3	8.1	-46.0	-7.4
4	466.2	322.8	656.3	4	448.3	368.2	660.8	4	17.9	-45.4	-4.5
5	467.3	423.4	656.2	5	431.2	466.2	658.6	5	36.1	-42.8	-2.4
6	467.4	524.1	651.6	6	370.9	539.9	653.4	6	96.5	-15.8	-1.8
7	467.6	623.3	651.8	7	294.9	603.7	653.1	7	172.7	19.7	-1.4
8	467.6	723.7	653.0	8	243.5	688.5	649.1	8	224.1	35.2	4.0
9	466.3	823.2	649.9	9	216.7	784.5	627.1	9	249.6	38.8	22.8
10	466.2	921.6	648.9	10	197.0	877.4	605.4	10	269.2	44.3	43.5
11	467.2	1022.4	645.7	11	174.0	971.6	583.4	11	293.3	50.8	62.4
12	468.8	21.9	549.4	12	480.4	66.9	560.2	12	-11.6	-45.1	-10.8
13	466.7	120.5	547.8	13	471.4	165.0	556.9	13	-4.7	-44.5	-9.1
14	467.3	222.5	545.3	14	461.1	266.5	552.8	14	6.1	-44.0	-7.5
15	466.0	323.1	547.1	15	451.3	366.0	550.6	15	14.7	-42.9	-3.6
16	467.5	424.6	541.9	16	436.7	464.7	544.7	16	30.9	-40.1	-2.8
17	468.8	521.7	540.1	17	371.9	536.2	542.2	17	96.9	-14.5	-2.0
18	467.9	621.7	538.6	18	294.4	597.8	541.9	18	173.6	23.9	-3.3
19	468.0	722.5	535.8	19	217.2	665.7	540.0	19	250.9	56.8	-4.3
20	466.3	822.8	539.4	20	166.0	749.6	534.8	20	300.3	73.2	4.6
21	468.1	921.1	534.4	21	140.6	844.0	515.8	21	327.5	77.1	18.6
22	466.8	1019.4	532.3	22	108.0	935.7	502.5	22	358.8	83.7	29.8

Table 9 Deformable Barrier Face Profile Cont'd.

Pre-Test				Post-Test				Difference			
Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm
23	466.9	22.1	438.6	23	524.5	68.0	464.7	23	-57.6	-45.9	-26.2
24	469.2	120.2	437.3	24	516.5	167.4	464.1	24	-47.4	-47.3	-26.8
25	467.5	218.8	435.1	25	509.1	265.4	461.2	25	-41.6	-46.6	-26.2
26	467.3	319.3	434.2	26	482.7	358.1	441.4	26	-15.4	-38.8	-7.3
27	468.1	419.8	431.5	27	417.3	436.3	440.7	27	50.9	-16.5	-9.2
28	469.2	519.6	428.1	28	350.8	508.2	440.7	28	118.4	11.4	-12.6
29	468.3	620.2	428.2	29	283.1	584.3	430.0	29	185.2	35.9	-1.9
30	468.5	720.5	426.3	30	215.5	655.6	430.7	30	253.0	64.9	-4.4
31	468.8	818.2	421.6	31	148.1	728.9	424.2	31	320.8	89.3	-2.6
32	469.4	918.5	421.0	32	94.6	814.8	419.5	32	374.8	103.7	1.5
33	468.8	1018.4	420.5	33	46.6	891.5	418.9	33	422.2	126.9	1.6
34	558.4	20.0	329.3	34	737.1	190.1	428.3	34	-178.7	-170.2	-99.0
35	557.9	119.7	327.7	35	670.9	264.7	420.5	35	-113.0	-145.0	-92.8
36	557.4	220.9	329.0	36	604.1	338.3	415.9	36	-46.7	-117.4	-86.9
37	555.8	320.2	324.1	37	538.6	414.3	405.7	37	17.2	-94.1	-81.6
38	558.5	420.7	321.0	38	470.0	489.2	396.6	38	88.5	-68.5	-75.6
39	557.9	518.4	319.6	39	400.3	560.8	389.7	39	157.6	-42.4	-70.1
40	557.6	621.0	318.2	40	321.1	623.8	376.3	40	236.6	-2.8	-58.2
41	558.3	718.4	316.2	41	244.9	684.4	362.9	41	313.4	34.0	-46.7
42	556.3	820.4	315.1	42	190.5	768.6	361.0	42	365.8	51.8	-45.9
43	557.9	919.4	312.3	43	136.6	852.6	355.7	43	421.3	66.8	-43.4
44	555.9	1017.3	311.7	44	50.7	911.5	334.8	44	505.2	105.8	-23.1

Table 9 Deformable Barrier Face Profile Cont'd.

Pre-Test				Post-Test				Difference			
Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm	Index	Xmm	Ymm	Zmm
45	558.1	17.2	214.8	45	756.2	186.3	311.8	45	-198.1	-169.1	-97.0
46	558.6	116.8	212.3	46	695.0	264.3	308.1	46	-136.5	-147.5	-95.8
47	556.8	215.4	212.9	47	634.1	342.0	305.1	47	-77.3	-126.6	-92.2
48	558.3	317.6	210.0	48	571.9	421.5	303.1	48	-13.6	-104.0	-93.2
49	558.1	417.9	206.5	49	491.0	490.8	298.5	49	67.1	-72.9	-92.0
50	557.2	515.8	203.9	50	444.6	580.0	294.7	50	112.6	-64.2	-90.8
51	555.0	615.4	204.0	51	379.6	655.7	289.0	51	175.4	-40.3	-85.1
52	558.0	717.9	202.1	52	310.9	730.3	279.4	52	247.1	-12.4	-77.3
53	558.7	816.3	199.3	53	252.4	805.0	274.6	53	306.3	11.3	-75.4
54	558.6	916.4	196.2	54	186.7	885.0	267.4	54	372.0	31.4	-71.2
55	556.9	1013.2	197.7	55	123.0	952.7	262.6	55	433.9	60.5	-64.9
56	554.4	113.6	106.7	56	706.9	159.5	112.8	56	-152.5	-145.9	-6.1
57	555.9	113.6	104.6	57	644.9	237.6	117.8	57	-89.0	-124.0	-13.2
58	556.9	213.9	102.4	58	581.6	318.4	121.9	58	-24.7	-104.5	-19.5
59	556.6	314.5	101.3	59	521.6	394.9	126.6	59	35.0	-80.4	-25.4
60	558.8	416.0	95.8	60	442.6	453.7	133.8	60	116.3	-37.7	-38.0
61	558.5	516.0	96.2	61	439.2	548.7	131.7	61	119.4	-32.7	-35.5
62	558.4	616.6	94.2	62	409.4	648.5	132.7	62	149.1	-31.9	-38.5
63	558.2	716.5	92.7	63	356.2	731.0	141.7	63	202.1	-14.6	-49.0
64	555.8	812.7	90.5	64	290.7	803.2	150.4	64	265.2	9.4	-60.0
65	560.1	915.2	86.0	65	236.2	886.7	151.9	65	324.0	28.4	-65.9
66	557.9	1014.0	86.5	66	167.5	961.6	151.2	66	390.4	52.5	-64.7

