

DOT 1395

VEHICLE AND DUMMY KINEMATICS
IN A CONTROLLED ROLLOVER CRASH
1989 PONTIAC GRAND AM

PREPARED BY:
THE TRANSPORTATION RESEARCH CENTER OF OHIO
U.S. RT. 33, LOGAN COUNTY
EAST LIBERTY, OHIO 43319

TEST REPORT
NOVEMBER - DECEMBER, 1989

PREPARED FOR:
SYSTEMS RESEARCH LABORATORIES, INC.
2800 INDIAN RIPPLE ROAD
DAYTON, OHIO 45440

NOTICE

The Transportation Research Center of Ohio does not endorse or certify products of manufacturers. The manufacturer's name appears solely to identify the test article. The Transportation Research Center 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.

Report Prepared By:

Najih A. El-Habash Date 1/4/90
N.A. El-Habash
Project Engineer

Report Approved By:

John C. Stultz Date 1-4-90
J.C. Stultz
Chief Engineer Impact Laboratory

J.F. Shultz Date 1-4-90
J.F. Shultz
Manager Impact Laboratory

T.E. Elliot Date 1/5/90
T.E. Elliot
Project Manager

TABLE OF CONTENTS

<u>Section</u>	<u>Description</u>	<u>Page</u>
1.0	PURPOSE AND TEST SUMMARY	1-1
2.0	SUMMARY OF ROLLOVER CRASH TEST	2-1
3.0	GENERAL TEST AND VEHICLE PARAMETER DATA	3-1
4.0	OCCUPANT INFORMATION	4-1
APPENDIX A	PHOTOGRAPHS	A-1
APPENDIX B	DATA PLOT PRESENTATION	B-1
APPENDIX C	DUMMY CERTIFICATION	C-1
APPENDIX D	MISCELLANEOUS TEST INFORMATION	D-1

LIST OF PHOTOGRAPHS

<u>Title</u>	<u>Figure</u>
PRE-TEST OVERALL FRONT VIEW	A-1
PRE-TEST OVERALL LEFT VIEW	A-2
PRE-TEST OVERALL REAR VIEW	A-3
PRE-TEST OVERALL RIGHT VIEW	A-4
PRE-TEST DRIVER DUMMY VIEW	A-5
PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1	A-6
PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 2	A-7
PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1	A-8
PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 2	A-9
PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 1	A-10
PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2	A-11
PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 1	A-12
PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2	A-13
PRE-TEST VEHICLE INSTRUMENTATION LOCATION	A-14
PRE-TEST VEHICLE CAMERA LOCATION	A-15
PRE-TEST GYRO PLACEMENT VIEW	A-16
POST-TEST OVERALL FRONT - VIEW 1	A-17
POST-TEST OVERALL FRONT - VIEW 2	A-18
POST-TEST OVERALL FRONT - VIEW 3	A-19
POST-TEST OVERALL LEFT - VIEW 1	A-20
POST-TEST OVERALL LEFT - VIEW 2	A-21
POST-TEST OVERALL REAR - VIEW 1	A-22
POST-TEST OVERALL REAR - VIEW 2	A-23
POST-TEST OVERALL RIGHT - VIEW 1	A-24
POST-TEST OVERALL RIGHT - VIEW 2	A-25
POST-TEST DUMMY AND VEHICLE - VIEW 1	A-26
POST-TEST DUMMY AND VEHICLE - VIEW 2	A-27
POST-TEST VEHICLE - VIEW 1	A-28
POST-TEST VEHICLE - VIEW 2	A-29
POST-TEST VEHICLE - VIEW 3	A-30
POST-TEST VEHICLE - VIEW 4	A-31
POST-TEST VEHICLE - VIEW 5	A-32
POST-TEST VEHICLE - VIEW 6	A-33

SECTION 1.0

PURPOSE AND TEST PROCEDURE

This rollover crash test has the main objective to investigate both vehicle and occupant dynamics during automobile rollover crashes.

This test was conducted by placing a 1989 Pontiac Grand Am 2-door coupe on the NHTSA rollover cart at an angle 30° above the horizontal, crabbing the rollover cart 0°, towing the rollover cart to 30 mph, and releasing the test vehicle with its roll axis perpendicular to the direction of the rollover cart motion. The test vehicle contained an instrumented Part 572E dummy with a three-point unbelt restraint system. The vehicle was oriented to first contact its right side.

SECTION 2.0

SUMMARY OF ROLLOVER CRASH TEST

A 1989 Pontiac Grand Am 2-door coupe containing one Part 572E instrumented test dummy was placed upon the rollover test device at 30 degrees above the horizontal. The device was attached to the tow cable of the drive system. The vehicle was placed on the roll cart, the cart was attached to the drive system, and the cart was accelerated to 30 mph. At this point the rollover cycle began, but mechanical binding delayed the release of the car hold-down chain pin retract cylinder. Logic circuits in the cart's electrical control box prevented the lift cylinders from actuating since the pin retract indication switch had not signalled that the pin was released at this time. Subsequently, the pin did retract, and when the cart and remote brakes were applied, the right vehicle support arm broke allowing the car to fall onto its right side. Since this occurred much later than the time the cart was released from the tow system, the car speed was reduced due to the cart's coastdown. The vehicle made one-half of a roll and came to rest on its roof. The rollover crash test was conducted by the Transportation Research Center of Ohio in East Liberty, Ohio on November 29, 1989.

The Part 572E 50th percentile adult male anthropomorphic test device (ATD) was placed in the driver's designated seating position according to the seating procedure in FMVSS 208 Notice 45. The ATD was instrumented with head, chest, and pelvis triaxial accelerometers, a six-axis neck load cell, and a chest displacement potentiometer. The crash event was recorded by thirty-four channels of data on one 14-track tape drive. The analog data was digitally sampled at 8000 samples per second. The data was digitally filtered per SAE J211.

The crash event was filmed by seven high-speed motion picture cameras operating at approximately 500 frames per second and one real-time panning motion picture camera.

Section 1.0 contains the purpose and test procedure. Section 2.0 contains a summary of the rollover crash test. Section 3.0 contains the

general test and vehicle parameter data. Section 4.0 contains the occupant information. Appendix A contains the pre-test and post-test still photographs. Appendix B contains the final data plots. Appendix C contains the post-test dummy calibrations. Appendix D contains the pre-test and post-test IPMD vehicle data sheet.

TEST NUMBER 891129

ROLL CART DATA SUMMARY

No. LOCATION	POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	SEC	MAX	SEC
1 CENTER OF GRAVITY				
ACCELERATION (g)	---	---Y	---	---Y
LONGITUDINAL	---	---Y	---	---Y
LATERAL	---	---Y	---	---Y
VERTICAL	---	---Y	---	---
RESULTANT	---	---	---	---
2 PLATFORM DISPLACEMENT (in)				
LEFT SIDE	---	---Y	---	---Y
RIGHT SIDE	---	---Y	---	---
VEHICLE/ROLL CART SEPARATION TIMES:				
			UPPER SWITCH:	---Y SEC
			LOWER SWITCH:	---Y SEC

POSITIVE DIRECTION
LONGITUDINAL: FORWARD
LATERAL: LEFTWARD
VERTICAL: UPWARD
FORCE: OUTWARD

NEGATIVE DIRECTION
LONGITUDINAL: REARWARD
LATERAL: RIGHTWARD
VERTICAL: DOWNWARD
FORCE: INWARD

Y See TEST ANOMALIES FOR INFORMATION RELATIVE TO ALL OF THE ABOVE DATA CHANNELS

FINAL RESTING PLACES OF PARTS AND CARS

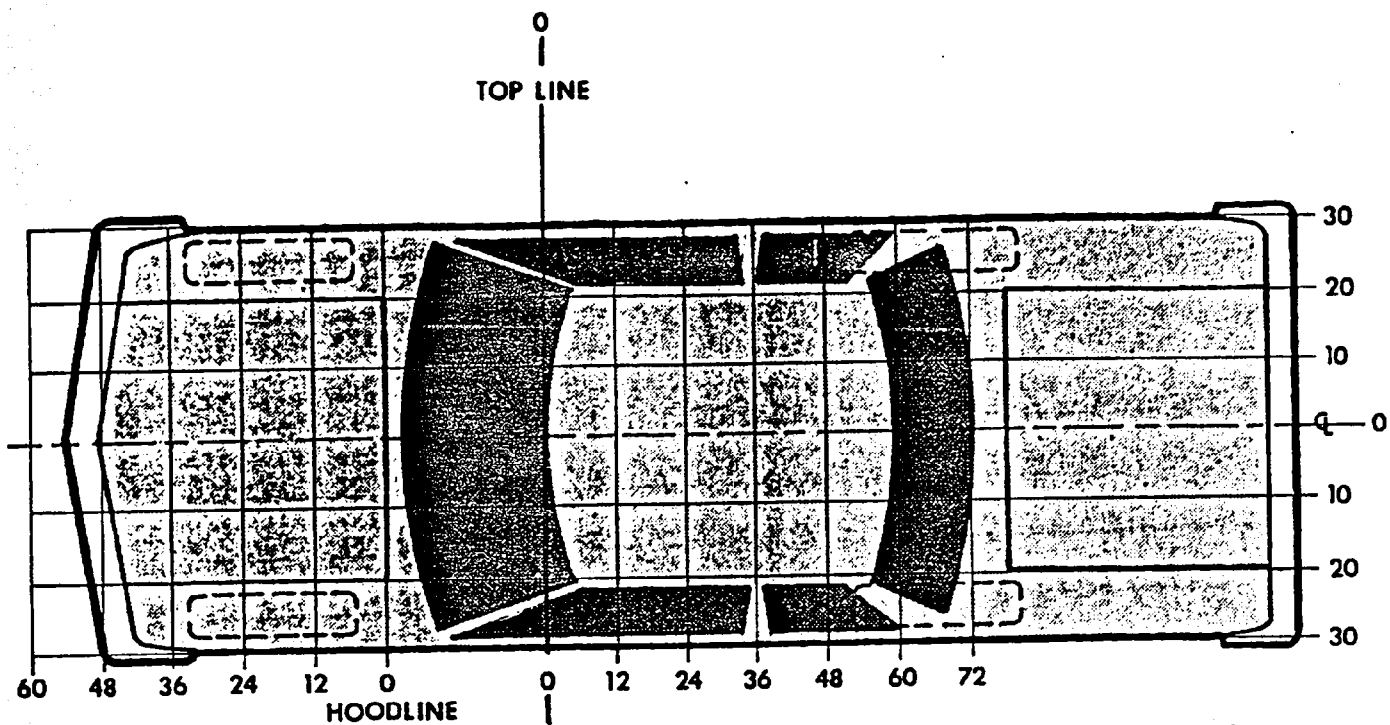
<u>DESCRIPTION OF PART</u>	<u>X. FT*</u>	<u>Y. FT*</u>
1989 Pontiac Grand Am	117.4	27.4

*REFERENCE: *X: FORWARD FROM RELEASE BLOCK
*Y: LEFTWARD FROM CENTER RELEASE BLOCK

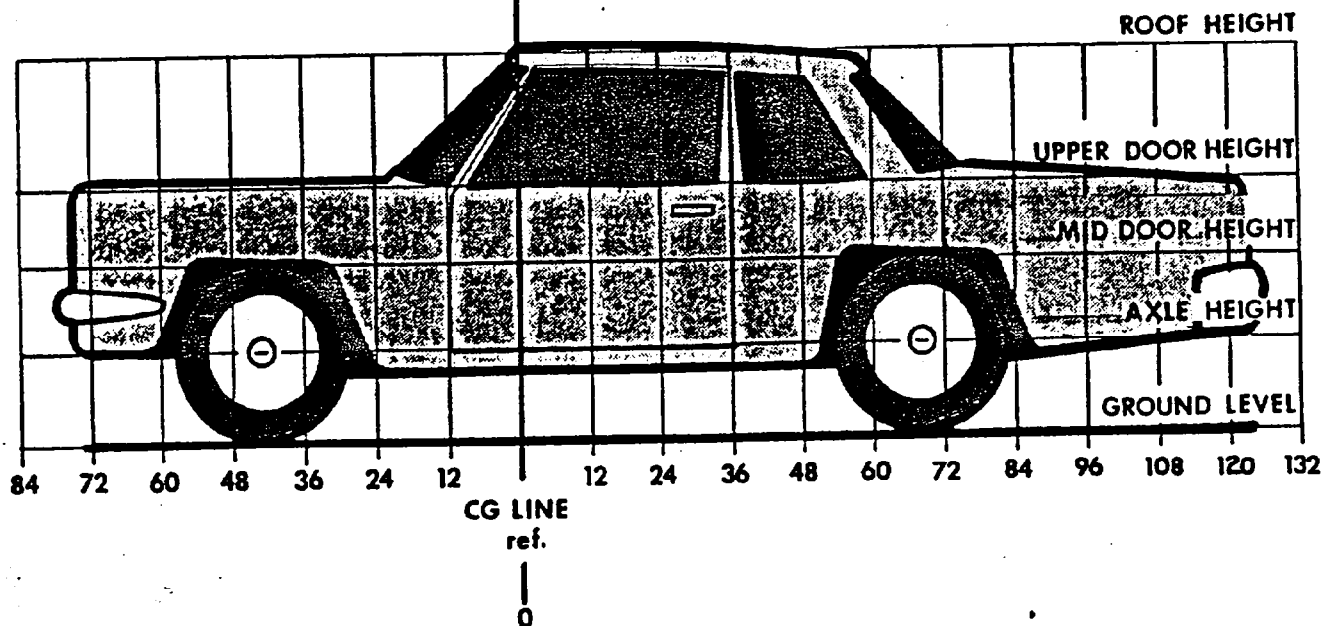
VEHICLE INTERIOR MEASUREMENTS

<u>DESCRIPTION</u>	<u>PRE</u>	<u>POST</u>	<u>DIFF</u>
Floor board to top of left "A" post	38.2	31.8	6.4
Floor board to top of right "A" post	37.9	34.6	3.3
Door sill to top of left "B" post	38.2	36.8	1.4
Door sill to top of right "B" post	38.0	37.6	0.4
Door sill to top of left door opening	37.2	32.5	4.7
Door sill to top of right door opening	37.2	36.8	0.4
Floor tunnel to windshield header	31.1	26.4	4.7
Floor tunnel to center of roof	34.6	32.1	2.5
Rear of floor tunnel to roof	34.0	33.9	0.1
Maximum width at "B" post	54.2	54.2	0.0
Maximum width at "A" post	52.8	52.8	0.0
Maximum width at top of door opening	47.2	48.0	-0.8

ALL MEASUREMENTS ARE IN INCHES



HOOD AND ROOF STATIC CRUSH LOCATIONS



LEFT AND RIGHT SIDE STATIC CRUSH LOCATIONS

**VEHICLE HOOD EXTERIOR PROFILES
ZERO DISTANCE AT VEHICLE HOOD CENTERLINE***

LOCATION	30	20	10	0	10	20	30
PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)							
Trailing edge of cowl at centerline	X	36.1	36.8	36.8	36.9	36.8	X
Trailing edge of cowl + 12 inches***	X	35.2	35.8	36.2	36.1	35.6	X
Trailing edge of cowl + 24 inches	X	33.8	34.2	34.8	34.4	34.2	X
Trailing edge of cowl + 36 inches	X	31.7	32.0	32.6	32.2	31.8	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)							
Trailing edge of cowl at centerline	X	34.1	34.6	34.4	34.4	33.8	X
Trailing edge of cowl + 12 inches	X	32.1	32.9	33.0	33.1	32.6	X
Trailing edge of cowl + 24 inches	X	29.5	30.6	31.5	31.2	30.6	X
Trailing edge of cowl + 36 inches	X	27.0	27.8	28.1	28.2	28.2	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
STATIC CRUSH (IN)							
Trailing edge of cowl at centerline	X	-2.0	-2.2	-2.4	-2.5	-3.0	X
Trailing edge of cowl + 12 inches	X	-3.1	-2.9	-3.2	-3.0	-3.0	X
Trailing edge of cowl + 24 inches	X	-4.3	-3.6	-3.3	-3.2	-3.6	X
Trailing edge of cowl + 36 inches	X	-4.7	-4.2	-4.5	-4.0	-3.6	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X

- * Column readings are left to right from left to right on vehicle.
- ** Reference plane is a horizontal plane at ground level.
- ***Longitudinal distance from trailing edge of cowl at centerline forward to measurement plane.
- + Static crush means vehicle structure is bowed upward.
- Static crush means vehicle structure is crushed.

**VEHICLE ROOF EXTERIOR PROFILES
ZERO DISTANCE AT VEHICLE ROOF CENTERLINE***

LOCATION	20	10	0	10	20
PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	X	50.6	50.7	51.0	X
Longitudinal Center of Gravity + 12 inches***	51.4	52.2	52.2	52.8	52.3
Longitudinal Center of Gravity + 24 inches	52.1	52.7	53.1	53.1	52.9
Longitudinal Center of Gravity + 36 inches	51.9	52.6	52.9	52.9	52.8
Longitudinal Center of Gravity + 48 inches	51.1	51.8	52.0	52.3	52.8
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	X	43.9	45.1	46.2	X
Longitudinal Center of Gravity + 12 inches	44.6	46.8	47.6	48.0	49.5
Longitudinal Center of Gravity + 24 inches	47.8	48.4	49.1	50.6	50.5
Longitudinal Center of Gravity + 36 inches	49.8	51.5	52.1	52.4	51.2
Longitudinal Center of Gravity + 48 inches	49.1	50.0	51.1	52.0	51.6
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X
STATIC CRUSH (IN)					
Longitudinal Center of Gravity	X	-6.7	-5.6	-4.8	X
Longitudinal Center of Gravity + 12 inches	-6.8	-5.4	-4.6	-4.8	-2.8
Longitudinal Center of Gravity + 24 inches	-4.3	-4.3	-4.0	-2.5	-2.4
Longitudinal Center of Gravity + 36 inches	-2.1	-1.1	-0.8	-0.5	-1.6
Longitudinal Center of Gravity + 48 inches	-2.0	-1.8	-0.9	-0.3	-1.2
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X

- * Column readings are left to right from left to right on vehicle.
- ** Reference plane is a horizontal plane at ground level.
- ***Longitudinal distance from center of gravity rearward to measurement plane.
- Static crush means vehicle structure is bowed upward.
- Static crush means vehicle structure is crushed.

VEHICLE LEFT SIDE EXTERIOR PROFILES AND STATIC CRUSH
ZERO DISTANCE AT VEHICLE LONGITUDINAL CENTER OF GRAVITY*

LOCATION	HEIGHT(IN)	72	60	48	36	24	12	0	12	24	36	48	60	72	84	9
<u>PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)</u>																
Roof Height	52.2	X	X	X	X	X	X	24.2	24.8	24.5	24.5	24.6	X	X	X	X
Upper Door	33.1	X	X	17.6	17.1	16.8	16.8	16.5	17.0	16.5	16.9	16.5	17.1	17.8	18.6	
Mid Door	24.5	X	16.6	X	X	16.1	14.6	14.4	14.6	14.8	15.0	14.9	X	16.2	17.1	
Axle Height	11.2	X	X	X	X	17.9	17.6	17.5	17.6	17.4	17.8	X	X	X	X	

POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)

Roof Height	52.2	X	X	X	X	X	X	24.3	25.5	25.8	25.8	25.5	X	X	X	
Upper Door	33.1	X	X	18.5	17.4	17.1	16.2	15.8	15.5	15.6	17.0	17.1	17.4	17.8	18.8	
Mid Door	24.5	X	16.6	X	X	15.5	14.7	14.4	14.4	14.5	14.8	15.4	X	16.2	17.0	
Axle Height	11.2	X	X	X	X	18.2	17.8	17.5	17.3	17.4	17.5	X	X	X	X	

STATIC CRUSH (IN)

Roof Height	52.2	X	X	X	X	X	X	0.1	0.7	1.3	1.3	0.9	X	X	X	
Upper Door	33.1	X	X	0.9	0.3	0.3	-0.6	-0.7	-1.5	-0.9	0.1	0.6	0.3	0.0	0.2	
Mid Door	24.5	X	0.0	X	X	-0.6	0.1	0.0	-0.2	-0.3	-0.2	0.5	X	0.0	-0.1	
Axle Height	11.2	X	X	X	X	0.3	0.2	0.0	-0.3	0.0	-0.3	X	X	X	X	

* Center of gravity is located 42.3 inches rearward of vehicle front wheels. Column readings are left to right from front to rear on vehicle.

** Reference plane is parallel to and 48 inches from the vehicle longitudinal centerline.

+ Static crush means that vehicle structure is crushed.

- Static crush means that vehicle structure is bowed outward.

VEHICLE RIGHT SIDE EXTERIOR PROFILES AND STATIC CRUSH
ZERO DISTANCE AT VEHICLE LONGITUDINAL CENTER OF GRAVITY*

LOCATION	HEIGHT(IN)	72	60	48	36	24	12	0	12	24	36	48	60	72	84	96
<u>PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)</u>																
Roof Height	52.2	X	X	X	X	X	X	24.1	24.8	25.1	24.8	25.1	X	X	X	X
Upper Door	33.1	X	X	17.5	17.0	16.6	17.1	16.8	16.2	16.5	16.8	16.8	17.1	18.4	18.4	X
Mid Door	24.5	X	16.6	X	X	15.3	14.8	14.8	14.5	14.8	15.2	15.2	X	16.6	17.1	X
Axle Height	11.2	X	X	X	X	17.9	17.8	17.7	17.6	17.6	17.9	X	X	X	X	X

POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)

Roof Height	52.2	X	X	X	X	X	X	23.8	24.4	25.4	26.0	26.3	X	X	X	X
Upper Door	33.1	X	X	18.6	18.1	18.0	17.4	17.2	16.9	16.7	16.8	17.2	17.5	18.1	18.7	X
Mid Door	24.5	X	17.5	X	X	15.8	15.4	15.1	15.2	15.3	15.4	15.5	X	16.6	17.2	X
Axle Height	11.2	X	X	X	X	18.5	18.4	18.2	17.9	17.9	18.0	X	X	X	X	X

STATIC CRUSH (IN)

Roof Height	52.2	X	X	X	X	X	X	-0.3	-0.4	0.3	1.2	1.2	X	X	X	X
Upper Door	33.1	X	X	1.1	1.1	1.4	0.3	0.4	0.7	0.2	0.0	0.4	0.4	-0.3	0.3	X
Mid Door	24.5	X	0.9	X	X	0.5	0.6	0.3	0.7	0.5	0.2	0.3	X	0.0	0.1	X
Axle Height	11.2	X	X	X	X	0.6	0.6	0.5	0.3	0.3	0.1	X	X	X	X	X

* Center of gravity is located 42.3 inches rearward of vehicle front wheels. Column readings are left to right from front to rear on vehicle.

** Reference plane is parallel to and 48 inches from the vehicle longitudinal centerline.

+ Static crush means that vehicle structure is crushed.

- Static crush means that vehicle structure is bowed outward.

IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: Pontiac/Grand Am TEST NUMBER: 891129

NO.	TYPE OF MEASUREMENT	DIMENSIONS IN INCHES		
		PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	180.2	180.0	0.2
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	150.2	150.2	0.0
X3	REAR SURFACE OF VEHICLE TO FIREWALL	129.0	129.2	-0.2
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	118.8	119.3	-0.5
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	119.0	119.5	-0.5
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	118.0	117.7	0.3
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	118.0	117.8	0.2
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	68.2	68.8	-0.6
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	68.2	68.8	-0.6
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	67.5	67.2	0.3
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	67.4	67.0	0.4
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	117.0	116.5	0.5
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	117.0	116.6	0.4
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	126.0	126.5	-0.5
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	126.2	127.1	-0.9
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	102.0	102.1	-0.1
X17	CENTER OF STEERING COLUMN TO "A" POST	15.8	13.9	1.9
X18	CENTER OF STEERING COLUMN TO HEADLINER	16.9	12.4	4.5
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	174.0	173.9	0.1
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	174.0	174.2	-0.2
X21	LENGTH OF ENGINE BLOCK	20.0	20.0	0.0

SECTION 3.0

GENERAL TEST AND VEHICLE PARAMETER DATA

The following data sheets describe the General Test and Vehicle Parameter Data.

TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: General Motor Corporation

MAKE/MODEL: Pontiac/Grand Am

VIN: 1G2NE14U5KC729045

BODY STYLE: 2-door coupe

MODEL YEAR: 1989

NHTSA NO.: NA

COLOR: Red

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

TRANSMISSION DATA: 5 SPEED, X MANUAL, AUTOMATIC, X FWD, RWD, 4WD

DATE VEHICLE RECEIVED: 10/30/89

ODOMETER READING: 53

DEALER'S NAME AND ADDRESS: Dennis Pontiac
2900 Morse Road
Columbus, Ohio

ACCESSORIES:

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

REMARKS:

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

DATA FROM CERTIFICATION LABEL ON LEFT DOOR FACE OR "B" POST:

VEHICLE MANUFACTURED BY: General Motor Corporation

DATE OF MANUFACTURE: 2/89

GVWR: 3440 LBS

GAWR: FRONT 1889 LBS., REAR 1551 LBS.

*Left and right front door side glazing was replaced with an experimental Bilayer type designed to help prevent occupant ejection through side windows. The glazing inside surface was covered with a multilayer plastic sheet that extended beyond the window edges and was fastened to the door frame on the top and the sides. During impact the plastic acts as a stretchable barrier that prevents ejection while also limiting head and neck loading. Also the windshield was replaced and has the same material.

TEST VEHICLE INFORMATION CONT'D

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL ON DOOR, POST, GLOVEBOX, ETC.

VEHICLE LOAD (UP TO CAPACITY): FRONT 35 psi; REAR 35 psi

RECOMMENDED TIRE SIZE: P185/80R13 LOAD RANGE X B C D

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear Ameri-Tech P185/85R13

IS SPARE TIRE A "SPACE SAVER": Yes

IS SPARE TIRE STANDARD EQUIPMENT: Yes

VEHICLE CAPACITY: TYPES OF SEATS: FRONT: Bucket, adjustable
REAR: Bench

TYPE OF FRONT SEAT BACKS:

*NUMBER OF OCCUPANTS 2 FRONT 3 REAR 5 TOTAL

**CARGO LOAD 132 LBS. TOTAL 882 LBS.

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

RIGHT FRONT 820 lbs. RIGHT REAR 420 lbs.

LEFT FRONT 800 lbs. LEFT REAR 460 lbs.

TOTAL FRONT WEIGHT 1620 lbs. (64.8% OF TOTAL VEHICLE WEIGHT)

TOTAL REAR WEIGHT 880 lbs. (35.2% OF TOTAL VEHICLE WEIGHT)

TOTAL DELIVERED WEIGHT 2500 lbs.

CALCULATION FOR TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (2500 LBS)

VCW = VEHICLE CAPACITY WEIGHT (882 LBS)

DSC = DESIGNATED SEATING CAPACITY (5)

RCLW = VCW - 150 (DCS) = 882 - 150 (5) = 132 LBS

TARGET TEST WEIGHT = UDW + RCLW + (1 DUMMY X 167 LBS/DUMMY)

= 2500 + 132 + 167 LBS

TARGET TEST WEIGHT = 2799 LBS

TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 187 LBS. CARGO

RIGHT FRONT	806 lbs.	RIGHT REAR	551 lbs.
LEFT FRONT	860 lbs.	LEFT REAR	602 lbs.
TOTAL FRONT WEIGHT	1666 lbs.	(59.1% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1153 lbs.	(40.9% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	2819 lbs.	(0.7% OVER TARGET WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE TRUNK AREA: 30 LBS.

COMPONENTS REMOVED TO MEET TARGET WEIGHT: None

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	LF 26.8	; RF 27.0	; LR 28.5	; RR 28.8
PRE-TEST ATTITUDE:	LF 26.3	; RF 26.8	; LR 25.8	; RR 26.6
POST-TEST ATTITUDE:	LF 27.3	; RF 23.9	; LR 27.5	; RR 24.5

WHEELBASE: 103.5 INCHES

CG = 42.3 INCHES REARWARD OF FRONT WHEEL CENTERLINE

VEHICLE REBOUND AND CRUSH (ALL DIMENSIONS IN INCHES):

OVERALL LENGTH OF TEST VEHICLE:	PRE-TEST:	L 174.0	; C 180.2	; R 174.0
	POST-TEST:	L 174.2	; C 180.0	; R 173.9
	TOTAL CRUSH:	L -0.2	; C 0.2	; R 0.1

TEST CONDITIONS

TEST NUMBER: 891129

DATE OF TEST: 11/29/89

TIME OF TEST: 1330

WIND VELOCITY: NA

HUMIDITY: NA

AMBIENT TEMPERATURE AT IMPACT AREA: 28°F

TEMPERATURE IN OCCUPANT COMPARTMENT: 55°F

DRIVER DUMMY TEMPERATURE: 65°F

SUBJECT VEHICLE DATA

	<u>ACTUAL</u>	<u>INTENDED</u>
TEST WEIGHT (lbs.)	2819	2799
VEHICLE ORIENTATION (deg.) YAW*	270	270
VEHICLE ORIENTATION (deg.) ROLL**	30	30
VEHICLE VELOCITY (mph)	Y	30

DUMMIES

RIGHT FRONT PASSENGER

TYPE:	Part 572E
SERIAL NO.:	245
INSTRUMENTATION:	
HEAD ACCEL.:	3
NECK L.C.'C.:	6
CHEST ACCEL.:	3
PELVIS ACCEL.:	3
CHEST DISPLACEMENT	1
POTENTIOMETER:	
RESTRAINT SYSTEM:	3-point unbelt

REMARKS:

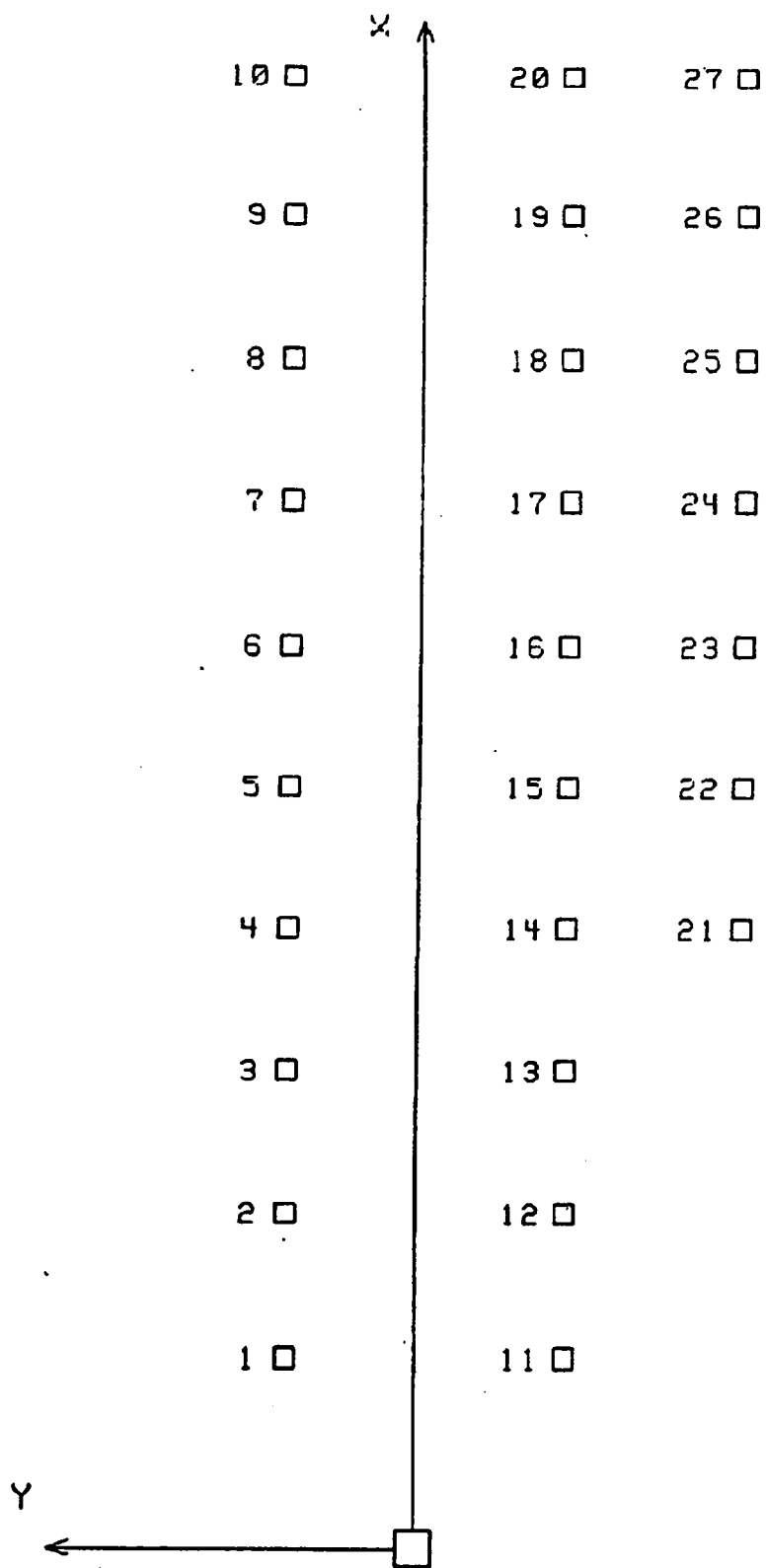
*AS MEASURED CLOCKWISE FROM THE DIRECTION OF TRAVEL.

