V1392

VEHICLE AND DUMMY KINEMATICS IN A CONTROLLED ROLLOVER CRASH 1989 FORD BRONCO II

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

V 1392

ERRATA (as of Nov 93)
Test Number 891113

1. The following channel on the Sign Convention Sheet at the end of Appendix D should read:

   Neck Load Cells: +Y Force: Head Pushed Leftward

2. All neck load cell moments should be labeled lb-ft, instead of lb-in, including:

   Dummy Data Summary Sheet, page 4-4.
   Plots, Appendix B
   - Driver Neck Moment About X Axis
   - Driver Neck Moment About Y Axis
   - Driver Neck Moment About Z Axis

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.

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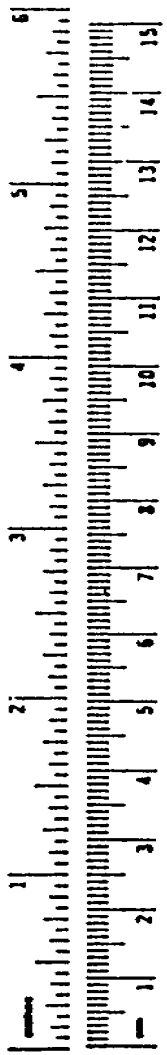
METRIC CONVERSION FACTORS

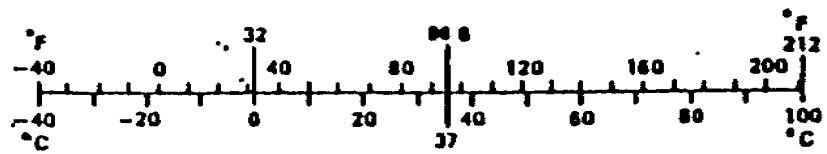
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric ton	t
	VOLUME			
tsp	teaspoons	5	milliliters	mL
Tbsp	tablespoons	15	milliliters	mL
in^3	cubic inches	16	milliliters	mL
fl oz	fluid ounces	30	milliliters	mL
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	degrees Fahrenheit	5/9 (after subtracting 32)	degrees Celsius	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10 000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton (1000 kg)	1.1	short tons	
	VOLUME			
mL	milliliters	0.03	fluid ounces	fl oz
mL	milliliters	0.06	cubic inches	in^3
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	degrees Celsius	9/5 (then add 32)	degrees Fahrenheit	°F



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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 Ford Bronco II 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 rolover cart motion. The test vehicle contained an instrumented Part 572E dummy with a three-point unibelt restraint system. The vehicle was oriented to first contact its right side.

SECTION 2.0

SUMMARY OF ROLLOVER CRASH TEST

A 1989 Ford Bronco II containing one Part 572E instrumented test dummy was placed upon the rollover test device at 30 degrees above the horizontal and was released when the device had reached 30 mph. The device was attached to the tow cable of the drive system and crabbed 0°. After the vehicle had been released the device was brought to a stop with an auxiliary brake system. After release the vehicle impacted the ground on its right side. The vehicle made two full rolls and came to rest on its tires. The rollover crash test was conducted by the Transportation Research Center of Ohio in East Liberty, Ohio on November 13, 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-five 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 six 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 pre-test dummy calibrations. Appendix D contains the pre-test and post-test IPMD vehicle data sheet.

TEST NUMBER 891113

ROLL CART DATA SUMMARY

No.	LOCATION	POSITIVE DIRECTION MAX	POSITIVE DIRECTION SEC	NEGATIVE DIRECTION MAX	NEGATIVE DIRECTION SEC
1	CENTER OF GRAVITY ACCELERATION (g)				
	LONGITUDINAL	3.7	2.3 Y	6.4	2.3 Y
	LATERAL	11.0	2.3 Y	7.7	2.3 Y
	VERTICAL	14.8	2.3 Y	10.4	2.3 Y
	RESULTANT	16.0	2.3 Y		
2	PLATFORM DISPLACEMENT (in)				
	LEFT SIDE	23.8	1.4	0.1	0.4
	RIGHT SIDE	24.5	0.9	0.1	0.4

VEHICLE/ROLL CART SEPARATION TIMES

UPPER SWITCH: 0 8 SEC
LOWER SWITCH. 0.7 SEC

POSITIVE DIRECTION	
LONGITUDINAL	FORWARD
LATERAL	LEFTWARD
VERTICAL	UPWARD
DISPLACEMENT	OUTWARD

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

Y See TEST ANOMALIES

FINAL RESTING PLACES OF PARTS AND CARS

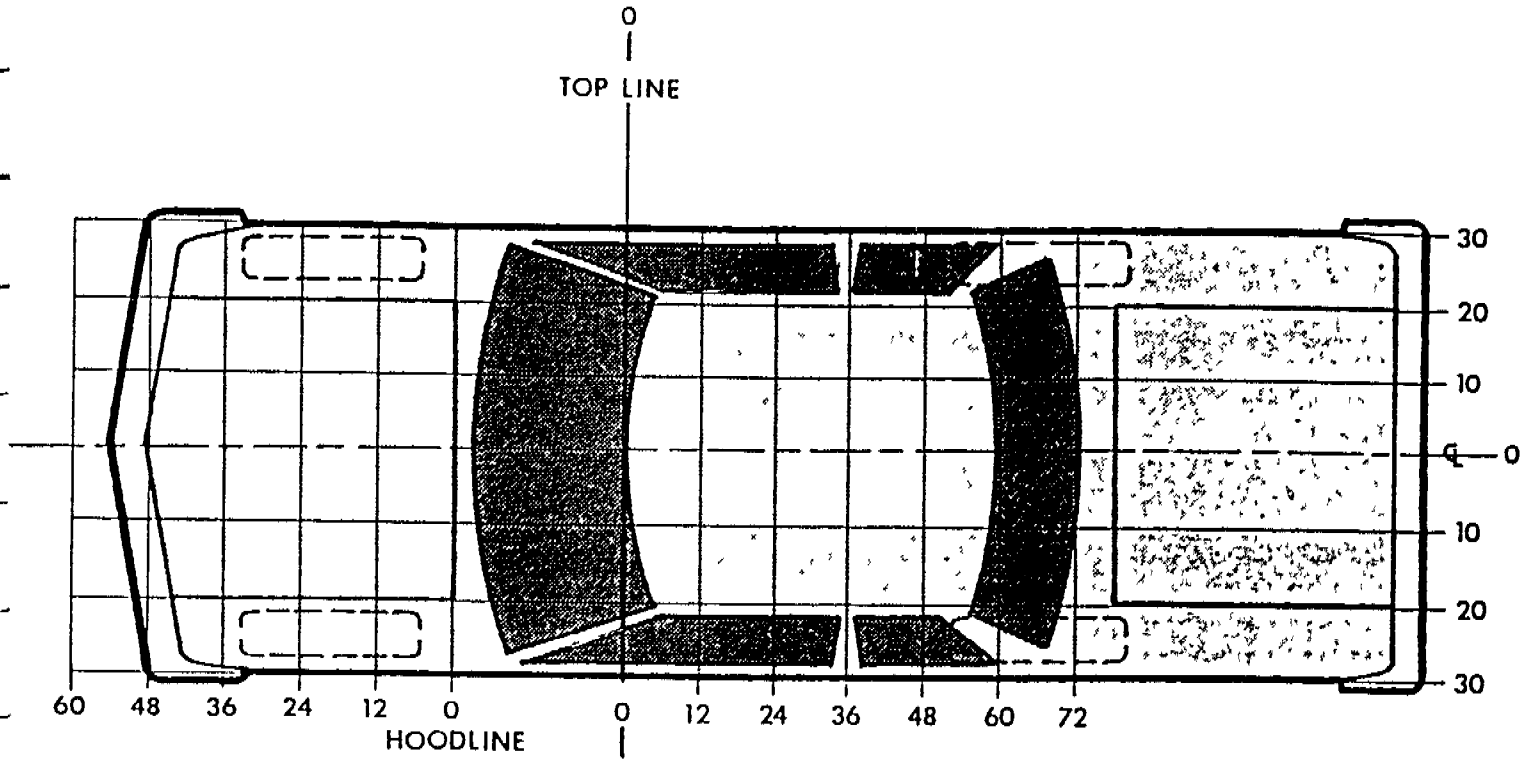
DESCRIPTION OF PART	DISTANCE, FT*	DISTANCE, FT*
1989 Ford Bronco II	105.2	10.6
Rear window rubber frame	87.2	0.9

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

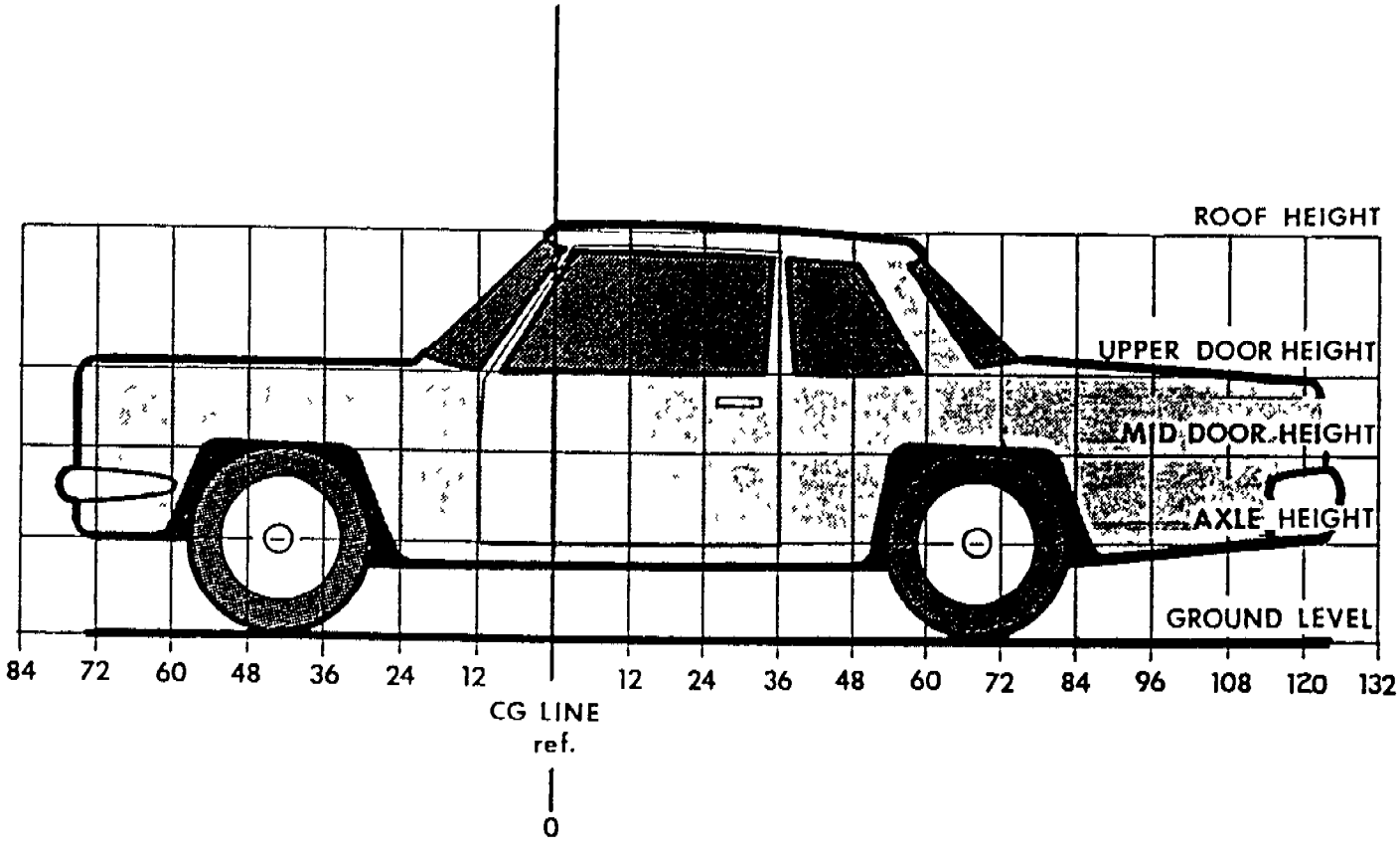
VEHICLE INTERIOR MEASUREMENTS

DESCRIPTION	PRE	POST	DIFF
Floor board to top of left "A" post	40.7	29.5	11.2
Floor board to top of right "A" post	40.8	31.5	9.3
Door sill to top of left "B" post	41.4	37.1	4.3
Door sill to top of right "B" post	41.4	37.2	4.2
Door sill to top of left door opening	43.6	35.0	8.6
Door sill to top of right door opening	43.8	34.4	9.4
Floor tunnel to windshield header	36.5	32.5	4.0
Floor tunnel to center of roof	40.2	33.0	7.2
Rear of floor tunnel to roof	44.2	33.8	10.4
Maximum width at "B" post	53.9	58.0	-4.1
Maximum width at "A" post	53.1	50.0	3.1
Maximum width at top of door opening	48.7	40.5	8.2

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	45.4	45.9	45.8	45.5	45.1	X
Trailing edge of cowl + 12 inches***	X	44.7	45.2	45.6	44.8	44.2	X
Trailing edge of cowl + 24 inches	X	43.8	44.2	44.6	44.1	43.3	X
Trailing edge of cowl + 36 inches	X	41.4	41.8	41.9	41.7	41.4	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	43.9	45.5	47.0	48.4	46.0	X
Trailing edge of cowl + 12 inches	X	43.5	45.9	46.8	47.2	45.8	X
Trailing edge of cowl + 24 inches	X	43.4	44.9	46.2	46.0	45.1	X
Trailing edge of cowl + 36 inches	X	41.0	42.8	43.9	44.4	44.0	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
STATIC CRUSH (IN)							
Trailing edge of cowl at centerline	X	-1.5	-0.4	1.2	2.9	0.9	X
Trailing edge of cowl + 12 inches	X	-1.2	0.7	1.2	2.4	1.6	X
Trailing edge of cowl + 24 inches	X	-0.4	0.7	1.6	1.9	1.8	X
Trailing edge of cowl + 36 inches	X	0.4	1.0	2.0	2.7	2.6	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.
***Longutudinal 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	65.6	65.9	65.9	65.8	65.1
Longitudinal Center of Gravity + 12 inches***	65.8	65.9	65.9	66.5	66.2
Longitudinal Center of Gravity + 24 inches	66.4	66.1	65.9	65.3	66.1
Longitudinal Center of Gravity + 36 inches	66.5	66.1	66.0	65.3	65.8
Longitudinal Center of Gravity + 48 inches	66.1	65.9	65.9	65.2	65.5
Longitudinal Center of Gravity + 60 inches	64.8	65.1	65.1	65.1	65.1
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	51.5	53.4	58.9	59.5	55.7
Longitudinal Center of Gravity + 12 inches	52.0	54.0	56.1	57.9	59.9
Longitudinal Center of Gravity + 24 inches	52.1	53.9	57.3	59.2	59.9
Longitudinal Center of Gravity + 36 inches	52.4	54.5	57.2	59.5	59.5
Longitudinal Center of Gravity + 48 inches	51.6	54.4	57.2	59.7	58.9
Longitudinal Center of Gravity + 60 inches	50.5	53.9	56.9	58.2	59.4
STATIC CRUSH (IN)					
Longitudinal Center of Gravity	-14.1	-12.5	-7.0	-6.3	-9.4
Longitudinal Center of Gravity + 12 inches	-13.8	-11.9	-9.8	-8.6	-6.3
Longitudinal Center of Gravity + 24 inches	-14.3	-12.2	-8.6	-6.1	-6.2
Longitudinal Center of Gravity + 36 inches	-14.1	-11.6	-8.8	-5.8	-6.3
Longitudinal Center of Gravity + 48 inches	-14.5	-11.5	-8.7	-5.5	-6.6
Longitudinal Center of Gravity + 60 inches	-14.3	-11.2	-8.2	-6.9	-5.7

* 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	96
PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	64.2	X	X	X	X	X	22.8	22.2	22.3	X	X	X	X	X	X	X
Upper Door	44.0	X	18 1	17.6	17.2	17 1	17.1	17.2	17.2	17 5	17.1	17.6	17.6	18 3	X	X
Mid Door	31.7	16.9	15.4	15.1	15.6	15.2	15.1	15.1	15.3	15.6	14.8	15.1	15 8	X	X	X
Axle Height	17.0	X	X	X	X	17.9	17.8	17.8	17.8	18 1	X	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	64.2	X	X	X	X	X	38.7	36 2	37.8	X	X	X	X	X	X	X
Upper Door	44.0	X	25.1	24 8	24 4	24.0	24.5	22.7	21.5	21.4	20.4	20.3	19.6	20.0	X	X
Mid Door	31.7	18.9	18 2	18 0	18.5	18.1	16.6	16.2	16.0	16.9	15.8	15.8	16.5	X	X	X
Axle Height	17.0	X	X	X	X	18 4	17.9	18.1	18.3	19 1	X	X	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	64.2	X	X	X	X	X	15.9	14.0	15.5	X	X	X	X	X	X	X
Upper Door	44.0	X	7.0	7.2	7.2	6.9	7.4	5.5	4.3	3.9	3.3	2.7	2.0	1.7	X	X
Mid Door	31.7	2.0	2.8	2.9	2.9	2.9	1.5	1.1	0.7	1.3	1.0	0.7	0.7	X	X	X
Axle Height	17.0	X	X	X	X	0.5	0.1	0.3	0.5	1.0	X	X	X	X	X	X

* Center of gravity is located 52.0 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 stucture 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
PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	64.2	X	X	X	X	X	22.6	21.9	21.8	X	X	X	X	X	X	X
Upper Door	44 0	X	18.4	17.6	17.2	16 9	17.2	16.8	16 4	16.6	16.9	16.9	17.0	17.5	X	X
Mid Door	31.7	16.8	15.1	14.6	15 3	15.0	15.5	15.5	14.9	14.9	14.4	14.8	15.1	X	X	X
Axle Height	17.0	X	X	X	X	17.4	17.8	17.9	17.4	17.4	X	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	64 2	X	X	X	X	X	20.2	20.6	20 2	X	X	X	X	X	X	X
Upper Door	44.0	X	16 4	15.8	15.0	13 5	11.3	11.9	11.4	11.0	12.8	13.9	15.4	16.0	X	X
Mid Door	31.7	15.6	14.0	13.5	14 2	14.2	14.9	12.8	12.0	13.8	13.9	14.1	14.6	X	X	X
Axle Height	17.0	X	X	X	X	18.5	18.6	18.8	18.6	18.5	X	X	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	64.2	X	X	X	X	X	-2.4	-1.3	-1.6	X	X	X	X	X	X	X
Upper Door	44.0	X	-2.0	-1.8	-2.2	-3.4	-5.9	-4.9	-5.0	-5.6	-4.1	-3.0	-1.6	1.5	X	X
Mid Door	31.7	-1.2	-1.1	-1.1	-1.1	-0.8	-0.6	-2.7	-2.9	-1.1	-0.5	-0.7	-0.5	X	X	X
Axle Height	17.0	X	X	X	X	1.1	0.8	0.9	1.2	1.1	X	X	X	X	X	X

* Center of gravity is located 52.0 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 stucture is bowed outward.

IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: Ford Bronco II TEST NUMBER: 891113

NO	TYPE OF MEASUREMENT	DIMENSIONS IN INCHES PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	159.5	160.0	-0.5
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	134.5	132.8	1.7
X3	REAR SURFACE OF VEHICLE TO FIREWALL	117.6	117.4	0 2
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	106.5	105.2	1 3
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	106.0	104.9	1.1
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	106.2	106 0	0.2
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	105.9	105.6	0 3
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	64 6	63.8	0.8
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	64.1	63.8	0.3
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	64.1	64.0	0.1
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	63.8	63.9	-0.1
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	104.8	104.6	0.2
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	104.5	104.8	-0.3
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	117.0	115.9	1.1
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	117.5	118.0	-0.5
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	91.0	88.8	2.2
X17	CENTER OF STEERING COLUMN TO "A" POST	11.6	12.1	-0.5
X18	CENTER OF STEERING COLUMN TO HEADLINER	17.5	4.1	13.4
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	159.1	158.2	0.9
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	158.2	158.2	0.0
X21	LENGTH OF ENGINE BLOCK	16.0	16.0	0.0

TEST ANOMALIES

The following data channels recorded anomalous spikes between 0.0 and 0.13 seconds. The data from 0.14 to 4.8 seconds is included on the data summary.

Rollcart Center of Gravity X-axis acceleroemter, YCGXG2

Rollcart Center of Gravity Y-axis Accelerometer, YCGYG2

Rollcart Center of Gravity Z-axis Accelerometer, YCGZG2

Rollcart Center of Gravity Resultant, YCGRG2, due to above.

The Driver Head Z-axis Accelerometer, HEDZG1. data did not return to zero following the crash test event. The Driver Head Resultant, HEDRG1, data is not valid after 1.41 seconds, due to above.

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: Ford Motor Company

MAKE/MODEL: Ford/Bronco II VIN: 1FMCU12TXKUC02186

BODY STYLE: Truck MODEL YEAR: 1989

NHTSA NO.: NA COLOR: White

ENGINE DATA: TYPE: Inline CYLINDERS: 6 DISPLACEMENT: 2.9 liter

TRANSMISSION DATA: _5_ SPEED, _X_ MANUAL, ____ AUTOMATIC, ____ FWD, _X_ RWD, ____ 4WD

DATE VEHICLE RECEIVED: 10/25/89 ODOMETER READING: 58.7

DEALER'S NAME AND ADDRESS: Ricart Ford
4255 South Hamilton Road & Route 33
P.O. Box 27130
Columbus, OH 43227

ACCESSORIES:

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

REMARKS:

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

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

VEHICLE MANUFACTURED BY: Ford Motor Company

DATE OF MANUFACTURE: 5/89

GVWR: 4040 LBS

GAWR: FRONT 1940 LBS., REAR 2300 LBS.

*The passenger door is dented.

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: P205/75R15 LOAD RANGE X B, C, D

TIRES ON VEHICLE (MFR., LINE, SIZE): Firestone P205/75R15

IS SPARE TIRE A "SPACE SAVER": No

IS SPARE TIRE STANDARD EQUIPMENT: Yes

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

TYPE OF FRONT SEAT BACKS: Adjustable

*NUMBER OF OCCUPANTS 2 FRONT ____REAR ____TOTAL

**CARGO LOAD_____LBS. TOTAL_____LBS.

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

RIGHT FRONT	859 lbs.	RIGHT REAR	855 lbs.
LEFT FRONT	840 lbs.	LEFT REAR	886 lbs.

TOTAL FRONT WEIGHT 1699 lbs. (49.4% OF TOTAL VEHICLE WEIGHT)

TOTAL REAR WEIGHT 1741 lbs. (50.6% OF TOTAL VEHICLE WEIGHT)

TOTAL DELIVERED WEIGHT 3440 lbs.

CALCULATION FOR TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (3440 LBS)

VCW = VEHICLE CAPACITY WEIGHT (LBS)

DSC = DESIGNATED SEATING CAPACITY ( )

RCLW = VCW - 150 (DCS) = 300 LBS*

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

= 3440 + 300 + 167 LBS

TARGET TEST WEIGHT = 3907 LBS

* FOR MULTI-PURPOSE VEHICLES, TRUCKS, AND BUSES A RATED CARGO AND LUGGAGE WEIGHT OF 300 POUNDS WAS USED.
**THE VEHICLE CONTAINED NO RECOMMENDED CARGO LOAD ON THE TIRE PRESSURE LABEL.

TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 307 LBS. CARGO

RIGHT FRONT	849 lbs.	RIGHT REAR	1093 lbs.
LEFT FRONT	883 lbs.	LEFT REAR	1089 lbs.
TOTAL FRONT WEIGHT	1732 lbs.	(44.3% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	2182 lbs.	(55.7% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	3914 lbs.	(0.2% OVER TARGET WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE TRUNK AREA: 300

COMPONENTS REMOVED TO MEET TARGET WEIGHT: None

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	LF	30.9	;RF	31.0	;LR	31.2	;RR 30.9
PRE-TEST ATTITUDE:	LF	31.6	;RF	31.6	;LR	28.5	;RR 28.4
POST-TEST ATTITUDE:	LF	31.2	;RF	27.1	;LR	27.9	;RR 23.4

WHEELBASE: 94.5 INCHES

CG = 52.0 INCHES REARWARD OF FRONT WHEEL CENTERLINE

VEHICLE REBOUND AND CRUSH (ALL DIMENSIONS IN INCHES):

OVERALL LENGTH OF TEST VEHICLE:	PRE-TEST:	L	158.2	;C	159.5	;R	159.1
	POST-TEST:	L	158.2	;C	160.0	;R	158.2
	TOTAL CRUSH:	L	0.0	;C	-0.5	;R	0.9

TEST CONDITIONS

TEST NUMBER: 891113

DATE OF TEST: 11/13/89 TIME OF TEST: 1359

WIND VELOCITY: NA HUMIDITY: NA

AMBIENT TEMPERATURE AT IMPACT AREA: 70°F

TEMPERATURE IN OCCUPANT COMPARTMENT: 69°F

DRIVER DUMMY TEMPERATURE: 69°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
VEHICLE TEST WEIGHT (lbs.)	3914	3907
VEHICLE ORIENTATION (deg.) YAW*	270	270
VEHICLE ORIENTATION (deg.) ROLL**	30	30
VEHICLE VELOCITY (mph)	30	30

DUMMIES

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

REMARKS:

*AS MEASURED CLOCKWISE FROM THE DIRECTION OF TRAVEL.

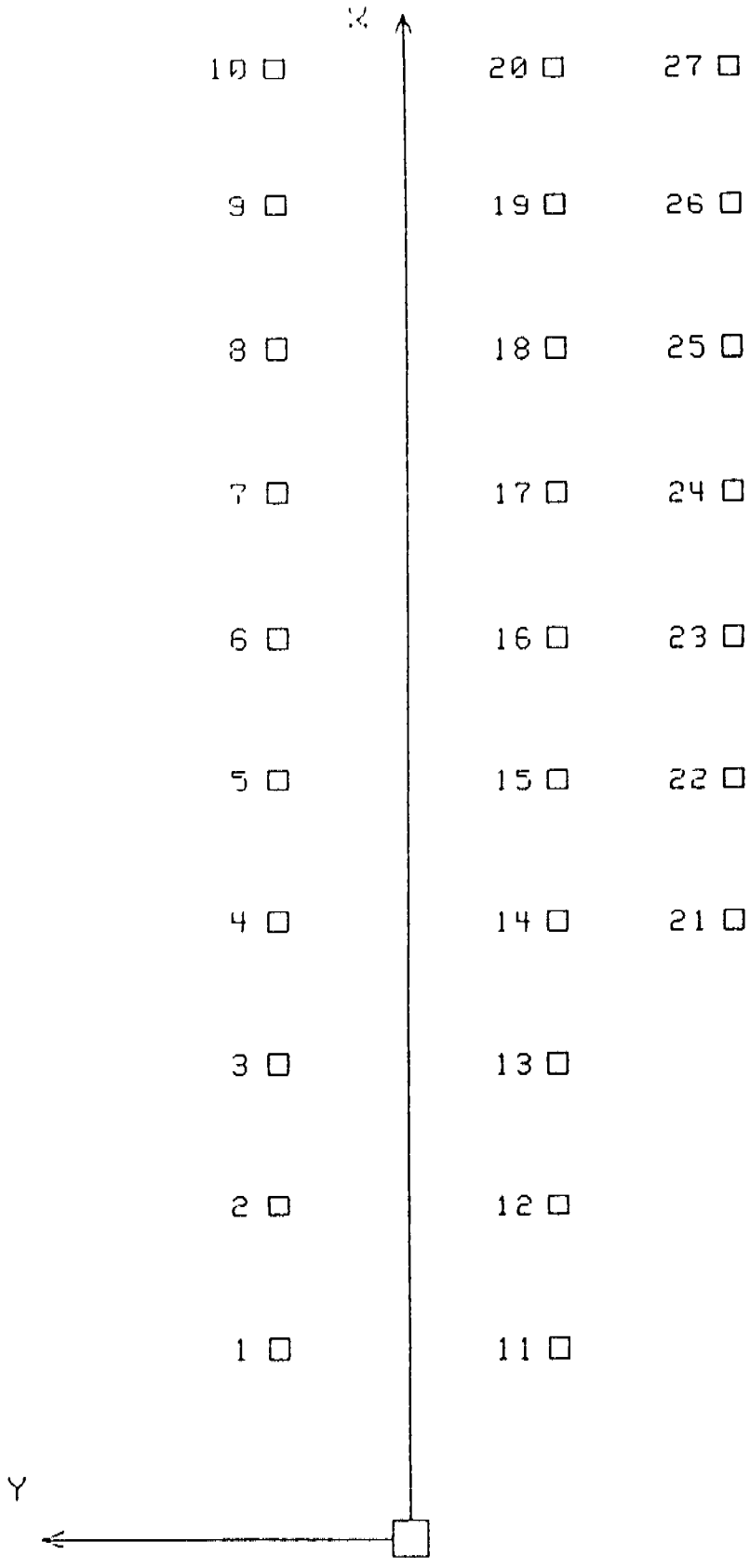
**AS MEASURED FROM THE HORIZONTAL.

TEST NUMBER 891113

VEHICLE DATA SUMMARY

No.	LOCATION	POSITIVE DIRECTION MAX	POSITIVE DIRECTION SEC	NEGATIVE DIRECTION MAX	NEGATIVE DIRECTION SEC
1	CENTER OF GRAVITY ACCELERATION (g)				
	LONGITUDINAL	26 4	4.2	24.4	4.2
	LATERAL	22.6	2.3	37.9	4.2
	VERTICAL	44.9	4.2	15.3	1.5
	RESULTANT	46 6	4.2		
2	CENTER OF GRAVITY				
	ROLL (X-AXIS)	449.4	1.4	86.6	4.3
	PITCH (Y-AXIS)	159.5	4.2	103.8	2.3
	YAW (Z-AXIS)	98 0	4.2	79.9	2.3
3	LEFT FRONT SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0 6	0.6	6.0	1.6
4	RIGHT FRONT SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0 2	0.6	9.0	2.3
5	LEFT REAR SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0.4	2.8	10.9	2.0
6	RIGHT REAR SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0 5	1.7	11.0	4.3
7	SHOULDER BELT DISPLACEMENT (in)				
	DRIVER	0 8	1.4	2 4	1.7

POSITIVE DIRECTION		NEGATIVE DIRECTION	
LONGITUDINAL	FORWARD	LONGITUDINAL:	REARWARD
LATERAL	LEFTWARD	LATERAL	RIGHTWARD
VERTICAL	UPWARD	VERTICAL:	DOWNWARD
ROLL	TO RIGHT	ROLL	TO LEFT
PITCH	NOSE DOWNWARD	PITCH	NOSE UPWARD
YAW	COUNTER CLOCKWISE	YAW	CLOCKWISE
DISPLACEMENT	OUTWARD	DISPLACEMENT:	INWARD



STADIA POLE LAYOUT AND NUMBERING SYSTEM

STADIA POLE LOCATIONS

POLE NO.	X DISTANCE, FT. *	Y DISTANCE, FT. *
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	500	Vehicle Kinematics
3	Left wide (mid)	Photosonic 1B	13	507	Vehicle Kinematics
4	Left angle	Photosonic 1B	25	500	Vehicle Kinematics
5	Downstream	Photosonic 1B	50	495	Vehicle Kinematics
6	Onboard - floor	Photosonic 1B	8	500	Dummy Kinematics
7	Onboard - rear	Photosonic 1B	8	500	Dummy Kinematics
8	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.)
3	107.6	420.8	5.0
4	107.6	195.0	5.1
5	240.8	81.9	3.8
6	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	-2.8	16.8	8.2
7	-71.6	31.5	30.5

**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	Left B-pillar and roof	NA
Chest	Chin and roof	NA
Abdomen	NA	NA
Left knee	Lt. front door padding	NA
Right knee	NA	NA

DOOR OPENING:

	LEFT	RIGHT
Front	Easy	NA
Rear	NA	NA

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
Front	None	None
Rear	NA	NA

GLAZING DAMAGE:

The entire windshield was cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS.

