VEHICLE AND DUMMY KINEMATICS
IN A CONTROLLED ROLLOVER CRASH
1991 VOLVO 240 4-DOOR SEDAN

PREPARED BY:
THE TRANSPORTATION RESEARCH CENTER OF OHIO
10820 STATE ROUTE 347
EAST LIBERTY, OHIO 43319

OCTOBER - NOVEMBER 1991
TEST REPORT

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

V 1851

ERRATA (as of Nov 93)
Test Number 911007

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

   Neck Load Cells: +Y Force: Head Pushed Leftward

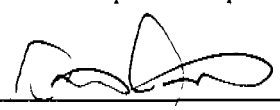
2. All neck load cell moments should be labeled lb-ft, instead of lb-in, including:

   Dummy Data Summary Sheet, page 4-5.
   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

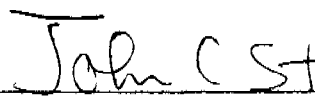
Report Prepared By:



Date 11/6/91

Scott A. Johnston
Project Engineer

Report Approved By:



Date 11-7-91

John C Stultz
Chief Engineer Impact Laboratory

Date 11-7-91

Teri H. Elliot
Project Manager

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LIST OF PHOTOGRAPHS

SECTION 1 0

PURPOSE AND TEST SUMMARY

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

This test was conducted with a 1991 Volvo 240 4-door sedan on the NHTSA rollover cart moving at 30 mph, releasing the vehicle with its roll axis perpendicular to the direction of rollover cart motion, and first contacting the vehicle's driver's side The test vehicle contained an instrumented Part 572E dummy restrained with a three-point unibelt.

SECTION 2.0

SUMMARY OF ROLLOVER CRASH TEST

A 1991 Volvo 240 4-door sedan, containing one instrumented Part 572E test dummy, was placed upon the rollover test device at 30 degrees above the horizontal and was released at 30 mph The device was attached to the tow cable of the drive system 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 and one half rolls 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 October 7, 1991

The Part 572E 50th percentile adult male anthropomorphic test device (dummy) was placed in the driver's designated seating position according to the seating procedure in FMVSS 208 Notice 60. The dummy was instrumented with head, chest, and pelvis triaxial accelerometers, a six-axis neck load cell, and a chest displacement potentiometer. The crash event was recorded by thirty-four (34) channels of data on one 14-track tape drive. The analog data was digitally sampled at 1500 samples per second. The data was digitally filtered per SAE J211 OCT88

The crash event was filmed by seven (7) 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 summary. Section 2 0 contains a summary of the rollover crash test. Section 3.0 contains the general test and vehicle parameter data. Section 4 0 contains the occupant information. Appendix A contains the pre-test and post-test still photographs Appendix B contains the final data plots Appendix C contains the post-test dummy calibrations Appendix D contains the pre-test and post-test IPMD vehicle data sheets

ROLLOVER CART INSTRUMENTATION LOCATIONS AND DATA SUMMARY

TEST NUMBER 911007

No	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	POSITIVE DIRECTION MSEC	NEGATIVE DIRECTION MAX G	NEGATIVE DIRECTION MSEC
1	CENTER OF GRAVITY	39 2	3 5	8 2				
	ACCELERATION (g)							
	LONGITUDINAL				4 0	106 7	2 4	180 0
	LATERAL				1.9	366 0	1 8	1586 0
	VERTICAL				5.2	974 0	12 6	195 3
	RESULTANT				12 7	195 3		
2	PLATFORM DISPLACEMENT (in)	24 6	24 5	47 3				
	LEFT SIDE				23.8	576.0	0 0	70 0
	RIGHT SIDE				24 5	519 3	0 0	12 7
3	VEHICLE/ROLLOVER CART SEPARATION TIMES (sec)	28 5	22.0	76 2				
	UPPER SWITCH				315.3			
	LOWER SWITCH				306.7			

* ALL MEASUREMENTS OF INSTRUMENTATION LOCATIONS ARE IN INCHES

REFERENCE: X + FORWARD FROM REAR BEAM OF ROLLOVER CART
Y + LEFTWARD FROM ROLLOVER CART CENTERLINE
Z + UPWARD FROM THE GROUND LEVEL
DISPLACEMENT: + OUTWARD

FINAL RESTING PLACE OF VEHICLE, PARTS, AND ROLLOVER CART

DESCRIPTION OF VEHICLE	X, DISTANCE*	Y, DISTANCE*
Left rear corner	95 2	7 1
Right rear corner	100 0	5 2
Left front corner	89 2	-7 0
Right front corner	94 2	-9 0
DESCRIPTION OF PARTS		
Rear window molding	59.5	3.8
DESCRIPTION OF ROLLOVER CART		
Left rear corner	54 3	5 2
Right rear corner	52 3	-4 7
Left front corner	60 5	5 5
Right front corner	58.3	-6 9

*REFERENCE: +X FORWARD FROM RELEASE BLOCK

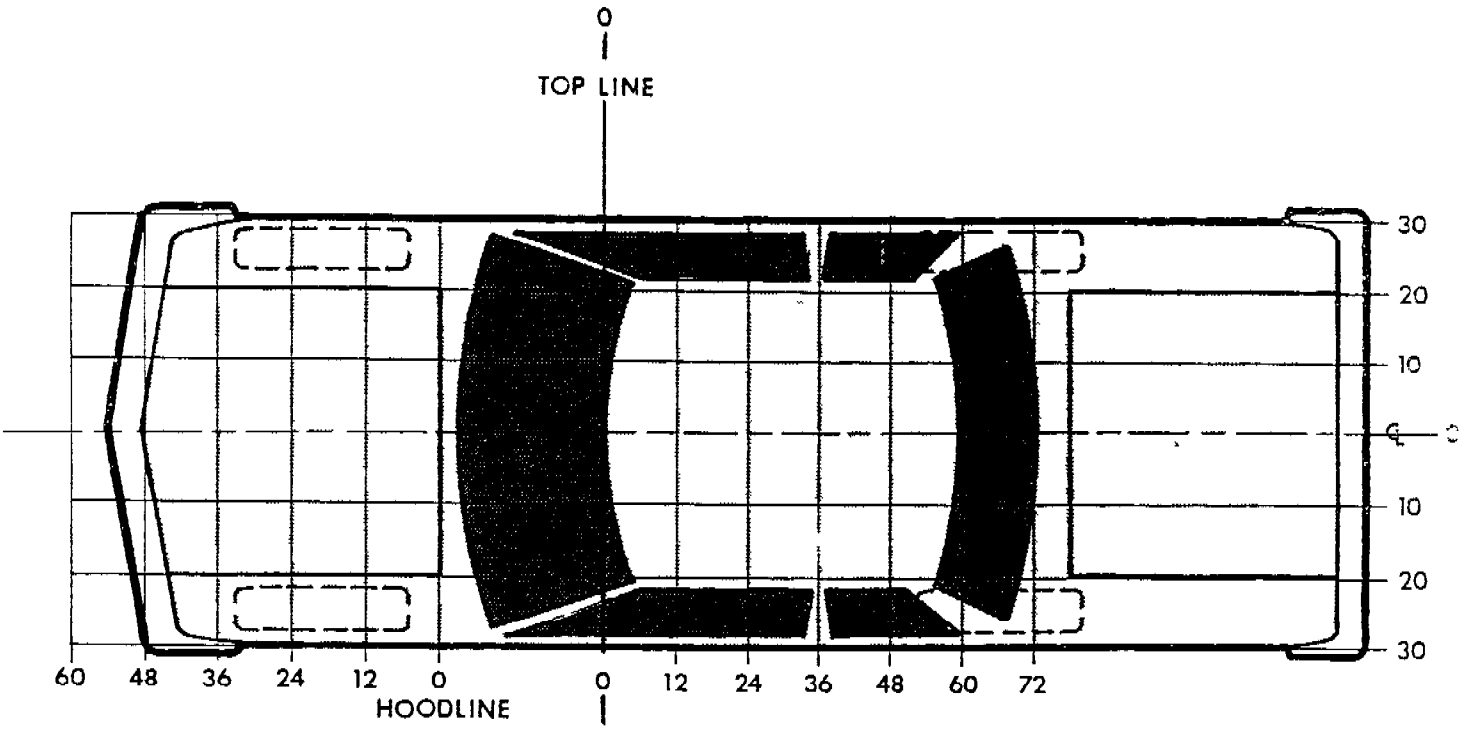
+Y: LEFTWARD FROM CENTER RELEASE BLOCK

ALL MEASUREMENTS ARE IN FEET.

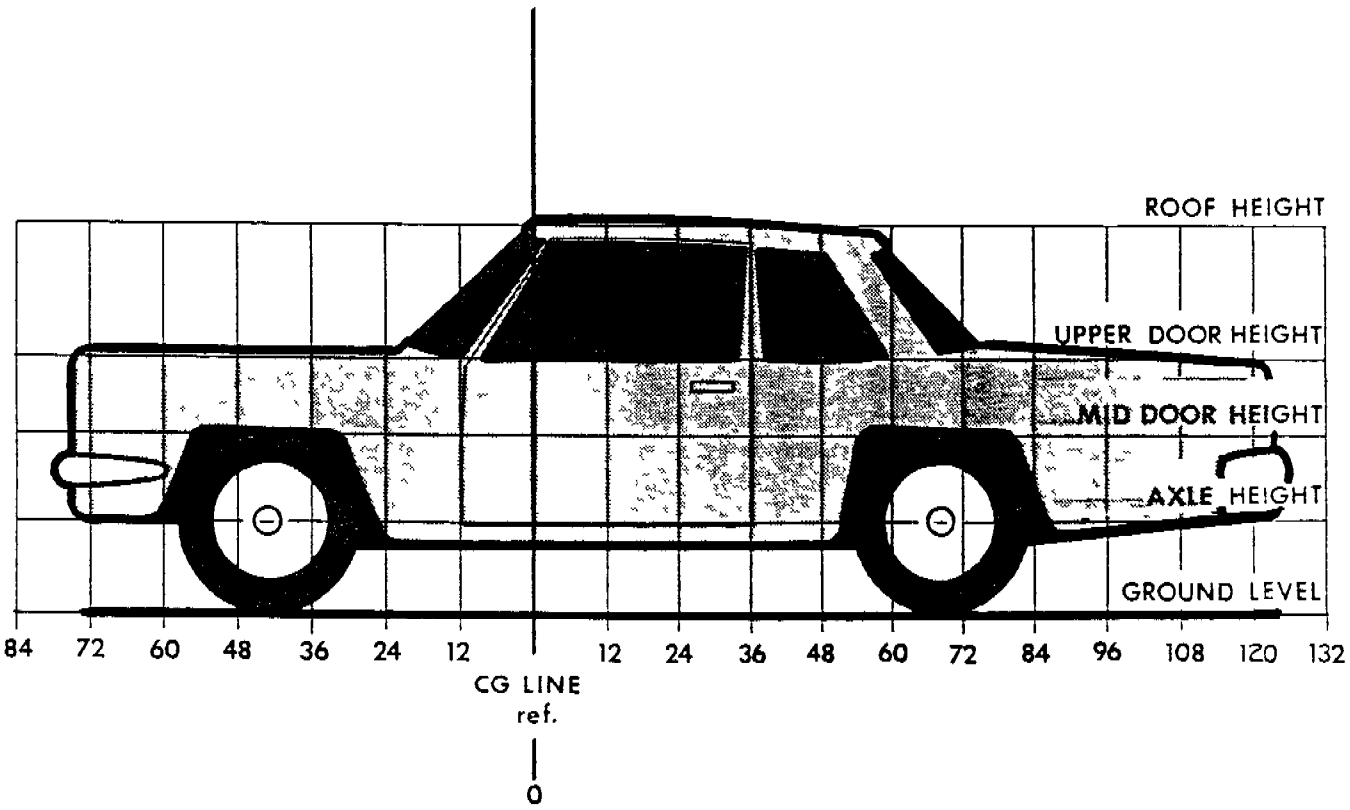
VEHICLE INTERIOR MEASUREMENTS

DESCRIPTION	PRE-TEST	POST-TEST	DIFFERENCE
Floor board to top of left "A" post	41 9	37 0	4 9
Floor board to top of right "A" post	41 8	34 2	7 6
Door sill to top of left "B" post	39 0	37 1	1 9
Door sill to top of right "B" post	39 0	33 4	5 6
Door sill to top of left door opening	40 0	36 1	3 9
Door sill to top of right door opening	40 0	30 8	9 2
Floor tunnel to windshield header	33 9	24 8	9 1
Floor tunnel to center of roof	41.2	29.3	11 9
Rear of floor tunnel to roof	37.4	31 3	6 1
Maximum width at "B" post	61.0	64.7	-3.7
Maximum width at "A" post	60.5	61 1	-0 6
Maximum width at top of door opening	46.5	45 8	0 7

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	36 1	37 4	38 4	38 8	38 5	37 5	36 1
Trailing edge of cowl + 12 inches***	35 2	36 6	37 6	37 8	37 7	36.6	35.5
Trailing edge of cowl + 24 inches	34 1	35.3	36 2	36.6	36 2	35 4	34 2
Trailing edge of cowl + 36 inches	X	33 9	34.5	35.0	34 6	33 8	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)							
Trailing edge of cowl at centerline	36.4	41 4	41.1	NA	NA	NA	35.0
Trailing edge of cowl + 12 inches	35 8	42 4	42.4	41.2	40 6	39 4	34 2
Trailing edge of cowl + 24 inches	35 0	40 1	40 0	39 8	38 8	36.8	32.8
Trailing edge of cowl + 36 inches	X	38.2	37.8	37.2	35 4	31 3	X
Trailing edge of cowl + 48 inches	X	X	X	X	X	X	X
STATIC CRUSH (IN)							
Trailing edge of cowl at centerline	0 3	4.0	2 7	NA	NA	NA	-1 1
Trailing edge of cowl + 12 inches	0 6	5 8	4 8	3.4	2.9	2.8	-1 3
Trailing edge of cowl + 24 inches	0 9	4 8	3.8	3.2	2 6	1.4	-1 4
Trailing edge of cowl + 36 inches	X	4.3	3.3	2 2	0 8	-2.5	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	55 9	56 8	56 6	57 1	56 4
Longitudinal Center of Gravity + 12 inches***	56 5	57 3	56 4	57 1	56 4
Longitudinal Center of Gravity + 24 inches	56 4	57 4	57 2	57 1	56 5
Longitudinal Center of Gravity + 36 inches	56 4	57 2	56 9	56 9	56 0
Longitudinal Center of Gravity + 48 inches	X	55 6	56 1	55 6	X
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)					
Longitudinal Center of Gravity	49 4	48.0	43.4	44.0	42 8
Longitudinal Center of Gravity + 12 inches	49.8	48 8	46 8	42 6	42.2
Longitudinal Center of Gravity + 24 inches	50 2	48.1	43 2	44 6	45 0
Longitudinal Center of Gravity + 36 inches	50 4	44 4	47 0	48 9	48 0
Longitudinal Center of Gravity + 48 inches	X	48.0	49.1	49.6	X
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X
STATIC CRUSH (IN)					
Longitudinal Center of Gravity	-6.5	-8.8	-13 2	-13.1	-13 6
Longitudinal Center of Gravity + 12 inches	-6 7	-8.5	-9.6	-14.5	-14 2
Longitudinal Center of Gravity + 24 inches	-6.2	-9.3	-14 0	-12 5	-11 5
Longitudinal Center of Gravity + 36 inches	-6.0	-12.8	-9 9	-8 0	-8 0
Longitudinal Center of Gravity + 48 inches	X	-7.6	-7.0	-6 0	X
Longitudinal Center of Gravity + 60 inches	X	X	X	X	X

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

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

LOCATION	HEIGHT(IN)	72	60	48	36	24	12	0	12	24	36	48	60	72	84	96
PRE-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	54.8	X	X	X	X	X	X	23 8	23 5	23 6	23 8	24 6	X	X	X	X
Upper Door	36.8	18.9	17.9	17.1	16.6	16.2	16.1	15 9	15.8	16 9	16.0	16.4	16 8	17.0	18 1	X
Mid Door	26.8	17.5	16.4	14.8	15.5	15.2	14.8	14.4	14.6	14.8	15 1	15 1	15.8	16 2	17 0	X
Axle Height	11.8	X	X	X	X	17.5	17.4	17.4	17.4	17.6	17 8	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	54 8	X	X	X	X	X	X	29.8	29.3	29.2	29.2	29.4	X	X	X	X
Upper Door	36.8	19.0	17.8	17.2	16.6	16.0	15.5	15 1	15.2	15.5	15 8	16.5	17 1	17.6	18 1	X
Mid Door	26 8	17.5	16.2	14.6	15.2	14.9	14.4	14.0	14.1	14.5	14.9	15 2	15.6	16 1	16 9	X
Axle Height	11.8	X	X	X	X	17.2	17.1	17.2	17.4	17.4	17 8	X	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	54.8	X	X	X	X	X	X	6.0	5.8	5.6	5.4	4.8	X	X	X	X
Upper Door	36.8	0.1	-0.1	0 1	0 0	-0.2	-0.6	-0.8	-0.6	-1 4	-0 2	0 1	0 3	0.6	0.0	X
Mid Door	26.8	0 0	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.5	-0.3	-0 2	0 1	-0 2	-0.1	-0 1	X
Axle Height	11.8	X	X	X	X	-0.3	-0 3	-0.2	0.0	-0.2	0.0	X	X	X	X	X

* Center of gravity is located 50.8 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	54.8	X	X	X	X	X	X	24 0	23.9	24 0	24 0	24 6	X	X	X	X
Upper Door	36.8	18.9	18.1	17.6	17.0	16.8	16.5	16.5	16.0	16.4	16 5	16.8	17 5	17.5	18 2	X
Mid Door	26.8	17.2	16.2	14.6	15.4	15.2	14.9	14 9	14.9	15 0	15 1	15 3	15 8	16.2	17.1	X
Axle Height	11 8	X	X	X	X	17.6	17 5	17 8	17.5	17.8	17 7	X	X	X	X	X
POST-TEST PROFILE (DISTANCE IN INCHES FROM REFERENCE PLANE**)																
Roof Height	54 8	X	X	X	X	X	X	20 1	26.2	23 3	23.0	25 0	X	X	X	X
Upper Door	36 8	21 0	19 8	18 8	16 6	16 2	12 2	9 0	12 8	11 9	11 5	18 1	16 7	16 9	17 8	X
Mid Door	26 8	17 5	16 0	14 5	14 8	15.2	12 4	9.1	13.6	12 4	11 6	15 1	15 6	15 3	16 9	X
Axle Height	11 8	X	X	X	X	18 0	18.1	18.1	18.2	18.0	18.4	X	X	X	X	X
STATIC CRUSH (IN)																
Roof Height	54.8	X	X	X	X	X	X	-3.9	2.3	-0.7	-1 0	0 4	X	X	X	X
Upper Door	36.8	2.1	1.7	1.2	-0.4	-0.6	-4.3	-7.5	-3.2	-4.5	-5 0	1.3	-0.8	-0.6	-0.4	X
Mid Door	26.8	0.3	-0.2	-0.1	-0.6	0.0	-2.5	-5.8	-1.3	-2.6	-3 5	-0 2	-0.2	-0.9	-0 2	X
Axle Height	11.8	X	X	X	X	0.4	0.6	0.3	0.7	0.2	0.7	X	X	X	X	X

Center of gravity is located 50.8 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: Volvo/240 TEST NUMBER: 911007

ALL MEASUREMENTS ARE IN INCHES

NO	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST	DIFF
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	189 9	189 8	0 1
X2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	160 1	160 6	-0 5
X3	REAR SURFACE OF VEHICLE TO FIREWALL	138.8	138 5	0 3
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	126 6	125 4	1 2
X5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	126 5	126 5	0 0
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	125 8	127 2	-1 4
X7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	126 1	126 4	-0 3
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	90 8	90 8	0 0
X9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	90 6	90 9	-0 3
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	90 4	90 9	-0 5
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	90 6	94 0	-3 4
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON RIGHT SIDE	124 8	123 9	0 9
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST ON LEFT SIDE	124.9	124 8	0 1
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	134 9	134 5	0 4
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	137 0	136 6	0 4
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	110 2	111 0	-0.8
X17	CENTER OF STEERING COLUMN TO "A" POST	11 8	16 0	-4 2
X18	CENTER OF STEERING COLUMN TO HEADLINER	16 0	9 9	6 1
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	186 0	185 4	1 6
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	186 0	186 0	0 0
X21	LENGTH OF ENGINE BLOCK	21 0	21 0	0 0

TEST ANOMALIES

The driver pelvis Y-axis acceleration, PEVYG1, data channel contained intermittent anamolous spikes between 80 and 220 milliseconds

The driver pelvis resultant acceleration, PEVRG1, data channel was affected by the above anomaly

The vehicle center of gravity Z-axis acceleration, VCGZG1, data did not return to zero at the end of the event

The vehicle center of gravity resultant acceleration, VCGRG1, data channel was affected by the above anomaly

EVENT TIMES

TEST DATE 10/07/91

EVENT DESCRIPTION	TIME, SEC
CONTACT RELEASE BLOCK	0 0
START COLLECTING DATA	-0 2
STOP COLLECTING DATA	4 9
ZERO TIME FOR DATA	0.0
STROBE LIGHTS FLASH	0 0
CAMERA L E D GOES OFF	0 0 *
PIN RELEASES (ROLLOVER CART)	-0 429 **
CYLINDERS START (ROLLOVER CART)	0 117

*Locate frame where event LED stripe ends Put projector into reverse mode and go backwards 4 frames. This frame is T-zero for the data.

**Release time as setup on rollover cart control panel and as setup by position of rollover cart cycle start switch and release block Cycle start switch was 20 feet in front of release block

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 Volvo MAKE/MODEL Volvo 240

BODY STYLE: 4-door sedan VIN. YV1AA8242M1453692

MODEL YEAR 1991 COLOR White

ENGINE DATA: TYPE Inline CYLINDERS 4 DISPLACEMENT 141CI

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

DATE VEHICLE RECEIVED 09/13/91 ODOMETER READING: 58 0

DEALER'S NAME AND ADDRESS Segna Motors, Inc.
2265 W Dublin-Granville
Columbus, OH 43085

ACCESSORIES

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	No
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	No
POWER SEATS	No	TILTING STEERING WHEEL	No
POWER WINDOWS	Yes	TELESCOPING STEERING WHEEL	No
TINTED GLASS	Yes	AIR CONDITIONING	Yes
RADIO	Yes	ANTI-SKID BRAKE	Yes
CLOCK	Yes	REAR WINDOW DEFROSTER	Yes
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

CERTIFICATION DATA FROM VEHICLE'S LABEL

VEHICLE MANUFACTURED BY. Volvo

DATE OF MANUFACTURE: 04/9 / N YV1AA8242M1453692

GVWR. 4030 LBS

GAWR: FRONT: 1885 LBS) LBS

TEST VEHICLE INFORMATION CONT'D

TIRES ON VEHICLE (MFR , LINE, SIZE) Michelin MXL 185/70R14

TIRE PRESSURE WITH MAXIMUM CAPACITY VEHICLE LOAD FRONT 35 PSI
REAR 35 PSI

SPARE TIRE (MFR , LINE, SIZE) Firestone Radial Special Spare 155/R15

TYPE OF SEATS FRONT Bucket
REAR Bench

TYPE OF FRONT SEAT BACKS Manually Adjustable

MAXIMUM WIDTH 67 5 INCHES

WHEELBASE 104.0 INCHES

LOCATION OF LABEL STATING TIRE & CAPACITY DATA·

The label was located on the passenger door.

TIRE & CAPACITY DATA FROM VEHICLE'S LABEL:

RECOMMENDED TIRE SIZE. 185/70R14

RECOMMENDED COLD TIRE PRESSURE· FRONT. 36 PSI; REAR: 36 PSI

DESIGNATED SEATING CAPACITY· 2 FRONT 3 REAR 5 TOTAL

VEHICLE CAPACITY WEIGHT· 945 LBS.

TEST VEHICLE ATTITUDE (ALL MEASUREMENTS ARE IN INCHES):

DELIVERED ATTITUDE:	LF	26 9;	RF	27.2;	LR	25 8;	RR	25 9
FULLY LOADED ATTITUDE:	LF	26 6;	RF	26.6;	LR	24.3;	RR	24 3
PRE-TEST ATTITUDE:	LF	26.6;	RF	27 0;	LR	25 1,	RR	24 9
POST-TEST ATTITUDE:	LF	27 7;	RF	25 7;	LR	24 0;	RR	22 7

TEST VEHICLE INFORMATION CONT'D

WEIGHT OF TEST VEHICLE AS RECEIVED (WITH MAXIMUM FLUIDS)

RIGHT FRONT	810 LBS	RIGHT REAR	640 LBS
LEFT FRONT	730 LBS	LEFT REAR	670 LBS
TOTAL FRONT WEIGHT	1540 LBS	(54 0% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1310 LBS	(46 0% OF TOTAL VEHICLE WEIGHT)	
TOTAL DELIVERED WEIGHT	2850 LBS		

CALCULATION OF TEST VEHICLE'S TARGET TEST WEIGHT:

RCLW = RATED CARGO AND LUGGAGE WEIGHT*

UDW = UNLOADED DELIVERED WEIGHT (2850 LBS)

VCW = VEHICLE CAPACITY WEIGHT (945 LBS)

DSC = DESIGNATED SEATING CAPACITY (5)

RCLW*= VCW - 150 (DSC) = 945 - 150(5) = 195

TARGET TEST WEIGHT = UDW + RCLW*+ (NO. OF HYBRID III DUMMIES X 167 LBS/DUMMY)

TARGET TEST WEIGHT = 2850 + 195 + 167

TARGET TEST WEIGHT = 3212 LBS

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 210 LBS. OF CARGO WEIGHT

RIGHT FRONT	785 LBS.	RIGHT REAR	778 LBS.
LEFT FRONT	866 LBS	LEFT REAR	798 LBS.
TOTAL FRONT WEIGHT	1651 LBS	(51.2% OF TOTAL VEHICLE WEIGHT)	
TOTAL REAR WEIGHT	1576 LBS	(48 8% OF TOTAL VEHICLE WEIGHT)	
TOTAL TEST WEIGHT	3227 LBS	(0.5% OVER TARGET TEST WEIGHT)	

WEIGHT OF BALLAST SECURED IN VEHICLE CARGO AREA: 50 LBS. behind driver's seat

COMPONENTS REMOVED TO MEET TARGET TEST WEIGHT: NA

CG = 50.8 INCHES REARWARD OF FRONT WHEEL CENTERLINE

*Cargo weight for multi-purpose passenger vehicles, trucks, and buses is the vehicle's rated cargo and luggage weight from the vehicle's label or 300 pounds, whichever is less

TEST CONDITIONS

TEST NUMBER· 911007 TEST DATE 10/07/91

TEST TEMPERATURES

IMPACT AREA	59° F,	OCCUPANT COMPARTMENT	70° F
DRIVER DUMMY	70° F,	PASSENGER DUMMY	NA F

VEHICLE AND ROLL CART DATA

	ACTUAL	INTENDED
VEHICLE TEST WEIGHT (LBS)	3227	3212
VEHICLE ORIENTATION (DEG) ROLL*	30	30
IMPACT SIDE	Left	Left
ROLL CART WEIGHT (LBS.).	3347	3347
ROLL CART CRABBED ANGLE (DEG)**	0	0
ROLL CART VELOCITY (MPH)***·	30.0	30 0

VEHICLE MEASUREMENTS

MAX LENGTH	189 9	WHEELBASE·	67 5
MAX WIDTH	67 5	TOP WIDTH	NA

C G REARWARD OF FRONT WHEEL CENTERLINE· 50.8
C G HEIGHT ABOVE GROUND LEVEL. 22.3

VEHICLE TEST CONDITIONS

LEFT FRONT·	DOOR - unlocked	WINDOW - Up	
LEFT REAR	DOOR - unlocked	WINDOW - Up	
RIGHT FRONT	DOOR - unlocked	WINDOW - Up	
RIGHT REAR	DOOR - unlocked	WINDOW - Up	
EMERGENCY BRAKE	Off	TRANSMISSION	Neutral
HEADRESTS:	DRIVER - fixed	PASSENGER - NA	
TIRE PRESSURE	FRONT - 35 PSI,	REAR - 35 PSI	

DUMMY INFORMATION

TYPE	Part 572E
POSITION·	Driver
SERIAL NO.:	907
INSTRUMENTATION:	
HEAD ACCELS..	3
NECK LOAD CELLS·	6
CHEST ACCELS ·	3
CHEST DISPLACMENT POTENTIOMETER·	1
PELVIS ACCELS.:	3
RIB DISPLACEMENT POTENTIOMETER:	
RESTRAINT SYSTEM:	Three-point unibelt and driver's airbag

ALL DISTANCE MEASUREMENTS ARE IN INCHES
*AS MEASURED ON THE ROLL CART WITH CYLINDER IN REST POSITION
**AS MEASURED FROM ROLL CART'S CENTERLINE TO DIRECTION OF TRAVEL (POSITIVE IS CLOCKWISE)

VEHICLE INSTRUMENTATION LOCATIONS AND DATA SUMMARY

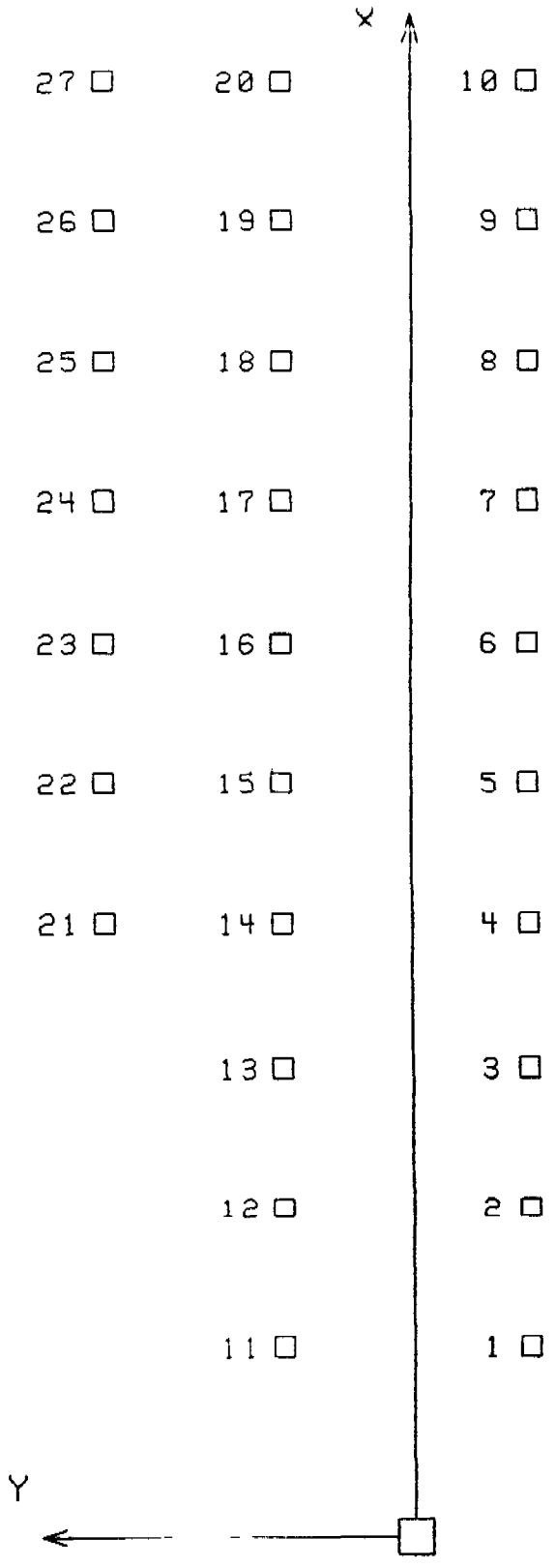
TEST NUMBER 911007

No	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX G	MSEC	NEGATIVE DIRECTION MAX G	MSEC
1	CENTER OF GRAVITY	106 8	0 0	16 6				
	ACCELERATION (g)							
	LONGITUDINAL				2 5	2028 7	4 5	952 3
	LATERAL				11 2	1778 7	3 3	831 3
	VERTICAL				3.5	122 0 Y	19 2	950 0 Y
	RESULTANT				19 5	950.7 Y		
2	CENTER OF GRAVITY	83 8	0.0	20 1				
	ROLL (X-AXIS)				130 4	2636 0	503 5	920 7
	PITCH (Y-AXIS)				70 7	2026 0	149 9	1700 0
	YAW (Z-AXIS)				118 4	954.7	81 5	1727 3
3	LEFT FRONT SUSPENSION	20.8	160 0	33.1				
	DISPLACEMENT (in)							
	VERTICAL				2.2	2111 3	0 2	1839 3
4	RIGHT FRONT SUSPENSION	20 5	-155 9	33 3				
	DISPLACEMENT (in)							
	VERTICAL				4 2	1732 0	0 1	867 3
5	LEFT REAR SUSPENSION	47 0	15 1	27 9				
	DISPLACEMENT (in)							
	VERTICAL				4 4	2032 7	0 3	2216 7
6	RIGHT REAR SUSPENSION	47 0	-16 2	28.0				
	DISPLACEMENT (in)							
	VERTICAL				5.4	1012.7	0 2	1882 0

* ALL MEASUREMENTS OF INSTRUMENTATION LOCATIONS ARE IN INCHES

REFERENCE. X: + FORWARD FROM VEHICLE'S REAR BUMPER
Y: + LEFTWARD FROM VEHICLE'S CENTERLINE
Z + UPWARD FROM GROUND LEVEL
ROLL: + TO RIGHT
PITCH: + NOSE DOWNWARD
YAW: + COUNTERCLOCKWISE
DISPLACEMENT: + UPWARD

Y See TEST ANOMALIES



STADIA POLE LAYOUT AND NUMBERING SYSTEM

STADIA POLE LOCATIONS

POLE NO.	X DISTANCE*	Y DISTANCE*
1	35 0	8 0
2	43 0	8 0
3	51 0	8 0
4	59 0	8 0
5	67 0	8 0
6	75 0	8 0
7	83.0	8 0
8	91 0	8.0
9	99 0	8 0
10	107 0	8.0
11	35 0	-10 0
12	43 0	-10 0
13	51 0	-10 0
14	59 0	-10 0
15	67.0	-10 0
16	75.0	-10 0
17	83.0	-10 0
18	91.0	-10 0
19	99.0	-10.0
20	107 0	-10 0
21	59.0	-20 0
22	67 0	-20.0
23	75 0	-20 0
24	83.0	-20 0
25	91.0	-20 0
26	99 0	-20 0
27	107 0	-20 0

*REFERENCE· +X· FORWARD FROM RELEASE BLOCK

+Y. LEFTWARD FROM CENTER RELEASE BLOCK

ALL MEASUREMENTS ARE IN FEET

HIGH-SPEED CAMERAS LOCATION

OFFBOARD

CAMERA NO	X*	Y*	Z*
2	95 0	195 4	2 7
3	240 6	124 3	2 7
4	209 0	0 0	3 6
5	67 0	-72 2	2 8

*Reference.

+X: Forward from release block

+Y Leftward from the centerline of the release block

+Z Upward from the ground level

ONBOARD

CAMERA NO	X**	Y**	Z**
7	1 6	-1 4	1.4
8	3 5	-1 3	3 3

**Reference.

+X. Forward from the C G of vehicle

+Y· Leftward from centerline of vehicle

+Z: Upward from the ground level

ALL MEASUREMENTS ARE IN FEET

CAMERA INFORMATION

CAMERA NO	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Left panning	Bolex	16	24	Real-time documentary
2	Left wide	Photosonic	13	498	Vehicle Dynamics
3	Left angle	Photosonic	25	500	Vehicle Dynamics
4	Downstream	Photosonic	50	500	Vehicle Dynamics
5	Right wide	Photosonic	13	493	Vehicle Dynamics
6	Overhead	Photosonic	8 5	498	Vehicle Dynamics
7	Onboard - front	Photosonic	8	495	Dummy kinematics
8	Onboard rear	Photosonic	8	499	Dummy kinematics

SECTION 4 0

OCCUPANT INFORMATION

POST-IMPACT DUMMY/VEHICLE DATA

VISIBLE DUMMY CONTACT POINTS

	DRIVER #907	PASSENGER #NA
HEAD	Roof	
CHEST	Door panel	
ABDOMEN	None	
LEFT KNEE	Dash panel	
RIGHT KNEE	Dash panel	

DOOR OPENING:

	LEFT	RIGHT
FRONT	With difficulty	Opened during roll
REAR	With difficulty	Opened during roll

SEAT MOVEMENT

	SEAT BACK FAILURE	SEAT SHIFT
FRONT	No	No
REAR	No	No

GLAZING DAMAGE:

The windshield, the left front and rear, right front and rear door windows, and the rear window cracked during the roll over

OTHER NOTABLE IMPACT EFFECTS

The rear [illegible]ors and rear window molding became detached during the rollover. The right rear tire was flat. The airbag did not deploy.

DUMMY KINEMATIC SUMMARY

The vehicle struck the ground at the junction of the roof and the driver's side A, B, and C pillars The dummy's knees then rose and struck the dash panel as the dummy's right hand and arm rose and struck the roof Simultaneously, the roof collapsed onto the dummy's head The vehicle then rolled fully onto its top collapsing the passenger side of the roof and causing both passenger's side doors to fly open The vehicle next rolled onto its passenger's side as the roll cart came to a stop The vehicle then bounced onto the driver's side wheels as the hood opened The vehicle next bounced onto the roof again, crushing the open hood into the engine compartment The dummy's head, right arm, and right hand struck the roof a second time The vehicle rolled approximately 540° total The dummy was restrained with a 3-point unibelt The dummy's head injury criteria, HIC, was 207 and its chest resultant acceleration with three milliseconds minimum duration was 21 4 g

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. The temperature was controlled to the last minute before launching of the vehicle.

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 adjusted to 23°. The dummy was positioned in the seat using NHTSA's Notice #60 seating procedure. The H-point location of the seat was obtained by using the SAE J211 OCT88 H-point machine as specified in the Notice #60. The driver dummy was restrained with a three-point unibelt.

DUMMY DATA SUMMARY

TEST NUMBER 911007

DRIVER DUMMY
SN 907

	POSITIVE DIRECTION MAX	MSEC	NEGATIVE DIRECTION MAX	MSEC
HEAD ACCELERATION (g)				
LONGITUDINAL	15.0	952 0	21 7	826 7
LATERAL	14 5	842 7	73 4	827 3
VERTICAL	9 4	834 0	34 5	838 0
RESULTANT	81 5	827 3		
HIC	208 FROM 824 7 TO 832.0			
NECK FORCES (lbs)				
LONGITUDINAL	105 8	912 0	106 4	830 7
LATERAL	15 4	108 0	400.6	854 0
VERTICAL	63 7	1848 0	1354 3	850.7
NECK MOMENT (in-lbs)				
ABOUT LONG	38 2	2088 7	150 0	854 0
ABOUT LATERAL	15 9	1105 3	46 3	864 0
ABOUT VERTICAL	13 8	856.0	10.4	962 0
CHEST ACCELERATION (g)				
LONGITUDINAL	4 6	1788 0	7 6	830 7
LATERAL	7 8	1754 0	7 4	835 3
VERTICAL	5 1	2058 0	22 4	844 0
RESULTANT	23 2	844 0		
3 MSEC	21 4			
CHEST DISPLACEMENT (in)				
LONGITUDINAL	0 2	1790 7	0.2	1871.3
PELVIS ACCELERATION (g)				
LONGITUDINAL	4.0	1775 3	6 0	898 0
LATERAL	62 7	1714 7 Y	29 2	2005.3 Y
VERTICAL	4 4	2064 0	16 9	847.3
RESULTANT	62 7	1714 7		

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

See APPENDIX D for neck load cell polarities.

Y S e TEST ANOMALIES

DUMMY IN-VEHICLE POSITION RECORDING SHEET

MFR /MAKE/MODEL: Volvo/240

SEAT TYPE ____Bench
X Bucket
____Split bench

ADJUSTER TYPE: X Manual
____Power
____Non-adjustable

BUCKET SEAT BACK TYPE ____Non-adjustable
X Adjustable reclining

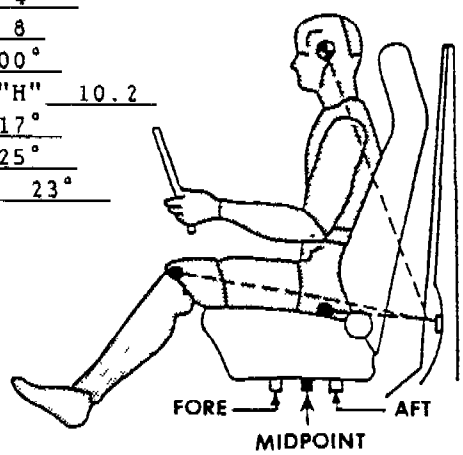
POSITIONING DATE 10/07/91

AMBIENT TEMP 59° F TIME: 1520

TECHNICIANS:
1 B Miller
2. S. Ericksen
3. ____
4. ____

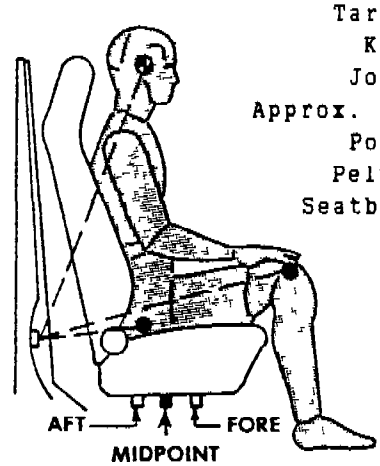
DRIVER DUMMY* # 907 TYPE. HIII

Head 19.7
Target 4°
Knee 21 8
Joint 100°
Approx "H" 10.2
Point 117°
Pelvis 25°
Seatback 23°



PASSENGER DUMMY* # NA TYPE ____

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

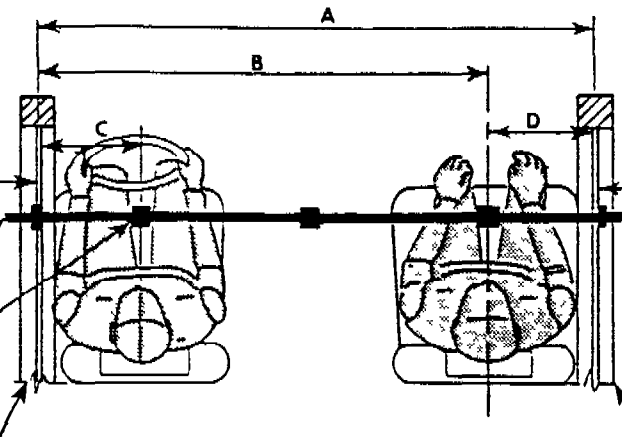


A = 53.1
B = NA
C = 12.2
D = NA

DOOR GLASS HEIGHT = 8.4

LATERAL BAR

ADJUSTABLE POINTER



DOOR GLASS HEIGHT = ____

LEFT FRONT DOOR

DRIVER DUMMY

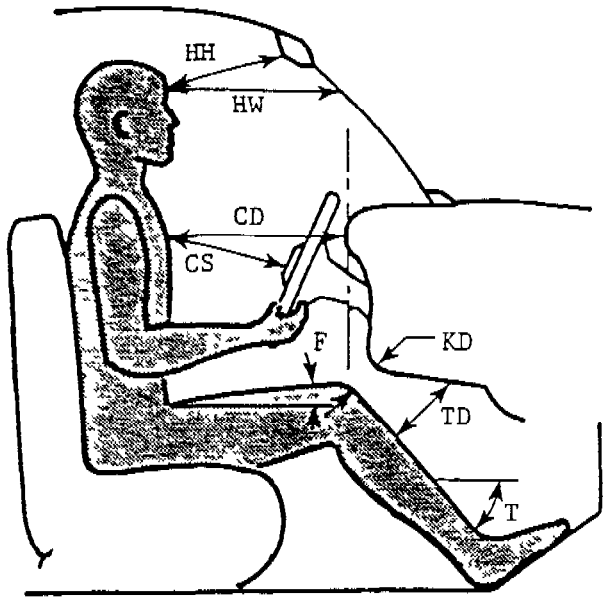
PASSENGER DUMMY

RIGHT FRONT DOOR

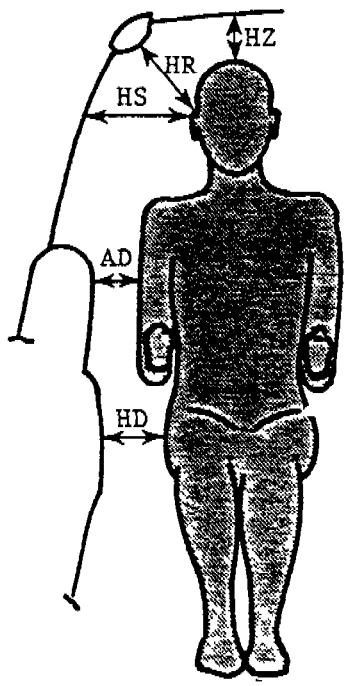
*Dummy measurements are referenced to top of striker bolt and all angles are referenced to vertical.

DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER	PASSENGER
		NA
HH	17 8	
HW	22 4	
CD	20 5	
CS	12 2	
KDL	4 4	
KDR	4 5	
FL	17°	
FR	15°	
TDL	3 9	
TDR	3 5	
TL	44°	
TR	47°	

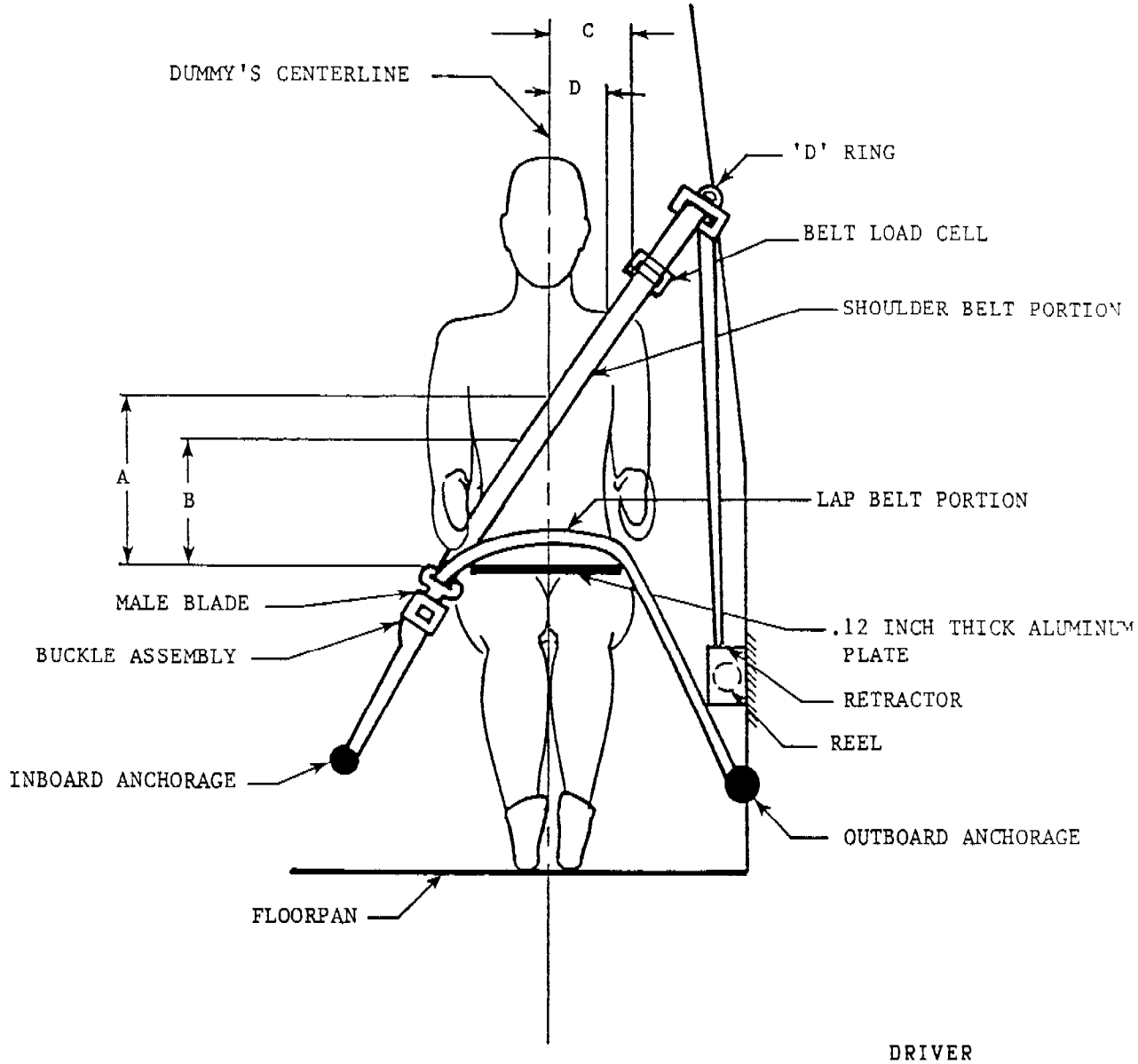


	DRIVER	PASSENGER
HR	6.8	
HS	7.0	
AD	4.0	
HD	6.4	
HZ	3.3	



ALL DISTANCE MEASUREMEN[illegible] NCHES.

