DOT494

AIR BAG DEMONSTRATION TEST

1981 DODGE ARIES INTO A FIXED BARRIER AT 30.1 MPH

PREPARED BY:
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FINAL REPORT
MAY 1986

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
400 SEVENTH STREET, S.W.
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16. Abstract

This test report documents an air bag demonstration crash test. Testing was conducted on a 1981 Dodge Aries 4-door Sedan at the TRCO Crash Test Facility, East Liberty, Ohio. The test vehicle was impacted into a fixed, non-yielding barrier at 30.1 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. Occupant responses relative to FMVSS 208 were measured for both dummies along with vehicle accelerations. In addition, the Hybrid III dummy was instrumented with pelvis force load cells that measure lap belt induced loads on the pelvis. The test date was May 1, 1986 and the ambient temperature was 60°F.

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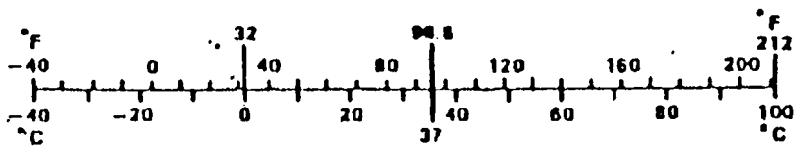
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

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

Approximate Conversions From Metric Measures

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



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SECTION 1.0
PURPOSE AND 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 1981 Dodge Aries 4-door Sedan was towed into a fixed rigid barrier on May 1, 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 30.1 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: Chrysler Corporation

MAKE/MODEL: Dodge Aries VIN: 1B3BK26B8BC178099

BODY STYLE: 4-Door Sedan MODEL YEAR: 1981

NHTSA NO.: R & D COLOR: Beige

ENGINE DATA: TYPE: Inline CYLINDERS: 4 DISPLACEMENT 2213cc

TRANSMISSION DATA: Automatic

DATE VEHICLE RECEIVED: 4/21/86 ODOMETER READING: 68,993

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

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

DATE OF MANUFACTURE: 1/81

GVWR: 3665 LBS.,

GAWR: FRONT 1940 LBS., REAR 1775 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): Dayton Quadra P165/80R13

BIAS PLY, BELTED, OR RADIAL: Radial

PLY RATING: 3

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	736	LBS.	RIGHT REAR	465	LBS.
LEFT FRONT	794	LBS.	LEFT REAR	446	LBS.
TOTAL FRONT WEIGHT	1530	LBS. (62.7 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	911	LBS. (37.3 % OF TOTAL VEHICLE WEIGHT)			
TOTAL DELIVERED WEIGHT	2441	LBS.			

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	RF 25.3	;LF 25.4	;RR 24.8	;LR 25.0
PRE-TEST ATTITUDE:	RF 24.5	;LF 24.5	;RR 21.4	;LR 22.3
POST-TEST ATTITUDE:	RF 26.4	;LF 27.3	;RR 21.4	;LR 22.3

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 234 LBS. CARGO:

RIGHT FRONT	758	LBS.	RIGHT REAR	667	LBS.
LEFT FRONT	861	LBS.	LEFT REAR	720	LBS.
TOTAL FRONT WEIGHT	1619	LBS. (53.9 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	1387	LBS. (46.1 % OF TOTAL VEHICLE WEIGHT)			
TOTAL TEST WEIGHT	3006	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: 13.0 GALLONS (92-94% OF USEABLE)

FUEL SYSTEM CAPACITY (DATA FROM OWNERS MANUAL): 13.0 GALLONS

DETAILS OF FUEL SYSTEM: DNA

ELECTRIC FUEL PUMP: Yes FUEL INJECTION: No

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

VEHICLE REBOUND AND CRUSH

OVERALL LENGTH OF TEST VEHICLE: PRE-TEST: R 173 ;L 173 1/8 ;C 175 3/8

POST-TEST: R 154 1/4 ;L 153 3/8 ;C 154 3/16

TOTAL CRUSH: R 18 3/4 ;L 19 3/4 ;C 21 3/16

FOR FRONTAL IMPACTS, DISTANCE FORM FRONT OF TEST VEHICLE TO BARRIER AFTER IMPACT: CENTER: 8 1/2 ; R 8 5/8 ; L 9 1/4

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: P175/75R13 LOAD RANGE: X B, C,

VEHICLE CAPACITY: TYPE OF SEATS: Bench - front & rear

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

CARGO LOAD 115 LBS.

TOTAL 1015 LBS.

TEST CONDITIONS

TEST NUMBER: 860501

DATE OF TEST: May 1, 1986	TIME OF TEST: 11:59
WIND VELOCITY: 10-15 mph @ 306°	HUMIDITY: NA
AMBIENT TEMPERATURE AT IMPACT AREA:	60°F
TEMPERATURE IN OCCUPANT COMPARTMENT:	73°F
TEMPERATURE OF DRIVER DUMMY	71°F
TEMPERATURE OF PASSENGER DUMMY	71°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (LBS.)	3006	2887
VEHICLE ORIENTATION (DEGREES)	0	0
VEHICLE VELOCITY (mph)	30.1	30.0
MAXIMUM CRUSH (INCHES):	21.2	N/A
STEERING COLUMN STROKE (in.)	1 3/4	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				3
CHEST ACCEL.:	3				3
FEMUR L.C.'S:	2				2
OTHER:					6 Pelvis load bolts
RESTRAINT SYSTEM:	Romeo Kojyo airbag & knee bar				lap belt only

VISIBLE DUMMY CONTACT POINTS:

	DRIVER 187	RIGHT REAR PASSENGER 45
Head	Airbag	Seatback
Chest	Airbag	None
Abdomen	None	None
Left Knee	Knee bolster	None
Right Knee	Knee bolster	Seatback

DOOR OPENING:

	LEFT	RIGHT
Front	Tools required	Tools required
Rear	Normal	Tools required

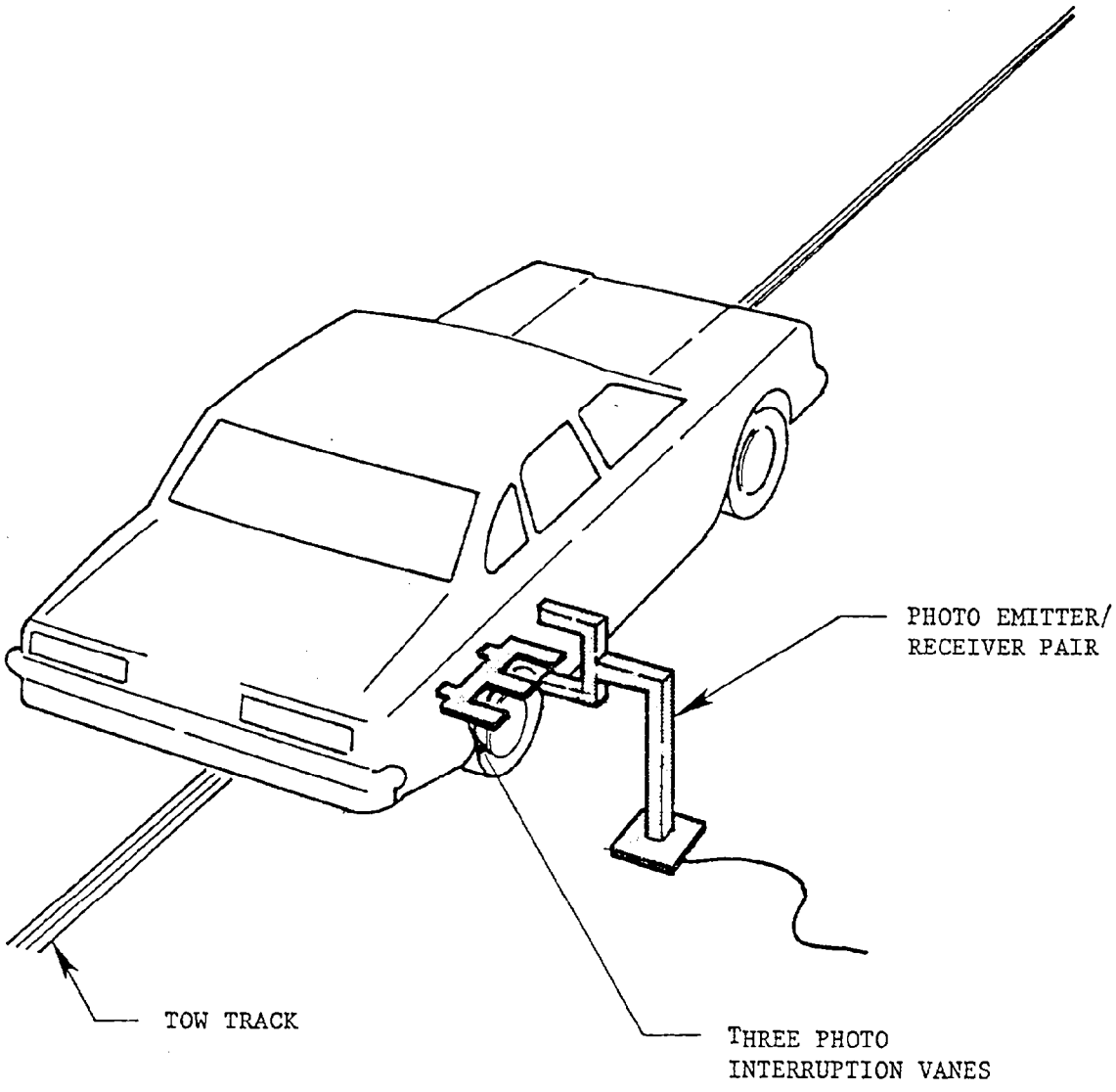
SEAT MOVEMENT:

	SEAT BACK FAILURE	SEAT SHIFT
Front	None	Seat track latch failed
Rear	None	None

GLAZING DAMAGE: Windshield was shattered

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
= 2441 + 1 X 164 + 1 X 167 + 115 lbs.
= 2887 lbs.

To achieve test weight, 13.0 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 accelerometer, HEDYG1, did not return to zero following impact.

The driver's right femur force transducer, RFMF1, recorded anomalous spikes at approximetely 175 and 270 msec.

The passenger's X axis head accelerometer, HEDXG3, did not return to zero following impact.

The passenger's X axis chest accelerometer CSTXG2, recorded anomalous spikes at approximately 35, 51, and 148 msec.

The passenger's Y axis chest accelerometer, CSTYG3, recorded an anomalous spike at 125 msec.

The passenger's Z axis chest accelereometer, CSTZG3, recorded anomalous data throughout the test.

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.

DUMMY PLACEMENT AND POSITIONING (CONTINUED)

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: Dodge Aries

SEAT TYPE: X Bench ADJUSTER TYPE: X Manual

____ Bucket ____ Power

____ Split bench

TECHNICIANS:

BUCKET SEAT BACK TYPE: X Fixed 1. J. Clarridge

____ Adjustable Reclining 2. B. Miller

POSITIONING DATE: 5/1/86 3. T. Tomlin

AMBIENT TEMP.: 72° F. TIME: 8:45 a.m. 4. ____

DRIVER DUMMY # 187 TYPE P572

Head 20 1/8"

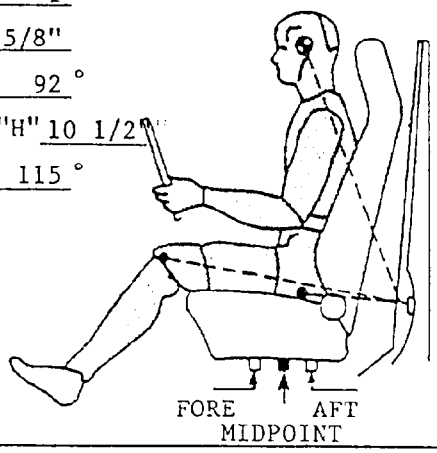
Target 1 °

Knee 24 5/8"

Joint 92 °

Approx. "H" 10 1/2"

Point 115 °



PASSENGER DUMMY # 45 TYPE HIII

(Right rear)

Head 15 1/2"

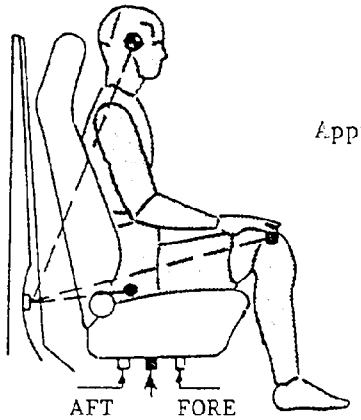
Target 2 °

Knee 23 1/8"

Joint 95 °

Approx."H" 12"

Point 140 °



A = N/A

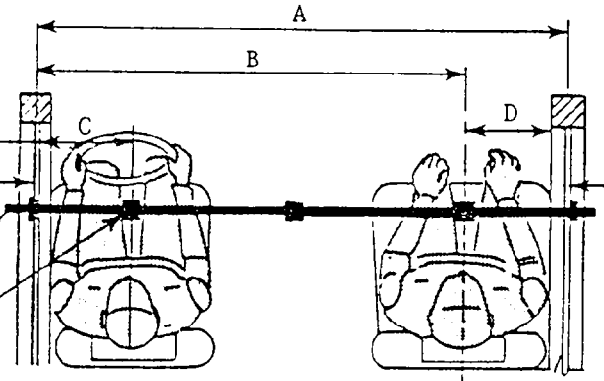
B = N/A

C = 12 7/8"

D = N/A

Door glass height 9 1/2"

Lateral bar Adjustable Pointer



Door glass height N/A

Left Front Door

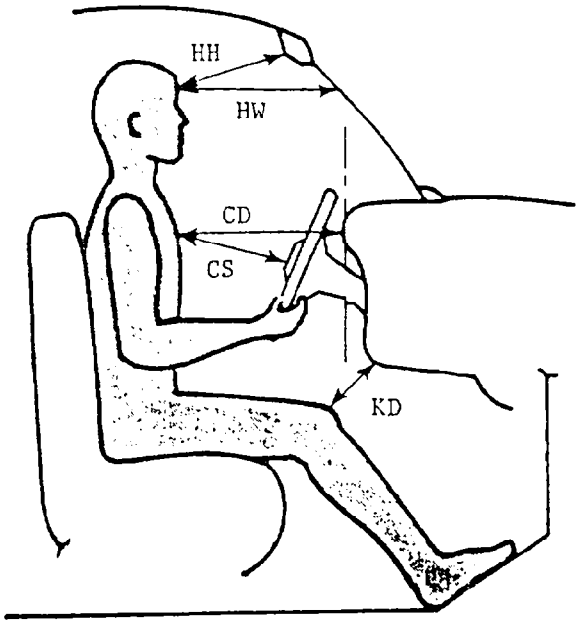
Driver Dummy# 187

Passenger Dummy# N/A

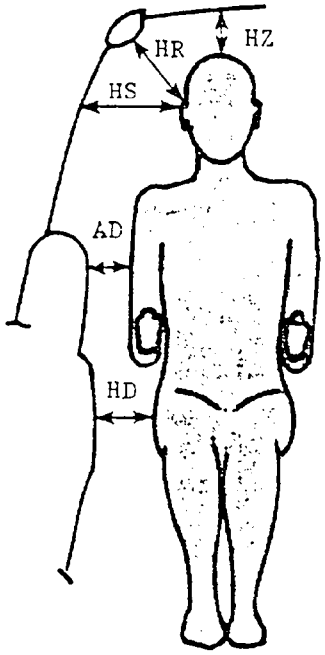
Right Front Door

DUMMY IN-VEHICLE POSITION RECORDING SHEET

	DRIVER 187	RIGHT REAR PASSENGER 45
HH	15 3/8	N/A
HW	20 1/8	21 1/2*
CD	23 5/16	18 3/4*
CS	14 1/8	N/A
KDL	5 3/8	3 5/8*
KDR	6 1/16	3 1/2*



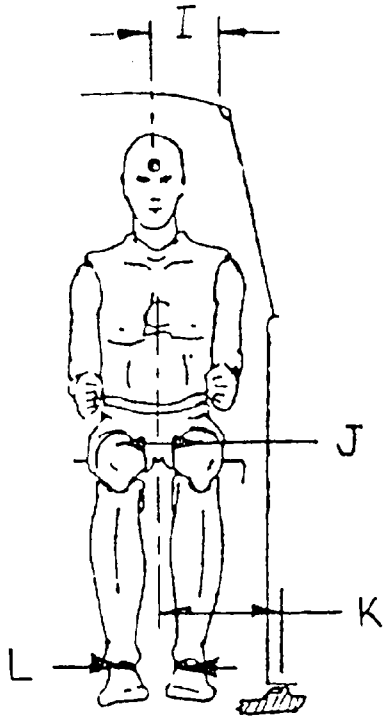
	DRIVER 187	RIGHT REAR PASSENGER 45
HR	6 11/16	8 1/4
HS	9 3/16	7 1/2
AD	4 7/8	5 1/8
HD	7 1/8	6 3/8
HZ	2 7/8	4 3/16

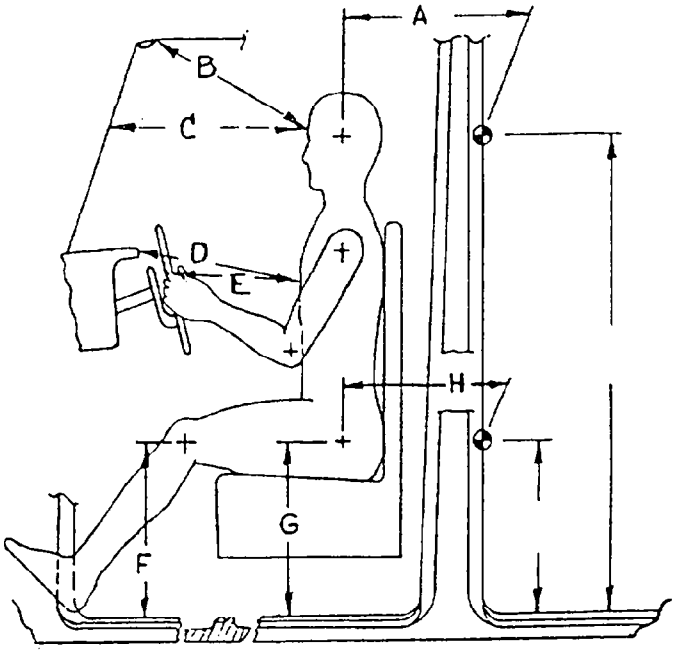


ALL MEASUREMENTS IN INCHES

* Measured to back of front seat

DUMMY IN-VEHICLE POSITION RECORDING SHEET





A = 8 5/8	E = 14 1/8	I = 7"
B = 15 3/8	F = 10 1/2	J = 10 1/8
C = 20 1/8	G = 5 5/8	K = 15 1/2
D = 23 5/16	H = 14 1/8	L = 8 1/8

SEAT POSITION - Mid Position

HEAD REST POSITION - Down

ALL MEASUREMENTS IN INCHES

DUMMY KINEMATIC SUMMARY

DRIVER

During impact, the dummy just began to move forward slightly when the airbag inflated. The dummy continued forward as its knees impacted the lower instrument panel and its head and torso were restrained by the airbag. The dummy rebounded from the airbag toward the left side of the car. The dummy came to rest sitting on the seat and leaning to the left.

RIGHT REAR PASSENGER

During impact, the dummy slid forward on the seat until its right knee contacted the back of the front seat. The dummy continued forward as its torso rotated forward about the waist until its chest contacted its knees. The dummy rebounded and came to rest sitting on the seat and leaning forward.

DUMMY DATA SUMMARY

	DRIVER DUMMY			
	POSITIVE DIRECTIONS*		NEGATIVE DIRECTIONS**	
	MAX	TIME (msec)	MAX	TIME (msec)
HEAD ACCELERATION (g)				
LONGITUDINAL	14.89	136.00	49.48	89.00
LATERAL	4.67	22.13	24.41	129.25[Y]
VERTICAL	20.74	80.13	30.66	117.75
RESULTANT	52.02	89.00		
HIC	378.42	from 81.13 to 96.13 msec.		
DELTA V (MPH)	39.2	223.13		
CHEST ACCELERATION (g)				
LONGITUDINAL	11.53	191.75	37.24	102.50
LATERAL	8.42	120.75	4.68	191.25
VERTICAL	4.45	238.75	13.13	122.25
RESULTANT	38.51	102.50		
DELTA V (MPH)	42.8	156.25		
3 MSEC CLIP	36.95			
FEMUR FORCE*** (lb)				
LEFT	216.42	15.88	1372.78	66.63
RIGHT	---	---[X]	1695.15	73.38

* LONGITUDINAL: FORWARD
LATERAL: RIGHTWARD
VERTICAL: DOWNWARD

** LONGITUDINAL: REARWARD
LATERAL: LEFTWARD
VERTICAL: UPWARD

*** COMPRESSION: NEGATIVE

[X] No positive value in the time interval of interest

[Y] See TEST ANOMALIES

DUMMY DATA SUMMARY

PASSENGER DUMMY

	POSITIVE DIRECTIONS* MAX	POSITIVE DIRECTIONS* TIME (msec)	NEGATIVE DIRECTIONS* MAX	NEGATIVE DIRECTIONS* TIME (msec)
HEAD ACCELERATION (g)				
LONGITUDINAL	21.40	30.50	102.91	130.50
LATERAL	20.93	152.88	34.84	130.75
VERTICAL	96.91	126.75	6.43	302.13
RESULTANT	132.81	131.25		
HIC	2785.48	from 108.75 to 140.38 msec.		
DELTA V (mph)	---	--- Y		
CHEST ACCELERATION				
LONGITUDINAL	---	--- Y	41.03	88.25
LATERAL	7.13	81.88	---	--- Y
VERTICAL	---	--- Y		
RESULTANT	---	--- Y		
DELTA V (mph)	---	--- Y		
3 MSEC CLIP	---	--- Y		
PELVIS FORCE** (lb)				
LEFT UPPER	24.61	66.63	1.65	29.00
LEFT MIDDLE	71.66	99.38	1.75	24.50
LEFT LOWER	73.80	89.88	2.14	337.88
RIGHT UPPER	11.51	140.63	2.28	24.63
RIGHT MIDDLE	28.28	142.88	1.83	8.00
RIGHT LOWER	115.05	140.25	3.37	7.88
FEMUR FORCE*** (lb)				
LEFT	487.39	90.75	533.14	118.63
RIGHT	612.69	90.00	663.12	138.13

* LONGITUDINAL: POSITIVE FORWARD — NEGATIVE REARWARD
LATERAL: POSITIVE RIGHTWARD — NEGATIVE LEFTWARD
VERTICAL: POSITIVE DOWNWARD — NEGATIVE UPWARD

** Force on pelvis from lap belt is positive

*** COMPRESSION: NEGATIVE

Y See TEST ANOMALIES

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

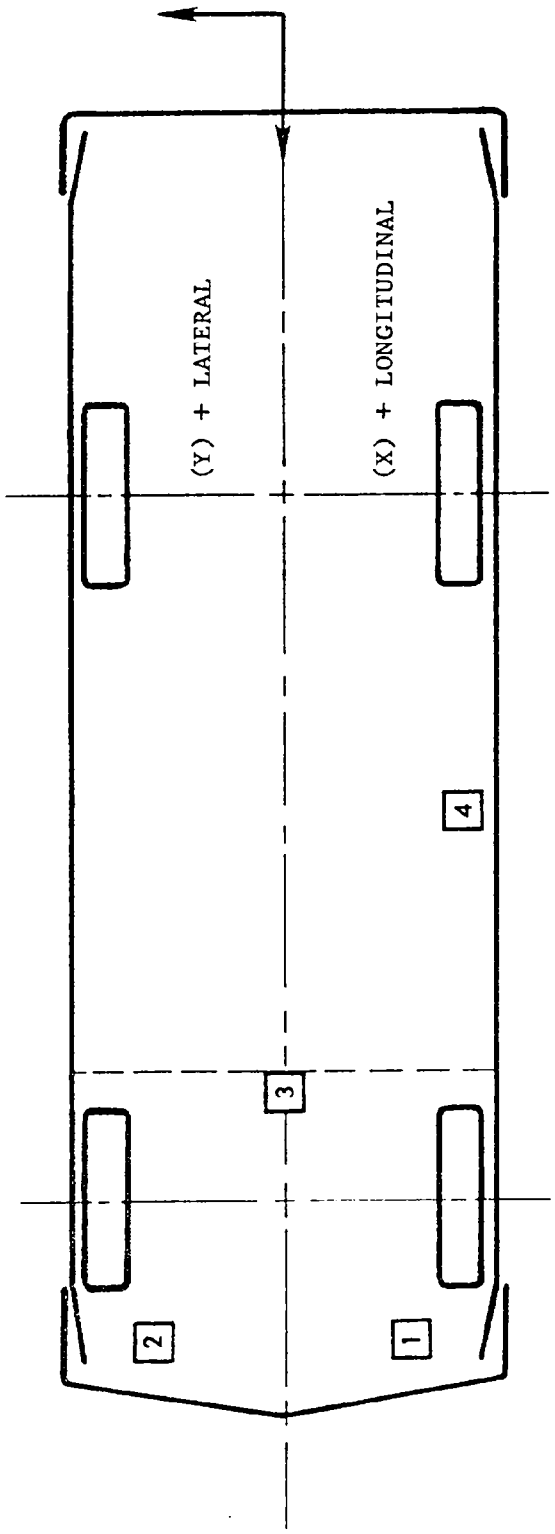
NO.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION** MAX (g)	POSITIVE DIRECTION** TIME (msec)	NEGATIVE DIRECTION** MAX (g)	NEGATIVE DIRECTION** TIME (msec)
1	LEFT FRONT FRAME RAIL (LONGITUDINAL)	156.9	-18.8	17.9	32.61	30.25	152.20	17.00
2	RIGHT FRONT FRAME RAIL LONGITUDINAL	157.0	18.9	19.0	25.18	57.25	297.07	17.00
3	FIREWALL LONGITUDINAL	132.6	16.5	29.0	23.73	34.38	70.87	43.75
4	LEFT B-PILLAR (LONGITUDINAL)	80.6	-25.5	10.4	3.13	167.63	22.83	40.50

