"BUMPER TESTS OF A 1979 FORD LTD RETROFITTED WITH ROMEO-KOJYO AND BREED ALL MECHANICAL AIR BAG SYSTEMS SENSORS"

PREPARED BY:
VEHICLE RESEARCH AND TEST CENTER
ST. RT. 33 LOGAN COUNTY
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JULY 1984

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Prepared By: J. C. Stultz

J. C. Stultz
Project Engineer
Transportation Research Center of Ohio

Approved By: Richard W. Runyon

R. W. Runyon
Project Manager
Transportation Research Center of Ohio

Report Accepted By: Andrew G. Detrick

A. G. Detrick
Vehicle Research & Test Center

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16. Abstract

This test report documents the three bumper tests conducted on a 1979 Ford LTD 4-door Sedan. Testing was conducted on June 8, 1984 and June 11, 1984. The purpose of the tests was to evaluate firing velocity levels of a retrofitted Romeo-Kojyo air bag sensor system and a Breed All Mechanical air bag sensor system. The test velocities were 5.1 mph, 7.1 mph and 9.1 mph.

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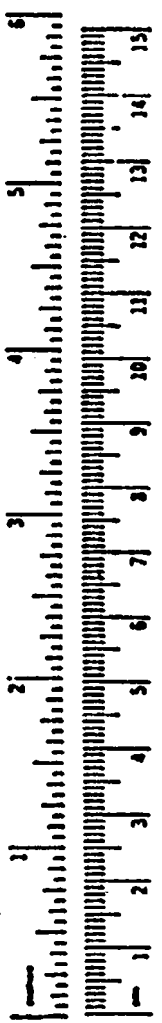
METRIC CONVERSION FACTORS

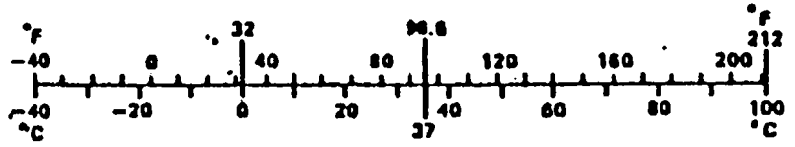
Approximate Conversions to Metric Measures

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

Approximate Conversions from Metric Measures

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





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SECTION 1.0

PURPOSE AND INTRODUCTION

PURPOSE

The purpose of conducting three bumper tests was to evaluate the velocity levels at which Romeo-Kojyo air bag sensors would fire when the vehicle was equipped with a pusher bar on the front bumper as used by various state police department vehicles which are being retrofitted with Romeo-Kojyo airbag systems. In addition, the vehicle was fitted with a prototype Breed Corporation mechanical airbag system firing mechanism which was undergoing preliminary testing at the time. The vehicle was tested using conditions not currently contained in a Federal Motor Vehicle Safety Standard.

INTRODUCTION

A 1979 Ford LTD 4-door sedan was towed into a fixed rigid barrier twice on June 8, 1984 and once on June 11, 1984 at velocities of 5.1 mph, 9.1 mph and 7.1 mph respectively. The tests were conducted to determine at what velocity levels the Romeo-Koyjo airbag system and its attendant sensors would fire. A Breed Corporation All Mechanical Air Bag System sensor was also monitored for firing signals.

The test vehicle contained no anthropomorphic dummies. Photographic coverage consisted of two (2) high speed 16mm motion picture films and still coverage. The purpose of the high speed film was to document the firing or non-firing of a flash bulb wired so it would light only if both the right front sensor and the safety sensor of the Romeo-Kojyo system were fired simultaneously. Other Romeo-Kojyo sensors on the vehicle which were monitored were the left front sensor and a special high level prototype sensor. The firing of the Breed System sensor was monitored by a single switch. The following table summarizes the firing of each system for the three tests.

TEST	BREED	ROMEO-KOJYO			
SPEED (MPH)	SENSOR	RT. FRONT	SAFE	LEFT FRONT	HIGH
5.1	No	No	Yes	No	No
7.1	No	Yes	Yes	Yes	Yes
9.1	Yes	Yes	Yes	Yes	Yes

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

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: Ford Motor Company of Canada Ltd.

MAKE/MODEL: Ford LTD VIN: F0B63F103382F

BODY STYLE: 4-Door Sedan MODEL YEAR: 1979

NHTSA NO.: R & D COLOR: Burgundy

ENGINE DATA: TYPE: V8 CYLINDERS: 8 DISPLACEMENT 302 CID

TRANSMISSION DATA: 3-Speed Automatic

DATE VEHICLE RECEIVED: 5/31/84 ODOMETER READING: 86142

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	Yes
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	No
POWER SEATS	No	TILTING STEERING WHEEL	No
POWER WINDOWS	No	TELESCOPING STEERING WHEEL	No
TINTED GLASS	Yes	AIR CONDITIONING	Yes
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: Ford Motor Company of Canada Ltd.

DATE OF MANUFACTURE: 9/79

GVWR: 5333 LBS.

GAWR: FRONT 2719 LBS.; REAR 2664 LBS.

VEHICLE TIRE DATA

RECOMMENDED COLD TIRE PRESSURE: FRONT 31 psi; REAR 35 psi

TIRES ON VEHICLE (MFGR. & LINE, SIZE): Tiempo Goodyear P205/75 R 14

BIAS PLY, BELTED, OR RADIAL: Radial

PLY RATING: 4

IS SPARE TIRE "SPACE SAVER"? No

IS SPARE TIRE STANDARD EQUIPMENT? No

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

RIGHT FRONT	1130	LBS.	RIGHT REAR	780	LBS.
LEFT FRONT	1130	LBS.	LEFT REAR	750	LBS.
TOTAL FRONT WEIGHT	2260	LBS. (59.6 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	1530	LBS. (40.4 % OF TOTAL VEHICLE WEIGHT)			
TOTAL TEST WEIGHT	3790	LBS.			

WEIGHT OF BALLAST SECURED IN VEHICLE TRUNK AREA: 0 LBS.

TEST CONDITIONS

TEST NUMBER: 840608A

DATE OF TEST: 6/8/84 TIME OF TEST: 11:20

AMBIENT TEMPERATURE AT IMPACT AREA: 80°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (LBS.)	3790	DNA
VEHICLE VELOCITY (mph)	5.1	5

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	RF 26 7/16	;LF 25 5/8	;RR 27 5/8	;LR 26 15/16
PRE-TEST ATTITUDE:	RF 26 11/16	;LF 26 5/16	;RR 26 3/4	;LR 26 15/16
POST-TEST ATTITUDE:	RF 26 11/16	;LF 26 5/16	;RR 26 13/16	;LR 26 15/16

BUMPER STROKE (ALL DIMENSIONS IN INCHES):

LEFT BUMPER STROKE: 1/16

RIGHT BUMPER STROKE: 1/16

TEST CONDITIONS

TEST NUMBER: 840608B

DATE OF TEST: 6/8/84 TIME OF TEST: 13:00

AMBIENT TEMPERATURE AT IMPACT AREA: 80°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (LBS.)	3790	DNA
VEHICLE VELOCITY (mph)	9.1	9

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

DELIVERED ATTITUDE:	RF 26 7/16	;LF 25 5/8	;RR 27 5/8	;LR 26 15/16
PRE-TEST ATTITUDE:	RF 26 11/16	;LF 26 5/16	;RR 26 3/4	;LR 26 15/16
POST-TEST ATTITUDE:	RF 26 5/8	;LF 26 1/8	;RR 27 1/16	;LR 26 3/4

BUMPER STROKE (ALL DIMENSIONS IN INCHES):

LEFT BUMPER STROKE: 1 5/16

RIGHT BUMPER STROKE: 2

TEST CONDITIONS

TEST NUMBER: 840611

DATE OF TEST: 6/11/84 TIME OF TEST: 14:50

AMBIENT TEMPERATURE AT IMPACT AREA: 80°F

SUBJECT VEHICLE DATA

	ACTUAL	INTENDED
TEST WEIGHT (LBS.)	3790	DNA
VEHICLE VELOCITY (mph)	7.1	7

VEHICLE ATTITUDE (ALL DIMENSIONS IN INCHES):

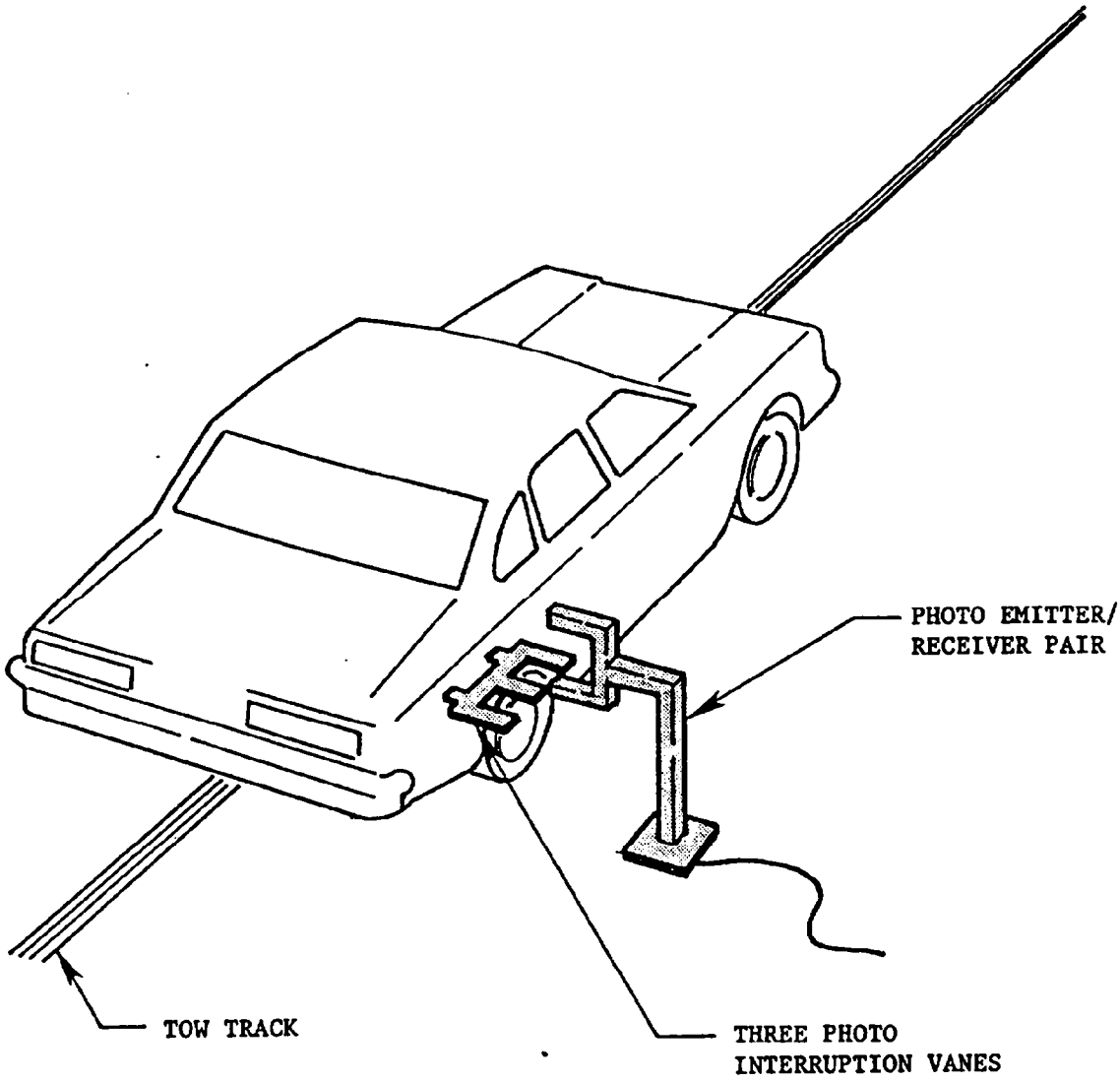
DELIVERED ATTITUDE:	RF 26 7/16	;LF 25 5/8	;RR 27 5/8	;LR 26 15/16
PRE-TEST ATTITUDE:	RF 26 5/16	;LF 25 7/8	;RR 27 1/4	;LR 27 3/16
POST-TEST ATTITUDE:	RF 26 5/16	;LF 25 15/16	;RR 26 13/16	;LR 26 15/16

BUMPER STROKE (ALL DIMENSIONS IN INCHES):

LEFT BUMPER STROKE: 3 3/16

RIGHT BUMPER STROKE: 3 1/16

IMPACT VELOCITY MEASUREMENT SYSTEM



The final vane is located two inches before impact.

The vanes have one foot spacing.