SEAT BELT POSITIONING DATA



	DRIVER DUMMY
A - TOP SURFACE OF ALUM. PLATE TO BELT UPPER EDGE (IN)	11.7
B - TOP SURFACE OF ALUM. PLATE TO BELT LOWER EDGE (IN)	8 9
C - DUMMY CENTERLINE TO OUTER EDGE OF BELT AT CHEST FLESH TOP (IN)	5 0
D - DUMMY CENTERLINE TO INNER EDGE OF BELT AT CHEST FLESH TOP (IN)	3 0

APPENDIX A

PHOTOGRAPHS

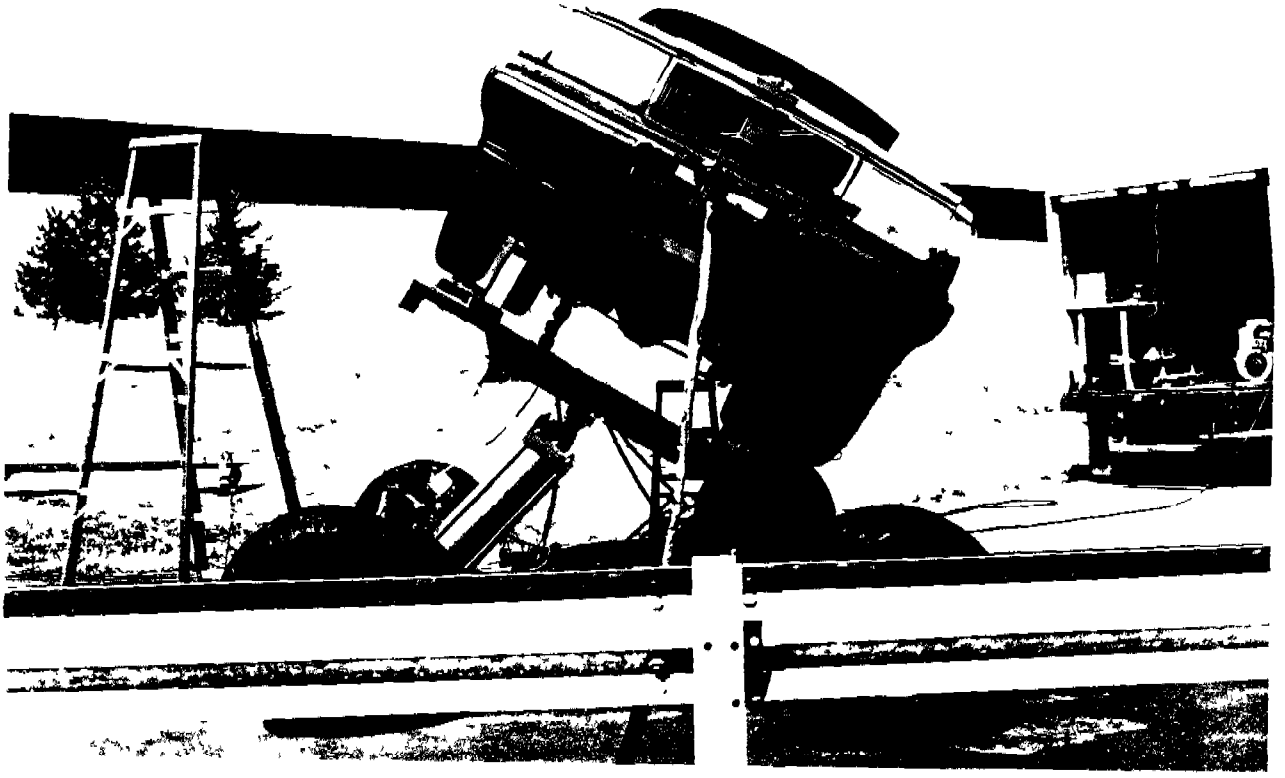


Figure A-1 PRE-TEST FRONT VIEW

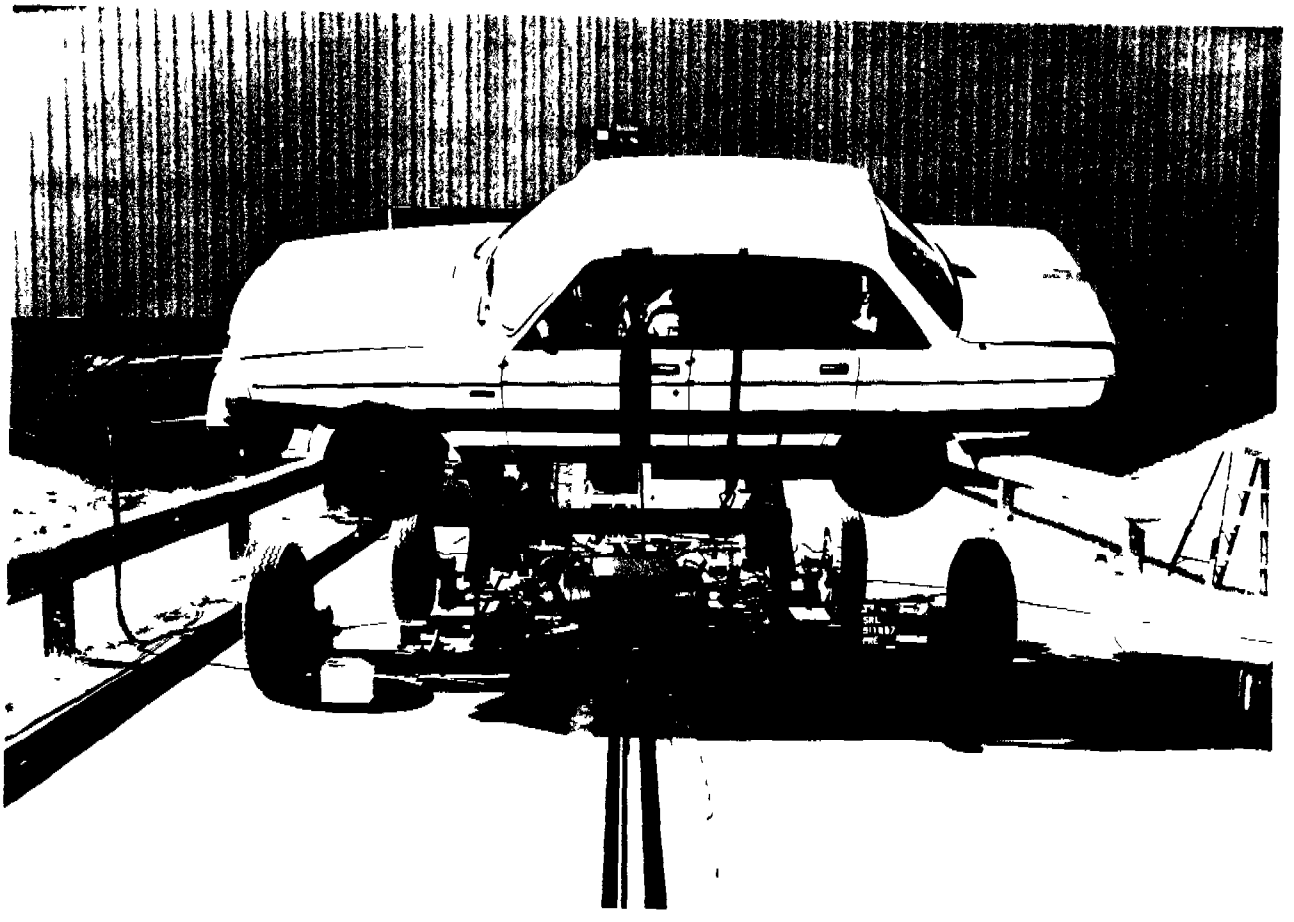


Figure A-2 PRE-TEST LEFT SIDE VIEW

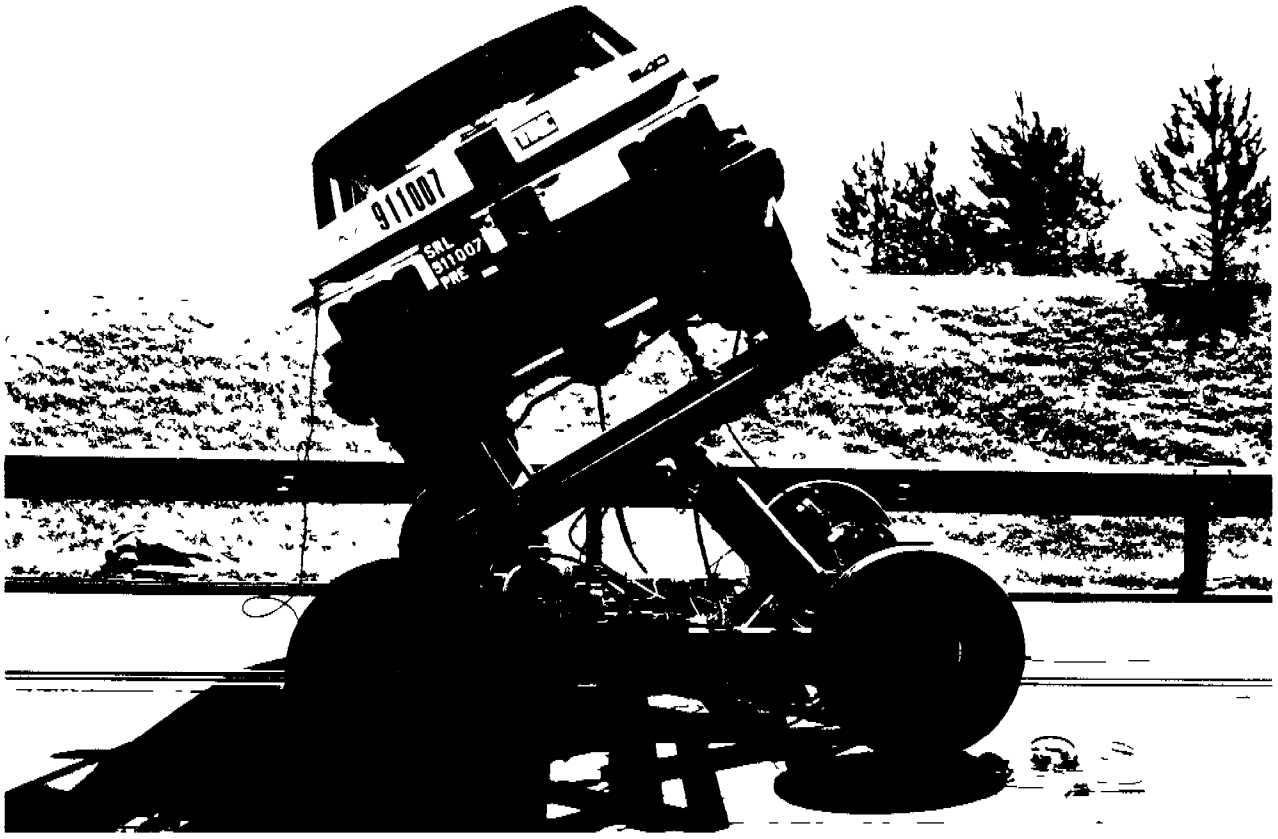


Figure A-3 PRE TEST REAR VIEW

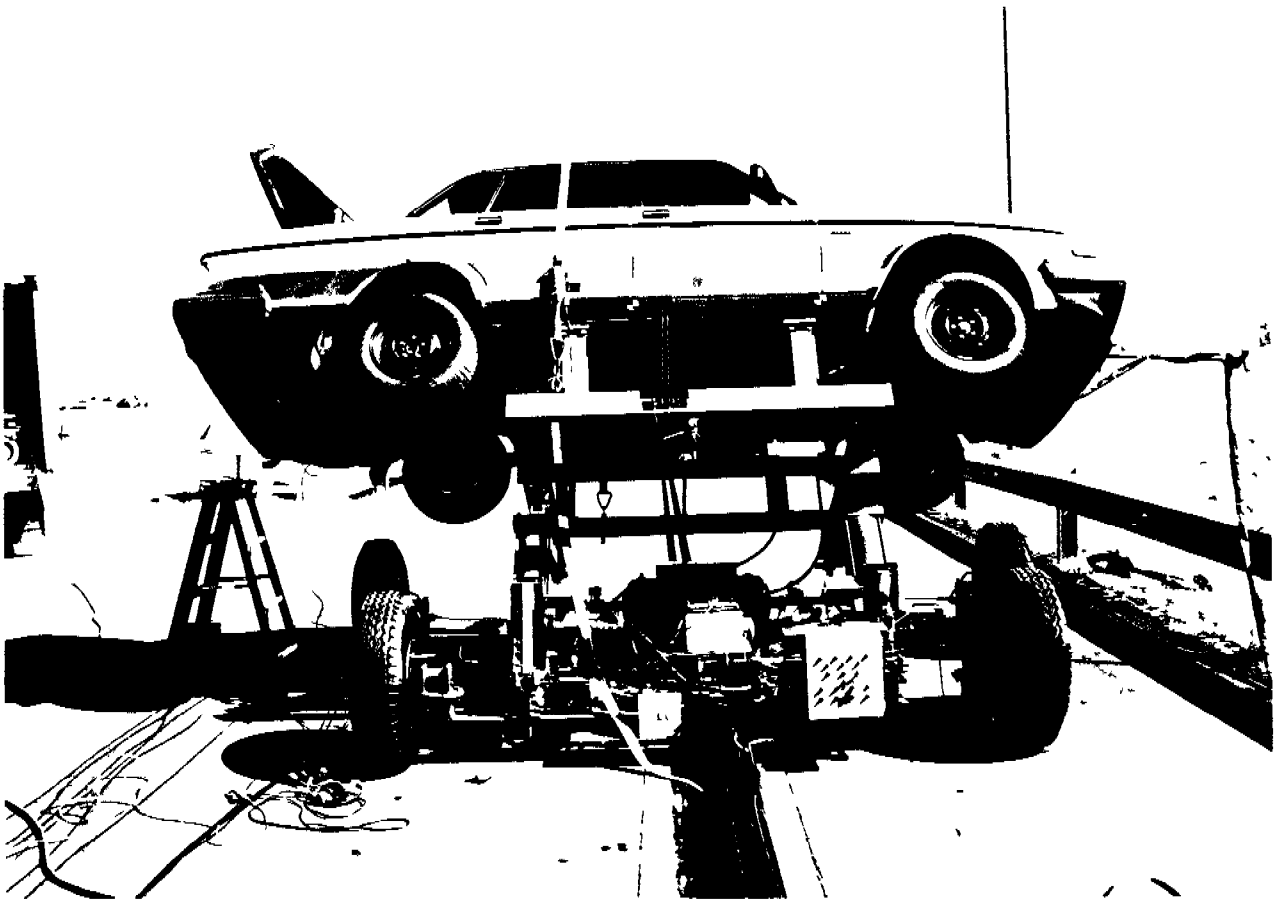


Figure A-4 PRE-TEST RIGHT SIDE VIEW

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

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

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

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

Figure A-9 PRE-TEST LEFT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1

Figure A 10 PRE-TEST LEFT F NION STRING POTENTIOMETER - VIEW 2

Figure A-11 PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 1

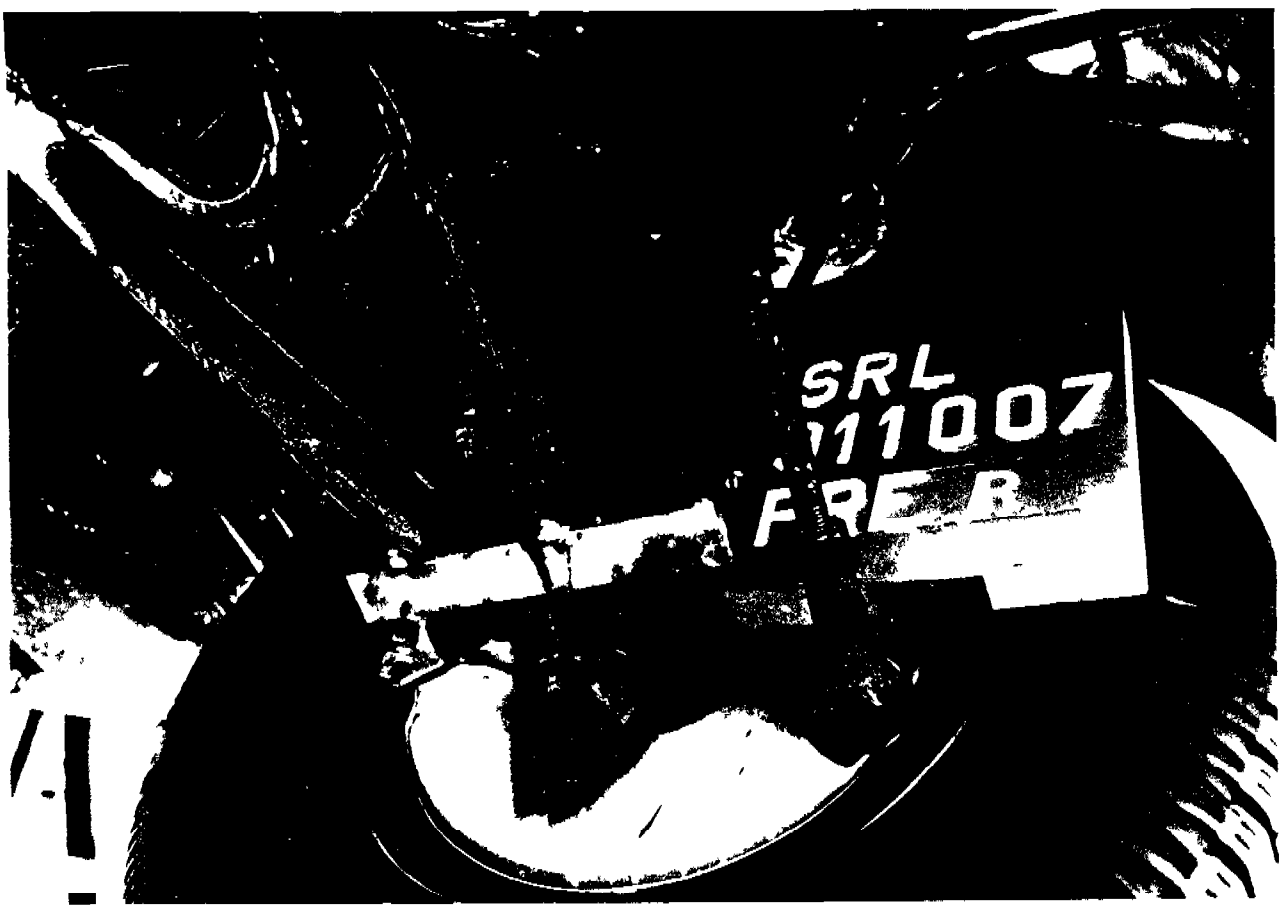


Figure A-12 PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER VIEW 2

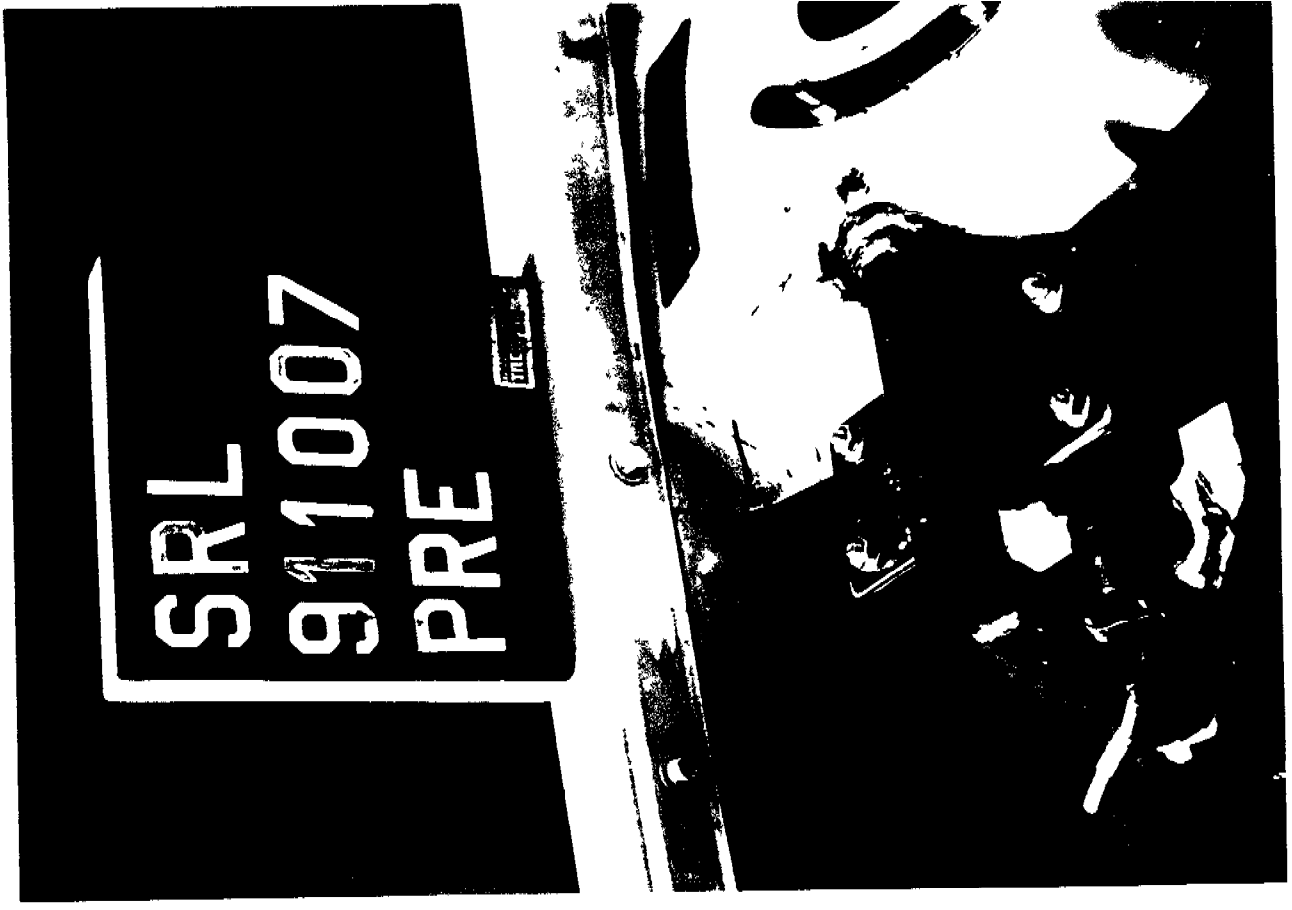


Figure A-13 PRE-TEST RIGHT FRONT SUSPENSION STRING POTENTIOMETER - VIEW 3

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

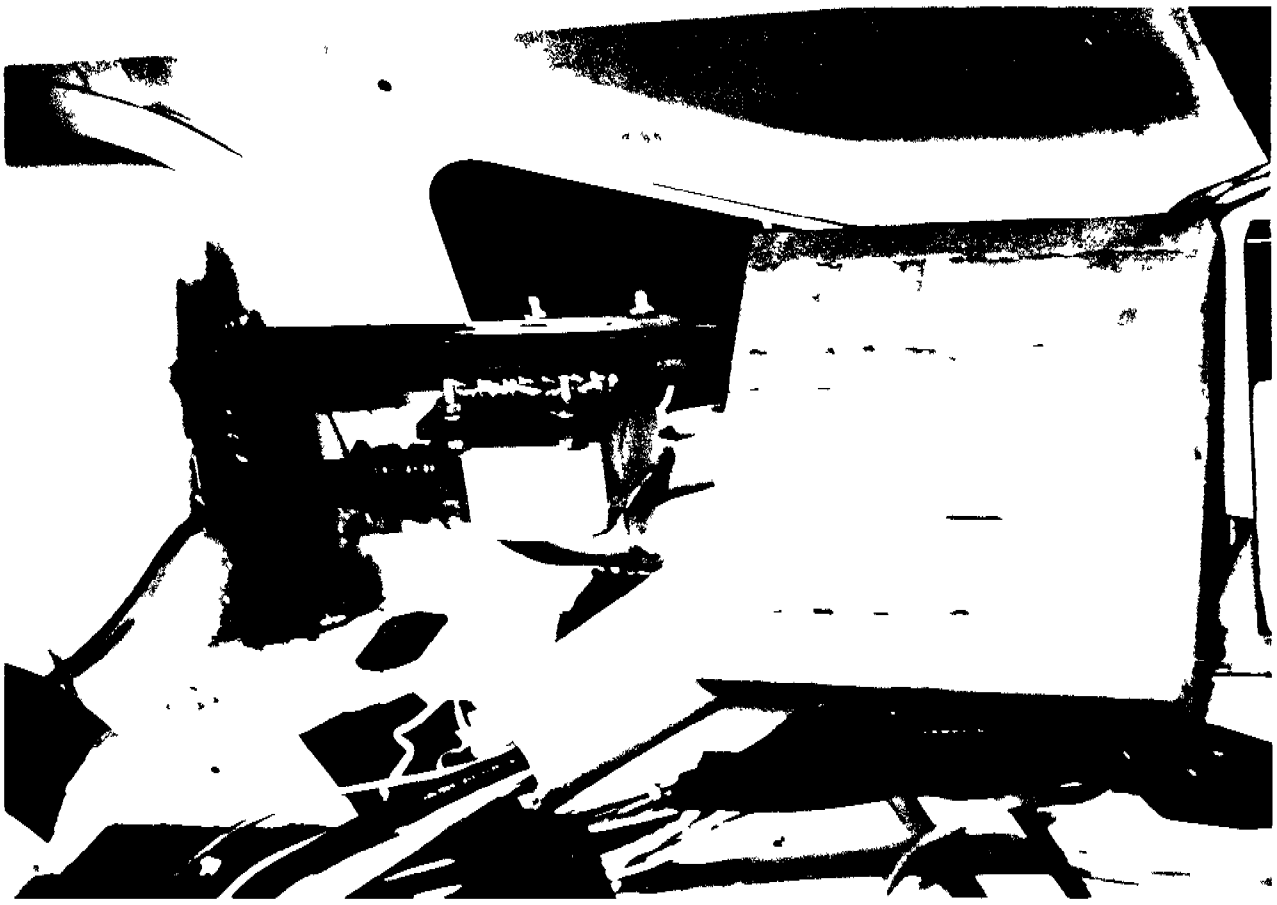


Figure A 15 PRE-TEST LEFT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2

Figure A-16 PRE-TEST RIGHT -NSION STRING POTENTIOMETER - VIEW 1

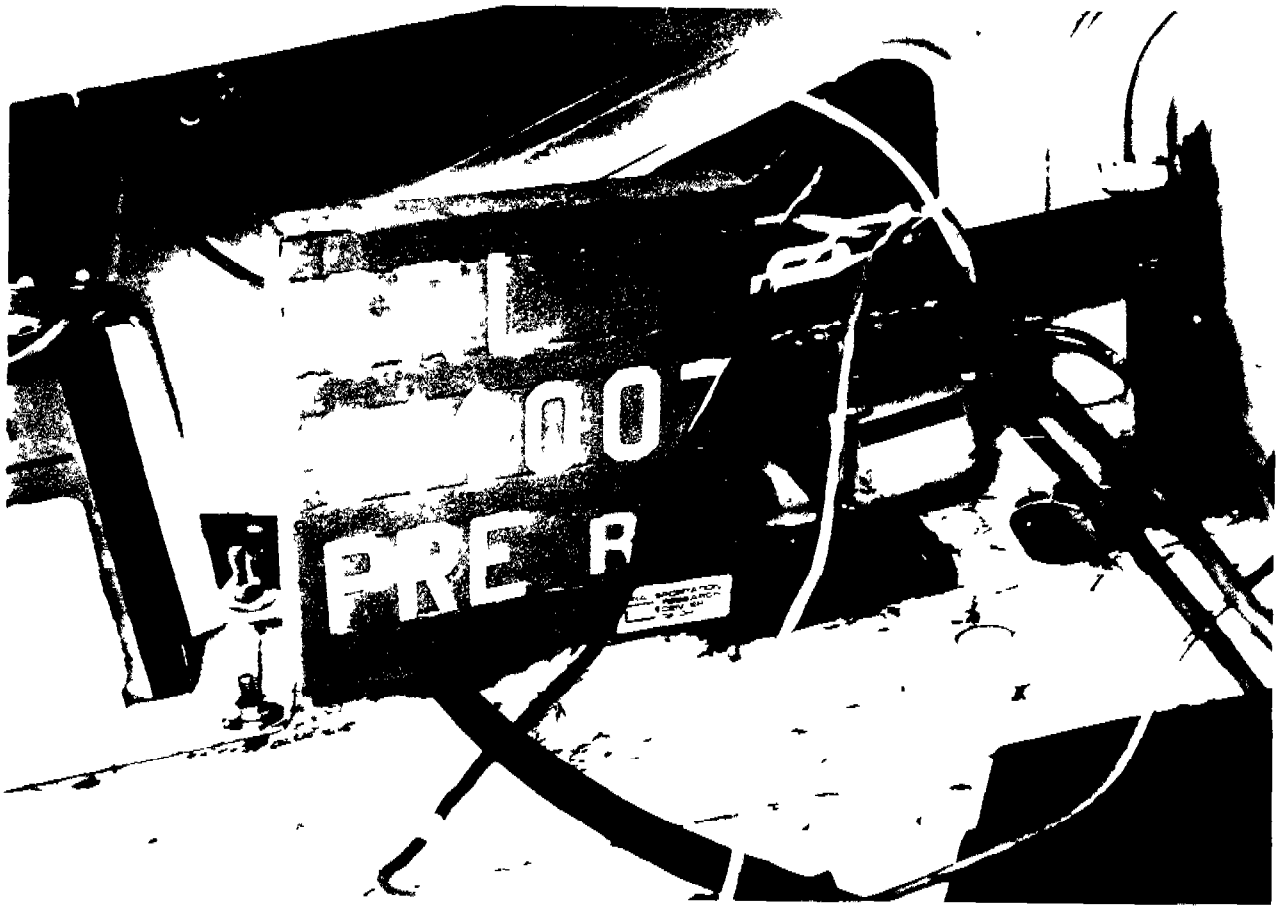


Figure A-17 PRE-TEST RIGHT REAR SUSPENSION STRING POTENTIOMETER - VIEW 2

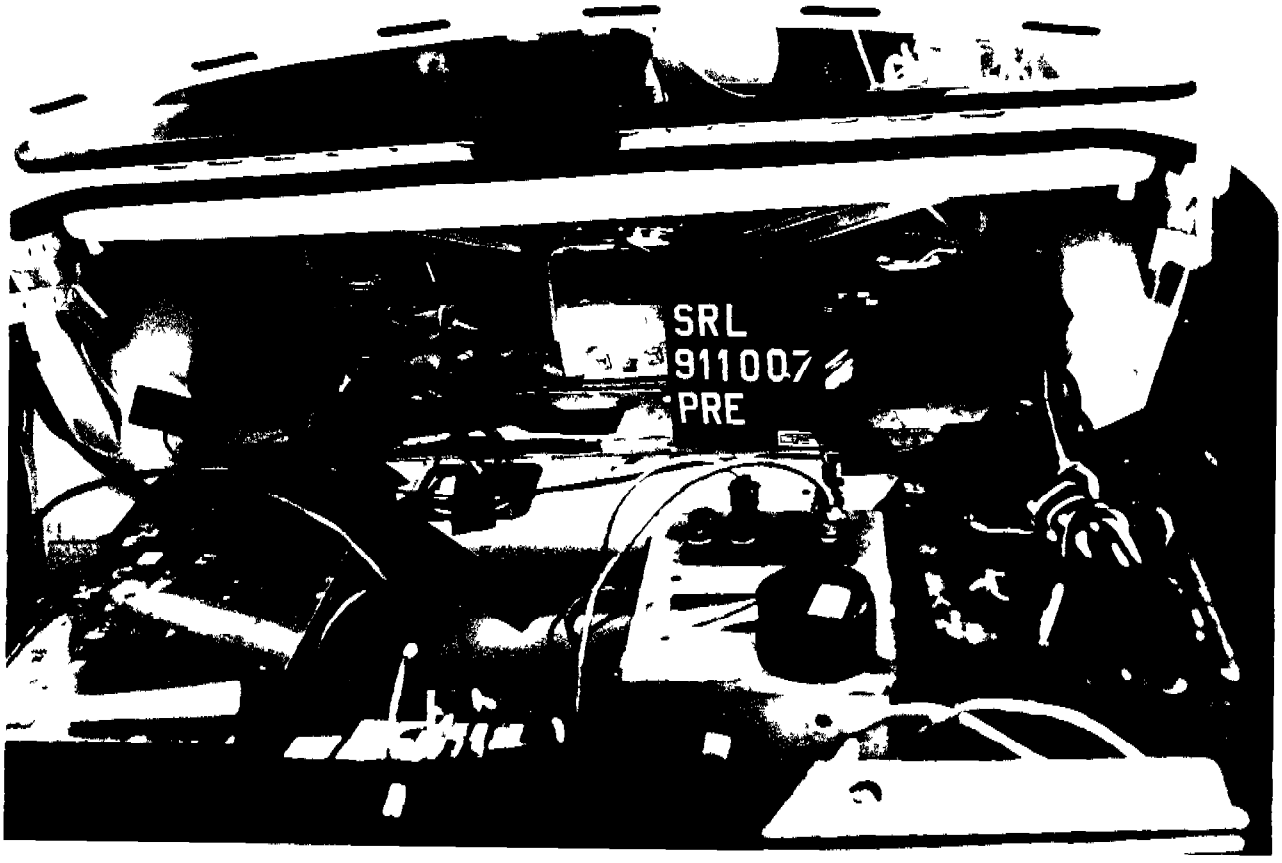


Figure A-18. PRE-TEST VEHICLE INSTRUMENTATION AND BALLAST LOCATION - VIEW 1

Figure A-19 PRE-TEST VEHICLE INSTRUMENTATION AND BALLAST LOCATION - VIEW 2

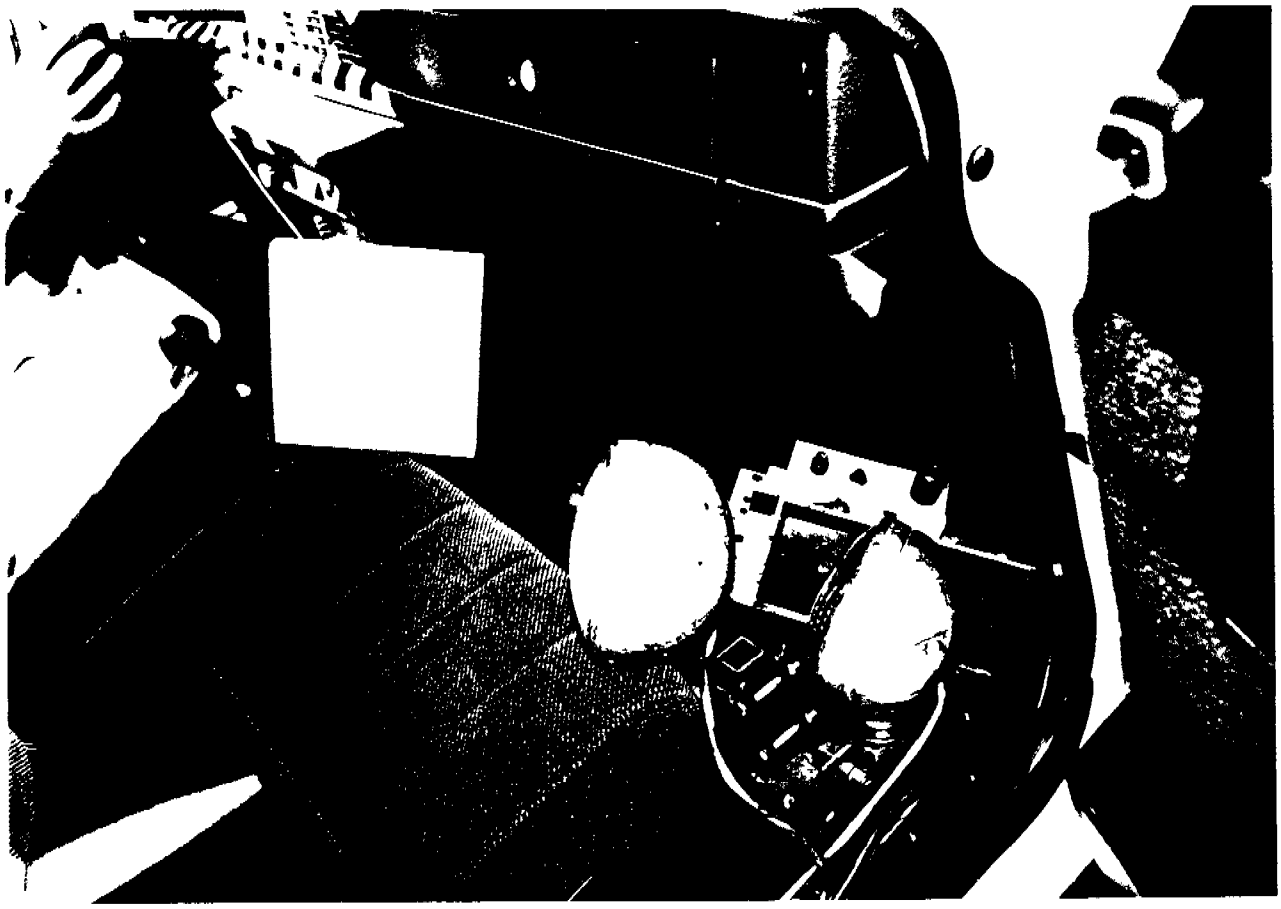


Figure A-20 PRE-TEST VEHICLE INSTRUMENTATION AND BALLAST LOCATION - VIEW 3

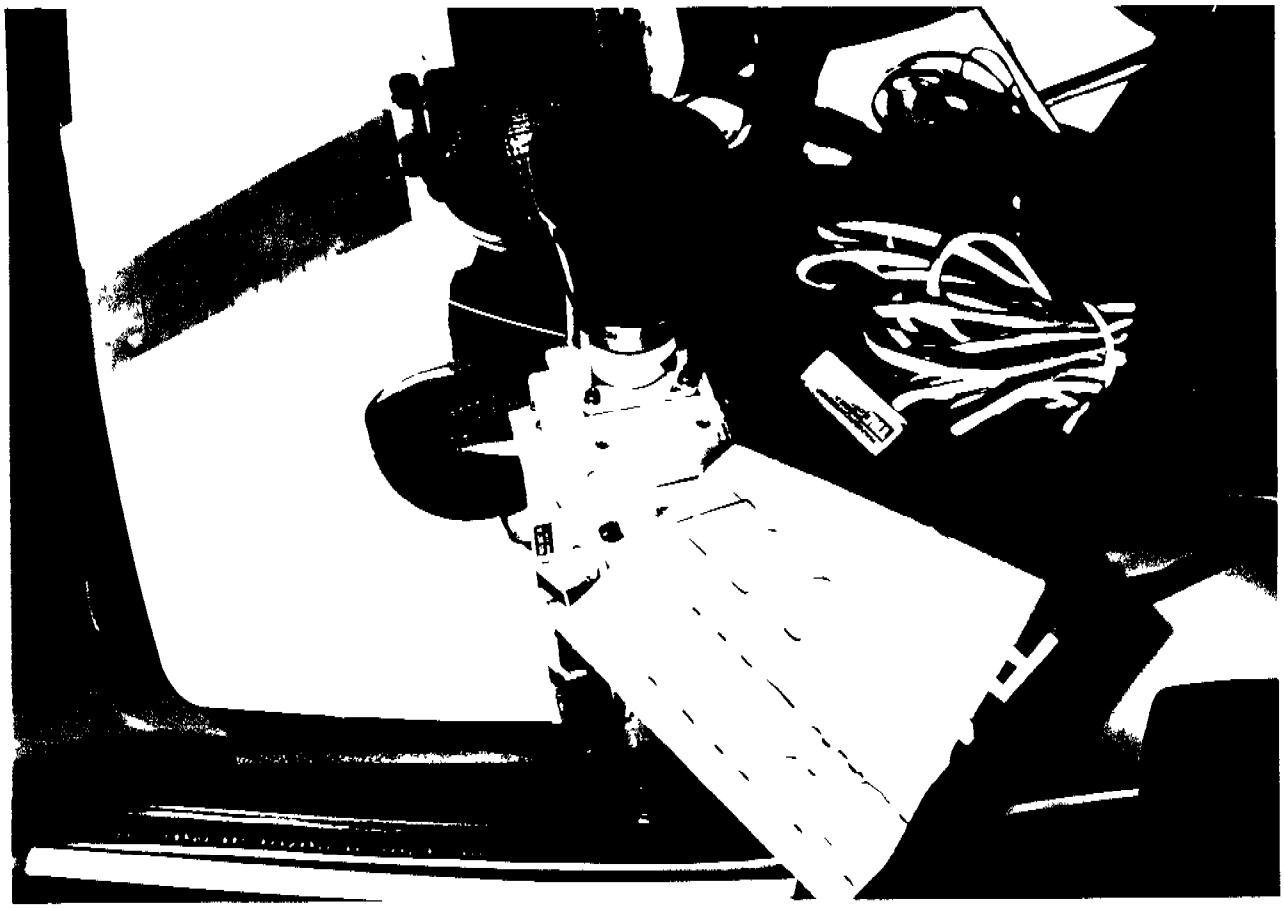


Figure A-21 PRE-TEST INSTRUMENTATION AND BALLAST LOCATION - VIEW 4

Figure A-22 PRE-TEST VEHICLE INSTRUMENTATION AND BALLAST LOCATION - VIEW 5

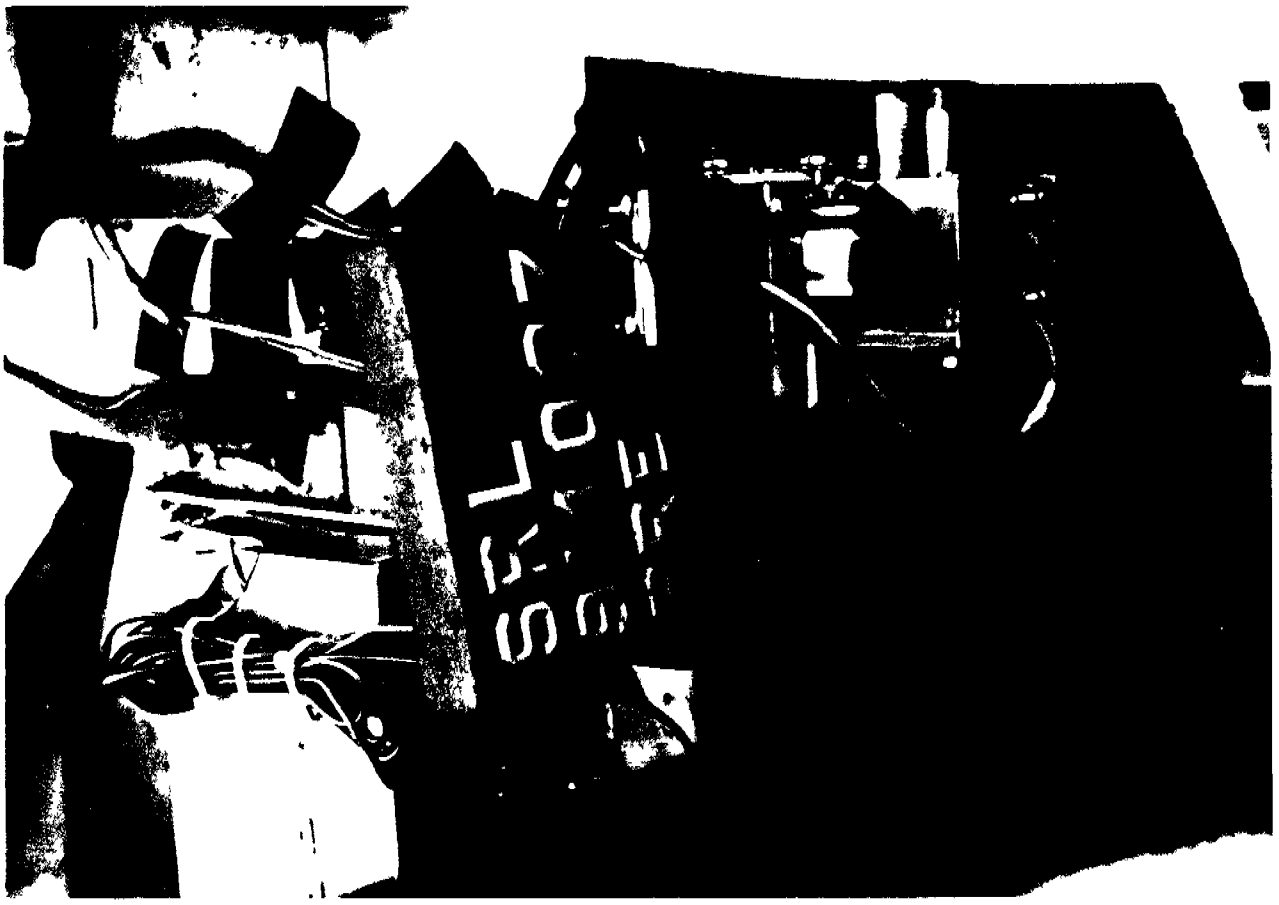


Figure A-23 PRE-TEST GYROSCOPE PLACEMENT - VIEW 1

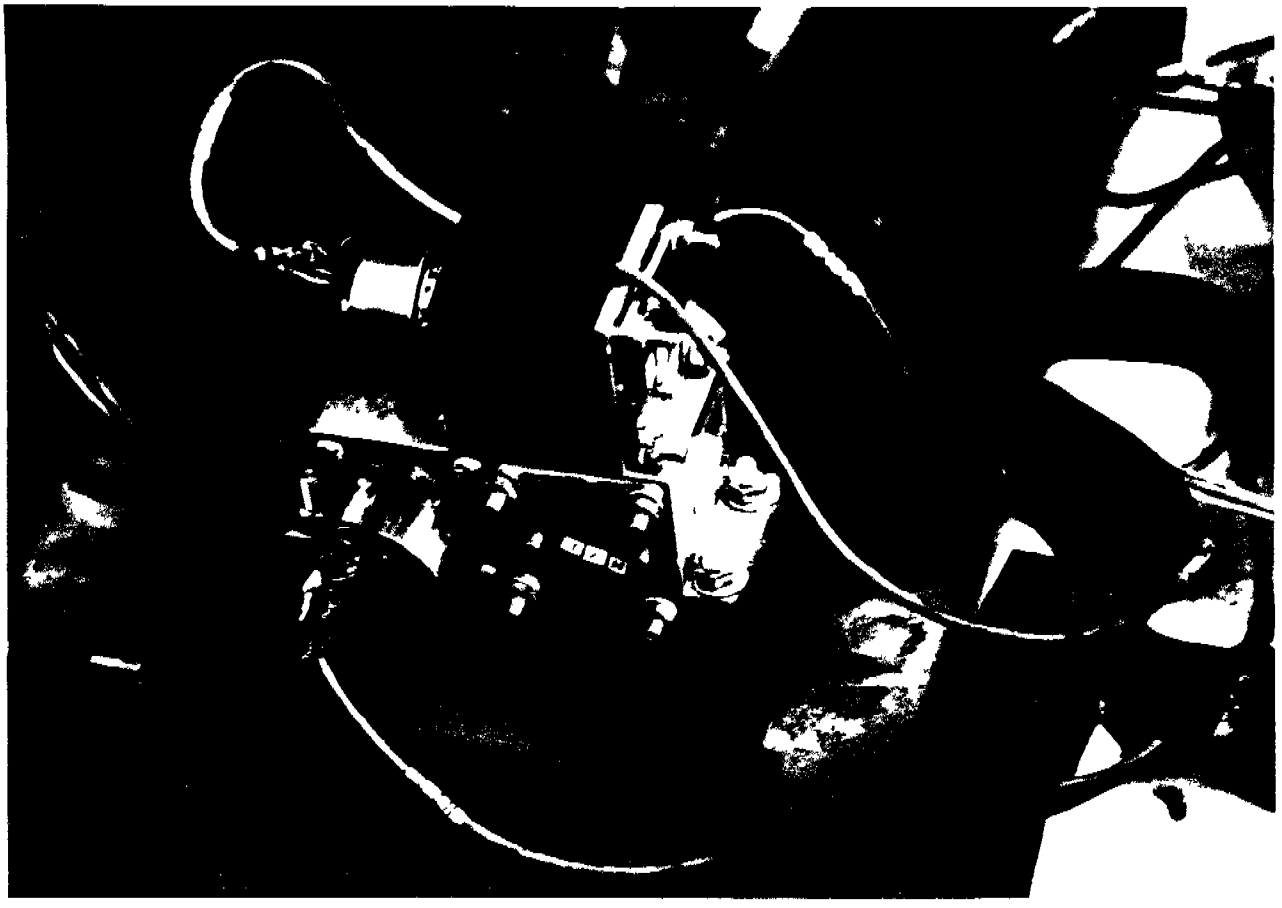


Figure A-24 PRE-TEST GYROSCOPE PLACEMENT - VIEW 2

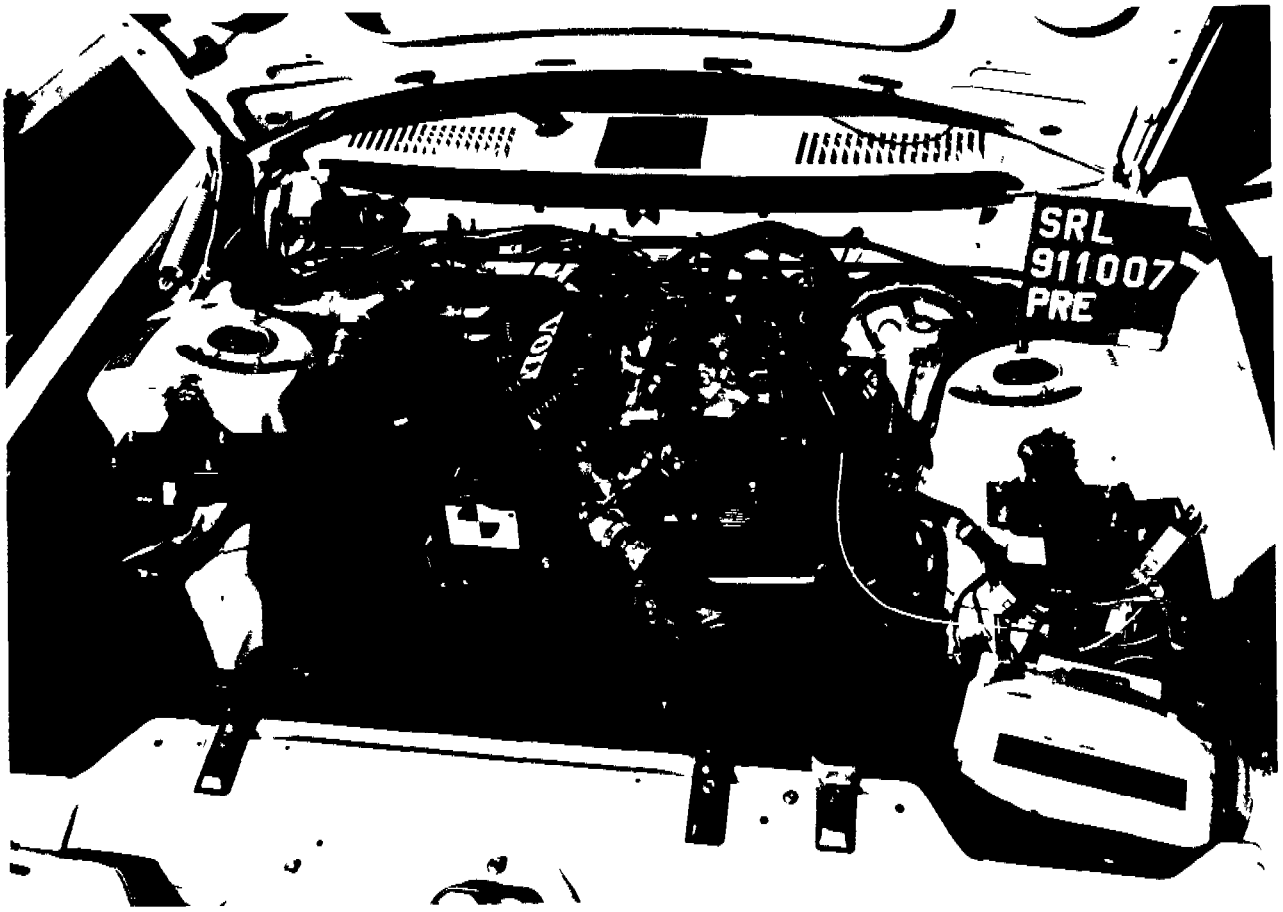
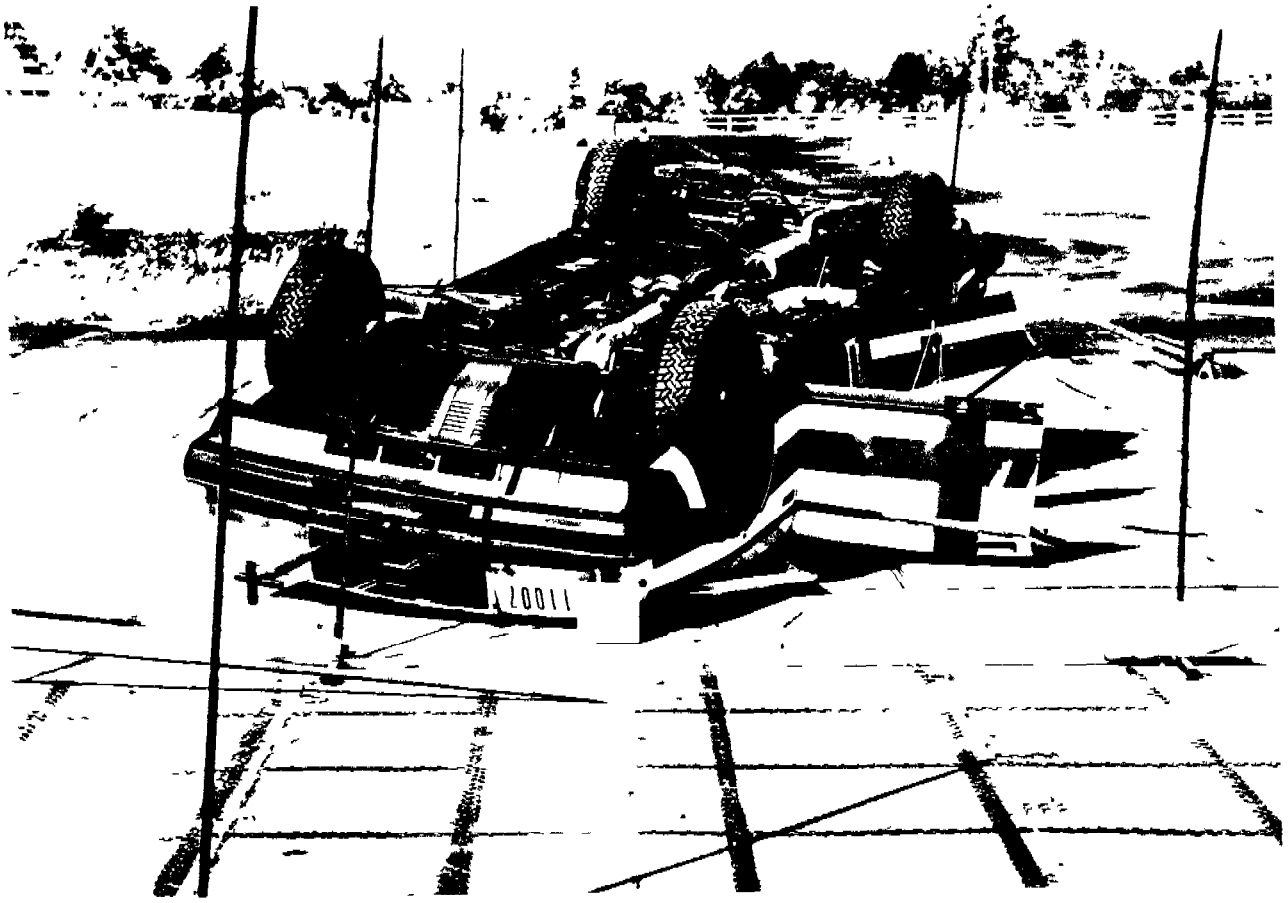