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

** LONGITUDINAL: POSITIVE FORWARD LONGITUDINAL: NEGATIVE REARWARD
LATERAL: POSITIVE RIGHTWARD LATERAL: NEGATIVE LEFTWARD
VERTICAL: POSITIVE DOWNWARD VERTICAL: NEGATIVE UPWARD

ALL MEASUREMENTS OF ACCELEROMETER LOCATIONS IN INCHES

VEHICLE ACCELEROMETER LOCATIONS



IMPACTED VEHICLE MEASUREMENTS

VEHICLE MAKE/MODEL Dodge Aries TEST NUMBER 860501

DIMENSIONS IN INCHES

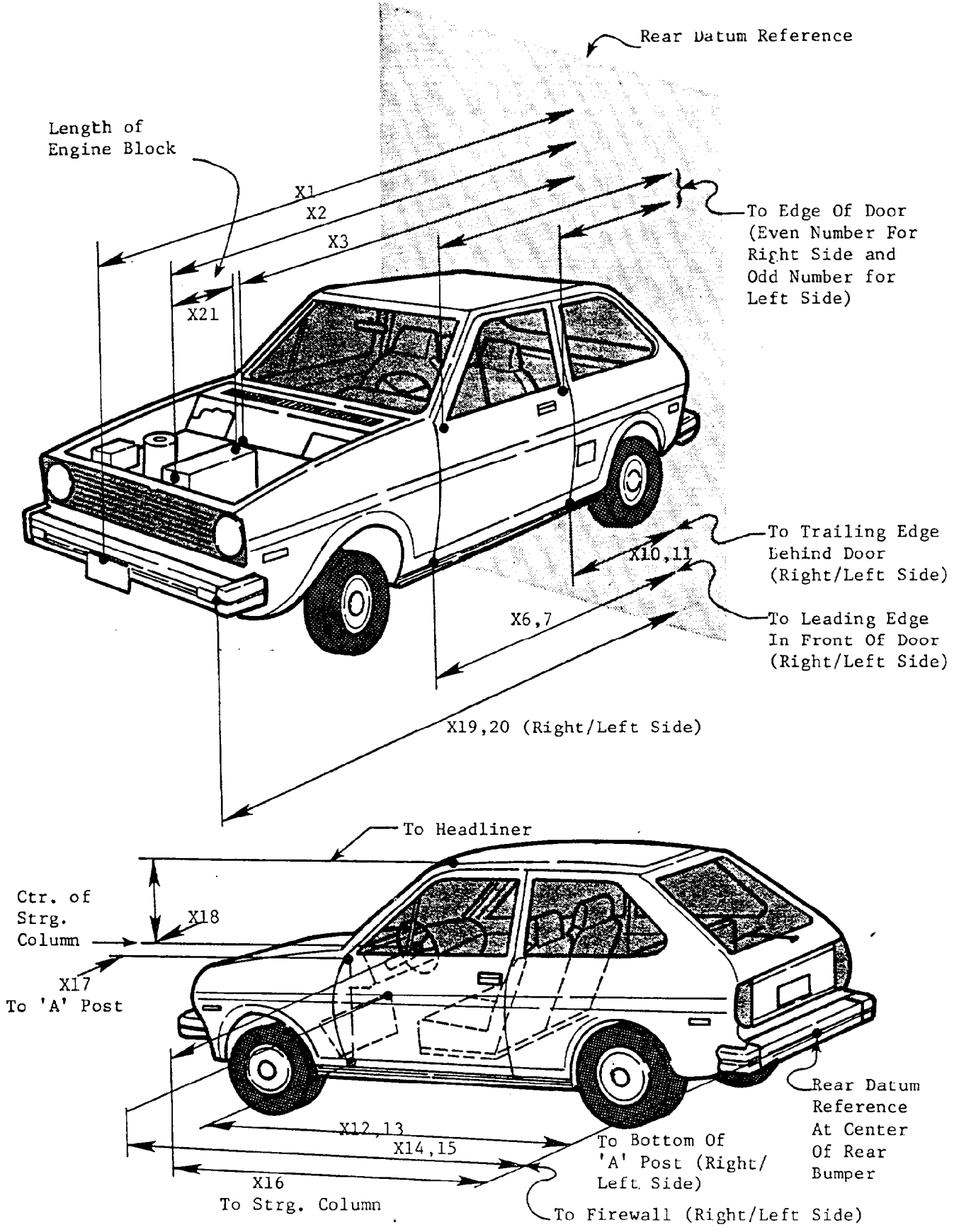
NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X 1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	175 3/8	154 3/16
X 2	REAR SURFACE OF VEHICLE TO FRONT OF ENGINE BLOCK	148	139 1/2
X 3	REAR SURFACE OF VEHICLE TO FIREWALL	132 1/2	126 3/4
X 4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	114 3/4	114 1/4
X 5	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	114 15/16	114 1/2
X 6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	117 7/8	116 3/4
X 7	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	117 3/4	116 15/16
X 8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	78 1/4	78 1/16
X 9	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	78 3/16	78 1/4
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	78 3/4	77 5/8
X11	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	78 7/8	78
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF RIGHT SIDE	116 1/4	115 1/2
X13	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF LEFT SIDE	116 3/4	116 1/8
X14	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	131 5/8	126 1/4
X15	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	130 13/16	128 1/4
X16	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	101	104 3/4
Y17	STEERING COLUMN TO "A" POST	16 1/4	16 1/2

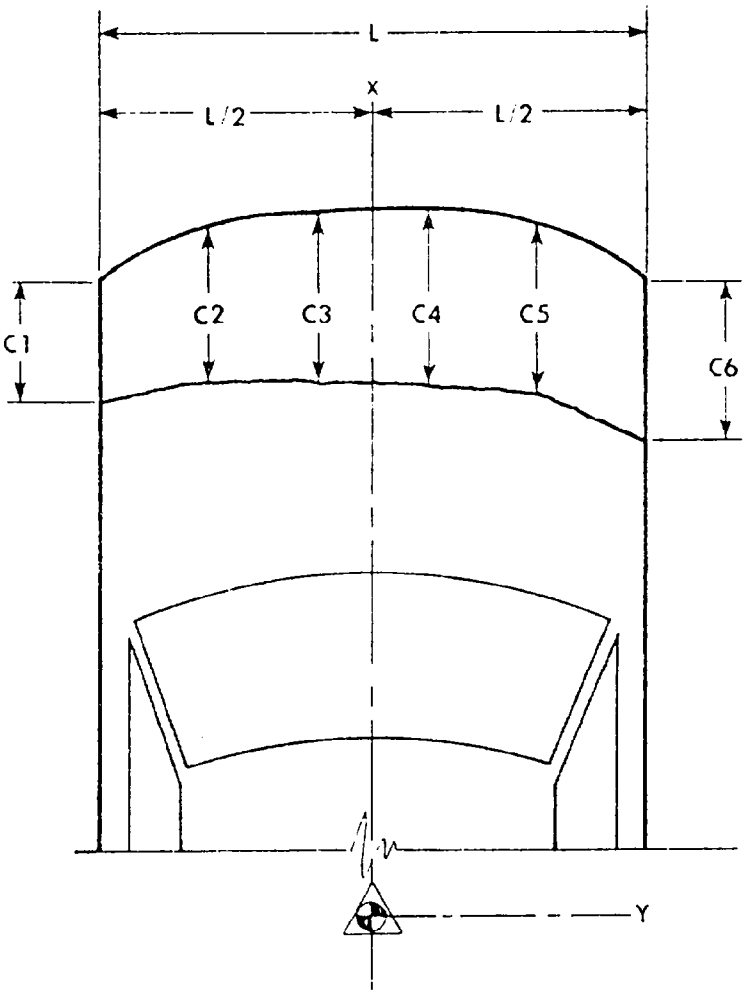
IMPACTED VEHICLE MEASUREMENTS CONTD

VEHICLE MAKE/MODEL Dodge Aries TEST NUMBER 860501

NO.	TYPE OF MEASUREMENT	DIMENSIONS IN INCHES PRE-TEST	POST-TEST
X18	CENTER OF STEERING COLUMN TO HEADLINING	18	13 1/16
X19	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	173	154 1/4
X20	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	173 1/8	153 3/8
X21	WIDTH OF ENGINE BLOCK	7 1/4	7 1/4

PRE-TEST AND POST-TEST MEASUREMENT POINTS





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

VEHICLE Dodge Aries

CRUSH

L	61.9
C1	19.8
C2	20.8
C3	20.8
C4	21.1
C5	20.5
C6	18.8
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	995	Vehicle crush
3	Left angle	Hycam	25	998	Driver kinematics
4	Onboard front window	Photosonic 1B	8	922	Driver kinematics
5	Onboard roof	Photosonic 1B	8	957	Driver kinematics
6	Onboard floor	Photosonic 1B	8	852	Driver kinematics
7	Onboard back window	Photosonic 1B	8	997	Passenger kinematics

HIGH SPEED CAMERA LOCATIONS FOR FRONT IMPACT

CAMERA	LOCATION	X	Y	Z
2	LEFT WIDE	84 1/4	-305	37 1/4
3	LEFT ANGLE	168 1/2	-186	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