SECTION 3.0

DATA REQUIRED BY R&D

The following pages are included in this section:

1. Vehicle accelerometer data summary
2. High speed camera information

VEHICLE ACCELEROMETER TEST NO. 840608A (5.1 MPH) DATA SUMMARY

NO.	LOCATION		POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	LEFT FRONT CROSSMEMBER (LONGITUDINAL)		3.09	166.88	9.23	38.75
2	RIGHT FRONT CROSSMEMBER (LONGITUDINAL)	Δ V = -5.2 mph @ 143.38 msec	1.36	22.75	10.43	13.00
3	LOWER STEERING COLUMN (LONGITUDINAL)	Δ V = -5.8 mph @ 107.63 msec	0.75	118.75	6.84	37.50
	(VERTICAL)	Δ V = 5.1 mph @ 0.00 msec	0.93	181.63	5.58	39.38
4	UPPER STEERING COLUMN (LONGITUDINAL)	Δ V = -5.7 mph @ 105.50 msec	0.96	155.50	6.55	37.63
	(VERTICAL)	Δ V = 7.6 mph @ 56.63 msec	5.32	80.63	5.96	46.38
5	LEFT B-PILLAR (LONGITUDINAL)		0.52	186.63	6.87	36.25

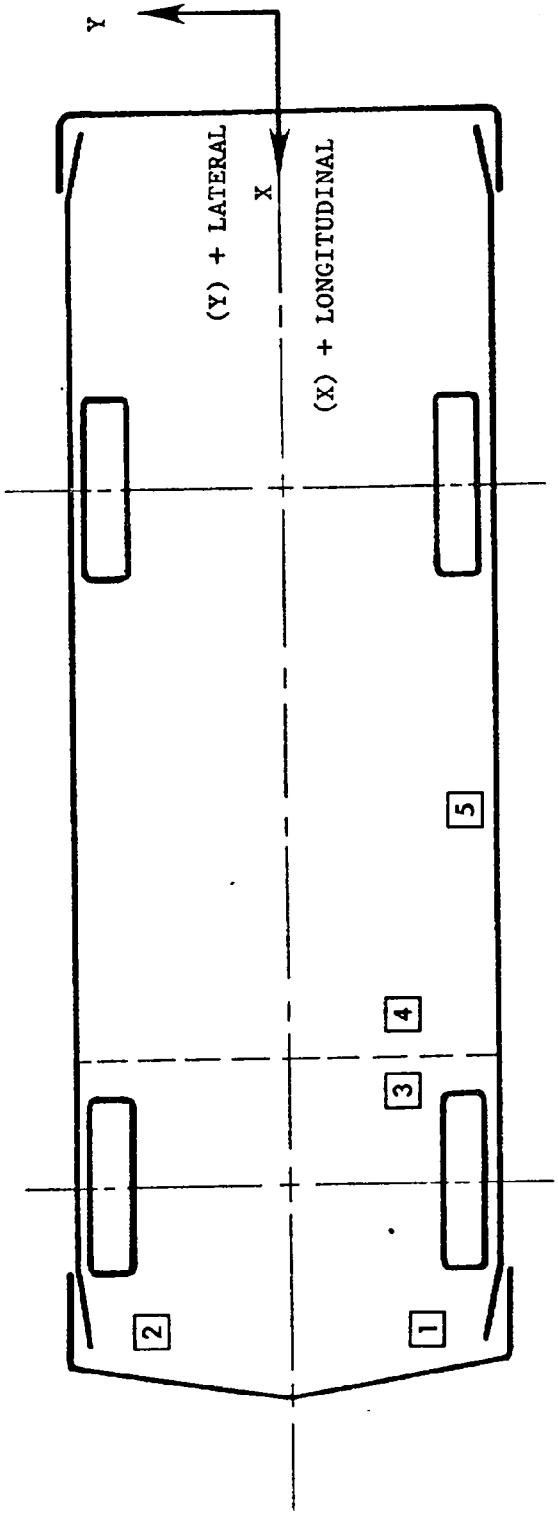
VEHICLE ACCELEROMETER TEST NO. 840608B (9.1 MPH) DATA SUMMARY

NO.	LOCATION		POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	LEFT FRONT CROSSMEMBER (LONGITUDINAL)		2.08	110.63	19.25	59.63
2	RIGHT FRONT CROSSMEMBER (LONGITUDINAL)	Δ V = -9.5 mph @ 145.63 msec	3.56	32.00	24.39	37.75
3	LOWER STEERING COLUMN (LONGITUDINAL)	Δ V = -10.7 mph @ 105.88 msec	1.01	133.63	11.44	46.00
	(VERTICAL)	Δ V = 9.1 mph @ 0.00 msec	3.97	85.25	7.16	45.63
4	UPPER STEERING COLUMN (LONGITUDINAL)	Δ V = -10.9 mph @ 106.50 msec	1.14	187.63	11.51	44.63
	(VERTICAL)	Δ V = 13.5 mph @ 180.25 msec	5.32	88.00	10.39	51.13
5	LEFT B-PILLAR (LONGITUDINAL)		0.91	181.38	11.85	52.00

VEHICLE ACCELEROMETER TEST NO. 840611 (7.1 MPH) DATA SUMMARY

NO.	LOCATION	POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	LEFT FRONT CROSSMEMBER (LONGITUDINAL)	3.78	27.88	15.85	20.00
2	RIGHT FRONT CROSSMEMBER (LONGITUDINAL) ΔV = -8.9 mph @ 109.75 msec	1.74	146.50	10.57	35.88
3	LOWER STEERING COLUMN				
	(LONGITUDINAL) ΔV = 7.1 mph @ 1.88 msec	1.09	146.25	8.86	44.38
	(VERTICAL) ΔV = 10.5 mph @ 186.75 msec	1.51	105.25	5.98	46.25
4	UPPER STEERING COLUMN				
	(LONGITUDINAL) ΔV = 7.1 mph @ 0.00 msec	1.04	146.00	8.60	44.50
	(VERTICAL) ΔV = 10.3 mph @ 194.00 msec	2.62	85.13	7.46	51.75
5	LEFT B-PILLAR (LONGITUDINAL)	1.19	130.88	9.50	55.25

VEHICLE ACCELEROMETER LOCATIONS



HIGH SPEED CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Driver's Side	Photosonic 1B	25	500	Bumper Stroke
2	Driver's Side	Photosonic 1B	50	500	Bumper Stroke