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

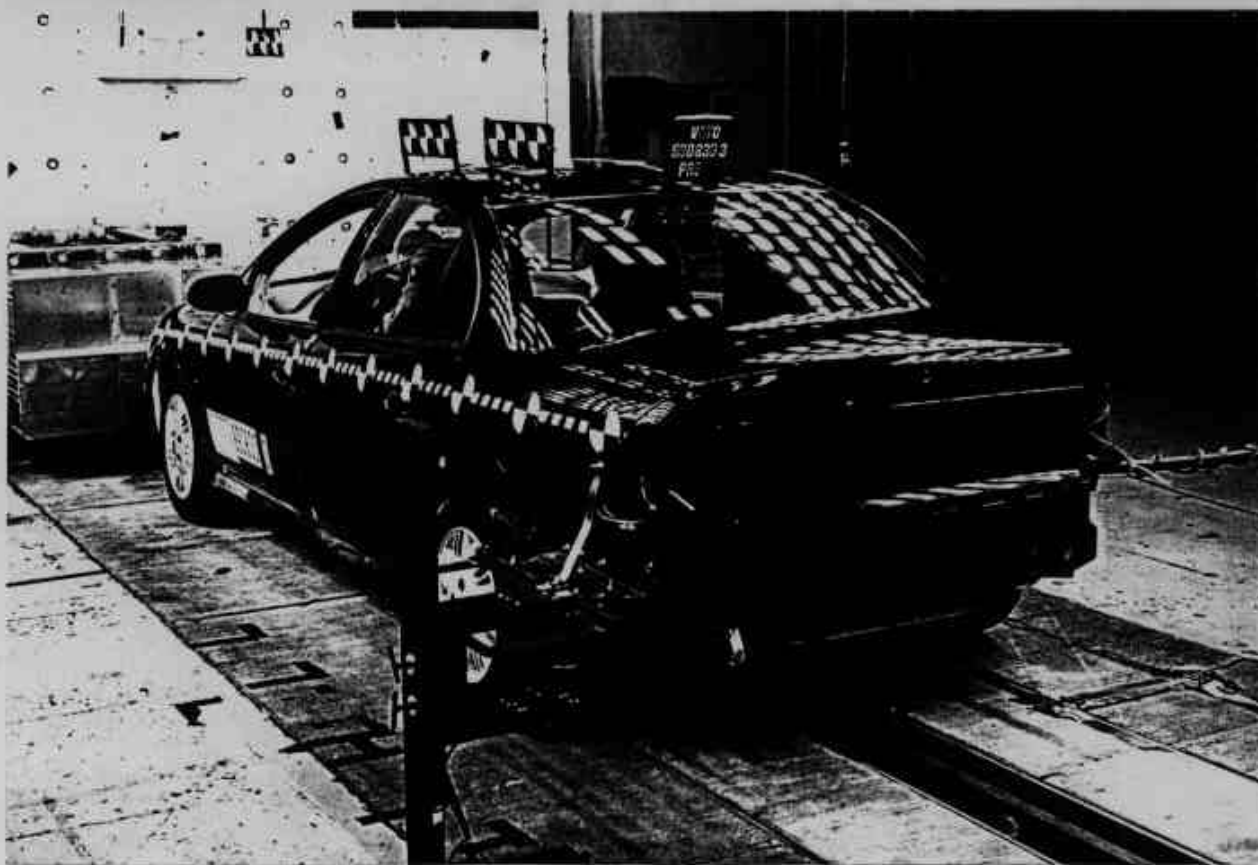


Figure A-5 Pre-Test Left Rear Three-Quarter View



Figure A-6 Post-Test Left Rear Three-Quarter View



Figure A-7 Pre-Test Rear View



Figure A-8 Post-Test Rear View



Figure A-9 Pre-Test Right Side View



Figure A-10 Post-Test Right Side View



Figure A-11 Pre-Test Right Front Three-Quarter View



Figure A-12 Post-Test Right Front Three-Quarter View

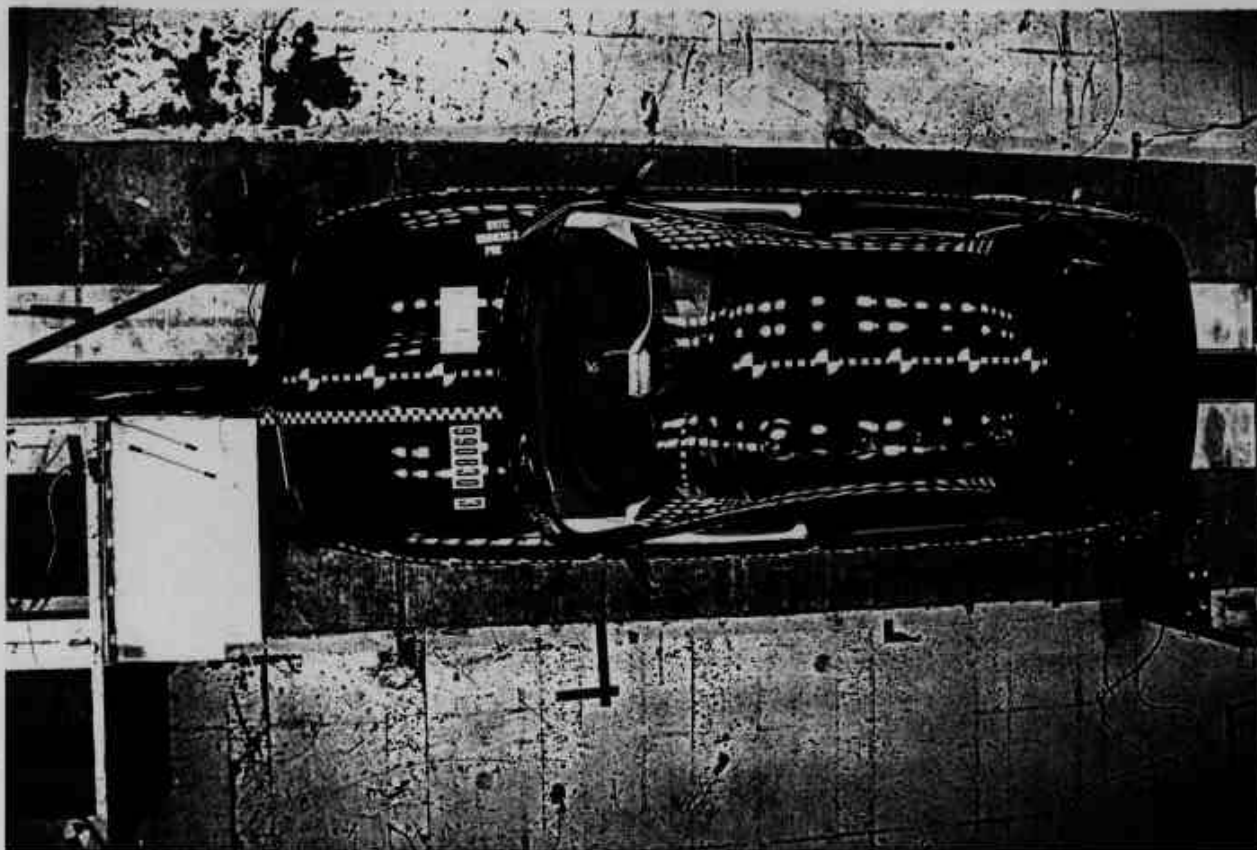


Figure A-13 Pre-Test Overhead View

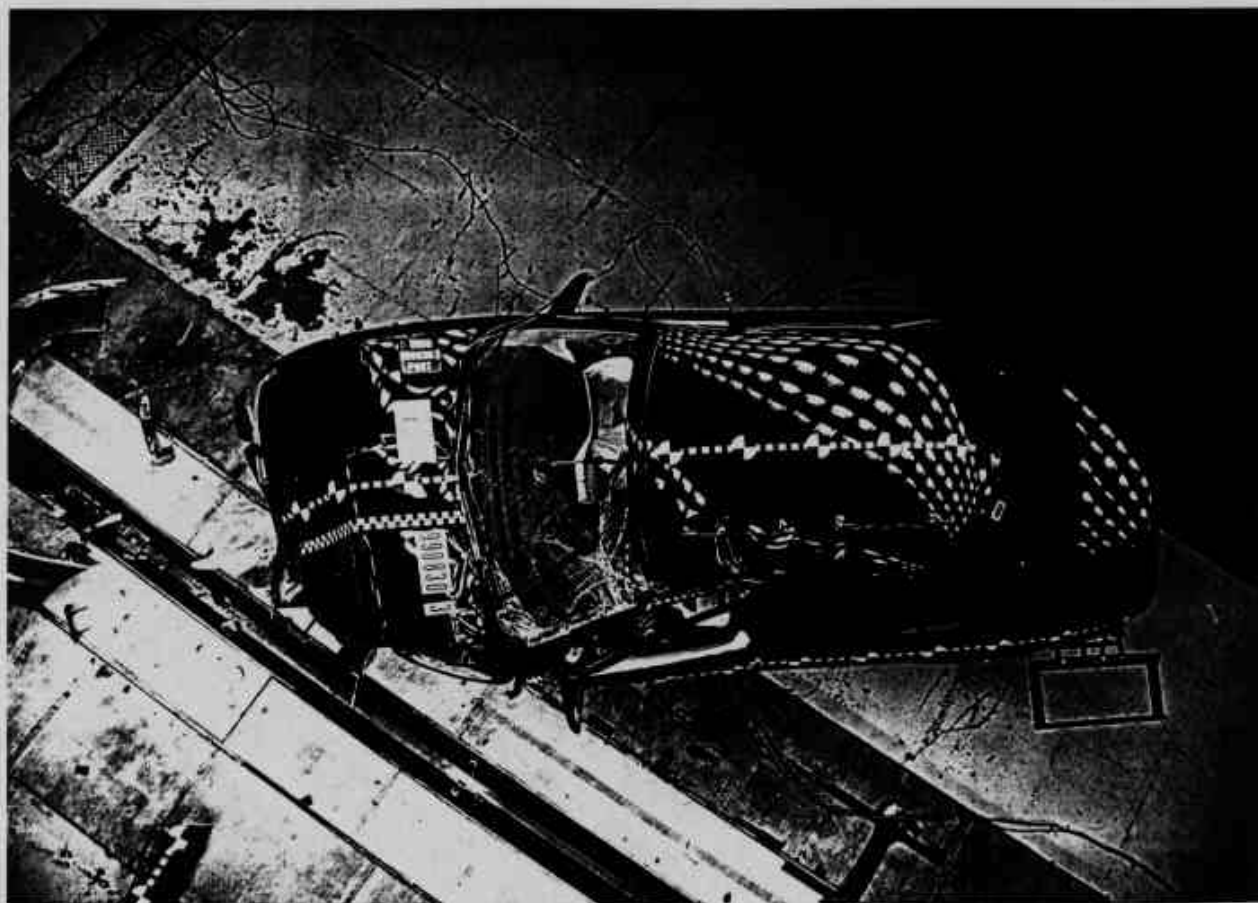


Figure A-14 Post-Test Overhead View

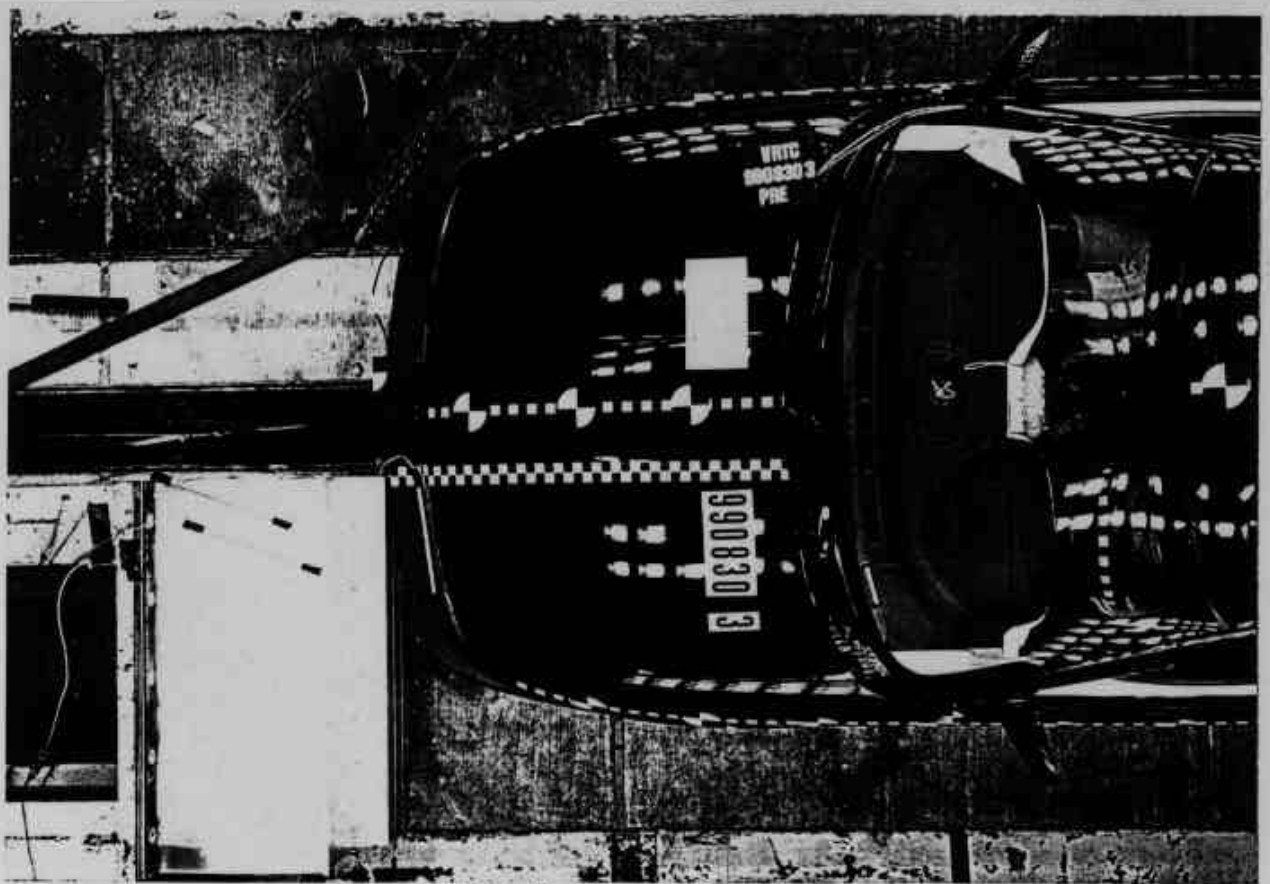


Figure A-15 Pre-Test Overhead Close-Up View



Figure A-16 Post-Test Overhead Close-Up View

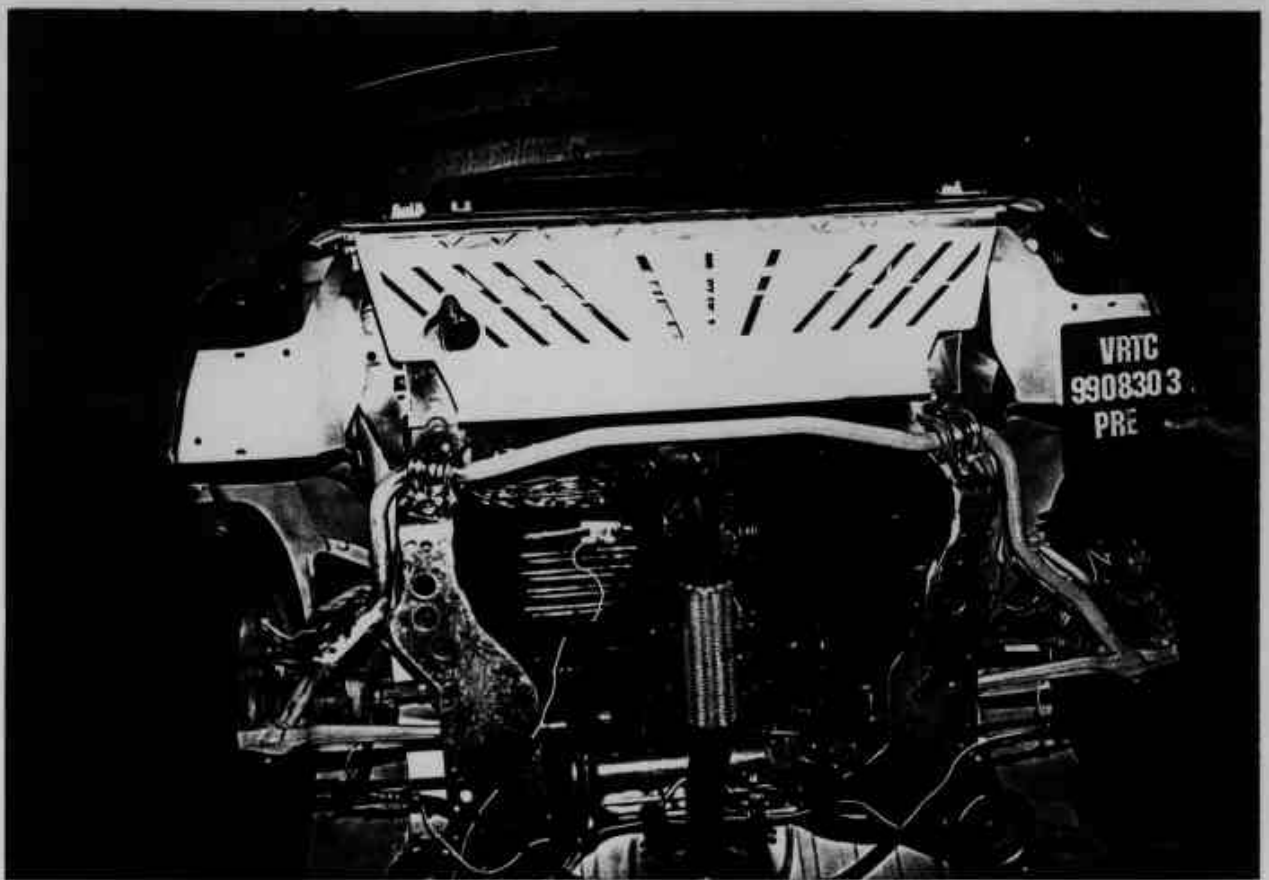


Figure A-17 Pre-Test Front Underbody View



Figure A-18 Post-Test Front Underbody View

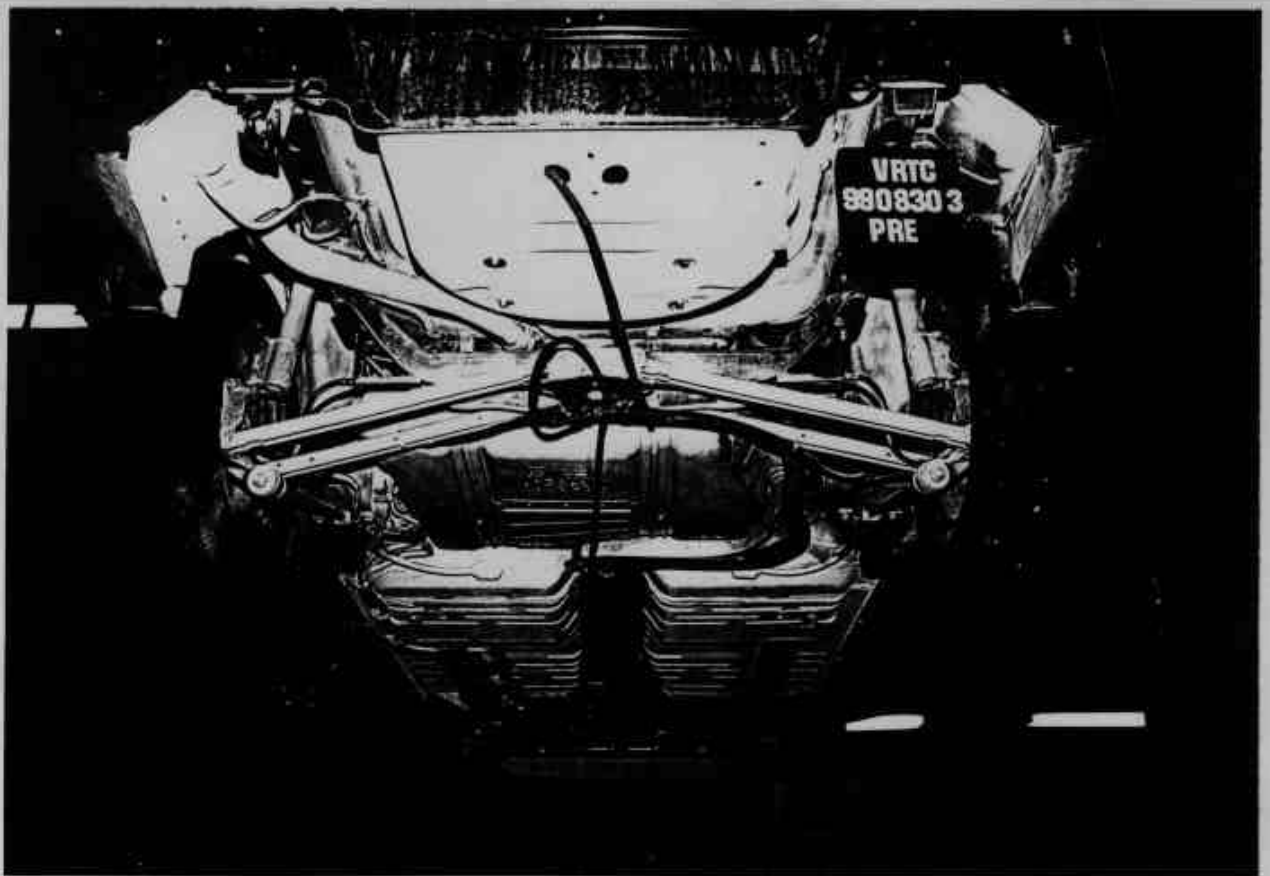


Figure A-19 Pre-Test Rear Underbody View

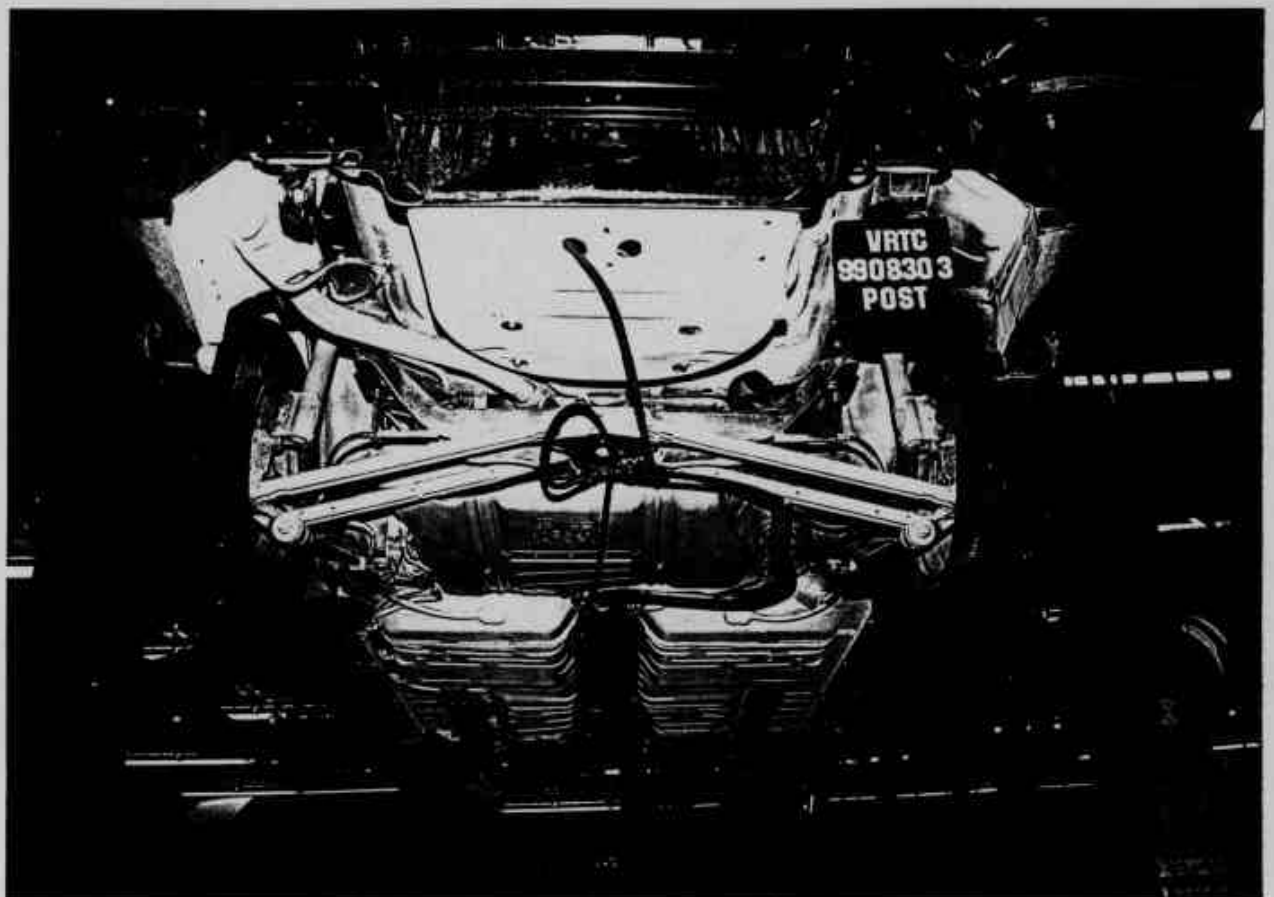


Figure A-20 Post-Test Rear Underbody View

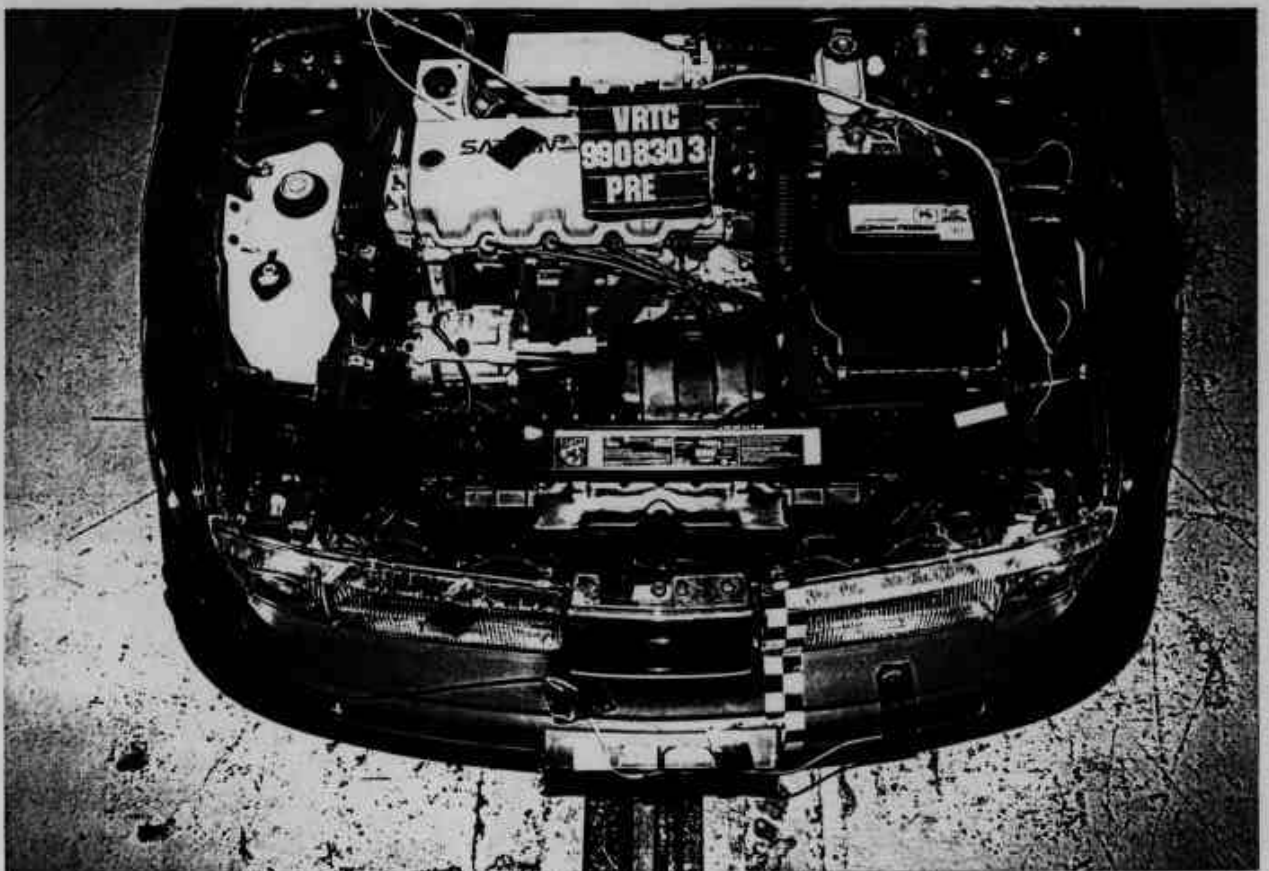


Figure A-21 Pre-Test Engine Compartment View



Figure A-22 Post-Test Engine Compartment View

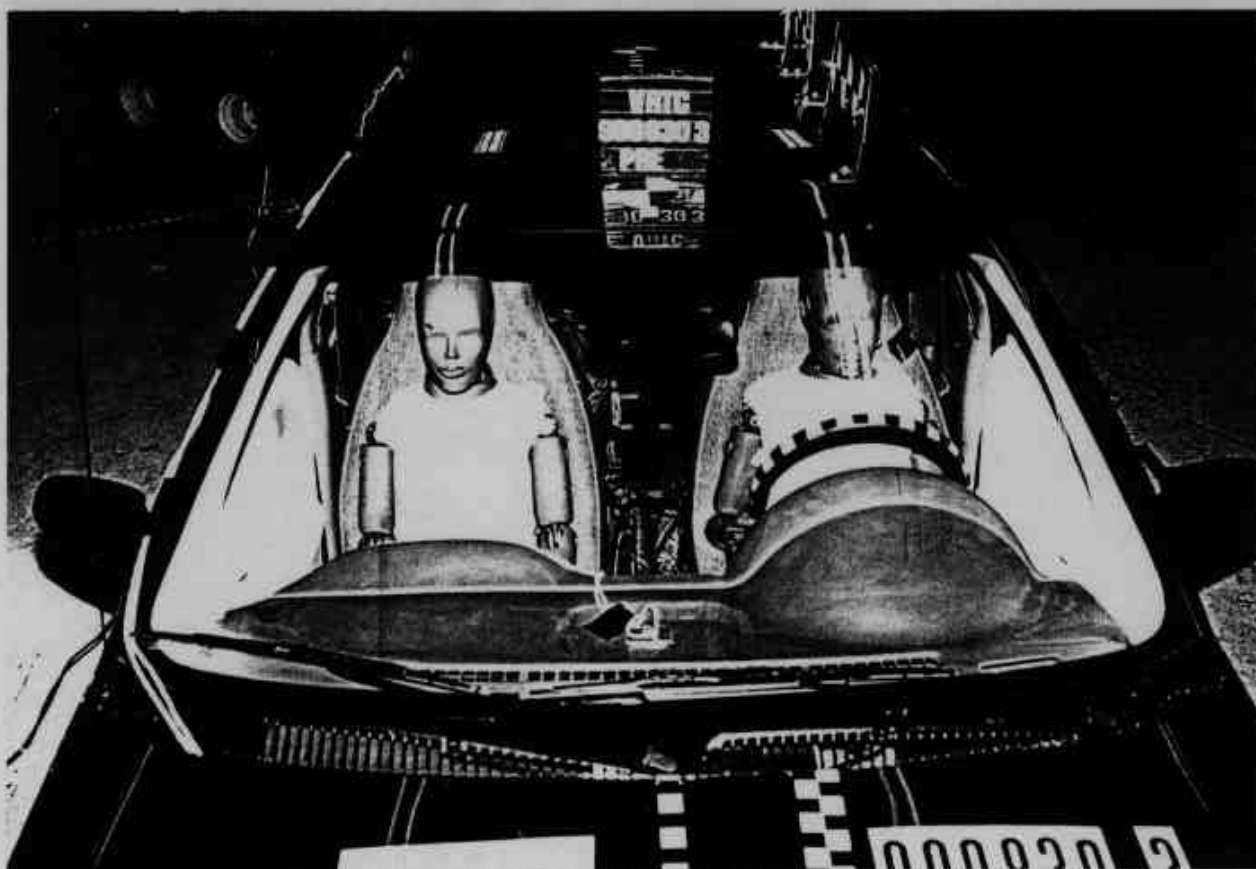


Figure A-23 Pre-Test Windshield - View 1

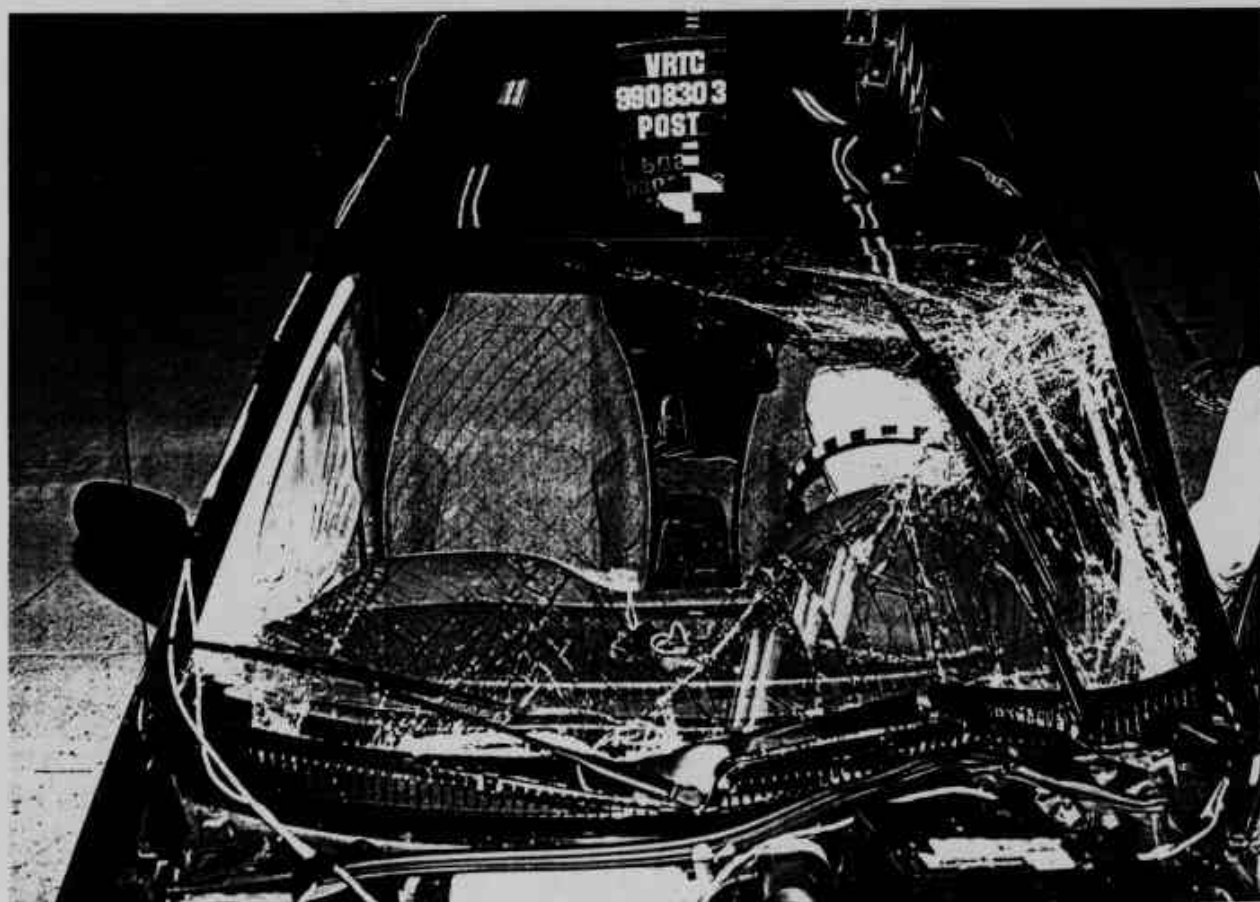


Figure A-24 Post-Test Windshield - View 1



Figure A-25 Pre-Test Windshield - View 2

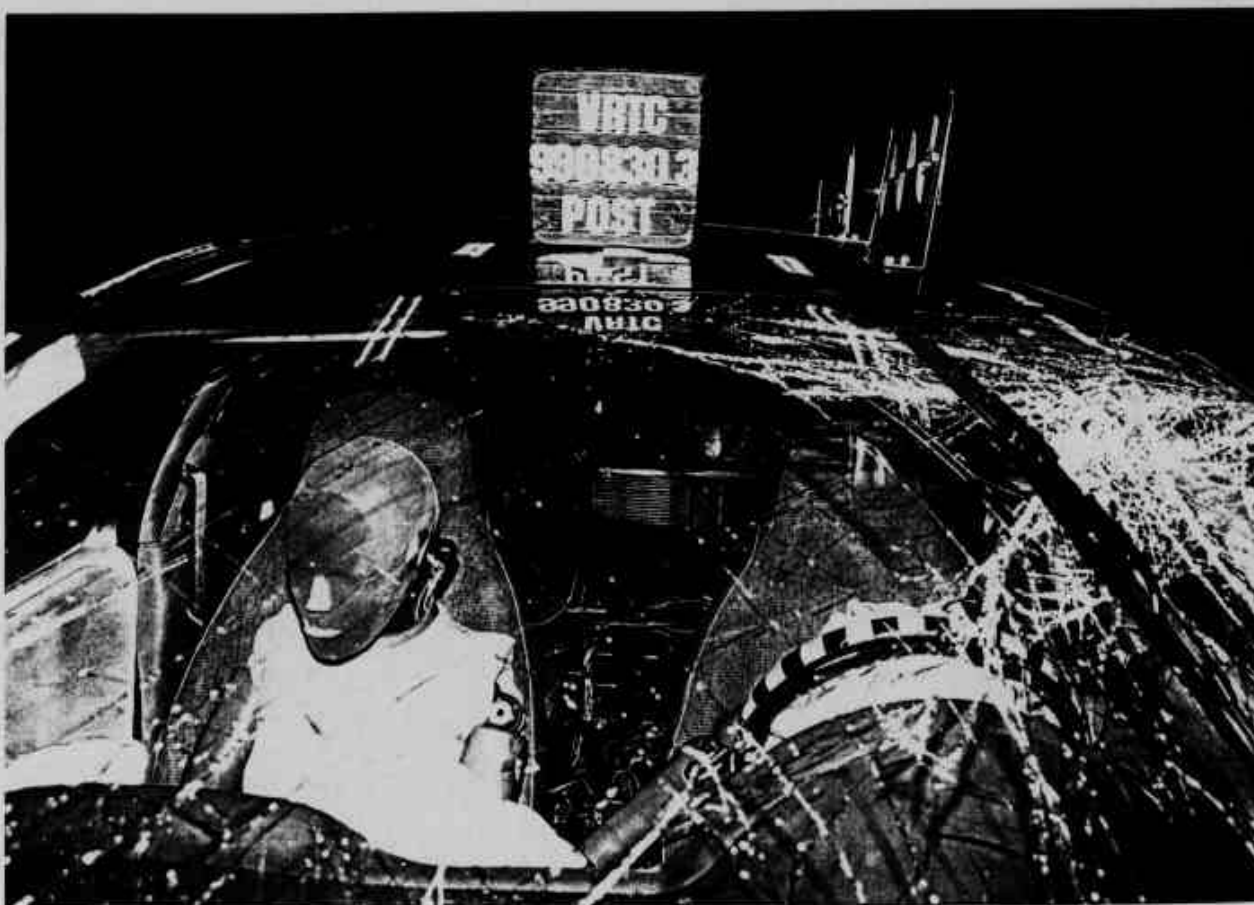


Figure A-26 Post-Test Windshield - View 2



Figure A-27 Pre-Test Driver Dummy Windshield View



Figure A-28 Post-Test Driver Dummy Windshield View

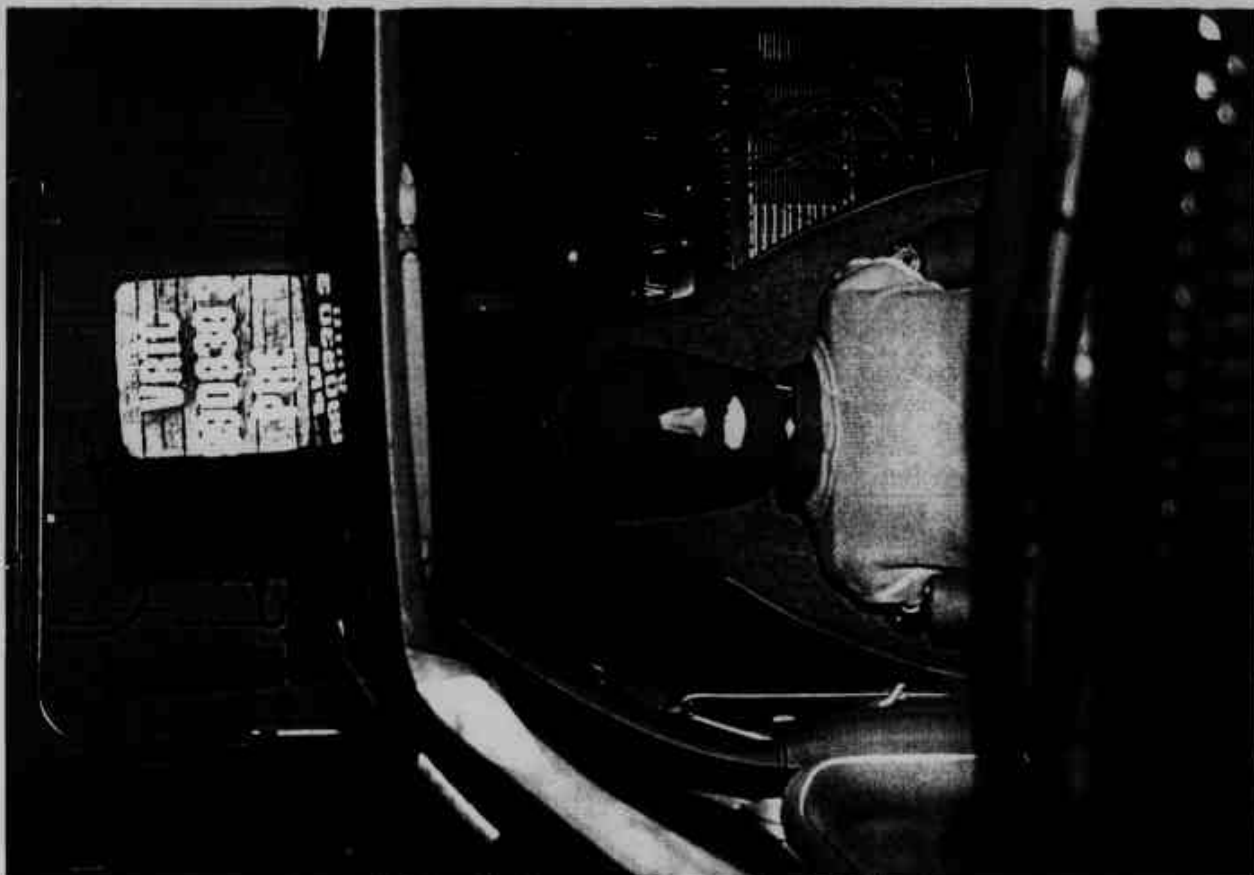


Figure A-29 Pre-Test Passenger Dummy Windshield View



Figure A-30 Post-Test Passenger Dummy Windshield View



Figure A-31 Pre-Test Driver Dummy Position - View 1



Figure A-32 Post-Test Driver Dummy Position - View 1



Figure A-33 Pre-Test Driver Dummy Position - View 2



Figure A-34 Post-Test Driver Dummy Position - View 2



Figure A-35 Pre-Test Driver Dummy Position - View 3



Figure A-36 Post-Test Driver Dummy Position - View 3



Figure A-37 Pre-Test Passenger Dummy Position - View 1



Figure A-38 Post-Test Passenger Dummy Position - View 1



Figure A-39 Pre-Test Passenger Dummy Position - View 2



Figure A-40 Post-Test Passenger Dummy Position - View 2

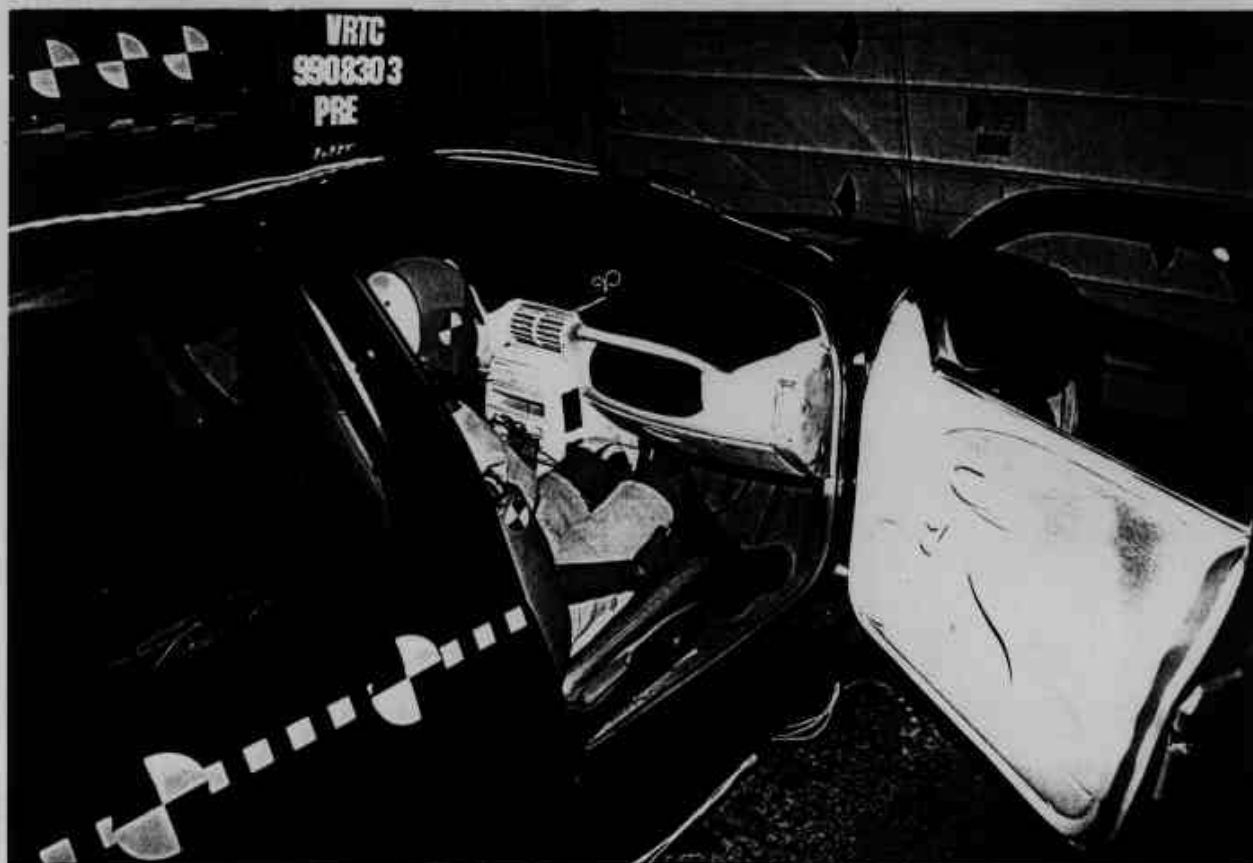


Figure A-41 Pre-Test Passenger Dummy Position - View 3



Figure A-42 Post-Test Passenger Dummy Position - View 3

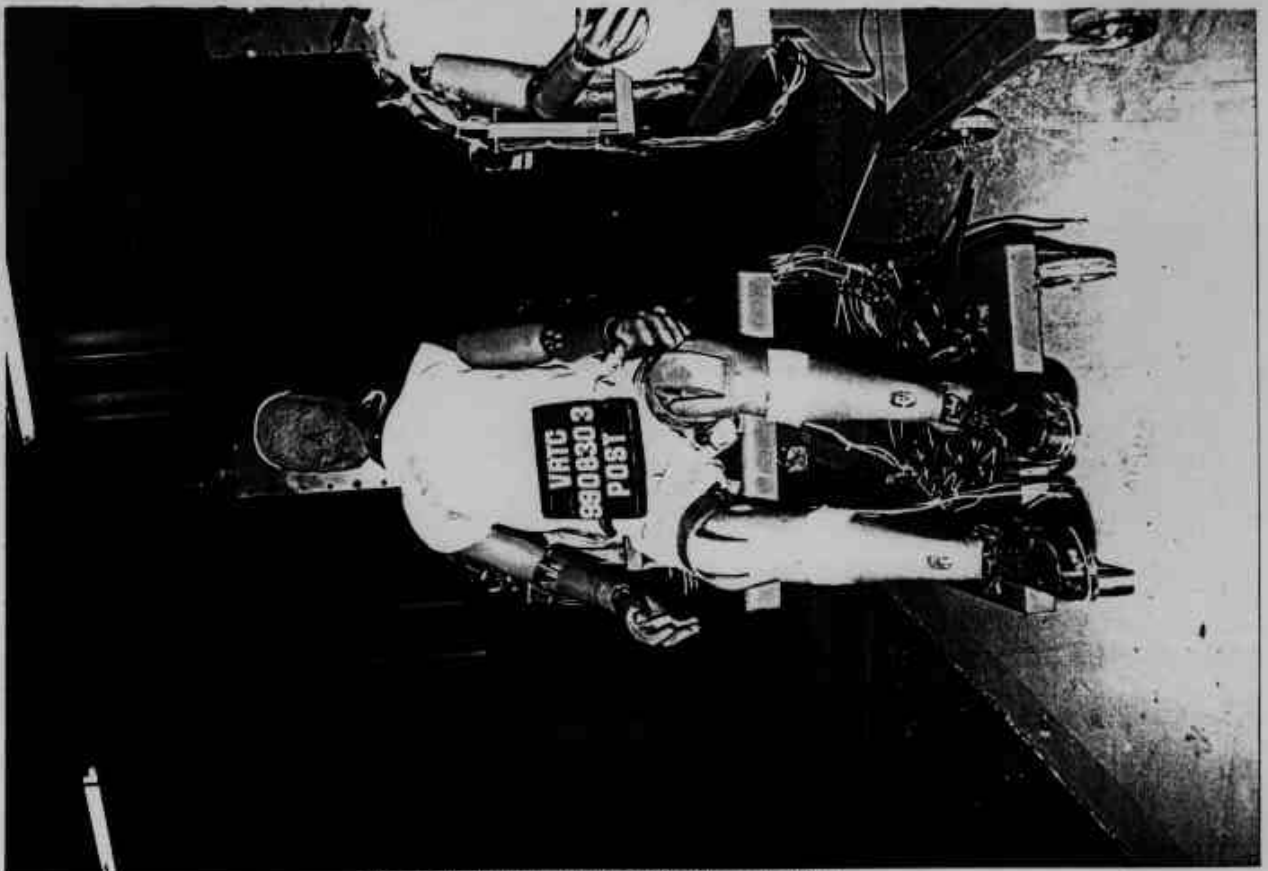


Figure A-43 Post-Test Driver Dummy View



Figure A-44 Post-Test Driver Dummy Head Contact - View 1



Figure A-45 Post-Test Driver Dummy Head Contact - View 2



Figure A-46 Post-Test Driver Dummy Head Contact - View 3

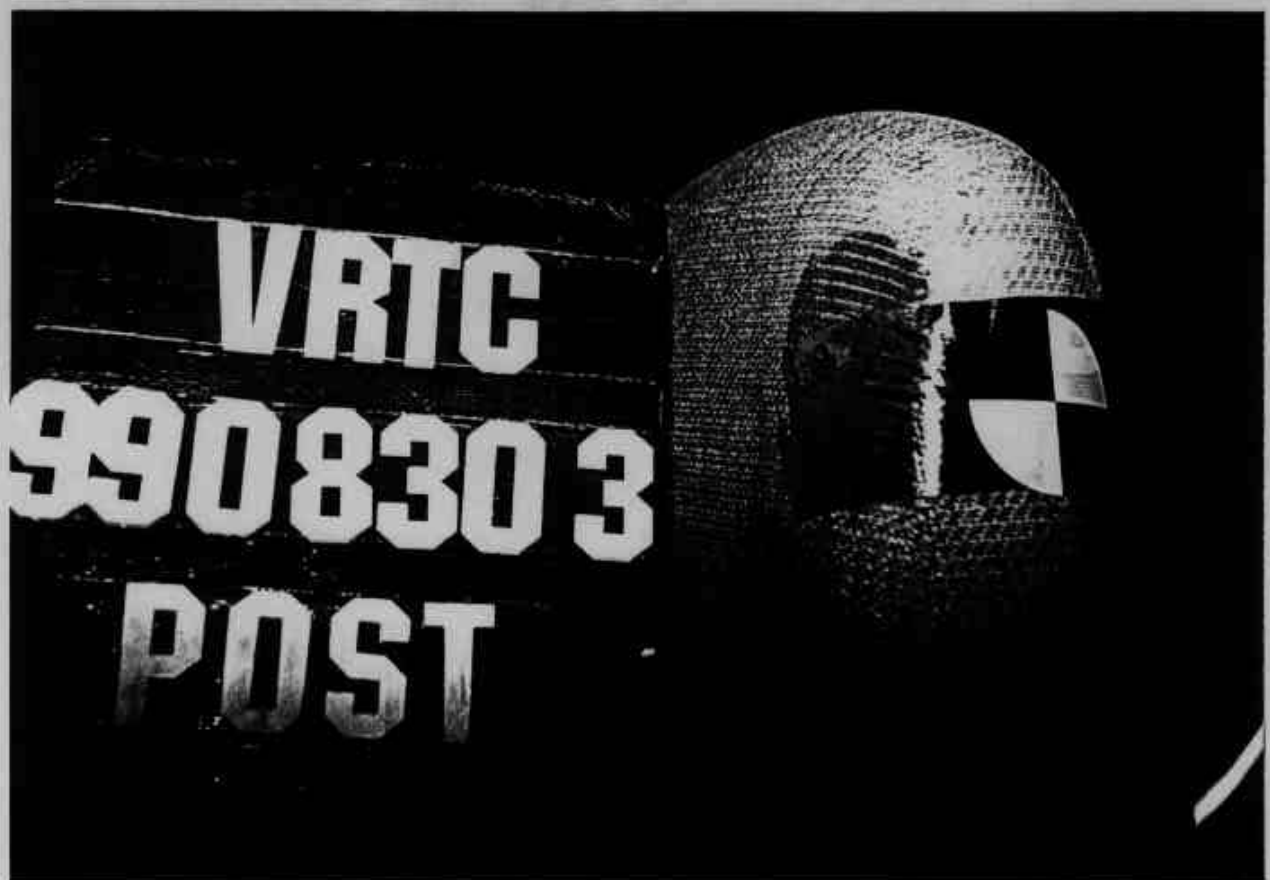


Figure A-47 Post-Test Driver Dummy Head Contact - View 4



Figure A-48 Post-Test Driver Dummy Knee Contact - View 1



Figure A-49 Post-Test Driver Dummy Knee Contact - View 2



Figure A-50 Post-Test Driver Footwell Deformation View

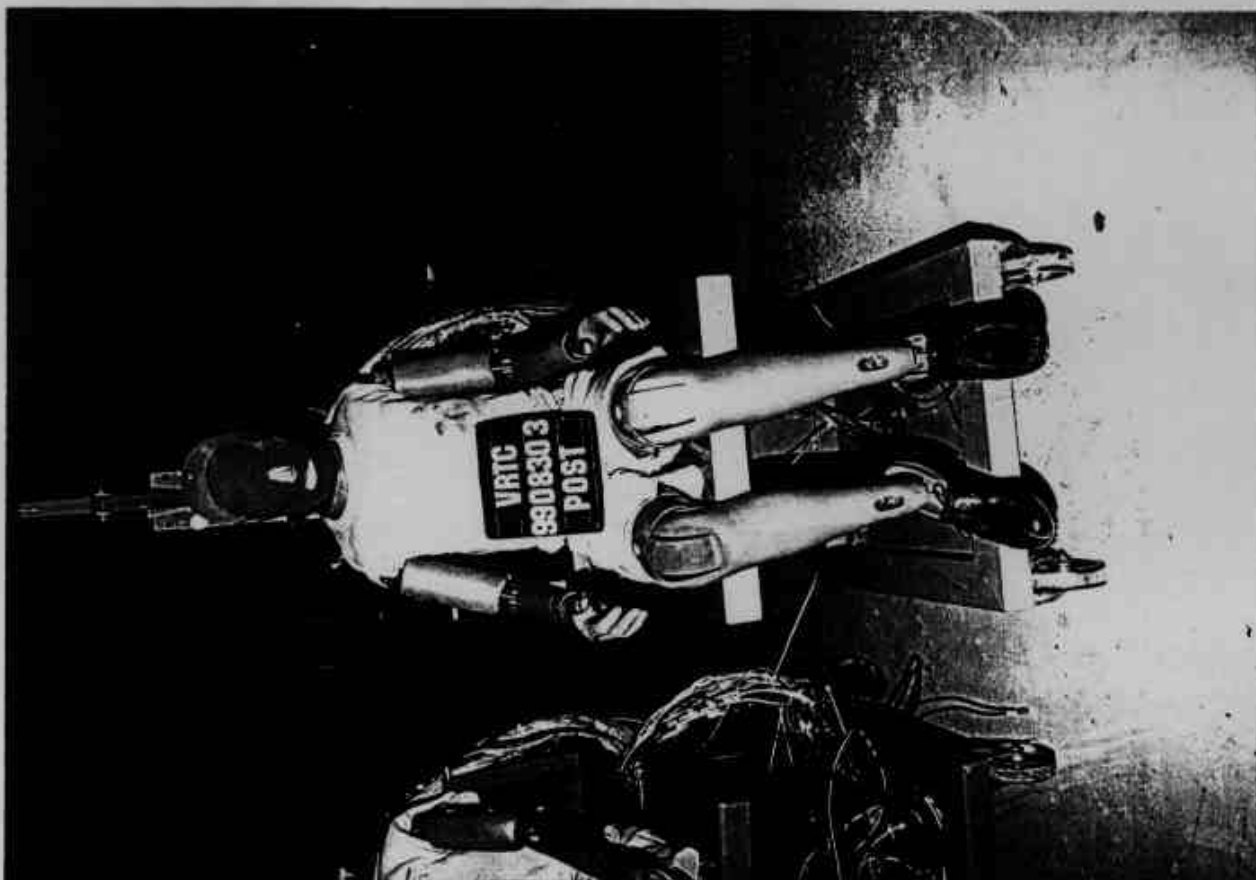


Figure A-51 Post-Test Passenger Dummy View



Figure A-52 Post-Test Passenger Dummy Head Contact - View 1



Figure A-53 Post-Test Passenger Dummy Head Contact - View 2



Figure A-54 Post-Test Passenger Dummy Knee Contact - View 1



Figure A-55 Post-Test Passenger Dummy Knee Contact - View 2

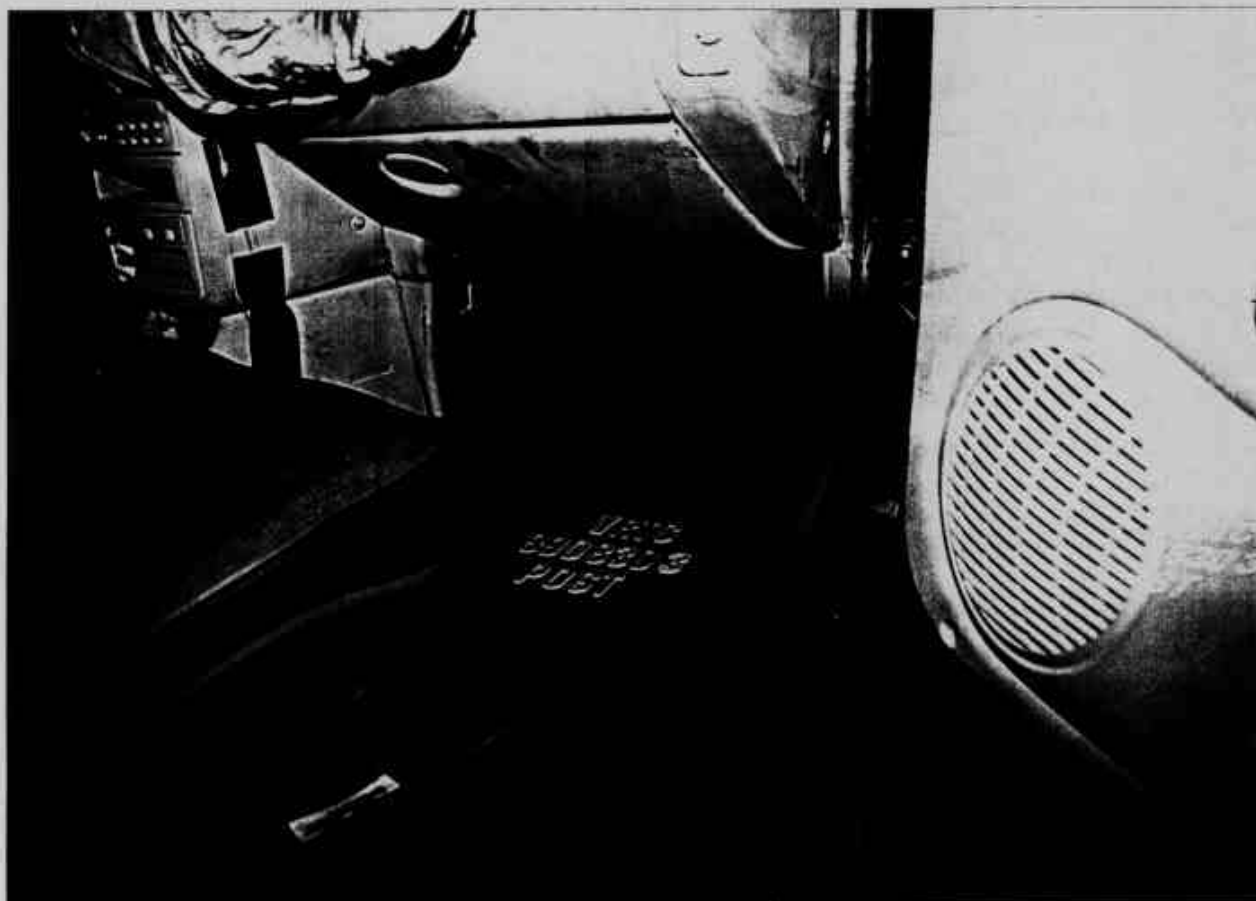


Figure A-56 Post-Test Passenger Footwell Deformation View



Figure A-57 Pre-Test Vehicle Certification Label View

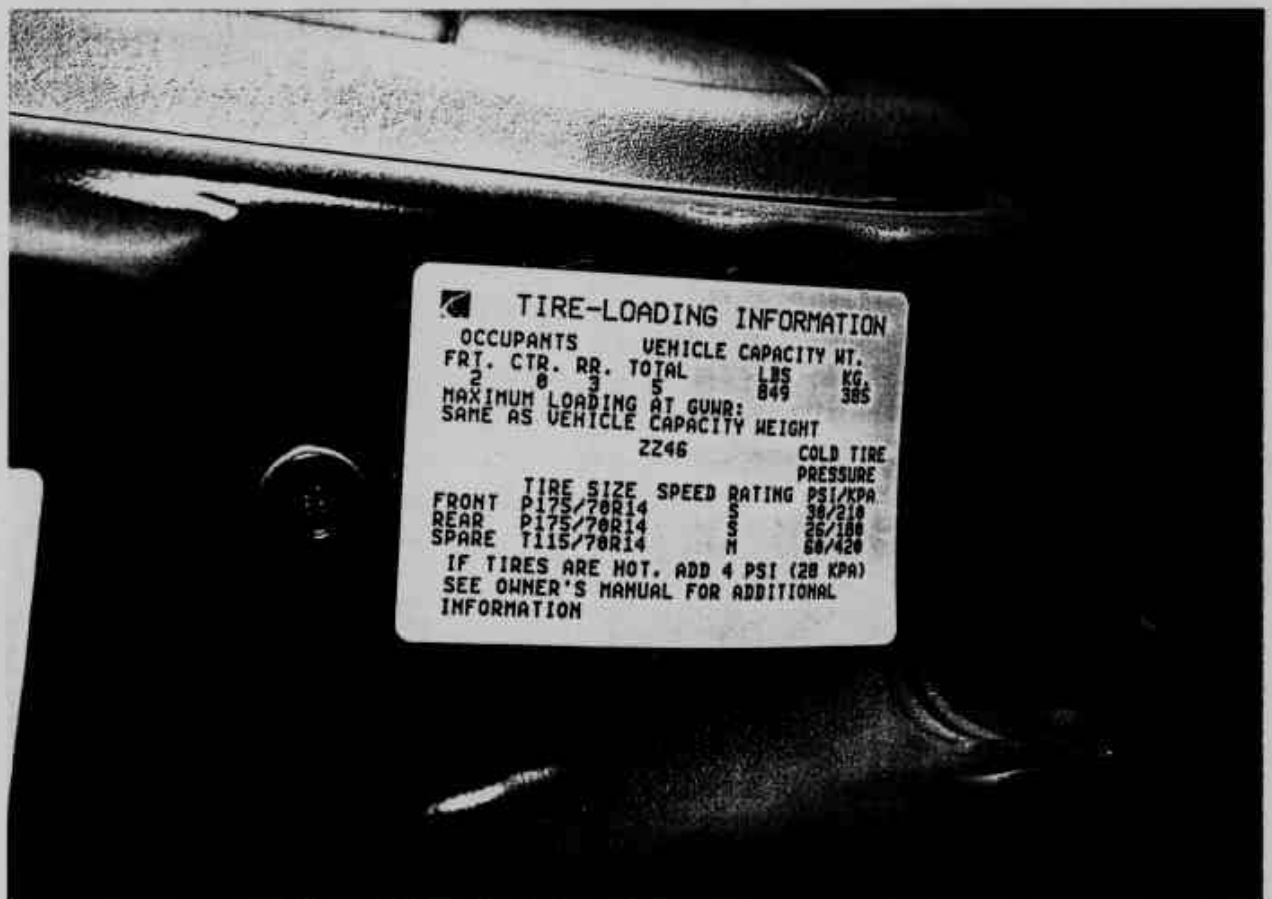


Figure A-58 Pre-Test Vehicle Tire Information Label View



Figure A-59 Post-Test Barrier Front View



Figure A-60 Post-Test Barrier Left Side View

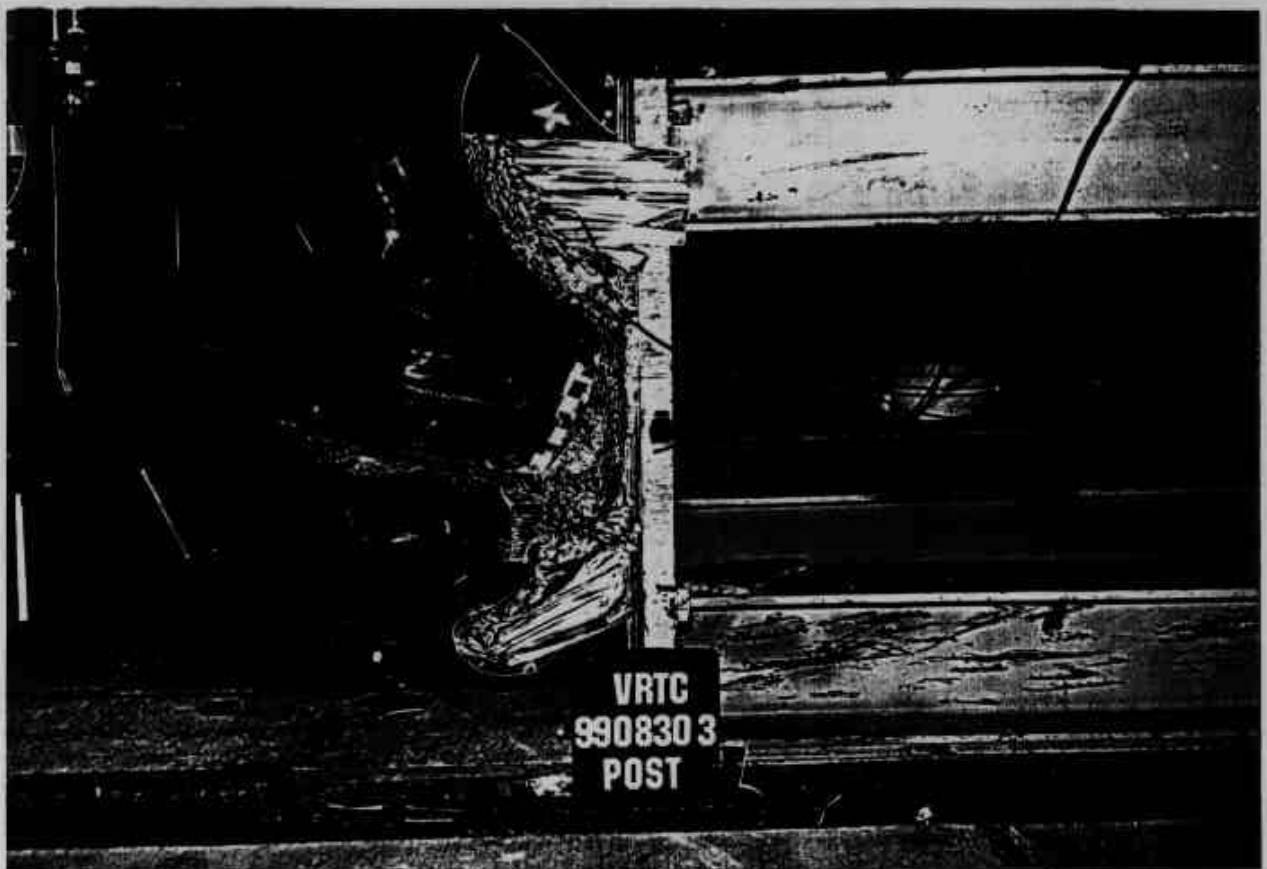


Figure A-61 Post-Test Barrier Right Side View



Figure A-62 Impact Event

Appendix B

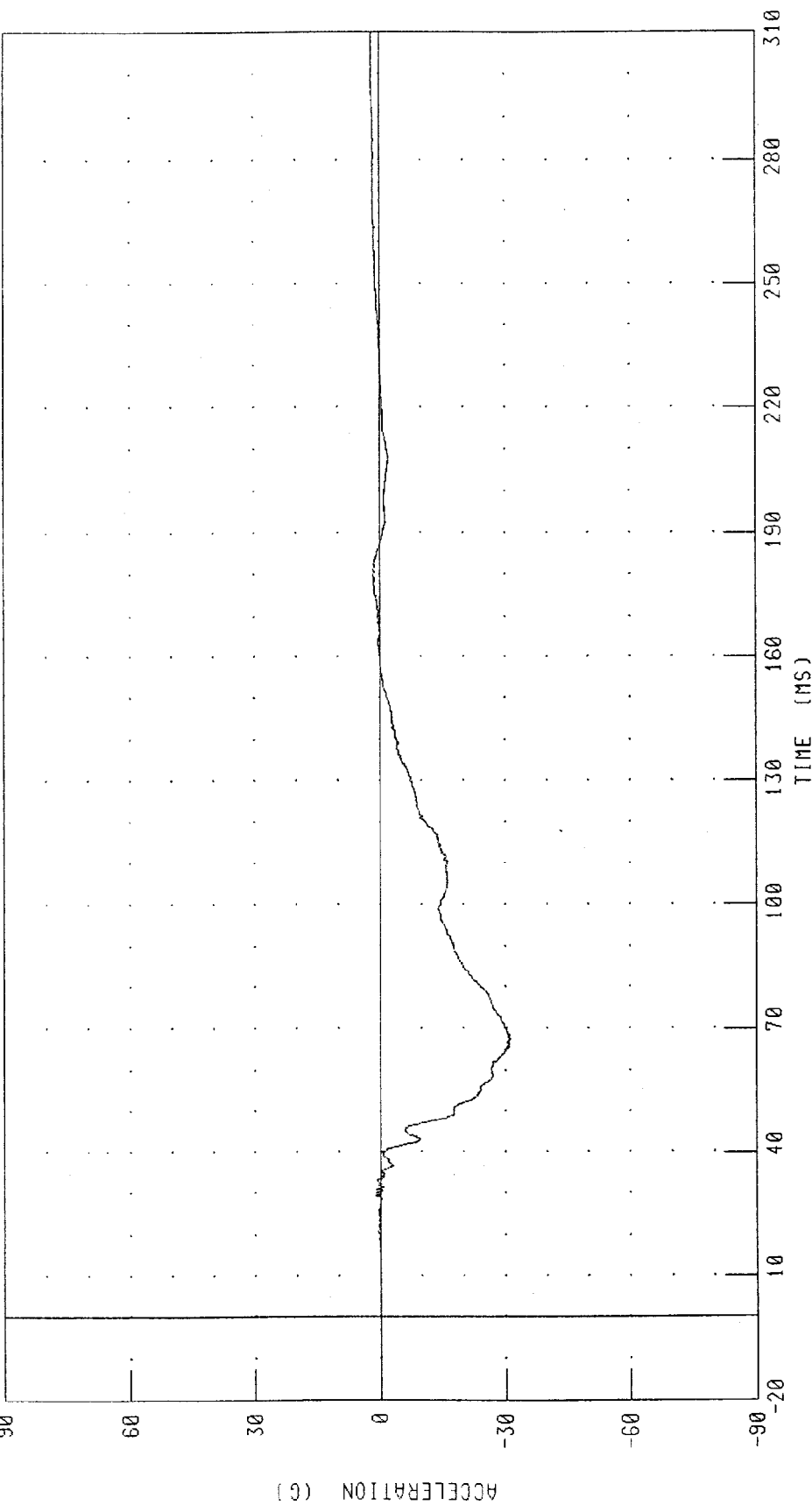
Data Plots

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER HEAD X-AXIS ACCELERATION

TEST NUMBER: 990830-3

FNVS 208

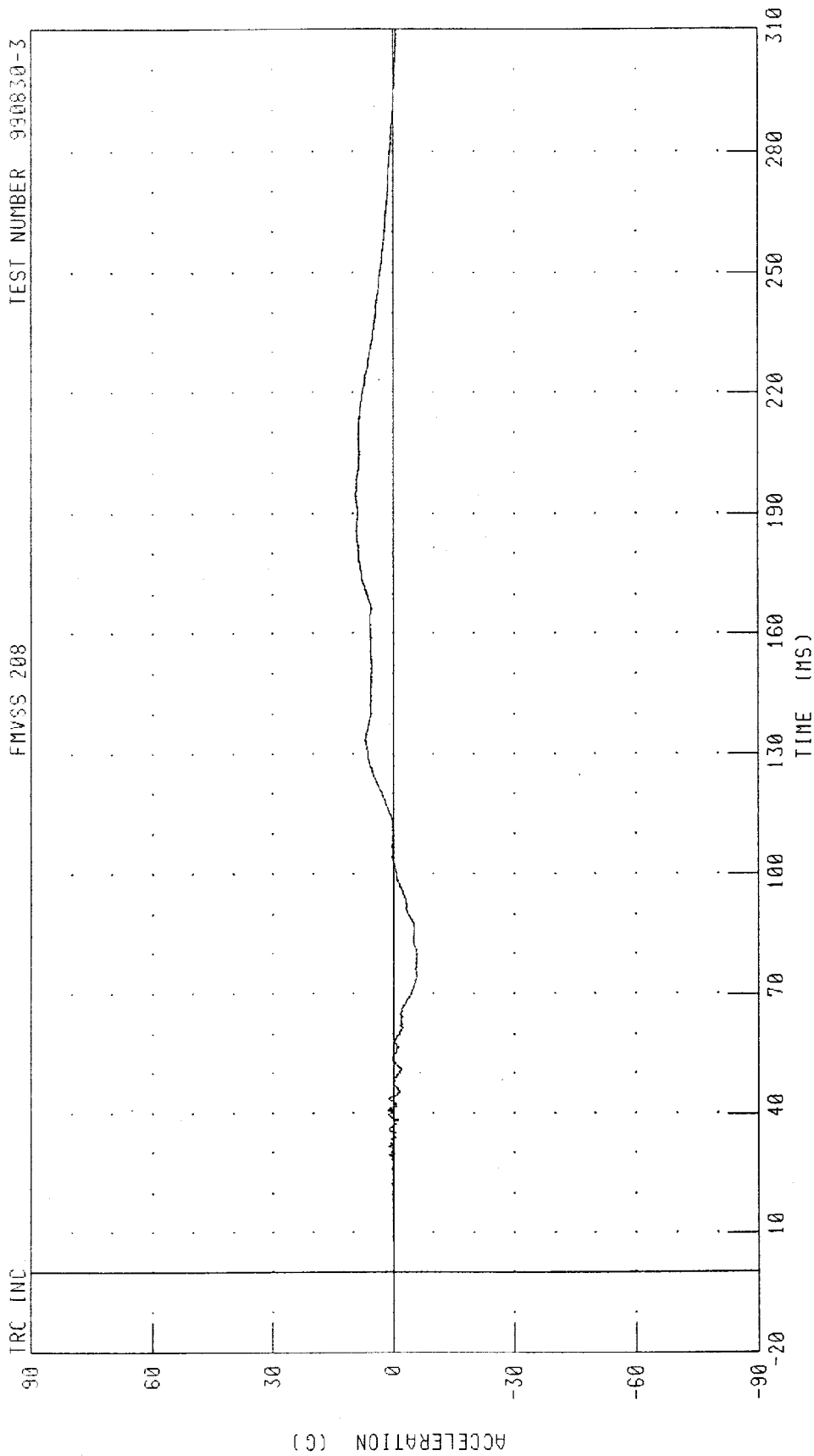
TRC INC



CHANNEL: HEDXC1 FILTER: CH. CLASS 1000

PEAK DATA: 1.92 G @ 310.00 MS; -31.30 G @ 67.52 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER HEAD Y-AXIS ACCELERATION



CHANNEL: HEDYC1 FILTER: CH. CLASS 1000

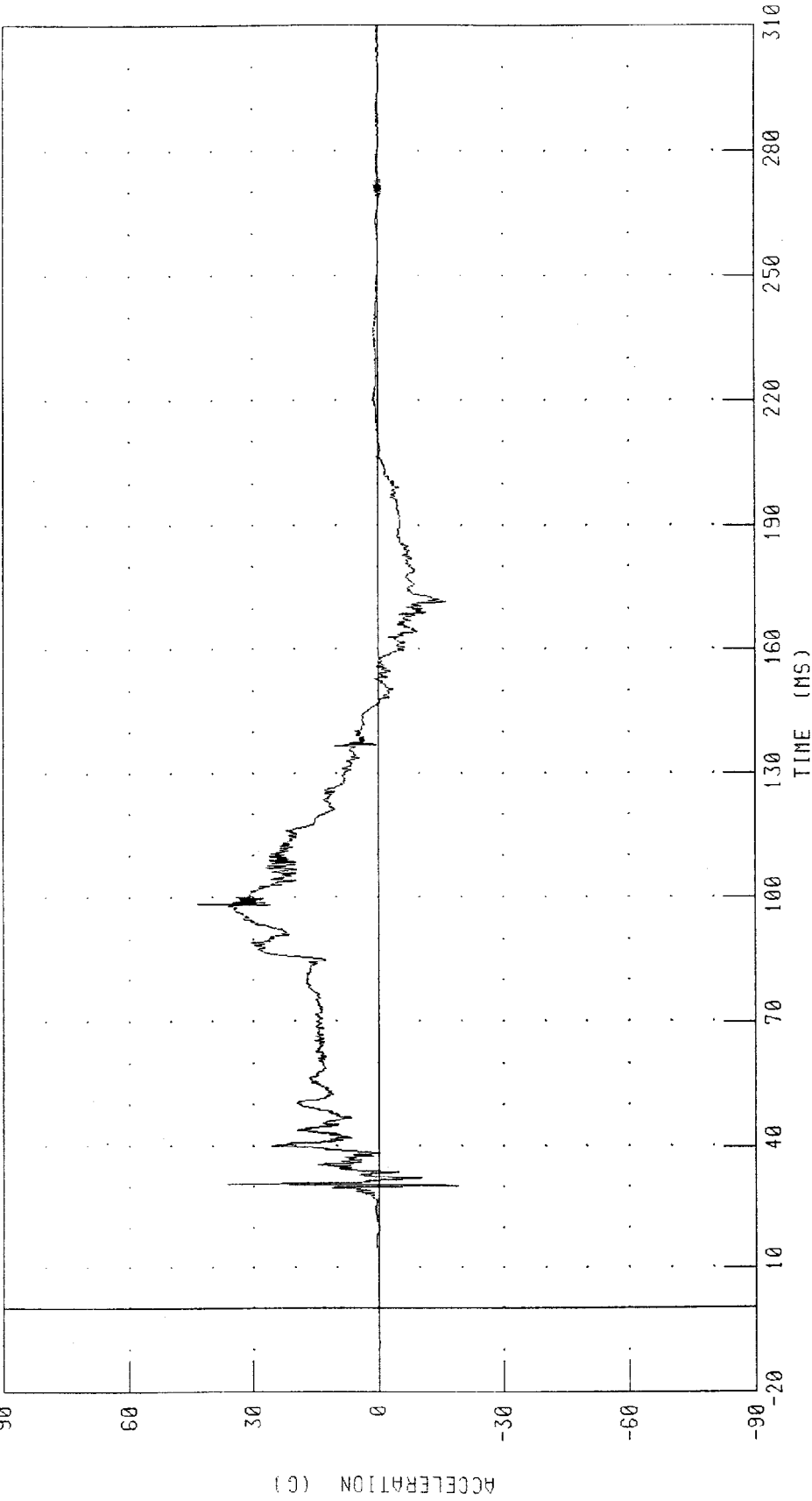
PEAK DATA: 9.25 G @ 185.60 MS; -6.02 G @ 79.36 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER HEAD Z-AXIS ACCELERATION

TEST NUMBER 990830-3

FMVSS 208

TRC INC



CHANNEL: HEDZG1 FILTER: CH. CLASS 1000

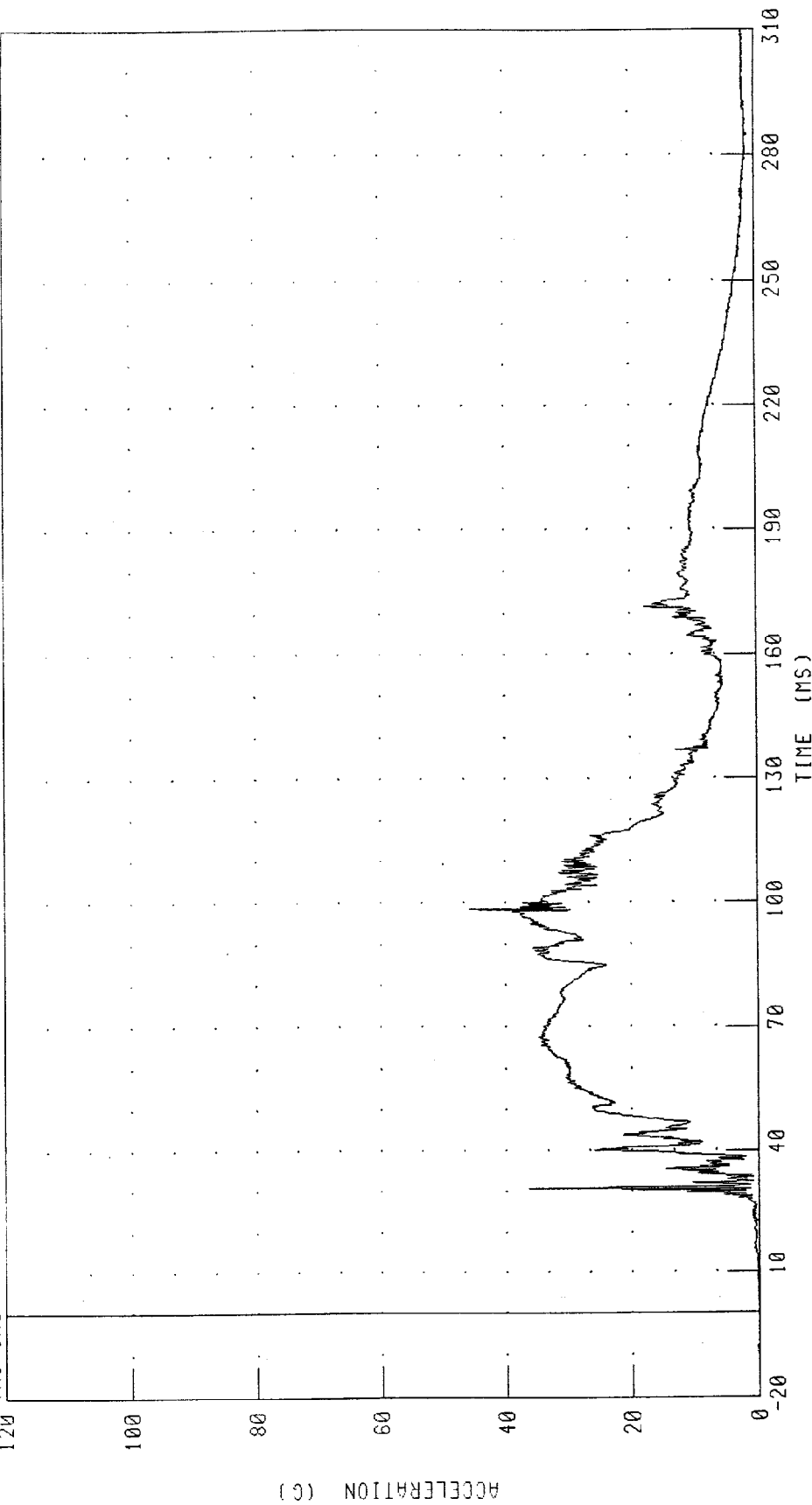
PEAK DATA: 43.65 G @ 98.48 MS; -19.10 G @ 30.32 MS

1999 SATURN SL1 INTO LIHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER HEAD RESULTANT ACCELERATION

TEST NUMBER: 990830-3

FMVSS 203

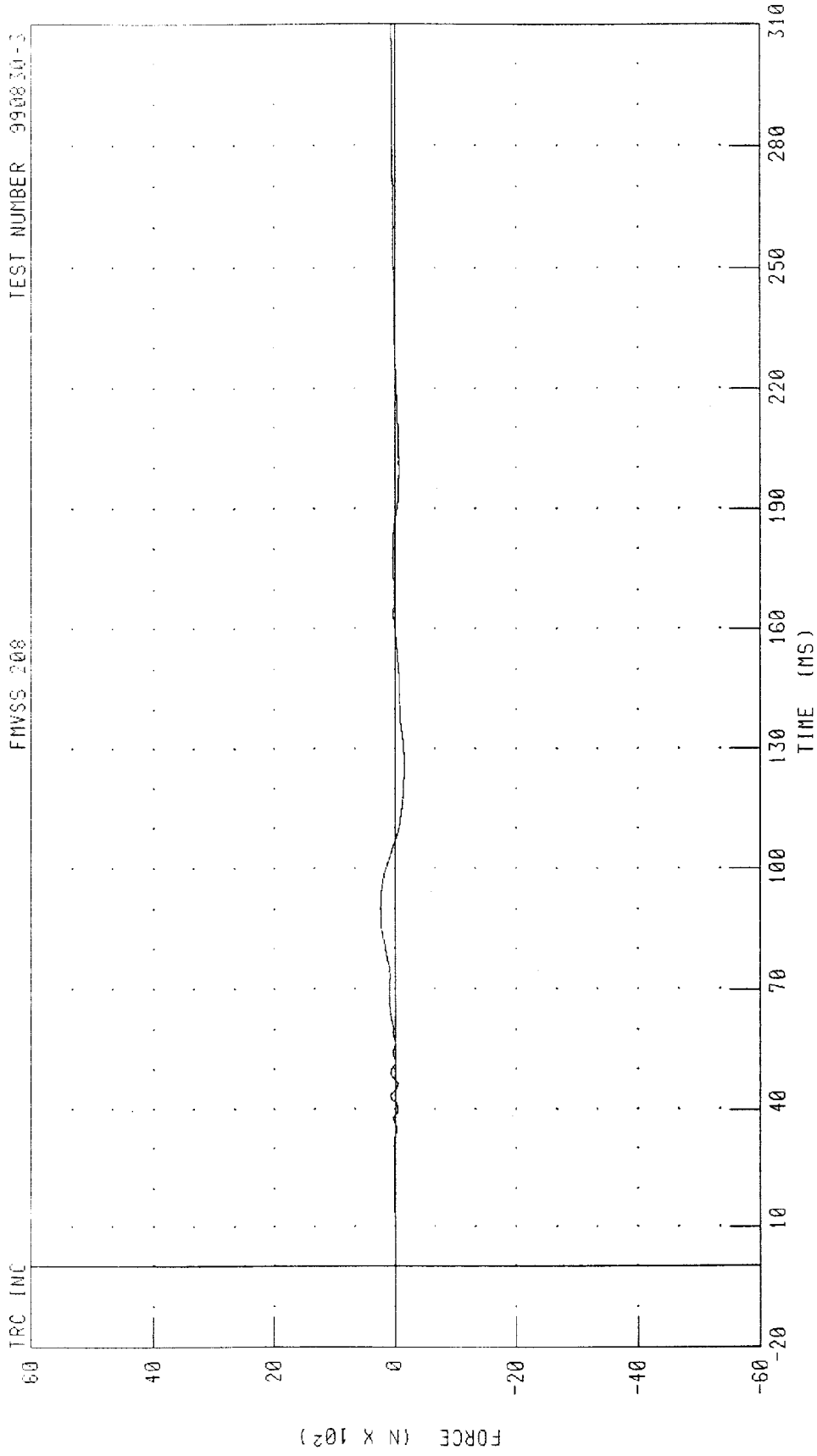
TRC INC



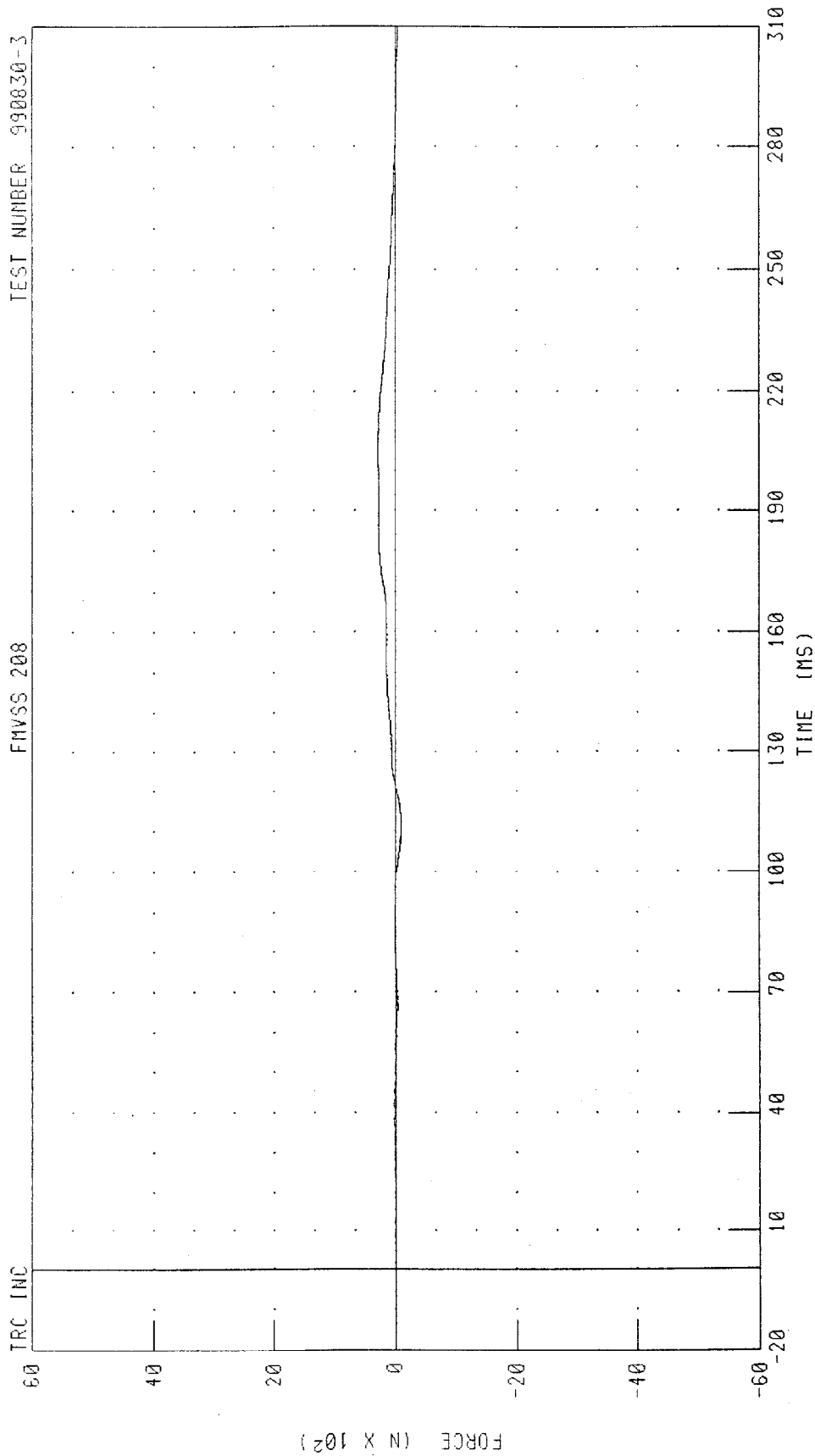
CHANNEL: HEDRG1 FILTER: CH. CLASS 1000

PEAK DATA: 45.93 G @ 98.48 MS, 0.04 G @ -20.00 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK X-AXIS SHEAR FORCE



1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK Y-AXIS SHEAR FORCE



CHANNEL: NEKYF1 FILTER: CH. CLASS 1000

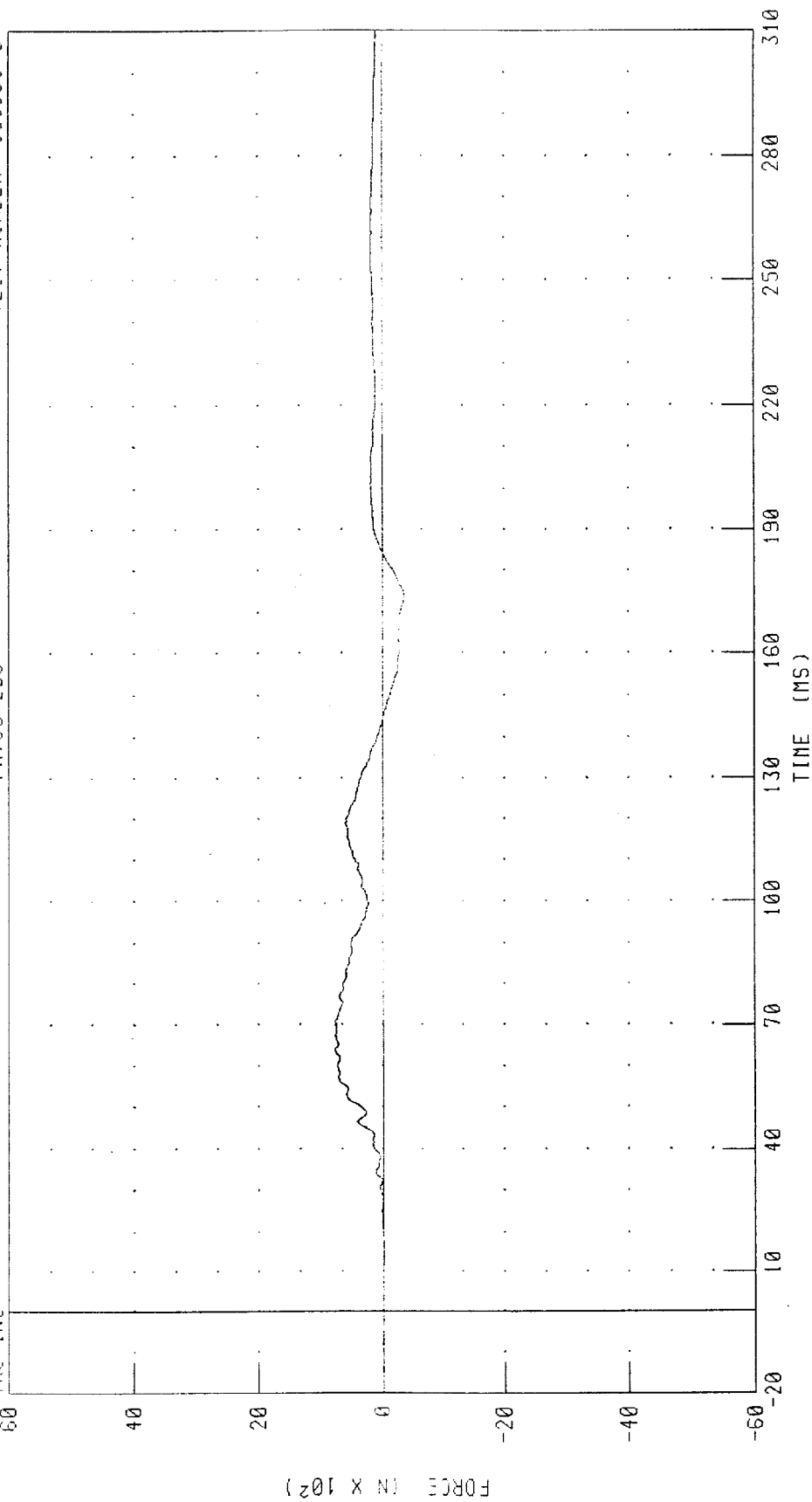
PEAK DATA: 276.46 N @ 202.08 MS; -96.88 N @ 109.28 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK Z-AXIS AXIAL FORCE

TEST NUMBER 990830-3

FMVSS 208

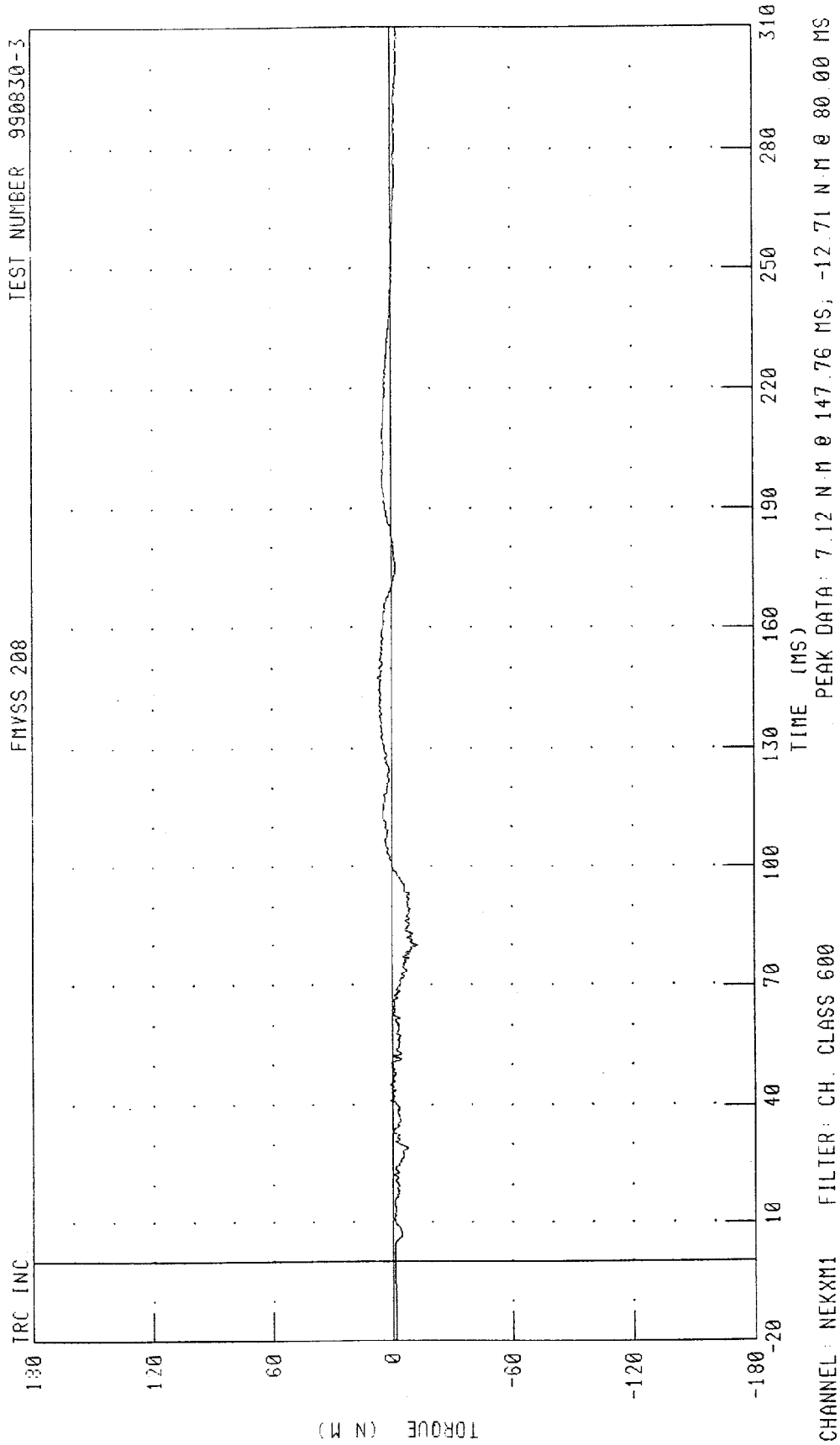
TRC INC



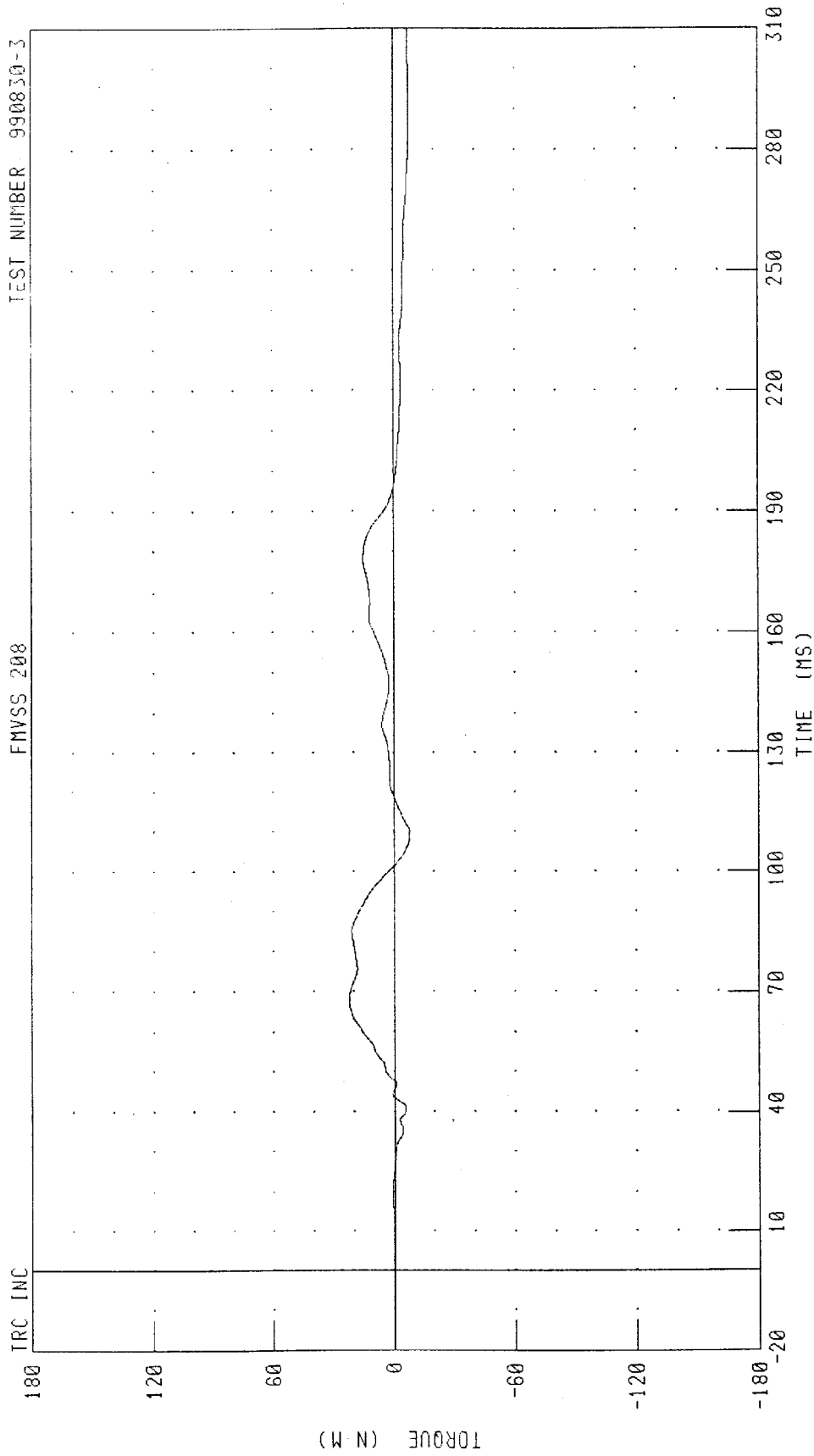
CHANNEL: NEKZF1 FILTER: CH. CLASS 1000

PEAK DATA: 770.11 N @ 63.76 MS, -355.87 N @ 173.92 MS

1999 SATURN SL1 INTO I1HS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK MOMENT ABOUT X AXIS



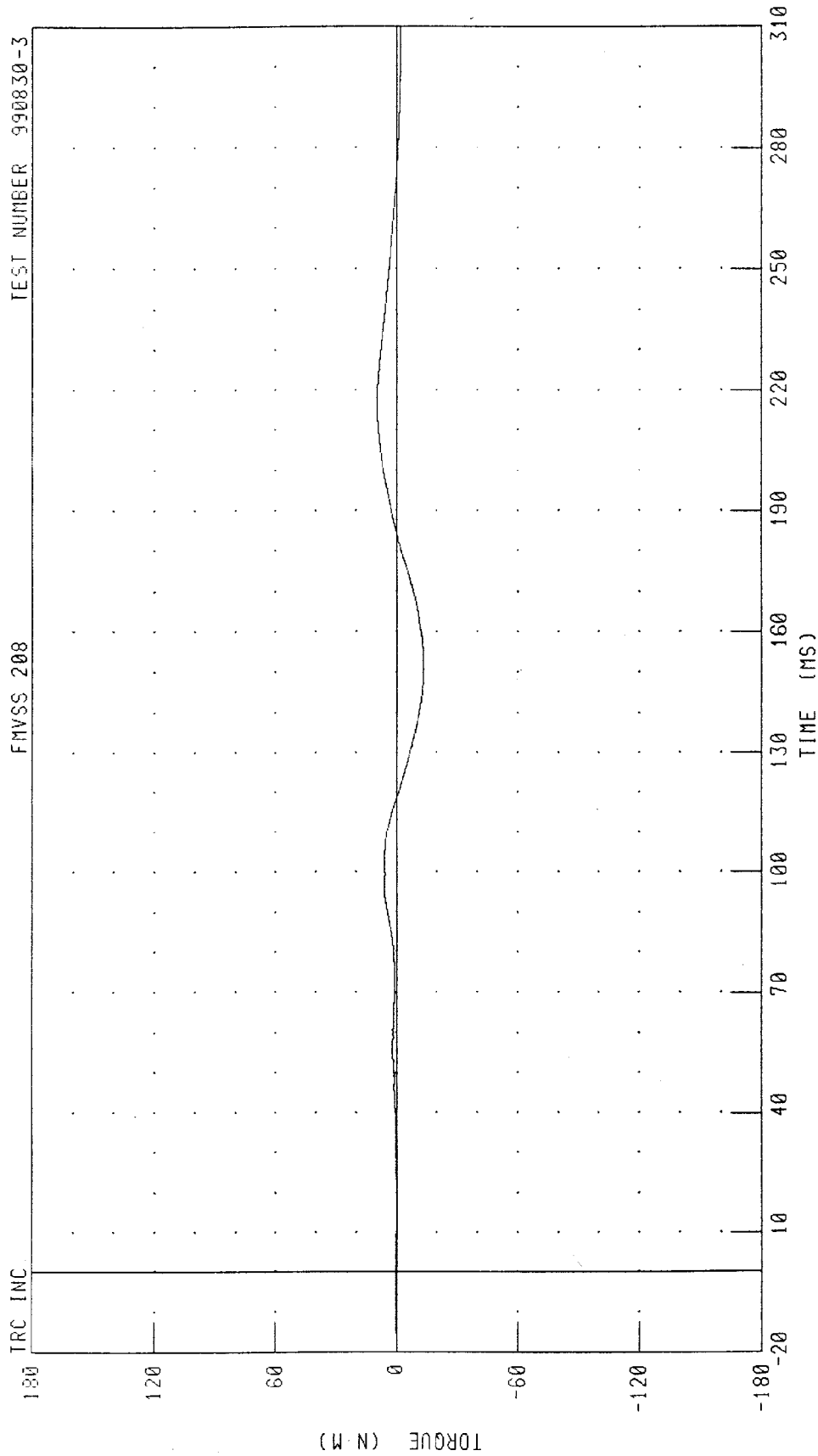
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK MOMENT ABOUT Y AXIS



CHANNEL: NEKYM1 FILTER: CH. CLASS 600

PEAK DATA: 22.36 N-M @ 68.56 MS; -8.09 N-M @ 110.24 MS

1999 SATURN SL1110 LHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK MOMENT ABOUT Z AXIS



CHANNEL: NEKZM1 FILTER: CH. CLASS 600

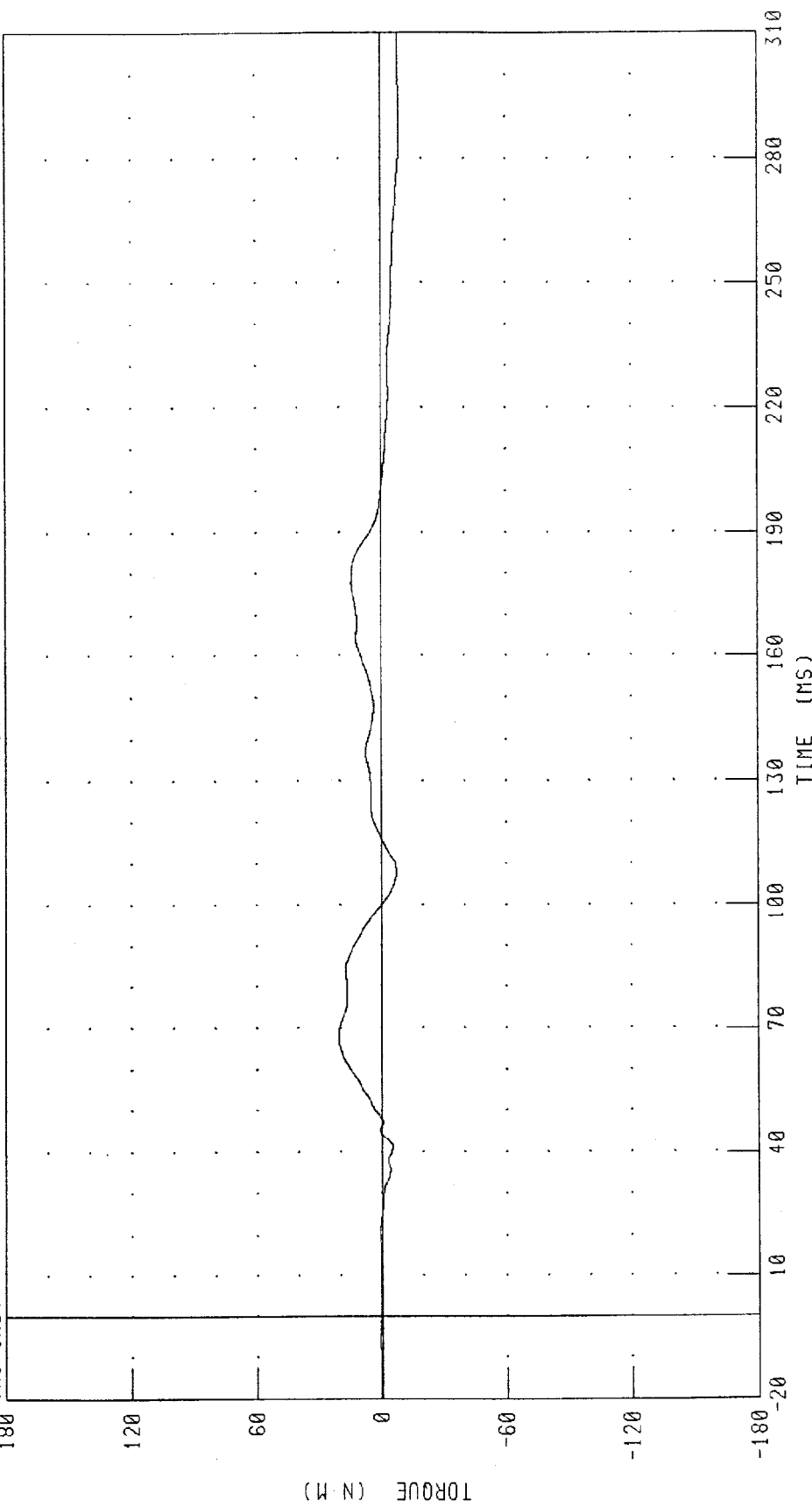
PEAK DATA: 9.39 N-M @ 218.72 MS, -13.53 N-M @ 153.44 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER NECK OCCIPITAL CONDYLE MOMENT ABOUT Y AXIS

TRC INC.

FMVSS 208

TEST NUMBER: 990830-3



CHANNEL: NEKOM1 FILTER: CH. CLASS 600

PEAK DATA: 20.78 N-M @ 68.64 MS, -8.82 N-M @ 283.52 MS

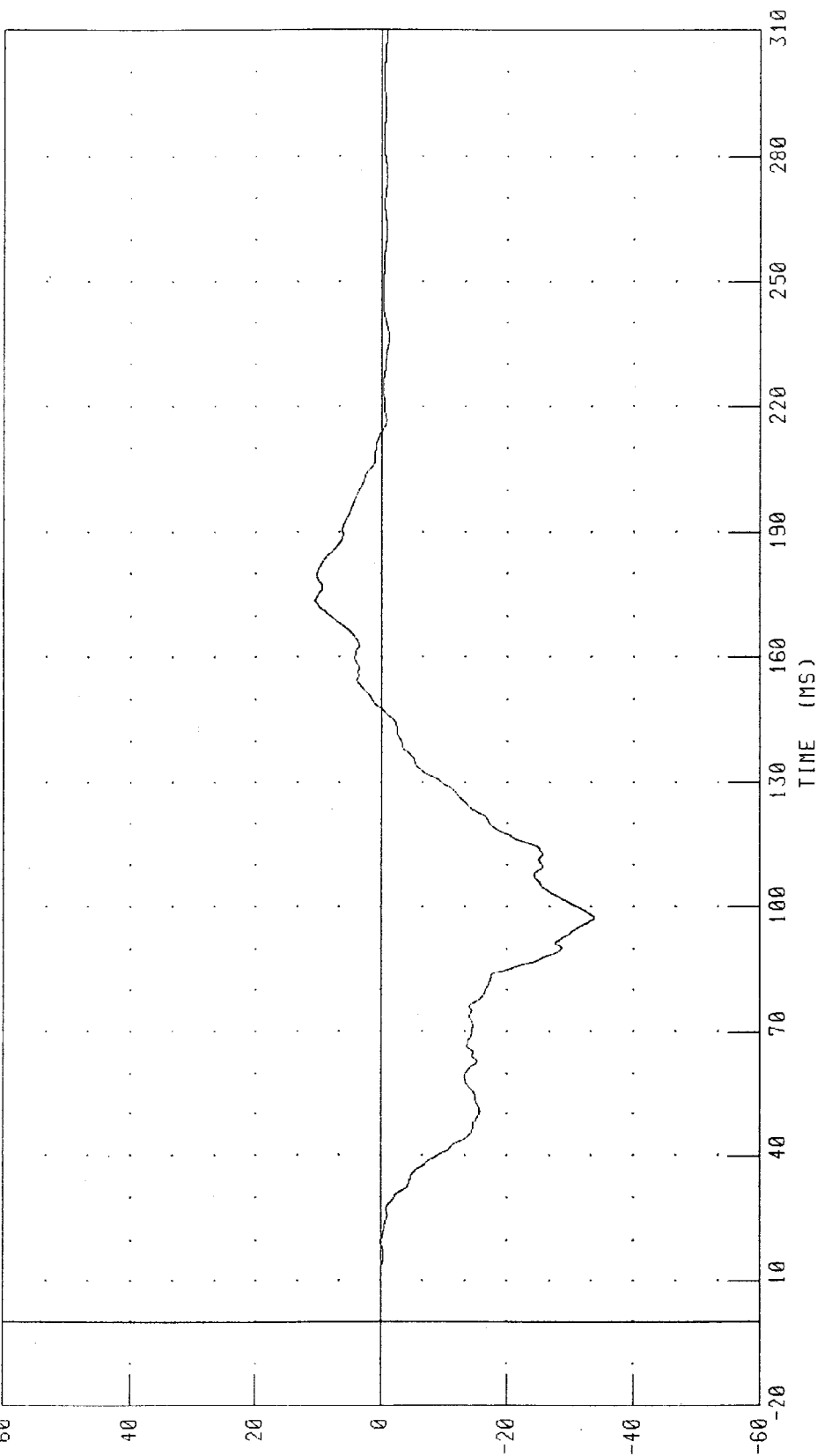
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER CHEST X-AXIS ACCELERATION

TRC INC.

FMVSS 208

TEST NUMBER 990830-3

ACCELERATION (G)

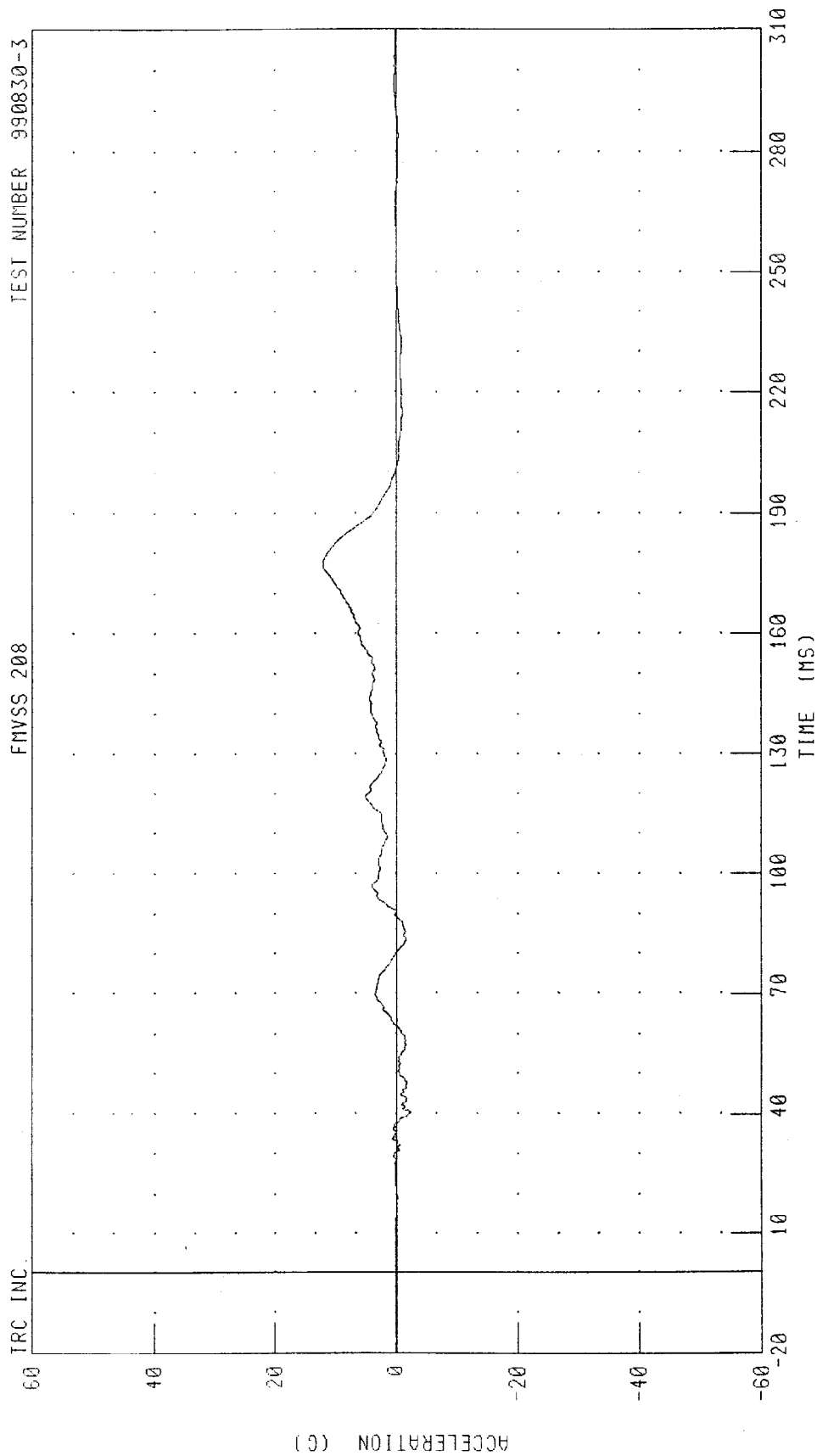


CHANNEL: CSTXG1 FILTER: CH. CLASS 180

PEAK DATA: 10.53 G @ 173.76 MS; -33.84 G @ 97.44 MS

1999 SATURN SL1110 IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER CHEST Y-AXIS ACCELERATION

TRC INC. FMVSS 208 TEST NUMBER 990830-3



CHANNEL: CSTYG1 FILTER: CH. CLASS 180

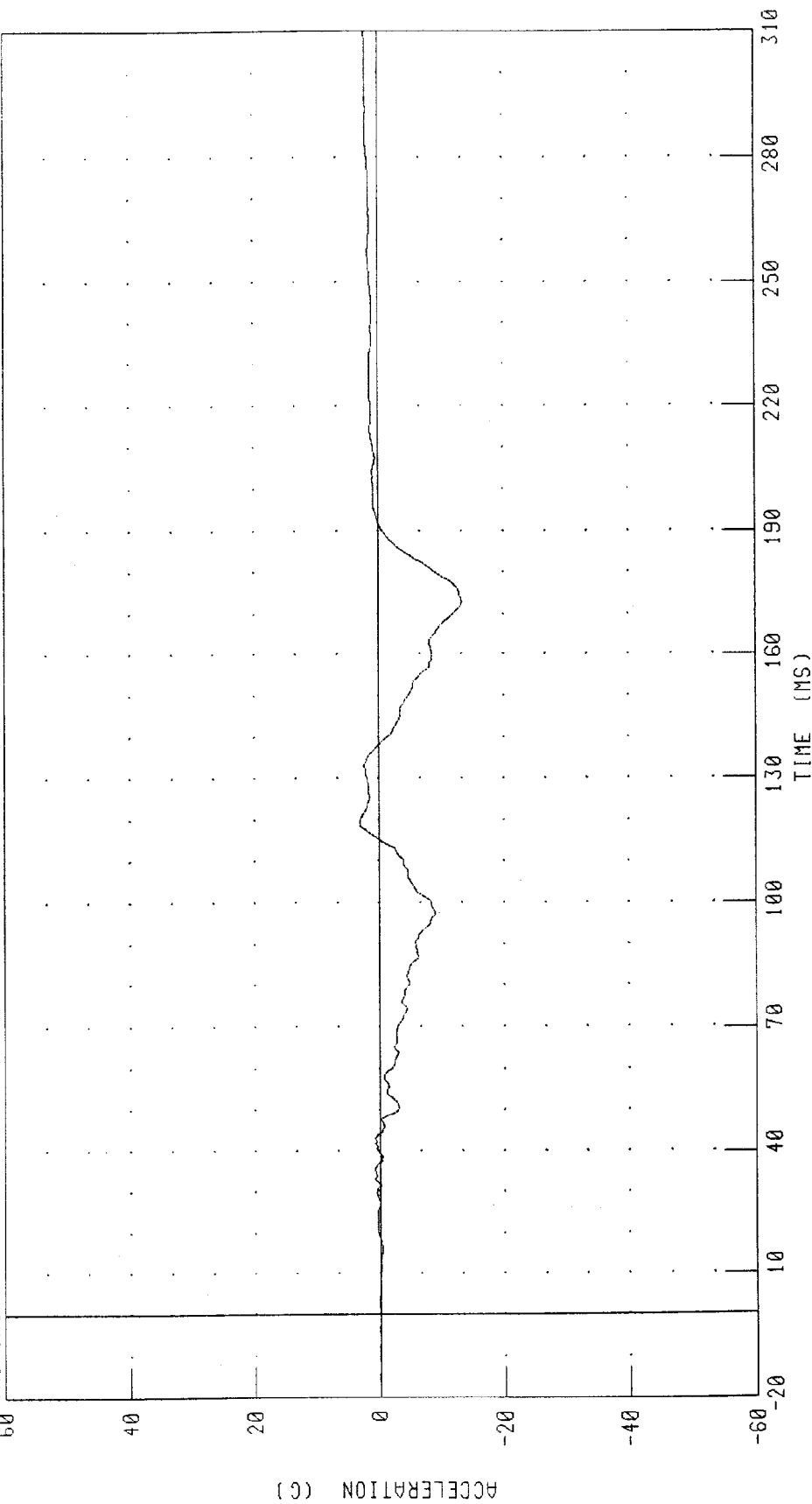
PEAK DATA: 12 02 G @ 177.60 MS; -2 38 G @ 40.48 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER CHEST Z-AXIS ACCELERATION

TEST NUMBER: 990830-3

FMVSS 208

TRC INC.



