

DOT 418

NEW CAR ASSESSMENT TESTING

VOLVO CORP.
1982 VOLVO DL

VRTC NO.444

Prepared By:

VEHICLE RESEARCH AND TEST CENTER
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East Liberty, Ohio 43319



FINAL REPORT

April 1982

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
-----ENFORCEMENT-----
OFFICE OF AUTOMOTIVE RATINGS
400 SEVENTH STREET, S.W.
WASHINGTON, D.C. 20590

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol When You Know Multiply by To Find Symbol

LENGTH			Symbol
in	inches	2.5	
ft	feet	30	cm
yd	yards	0.9	m
mi	miles	1.6	km
AREA			Symbol
in ²	square inches	6.5	
ft ²	square feet	0.09	square centimeters
yd ²	square yards	0.8	square meters
mi ²	square miles	2.6	square kilometers
	acres	0.4	hectares
MASS (weight)			Symbol
oz	ounces	28	
lb	pounds	0.45	grams
	short tons	0.9	kilograms
	(2000 lb)		metric ton
VOLUME			Symbol
tsp	teaspoons	5	
Tbsp	tablespoons	15	milliliters
in ³	cubic inches	16	milliliters
fl oz	fluid ounces	30	milliliters
c	cups	0.24	liters
pt	pints	0.47	liters
qt	quarts	0.95	liters
gal	gallons	3.8	liters
ft ³	cubic feet	0.03	cubic meters
yd ³	cubic yards	0.76	cubic meters
TEMPERATURE (exact)			Symbol
°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			Symbol
mm	millimeters	0.04	
cm	centimeters	0.4	inches
m	meters	3.3	feet
m	meters	1.1	yards
km	kilometers	0.6	miles
AREA			Symbol
cm ²	square centimeters	0.16	
m ²	square meters	1.2	square inches
km ²	square kilometers	0.4	square yards
ha	hectares	2.5	square miles
	(10 000 m ²)		acres
MASS (weight)			Symbol
g	grams	0.035	
kg	kilograms	2.2	ounces
t	metric ton	1.1	pounds
	(1000 kg)		short tons
VOLUME			Symbol
mL	milliliters	0.03	
mL	milliliters	0.06	fluid ounces
L	liters	2.1	cubic inches
L	liters	1.06	pints
L	liters	0.26	quarts
m ³	cubic meters	35	gallons
m ³	cubic meters	1.3	cubic feet
			cubic yards
TEMPERATURE (exact)			Symbol
°C	degrees Celsius	9/5 (then add 32)	
	degrees Fahrenheit		°F

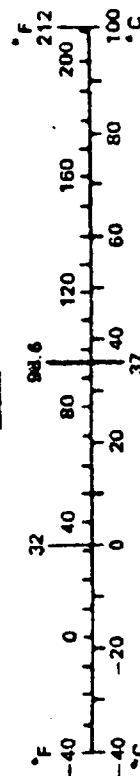


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SECTION 1
PURPOSE AND INTRODUCTION

PURPOSE:

Perform a vehicle assessment test in accordance with test plan "IP-212-02" except that tests for FMVSS Numbers 212, 219, and 301 were omitted.

INTRODUCTION:

The test check lists completed for each vehicle are contained in Section 2. Section 4 contains photographs related to these tests. The test procedure, description of the facilities used and objectives are contained in Appendix A. Appendix B contains Data Plots.

SECTION 2
GENERAL TEST AND VEHICLE PARAMETER DATA

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

RECEIVING INSPECTION OF VEHICLES

Contractor: VRTC Contract No.: SRL-48
VIN No.: YV1AX4925C1208444 NHTSA No.: TRC444
Make: Volvo Model: DL
Year: 1982 Color: Yellow
Mfgr. Date: 9-81 Date Received: 12-18-81
Shipping Weight: 2866 Odometer: 000088
Dealer: George Byers, Sons, Inc.

Accessories

Power Steering	Yes	Automatic Transmission	No
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	No	Anti-Skid Brake	No
Clock	Yes	Rear Window Defroster	Yes
Other:			

Seats (front): Bucket

Brakes

Front: Disc - Power Assisted
Rear: Disc - Power Assisted

Tires

Size: 175-SR-14 Mfgr. & Line: Michelin XZX
Ply Rating: Tread: 2 Rayon+2 Steel-SW: 2 Rayon Bias Ply: No
Radial: Yes
"Space Saver" Spare Tire: Firestone Special Spare - 165-H-14 - 6P.R.

Engine

Type: In Line Overhead Camshaft Cylinders: 4
Transmission, Frwd Speeds: 4/OD Total Displacement: 130 CID

Fuel Capacity: 15.8 Gals. - 60 Liters

Restraint System: Four 3-Point Self-Adjusting Safety Belts

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 bumper and frame: New

SUMMARY OF CRASH TEST CONDITIONS

Test Vehicle Information

Manufacturer: Volvo	Make & Model: Volvo DL
VIN Number: YV1AX4925C1208444	NHTSA Number: TRC444
Model Year: 1982	Build Date: 9-81
Transmission: 4 Speed Manual W/OD	Date Received: 12-18-81
Body Style: 2 Door Sedan	Color: Yellow
Dealer: George Byers, Sons, Inc.	

Engine Data

Type: Overhead Camshaft	Cylinders: 4
Displacement: 130 CID	

Data from Certification Label on Left Door Rear Face or B-Post

Vehicle Mfrgr: Volvo Gothenburg Sweden	VIN: YV1AX4925C1208444
Date of mfrgr: 9-81	
GVWR: 4030	GAWR: Front - 1885
	Rear - 2180

Data from "Recommended Tire Pressure" Label on Door, Post Glovebox, Etc.

Vehicle Load Up to Capacity	Recommended Tire Size: 175-R-14
Front: Max. Load - 920	Load Range: DNA
Rear:	

Vehicle Capacity	No. of Occupants (designated seating capacity): 5
Type of Seats: F. Bucket	
Cargo Load: 170	

Weight of Test Vehicle as Received from Dealer (with maximum fluids)

Right Front: 735	Right Rear: 677
Left Front: 779	Left Rear: 675
Total Front Weight: 1514	
Total Rear Weight: 1352	
Total Delivered Weight: 2866	

Weight of Test Vehicle with Required Dummies and -0- Pounds of Cargo

Right Front: 762 + 9* = 771	Right Rear: 874
Left Front: 820 + 9* = 829	Left Rear: 870
Total Front Weight: 1600	
Total Rear Weight: 1754**	
Total Test Weight: 3354	

Weight of Ballast Secured in Vehicle Trunk Area: 0

* Guide shoe hardware weight 18 lbs. forward of front wheel center line.
** Plus 10 lbs. for tow system tensioning hardware.

Test Conditions

Date of Test: 2/10/82
Time of Test: 1:00 P.M.
Wind Velocity: DNA

Ambient Temperature
at Impact Area: 70 degrees

Test No.: 820210

Project Title: Vehicle Assessment

Date: Feb. 10, 1982
Temperature: 70 degrees

Time: 1:00 P.M.
Wind Velocity: DNA

Subject Vehicle Data

Description:

	<u>Actual</u>	<u>Intended</u>
Test Weight (lbs.)	3354	3364
Vehicle Orientation (degrees)	0	0
Vehicle Velocity (mph)	34.9	35
Maximum Crush (inches)	Right Side 26 9/16	
Static	Left Side 27	

Dummies

	<u>Driver</u>	<u>Middle Passenger</u>	<u>Rt. Front Passenger</u>	<u>Left Rear Passenger</u>	<u>Rt. Rear Passenger</u>
Type	572		572		
Serial No.	392		826		
Instrumentation					
Head Accel.	Yes		Yes		
Chest Accel.	Yes		Yes		
Femur L.C.'s	Yes		Yes		
Other					
Restraint System	FMVSS 209 Type 2				

Remarks:

SUMMARY OF TEST CONDITIONS

TEST VEHICLE INFORMATION:

Vehicle Manufacturer: Volvo Gothenburg Sweden
Make/Model: Volvo / DL
Body Style: 2 Door Sedan; Model Year: 1982
VIN: YV1AX4925C1208444; Build Date: 9-81
NHTSA No.: TRC444; Color: Yellow
Engine Data: 4 cylinders; 130 in³/cc displacement
Transmission Data: 4 speed (X) Manual/ () Automatic W/O-D
Date Vehicle Received by Laboratory: 12-18-81
Dealer's Name & Address: George Byers N. Hamilton Rd., Columbus, Ohio

DATA FROM CERTIFICATION LABEL ON LEFT DOOR REAR FACE OR 'B' POST:

Vehicle Manufactured By: Volvo Gothenburg Sweden
Date of Manufacture: 9-81; VIN: YV1AX4925C1208444
GVWR: 4030 lbs.; GAWR: Front = 1885 lbs.; Rear = 2180 lbs.

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL ON DOOR, POST, GLOVE BOX, ETC.:

Vehicle Load:	FRONT	REAR	RECOMMENDED TIRE SIZE:	LOAD RANGE:
Up to Capacity	<u>3</u> <u>6</u> psi	<u>3</u> <u>6</u> psi	<u>175-R-14</u>	<u>B</u> <u>C</u> <u>D</u>

Vehicle Capacity:
Type of Seats - ☒ Bench
☒ Bucket
☐ Split Bench
CARGO LOAD = ☒ 1 7 0 lbs.
TOTAL = ☐ 9 2 0 lbs.

Number of Occupants = ☐ 2 Front
(Designated Seating Capacity) ☐ 3 Rear
☐ 5 Total

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with max. fluids):

Right Front = ☐ 7 3 5 lbs. Right Rear = ☐ 6 7 7 lbs.
Left Front = ☐ 7 7 9 lbs. Left Rear = ☐ 6 7 5 lbs.
TOTAL FRONT WEIGHT = ☐ 1 5 1 4 lbs. (53 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = ☐ 1 3 5 2 lbs. (47 % of Total Vehicle Weight)
TOTAL DELV. WEIGHT = ☐ 2 8 6 6 lbs.

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 170 lbs. CARGO:

Right Front = ☐ 7 7 1 lbs. Right Rear = ☐ 8 7 4 lbs.
Left Front = ☐ 8 2 9 lbs. Left Rear = ☐ 8 7 0 lbs.
TOTAL FRONT WEIGHT = ☐ 1 6 0 0 lbs. (48 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = ☐ 1 7 4 4 lbs. (52 % of Total Vehicle Weight)
TOTAL TEST WEIGHT = ☐ 3 3 5 4 lbs.
Weight of ballast secured in vehicle trunk area = ☐ 0 lbs.

TEST CONDITIONS:

Date of Test: February 10, 1982; Time of Test: 1:00 AM/PM
Ambient Temperature: 70 °F at impact area.

VEHICLE ATTITUDE: (all dimensions in inches)

Delivered Attitude: RF 9 3/4 ; LF 9 3/4; RR 10 3/4 LR 10 3/4

Test Attitude: RF 2 7/8 ; LF 7 7/16 RR 5 13/16 LR 10 1/4

VEHICLE TIRE DATA:

Recommended Cold Tire Pressure: Front = 36 psi
Rear = 36 psi

Recommended Tire Size: 175-R-14

Load Range: DNA

Tires on Vehicle: Michelin XZX

Is Spare Tire a "Space Saver": Yes (yes/no)

Is Spare Tire standard equipment: Yes (yes/no)

TEST FLUID DATA:

Test Fluid Type: Red Stoddard Solvent #2; Spec. Grav.: 0.764

Kinematic Viscosity: _____

"USEABLE" CAPACITY*: 15.8 Gallons (Furnished By CTM)

Test Volume: 12.7 Gallons (92-94% of USEABLE)

Fuel System Capacity (data from Owner's Manual): 15.8 gal.

Details of fuel system: This was not an objective on this test

Electric Fuel Pump: X Yes; _____ No; Fuel Injection: X Yes; _____ No

Does electric fuel pump operate with ignition switch "on" and the engine not operating: X Yes; _____ No

VEHICLE REBOUND AND CRUSH:

Overall Length of Test Vehicle: Pre-Test = R189 3/4 L189 3/4 inches

CRUSH=R

/L

Post-Test= R63 3/16 L162 5/8 inches

FOR FRONTAL IMPACTS, distance from front of test vehicle to the barrier after impact = Center 1 1/4 inches LF - 1 1/8
RF - 3 7/8

*With entire fuel system filled from fuel tank through carburetor bowl.

VEHICLE TEST WEIGHT CALCULATION

UDW - unloaded delivered weight

VCW - vehicle capacity weight

DSC - designated seating capacity

RCLW - rated cargo and luggage weight

$$VCW - 150 \times DSC = RCLW$$

$$920 - (150 \times 5) 750 = 170$$

$$UDW + RCLW + \text{Number of dummies} \times 164 \text{ lbs.} = \text{Test weight}$$

$$2866 + 170 + (2 \times 164) 328 = 3364$$

VISIBLE DUMMY CONTACT POINTS

Head	<u>Driver</u> <u>Steering Wheel</u>	<u>Passenger</u> <u>Top of Dash</u>
Chest	<u>None</u>	<u>None</u>
Abdomen	<u>None</u>	<u>None</u>
Left Knee	<u>Dash</u>	<u>Dash</u>
Right Knee	<u>Center Console</u>	<u>Dash</u>
<u>DOOR OPENING</u>	<u>FRONT</u>	<u>REAR</u>
	<u>Left</u> <u>Right</u>	<u>Left</u> <u>Right</u>
Easy	_____	_____
Difficult	<u>Yes</u> <u>Yes</u>	_____
Tools Required	_____	_____
<u>SEAT BACK</u>		
Failure	_____	_____
<u>GLAZING DAMAGE</u>		
Windshield	<u>Cracked</u>	
Backlight		_____
Others	<u>No</u> <u>No</u>	<u>None</u> <u>None</u>

SECTION 3

DATA REQUIRED BY R&D AND OAR

The following pages are included in this section:

1. Dummy positional data
2. Vehicle crush data
3. Accelerometer location and data summary
4. High speed camera information
5. Dummy Certification

FRONTAL TESTS ONLY PART 572 DUMMY IN-VEHICLE POSITION

RECORDING SHEET

VEH. NHTSA NO.: 820210; MFR./MAKE/MODEL: Volvo DL 1982

SEAT TYPE: ☐ Bench
☒ Bucket
☐ Split Bench

ADJUSTER TYPE: ☒ Manual
☐ Power

BUCKET SEAT BACK TYPE:
☐ Fixed
☒ Adjustable Reclining

POSITIONING DATE: Feb. 10, 1982; TECHNICIANS: 1. Levan

AMBIENT TEMP.: 70 °F. TIME: 10:45

2. Kokoruda

3. Wills

4. Grumblin

Using the trammel and lateral bar shown in FIGURE 2C or the positioning gage shown in FIGURE 3C, fill in the following information.

DRIVER DUMMY #		PASSENGER DUMMY #	
3	9 2	8	2 6
HEAD TARGET		HEAD TARGET	
24 1/8	55°	25 3/16	58°
KNEE JOINT		KNEE JOINT	
33 3/8	0°	32 5/8	7°
APPROXIMATE "H" POINT		APPROXIMATE "H" POINT	
18 7/8	23°	17 15/16	19°
Fore Midpoint		Fore Midpoint	
Aft		Aft	
Midpoint		Midpoint	
Door Glass Height = 9 1/8		Door Glass Height = 9 1/8	
Left Frt. Door		Right Frt. Door	
Adjustable Pointer Lat. Bar		Adjustable Pointer Lat. Bar	
Using CIR. or PASS. dummy but not both!		Using CIR. or PASS. dummy but not both!	
DRIVER DUMMY #		PASSENGER DUMMY #	
3	9 2	8	2 6
TOP VIEW		TOP VIEW	

*Door glass height is equal on the right and left side of vehicle

SECTION 4
PART 572 DUMMY DATA SUMMARY

	DRIVER DUMMY				Passenger Dummy			
	Positive *		Negative **		Positive *		Negative **	
	Direction		Direction		Direction		Direction	
	Peak	Time	Peak	Time	Peak	Time	Peak	Time
	(G)	(msec)	(G)	(msec)	(G)	(msec)	(G)	(msec)
Head Acceleration								
Longitudinal	14.44	175.25	81.84	77.25	3.87	20.13	24.01	124.25
Lateral	20.33	122.88	5.72	96.88	7.07	150.50	7.07	70.00
Vertical	5.58	138.63	59.52	88.63	2.61	14.75	43.75	99.88
Resultant	94.49	177.25	0.00	9.25	47.69	99.88	0.00	11.63
HIC	545.32 from 76.625 to 99.250 / 380.69 from 45.250 to 150.250							
Chest Acceleration								
Longitudinal	253.55	135.83	333.02	166.00	2.25	179.25	34.70	63.75
Lateral	7.25	74.13	2.13	57.75	8.52	72.25	3.67	150.38
Vertical	14.34	50.63	15.87	80.38	22.97	9.38	54.07	181.88
Resultant (Max)	333.02	166.00	0.07	18.50	54.07	181.88	0.23	183.88
	Peak	Time	Peak	Time	Peak	Time	Peak	Time
	(lb)	(msec)	(lb)	(msec)	(lb)	(msec)	(lb)	(msec)
Femur Loads								
Left	319.46	64.13	140.42	47.63	302.04	62.25	842.09	78.63
Right	236.99	59.63	1107.39	77.63	186.57	58.75	180.79	50.50
Belt Loads								
Lap	N/A							
Torso	N/A							
Vehicle Impact Speed (mph): 34.9								
*Longitudinal:	Forward							
Lateral:	Rightward							
Vertical:	Downward							
**Longitudinal:	Rearward							
Lateral:	Leftward							
Vertical:	Upward							

IMPACTED VEHICLE

VEHICLE MEASUREMENTS		ALL DIMENSIONS IN INCHES	
NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	192 3/8	162 1/2
X2	REAR SURFACE OF VEHICLE TO FIREWALL	140 5/8	DNA
X3	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	125 5/16	125 1/8
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	125 3/16	125
X5	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	127 3/4	128 3/8
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	127 5/8	128 1/4
X7	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	81 7/16	81 3/4
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	81 3/8	81 7/8
X9	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	81 3/16	81 1/8
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	81 3/16	81 1/16
X11	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF RIGHT SIDE	126 1/8	124 15/16
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF LEFT SIDE	126 1/8	124 3/8
X13	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	140 5/8	DNA
X14	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	140 1/4	137
X15	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	113	111 5/8
X16	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	189 3/4	163 3/16
X17	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	189 5/8	162 5/8
X18	REAR OF WINDOW HEADER TO STEERING WHEEL CENTER	17 1/4	18 1/4

MEASUREMENT TABLE FOR FRONTALLY IMPACTED VEHICLES

IMPACTED VEHICLE

VEHICLE MEASUREMENTS

ALL DIMENSIONS
IN INCHES

NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X19	SILL TO GROUND PLANE LEFT FRONT	27 1/2	30 3/4
X20	SILL TO GROUND PLANE RIGHT FRONT	27 1/2	27
X21	SILL TO GROUND PLANE LEFT REAR	25 1/2	26 1/4
X22	SILL TO GROUND PLANE RIGHT REAR	25 1/2	20 1/8