The entire left and right front and rear door glasses were shattered upon impact.

DUMMY KINEMATIC SUMMARY

Driver Dummy

Upon the vehicle's impact with the ground, the driver dummy's head struck the left B-pillar and 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 left door. The vehicle came to rest on its tires after two full rollovers, with the driver dummy's head resting against the roof. The dummy was restrained with three-point unibelt.

DUMMY DATA SUMMARY

TEST NUMBER 891113

	DRIVER DUMMY SN. 192			
	POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	SEC	MAX	SEC
HEAD ACCELERATION (g)				
LONGITUDINAL	19 5	1 4	24 7	1 4
LATERAL	57 6	1 4	63.2	1.4
VERTICAL	399 7	1 4 Y	128 0	1.4 Y
RESULTANT	403 4	1 4 Y		
HIC 36 MSEC	2139 8 FROM 1 399 TO 1.401			
NECK FORCES (lbs)				
LONGITUDINAL	208 6	2 4	283 9	1.4
LATERAL	129 9	2 4	655 2	1.4
VERTICAL	20 6	1 4	215.3	1.4
NECK MOMENT (in-lbs)				
ABOUT LONG	222 6	1 4	19.7	4.4
ABOUT LATERAL	36 4	1 5	69.7	1.4
ABOUT VERTICAL	13 9	3 0	57 0	1.4
CHEST ACCELERATION (g)				
LONGITUDINAL	8 8	1 4	33.6	1.4
LATERAL	29 9	1 4	13.3	1.5
VERTICAL	10 5	2 3	77.3	1.4
RESULTANT	84 4	1 4		
3 MSEC	59 3 FROM 1.401 TO 1.404			
CHEST DISPLACEMENT (in)				
LONGITUDINAL	0 2	1 4	0.1	1.3
PELVIS ACCELERATION (g)				
LONGITUDINAL	18 8	1 4	12.8	1.4
LATERAL	14 5	2 3	18.8	1.5
VERTICAL	9.0	1 4	59.3	1.4
RESULTANT	62 4	1.4		

POSITIVE DIRECTION		NEGATIVE DIRECTION	
LONGITUDINAL	FORWARD	LONGITUDINAL:	REARWARD
LATERAL	LEFTWARD	LATERAL	RIGHTWARD
VERTICAL	UPWARD	VERTICAL.	DOWNWARD
FORCE	OUTWARD	FORCE:	INWARD

See APPENDIX D for neck load cell polarities

Y See 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 26°. 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 unibelt.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

MFR./MAKE/MODEL: Ford Bronco II

SEAT TYPE: ____Bench
__X__Bucket
____Split bench

ADJUSTER TYPE: __X__Manual
____Power
____Non-adjustable

BUCKET SEAT BACK TYPE: ____Non-adjustable
__X__Adjustable reclining

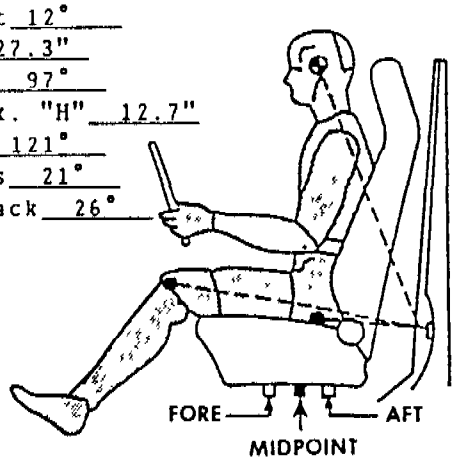
TECHNICIANS:
1. B. Crabtree
2. R. Branham
3. ____
4. ____

POSITIONING DATE: 11/13/89

AMBIENT TEMP. 70°F TIME: 1359

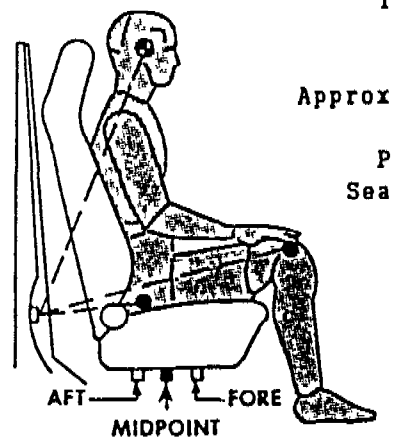
DRIVER DUMMY* # 245 TYPE: HIII

Head 19.5"
Target 12°
Knee 27.3"
Joint 97°
Approx. "H" 12.7"
Point 121°
Pelvis 21°
Seatback 26°



PASSENGER DUMMY* # NA TYPE: ____

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

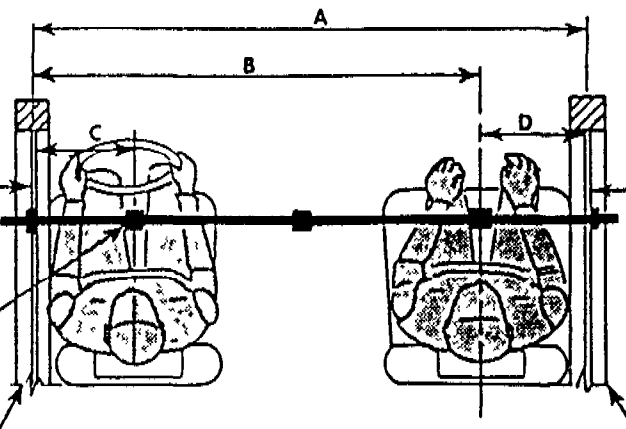


A = 58.4"
B = NA
C = 13.2"
D = NA

DOOR GLASS HEIGHT = 10.2"

LATERAL BAR

ADJUSTABLE POINTER



DOOR GLASS HEIGHT = NA

LEFT FRONT DOOR

DRIVER DUMMY

PASSENGER DUMMY

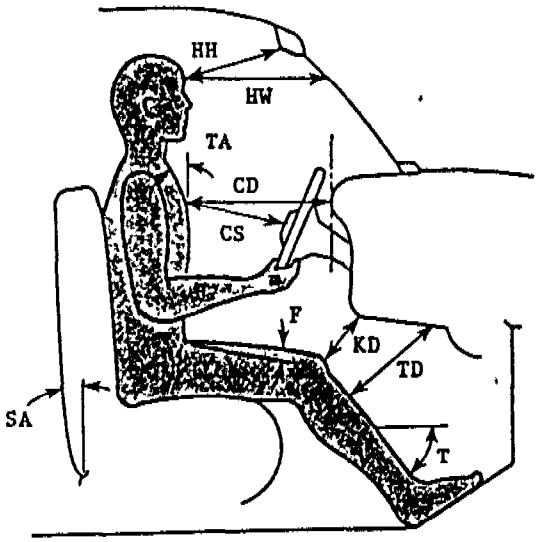
RIGHT FRONT DOOR

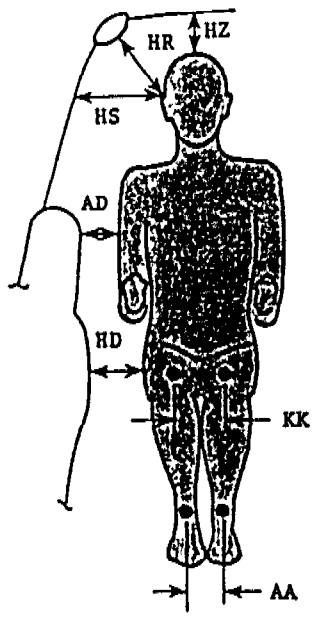
*Dummy measurements are referenced to top of striker bolt and all angles are referenced to vertical.

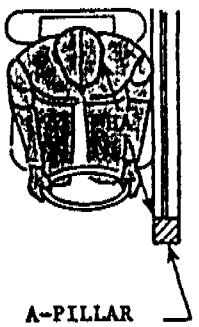
DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER	PASSENGER
HH	20.2	NA
HW	25.9	NA
CD	23.1	NA
CS	10.5	NA
KDL	7.4	NA
KDR	6.9	NA
TA	22°	NA
SA	26°	NA
HA	19.6	NA
FL	12°	NA
FR	12°	NA
TDL	3.8	NA
TDR	4.0	NA
TL	37°	NA
TR	40°	NA
HZ	4.8	NA
HR	8.6	NA
HS	10.2	NA
AD	4.2	NA
HD	5.8	NA
KK	8.1	NA
AA	9.1	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