Figure A-25 PRE-TEST VEHICLE ENGINE COMPARTMENT VIEW



Figuer A - TEST FRONT VIEW

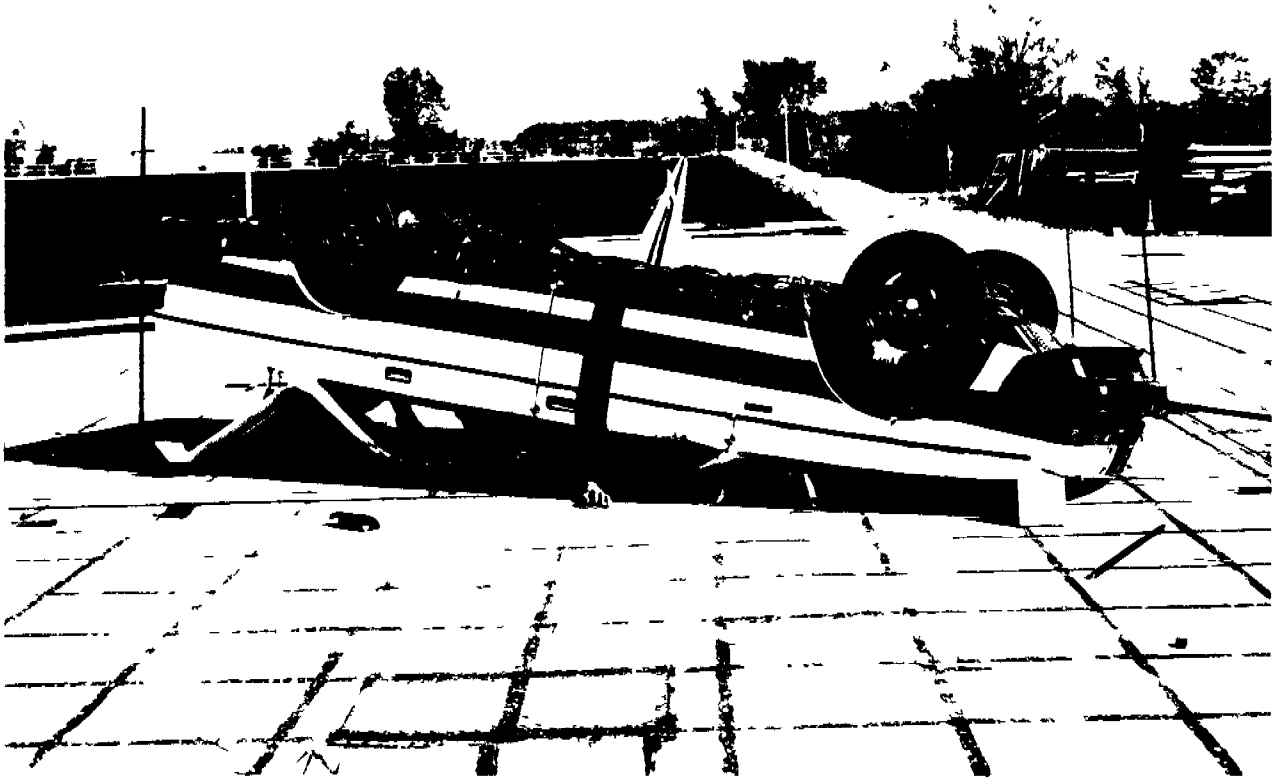


Figure A-27 POST TEST LEFT SIDE VIEW

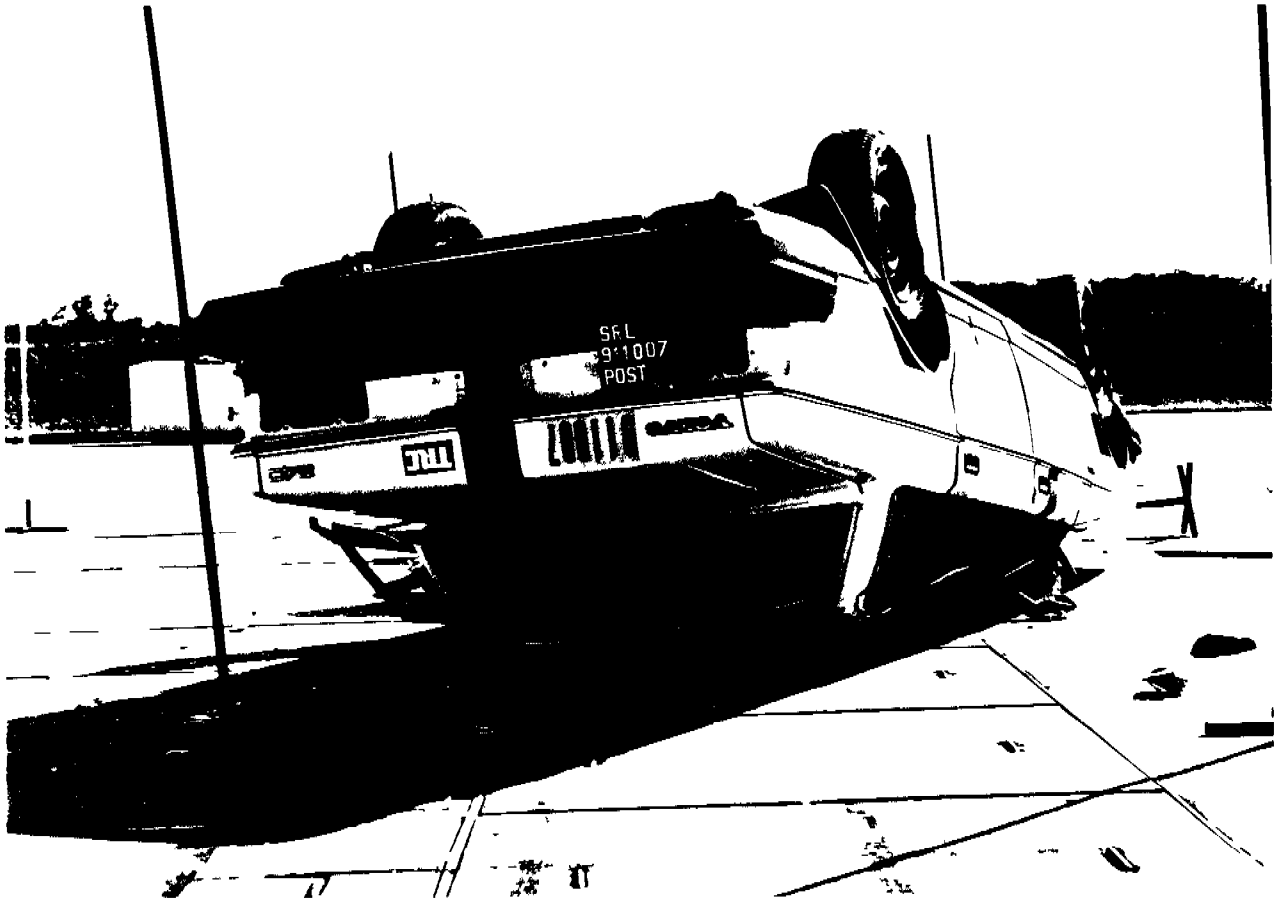


Figure A 28 POST-TEST REAR VIEW

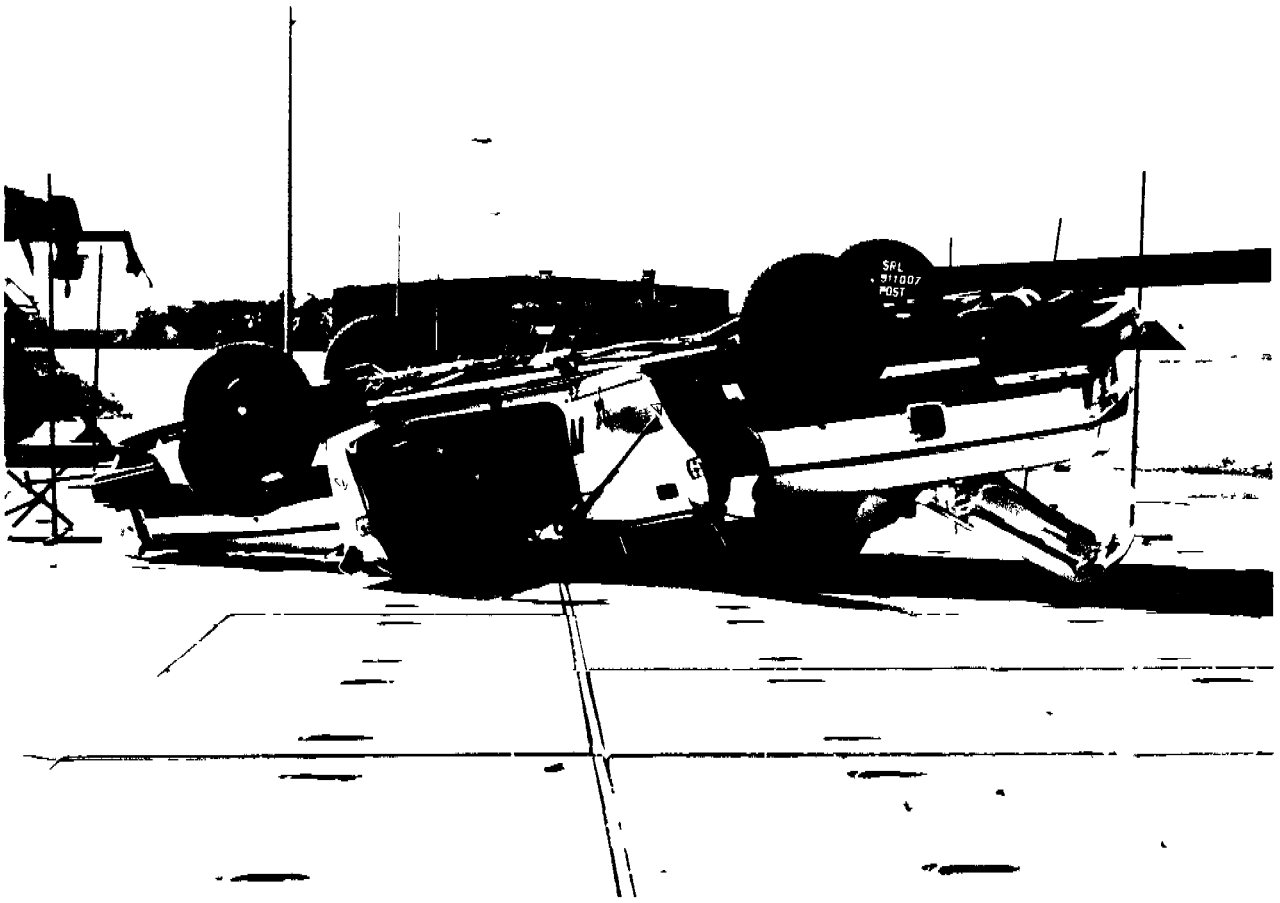


Figure A-29 POST-TEST RIGHT SIDE VIEW

Figure A-30 POST TEST DUMMY AND VEHICLE - VIEW 1

Figure A-31. POST-TEST DUMMY AND VEHICLE - VIEW 2

Figure A-32 POST-TEST DUMMY CONTACT - VIEW 1

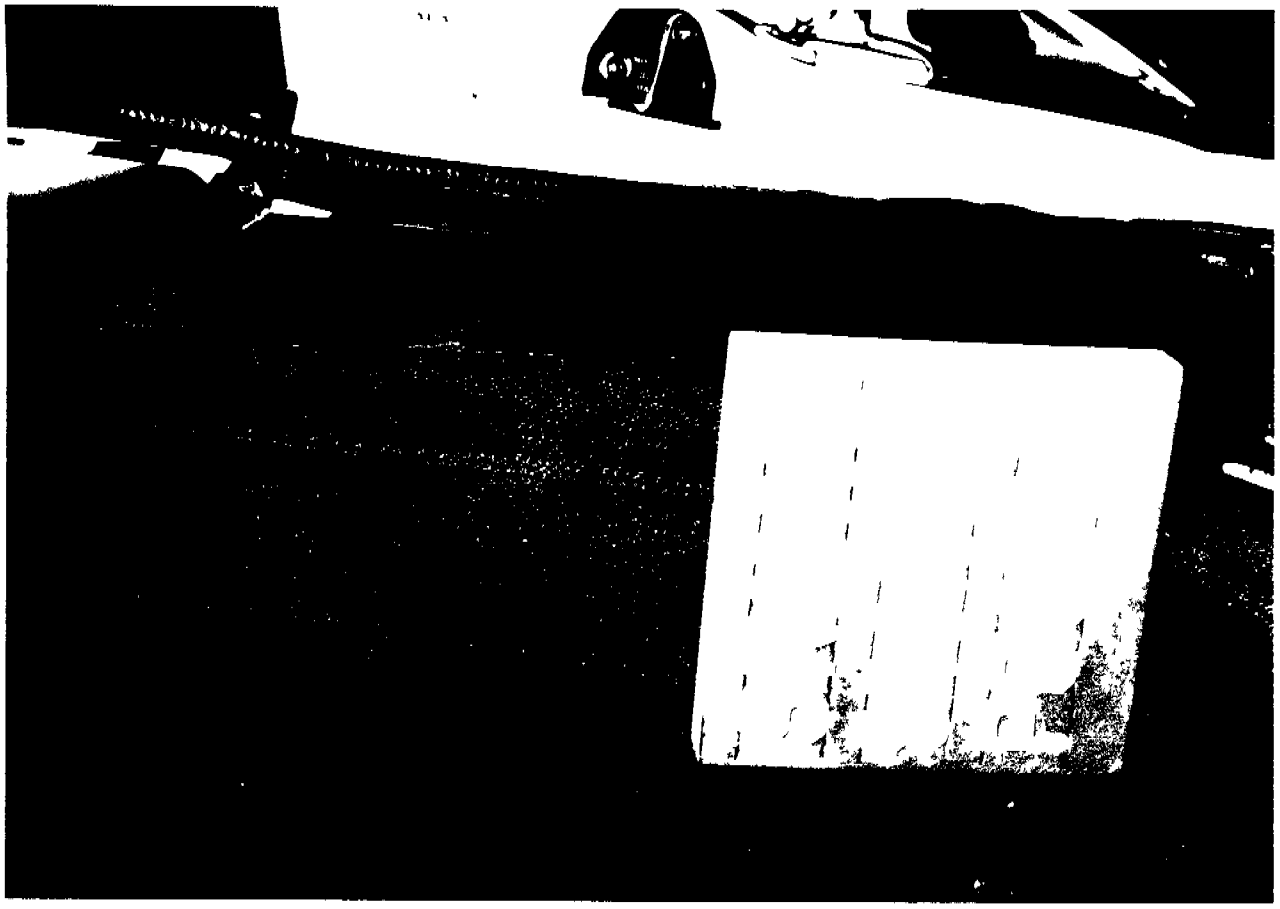


Figure A-33 POST-TEST DUMMY CONTACT - VIEW 2

Figure A-34 POST-TEST DUMMY CONTACT - VIEW 3

Figure A-35 POST-TEST VEHICLE DAMAGE CLOSE-UP

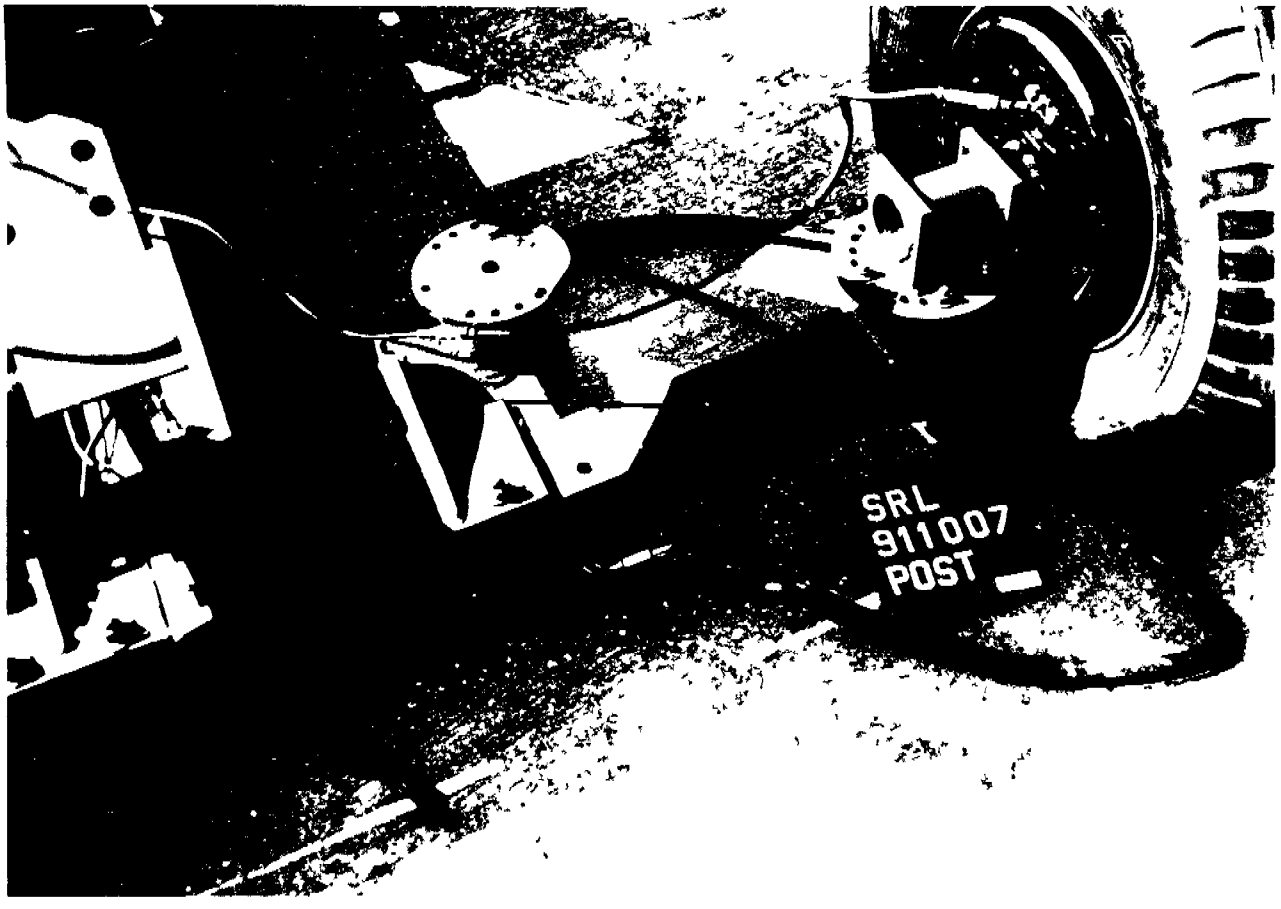
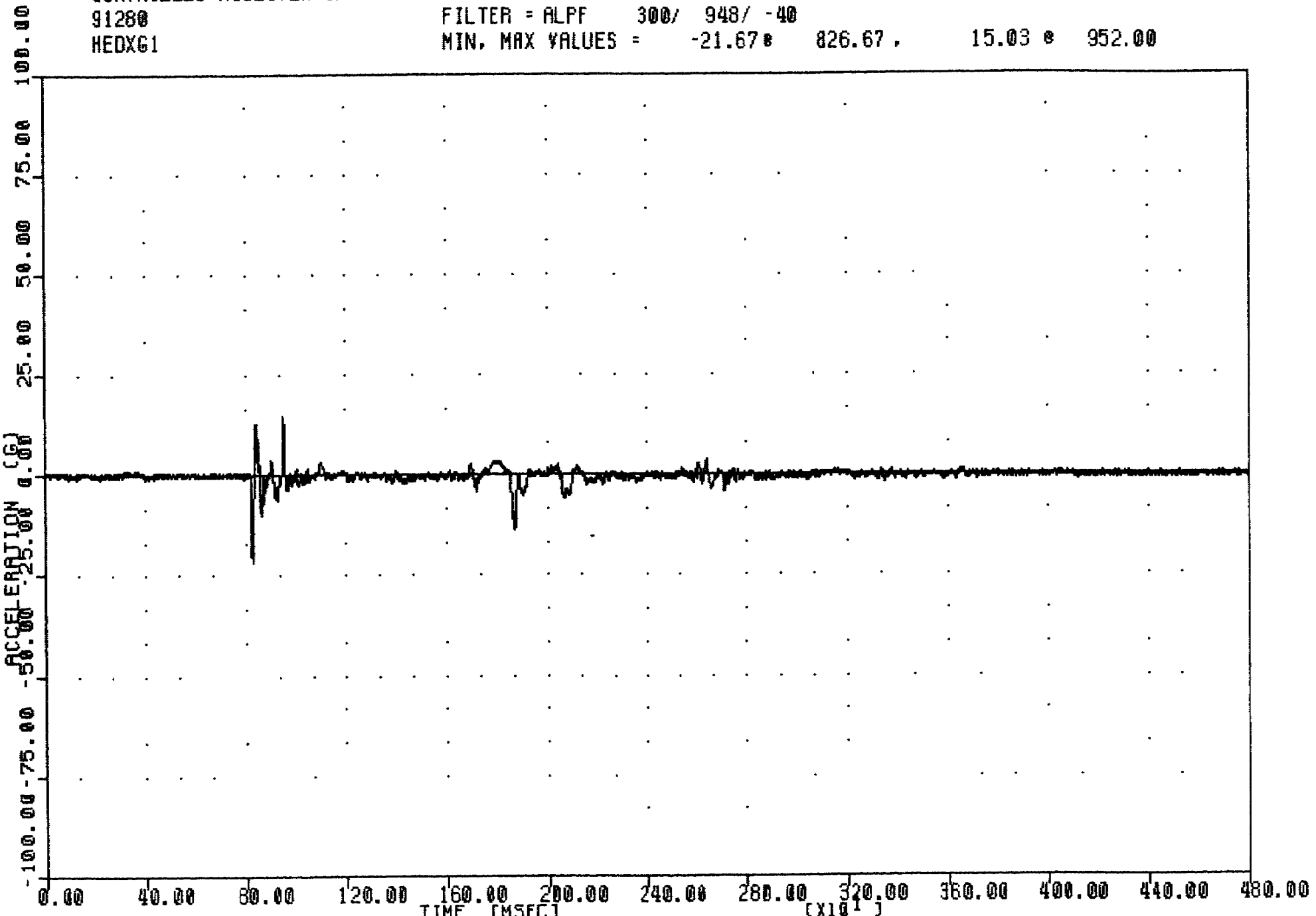


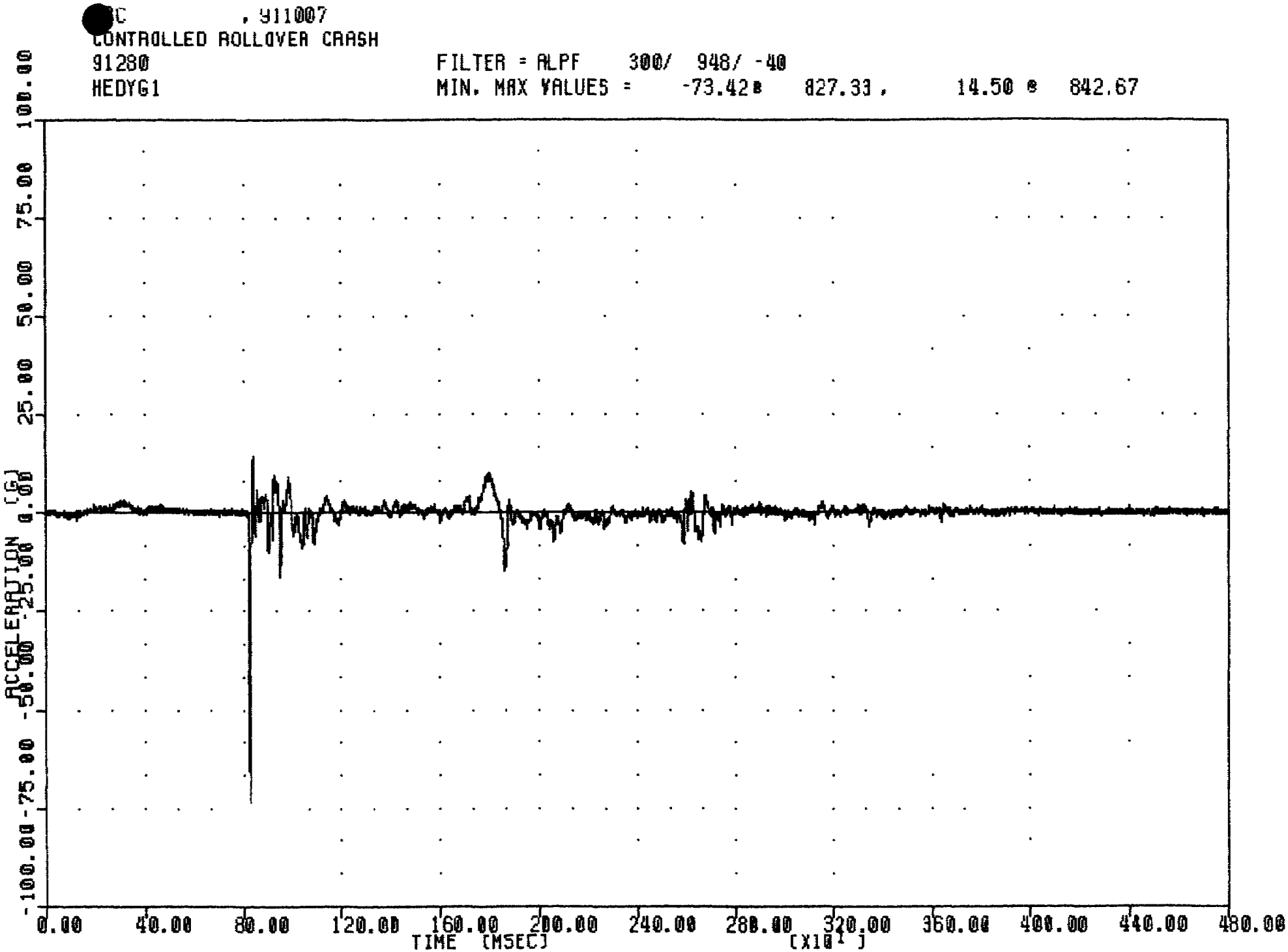
Figure A-36 POST TEST REAR WINDOW MOLDING RESTING POSITION

APPENDIX B

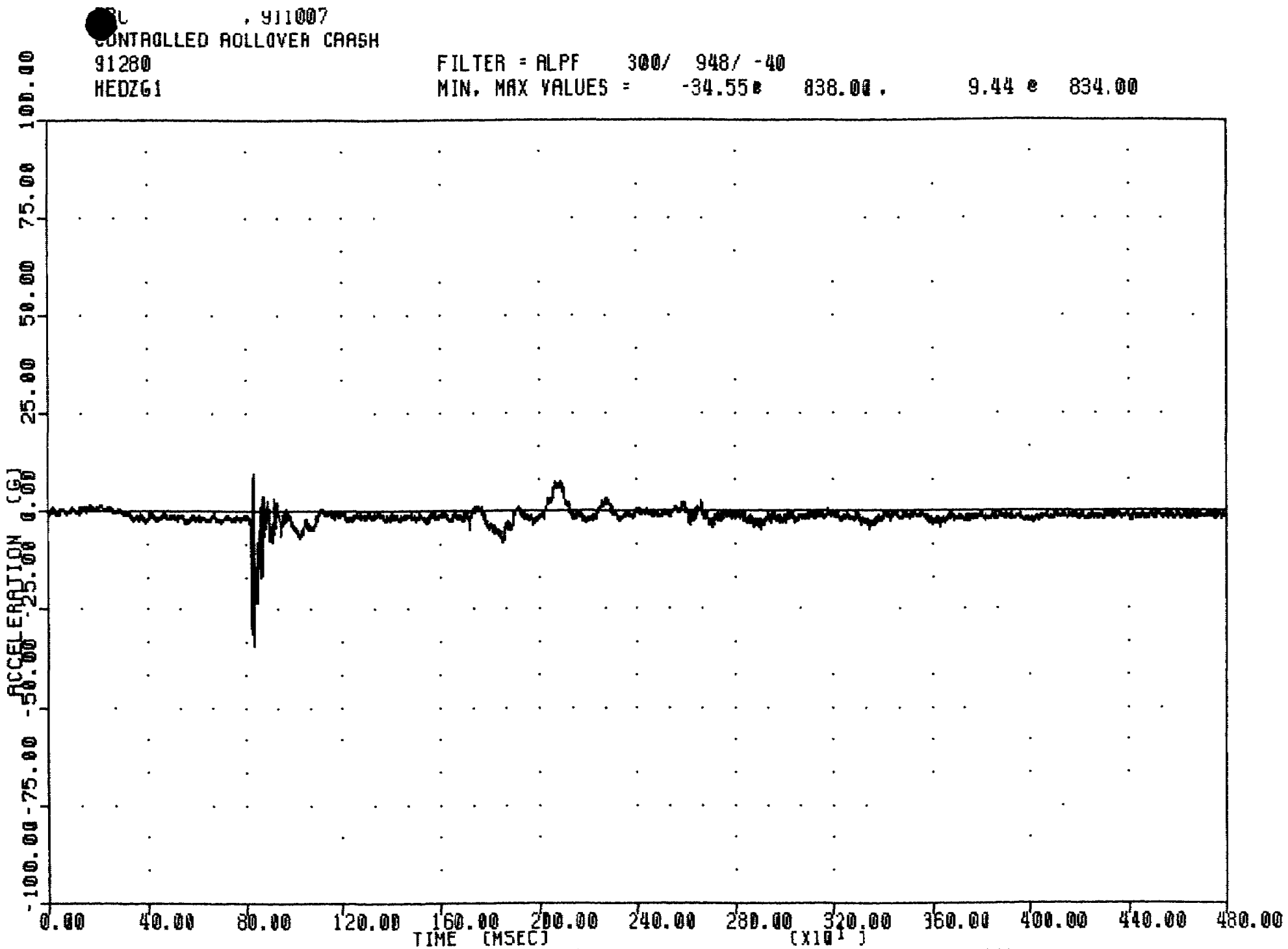
DATA PLOTS



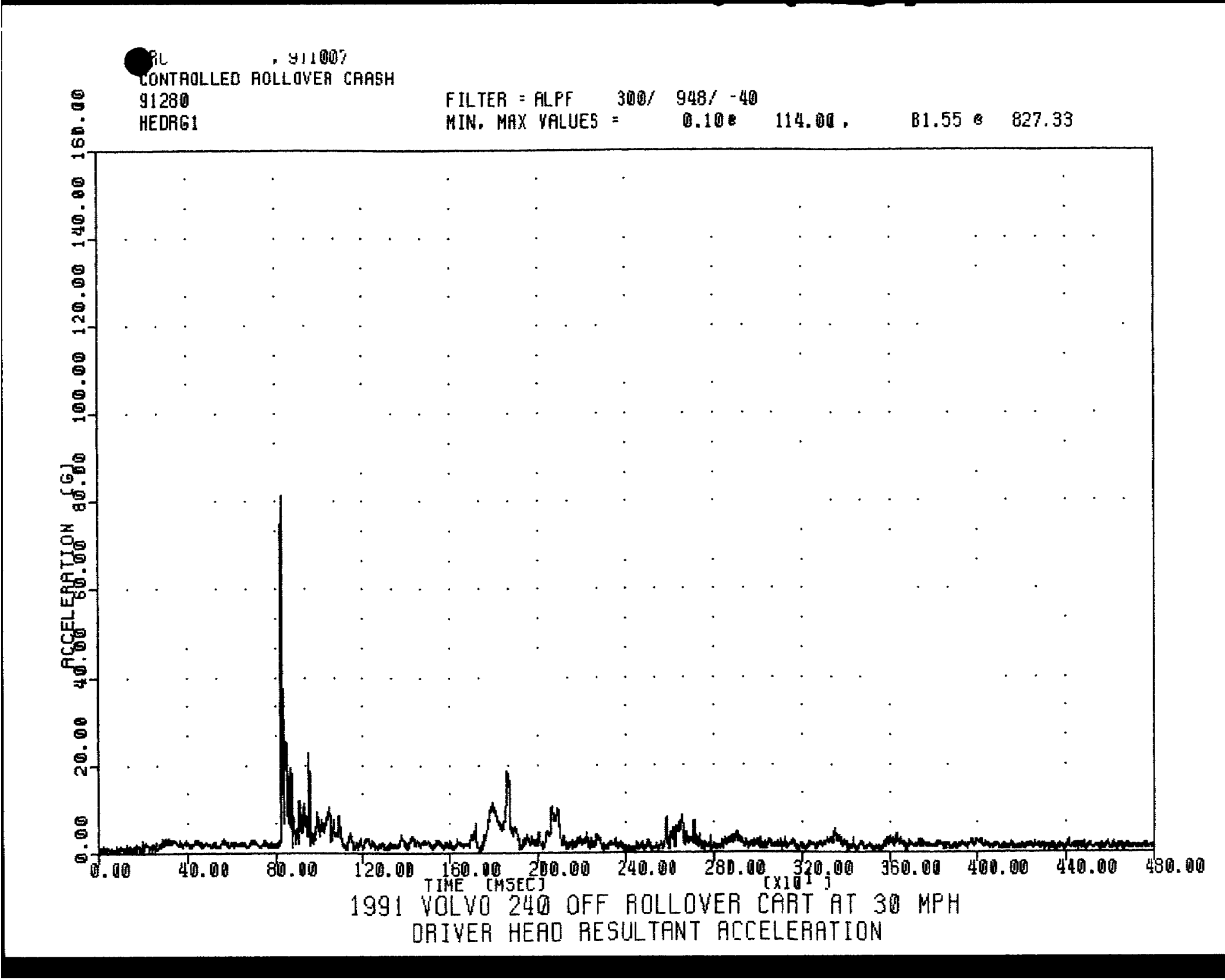
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD X AXIS ACCELERATION

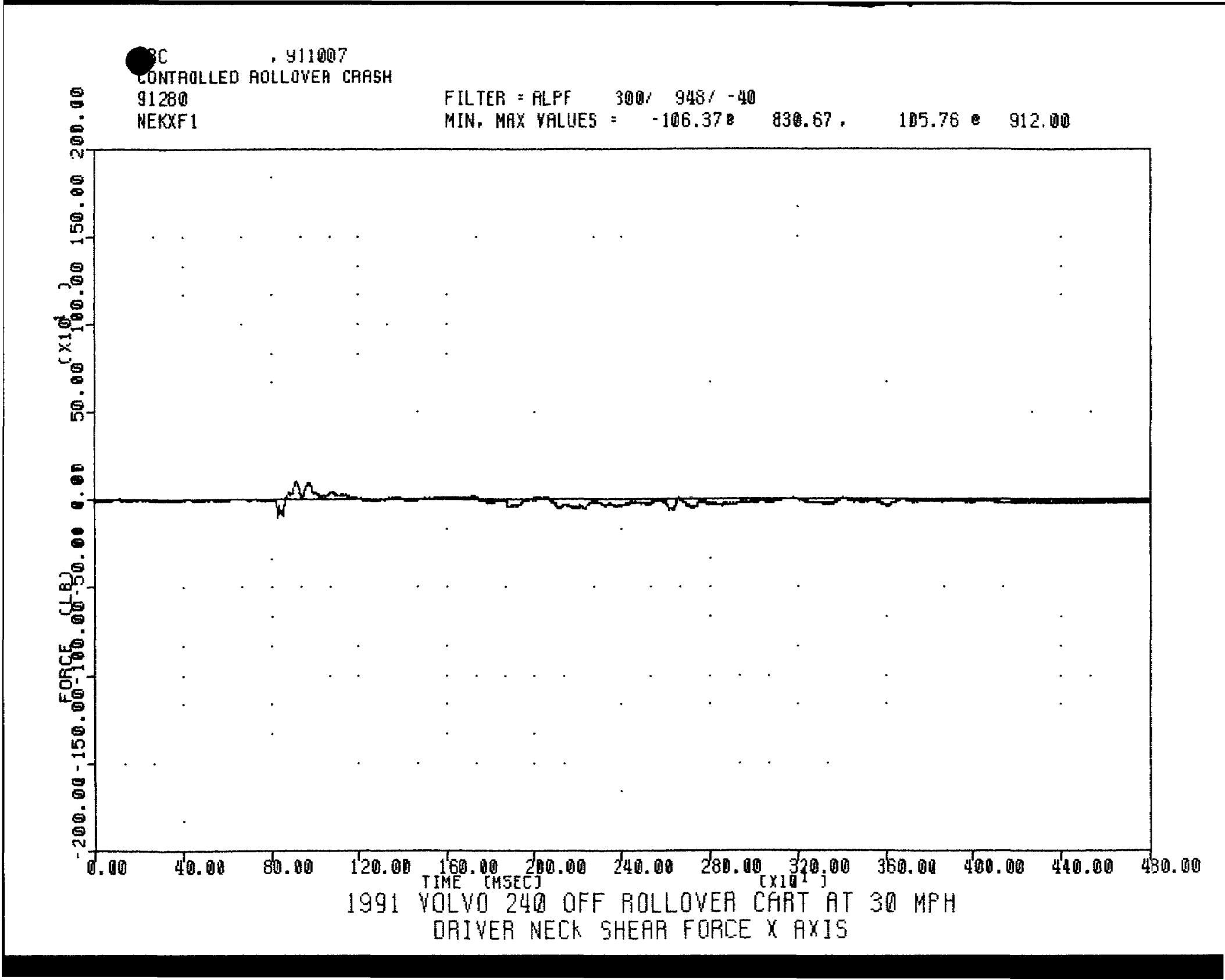


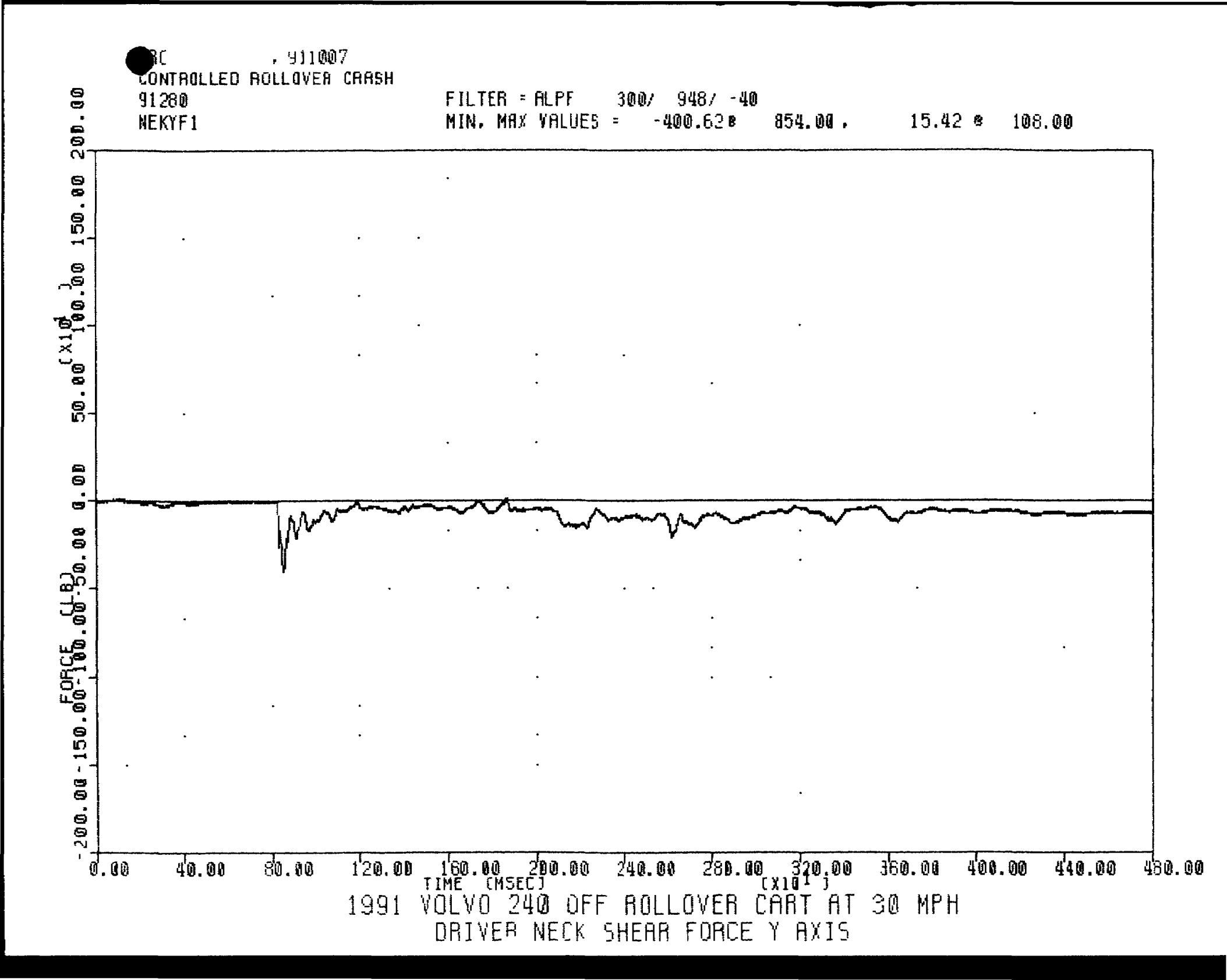
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Y AXIS ACCELERATION



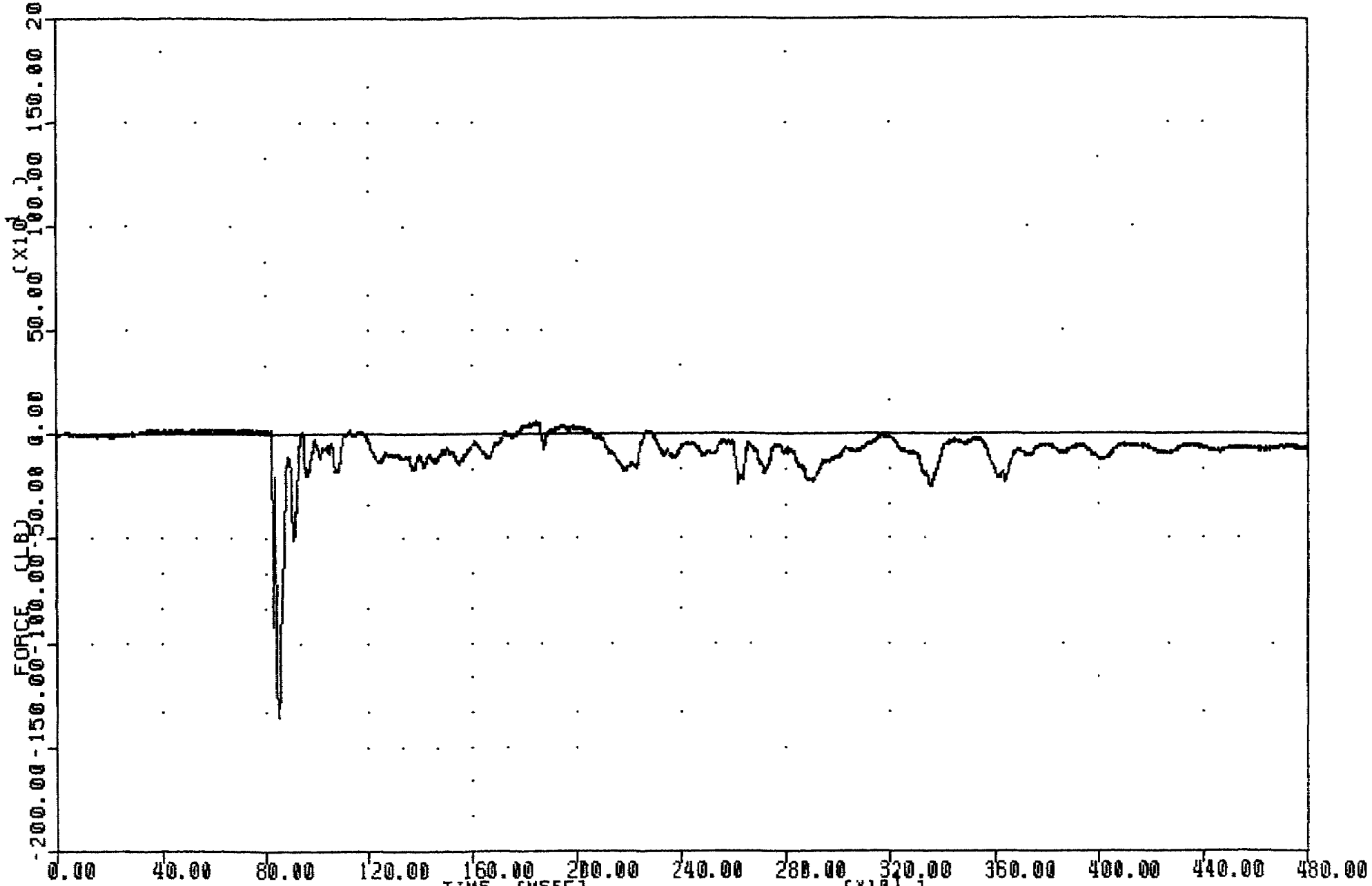
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD Z AXIS ACCELERATION


, 911007
CONTROLLED ROLLOVER CRASH
91280
HEDRG1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = 0.10@ 114.00, B1.55 @ 827.33
ACCELERATION (G)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC)
(X10[1])
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER HEAD RESULTANT ACCELERATION

