U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

DOT HS 806 999
Final Report

May 1986

Air Bag Demonstration Test

1982 Chevrolet Caprice into a Fixed Barrier at 30.0 mph

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16. Abstract

This test report documents an air bag demonstration crash test. Testing was conducted on a 1982 Chevrolet Caprice 4-door Sedan at the TRCO Crash Test Facility, East Liberty, Ohio. The test vehicle was impacted into a fixed, non-yielding barrier at 30.0 mph. The test vehicle was retrofitted with a Romeo Kojyo air bag and knee restraint for the driver's position. An instrumented Part 572 dummy was positioned in the driver's designated seating position and a Hybrid III dummy was positioned in the right rear passenger's seat. The Hybrid III dummy was instrumented with pelvis force load cells that measure lap belt induced loads on the pelvis. Occupant responses relative to FMVSS 208 were measured for the driver along with vehicle accelerations. The test date was April 28, 1986 and the ambient temperature was 81°F.

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SECTION 1.0

PURPOSE AND INTRODUCTION

PURPOSE

The purpose of this crash test was to demonstrate the effectiveness of a Romeo Kojyo air bag and knee restraint retrofitted in an otherwise unmodified vehicle and to determine the effectiveness of a lap belt for a rear seat occupant.

INTRODUCTION

A 1982 Chevrolet Caprice 4-door Sedan was towed into a fixed rigid barrier on April 28, 1986. The test was conducted to demonstrate the effectiveness of a Romeo Kojyo air bag and knee restraint. The intended test speed was 30.0 mph and the actual test speed was 30.0 mph.

Section 2 contains General Test and Vehicle Parameter Data. Section 3 contains data required by R & D. Appendix A contains pre-test and post-test vehicle and dummy photographs. Appendix B contains Data Plots. Appendix C contains Dummy Certification Data.

SECTION 2.0

GENERAL TEST AND VEHICLE PARAMETER DATA

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

TEST VEHICLE INFORMATION

VEHICLE MANUFACTURER: General Motors Corporation

MAKE/MODEL: Chevrolet Caprice VIN: 2G1AN69N2C1112310

BODY STYLE: 4-Door Sedan MODEL YEAR: 1982

NHTSA NO.: R & D COLOR: silver

ENGINE DATA: TYPE: V8 CYLINDERS: 8 DISPLACEMENT 350 CID

TRANSMISSION DATA: Automatic

DATE VEHICLE RECEIVED: 4/18/86 ODOMETER READING: 45,739

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

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

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: General Motors Corporation

DATE OF MANUFACTURE: 9/81

GVWR: 5331 LBS.,

GAWR: FRONT 2668 LBS., REAR 2663 LBS.

*A Romeo Kojyo airbag with knee restraint was installed in the vehicle.

VEHICLE TIRE DATA

RECOMMENDED COLD TIRE PRESSURE: FRONT 35 psi; REAR 35 psi

TIRES ON VEHICLE (MFGR. & LINE SIZE): Shell Comfort Ride 2, P215/75B15

BIAS PLY, BELTED, OR RADIAL: Bias ply

PLY RATING: 4

IS SPARE TIRE "SPACE SAVER"? Yes

IS SPARE TIRE STANDARD EQUIPMENT? Yes

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

RIGHT FRONT	1173	LBS.	RIGHT REAR	862	LBS.
LEFT FRONT	1171	LBS.	LEFT REAR	849	LBS.
TOTAL FRONT WEIGHT	2344	LBS. (57.8 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	1711	LBS. (42.2 % OF TOTAL VEHICLE WEIGHT)			
TOTAL DELIVERED WEIGHT	4055	LBS.			

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	RF 29.1	;LF 28.7	;RR 29.1	;LR 28.7
PRE-TEST ATTITUDE:	RF 28.9	;LF 28.6	;RR 26.3	;LR 26.2
POST-TEST ATTITUDE:	RF 31.1	;LF 32.8	;RR 26.3	;LR 26.5

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 121 LBS. CARGO:

RIGHT FRONT	1170	LBS.	RIGHT REAR	1088	LBS.
LEFT FRONT	1153	LBS.	LEFT REAR	1096	LBS.
TOTAL FRONT WEIGHT	2323	LBS. (51.5 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	2184	LBS. (48.5 % OF TOTAL VEHICLE WEIGHT)			
TOTAL TEST WEIGHT	4507	LBS.			

WEIGHT OF BALLAST SECURED IN VEHICLE REAR FLOOR PAN AREA: 0 LBS.

TEST FLUID DATA

TEST FLUID TYPE: BLUE STODDARD SOLVENT #2; SPEC. GRABITY: 0.764

KINEMATIC VISCOSITY: 0.99 CENTISTOKES

"USEABLE" CAPACITY*: NA GALLONS (FURNISHED BY CTM)

TEST VOLUME: 25.1 GALLONS (92-94% OF USEABLE)

FUEL SYSTEM CAPACITY (DATA FROM OWNERS MANUAL): 27.0 GALLONS

DETAILS OF FUEL SYSTEM: DNA

ELECTRIC FUEL PUMP: NO FUEL INJECTION: YES

DOES ELECTRIC FUEL PUMP OPERATE WITH IGNITION SWITCH "ON"" AND THE ENGINE NOT OPERATING? NA

VEHICLE REBOUND AND CRUSH

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: R 208 1/4 ;L 207 1/2 ;C 212 7/8

POST-TEST: R 187 3/4 ;L 187 1/2 ;C 188

TOTAL CRUSH: R 20 1/2 ;L 20 ;C 24 7/8

FOR FRONTAL IMPACTS, DISTANCE FORM FRONT OF TEST VEHICLE TO BARRIER AFTER IMPACT: CENTER: 18 5/8 ; R 19 1/8 ; L 19 3/8

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

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

RECOMMENDED TIRE SIZE: P205 75/R15 LOAD RANGE: X B, C,

VEHICLE CAPACITY: TYPE OF SEATS: Split bench - front
Bench - rear

NUMBER OF OCCUPANTS (DESIGNATED SEATING CAPACITY): 3 FRONT
3 REAR
6 TOTAL

CARGO LOAD 200 LBS.

TOTAL 1100 LBS.

TEST CONDITIONS

TEST NUMBER: 860428

DATE OF TEST: April 28, 1986 TIME OF TEST: 11:55

WIND VELOCITY: N/A HUMIDITY: NA

AMBIENT TEMPERATURE AT IMPACT AREA: 81°F

TEMPERATURE IN OCCUPANT COMPARTMENT: 76°F

TEMPERATURE OF DRIVER DUMMY 77°F

TEMPERATURE OF PASSENGER DUMMY 75°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (LBS.)	4507	4586
VEHICLE ORIENTATION (DEGREES)	0	0
VEHICLE VELOCITY (mph)	30.0	30.0
MAXIMUM CRUSH (INCHES):	25.3	N/A

DUMMIES

	DRIVER	MIDDLE PASSENGER	RT. FRONT PASSENGER	LEFT REAR PASSENGER	RT. REAR PASSENGER
TYPE:	572				HYBRID III
SERIAL NO.:	187				45
INSTRUMENTATION:					
HEAD ACCEL.:	3				0
CHEST ACCEL.:	3				0
FEMUR L.C.'S:	2				0
OTHER:					6 Pelvis load bolts
RESTRAINT SYSTEM:	Romeo Kojyo airbag & knee bar				lap belt only

VISIBLE DUMMY CONTACT POINTS:

	DRIVER	RIGHT REAR PASSENGER
Head	Air Bag	Left knee & seat back
Chest	Air Bag	Knees
Abdomen	None	None
Left Knee	Knee Bar	Seat back
Right Knee	Knee Bar	Seat back

DOOR OPENING:

	LEFT	RIGHT
Front	Easy	Easy
Rear	Easy	Easy

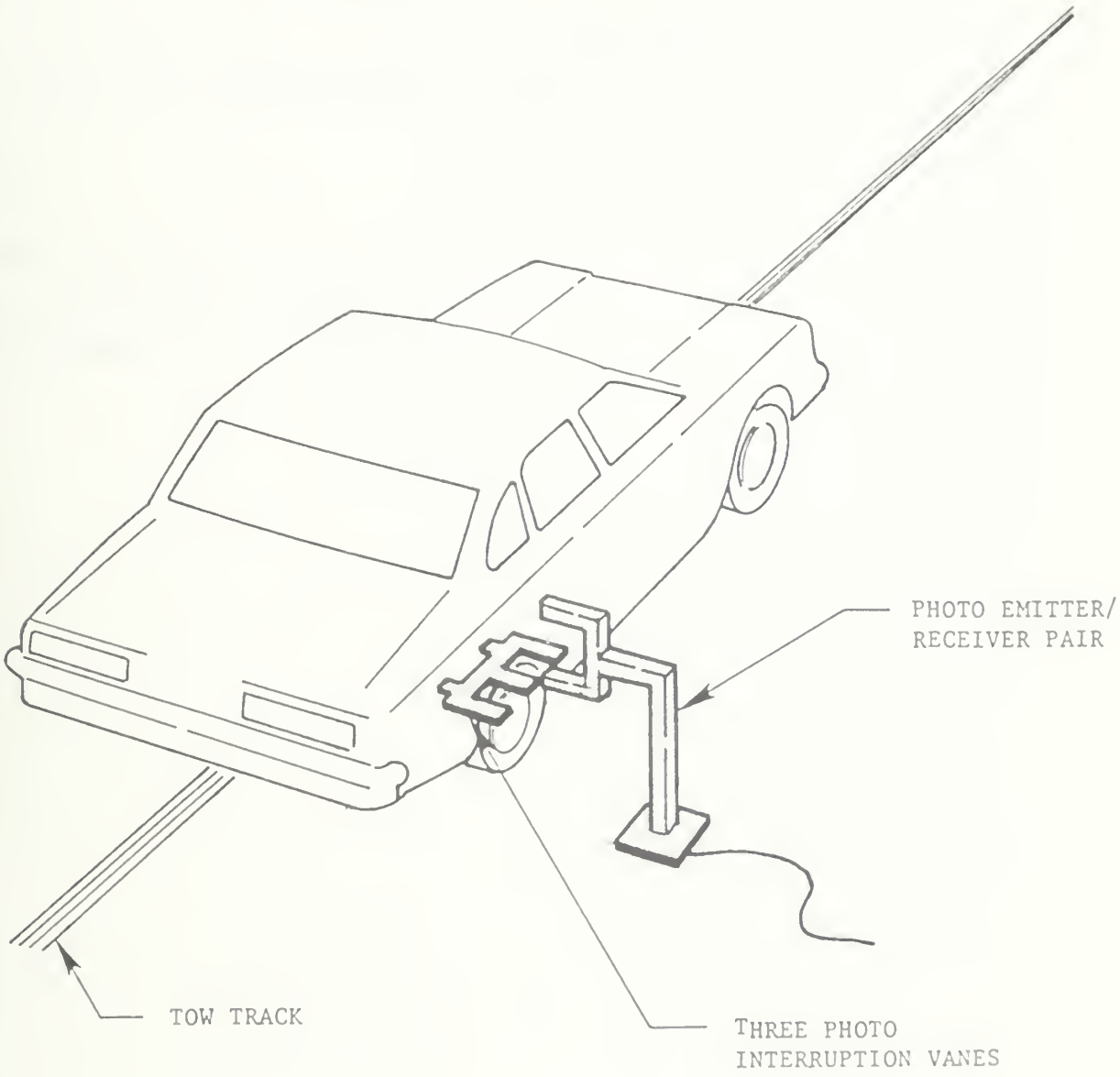
SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
Front	No	No
Rear	No	No

GLAZING DAMAGE: Windshield cracked; no other damage.

OTHER NOTABLE IMPACT EFFECTS:

IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane clears emitter/receiver two inches before impact.

The vanes have one foot spacing.

VEHICLE TEST WEIGHT

Test Weight =Unloaded Delivered Weight +
Number of Part 572 dummies X 164 +
Number of Hybrid III dummies X 167 +
Cargo Weight
= 4055 + 1 X 164 + 1 X 167 + 200 lbs.
= 4586 lbs.

To achieve test weight, 25.1 gallons of stoddard solvent were added in the fuel tank. The weight of the test vehicle was measured by placing each wheel on a force plate manufactured by K.J. Law Engineers, Inc. Detroit, Michigan.

TEST ANOMALIES

The driver's Y axis head acceleration, HEDYG1, recorded anomalous data following 31 msec.

The left forward frame rail X axis acceleration, FFRXG1, recorded anomalous data following 75 msec due to a pinched cable.

SECTION 3.0
DATA REQUIRED BY R&D

The following pages are included in this section:

1. Dummy temperature control and positioning data
2. Dummy kinematic summary
3. Vehicle crush data
4. Dummy and vehicle accelerometer location and data summary
5. High speed camera information

DUMMY TEMPERATURE CONTROL AND POSITIONING

The vehicle was kept inside the temperature controlled crash test building until approximately 30 minutes prior to the test. At that time the vehicle was taken outside and into another temperature controlled building. The vehicle remained there until launch.

The following table summarized the steps taken to position the instrumented, calibrated dummy in the test vehicle.

DUMMY PLACEMENT AND POSITIONING

PART 572 DUMMY	DRIVER DSP	PASSENGER DSP
HEAD	Surface of transverse instrument mounting platform is horizontal & midsagittal plane falls in longitudinal plane.	Surface of transverse instrument mounting platform is horizontal & midsagittal plane falls in longitudinal plane.
UPPER TORSO	Placed against seat back. Midsagittal plane is vertical & longitudinal & passes through center point of steering wheel rim.	Placed against seat back. Midsagittal plane is vertical, longitudinal, & the same distance from vehicle longitudinal centerline as driver dummy midsagittal plane.
UPPER ARMS	Initially placed against seat back & tangent to side of upper torso. Push arms rearward into seat back with bending at elbows.	Initially placed against seat back & tangent to side of upper torso. Push arms rearward into seat back with bending at elbows. Remains tangent.
LOWER ARMS	Initially placed against the outside of the thighs. Centerline as close as possible in a vertical plane.	Initially placed against the outside of the thighs. Centerline as close as possible in a vertical plane.
HAND PALMS	Palms contact outer part of steering wheel rim at horizontal centerline.	Palms contact the outsides of the thighs.
HAND THUMBS	Placed over steering wheel rim.	
HAND LITTLE FINGERS		Barely in contact with the seat cushion.
LOWER TORSO	Centered on bucket seat cushion. Midsagittal plane is vertical & longitudinal. For bench seat, midsagittal plane is vertical & longitudinal & passes through center point of plane described by steering wheel rim.	Centered on bucket seat cushion. Midsagittal plane is vertical & longitudinal. For bench seat, midsagittal plane is vertical, and same distance from vehicle longitudinal centerline as driver dummy midsagittal plane.
UPPER LEGS (thighs or femurs)	Placed against seat cushion. Plane defined by femur and tibia centerlines is as close as possible to vertical.	Placed against seat cushion. Plane defined by femur and tibia centerlines is as close as possible to vertical.
RIGHT KNEE	Knees initially set 14.5" apart between pivot bolt head outer surfaces.	Located so that plane defined by femur and tibia centerlines is as close as possible to vertical.

PART 572 DUMMY	DRIVER DSP	PASSENGER DSP
LEFT KNEE	Outer surface of pivot bolt head is 5.9" from midsagittal plane of dummy.	Located as above.
LOWER LEGS	Plane defined by femur and tibia centerlines is as close as possible to vertical longitudinal plane.	Plane defined by femur and tibia centerlines is as close as possible to vertical longitudinal plane.
RIGHT FOOT	Placed on undepressed accelerometer pedal -- rearmost point of heel on floorpan in plane of pedal.	Centerline falls in vertical longitudinal plane. Placed on toeboard -- rearmost point of heel on floorpan as close as possible to intersection of toeboard and floorpan.
LEFT FOOT	Placed on towboard -- rearmost point of heel on floorpan as close as possible to intersection of toeboard and floorpan. Centerline falls in vertical longitudinal plane.	Centerline falls in vertical longitudinal plane. Placed on toeboard -- rearmost point of heel on floorpan as close as possible to intersection of toeboard and floorpan.

DUMMY IN-VEHICLE POSITION

RECORDING SHEET

VEHICLE NHTSA NO. R & D MFR./MAKE/MODEL: Chevrolet Caprice Classic

SEAT TYPE: ___ Bench ADJUSTER TYPE: ___ Manual

___ Bucket x Power

X Split bench

TECHNICIANS:

BUCKET SEAT BACK TYPE: ___ Fixed 1. D. Carpenter

X Adjustable Reclining 2. B. Fishbaugh

POSITIONING DATE: April 28, 1986 3. ___

AMBIENT TEMP.: 70° F. TIME: 9:00 a.m. 4. ___

DRIVER DUMMY # 187 TYPE P572

Head 21 15/16"

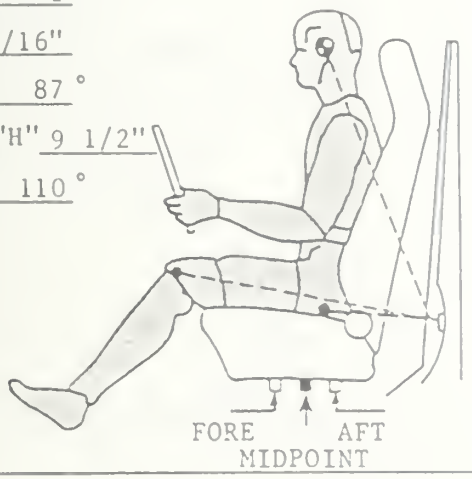
Target 1 °

Knee 23 1/16"

Joint 87 °

Approx. "H" 9 1/2"

Point 110 °



PASSENGER DUMMY # 45 TYPE HIII
(RIGHT REAR)

Head 13 7/8"

Target 7 °

Knee 24 5/16"

Joint 101 °

Approx."H" 13 1/4"

Point 143 °

A = N/A

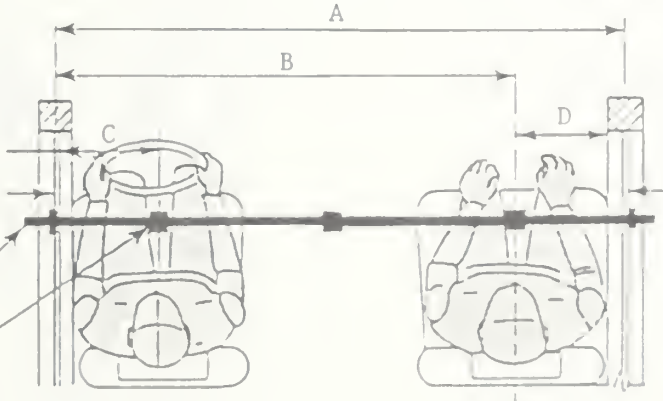
B = N/A

C = 14 9/16"