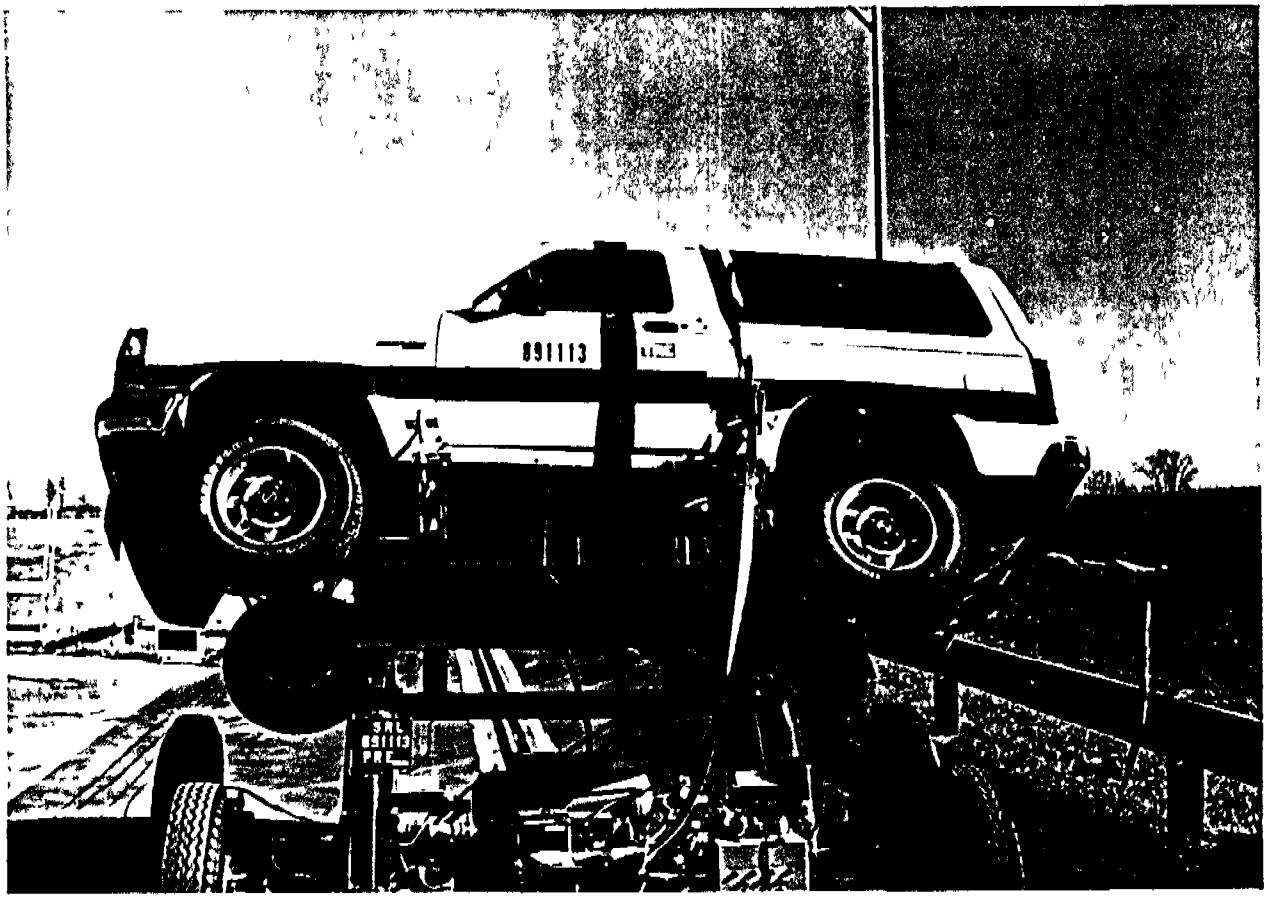


Figure A-2. PRE-TEST OVERALL LEFT VIEW

Figure A-3 PRE-TEST OVERALL REAR VIEW

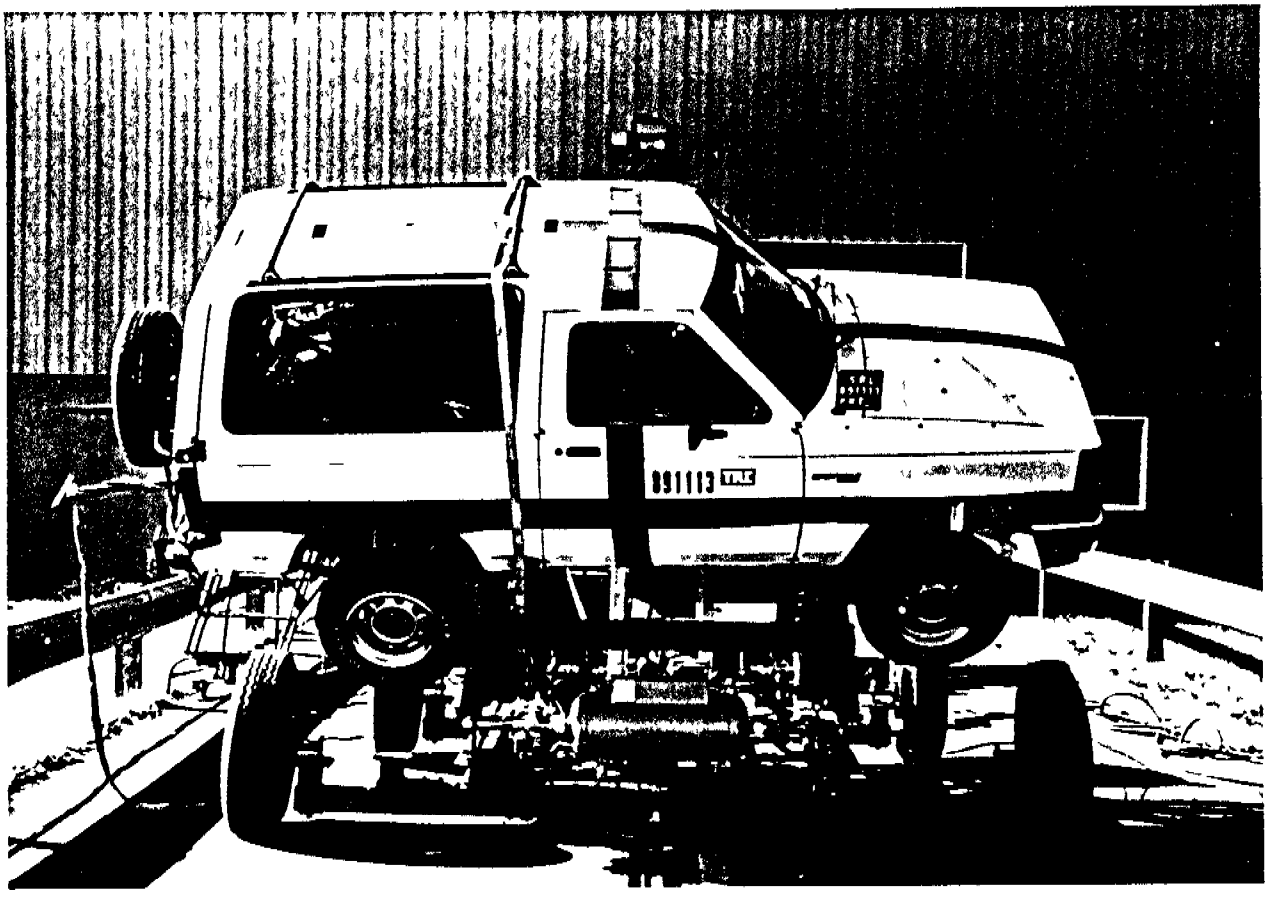


Figure A-4 PRE-TEST OVERALL RIGHT VIEW

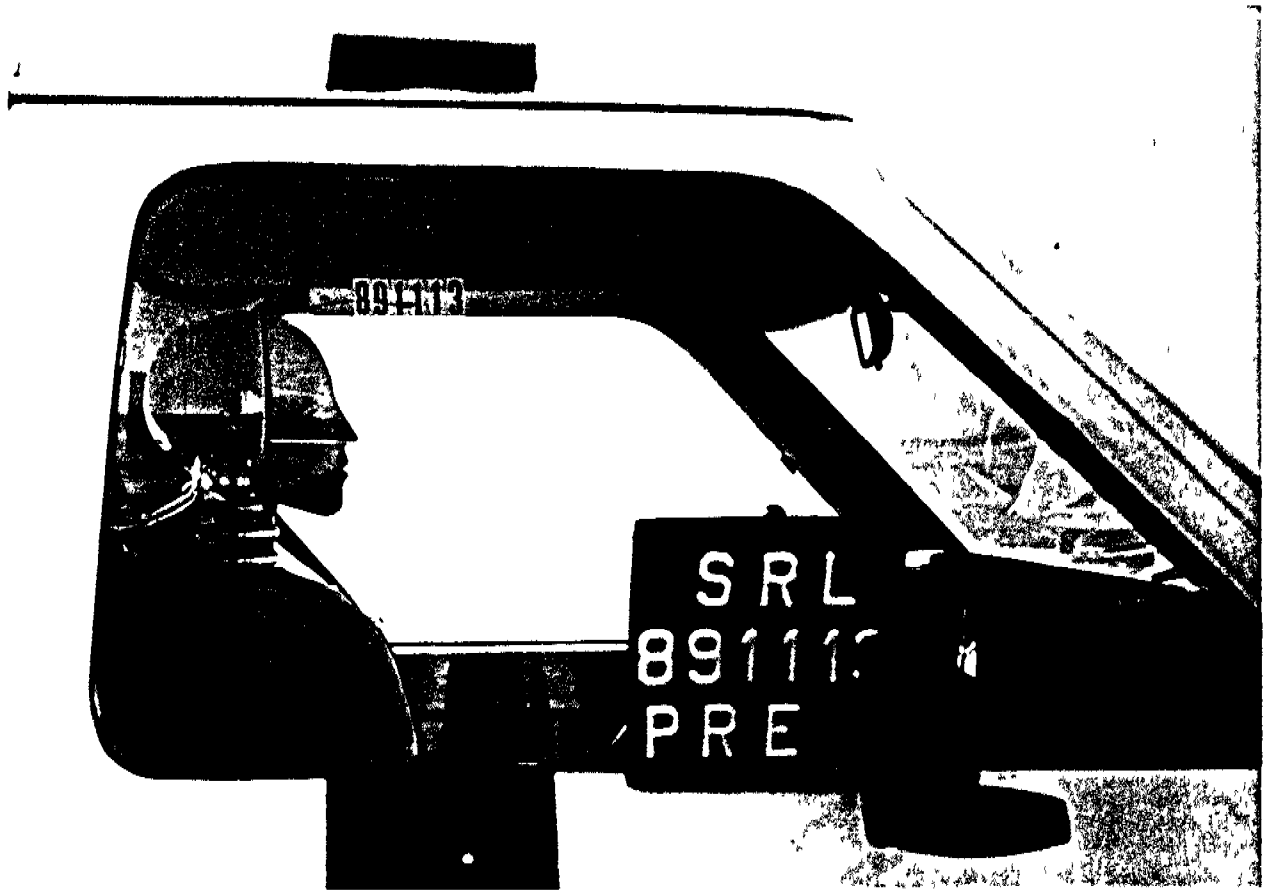


Figure A-5 PRE-TEST DRIVER DUMMY - VIEW 1

Figure A-6 PRE-TEST DRIVER DUMMY - VIEW 2

Figure A-7 PRE-TEST DRIVER DUMMY - VIEW 3

Figure A-8 PRE-TEST DRIVER DUMMY - VIEW 4

Figure A-9 PRE-TEST DRIVER DUMMY - VIEW 5

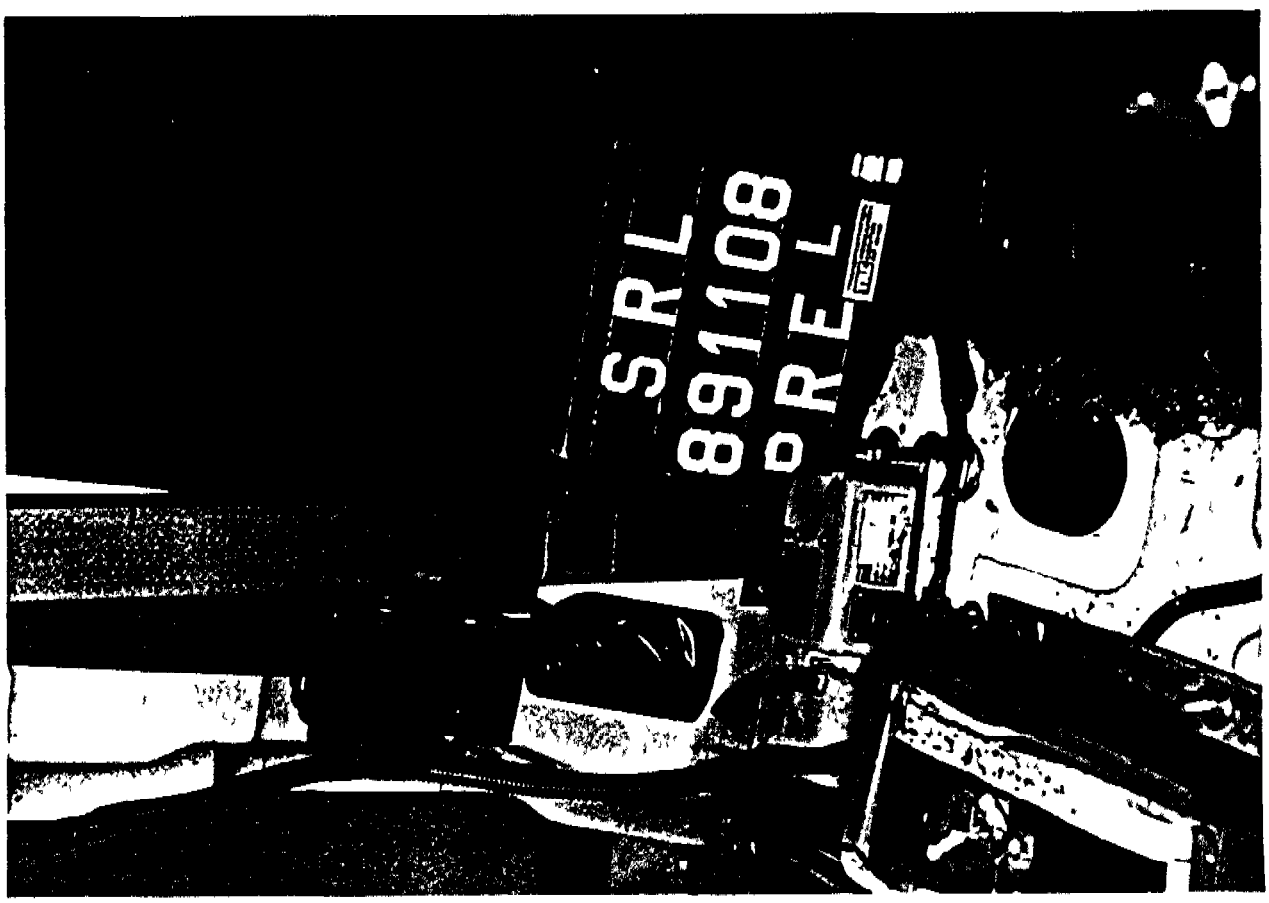


Figure A-10. PRE-TEST SEAT BELT SPOOL-OUT STRING POTENTIOMETER

Figure A-11 PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER VIEW

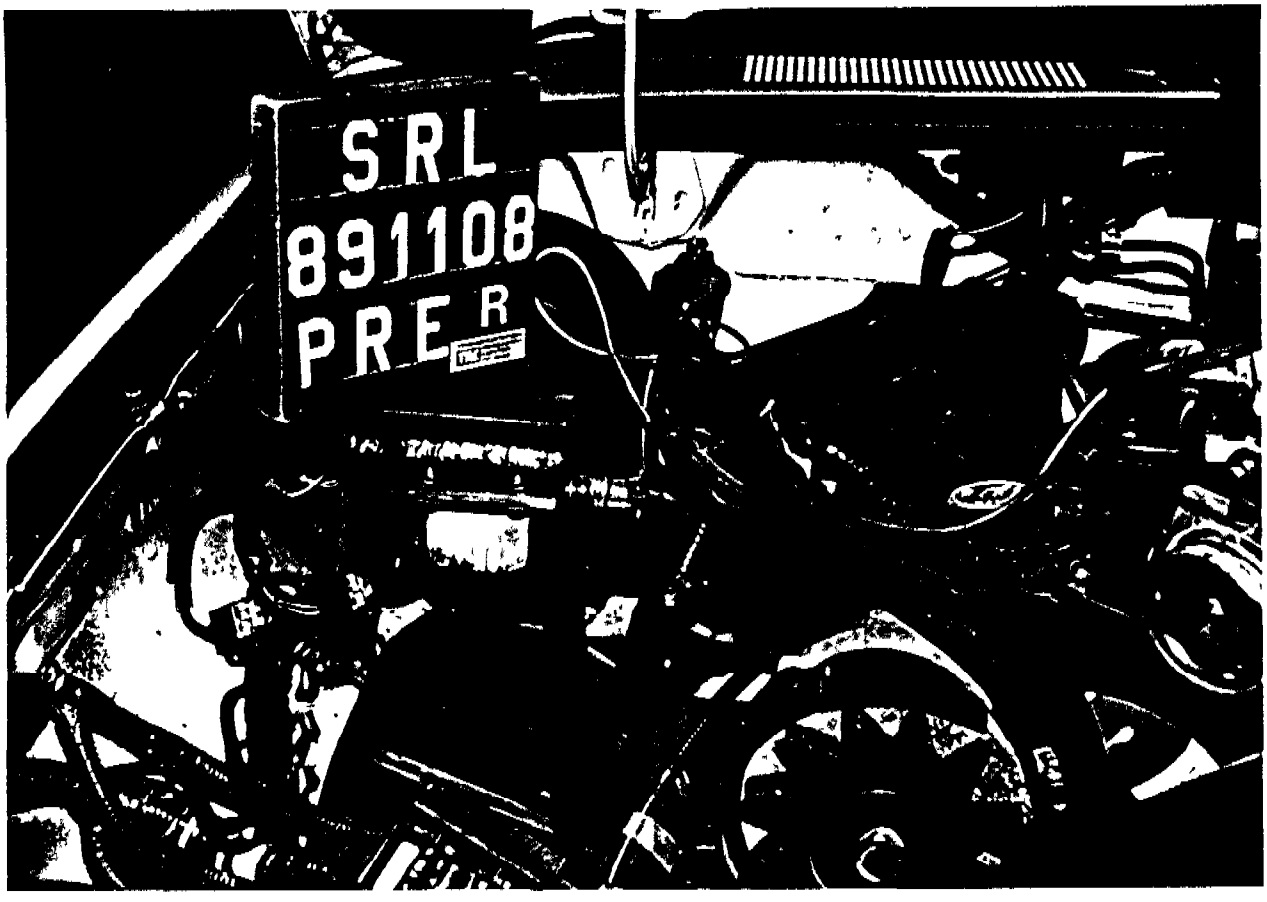


Figure A-12 PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER VIEW

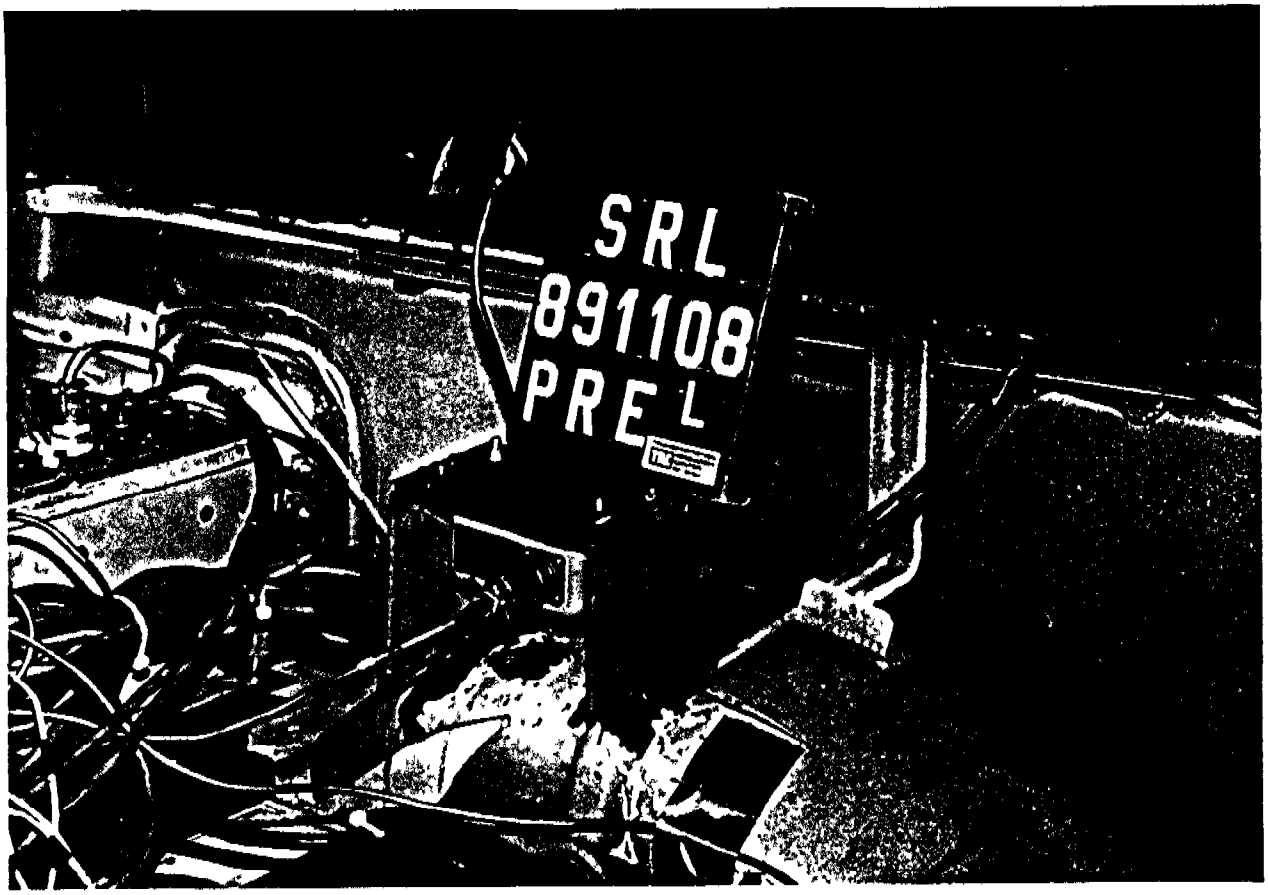


Figure A-13 PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER VIEW

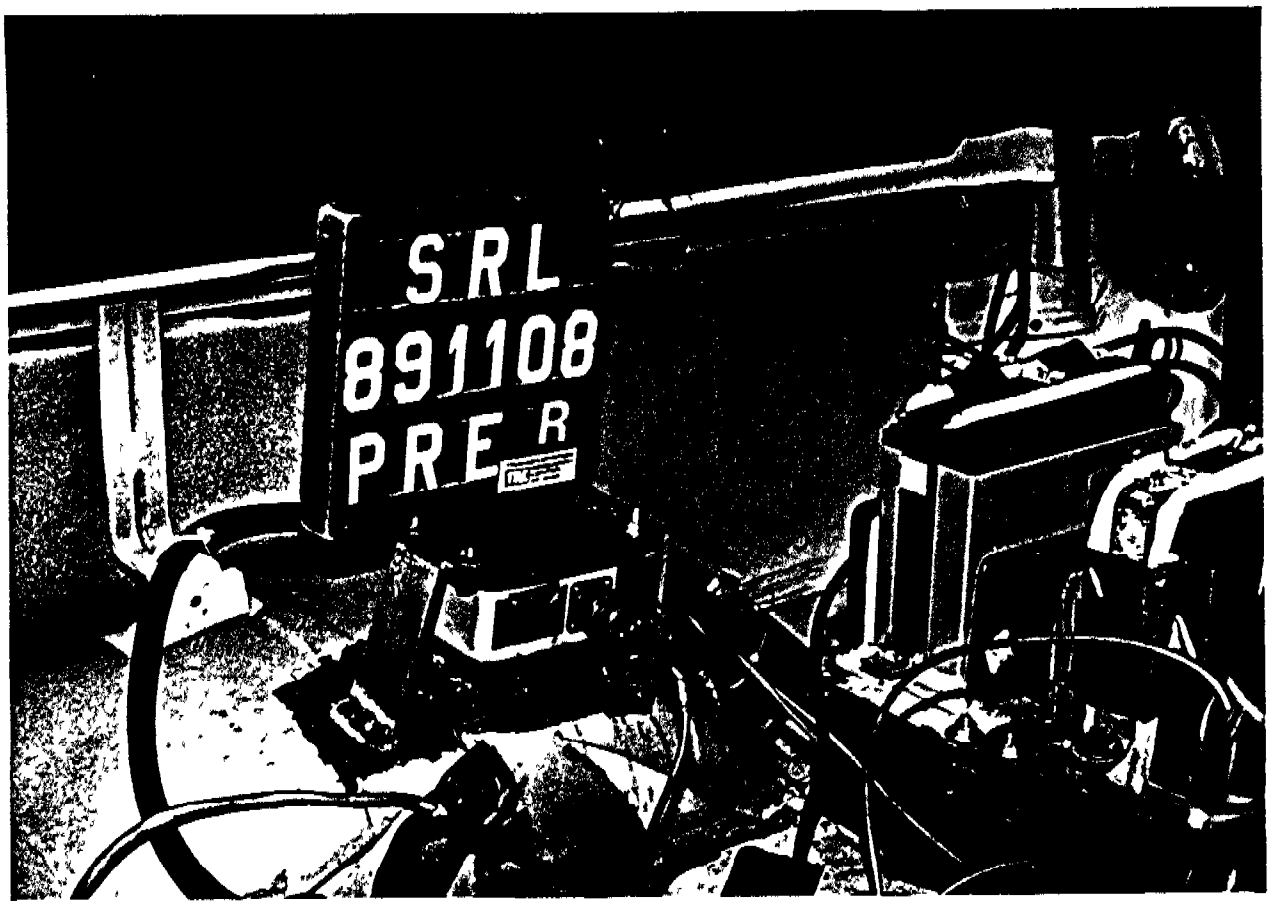


Figure A-14 PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER VIEW

Figure A 15 PRE-TEST ACCELEROMETER LOCATION VIEW

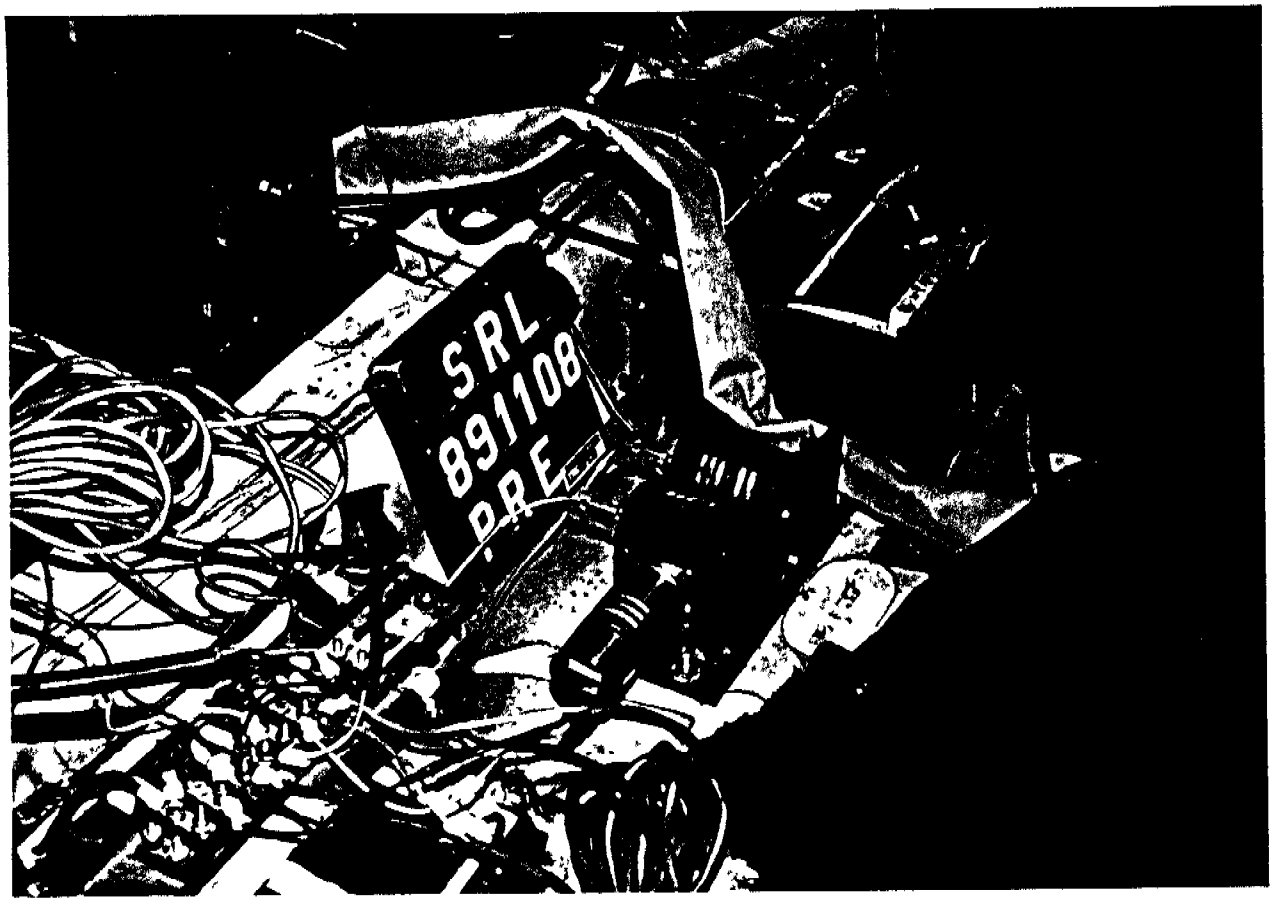


Figure A-16 PRE-TEST GYRO PLACEMENT VIEW

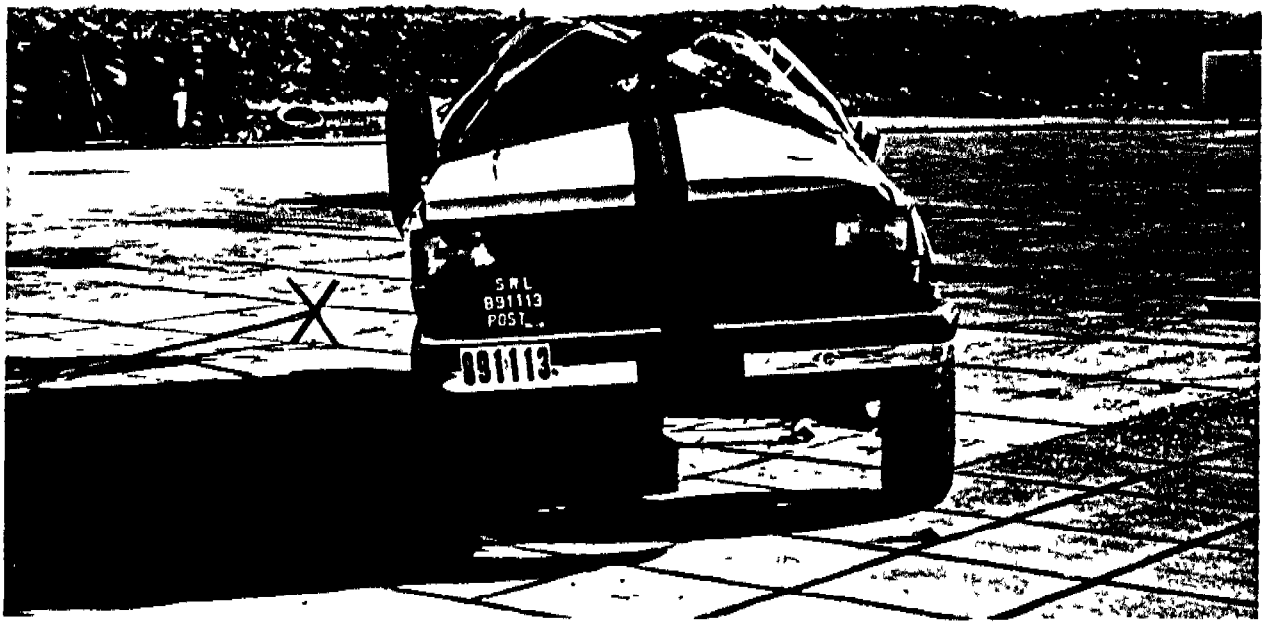


Figure A-17. POST-TEST OVERALL FRONT VIEW

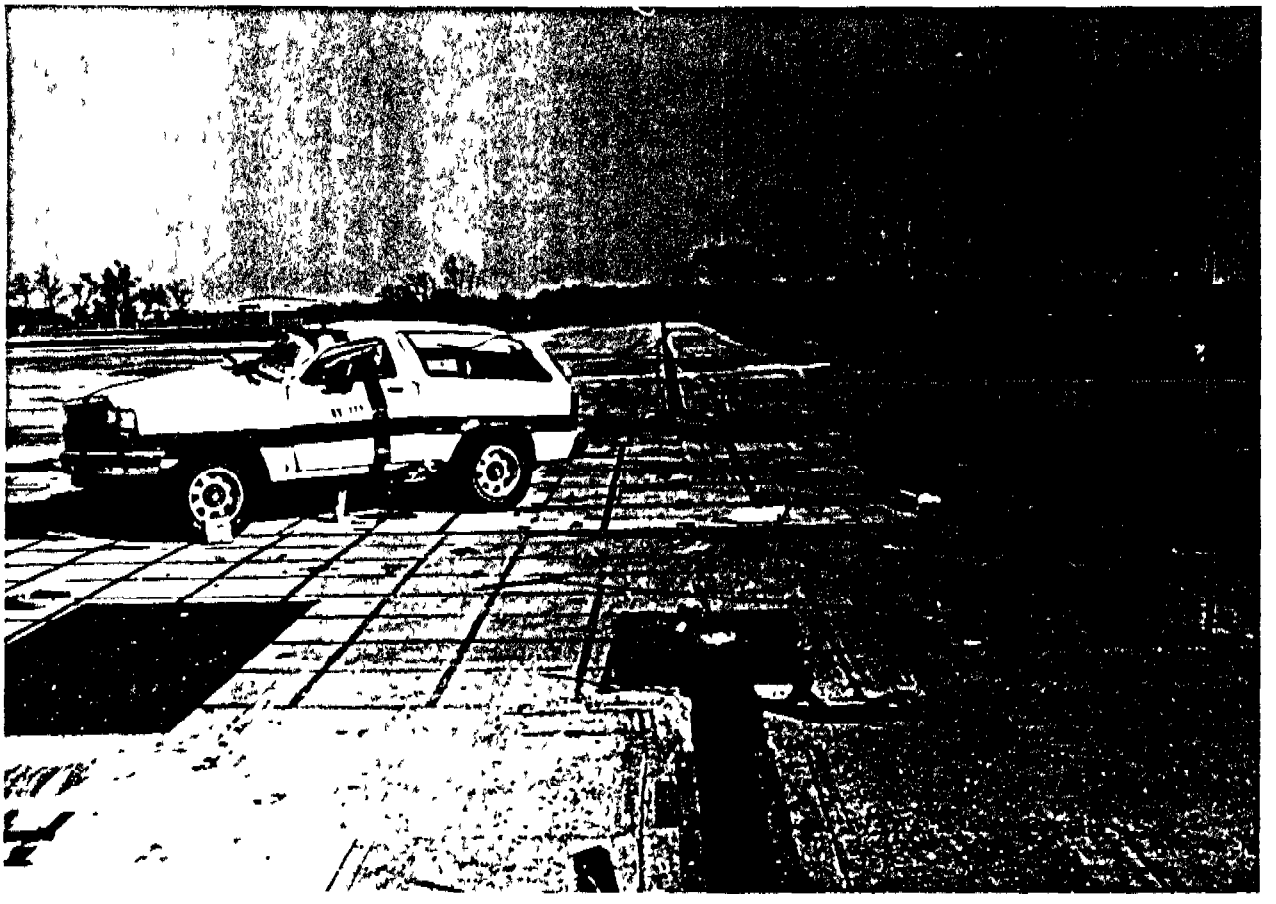


Figure A-18. POST-TEST OVERALL LEFT - VIEW 1

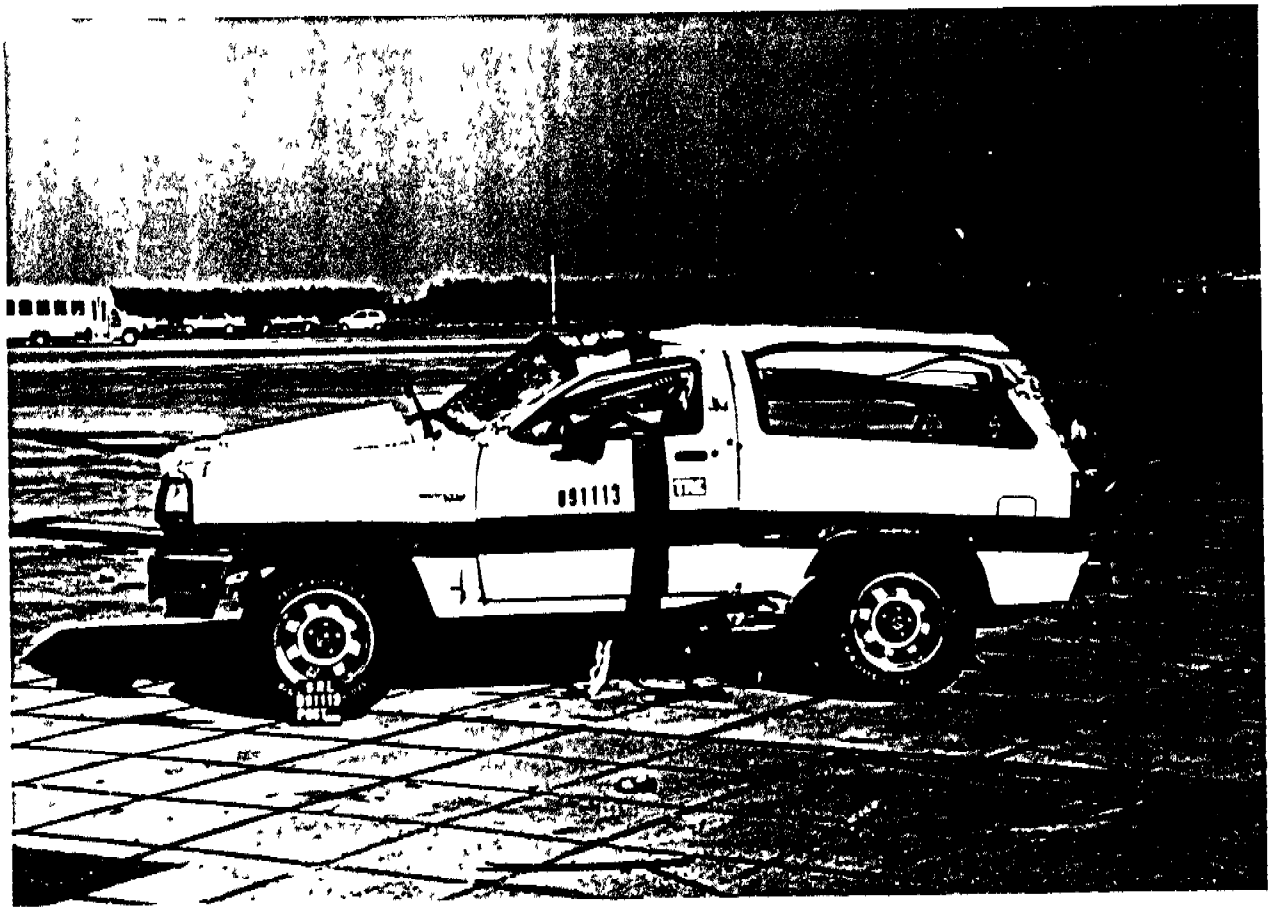


Figure A-19 POST-TEST OVERALL LEFT - VIEW 2

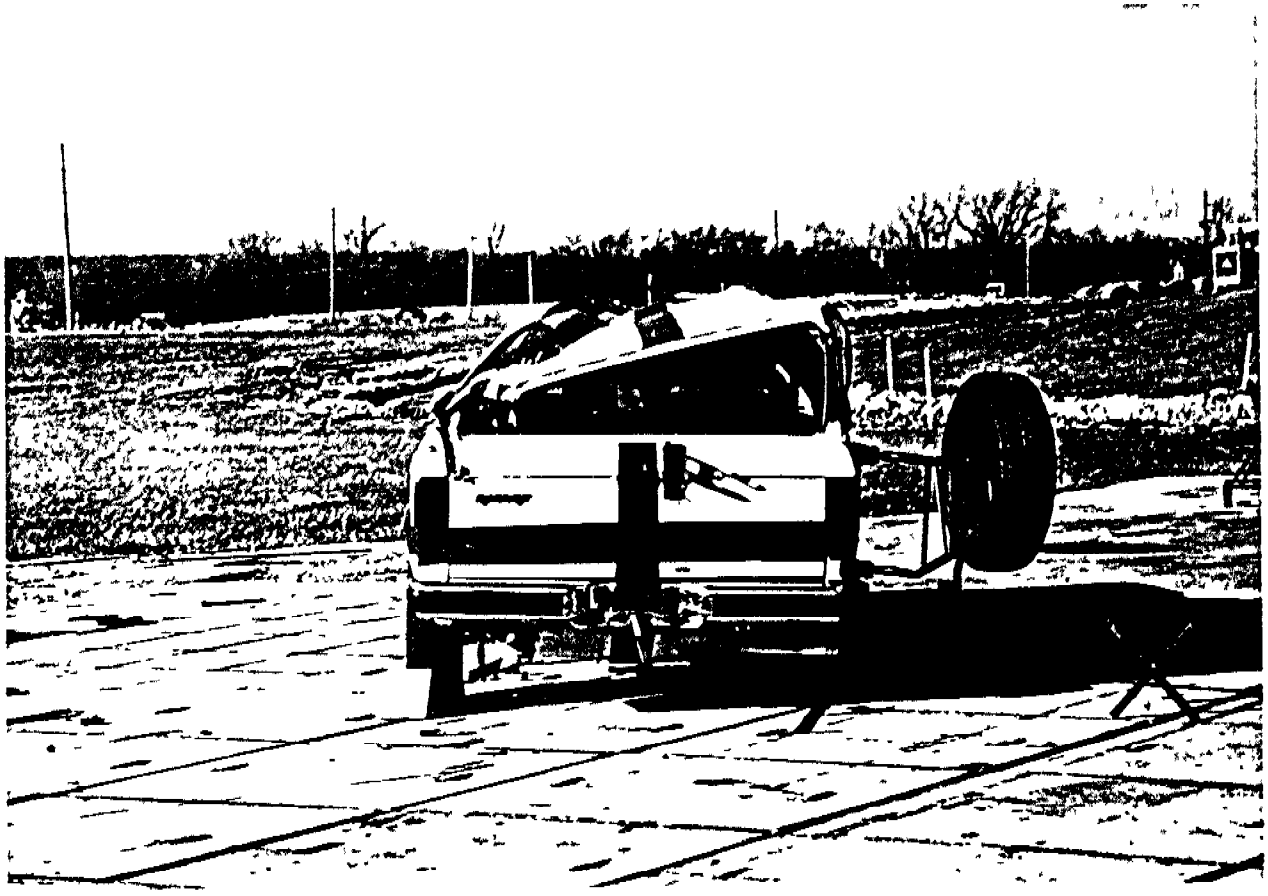


Figure A 20 POST-TEST OVERALL REAR VIEW

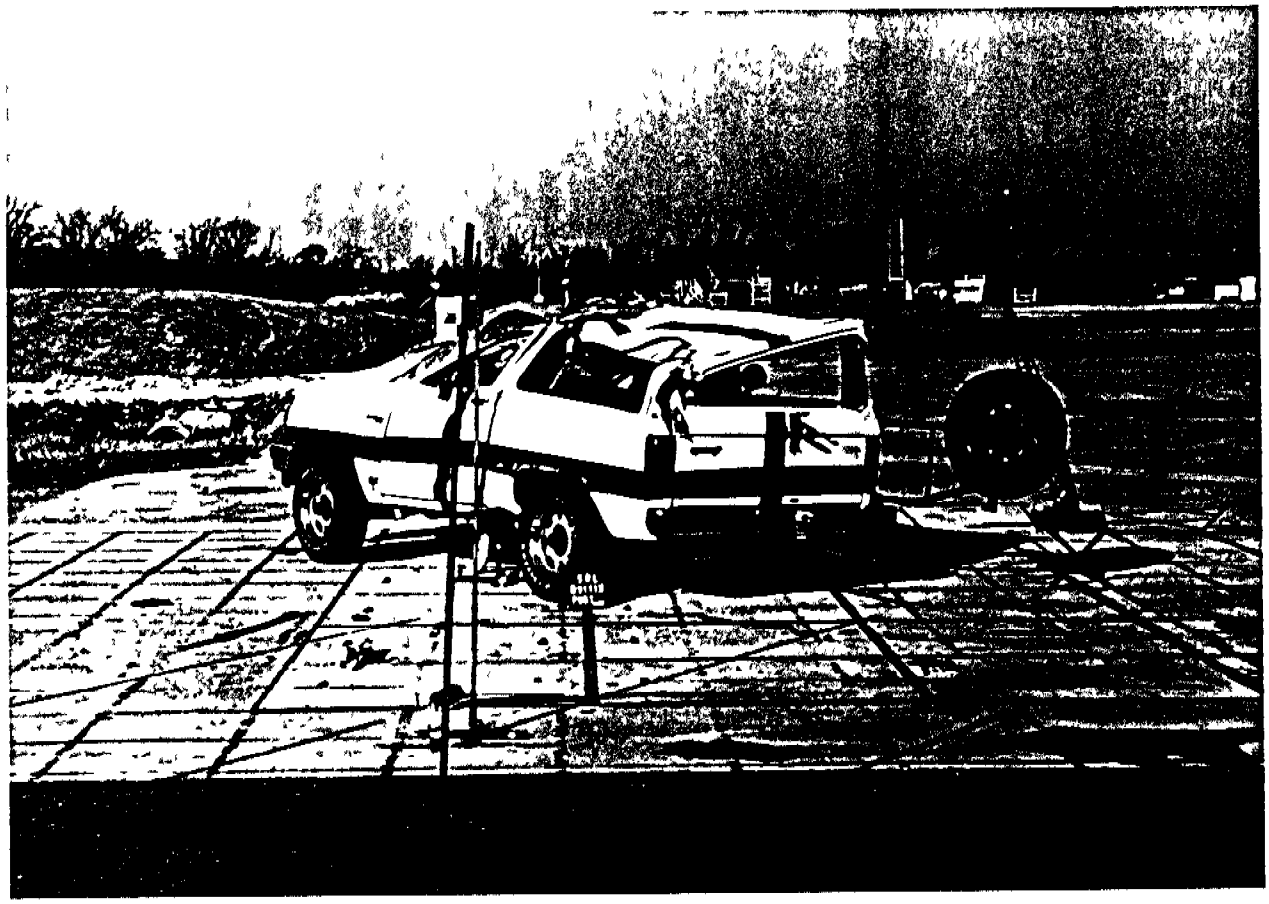


Figure A 21 POST TEST OVERALL LEFT REAR VIEW

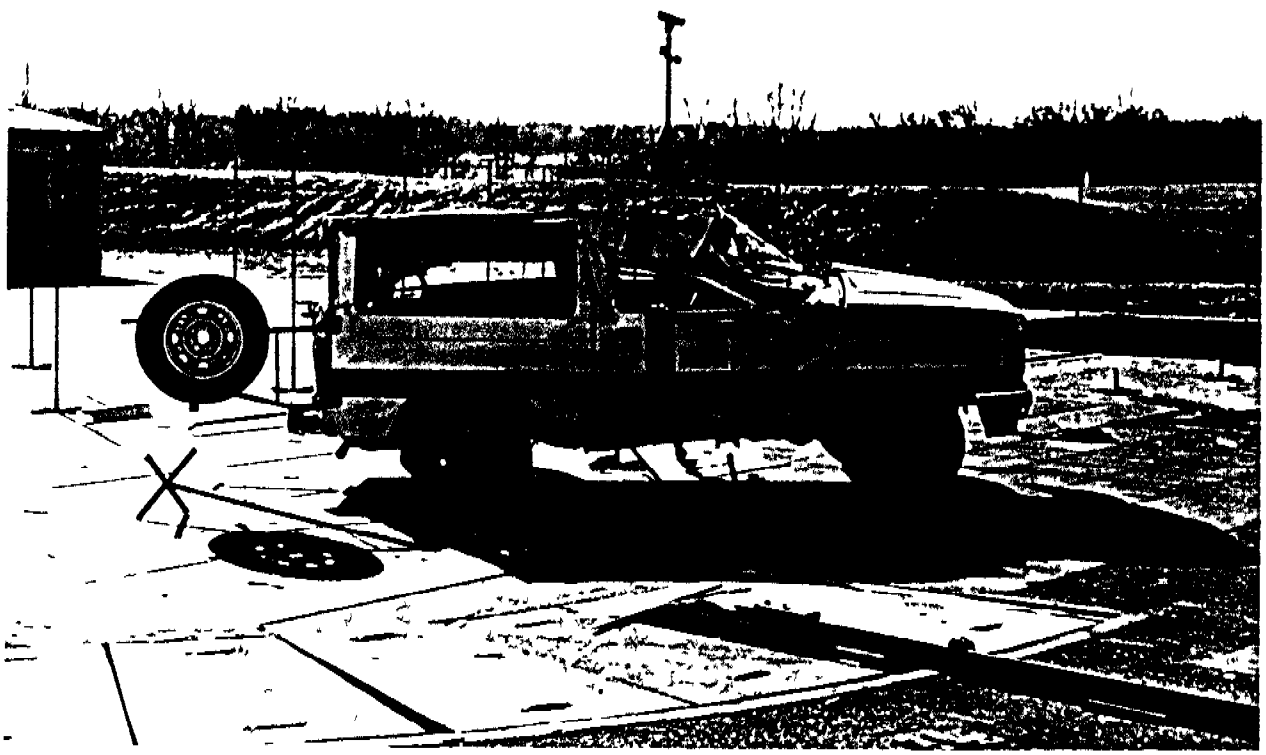


Figure A 22 POST TEST OVERALL RIGHT VIEW

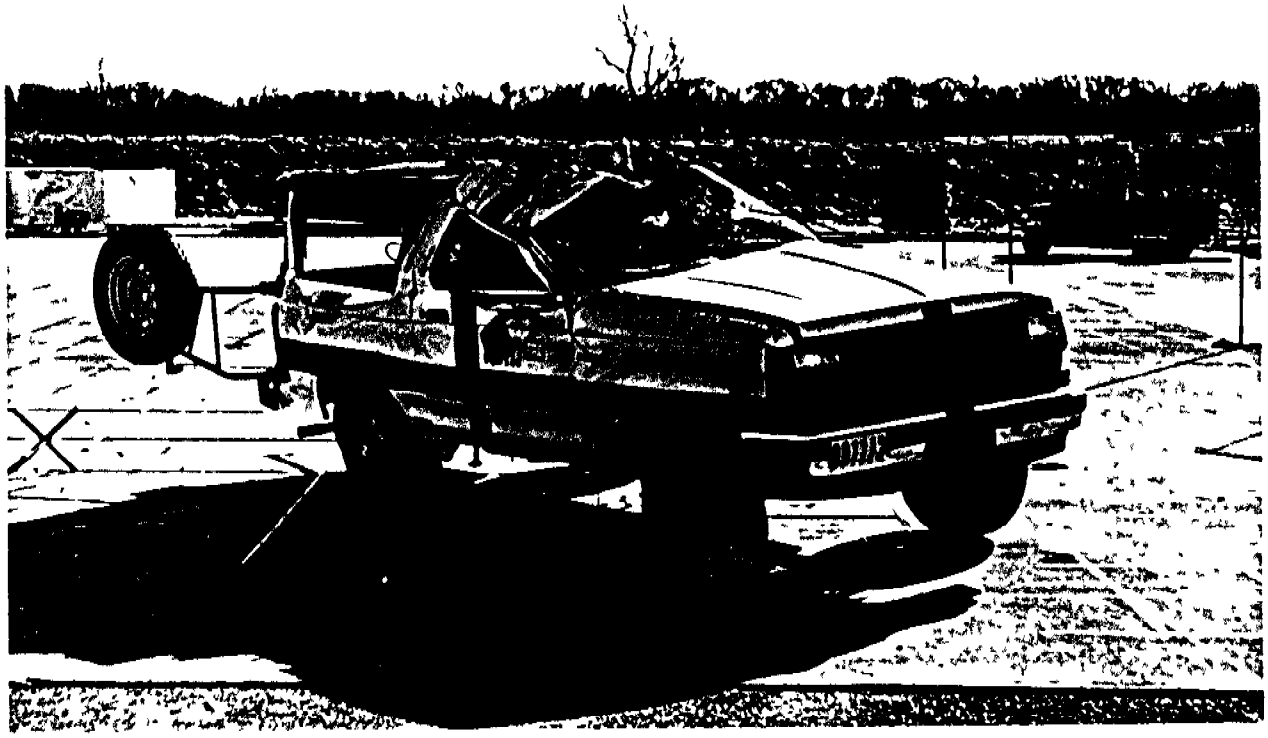


