VEHICLE AND DUMMY KINEMATICS IN A CONTROLLED ROLLOVER CRASH 1988 FORD BRONCO

PREPARED BY:

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

TEST REPORT

OCTOBER, 1988

PREPARED FOR:

SYSTEMS RESEARCH LABORATORIES, INC.
2800 INDIAN RIPPLE ROAD
DAYTON, OH 45440

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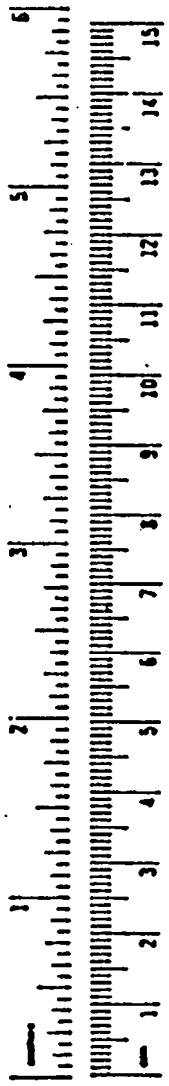
METRIC CONVERSION FACTORS

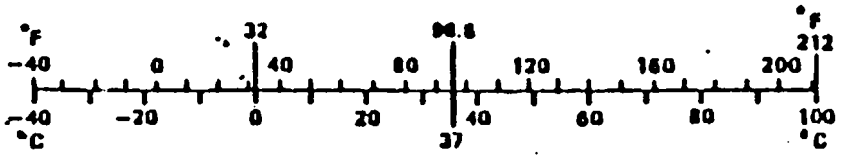
Approximate Conversions to Metric Measures

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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PURPOSE AND TEST PROCEDURE

This rollover crash test is the fifth test in a five test series. The test series has the main objective to investigate both vehicle and occupant dynamics during automobile rollover crashes.

This test was conducted by placing a 1988 Ford Bronco on the NHTSA rollover cart at an angle of 30° above the horizontal, crabbing the rollover cart 45°, towing the rollover cart to 30 mph, and releasing the test vehicle. The test vehicle contained an instrumented Part 572E dummy unrestrained.

SECTION 2.0

SUMMARY OF ROLLOVER CRASH TEST

A 1988 Ford Bronco 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 45° clockwise. 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 left side. The vehicle made one-half 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 September 23, 1988. Pre-test and post-test photographs of the test vehicle, dummy and device are shown in Appendix A.

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. A summary of Dummy Calibration test data can be found in Appendix C.

The crash event was recorded on 35 channels of data on one 14-track tape drive. Appendix B contains the vehicle, rollover device and dummy response data plots.

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

TEST NUMBER 880923

ROLL CART DATA SUMMARY

No.	LOCATION	POSITIVE DIRECTION MAX G	MSEC	NEGATIVE DIRECTION MAX G	MSEC
1	CENTER OF GRAVITY ACCELERATION (g)				
	LONGITUDINAL	37.2	0.1	8.8	0.1
	LATERAL	70.2	0.1	8.3	0.1
	VERTICAL	42.2	0.1	31.5	0.1
	RESULTANT	79.7	0.1		
2	PLATFORM DISPLACEMENT (in)				
	LEFT SIDE	24.1	1.3	0.1	0.1
	RIGHT SIDE	24.8	1.0	0.1	0.7
VEHICLE/ROLL CART SEPARATION TIME		UPPER SWITCH: 0.7 SEC Y LOWER SWITCH: 0.7 SEC			

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

Y See TEST ANOMALIES

FINAL RESTING PLACES OF PARTS AND CAR

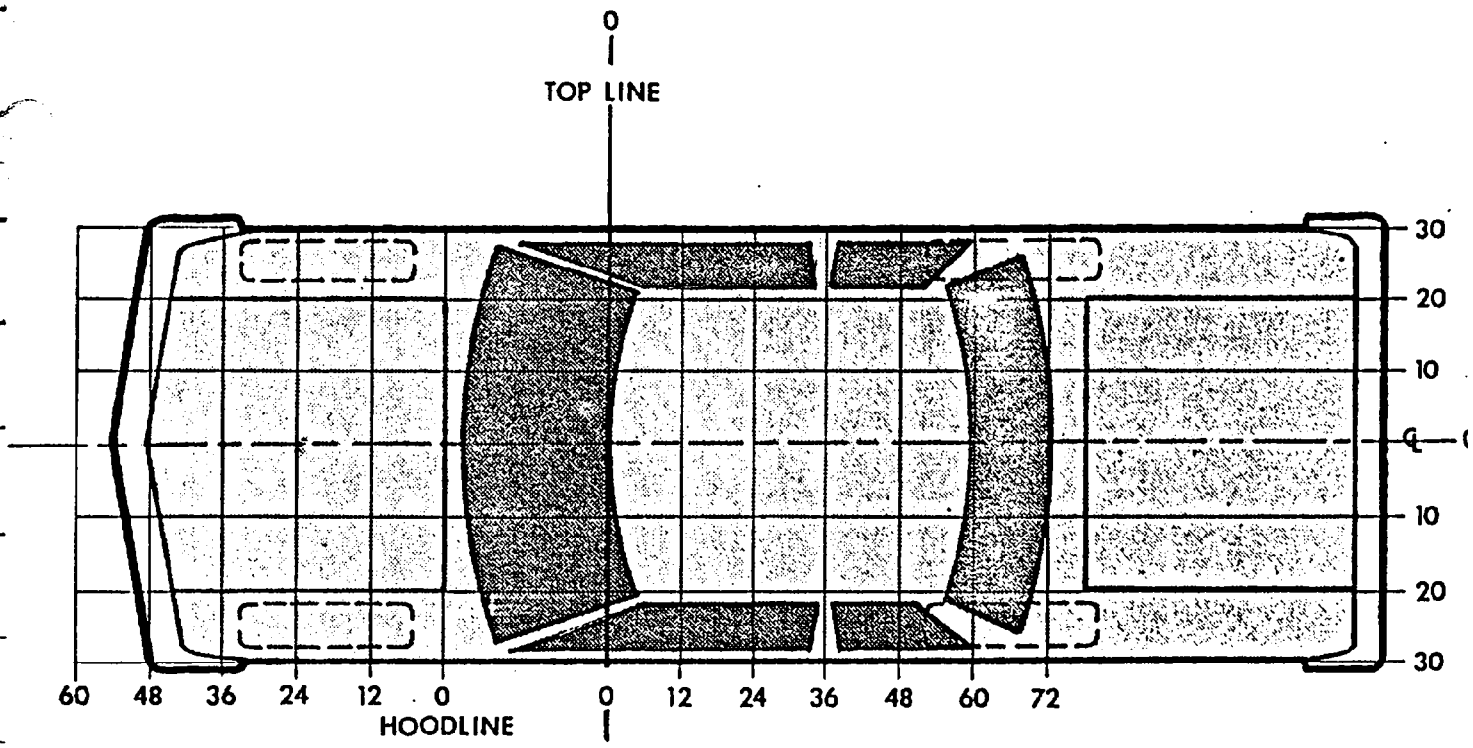
DESCRIPTION OF PART	X DISTANCE, FT*	Y DISTANCE, FT*
1988 Ford Bronco	136.0 ~~272.0~~	4.6
Rear Glass Moulding	84.0 ~~168.0~~	6.2

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

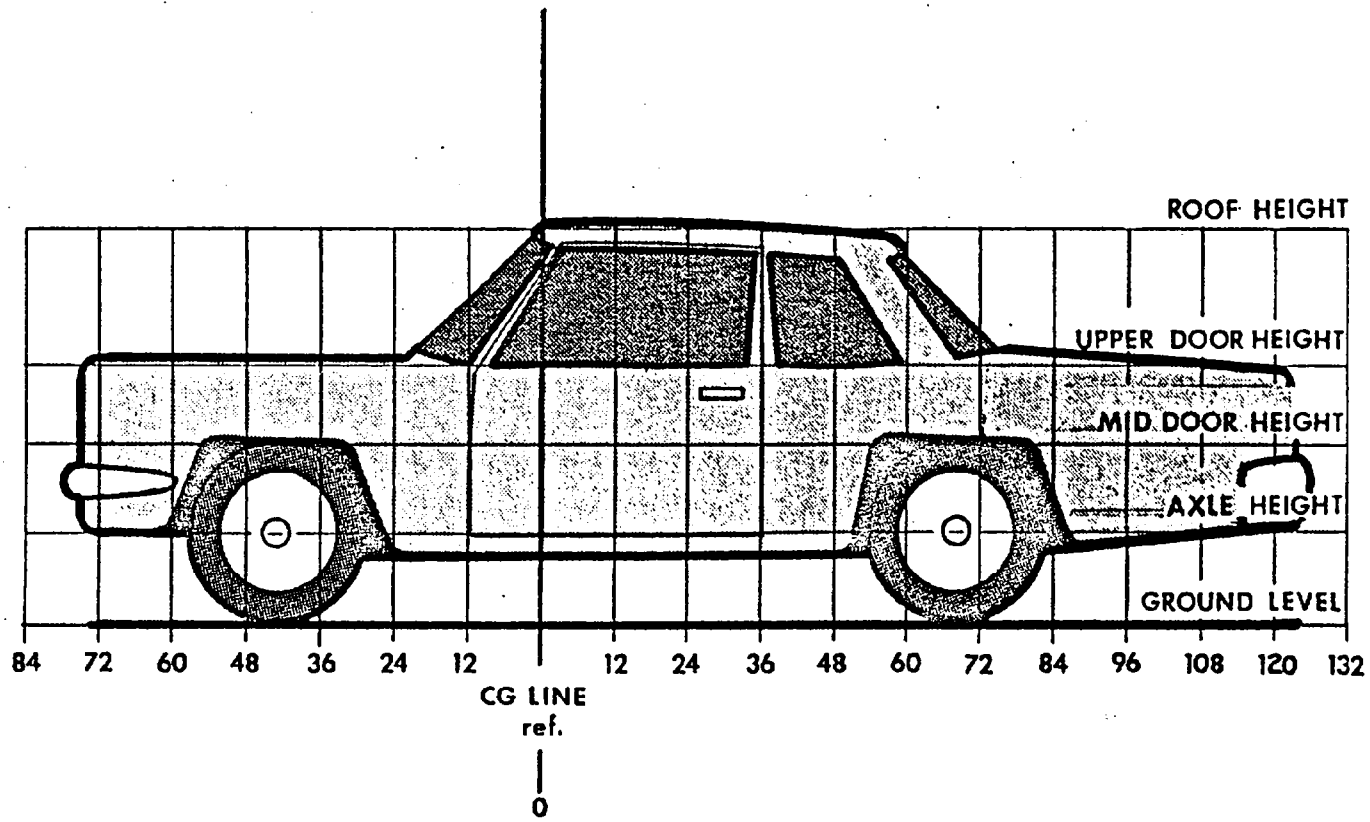
VEHICLE INTERIOR MEASUREMENTS

DESCRIPTION	PRE	POST	DIFF
Floor board to top of left "A" post	42.8	38.8	4.0
Floor board to top of right "A" post	43.0	40.7	2.3
Door sill to top of left "B" post	43.9	42.8	1.1
Door sfil to top of right "B" post	43.9	43.4	0.5
Door sill to top of left door opening	44.1	40.1	4.0
Door sill to top of right door opening	44.0	42.5	1.5
Floor tunnel to windshield header	35.8	26.6	9.2
Floor tunnel to center of roof	42.5	38.3	4.2
Rear of floor tunnel to roof	44.4	43.3	1.1
Maximum width at "B" post	54.1	55.9	-1.8
Maximum width at "A" post	52.9	48.6	4.3
Maximum width at top of door opening	48.7	43.5	5.2

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	48.4	49.5	49.2	49.0	48.6	X
Trailing edge of cowl + 12 inches	X	47.8	48.1	48.8	48.4	47.9	X
Trailing edge of cowl + 24 inches	X	46.6	47.1	47.4	47.1	46.4	X
Trailing edge of cowl + 36 inches	X	43.2	43.6	43.9	43.6	43.3	X
Trailing edge of cowl + 42 inches	X	X	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)							
Trailing edge of cowl at centerline	X	48.6	48.4	48.6	48.1	47.3	X
Trailing edge of cowl + 12 inches	X	45.8	47.8	47.8	47.4	46.6	X
Trailing edge of cowl + 24 inches	X	44.8	45.7	46.1	45.9	45.2	X
Trailing edge of cowl + 36 inches	X	42.8	42.8	43.1	42.6	41.9	X
Trailing edge of cowl + 42 inches	X	X	X	X	X	X	X
Trailing edge of cowl at centerline	X	-0.2	-1.1	-0.6	-0.9	-1.3	X
Trailing edge of cowl + 12 inches	X	-2.0	-0.3	-1.0	-0.1	-1.3	X
Trailing edge of cowl + 24 inches	X	-1.8	-1.4	-1.3	-1.2	-1.2	X
Trailing edge of cowl + 36 inches	X	-0.4	-0.8	-0.8	-1.0	-1.4	X
Trailing edge of cowl + 42 inches	X	X	X	X	X	X	X

* Column reading are left to right from left to right on vehicle.
**Reference plane is a horizontal plane at ground level.
+ 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	68.7	69.3	69.4	69.2	68.8
Longitudinal Center of Gravity + 12	69.0	69.6	69.8	69.7	69.9
Longitudinal Center of Gravity + 24	69.0	69.8	69.9	69.8	69.0
Longitudinal Center of Gravity + 36	69.0	69.8	69.9	69.7	69.0
Longitudinal Center of Gravity + 48	68.9	69.7	69.8	69.6	68.9
Longitudinal Center of Gravity + 60	68.7	69.3	69.4	69.9	68.6
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	62.4	60.2	61.5	58.3	64.8
Longitudinal Center of Gravity + 12	63.6	66.3	65.9	64.6	67.8
Longitudinal Center of Gravity + 24	64.4	68.4	68.9	70.6	68.6
Longitudinal Center of Gravity + 36	64.4	69.4	70.7	70.6	69.0
Longitudinal Center of Gravity + 48	64.9	68.6	69.6	69.9	68.9
Longitudinal Center of Gravity + 60	65.2	67.3	68.7	68.9	68.4
STATIC CRUSH (IN)					
Longitudinal Center of Gravity	-6.3	-9.1	-7.9	-10.9	-4.0
Longitudinal Center of Gravity + 12	-5.4	-3.3	-3.9	-5.1	-2.1
Longitudinal Center of Gravity + 24	-4.6	-1.4	-1.0	0.8	-0.4
Longitudinal Center of Gravity + 36	-4.6	-0.4	0.8	0.9	0.0
Longitudinal Center of Gravity + 48	-4.0	-1.1	-0.2	0.3	0.0
Longitudinal Center of Gravity + 60	-3.5	-2.0	-1.2	-0.3	-0.2

* Column reading are left to right from left to right on vehicle.
**Reference plane is a horizontal plane at ground level.
+ 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	65.6	X	X	X	X	X	X	22.5	22.4	X	X	X	X	22.9	X	X
Upper Door	45.5	X	18.8	18.1	17.6	17.3	17.1	17.2	17.2	17.2	17.2	17.2	17.2	17.4	X	X
Mid Door	30.8	17.7	16.2	15.4	15.5	15.8	15.4	15.4	15.4	15.4	14.6	14.2	15.5	15.7	X	X
Axle Height	19.5	18.8	X	X	X	17.4	17.2	17.1	17.1	17.1	X	X	X	17.8	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	65.6	X	X	X	X	X	X	30.0	29.5	X	X	X	X	29.8	X	X
Upper Door	45.5	X	12.2	21.8	21.1	20.6	19.8	17.6	16.5	17.2	17.6	18.0	18.2	18.4	X	X
Mid Door	30.8	18.4	17.1	16.0	15.5	17.1	15.8	14.7	14.4	15.5	14.6	14.2	15.5	16.0	X	X
Axle Height	19.5	19.8	X	X	X	17.6	17.3	17.1	17.1	16.6	X	X	X	18.0	X	X
STATIC CRUSH (IN)																
Roof Height	65.6	X	X	X	X	X	X	-7.5	-7.1	X	X	X	X	-6.9	X	X
Upper Door	45.5	X	6.6	-3.7	-3.5	-3.3	-2.7	-0.4	0.7	0.0	-0.4	-0.8	-1.0	-1.0	X	X
Mid Door	30.8	-0.7	-0.9	-0.6	0.0	-1.3	-0.4	0.7	1.0	-0.1	0.0	0.0	0.0	-0.3	X	X
Axle Height	19.5	-1.0	X	X	X	-0.2	-0.1	0.0	0.0	0.5	X	X	X	-0.2	X	X

* Center of gravity is located 38.4 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	65.6	X	X	X	X	X	X	23.1	23.2	X	X	X	X	X	X	X
Upper Door	45.5	X	18.8	18.8	18.2	18.0	18.0	17.3	17.9	18.0	18.1	18.1	18.2	18.4	X	X
Mid Door	30.8	17.6	15.5	15.2	15.3	15.6	15.6	15.6	15.8	15.9	14.6	14.6	16.2	16.8	X	X
Axle Height	19.5	X	X	X	X	17.2	17.2	17.2	17.2	17.6	X	X	X	19.0	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	65.6	X	X	X	X	X	X	21.9	20.1	X	X	X	X	X	X	X
Upper Door	45.5	X	18.2	17.4	16.8	16.1	16.4	16.2	16.1	15.6	16.1	16.4	16.8	17.1	X	X
Mid Door	30.8	17.1	14.9	14.6	14.6	14.8	14.7	14.7	14.9	15.2	14.4	14.4	15.9	16.2	X	X
Axle Height	19.5	X	X	X	X	17.0	17.0	17.1	17.3	17.1	X	X	X	19.2	X	X
STATIC CRUSH (IN)																
Roof Height	65.6	X	X	X	X	X	X	1.2	3.1	X	X	X	X	X	X	X
Upper Door	45.5	X	0.6	1.4	1.4	1.9	1.6	1.1	1.8	2.4	2.0	1.7	1.4	1.3	X	X
Mid Door	30.8	0.5	0.6	0.6	0.7	0.8	0.9	0.9	0.9	0.7	0.2	0.2	0.3	0.6	X	X
Axle Height	19.5	X	X	X	X	0.2	0.2	0.1	-0.1	0.5	X	X	X	-0.2	X	X

* Center of gravity is located 38.4 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.

TEST ANOMALIES

The Driver Neck Moment About Z-axis, NEKZM1, data was lost between 0.5 second and 1.6 seconds.

The Driver Chest Z-axis Accelerometer, CSTZG1, data did not return to zero.

The Driver Chest Acceleration Resultant, CSTRG1, data did not return to zero, due to the above.

The Vehicle Center of Gravity Z-axis Accelerometer, VCGZG1, data did not return to zero.

The Vehicle Center of Gravity Acceleration Resultant, VCGRG1, data did not return to zero, due to the above.

The Vehicle Left Front Suspension Displacement, SFLD1, data was lost after 1.3 seconds due to the string potentiometer's string breaking off from the attachment point.

The Vehicle/Roll Cart Separation Time - Upper Switch, OTH1, data contained anomalous spikes from 0 second to 1.6 seconds.

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 VIN: 1FMCU14T4JUD70918

BODY STYLE: Multipurpose vehicle MODEL YEAR: 1988

NHTSA NO.: COLOR: Black

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

TRANSMISSION DATA: 5 SPEED, X MANUAL, ____AUTOMATIC, ____FWD, ____RWD, X 4WD

DATE VEHICLE RECEIVED: 8/31/88 ODOMETER READING: 105

DEALER'S NAME AND ADDRESS:

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	Yes	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: Good

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

VEHICLE MANUFACTURED BY: Ford Motor Company

DATE OF MANUFACTURE: 8/88

GVWR: 4200 LBS

GAWR: FRONT 2120 LBS., REAR 2399 LBS.

*The driver and front passenger seat 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. The top edge of the glazing was strengthened with a molded channel incorporating a small steel rod. The side edges of the glazing were bonded to a molded T-shaped edge that moved up and down inside the modified window channel, allowing full window function. During impact the plastic acts as a stretchable barrier that prevents ejection while also limiting head and neck loading.

TEST VEHICLE INFORMATION CONT'D

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

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

RECOMMENDED TIRE SIZE: LOAD RANGE B, C, D

TIRES ON VEHICLE (MFR., LINE, SIZE): Uniroyal Tiger Paw P225/75R15

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: NA

**NUMBER OF OCCUPANTS____FRONT ____REAR ____TOTAL

**CARGO LOAD_____LBS. **TOTAL_____LBS.

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

RIGHT FRONT	867	lbs.	RIGHT REAR	842	lbs.
LEFT FRONT	829	lbs.	LEFT REAR	830	lbs.
TOTAL FRONT WEIGHT	1696	lbs.	(50.4% OF TOTAL VEHICLE WEIGHT)		
TOTAL REAR WEIGHT	1672	lbs.	(49.6% OF TOTAL VEHICLE WEIGHT)		
TOTAL DELIVERED WEIGHT	3368	lbs.			

CALCULATION FOR TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (3368 LBS)

VCW = VEHICLE CAPACITY WEIGHT (LBS)*

DSC = DESIGNATED SEATING CAPACITY ( )*

RCLW = 300 LBS*

TARGET TEST WEIGHT = UDW + RCLW + (1 DUMMY X 164 LBS/DUMMY)

= 3368 + 300 + 167 LBS

TARGET TEST WEIGHT = 3835 LBS

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

TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 286 LBS. CARGO

RIGHT FRONT	935 lbs.	RIGHT REAR	998 lbs.
LEFT FRONT	909 lbs.	LEFT REAR	979 lbs.
TOTAL FRONT WEIGHT	1844 lbs.	(48.3% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1977 lbs.	(51.7% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	3821 lbs.	(0.2% UNDER TARGET WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE BEHIND EACH FRONT SEAT: 100 LBS.

COMPONENTS REMOVED TO MEET TARGET WEIGHT: None

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	LF	31.3	;RF	31.3	;LR	31.1	;RR 30.9
PRE-TEST ATTITUDE:	LF	30.9	;RF	31.0	;LR	29.6	;RR 29.5
POST-TEST ATTITUDE:	LF	29.9	;RF	30.8	;LR	29.8	;RR 30.1

WHEELBASE: 94.2 INCHES

CG = 48.7 INCHES REARWARD OF FRONT WHEEL CENTERLINE

VEHICLE REBOUND AND CRUSH (ALL DIMENSIONS IN INCHES):

OVERALL LENGTH OF TEST VEHICLE:	PRE-TEST:	L	157.6	;C	159.9	;R	157.4
	POST-TEST:	L	157.2	;C	159.7	;R	157.5
	TOTAL CRUSH:	L	0.4	;C	0.2	;R	-0.1

TEST CONDITIONS

TEST NUMBER: 880923

DATE OF TEST: 9/23/88 TIME OF TEST: 1450

WIND VELOCITY: NA HUMIDITY: NA

AMBIENT TEMPERATURE AT IMPACT AREA: 72°F

TEMPERATURE IN OCCUPANT COMPARTMENT: 72°F

DRIVER DUMMY TEMPERATURE: 70°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (lbs.)	3821	3835
VEHICLE ORIENTATION (deg.) YAW*	45	45
VEHICLE ORIENTATION (deg.) ROLL**	30	30
VEHICLE VELOCITY (mph)	30	30

DUMMIES

	DRIVER	MIDDLE PASSENGER	RT. FRONT PASSENGER	LEFT REAR PASSENGER	RT. REAR PASSENGER
TYPE:	Part 572E				
SERIAL NO:	192				
INSTRUMENTATION:					
HEAD ACCEL.:	3				
NECK L.C.'C.:	6				
CHEST ACCEL.:	3				
PELVIS ACCEL.:	3				
CHEST DISPLACEMENT POTENTIOMETER:	1				
RESTRAINT SYSTEM:	Unrestrained				

REMARKS:

*AS MEASURED CLOCKWISE FROM THE DIRECTION OF TRAVEL.

**AS MEASURED FROM THE HORIZONTAL.

TEST NUMBER 880923

VEHICLE DATA SUMMARY

No.	LOCATION	POSITIVE DIRECTION MAX G	MSEC	NEGATIVE DIRECTION MAX G	MSEC	
2	CENTER OF GRAVITY					
	ACCELERATION (g)					
	LONGITUDINAL	5.6	1.4	18.4	1.4	
	LATERAL	6.6	1.4	11.3	1.3	
	VERTICAL	8.1	1.3	13.4	1.3	Y
	RESULTANT	18.4	1.4			Y
3	CENTER OF GRAVITY					
	ANGULAR VELOCITY					
	ROLL (X-AXIS)	16.8	1.3	21.8	1.4	
	PITCH (Y-AXIS)	80.8	1.3	137.1	1.4	
	YAW (Z-AXIS)	64.2	1.4	25.0	2.5	
4	LEFT FRONT SUSPENSION					
	DISPLACEMENT (in)					
	VERTICAL	0.3	0.6	---	---	Y
5	RIGHT FRONT SUSPENSION					
	DISPLACEMENT (in)					
	VERTICAL	0.7	0.6	3.9	1.4	
6	LEFT REAR SUSPENSION					
	DISPLACEMENT (in)					
	VERTICAL	1.7	1.2	9.1	1.4	
7	RIGHT REAR SUSPENSION					
	DISPLACEMENT (in)					
	VERTICAL	1.1	0.6	3.5	1.4	

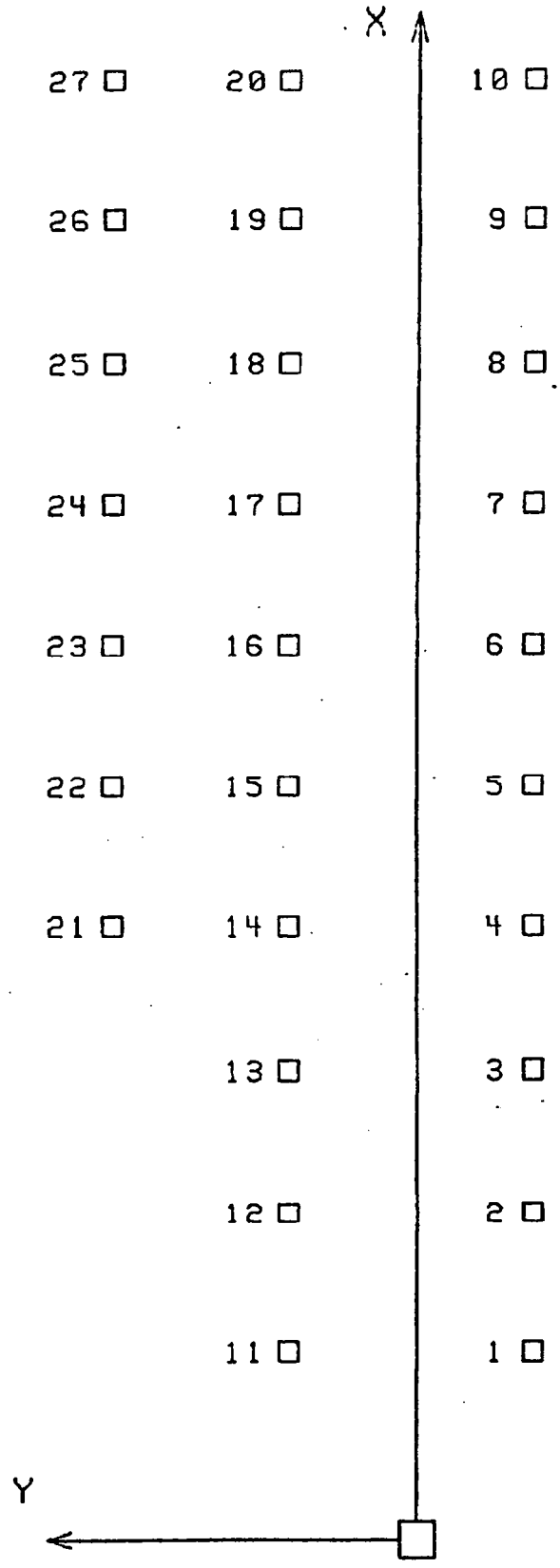
	POSITIVE DIRECTION	NEGATIVE DIRECTION
LONGITUDINAL:	FORWARD	REARWARD
LATERAL:	LEFTWARD	RIGHTWARD
VERTICAL:	UPWARD	DOWNWARD
ROLL:	TO RIGHT	TO LEFT
PITCH:	NOSE DOWNWARD	NOSE UPWARD
YAW:	COUNTER CLOCKWISE	CLOCKWISE
DISPLACEMENT:	OUTWARD	INWARD

Y See TEST ANOMALIES

IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL: 1988 FORD BRONCO TEST NUMBER: 880923

NO.	TYPE OF MEASUREMENT	DIMENSIONS IN INCHES PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	159.9	159.7	0.2
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	134.4	135.4	-1.0
X3	REAR SURFACE OF VEHICLE TO FIREWALL	118.6	120.2	-1.6
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	105.7	105.8	-0.1
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	106.1	105.9	0.2
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	105.6	105.5	0.1
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	105.8	105.2	0.6
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	63.9	64.2	-0.3
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	64.2	64.1	0.1
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	63.7	63.4	0.3
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	63.9	63.2	0.7
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	104.6	104.4	0.2
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	104.7	103.8	0.9
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	116.4	115.5	0.9
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	117.0	117.8	-0.8
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	88.9	89.0	-0.1
X17	CENTER OF STEERING COLUMN TO "A" POST	13.5	9.5	4.0
X18	CENTER OF STEERING COLUMN TO HEADLINING	17.9	8.2	9.7
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	157.4	157.5	-0.1
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	157.6	157.2	0.4
X21	LENGTH OF ENGINE BLOCK	21.5	21.5	0.0



STADIA POLE LAYOUT AND NUMBERING SYSTEM

STADIA POLE LOCATIONS

POLE NO.	X DISTANCE, FT. *	Y DISTANCE, FT. *
1	34.0	-6.0
2	42.0	-6.0
3	50.0	-6.0
4	58.0	-6.0
5	66.0	-6.0
6	74.0	-6.0
7	82.0	-6.0
8	90.0	-6.0
9	98.0	-6.0
10	106.0	-6.0
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 Documentation
2	Right wide	Photosonic 1B	25	500	Vehicle Kinematics
3	Right angle	Photosonic 1B	25	500	Vehicle Kinematics
4	Front wide	Photosonic 1B	25	498	Vehicle Kinematics
5	Onboard - floor	Photosonic 1B	8	499	Dummy Kinematics
6	Onboard - rear	Photosonic 1B	8	505	Dummy Kinematics
7	Documentary	Beaulieu	16-105	24	Pre-test & Post-test Documentation

HIGH SPEED CAMERA INFORMATION

CAMERA NO.	X* (ft.)	Y* (ft.)	Z* (ft.)
2	54.8	-297.0	3.6
3	122.6	-221.2	4.9
4	196.2	2.9	2.6

*Reference:

+X = Forward from release block

+Y = Leftward from center release block

+Z = Upward from ground level

SECTION 4.

OCCUPANT INFORMATION

VISIBLE DUMMY CONTACT POINTS:

	DRIVER	PASSENGER #192
Head	Roof and left side headliner	NA
Chest	None	NA
Abdomen	None	NA
Left knee	Knee blocker	NA
Right knee	Right door	NA

DOOR OPENING:

	LEFT	RIGHT
Front	NA	NA
Rear	NA	NA

SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
Front	None	None
Rear	NA	NA

GLAZING DAMAGE:

The windshield was cracked upon impact.

OTHER NOTABLE IMPACT EFFECTS:

The left and right front windows were cracked upon impact. The left right and rear windows were shattered upon impact.

DUMMY DATA SUMMARY

TEST NUMBER 880923

	DRIVER DUMMY SN: 192			
	POSITIVE DIRECTION		NEGATIVE DIRECTION	
	MAX	MSEC	MAX	MSEC
HEAD ACCELERATION (g)				
LONGITUDINAL	9.1	1.3	14.0	1.3
LATERAL	7.2	1.4	77.0	1.3
VERTICAL	8.1	1.3	34.2	1.3
RESULTANT	83.6	1.3		
HIC	240.0 FROM 2479 TO 2487 MSEC			
NECK FORCE (lbs)				
LONGITUDINAL	45.0	1.3	14.9	1.7
LATERAL	26.6	1.3	204.8	1.3
VERTICAL	36.0	1.3	263.1	1.3
NECK MOMENT (ft-lbs)				
ABOUT LONGITUD.	13.9	1.4	80.4	1.3
ABOUT LATERAL	19.5	2.1	17.7	1.3
ABOUT VERTICAL	8.5	1.2	---	--- Y
CHEST ACCELERATION (g)				
LONGITUDINAL	57.6	1.3	27.2	1.3
LATERAL	44.6	1.3	116.3	1.3
VERTICAL	25.8	1.3 Y	34.1	1.3 Y
RESULTANT	132.3	1.3 Y		
3 MSEC CLIP	6.1			
CHEST DISPLACEMENT (in)				
LONGITUDINAL	0.5	1.3	0.1	1.3
PELVIS ACCELERATION (g)				
LONGITUDINAL	7.9	1.3	4.5	1.3
LATERAL	5.7	3.9	12.4	1.3
VERTICAL	3.8	0.2	17.8	1.3
RESULTANT	20.7	1.3		

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

SEE APPEND D FOR NECK LOAD CELL POLARITIES

Y See TEST ANOMALIES

DUMMY KINEMATIC SUMMARY

Driver Dummy

Upon the vehicle's impact with the ground, the driver dummy's head struck the roof and the left head liner. The left arm impacted the left window and left side door. The knees impacted the knee blocker, and the left leg impacted the left side door and the right leg impacted the left leg. As the vehicle rolled onto its roof, the dummy's head remained in contact with the roof. The dummy's left arm and the left leg remained in contact with the left side door. The vehicle came to rest on its roof. The driver dummy was unrestrained.