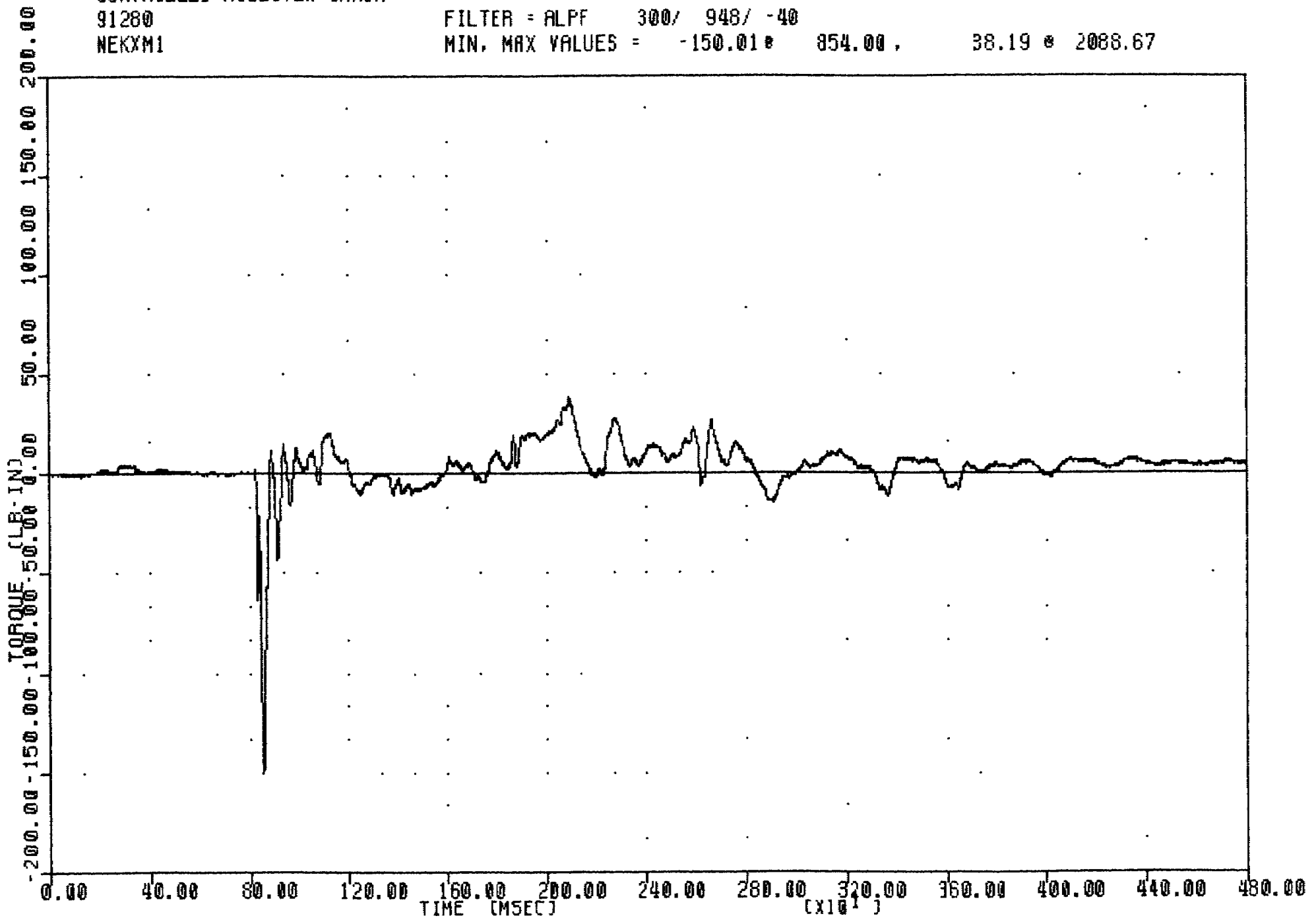

SC , 911007
CONTROLLED ROLLOVER CRASH
91280
NEKXF1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = -106.37@ 830.67, 105.76 @ 912.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
FORCE (LB)
(X10)
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC)
(X10)
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK SHEAR FORCE X AXIS


, 911007
CONTROLLED ROLLOVER CRASH
91280
NEKYF1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = -400.62 @ 854.00 , 15.42 @ 108.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
FORCE (LB)
(X10)
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC)
(X10)
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK SHEAR FORCE Y AXIS

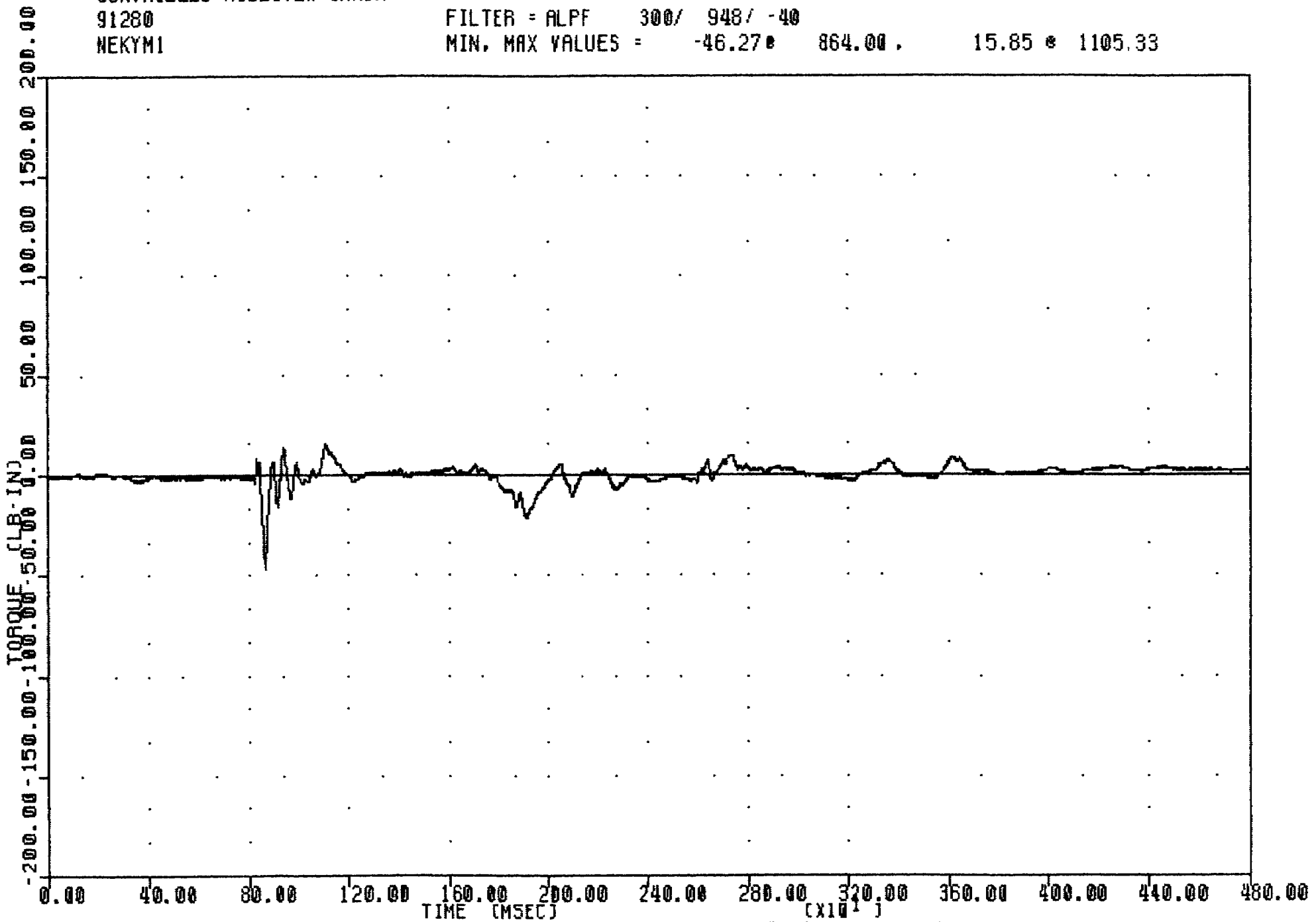
[redacted], 911007
CONTROLLED ROLLOVER CRASH
91280
NEKZF1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = -1354.31 @ 850.67 , 63.74 @ 1848.00



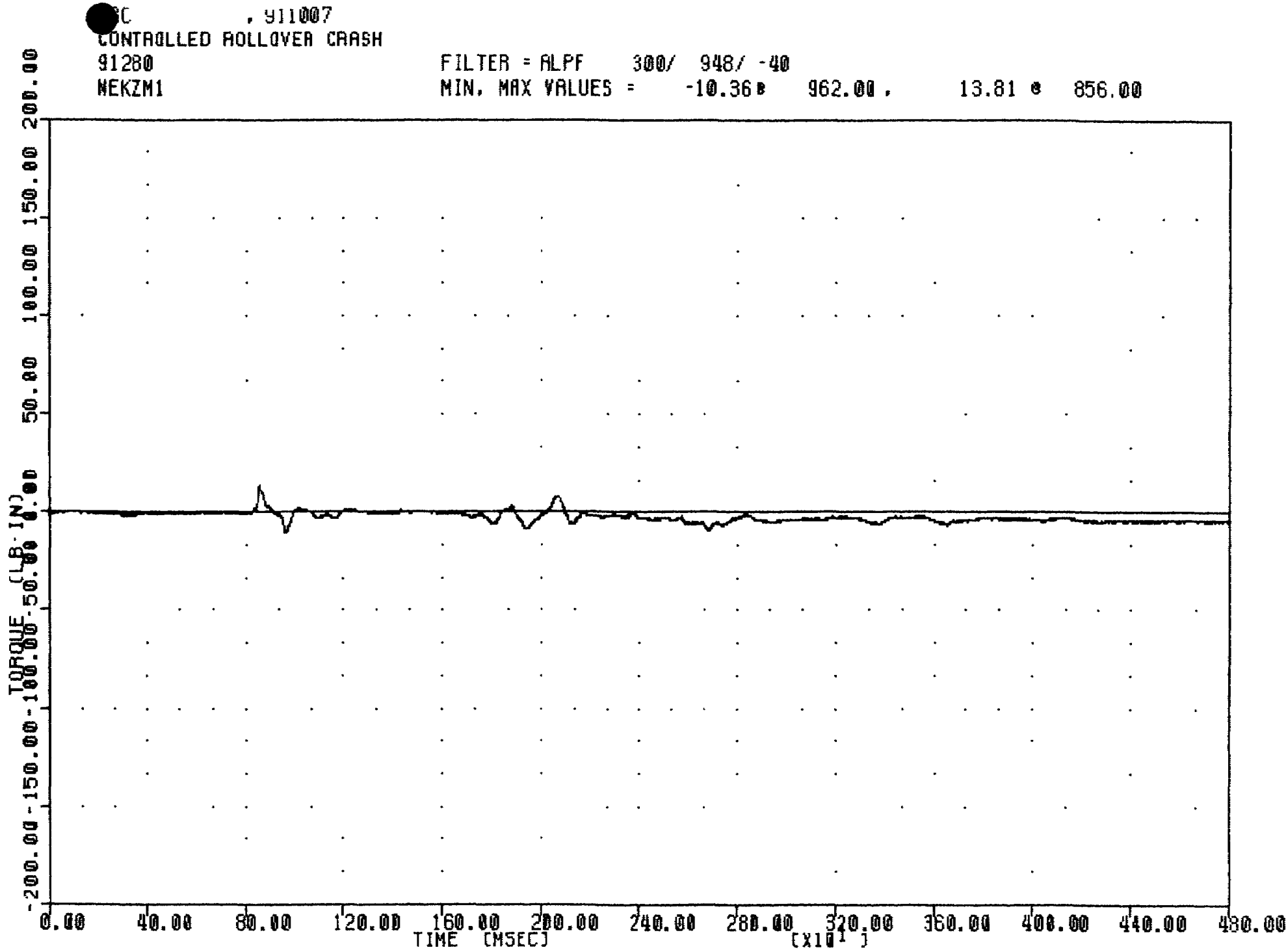
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK AXIAL FORCE Z AXIS



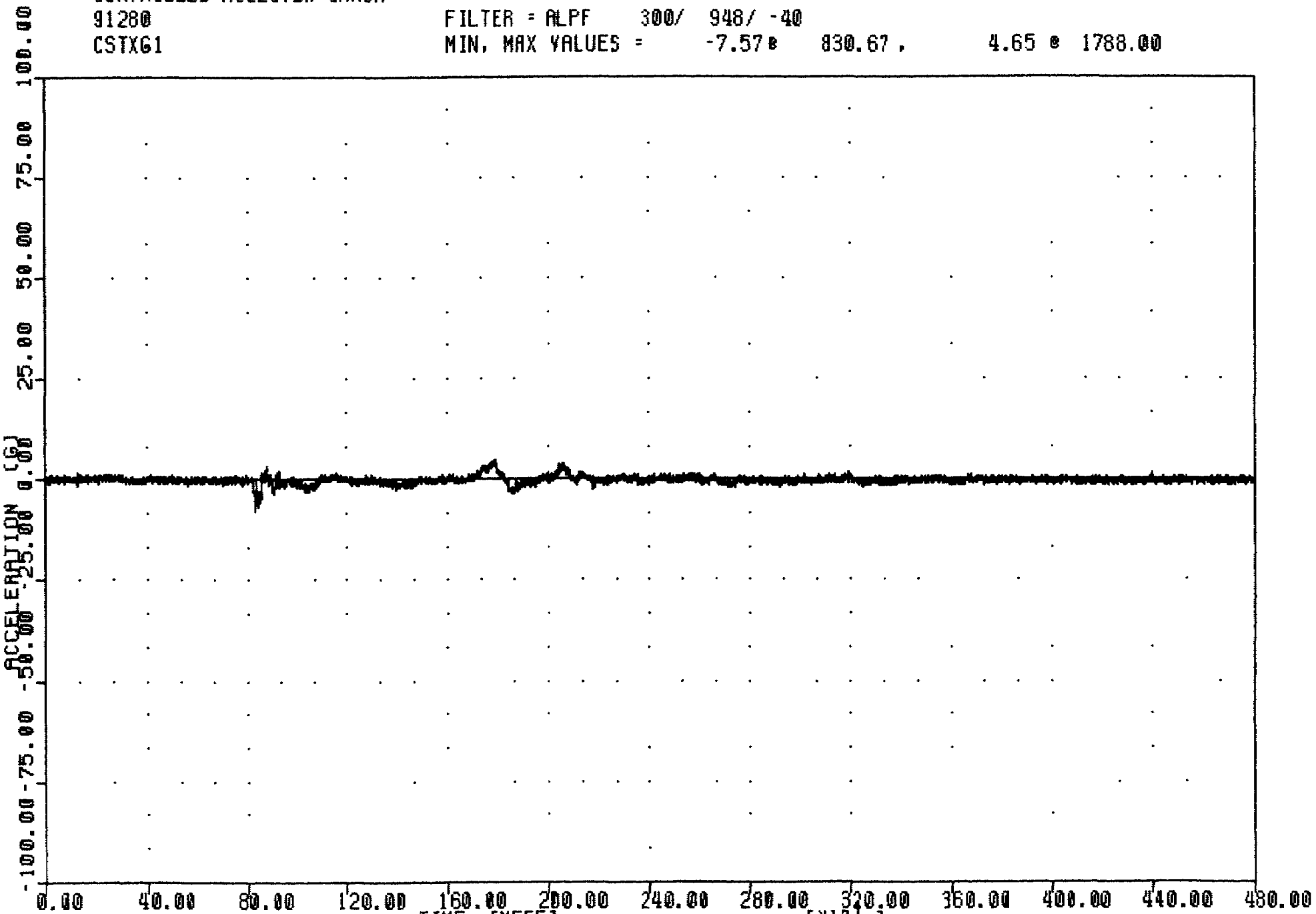
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT X AXIS



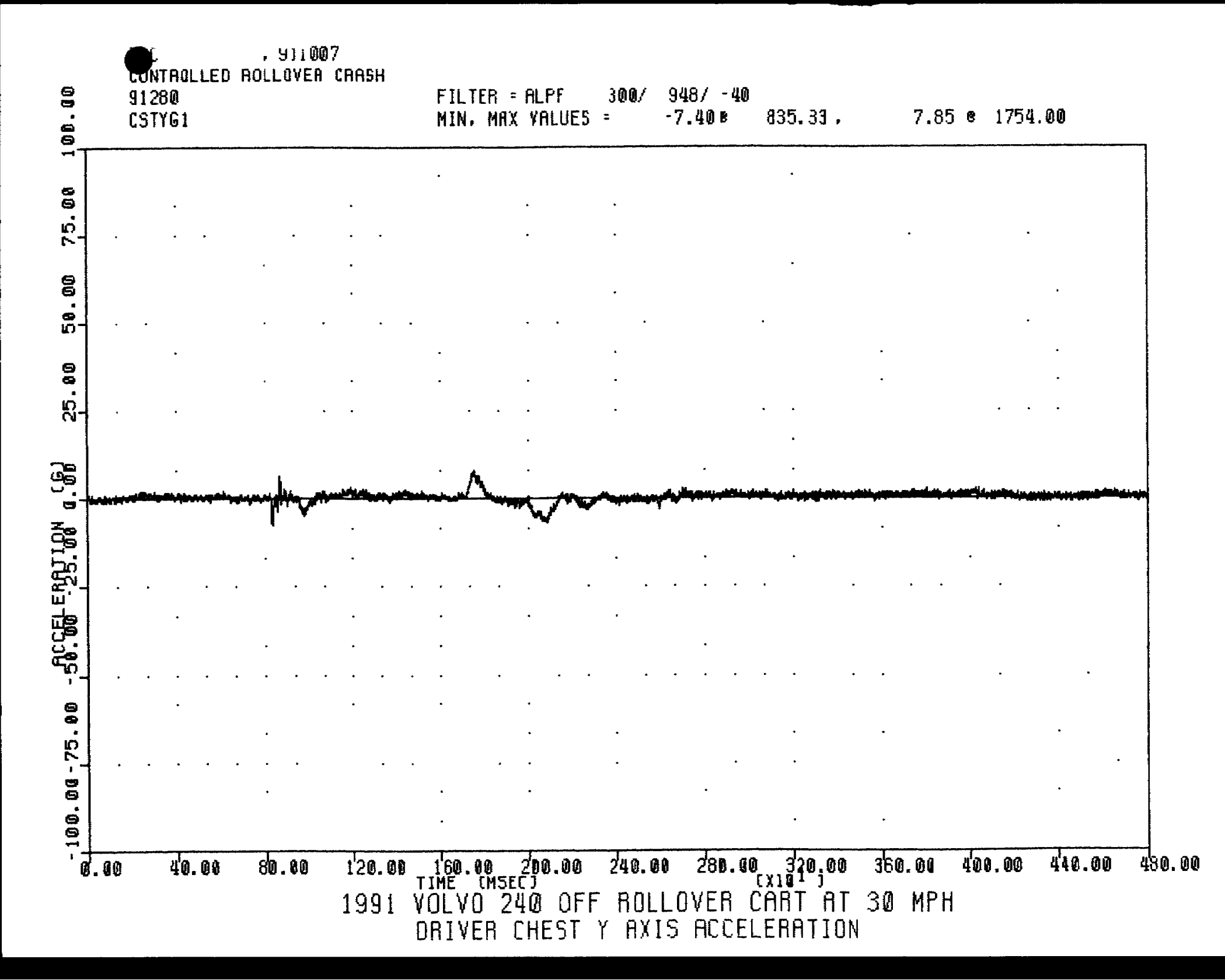
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT Y AXIS



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER NECK MOMENT ABOUT Z AXIS



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS ACCELERATION


, 911007
CONTROLLED ROLLOVER CRASH
91280
CSTYG1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = -7.40 @ 835.33 , 7.85 @ 1754.00
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
ACCELERATION (G)
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC)
(X10^1)
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST Y AXIS ACCELERATION

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK FLEXION TEST

HYBRID III 25-Sep-91

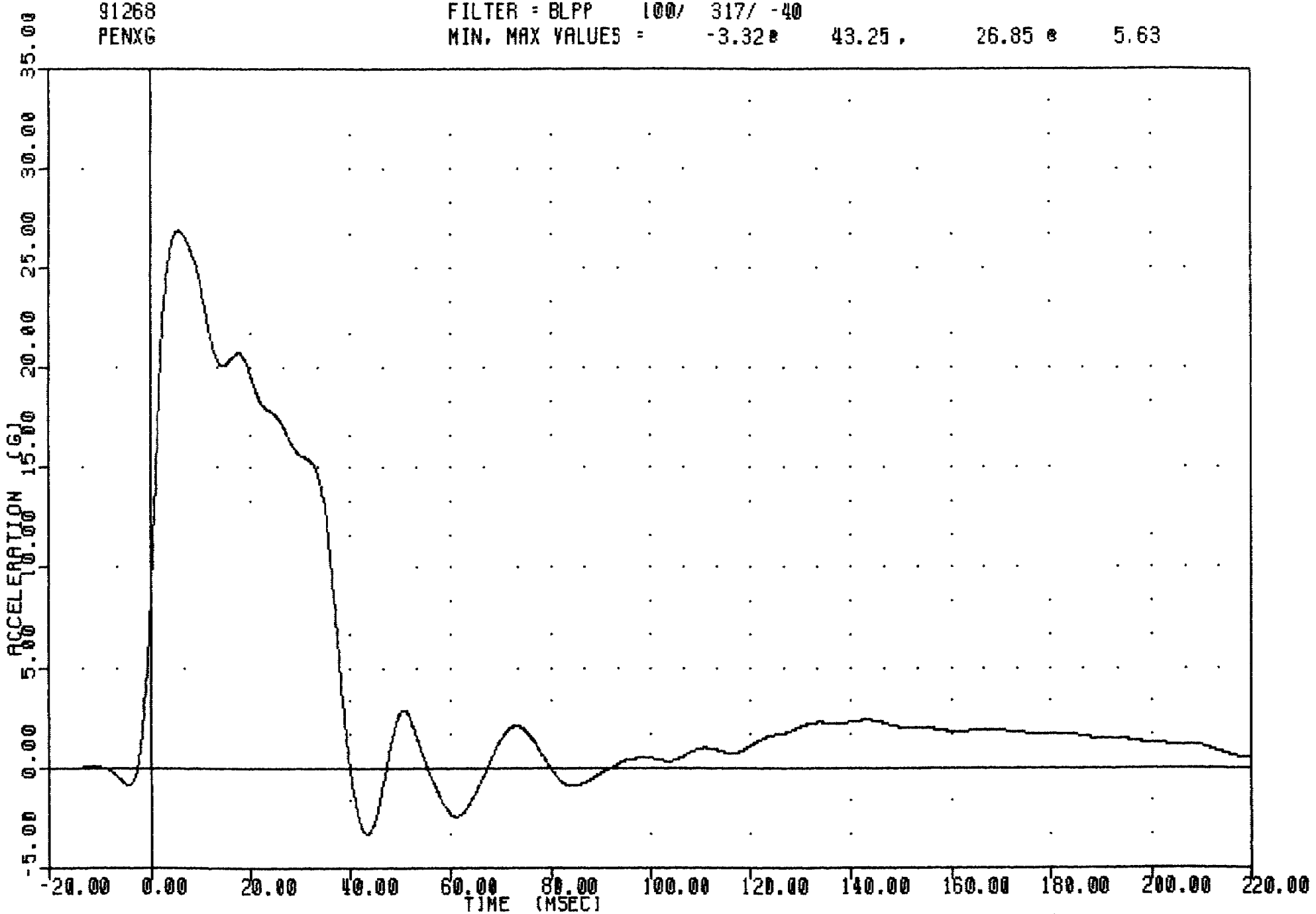
6 AXIS NECK TRANSDUCER
SRL 907C4NF1 572E SN907 NECK FLEXION CAL04

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		69 - 72 DEG. F	70.00 DEG. F
RELATIVE HUMIDITY		10% - 70%	54.00 %
IMPACT VELOCITY		22.6-23.4 FT/SEC	23.30 FT/SEC
PENDULUM DECELERATION	10 MS	22.50 - 27.50 G	24.00 G
	20 MS	17.60 - 22.60 G	19.72 G
	30 MS	12.50 - 18.50 G	15.65 G
MAX PENDULUM G ABOVE 30 MS		29 G MAX	15.62 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		34 - 42 MS	37.75 MS
D PLANE ROTATION	MAX	64 - 78 DEG.	69.76 DEG.
	TIME	57 - 64 MS	59.25 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MAX	65 - 80 FT.LBS	70.21 FT.LBS
	TIME	47 - 58 MS	51.25 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		113 - 128 MS	113.25 MS
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 - 107 MS	99.50 MS

TEST MEETS SPECIFICATIONS

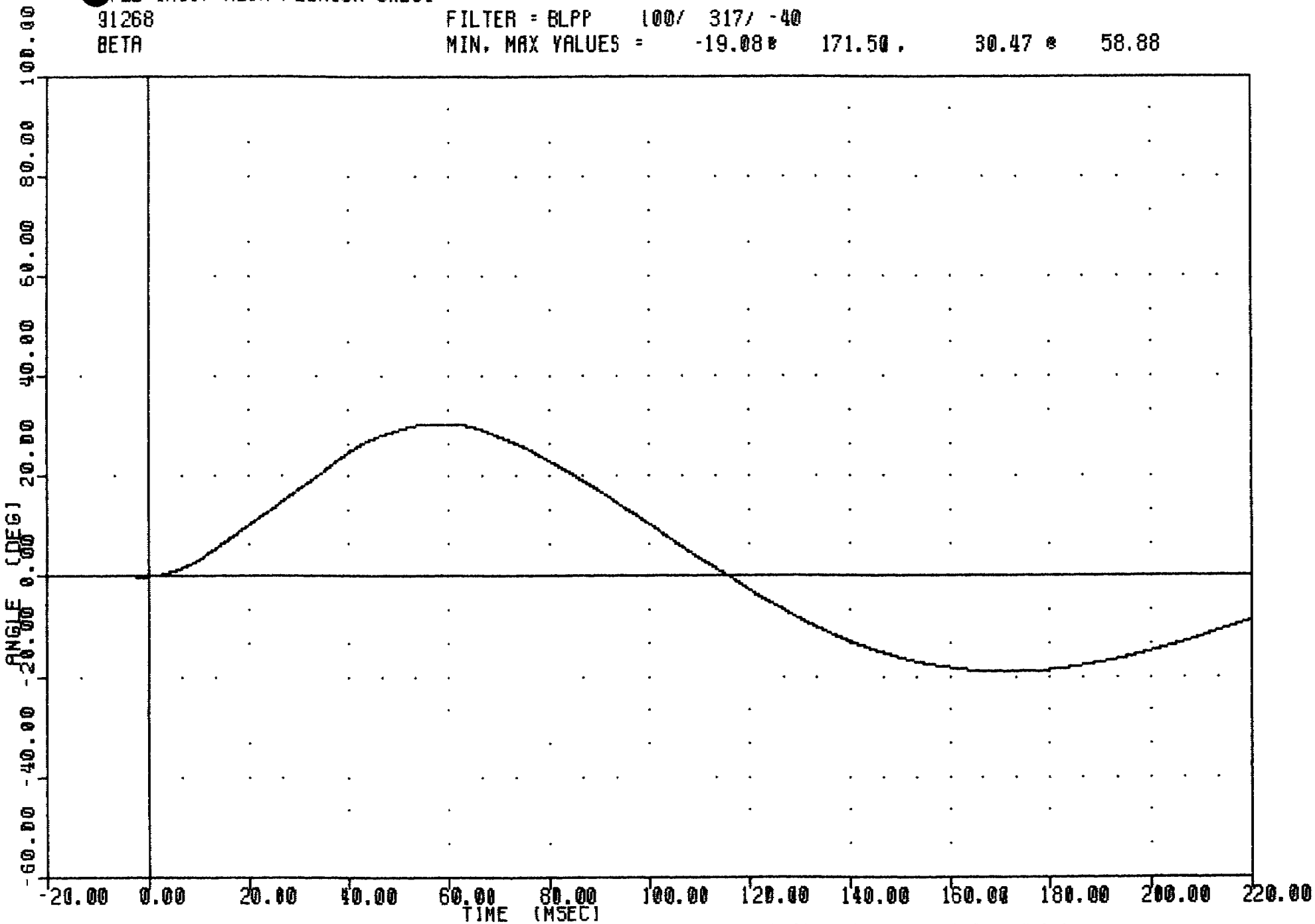
TECHNICIAN Chas. Middlet

SRL , 907C4NF1
572E SN907 NECK FLEXION CAL04
91268 FILTER = BLPP 100/ 317/ -40
PENXG MIN, MAX VALUES = -3.32 @ 43.25 , 26.85 @ 5.63



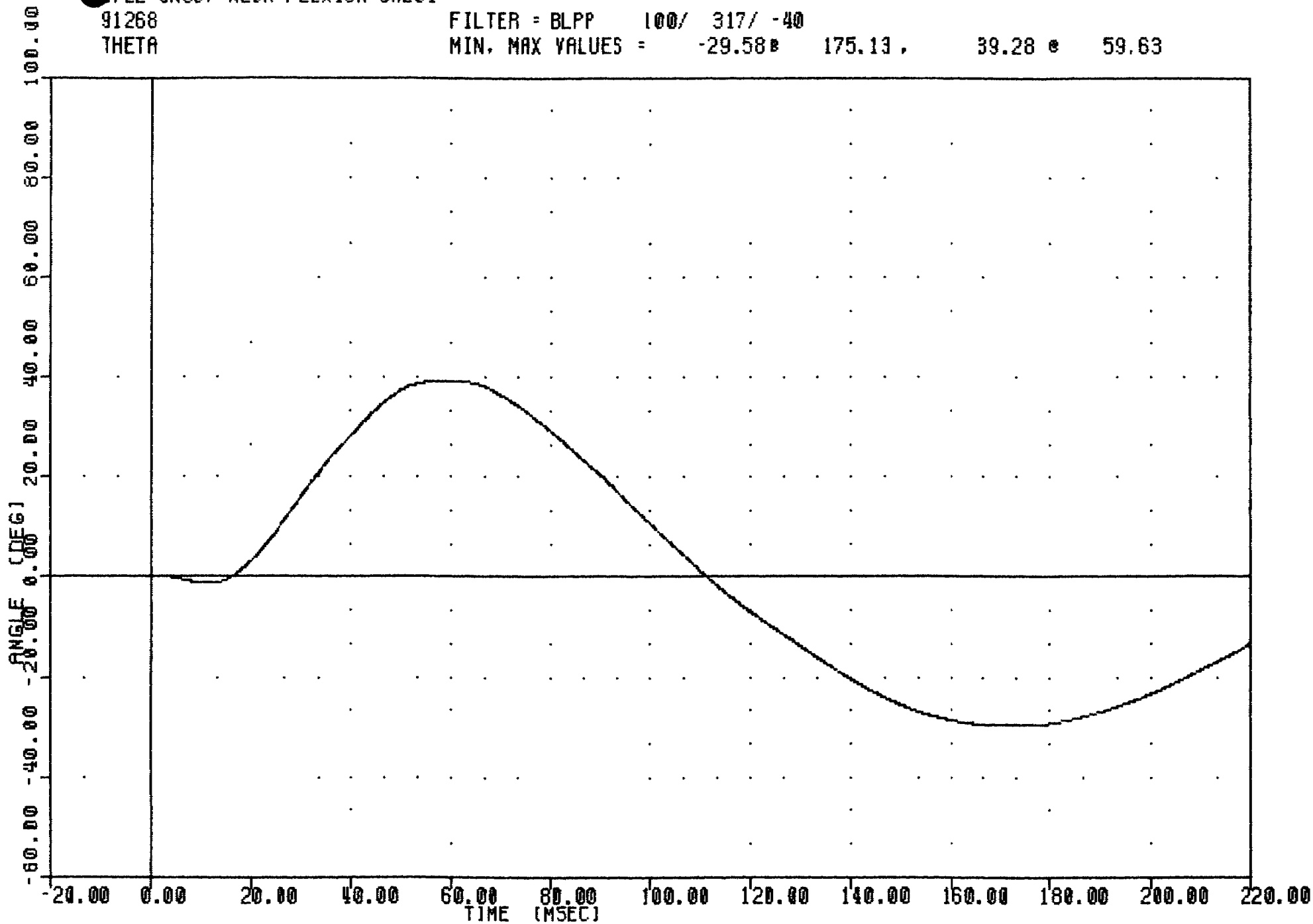
PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

SRL , 907C4NF1
572E SN907 NECK FLEXION CAL04
91268 FILTER = BLPP 100/ 317/ -40
BETA MIN, MAX VALUES = -19.08 @ 171.50 , 30.47 @ 58.88

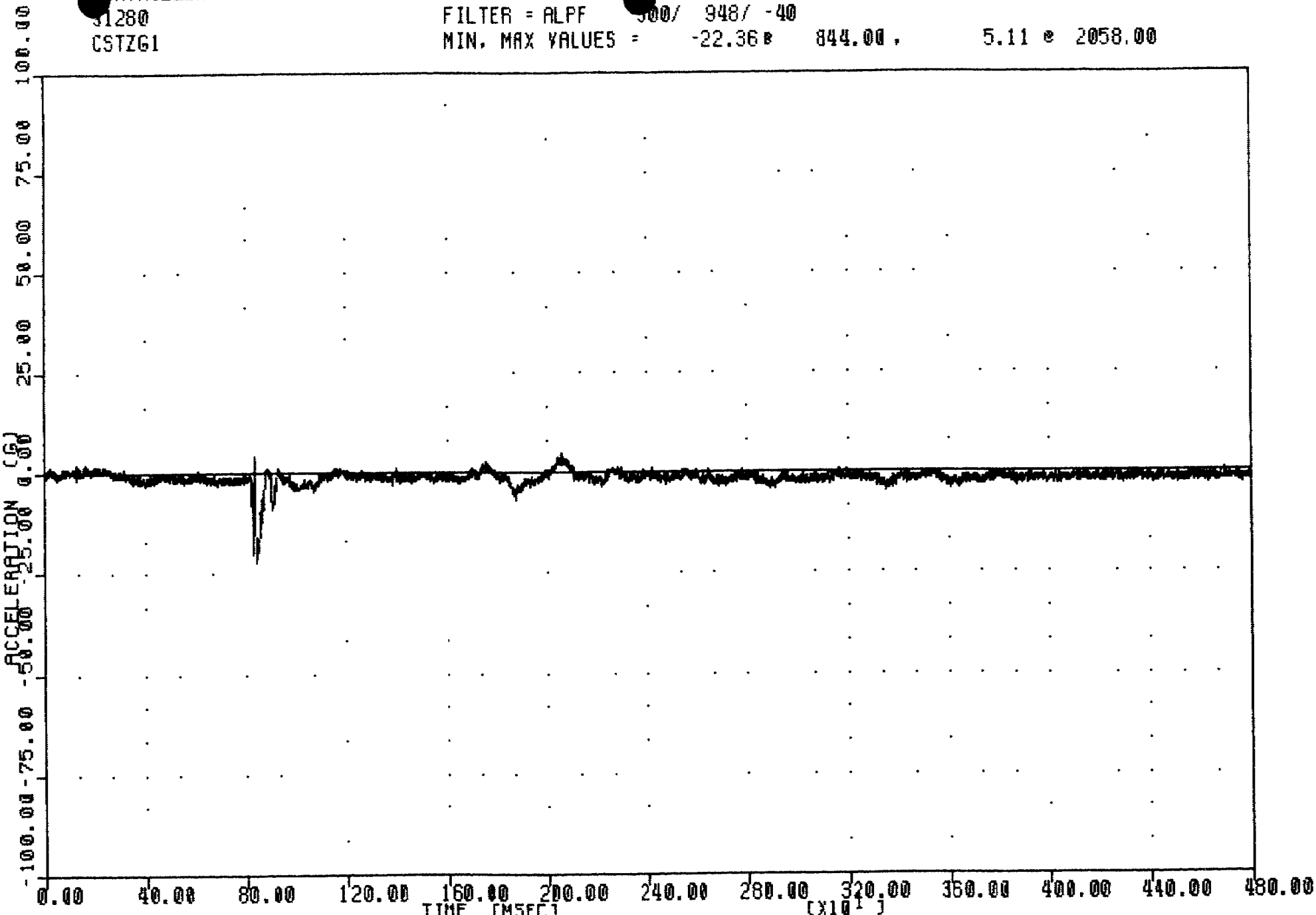


PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT BASE OF NECK

SRL , 907C4NF1
572E SN907 NECK FLEXION CAL@4
91268 FILTER = BLPP 100/ 317/ -40
THETA MIN, MAX VALUES = -29.58@ 175.13 , 39.28 @ 59.63



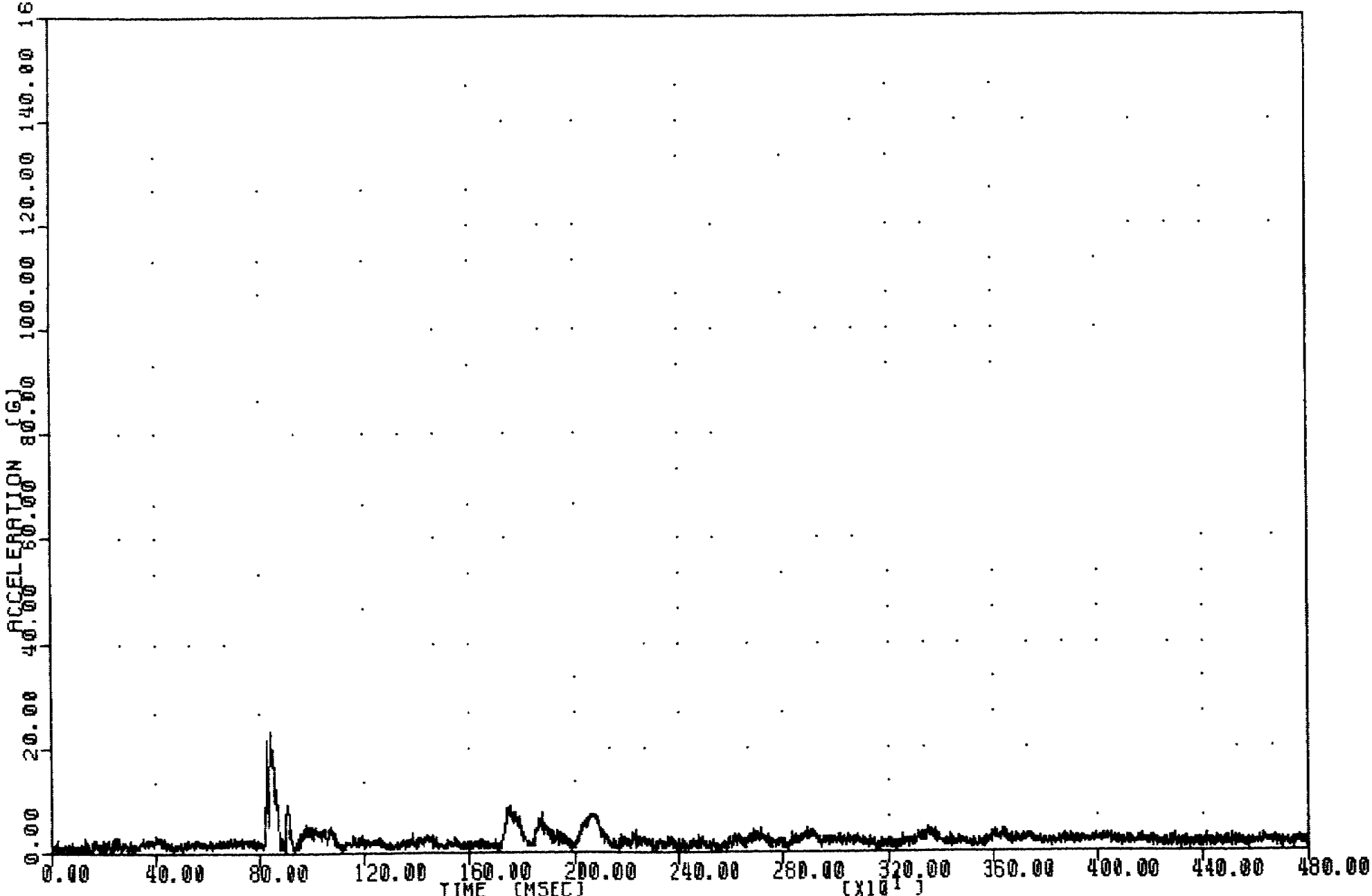
PART 572-E HYBRID III NECK FLEXION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST Z AXIS ACCELERATION

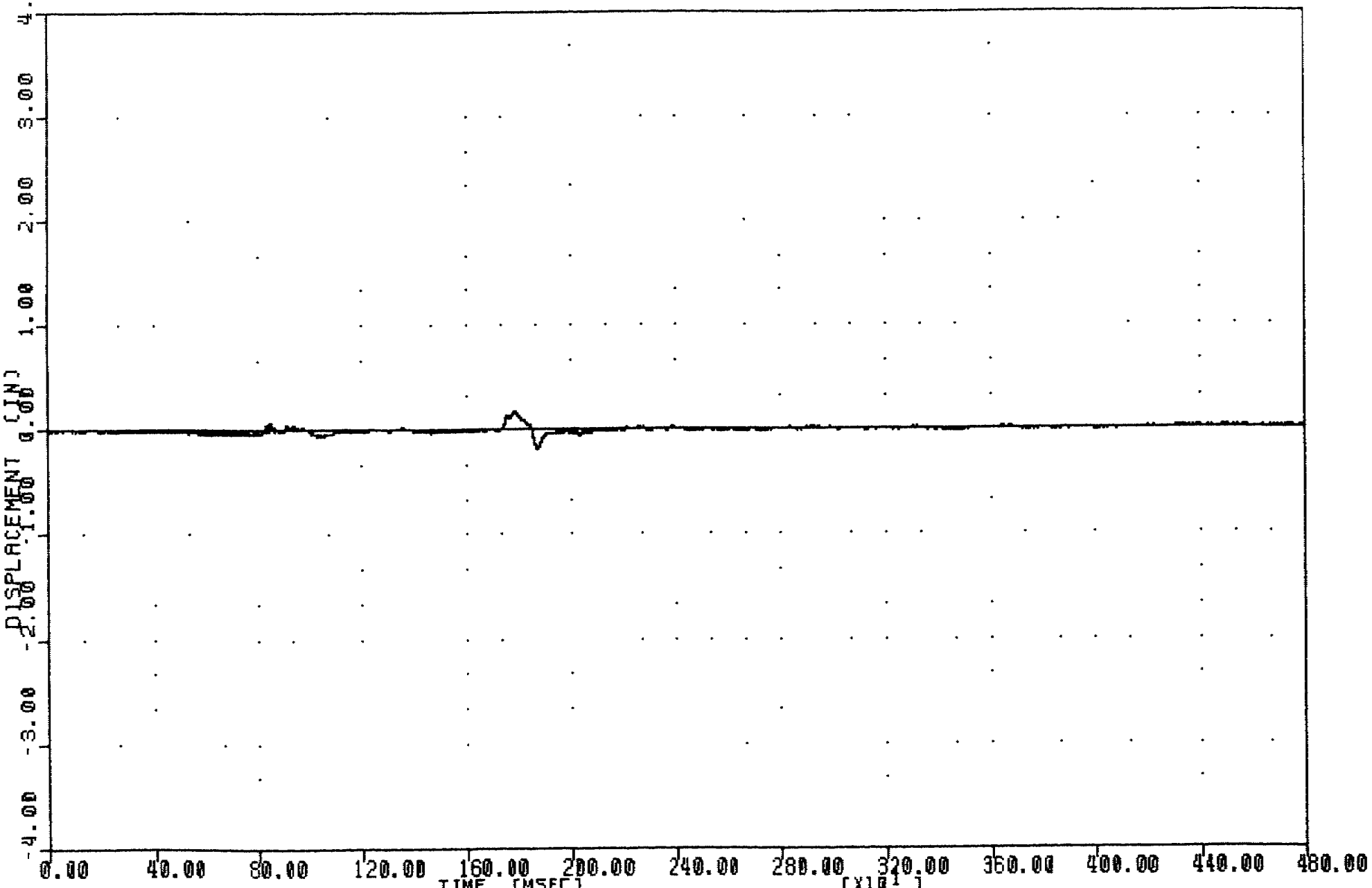
TRL , 911007
CONTROLLED ROLLOVER CRASH
91280
CSTRG1

FILTER = ALPF 500/ 948/ -40
MIN, MAX VALUES = 0.12 @ 84.67 , 23.25 @ 844.00

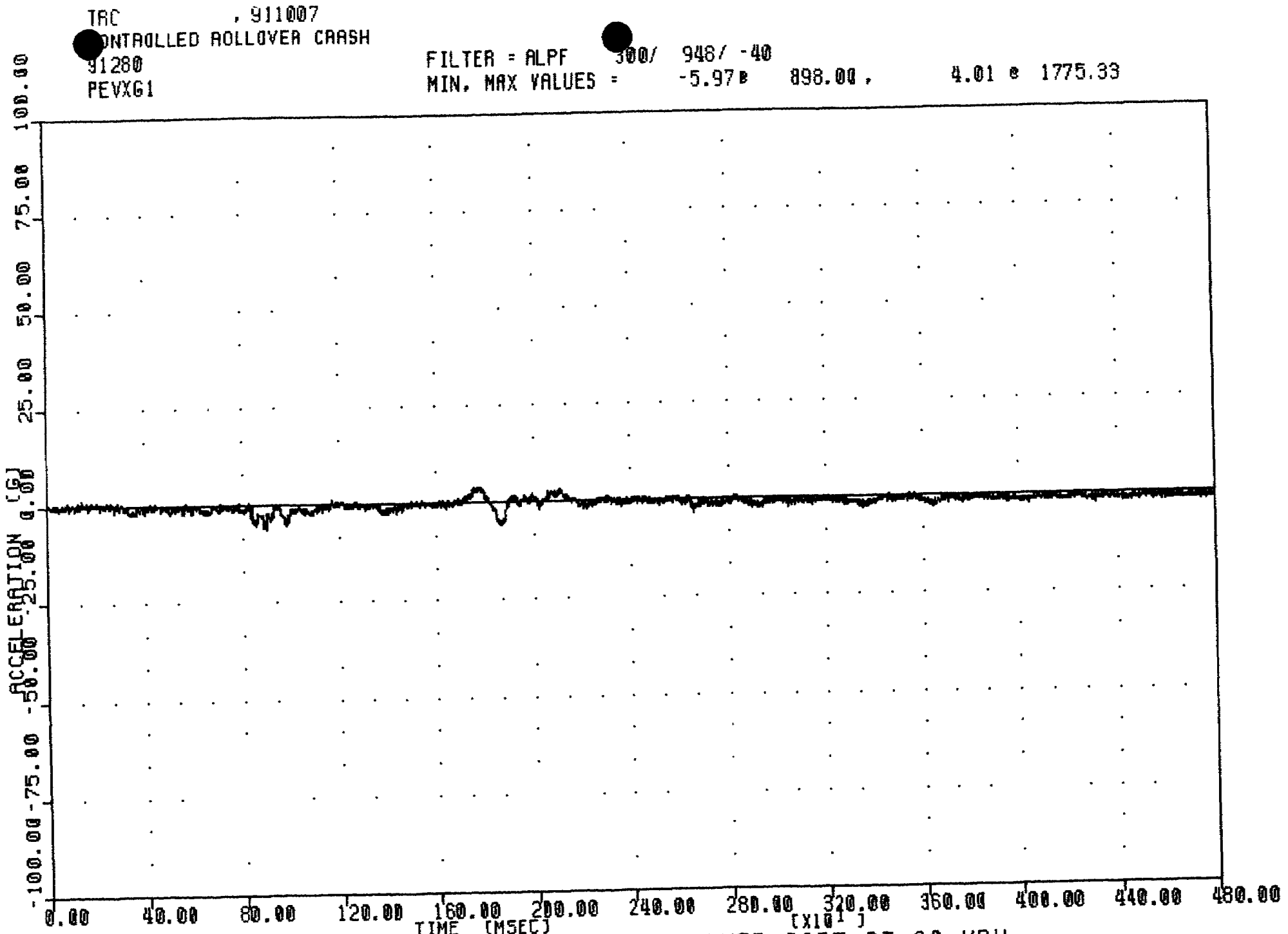


1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST RESULTANT ACCELERATION

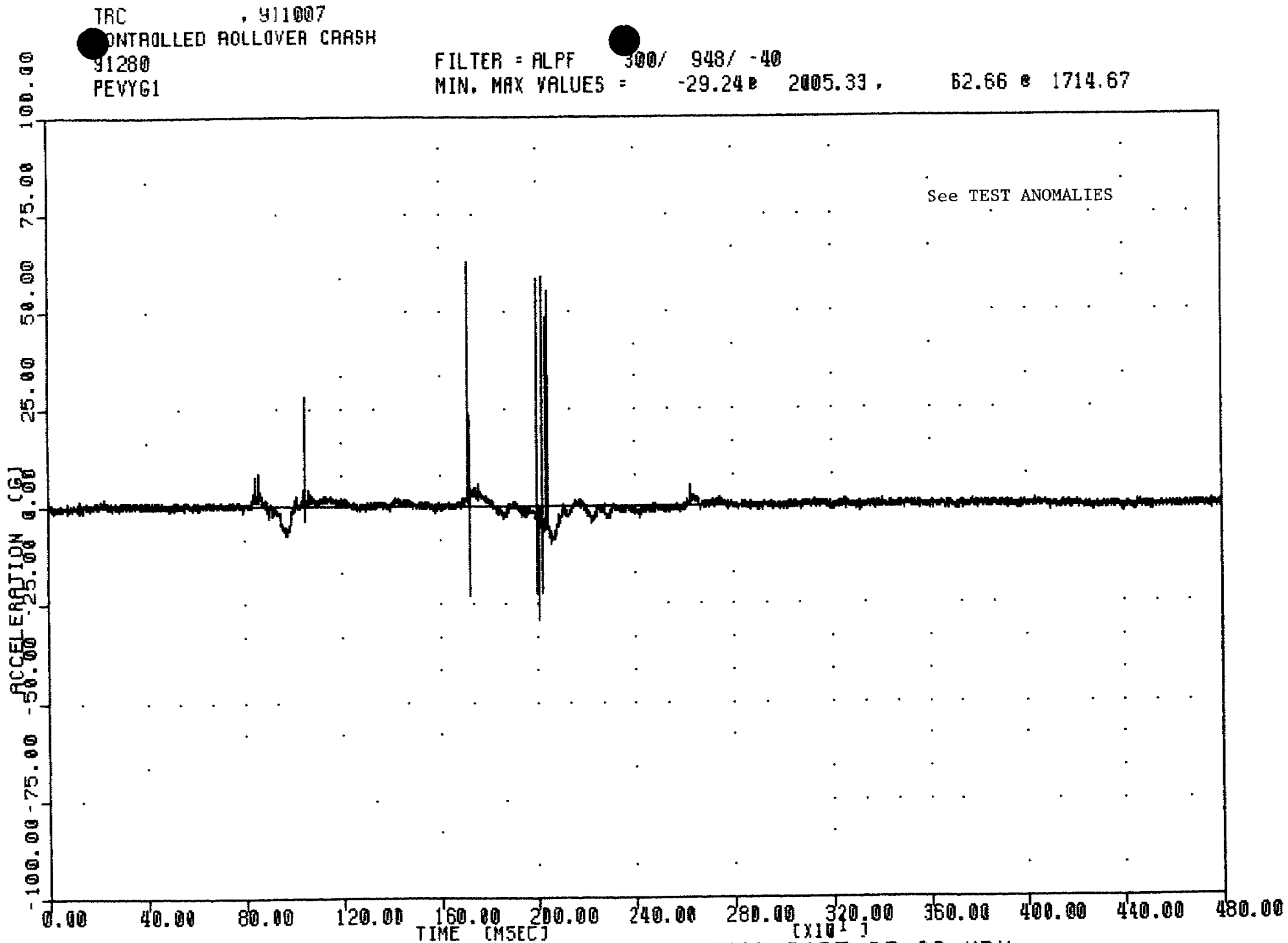
TRL , 911007
CONTROLLED ROLLOVER CRASH
91280
CSTXD1
FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = -0.18 @ 1871.33 , 0.18 @ 1790.67