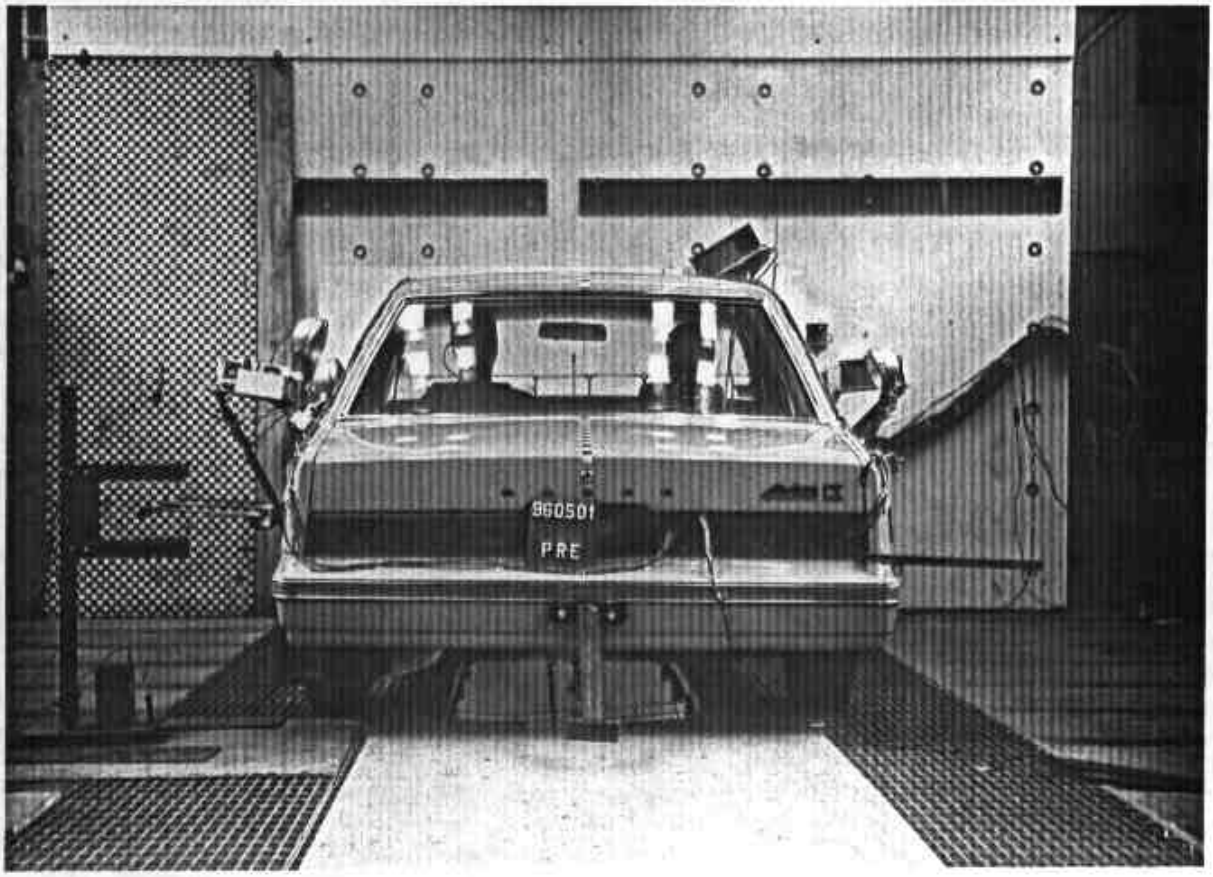


Figure A-4. PRE-TEST REAR VIEW

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

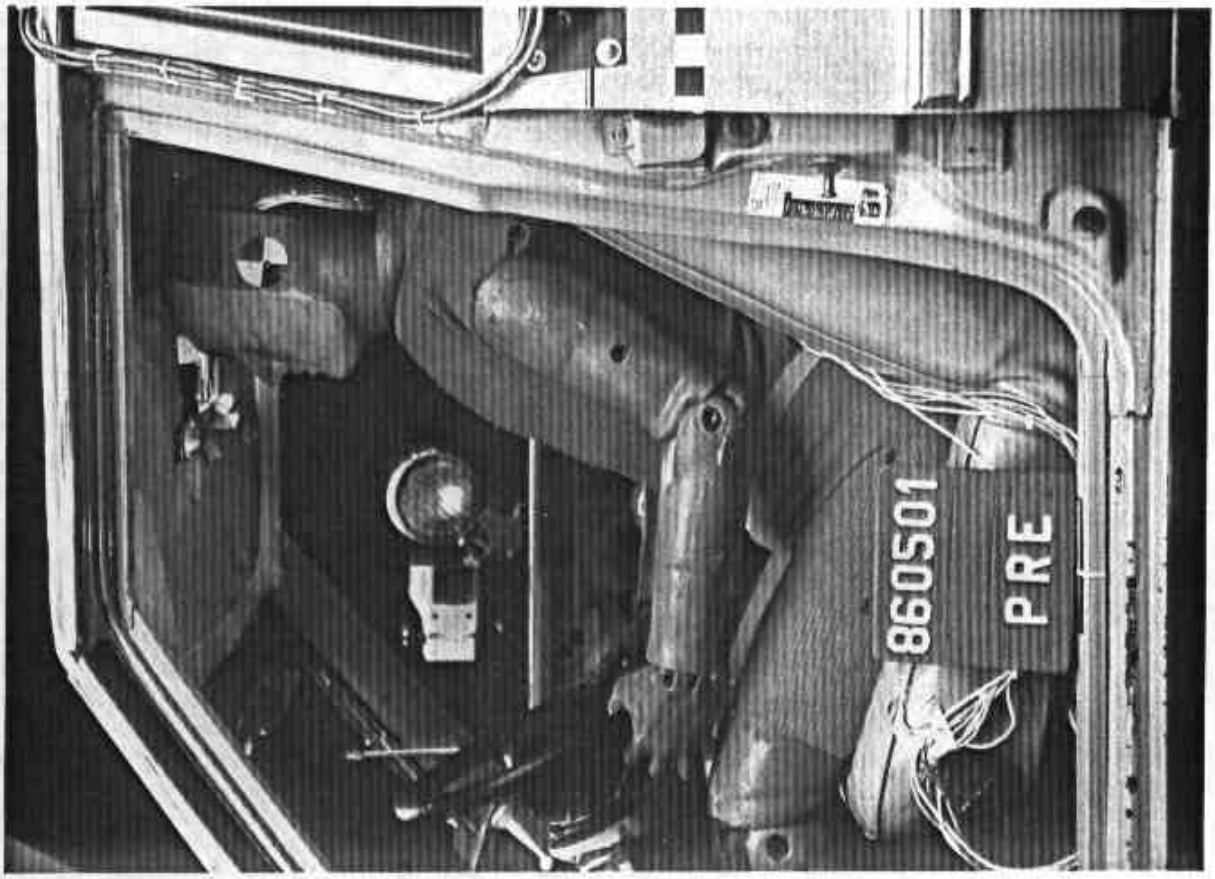


Figure A-6. PRE-TEST DRIVER DUMMY - VIEW 2

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

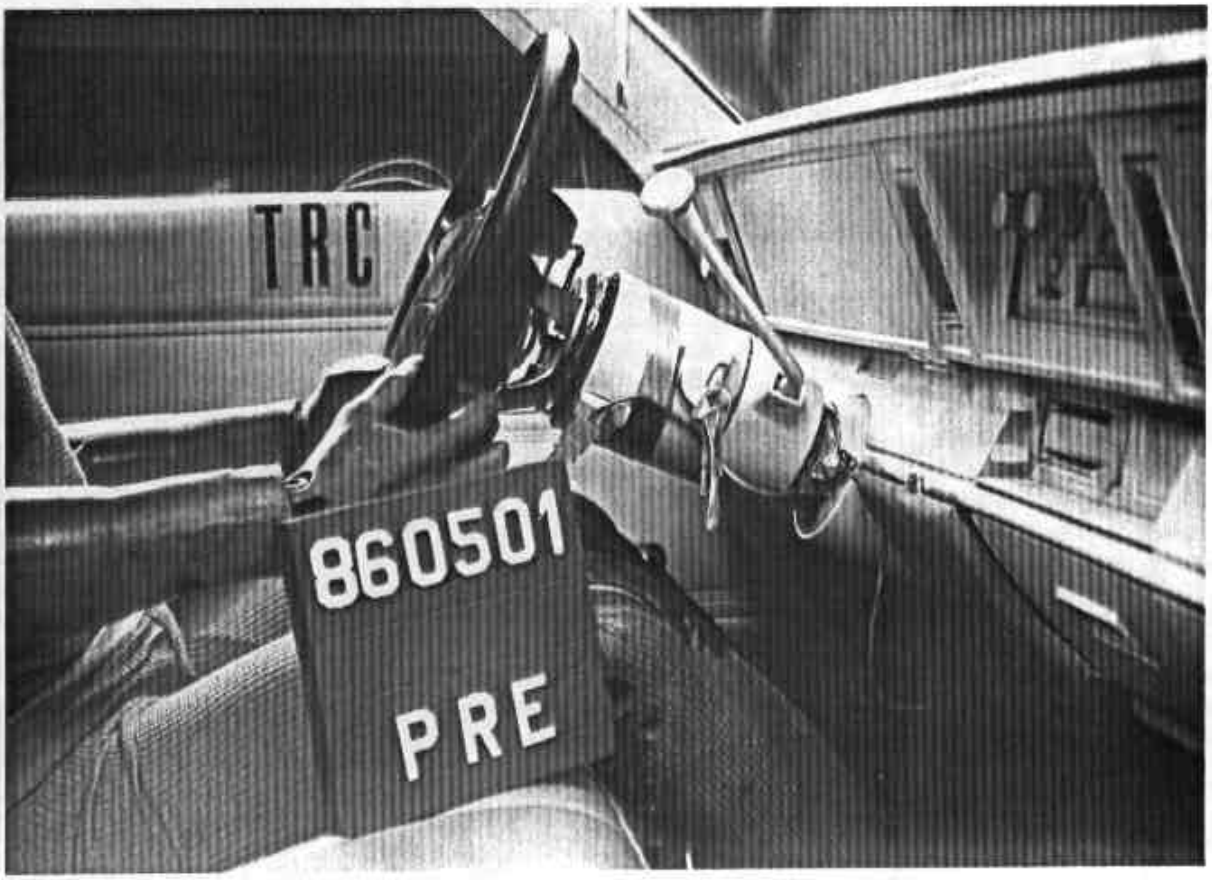


Figure A-8. PRE-TEST DRIVER DUMMY - VIEW 4

Figure A-9. PRE-TEST PASSENGER DUMMY

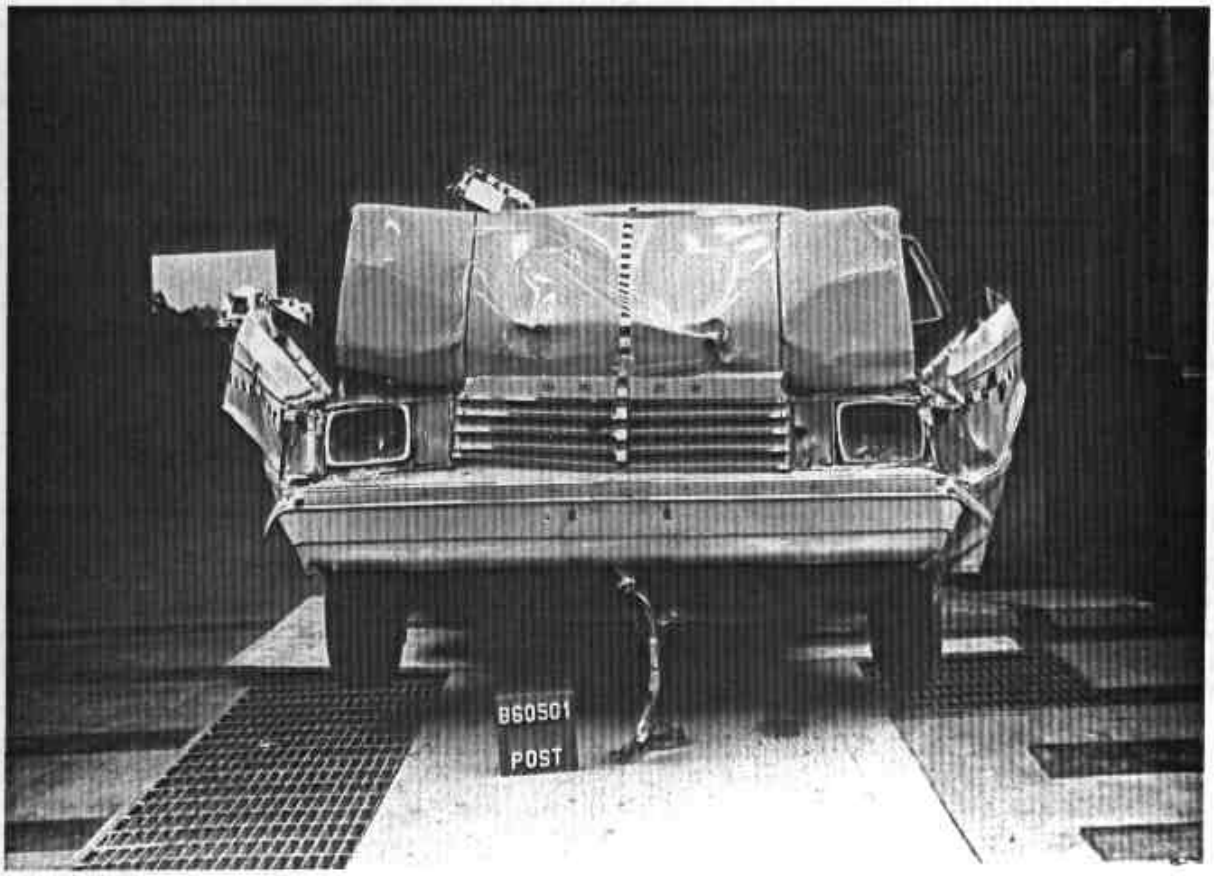


Figure A-10. POST-TEST FRONT VIEW

Figure A-11. POST-TEST DRIVER SIDE VIEW

Figure A-12. POST-TEST PASSENGER SIDE VIEW

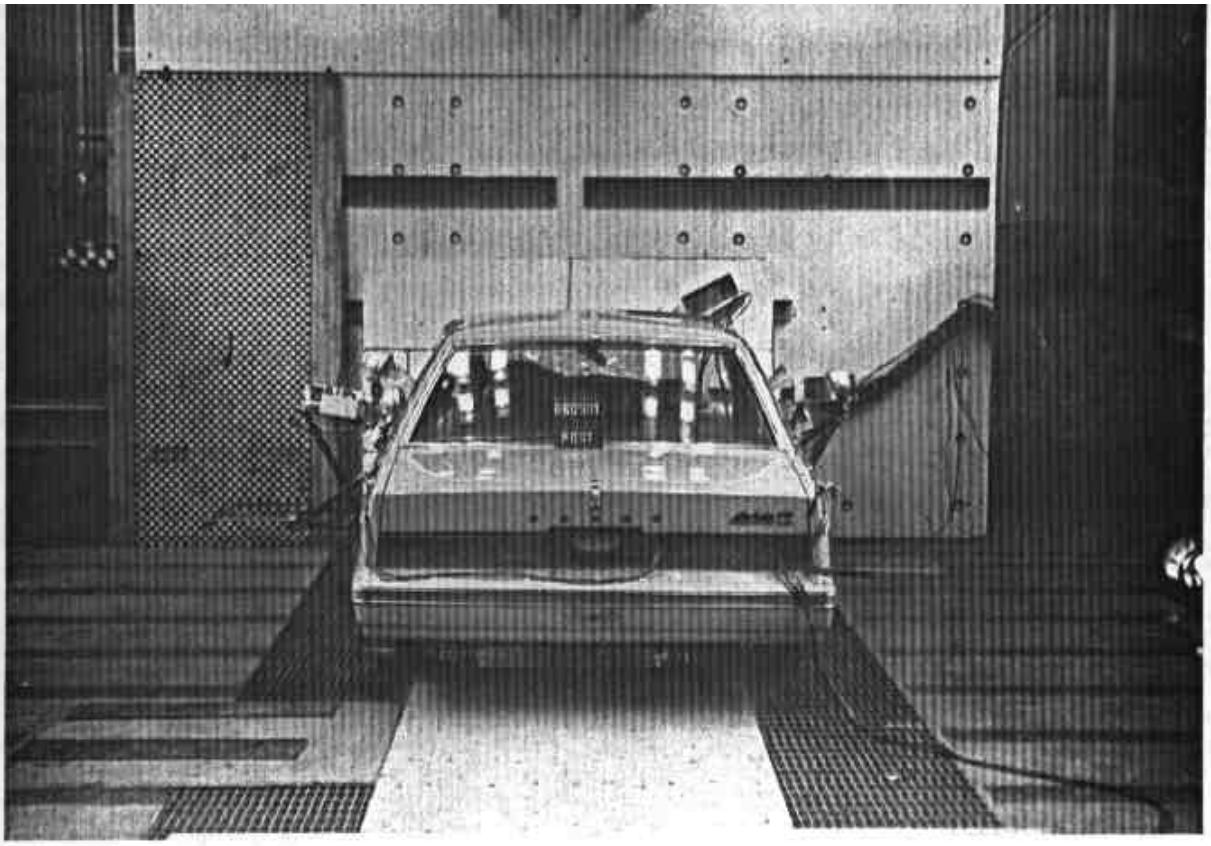


Figure A-13. POST-TEST REAR VIEW

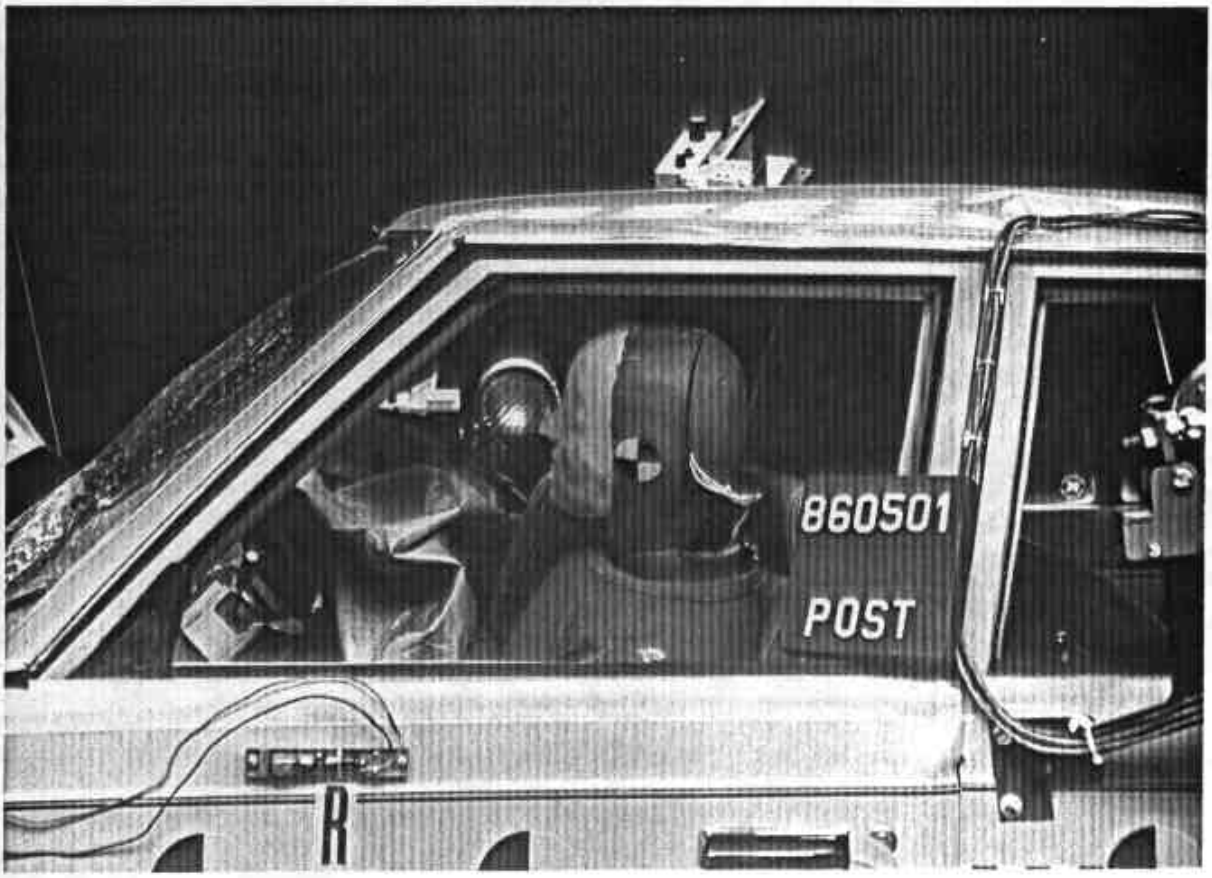


Figure A-14. POST-TEST DRIVER DUMMY - VIEW 1

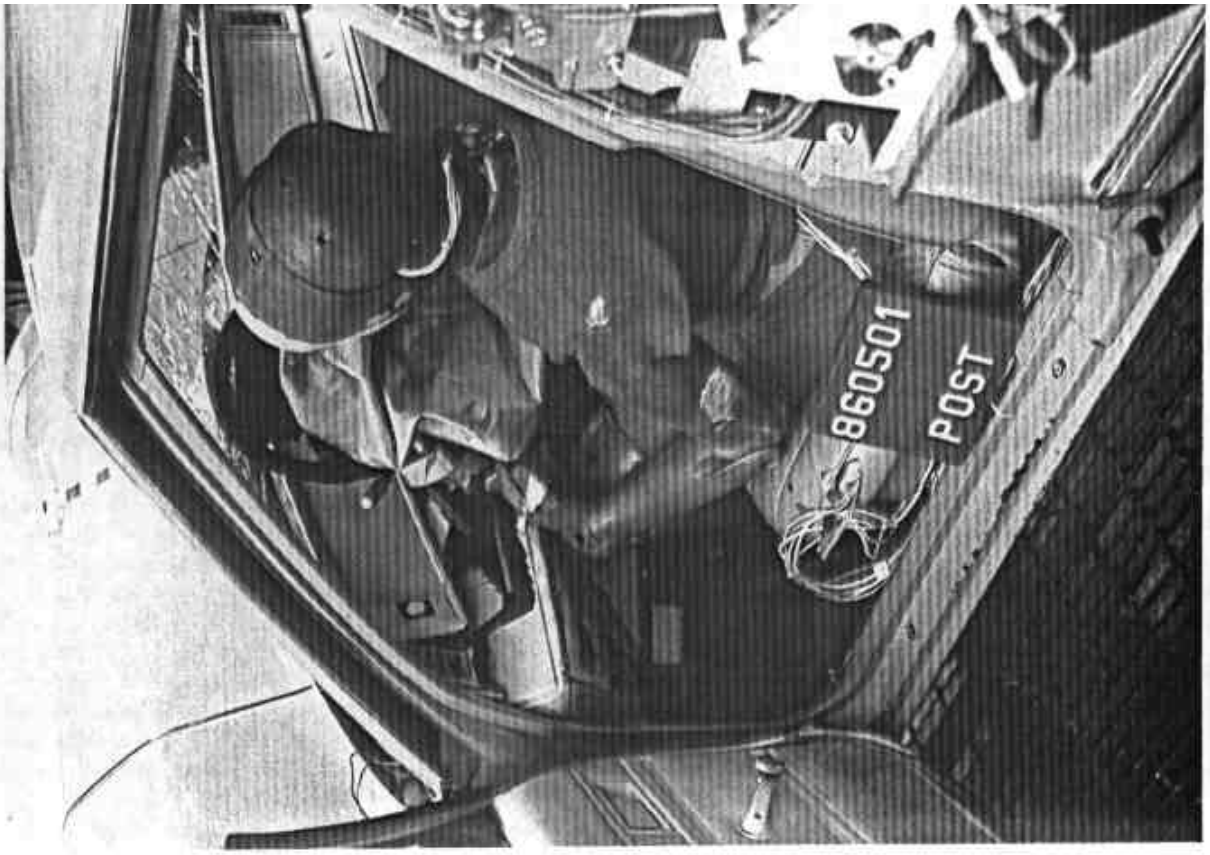


Figure A-15. POST-TEST DRIVER DUMMY - VIEW 2

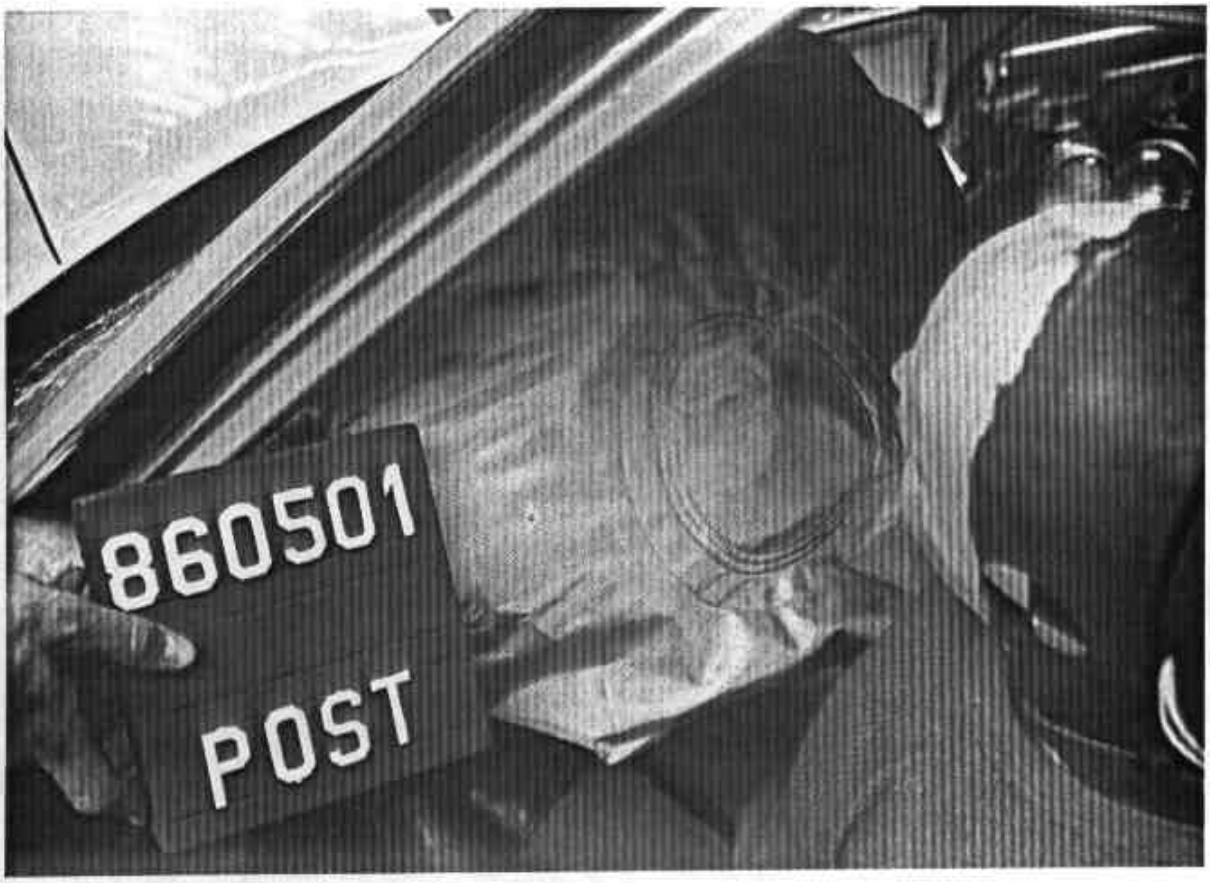


Figure A-16. POST-TEST DRIVER DUMMY - VIEW 3

Figure A-17. POST-TEST DRIVER DUMMY - VIEW 4

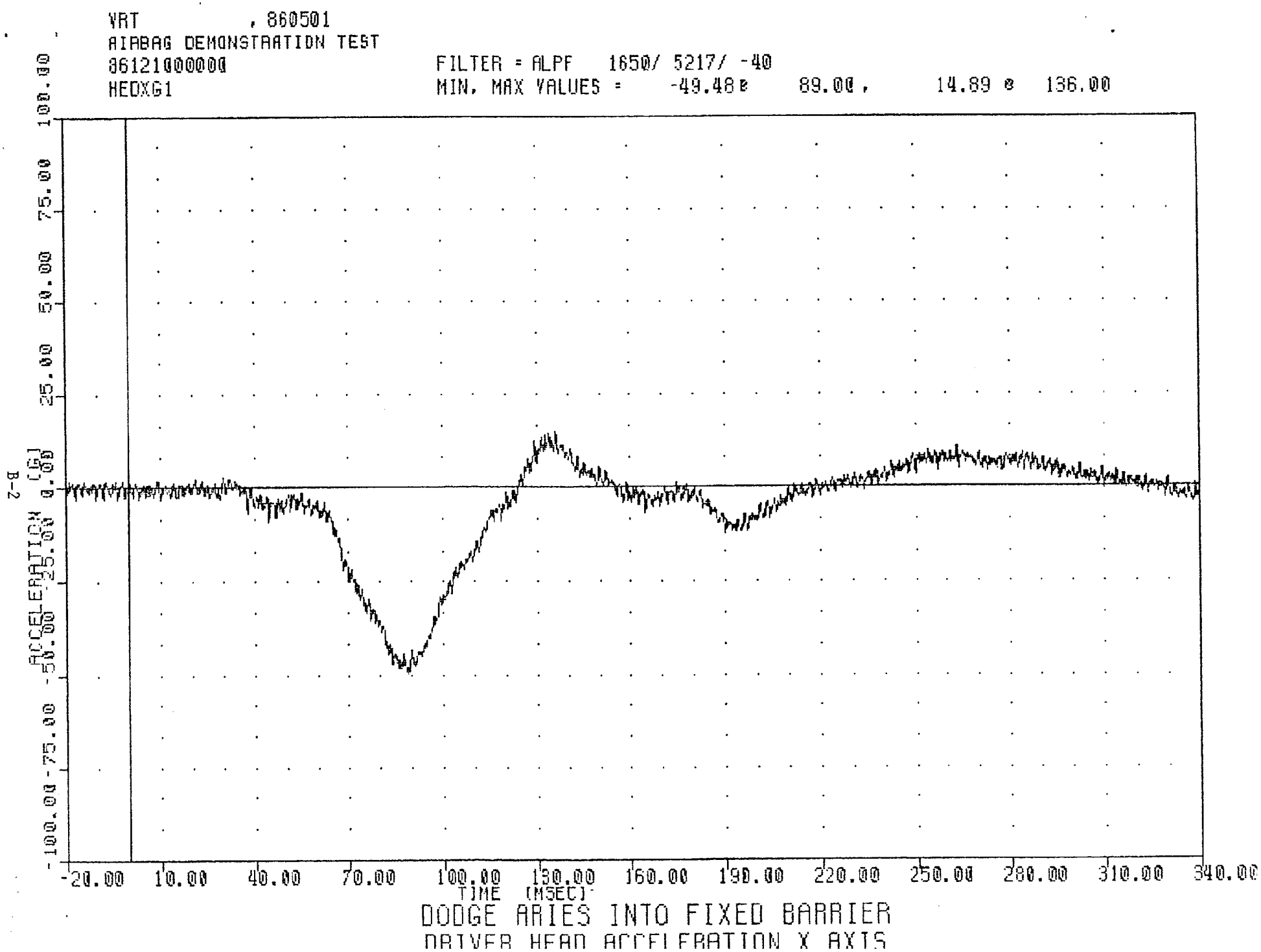
Figure A-18. POST-TEST PASSENGER DUMMY - VIEW 1

Figure A-19. POST-TEST PASSENGER DUMMY - VIEW 2

APPENDIX B

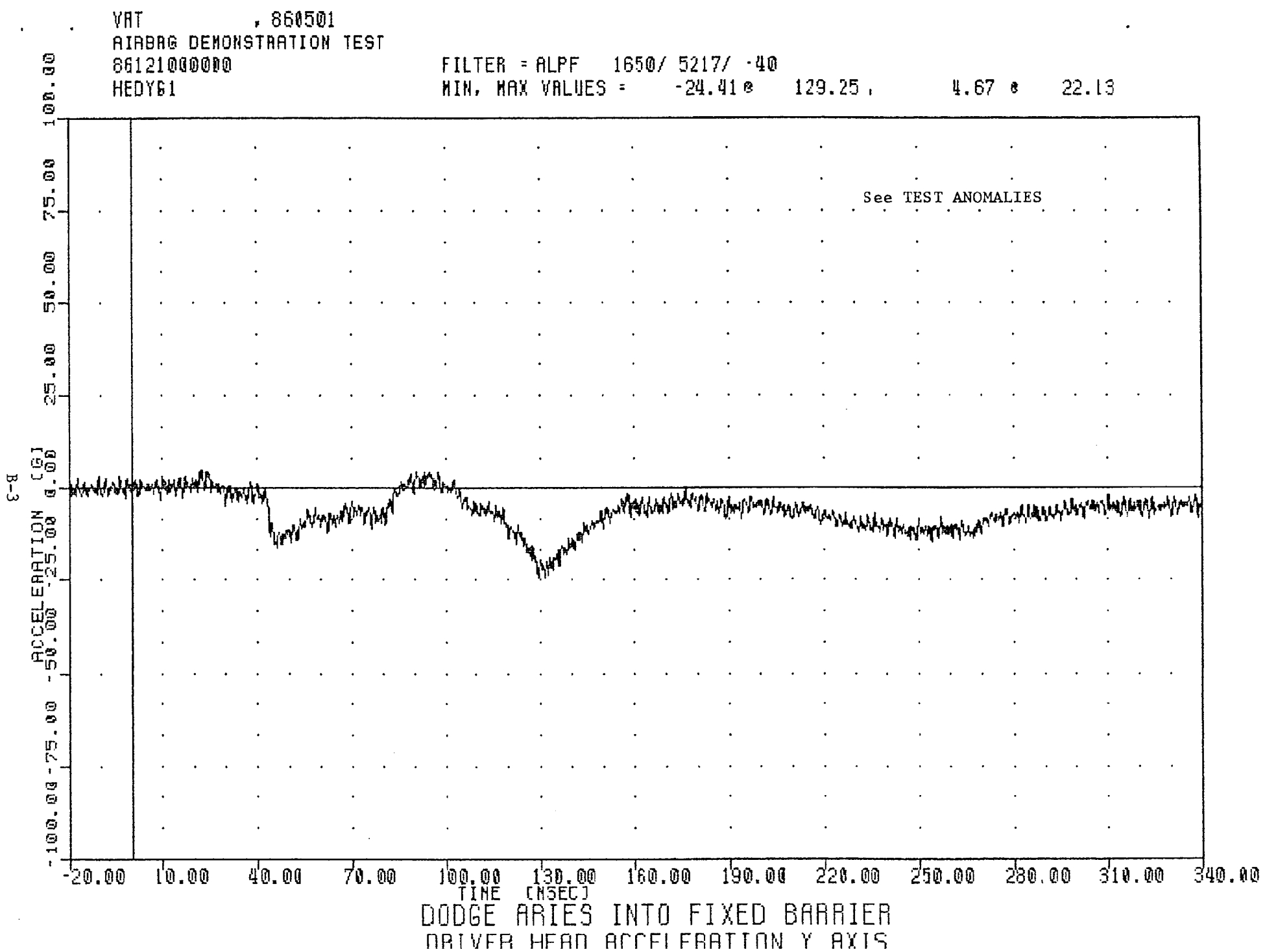
DATA PLOT PRESENTATION

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.