Figure A-23 POST-TEST OVERALL RIGHT FRONT VIEW

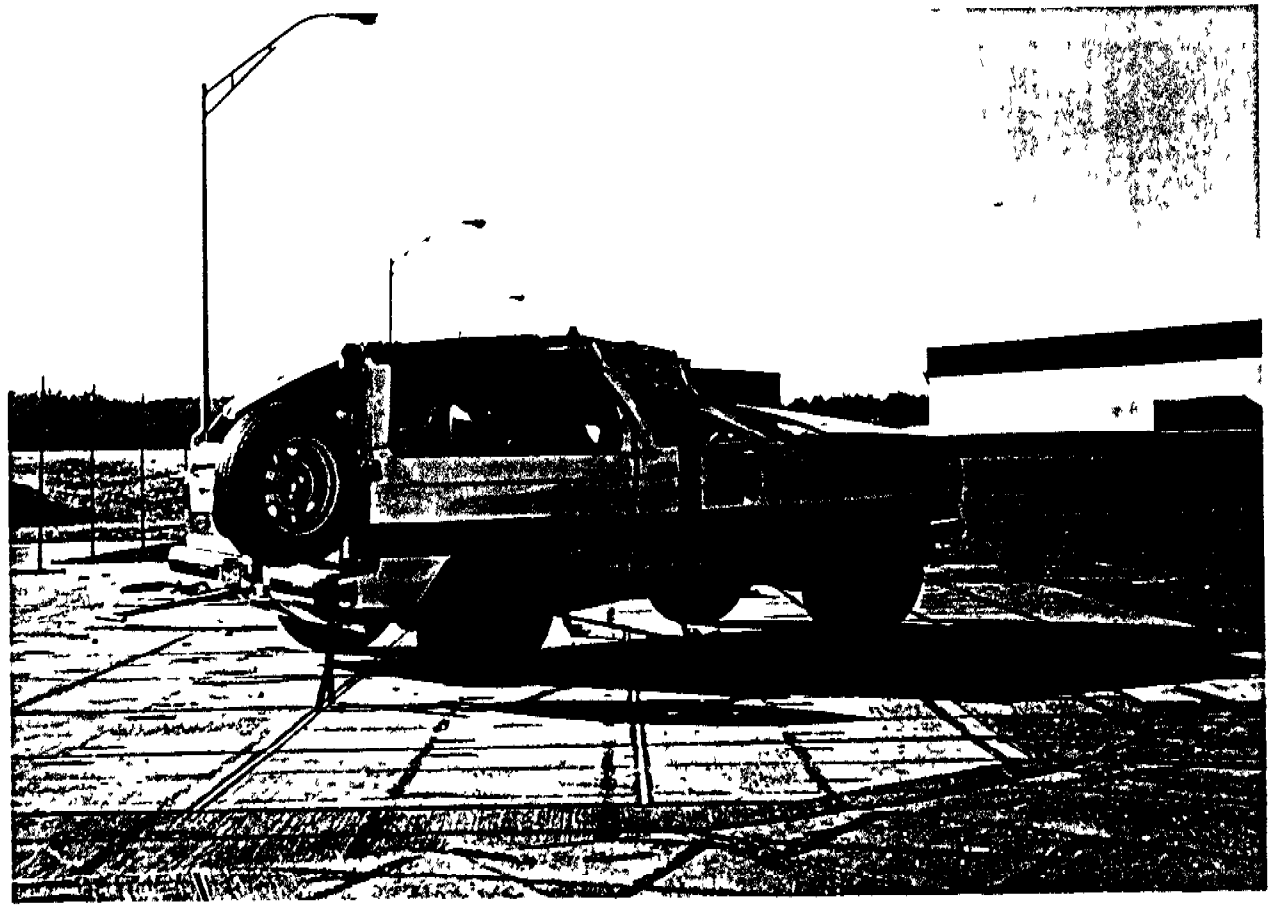


Figure A-24 POST-TEST OVERALL RIGHT REAR VIEW

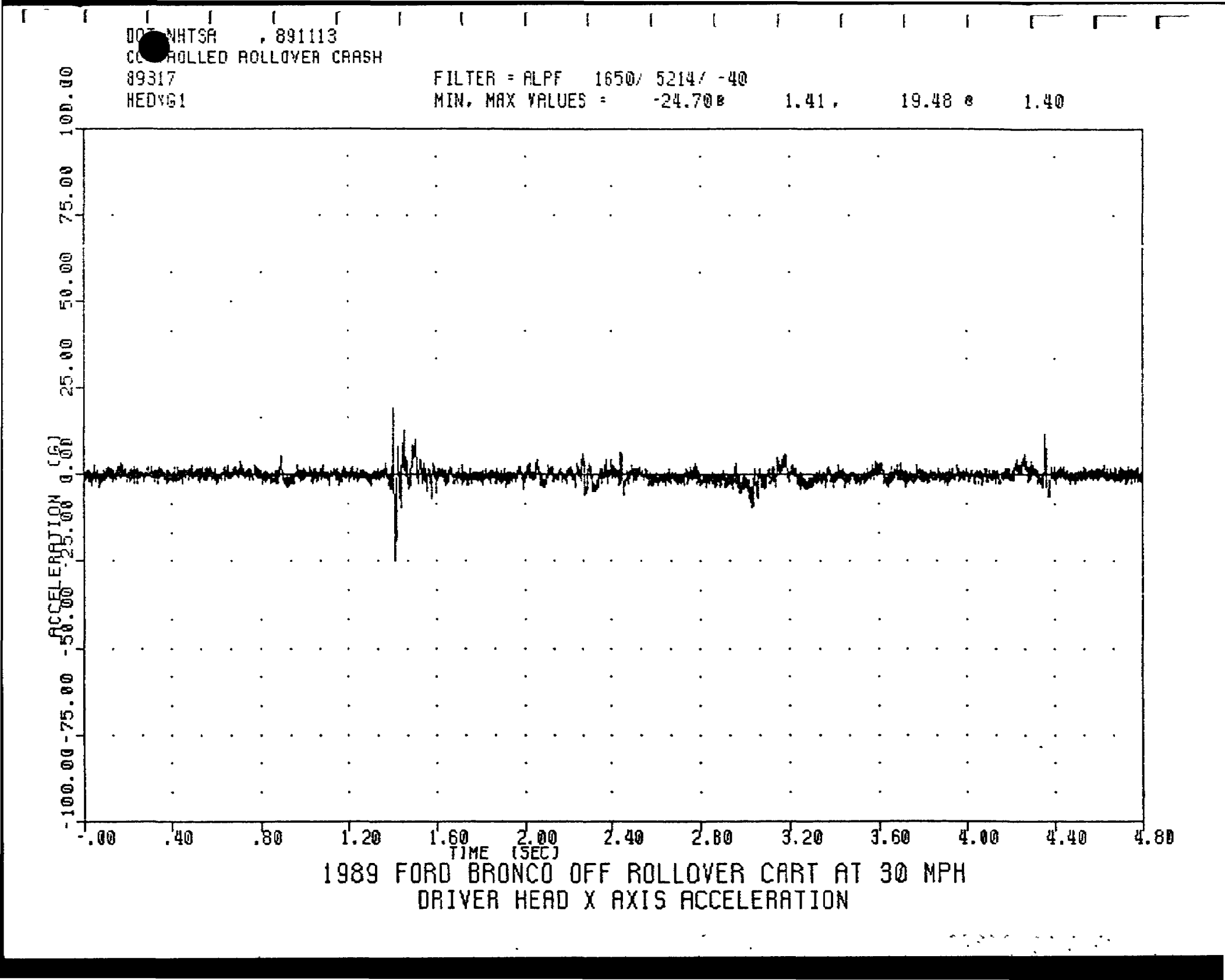
Figure A-25 POST-TEST DUMMY AND VEHICLE - VIEW 1

Figure A-26 POST-TEST DUMMY AND VEHICLE - VIEW 2

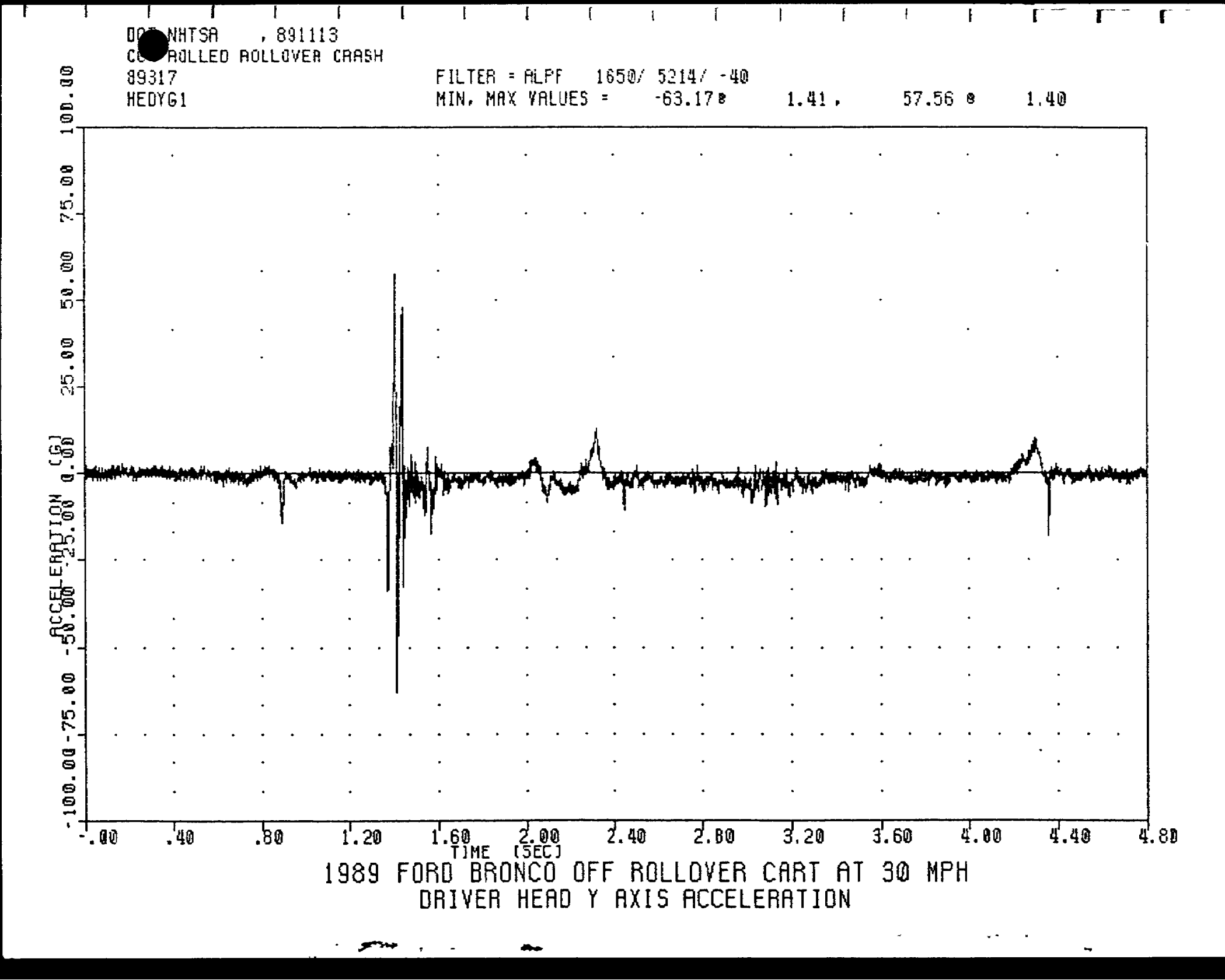
Figure A-27 POST-TEST DUMMY AND VEHICLE - VIEW 3

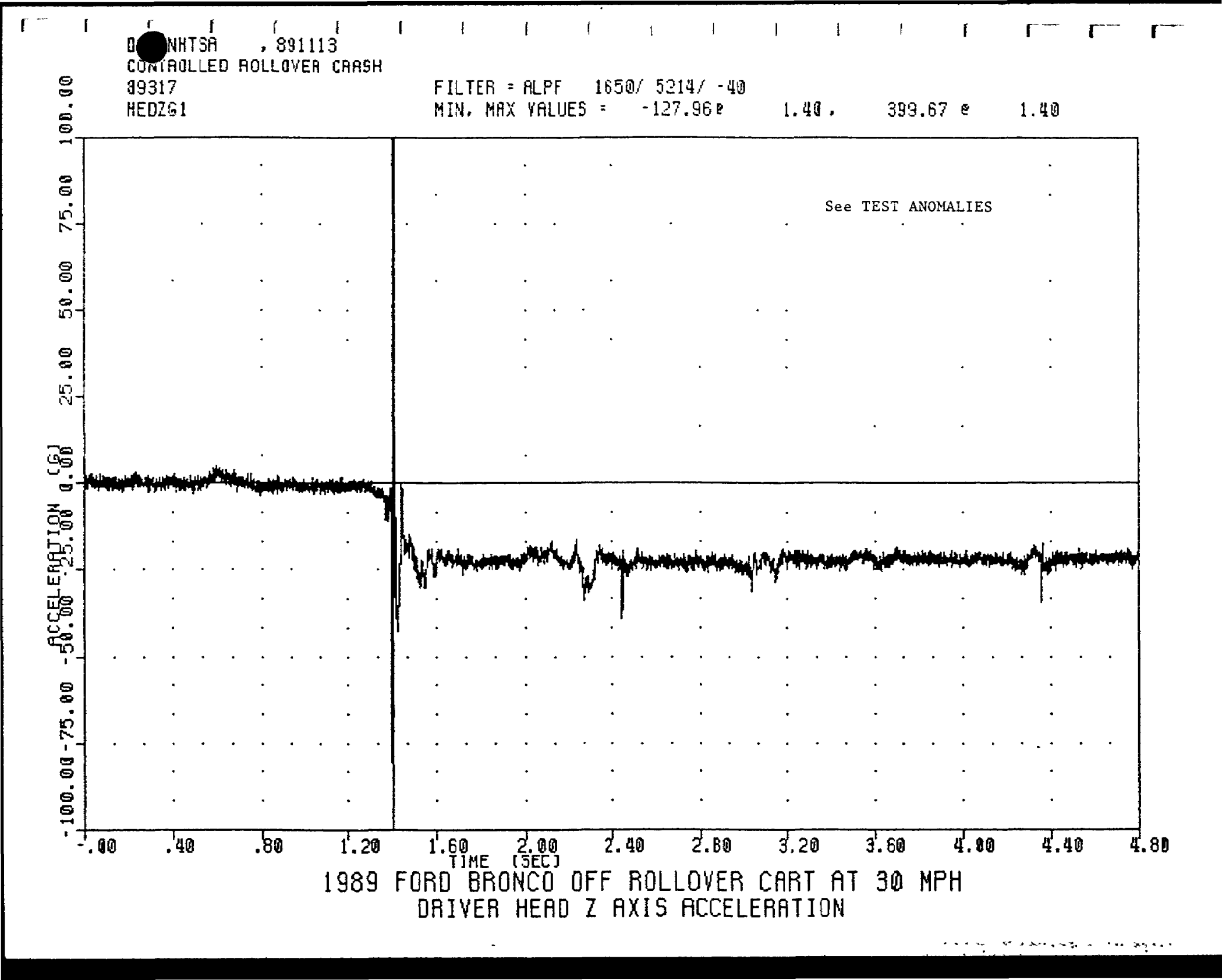
APPENDIX B

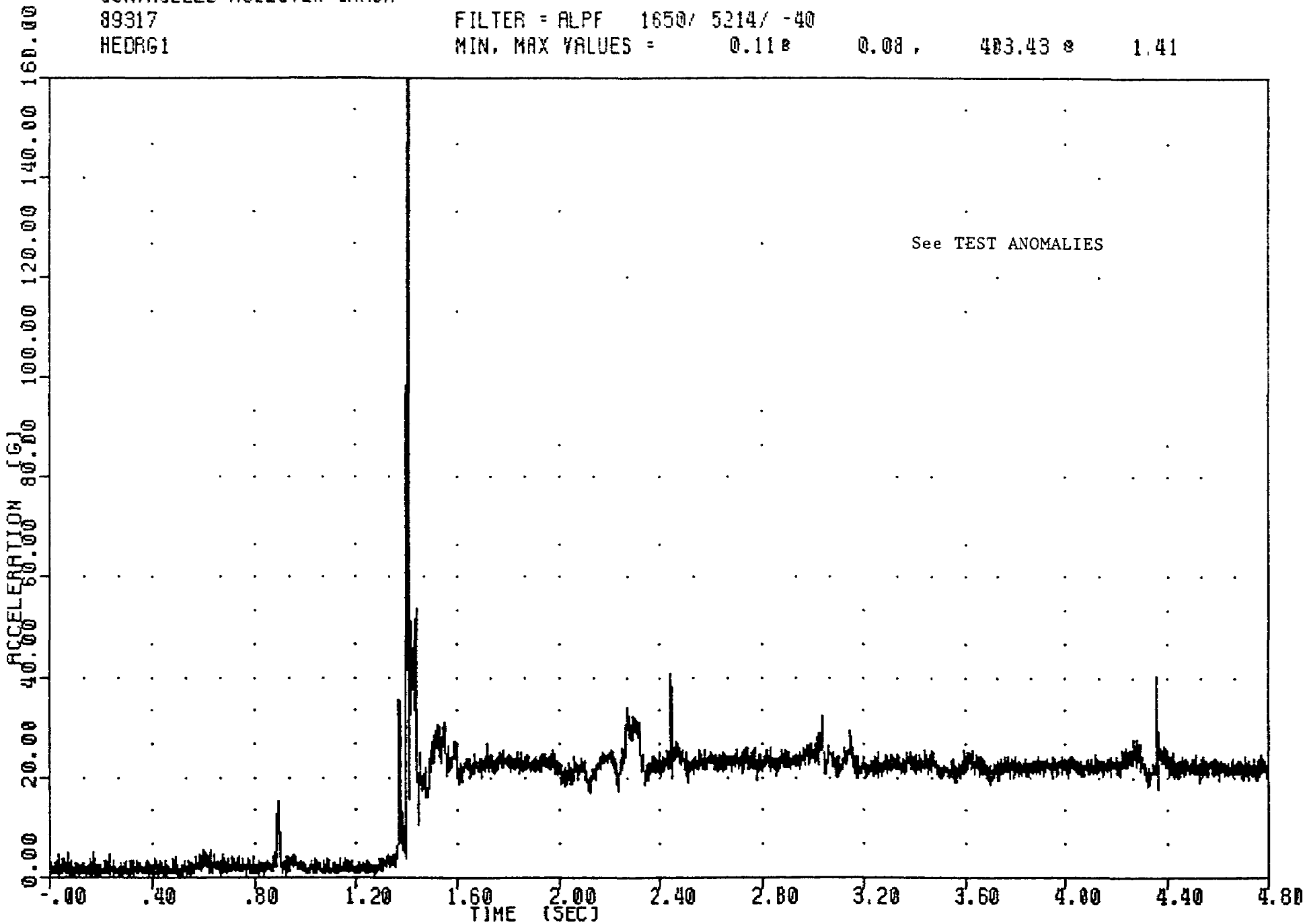
DATA PLOT PRESENTATION



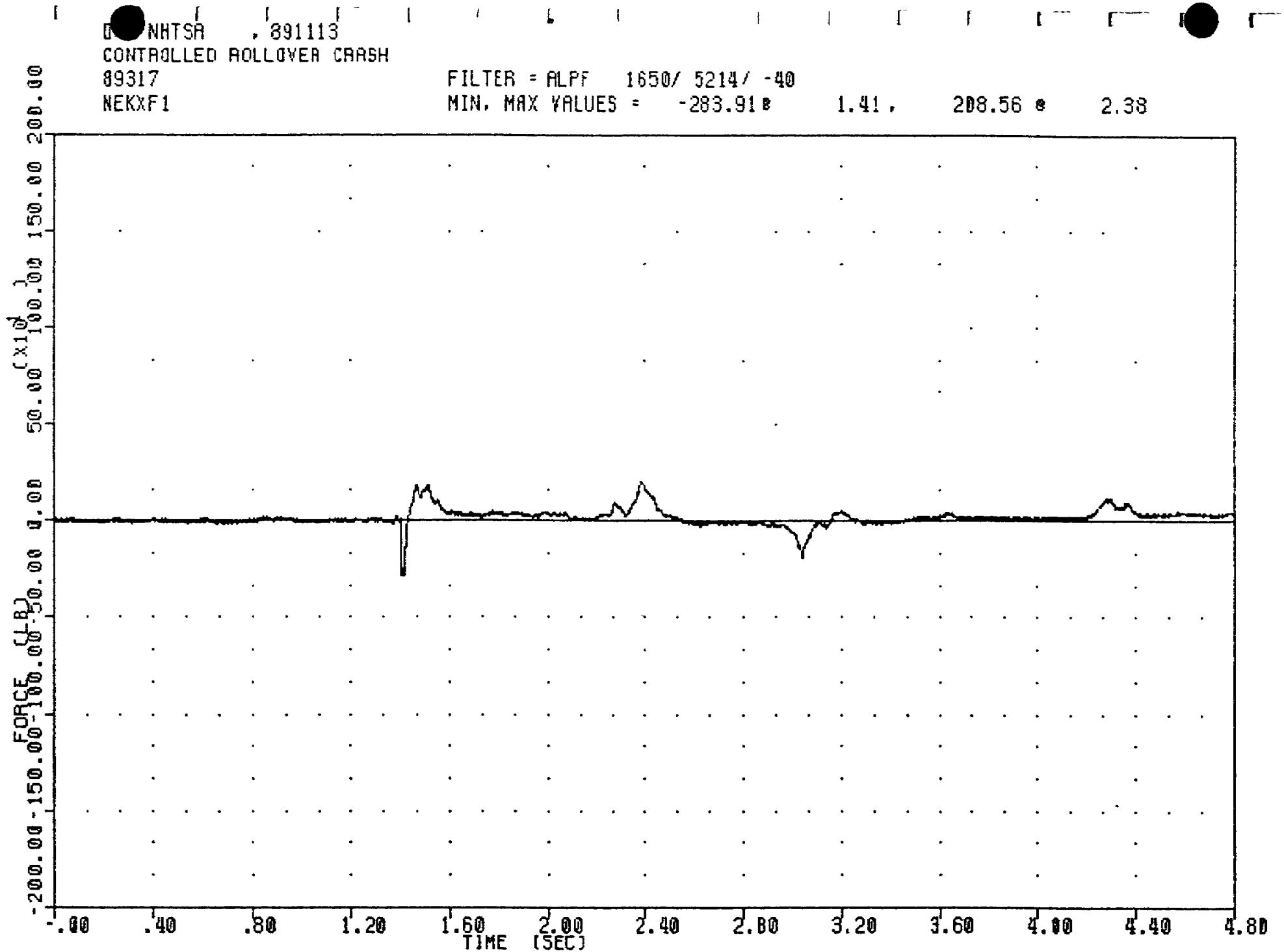
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD X AXIS ACCELERATION


DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
HEDYG1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -63.17 @ 1.41 , 57.56 @ 1.40
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
ACCELERATION [G]
.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 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Y AXIS ACCELERATION


D NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
HEDZG1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -127.96 @ 1.40 , 399.67 @ 1.40
See TEST ANOMALIES
ACCELERATION (G)
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
.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 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Z AXIS ACCELERATION



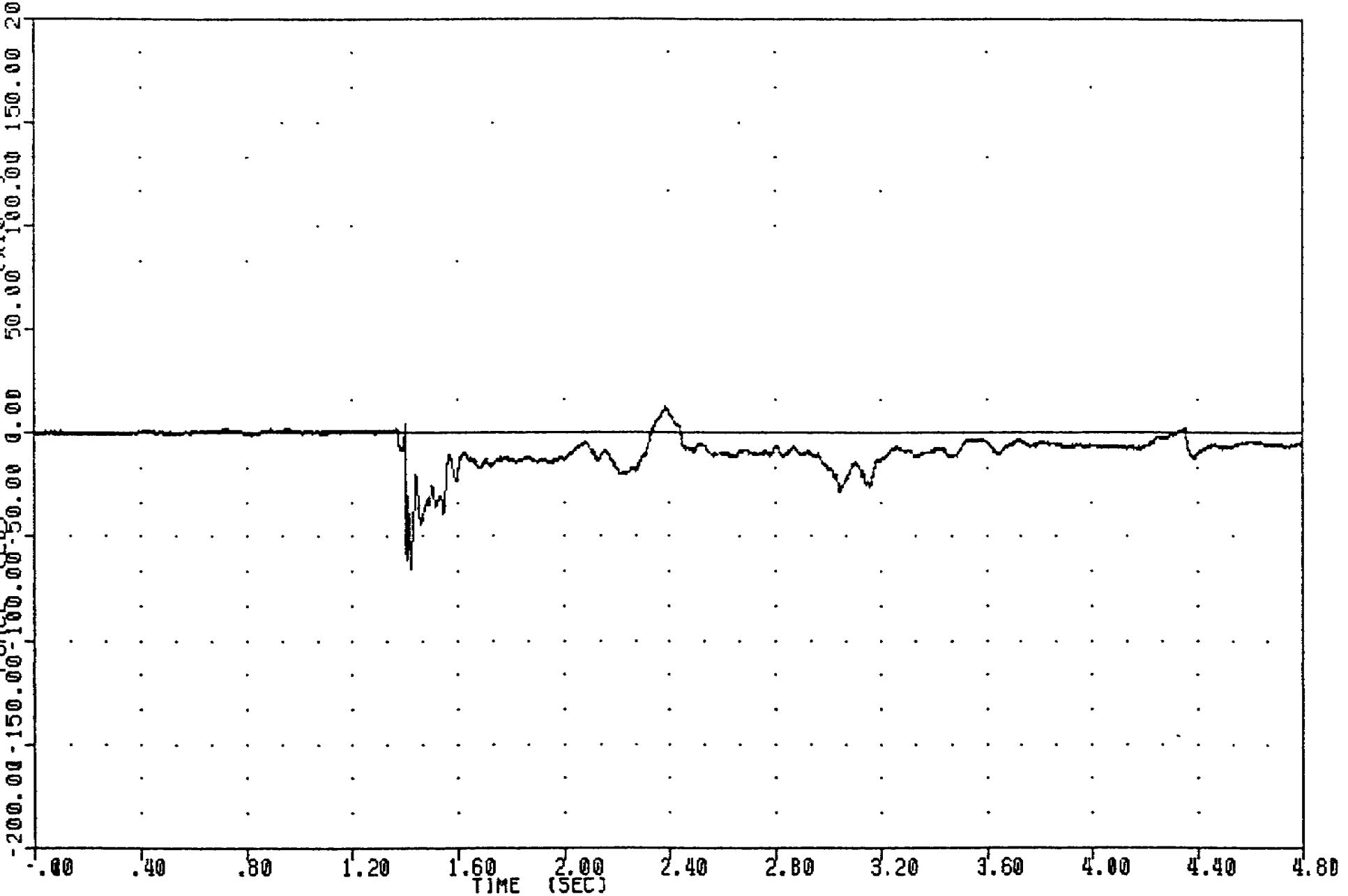
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD RESULTANT ACCELERATION



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK SHEAR FORCE X AXIS

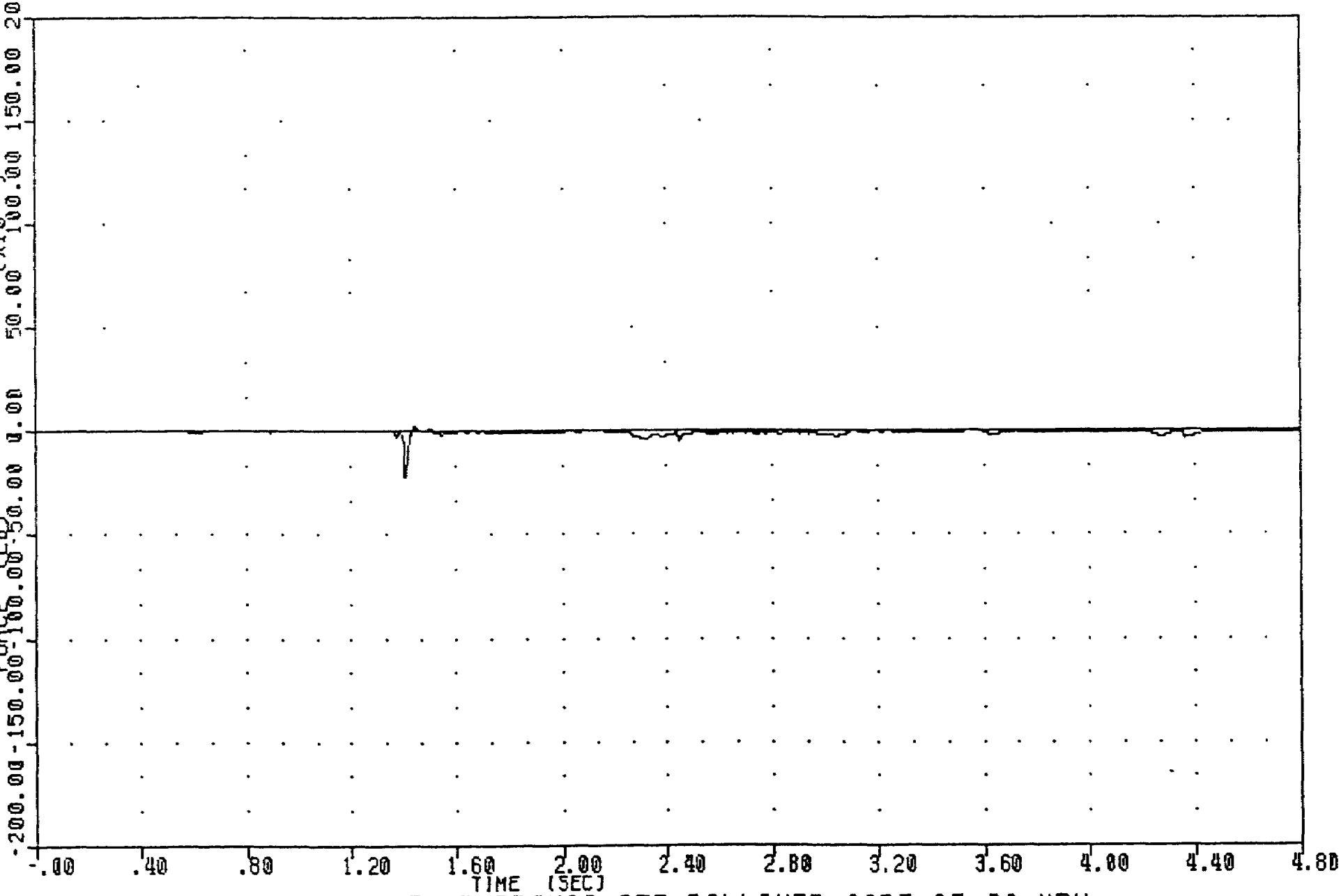
DO NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
NEKYF1

FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -655.24 @ 1.42 , 129.94 @ 2.38