D = N/A

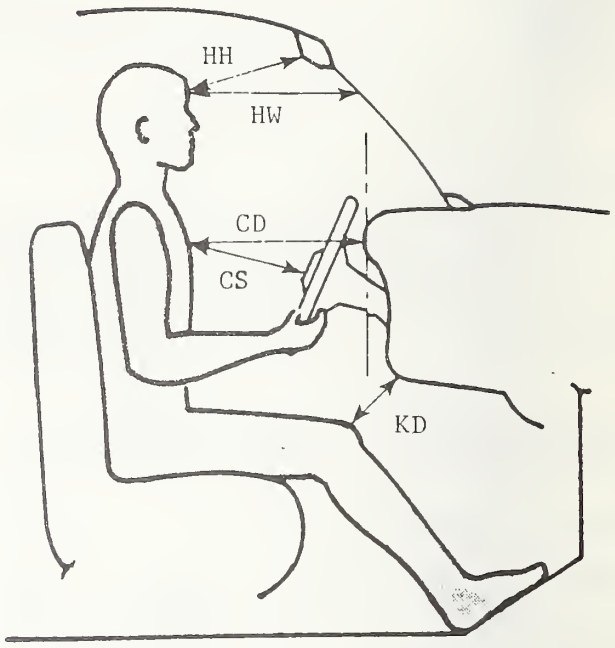
Door glass height
10 7/16"

Lateral bar
Adjustable
Pointer

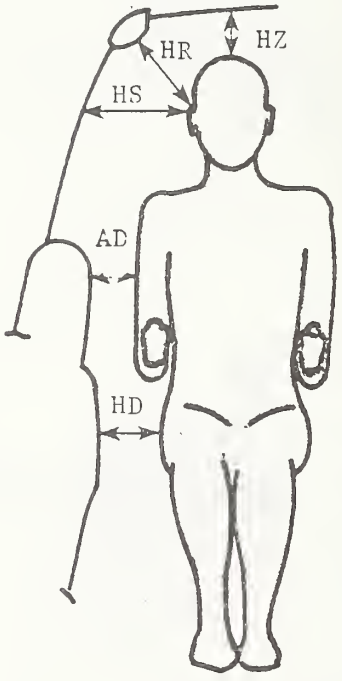


DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER 187	RIGHT REAR PASSENGER 45
HH	14 1/16	N/A
HW	19 9/16	22 1/8*
CD	19 7/8	21 1/16*
CS	10 15/16	N/A
KDL	5 3/8	7 1/8*
KDR	6 1/4	7 9/16*



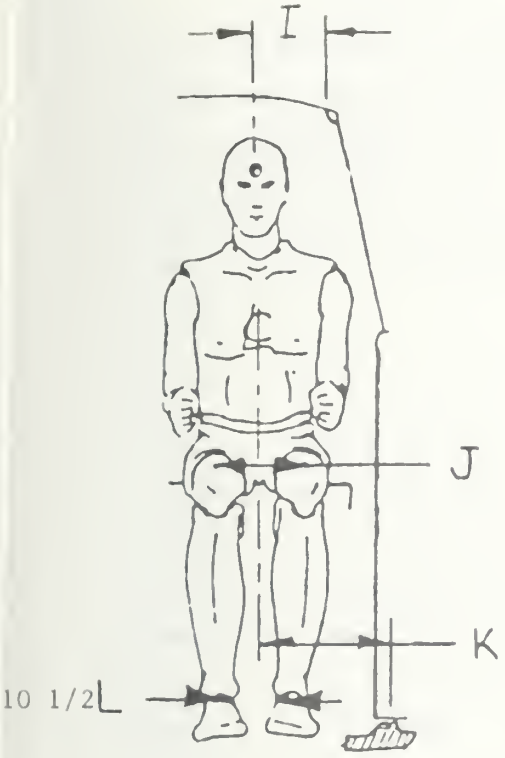
	DRIVER 187	RIGHT REAR PASSENGER 45
HR	7 1/2	10 7/16
HS	11 3/8	14 5/16
AD	5	8
HD	6 7/8	9 1/4
HZ	3 5/8	5 5/16

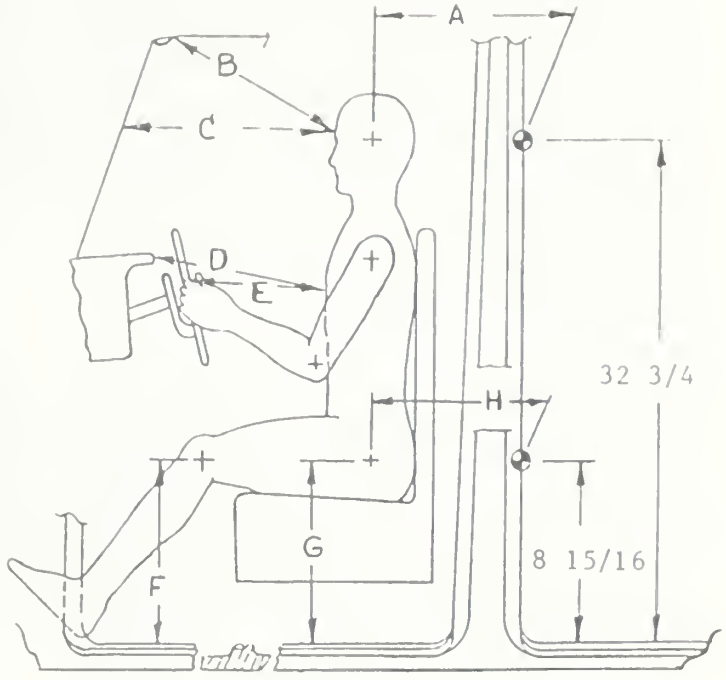


ALL MEASUREMENTS IN INCHES

* Measured to back of front seat.

DRIVER DUMMY IN-VEHICLE POSITION RECORDING SHEET





A = 9
B = 14 1/16
C = 19 9/16
D = 19 7/8
E = 10 15/16
F = 11 13/16
G = 6 9/16
H = 13 1/2
I = 8 5/16
J = 10 3/4
K = 13 3/4

SEAT POSITION - Mid Position
PRE-TEST TILT POSITION - Mid
HEAD REST POSITION - Down

ALL MEASUREMENTS IN INCHES

DUMMY KINEMATIC SUMMARY

DRIVER

During impact, the dummy began to slide forward on the seat as the airbag inflated. The dummy continued forward until the airbag restrained its head and chest and the knee restraint stopped the forward motion of the dummy's legs and pelvis. The dummy came to rest with its knees embedded in the lower instrument panel and leaning back against the seatback.

RIGHT REAR PASSENGER

During impact, the dummy slid forward on the seat until the lap belt restrained its forward movement. The dummy's torso then rotated forward and down about the waist until the dummy's chest contacted its knees. Upon rebound, the dummy's head hit the head liner. The dummy then came to rest sitting upright on the seat.

DUMMY DATA SUMMARY

	DRIVER DUMMY			
	POSITIVE DIRECTIONS*		NEGATIVE DIRECTIONS**	
	MAX	TIME (msec)	MAX	TIME (msec)
HEAD ACCELERATION (g)				
LONGITUDINAL	30.86	200.25	48.47	106.13
LATERAL	---	--- †	---	--- †
VERTICAL	36.95	99.38	12.57	129.50
RESULTANT	54.26	106.13		
HIC	372.35	from 80.38 to 129.25 msec.		
DELTA V (MPH)	43.1	175.25		
CHEST ACCELERATION (g)				
LONGITUDINAL	7.76	157.00	35.41	110.38
LATERAL	3.80	128.88	5.79	115.88
VERTICAL	7.66	91.13	13.52	127.00
RESULTANT	35.97	114.88		
DELTA V (MPH)	39.6	137.00		
3 MSEC CLIP	34.57			
FEMUR FORCE*** (lb)				
LEFT	388.85	30.13	2177.52	85.25
RIGHT	247.91	120.75	1581.32	83.88

* LONGITUDINAL: FORWARD
LATERAL: RIGHTWARD
VERTICAL: DOWNWARD

** LONGITUDINAL: REARWARD
LATERAL: LEFTWARD
VERTICAL: UPWARD

*** COMPRESSION: NEGATIVE

† See TEST ANOMALIES

DUMMY DATA SUMMARY

PASSENGER DUMMY

	POSITIVE DIRECTIONS*		NEGATIVE DIRECTIONS*	
	MAX	TIME (msec)	MAX	TIME (msec)
PELVIS FORCE (lb)				
LEFT UPPER	89.26	106.75	2.94	204.88
LEFT MIDDLE	46.86	118.50	3.29	25.13
LEFT LOWER	60.42	129.88	4.37	8.75
RIGHT UPPER	21.46	116.00	2.26	253.75
RIGHT MIDDLE	70.82	120.50	4.38	272.75
RIGHT LOWER	34.86	137.13	2.65	8.88

* Force on pelvis from lap belt is positive.

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

NO.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	LEFT FRONT FRAME RAIL (LONGITUDINAL)	185.5	-16.8	19.6	---	--- Y	108.20	24.25
2	RIGHT FRONT FRAME RAIL LONGITUDINAL	187.5	16.5	19.6	37.95	40.00	108.71	24.25
3	FIREWALL LONGITUDINAL	154.3	-9.9	34.8	35.11	71.00	98.87	65.13
4	LEFT B-PILLAR (LONGITUDINAL)	106.0	-29.8	15.1	4.42	19.50	31.21	25.63

* REFERENCE: X - REAR BUMPER (+ FORWARD), Y - VEHICLE CENTERLINE (+ TO RIGHT)
Z - GROUND LEVEL (+ UP)

ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS IN INCHES

Y See TEST ANOMALIES

IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL Chevrolet Caprice TEST NUMBER 860428

DIMENSIONS IN INCHES

NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X 1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	212 7/8	188
X 2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	176 7/8	173 1/2
X 3	REAR SURFACE OF VEHICLE TO FIREWALL	153 5/8	153 1/8
X 4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	141 5/16	142 1/8
X 5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	141	142
X 6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	144 1/4	144 3/8
X 7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	144	144 1/4
X 8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	100 15/16	101 3/4
X 9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	101	101 7/8
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	102 3/8	102 1/2
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	102 1/8	102 5/8
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF RIGHT SIDE	141 1/4	141 1/4
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF LEFT SIDE	142 1/8	141 1/2
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	152 7/8	152 5/8
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	154 3/4	154 1/2
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	123 1/8	131 1/8
Y17	STEERING COLUMN TO "A" POST	14 3/4	13 15/16

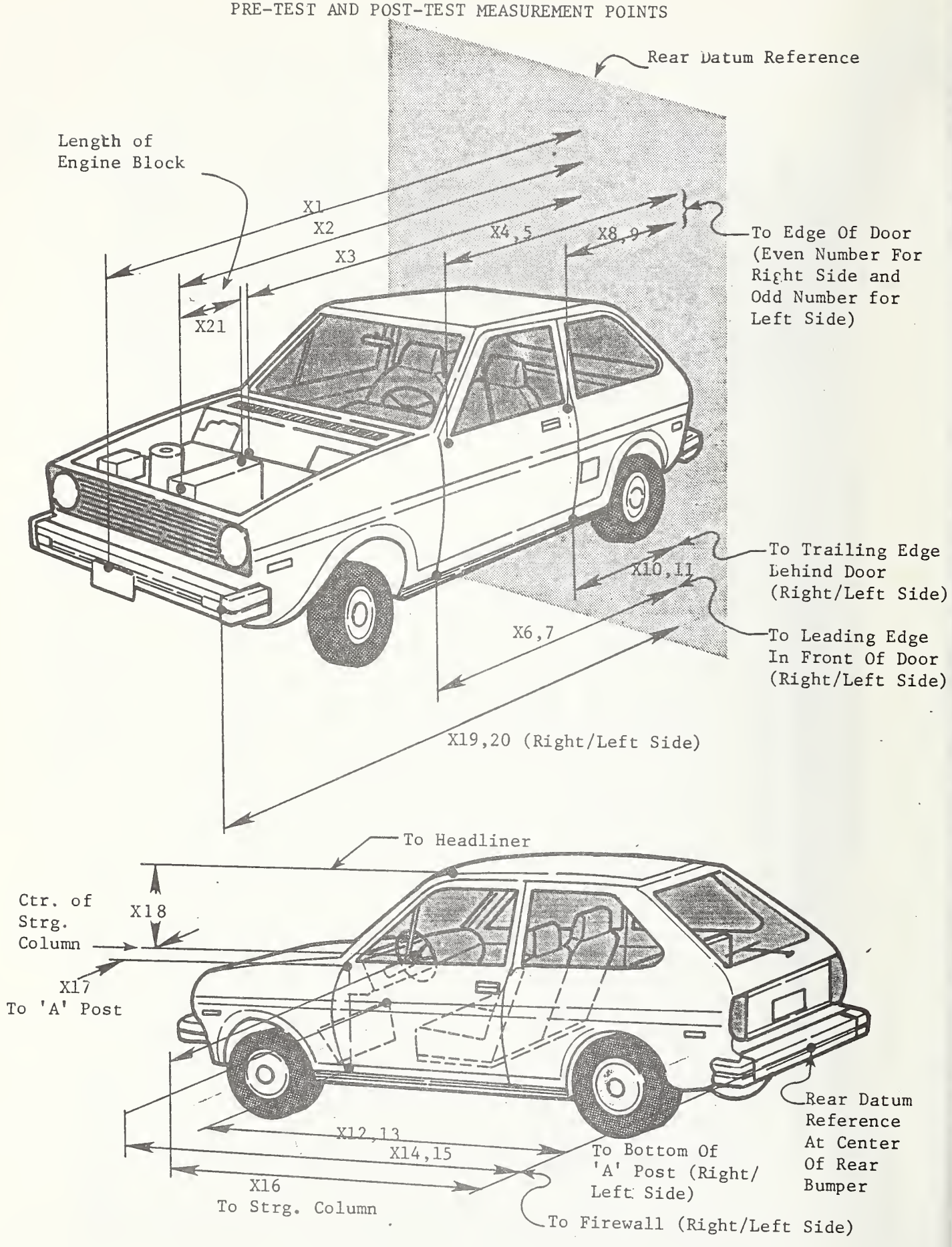
IMPACTED VEHICLE MEASUREMENTS CONTD

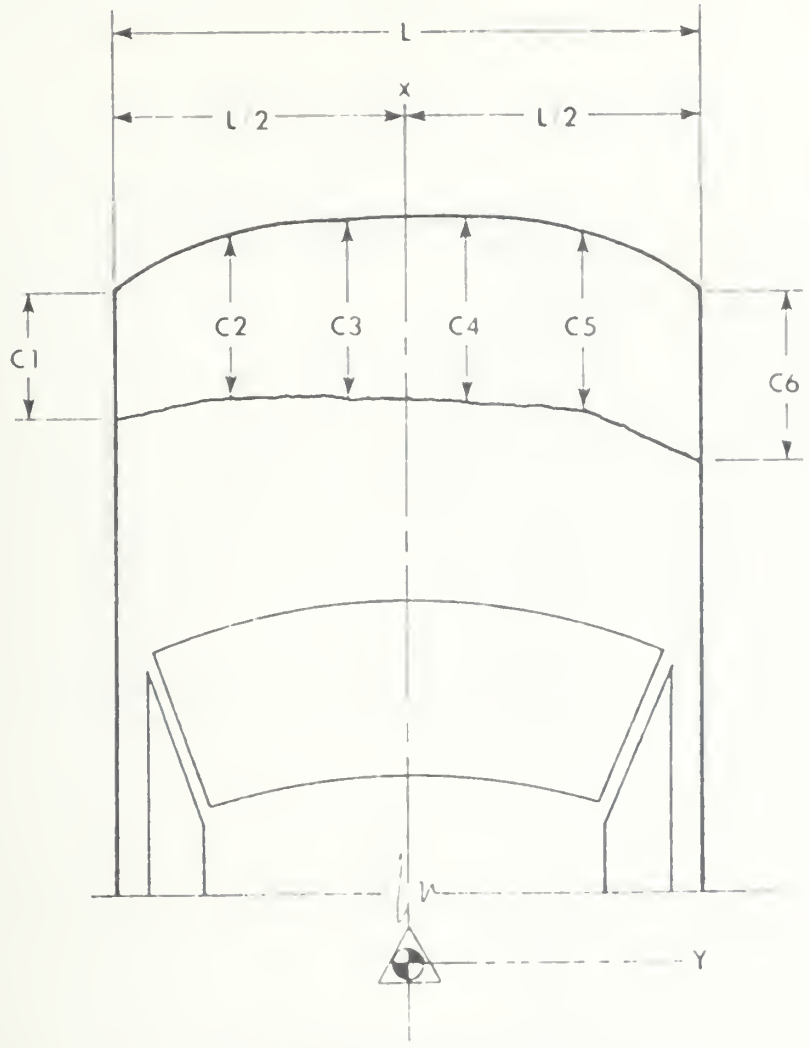
VEHICLE MAKE/MODEL Chevrolet Caprice TEST NUMBER 860428

DIMENSIONS IN INCHES

NO	TYPE OF MEASUREMENT	PRE TEST	POST TEST
Z18	REAR OF WINDSHIELD HEADER TO STEERING WHEEL CENTER	16 15/16	19 3/4
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	208 1/4	187 3/4
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	207 1/2	187 1/2
Y21	LENGTH OF ENGINE BLOCK	21	21

PRE-TEST AND POST-TEST MEASUREMENT POINTS





NOTE: C1 through C6 are spaced equally apart
All measurements in inches

VEHICLE Chevrolet Caprice Classic

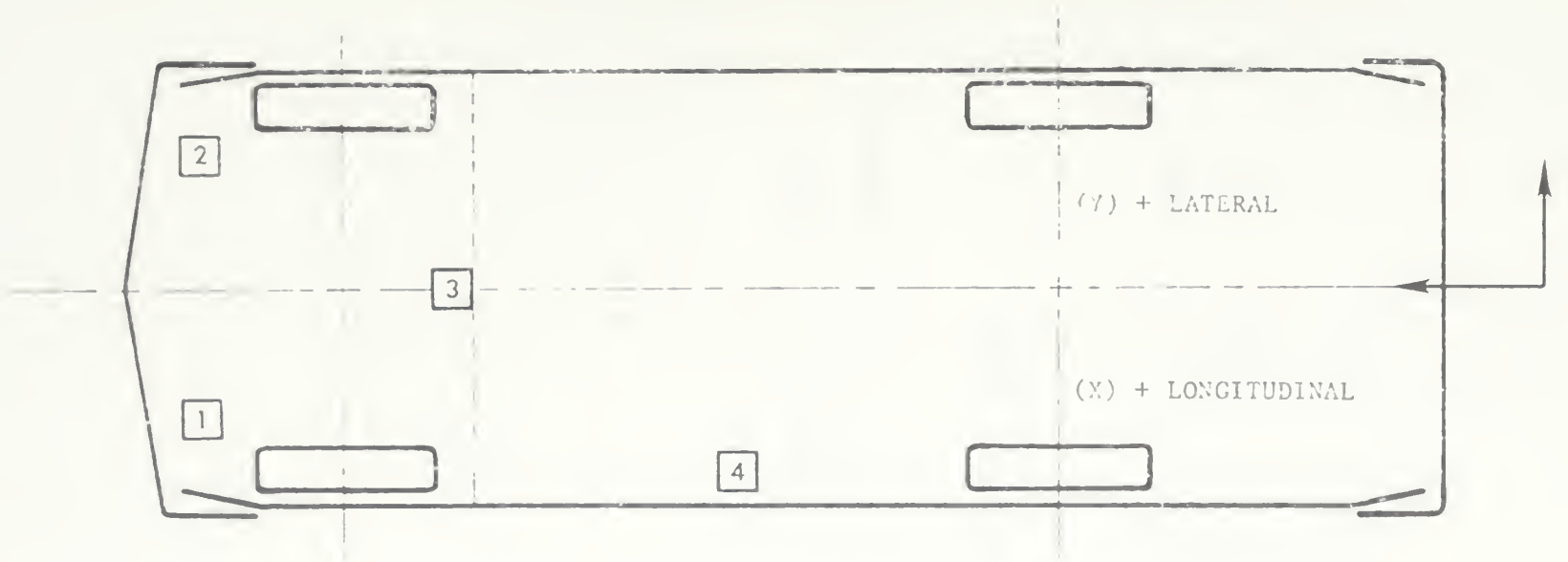
	CRUSH
L	70.1
C1	20.0
C2	22.4
C3	25.0
C4	25.3
C5	22.5
C6	20.5
D	0.0

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right	Kodak	16	24	Real time
2	Left wide	Photosonic 1B	13	998	Vehicle crush
3	Left angle	Hycam	25	993	Driver kinematics
4	Onboard front window	Photosonic 1B	8	998	Driver kinematics
5	Onboard roof	Photosonic 1B	8	1000	Driver kinematics
6	Onboard floor	Photosonic 1B	8	945	Driver kinematics
7	Onboard back window	Photosonic 1B	8	1000	Passenger kinematics

NOTE: Cameras are numbered according to splicing sequence of film.