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 adjustable. The driver dummy was unrestrained.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

MFR./MAKE/MODEL: Ford Bronco

SEAT TYPE: ____Bench
__X__Bucket
____Split bench
Non-adjustable

ADJUSTER TYPE: __X__Manual
____Power

TECHNICIANS:

BUCKET SEAT BACK TYPE: ____Non-adjustable
__X__Adjustable reclining

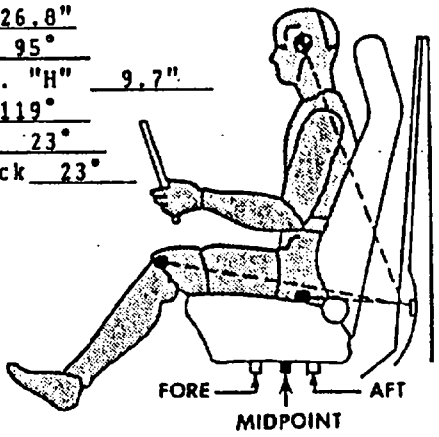
1. N. Kinney
2. B. Fishbaugh
3. _____
4. _____

POSITIONING DATE: 9/23/88

AMBIENT TEMP. 72°F TIME: 0930

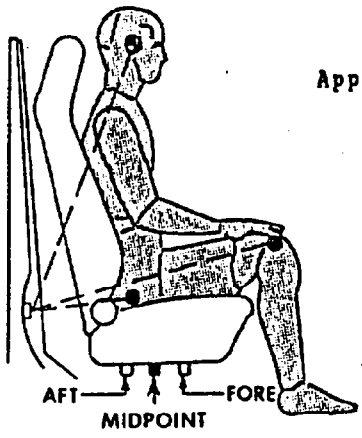
DRIVER DUMMY #192 TYPE HIII

Head 19.8"
Target 11°
Knee 26.8"
Joint 95°
Approx. "H" 9.7"
Point 119°
Pelvis 23°
Seatback 23°

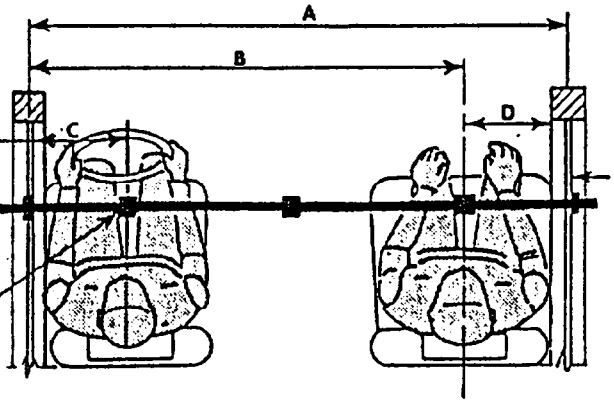


PASSENGER DUMMY #NA

Head_____
Target_____
Knee_____
Joint_____
Approx. "H"_____
Point_____
Pelvis_____
Seatback_____



A = 55.2"
B = NA
C = 12.9
D = NA
LEFT GLASS HEIGHT 11.1"
LATERAL BAR
ADJUSTABLE POINTER

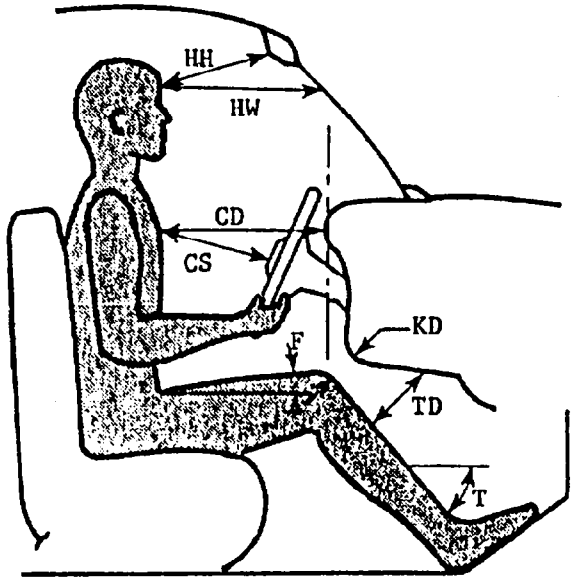


DOOR GLASS HEIGHT

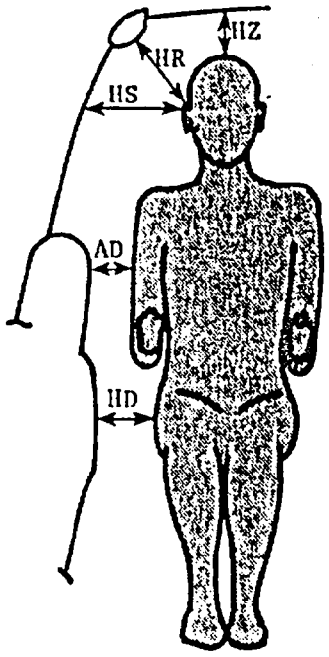
LEFT FRONT DOOR | DRIVER DUMMY | PASSENGER DUMMY | RIGHT FRONT DOOR

DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER	PASSENGER
	192	NA
HH	18.9	
HW	23.0	
CD	22.2	
CS	12.5	
KDL	6.3	
KDR	6.3	
FL	10°	
FR	16°	
TDL	3.9	
TDR	4.5	
TL	40°	
TR	42°	



	DRIVER	PASSENGER
HR	7.9	
HS	10.1	
AD	4.3	
HD	6.2	
HZ	4.8	



ALL DISTANCE MEASUREMENTS ARE IN INCHES.