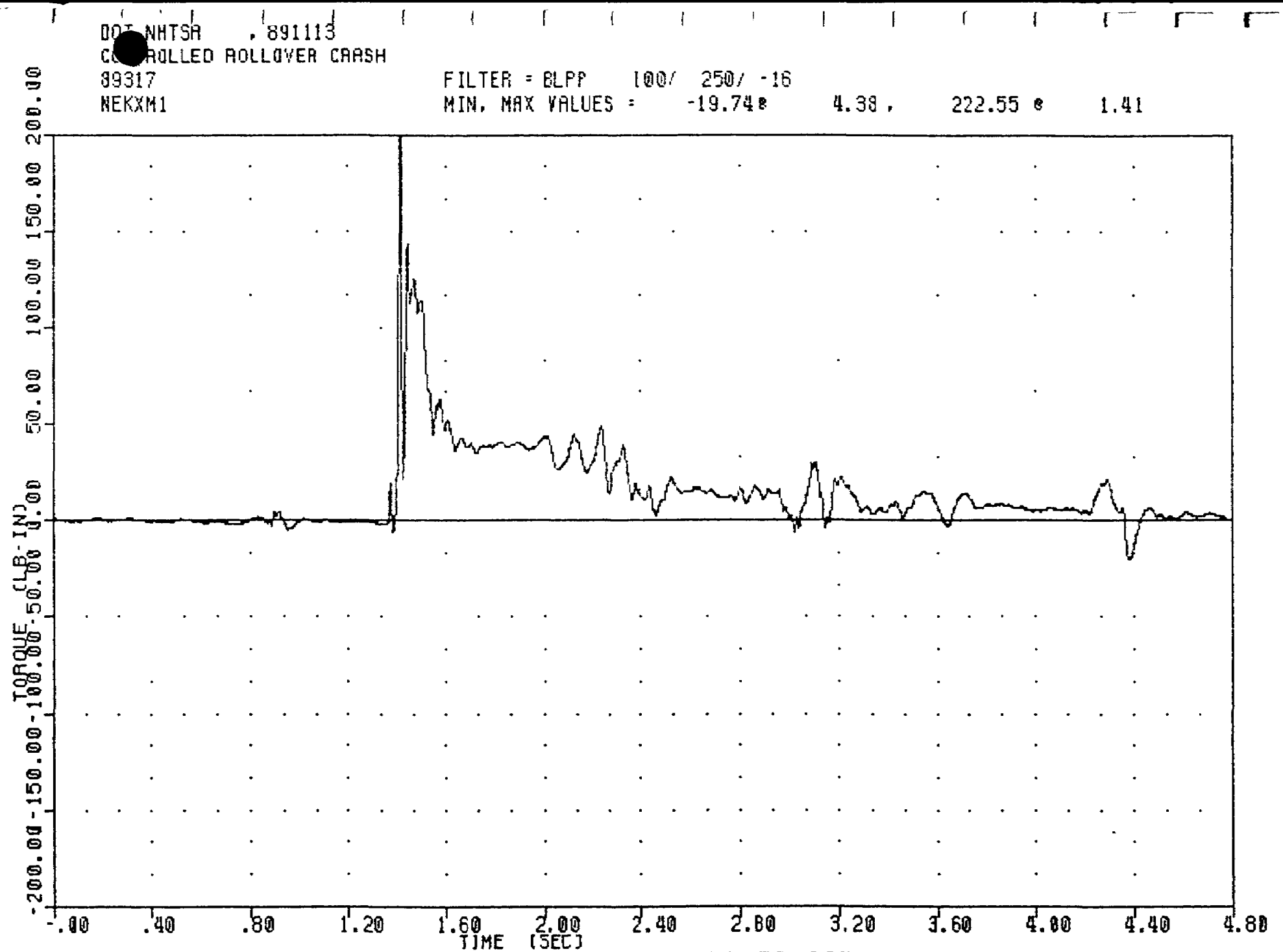


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK SHEAR FORCE Y AXIS

DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
NEKZF1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -215.27@ 1.40 , 20.60 @ 1.44



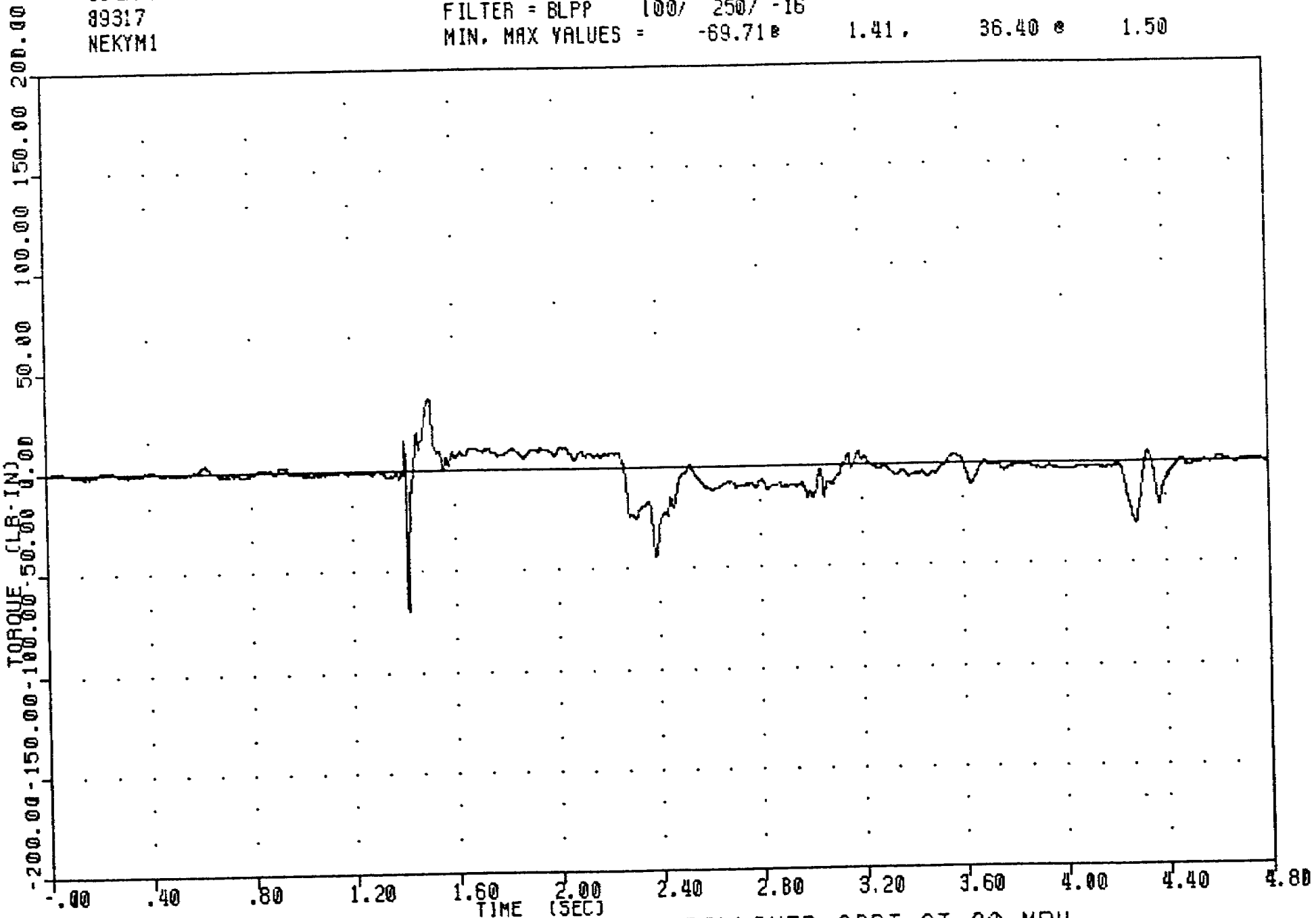
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK AXIAL FORCE Z AXIS



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT X AXIS

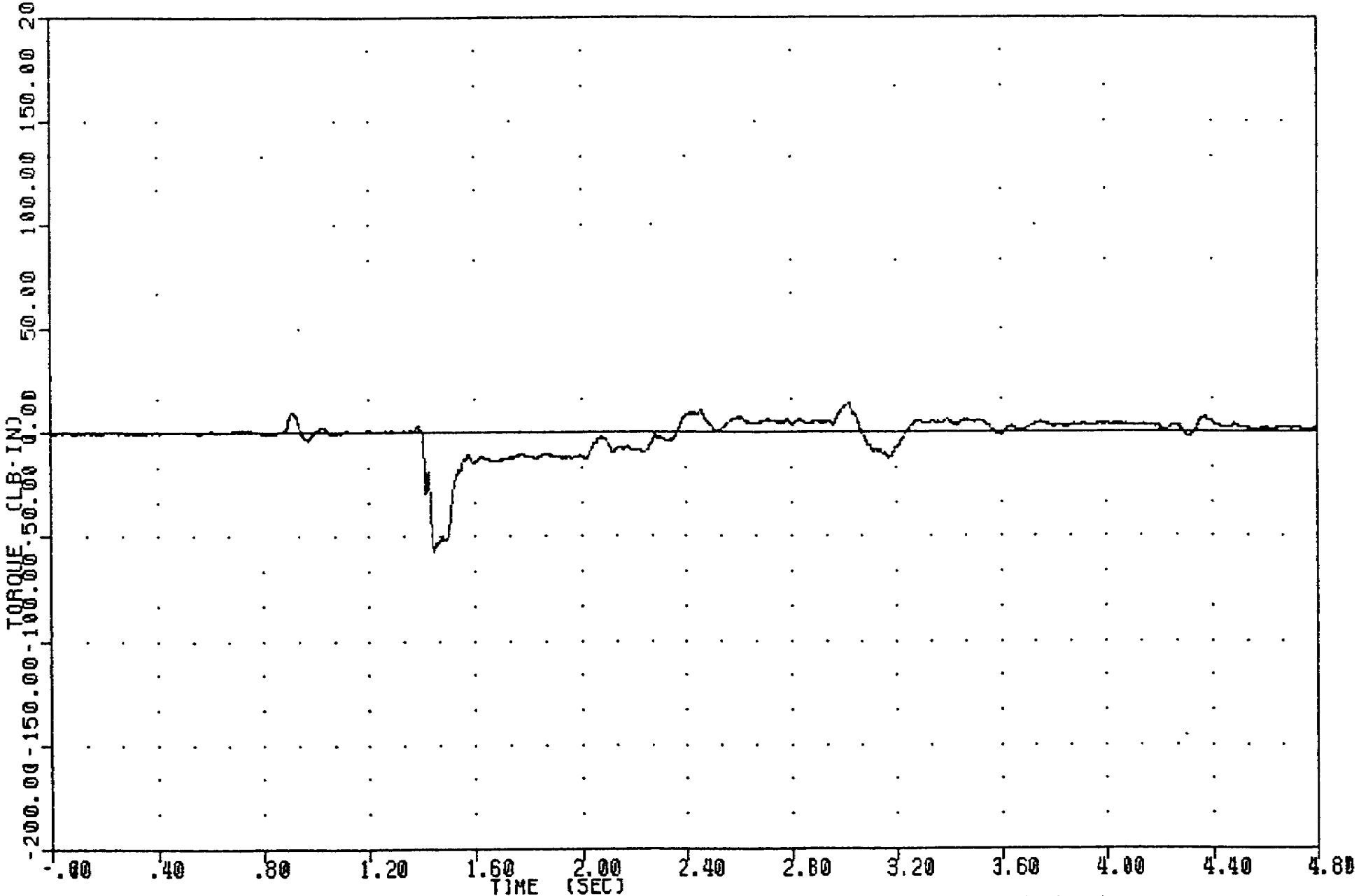
DOT NHTSA . 891113
CONTROLLED ROLLOVER CRASH
89317
NEKYM1

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -69.71 @ 1.41 , 36.40 @ 1.50

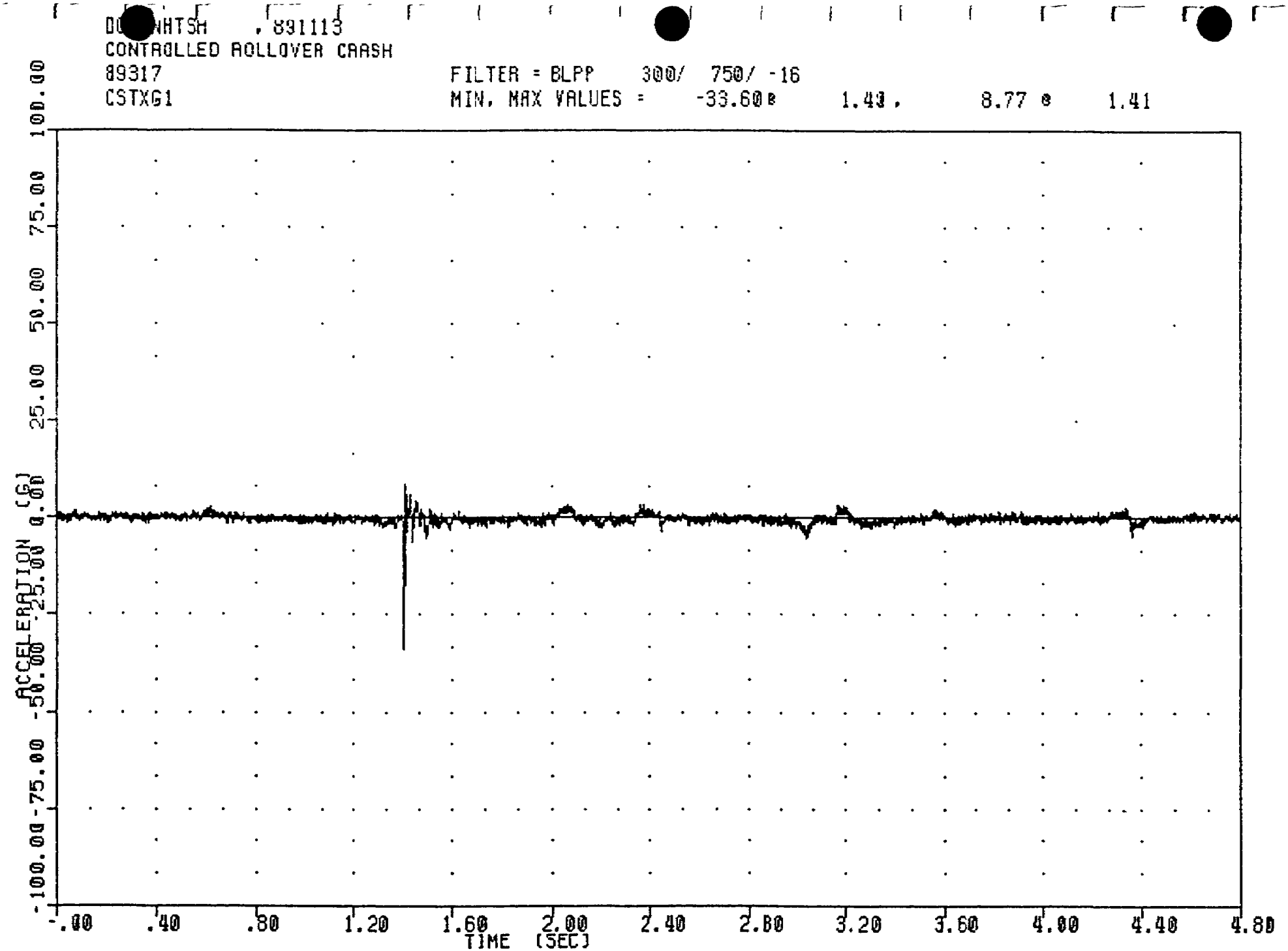


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT Y AXIS

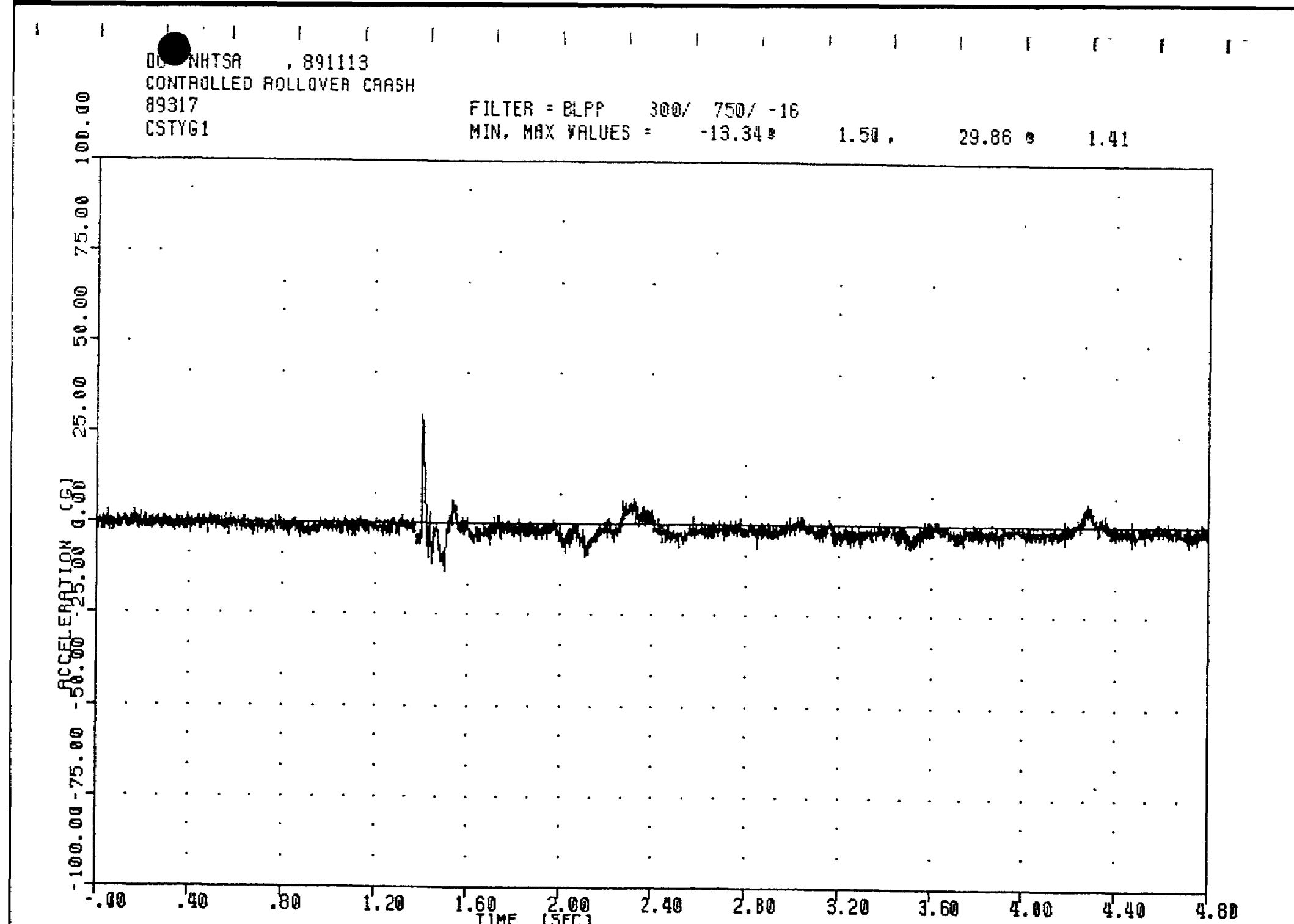
DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317 FILTER = BLPP 100/ 250/ -16
NEKZM1 MIN, MAX VALUES = -56.98 @ 1.44 , 13.94 @ 3.02



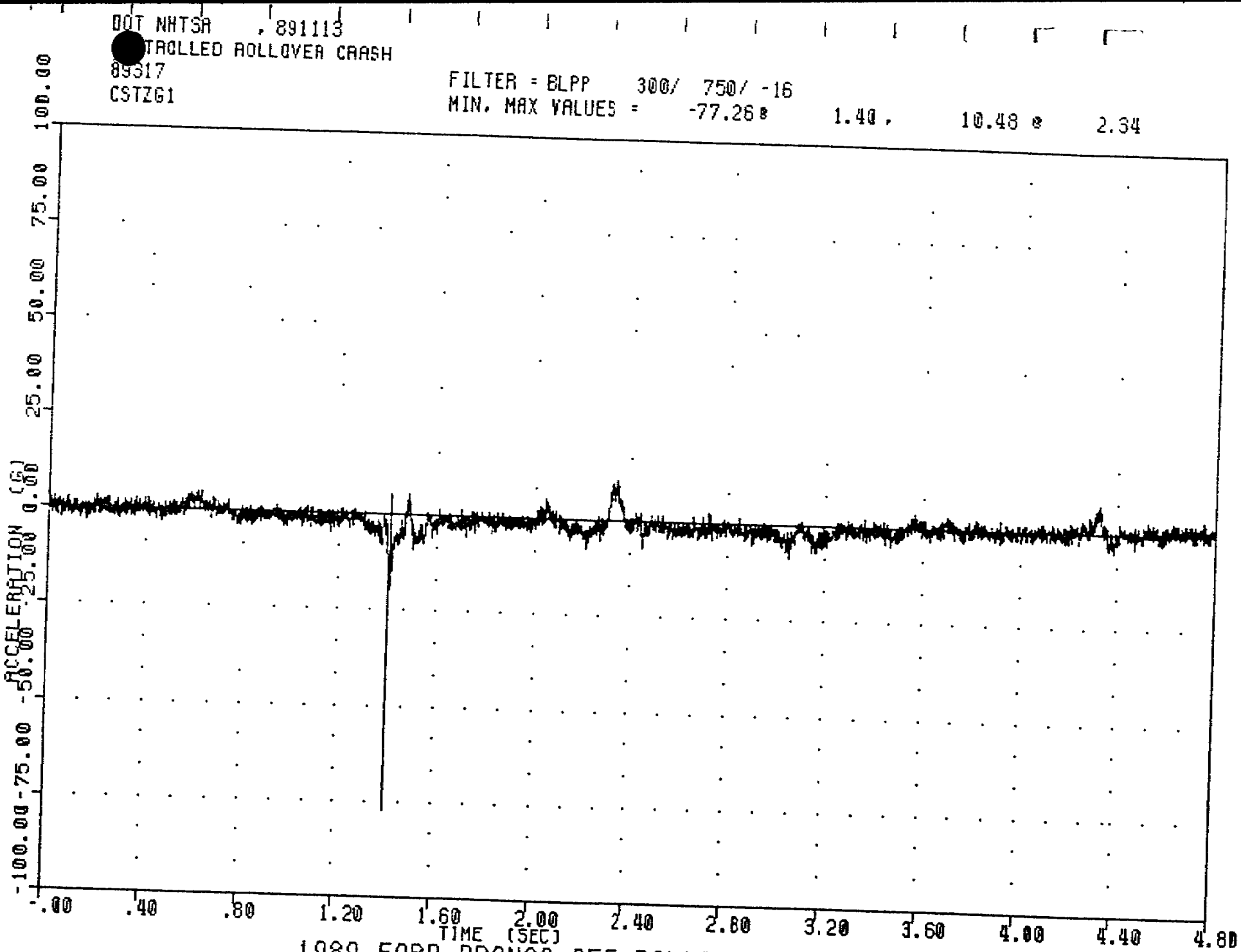
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT Z AXIS



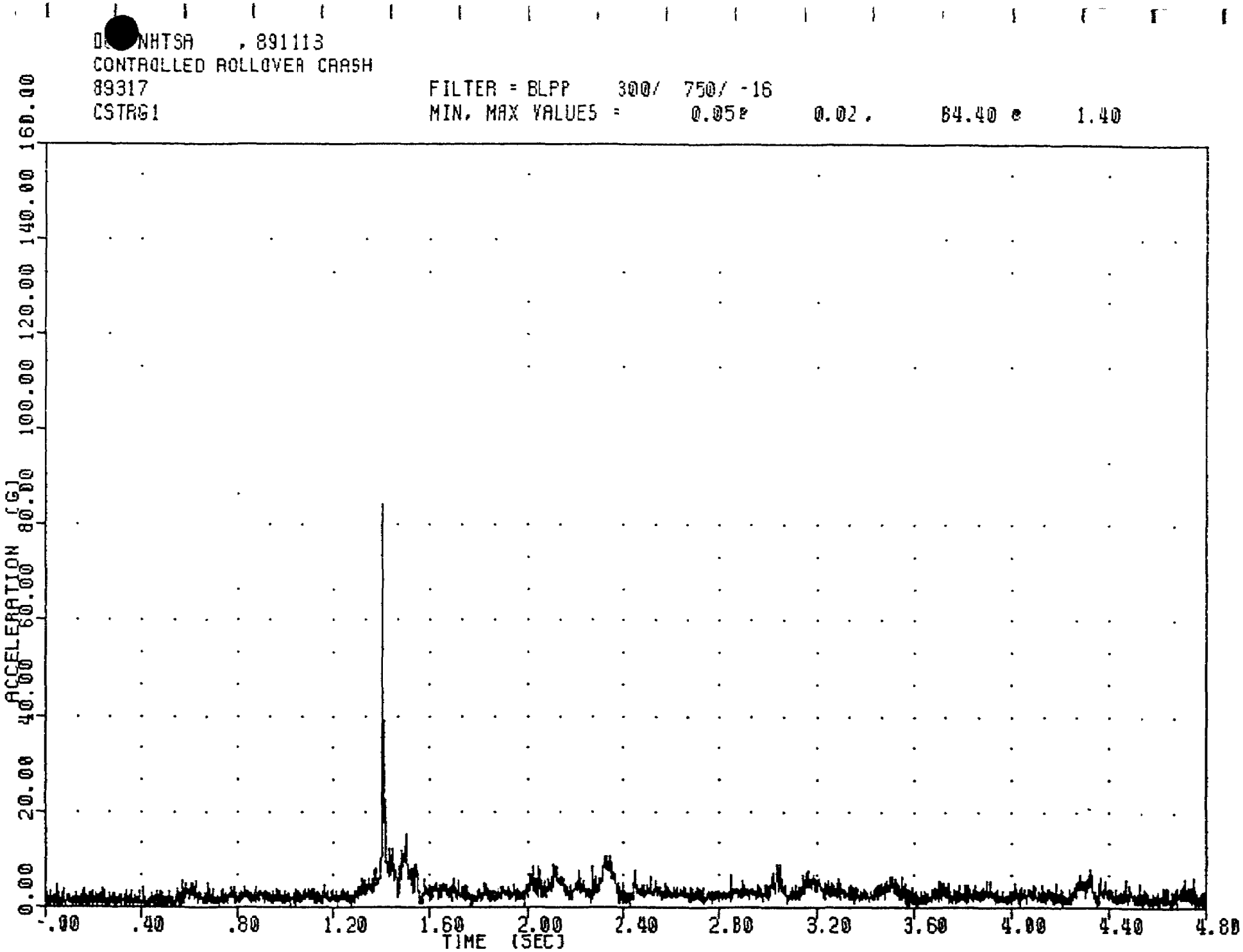
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS ACCELERATION