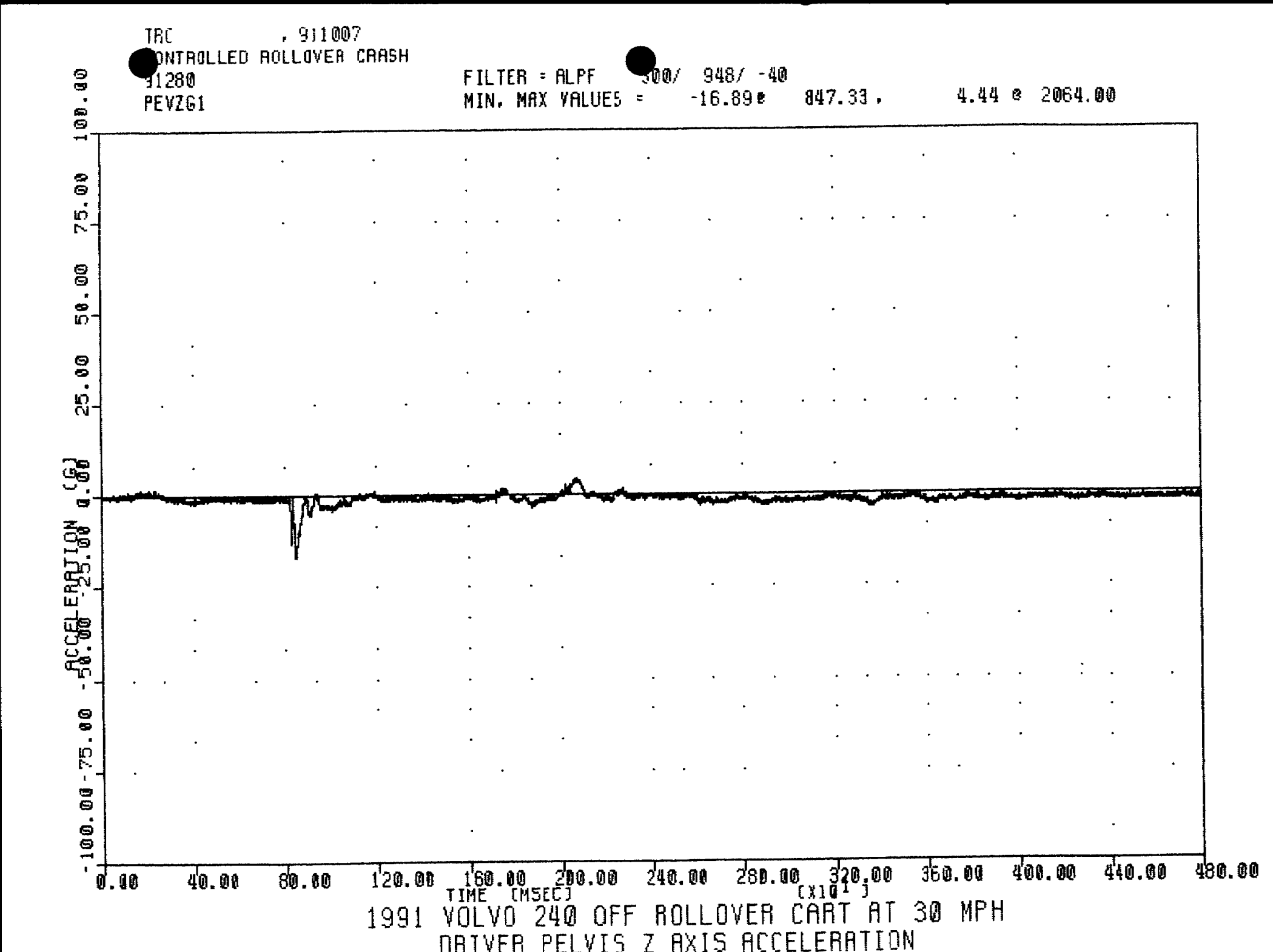
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER CHEST X AXIS DISPLACEMENT



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS X AXIS ACCELERATION



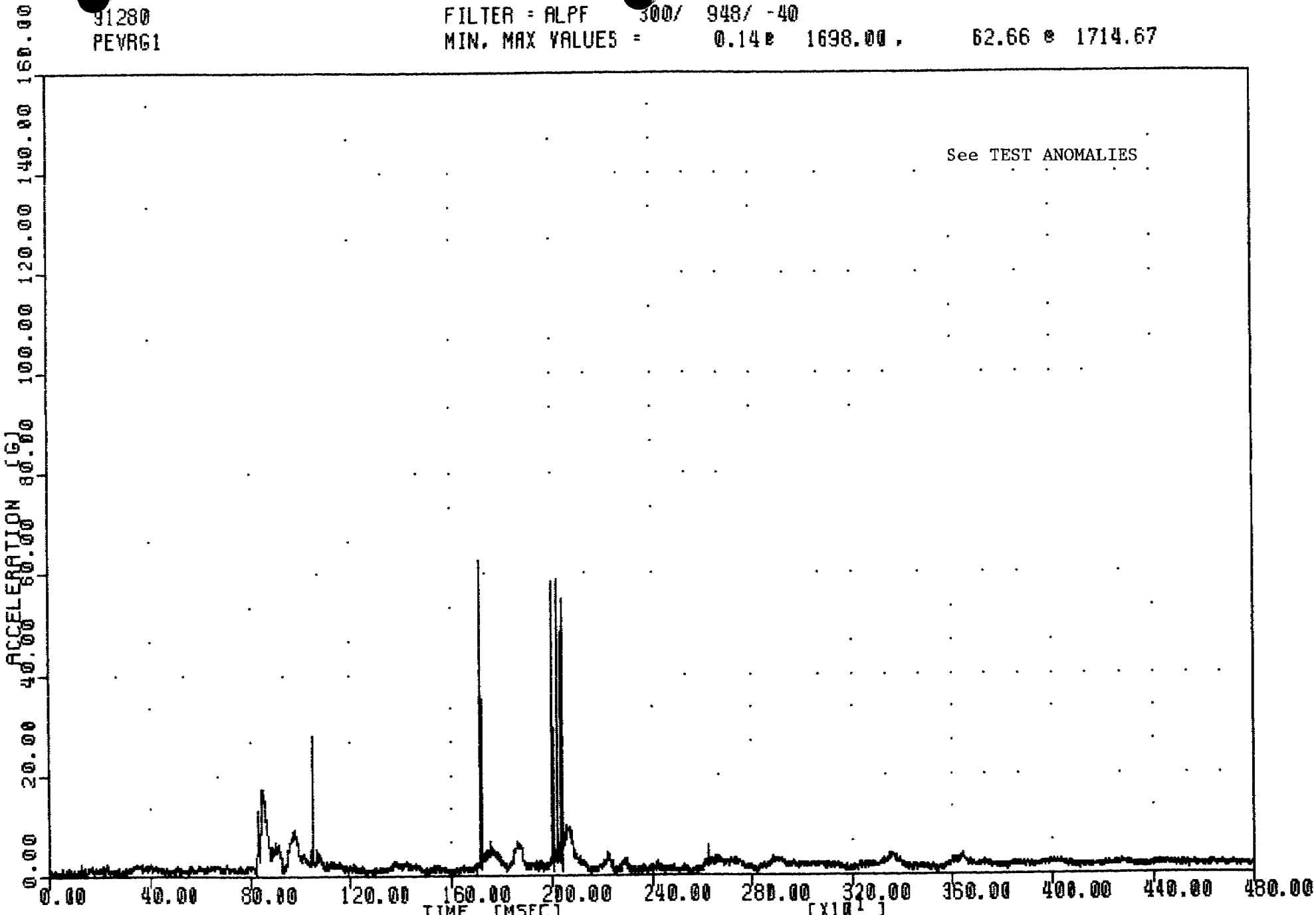
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS Y AXIS ACCELERATION



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS Z AXIS ACCELERATION

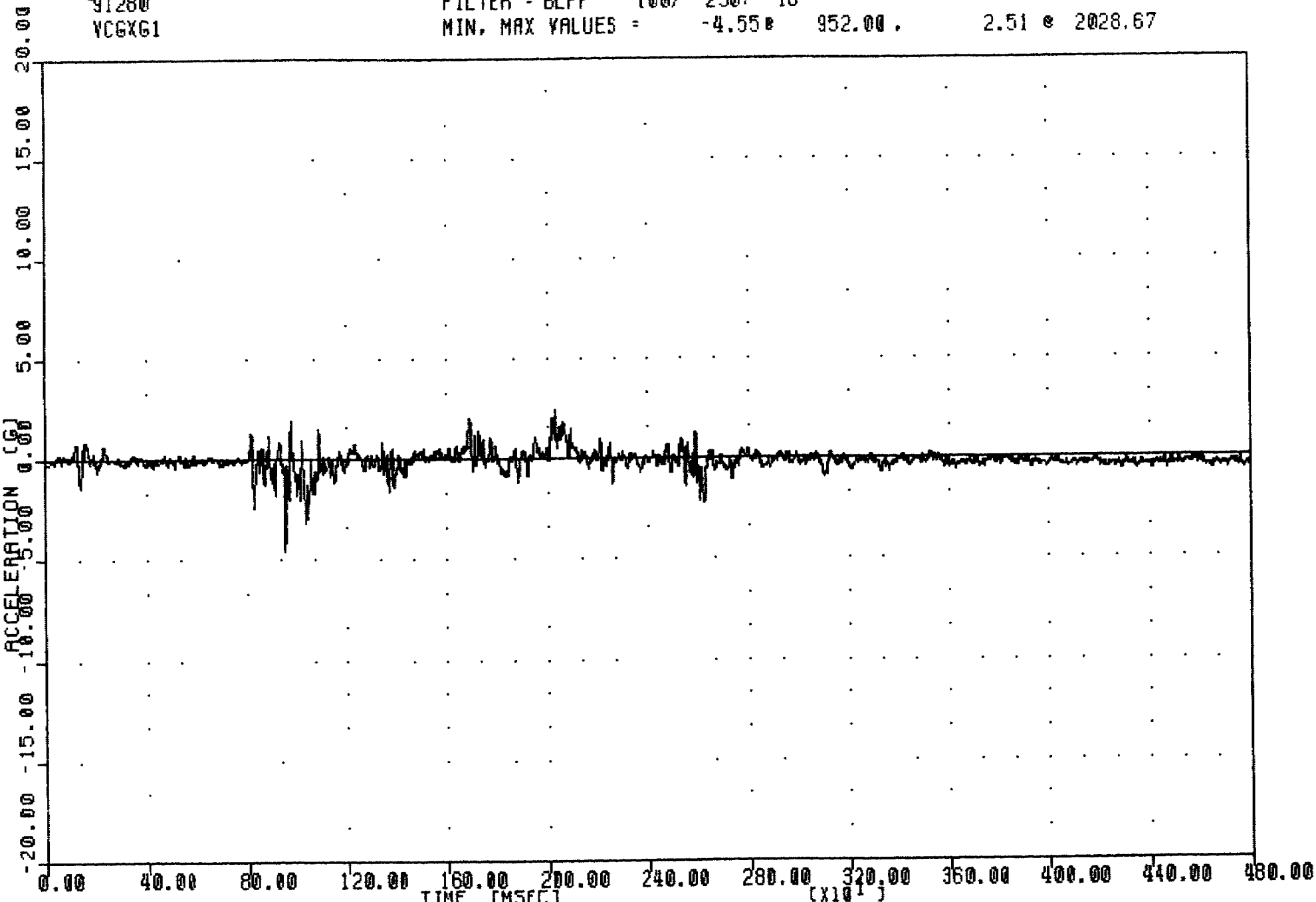
TRL , 911007
CONTROLLED ROLLOVER CRASH
91280
PEVRG1

FILTER = ALPF 300/ 948/ -40
MIN, MAX VALUES = 0.14 @ 1698.00 , 62.66 @ 1714.67

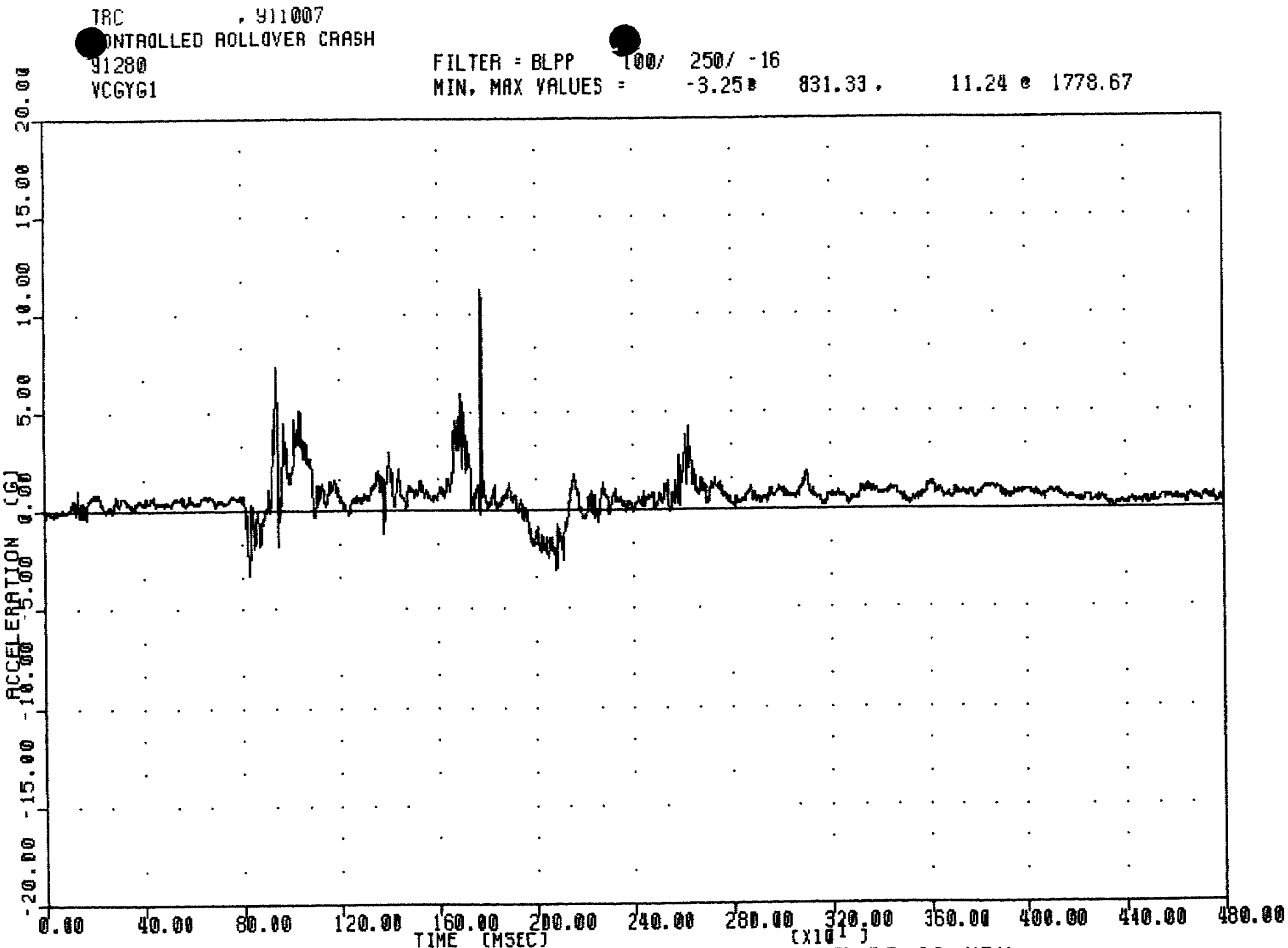


1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
DRIVER PELVIS RESULTANT ACCELERATION

TRC , 911007
CONTROLLED ROLLOVER CRASH
91280
VCGXG1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -4.55 @ 952.00 , 2.51 @ 2028.67



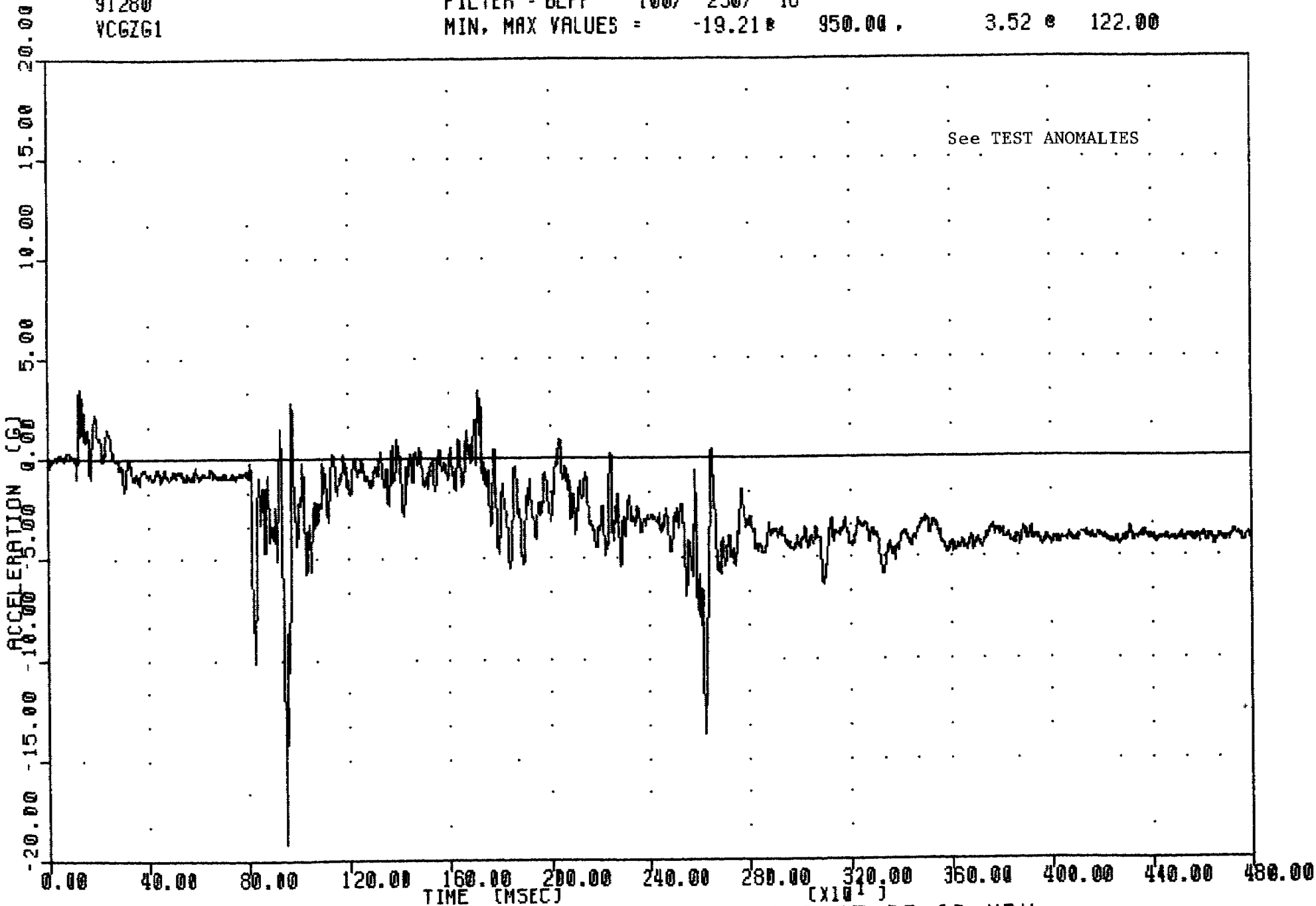
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY X AXIS ACCELERATION



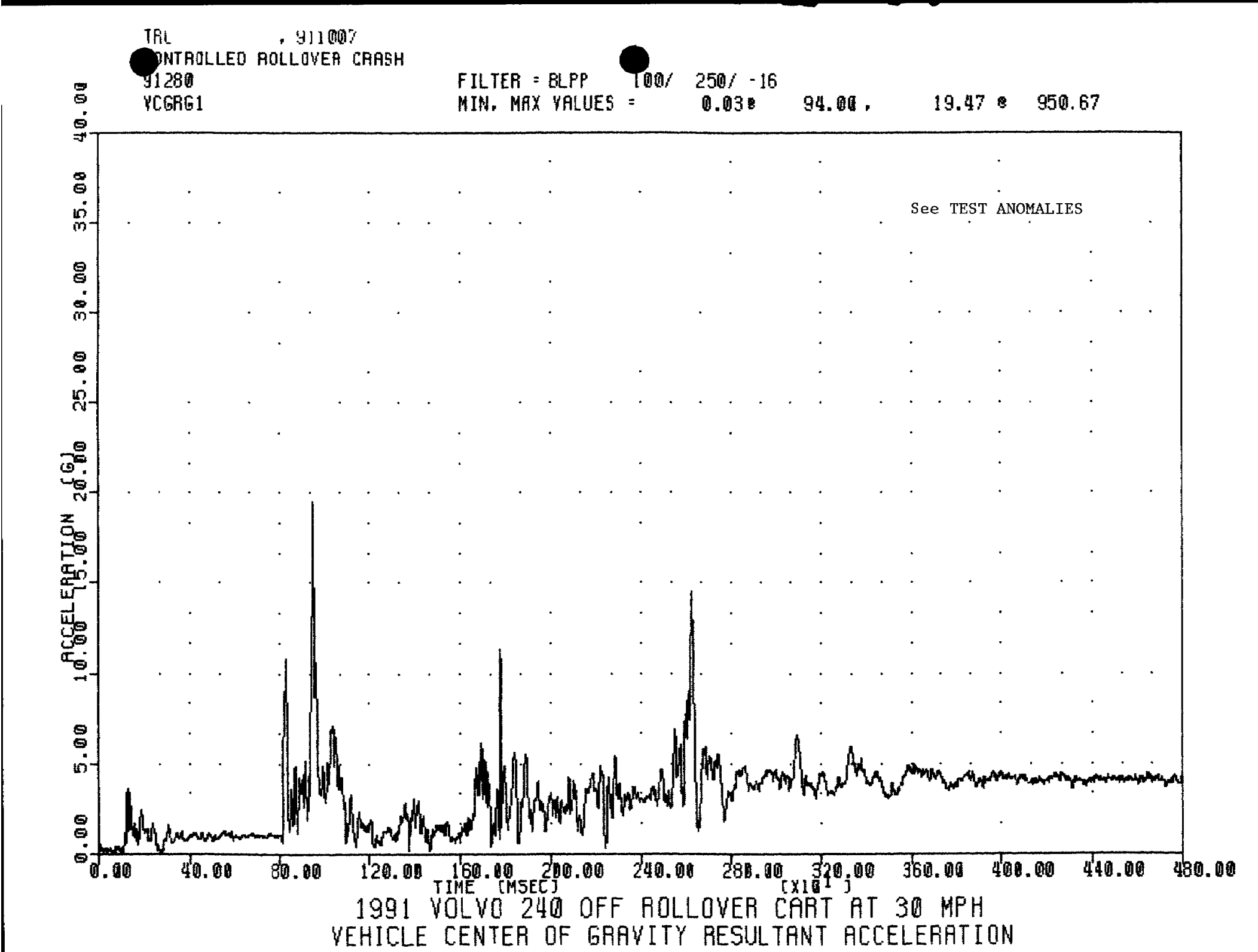
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Y AXIS ACCELERATION

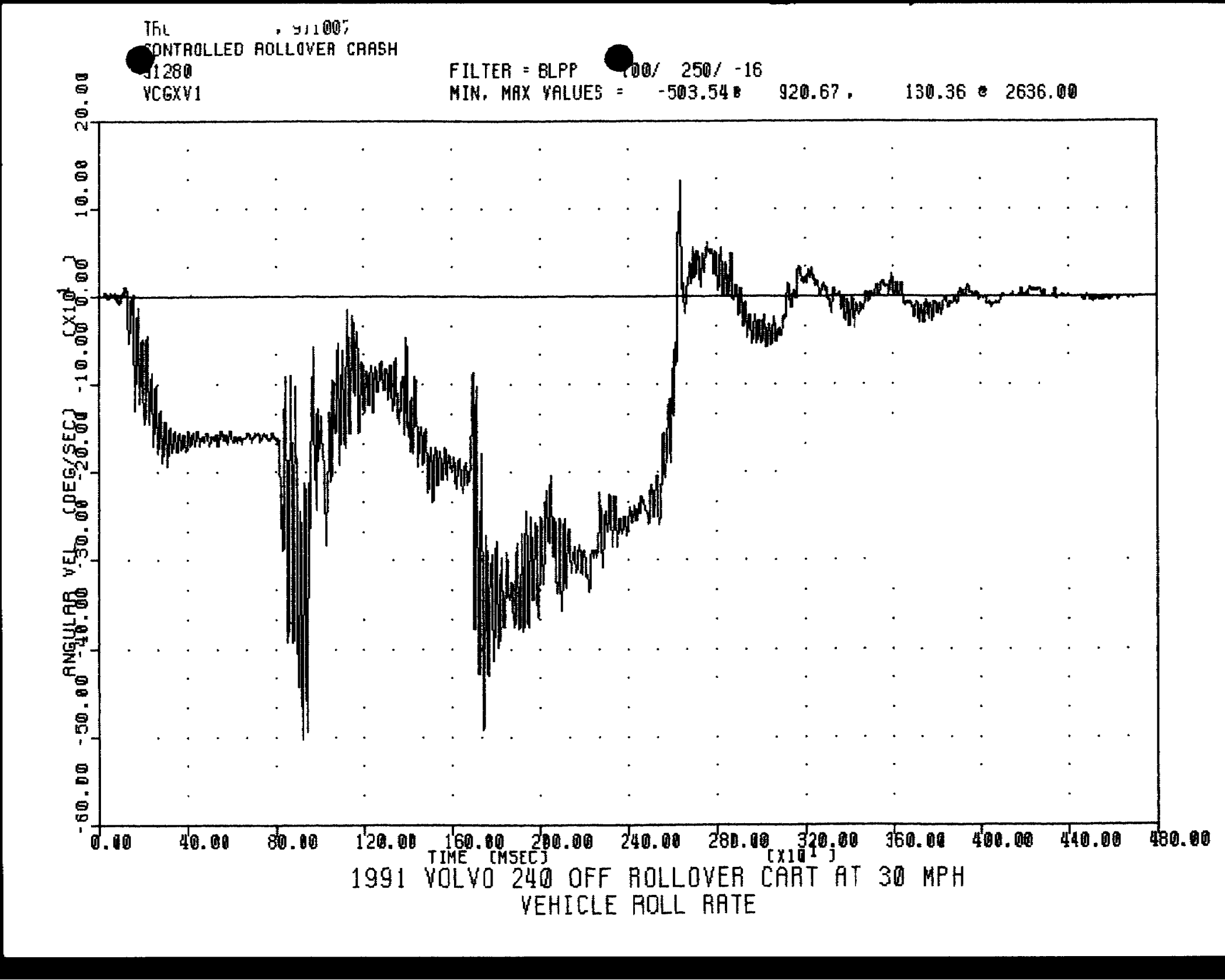
TRC , 911007
ONTROLLED ROLLOVER CRASH
91280
VCGZG1

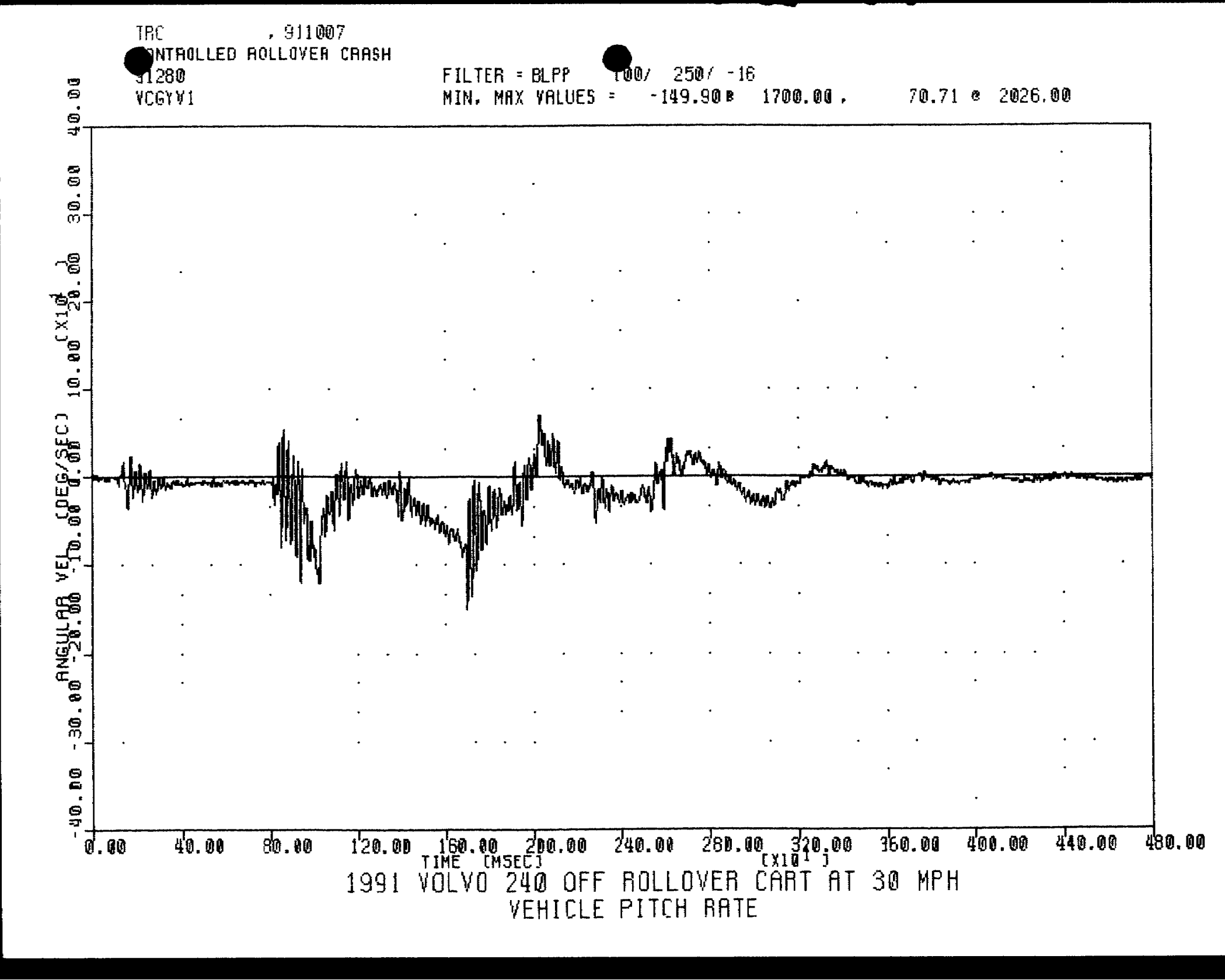
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -19.21 @ 950.00 , 3.52 @ 122.00

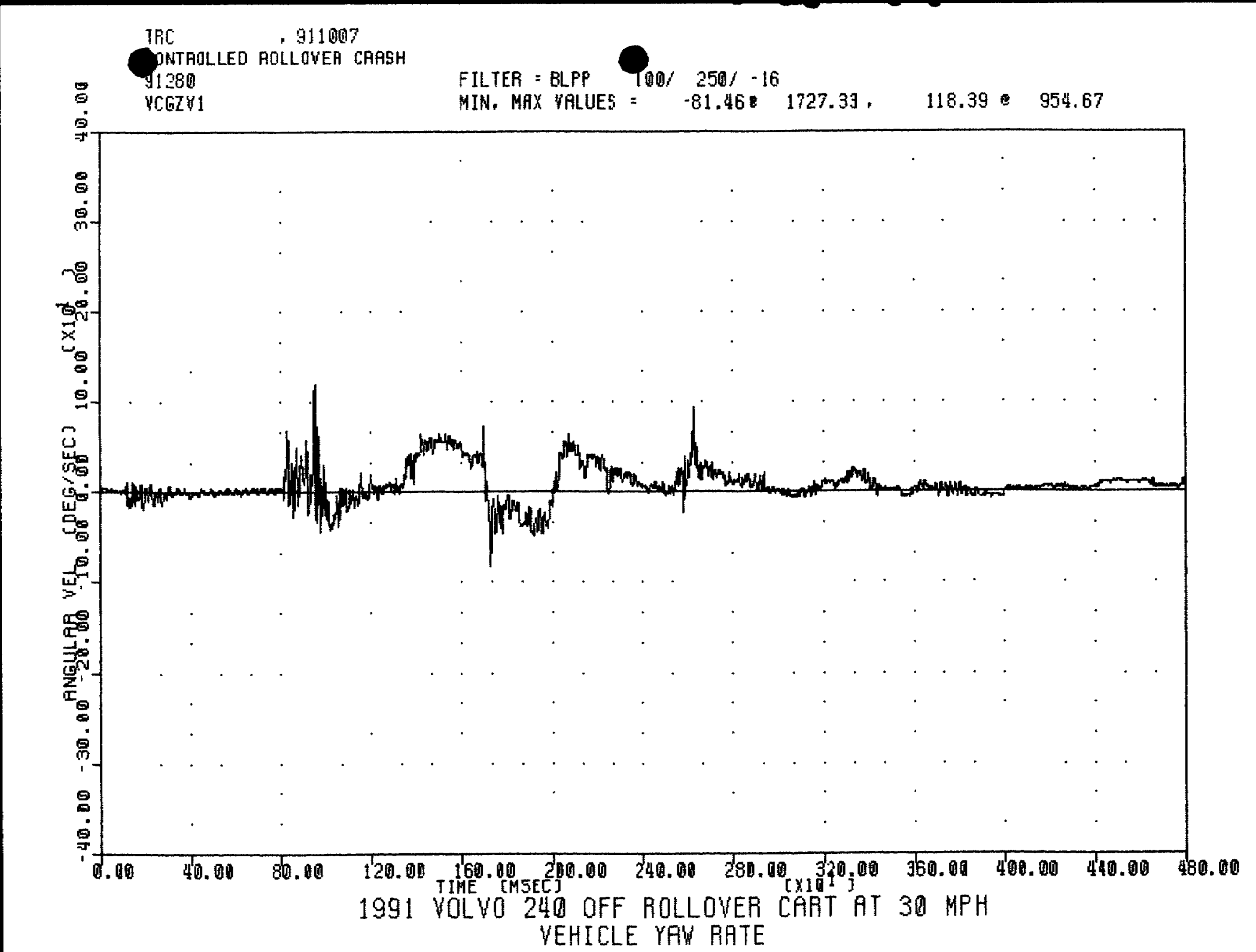


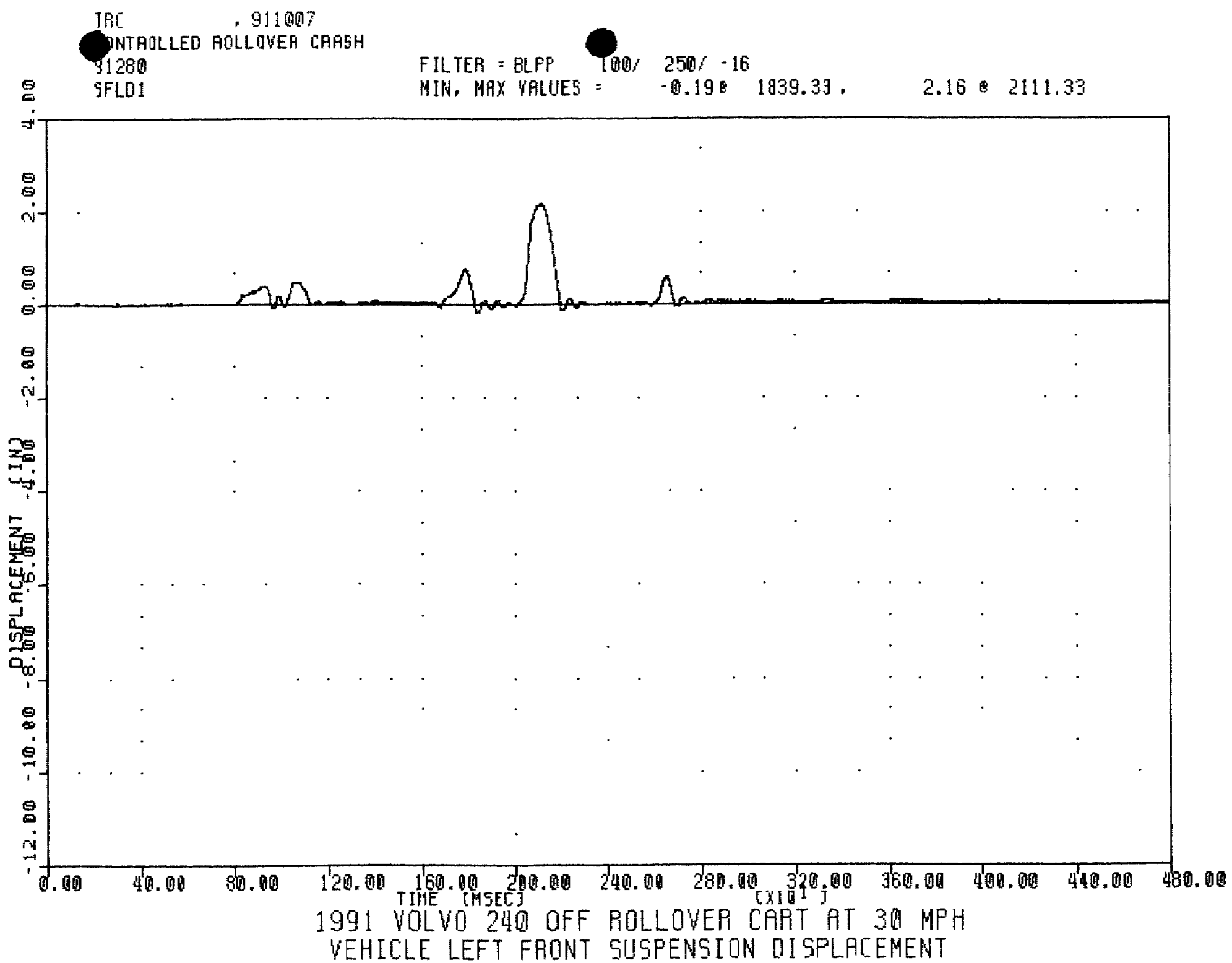
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY Z AXIS ACCELERATION


TRL , 911007
CONTROLLED ROLLOVER CRASH
91280
VCGRG1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = 0.03 @ 94.00 , 19.47 @ 950.67
See TEST ANOMALIES
ACCELERATION (G)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC)
(X10^-1)
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION


TRL , 911007
CONTROLLED ROLLOVER CRASH
01280
VCGXV1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -503.54 @ 920.67 , 130.36 @ 2636.00
ANGULAR VEL (DEG/SEC) [X10^1]
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME [MSEC] [X10^1]
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE ROLL RATE

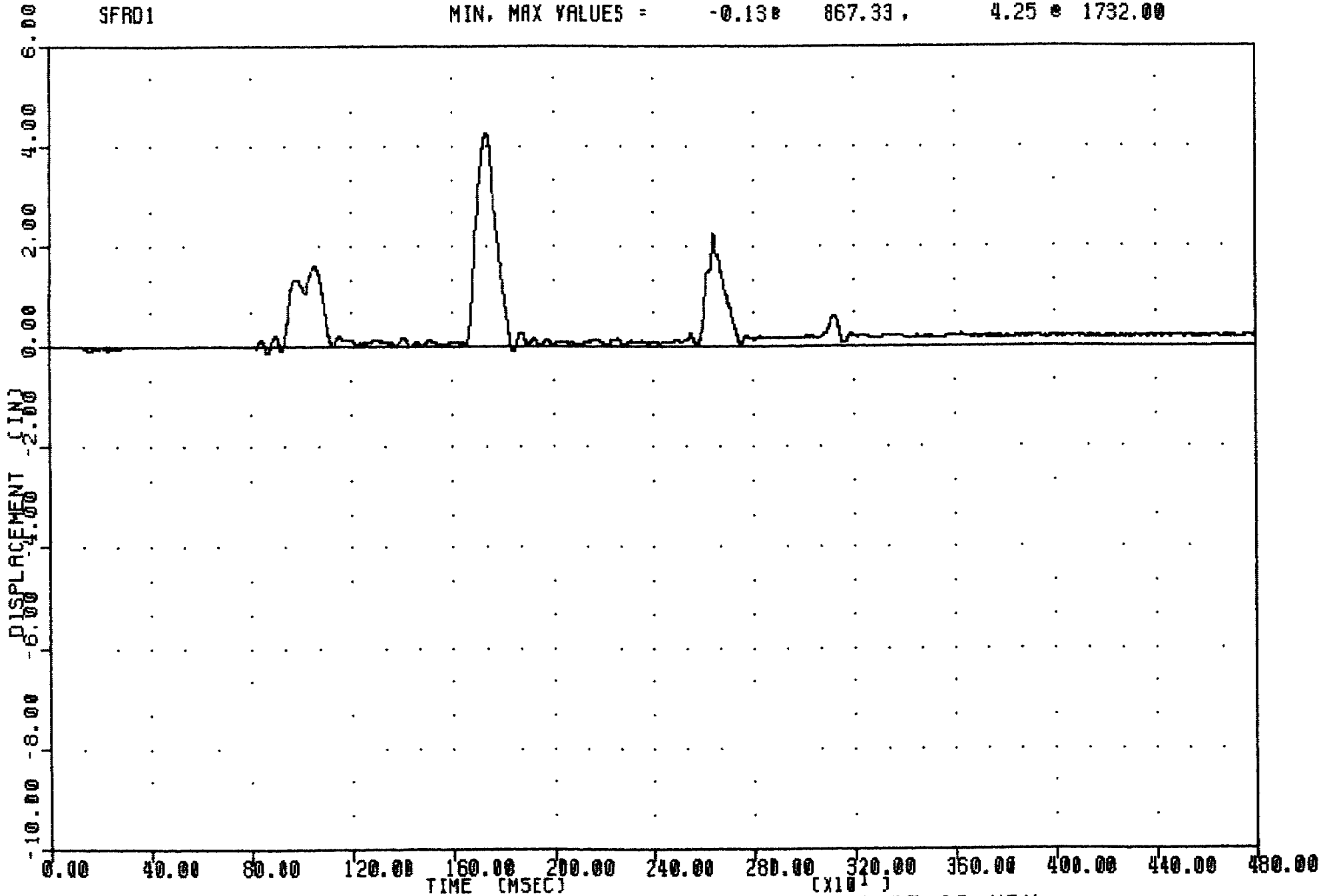

TRC , 911007
CONTROLLED ROLLOVER CRASH
01280
VCGYV1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -149.90 @ 1700.00 , 70.71 @ 2026.00
ANGULAR VEL (DEG/SEC) [X10^1]
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME [MSEC] [X10^1]
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE PITCH RATE


TRC , 911007
CONTROLLED ROLLOVER CRASH
91280
VCGZV1
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -81.46 @ 1727.33 , 118.39 @ 954.67
ANGULAR VEL (DEG/SEC) (X10^1)
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
-40.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
440.00
480.00
TIME (MSEC) (X10^1)
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE YAW RATE



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT FRONT SUSPENSION DISPLACEMENT

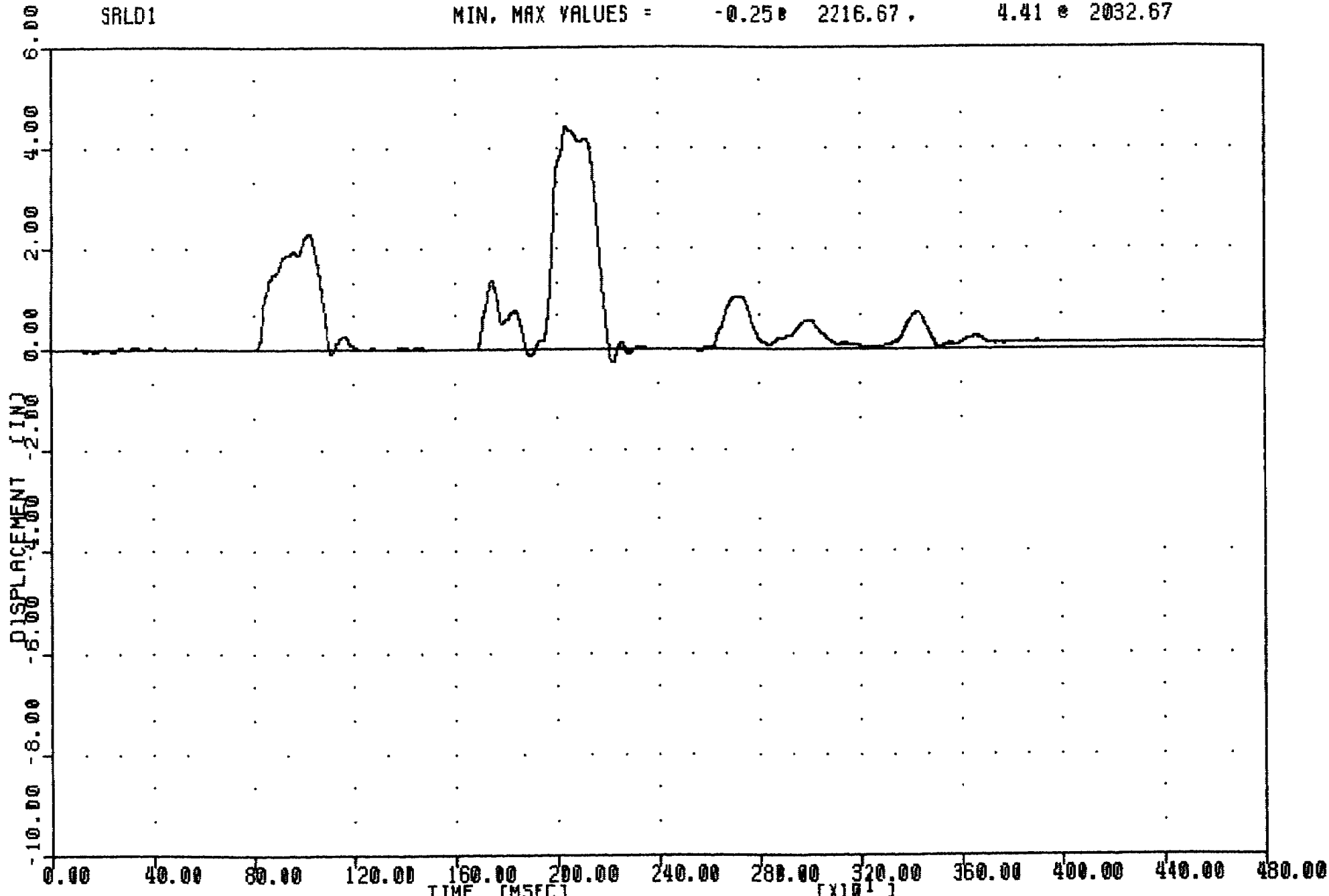
TRC , 911007
CONTROLLED ROLLOVER CRASH
1280
SFRD1
FILTER = BLPP 00/ 250/ -16
MIN, MAX VALUES = -0.13 @ 867.33 , 4.25 @ 1732.00