**AS MEASURED FROM THE HORIZONTAL.

Y See TEST ANOMALIES

VEHICLE DATA SUMMARY

Y See TEST ANOMALIES



STADIA POLE LAYOUT AND NUMBERING SYSTEM

STADIA POLE LOCATIONS

<u>POLE NO.</u>	<u>X DISTANCE, FT. *</u>	<u>Y DISTANCE, FT. *</u>
1	34.0	8.0
2	42.0	8.0
3	50.0	8.0
4	58.0	8.0
5	66.0	8.0
6	74.0	8.0
7	82.0	8.0
8	90.0	8.0
9	98.0	8.0
10	106.0	8.0
11	34.0	-8.0
12	42.0	-8.0
13	50.0	-8.0
14	58.0	-8.0
15	66.0	-8.0
16	74.0	-8.0
17	82.0	-8.0
18	90.0	-8.0
19	98.0	-8.0
20	106.0	-8.0
21	58.0	-18.0
22	66.0	-18.0
23	74.0	-18.0
24	82.0	-18.0
25	90.0	-18.0
26	98.0	-18.0
27	106.0	-18.0

*REFERENCE: +X: FORWARD FROM RELEASE BLOCK

+Y: LEFTWARD FROM CENTER RELEASE BLOCK

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right panning	Kodak	16	24	Real Time
2	Left wide	Photosonic 1B	25	498	Vehicle Kinematics
3	Left mid	Photosonic 1B	13	510	Vehicle Kinematics
4	Left angle	Photosonic 1B	25	495	Vehicle Kinematics
5	Front wide	Photosonic 1B	50	502	Vehicle Kinematics
6	Onboard - rear left	Photosonic 1B	8	505	Dummy Kinematics
7	Onboard - rear right	Photosonic 1B	8	500	Dummy Kinematics
8	Onboard - floor	Photosonic 1B	8	495	Dummy Kinematics
9	Documentary	Bealieu	12-120	24	Pre-test and Post-test Documentation

HIGH SPEED CAMERA INFORMATION

GROUND LEVEL

CAMERA NO.	X* (ft.)	Y* (ft.)	Z* (ft.)
2	107.6	420.8	5.0
3	107.6	195.0	5.1
4	240.8	81.9	3.8
5	221.2	0.4	2.5

*Reference:

- +X = Forward from release block
- +Y = Leftward from center release block
- +Z = Upward from ground level

ONBOARD

CAMERA NO.	X**(inch)	Y**(inch)	Z**(inch)
6	-56.9	34.0	33.1
7	-56.0	24.4	33.4
8	-3.0	15.0	9.0

**Reference:

- +X = Forward from dash panel
- +Y = Leftward from the right door sill
- +Z = Upward from the vehicle floor level

SECTION 4.0

OCCUPANT INFORMATION

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #245	PASSENGER #NA
Head	<u>Roof</u>	<u>NA</u>
Chest	<u>None</u>	<u>NA</u>
Abdomen	<u>None</u>	<u>NA</u>
Left knee	<u>Steering wheel and left door padding</u>	<u>NA</u>
Right knee	<u>Steering wheel</u>	<u>NA</u>

DOOR OPENING:

	LEFT	RIGHT
Front	<u>Easy</u>	<u>Easy</u>
Rear	<u>NA</u>	<u>NA</u>

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
Front	<u>None</u>	<u>None</u>
Rear	<u>NA</u>	<u>NA</u>

GLAZING DAMAGE:

The entire windshield was cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS:

The left front door glass was cracked. The left and right rear glass was broken upon impact.

DUMMY KINEMATIC SUMMARY

Passenger Dummy

Upon the vehicle's impact with the ground, the driver dummy's head struck the roof continuously. As the vehicle rolled onto its roof, the dummy's head remained in contact with the roof and the dummy's upper torso remained near the right door. The vehicle came to rest on its roof with the driver dummy's head resting against the roof. The dummy was restrained with three-point unbelt.

DUMMY DATA SUMMARY

TEST NUMBER 891129

DRIVER DUMMY

SN: 245

POSITIVE DIRECTION		NEGATIVE DIRECTION	
MAX	SEC	MAX	SEC

HEAD ACCELERATION (g)

LONGITUDINAL	12.8	3.5	12.2	3.8
LATERAL	10.2	3.8 Y	32.2	3.8 Y
VERTICAL	11.7	3.8 Y	77.9	3.8 Y
RESULTANT	85.2	3.8 Y		
HIC 36 MSEC	88.8 FROM 3.780 TO 3.783			

NECK FORCES (lbs)

LONGITUDINAL	152.9	3.8	59.4	3.8
LATERAL	31.7	2.9	154.6	3.8
VERTICAL	66.4	2.7	1530.9	3.8

NECK MOMENT (in-lbs)

ABOUT LONG.	11.4	2.8	65.1	3.8
ABOUT LATERAL	29.1	3.8	6.9	2.7
ABOUT VERTICAL	2.4	2.5	19.7	3.9

CHEST ACCELERATION (g)

LONGITUDINAL	5.7	3.8	14.5	3.8
LATERAL	6.0	2.7	6.6	3.8
VERTICAL	4.9	0.4	30.3	3.8
RESULTANT	33.6	3.8		
3 MSEC	25.1 FROM 3.782 TO 3.785			

CHEST DISPLACEMENT (in)

LONGITUDINAL	0.0	3.8	0.1	4.0
--------------	-----	-----	-----	-----

PELVIS ACCELERATION (g)

LONGITUDINAL	5.9	2.4	10.6	3.9
LATERAL	5.7	2.9	8.8	3.9
VERTICAL	4.3	2.6	23.2	3.8
RESULTANT	23.4	3.8		

POSITIVE DIRECTION

LONGITUDINAL: FORWARD
LATERAL: LEFTWARD
VERTICAL: UPWARD
FORCE: OUTWARD

NEGATIVE DIRECTION

LONGITUDINAL: REARWARD
LATERAL: RIGHTWARD
VERTICAL: DOWNWARD
FORCE: INWARD

See APPENDIX D for neck load cell polarities.

γSee TEST ANOMALIES

DUMMY TEMPERATURE CONTROL AND POSITIONING

The vehicle and dummy were left inside the temperature controlled building eight hours prior to the time the dummy was loaded into the vehicle. After the vehicle had been positioned on the rollover device it was towed outside for launch.

One Part 572E dummy was instrumented for this test. The dummy instrumentation consisted of triaxial accelerometers in the head, chest, and pelvis, a displacement potentiometer in the chest, and six (6) load cells in the neck. Prior to seating the dummy, the driver's seat was positioned in the mid-adjustment notch of the seat track. The seat back angle was fixed. The dummy was positioned in the seat using NHTSA's Notice #45 seating procedure. The H-point location of the seat was obtained by using the SAE J826 H-point machine as specified in the Notice #45. The driver dummy was restrained with three-point unbelt.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

MFR./MAKE/MODEL: Pontiac Grand AM

SEAT TYPE: Bench
 X Bucket
 Split bench

ADJUSTER TYPE: X Manual
 Power
 Non-adjustable

TECHNICIANS:

BUCKET SEAT BACK TYPE: Non-adjustable
 X Adjustable reclining

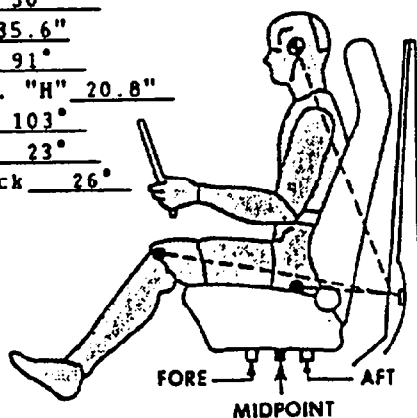
1. S. Ericksen
2. B. Miller
3.
4.

POSITIONING DATE: 11/29/89

AMBIENT TEMP. 75°F TIME: 900

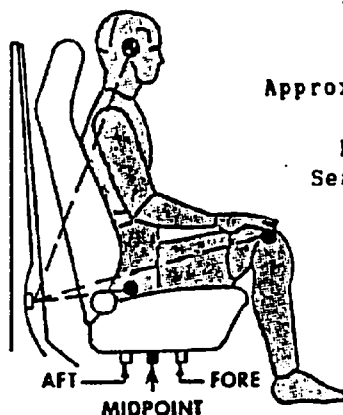
DRIVER DUMMY* # 245 TYPE: HIII

Head 25.3"
Target 30°
Knee 35.6"
Joint 91°
Approx. "H" 20.8"
Point 103°
Pelvis 23°
Seatback 26°



PASSENGER DUMMY* # NA TYPE:

Head
Target
Knee
Joint
Approx. "H"
Point
Pelvis
Seatback



A = 53.2"
B =
C = 13.5"
D =

DOOR GLASS
HEIGHT = NA

LATERAL BAR

ADJUSTABLE
POINTER

LEFT
FRONT
DOOR

DRIVER
DUMMY

PASSENGER
DUMMY

DOOR GLASS
HEIGHT = NA

RIGHT
FRONT
DOOR

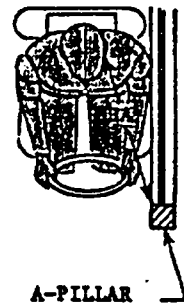
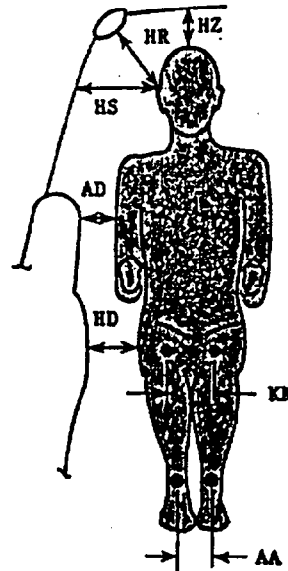
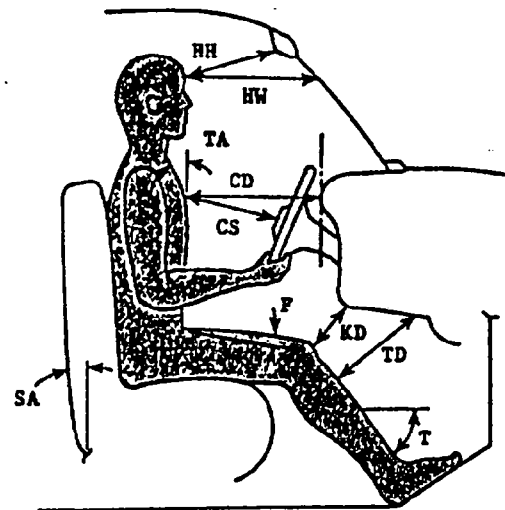
*Dummy measurements are referenced to top of striker bolt and all angles are referenced to vertical.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER	PASSENGER
HH	11.4	NA
HW	18.2	NA
CD	21.1	NA
CS	14.0	NA
KDL	5.6	NA
KDR	6.5	NA
TA	16°	NA
SA	26°	NA
HA	12.1	NA
FL	15°	NA
FR	14°	NA
TDL	4.1	NA
TDR	5.3	NA
TL	39°	NA
TR	35°	NA
HZ	2.6	NA
HR	5.8	NA
HS	9.8	NA
AD	5.1	NA
HD	4.2	NA
KK	8.5	NA
AA	9.8	NA

Knee outer clevis to outer clevis:
Driver = 10.6 Passenger = NA

HH = Head to Windshield Header
HW = Head to Windshield
CD = Chest to Dash
CS = Chest to Steering Wheel
KD = Knee to Dash
TA = Torso Angle
SA = Seat Back Angle
HA = Head to A-Pillar
FL = Femur Left
FR = Femur Right
TDL = Tibia Dash Left



TDR = Tibia Dash Right
TL = Tibia Left
TR = Tibia Right
HZ = Head to Roof
HR = Head to Side Roof
HS = Head to Side Window
AD = Arm to Door
HD = Hip to Door
KK = Knee to Knee
AA = Ankle to Ankle

Torso and seat back angles are relative to vertical.
Femur and tibia angles are relative to horizontal.
ALL DISTANCE MEASUREMENTS ARE IN INCHES.