VEHICLE ACCELEROMETER LOCATIONS



HIGH SPEED CAMERA LOCATIONS FOR FRONT IMPACT

CAMERA	LOCATION	X	Y	Z
2	LEFT WIDE	84 1/4	-352	37 1/4
3	LEFT ANGLE	168 1/2	-186 1/2	75 1/2

NOTE: All measurements in inches

Reference: X - Barrier face (+ out of barrier),

Y - Rail centerline (+ to right),

Z - Ground level (+ up)

APPENDIX A

PHOTOGRAPHS

Figure A-1. PRE-TEST FRONT VIEW

Figure A-2. PRE-TEST DRIVER SIDE VIEW

Figure A-3. PRE-TEST PASSENGER SIDE VIEW

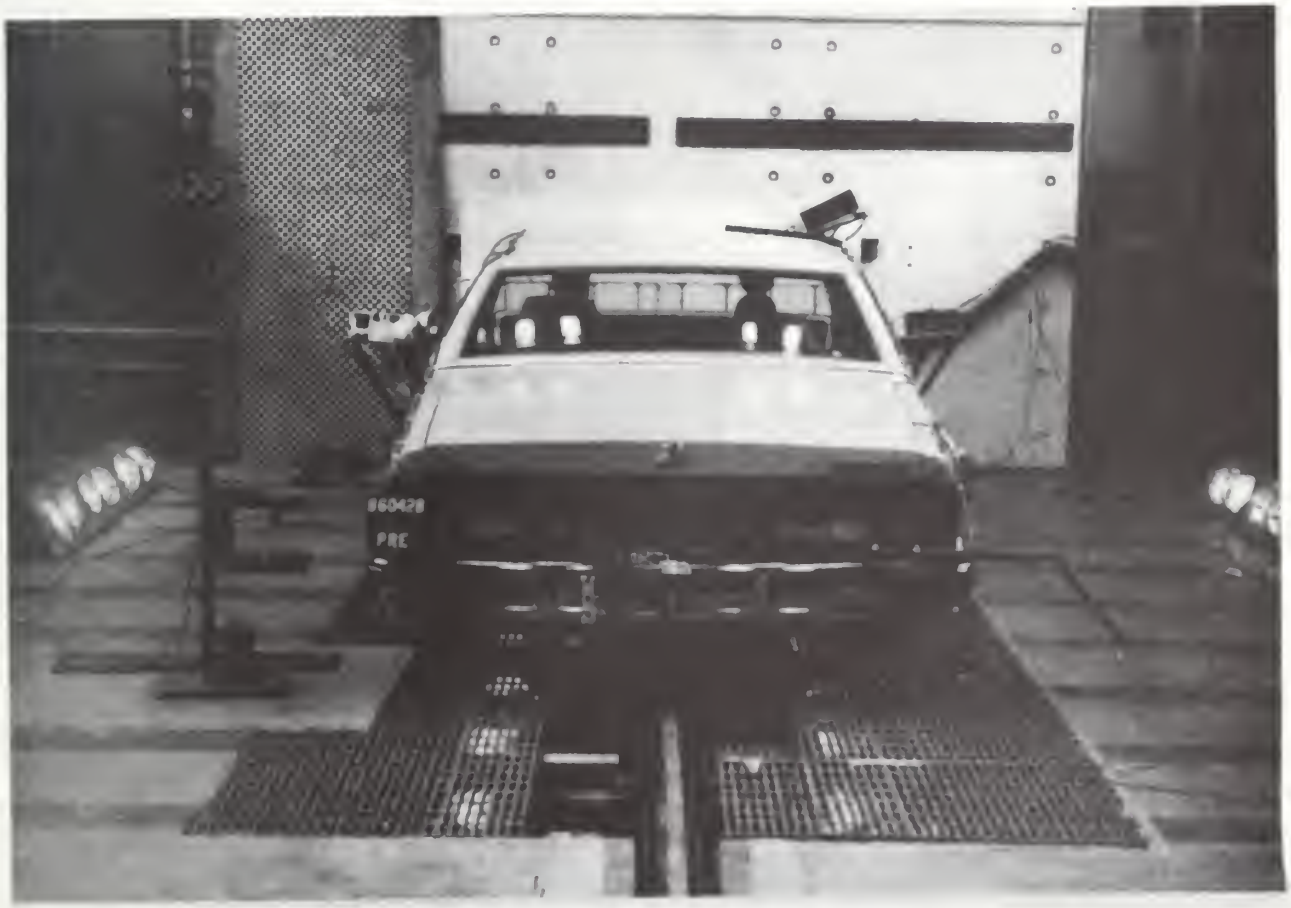


Figure A-4. PRE-TEST REAR VIEW

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

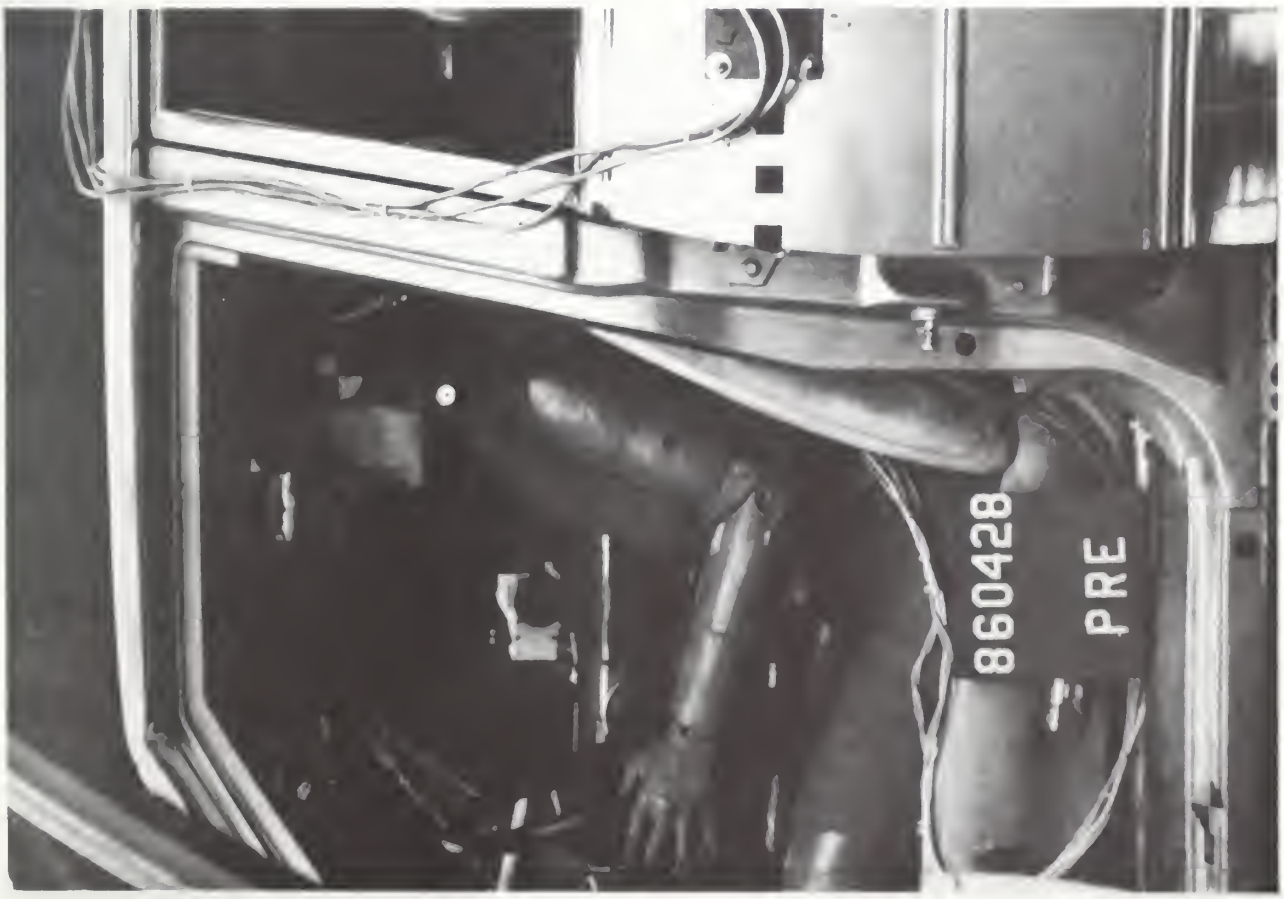


Figure A-6. PRE-TEST DRIVER DUMMY - VIEW 2

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

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

Figure A-9. PRE-TEST PASSENGER DUMMY - VIEW 1

Figure A-10. PRE-TEST PASSENGER DUMMY - VIEW 2

Figure A-11. POST-TEST FRONT VIEW

Figure A-12. POST-TEST DRIVER SIDE VIEW

Figure A-13. POST-TEST PASSENGER SIDE VIEW

Figure A-14. POST-TEST REAR VIEW

Figure A-15. POST-TEST DRIVER DUMMY - VIEW 1

Figure A-16. POST-TEST DRIVER DUMMY - VIEW 2

Figure A-17. POST-TEST DRIVER DUMMY - VIEW 3

Figure A-18. POST-TEST DRIVER DUMMY - VIEW 4

Figure A-19. POST-TEST PASSENGER DUMMY - VIEW 1

Figure A-20. POST-TEST PASSENGER DUMMY - VIEW 2

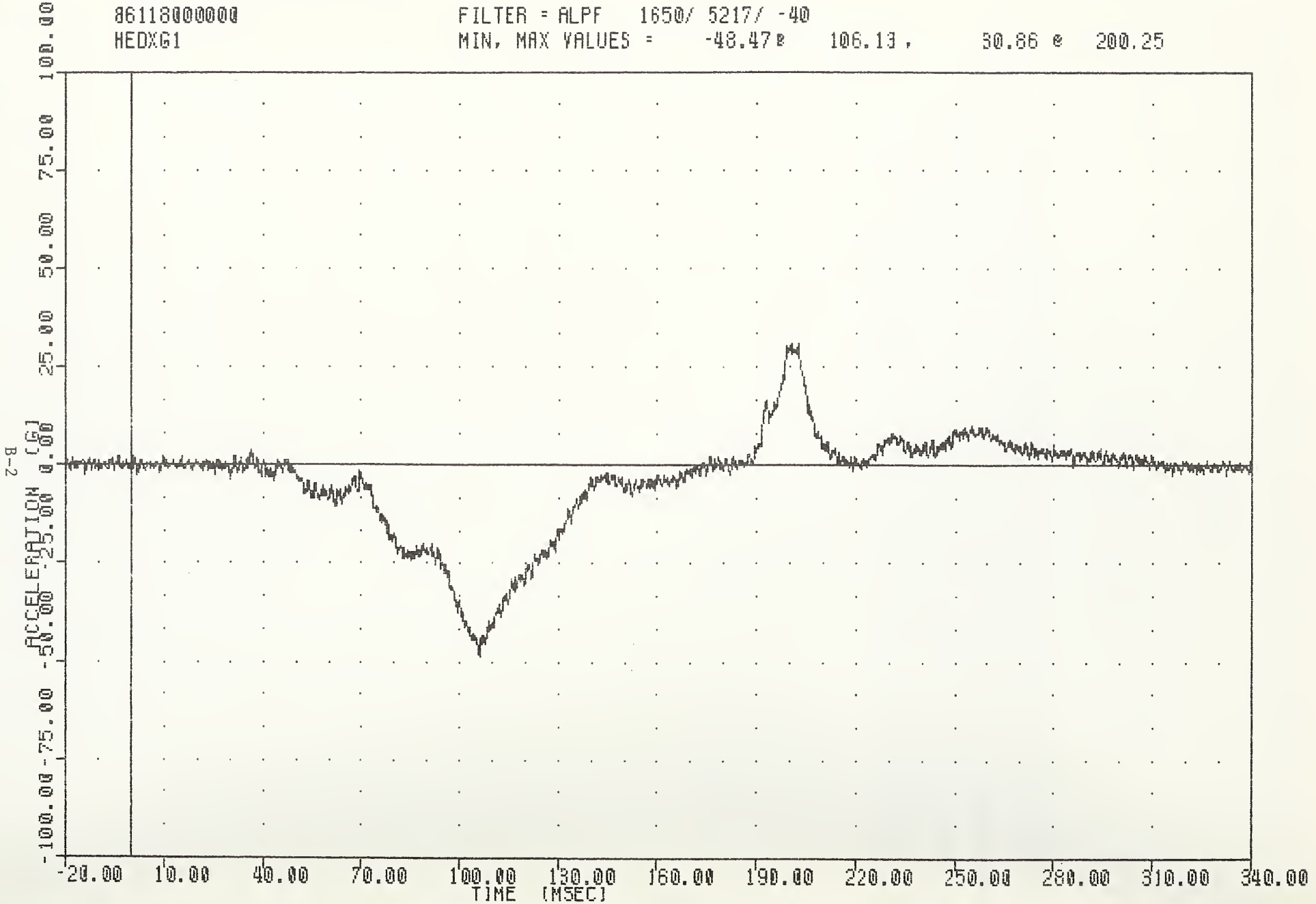
Figure A-21. POST-TEST STEERING COLUMN

APPENDIX B

DATA PLOT PRESENTATION

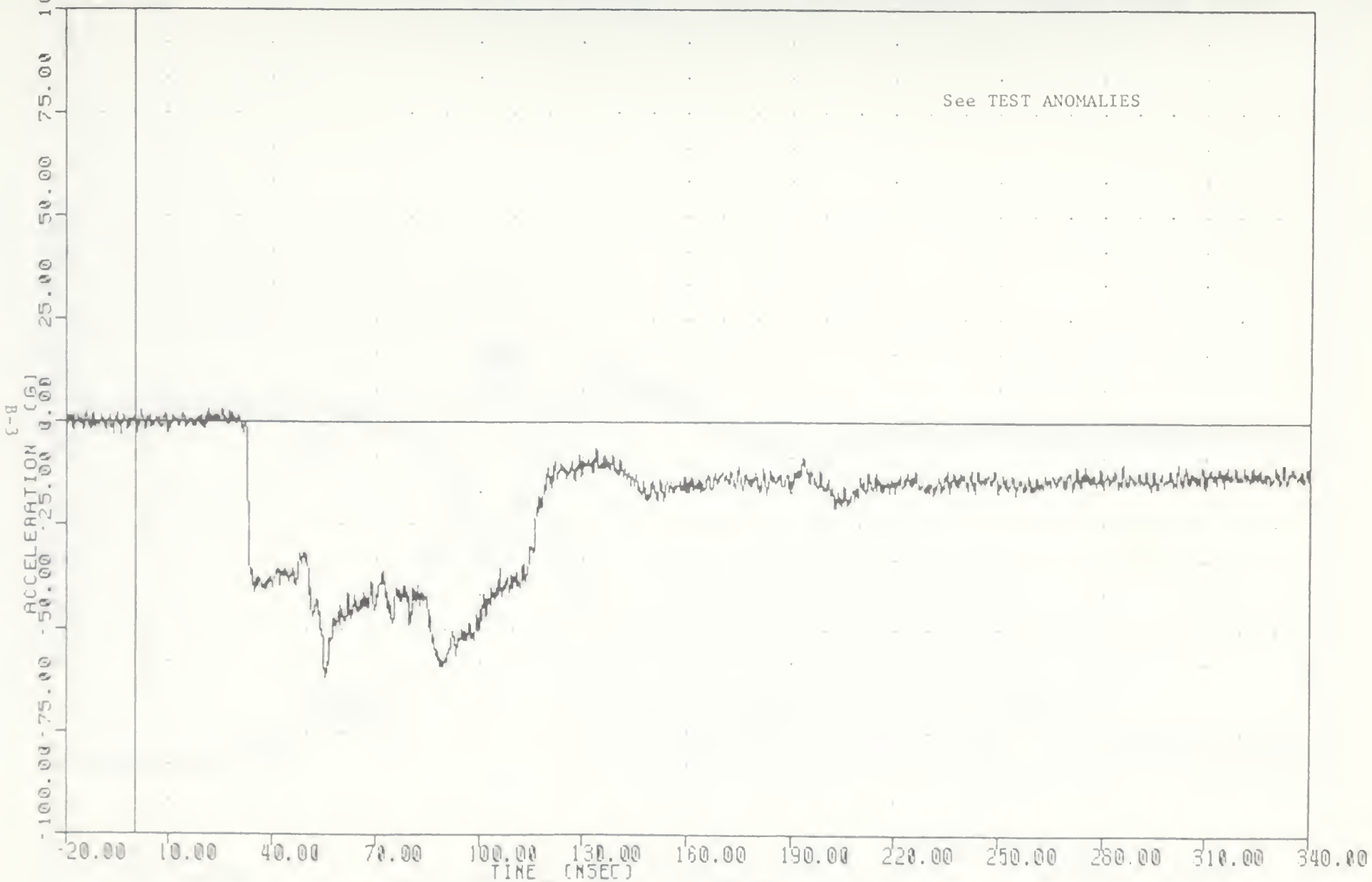
Data plots generated from the crash test data are presesnted on the following pages. All data are recorded on magnetic tape for inclusion in the NHTSA crash test data base system. All data were filtered according to SAE J211. Except that dummy thorax data were filtered using the HSRI filter.

