DOT#968+969

DYNAMIC TESTING FOR SIDE CRUSH

MRB-TO-CAR SIDE IMPACT TEST OF
A 90° MOVING RIGID BARRIER
TO A 1980 FORD LTD
TEST #1 20.9 MPH
TEST #2 42.1 MPH

PREPARED BY:
VEHICLE RESEARCH AND TEST CENTER
ST. RT. 33 LOGAN COUNTY
EAST LIBERTY, OHIO 43319

TEST REPORT
JUNE 1986

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
400 SEVENTH STREET, S.W.
WASHINGTON, D.C. 20590

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
DYNAMIC TESTING FOR SIDE CRUSH MRB-To-Car Side Impact Test of A 90° Moving Rigid Barrier To A 1980 Ford LTD Test #1 20.9 mph, Test #2 42.1 mph	JUNE 1986
	6. Performing Organization Code
7. Author(s) N. A. El-Habash Project Engineer, TRCO	8. Performing Organization Report No. 860506
9. Performing Organization Name and Address Vehicle Research and Test Center St. Rt. 33, Logan County East Liberty, Ohio 43319	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DTNH22-85-C-08123
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington, DC 20590	13. Type of Report and Period Covered TEST REPORT May-June 1986
	14. Sponsoring Agency Code

15. Supplementary Notes

This test was conducted as part of VRTC Project No. SRL 46 Side Impact Protection In Production Vehicles

16. Abstract

This test report documents two of a series of nine crash tests to measure side crush in various vehicle models. Testing was conducted on a 1980 Ford LTD Sedan at the TRCO Crash Test Facility, East Liberty, Ohio. The test vehicle was impacted on the left and right side perpendicular by a Moving Rigid Barrier (MRB). The test date was May 6, 1986.

Test #1 Vehicle was impacted perpendicular on the left side at 20.9 mph, the ambient temperature was 72°F and the time was 1150.

Test #2 Vehicle was impacted perpendicular on the right side at 42.1 mph, the ambient temperature was 78°F and the time was 1320.

17. Key Words	18. Distribution Statement
Occupant Response Moving Barrier Crash Testing	Available from: National Technical Information Service Springfield, Virginia 22161

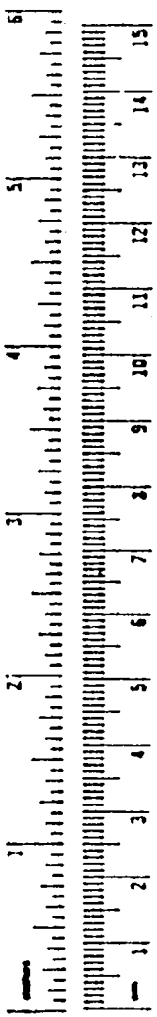
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	88	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

METRIC CONVERSION FACTORS

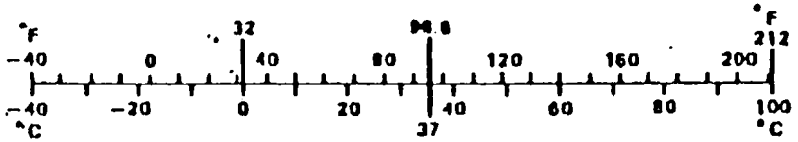
Approximate Conversions to Metric Measures

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 main purpose of this test was to obtain side crush measurements for improvement of computer simulation models in one of a fleet of vehicles. The vehicle was tested using conditions not currently contained in a Federal Motor Vehicle Safety Standard.

INTRODUCTION

A stationary 1980 Ford LTD 4-Door Sedan was impacted on the left and right side by a Moving Rigid Barrier (MRB) on May 6, 1986.

Test #1: The MRB was to be towed into the stationary Ford LTD at 20.9 mph, and the intended contact point of the MRB longitudinal centerline was to be 0.0 inches from the center of gravity of the Ford LTD. The angle of the MRB was 90^{o} counter clockwise with respect to the longitudinal axis of the struck vehicle. The actual test speed was 20.9 mph and the actual contact point was 0.0 inches from the midpoint of the Ford LTD.

Test #2: The MRB was to be towed into the stationary Ford LTD at 41.9 mph, and the intended contact point of the MRB longitudinal centerline was to be 0.0 inches from the center of gravity of the Ford LTD. The angle of the MRB was 90^{o} clockwise with respect to the longitudinal axis of the struck vehicle. The actual speed was 42.1 mph and the actual contact point was 0.0 inches from the center of gravity of the Ford LTD.

Section 2 contains General Test and Vehicle Parameter Data. Section 3 contains data required by R & D. Appendix A & B contains pre-test and post-test vehicle photographs. Appendix C & D 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 Co. of Canada LTD

MAKE/MODEL: Ford LTD VIN: F0B63F103382F

BODY STYLE: 4-Door Sedan MODEL YEAR: 1980

NHTSA NO.: R & D COLOR: Maroon

ENGINE DATA: TYPE: Inline CYLINDERS: 8 DISPLACEMENT: N/A

TRANSMISSION DATA: 3 Speed Automatic

DATE VEHICLE RECEIVED: 4/28/86 ODOMETER READING: 86,157

DEALER'S NAME AND ADDRESS: NA

ACCESSORIES:

POWER STEERING	Yes	AUTOMATIC TRANSMISSION	Yes
POWER BRAKES	Yes	AUTOMATIC SPEED CONTROL	Yes
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? Yes
3. DOES VEHICLE SHOW ANY SIGNIFICANT CORROSION? Yes
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 Co. of Canada LTD

DATE OF MANUFACTURE: 09/79

GVWR: 5333 LBS.,

GAWR: FRONT 2719 LBS., REAR 2664 LBS.

VEHICLE TIRE DATA

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

TIRES ON VEHICLE (MFGR. & LINE, SIZE): NA

BIAS PLY, BELTED, OR RADIAL: Radial

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	DNA	LBS.	RIGHT REAR	DNA	LBS.
LEFT FRONT	DNA	LBS.	LEFT REAR	DNA	LBS.
TOTAL FRONT WEIGHT	DNA	LBS. (% OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	DNA	LBS. (% OF TOTAL VEHICLE WEIGHT)			
TOTAL DELIVERED WEIGHT	DNA	LBS.			

WEIGHT OF TEST VEHICLE AFTER PREPARATION:

RIGHT FRONT	987	LBS.	RIGHT REAR	764	LBS.
LEFT FRONT	1008	LBS.	LEFT REAR	795	LBS.
TOTAL FRONT WEIGHT	1995	LBS. (56.1 % OF TOTAL VEHICLE WEIGHT)			
TOTAL REAR WEIGHT	1559	LBS. (43.9 % OF TOTAL VEHICLE WEIGHT)			
TOTAL TEST WEIGHT	3554	LBS.			

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

TEST FLUID DATA

TEST FLUID TYPE: PURPLE STODDARD SOLVENT 2; SPEC. GRAVITY: 0.764

KINEMATIC VISCOSITY: 0.99 CENTISTOKES

"USEABLE" CAPACITY*: NA GALLONS ACTUAL

TEST VOLUME: 0.0 GALLONS

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

DETAILS OF FUEL SYSTEM: DNA

ELECTRIC FUEL PUMP: DNA FUEL INJECTION: DNA

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

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

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

RECOMMENDED TIRE SIZE: P205/70R14 LOAD RANGE X B, C,

VEHICLE CAPACITY: TYPES OF SEATS: Front - Bench
Rear - Bench

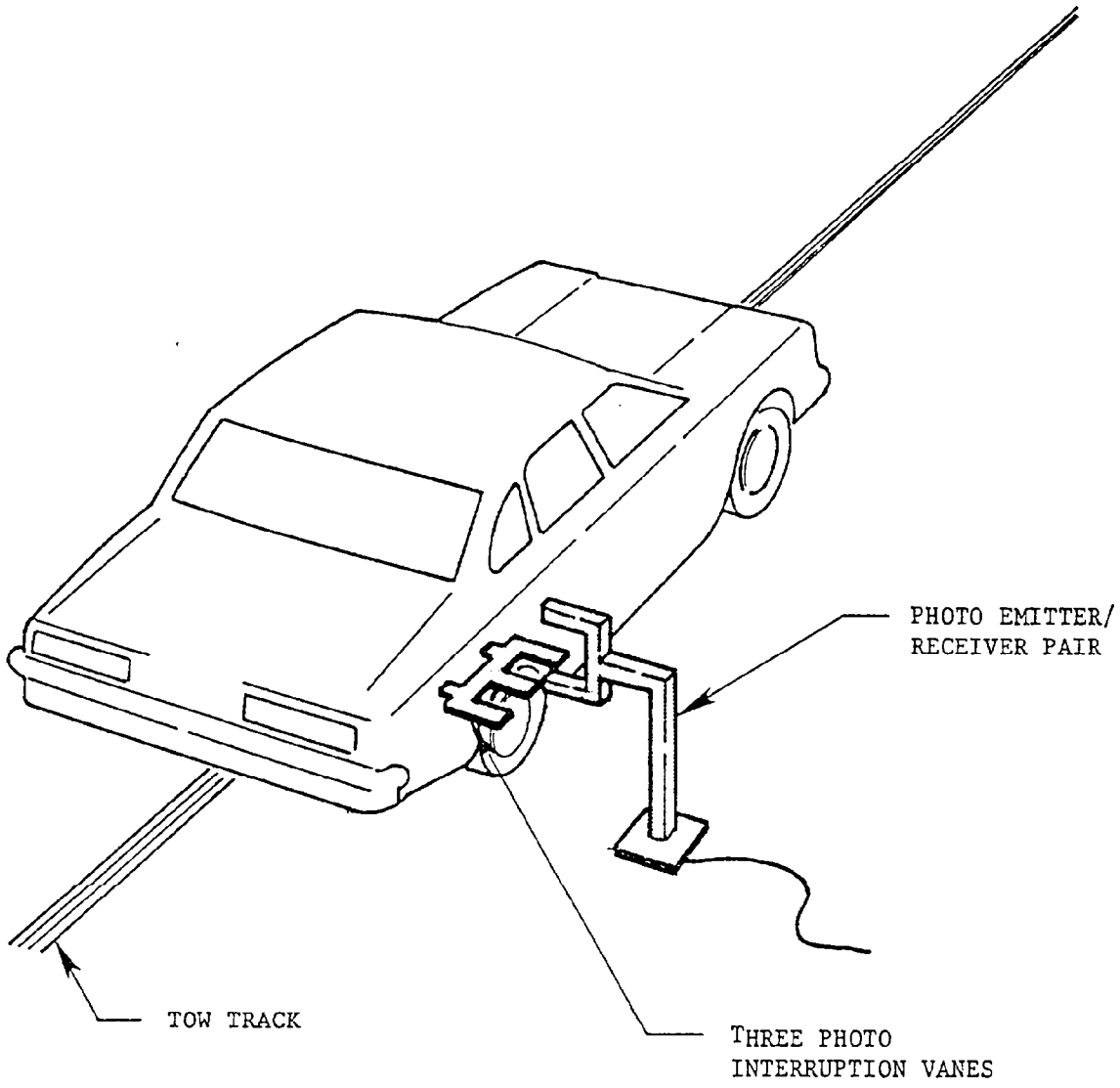
NUMBER OF OCCUPANTS (DESIGNATED SEATING CAPACITY): 2 FRONT
3 REAR
5 TOTAL

CARGO LOAD DNA LBS.

TOTAL DNA LBS.

*WITH ENTIRE FUEL SYSTEM FILLED WITH FUEL TANK THROUGH CARBURETOR BOWL.

IMPACT VELOCITY MEASUREMENT SYSTEM



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

The vanes have one foot spacing.

TEST ANOMALIES

Test #1 vehicle was impacted perpendicular on the left side low speed.

1. The following data channels did not return to baseline following the crash pulse.

   BCGYG Barrier Center of Gravity Acceleration Y Axis.
   RDKZV Vehicle Rear Deck Rate Gyro
   BRCXG Barrier Rear Crossmember Acceleration X Axis

Test #2 vehicle was impacted perpendicular on the right side high speed.

1. The following data channel did not return to baseline following the crash pulse.

   VCGYG Vehicle Center of Gravity Acceleration Y Axis.
   BCGYG Moving Barrier Center of Gravity Acceleration Y Axis.

2. RDKXG Data loss after approximately 100 msec due to the extention cable pin breaking during impact.

Y TRCO is investigating the zero-shift phenomenon of accelerometer and rate gyro data during the crash pulse in conjunction with Metraplex Corporation and Endevco Representatives. There is no definite resolutions as of the date of this report.

SECTION 3.0
DATA REQUIRED BY R & D TEST #1

The following pages are included in this section:

Test #1 vehicle was impacted perpendicular on the left side low speed.

1. Vehicle crush data

2. Vehicle accelerometer location and data summary

3. High speed camera information

4. Transducer information

TEST #1 VEHICLE WAS IMPACTED PERPENDICULAR ON LEFT SIDE LOW SPEED

Test Condition

Test Number: 860506 Date of Test = May 6, 1986

Wind Velocity 10 - 15/216S Time of Test = 11:50

Ambient Temperature at Impact Area: 72°F

Subject Vehicle Data	Actual	Intended
Vehicle Test Weight (lbs.)	3554	3554
MRB Test Weight (lbs.)	3237	3237
MRB Velocity (mph)*	20.9	20.9
Impact Point (in.)**	0.0	0.0

Vehicle Attitude (All dimensions in inches):

Delivered Attitude:	RF 28	;LF 26 1/2	;RR 27 1/4	;LR 25 7/8
Pre-Test Attitude:	RF 28	;LF 26 1/2	;RR 27 1/4	;LR 25 7/8
Post-Test Attitude:	RF 27 3/4	;LF 26 7/16	;RR 27 1/8	;LR 27 1/8

Vehicle dimension (All in inches):

***Center of Gravity	= 50 1/8	, wheel base	= 114 1/4
Width Car	= 77 1/2	, length car	= 206 1/8
Width Roof	= 52 1/8	, track width	= 62 5/8
Front overhang	= 36	, rear overhang	= 56 1/4

* As measured over final one foot of travel.

** As measured + is forward of the center of gravity of the test vehicles.
As measured - is rearward of the center of gravity of the test vehicles.

*** Rearward of front wheel centerline.

National Accident Sampling System — Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

NCI

Complete When Applicable	
End Damage	**Side Damage**
Undeformed end width _____	Bowing: B1 _____ X1 _____
Corner shift: A1 _____	B2 _____ X2 _____
A2 _____	Bowing constant
End shift at frame (CDC) (check one)	$\frac{X1 + X2}{2}$ = _____
<4 inches X	
⩾4 inches _____	

Note: Measure C1 to C6 from Driver to Passenger side in Front or Rear impacts–Rear to Front in Side impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width** (CDC)	Max*** Crush								
	Bumper crush				0	9	8.3	8.5	8.4	0	
	Door free space				–	2.3	2.3	2.3	2.3	–	
	Net bumper crush			85.3	0	6.7	6.0	6.2	6.1	0	-4.6
	Sill crush				–	5.7	6.8	6.4	6.4	–	
	Sill free space				–	4.3	4.3	4.3	4.3	–	
	Net sill crush				–	1.4	2.5	2.1	2.1	–	

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

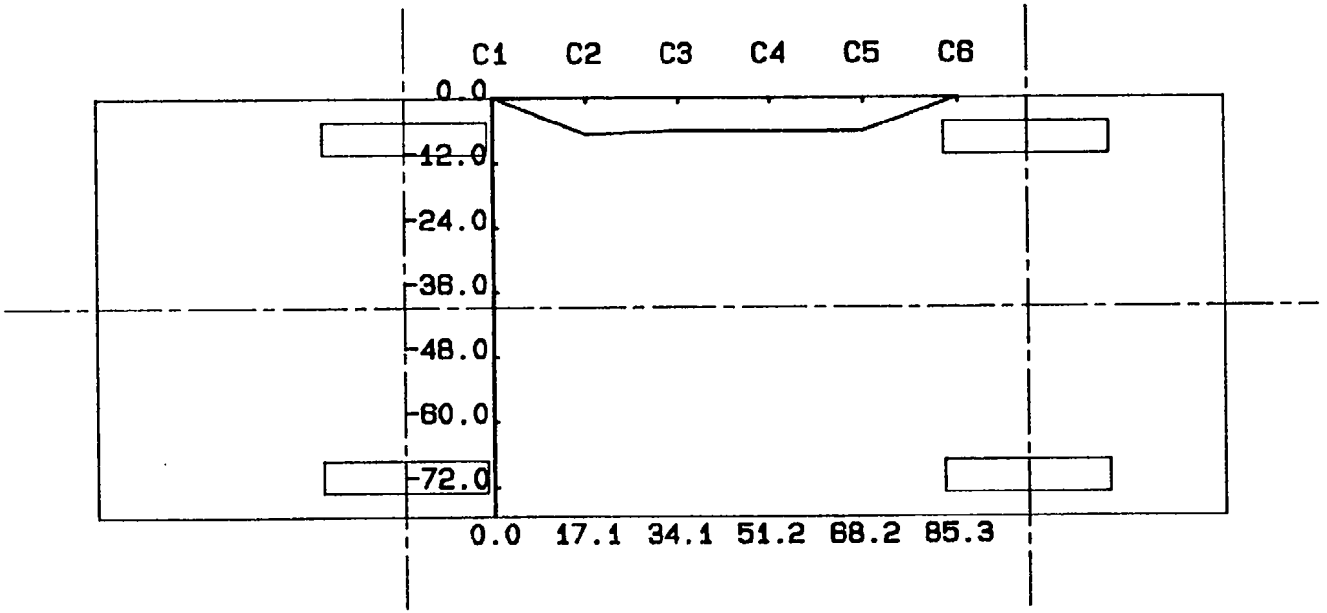
Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle.)

***Measure and document on the vehicle diagram the location of the maximum crush.

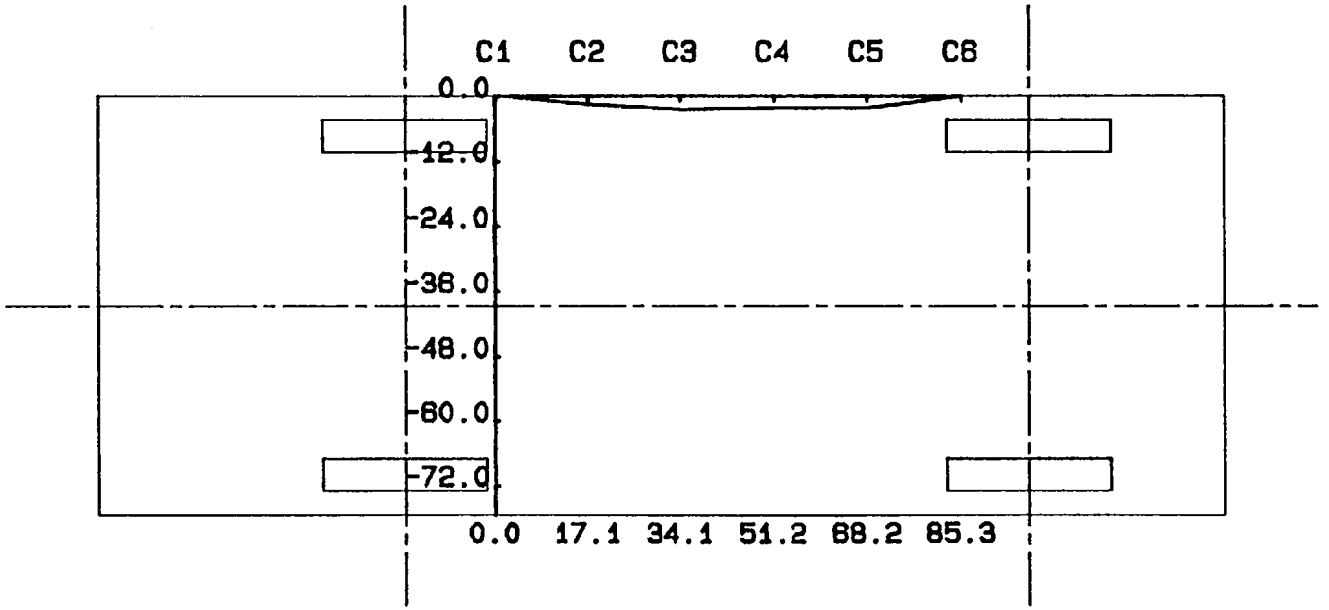
Note: Use as many lines/columns as necessary to describe each damage profile.

VEHICLE EXTERIOR STATIC CRUSH PROFILE



PROFILE LEVEL EQUALS MID-BUMPER HEIGHT WHICH IS 17.0 " ABOVE GROUND LEVEL
THE CENTER OF THE CRUSH IS -4.6 " FROM THE CENTER OF GRAVITY
SCALE FACTOR EQUALS 0.030

VEHICLE EXTERIOR STATIC CRUSH PROFILE



PROFILE LEVEL EQUALS SILL EDGE HEIGHT WHICH IS 12.3 " ABOVE GROUND LEVEL
THE CENTER OF THE CRUSH IS -4.6 " FROM THE CENTER OF GRAVITY
SCALE FACTOR EQUALS 0.030

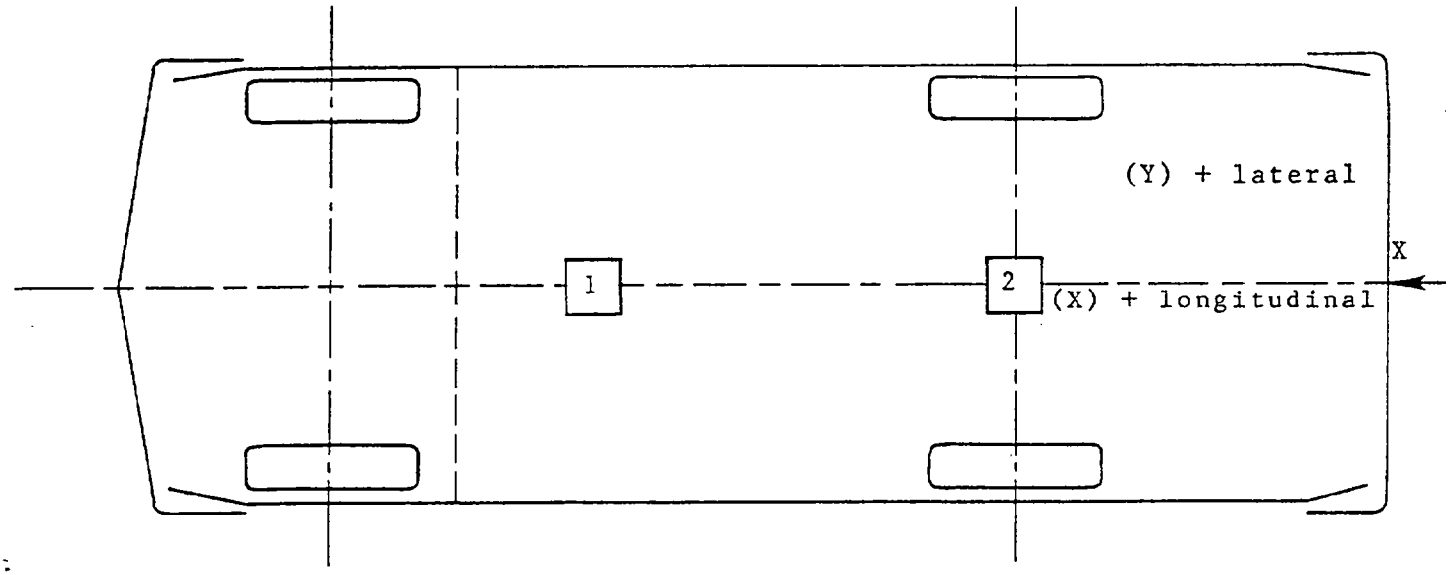
VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

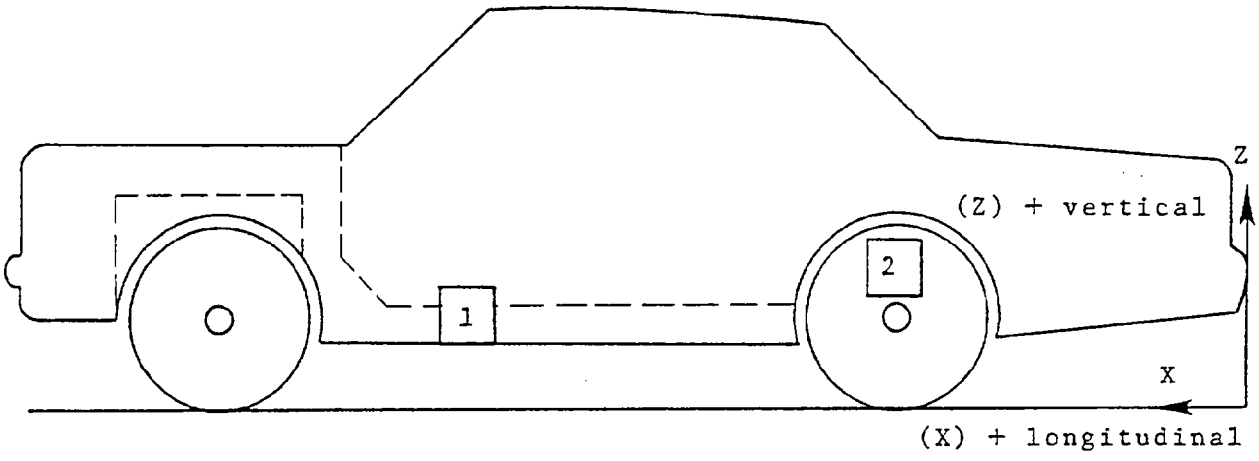
NO.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	CENTER OF GRAVITY	-50.1	-0.6	16.1				
	(LONGITUDINAL)				13.12	17.63	10.68	12.38
	(LATERAL)	ΔV = -11.7 mph @ 90.00 msec			2.79	53.88	18.29	39.38
	(VERTICAL)				22.57	25.13	22.01	31.38
	(RESULTANT)					28.73 @ 27.88		
2	REAR DECK OVER AXLE	-113.8	0.0	28.6				
	(LONGITUDINAL)				4.94	11.75	7.13	16.88
	(LATERAL)	ΔV = -10.2 mph @ 90.00			1.48	246.00	12.89	47.50
	(VERTICAL)							
	(RESULTANT)							

* Reference: X - Front Axle (+ Forward), Y - Vehicle Centerline (+ To Right), Z - Ground Level (+ Up)

All measurements of accelerometer locations in inches.

VEHICLE ACCELEROMETER LOCATIONS





YAW RATE GYRO LOCATION AND DATA SUMMARY

LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX (deg/sec)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (deg/sec)	NEGATIVE DIRECTION TIME (msec)
YAW RATE GYRO	-118.0	0.0	33.4	---	--- ϒ	---	--- ϒ

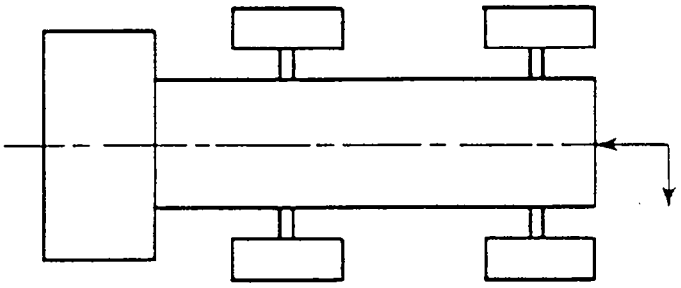
*Reference: X - Front Axle (+ Forward), Y - Vehicle Centerline (+ To Left), Z - Ground Level (+ Up)

All measurements of rate gyro in inches.

Yaw rotation is positive when measured counterclockwise as viewed from above.

ϒSee TEST ANOMALIES

MOVING BARRIER 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	CENTER OF GRAVITY	61.2	0.0	11.8				
	LONGITUDINAL	Δ V = -13.42 mph @ 90.00 msec			0.34	20.0	14.08	30.50
	(LATERAL)				---	---Y	---	---Y
	(VERTICAL)				3.65	34.00	3.80	23.63
	(RESULTANT)					--- @ ---Y		
2	REAR FRAME MEMBER	22.0	+18.4	11.9				
	(LONGITUDINAL)	Δ V = --- mph @ ---Y msec			---	---Y	---	---Y
	(LATERAL)				1.13	66.38	2.45	42.25

*Reference: X - Rear most point of frame (+ Forward),
Y - Barrier centerline (+ To left),
Z - Ground level (+ Up)

All measurements of accelerometer locations in inches.

Y See TEST ANOMALIES

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right Panning	Kodak	25	24	Real Time Panning
2	Overhead Wide	Photosonic 1B	8	1000	Vehicle Dynamics
3	Overhead Tight	Photosonic 1B	25	1001	Close-up of Impact Point
4	Onboard MRB	Photosonic 1B	13	998	Close-up of Impact Point

NON-GOVERNMENT FURNISHED TRANSDUCER INFORMATION

PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NUMBER	SERIAL NUMBER	MFGR.	DATE OF LAST CALIBRATION	SENSITIVITY	DESIRED FULL SCALE (ENGR. UNITS)
BCGXG	Accel	4-202-0001	18849	Bell Howell	3/25/86	.2225	100 G
BCGYG	Accel	4-202-0001	18859	Bell Howell	3/25/86	.2115	100 G
BCGZG	Accel	4-202-0001	18235	Bell Howell	3/25/86	.2381	100 G
BRCYG	Accel	4-202-0001	19022	Bell Howell	3/25/86	.2211	100 G
BRCXG	Accel	4-202-0001	18851	Bell Howell	3/25/86	.2488	100 G

All struck vehicle accelerometers were Government Furnished Equipment and were Endevco 2264 and 7264 Accelerometers.

SECTION 4.0
DATA REQUIRED BY R & D TEST #2

The following pages are included in this section:

Test #2 vehicle was impacted perpendicular on the right side high speed.

1. Vehicle crush data
2. Vehicle accelerometer location and data summary
3. High speed camera information
4. Transducer information

TEST #2 VEHICLE WAS IMPACTED PERPENDICULAR ON RIGHT SIDE HIGH SPEED

Test Condition

Test Number: 860506 Date of Test = May 6, 1986

Wind Velocity 7 - 14/243 S.W. Time of Test = 13:20

Ambient Temperature at Impact Area: 78°F

Subject Vehicle Data	Actual	Intended
Vehicle Test Weight (lbs.)	3554	3554
MRB Test Weight (lbs.)	3237	3232
MRB Velocity (mph)*	42.1	41.9
Impact Point (in.)**	0.0	0.0

Vehicle Attitude (All dimensions in inches):

Delivered Attitude:	RF	28	;LF	26 1/2	;RR	27 1/4	;LR	25 7/8
Pre-Test Attitude:	RF	27 3/4	;LF	26 1/2	;RR	27 1/8	;LR	27 1/8
Post-Test Attitude:	RF	26 1/2	;LF	22 13/16	;RR	26 7/8	;LR	24 1/8

Vehicle dimension (All in inches):

***Center of Gravity	=	50 1/8	, wheel base	=	114 1/4
Width Car	=	77 1/2	, length car	=	206 1/8
Width Roof	=	52 1/8	, track width	=	62 5/8
Front overhang	=	36	, rear overhang	=	56 1/4

* As measured over final one foot of travel.

** As measured + is forward of the center of gravity of the test vehicles.
As measured - is rearward of the center of gravity of the test vehicles.