APPENDIX A

PHOTOGRAPHS

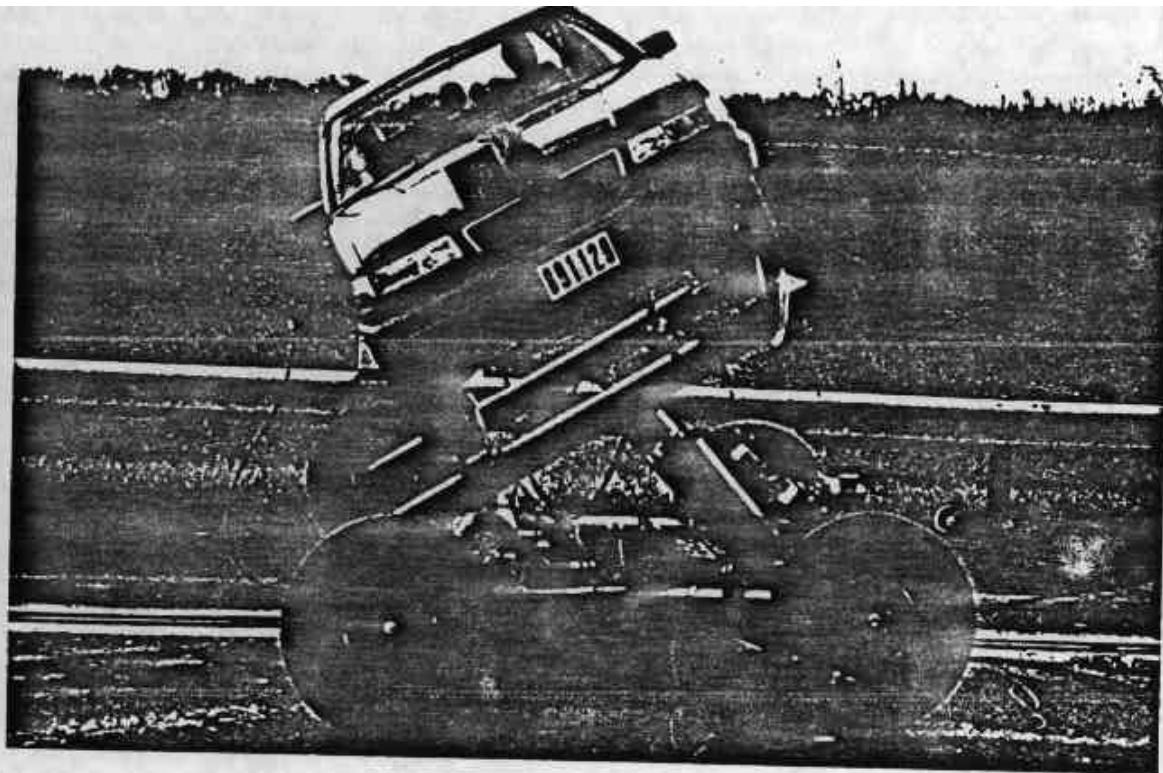


Figure A-1. PRE-TEST OVERALL FRONT VIEW

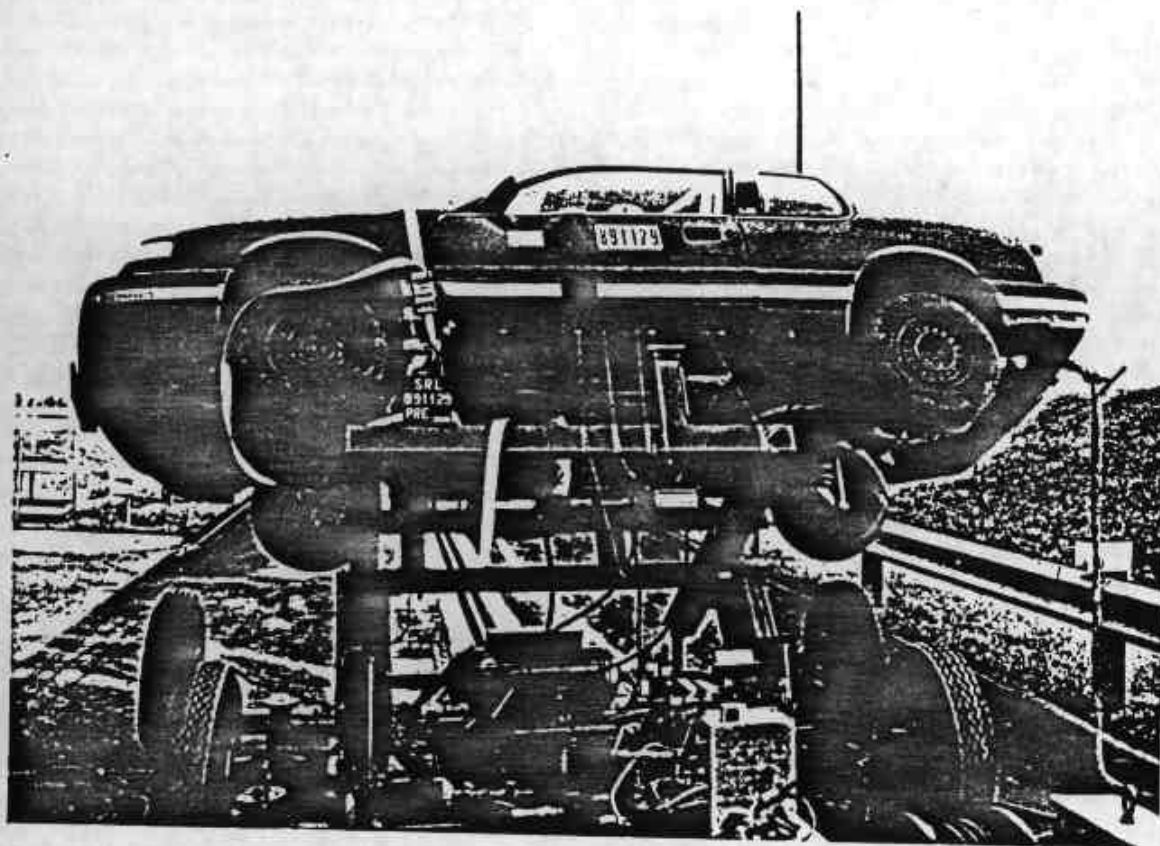


Figure A-2. PRE-TEST OVERALL LEFT VIEW

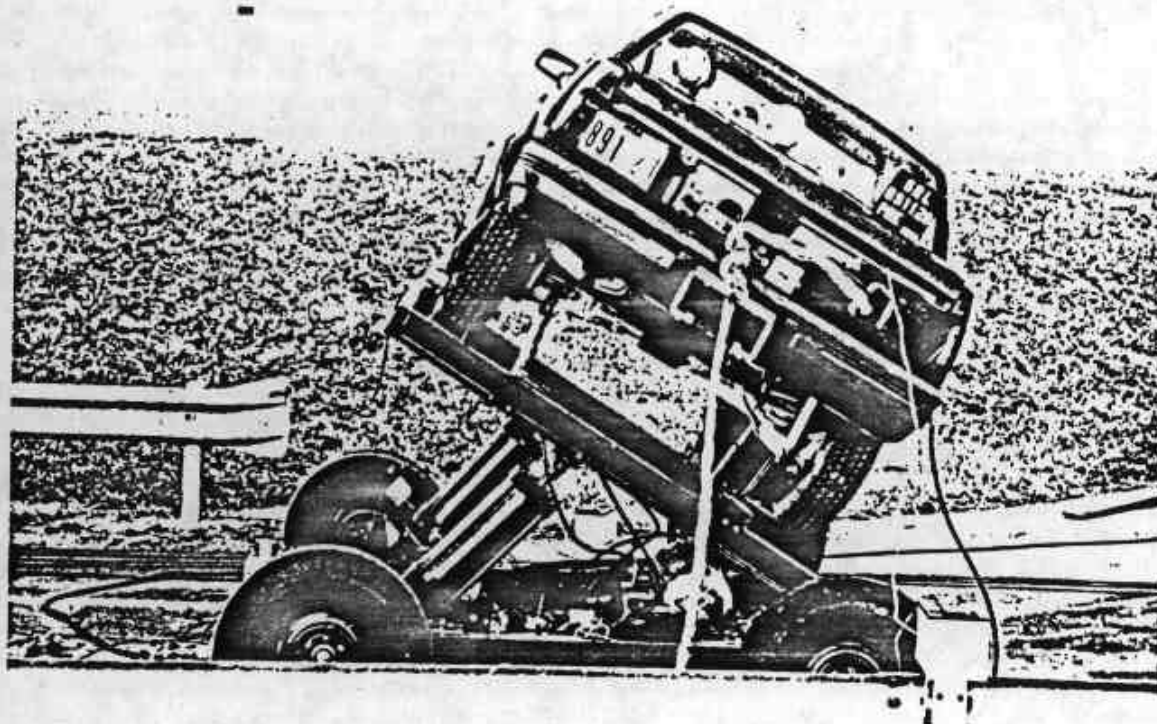


Figure A-3. PRE-TEST OVERALL REAR VIEW

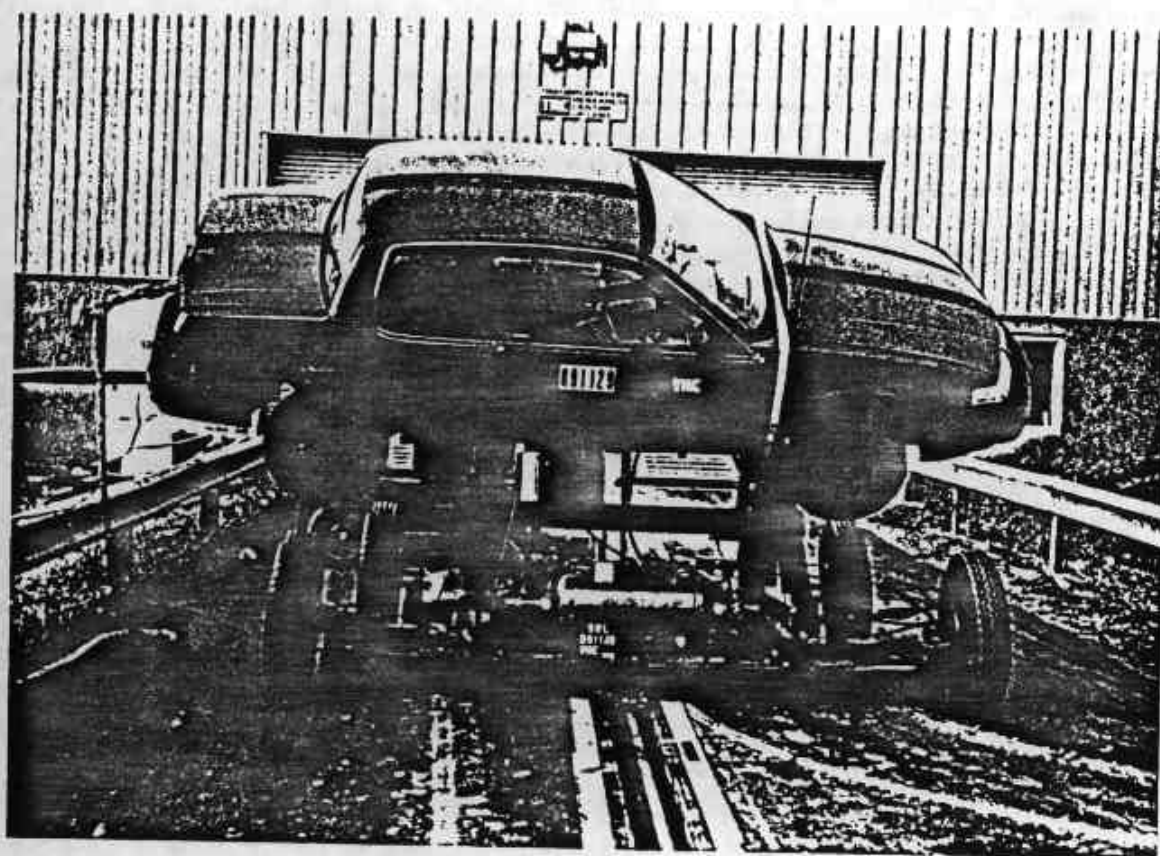


Figure A-4. PRE-TEST OVERALL RIGHT VIEW

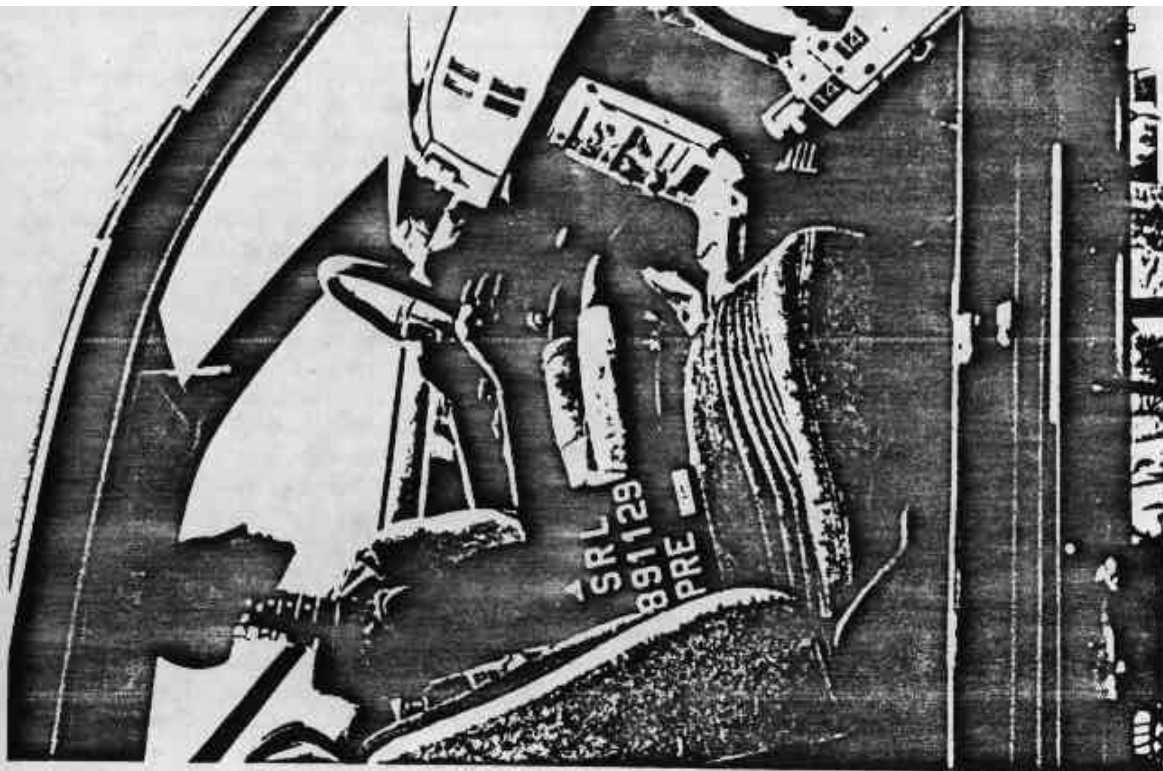


Figure A-5. PRE-TEST DRIVER DUMMY VIEW



Figure A-6. PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1

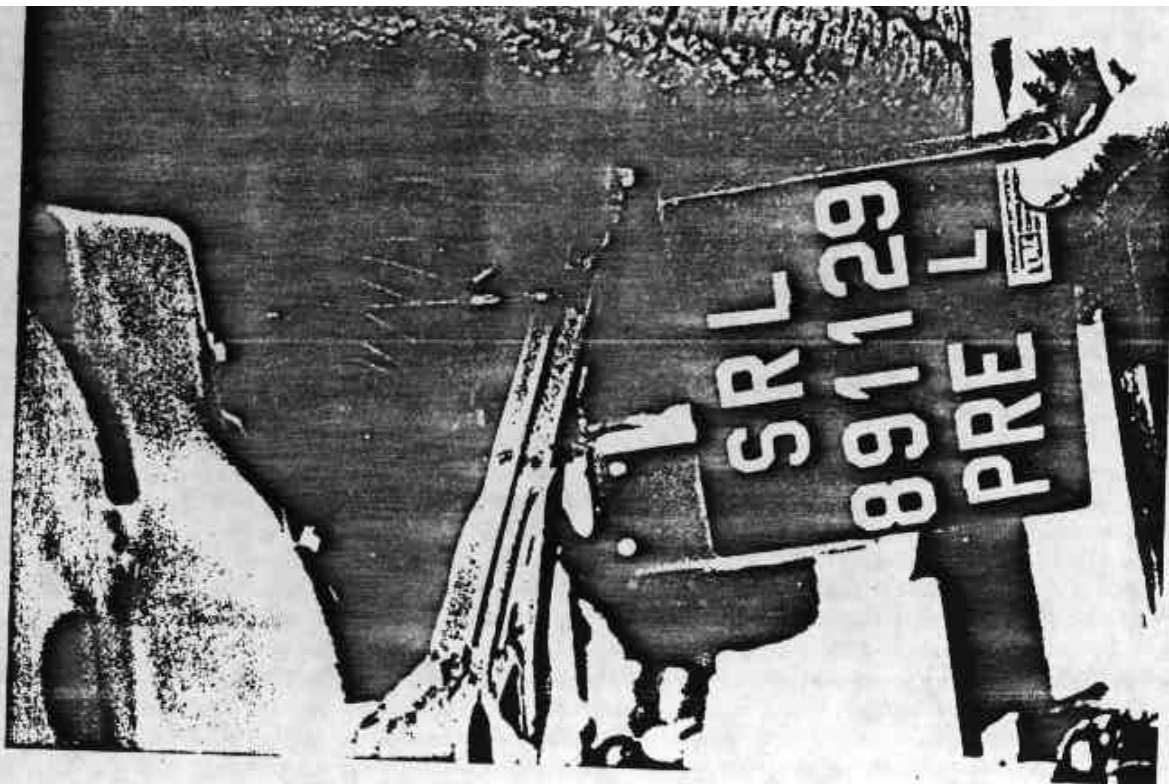


Figure A-7. PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 2



Figure A-8. PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1



Figure A-9. PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 2

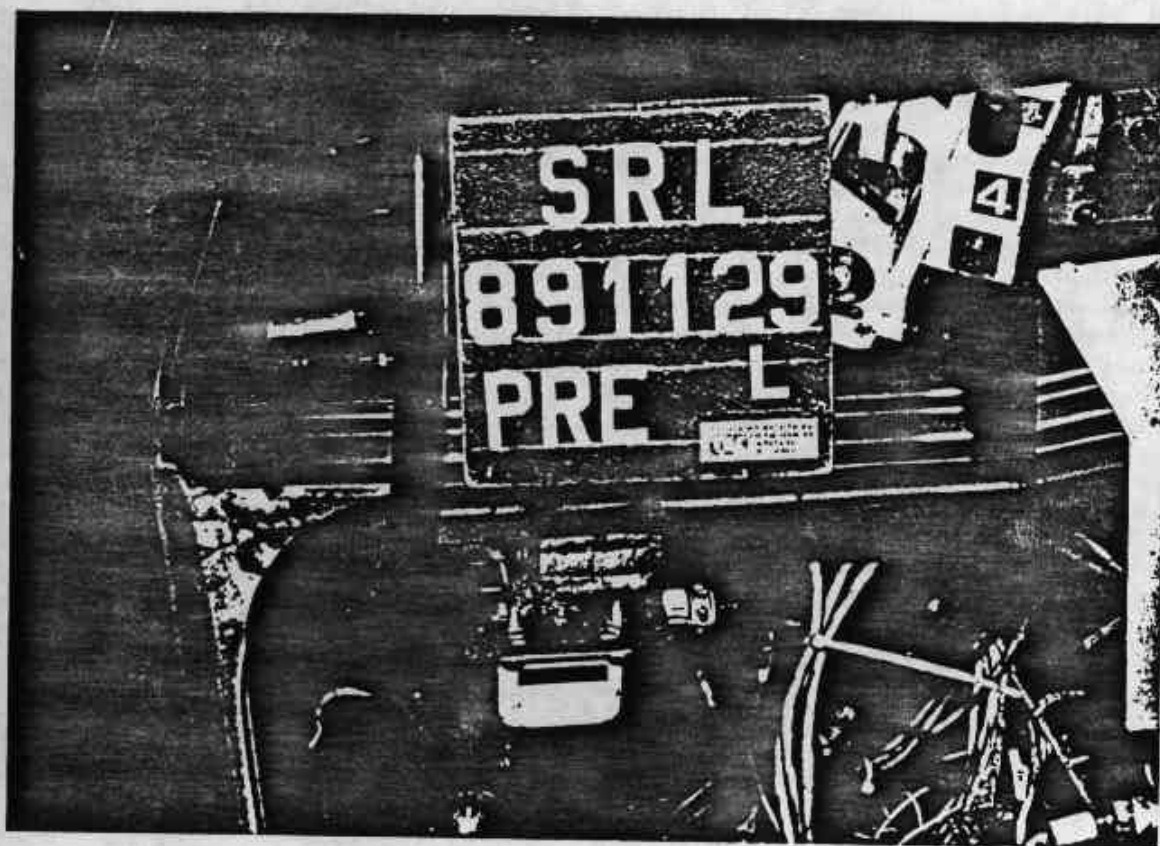


Figure A-10. PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 1



Figure A-11. PRE-TEST LEFT REAR SUSPENSION STING POTENTIOMETER - VIEW 2



Figure A-12. PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER VIEW 1



Figure A-13. PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2

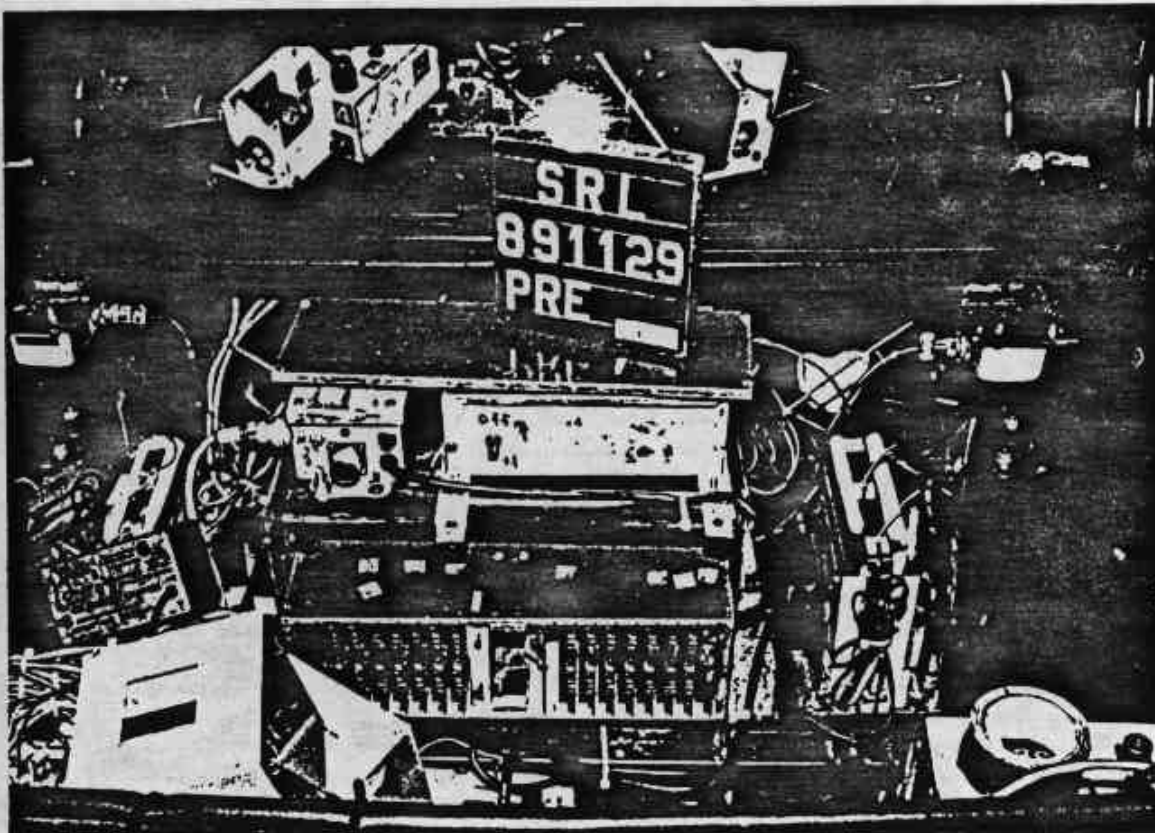


Figure A-14. PRE-TEST VEHICLE INSTRUMENTATION LOCATION



Figure A-15. PRE-TEST VEHICLE CAMERA LOCATION



Figure A-16. PRE-TEST GYRO PLACEMENT VIEW

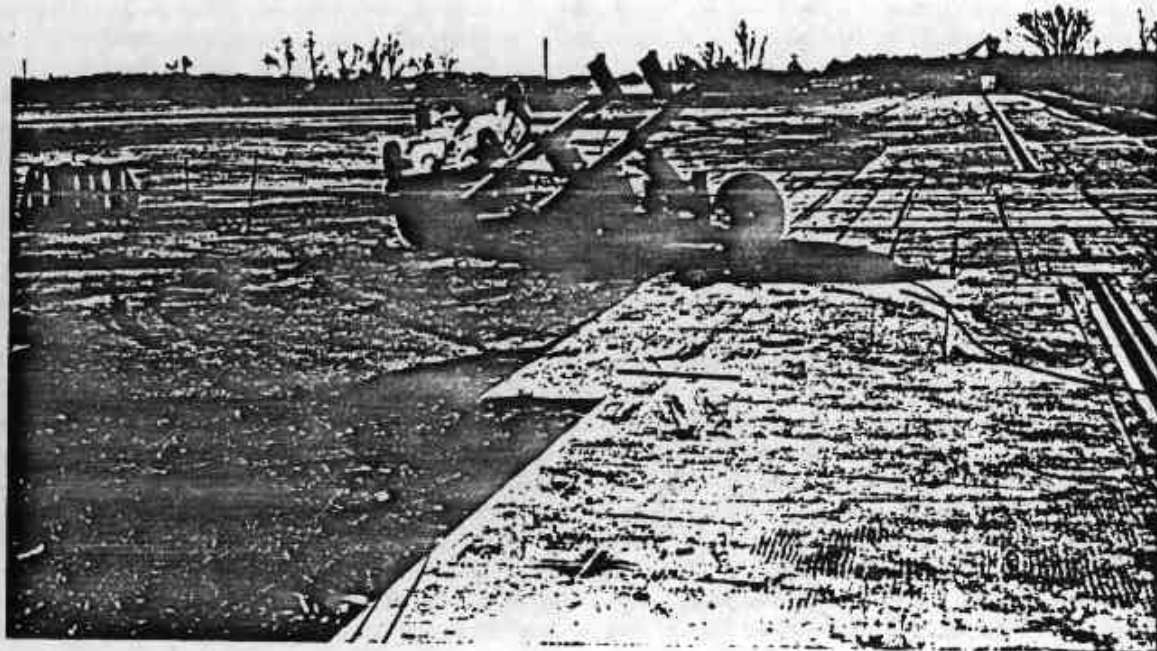


Figure A-17. POST-TEST OVERALL FRONT - VIEW 1



Figure A-18. POST-TEST OVERALL FRONT - VIEW 2

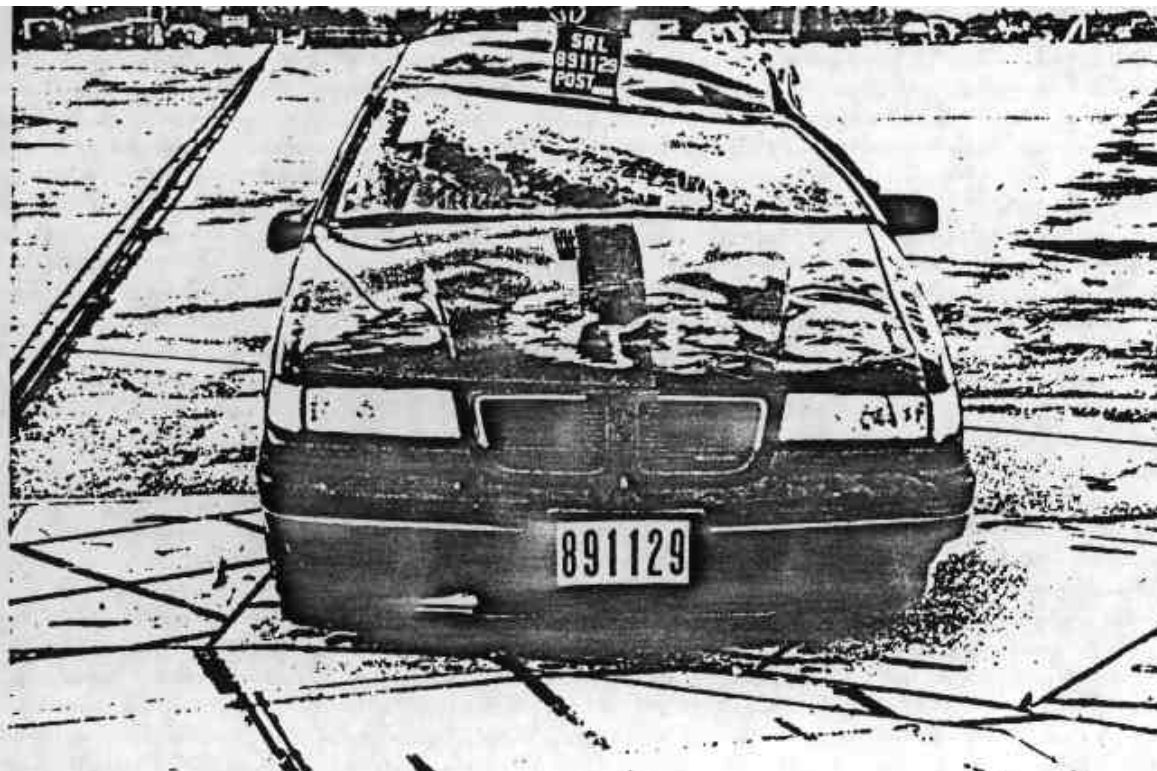


Figure A-19. POST-TEST OVERALL FRONT - VIEW 3

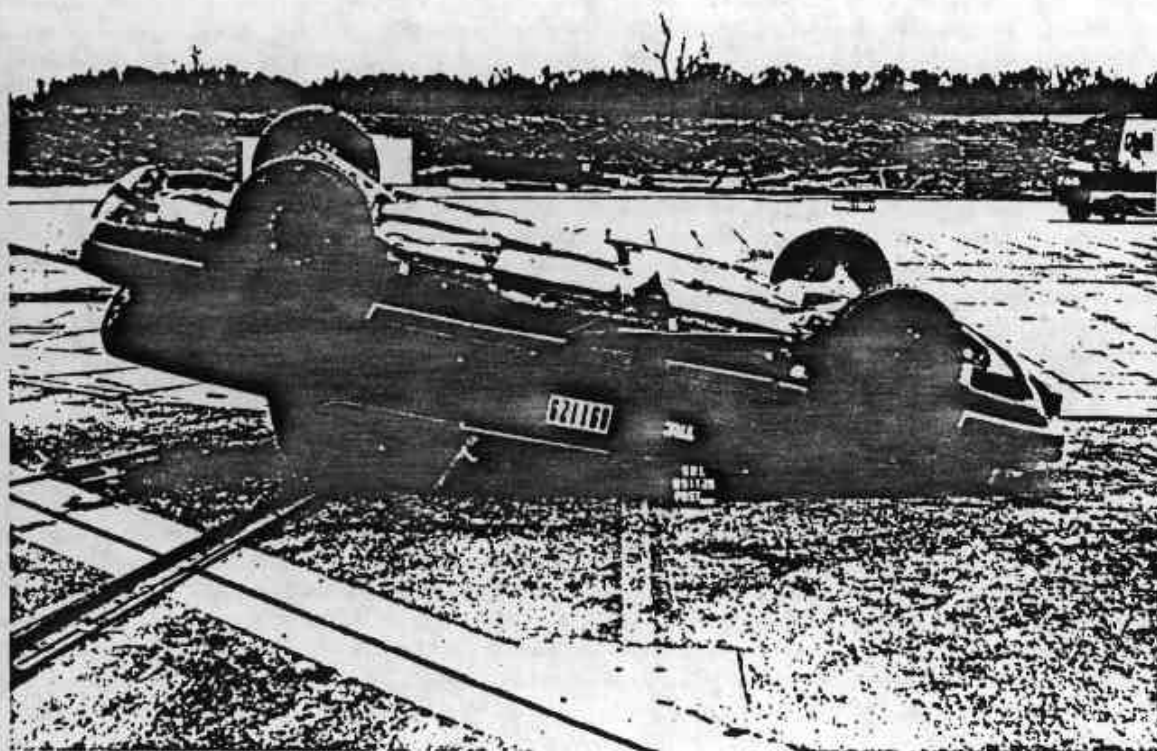


Figure A-20. POST-TEST OVERALL LEFT - VIEW 1

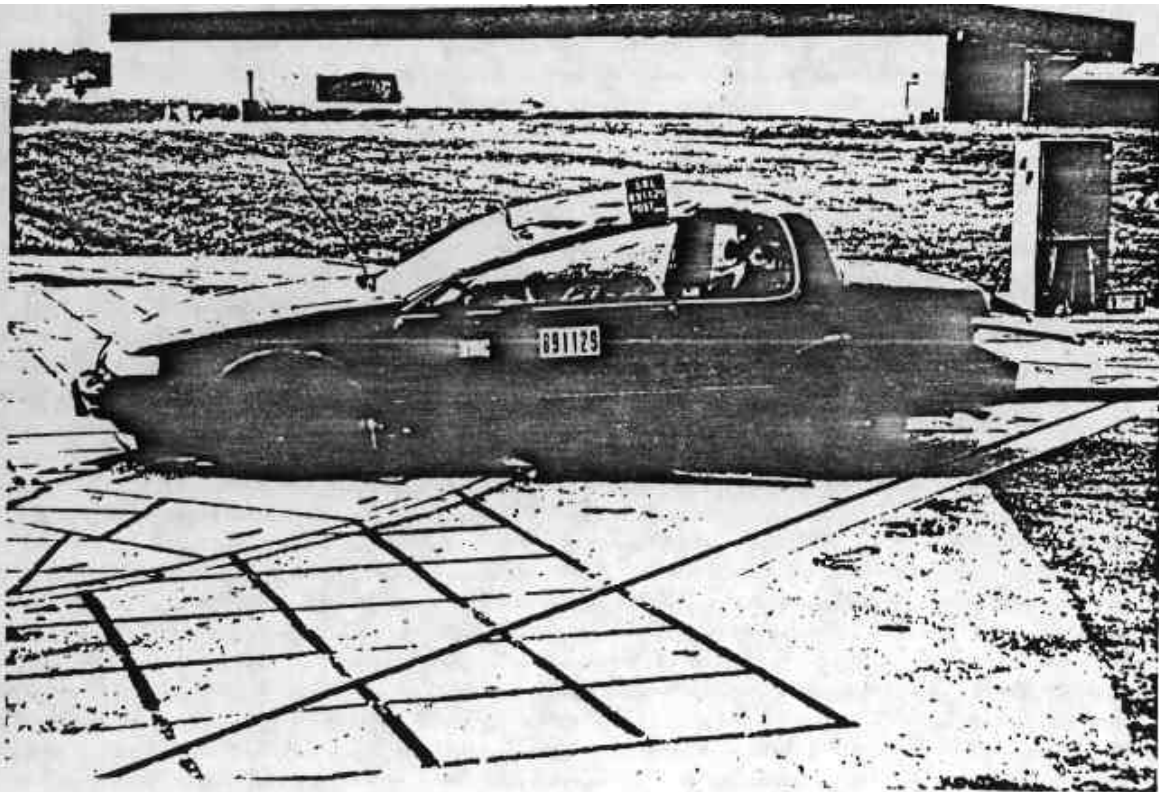


Figure A-21. POST-TEST OVERALL LEFT - VIEW 2

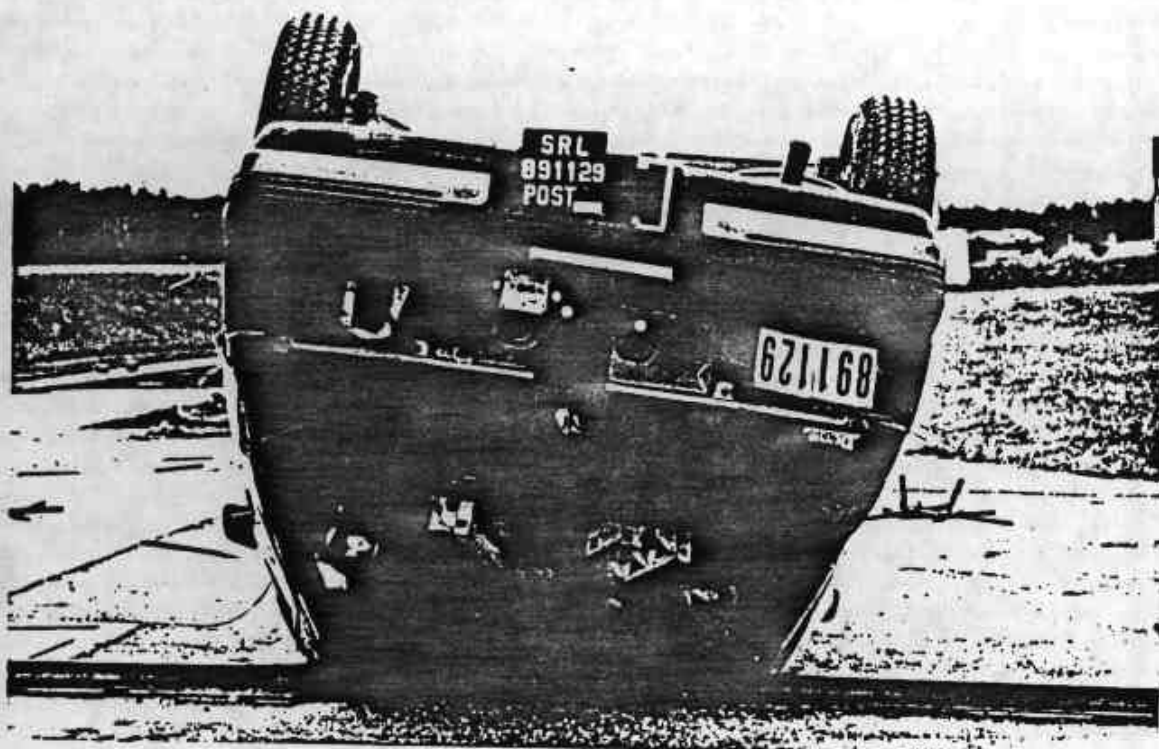


Figure A-22. POST-TEST OVERALL REAR - VIEW 1

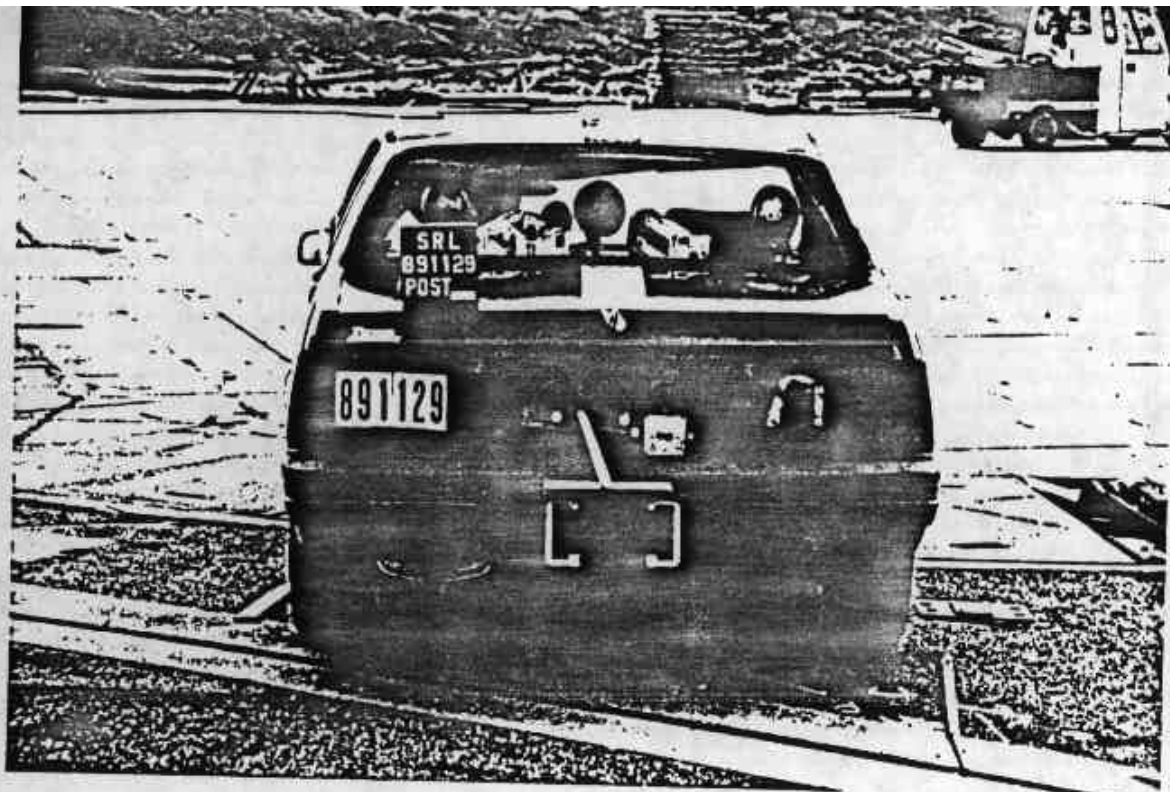


Figure A-23. POST-TEST OVERALL REAR - VIEW 2



Figure A-24. POST-TEST OVERALL RIGHT - VIEW 1