TEST NOS.: 840608A, 840608B and 840611

APPENDIX A

PHOTOGRAPHS

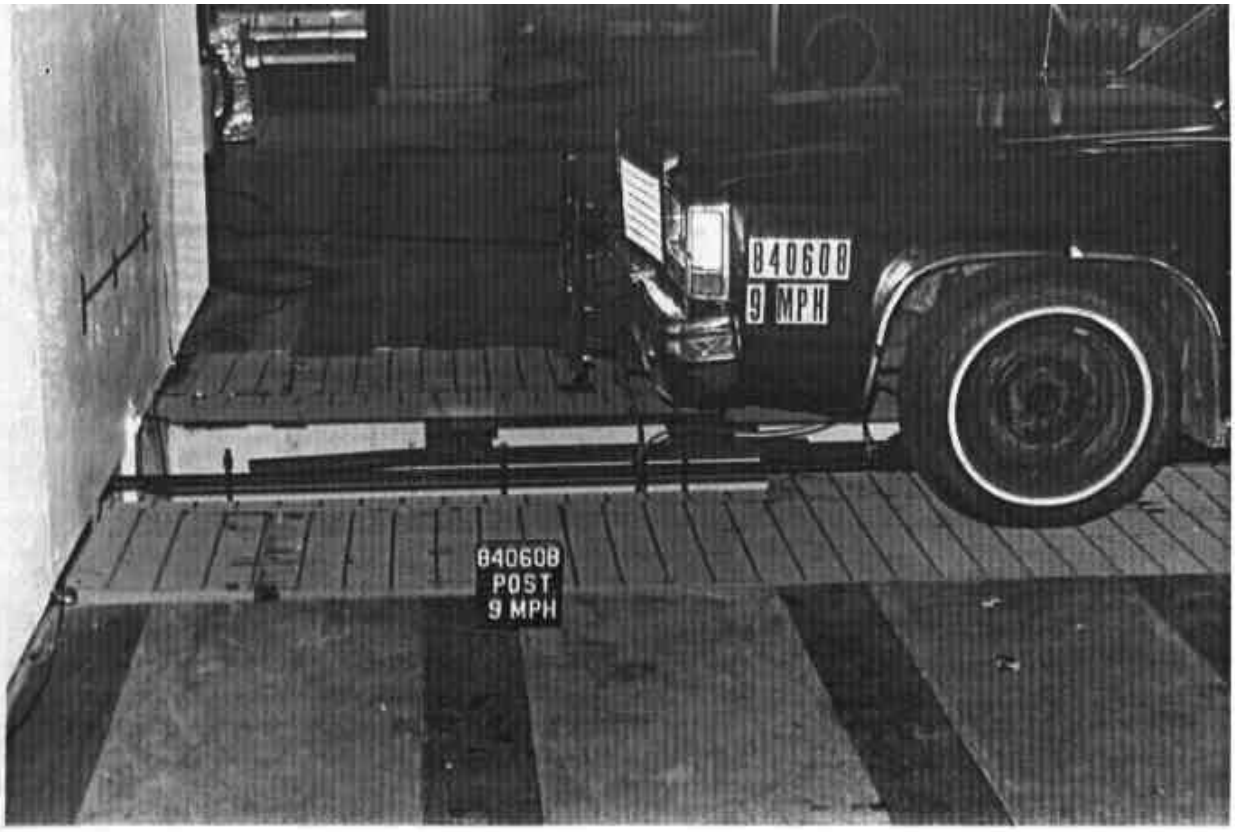


Figure A-9. TEST 840608B POST-TEST - VIEW 1

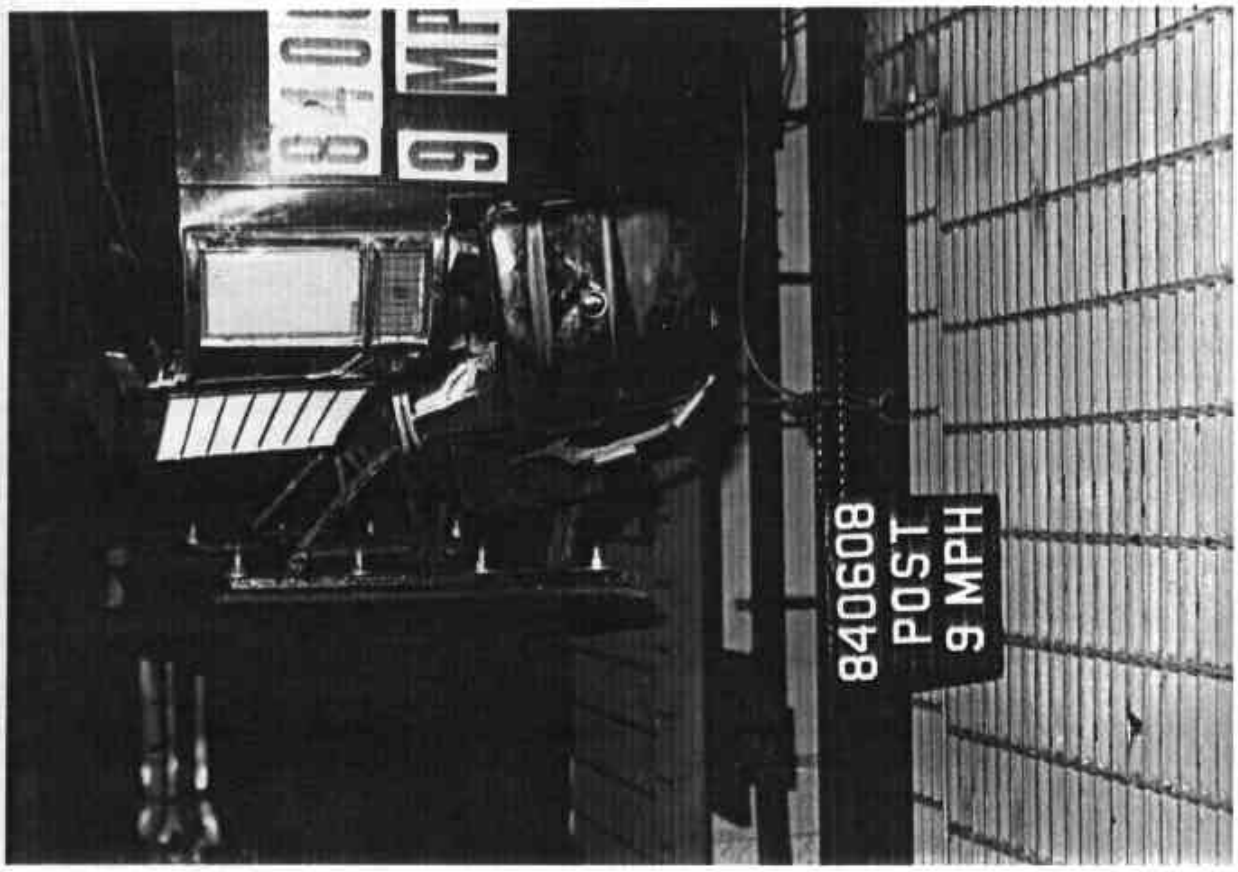


Figure A-10. TEST 840608B POST-TEST - VIEW 2

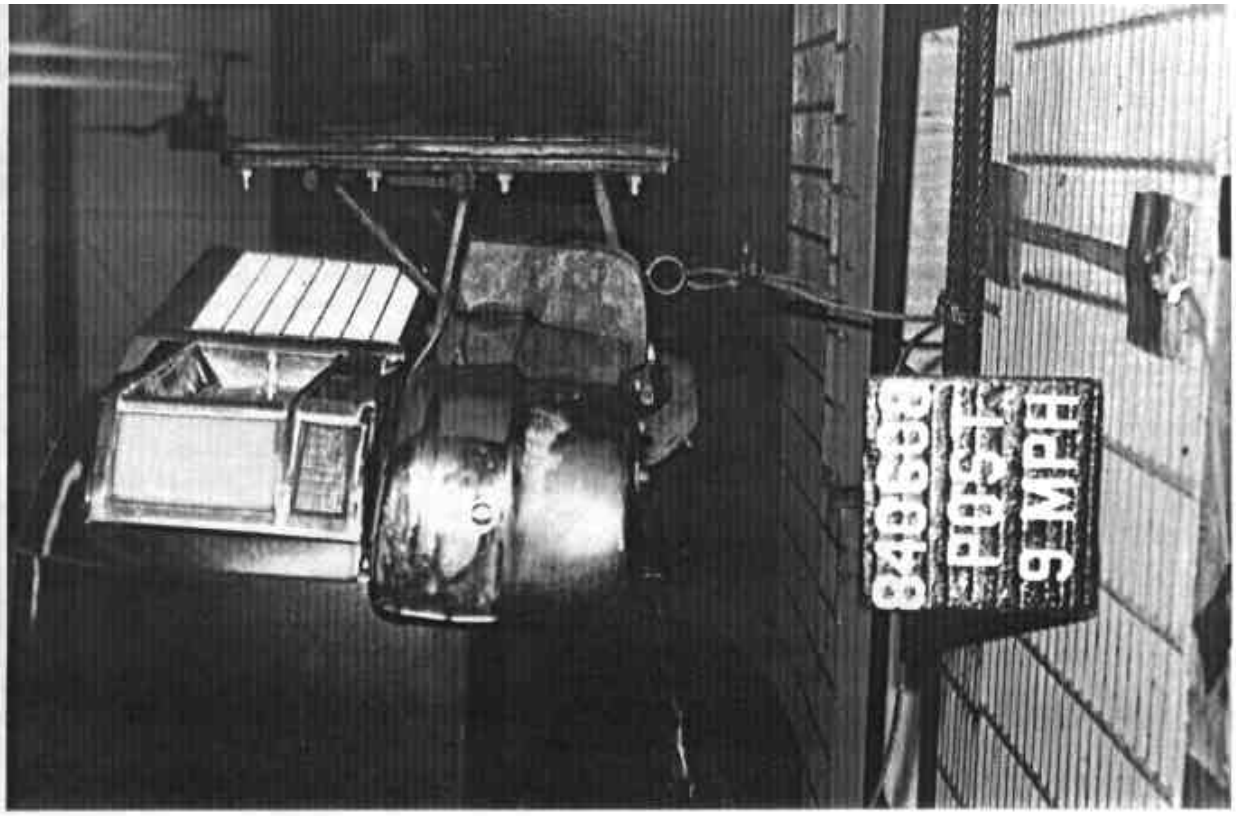


Figure A-11. TEST 840608B POST-TEST - VIEW 3

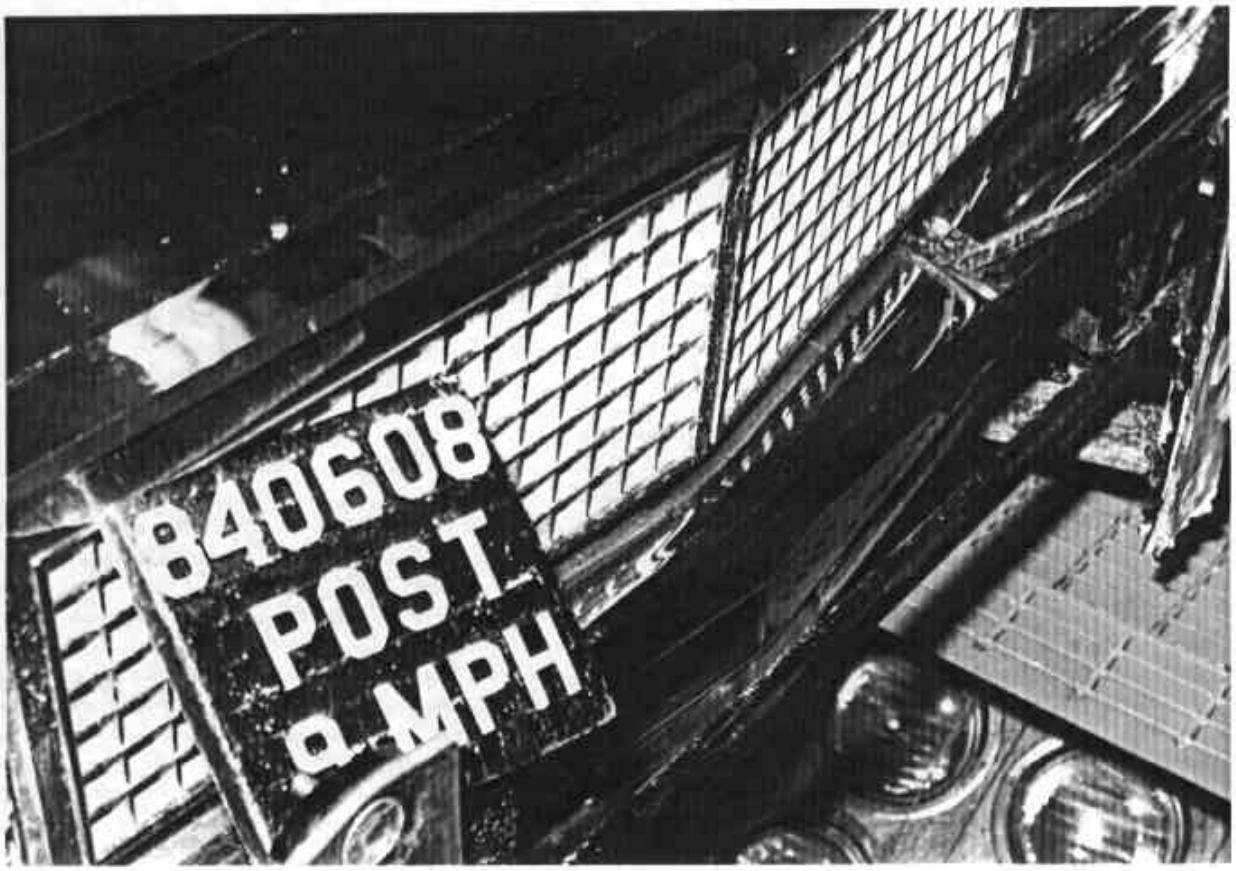


Figure A-12. TEST 840608B VEHICLE DAMAGE - VIEW 1

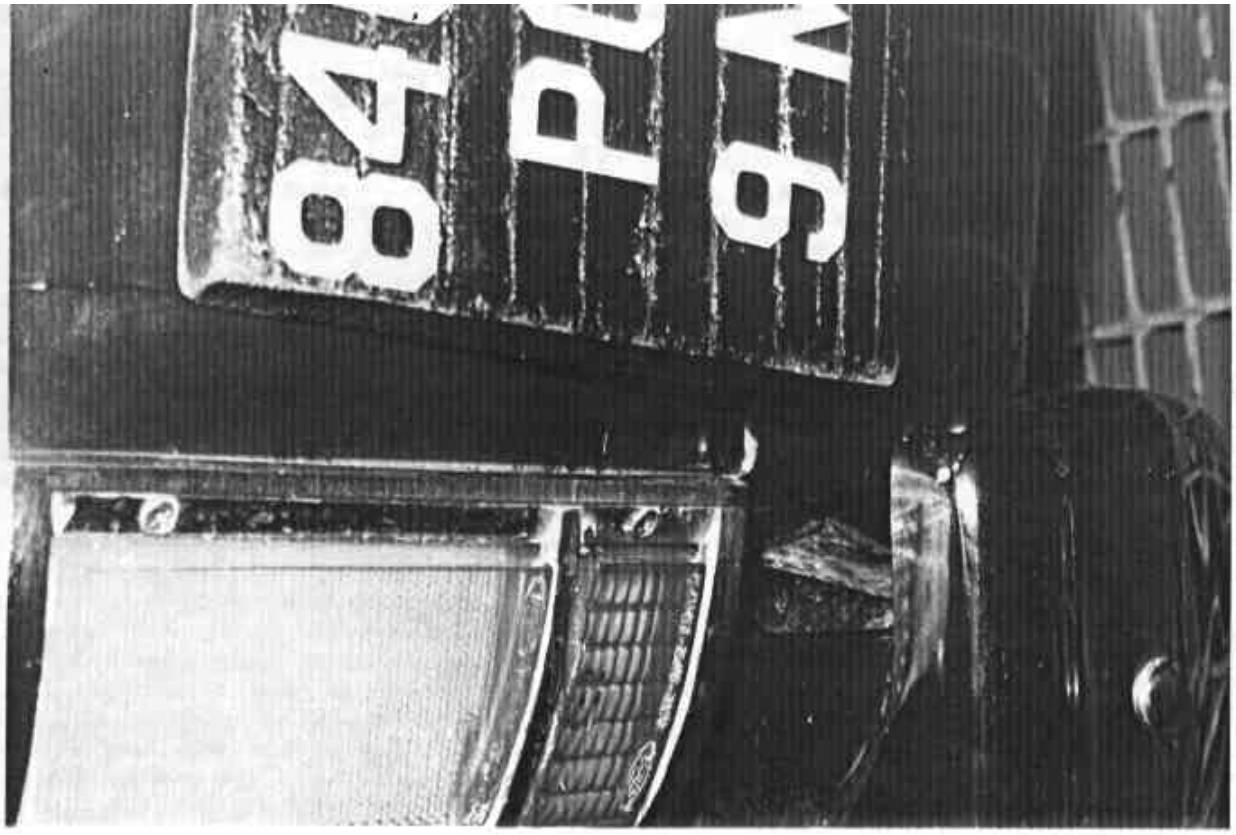