APPENDIX A

PHOTOGRAPHS

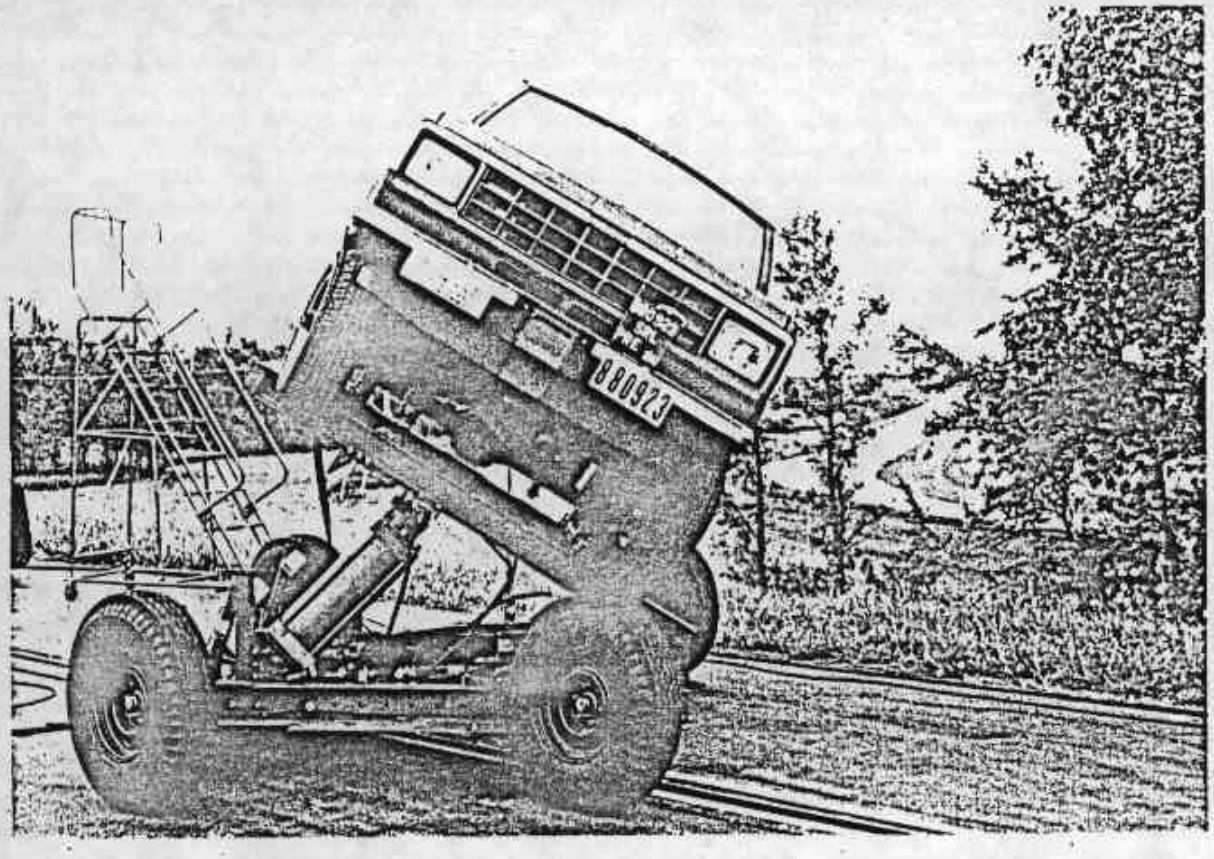


Figure A-1. PRE-TEST OVERALL FRONT VIEW

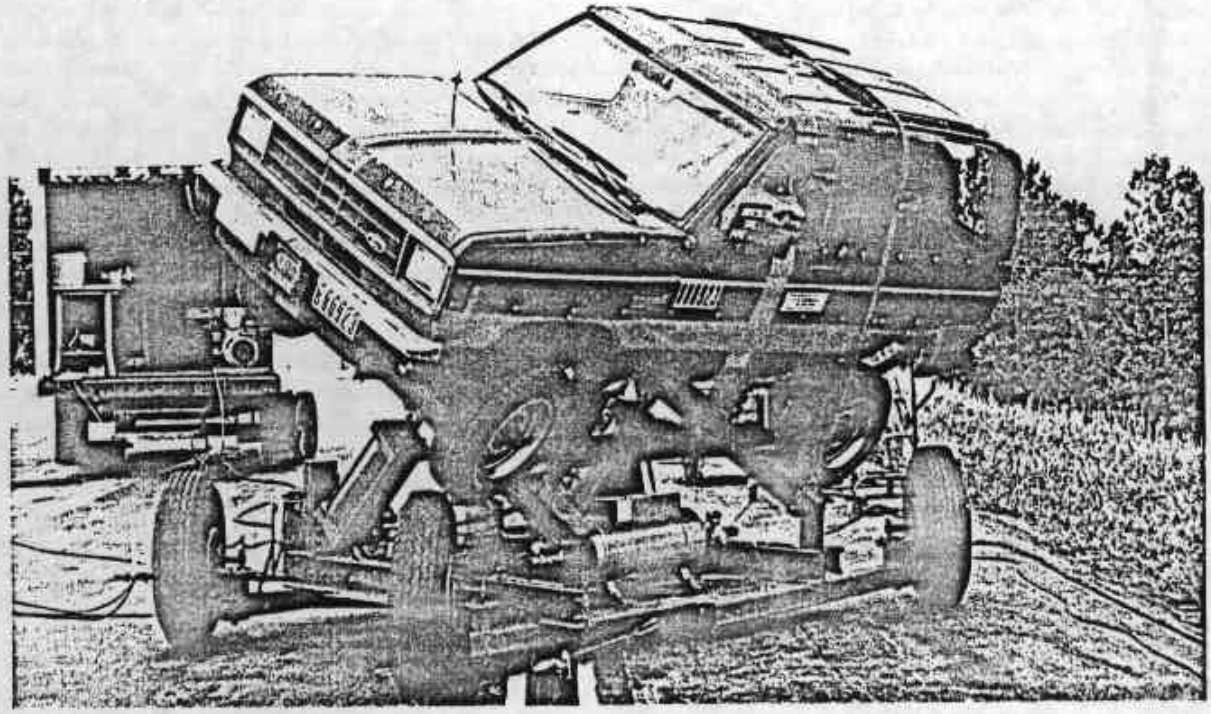


Figure A-2. PRE-TEST OVERALL LEFT VIEW

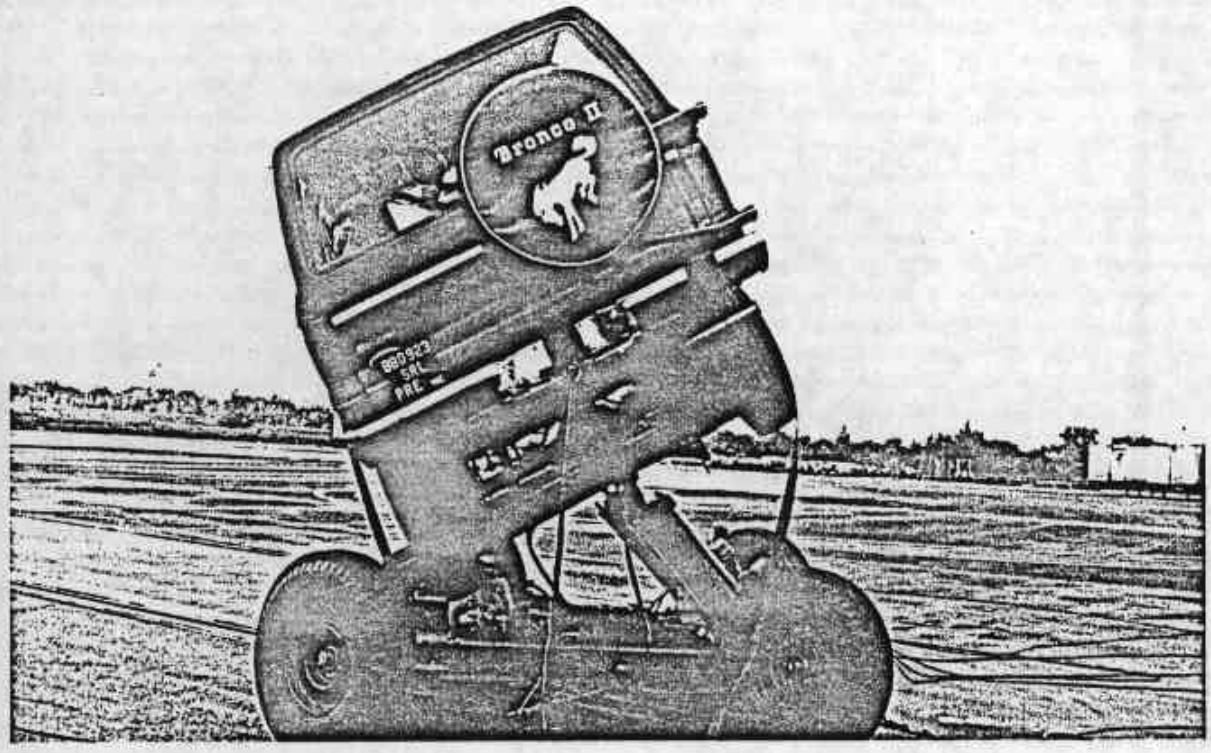


Figure A-3. PRE-TEST OVERALL REAR VIEW

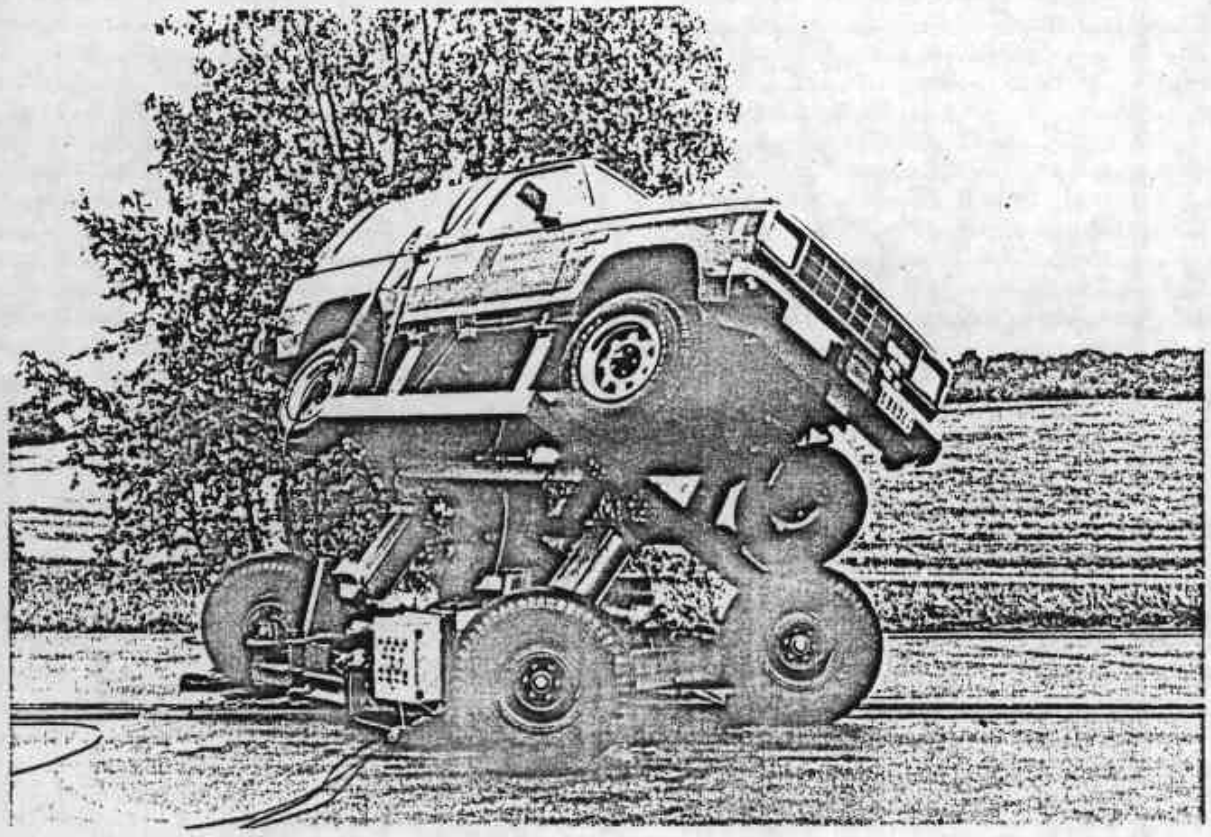


Figure A-4. PRE-TEST OVERALL RIGHT VIEW

Figure A-5. PRE-TEST CLOSE-UP FRONT VIEW

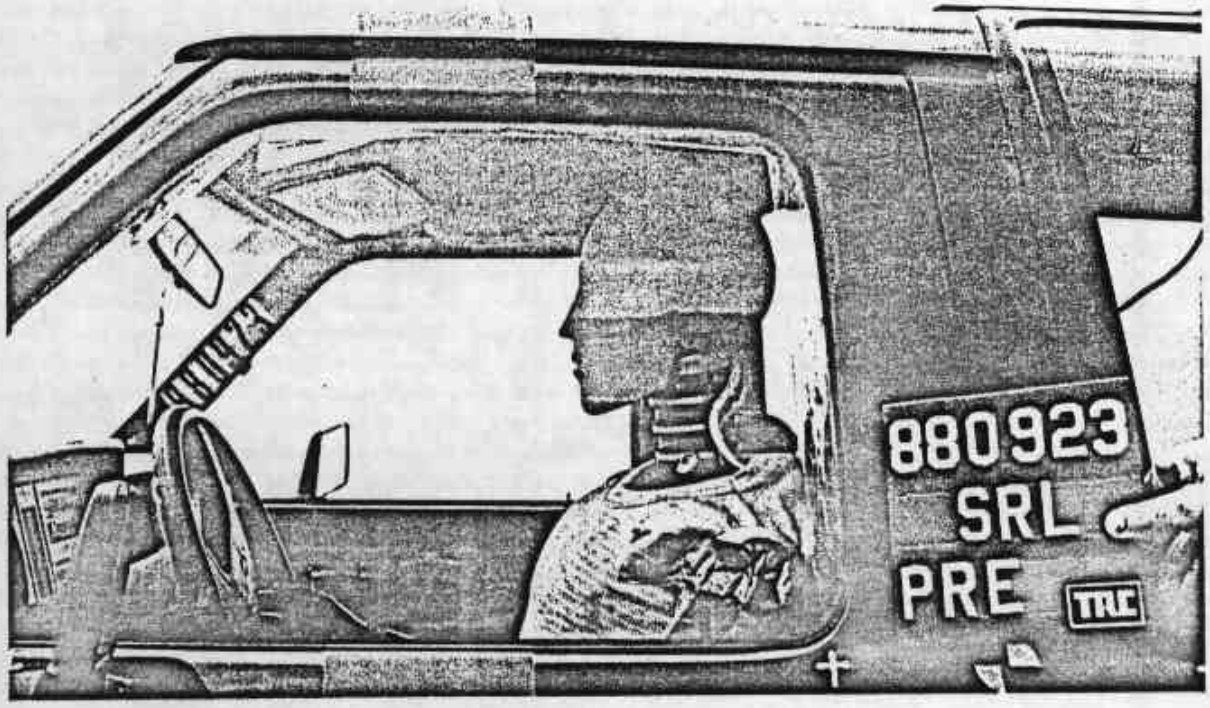


Figure A-6. PRE-TEST DRIVER DUMMY - VIEW 1

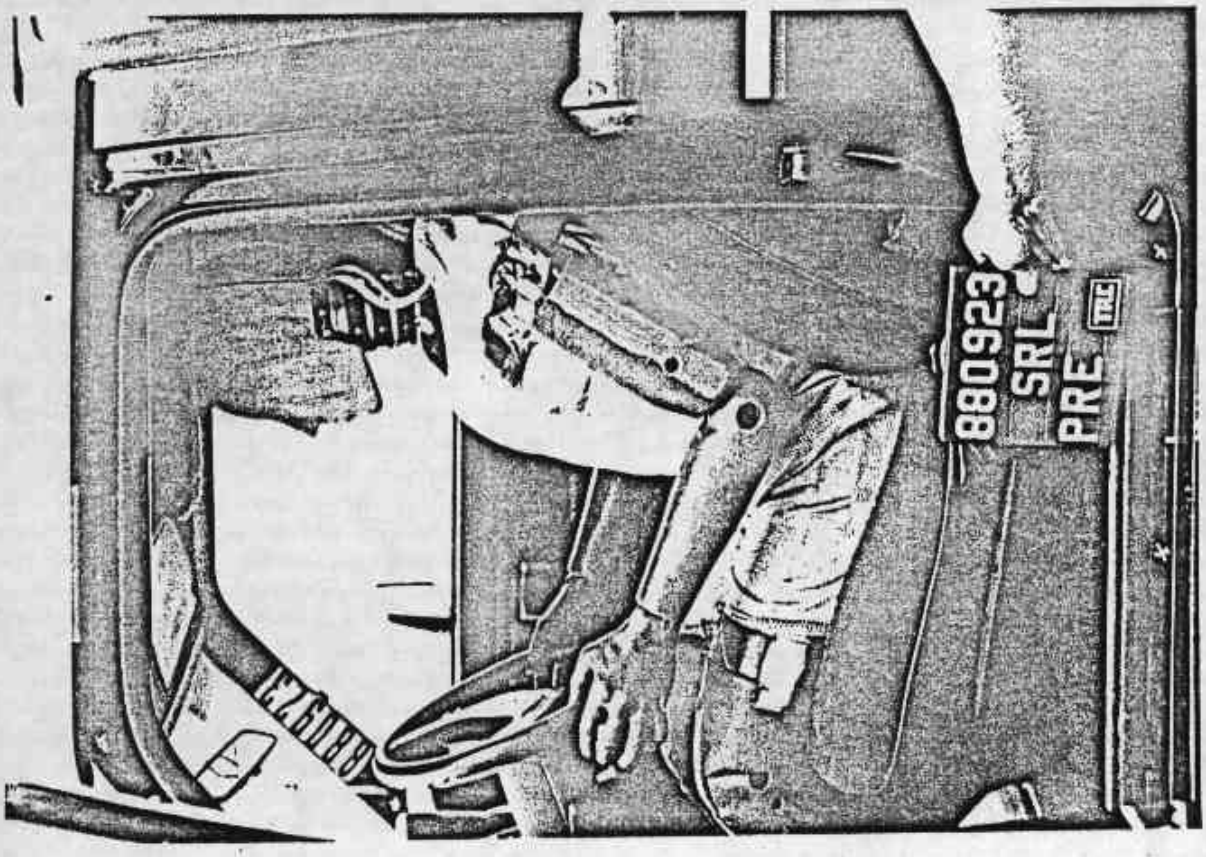


Figure A-7. PRE-TEST DRIVER DUMMY - VIEW 2

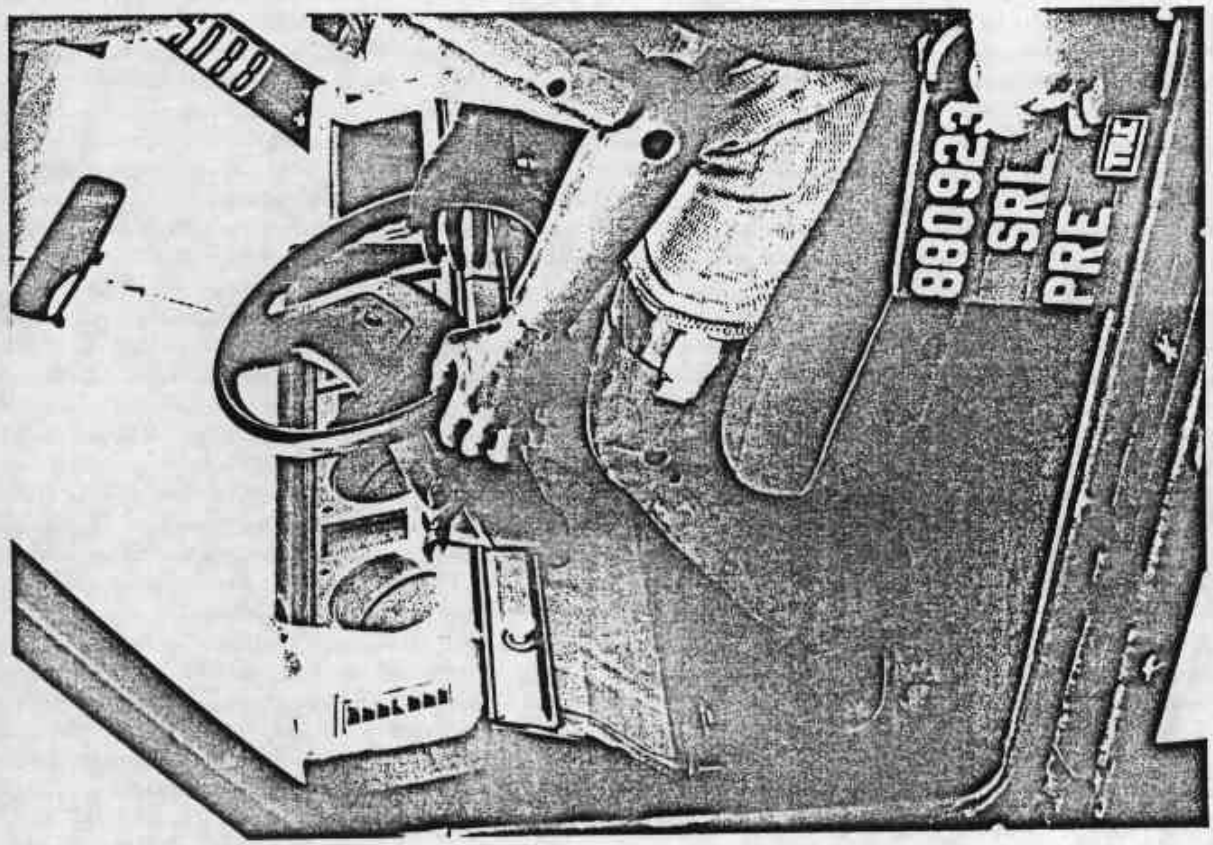


Figure A-8. PRE-TEST DRIVER DUMMY - VIEW 3

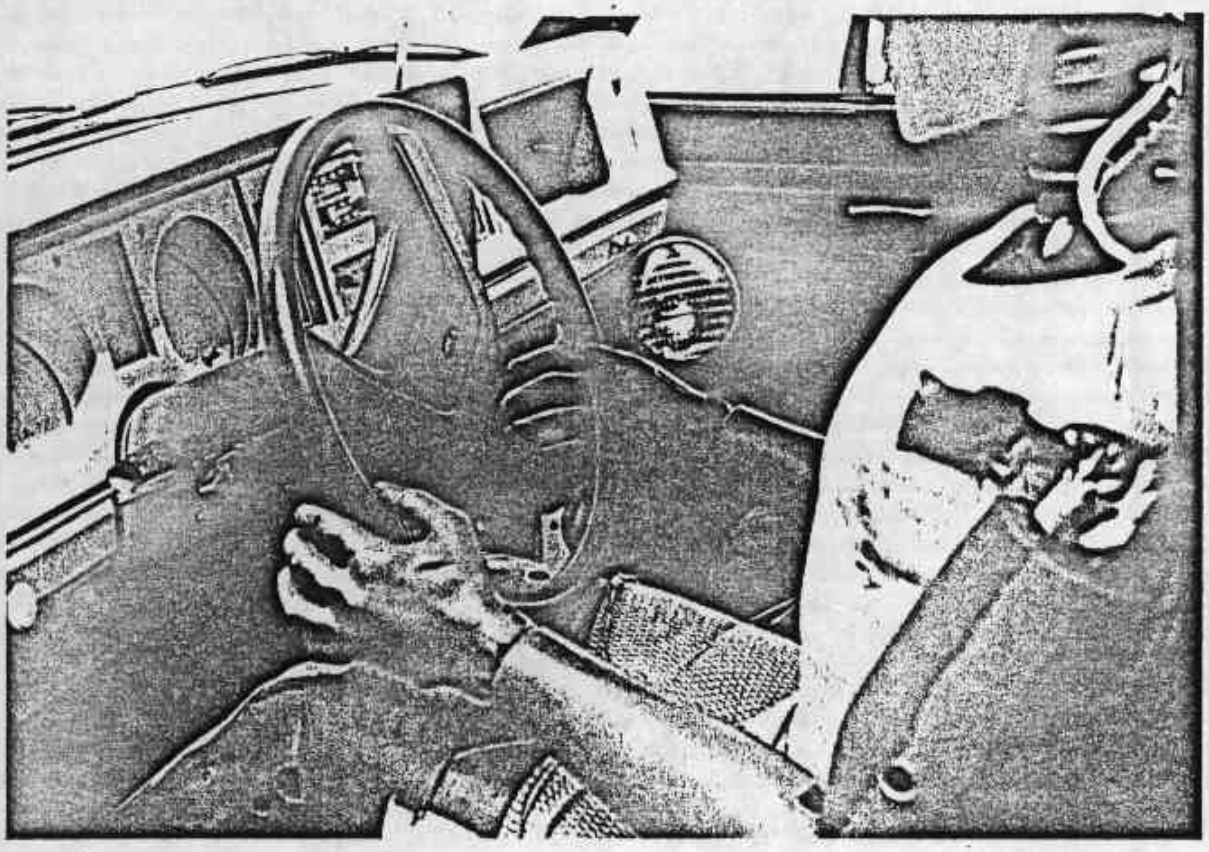


Figure A-9. PRE-TEST DRIVER DUMMY - VIEW 4

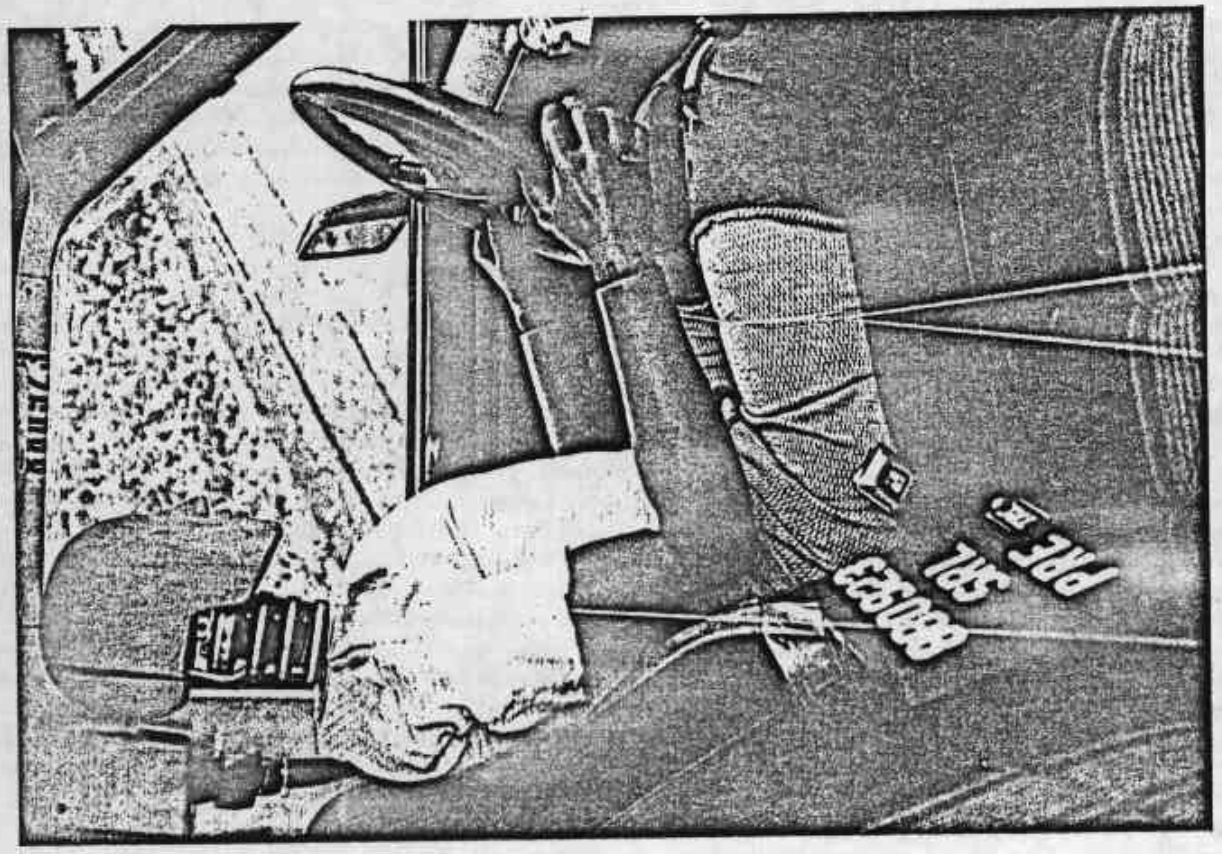


Figure A-10. PRE-TEST DRIVER DUMMY - VIEW 5

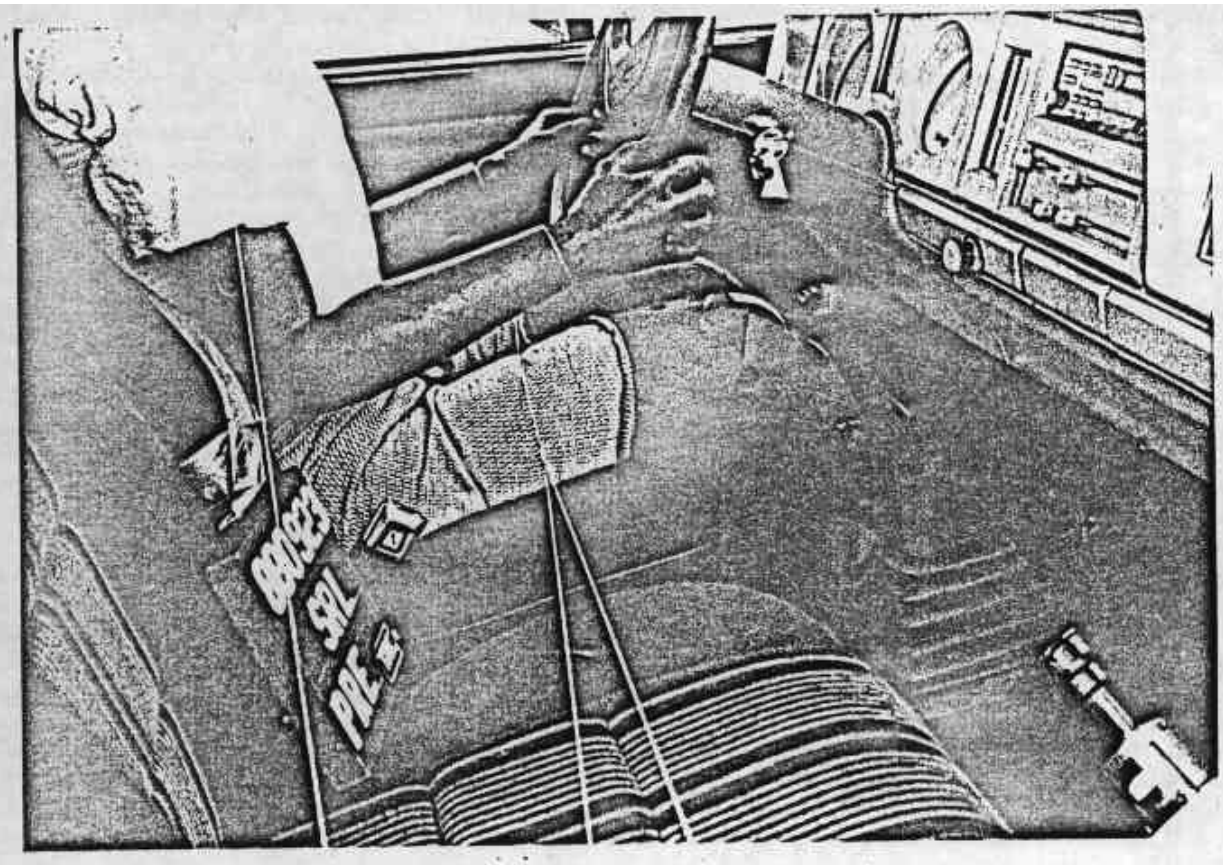


Figure A-11. PRE-TEST DRIVER DUMMY - VIEW 6

Figure A-12. PRE-TEST LEFT FRONT SUSPENSION STRING POT. - VIEW 1

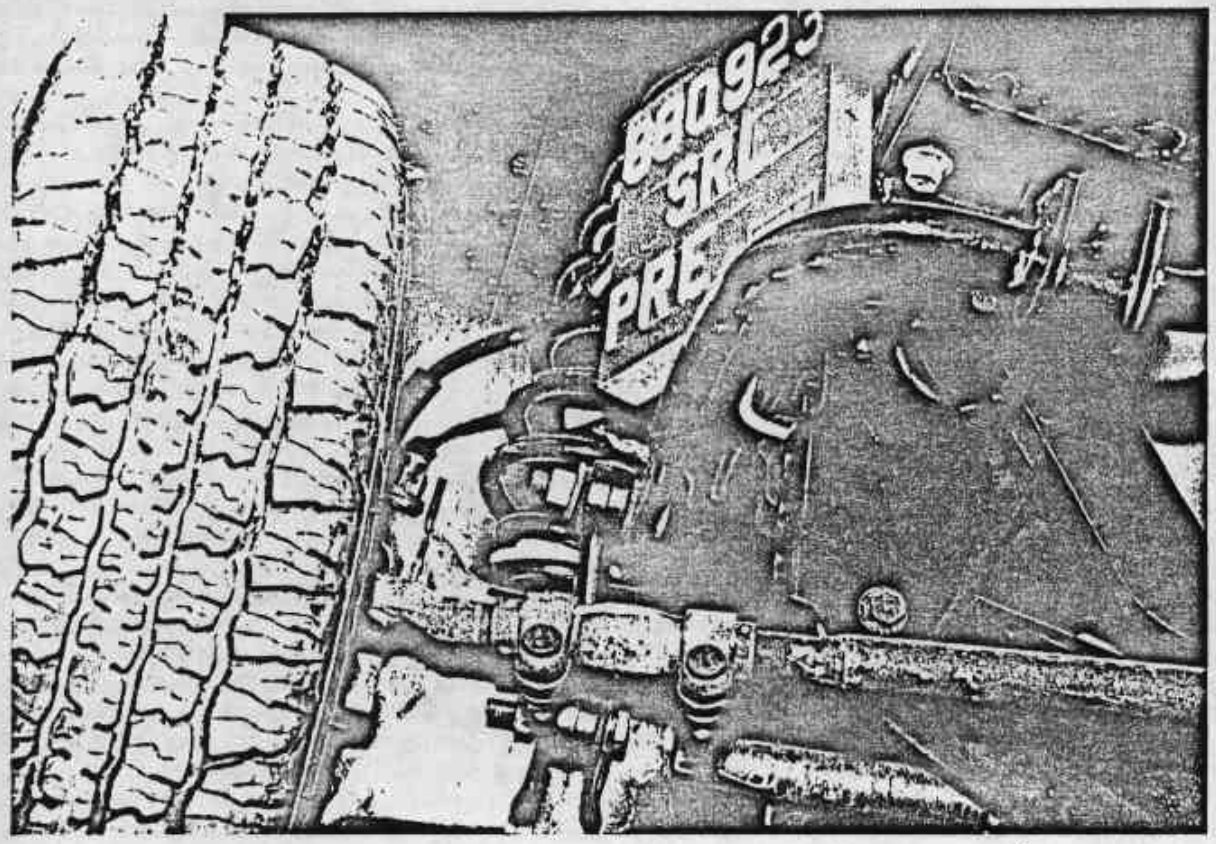


Figure A-13. PRE-TEST LEFT FRONT SUSPENSION STRING POT. - VIEW 2

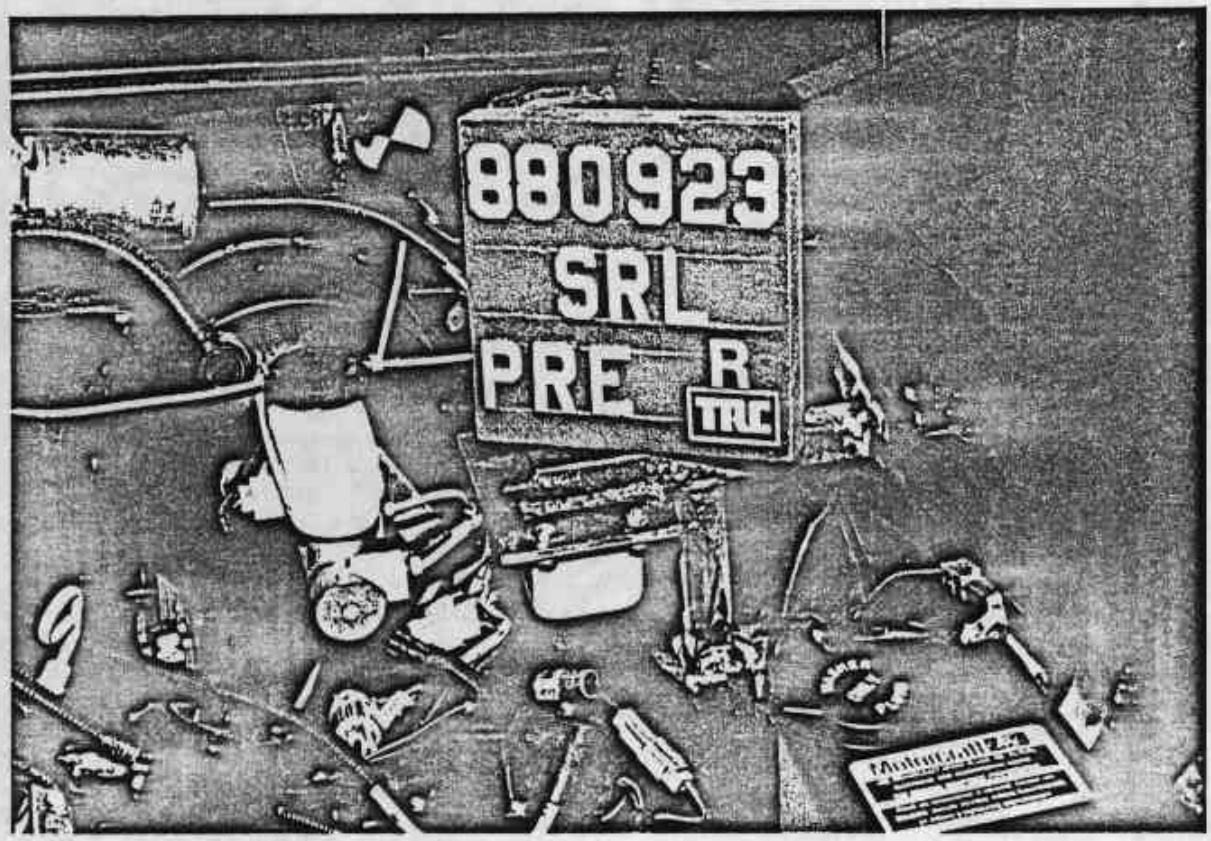


Figure A-14. PRE-TEST RIGHT FRONT SUSPENSION STRING POT. - VIEW 1

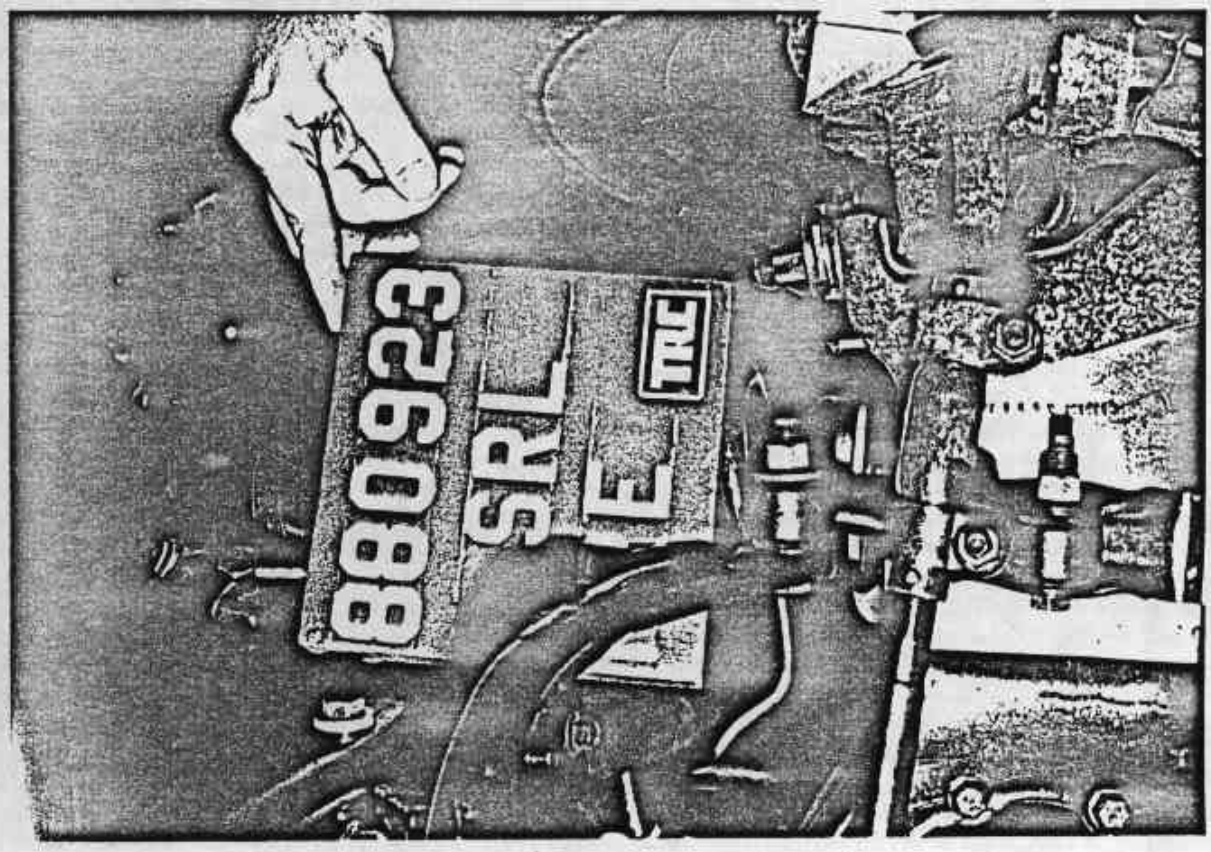


Figure A-15. PRE-TEST RIGHT FRONT SUSPENSION STRINT POT. - VIEW 2

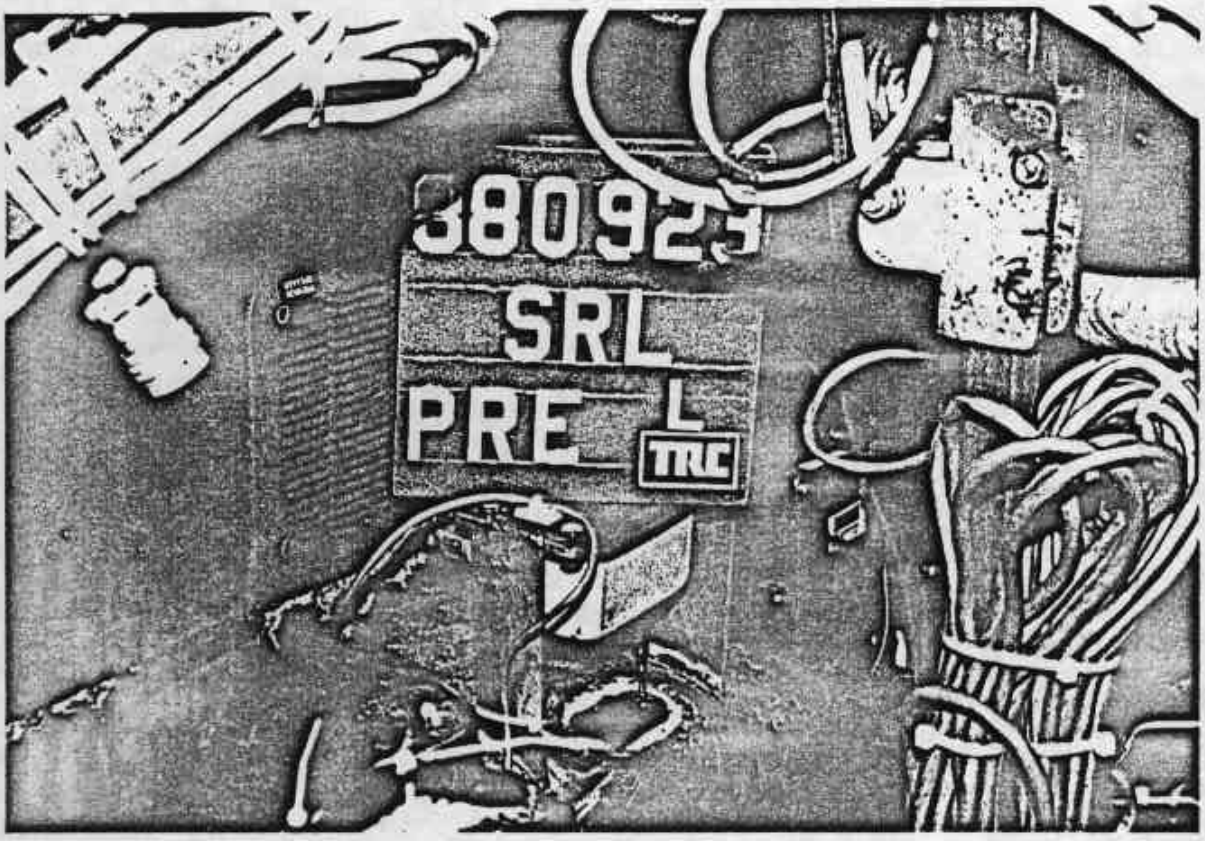


Figure A-16. PRE-TEST LEFT REAR SUSPENSION STRING POT. - VIEW 1

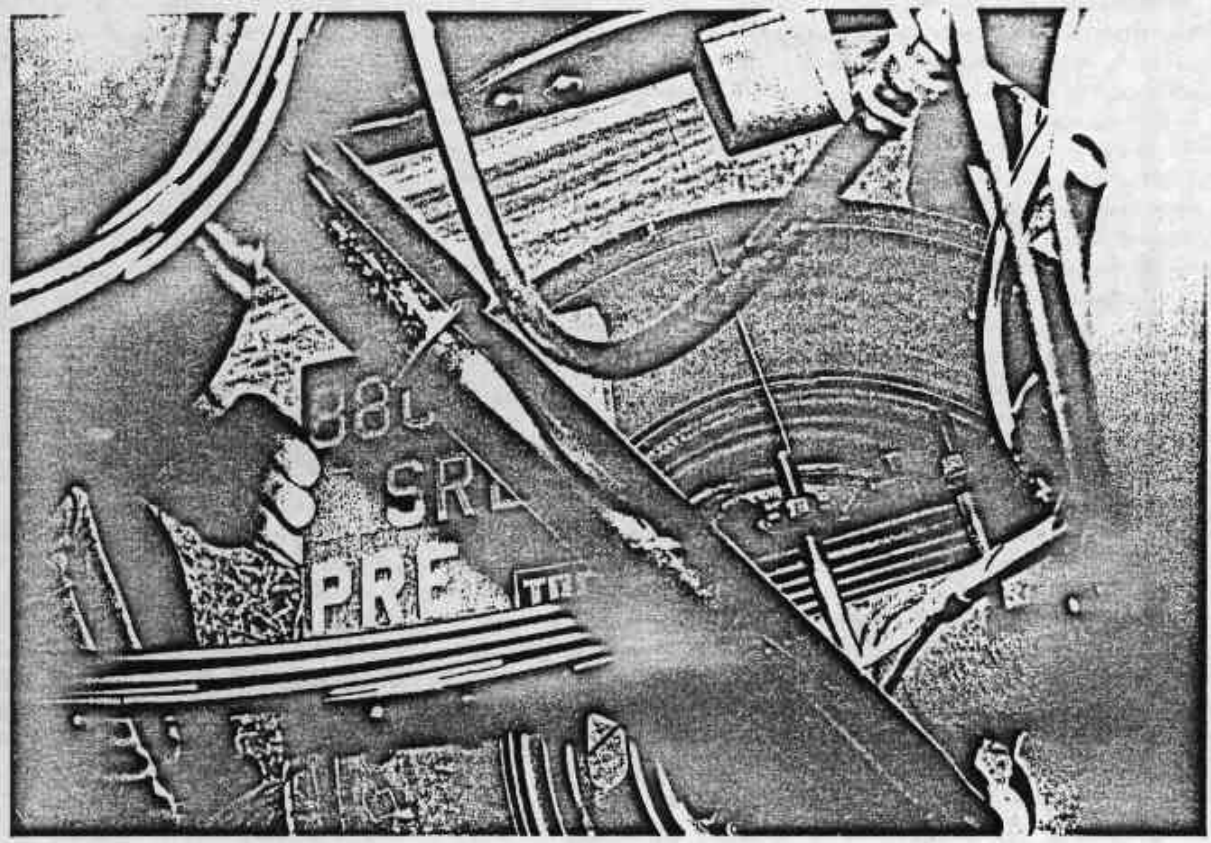


Figure A-17. PRE-TEST LEFT REAR SUSPENSION STRING POT. - VIEW 2

Figure A-18. PRE-TEST RIGHT REAR SUSPENSION STRING POT. - VIEW 1

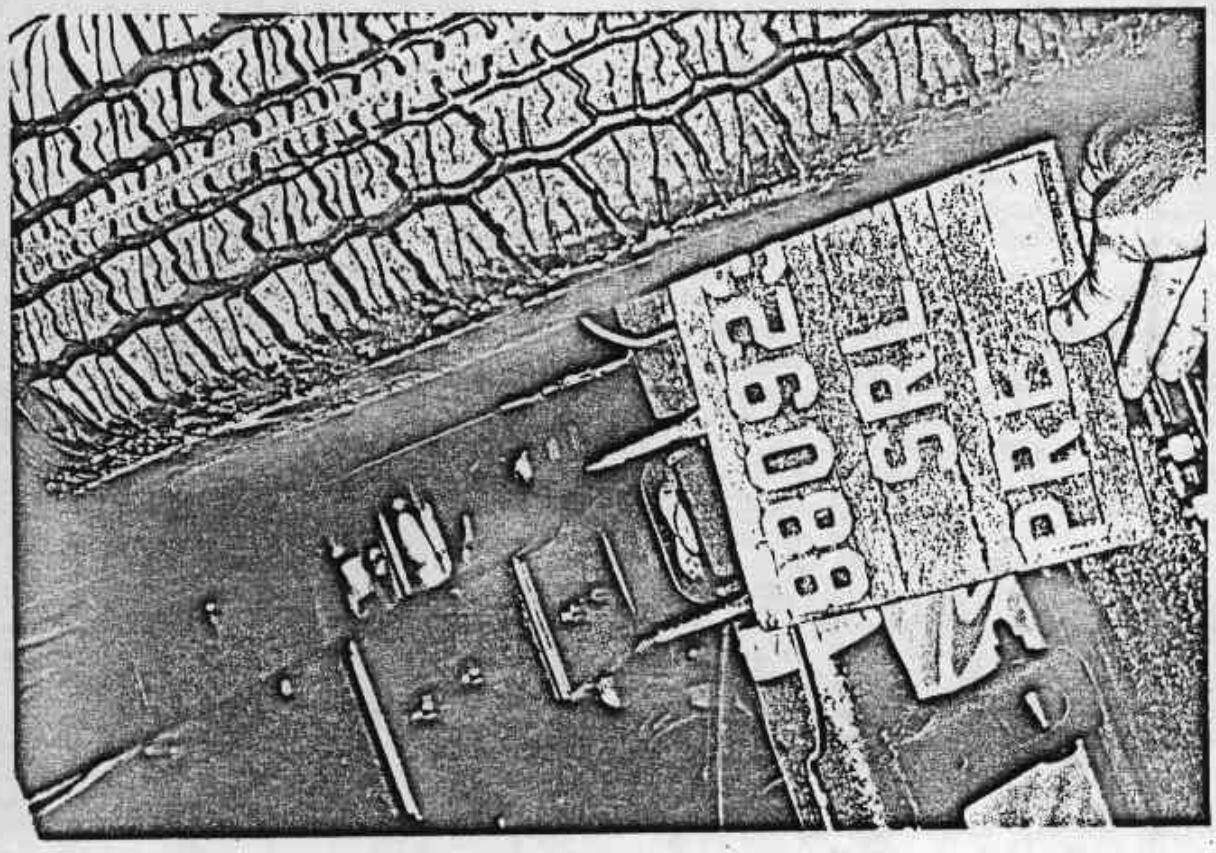


Figure A-19. PRE-TEST RIGHT REAR SUSPENSION STRING POT. - VIEW 2