*** Rearward of front wheel centerline.

National Accident Sampling System — Continuous Sampling Subsystem: Vehicle Data

FIELD MEASUREMENTS

NCI

Complete When Applicable	
End Damage	**Side Damage**
Undeformed end width _____	Bowing: B1 _____ X1 4.8
Corner shift: A1 _____	B2 _____ X2 8.0
A2 _____	Bowing constant
End shift at frame (CDC) (check one)	$\frac{X1 + X2}{2}$ = 6.4
<4 inches _____	
≥4 inches *	

Note: Measure C1 to C6 from Driver to Passenger side in Front or Rear impacts–
Rear to Front in Side impacts.

Specific Impact Number	Plane* of C-Measurements	Direct Damage		Field L**	C_1	C_2	C_3	C_4	C_5	C_6	±D
		Width** (CDC)	Max*** Crush								
	Bumper crush				0	20.8	22.0	21.5	19.0	0	
	Door free space				-	2.3	2.3	2.3	2.3	-	
	Net bumper crush				0	18.5	19.7	19.2	16.7	0	
	Bowing				6.4	6.4	6.4	6.4	6.4	6.4	
	Net crush			103	6.4	24.9	26.1	25.6	23.1	6.4	-2.6
	Sill Crush				-	11.4	20.6	19.0	16.8	-	
	Sill free space				-	4.3	4.3	4.3	4.3	-	
	Net sill crush				-	7.1	16.3	14.7	12.5	-	

*Identify the plane at which the C-measurements are taken (e.g., at bumper, above bumper, at sill, above sill, at beltline, etc.) or label adjustments (e.g., free space).

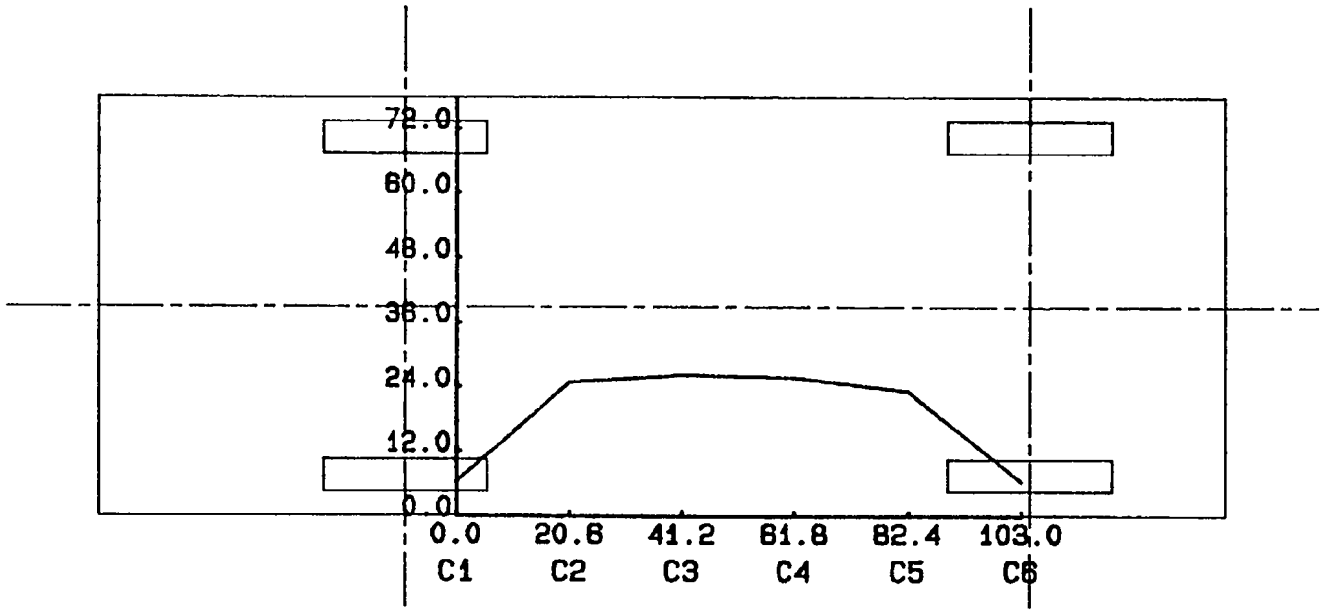
Free space value is defined as the distance between the baseline and the original body contour taken at the individual C locations. This may include the following: bumper lead, bumper taper, side protrusion, side taper, etc. Record the value for each C-measurement and maximum crush.

**Measure and document on the vehicle diagram the beginning or end of the direct damage width and field L (e.g., side damage with respect to undamaged axle.)

***Measure and document on the vehicle diagram the location of the maximum crush.

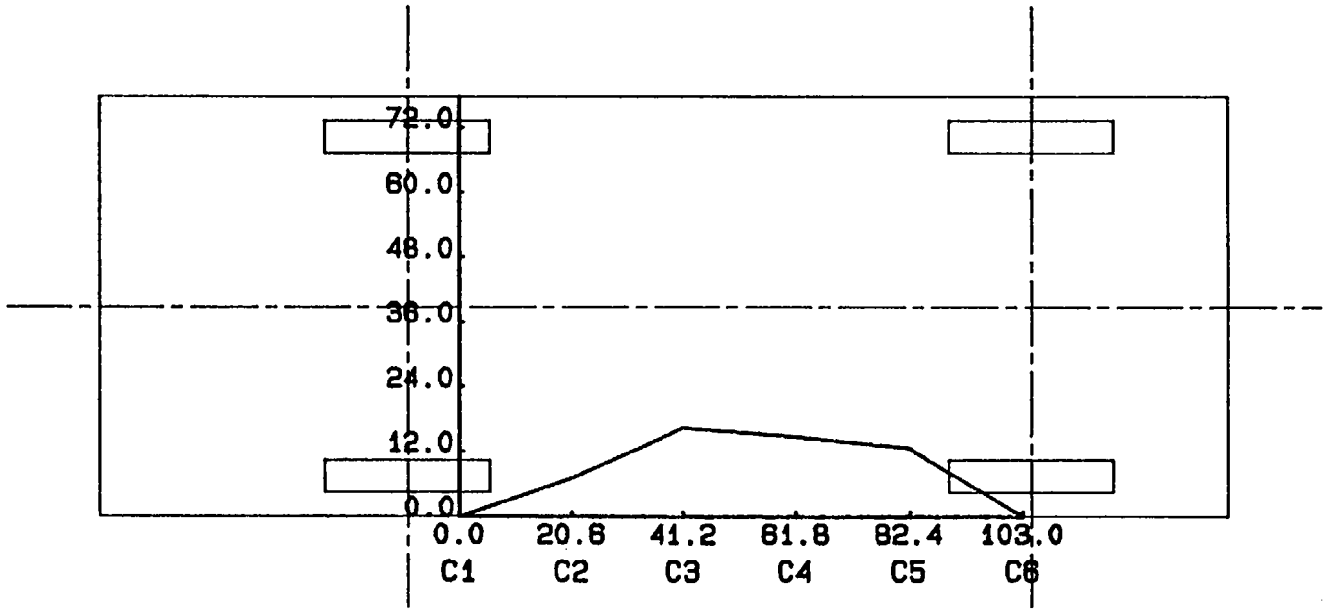
Note: Use as many lines/columns as necessary to describe each damage profile.

VEHICLE EXTERIOR STATIC CRUSH PROFILE



PROFILE LEVEL EQUALS MID-BUMPER HEIGHT WHICH IS 17.0 " ABOVE GROUND LEVEL
THE CENTER OF THE CRUSH IS -2.6 " FROM THE CENTER OF GRAVITY
SCALE FACTOR EQUALS 0.030

VEHICLE EXTERIOR STATIC CRUSH PROFILE



PROFILE LEVEL EQUALS SILL EDGE HEIGHT WHICH IS 12.3 " ABOVE GROUND LEVEL
THE CENTER OF THE CRUSH IS −2.6 " FROM THE CENTER OF GRAVITY
SCALE FACTOR EQUALS 0.030

VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

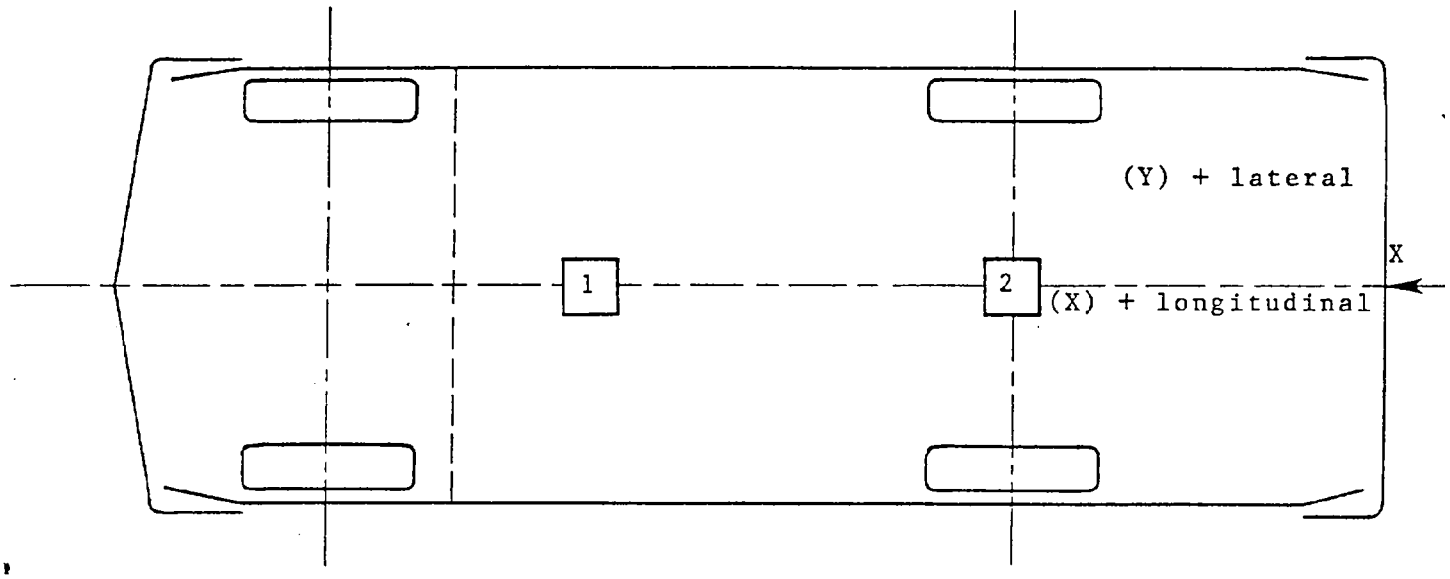
NO.	LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX (g)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (g)	NEGATIVE DIRECTION TIME (msec)
1	CENTER OF GRAVITY	-50.1	-0.6	16.1				
	(LONGITUDINAL)				53.22	25.13	49.07	12.63
	(LATERAL)	Δ V = ---	mph @ ---	Y msec	---	--- Y	---	---Y
	(VERTICAL)				71.61	24.38	29.32	43.88
	(RESULTANT)					--- @ --- Y		
2	REAR DECK OVER AXLE	-113.8	0.0	28.6				
	(LONGITUDINAL)				---	---Y	---	---Y
	(LATERAL)	V = 20.6	mph @	180.00 msec	21.74	12.88	2.97	35.25
	(VERTICAL)							
	(RESULTANT							

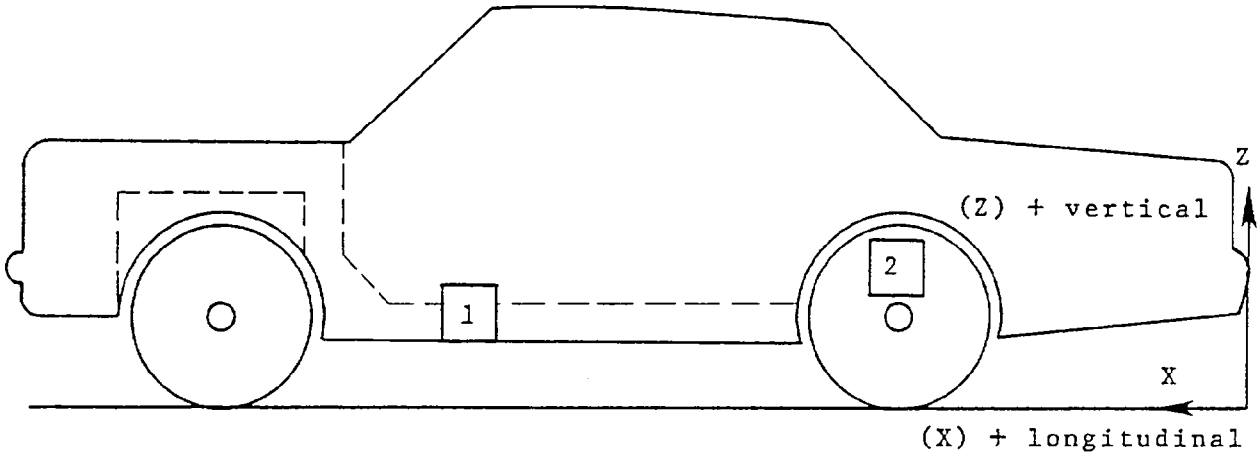
* Reference: X - Front Axle (+ Forward), Y - Vehicle Centerline (+ To Right), Z - Ground Level (+ Up)

All measurements of accelerometer locations in inches.

Y See TEST ANOMALIES

VEHICLE ACCELEROMETER LOCATIONS





YAW RATE GYRO LOCATION AND DATA SUMMARY

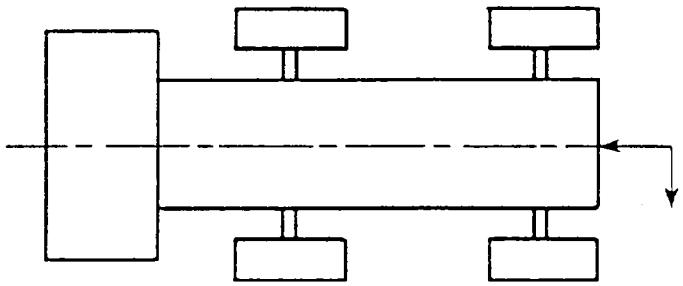
LOCATION	X*	Y*	Z*	POSITIVE DIRECTION MAX (deg/sec)	POSITIVE DIRECTION TIME (msec)	NEGATIVE DIRECTION MAX (deg/sec)	NEGATIVE DIRECTION TIME (msec)
YAW RATE GYRO	-118.0	0.0	33.4	173.38	66.38	11.95	233.25

*Reference: X - Front Axle (+ Forward), Y - Vehicle Centerline (+ To Left), Z - Ground Level (+ Up)

All measurements of rate gyro in inches.

Yaw rotation is positive when measured counterclockwise as viewed from above.

MOVING BARRIER 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	CENTER OF GRAVITY	61.2	0.0	11.8				
	LONGITUDINAL	Δ V = -24.6 mph @ 180.00 msec			0.81	209.25	25.04	17.75
	(LATERAL)				---	--- Y	---	--- Y
	(VERTICAL)				10.71	56.63	18.72	16.75
	(RESULTANT)					--- @	--- Y	
2	REAR FRAME MEMBER	22.0	+18.4	11.9				
	(LONGITUDINAL)	Δ V = -19.5 mph @ 180.00 msec			1.31	223.88	17.56	23.00
	(LATERAL)				4.90	16.13	2.47	90.38

*Reference: X - Rear most point of frame (+ Forward),
Y - Barrier centerline (+ To left),
Z - Ground level (+ Up)

All measurements of accelerometer locations in inches.

Y See TEST ANOMALIES

CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Right Panning	Kodak	25	24	Real Time Panning
2	Overhead Wide	Photosonic 1B	8	1000	Vehicle Dynamics
3	Overhead Tight	Photosonic 1B	25	1003	Close-up of Impact Point
4	Onboard MRB	Photosonic 1B	13	995	Close-up of Impact Point

NON-GOVERNMENT FURNISHED TRANSDUCER INFORMATION

PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NUMBER	SERIAL NUMBER	MFGR.	DATE OF LAST CALIBRATION	SENSITIVITY	DESIRED FULL SCALE (ENGR. UNITS)
BCGXG	Accel	4-202-0001	18849	Bell Howell	3/25/86	.2225	100 G
BCGYG	Accel	4-202-0001	18859	Bell Howell	3/25/86	.2115	100 G
BCGZG	Accel	4-202-0001	18235	Bell Howell	3/25/86	.2381	100 G
BRCYG	Accel	4-202-0001	19022	Bell Howell	3/25/86	.2211	100 G
BRCXG	Accel	4-202-0001	18851	Bell Howell	3/25/86	.2488	100 G

All struck vehicle accelerometers were Government Furnished Equipment and were Endevco 2264 and 7264 Accelerometers.

APPENDIX A

PHOTOGRAPHS

TEST #1 VEHICLE WAS IMPACTED PERPENDICULAR ON THE LEFT SIDE LOW SPEED.

