V1391

VEHICLE AND DUMMY KINEMATICS IN A CONTROLLED ROLLOVER CRASH 1989 DODGE CARAVAN

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

TEST REPORT
OCTOBER - NOVEMBER, 1989

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

ERRATA (as of Nov 93)
Test Number 891025

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 3-6.
   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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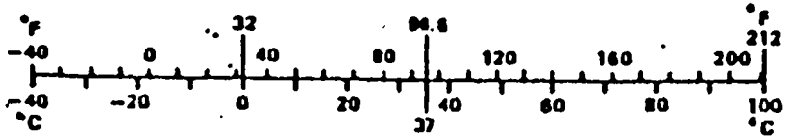
METRIC CONVERSION FACTORS

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 Dodge Caravan on the NHTSA rollover cart at an angle 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 with a three-point unibelt restraint system.

SECTION 2.0

SUMMARY OF ROLLOVER CRASH TEST

NOTE

A 1989 Dodge Caravan 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° counter-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 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 October 25, 1989.

The Part 572E 50th percentile adult male anthropomorphic test device (ATD) was placed in the right front passenger's designated seating position according to the seating procedure in FMVSS 208 Notice 45. The ATD was instrumented with head, chest, and pelvis traixial 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 891025

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	5.8	0.1	4.7	0.2
	LATERAL	9.9	0.1	2.8	0.2
	VERTICAL	9.9	0.1	6.3	0.0
	RESULTANT	11.8	0.1		
2	PLATFORM DISPLACEMENT (in)				
	LEFT SIDE	23.8	1.8	0.1	0.4
	RIGHT SIDE	24.4	1.9	0.2	0.2
3	VEHICLE/ROLL CART SEPARATION TIMES:				
				UPPER SWITCH:	0.8 SEC
				LOWER SWITCH:	1.0 SEC

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

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

FINAL RESTING PLACES OF PARTS AND CARS

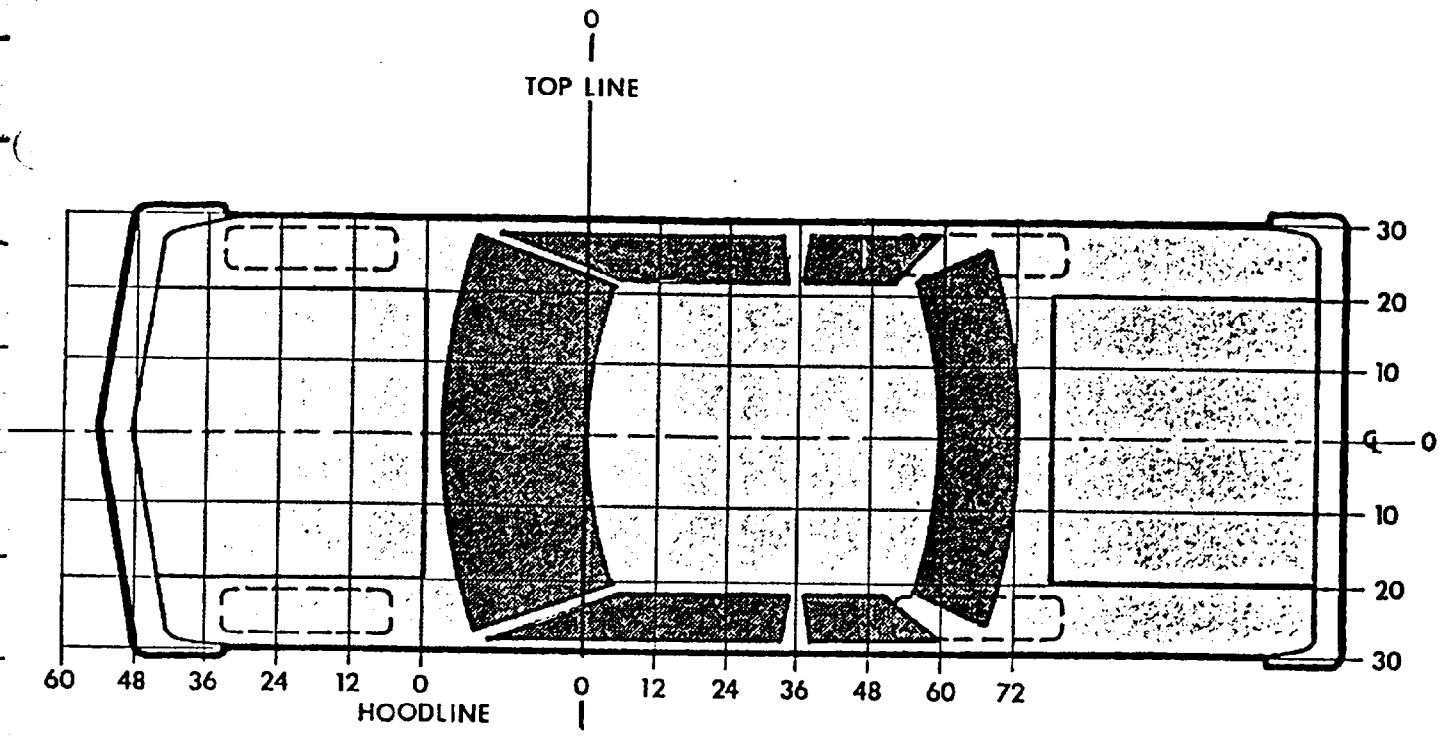
DESCRIPTION OF PART	DISTANCE, FT*	DISTANCE, FT*
1989 Dodge Caravan	130.0	-16.4

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

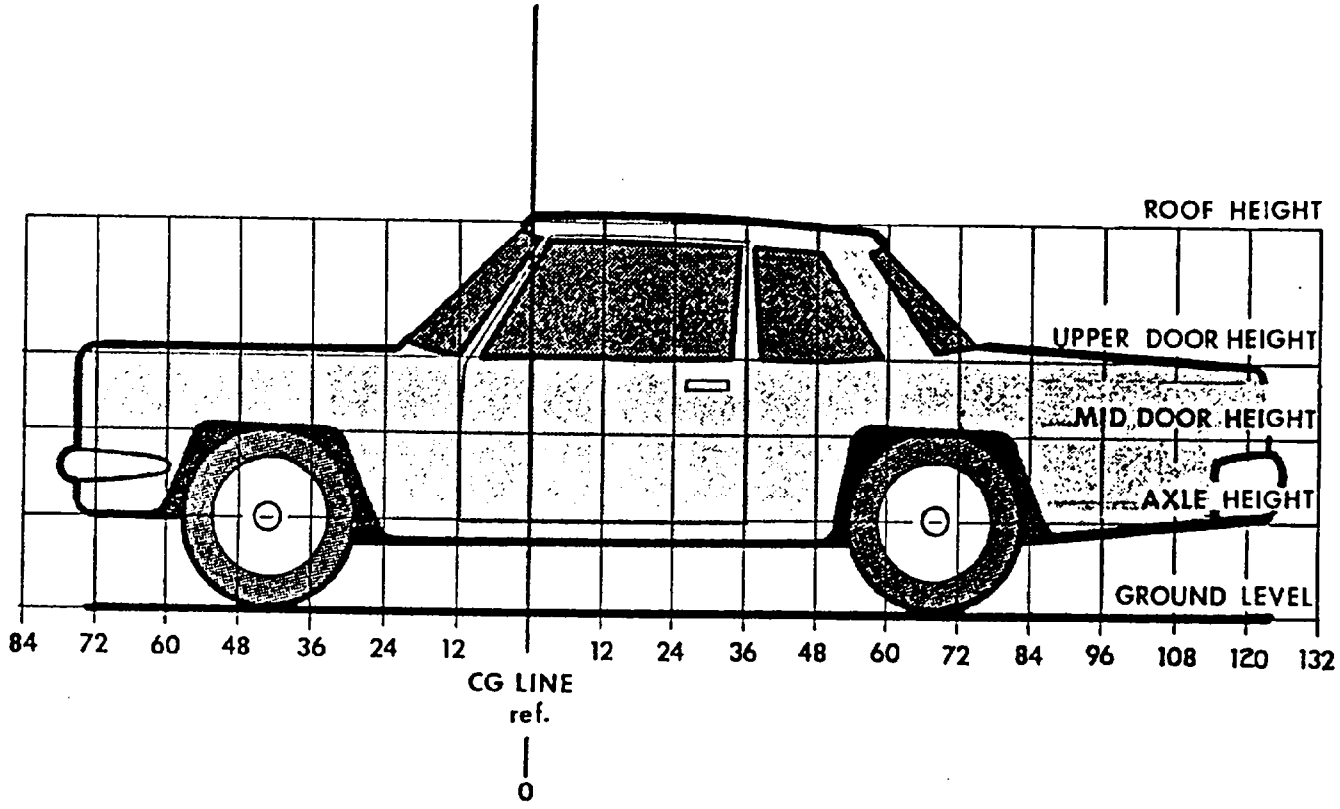
VEHICLE INTERIOR MEASUREMENTS

DESCRIPTION	PRE	POST	DIFF
Floor board to top of left "A" post	44.0	31.0	13.0
Floor board to top of right "A" post	44.0	38.2	5.8
Door sill to top of left "B" post	44.0	34.4	9.6
Door sill to top of right "B" post	44.5	41.4	3.1
Door sill to top of left door opening	43.2	31.6	11.6
Door sill to top of right door opening	43.2	37.9	5.3
Floor tunnel to windshield header	45.6	38.2	7.4
Floor tunnel to center of roof	49.8	35.3	14.5
Rear of floor tunnel to roof	47.9	42.1	5.8
Maximum width at "B" post	57.1	60.6	-3.5
Maximum width at "A" post	55.0	41.2	13.8
Maximum width at top of door opening	49.8	42.2	7.6

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	44.0	45.1	45.4	45.4	45.2	44.9	43.9
Trailing edge of cowl + 12 inches***	41.2	42.4	42.6	42.8	42.8	42.0	40.9
Trailing edge of cowl + 24 inches	X	39.9	40.0	40.0	39.8	39.4	X
Trailing edge of cowl + 36 inches	X	X	X	X	X	X	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	41.5	43.2	43.8	44.0	45.0	44.6	43.0
Trailing edge of cowl + 12 inches	38.8	40.8	41.8	42.2	42.6	42.5	41.9
Trailing edge of cowl + 24 inches	X	38.2	39.1	40.0	40.6	40.4	X
Trailing edge of cowl + 36 inches	X	X	X	X	X	X	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
STATIC CRUSH (IN)							
Trailing edge of cowl at centerline	-2.5	-1.9	-1.6	-1.4	-0.2	-0.3	-0.9
Trailing edge of cowl + 12 inches	-2.4	-1.6	-0.8	-0.6	-0.2	0.5	1.0
Trailing edge of cowl + 24 inches	X	-1.7	-0.9	0.0	0.8	1.0	X
Trailing edge of cowl + 36 inches	X	X	X	X	X	X	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	65.8	66.0	66.2	66.0	65.2
Longitudinal Center of Gravity + 12 inches***	66.0	65.9	66.0	65.5	65.8
Longitudinal Center of Gravity + 24 inches	66.0	66.1	66.0	65.8	65.4
Longitudinal Center of Gravity + 36 inches	66.0	66.0	65.9	65.8	65.8
Longitudinal Center of Gravity + 48 inches	65.9	66.0	65.8	65.8	65.5
Longitudinal Center of Gravity + 60 inches	65.5	65.5	65.5	65.5	65.2
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	50.5	51.0	53.9	58.0	61.9
Longitudinal Center of Gravity + 12 inches	54.5	56.0	57.8	57.0	63.2
Longitudinal Center of Gravity + 24 inches	58.0	61.2	59.5	58.2	64.2
Longitudinal Center of Gravity + 36 inches	63.2	63.9	61.0	59.2	64.8
Longitudinal Center of Gravity + 48 inches	63.8	65.2	63.8	62.8	65.4
Longitudinal Center of Gravity + 60 inches	64.9	65.5	65.4	65.0	65.8
STATIC CRUSH (IN)					
Longitudinal Center of Gravity	-15.3	-15.0	-12.3	-8.0	-3.3
Longitudinal Center of Gravity + 12 inches	-11.5	-9.9	-8.2	-8.5	-2.6
Longitudinal Center of Gravity + 24 inches	-8.0	-4.9	-6.5	-7.6	-1.2
Longitudinal Center of Gravity + 36 inches	-2.8	-2.1	-4.9	-6.6	-1.0
Longitudinal Center of Gravity + 48 inches	-2.1	-0.8	-2.0	-3.0	-0.1
Longitudinal Center of Gravity + 60 inches	-0.6	-0.0	-0.1	-0.5	0.6

* 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	63.4	X	X	X	X	X	21.0	21.5	21.5	21.2	21.1	21.1	21.2	21.5	X	X
Upper Door	41.5	X	17.9	16.1	15.5	14.9	14.9	14.6	14.6	14.5	14.2	14.4	14.4	14.6	14.8	X
Mid Door	27.6	X	14.6	X	14.1	13.6	13.2	13.2	13.1	13.1	13.0	12.9	X	X	X	X
Axle Height	13.2	X	X	X	X	16.2	15.9	15.8	15.5	15.4	15.5	15.5	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	63.4	X	X	X	X	X	26.9	25.1	27.6	25.5	24.1	23.4	23.1	22.6	X	X
Upper Door	41.5	X	19.7	17.1	16.2	15.2	14.4	13.9	14.1	14.2	14.4	14.6	14.9	15.2	15.9	X
Mid Door	27.6	X	14.4	X	14.0	13.4	13.1	12.6	12.9	13.9	13.2	13.8	X	X	X	X
Axle Height	13.2	X	X	X	X	16.1	16.1	16.2	15.9	15.9	16.1	16.1	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	63.4	X	X	X	X	X	5.9	3.6	6.1	4.3	3.0	2.3	1.9	1.1	X	X
Upper Door	41.5	X	1.8	1.0	0.7	0.3	-0.5	-0.7	-0.5	-0.3	0.2	0.2	0.5	0.6	1.1	X
Mid Door	27.6	X	-0.2	X	-0.1	-0.2	-0.1	-0.6	-0.2	-0.8	0.2	0.9	X	X	X	X
Axle Height	13.2	X	X	X	X	-0.1	0.2	0.4	0.4	-0.5	0.2	0.6	X	X	X	X

* Center of gravity is located 48.5 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	63.4	X	X	X	X	X	21.5	21.0	21.1	21.0	21.0	21.4	21.5	21.4	X	X
Upper Door	41.5	X	17.6	16.1	15.2	15.0	15.0	14.4	14.5	14.5	14.5	14.5	14.5	14.6	15.2	X
Mid Door	27.6	X	14.5	X	14.0	13.5	13.5	13.0	13.1	12.9	13.2	13.2	X	X	X	X
Axle Height	13.2	X	X	X	X	16.2	16.1	15.9	15.8	15.4	15.8	15.6	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	63.4	X	X	X	X	X	23.8	22.6	18.5	18.0	18.0	17.8	19.8	19.7	X	X
Upper Door	41.5	X	16.6	15.1	13.9	13.9	13.0	12.1	9.8	10.2	10.1	10.4	11.8	12.1	12.6	X
Mid Door	27.6	x	13.8	X	13.1	12.6	12.1	11.7	10.8	11.2	11.6	12.2	X	X	X	X
Axle Height	13.2	X	X	X	X	16.2	16.1	16.0	15.8	15.8	16.6	16.0	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	63.4	X	X	X	X	X	2.3	1.6	-2.6	-3.0	-3.0	-3.6	-1.7	-1.7	X	X
Upper Door	41.5	X	-1.0	-1.0	-1.3	-1.1	-2.0	-2.3	-4.7	-4.3	-4.4	-4.1	-2.7	-2.5	-2.6	X
Mid Door	27.6	X	-0.7	X	-0.9	-0.9	-1.4	-1.3	-2.3	-1.7	-1.6	-1.0	X	X	X	X
Axle Height	13.2	X	X	X	X	0.0	0.0	0.1	0.0	-0.4	0.8	0.4	X	X	X	X

* Center of gravity is located 48.5 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: Dodge/Caravan TEST NUMBER: 891025

NO.	TYPE OF MEASUREMENT	DIMENSIONS IN INCHES PRE-TEST	POST-TEST	DIFF.
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	176.0	176.6	-0.6
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	159.8	162.6	-2.8
X3	REAR SURFACE OF VEHICLE TO FIREWALL	140.0	142.4	-2.4
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	127.1	127.1	0.0
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	127.4	126.1	1.3
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	124.4	125.0	-0.6
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	124.8	123.8	1.0
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	84.9	85.0	-0.1
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	85.0	83.6	1.4
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	84.8	85.2	-0.4
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	85.1	84.0	1.1
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	122.4	122.5	-0.1
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	122.2	121.9	0.3
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	138.6	137.2	1.4
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	138.9	137.0	1.9
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	109.5	108.2	1.3
X17	CENTER OF STEERING COLUMN TO "A" POST	14.6	10.2	4.4
X18	CENTER OF STEERING COLUMN TO HEADLINER	17.8	7.4	10.4
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	173.4	172.2	1.2
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	173.5	173.8	-0.3
X21	LENGTH OF ENGINE BLOCK	13.5	13.5	0.0

TEST ANOMALIES

All data channels in one multiplexing box are questionable after 2.94 seconds, cause unknown. Only the data from 0.0 to 2.94 seconds is included on the data summary.

All the data channels were lost after 2.94 seconds are:

Right Front Passenger Shoulder Belt Displacement, SHBD2
Vehicle Roll Rate, VCGXV1
Vehicle Pitch Rate, VCGYV1
Vehicle Yaw Rate, VCGZV1
Vehicle Left Front Suspension Displacement, SFLD1
Vehicle Right Front Suspension Displacement, SFRD1
Vehicle Left Rear Suspension Displacement, SRLD1
Vehicle Right Rear Suspension Displacement, SRRD1
Rollcart Right Cylinder Displacement, RCPDR
Rollcart Left Cylinder Displacement, RCPDL
Vehicle/Rollcart Separation Time - Upper Switch, OTH1
Vehicle/Rollcart Separation Time - Lower Switch, OTH2

The following data channels recorded anomalous noise spikes at 0.06 and 0.07 seconds. Only the data from 0.77 to 4.8 seconds is included on the data summary.

Rollcart Center of Gravity X-axis Accelerometer, VCGXG2
Rollcart Center of Gravity Y-axis Accelerometer, VCGYG2
Rollcart Center of Gravity Z-axis Accelerometer, VCGZG2

The rollcart Center of Gravity Resultant Acceleration calculation, VCGRG2, was affected by the above anomalies.

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: Chrysler Canada Ltd.

MAKE/MODEL: Dodge/Caravan VIN: 2B7FK1138KR376585

BODY STYLE: Mini Van MODEL YEAR: 1989

NHTSA NO.: NA COLOR: White

ENGINE DATA: TYPE: Transverse CYLINDERS: 6 DISPLACEMENT: 3 liter

TRANSMISSION DATA: 3 SPEED, ____MANUAL, X AUTOMATIC, X FWD, ____RWD, ____4WD

DATE VEHICLE RECEIVED: 10/1/89 ODOMETER READING: 52

DEALER'S NAME AND ADDRESS: Jefferson Motors, Inc.
2277 East Main Street
Lancaster, Ohio

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	Yes
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	No	ANTI-SKID BRAKE	No
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? 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: Chrysler Canada Ltd.

DATE OF MANUFACTURE: 7/89

GVWR: 4060 LBS

GAWR: FRONT 2425 LBS., REAR 2450 LBS.

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: P195/75R14 LOAD RANGE X B, C, D

TIRES ON VEHICLE (MFR., LINE, SIZE): Goodyear Invicta GL P195/75R14

IS SPARE TIRE A "SPACE SAVER": Yes

IS SPARE TIRE STANDARD EQUIPMENT: No

VEHICLE CAPACITY: TYPES OF SEATS: FRONT: Bucket
REAR: None

TYPE OF FRONT SEAT BACKS: Non-adjustable

*NUMBER OF OCCUPANTS____FRONT ____REAR ____TOTAL

**CARGO LOAD_____LBS. TOTAL_____LBS.

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

RIGHT FRONT	930 lbs.	RIGHT REAR	600 lbs.
LEFT FRONT	990 lbs.	LEFT REAR	560 lbs.

TOTAL FRONT WEIGHT 1920 lbs. (62.3% OF TOTAL VEHICLE WEIGHT)

TOTAL REAR WEIGHT 1160 lbs. (37.7% OF TOTAL VEHICLE WEIGHT)

TOTAL DELIVERED WEIGHT 3080 lbs.

CALCULATION FOR TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT

UDW = UNLOADED DELIVERED WEIGHT (3080 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)

= 3080 + 300 + 167 LBS

TARGET TEST WEIGHT = 3547 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 295 LBS. CARGO

RIGHT FRONT	1002 lbs.	RIGHT REAR	786 lbs.
LEFT FRONT	1009 lbs.	LEFT REAR	745 lbs.

TOTAL FRONT WEIGHT 2011 lbs. (56.8% OF TOTAL VEHICLE WEIGHT)

TOTAL REAR WEIGHT 1531 lbs. (43.2% OF TOTAL VEHICLE WEIGHT)

TOTAL TEST WEIGHT 3542 lbs. (0.1% UNDER TARGET WEIGHT)

WEIGHT OF BALLAST SECURED IN VEHICLE TRUNK AREA: 200

COMPONENTS REMOVED TO MEET TARGET WEIGHT: None

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	LF 29.1	;RF 29.2	;LR 30.9	;RR 30.8
PRE-TEST ATTITUDE:	LF 29.8	;RF 29.3	;LR 29.5	;RR 28.8
POST-TEST ATTITUDE:	LF 29.0	;RF 27.5	;LR 29.9	;RR 28.2

WHEELBASE: 112.0 INCHES

CG = 48.5 INCHES REARWARD OF FRONT WHEEL CENTERLINE

VEHICLE REBOUND AND CRUSH (ALL DIMENSIONS IN INCHES):

OVERALL LENGTH OF TEST VEHICLE:	PRE-TEST:	L	173.5	;C	176.0	;R 173.4
	POST-TEST:	L	173.8	;C	176.6	;R 172.2
	TOTAL CRUSH:	L	-0.3	;C	-0.6	;R 1.2

TEST CONDITIONS

TEST NUMBER: 891025

DATE OF TEST: 10/25/89 TIME OF TEST: 1505

WIND VELOCITY: NA HUMIDITY: NA

AMBIENT TEMPERATURE AT IMPACT AREA: 75°F

TEMPERATURE IN OCCUPANT COMPARTMENT: 78°F

RIGHT FRONT PASSENGER DUMMY TEMPERATURE: 70°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (lbs.)	3542	3547
VEHICLE ORIENTATION (deg.) YAW*	315	315
VEHICLE ORIENTATION (deg.) ROLL**	30	30
VEHICLE VELOCITY (mph)	30	30

DUMMIES

RIGHT FRONT 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:	3-point unibelt

REMARKS:

*AS MEASURED CLOCKWISE FROM THE DIRECTION OF TRAVEL.

**AS MEASURED FROM THE HORIZONTAL.

DUMMY DATA SUMMARY

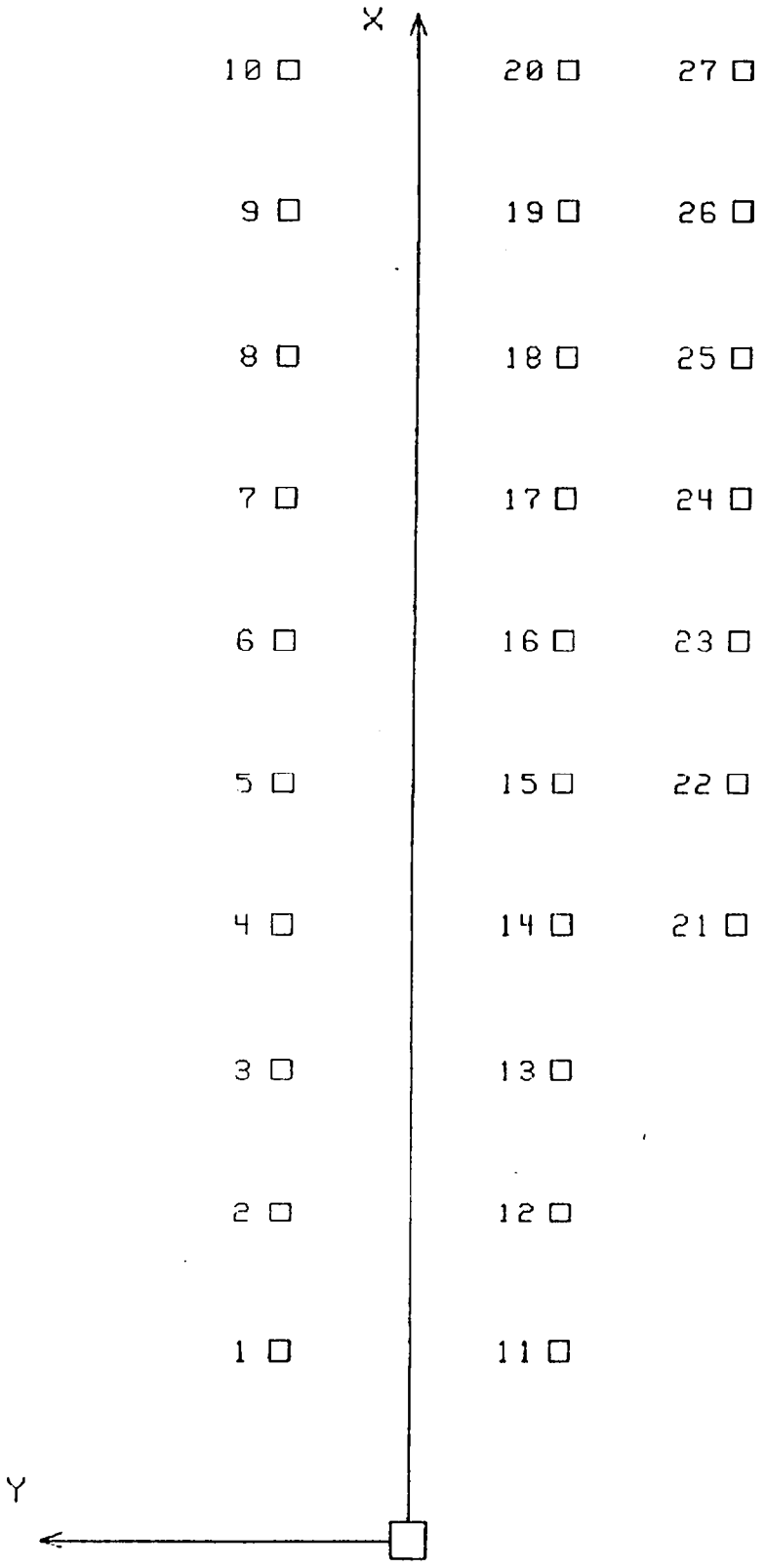
TEST NUMBER 891025

RIGHT FRONT PASSENGER DUMMY
SN: 192

	POSITIVE DIRECTION MAX	POSITIVE DIRECTION SEC	NEGATIVE DIRECTION MAX	NEGATIVE DIRECTION SEC
HEAD ACCELERATION (g)				
LONGITUDINAL	9.6	1.3	12.2	1.5
LATERAL	89.7	1.5	10.8	1.3
VERTICAL	18.2	1.3	27.0	1.3
RESULTANT	90.5	1.5		
HIC 36 MSEC	220.3 FROM 1578 TO 1584 MSEC			
NECK FORCES (lbs)				
LONGITUDINAL	56.7	2.7	120.2	1.3
LATERAL	246.9	1.3	57.1	1.5
VERTICAL	163.1	1.3	1031.7	1.3
NECK MOMENT (in-lbs)				
ABOUT LONG.	95.2	1.3	49.8	1.5
ABOUT LATERAL	27.1	1.3	6.2	1.5
ABOUT VERTICAL	12.7	1.4	9.3	1.3
CHEST ACCELERATION (g)				
LONGITUDINAL	4.7	1.6	8.0	1.3
LATERAL	5.2	1.5	5.5	1.6
VERTICAL	5.3	2.4	19.8	1.3
RESULTANT	20.8	1.3		
3 MSEC CLIP	15.5 FROM 1367 TO 1370 MSEC			
CHEST DISPLACEMENT (in)				
LONGITUDINAL	0.1	1.3	0.2	1.4
PELVIS ACCELERATION (g)				
LONGITUDINAL	4.5	1.1	8.1	1.4
LATERAL	7.8	1.5	5.7	1.5
VERTICAL	4.4	1.5	15.7	1.3
RESULTANT	16.0	1.3		

See APPENDIX B for sign convention

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



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	-10.0
12	42.0	-10.0
13	50.0	-10.0
14	58.0	-10.0
15	66.0	-10.0
16	74.0	-10.0
17	82.0	-10.0
18	90.0	-10.0
19	98.0	-10.0
20	106.0	-10.0
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	495	Vehicle Kinematics
3	Left wide (mid)	Photosonic 1B	13	500	Vehicle Kinematics
4	Left angle	Photosonic 1B	25	500	Vehicle Kinematics
5	Downstream	Photosonic 1B	50	507	Vehicle Kinematics
6	Onboard - floor	Photosonic 1B	8	500	Dummy Kinematics
7	Onboard - rear	Photosonic 1B	8	495	Dummy Kinematics
8	Documentary	Bealieu	11-108	24	Pre-test and Post-test Documentation

HIGH SPEED CAMERA INFORMATION

GROUND LEVEL

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

*Reference:

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

ONBOARD

CAMERA NO.	X**(inch)	Y**(inch)	Z**(inch)
6	0.5	39.8	8.2
7	-78.2	28.5	27.6

**Reference:

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

SECTION 4.0

OCCUPANT INFORMATION

VISIBLE DUMMY CONTACT POINTS:

	DRIVER #NA	PASSENGER #192
Head	NA	Roof and B-pillar
Chest	NA	None
Abdomen	NA	None
Left knee	NA	None
Right knee	NA	Rt. front door padding

DOOR OPENING:

	LEFT	RIGHT
Front	Easy	Easy
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 door glasses were shattered upon impact.