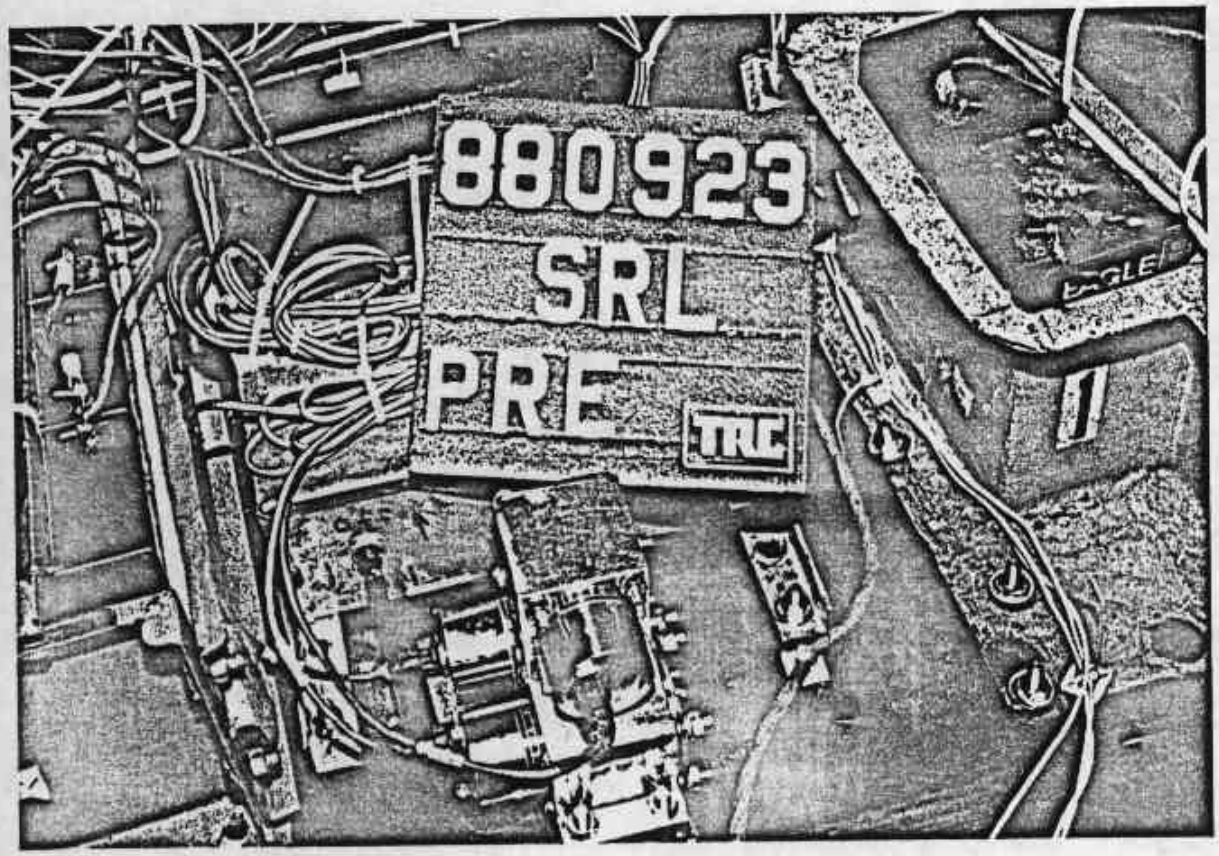


Figure A-20. PRE-TEST GYRO PLACEMENT VIEW

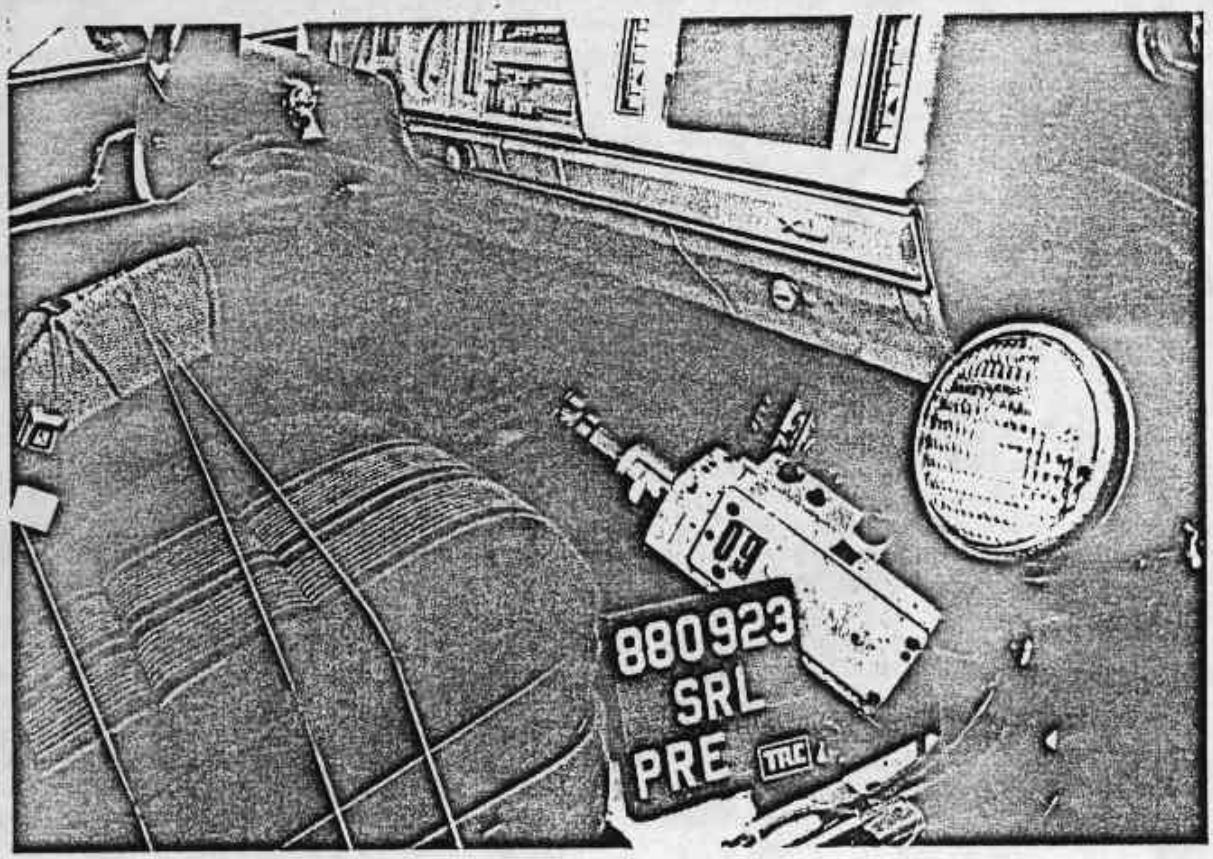


Figure A-21. PRE-TEST FRONT CAMERA PLACEMENT VIEW

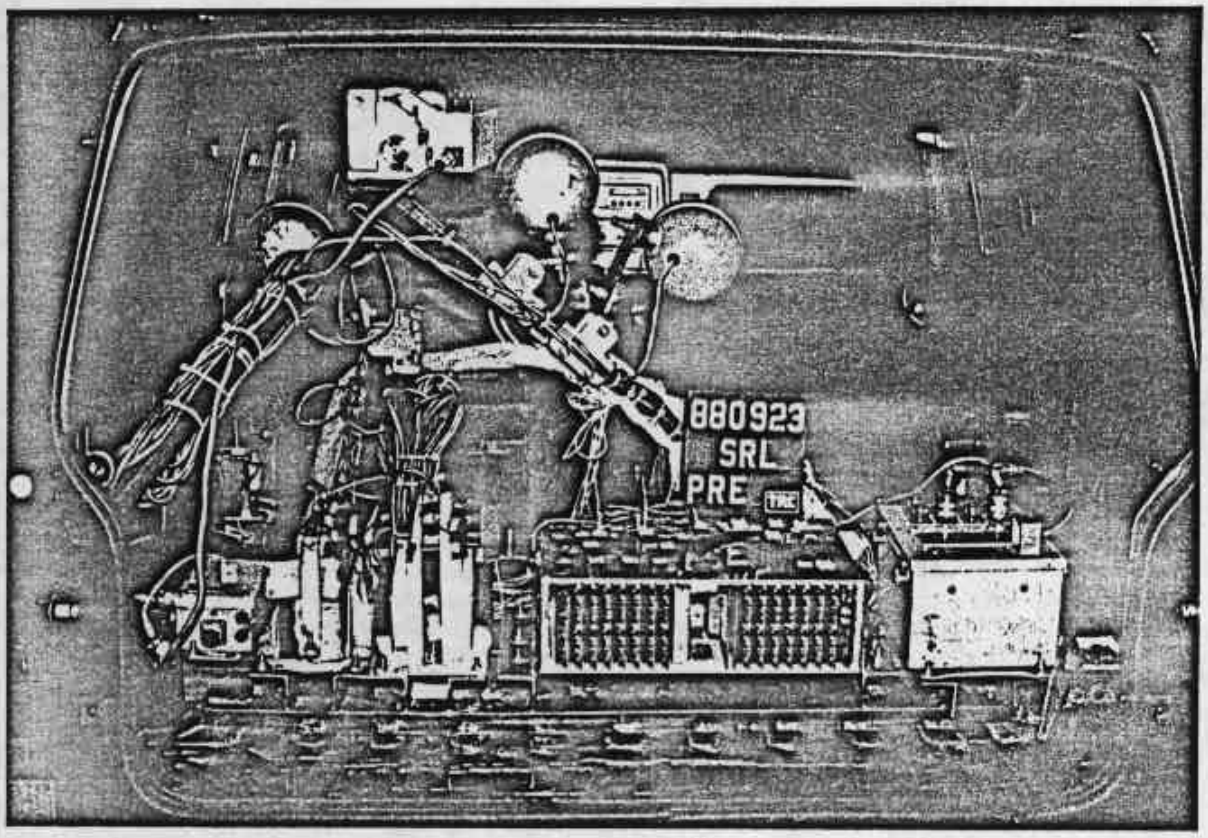


Figure A-22. PRE-TEST REAR CAMERA AND INSTRUMENTATION PLACEMENT VIEW

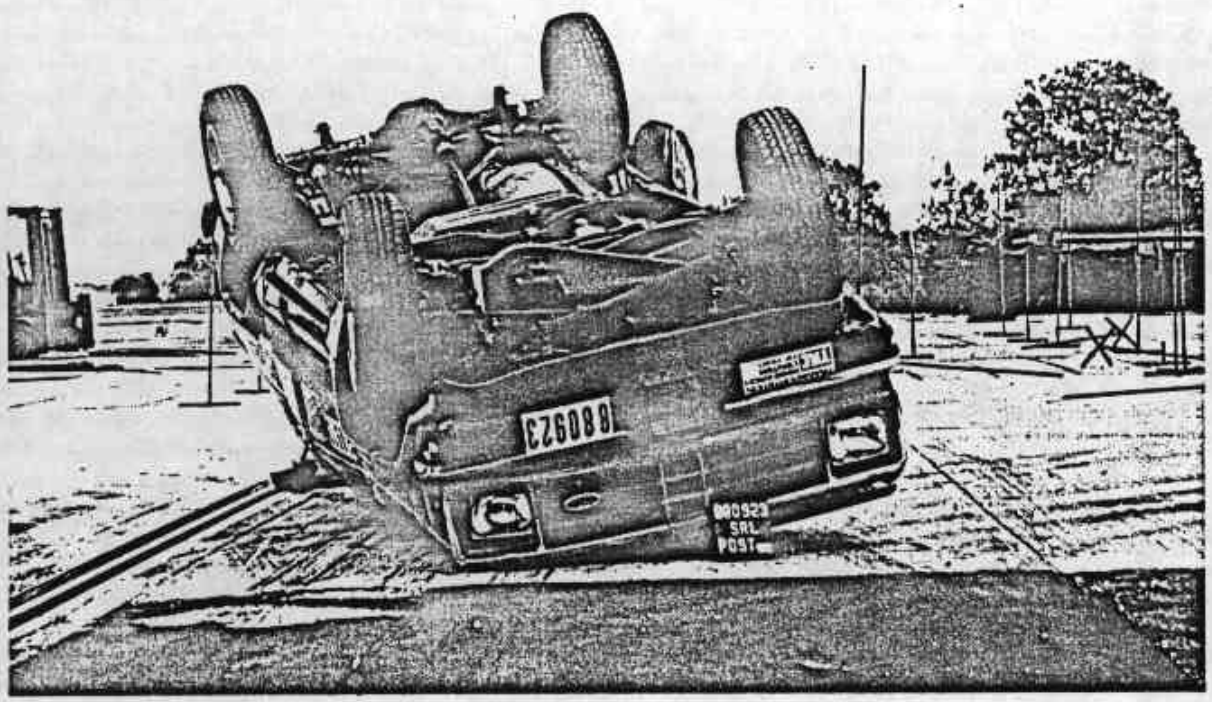


Figure A-23. POST-TEST OVERALL FRONT - VIEW 1

Figure A-24. POST-TEST OVERALL FRONT - VIEW 2

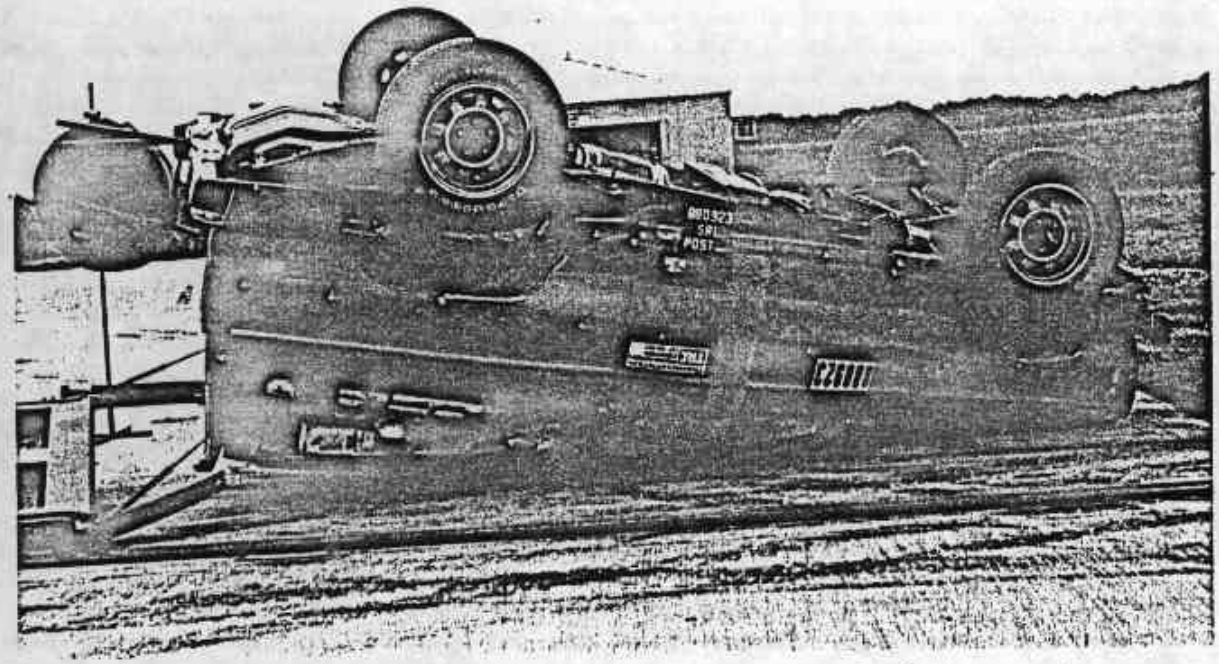


Figure A-25. POST-TEST OVERALL LEFT - VIEW 1

Figure A-26. POST-TEST OVERALL LEFT - VIEW 2

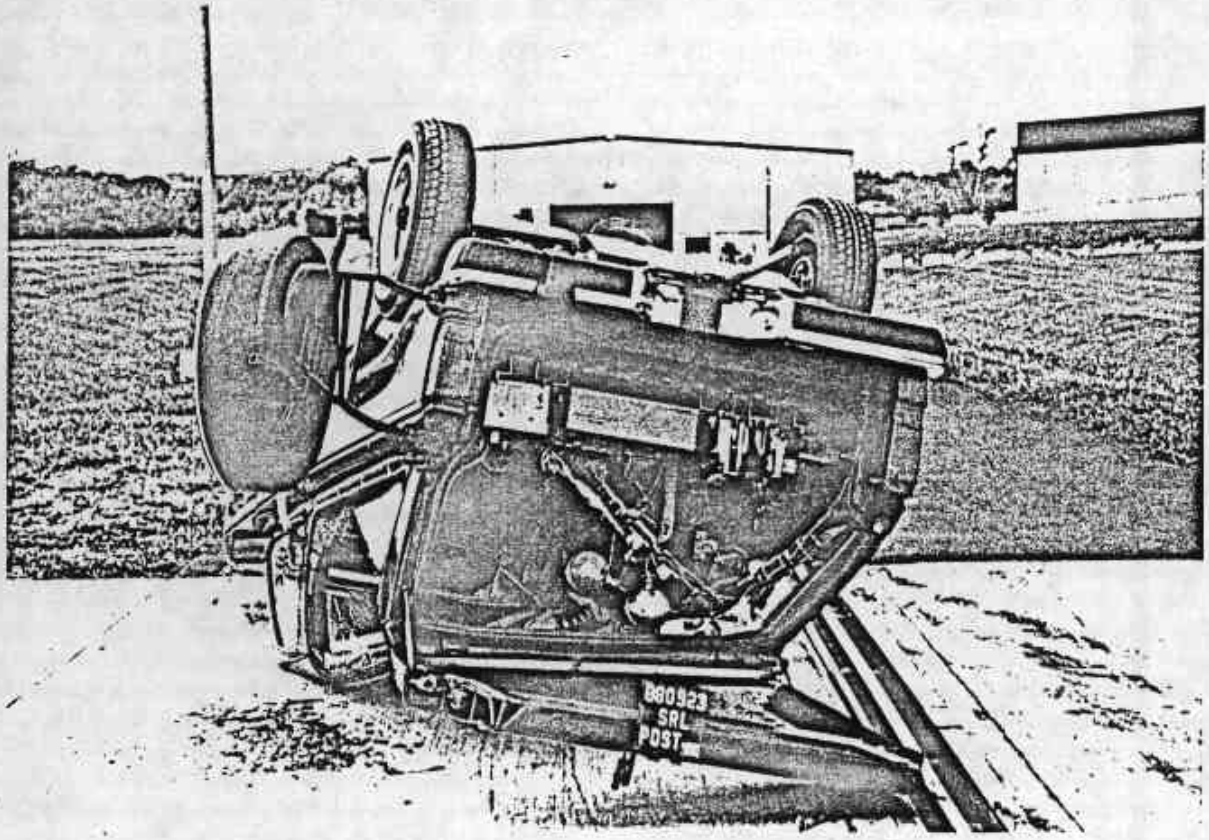


Figure A-27. POST-TEST OVERALL REAR - VIEW 1

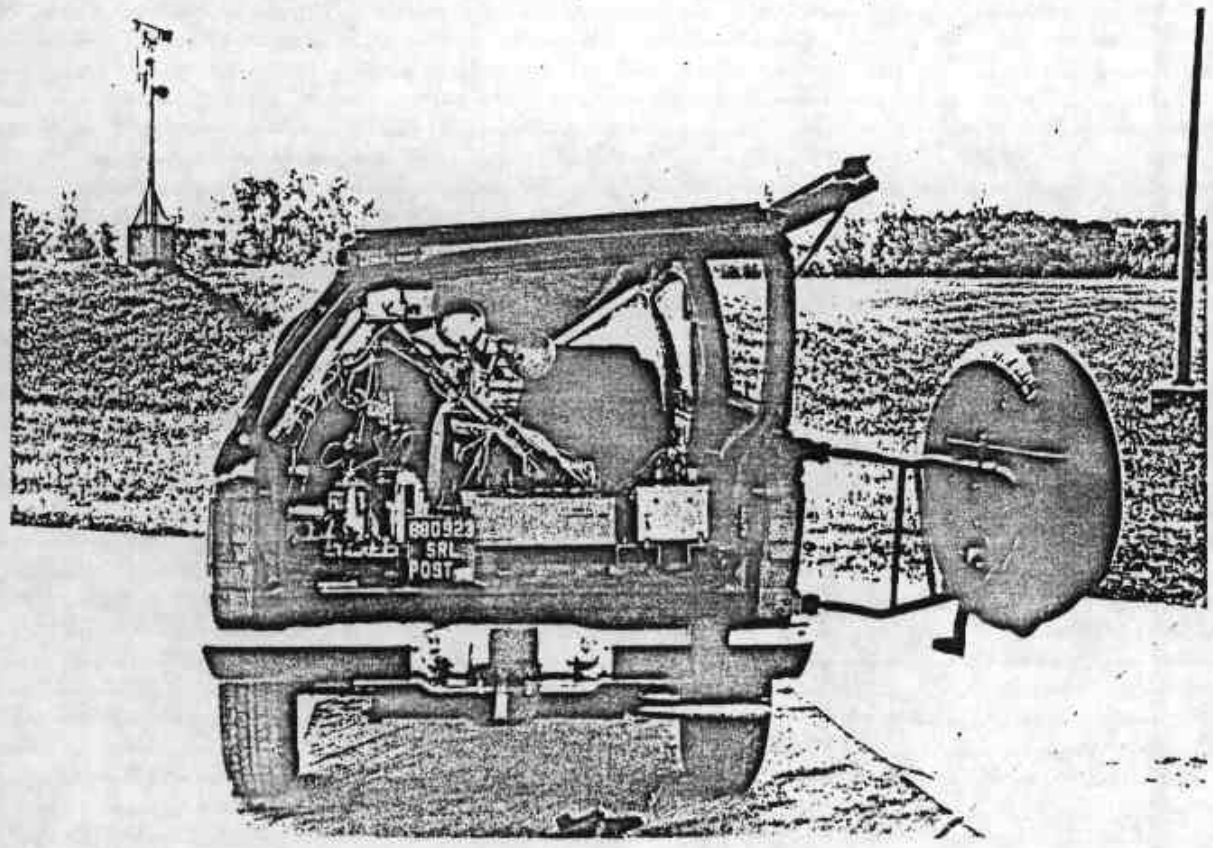


Figure A-28. POST-TEST OVERALL REAR - VIEW 2

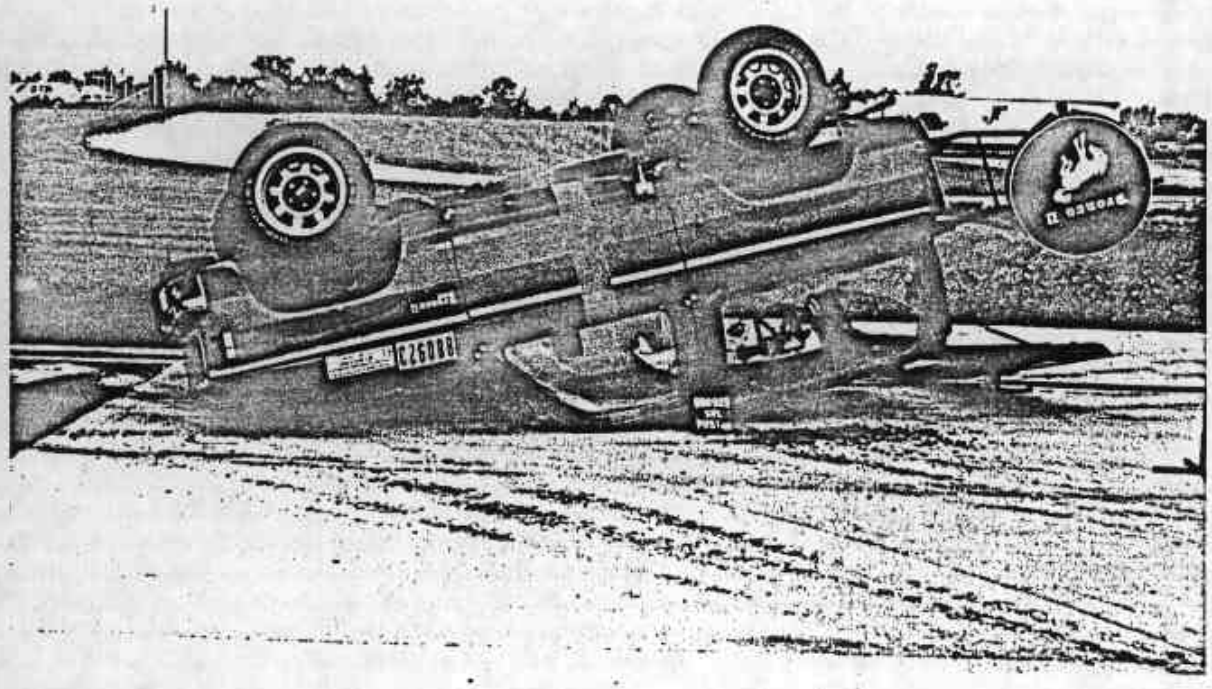


Figure A-29. POST-TEST OVERALL RIGHT - VIEW 1

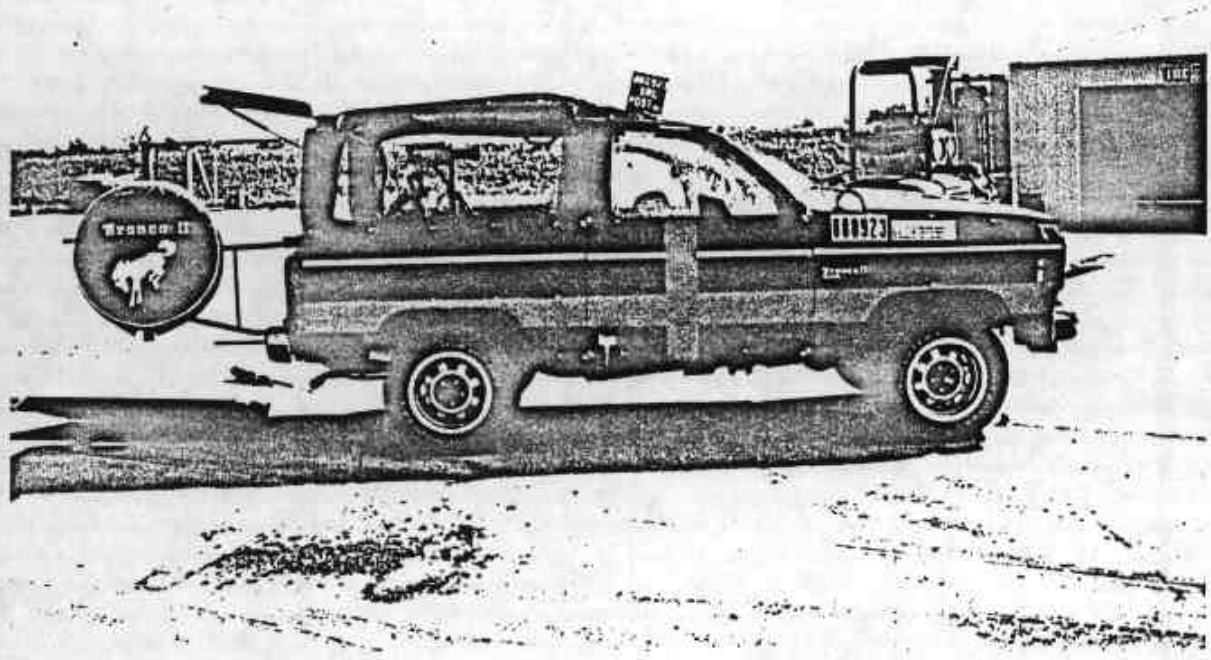


Figure A-30. POST-TEST OVERALL RIGHT - VIEW 2

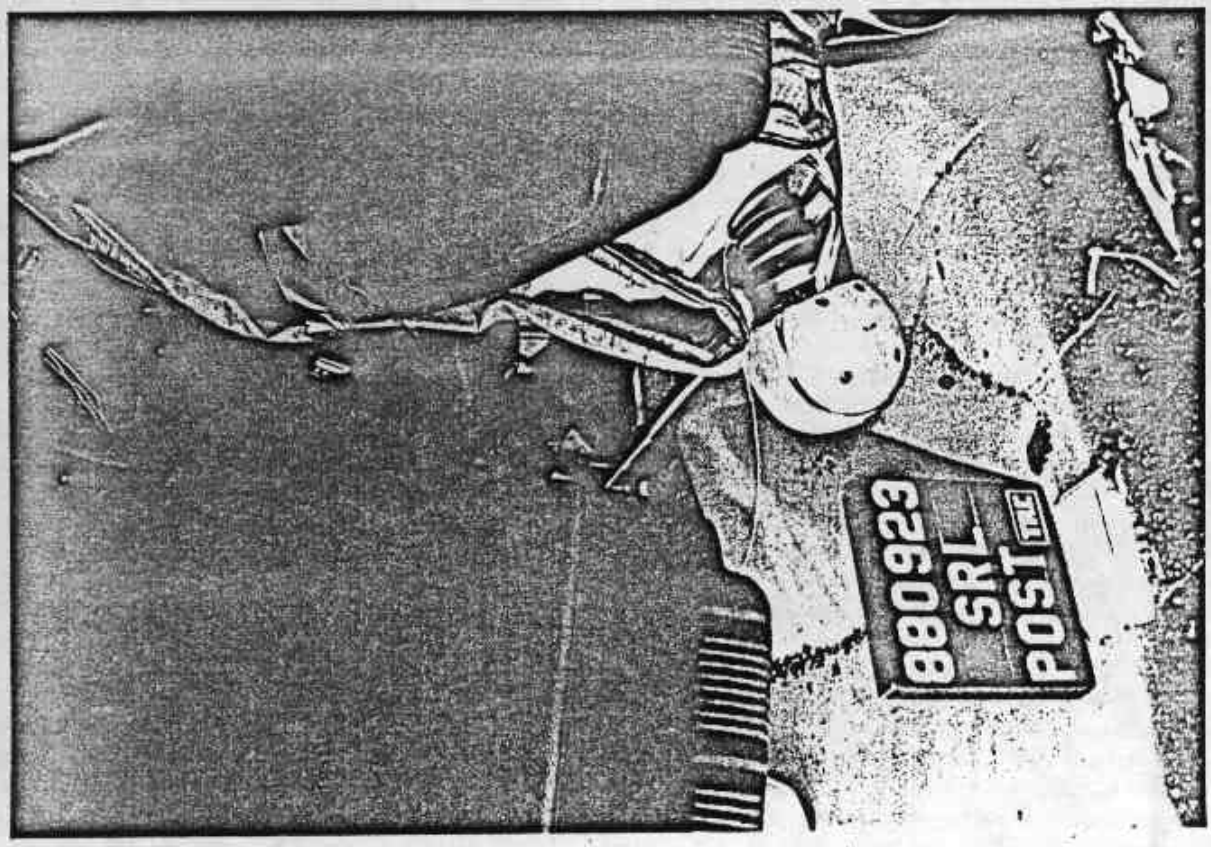


Figure A-31. POST-TEST DUMMY CONTACT - VIEW 1

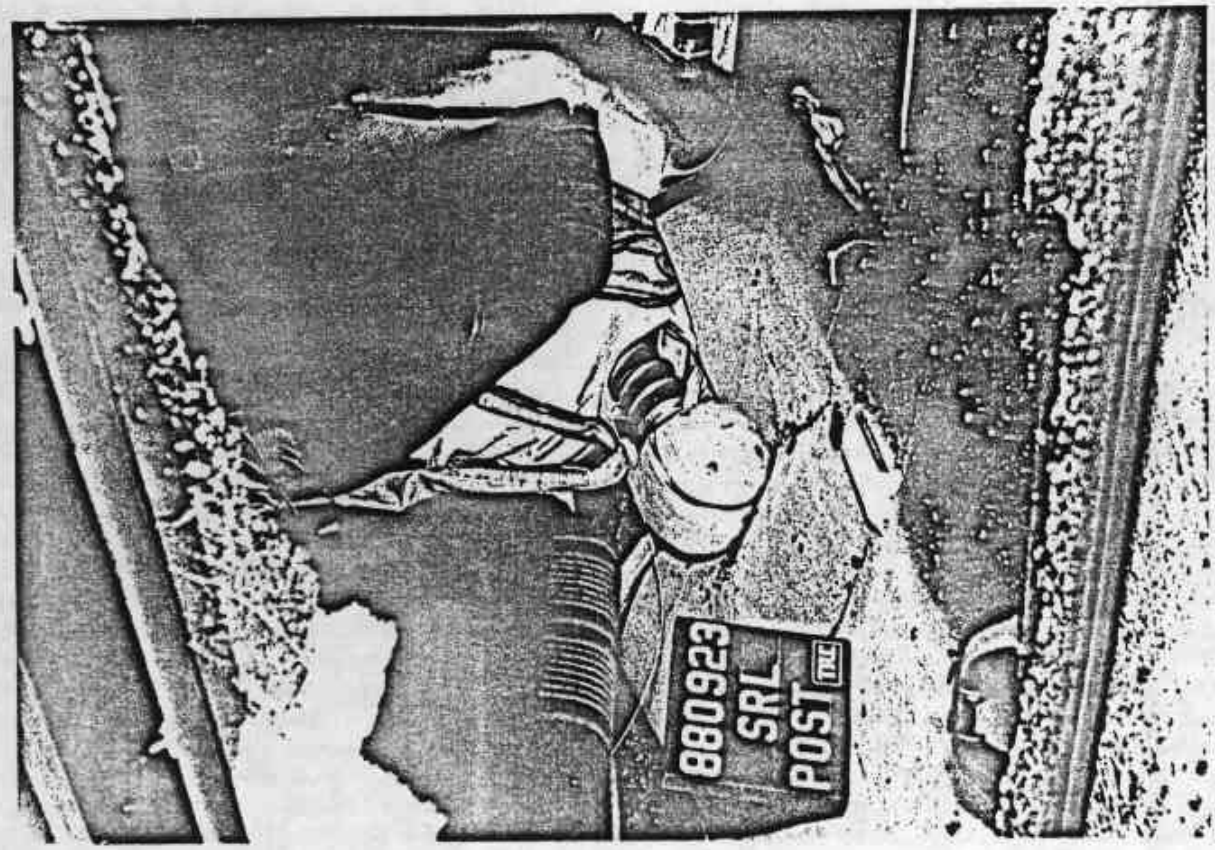
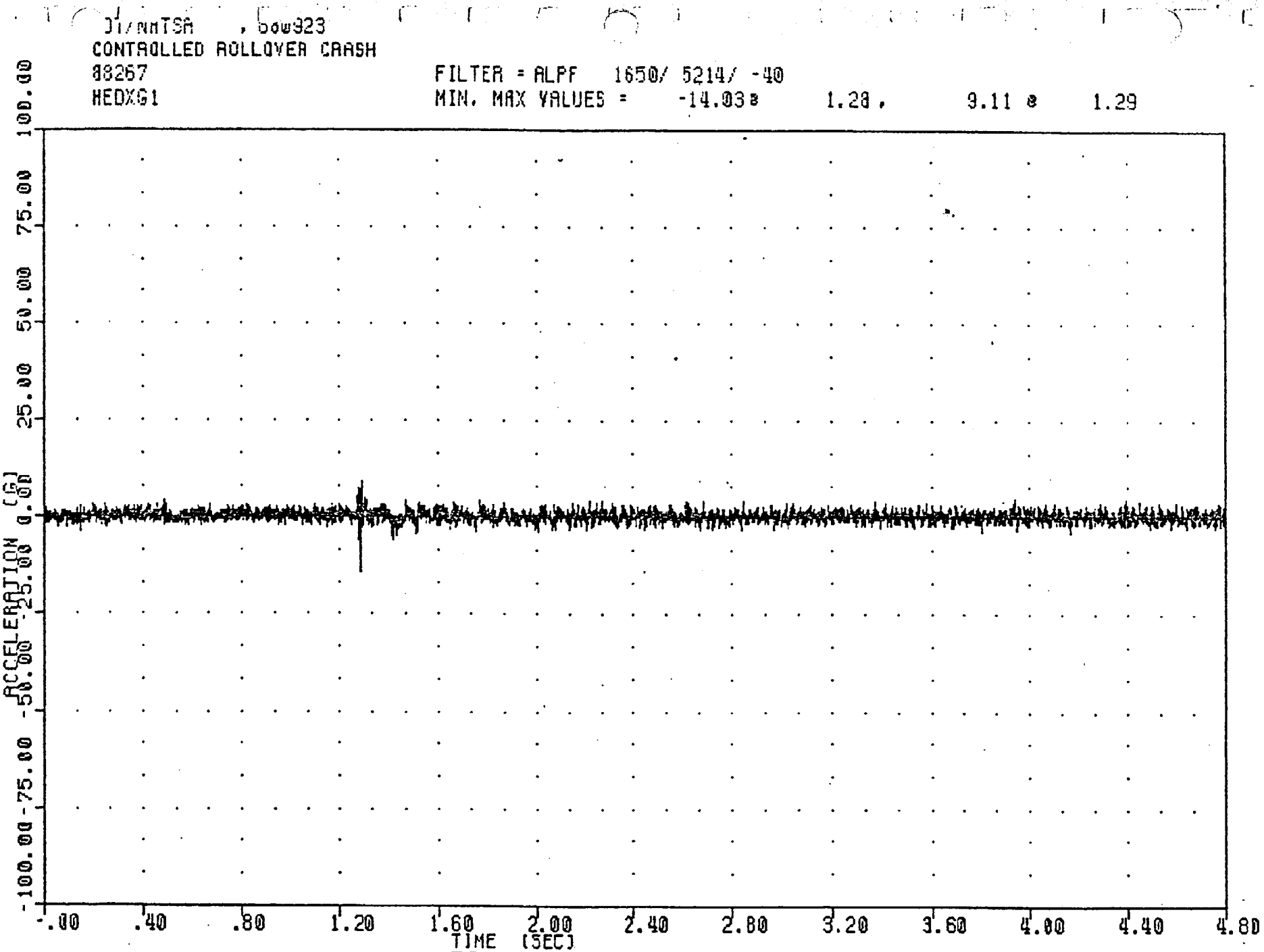


Figure A-32. POST-TEST DUMMY CONTACT - VIEW 2

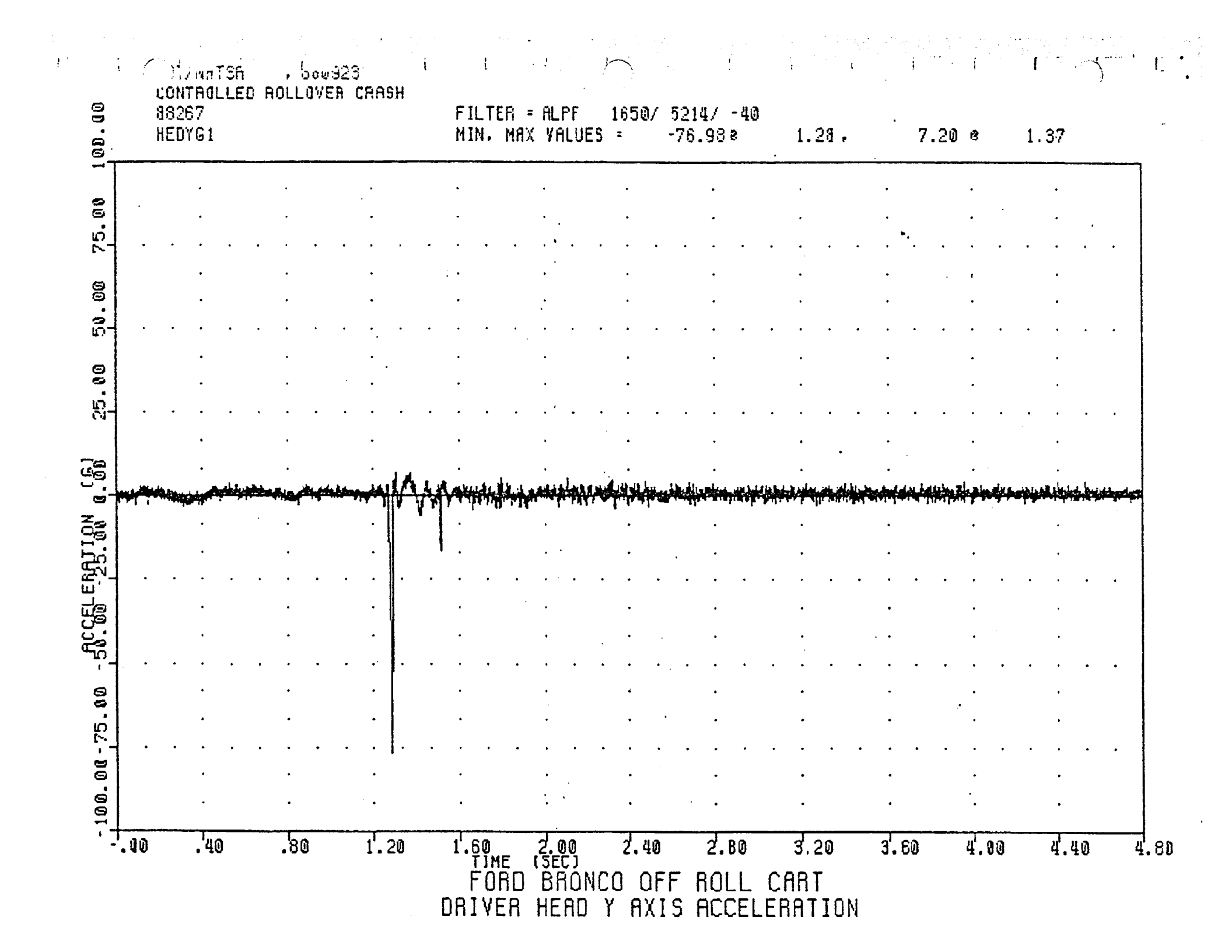
APPENDIX B

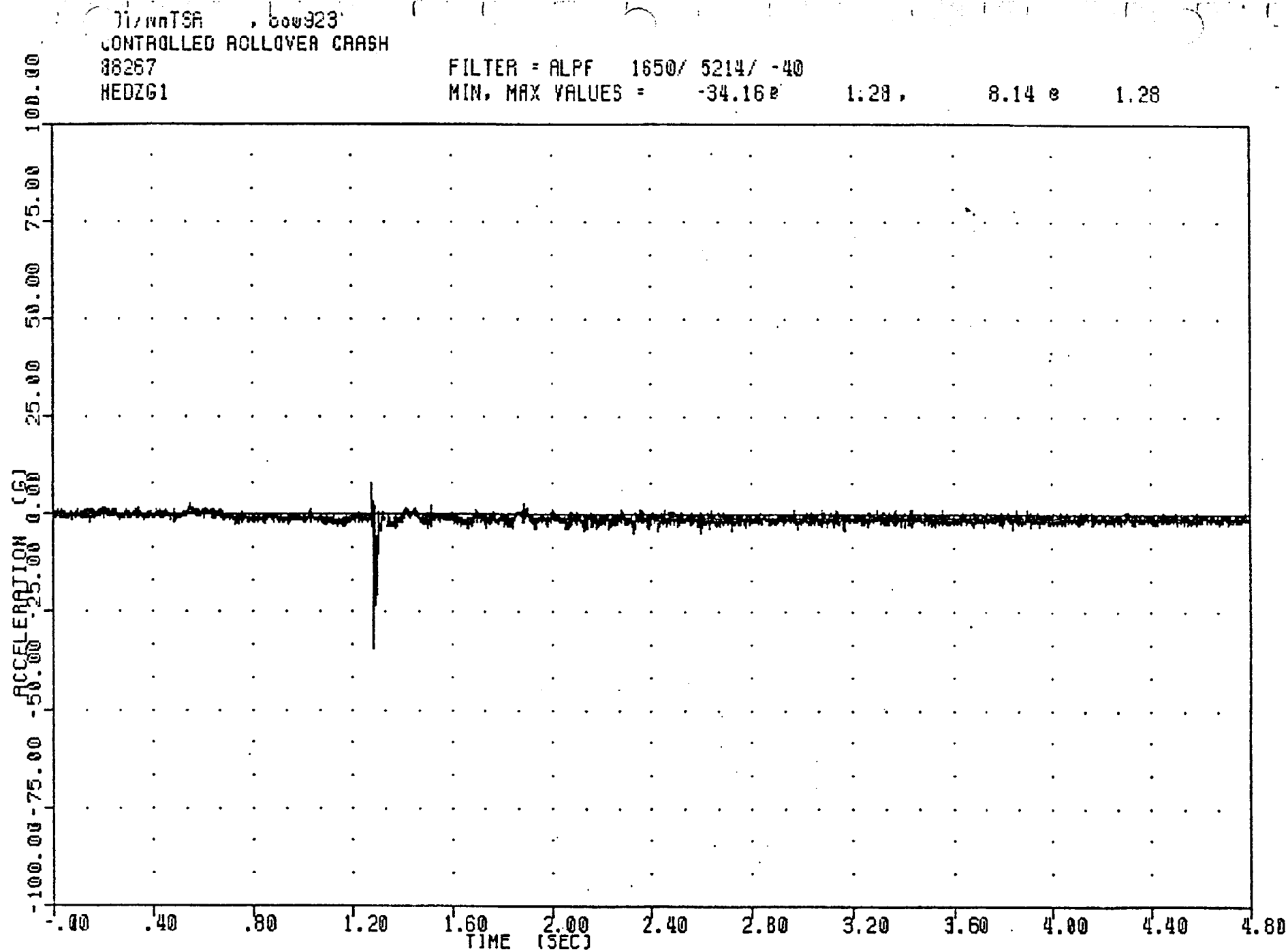
DATA PLOT PRESENTATION



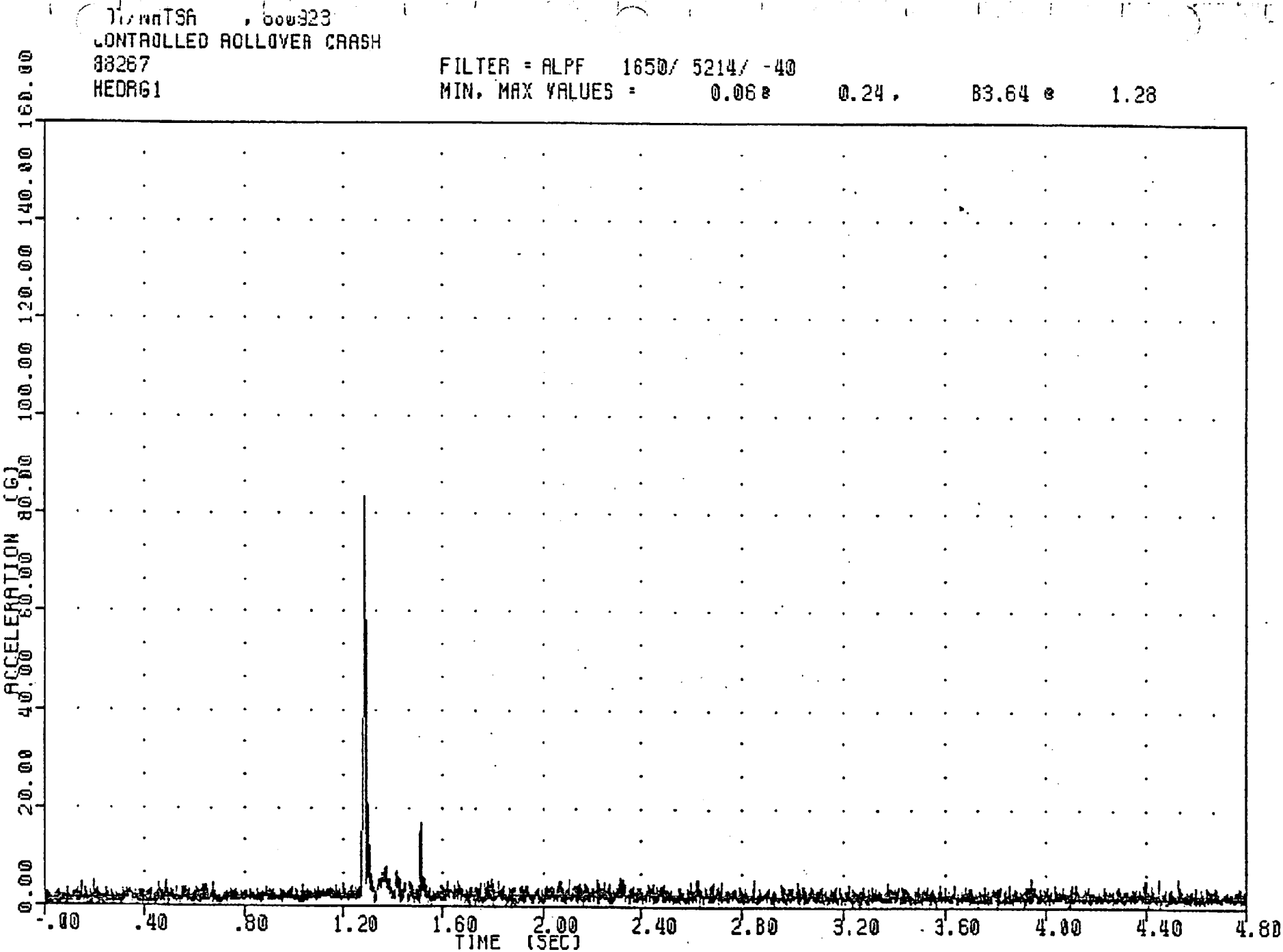
FORD BRONCO OFF ROLL CART

DRIVER HEAD X AXIS ACCELERATION

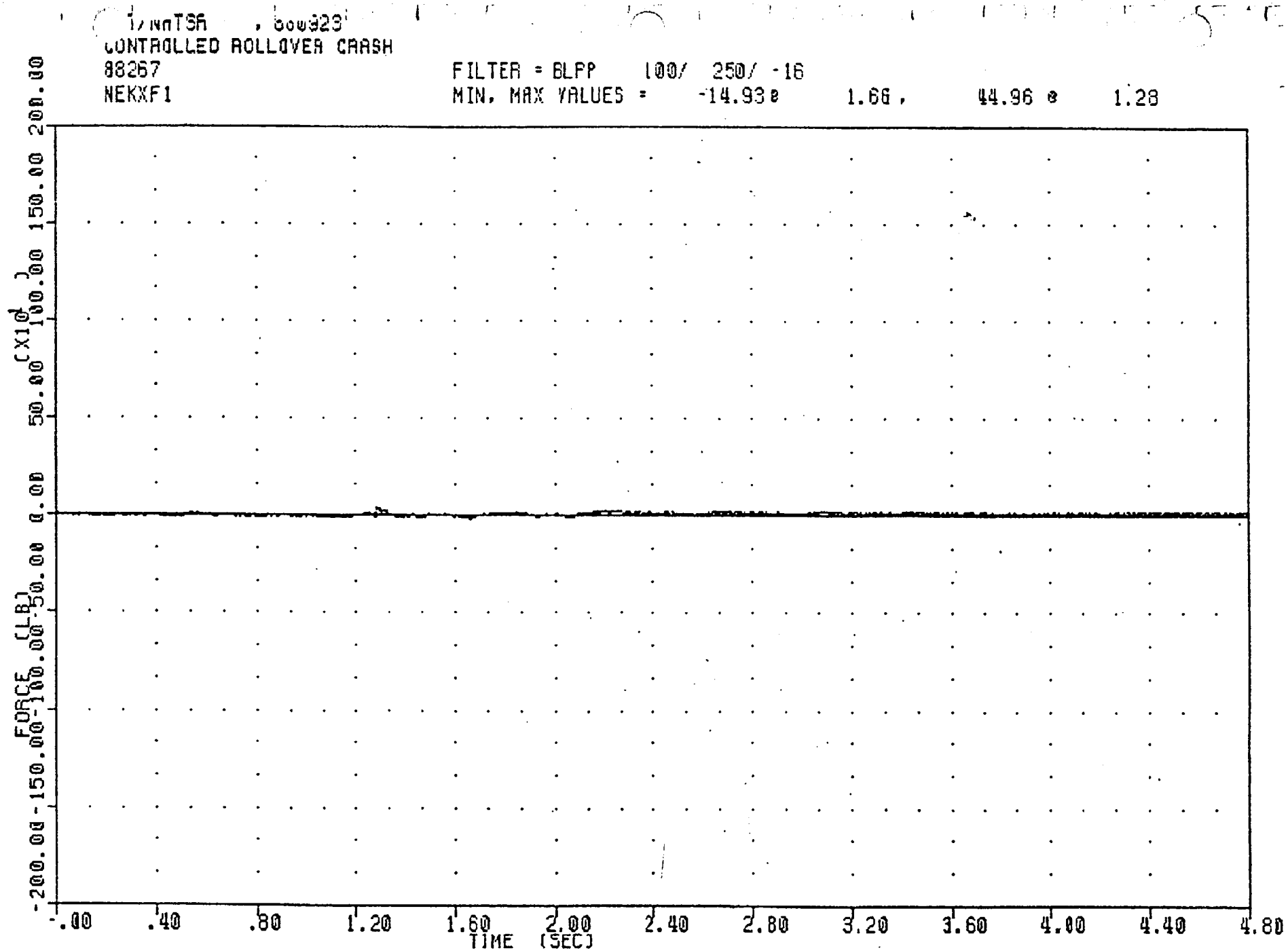

CONTROLLED ROLLOVER CRASH
88267
HEDYG1
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -76.98 @ 1.28 , 7.20 @ 1.37
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
ACCELERATION (G)
.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
FORD BRONCO OFF ROLL CART
DRIVER HEAD Y AXIS ACCELERATION