Figure A-1. PRE-TEST FRONT VIEW

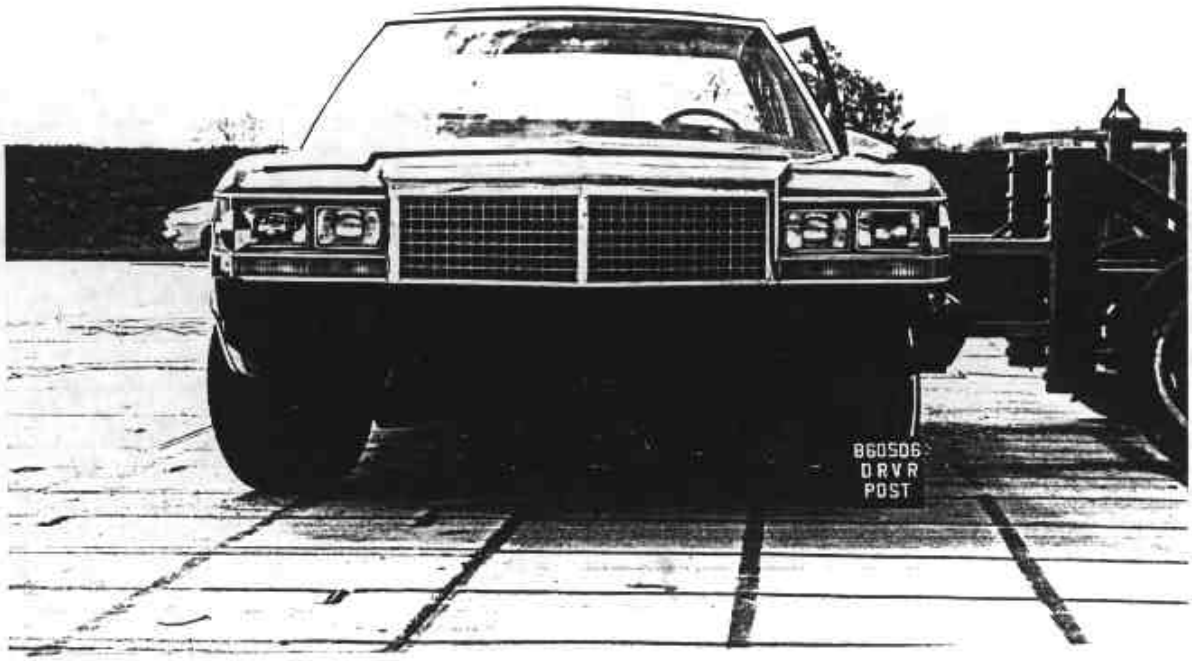


Figure A-2. POST-TEST FRONT VIEW

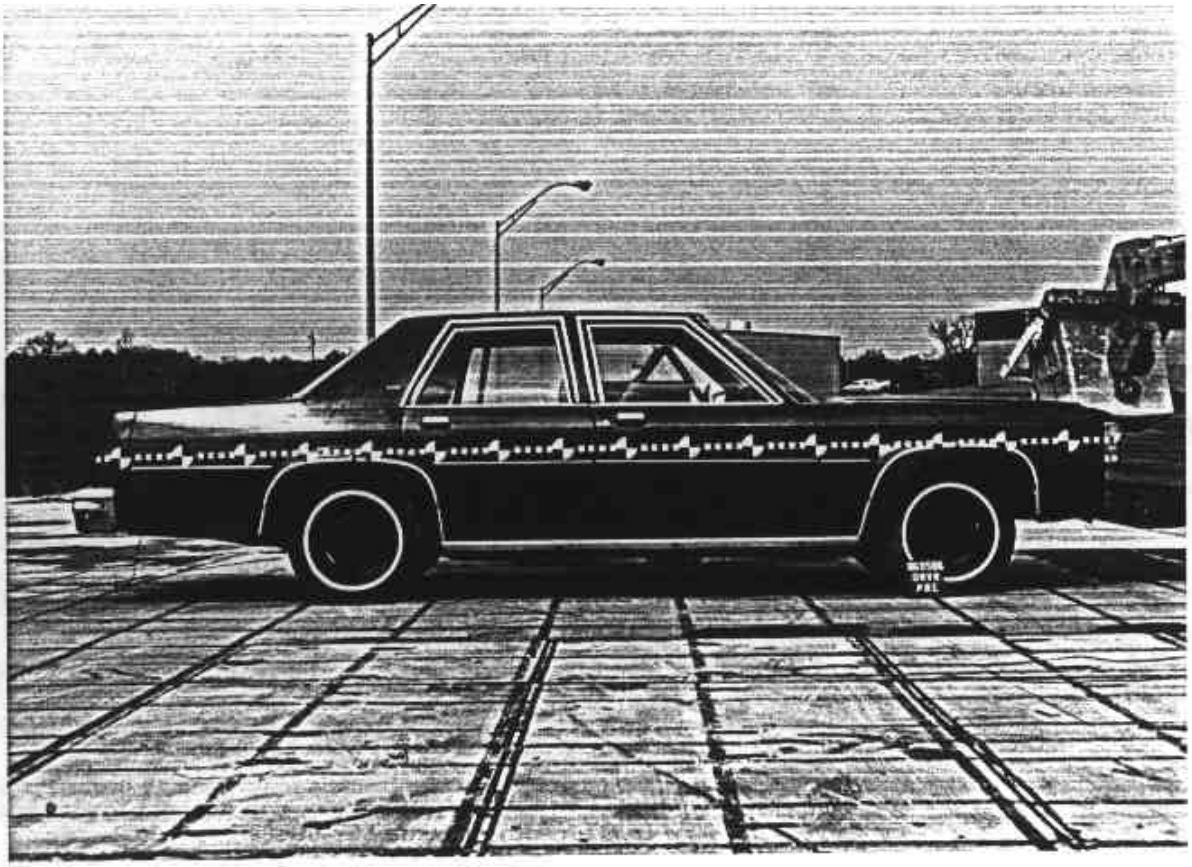


Figure A-3. PRE-TEST PASSENGER SIDE VIEW

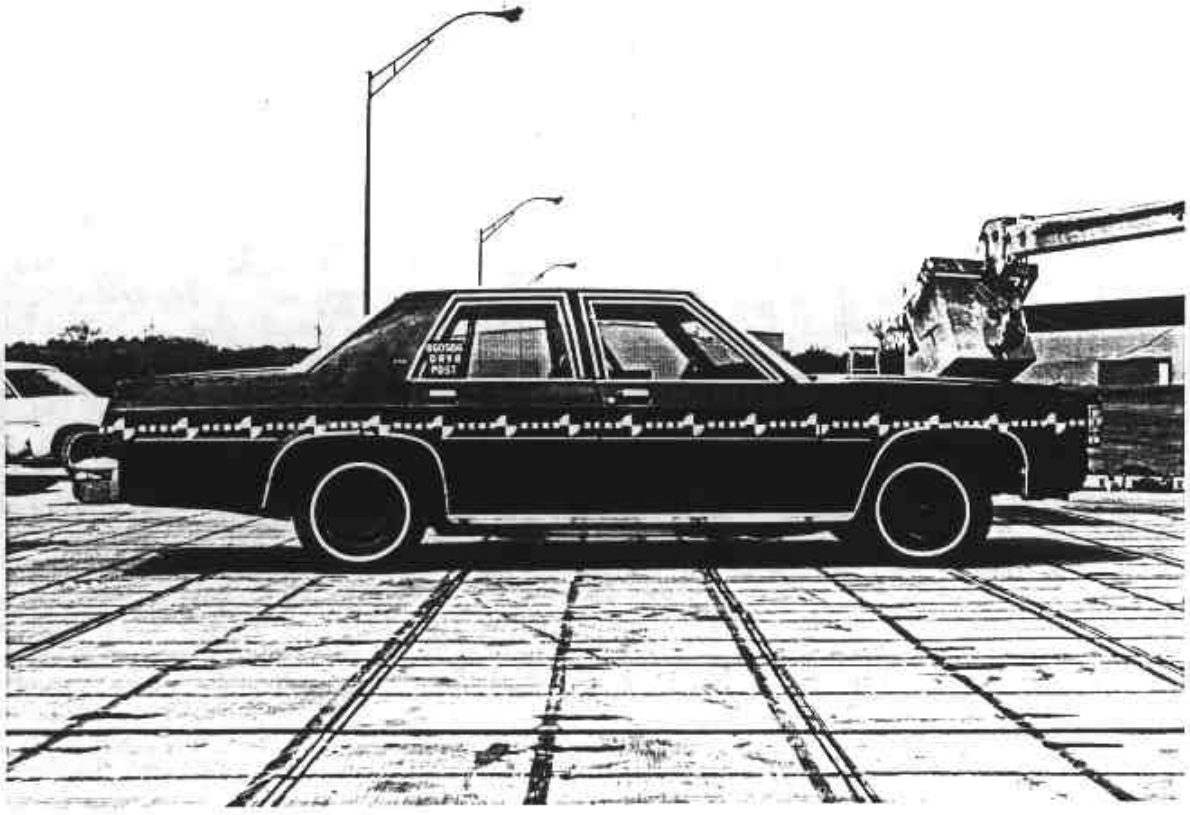


Figure A-4. POST-TEST PASSENGER SIDE VIEW

Figure A-5. PRE-TEST REAR VIEW

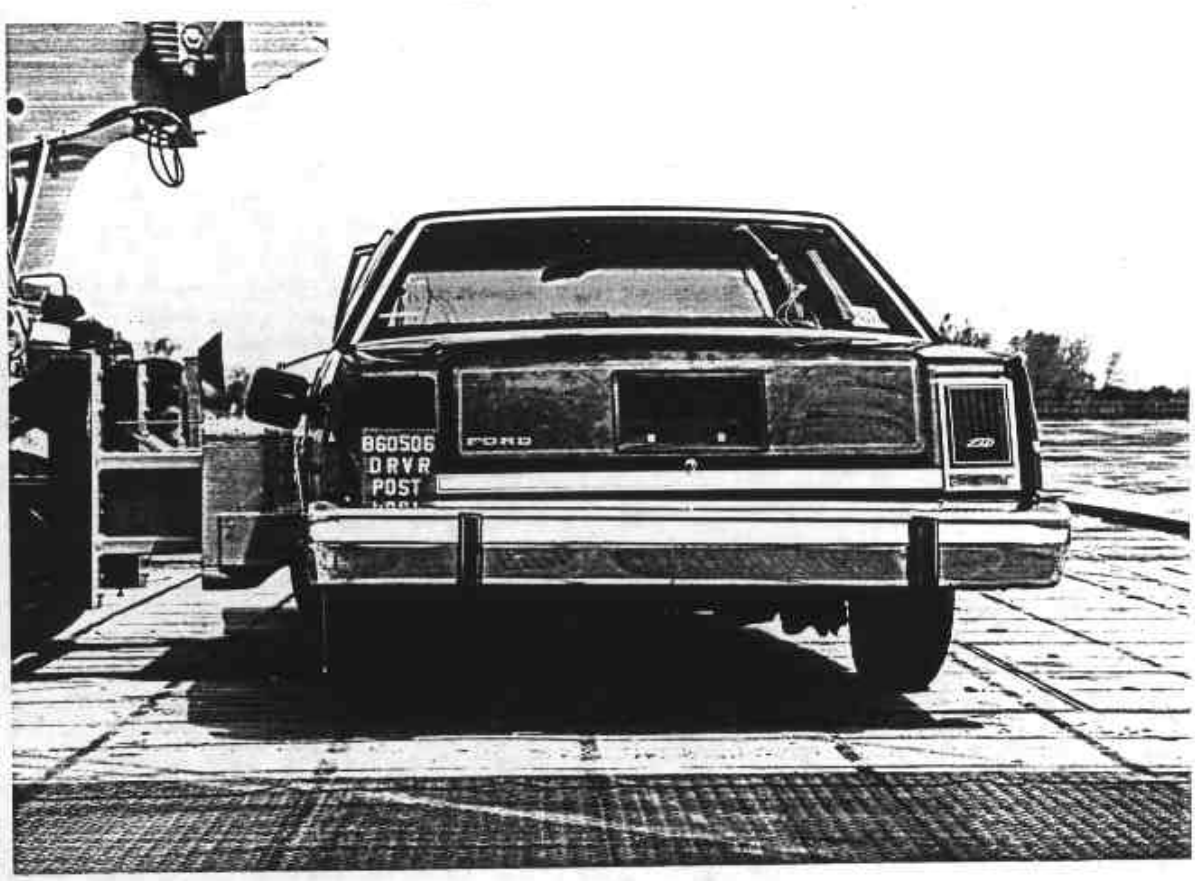


Figure A-6. POST-TEST REAR VIEW

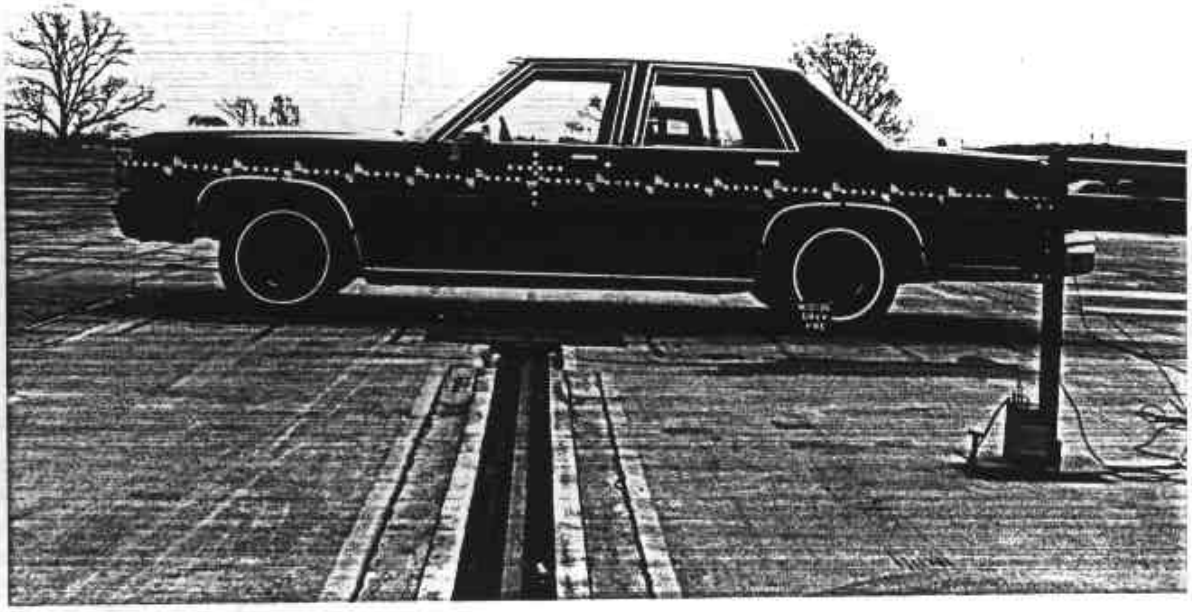


Figure A-7. PRE-TEST DRIVER SIDE VIEW

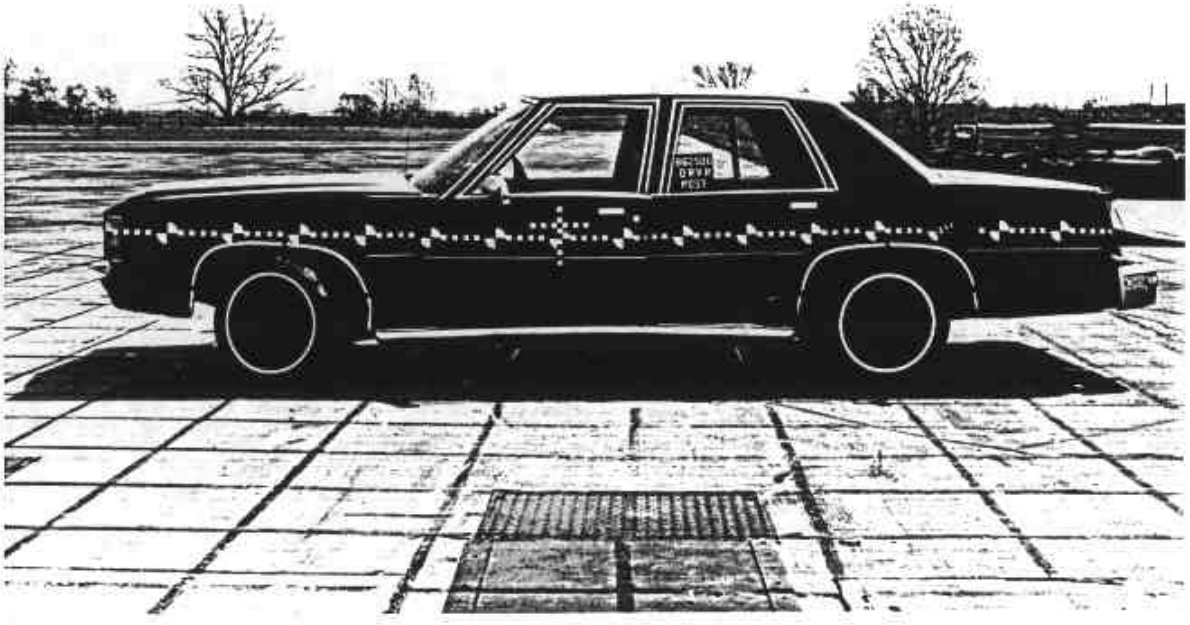


Figure A-8. POST-TEST DRIVER SIDE VIEW

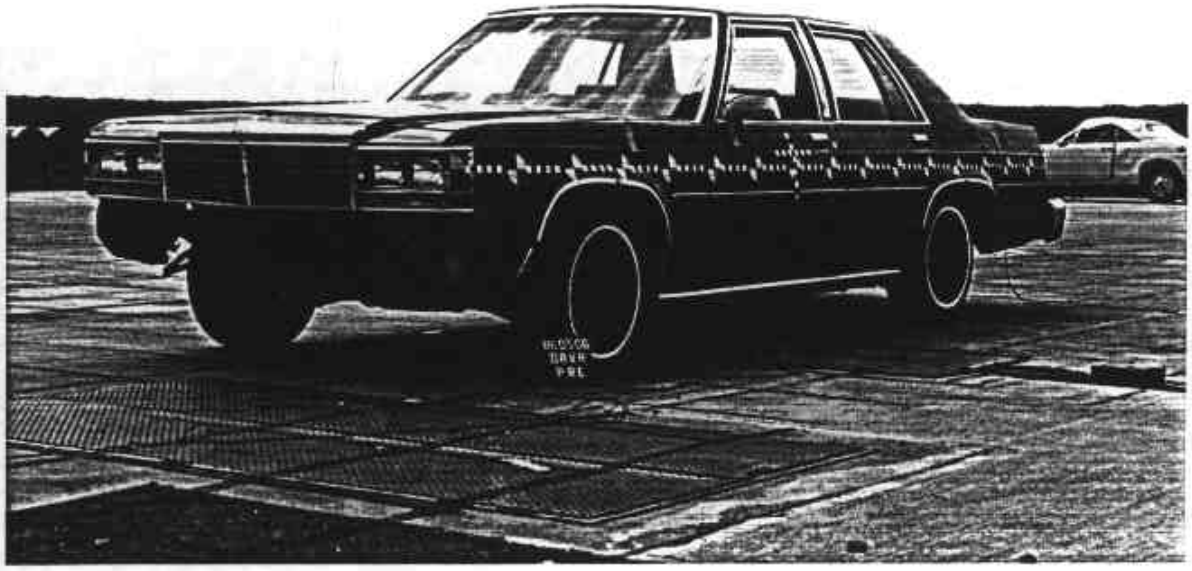


Figure A-9. PRE-TEST DRIVER FRONT THREE-QUARTER VIEW

Figure A-10. POST-TEST DRIVER FRONT THREE-QUARTER VIEW

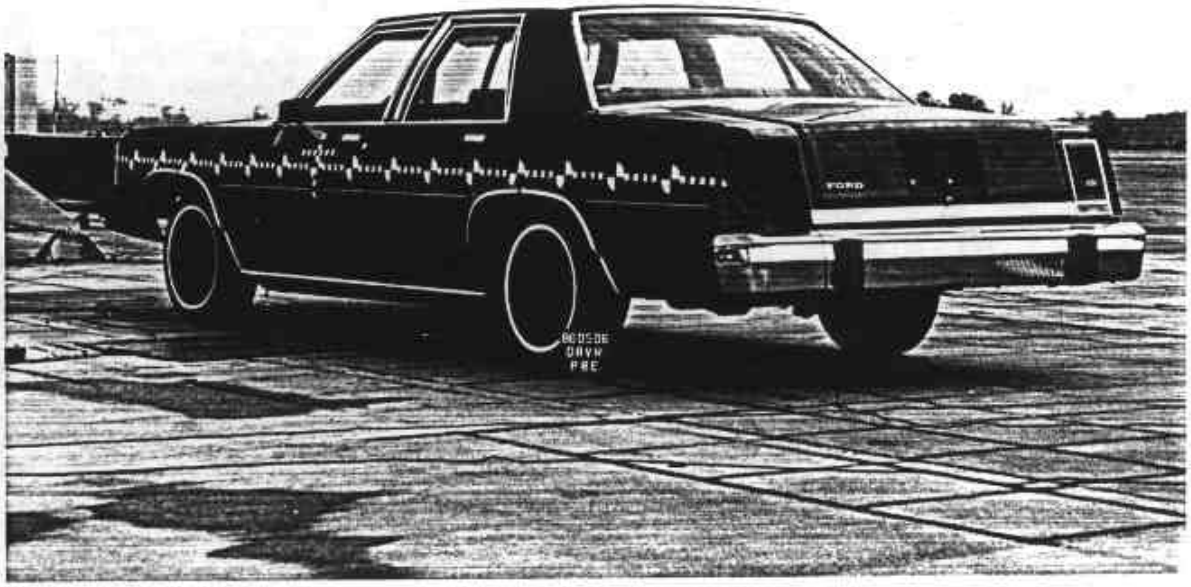


Figure A-11. PRE-TEST DRIVER REAR THREE-QUARTER VIEW

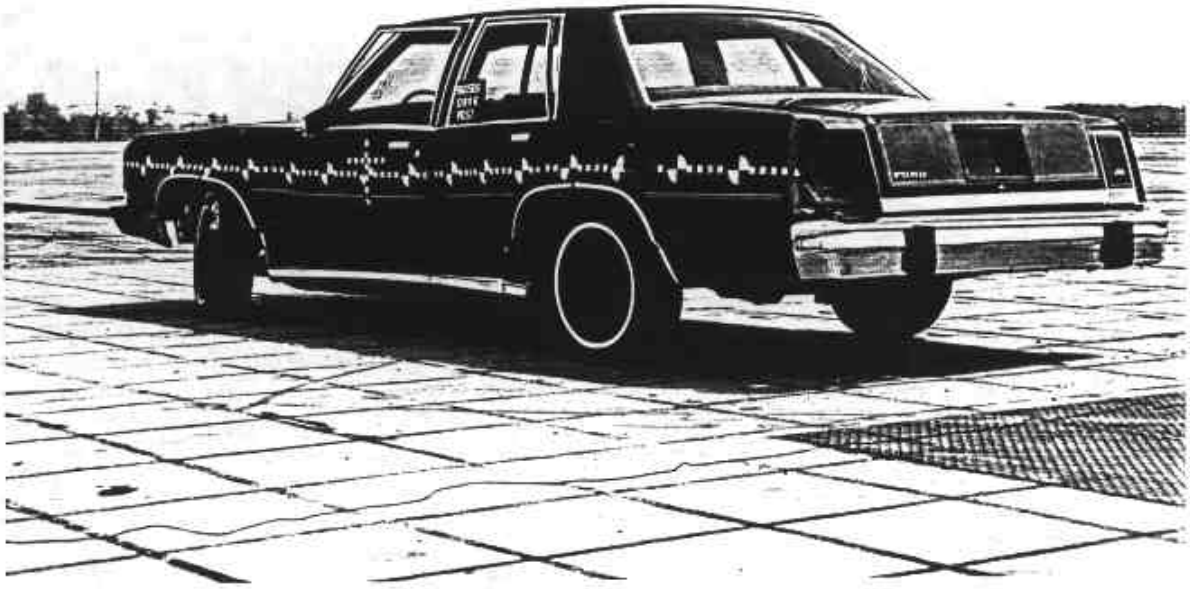


Figure A-12. POST-TEST DRIVER REAR THREE-QUARTER VIEW

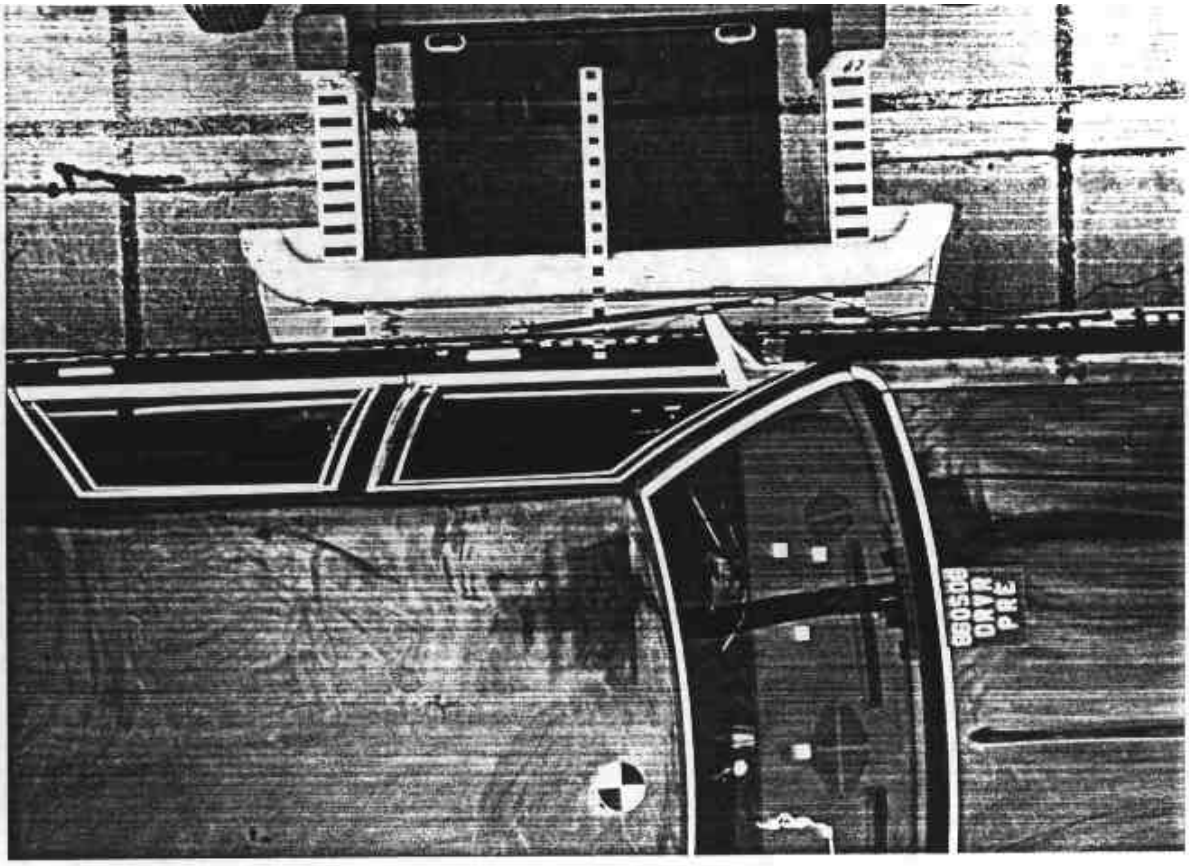


Figure A-13. PRE-TEST OVERHEAD VIEW

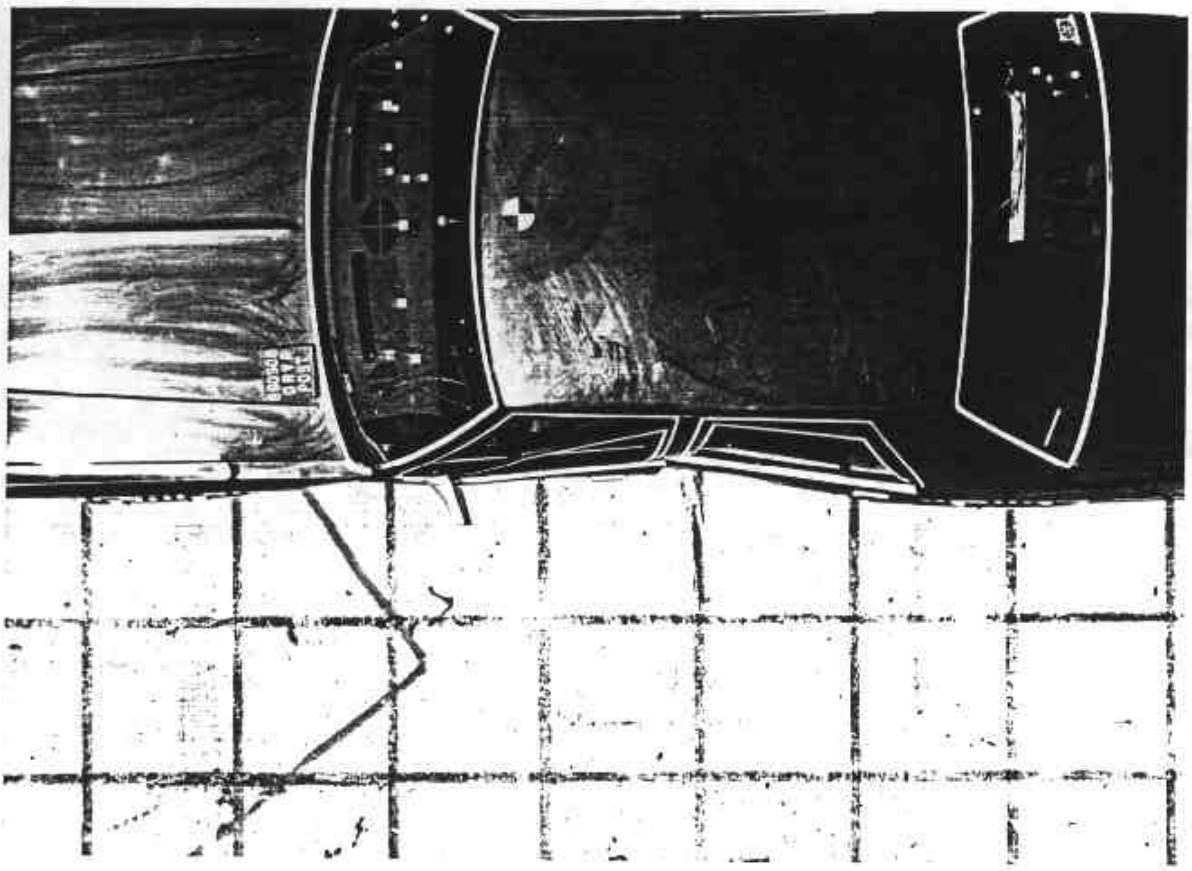


Figure A-14. POST-TEST OVERHEAD VIEW

Figure A-15. POST-TEST OVERALL VIEW

Figure A-16. POST-TEST DRIVER SIDE VIEW

APPENDIX B

PHOTOGRAPHS

TEST #2 VEHICLE WAS IMPACTED PERPENDICULAR ON THE RIGHT SIDE HIGH SPEED.