YRI , 860428
AIRBAG DEMONSTRATION TEST
86118000000 FILTER = ALPF 1650/ 5217/ -40
HEDXG1 MIN, MAX VALUES = -48.47 @ 106.13 , 30.86 @ 200.25

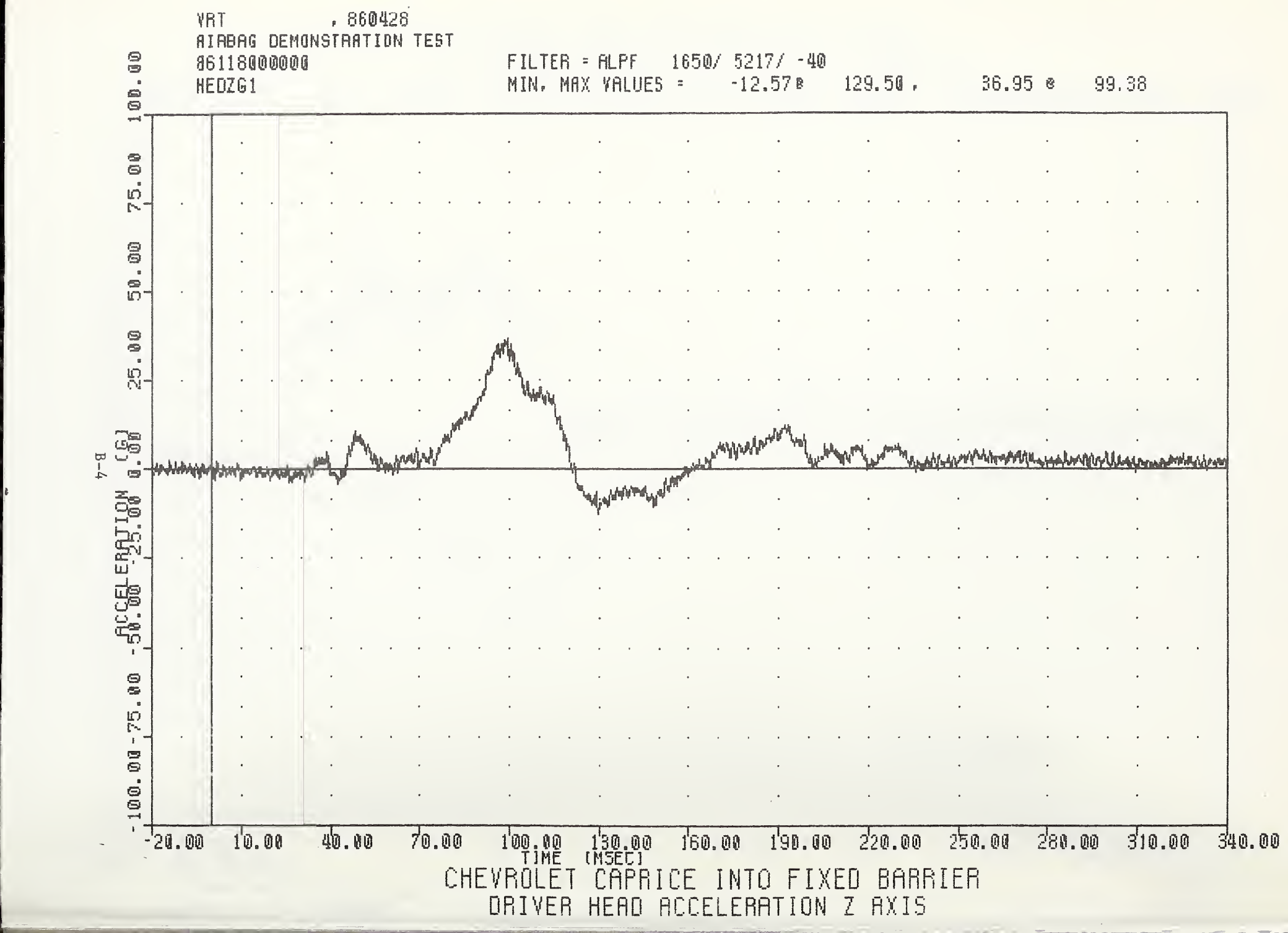


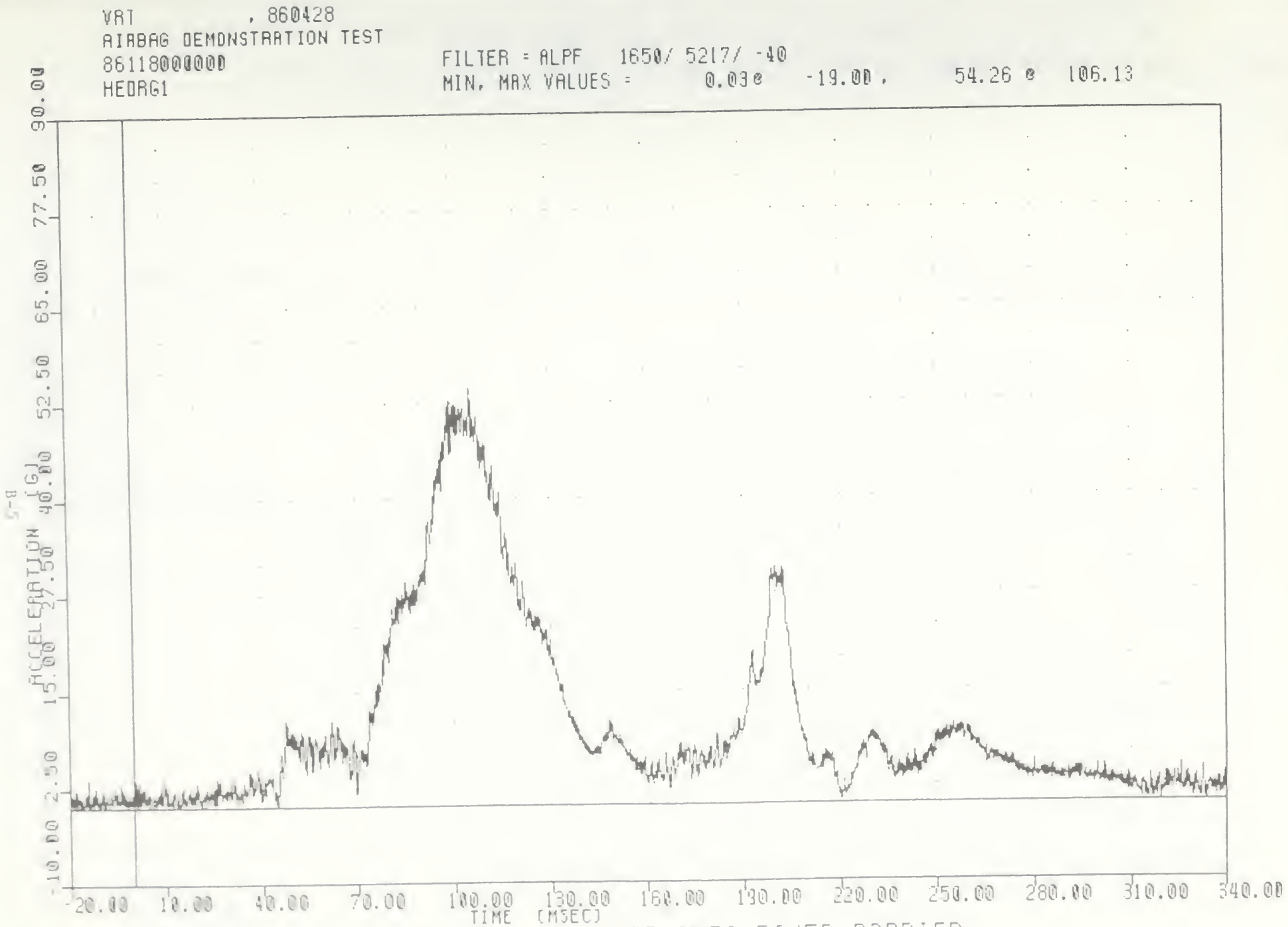
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER HEAD ACCELERATION X AXIS

VHI , 860428
AIRBAG DEMONSTRATION TEST
8611800000D FILTER = ALPF 1650/ 5217/ -40
HEOY61 MIN, MAX VALUES = -61.69 @ 55.38 , 3.32 @ 21.50



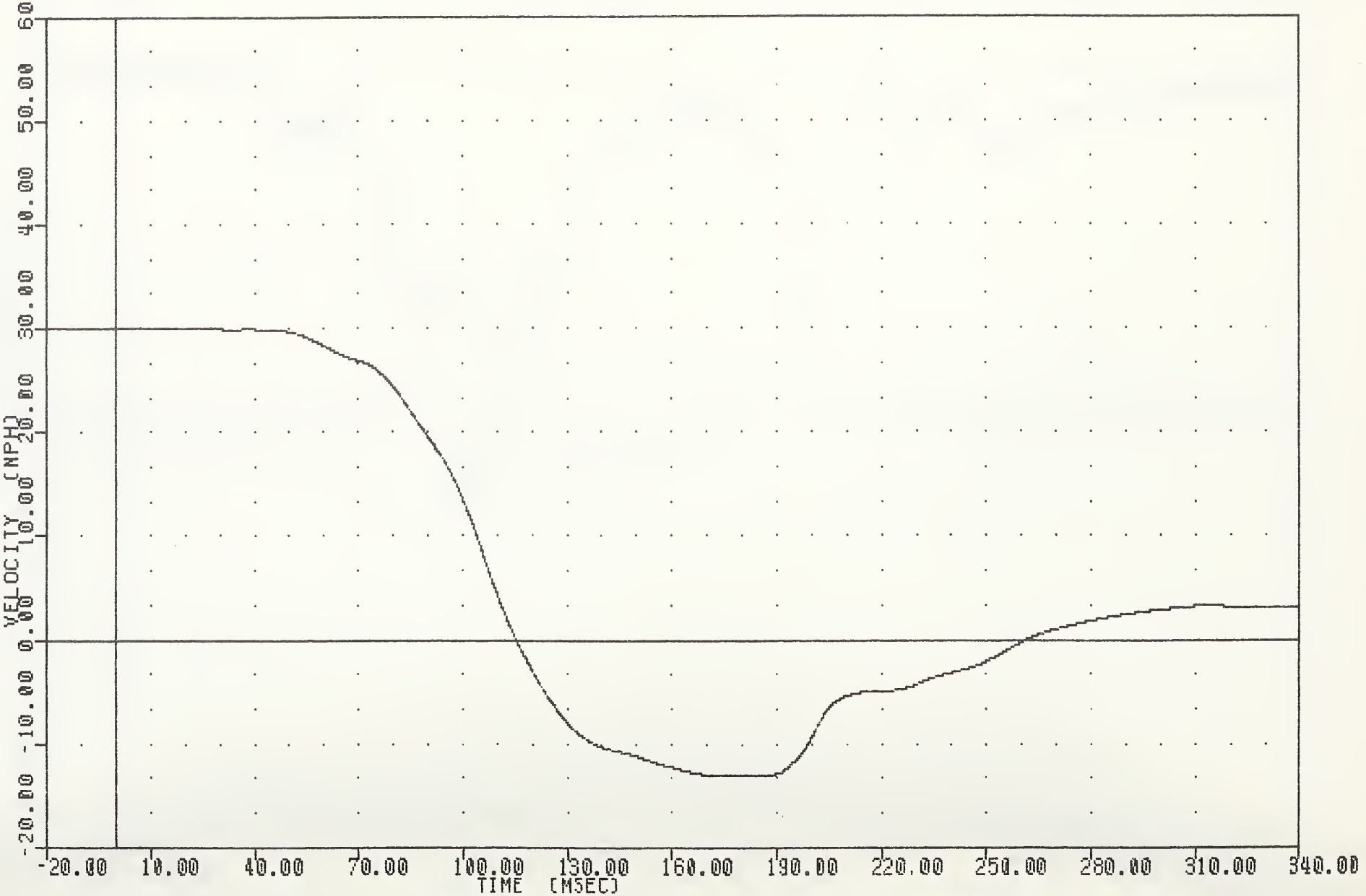
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER HEAD ACCELERATION Y AXIS


VRT , 860428
AIRBAG DEMONSTRATION TEST
86118000000
HEDZG1
FILTER = ALPF 1650/ 5217/ -40
MIN, MAX VALUES = -12.57 @ 129.50 , 36.95 @ 99.38
100.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00
ACCELERATION (G)
-20.00
10.00
40.00
70.00
100.00
130.00
160.00
190.00
220.00
250.00
280.00
310.00
340.00
TIME (MSEC)
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER HEAD ACCELERATION Z AXIS



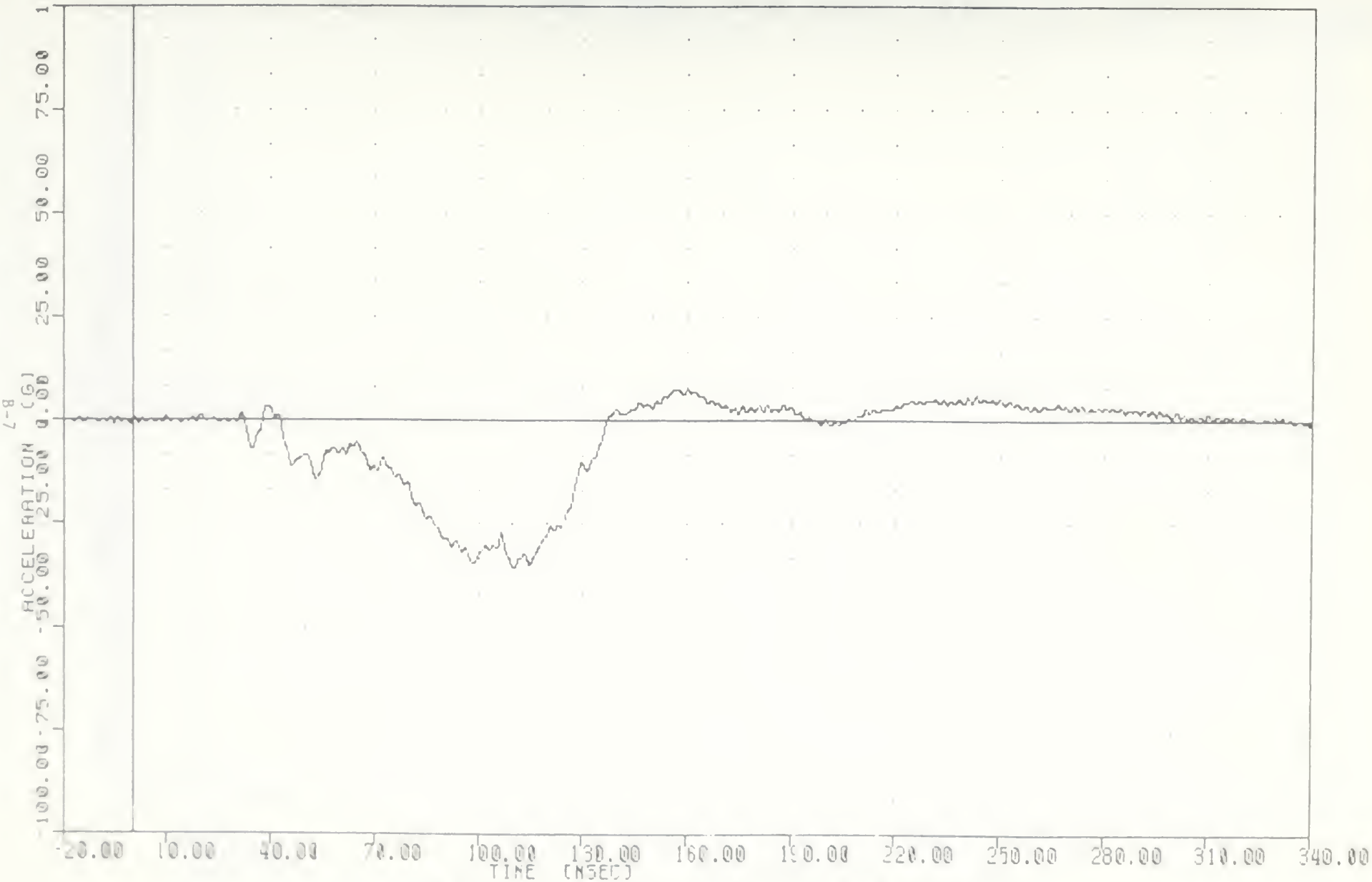
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER HEAD RESULTANT USING ONLY X AND Z

VRI , 860428
AIABAG DEMONSTRATION TEST
8611800000D FILTER = BLPP 300/ 750/ -16
HEDXV1 MIN. MAX VALUES = -13.10@ 175.25 , 30.03 @ -3.38

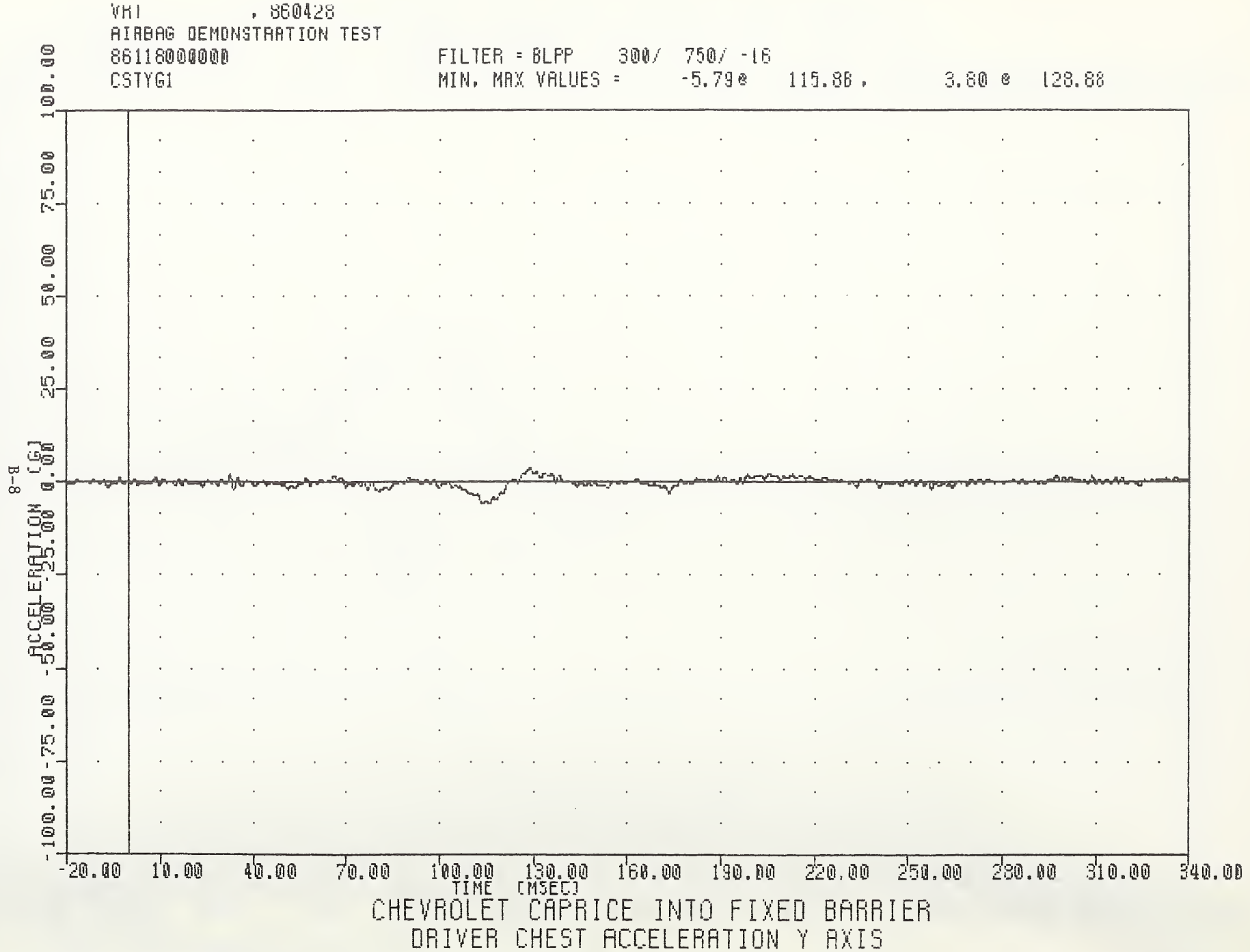


CHEVROLET CAPRICE INTO FIXED BARRIER
DELTA V USING HEDXG1

VRT , 860428
AIABAG DEMONSTRATION TEST
8611800000D FILTER = BLPP 300/ 750/ -16
CSTX61 MIN, MAX VALUES = -35.41 @ 110.38 , 7.76 @ 157.00