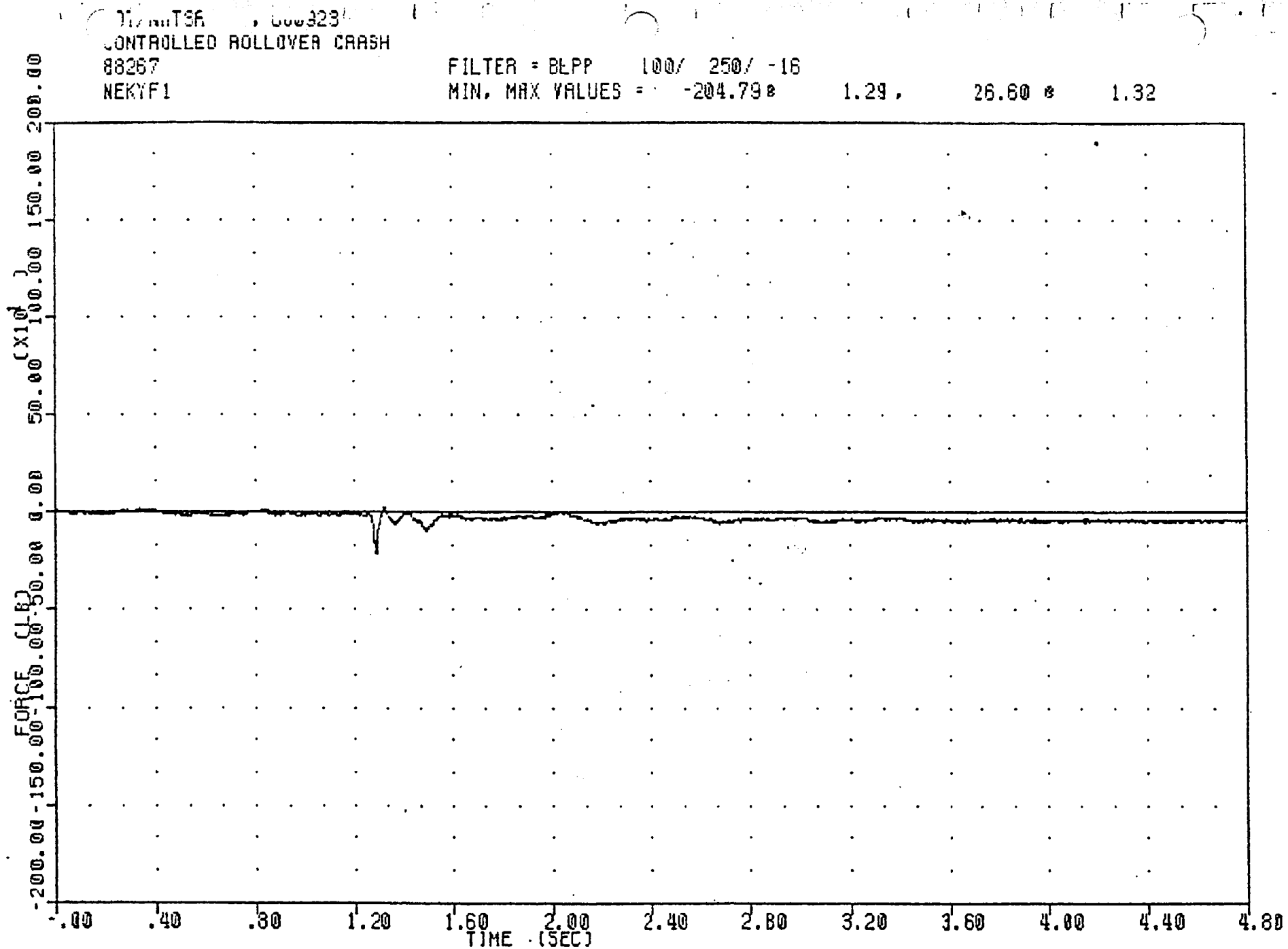
FORD BRONCO OFF ROLL CART
DRIVER HEAD Z AXIS ACCELERATION



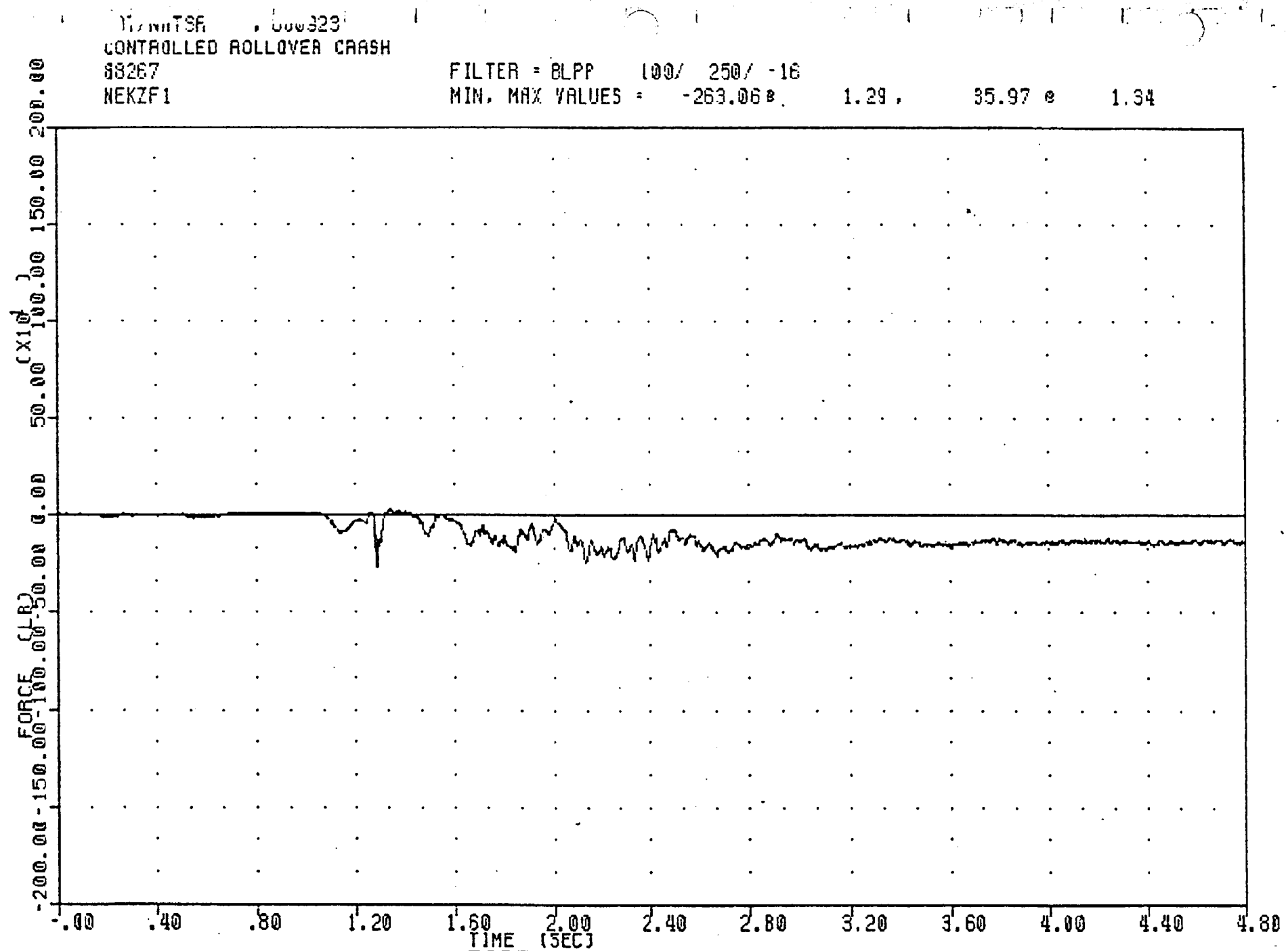
FORD BRONCO OFF ROLL CART
DRIVER HEAD ACCELERATION RESULTANT



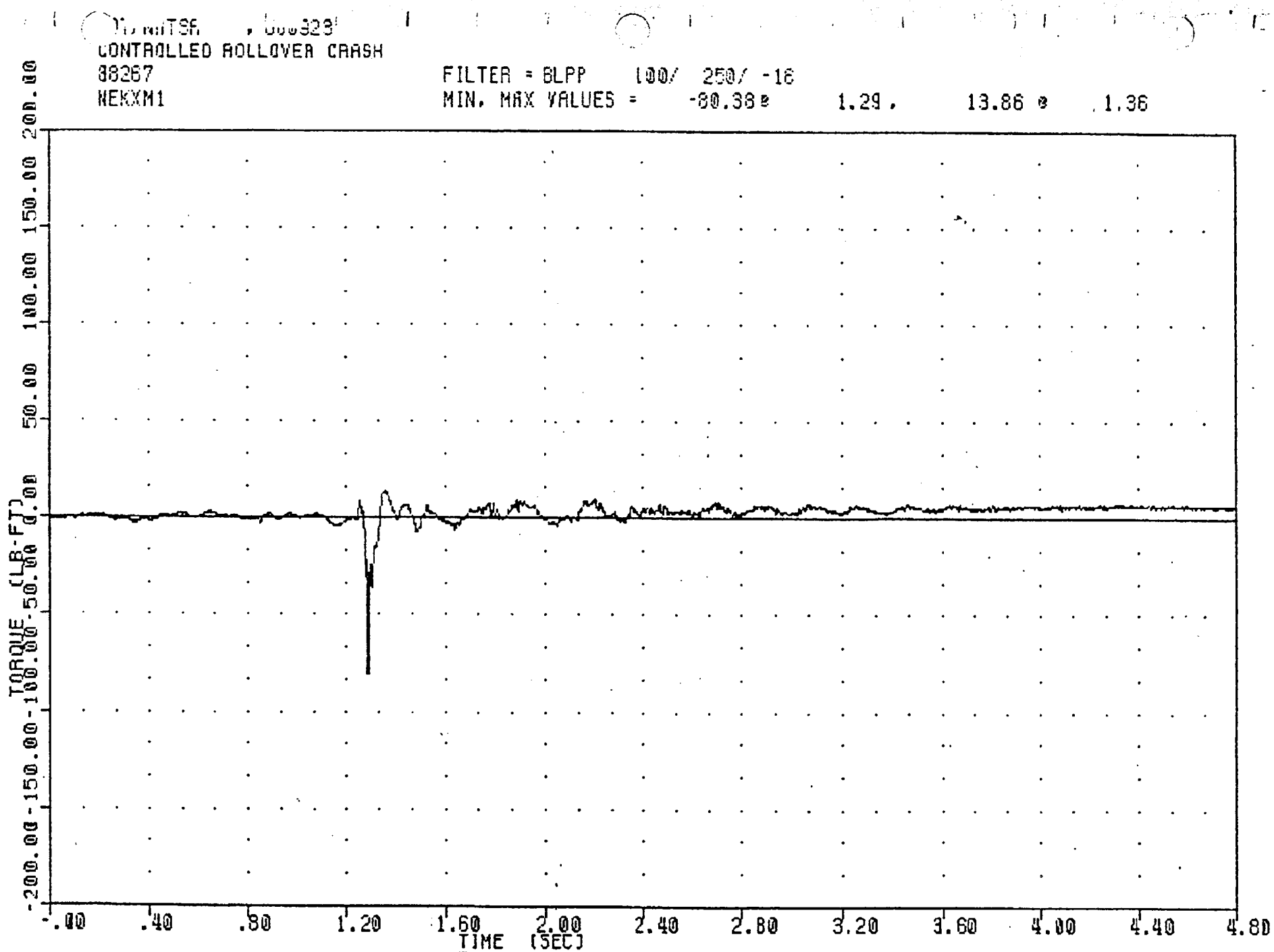
FORD BRONCO OFF ROLL CART
DRIVER NECK SHEAR FORCE X AXIS



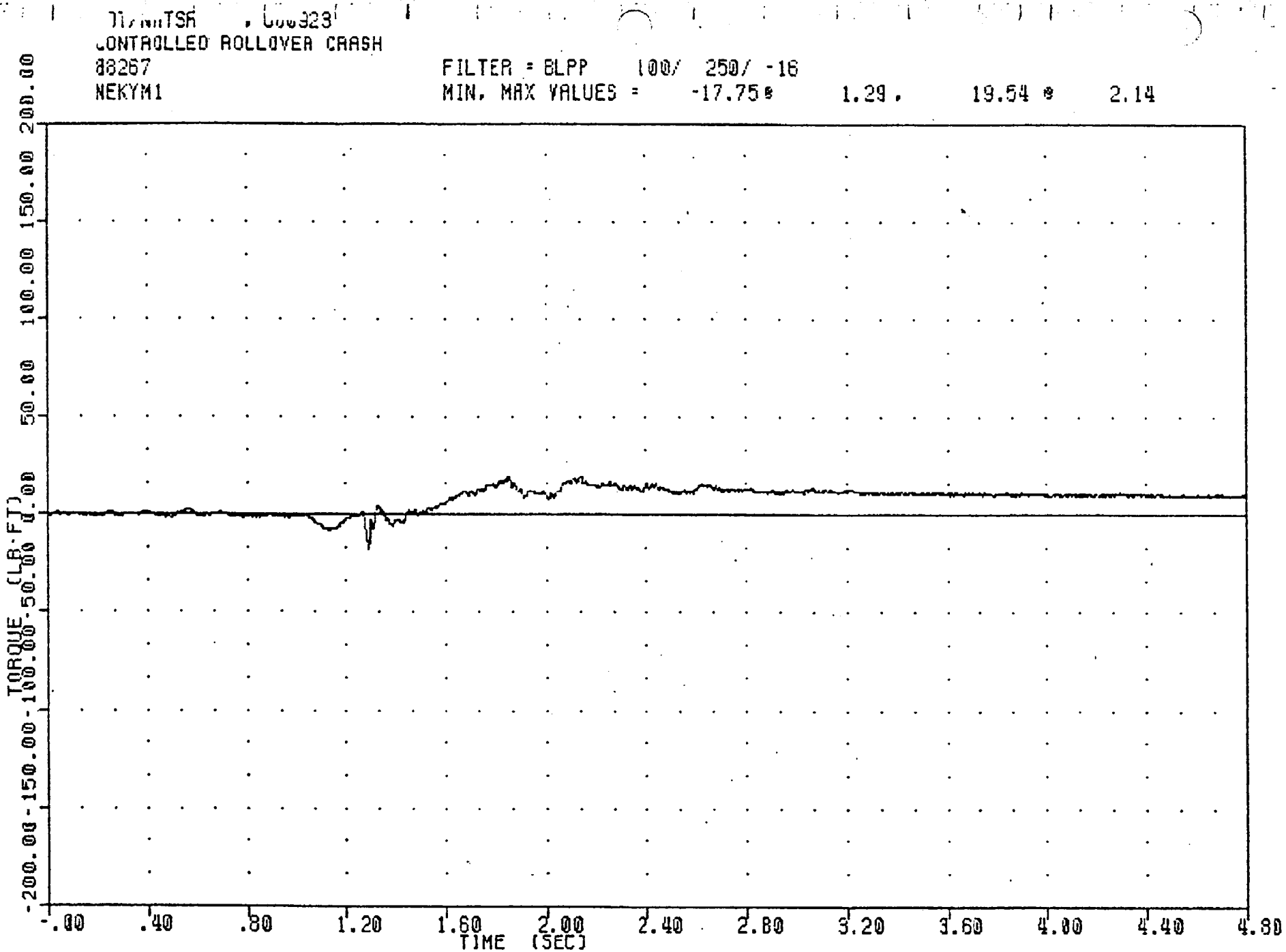
FORD BRONCO OFF ROLL CART
DRIVER NECK SHEAR FORCE Y AXIS



FORD BRONCO OFF ROLL CART
DRIVER NECK AXIAL FORCE Z AXIS



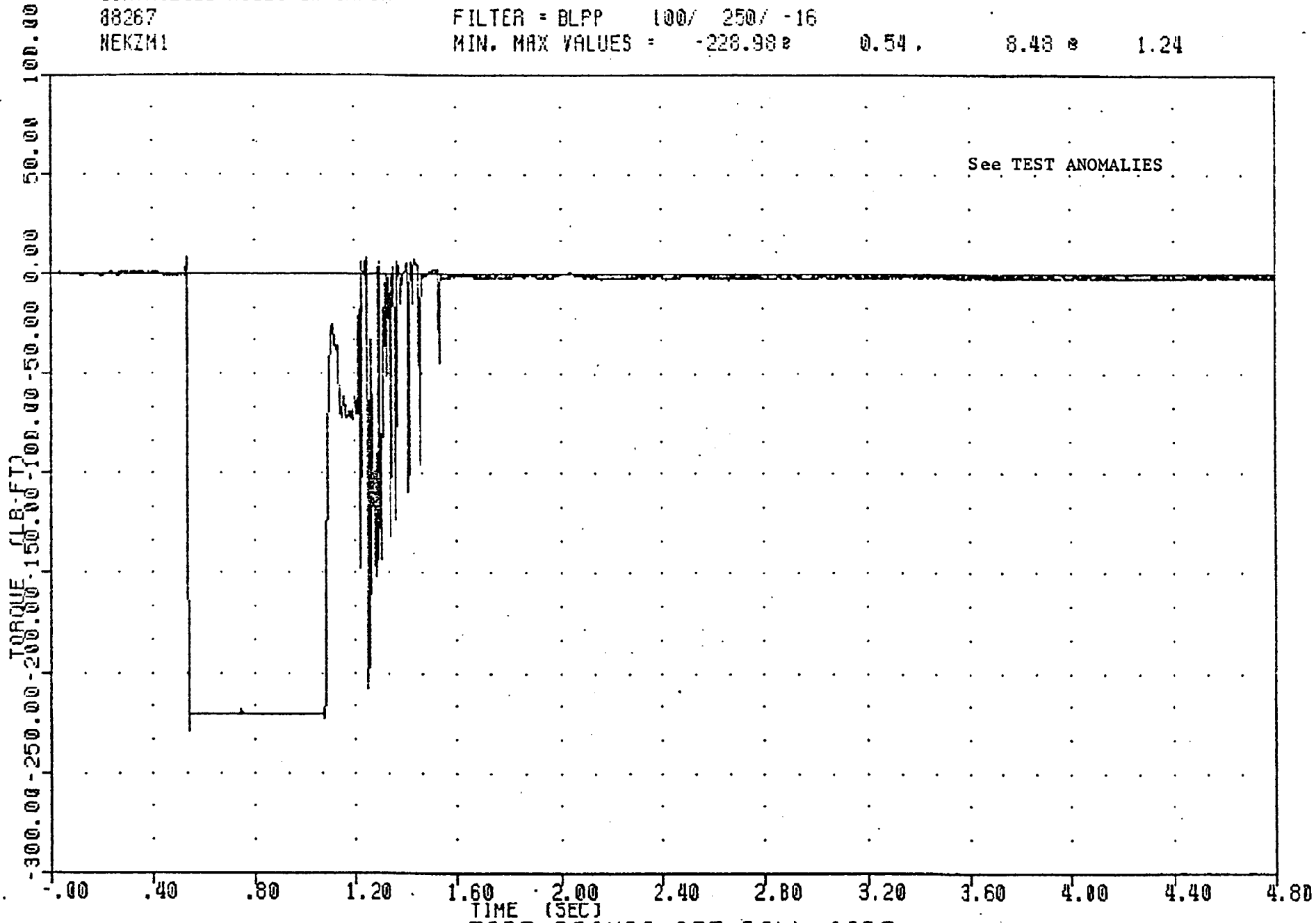
FORD BRONCO OFF ROLL CART
DRIVER NECK MOMENT ABOUT X AXIS



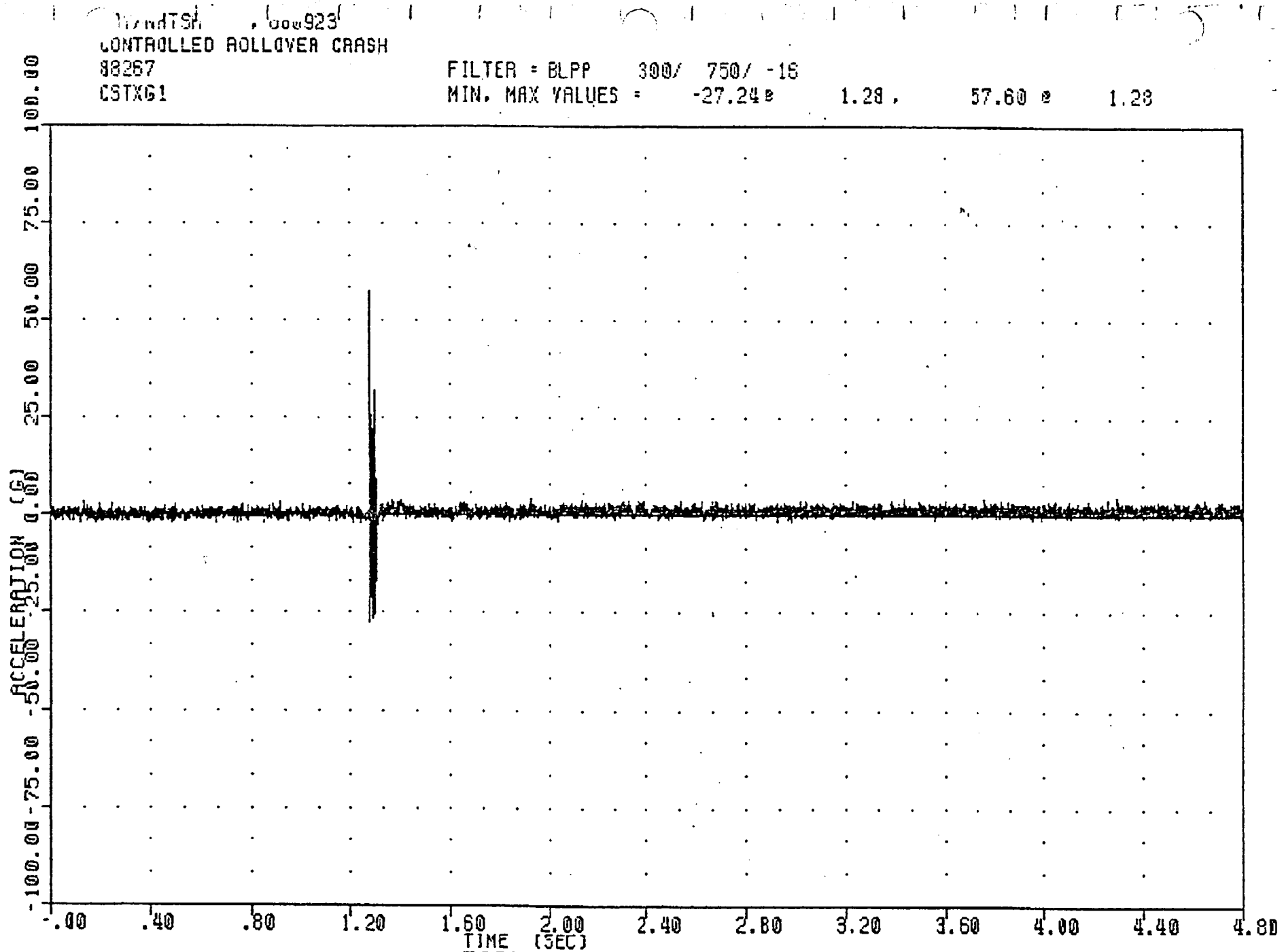
FORD BRONCO OFF ROLL CART
DRIVER NECK MOMENT ABOUT Y AXIS

CONTACLLED ROLLOVER CRASH
88267
NEKZM1

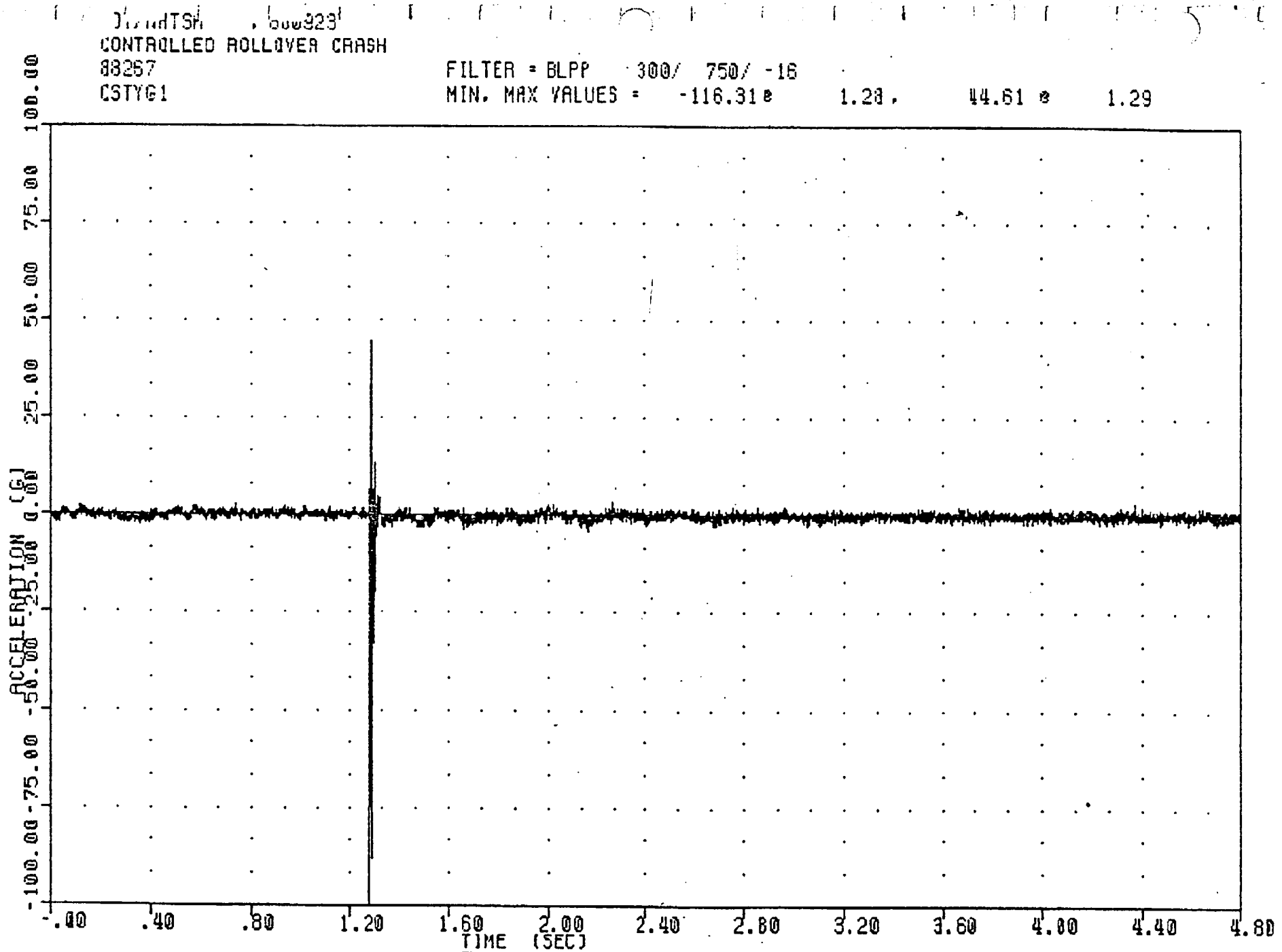
FILTER = BLPP 100/ 250/ -16
MIN. MAX VALUES = -228.98 @ 0.54 , 8.48 @ 1.24



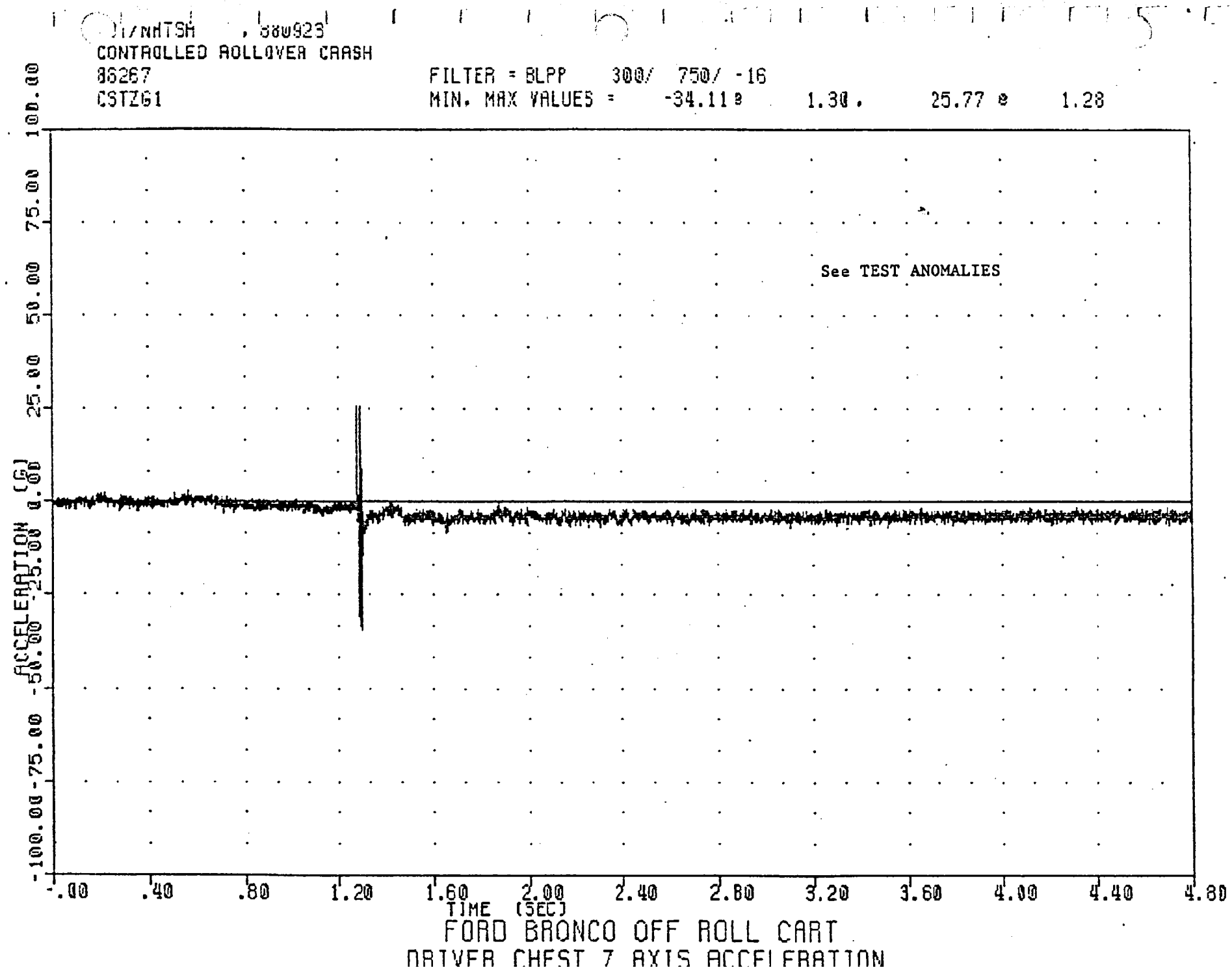
FORD BRONCO OFF ROLL CART
DRIVER NECK MOMENT ABOUT Z AXIS