VEHICLE NUMBER TRC444 TEST NUMBER 820210

TEST TECHNICIANS

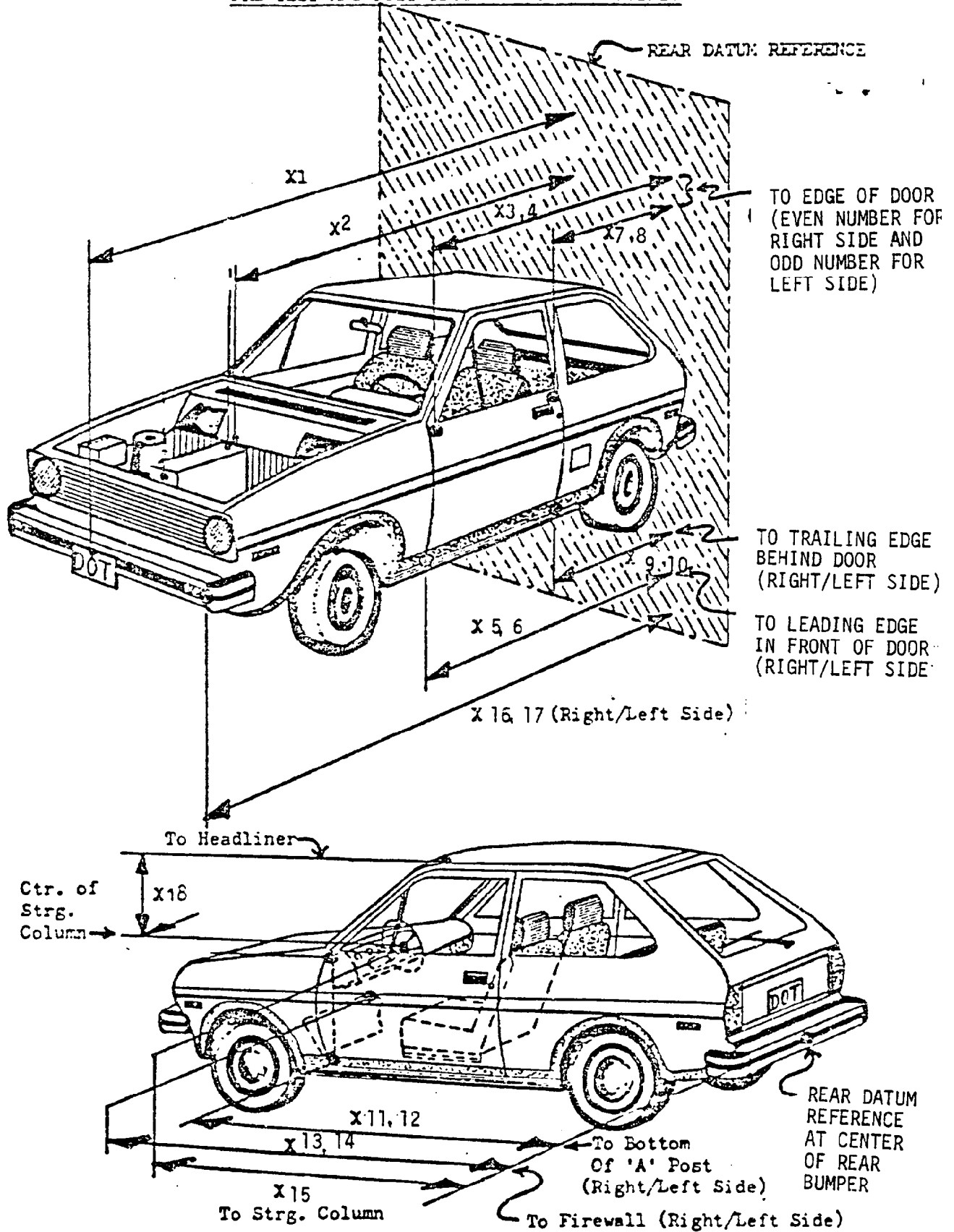
J. M. Johnson

J. Clay

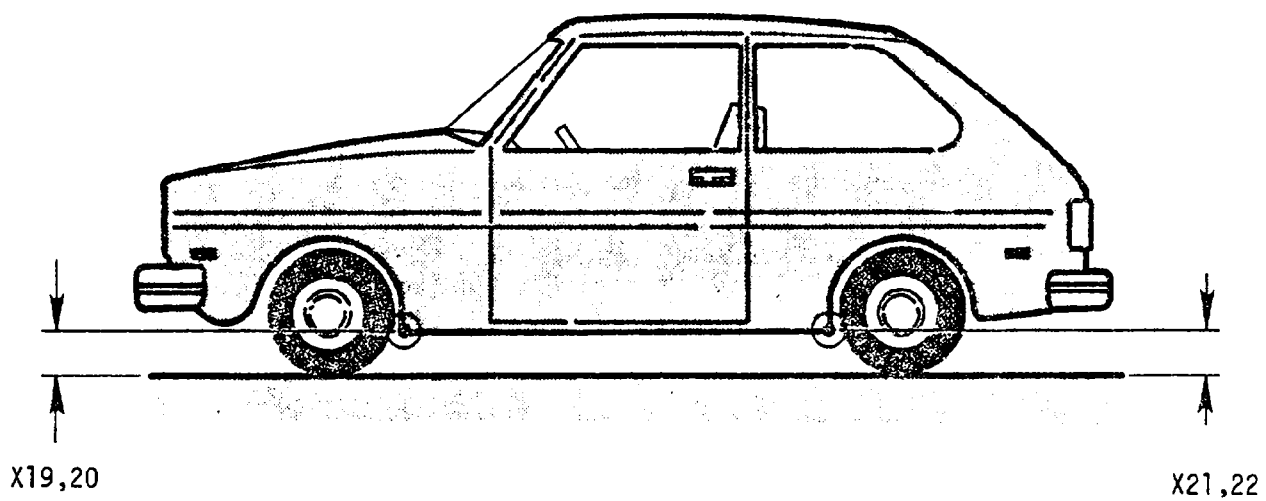
TEST ENGINEER

J. E. Farnon

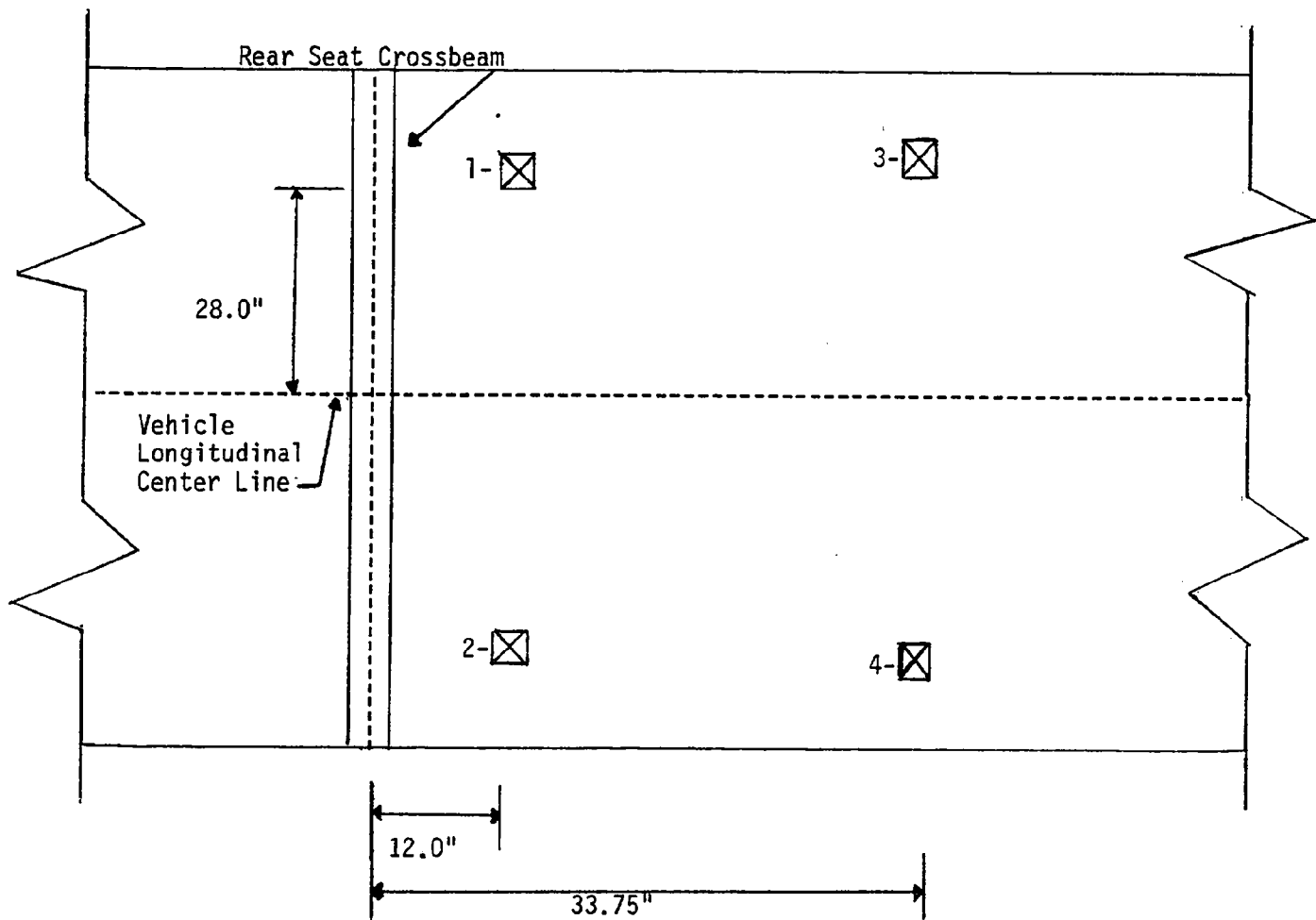
PRE-TEST AND POST-TEST MEASUREMENT POINTS



SILL HEIGHT MEASUREMENT POINT



ACCELEROMETER PLACEMENT



VOLVO

SRL-48

Jack Favors

DATE 1/4/82

[illegible]

HIGH SPEED CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Overhead	Photosonic	25 mm	1000	Crush analysis
2	Passenger side-front 3/4 view	Photosonic	25 mm	1000	Analysis of dummy movement and windshield crush
4	Drivers side-full sideview	Photosonic	13 mm	1000	Crush analysis
5	Passenger side - overall view	Kodak K-100	16 mm	24 (real-time)	Overall view of crush
9	Drivers side-front 3/4 view	Photosonic	17 mm	1000	Analysis of dummy movement
10	Passenger side - sideview	Photosonic	17 mm	1000	Analysis of dummy movement

NOTE: CAMERAS ARE NUMBERED ACCORDING TO SPLICING SEQUENCE OF FILM.
(24 fps) REAL TIME MOVIE FILM COVERAGE OF PRE-CRASH, POST-CRASH
AND CRASH EVENT SPLICED AT START AND END OF FILM.

HIGH SPEED CAMERA INFORMATION

CAMERA NO.	CAM/MAG	X	Y	Z
1	1439 - 1144	15'	4'	N/A
2	1440 - 1148	14' 9"	-1'	38"
4	1437 - 1145	24' 8"	7'	45"
5*	Kodak K-100	48'	19'	5'
9	1444 - 1150	36' 6"	1' 5"	43"
10	1438 - 1142	13' 7"	1' 8"	45"

* Real-time

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

50TH PERCENTILE ADULT MALE (PART 572)

Dummy S/N VRTC
392, SRL 48

Manufacturer Humanoid

Date Jan. 6, 1982

Description	Specification	Actual
Sitting Height	35.7" $\pm$.1"	35.62"
Shoulder Pivot Height	22.1" $\pm$.3"	22.2"
Hip Pivot Height	3.9" (ref.)	3.9"
Hip Pivot From Backline	4.8" (ref.)	4.8"
Knee Pivot From Backline	20.4" $\pm$.3"	20.6"
Rear of Head From Backline	1.7" (ref.)	1.7"
Chest Depth	9.3" $\pm$.2"	9.5"
Shoulder Width	18.1" $\pm$.3"	18.0"
Chest Circumference Over Nipples	37.4" $\pm$.6"	37.6"
Waist Circumference at Min. Girth	32.0" $\pm$.6"	31.9"
Hip Width	14.7" $\pm$.7"	15.1"
Knee Pivot From Floor	19.6" $\pm$.3"	19.5"

Pass/Fail Pass

Weight 161.3 lbs.

COMMENTS: _____

Technician R. E. Lora Date Jan. 6, 1982

Test Engineer J. B. Blaker Date Jan. 6, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Jan. 7, 1982 Time of Test 1715 hrs.

Ambient Temperature 72° F Relative Humidity 44%

Test No. 01

Deflection Angle	Specification	Test Results
0°	0 lbs.	0
20°	22 - 34 lbs.	25
30°	34 - 46 lbs.	40
40°	46 - 58 lbs.	50

Pass/Fail Pass

Starting Reference Angle 0°

Return Angle 10.5°

Net Return Angle 10.5°

COMMENTS:

Technician R. E. Levan Date Jan. 7, 1982

Test Engineer J. L. Blaker Date Jan. 7, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Jan. 7, 1982 Time of Test 1745 hrs.

Ambient Temperature 71° F Relative Humidity 42%

Test No. 01

Specification		
Displacement (inches)	Force (lbs.)	Test Results
0	10	10
1.00	50 - 63	58
1.30	73 - 88	81.5

Pass/Fail Pass

COMMENTS:

Technician R. E. LeVan Date Jan 8, 1982

Test Engineer J. B. Blaker Date Jan 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 392 Manufacturer Humanoid
 Test Date Jan. 8, 1982 Time of Test 1315 hrs.
 Ambient Temperature 70° F Relative Humidity 40%
 Test No. 01

Test Parameter	Specification	Test Results
Peak Resultant Acceleration	210 - 260 G	220.3
Time Above 100 G Level	0.9 - 1.5 ms.	1.34
Peak Lateral Acceleration	10 G max.	7.7
Is Acceleration Curve Unimodal?		yes

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Jan 8, 1982
 Test Engineer J. L. Blaker Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1650 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01 Left or Right Knee Left

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.90
Peak Force	1,850 - 2,500 lbs.	2,279
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.754

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blake Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1830 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01 Left or Right Knee Right

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,374
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.755

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. Lavan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1635 hrs.

Ambient Temperature 73°F Relative Humidity 50%

Test No. 01

LOW SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	14.0 fps	13.99
Peak Deflection	1.1 inches max.	1.021
Peak Resistive Force	1,450 pounds max.	1,304
Internal Hysteresis	50% - 70%	57.4%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1730 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01

HIGH SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	22.0 fps	22.02
Peak Deflection	1.7 inches max.	1.590
Peak Resistive Force	2,250 pounds max.	2,008
Internal Hysteresis	50% - 70%	57.9%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392

Manufacturer Humanoid

Test Date Jan. 30, 1982

Time of Test 1400 hrs.

Ambient Temperature 73° F

Relative Humidity 48%

Test No. 01

Test Parameter	Specification	Test Results
Pendulum Velocity	21.5 - 25.5 fps	22.06 fps
Pendulum Deceleration: $T_1 - T_2$: 5 - 20 G	3 ms. max.	3.0
$T_2 - T_3$: 20 - 20 G	25 - 30 ms.	28.375
$T_3 - T_4$: 20 - 5 G	10 ms. max.	3.625
Avg. G Level $T_2 - T_3$	20 - 24 G	21.84
Rotation Angle	63 - 73 degrees	65.53
Peak Head Resultant Acceleration	26 G max.	24.9

Test Parameter	Specification		Test Results	
Rotation Angle (degrees)	Time (ms.)	Chordal Dis- placement (in.)	Time (ms.)	Chordal Dis- placement (in.)
0	0	-0.5 - +0.5	0	
30	25.6 - 34.4	2.1 - 3.1	31.125	2.73
60	40.3 - 51.7	4.3 - 5.3	49.875	5.14
max.	53.2 - 66.8	5.0 - 6.0	62.375	5.62
60	67.0 - 83.0	4.3 - 5.3	74.625	5.24
30	85.4 - 104.6	2.1 - 3.1	97.75	2.60
0	101.0 - 123.0	-0.5 - +0.5	115.0	0.12

Pass/Fail Pass

Neck Base - Head CG = 5.99"

*Indicates failure to meet specifications.

COMMENTS: _____

Technician R. E. LeVan

Date Jan. 30, 1982

Test Engineer J. S. Blaker

Date Jan. 30, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

50TH PERCENTILE ADULT MALE (PART 572)

Dummy S/N VRTC
826, SRL 48

Manufacturer Alderson

Date Jan. 6, 1982

Description	Specification	Actual
Sitting Height	35.7" $\pm$.1"	35.75"
Shoulder Pivot Height	22.1" $\pm$.3"	22.2"
Hip Pivot Height	3.9" (ref.)	3.9"
Hip Pivot From Backline	4.8" (ref.)	4.8"
Knee Pivot From Backline	20.4" $\pm$.3"	20.75"
Rear of Head From Backline	1.7" (ref.)	1.7"
Chest Depth	9.3" $\pm$.2"	9.25"
Shoulder Width	18.1" $\pm$.3"	18.1"
Chest Circumference Over Nipples	37.4" $\pm$.6"	37.9"
Waist Circumference at Min. Girth	32.0" $\pm$.6"	31.9"
Hip Width	14.7" $\pm$.7"	15.37"
Knee Pivot From Floor	19.6" $\pm$.3"	19.65"

Weight 161.3 lbs.

Pass/Fail Pass

COMMENTS: _____

Technician R. E. LeVan Date Jan. 6, 1982

Test Engineer J. L. Blaker Date Jan. 6, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 7, 1982 Time of Test 1640 hrs.

Ambient Temperature 72° F Relative Humidity 45%

Test No. 01

Deflection Angle	Specification	Test Results
0°	0 lbs.	0
20°	22 - 34 lbs.	30
30°	34 - 46 lbs.	45
40°	46 - 58 lbs.	58

Pass/Fail Pass

Starting Reference Angle 0°

Return Angle 11.1°

Net Return Angle 11.1°

COMMENTS:

Technician R. E. LeVan Date Jan 7, 1982

Test Engineer J. L. Blaker Date Jan. 7, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 7, 1982 Time of Test 1855 hrs.

Ambient Temperature 70°F Relative Humidity 42%

Test No. 01

Specification		
Displacement (inches)	Force (lbs.)	Test Results
0	10	10
1.00	50 - 63	60
1.30	73 - 88	80

Pass/Fail Pass

COMMENTS:

Technician R. E. LeVan Date Jan 8, 1982

Test Engineer J. L. Blaker Date Jan 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 8, 1982 Time of Test 1420 hrs.

Ambient Temperature 71°F Relative Humidity 40%

Test No. 01

Test Parameter	Specification	Test Results
Peak Resultant Acceleration	210 - 260 G	235.5
Time Above 100 G Level	0.9 - 1.5 ms.	1.23
Peak Lateral Acceleration	10 G max.	9.4
Is Acceleration Curve Unimodal?		yes

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. Loken Date Jan 8, 1982

Test Engineer J. L. Blaker Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 1, 1982 Time of Test 2000 hrs.

Ambient Temperature 72°F Relative Humidity 52%

Test No. 01 Left or Right Knee Left

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,319
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.767

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 1, 1982 Time of Test 1945 hrs.

Ambient Temperature 72°F Relative Humidity 52%

Test No. 01 Left or Right Knee Right

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,318
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.798

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 826 Manufacturer Alderson
 Test Date Feb. 2, 1982 Time of Test 0850 hrs.
 Ambient Temperature 71°F Relative Humidity 51%
 Test No. 01

LOW SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	14.0 fps	13.99
Peak Deflection	1.1 inches max.	0.923
Peak Resistive Force	1,450 pounds max.	1,360
Internal Hysteresis	50% - 70%	59.4%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 2, 1982
 Test Engineer J. L. Blaker Date Feb. 02, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 826 Manufacturer Alderson
 Test Date Feb. 2, 1982 Time of Test 1003 hrs.
 Ambient Temperature 72°F Relative Humidity 53%
 Test No. 01

HIGH SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	22.0 fps	22.01
Peak Deflection	1.7 inches max.	1.467
Peak Resistive Force	2,250 pounds max.	2,137
Internal Hysteresis	50% - 70%	60.9%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 2, 1982
 Test Engineer J. L. Blaker Date Feb 02, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 826 Manufacturer Alderson
 Test Date Feb. 1, 1982 Time of Test 1130 hrs.
 Ambient Temperature 72°F Relative Humidity 52%
 Test No. _____

Test Parameter	Specification	Test Results
Pendulum Velocity	21.5 - 25.5 fps	21.9
Pendulum Deceleration: T ₁ - T ₂ : 5 - 20 G	3 ms. max.	2.259
T ₂ - T ₃ : 20 - 20 G	25 - 30 ms.	27.135
T ₃ - T ₄ : 20 - 5 G	10 ms. max.	3.08
Avg. G Level T ₂ - T ₃	20 - 24 G	22.9
Rotation Angle	63 - 73 degrees	65.68
Peak Head Resultant Acceleration	26 G max.	26.0

Test Parameter	Specification		Test Results	
Rotation Angle (degrees)	Time (ms.)	Chordal Dis- placement (in.)	Time (ms.)	Chordal Dis- placement (in.)
0	0	-0.5 - +0.5		0.07
30	25.6 - 34.4	2.1 - 3.1	29.625	2.56
60	40.3 - 51.7	4.3 - 5.3	47.25	4.63
max.	53.2 - 66.8	5.0 - 6.0	57.125	5.08
60	67.0 - 83.0	4.3 - 5.3	71.0	4.70
30	85.4 - 104.6	2.1 - 3.1	91.625	2.42
0	101.0 - 123.0	-0.5 - +0.5	107.75	0.078

Pass/Fail Pass Neck Base to Head CG = 5.93"

*Indicates failure to meet specifications.

COMMENTS: _____

Technician R. E. LeVan Date Feb. 1, 1982
 Test Engineer J. L. Blaker Date Feb. 01, 1982

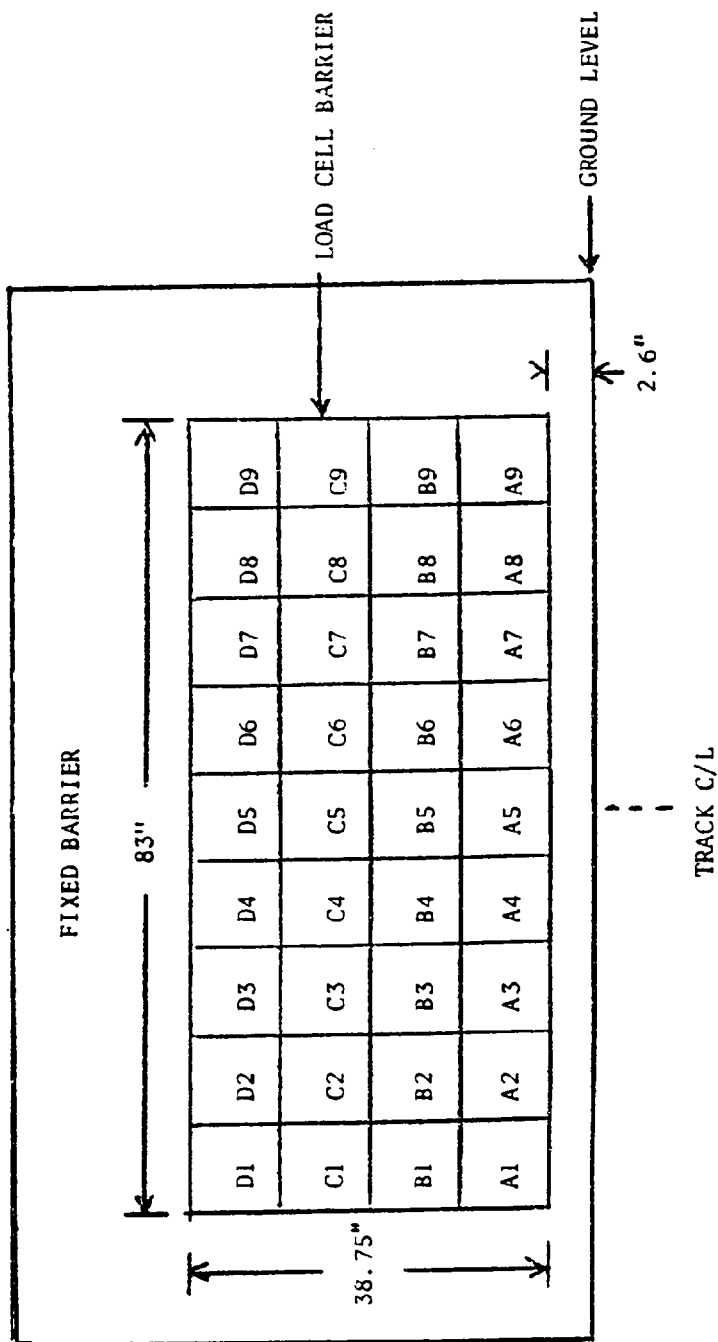
Load Cell Barrier Face

The fixed, segmented barrier was instrumented with 36 load cells to provide an axial force-time history mapping during the impact. The load cell configuration employed is depicted on the following page. Data recorded by these sensors are presented in Appendix B.

Due to limitations of the data aquisition system, only 22 of the 36 load cells, on the load cell barrier face were recorded.