Figure A-13. TEST 840608B VEHICLE DAMAGE - VIEW 2

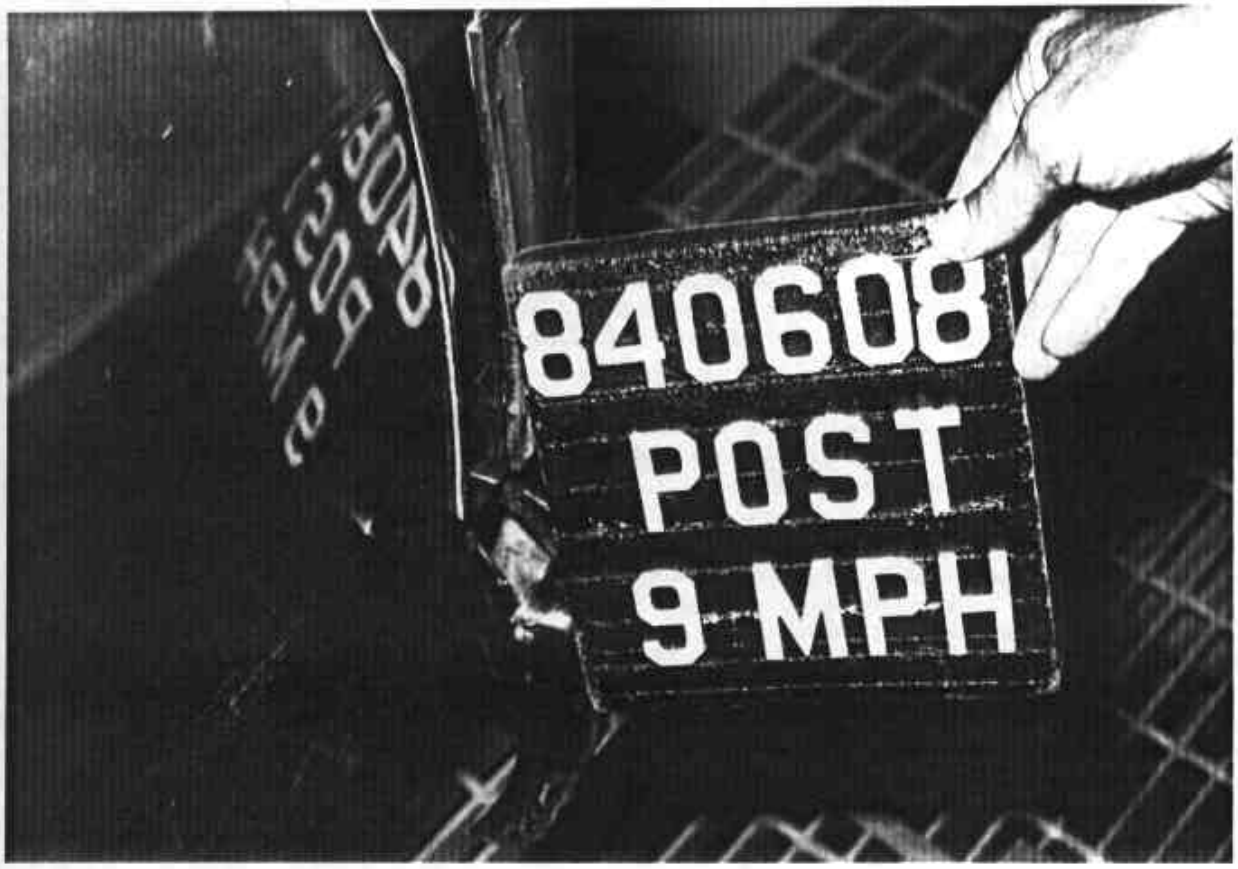


Figure A-14. TEST 840608B VEHICLE DAMAGE - VIEW 3

Figure A-15. TEST 840608B VEHICLE DAMAGE - VIEW 4

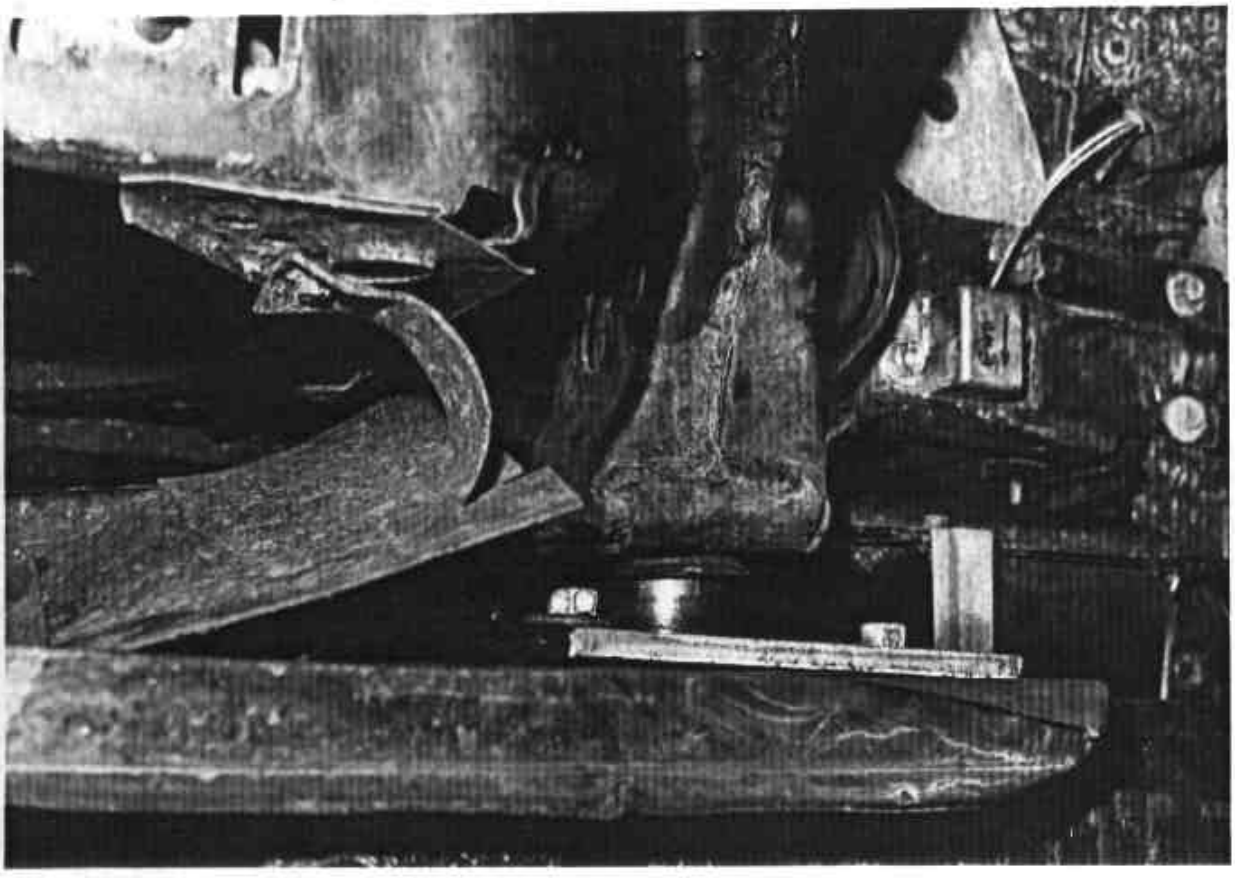


Figure A-16. TEST 840608B VEHICLE DAMAGE - VIEW 5

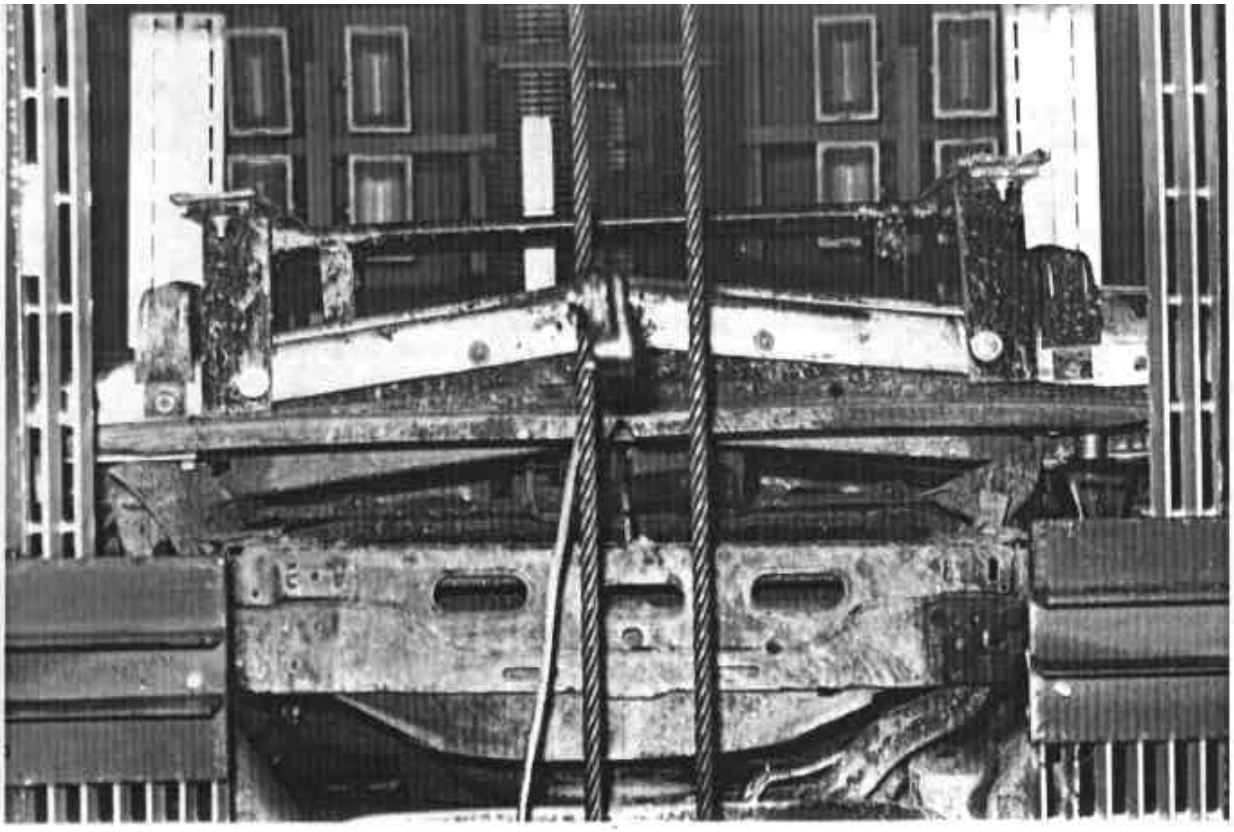


Figure A-17. TEST 840608B VEHICLE DAMAGE - VIEW 6

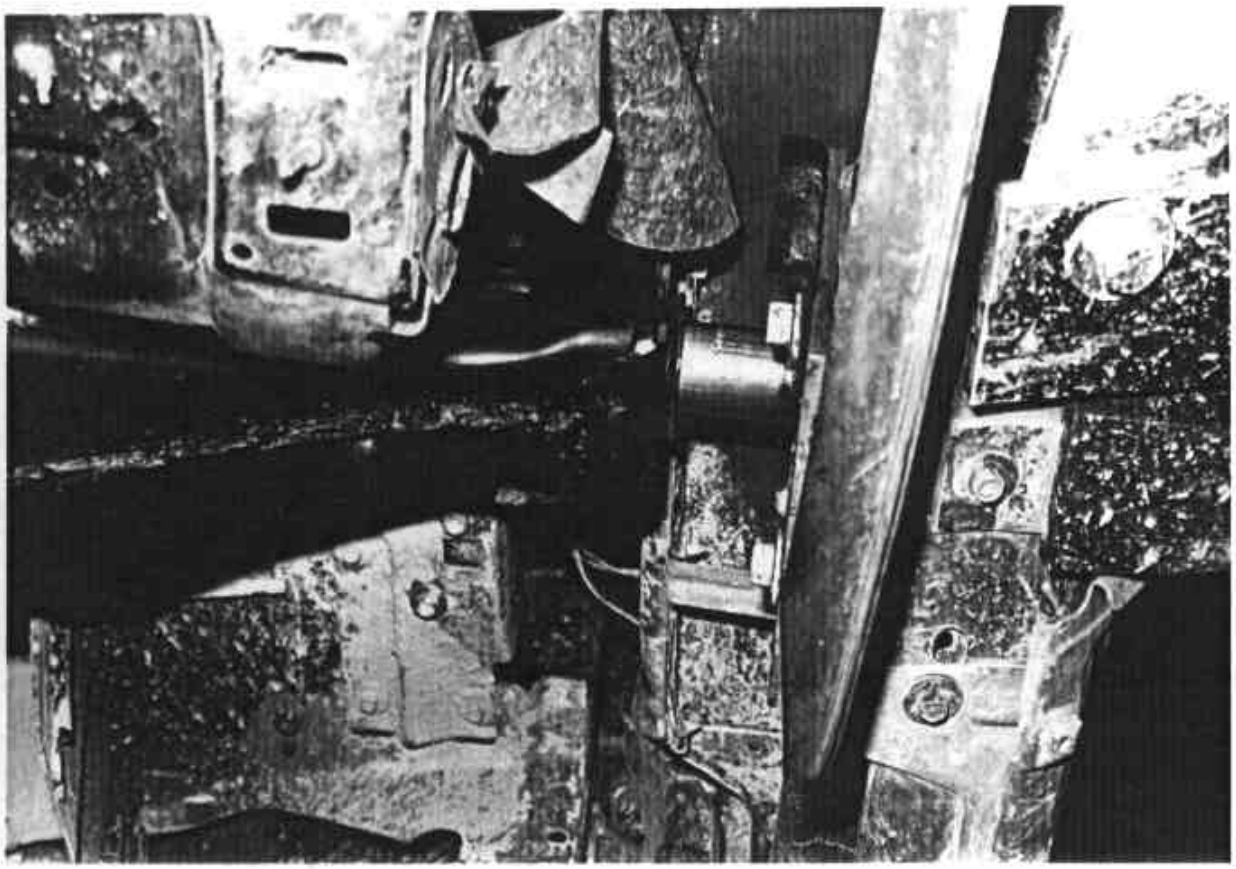
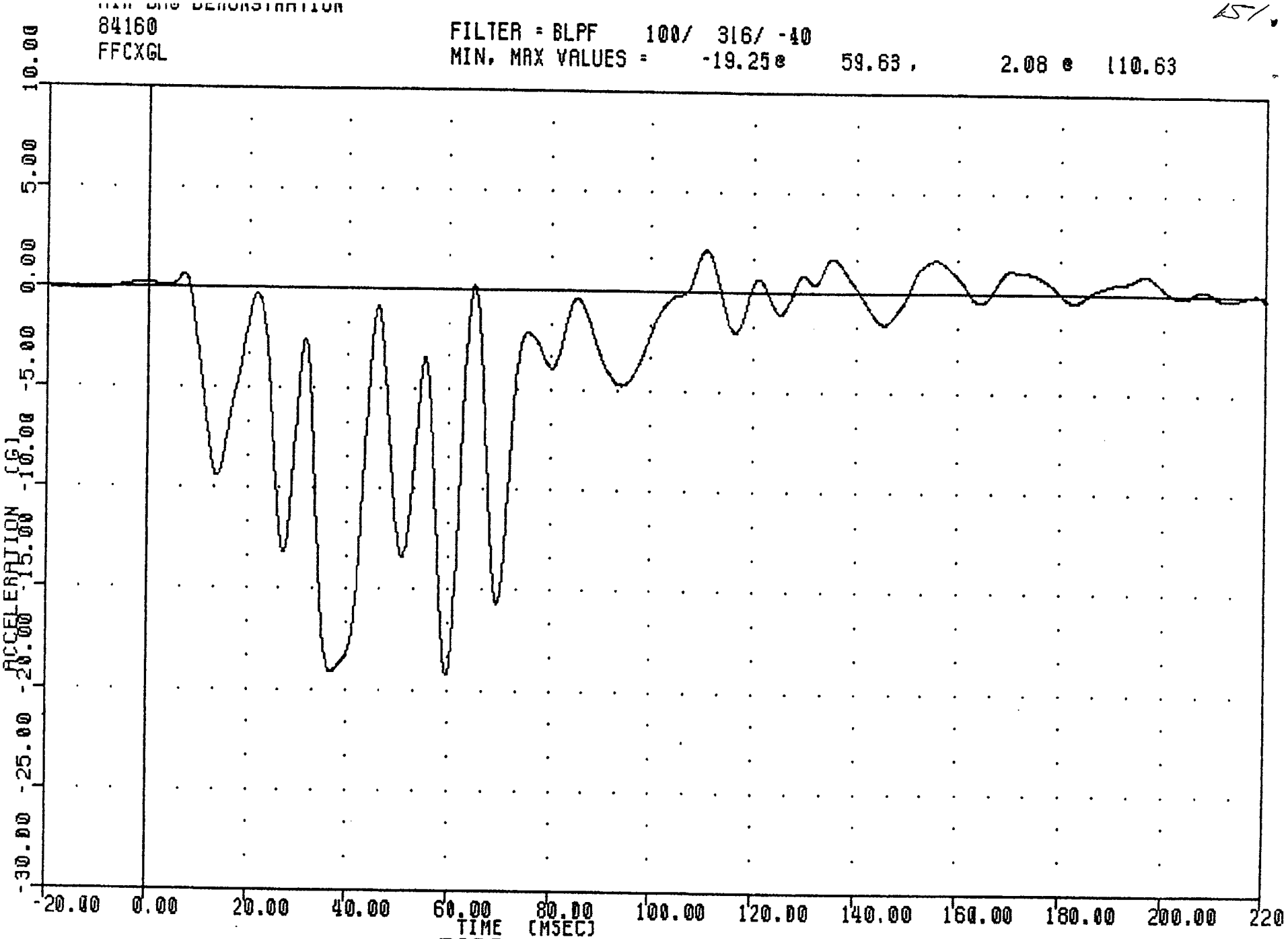
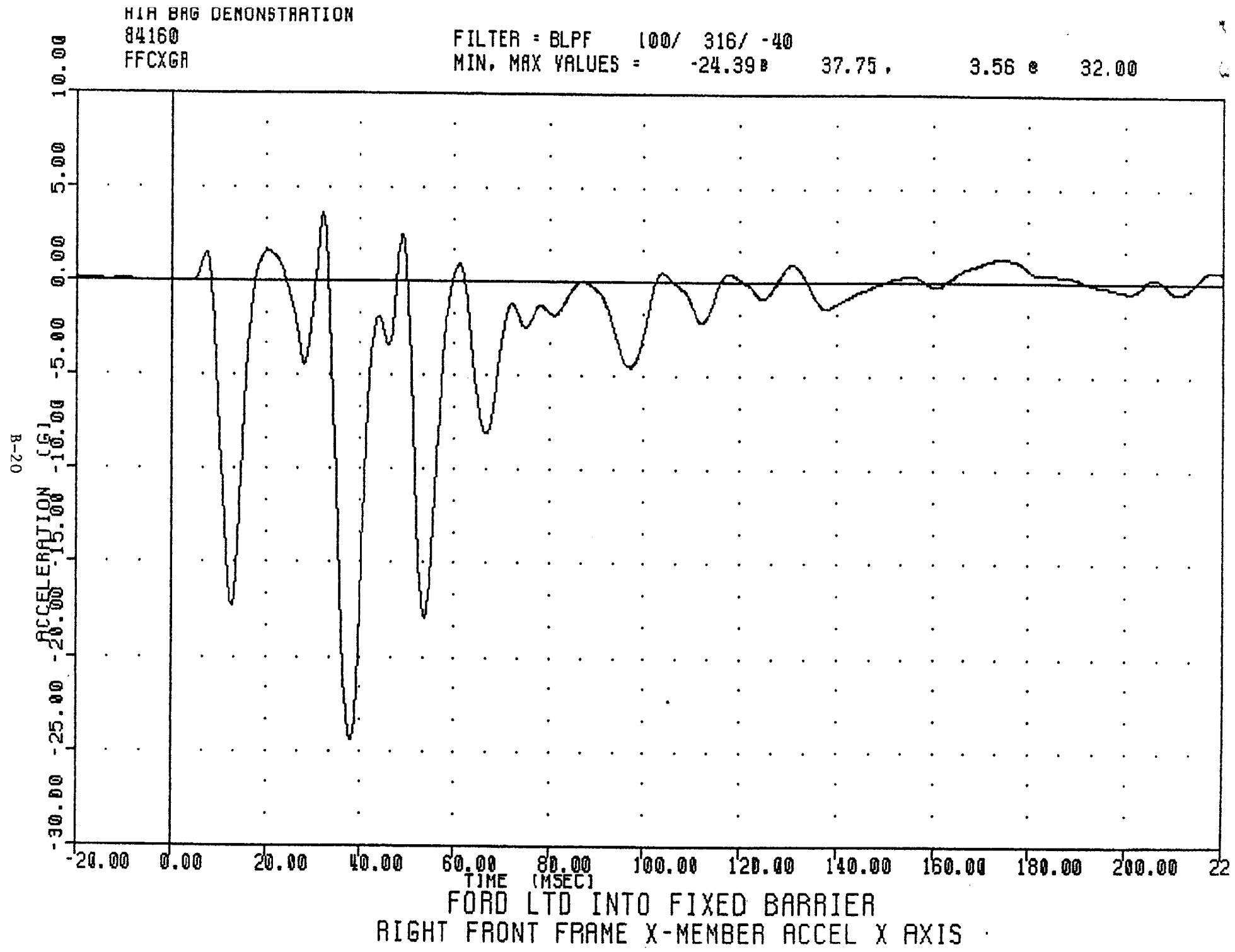