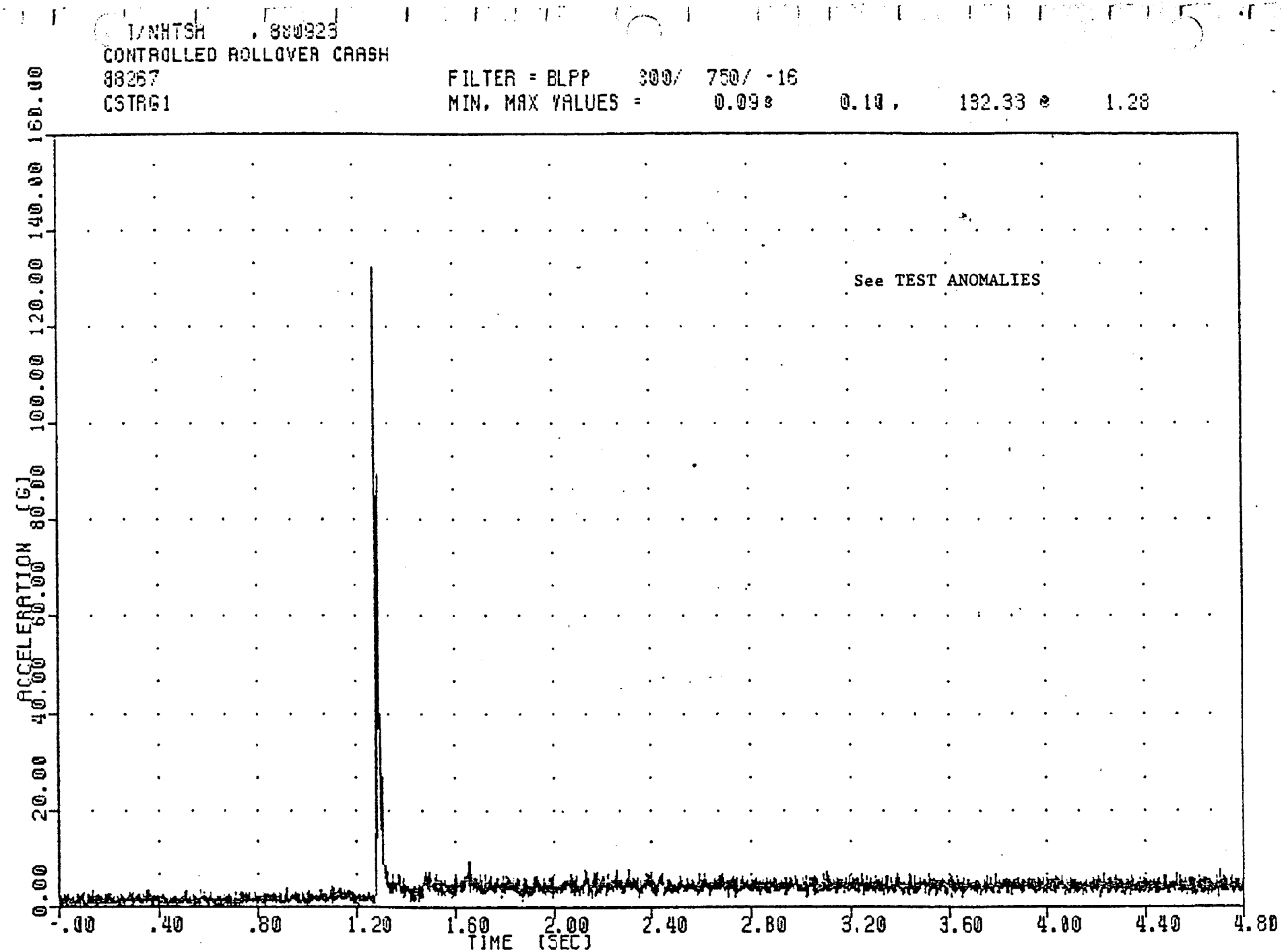


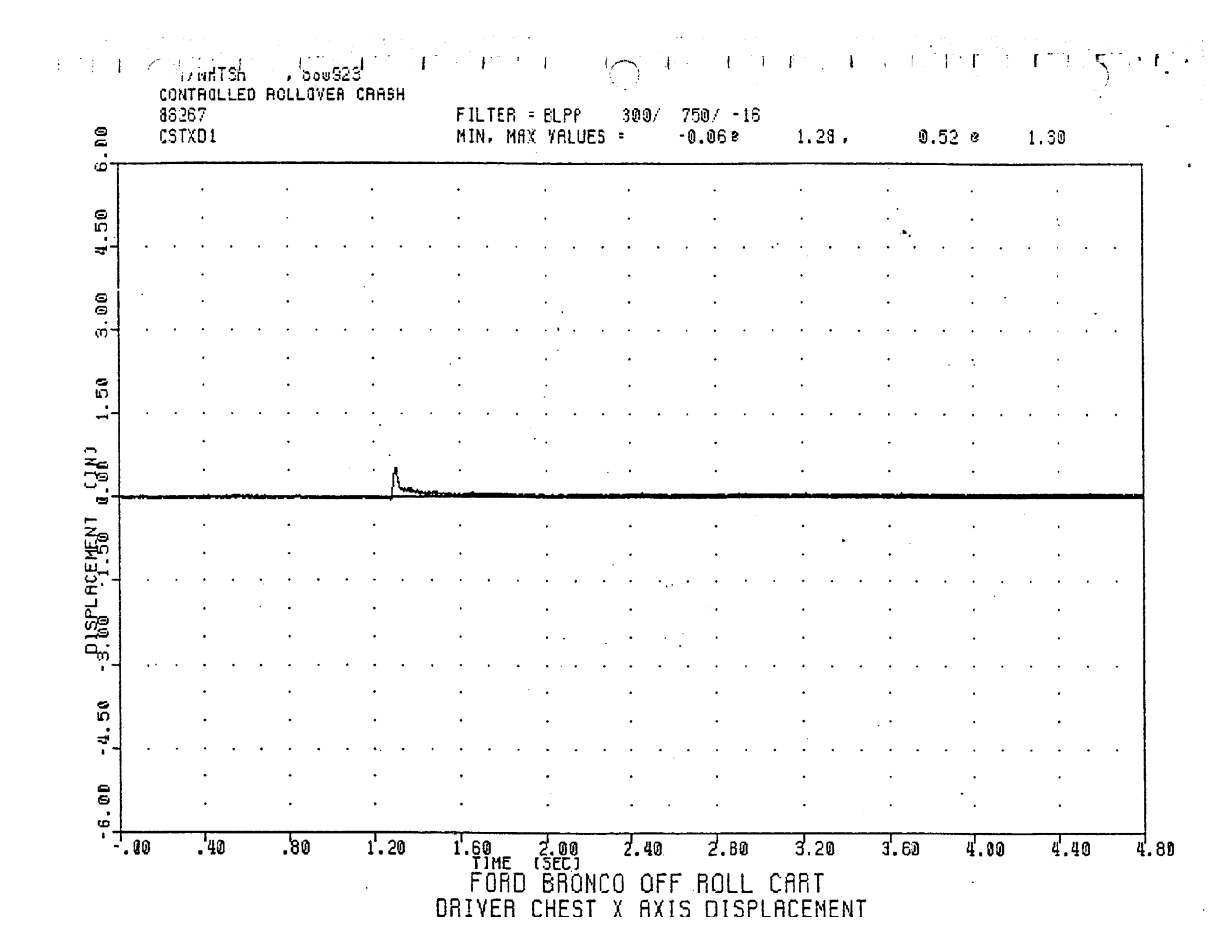
FORD BRONCO OFF ROLL CART
DRIVER CHEST X AXIS ACCELERATION

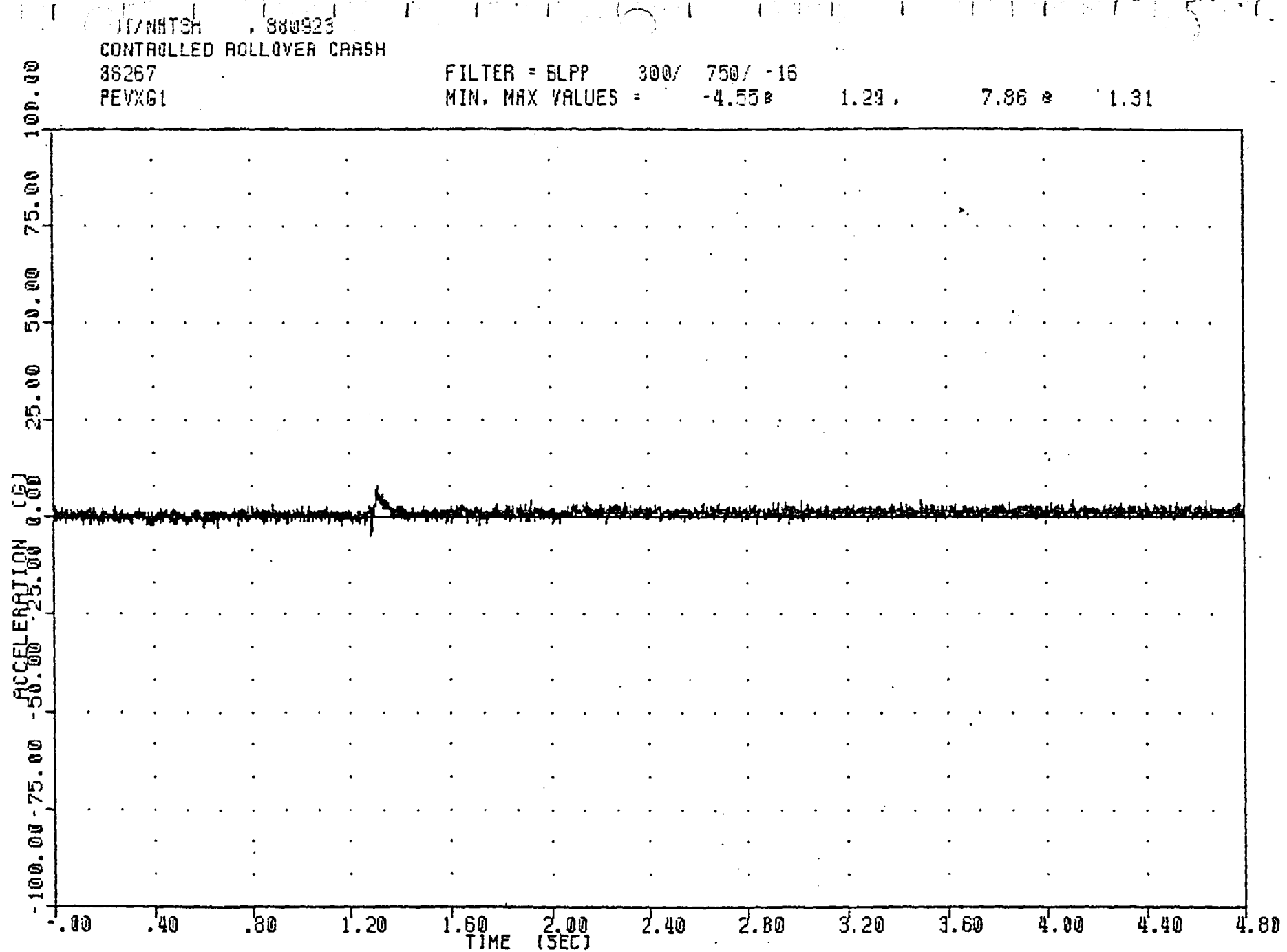


FORD BRONCO OFF ROLL CART
DRIVER CHEST Y AXIS ACCELERATION

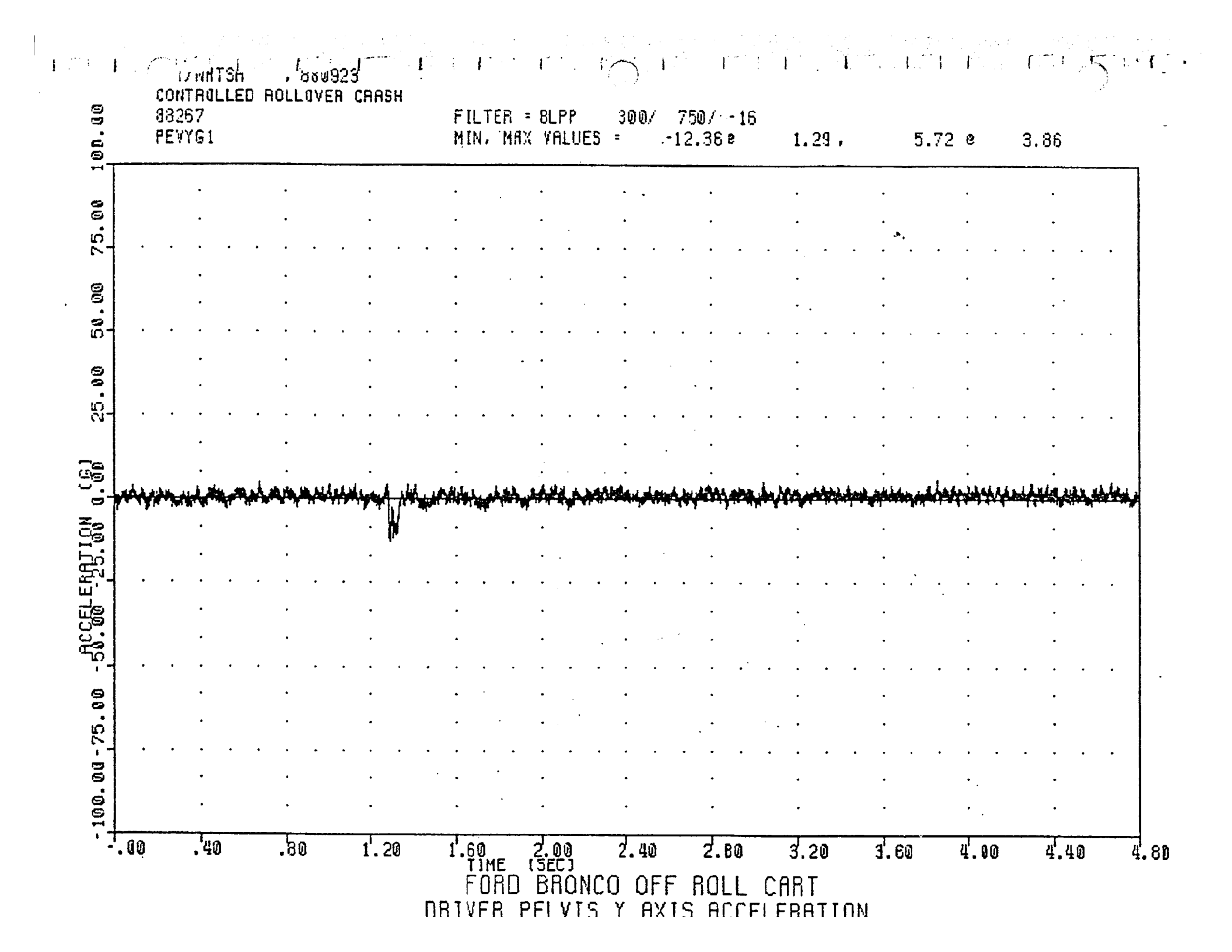

NHTSA , 880923
CONTROLLED ROLLOVER CRASH
86267
CSTZ61
FILTER = BLPP 300/ 750/ -16
MIN. MAX VALUES = -34.11 @ 1.30 , 25.77 @ 1.28
See TEST ANOMALIES
ACCELERATION (G)
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
FORD BRONCO OFF ROLL CART
DRIVER CHEST Z AXIS ACCELERATION

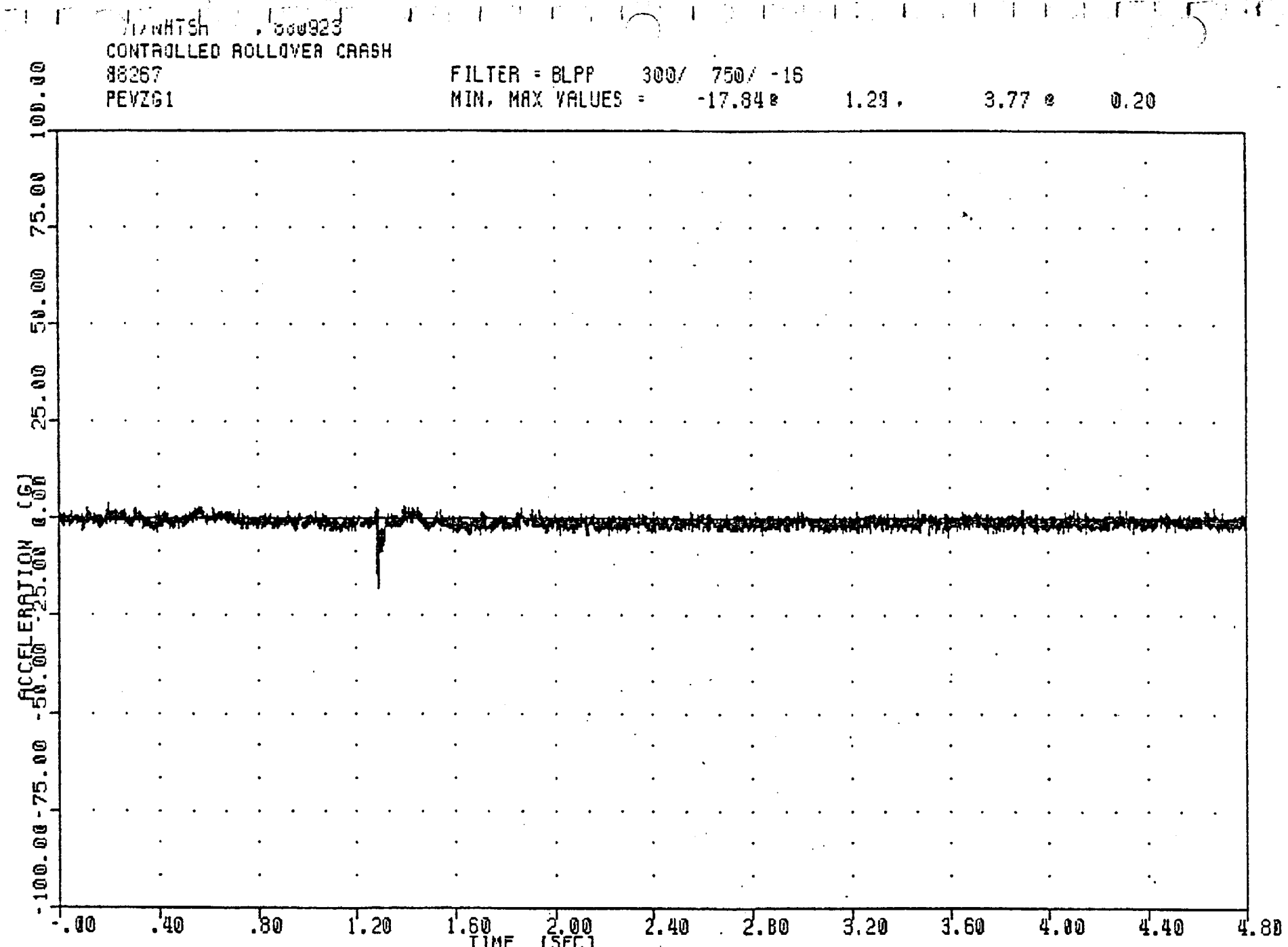

T/NHTSA , 880926
CONTROLLED ROLLOVER CRASH
88267
CSTRG1
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = 0.09 @ 0.10 , 132.33 @ 1.28
See TEST ANOMALIES
ACCELERATION [G]
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
-.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
FORD BRONCO OFF ROLL CART
DRIVER CHEST ACCELERATION RESULTANT


CONTROLLED ROLLOVER CRASH
86267
CSTXD1
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = -0.06 @ 1.28 , 0.52 @ 1.30
6.00
4.50
3.00
1.50
0.00
-1.50
-3.00
-4.50
-6.00
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)
FORD BRONCO OFF ROLL CART
DRIVER CHEST X AXIS DISPLACEMENT

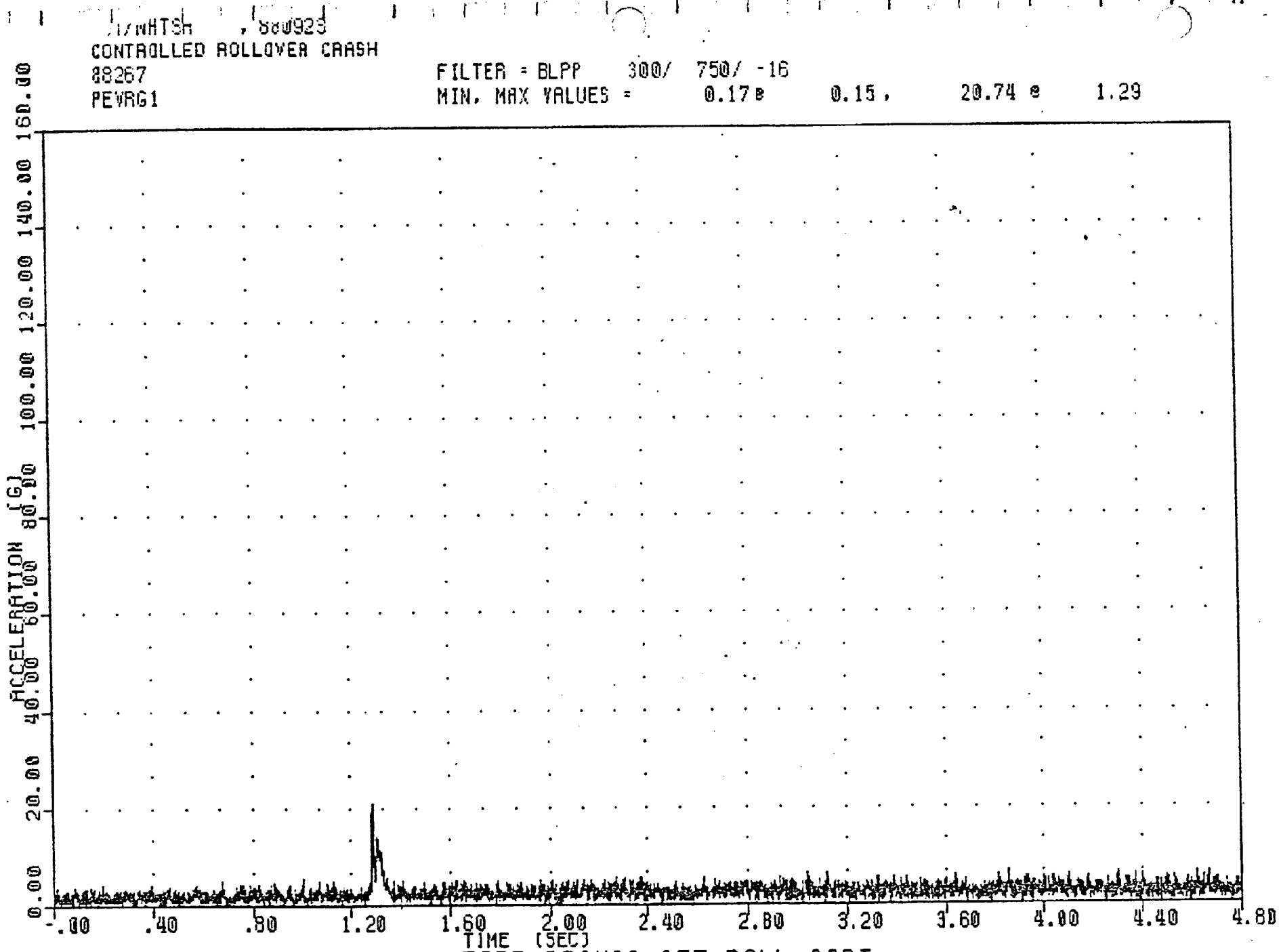


FORD BRONCO OFF ROLL CART
DRIVER PELVIS X AXIS ACCELERATION


NHTSA ,880923
CONTROLLED ROLLOVER CRASH
88267
PEVYG1
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = -12.36 @ 1.29 , 5.72 @ 3.86
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)
FORD BRONCO OFF ROLL CART
DRIVER PELVIS Y AXIS ACCELERATION

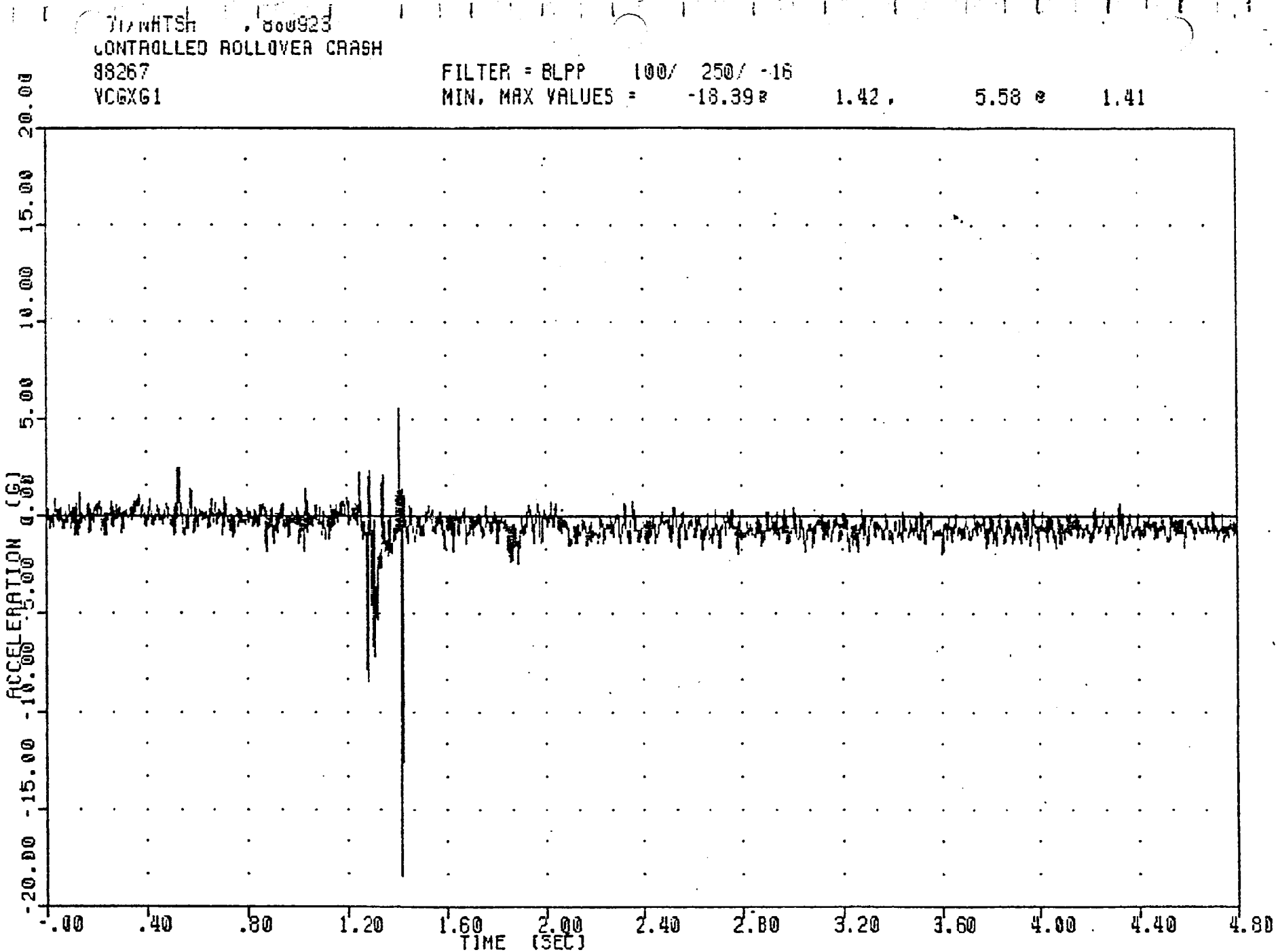


FORD BRONCO OFF ROLL CART
DRIVER PELVIS Z AXIS ACCELERATION



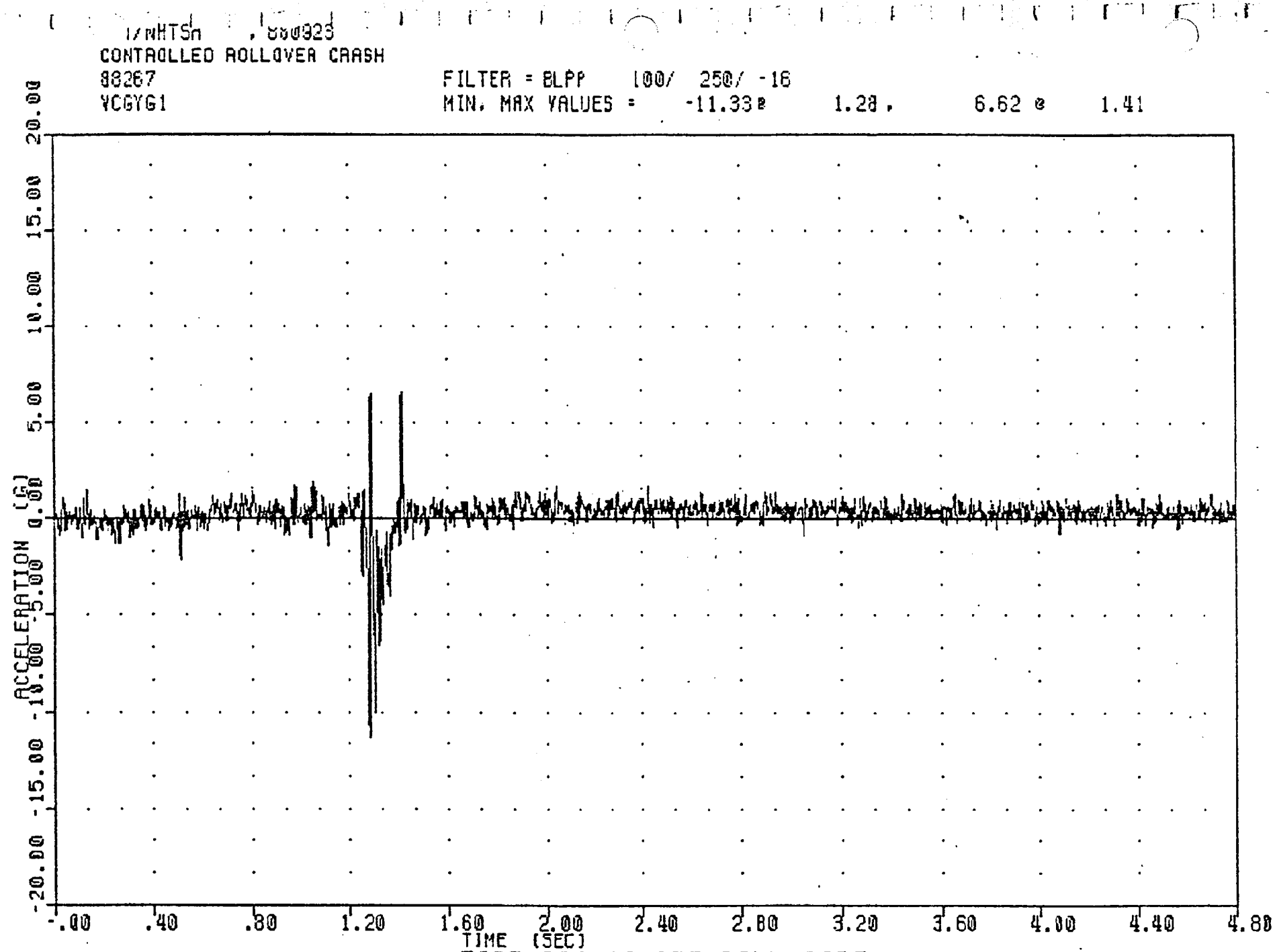
FORD BRONCO OFF ROLL CART

DRIVER PELVIS ACCELERATION RESULTANT



FORD BRONCO OFF ROLL CART

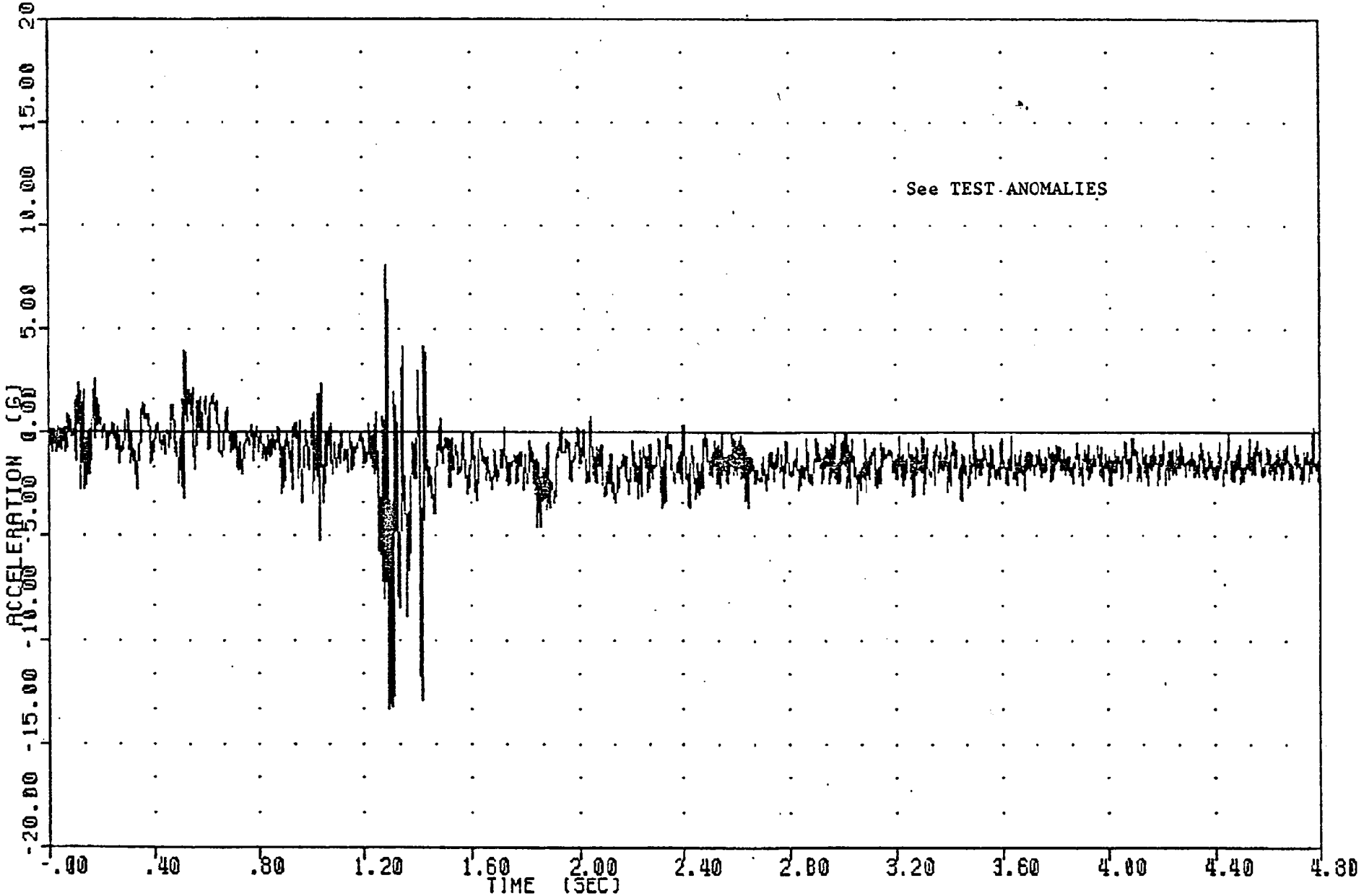
VEHICLE CENTER OF GRAVITY X AXIS ACCELERATION