Figure B-1. PRE-TEST FRONT VIEW

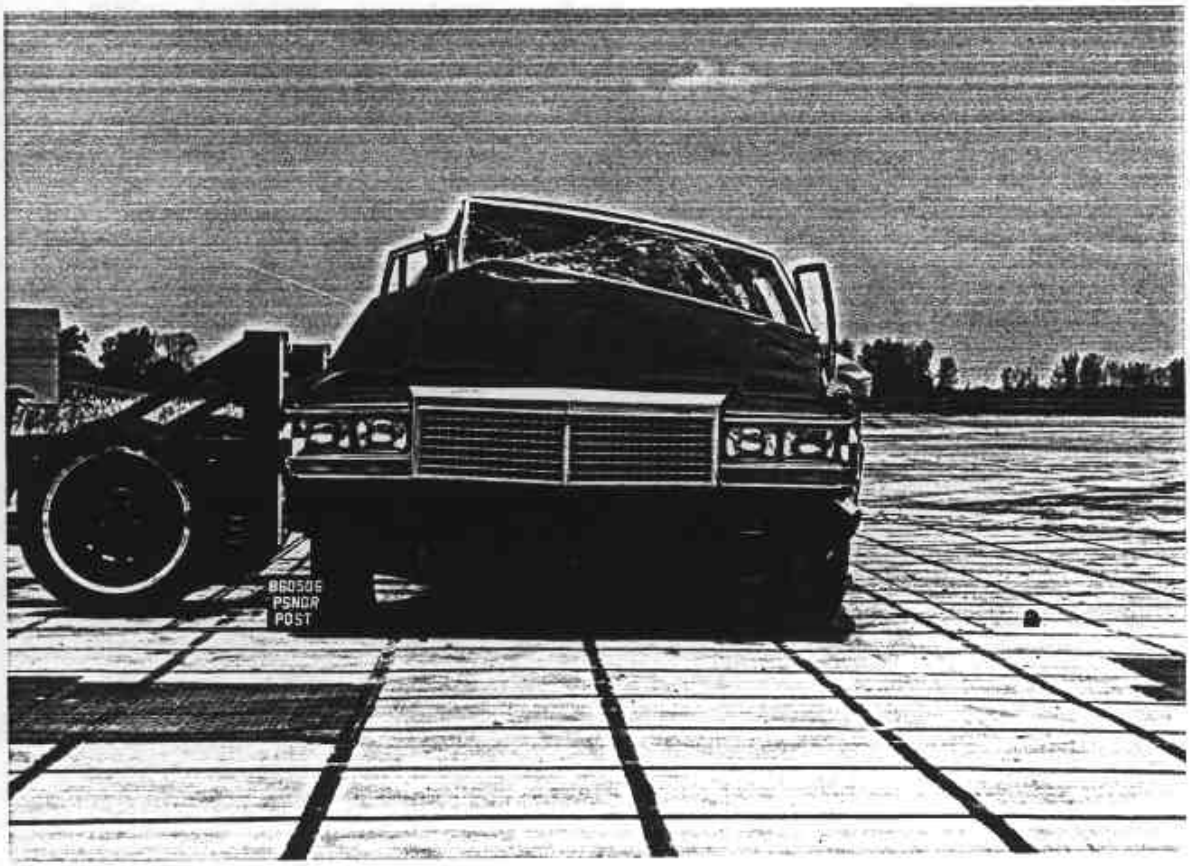


Figure B-2. POST-TEST FRONT VIEW

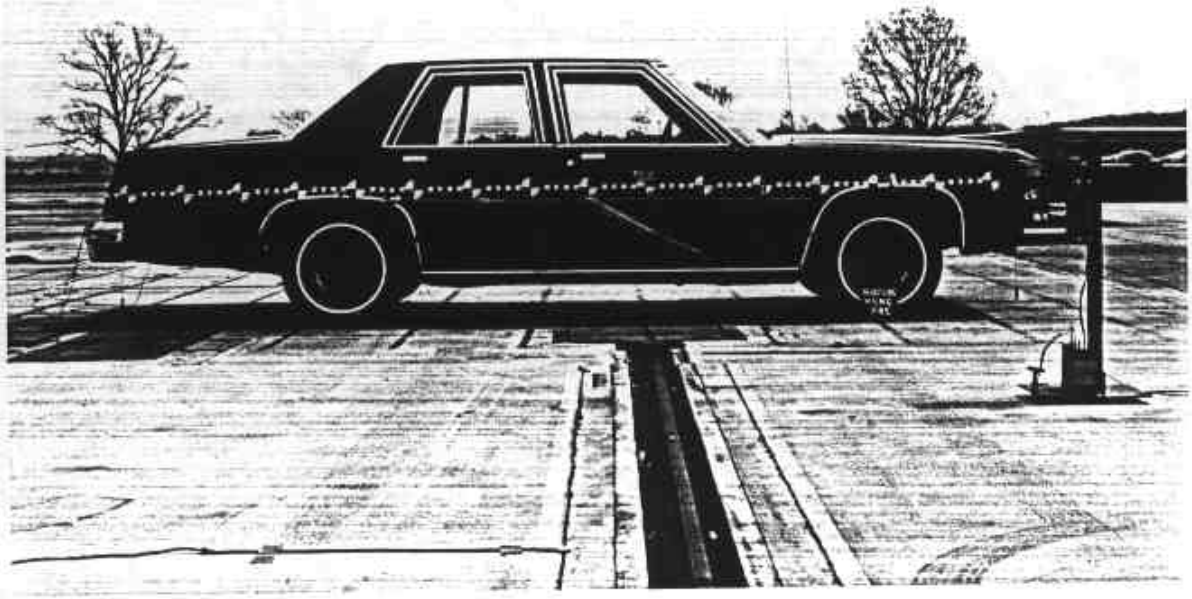


Figure B-3. PRE-TEST PASSENGER SIDE VIEW

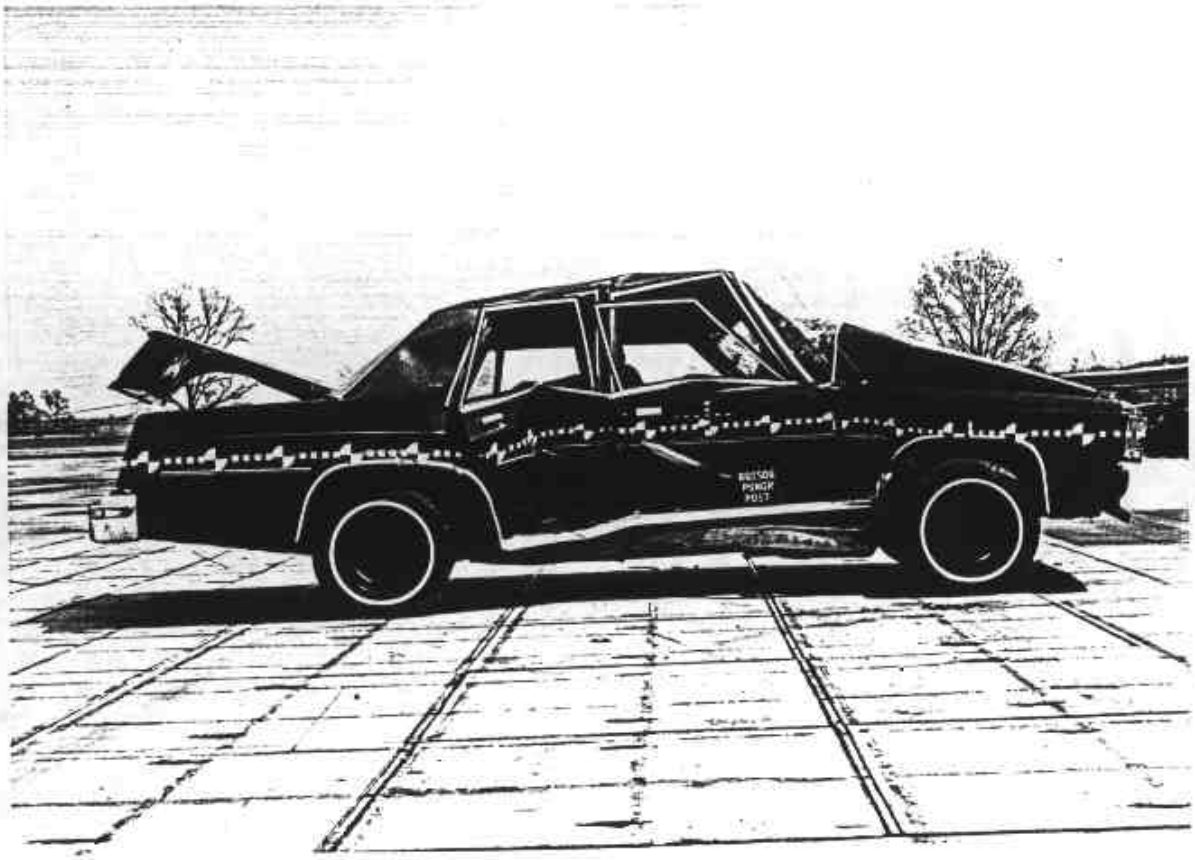


Figure B-4. POST-TEST PASSENGER SIDE VIEW

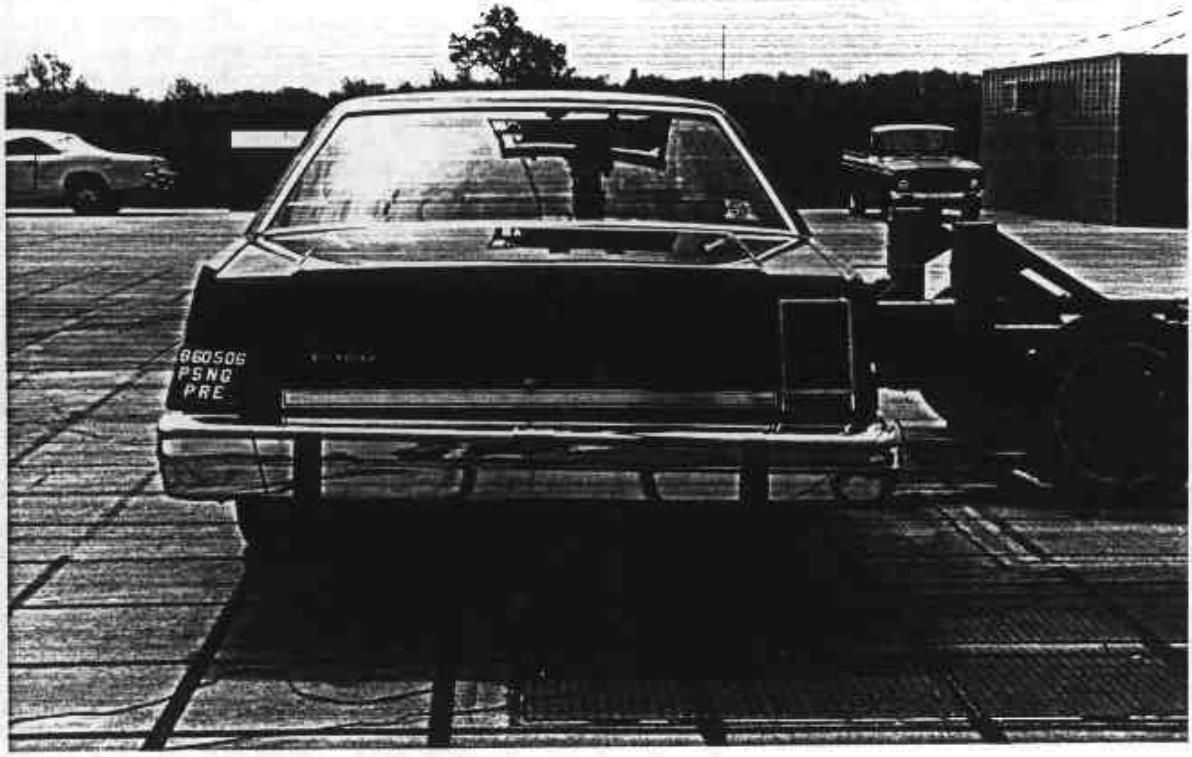


Figure B-5. PRE-TEST REAR VIEW

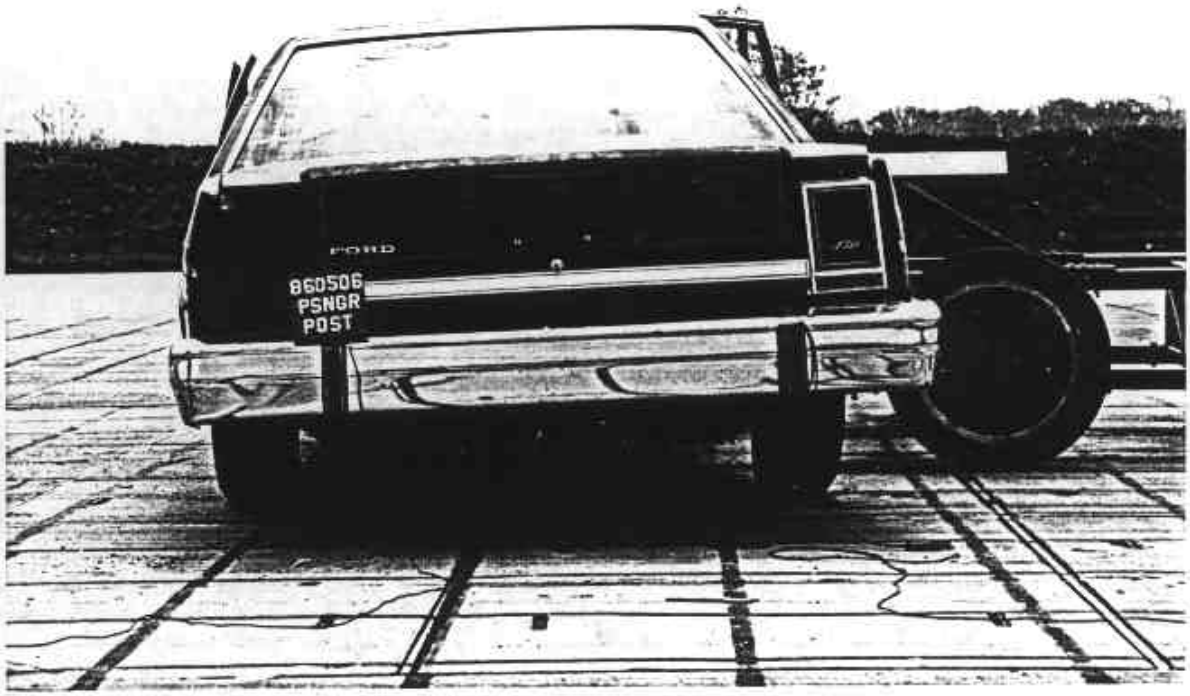


Figure B-6. POST-TEST REAR VIEW

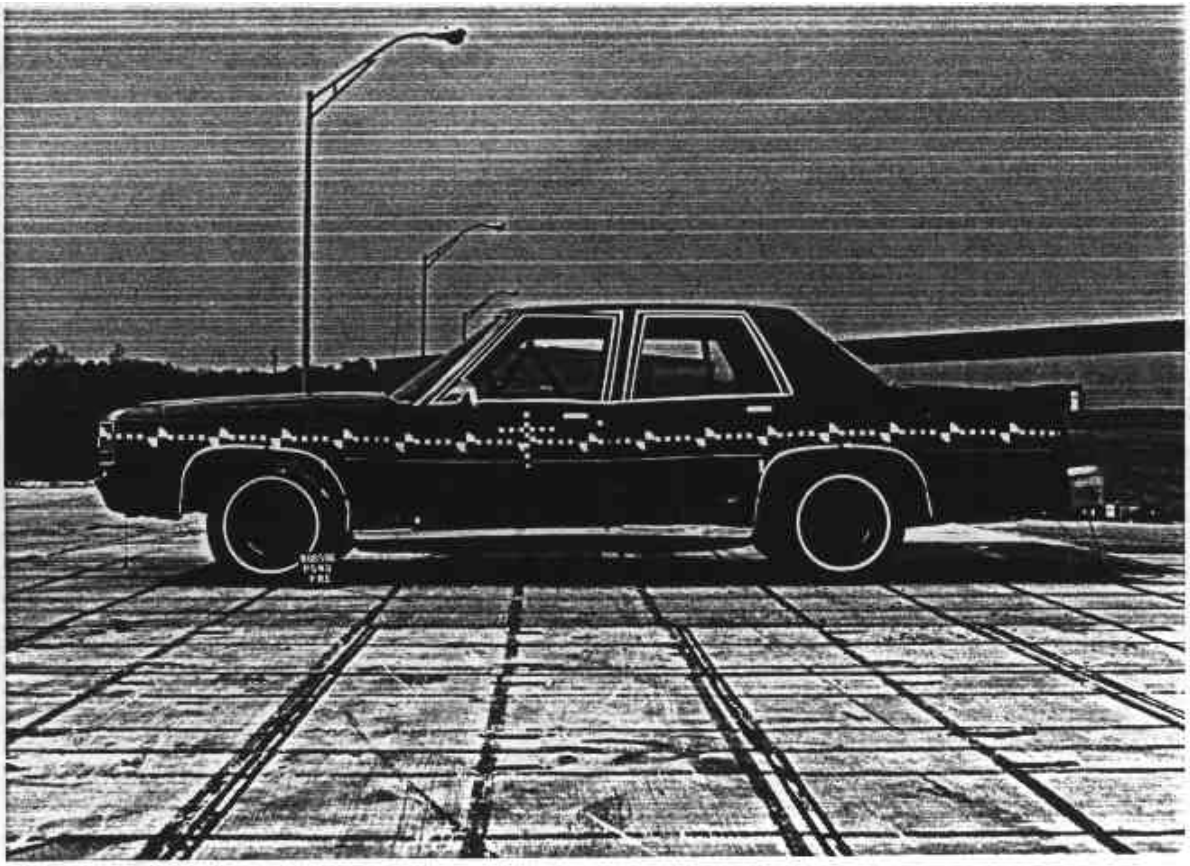


Figure B-7. PRE-TEST DRIVER SIDE VIEW

Figure B-8. POST-TEST DRIVER SIDE VIEW

Figure B-9. PRE-TEST DRIVER FRONT THREE-QUARTER VIEW

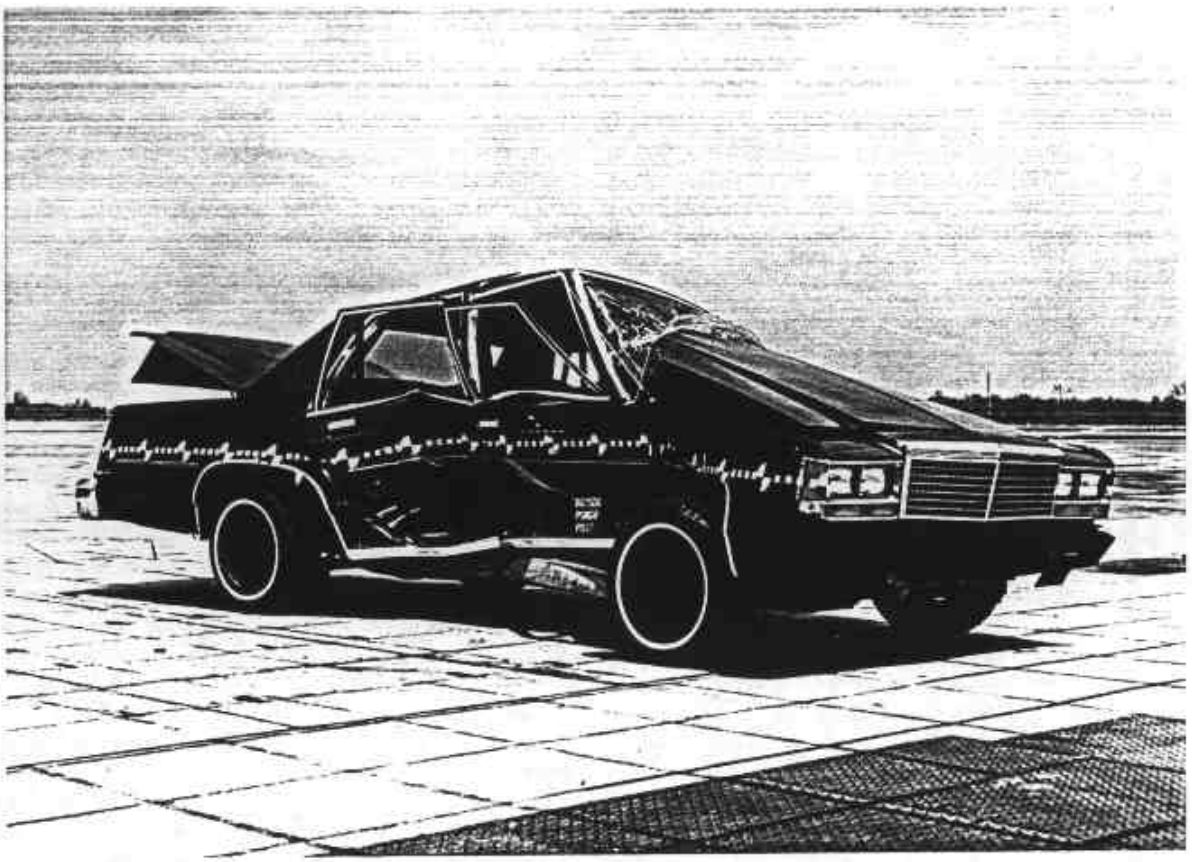


Figure B-10. POST-TEST DRIVER FRONT THREE-QUARTER VIEW

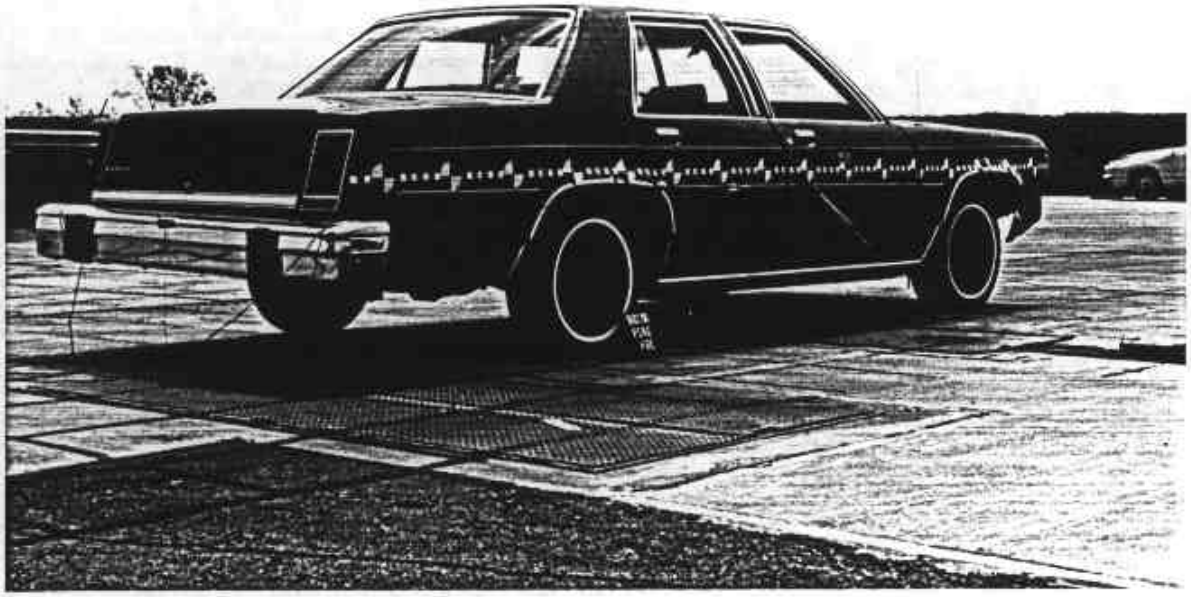


Figure B-11. PRE-TEST DRIVER REAR THREE-QUARTER VIEW

Figure B-12. POST-TEST DRIVER REAR THREE-QUARTER VIEW

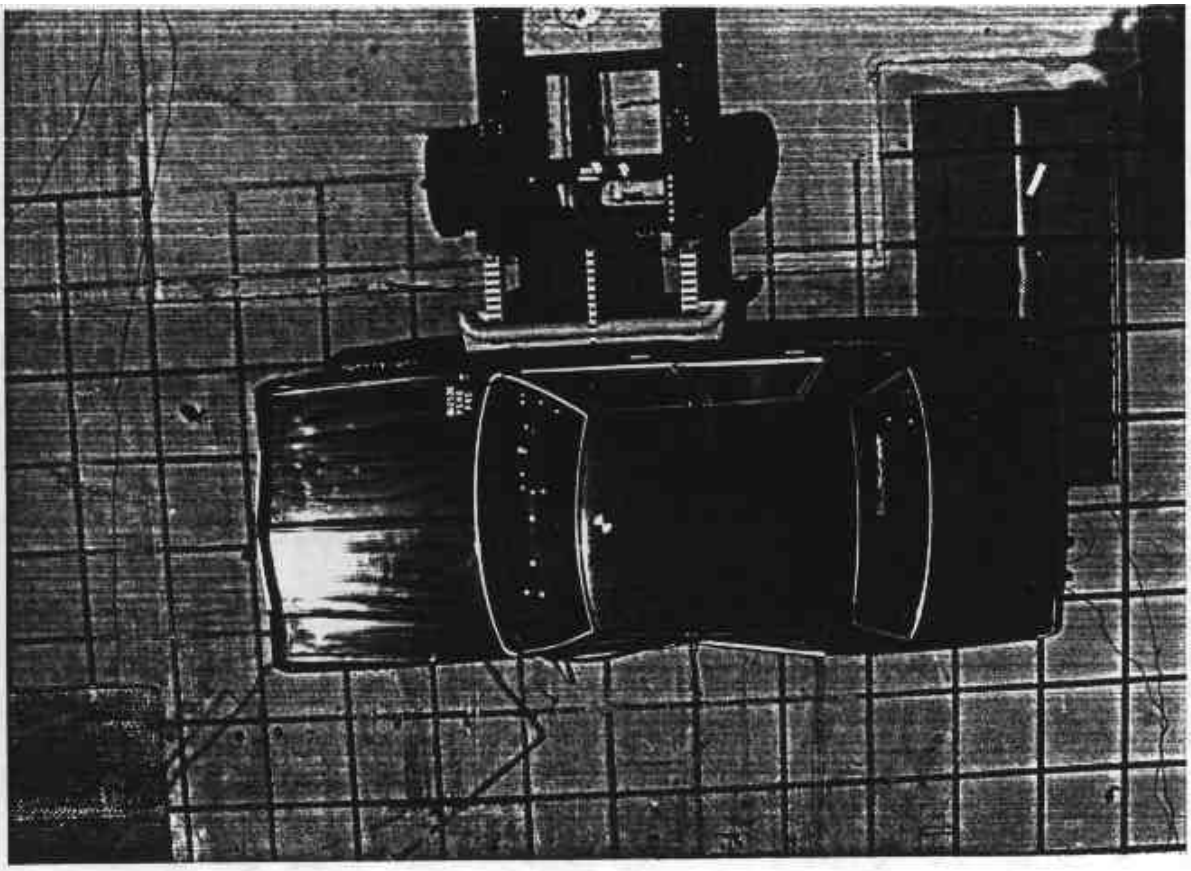


Figure B-13. PRE-TEST OVERHEAD VIEW

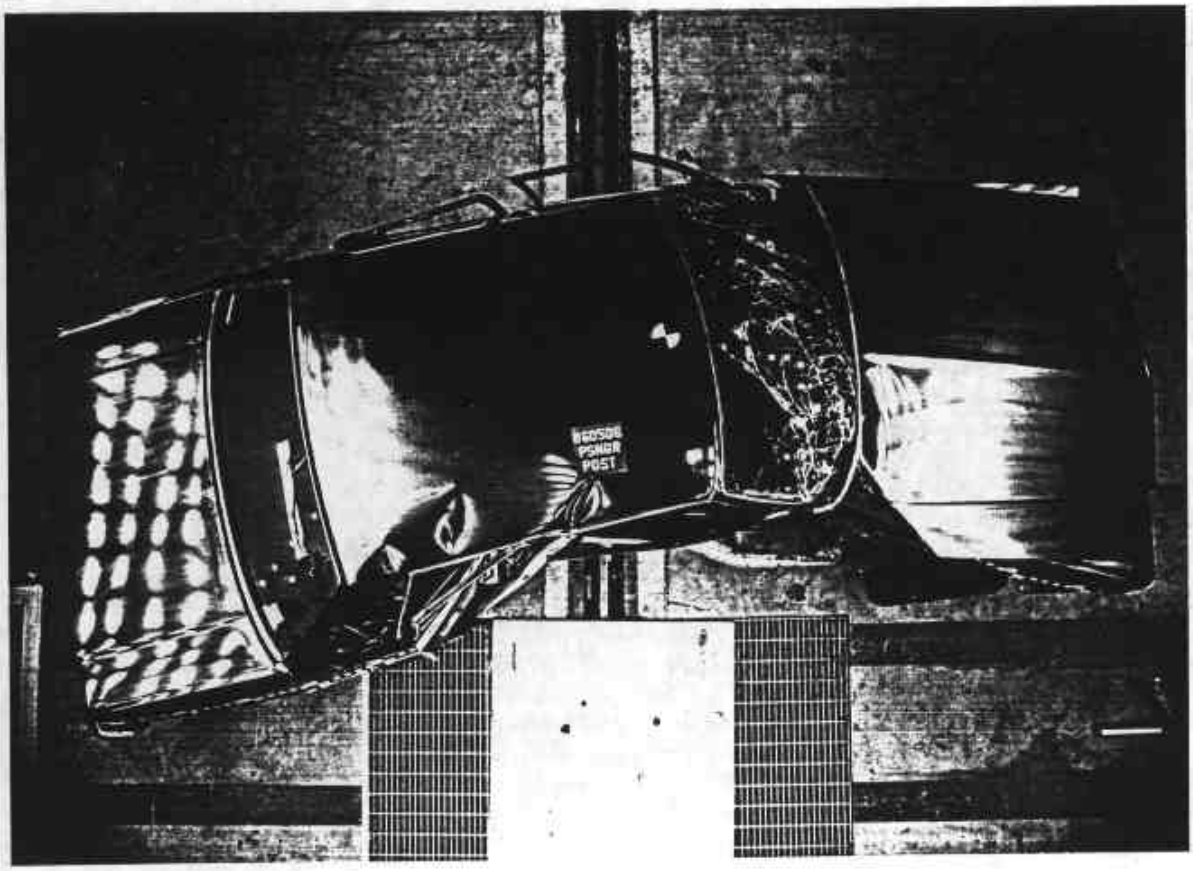


Figure B-14. POST-TEST OVERHEAD VIEW

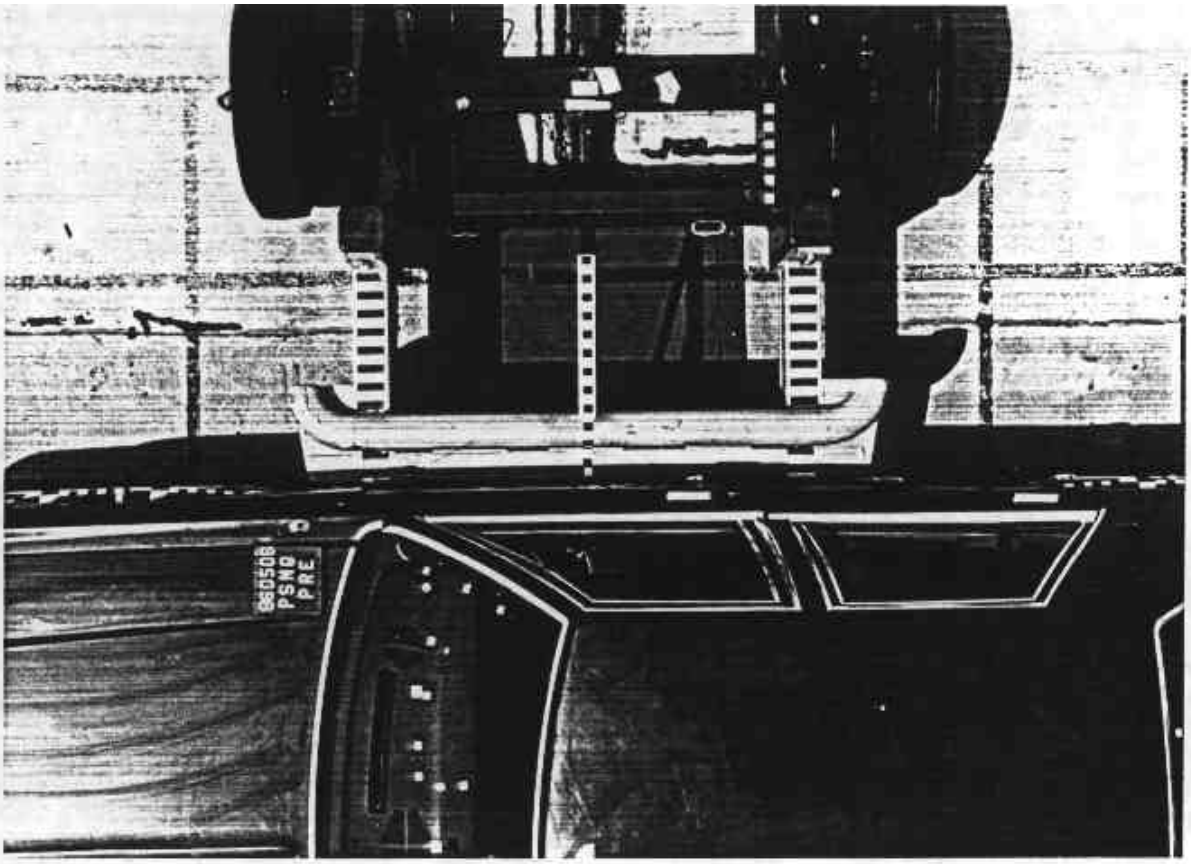


Figure B-15. PRE-TEST CLOSE-UP OVERHEAD VIEW

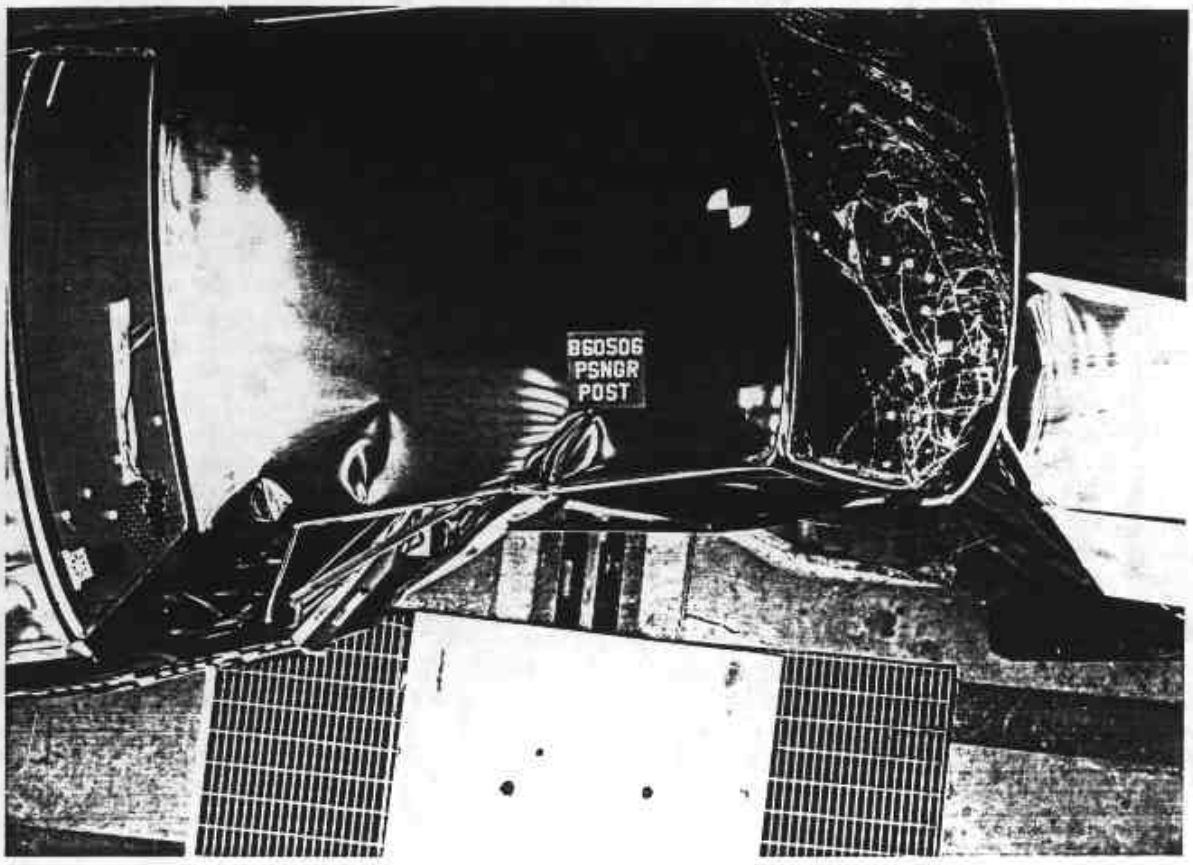


Figure B-16. POST-TEST CLOSE-UP OVERHEAD VIEW

Figure B-17. POST-TEST OVERALL VIEW

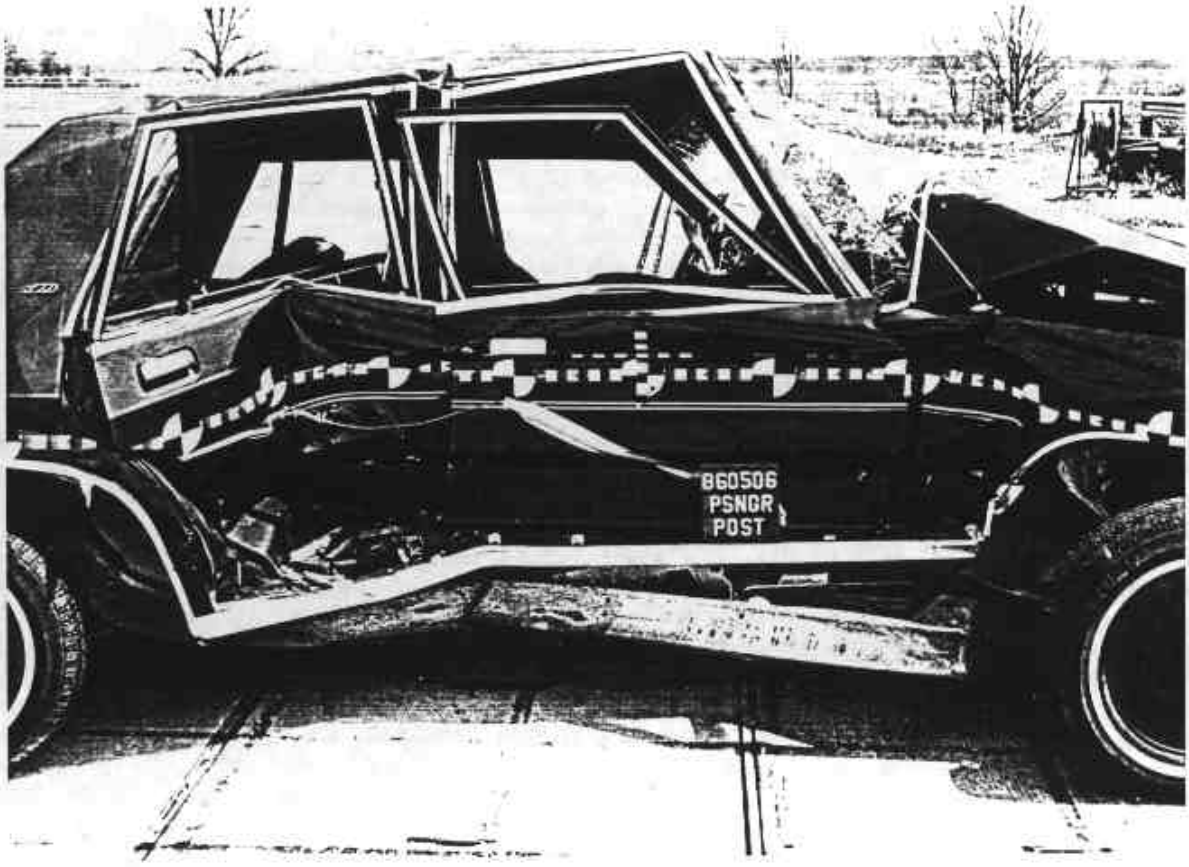


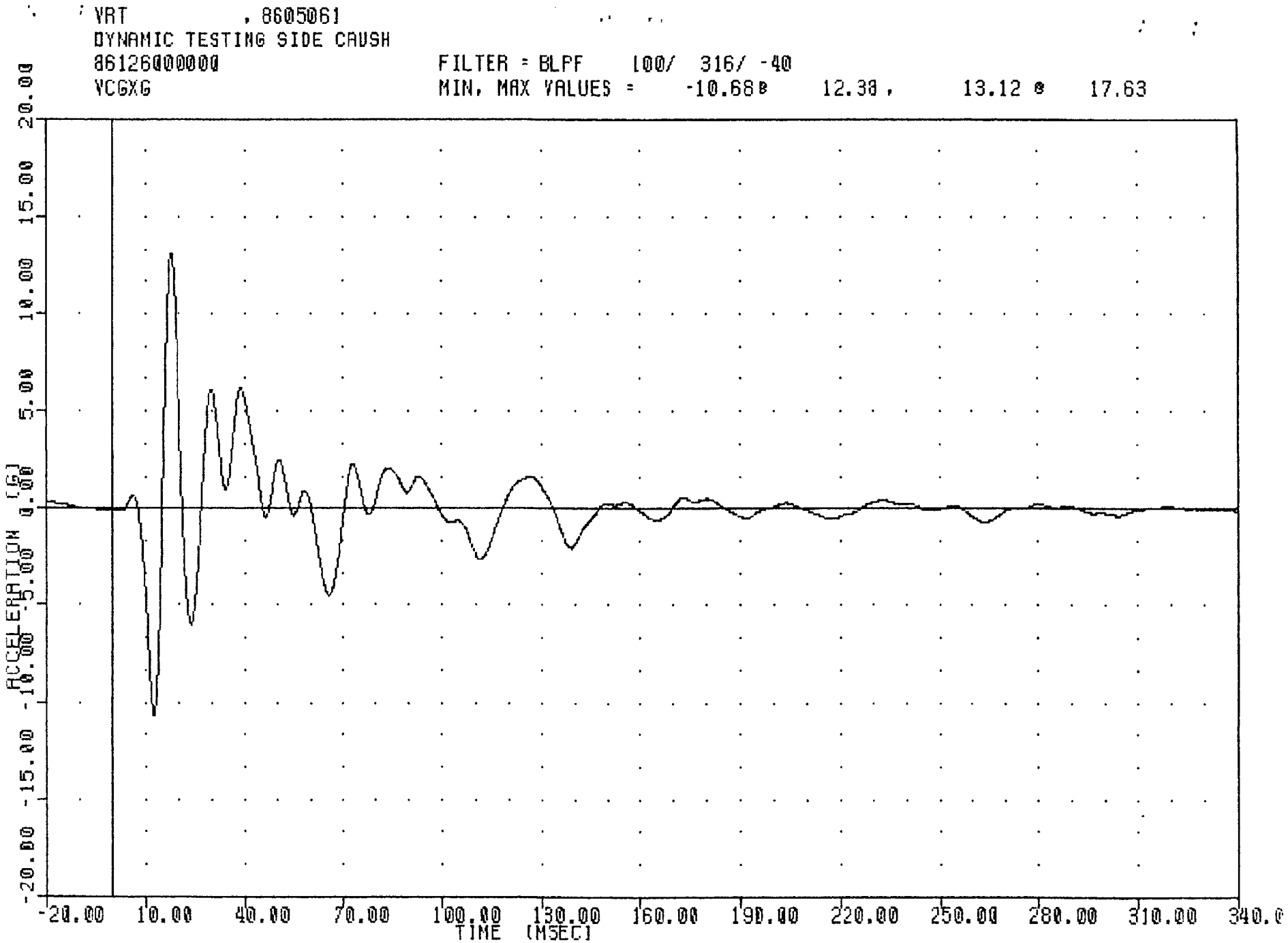
Figure B-18. POST-TEST CLOSE-UP VIEW

APPENDIX C

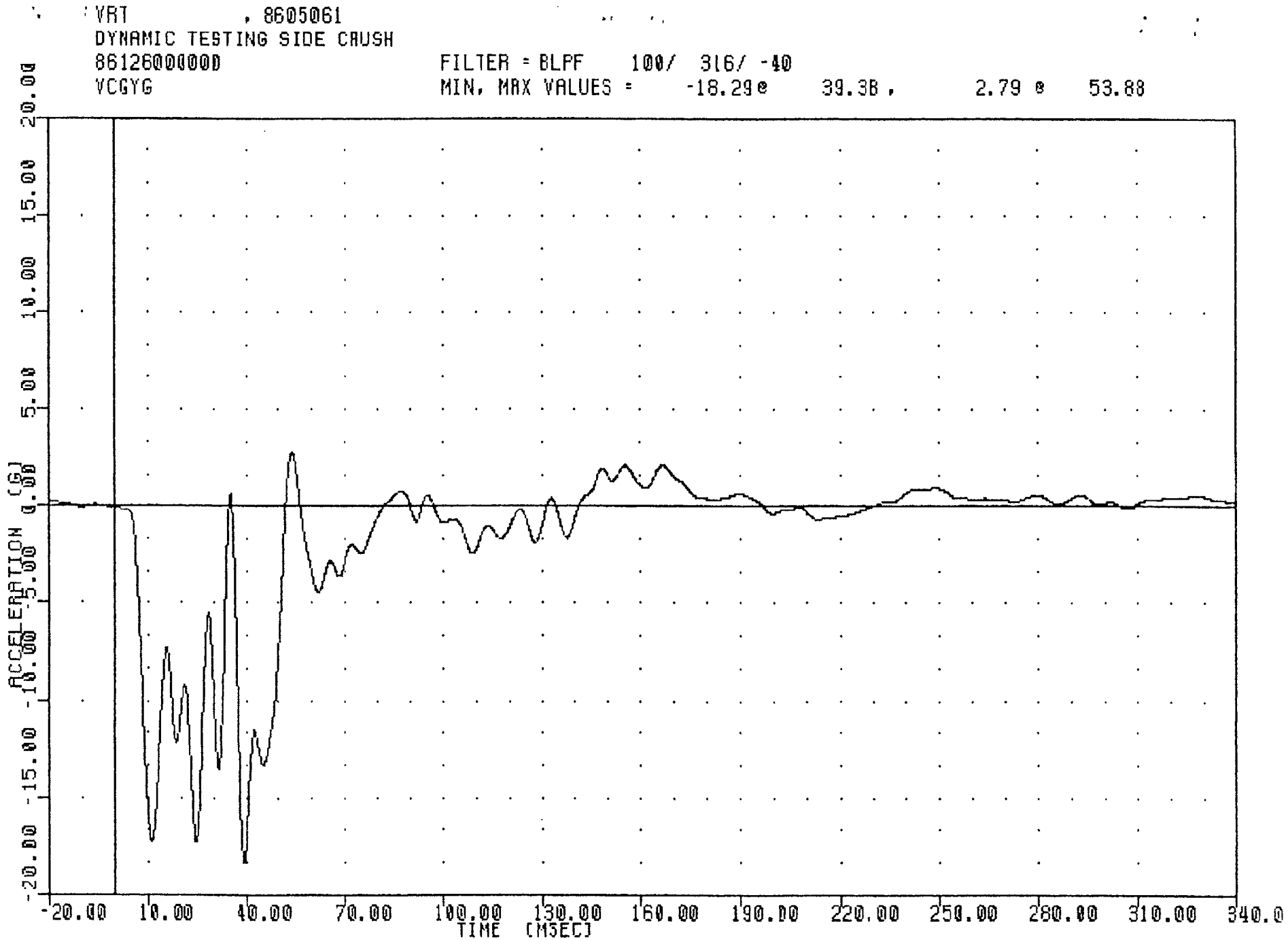
DATA PLOT PRESENTATION

TEST #1 VEHICLE WAS IMPACTED PERPENDICULAR ON THE LEFT SIDE LOW SPEED.