36 LOAD CELLS
4 ROWS
9 COLUMNS

FRONT VIEW



BARRIER LOAD CELL CONFIGURATION

SECTION 4

PRE & POST TEST PHOTOGRAPHS



Figure4-1. PRE TEST - OF VEHICLE



Figure 4-2. PRE TEST - DUMMY IN DRIVER POSITION



Figure 4-3. PRE TEST - DUMMY IN PASSENGER POSITION

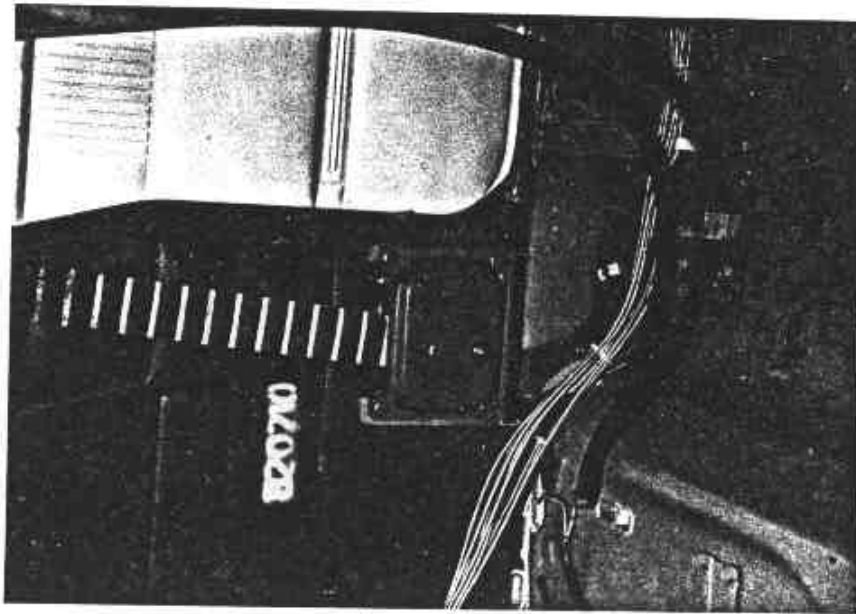


Figure 4-4. POST CRASH - DRIVER SIDE TETHER STRAP

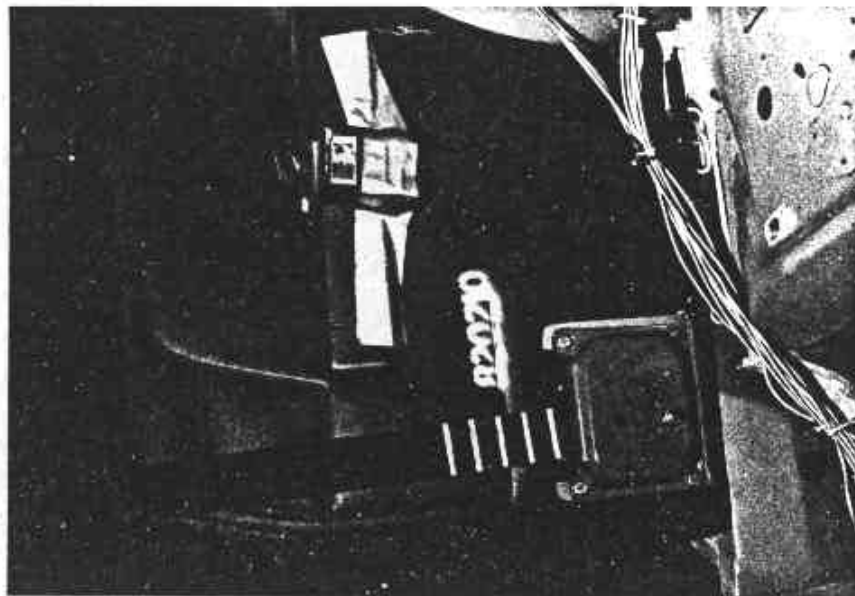


Figure 4-5. POST CRASH - PASSENGER SIDE TETHER STRAP



Figure 4-6. POST CRASH - LEFT FRONT DUMMY



Figure 4-7. POST CRASH - RIGHT FRONT DUMMY

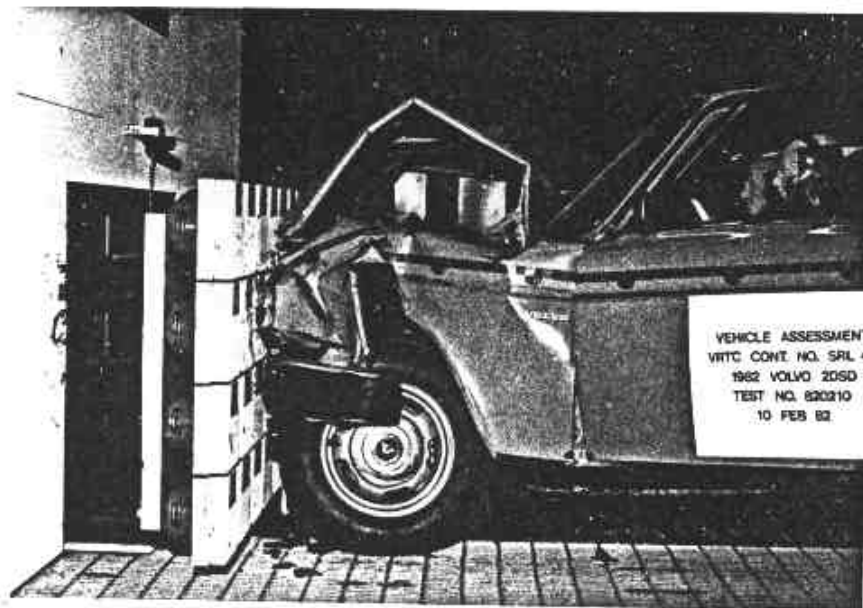


Figure 4-8. POST CRASH - LEFT FRONT OF VEHICLE

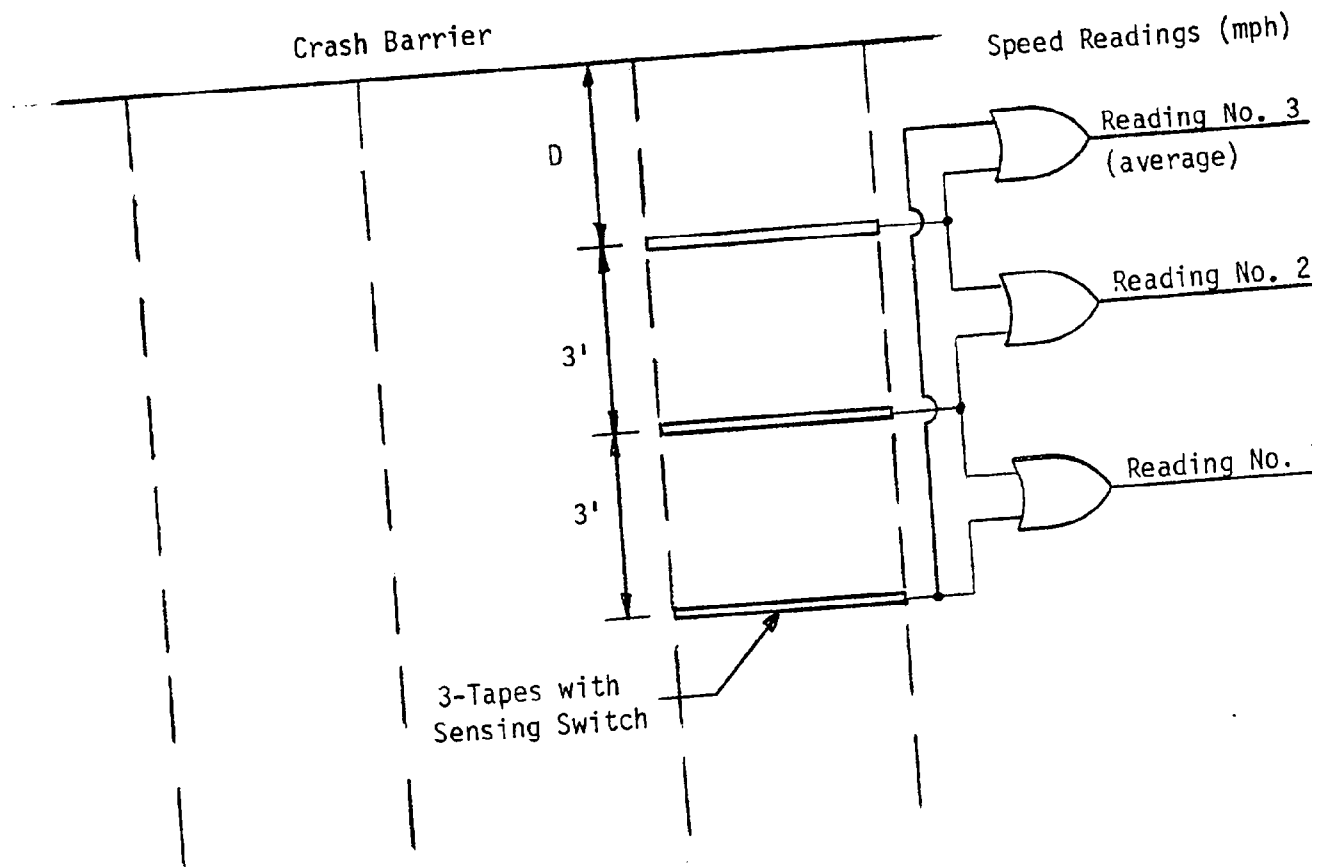


Figure 4-9. POST CRASH - RIGHT FRONT OF VEHICLE



Figure 4-10. CRASH EVENT PHOTOGRAPH

APPENDIX A
TEST PROCEDURE AND OBJECTIVE



D = Distance from bumper to center of tire - plus 2 inches

IMPACT VELOCITY MEASURING SYSTEM

Vehicle Weight

The weights of the test vehicle are determined by placing each wheel on a KG Law Air Bearing Force Plate, certified with test weights scaled to National Bureau of Standards Class B tolerances

Dummy Positioning

The following table summarizes the steps taken to position the instrumented, calibrated dummies in the test vehicle. The dummies were kept in a temperature-controlled enclosure at the head of the track until t-30 seconds. The temperatures both in the enclosure, and the outside ambient temperature were recorded immediately prior to rollout.

Objectives

The objectives of this vehicle assessment test were:

To measure the dynamic responses, acceleration, velocity, and deformation of vehicles and dummies during impact modes that are representative of real world automobile crashes.

To evaluate the performance of late model production or modified automobiles with respect to their crash survivability in this crash mode.

To evaluate the protection performance of the restraint device by full-scale impact tests.

DUMMY PLACEMENT AND POSITIONING

Part 572 Dummy

	<u>Driver DSP</u>	<u>Passenger DSP</u>
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 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.

DUMMY PLACEMENT AND POSITIONING (CONTD)

Part 572
DUMMY

	<u>Driver DSP</u>	<u>Passenger DSP</u>
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, longitudinal, 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.
LEFT KNEE	Outer surface of pivot bolt head is 5.9" from midsagittal plane of dummy.	Located as above.
LOWER LEGS (tibias)	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 underpressed accelerator 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 toeboard--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.

TEST EQUIPMENT LIST & FUNCTION

<u>ITEM</u>	<u>MANUFACTURE</u>	<u>MODEL</u>	<u>PURPOSE</u>
Speed Trap	Digitec & Tapeswitch	8211 None	Determine impact speed in mph by using a programmable comput- ing rate monitor , using a start and stop signal.
Speed Control	Reliance & Hale & Kullgren	None	Precision control of drive cable using a computer, D.C. Motor and Cable Drive Stand.
High-Speed Motion Picture Cameras	Photosonics	16-1B	Used for side & overload film coverage.
Motion Picuture Camera			Panning & Documentation
Still Camera			Documentary photo coverage
10,000 & 1000 Hz Time Code Generator	TRC of Ohio	None	Furnish timing signal for high- speed cameras.
Anthropomorphic Dummies			

CRASH TEST FACILITY

Introduction

A multipurpose Crash Test Facility is in operation at TRC. The facility is located adjacent to the existing Impact Simulator Building, which houses a 24 inch Hyge Sled. The Crash Test Facility provides one of the most sophisticated laboratory environments in the world for engineers, scientists and safety designers to study the dynamics of vehicle crashes. Figure 1 is an aerial photograph of the facility. Descriptions of various parts of the facility are given below.

Barrier Building

The Barrier Building is an 80-foot by 100-foot heated and ventilated pre-engineered metal building with a 26-foot wide access door (See Figure 2). The Barrier Building contains the barrier, an underground camera pit, an enclosed data acquisition room, an observation deck and the operator's console area.

The barrier is 125 cubic yards of reinforced concrete (See Figure 3). It is designed to absorb less than one percent of the kinetic energy of vehicles weighing 10,000 pounds traveling at 60 mph. The barrier is 25-feet high, 15-feet wide and 9-feet thick. Ten-and-one-half-feet of the barrier is above the floor level while 14-1/2-feet is below floor level. A 1-1/2 inch steel face plate is attached to the front of the barrier. An underground camera pit is located in front of the barrier face. The pit is 24-feet long, 12-feet deep and 8-feet wide with a 4-foot wide unobstructed view of the bottom of the vehicle.

Located above the camera pit are the overhead camera lights. There are 336-1500 watt tungsten-halogen (quartz) lights each providing 35,800 lumens. This is sufficient for color photography at 1000 frames per second. Located in the camera pit are 84-1000 watt tungsten-halogen (quartz) lights. These also provide enough light for color photography at 1000 frames per second.

An 18-foot by 20-foot enclosed climate controlled (nominally 70 degrees F) data acquisition room houses all the high speed recording electronics. All cable routing in the data acquisition room is done below the access flooring.

Located in front of the data acquisition room is an 18-foot by 13-1/2-foot operator's console area (See Figure 4). From here the operator has a clear view of the barrier. A closed circuit video system gives the operator a 12 inch color picture of the car and track area. The video camera controls for pan, tilt and zoom are located on the operator's console.

Tow Road

The barrier track is a 564-foot asphalt roadway running into the barrier.

It is lighted for round the clock operation and is designed for year round operation (See Figure 5).

Drive System

The mechanical equipment room houses three (3) 27 ton cable drive systems (See Figure 6), three (3) 1000 HP d.c. electric motors, three (3) lubrication pumps, three (3) hydraulic pumps and an air compressor. The cable drive consists of three (3) spools that have the 5/8 inch wire rope cable threaded through them. Each spool has several loops of the cable with approximately 270 degrees of wrap per loop. The three (3) spools act as a single inertial mass to assure negligible cable slippage. The electrical equipment room is 47-feet long and 12-feet wide. It houses the transformer, motor controllers and the drive computer (See Figure 7).

Drive Control Computer

The drive control computer is operated from a video terminal at the operator's console located in the barrier building. The computer is programmed to perform seven (7) test types: (1) Barrier Only, Parked Vehicle; (2) Movable Only; (3) Remote Only; (4) Barrier (against the barrier); (5) Head-On; (6) Acute Angle and (7) Obtuse Angle. The computer determines which of the three (3) tracks to energize based upon this input data. Car-to-car crashes can be done with each vehicle moving at a different speed by using the computer. The computer is designed to control the speed of the vehicles to ± 0.1 mph. The computer calculates the release velocity of each test vehicle based on its impact velocity, weight, frontal area, free-rolling distance, umbilical drag factor and length constant and the wind velocity. It prescribes velocity and position profiles for the vehicles based on release velocities, acceleration curves, drive system control criteria and test input data. The slower vehicle is required to be located at a mid-track position. The computer calculates the minimum starting position (feet) of the slower vehicle based on its profiles.

The computer, based on input conditions, calculates for each vehicle the latest point at which it can be aborted without being released from the track. The latest of the two (2) points represents the latest time that the test may be safely aborted and is defined as the abort decision point. The computer cannot initiate an abort command after the abort decision point.

The computer calculates point values of the velocity and position errors allowed throughout the test (for each vehicle). The values are based on error window input data and required drive system control criteria. Errors detected during the test, between actual and reference values, are periodically compared with allowable preset values in order to provide an abort command when the vehicles fall outside the permitted tolerances. The window values keyed in represent the final allowable test tolerances. Actual errors must fall and remain within window values at the end of the stabilization period.

The computer assumes control of the test upon receiving a signal from the time-contacts of the launch warning relay. Receipt is acknowledged by sending a signal back to the relay system which is used to lockout all console controls, except the abort and vehicle brake commands. The lockout signal remains until the system has come to rest after the test.

The computer accelerates the vehicle to approximately final velocity using an "S" shaped velocity profile as a reference. The computer switches to a proportional plus integral position and velocity control when either one of two conditions exist. They are: (1) the vehicle has attained final velocity or (2) the vehicle position error signal passes through zero.

During the test, from the time of initial movement to the end of the test, the computer compares the speeds of the jackshaft mounted shaft encoder and the position shaft encoder. If the difference exceeds a prescribed value, representative of slippage between the towing cable and the driving drums, the computer initiates an automatic abort command. The computer continually checks for velocity and position errors. The shaft encoders which are part of a feedback loop with the computer provide actual readings that are compared with desired values to give these errors. The computer then corrects the velocity or position of the vehicle. If the errors are beyond prescribed limits, an abort is initiated. If an abort is initiated by the computer, the cause is displayed on the operator's video terminal. When a manual abort command is initiated, the computer shuts down the drive system and applies the vehicle brakes.

During the period of obtaining release velocity and vehicle releases, the computer continuously adjusts the position register (controlled by the shaft encoder) to account for the towing cable's stretch, so that the register represents "true" vehicle position.

The computer provides a contact opening at the calculated release point. This signal is utilized to lockout the vehicle brake command. The computer provides a contact opening at a time equal to the calculated release point, plus the calculated free rolling time, plus an operator adjustable time delay after impact. This signal is used as an automatic vehicle brake override command in the event the operator fails to brake the vehicle after impact.

At the calculated release position, plus the prescribed time delay to allow for any possible inaccuracy between the actual vehicle position and the position "seen" by the computer, the computer directs the drive system to stop. This signals the end of the test.

Data Acquisition System

The data acquisition system was built by Metraplex Corporation (See Figure 8). It is capable of acquiring up to 168 channels of vehicle impact response data from one or more vehicles, using a ruggedized FM multiplex data system mounted in the test vehicle. These data measurements are recorded on a Honeywell 101-14 Track Direct Tape Recorder. Signal conditioning is provided to condition piezoresistive accelerometers, piezoelectric accelerometers, strain gages, thermocouples EMF Signals, potentiometric transducer inputs. Real time and post processing data playback equipment are provided to display acquired data for analysis. An integral part of the playback system is an automatic calibration system for end-to-end calibration of the vehicle data acquisition system. The data acquisition system consists of four major subsystems. The subsystems are: (1) the vehicle instrumentation subsystem including six ruggedized 28 channel FM multiplexers with signal conditioning and one 30 channel ruggedized portable signal conditioning box; (2) a laboratory FM multiplex system capable of multiplexing 28 data measurements; (3) a laboratory demultiplex system to display 7 data measurements; (4) and an automatic calibration subsystem for real time calibration of the vehicle instrumentation subsystem and local calibration of the laboratory multiplex and demultiplex.

The basic method for acquiring data in the data acquisition system is FM multiplexing. A 7 channel FM multiplex format is used for the vehicle multiplexer and the laboratory FM multiplex subsystem. The multiplex structure has the following carrier frequency and deviations:

Data Channel No. 1	96KHz + 4KHz
Data Channel No. 2	112KHz + 4KHz
Data Channel No. 3	128KHz + 4KHz
Data Channel No. 4	144KHz + 4KHz
Data Channel No. 5	160KHz + 4KHz
Data Channel No. 6	176KHz + 4KHz
Data Channel No. 7	192KHz + 4KHz

Each multiplexer has a reference signal multiplexed with the channels for tape speed compensation during tape recorder playback. This reference frequency is 240KHz. Additionally, the vehicle multiplexers provide an auto command channel to transmit calibration commands to the laboratory demultiplex system to initiate. This command frequency is 16 KHz.

The vehicle multiplexer and the portable signal conditioning box are ruggedly designed to withstand vibrations and accelerations associated with crash barrier testing up to 60 mph. The housing is designed to mount directly to the vehicle structure without additional shock absorption protection.

Random frequencies up to 15 g's RMS over a frequency range of 5Hz to 20KHz, and impact shock up to 250 g's peak for 400 ms are tolerable. Each multiplexer and portable signal conditioning box are self contained in a ruggedized box 17 inches wide by 10 inches deep by 5-1/2 inches tall.

Interchangeable plug-in signal conditioning modules are available for both the vehicle multiplexer and portable conditioning box. The following quantities and types of conditioners are available:

- 75 - Strain Gage Conditioners
- 75 - Piezoresistive Accelerometer Conditioners
- 6 - Potentiometric Conditioners
- 6 - Piezoelectric (charge) Accelerometer Conditioners
- 8 - Thermocouple Conditioners
- 13 - EMF Conditioner

Each conditioner is a plug-in module fully interchangeable with any other module.

The data from the data acquisition system is recorded on a Honeywell 101 Magnetic Tape Recorder/Reproducer. It is capable of bidirectionally recording and reproducing up to 14 channels of data FM or Direct in any combination. The FM electronics are capable of conversion between Intermediate Band (40KHz) and Wide Band group 1 (80KHz) electronics. The Direct electronics are capable of Intermediate Band operation, i.e., 600 KHz at 120 IPS. The tape recorder is capable of handling 1/2 inch and 1 inch tape in thicknesses of 0.7, 1 and 1.5 mils. An internal calibration subsystem is available on the tape system. It is possible with the calibration subsystem to calibrate the FM and Direct data electronics without cable interconnection or external test equipment. A Moxon, Inc., Model 175 Time Code Generator/Translator provides the timing signals for the Honeywell 101 Magnetic Recorder. The time code used IRIG B. The carrier frequencies are 100KHz, 1KHz or 10KHz.

Analog to Digital Converter and Computer System

The data from the data acquisition system is digitized on the analog to digital converter. The converter digitizes 8 channels simultaneously at a conversion rate of 8KHz per channel. This digitized data is fed into a Digital Equipment Corp. VAX 11/780 (See Figure 9) computer system. The computer has 1.5 megabytes of main memory, a tape drive system, dual floppy disk system and a 256 megabyte hard disk. Three (3) video terminals and a graphics video terminal along with a 600 line per minute printer/plotter provide the input/output capabilities of the computer system. The computer system is capable of providing magnetic tapes in the NHTSA Crash Test Data Base Format.

Data Acquisition and Reduction Equipment

Transducers:

1. Accelerometers, Bell & Howell (CEC) 4-202-0001.
2. Accelerometers, Endevco, 7267C-750, 2260C-750, 7232C-750.
3. Pressure Transducers, Bell & Howell (CEC) 40326-0001.
4. Pressure Transducers, Statham PA 288TC-50-350.
5. Femur Load Transducers, GSE 2430.
6. Seat Belt Load Transducers, LeBow, 3419-3.5K.
7. Load Cells, LeBow 3157, 3124.
8. Displacement Transducers - Bourne 80294.
9. Displacement Transducers - Celesco PT101.

Signal Conditioners:

1. Bell & Howell, Model 8-114.
2. Endevco, Model 7740.

FM Multiplex System

Metraplex Corp.; Vehicle Data Multiplexers:

1. 84 - Model 340-1 dual conditioner/VCO cards
2. 75 - Model 340A strain gage conditioners
3. 75 - Model 340B piezoresistive conditioners
4. 6 - Model 340C potentiometric conditioners
5. 13 - Model 340D EKMF conditioners
6. 6 - Model 340F charge conditioners
7. 8 - Model 340G thermocouple conditioners
8. 168 - Model 304C high level VCO; external controllers
16 - 96, 112, 128, 244, 160, 176, 192, HKz(+4KHz)
9. 6 - Model 331 reference mixer cards with reference oscillator
(240KHz+8KHz)
10. 6 - Model 344 conditioner calibration cards
11. 6 - Model 304 high level VCO, internal controls - 16KHz +4KHz

Portable Conditioning Box:

1. 16 - Model 314 buffer amplifiers - +10V @ 10mV output
2. 8 - Model 340-1 dual conditioner/VCO cards

Laboratory FM Multiplex Subsystem:

1. 9 - Model 120-01 FM demodulators
2. 9 - Model 120-12 channel selector - IRIG CBW
1 - 16, 96, 112, 128, 144, 160, 176, 192 HKz (+4KHz)
3. 29 - Model 120-55 filters
7 - 3 pole constant amplitude, SAE class 60, 180, 600, 1000 & 1-2KHz
4. 1 - Model 120-51 reference output filter; plus associated power
supplies, housings, and autocalibration equipment.

Tape Deck

Honeywell Model 101 Fourteen (14) Track Intermediate Band, Direct Recording Tape System.

Oscilloscope

Honeywell Model 1858. Twelve (12) Channels with Model 1883A-MPD Medium Gain Differential Amplifier Modules.

Data Reduction System

DEC VAX 11/780 Computer System, 32 bit processor with 1.5 megabytes of main memory, Model TU77 tape transport, Model RM05-256 megabyte hard disk, Model RX211 dual floppy disk, floating point processor, battery backup, Model LXY21-600 LPM printer/plotter, Model VT105 Waveform graphics terminal, Hewlett Packard Model 7221T 8-pen plotter: Moxon Model 175 Time Code Generator/Translator, IRIG B format. The data reduction system accepts the analog data played back from the tape deck, digitizes the data, applies gain factors, scaling normalization for calibration constants and provides X-Y plots and tabulated data on high speed oscilloscope. The system records the data on a digital magnetic tape in NHTSA Crash Test Data Base Format.