DUMMY KINEMATIC SUMMARY

Passenger Dummy

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

TEST NUMBER 891025

DATA SUMMARY

No.	LOCATION	POSITIVE DIRECTION MAX	POSITIVE DIRECTION SEC	NEGATIVE DIRECTION MAX	NEGATIVE DIRECTION SEC
1	CENTER OF GRAVITY ACCELERATION (g)				
	LONGITUDINAL	7.9	1.4	20.6	1.5
	LATERAL	22.9	1.5	28.9	1.5
	VERTICAL	5.3	0.5	20.5	1.5
	RESULTANT	29.0 *	1.5		
	HIC	220.3	1578 ms to 1584 ms		
2	CENTER OF GRAVITY				
	ROLL (X-AXIS)	6.0	0.3	319.3	1.4
	PITCH (Y-AXIS)	36.3	1.3	78.9	1.4
	YAW (Z-AXIS)	38.3	2.0	46.2	2.4
3	LEFT FRONT SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0.0	0.2	3.3	2.4
4	RIGHT FRONT SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0.1	1.5	0.4	1.5
5	LEFT REAR SUSPENSION DISPLACEMENT (in)				
	VERTICAL	0.6	1.6	8.2	2.4
6	RIGHT REAR SUSPENSION DISPLACEMENT (in)				
	VERTICAL	1.0	2.4	4.9	1.4

REFERENCE:
X: +FORWARD FROM REAR BUMPER
Y: +LEFTWARD FROM VEHICLE CENTERLINE
Z: +UPWARD FROM GROUNDLEVEL
ROLL: +TO RIGHT
PITCH: +NOSE DOWNWARD
YAW: +COUNTER CLOCKWISE
DISPLACEMENT: +OUTWARD

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

* See calculations in the envelope for the calculation of HIC.

ajd
June 28, 1990

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 right front passenger's seat was positioned in the mid-adjustment notch of the seat track. The seat back angle was fixed. The dummy was positioned in the seat using NHTSA's Notice #45 seating procedure. The H-point location of the seat was obtained by using the SAE J826 H-point machine as specified in the Notice #45. The right front passenger dummy was restrained with three-point unibelt.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

MFR./MAKE/MODEL: Dodge/Caravan

SEAT TYPE: ____ Bench
__X__ Bucket
____ Split bench

ADJUSTER TYPE: __X__ Manual
____ Power
____ Non-adjustable

BUCKET SEAT BACK TYPE: __X__ Non-adjustable
____ Adjustable reclining

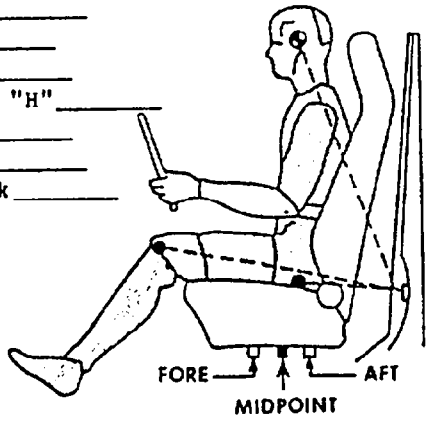
POSITIONING DATE: 10/24/89

AMBIENT TEMP. 75°F TIME: 1120

TECHNICIANS:
1. D. Carpenter
2. B. Fishbaugh
3. N. Kinney
4. _____

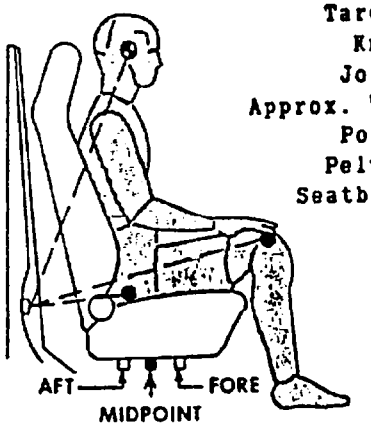
DRIVER DUMMY* # NA TYPE: NA

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



PASSENGER DUMMY* # 192 TYPE: HIII

Head 24.8"
Target 3°
Knee 24.2"
Joint 85°
Approx. "H" 9.1"
Point 98°
Pelvis 22°
Seatback 26°

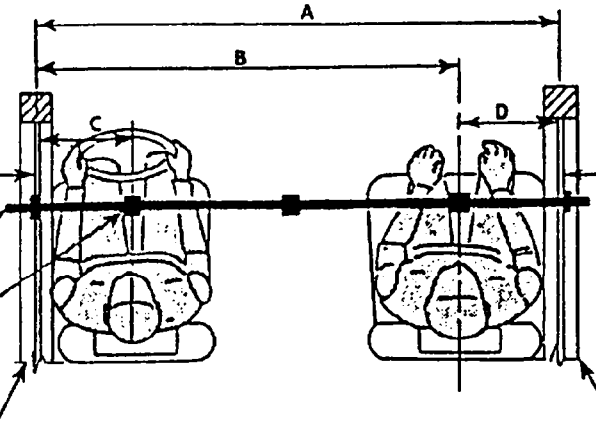


A = 57.5"
B = 45.0"
C = NA
D = 12.5"

DOOR GLASS HEIGHT = NA

LATERAL BAR

ADJUSTABLE POINTER



DOOR GLASS HEIGHT = 13.0"

LEFT FRONT DOOR

DRIVER DUMMY

PASSENGER DUMMY

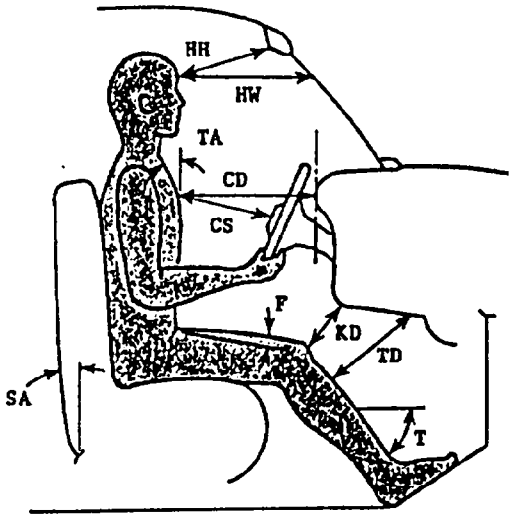
RIGHT FRONT DOOR

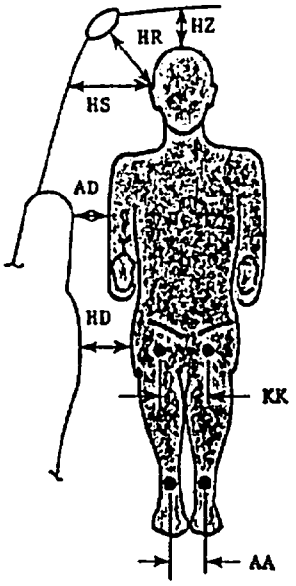
*Dummy measurements are referenced to top of striker bolt and all angles are referenced to vertical.

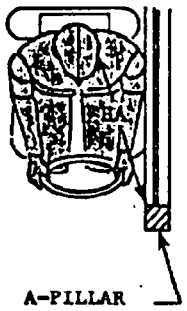
DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER	PASSENGER
HH	NA	18.6
HW	NA	24.9
CD	NA	25.6
CS	NA	NA
KDL	NA	9.7
KDR	NA	9.2
TA	NA	20°
SA	NA	26°
HA	NA	14.8
FL	NA	14°
FR	NA	12°
TDL	NA	6.9
TDR	NA	6.9
TL	NA	55°
TR	NA	56°
HZ	NA	4.3
HR	NA	7.6
HS	NA	10.0
AD	NA	3.8
HD	NA	3.0
KK	NA	8.2
AA	NA	9.0