Figure A-25. POST-TEST OVERALL RIGHT - VIEW 2



Figure A-26. POST-TEST DUMMY AND VEHICLE - VIEW 1

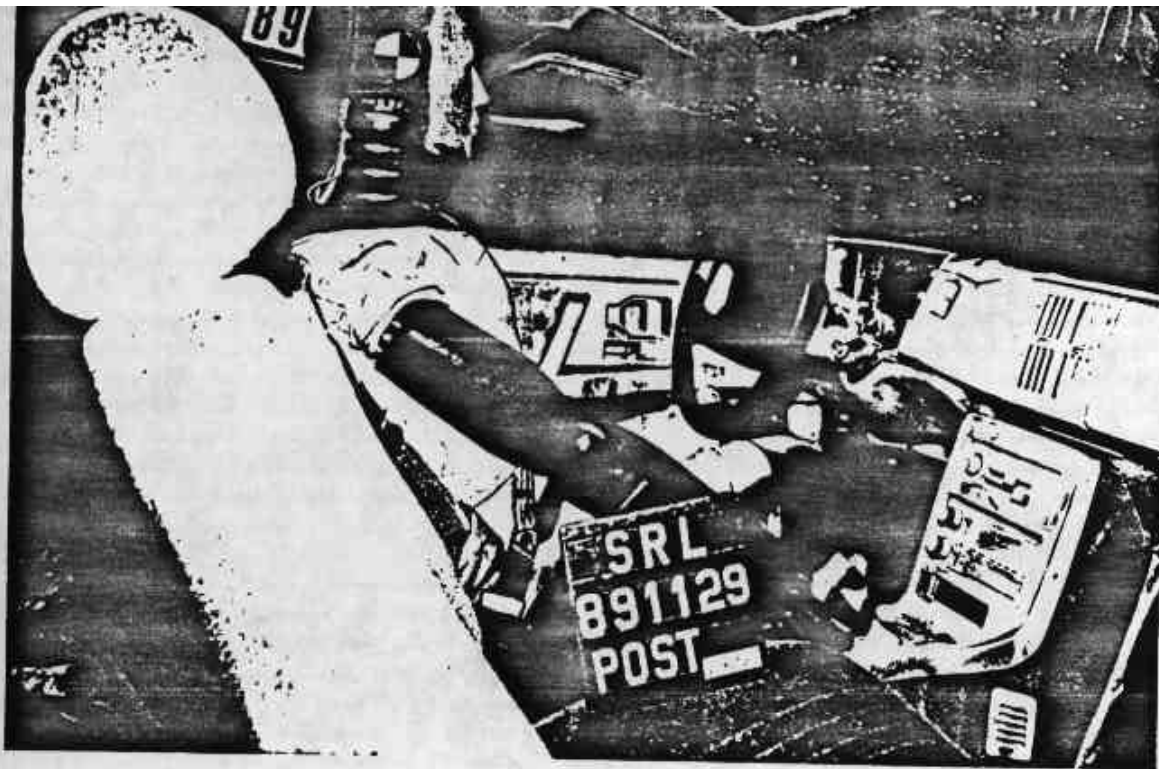


Figure A-27. POST-TEST DUMMY AND VEHICLE - VIEW 2



Figure A-28. POST-TEST VEHICLE - VIEW 1



Figure A-29. POST-TEST VEHICLE - VIEW 2

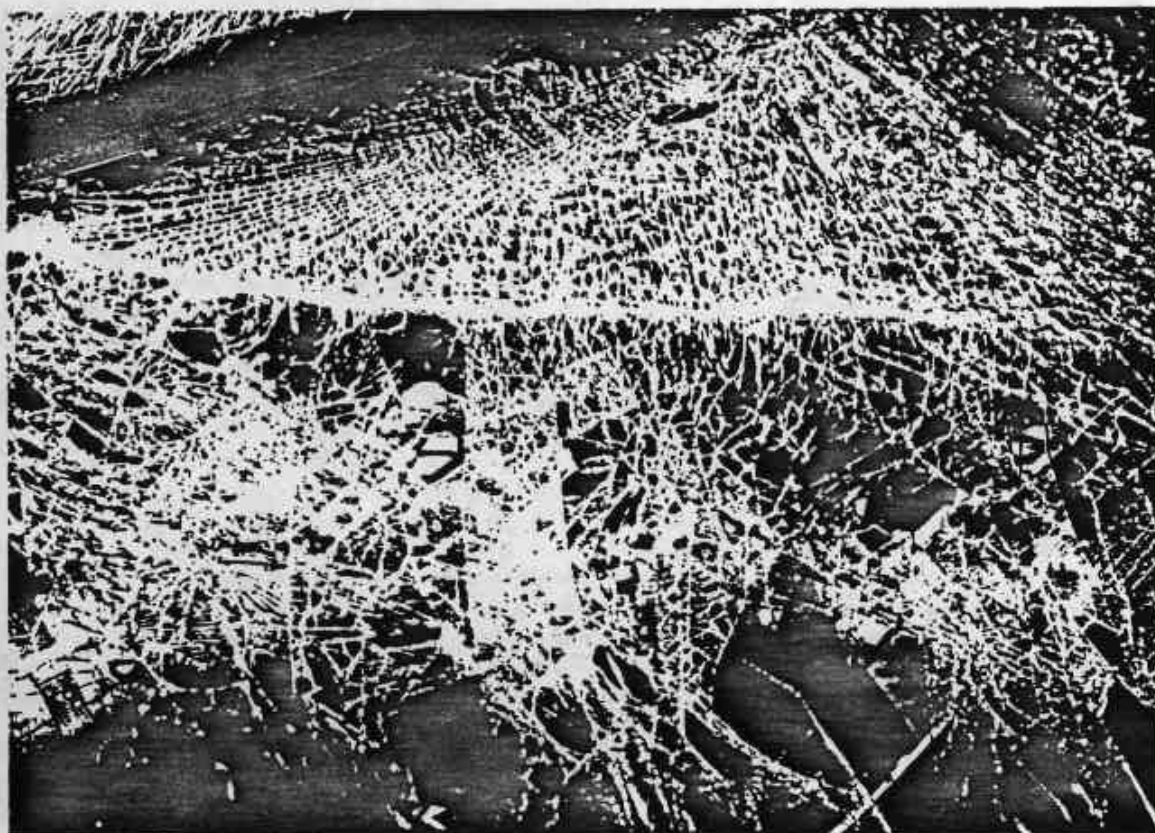


Figure A-30. POST-TEST VEHICLE - VIEW 3



Figure A-31. POST-TEST VEHICLE - VIEW 4

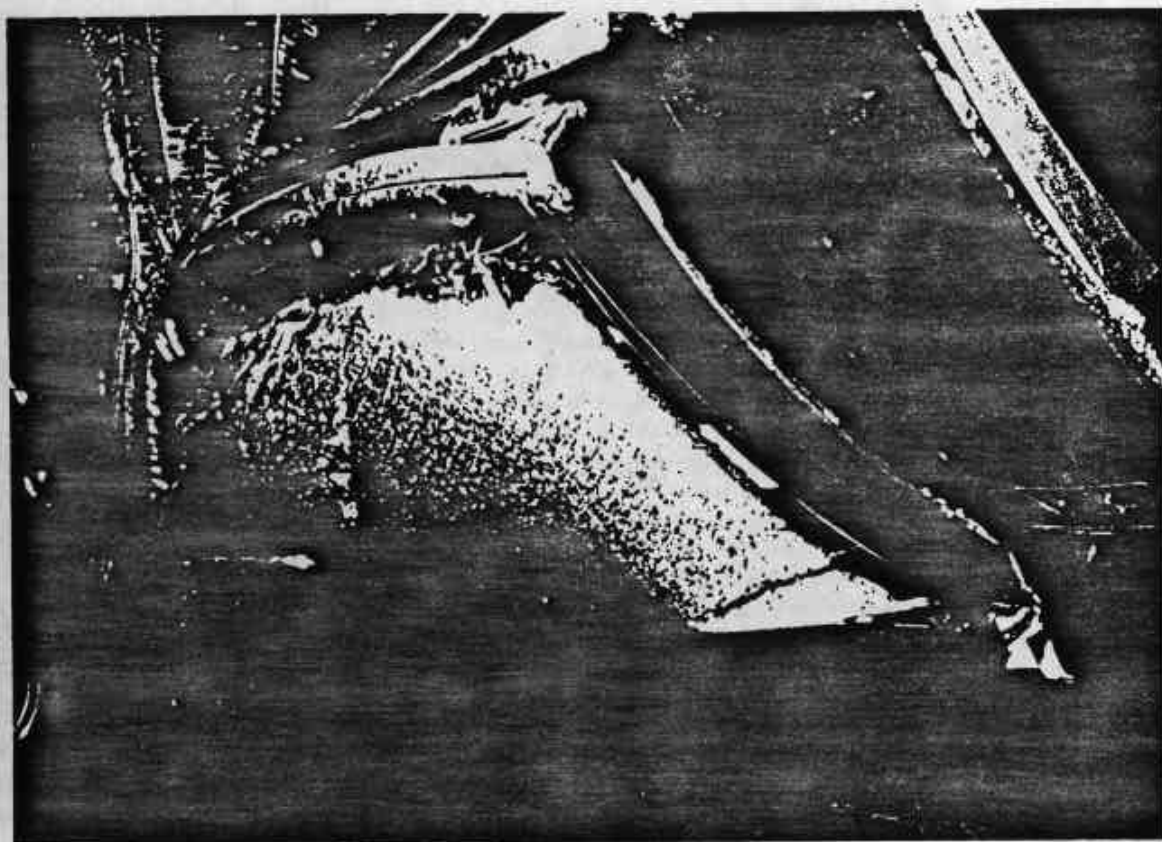


Figure A-32. POST-TEST VEHICLE - VIEW 5



Figure A-33. POST-TEST VEHICLE - VIEW 6

APPENDIX B

DATA PLOT PRESENTATION

T 1111 SA 1, 831129

CONTROLLED ROLLOVER CRASH

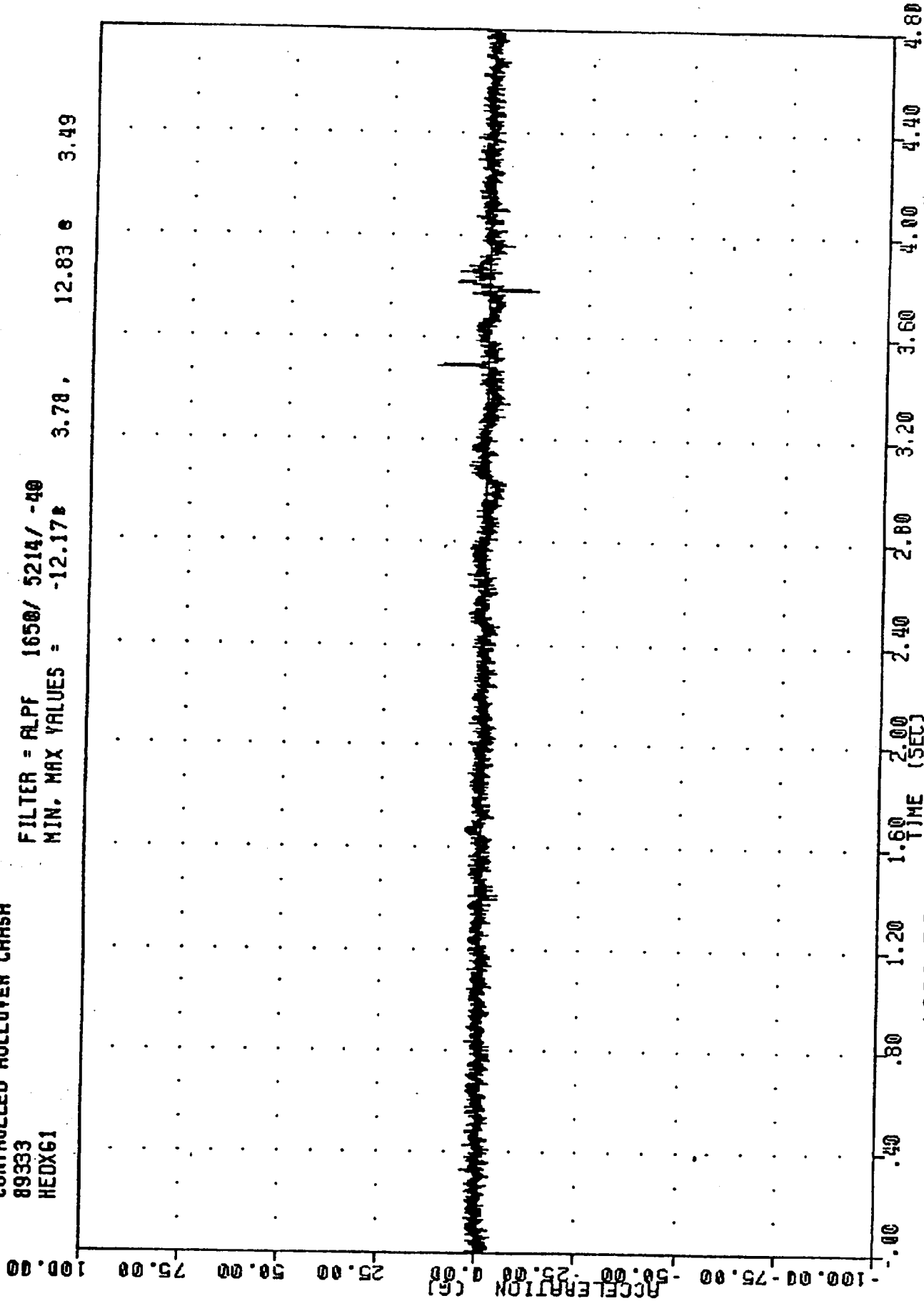
89333

HEDX61

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -12.17

3.78, 12.83 3.49



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD X AXIS ACCELERATION

SA 831129

CONTROLLED ROLLOVER CRASH

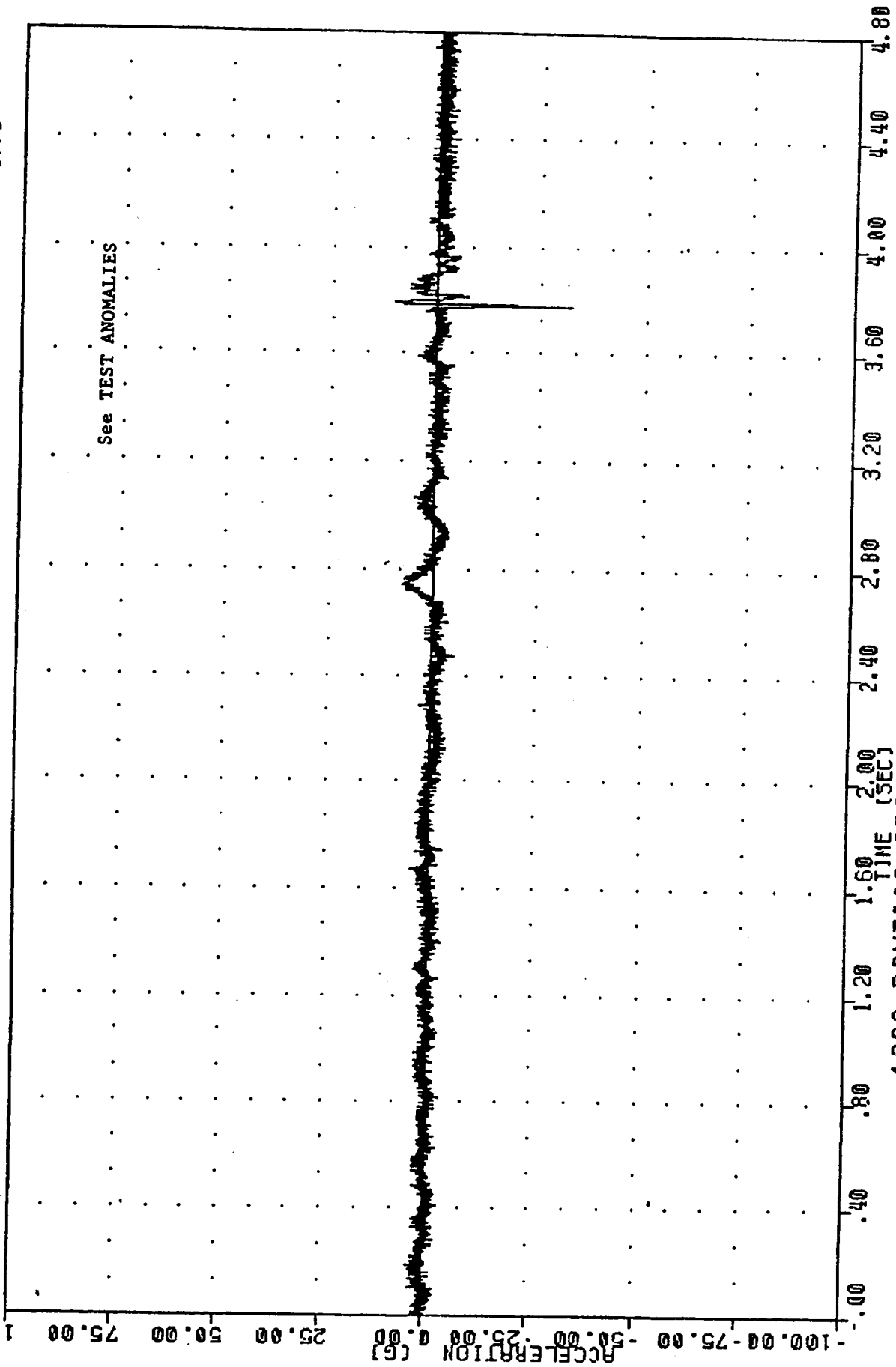
89333

HEDY61

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -32.16

3.78, 10.17 e 3.79

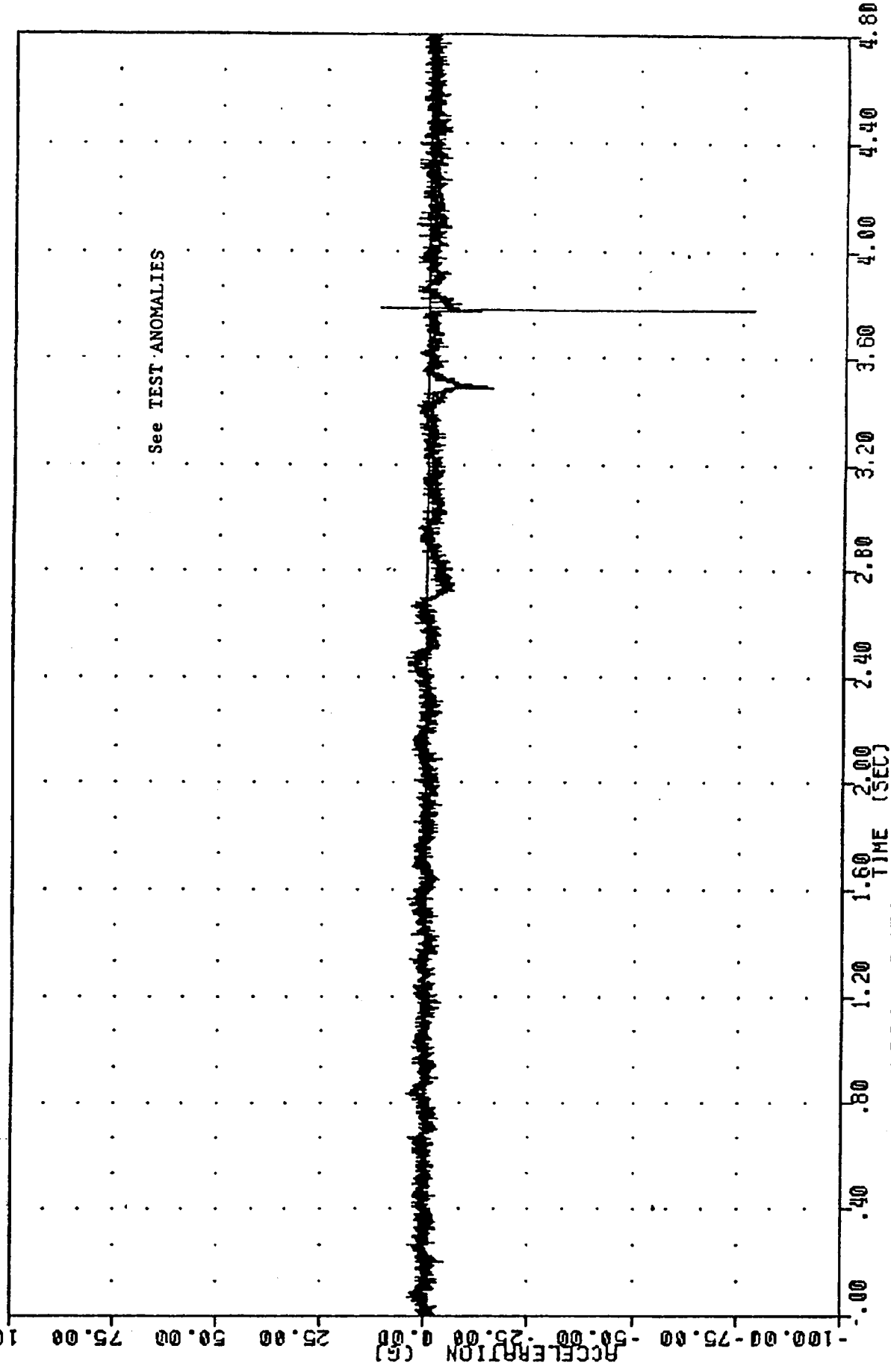


1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Y AXIS ACCELERATION

SA 80129
CONTROLLED ROLLOVER CRASH
89333
HEDZ61

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -77.90 3.78

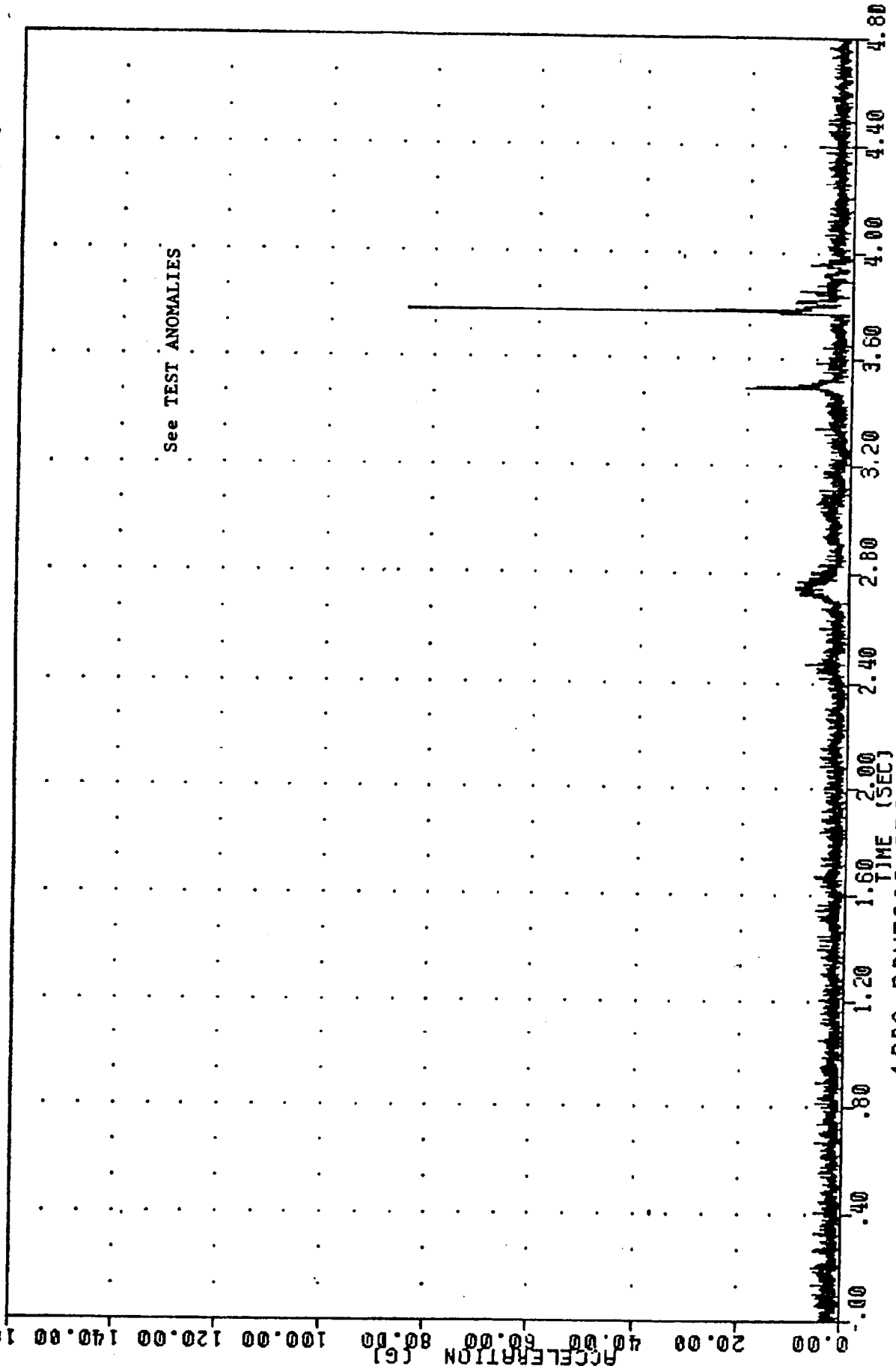
11.73 e 3.78



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Z AXIS ACCELERATION

JT MMSR, 831129
CONTROLLED ROLLOVER CRASH
89333
HEDR61

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES : 0.09 1.26 85.15 3.78



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD RESULTANT ACCELERATION

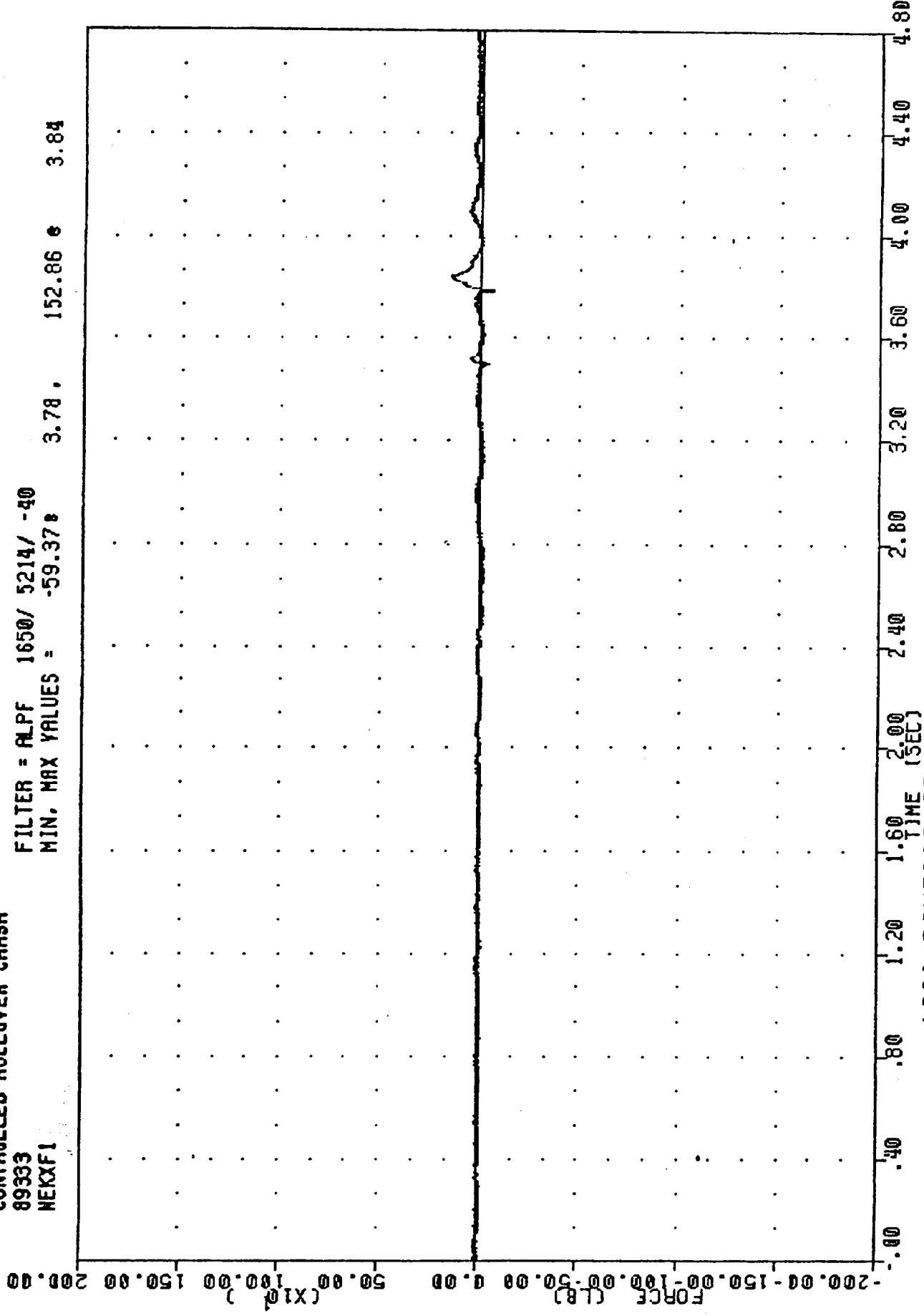
SA, 89333
CONTROLLED ROLLOVER CRASH

89333

WEKXF1

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -59.37 3.78, 152.86 3.84



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER NECK SHEAR FORCE X AXIS

SA, 89333

CONTROLLED ROLLOVER CRASH