A/D Conversion

The analog to digital conversion system is a Tustin Model 21133-8S. The digitizing sampling rate is up to 32,000 samples/second on 8 channels. Each of the 8 channels has a simultaneous sample and hold amplifier. The maximum system throughput is 250,000 samples per second.

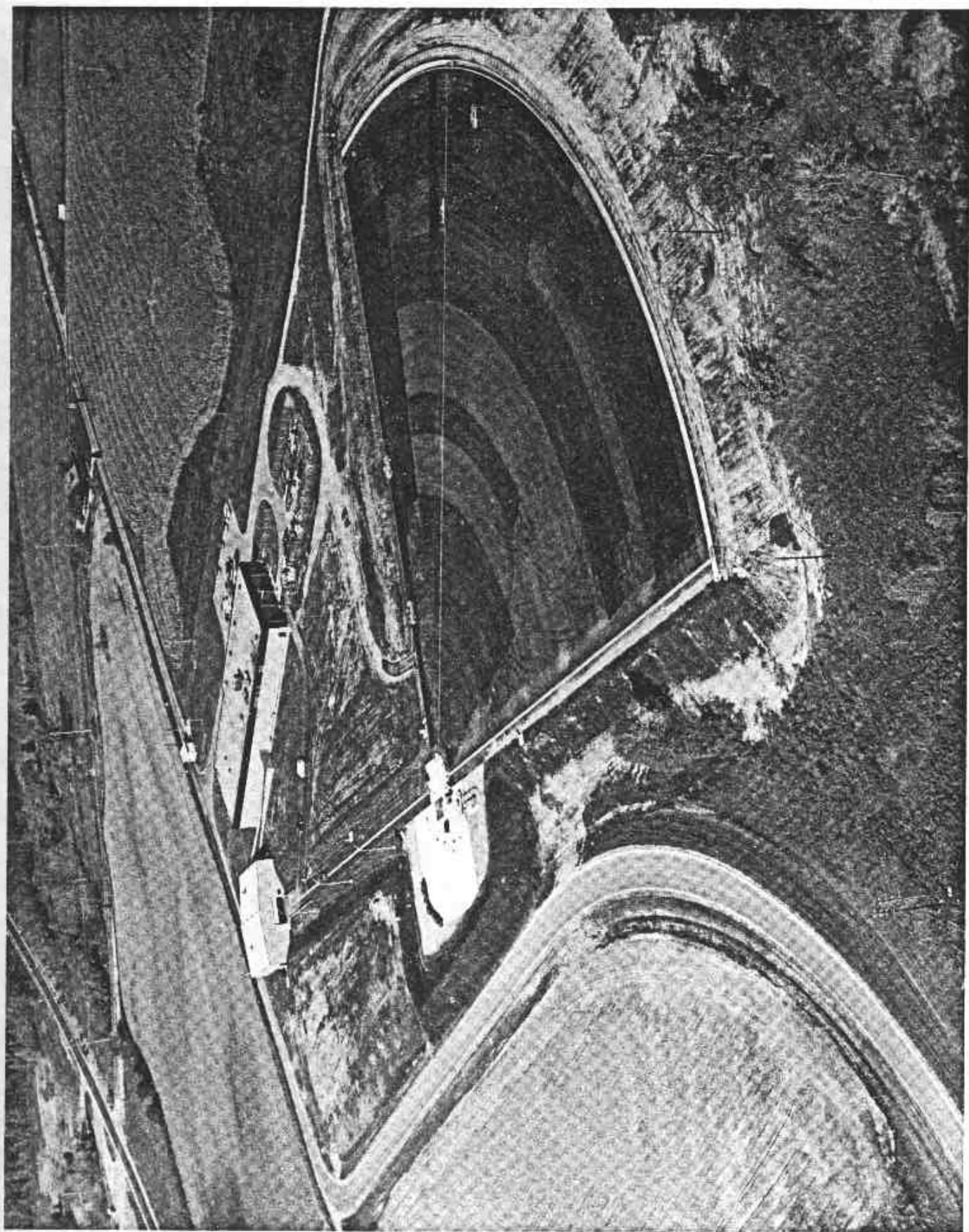


FIG. 1 AERIAL SITE PHOTOGRAPH

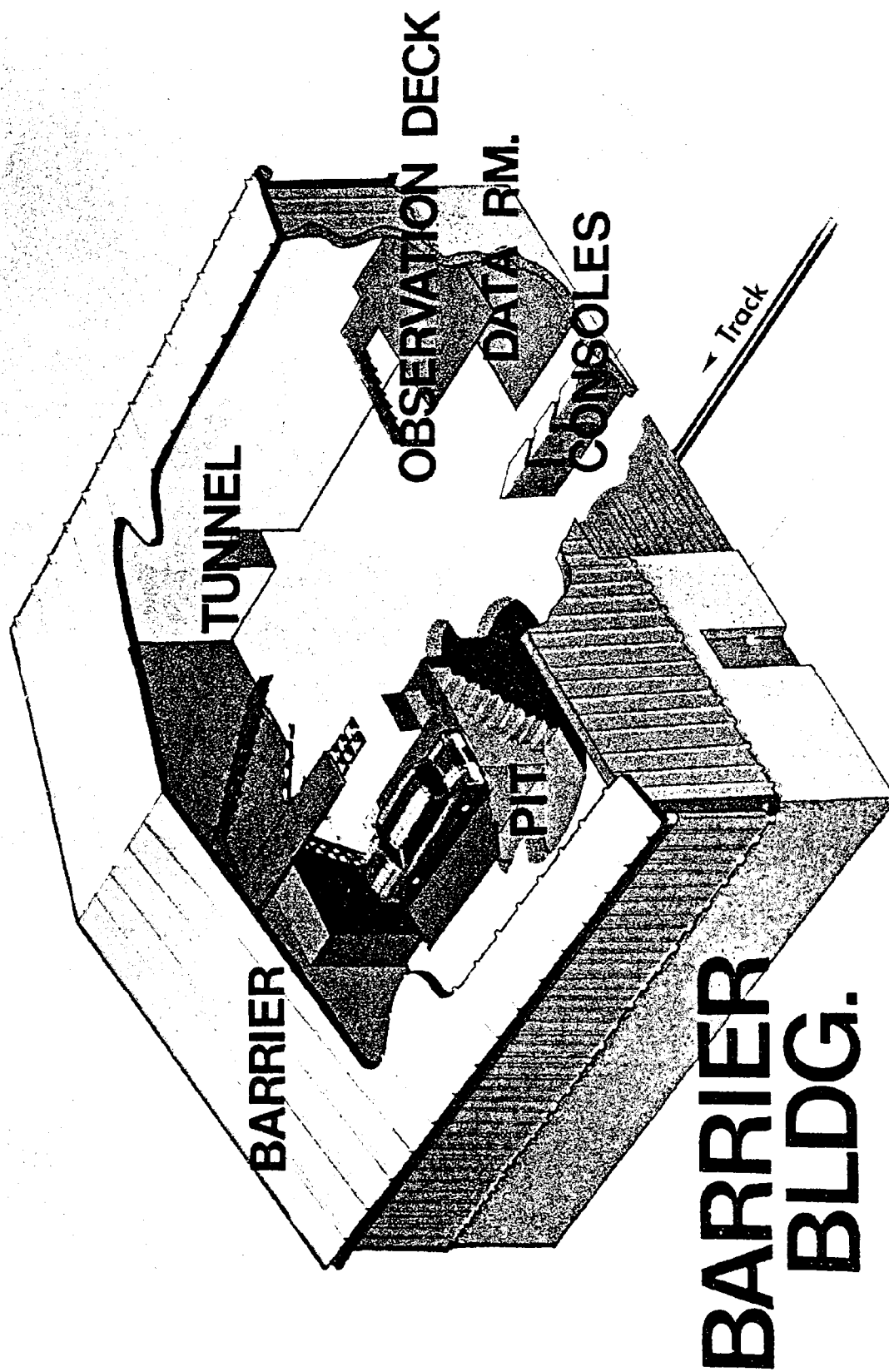


Fig 2. BARRIER BUILDING

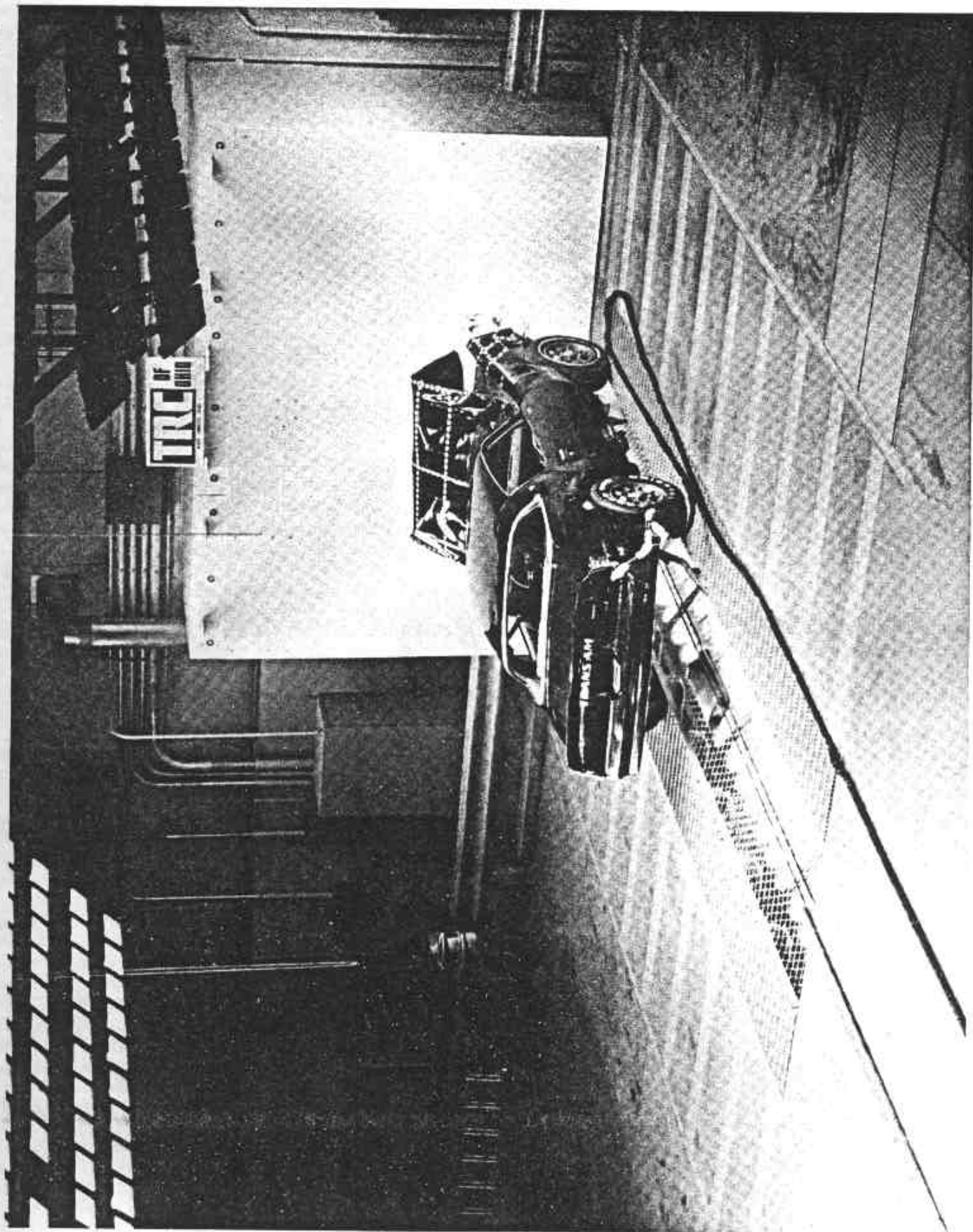


FIG. 3 CAR IMPACTING BARRIER

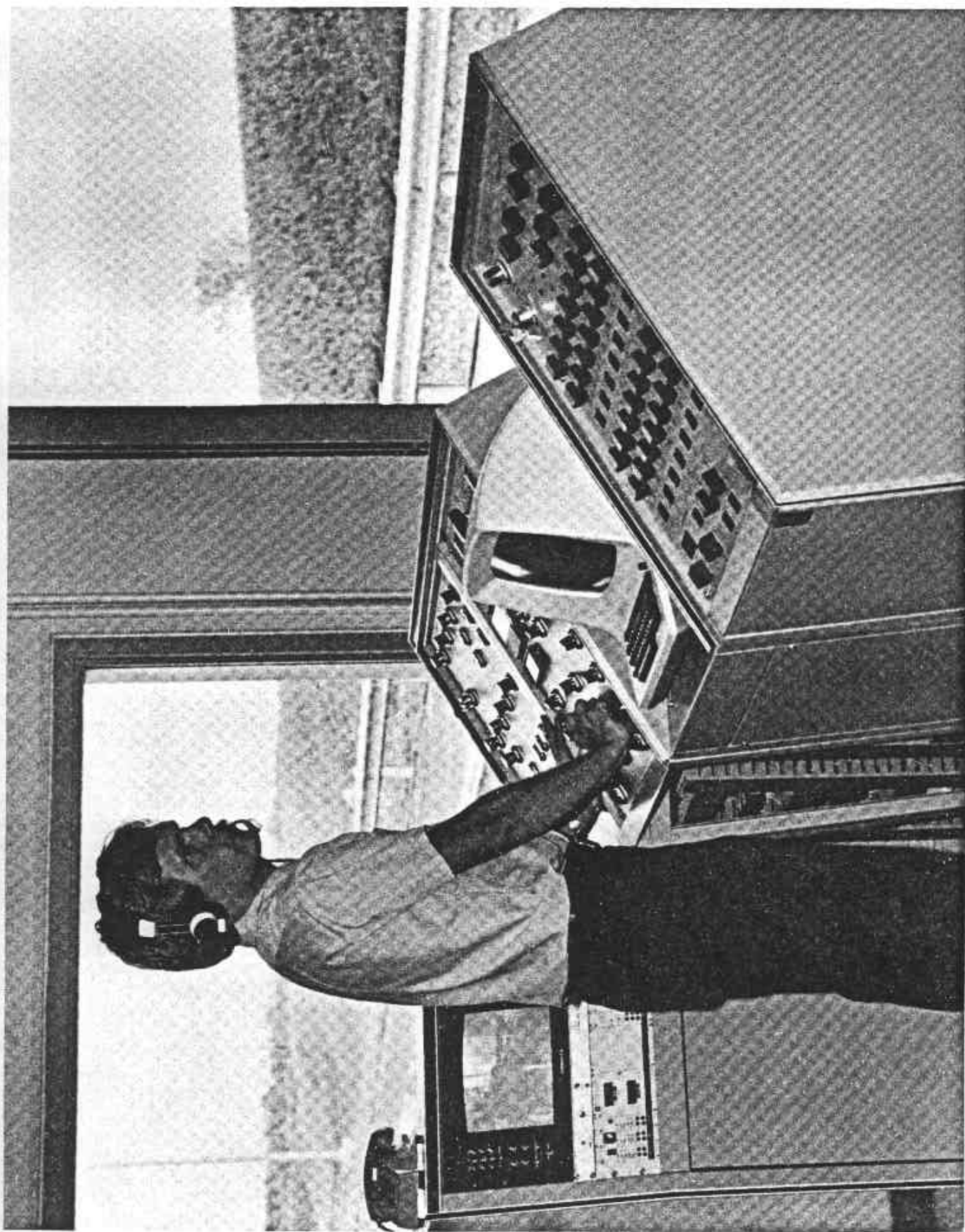


FIG. 4 OPERATOR'S CONSOLE

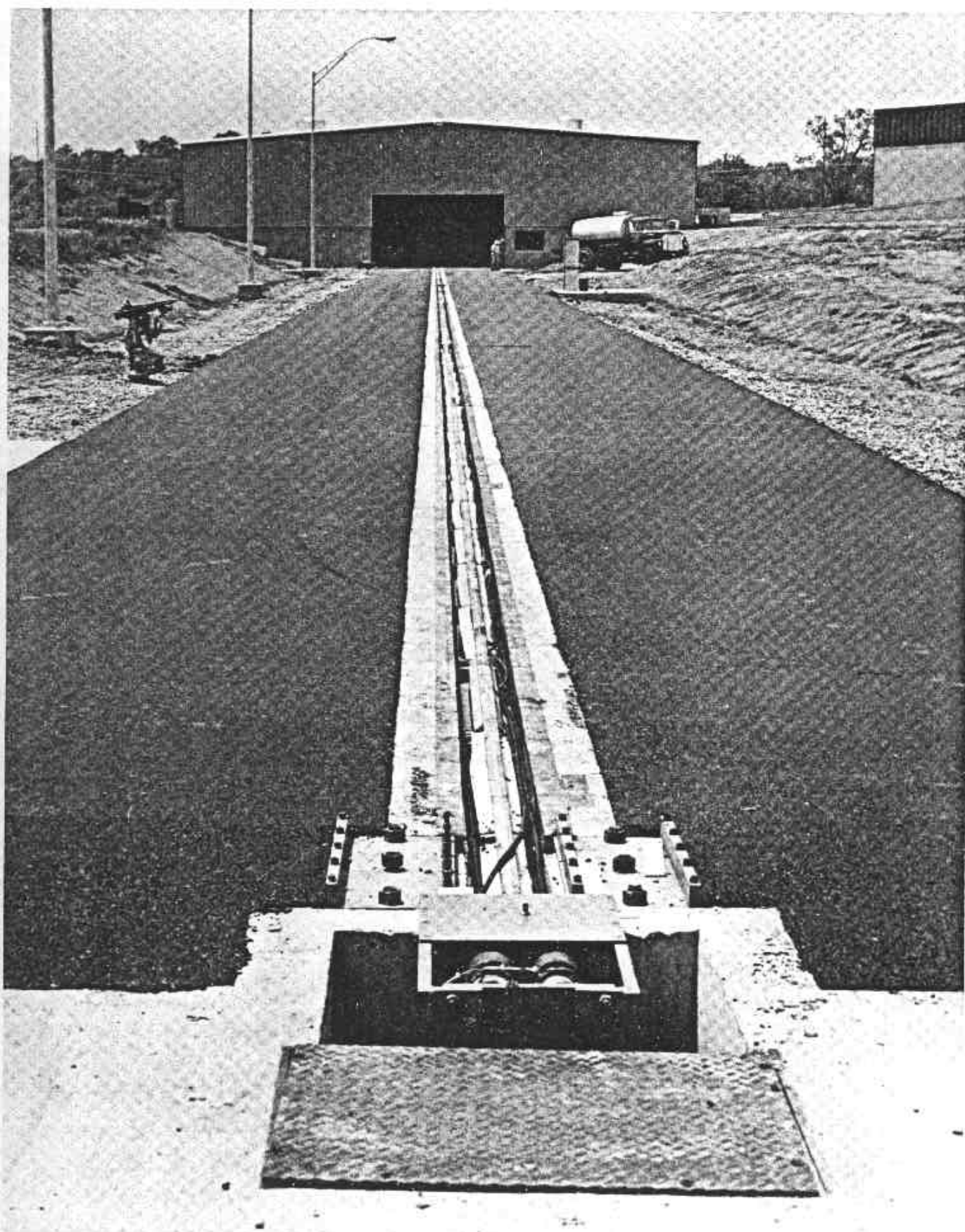


FIG. 5 BARRIER GUIDE RAIL
A-17

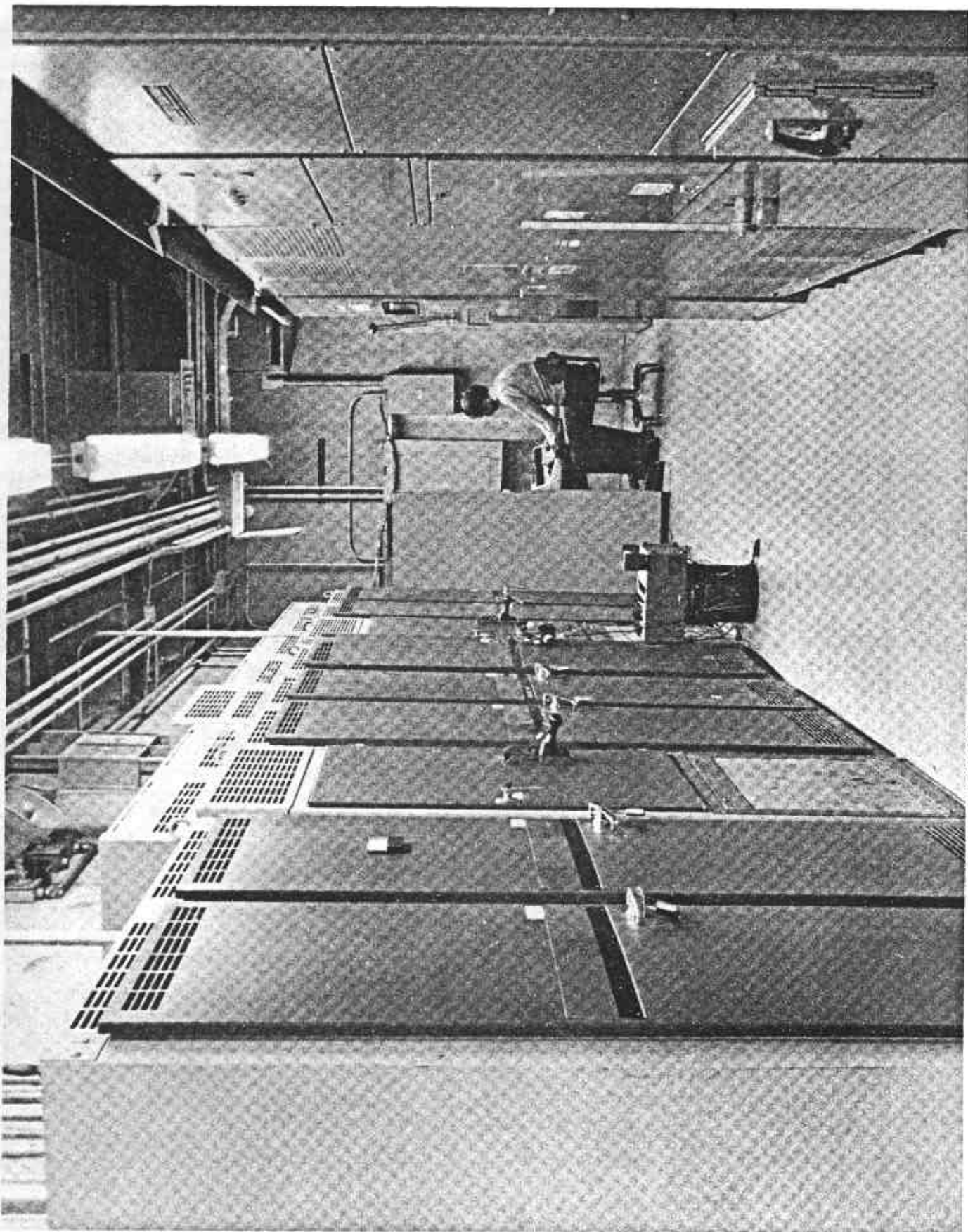


FIG. 6 ELECTRICAL & DRIVE COMPUTER EQUIPMENT ROOM

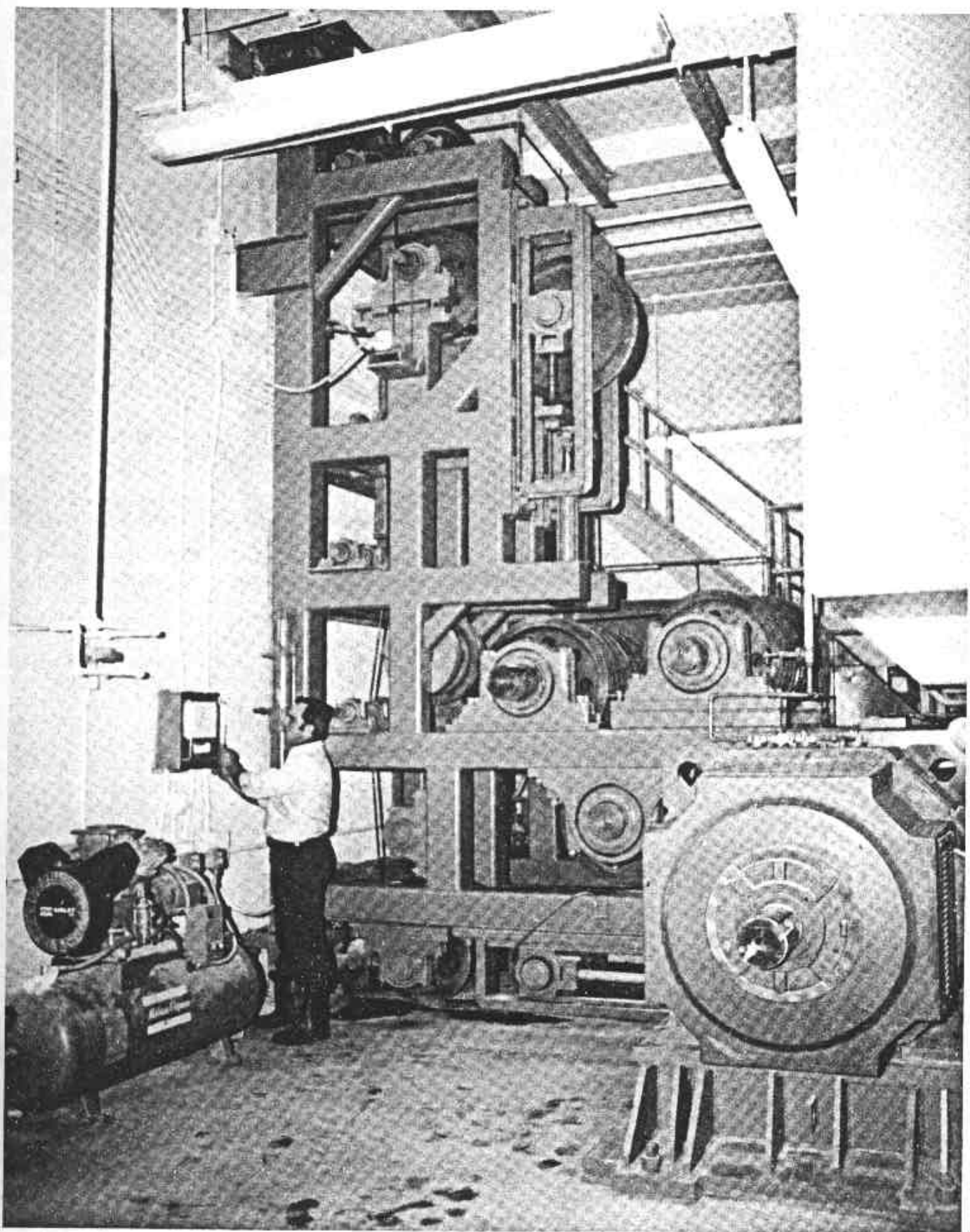


FIG. 7 BARRIER DRIVE STAND AND MOTOR
A-19

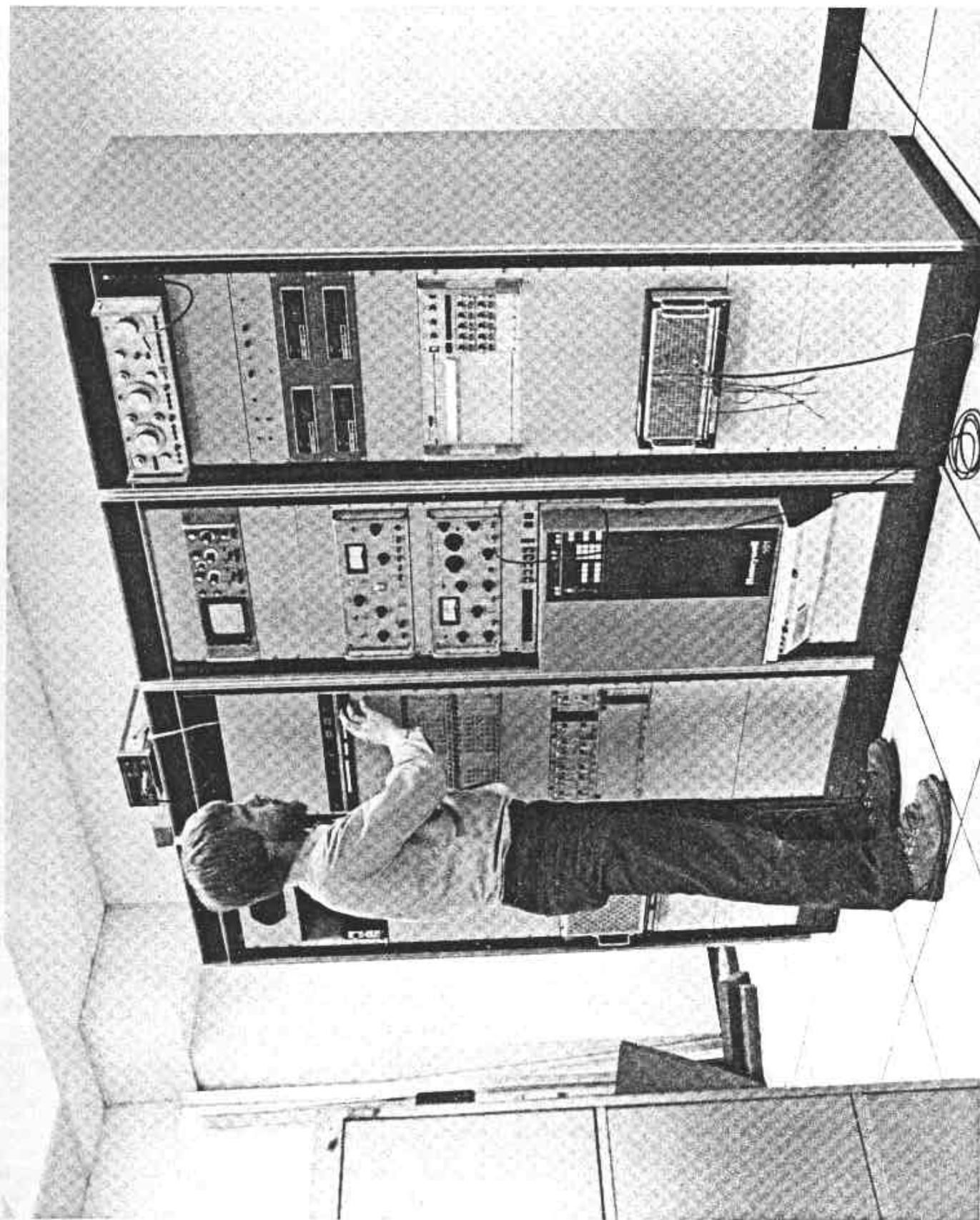


FIG. 8 DATA ACQUISITION BASE STATION



FIG. 9 VAX 11/780 COMPUTER SYSTEM

APPENDIX B

DATA PLOT PRESENTATION

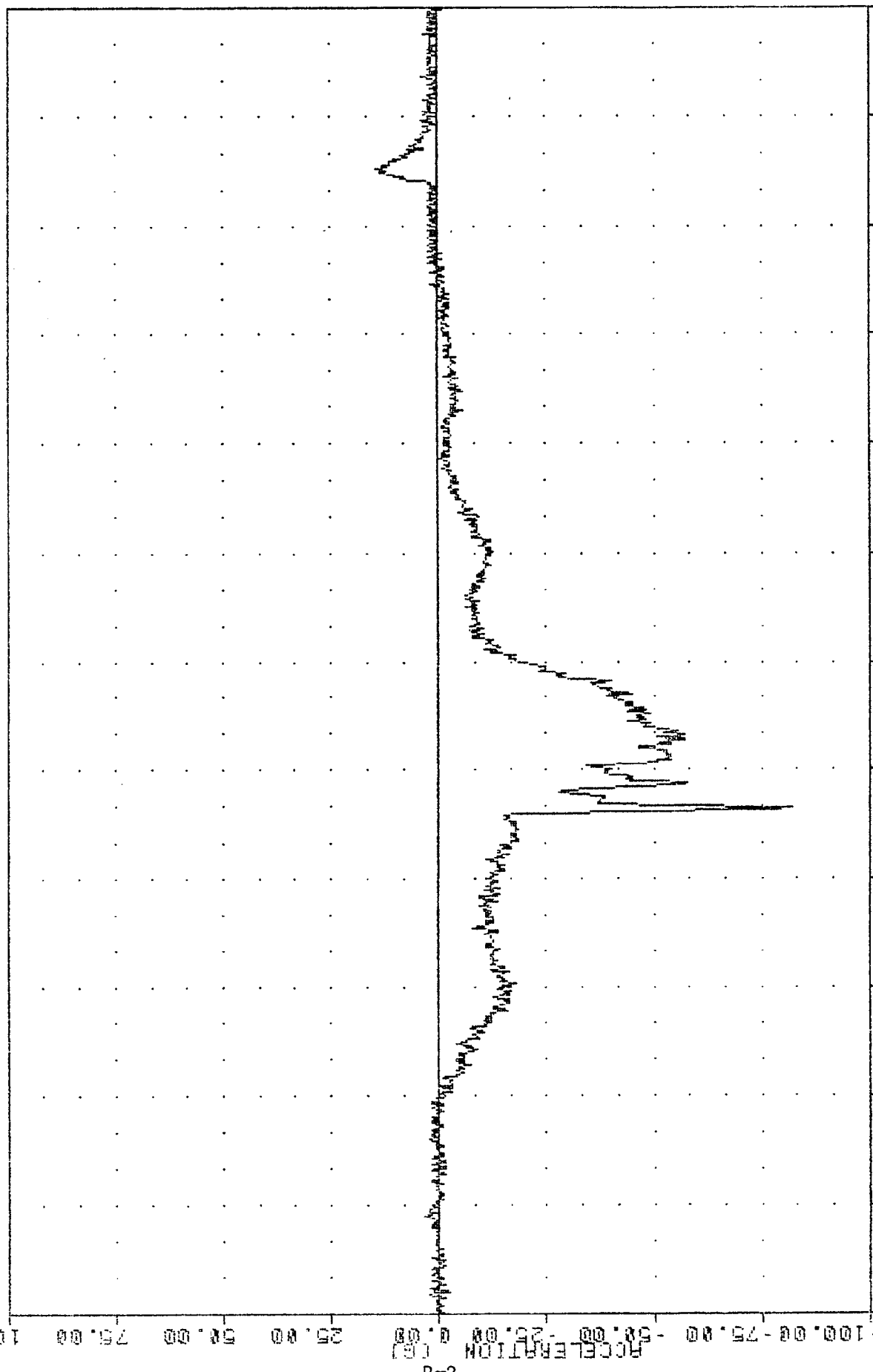