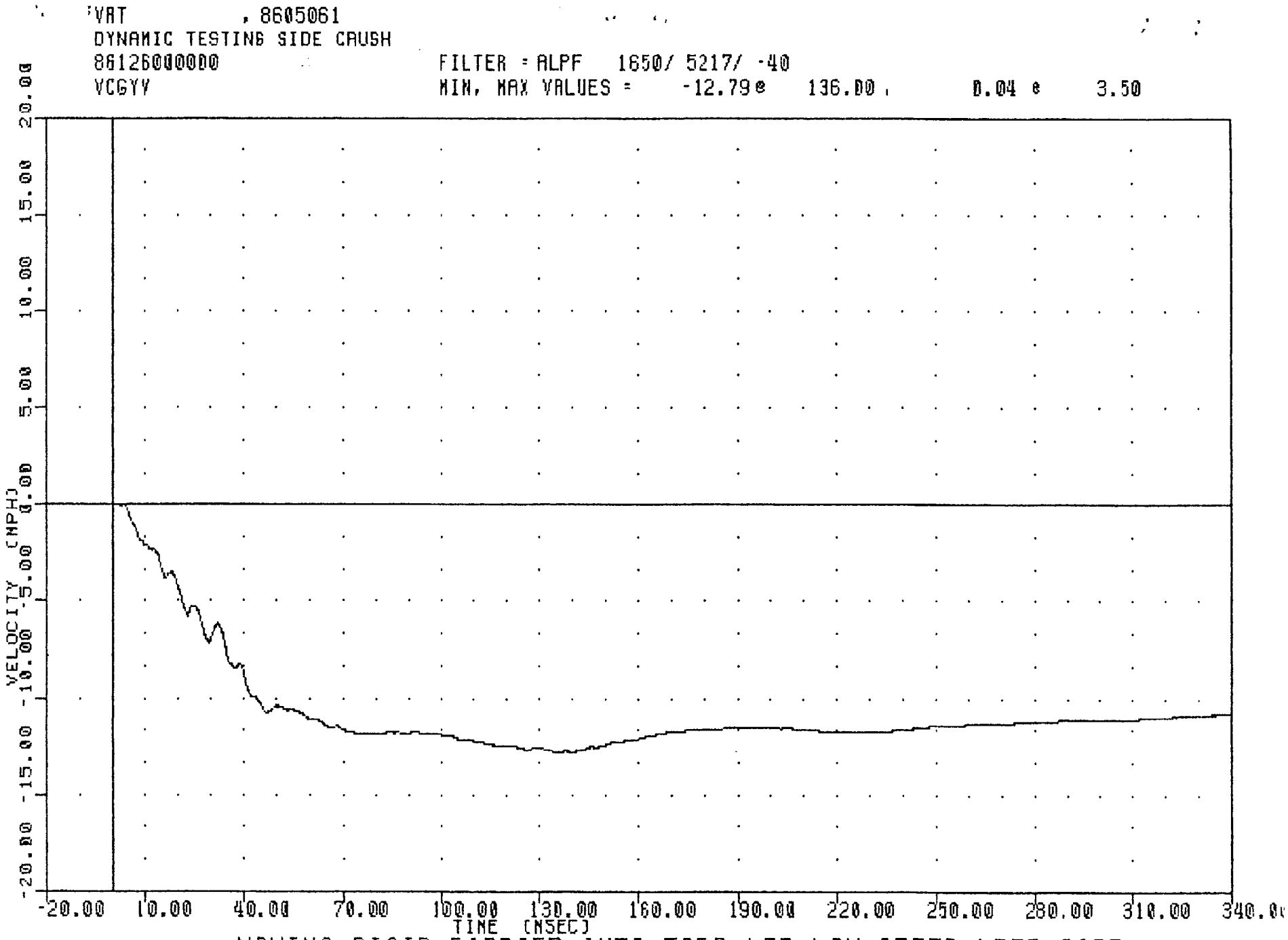
Data plots generated from the crash test data are presented on the following pages. All data are recorded on magnetic tape for inclusion in the NHTSA crash test data base system. All data were filtered according to SAE J211.



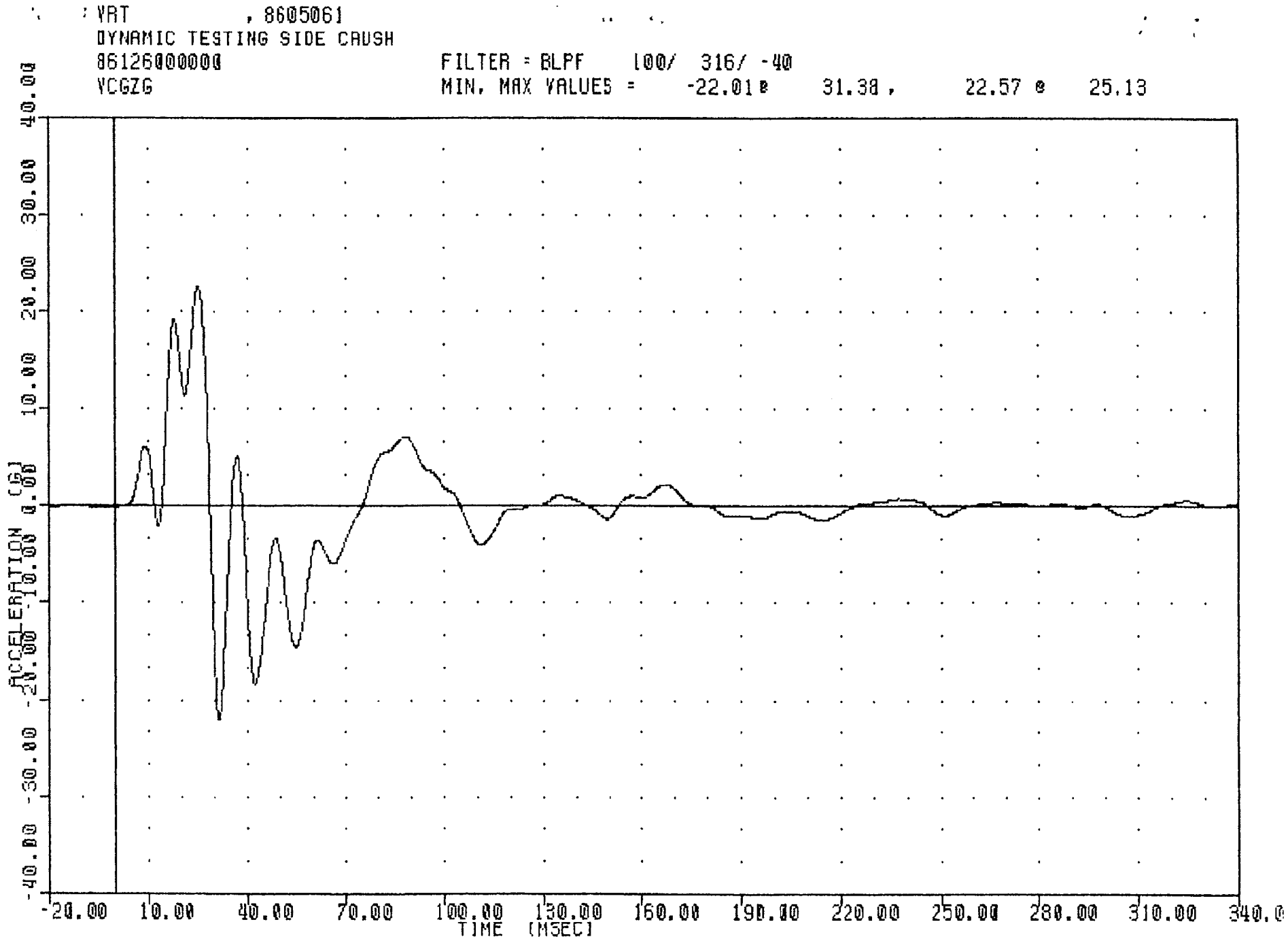
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION X AXIS



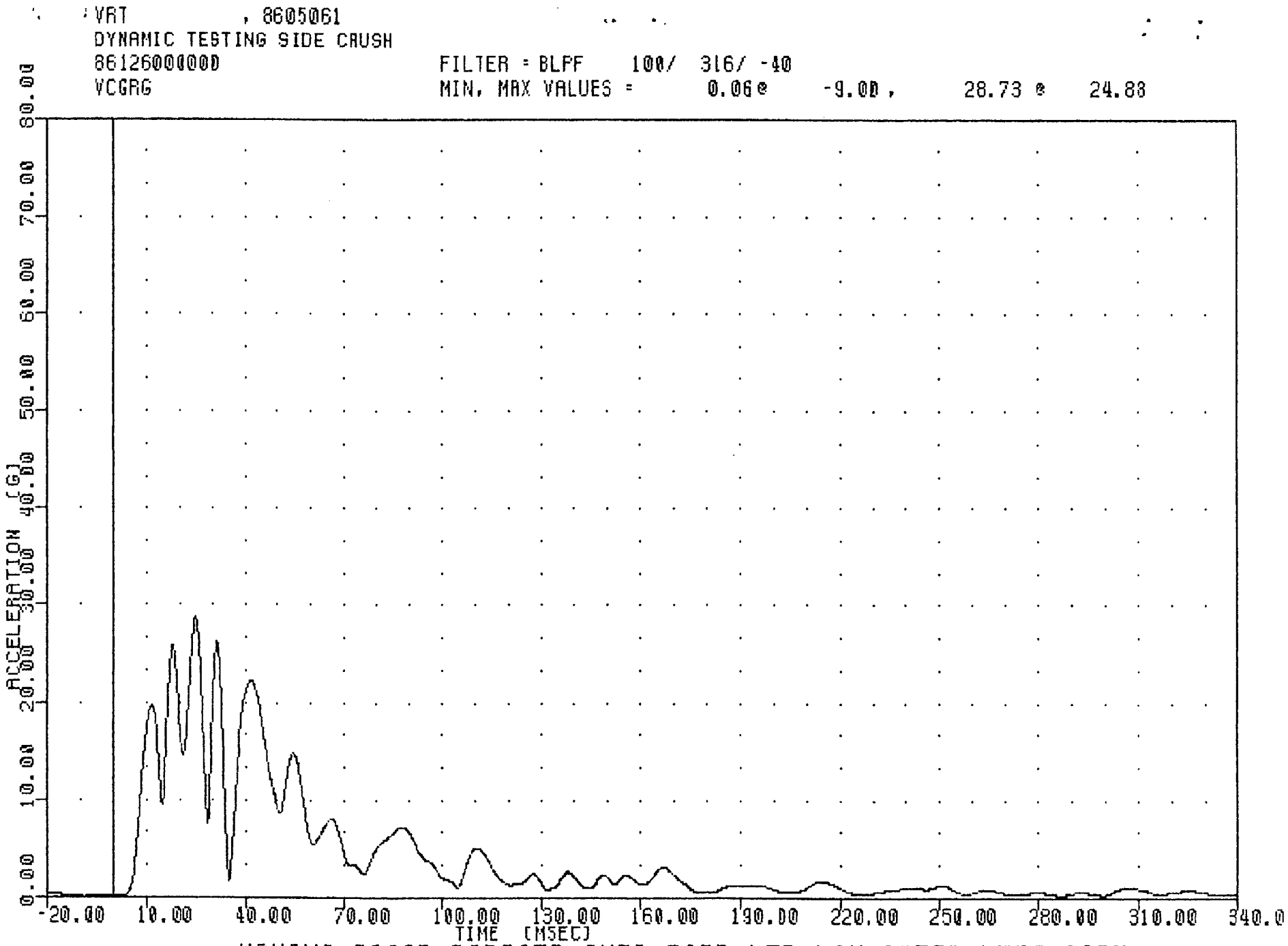
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION Y AXIS



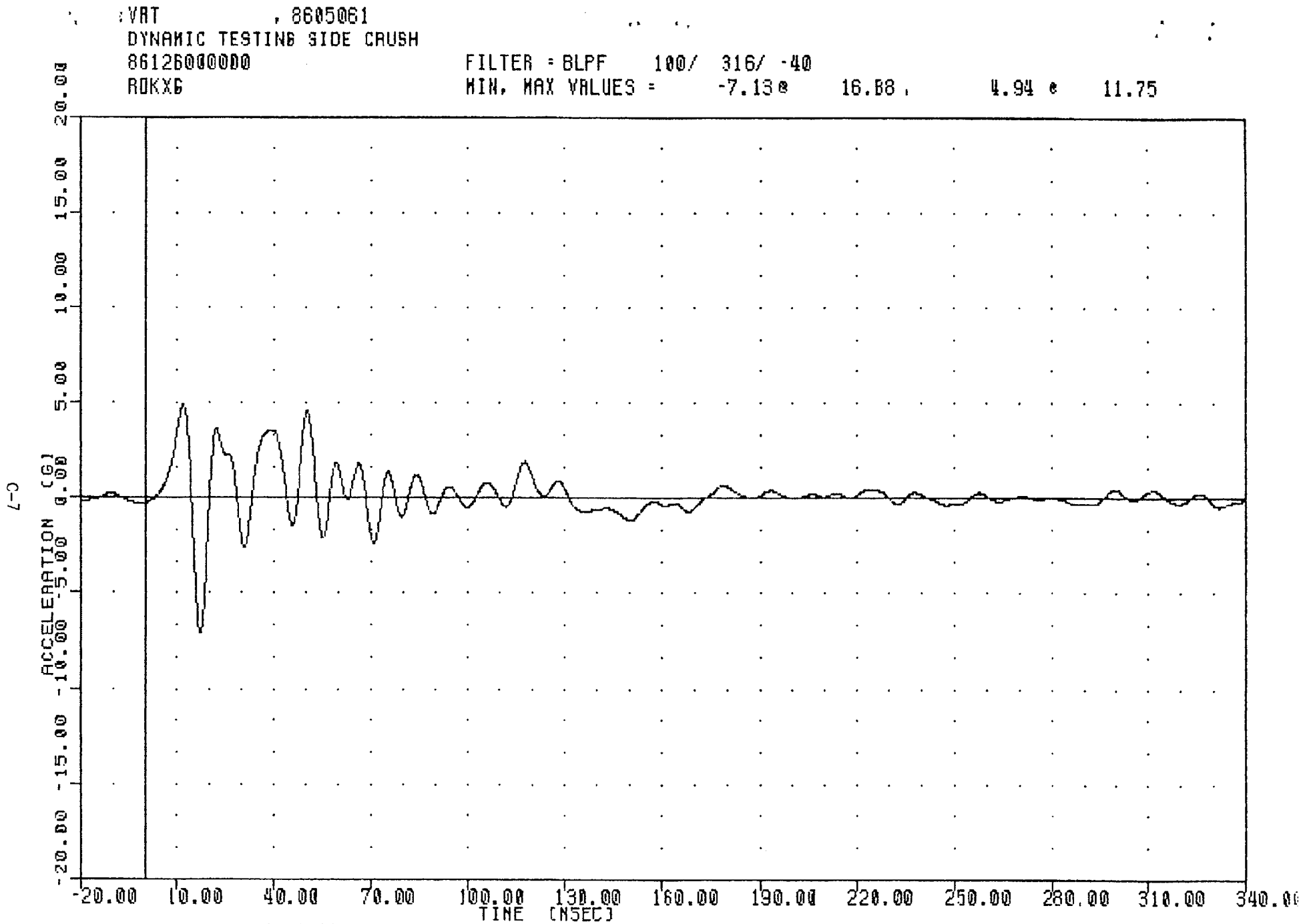
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
DELTA V USING VCGYG



MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION Z AXIS

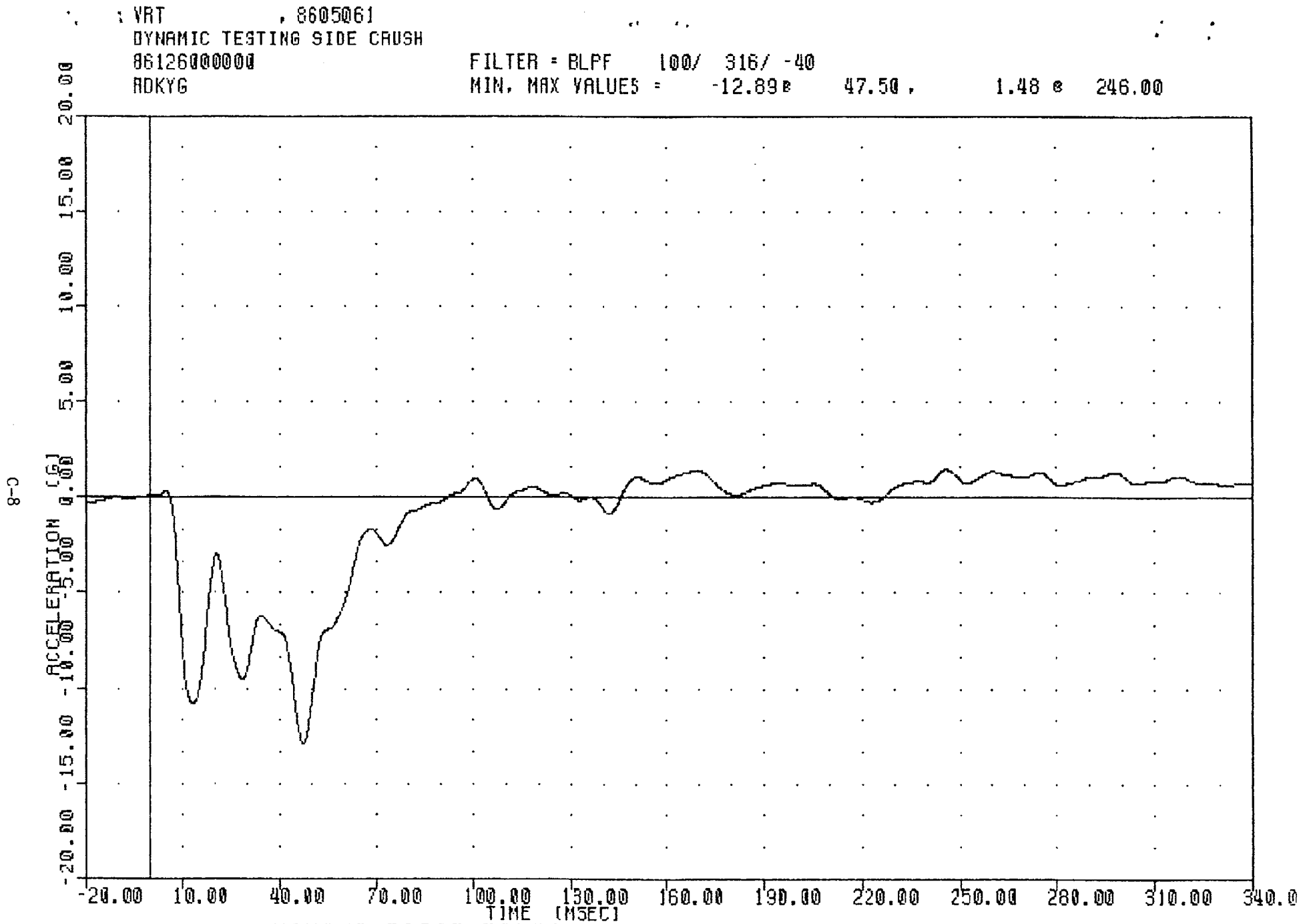


MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION RESULTANT



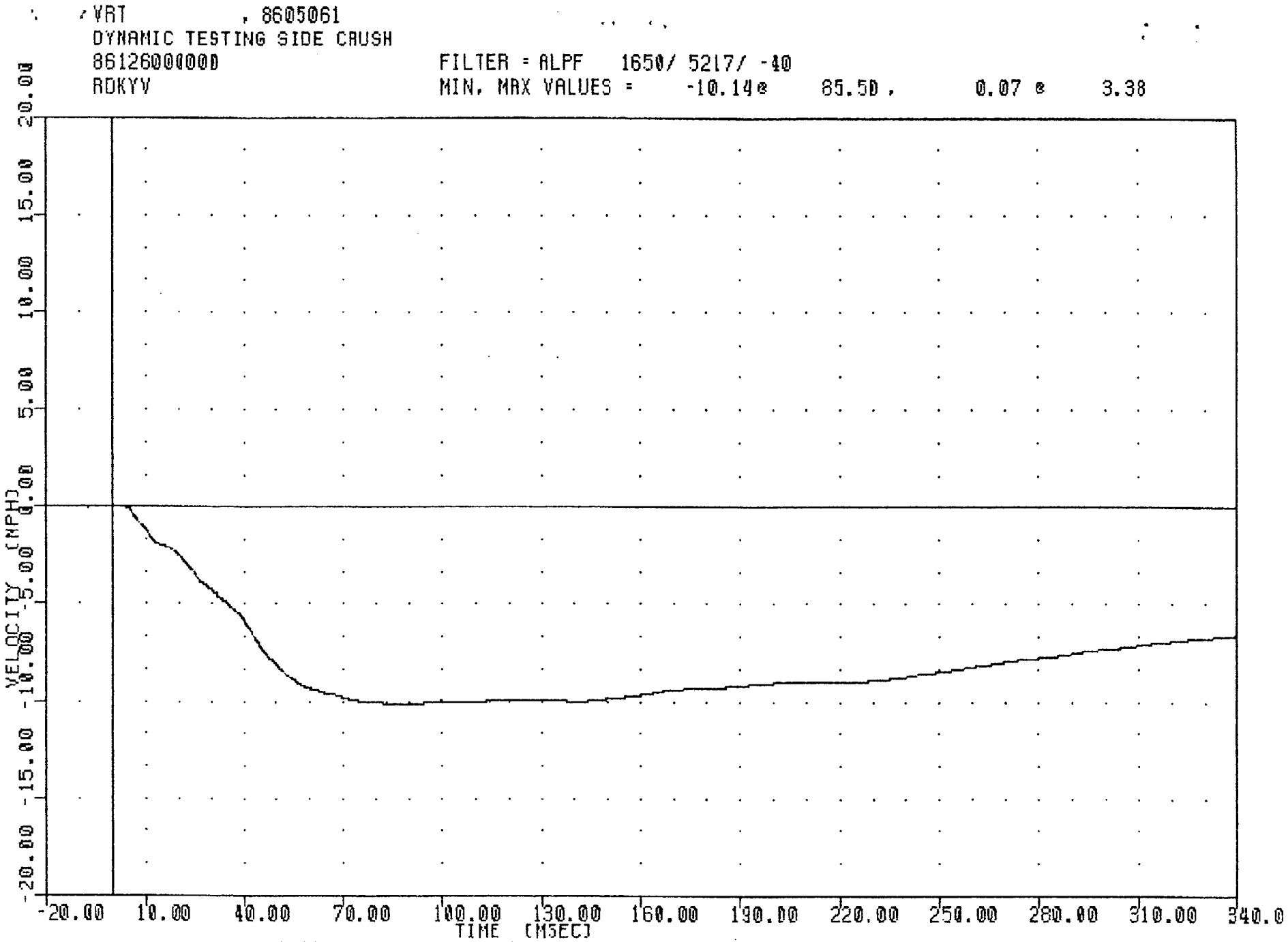
C-7

MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE REAR DECK ACCELERATION X AXIS

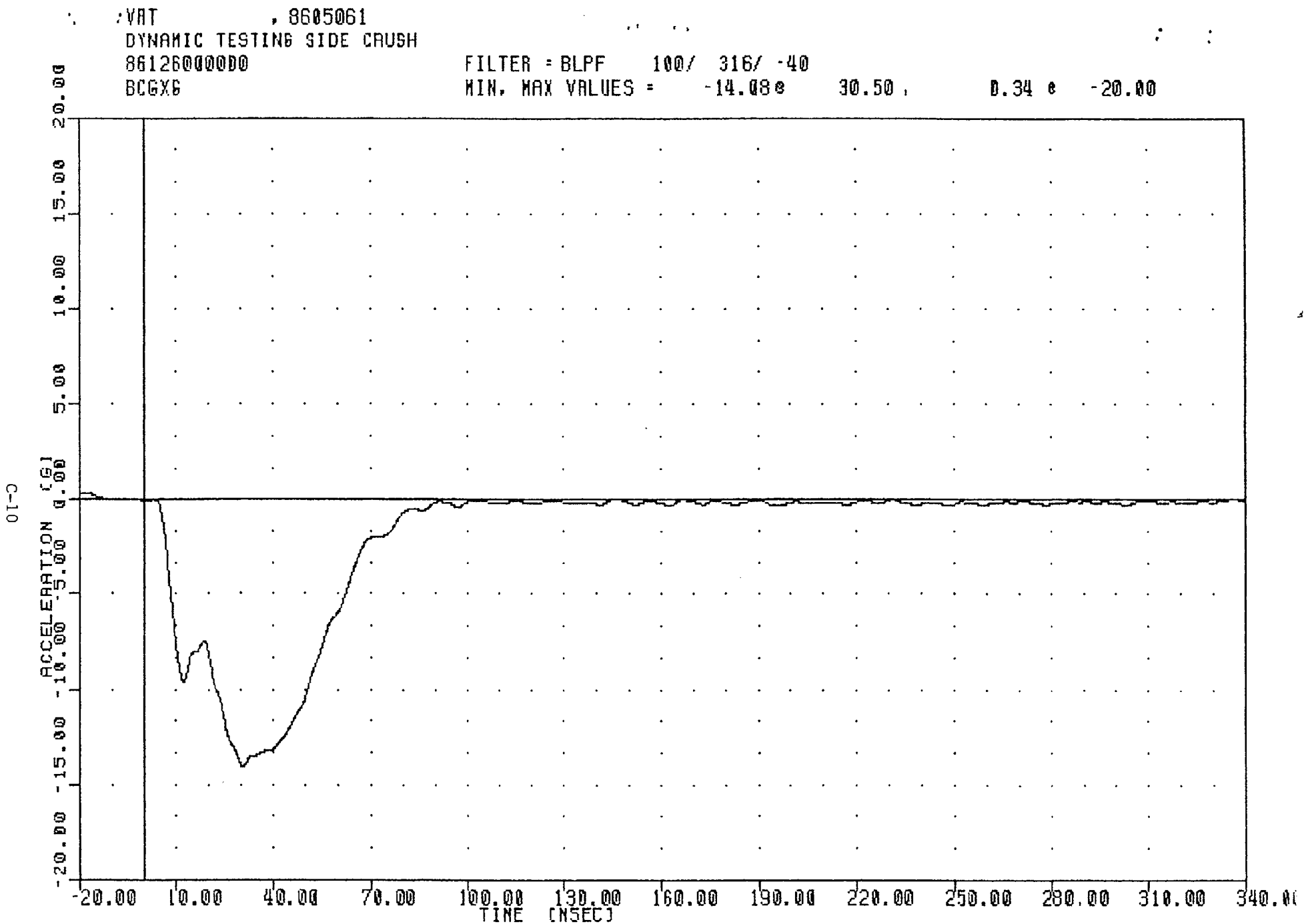


C-8

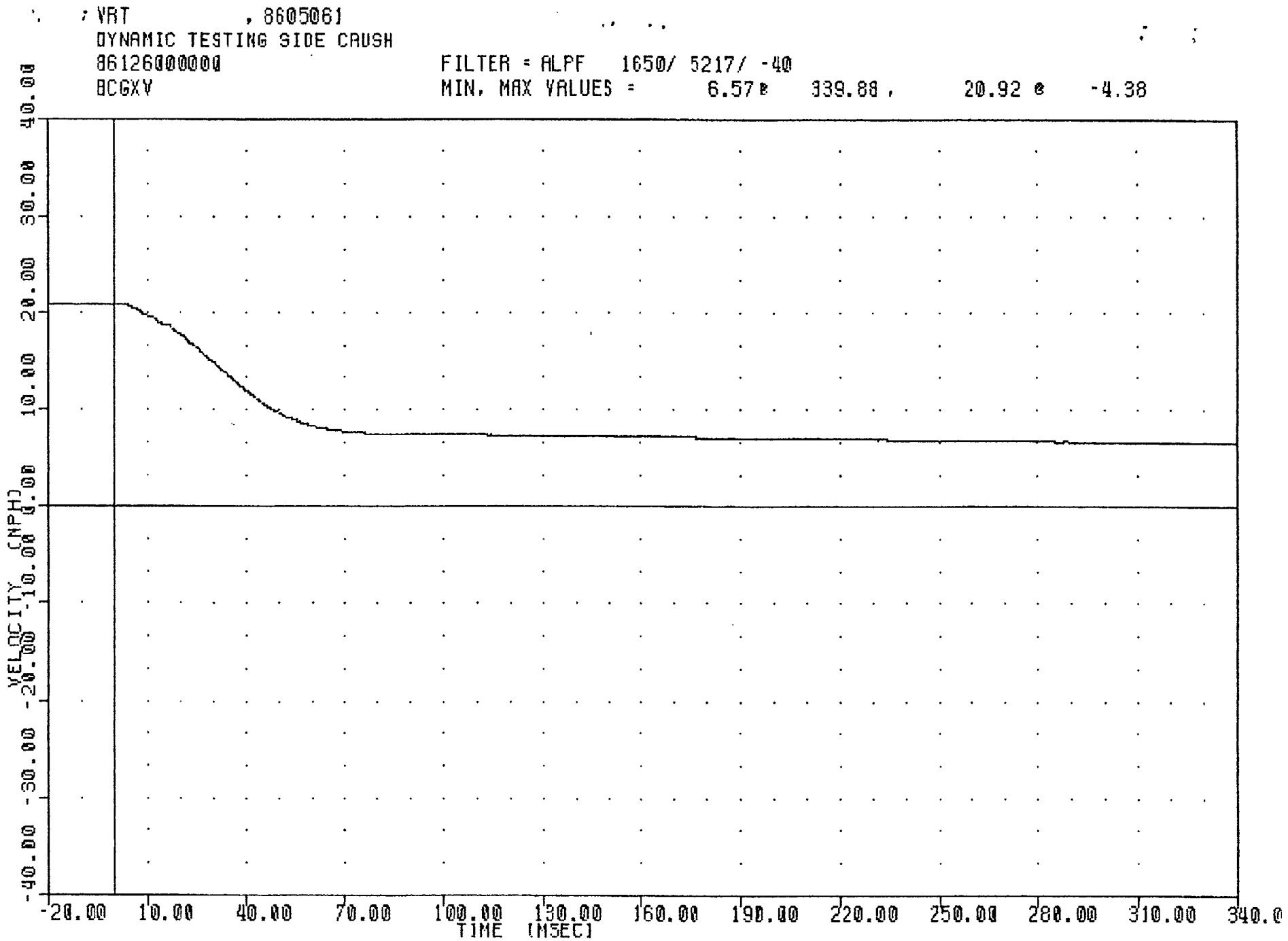
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE REAR DECK ACCELERATION Y AXIS