CHANNEL: CSTZG1 FILTER: CH. CLASS 180

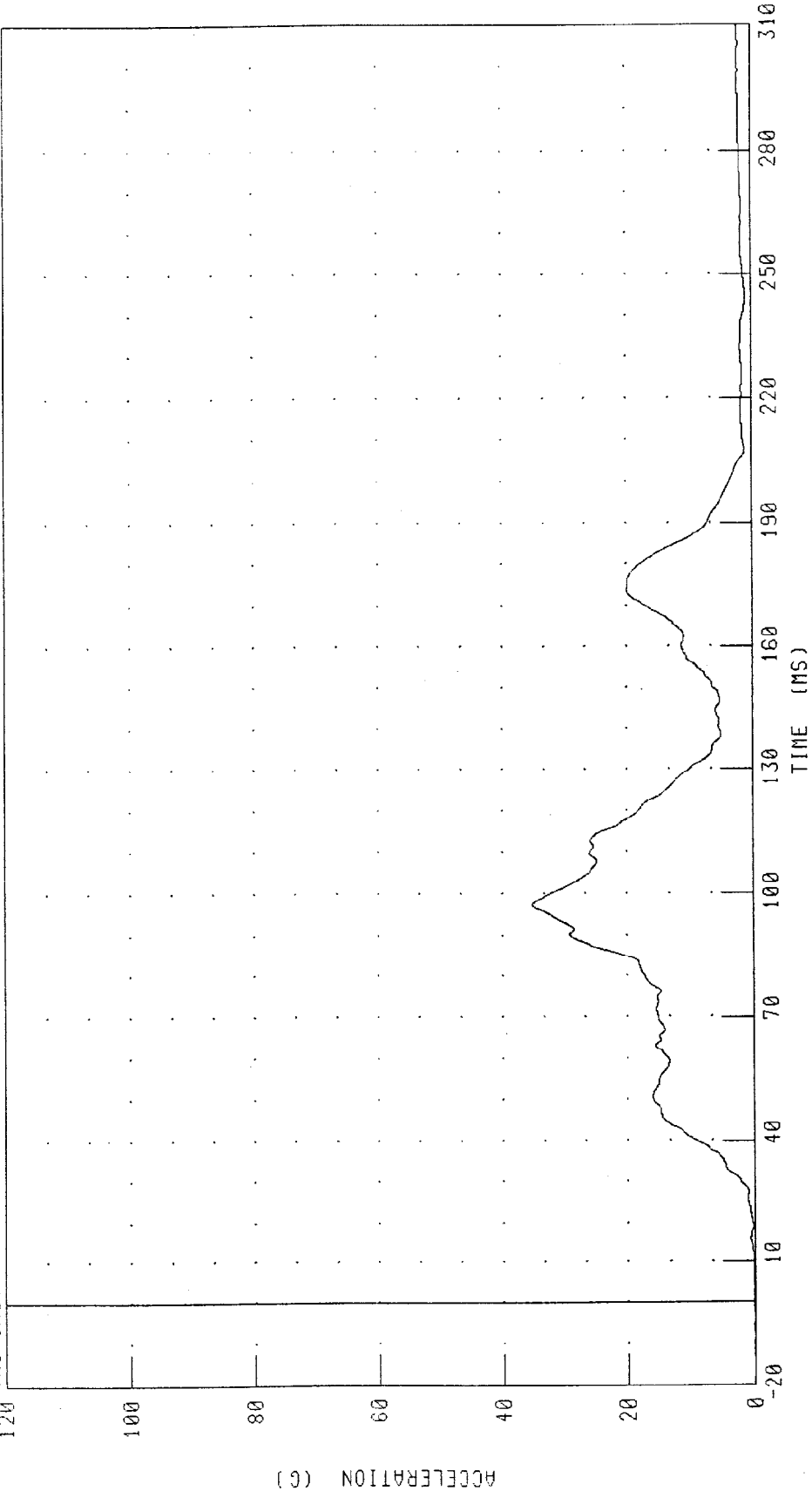
PEAK DATA: 3.05 G @ 119.44 MS, -13.43 G @ 172.96 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER CHEST RESULTANT ACCELERATION

TEST NUMBER 990830-3

ENVSS 208

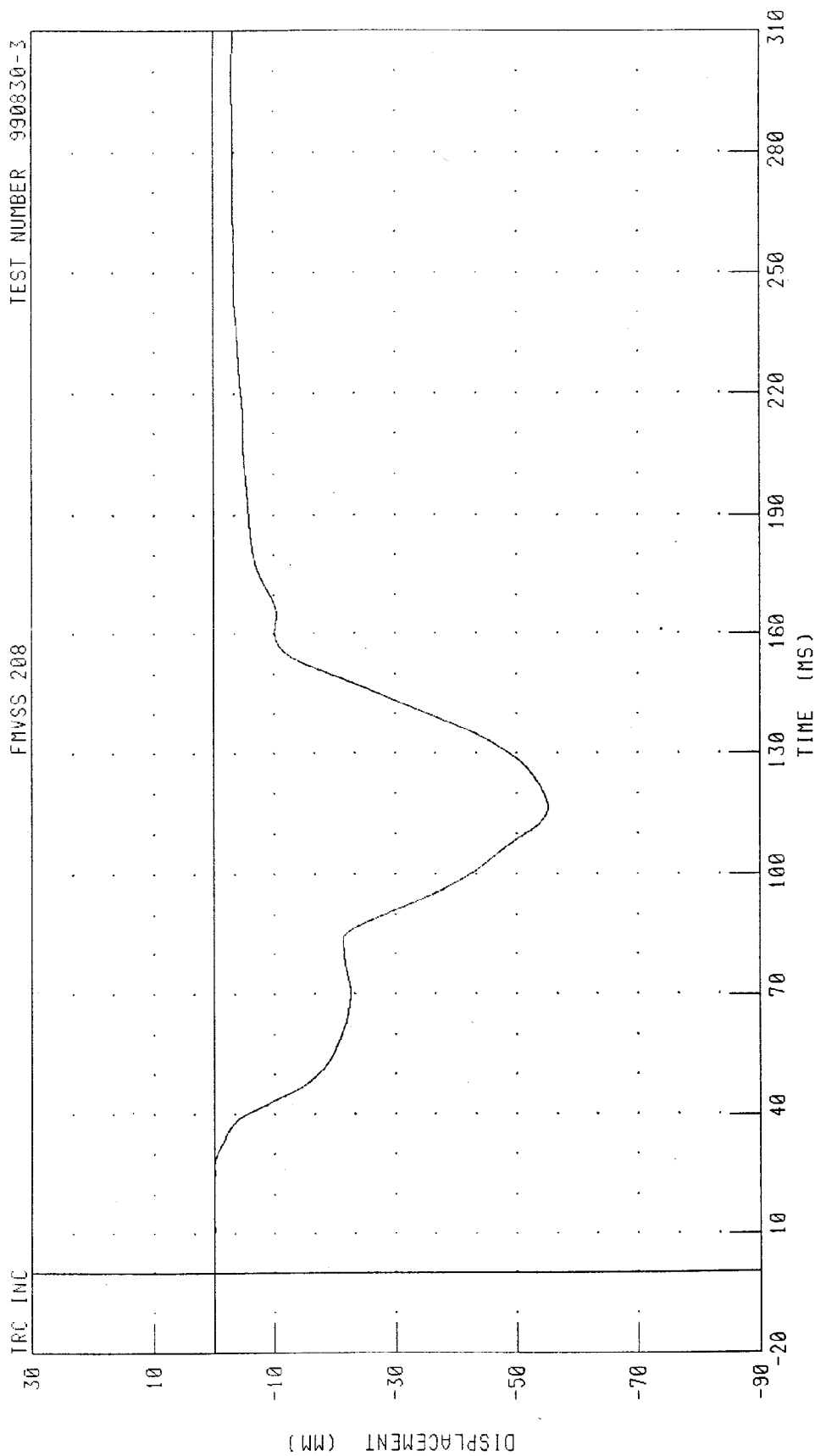
IRC INC



CHANNEL: CSTRG1 FILTER: CH. CLASS 180

PEAK DATA: 35.24 G @ 97.36 MS; 0.01 G @ -20.00 MS

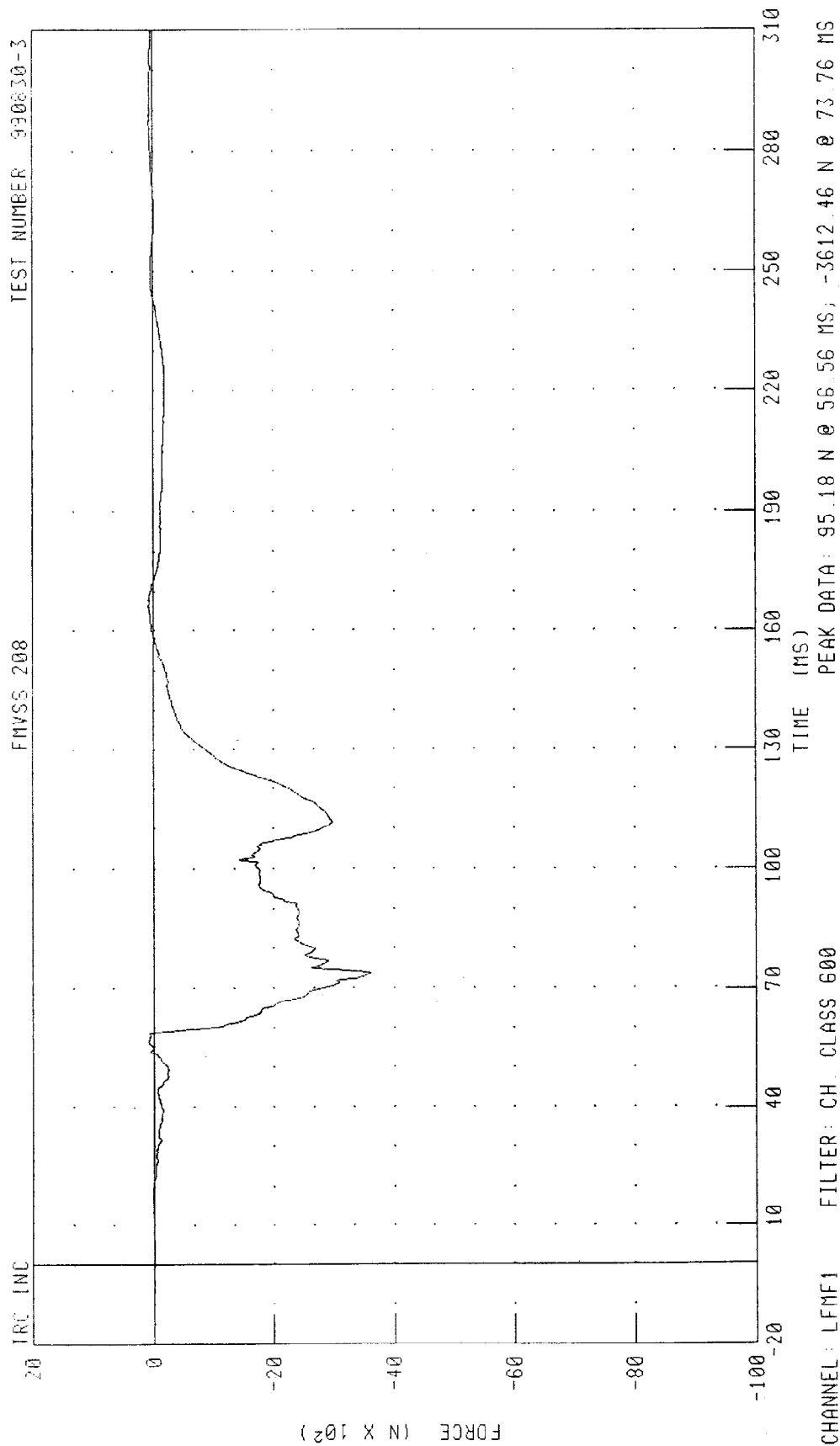
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER CHEST DEFLECTION



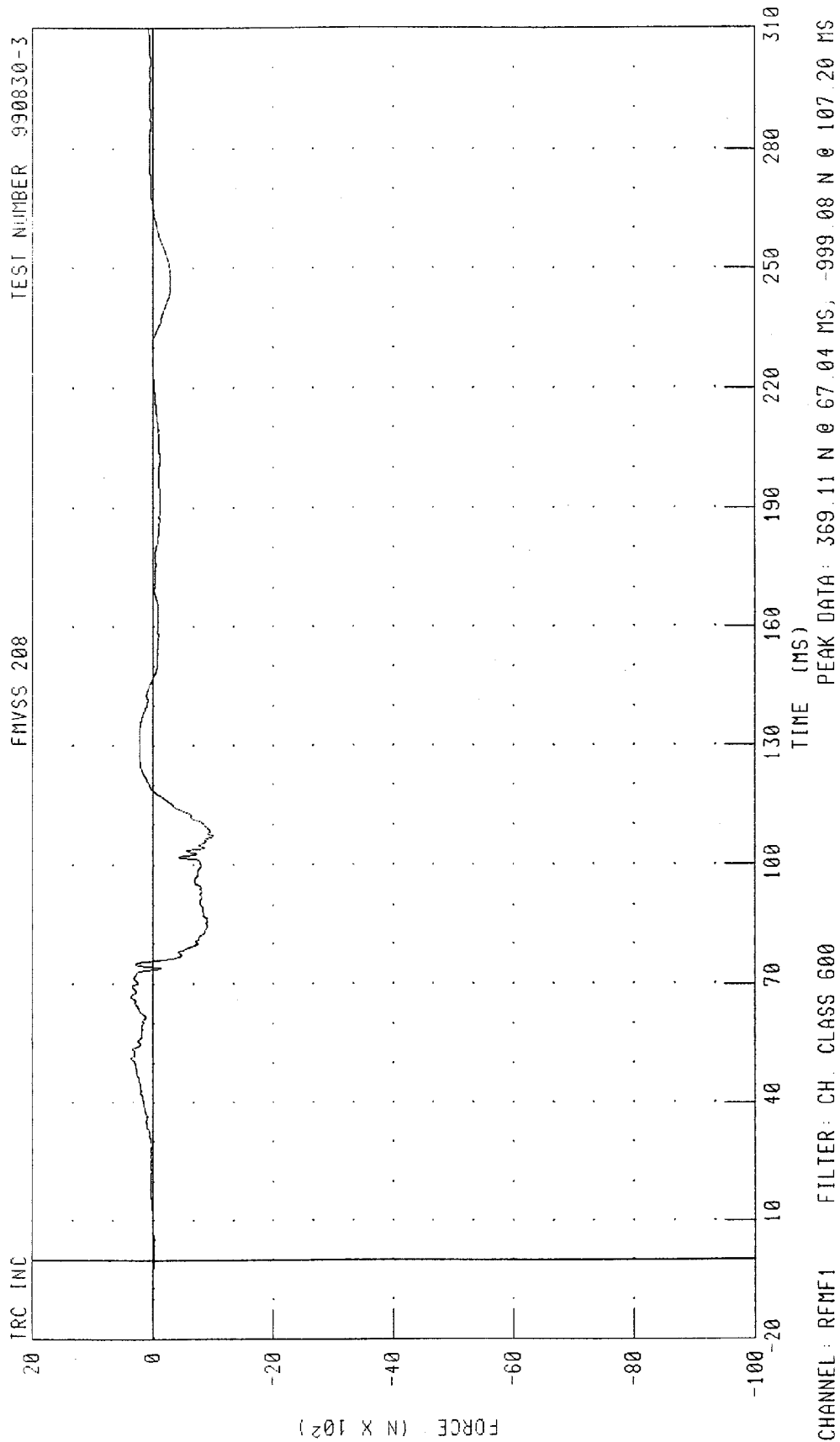
CHANNEL: CSTXD1 FILTER: CH. CLASS 180

PEAK DATA: 0.04 MM @ 19.04 MS; -55.14 MM @ 116.80 MS

1999 SATURN SL1 INTO LHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT FEMUR FORCE



1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT FEMUR FORCE

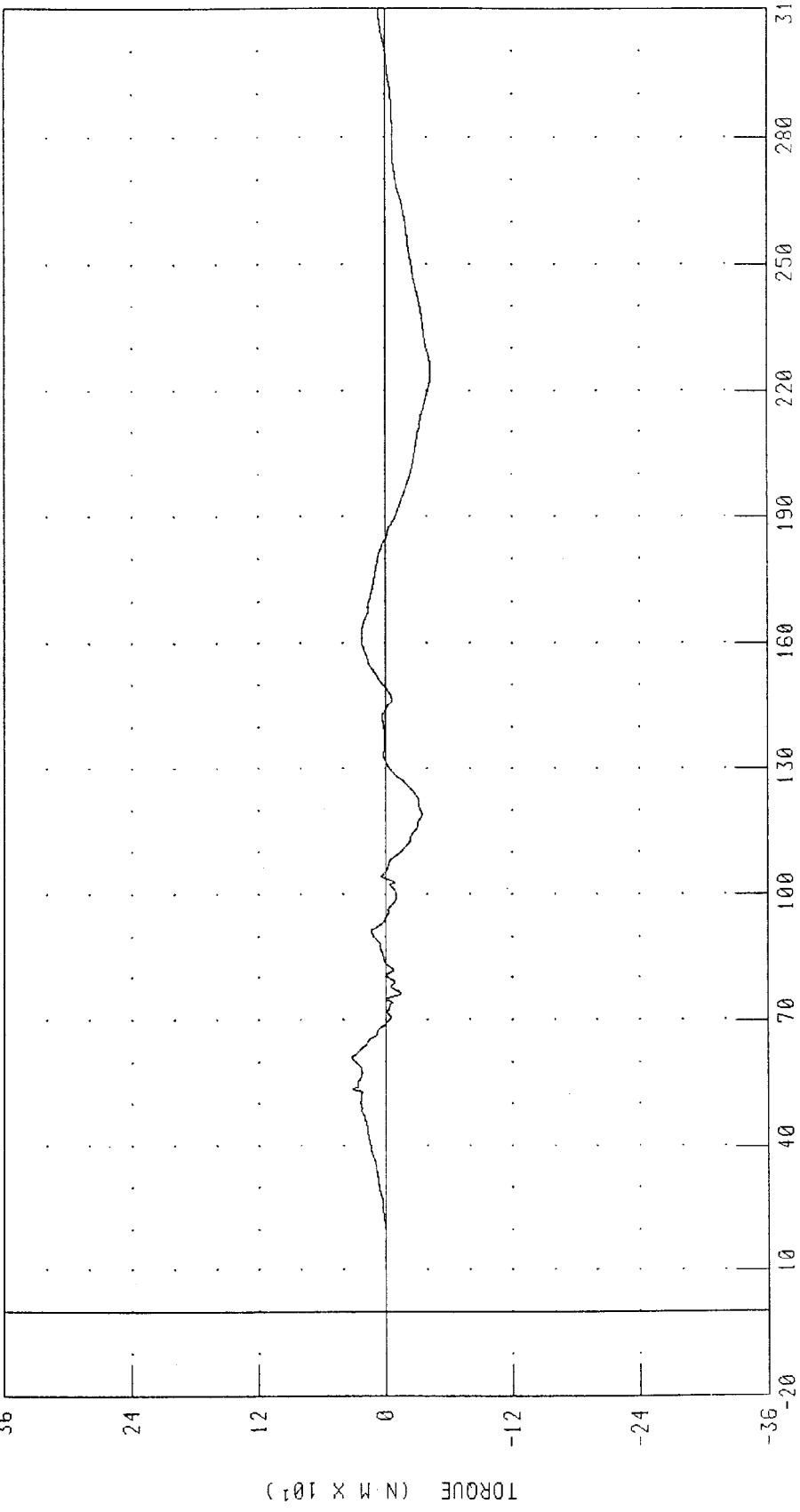


1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT UPPER TIBIA MOMENT ABOUT X AXIS

TEST NUMBER: 990830-3

FNVS 208

TRC INC.



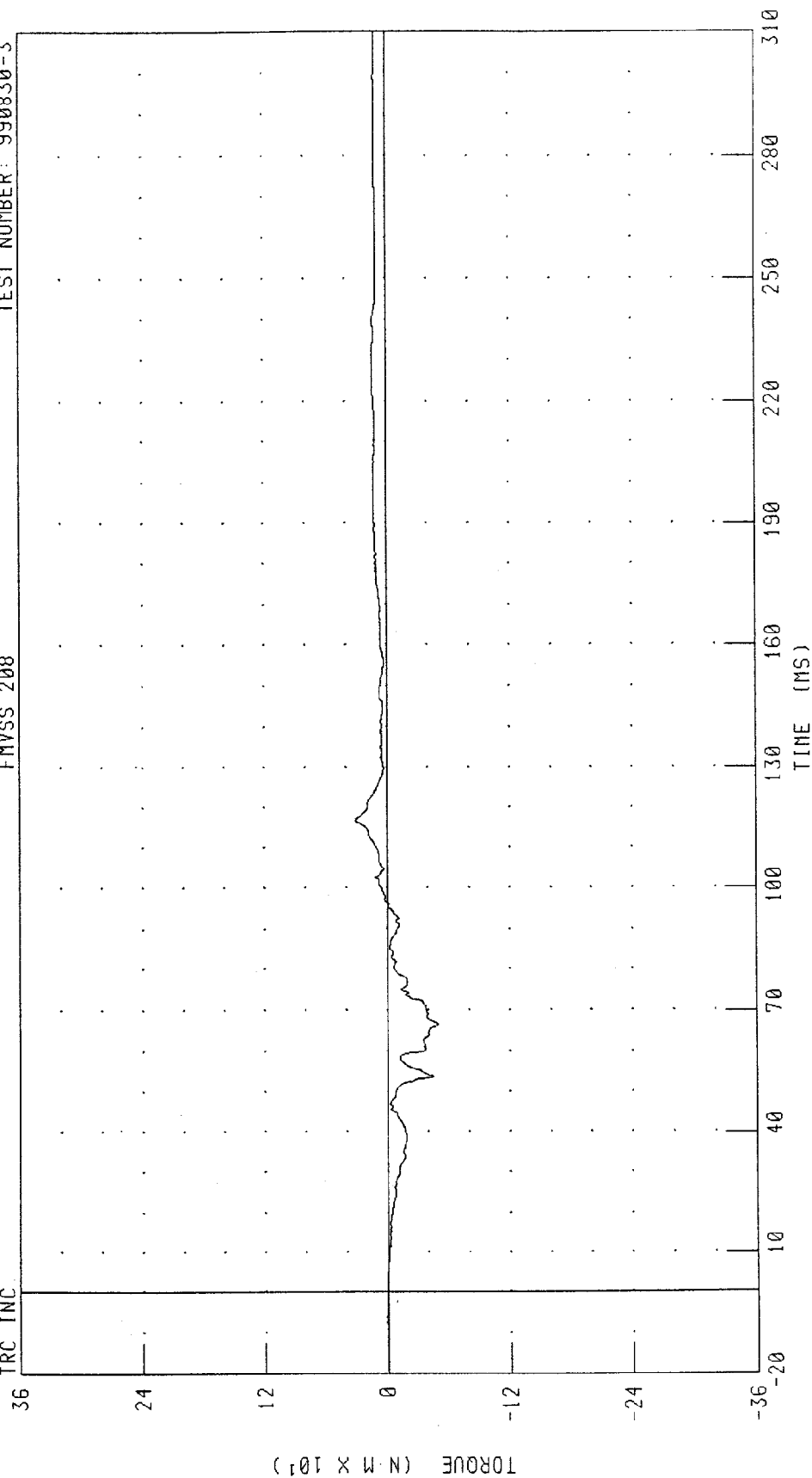
CHANNEL TBLXM1 FILTER: CH CLASS 600 PEAK DATA: 31.92 N M @ 61.36 MS, -43.55 N M @ 224.88 MS

1999 SATURN SL1 INTO TIHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT UPPER TIBIA MOMENT ABOUT Y AXIS

TEST NUMBER: 990830-3

FMVSS 208

TRC INC



PEAK DATA: 30.32 N-M @ 116.96 MS, -49.76 N-M @ 66.48 MS

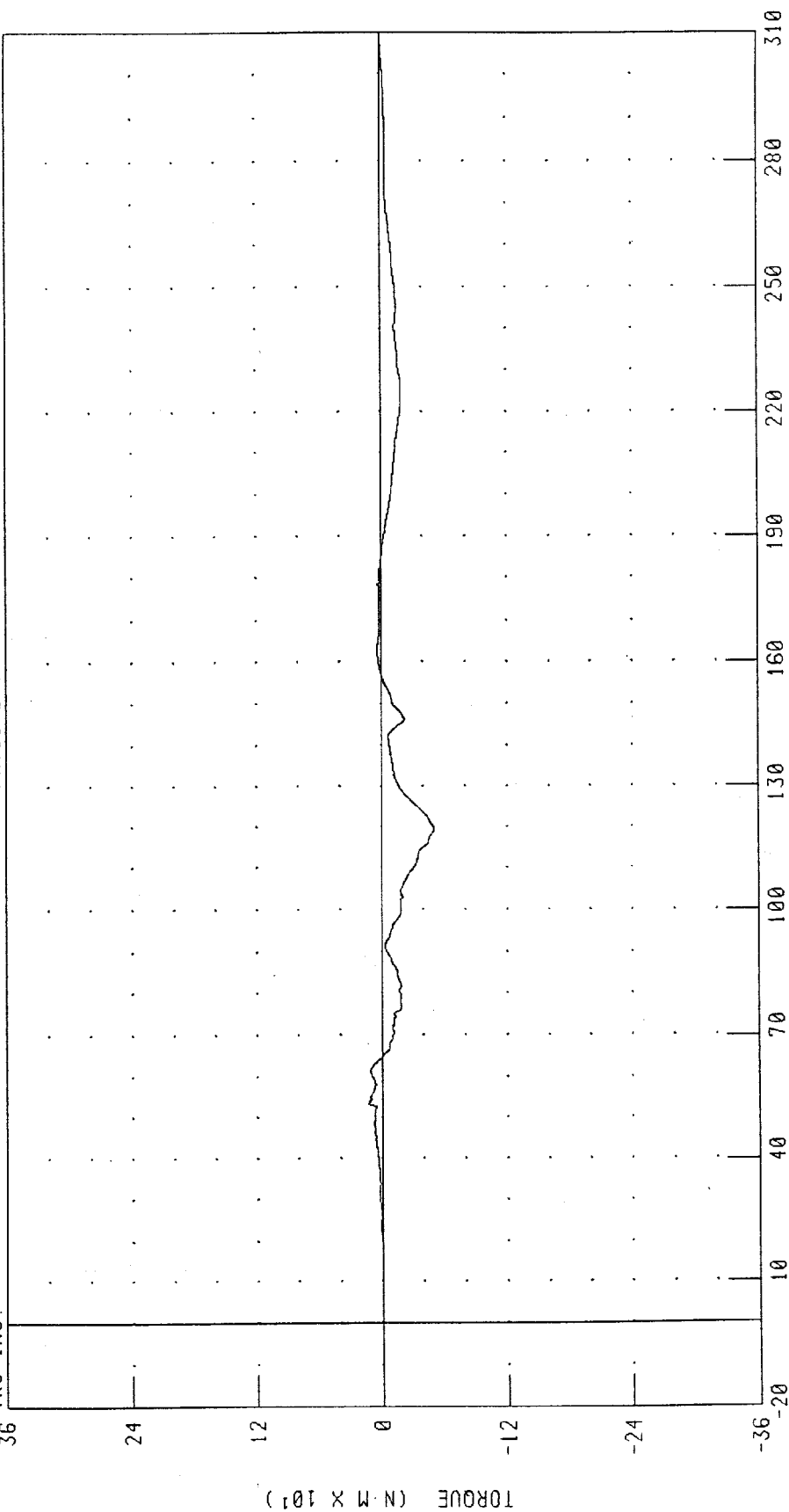
CHANNEL: TBLYM1 FILTER: CH. CLASS 600

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT LOWER TIBIA MOMENT ABOUT X AXIS

TEST NUMBER: 990830-3

FMYSS 208

TRC INC.



CHANNEL: ANLXM1 FILTER: CH. CLASS 600

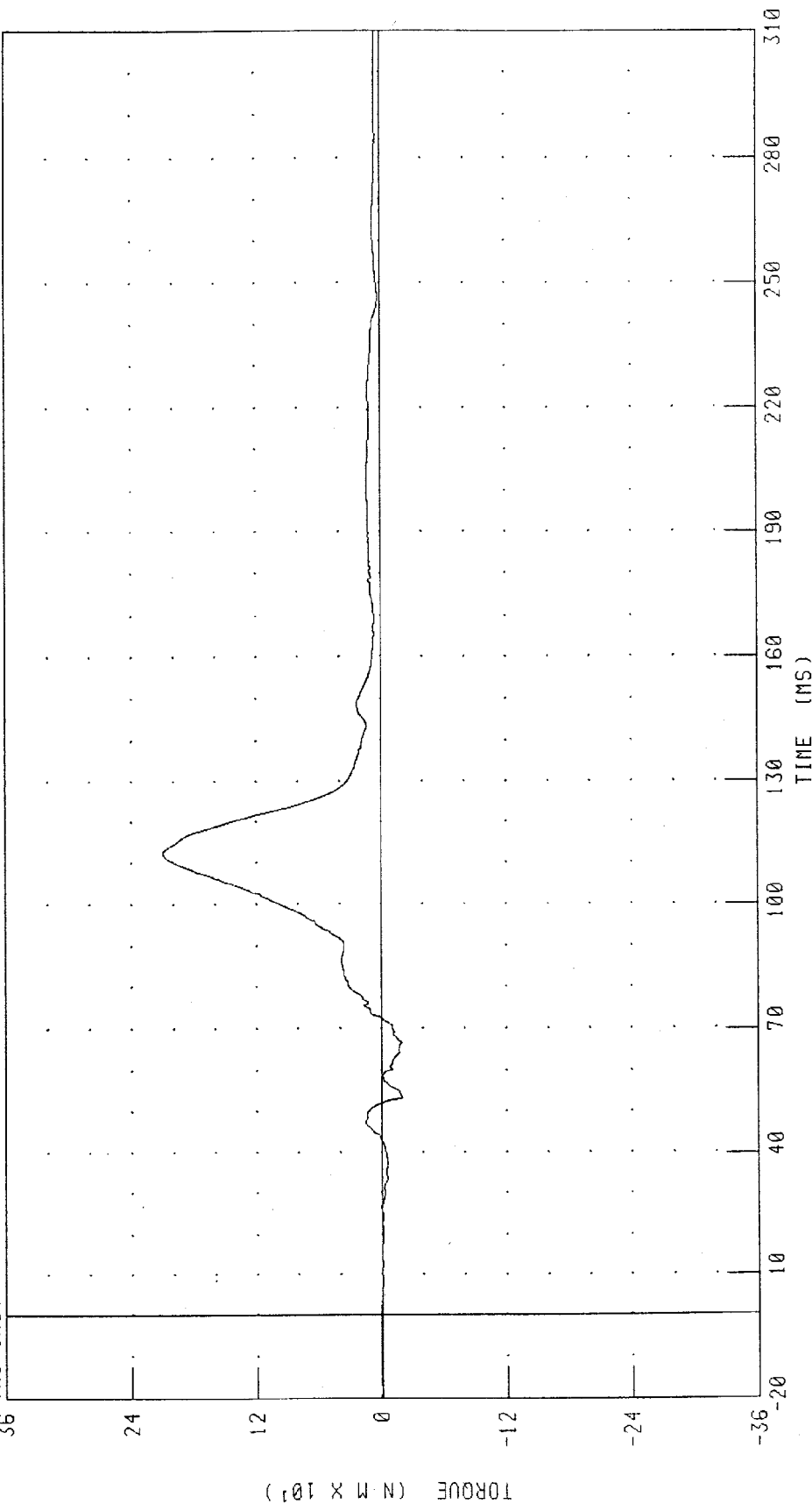
PEAK DATA: 13.38 N M @ 53.20 MS; -50.45 N M @ 119.44 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT LOWER TIBIA MOMENT ABOUT Y AXIS

TEST NUMBER: 990830-3

FMVSS 208

TRC INC.



PEAK DATA: 210 06 N M @ 112 64 MS, -20 07 N M @ 53 36 MS

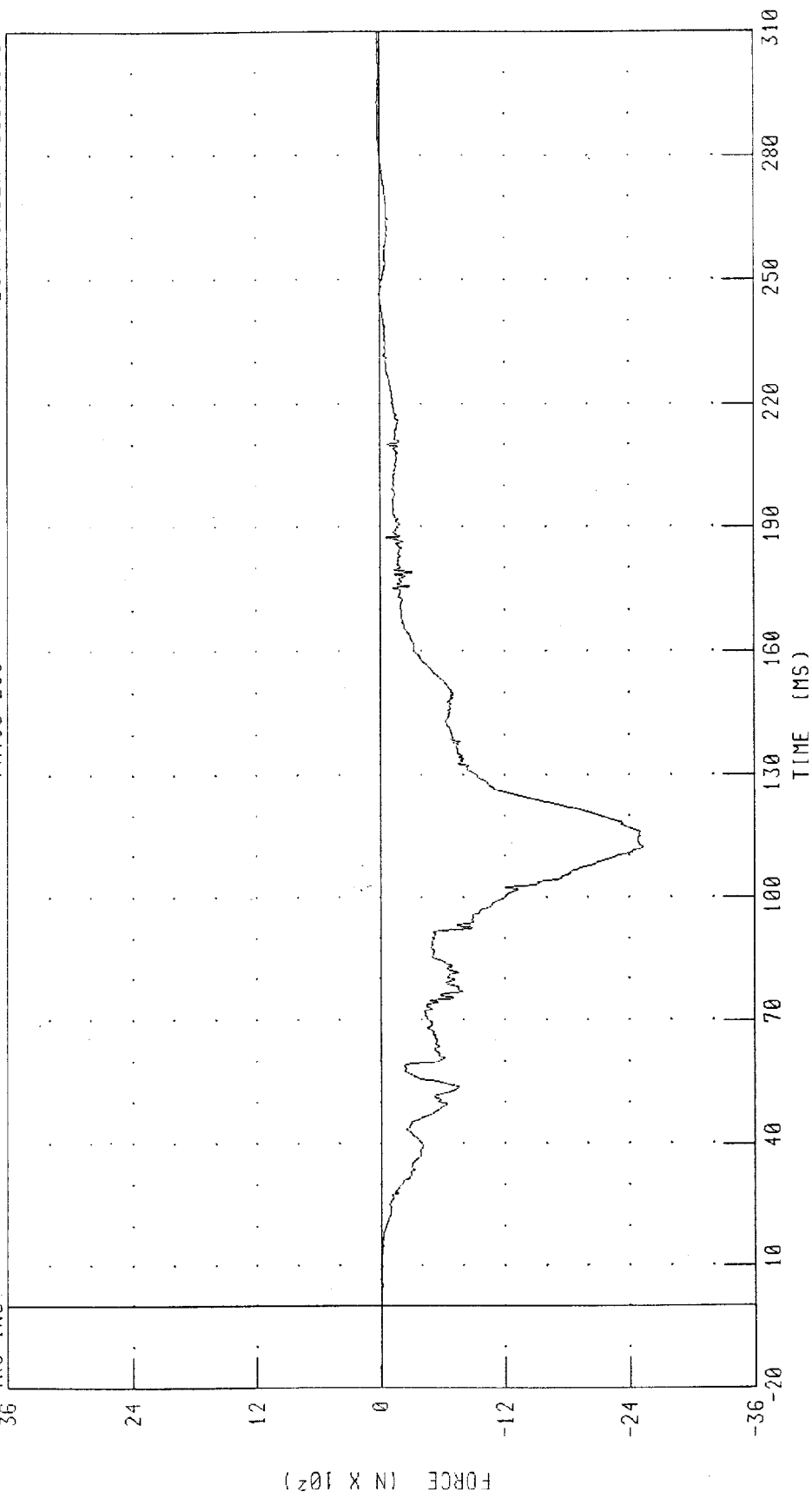
CHANNEL: ANLYM1 FILTER: CH CLASS 600

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER LEFT TIBIA Z-AXIS FORCE

TEST NUMBER 990830-3

FMVSS 208

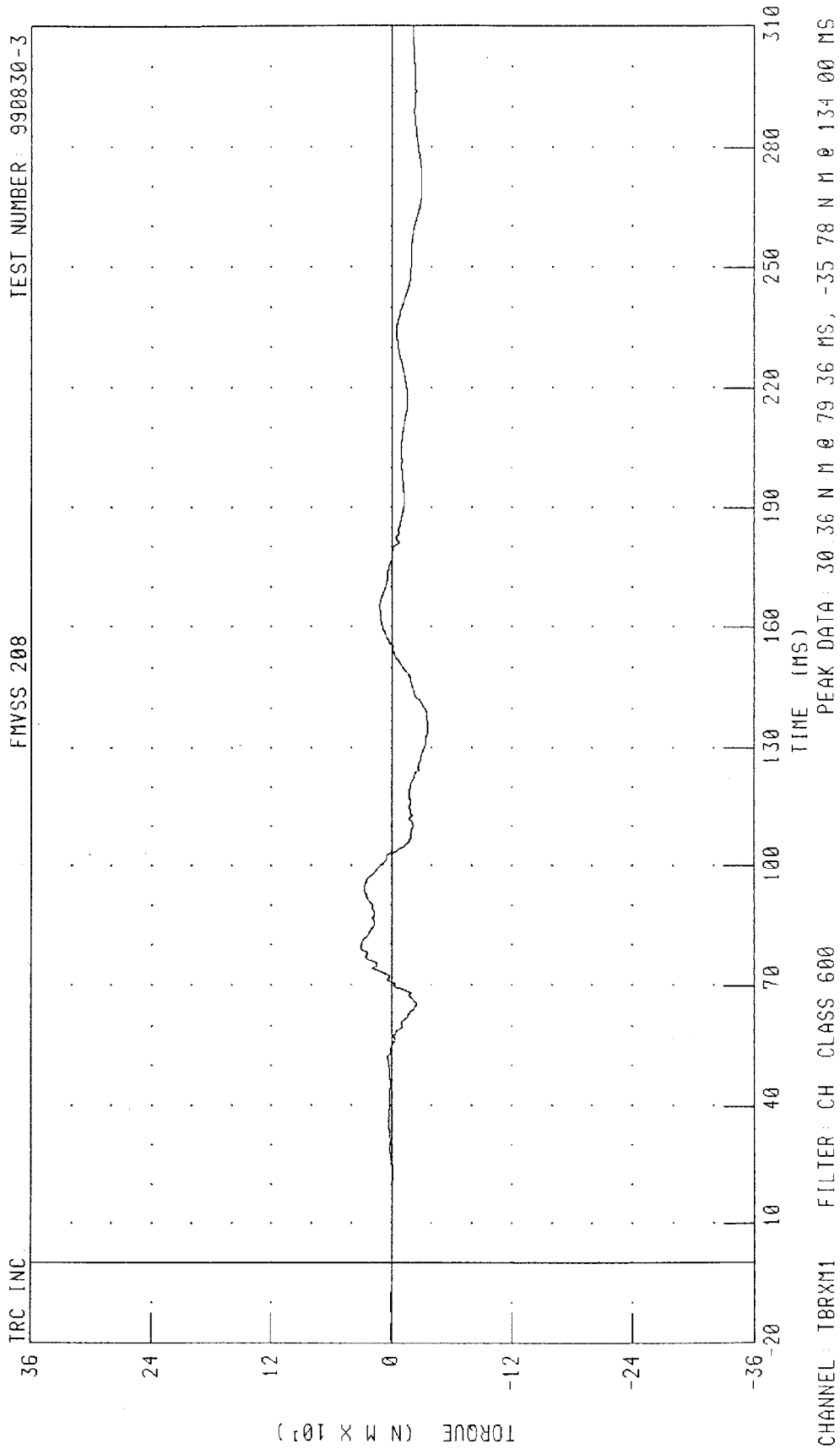
TRC INC.



PEAK DATA: 22.01 N @ 292.80 MS, -2535.31 N @ 112.40 MS

CHANNEL: TBLZF1 FILTER: CH. CLASS 600

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT UPPER TIBIA MOMENT ABOUT X AXIS

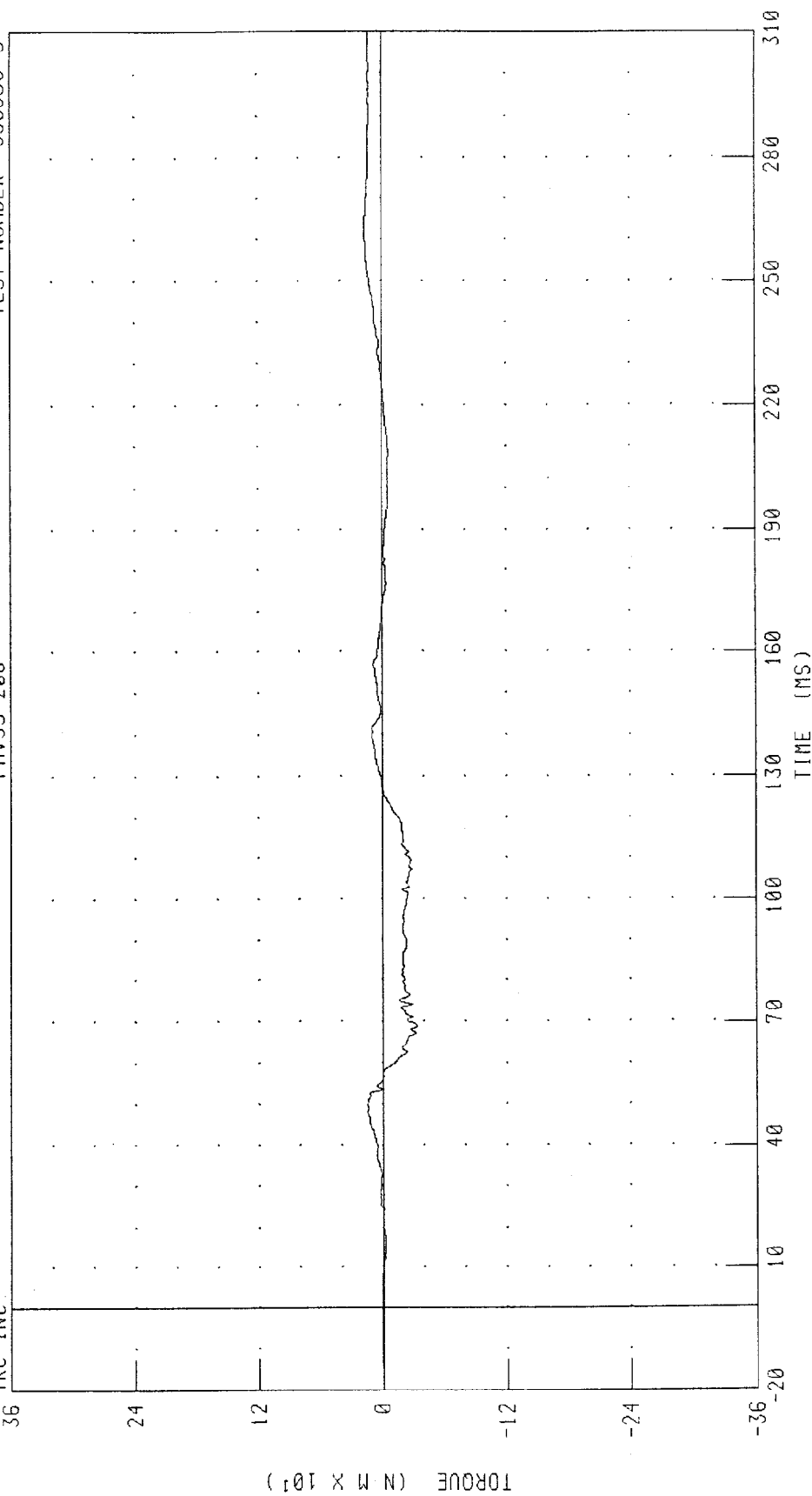


1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT UPPER TIBIA MOMENT ABOUT Y AXIS

TEST NUMBER: 990830-3

FMVSS 208

TRC INC



CHANNEL: TBRYM1 FILTER CH: CLASS 600

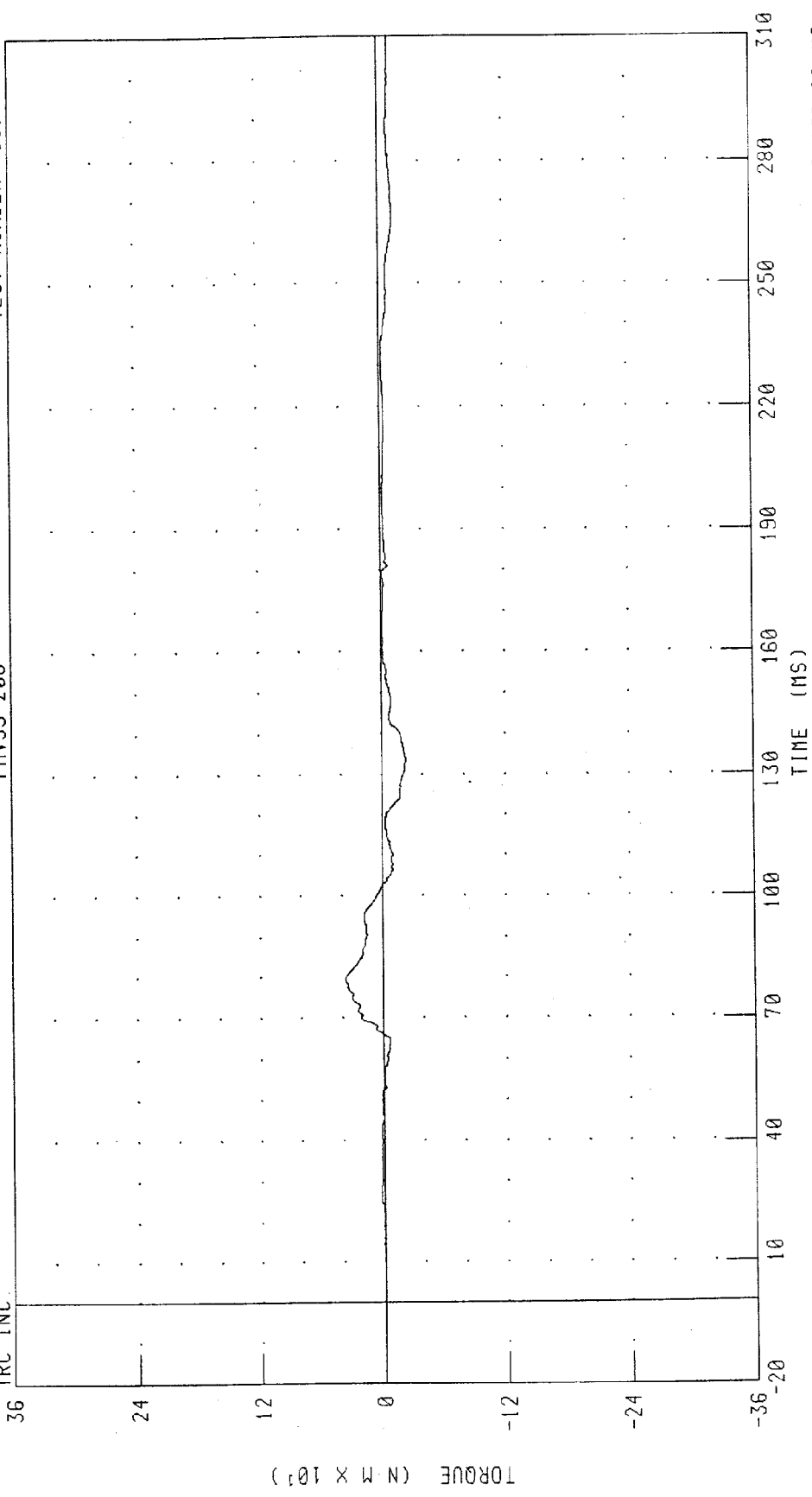
PEAK DATA: 15.71 N M @ 262.16 MS, -33.31 N M @ 68.96 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT LOWER TIBIA MOMENT ABOUT X AXIS

TEST NUMBER: 990830-3

FMVSS 208

TRC INC



PEAK DATA: 36.81 N·M @ 79.44 MS, -23.69 N·M @ 133.60 MS

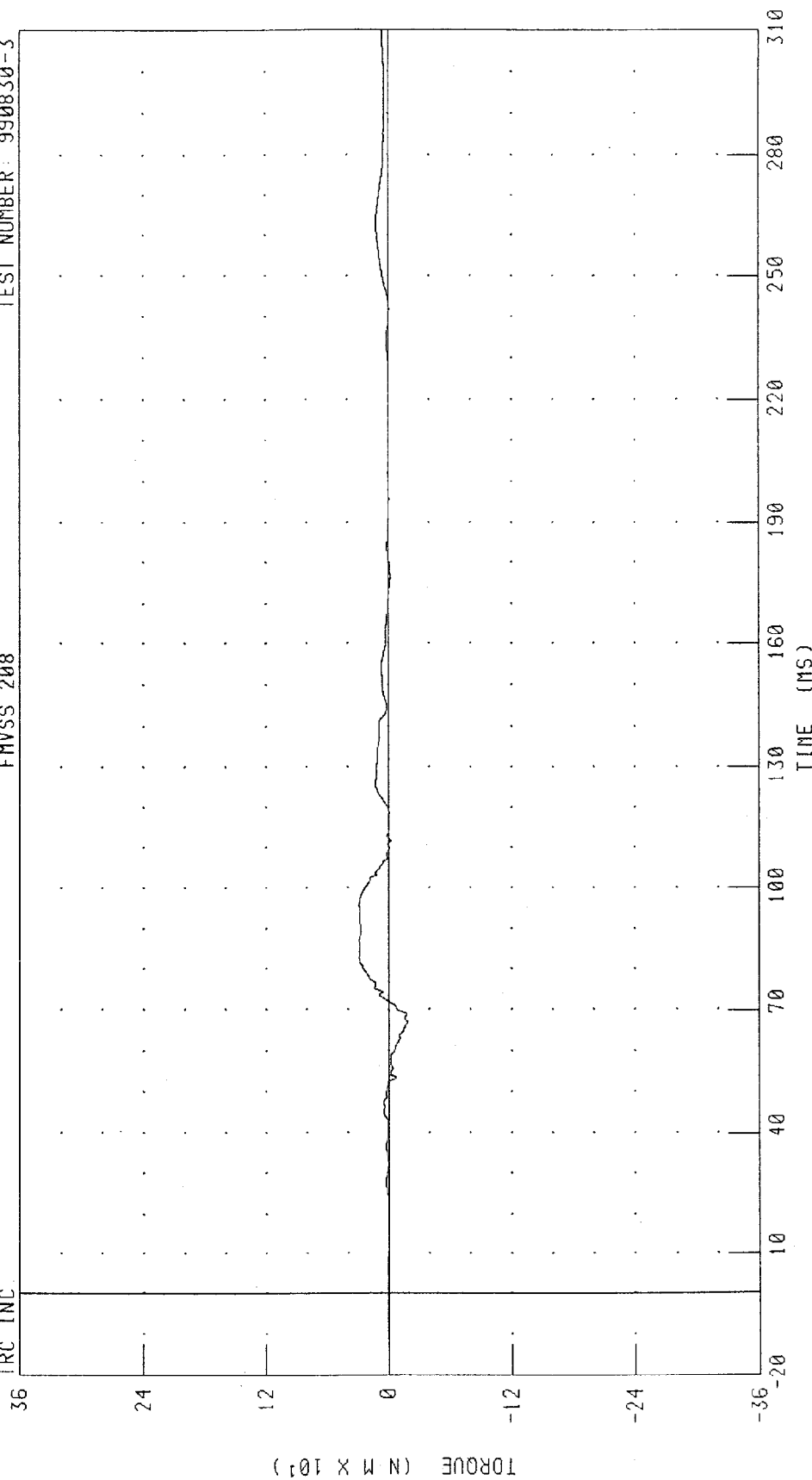
CHANNEL ANR XM1 FILTER: CH CLASS 600

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT LOWER TIBIA MOMENT ABOUT Y AXIS

TEST NUMBER: 990830-3

FMVSS 208

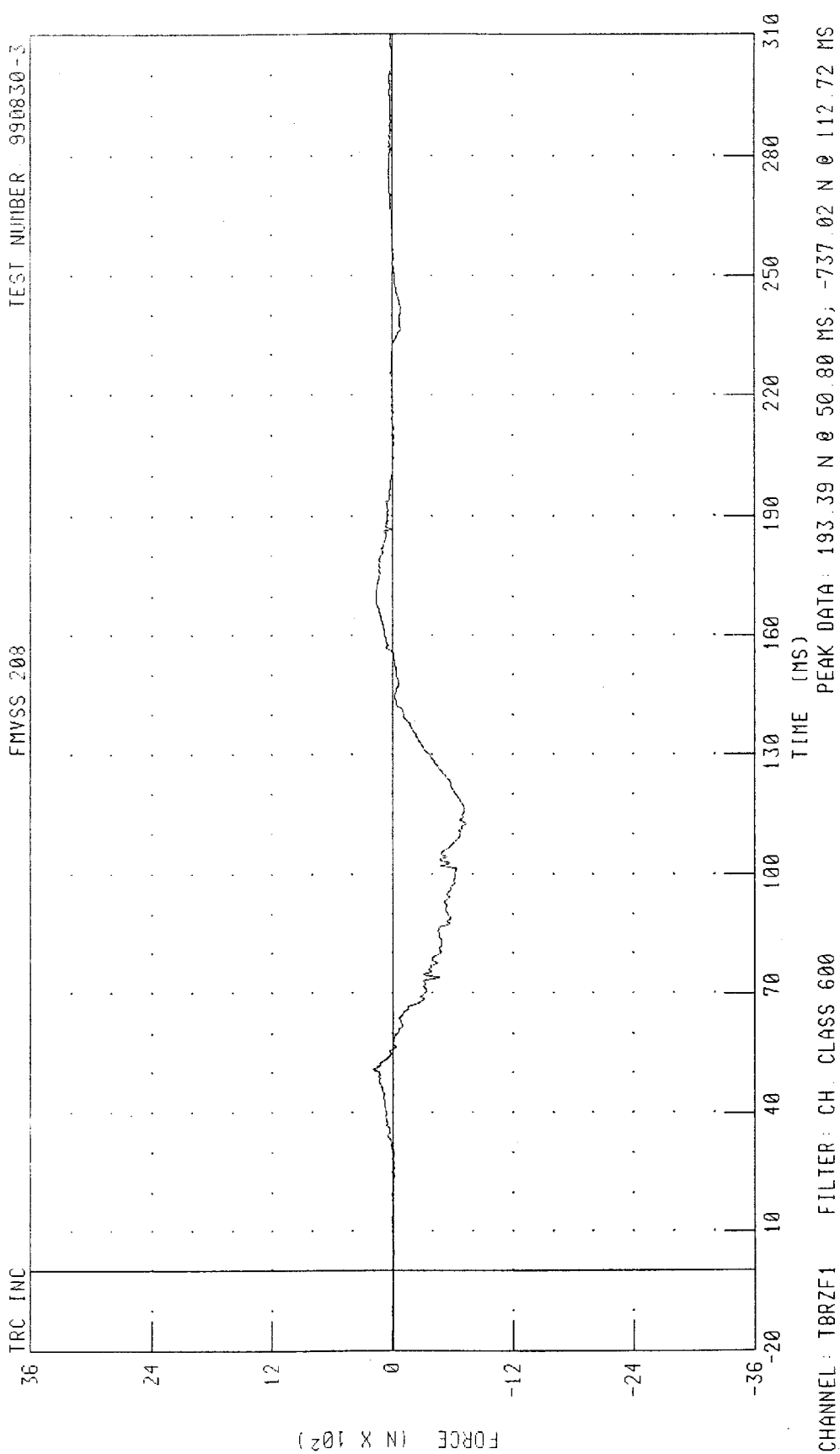
TRC INC.



PEAK DATA: 29.19 N M @ 95.84 MS; -19.05 N M @ 67.04 MS

CHANNEL: ANRYM1 FILTER: CH CLASS 600

1999 SATURN SL11INT0 11HS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER RIGHT TIBIA Z-AXIS FORCE



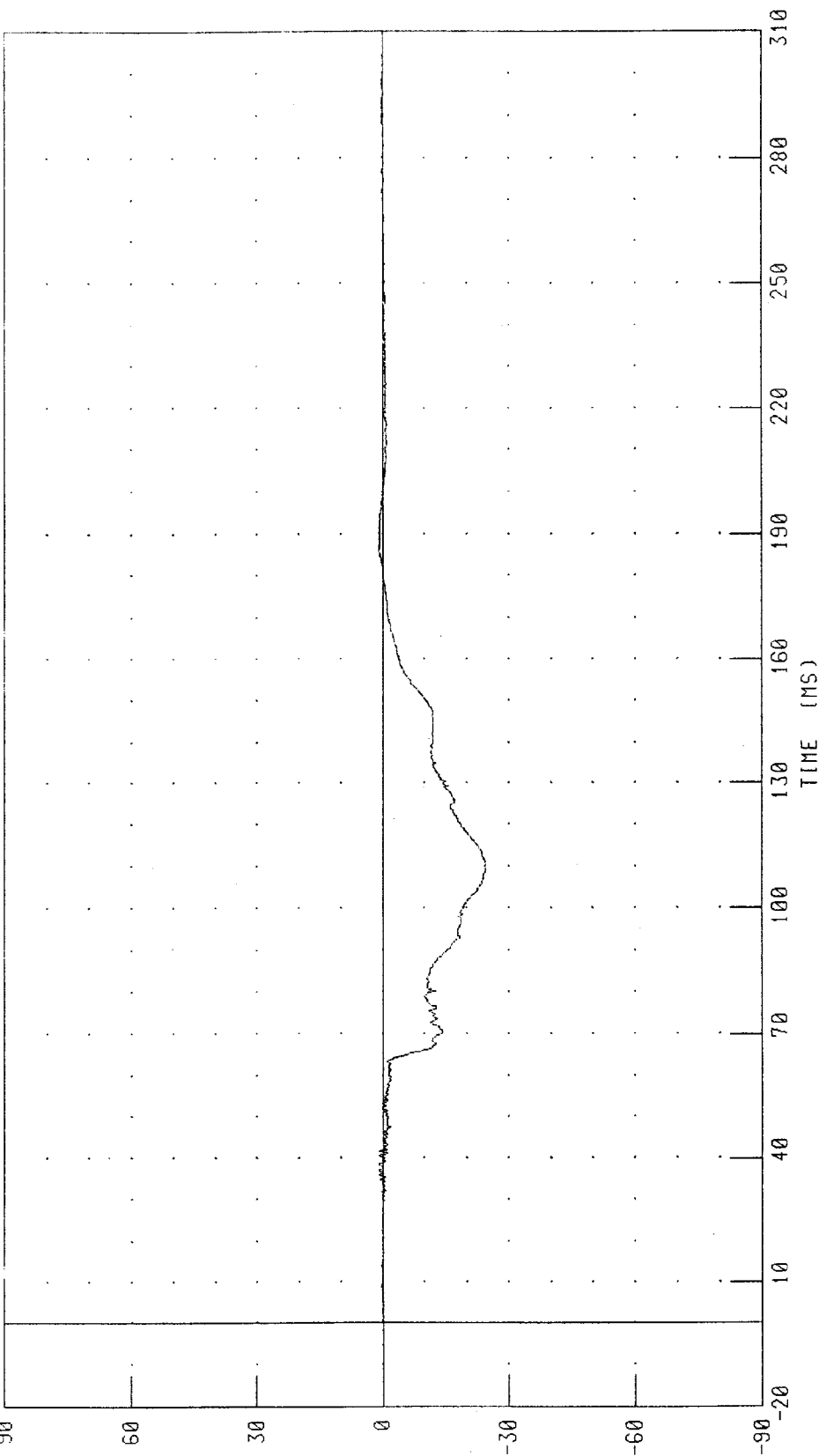
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER HEAD X-AXIS ACCELERATION

TRC INC

FWSS 203

TEST NUMBER 990830-3

ACCELERATION (G)



CHANNEL: HEDXC2 FILTER: CH. CLASS 1000

PEAK DATA: 0.94 G @ 38.48 MS, -24.57 G @ 109.20 MS

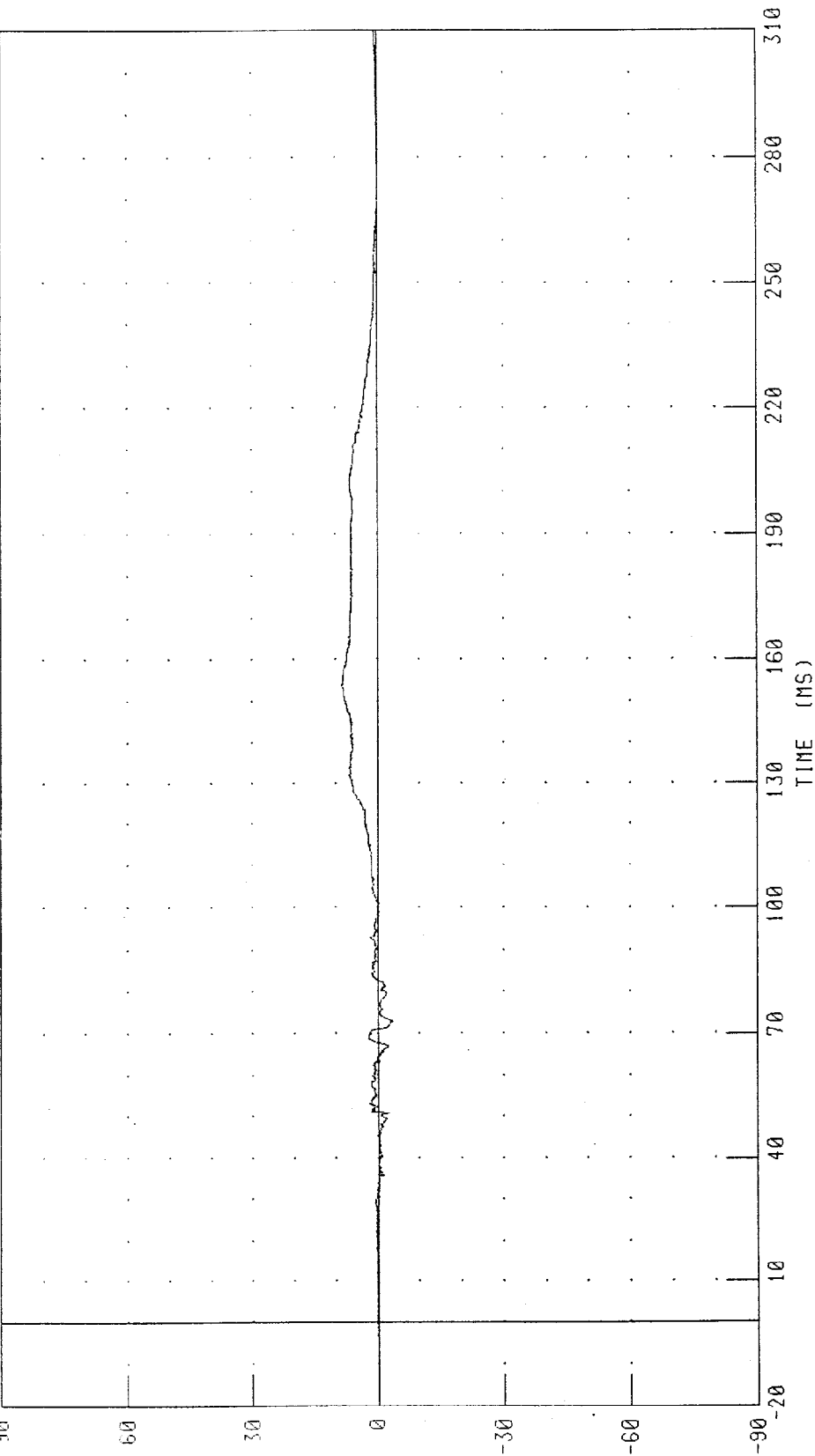
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER HEAD Y-AXIS ACCELERATION

TRC INC

FMVSS 208

TEST NUMBER 990830-3

ACCELERATION (G)



CHANNEL: HEDYC2 FILTER: CH. CLASS 1000

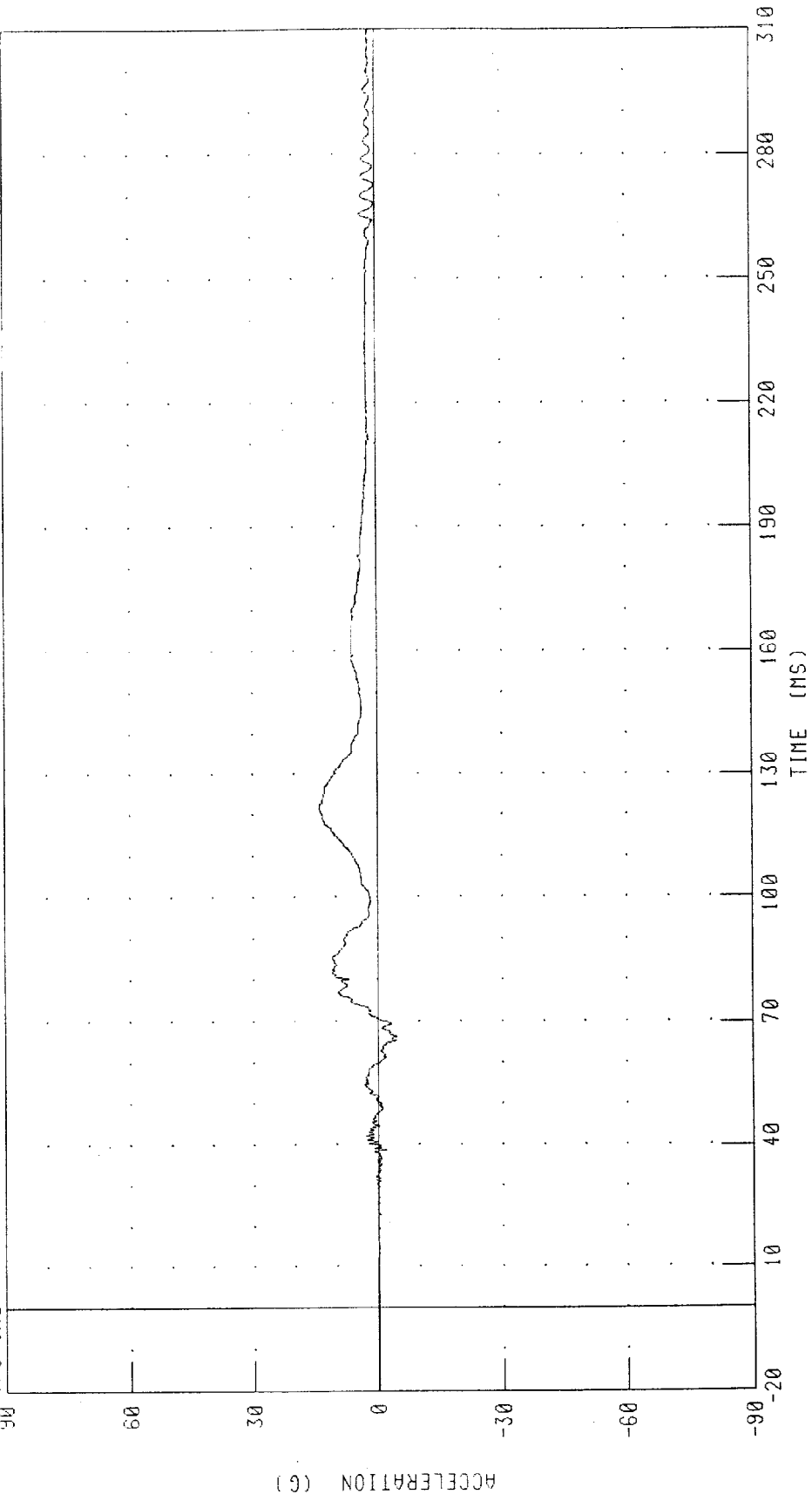
PEAK DATA: 8.54 C @ 153.60 MS, -3.63 C @ 72.96 MS

1999 SATURN SL11INT0 [IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER HEAD Z-AXIS ACCELERATION

TRC INC

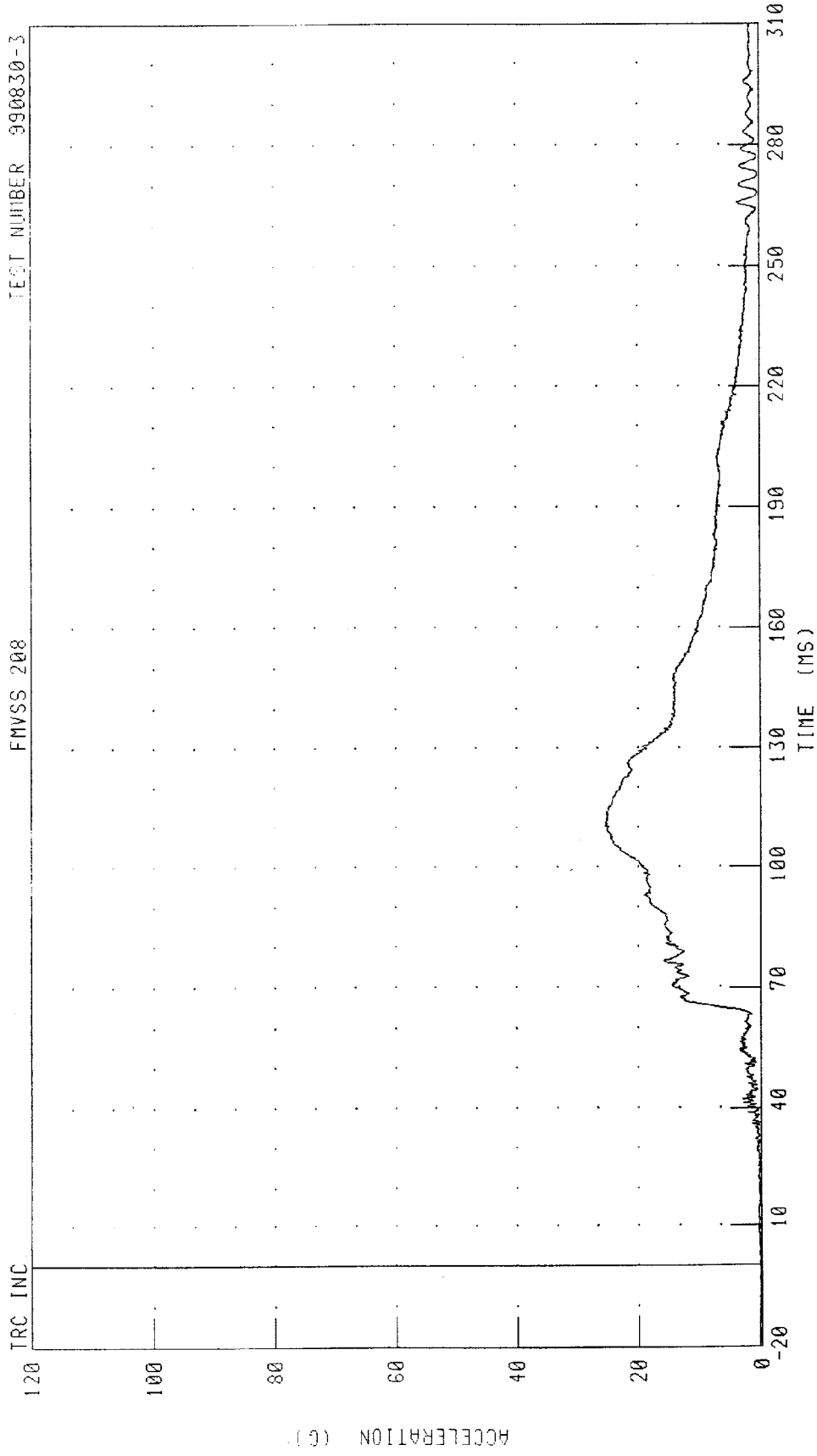
FMVSS 208

TEST NUMBER 990830-1



CHANNEL: HEDZ02 FILTER: CH. CLASS 1000 PEAK DATA: 13.88 G @ 121.52 MS, -4.57 G @ 66.40 MS

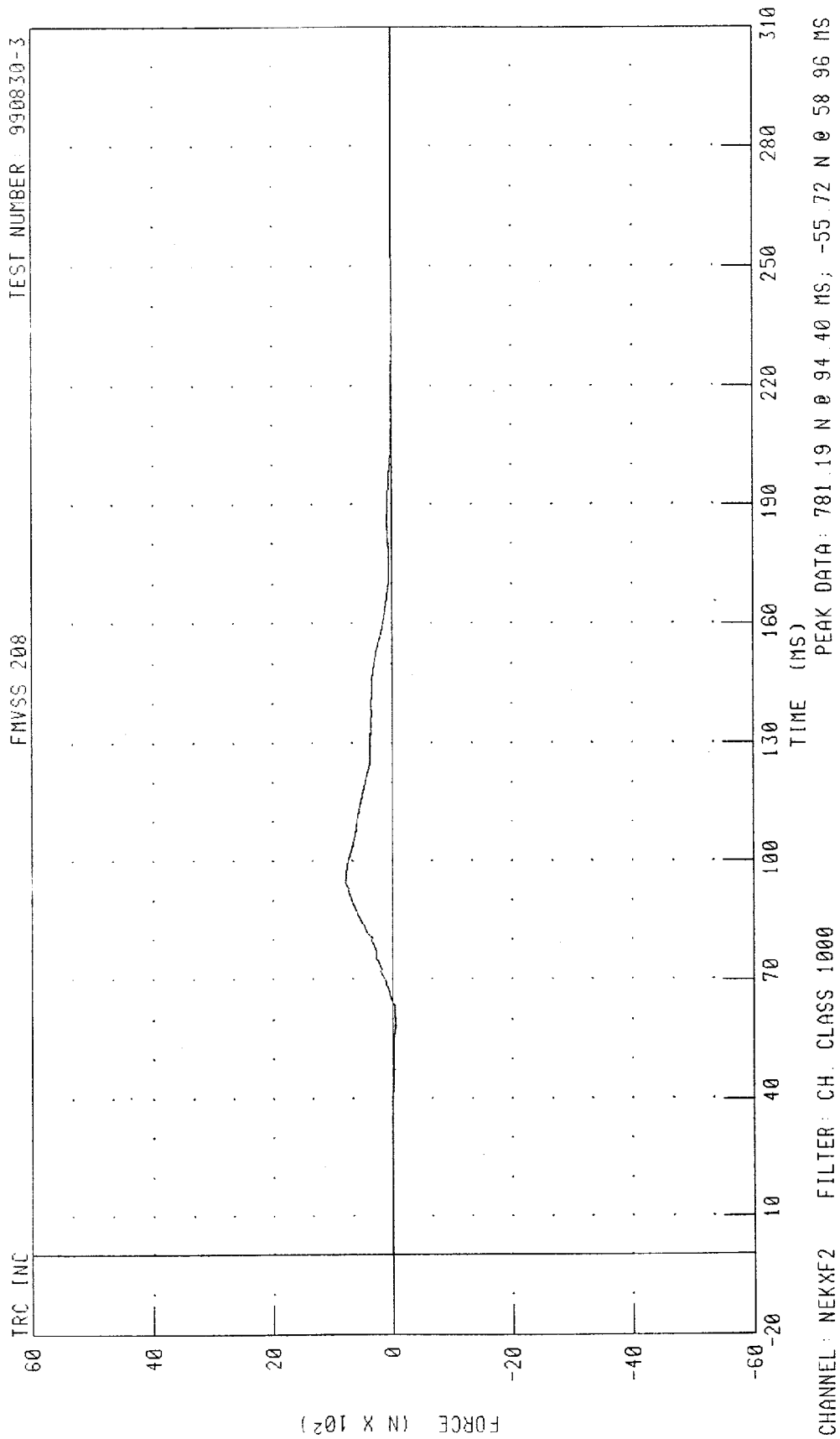
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER HEAD RESULTANT ACCELERATION



CHANNEL: HEDRC2 FILTER: CH. CLASS 1000

PEAK DATA: 25.36 G @ 110.64 MS, 0.14 G @ -19.36 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK X-AXIS SHEAR FORCE

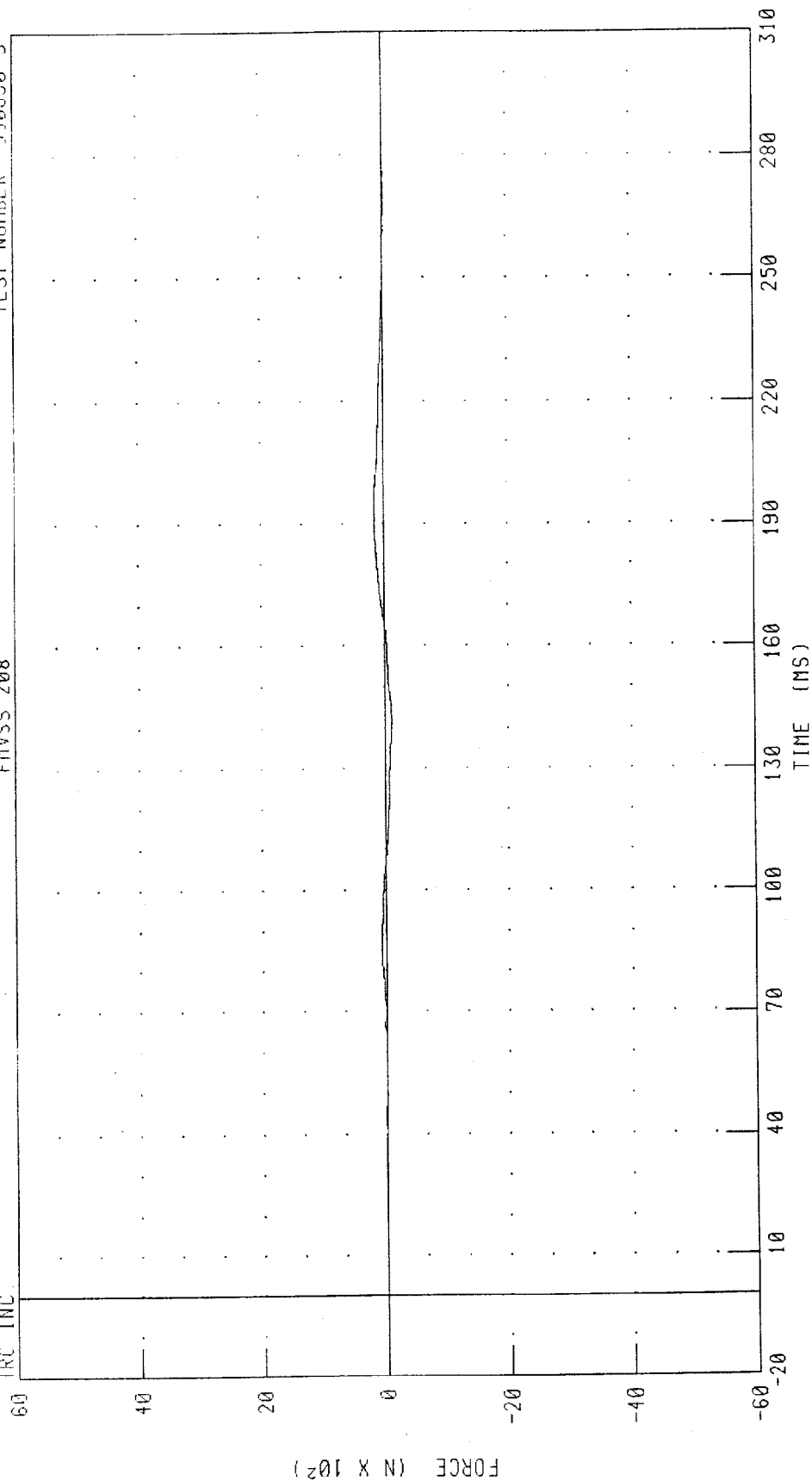


1999 SATURN SLI INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK Y-AXIS SHEAR FORCE

TEST NUMBER 990830-3

FMVSS 208

TRC INC.