Data plots generated from the crash test data are presented on the following pages. All data is recorded on magnetic tape for inclusion in the NHTSA crash test data base system. All data was filtered according to SAE J211.

4-088-82 14.25.06

SRL48
1982 VOLVO 2DR
820411300
HEDX61

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -81.84 8 77.25, 14.44 8 175.25

102.00
75.00
50.00
25.00
0.00
-25.00
-50.00
-75.00
-100.00



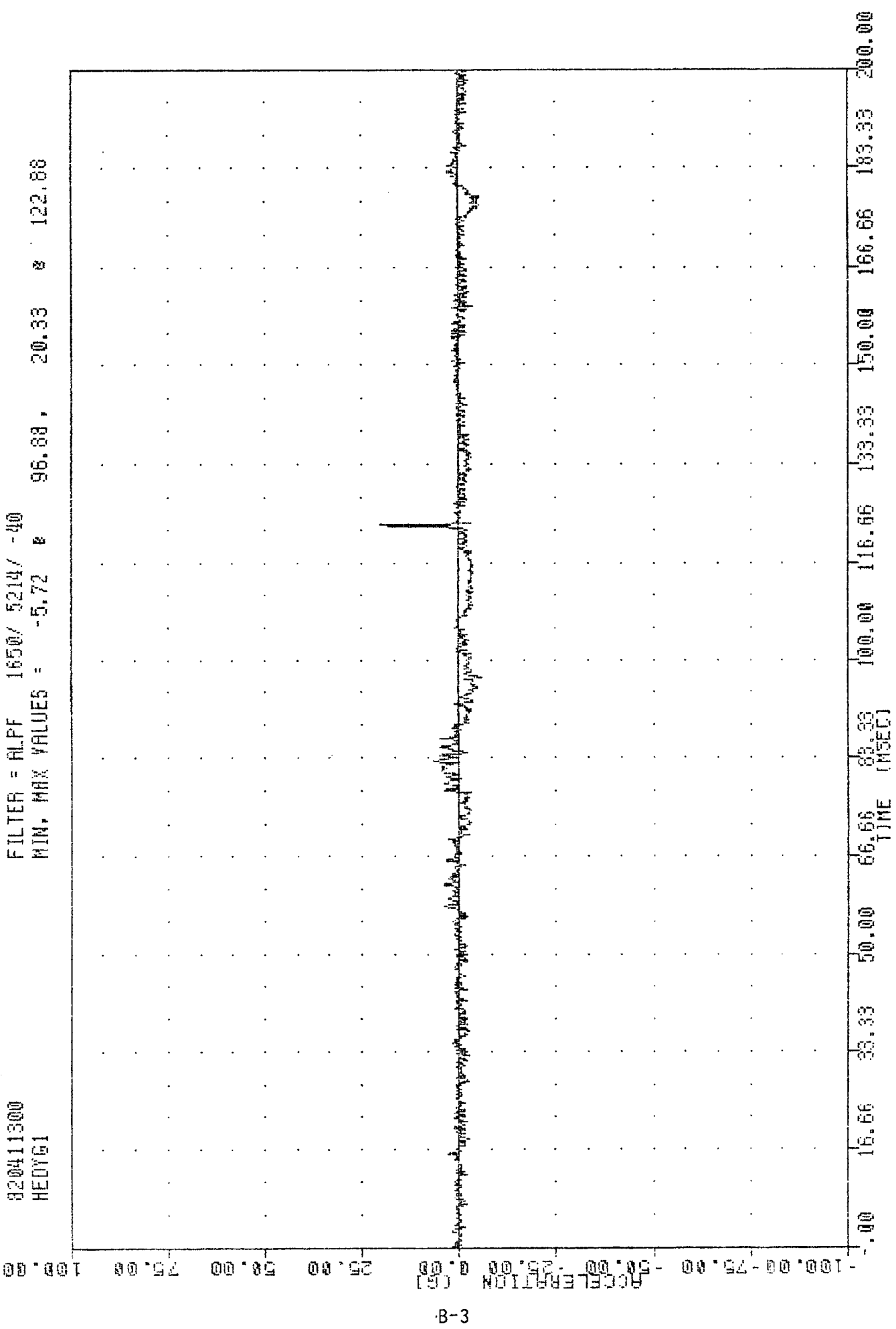
0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

DRIVER HEAD X

4-11-82 14:20:06

3RL40
1982 VOLVO 20R
820411300
HEDYG1

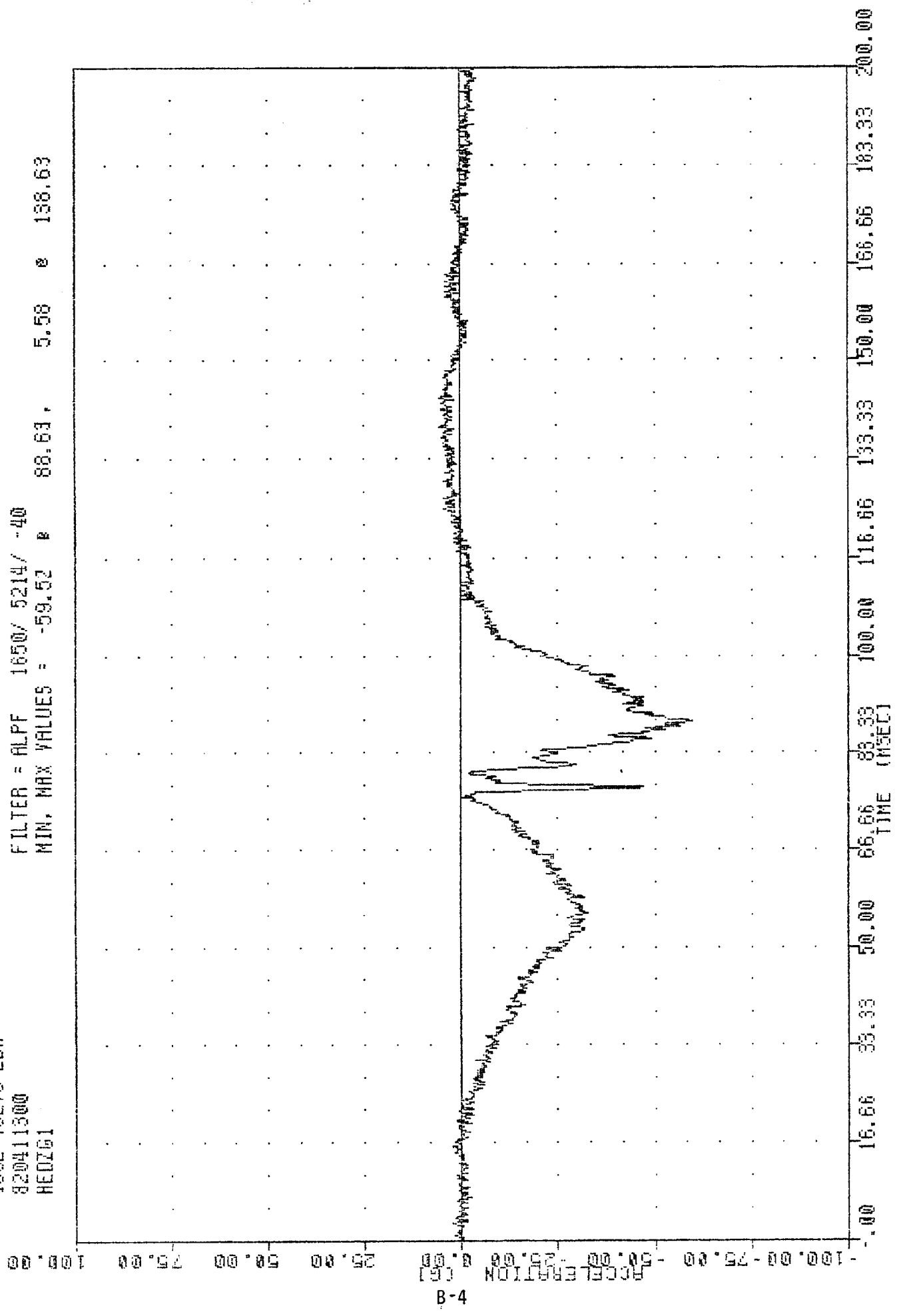
FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -5.72 e 96.88 20.33 e 122.88



4-11-82 14:20:05

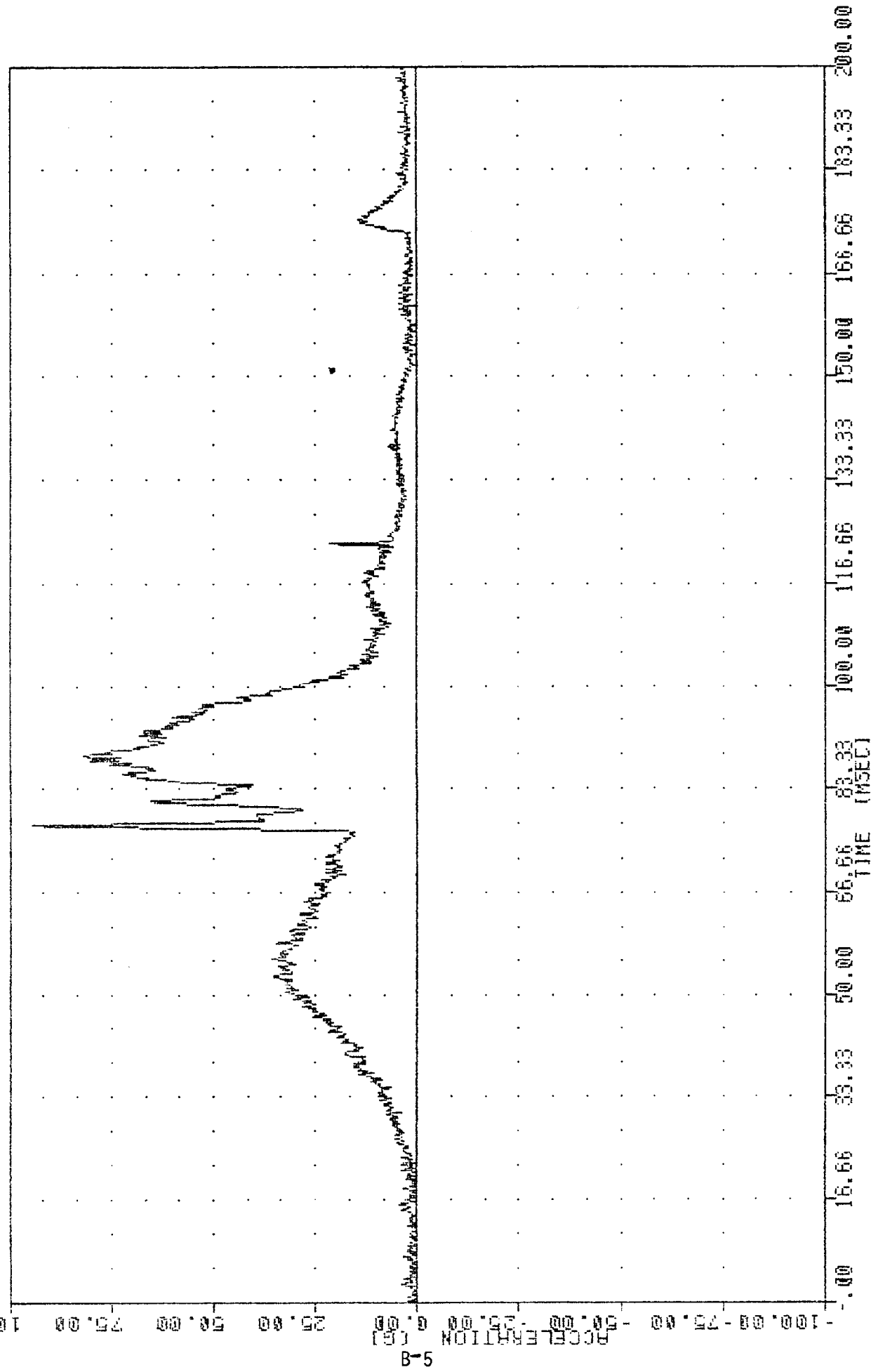
1982 VOLVO 20R
820411300
HEDZG1

FILTER = ALPF 1650/ 5214/ -40
MIN. MAX VALUES = -59.52 88.63 5.58 138.63



DRIVER HEAD Z

3RL13
 1982 VOLVO 20R
 820411300
 HEDRG1
 4-82 14 58
 FILTER = ALPF 1650/ 5214/ -40
 MIN. MAX VALUES = 0.00 9.25, 94.49 77.25