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST Y AXIS ACCELERATION

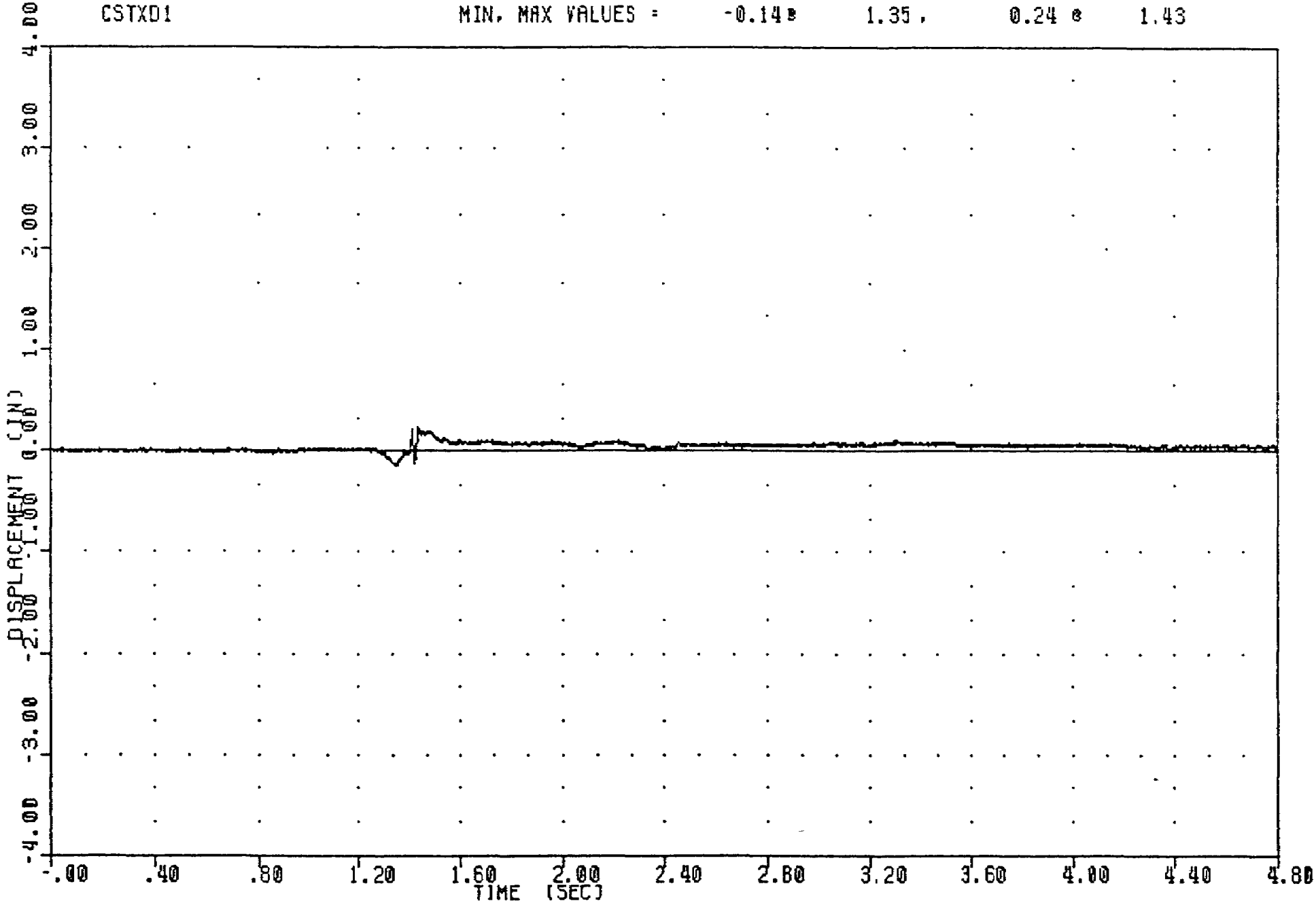


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST Z AXIS ACCELERATION

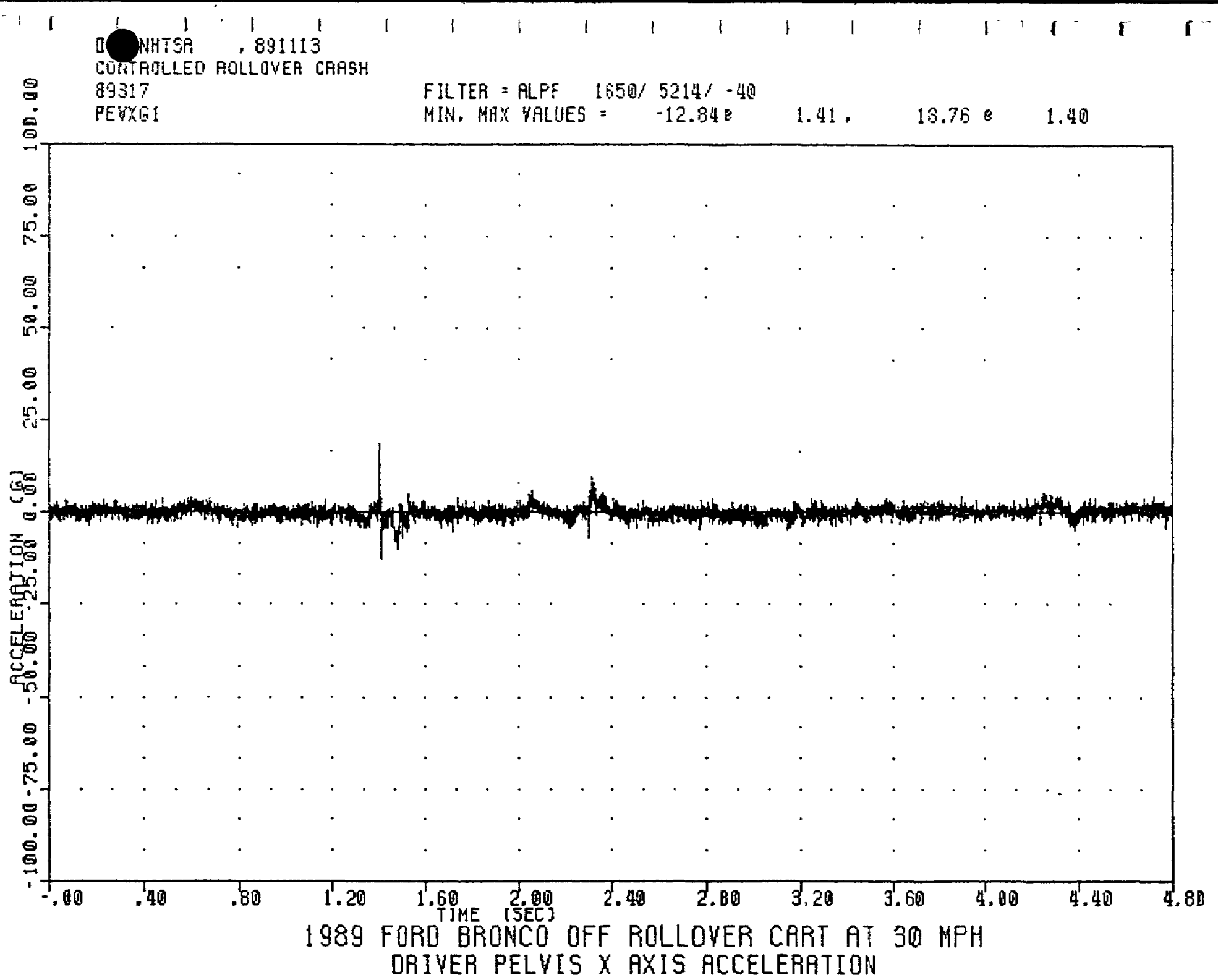


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST RESULTANT ACCELERATION

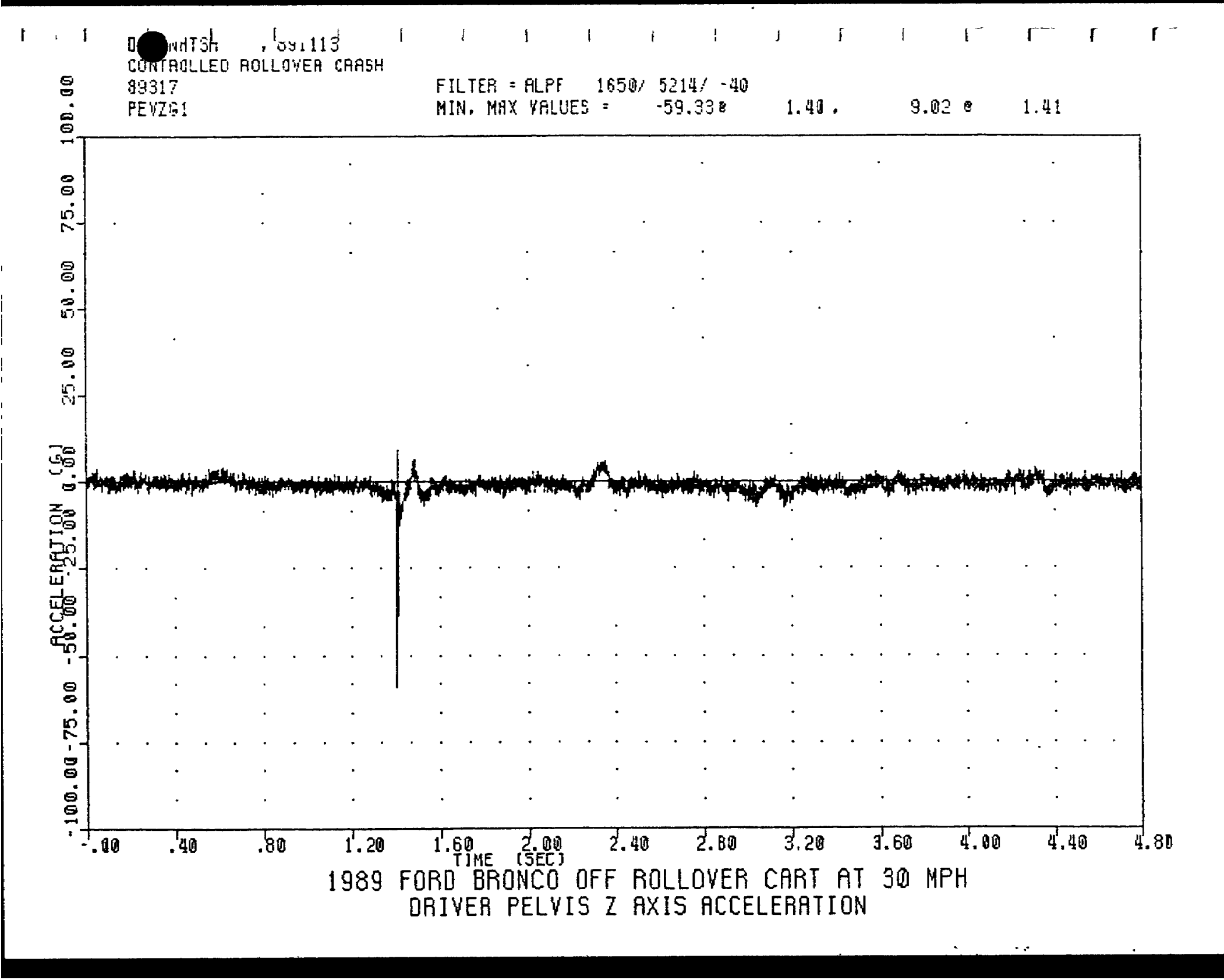
DOT NHTSA . 891113
CONTROLLED ROLLOVER CRASH
89317 FILTER = BLPP 300/ 750/ -16
CSTXD1 MIN, MAX VALUES = -0.14 @ 1.35 , 0.24 @ 1.43

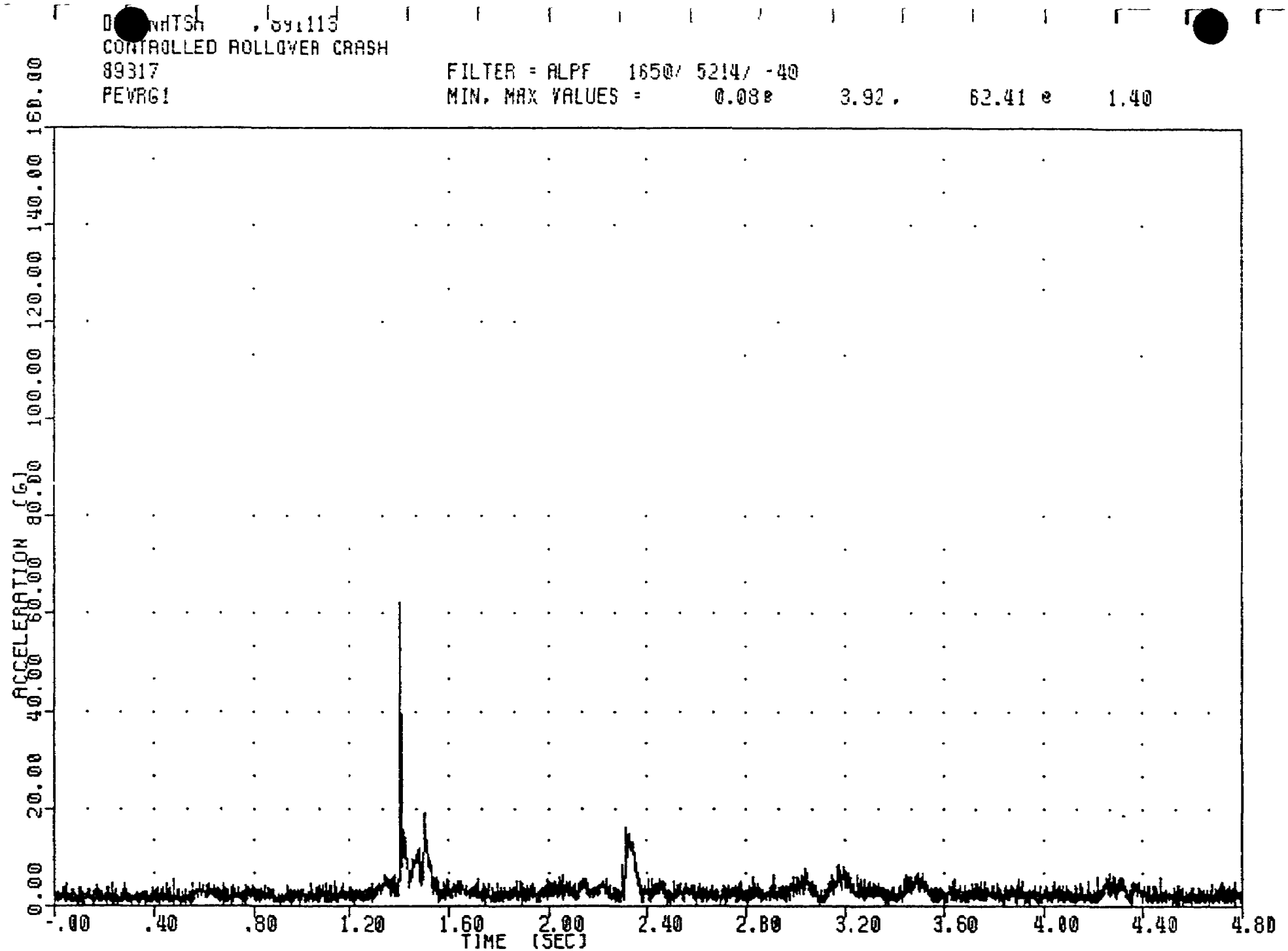


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS DISPLACEMENT

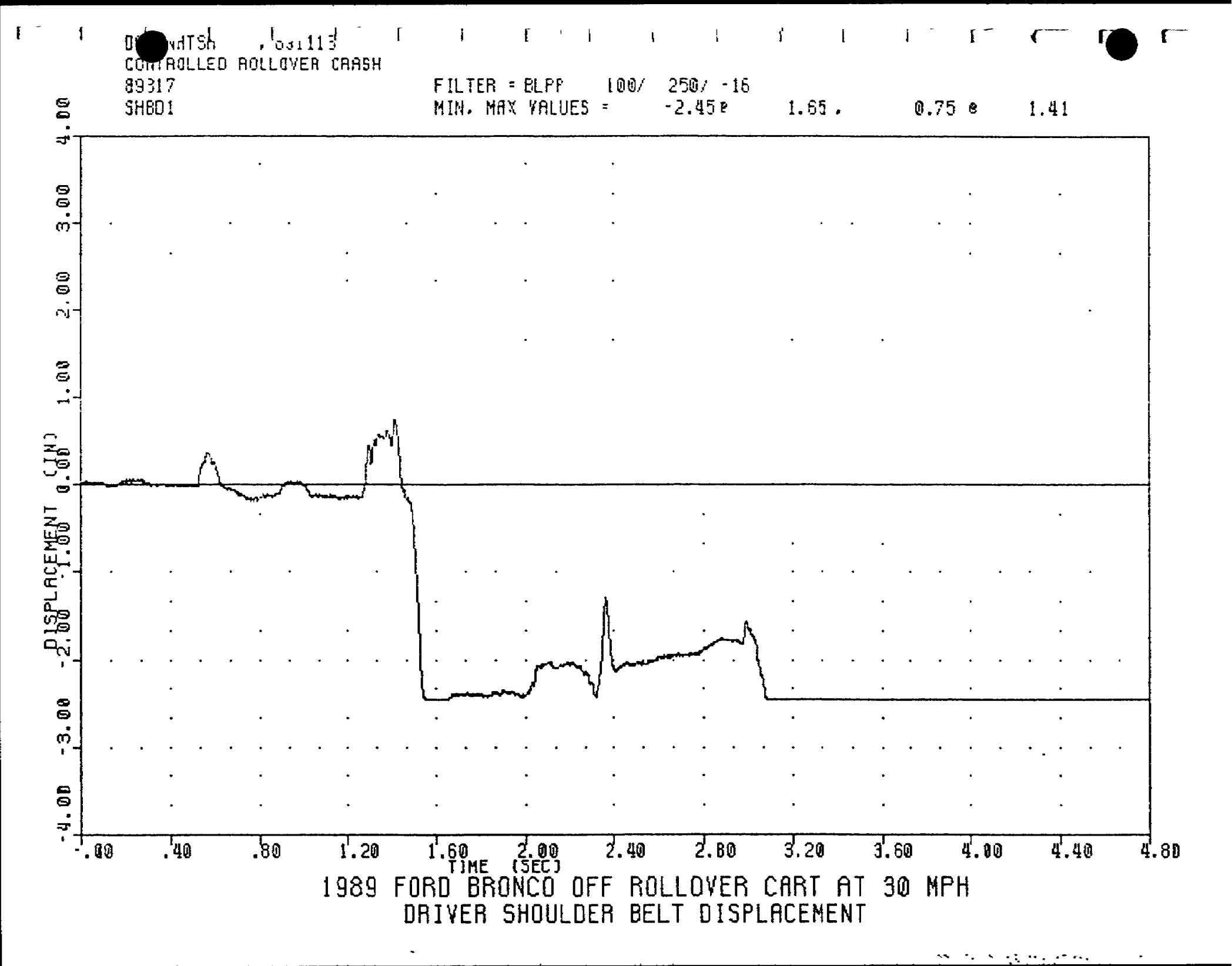


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS X AXIS ACCELERATION

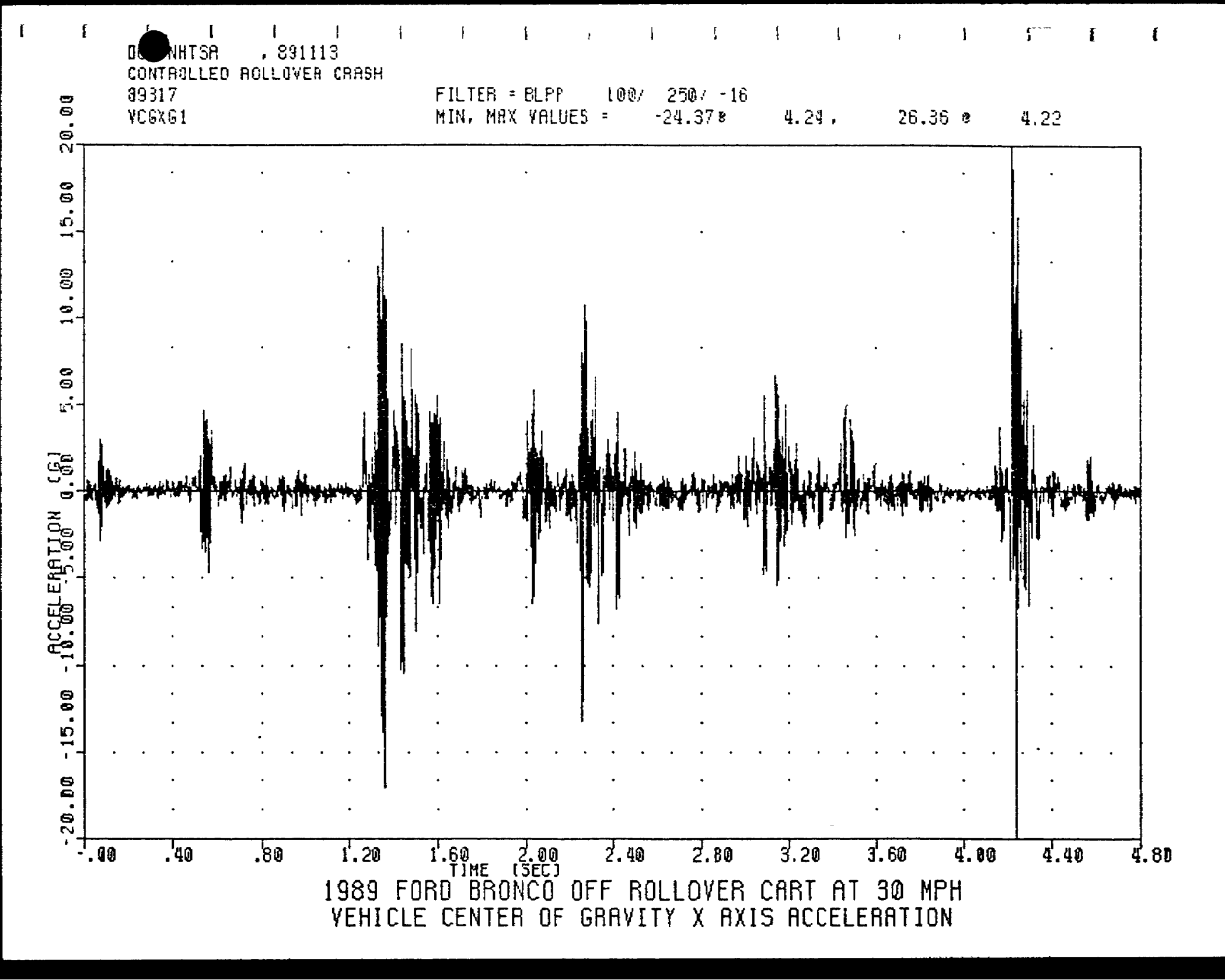

CONTROLLED ROLLOVER CRASH
89317
PEVZG1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -59.33 @ 1.40 , 9.02 @ 1.41
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
ACCELERATION (G)
.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS Z AXIS ACCELERATION



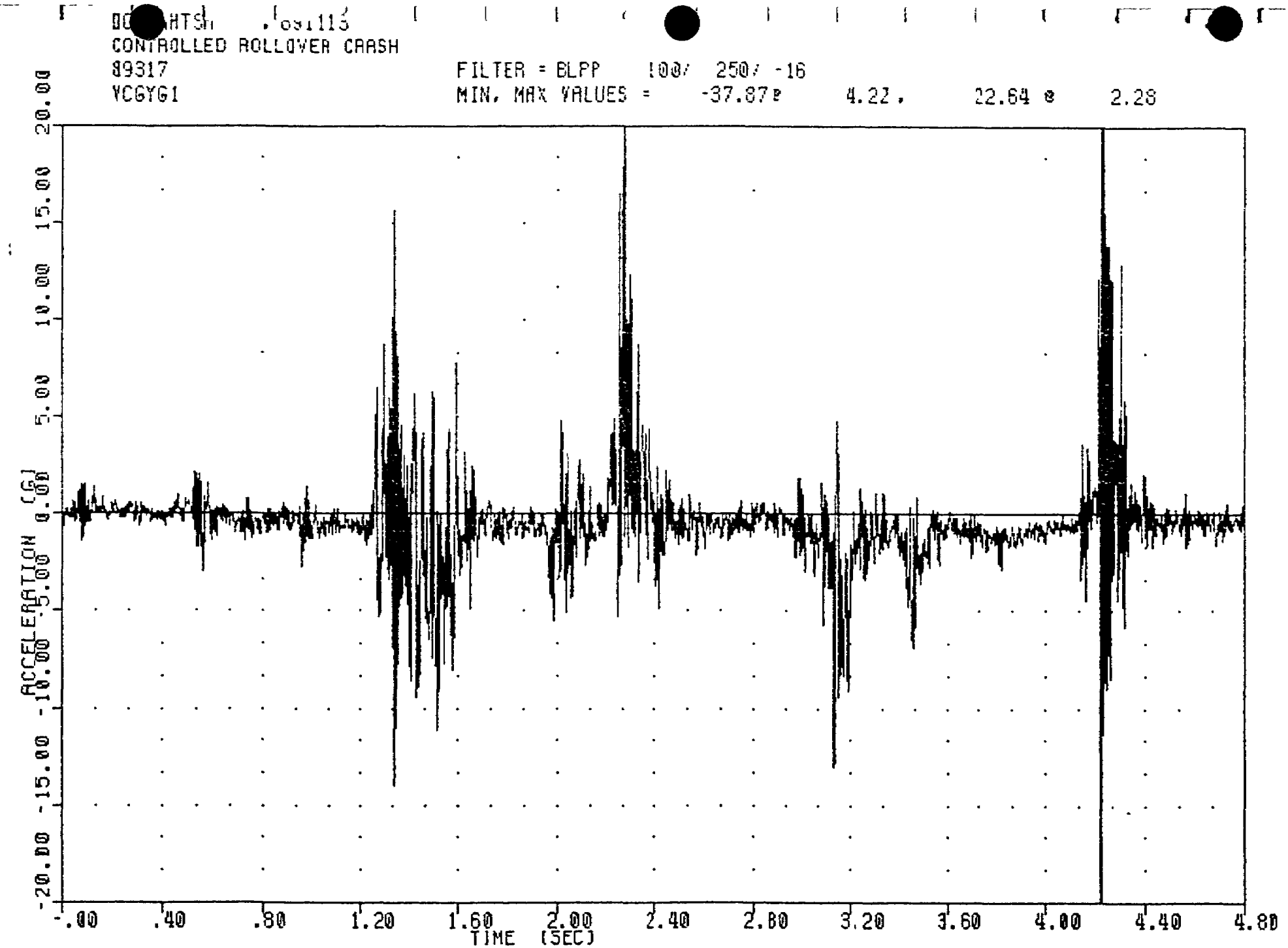
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS RESULTANT ACCELERATION



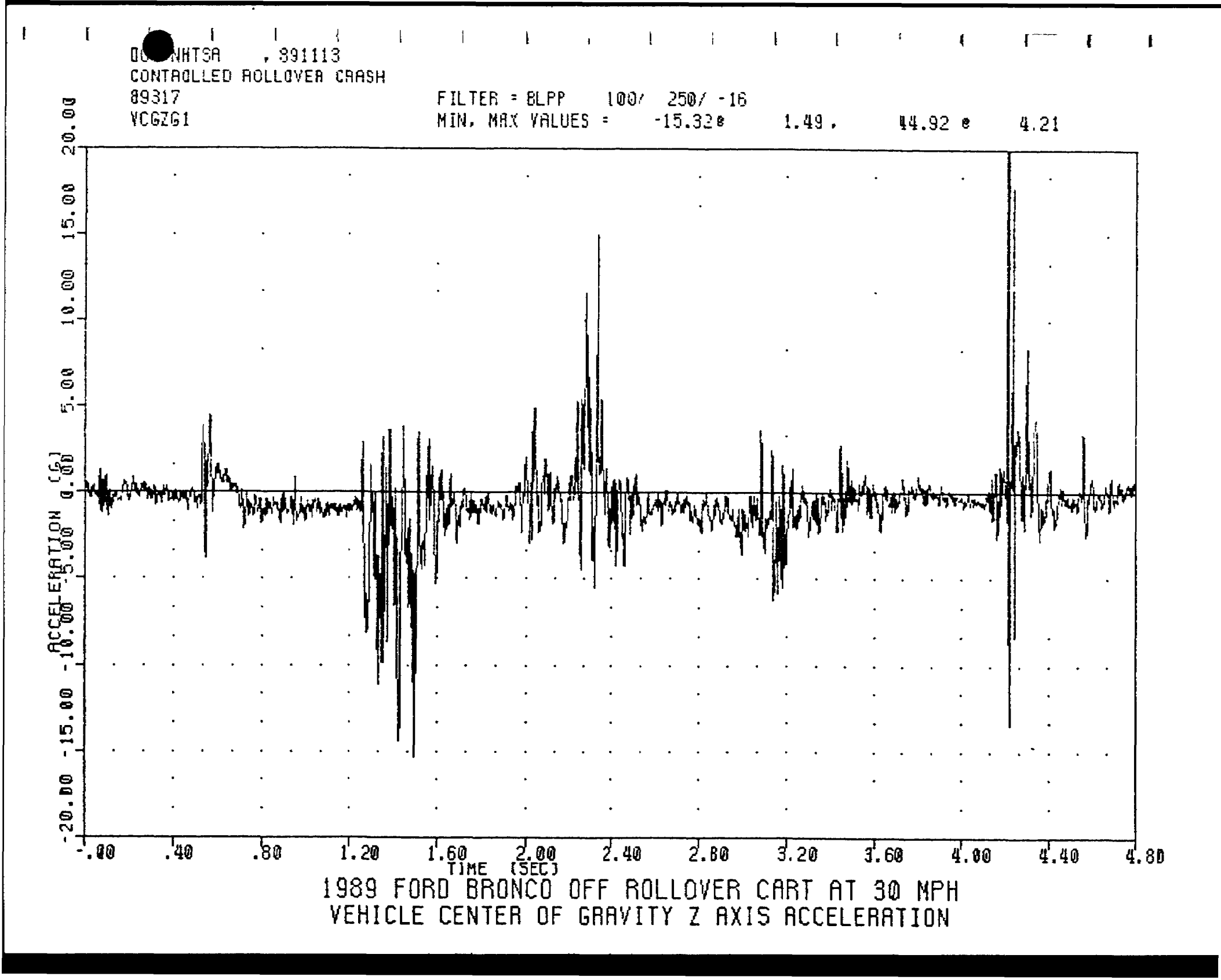
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
DRIVER SHOULDER BELT DISPLACEMENT



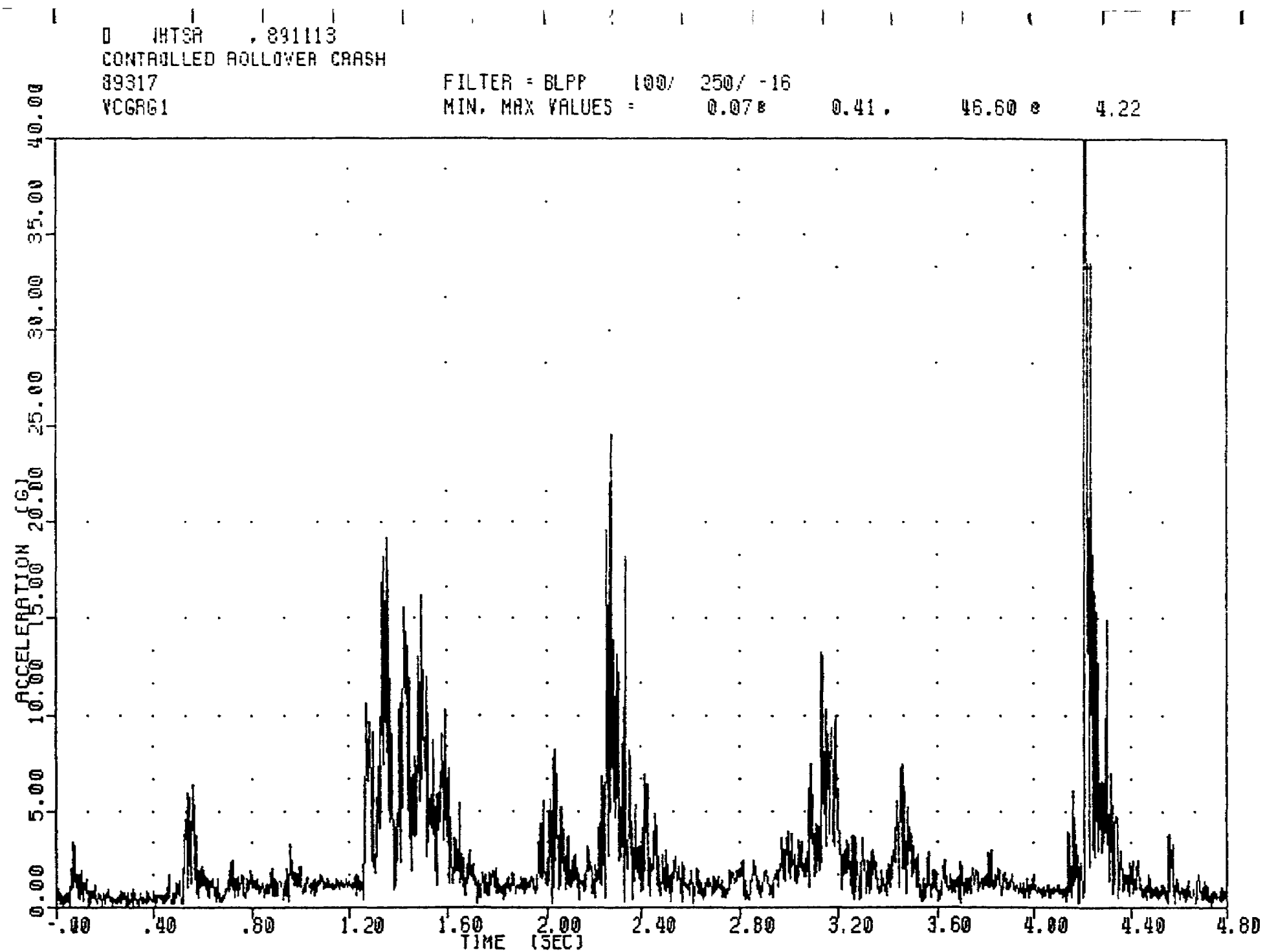
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY X AXIS ACCELERATION



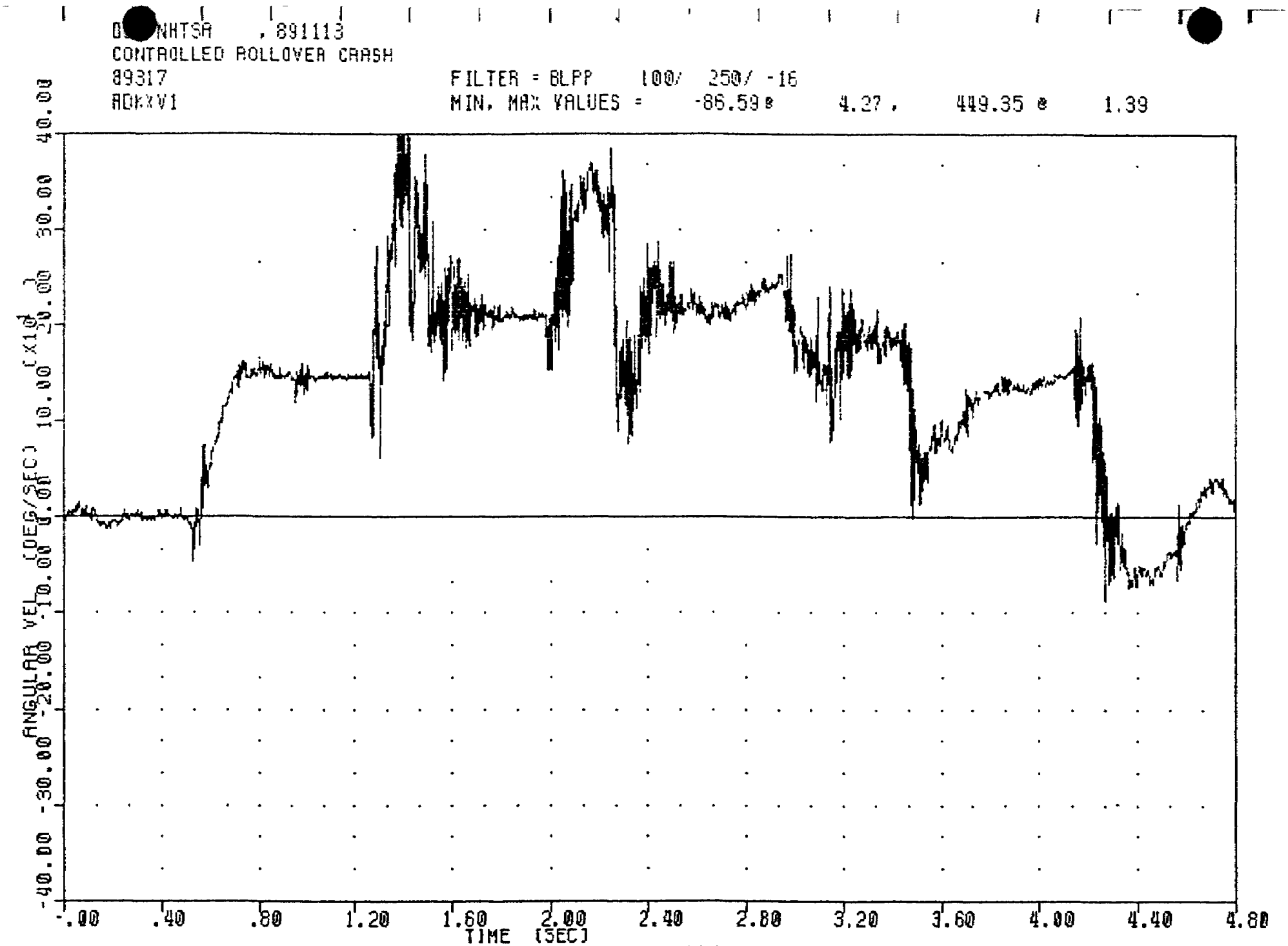
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Y AXIS ACCELERATION