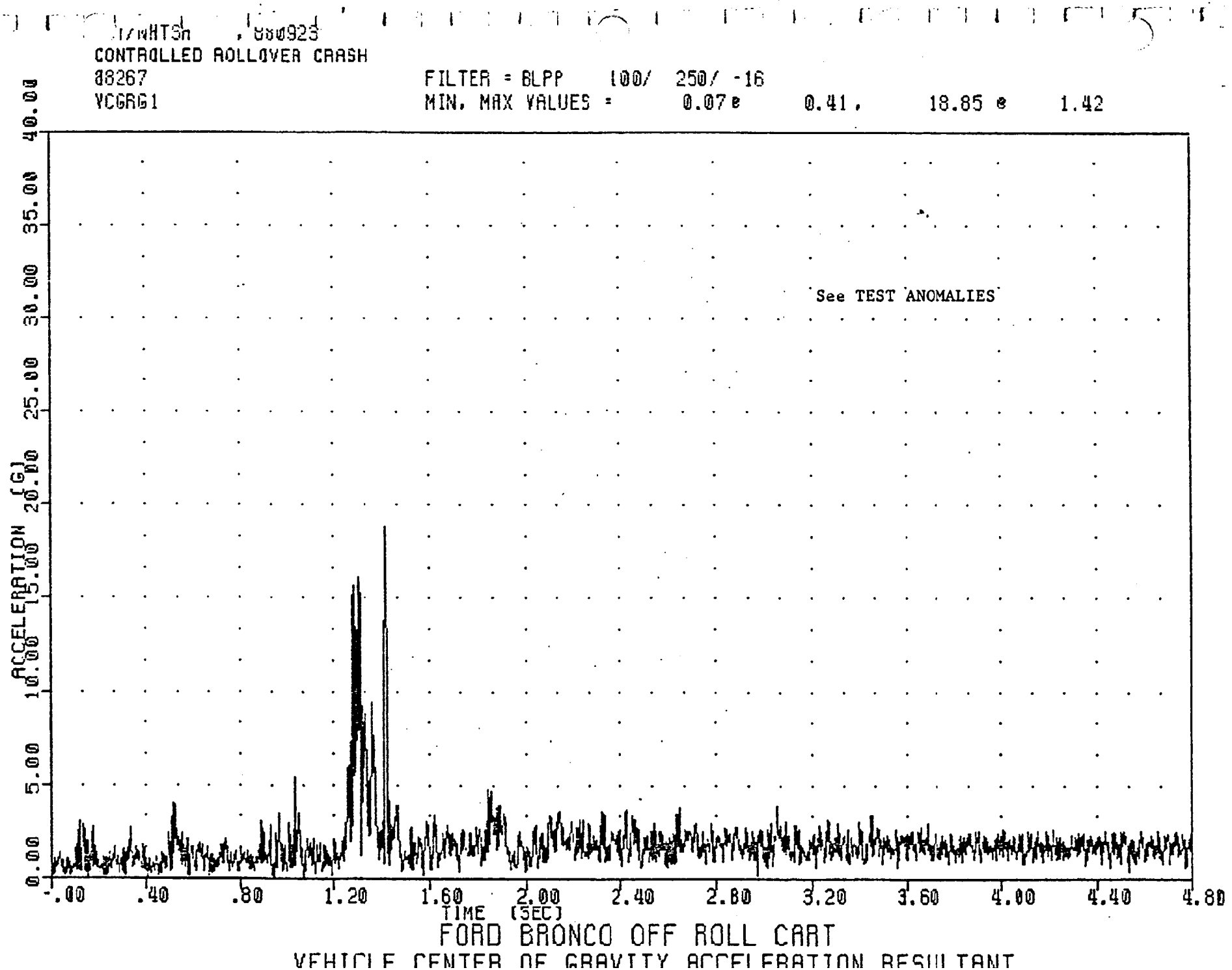
FORD BRONCO OFF ROLL CART

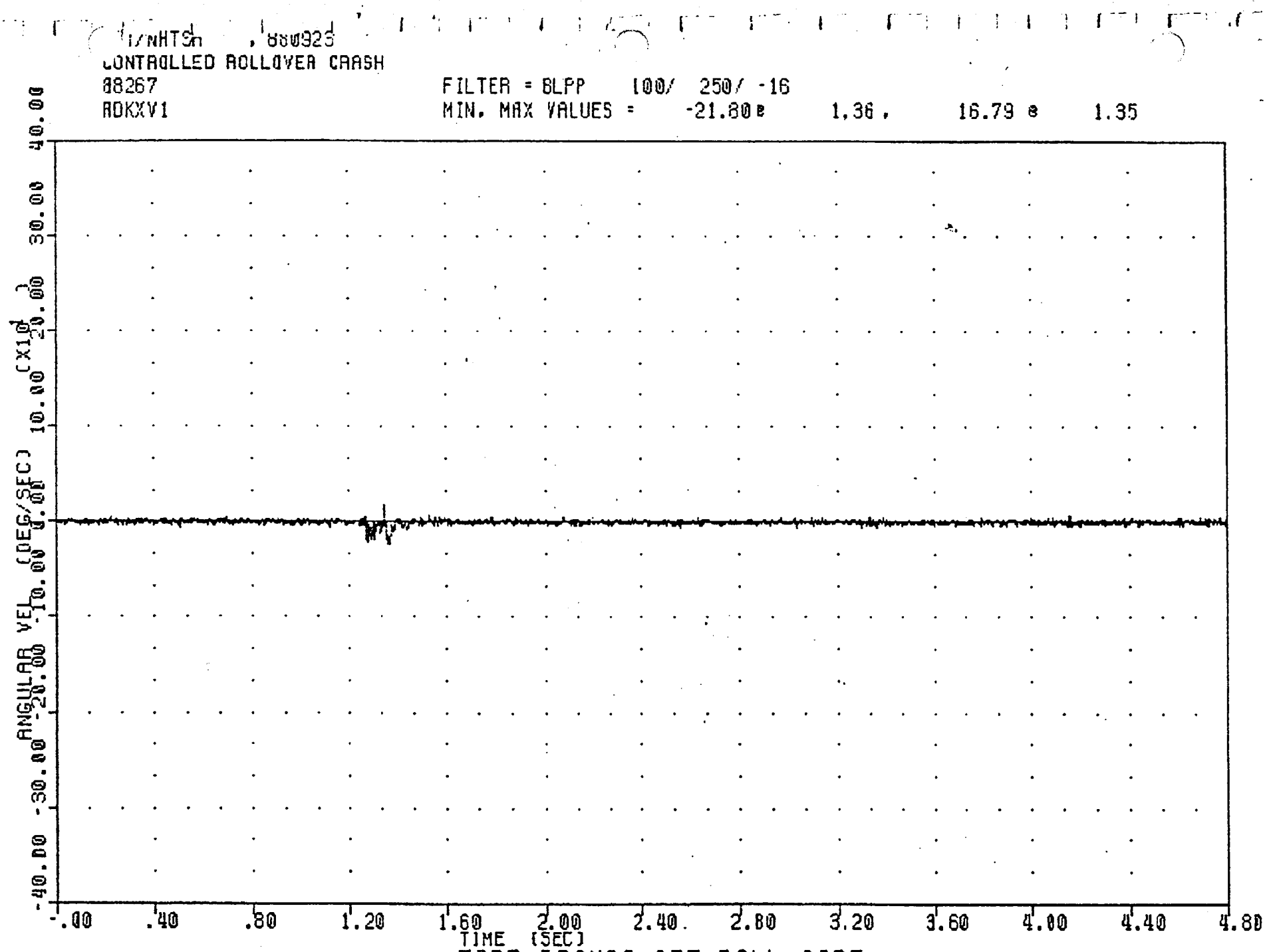
VEHICLE CENTER OF GRAVITY Y AXIS ACCELERATION

T/NHTSA ,880923
CONTROLLED ROLLOVER CRASH
88267
YCGZG1
FILTER = ELPP 100/ 250/ -16
MIN, MAX VALUES = -13.38 @ 1.29 , 8.10 @ 1.29



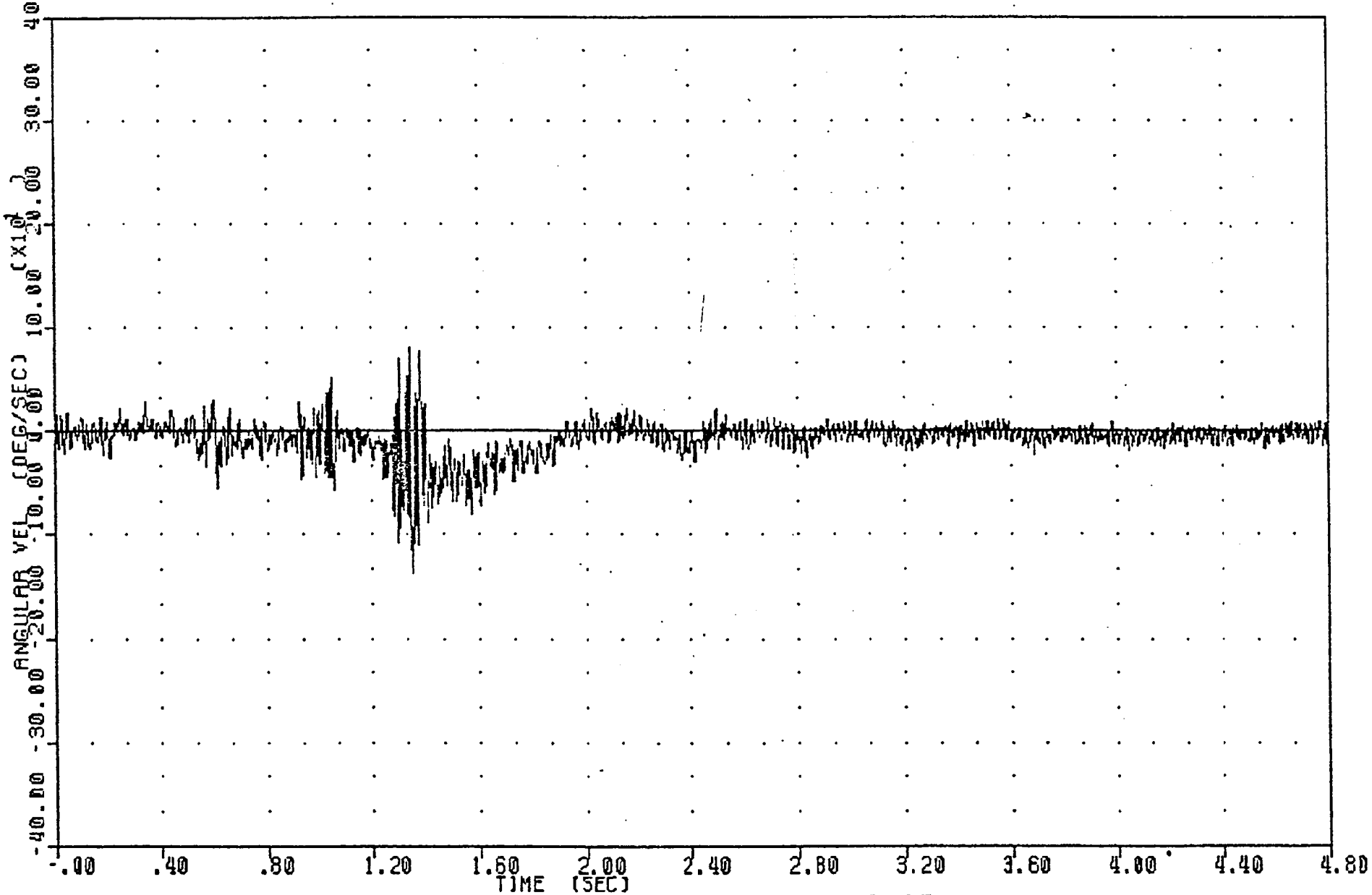
FORD BRONCO OFF ROLL CART
VEHICLE CENTER OF GRAVITY Z AXIS ACCELERATION


CONTROLLED ROLLOVER CRASH
88267
VCGRG1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = 0.07 @ 0.41 , 18.85 @ 1.42
See TEST ANOMALIES
ACCELERATION (G)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
-.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)
FORD BRONCO OFF ROLL CART
VEHICLE CENTER OF GRAVITY ACCELERATION RESULTANT

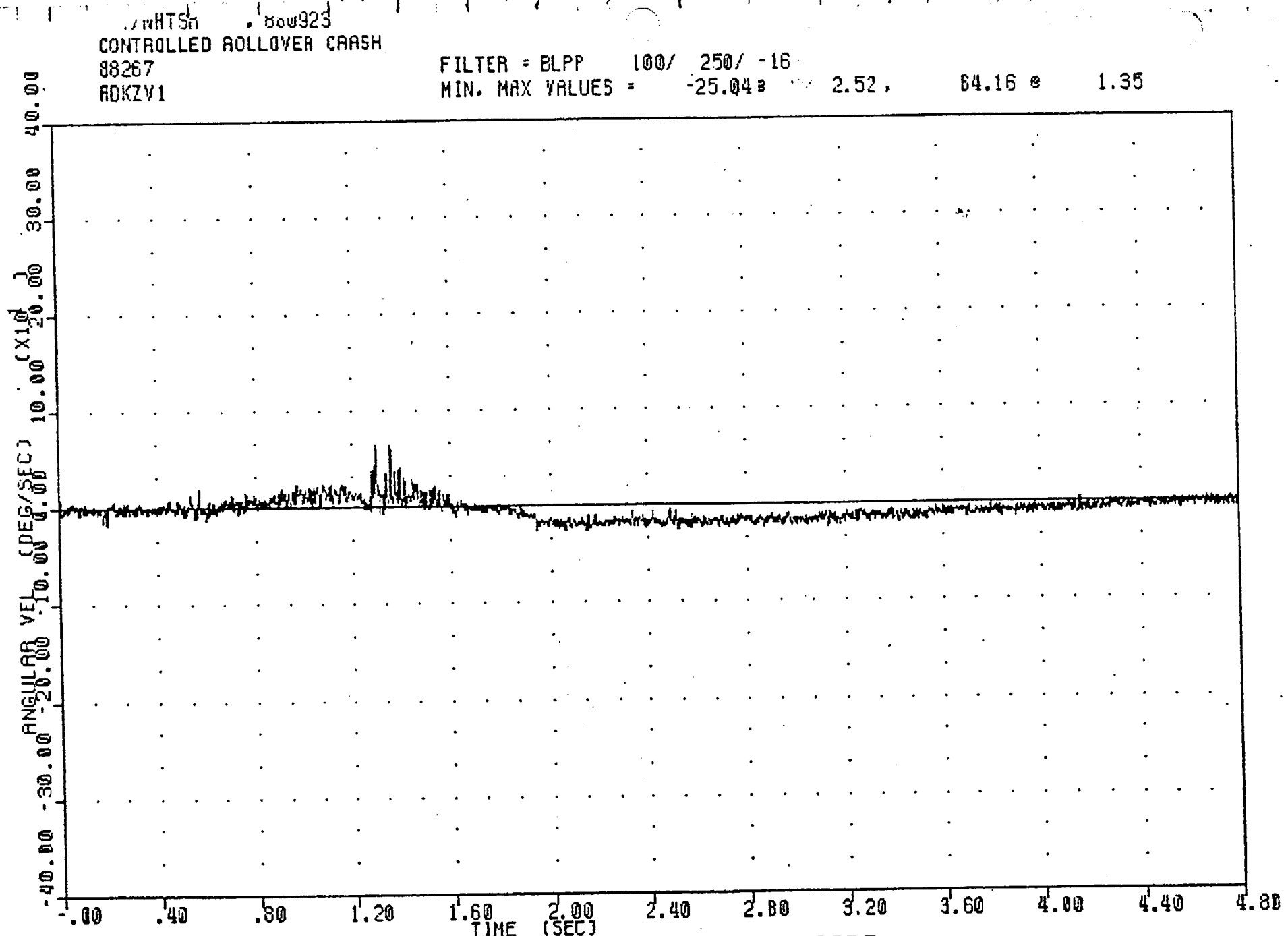


FORD BRONCO OFF ROLL CART
VEHICLE ROLL RATE

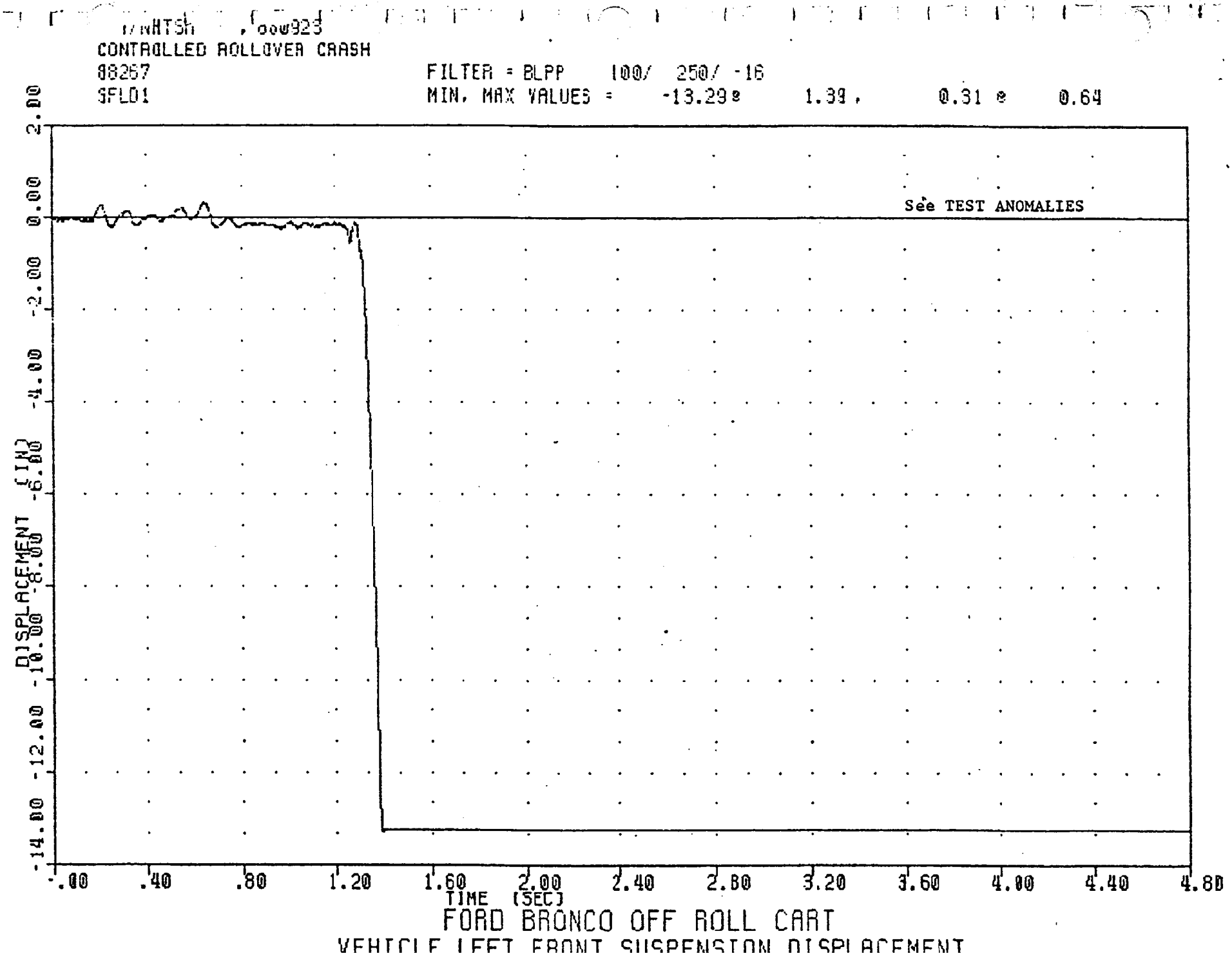
T/NHTSA .880923
CONTROLLED ROLLOVER CRASH
88267
RDKYV1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -137.12 @ 1.35 , 80.82 @ 1.34

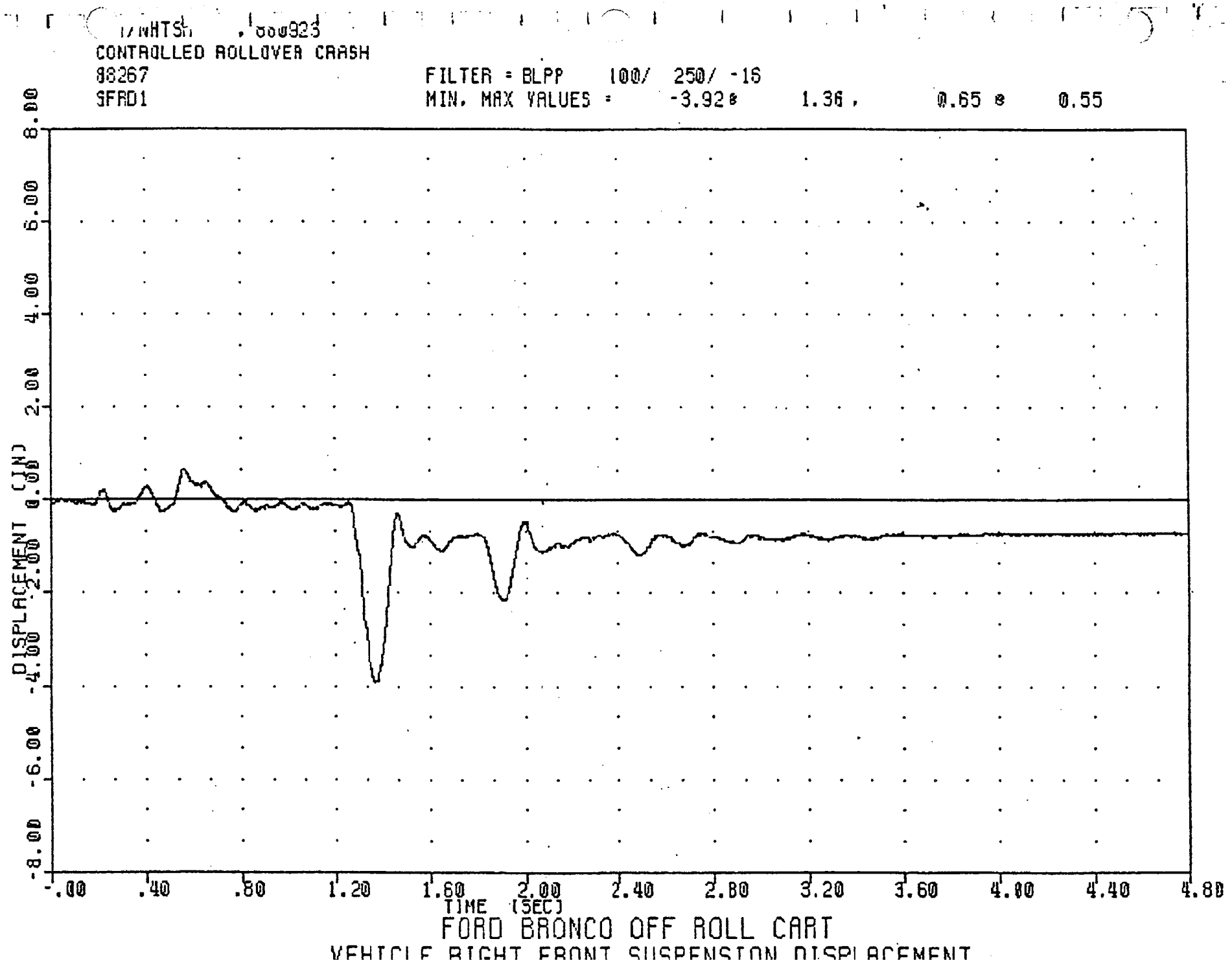


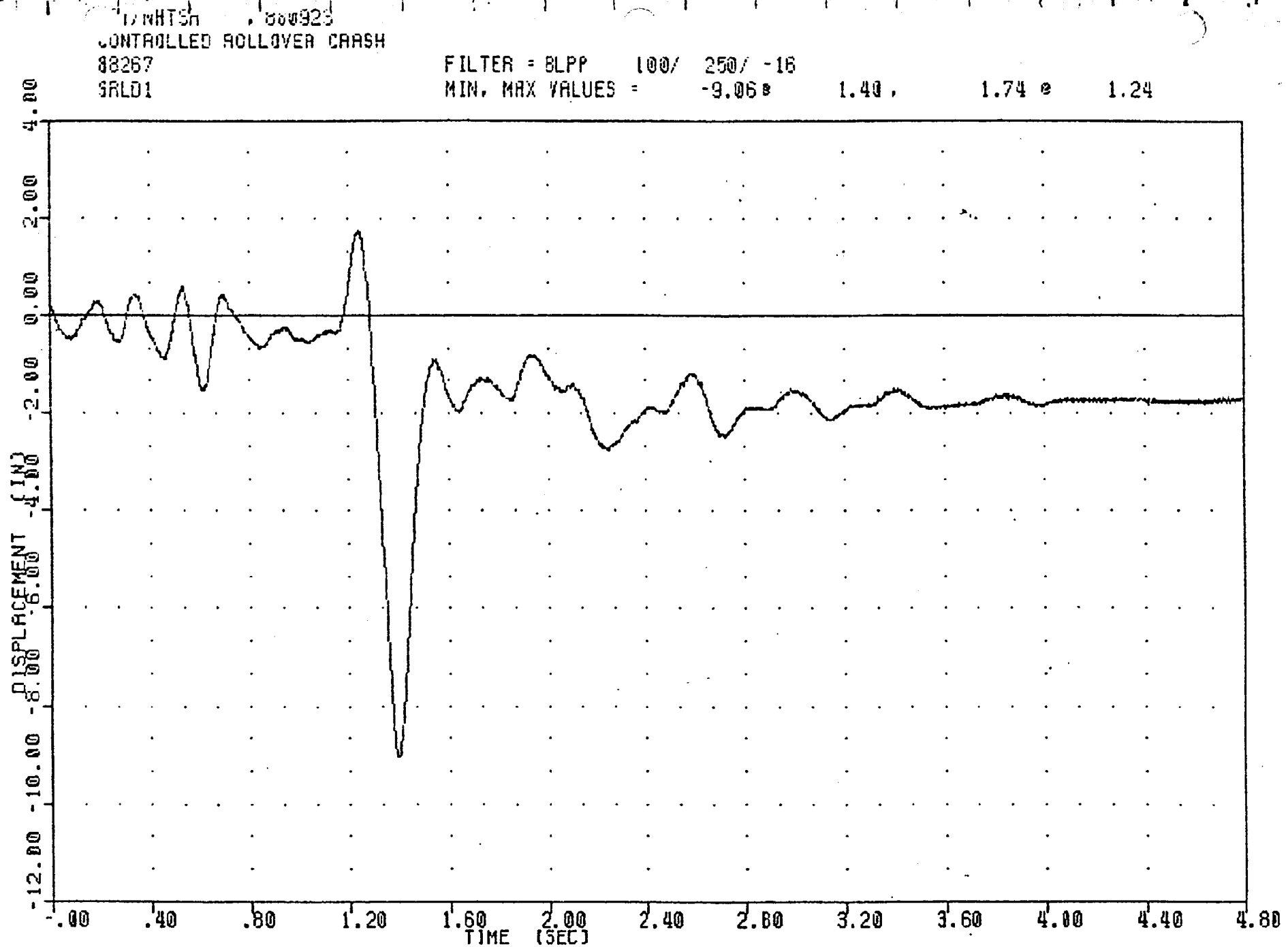
FORD BRONCO OFF ROLL CART
VEHICLE PITCH RATE



FORD BRONCO OFF ROLL CART
VEHICLE YAW RATE


NHTSA
CONTROLLED ROLLOVER CRASH
88267
SFLD1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -13.29 @ 1.39 , 0.31 @ 0.64
See TEST ANOMALIES
DISPLACEMENT (IN)
2.00
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
.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)
FORD BRONCO OFF ROLL CART
VEHICLE LEFT FRONT SUSPENSION DISPLACEMENT

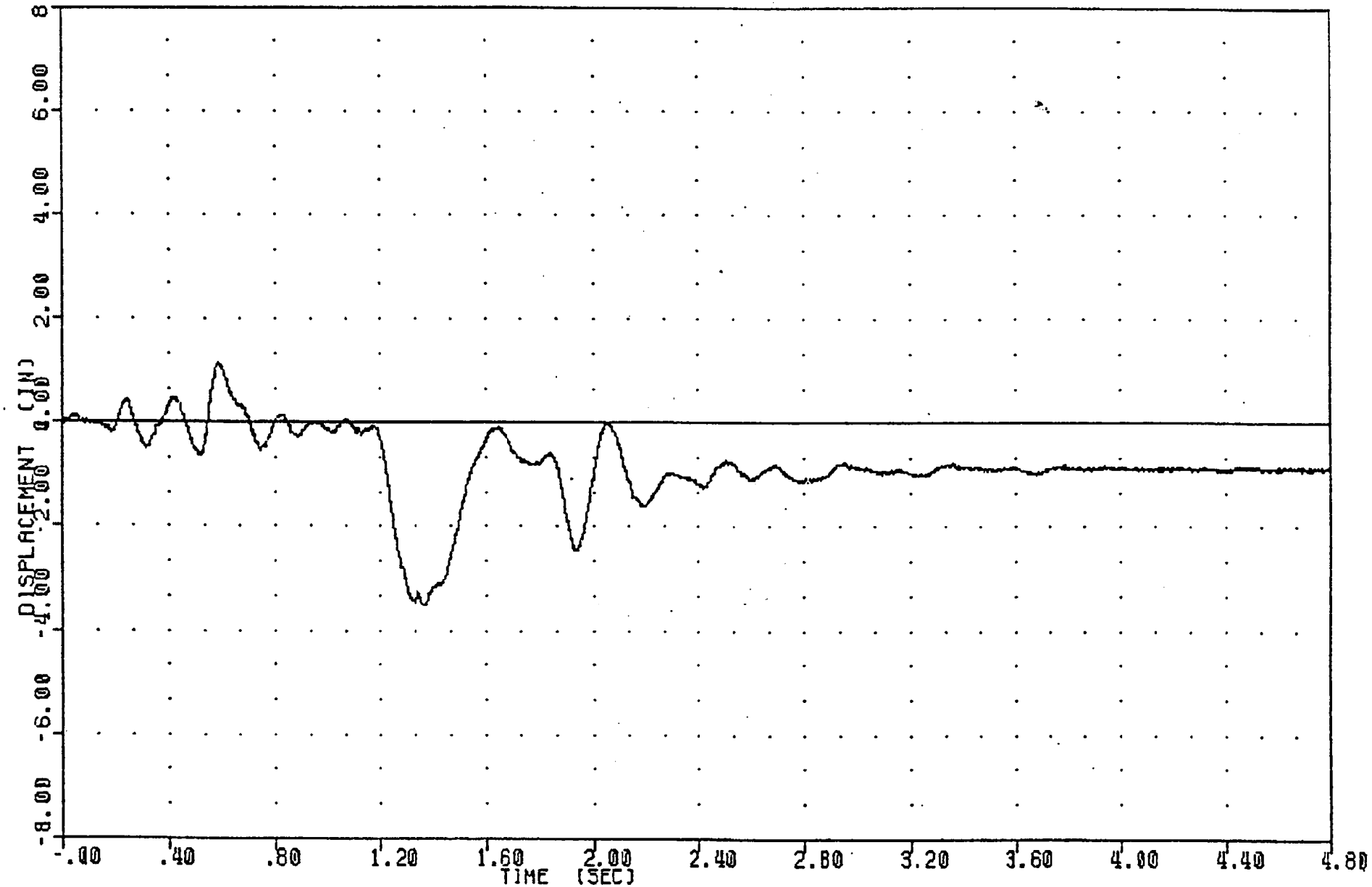

NHTSA
CONTROLLED ROLLOVER CRASH
88267
SFRD1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -3.92 1.36 0.65 0.55
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
DISPLACEMENT (IN)
.00
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
FORD BRONCO OFF ROLL CART
VEHICLE RIGHT FRONT SUSPENSION DISPLACEMENT



FORD BRONCO OFF ROLL CART

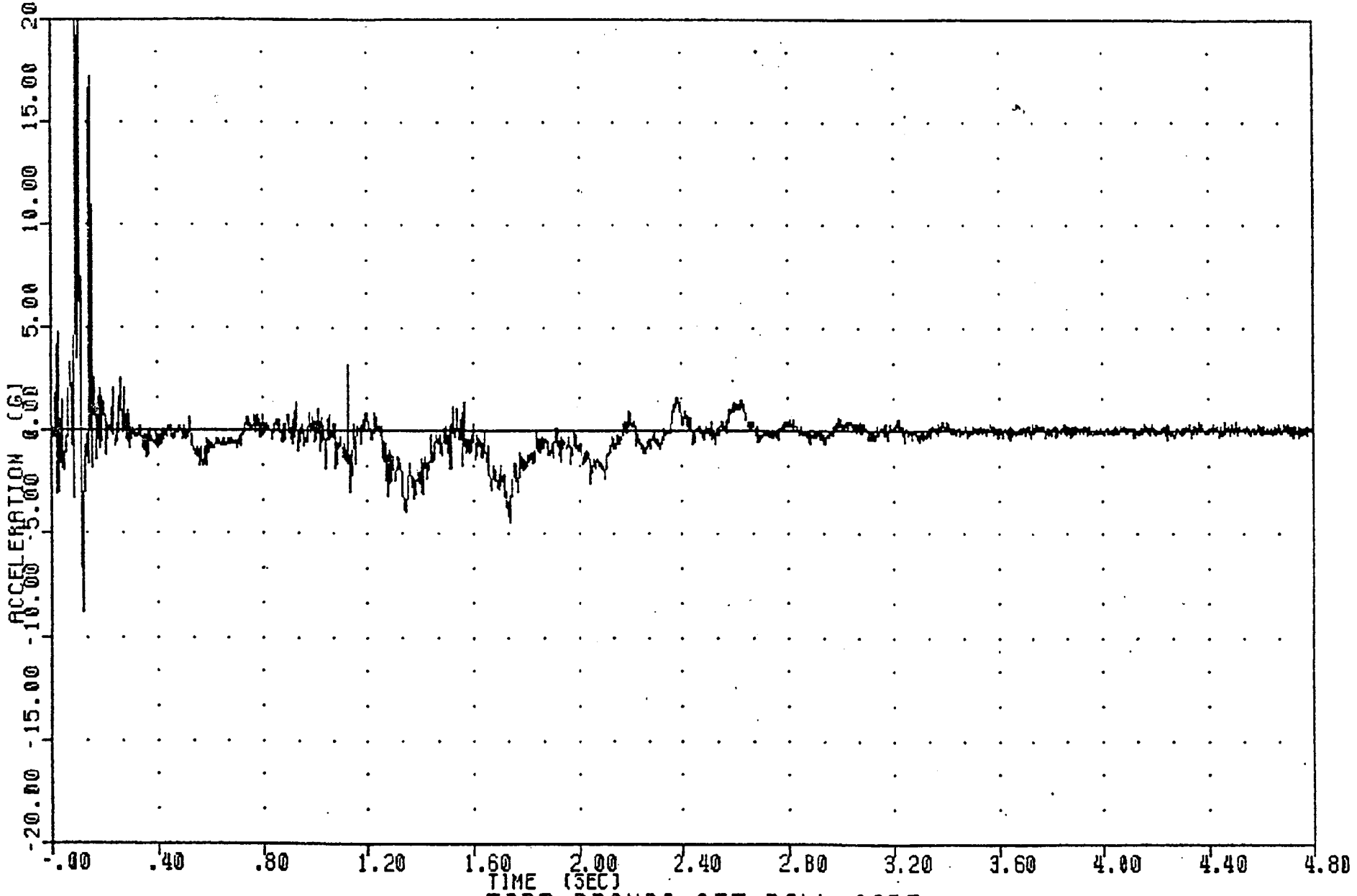
VEHICLE LEFT REAR SUSPENSION DISPLACEMENT

T/NHTSA 880923
CONTROLLED ROLLOVER CRASH
88267 FILTER = BLPP 100/ 250/ -16
SRRD1 MIN. MAX VALUES = -3.52 @ 1.36 , 1.14 @ 0.58

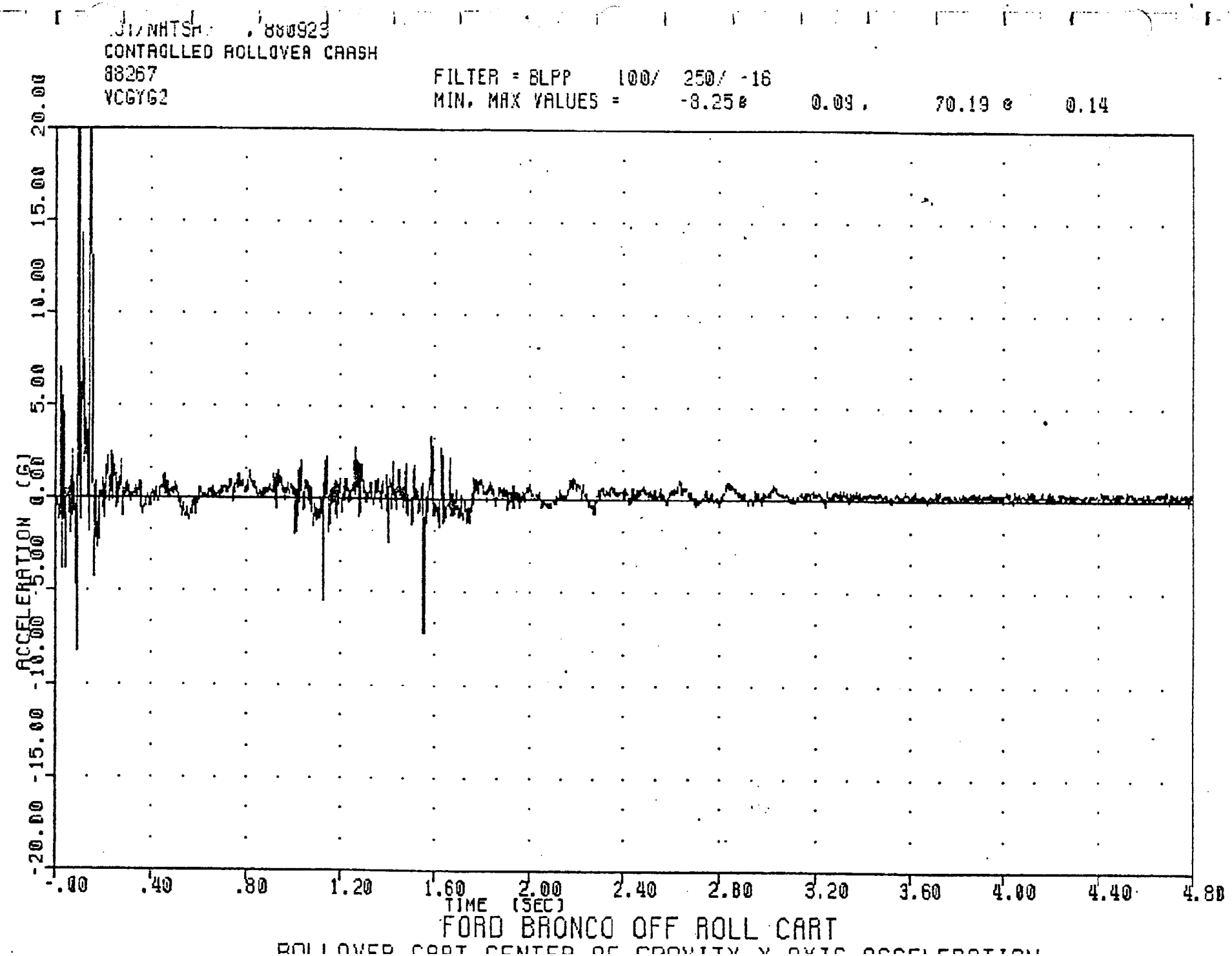


FORD BRONCO OFF ROLL CART
VEHICLE RIGHT REAR SUSPENSION DISPLACEMENT

T/NHTSA ,'880923
CONTROLLED ROLLOVER CRASH
88267
YCGXG2
FILTER = BLPF 100/ 250/ -16
MIN, MAX VALUES = -8.78@ 0.12, 37.23@ 0.09