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







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

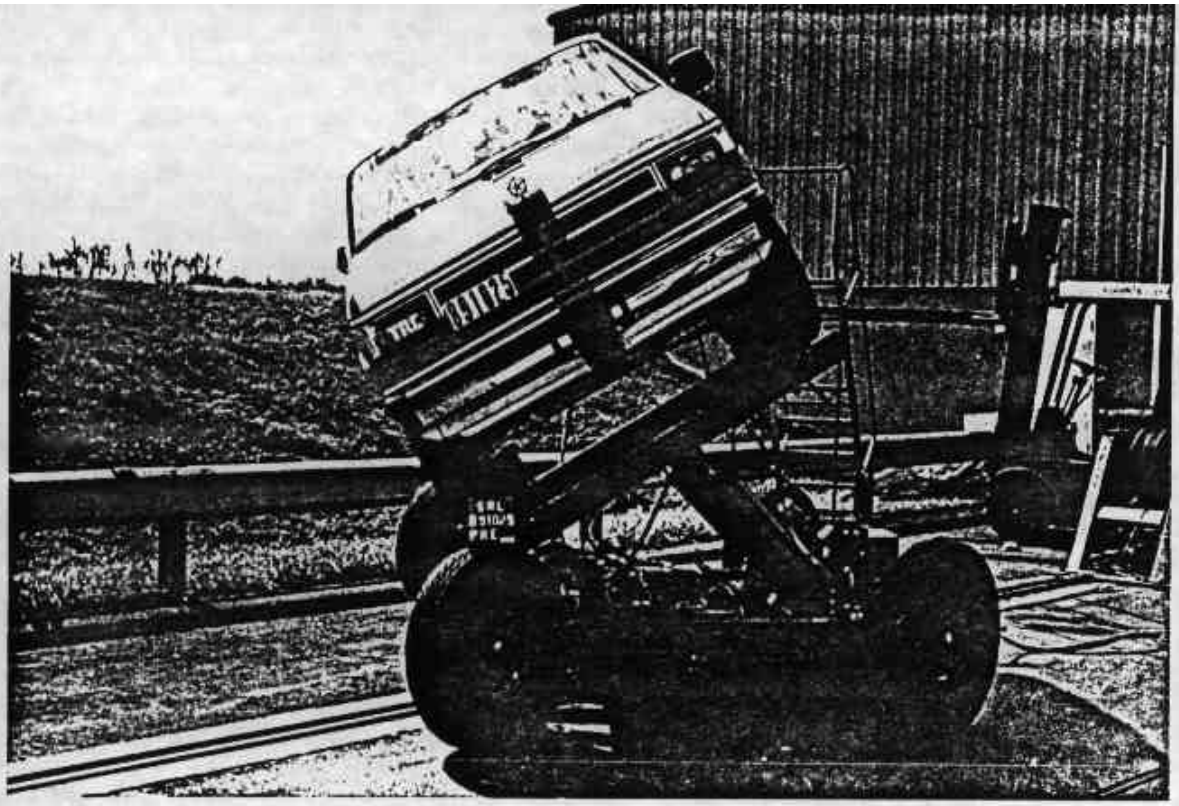


Figure A-1. PRE-TEST OVERALL FRONT VIEW

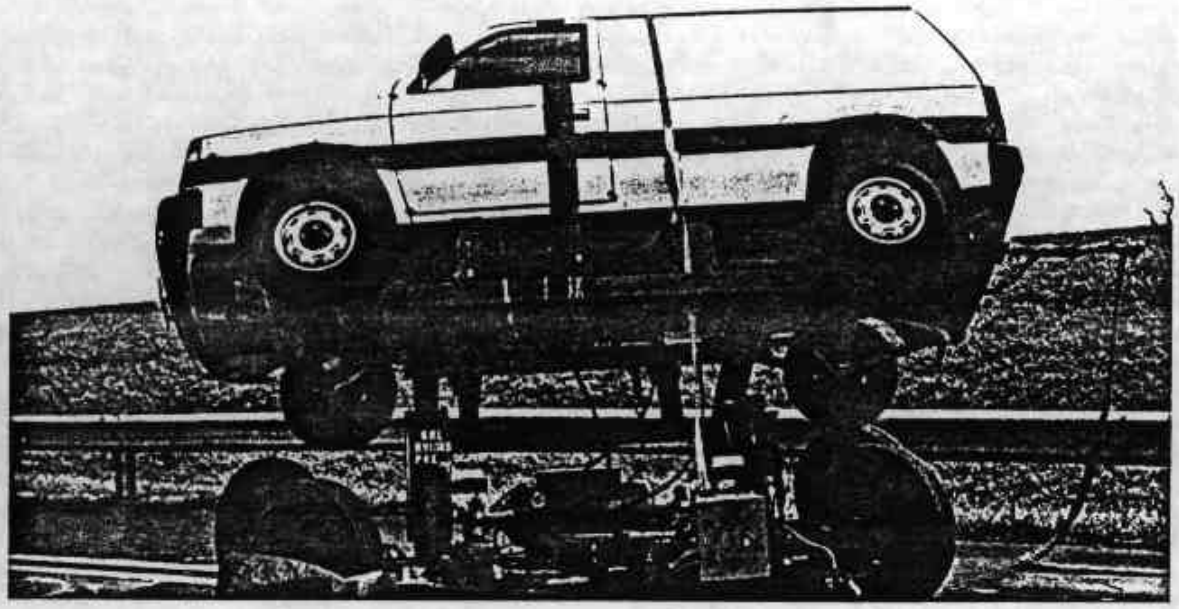


Figure A-2. PRE-TEST OVERALL LEFT VIEW

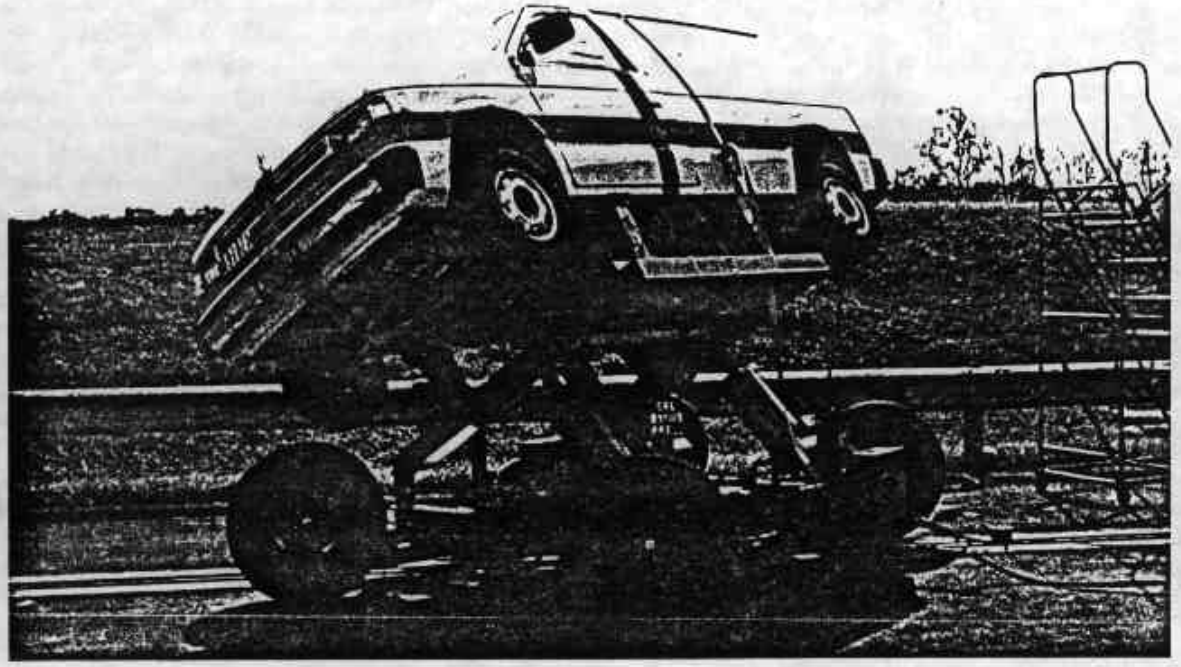


Figure A-5. PRE-TEST OVERALL LEFT FRONT VIEW

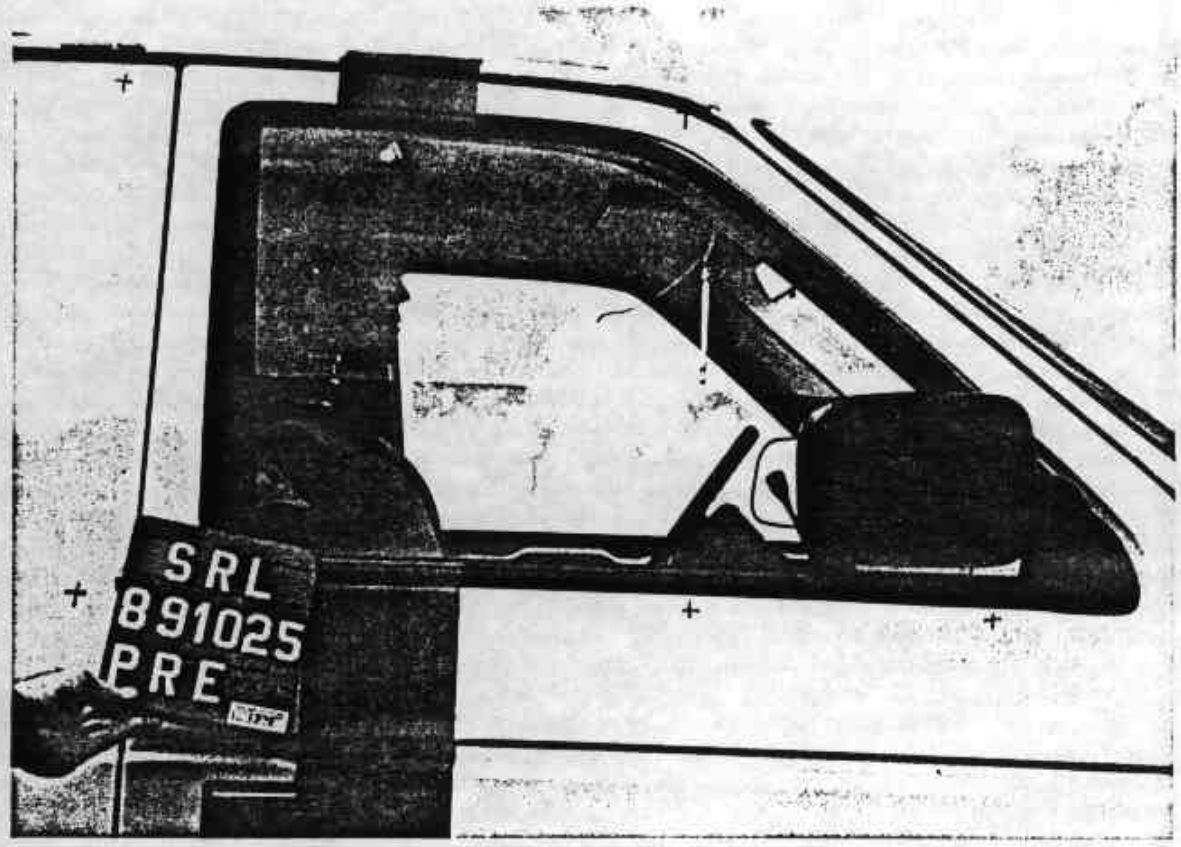


Figure A-6. PRE-TEST RIGHT FRONT PASSENGER DUMMY - VIEW 1

Figure A-7. PRE-TEST RIGHT FRONT PASSENGER DUMMY - VIEW 2

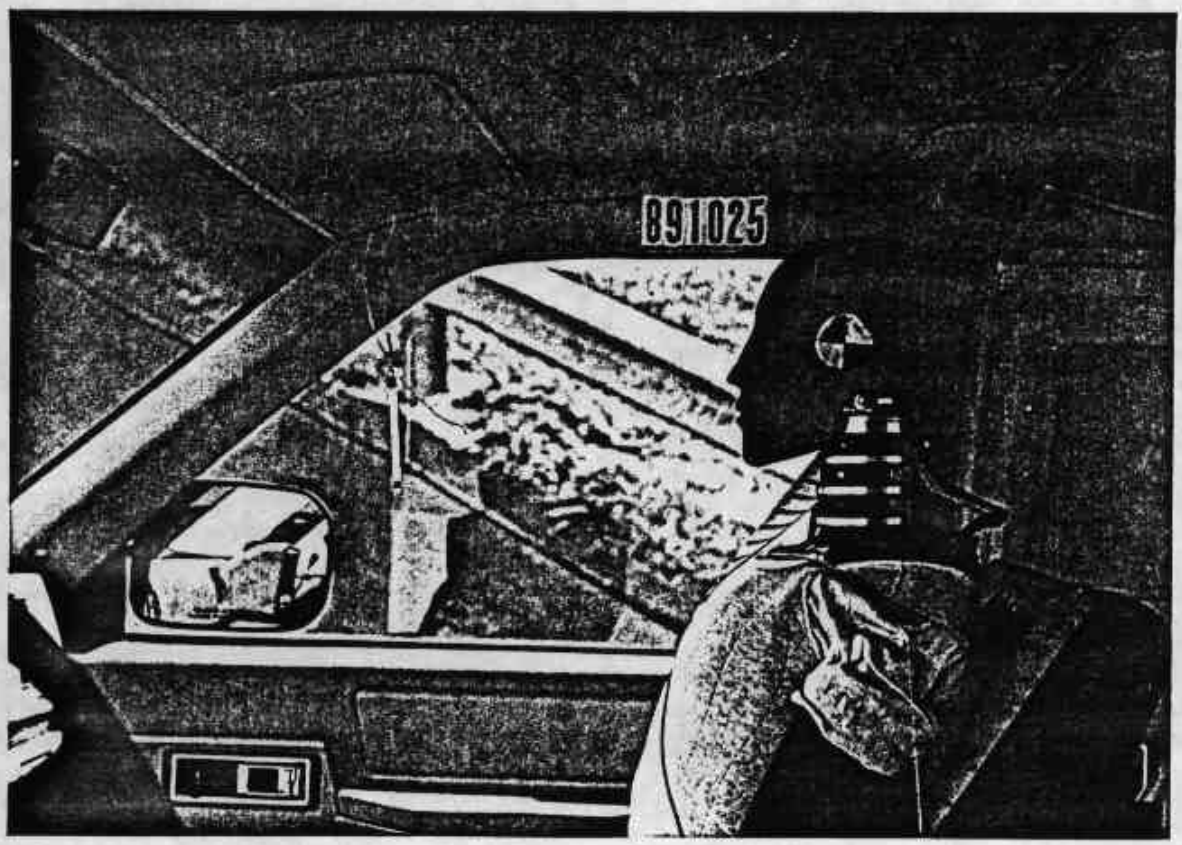


Figure A-8. PRE-TEST RIGHT FRONT PASSENGER DUMMY - VIEW 3

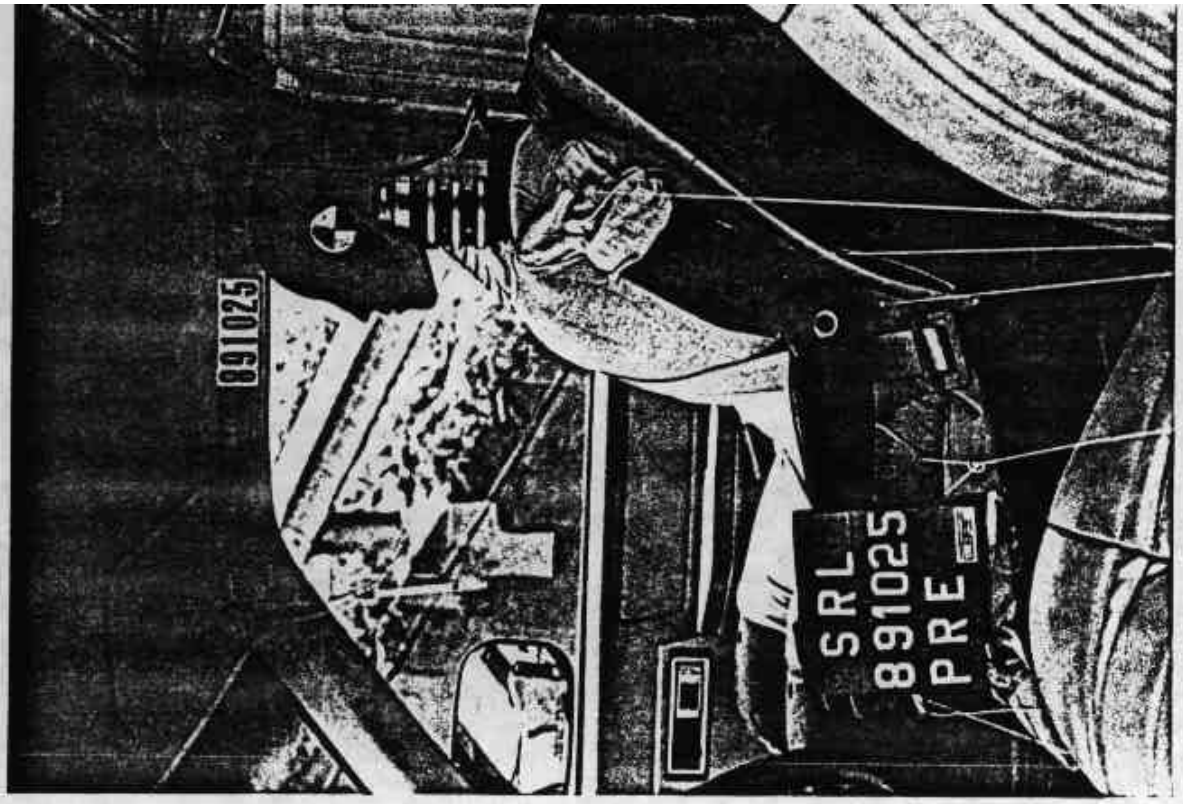


Figure A-9. PRE-TEST RIGHT FRONT PASSENGER DUMMY - VIEW 4

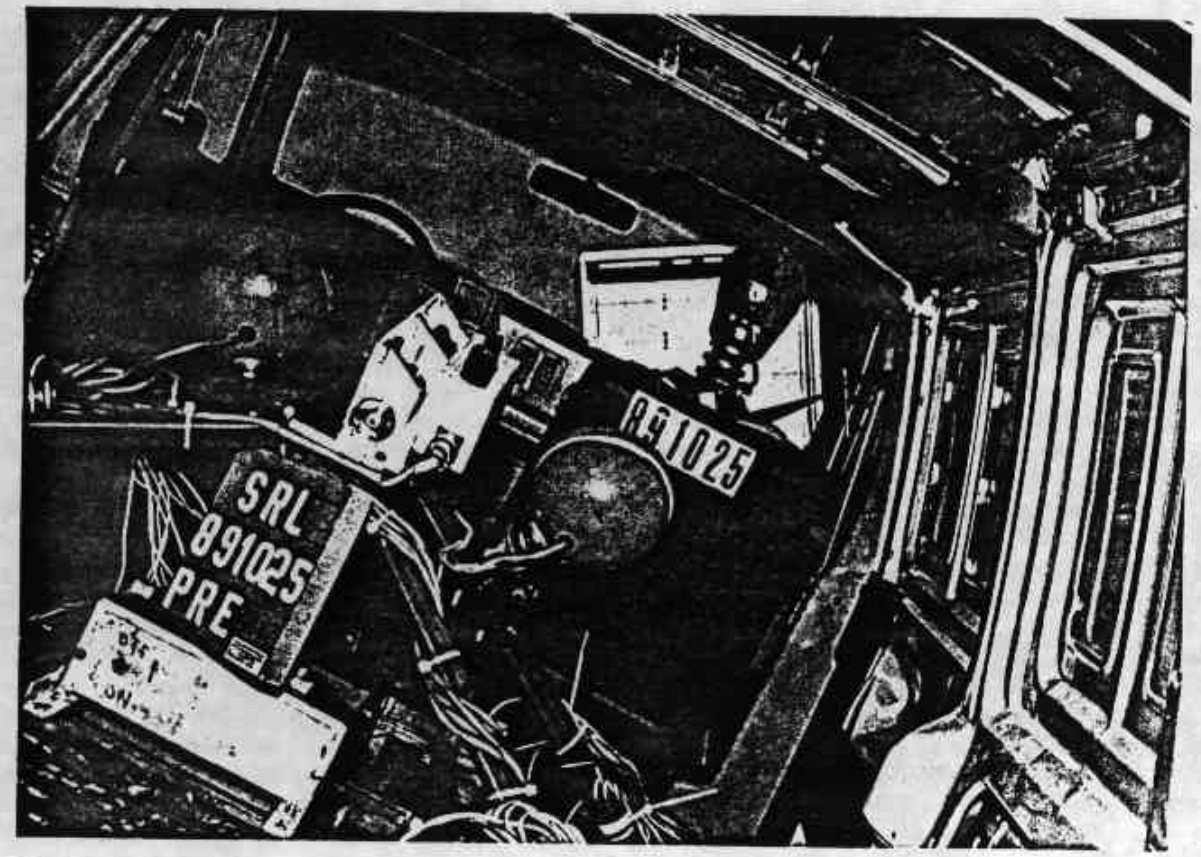


Figure A-10. PRE-TEST RIGHT FRONT PASSENGER DUMMY - VIEW 5

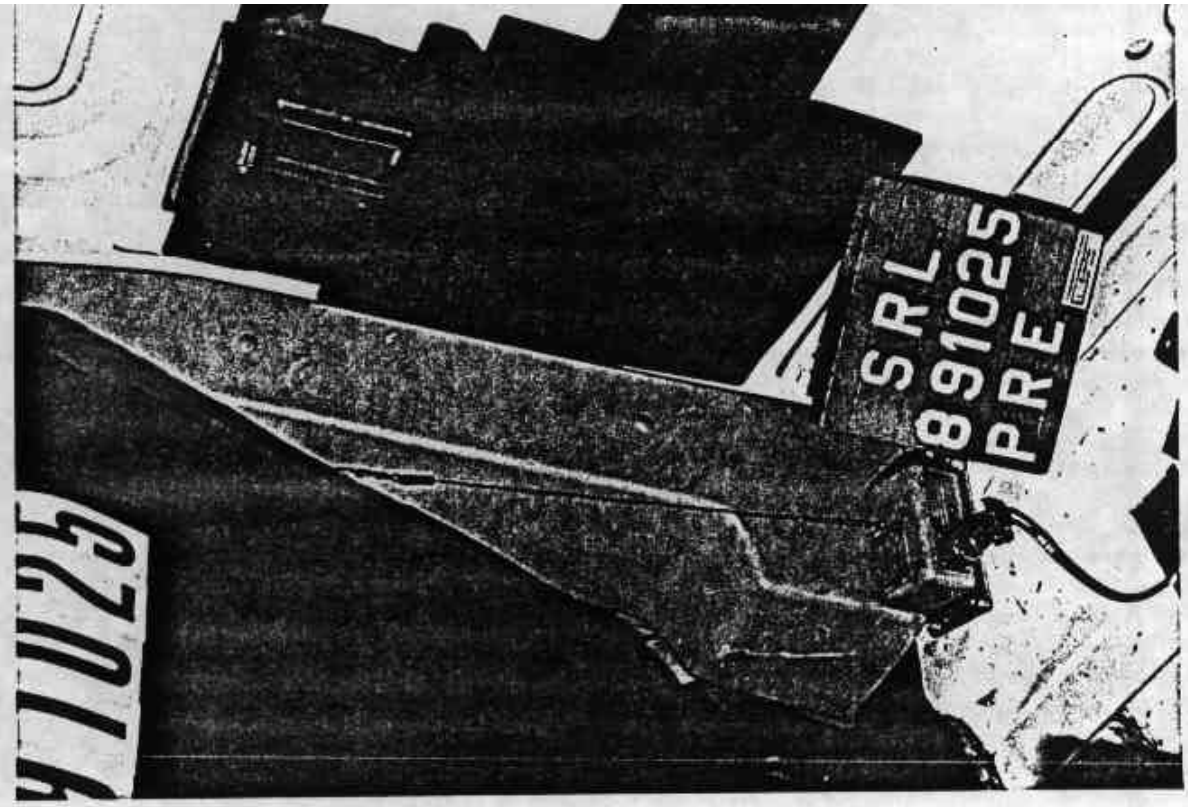


Figure A-11. PRE-TEST SEAT BELT SPOOL-OUT STRING POTENTIOMETER - VIEW 2

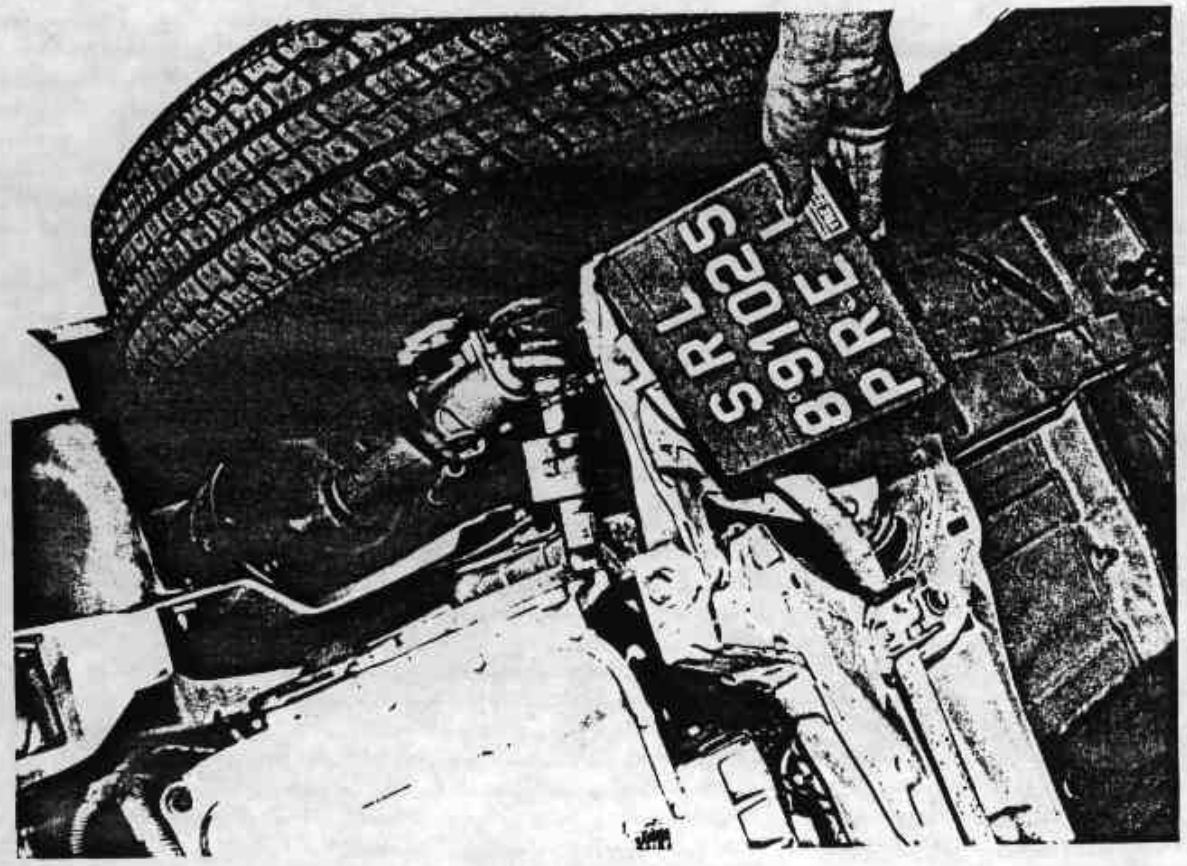


Figure A-12. PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER VIEW

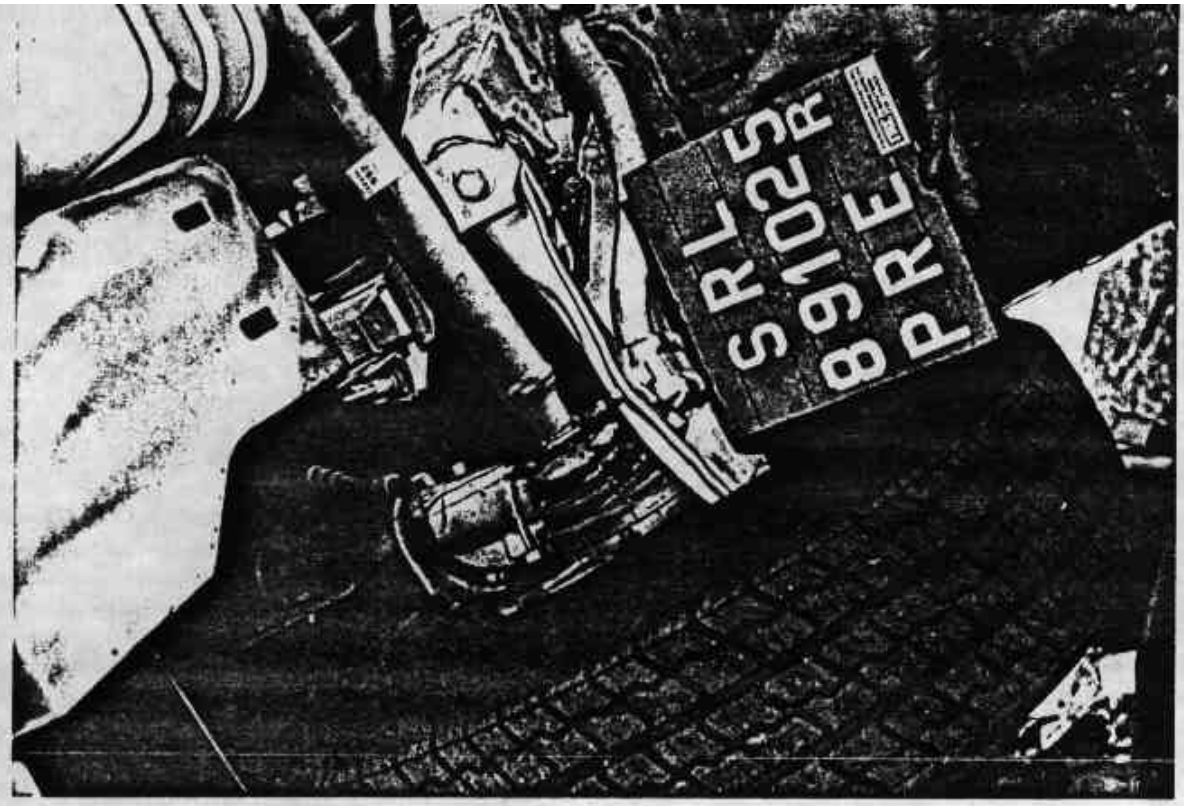


Figure A-13. PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER VIEW

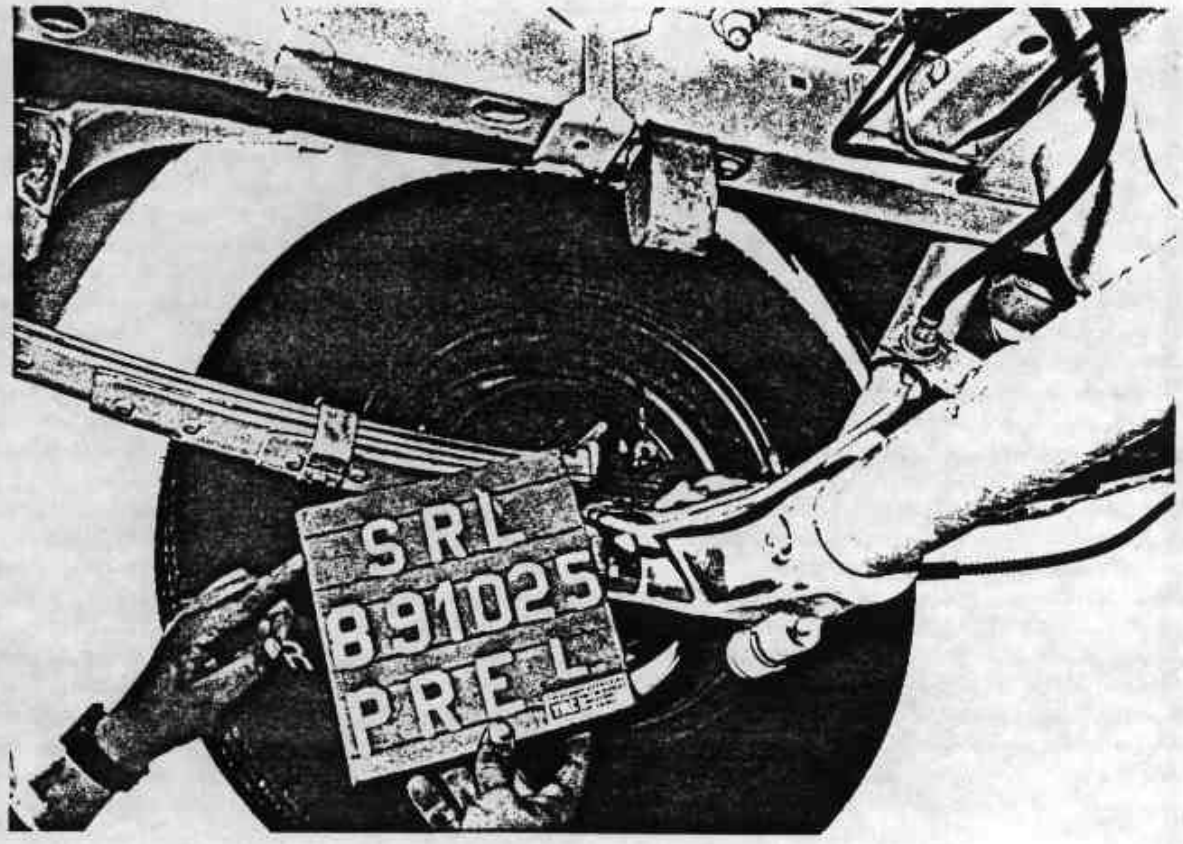


Figure A-14. PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 1

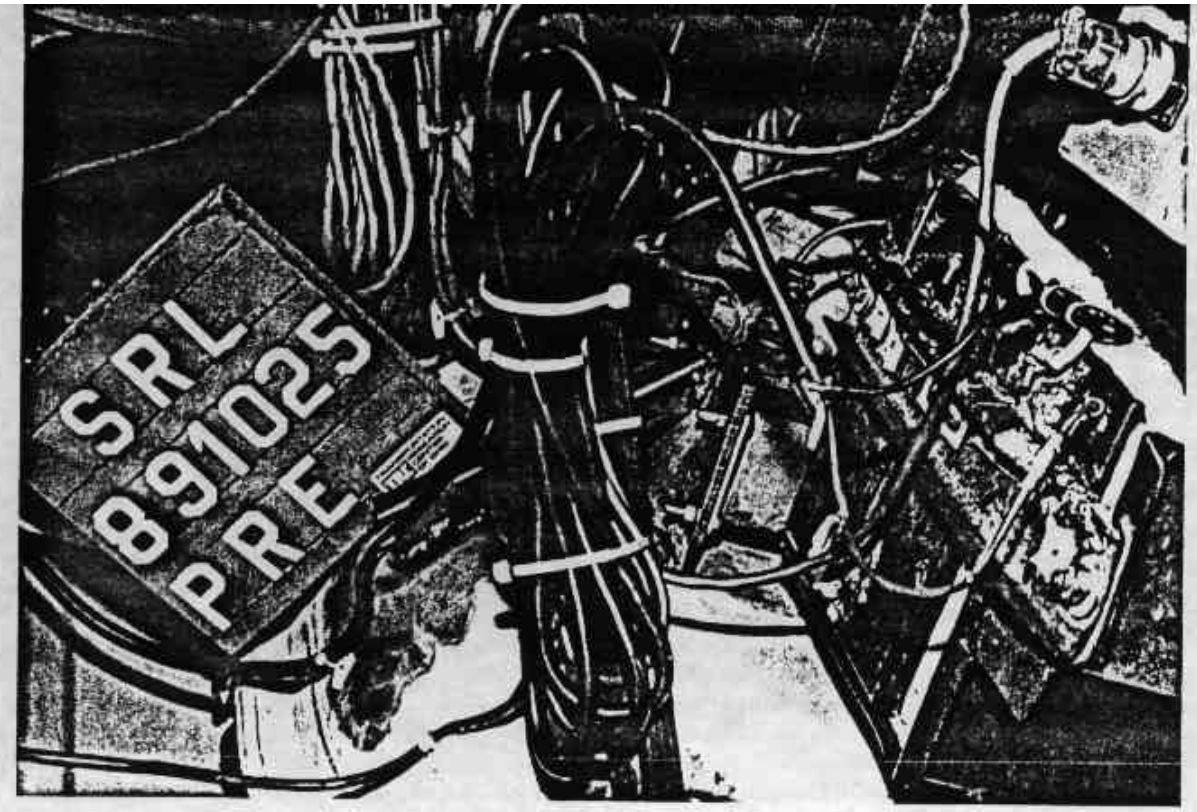


Figure A-15. PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2

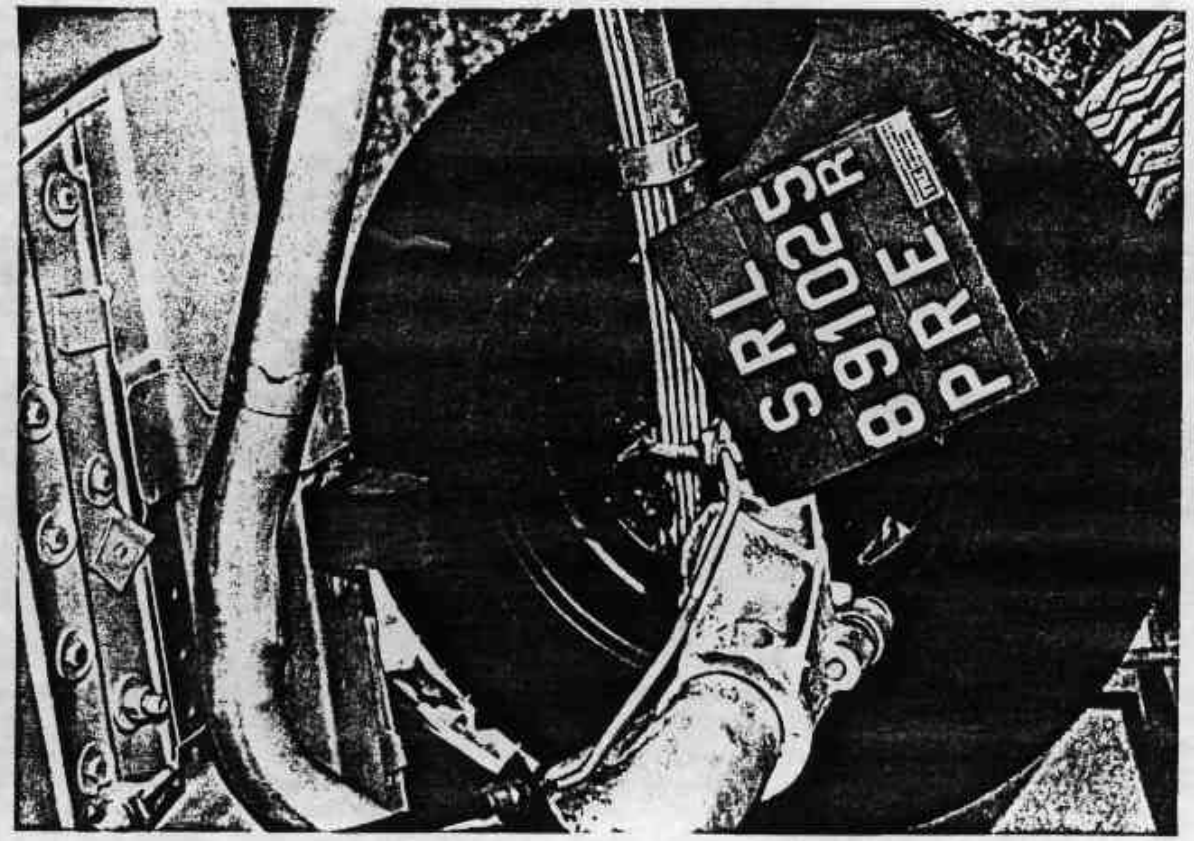


Figure A-16. PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 1

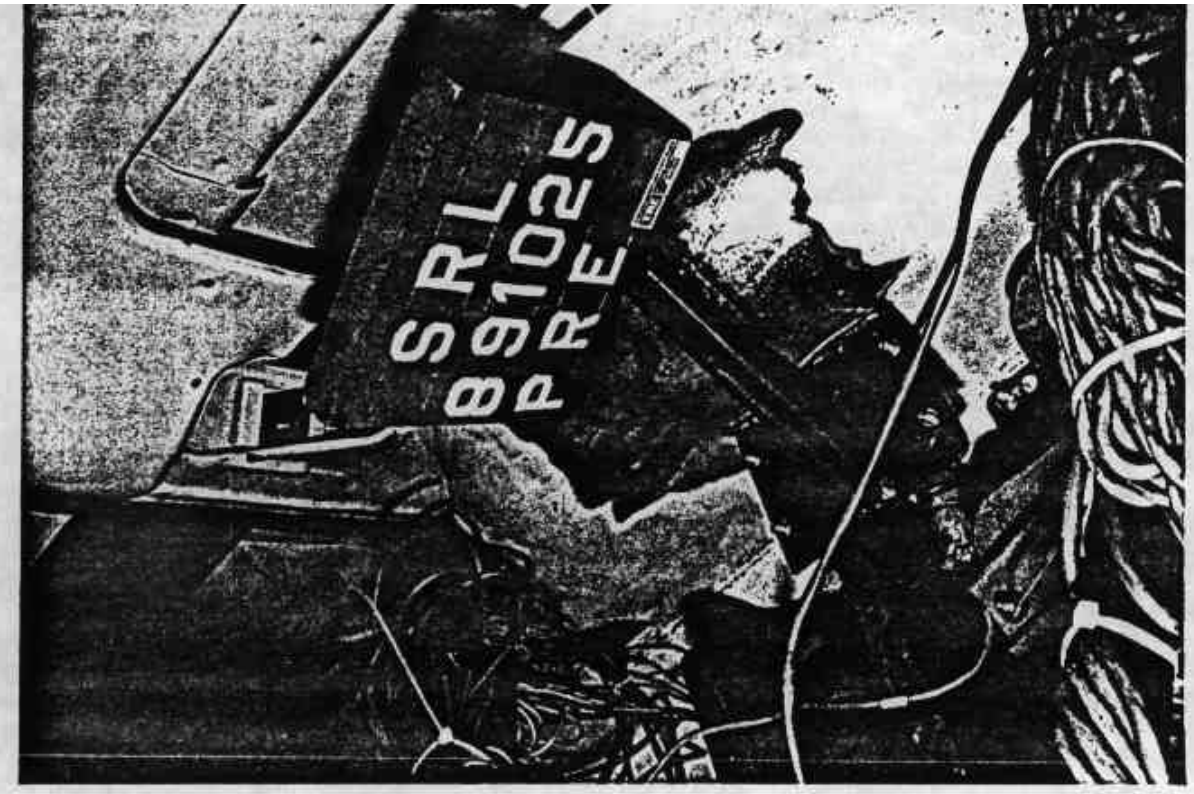


Figure A-17. PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2