Figure A-18. TEST 840608B VEHICLE DAMAGE - VIEW 7



FORD LTD INTO FIXED BARRIER
LEFT FRONT FRAME X-MEMBER ACCEL X AXIS



FORD LTD INTO FIXED BARRIER
RIGHT FRONT FRAME X-MEMBER ACCEL X AXIS

84160
FFCXVR

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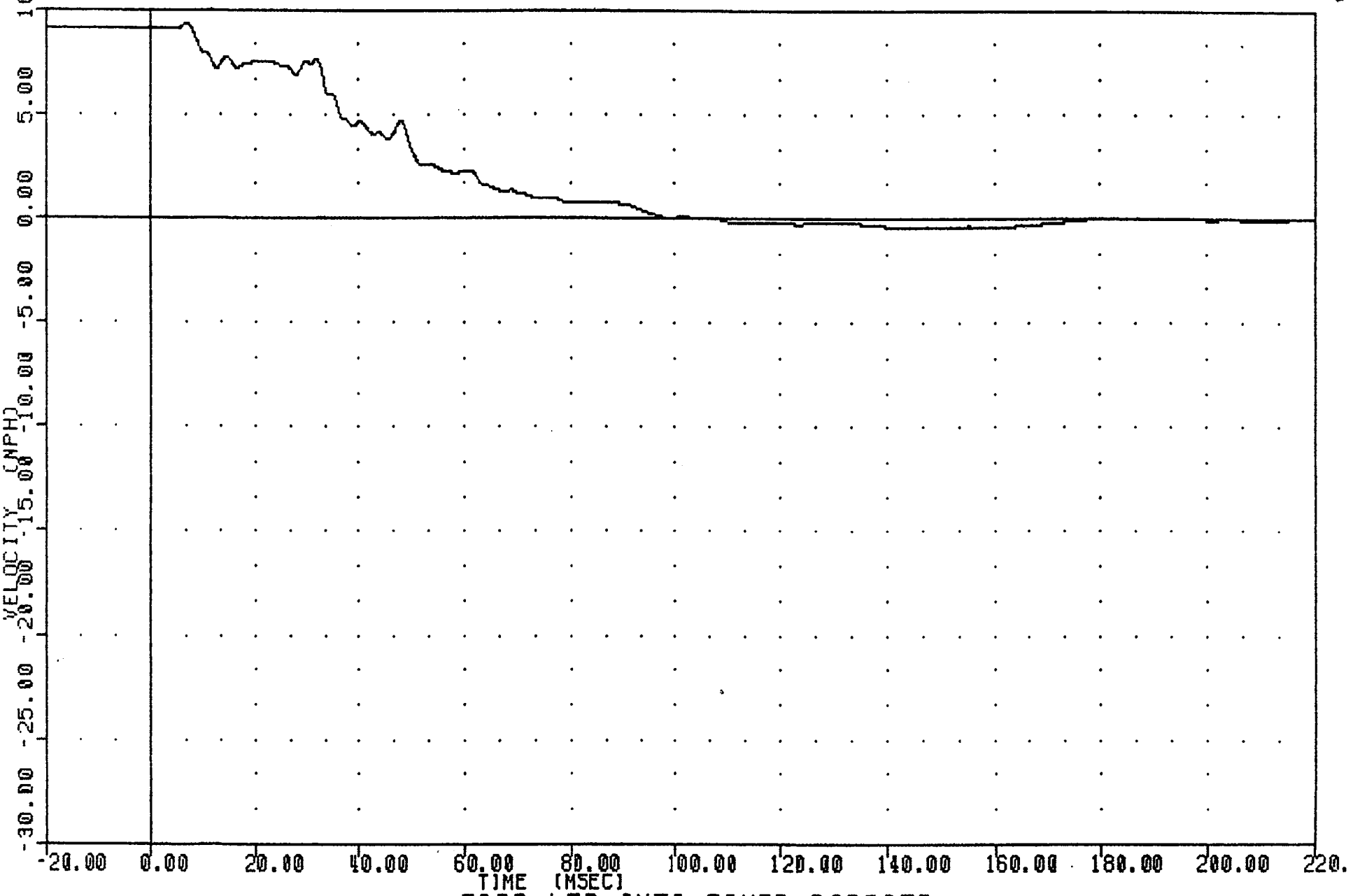

FORD LTD INTO FIXED BARRIER
DELTA V USING FFCXGR

84160
SCAP61

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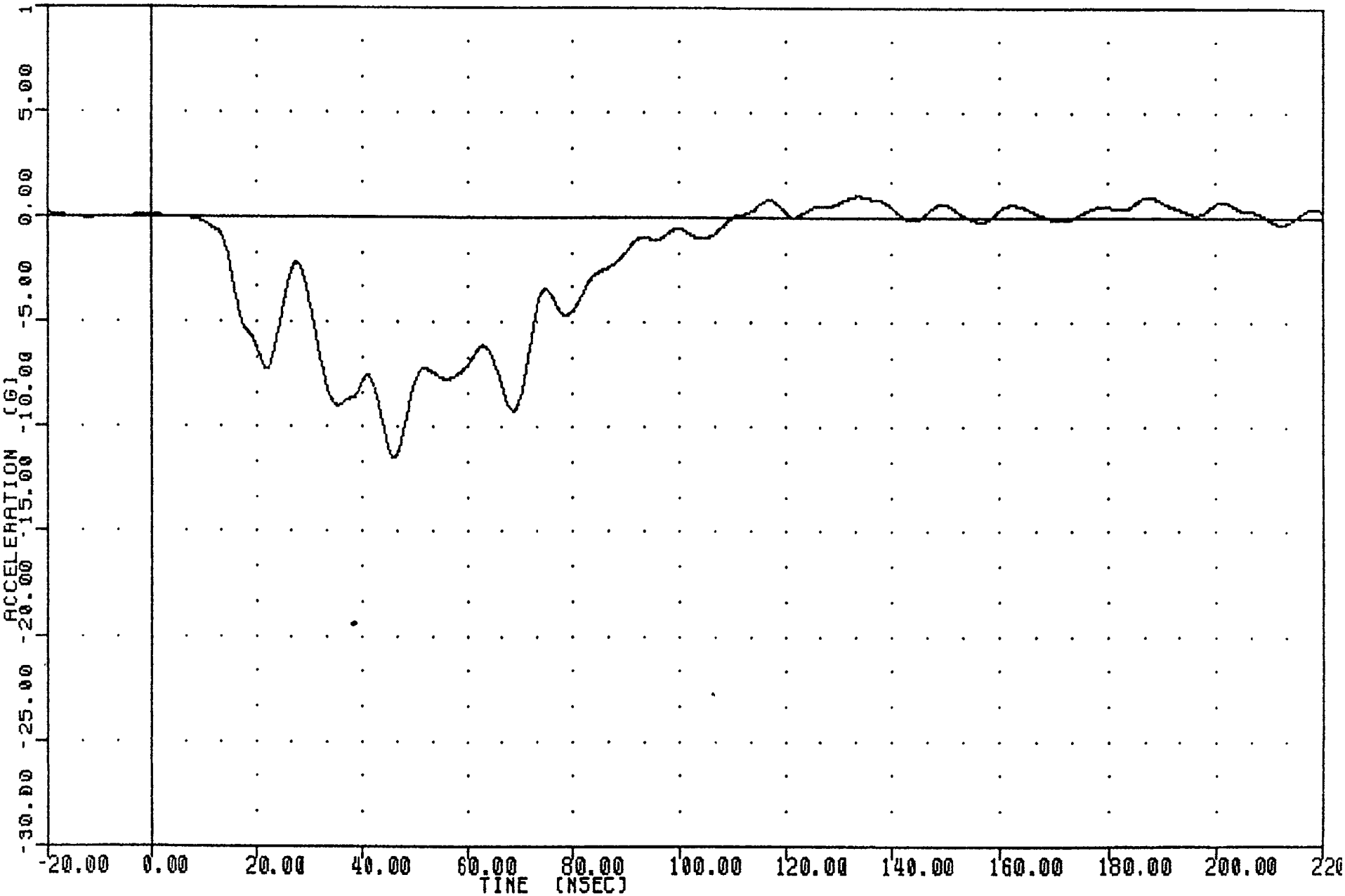

FORD LTD INTO FIXED BARRIER
STEERING COLUMN ACCELERATION LOWER

84160
SCAPV1

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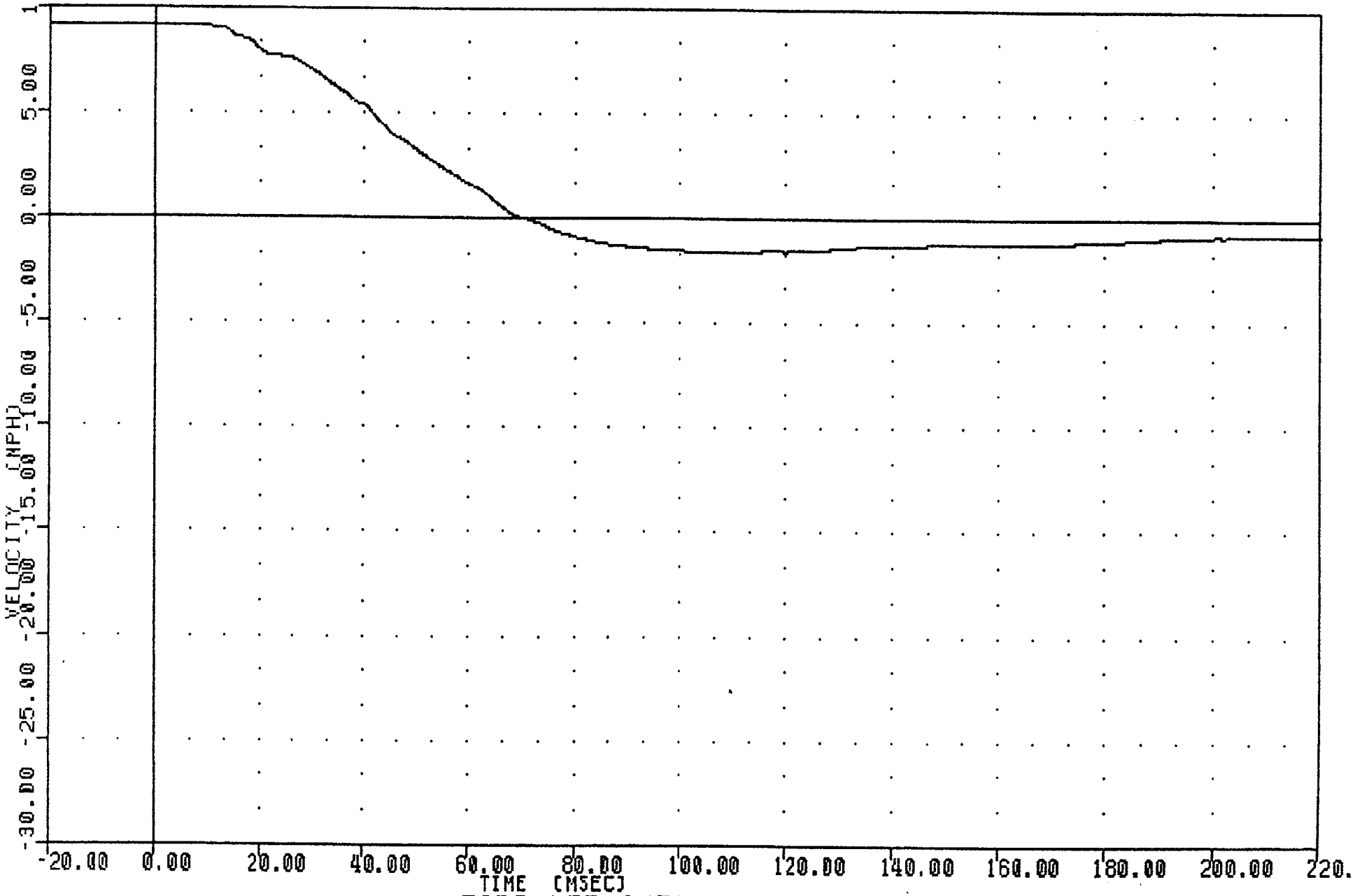
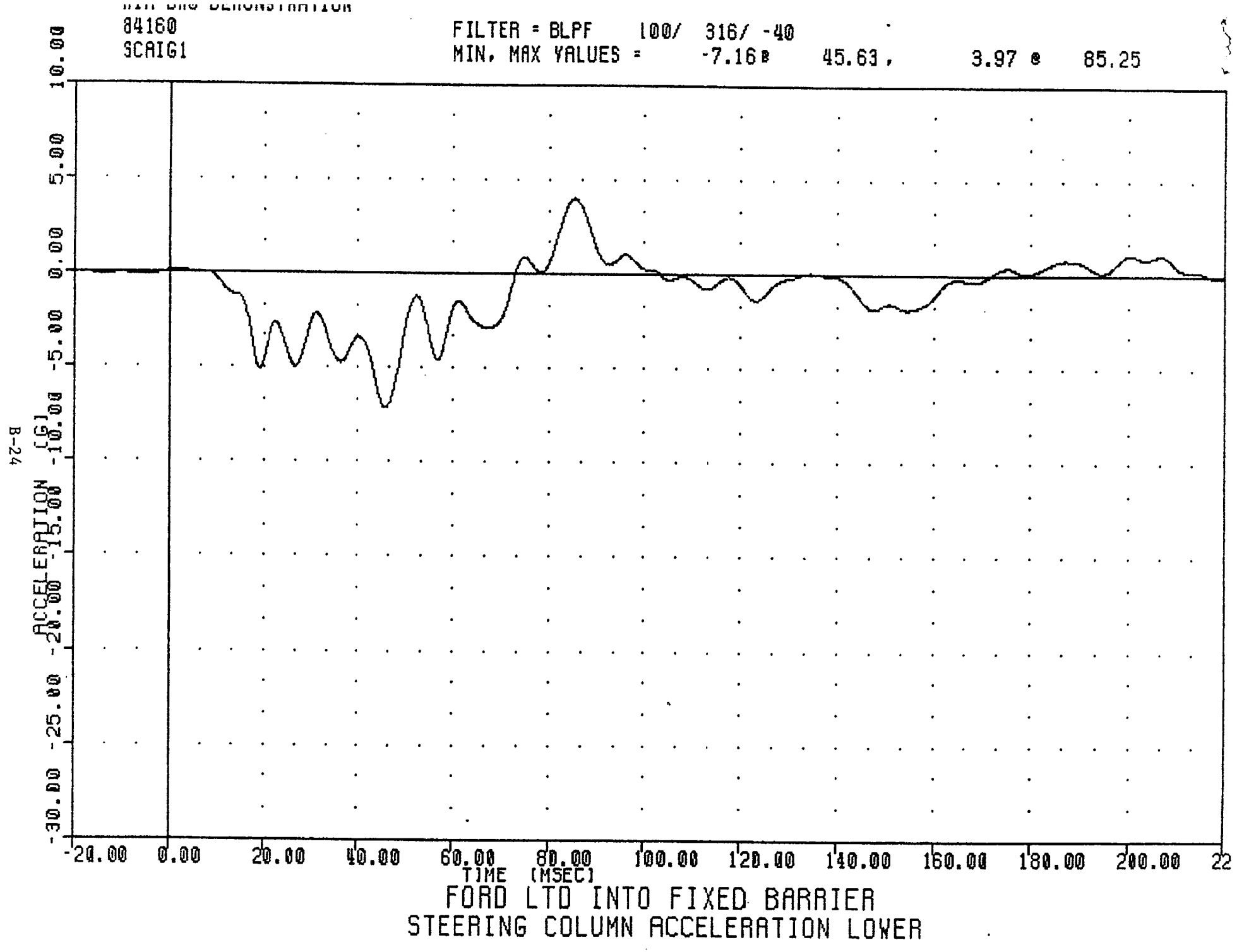