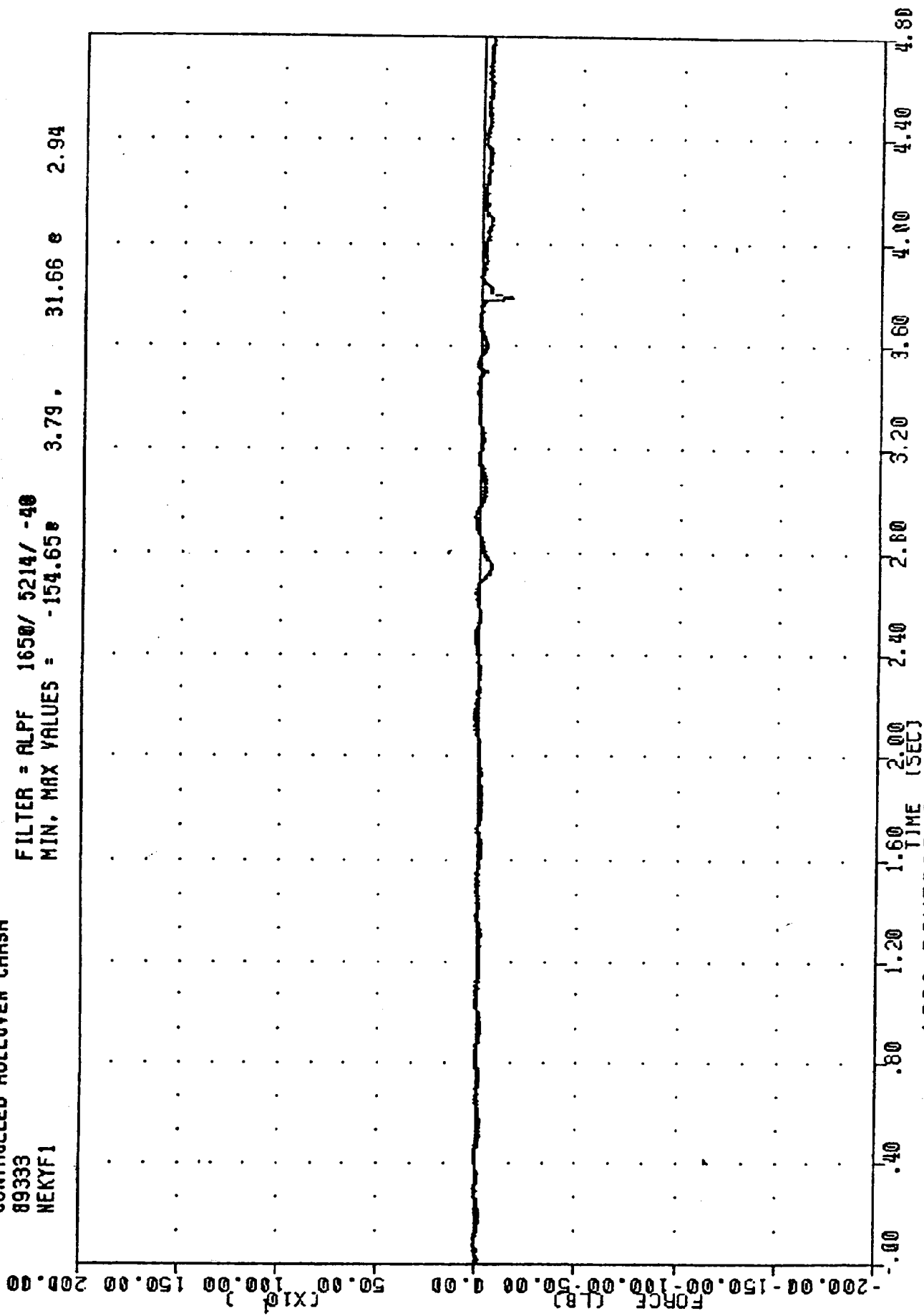
89333

NEKYF1

FILTER = ALPF 1650/ 5214/ -48

MIN, MAX VALUES = -154.658

3.79, 31.66 e 2.94

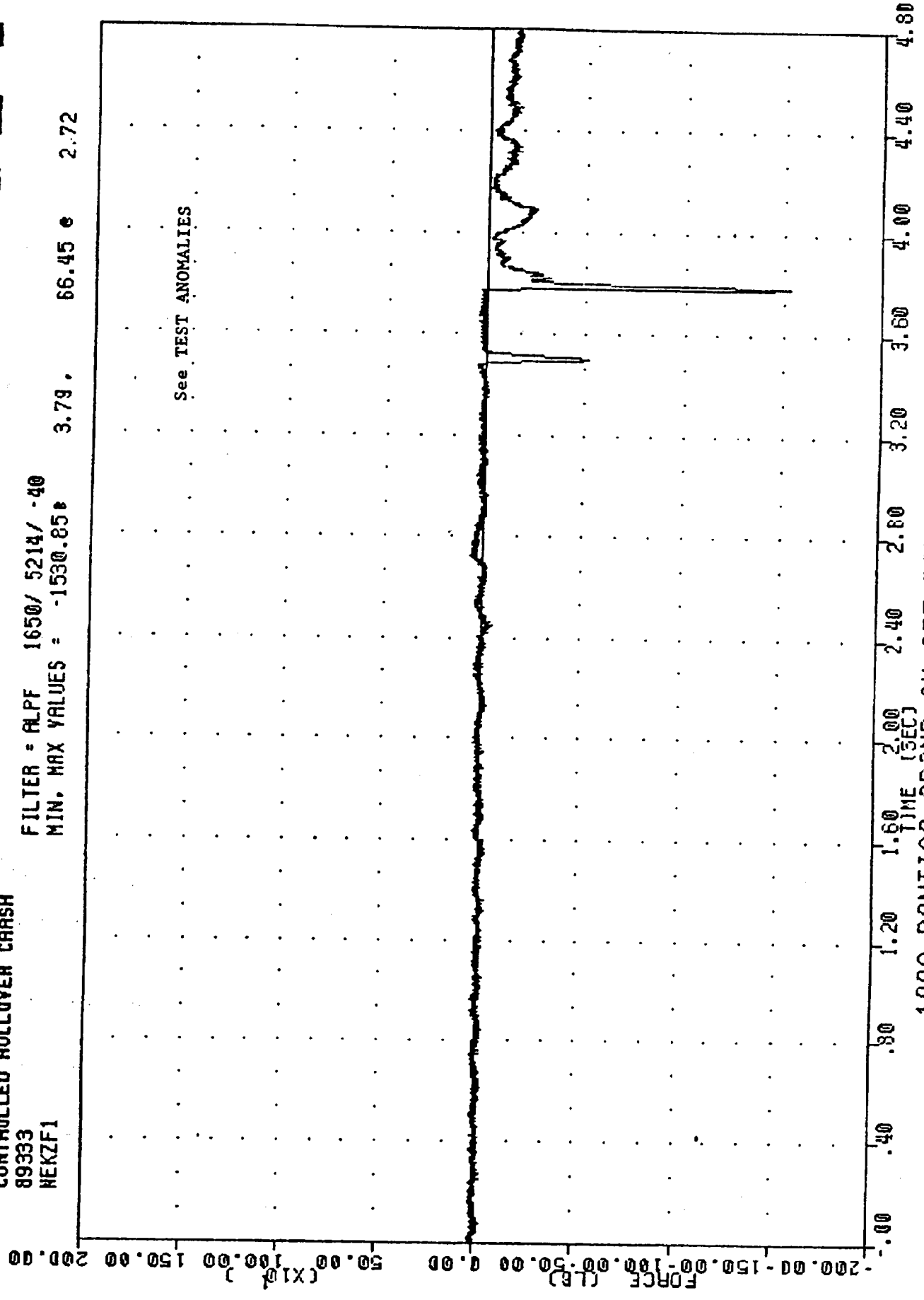


1989 PONTIAC GRAND AM OFF ROLLOVER CRASH AT 30 MPH
DRIVER NECK SHEAR FORCE Y AXIS



SA, 8-12-9
CONTROLLED ROLLOVER CRASH
89333
NEKZF1

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -1530.85 3.79, 66.45 e 2.72

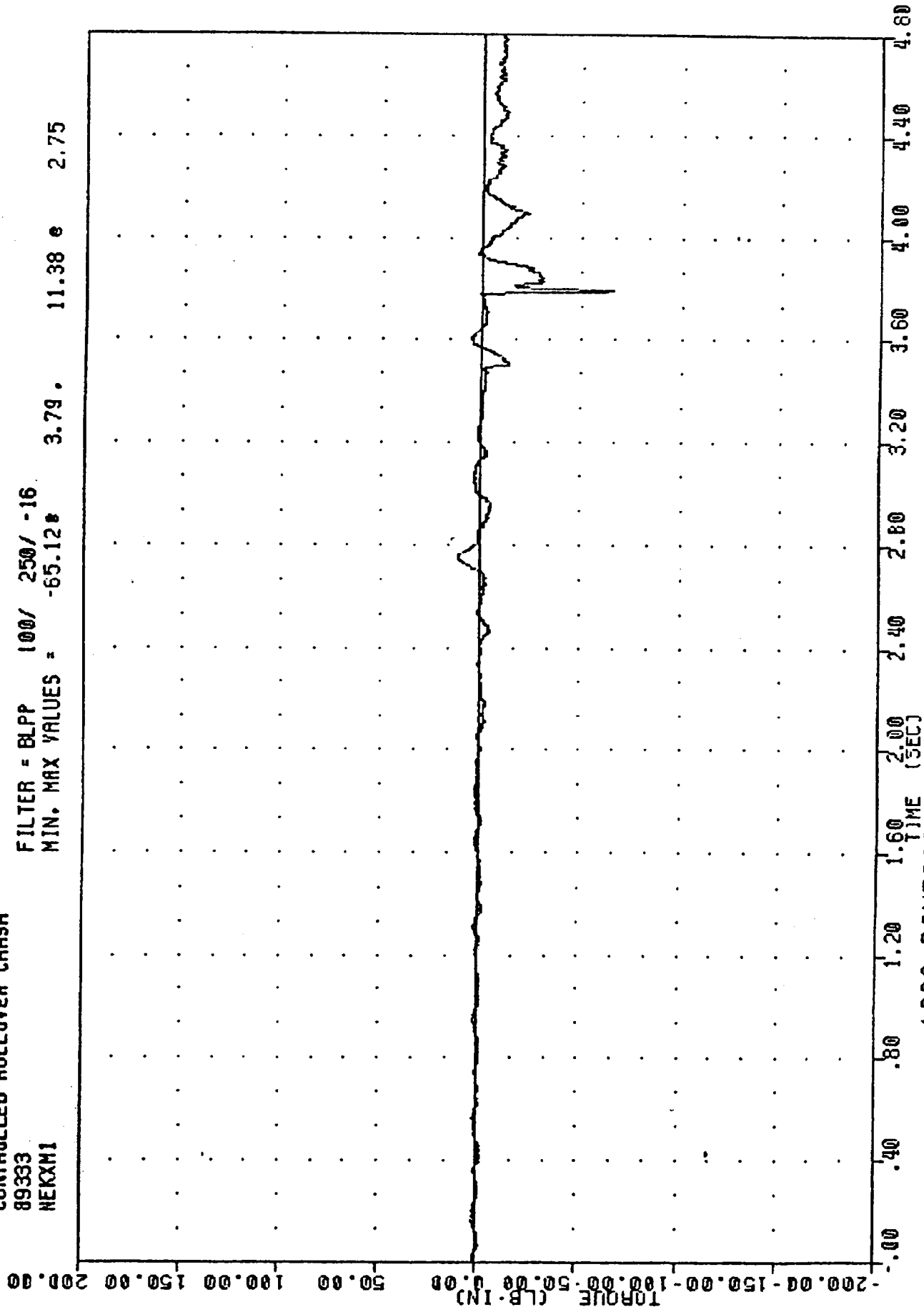


1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER NECK AXIAL FORCE Z AXIS

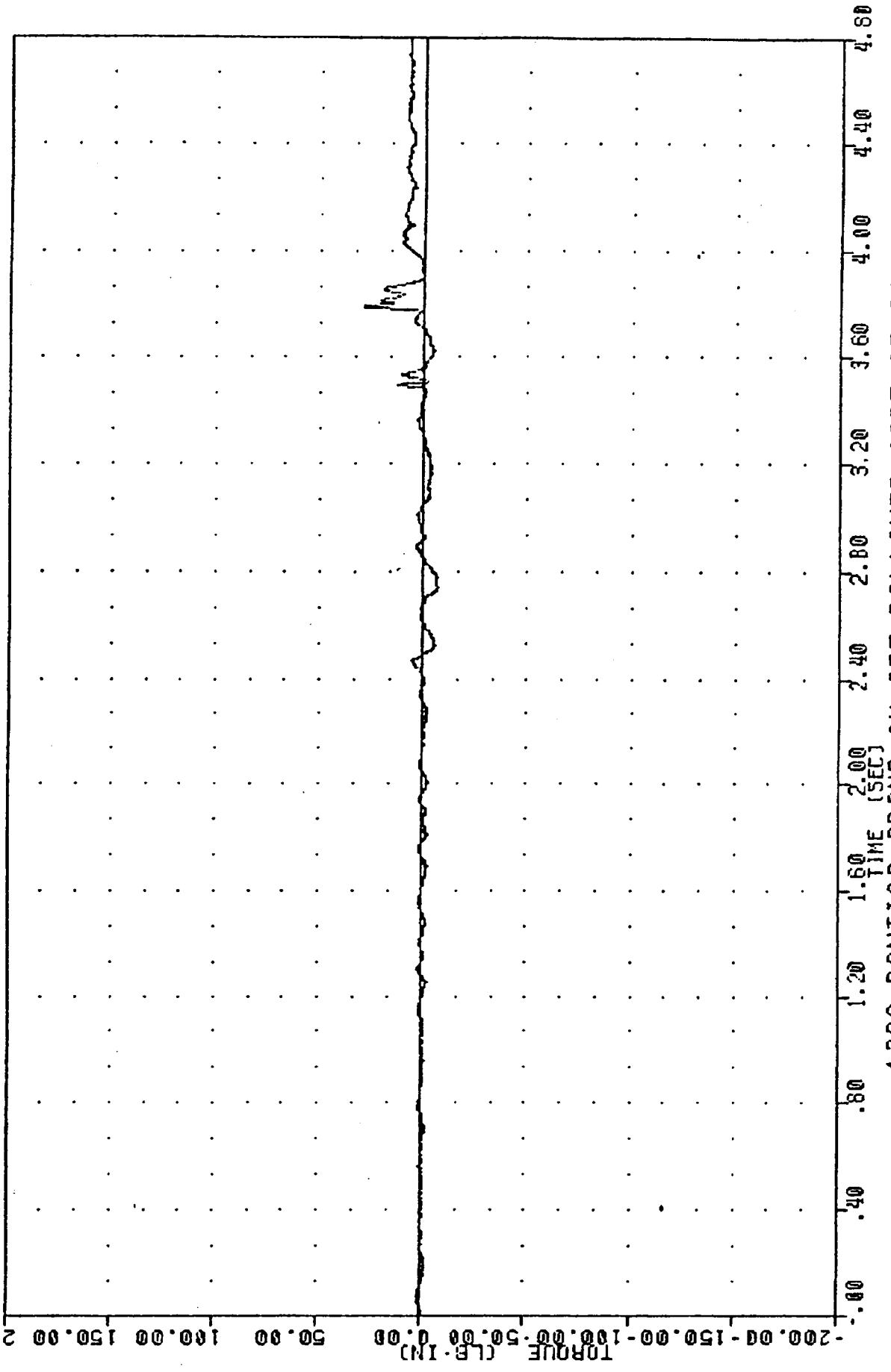
SR 83.129
CONTROLLED ROLLOVER CRASH
89333
NEKXMI

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -65.12 3.79.

11.38 e 2.75



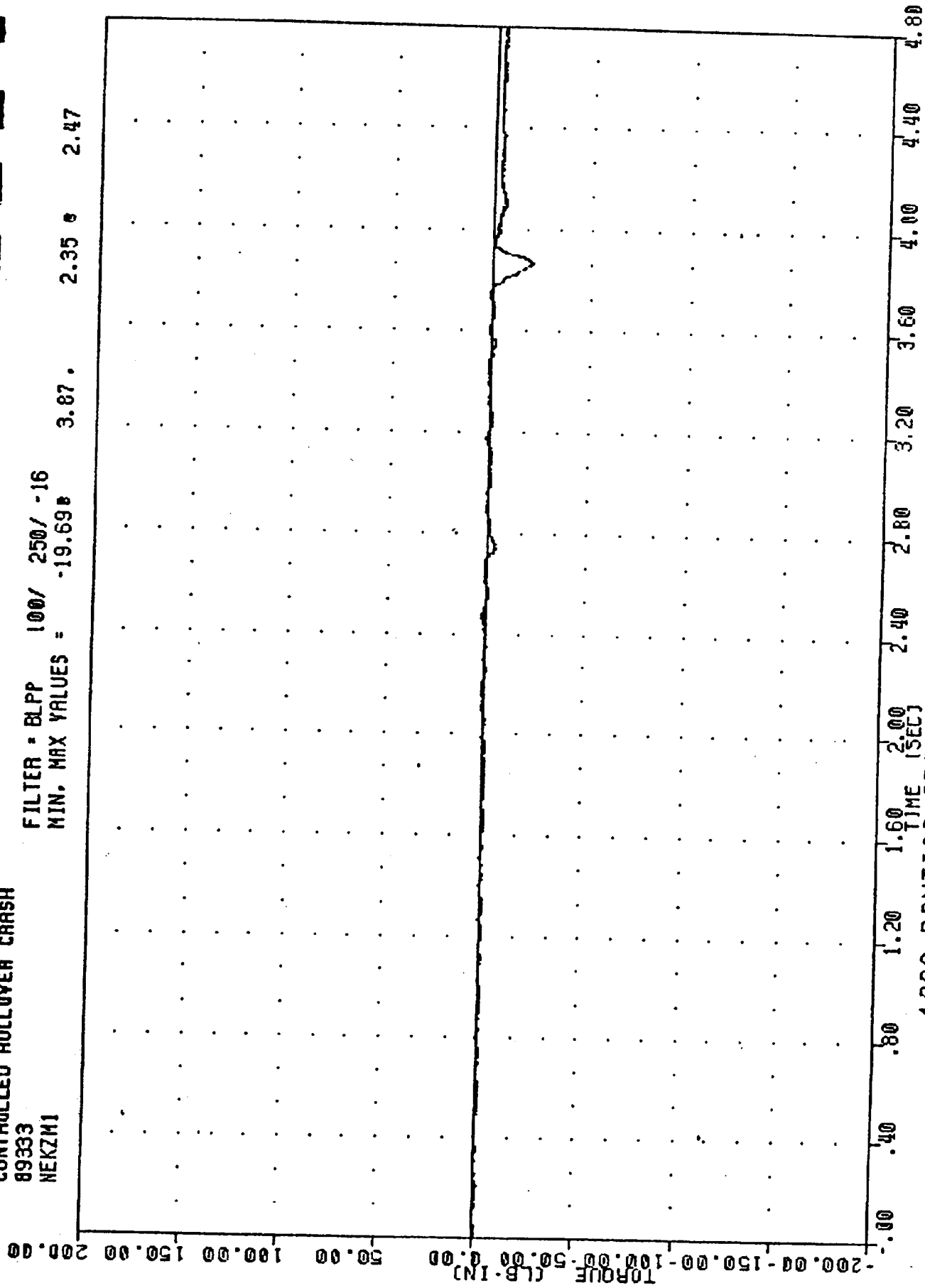
SA 89333
 CONTROLLED ROLLOVER CRASH
 NEKYM1
 FILTER = BLPP 100/ 250/ -16
 MIN. MAX VALUES = -6.87 2.74, 29.06 3.79



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
 DRIVER NECK MOMENT ABOUT Y AXIS

SA, 83129
CONTROLLED ROLLOVER CRASH
89333
NEKZM1

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -19.69 3.87 2.35 2.47



SA 891129

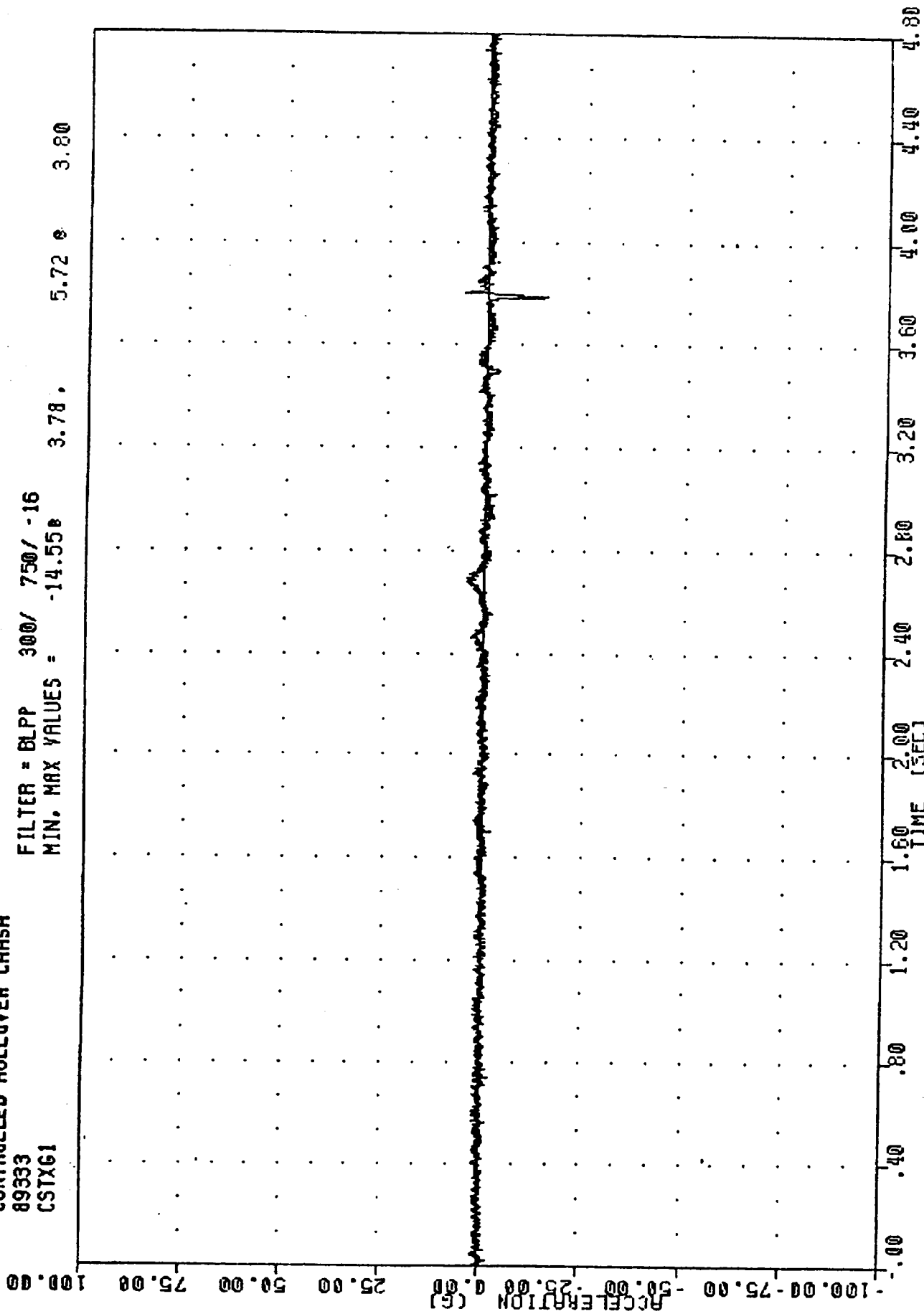
CONTROLLED ROLLOVER CRASH

89333

CSTXG1

FILTER = BLPP 300/ 750/ -16

MIN. MAX VALUES = -14.55 3.78 5.72 3.80



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS ACCELERATION

SA, 8-11-9

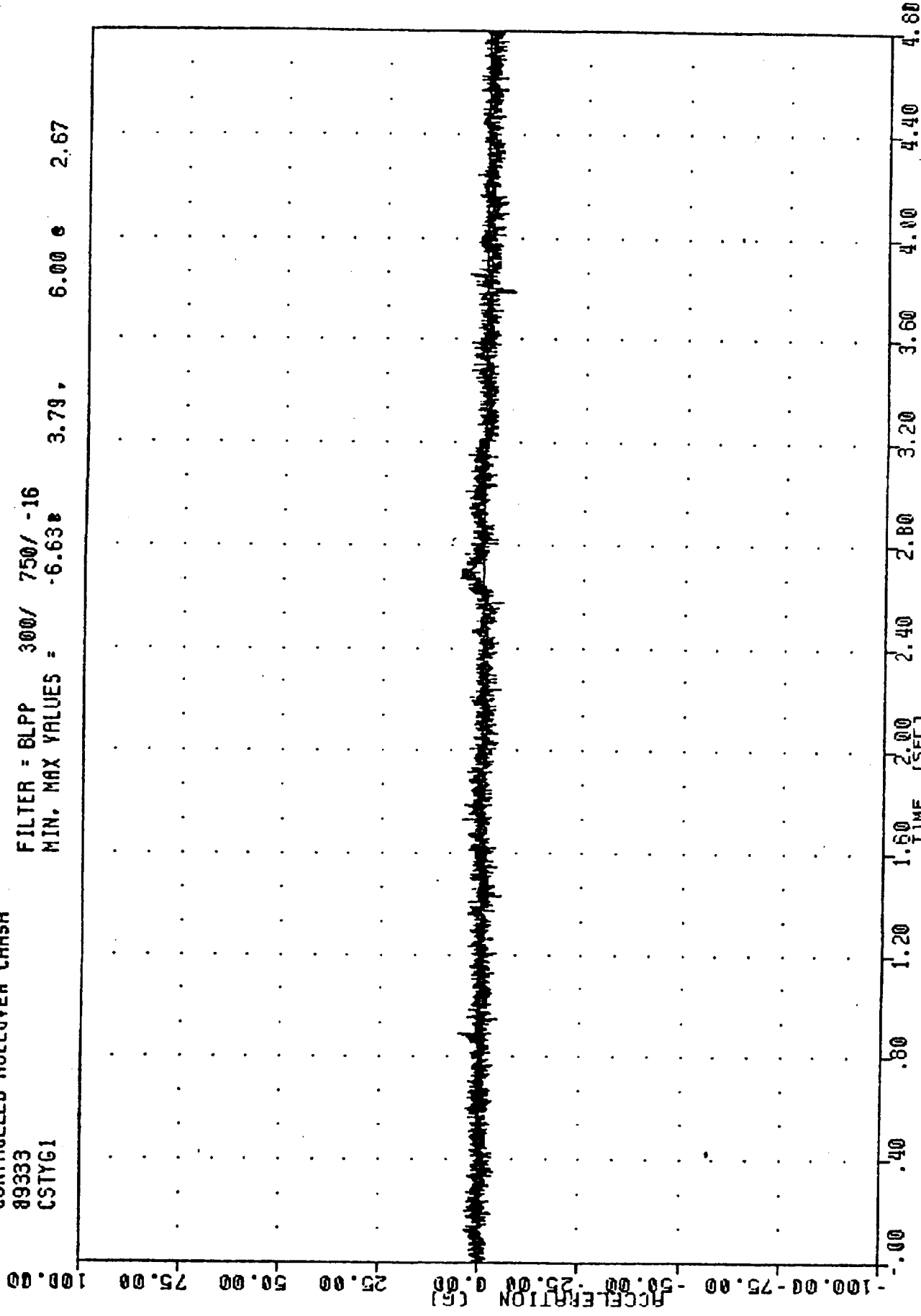
CONTROLLED ROLLOVER CRASH

89333

CSTY61

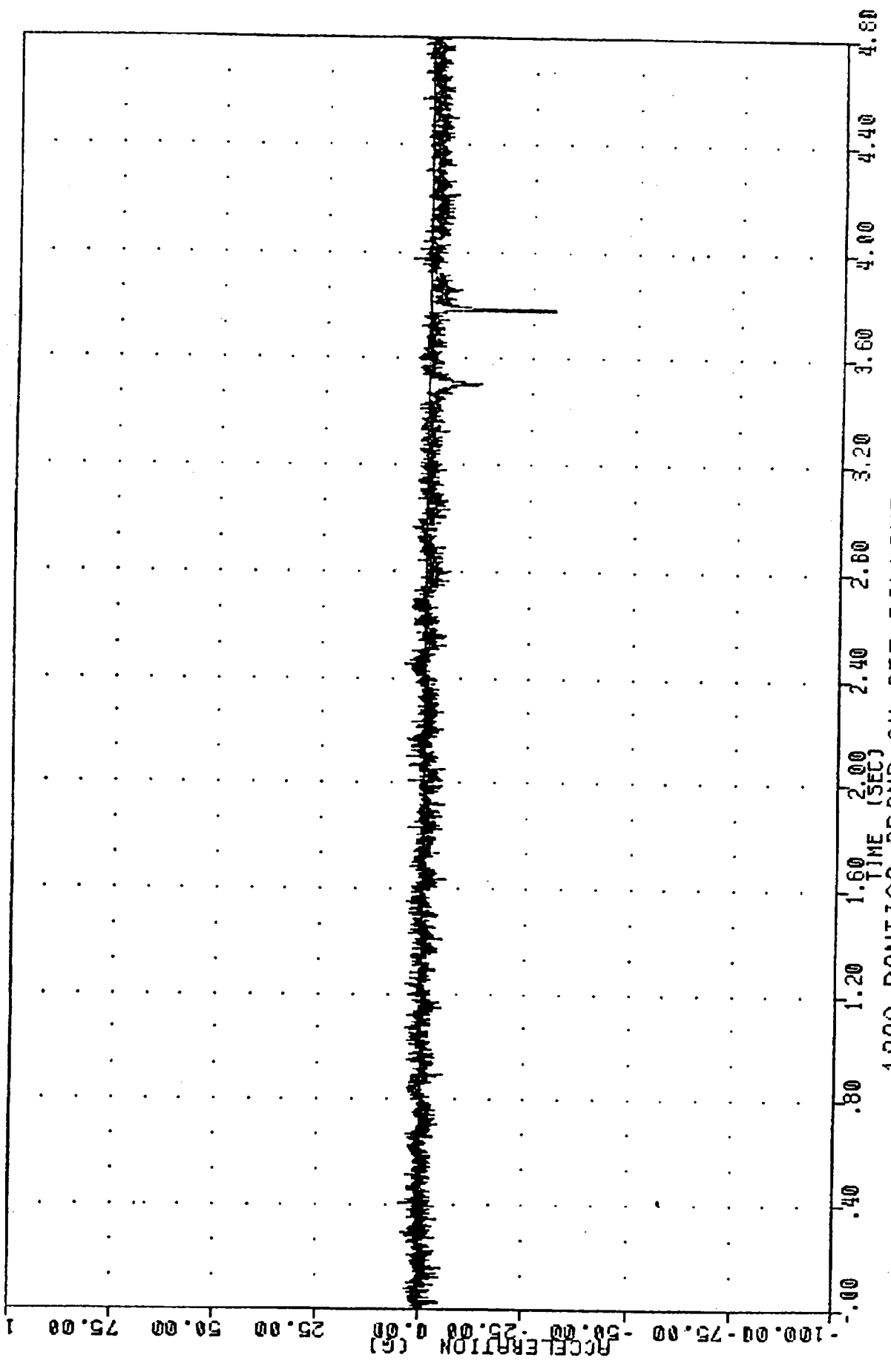
FILTER = BLPP 300/ 750/ -16

MIN. MAX VALUES = -6.63 3.79, 6.00 2.67



SA, 83-129
CONTROLLED ROLLOVER CRASH
89333
CSTZG1

FILTER = BLPP 300/ 750/ -16
MIN. MAX VALUES = -30.26 3.78, 4.87 e 0.41



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST Z AXIS ACCELERATION

7-11-89

CONTROLLED ROLLOVER CRASH

89333

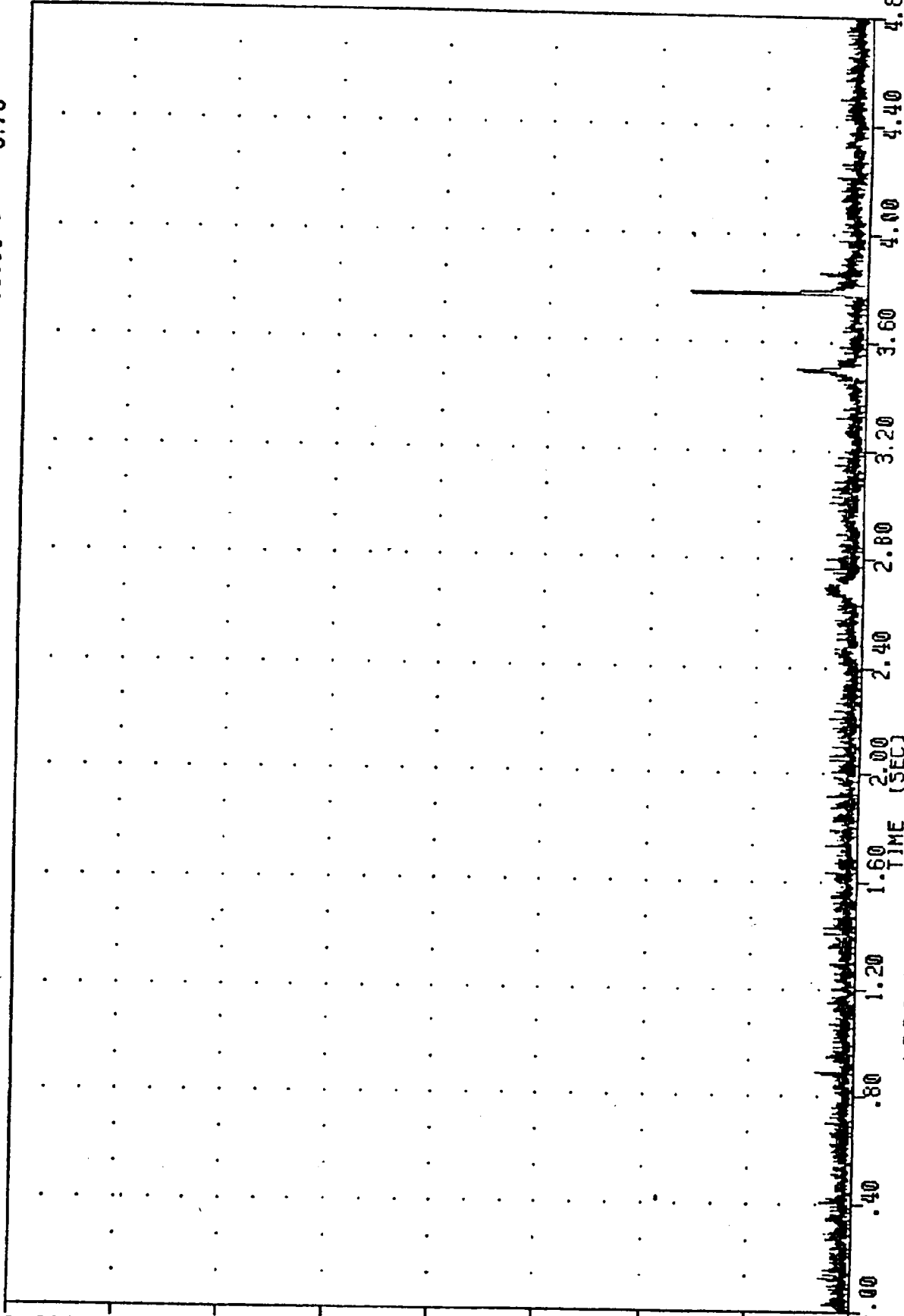
CSTRG1

FILTER = BLPP 300/ 750/ -16

MIN. MAX VALUES = 0.03 3.78

2.20 33.59 e

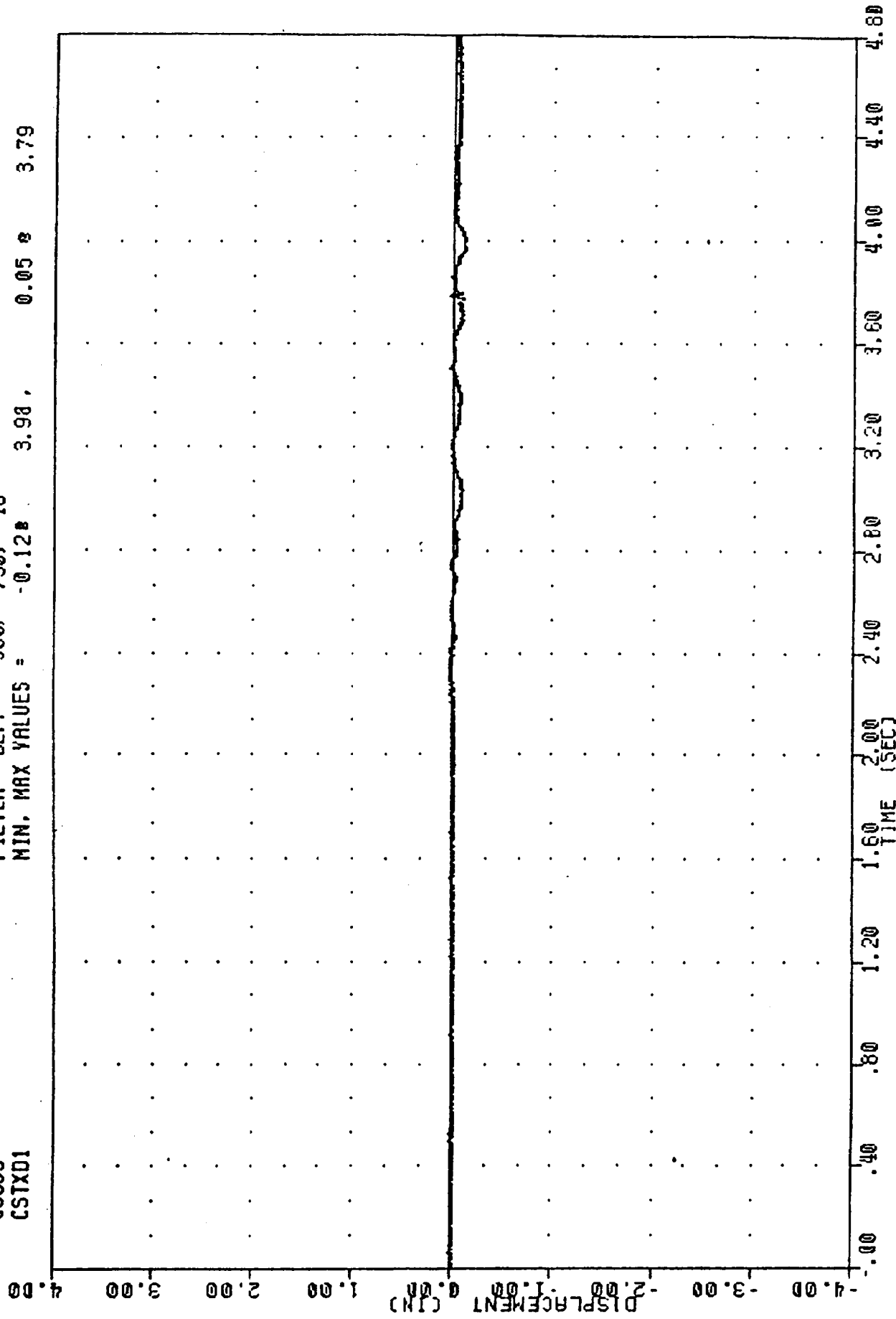
ACCELERATION (G)