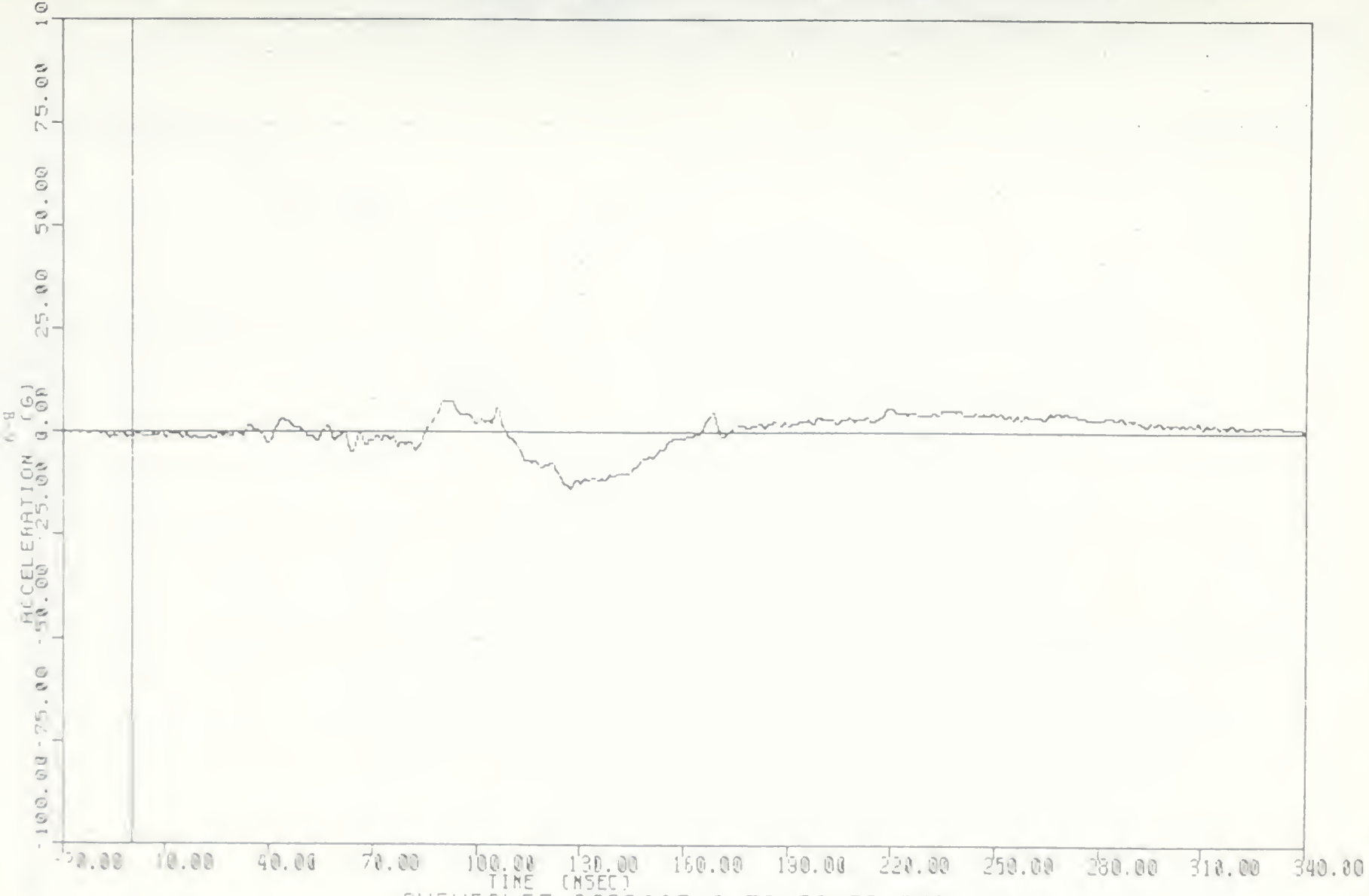


CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER CHEST ACCELERATION X AXIS

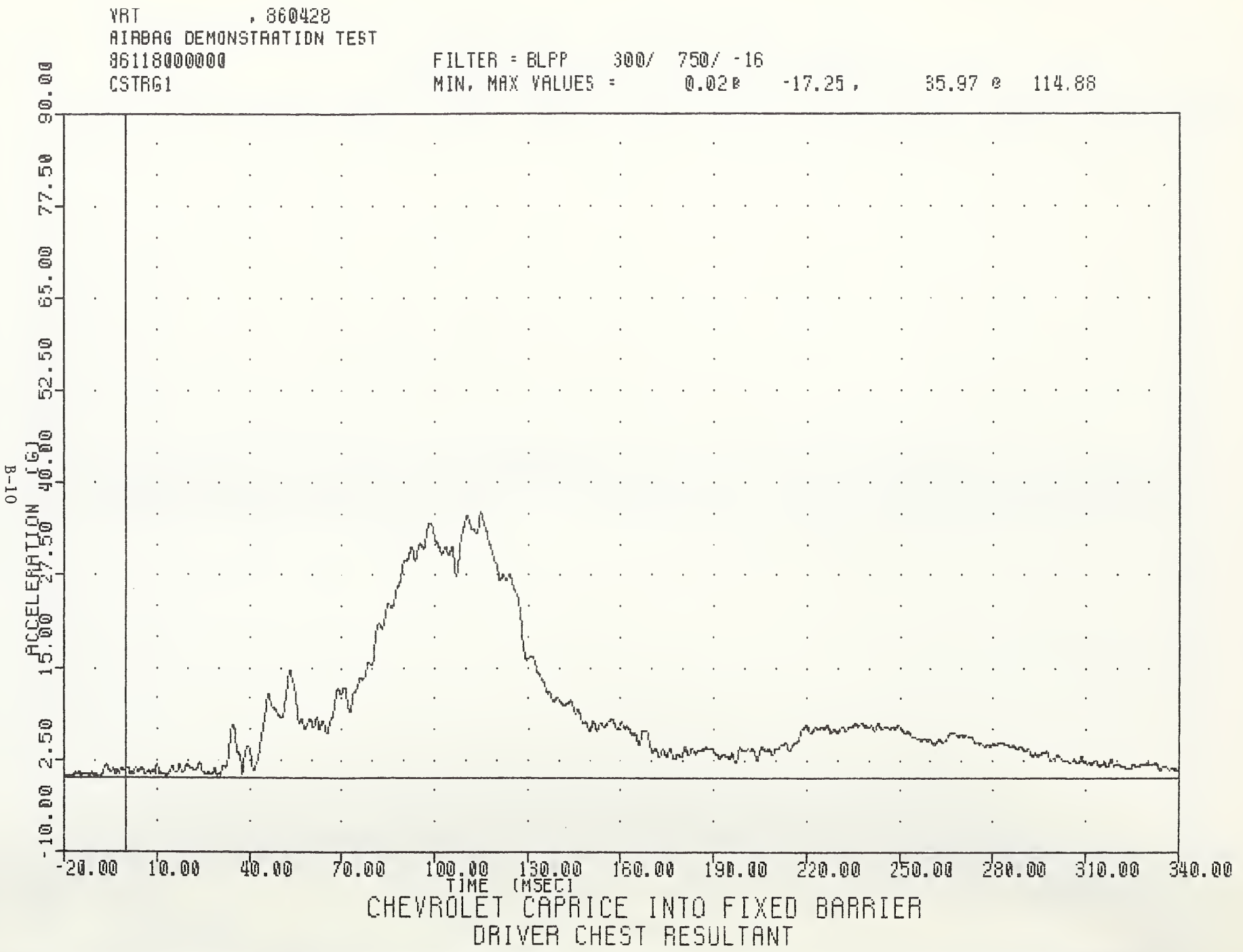


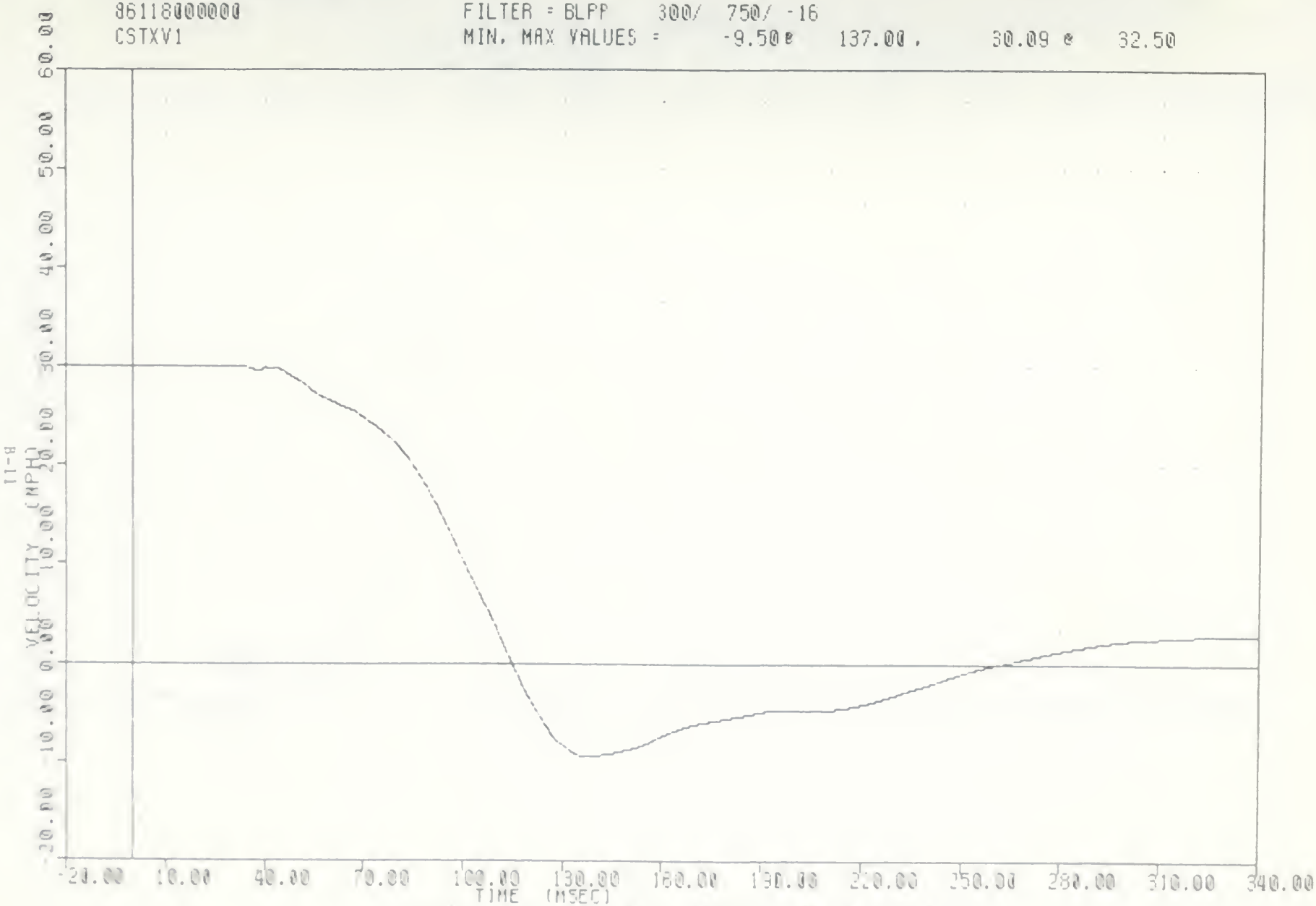
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER CHEST ACCELERATION Y AXIS

VAT , 860428
AIRBAG DEMONSTRATION TEST
861180@0000 FILTER = BLPP 300/ 750/ -16
CSTZ61 MIN, MAX VALUES = -13.52@ 127.00, 7.66@ 91.13

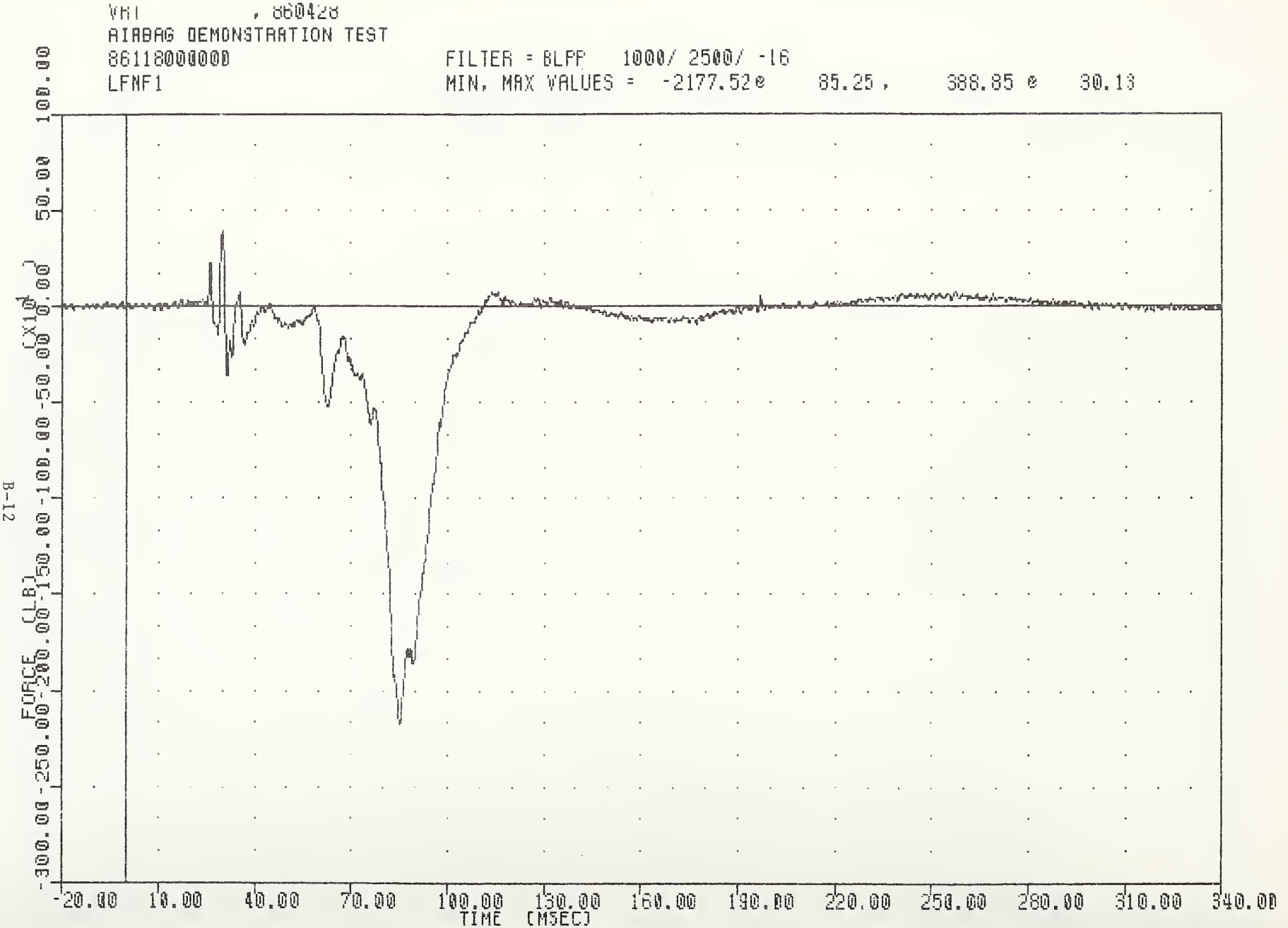


CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER CHEST ACCELERATION Z AXIS

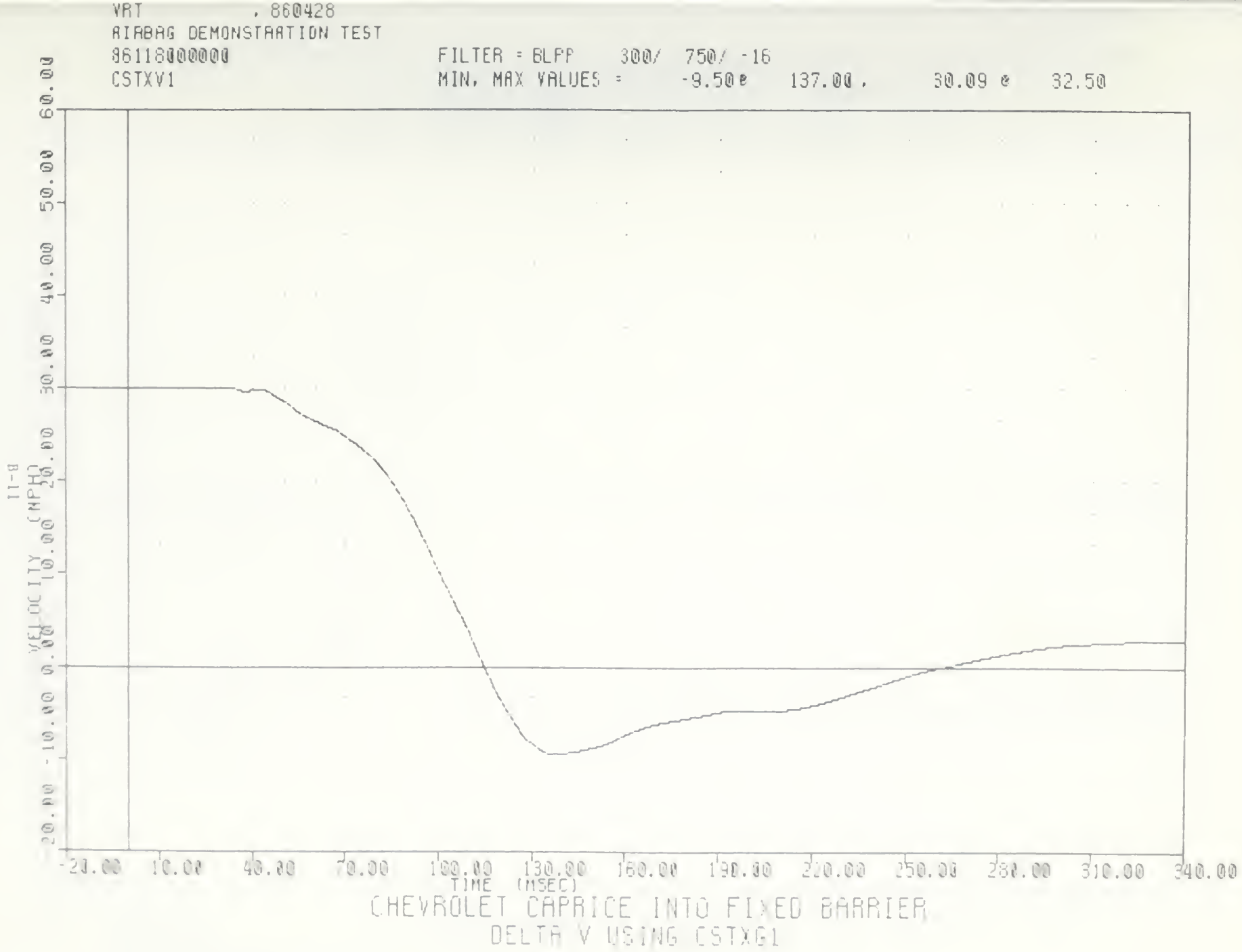

YRT , 860428
AIRBAG DEMONSTRATION TEST
86118000000
CSTRG1
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = 0.02 @ -17.25 , 35.97 @ 114.88
ACCELERATION (G)
90.00
77.50
65.00
52.50
40.00
27.50
15.00
2.50
-10.00
-20.00
10.00
40.00
70.00
100.00
130.00
160.00
190.00
220.00
250.00
280.00
310.00
340.00
TIME (MSEC)
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER CHEST RESULTANT