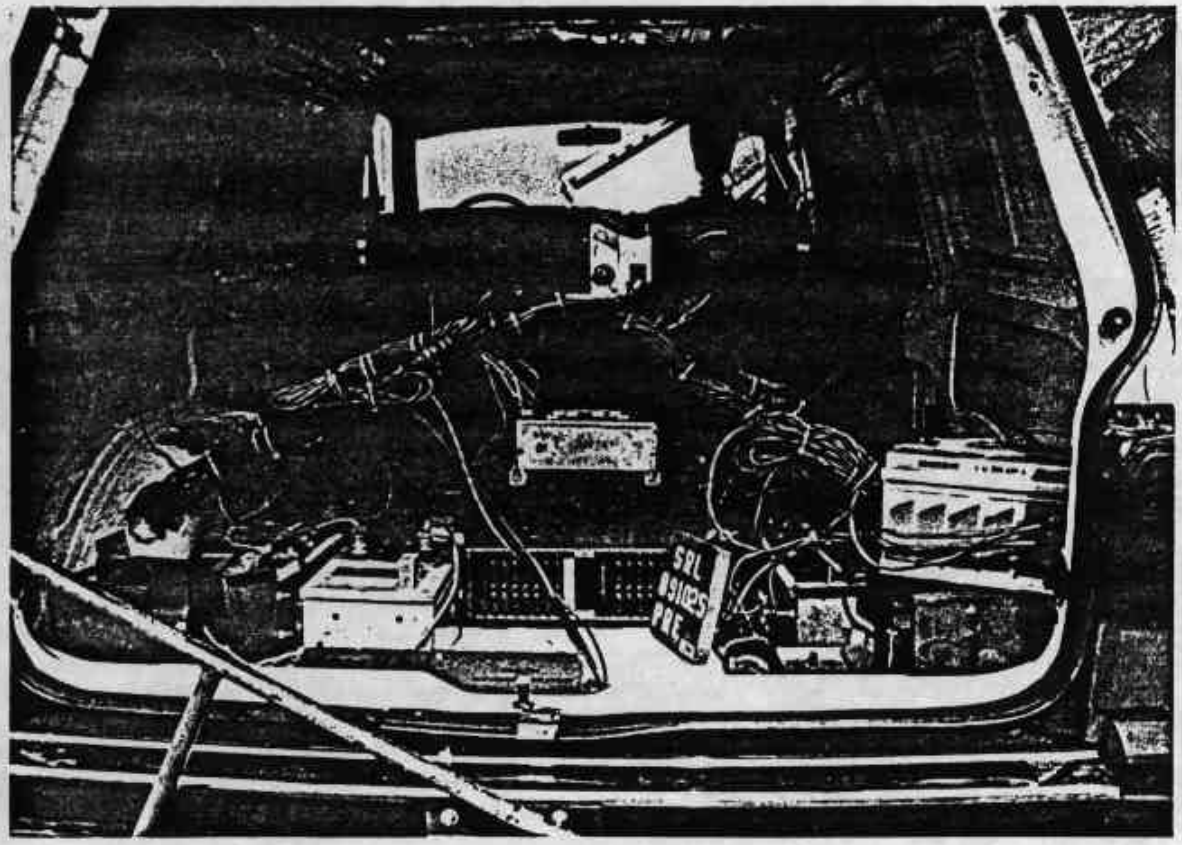


Figure A-18. PRE-TEST VEHICLE INSTRUMENTATION AND CAMERA LOCATION

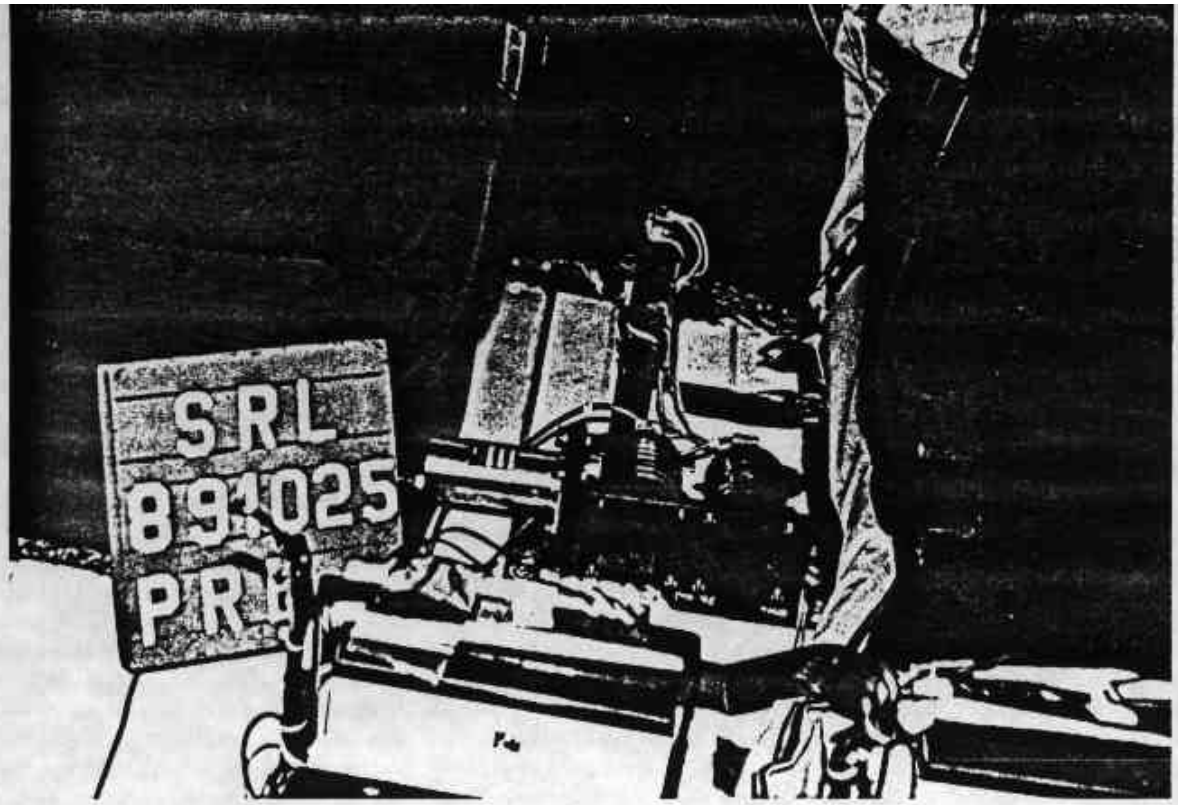


Figure A-19. PRE-TEST GYRO PLACEMENT VIEW

Figure A-20. POST-TEST OVERALL FRONT VIEW

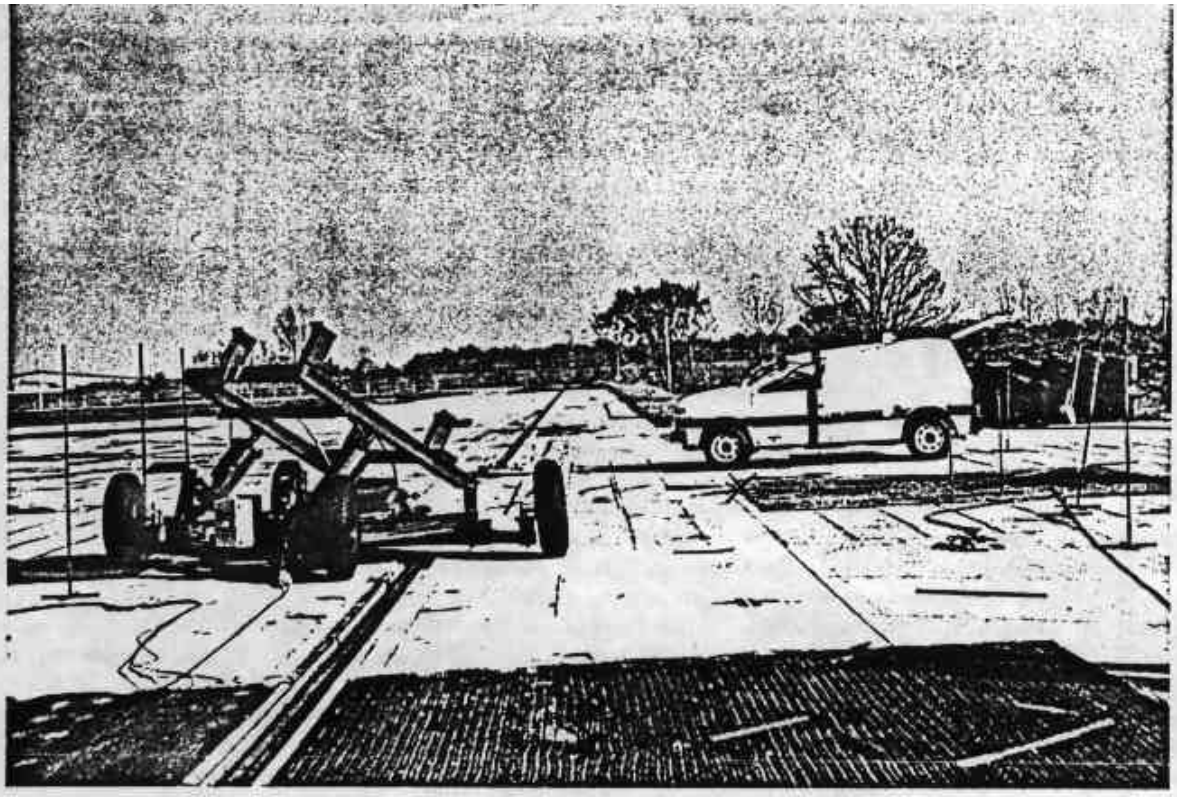


Figure A-21. POST-TEST OVERALL LEFT - VIEW 1

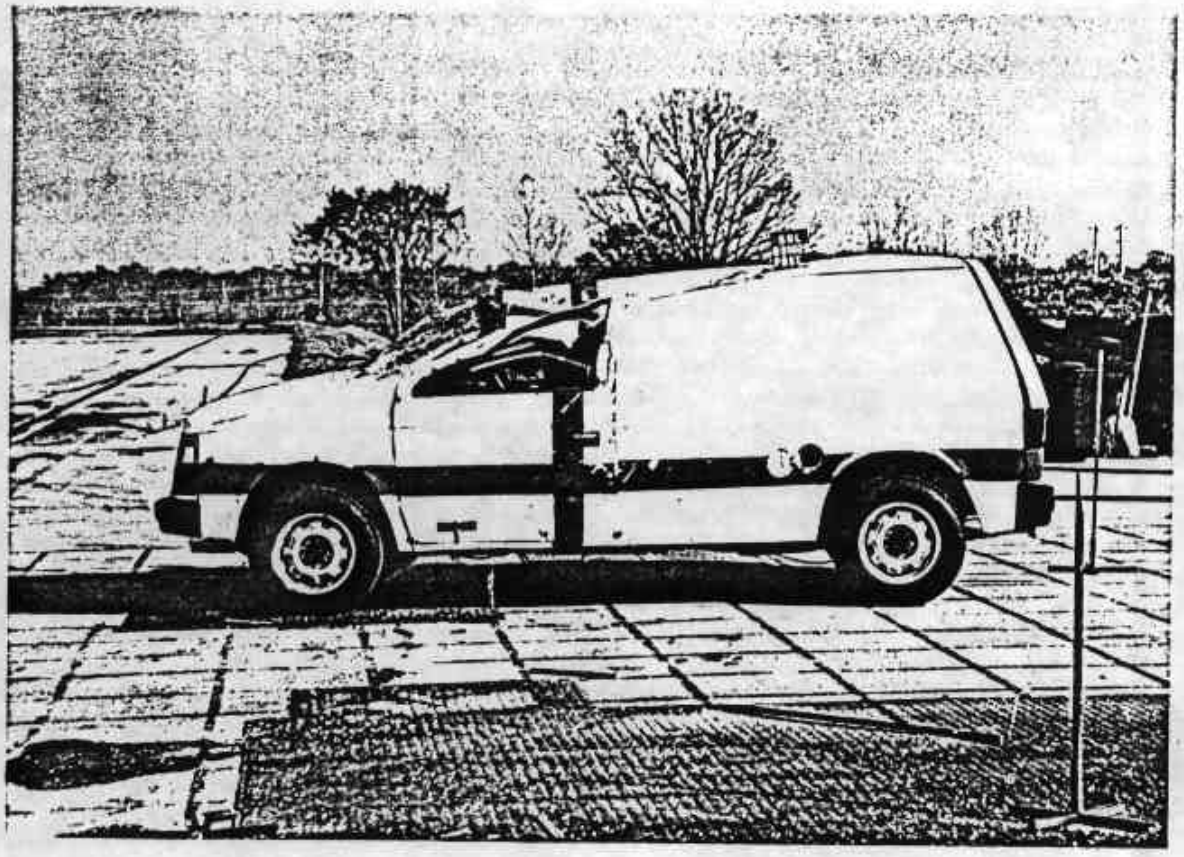


Figure A-22. POST-TEST OVERALL LEFT - VIEW 2

Figure A-23. POST-TEST CLOSE-UP LEFT VIEW

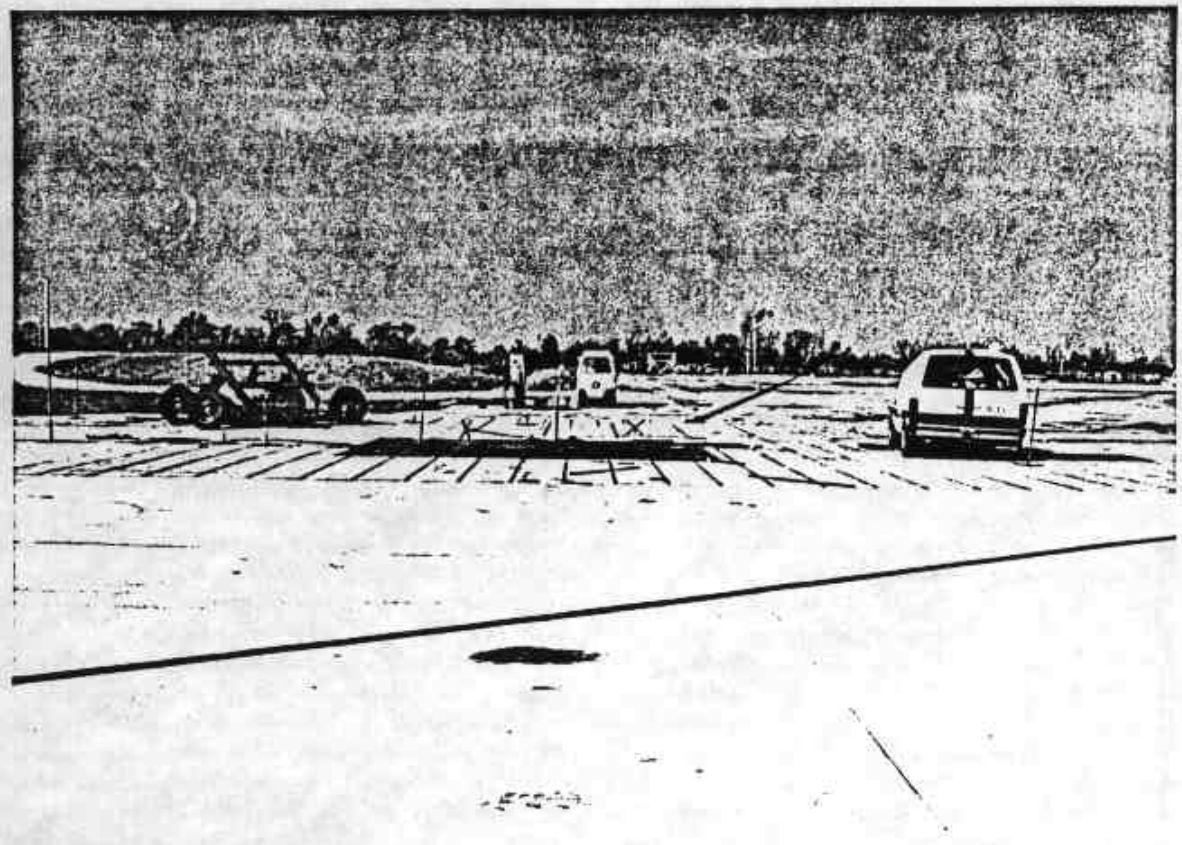


Figure A-24. POST-TEST OVERALL REAR - VIEW 1

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

Figure A-26. POST-TEST OVERALL RIGHT VIEW

Figure A-27. POST-TEST DUMMY AND VEHICLE - VIEW 1

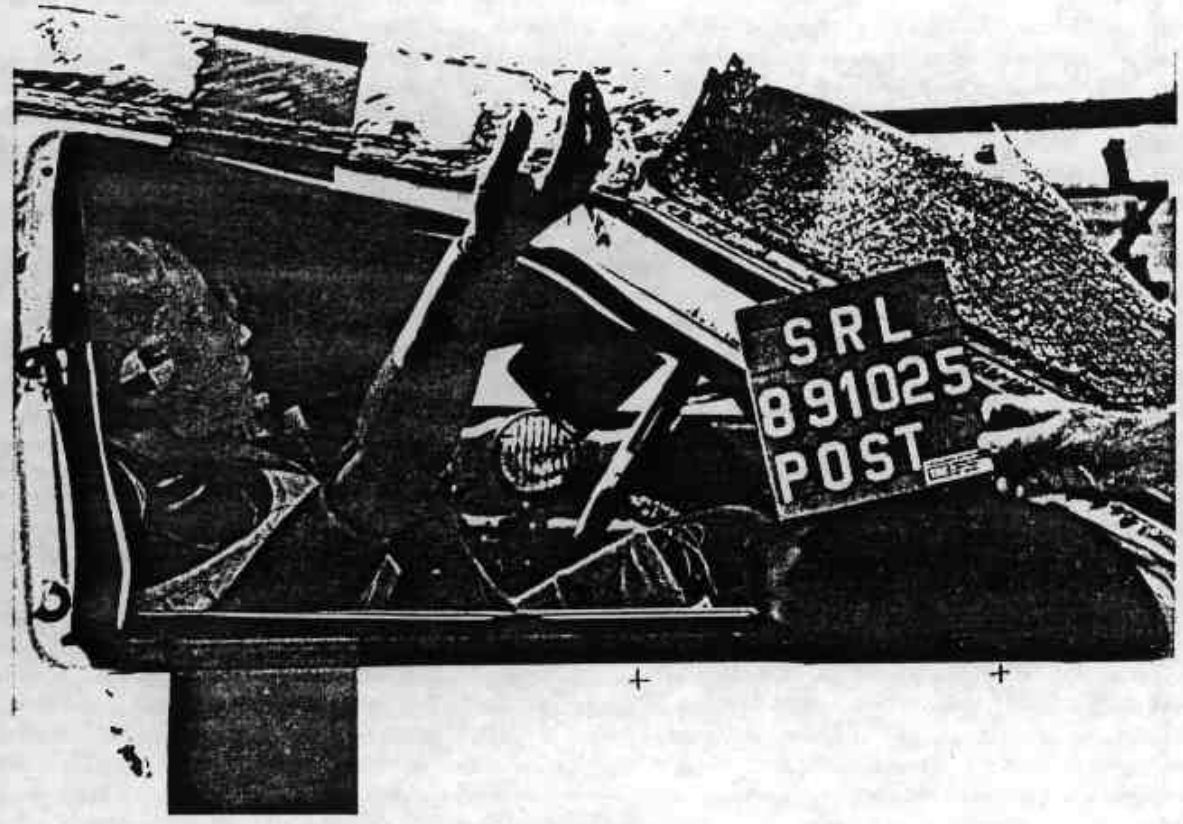


Figure A-28. POST-TEST DUMMY AND VEHICLE - VIEW 2

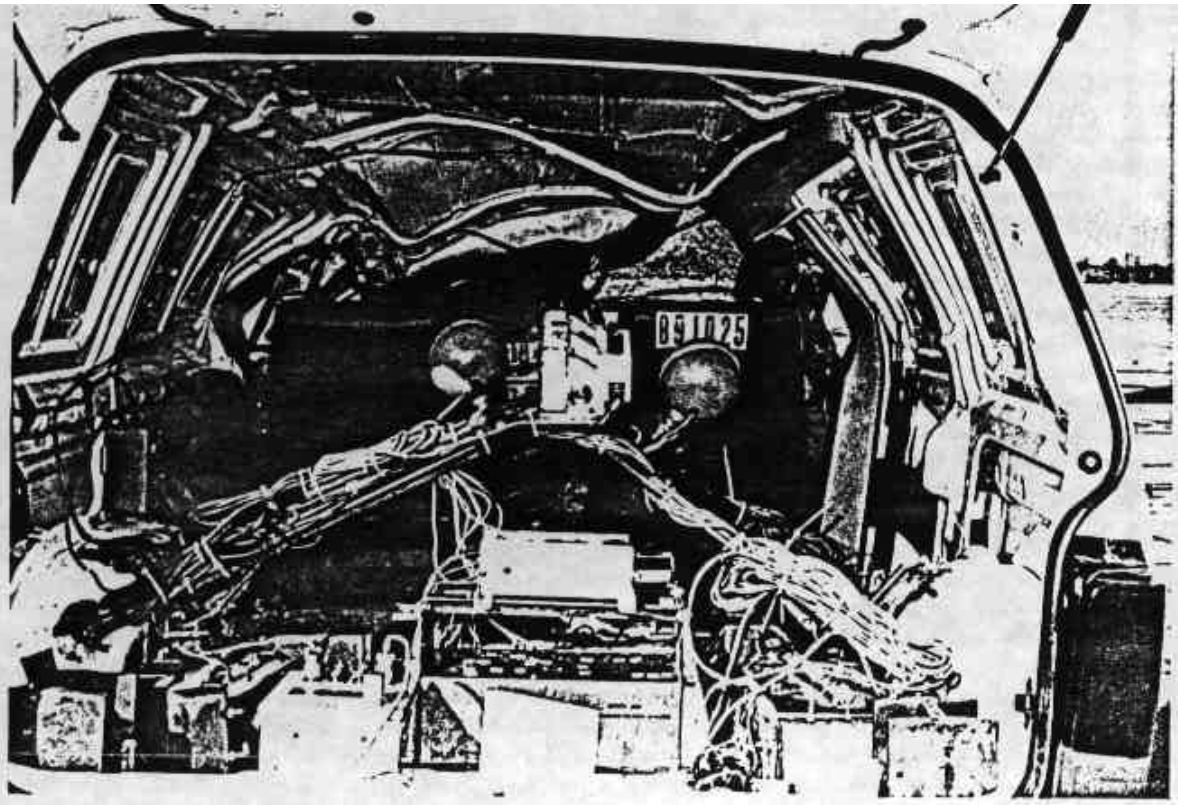


Figure A-29. POST-TEST DUMMY AND VEHICLE - VIEW 3

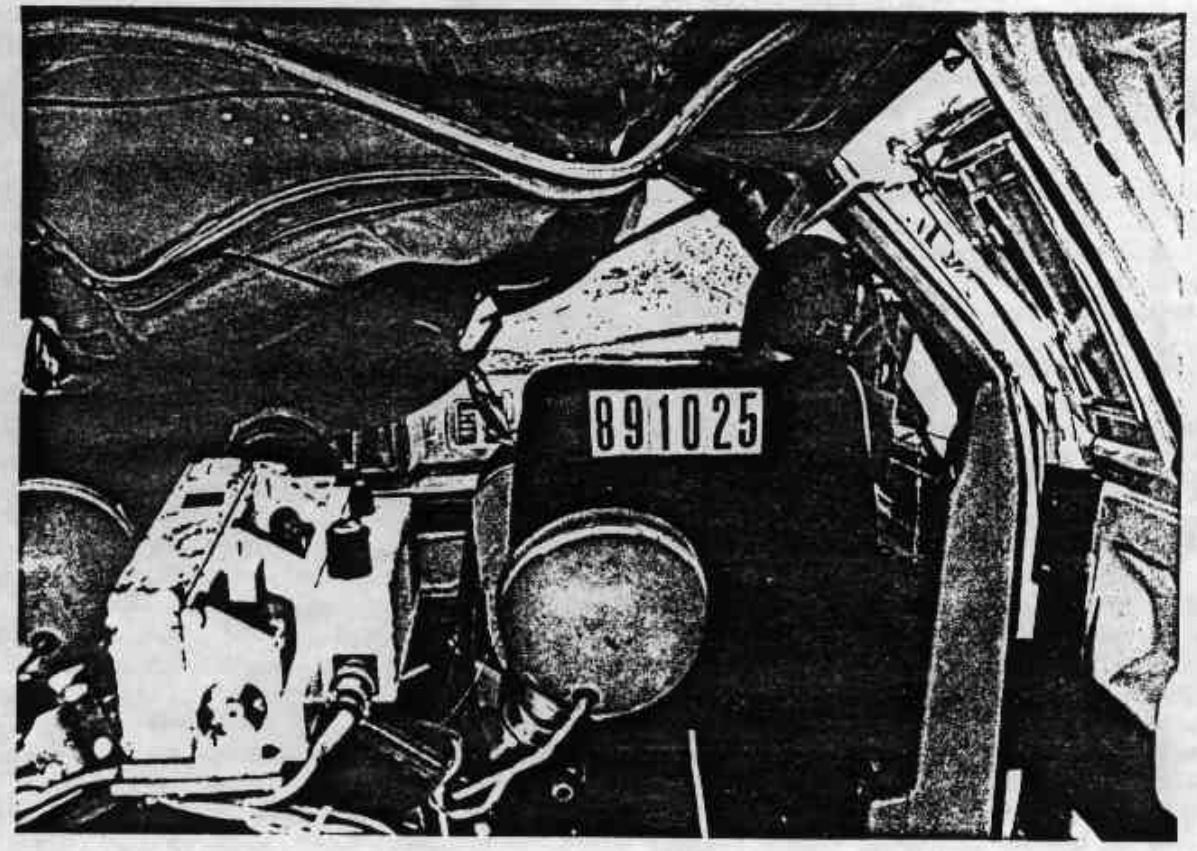


Figure A-30. POST-TEST DUMMY AND VEHICLE - VIEW 4

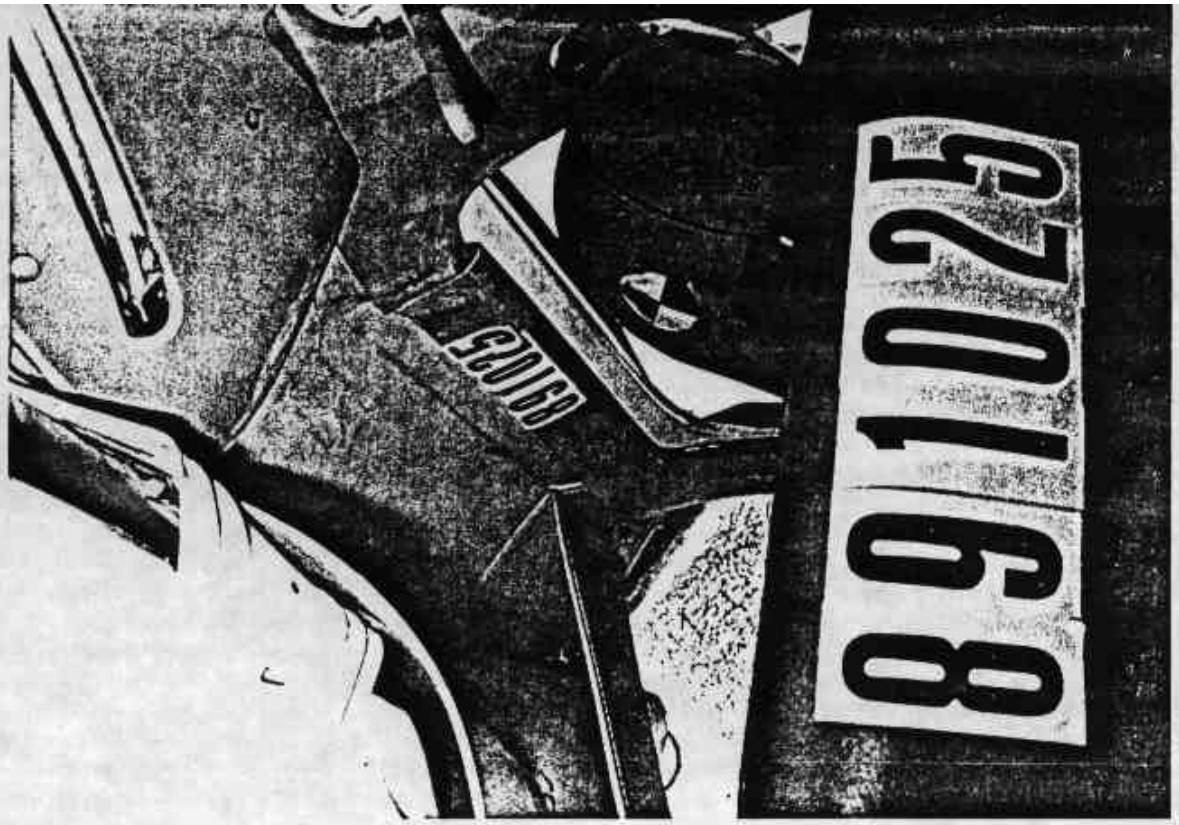


Figure A-31. POST-TEST DUMMY AND VEHICLE - VIEW 5

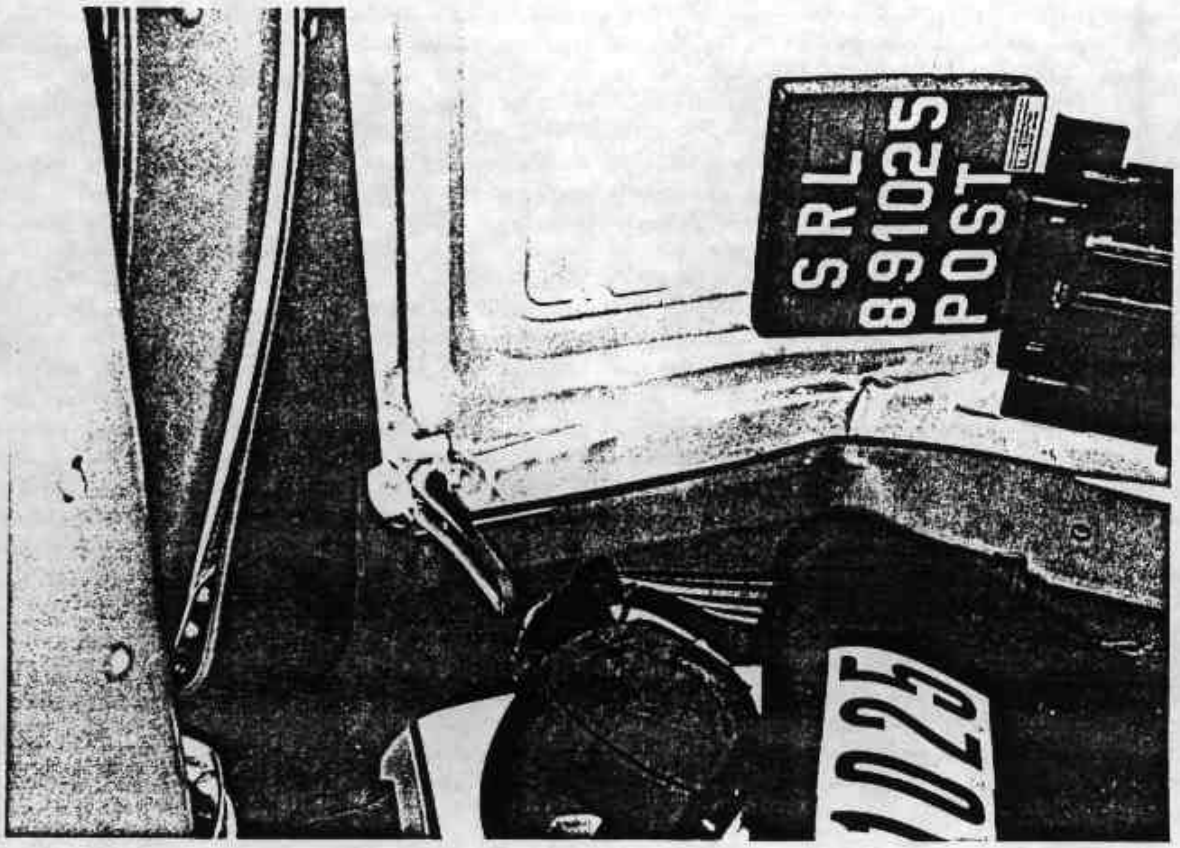
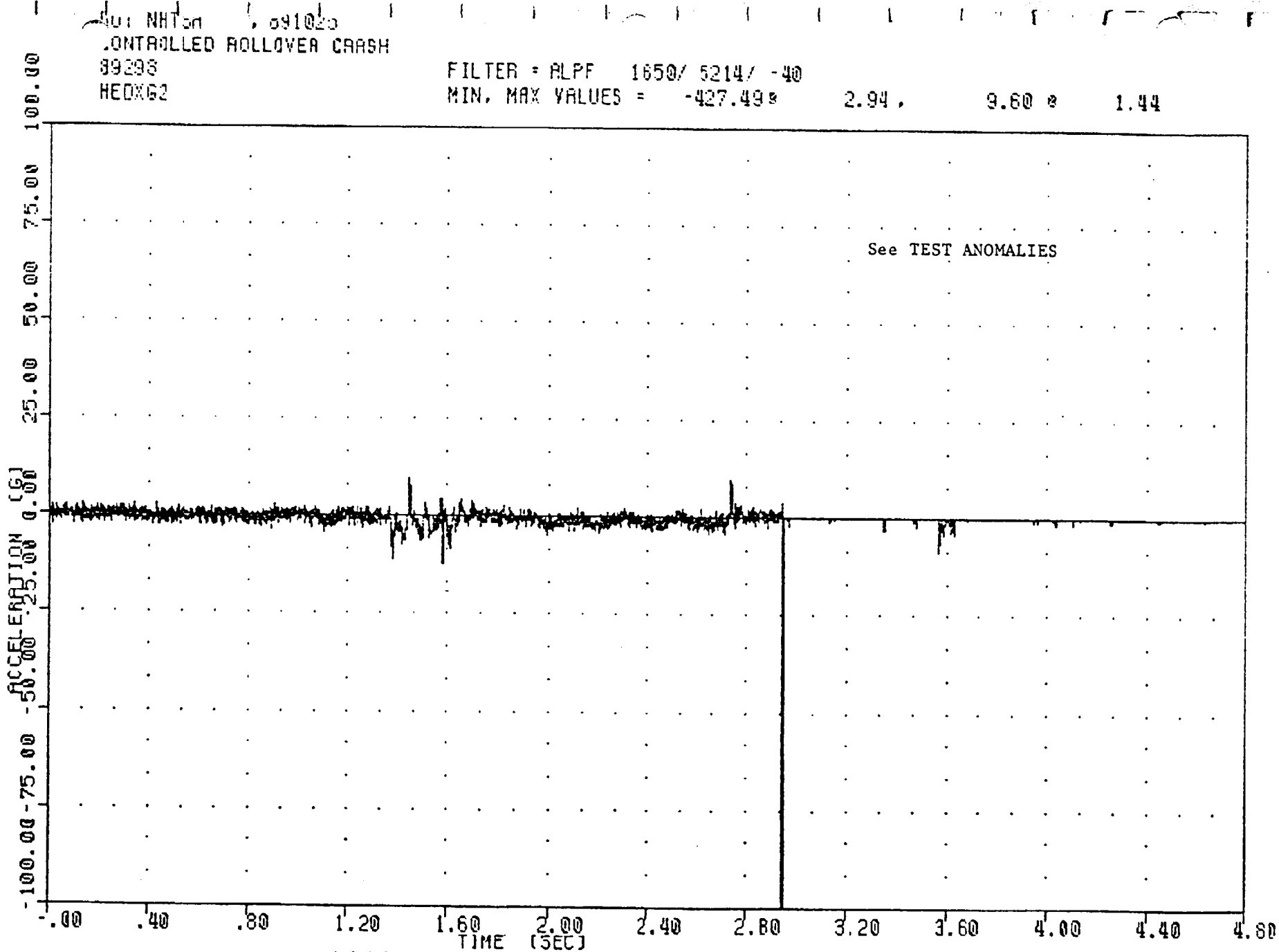


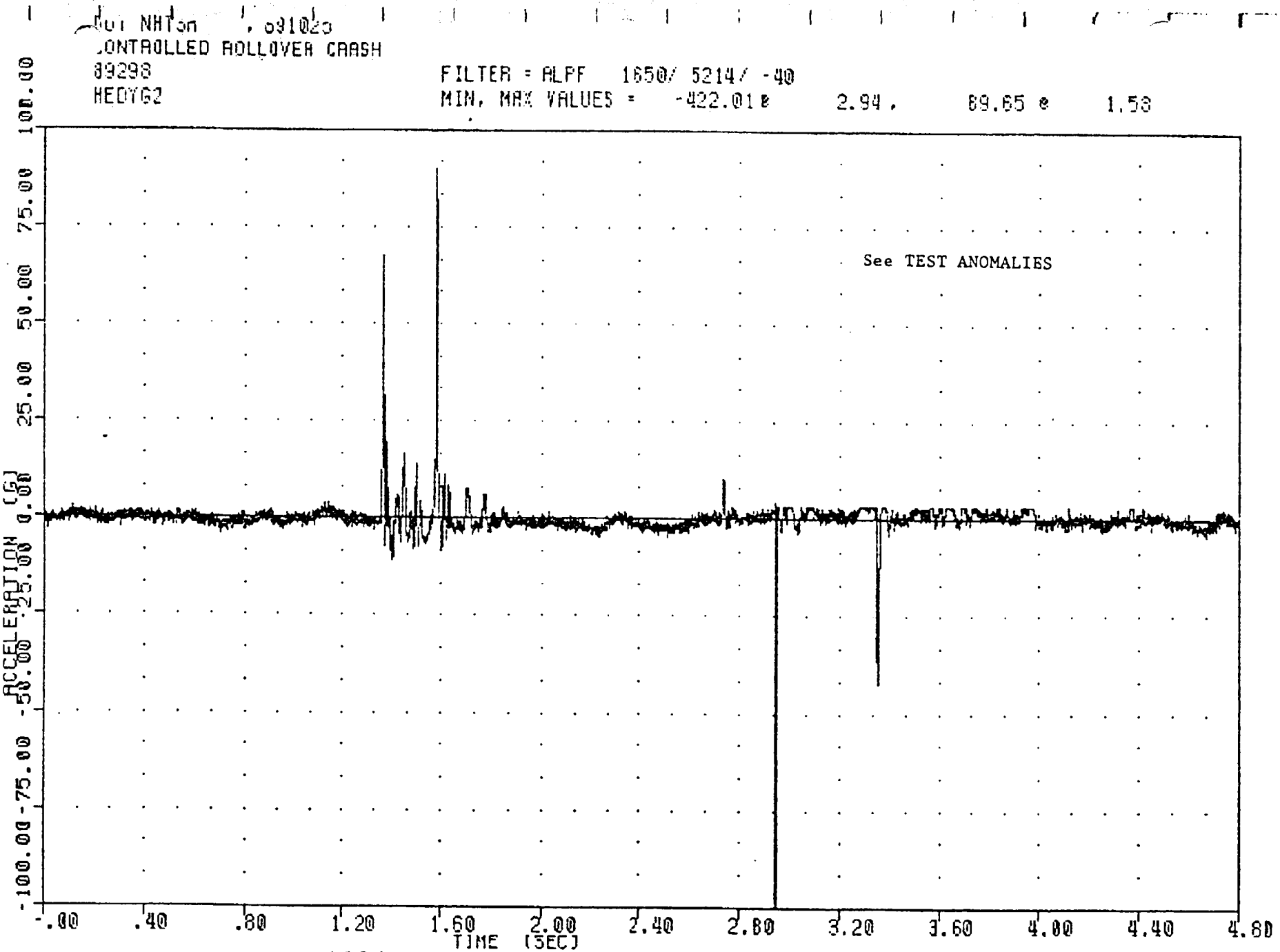
Figure A-32. POST-TEST DUMMY AND VEHICLE - VIEW 6

APPENDIX B

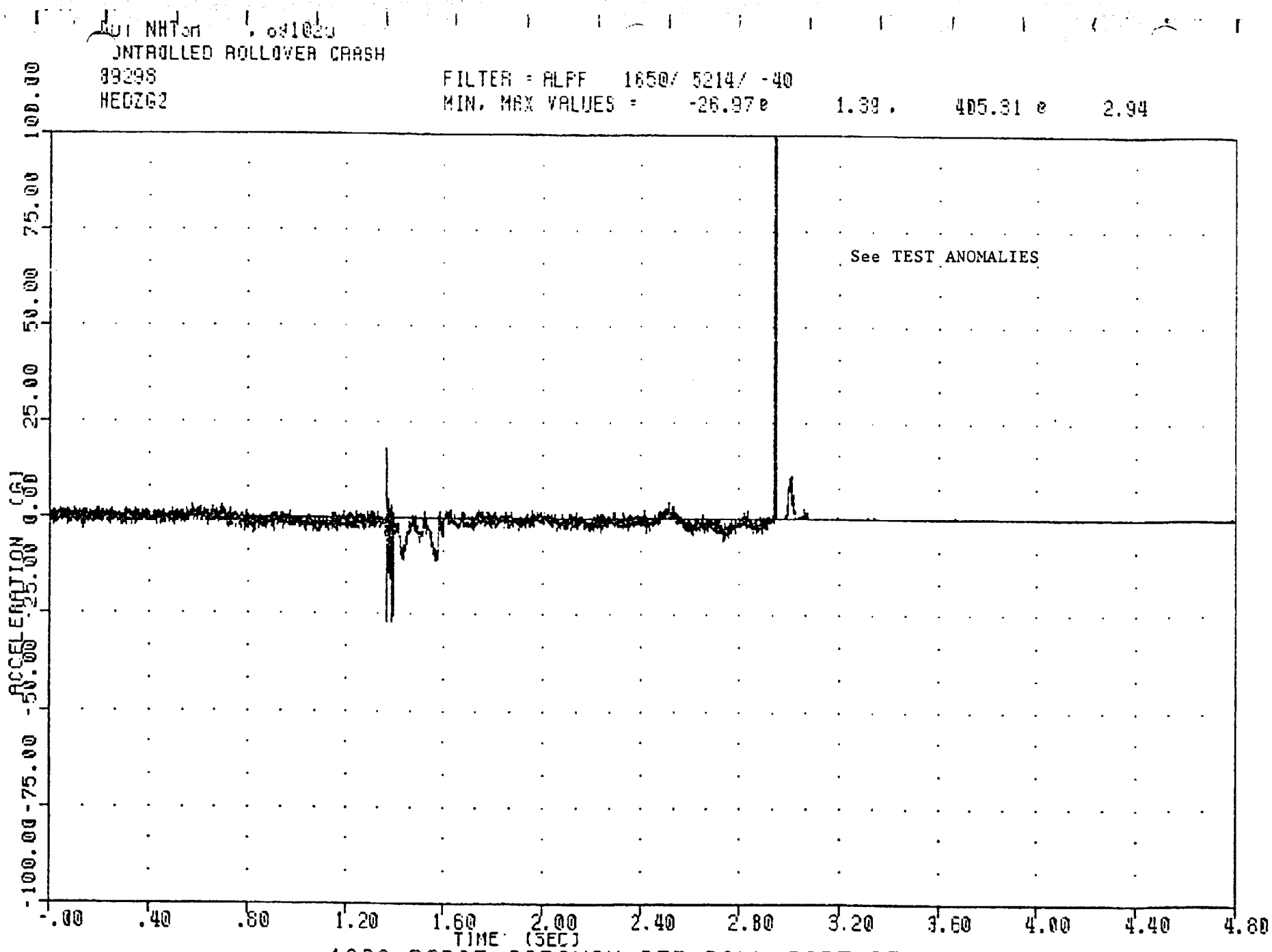
DATA PLOT PRESENTATION



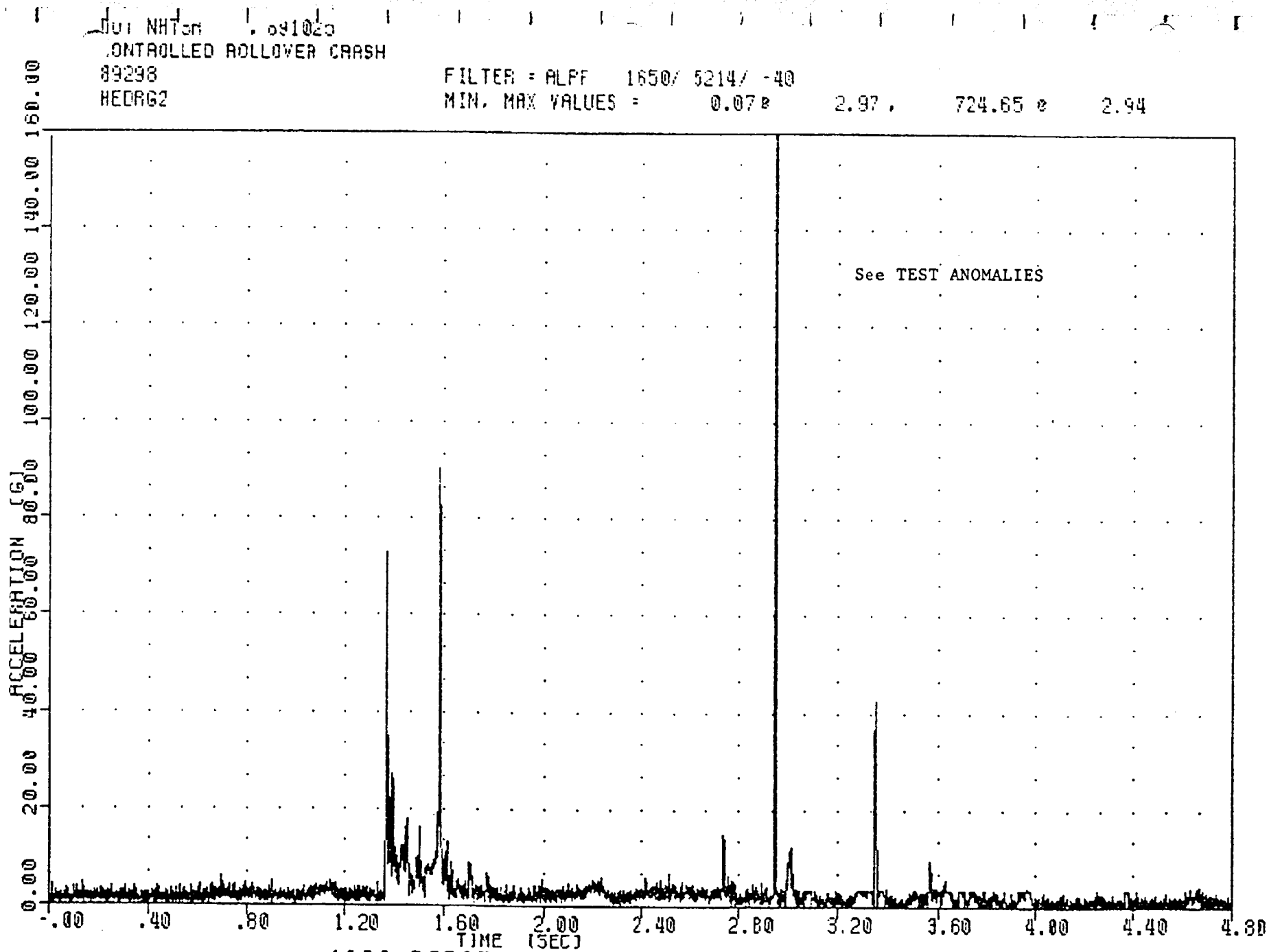
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER HEAD X AXIS ACCELERATION



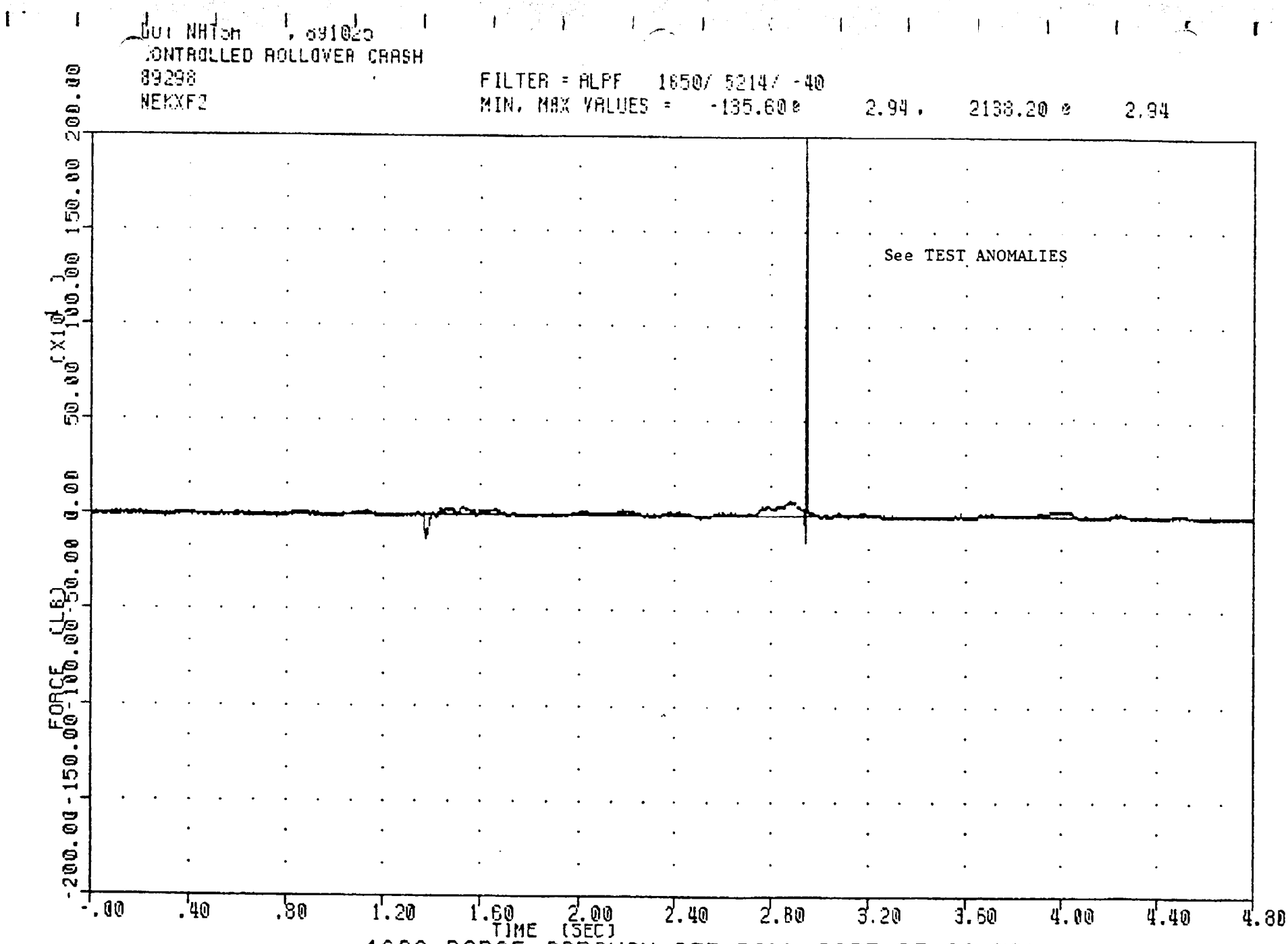
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER HEAD Y AXIS ACCELERATION