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST RESULTANT ACCELERATION

SA, 83119
CONTROLLED ROLLOVER CRASH
89333
CSTXD1

FILTER = BLPP 300/ 750/ -16
MIN. MAX VALUES = -0.12 3.98, 0.05 3.79



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS DISPLACEMENT

SA, 8-11-29

CONTROLLED ROLLOVER CRASH

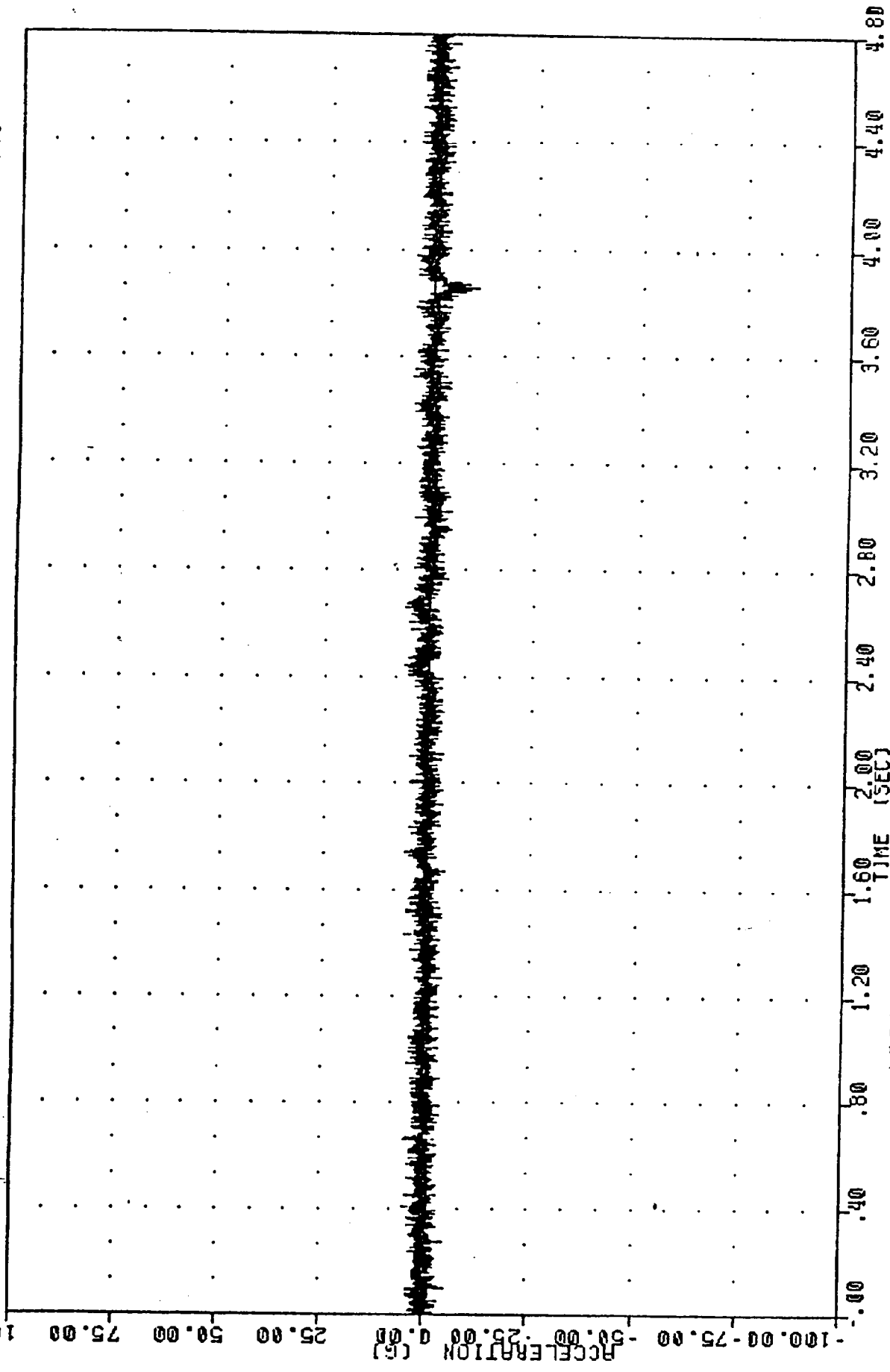
89333

PEVXG1

FILTER : ALPF 1650/ 5214/ -40

MIN. MAX VALUES : -10.57 3.86

5.91 e 2.44



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS X AXIS ACCELERATION

SA 89333

CONTROLLED ROLLOVER CRASH

89333

PEVYG1

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -8.75 3.86

5.70 2.93

100.00

75.00

50.00

25.00

0.00

-25.00

-50.00

-75.00

-100.00

0.00

.40

.80

1.20

1.60

2.00

2.40

2.80

3.20

3.60

4.00

4.40

4.80

TIME (SEC)

1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH

DRIVER PELVIS Y AXIS ACCELERATION

SA 89333

CONTROLLED ROLLOVER CRASH

89333

PEVZ61

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -23.21 3.79, 4.33 2.63

100.00

75.00

50.00

25.00

0.00

-25.00

-50.00

-75.00

-100.00

0.00

.40

.80

1.20

1.60

2.00

2.40

2.80

3.20

3.60

4.00

4.40

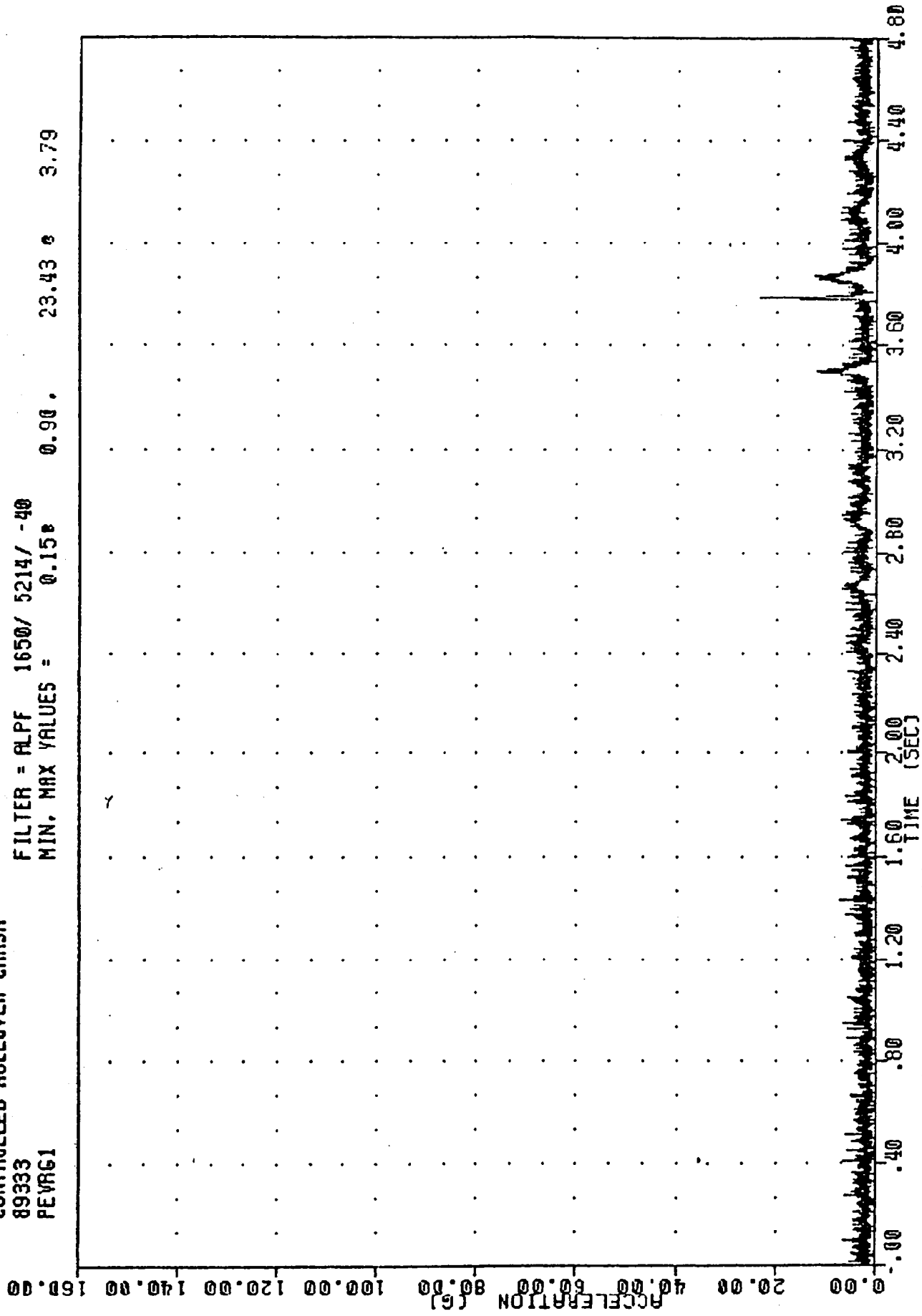
4.80

TIME (SEC)

1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS Z AXIS ACCELERATION

SA 89-119
CONTROLLED ROLLOVER CRASH
89333
PEVRG1

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = 0.15 23.43 3.79



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS RESULTANT ACCELERATION

SA 80019

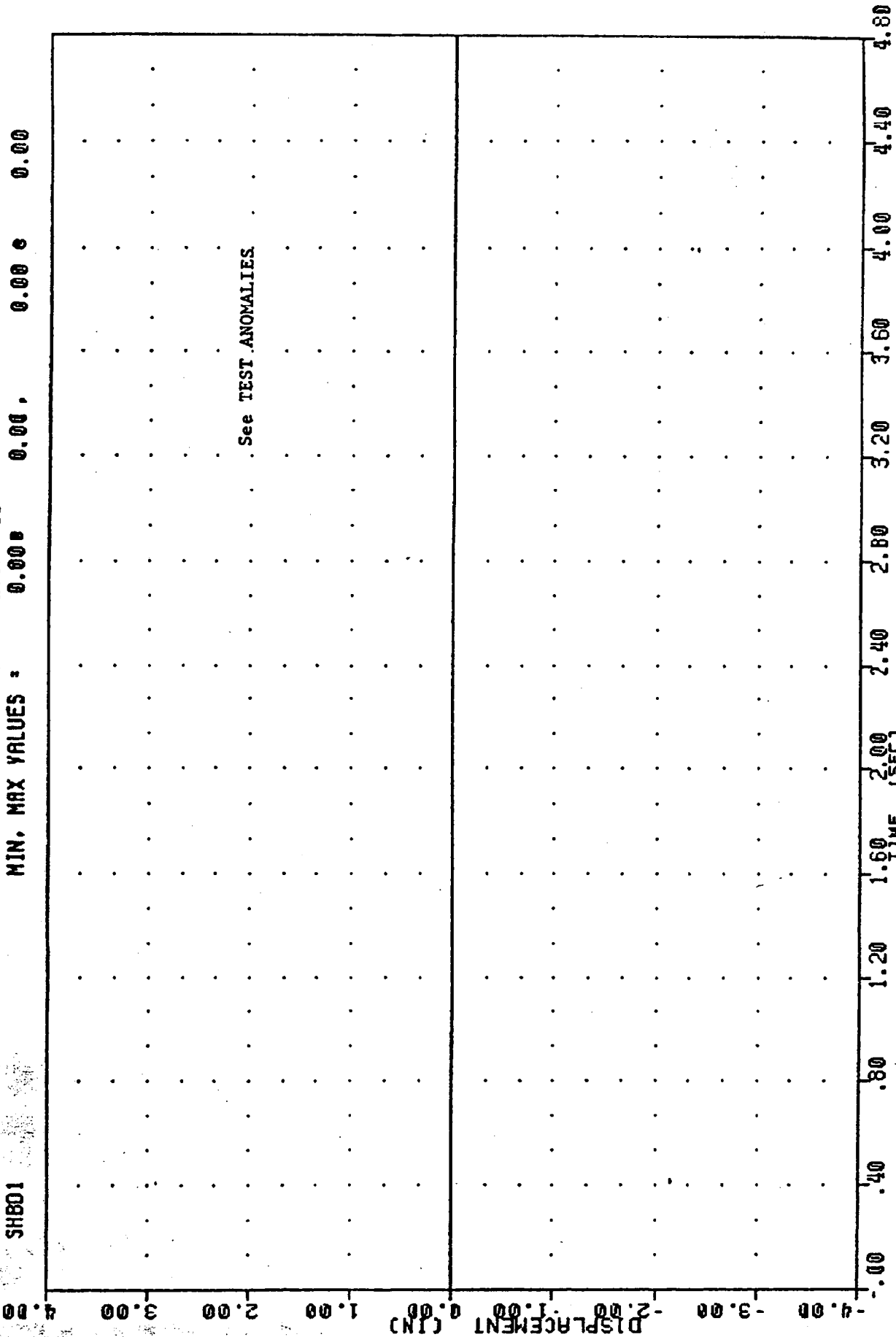
CONTROLLED ROLLOVER CRASH

89333

SHB01

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = 0.00 0.00 0.00 0.00



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
DRIVER SHOULDER BELT DISPLACEMENT

SA, 8-19

CONTROLLED ROLLOVER CRASH

89333

YCGXG1

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES =

2.50 .

9.17 e

2.40

ACCELERATION (G)

20.00

15.00

10.00

5.00

0.00

-5.00

-10.00

-15.00

-20.00

-

0.00

.40

.80

1.20

1.60

2.00

2.40

2.80

3.20

3.60

4.00

4.40

4.80

5.20

5.60

6.00

6.40

6.80

7.20

7.60

8.00

8.40

8.80

9.20

9.60

10.00

10.40

10.80

11.20

11.60

12.00

12.40

12.80

13.20

13.60

14.00

14.40

14.80

15.20

15.60

16.00

16.40

16.80

17.20

17.60

18.00

18.40

18.80

19.20

19.60

20.00

20.40

20.80

21.20

21.60

22.00

22.40

22.80

23.20

23.60

24.00

24.40

24.80

25.20

25.60

26.00

26.40

26.80

27.20

27.60

28.00

28.40

28.80

29.20

29.60

30.00

30.40

30.80

31.20

31.60

32.00

32.40

32.80

33.20

33.60

34.00

34.40

34.80

35.20

35.60

36.00

36.40

36.80

37.20

37.60

38.00

38.40

38.80

39.20

39.60

40.00

40.40

40.80

41.20

41.60

42.00

42.40

42.80

43.20

43.60

44.00

44.40

44.80

45.20

45.60

46.00

46.40

46.80

47.20

47.60

48.00

48.40

48.80

49.20

49.60

50.00

50.40

50.80

51.20

51.60

52.00

52.40

52.80

53.20

53.60

54.00

54.40

54.80

55.20

55.60

56.00

56.40

56.80

57.20

57.60

58.00

58.40

58.80

59.20

59.60

60.00

60.40

60.80

61.20

61.60

62.00

62.40

62.80

63.20

63.60

64.00

64.40

64.80

65.20

65.60

66.00

66.40

66.80

67.20

67.60

68.00

68.40

68.80

69.20

69.60

70.00

70.40

70.80

71.20

71.60

72.00

72.40

72.80

73.20

73.60

74.00

74.40

74.80

75.20

75.60

76.00

76.40

76.80

77.20

77.60

78.00

78.40

78.80

79.20

79.60

80.00

80.40

80.80

81.20

81.60

82.00

82.40

82.80

83.20

83.60

84.00

84.40

84.80

85.20

85.60

86.00

86.40

86.80

87.20

87.60

88.00

88.40

88.80

89.20

89.60

90.00

90.40

90.80

91.20

91.60

92.00

92.40

92.80

93.20

93.60

94.00

94.40

94.80

95.20

95.60

96.00

96.40

96.80

97.20

97.60

98.00

98.40

98.80

99.20

99.60

100.00

100.40

100.80

101.20

101.60

102.00

102.40

102.80

103.20

103.60

104.00

104.40

104.80

105.20

105.60

106.00

106.40

106.80

107.20

107.60

108.00

108.40

108.80

109.20

109.60

110.00

110.40

110.80

111.20

111.60

112.00

112.40

112.80

113.20

113.60

114.00

114.40

114.80

115.20

115.60

116.00

116.40

116.80

117.20

117.60

118.00

118.40

118.80

119.20

119.60

120.00

120.40

120.80

121.20

121.60

122.00

122.40

122.80

123.20

123.60

124.00

124.40

124.80

125.20

125.60

126.00

126.40

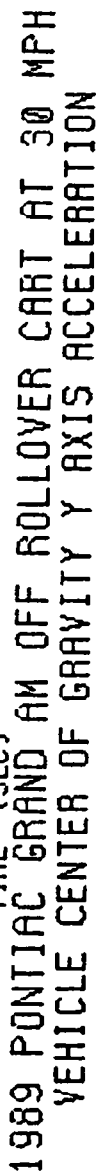
126.80

127.20

127.60

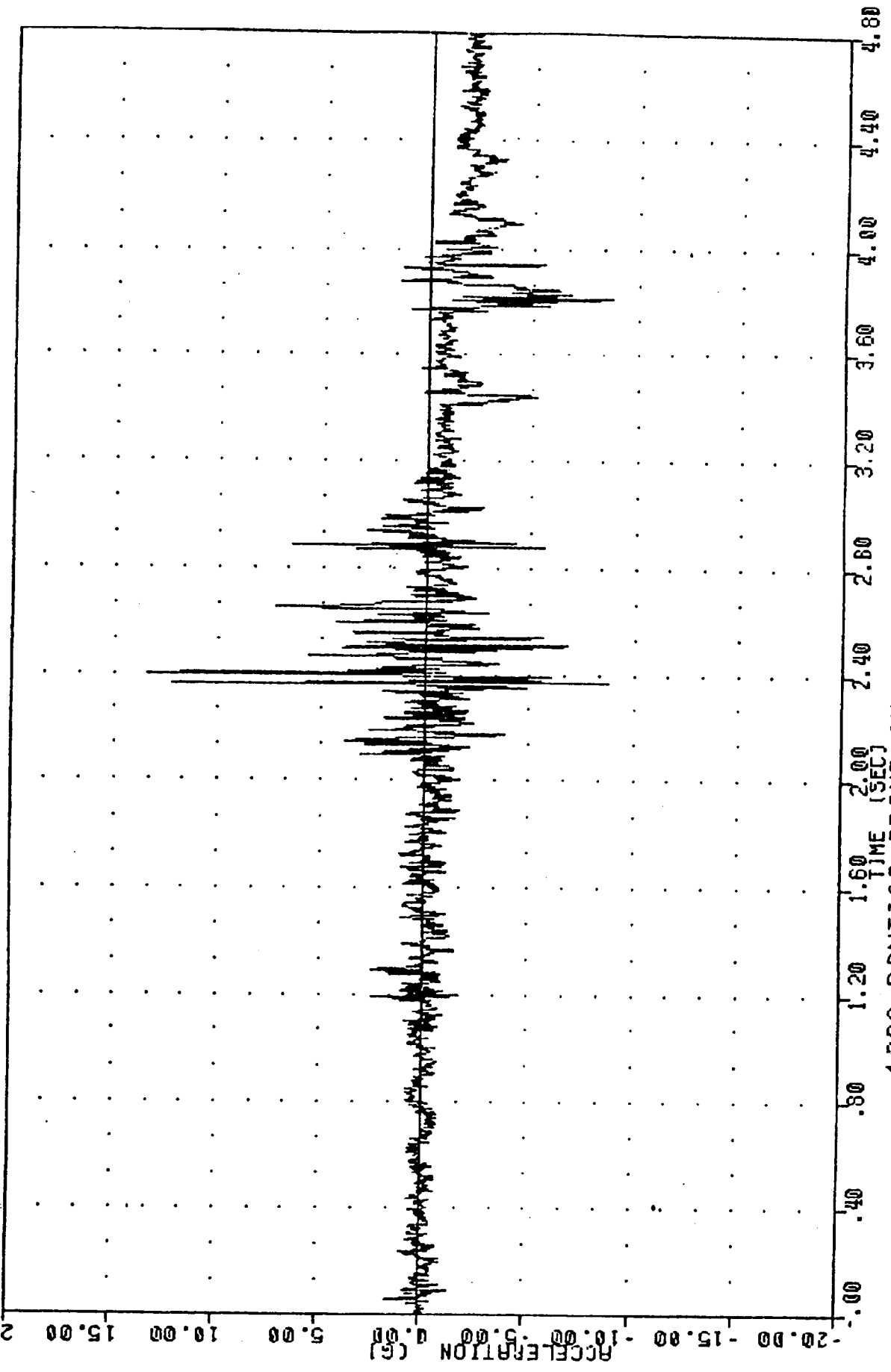
128.00

2.60. 9.17 2.64



SA, 89-29
CONTROLLED ROLLOVER CRASH
89333
YC6ZG1

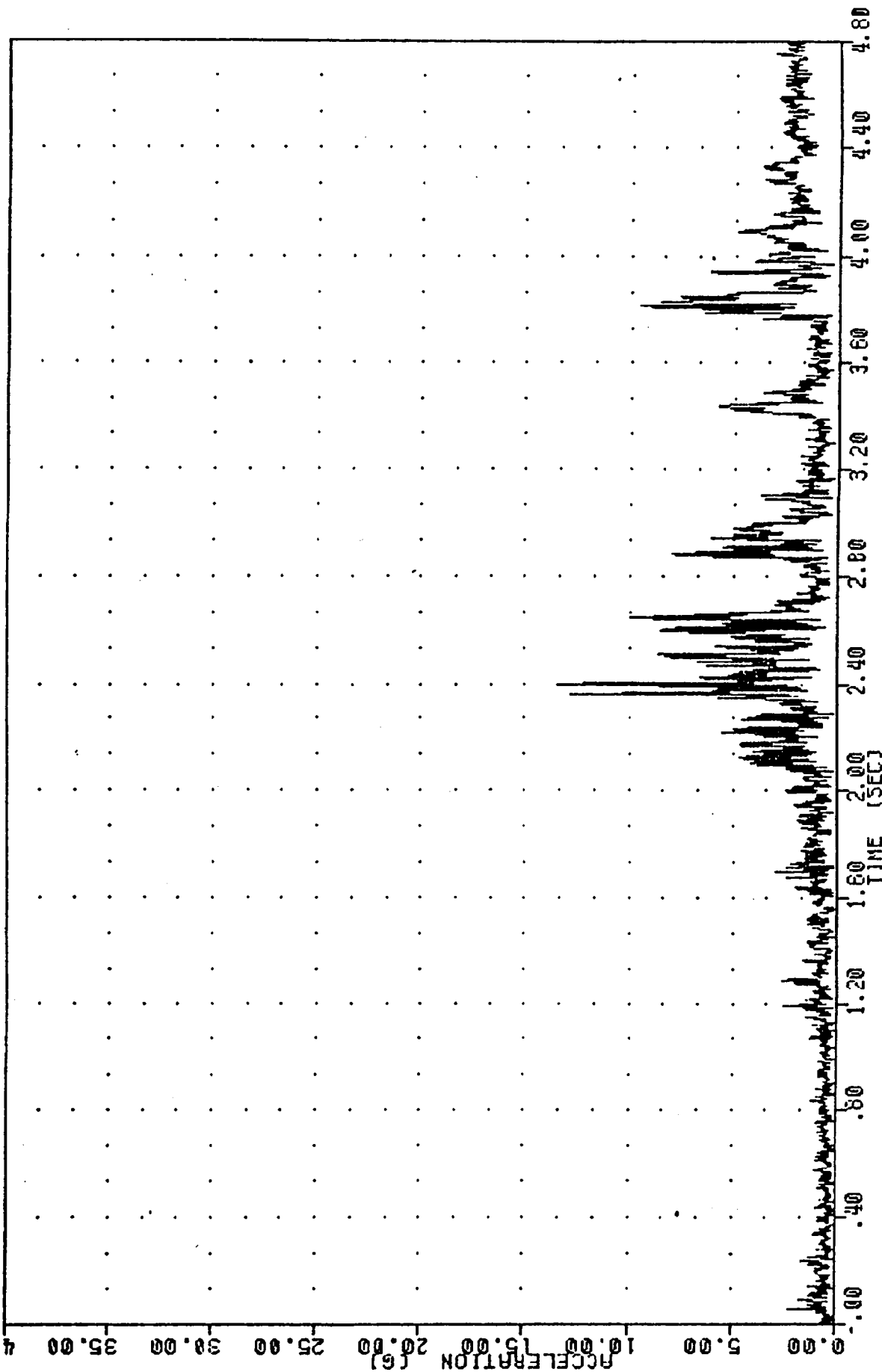
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -8.83 3.81. 13.35 e 2.40



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Z AXIS ACCELERATION

INT SA, 8/19/89
CONTROLLED ROLLOVER CRASH
89333
YC6RG1

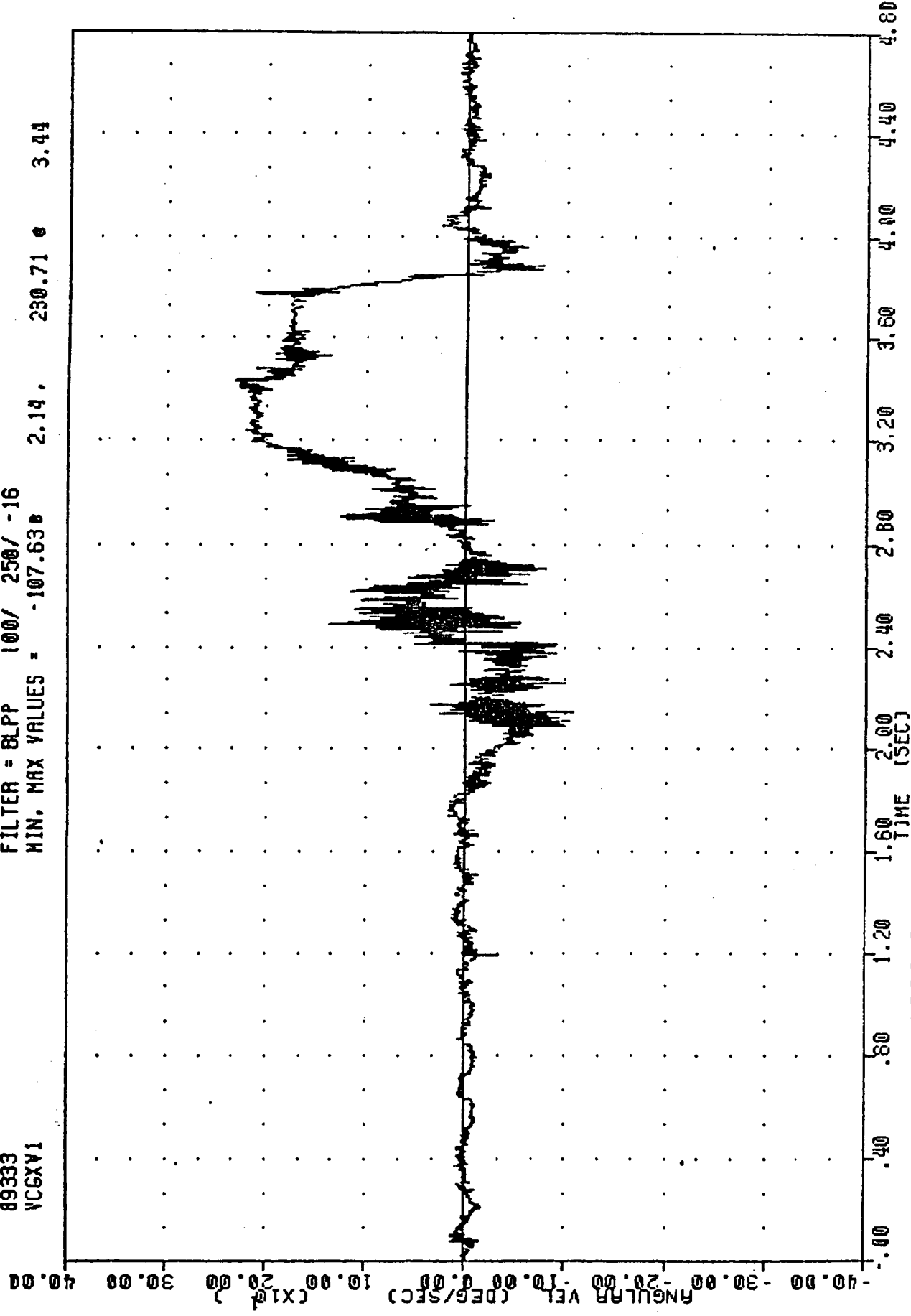
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = 0.018 0.24. 13.48 e 2.40