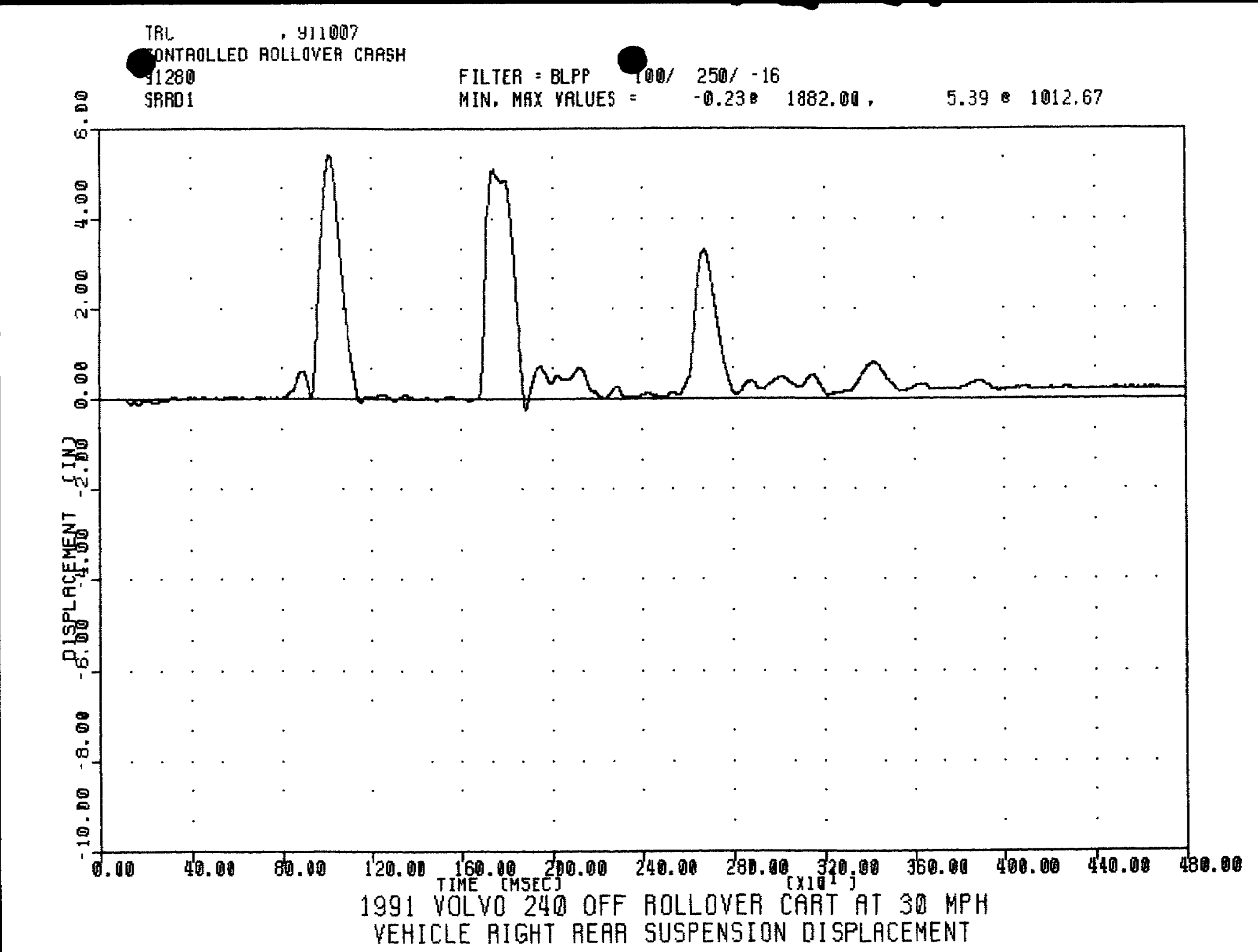
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE RIGHT FRONT SUSPENSION DISPLACEMENT

TRC . 911007
CONTROLLED ROLLOVER CRASH
91280
SRLD1

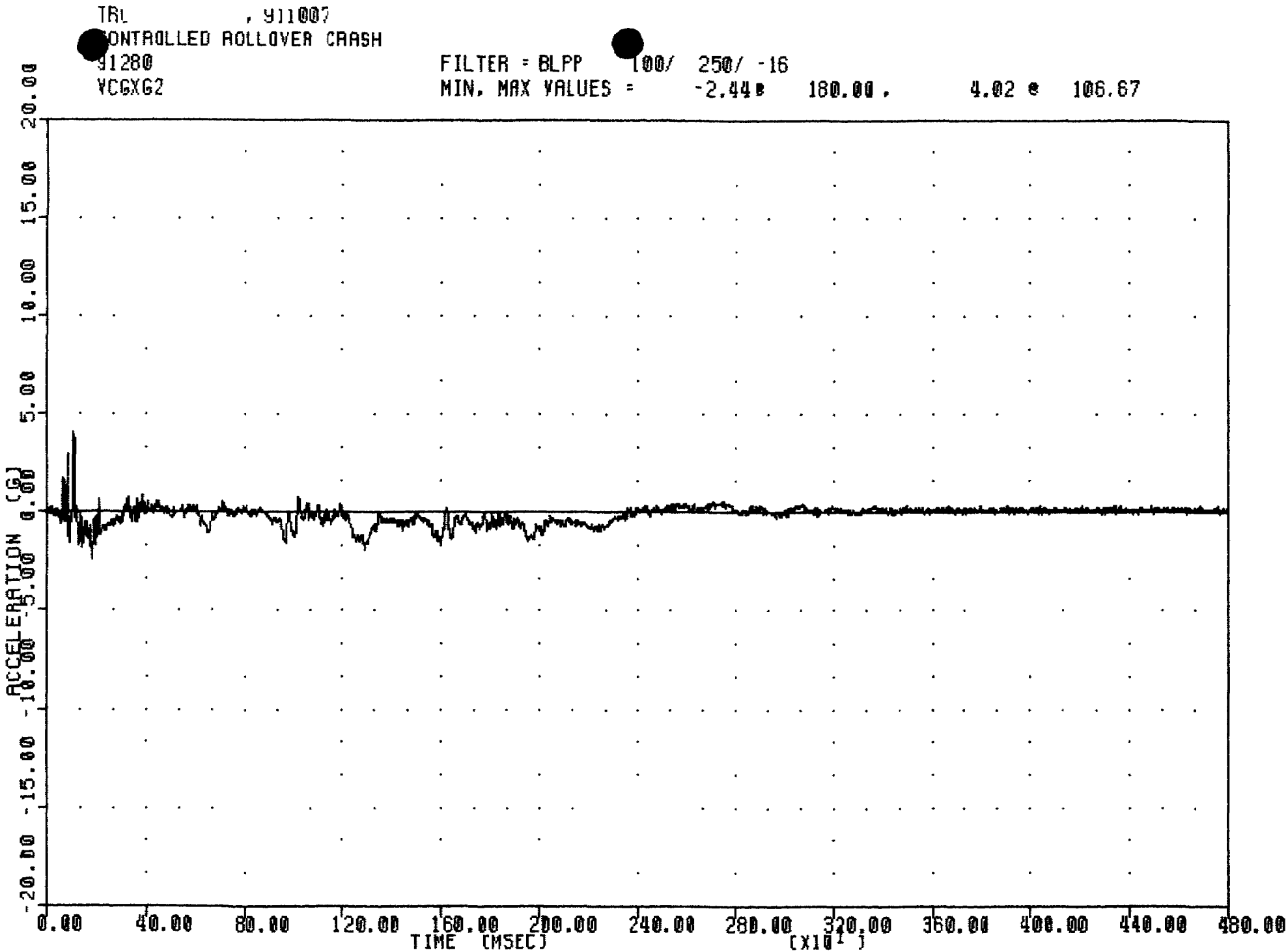
FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -0.25 @ 2216.67 , 4.41 @ 2032.67



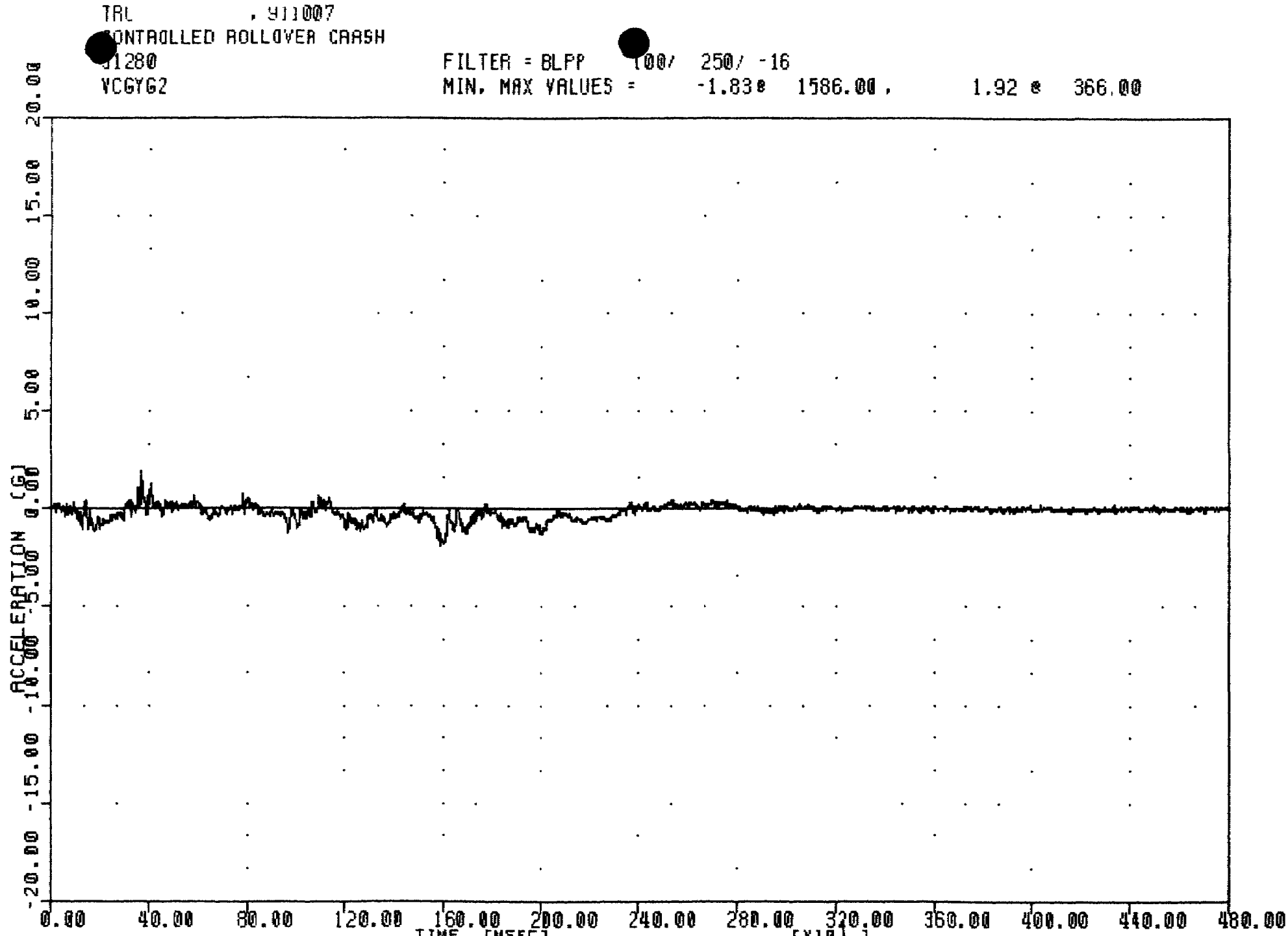
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE LEFT REAR SUSPENSION DISPLACEMENT



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
VEHICLE RIGHT REAR SUSPENSION DISPLACEMENT



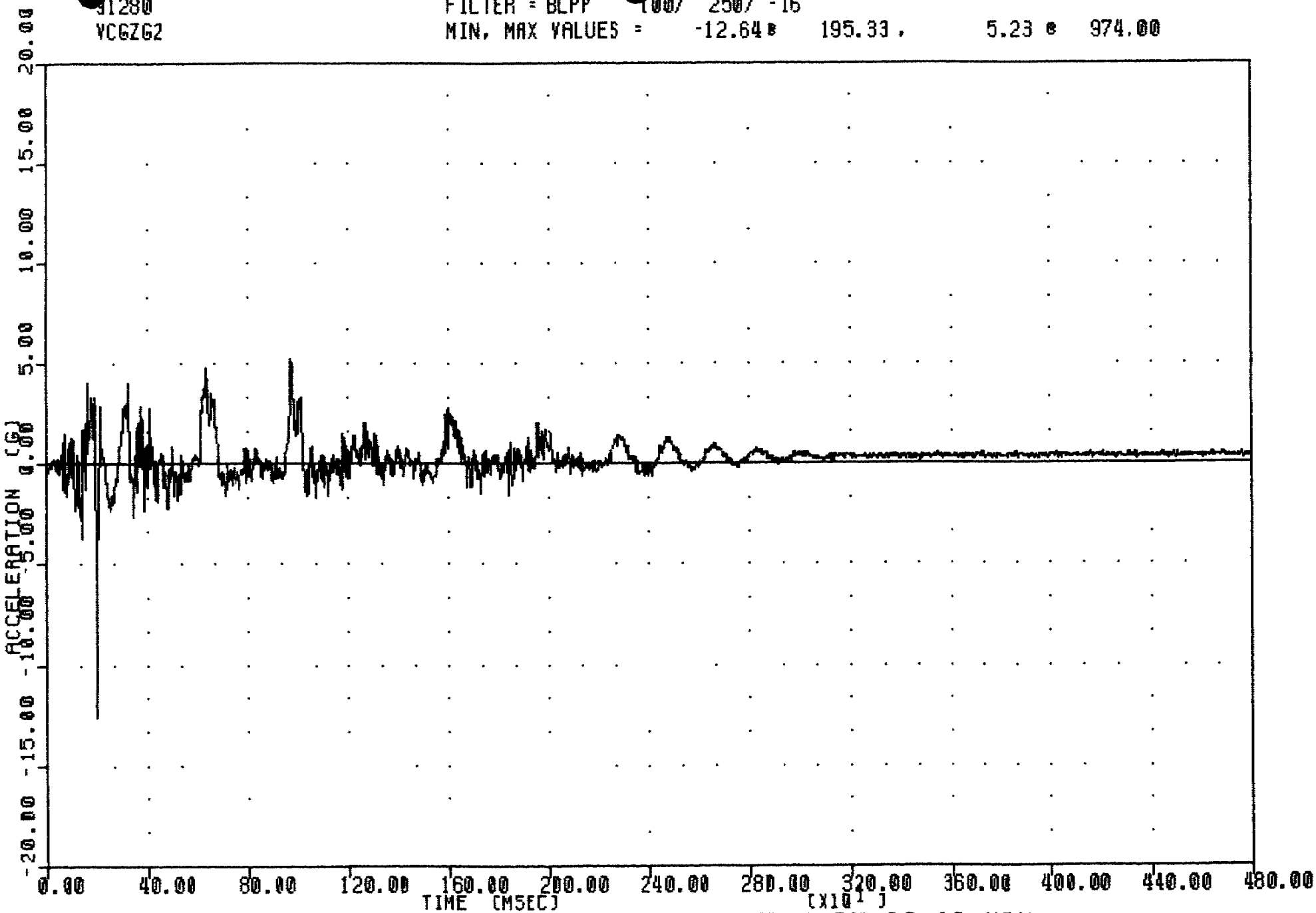
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY X AXIS ACCELERATION



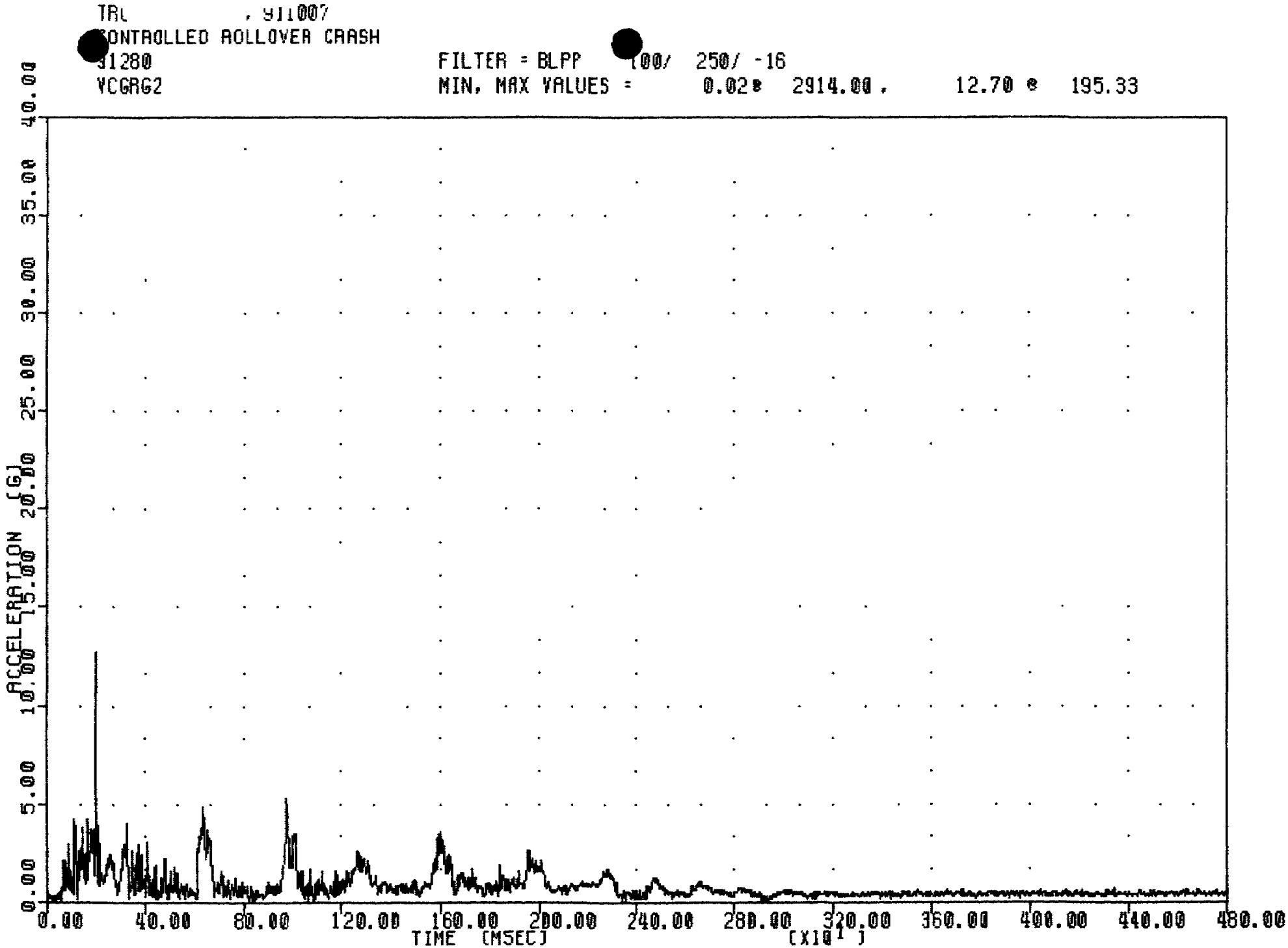
1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Y AXIS ACCELERATION

TRL . 911007
CONTROLLED ROLLOVER CRASH
91280
VCGZG2

FILTER = BLPP 100/ 250/ -16
MIN, MAX VALUES = -12.64 @ 195.33 , 5.23 @ 974.00

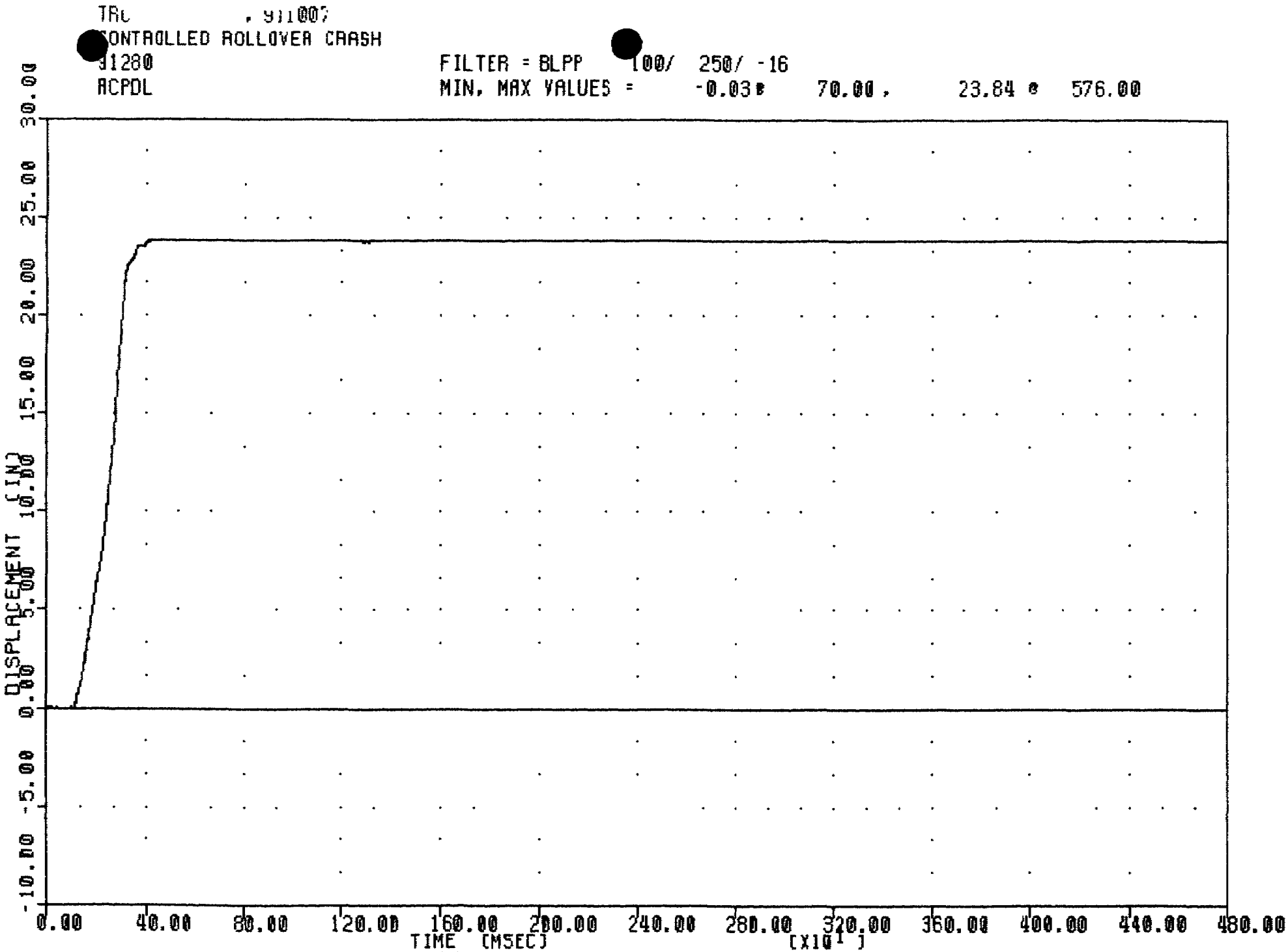


1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
ROLL CART CENTER OF GRAVITY Z AXIS ACCELERATION

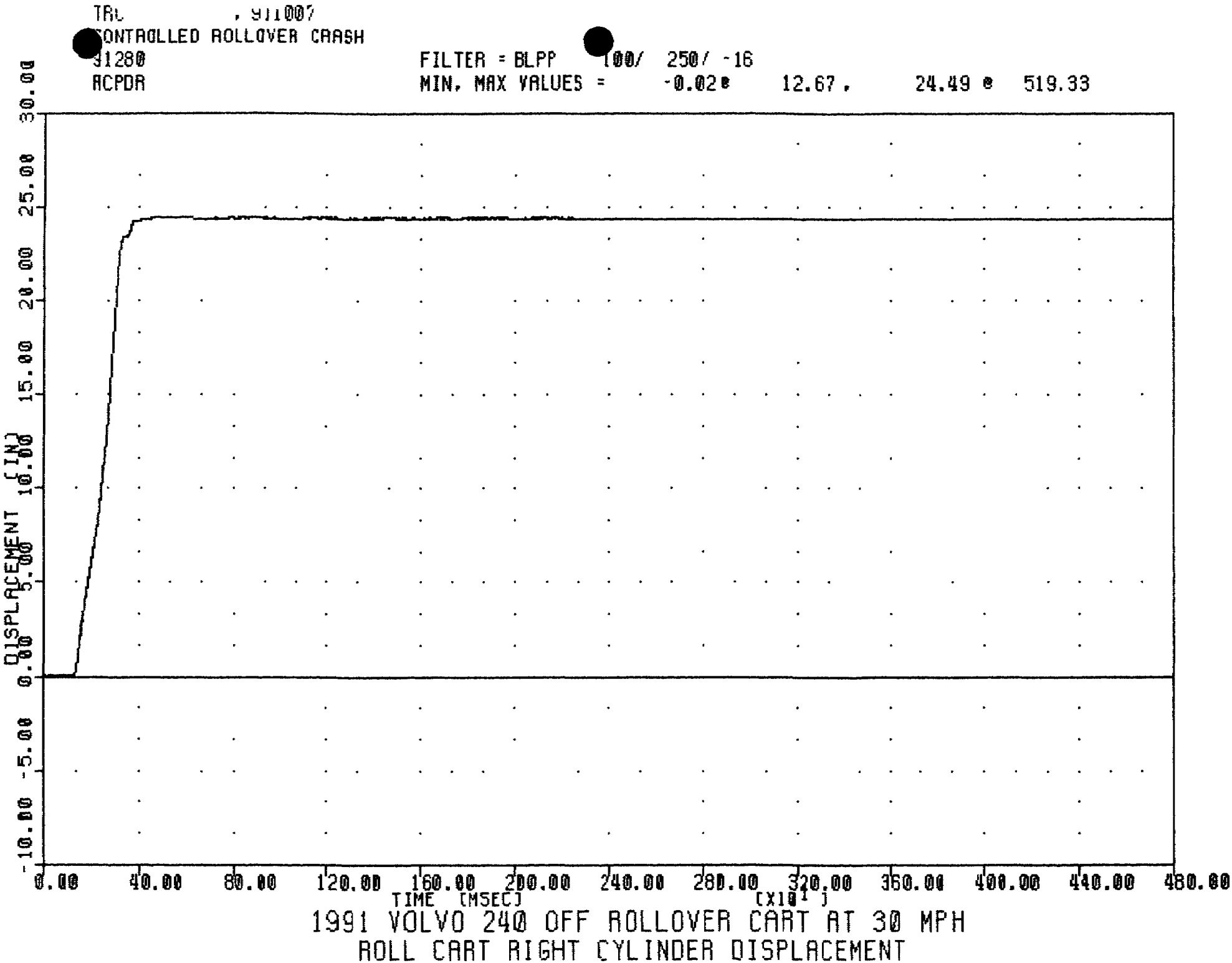


1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH

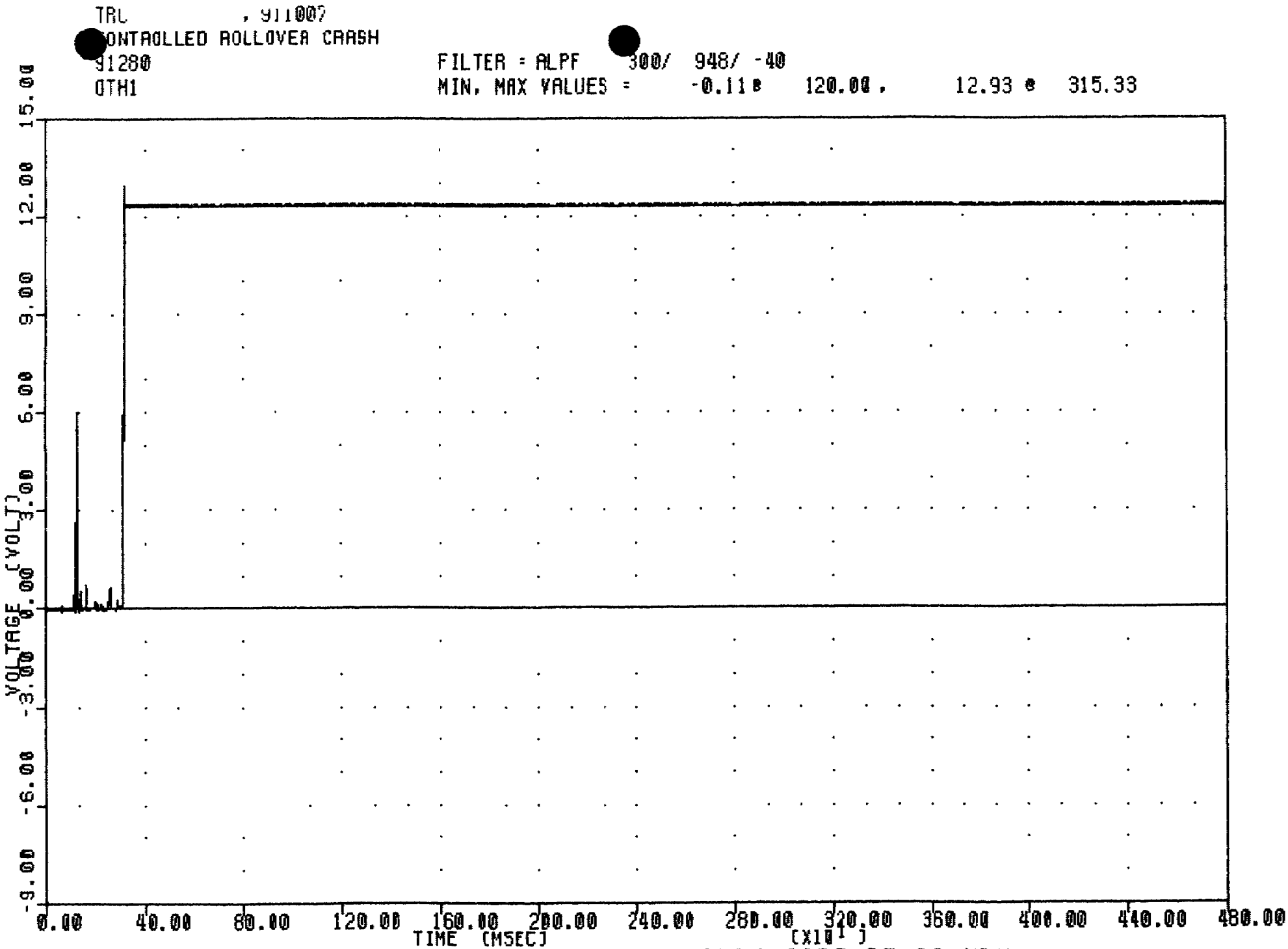
ROLL CART CENTER OF GRAVITY RESULTANT ACCELERATION



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
ROLL CART LEFT CYLINDER DISPLACEMENT

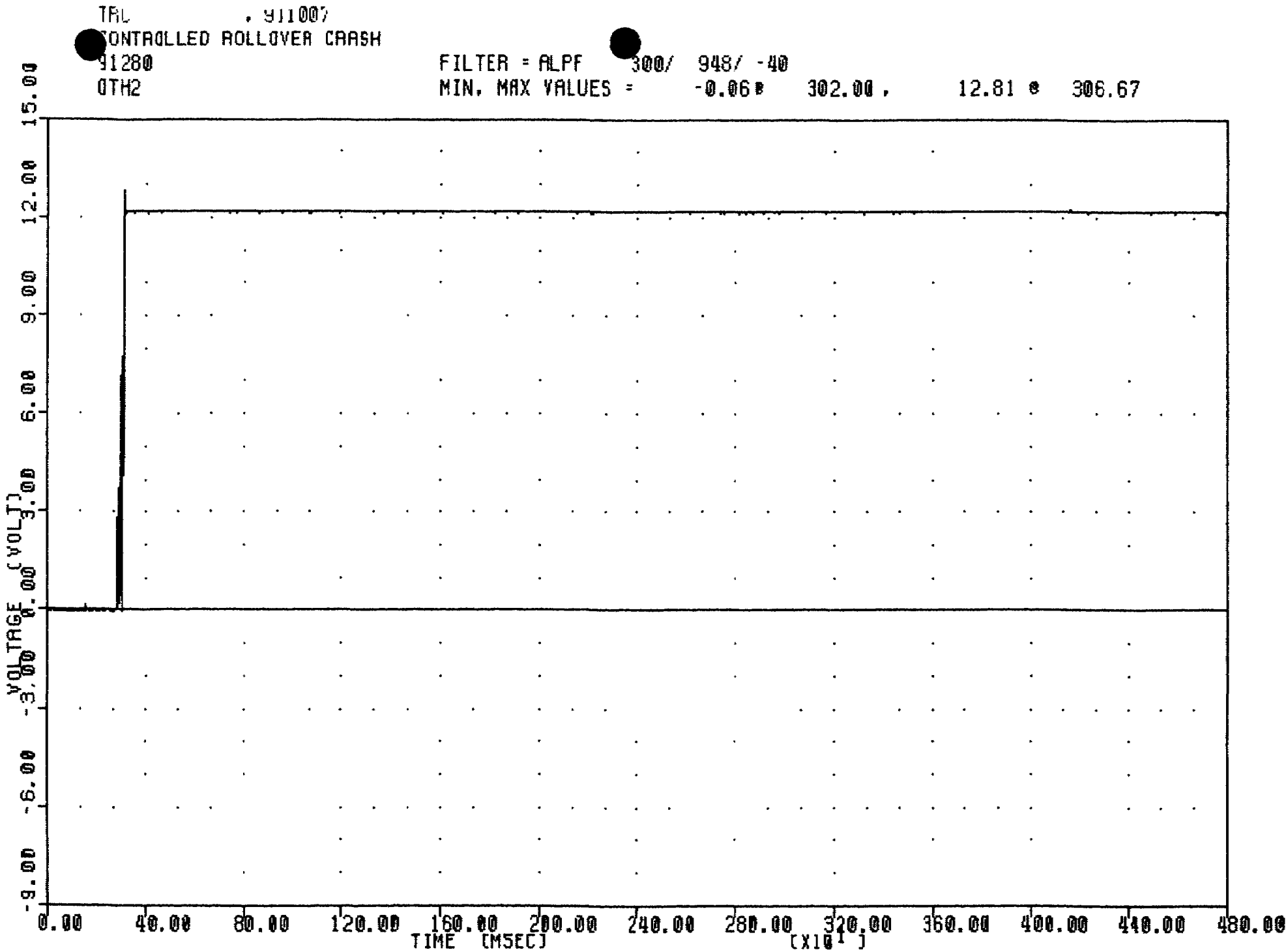


1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH
ROLL CART RIGHT CYLINDER DISPLACEMENT



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH

VEHICLE/ROLL CART SEPARATION TIME - UPPER SWITCH



1991 VOLVO 240 OFF ROLLOVER CART AT 30 MPH

VEHICLE/ROLL CART SEPARATION TIME - LOWER SWITCH

SIGN CONVENTION

ACCELEROMETERS:

+X: FORWARD

+Y: LEFTWARD

+Z: UPWARD

POTENTIOMETERS:

+CHEST DISPLACEMENT	OUTWARD
+SEAT BELT DISPLACEMENT.	OUTWARD
+SEAT BELT EXTENSION	ENLONGATION
+VEHICLE SUSPENSION DISPLACEMENT:	UPWARD

LOAD CELLS:

+FEMUR FORCE:	TENSION
+SEAT BELT FORCE:	TENSION
+BARRIER FORCE:	TENSION

NECK LOAD CELLS:

+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

GYROSCOPES:

+X ROLL:	TO RIGHT
+Y PITCH·	FRONT DOWN
+Z YAW·	COUNTERCLOCKWISE

APPENDIX C

DUMMY CERTIFICATION DATA

PRE-TEST CERTIFICATION DATA

DRIVER DUMMY S/N: 907

TRANSPORTATION RESEARCH CENTER OF OHIO
HYBRID III EXTERNAL DIMENSIONS
907 HUMANOID

24-SEP-91

SRL 907C4ED1 572E SN907 EXT DIMENSION CAL04

TEST PARAMETER	(DIMEN)	SPECIFICATION	TEST RESULTS
TEMPERATURE			69 0 DEG F
RELATIVE HUMIDITY			54 0 %
LOCATION FOR CHEST CIRCUMFERENCE	(AA)	16 9-17 1 IN	17 0 IN
LOCATION FOR WAIST CIRCUMFERENCE	(BB)	8 9- 9 1 IN	9 0 IN
CHEST CIRCUMFERENCE	(Y)	38 2-39.4 IN	38 7 IN
WAIST CIRCUMFERENCE	(Z)	32 9-34.1 IN	33 6 IN
CHEST DEPTH	(D)	8.4- 9 0 IN	8 6 IN
H-POINT HEIGHT	(C)	3 3- 3 5 IN	3 5 IN
H-POINT FROM SEATBACK	(D)	5.3- 5 5 IN	5 5 IN
SKULL CAP TO BACKLINE	(H)	1 6- 1 8 IN	1 7 IN
TOTAL SITTING HEIGHT	(A)	34.6-35 0 IN	34 7 IN
THIGH CLEARANCE	(F)	5 5- 6 1 IN	6 0 IN
BUTTOCK KNEE LENGTH	(K)	22 8-23 8 IN	23 6 IN
BUTTOCK POPLITEAL LENGTH	(N)	17 8-18 8 IN	18 5 IN
POPLITEAL HEIGHT	(L)	16 9-17 9 IN	17 5 IN
KNEE PIVOT HEIGHT	(M)	19 1-19 7 IN	19 4 IN
FOOT LENGTH	(P)	9 9-10 5 IN	10 1 IN
FOOT BREADTH	(W)	3 6- 4 2 IN	3 8 IN
SHOULDER PIVOT FROM BACKLINE	(E)	3.3- 3 7 IN	3 7 IN
SHOULDER BREADTH	(V)	16 6-17 2 IN	16 7 IN
SHOULDER PIVOT HEIGHT	(B)	19 9-20 5 IN	20 2 IN
ELBOW REST HEIGHT	(J)	7 5- 8.3 IN	7 9 IN
SHOULDER-ELBOW LENGTH	(I)	13 0-13 6 IN	13 4 IN
BACK OF ELBOW TO WRIST PIVOT	(G)	11 4-12 0 IN	11 5 IN

TEST MEETS SPECIFICATIONS

TECHNICIAN Chas Middleton

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

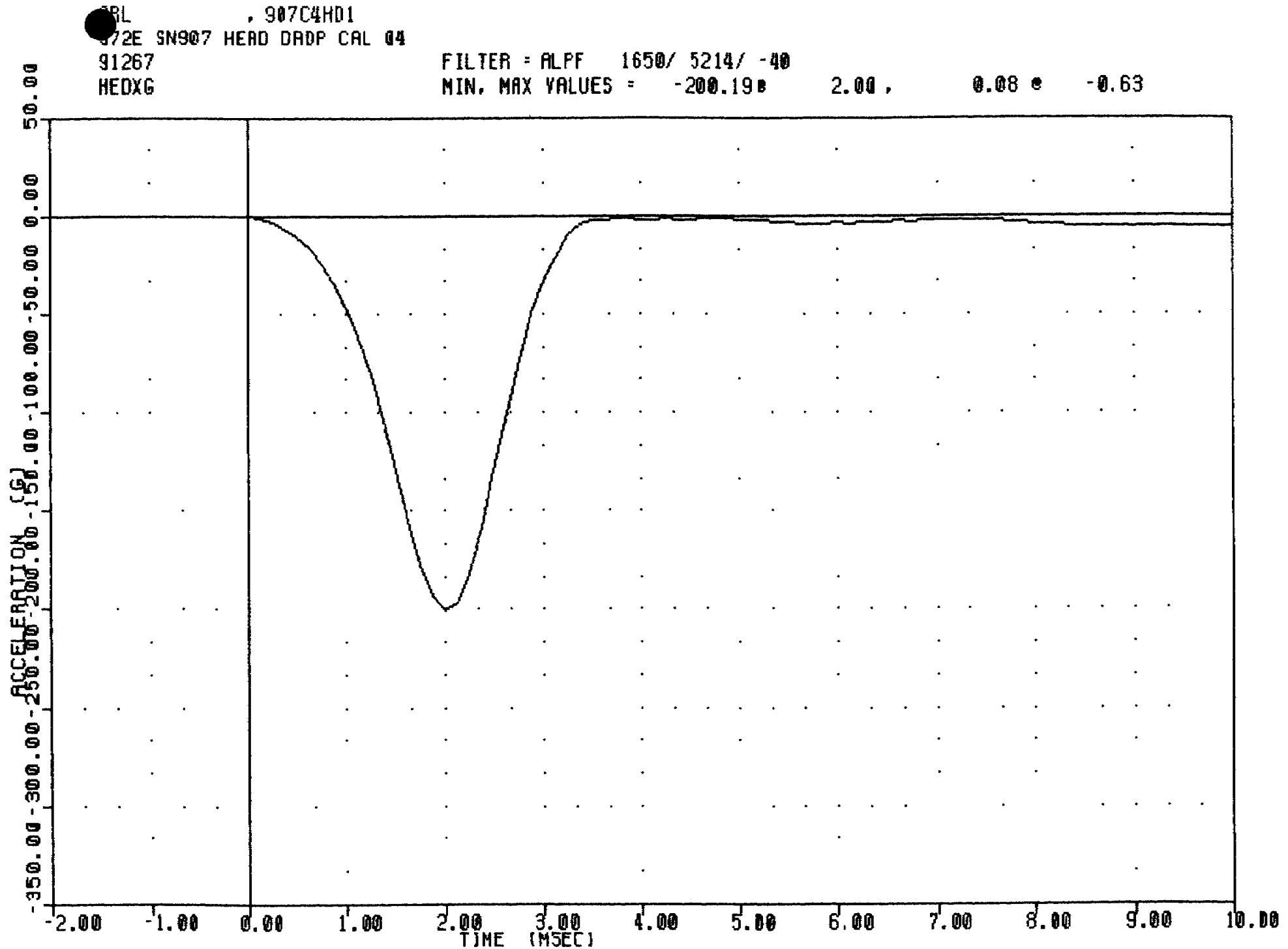
HYBRID III 24-Sep-91

SRL 907C4HD1 572E SN907 HEAD DROP CAL 04

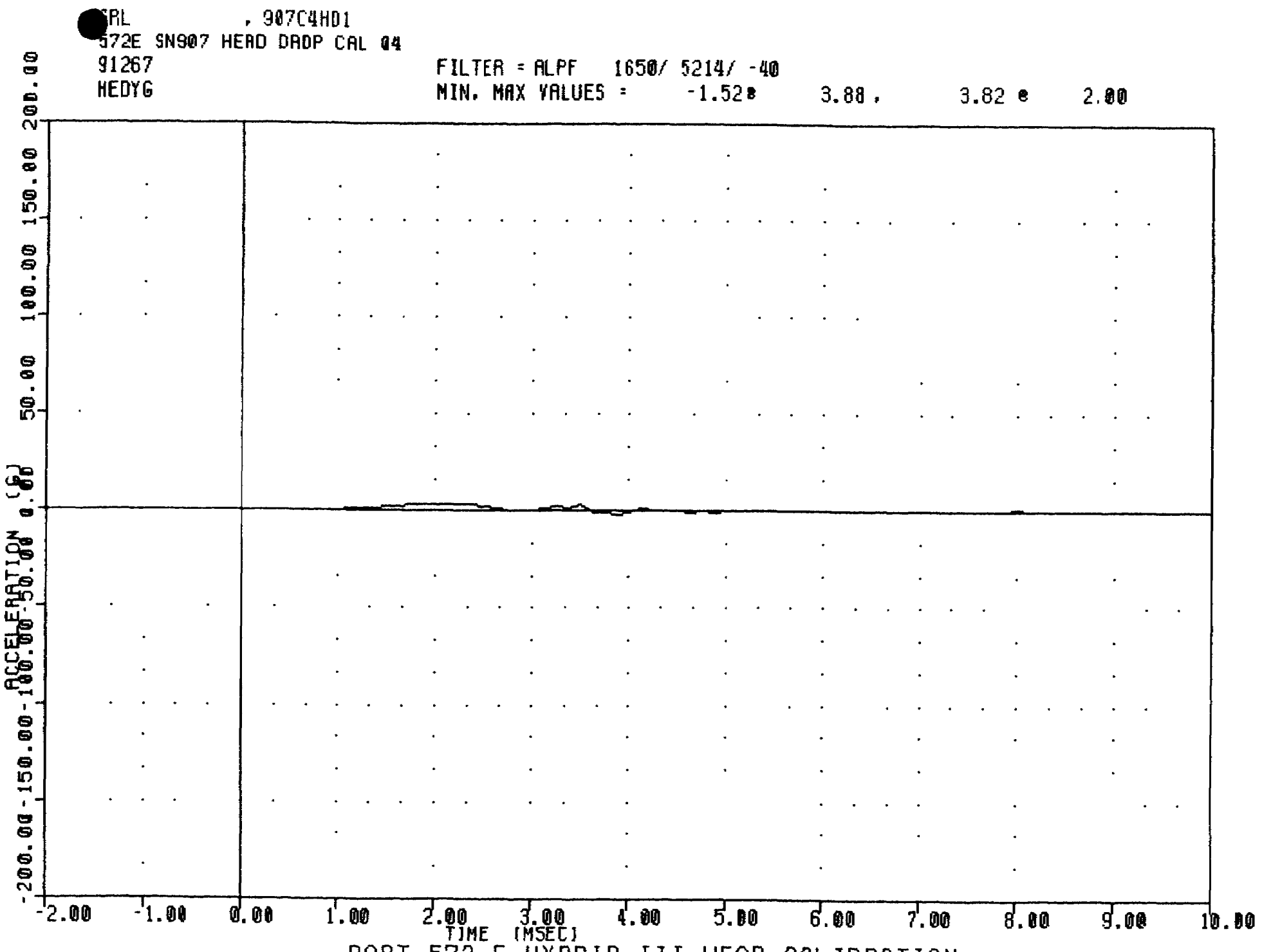
TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	69.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	54.00 %
PEAK RESULTANT ACCELERATION	225 - 275 G	230.98 G
PEAK LATERAL ACCELERATION	15 G MAX	3.82 G
IS ACCELERATION CURVE UNIMODAL?	YES	YES

TEST MEETS SPECIFICATIONS

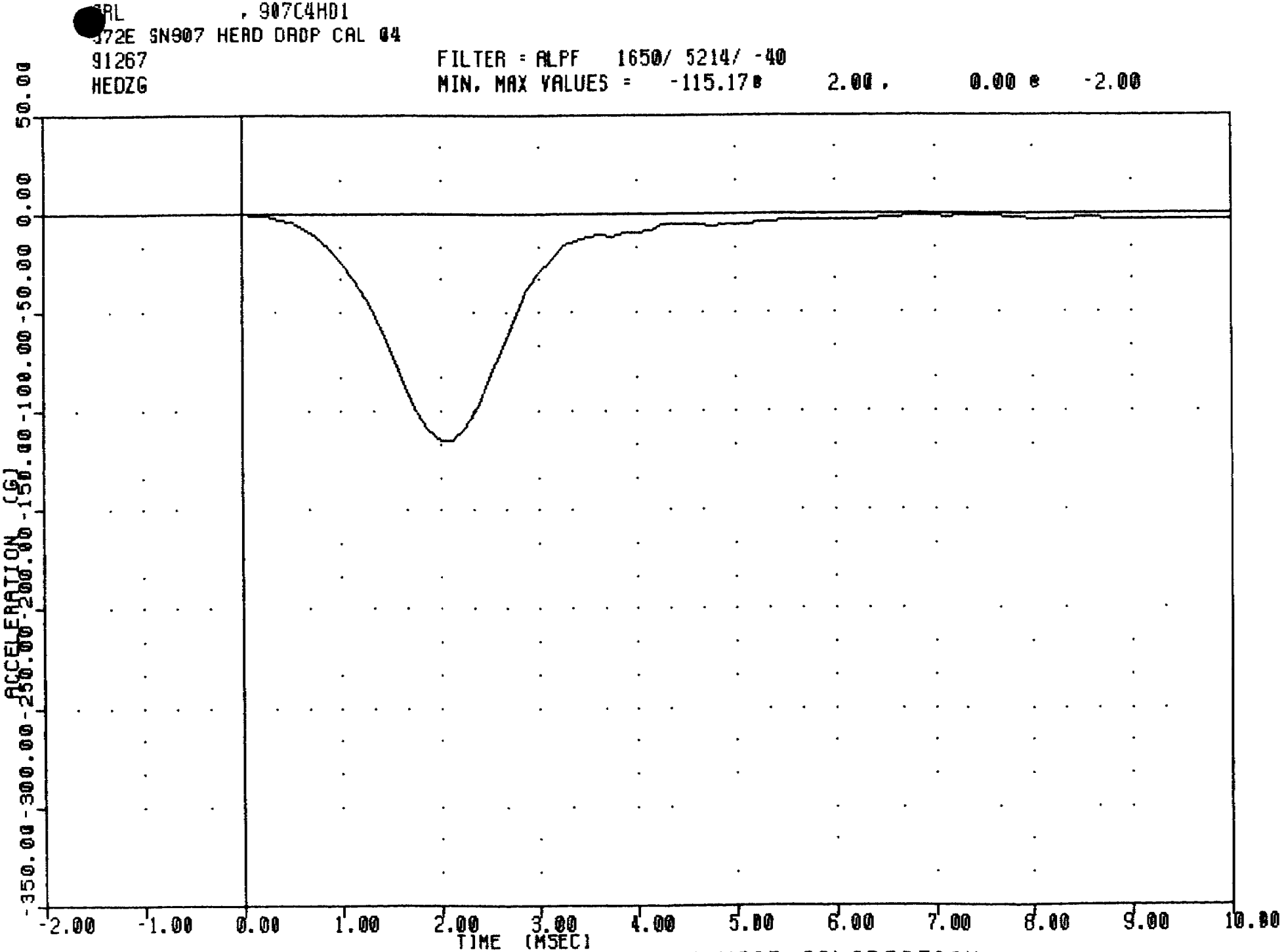
TECHNICIAN Chas. Middlet



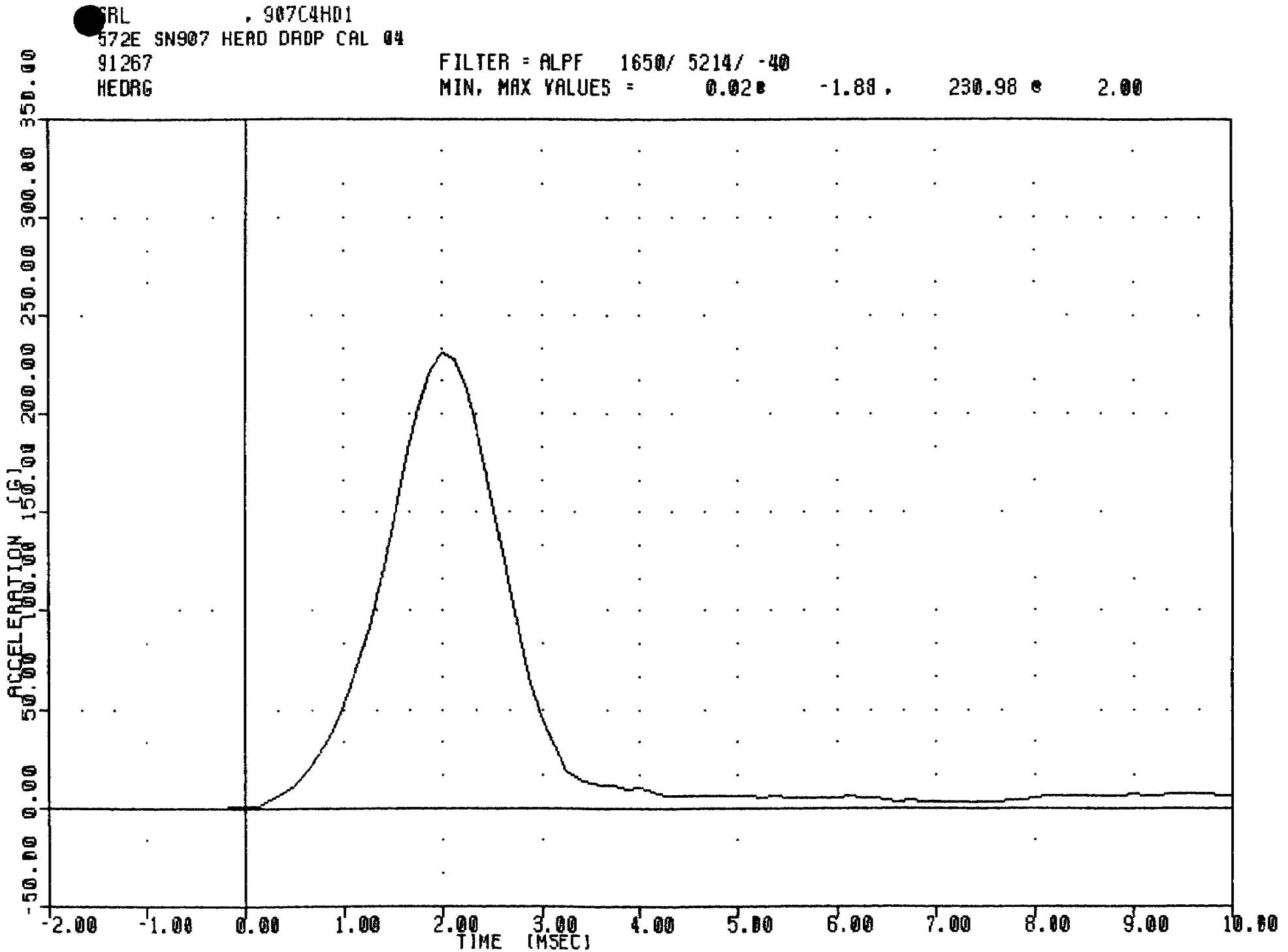
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS



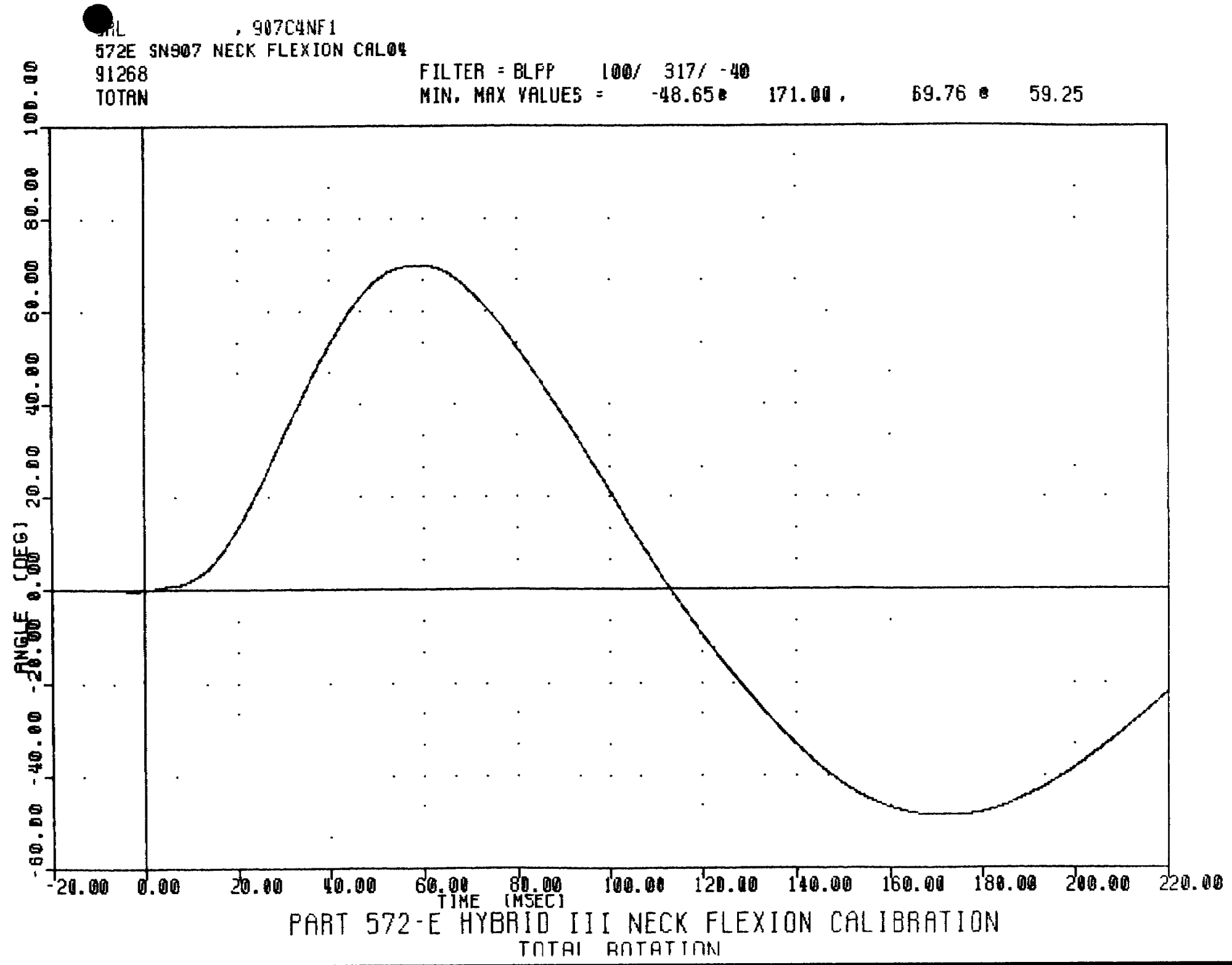
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

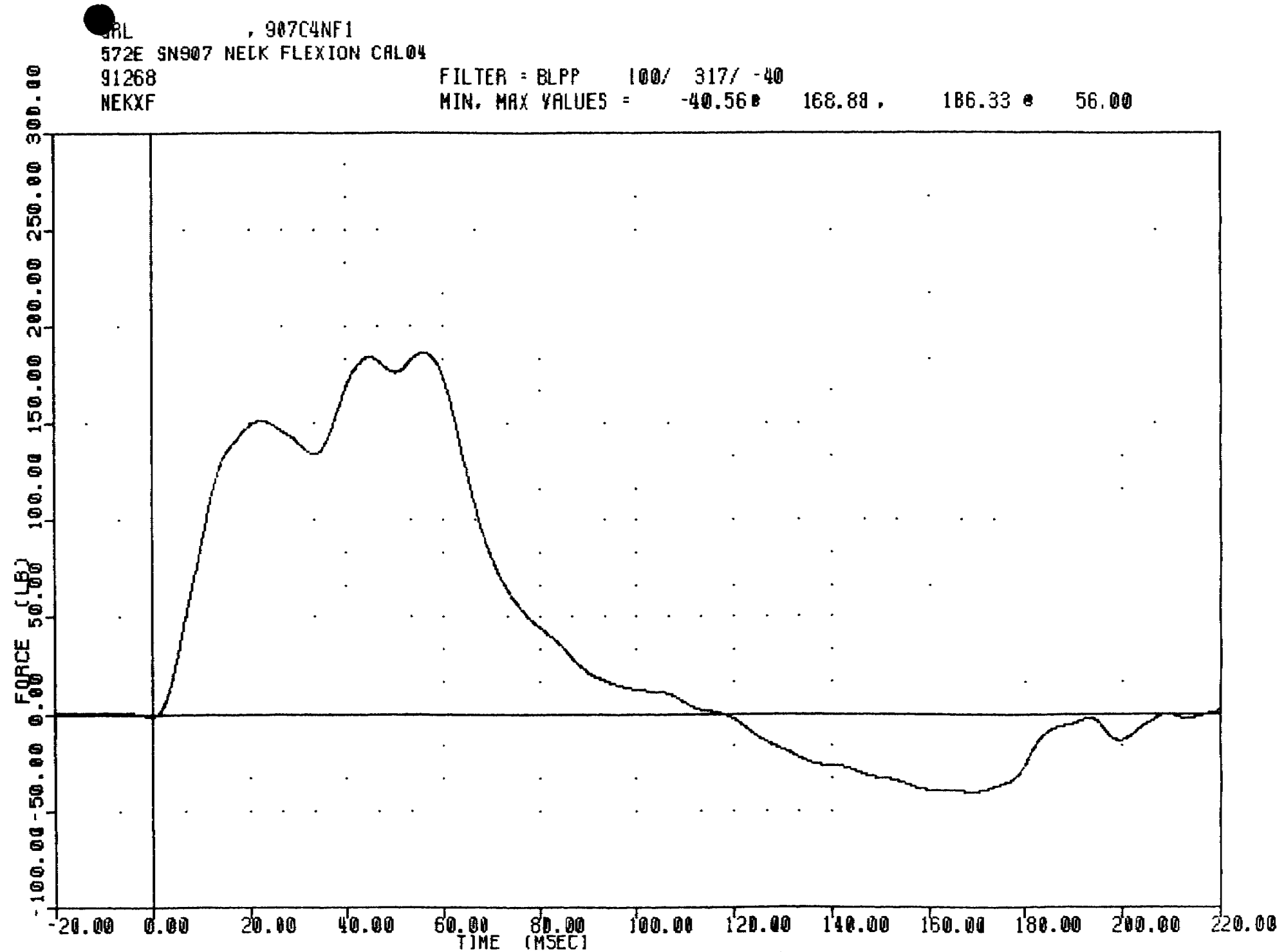


PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS



PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

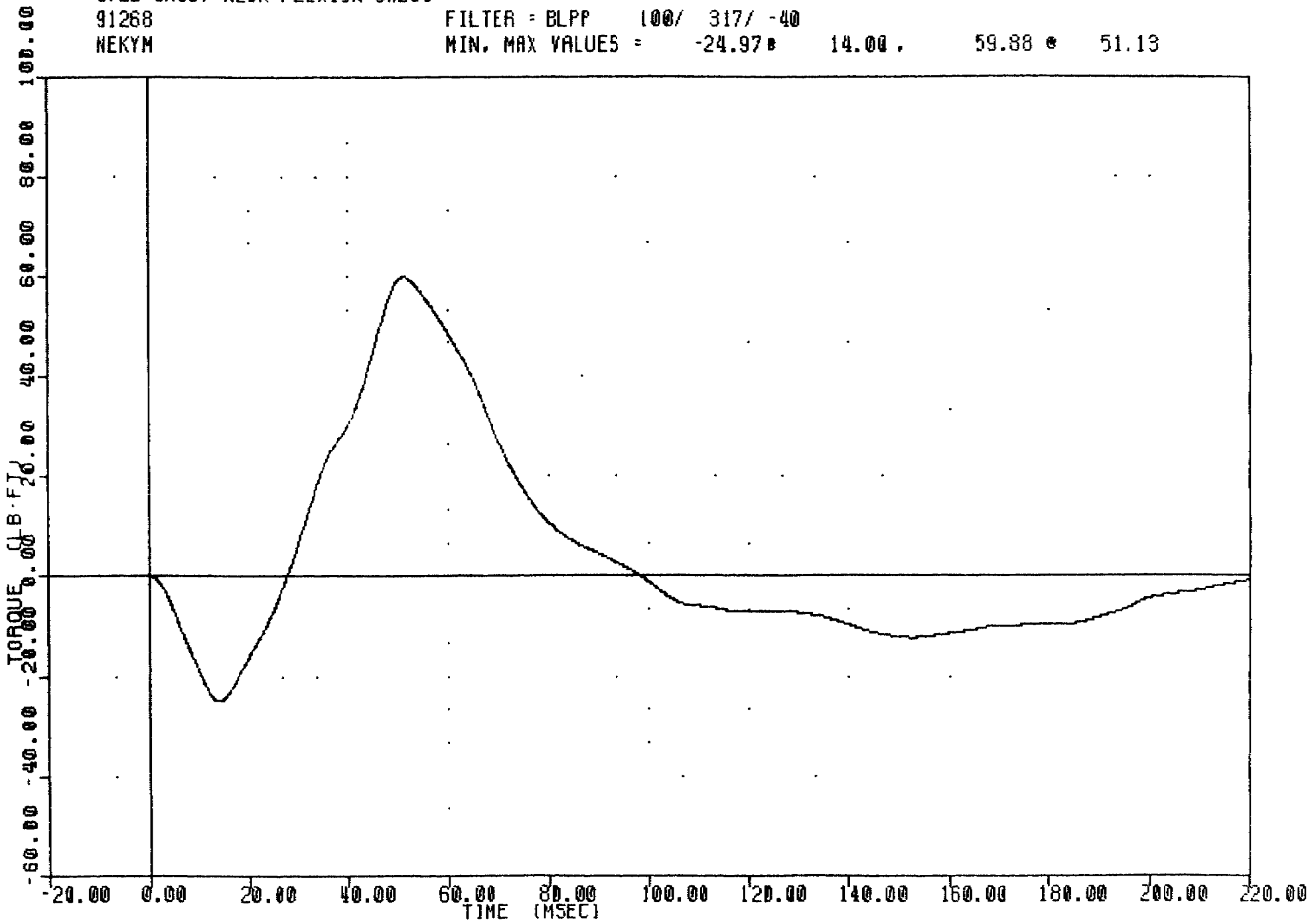

, 907C4NF1
572E SN907 NECK FLEXION CAL04
91268
TOTAN
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -48.65 @ 171.00 , 69.76 @ 59.25
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
-60.00
ANGLE [DEG]
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL ROTATION



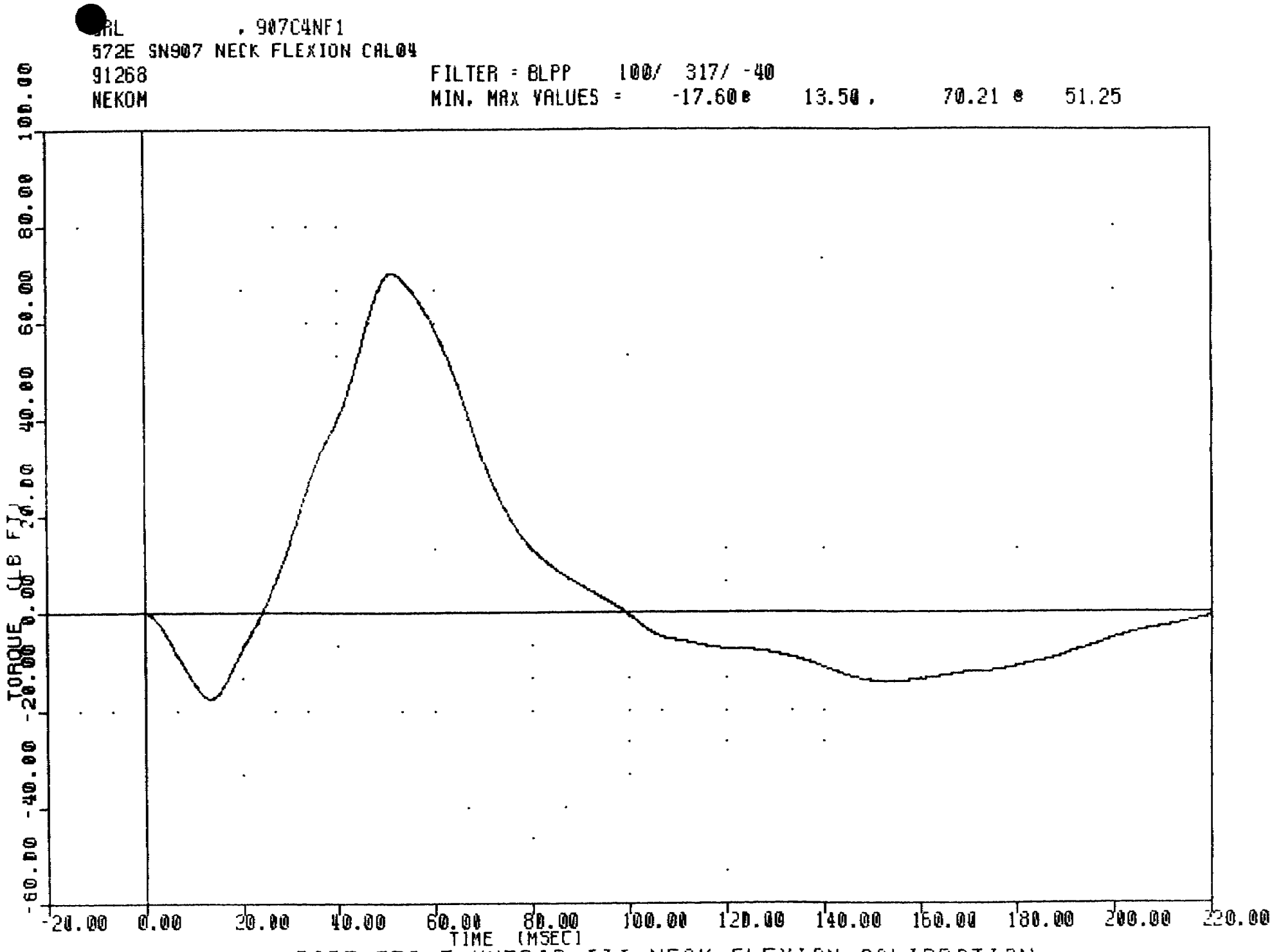
PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

SRL , 907C4NF1
572E SN907 NECK FLEXION CAL04
91268 FILTER = BLPP 100/ 317/ -40
NEKYM MIN. MAX VALUES = -24.97 @ 14.00 , 59.88 @ 51.13



PART 572-E HYBRID III NECK FLEXION CALIBRATION
NECK MOMENT Y AXIS



PART 572-E HYBRID III NECK FLEXION CALIBRATION

TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK EXTENSION TEST

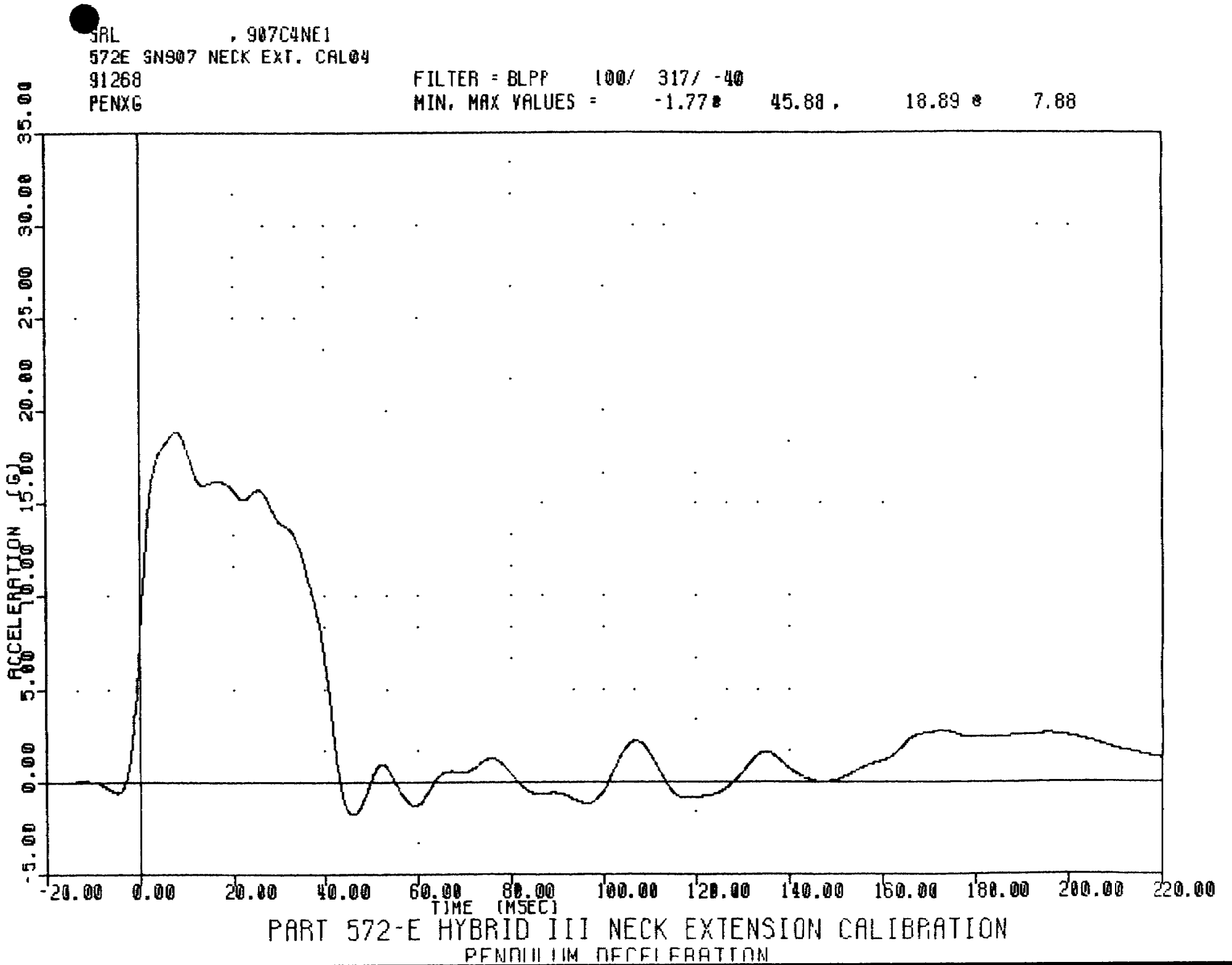
HYBRID III 25-Sep-91

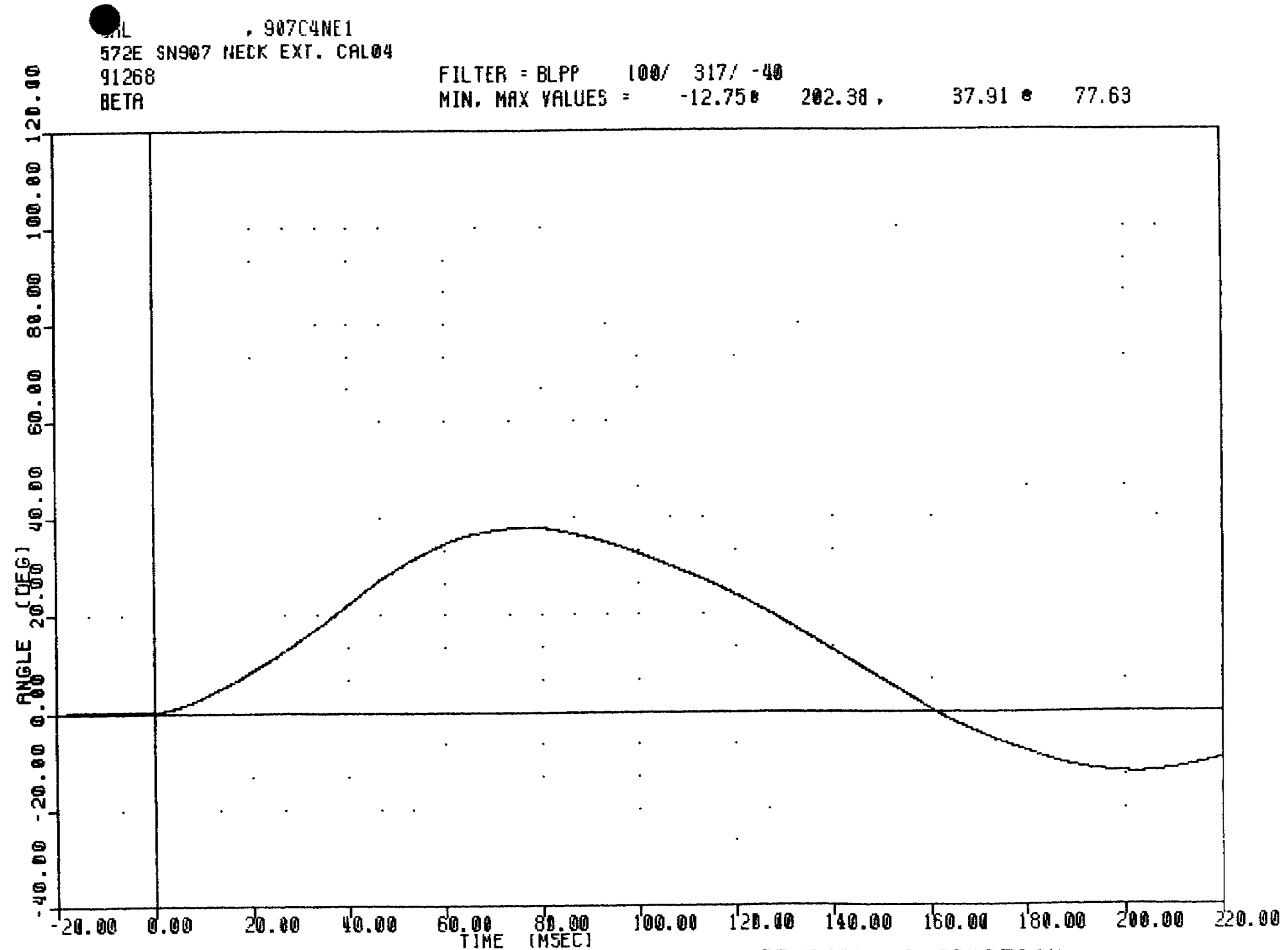
6 AXIS NECK TRANSDUCER
SRL 907C4NE1 572E SN907 NECK EXT. CAL04

TEST PARAMETER		SPECIFICATION	TEST RESULTS
TEMPERATURE		69 - 72 DEG. F	70.00 DEG. F
RELATIVE HUMIDITY		10% - 70%	54.00 %
IMPACT VELOCITY		19.50-20.30 FT/SEC	19.83 FT/SEC
PENDULUM DECELERATION	10 MS	17.20 - 21.20 G	17.98 G
	20 MS	14.00 - 19.00 G	15.77 G
	30 MS	11.00 - 16.00 G	14.05 G
MAX PENDULUM G ABOVE 30 MS		22 G MAX	14.02 G
DECELERATION-TIME CURVE DECAY TIME TO 5 G		38 - 46 MS	40.63 MS
D PLANE ROTATION	MAX	81 - 106 DEG.	96.34 DEG.
	TIME	72 - 82 MS	78.25 MS
MOMENT ABOUT OCCIPITAL CONDYLE	MIN	-59.0/-39.0 FT.LBS	-43.47 FT.LBS
	TIME	65 - 79 MS	72.13 MS
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 - 174 MS	160.25 MS
NEGATIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 - 148 MS	140.13 MS

TEST MEETS SPECIFICATIONS

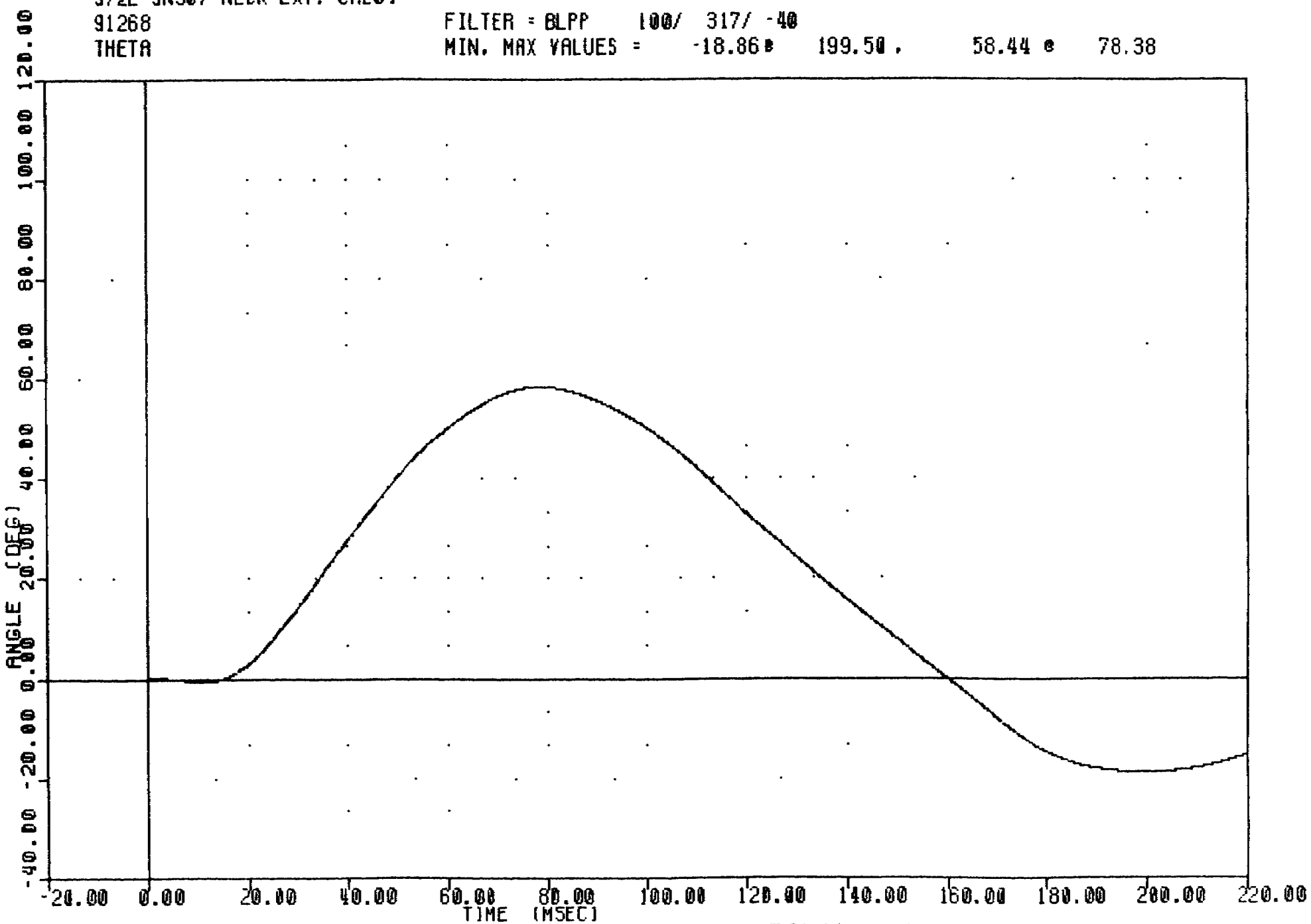
TECHNICIAN Chas. Middlet


SRL , 907C4NE1
572E SN907 NECK EXT. CAL04
91268
PENXG
FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -1.77 @ 45.88 , 18.89 @ 7.88
ACCELERATION (G)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION



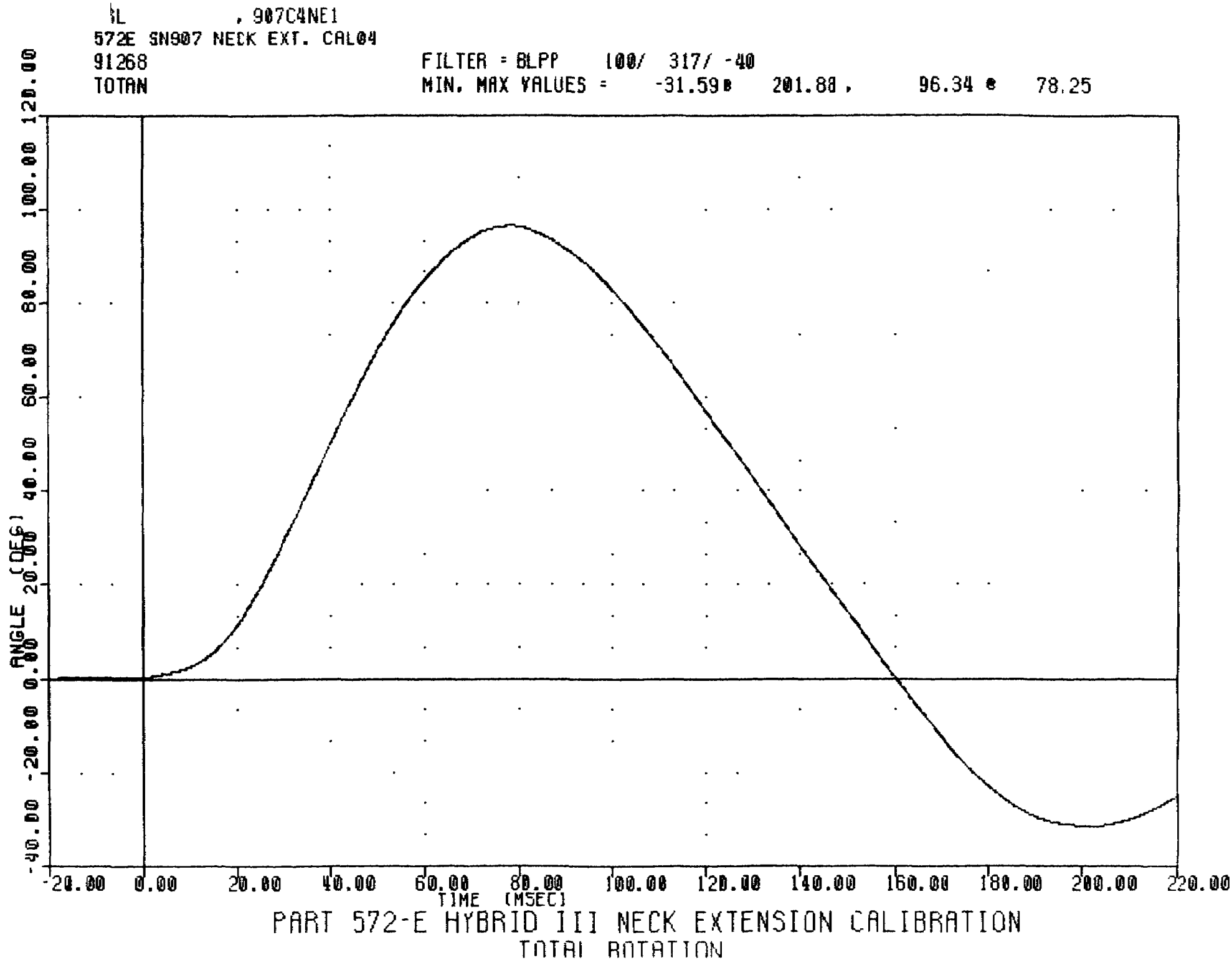
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

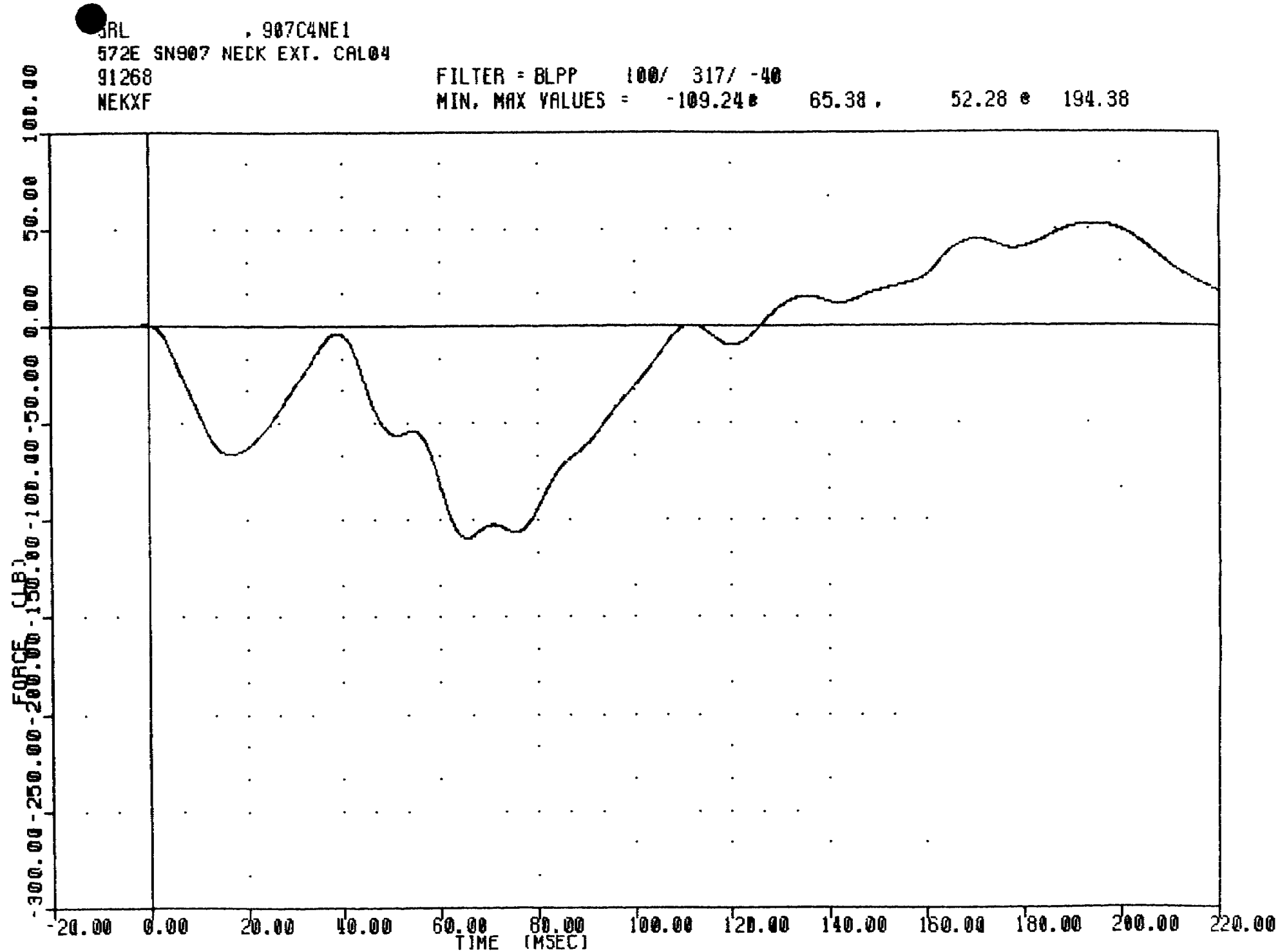
ROTATION ABOUT BASE OF NECK



PART 572-E HYBRID III NECK EXTENSION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

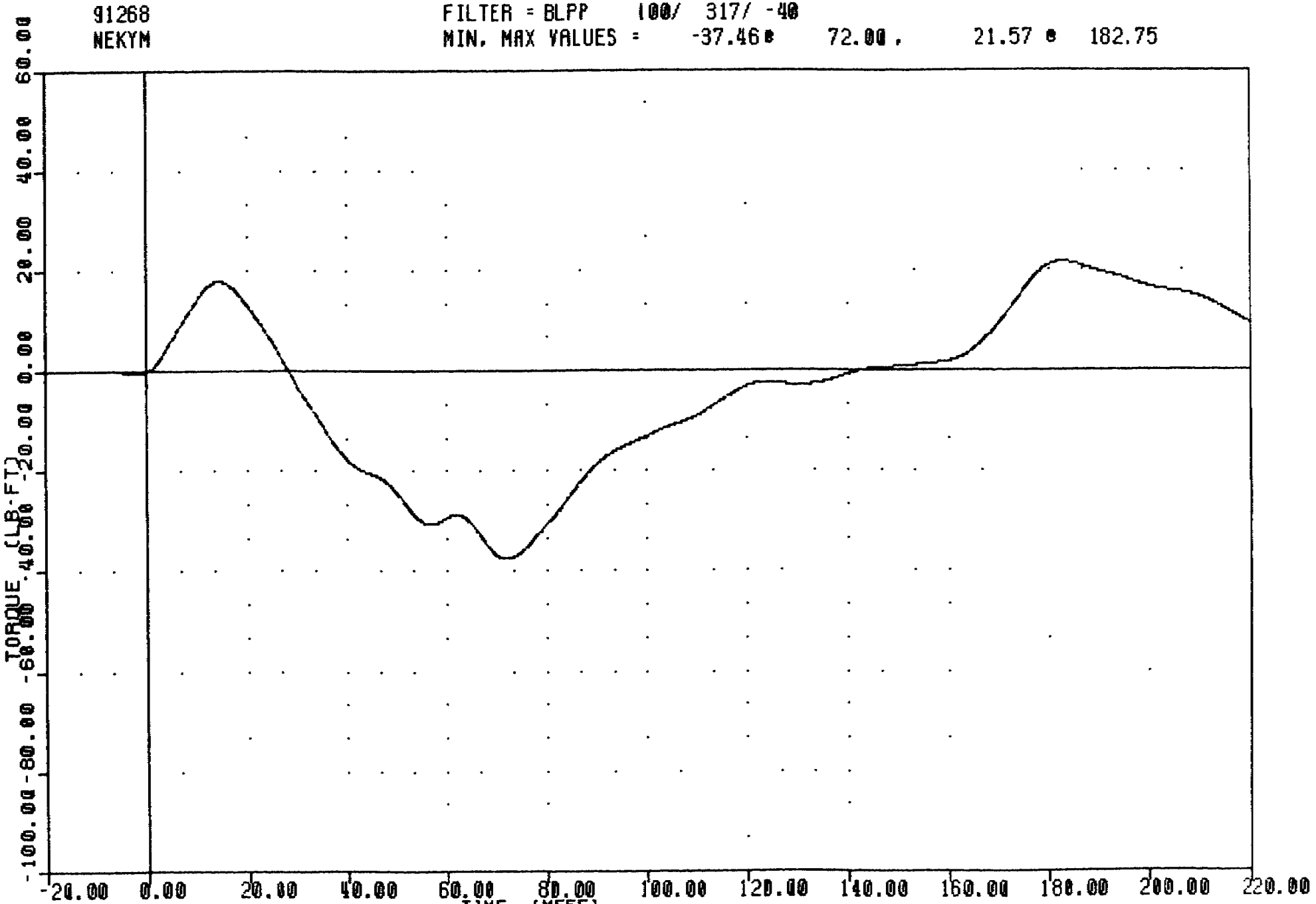

SL , 907C4NE1
572E SN907 NECK EXT. CAL04
91268
TOTAN
FILTER = BLPP 100/ 317/ -40
MIN. MAX VALUES = -31.59 201.88 96.34 78.25
120.00
100.00
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
ANGLE (DEG)
-20.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
220.00
TIME (MSEC)
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION



PART 572-E HYBRID III NECK EXTENSION CALIBRATION

NECK FORCE X AXIS

JRL , 907C4NE1
572E SN907 NECK EXT. CAL04
91268 FILTER = BLPP 100/ 317/ -40
NEKYM MIN, MAX VALUES = -37.46 @ 72.00 , 21.57 @ 182.75

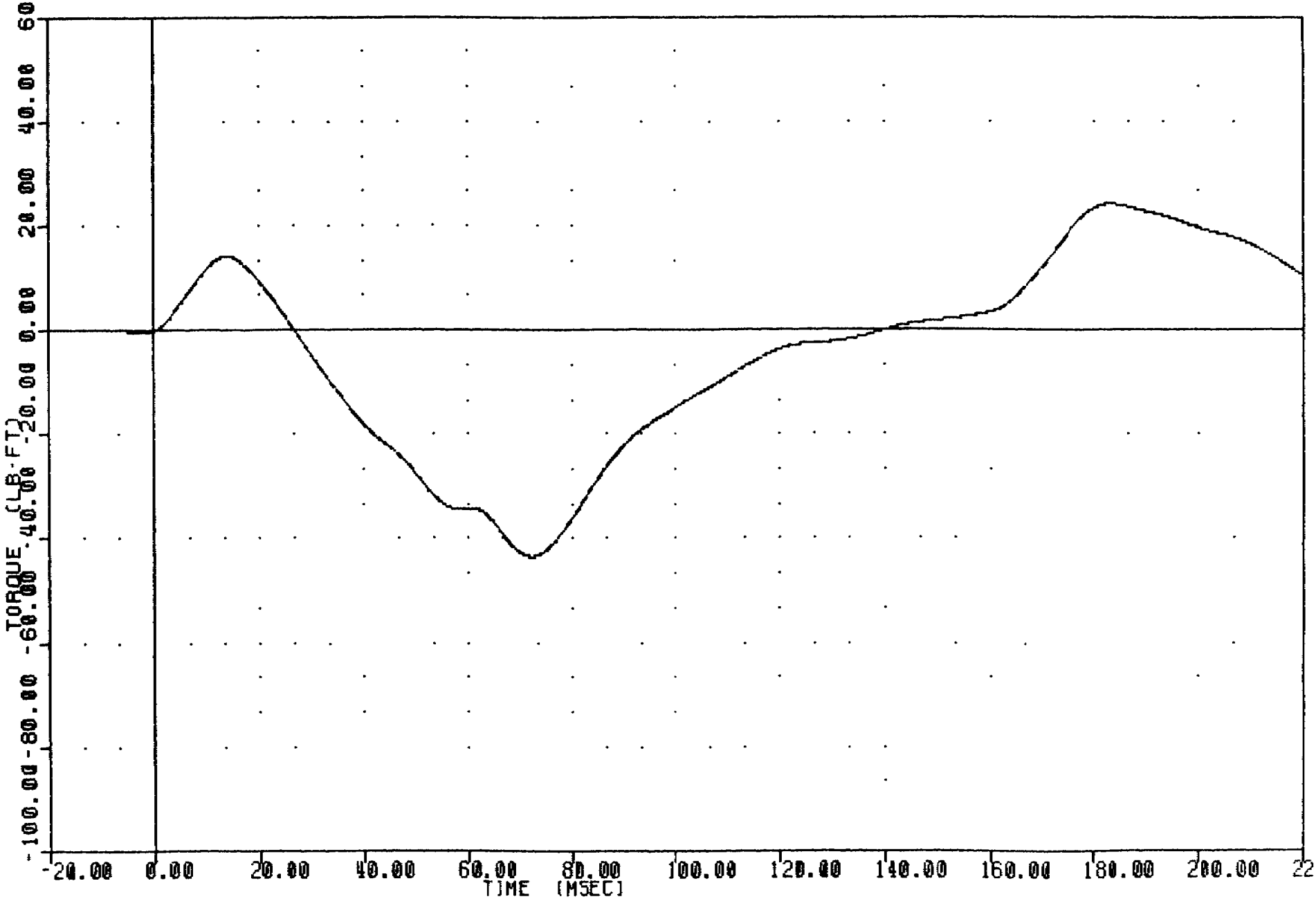


PART 572-E HYBRID III NECK EXTENSION CALIBRATION

NECK MOMENT Y BYTS

SRL , 907C4NE1
572E SN907 NECK EXT. CAL04
91268
NEKOM

FILTER = BLPP 100/ 317/ -40
MIN, MAX VALUES = -43.47 @ 72.13 , 24.09 @ 183.25



PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

HYBRID III 26-Dec-91

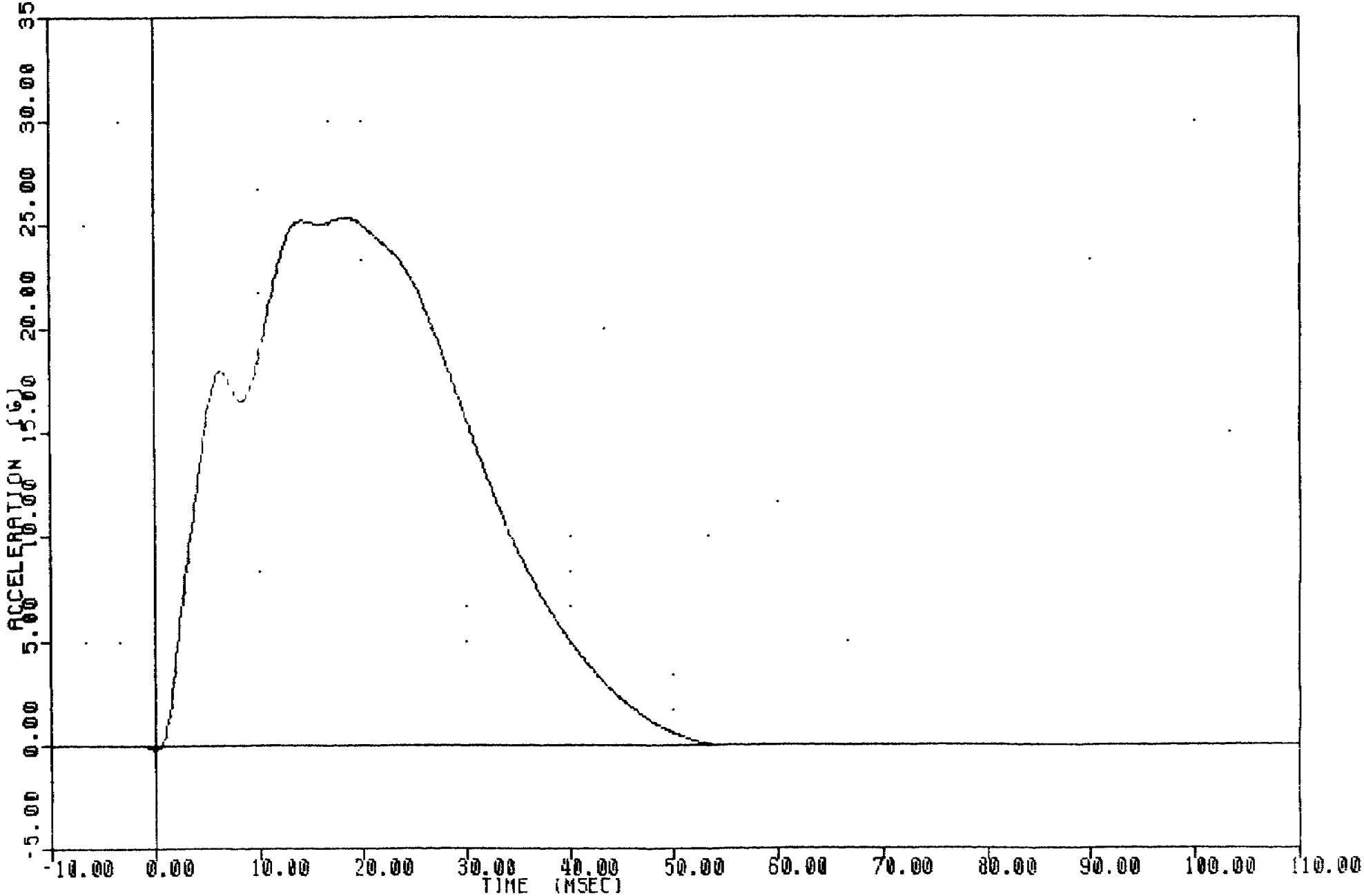
SRL 907C4TH1 5'2F 3N907 H.3.THORAX CAL04