PEAK DATA: 148.77 N @ 190.00 MS, -120.68 N @ 140.24 MS

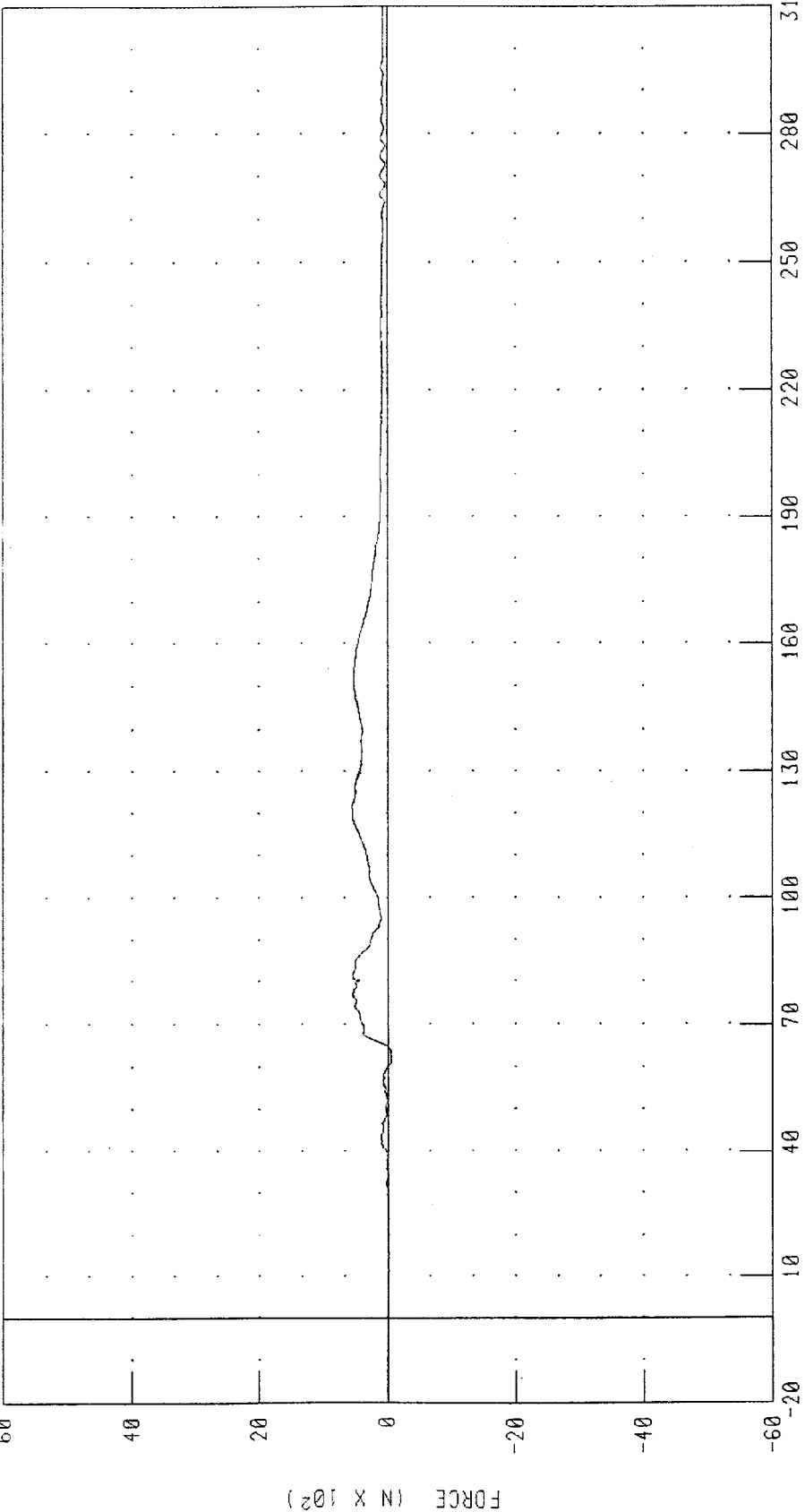
CHANNEL: NEKYF2 FILTER: CH. CLASS 1000

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK Z-AXIS AXIAL FORCE

TEST NUMBER: 990830-3

FMVSS 208

TRC INC.

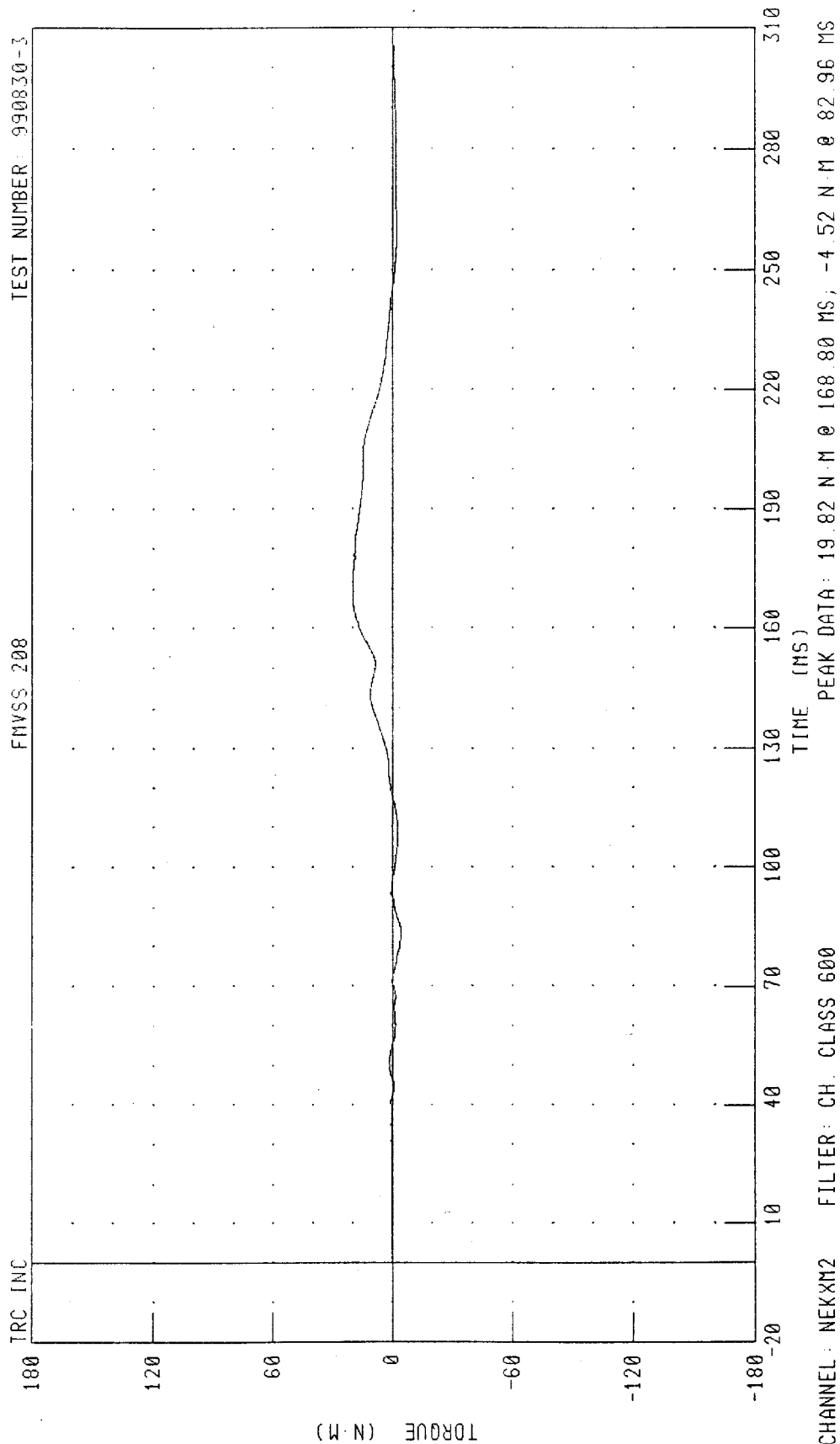


TIME (MS)

PEAK DATA: 543.08 N @ 77.04 MS; -64.36 N @ 61.60 MS

CHANNEL: NEKZF2 FILTER: CH CLASS 1000

1993 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT X AXIS

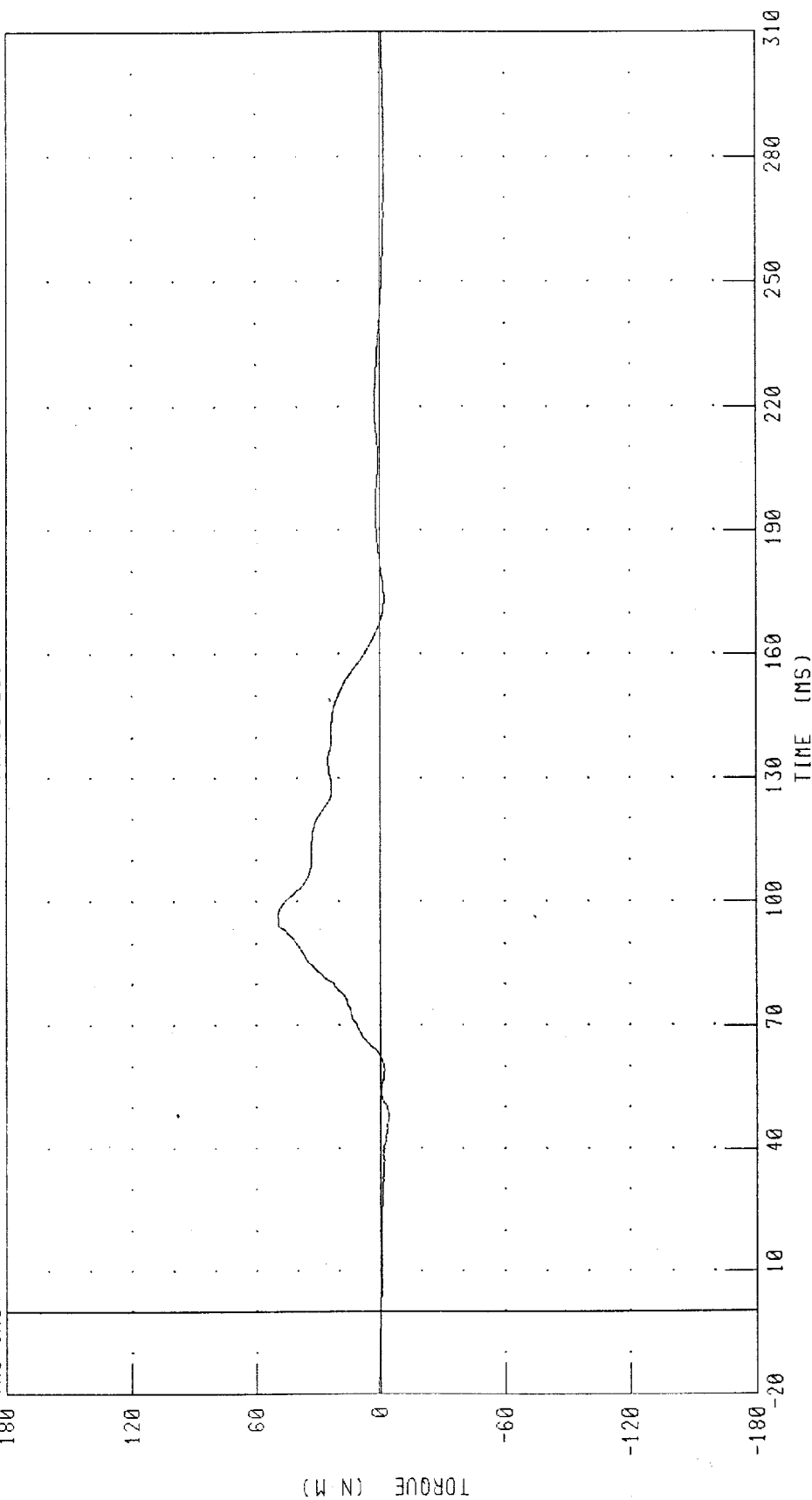


1999 SATURN SL1 INTO I1HS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT Y AXIS

TEST NUMBER 990830-3

FMVSS 208

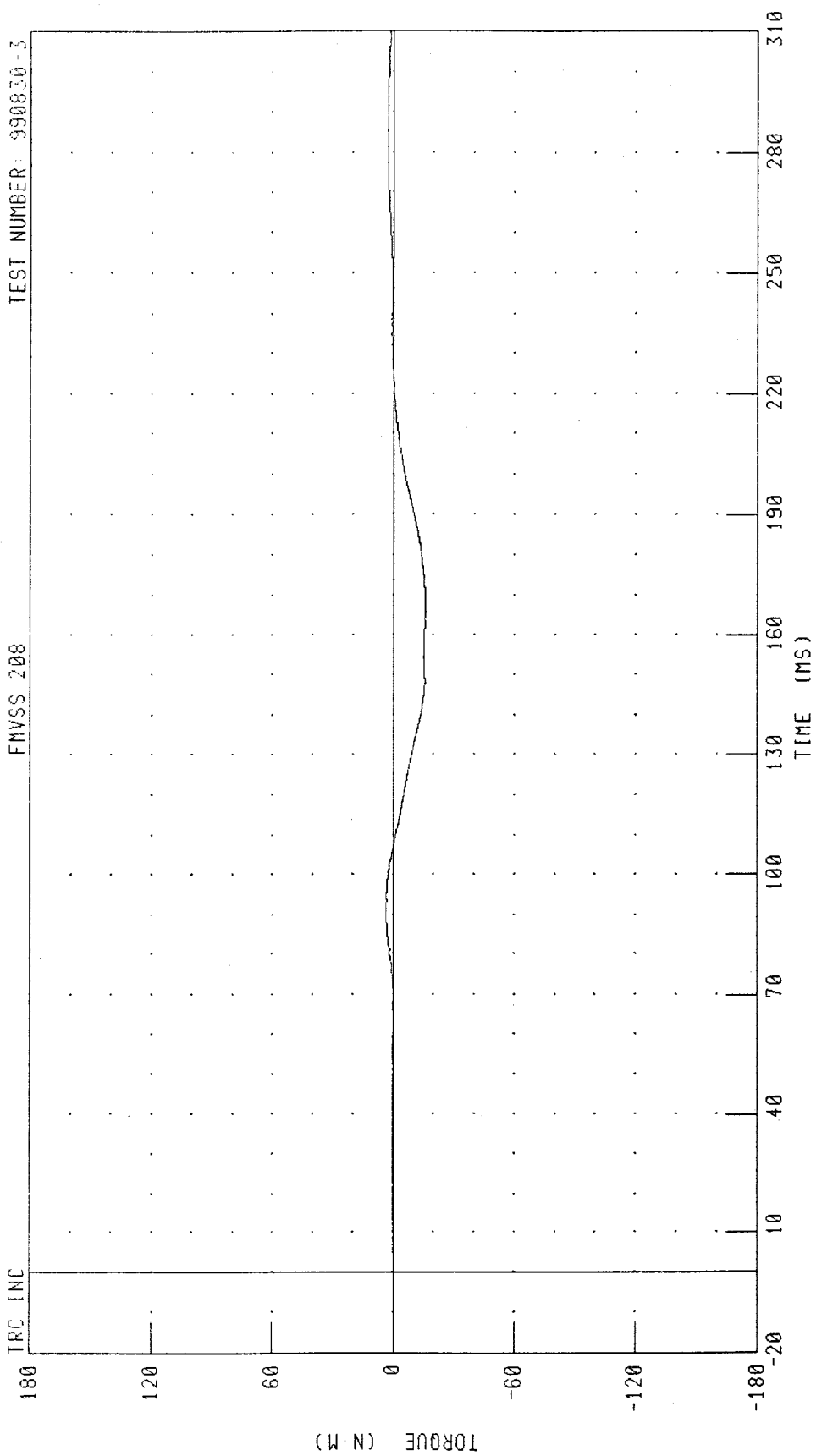
TRC INC



CHANNEL: NEKYM2 FILTER: CH. CLASS 600

PEAK DATA: 49.37 N·m @ 96.64 ms, -4.42 N·m @ 47.92 ms

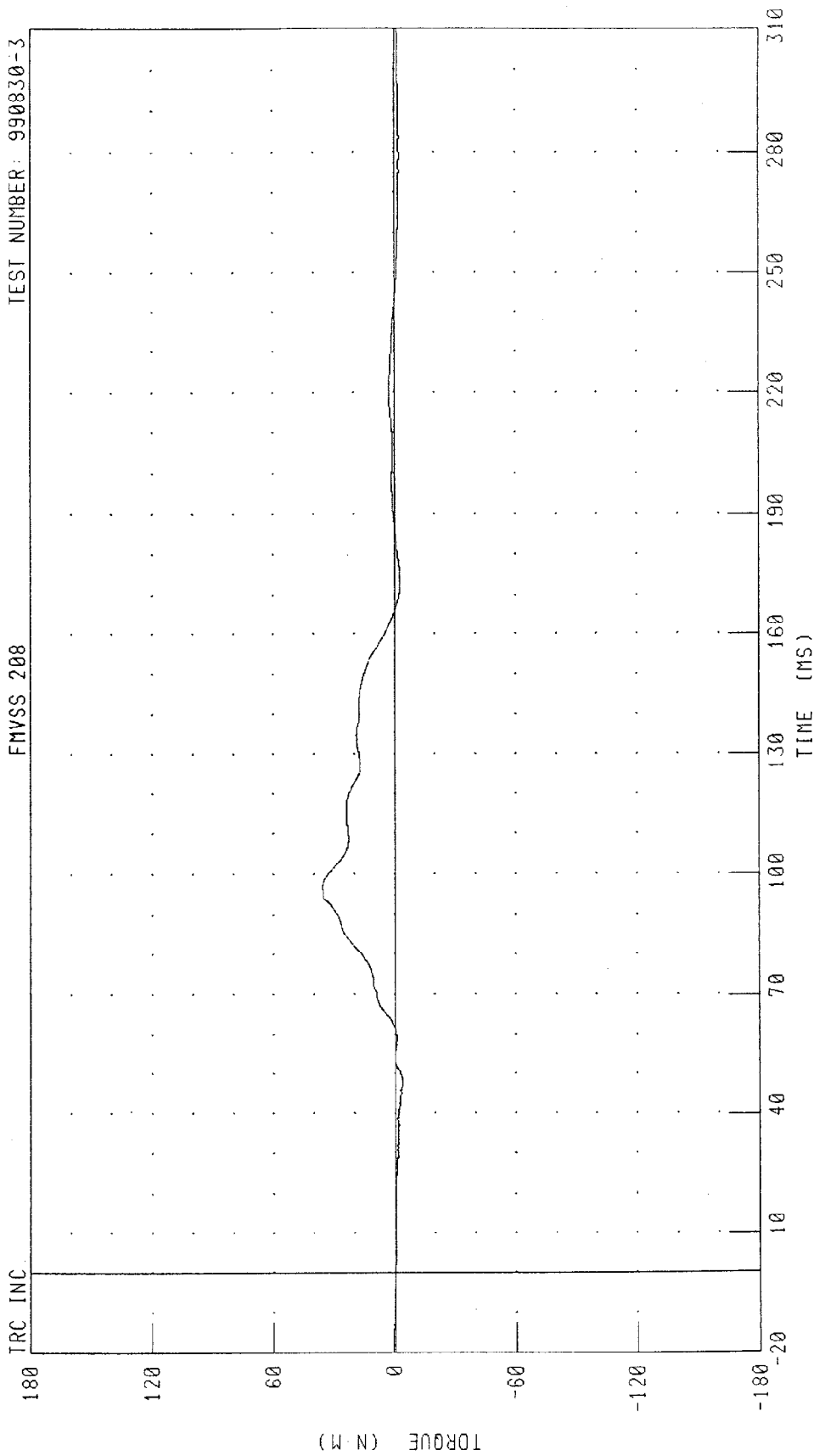
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT Z AXIS



CHANNEL: NEKZM2 FILTER: CH. CLASS 600

PEAK DATA: 3.57 N M @ 90.80 MS; -16.25 N M @ 165.92 MS

1999 SATURN SL1 INTO IIHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER NECK OCCIPITAL CONDYLE MOMENT ABOUT Y AXIS



CHANNEL: NEKOM2 FILTER: CH. CLASS 600

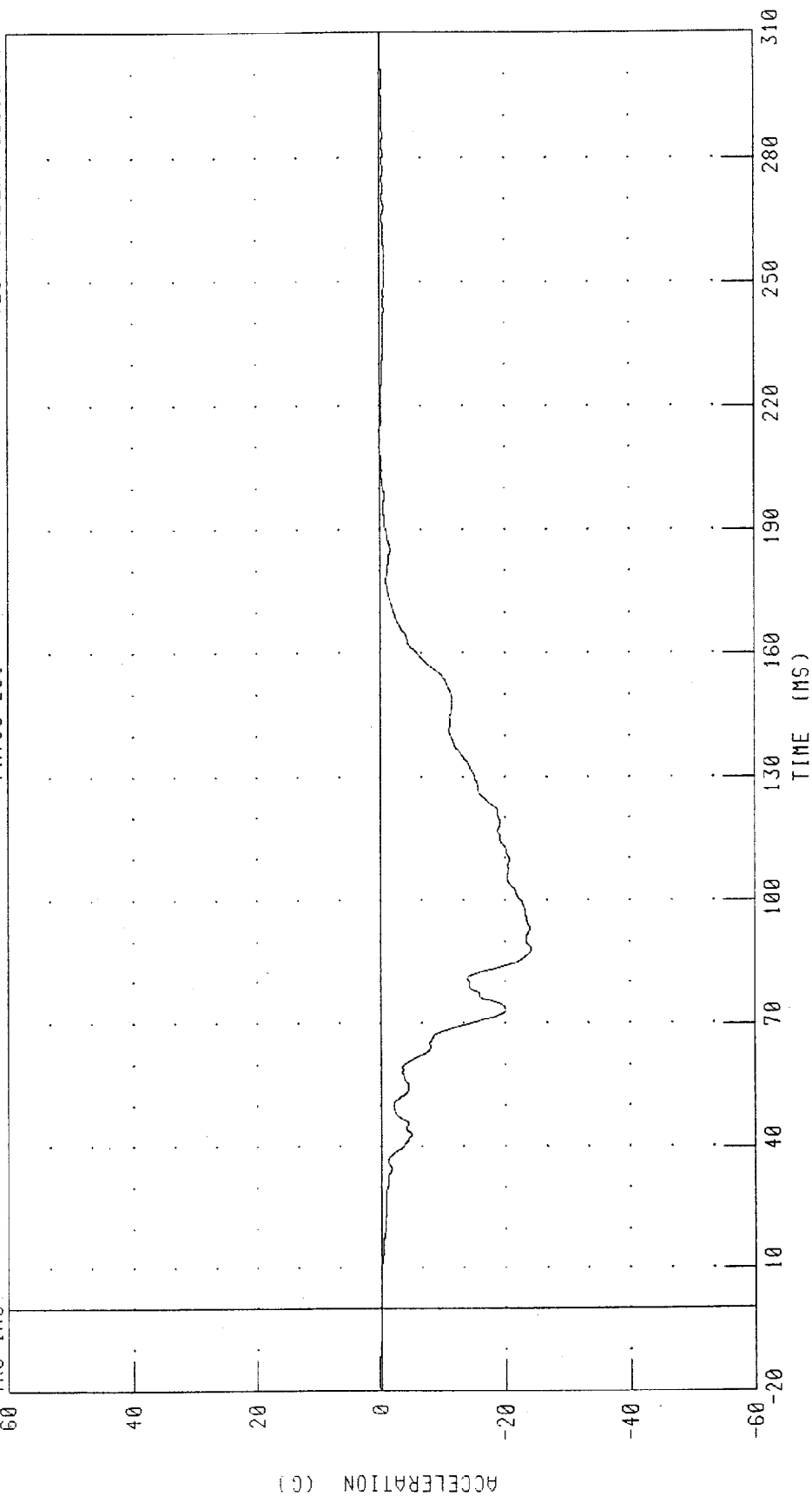
PEAK DATA: 35.66 N-M @ 96.72 MS, -3.90 N-M @ 47.84 MS

1999 SATURN SL1 INTO IJHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER CHEST X-AXIS ACCELERATION

TEST NUMBER 990830-3

FMVSS 208

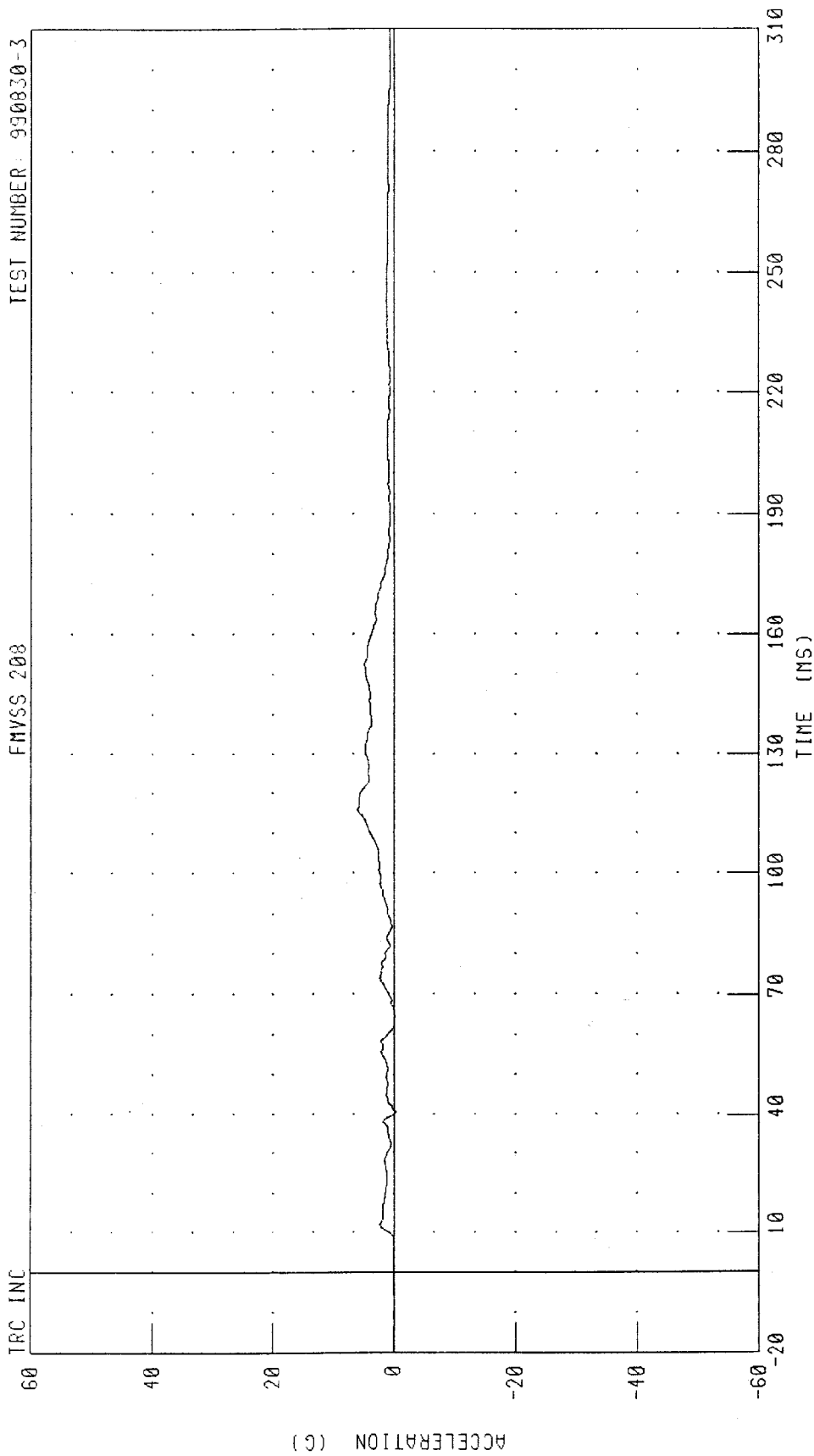
TRC INC



CHANNEL: CSTXG2 FILTER: CH. CLASS 180

PEAK DATA: 0.23 G @ -18.64 MS, -24.18 G @ 88.24 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER CHEST Y-AXIS ACCELERATION



CHANNEL: CSTYC2 FILTER: CH. CLASS 180

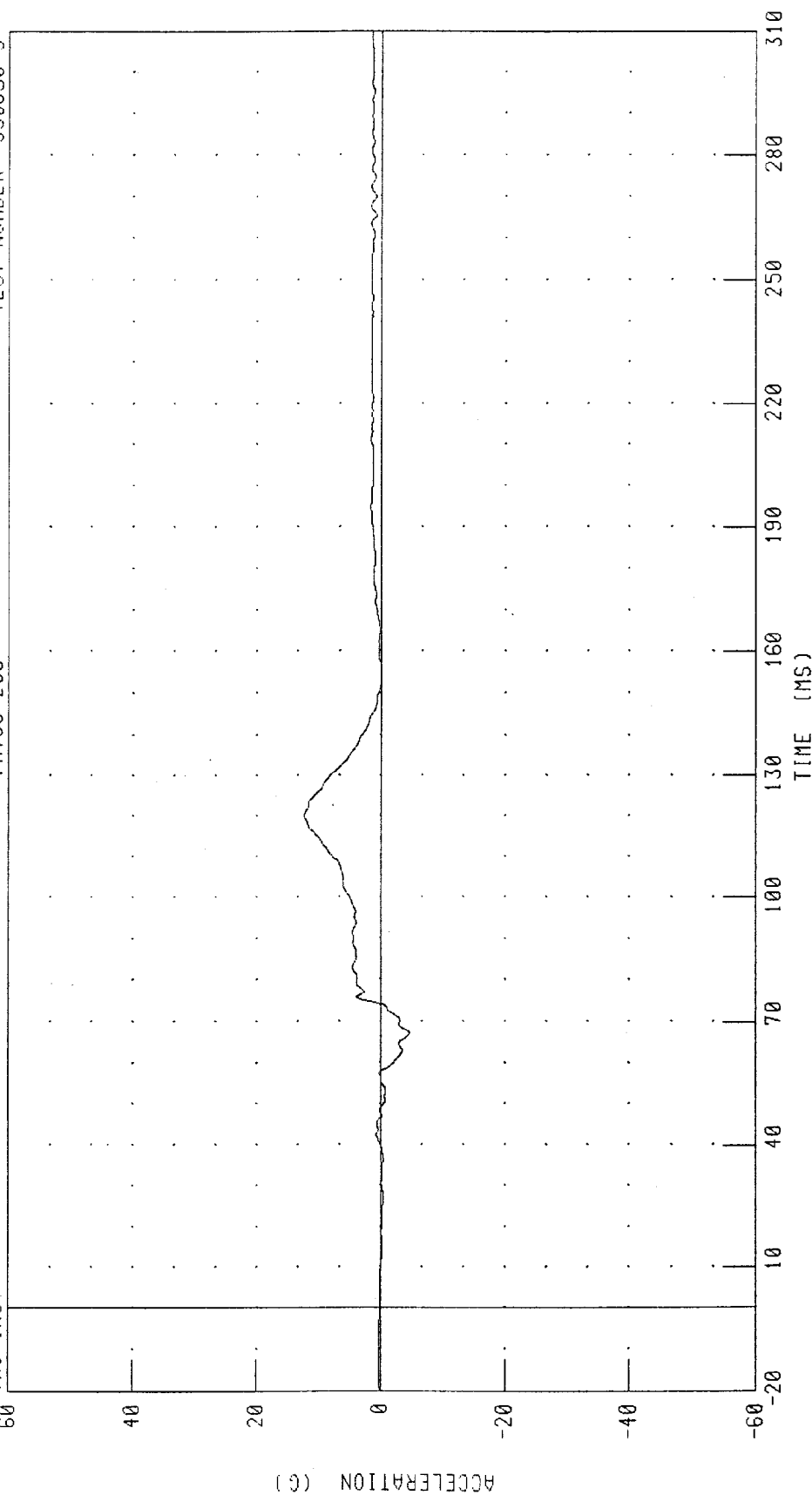
PEAK DATA: 5.97 G @ 116.08 MS; -0.35 G @ 40.72 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER CHEST Z-AXIS ACCELERATION

TRC INC.

FMVSS 208

TEST NUMBER: 990830-3



CHANNEL: CSTZC2 FILTER: CH. CLASS 180

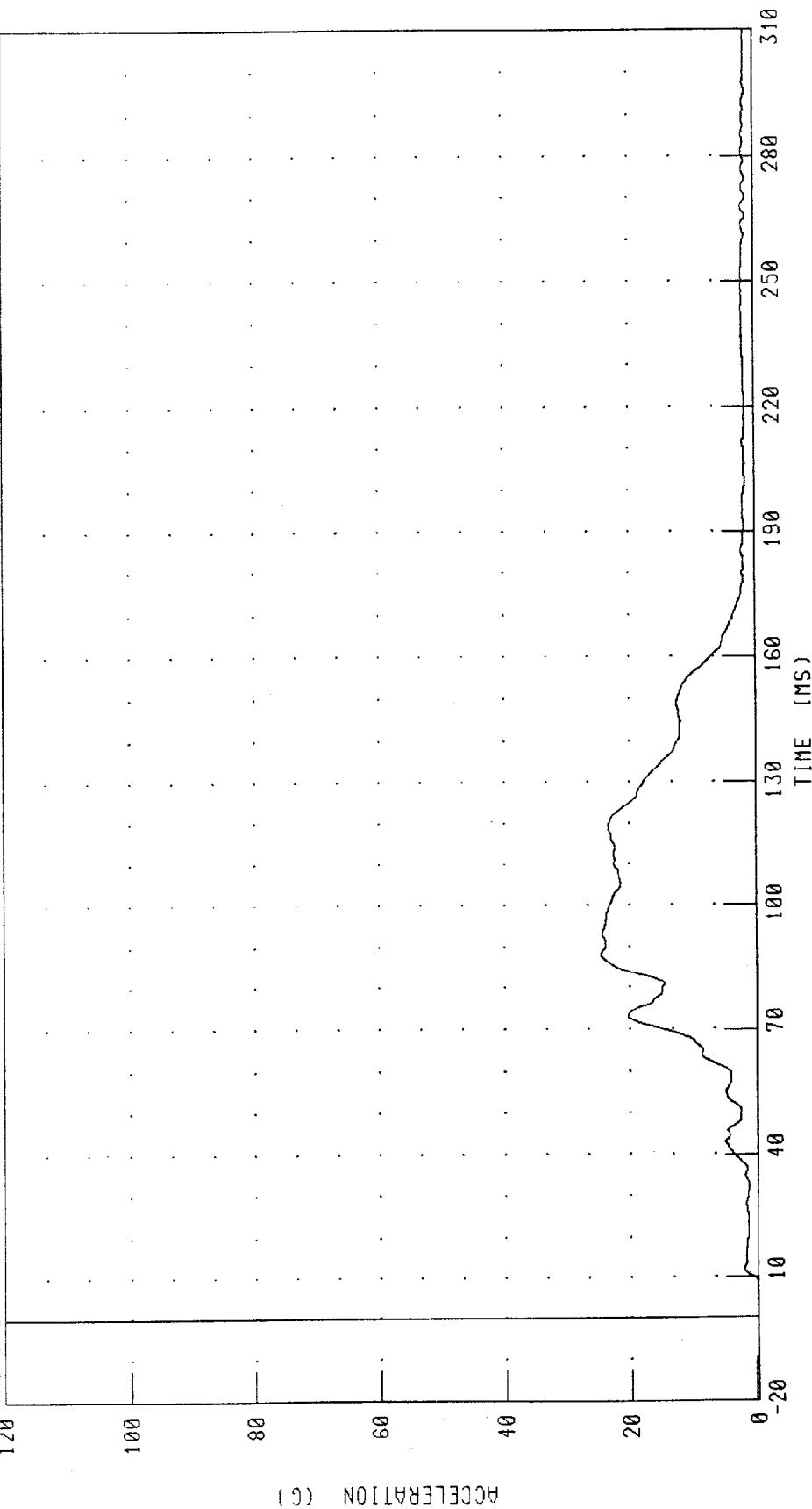
PEAK DATA: 12.28 G @ 120.08 MS, -4.66 G @ 67.36 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION

TEST NUMBER: 990830-3

FMVSS 208

TRC INC



CHANNEL: CSTRG2 FILTER: CH. CLASS 180

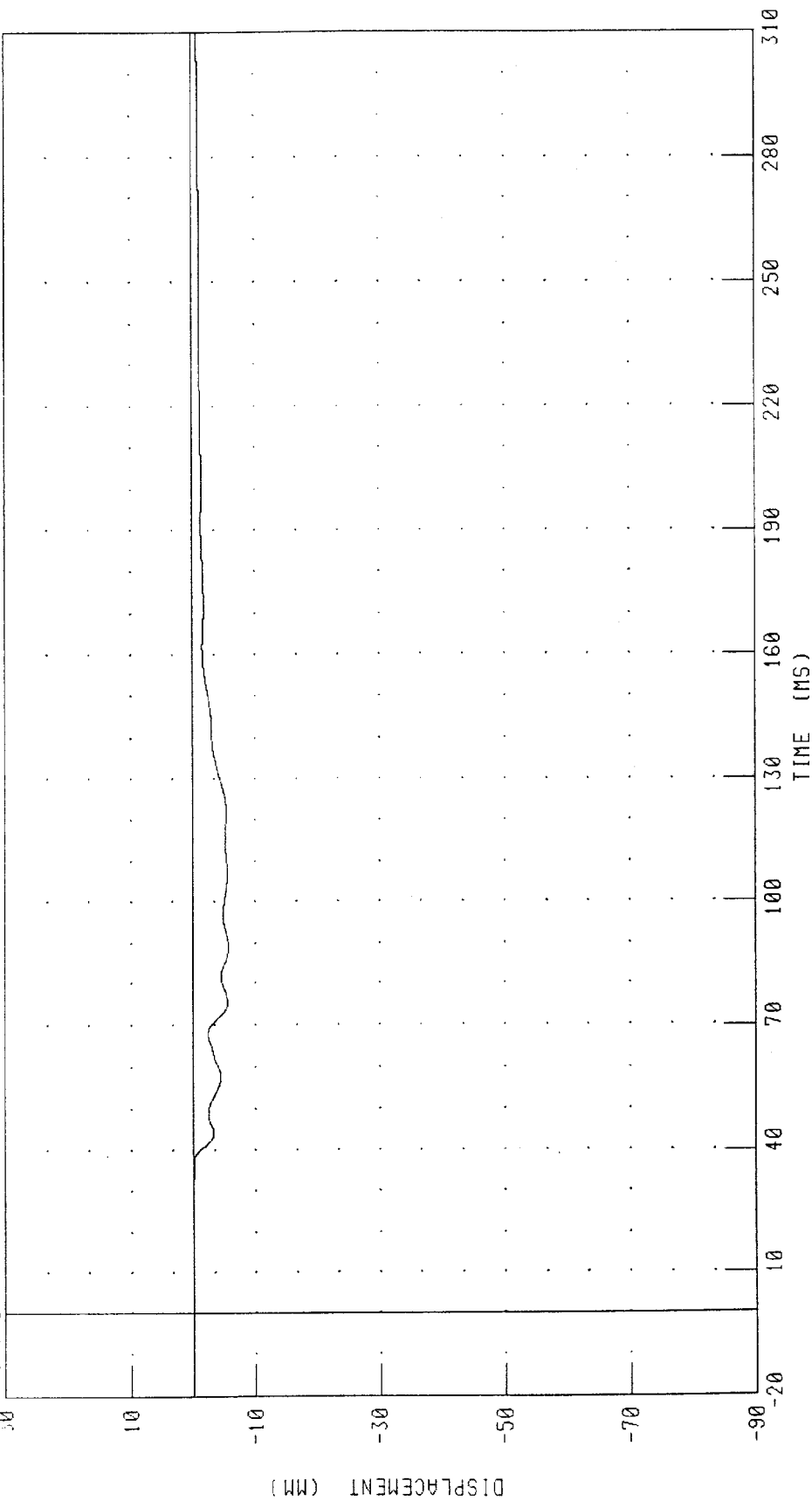
PEAK DATA: 24.57 G @ 88.32 MS; 0.02 G @ -20.00 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER CHEST DEFLECTION

TEST NUMBER 990830-3

FMVSS 208

TRC INC



CHANNEL: CSTXD2 FILTER: CH CLASS 180

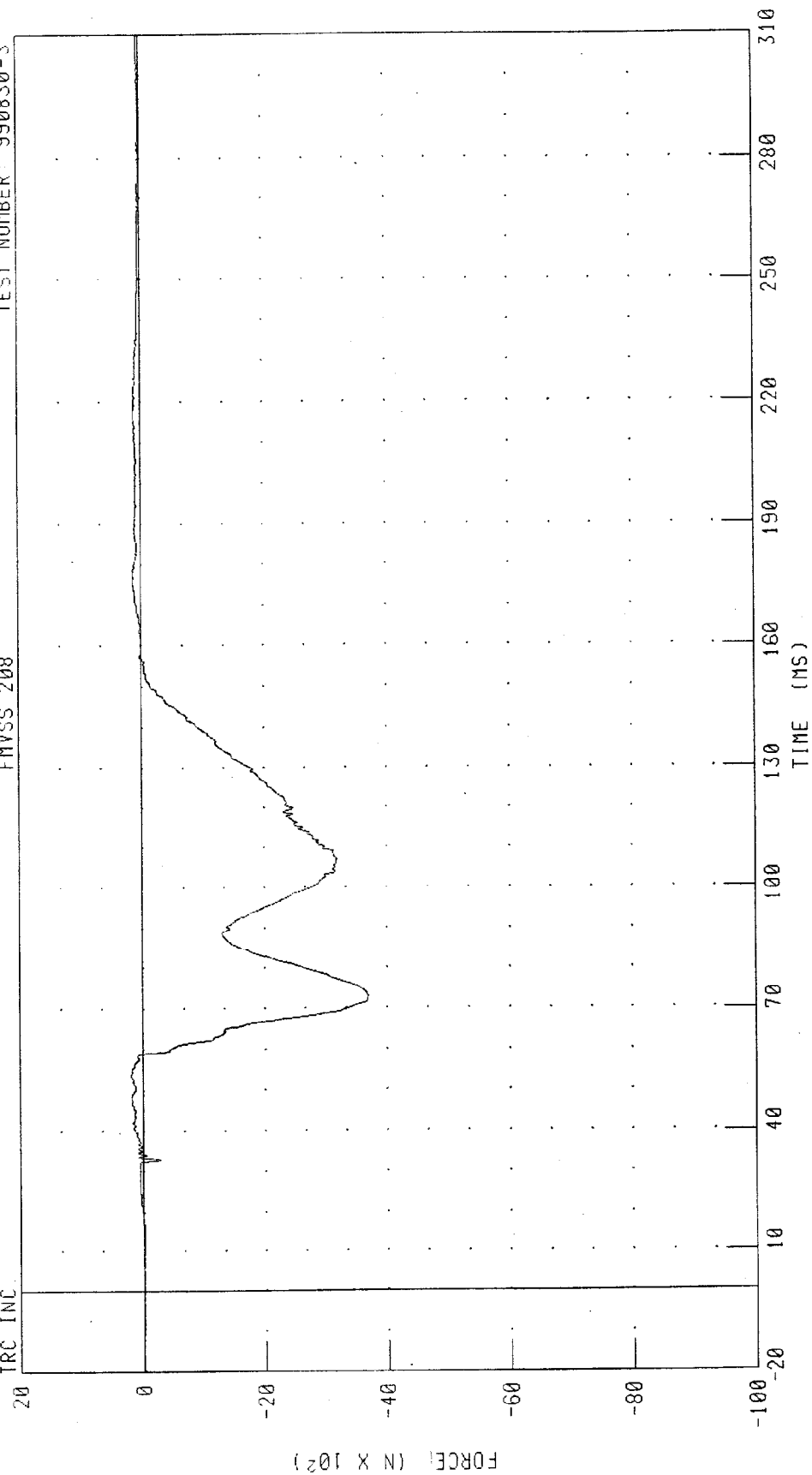
PEAK DATA: 0 03 MM @ 19 12 MS, -5 73 MM @ 89 12 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER LEFT FEMUR FORCE

TEST NUMBER: 990330-3

FMVSS 208

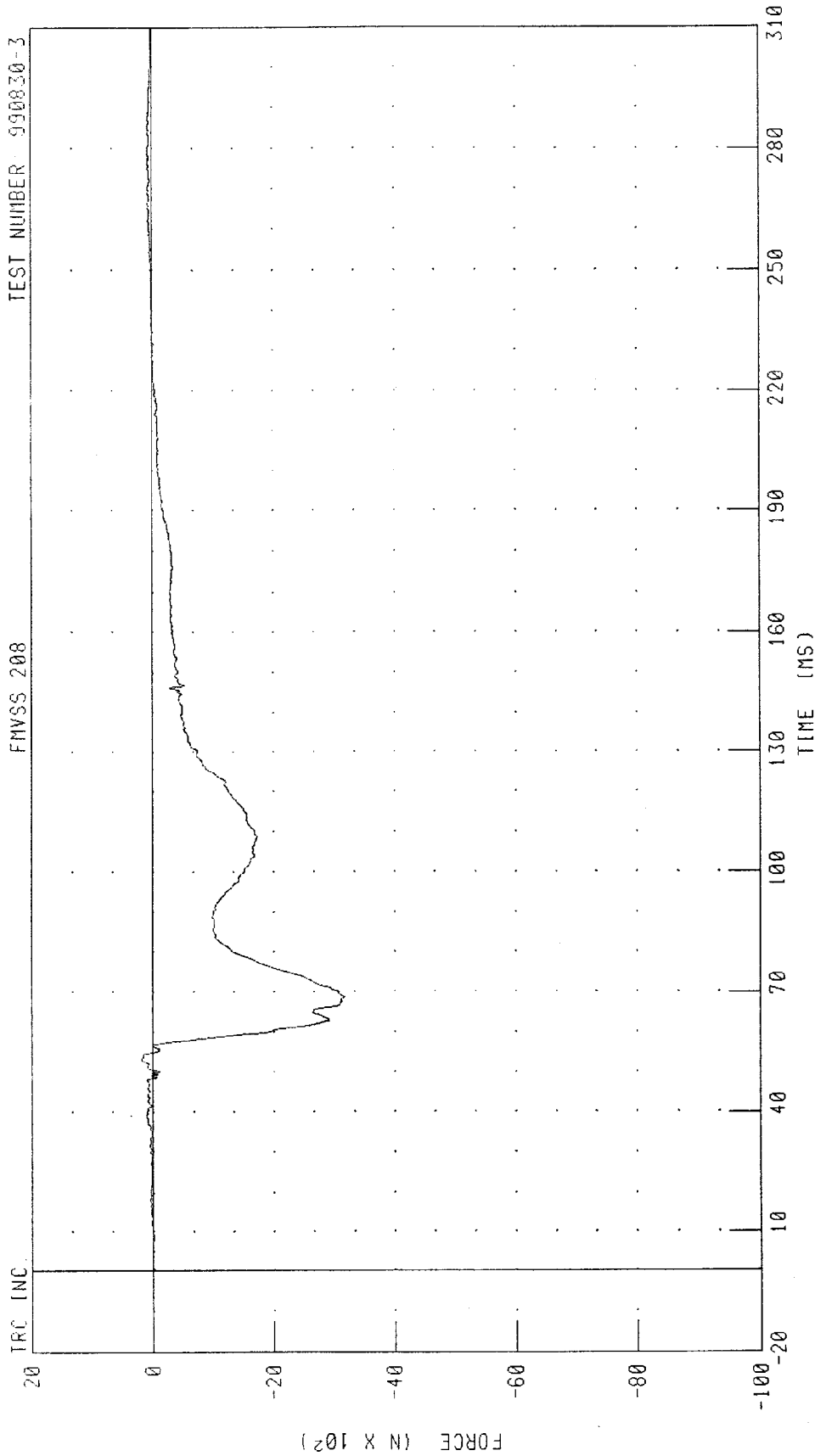
TRC INC



PEAK DATA: 211.49 N @ 53.52 MS, -3700.58 N @ 73.04 MS

CHANNEL: LFMF2 FILTER: CH. CLASS 600

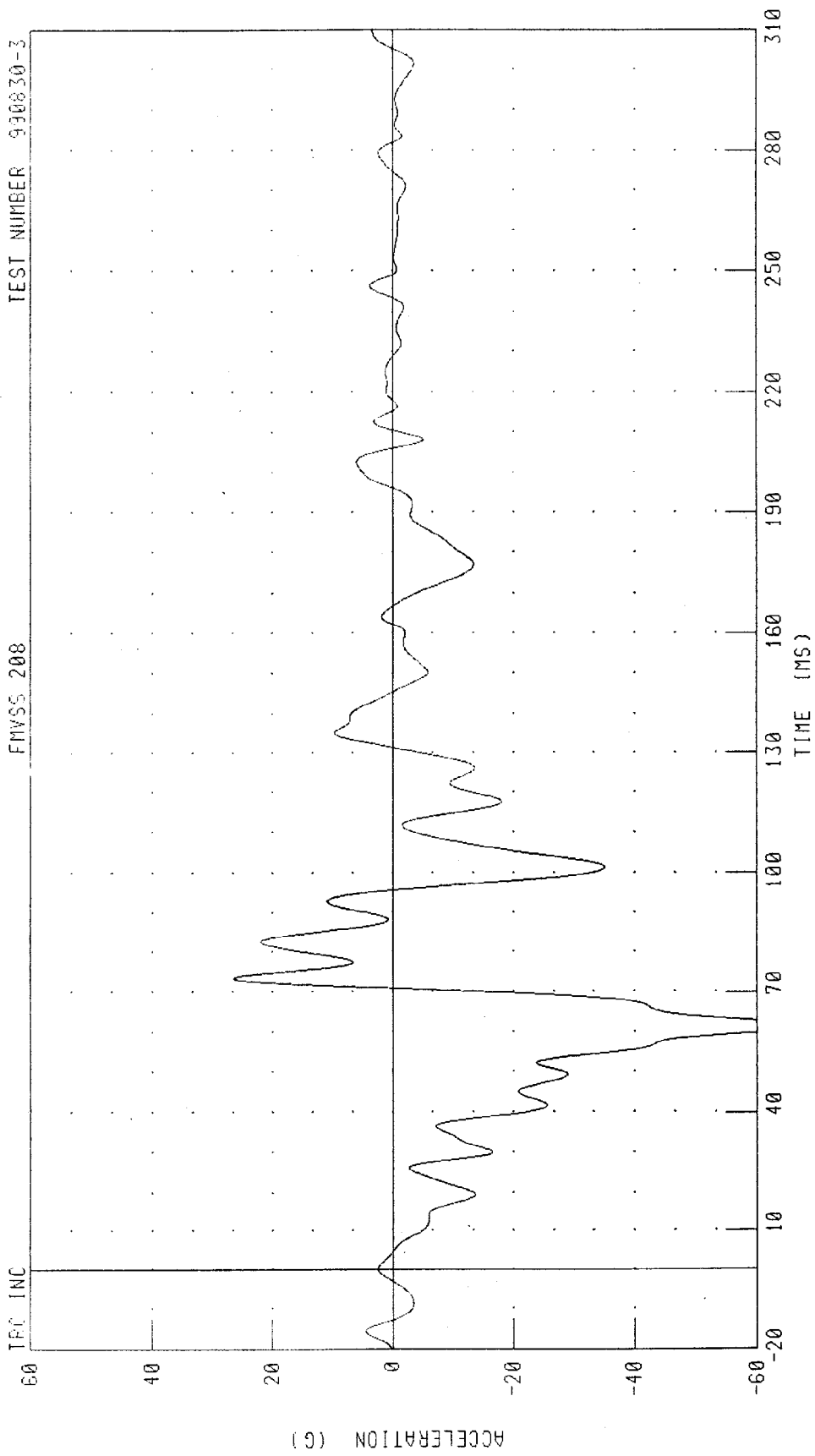
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT FRONT PASSENGER RIGHT FEMUR FORCE



CHANNEL: RFMF2 FILTER: CH. CLASS 600

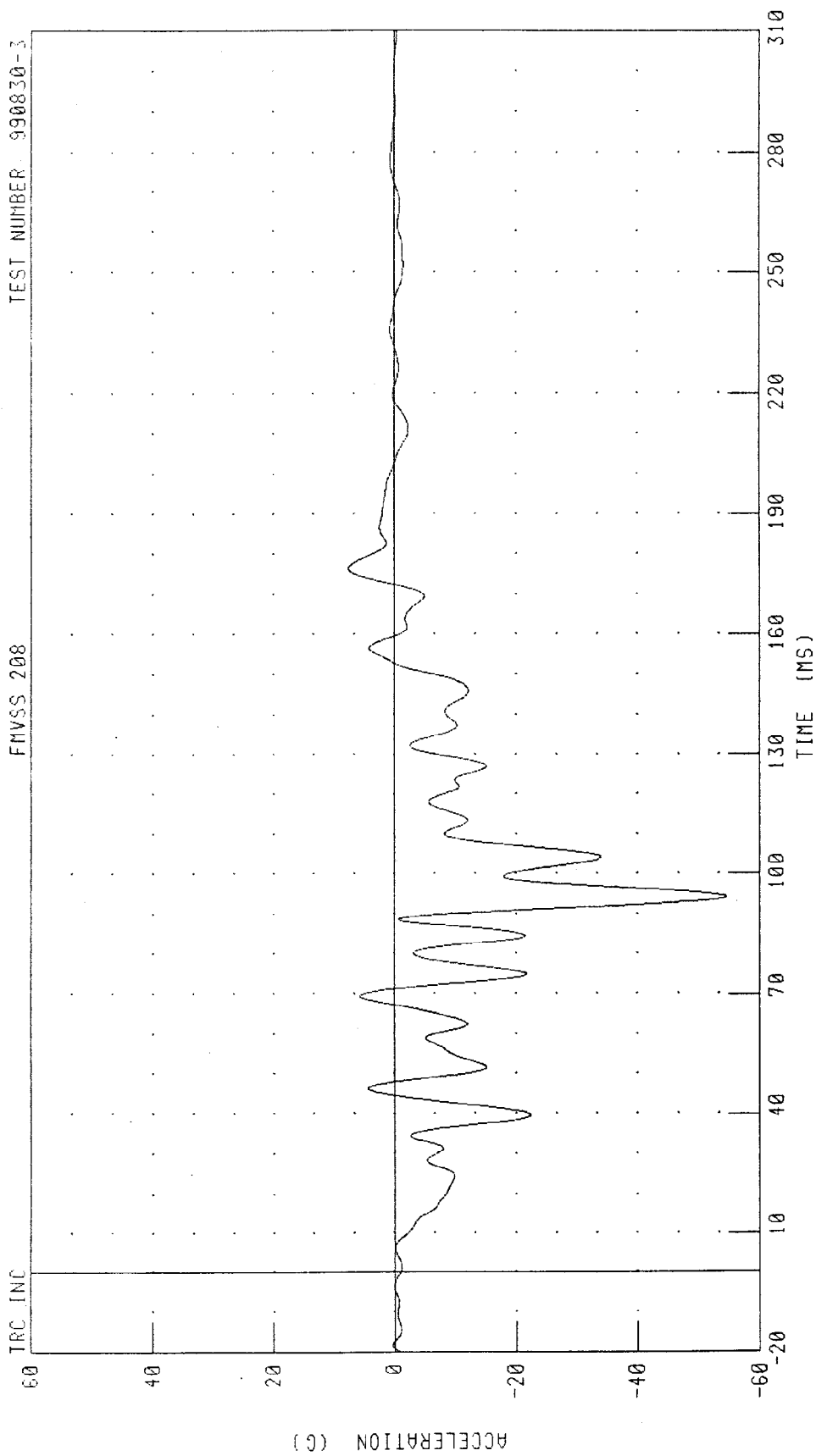
PEAK DATA: 197.06 N @ 53.20 MS, -3170.78 N @ 68.80 MS

1999 SATURN SL11INT0 [IHS 40% LEFT OFFSET BARRIER AT 35 MPH
LEFT BRAKE CALIPER X-AXIS ACCELERATION



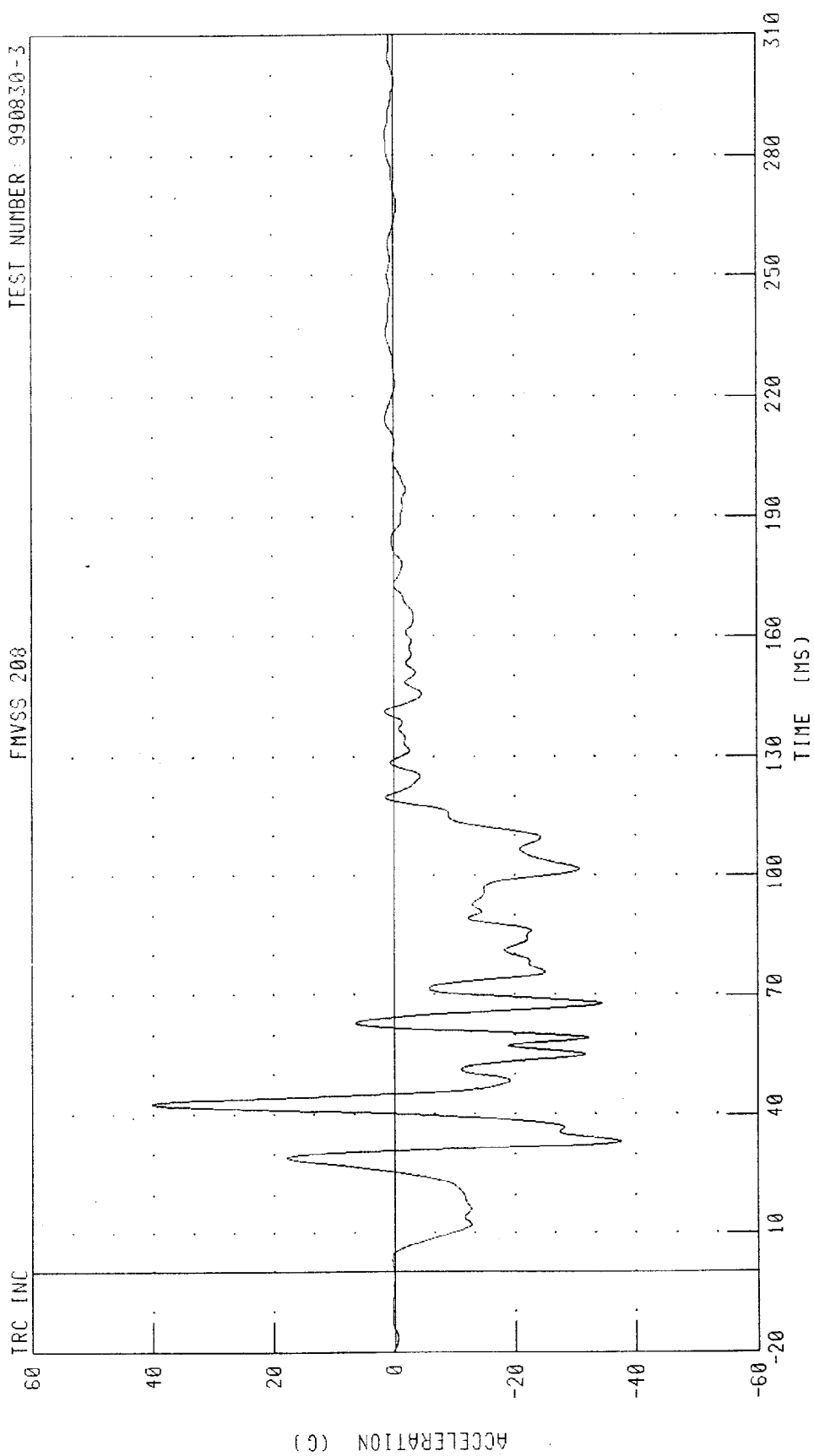
CHANNEL: BCLXG1 FILTER: CH. CLASS 60 PEAK DATA: 26.45 G @ 73.44 MS, -68.67 G @ 61.28 MS

1999 SATURN SLI INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT BRAKE CALIPER X-AXIS ACCELERATION



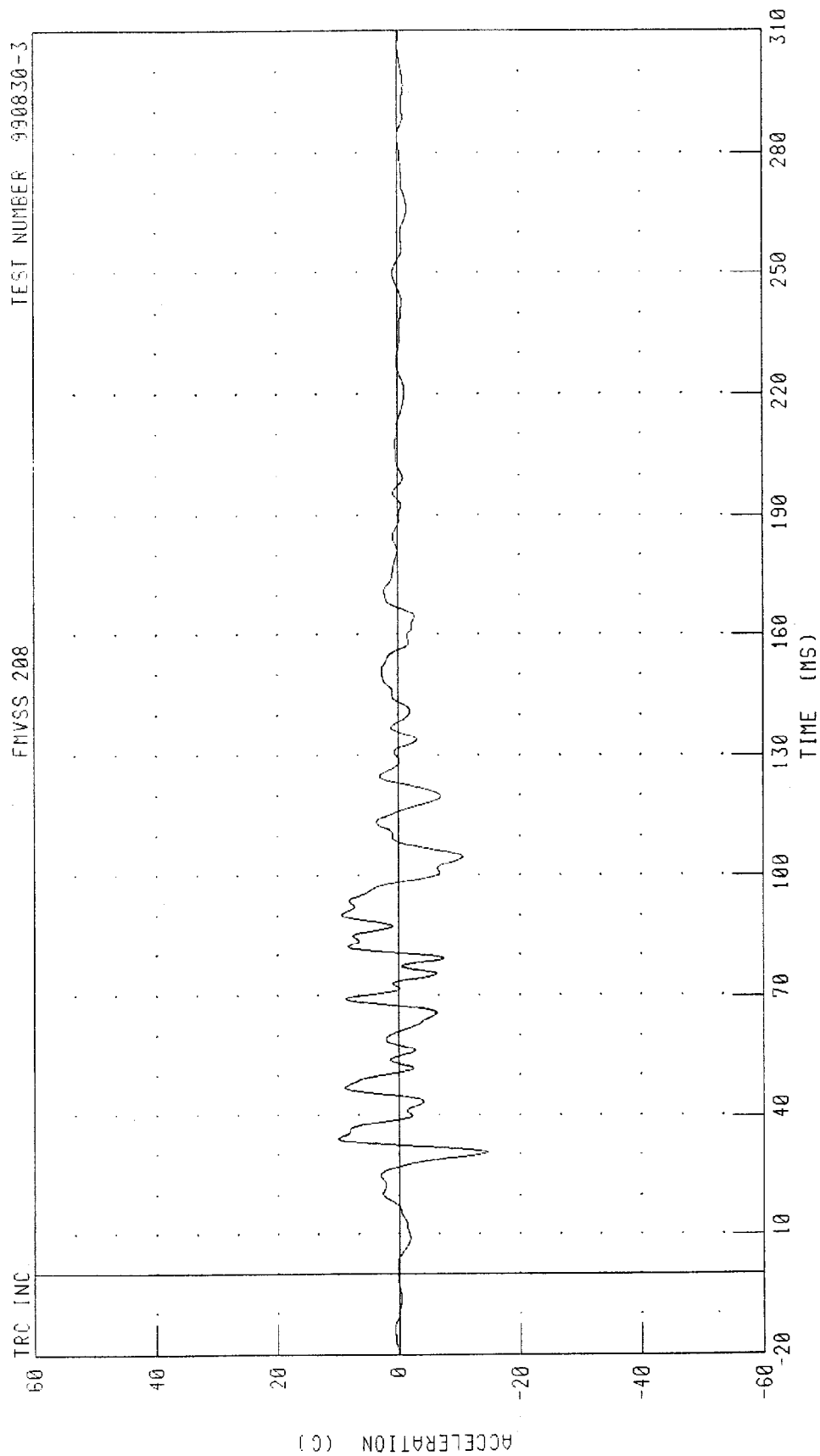
CHANNEL: BCRXG1 FILTER: CH. CLASS 60

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DASH PANEL CENTER X-AXIS ACCELERATION



CHANNEL: DPCXG1 FILTER: CH. CLASS 60 PEAK DATA: 40.21 G @ 42.80 MS, -37.52 G @ 33.44 MS

1999 SATURN SL11INT0 I1HS 40% LEFT OFFSET BARRIER AT 35 MPH
DASH PANEL CENTER Y-AXIS ACCELERATION



CHANNEL: DPCYG1 FILTER: CH CLASS 60

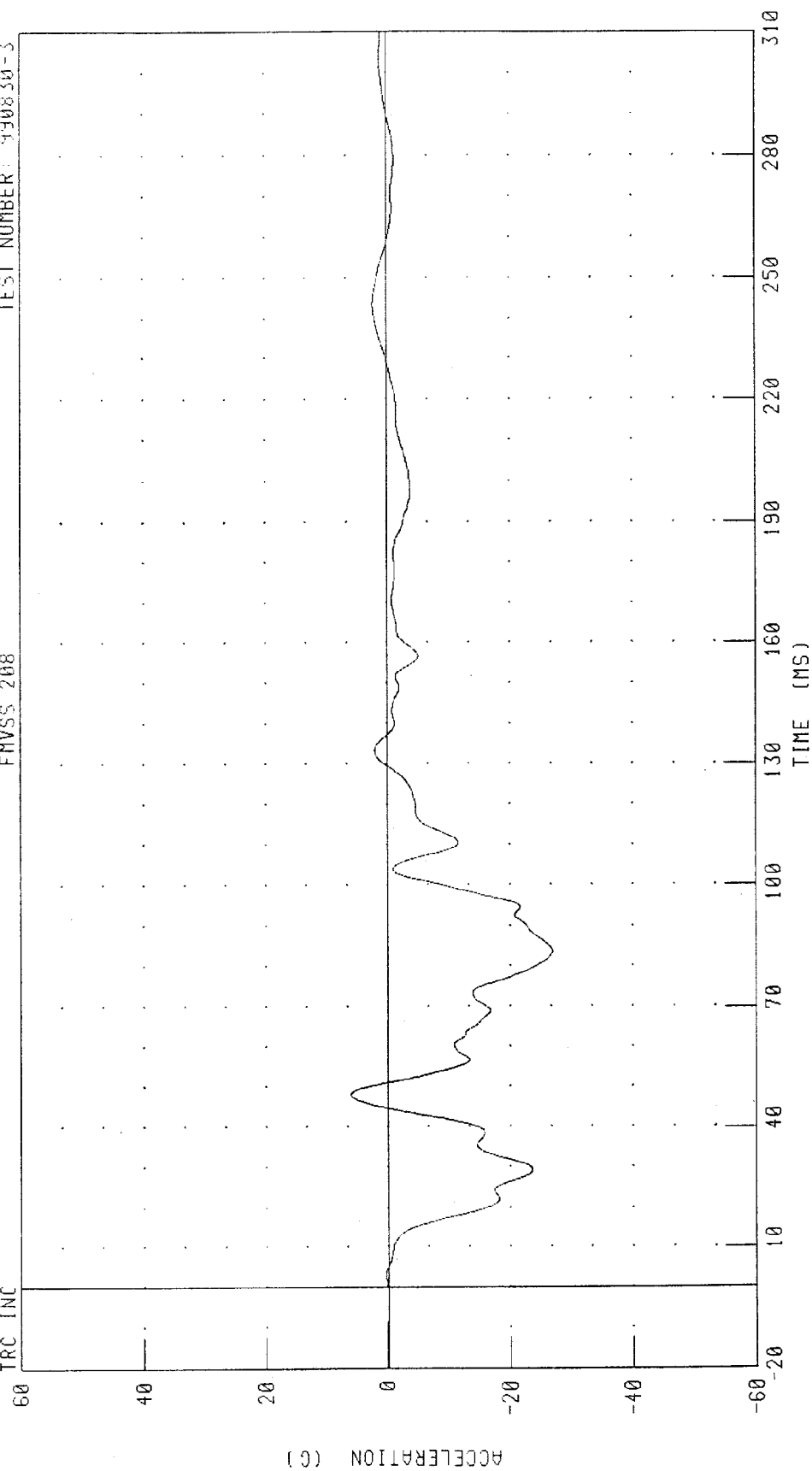
PEAK DATA: 10.03 G @ 34.32 MS, -14.75 G @ 30.72 MS