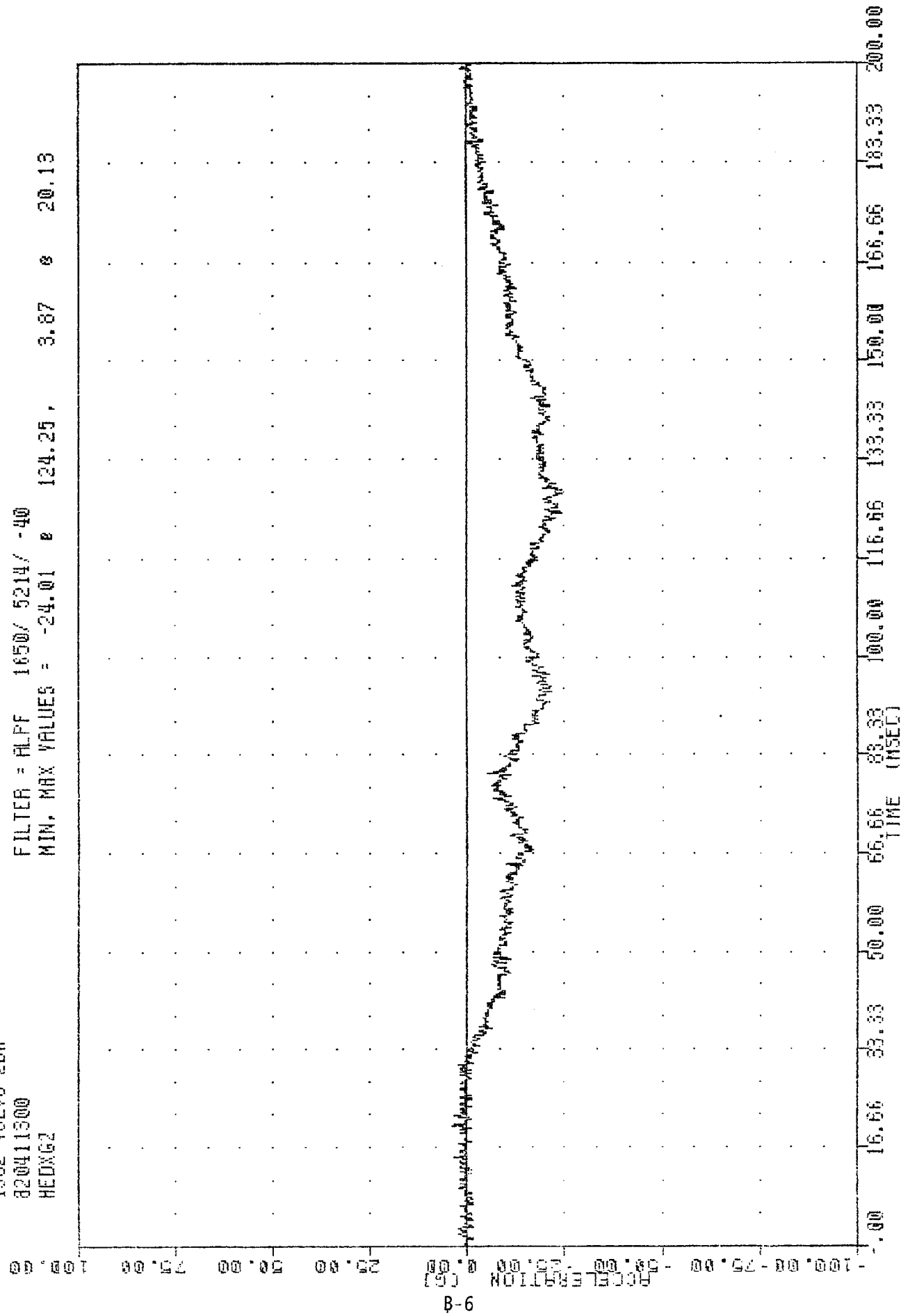


DRIVER HEAD RESULTANT

4-MAR-82 14:28:06

SRL42
1992 VOLVO 2DR
820411300
HEDXG2

FILTER = ALPF 1650/ 5214/ -40
MIN, MAX VALUES = -24.01 e 124.25, 3.87 e 20.13



PASS HEAD X

4-MAR-82 14:26:06

SRL48

1982 VOLVO 2DR

820411300

HEDY62

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -7.07 7.07 70.00 150.50

100.00

75.00

50.00

25.00

0.00

-25.00

-50.00

-75.00

-100.00

-

33.33

50.00

66.66

83.33

100.00

116.66

133.33

150.00

166.66

183.33

200.00

TIME (MSEC)

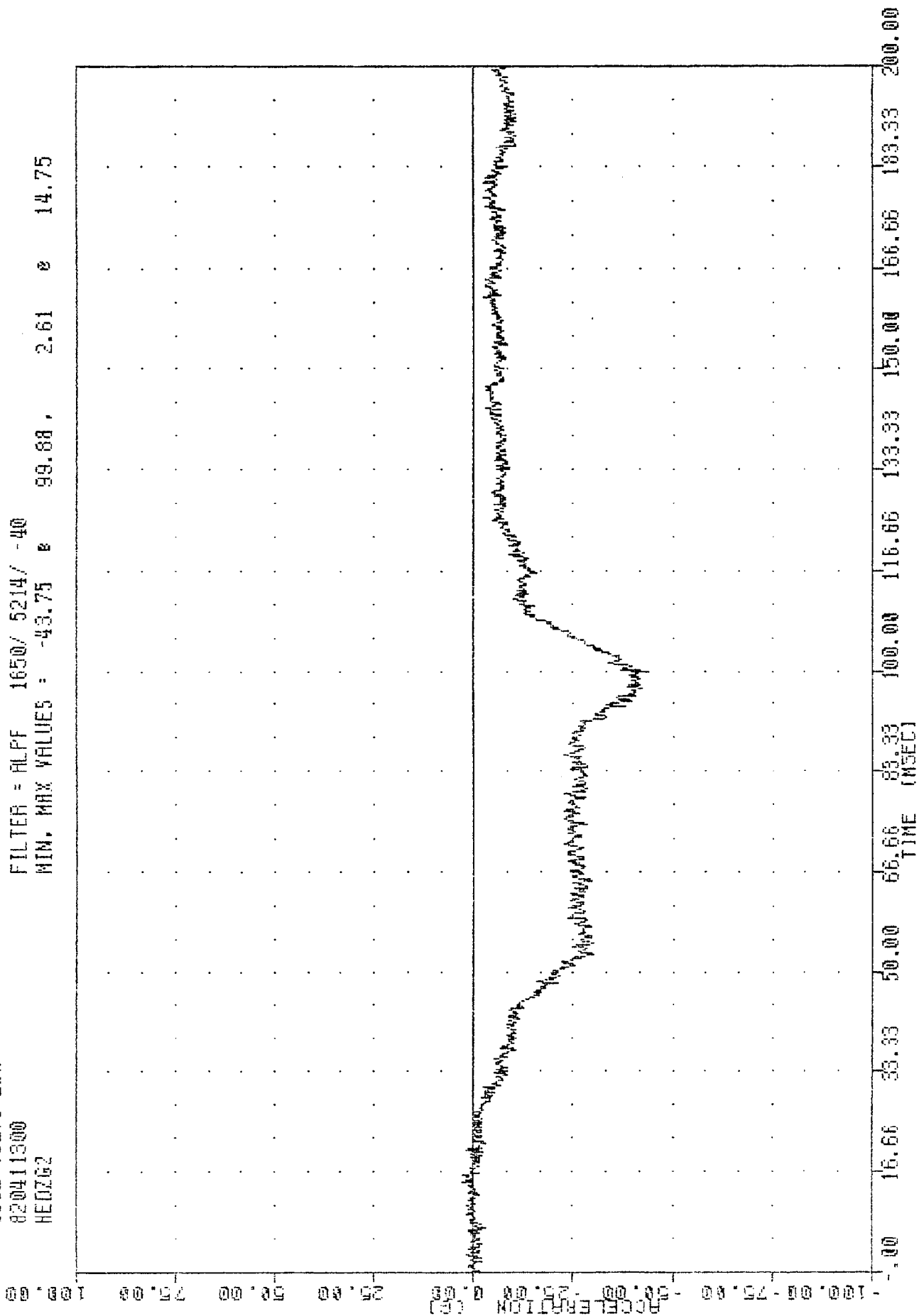
PASS HEAD Y

4-MAR-82 14:26:06

SRL46
1982 VOLVO 20R
820411300
HEDZG2

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES : -43.75 e 99.88 , 2.61 e 14.75



SRL48

1982 VOLVO 20R

820411300

HEDR62

4-MAR-82

14:38:58

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = 0.00 B 11.63, 47.69 @ 99.88

100.00

75.00

50.00

25.00

0.00

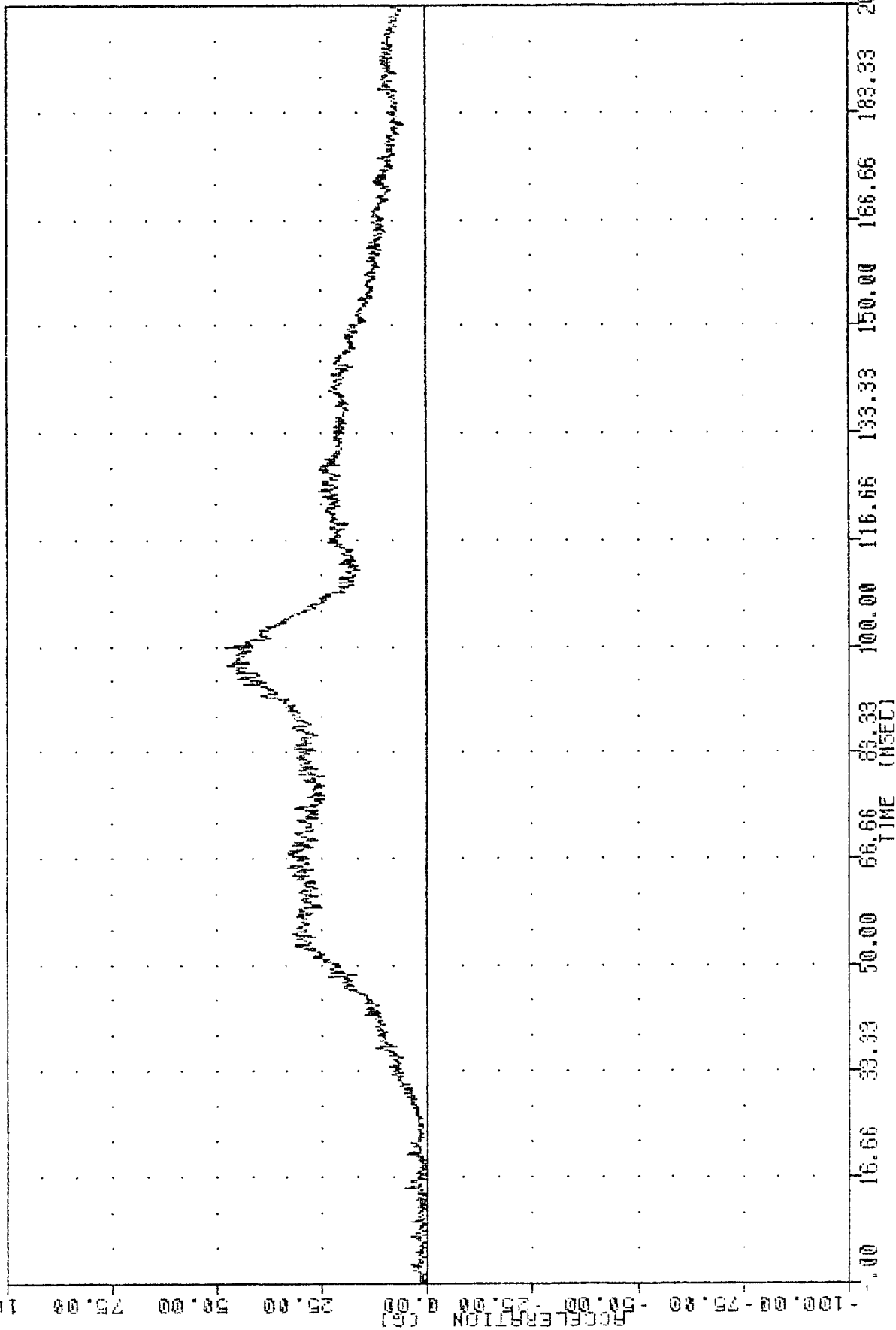
-25.00

-50.00

-75.00

-100.00

B-9



PASS HEAD RESULTANT

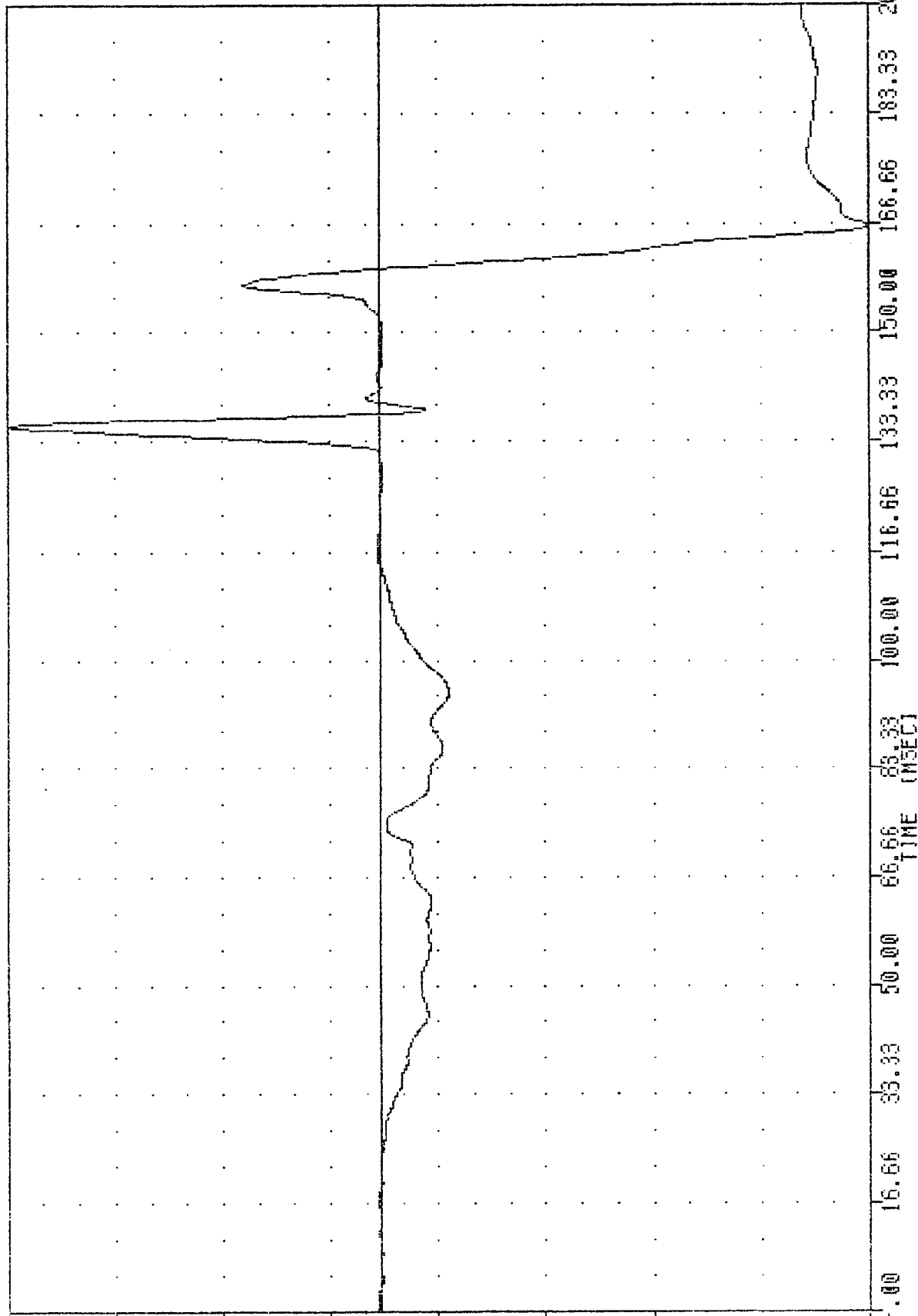
3RL48
1982 VOLVO 20R
820411500
CSTX61

4-MAR-82 14:28:06

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = -353.02 168.00, 253.55 135.63

ACCELERATION (G)



DRIVER CHEST X

3RL48

1992 VOLVO 208

820411300

CSTY61

4-MAR-82 14:38:58

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = -2.13 0 57.75, 7.25 8 74.13

100.00

75.00

50.00

25.00

0.00

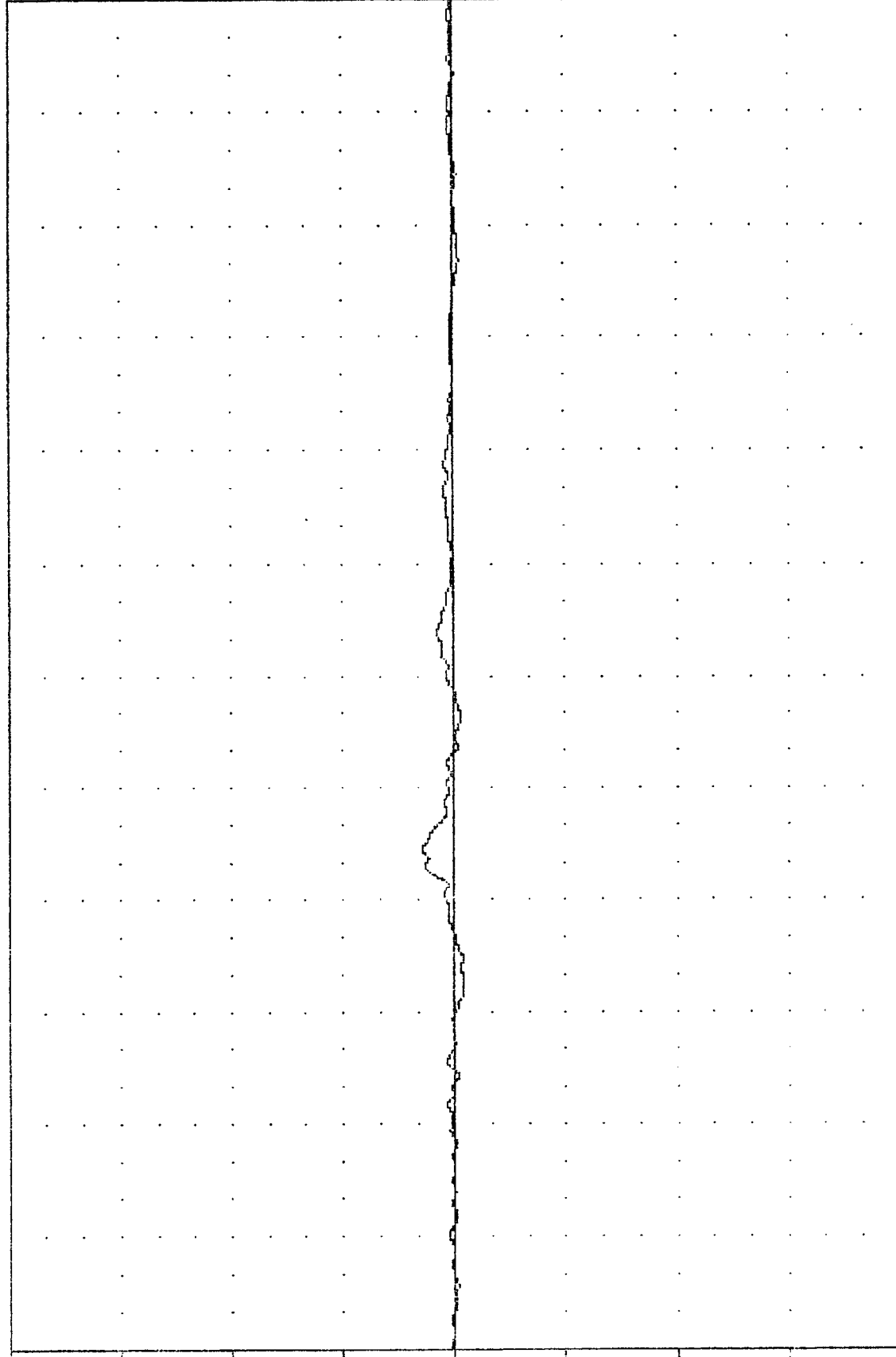
ACCELERATION (G)

-25.00

-50.00

-75.00

-100.00



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

TIME (MSEC)

DRIVER CHEST Y

58L46
1982 VOLVO 2DR
820411300
CSTIG1

4-MAR-82 14:38:58

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = -15.87 80.38, 14.34 50.63

100.00

75.00

50.00

25.00

0.00

ACCELERATION (G)