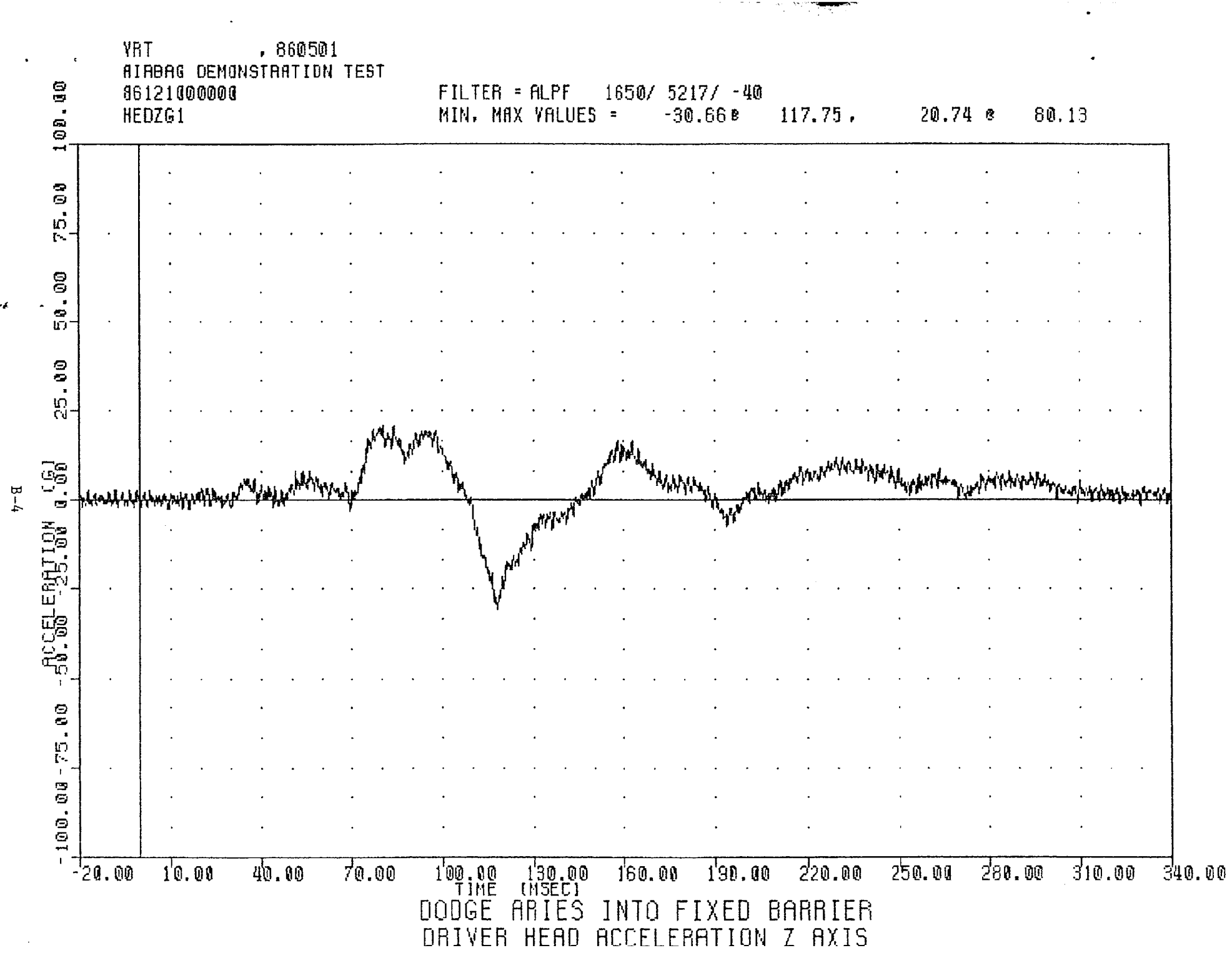
DODGE ARIES INTO FIXED BARRIER

DRIVER HEAD ACCELERATION X AXIS

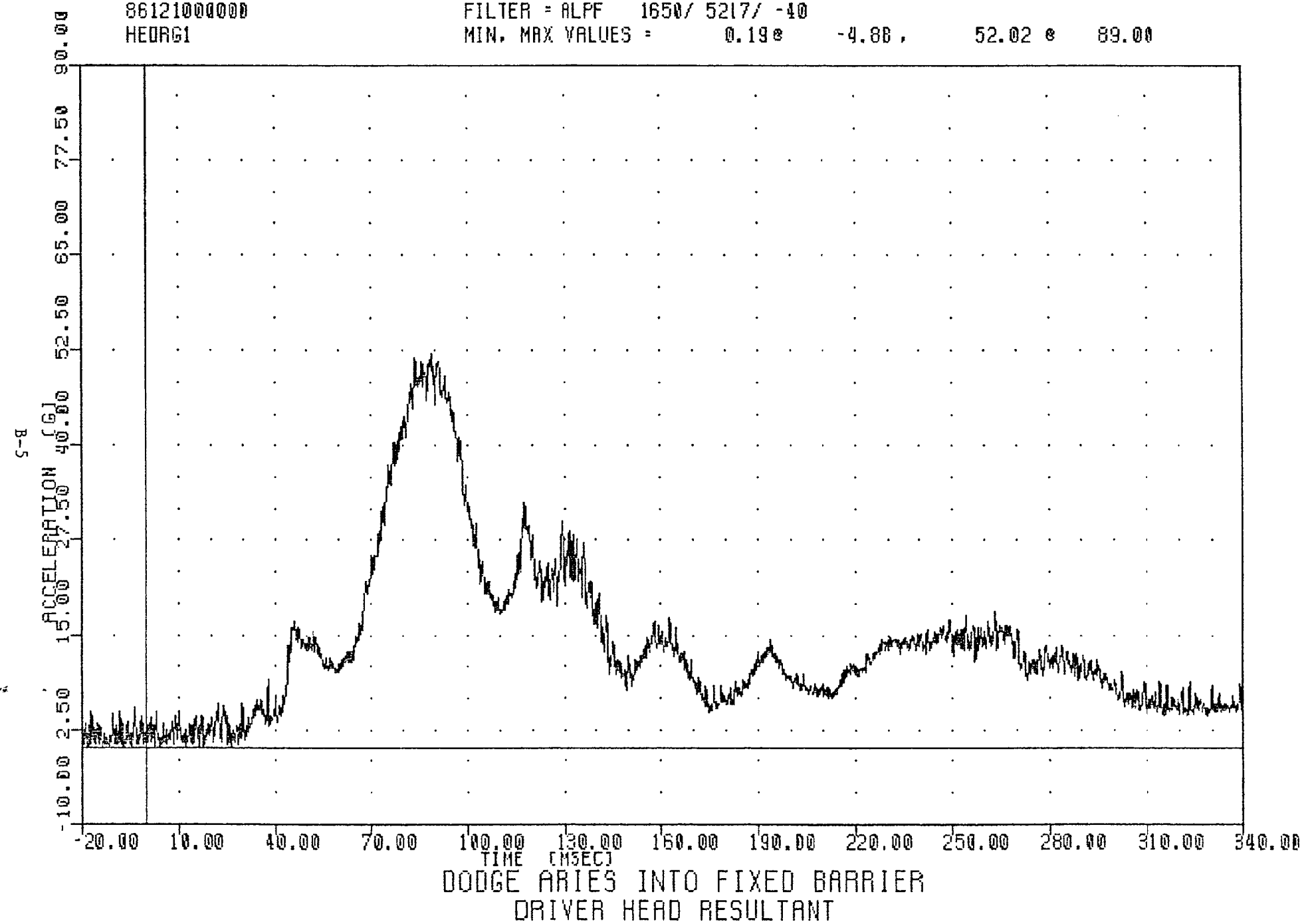


DODGE ARIES INTO FIXED BARRIER

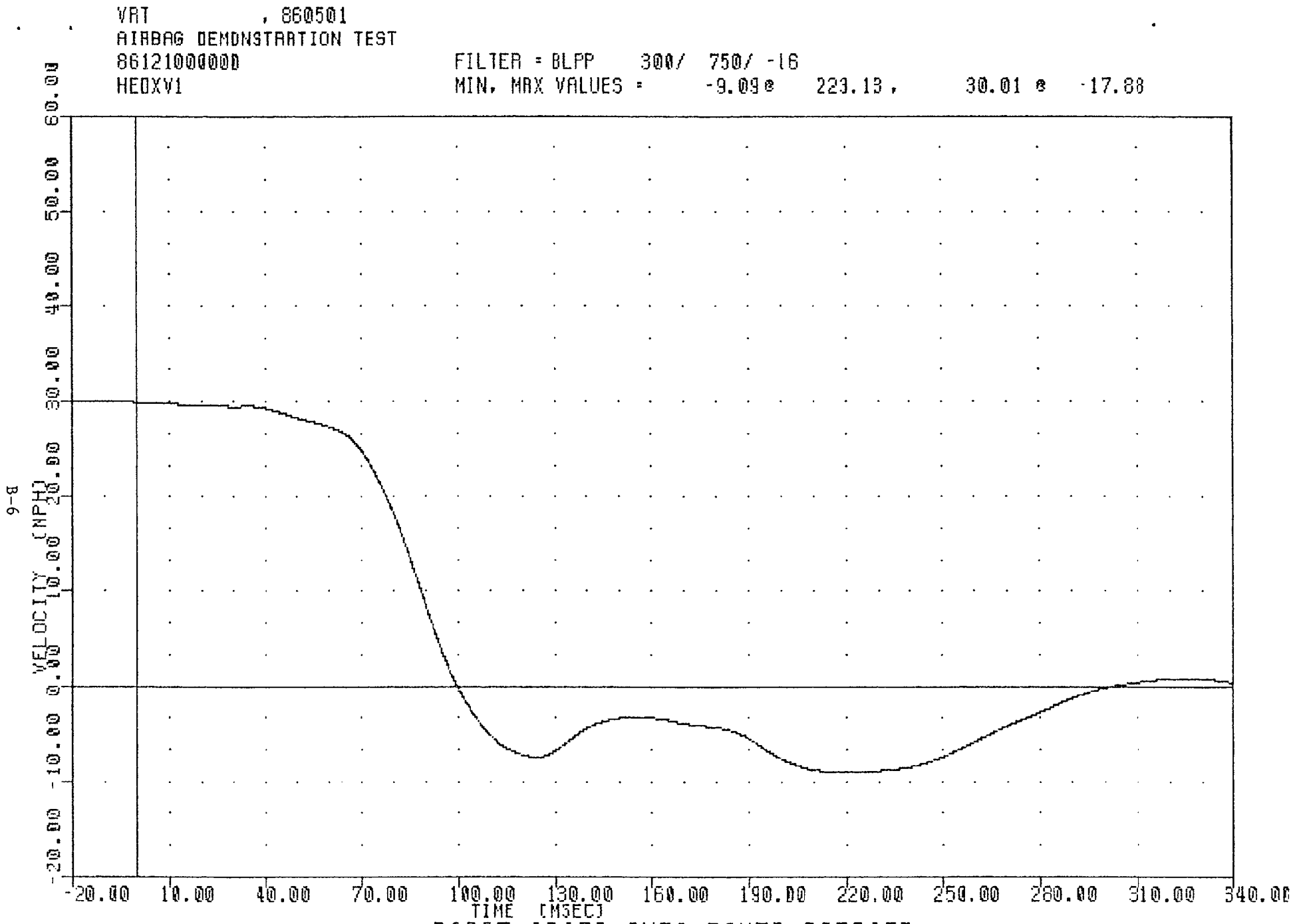
DRIVER HEAD ACCELERATION Y AXIS



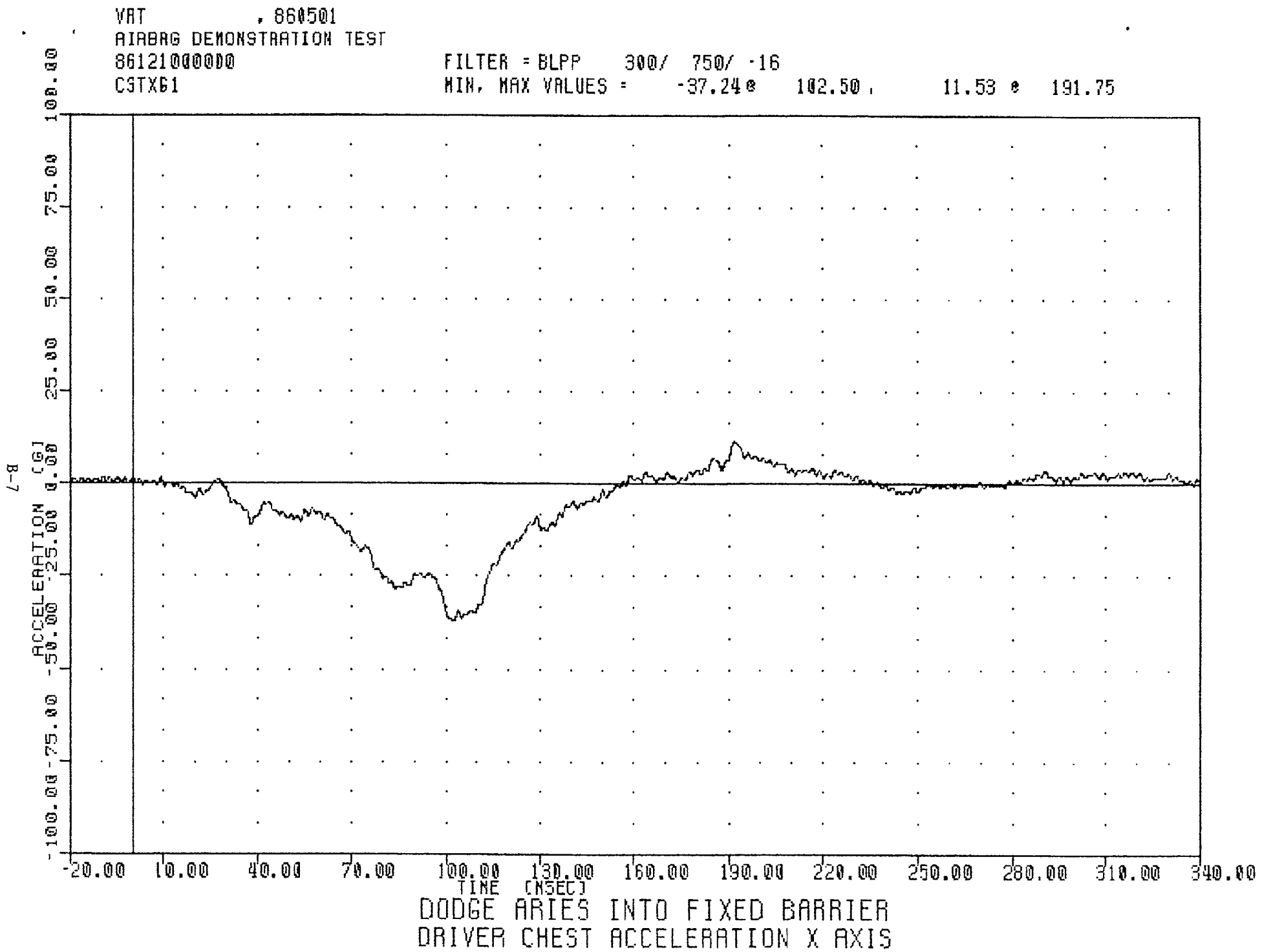
DODGE ARIES INTO FIXED BARRIER
DRIVER HEAD ACCELERATION Z AXIS



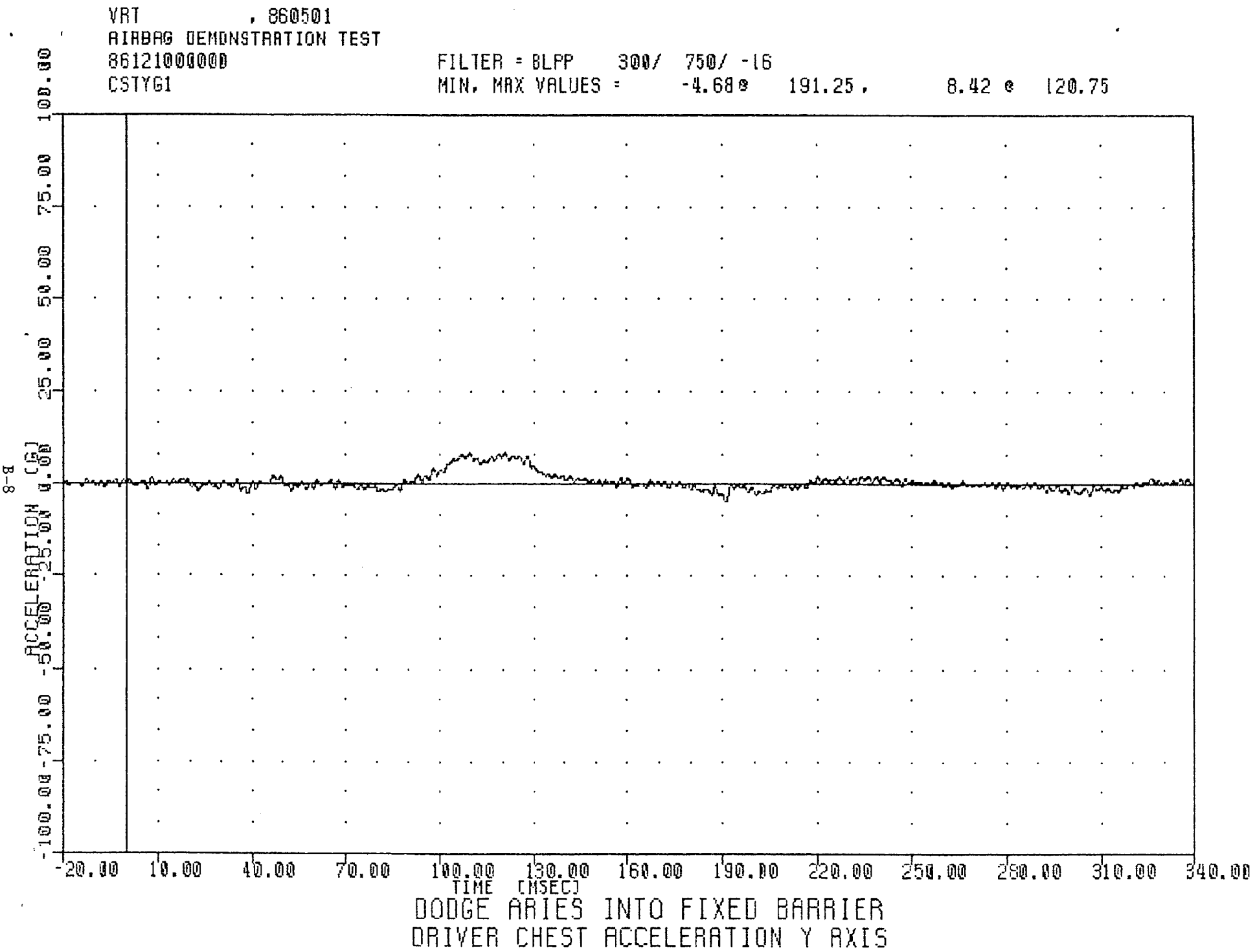
DODGE ARIES INTO FIXED BARRIER
DRIVER HEAD RESULTANT



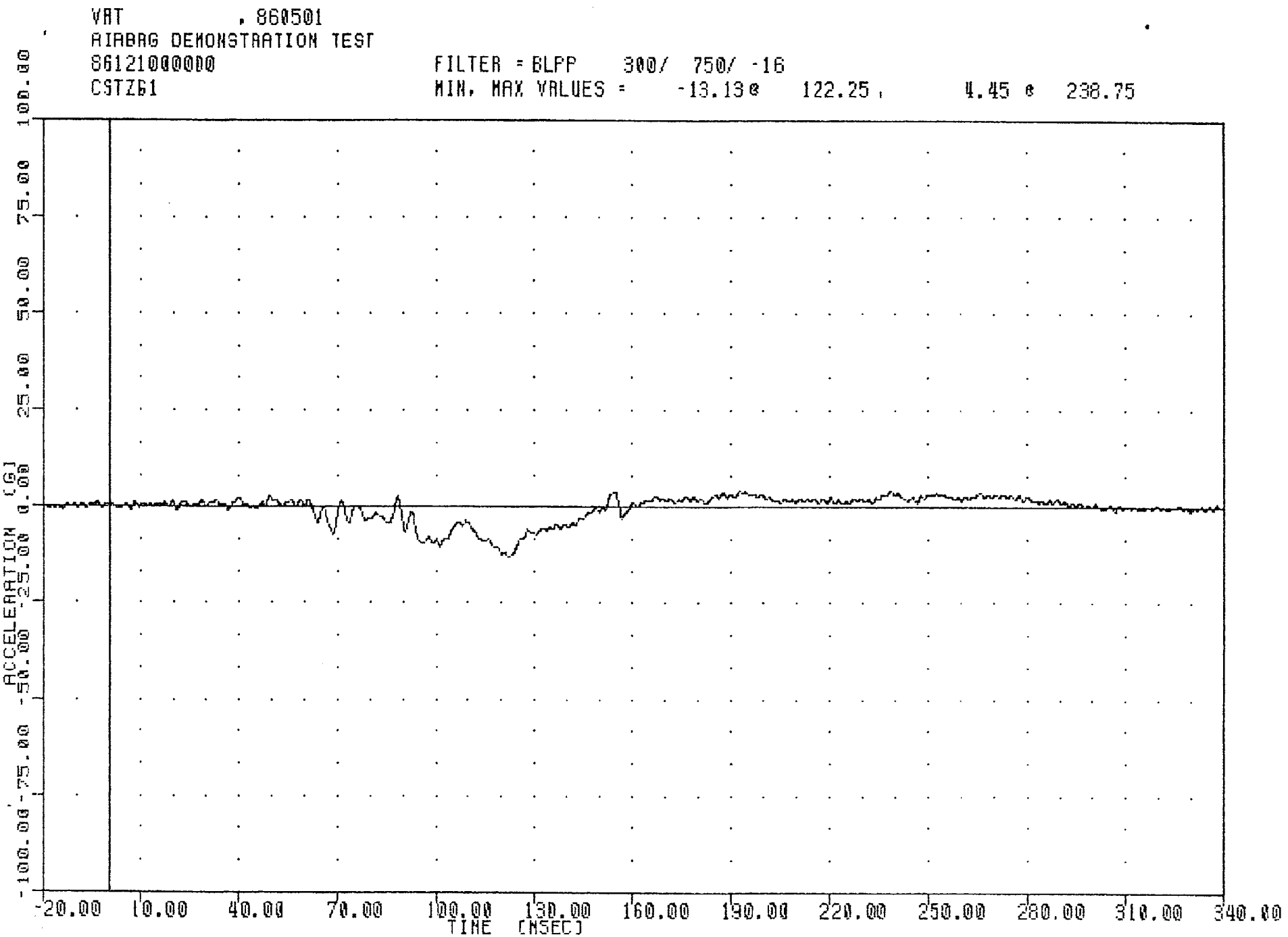
DODGE ARIES INTO FIXED BARRIER
DELTA V USING HEOXG1