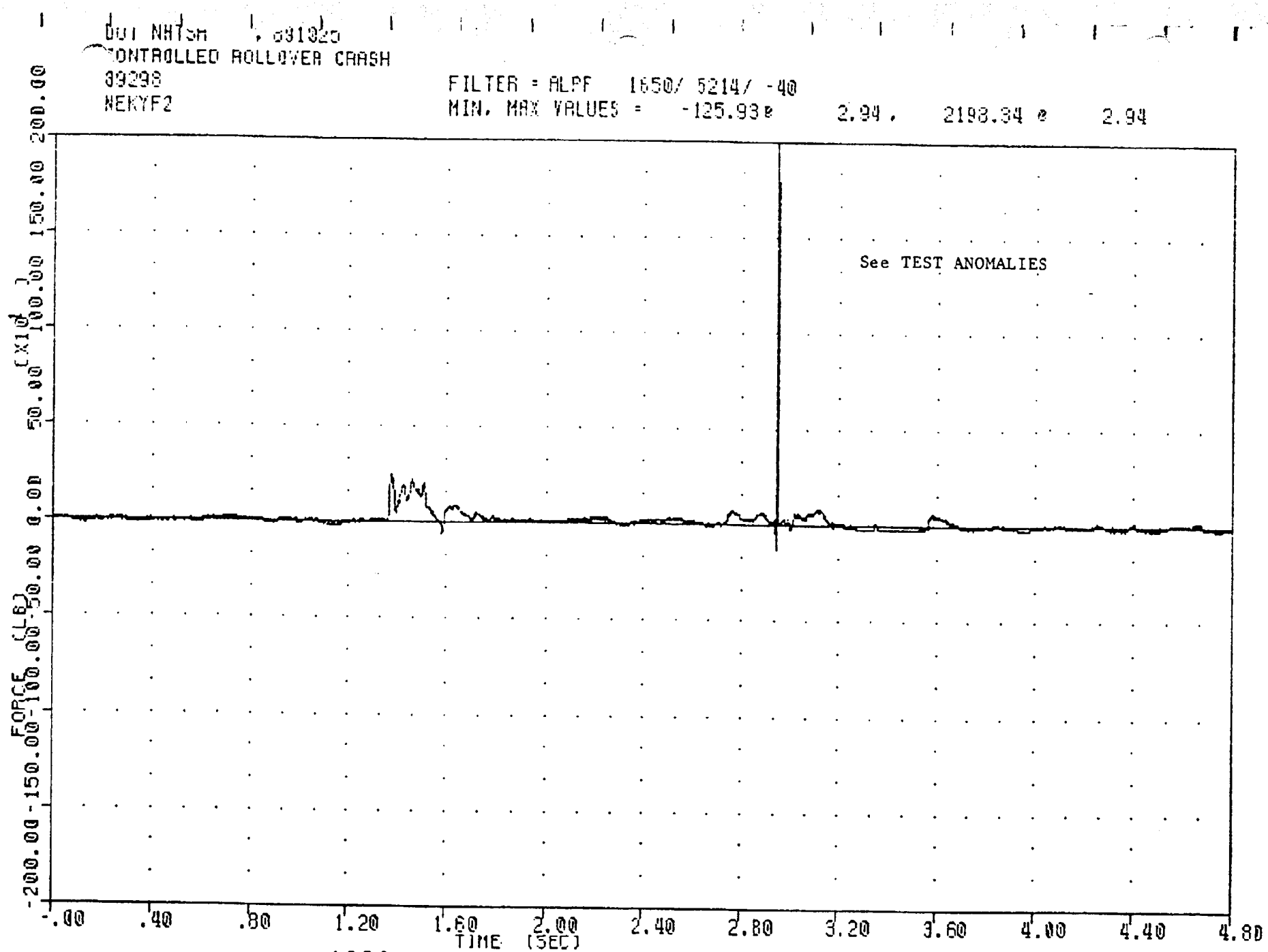
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER HEAD Z AXIS ACCELERATION



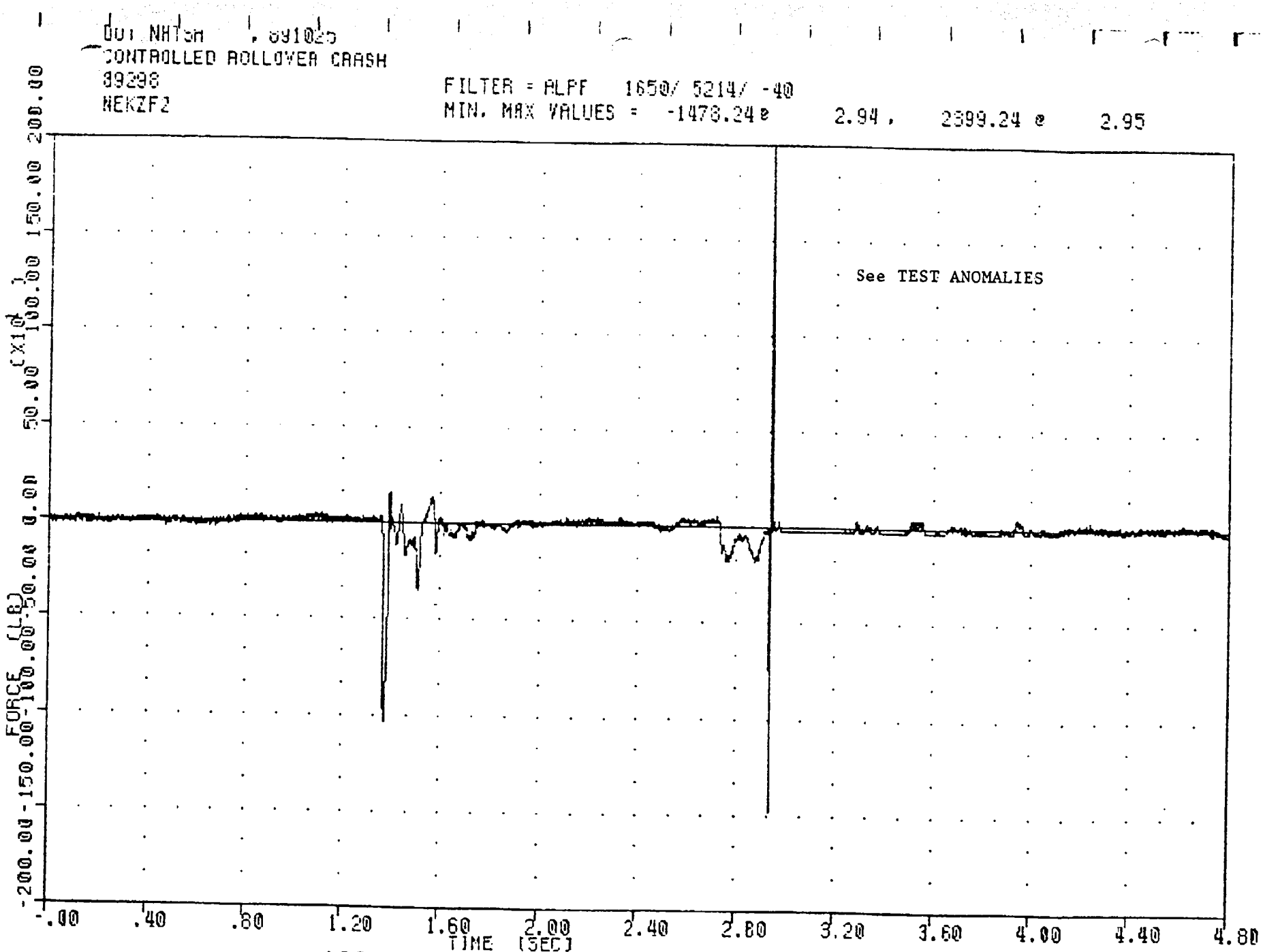
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER HEAD RESULTANT ACCELERATION



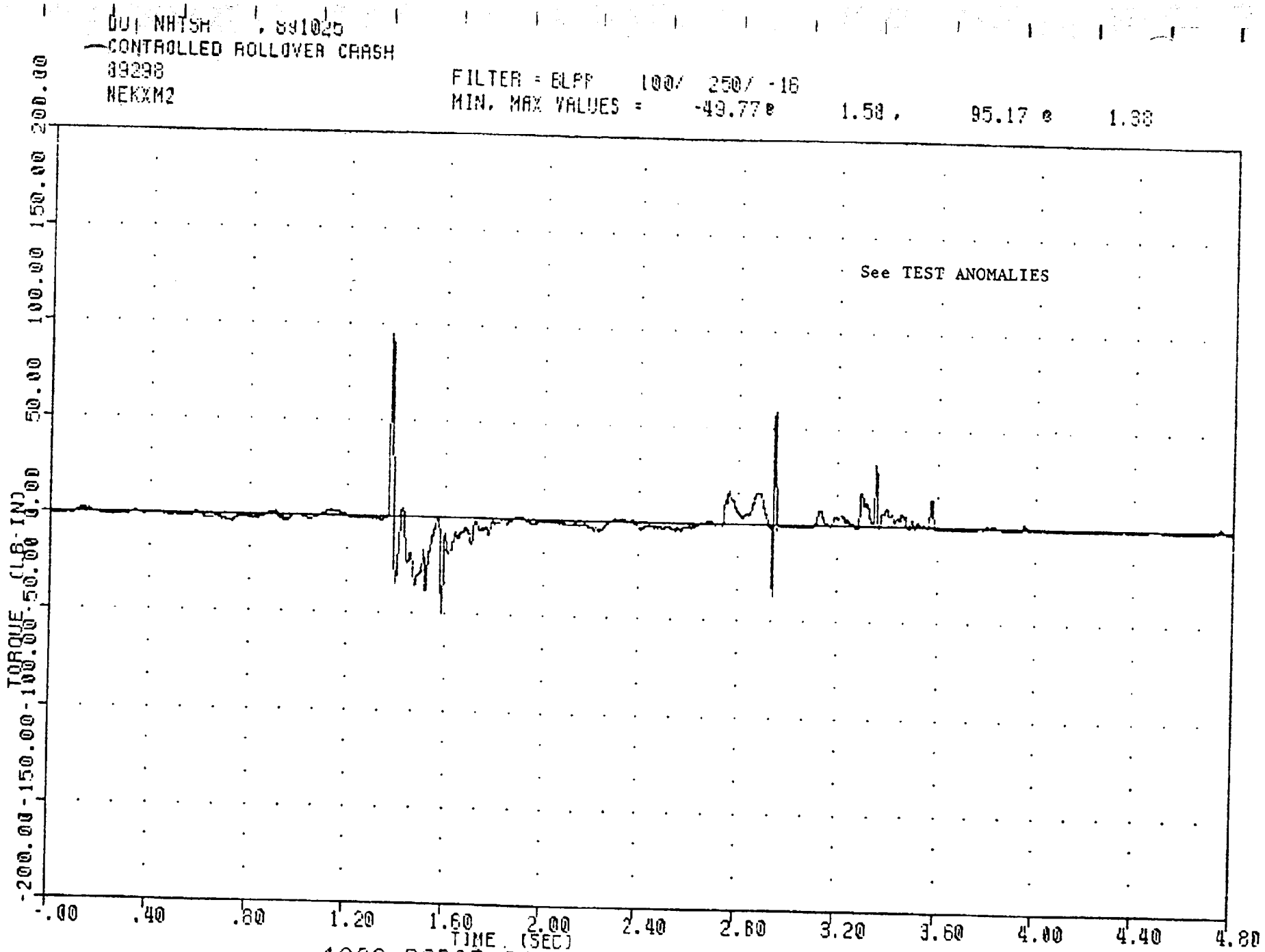
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK SHEAR FORCE X AXIS



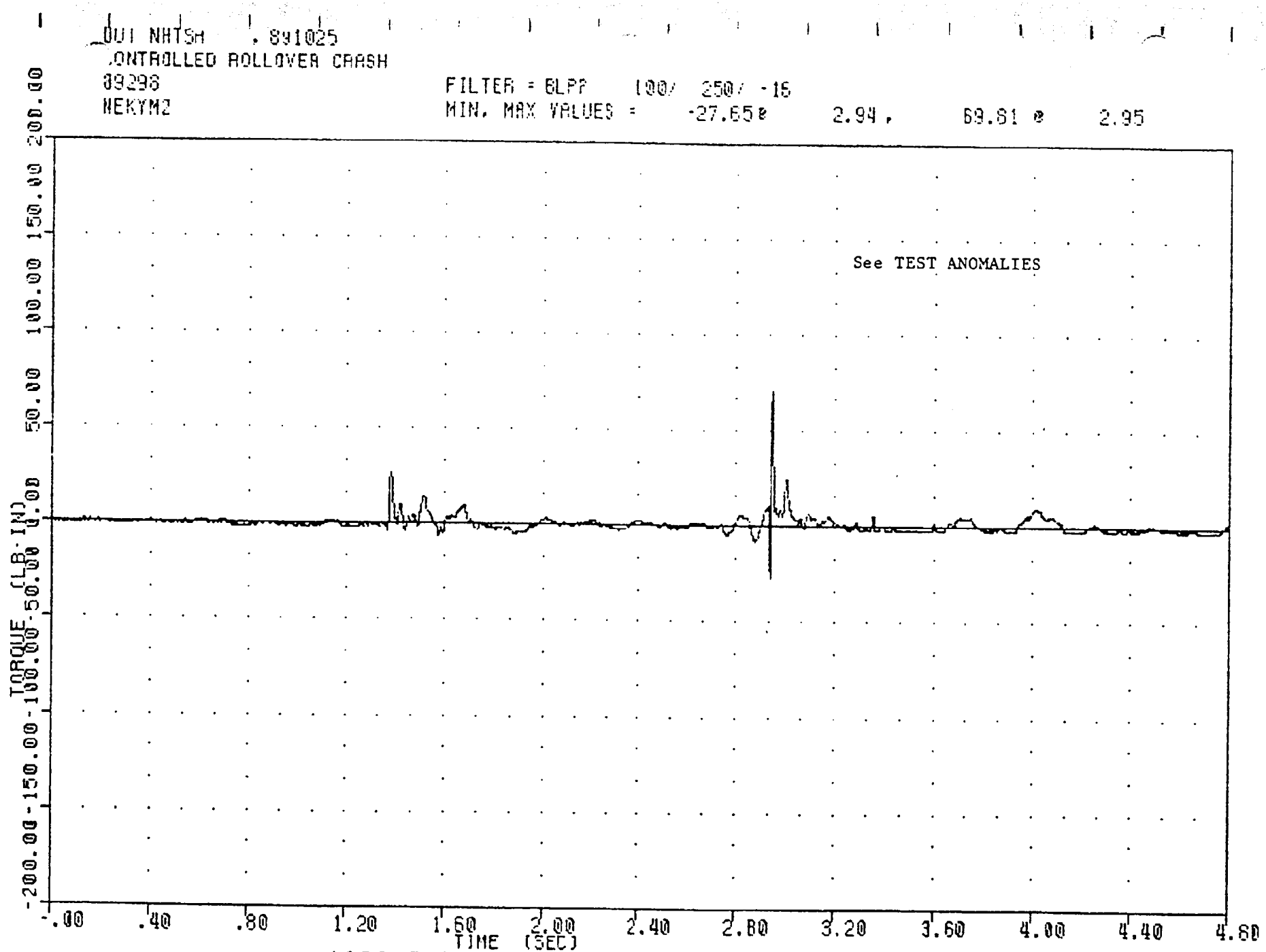
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK SHEAR FORCE Y AXIS



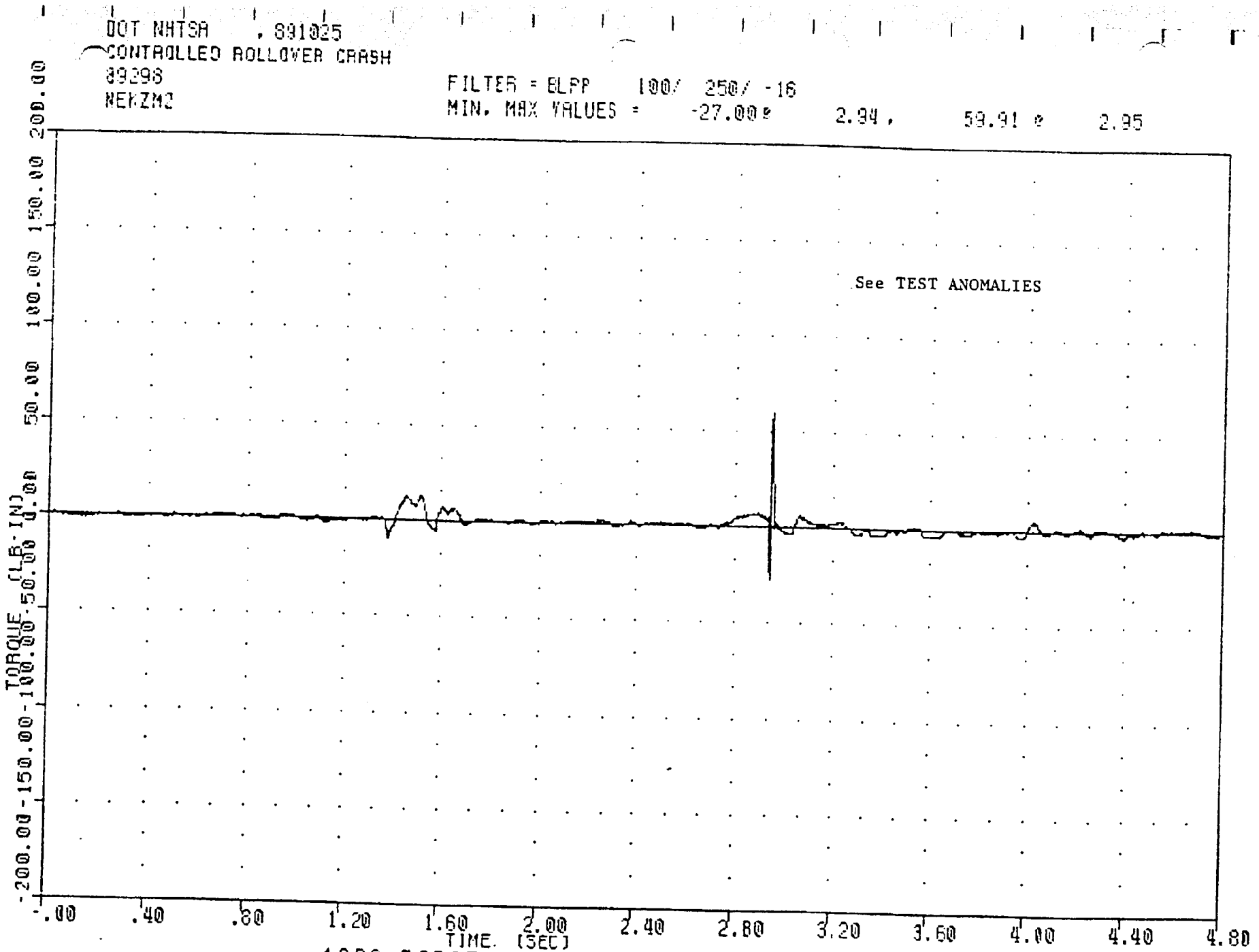
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK AXIAL FORCE Z AXIS



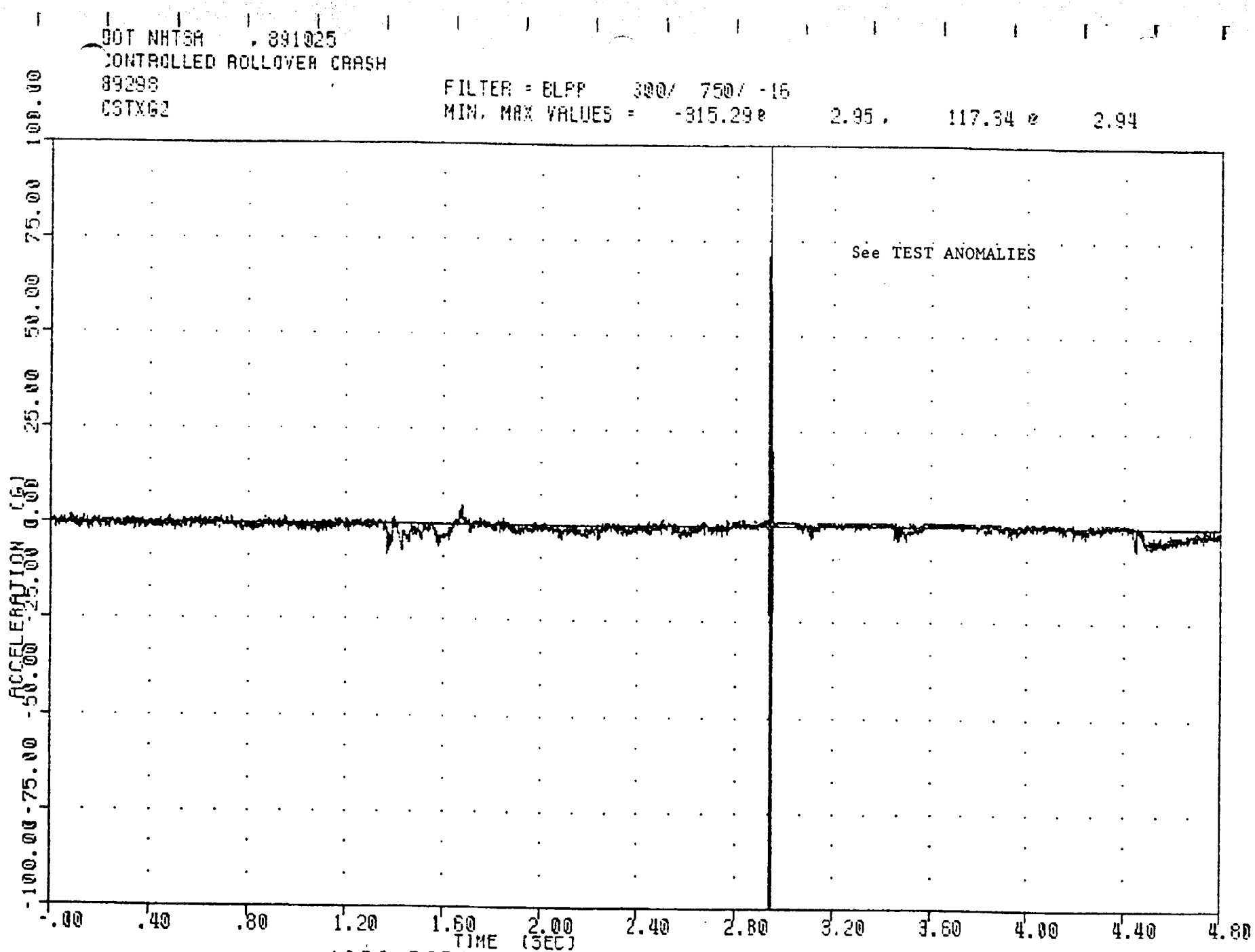
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT X AXIS



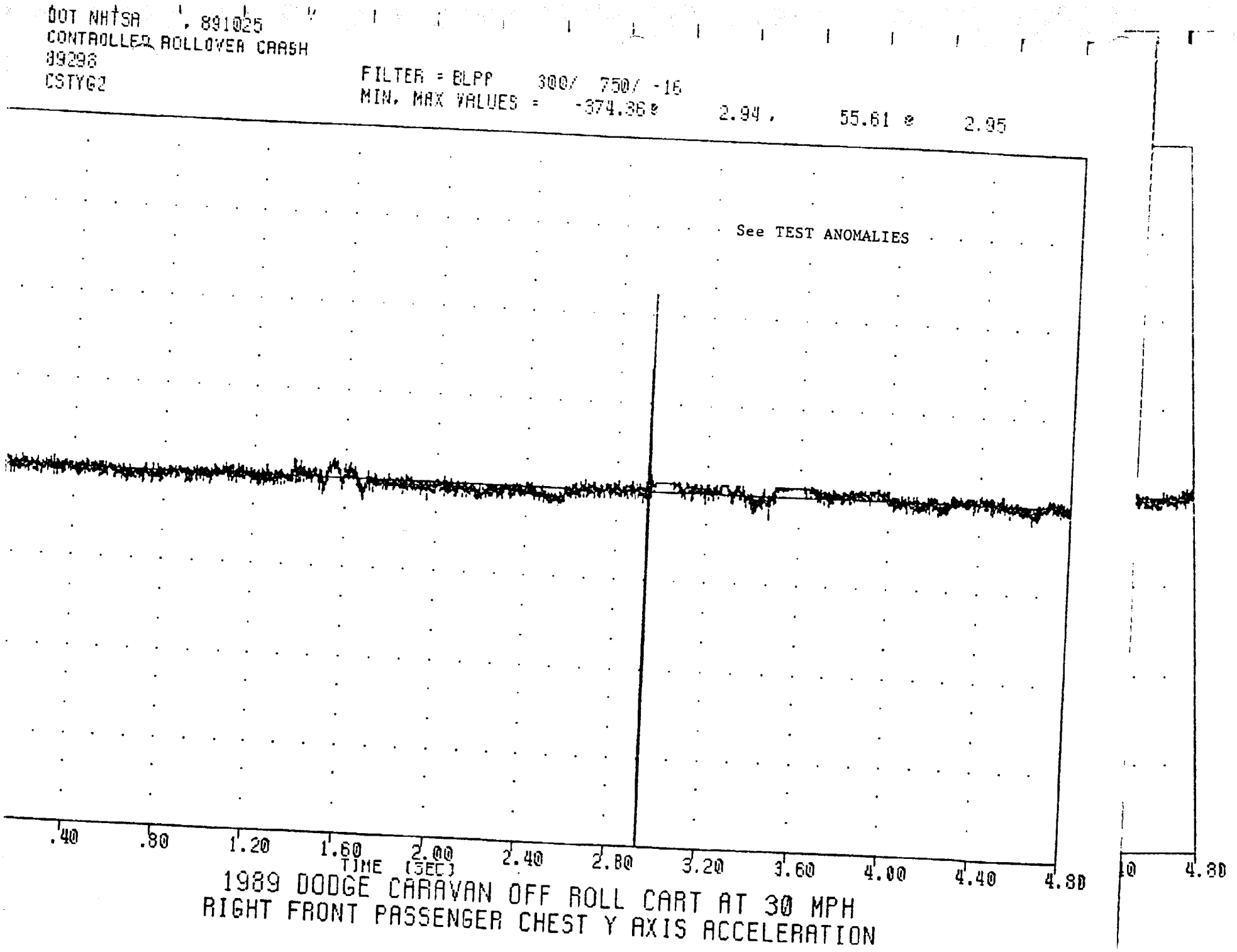
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT Y AXIS

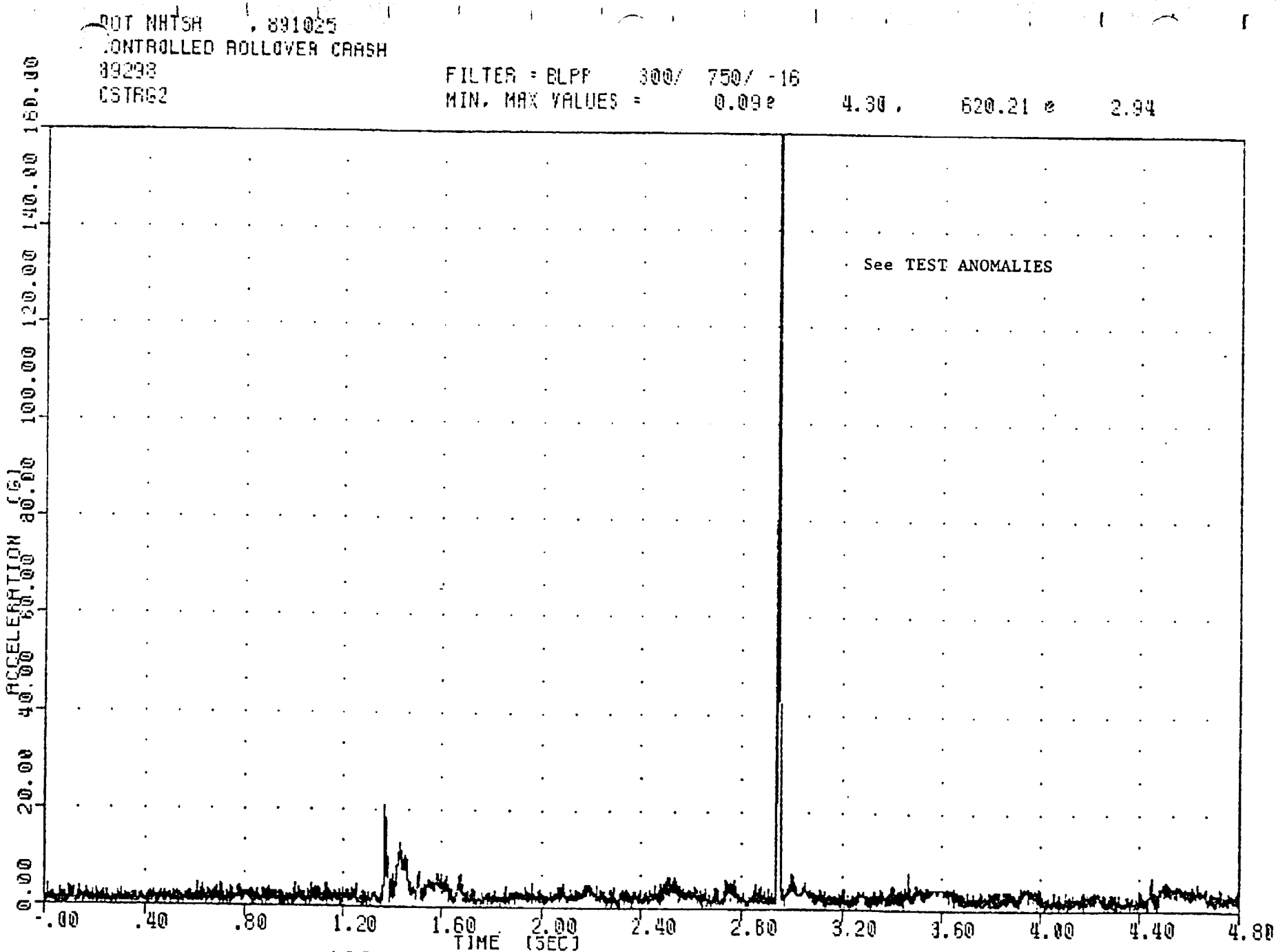


1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER NECK MOMENT ABOUT Z AXIS

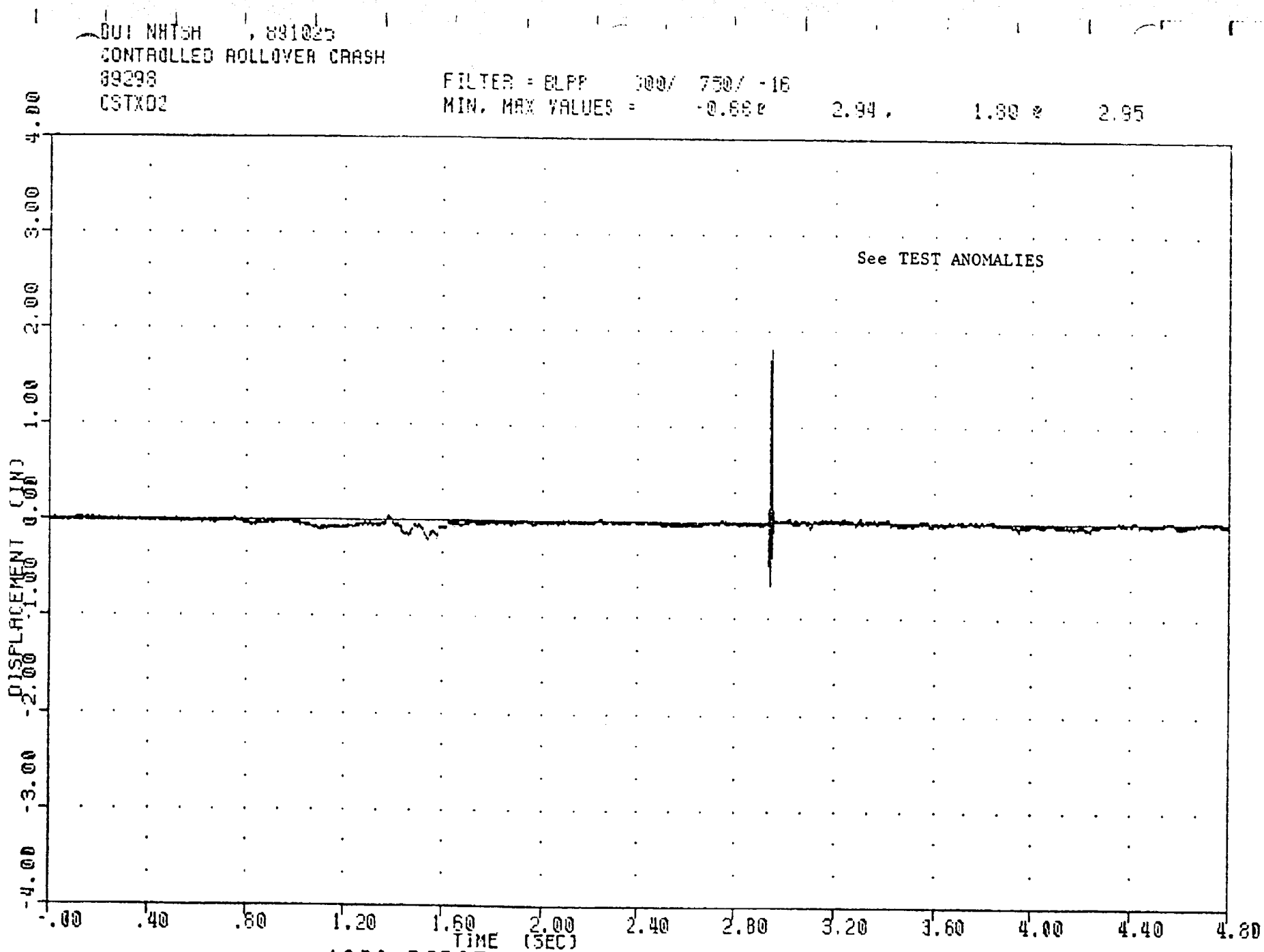


1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER CHEST X AXIS ACCELERATION