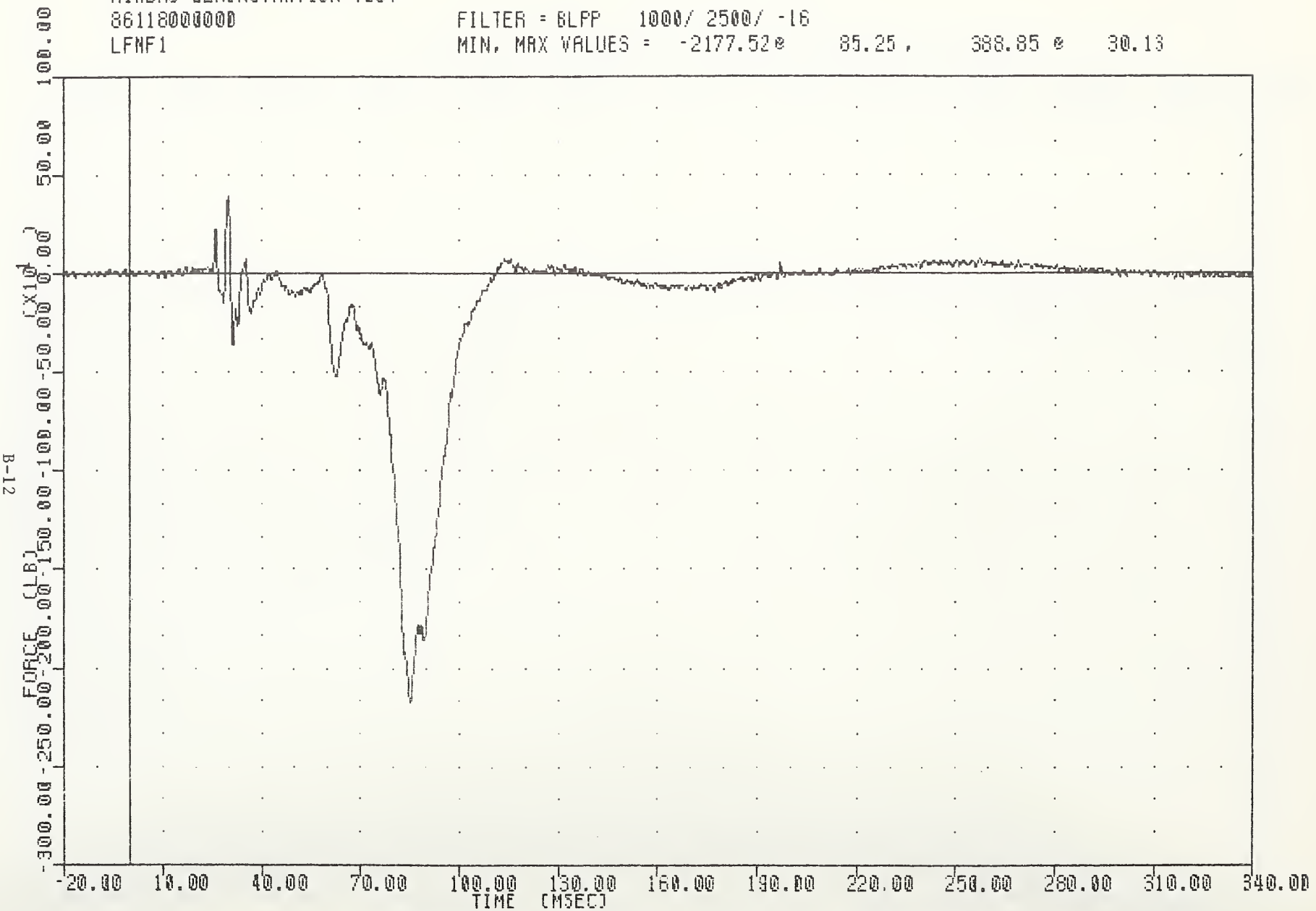
CHEVROLET CAPRICE INTO FIXED BARRIER
DELTA V USING CSTXG1



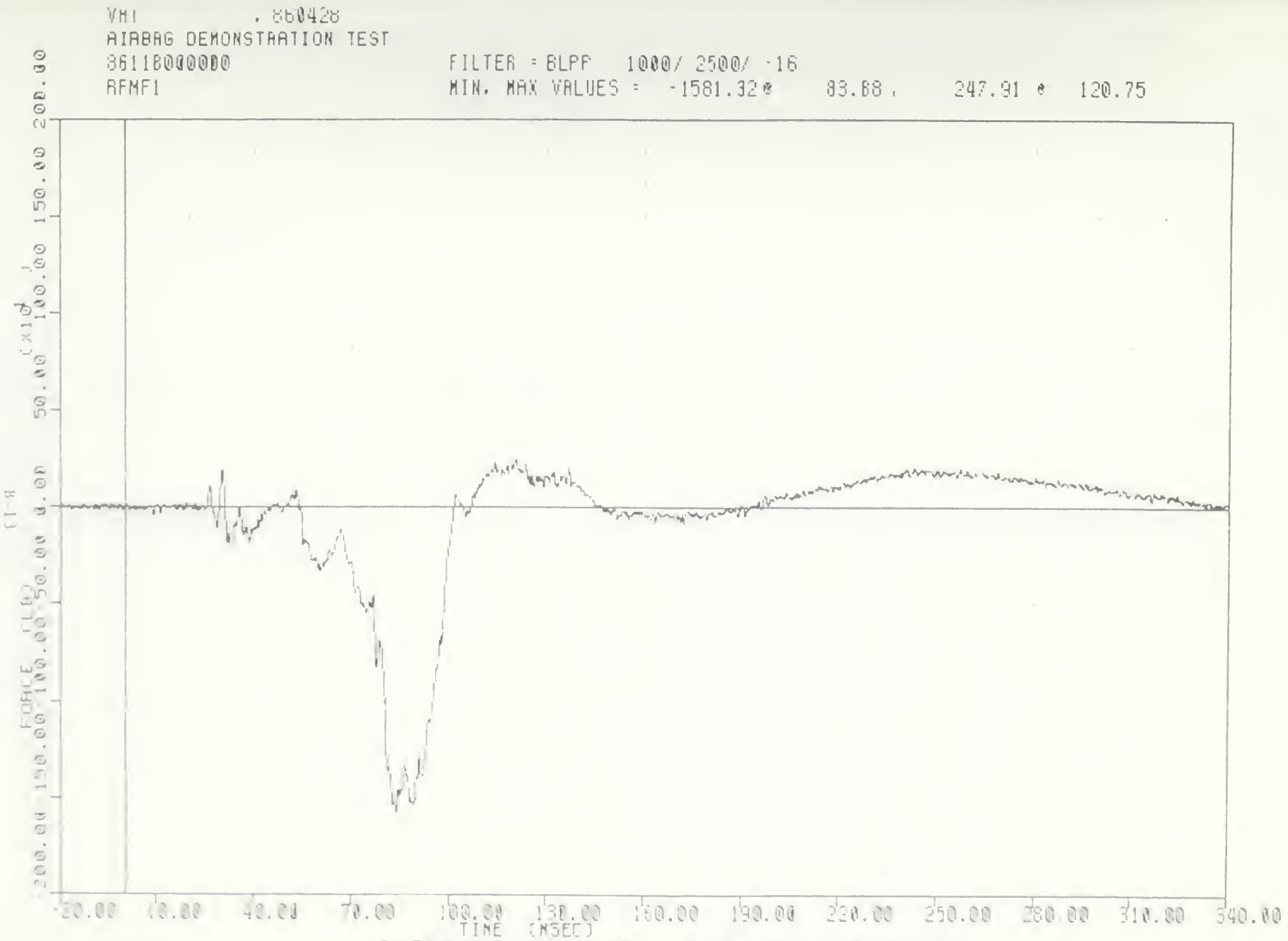
CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER LEFT FEMUR FORCE LBS