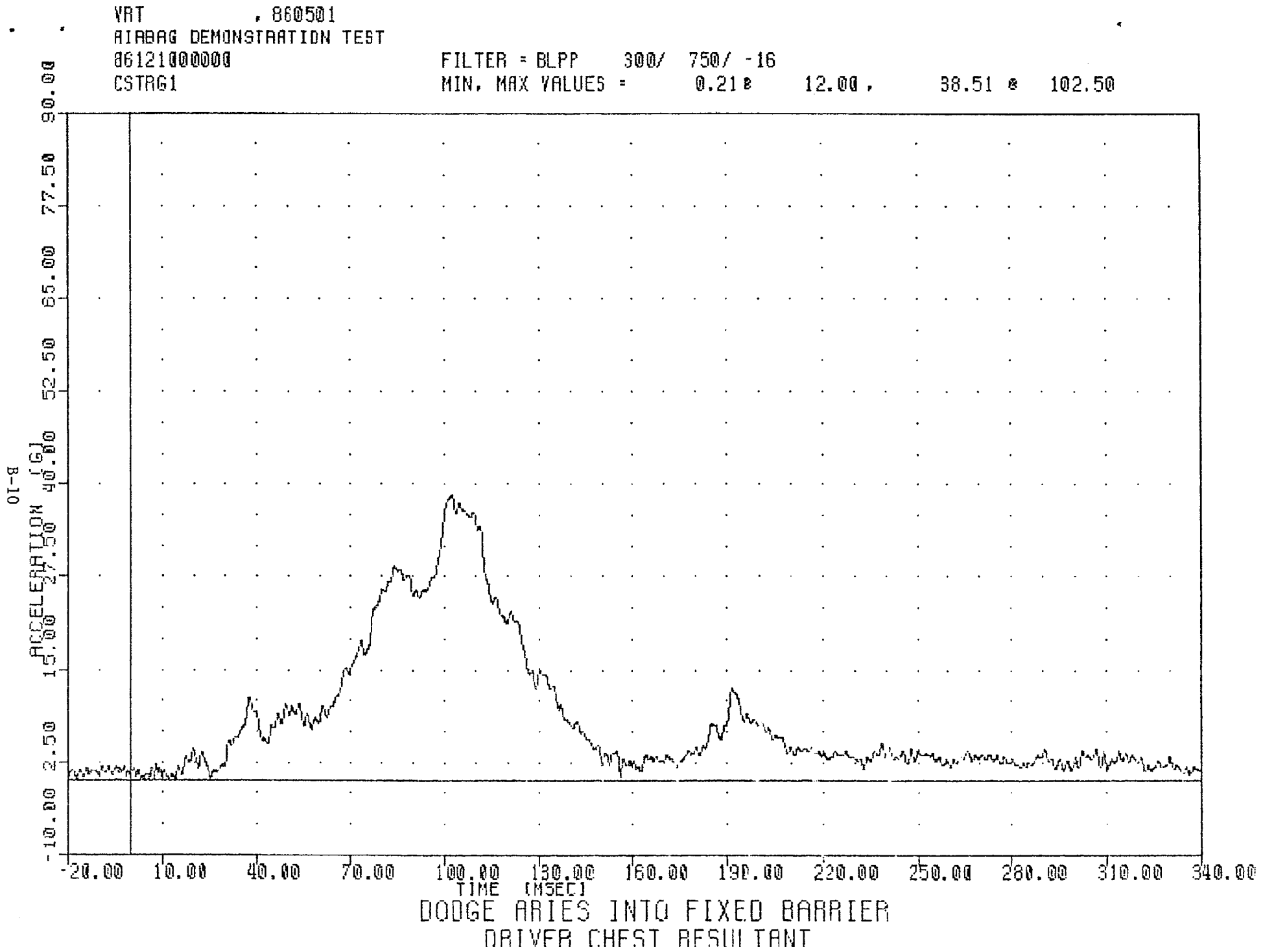
DODGE ARIES INTO FIXED BARRIER
DRIVER CHEST ACCELERATION X AXIS

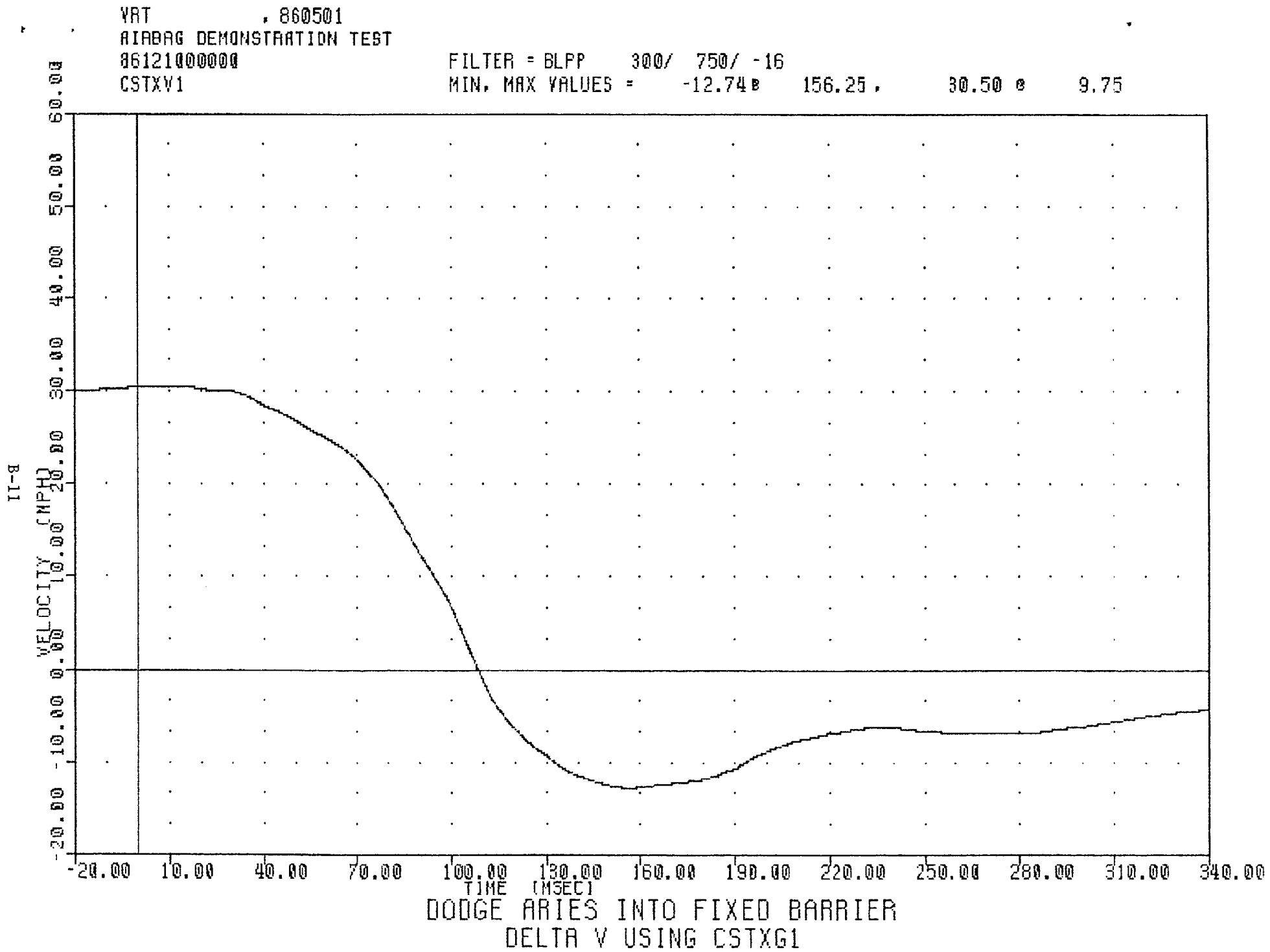


DODGE ARIES INTO FIXED BARRIER
DRIVER CHEST ACCELERATION Y AXIS

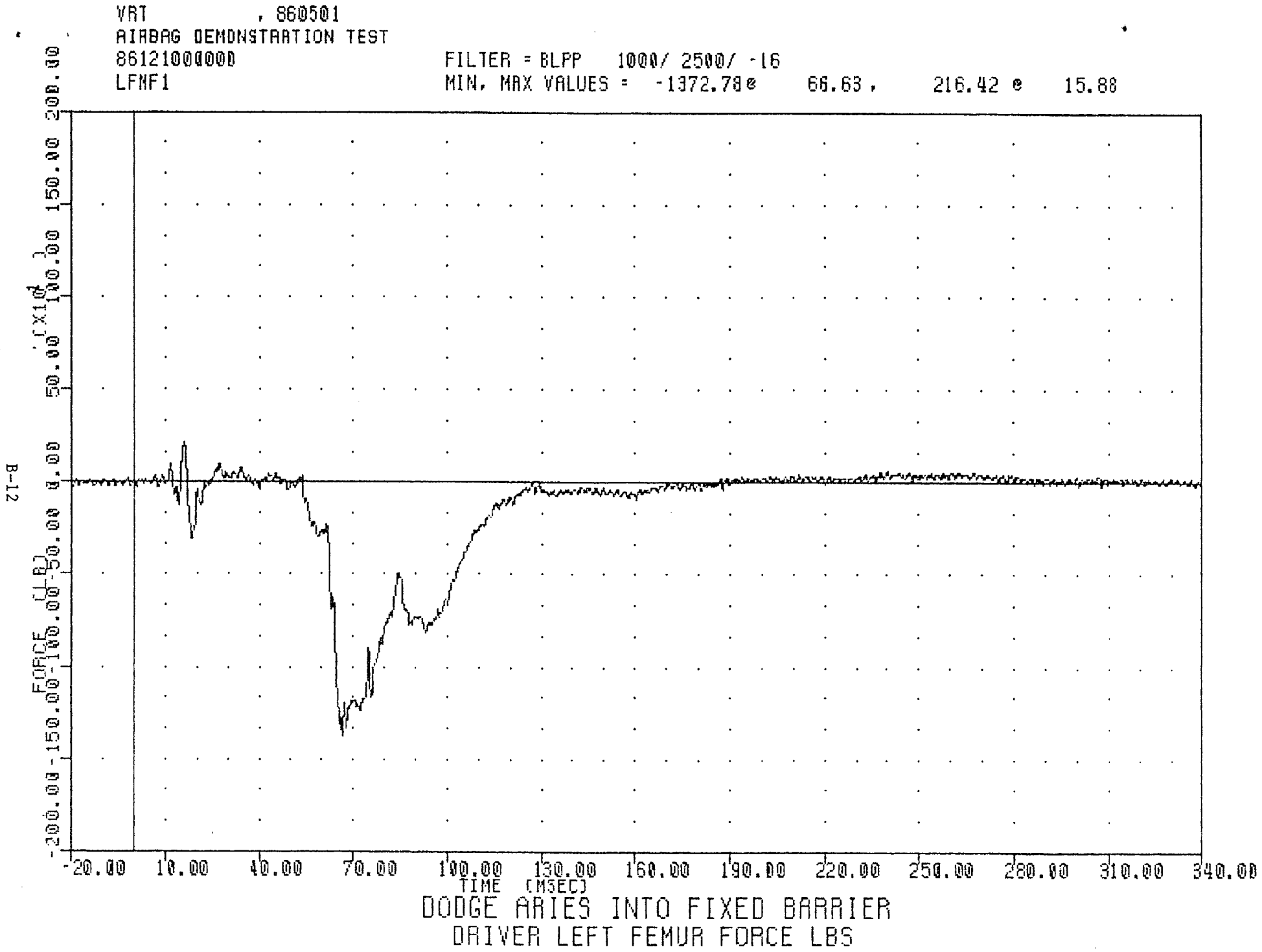


DODGE ARIES INTO FIXED BARRIER
DRIVER CHEST ACCELERATION Z AXIS

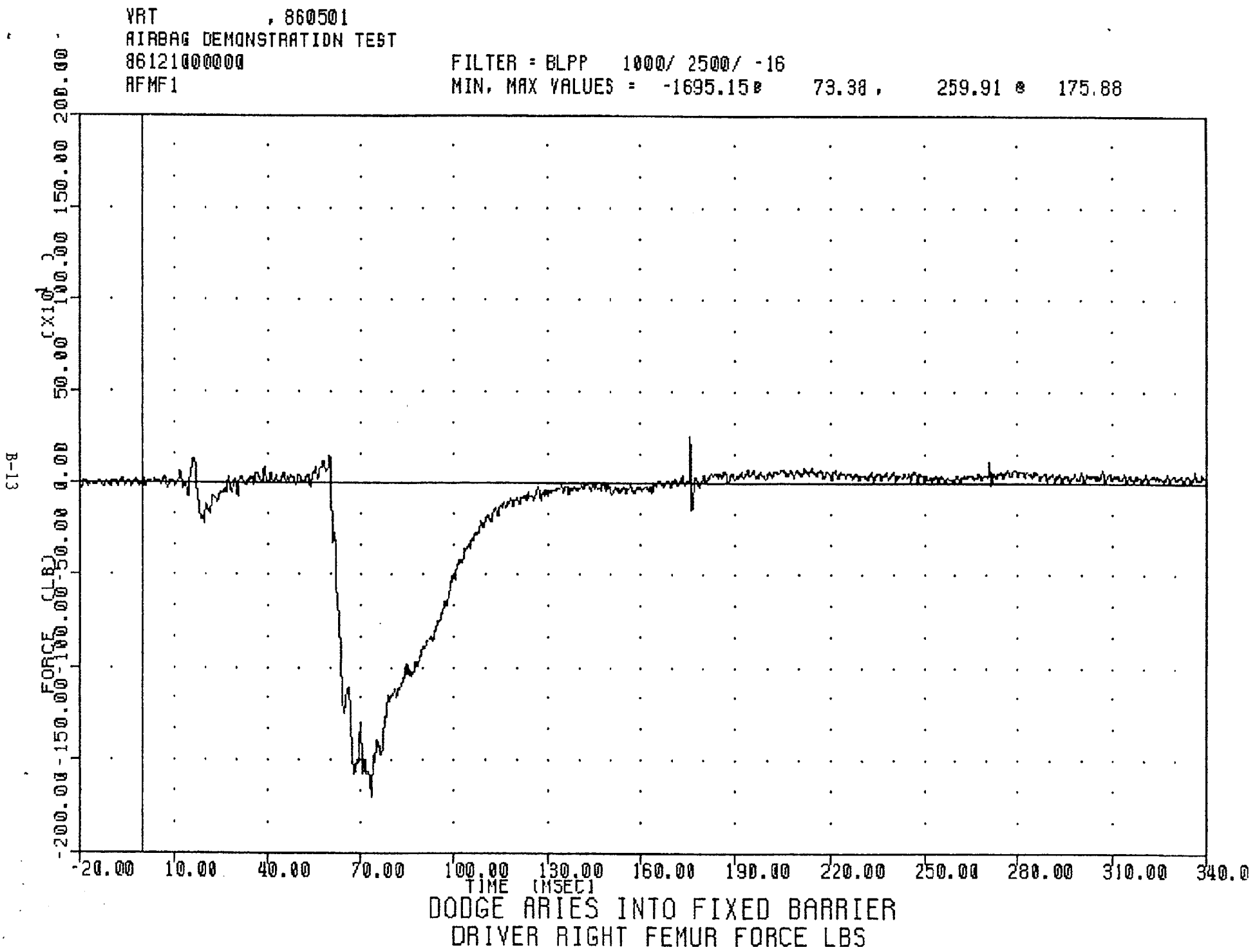

VRT , 860501
AIRBAG DEMONSTRATION TEST
861210000000
CSTRG1
FILTER = BLPP 300/ 750/ -16
MIN, MAX VALUES = 0.21 @ 12.00 , 38.51 @ 102.50
ACCELERATION [G]
90.00
77.50
65.00
52.50
40.00
27.50
15.00
2.50
-10.00
-20.00
10.00
40.00
70.00
100.00
130.00
160.00
190.00
220.00
250.00
280.00
310.00
340.00
TIME [MSEC]
DODGE ARIES INTO FIXED BARRIER
DRIVER CHEST RESULTANT



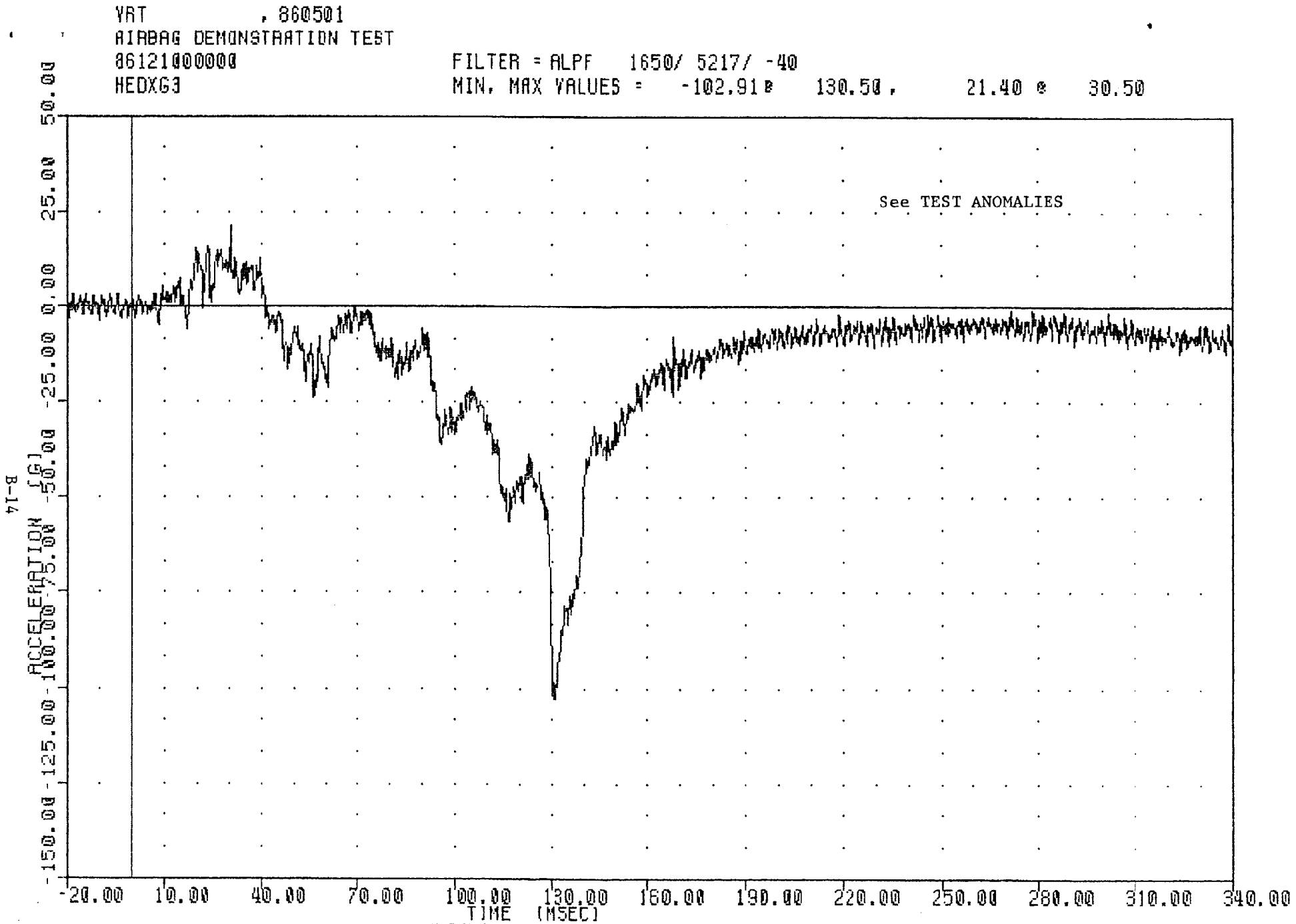
DODGE ARIES INTO FIXED BARRIER
DELTA V USING CSTXG1



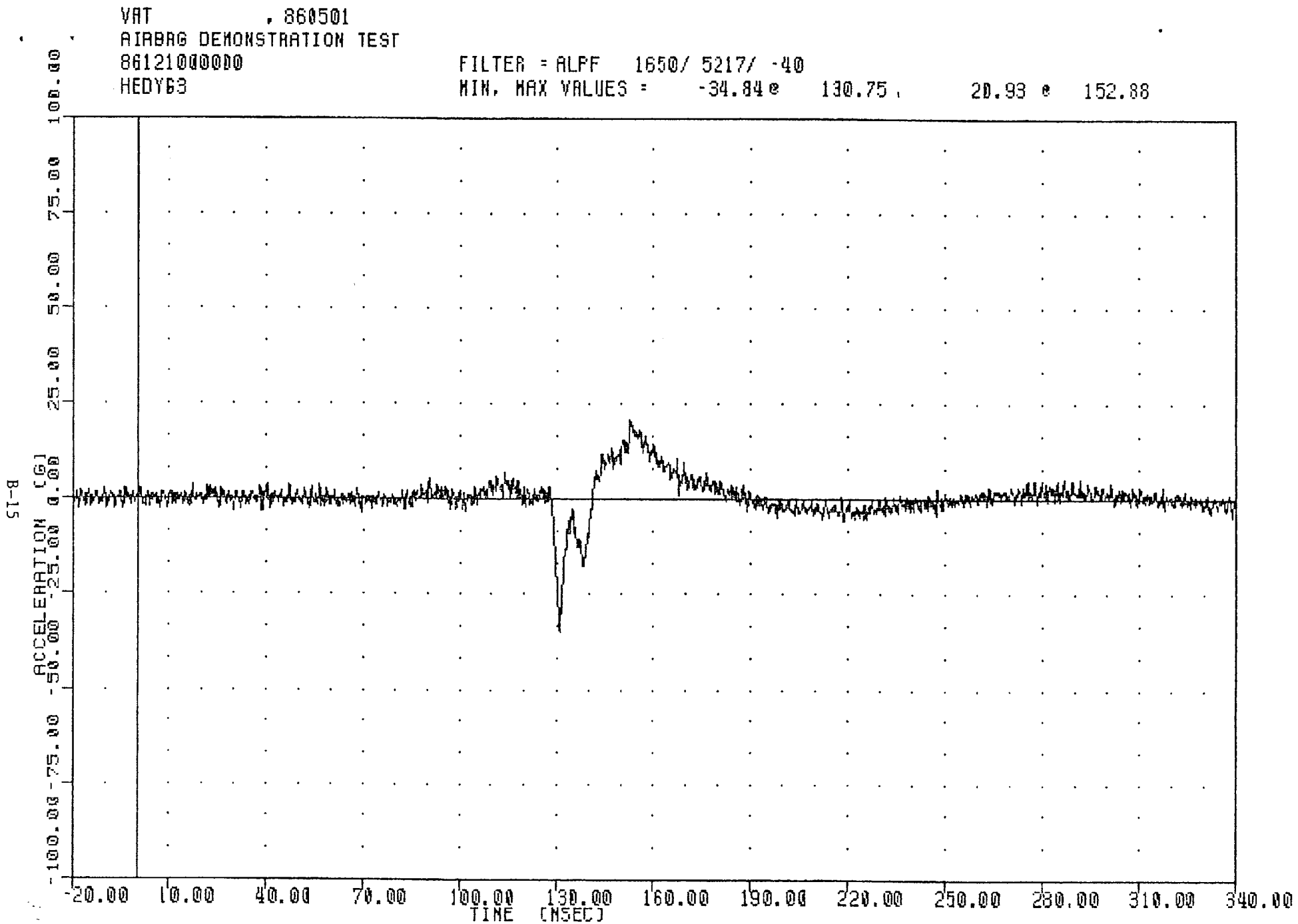
DODGE ARIES INTO FIXED BARRIER
DRIVER LEFT FEMUR FORCE LBS



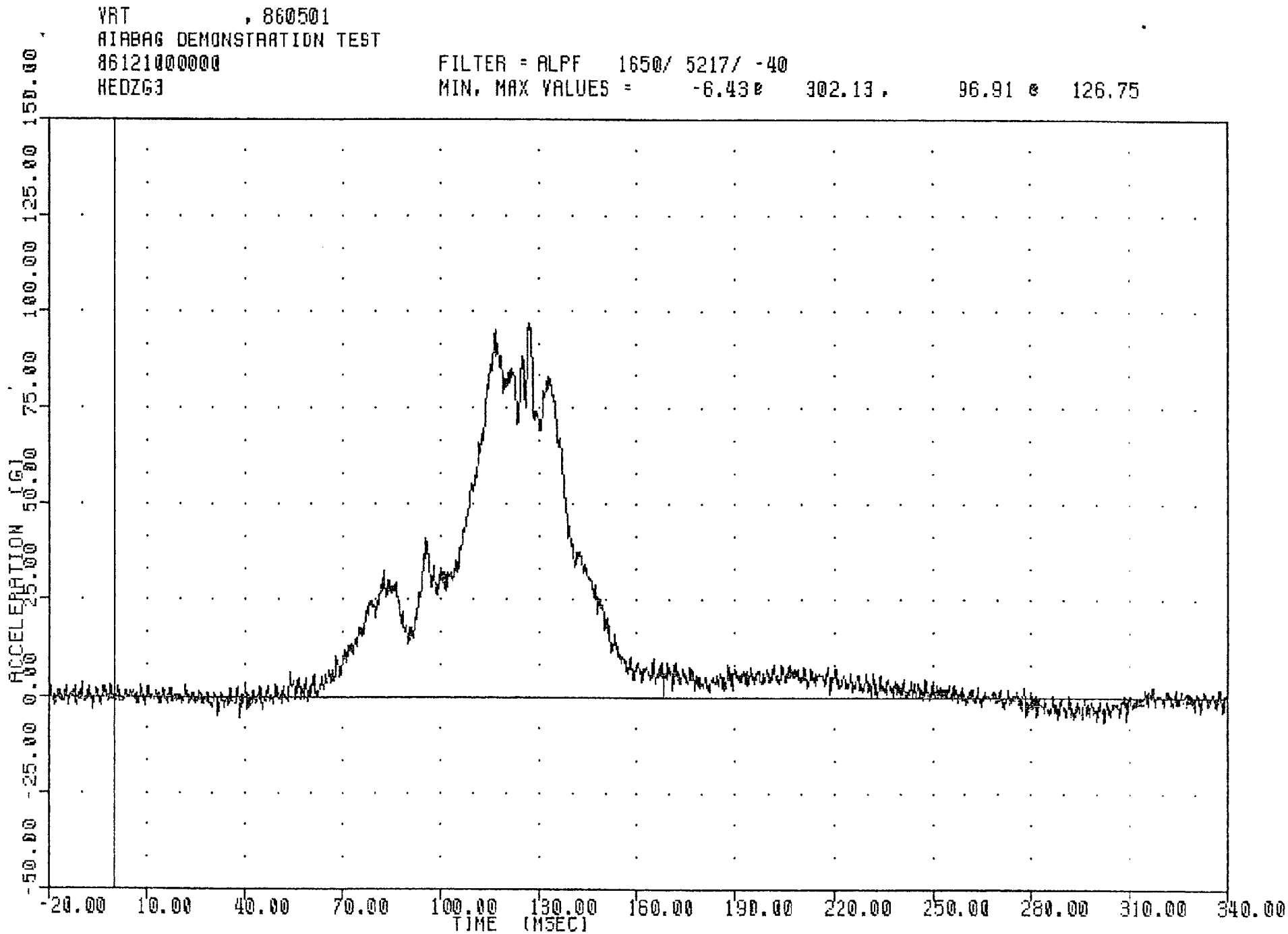
DODGE ARIES INTO FIXED BARRIER
DRIVER RIGHT FEMUR FORCE LBS



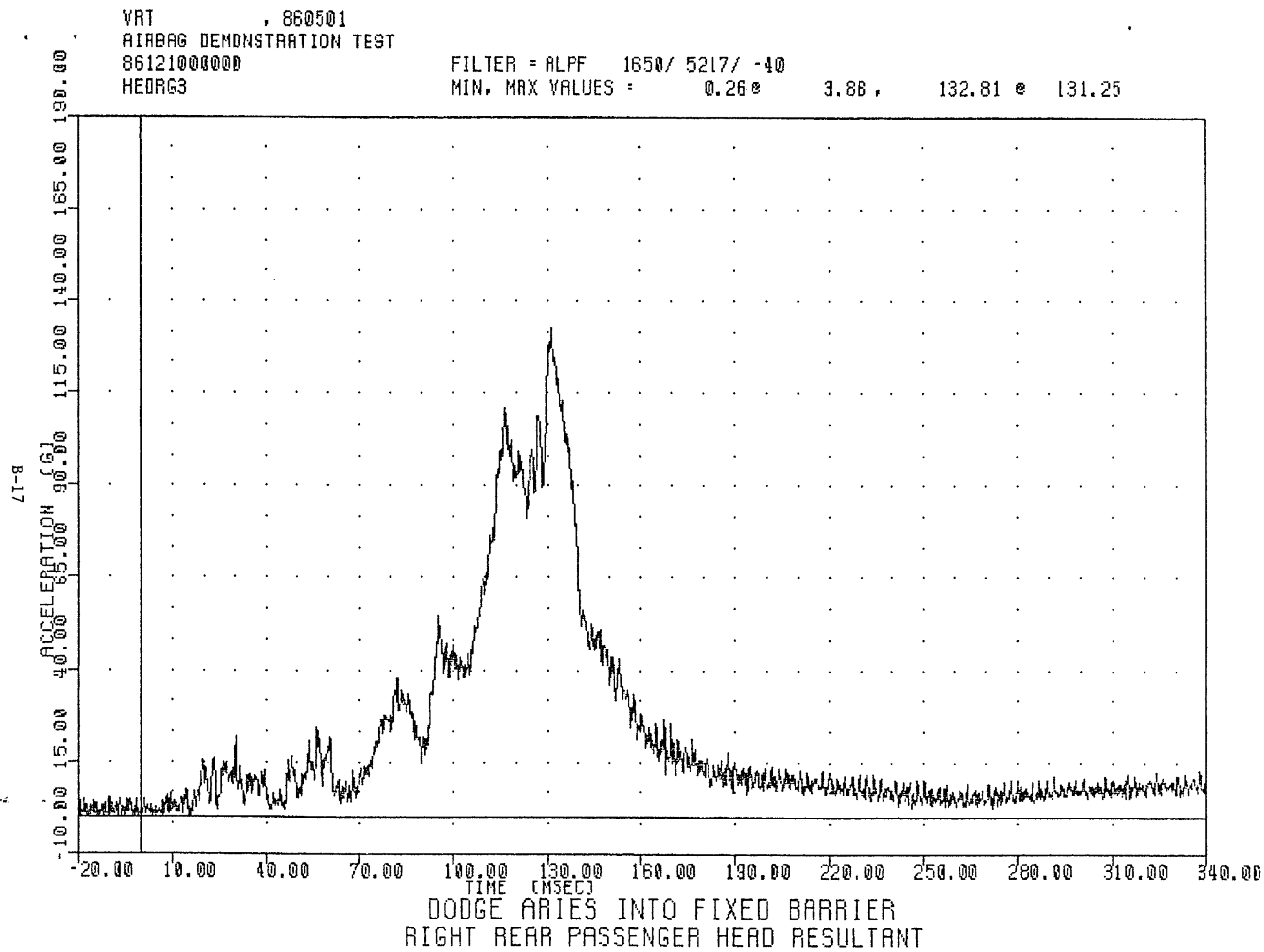
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER HEAD ACCELERATION X AXIS



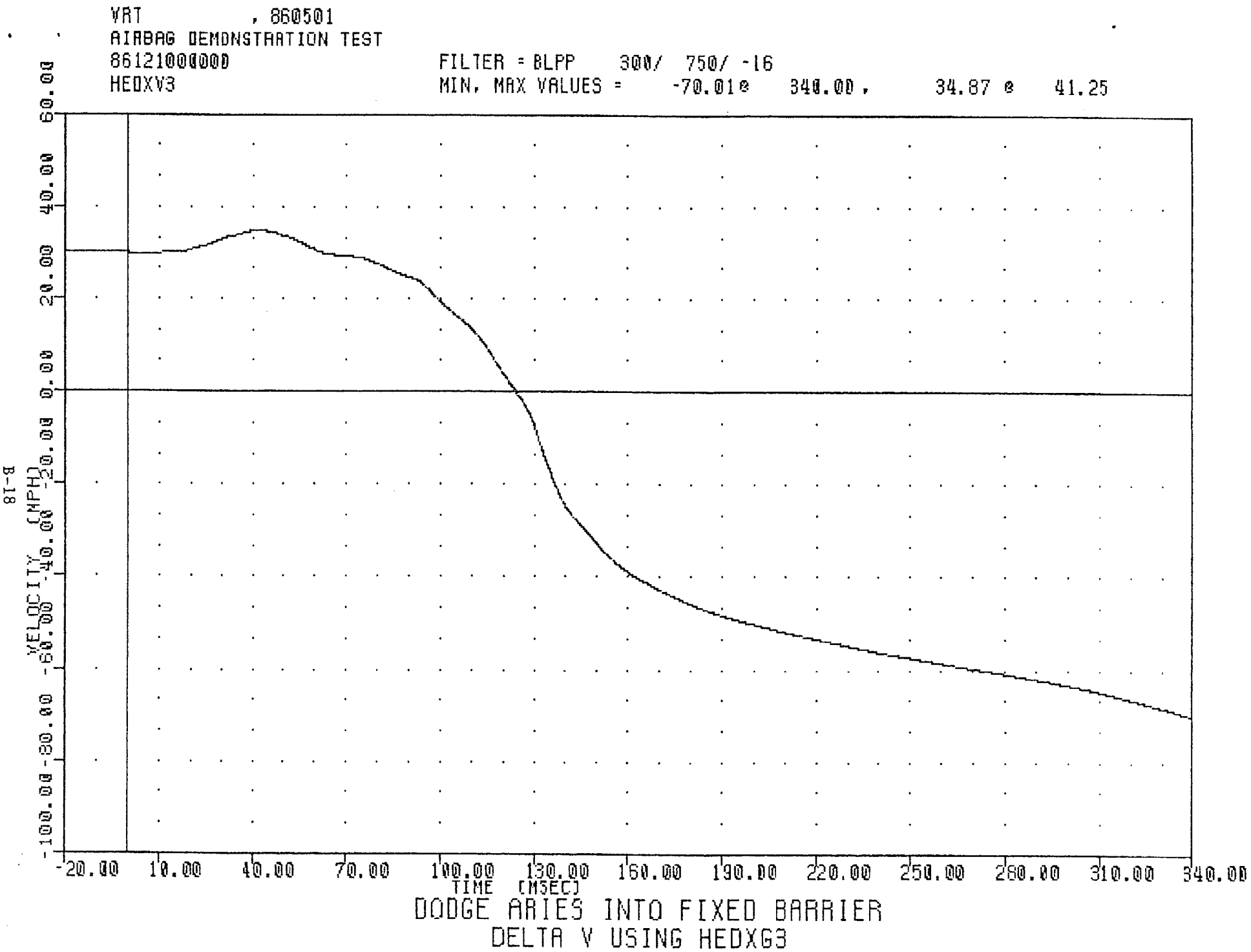
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER HEAD ACCELERATION Y AXIS