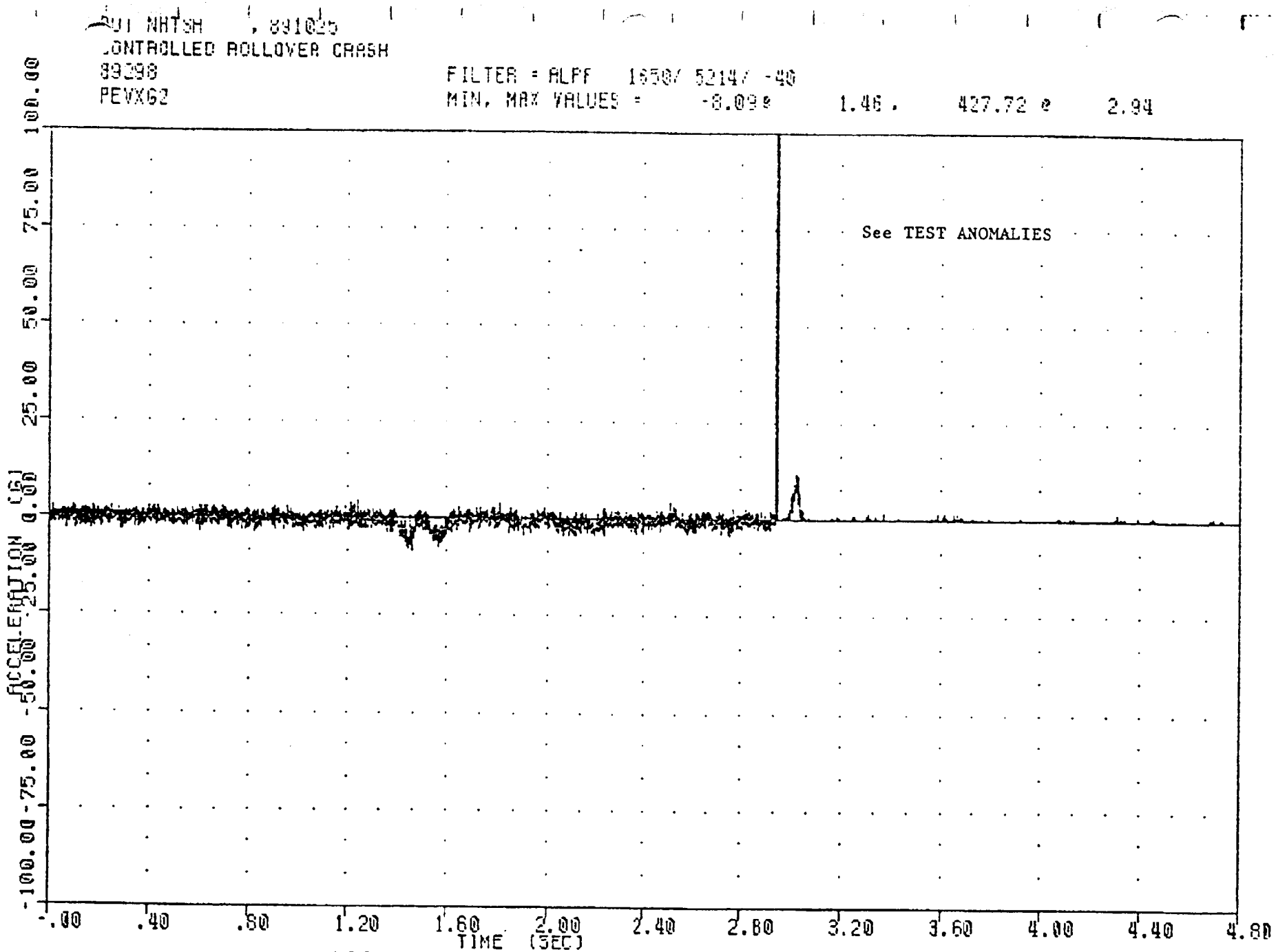

DOT NHTSA 891025
CONTROLLED ROLLOVER CRASH
89298
CSTYG2
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = -374.36 @ 2.94 , 55.61 @ 2.95
See TEST ANOMALIES
.40
.80
1.20
1.60
2.00
2.40
2.80
3.20
3.60
4.00
4.40
4.80
TIME (SEC)
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER CHEST Y AXIS ACCELERATION



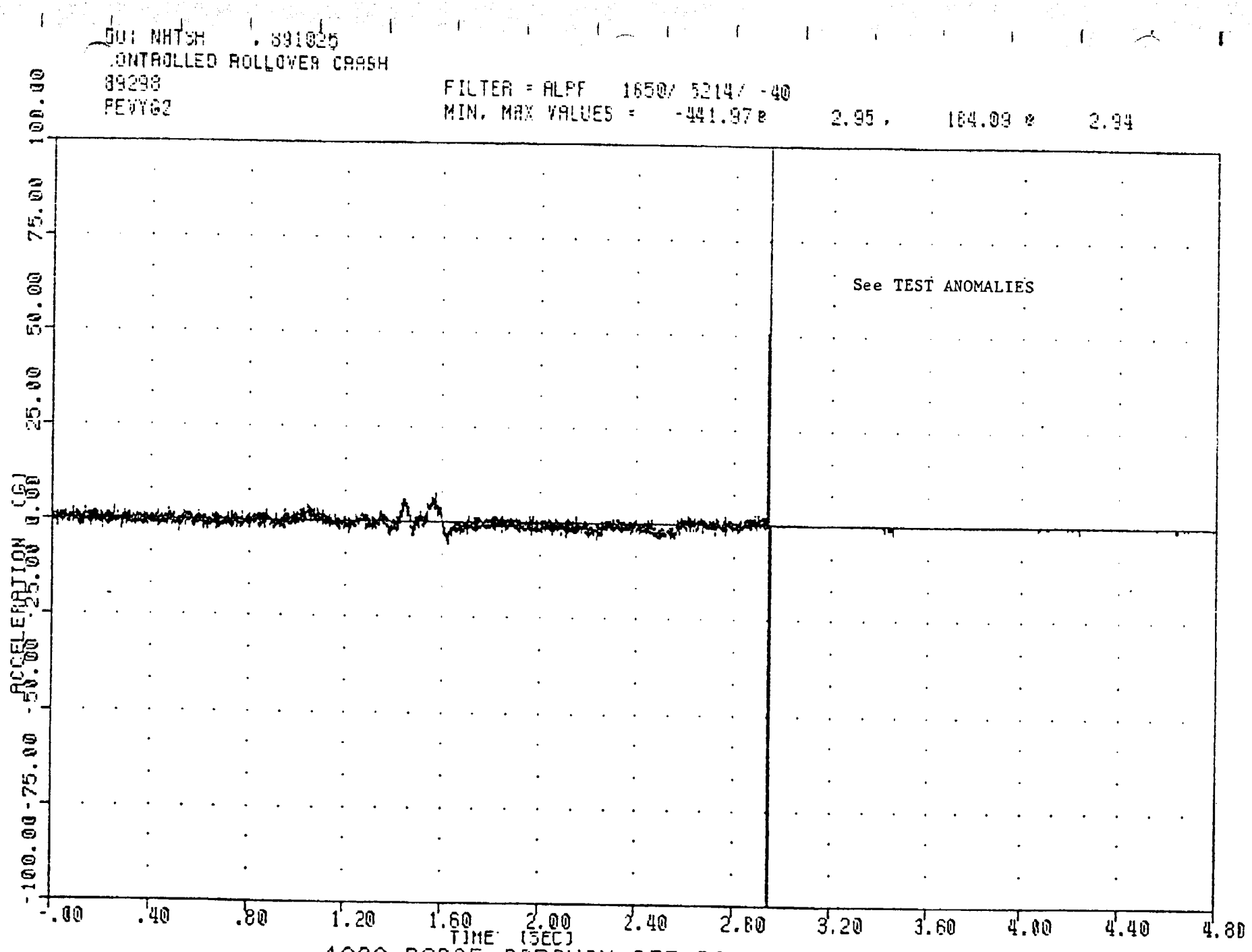
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER CHEST RESULTANT ACCELERATION



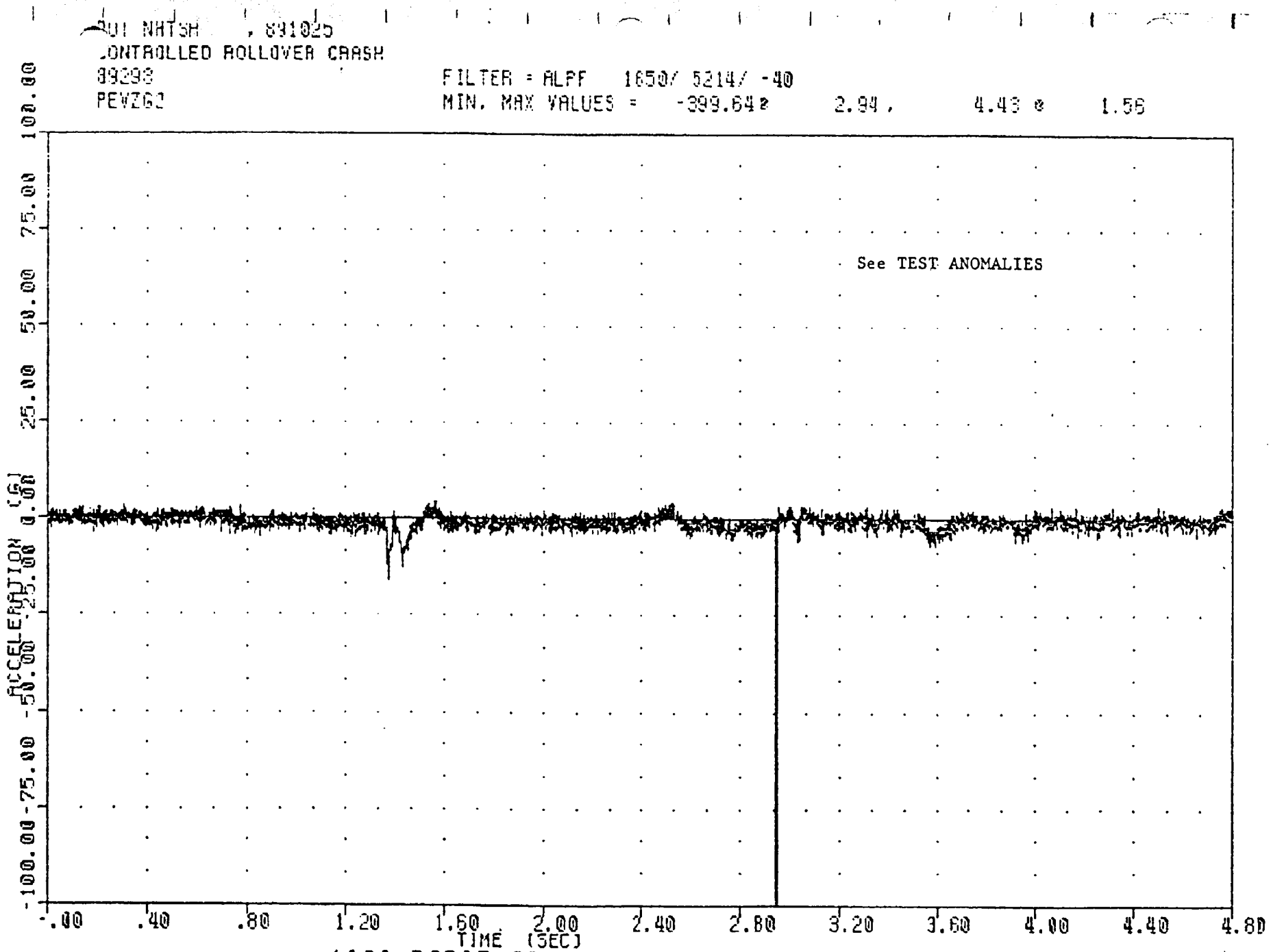
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER CHEST X AXIS DISPLACEMENT



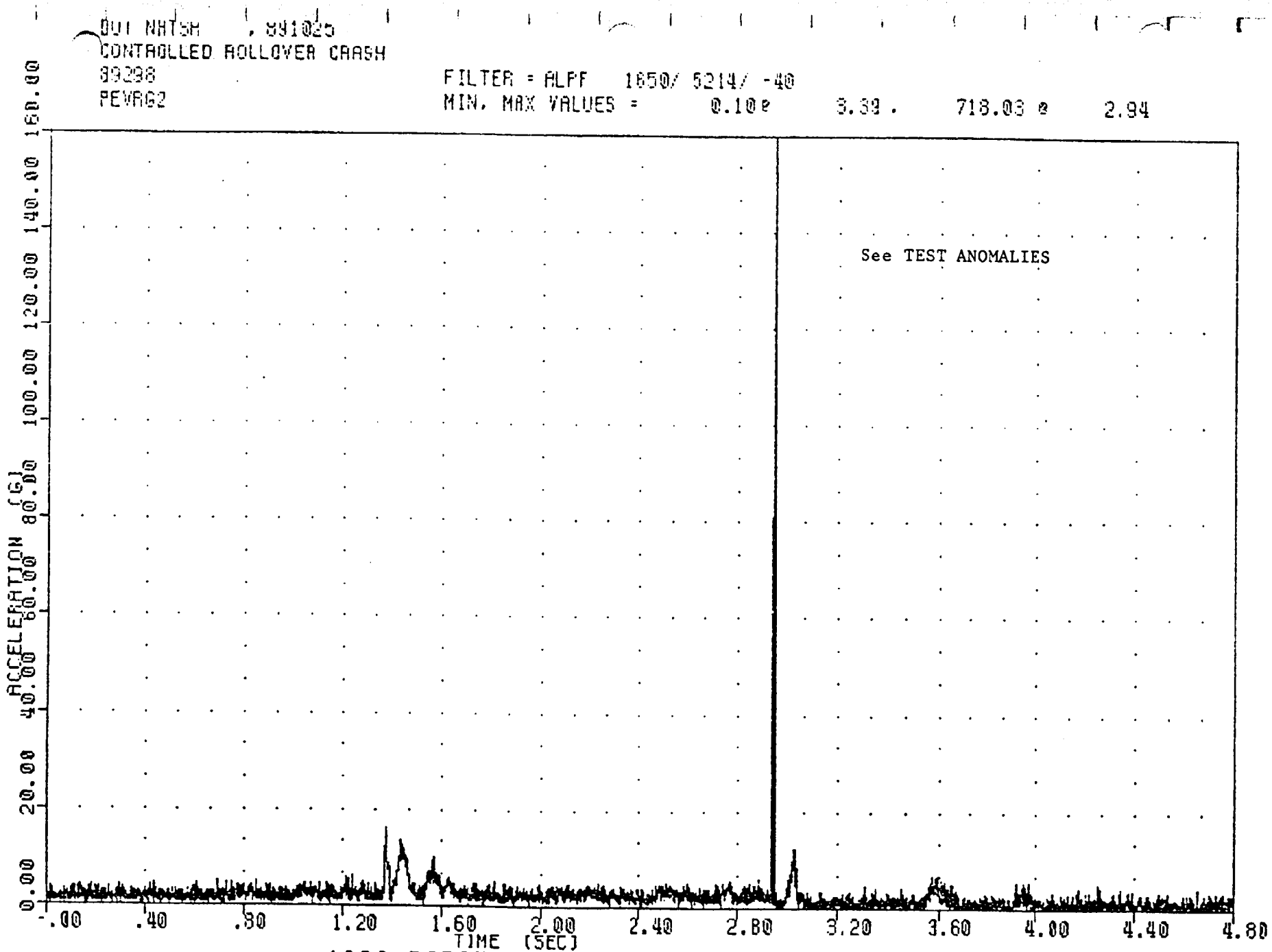
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER PELVIS X AXIS ACCELERATION



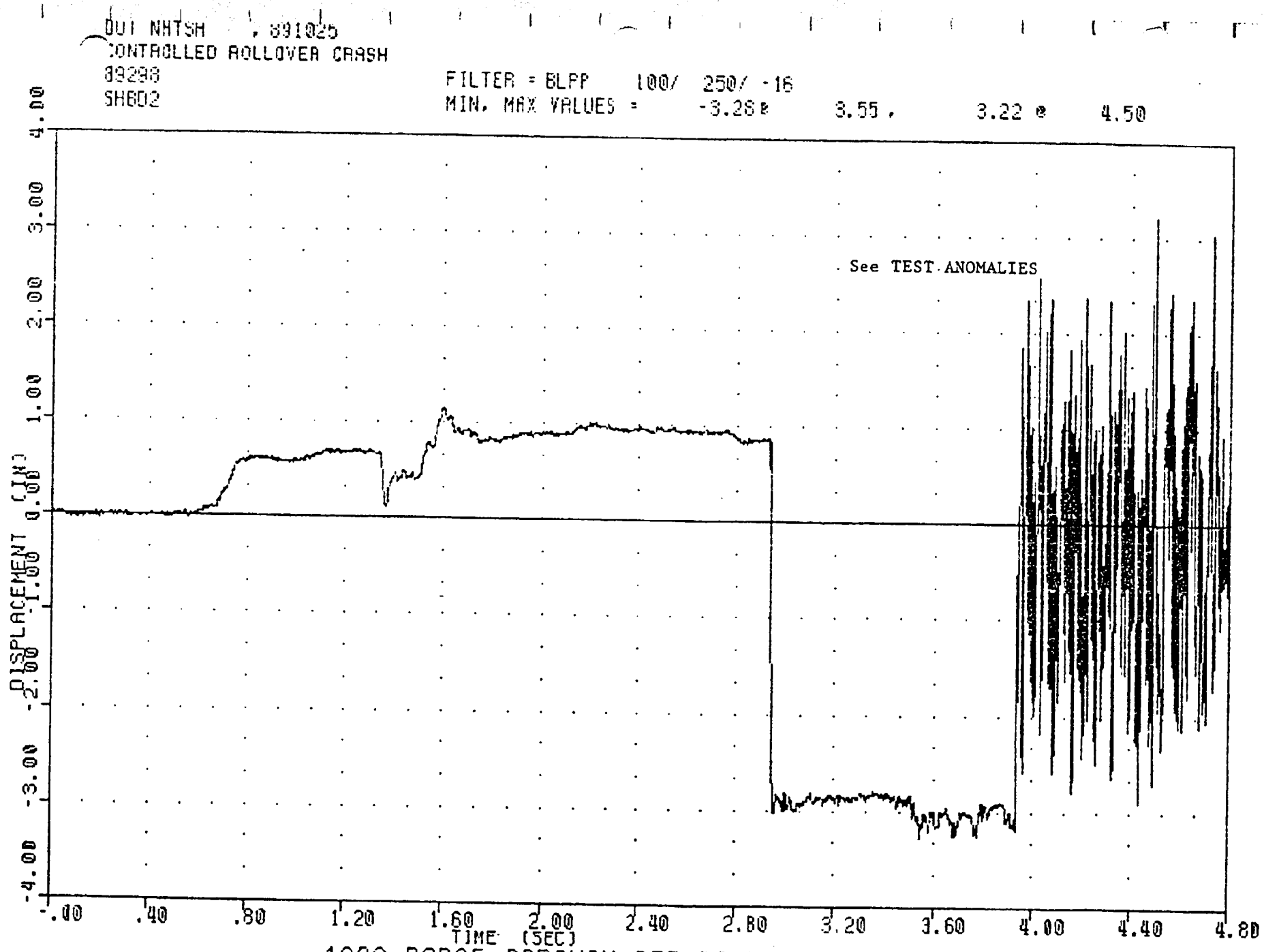
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER PELVIS Y AXIS ACCELERATION



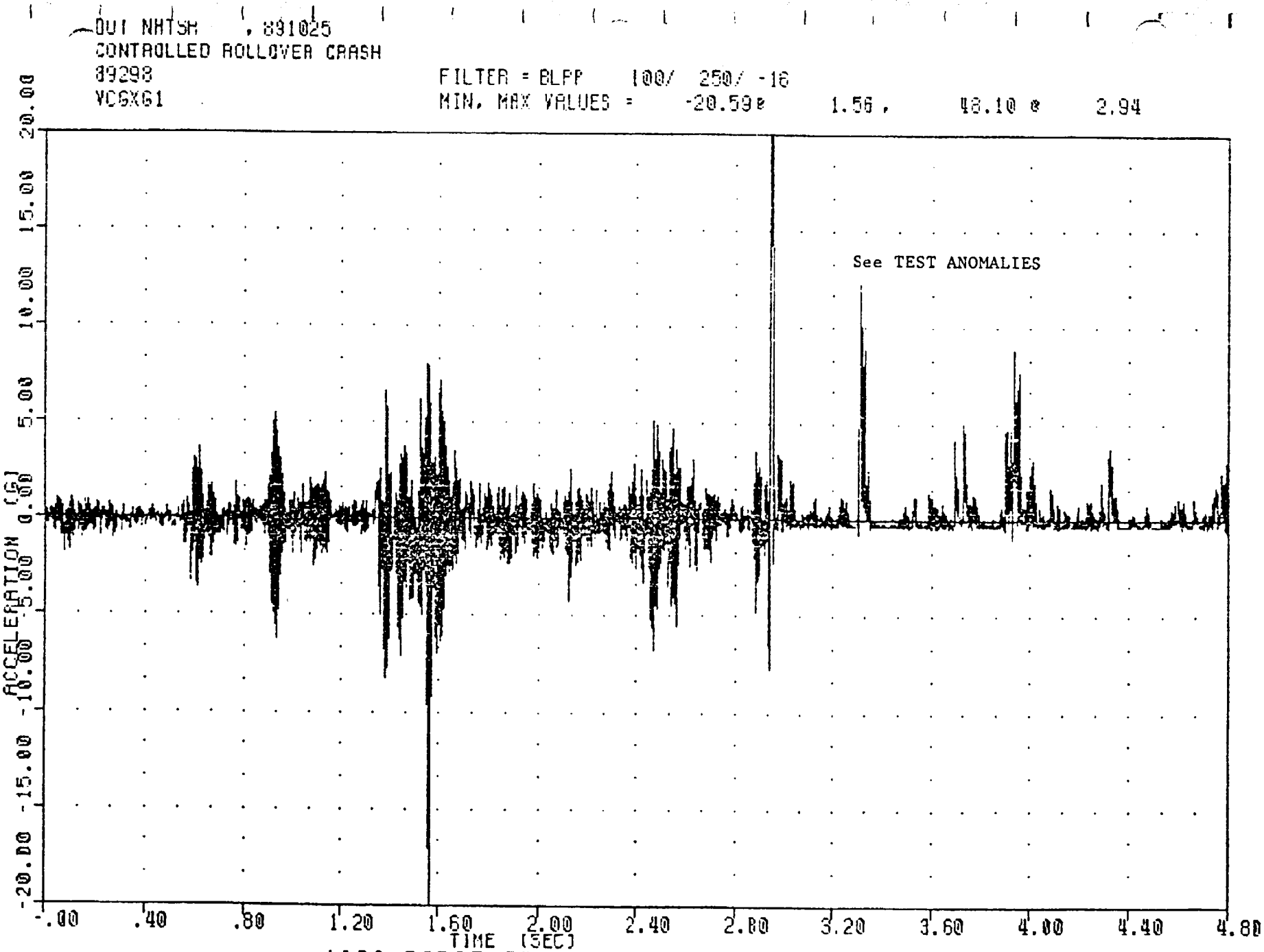
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER PELVIS Z AXIS ACCELERATION



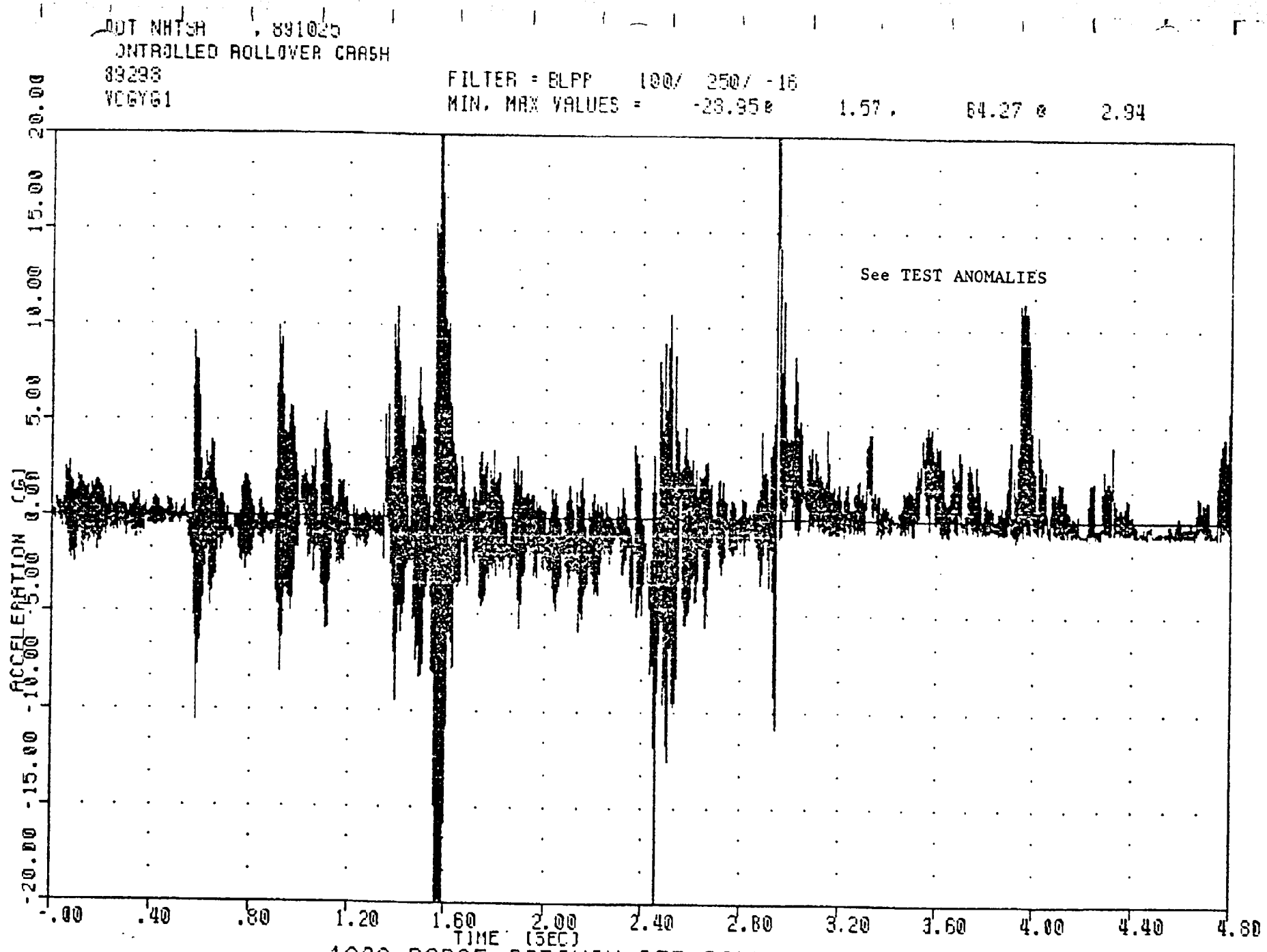
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER PELVIS RESULTANT ACCELERATION



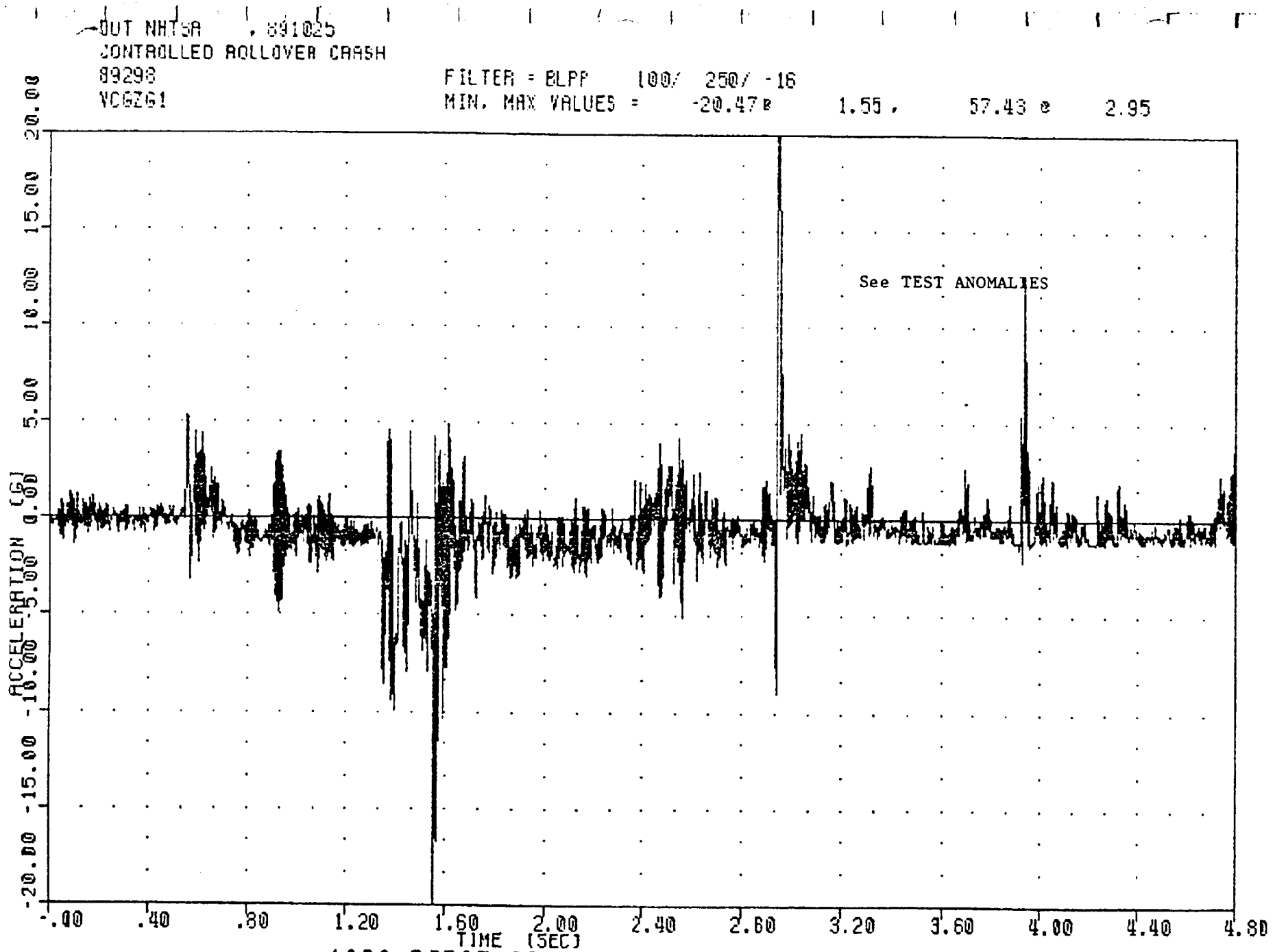
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
RIGHT FRONT PASSENGER SHOULDER BELT DISPLACEMENT



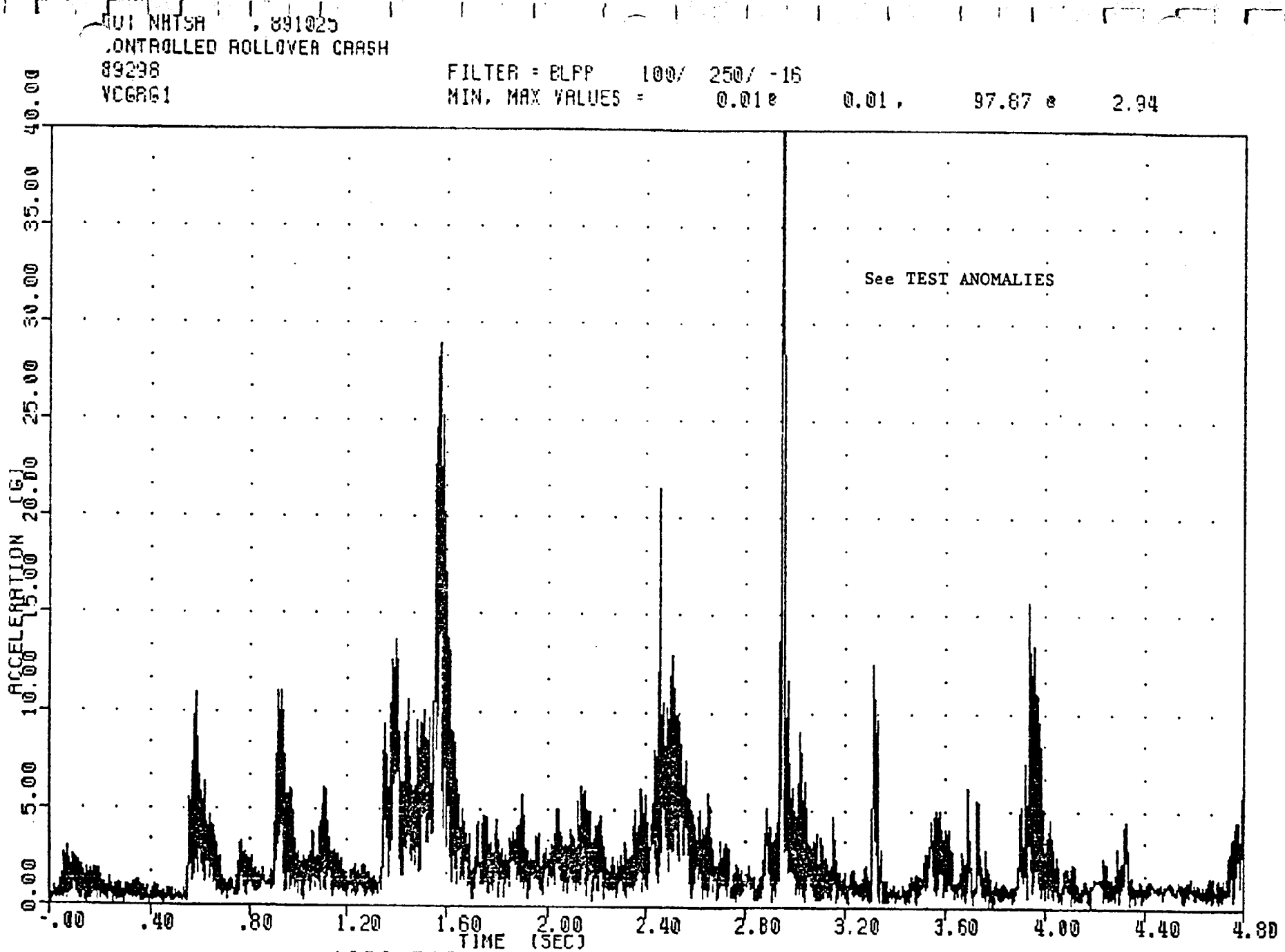
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE CENTER OF GRAVITY X AXIS ACCELERATION