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
TEMPERATURE	69 - 72 DEG. F	69.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	55.00 %
PENDULUM VELOCITY	21.6-22.4 FT/SEC	22.07 FT/SEC
MAXIMUM DEFLECTION	2.50 - 2.86 IN	2.51 IN
MAXIMUM RESISTIVE FORCE	1160 - 1325 LBS	1303.9 LBS
INTERNAL HYSTERESIS	69% - 85%	76.3%

TEST MEETS SPECIFICATIONS

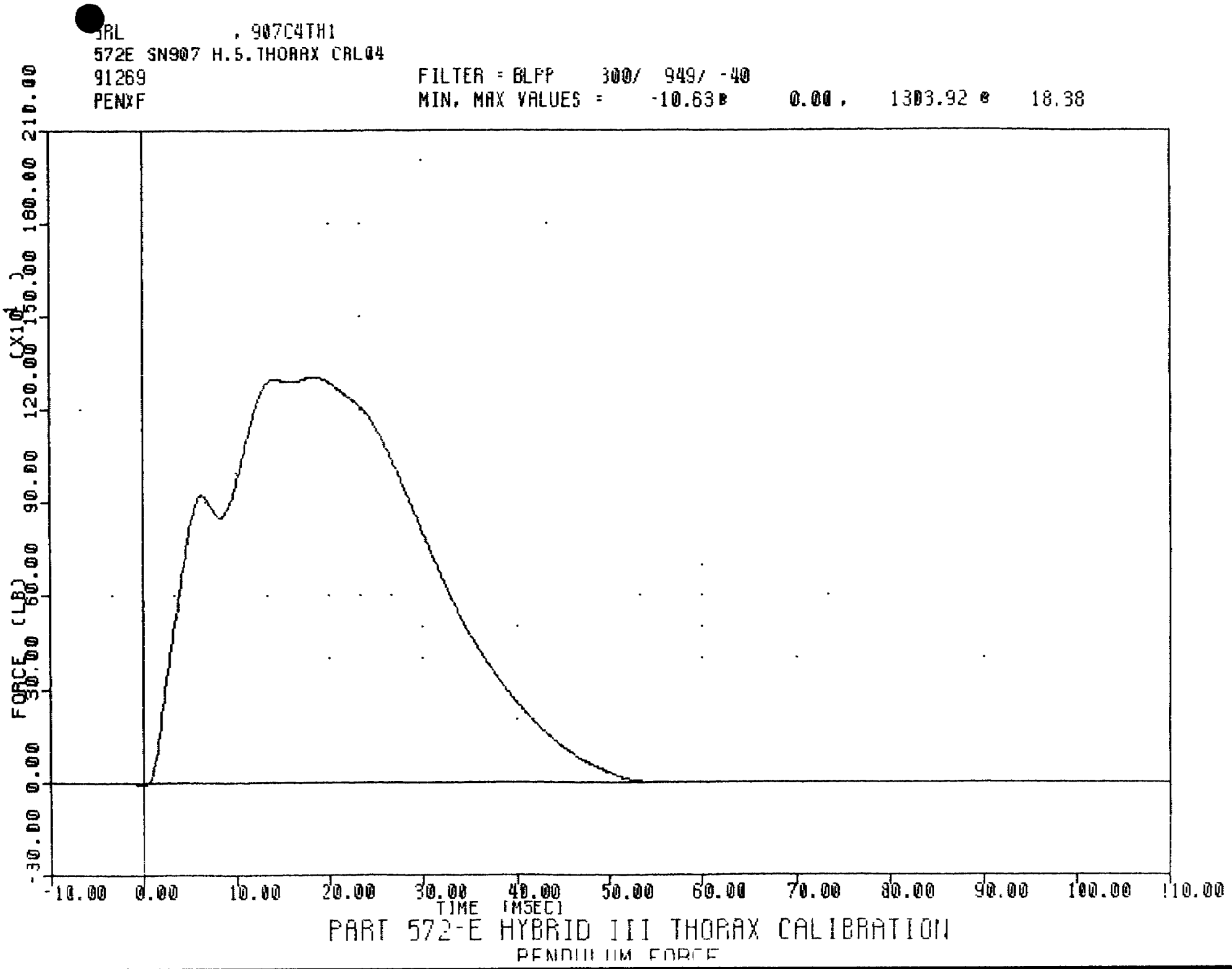
TECHNICIAN Chas. Middlet

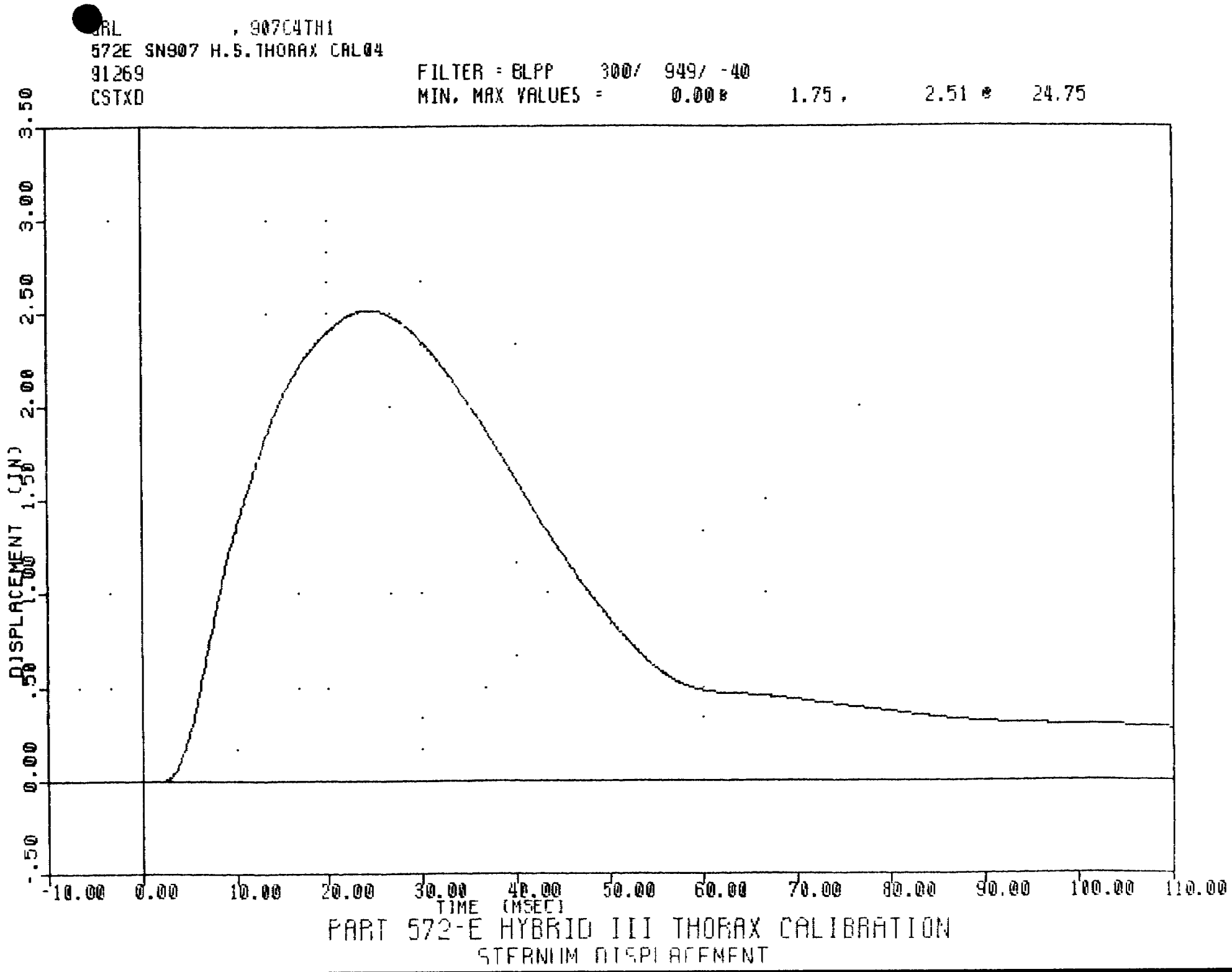
IRL , 907C4TH1
572E SN907 H.S.THORAX CAL04
91269 FILTER = BLPP 300/ 949/ -40
PENXG MIN, MAX VALUES = -0.21 @ 0.00 , 25.32 @ 18.38



PART 572-E HYBRID III THORAX CALIBRATION

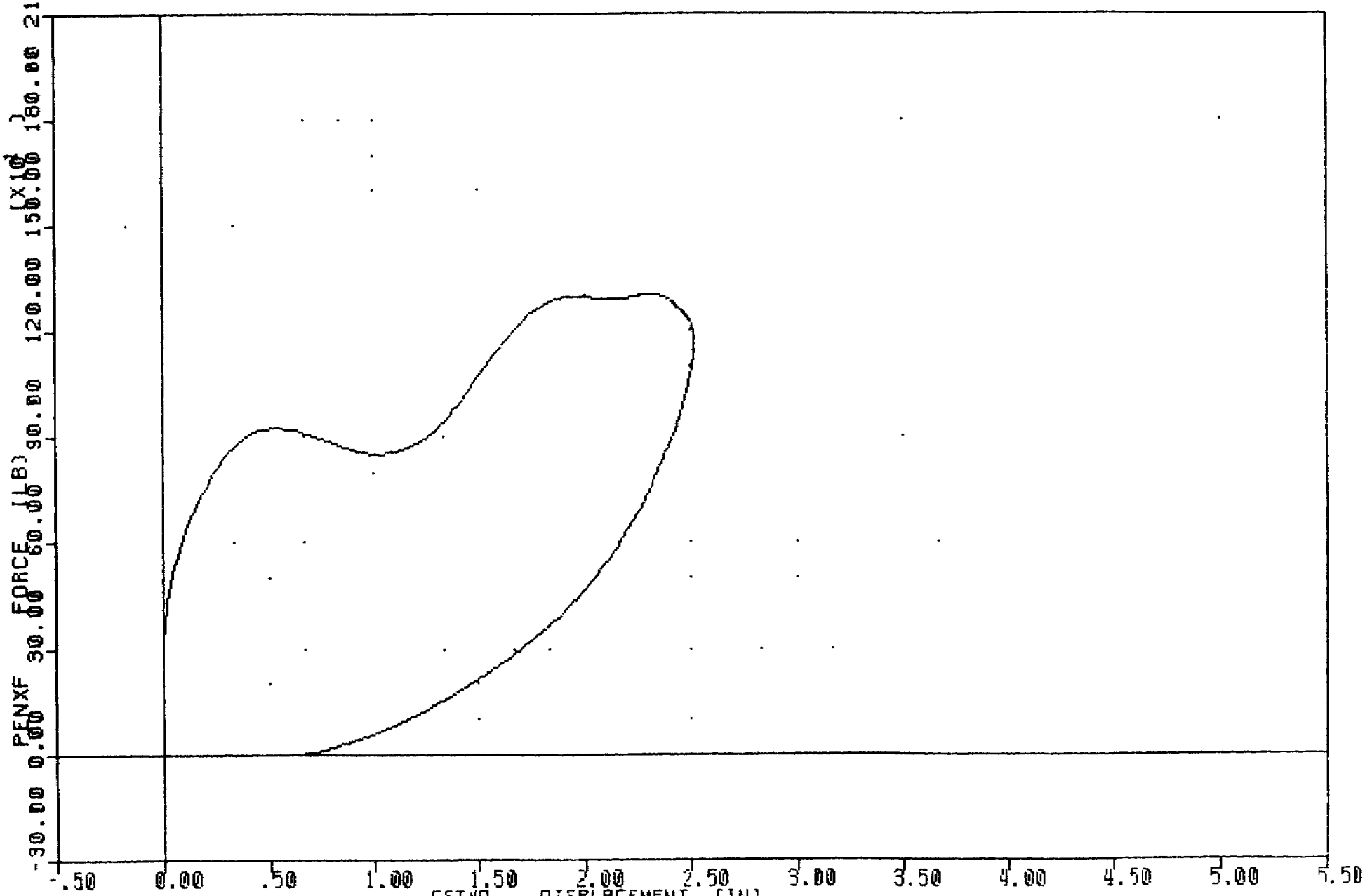
PENDULUM DECELERATION


IRL , 907C4TH1
572E SN907 H.5.THORAX CRL04
91269
PENXF
FILTER = BLPP 300/ 949/ -40
MIN, MAX VALUES = -10.63 @ 0.00 , 1303.92 @ 18.38
FORCE (LB) (X10)
-30.00 0.00 30.00 60.00 90.00 120.00 150.00 180.00 210.00
-10.00 0.00 10.00 20.00 30.00 40.00 50.00 60.00 70.00 80.00 90.00 100.00 110.00
TIME (MSEC)
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE


RL , 907C4TH1
572E SN907 H.S.THORAX CAL@4
91269
CSTXD
FILTER = BLPP 300/ 949/ -40
MIN, MAX VALUES = 0.00 @ 1.75 , 2.51 @ 24.75
DISPLACEMENT (IN)
3.50
3.00
2.50
2.00
1.50
1.00
.50
0.00
-.50
-10.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
110.00
TIME (MSEC)
PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT

SAL ,90704THL 572E SN907 H.S.THORAX CAL04 91269

CSTXD	FILTER = BLPP	300/	949/	-40	MIN, MAX =	0.00 @	1.75 ,	2.51 @	24.75
PENXF	FILTER = BLPP	300/	949/	-40	MIN, MAX =	-10.63 @	0.00 ,	1303.82 @	18.38



PART 572-E HYBRID III THORAX CALIBRATION

CHEST DISPLACEMENT VS PENDULUM FORCE

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

F/B&ID 111 24-Sep-91

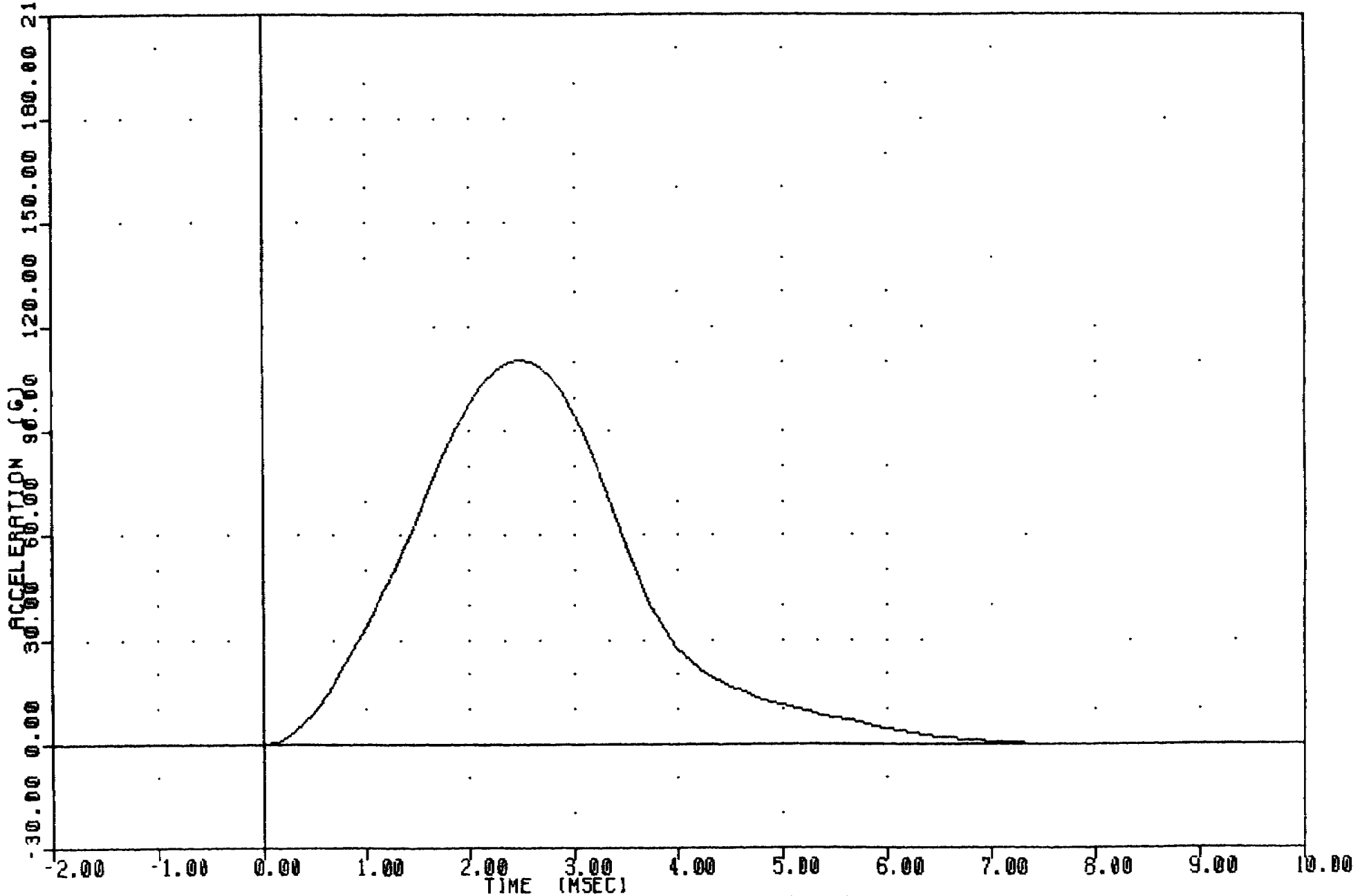
RIGHT KNEE
S&L 907C4RK1 572E SN907 F.KNEE 11LB CAL 04

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	69.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	54.00 %
PROBE VELOCITY	6.8 - 7.0 FT/SEC	6.87 FT/SEC
PEAK KNEE IMPACT FORCE	1060 - 1300 LBS	1214.05 LBS
PROBE WEIGHT	11.0 LBS	

TEST MEETS SPECIFICATIONS

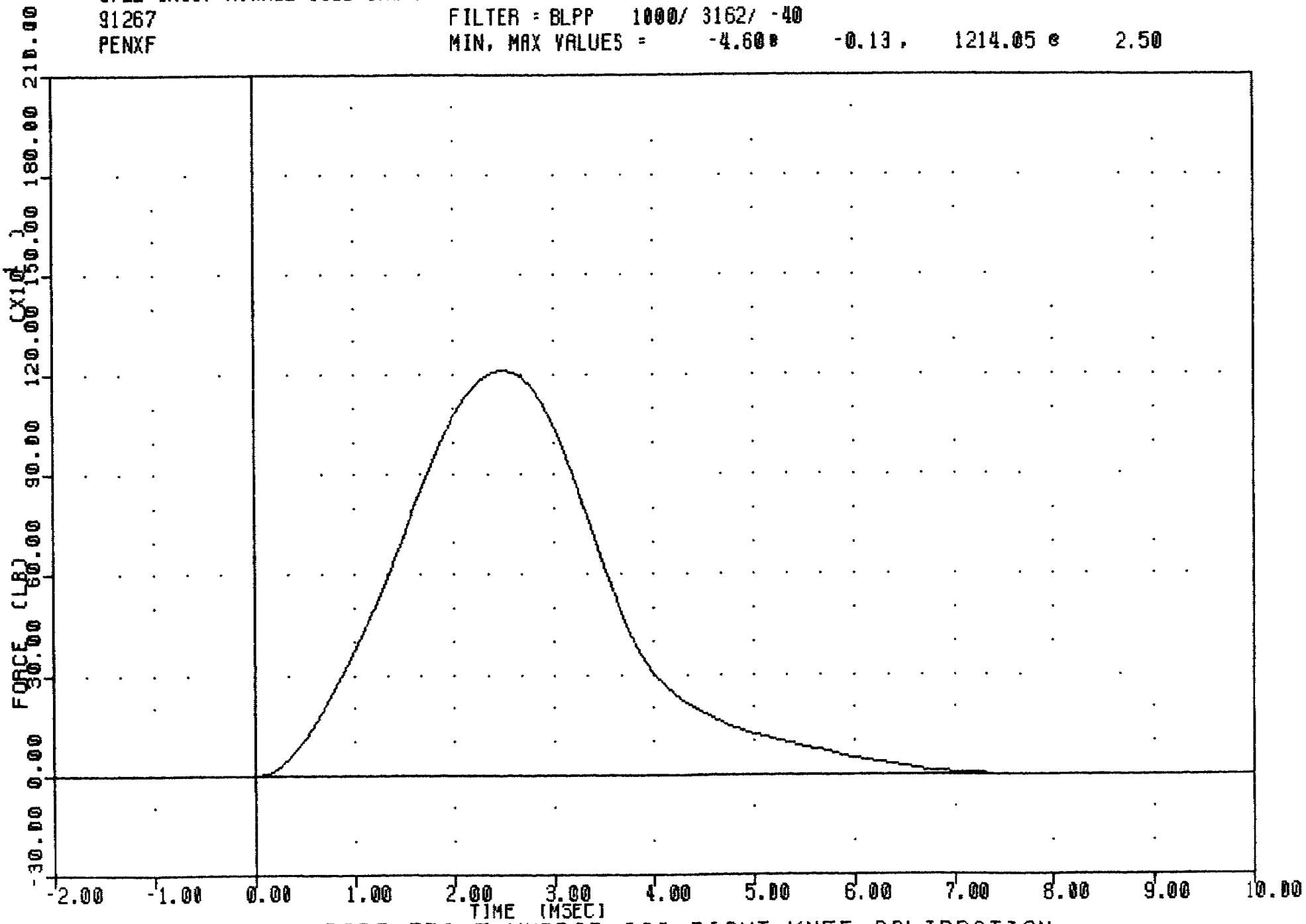
TECHNICIAN Chas. Middleton

SRL , 907C4RK1
572E SN907 R.KNEE 11LB CAL 04
91267
PENXG
FILTER = BLPP 1000/ 3162/ -40
MIN, MAX VALUES = -0.42 @ -0.13 , 110.37 @ 2.50



PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM ACCELERATION 11 LB PEND 1

RL , 907C4RK1
572E SN907 R.KNEE 11LB CAL 04
91267
PENXF
FILTER = BLPP 1000/ 3162/ -40
MIN, MAX VALUES = -4.60@ -0.13 , 1214.05 @ 2.50



PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (11 LB PEND.)

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

HYBRID III 24-Sep-91

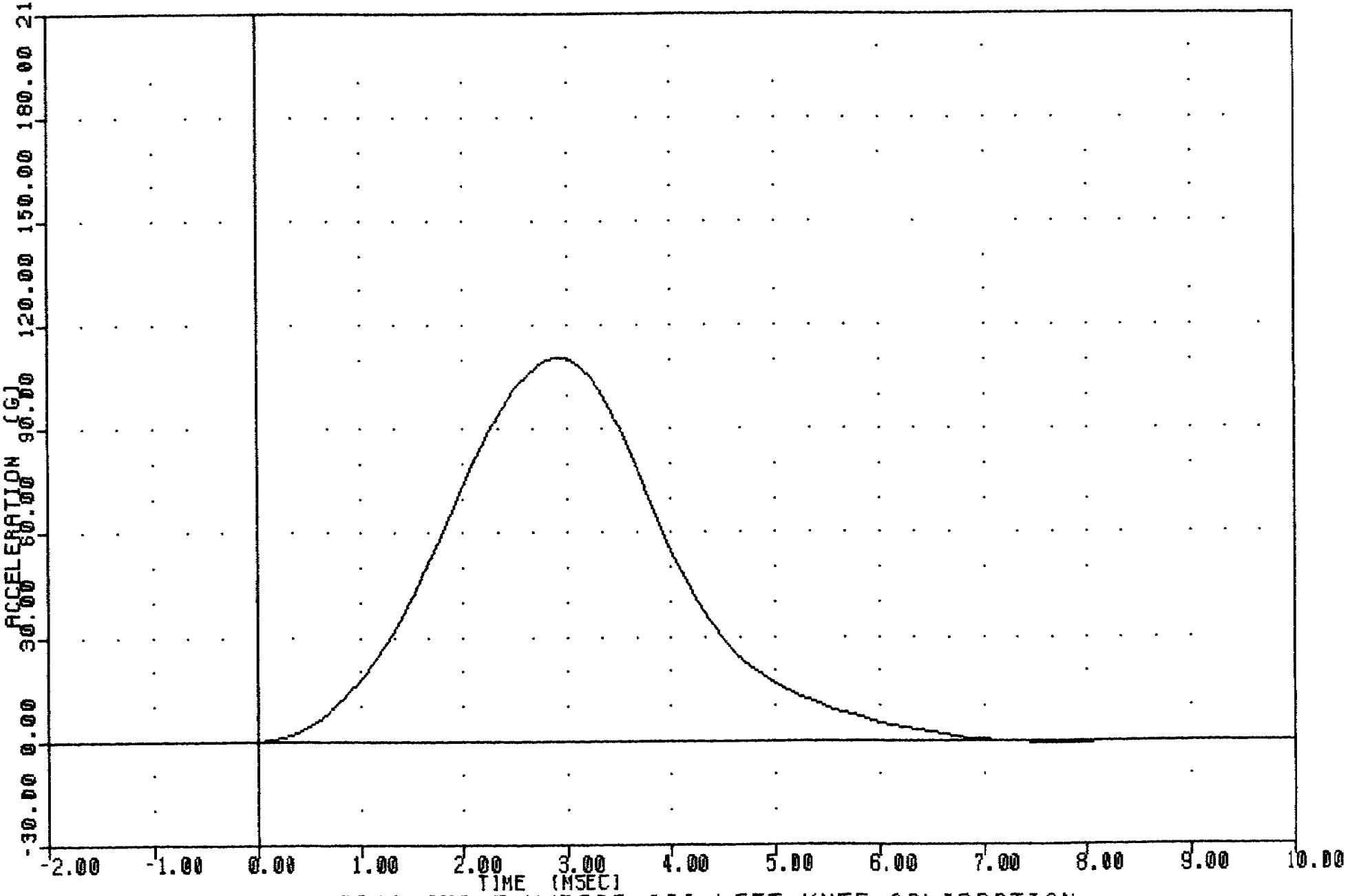
LEFT KNEE
SRL 907C4LK1 572E SN907 L.KNEE 11LB CAL 04

TEST PARAMETER	SPECIFICATION	TEST RESULTS
TEMPERATURE	66 - 78 DEG. F	69.00 DEG. F
RELATIVE HUMIDITY	10% - 70%	54.00 %
PROBE VELOCITY	6.8 - 7.0 FT/SEC	6.85 FT/SEC
PEAK KNEE IMPACT FORCE	1060 - 1300 LBS	1216.70 LBS
PROBE WEIGHT	11.0 LBS	

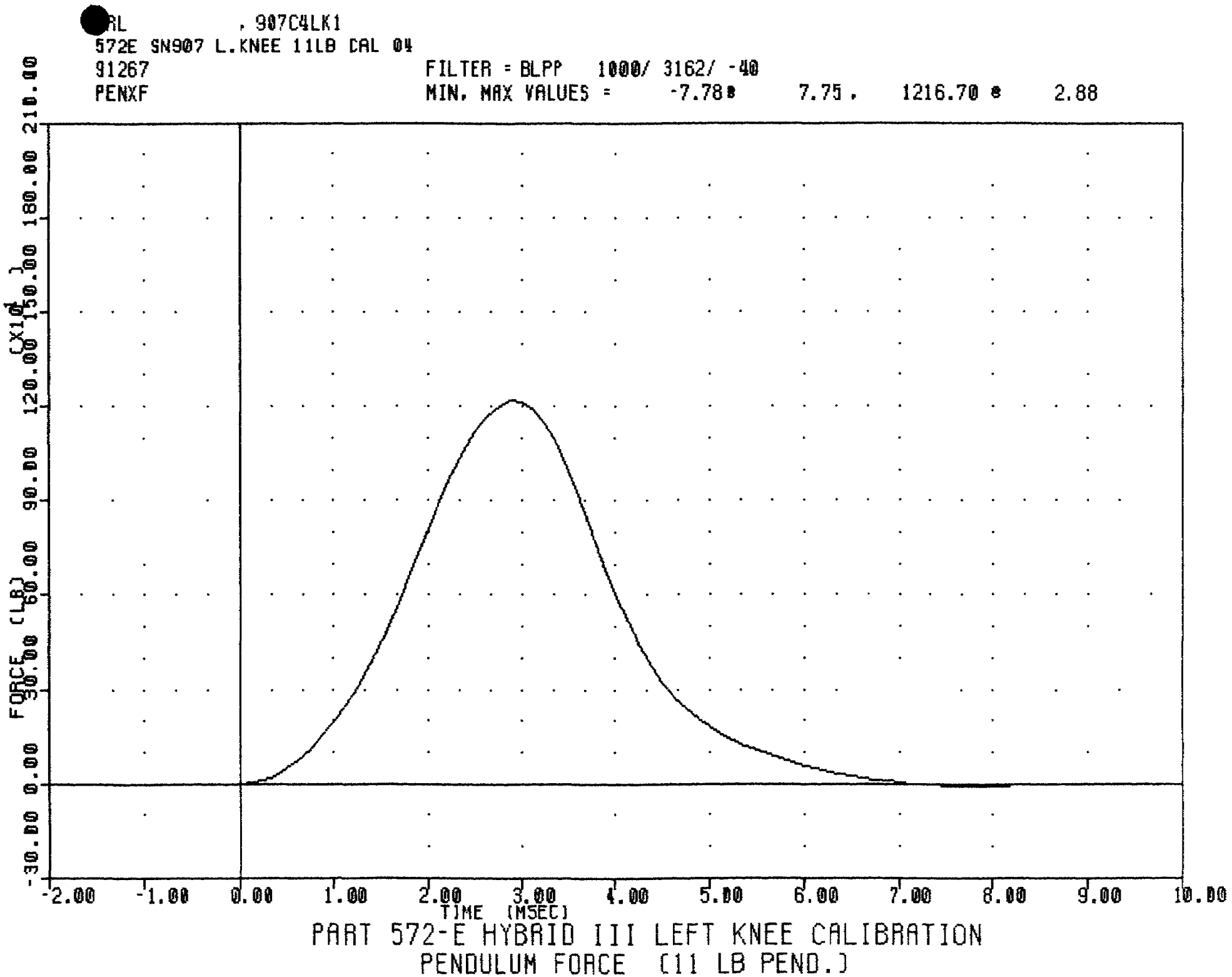
TEST MEETS SPECIFICATIONS

TECHNICIAN Chas Middleton

RL , 907C4LK1
572E SN907 L.KNEE 11LB CAL 04
91267 FILTER = BLPP 1000/ 3162/ -40
PENXG MIN. MAX VALUES = -0.71 @ 7.75 , 110.61 @ 2.88



PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (11 LB PEND.)


RL , 907C4LK1
572E SN907 L.KNEE 11LB CAL 04
91267
PENXF
FILTER = BLPP 1000/ 3162/ -40
MIN. MAX VALUES = -7.78 7.75 1216.70 2.88
FORCE (LB) (X10)
-30.00 0.00 30.00 60.00 90.00 120.00 150.00 180.00 210.00
-2.00 -1.00 0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.00
TIME (MSEC)
PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (11 LB PEND.)

APPENDIX D

MISCELLANEOUS TEST INFORMATION

DUMMY INSTRUMENTATION PLACEMENT

DUMMY MANUFACTURER & S/N: HUMANOID #907

SEATING POSITION: DRIVER

LOCATION	AXIS	MFR	MODEL	S/N	ORIENTATION (+ SENSING)
HEAD ACCELERATION	X	ENDEVCO	7264	FG97J	FRONT
HEAD ACCELERATION	Y	ENDEVCO	7264	FF79J	LEFT
HEAD ACCELERATION	Z	ENDEVCO	7264	FF73J	UP
NECK FORCE	X	DENTON	1716	0106-FX	**
NECK FORCE	Y	DENTON	1716	0106-FY	**
NECK FORCE	Z	DENTON	1716	0106-FZ	**
NECK MOMENT	X	DENTON	1716	0106-MX	**
NECK MOMENT	Y	DENTON	1716	0106-MY	**
NECK MOMENT	Z	DENTON	1716	0106-MZ	**
CHEST ACCELERATION	X	ENDEVCO	7264	FG28J	FRONT
CHEST ACCELERATION	Y	ENDEVCO	7264	FG43J	LEFT
CHEST ACCELERATION	Z	ENDEVCO	7264	FC43J	UP
CHEST DISPLACEMENT		VERNITECH	81422-A	CP56	OUTWARD
PELVIS ACCELERATION	X	ENDEVCO	7264	BC20J	REAR
PELVIS ACCELERATION	Y	ENDEVCO	7264	FG33J	RIGHT
PELVIS ACCELERATON	Z	ENDEVCO	7264	FC60J	UP

**See SIGN CONVENTION sheet for positive sensing orientation of neck load channels

VEHICLE INSTRUMENTATION PLACEMENT

LOCATION	AXIS	MFR	MODEL	S/N	ORIENTATION (+ SENSING)
CENTER OF GRAVITY ACCEL	X	ENDEVCO	7264	BP34J	FRONT
CENTER OF GRAVITY ACCEL	Y	ENDEVCO	7264	CH35H	LEFT
CENTER OF GRAVITY ACCEL	Z	ENDEVCO	7264	CJ60H	UP
CENTER OF GRAVITY ROLL	X	HUMPHREY	RG28-0128-1	H-14	RIGHT
CENTER OF GRAVITY PITCH	Y	HUMPHREY	RG28-0128-1	H-16	UP
CENTER OF GRAVITY YAW	Z	HUMPHREY	RG28-0128-1	H-21	LEFT
LEFT FRONT SUSPENSION					
DISPLACEMENT		CELESCO	PT-101-40A	A02465	OUTWARD
RIGHT FRONT SUSPENSION					
DISPLACEMENT		CELESCO	PT-101-40A	A128	OUTWARD
LEFT REAR SUSPENSION					
DISPLACEMENT		CELESCO	PT-101-50A	A12899	OUTWARD
RIGHT REAR SUSPENSION					
DISPLACEMENT		CELESCO	PT-101-40A	0586135	OUTWARD

ROLL CART INSTRUMENTATION PLACEMENT

LOCATION	AXIS	MFR	MODEL	S/N	ORIENTATION (+ SENSING)
CENTER OF GRAVITY	X	ENDEVCO	7264	CH46H	FRONT
CENTER OF GRAVITY	Y	ENDEVCO	7264	CJ66H	RIGHT
CENTER OF GRAVITY	Z	ENDEVCO	7264	CM07H	UP
LEFT CYLINDER DISPLACEMENT		CELESCO	PT-101-60A	A23305	UP
RIGHT CYLINDER DISPLACEMENT		CELESCO	PT-101-60A	A23306	UP

PRE-TEST

IPMD VEHICLE DATA SHEET

Filled Out By: B Dotson Date: 09/20/91

Checked By: _____ Date: _____

VEHICLE DATA

Vehicle Make and Model (written out): Volvo 240

NHTSA ID Code (7 characters) 91T323 /Model Year (2 digits): 91

Vehicle Make (2 characters): 20

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): 4S

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 (20 characters): YV1AA8242M1453692

Odometer Reading: 72 Thousands of Miles: _____

Overall Length: 189.3 (in) x 25.4 =: 4808 (mm)

Wheelbase: 104.2 (in) x 25.4 =: 2647 (mm)

Front Track: 56.5 (in) x 25.4 =: 1435 (mm)

Rear Track: 53.4 (in) x 25.4 =: 1356 (mm)

Roof Height: 57.4 (in) x 25 4 =: 1458 (mm)

PRE-TEST

IPMD VEHICLE DATA SHEET

G V W R.: 4030 (lbs) x 4.45 =: 17935 (N)

FRONT G.A W R · 1885 (lbs) x 4.45 =: 8388 (N)

REAR G A W.R · 2180 (lbs) x 4.45 =: 9701 (N)

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

Weight on RF Tire: 789 (lbs) x 4.45 =: 3511 (N)

Weight on LF Tire· 855 (lbs) x 4 45 =: 3805 (N)

Weight on LR Tire: 807 (lbs) x 4.45 =: 3591 (N)

Weight on RR Tire: 787 (lbs) x 4.45 =: 3502 (N)

Vehicle Test Weight: 3238 (lbs) x 4.45 =: 14409 (N)

Lateral and Longitudinal Center of Gravity Location

From Front Axle· 51 30 (in) x 25.4 =: 1303 (mm)

From Center Line: -0.75 (in) x 25.4 =: -19 (mm)

Engine Displacement· 141 (cu in) x 0.0164 =: 2.3 (L)

Engine Type (2 characters)· L4

L3 F4 L4

V4 F6 L6

V6 V8 RT = Rotary

L5 OT = Other:

Engine Location (1 character)· F

F = Front M = Mid R = Rear

Engine Orientation (1 character) L

L = Longitudinal T = Transverse

Transmission Type· (1 character) M

M = Manual A - Automatic

Drive Axle (1 character) R

F = Front R = Rear 4 Four Wheel Drive

Vehicle Comments (30 characters) tested at curb & driver pre-rollover

PRE-TEST
IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): _____

Front/Rear Flag (1 character): F

Axle Type (1 character): I

I = Independent S = Solid

Suspension Type (1 character): S

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

Spring Type (2 characters): CO

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

Brake Type (2 characters): DI

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

Suspension Modified (1 character): N

N = No Y = Yes

Suspension Modification

R = Raised L = Lowered
S = Stiffened W = Widened
O = Other 1 = _____
2 = _____

PRE-TEST
IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Tire Manufacturer (10 characters): Michelin

Tire Size Code (10 characters): 185/70R14

Tire Construction (2 characters): SB

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

Tire Rim width: 5.0 (in) X 25.4 =: 127 (mm)

Axle Height: 11.5 (in) X 25.4 =: 292 (mm)

Tire Pressure: 36.0 (psi) X 6.897 =: 248 (kpa)

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Suspension Number (4 digits): _____

Front/Rear Flag (1 character): R

Axle Type (1 character): S

I = Independent
S = Solid

Suspension Type (1 character): T

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
S = Stiffened
O = Other
L = Lowered
W = Widened
1 = _____
2 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): Michelin

Tire Size Code (10 characters): 185/70R14

Tire Construction (2 characters): SB

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

Tire Rim Width: 5.0 (in) X 25.4 =: 127 (mm)

Axle Height: 11.7 (in) X 25 4 =: 297 (mm)

Tire Pressure: 36.0 (psi) X 6.897 =: 248 (kpa)

IPMD MEASURED DATA

Distance between ramps (in): 46.00
String Pot Offset from platform center (in): 13

IPMD Calibration Check (no vehicle):

Applied Weight (lbs)	Schaevitz Output (Deg)	System C.G Pivot
0	-0 05	0.00
+100	-5.34	32.73
+200	-10.55	32.79
0	-0 05	0 00
-100	5 23	32.85
-200	10.40	32.96
0	-0.04	0.00

Average System C.G. Pivot (in): 32.84

C.G. HEIGHT:

Applied Weight (lbs.)	Schaevitz Output (Deg.)	Resultant Longitudinal Movement (mv)	Individual C.G. Values
0	-0 57	0.000	0.00
+100	-3.88	0.058	22.36
+200	-7.23	0.144	22.35
0	-0 65	0.034	0.00
-100	2 70	-0.049	22.27
-200	6 05	-0.132	22.31
0	-0 56	-0.015	0.00

Calculated C.G. Height (in) 22.32

IPMD MEASURED DATA

Pitch Inertia:

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Pitch Calcu. (Ft Lb Sec^2)
1	3.875	10.37	0.162	1897 2
2	3 875	9.71	0.150	1898 0
3	3 870	9.74	0.147	1893 1

Pitch Inertia (ft. lb sec^2): 1896.1

Roll Inertia·

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Roll Calcu. (Ft Lb Sec^2)
1	2.350	8.80	0.102	355.8
2	2.345	8.94	0.104	351 4
3	2.345	8.91	0.103	351.6

Roll Inertia (ft. lb. sec^2)· 352.9

Yaw Inertia:

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Yaw Calcu (Ft Lb Sec^2)
1	2.430	10.97	0.12	1962.6
2	2.440	9 87	0.10	1983.1
3	2.435	10 03	0.10	1973.0

Yaw Inertia (ft. lb. sec^2): 1972.9

POST-TEST

IPMD VEHICLE DATA SHEET

Filled Out By: B. Dotson Date: 10/09/91

Checked By: _____ Date: _____

VEHICLE DATA

Vehicle Make and Model (written out): Volvo 240

NHTSA ID Code (7 characters): 91T3271 /Model Year (2 digits): 91

Vehicle Make (2 characters) 20

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): 4S

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 (20 characters): YV1AA8242M1453692

Odometer Reading: 75 Thousands of Miles: _____

Overall Length: 189.3 (in) x 25.4 =: 4808 (mm)

Wheelbase: 104.5 (in) x 25.4 =: 2654 (mm)

Front Track: 56 5 (in) x 25.4 =: 1435 (mm)

Rear Track: 53.4 (in) x 25.4 =: 1356 (mm)

Roof Height: 50.0 (in) x 25.4 =: 1270 (mm)

POST-TEST

IPMD VEHICLE DATA SHEET

G V.W.R.: 4030 (lbs) x 4 45 =: 17935 (N)

FRONT G A.W R. 1885 (lbs) x 4.45 =: 8388 (N)

REAR G.A.W.R.: 2180 (lbs) x 4.45 =· 9701 (N)

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

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

Weight on LF Tire: 732 (lbs) x 4.45 =: 3257 (N)

Weight on LR Tire: 923 (lbs) x 4.45 =· 4107 (N)

Weight on RR Tire· 634 (lbs) x 4.45 =: 2821 (N)

Vehicle Test Weight: 3188 (lbs) x 4 45 =: 14187 (N)

Lateral and Longitudinal Center of Gravity Location.

From Front Axle: 51 03 (in) x 25.4 =: 1296 (mm)

From Center Line: -1.08 (in) x 25.4 =: 27 (mm)

Engine Displacement: 141 (cu in) x 0.0164 =: 2.3 (L)

Engine Type (2 characters)· L4

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

Engine Location (1 character). F

F = Front M = Mid R = Rear

Engine Orientation (1 character): L

L = Longitudinal T = Transverse

Transmission Type: (1 character)· M

M = Manual A = Automatic

Drive Axle (1 character)· R

F = Front R = Rear 4 = Four Wheel Drive

Vehicle Comments (30 characters) Curb & driver Post-rollover

POST-TEST
IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Suspension Number (4 digits): _____

Front/Rear Flag (1 character): __F__

Axle Type (1 character): __I__

I = Independent S = Solid

Suspension Type (1 character): _____

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

Spring Type (2 characters): __CO__

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

Brake Type (2 characters): __DI__

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

Suspension Modified (1 character): __N__

N = No Y = Yes

Suspension Modification

R = Raised L = Lowered
S = Stiffened W = Widened
O = Other 1 = _____
2 = _____

POST-TEST
IPMD VEHICLE DATA SHEET

FRONT SUSPENSION

Tire Manufacturer (10 characters): Michelin

Tire Size Code (10 characters): 185/70R14

Tire Construction (2 characters): SB

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

Tire Rim width: 5.0 (in) X 25.4 =: 127 (mm)

Axle Height: 11 5 (in) X 25.4 =: 292 (mm)

Tire Pressure: 36.0 (psi) X 6 897 =: 248 (kpa)

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Suspension Number (4 digits): _____

Front/Rear Flag (1 character): R

Axle Type (1 character): S

I = Independent
S = Solid

Suspension Type (1 character): T

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
S = Stiffened
O = Other
L = Lowered
W = Widened
1 = _____
2 = _____

IPMD VEHICLE DATA SHEET

REAR SUSPENSION

Tire Manufacturer (10 characters): Michelin

Tire Size Code (10 characters): 185/70R14

Tire Construction (2 characters): SB

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

Tire Rim Width: 5.0 (in) X 25 4 =: 127 (mm)

Axle Height: 11.7 (in) X 25.4 =: 297 (mm)

Tire Pressure: 36.0 (psi) X 6 897 =: 248 (kpa)

IPMD MEASURED DATA

Distance between ramps (in): 46.10

String Pot Offset from platform center (in): 13.00

IPMD Calibration Check (no vehicle):

Applied Weight (lbs)	Schaevitz Output (Deg.)	System C G Pivot
0	-0.12	0.00
+100	-5.40	32 81
+200	-10.58	32.91
0	-0.12	0.00
-100	5.14	32.95
-200	10.32	33.00
0	-0.12	0 00

Average System C G. Pivot (in): 32.92

C G. HEIGHT:

Applied Weight (lbs)	Schaevitz Output (Deg)	Resultant Longitudinal Movement (mv)	Individual C.G. Values
0	0 07	0.000	0.00
+100	-3.04	0.047	20.32
+200	-6.21	0.115	20.45
0	-0.02	0.026	0.00
-100	3.16	-0.028	20.45
-200	6.29	-0.084	20 41
0	-0.09	-0.005	0.00

Calculated C.G. Height (in): 20.41

IPMD MEASURED DATA

Pitch Inertia:

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Pitch Calcu (Ft Lb Sec²)
1	3 715	10 83	0.137	1795 8
2	3 715	10 74	0 138	1794.9
3	3.715	10 76	0 139	1794.6

Pitch inertia (ft. lb. sec²): 1795.1

Roll Inertia:

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Roll Calcu. (Ft Lb Sec²)
1	2.290	8.89	0.093	328 9
2	2.295	8.84	0.094	332.9
3	2.290	9.01	0.096	328 6

Roll Inertia (ft. lb. sec²): 330.1

Yaw Inertia:

Run	Period (sec)	Platform Motion Amplitude (Deg)	Relative Motion Amplitude (In.)	Individual Yaw Calcu. (Ft Lb Sec²)
1	2.385	10 35	0.09	1880 4
2	2 385	10 14	0.09	1880.7
3	2.390	9.52	0.08	1890.2

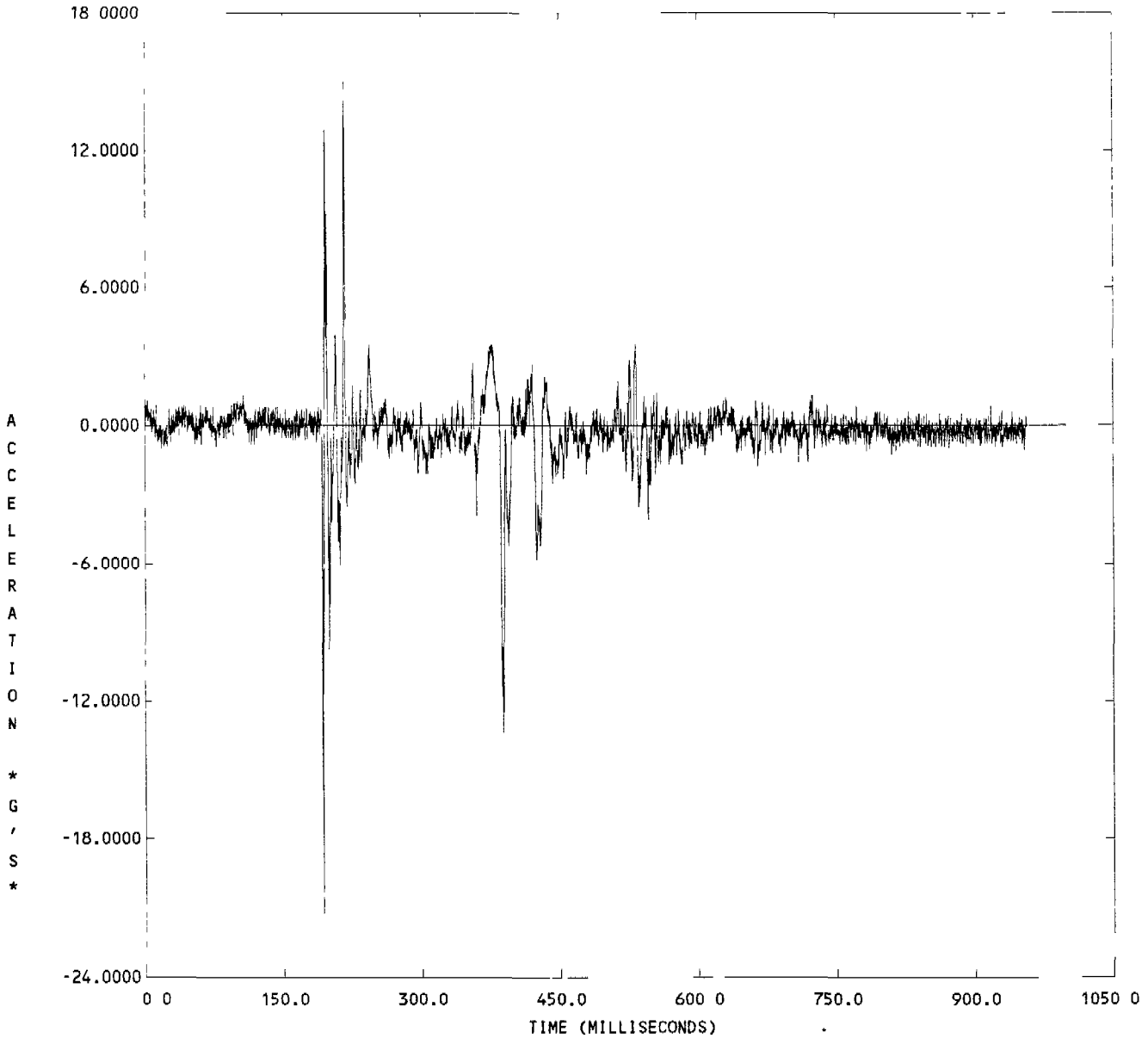
Yaw Inertia (ft. lb sec²): 1883.8

The test report the time for the test is 4.8 seconds.

File: V1851AA0.001

TRC OF OHIO 911007 48.3 kph ROL

91 VOLVO 240 ROLLOVER CART
Vehicle number: 1
Occupant location, type: 01 HYBRID
Sensor Attachment: HEAD CG Axis: XL
Status. AS MEASURED YMIN = -21.669 at 192.500
Filter cutoff· 300 Hz YMAX = 15.027 at 216 000
NON STANDARD ROLLOVER TEST (ALIASED DATA)



V1851AA00001

TRC OF OHIO 911007 48.3 kph ROL

91 VOLVO 240 FOUR DOOR SEDAN
VEH 1
OCCUPANT LOC 01 HYBRID
HEAD CG XL AXIS
AS MEASURED YMIN =-21.66880 at 825.8400
FILTER CUTOFF. 300Hz YMAX = 15.02720 at 951.0480