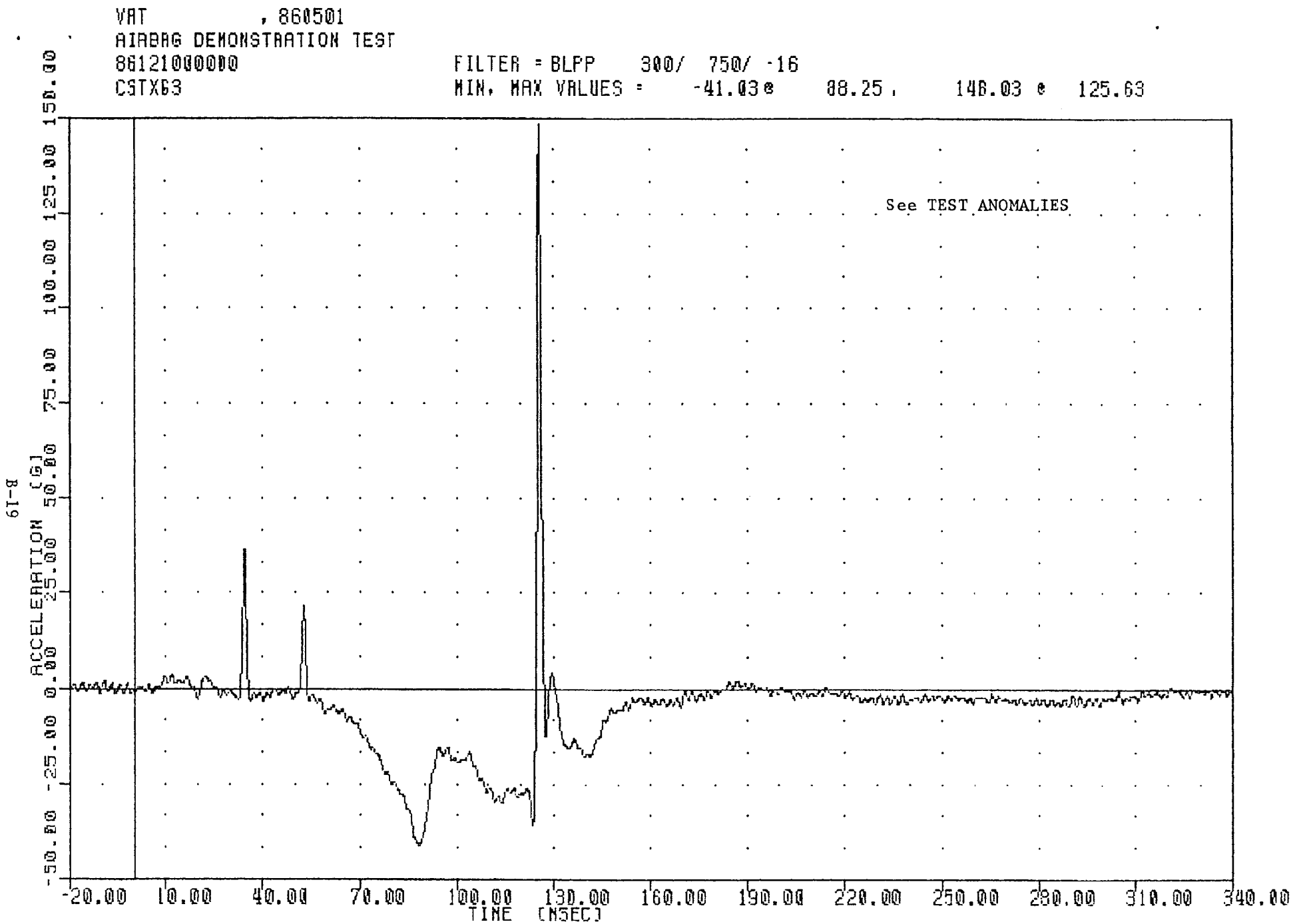
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER HEAD ACCELERATION Z AXIS



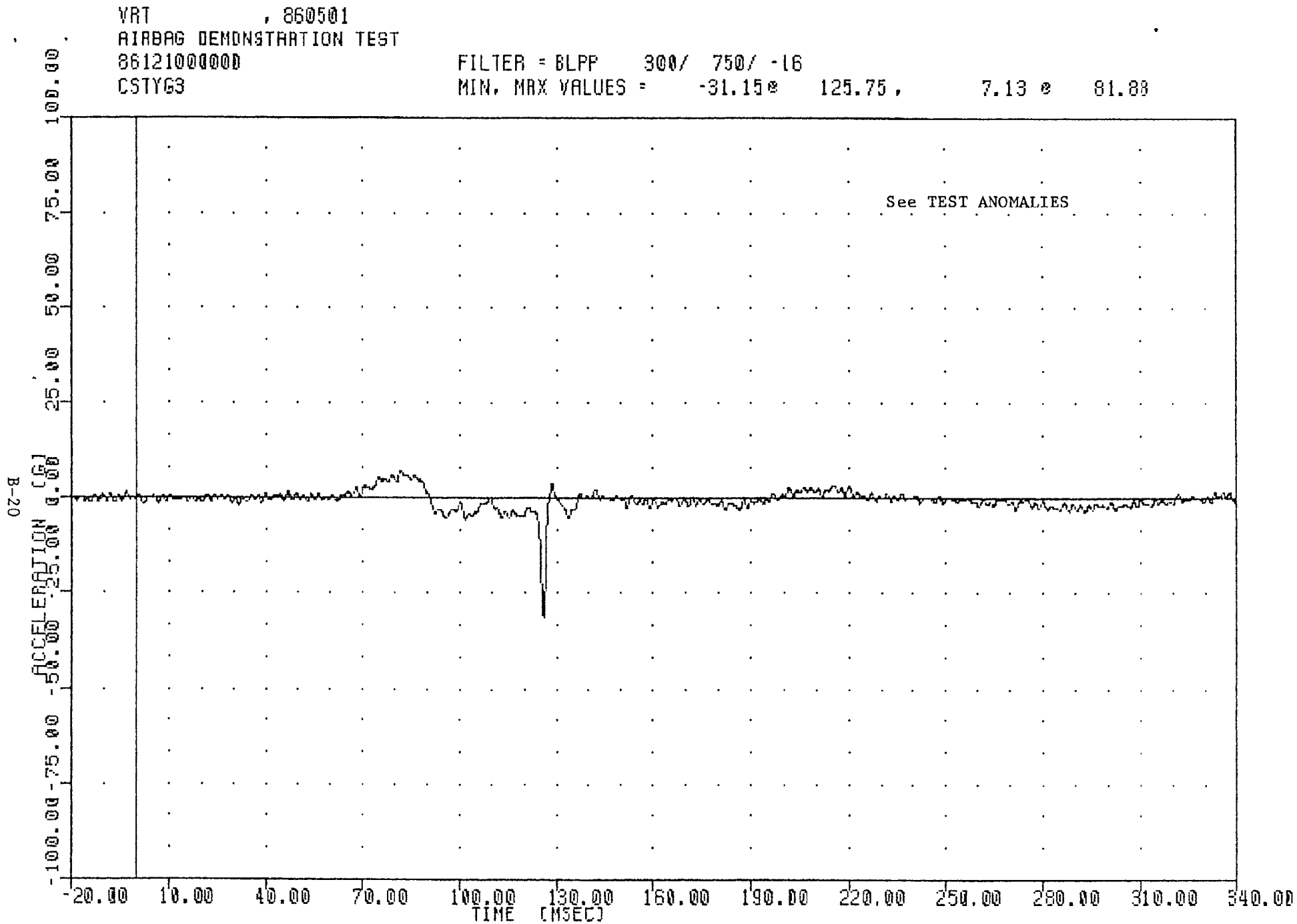
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER HEAD RESULTANT



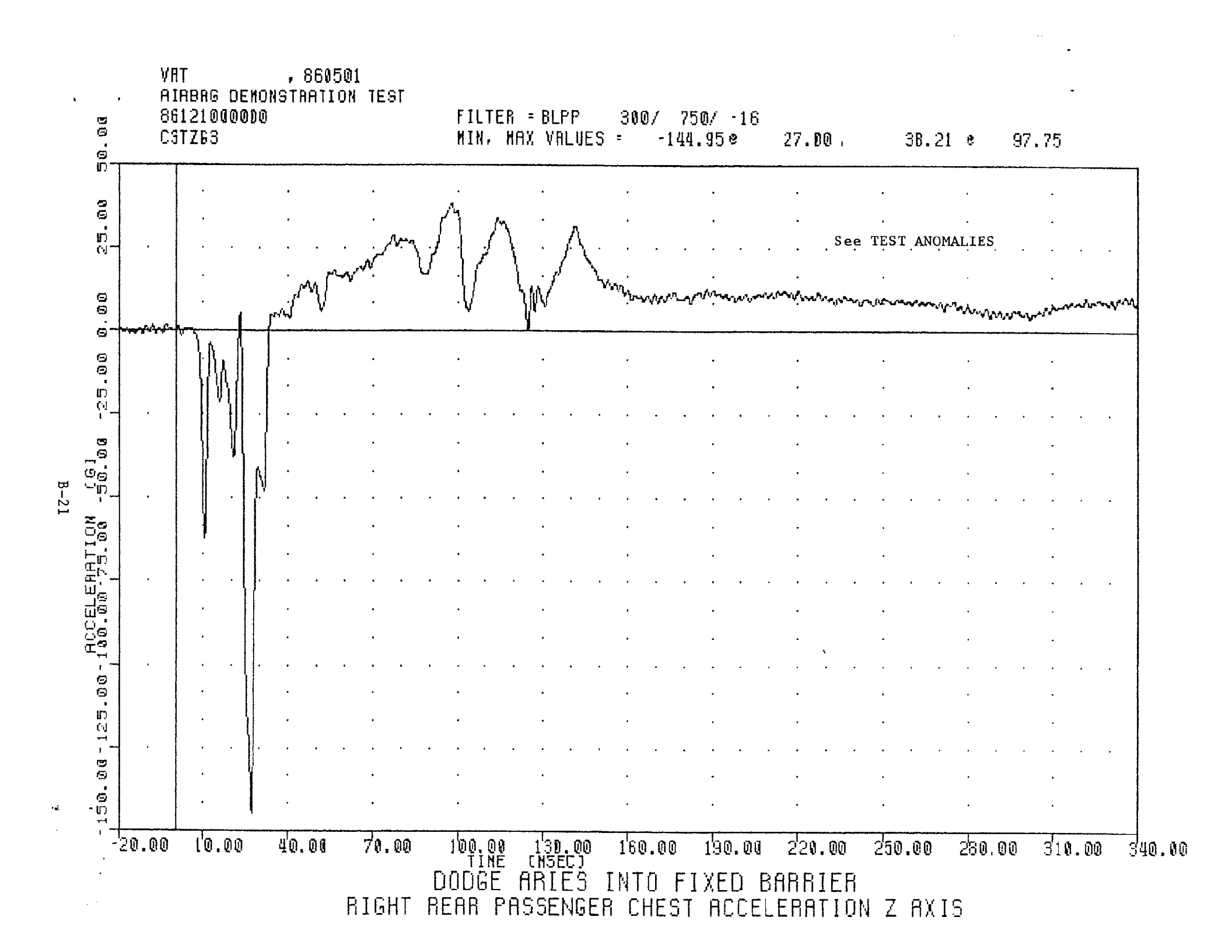
DODGE ARIES INTO FIXED BARRIER
DELTA V USING HEDXG3



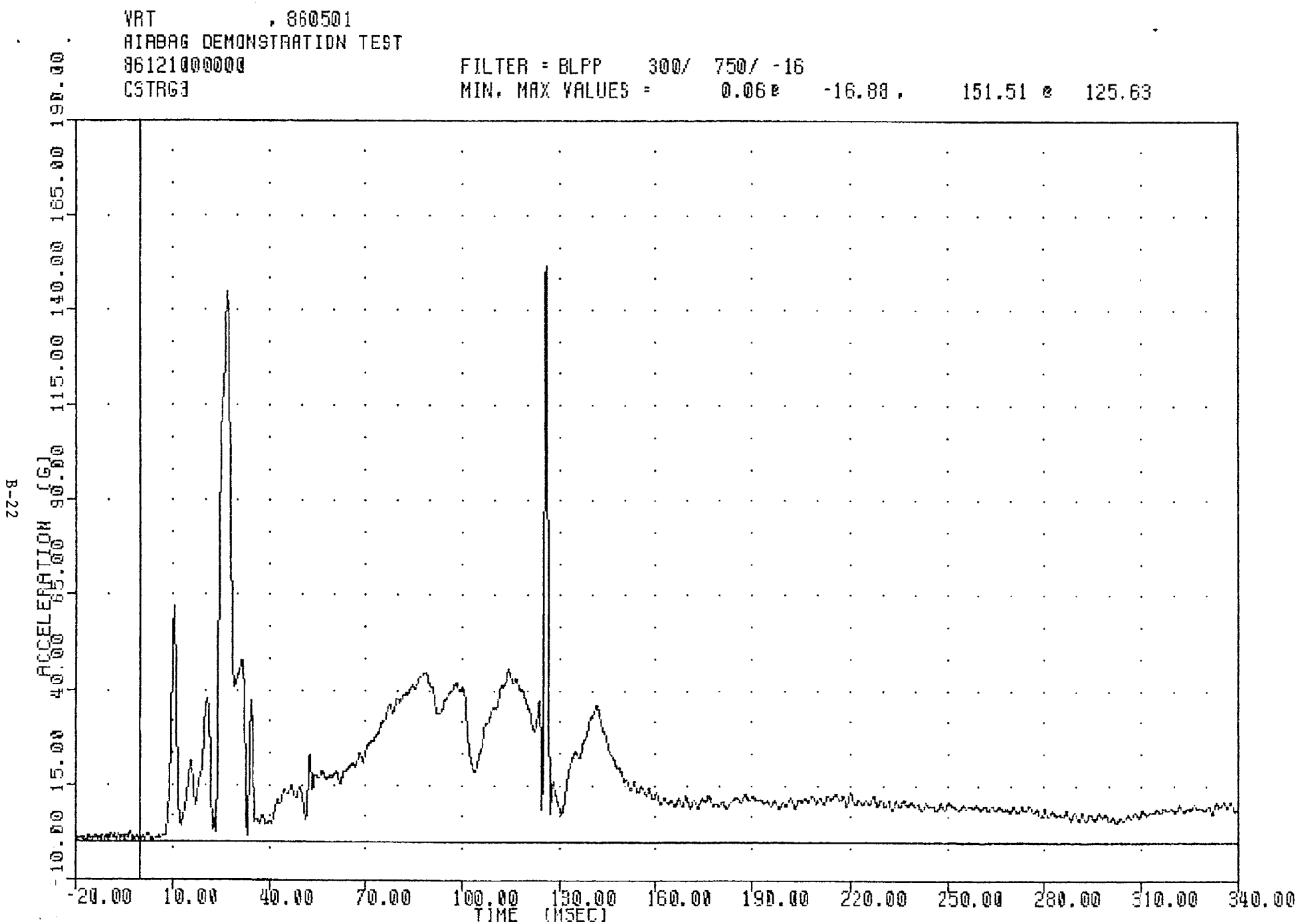
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER CHEST ACCELERATION X AXIS



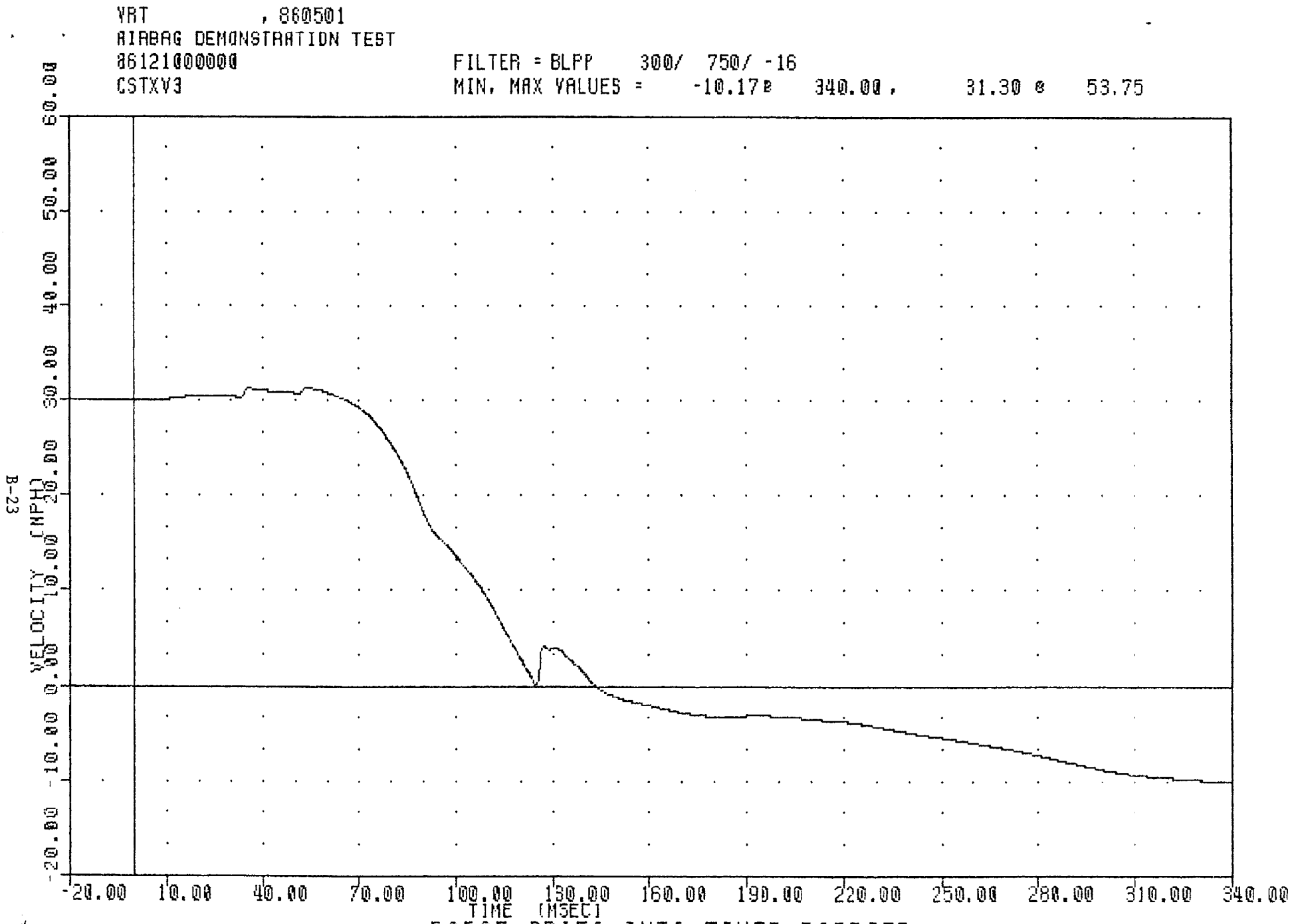
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER CHEST ACCELERATION Y AXIS



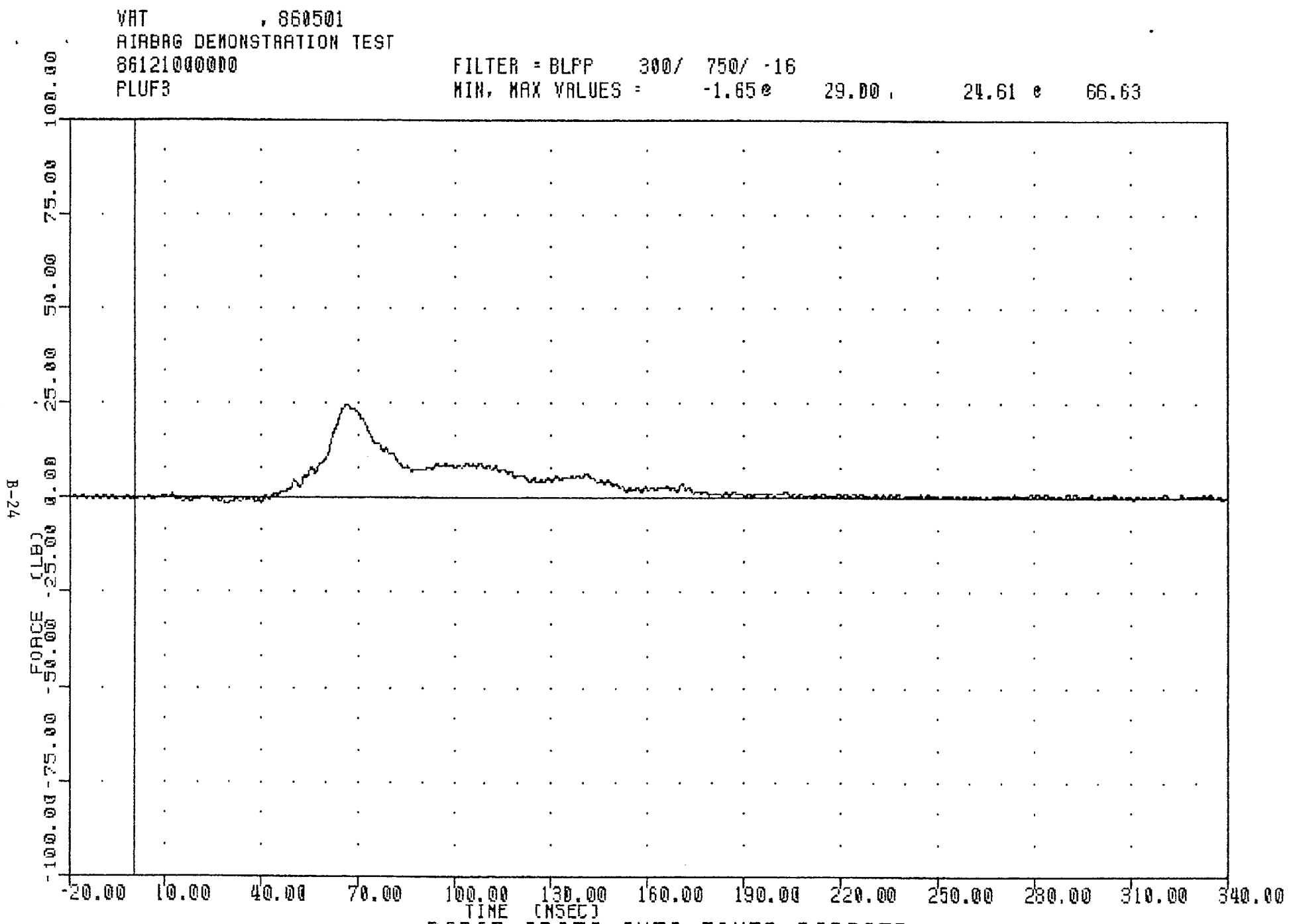
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER CHEST ACCELERATION Z AXIS



DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER CHEST RESULTANT



DODGE ARIES INTO FIXED BARRIER
DELTA V USING CSTXG3



DODGE ARIES INTO FIXED BARRIER

RIGHT REAR PASSENGER PELVIS LEFT UPPER FORCE LBS

VAT , 860501
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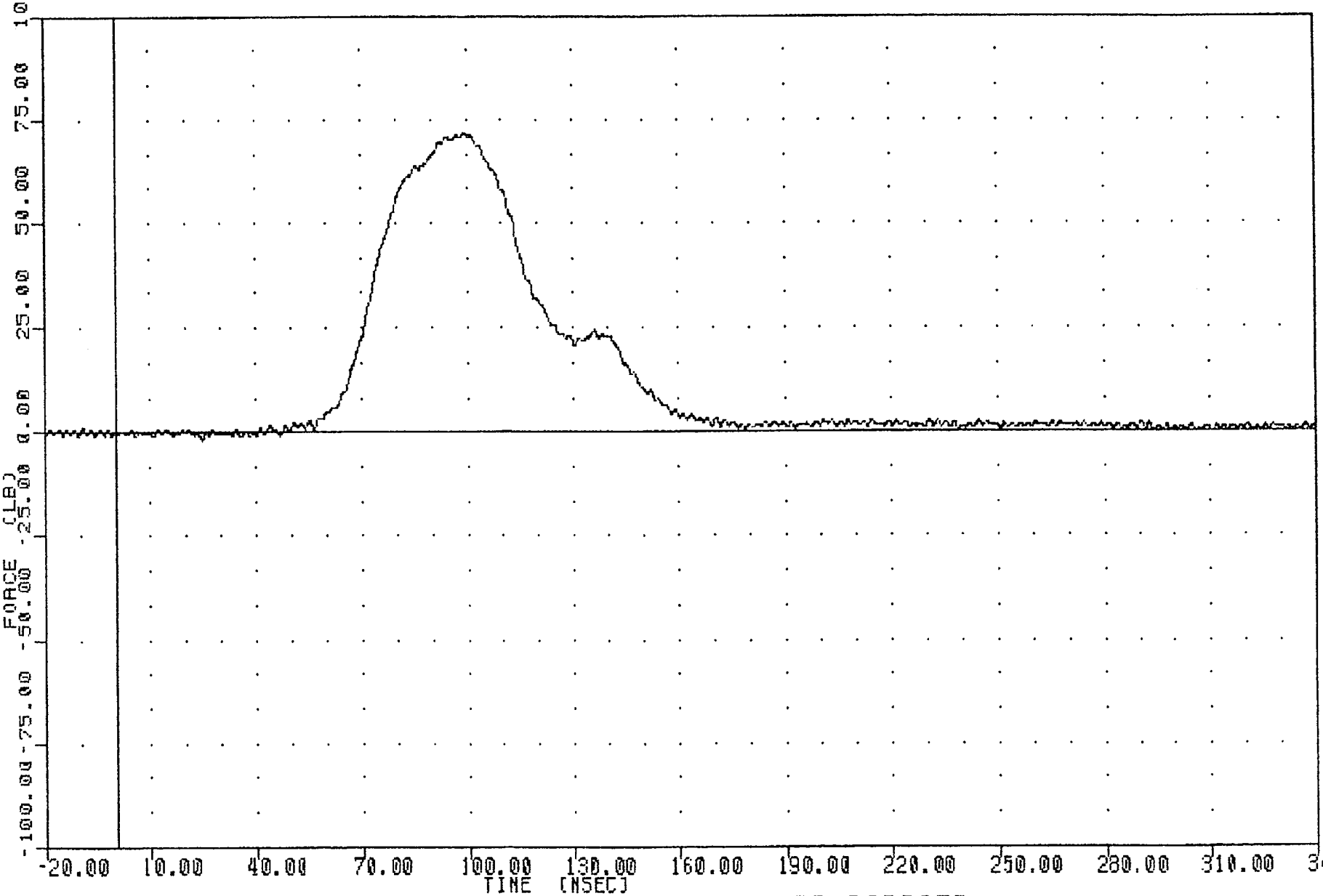
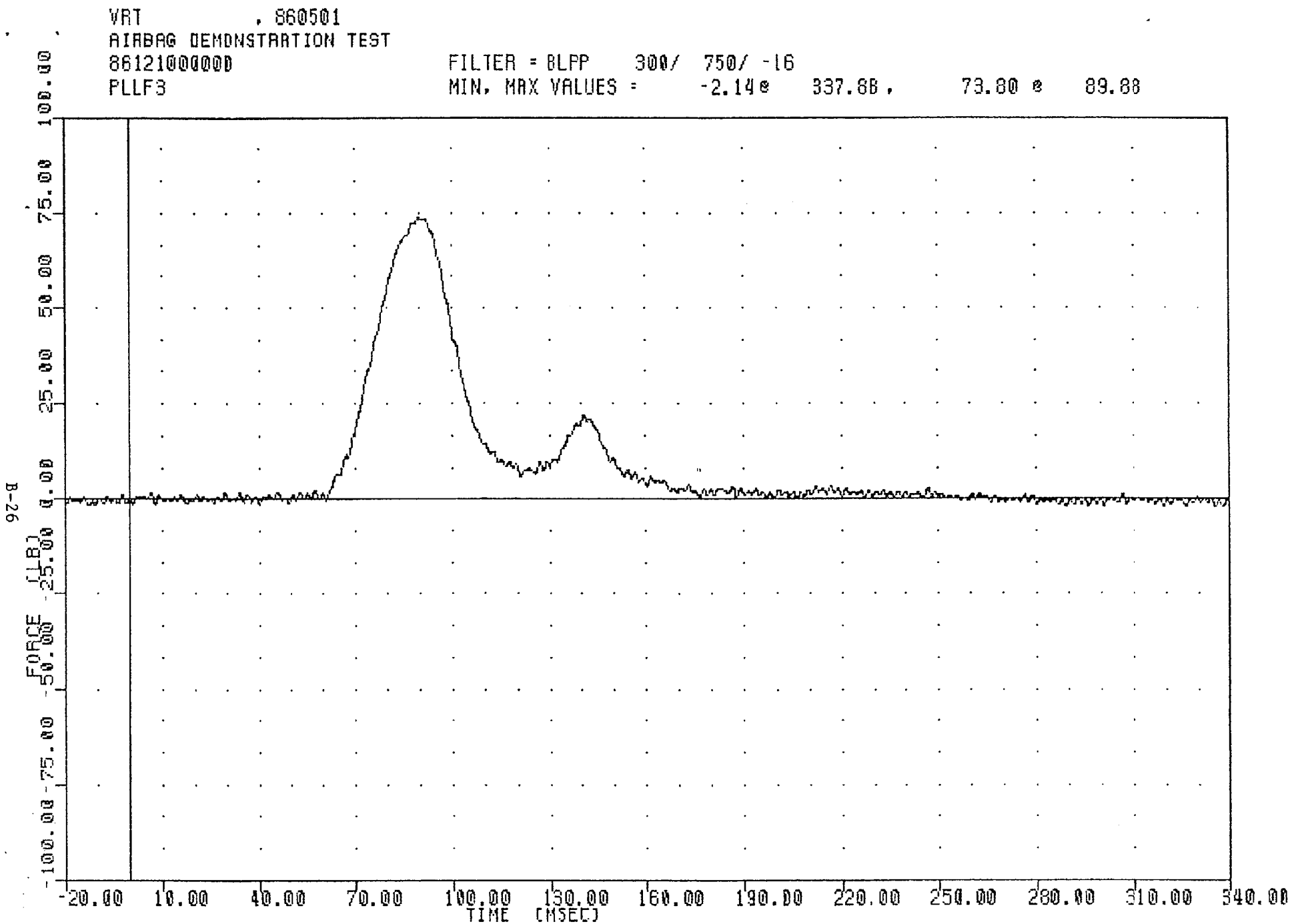
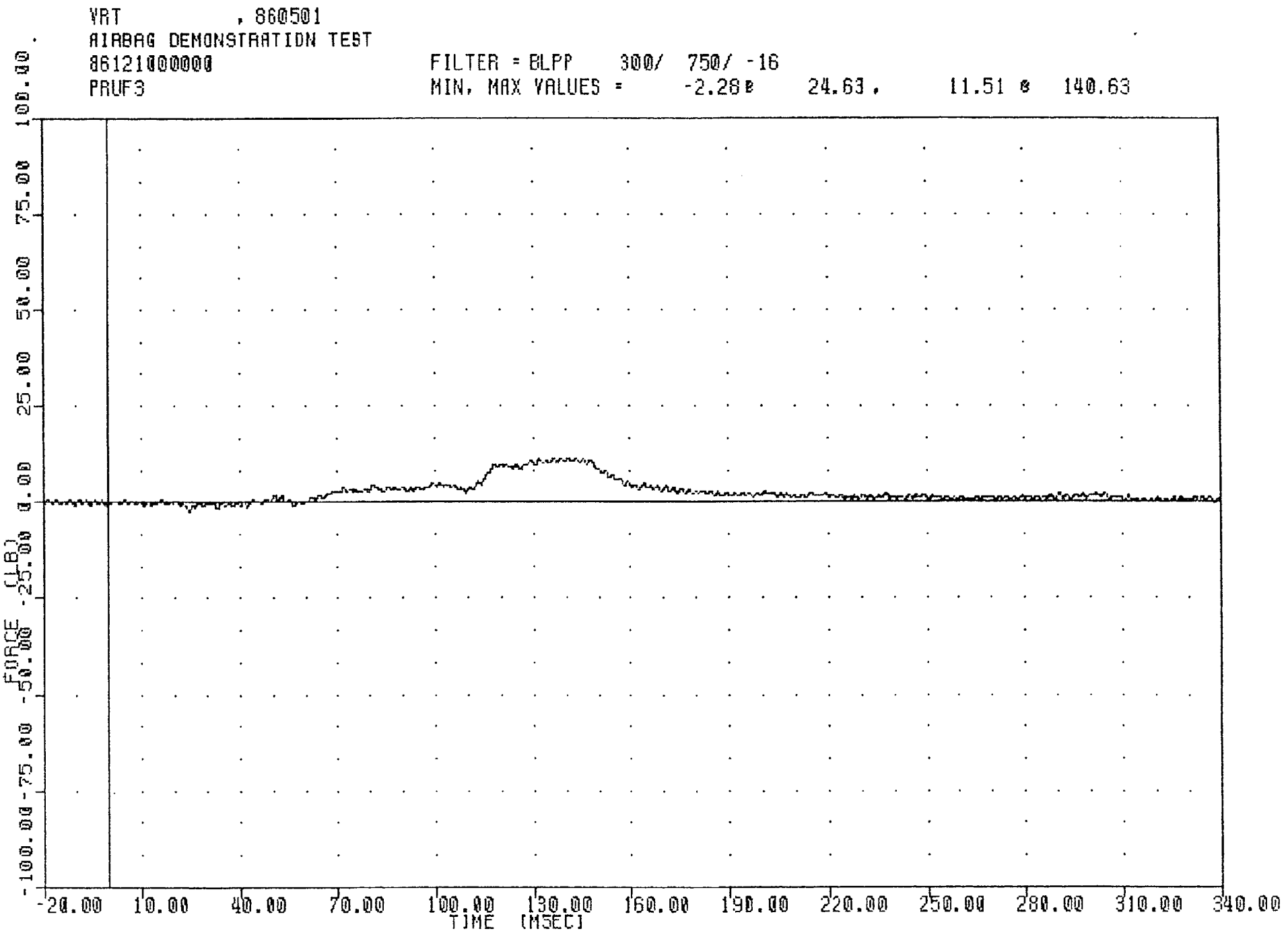


DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS LEFT MIDDLE FORCE LBS



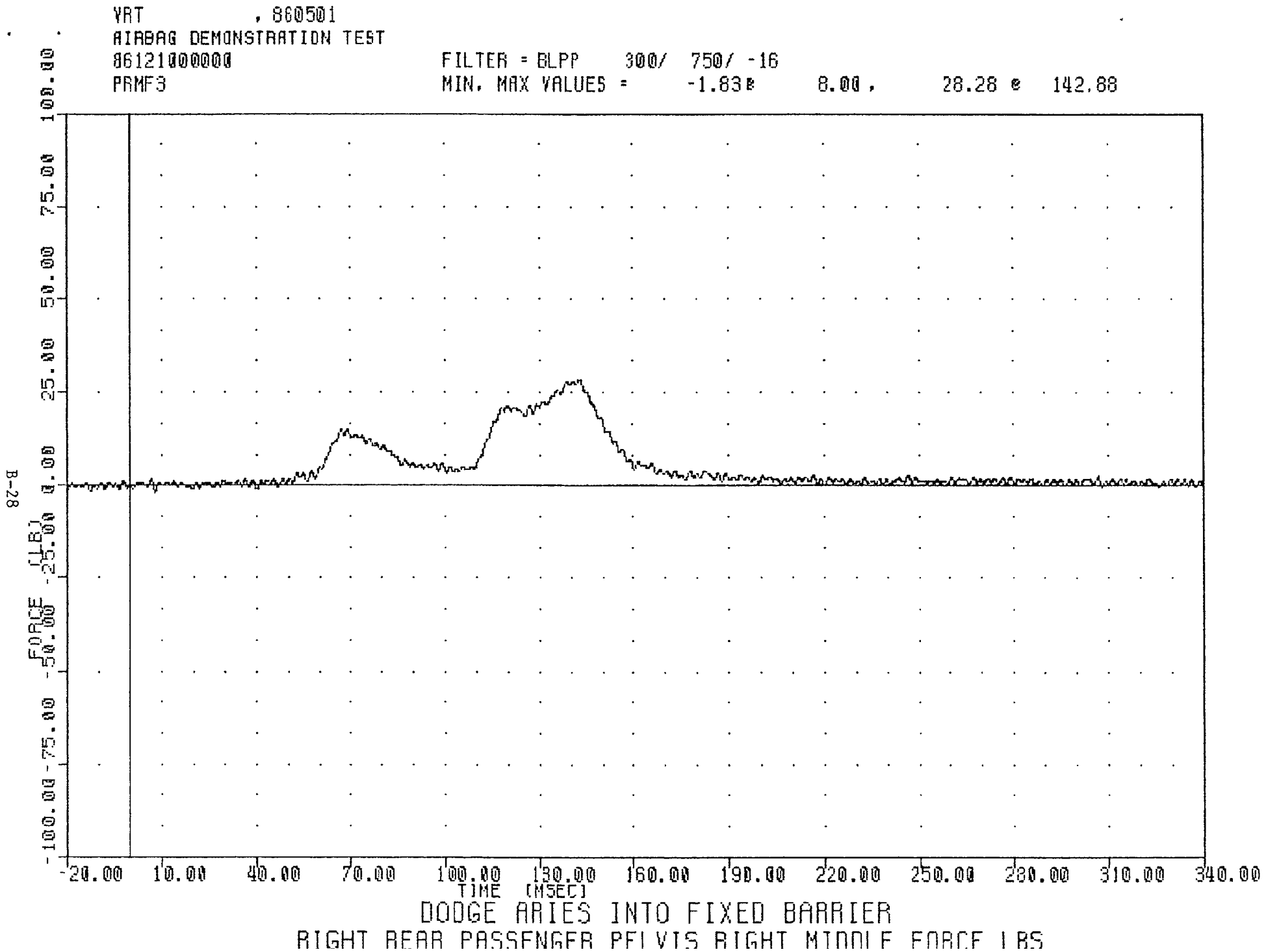
DODGE ARIES INTO FIXED BARRIER

RIGHT REAR PASSENGER PELVIS LEFT LOWER FORCE LBS



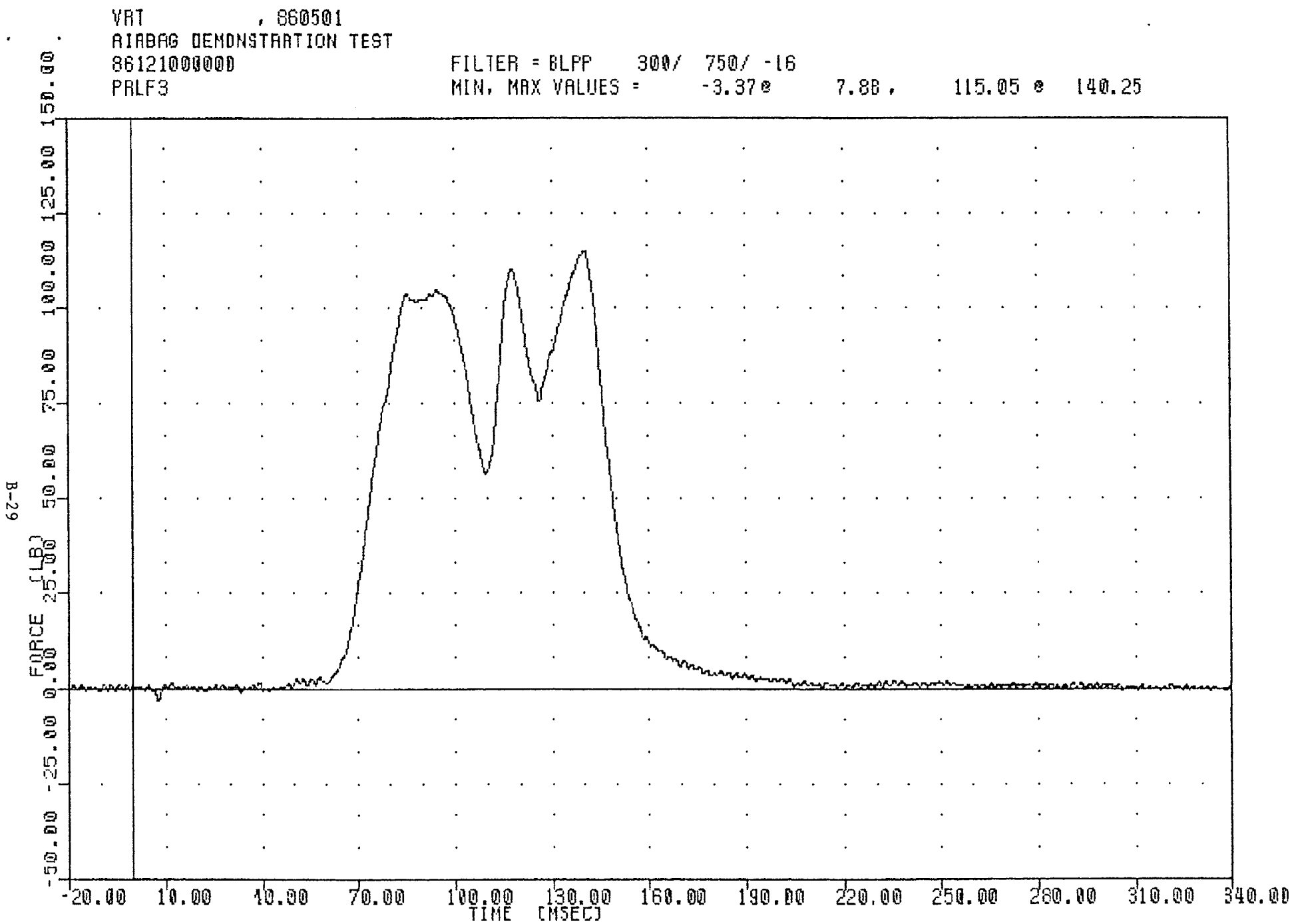
DODGE ARIES INTO FIXED BARRIER

RIGHT REAR PASSENGER PELVIS RIGHT UPPER FORCE LBS

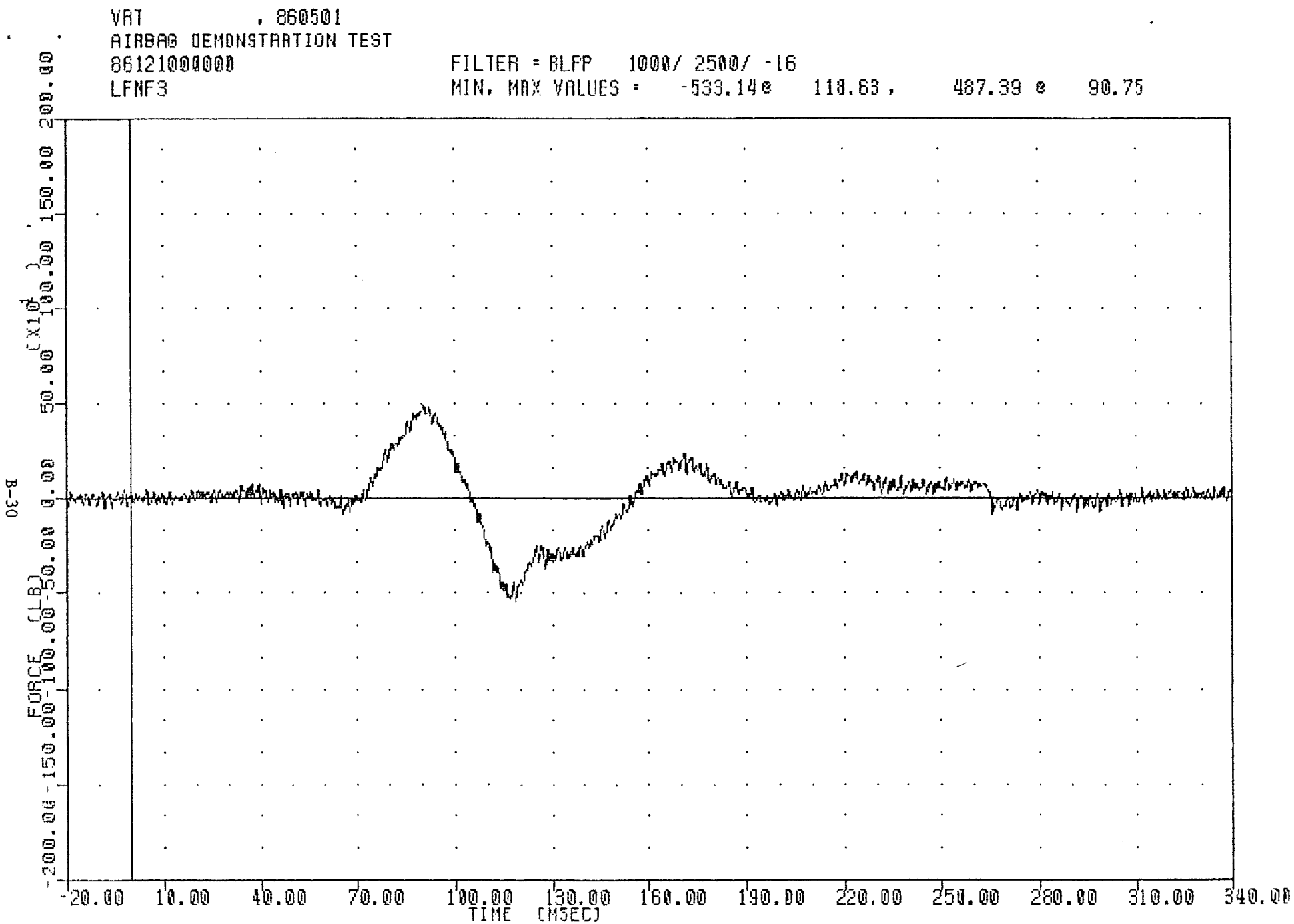


DODGE ARIES INTO FIXED BARRIER

RIGHT REAR PASSENGER PELVIS RIGHT MIDDLE FORCE LBS

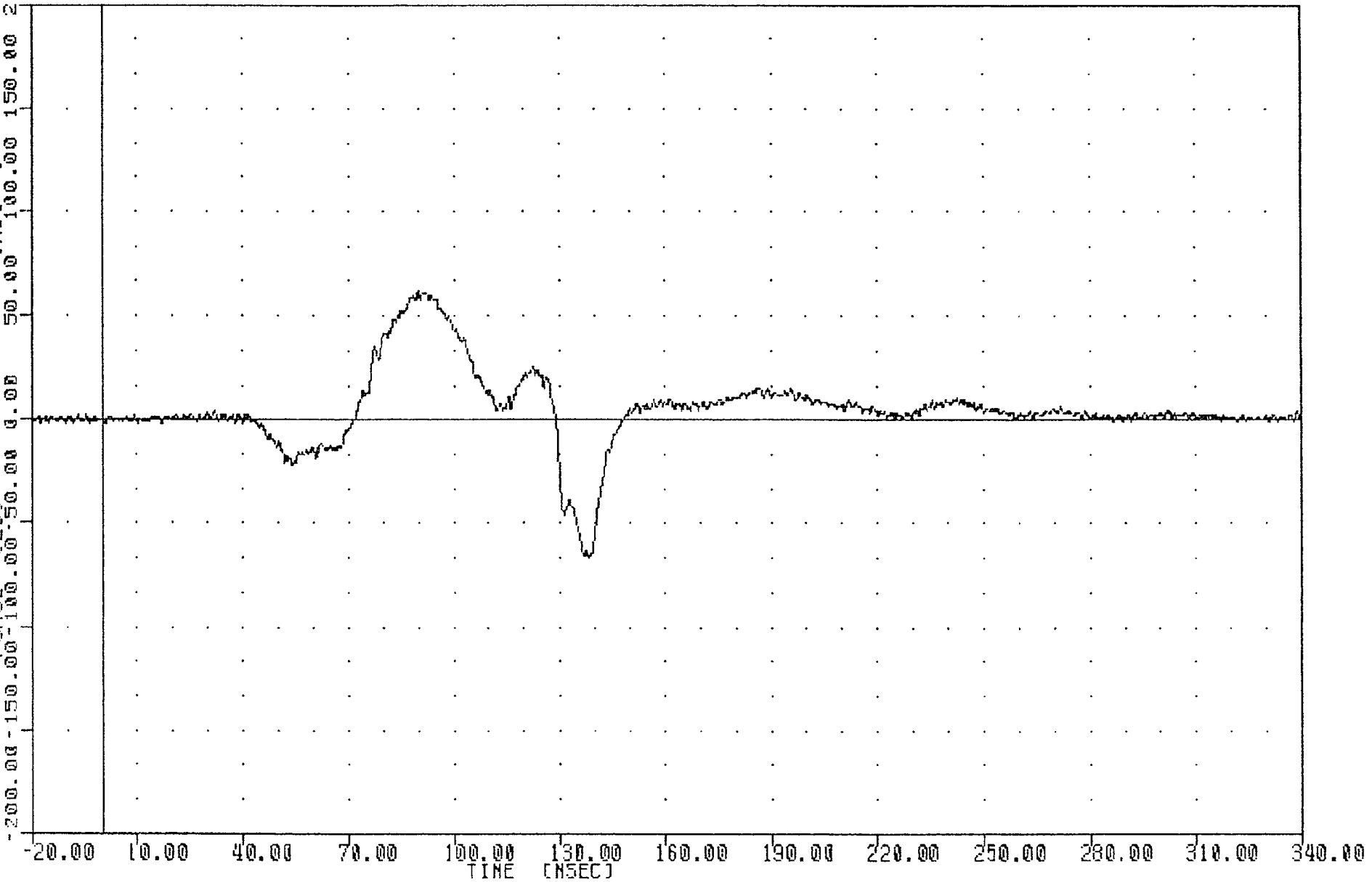


DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER PELVIS RIGHT LOWER FORCE LBS