FORD LTD INTO FIXED BARRIER
DELTA V USING SCAPG1



FORD LTD INTO FIXED BARRIER
STEERING COLUMN ACCELERATION LOWER

AIR BAG DENONSTRATION
84160
SCAIV1

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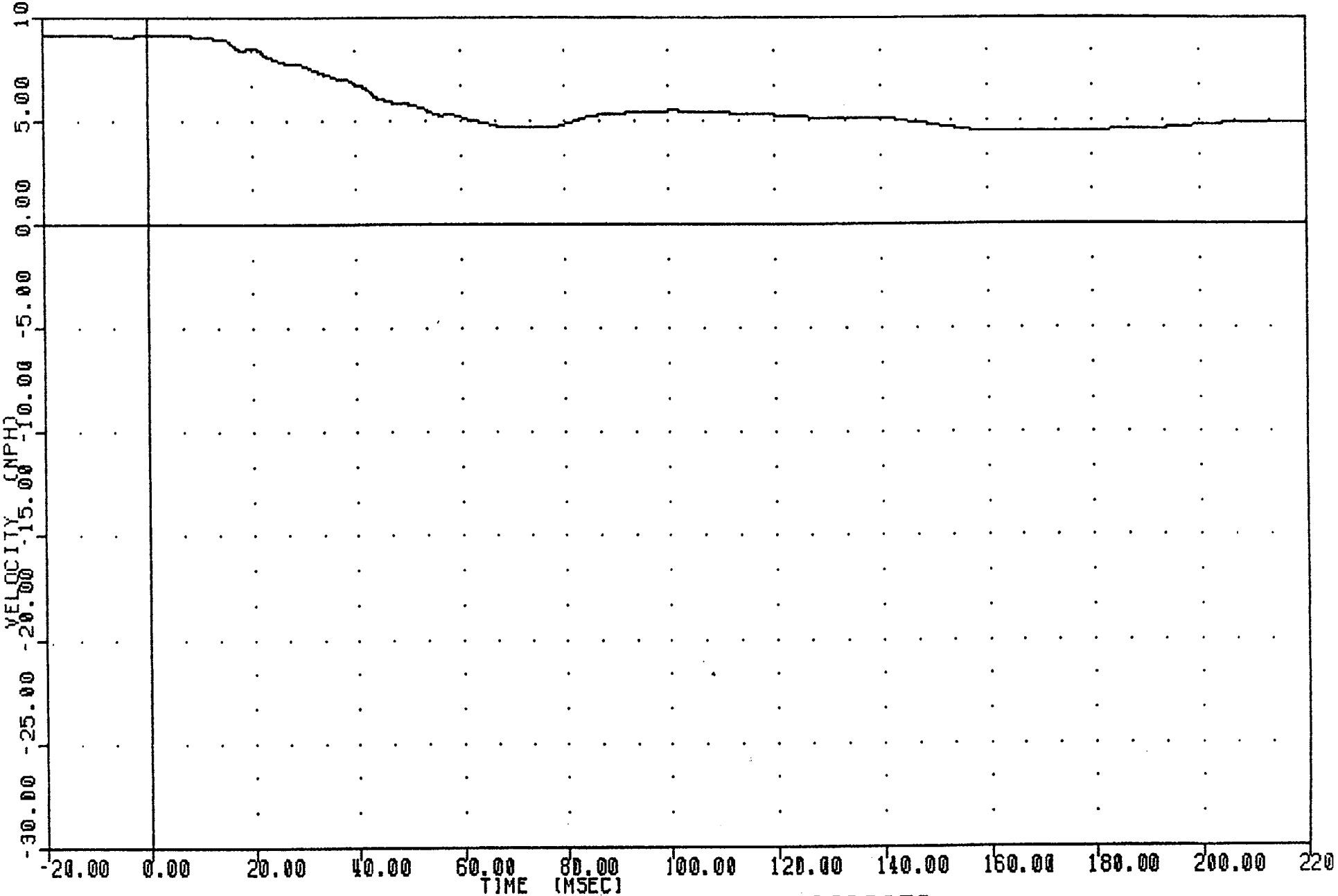
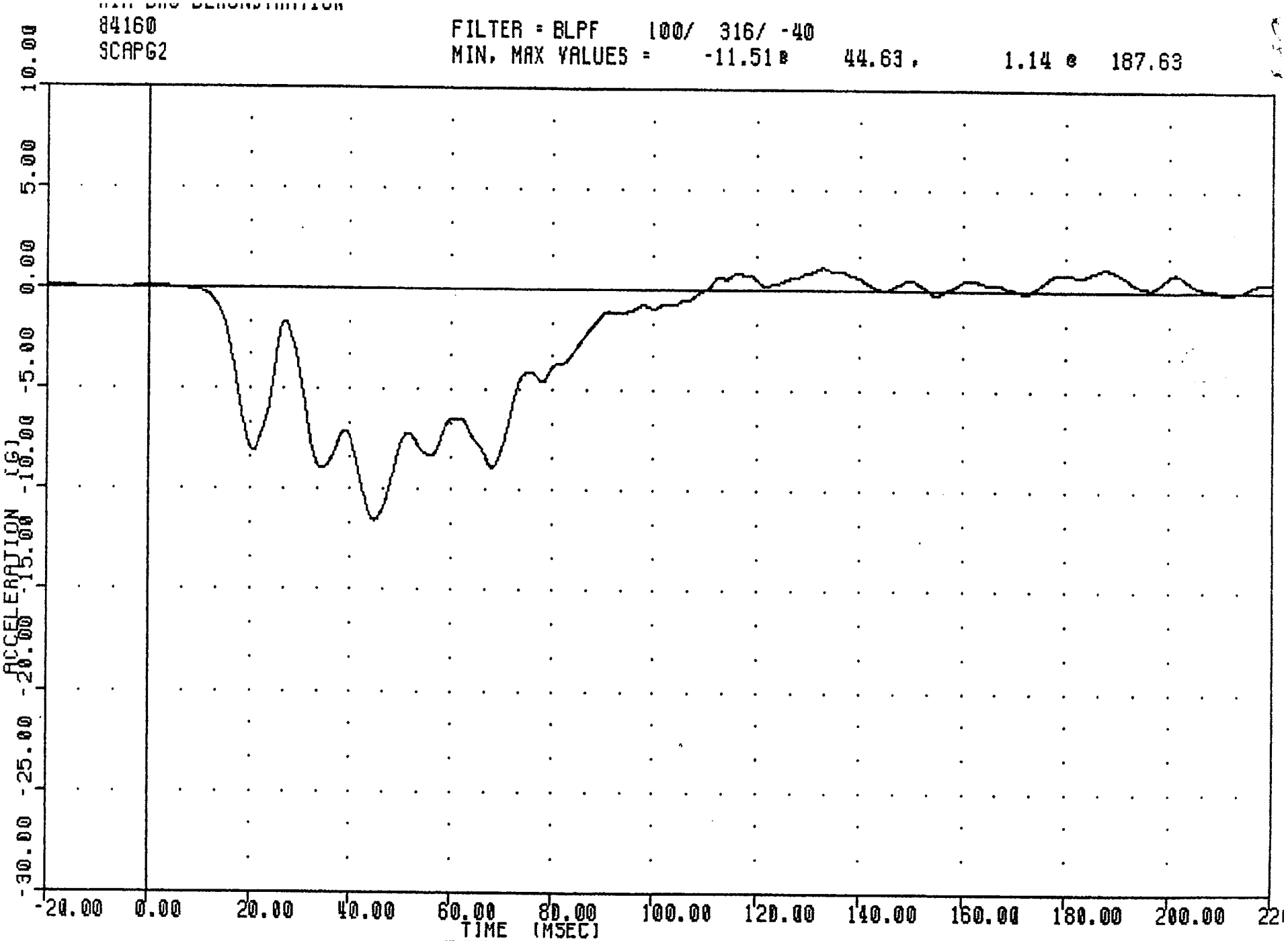
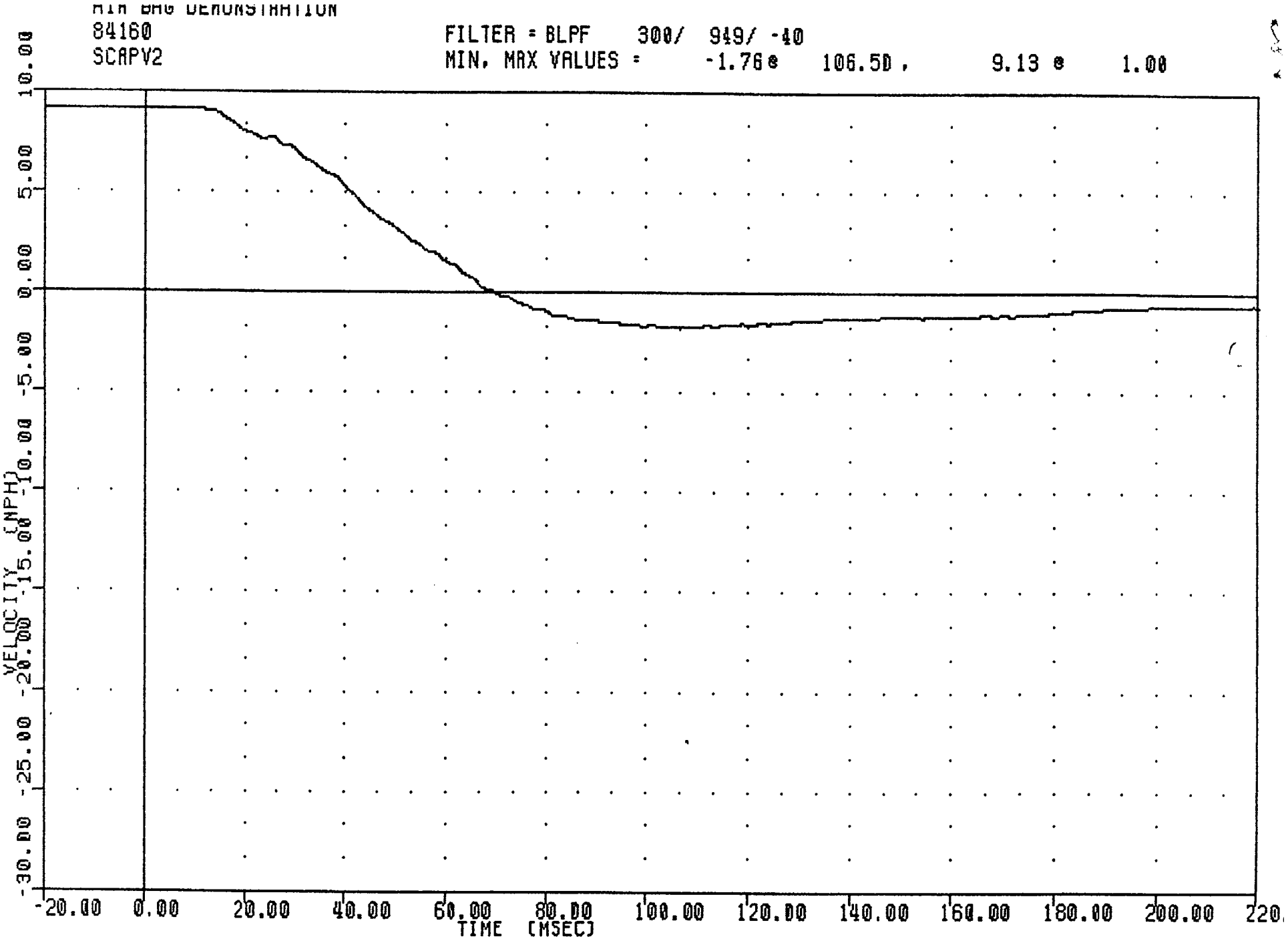
MIN, MAX VALUES = 4.40 @ 168.38 , 9.10 @ -20.00



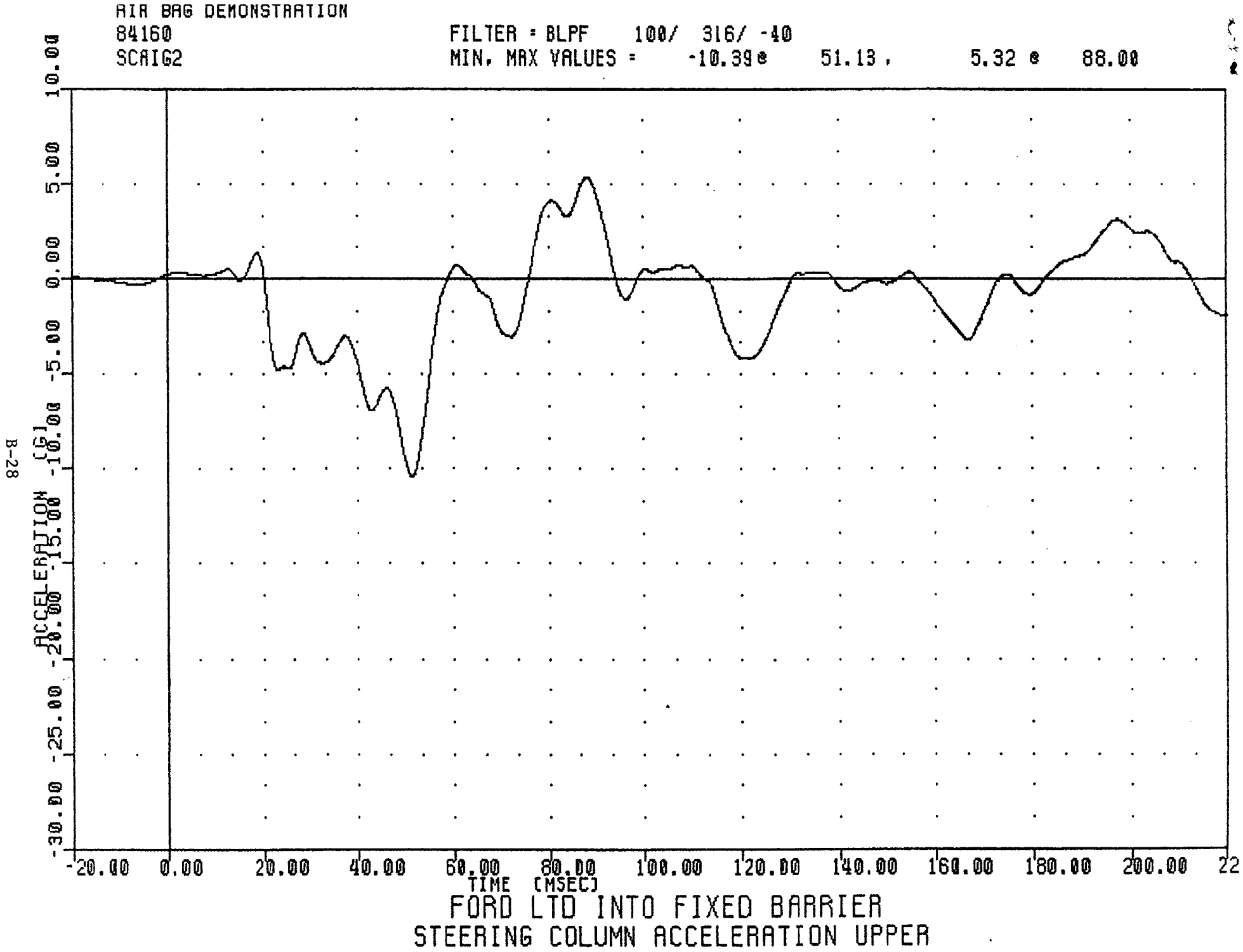
FORD LTD INTO FIXED BARRIER
DELTA V USING SCAIG1