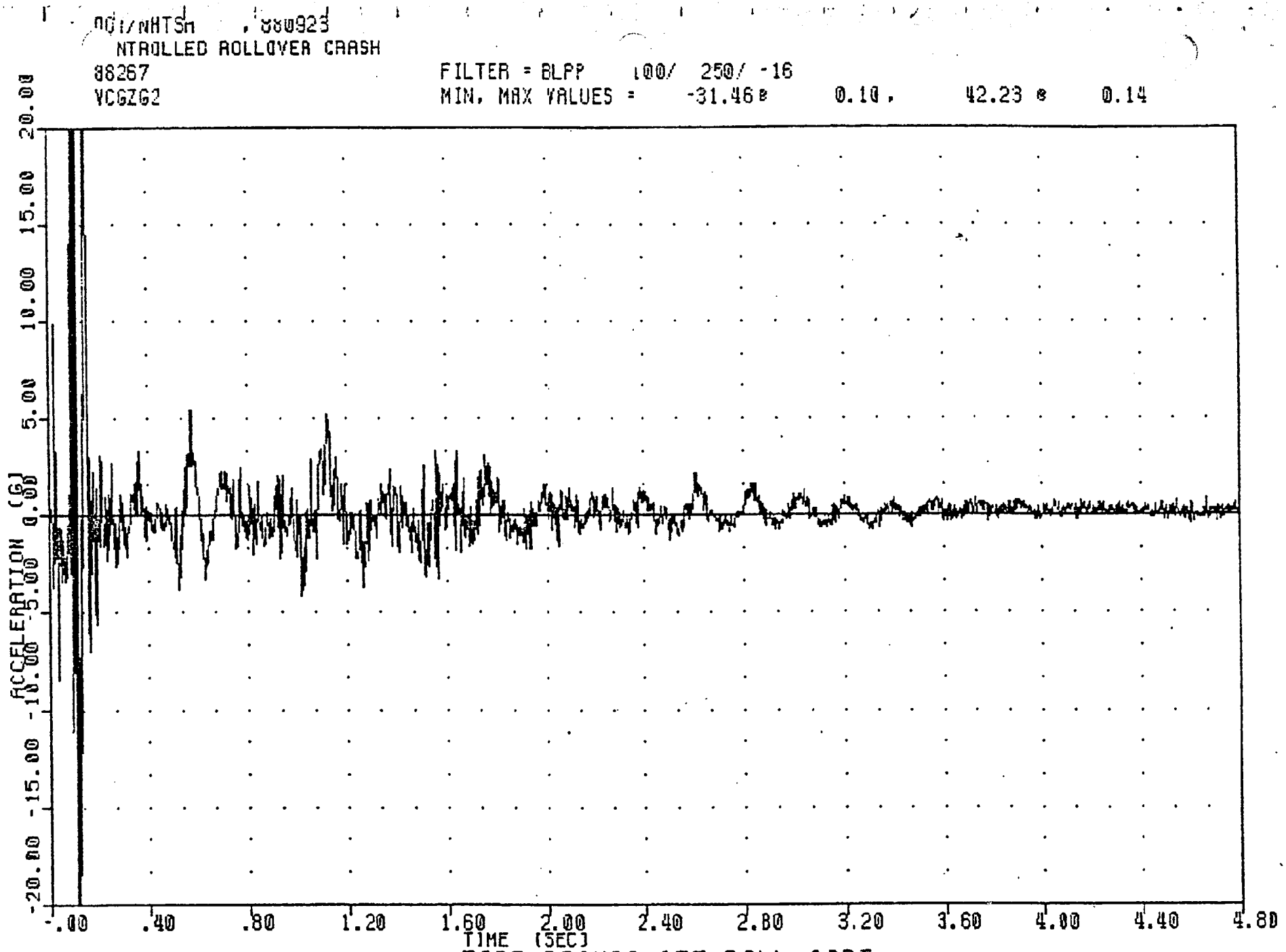


FORD BRONCO OFF ROLL CART
ROLLOVER CART CENTER OF GRAVITY X AXIS ACCELERATION



FORD BRONCO OFF ROLL CART

ROLLOVER CART CENTER OF GRAVITY X AXIS ACCELERATION

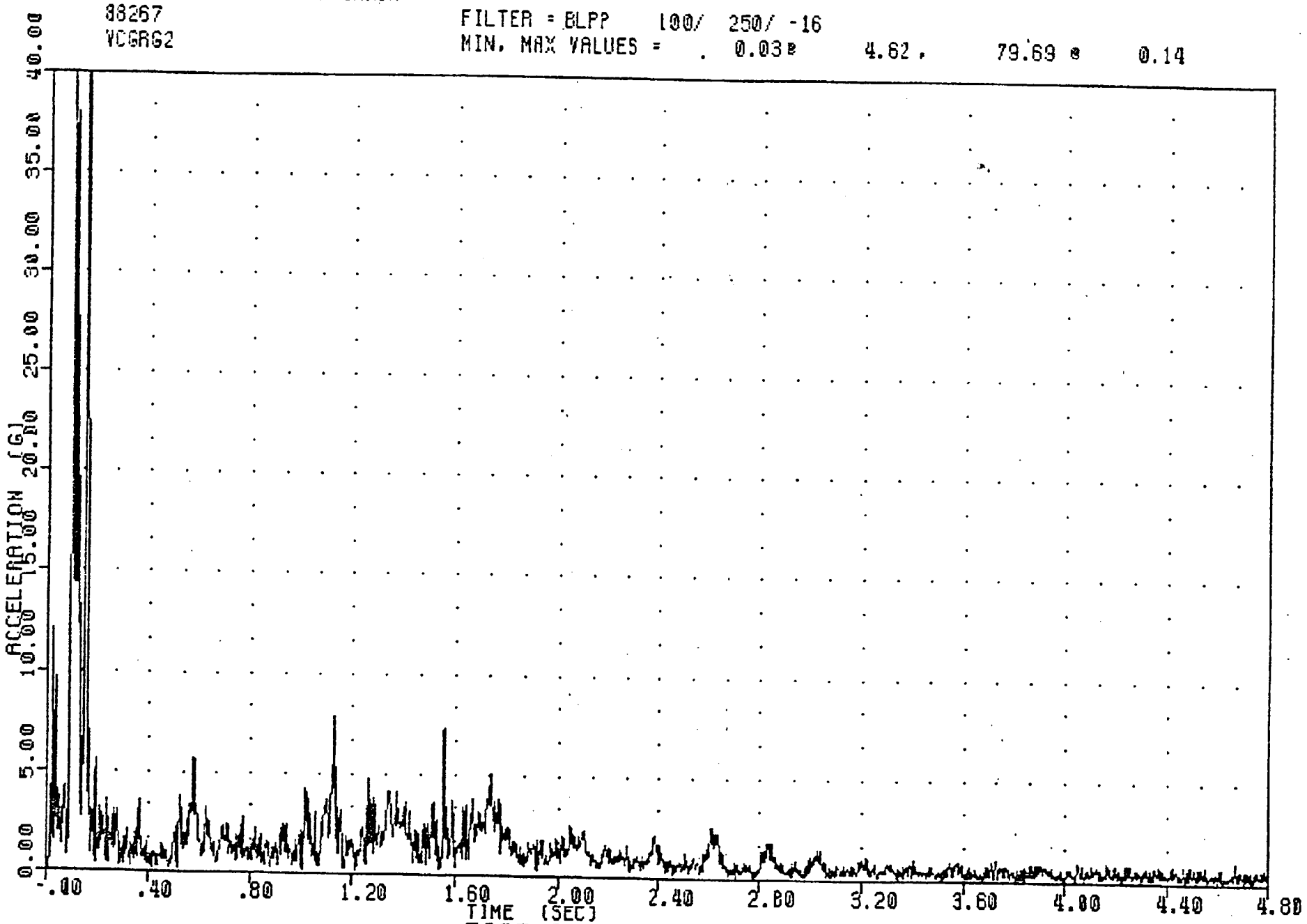


FORD BRONCO OFF ROLL CART

ROLLOVER CART CENTER OF GRAVITY Z AXIS ACCELERATION

701/NHTSA ,880923
CONTROLLED ROLLOVER CRASH
88267
VCGRG2

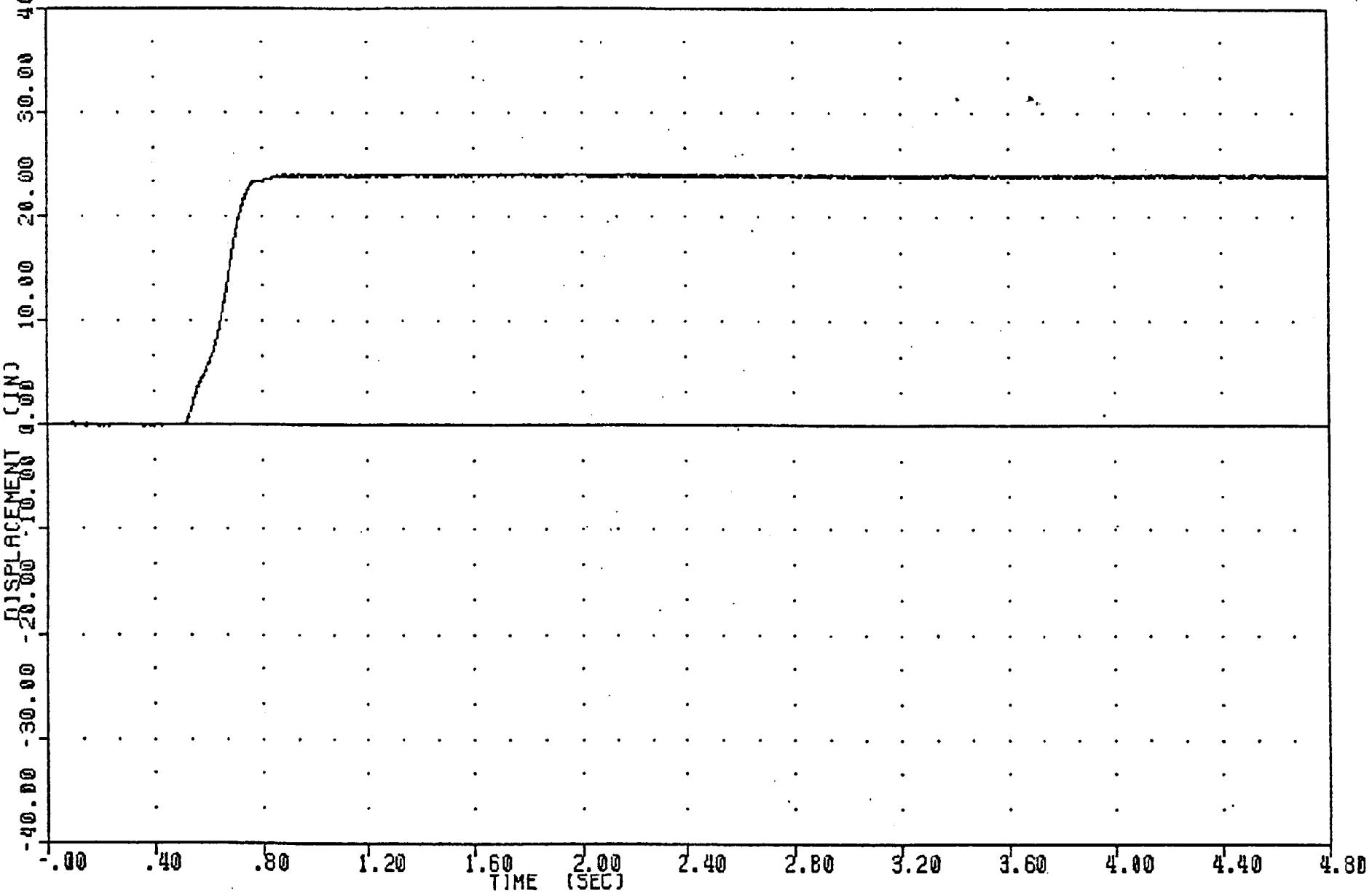
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = . 0.03 @ 4.62 , 79.69 @ 0.14



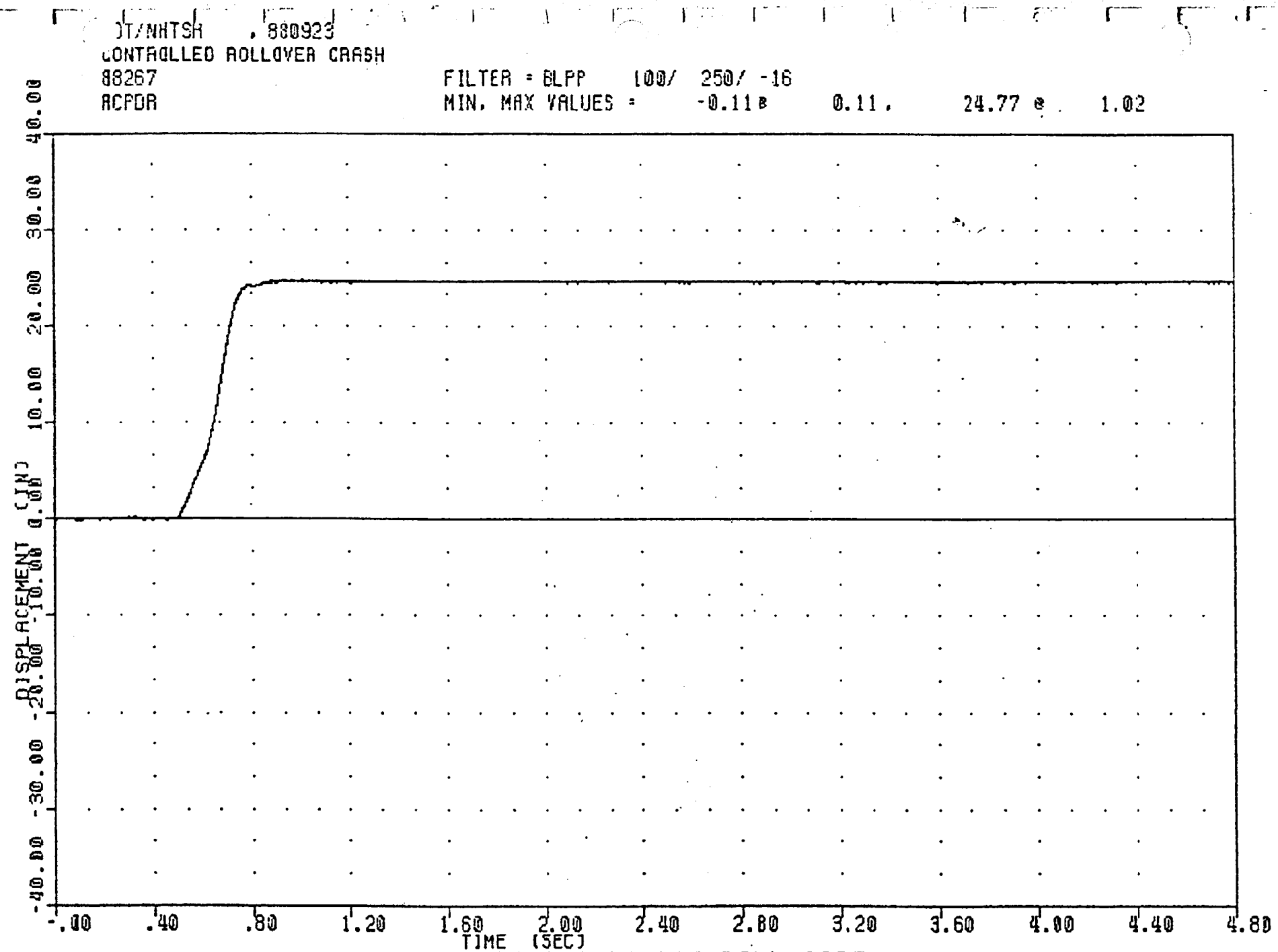
FORD BRONCO OFF ROLL CART
ROLLOVER CART CENTER OF GRAVITY ACCELERATION RESULTANT

T/NHTSA .880923
CONTROLLED ROLLOVER CRASH
88267
RCPDL

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -0.11 @ 0.14 , 24.06 @ 1.27

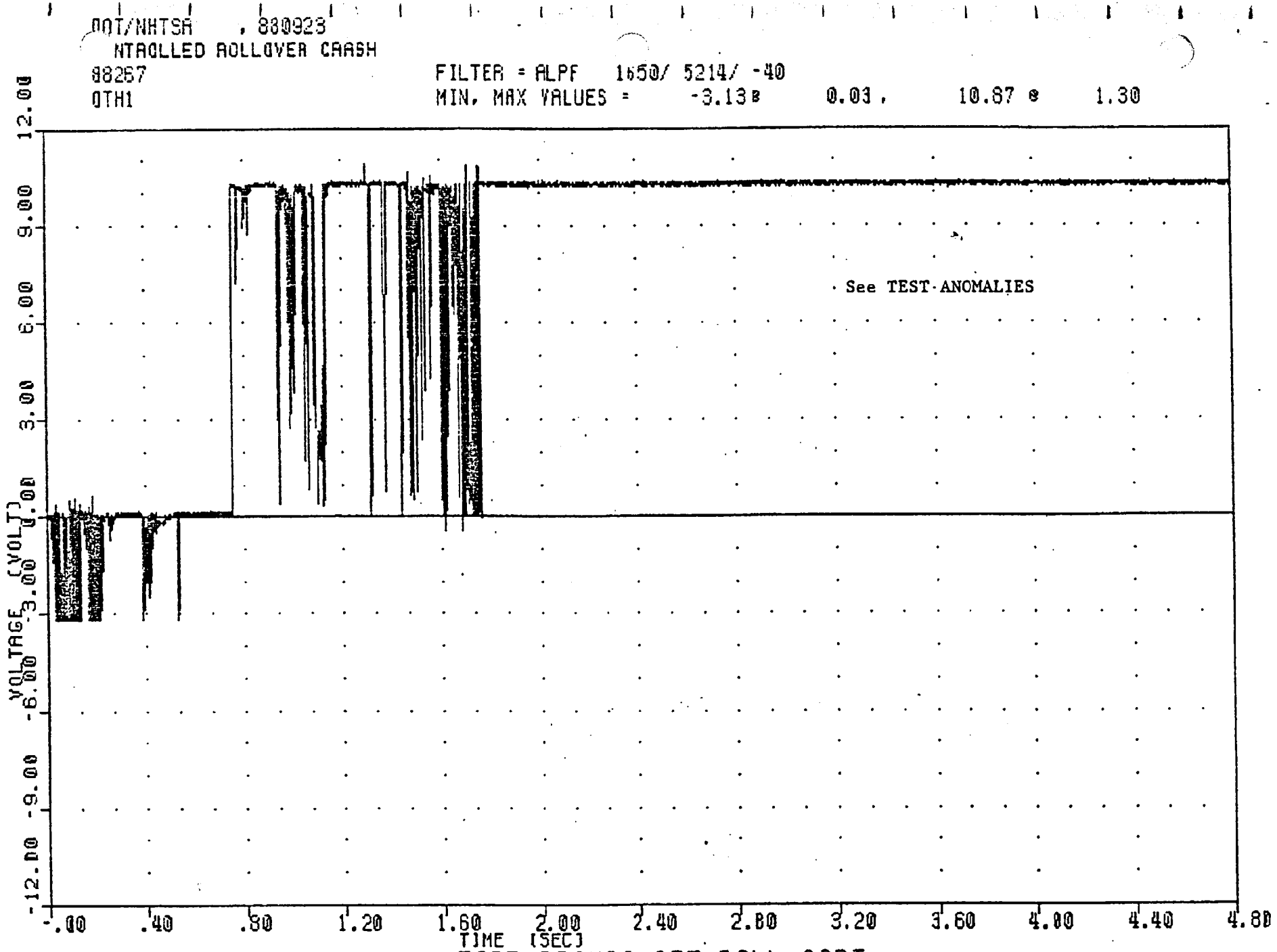


FORD BRONCO OFF ROLL CART
ROLLOVER CART PLATFORM DISPLACEMENT - LEFT SIDE



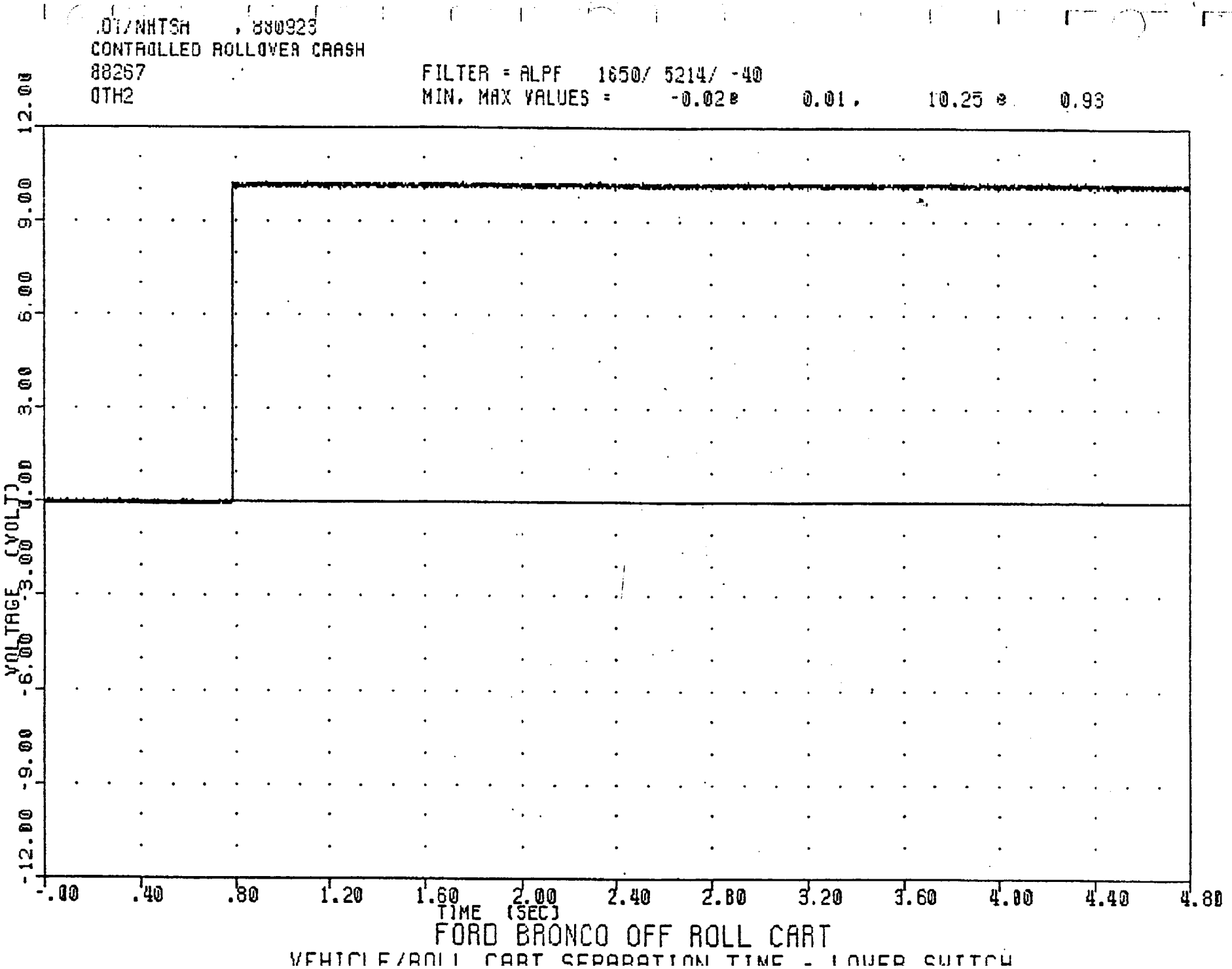
FORD BRONCO OFF ROLL CART

ROLLOVER CART PLATFORM DISPLACEMENT - RIGHT SIDE



FORD BRONCO OFF ROLL CART

VEHICLE/ROLL CART SEPARATION TIME - UPPER SWITCH


.DT/NHTSA , 880923
CONTROLLED ROLLOVER CRASH
88267
DTH2
FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -0.02 @ 0.01 , 10.25 @ 0.93
12.00
9.00
6.00
3.00
0.00
-3.00
-6.00
-9.00
-12.00
VOLTAGE (VOLT)
.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)
FORD BRONCO OFF ROLL CART
VEHICLE/ROLL CART SEPARATION TIME - LOWER SWITCH

APPENDIX C

DUMMY CERTIFICATION

HYBRID III EXTERIOR DIMENSIONS

Dimensional Symbol	Description	Spec Dimension	Dummy Dimension S/N: 192
A	Sitting Height (Erect)	34.8 ± .2	34.7
B	Shoulder Pivot Height	20.2 ± .3	20.3
C	"H" Point Height	3.4 ref.	3.4
D	"H" Point Location from Back Line	5.4 ref.	5.4
E	Shoulder Pivot Location from Back Line	3.5 ± .2	3.7
F	Thigh Clearance	5.8 ± .3	5.7
G	Back of Elbow to Wrist Pivot	11.7 ± .3	11.5
H	Occiput to Z-Axis	1.7 ± .1	1.7
I	Shoulder - Elbow Length	13.3 ± .3	13.1
J	Elbow Rest Height	7.9 ± .4	8.2
K	Buttock Knee Length	23.3 ± .5	23.3
L	Popliteal Height	17.4 ± .5	17.3
M	Knee Pivot Height	19.4 ± .3	19.1
N	Buttock Popliteal Length	18.3 ± .5	18.3
O	Chest Depth	8.7 ± .3	8.8
P	Foot Length	10.2 ± .3	10.2
V	Shoulder Breadth	16.9 ± .3	16.8
W	Foot Breadth	3.9 ± .3	4.0
Y	Chest Circumference	38.8 ± .6	38.4
Z	Waist Circumference	33.5 ± .6	33.3
AA	Location for Measurement of Chest Circumference	17.0 ± .1	17.0
BB	Location for Measurement of Waist Circumference	9.0 ± .1	9.0

NOTE: The "H" point is located 1.83 inches forward and 2.57 inches down from the center of the pelvis angle reference hole.

APPENDIX D

MISCELLANEOUS TEST INFORMATION

DOT/NHTSA 880923 CONTROLLED ROLLOVER CRASH
88267

		Min value		Max value		Data Units	Filter		
1	HEDXG1	-14.025 @	1.281	9.107 @	1.286 sec	g	ALPF	1650/	5214/ -40
2	HEDYG1	-76.977 @	1.284	7.198 @	1.374 sec	g	ALPF	1650/	5214/ -40
3	HEDZG1	-34.158 @	1.282	8.135 @	1.278 sec	g	ALPF	1650/	5214/ -40
4	NEKXF1	-14.931 @	1.659	44.956 @	1.284 sec	lb	BLPP	100/	250/ -16
5	NEKYF1	-204.789 @	1.285	26.596 @	1.321 sec	lb	BLPP	100/	250/ -16
6	NEKZF1	-263.056 @	1.286	35.970 @	1.341 sec	lb	BLPP	100/	250/ -16
7	NEKXM1	-80.380 @	1.286	13.862 @	1.359 sec	lb-ft	BLPP	100/	250/ -16
8	NEKYM1	-17.749 @	1.290	19.536 @	2.136 sec	lb-ft	BLPP	100/	250/ -16
9	NEKZM1	-228.978 @	0.541	8.479 @	1.243 sec	lb-ft	BLPP	100/	250/ -16
10	CSTXG1	-27.241 @	1.276	57.604 @	1.278 sec	g	BLPP	300/	750/ -16
11	CSTYG1	-116.311 @	1.278	44.606 @	1.290 sec	g	BLPP	300/	750/ -16
12	CSTZG1	-34.110 @	1.298	25.772 @	1.278 sec	g	BLPP	300/	750/ -16
13	CSTXD1	-0.059 @	1.278	0.524 @	1.302 sec	in	BLPP	300/	750/ -16
14	PEVXG1	-4.549 @	1.285	7.863 @	1.308 sec	g	BLPP	300/	750/ -16
15	PEVYG1	-12.358 @	1.286	5.716 @	3.857 sec	g	BLPP	300/	750/ -16
16	PEVZG1	-17.840 @	1.287	3.768 @	0.195 sec	g	BLPP	300/	750/ -16
17	VCGXG1	-18.392 @	1.417	5.581 @	1.411 sec	g	BLPP	100/	250/ -16
18	VCGYG1	-11.329 @	1.279	6.624 @	1.413 sec	g	BLPP	100/	250/ -16
19	VCGZG1	-13.384 @	1.290	8.102 @	1.285 sec	g	BLPP	100/	250/ -16
20	RDKXV1	-21.796 @	1.362	16.794 @	1.346 sec	deg/sec	BLPP	100/	250/ -16
21	RDKYV1	-137.121 @	1.350	80.820 @	1.343 sec	deg/sec	BLPP	100/	250/ -16
22	RDKZV1	-25.043 @	2.521	64.159 @	1.354 sec	deg/sec	BLPP	100/	250/ -16
23	SFLD1	-13.285 @	1.389	0.311 @	0.638 sec	in	BLPP	100/	250/ -16
24	SFRD1	-3.920 @	1.364	0.653 @	0.554 sec	in	BLPP	100/	250/ -16
25	SRLD1	-9.055 @	1.397	1.738 @	1.240 sec	in	BLPP	100/	250/ -16
26	SRRD1	-3.518 @	1.361	1.144 @	0.584 sec	in	BLPP	100/	250/ -16
27	VCGXG2	-8.779 @	0.116	37.233 @	0.091 sec	g	BLPP	100/	250/ -16
28	VCGYG2	-8.254 @	0.088	70.189 @	0.144 sec	g	BLPP	100/	250/ -16
29	VCGZG2	-31.463 @	0.102	42.228 @	0.143 sec	g	BLPP	100/	250/ -16
30	RCPDL	-0.114 @	0.142	24.063 @	1.267 sec	in	BLPP	100/	250/ -16
31	RCPDR	-0.125 @	-0.663	24.774 @	1.016 sec	in	BLPP	100/	250/ -16
32	OTH1	-3.134 @	0.029	10.870 @	1.298 sec	volt	ALPF	1650/	5214/ -40
33	OTH2	-0.020 @	-1.195	10.254 @	0.928 sec	volt	ALPF	1650/	5214/ -40
34	HEDRG1	0.060 @	0.240	83.639 @	1.284 sec	g	ALPF	1650/	5214/ -40
35	CSTRG1	0.091 @	0.095	132.328 @	1.278 sec	g	BLPP	300/	750/ -16
36	PEVRG1	0.142 @	-0.388	20.737 @	1.286 sec	g	BLPP	300/	750/ -16
37	VCGRG1	0.035 @	-0.182	18.848 @	1.417 sec	g	BLPP	100/	250/ -16
38	VCGRG2	0.026 @	-1.008	79.692 @	0.144 sec	g	BLPP	100/	250/ -16

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 ROTATIONG LEFTWARD

IPMD VEHICLE DATA SHEET

Version 2 -- June-25, 1987

Filled Out By: Joe Linscott Date: 9/15/88

Checked By: Burton/Chrystos Date: 10/5/88

VEHICLE DATA

Vehicle ID Code (7 characters): V88-219A

Vehicle Model Year (2 digits): 88

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): OH

2C - 2Dr Coupe	SW - Stationwagon
2S - 2Dr Sedan	PU - Pickup Truck
3H - 3Dr Hatchback	TR - Truck
4S - 4Dr Sedan	VN - Van
5H - 5Dr Hatchback	BU - Bus

OH - Other: Utility

VIN Number (20 Characters): 1 F M C U 1 4 T 4 J U D 7 0 9 1 8 _ _ _

Odometer Reading: 105 Thousands of Miles: 0

Wheelbase: 94.2 (in) x 25.4 -: 2392.7 (mm)

Front Track: 56.5 (in) x 25.4 -: 1435.1 (mm)

Rear Track: 57.0 (in) x 25.4 -: 1447.8 (mm)

Roof Height: 68.4 (in) x 25.4 -: 1737.4 (mm)

G.V.W.R.: 4200 (lbs) x 4.45 =: 18690 (N)

Front G.A.W.R: 2120 (lbs) x 4.45 =: 9434 (N)

Rear G.A.W.R: 2399 (lbs) x 4.45 =: 10676 (N)

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

Weight on RF Tire: 899 (lbs) x 4.45 =: 4001 (N)

Weight on LF Tire: 932 (lbs) x 4.45 =: 4147 (N)

Weight on LR Tire: 1002 (lbs) x 4.45 =: 4459 (N)

Weight on RR Tire: 976 (lbs) x 4.45 =: 4343 (N)

Vehicle Test Weight: 3810 (lbs) x 4.45 =: 16954 (N)

Lateral and Longitudinal Center of Gravity Location

From Front Axle: 48.9 (in) x 25.4 =: 1242.1 (mm)

From Center Line: -0.4 (in) x 25.4 =: -10.2 (mm)

Engine Displacement: 177.0 (cu in) x 0.0164 =: 2.90 (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

Transmision Type: M

M - Manual A - Automatic

Drive Axle (1 character): 4

F - Front R - Rear
4 - Four Wheel Drive

Vehicle Comments (30 characters): Tested with driver, pre-rollover.

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): F219

Front/Rear Flag (1 character): F

Axle Type (1 character) I

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
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-Trailing Shoe
DS - Duo-Servo Shoe
OT - Other:_____

Suspension Modified

N - No Y - Yes N

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): 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: 5.5 (in) * 25.4 -: 139.7 (mm)

Axle Height: 12.6 (in) * 25.4 -: 320.0 (mm)

Tire Pressure: 35.0 (psi) * 6.897 -: 241.4 (kpa)

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Suspension Number (4 digits): R219

Front/Rear Flag (1 character): R

Axle Type (1 character) S
- I - Independent
- S - Solid

Suspension Type (1 character): L
- A - Unequal A Arm
- L - Leaf
- M - Multiple Link
- Q - Torque Arm
- S - Strut
- T - Semi-Trailing Arm
- W - Twist
- 4 - 4 Link
- 3 - 3 Link
- O - Other:_____

Spring Type (2 characters): LL
- CO - Coil
- LL - Longitudinal Leaf
- TB - Torsion Bar
- TL - Transverse Leaf
- OT - Other:_____

Brake Type (2 characters): LT
- DI - Disk
- DS - Duo-Servo Shoe
- LT - Leading-Trailing Shoe
- OT - Other:_____

Suspension Modified: N
- N - No
- Y - Yes

Suspension Modification:
- R - Raised
- S - Stiffened
- L - Lowered
- W - Widened
- O - Other

1 - ____
2 - ____

REAR SUSPENSION

Tire Manufacturer (10 characters): Firestone

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

Tire Construction (2 characters): SB

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

Tire Rim Width: 5.5 (in) * 25.4 -: 139.7 (mm)

Axle Height: 12.8 (in) * 25.4 -: 325.1 (mm)

Tire Pressure: 35.0 (psi) * 6.897 -: 241.4 (kpa)

IPMD MEASURED DATA

C.G. Height:

Applied Weight (lbs)	Resultant Angle (deg)	Resultant Lateral Movement (mv)-(in)	
0	0.0	1.737	
+100	-4.4	1.929	
+200	-9.3	2.360	
0	0.0	1.788	
-100	4.5	1.515	
-200	9.2	1.149	
0	0.2	1.651	

Calculated C.G. Height (in): 28.6

Pitch Inertia:

Run	Period(sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	4.49	230	401
2	4.49	225	390
3	4.50	229	398

Pitch Inertia (ft·lb·sec2): 1965.2

Roll Inertia:

Distance between ramps (in): 47.2

Run	Period (sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	2.74	187	419
2	2.74	182	418
3	2.74	183	421

Roll Inertia (ft·lb·sec2): 424.6