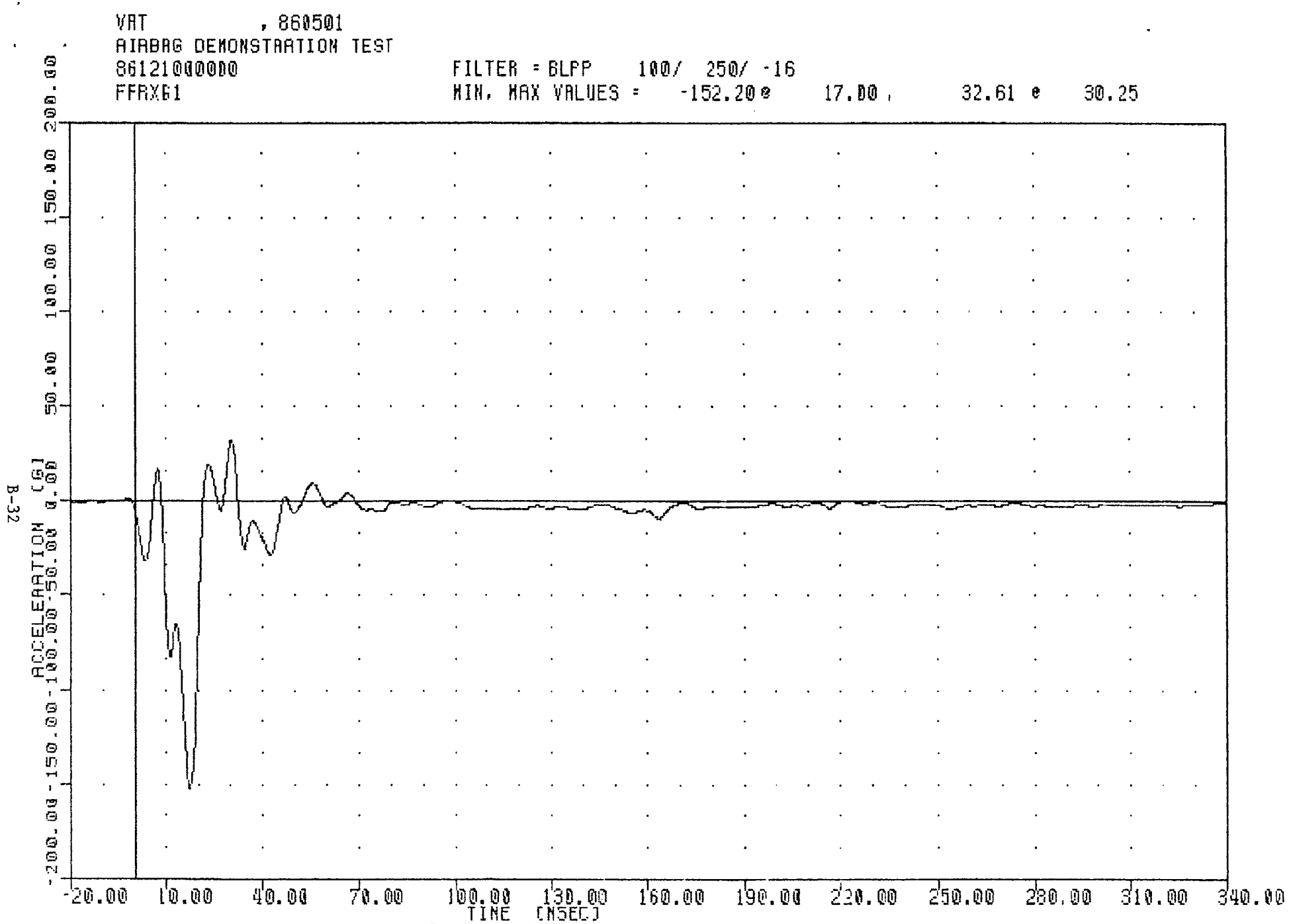


DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER LEFT FEMUR FORCE LBS

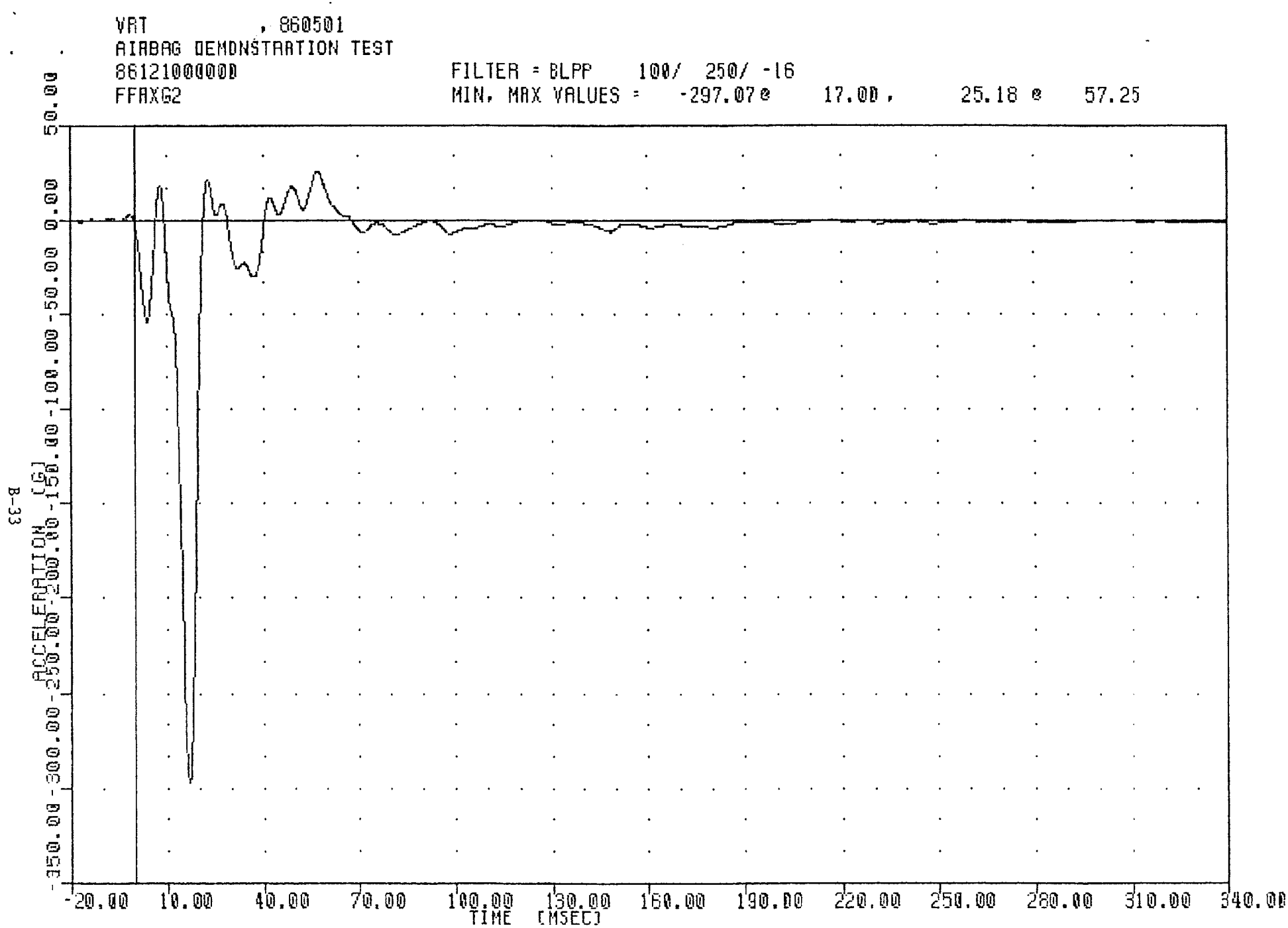
VAT , 860501
AIRBAG DEMONSTRATION TEST
861210000000 FILTER = BLPP 1000/ 2500/ -16
RFMF3 MIN, MAX VALUES = -663.12 @ 138.13 , 612.69 @ 90.00



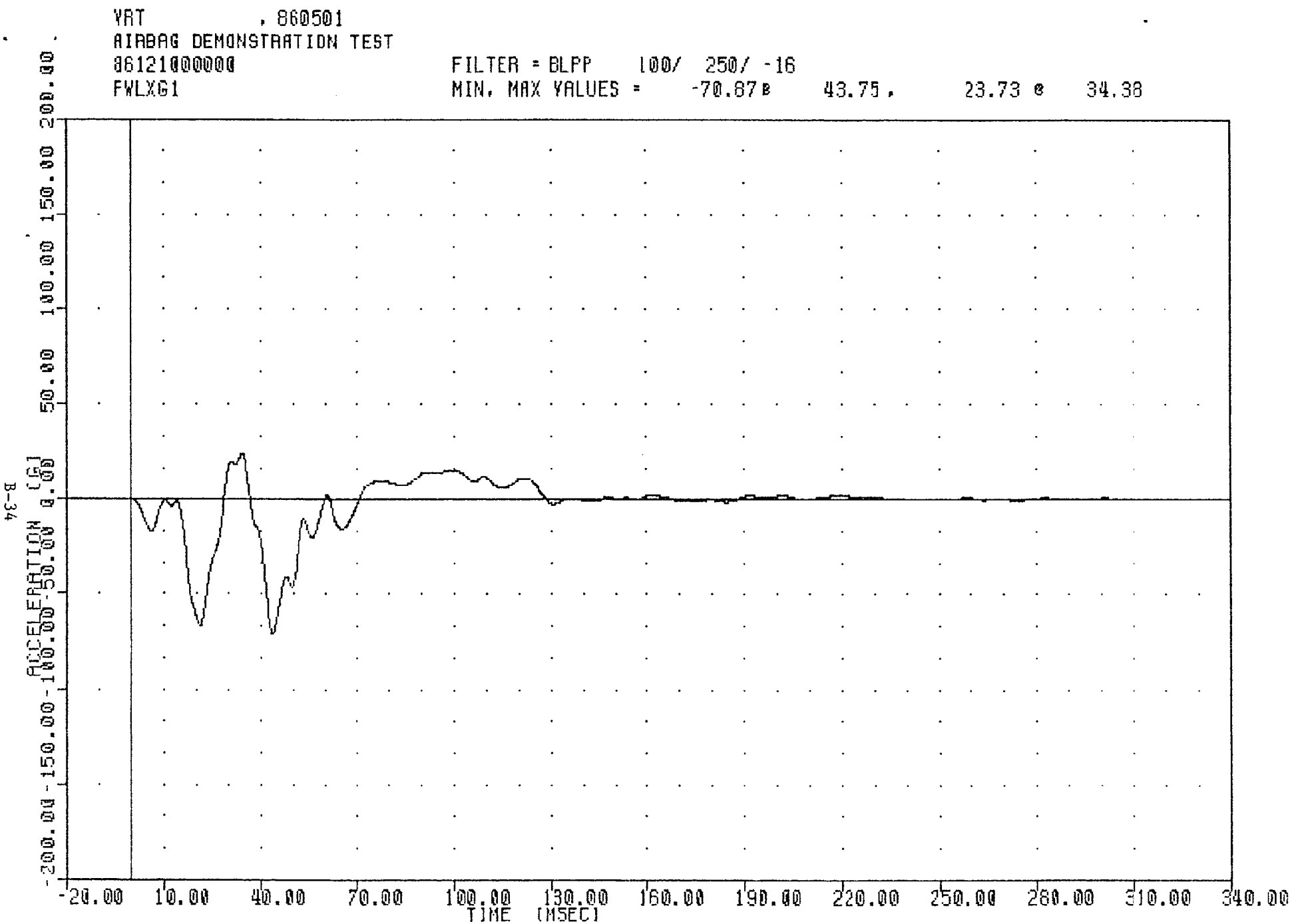
DODGE ARIES INTO FIXED BARRIER
RIGHT REAR PASSENGER RIGHT FEMUR FORCE LBS



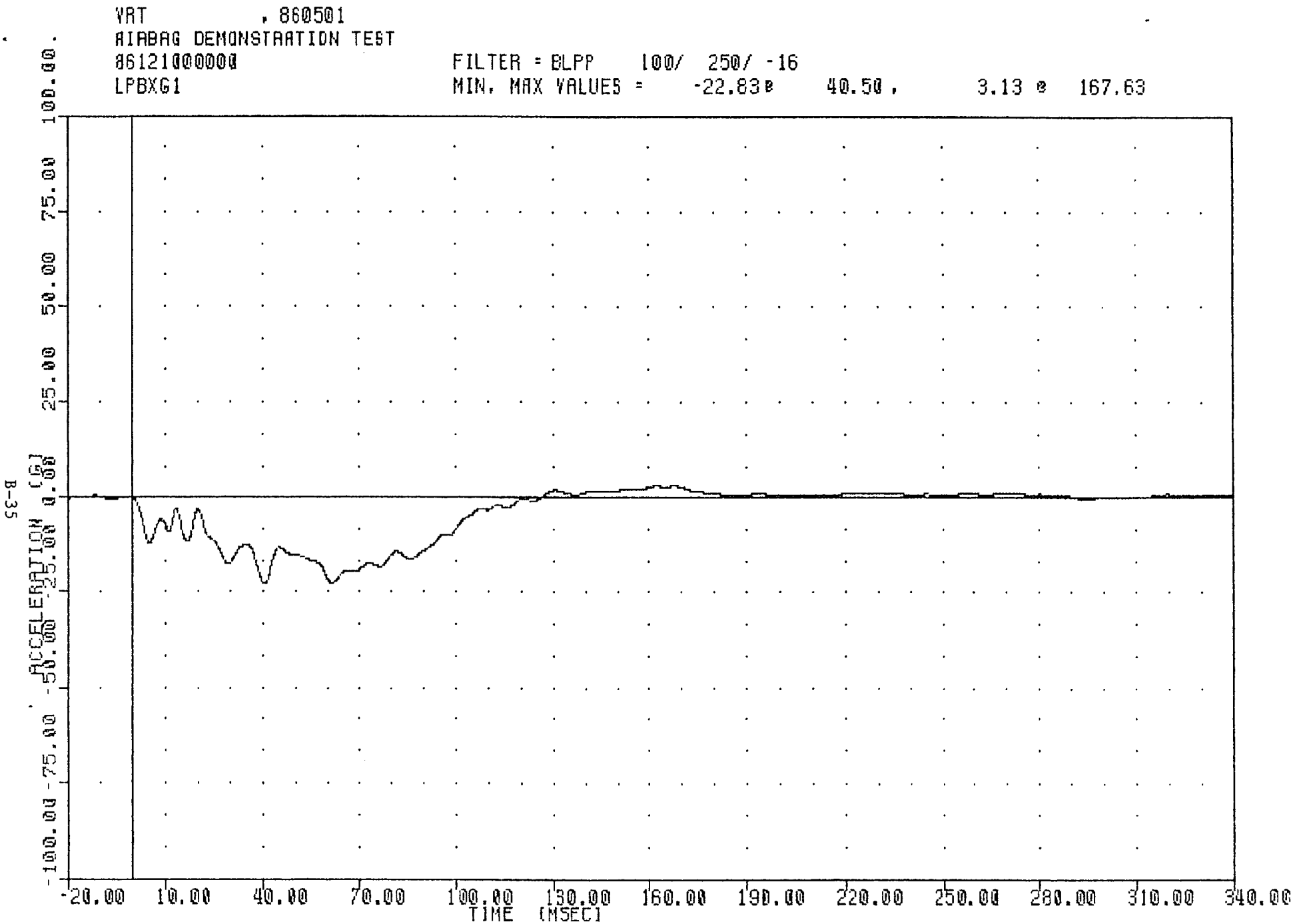
DODGE ARIES INTO FIXED BARRIER
LEFT FORWARD FRAME RAIL ACCELERATION X AXIS



DODGE ARIES INTO FIXED BARRIER
RIGHT FORWARD FRAME RAIL ACCELERATION X AXIS



DODGE ARIES INTO FIXED BARRIER
FIREWALL ACCELERATION X AXIS



DODGE ARIES INTO FIXED BARRIER
LEFT B PILLAR ACCELERATION X AXIS

APPENDIX C

DUMMY CERTIFICATION

POST - TEST

DUMMY CALIBRATION

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

PART 572 05-MAY-86

TEMPERATURE 71.00 F RELATIVE HUMIDITY 33.00 %
ED18710 572 SN 187 EXT.DIMENSION CAL10

DESCRIPTION SN HUMANOID 187	SPECIFICATION	TEST RESULTS
Sitting Height	35.6 - 35.8IN	35.6 INS
Shoulder Pivot Height	21.8 - 22.4IN	22.2 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	20.5 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	18.0 INS
Chest Circumference Over Nipples	36.8 - 40.0IN	37.3 INS
Waist Circumference at Min. Girth	31.4 - 32.6IN	32.5 INS
Hip Width	14.0 - 15.4IN	15.3 INS
Knee Pivot From Floor	19.3 - 19.9IN	19.5 INS

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Mary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572 05-MAY-86

TEMPERATURE 72.00 F
LF18710

RELATIVE HUMIDITY 32.00 %
572 SN 187 LUMBAR FLEX CAL10

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	54.00 LBS
NET RETURN ANGLE	< 12 DEG	5.40 DEG

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572 05-MAY-86

TEMPERATURE 71.00 F
AB18710

RELATIVE HUMIDITY 35.00 %
572 SN 187 ABDOM COMPR CAL 10

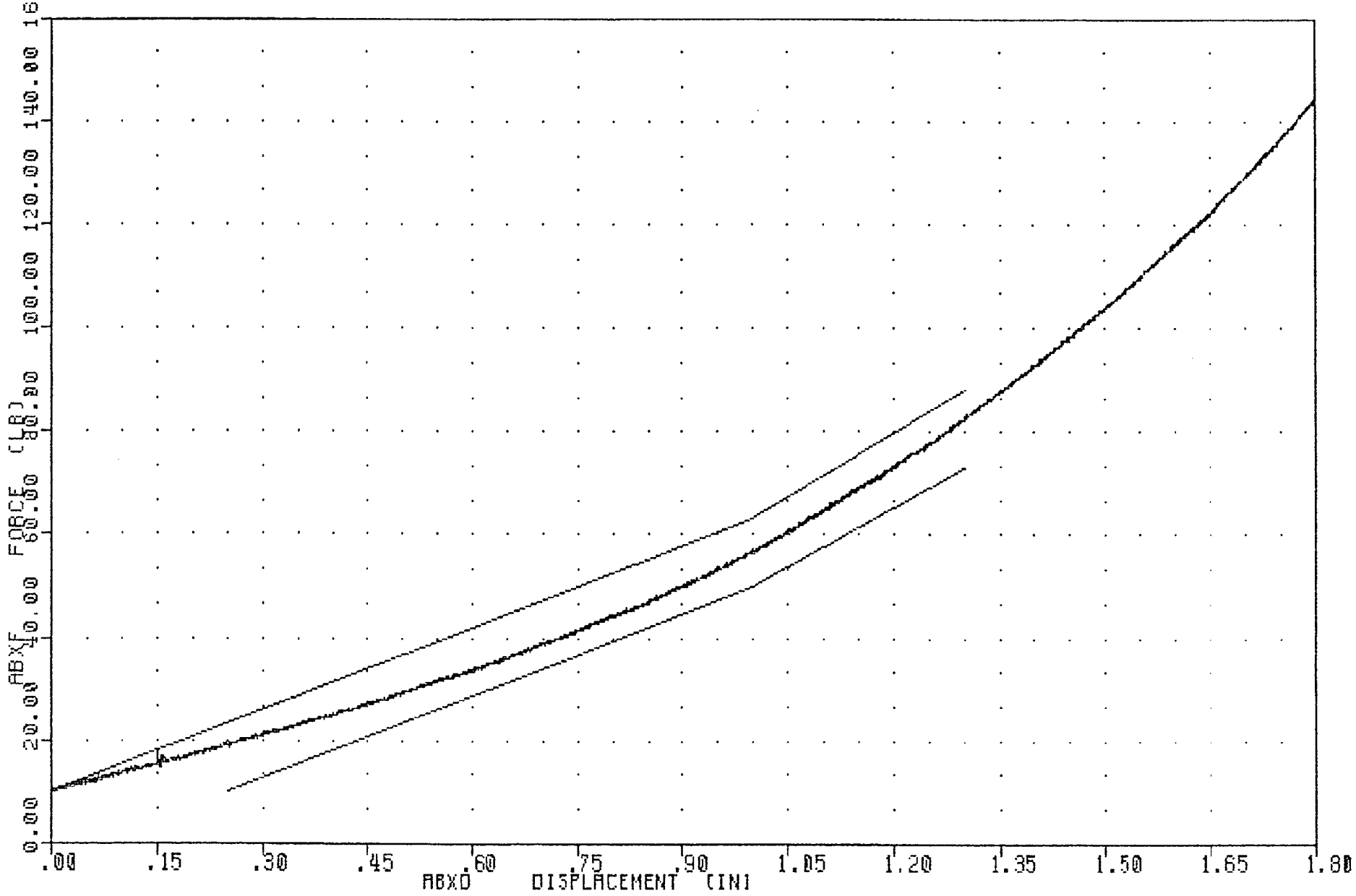
TEST CORRIDORS DISPLACEMENT	FORCE	TEST RESULTS
0 IN.	10 LBS	10 LBS
.50 IN.	23.00 - 36.00 LBS	29.17 LBS
.75 IN.	36.00 - 50.00 LBS	41.65 LBS
1.00 IN.	50.00 - 63.00 LBS	56.76 LBS
1.30 IN.	73.00 - 88.00 LBS	82.38 LBS

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

,AB18710 572 SN 187 ABDOM COMPR CAL 10 86125

ABXD	FILTER = ALPF	1650/ 5214/ -40	MIN, MAX =	0.00 @	0.00 ,	1.83 @	149.52
ABXF	FILTER = ALPF	1650/ 5214/ -40	MIN, MAX =	0.99 @	0.00 ,	149.52 @	1.83



ABDOMINAL COMPRESSION VS DISPLACEMENT

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572 05-MAY-86

TEMPERATURE 71 F RELATIVE HUMIDITY 36 %
HD18710 572 SN 187 HEAD DROP CAL 10

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PEAK RESULTANT ACCELERATION	210 - 260 G	248.50 G
TIME ABOVE 100 G LEVEL	0.9 - 1.5 MS	1.26 MS
PEAK LATERAL ACCELERATION	10 G MAX	-6.46 G
IS ACCELERATION CURVE UNIMODAL?		YES

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Mary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572 05-MAY-86

TEMPERATURE 70.00 F RELATIVE HUMIDITY 36.00 %
HN18710 572 SN 187 HEAD/NECK CAL 10

Test Parameter	Specification	Test Results
Pendulum velocity	21.5 to 25.5 fps	23.49 fps
Pendulum Deceleration:		
T1 - T2: 5 - 20 G	3 ms. max	2.41 ms.
T2 - T3: 20 - 20 G	25 - 30 ms.	26.41 ms.
T3 - T4: 20 - 5 G	10 ms. max	8.21 ms.
Avg. G level T2 - T3	20 - 24 G	23.91 G
Maximum Rotation Angle	63 - 73 deg.	64.56 deg.
Peak Head Resultant Accel	26 G max	23.67 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	0.00	0.00
30	25.6 - 34.4	2.1 - 3.1	30.61	2.39
60	40.3 - 51.7	4.3 - 5.3	48.91	4.60
max	53.2 - 66.8	5.0 - 6.0	60.00	5.08
60	67.0 - 83.0	4.3 - 5.3	69.68	4.73
30	85.4 - 104.6	2.1 - 3.1	89.89	2.38
0	101.0 - 123.0	-0.5 - +0.5	104.19	0.13

* DUMMY MEETS SPECIFICATIONS

TECHNICAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572 05-MAY-86

TEMPERATURE 71 F RELATIVE HUMIDITY 37 %
LEFT KNEE
LK18710 572 SN 187 L.KNEE IMP CAL 10

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PROBE VELOCITY	6.76 - 7.04 FT/SEC	6.95 FT/SEC
PEAK KNEE IMPACT FORCE	1850 - 2500 LBS.	2386.45 LBS.
DURATION ABOVE 1000 LBS.	>=1.7 MS.	1.73 MS.

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572 05-MAY-86

TEMPERATURE 71 F RELATIVE HUMIDITY 37 %
RIGHT KNEE
RK18710 572 SN 187 R.KNEE IMP CAL 10

TEST PARAMETER	SPECIFICATION	TEST RESULTS
PROBE VELOCITY	6.76 - 7.04 FT/SEC	6.96 FT/SEC
PEAK KNEE IMPACT FORCE	1850 - 2500 LBS.	1943.73 LBS.
DURATION ABOVE 1000 LBS.	>=1.7 MS.	1.71 MS.

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Mary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572 05-MAY-86

TEMPERATURE 71 F RELATIVE HUMIDITY 38 %
TL18710 572 SN 187 L.S.THORAX CAL 10

TEST PARAMETER	LOW SPEED TEST SPECIFICATION	TEST RESULTS
PENDULUM VELOCITY	13.86-14.14 FT/SEC	14.05 FT/SEC
PEAK DEFLECTION	1.1 INCHES MAX.	1.09 INCHES
PEAK RESISTIVE FORCE	1,450. POUNDS MAX.	1261. POUNDS
INTERNAL HYSTERESIS	50% - 70%	52.0%

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572 05-MAY-86

TEMPERATURE 71 F RELATIVE HUMIDITY 38 %
TH18710 572 SN 187 H.S.THORAX CAL 10

TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TEST RESULTS
PENDULUM VELOCITY	21.78-22.22 FT/SEC	22.22 FT/SEC
PEAK DEFLECTION	1.7 INCHES MAX.	1.63 INCHES
PEAK RESISTIVE FORCE	2,250. POUNDS MAX.	2014. POUNDS
INTERNAL HYSTERESIS	50% - 70%	51.8%

DUMMY MEETS SPECIFICATIONS

TECHNICIAN Gary L. Phelps