1999 SATURN SLI INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
ENGINE TOP X-AXIS ACCELERATION

TEST NUMBER: 930830-3

FMVSS 208

TRC INC

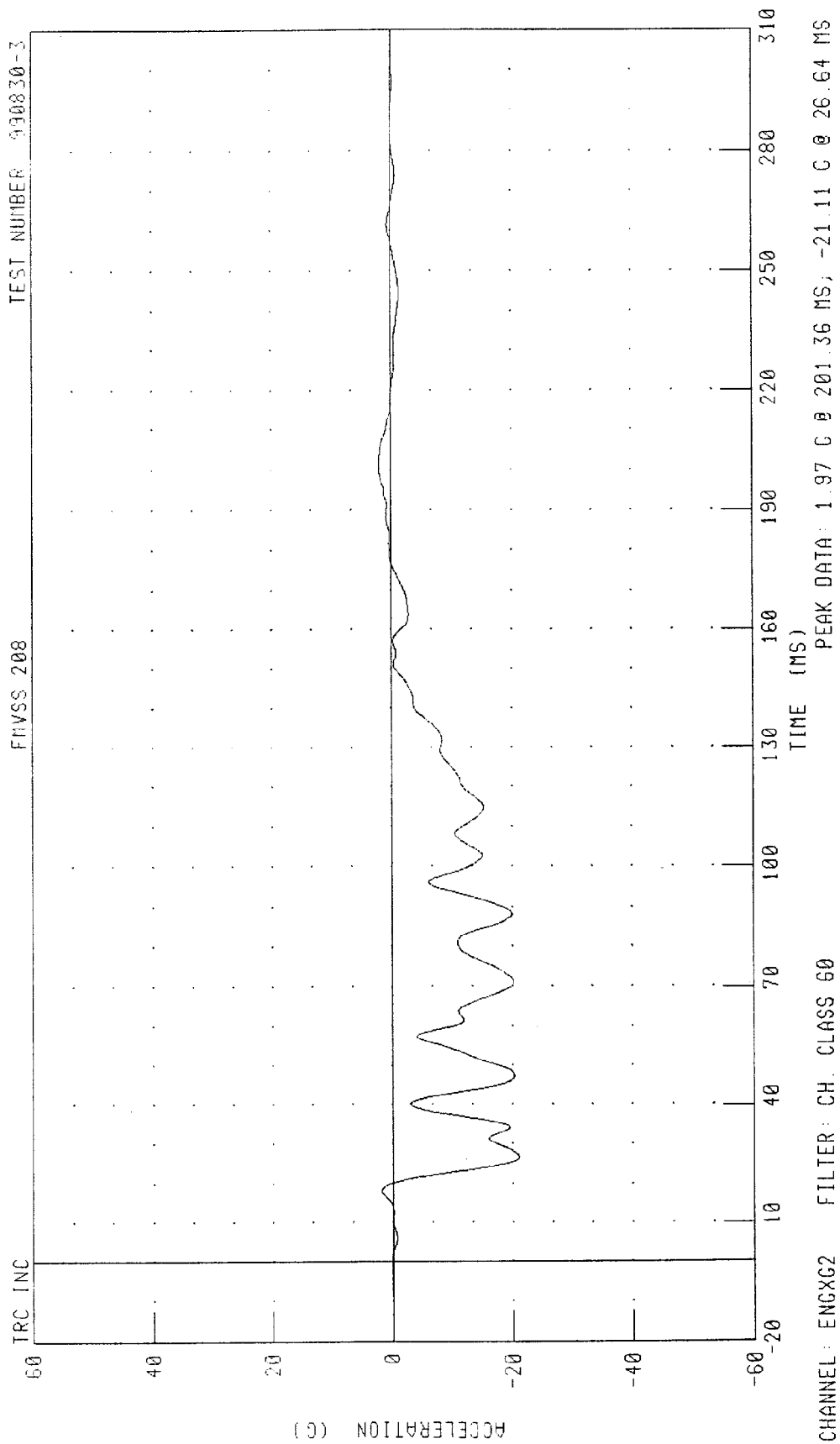


CHANNEL: ENC61 FILTER: CH. CLASS 60

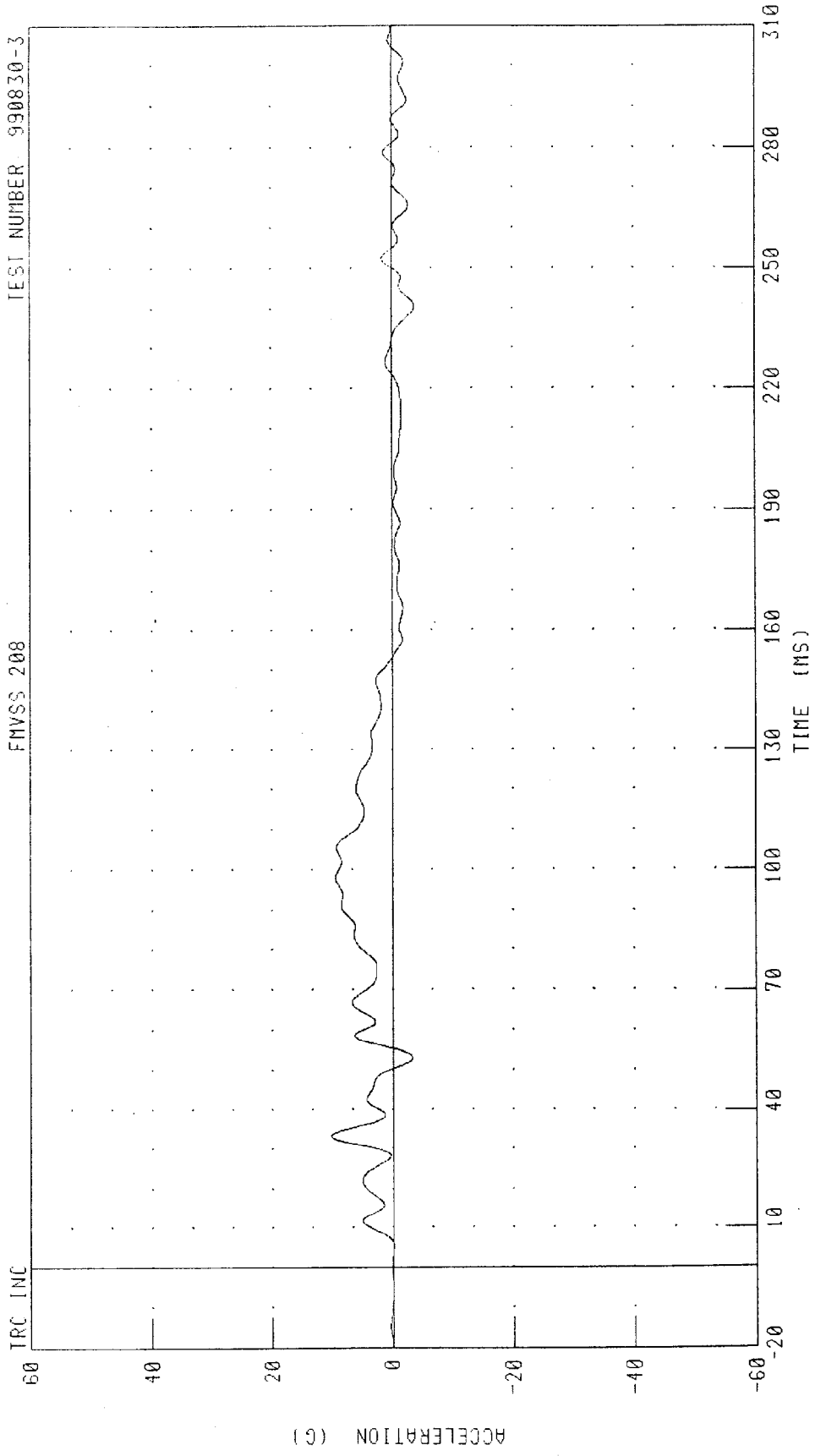
PEAK DATA: 6.03 G @ 48.00 MS; -26.94 G @ 83.84 MS

1999 SATURN SL1INT0 11HS 40% LEFT OFFSET BARRIER AT 35 MPH

ENGINE BOTTOM X-AXIS ACCELERATION

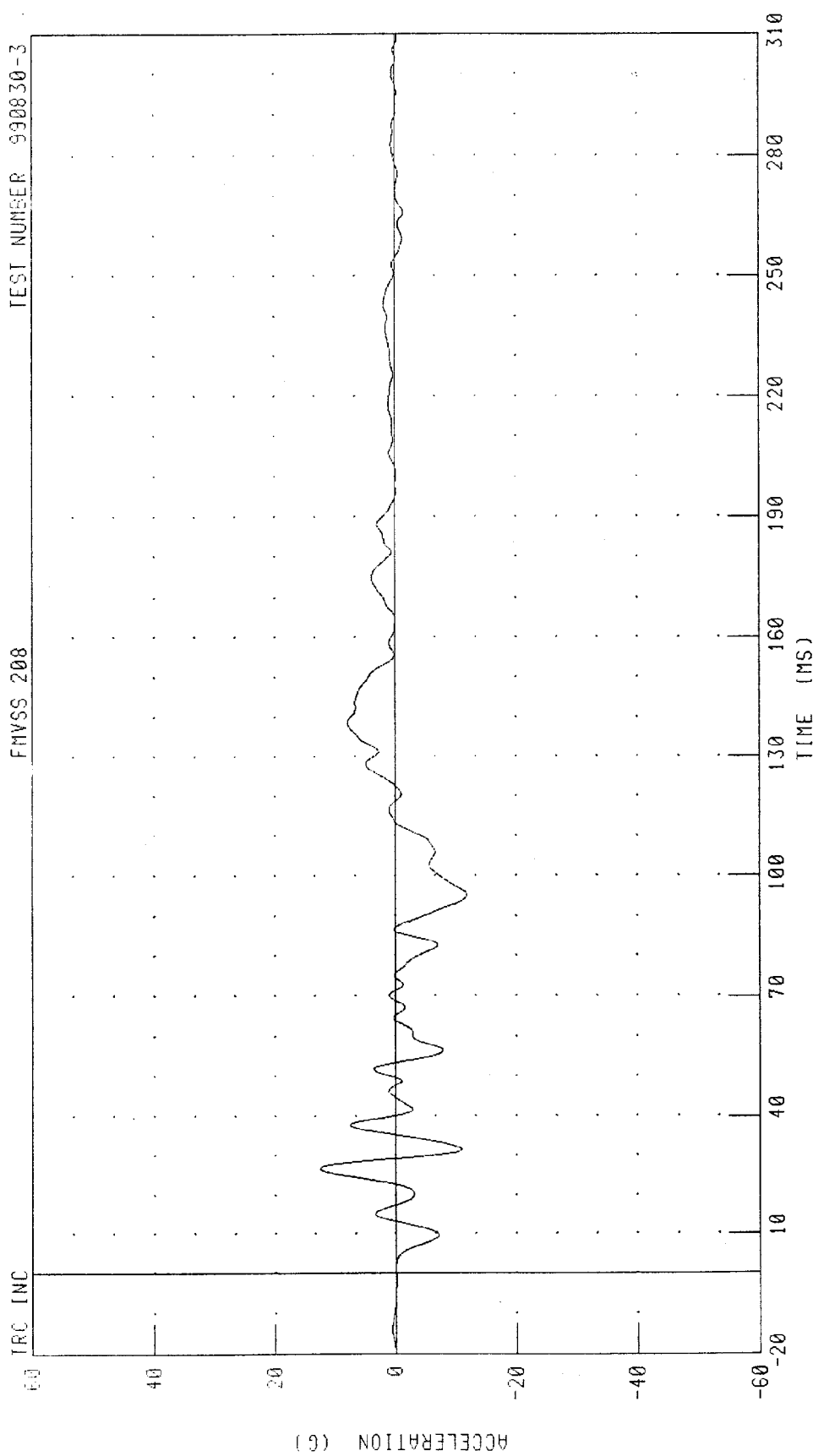


1999 SATURN SL1INT0 LHS 40% LEFT OFFSET BARRIER AT 35 MPH
VEHICLE REAR CENTER Y-AXIS ACCELERATION



CHANNEL: RDKYGI FILTER: CH. CLASS 60 PEAK DATA: 10.23 G @ 33.36 MS; -3.83 G @ 240.64 MS

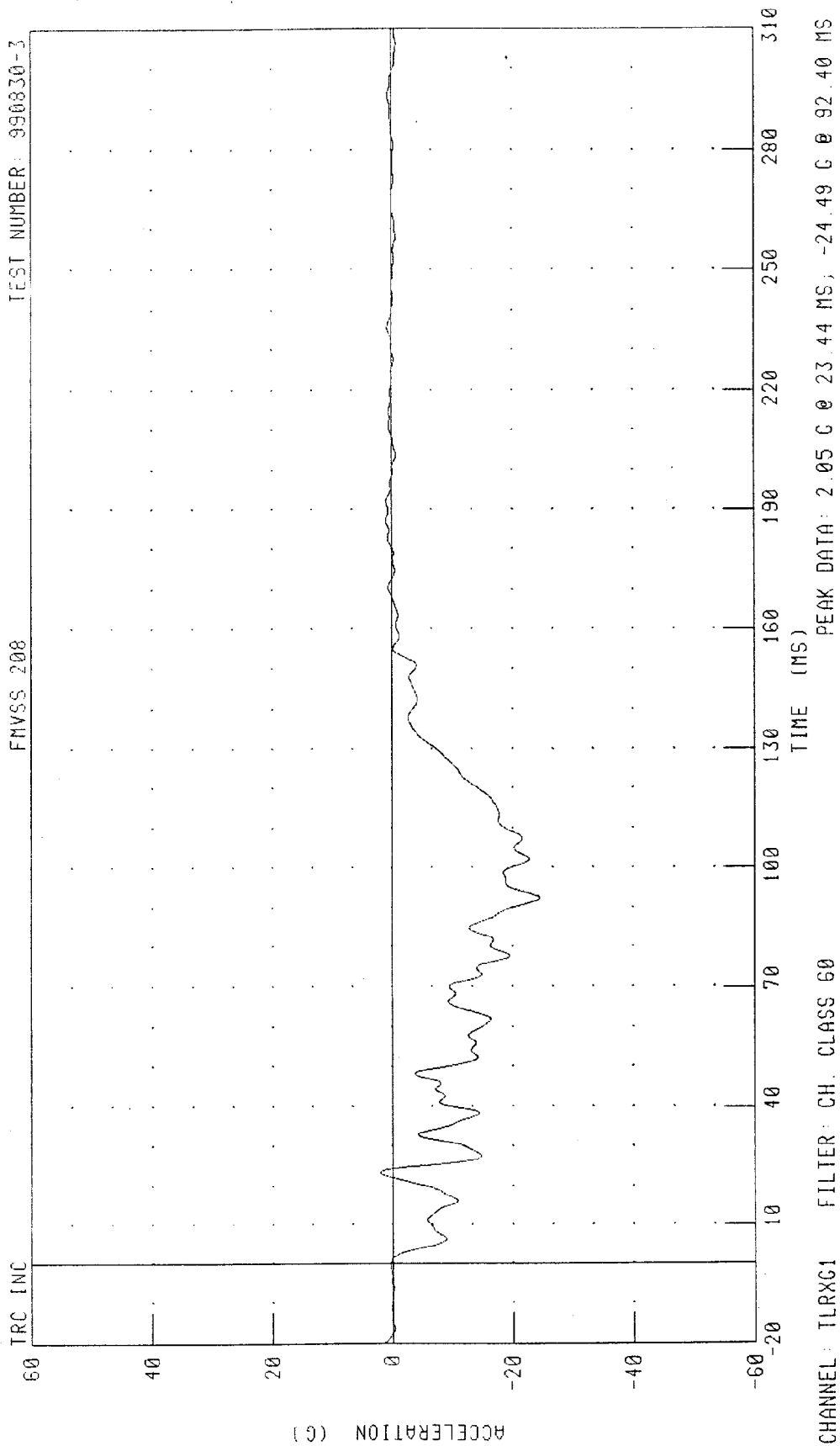
1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
VEHICLE REAR CENTER Z-AXIS ACCELERATION



CHANNEL: RDKZG1 FILTER: CH. CLASS 60

PEAK DATA: 12.55 G @ 26.80 MS, -11.96 G @ 95.20 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
LEFT REAR SEAT X-AXIS ACCELERATION

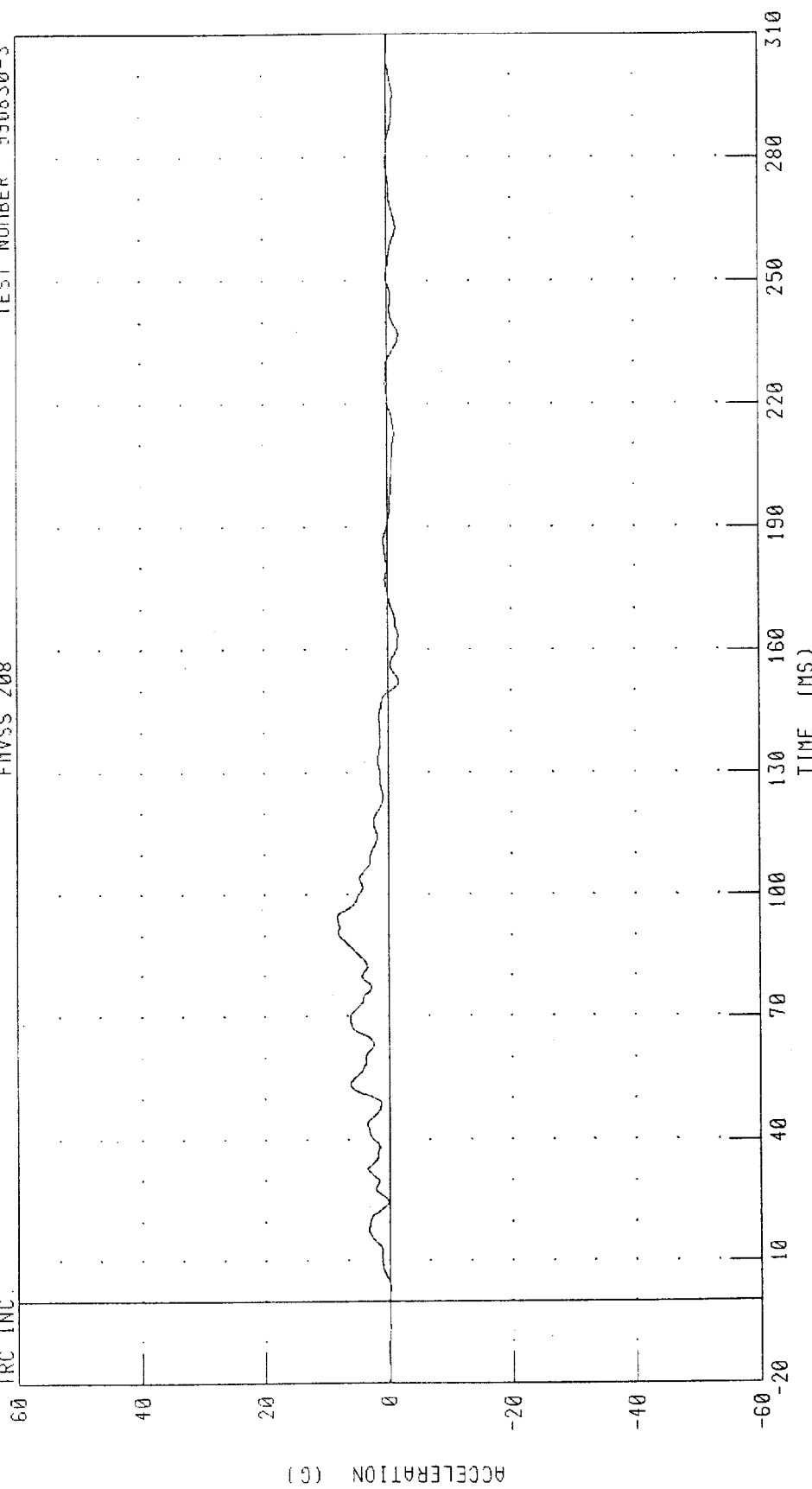


1999 SATURN SL1INT0 I1HS 40% LEFT OFFSET BARRIER AT 35 MPH
LEFT REAR SEAT Y-AXIS ACCELERATION

TEST NUMBER 990830-3

FMVSS 208

TRC INC.



CHANNEL: TLRYG1 FILTER: CH. CLASS 60

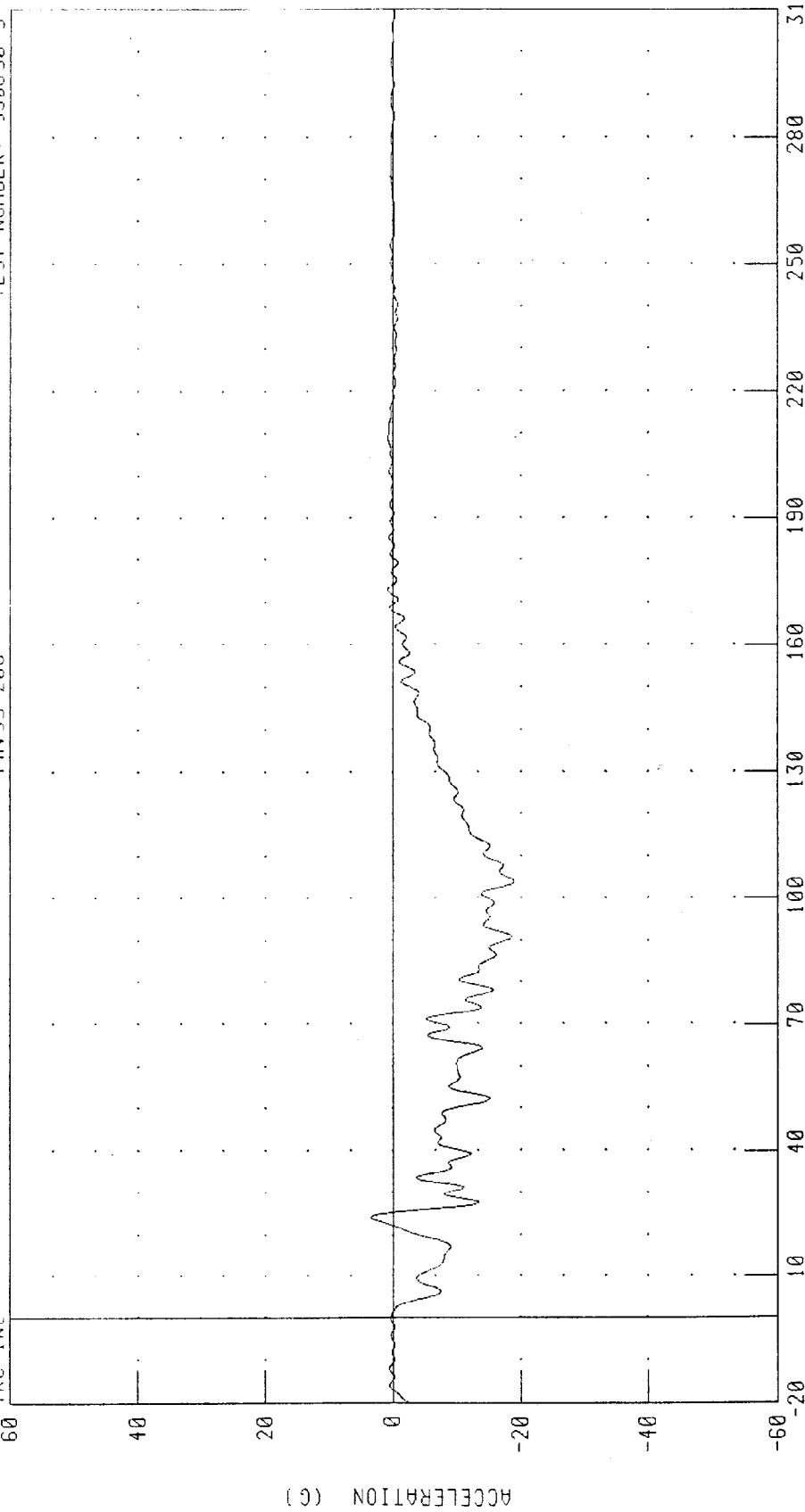
PEAK DATA: 8.26 G @ 94.40 MS, -1.87 G @ 236.88 MS

1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT REAR SEAT X-AXIS ACCELERATION

TEST NUMBER: 990830-3

FNVS 208

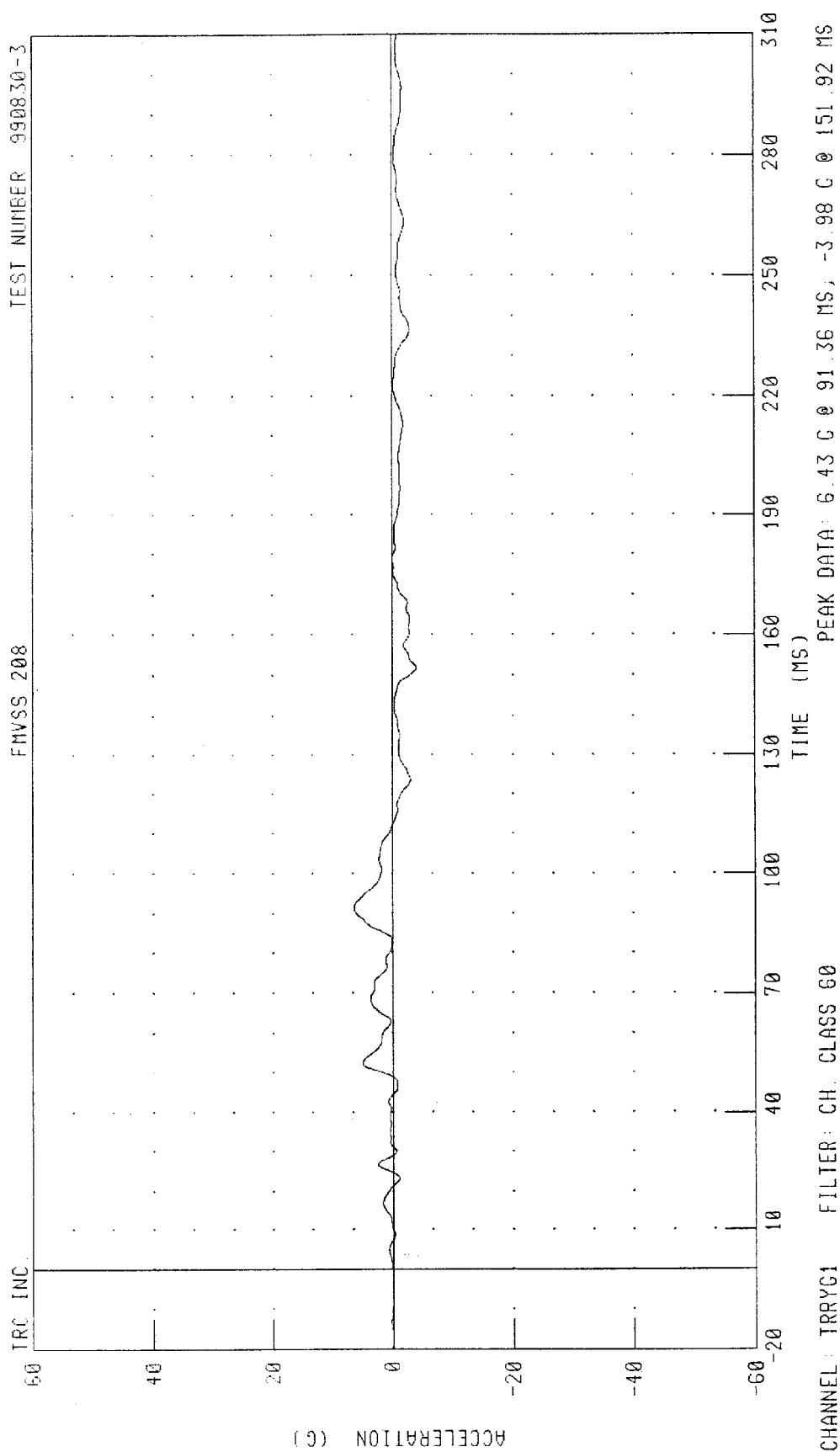
TRC INC



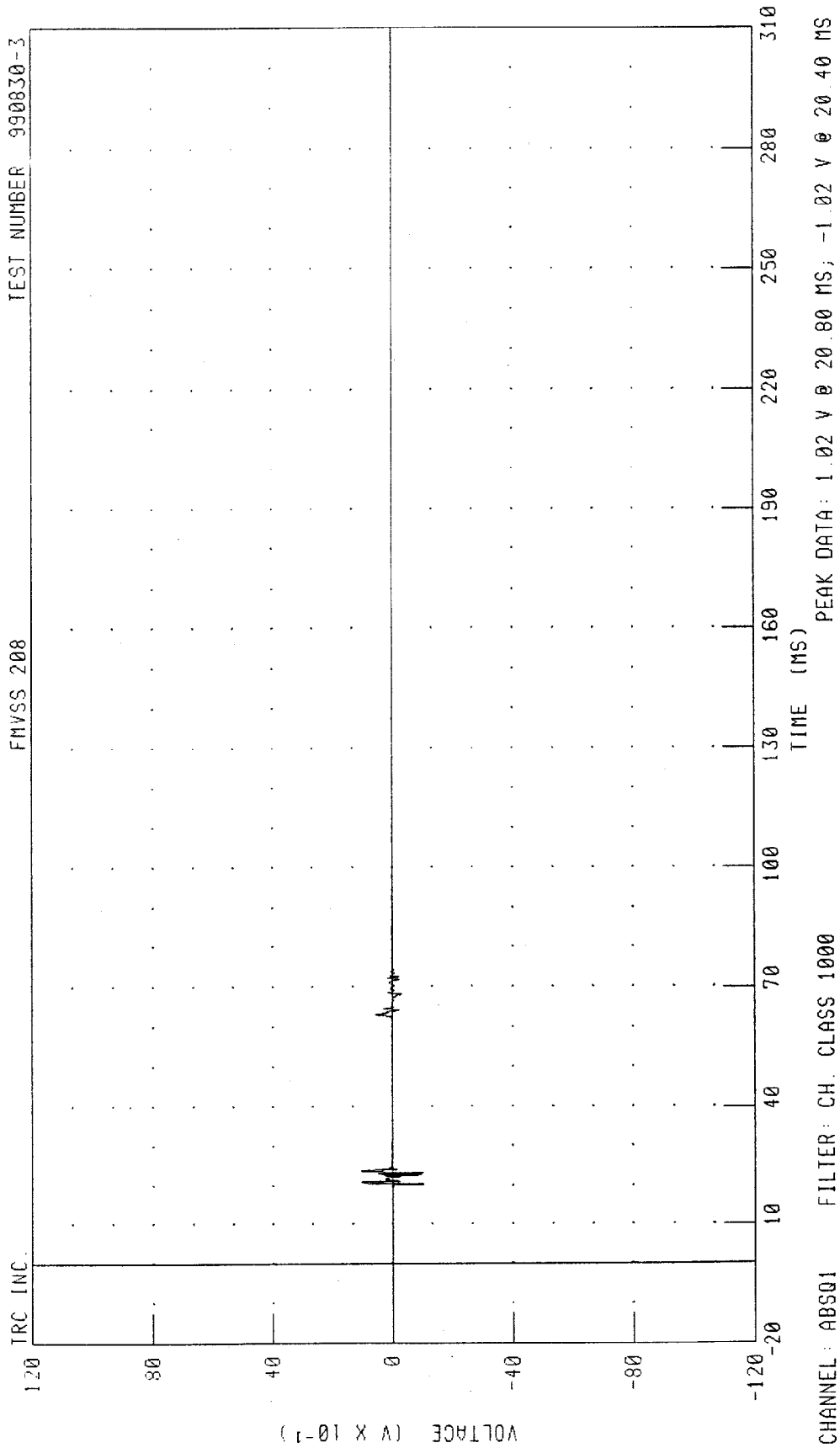
CHANNEL: TRRXG1 FILTER: CH. CLASS 60

PEAK DATA: 3.46 G @ 24.08 MS, -18.88 G @ 103.92 MS

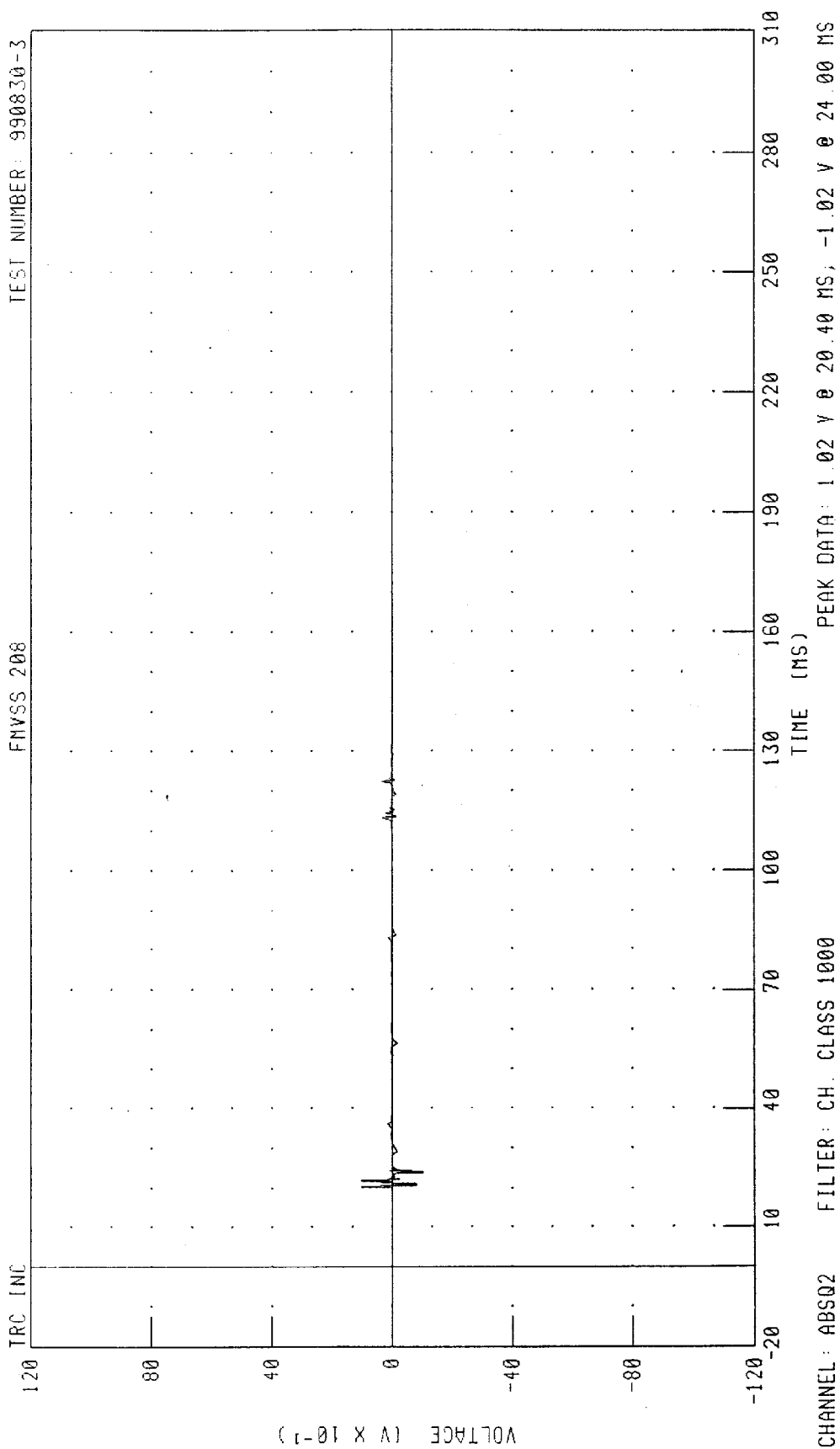
1999 SATURN SL11INT0 11HS 40% LEFT OFFSET BARRIER AT 35 MPH
RIGHT REAR SEAT Y-AXIS ACCELERATION



1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
DRIVER SIDE INDUCTIVE AIRBAG FIRE PICKUP



1999 SATURN SL1 INTO IHS 40% LEFT OFFSET BARRIER AT 35 MPH
PASSENGER SIDE INDUCTIVE AIRBAG FIRE PICKUP



Appendix C

Dummy Certification

Post-Test Dummy Certification

Driver Dummy S/N 289

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

HYBRID III SMALL FEMALE

25-AUG-99

TRC INC.

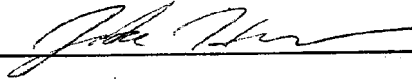
TEST NO: 289C9HD1

S.FEMALE SN289 HEAD DROP CAL9

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PEAK RESULTANT ACCELERATION	250 - 300 G	288.85 G
PEAK LATERAL ACCELERATION	15 G MAX	1.81 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

TECHNICIAN



RUN NUMBER: 082599.0845;1

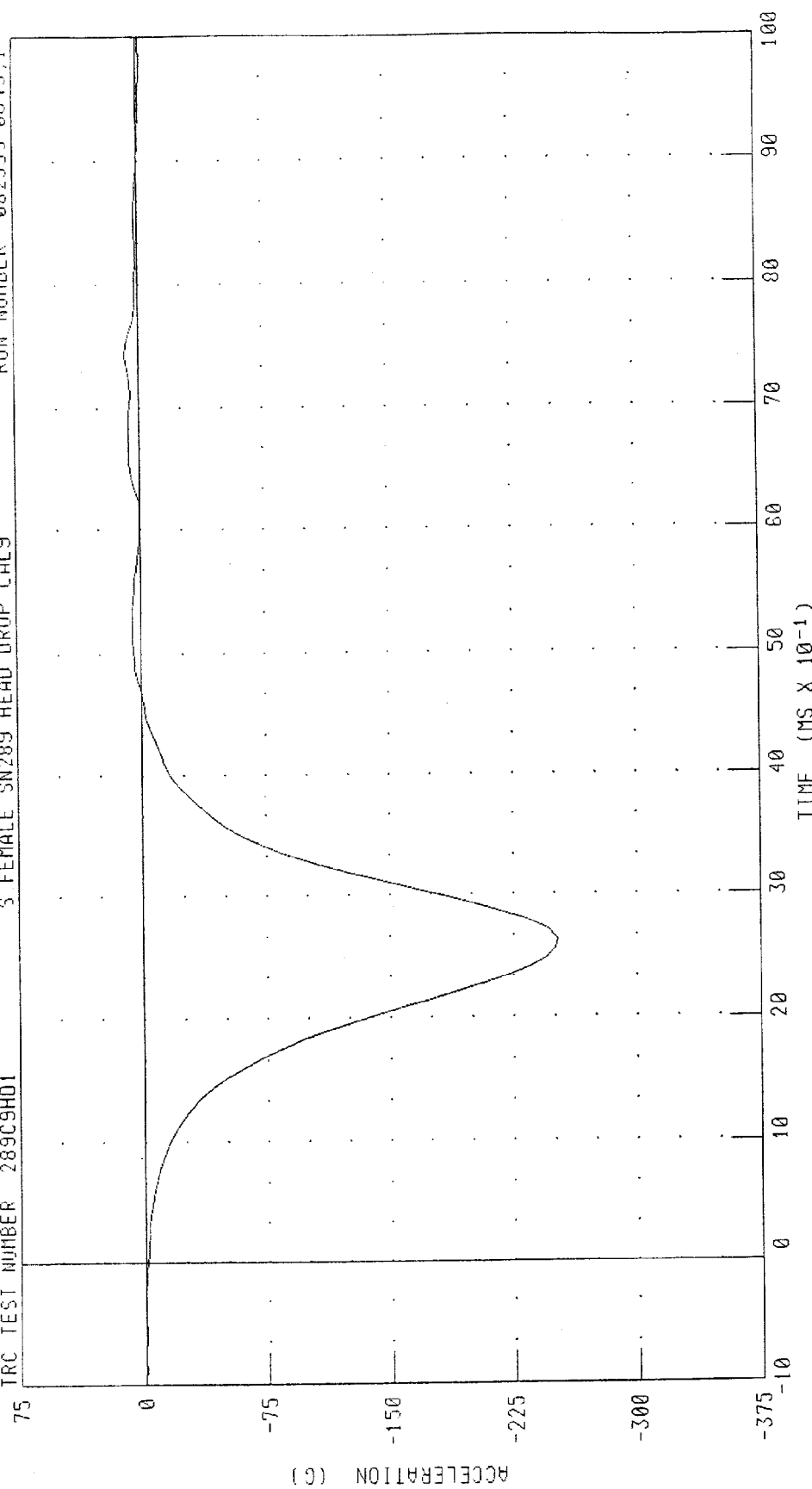
SMALL FEMALE HYBRID III HEAD CALIBRATION

HEAD ACCELERATION X AXIS

3 FEMALE SN289 HEAD DROP CAL9

TRC TEST NUMBER 289C9H01

RUN NUMBER 082599 0845.1



PEAK DATA: 8.49 G @ 7.44 MS; -251.68 G @ 2.64 MS

CHANNEL: HEDXC FILTER: CH. CLASS 1000

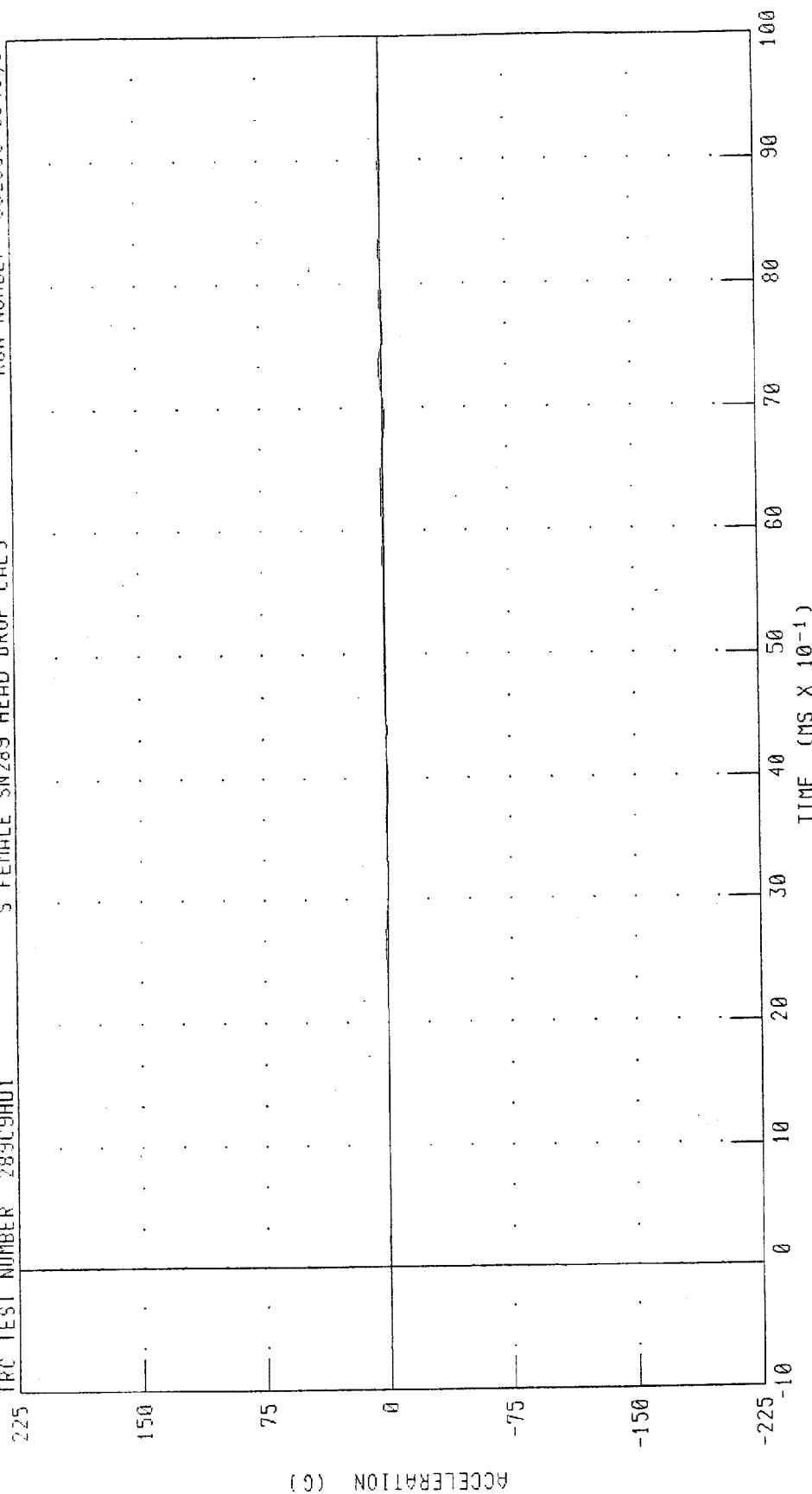
SMALL FEMALE HYBRID III HEAD CALIBRATION

HEAD ACCELERATION Y AXIS

S FEMALE SN289 HEAD DROP CAL9

TRC TEST NUMBER 289C9H01

RUN NUMBER 082599 0845;1



CHANNEL: HEDYC FILTER: CH. CLASS 1000

PEAK DATA: 1.81 G @ 7.36 MS, -1.61 G @ 6.88 MS

SMALL FEMALE HYBRID III HEAD CALIBRATION

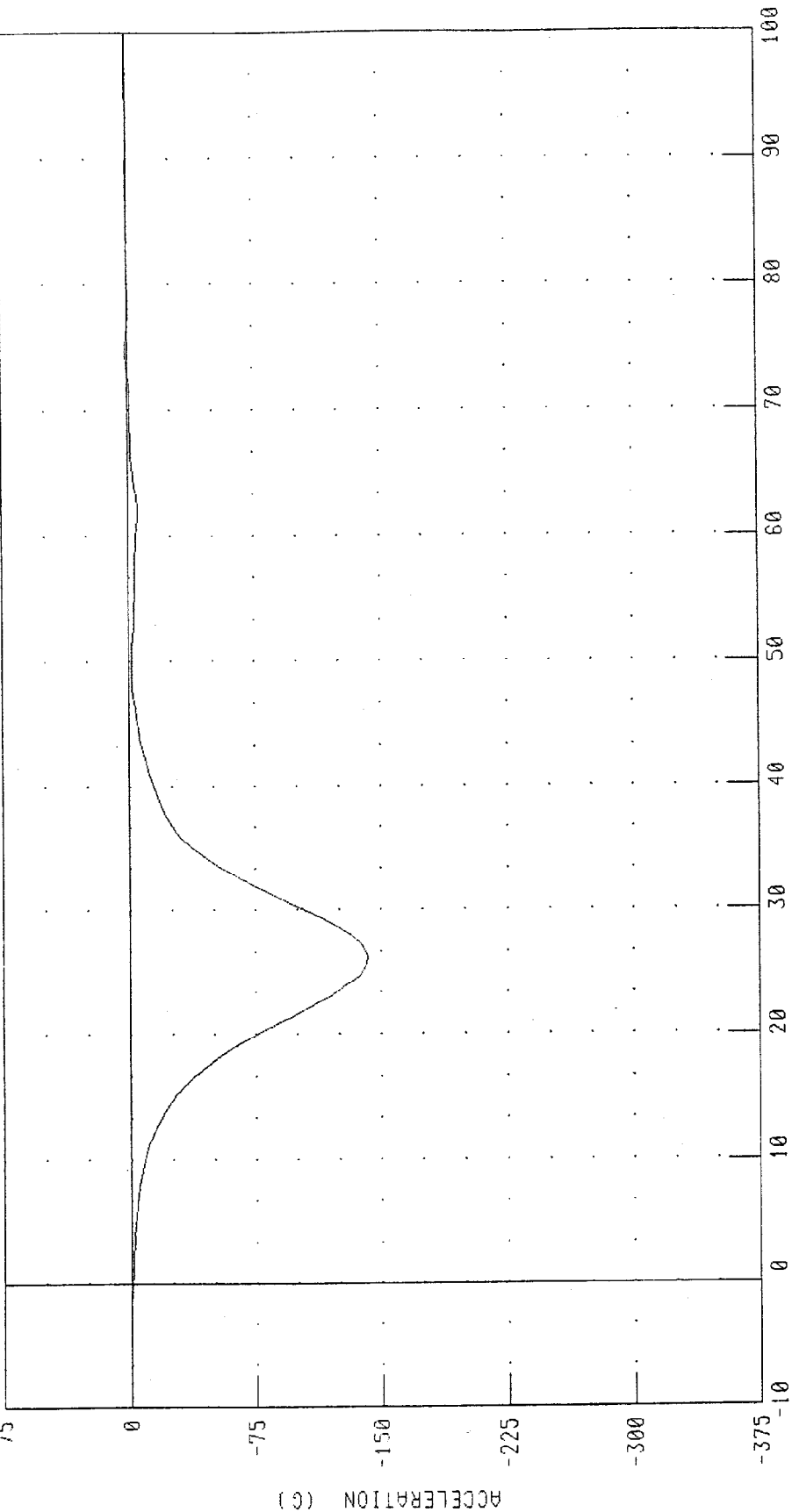
HEAD ACCELERATION Z AXIS

S FEMALE SN289 HEAD DROP CAL9

TRC TEST NUMBER 289C9HD1

75

RUN NUMBER 082599 0845.1



ACCELERATION (G)

TIME (MS X 10⁻¹)

PEAK DATA: 1.42 G @ 7.52 MS, -141.75 G @ 2.64 MS

CHANNEL: HEDZG FILTER: CH. CLASS 1000

SMALL FEMALE HYBRID III HEAD CALIBRATION

HEAD RESULTANT ACCELERATION

S FEMALE SN289 HEAD DROP CAL9

RUN NUMBER 082599 0845.1

TRC TEST NUMBER 289C9H01

375

300

225

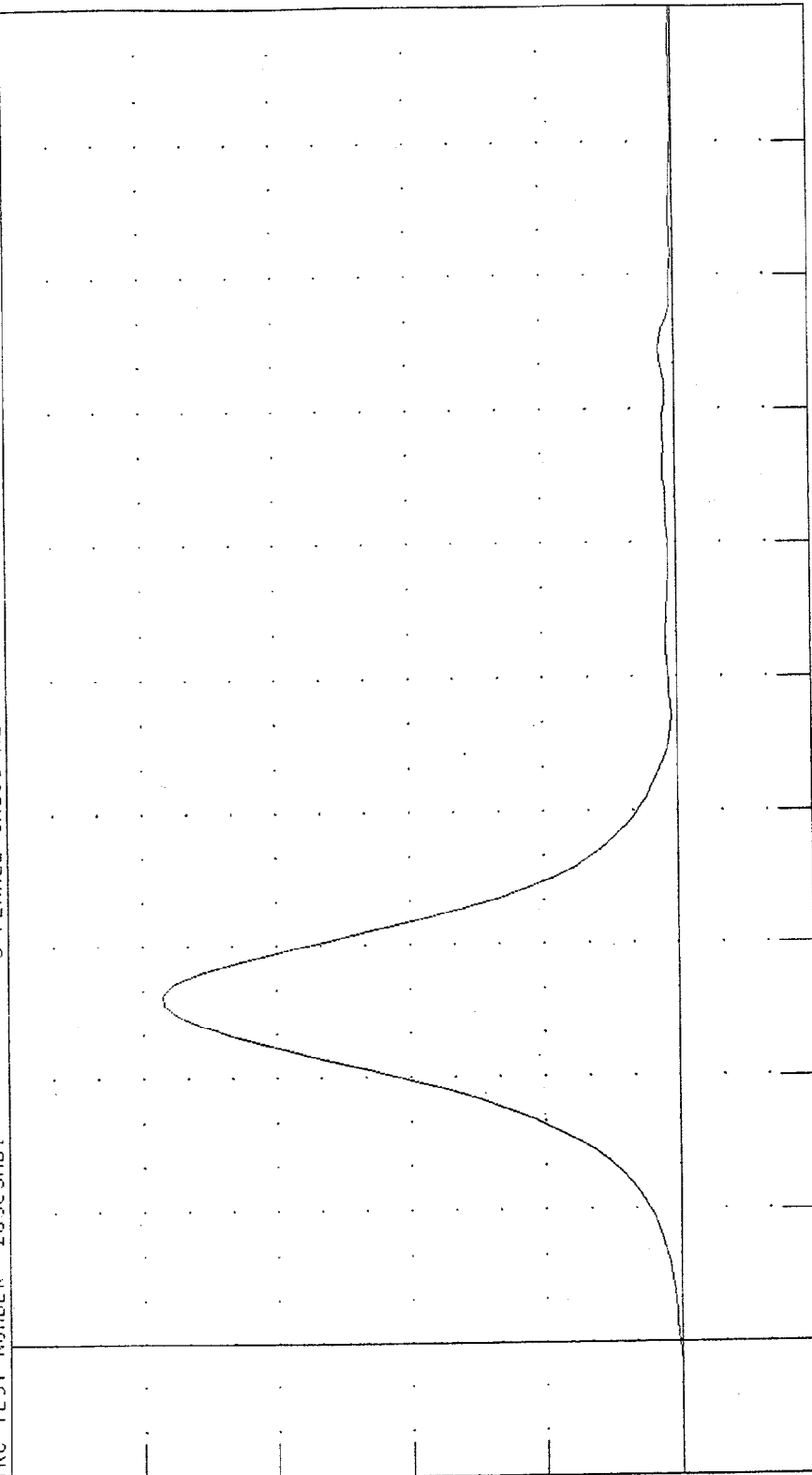
150

75

0

-75
-10

ACCELERATION (G)



TIME (MS X 10⁻¹)

PEAK DATA: 288 86 G @ 2.64 MS, 0.03 G @ -0.96 MS

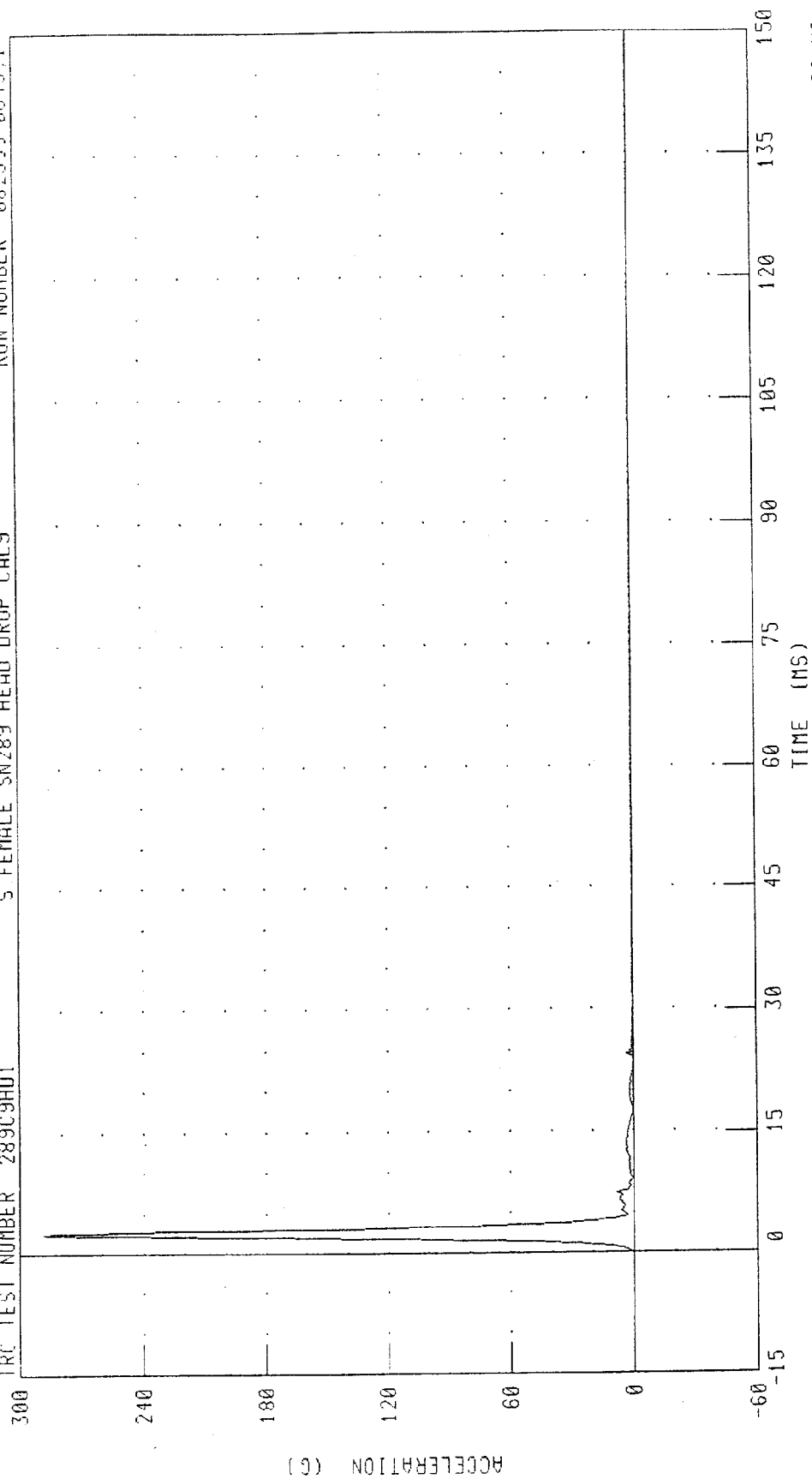
CHANNEL: HEDRC FILTER: CH. CLASS 1000

SMALL FEMALE HYBRID III HEAD CALIBRATION
CHECK PLOT - HEAD RESULTANT ACCELERATION

IRC TEST NUMBER 289C9HD1

S FEMALE SN289 HEAD DROP CAL9

RUN NUMBER 082599 0845.1



CHANNEL: HEDRC FILTER: CH. CLASS 1000

PEAK DATA: 288.86 G @ 2.64 MS, 0.03 G @ -14.96 MS

TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SMALL FEMALE

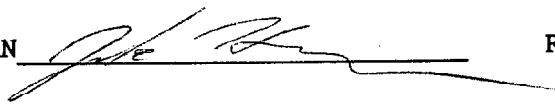
25-AUG-99

NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

TRC INC. TEST NO: 289C9NF1 S.FEMALE SN289 NECK FLEX. CAL9

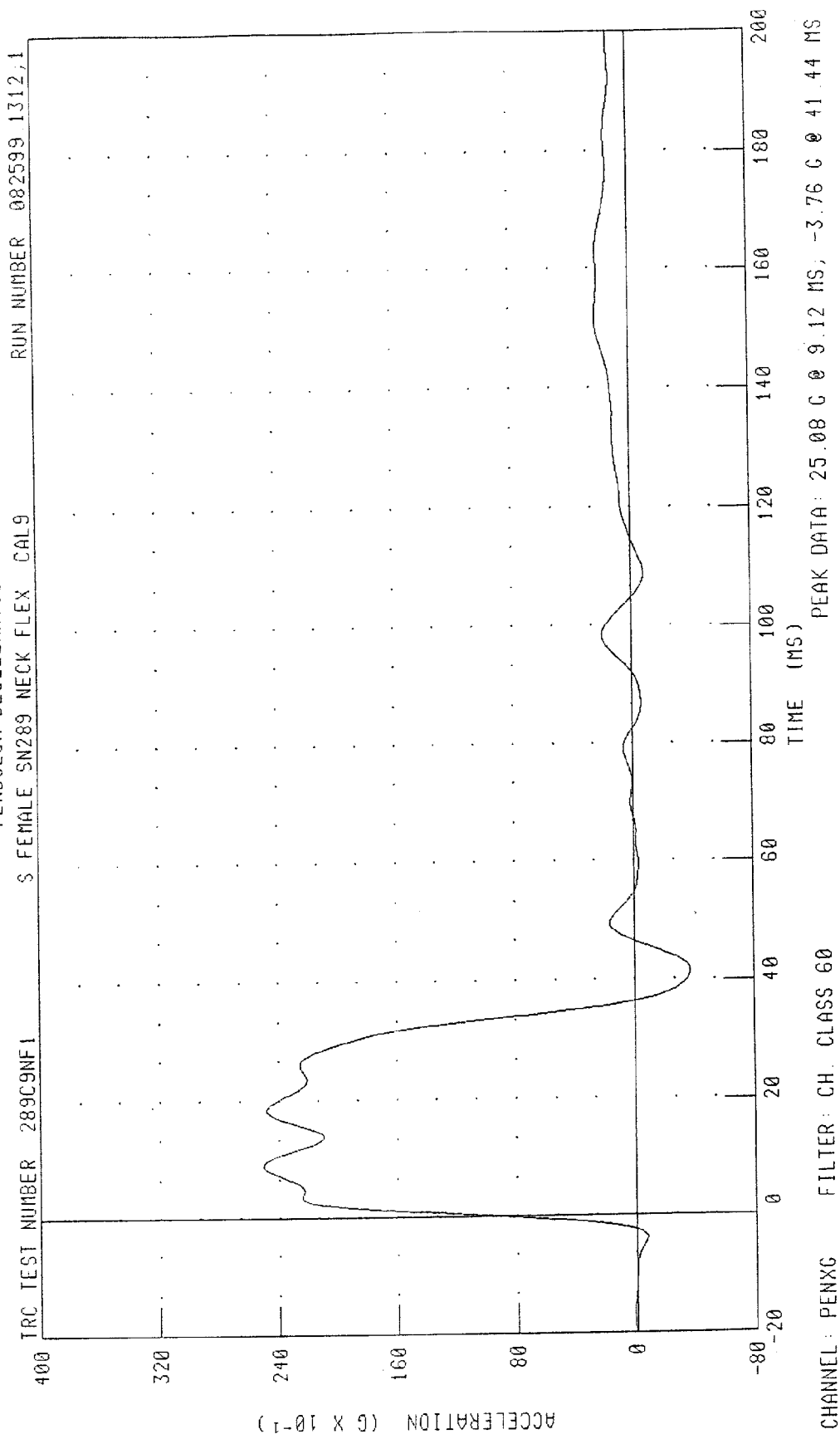
TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY		10 - 70 %	55.0 %
IMPACT VELOCITY		6.89 - 7.13 M/S	7.12 M/S
INTEGRATED PENDULUM VELOCITY	10 MS	2.1 - 2.5 M/S	2.18 M/S
	20 MS	4.0 - 5.0 M/S	4.44 M/S
	30 MS	5.8 - 7.0 M/S	6.62 M/S
PEAK D-PLANE ROTATION		80 - 92 DEG.	84.90 DEG.
PEAK MOMENT ABOUT OCCIPITAL CONDYLE DURING ROTATION INT		69 - 83 NM	71.14 NM
POSITIVE MOMENT DECAY TIME FROM TO TO 10 NM		80 - 100 MS	89.68 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN 

RUN NUMBER: 082599.1124;1

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION



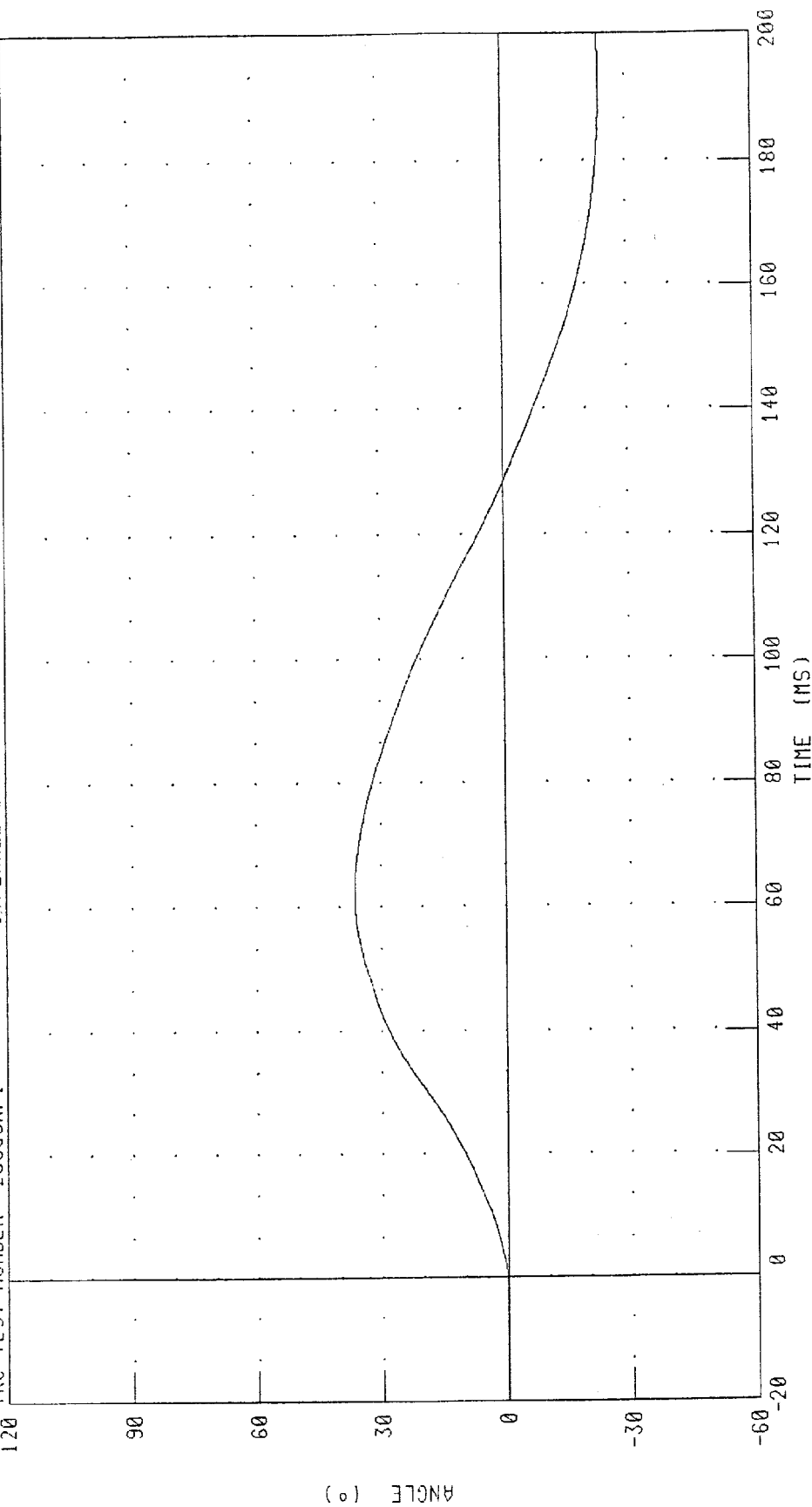
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT BASE OF NECK

S. FEMALE SN289 NECK FLEX. CAL9

RUN NUMBER 082599.1312.1

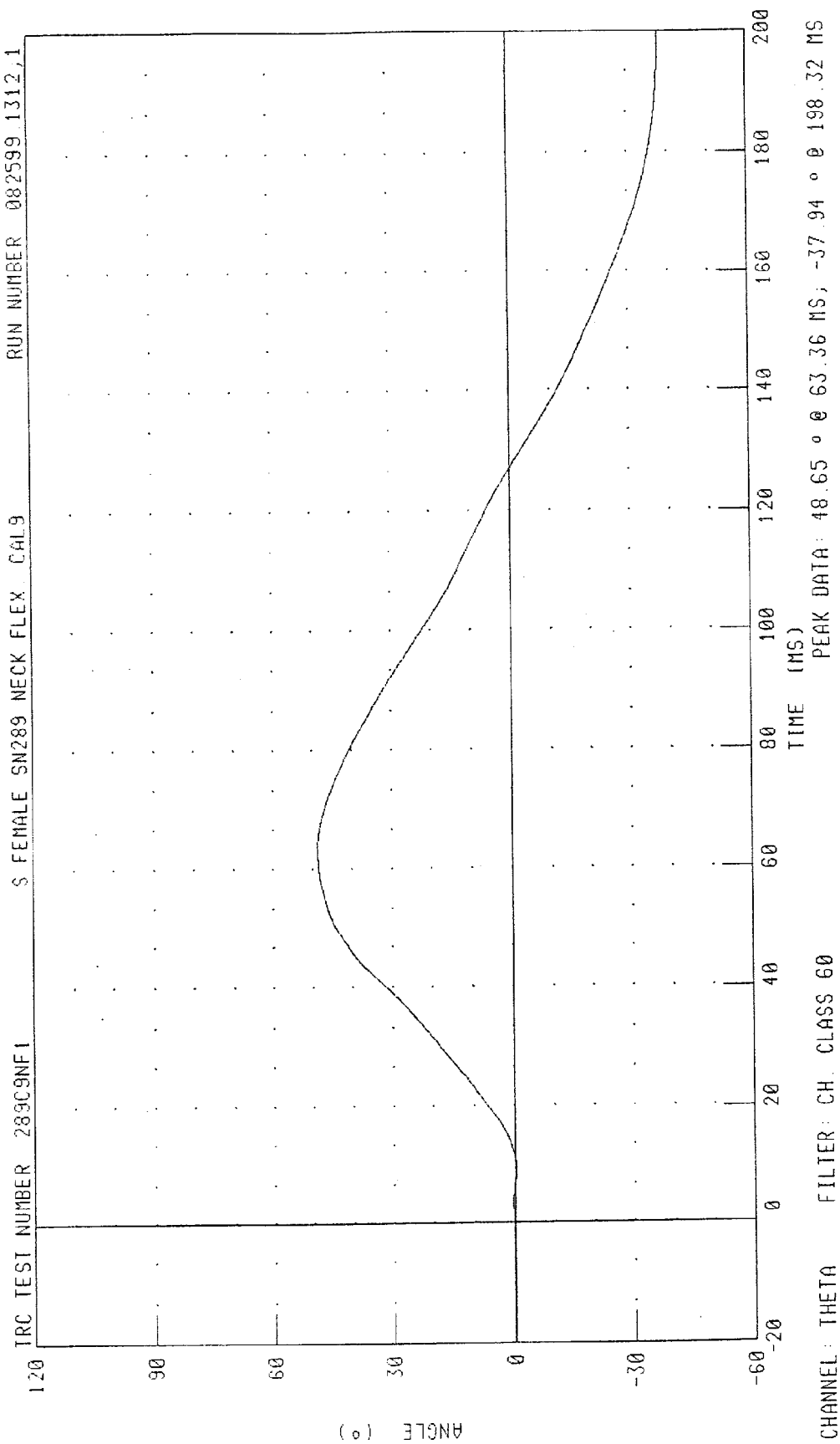
TRC TEST NUMBER 289C9NF1



PEAK DATA: 36.26 ° @ 62.48 MS; -23.76 ° @ 191.76 MS

CHANNEL: BETA FILTER: CH. CLASS 60

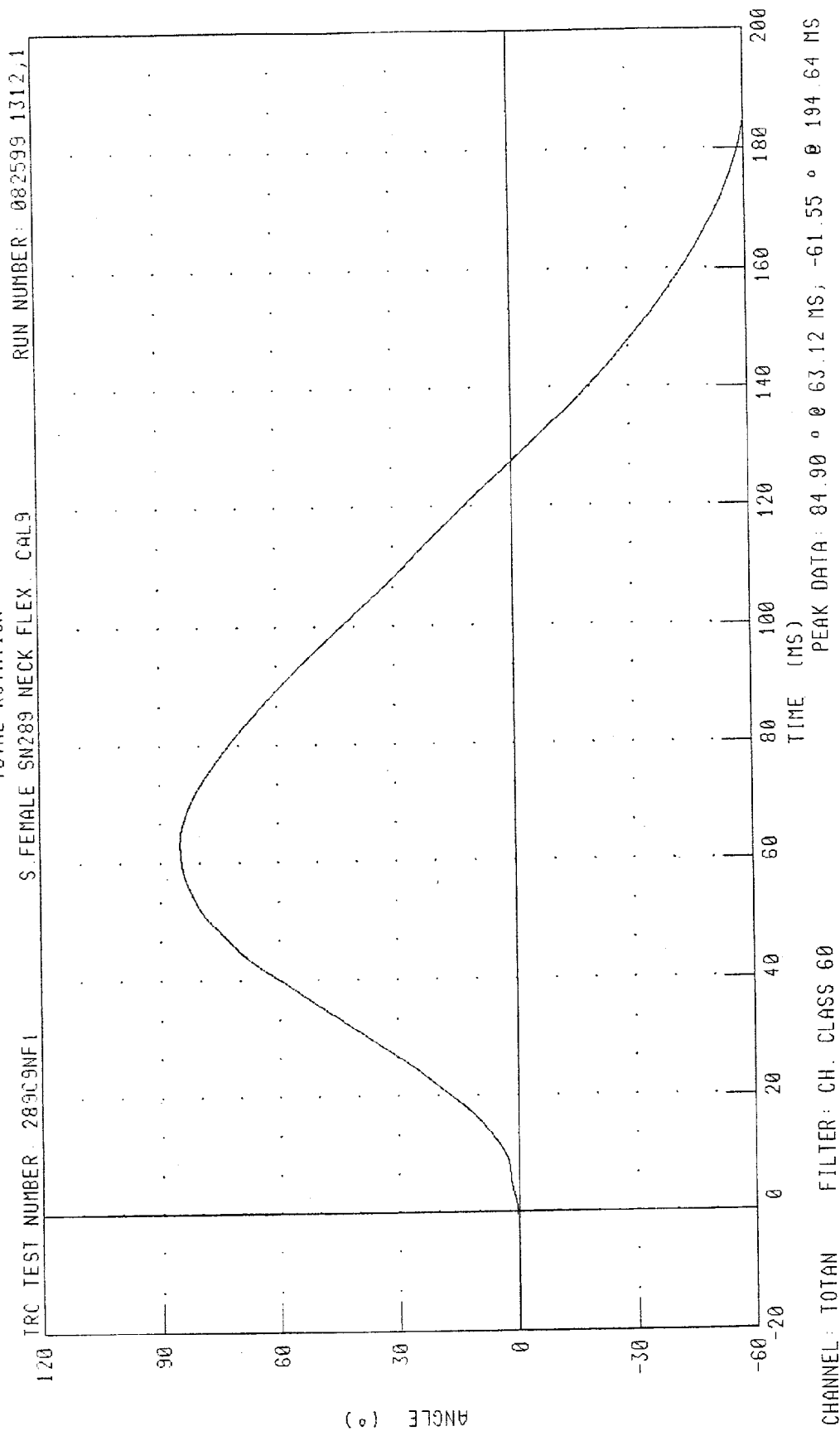
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