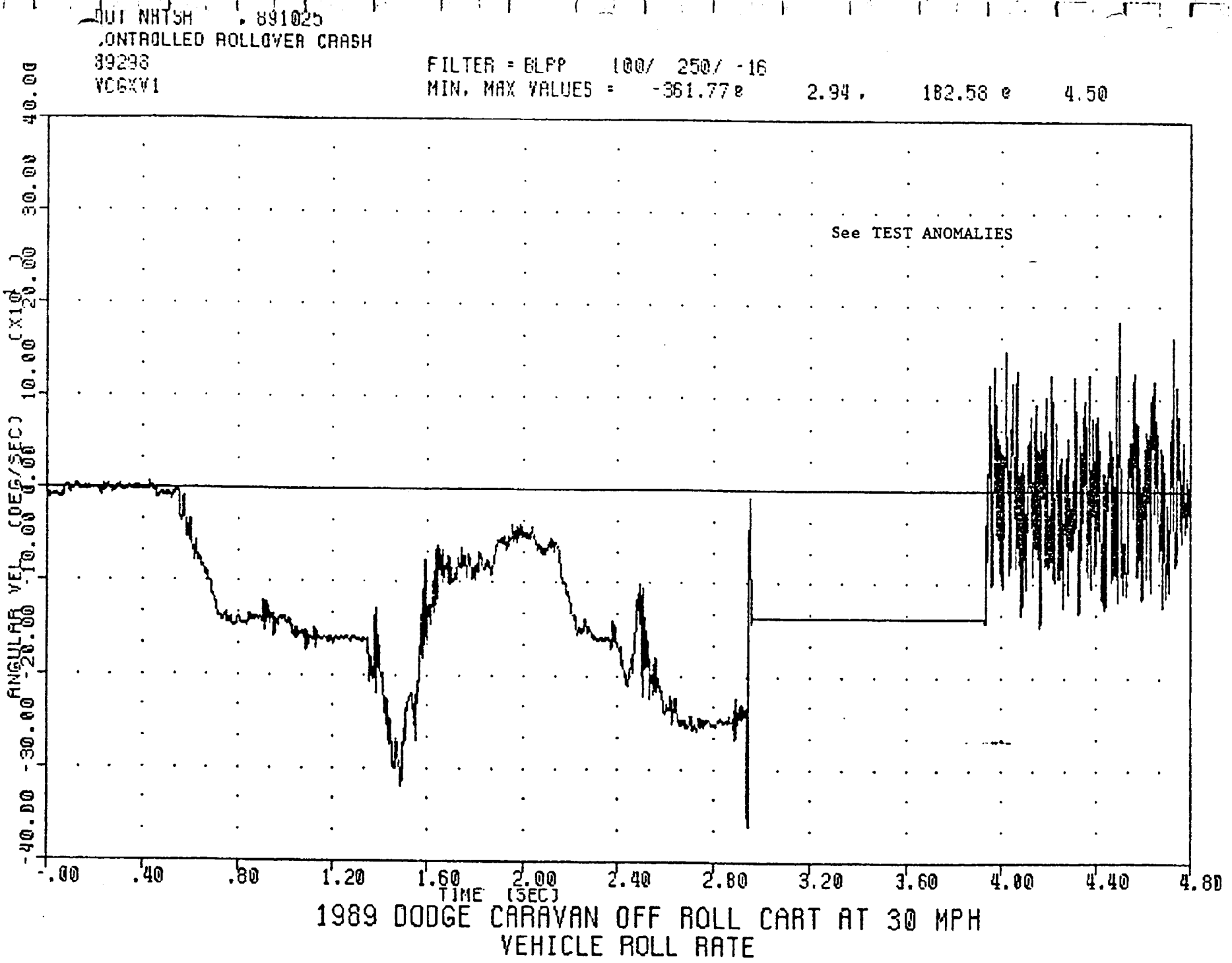
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Y AXIS ACCELERATION



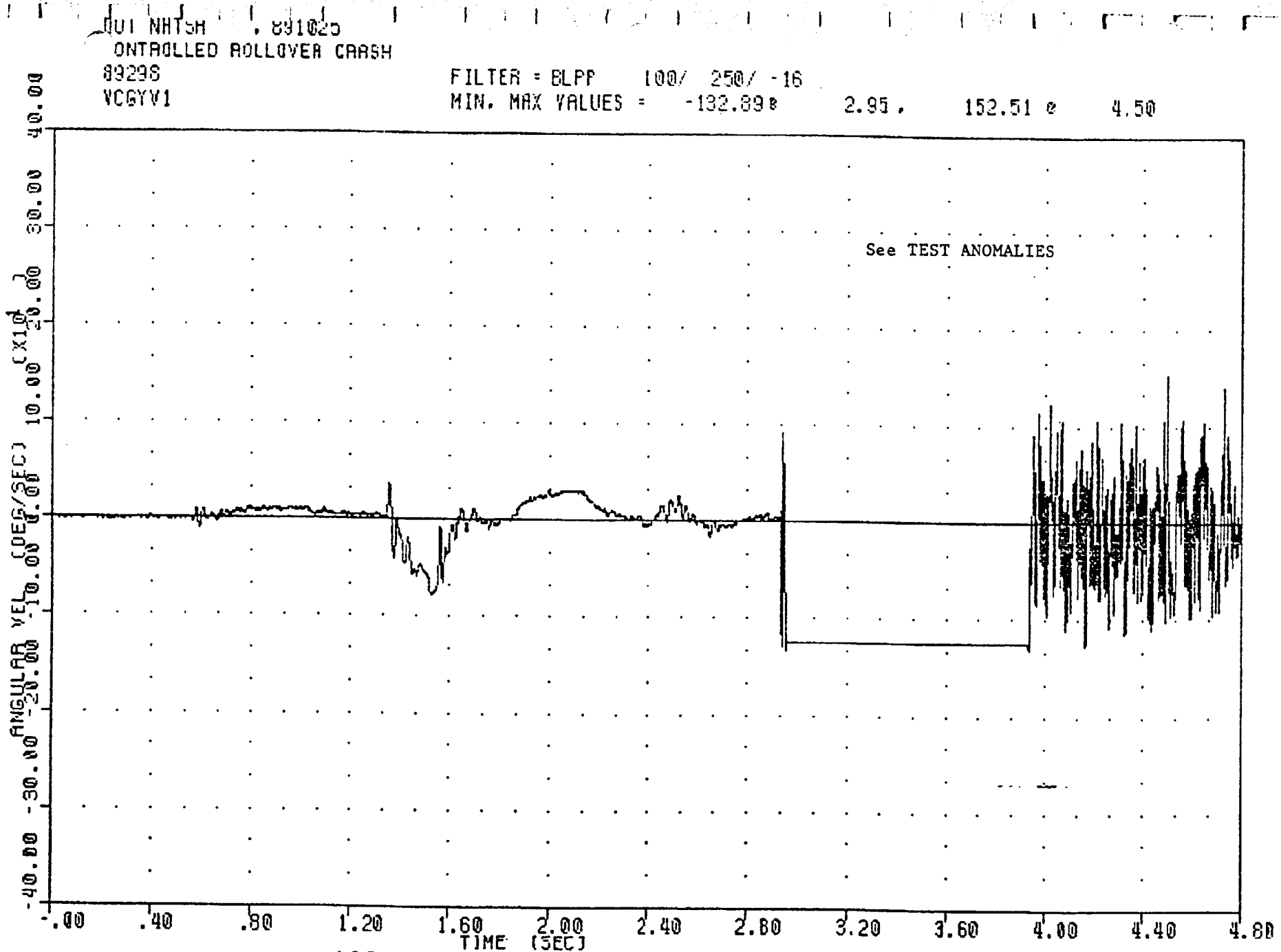
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Z AXIS ACCELERATION



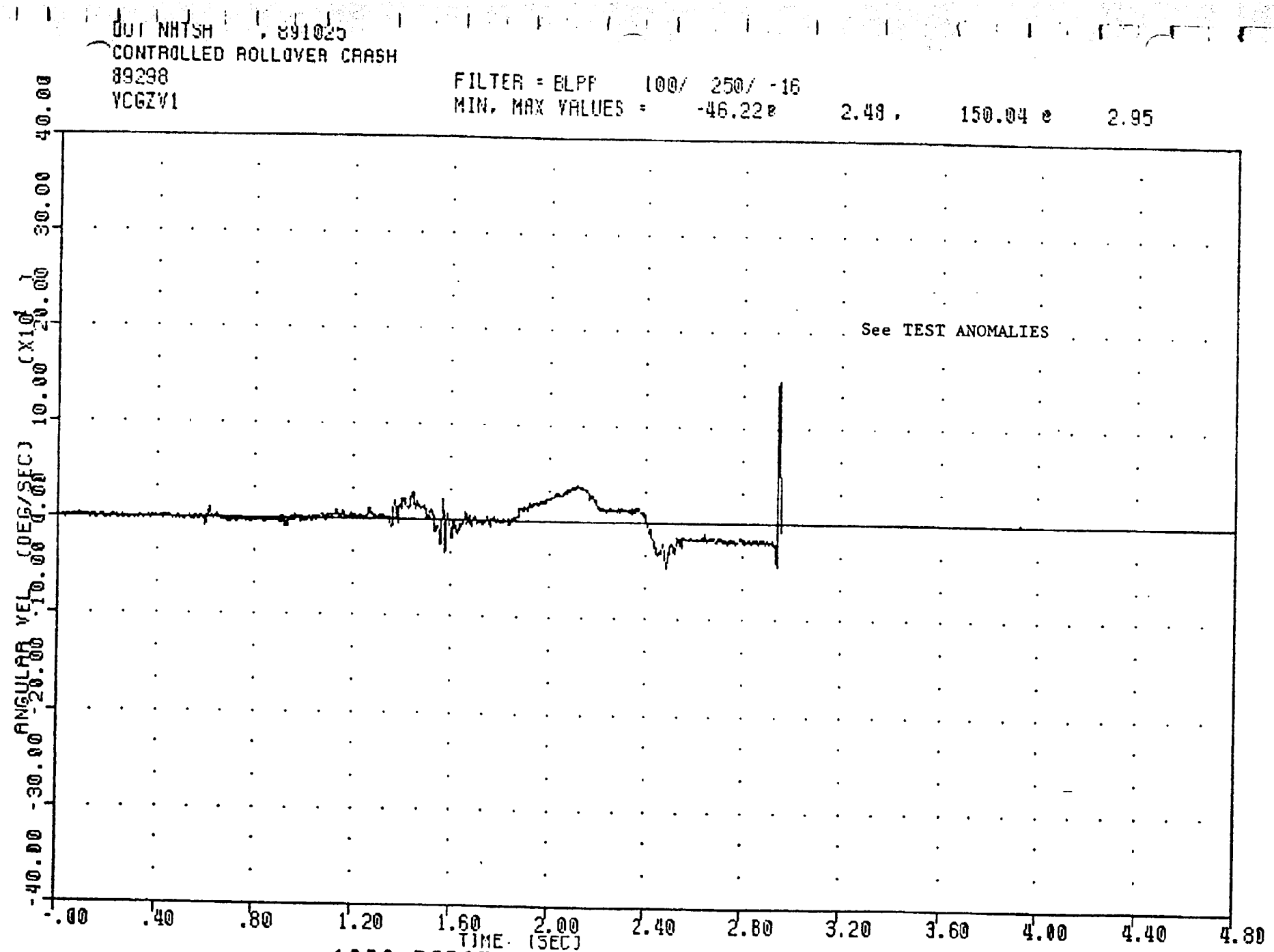
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION



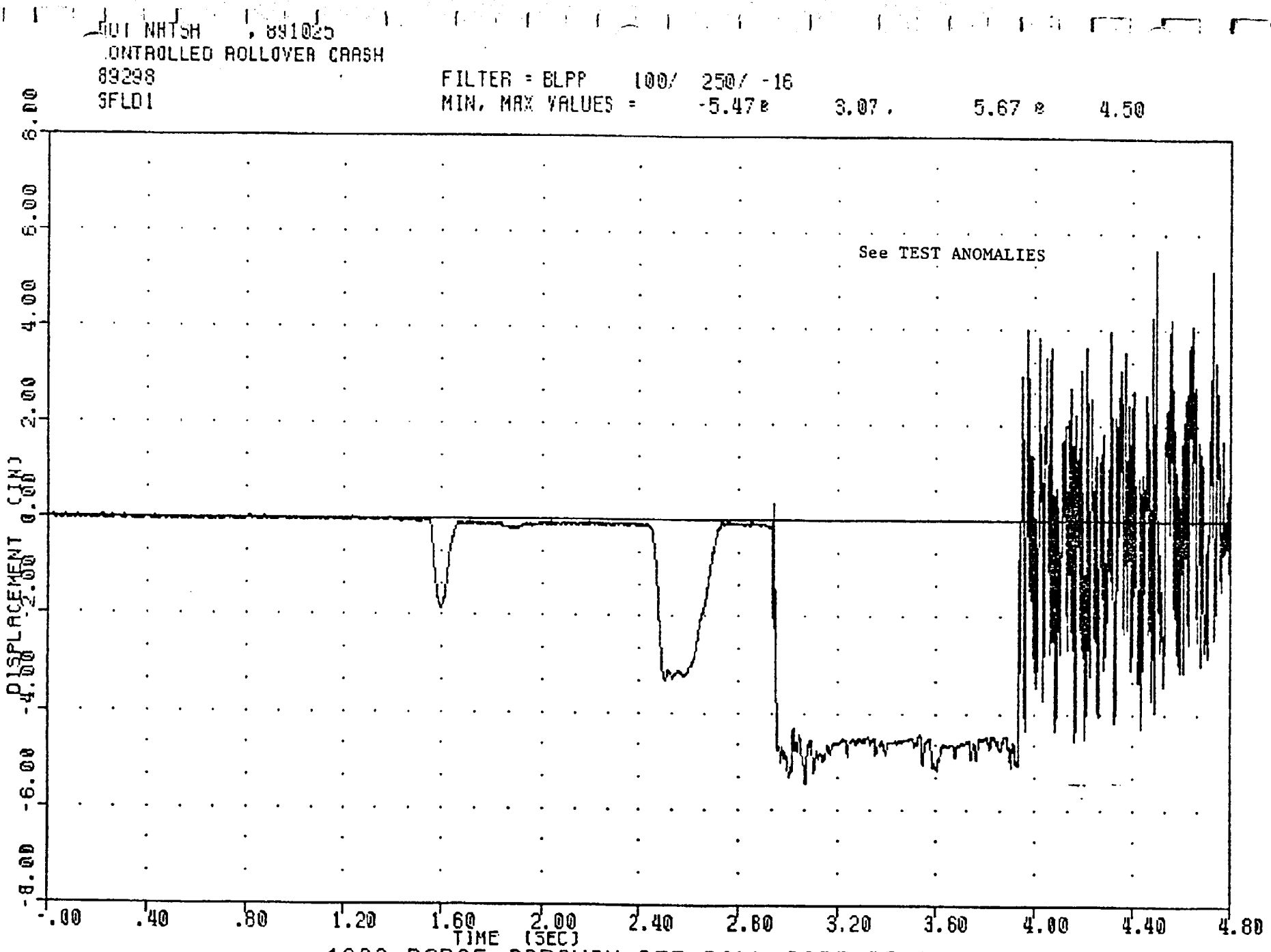
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE ROLL RATE



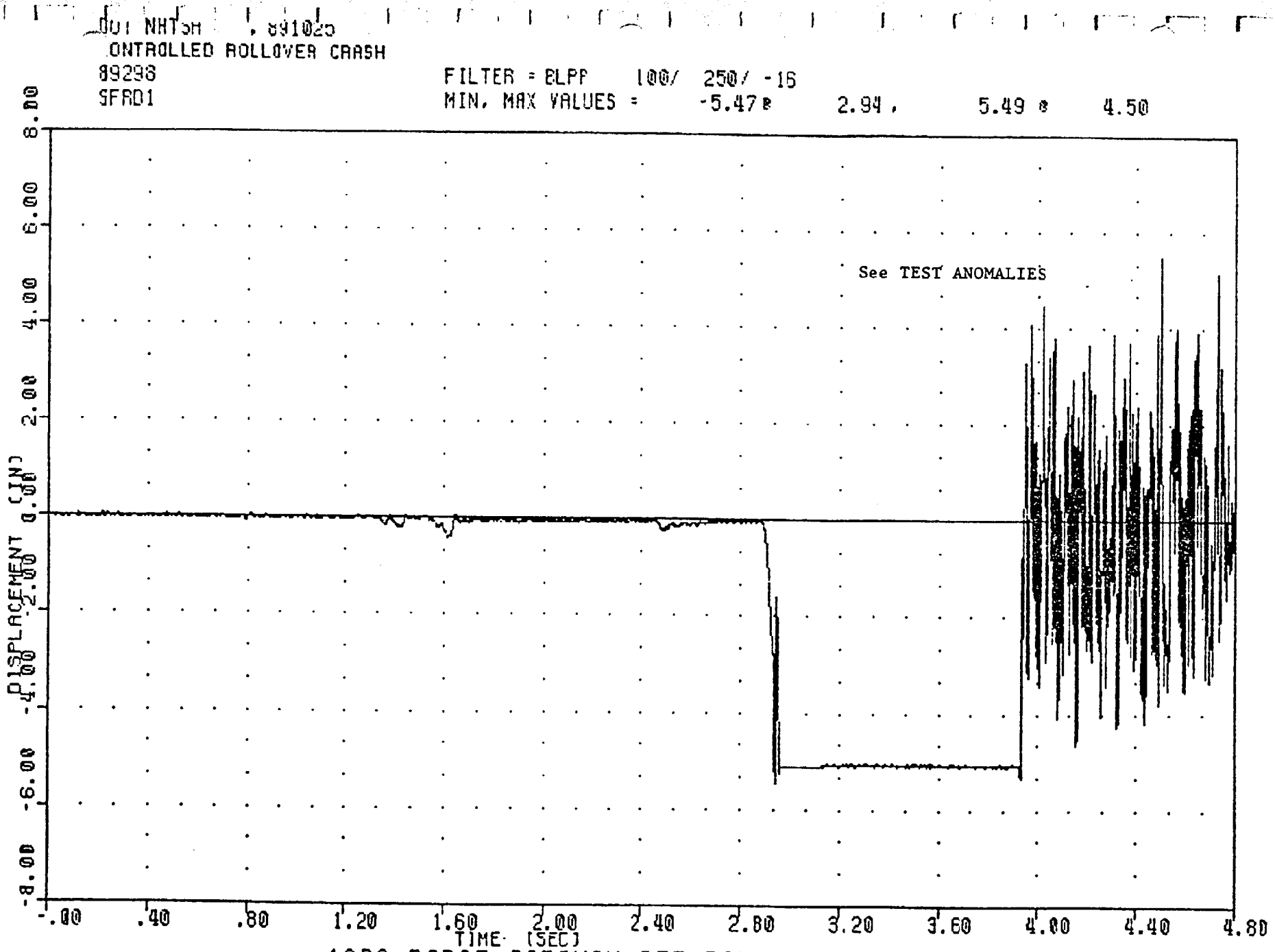
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE PITCH RATE



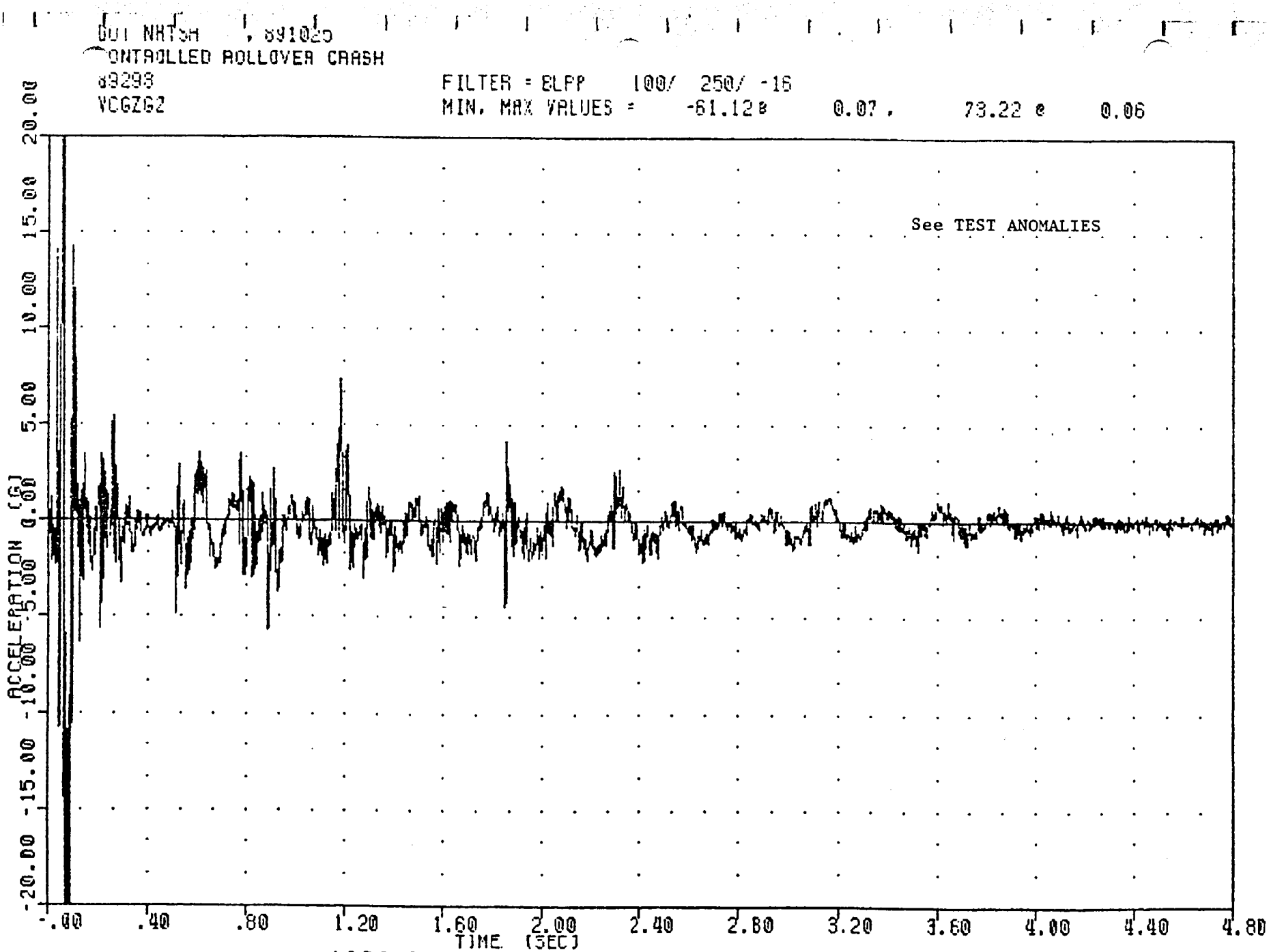
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE YAW RATE



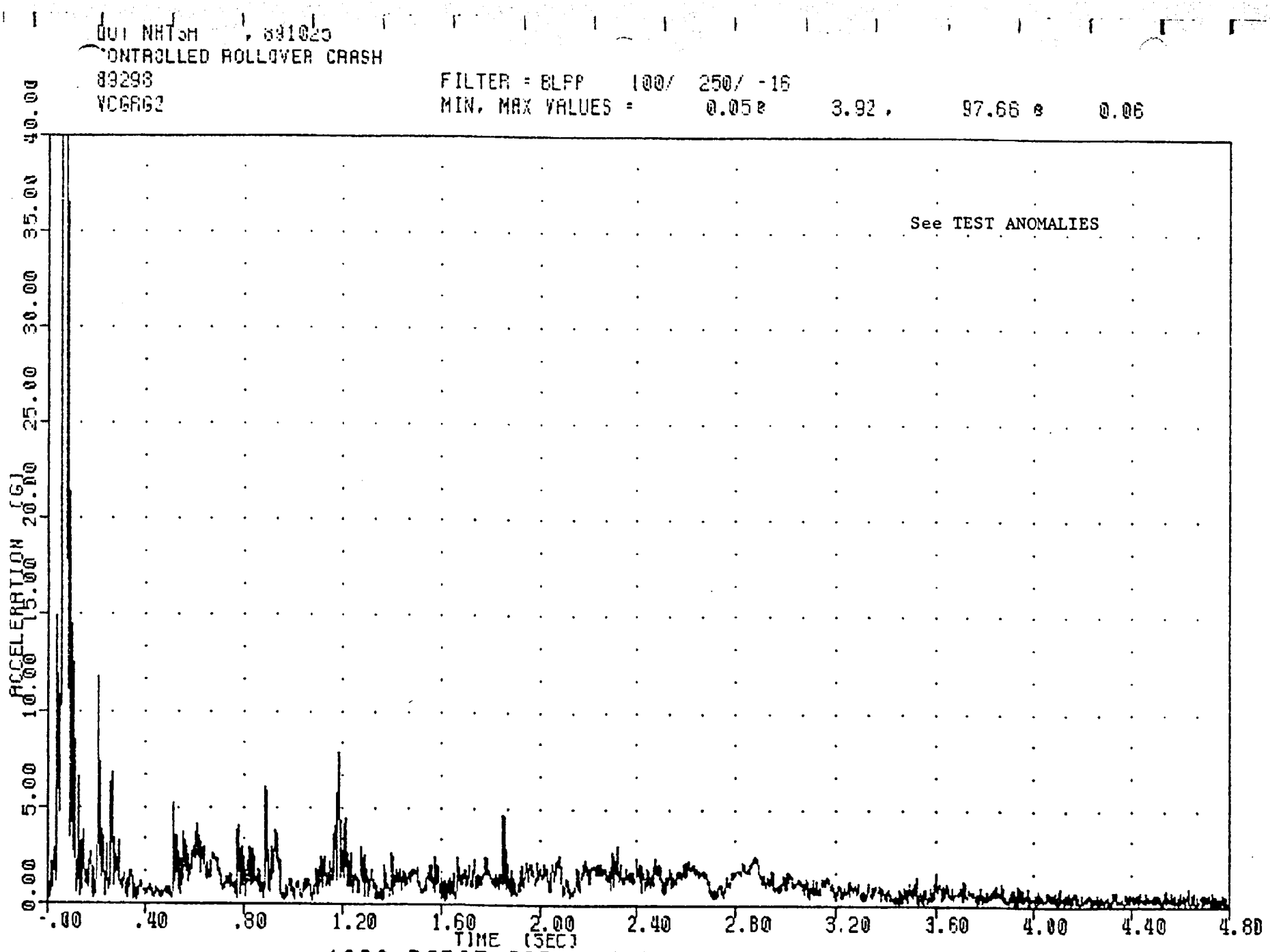
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE LEFT FRONT SUSPENSION DISPLACEMENT



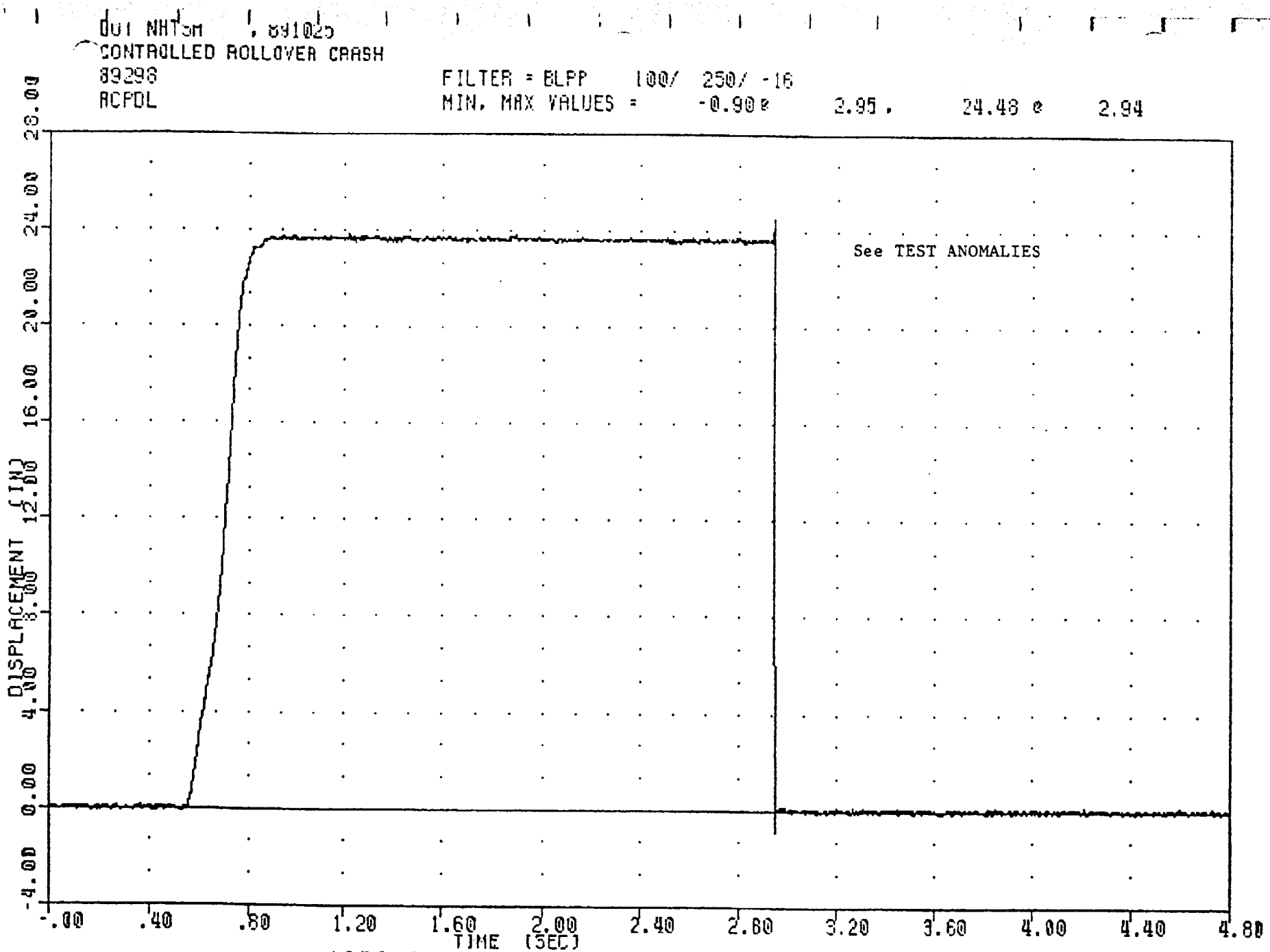
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE RIGHT FRONT SUSPENSION DISPLACEMENT