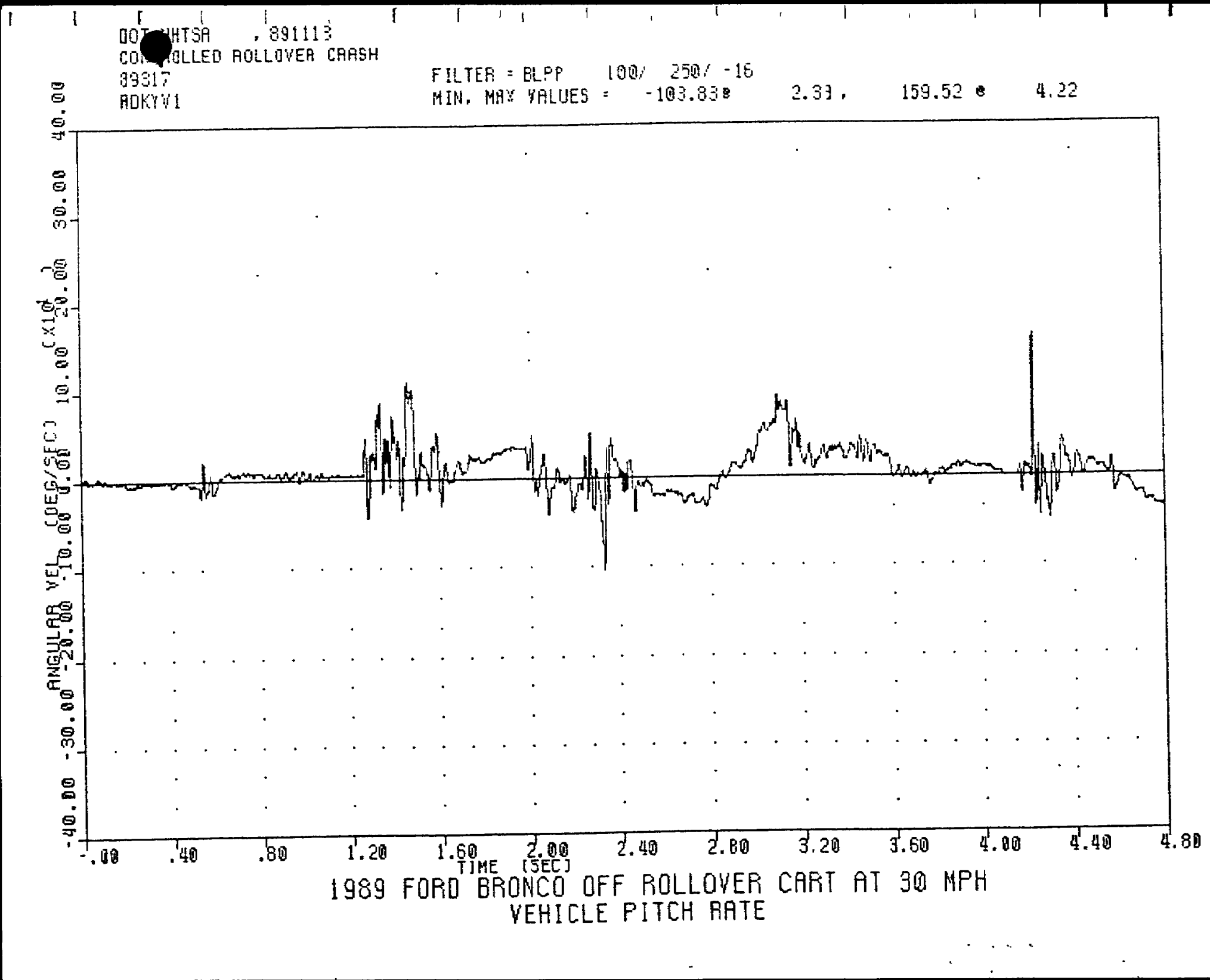
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Z AXIS ACCELERATION



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION



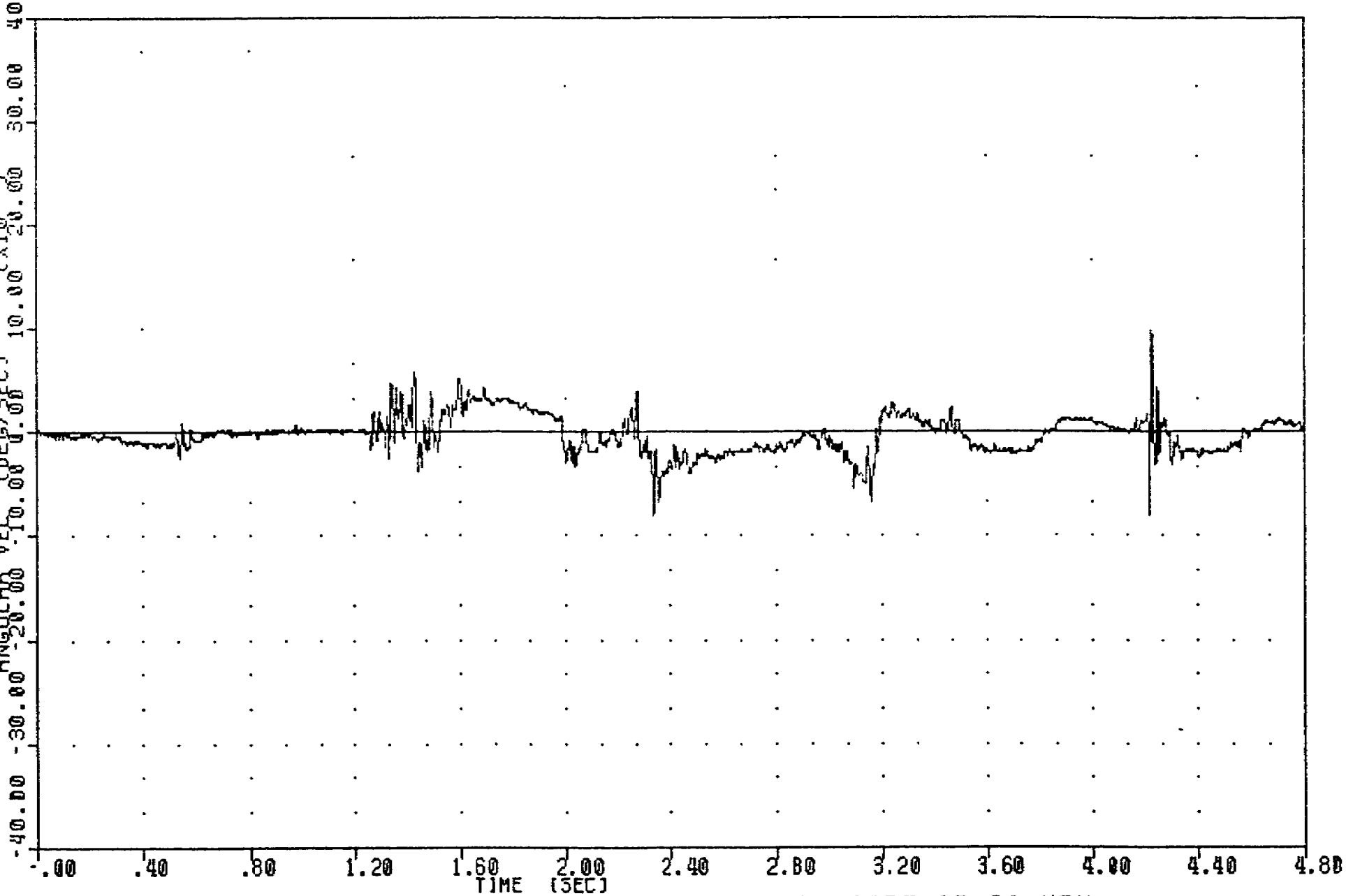
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE ROLL RATE



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE PITCH RATE

DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
RDKZV1

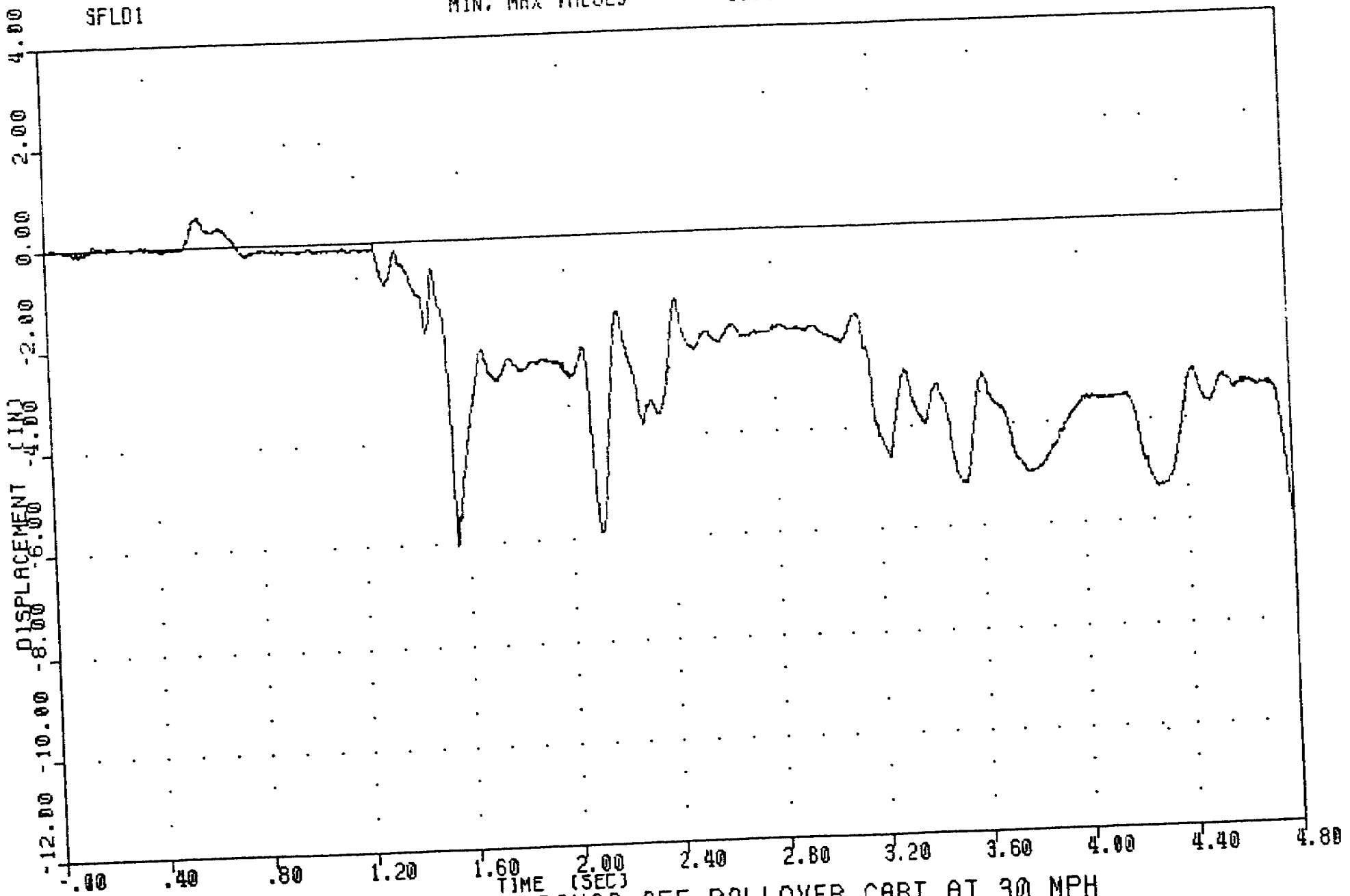
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -79.87 @ 2.34 , 97.99 @ 4.23



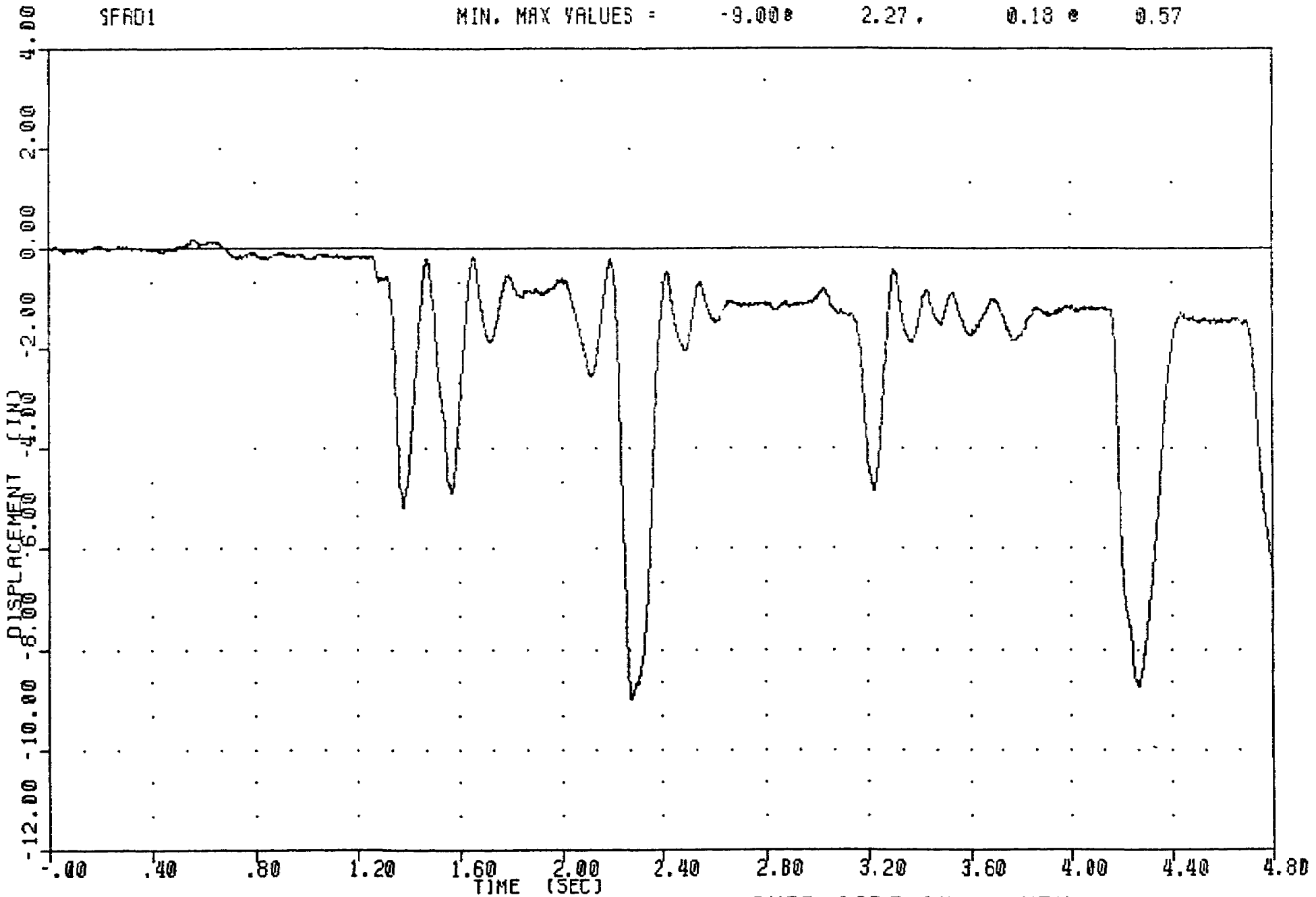
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE YAW RATE

DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
SFL01

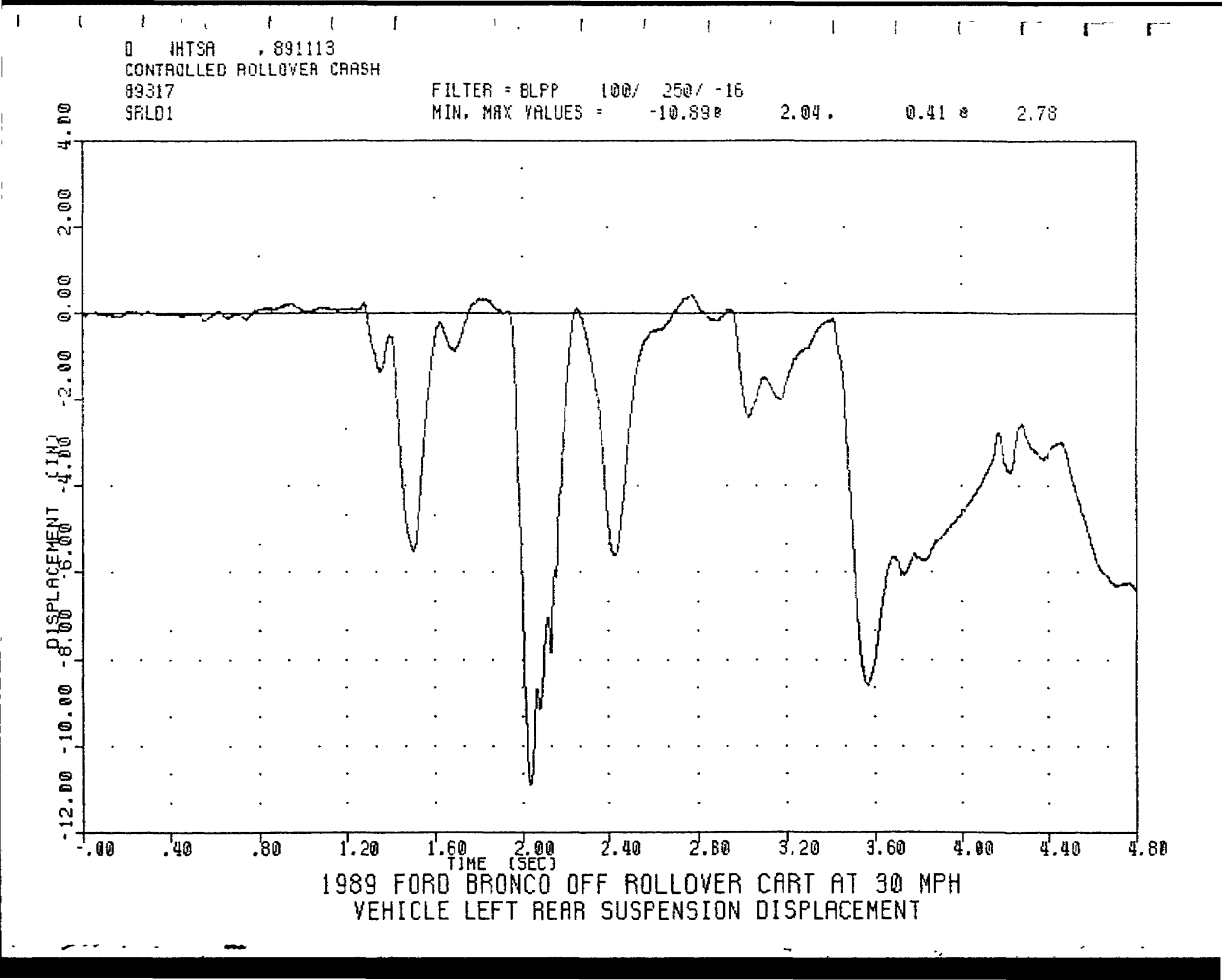
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -6.01@ 1.55, 0.59@ 0.59



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT FRONT SUSPENSION DISPLACEMENT

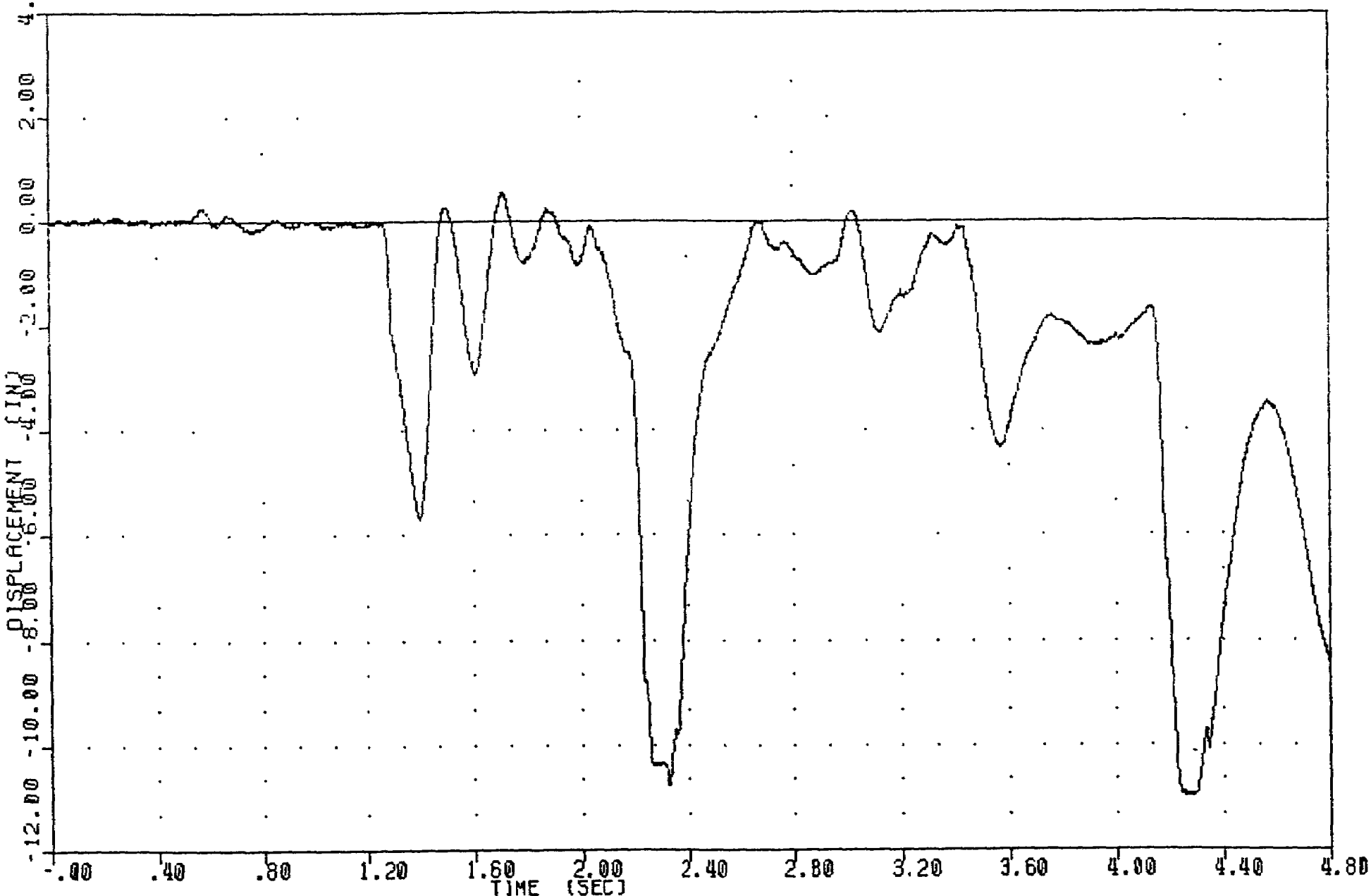


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE RIGHT FRONT SUSPENSION DISPLACEMENT


0 NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
SRL01
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -10.89@ 2.04, 0.41 @ 2.78
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
DISPLACEMENT (IN)
.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 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT REAR SUSPENSION DISPLACEMENT

DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
SRR01

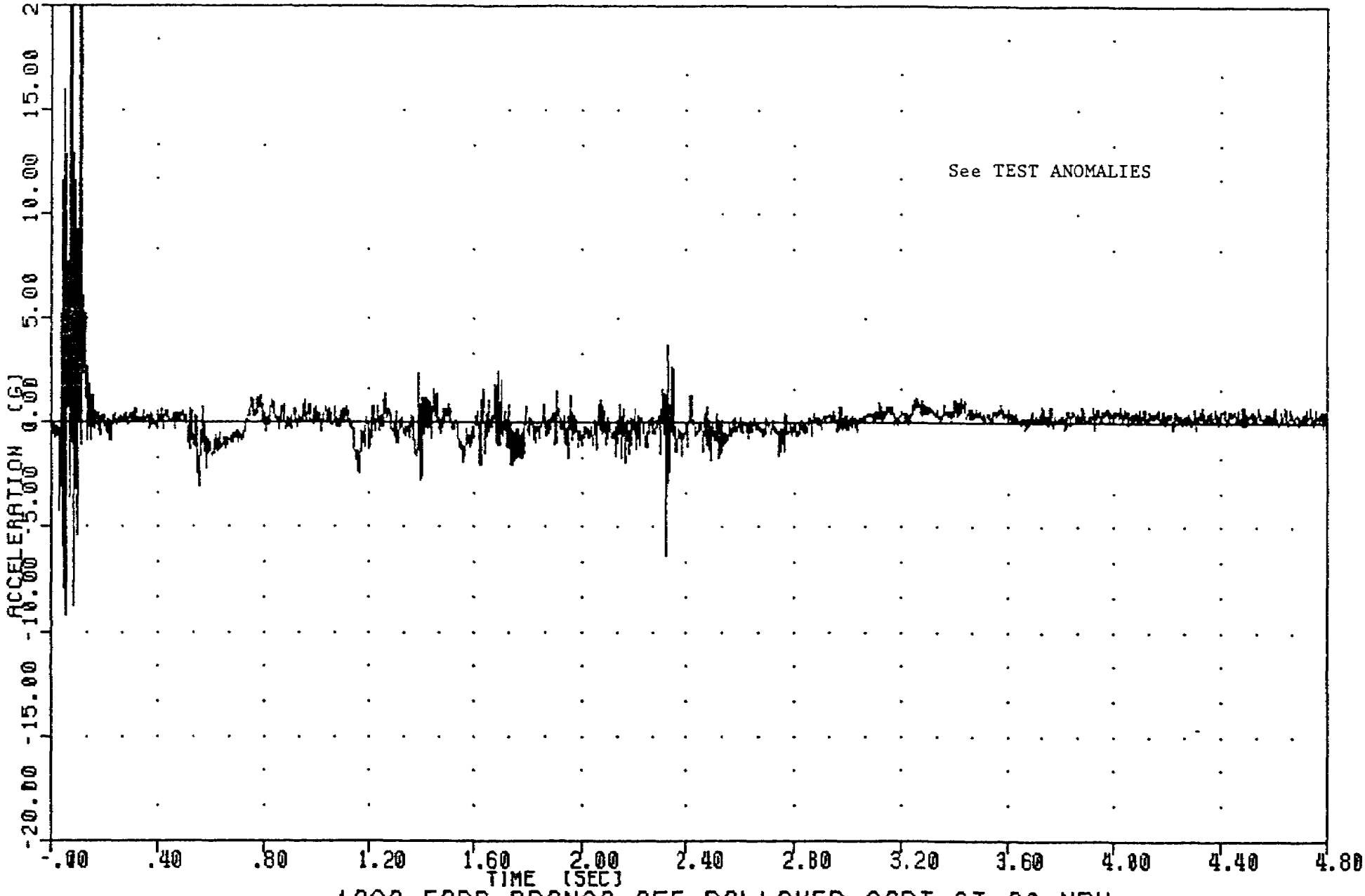
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -11.00 @ 4.27 , @ 0.54 @ 1.71



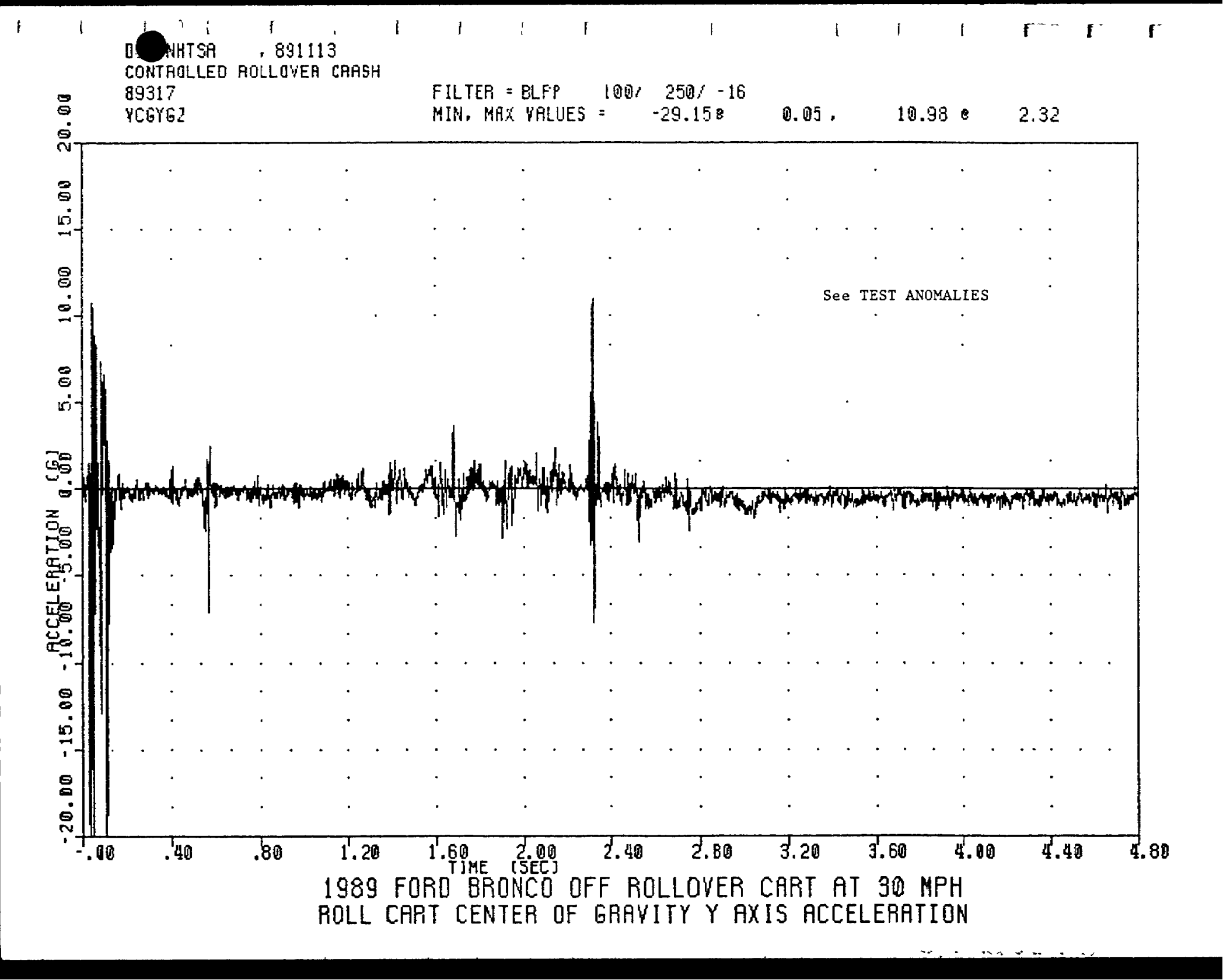
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE RIGHT REAR SUSPENSION DISPLACEMENT