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION

(NHISA 891129
CONTROLLED ROLLOVER CRASH
89333
VC6XV1

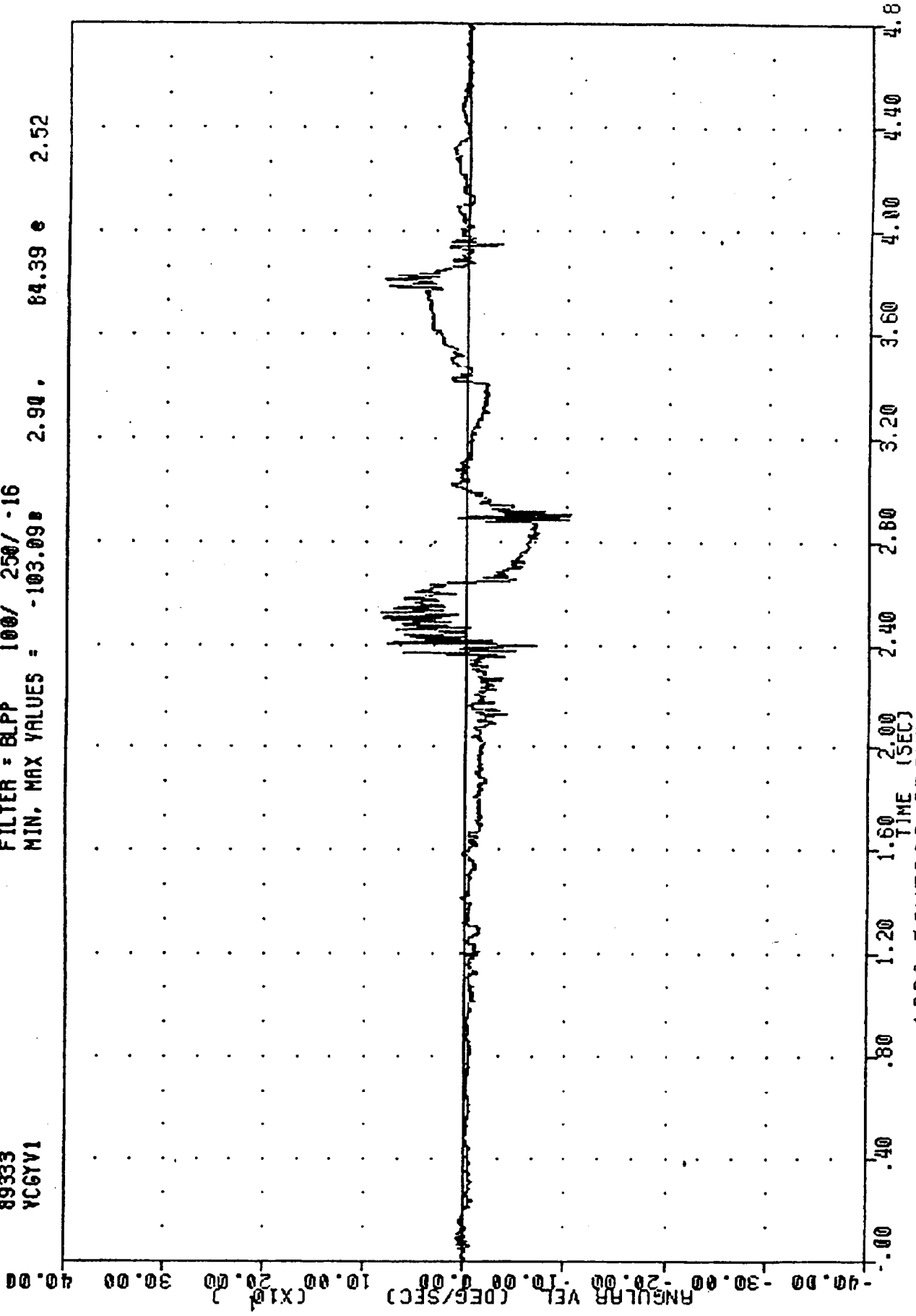
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -107.63 2.14 230.71 3.44



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE ROLL RATE

JT NHTSA , 891129
CONTROLLED ROLLOVER CRASH
89333
VC6YV1

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -103.09 2.90, 84.39 2.52



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE PITCH RATE

LCI NHISR 891129

CONTROLLED ROLLOVER CRASH

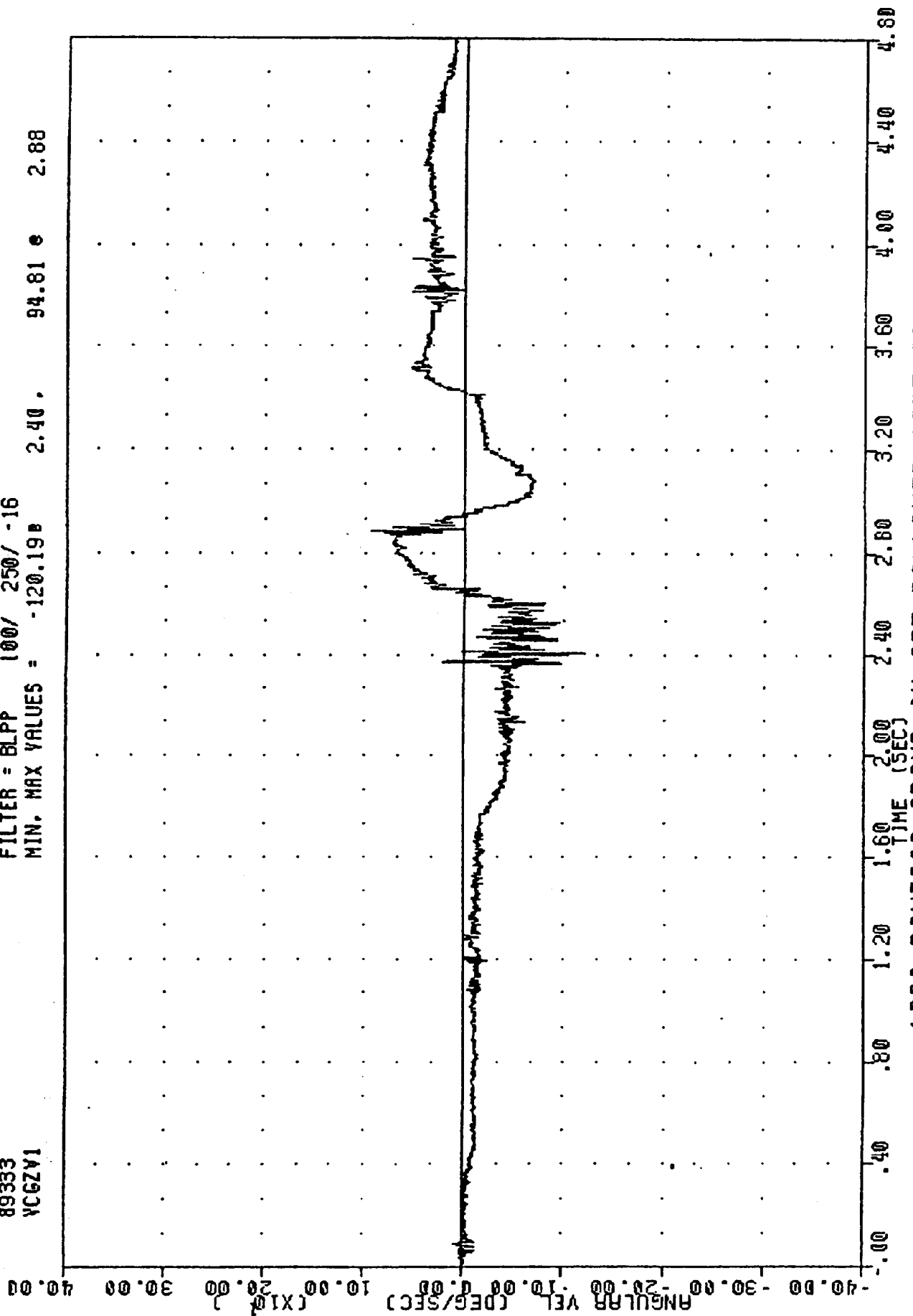
89333

YC6ZV1

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = -120.19 2.40

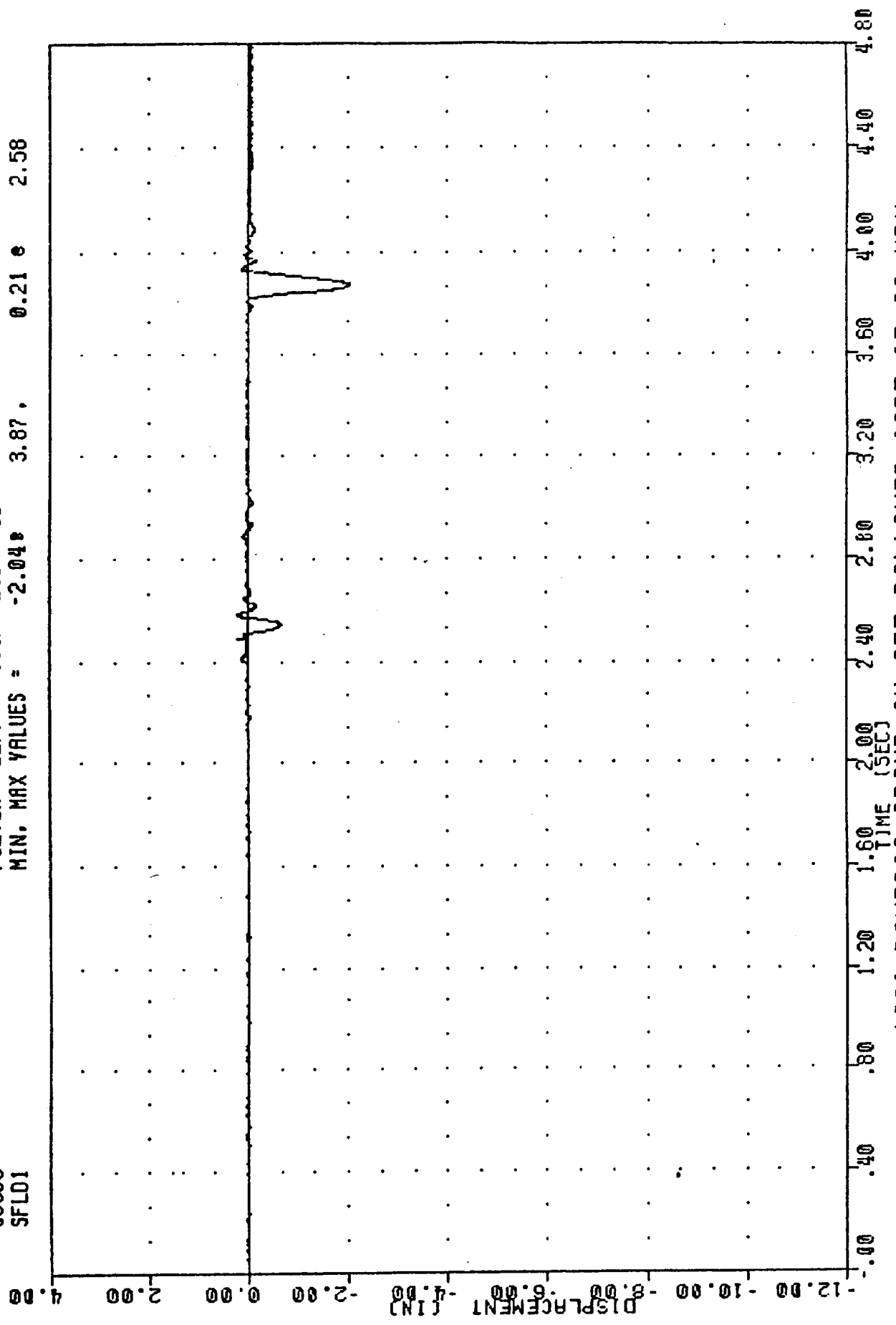
94.81 2.88



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE YAW RATE

SA 80129
CONTROLLED ROLLOVER CRASH
89333
SFL01

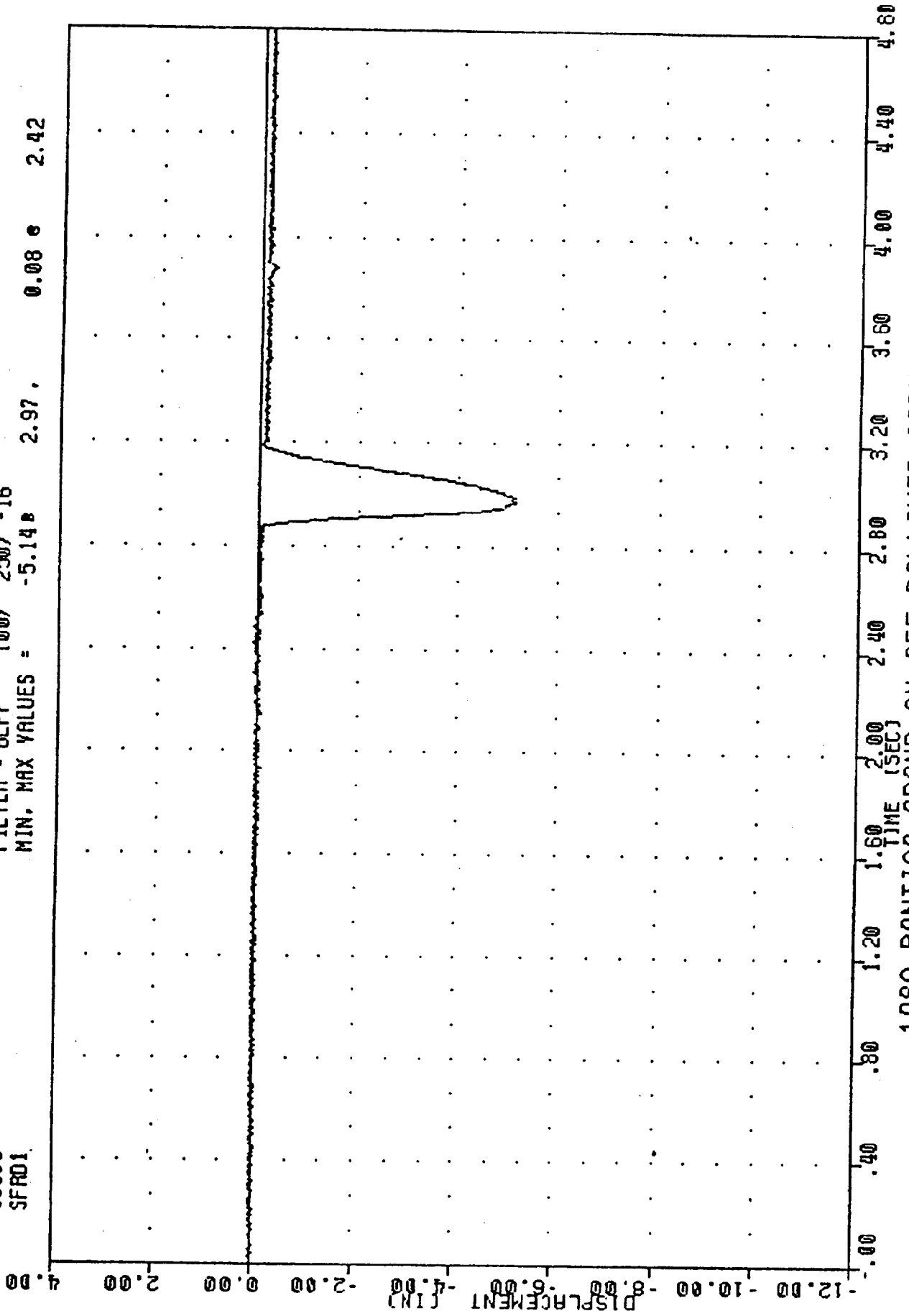
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -2.04 3.87 0.21 2.58



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT FRONT SUSPENSION DISPLACEMENT

DUI NHISA, 891129
CONTROLLED ROLLOVER CRASH
89333
SFR01

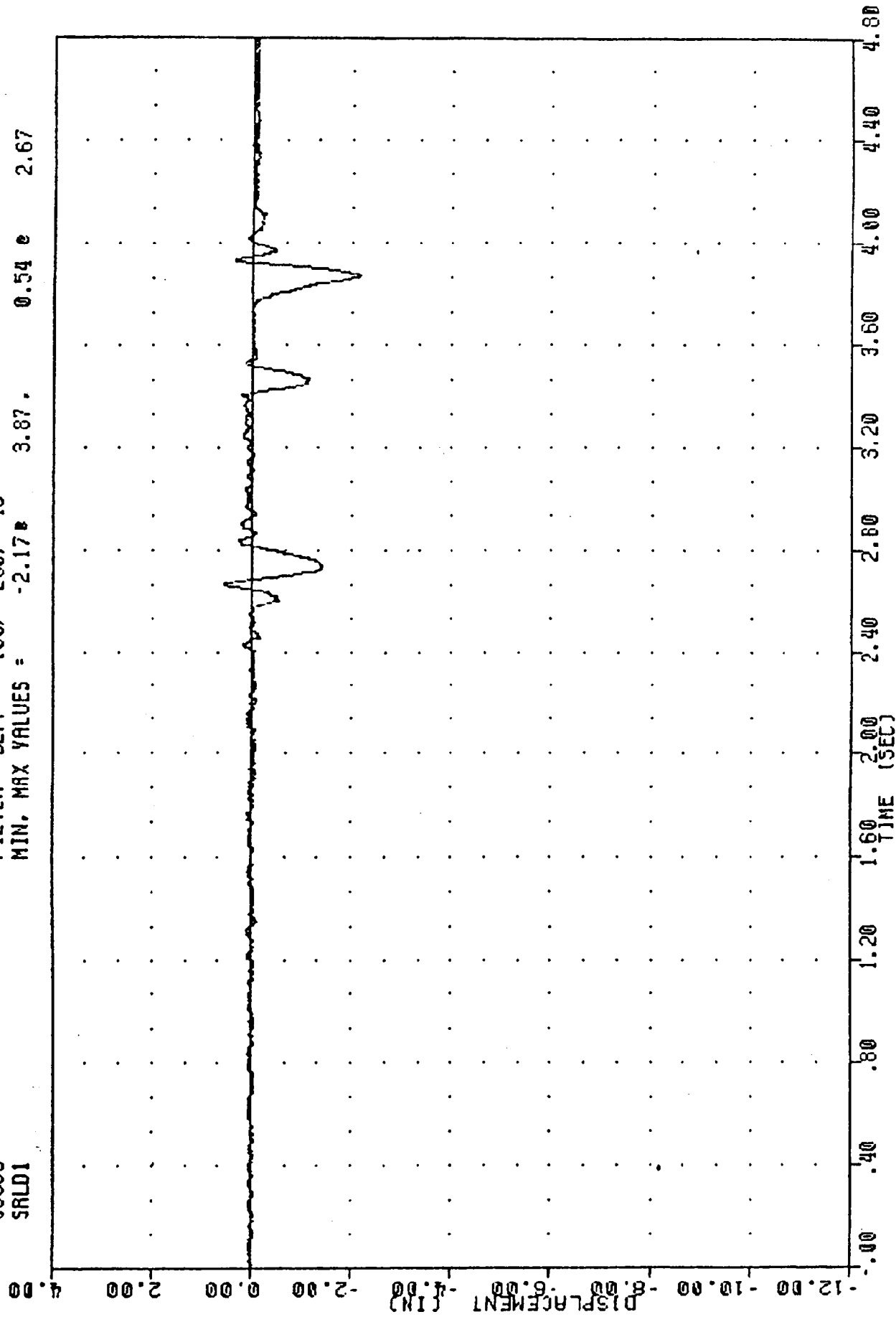
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -5.14 2.97 0.08 2.42



1989 PONTIAC GRAND AM OFF ROLLOVER CRASH AT 30 MPH
VEHICLE RIGHT FRONT SUSPENSION DISPLACEMENT

UCI NHTSA .891129
CONTROLLED ROLLOVER CRASH
89333
SRD01

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -2.17 0.54 2.67



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT REAR SUSPENSION DISPLACEMENT

891129

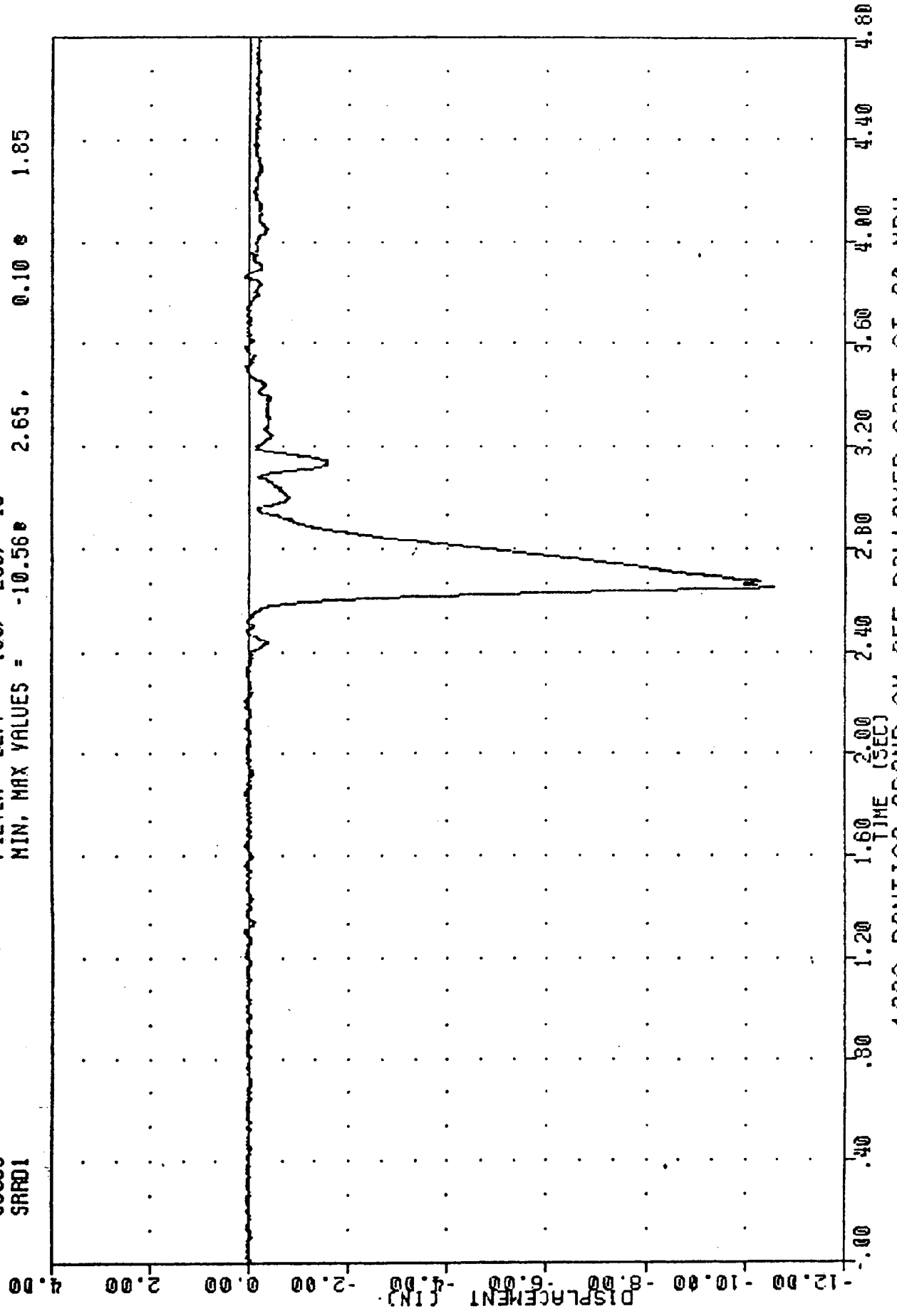
CONTROLLED ROLLOVER CRASH

89333

SRFD1

FILTER = BLPP 100/ 250/ -16

MIN, MAX VALUES = -10.56 2.65 0.10 1.85



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE RIGHT REAR SUSPENSION DISPLACEMENT

831129

CONTROLLED ROLLOVER CRASH

89333

YCGXG2

FILTER = BLPP 100/ 250/ -16

MIN, MAX VALUES = -25.99 0.12, 133.93 0.06

20.00

15.00

10.00

5.00

0.00

-5.00

-10.00

-15.00

-20.00

ACCELERATION (G)

See TEST ANOMALIES

0.00

.40

.80

1.20

1.60

2.00

2.40

2.80

3.20

3.60

4.00

4.40

4.80

TIME (SEC)

1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY X AXIS ACCELERATION

TNHISA, 891129

CONTROLLED ROLLOVER CRASH

89333

VC6Z62

FILTER = BLPP 100/ 250/ -16

MIN. MAX VALUES = -69.01 102.71 e 0.06

20.00

15.00

10.00

5.00

0.00

-5.00

-10.00

-15.00

-20.00

ACCELERATION (G)

See TEST ANOMALIES

-0.00

.40

.80

1.20

1.60

2.00

2.40

2.80

3.20

3.60

4.00

4.40

4.80

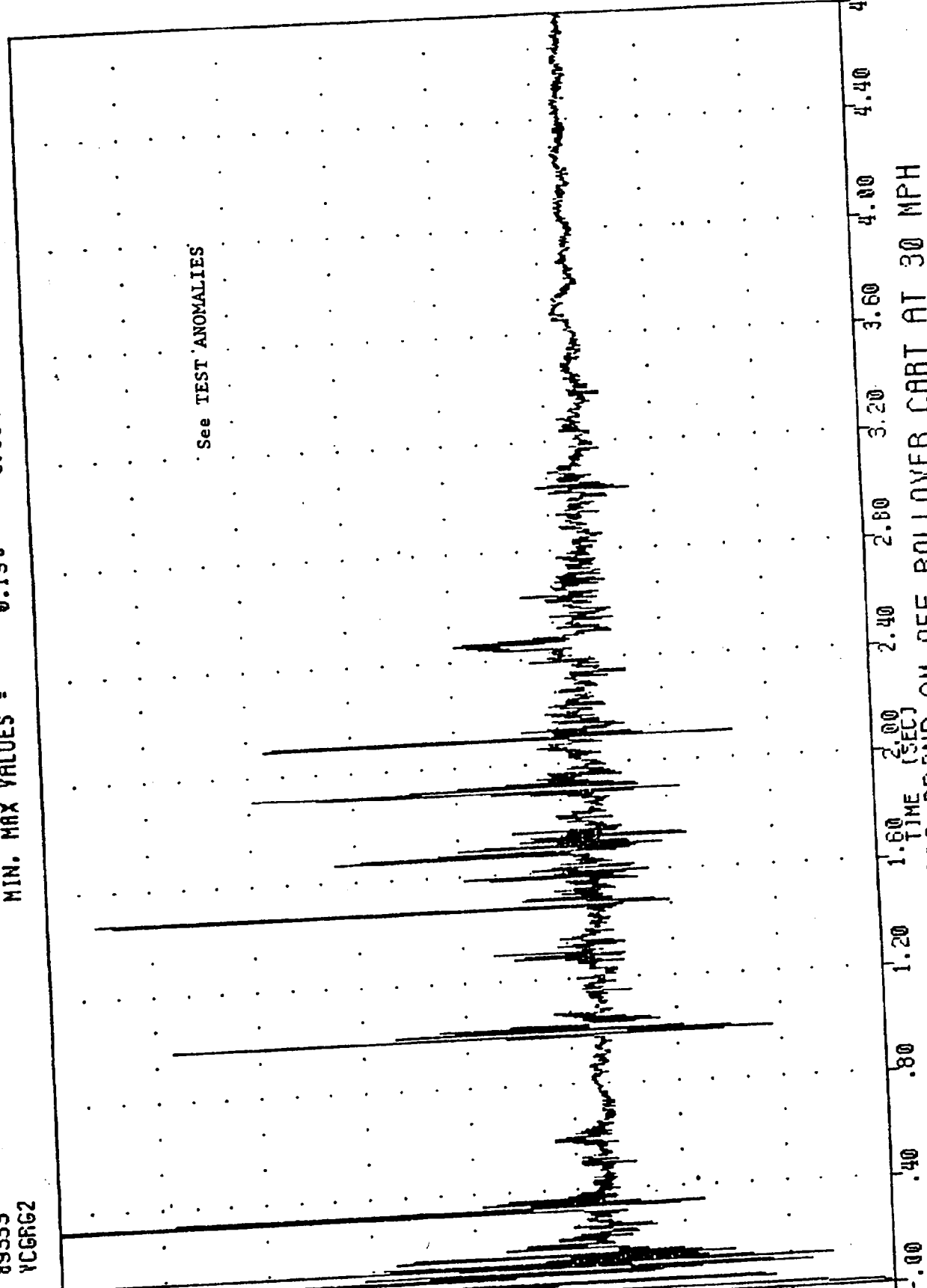
TIME (SEC)

1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Z AXIS ACCELERATION

SA, 831129
CONTROLLED ROLLOVER CRASH
89333
YCGRG2

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = 0.00. 117.66 e 0.06

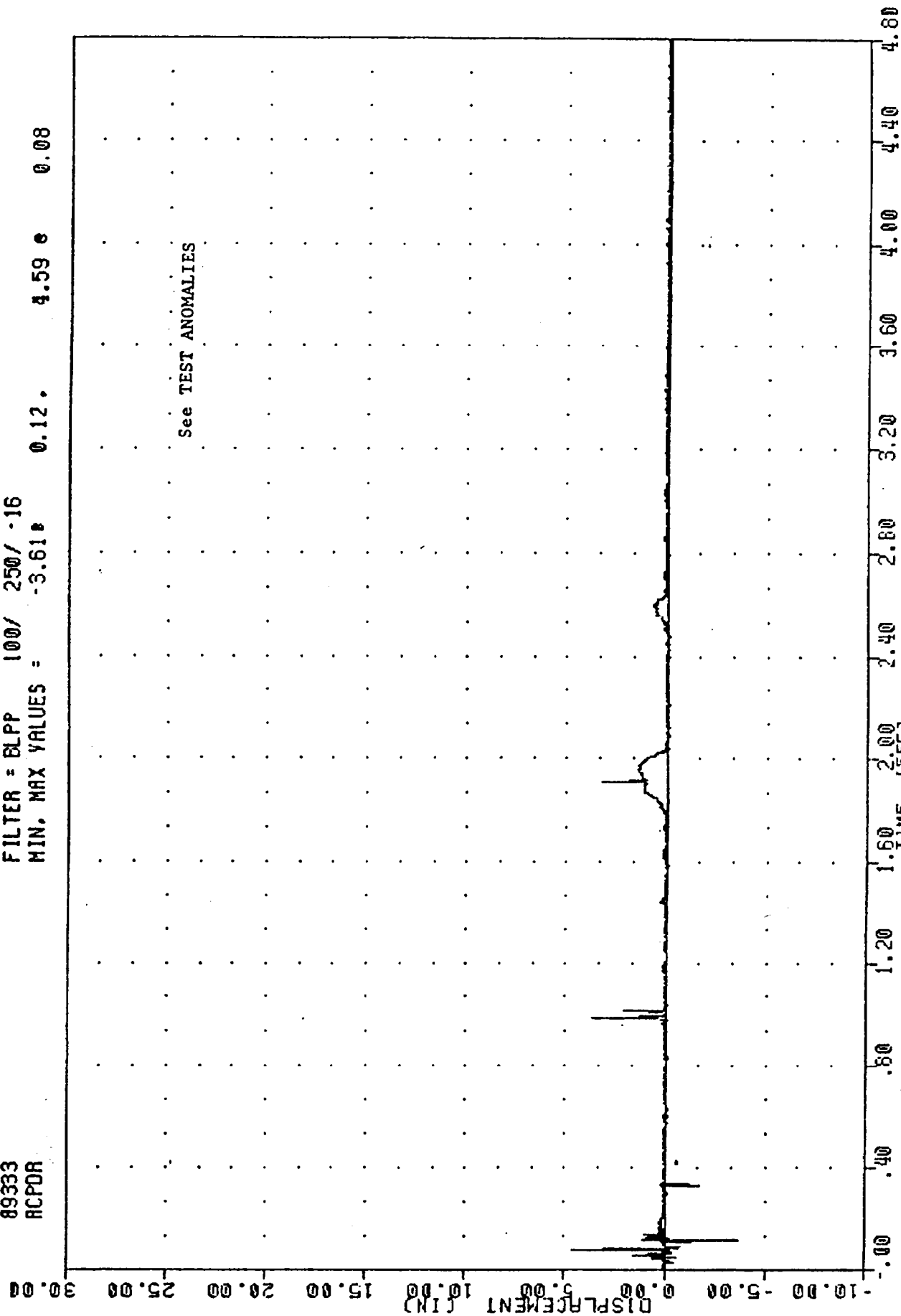
ACCELERATION (G)