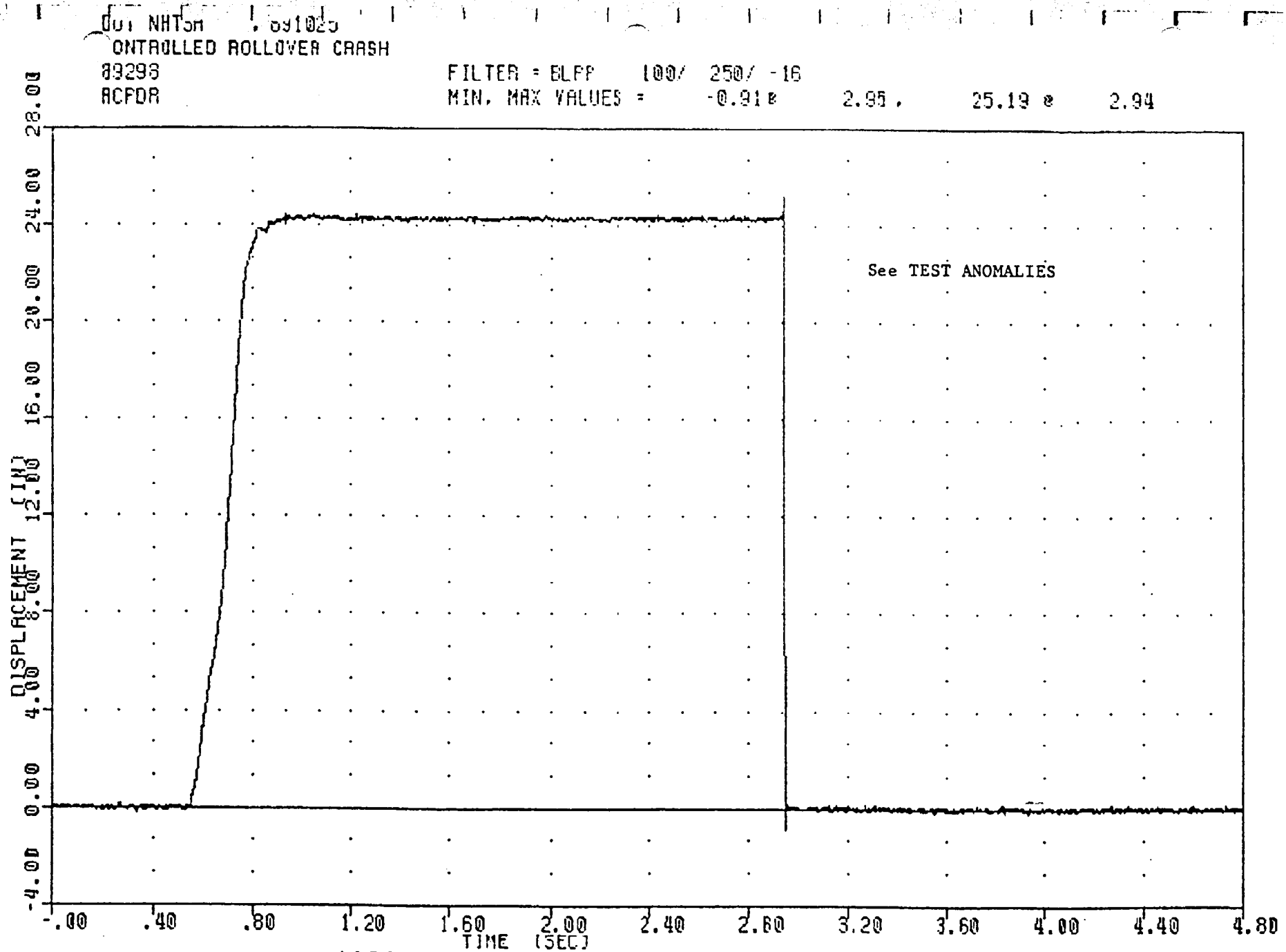
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Z AXIS ACCELERATION



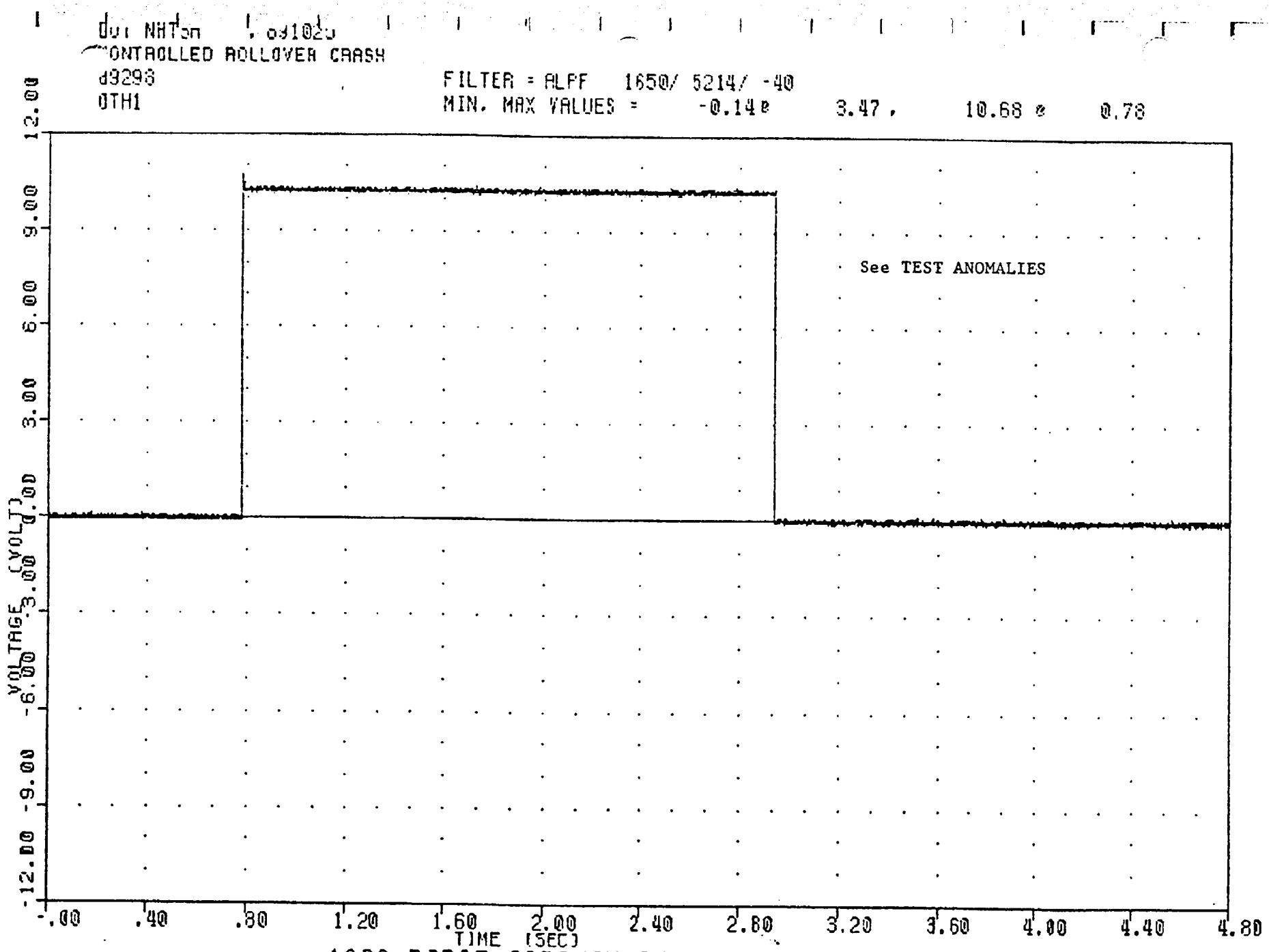
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART CENTER OF GRAVITY RESULTANT ACCELERATION



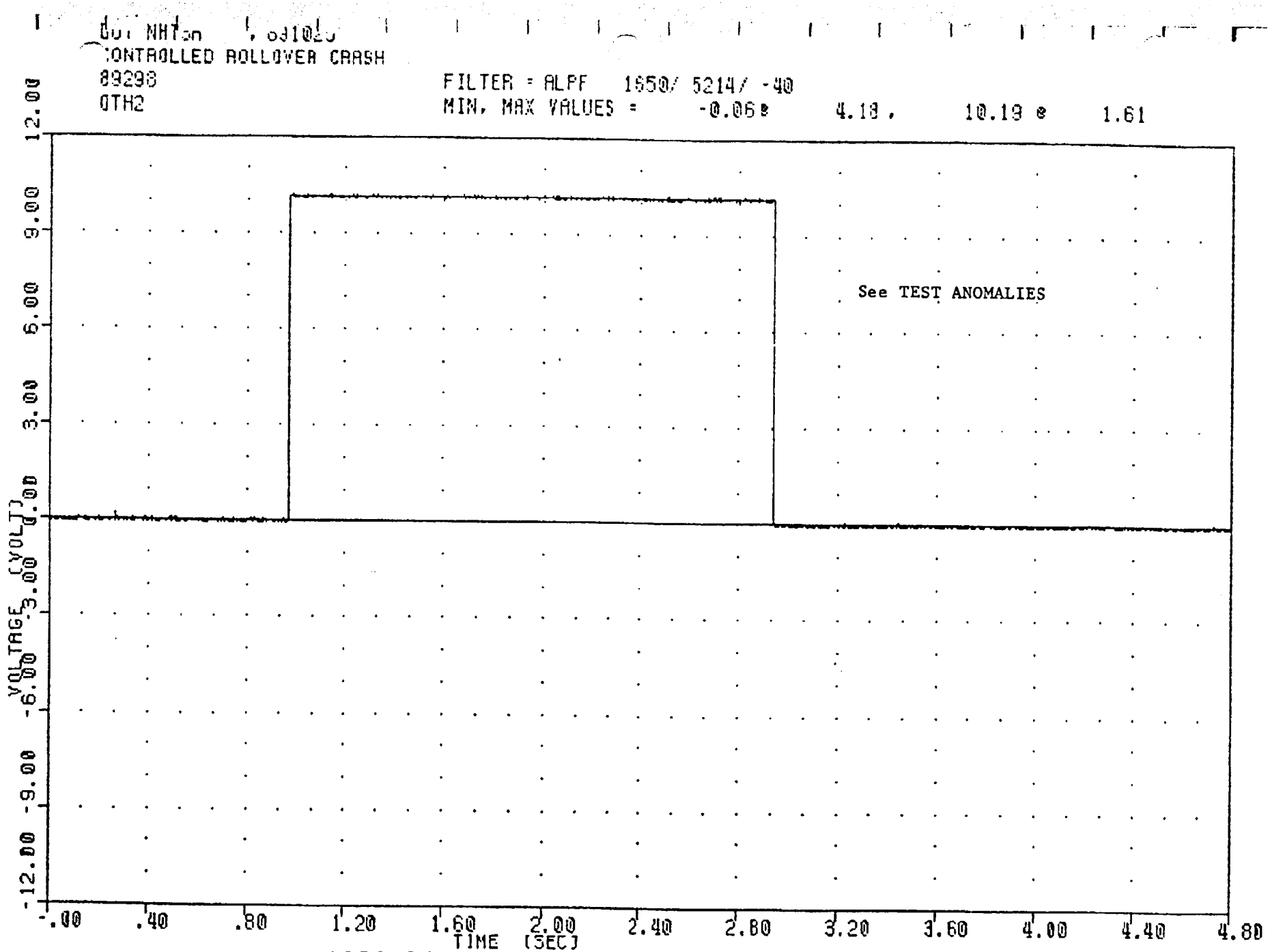
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART LEFT CYLINDER DISPLACEMENT



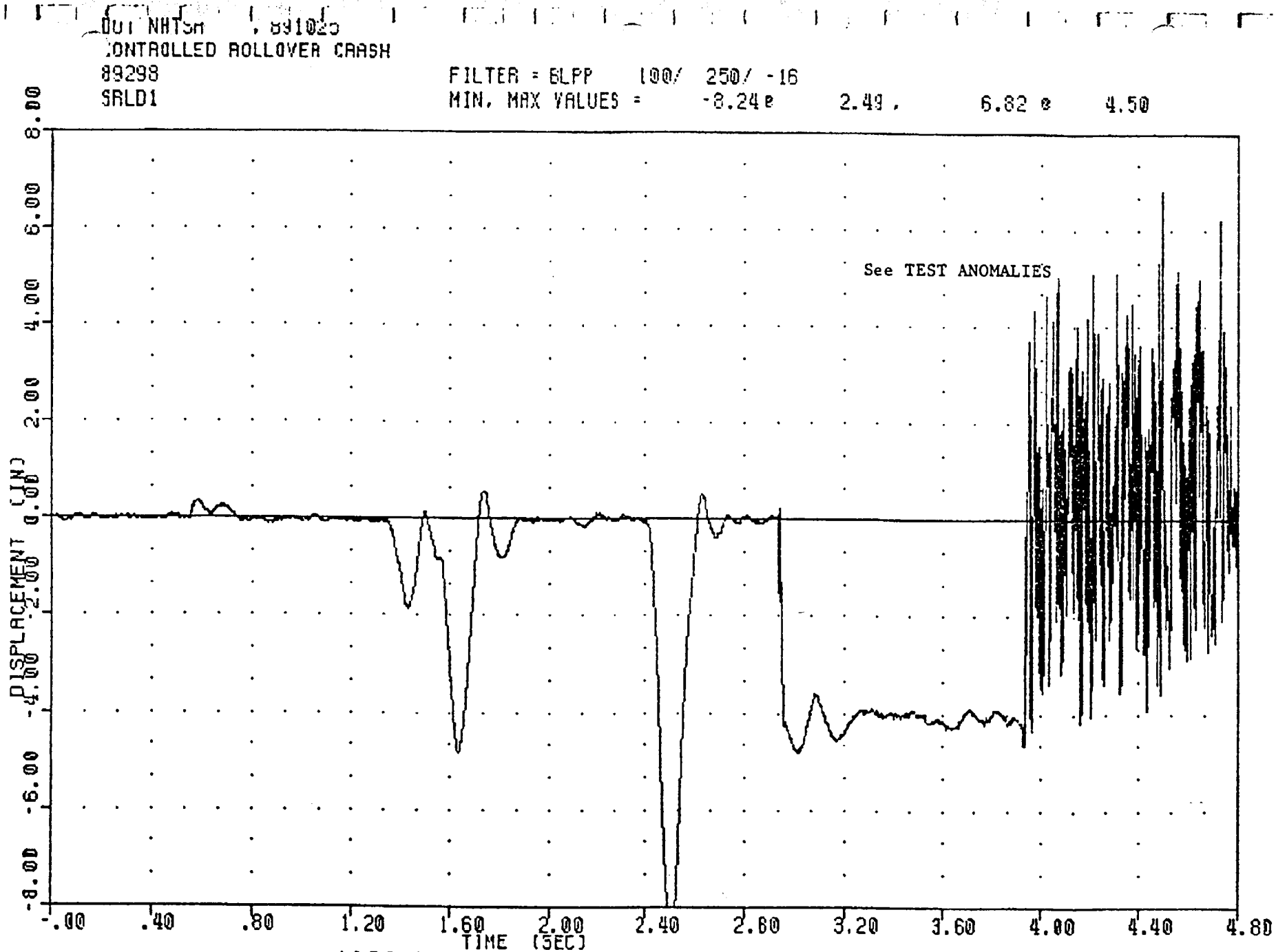
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART RIGHT CYLINDER DISPLACEMENT



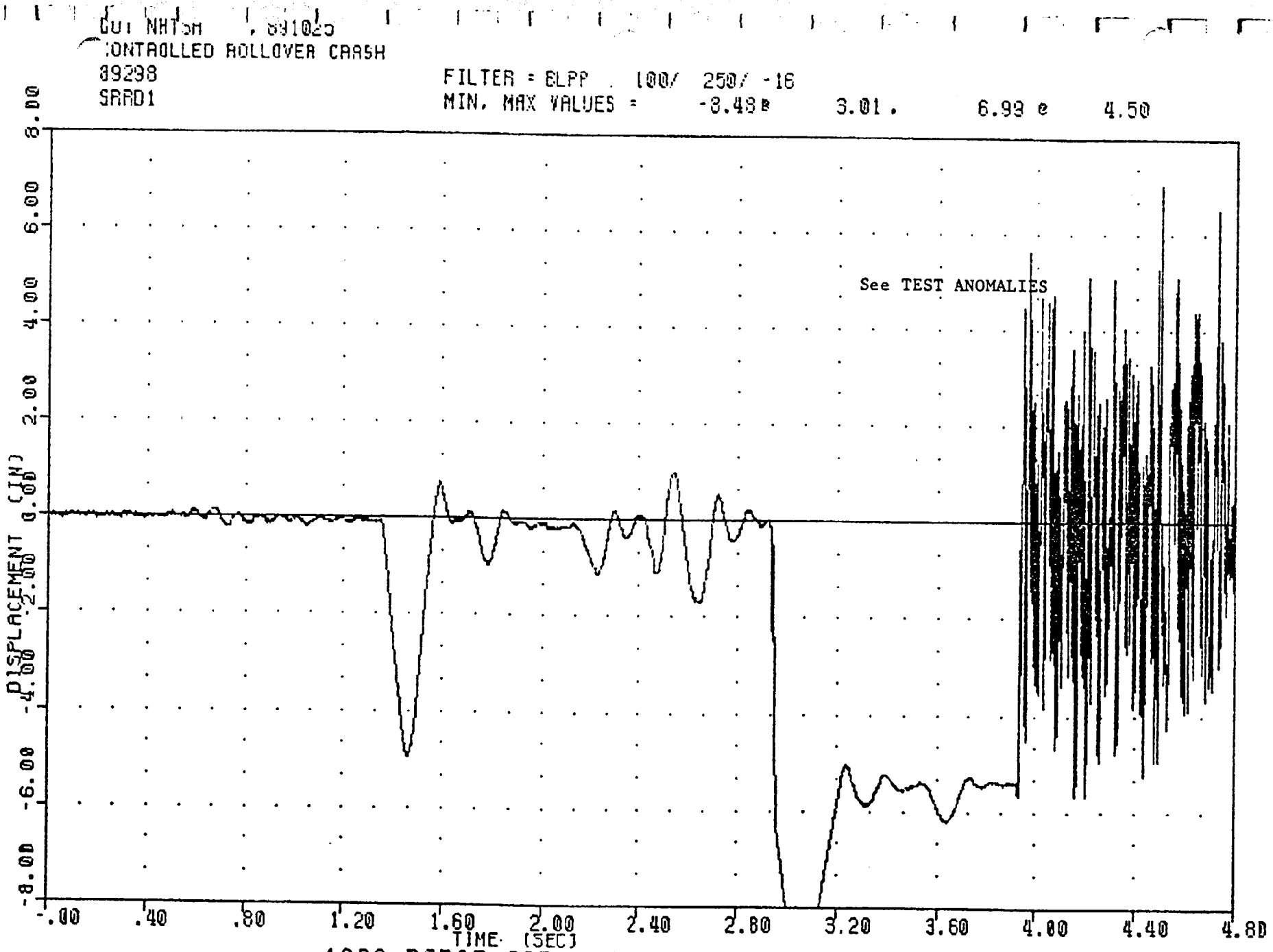
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - UPPER SWITCH



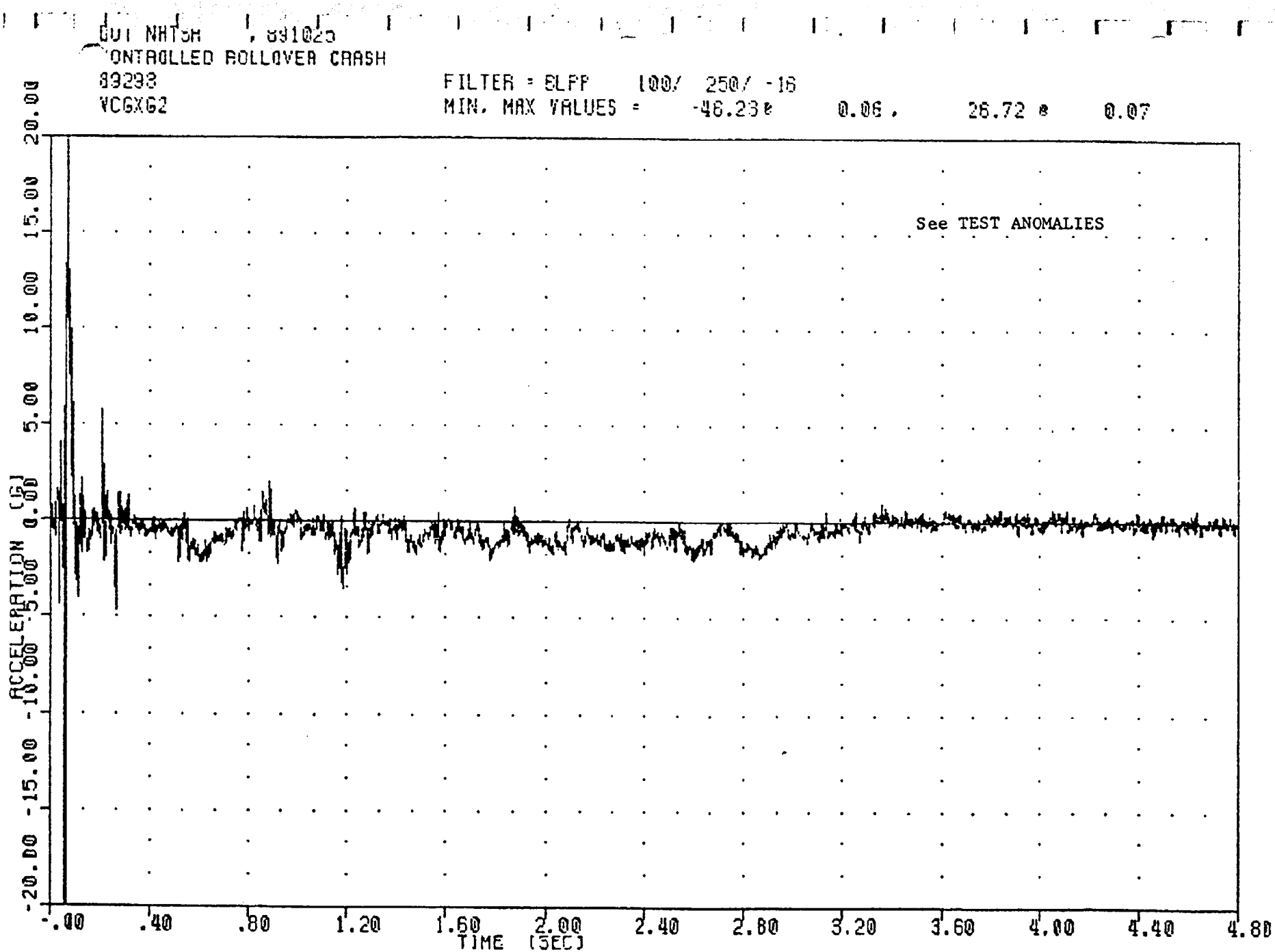
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE/ROLL CART SEPARATION TIME - LOWER SWITCH



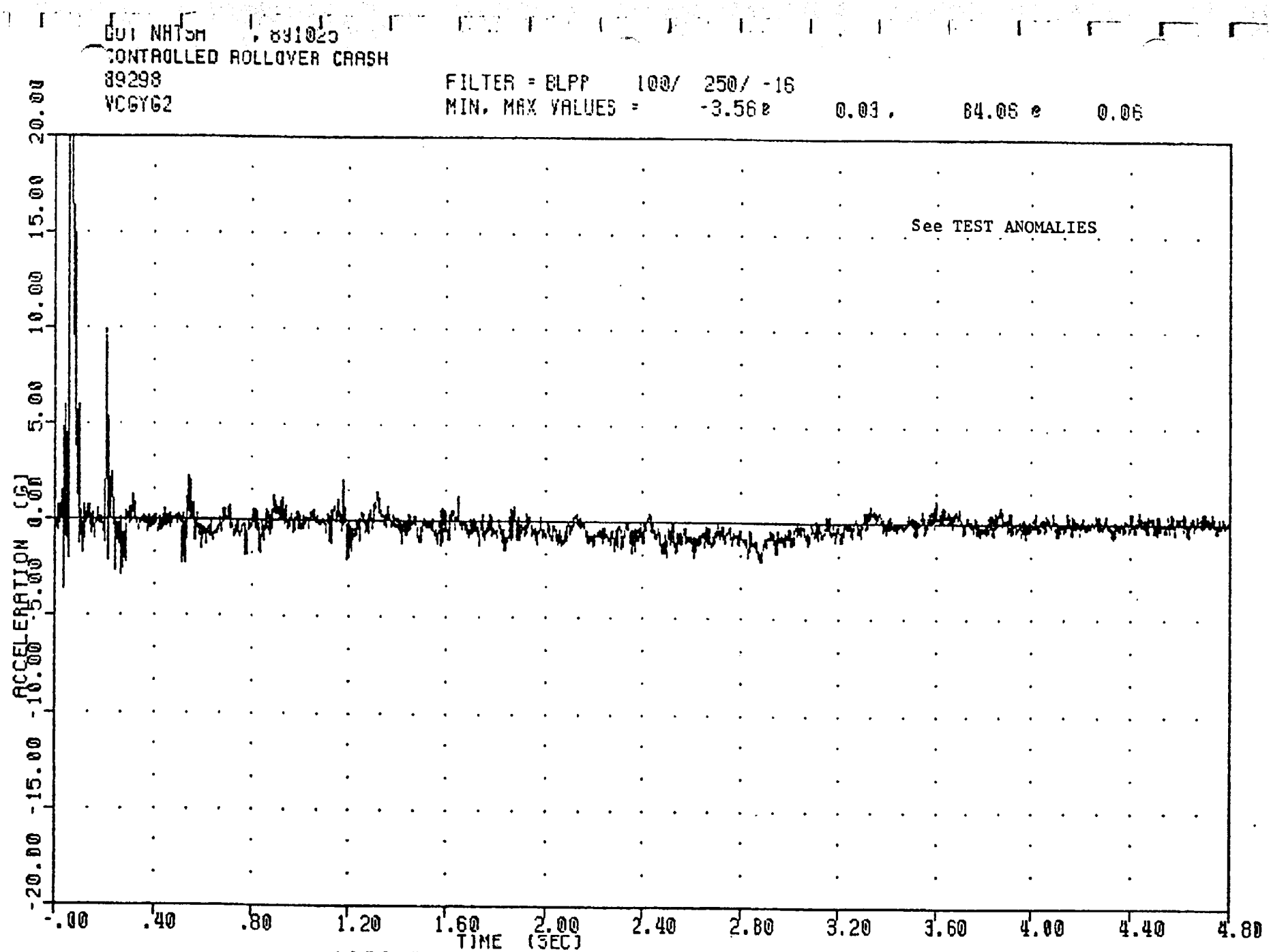
1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE LEFT REAR SUSPENSION DISPLACEMENT



1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
VEHICLE RIGHT REAR SUSPENSION DISPLACEMENT



1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART CENTER OF GRAVITY X AXIS ACCELERATION



1989 DODGE CARAVAN OFF ROLL CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Y AXIS ACCELERATION

APPENDIX C

DUMMY CERTIFICATION

The dummy's head belongs to TRC and was used for a different test other than SRL. Then calibration was necessary to apply before the test date on October 25, 1989.

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

HYBRID III 19-Oct-89

SRL 192C3AHD1 572E SN192 HEAD DROP CAL 03

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	72.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	32.00 %
PEAK RESULTANT ACCELERATION	225 - 275 G	251.62 G
PEAK LATERAL ACCELERATION	15 G MAX	-9.09 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

DUMMY COMPONENT MEETS SPECIFICATIONS

TECHNICIAN Chas Middleton

APPENDIX D

MISCELLANEOUS TEST INFORMATION

PRE-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson Date: 10/20/89

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

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Dodge Caravan C/V

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

Vehicle Make (2 characters): 07

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

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

Body Style (2 characters): VN

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): 2B7FK1138KR376585

Odometer Reading: 55.4 Thousands of Miles: 0.0554

Overall Length: 177.0 (in) x 25.4 =: 4496 (mm)

Wheelbase: 112.1 (in) x 25.4 =: 2847 (mm)

Front Track: 59.7 (in) x 25.4 =: 1516 (mm)

Rear Track: 62.1 (in) x 25.4 =: 1577 (mm)

Roof Height: 66.1 (in) x 25.4 =: 1679 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 4060 (lbs) x 4.45 =: 18067 (N)

FRONT G.A.W.R.: 2425 (lbs) x 4.45 =: 10791 (N)

REAR G.A.W.R.: 2450 (lbs) x 4.45 =: 10902 (N)

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

Weight on RF Tire: 930 (lbs) x 4.45 =: 4138 (N)

Weight on LF Tire: 1062 (lbs) x 4.45 =: 4726 (N)

Weight on LR Tire: 772 (lbs) x 4.45 =: 3435 (N)

Weight on RR Tire: 748 (lbs) x 4.45 =: 3329 (N)

Vehicle Test Weight: 3512 (lbs) x 4.45 =: 15628 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 48.52 (in) x 25.4 =: 1232.4 (mm)

From Center Line: -0.62 (in) x 25.4 =: -15.8 (mm)

Engine Displacement: 183.0 (cu in) x 0.0164 =: 3.0 (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): T

L = Longitudinal T = Transverse

Transmission Type: A

M = Manual A = Automatic

Drive Axle (1 character): F

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters): Pre rollover test.

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): F233

Front/Rear Flag (1 character): F

Axle Type (1 character): I

I = Independent S = Solid

Suspension Type (1 character): S

A = Unequal A Arm
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): Goodyear

Tire Size Code (10 characters): 195/75R14

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: 11.8 (in) X 25.4 =: 299.7 (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): L

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

1pring Type (2 characters): LL

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): Goodyear

Tire Size Code (10 characters): 195/75R14

Tire Construction (2 characters): SB

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

GP = Glass Belted Radial
SP = Steel Belted Radial

Tire Rim Width: 5.5 (in) X 25.4 =: 139.7 (mm)

Axle Height: 12.0 (in) X 25.4 =: 304.8 (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	0.090
+100	1.017
+200	1.919
0	0.090
-100	-0.838
-200	-1.742
0	0.089

C.G. HEIGHT:

Applied Weight (lbs)	Schaevitz Output (Volts)	Resultant Longitudinal Movement (mv)
0	0.049	2.497
+100	0.711	2.656
+200	1.392	2.928
0	0.057	2.552
-100	-0.615	2.235
-200	-1.307	1.795
0	0.033	2.439

Calculated C.G. Height (in): 24.922

Pitch Inertia:

Run	Period (sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	4.52	259	548
2	4.51	256	545
3	4.51	254	545

Pitch Inertia (ft. lb. sec2): 2426.394

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 51.25

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.71	206	130
2	2.71	206	128
3	2.71	197	128

Roll Inertia (ft. lb. sec2): 603.355

Yaw Inertia:

Distance betwee ramps (in): 51.25

String Pot Offset from platform center (in): 66

Run	Period (sec)	*Amplitude (mv)	Relative Motion
1	2.64	120	287
2	2.64	138	453
3	2.63	139	335

Yaw Inertia (ft. lb. sec2): 2420.431

POST-TEST INERTIA PARAMETERS DATA

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson Date: 10/20/89

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

VEHICLE DATA

Vehicle Make and Model (written out): 1989 Dodge Caravan C/V

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

Vehicle Make (2 characters): 07

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): VN

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): 2B7FK1138KR376585

Odometer Reading: 58.5 Thousands of Miles: 0.0585

Overall Length: 177.0 (in) x 25.4 =: 4496 (mm)

Wheelbase: 112.0 (in) x 25.4 =: 2845 (mm)

Front Track: 59.7 (in) x 25.4 =: 1516 (mm)

Rear Track: 62.1 (in) x 25.4 =: 1577 (mm)

Roof Height: 66.6 (in) x 25.4 =: 1692 (mm)

IPMD VEHICLE DATA SHEET

G.V.W.R.: 4060 (lbs) x 4.45 =: 18067 (N)

FRONT G.A.W.R.: 2425 (lbs) x 4.45 =: 10791 (N)

REAR G.A.W.R.: 2450 (lbs) x 4.45 =: 10902 (N)

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

Weight on RF Tire: 885 (lbs) x 4.45 =: 3938 (N)

Weight on LF Tire: 1057 (lbs) x 4.45 =: 4704 (N)

Weight on LR Tire: 741 (lbs) x 4.45 =: 3298 (N)

Weight on RR Tire: 783 (lbs) x 4.45 =: 3484 (N)

Vehicle Test Weight: 3466 (lbs) x 4.45 =: 15424 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 49.3 (in) x 25.4 =: 1252.2 (mm)

From Center Line: -1.16 (in) x 25.4 =: -29.5 (mm)

Engine Displacement: 183.0 (cu in) x 0.0164 =: 3.0 (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): T

L = Longitudinal T = Transverse

Transmission Type: A

M = Manual A = Automatic

Drive Axle (1 character): F

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters): Post rollover test.

IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): F233

Front/Rear Flag (1 character): F

Axle Type (1 character): I

I = Independent S = Solid

Suspension Type (1 character): S

A = Unequal A Arm
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): Goodyear

Tire Size Code (10 characters): 195/75R14

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: 11.8 (in) X 25.4 =: 299.7 (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): L

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): LL

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): Goodyear

Tire Size Code (10 characters): 195/75R14

Tire Construction (2 characters): SB

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

GP = Glass Belted Radial
SP = Steel Belted Radial

Tire Rim Width: 5.5 (in) X 25.4 =: 139.7 (mm)

Axle Height: 12.0 (in) X 25.4 =: 304.8 (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	0.087	2.849
+100	0.723	2.985
+200	1.370	3.131
0	0.096	2.908
-100	-0.561	2.658
-200	-1.216	2.464
0	0.074	2.840

Calculated C.G. Height (in): 24.497

Pitch Inertia:

Run	Period (sec)	*Amplitude (mv)	Relative Motion Amplitude (mv)
1	4.37	272	357
2	4.37	270	358
3	4.37	269	347

Pitch Inertia (ft. lb. sec2): 2338.774

IPMD MEASURED DATA

Roll Inertia:

Distance between ramps (in): 51.2

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.63	230	281
2	2.63	230	274
3	2.63	225	266

Roll Inertia (ft. lb. sec2): 528.669

Yaw Inertia:

Distance betwee ramps (in): 51.2

String Pot Offset from platform center (in):

Run	Period (sec)	*Amplitude (mv)	Amplitude (mv)
1	2.57	136	210
2	2.57	140	229
3	2.57	134	204

Yaw Inertia (ft. lb. sec2): 2284.698

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 displacment 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