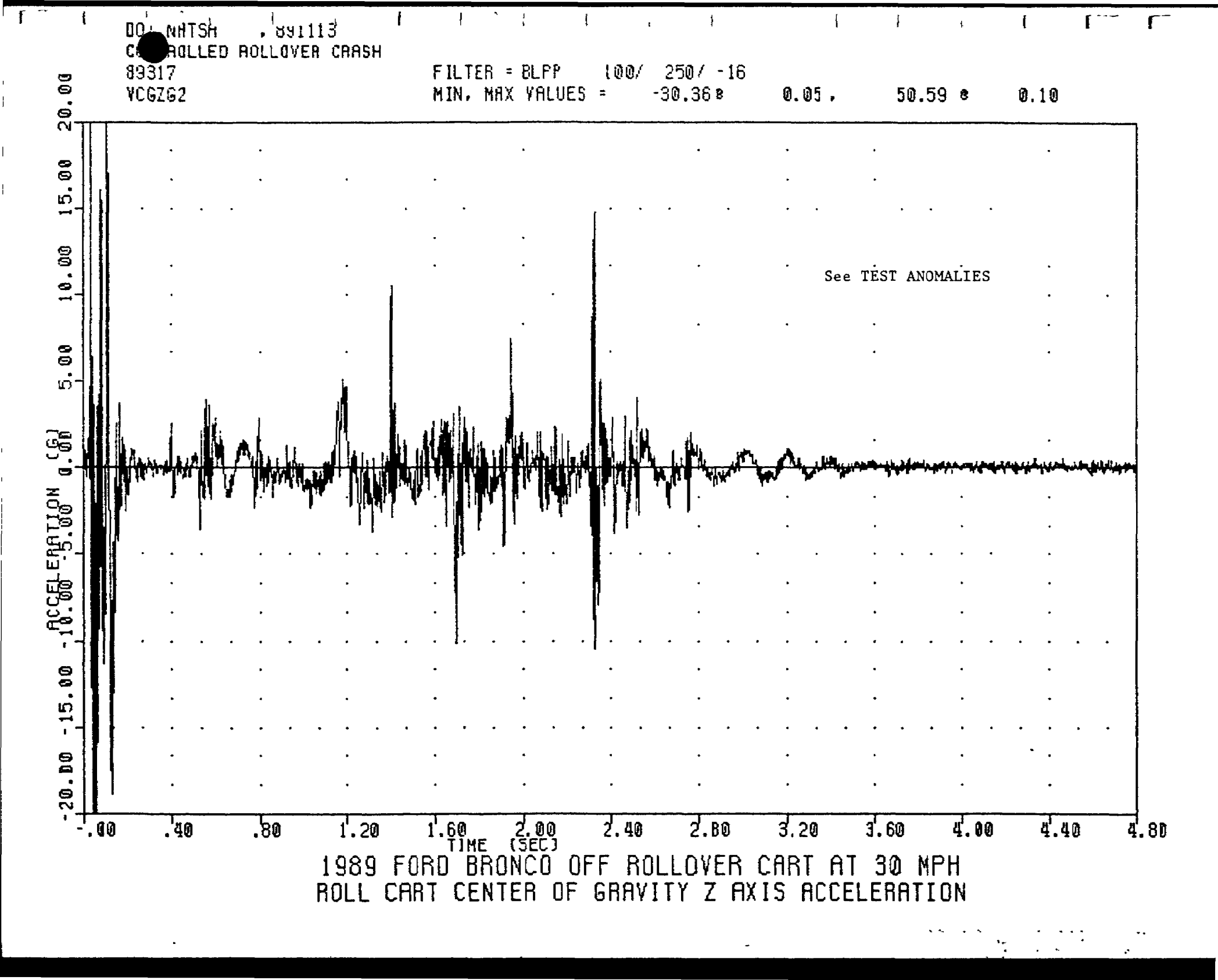
DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
VCGXG2

FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -9.20@ 0.05 , 91.11 @ 0.10

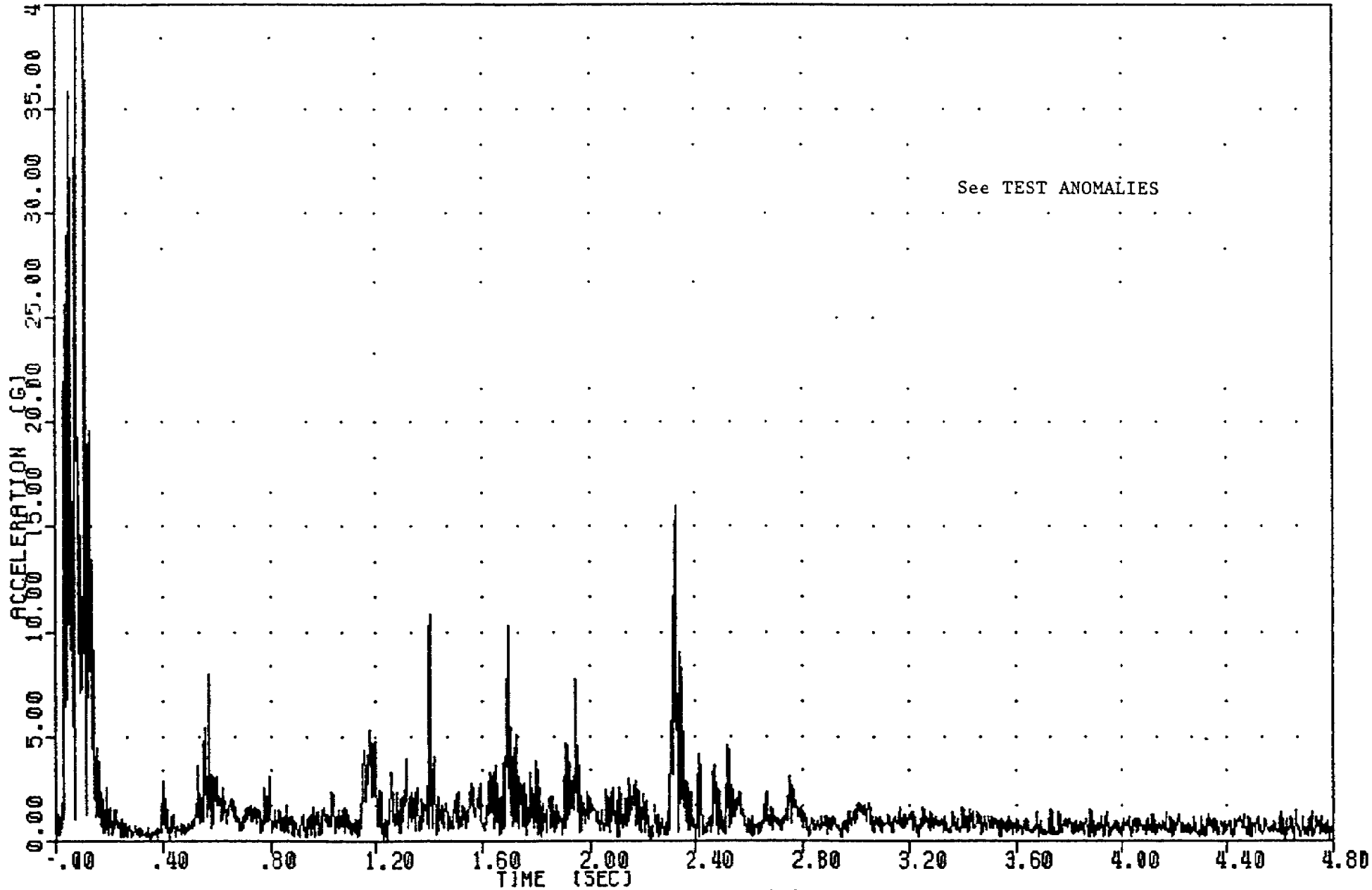


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY X AXIS ACCELERATION


[redacted] NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
YCGYG2
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -29.15 @ 0.05 , 10.98 @ 2.32
See TEST ANOMALIES
ACCELERATION (G)
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
.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 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Y AXIS ACCELERATION

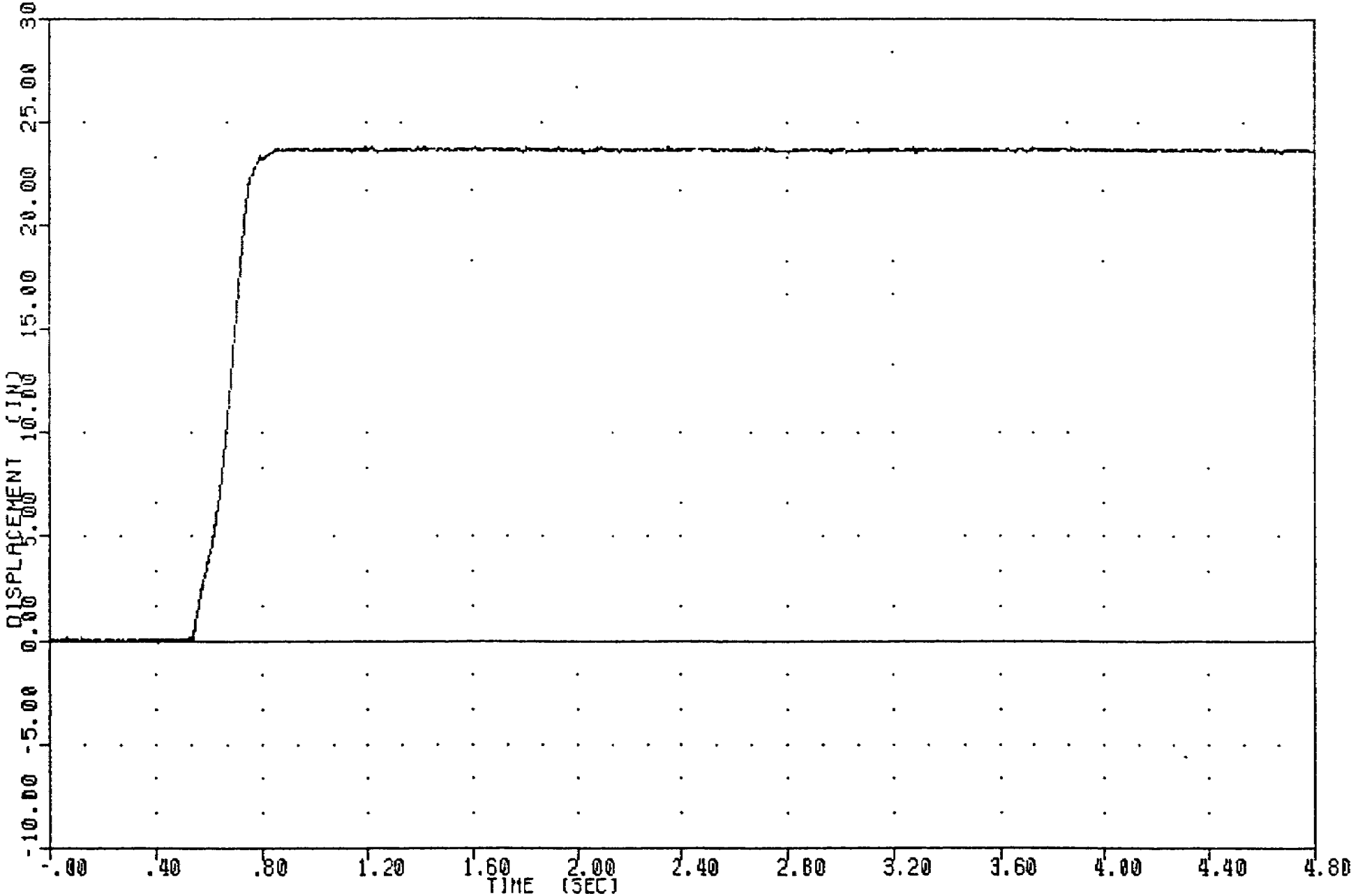

DO: NHTSH , 891113
CONTROLLED ROLLOVER CRASH
89317
VCGZG2
FILTER = BLPF 100/ 250/ -16
MIN, MAX VALUES = -30.36 @ 0.05 , 50.59 @ 0.10
See TEST ANOMALIES
ACCELERATION (G)
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Z AXIS ACCELERATION

D[redacted]NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317 FILTER = BLPF 100/ 250/ -16
VCGRG2 MIN, MAX VALUES = 0.06 @ 2.23 , 106.18 @ 0.10

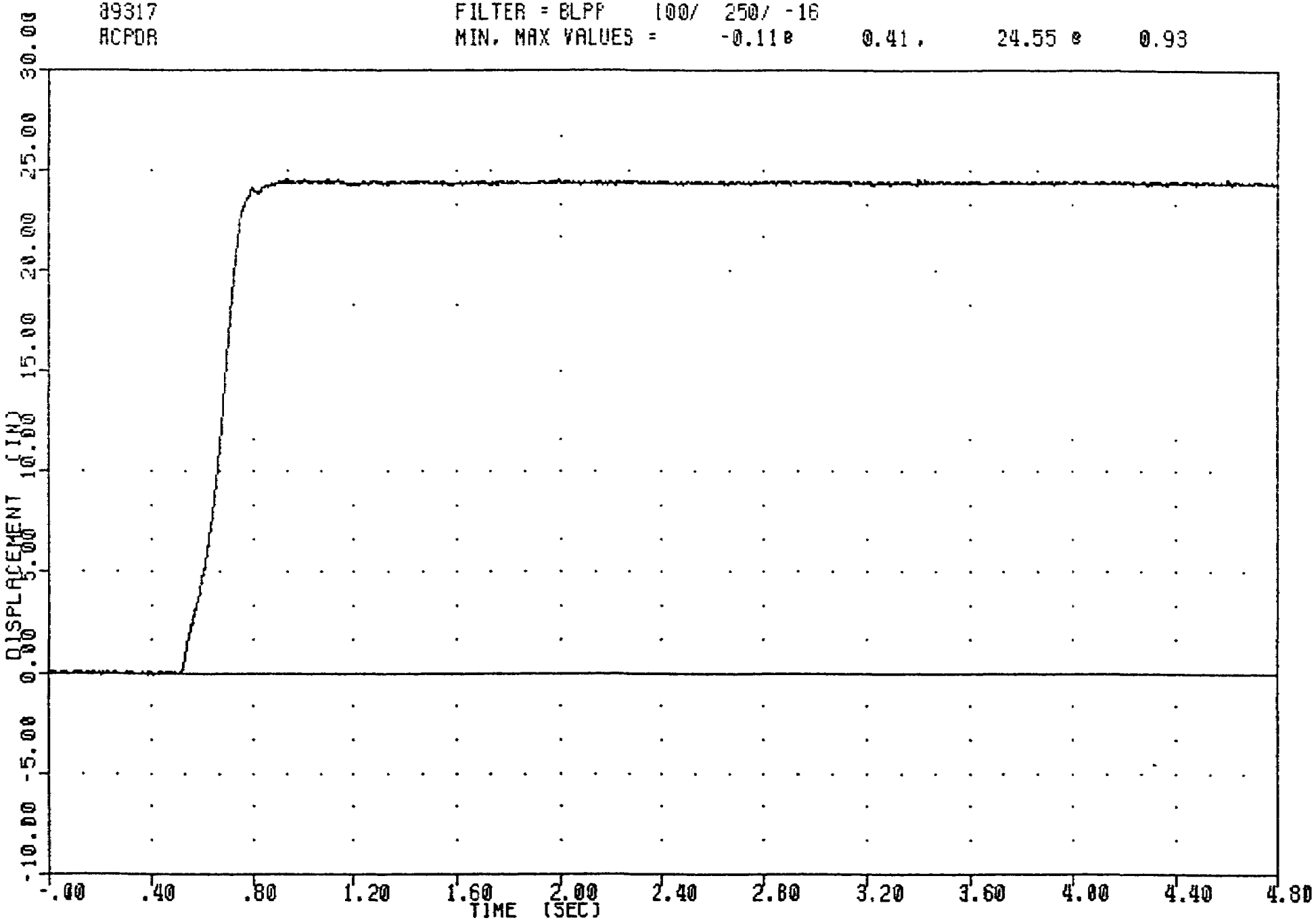


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY RESULTANT ACCELERATION

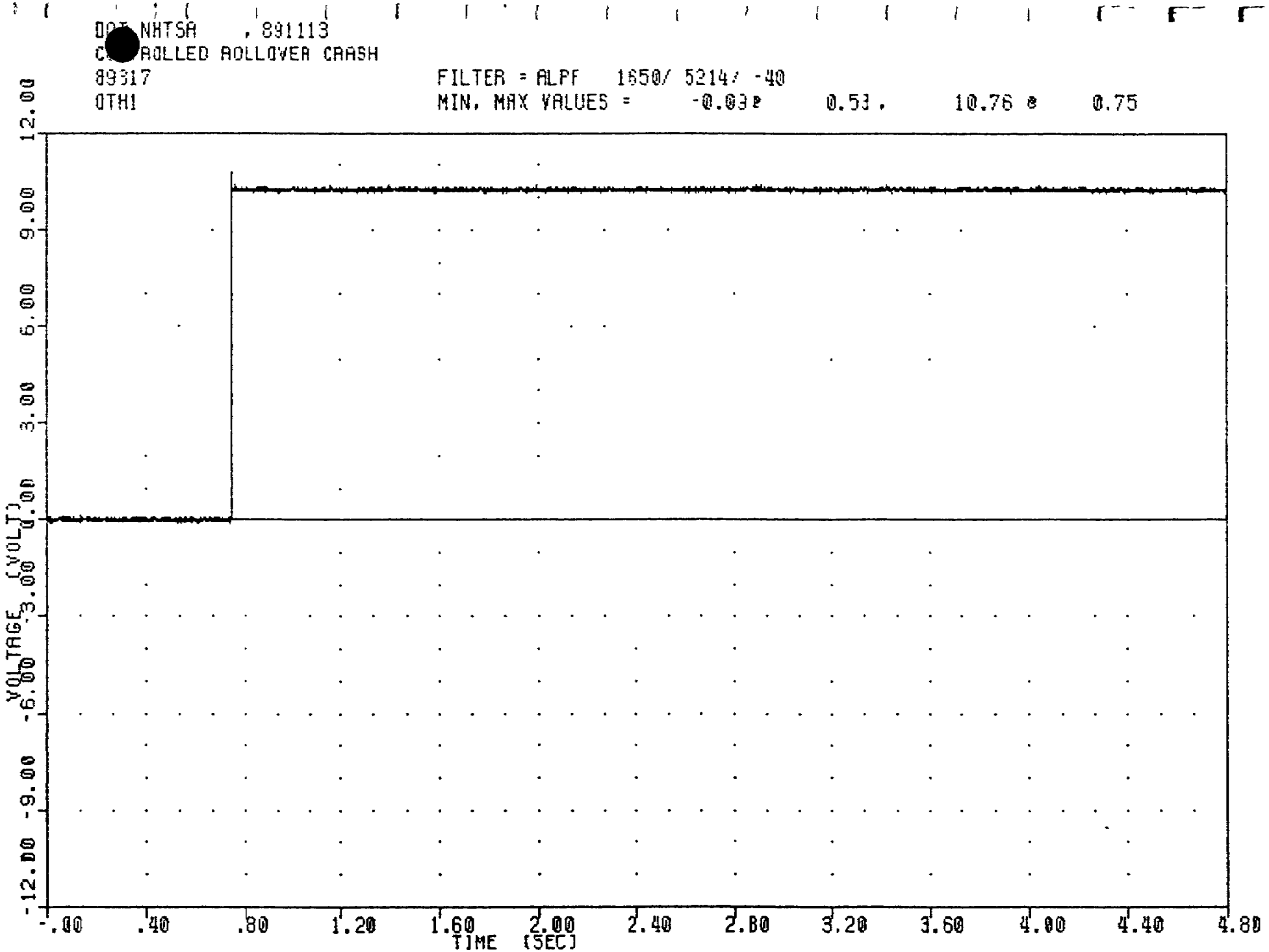
D[redacted] NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317 FILTER = BLPP 100/ 250/ -16
RCPDL MIN, MAX VALUES = -0.12 @ 0.41 , 23.79 @ 1.39



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART LEFT CYLINDER DISPLACEMENT

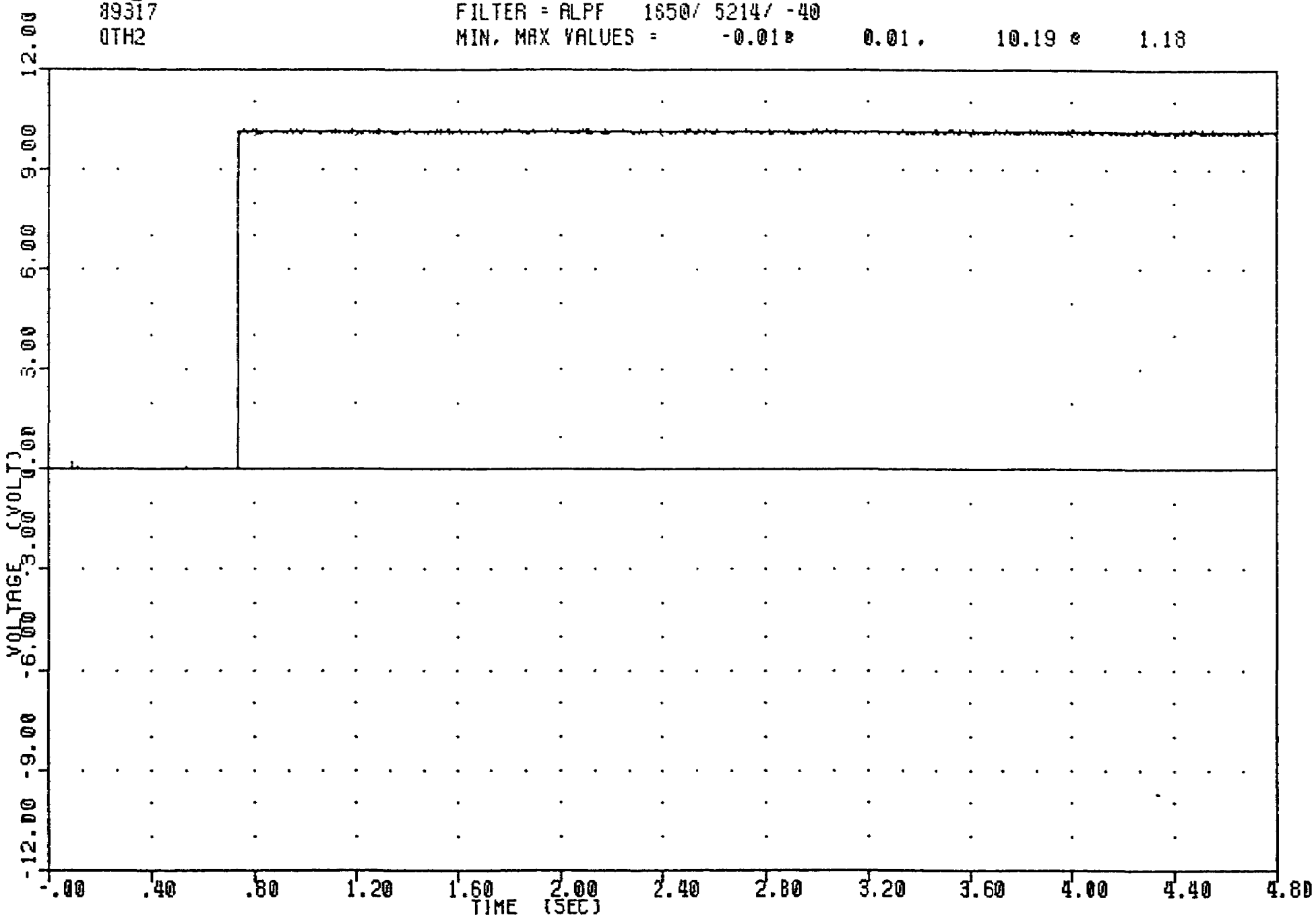


1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
ROLL CART RIGHT CYLINDER DISPLACEMENT



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - UPPER SWITCH

DOT NHTSA , 891113
CONTROLLED ROLLOVER CRASH
89317
OTH2
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -0.01 @ 0.01 , 10.19 @ 1.18



1989 FORD BRONCO OFF ROLLOVER CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - LOWER SWITCH

APPENDIX C

DUMMY CERTIFICATION

The dummy's head belonged to TRC, prior to this test and to the end of the series, a NHTSA dummy head will be used, therefore, calibration was necessary to apply before the November 13, 1989 test.

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

HYBRID III 06-Nov-89

SRL 192C3RHD1 572E SN192 HEAD DROP CAL 03

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	48.00 %
PEAK RESULTANT ACCELERATION	225 - 275 G	246.59 G
PEAK LATERAL ACCELERATION	15 G MAX	-8.27 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN Chas. Middlet

APPENDIX D

MISCELLANEOUS TEST INFORMATION

PRE-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson Date: 10/31/89

Checked By: J. Chrstos Date: 11/16/89

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Ford Bronco II XL

NHTSA ID Code (7 characters): V89233 / Model Year (2 digits): 89

Vehicle Make (2 characters): 02

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): 21

Body Style (2 characters): UT

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): 1FMCU12TXKUC02186

Odometer Reading: 61.5 Thousands of Miles: 0.0615

Overall Length: 160.0 (in) x 25.4 =: 4064 (mm)

Wheelbase: 94.1 (in) x 25.4 =: 2388 (mm)

Front Track: 57.3 (in) x 25.4 =: 1455 (mm)

Rear Track: 56.8 (in) x 25.4 =: 1443 (mm)

Roof Height: 67.0 (in) x 25.4 =: 1702 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 4040 (lbs) x 4.45 =: 17978 (N)

FRONT G.A.W.R.: 1940 (lbs) x 4.45 =: 8633 (N)

REAR G.A.W.R.: 2340 (lbs) x 4.45 =: 10413 (N)

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

Weight on RF Tire: 878 (lbs) x 4.45 =: 3907 (N)

Weight on LF Tire: 887 (lbs) x 4.45 =: 3947 (N)

Weight on LR Tire: 1071 (lbs) x 4.45 =: 4766 (N)

Weight on RR Tire: 1091 (lbs) x 4.45 =: 4855 (N)

Vehicle Test Weight: 3927 (lbs) x 4.45 =: 17475 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 51.75 (in) x 25.4 =: 1314.4 (mm)

From Center Line: 0.08 (in) x 25.4 =: 2.0 (mm)

Engine Displacement: 177.0 (cu in) x 0.0164 =: 2.9 (L)

Engine Type (2 characters): V6

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): L

L = Longitudinal T = Transverse

Transmission Type: M

M = Manual A = Automatic

Drive Axle (1 character): R

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): I

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 = _____

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Tire Manufacturer (10 characters): Firestone

Tire Size Code (10 characters): 205/75R15

Tire Construction (2 characters): SB

BB = Bias Belted
BP = Bias Ply
OT = Other: _____
GP = Glass Belted Radial
SB = Steel Belted Radial

Tire Rim width: 6.0 (in) X 25.4 =: 152.4 (mm)

Axle Height: 12.8 (in) X 25.4 =: 325.1 (mm)

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

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): TL

CO = Coil
LL = Longitudinal Leaf
OT = Other: _____

TB = Torsion Bar
TL = Transverse Leaf

Brake Type (2 characters): LT

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 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): Firestone

Tire Size Code (10 characters): 205/75R15

Tire Construction (2 characters): SB

BB = Bias Belted
BP = Bias Ply
OT = Other: _____

GP = Glass Belted Radial
SP = Steel Belted Radial

Tire Rim Width: 6.0 (in) X 25.4 =: 152.4 (mm)

Axle Height: 12.7 (in) X 25.4 =: 322.6 (mm)

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

IPMD MEASURED DATA

IPMD Calibration Check (no vehicle):

Applied Weight (lbs)	Schaevitz Output (Volts)
0	0.115
+100	1.055
+200	1.964
0	0.114
-100	-0.827
-200	-1.740
0	0.115

C.G. HEIGHT:

Applied Weight (lbs)	Schaevitz Output (Volts)	Resultant Longitudinal Movement (mv)
0	0.085	3.341
+100	0.841	3.445
+200	1.613	3.579
0	0.096	3.350
-100	-0.672	3.212
-200	-1.492	2.991
0	0.078	3.335

Calculated C.G. Height (in): 28.888

Pitch Inertia:

Run	Period (sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	4.53	263	246
2	4.51	267	245
3	4.53	263	243

Pitch Inertia (ft. lb. sec2): 2056.160

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 46.4

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.67	232	193
2	2.66	226	195
3	2.67	233	193

Roll Inertia (ft. lb. sec2): 414.117

Yaw Inertia:

Distance between ramps (in): 46.4

String Pot Offset from platform center (in): 76.0

Run	Period (sec)	*Amplitude (mv)	Relative Motion
1	2.41	137	156
2	2.40	122	140
3	2.40	132	151

Yaw Inertia (ft. lb. sec2): 1965.328

POST-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson Date: 11/30/89

Checked By: J. Chrstos Date: 12/05/89

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Ford Bronco II XL

NHTSA ID Code (7 characters): V89232B / Model Year (2 digits): 89

Vehicle Make (2 characters): 02

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): 99

Body Style (2 characters): UT

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): 1FMCU12TXKUC02186

Odometer Reading: 67.5 Thousands of Miles: 0.0675

Overall Length: 160.0 (in) x 25.4 =: 4064 (mm)

Wheelbase: 94.0 (in) x 25.4 =: 2388 (mm)

Front Track: 57.3 (in) x 25.4 =: 1455 (mm)

Rear Track: 56.8 (in) x 25.4 =: 1443 (mm)

Roof Height: 63.0 (in) x 25.4 =: 1660 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 4040 (lbs) x 4.45 =: 17978 (N)

FRONT G.A.W.R.: 1940 (lbs) x 4.45 =: 8633 (N)

REAR G.A.W.R.: 2340 (lbs) x 4.45 =: 10413 (N)

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

Weight on RF Tire: 1085 (lbs) x 4.45 =: 4828 (N)

Weight on LF Tire: 631 (lbs) x 4.45 =: 2808 (N)

Weight on LR Tire: 1101 (lbs) x 4.45 =: 4899 (N)

Weight on RR Tire: 1021 (lbs) x 4.45 =: 4543 (N)

Vehicle Test Weight: 3838 (lbs) x 4.45 =: 17079 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 51.97 (in) x 25.4 =: 1320.0 (mm)

From Center Line: 2.77 (in) x 25.4 =: 70.4 (mm)

Engine Displacement: 177.0 (cu in) x 0.0164 =: 2.9 (L)

Engine Type (2 characters): V6

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): L

L = Longitudinal T = Transverse

Transmission Type: M

M = Manual A = Automatic

Drive Axle (1 character): R

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters): Post rollover test. Flat right rear tire.

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Tire Manufacturer (10 characters): Firestone

Tire Size Code (10 characters): P205/75R15

Tire Construction (2 characters): SB

BB = Bias Belted
BP = Bias Ply
OT = Other: _____
GP = Glass Belted Radial
SB = Steel Belted Radial

Tire Rim width: 6.0 (in) X 25.4 =: 152.4 (mm)

Axle Height: 12.8 (in) X 25.4 =: 325.1 (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): I

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): TL

CO = Coil
LL = Longitudinal Leaf
OT = Other: _____

TB = Torsion Bar
TL = Transverse Leaf

Brake Type (2 characters): LT

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 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): Firestone

Tire Size Code (10 characters): 205/75R15

Tire Construction (2 characters): SB

BB = Bias Belted
BP = Bias Ply
OT = Other: _____

GP = Glass Belted Radial
SP = Steel Belted Radial

Tire Rim Width: 6.0 (in) X 25.4 =: 152.4 (mm)

Axle Height: 10.4 (in) X 25.4 =: 264.2 (mm)

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

IPMD MEASURED DATA

IPMD Calibration Check (no vehicle):

Applied Weight (lbs)	Schaevitz Output (Volts)
0	0.269
+100	1.200
+200	2.098
0	0.271
-100	-0.666
-200	-1.583
0	0.269

C.G. HEIGHT:

Applied Weight (lbs)	Schaevitz Output (Volts)	Resultant Longitudinal Movement (mv)
0	0.056	3.534
+100	0.730	3.640
+200	1.413	3.764
0	0.066	3.554
-100	-0.592	3.476
-200	-1.276	3.349
0	0.035	3.485

Calculated C.G. Height (in): 26.453

Pitch Inertia:

Run	Period (sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	4.13	268	159
2	4.12	262	163
3	4.12	266	162

Pitch Inertia (ft. lb. sec2): 1923.462

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 45.9

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.50	230	166
2	2.50	222	160
3	2.50	222	133

Roll Inertia (ft. lb. sec2): 403.053

Yaw Inertia:

Distance betwee ramps (in): 45.9

String Pot Offset from platform center (in): 76.0

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.39	138	47
2	2.39	132	44
3	2.39	136	49

Yaw Inertia (ft. lb. sec2): 1934.547

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