CHANNEL: THETA FILTER: CH. CLASS 60

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

TOTAL ROTATION



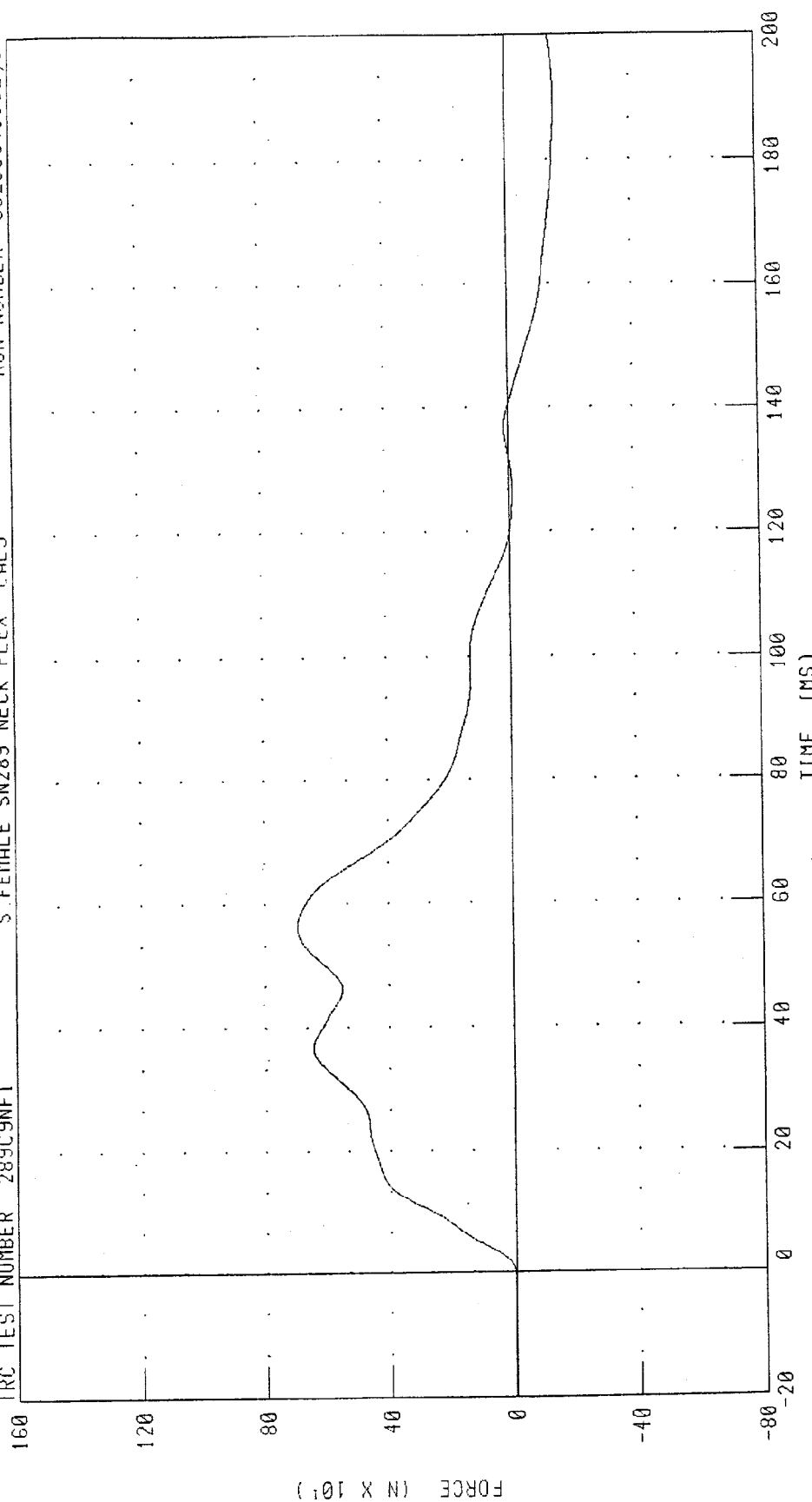
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER 289C9NF1

S FEMALE SN289 NECK FLEX CAL9

RUN NUMBER 082599.1312.1



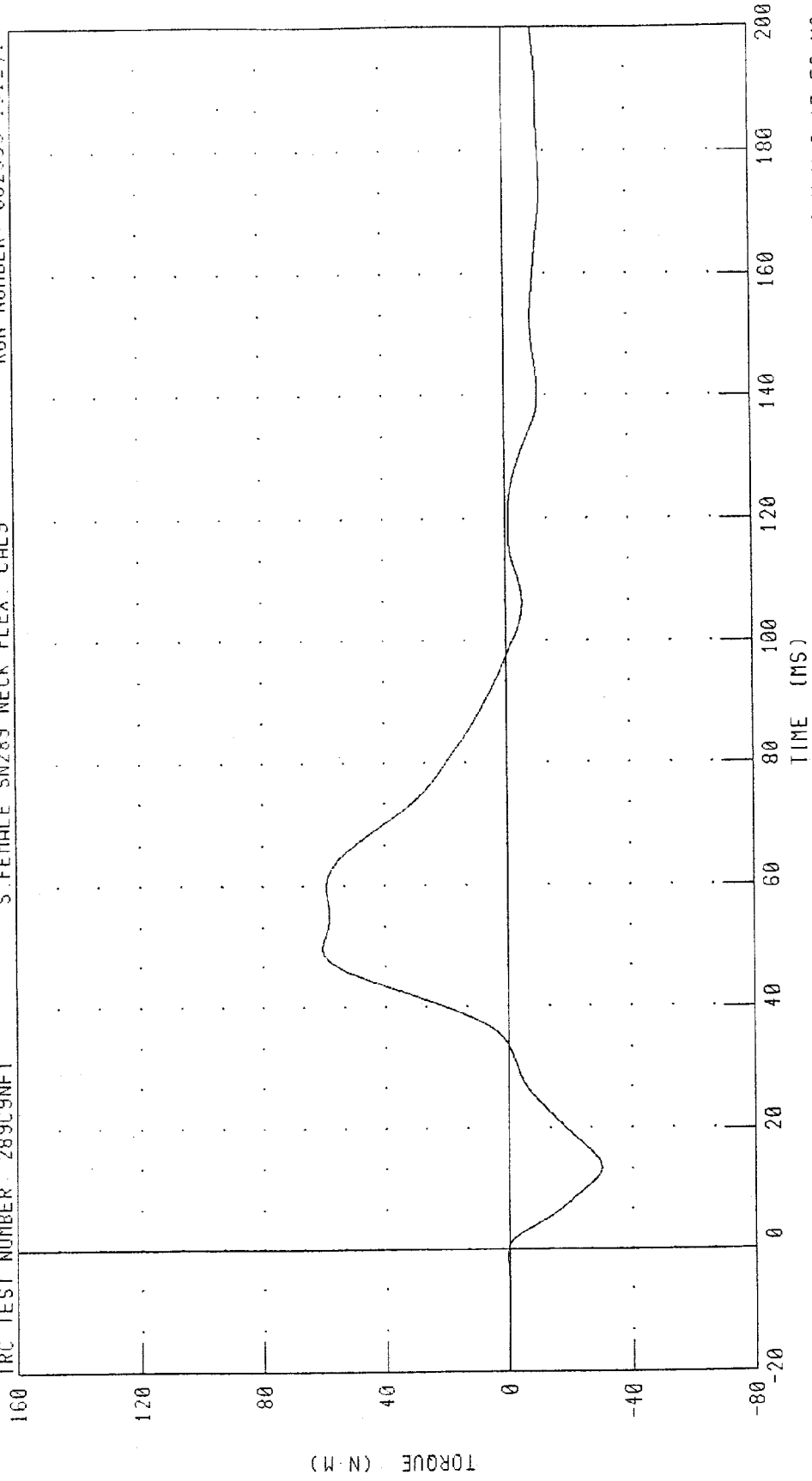
PEAK DATA: 694.06 N @ 56.48 MS, -158.03 N @ 189.28 MS

CHANNEL: NEKXF FILTER: CH. CLASS 60

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER: 289C9NF1 S. FEMALE SN289 NECK FLEX. CAL9 RUN NUMBER: 082599 1312.1



CHANNEL: NEKYM FILTER: CH. CLASS 60 PEAK DATA: 60.42 N-M @ 49.84 MS; -30.10 N-M @ 13.52 MS

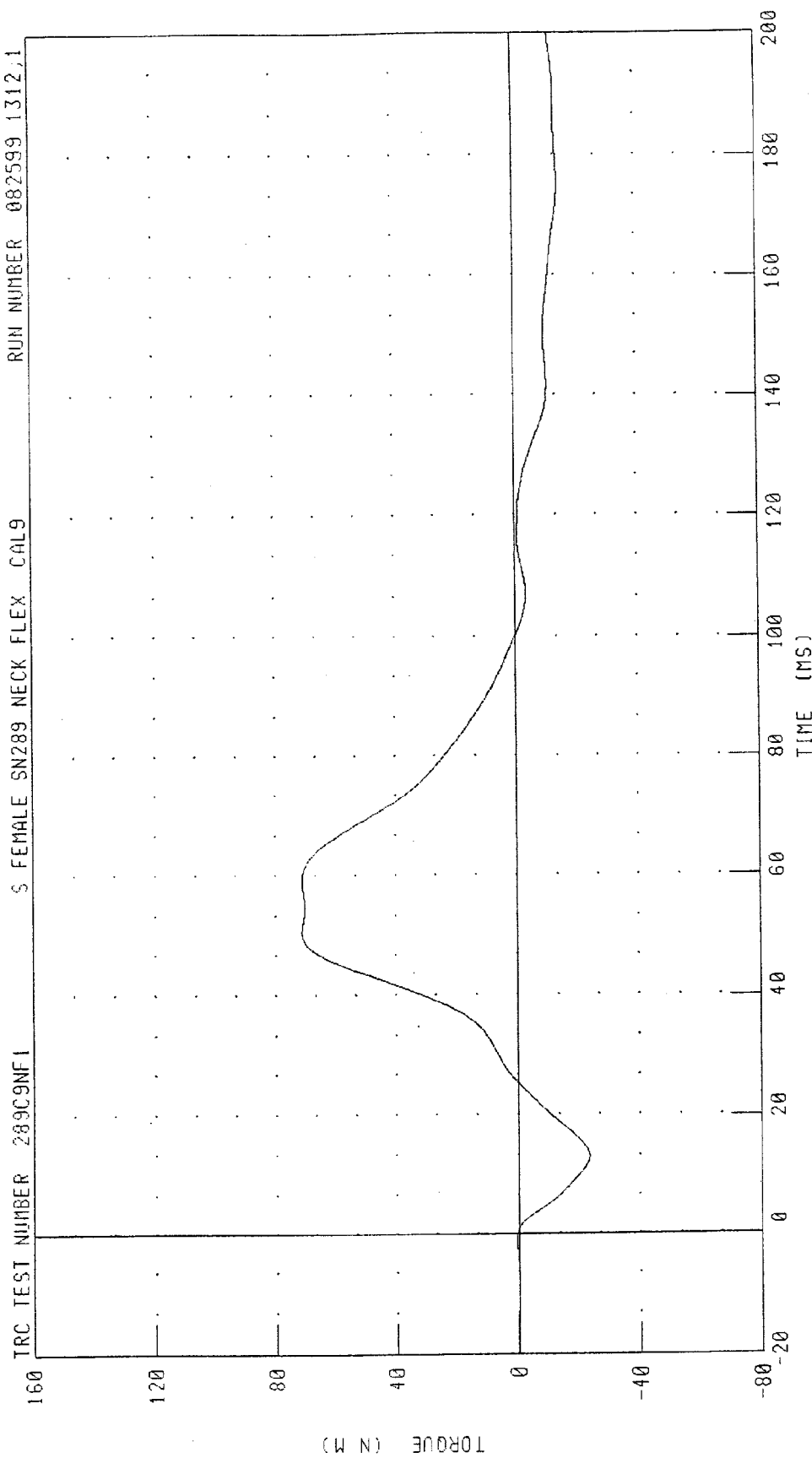
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

S FEMALE SN289 NECK FLEX CAL9

TRC TEST NUMBER 289C9NF1

RUN NUMBER 082599 1312.1



PEAK DATA: 71.19 N.M @ 50.56 MS, -23.34 N.M @ 13.04 MS

CHANNEL: NEKOM FILTER: CH. CLASS 60

TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SMALL FEMALE

25-AUG-99

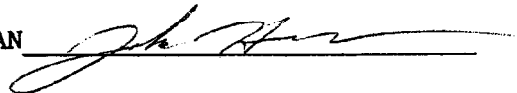
NECK EXTENSION TEST - 6 CHANNEL TRANSDUCER

TRC INC. TEST NO: 289C9NE1 S.FEMALE SN289 NECK EXT. CAL9

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6 - 22.2 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY		10 - 70 %	55.0 %
IMPACT VELOCITY		5.95 - 6.19 M/S	6.14 M/S
INTEGRATED PENDULUM VELOCITY	10 MS	1.5 - 1.9 M/S	1.65 M/S
	20 MS	3.1 - 3.9 M/S	3.34 M/S
	30 MS	4.6 - 5.6 M/S	5.04 M/S
PEAK D-PLANE ROTATION		97 - 109 DEG.	106.62 DEG.
PEAK MOMENT ABOUT OCCIPITAL CONDYLE DURING ROTATION INT		-55 / -69 NM	-61.57 NM
NEGATIVE MOMENT DECAY TIME FROM TO TO -10 NM		94 - 114 MS	105.84 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN



RUN NUMBER: 082599.1400;1

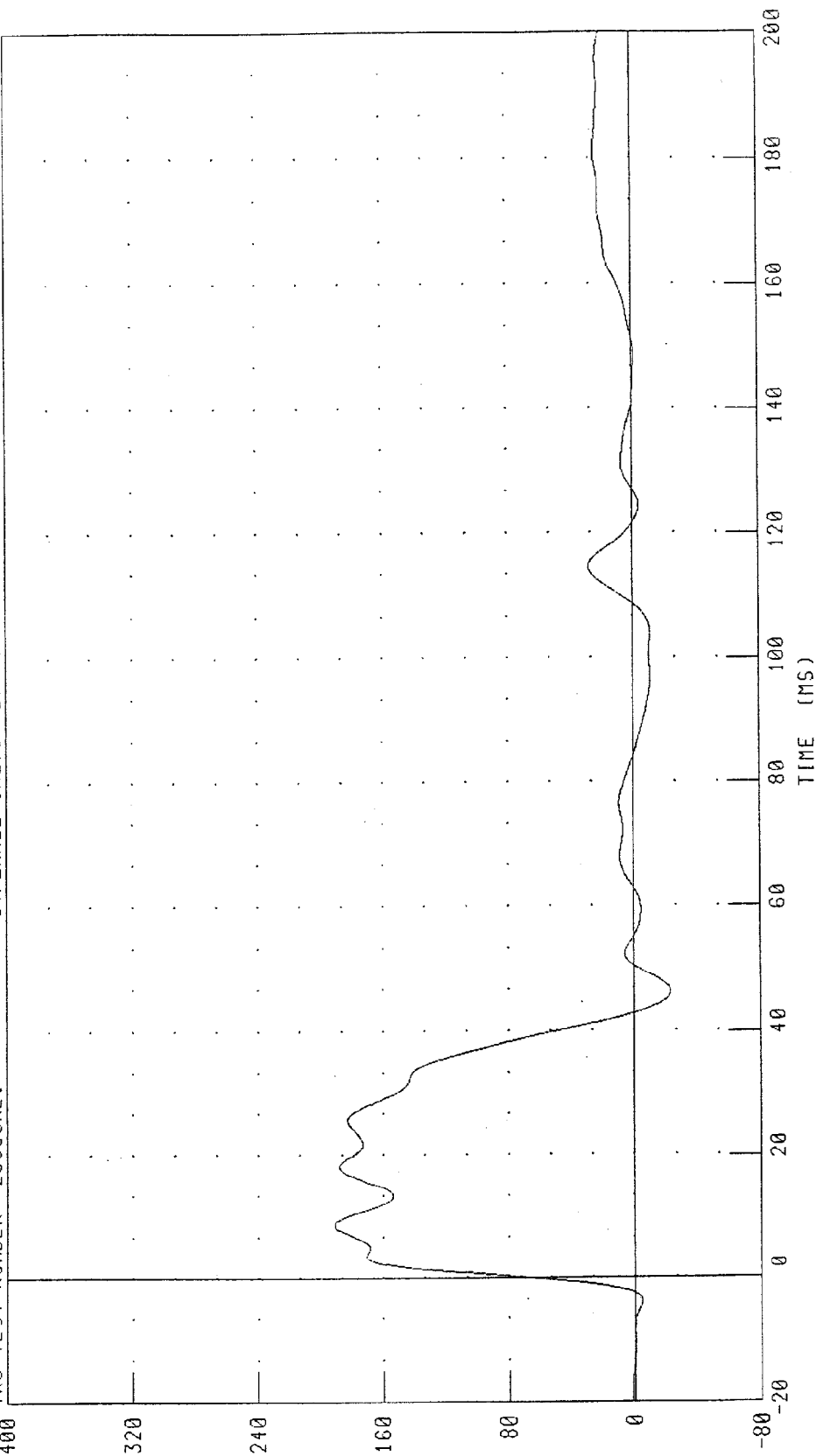
SMALL FEMALE NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

IRC TEST NUMBER 289C9NE1

S. FEMALE SN289 NECK EXT CAL9

RUN NUMBER 082599 1409.1

ACCELERATION ($G \times 10^{-1}$)



CHANNEL: PENXC

FILTER: CH. CLASS 60

TIME (MS)

PEAK DATA: 19.12 G @ 8.80 MS, -2.35 G @ 46.16 MS

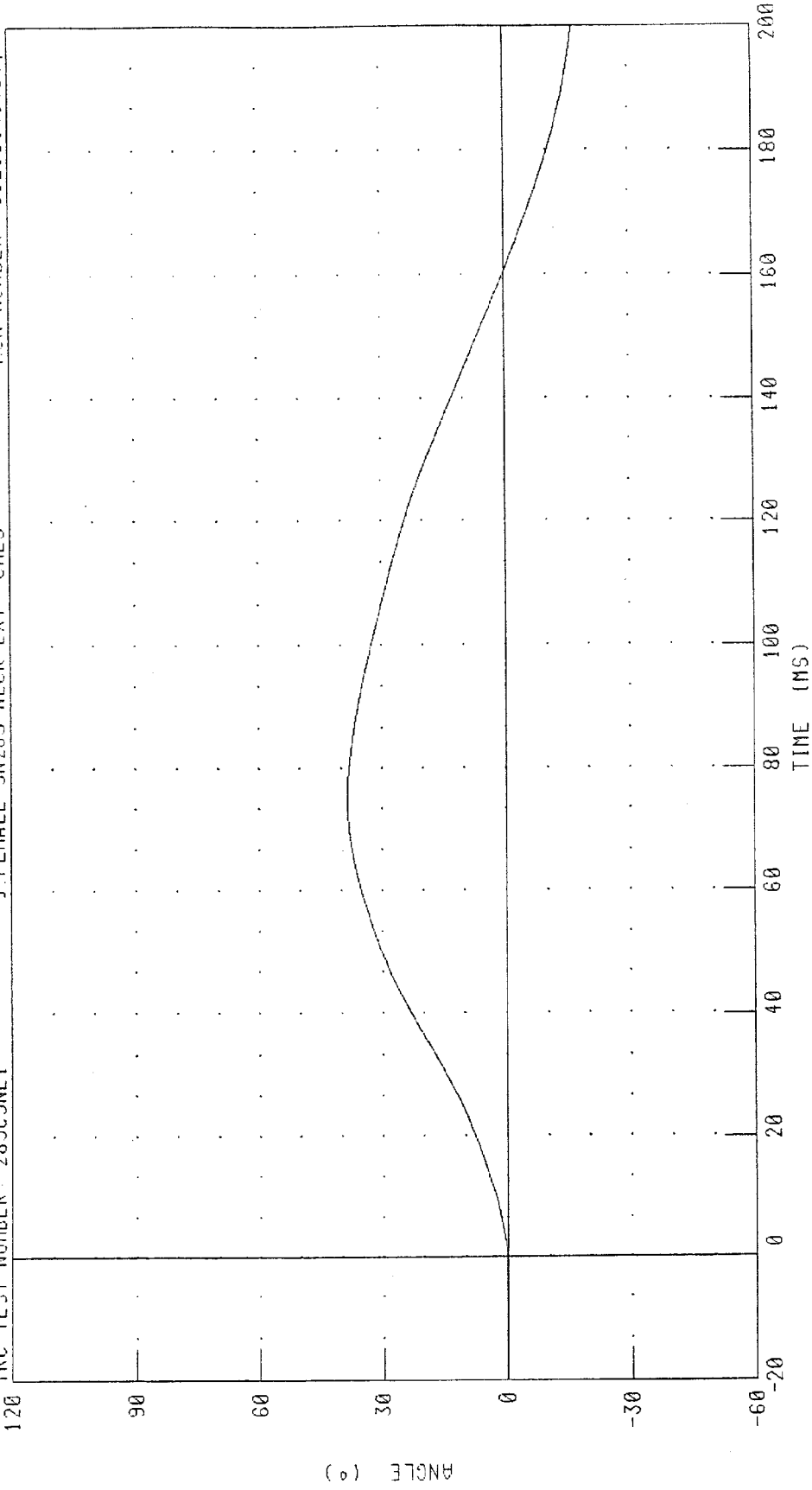
SMALL FEMALE NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 289C9NE1

S. FEMALE SN289 NECK EXT CAL9

RUN NUMBER: 082599.1409,1

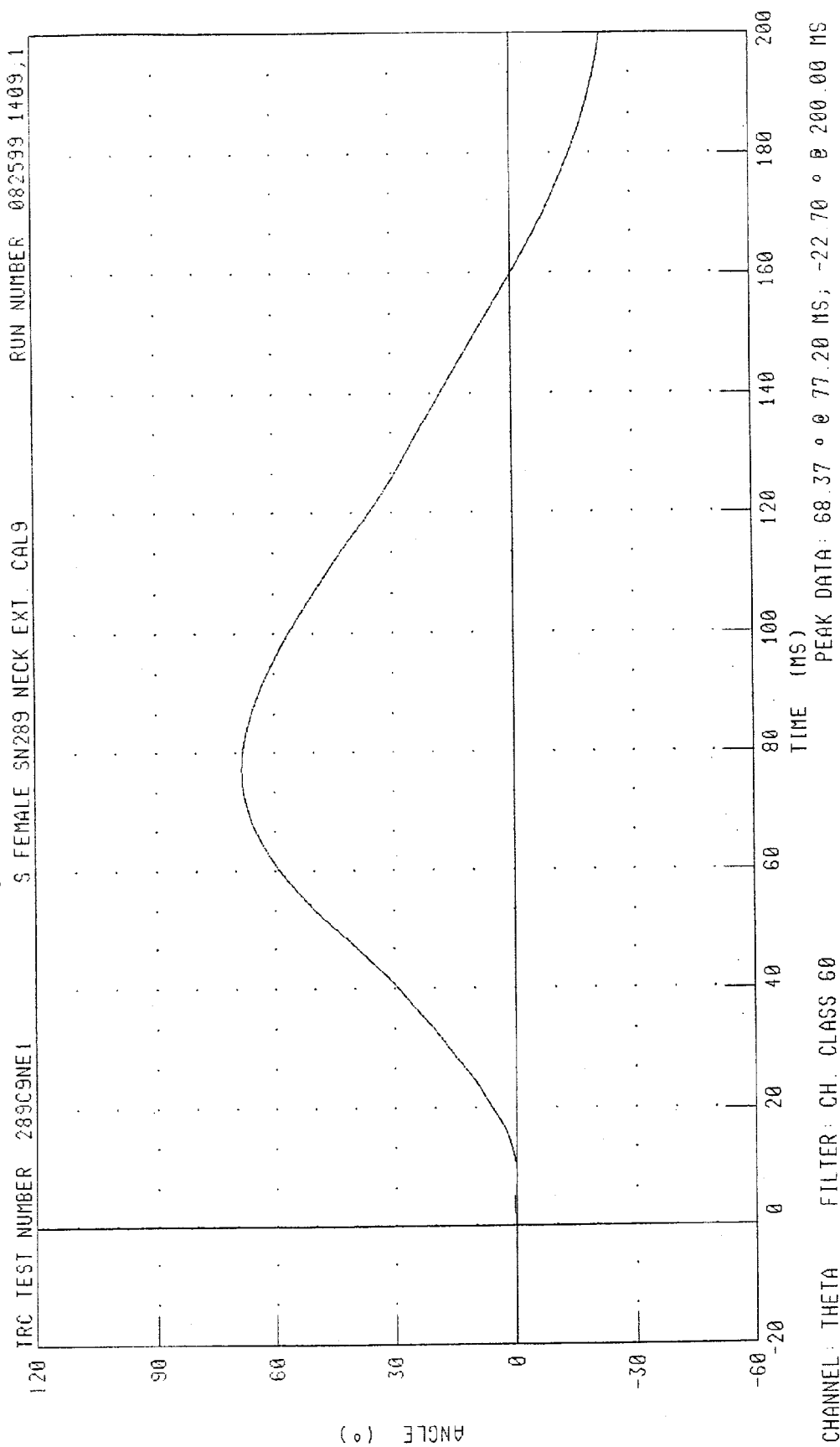


PEAK DATA: 38.28 ° @ 75.36 MS; -16.62 ° @ 200.00 MS

FILTER: CH. CLASS 60

CHANNEL: BETA

SMALL FEMALE NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



CHANNEL: THETA FILTER: CH. CLASS 60

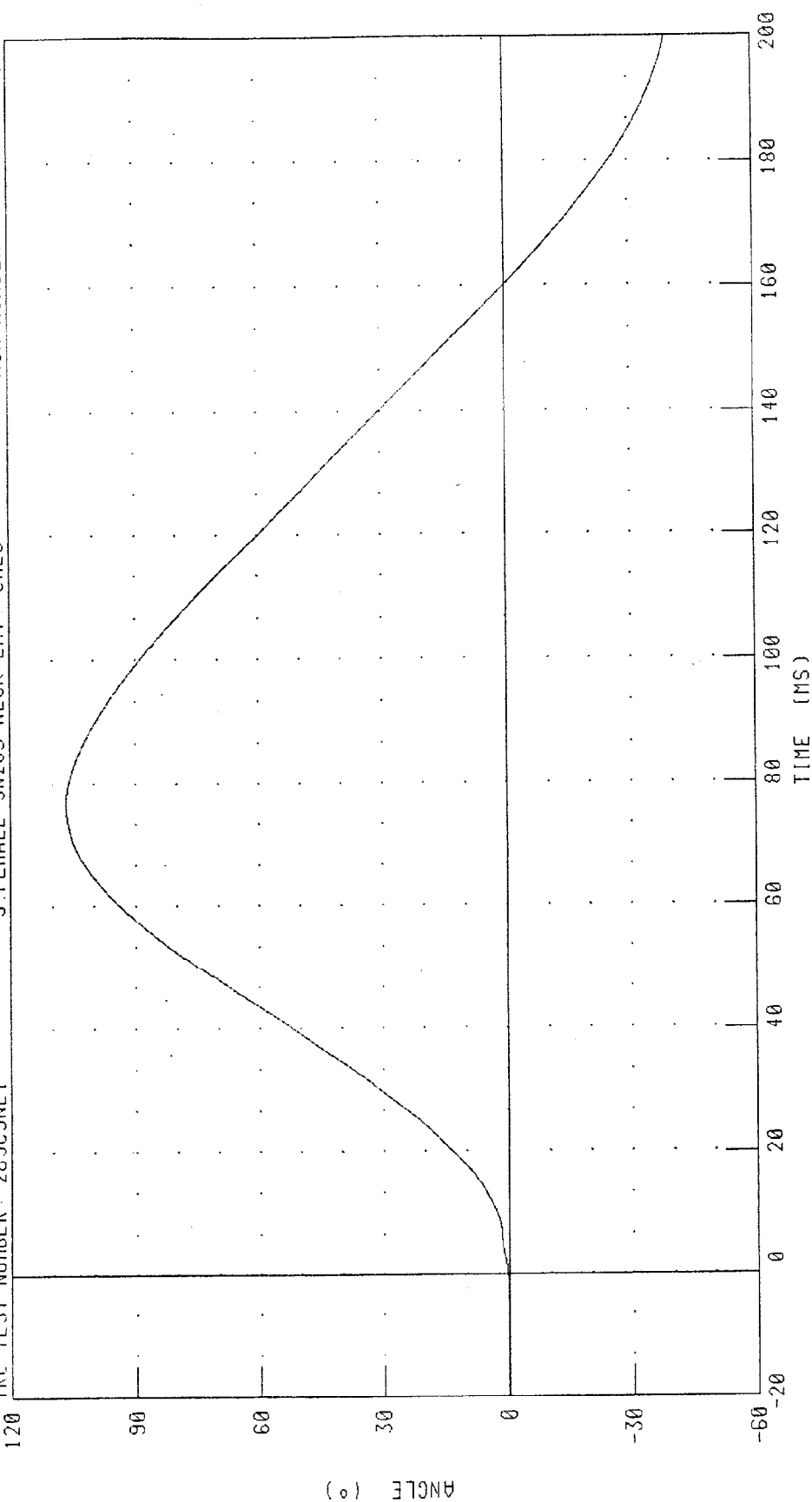
SMALL FEMALE NECK EXTENSION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 289C9NE1

S.FEMALE SN289 NECK EXT CAL9

RUN NUMBER: 082599 1403.1



CHANNEL: TOTAN FILTER: CH. CLASS 60

PEAK DATA: 106.62 ° @ 76.80 MS, -39.32 ° @ 200.00 MS

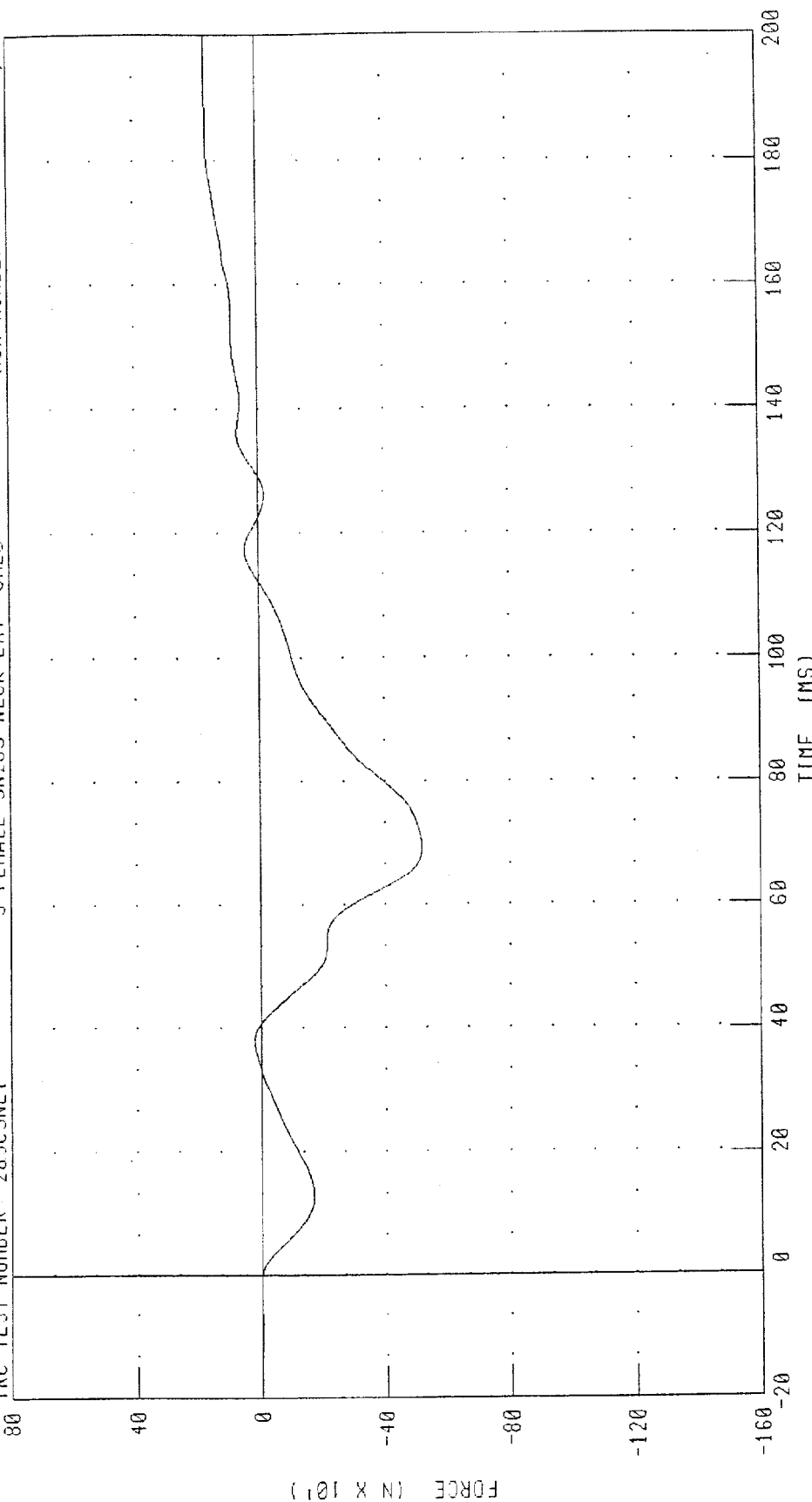
SMALL FEMALE NECK EXTENSION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 289C3NE1

S FEMALE SN289 NECK EXT CAL9

RUN NUMBER 082599.1409;1



PEAK DATA: 168.10 N @ 195.76 MS, -520.89 N @ 69.36 MS

CHANNEL: NEKXF FILTER: CH. CLASS 60

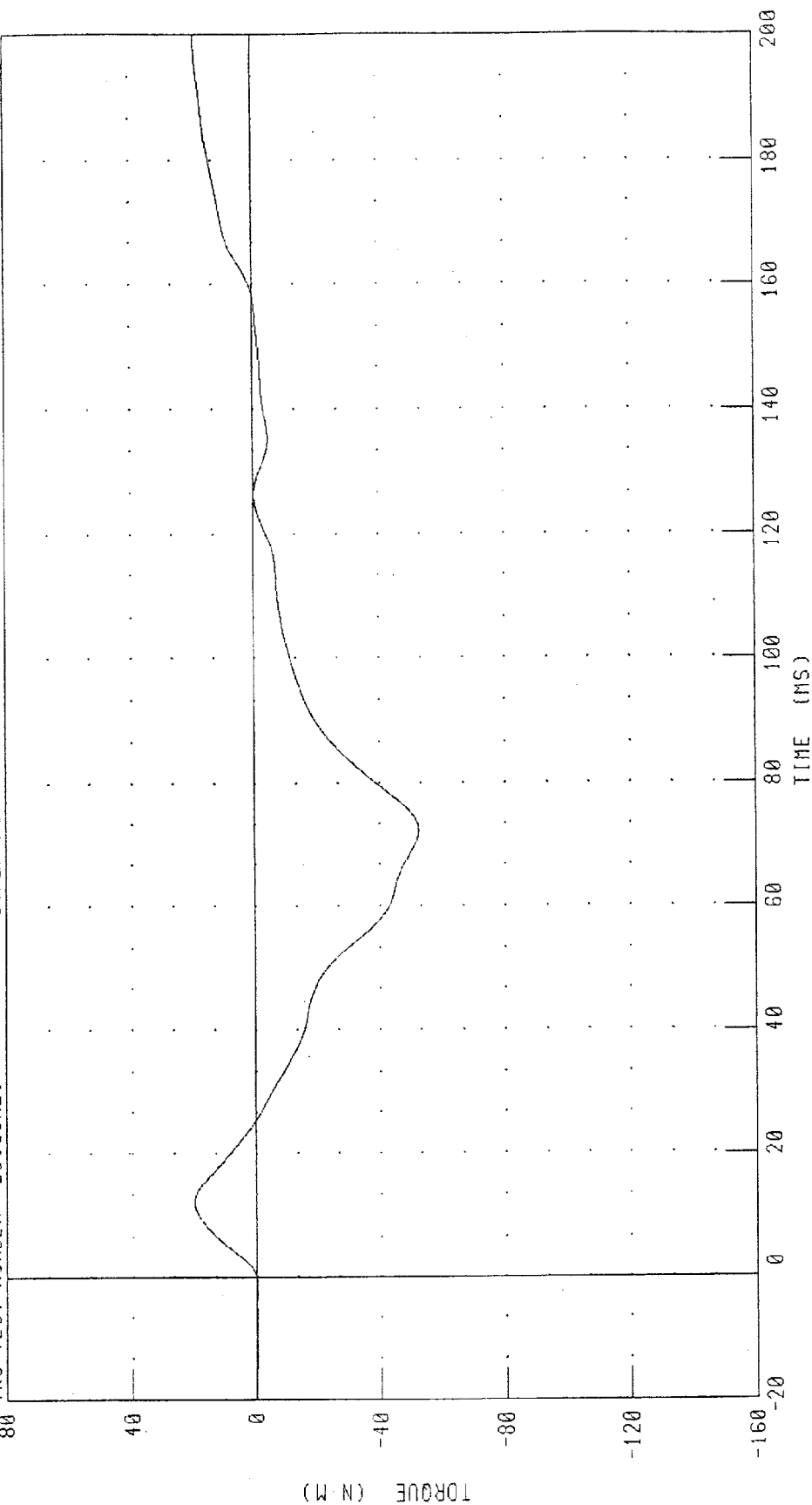
SMALL FEMALE NECK EXTENSION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER 289C9NE1

S. FEMALE SN289 NECK EXT CAL9

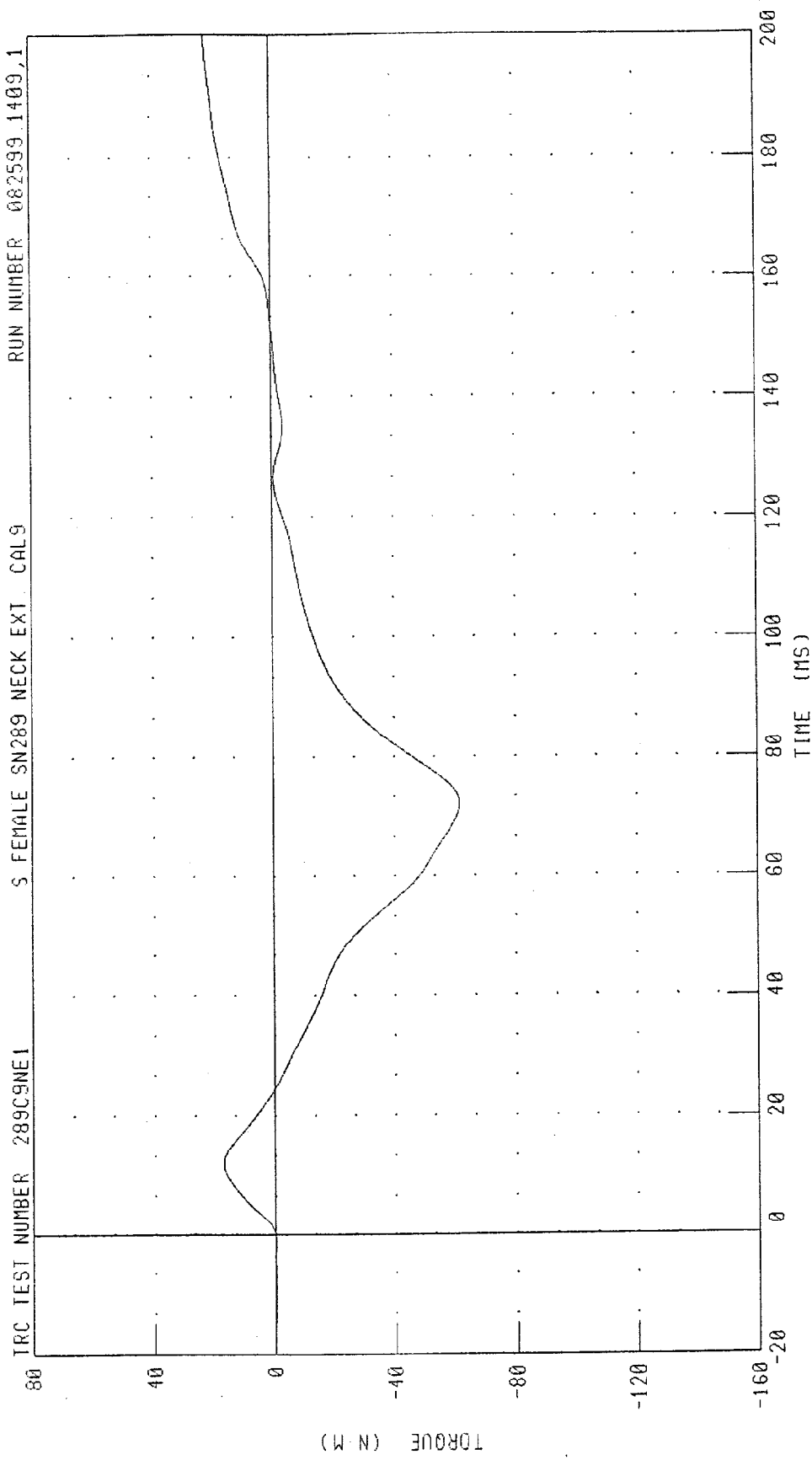
RUN NUMBER 082599.1409.1



PEAK DATA: 20.15 N-M @ 12.16 MS, -52.52 N-M @ 72.40 MS

CHANNEL: NEKYM FILTER: CH. CLASS 60

SMALL FEMALE NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE



PEAK DATA: 21.70 N-M @ 199.04 MS, -61.57 N-M @ 72.16 MS

CHANNEL: NEKOM FILTER: CH. CLASS 60

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III SMALL FEMALE

26-AUG-99

TRC INC.

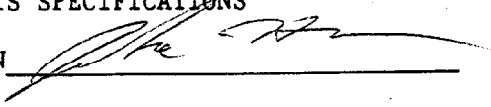
TEST NO: 289C9TH1

S.FEMALE SN289 THORAX CAL09

TEST PARAMETER	HIGH SPEED TEST	TEST RESULTS
	SPECIFICATION	
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/S	6.65 M/S
MAXIMUM DEFLECTION	48 - 55 MM	48.5 MM
MAXIMUM RESISTIVE FORCE WITHIN DEFLECTION CORRIDOR	3900 - 4400	4148. N
INTERNAL HYSTERESIS	69% - 85%	74.7%

TEST MEETS SPECIFICATIONS

TECHNICIAN



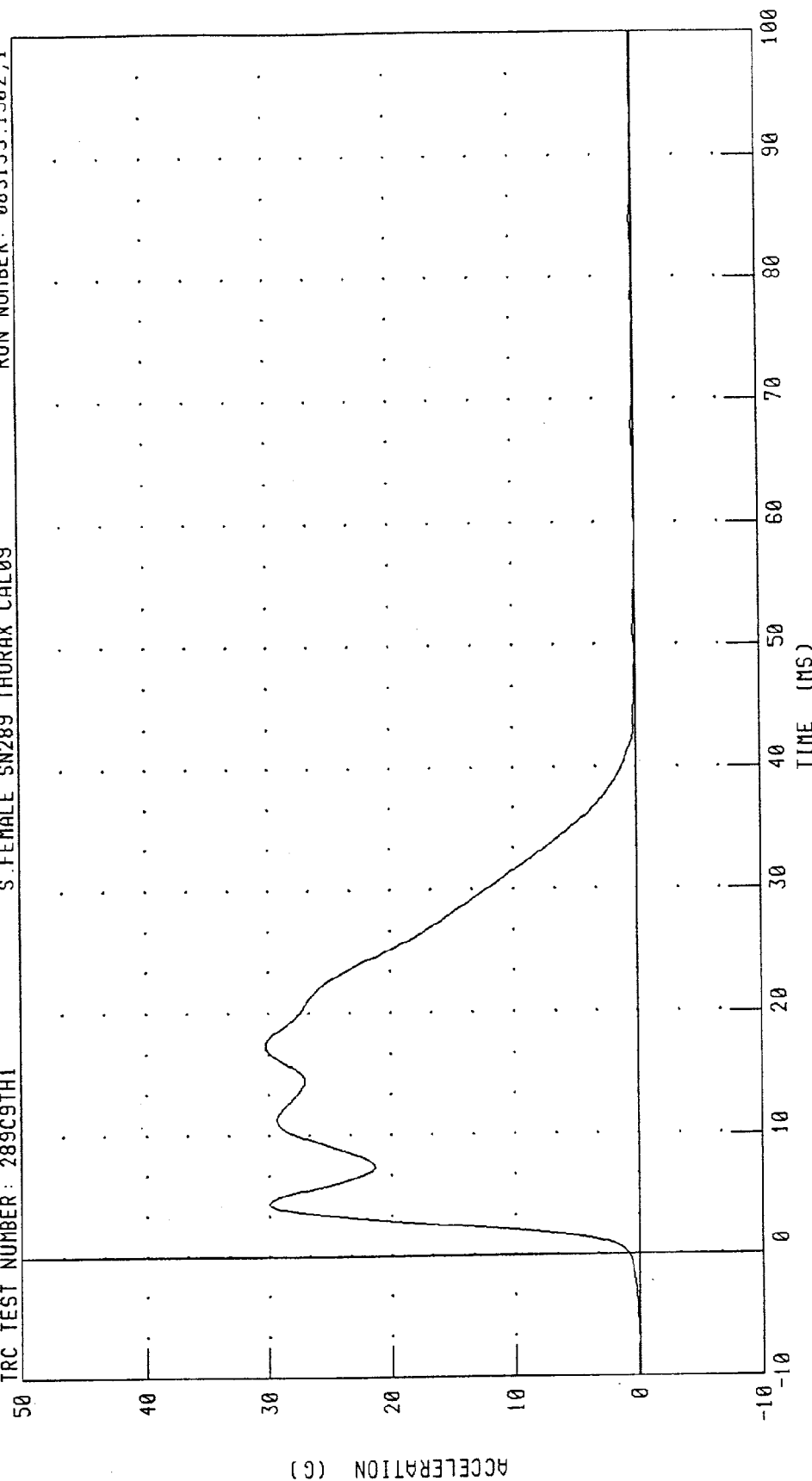
RUN NUMBER: 082699.0905;1

SMALL FEMALE THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 289C9TH1

S. FEMALE SN289 THORAX CAL09

RUN NUMBER: 083199.1502;1



CHANNEL: PENXC FILTER: CH. CLASS 180

PEAK DATA: 30.23 G @ 17.44 MS; -0.02 G @ 59.44 MS

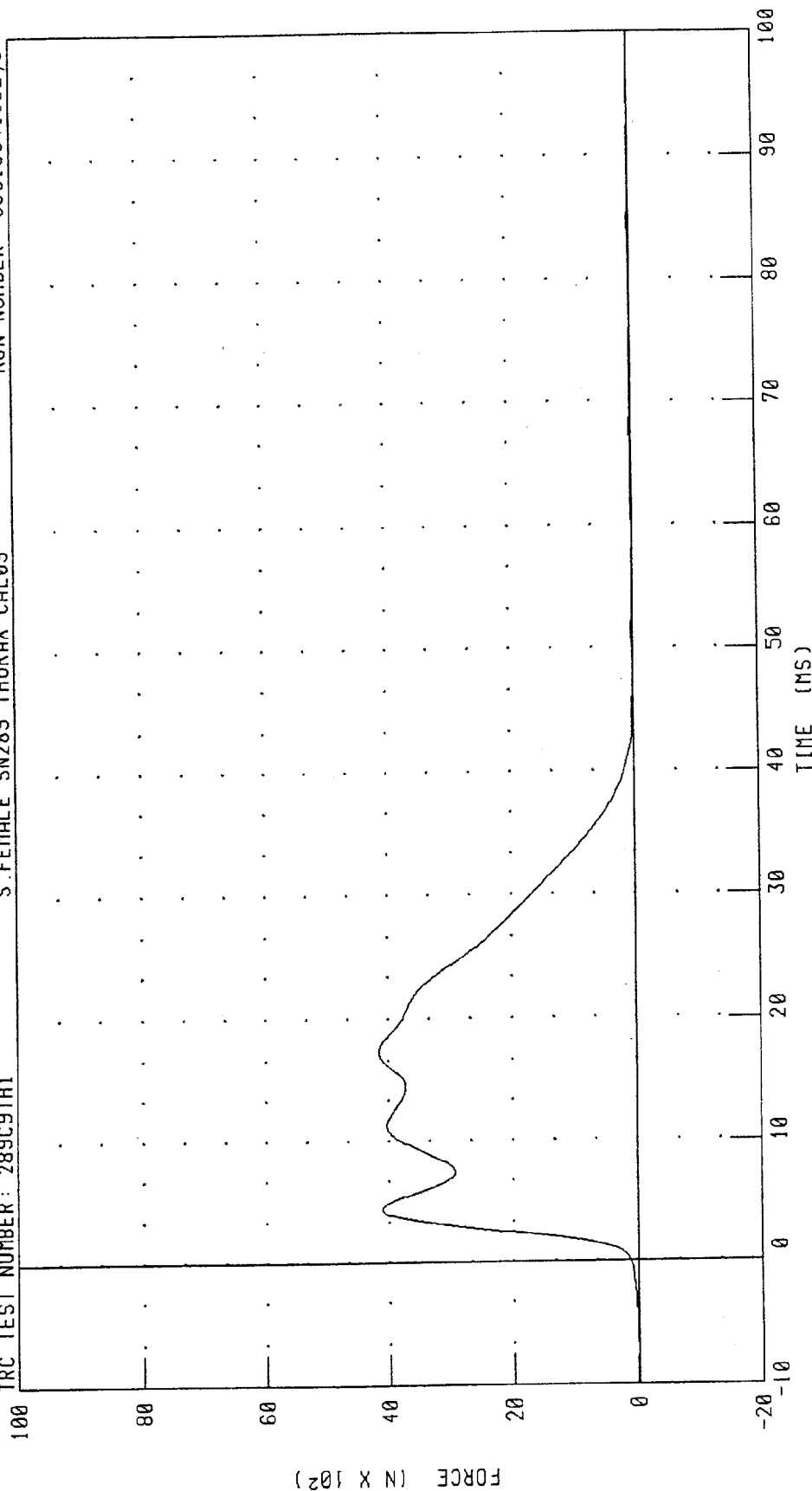
SMALL FEMALE THORAX CALIBRATION

PENDULUM FORCE

TRC TEST NUMBER: 289C9TH1

S. FEMALE SN289 THORAX CAL09

RUN NUMBER: 083199.1502;1



PEAK DATA: 4148.69 N @ 17.44 MS, -2.49 N @ 59.44 MS

CHANNEL: PENXF FILTER: CH. CLASS 180

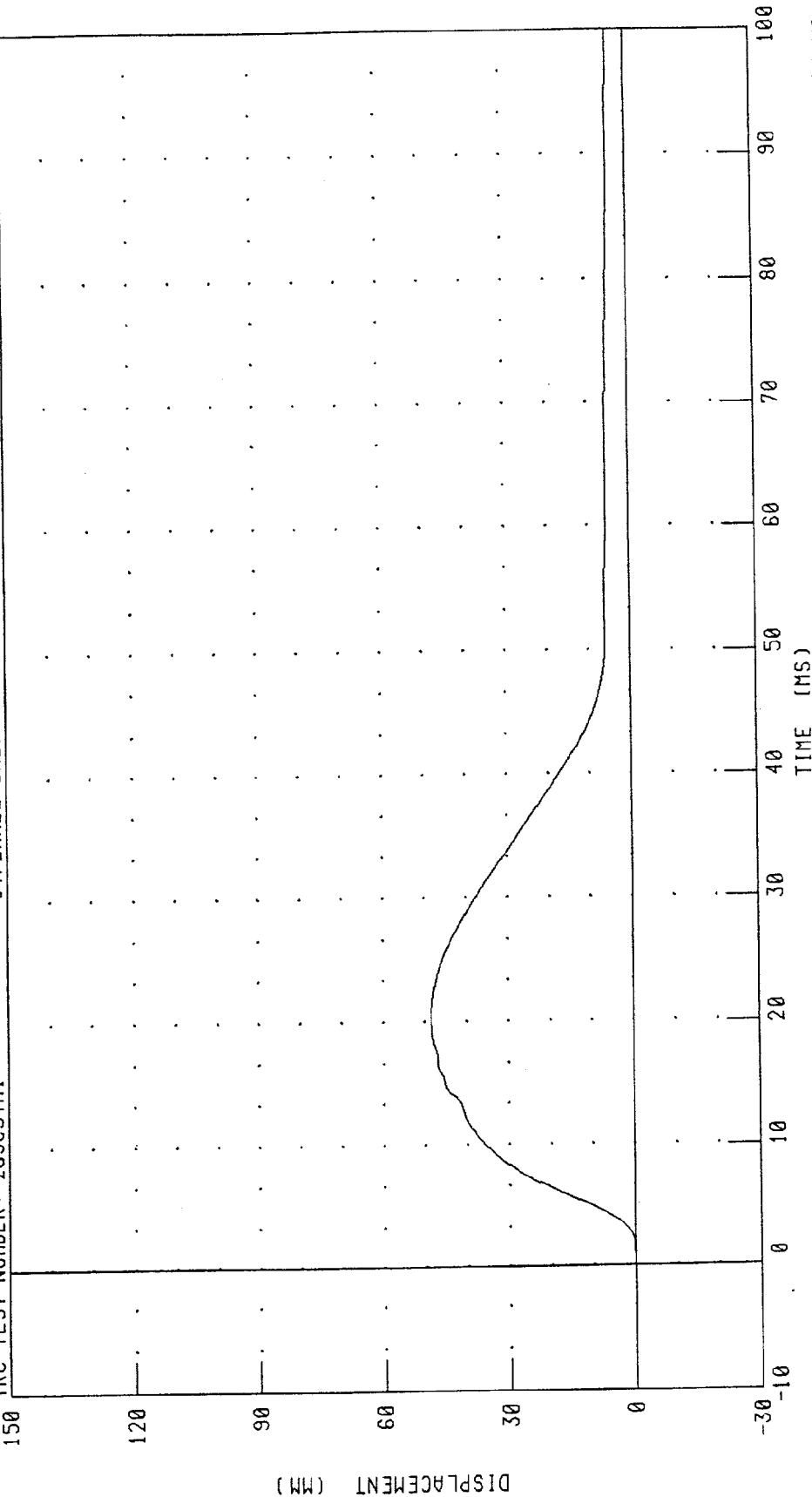
SMALL FEMALE THORAX CALIBRATION

STERNUM DISPLACEMENT

TRC TEST NUMBER: 289C9TH1

S. FEMALE SN289 THORAX CAL09

RUN NUMBER: 083199.1502;1



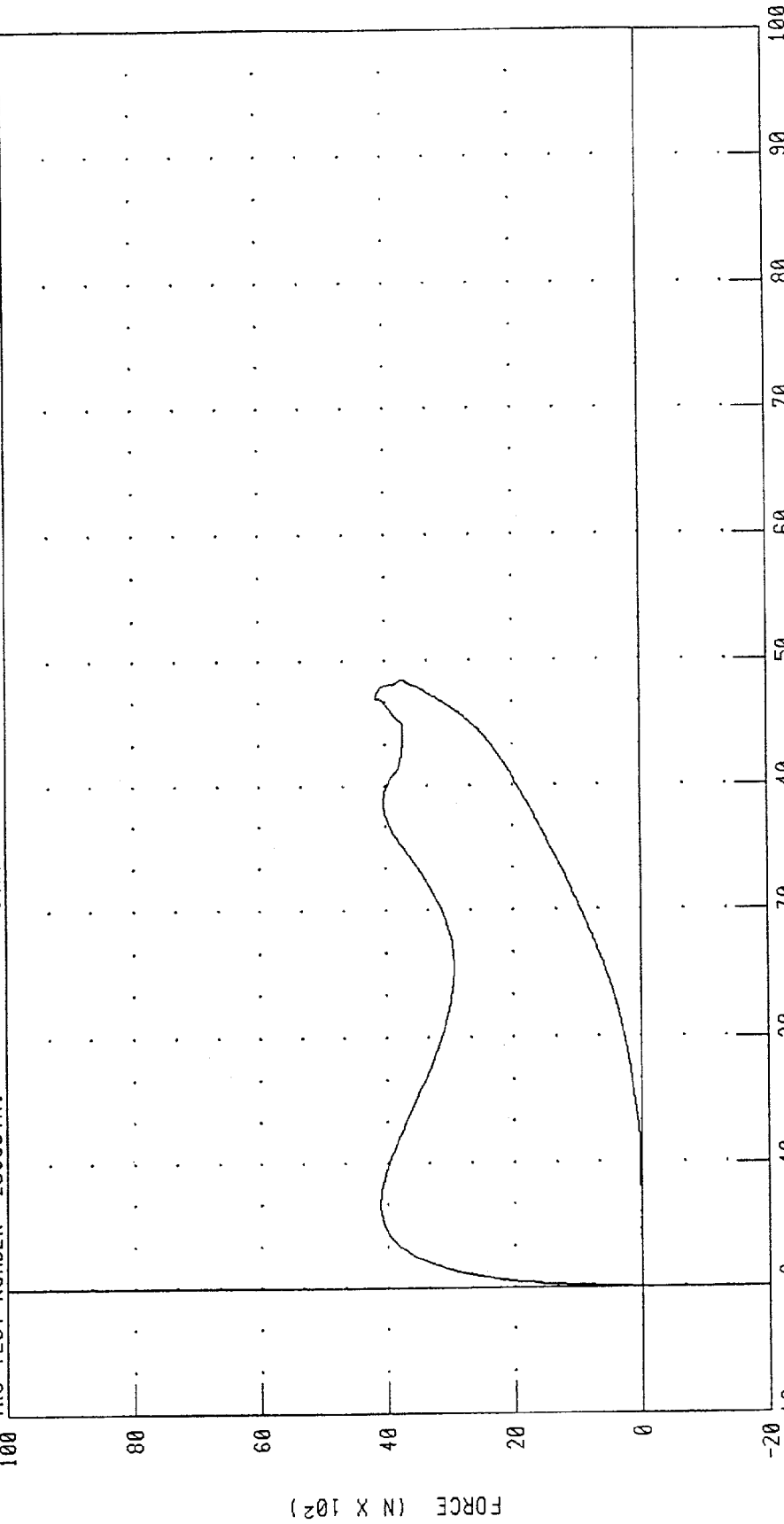
CHANNEL: CSTXD FILTER: CH. CLASS 180

PEAK DATA: 48.51 MM @ 20.40 MS, 0.00 MM @ -7.84 MS

SMALL FEMALE THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE
S.FEMALE SN289 THORAX CAL09

TRC TEST NUMBER: 289C9TH1

RUN NUMBER: 083199.1502;1



PEAK DATA:

48.51 MM @ 20.40 MS; 0.00 MM @ -7.84 MS
4148.69 N @ 17.44 MS; -2.49 N @ 59.44 MS

CHANNEL: CSTXD
PENXF
FILTER: CH. CLASS 180
CH. CLASS 180

TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III SMALL FEMALE

25-AUG-99

TRC INC.

TEST NO: 289C9RK1

S.FEMALE SN289 R.KNEE CAL9

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.07 M/S
PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM	3360 - 4080 N	3814.3 N

TEST MEETS SPECIFICATIONS

TECHNICIAN



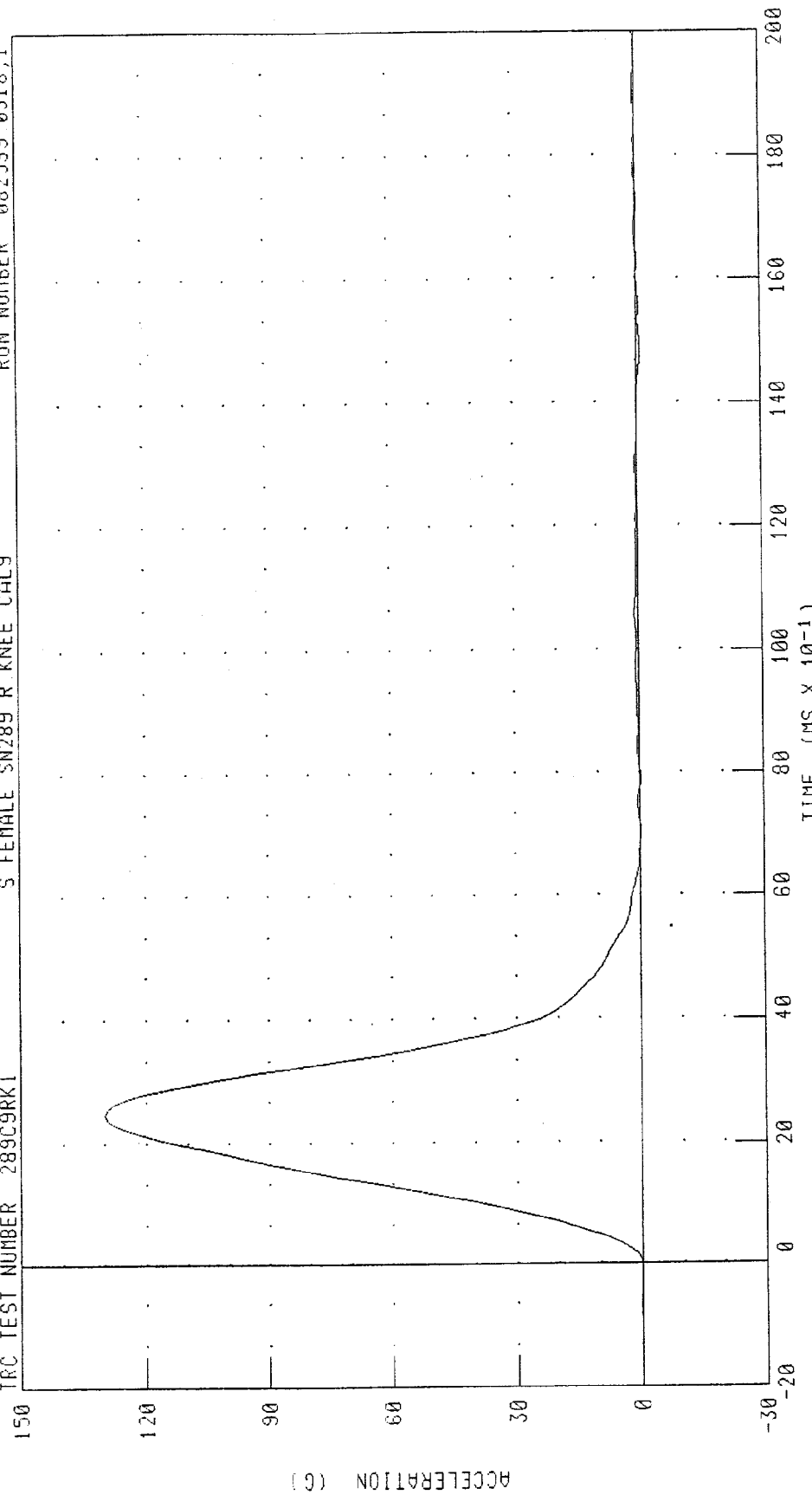
RUN NUMBER: 082599.0918;1

SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND)

TRC TEST NUMBER 289C9RK1

S FEMALE SN289 R KNEE CAL9

RUN NUMBER 082599 0918,1



CHANNEL: PENXC FILTER: CH. CLASS 600

PEAK DATA: 129.93 G @ 2.48 MS, -0.89 G @ 14.80 MS

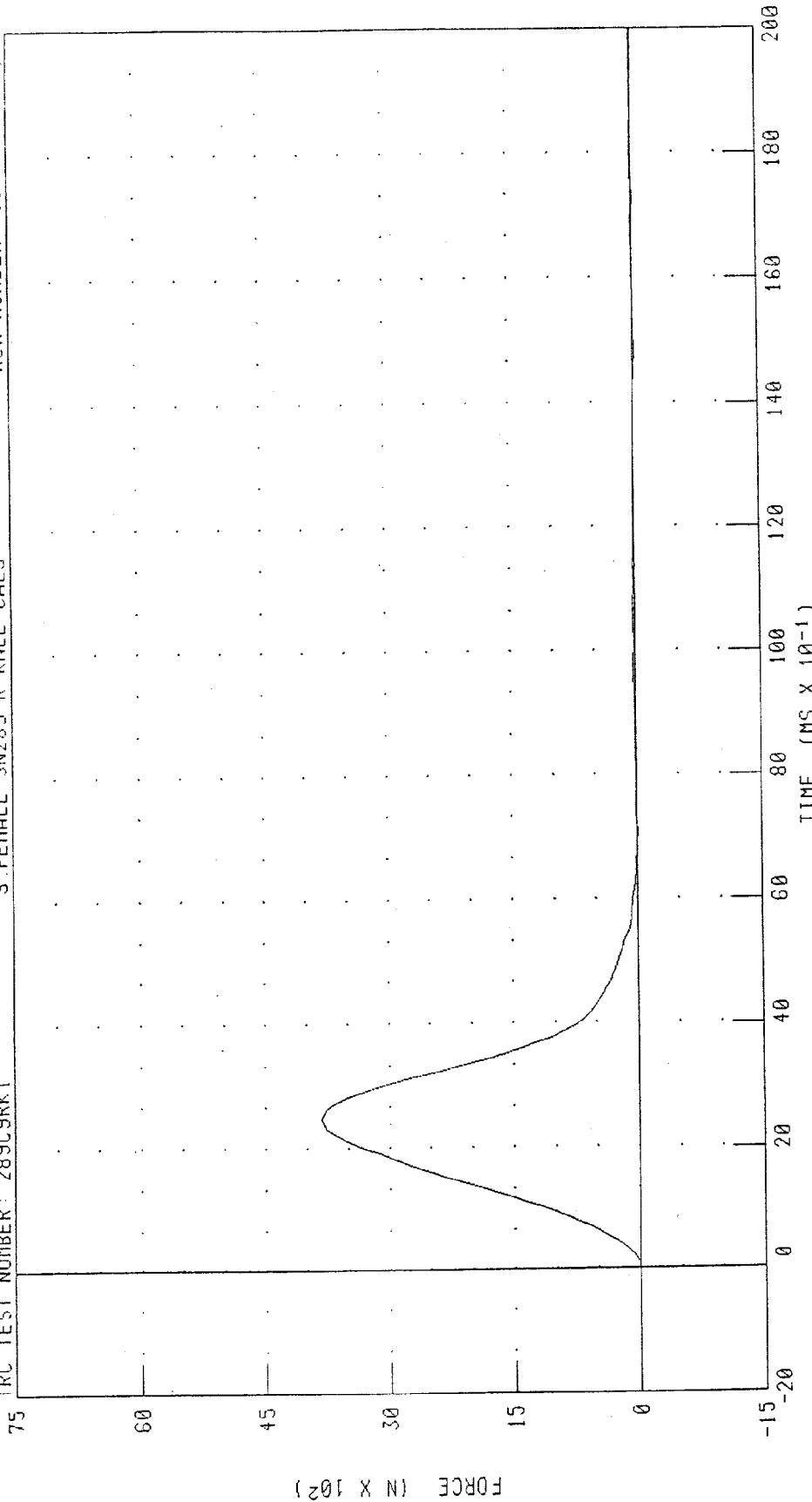
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION

PENDULUM FORCE (5 KG PEND.)

S. FEMALE SM269 R KNEE CAL9

RUN NUMBER: 082599 0918.1

TRC TEST NUMBER: 28909RK1



PEAK DATA: 3814.37 N @ 2.48 MS; -26.24 N @ 14.80 MS

CHANNEL: PENXF FILTER: CH CLASS 600

TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III SMALL FEMALE

25-AUG-99

TRC INC.