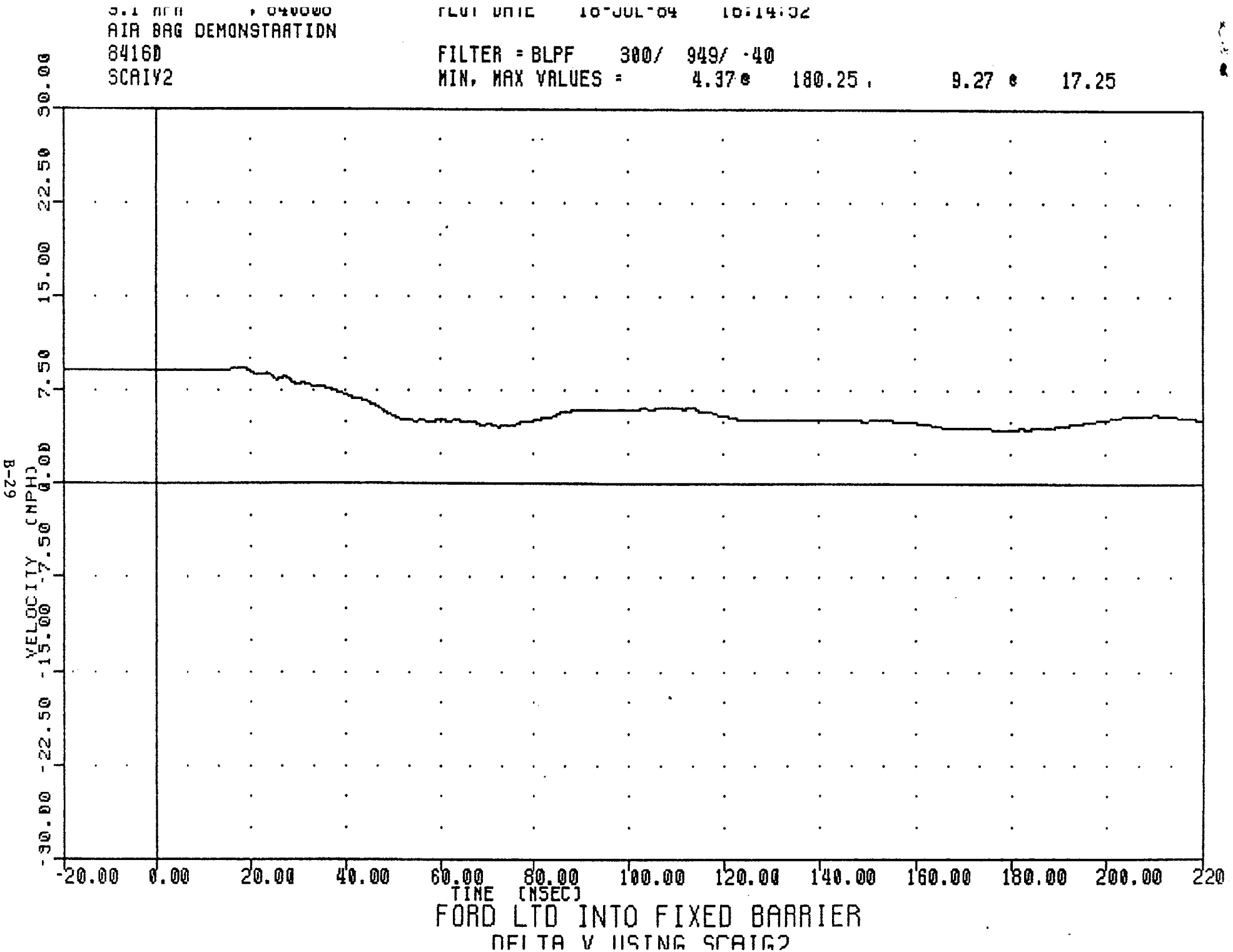
FORD LTD INTO FIXED BARRIER
STEERING COLUMN ACCELERATION UPPER 9.1 MPH



FORD LTD INTO FIXED BARRIER
DELTA V USING SCAPG2

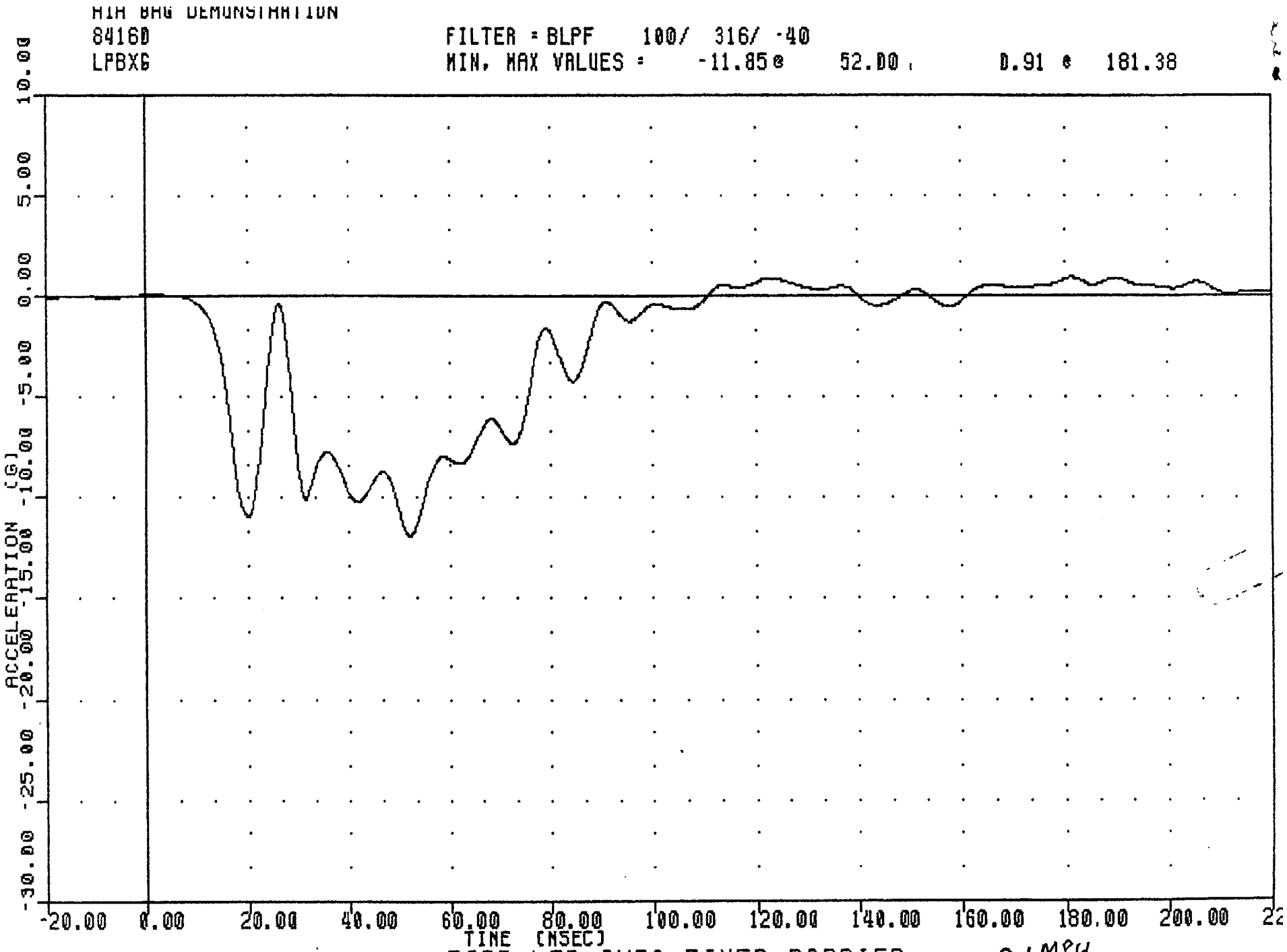


FORD LTD INTO FIXED BARRIER
STEERING COLUMN ACCELERATION UPPER



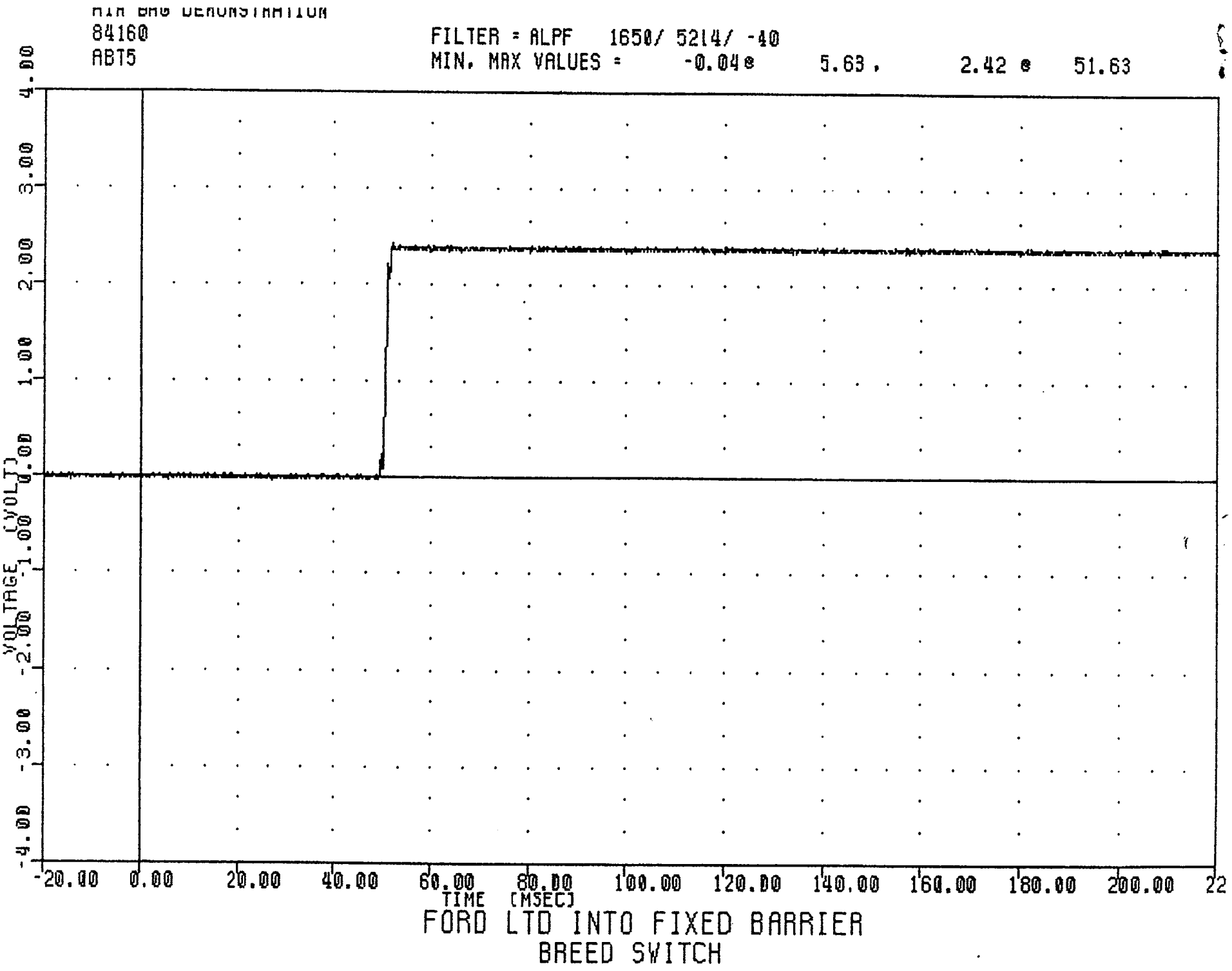
FORD LTD INTO FIXED BARRIER

DELTA V USING SCAIG2

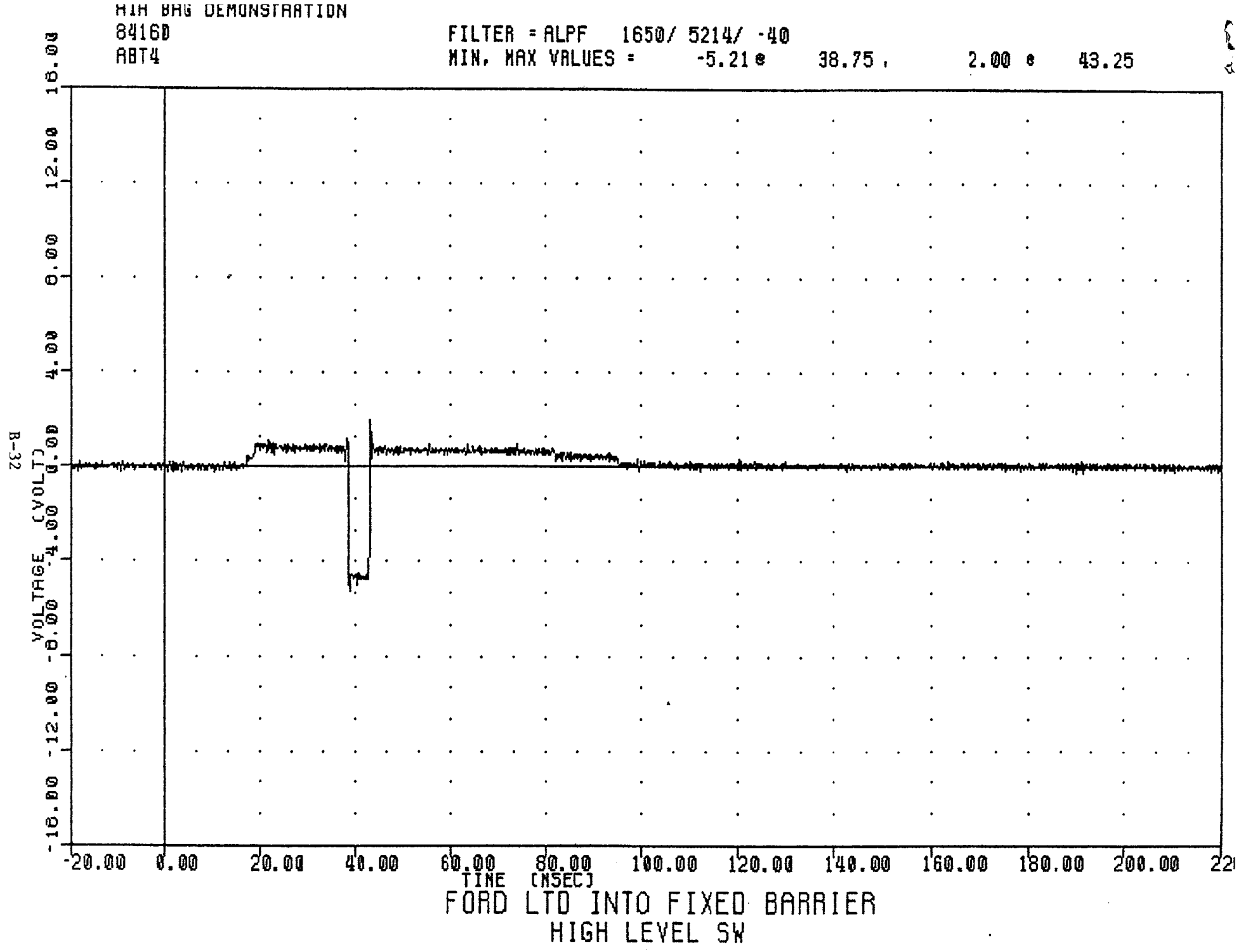


FORD LTD INTO FIXED BARRIER 9.1 MPH