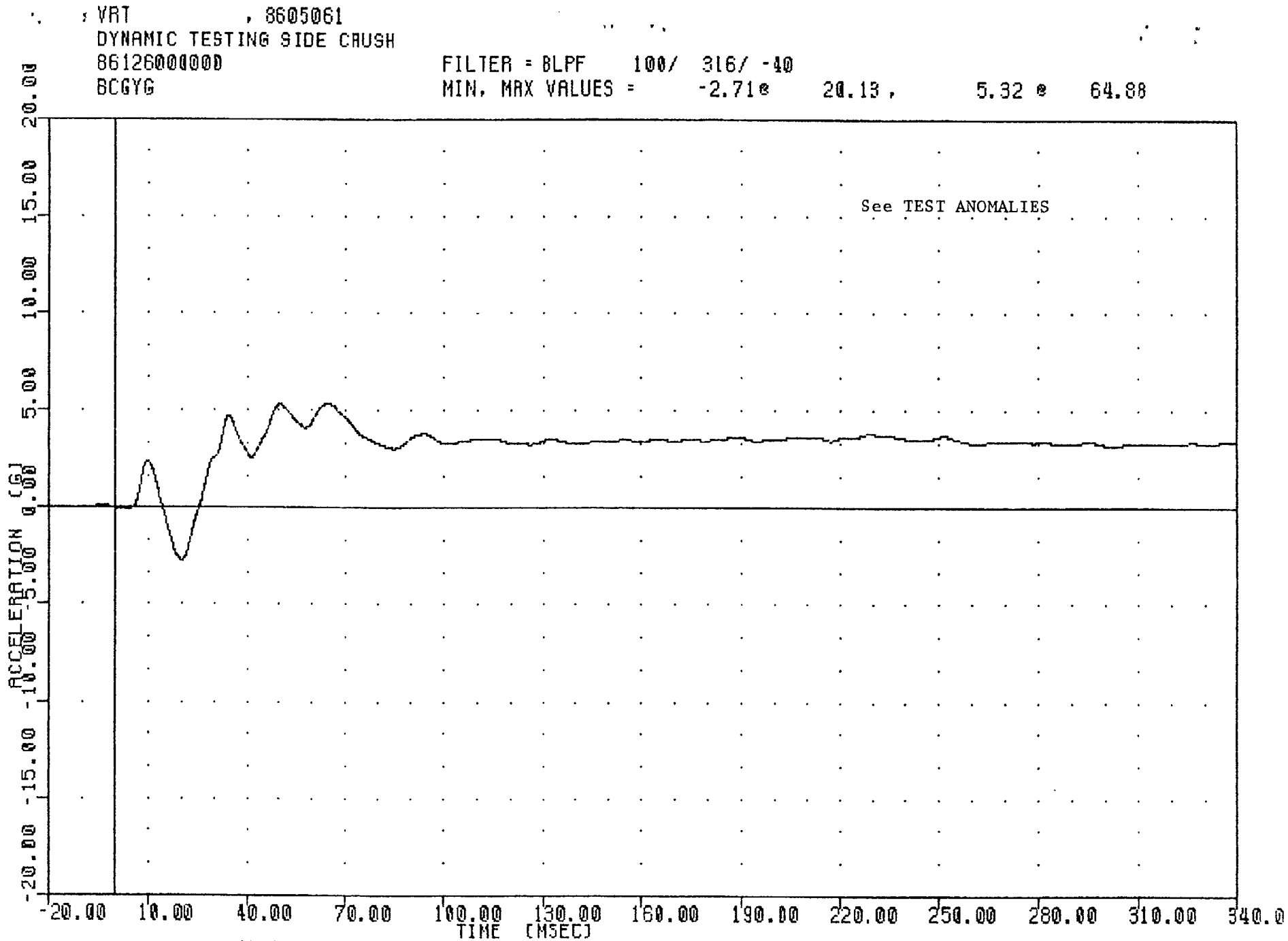
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
DELTA V USING RDKYG



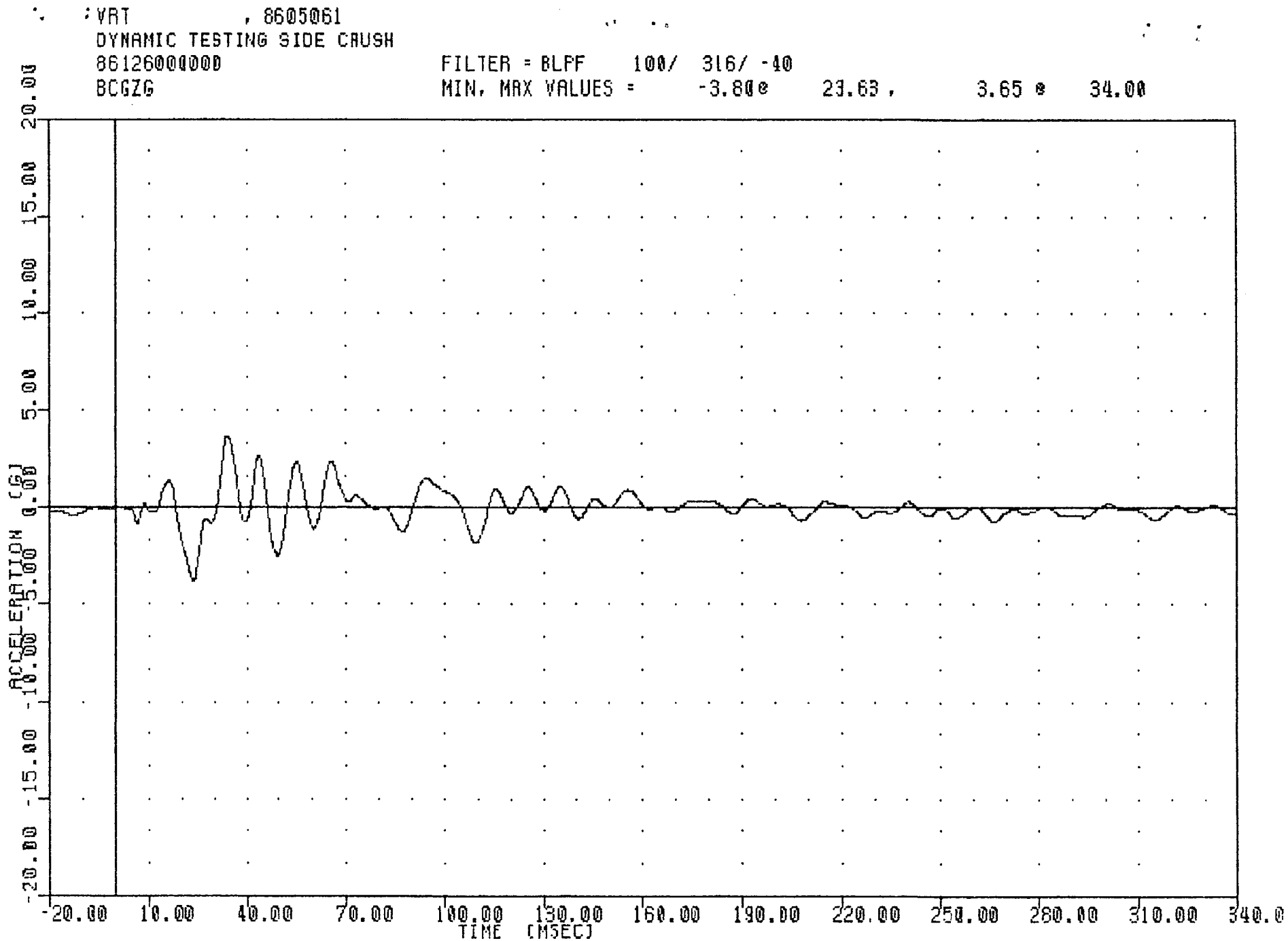
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION X AXIS



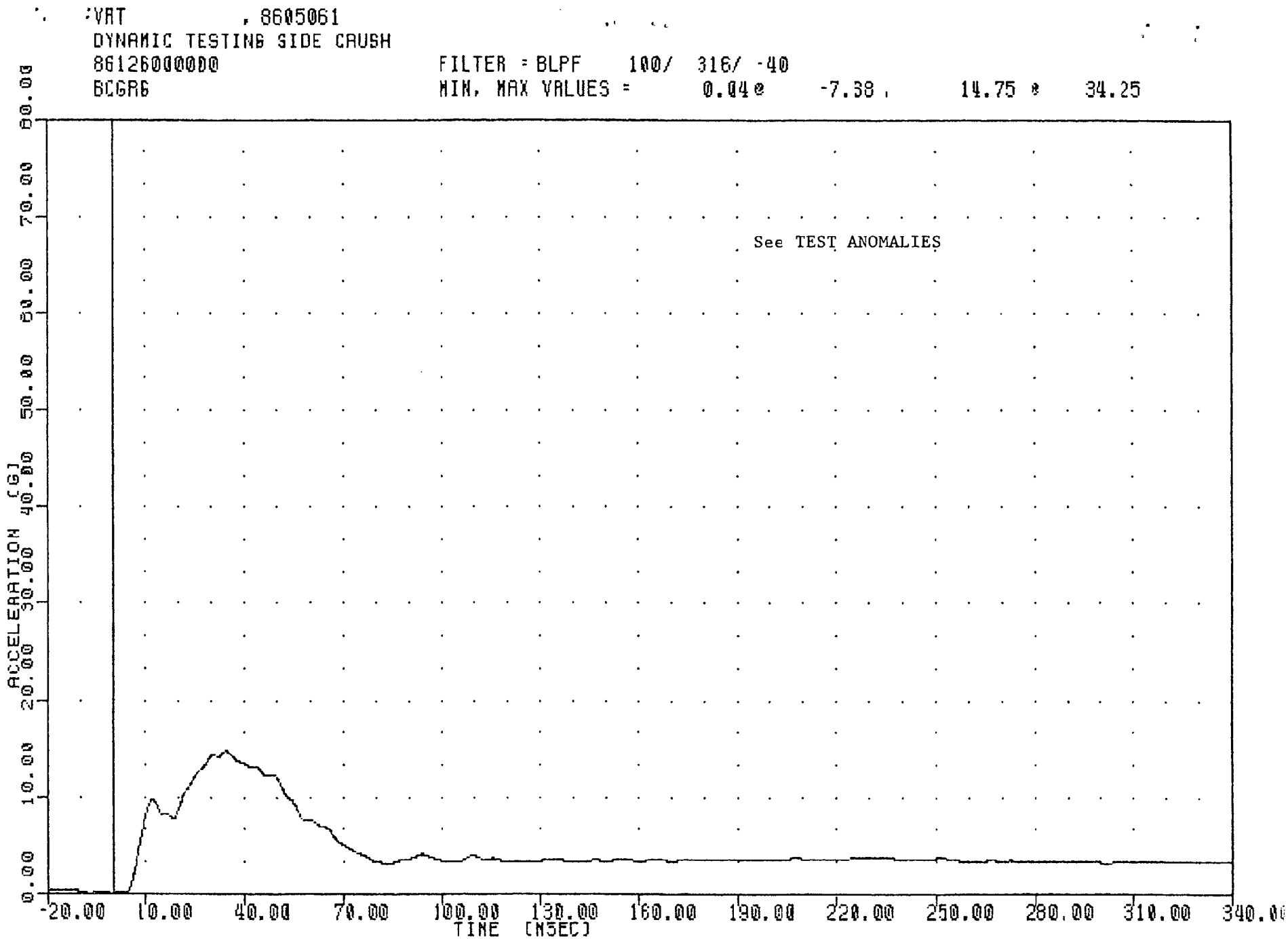
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
DELTA V USING BCGXG



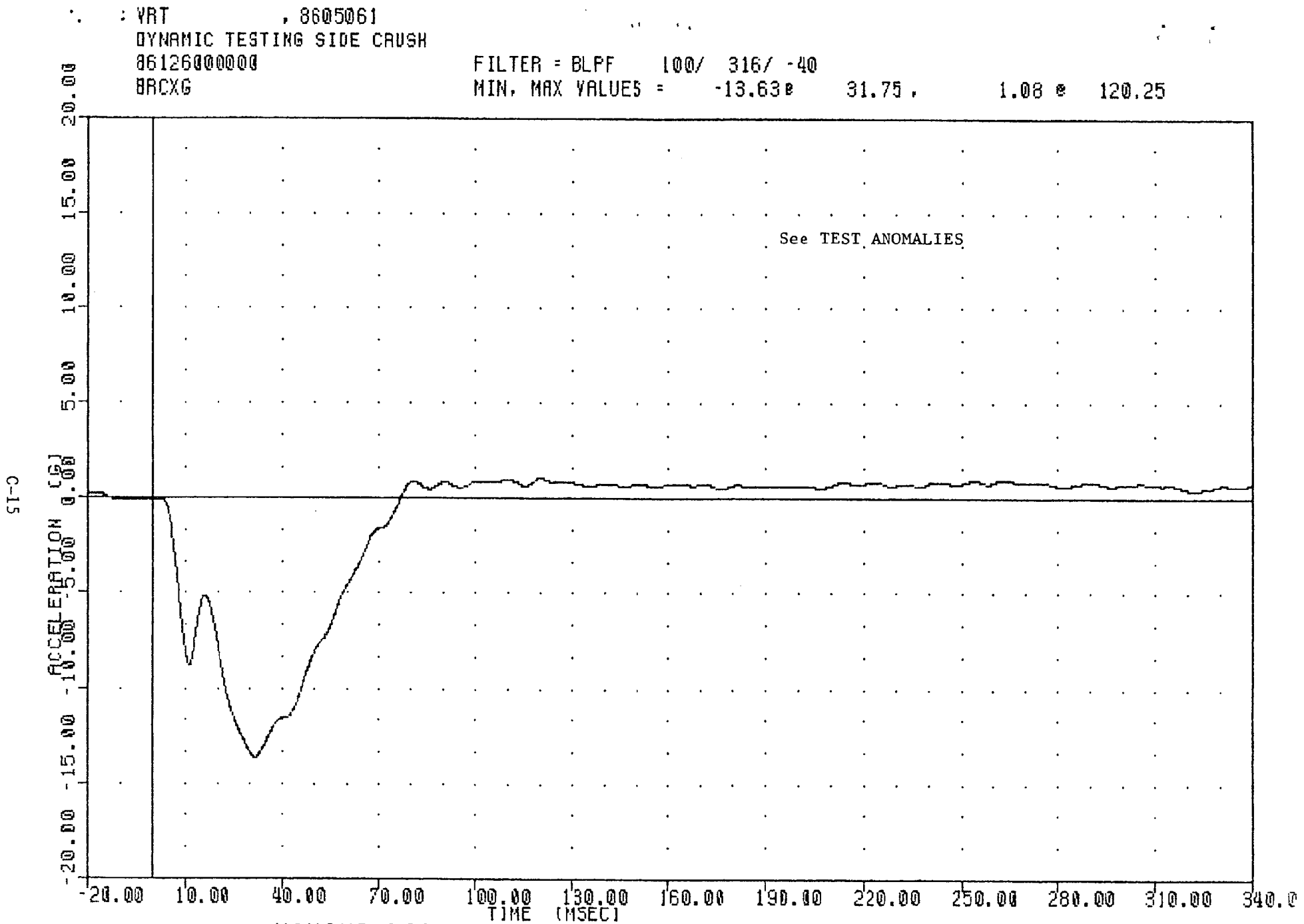
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION Y AXIS



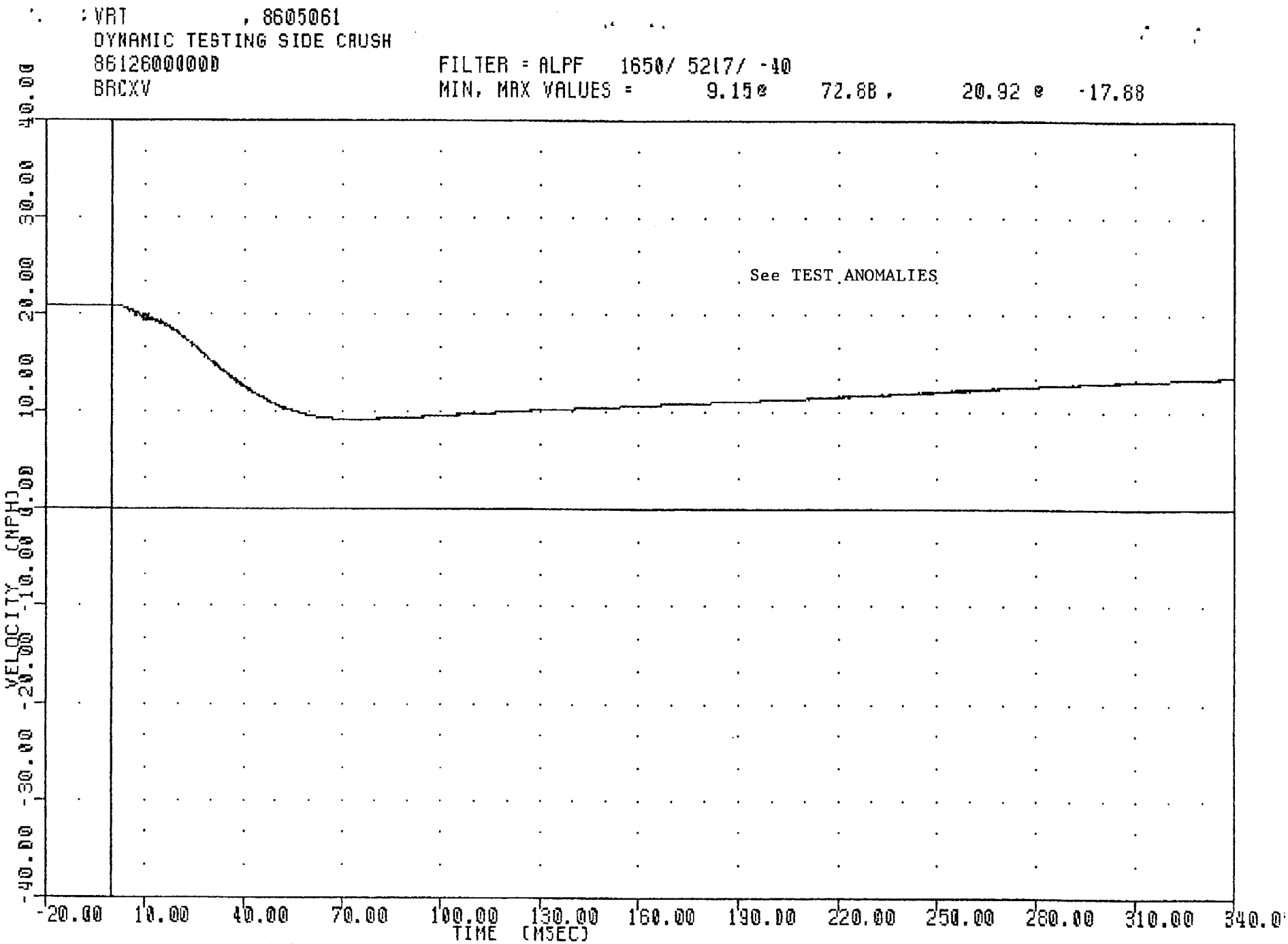
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION Z AXIS



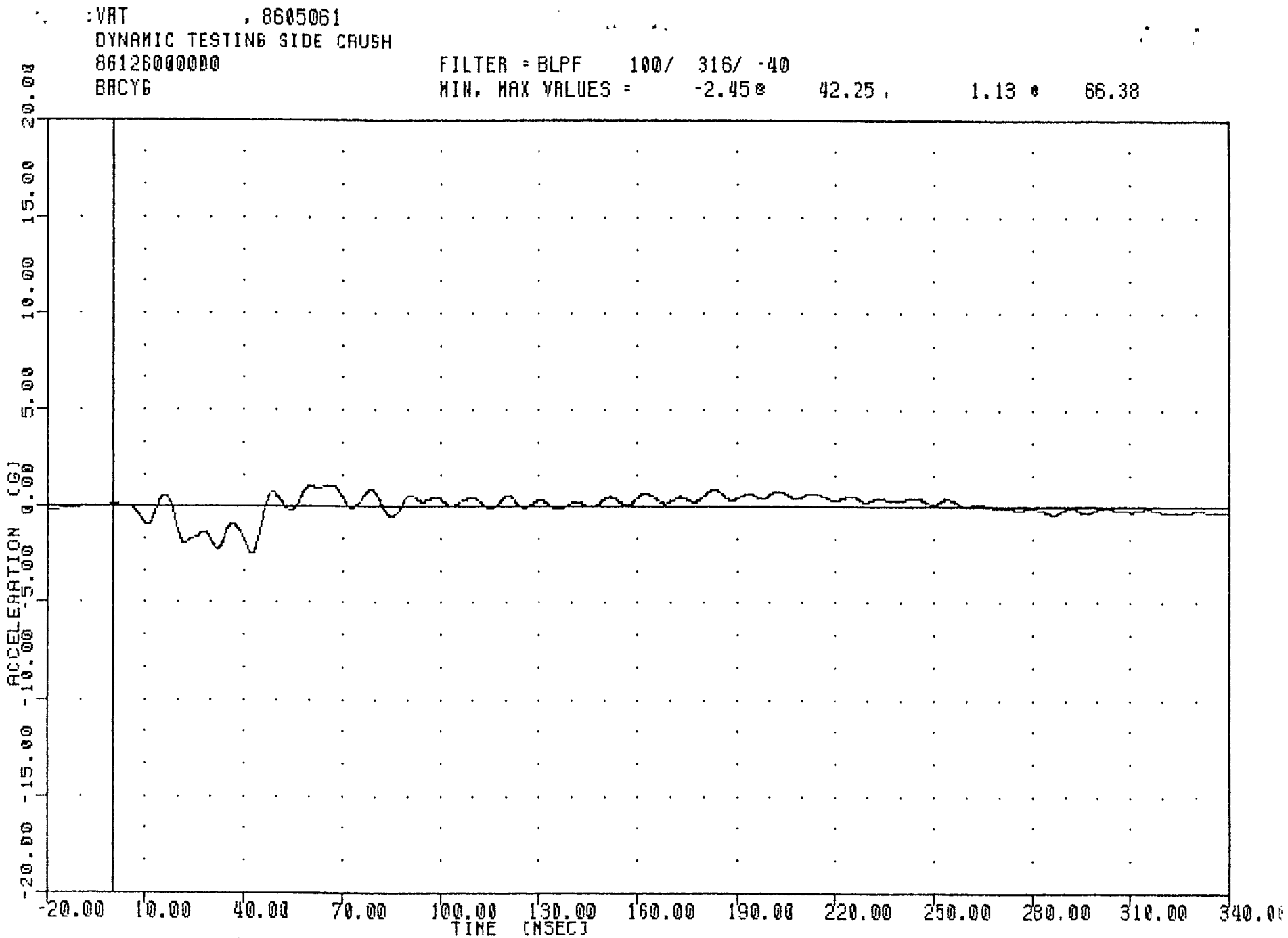
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION RESULTANT



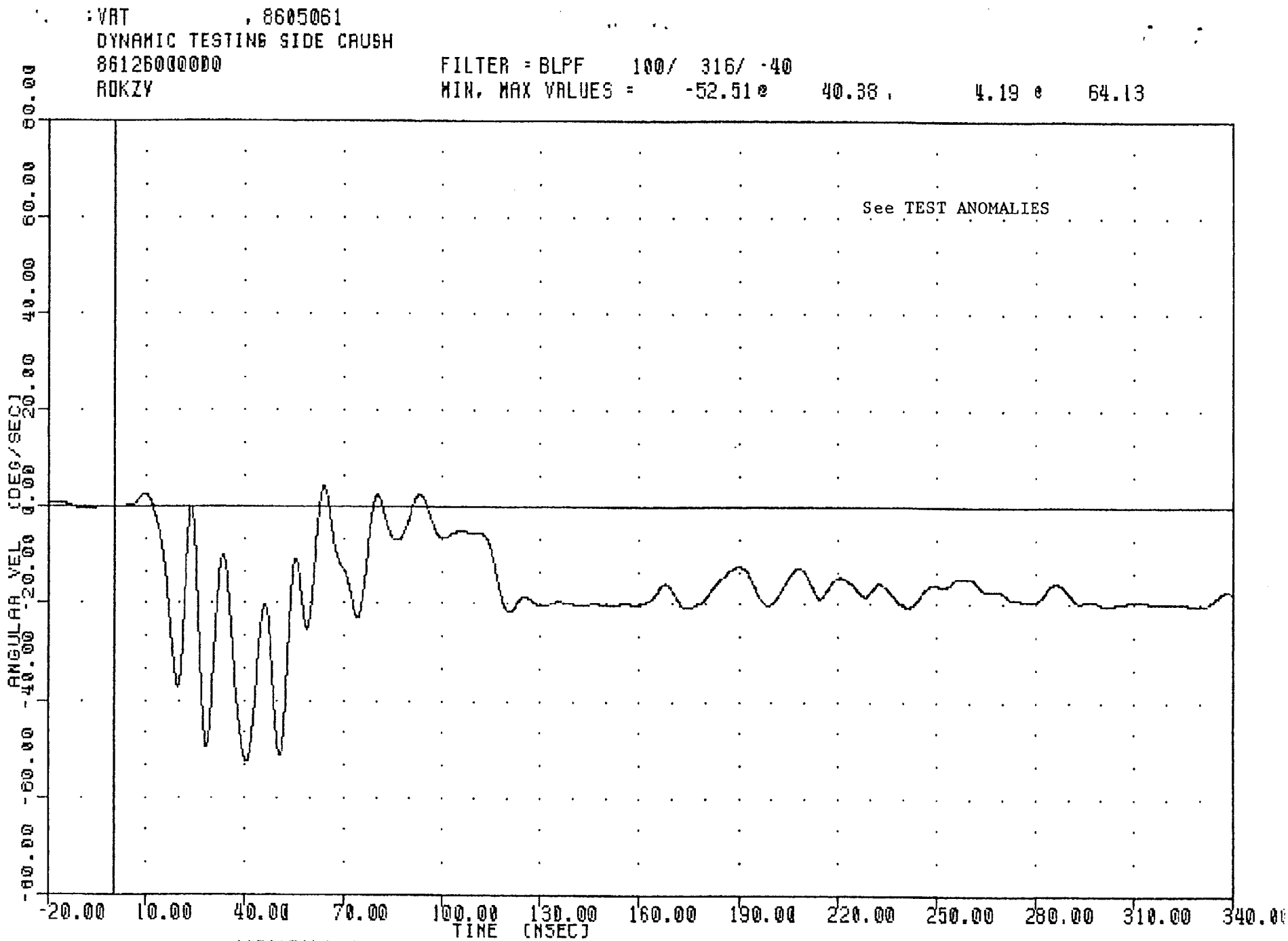
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER REAR CROSSMEMBER ACCELERATION X AXIS



MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
DELTA V USING BRCXG



MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
MOVING BARRIER REAR CROSSMEMBER ACCELERATION Y AXIS



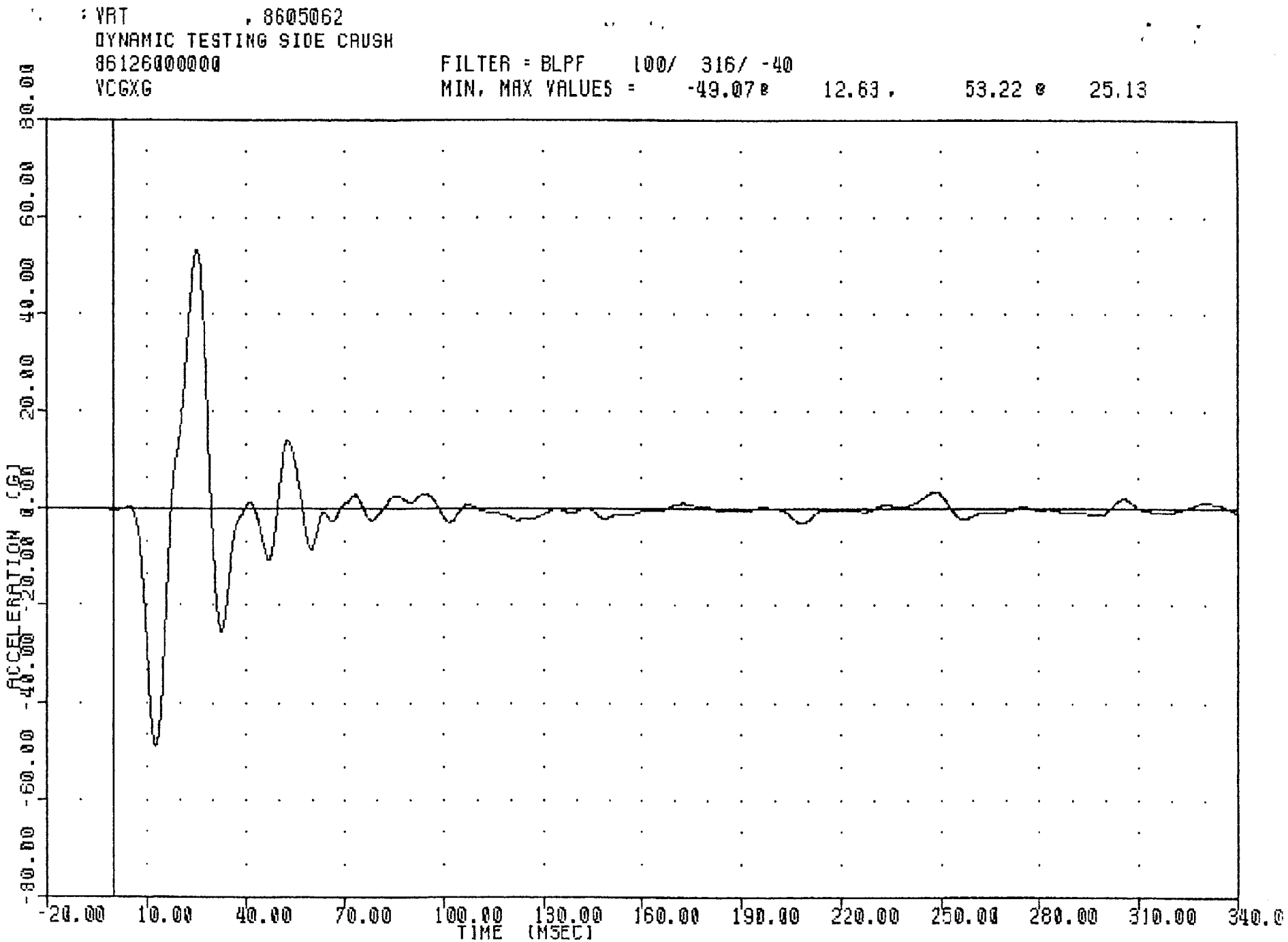
MOVING RIGID BARRIER INTO FORD LTD LOW SPEED LEFT SIDE
VEHICLE YAW RATE DEGREE/SECOND