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY RESULTANT ACCELERATION

U.S. NHTSA, 891129
CONTROLLED ROLLOVER CRASH
89333
RCPDR

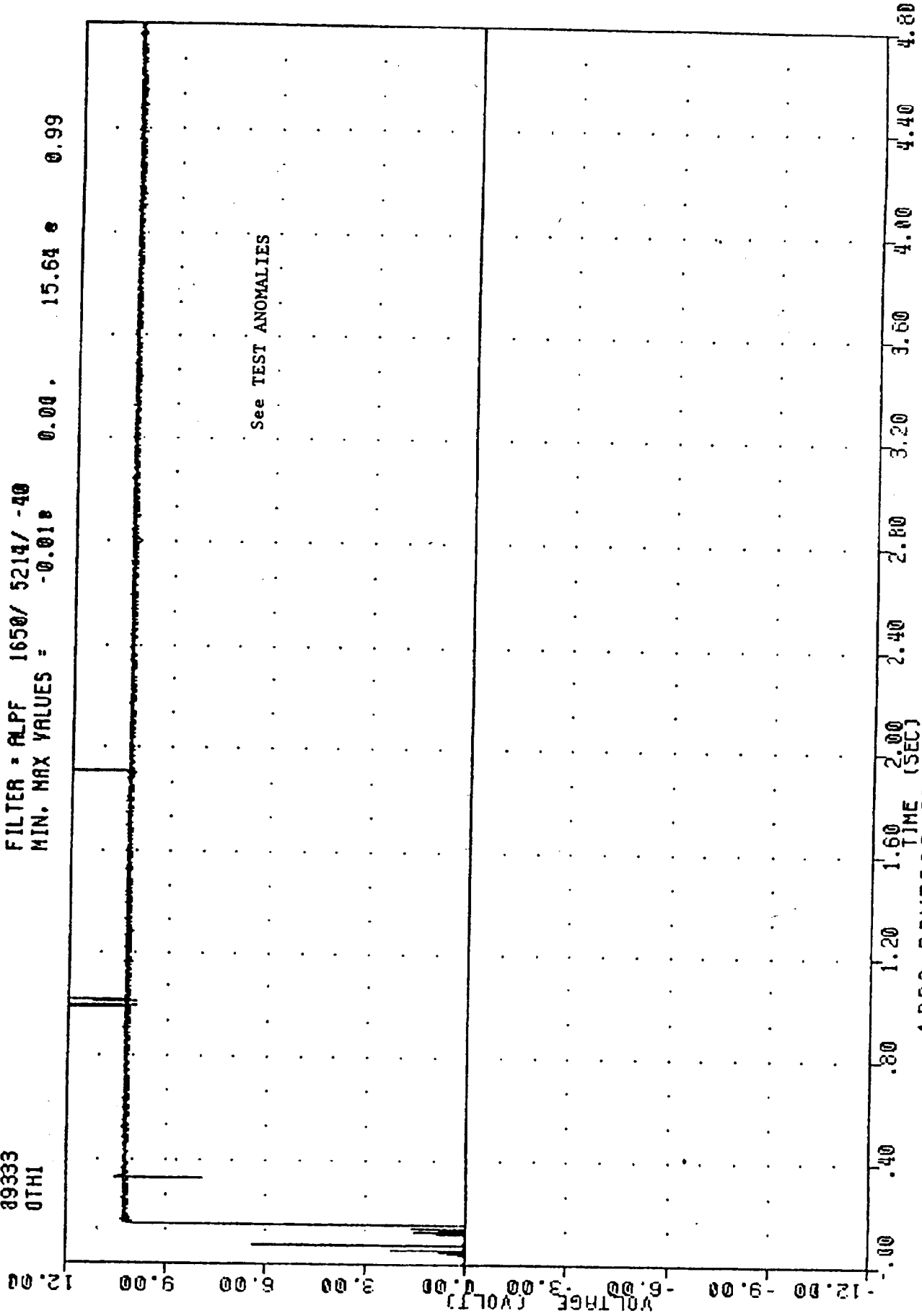
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -3.61 0.12 4.59 0.08



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
ROLL CART RIGHT CYLINDER DISPLACEMENT

PONTIAC, 831129
CONTROLLED ROLLOVER CRASH
89333
0TH1

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -0.018 0.00 15.64 0.99



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - UPPER SWITCH

WATSA 831129

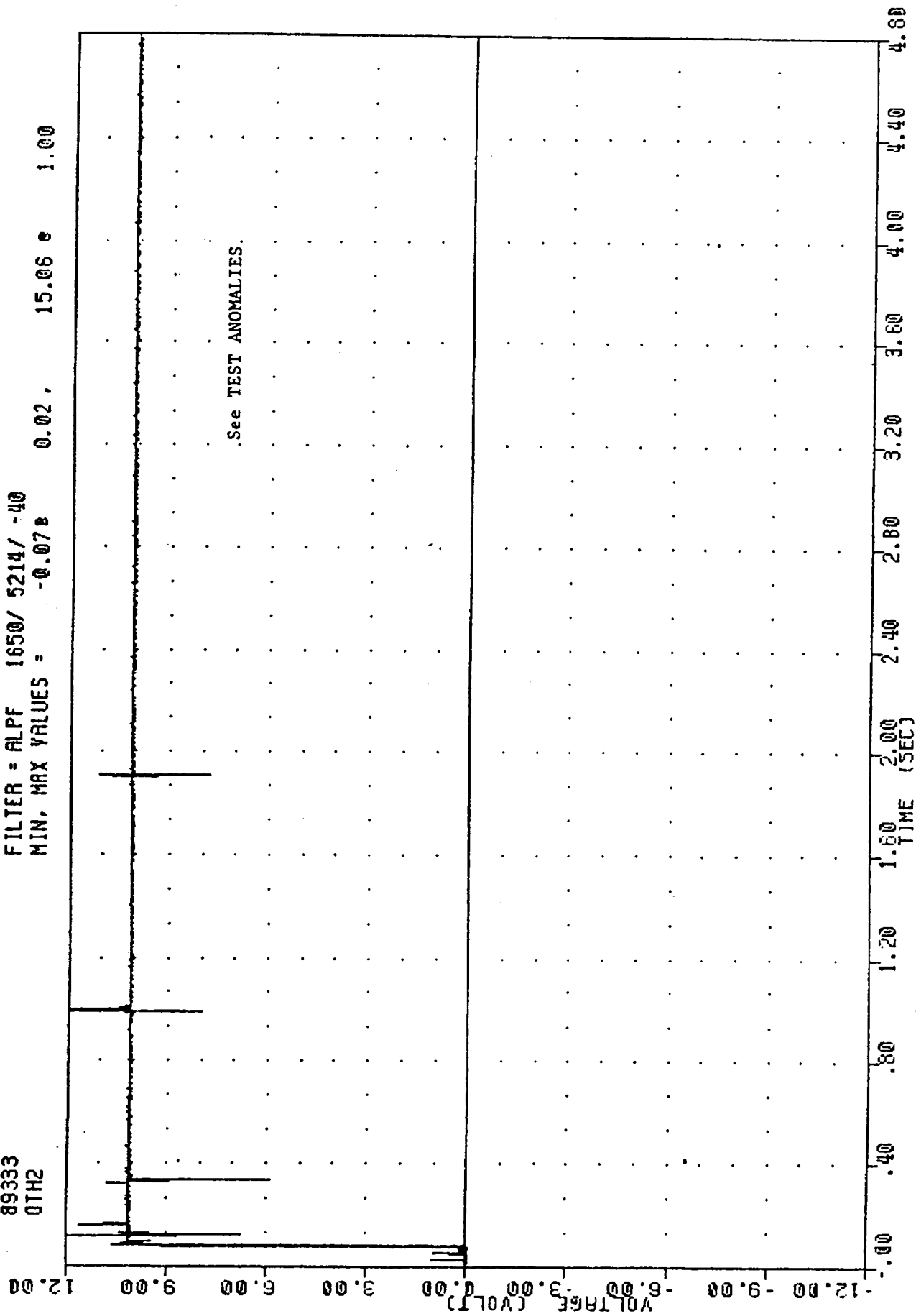
CONTROLLED ROLLOVER CRASH

89333

0TH2

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -0.078 0.02 15.06 1.00



1989 PONTIAC GRAND AM OFF ROLLOVER CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - LOWER SWITCH

APPENDIX C

DUMMY CERTIFICATION

DUMMY HEAD S/N.: 245

DUMMY HYBRID III S/N.: 192

TRANSPORTATION RESEARCH CENTER OF OHIO
HYBRID III EXTERNAL DIMENSIONS
192 HUMANOID

27-DEC-89

SRL	192C4ED1	572E SN192 EXT. DIMENSION CAL04		
TEST PARAMETER		(DIMEN.)	SPECIFICATION	TEST RESULTS
TEMPERATURE				72.0 DEG. F
RELATIVE HUMIDITY				15.0 %
LOCATION FOR CHEST CIRCUMFERENCE (AA)			16.9-17.1 IN	17.0 IN
LOCATION FOR WAIST CIRCUMFERENCE (BB)			8.9- 9.1 IN	9.0 IN
CHEST CIRCUMFERENCE		(Y)	38.2-39.4 IN	38.6 IN
WAIST CIRCUMFERENCE		(Z)	32.9-34.1 IN	33.3 IN
CHEST DEPTH		(D)	8.4- 9.0 IN	8.7 IN
H-POINT HEIGHT		(C)	3.3- 3.5 IN	3.3 IN
H-POINT FROM SEATBACK		(D)	5.3- 5.5 IN	5.4 IN
SKULL CAP TO BACKLINE		(H)	1.6- 1.8 IN	1.7 IN
TOTAL SITTING HEIGHT		(A)	34.6-35.0 IN	34.8 IN
THIGH CLEARANCE		(F)	5.5- 6.1 IN	5.9 IN
BUTTOCK KNEE LENGTH		(K)	22.8-23.8 IN	23.7 IN
BUTTOCK POPLITEAL LENGTH		(N)	17.8-18.8 IN	18.6 IN
POPLITEAL HEIGHT		(L)	16.9-17.9 IN	17.8 IN
KNEE PIVOT HEIGHT		(M)	19.1-19.7 IN	19.5 IN
FOOT LENGTH		(P)	9.9-10.5 IN	10.3 IN
FOOT BREADTH		(W)	3.6- 4.2 IN	4.0 IN
SHOULDER PIVOT FROM BACKLINE		(E)	3.3- 3.7 IN	3.7 IN
SHOULDER BREADTH		(V)	16.6-17.2 IN	16.9 IN
SHOULDER PIVOT HEIGHT		(B)	19.9-20.5 IN	20.3 IN
ELBOW REST HEIGHT		(J)	7.5- 8.3 IN	8.1 IN
SHOULDER-ELBOW LENGTH		(I)	13.0-13.6 IN	13.4 IN
BACK OF ELBOW TO WRIST PIVOT		(G)	11.4-12.0 IN	11.5 IN

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Chas. Middleton

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK FLEXION TEST

HYBRID III

27-Dec-89

3 AXIS NECK TRANSDUCER
SRL 192C4NF1

572E SN192 NECK FLEXION CAL04

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		69 - 72 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY		10% - 70%	14.00 %
IMPACT VELOCITY		22.6-23.4 FT/SEC	22.86 FT/SEC
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	23.25 G
	20 MS	17.60 - 22.60 G	18.93 G
	30 MS	12.50 - 18.50 G	16.23 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	16.17 G
DECELERATION-TIME CURVE			
DECAY TIME TO 5 G		34 - 42 MS	38.13 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	73.60 DEG.
	TIME	57 - 64 MS	60.25 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	65 - 80 FT.LBS	67.31 FT.LBS
	TIME	47 - 58 MS	53.00 MS
ROTATION ANGLE-TIME CURVE			
DECAY TIME TO ZERO		113 - 128 MS	118.00 MS
POSITIVE MOMENT-TIME CURVE			
DECAY TIME TO ZERO		97 - 107 MS	100.75 MS

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN Chas Middleton

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK EXTENSION TEST

HYBRID III

27-Dec-89

3 AXIS NECK TRANSDUCER
SRL 192C4NE1

572E SN192 NECK EXT. CAL4

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	69 - 72 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	14.00 %
IMPACT VELOCITY	19.50-20.30 FT/SEC	19.83 FT/SEC
PENDULUM	10 MS 17.20 - 21.20 G	17.71 G
DECELERATION	20 MS 14.00 - 19.00 G	15.44 G
	30 MS 11.00 - 16.00 G	13.75 G
MAX PENDULUM G ABOVE 30 MS	22 G MAX	13.69 G
DECELERATION-TIME CURVE		
DECAY TIME TO 5 G	38 - 46 MS	42.88 MS
D PLANE	MAX 81 - 106 DEG.	99.79 DEG.
ROTATION	TIME 72 - 82 MS	79.00 MS
MOMENT ABOUT OCCIPITAL	MIN -59.0/-39.0 FT.LBS	-49.74 FT.LBS
CONDYLE	TIME 65 - 79 MS	75.00 MS
ROTATION ANGLE-TIME CURVE		
DECAY TIME TO ZERO	147 - 174 MS	162.38 MS
NEGATIVE MOMENT-TIME CURVE		
DECAY TIME TO ZERO	120 - 148 MS	147.13 MS

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN

Chas. Middleton

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

HYBRID III

27-Dec-89

SRL

192C4TH1

572E SN192 H.S. THORAX CAL04

HIGH SPEED TEST		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	69 - 72 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	15.00 %
PENDULUM VELOCITY	21.6-22.4 FT/SEC	21.92 FT/SEC
MAXIMUM DEFLECTION	2.50 - 2.86 IN	2.67 IN
MAXIMUM RESISTIVE FORCE	1160 - 1325 LBS	1225.1 LBS
INTERNAL HYSTERESIS	69% - 85%	73.7%

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN Chris. Middleton

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

HYBRID III

27-Dec-89

LEFT
SRLKNEE
192C4LK1

572E SN192 L.KNEE 11LB CAL 04

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	15.00 %
PROBE VELOCITY	6.8 - 7.0 FT/SEC	6.87 FT/SEC
PEAK KNEE IMPACT FORCE	1060 - 1300 LBS	1221.74 LBS
PROBE WEIGHT	11.0 LBS	

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN

Chas. Middleton

APPENDIX D

MISCELLANEOUS TEST INFORMATION

PRE-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson

Date: 11/27/89

Checked By: J. Chrstos

Date: 12/22/89

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Pontiac Grand AM

NHTSA ID Code (7 characters): _____ / Model Year (2 digits): 89

Vehicle Make (2 characters): 03

11 = American	02 = Ford	64 = Nissan
12 = Audi	40 = GMC	48 = Odyssey
53 = Battronics	23 = Honda	06 = Oldsmobile
27 = BMW	34 = Hyundai	14 = Peugeot
04 = Buick	41 = IH	05 = Plymouth
10 = Cadillac	42 = Isuzu	03 = Pontiac
35 = Champion	44 = Jeep	17 = Renault
36 = Checker	54 = Jet	30 = Saab
01 = Chevrolet	22 = Lectra	26 = Subaru
37 = Chinook	59 = Lectric	33 = Suzuki
21 = Chrysler	13 = Lincoln	16 = Toyota
29 = Comuta	18 = Mazda	31 = Triumph
15 = Datsun	28 = Mercedes	56 = UM
38 = Delorean	09 = Mercury	08 = Volkswagen
07 = Dodge	25 = MG	20 = Volvo
58 = Eva	62 = Mitsubishi	60 = Winnebago
19 = Fiat	32 = NHTSA	24 = Yugo
99 = Other: _____		

Vehicle Model (2 characters = see appendix B): _____

Body Style (2 characters): _____

2C = 2 Door Coupe	SW = Stationwagon
2S = 2 Door Sedan	PU = Pickup Truck
3H = 3 Door Hatchback	TR = Truck
4S = 4 Door Sedan	VN = Van
5H = 5 Door Hatchback	BU = Bus
OH = Other: _____	MP = Multipurpose
	UT = Utility

VIN Number (20 characters): 1G2NE14U5KC729045

Odometer Reading: NA

Thousands of Miles: NA

Overall Length: 176.0

(in) x 25.4 =: 4470 (mm)

Wheelbase: 103.5

(in) x 25.4 =: 2629 (mm)

Front Track: 55.8

(in) x 25.4 =: 1417 (mm)

Rear Track: 55.3

(in) x 25.4 =: 1405 (mm)

Roof Height: 53.3

(in) x 25.4 =: 1354 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 3440 (lbs) x 4.45 =: 15308 (N)
 FRONT G.A.W.R.: 1889 (lbs) x 4.45 =: 8406 (N)
 REAR G.A.W.R.: 1551 (lbs) x 4.45 =: 6902 (N)

The following tire loadings are measured with vehicle at Curb Weight.

Weight on RF Tire: 833 (lbs) x 4.45 =: 3707 (N)
 Weight on LF Tire: 860 (lbs) x 4.45 =: 3827 (N)
 Weight on LR Tire: 610 (lbs) x 4.45 =: 2714 (N)
 Weight on RR Tire: 533 (lbs) x 4.45 =: 2372 (N)
 Vehicle Test Weight: 2836 (lbs) x 4.45 =: 12620 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 41.71 (in) x 25.4 =: 1059.4 (mm)
 From Center Line: -1.02 (in) x 25.4 =: -25.9 (mm)
 Engine Displacement: 152.5 (cu in) x 0.0164 =: 2.5 (L)

Engine Type (2 characters): L4

L3 F4 L4
 V4 F6 L6
 V6 V8 RT = Rotary
 L5 OT = Other: _____

Engine Location (1 character): F

F = Front M = Mid R = Rear

Engine Orientation (1 character): T

L = Longitudinal T = Transverse

Transmission Type: M

M = Manual A = Automatic

Drive Axle (1 character): F

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters): Pre rollover test.

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): F233

Front/Rear Flag (1 character): F

Axle Type (1 character): I
I = Independent S = Solid

Suspension Type (1 character): S

A = Unequal A Arm	T = Semi-Trailing Arm
L = Leaf	W = Twist
M = Multiple Link	4 = 4 Link
Q = Torque Arm	3 = 3 Link
S = Strut	I = Twin I Beam
O = Other: _____	

Spring Type (2 characters): CO

CO = Coil	TB = Torsion Bar
LL = Longitudinal Leaf	TL = Transverse Leaf
OT = Other: _____	

Brake Type (2 characters): DI

DI = Disk	LT = Leading-Trailer Shoe
DS = Duo-Servo Shoe	
OT = Other: _____	

Suspension Modified (1 character): N

N = No Y = Yes

Suspension Modification

R = Raised	L = Lowered
S = Stiffened	W = Widened
O = Other	

1 = _____
2 = _____

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Tire Manufacturer (10 characters): General

Tire Size Code (10 characters): 185/80R13

Tire Construction (2 characters): SB

BB = Bias Belted

GP = Glass Belted Radial

BP = Bias Ply

SB = Steel Belted Radial

OT = Other: _____

Tire Rim width: 5.0 (in) X 25.4 =: 127.0 (mm)

Axle Height: 11.5 (in) X 25.4 =: 292.1 (mm)

Tire Pressure: 35.0 (psi) X 6.897 =: 241.4 (kpa)

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Suspension Number (4 digits): R233

Front/Rear Flag (1 character): R

Axle Type (1 character): S
I = Independent S = Solid

Suspension Type (1 character): T

A = Unequal A Arm	T = Semi-Trailing Arm
L = Leaf	W = Twist
M = Multiple Link	4 = 4 Link
Q = Torque Arm	3 = 3 Link
S = Strut	I = Twin I Beam
O = Other: _____	

Spring Type (2 characters): CO

CO = Coil	TB = Torsion Bar
LL = Longitudinal Leaf	TL = Transverse Leaf
OT = Other: _____	

Brake Type (2 characters): DS

DI = Disk	LT = Leading-Trailer Shoe
DS = Duo-Servo Shoe	
OT = Other: _____	

Suspension Modified (1 character): N

N = No Y = Yes

Suspension Modification

R = Raised	L = Lowered
S = Stiffened	W = Widened
O = Other	

1 = _____
2 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): General

Tire Size Code (10 characters): 185/80R13

Tire Construction (2 characters):

BB = Bias Belted

GP = Glass Belted Radial

BP = Bias Ply

SP = Steel Belted Radial

OT = Other:

Tire Rim Width: 5.0 (in) X 25.4 =: 127.0 (mm)

Axle Height: 11.8 (in) X 25.4 =: 299.7 (mm)

Tire Pressure: 35.0 (psi) X 6.897 =: 241.4 (kpa)

IPMD RELEASED 1-7-71

IPMD Calibration Check (no vehicle):

<u>Applied Weight (lbs)</u>	<u>Schaevitz Output (Volts)</u>
0	0.116
+100	1.056
+200	1.963
0	0.118
-100	-0.827
-200	-1.742
0	0.115

C.G. HEIGHT:

<u>Applied Weight (lbs)</u>	<u>Schaevitz Output (Volts)</u>	<u>Resultant Longitudinal Movement (mv)</u>
0	0.086	3.608
+100	0.695	3.673
+200	1.302	3.755
0	0.093	3.634
-100	-0.509	3.582
-200	-1.109	3.521
0	0.084	3.602

Calculated C.G. Height (in): 21.582

Pitch Inertia:

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Relative Motion Amplitude (mv)</u>
1	3.75	272	119
2	3.75	274	127
3	3.75	274	125

Pitch Inertia (ft. lb. sec²): 1645.790

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 45.9

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Amplitude (mv)</u>
1	<u>2.34</u>	<u>217</u>	<u>206</u>
2	<u>2.34</u>	<u>220</u>	<u>212</u>
3	<u>2.34</u>	<u>220</u>	<u>208</u>

Roll Inertia (ft. lb. sec²): 321.941

Yaw Inertia:

Distance between ramps (in): 45.9

String Pot Offset from platform center (in): 65.3

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Relative Motion</u>
1	<u>2.24</u>	<u>123</u>	<u>144</u>
2	<u>2.23</u>	<u>139</u>	<u>172</u>
3	<u>2.23</u>	<u>138</u>	<u>178</u>

Yaw Inertia (ft. lb. sec²): 1664.699

POST-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson

Date: 12/15/89

Checked By: J. Chrstos

Date: 12/22/89

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Pontiac Grand AM

NHTSA ID Code (7 characters): _____ / Model Year (2 digits): 89

Vehicle Make (2 characters): 03

11 - American	02 - Ford	64 = Nissan
12 = Audi	40 = GMC	48 = Odyssey
53 = Battronics	23 = Honda	06 = Oldsmobile
27 = BMW	34 = Hyundai	14 = Peugeot
04 = Buick	41 = IH	05 = Plymouth
10 = Cadillac	42 = Isuzu	03 = Pontiac
35 = Champion	44 = Jeep	17 = Renault
36 = Checker	54 = Jet	30 = Saab
01 = Chevrolet	22 = Lectra	26 = Subaru
37 = Chinook	59 = Lectric	33 = Suzuki
21 = Chrysler	13 = Lincoln	16 = Toyota
29 = Comuta	18 = Mazda	31 = Triumph
15 = Datsun	28 = Mercedes	56 = UM
38 = Delorean	09 = Mercury	08 = Volkswagen
07 = Dodge	25 = MG	20 = Volvo
58 = Eva	62 = Mitsubishi	60 = Winnebago
19 = Fiat	32 = NHTSA	24 = Yugo
99 = Other: _____		

Vehicle Model (2 characters = see appendix B): _____

Body Style (2 characters): _____

2C = 2 Door Coupe
 2S = 2 Door Sedan
 3H = 3 Door Hatchback
 4S = 4 Door Sedan
 5H = 5 Door Hatchback
 OH = Other: _____

SW = Stationwagon
 PU = Pickup Truck
 TR = Truck
 VN = Van
 BU = Bus
 MP = Multipurpose
 UT = Utility

VIN Number (20 characters): 1G2NE14USKC729045

Odometer Reading: NA

Thousands of Miles: NA

Overall Length: 176.0

(in) x 25.4 =: 4470 (mm)

Wheelbase: 103.5

(in) x 25.4 =: 2629 (mm)

Front Track: 55.8

(in) x 25.4 =: 1417 (mm)

Rear Track: 55.3

(in) x 25.4 =: 1405 (mm)

Roof Height: 53.0

(in) x 25.4 =: 1346 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 3440 (lbs) x 4.45 =: 15308 (N)
 FRONT G.A.W.R.: 1889 (lbs) x 4.45 =: 8406 (N)
 REAR G.A.W.R.: 1551 (lbs) x 4.45 =: 6902 (N)

The following tire loadings are measured with vehicle at Curb Weight.

Weight on RF Tire: 811 (lbs) x 4.45 =: 3609 (N)
 Weight on LF Tire: 881 (lbs) x 4.45 =: 3920 (N)
 Weight on LR Tire: 563 (lbs) x 4.45 =: 2505 (N)
 Weight on RR Tire: 574 (lbs) x 4.45 =: 2554 (N)
 Vehicle Test Weight: 2829 (lbs) x 4.45 =: 12589 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 41.49 (in) x 25.4 =: 1053.8 (mm)
 From Center Line: -0.65 (in) x 25.4 =: 16.5 (mm)
 Engine Displacement: 152.5 (cu in) x 0.0164 =: 2.5 (L)

Engine Type (2 characters): L4

L3 F4 L4
 V4 F6 L6
 V6 V8 RT = Rotary
 L5 OT = Other: _____

Engine Location (1 character): F

F = Front M = Mid R = Rear

Engine Orientation (1 character): T

L = Longitudinal T = Transverse

Transmission Type: M

M = Manual A = Automatic

Drive Axle (1 character): F

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters): Post rollover test.

Front tires are flat..

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Vehicle Model Number (4 digits): F233

Front Rear Flag (1 character): F

Axle Type (1 character): I

I = Independent S = Solid

Suspension Type (1 character): S

A = Unequal A Arm

L = Leaf

M = Multiple Link

Q = Torque Arm

S = Strut

O = Other: _____

T = Semi-Trailing Arm

W = Twist

4 = 4 Link

3 = 3 Link

I = Twin I Beam

Spring Type (2 characters): CO

CO = Coil

LL = Longitudinal Leaf

OT = Other: _____

TB = Torsion Bar

TL = Transverse Leaf

Brake Type (2 characters): DI

DI = Disk

DS = Duo-Servo Shoe

OT = Other: _____

LT = Leading-Trailer Shoe

Suspension Modified (1 character): N

N = No

Y = Yes

Suspension Modification

R = Raised

L = Lowered

S = Stiffened

W = Widened

O = Other

1 = _____

2 = _____

1961 VEHICLE DATA SHEET

FRONT SUSPENSION

Manufacturer (10 characters): General

Tire Size (10 characters): 195R13

Tire Construction (2 characters): SB

BB = Bias Belted

GP = Glass Belted Radial

BP = Bias Ply

SB = Steel Belted Radial

OT = Other: _____

Tire Rim width: 5.0 (in) X 25.4 =: 127.0 (mm)

Axle Height: 7.6 (in) X 25.4 =: 193.0 (mm)

Tire Pressure: _____ (psi) X 6.897 =: _____ (kPa)

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Suspension Number (4 digits): R233

Front/Rear Flag (1 character): R

Axle Type (1 character): S
I = Independent S = Solid

Suspension Type (1 character): T

A = Unequal A Arm	T = Semi-Trailing Arm
L = Leaf	W = Twist
M = Multiple Link	4 = 4 Link
Q = Torque Arm	3 = 3 Link
S = Strut	I = Twin I Beam
O = Other: _____	

Spring Type (2 characters): CO

CO = Coil	TB = Torsion Bar
LL = Longitudinal Leaf	TL = Transverse Leaf
OT = Other: _____	

Brake Type (2 characters): DS

DI = Disk	LT = Leading-Trailer Shoe
DS = Duo-Servo Shoe	
OT = Other: _____	

Suspension Modified (1 character): N

N = No Y = Yes

Suspension Modification

R = Raised	L = Lowered
S = Stiffened	W = Widened
O = Other	

1 = _____
2 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): General

Tire Size Code (10 characters): 185/80R13

Tire Construction (2 characters):

BB = Bias Belted

GP = Glass Belted Radial

BP = Bias Ply

SP = Steel Belted Radial

OT = Other:

Tire Rim Width: 5.0 (in) X 25.4 =: 127.0 (mm)

Axle Height: 11.8 (in) X 25.4 =: 299.7 (mm)

Tire Pressure: 35.0 (psi) X 6.897 =: 241.4 (kpa)

IPMD MEASURED DATA

IPMD Calibration Check (no vehicle):

<u>Applied Weight (lbs)</u>	<u>Schaevitz Output (Volts)</u>
0	<u>-0.102</u>
+100	<u>-1.040</u>
+200	<u>-1.931</u>
0	<u>-0.105</u>
-100	<u>-0.844</u>
-200	<u>-1.771</u>
0	<u>-0.104</u>

C.G. HEIGHT:

<u>Applied Weight (lbs)</u>	<u>Schaevitz Output (Volts)</u>	<u>Resultant Longitudinal Movement (in)</u>
0	<u>-0.023</u>	<u>0.866</u>
+100	<u>-0.572</u>	<u>0.902</u>
+200	<u>-1.114</u>	<u>1.025</u>
0	<u>-0.026</u>	<u>0.865</u>
-100	<u>0.529</u>	<u>0.842</u>
-200	<u>1.082</u>	<u>0.720</u>
0	<u>-0.019</u>	<u>0.745</u>

Calculated C.G. Height (in): 18.799

Pitch Inertia:

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Relative Motion Amplitude (mv)</u>
1	<u>3.62</u>	<u>341</u>	<u>118</u>
2	<u>3.61</u>	<u>348</u>	<u>112</u>
3	<u>3.61</u>	<u>348</u>	<u>129</u>

Pitch Inertia (ft. lb. sec²): 1654.792

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 45.5

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Amplitude (mv)</u>
1	<u>2.29</u>	<u>293</u>	<u>65</u>
2	<u>2.27</u>	<u>289</u>	<u>82</u>
3	<u>2.26</u>	<u>300</u>	<u>71</u>

Roll Inertia (ft. lb. sec²): 325.472

Yaw Inertia:

Distance between ramps (in): 45.5

String Pot Offset from platform center (in): 61.0

<u>Run</u>	<u>Period (sec)</u>	<u>*Amplitude (mv)</u>	<u>Amplitude (mv)</u>
1	<u>2.27</u>	<u>168</u>	<u>106</u>
2	<u>2.19</u>	<u>213</u>	<u>188</u>
3	<u>2.21</u>	<u>209</u>	<u>253</u>

Yaw Inertia (ft. lb. sec²): 1646.116

SIGN CONVENTION

Compression on barrier face load cells is positive.

Compression on femur load cells is positive.

Tension on seat belt load cells is positive.

Outward chest displacement is positive.

All accelerometers:

+X: FORWARD

+Y: LEFTWARD

+Z: UPWARD

Neck load cell:

+X FORCE: HEAD FORWARD

+Y FORCE: HEAD RIGHTWARD

+Z FORCE: HEAD UPWARD (TENSION ON NECK)

+X MOMENT: RIGHT EAR TO RIGHT SHOULDER

+Y MOMENT: HEAD ROTATING FORWARD

+Z MOMENT: HEAD ROTATING LEFTWARD