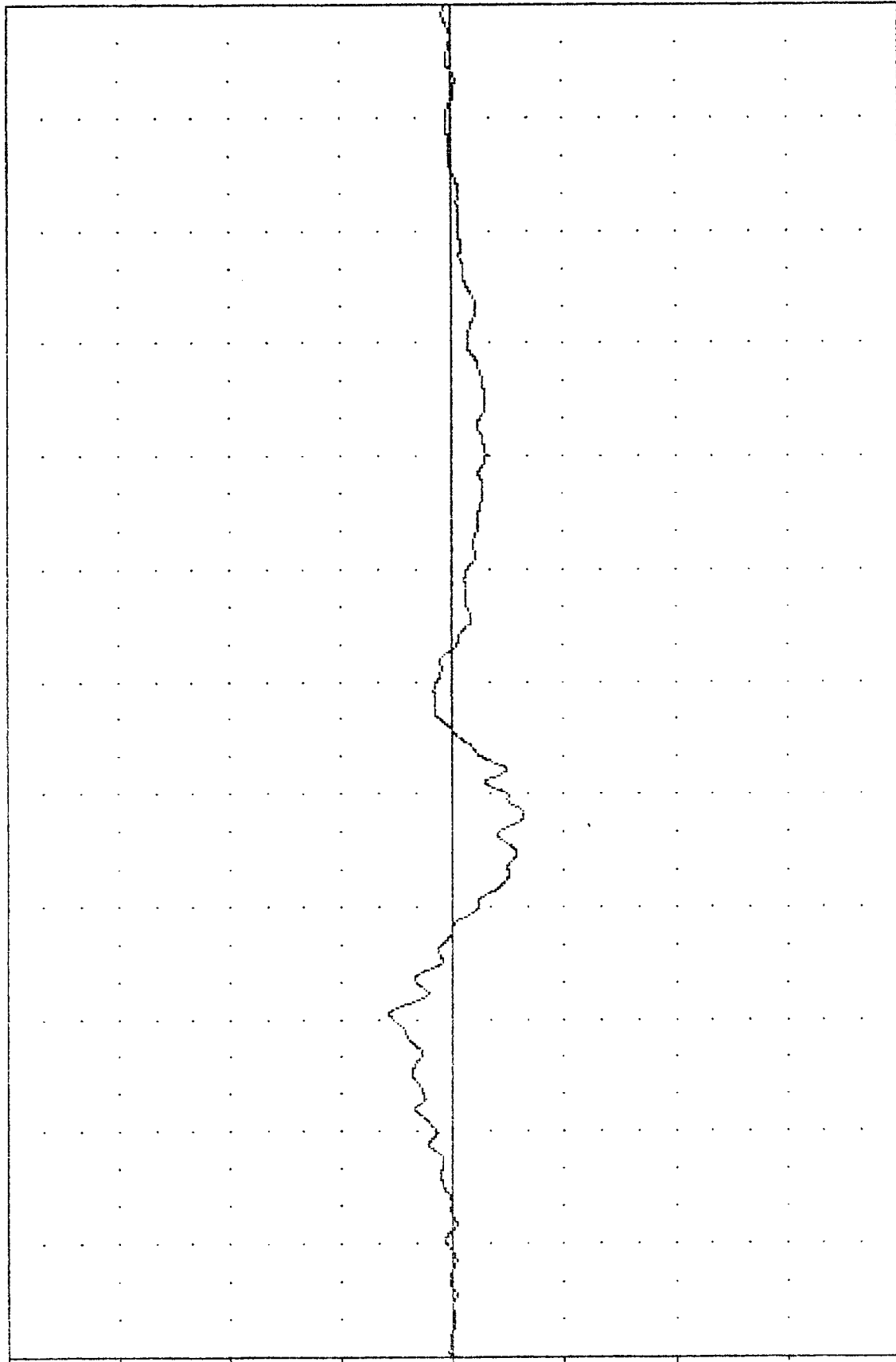
-25.00

-50.00

-75.00

-100.00

B-12



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

TIME (MSEC)

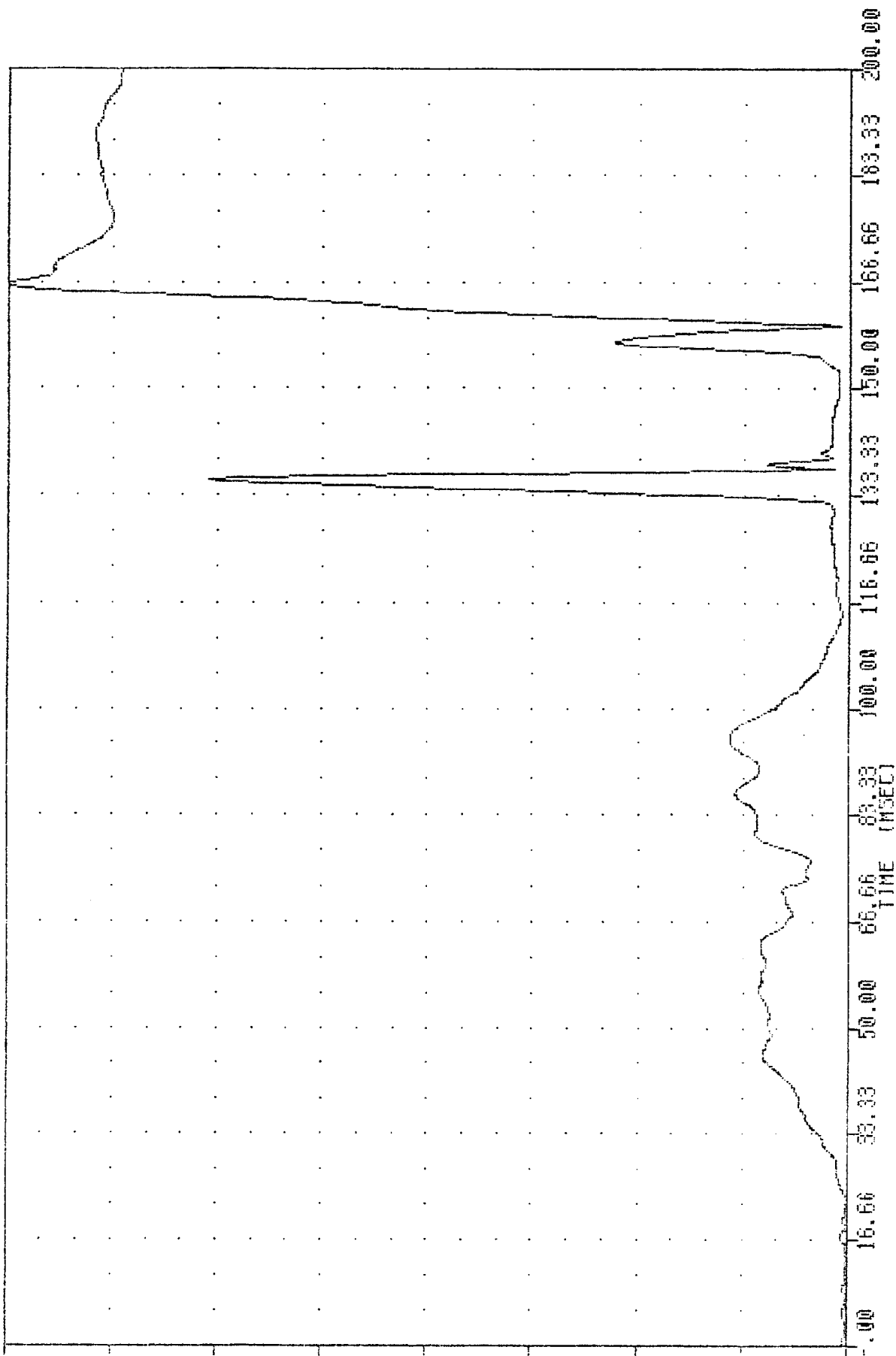
DRIVER CHEST Z

10-MAR-82 12:10:58

56L48
1982 VOLVO 208
820411300
CSTRG1

FILTER = BLPF 300/ 950/ -40
MIN. MAX VALUES = 0.07 8 18.50, 333.02 8 186.00

ACCELERATION (G)



3RL40

1982 VOLVO 2DR

820411300

CSTX62

10-MAR-82 12:11:39

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = -34.70 63.75, 2.25 0 179.25

100.00

75.00

50.00

25.00

0.00

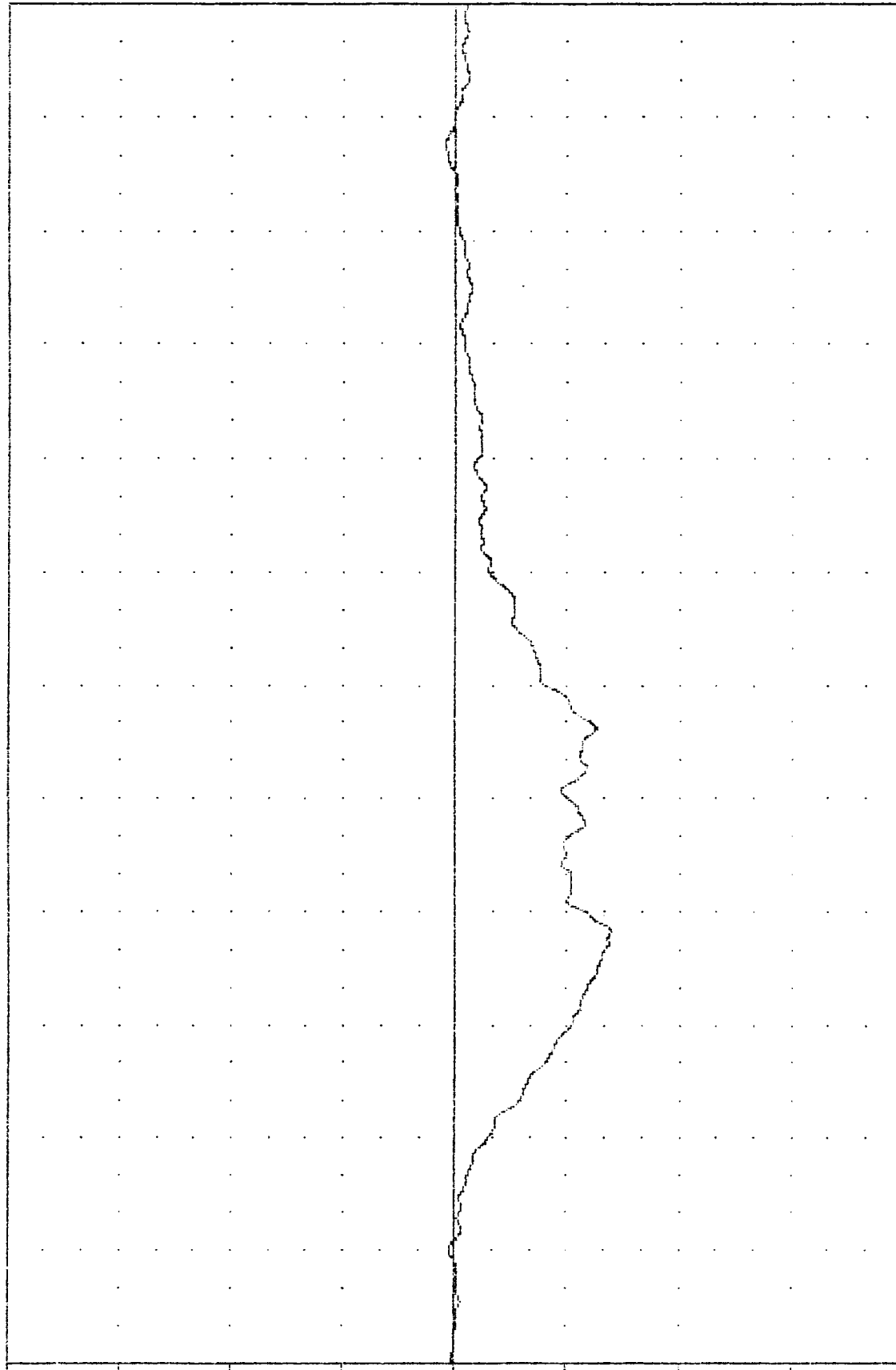
-25.00

-50.00

-75.00

-100.00

B-14



PRSS CHEST X

SRL48

1982 VOLVO 2DR

820411300

CSTY62

10-MAR-82 12:11:39

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = -3.67 8.52 0 72.25

100.00

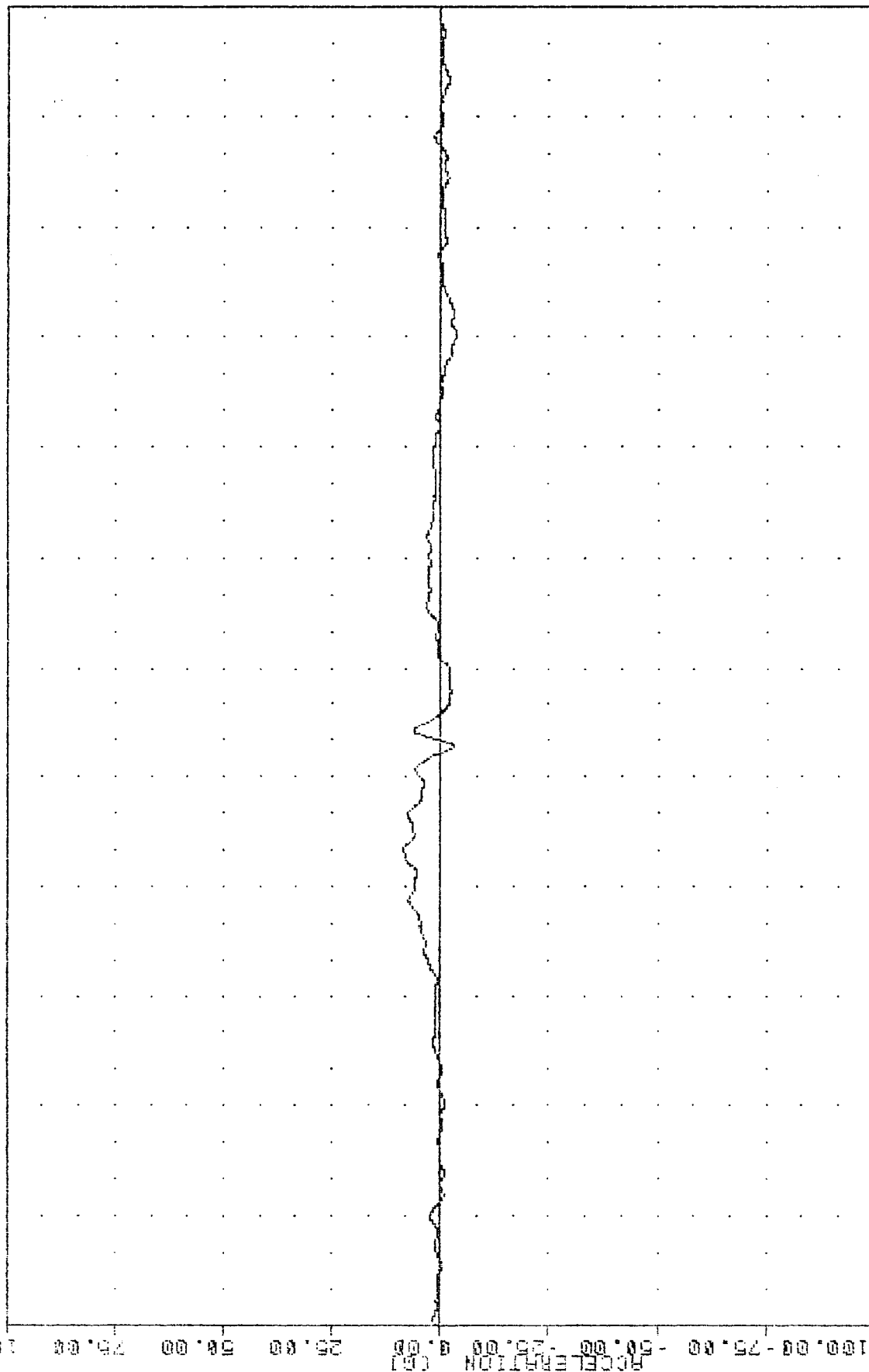
75.00

50.00

25.00

0.00

B-15



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

PRSS CHEST Y

3RL48

1982 VOLVO 2DR

920411300

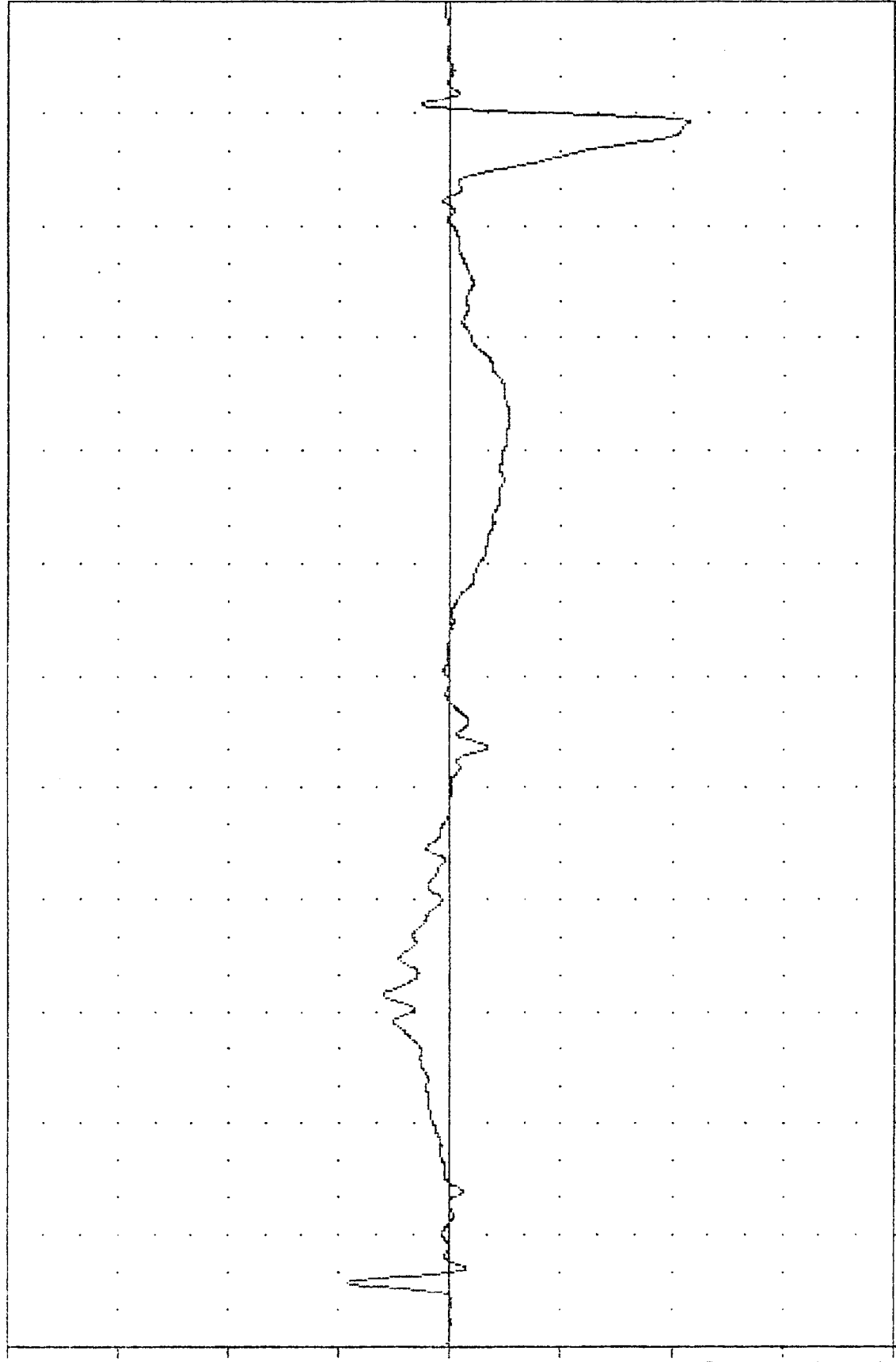
CSTZ62

10-MAR-82 12:11:39

FILTER = 6LPP 300/ 950/ -40

MIN. MAX VALUES = -54.07 e 181.88, 22.97 e 9.38

ACCELERATION (G)