APPENDIX D

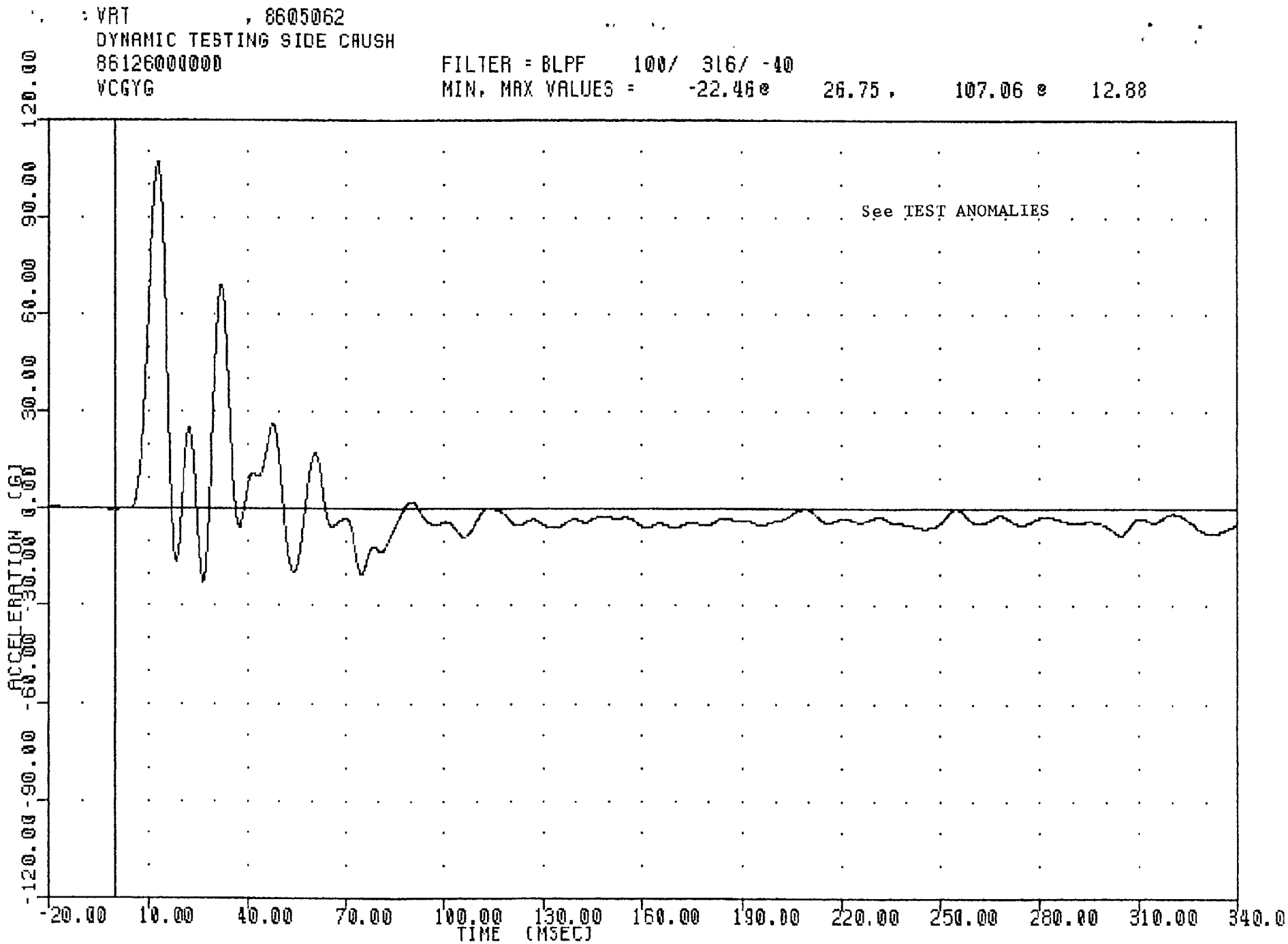
DATA PLOT PRESENTATION

TEST #2 VEHICLE WAS IMPACTED PERPENDICULAR ON THE RIGHT SIDE HIGH SPEED

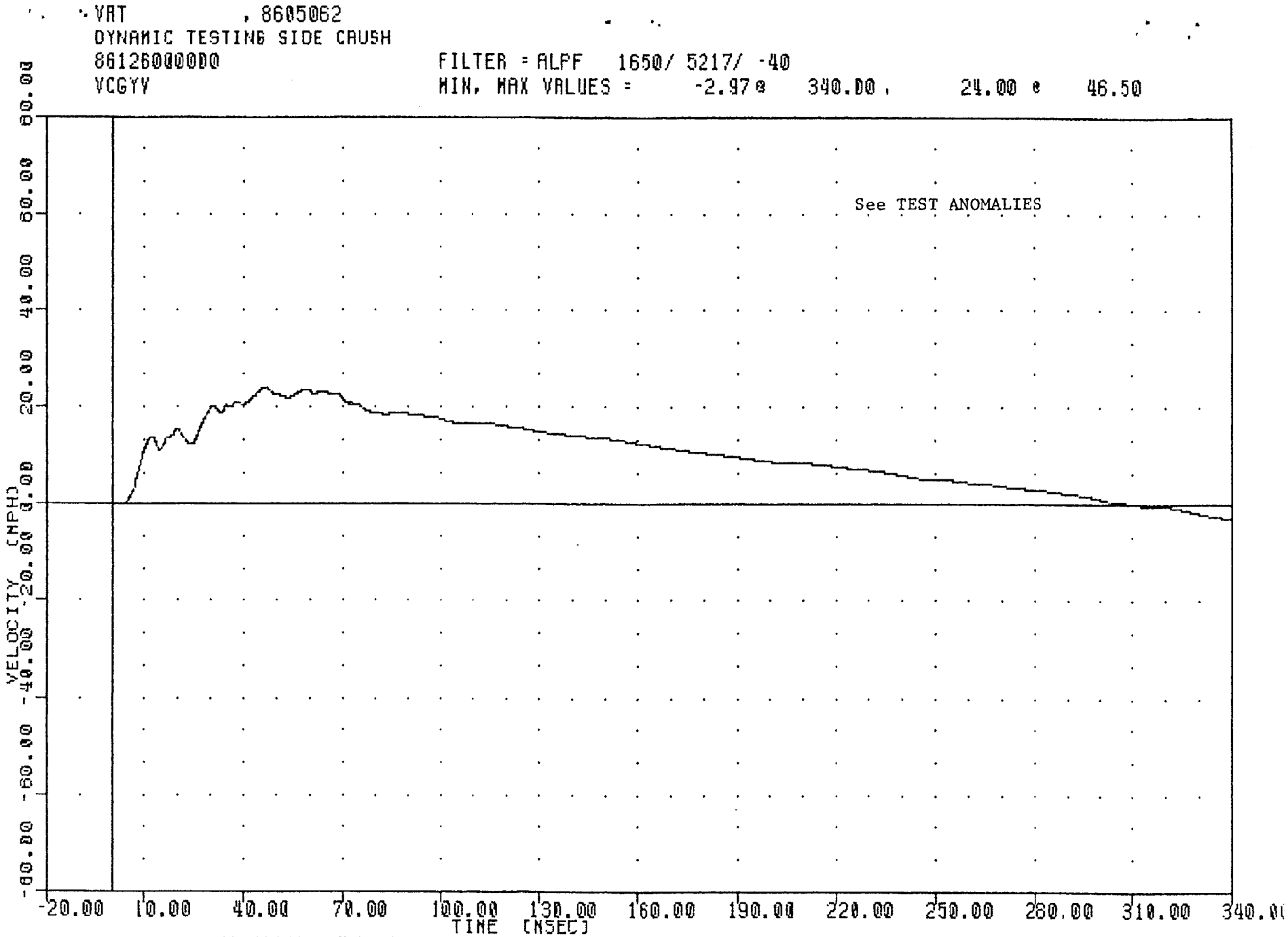
Data plots generated from the crash test data are presented on the following pages. All data are recorded on magnetic tape for inclusion in the NHTSA crash test data base system. All data were filtered according to SAE J211.



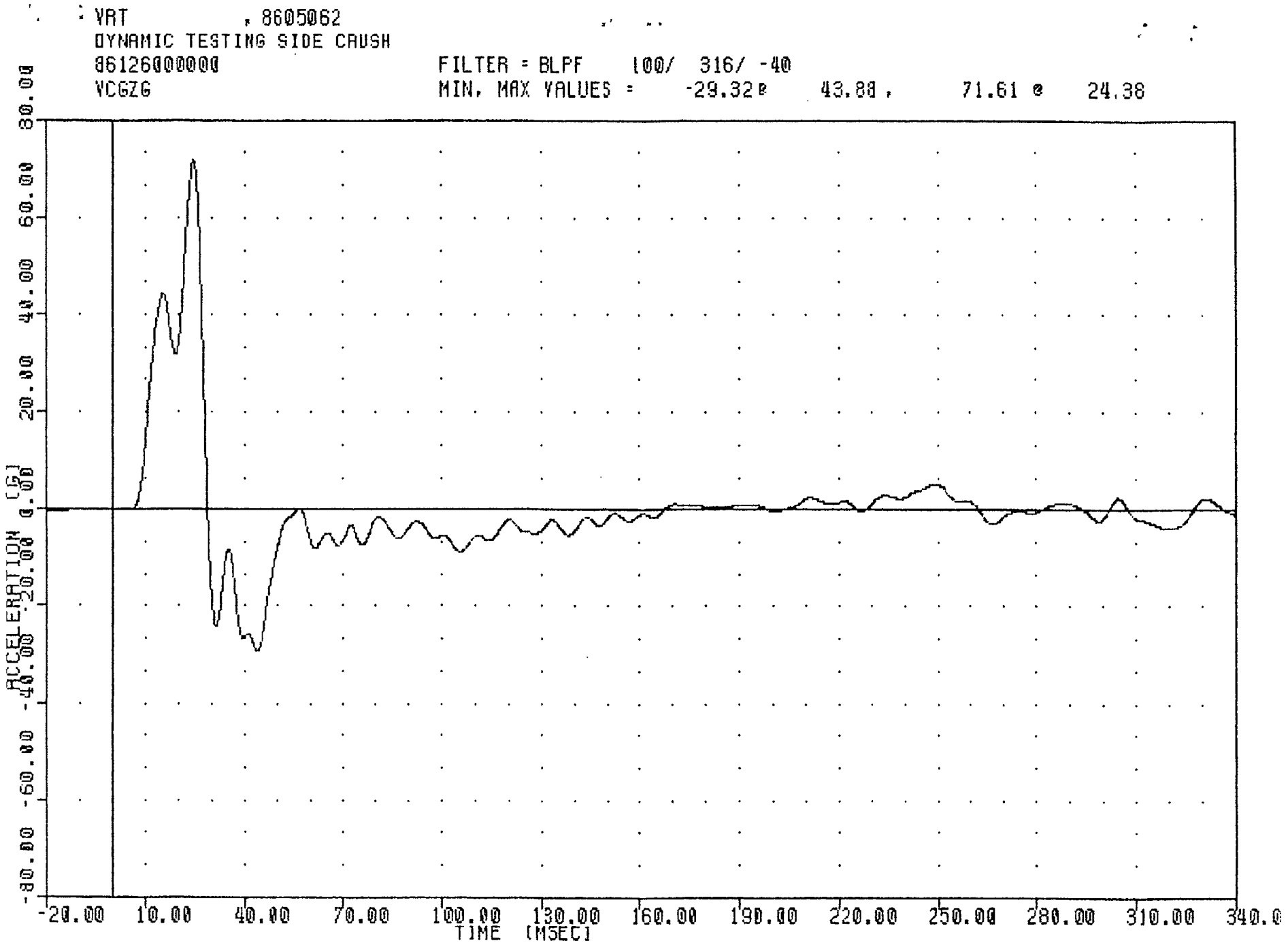
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION X AXIS



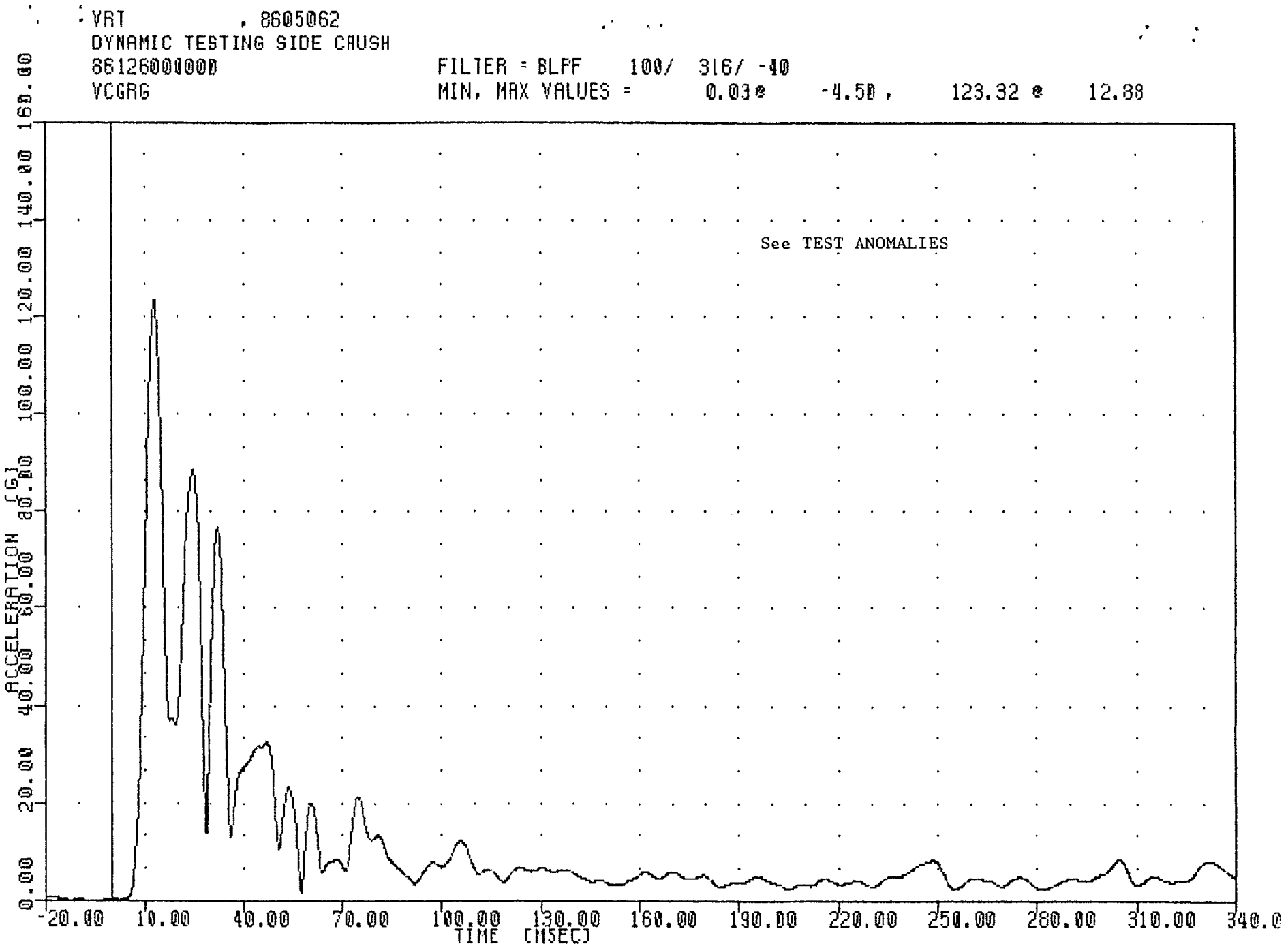
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION Y AXIS



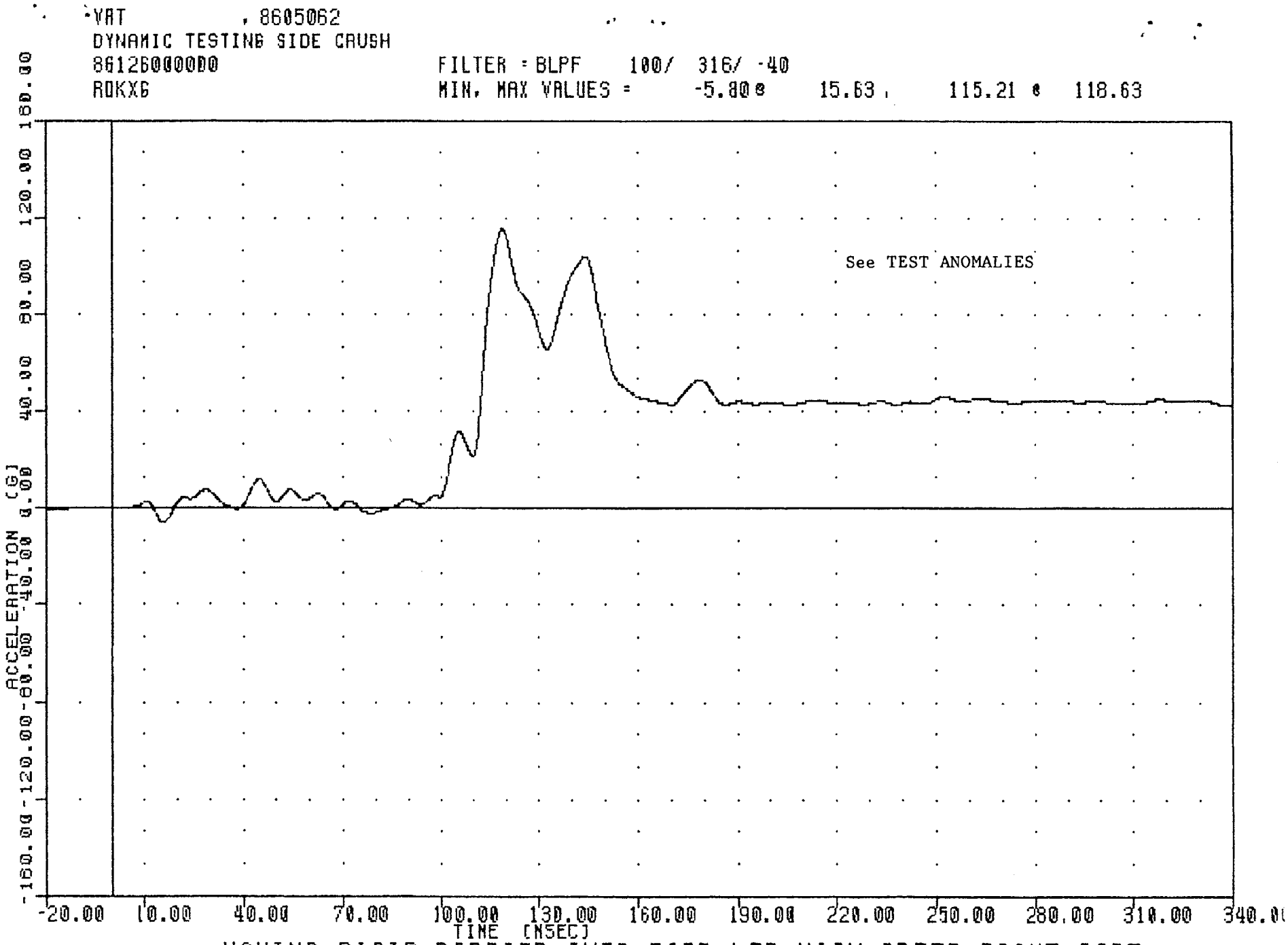
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
DELTA V USING VCGYG



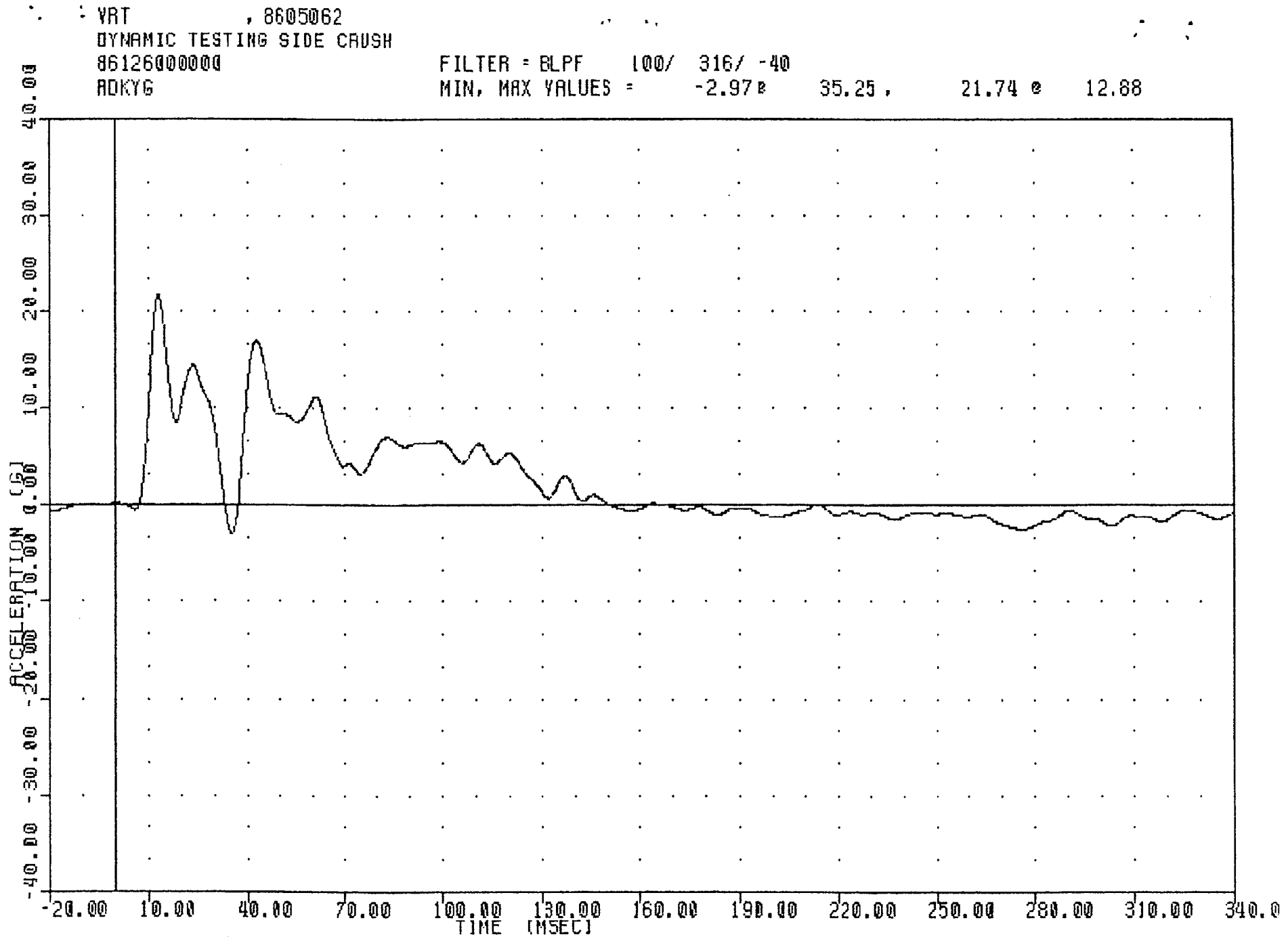
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION Z AXIS



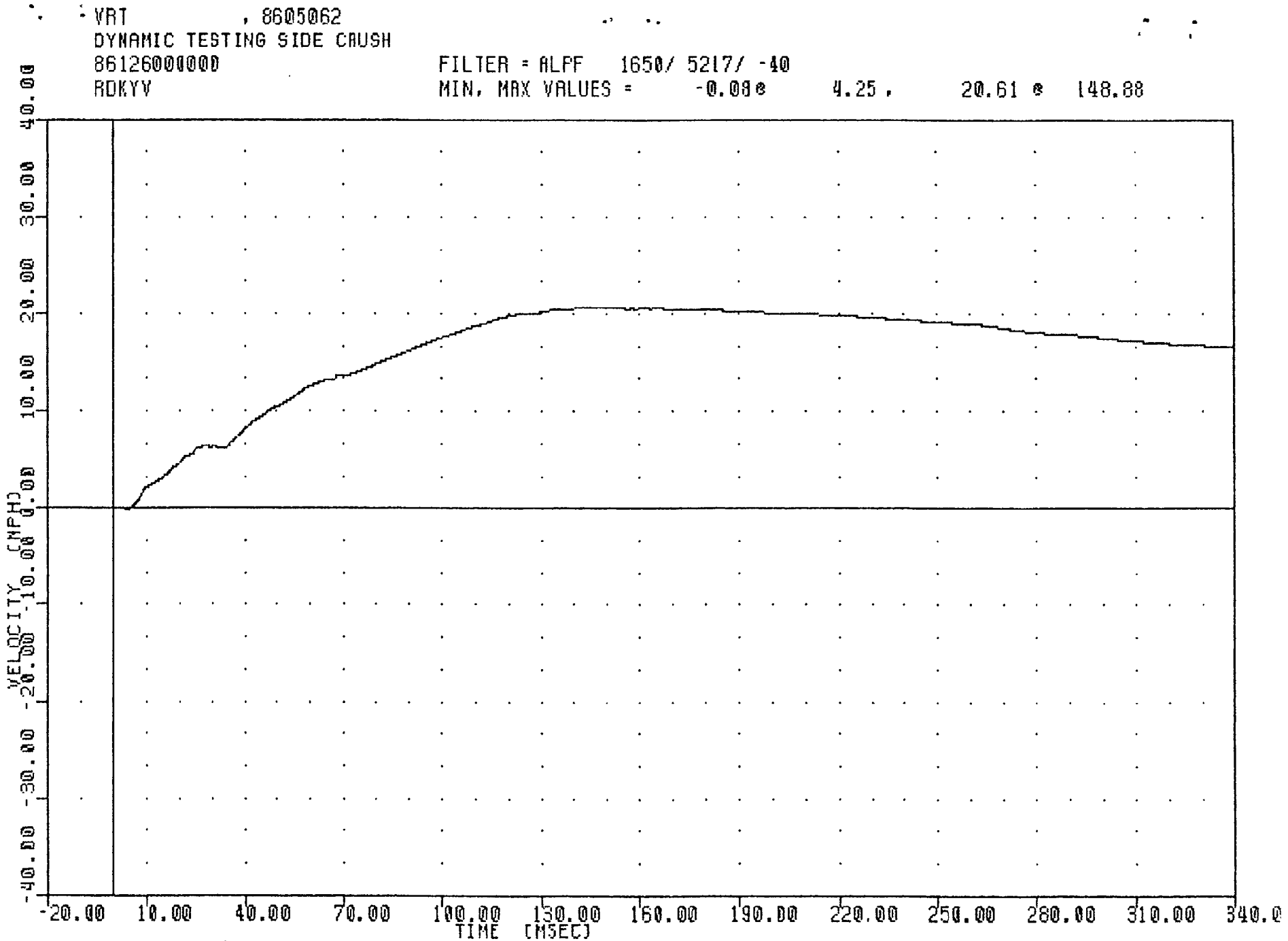
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE CENTER OF GRAVITY ACCELERATION RESULTANT



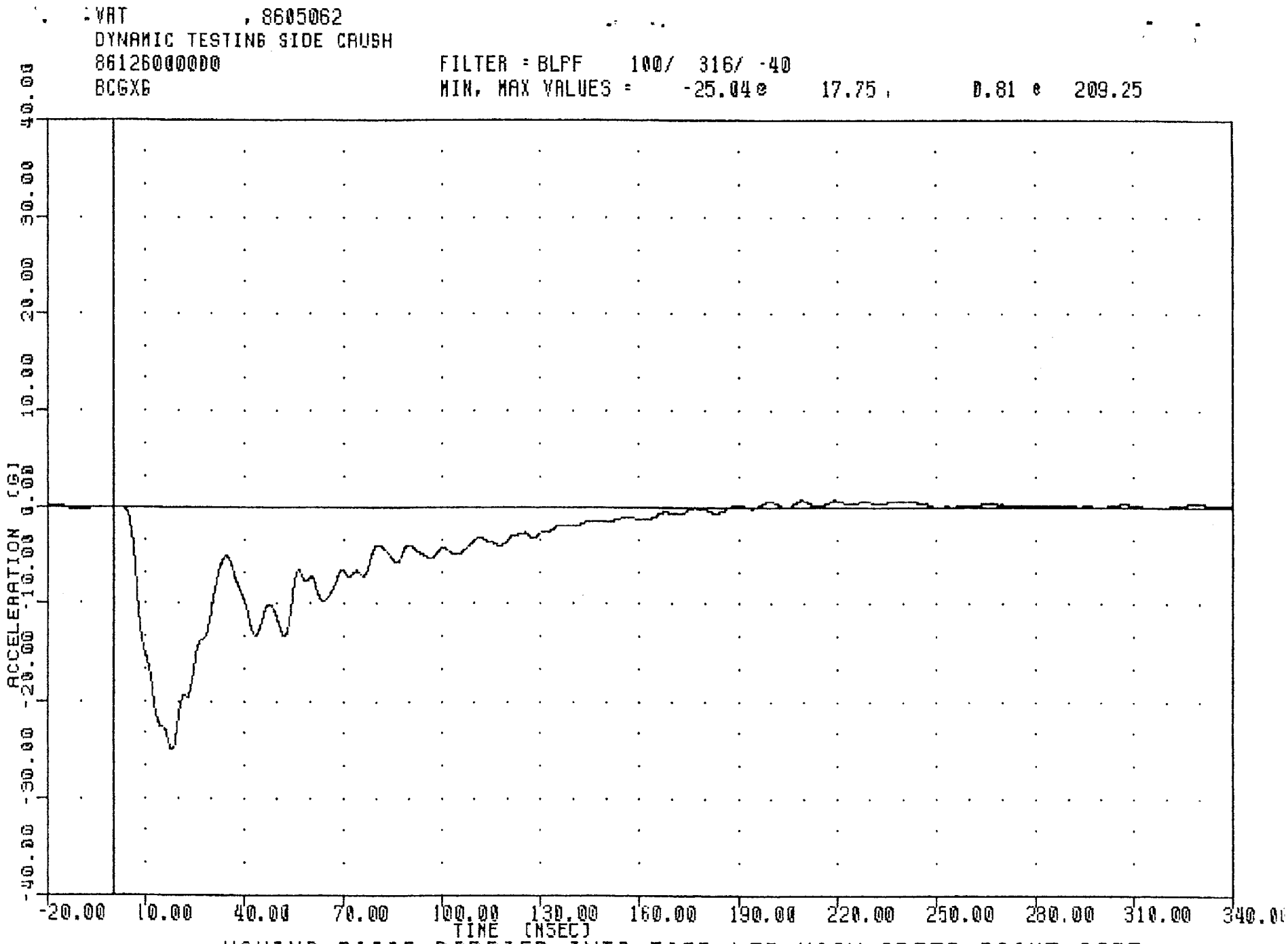
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE REAR DECK ACCELERATION X AXIS