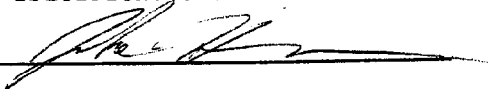
TEST NO: 289C9LK1

S.FEMALE SN289 LEFT KNEE CAL9

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.07 M/S
PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM	3360 - 4080 N	3711.7 N

TEST MEETS SPECIFICATIONS

TECHNICIAN

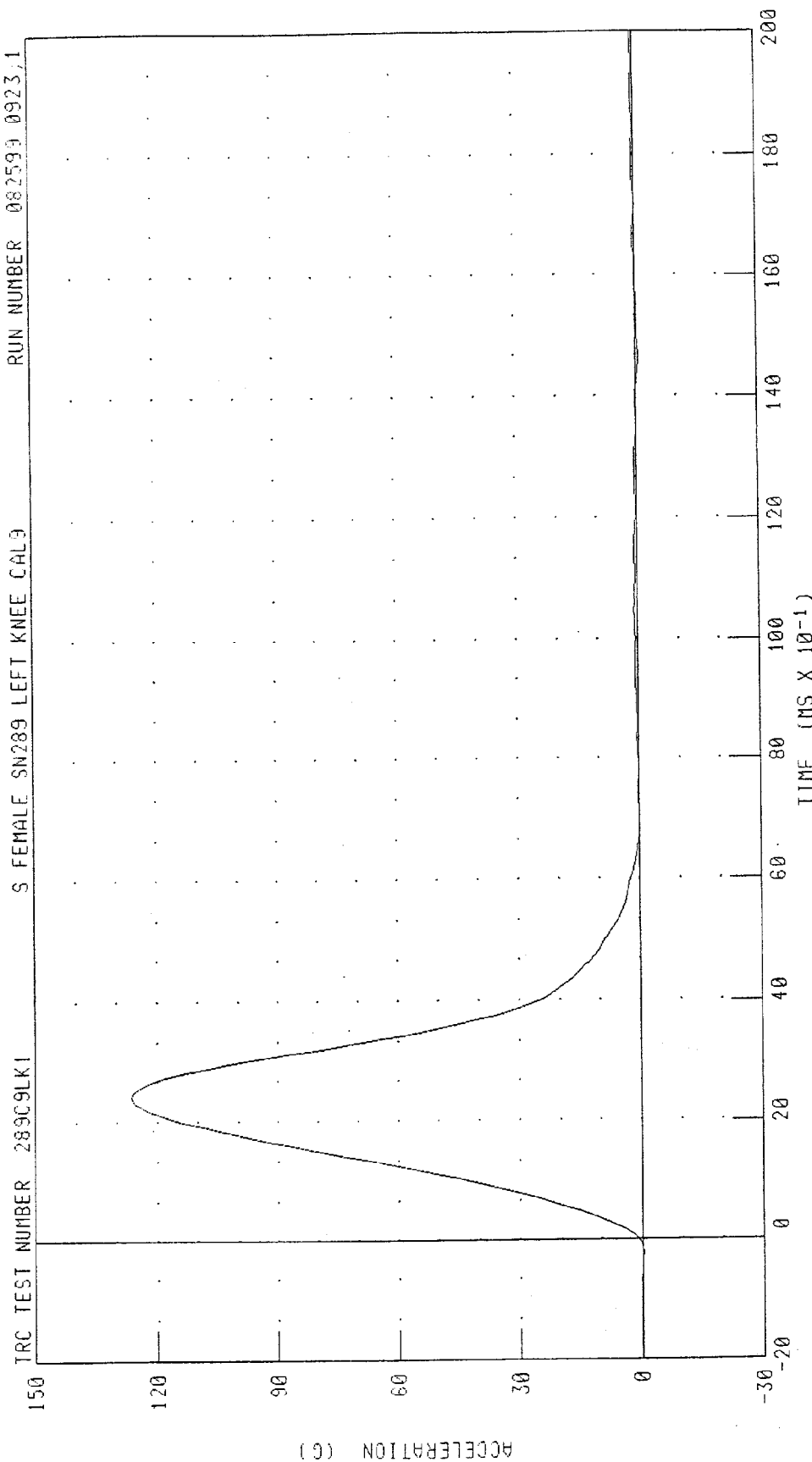


RUN NUMBER: 082599.0922;1

SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION

PENDULUM DECELERATION (5 KG PEND)

TRC TEST NUMBER 289C9LKI S FEMALE SN289 LEFT KNEE CAL3 RUN NUMBER 082599 0923,1



CHANNEL: PENXC FILTER: CH. CLASS 600

PEAK DATA: 126.44 G @ 2.40 MS; -0.74 G @ 14.64 MS

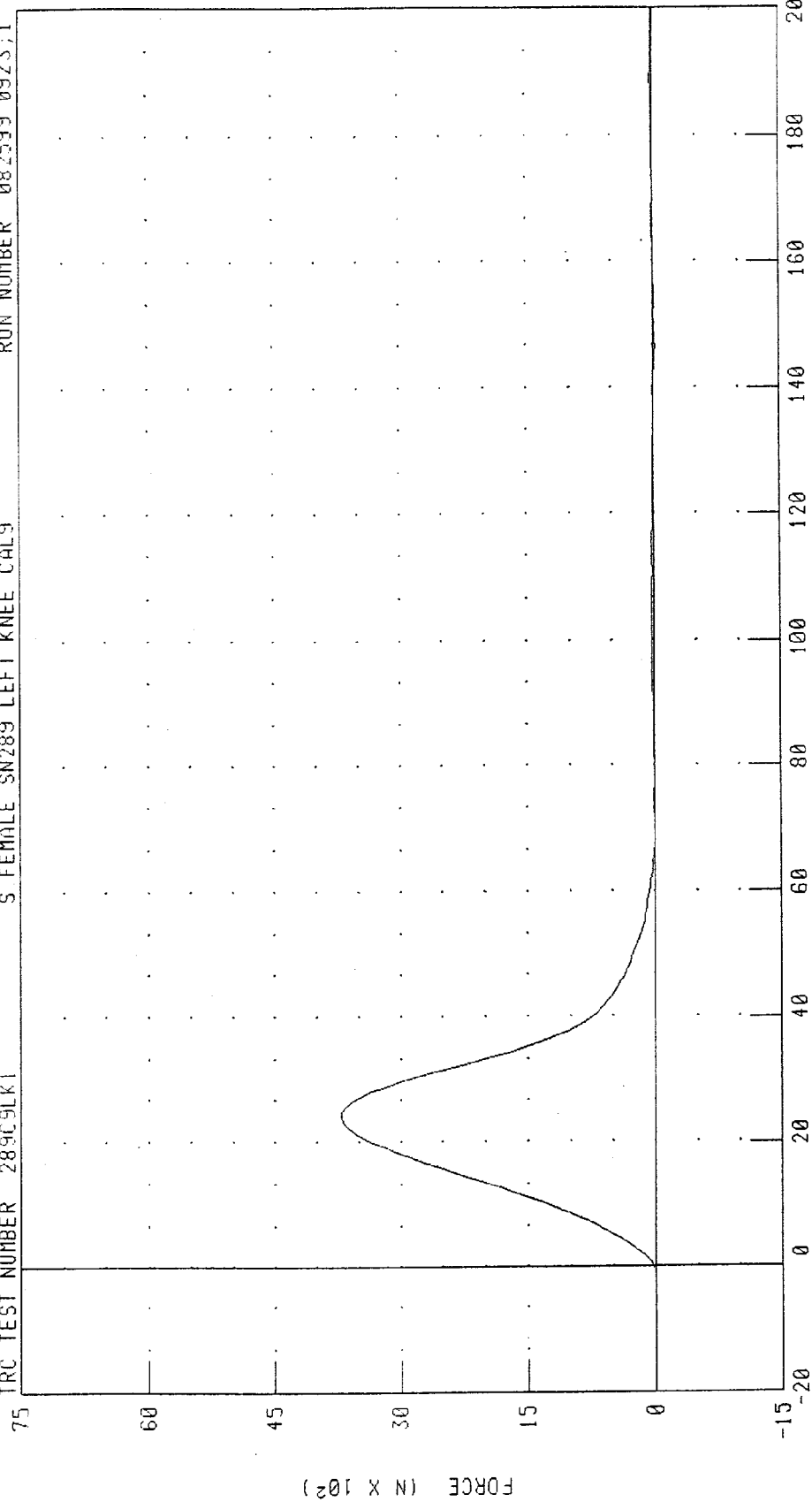
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION

PENDULUM FORCE (5 KG PEND)

S FEMALE SN289 LEFT KNEE CAL9

RUN NUMBER 082599 0923;1

TRC TEST NUMBER 289C9LK1



PEAK DATA: 3711.75 N @ 2.40 MS, -21.83 N @ 14.64 MS

CHANNEL: PENXF FILTER: CH. CLASS 600

Post-Test Dummy Certification

Passenger Dummy S/N 369

TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

HYBRID III SMALL FEMALE

24-AUG-99

TRC INC.

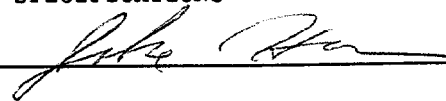
TEST NO: 369C5HD2

S.FEMALE SN369 HEAD DROP CAL5

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PEAK RESULTANT ACCELERATION	250 - 300 G	277.69 G
PEAK LATERAL ACCELERATION	15 G MAX	-9.28 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

TECHNICIAN



RUN NUMBER: 082499.1559;1

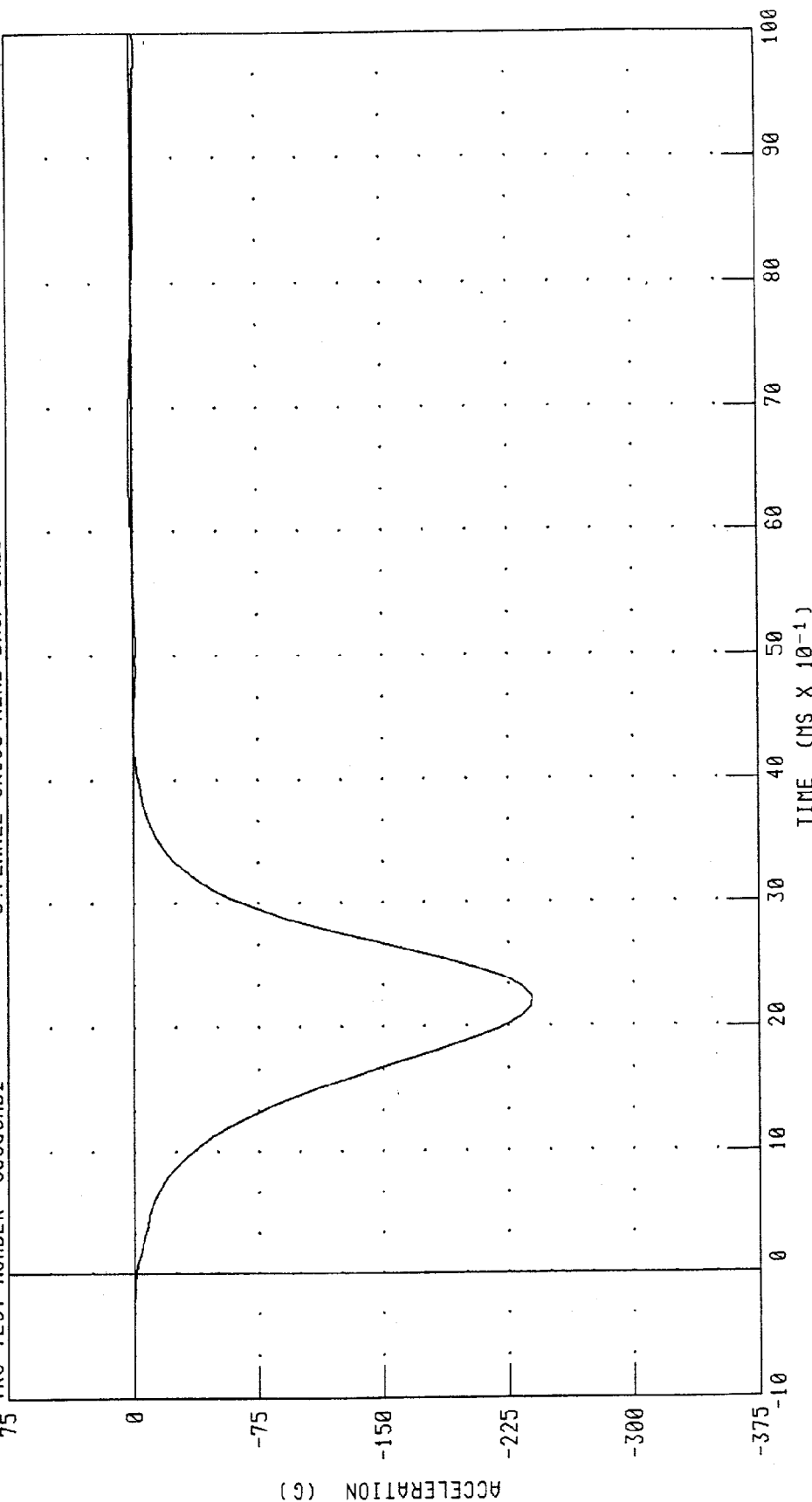
SMALL FEMALE HYBRID III HEAD CALIBRATION

HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 369C5HD2

S. FEMALE SN369 HEAD DROP CALS

RUN NUMBER: 083199.1506;1



CHANNEL: HEDXC FILTER: CH. CLASS 1000

PEAK DATA: 2.31 G @ 6.88 MS, -239.13 C @ 2.24 MS

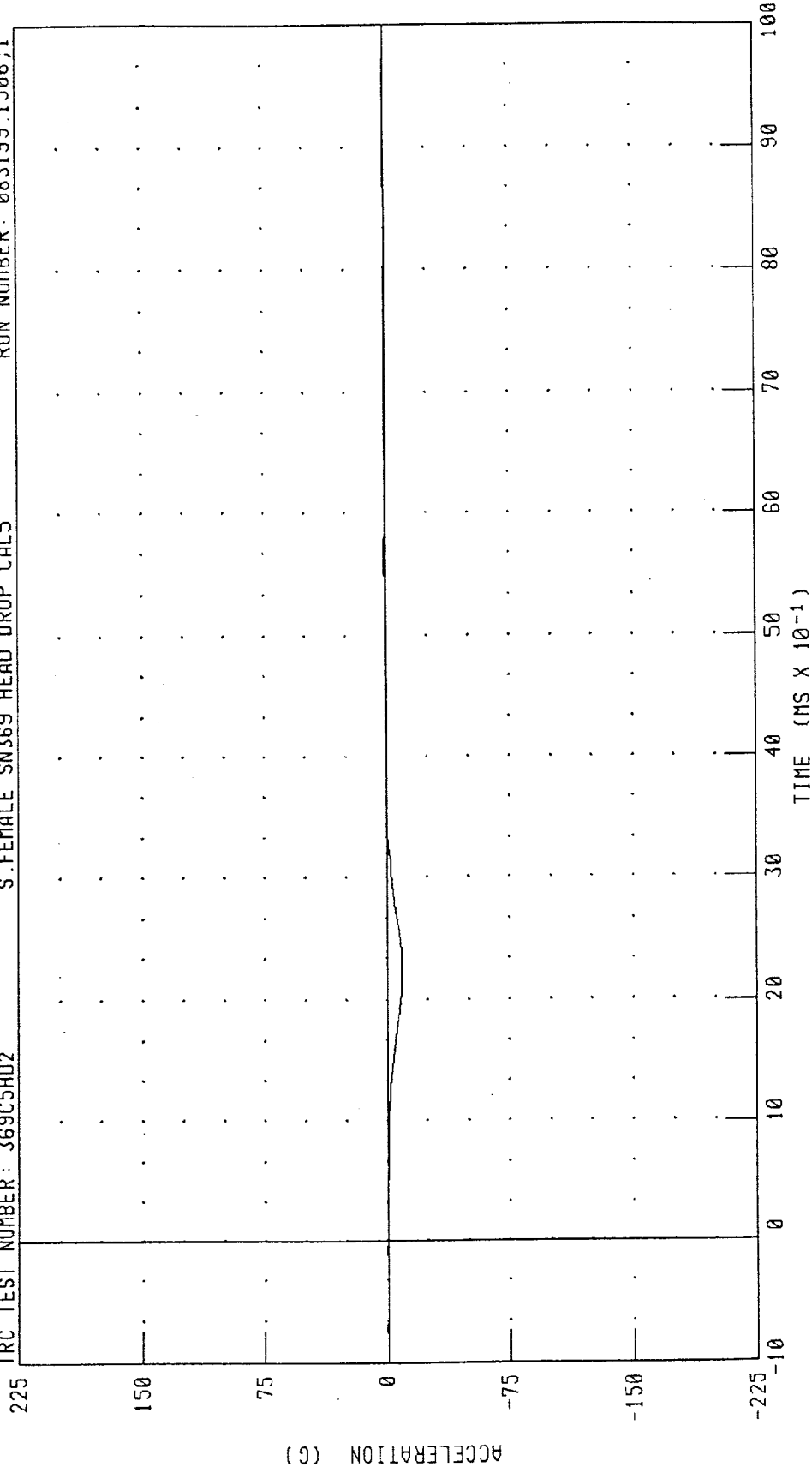
SMALL FEMALE HYBRID III HEAD CALIBRATION

HEAD ACCELERATION Y AXIS

TRC TEST NUMBER: 369C5HD2

S.FEMALE SN369 HEAD DROP CAL5

RUN NUMBER: 083199.1506,1



CHANNEL: HEDYC FILTER: CH. CLASS 1000

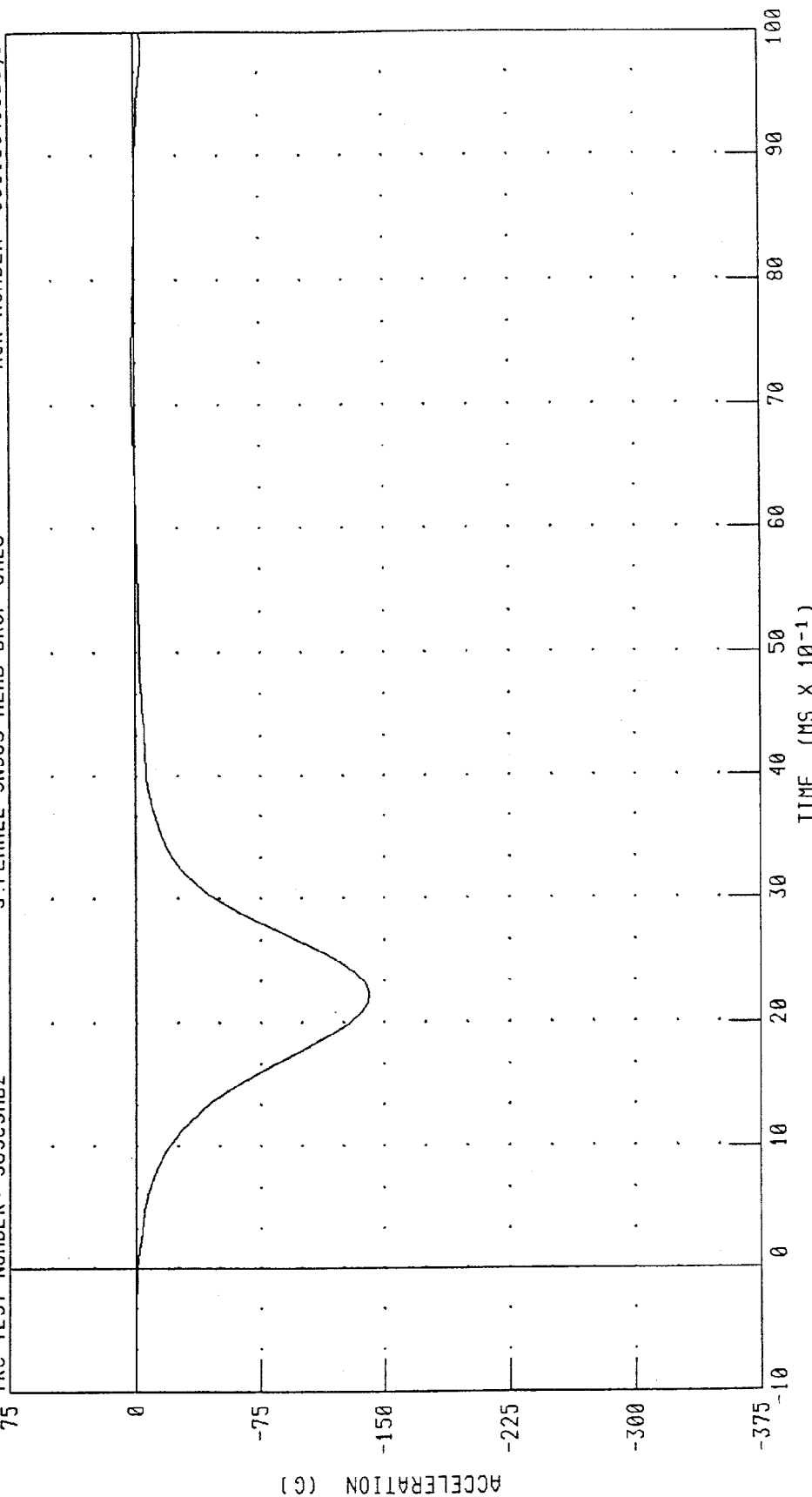
PEAK DATA: 0.78 G @ 5.52 MS, -9.29 G @ 2.16 MS

SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS

TRC TEST NUMBER: 369C5HD2

S. FEMALE SN369 HEAD DROP CAL5

RUN NUMBER: 083199.1506;1



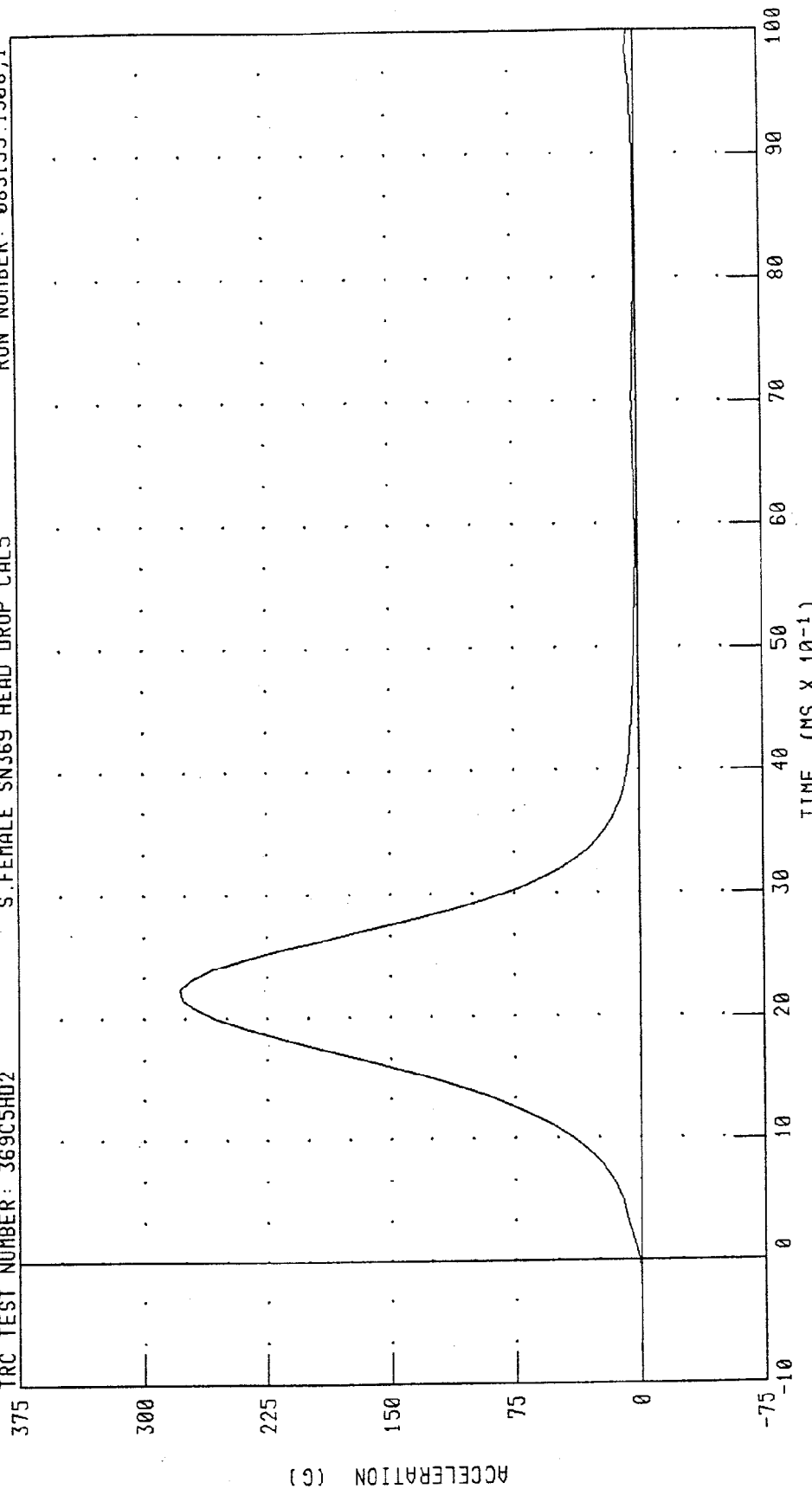
CHANNEL: HEDZG FILTER: CH. CLASS 1000

PEAK DATA: 1.90 G @ 7.04 MS; -140.87 G @ 2.24 MS

SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION
S.FEMALE SN369 HEAD DROP CAL5

TRC TEST NUMBER: 369C5HD2

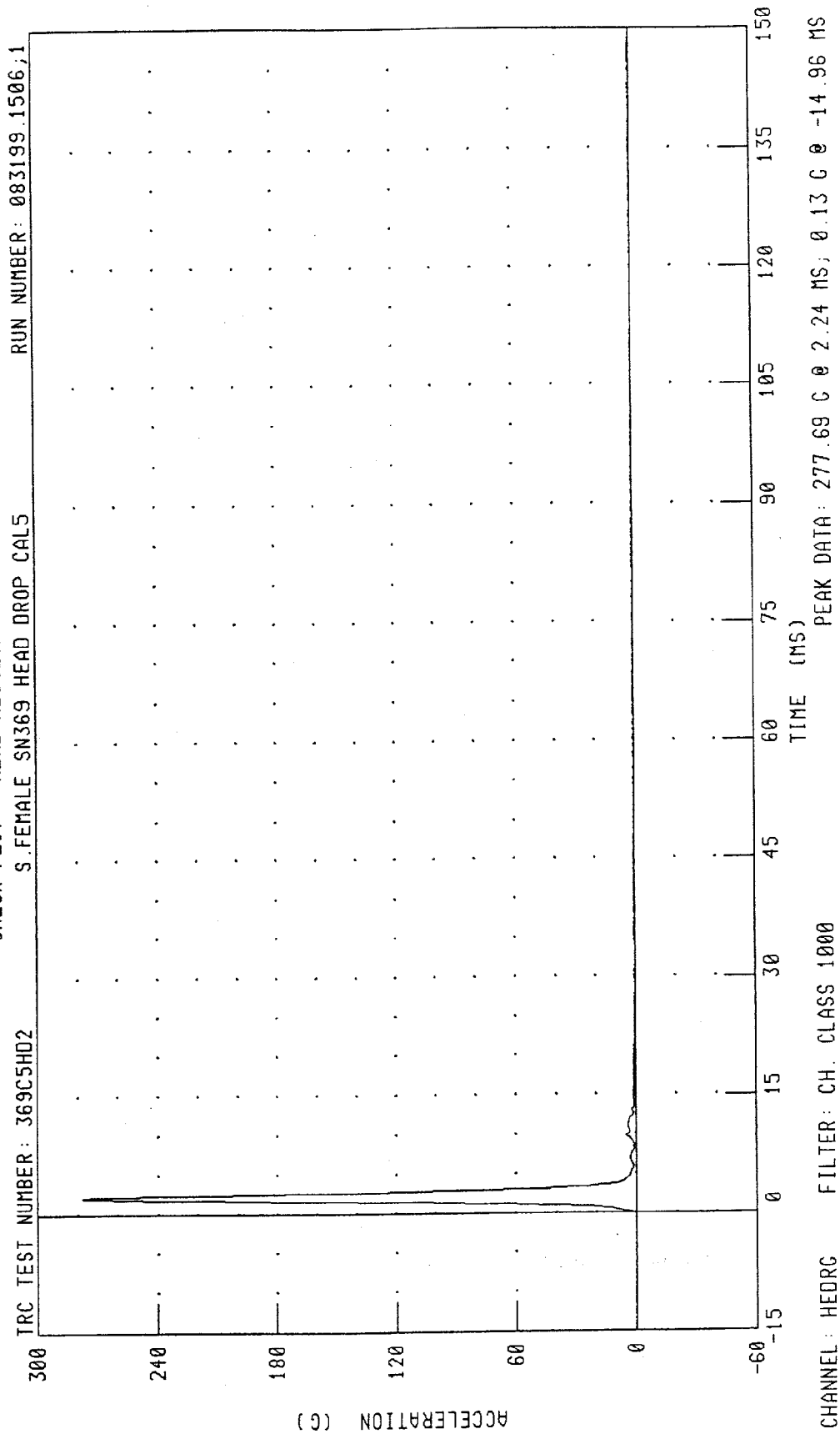
RUN NUMBER: 083199.1506,1



CHANNEL: HEDRG FILTER: CH. CLASS 1000

PEAK DATA: 277.69 G @ 2.24 MS; 0.13 G @ -0.80 MS

SMALL FEMALE HYBRID III HEAD CALIBRATION
CHECK PLOT - HEAD RESULTANT ACCELERATION



TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SMALL FEMALE

24-AUG-99

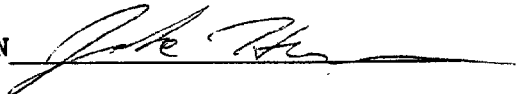
NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

TRC INC. TEST NO: 369C5NF1 S.FEMALE SN369 NECK FLEX. CAL5

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6-22.2 DEG. C	22.2 DEG. C
RELATIVE HUMIDITY		10 - 70 %	55.0 %
IMPACT VELOCITY		6.89 - 7.13 M/S	7.06 M/S
INTEGRATED PENDULUM VELOCITY	10 MS	2.1 - 2.5 M/S	2.27 M/S
	20 MS	4.0 - 5.0 M/S	4.70 M/S
	30 MS	5.8 - 7.0 M/S	7.00 M/S
PEAK D-PLANE ROTATION		80 - 92 DEG.	81.46 DEG.
PEAK MOMENT ABOUT OCCIPITAL CONDYLE DURING ROTATION INT		69 - 83 NM	75.71 NM
POSITIVE MOMENT DECAY TIME FROM TO TO 10 NM		80 - 100 MS	94.64 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN



RUN NUMBER: 082499.1403;2

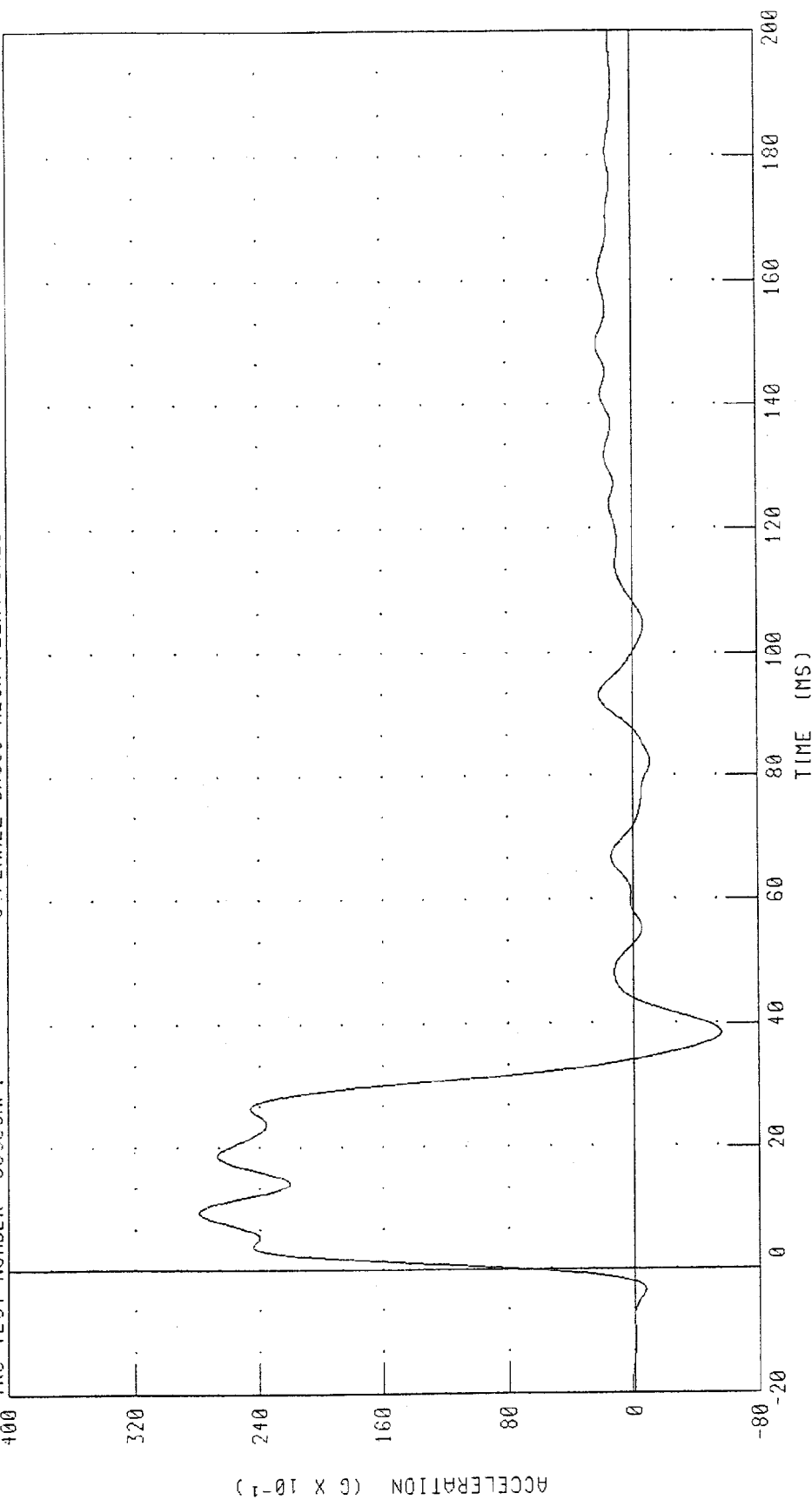
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

PENDULUM DECELERATION

TRC TEST NUMBER 369C5NF1

S. FEMALE SN369 NECK FLEX. CAL5

RUN NUMBER: 082499 1404;2



CHANNEL: PENXC FILTER: CH. CLASS 60

PEAK DATA: 27.94 G @ 9.52 MS; -5.61 G @ 38.48 MS

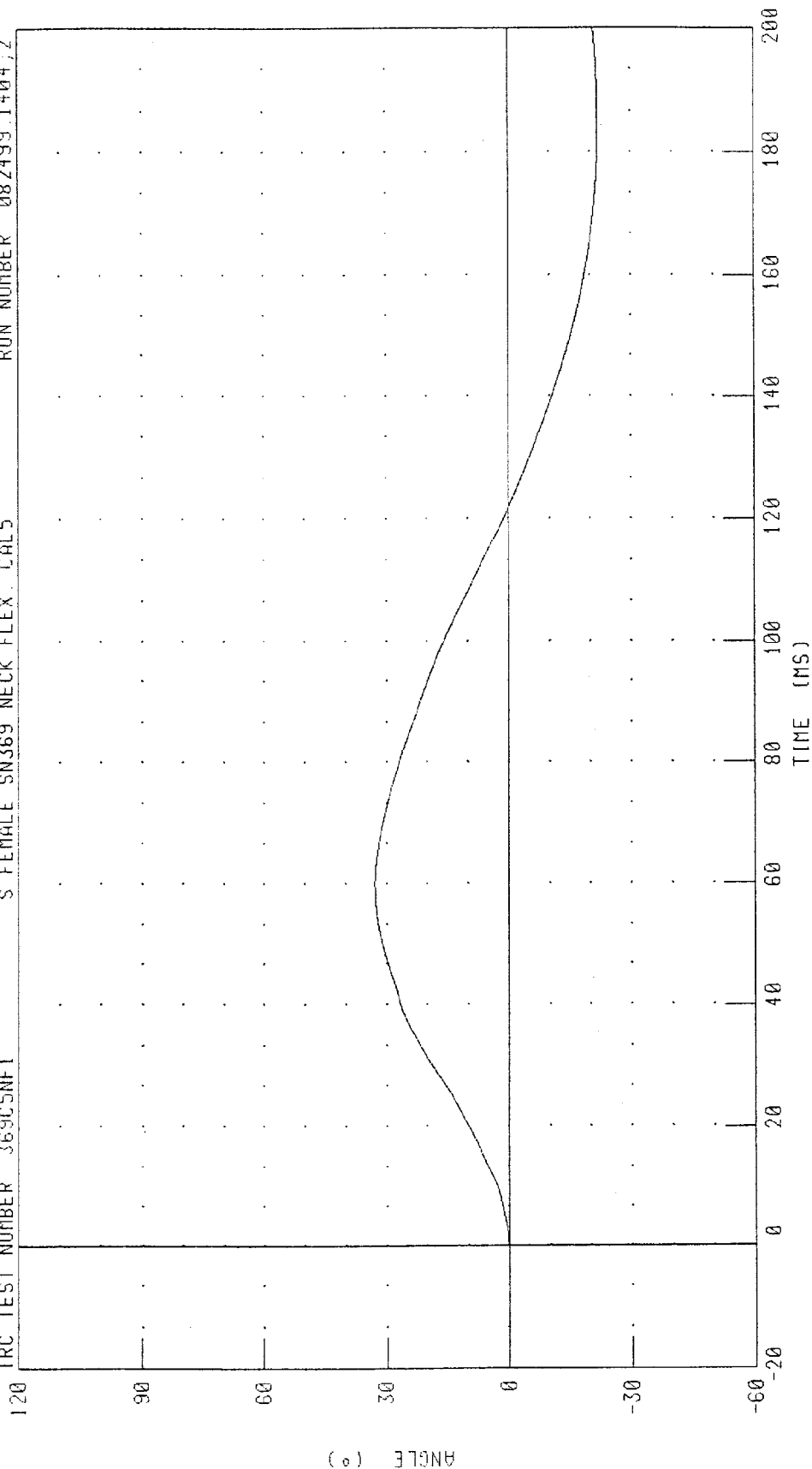
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER 369CSNF1

S FEMALE SN369 NECK FLEX. CAL5

RUN NUMBER 082499.1404.2



PEAK DATA: 32.82 ° @ 60.00 MS, -21.95 ° @ 184.88 MS

FILTER: CH. CLASS 60

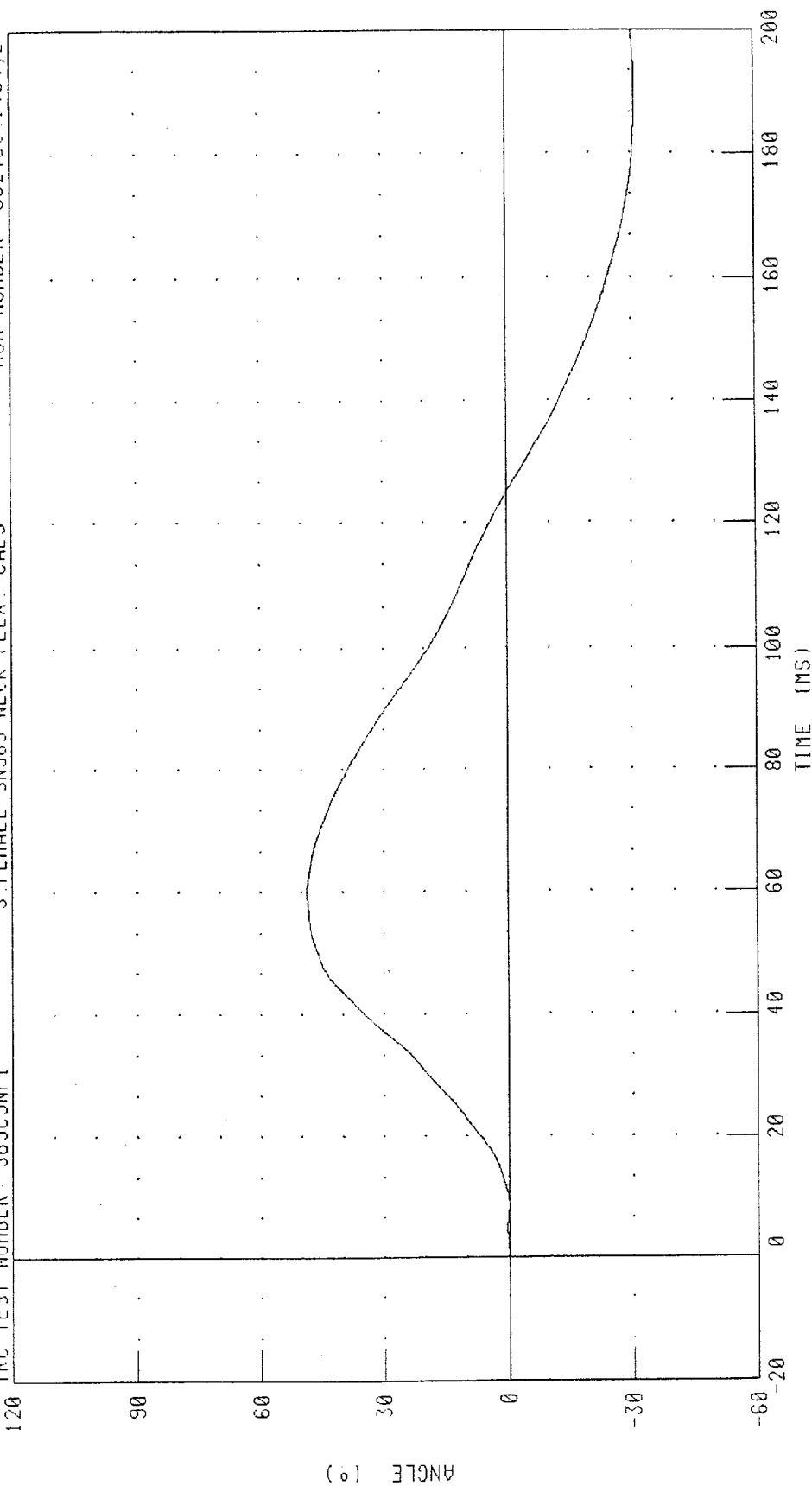
CHANNEL: BETA

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 369C5NFI

S. FEMALE SN369 NECK FLEX. CAL5

RUN NUMBER: 082499.1404,2



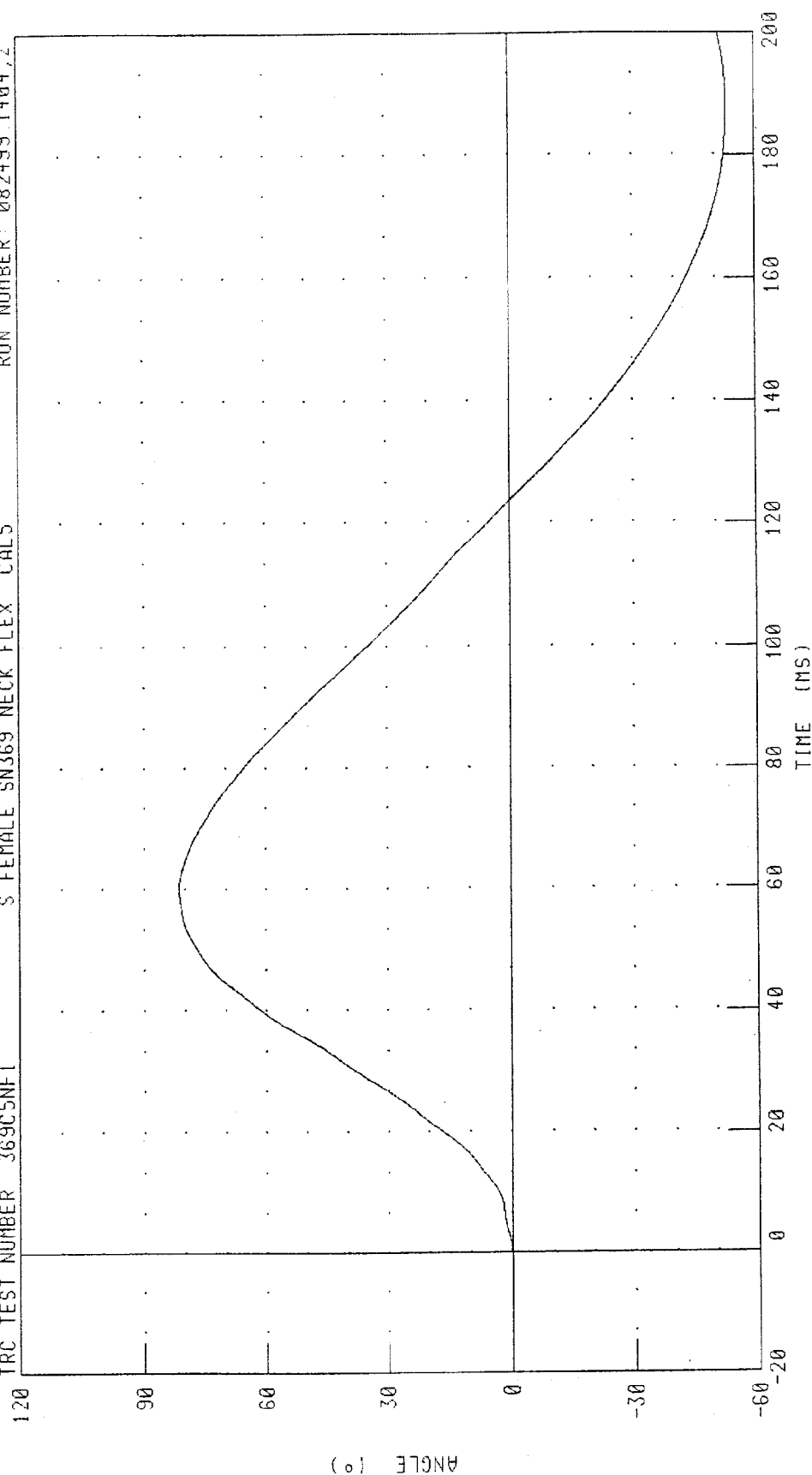
CHANNEL: THETA FILTER: CH. CLASS 60

PEAK DATA: 48.65 ° @ 60.00 MS, -31.10 ° @ 189.36 MS

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER 369C5NF1 S FEMALE SN369 NECK FLEX CAL5 RUN NUMBER: 082499.1404.2



CHANNEL: TOTAN FILTER: CH. CLASS 60 PEAK DATA: 81.47 ° @ 60.00 MS, -53.01 ° @ 187.44 MS

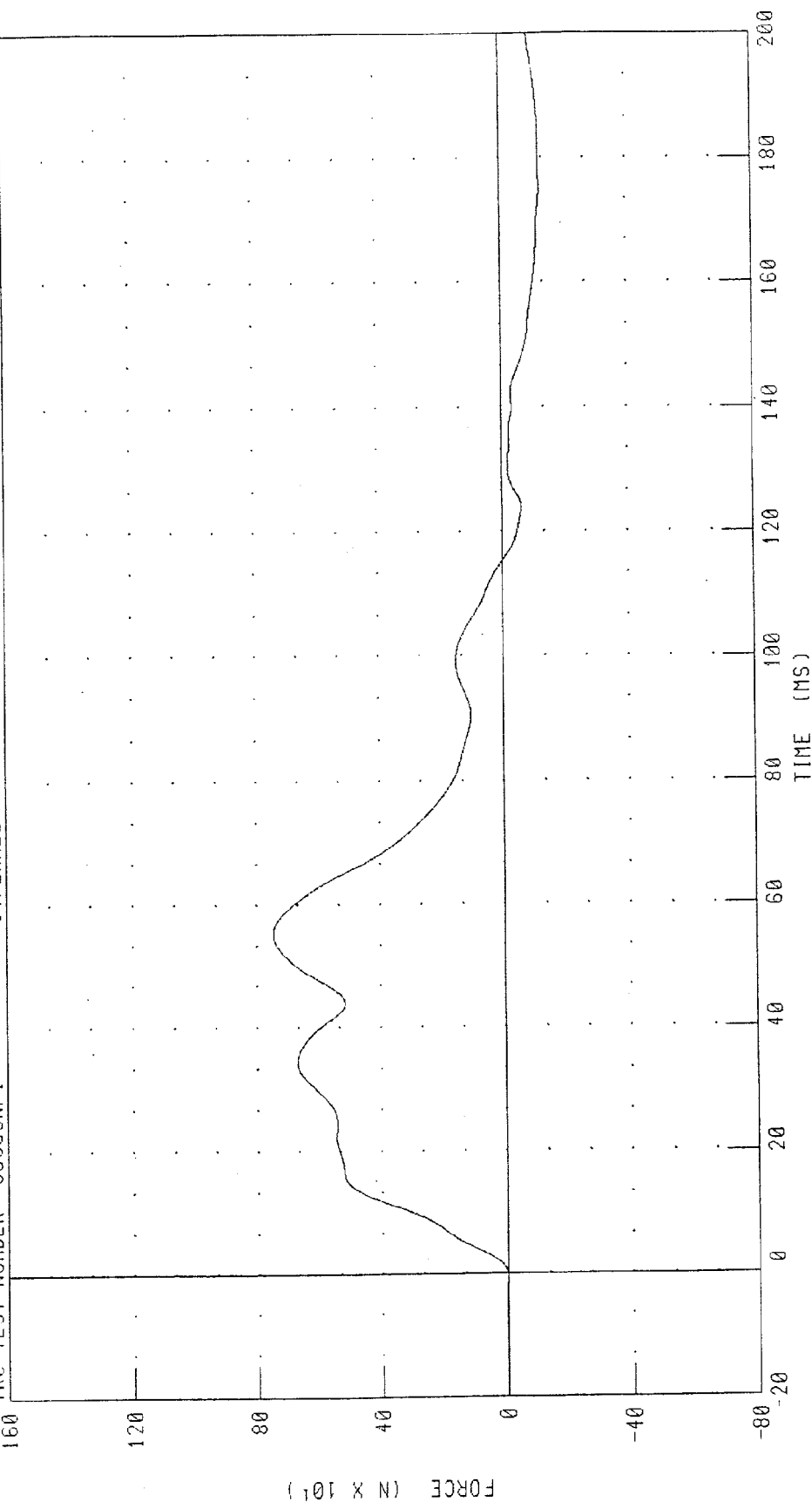
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 369C5NF1

S. FEMALE SN369 NECK FLEX. CALS

RUN NUMBER: 082499 1404.2



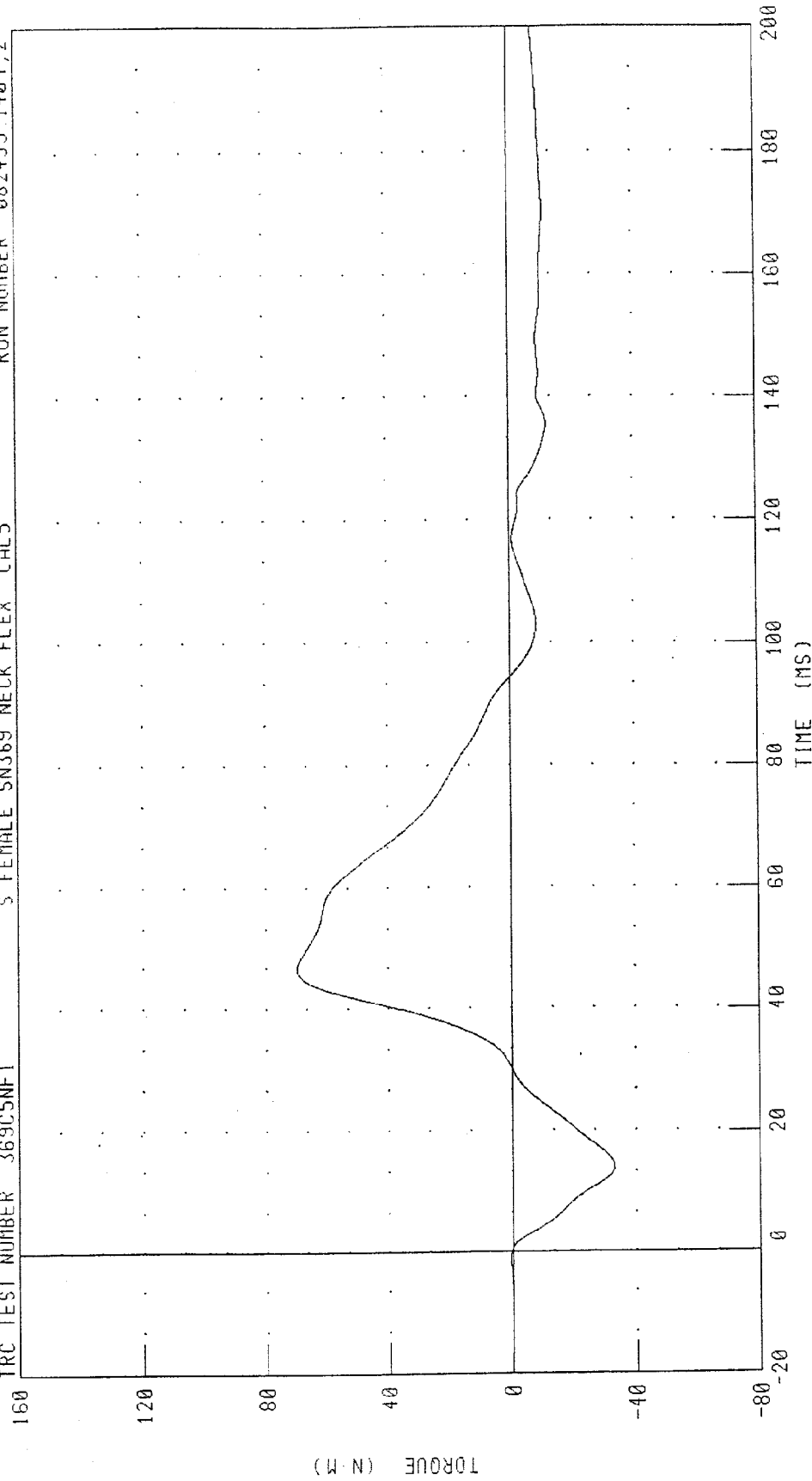
PEAK DATA: 745.36 N @ 55.28 MS, -125.53 N @ 175.20 MS

CHANNEL: NEKXF FILTER: CH. CLASS 60

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER 369C5NF1 S FEMALE SN369 NECK FLEX CAL5 RUN NUMBER 082499 1404,2



PEAK DATA: 69.74 N-M @ 46.64 MS, -33.03 N-M @ 14.16 MS

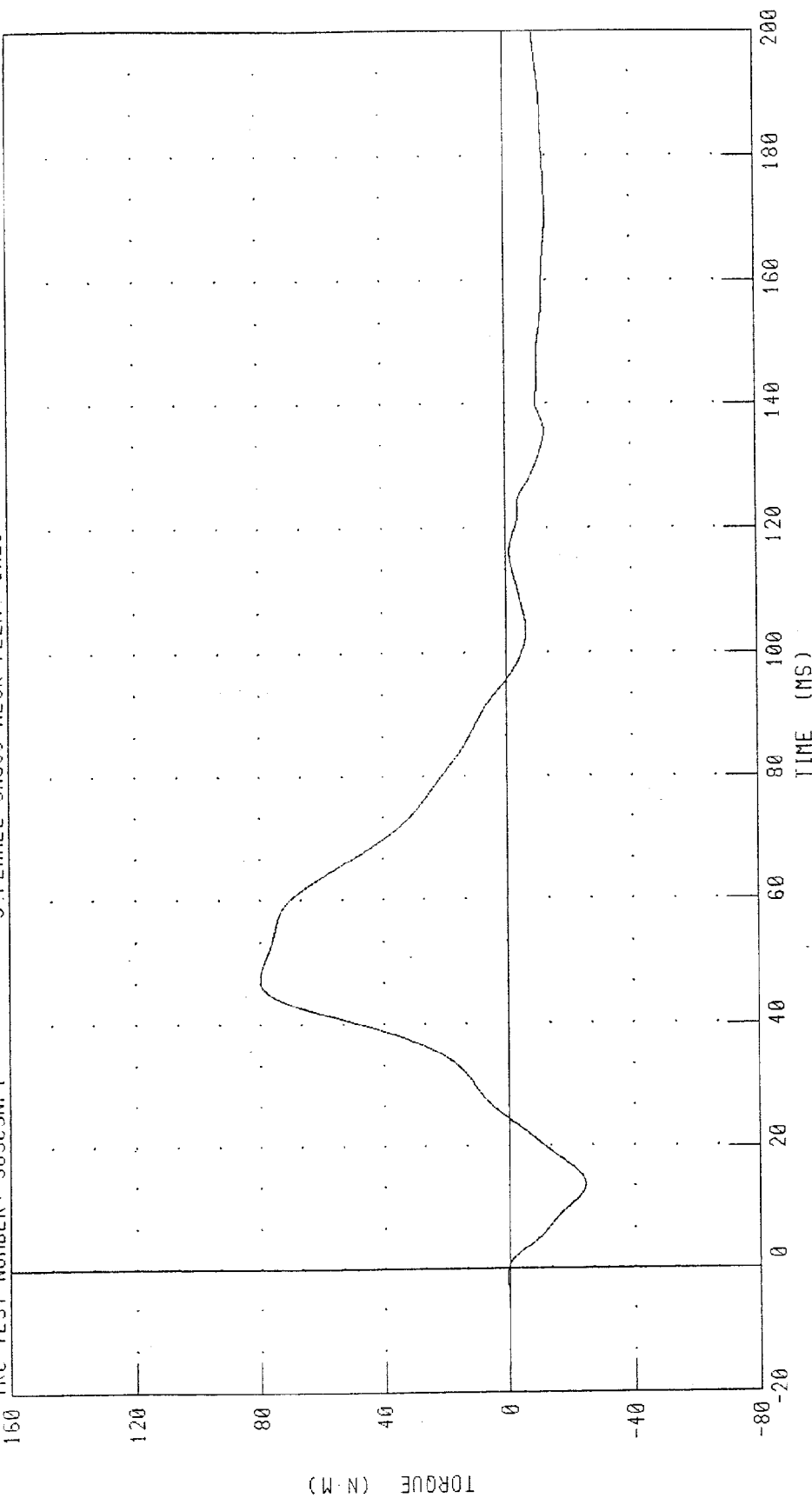
CHANNEL: NEKYM FILTER: CH. CLASS 60

SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 369C5NF1

S. FEMALE SN369 NECK FLEX. CAL5

RUN NUMBER: 082439 1404,2



CHANNEL: NEKOM

FILTER: CH. CLASS 60

PEAK DATA: 79.98 N M @ 47.36 MS; -24.41 N M @ 13.68 MS

TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SMALL FEMALE

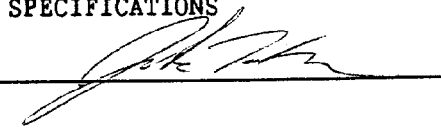
24-AUG-99

NECK EXTENSION TEST - 6 CHANNEL TRANSDUCER

TRC INC. TEST NO: 369C5NE1 S.FEMALE SN369 NECK EXT. CAL5

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		20.6 - 22.2 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY		10 - 70 %	55.0 %
IMPACT VELOCITY		5.95 - 6.19 M/S	6.00 M/S
INTEGRATED PENDULUM VELOCITY	10 MS	1.5 - 1.9 M/S	1.75 M/S
	20 MS	3.1 - 3.9 M/S	3.42 M/S
	30 MS	4.6 - 5.6 M/S	5.18 M/S
PEAK D-PLANE ROTATION		97 - 109 DEG.	104.15 DEG.
PEAK MOMENT ABOUT OCIPITAL CONDYLE DURING ROTATION INT		-55 \ -69 NM	-55.41 NM
NEGATIVE MOMENT DECAY TIME FROM TO TO -10 NM		94 - 114 MS	108.72 MS
TIME OF PEAK ROTATION AFTER PEAK MOMENT		0 - 10 MS	6.48 MS

TEST MEETS SPECIFICATIONS

TECHNICIAN 

RUN NUMBER: 082499.1452;1

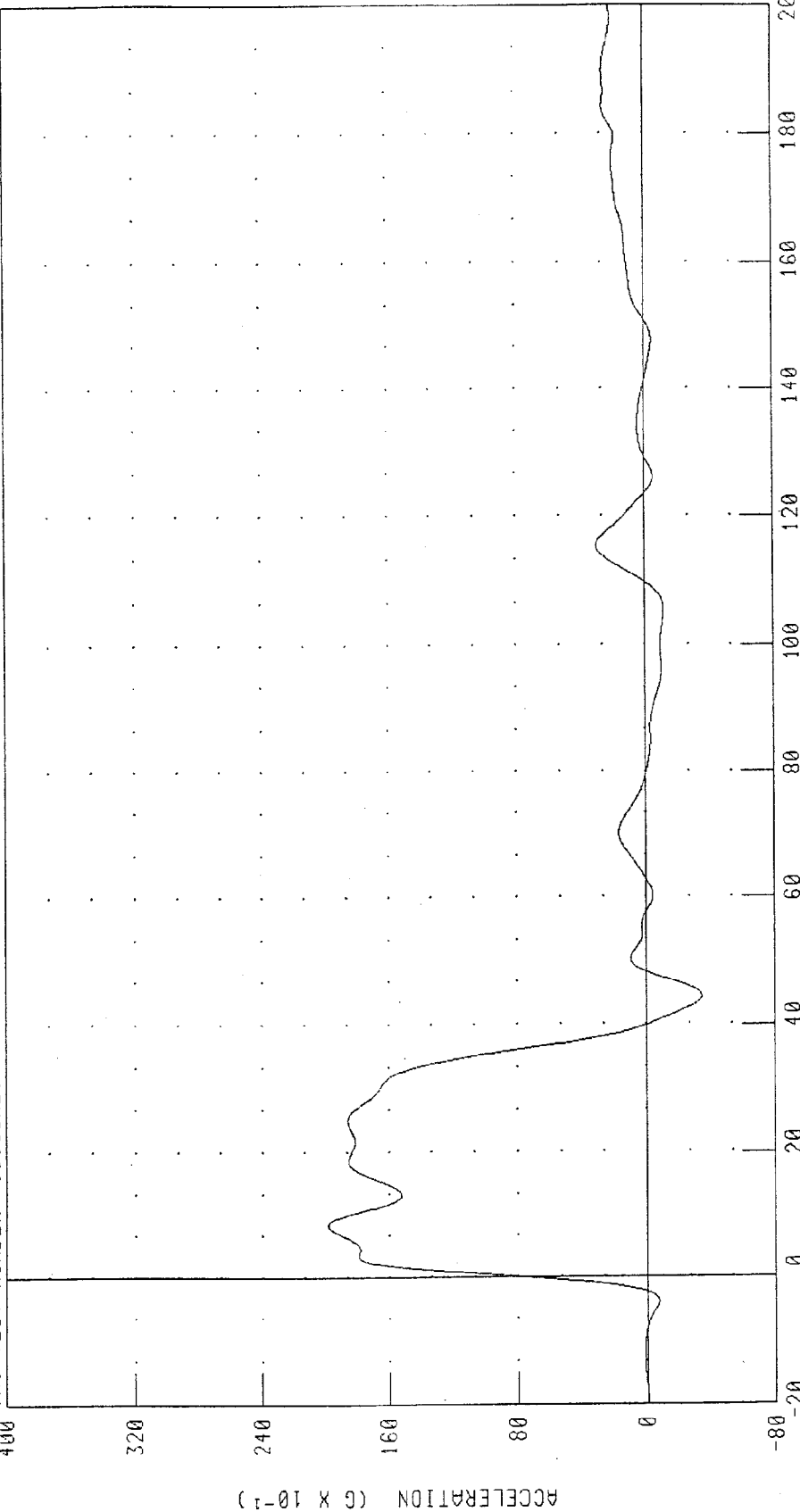
SMALL FEMALE NECK EXTENSION CALIBRATION

PENDULUM DECELERATION

TRC TEST NUMBER: 369CSNE1

S. FEMALE SN369 NECK EXT. CAL5

RUN NUMBER: 082439 1512.1



CHANNEL: PENXC FILTER: CH. CLASS 60

PEAK DATA: 19.86 G @ 8.32 MS, -3.46 G @ 44.40 MS

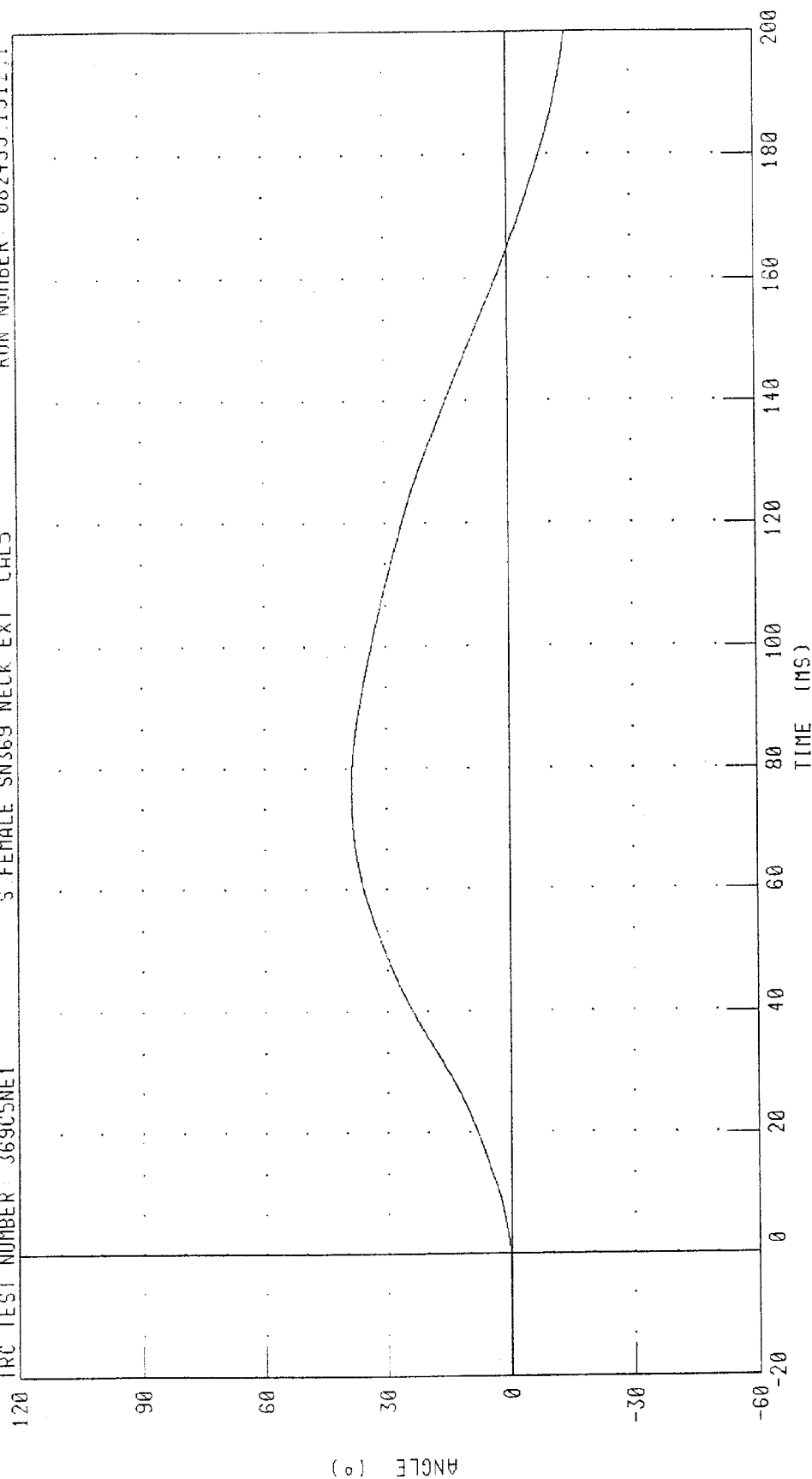
SMALL FEMALE NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 369CSNE1

S FEMALE SN369 NECK EXT CAL5

RUN NUMBER: 082499.1512.1



PEAK DATA: 38.61 ° @ 76.08 MS; -14.32 ° @ 200.00 MS

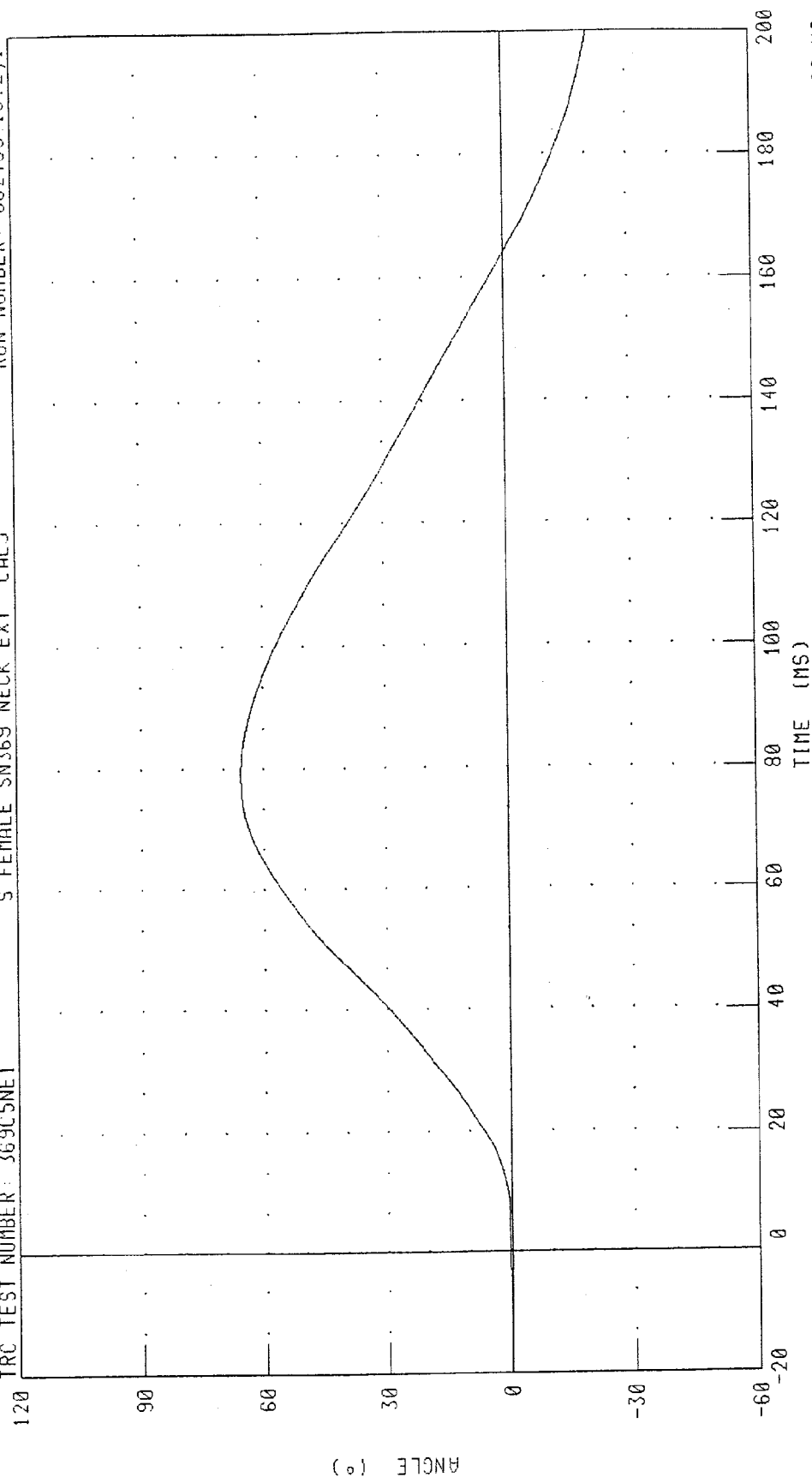
CHANNEL: BETA FILTER: CH. CLASS 60

SMALL FEMALE NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 369C5NE1

S FEMALE SN369 NECK EXT CAL5

RUN NUMBER: 082499.1512,1



PEAK DATA: 65.61 ° @ 79.12 MS, -20.77 ° @ 200.00 MS

CHANNEL: THETA FILTER: CH. CLASS 60

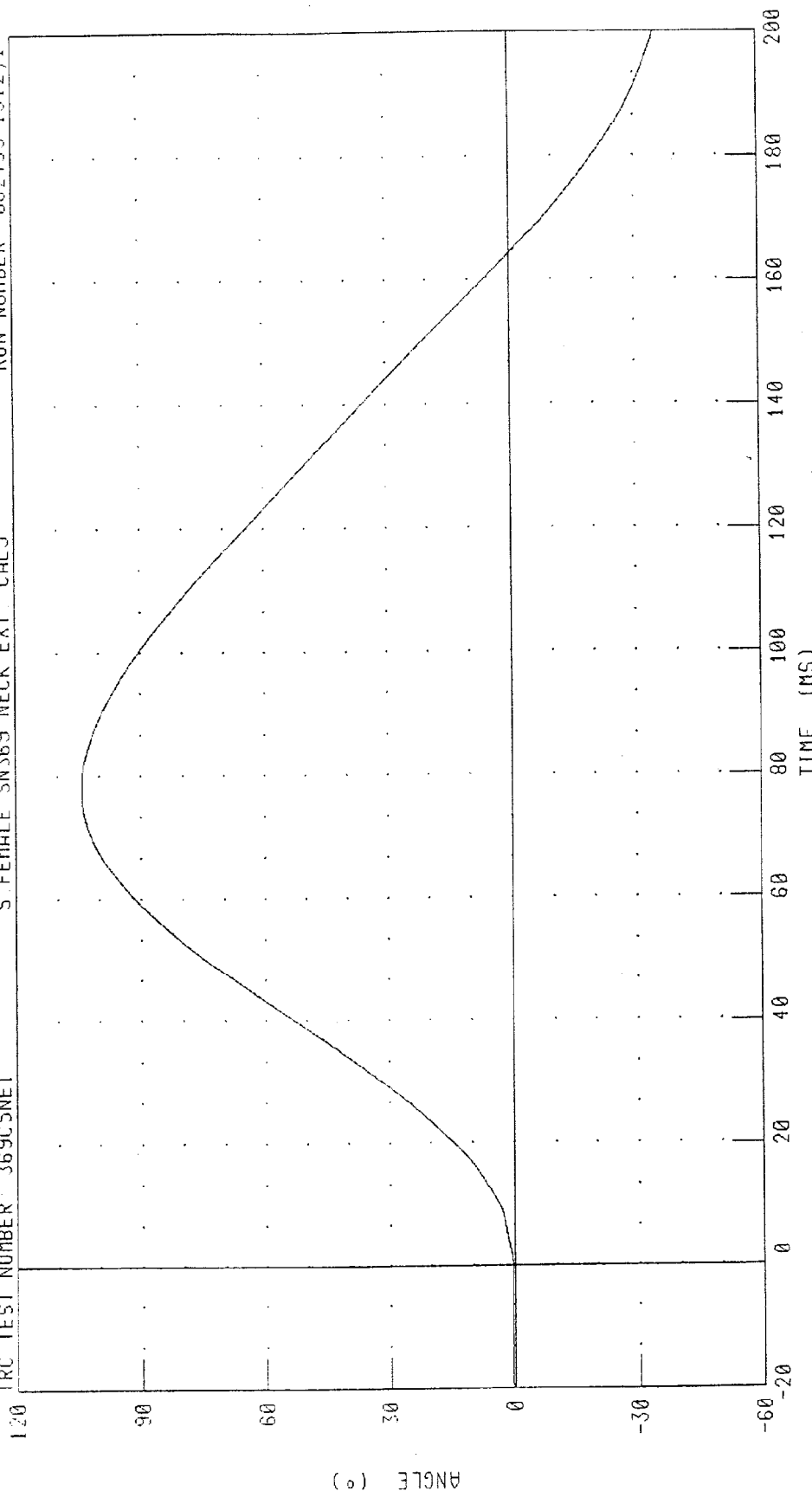
SMALL FEMALE NECK EXTENSION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 369C5NE1