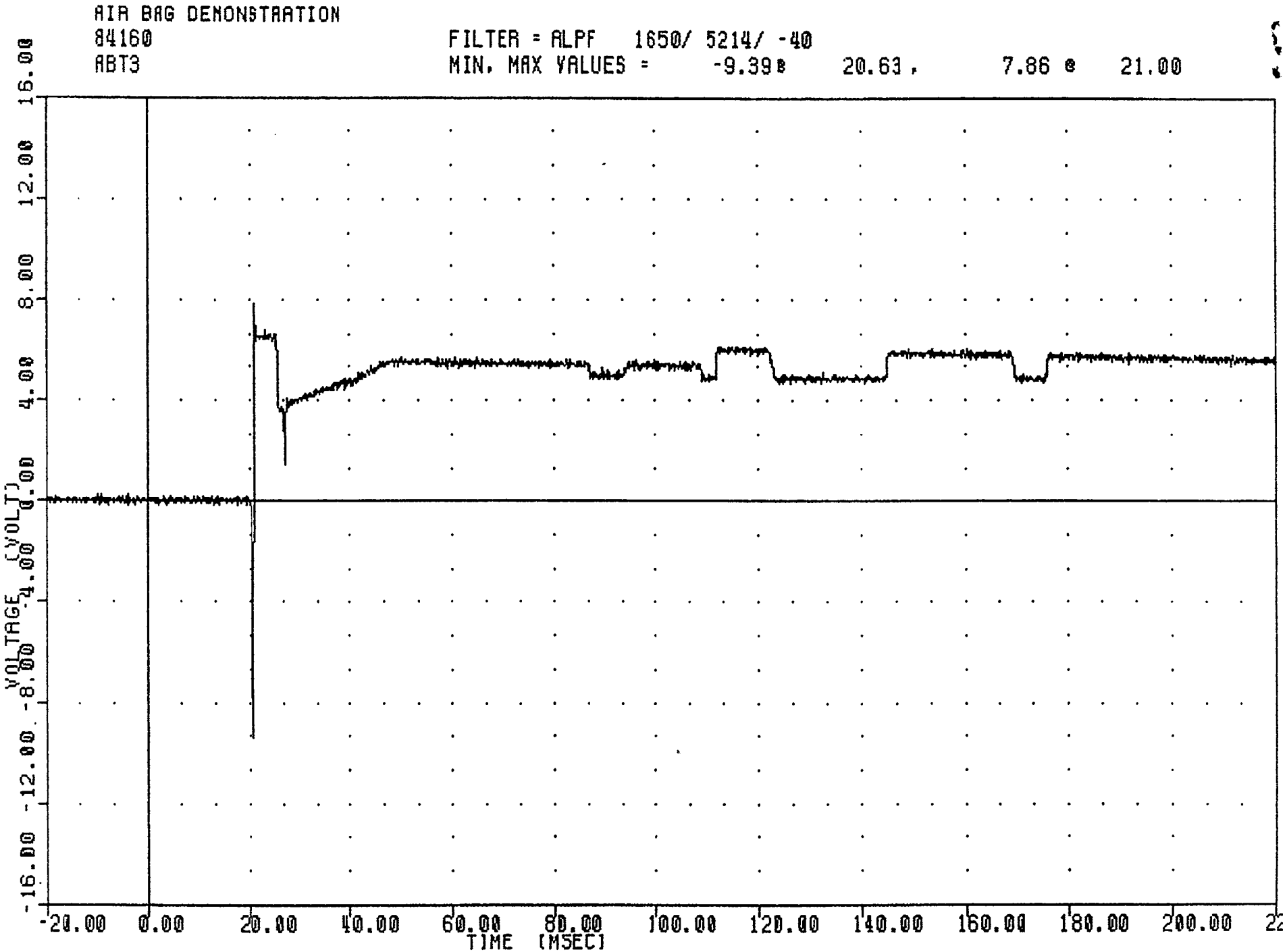
PILLAR LEFT B ACCELERATION X AXIS



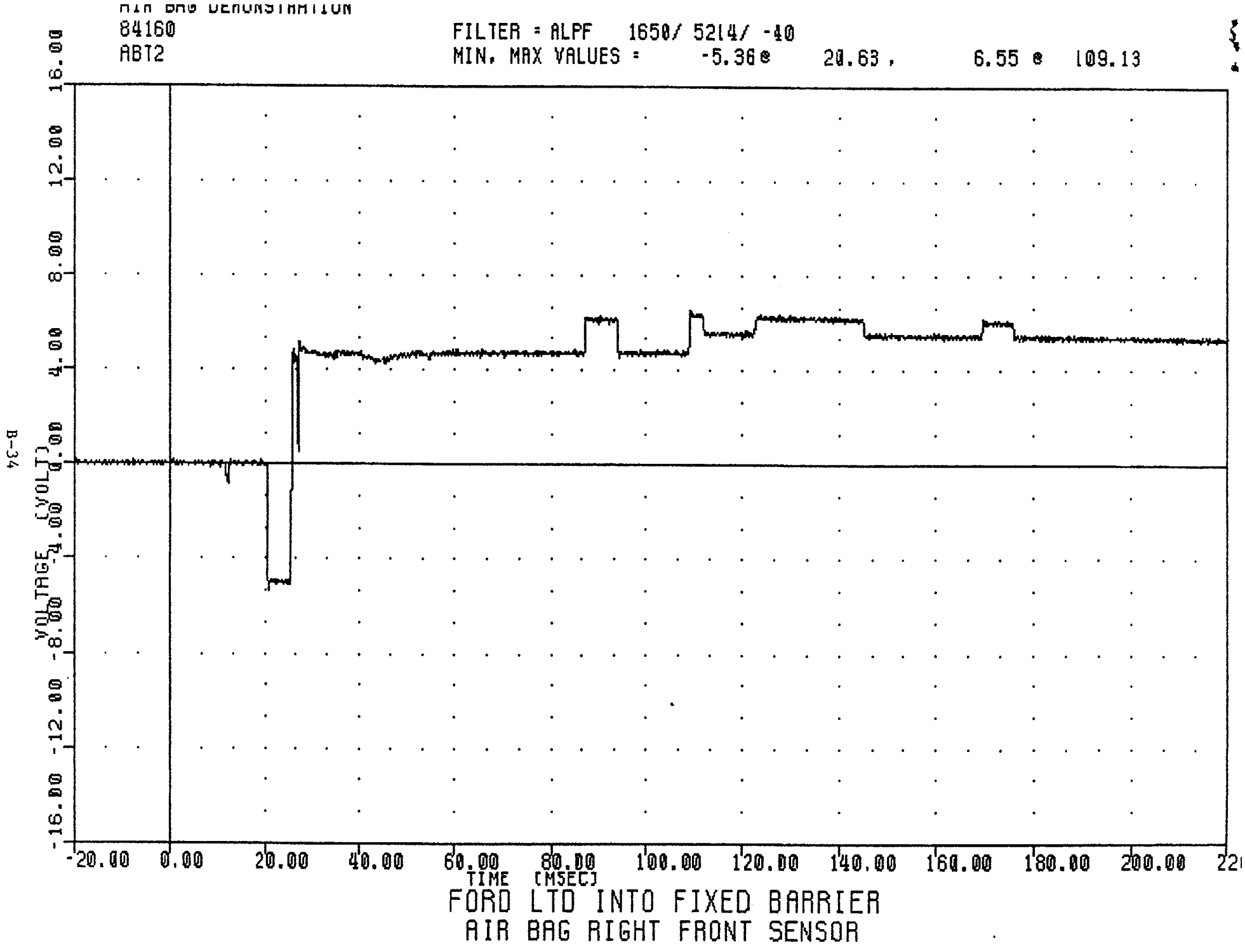
FORD LTD INTO FIXED BARRIER
BREED SWITCH



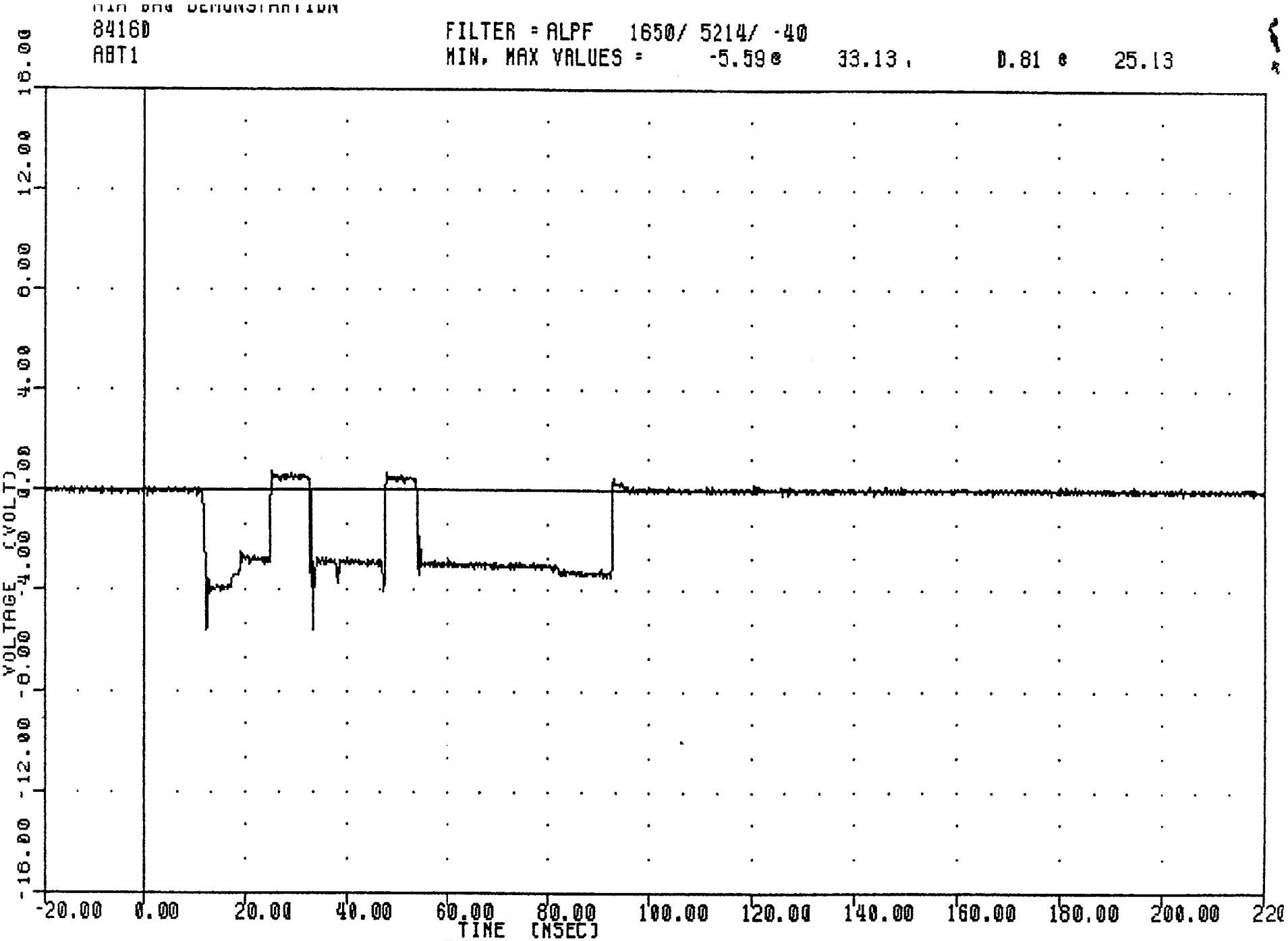
FORD LTD INTO FIXED BARRIER
HIGH LEVEL SW



FORD LTD INTO FIXED BARRIER
AIR BAG SAFETY SENSOR



FORD LTD INTO FIXED BARRIER
AIR BAG RIGHT FRONT SENSOR



FORD LTD INTO FIXED BARRIER
AIR BAG LEFT FRONT SENSOR