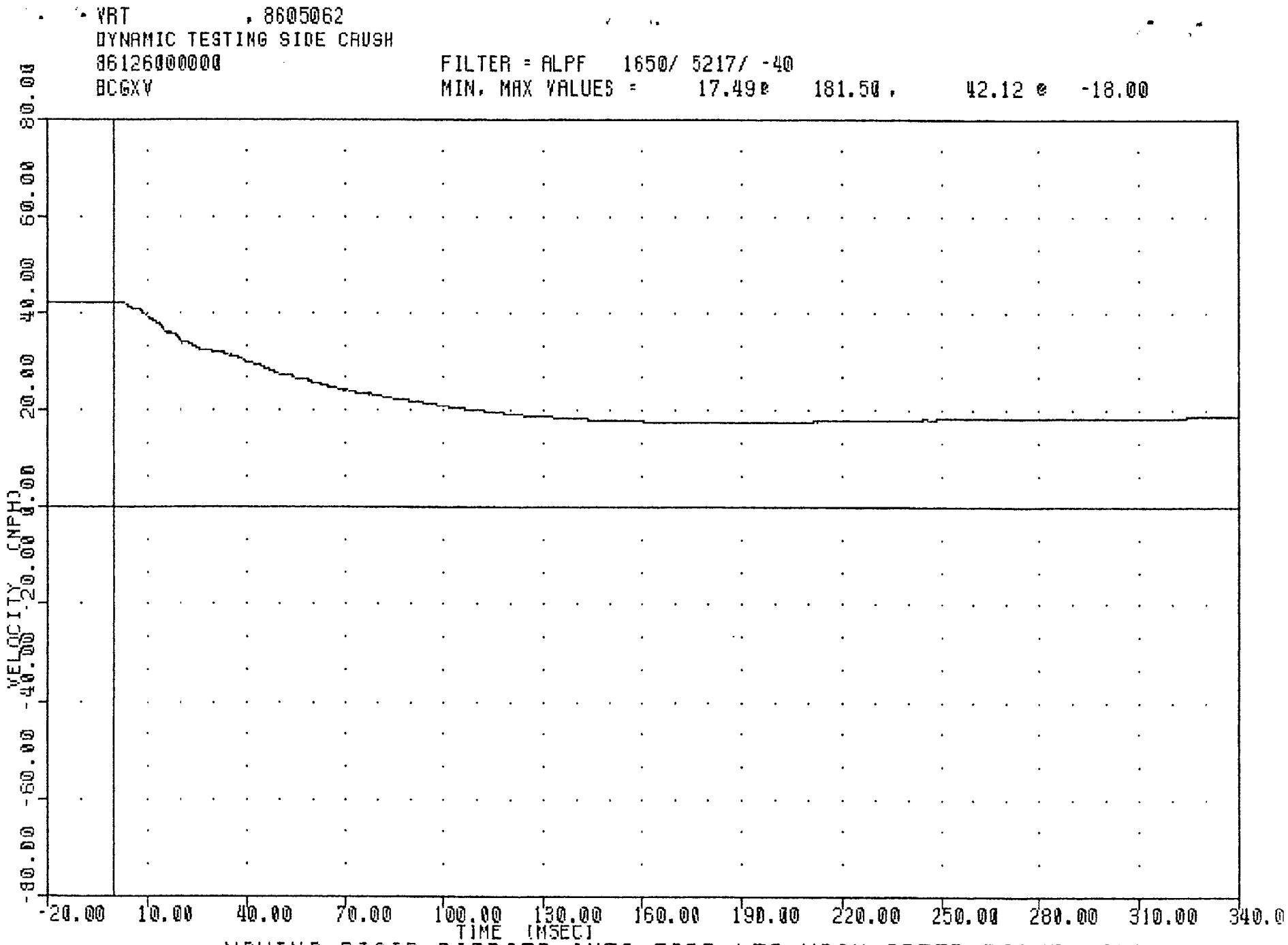
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE REAR DECK ACCELERATION Y AXIS



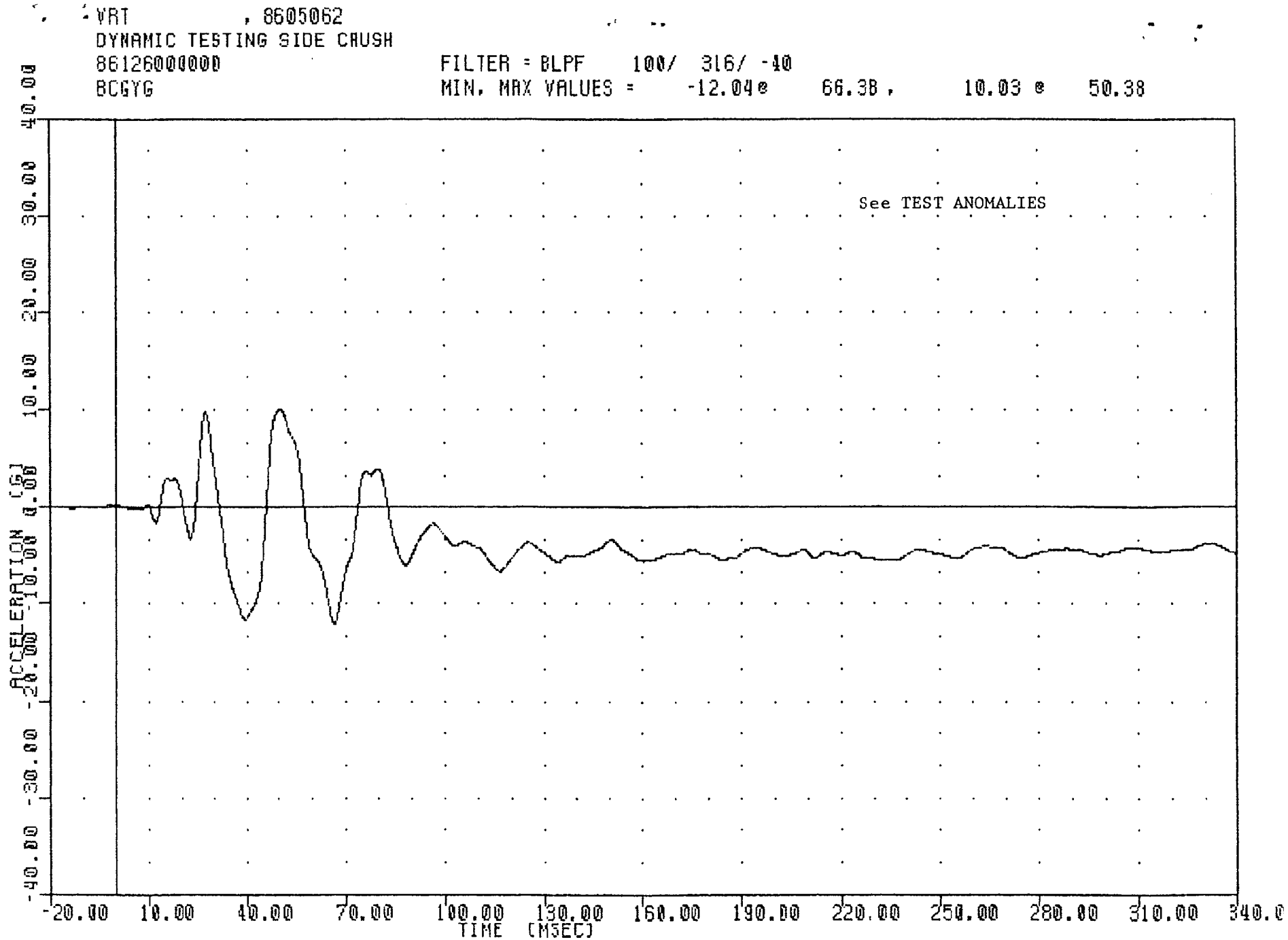
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
DELTA V USING RDKYG



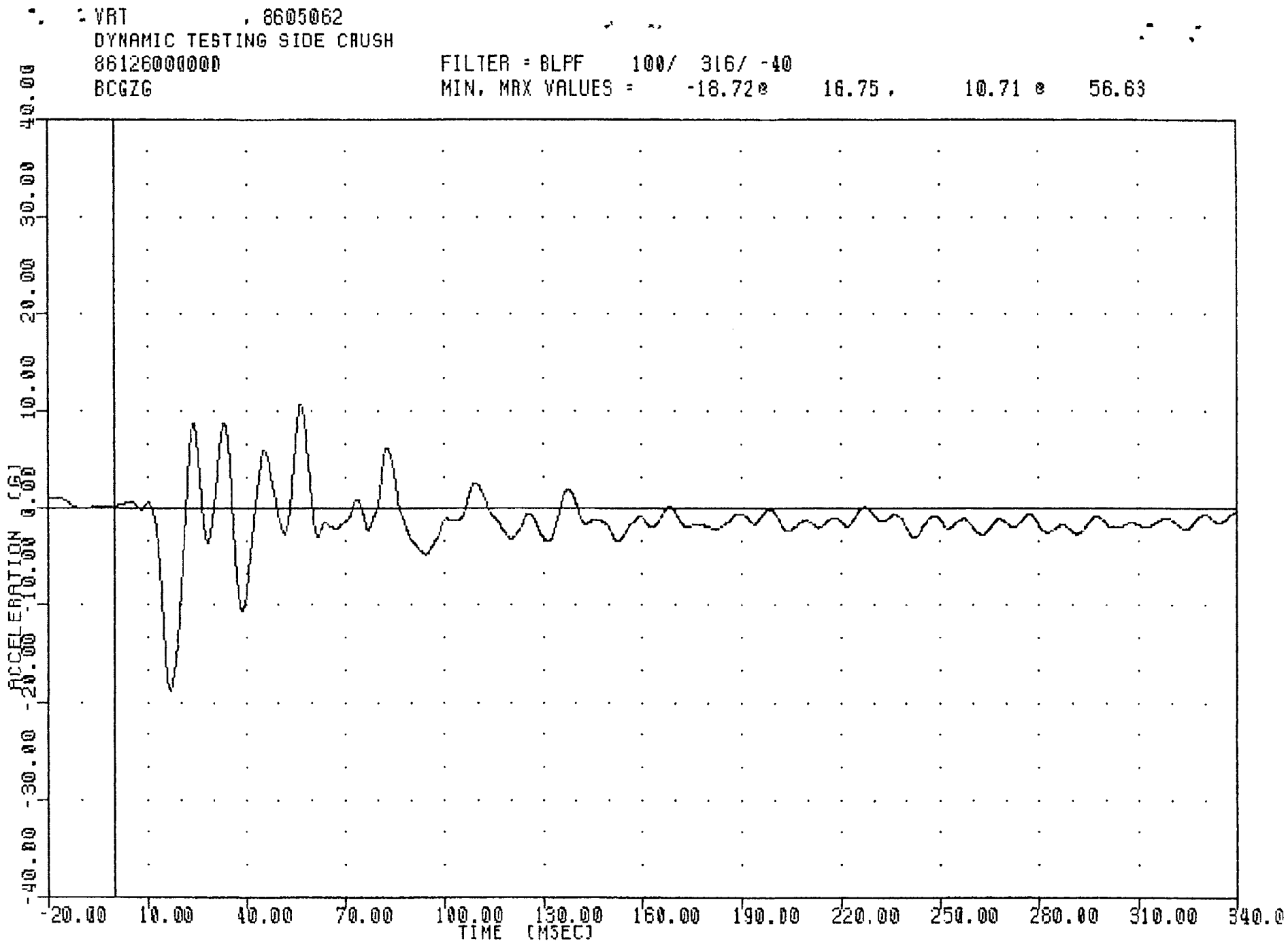
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION X AXIS



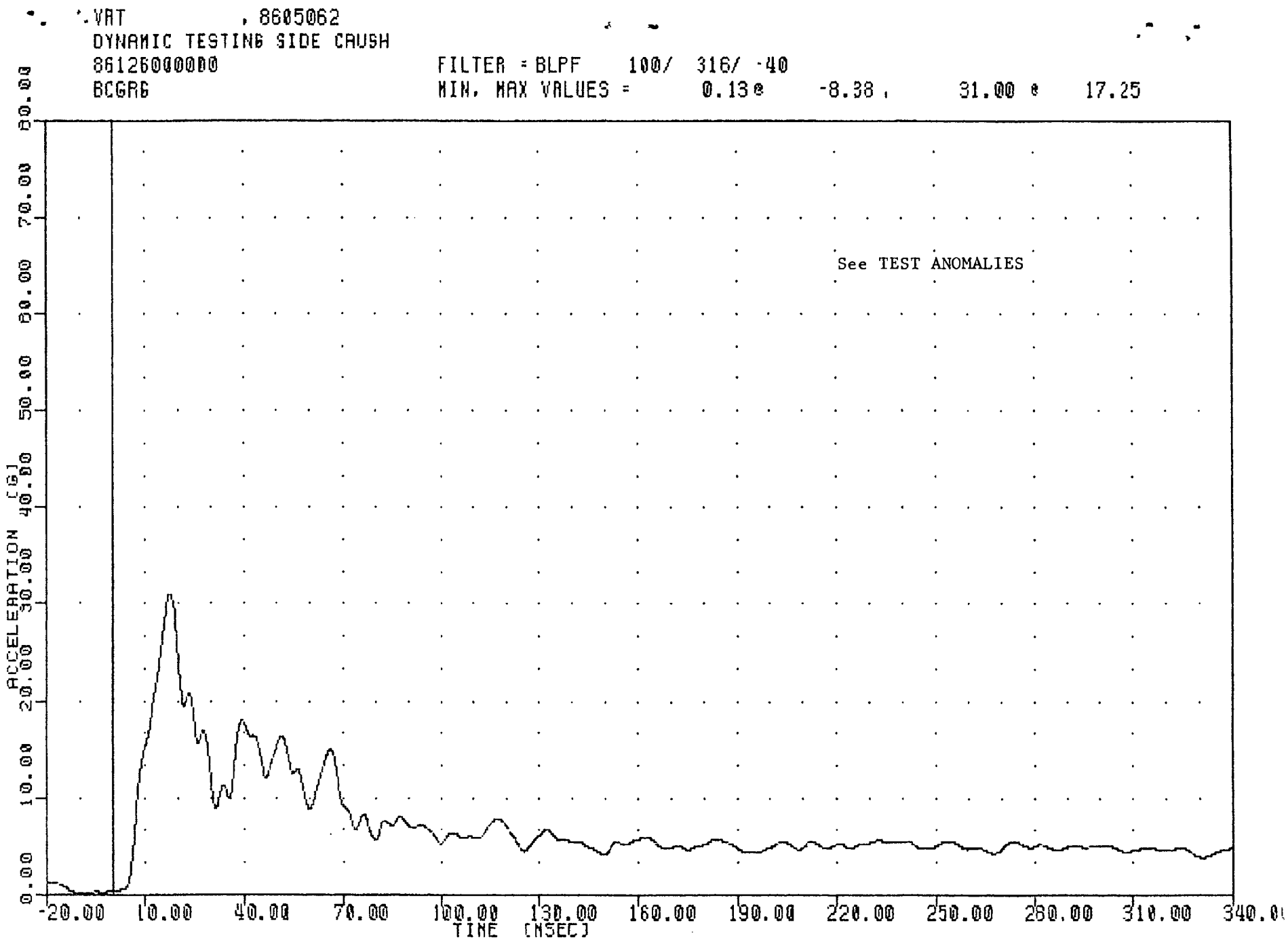
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
DELTA V USING BCGXG



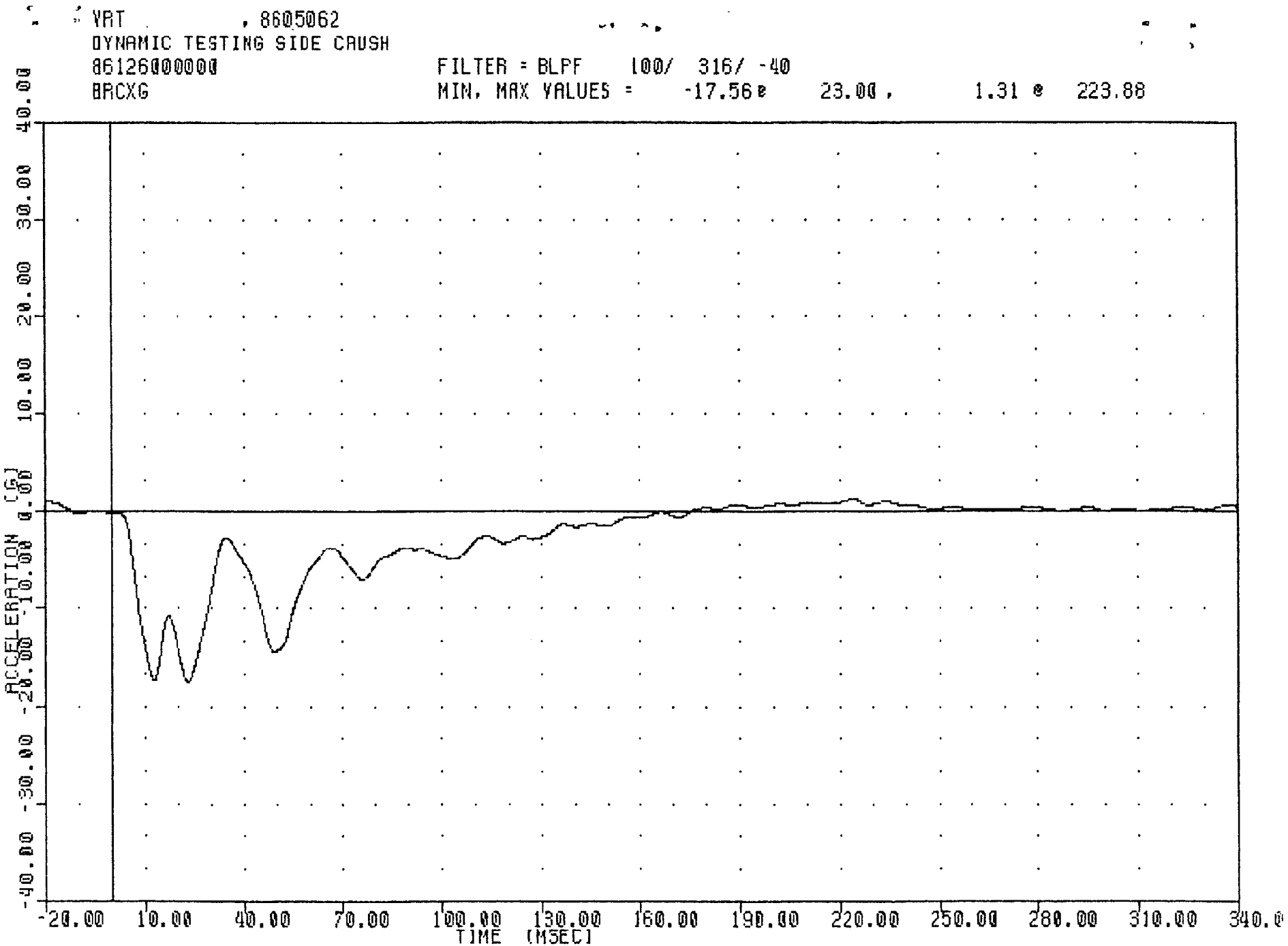
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION Y AXIS



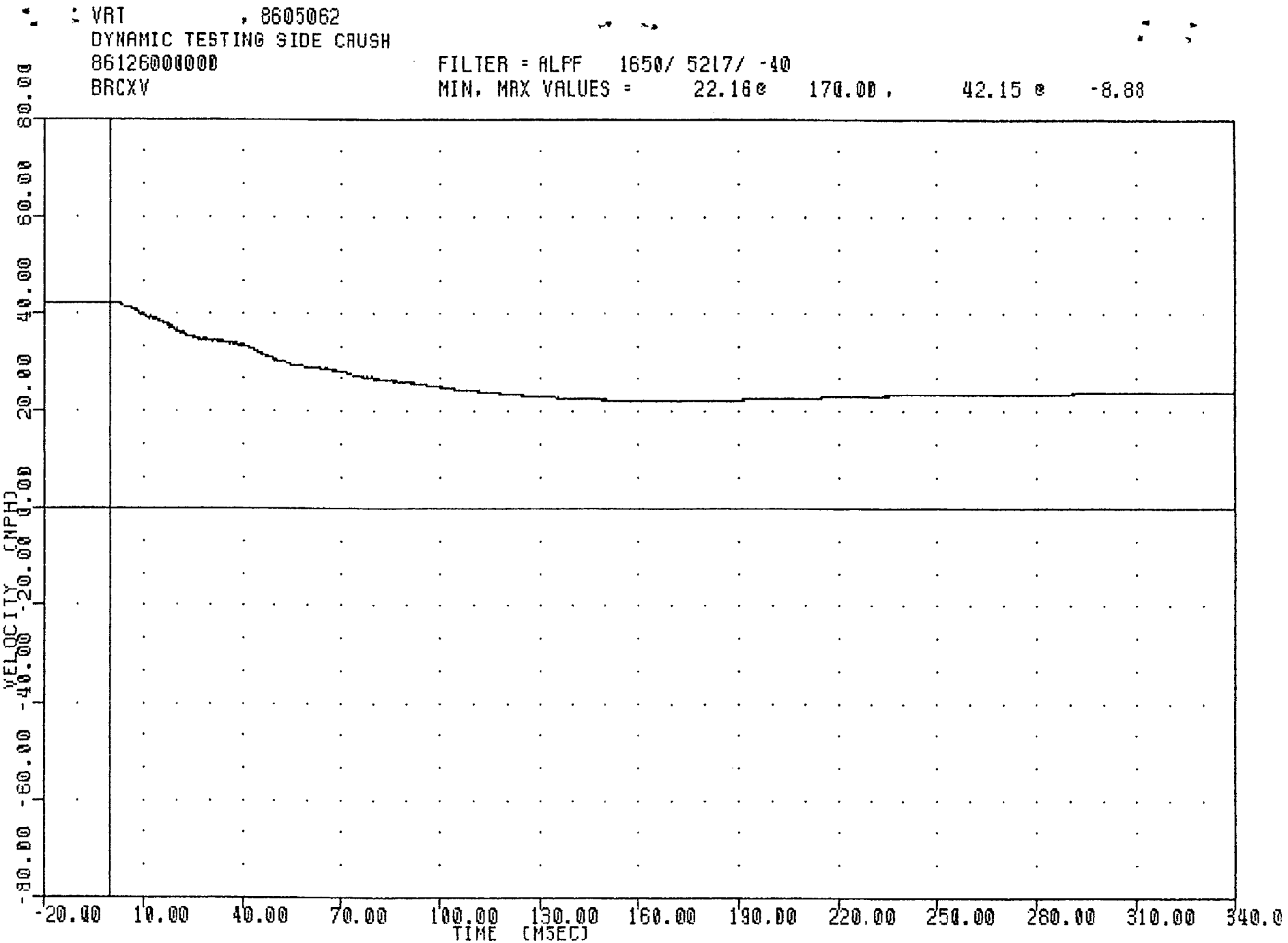
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION Z AXIS



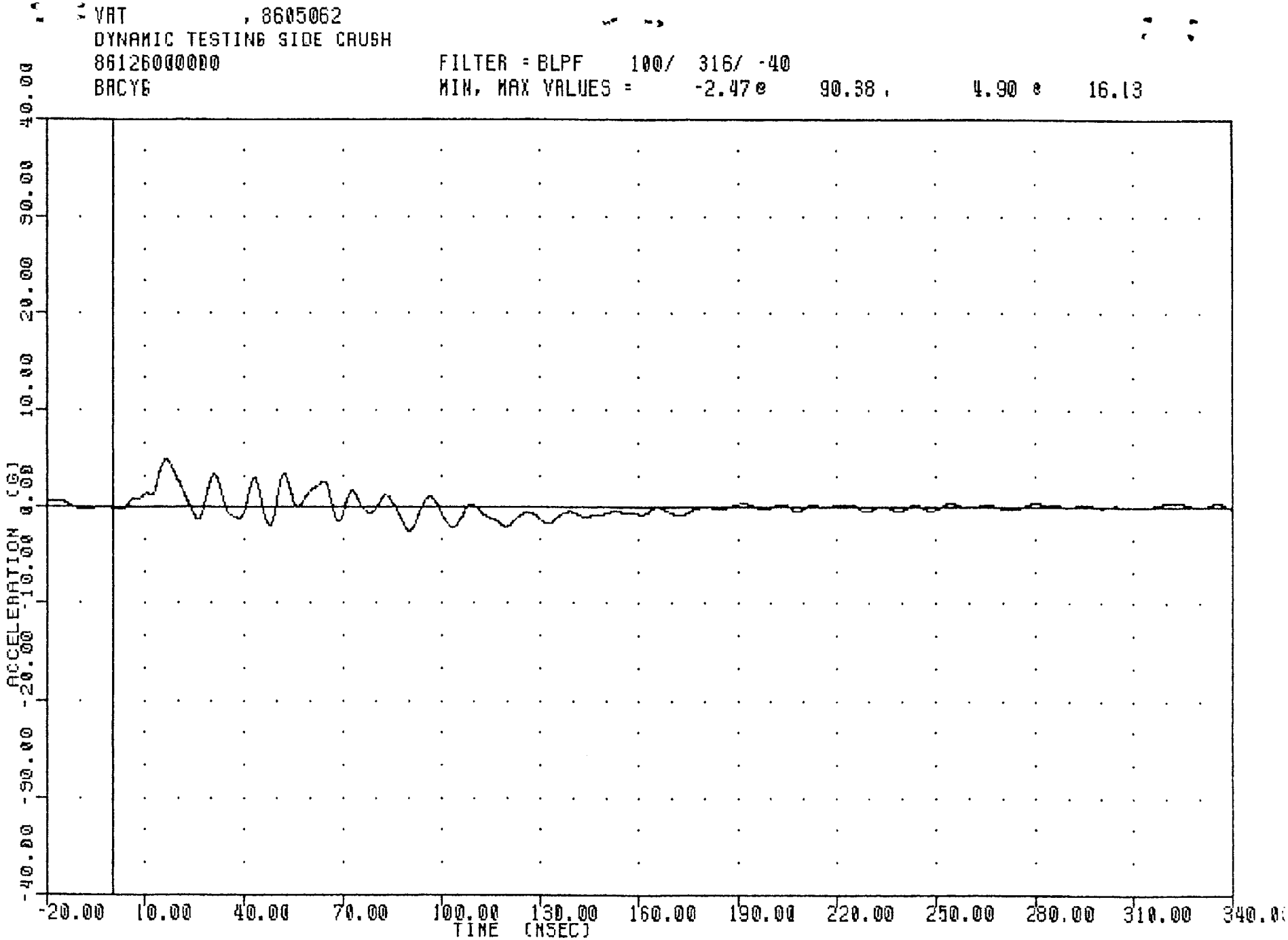
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER CENTER OF GRAVITY ACCELERATION RESULTANT



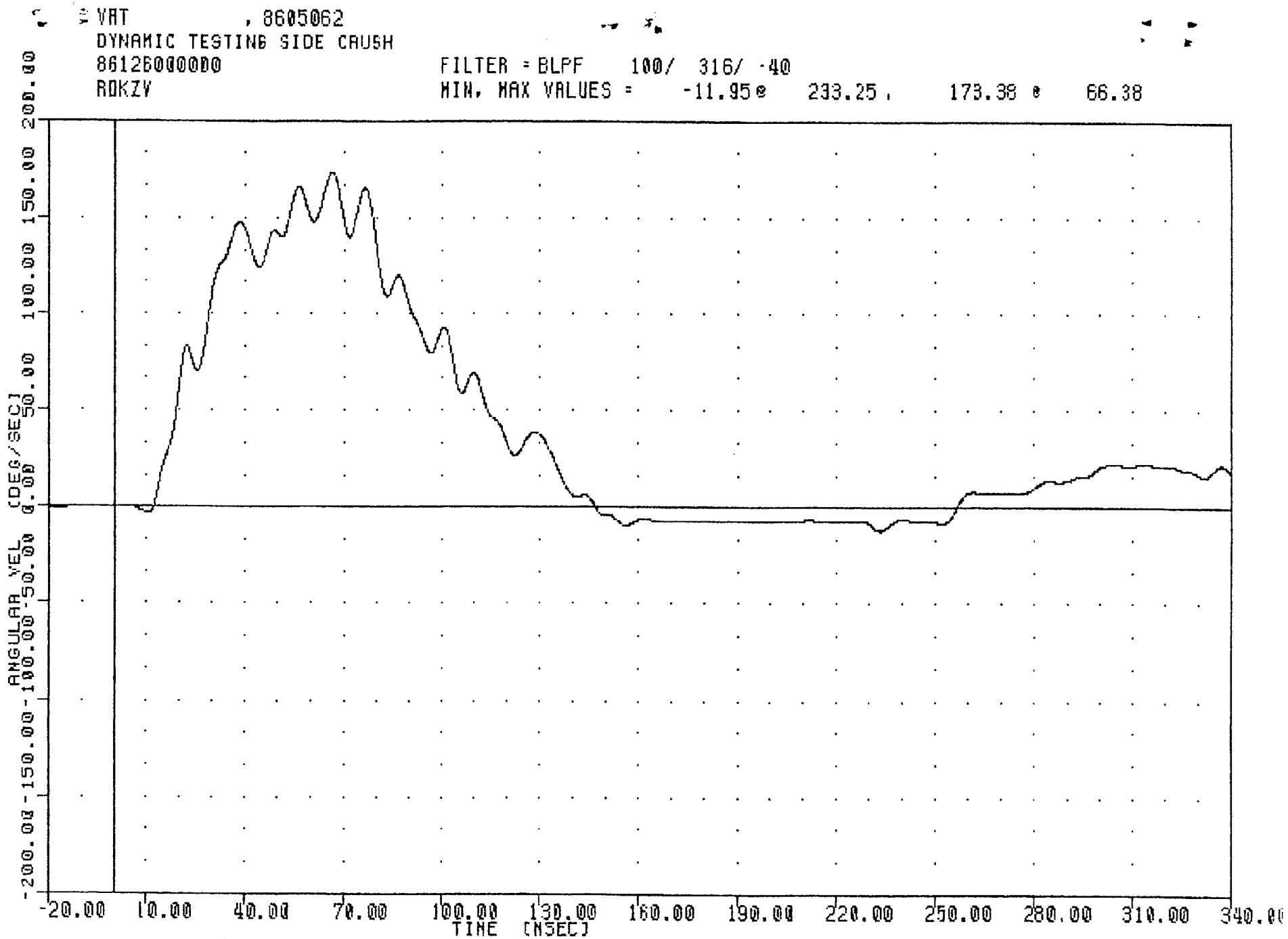
MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER REAR CROSSMEMBER ACCELERATION X AXIS



MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
DELTA V USING BRCXG



MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
MOVING BARRIER REAR CROSSMEMBER ACCELERATION Y AXIS



MOVING RIGID BARRIER INTO FORD LTD HIGH SPEED RIGHT SIDE
VEHICLE YAW RATE DEGREE/SECOND