S. FEMALE SN369 NECK EXT. CAL5

RUN NUMBER 082439 1512,1



PEAK DATA: 104.15 ° @ 77.92 MS, -35.09 ° @ 200.00 MS

CHANNEL: TOTAL FILTER: CH. CLASS 60

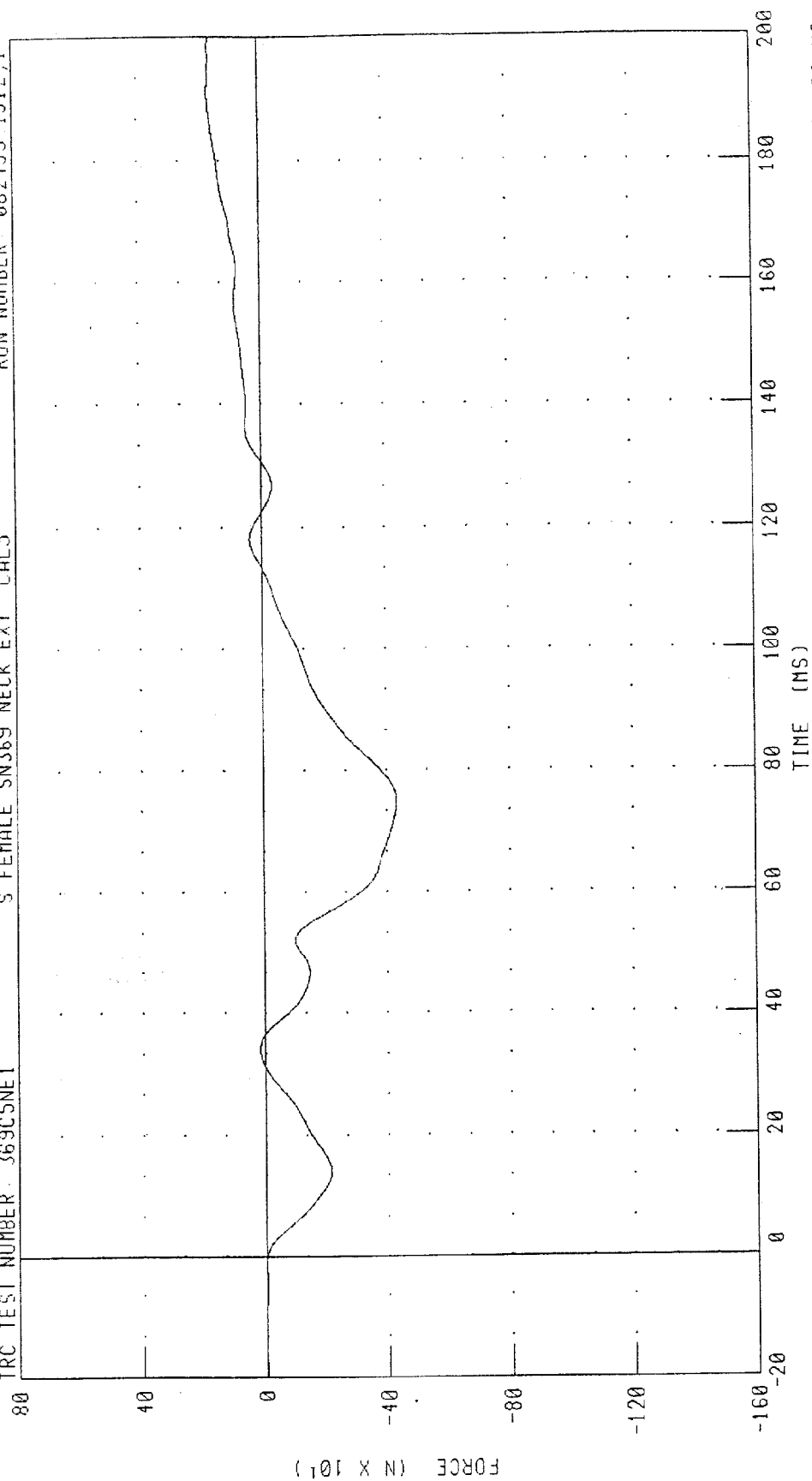
SMALL FEMALE NECK EXTENSION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 369C5NE1

S FEMALE SN369 NECK EXT CALS

RUN NUMBER: 082499 1512,1

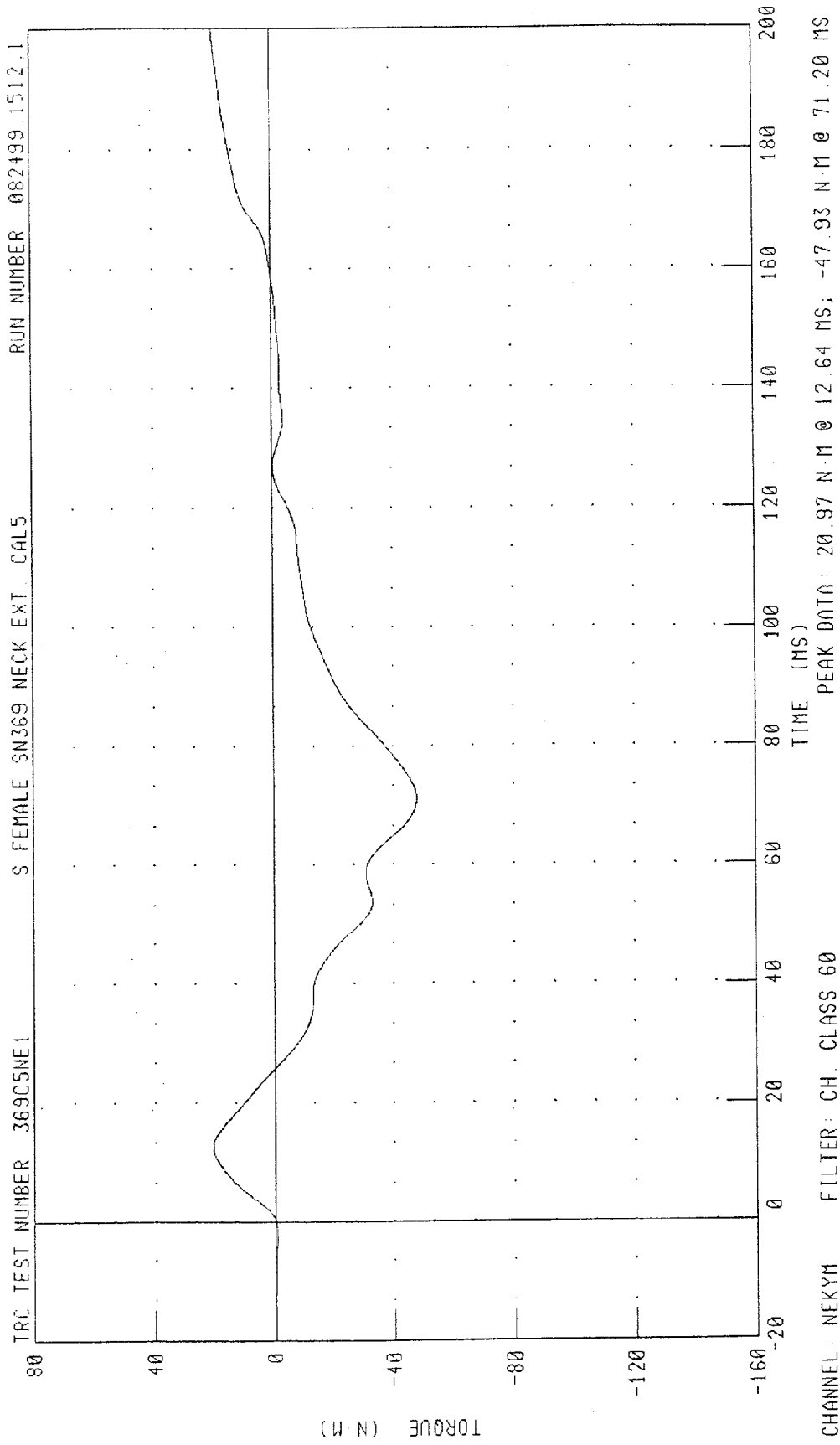


CHANNEL: NEKXF FILTER: CH. CLASS 60

PEAK DATA: 169.38 N @ 191.20 MS, -433.00 N @ 74.96 MS

SMALL FEMALE NECK EXTENSION CALIBRATION

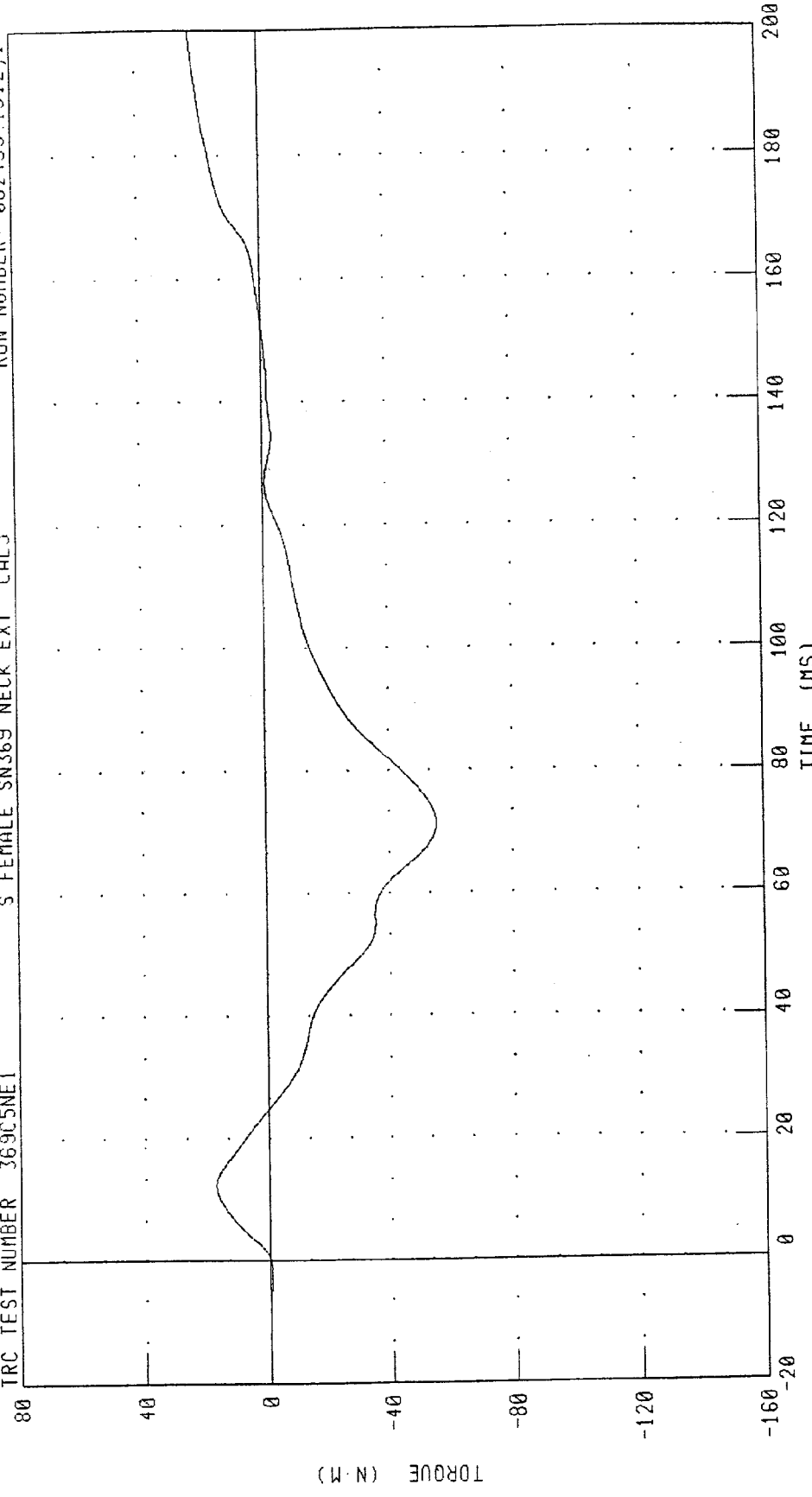
NECK MOMENT Y AXIS



SMALL FEMALE NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE
S FEMALE SN369 NECK EXT CAL5

TRC TEST NUMBER 369C5NE1

RUN NUMBER 082499.1512.1



PEAK DATA: 22.67 N·M @ 200.00 MS, -55.41 N·M @ 71.44 MS

CHANNEL: NEKOM FILTER: CH. CLASS 60

TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III SMALL FEMALE

26-AUG-99

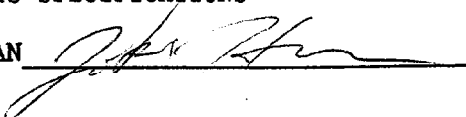
TRC INC.

TEST NO: 369C5TH1

S.FEMALE SN369 THORAX CAL05

TEST PARAMETER	HIGH SPEED TEST	TEST RESULTS
	SPECIFICATION	
TEMPERATURE	20.6-22.2 DEG. C	21.1 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PENDULUM VELOCITY	6.59 - 6.83 M/S	6.68 M/S
MAXIMUM DEFLECTION	48 - 55 MM	53.5 MM
MAXIMUM RESISTIVE FORCE WITHIN DEFLECTON CORRIDOR	3900 - 4400	4284. N
INTERNAL HYSTERESIS	69% - 85%	71.2%

TEST MEETS SPECIFICATIONS

TECHNICIAN 

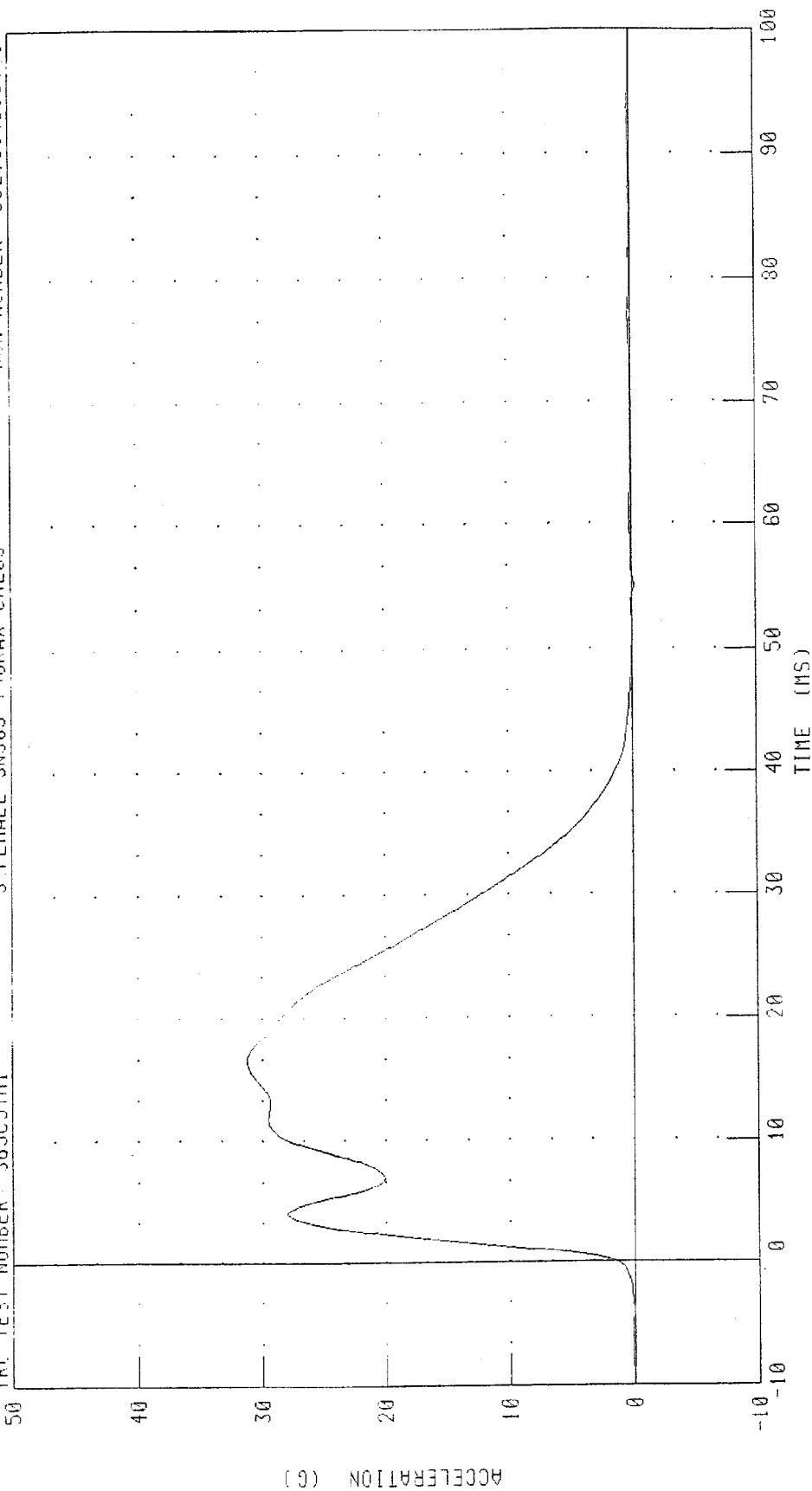
RUN NUMBER: 082699.0827;1

SMALL FEMALE THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 36905TH1

S FEMALE SN369 THORAX CAL05

RUN NUMBER: 082699.0835.1



PEAK DATA: 31.22 G @ 16.64 MS, -0.16 G @ 55.04 MS

CHANNEL: PENXG FILTER: CH. CLASS 180

SMALL FEMALE THORAX CALIBRATION

PENDULUM FORCE

TRC TEST NUMBER 369C5TH1

S FEMALE SN369 THORAX CAL05

RUN NUMBER: 082699 0835.1

100

80

60

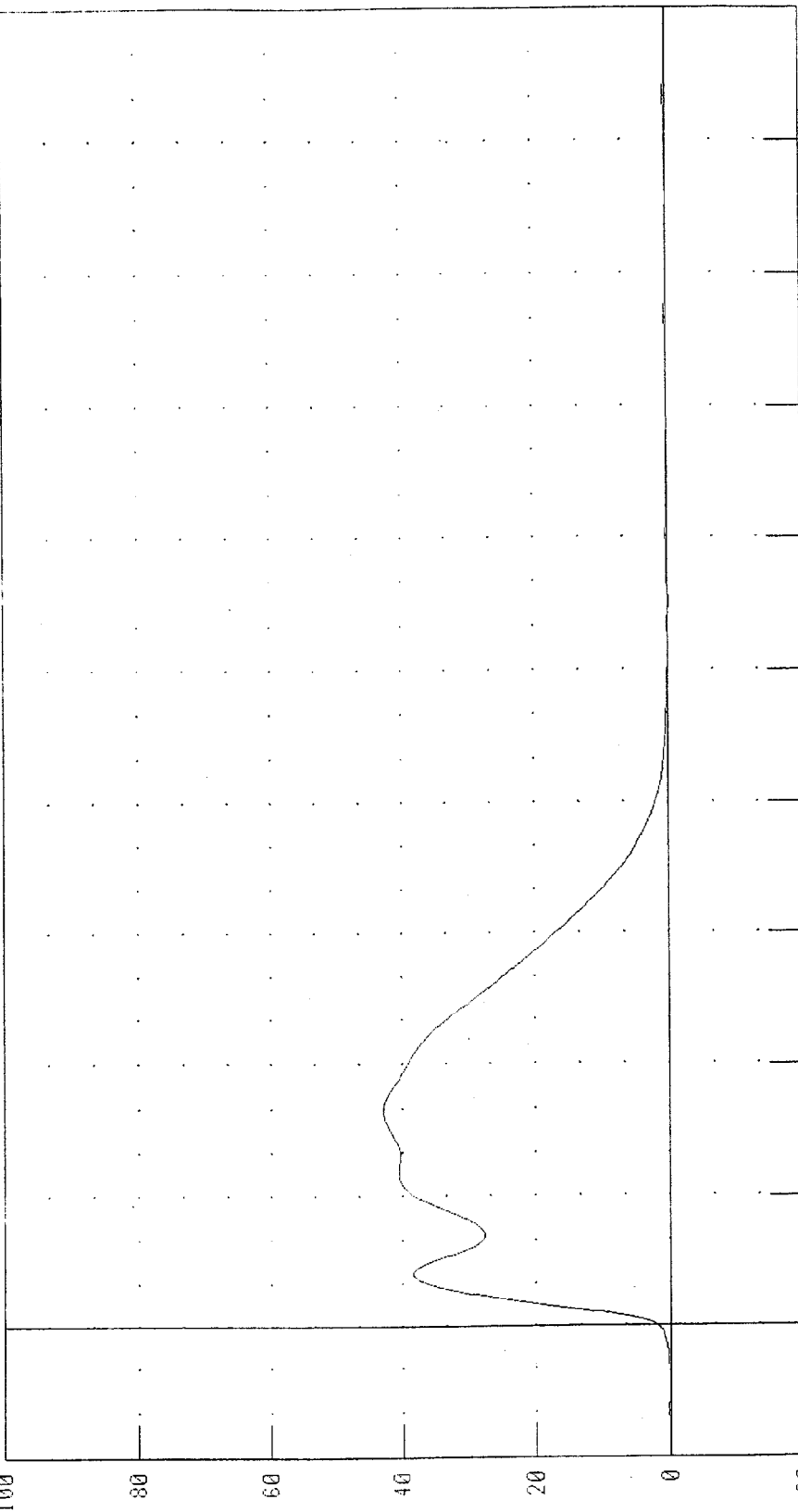
40

20

0

-20

FORCE (N X 10²)



TIME (MS)

PEAK DATA: 4284.56 N @ 16.64 MS, -22.47 N @ 55.04 MS

CHANNEL: PENXF FILTER: CH CLASS 180

SMALL FEMALE THORAX CALIBRATION

STERNUM DISPLACEMENT

TRC TEST NUMBER 36905TH1

S.FEMALE SN369 THORAX CAL05

DISPLACEMENT (MM)

150

120

90

60

30

0

-30

-10

0

10

20

30

40

50

60

70

80

90

100

TIME (MS)

PEAK DATA: 53.58 MM @ 19.84 MS, -0.01 MM @ -7.76 MS

CHANNEL: CSTXD FILTER: CH. CLASS 180

RUN NUMBER: 082639 0835.1

STERNUM DISPLACEMENT

S.FEMALE SN369 THORAX CAL05

TRC TEST NUMBER 36905TH1

DISPLACEMENT (MM)

150

120

90

60

30

0

-30

-10

0

10

20

30

40

50

60

70

80

90

100

TIME (MS)

PEAK DATA: 53.58 MM @ 19.84 MS, -0.01 MM @ -7.76 MS

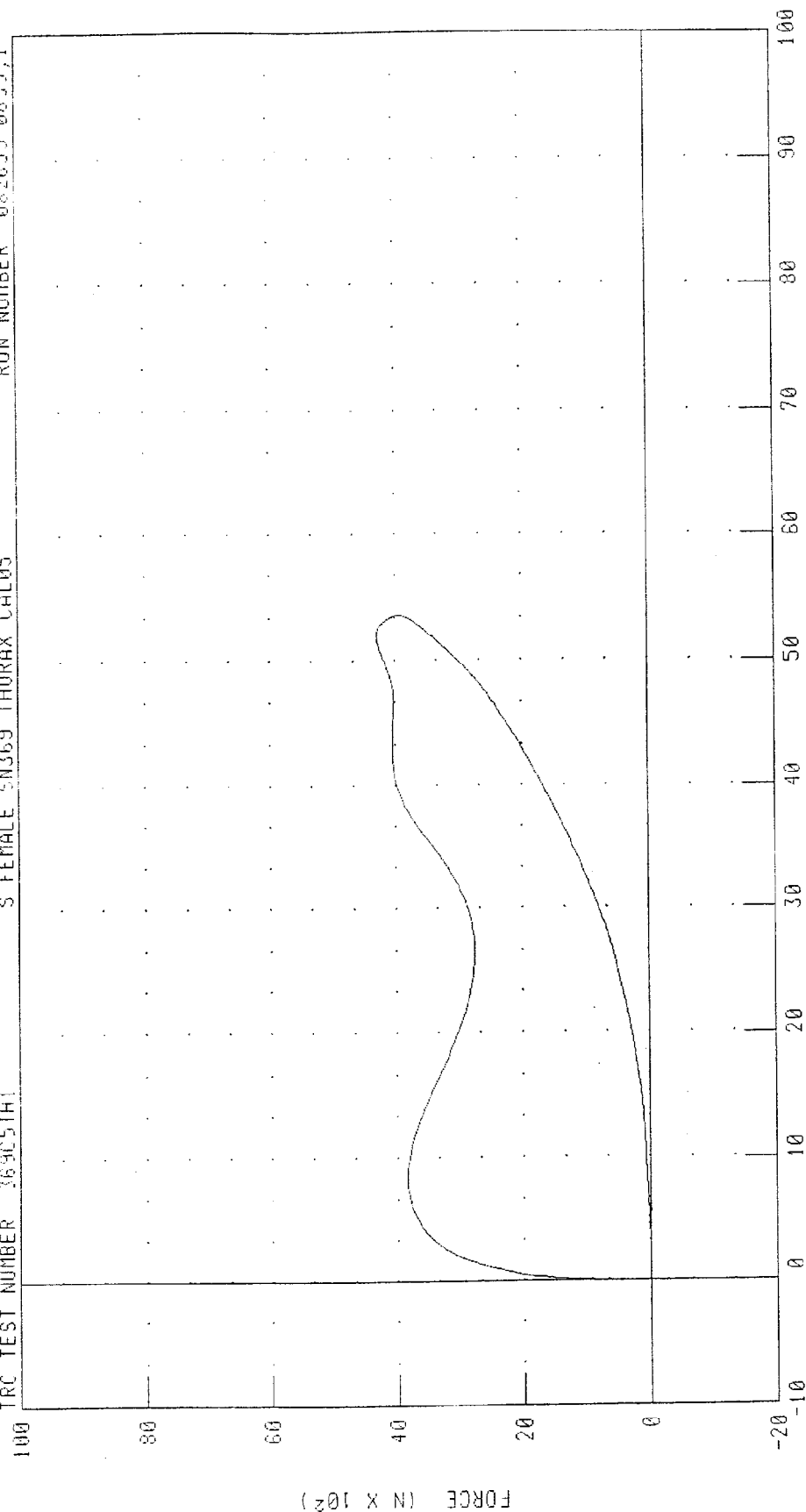
CHANNEL: CSTXD FILTER: CH. CLASS 180

RUN NUMBER: 082639 0835.1

SMALL FEMALE THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE
S FEMALE SN369 THORAX CAL05

IRC TEST NUMBER 369C5TH1

RUN NUMBER 082639 0835.1



CHANNEL: CSTXD FILTER: CH. CLASS 180
PENXF CH. CLASS 180

PEAK DATA:

53.58 mm @ 19.84 MS, -0.01 mm @ -7.76 MS
4284.50 N @ 16.64 MS, -22.47 N @ 55.04 MS

TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III SMALL FEMALE

24-AUG-99

TRC INC.

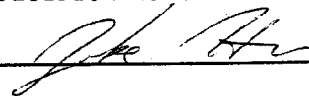
TEST NO: 369C5RK1

S.FEMALE SN369 R.KNEE CAL5

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.08 M/S
PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM	3360 - 4080 N	3717.6 N

TEST MEETS SPECIFICATIONS

TECHNICIAN



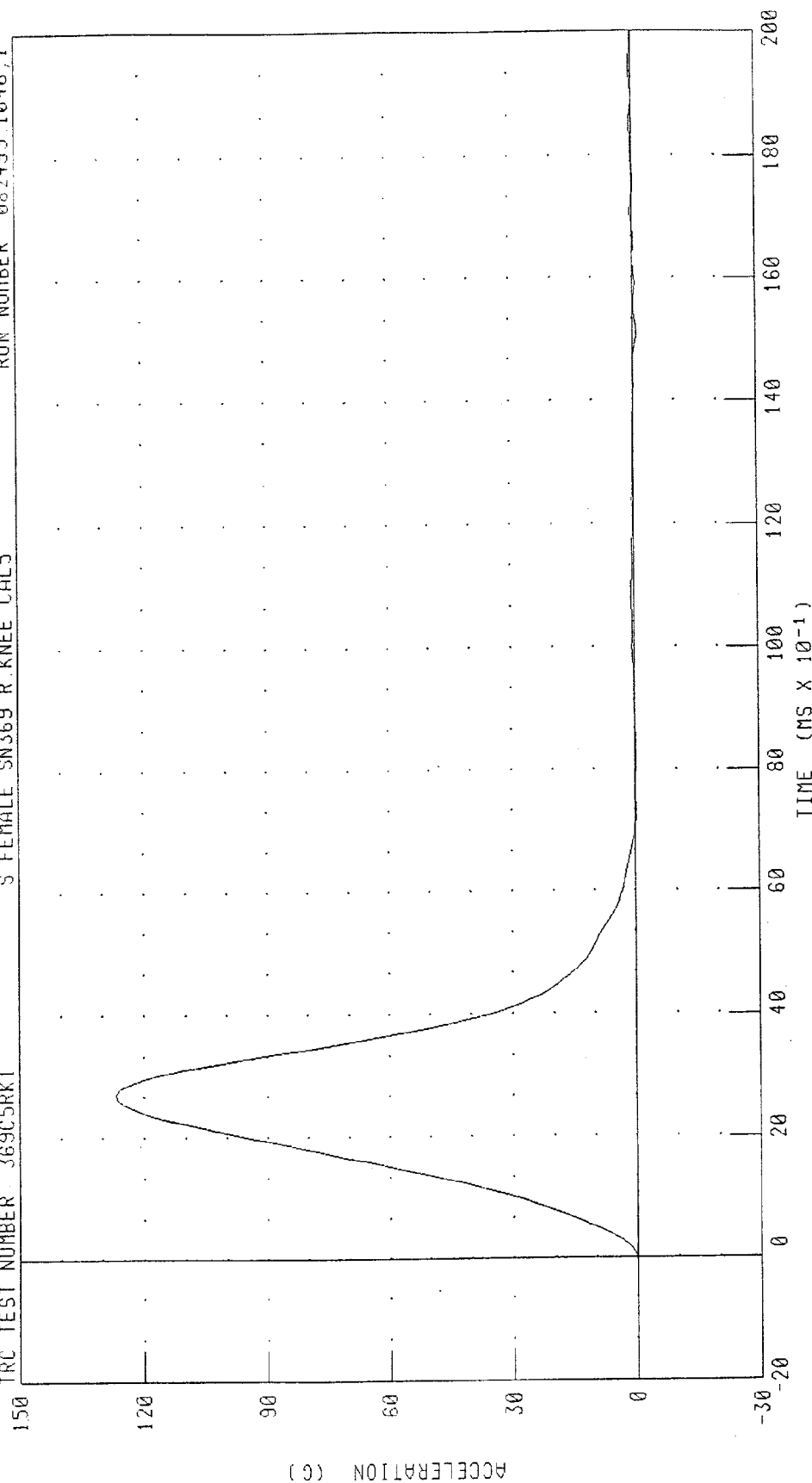
RUN NUMBER: 082499.1045;1

SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER 36905RK1

S FEMALE SN369 R.KNEE CAL5

RUN NUMBER 082499 1046,1



CHANNEL: PENXC FILTER: CH. CLASS 600

PEAK DATA: 126.64 G @ 2.72 MS; -1.11 G @ 15.12 MS

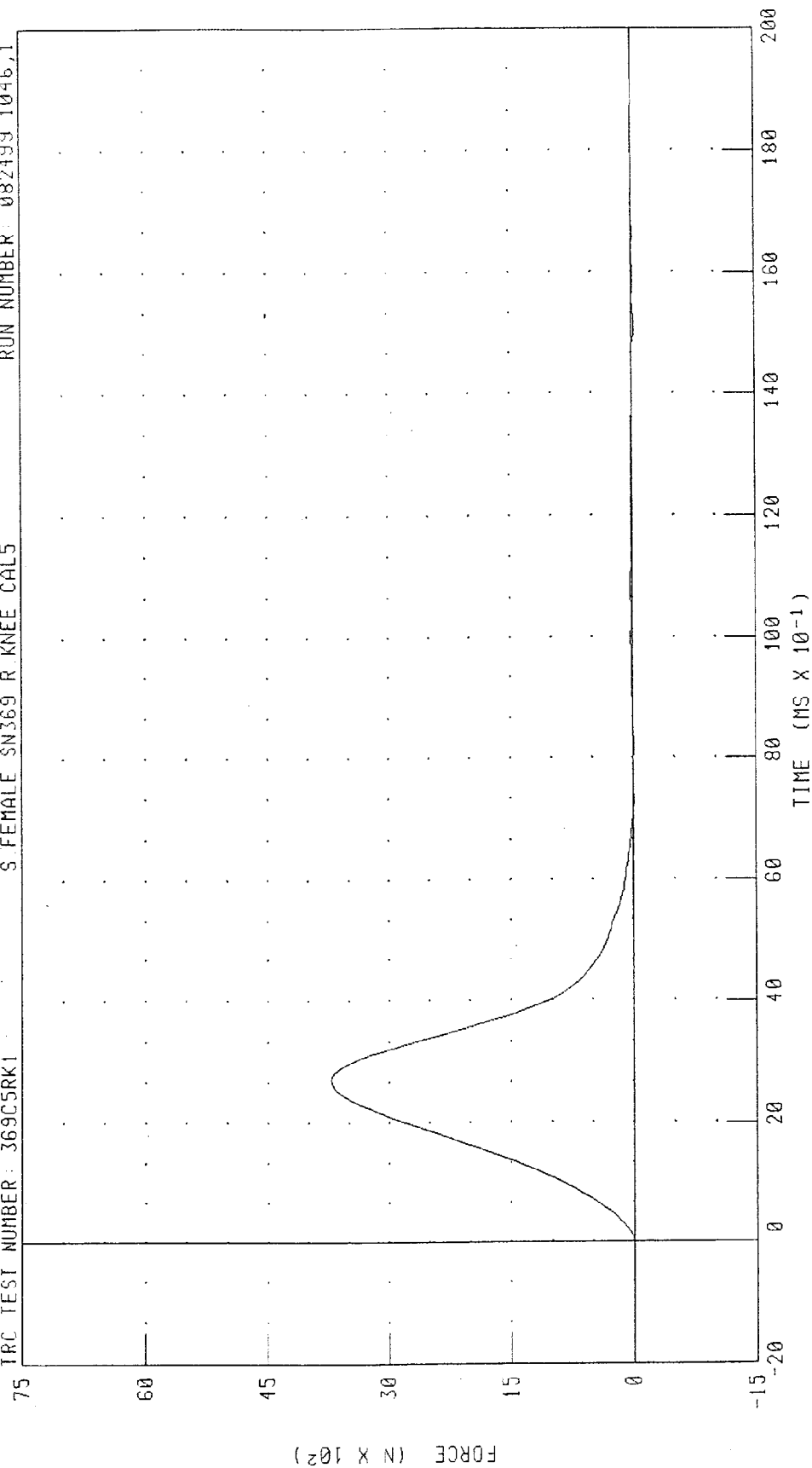
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION

PENDULUM FORCE (5 KG PEND.)

S FEMALE SN369 R KNEE CAL5

RUN NUMBER: 082499 1046,1

TRC TEST NUMBER: 369C5RK1



CHANNEL: PENXF FILTER: CH. CLASS 600 PEAK DATA: 3717.61 N @ 2.72 MS, -32.56 N @ 15.12 MS

TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III SMALL FEMALE

24-AUG-99

TRC INC.

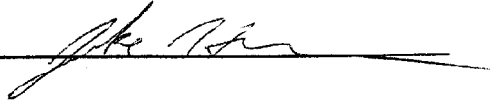
TEST NO: 369C5LK1

S.FEMALE SN369 LEFT KNEE CAL5

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	18.9-25.6 DEG. C	21.7 DEG. C
RELATIVE HUMIDITY	10 - 70 %	55.0 %
PROBE VELOCITY	2.07 - 2.13 M/S	2.08 M/S
PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM	3360 - 4080 N	3555.6 N

TEST MEETS SPECIFICATIONS

TECHNICIAN



RUN NUMBER: 082499.1039;1

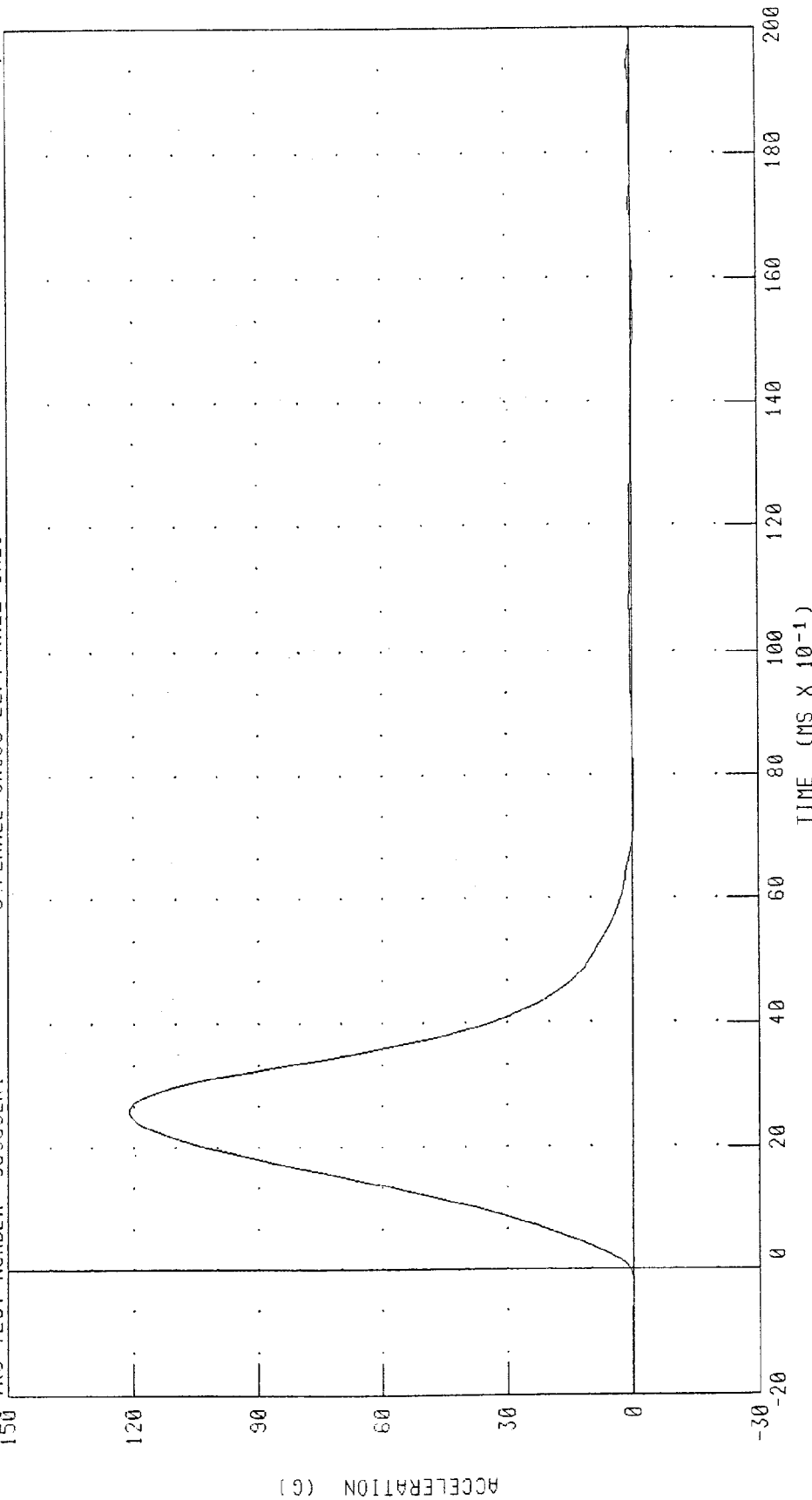
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION

PENDULUM DECELERATION (5 KG PEND)

TRC TEST NUMBER: 369C5LK1

S. FEMALE SN369 LEFT KNEE CAL5

RUN NUMBER 082499 1040,1



CHANNEL: PENXC

FILTER: CH. CLASS 600

PEAK DATA: 121.12 G @ 2.56 MS; -0.62 G @ 15.20 MS

SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION

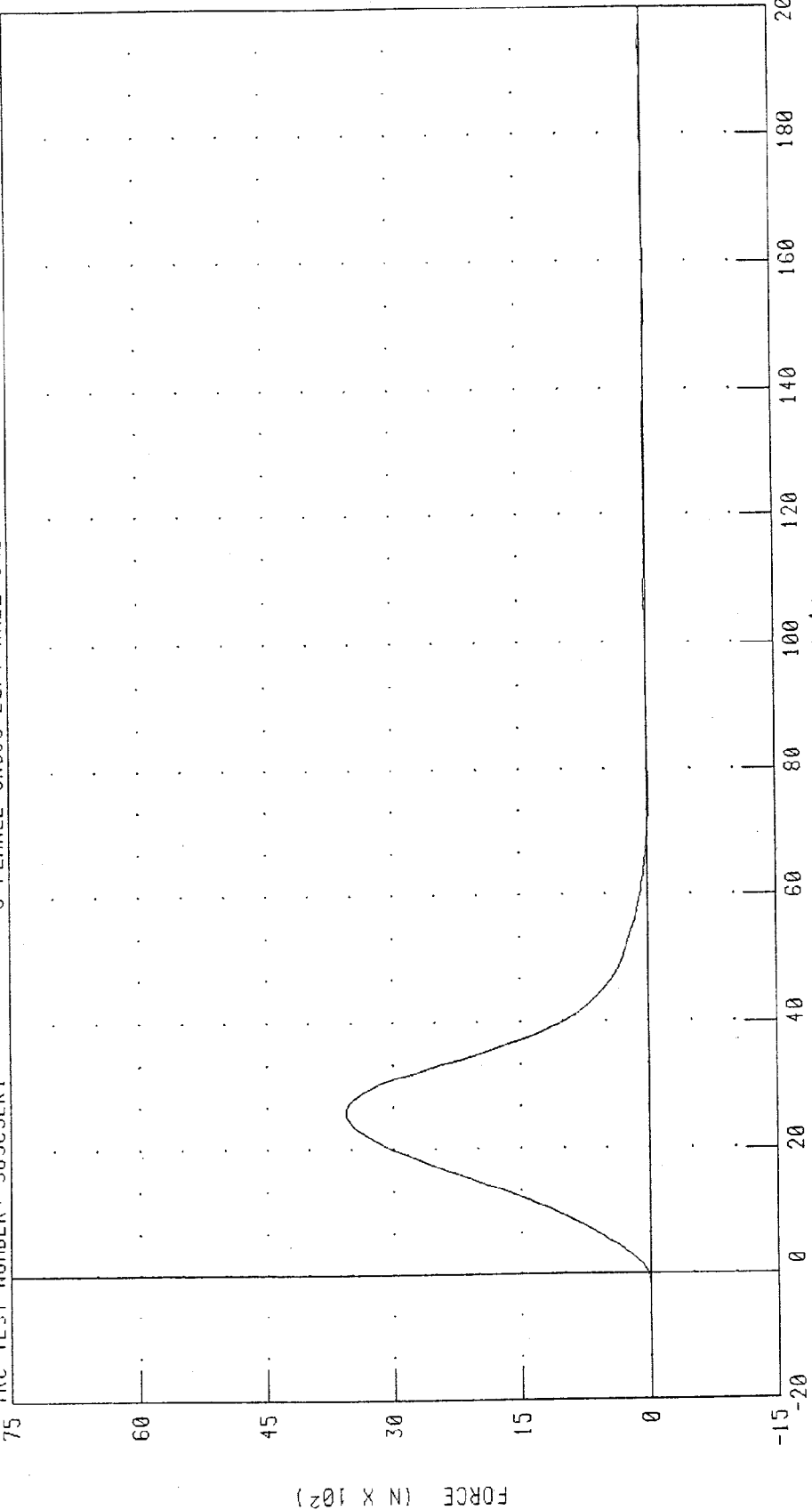
PENDULUM FORCE (5 KG PEND.)

S FEMALE SN389 LEFT KNEE CAL5

RUN NUMBER: 082499 1040.1

TRC TEST NUMBER: 369C5LK1

75



PEAK DATA: 3555.68 N @ 2.56 MS; -18.16 N @ 15.20 MS

CHANNEL: PENXF FILTER: CH. CLASS 600

Appendix D

Miscellaneous Test Information

Dummy Sign Convention

Accelerometers: +X: Forward
 +Y: Rightward
 +Z: Downward

Potentiometers: +Chest longitudinal deflection: Outward

Load cells: +Femur force: Tension

Neck load cells: +X force: Head rearward
 +Y force: Head leftward
 +Z force: Head upward (tension on neck)
 +X moment: Left ear rotating toward left shoulder
 +Y moment: Chin rotating toward chest
 +Z moment: Chin rotating toward left shoulder

Filtering Data

J211 MAR95

Load Cell Barrier Forces Class 60

Vehicle Structural Accelerations Class 60

Occupant

Head Accelerometer Class 1000

Neck Class 60

Chest Accelerometer Class 180

Chest Deflection Class 180

Femur Force Class 600

Sternum Accelerometer Class 180

Lower Leg Class 600

Accelerometer Information

Engineer: Rhule
 Test Date: Feb-98
 Dummy S/N: 289
 Type: 5th female

Mnemonic Parameter Being Measured	Description	Model Number	Serial Number	Mfr.	Sensitivity Mv/g @100 Hz	Cal Due Date	Full- Scale Desired G	Direction Of Positive Polarity
CSTXG	Chest X	7264	J20599	Endevco	0.2054	10/07/99	200	FWD
CSTYG	Chest Y	7264	J20580	Endevco	0.2237	10/07/99	200	LEFT
CSTZG	Chest Z	7264	EH88J	Endevco	0.2833	10/07/99	200	UP
STTXG	Sternum top X	7264	J20569	Endevco	0.2179	10/07/99	2000	FWD
STMXG	Sternum middle X	7264	J20064	Endevco	0.2279	10/07/99	2000	FWD
STBXG	Sternum bottom X	7264	J20570	Endevco	0.2230	10/07/99	2000	FWD
SPTXG	Spine top X	7264	J19872	Endevco	0.2406	10/07/99	200	REAR
SPMXG	Spine middle X	7264	J19877	Endevco	0.2472	10/07/99	200	REAR
SPBXG	Spine bottom X	7264	J19890	Endevco	0.2267	10/07/99	200	REAR
HEDXG	Head X	7264	J20165	Endevco	0.2225	10/07/99	200	REAR
HEDYG	Head Y	7264	J19865	Endevco	0.2129	10/07/99	200	LEFT
HEDZG	Head Z	7264	J19934	Endevco	0.2452	10/07/99	200	UP
PEVXG	Pelvis X	7264	CY06H	Endevco	0.3020	10/07/99	200	REAR
PEVYG	Pelvis Y	7264	AGAC4	Endevco	0.2385	10/07/99	200	LEFT
PEVZG	Pelvis Z	7264	BF65J	Endevco	0.3357	10/07/99	200	UP
PEVYGA	Pelvis Y	7264	J20218	Endevco	0.2473	10/27/99	200	RIGHT

Accelerometer Information

Engineer: Rhule
 Test Date: Feb-98
 Dummy S/N: 289
 Type: Hybrid III 5th percentile

Mnemonic Parameter Being Measured	Description	Model Number	Serial Number	Sensitivity (mV/V)	Cal Due Date	Full-Scale Desired G	Direction Of Positive Polarity
	Neck Load Cell						
NEKXF	Neck X-force	1716	425	1.6944 @ 2,000 lbs	10/07/99	2000	Head forward/chest rearward
NEKYF	Neck Y-force	1716	425	1.6421 @ 2,000 lbs	10/07/99	2000	Head left/chest right
NEKZF	Neck Z-force	1716	425	1.1515 @ 3,000 lbs	10/07/99	3000	Head up/chest down
NEKXM	Neck X-moment	1716	425	1.5817 @ 2500 in-lbs	10/07/99	2500	Right ear to right shoulder
NEKYM	Neck Y-moment	1716	425	1.6308 @ 2500 in-lbs	10/07/99	2500	Chin forward to sternum
NEKZM	Neck Z-moment	1716	425	2.2688 @ 2500 in-lbs	10/07/99	2500	Chin to left shoulder
	Femur Load Cells						
	Left femur						
LFM XF	Left femur X-force	1914	0259	1.9091 @ 3000 lbs	10/07/99	3000	Knee upward/upper femur down
LFM YF	Left femur Y-force	1914	0259	1.9105 @ 3000 lbs	10/07/99	3000	Knee left/upper femur right
LFM ZF	Left femur Z-force	1914	0259	1.1840 @ 5000 lbs	10/07/99	5000	Knee forward/pelvis rearward
LFM XM	Left femur X-moment	1914	0259	1.4989 @ 3000 in-lbs	10/07/99	3000	Knee left, hold upper femur in place
LFM YM	Left femur Y-moment	1914	0259	1.5040 @ 3000 in-lbs	10/07/99	3000	Knee up, hold upper femur in place
LFM ZM	Left femur Z-moment	1914	0259	2.6742 @ 3000 in-lbs	10/07/99	3000	Twist knee to right, hold up femur
	Right femur						
RFM XF	Right femur X-force	1914	0257	1.9130 @ 3000 lbs	10/07/99	3000	Knee upward/upper femur down
RFM YF	Right femur Y-force	1914	0257	1.9299 @ 3000 lbs	10/07/99	3000	Knee left/upper femur right
RFM ZF	Right femur Z-force	1914	0257	1.1926 @ 5000 lbs	10/07/99	5000	Knee forward/pelvis rearward
RFM XM	Right femur X-moment	1914	0257	1.4705 @ 3000 in-lbs	10/07/99	3000	Knee left, hold upper femur in place
RFM YM	Right femur Y-moment	1914	0257	1.5124 @ 3000 in-lbs	10/07/99	3000	Knee up, hold upper femur in place
RFM ZM	Right femur Z-moment	1914	0257	2.5006 @ 3000 in-lbs	10/07/99	3000	Twist knee to right, hold up femur

Engineer: Rhule
Test Date: Feb-98
Dummy S/N: 289
Type: Hybrid III 5th percentile

[illegible]

TRANSDUCER INFORMATION

5th Female HYBRID III DUMMY SERIAL NO.: 289v ; MFR.: ; SEATING POSITION: ;
 PROJECT-SEGMENT NO.: 096017 1513 ; ENGINEER: PG ; TEST DATE: 8-30-99

MNEMONIC PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NO.	SERIAL NO.	MFR.	SENSITIVITY	CAL DATE	FULL SCALE (ENGR. UNITS) DESIRED ACTUAL		DIRECTION OF POSITIVE POLARITY	CABLE NO.
KNLLF	LEFT KNEE LEFT SENSOR FORCE	1587	-LEFT	DEN	1.2872mv/v at 2000 lb.	1997	2,000 lbs. 9,000 N			-LEFT
KNLMF	LEFT KNEE RIGHT SENSOR FORCE	"	-RIGHT	"	1.2866 mv/v at 2000 lb.	"	2,000 lbs. 9,000 N			-RIGHT
KNRMF	RIGHT KNEE LEFT SENSOR FORCE	"	-LEFT	"	1.3049 mv/v at 2000 lb.	"	2,000 lbs. 9,000 N			-LEFT
KNRLF	RIGHT KNEE RIGHT SENSOR FORCE	"	-RIGHT	"	1.2844 mv/v at 2000 lb.	"	2,000 lbs. 9,000 N			-RIGHT
KNLXD	LEFT KNEE DISPLACEMENT	8TC1- 2702	018L V	SERV O	981.2 mv/v/in	8-11- 1999	1 inch 25 mm			018L
KNRXD	RIGHT KNEE DISPLACEMENT	"	018R V	"	1016 mv/v/in	"	1 inch 25 mm			018R
TBLXF	LEFT UPPER TIBIA X AXIS FORCE	3115	265-FX V	DEN	1.9815 mv/v at 2500 lb.	8-11- 1999	2,500 lbs 11,000 N			265-FX
TBLXM	LEFT UPPER TIBIA MOMENT ABOUT X AXIS	"	265-MX	"	2.9510 mv/v at 3500 in- lb.	"	300 ft.-lbs 400 N-m			265-MX
TBLYM	LEFT UPPER TIBIA MOMENT ABOUT Y AXIS	"	265-MY	"	3.0172 mv/v at 3500 in- lb.	"	300 ft.-lbs 400 N-m			265-MY

TRANSDUCER INFORMATION

5th Female HYBRID III DUMMY SERIAL NO.: 289v ; MFR.: ; SEATING POSITION: ;
 PROJECT-SEGMENT NO.: 096017 1513 ; ENGINEER: PG ; TEST DATE: 8-30-99

MNEMONIC PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NO.	SERIAL NO.	MFR.	SENSITIVITY	CAL DATE	FULL SCALE (ENGR. UNITS) DESIRED ACTUAL	DIRECTION OF POSITIVE POLARITY	CABLE NO.
TBLZF	LEFT UPPER TIBIA Z AXIS FORCE	3115	265-FZ	DEN	1.1181 mv/v at 2500 lb.	8-11- 1999	2,500 lbs. 11,000 N		265-FZ
TBRXF	RIGHT UPPER TIBIA X AXIS FORCE	"	266-FX V	"	1.9341 mv/v at 2500 lb.	"	2,500 lbs. 11,000 N		266-FX
TBRXM	RIGHT UPPER TIBIA MOMENT ABOUT X AXIS	"	266-MX	"	2.9020 mv/v at 3500 in- lb.	"	300 ft-lbs 400 N-m		266-MX
TBRYM	RIGHT UPPER TIBIA MOMENT ABOUT Y AXIS	"	266-MY	"	2.9367 mv/v at 3500 in- lb.	"	300 ft-lbs 400 N-m		266-MY
TBRZF	RIGHT UPPER TIBIA Z AXIS FORCE	"	266-FZ	"	1.0885 mv/v at 2500 lb.	"	2,500 lbs. 11,000 N		266-FZ
ANLXF	LEFT LOWER TIBIA X-AXIS FORCE	3287	178-FX V	"	1.9204 mv/v at 2500 lb.	"	2,500 lbs. 11,000 N		178-FX
ANLZF	LEFT LOWER TIBIA Z-AXIS FORCE	"	178-FZ	"	1.0526 mv/v at 2500 lb.	"	2,500 lbs. 11,000 N		178-FZ
ANLXM	LEFT LOWER TIBIA MOMENT ABOUT X AXIS	"	178-MX	"	2.9612 mv/v at 3500 in- lb.	"	300 ft-lbs 400 N-m		178-MX
ANLYM	LEFT LOWER TIBIA MOMENT ABOUT Y AXIS	"	178-MY	"	2.9779 mv/v at 3500 in - lb.	"	300 ft-lbs 400 N-m		178-MY

TRANSDUCER INFORMATION

5th Female HYBRID III DUMMY SERIAL NO.: 289v ; MFR.: ; SEATING POSITION:

PROJECT SEGMENT NO. : 096017 1513
: ENGINEER; PG : TEST DATE: 8-30-99

[illegible]

TRANSDUCER INFORMATION

5th Female HYBRID III DUMMY SERIAL NO.: 3691; MFR.: ; SEATING POSITION: PASS

PROJECT-SEGMENT NO.: 096017 1513; ENGINEER: PG; TEST DATE: 8-30-99 -3

MNEMONIC PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NO.	SERIAL NO.	MFR.	SENSITIVITY	CAL DUE DATE	FULL SCALE (ENGR. UNITS) DESIRED ACTUAL	DIRECTION OF POSITIVE POLARITY	CABLE NO.
HEDXG HAP	HEAD X-AXIS ACCEL.	7264	A20FJ	End.	.2563 mv/g at 10 volts	12-2- 1999	400 g	Rear	A20FJ
HEDYG HLR	HEAD Y-AXIS ACCEL.	"	A31FJ	"	.2683 mv/g at 10 volts	"	400 g	Left	A31FJ
HEDZG HIS	HEAD Z-AXIS ACCEL.	"	CL95H	"	.2822 mv/g at 10 volts	"	400 g	Up	CL95H
NEKXF NFX	NECK X-AXIS SHEAR FORCE	1716A	0534	DEN	1.7247 mv/v at 2000 lbs.	12-2- 1999	2,000 lbs. 9,000 N		FX
NEKYF NFY	NECK Y-AXIS SHEAR FORCE	"	"	"	1.6643 mv/v at 2000 lbs.	"	2,000 lbs. 9,000 N		FY
NEKZF NFZ	NECK Z-AXIS AXIAL FORCE	"	"	"	1.1561 mv/v at 3000 lbs.	"	3,000 lbs. 13,500 N		FZ
NEKXM NMX	NECK MOMENT ABOUT X AXIS	"	"	"	1.6355 mv/v at 2500 in. lbs.	"	200 ft-lbs 275 N-m		MX
NEKYM NMY	NECK MOMENT ABOUT Y AXIS	"	"	"	1.6430 mv/v at 2500 in. lbs.	"	200 ft-lbs 275 N-m		MY
NEKZM NMZ	NECK MOMENT ABOUT Z AXIS	"	"	"	2.3186 mv/v at 2500 in. lbs.	"	200 ft-lbs 275 N-m		MZ

TRANSDUCER INFORMATION

5th Female HYBRID III DUMMY SERIAL NO.: 3691; MFR.: _____; SEATING POSITION: _____ PASS _____

PROJECT-SEGMENT NO.: 096017 1513; ENGINEER: PG _____; TEST DATE: 8-30-99 -3

MNEMONIC PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NO.	SERIAL NO.	MFR.	SENSITIVITY	CAL DUE DATE	FULL SCALE (ENGR. UNITS) DESIRED ACTUAL	DIRECTION OF POSITIVE POLARITY	CABLE NO.
CSTXG CAP	CHEST X-AXIS ACCEL.	7264	A72JJ	End.	.2773 mv/g at 10 volts	12-2- 1999	400 g	Forward	A72JJ
CSTYG CLR	CHEST Y-AXIS ACCEL.	"	A69JJ	"	.2702 mv/g at 10 volts	"	400 g	Left	A69JJ
CSTZG CIS	CHEST Z-AXIS ACCEL.	"	A34FJ	"	.2565 mv/g at 10 volts	"	400 g	Up	A34FJ
CSTXD CAPD	CHEST DEFLECTION	14CB1- 2897	1188	Bourn	43.6 mv/v/in	"	6 inch 150 mm	Extension	1188
PEVXG PAP	PELVIS X-AXIS ACCEL.	7264	CY31H	End.	.2031 mv/g at 10 volts	"	400 g	Rear	C14981
PEVYG PLR	PELVIS Y-AXIS ACCEL.	"	A51JJ	"	.2917 mv/g at 10 volts	"	400 g	Left	C15183
PEVZG PIS	PELVIS Z-AXIS ACCEL.	"	A75JJ	"	.2695 mv/g at 10 volts	"	400 g	Up	C15184
LFMF LF	LEFT FEMUR FORCE	2430	1006	DEN	0.9459 mv/v at 3000 lbs.	12-2- 1999	1300 Kg 3,000 lbs. 13,500 N	Extension	1518
RFMF RF	RIGHT FEMUR FORCE	"	1007	"	0.9114 mv/v at 3000 lbs.	"	1300 Kg 3,000 lbs. 13,500 N	Extension	71

5th Female HYBRID III DUMMY SERIAL NO.: 369t ; MFR.: ; SEATING POSITION: PASS

PROJECT-SEGMENT NO.: 096017 1513 ; ENGINEER: PG ; TEST DATE: 8-30-99 -3

[illegible]

Vehicle Instrumentation Placement

Vehicle year/make/model/body style: 1999/Saturn/SL1/Sedan

Test number: 990830-3

Number	Location	Axis	Manufacturer	Model	S/N	Orientation (+ Sensing)
1	Left Brake Caliper	X	Endevco	7264-2000T	99A28-Z23	Rearward
2	Right Brake Caliper	X	Endevco	7364-2000T	99A28-Z08	Forward
3	Instrument Panel Center	X	Endevco	7264-2000T	99A28-Z07	Forward
		Y	Endevco	7264-2000T	99A28-Z01	Left
4	Engine Top	X	Endevco	7364-2000T	99A28-Z21	Forward
5	Engine Bottom	X	Endevco	7364-2000T	99A28-Z04	Rearward
6	Vehicle Rear Center	Y	Endevco	7264-2000T	J27328	Right
		Z	Endevco	7364-2000T	J28469	Up
7	Left Rear Seat Crossmember	X	Endevco	7264-2000T	J27471	Forward
		Y	Endevco	7264-2000T	J27229	Right
8	Right Rear Seat Crossmember	X	Endevco	7364-2000T	J29440	Right
		Y	Endevco	7364-2000T	99A28-Z15	Forward
9	Driver Airbag	N/A	Fluke	Y8101A	IP1	N/A
10	Passenger Airbag	N/A	Fluke	Y8101A	IP2	N/A

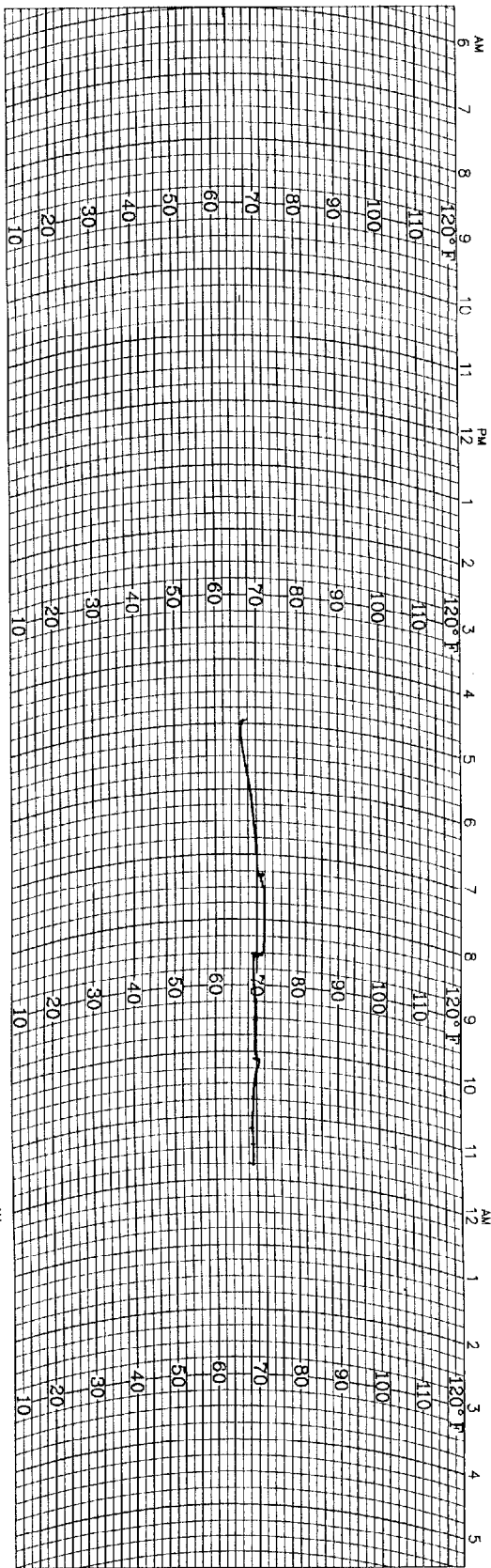
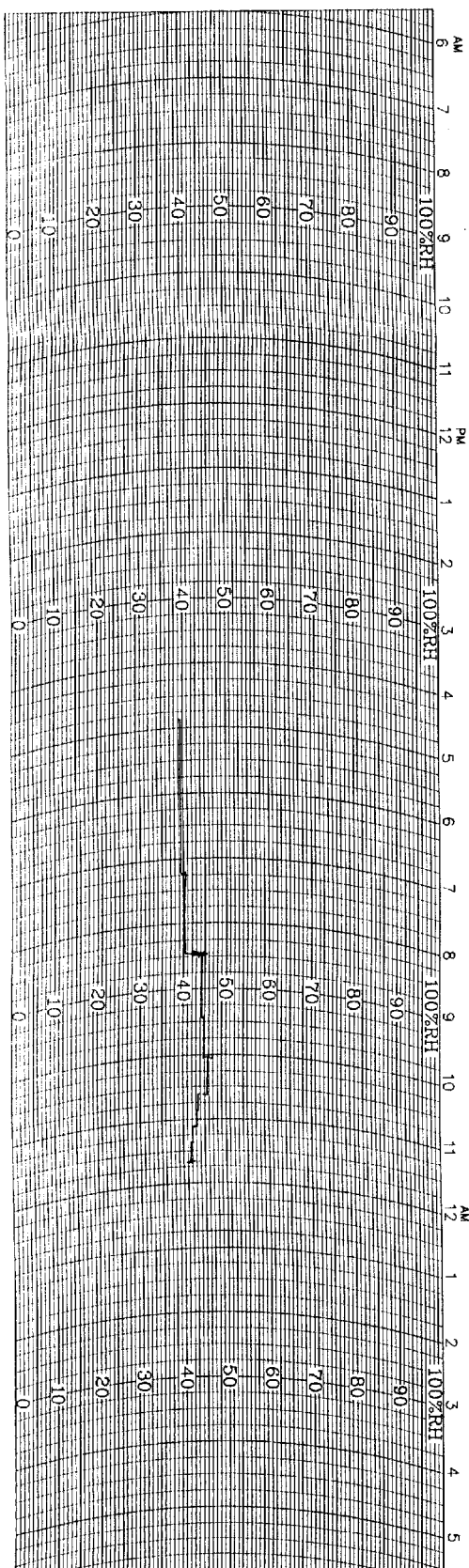
Description Of Timing Marks On TRC High-Speed Film

All TRC high-speed cameras are equipped with red LEDs which put timing marks on the right edge of the film. TRC uses a single timing generator to generate the timing for all cameras. This allows the timing marks to be common to all cameras. The timing marks can be used to measure camera speed (frames per second) or to locate a point in time before or after the time-zero event.

The timing marks appear on the film as small red marks on the right edge of the film. Round marks are left by the Photo-Sonics and Stalex cameras while horizontal bars are left by the Hycam, Locam, and Fastax II cameras.

The timing generator puts out a pulse for every millisecond plus it generates additional pulses for hundredths and tenths of seconds. To explain this further, we can use an example of a camera running at 1000 frames per second.

1. Every frame will have **one** LED appear in it. This indicates a *millisecond* pulse.
2. Every ten frames will have **two** LEDs appear in it. These indicate a *millisecond* pulse plus a *hundredth of a second* pulse.
3. Every one hundred frames will have **three** LEDs appear in it. These indicate a *millisecond* pulse, a *hundredth of a second* pulse, and a *tenth of a second* pulse.



WeatherMeasure
WEATHERtronics
Division of QUALIMETRICS, Inc.

P.O. BOX 41039
SACRAMENTO, CA 95841
PHONE: (916) 923-0055

HYGROTHERMOGRAPH
1 DAY

CHART NO. M699123
C311-D-HF
ECN 2717
6-9-87

STATION _____ DATE ON _____ DATE OFF _____