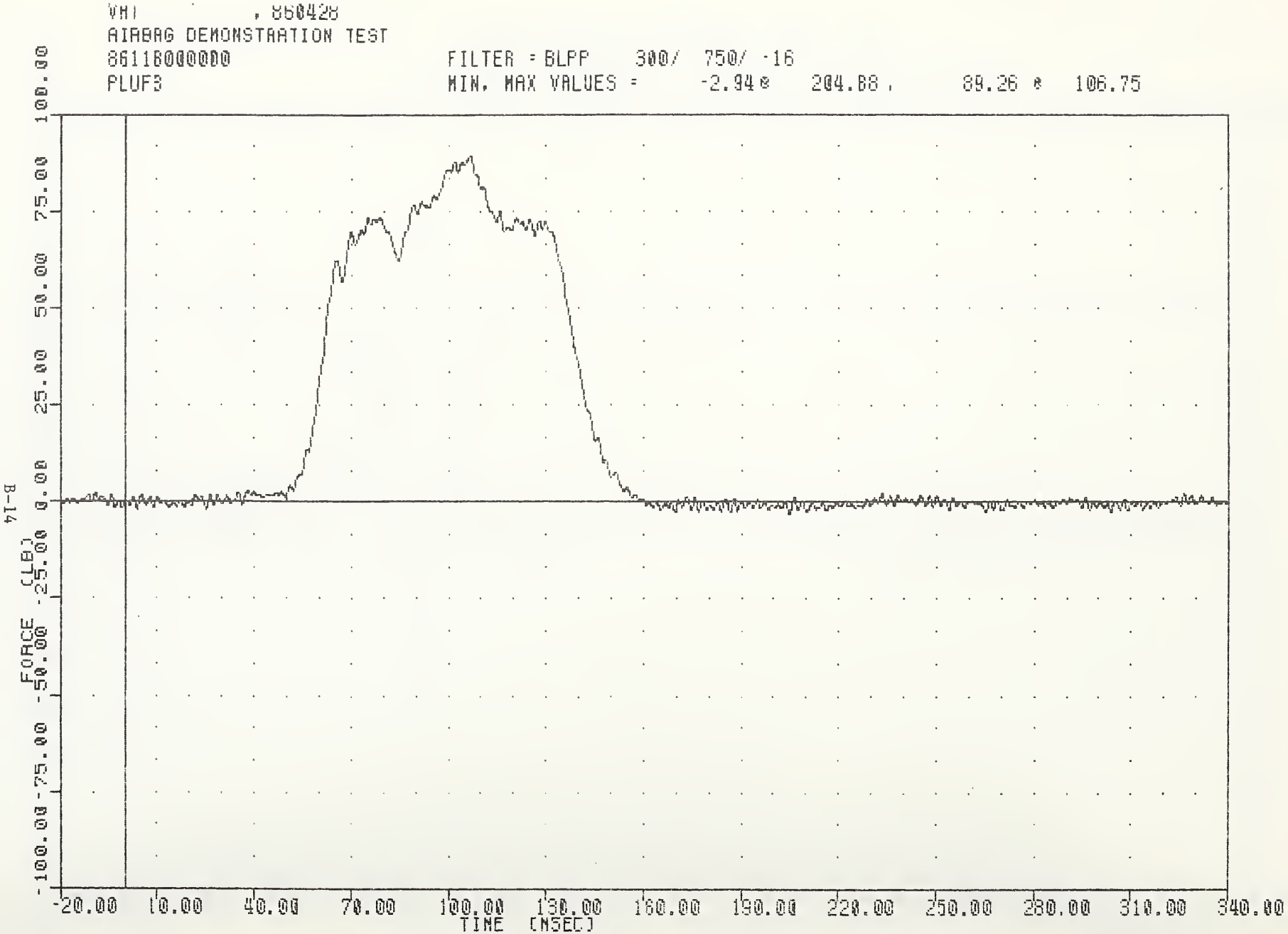
CHEVROLET CAPRICE INTO FIXED BARRIER
DELTA V USING CSTXG1



CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER LEFT FEMUR FORCE LBS

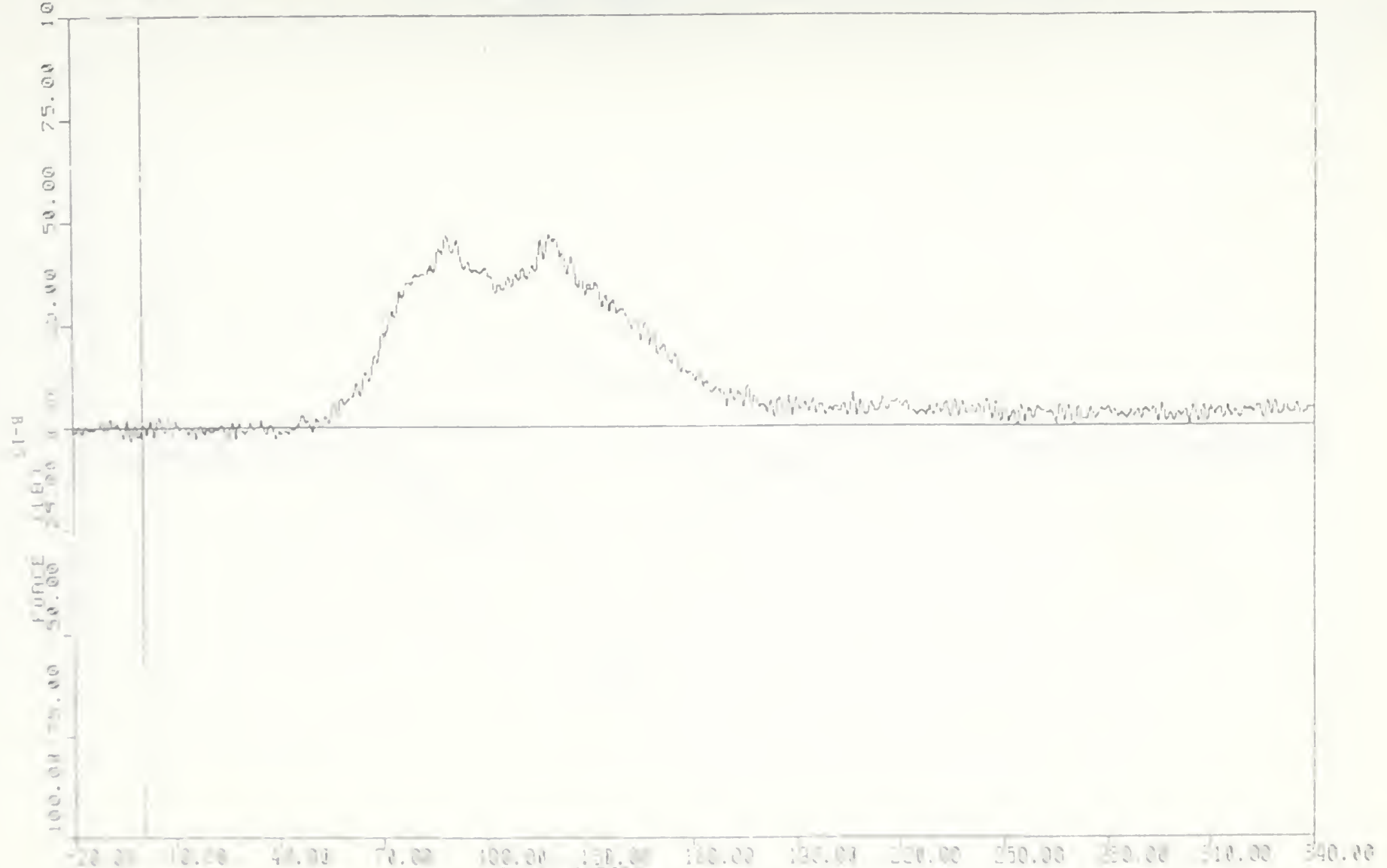


CHEVROLET CAPRICE INTO FIXED BARRIER
DRIVER RIGHT FEMUR FORCE LBS

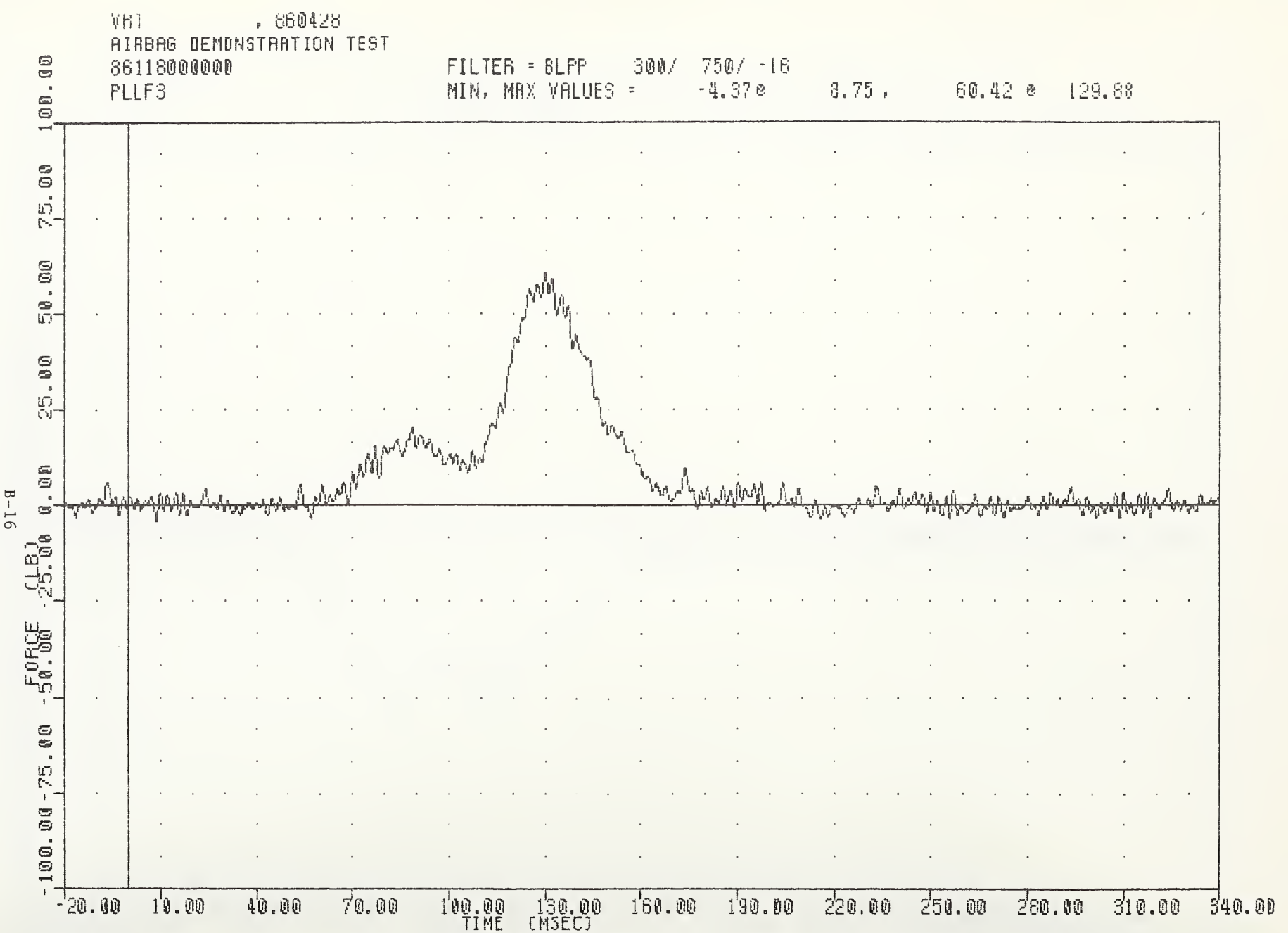


CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS LEFT UPPER FORCE LBS

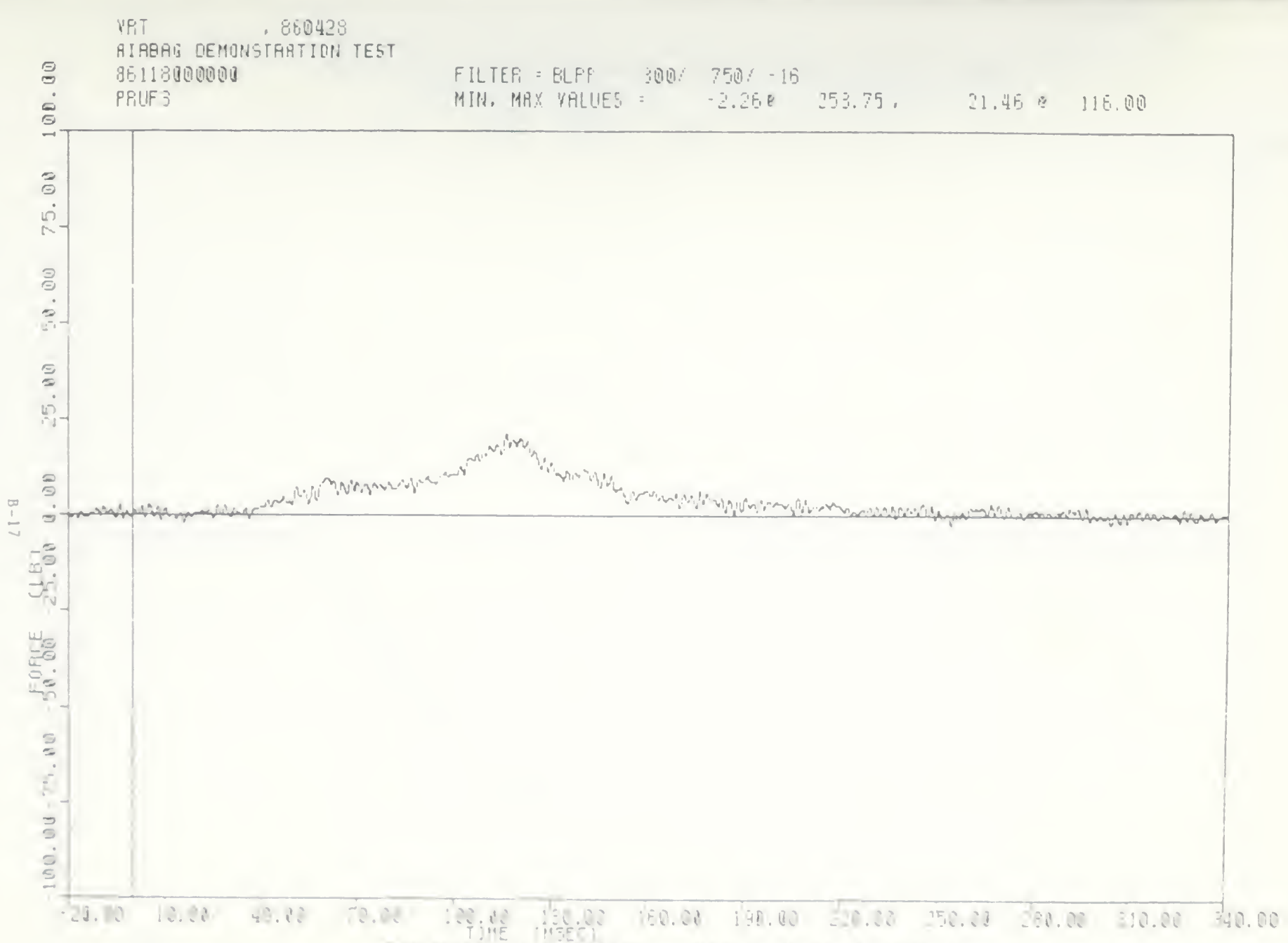
VnT , 860428
AIRBAG DEMONSTRATION TEST
6n1180000000
FLMF3
FILTER = BLPF 300/ 750/ -16
MIN. MAX VALUES = -3.29@ 25.13, 46.86 @ 118.50



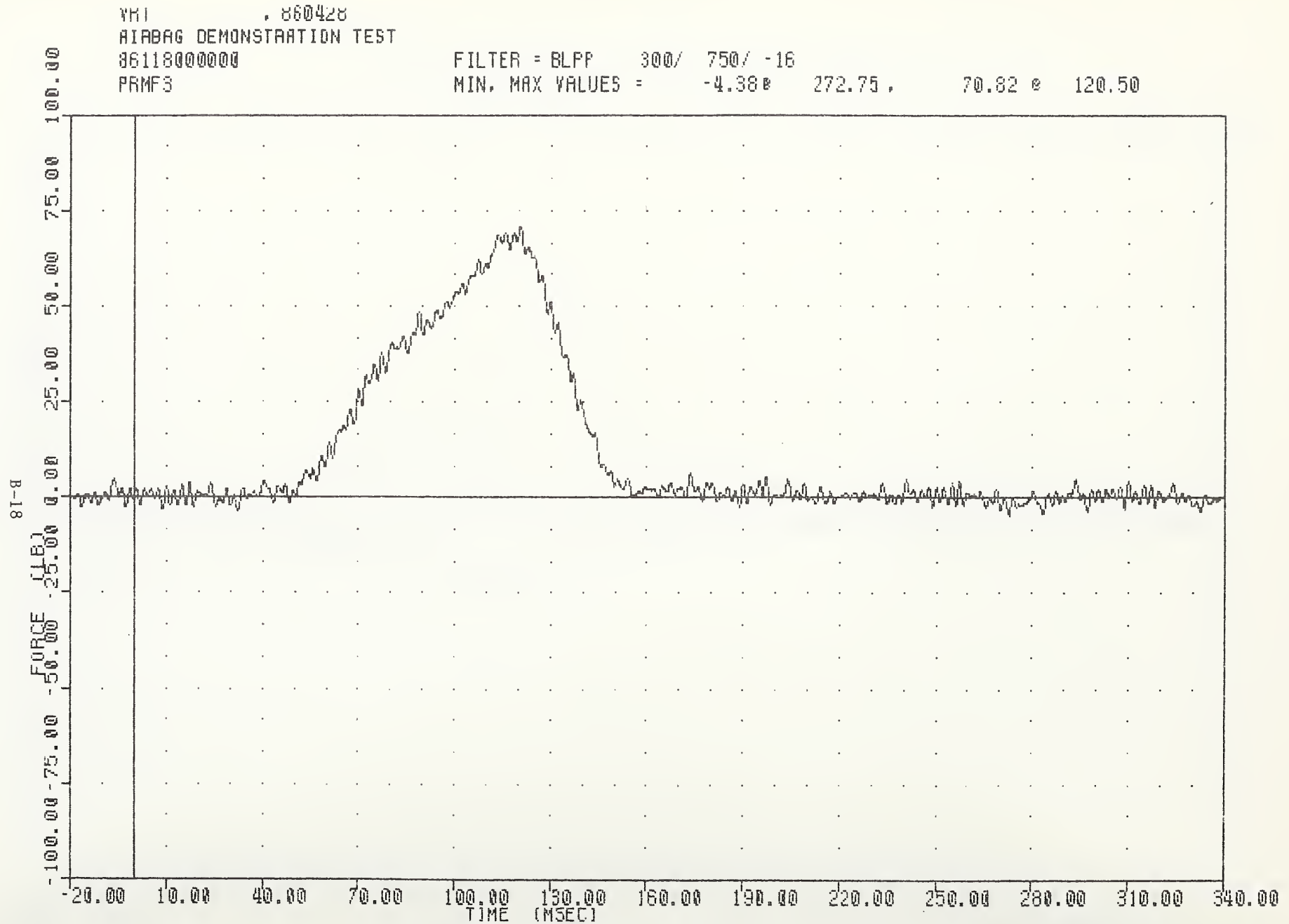
CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS LEFT MIDDLE FORCE LBS



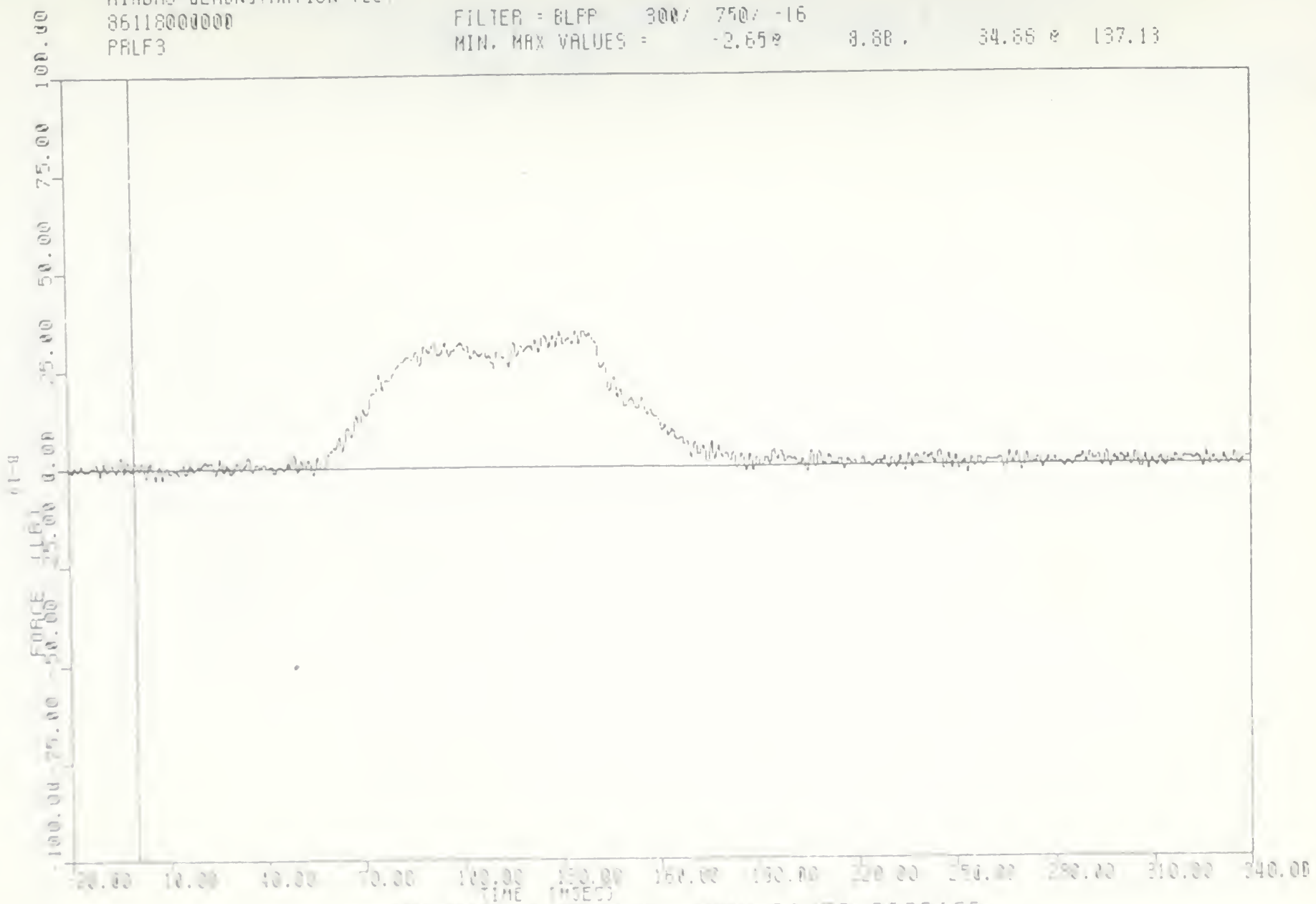
CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS LEFT LOWER FORCE LBS



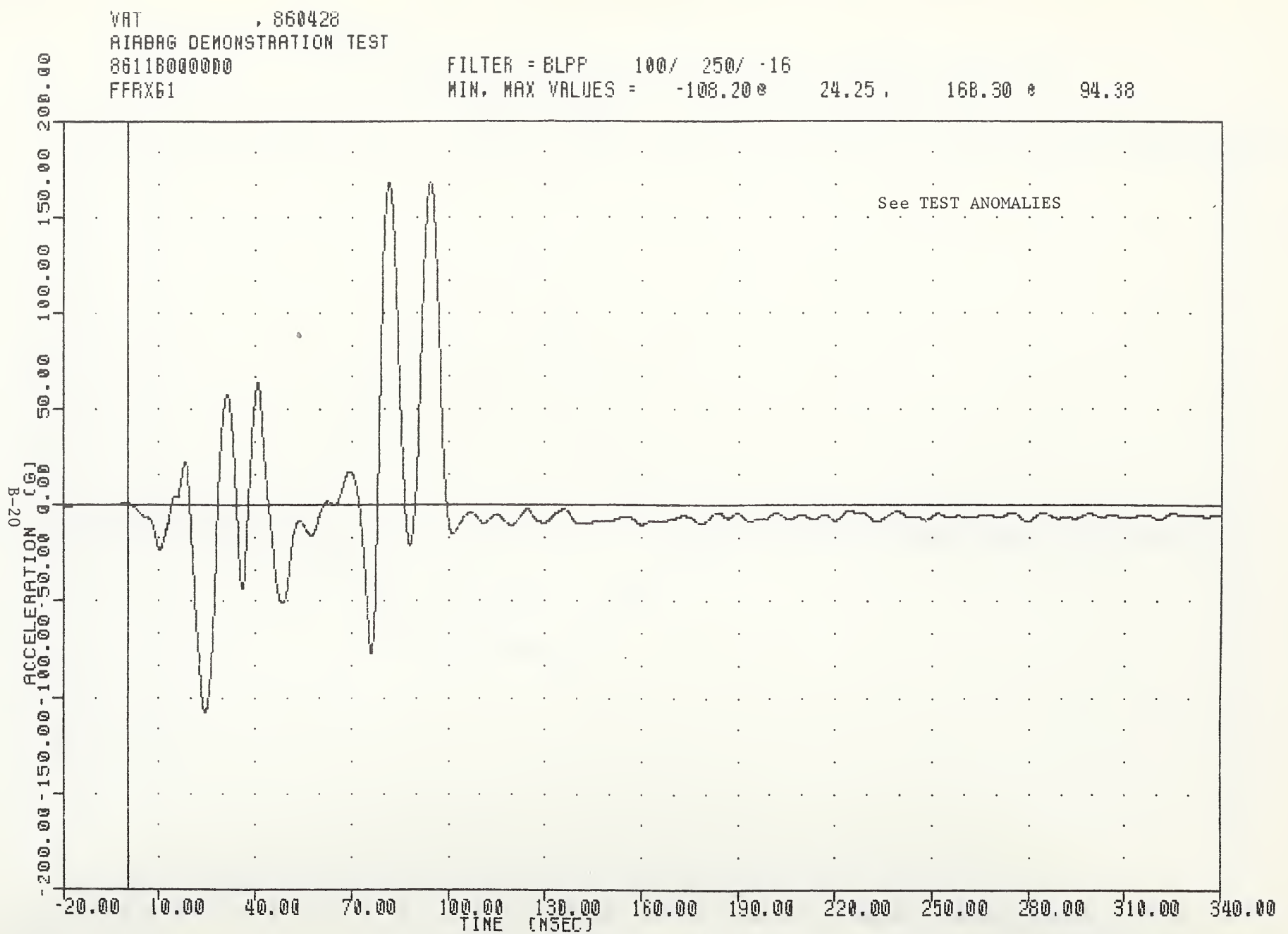
CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS RIGHT UPPER FORCE LBS



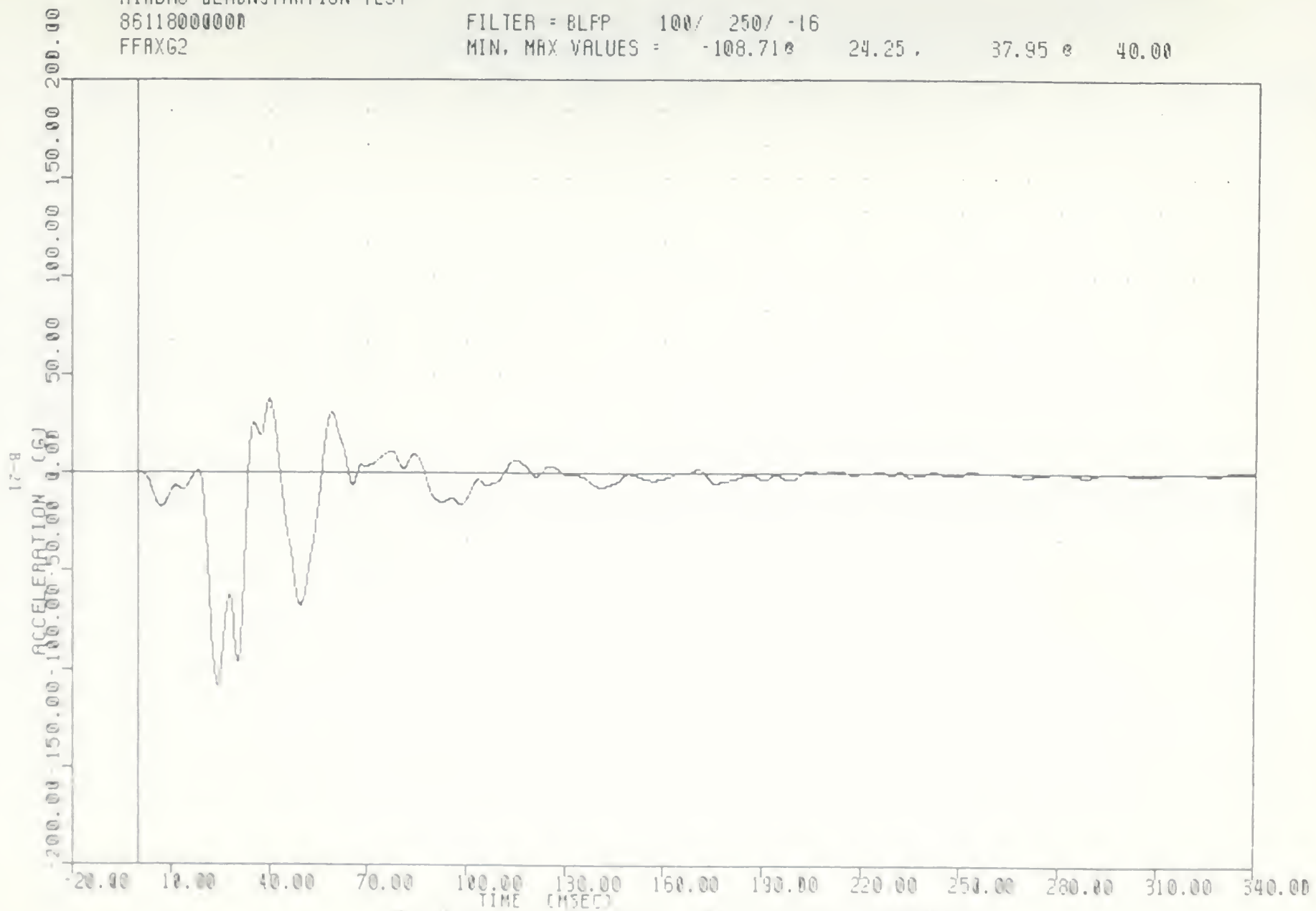
CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS RIGHT MIDDLE FORCE LBS



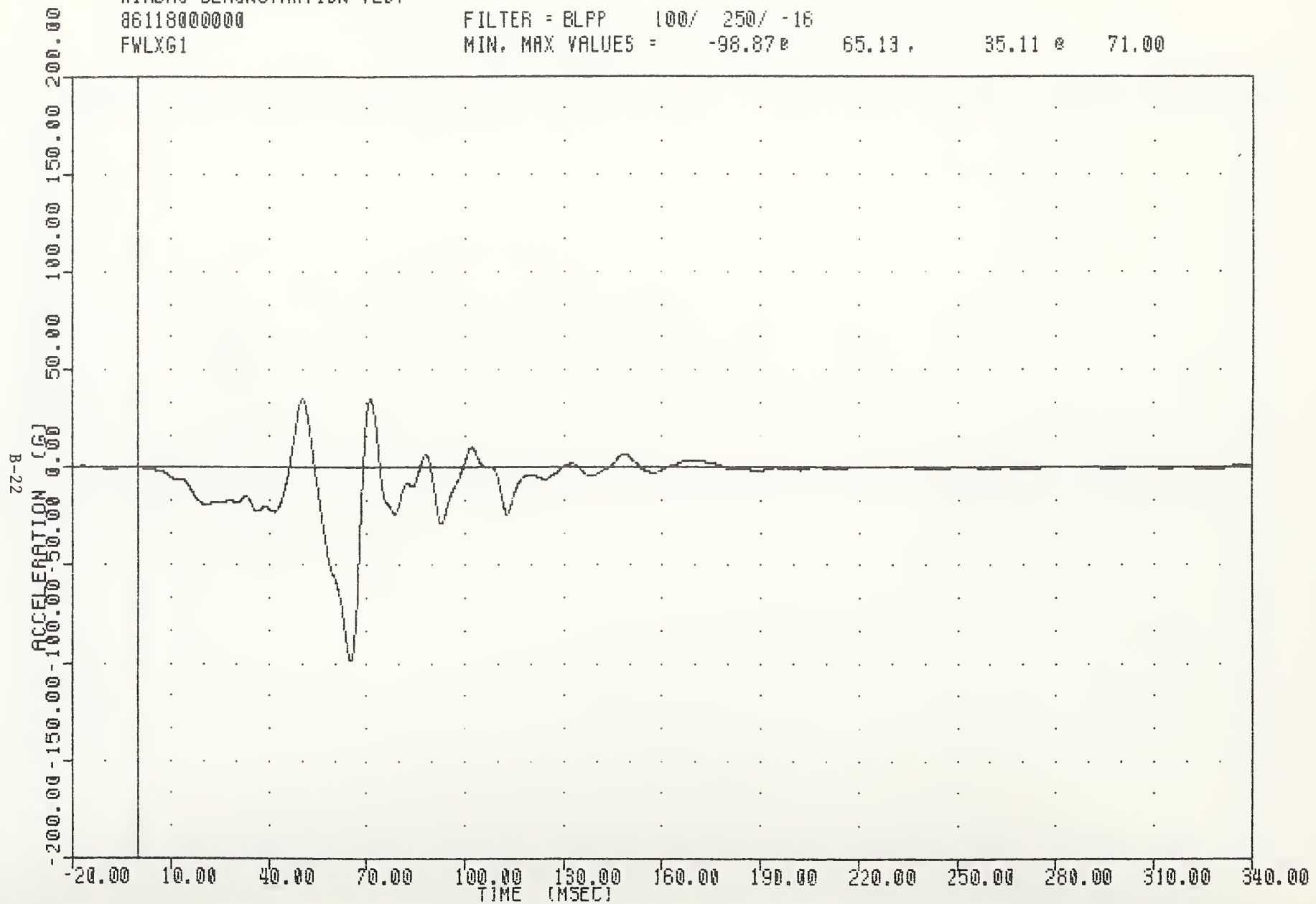
CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS RIGHT LOWER FORCE LBS



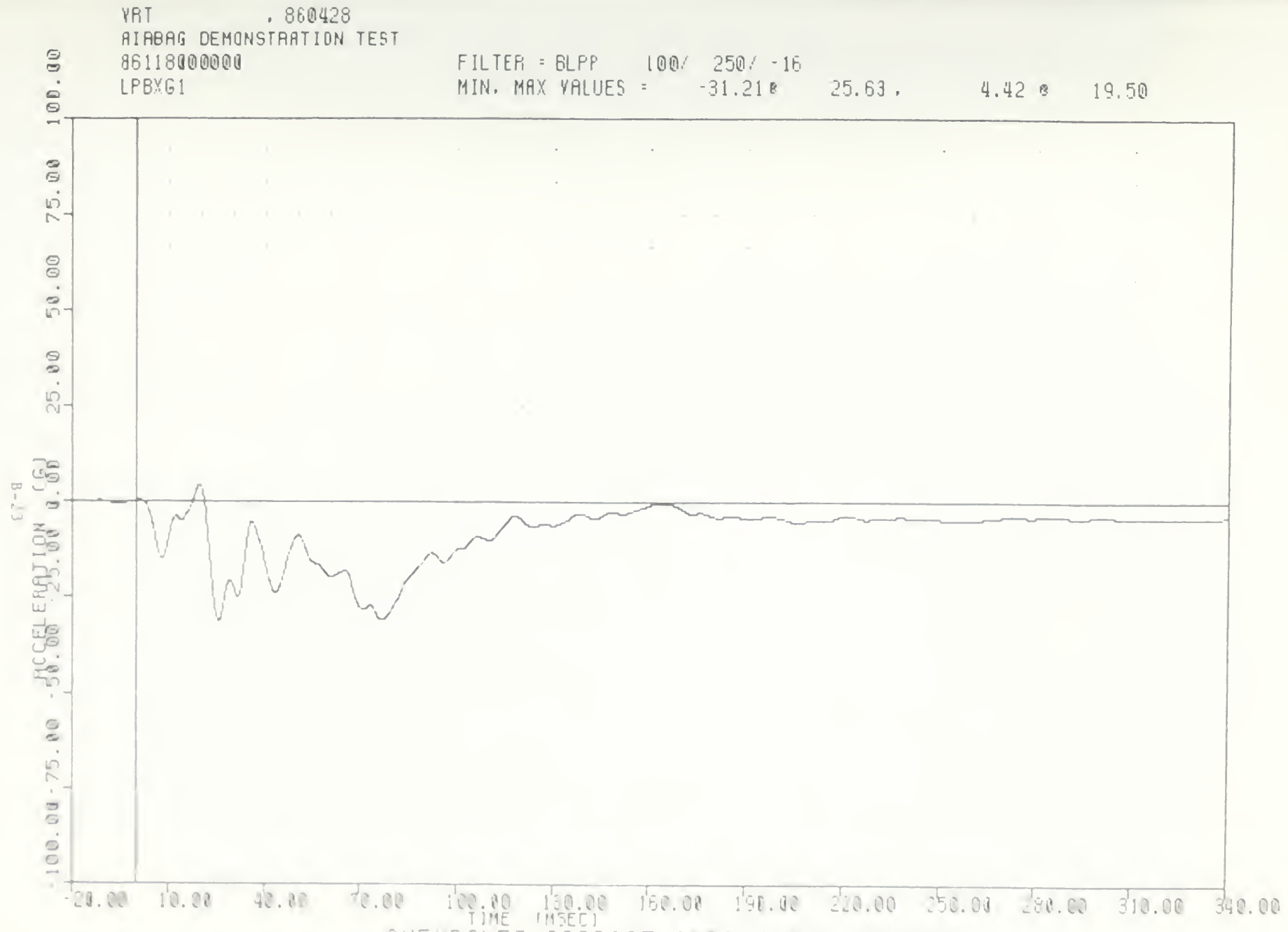
CHEVROLET CAPRICE INTO FIXED BARRIER
LEFT FORWARD FRAME RAIL ACCELERATION X AXIS



CHEVROLET CAPRICE INTO FIXED BARRIER
RIGHT FORWARD FRAME RAIL ACCELERATION X AXIS



CHEVROLET CAPRICE INTO FIXED BARRIER
FIREWALL ACCELERATION X AXIS



CHEVROLET CAPRICE INTO FIXED BARRIER
LEFT B PILLAR ACCELERATION X AXIS

APPENDIX C

DUMMY CERTIFICATION

PRE-TEST DRIVER

DUMMY CALIBRATION

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

PART 572 15-APR-88

TEMPERATURE 72.00 F RELATIVE HUMIDITY 35.00 %
ED18709 572 SN 187 EXT.DIMENSION CALCY

DESCRIPTION SN HUMANOID 187	SPECIFICATION	TEST RESULTS
Sitting Height	35.6 - 35.8IN	35.6 INS
Shoulder Pivot Height	21.8 - 22.4IN	22.3 INS
Hip Pivot Height	3.9 IN (ref.)	3.9 INS
Hip Pivot From Backline	4.8 IN (ref.)	4.8 INS
Knee Pivot From Backline	20.1 - 20.7IN	20.6 INS
Rear of Head From Backline	1.7 IN (ref)	1.7 INS
Chest Depth	9.1 - 9.6IN	9.5 INS
Shoulder Width	17.8 - 18.4IN	18.1 INS
Chest Circumference Over Nipples	36.8 - 40.0IN	37.0 INS
Waist Circumference at Min. Girth	31.4 - 32.6IN	32.5 INS
Hip Width	14.0 - 15.4IN	15.2 INS
Knee Pivot From Floor	19.3 - 19.9IN	19.4 INS

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572 15-APR-86

TEMPERATURE 72.00 F RELATIVE HUMIDITY 35.00 %
LF18709 572 SN 187 LUMBAR FLEX CAL09

DEFLECTION	SPECIFICATION	TEST RESULTS
0 Deg.	0 LBS	0.00 LBS
20 Deg	22.00 - 34.00 LBS	34.00 LBS
30 Deg	34.00 - 46.00 LBS	45.00 LBS
40 Deg	46.00 - 58.00 LBS	53.00 LBS
NET RETURN ANGLE	< 12 DEG	2.04 DEG

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572 15-APR-86

TEMPERATURE 71.00 F
AB18709

RELATIVE HUMIDITY 36.00 %
572 SN 187 ABDOM COMPR CAL 09

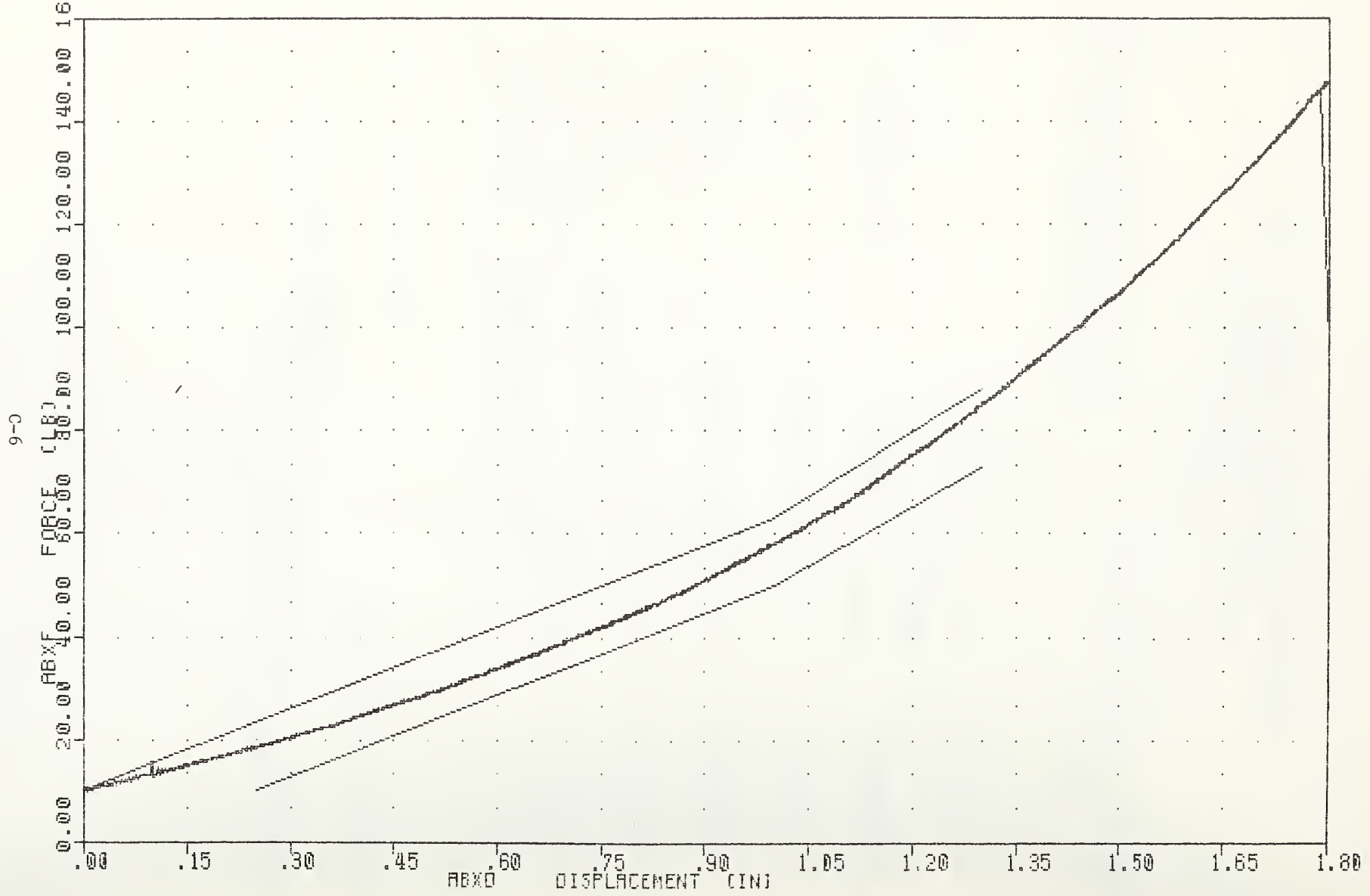
TEST CORRIDORS DISPLACEMENT	FORCE	TEST RESULTS
0 IN.	10 LBS	10 LBS
50 IN.	23.00 - 36.00 LBS	29.02 LBS
75 IN.	36.00 - 50.00 LBS	42.00 LBS
1.00 IN.	50.00 - 63.00 LBS	58.50 LBS
1.30 IN.	73.00 - 88.00 LBS	85.34 LBS

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Mary L. Phelps

,AB18Y09 572 SN 18/ ABDOM COMPR CAL 09 86105

ABXD	FILTER = ALPF	1650/ 5214/ -40	MIN, MAX =	0.00 @	0.00 ,	1.95 @ 96.05
ABXF	FILTER = ALPF	1650/ 5214/ -40	MIN, MAX =	9.87 @	0.00 ,	148.21 @ 1.80



ABDOMINAL COMPRESSION VS DISPLACEMENT

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572 15-APR-86

TEMPERATURE 71 F RELATIVE HUMIDITY 38 %
HD18709 572 SN 187 HEAD DROP CAL 69

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PEAK RESULTANT ACCELERATION	210 - 260 G	239.12 G
TIME ABOVE 100 G LEVEL	0.9 - 1.5 MS	1.26 MS
PEAK LATERAL ACCELERATION	10 G MAX	3.85 G
IS ACCELERATION CURVE UNIMODAL?		YES

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572 17-APR-86

TEMPERATURE 71.00 F RELATIVE HUMIDITY 39.00 %
HN18709 572 SN 187 HEAD/NECK CAL 09

Test Parameter	Specification	Test Results
Pendulum velocity	21.5 to 25.5 fps	23.51 fps
Pendulum Deceleration:		
T1 - T2: 5 - 20 G	3 ms. max	1.91 ms.
T2 - T3: 20 - 20 G	25 - 30 ms.	26.78 ms.
T3 - T4: 20 - 5 G	10 ms. max	7.83 ms.
Avg. G level T2 - T3	20 - 24 G	23.71 G
Maximum Rotation Angle	63 - 73 deg.	64.14 deg.
Peak Head Resultant Accel	26 G max	23.95 G

Test Parameter	Specification		Test Results	
Rotation Angle (degrees)	Time (ms.)	Chordal Disp. (in.)	Time (ms.)	Chordal Disp. (in.)
0	-2.0 - +2.0	-0.5 - +0.5	0.13	0.00
30	25.6 - 34.4	2.1 - 3.1	30.17	2.38
60	40.3 - 51.7	4.3 - 5.3	48.80	4.60
max	53.2 - 66.8	5.0 - 6.0	59.88	5.02
60	67.0 - 83.0	4.3 - 5.3	69.45	4.67
30	85.4 - 104.6	2.1 - 3.1	89.56	2.29
0	101.0 - 123.0	-0.5 - +0.5	103.65	0.10

* DUMMY MEETS SPECIFICATIONS

TECHNICAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572 17-APR-86

TEMPERATURE 71 F RELATIVE HUMIDITY 38 %
TL18709 572 SN 187 L.S.THORAX CAL 09

TEST PARAMETER	LOW SPEED TEST SPECIFICATION	TEST RESULTS
PENDULUM VELOCITY	13.86-14.14 FT/SEC	14.11 FT/SEC
PEAK DEFLECTION	1.1 INCHES MAX.	1.09 INCHES
PEAK RESISTIVE FORCE	1,450. POUNDS MAX.	1266. POUNDS
INTERNAL HYSTERESIS	50% - 70%	54.0%

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572 17-APR-86

TEMPERATURE 71 F RELATIVE HUMIDITY 38 %
TH18709 572 SN 187 H.S.THORAX CAL 09

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
PENDULUM VELOCITY	21.78-22.22 FT/SEC	22.03 FT/SEC
PEAK DEFLECTION	1.7 INCHES MAX.	1.57 INCHES
PEAK RESISTIVE FORCE	2,250. POUNDS MAX.	2009. POUNDS
INTERNAL HYSTERESIS	50% - 70%	53.7%

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572 17-APR-86

TEMPERATURE 71 F RELATIVE HUMIDITY 37 %
LEFT KNEE
LK18709 572 SN 187 L.KNEE IMP CAL 09

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PROBE VELOCITY	6.76 - 7.04 FT/SEC	6.83 FT/SEC
PEAK KNEE IMPACT FORCE	1850 - 2500 LBS.	2295.60 LBS.
DURATION ABOVE 1000 LBS.	=1.7 MS.	1.75 MS.

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572 17-APR-86

TEMPERATURE 72 F RELATIVE HUMIDITY 37 %
RIGHT KNEE
RK18709 572 SN 187 R.KNEE IMP CAL 09

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PROBE VELOCITY	6.76 - 7.04 FT/SEC	6.89 FT/SEC
PEAK KNEE IMPACT FORCE	1850 - 2500 LBS.	1852.41 LBS.
DURATION ABOVE 1000 LBS.	>=1.7 MS.	1.74 MS.

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

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