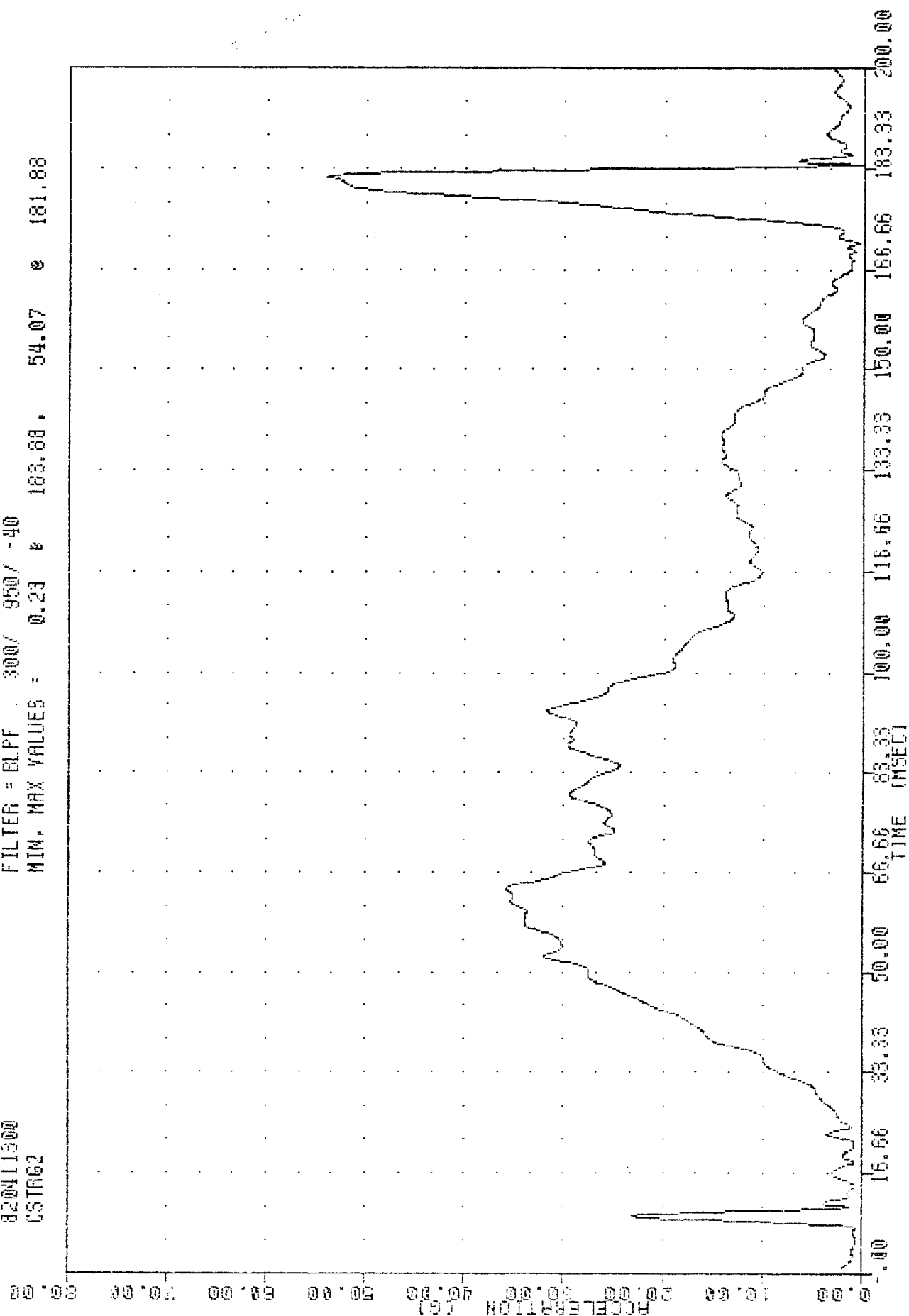


10-MAR-82 12:10:58

3AL48
1992 VOLVO 20R
820411300
CSTR62

FILTER = BLPF 300/ 950/ -40

MIN. MAX VALUES = 0.23 @ 183.88, 54.07 @ 181.88



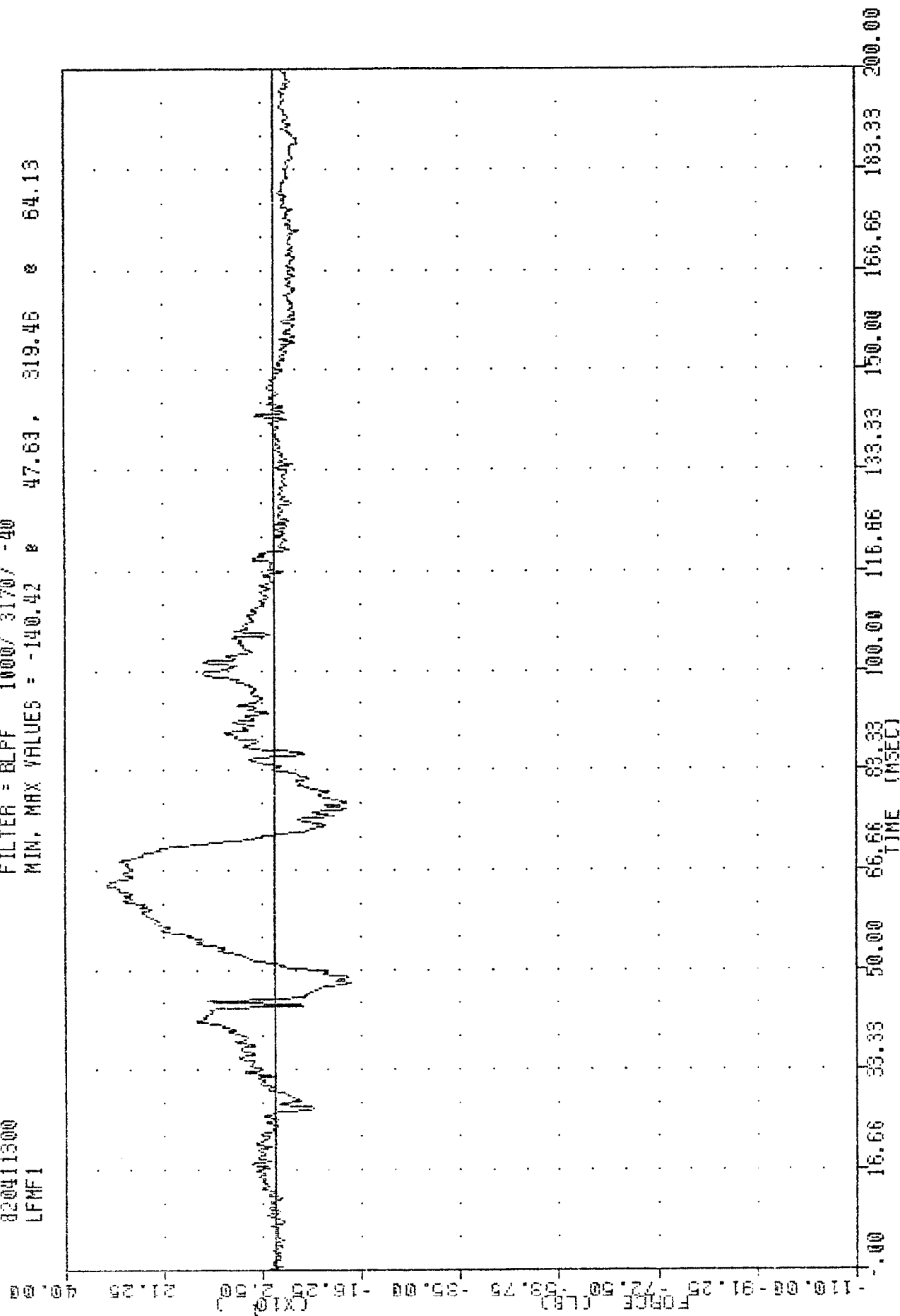
PASS CHEST RESULTANT

SRL48
1962 VOLVO 20A
820411300
LFMF1

4-MAR-82 14:26:06

FILTER = BLPF 1000/ 3170/ -40
MIN, MAX VALUES = -140.42 8

47.63, 319.45 8 64.13



B-18

DRIVER FEMUR LEFT

5RL48

1992 VOLVO 20R

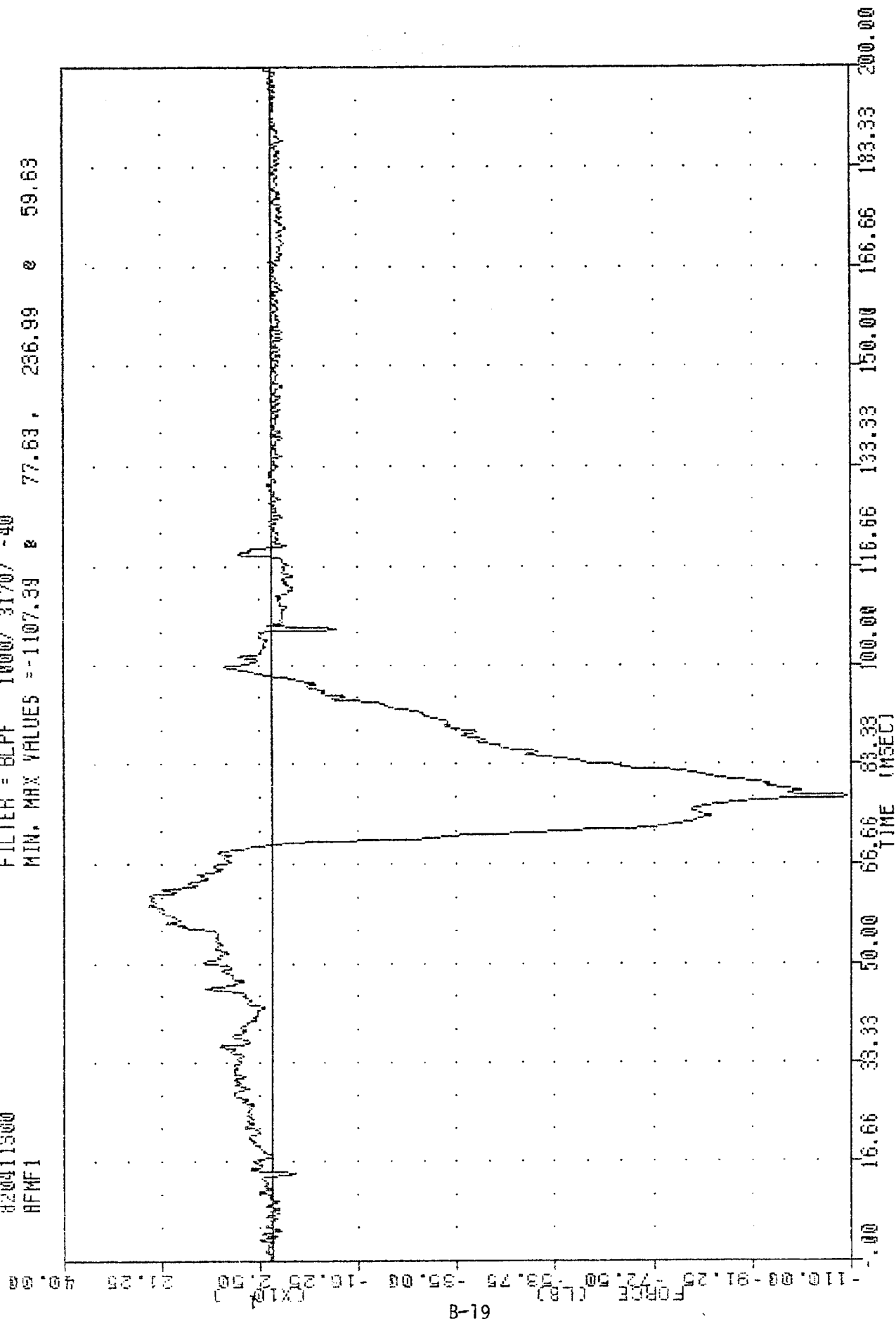
820411300

BFMF1

4-MAR-82 14:26:06

FILTER = BLPF 1000/ 3170/ -40

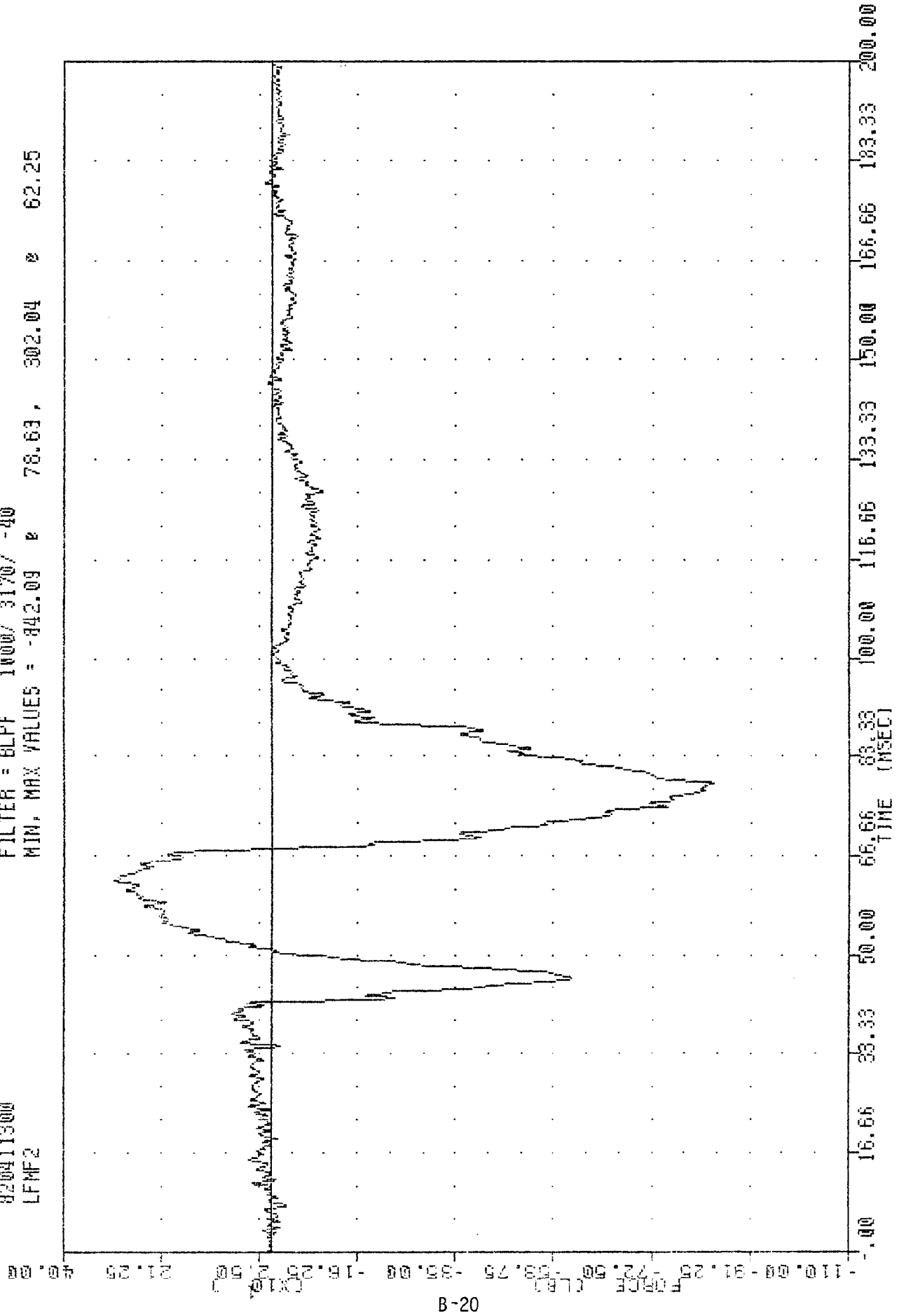
MIN. MAX VALUES = -1107.39 0 77.63, 236.99 0 59.63



4-MAR-82 14:38:58

9RL46
1982 VOLVO 20R
820411300
LFMF2

FILTER = BLPF 1000/ 3170/ -40
MIN, MAX VALUES = -842.09 8 78.63, 302.04 8 62.25



B-20

PASS FEMUR LEFT

SRL48

1982 VOLVO 2DR

820411300

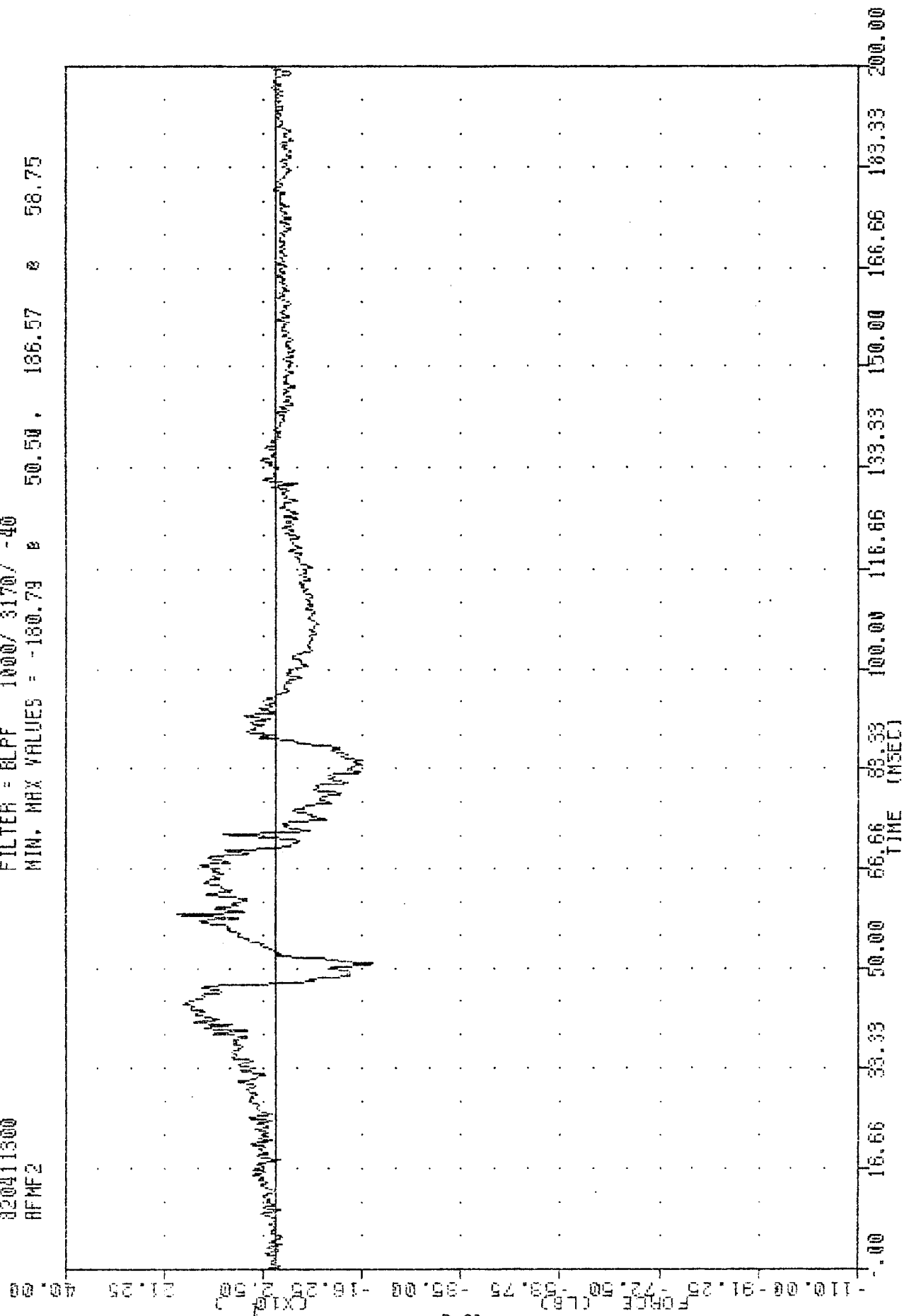
AFMF2

4-MAR-82

14:38:58

FILTER = BLPF 1000/ 3170/ -40

MIN. MAX VALUES = -180.79 50.50 136.57 58.75

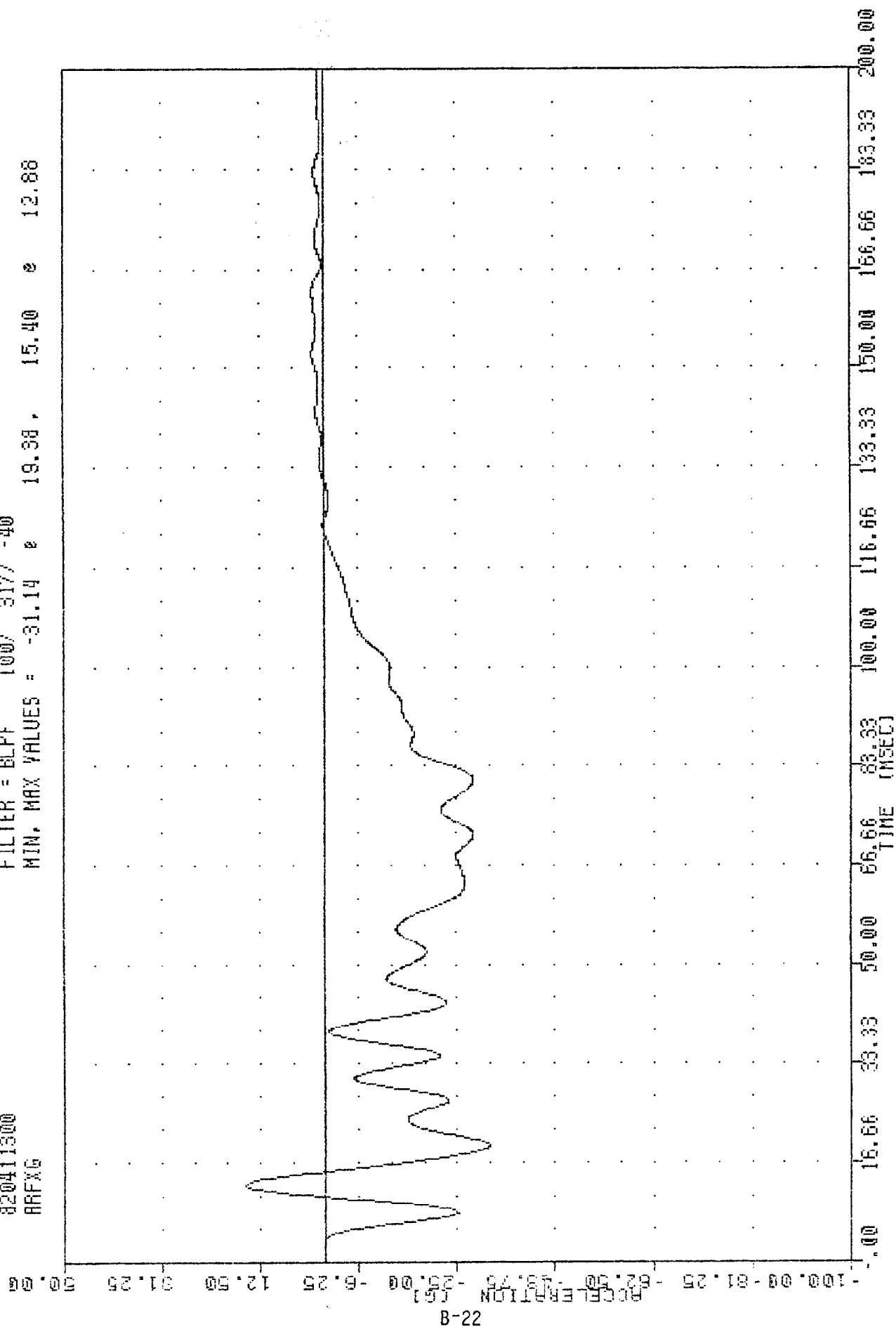


5RL48
1982 VOLVO 20A
820411300
BRFXG

4-MAR-82 14:58:58

FILTER = BLPF 100/ 317/ -40

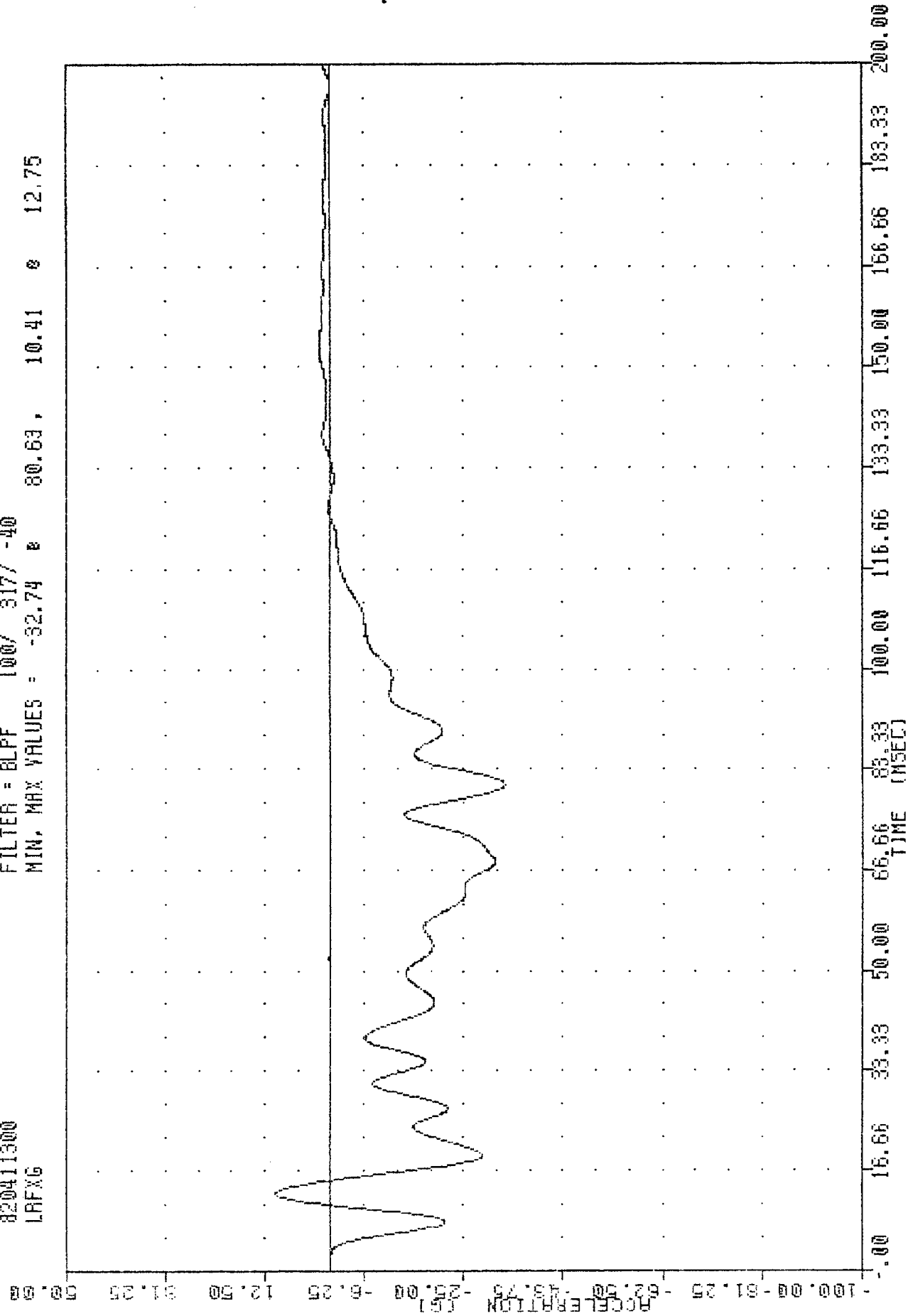
MIN, MAX VALUES = -31.14 19.38, 15.40 12.88



4-MAR-82 14:38:58

3H248
1982 VOLVO 2DR
820411300
LRFK6

FILTER = BLPF 100/ 317/ -40
MIN. MAX VALUES = -32.74 80.63, 10.41 12.75



3RL48

1982 VOLVO 20R

820411300

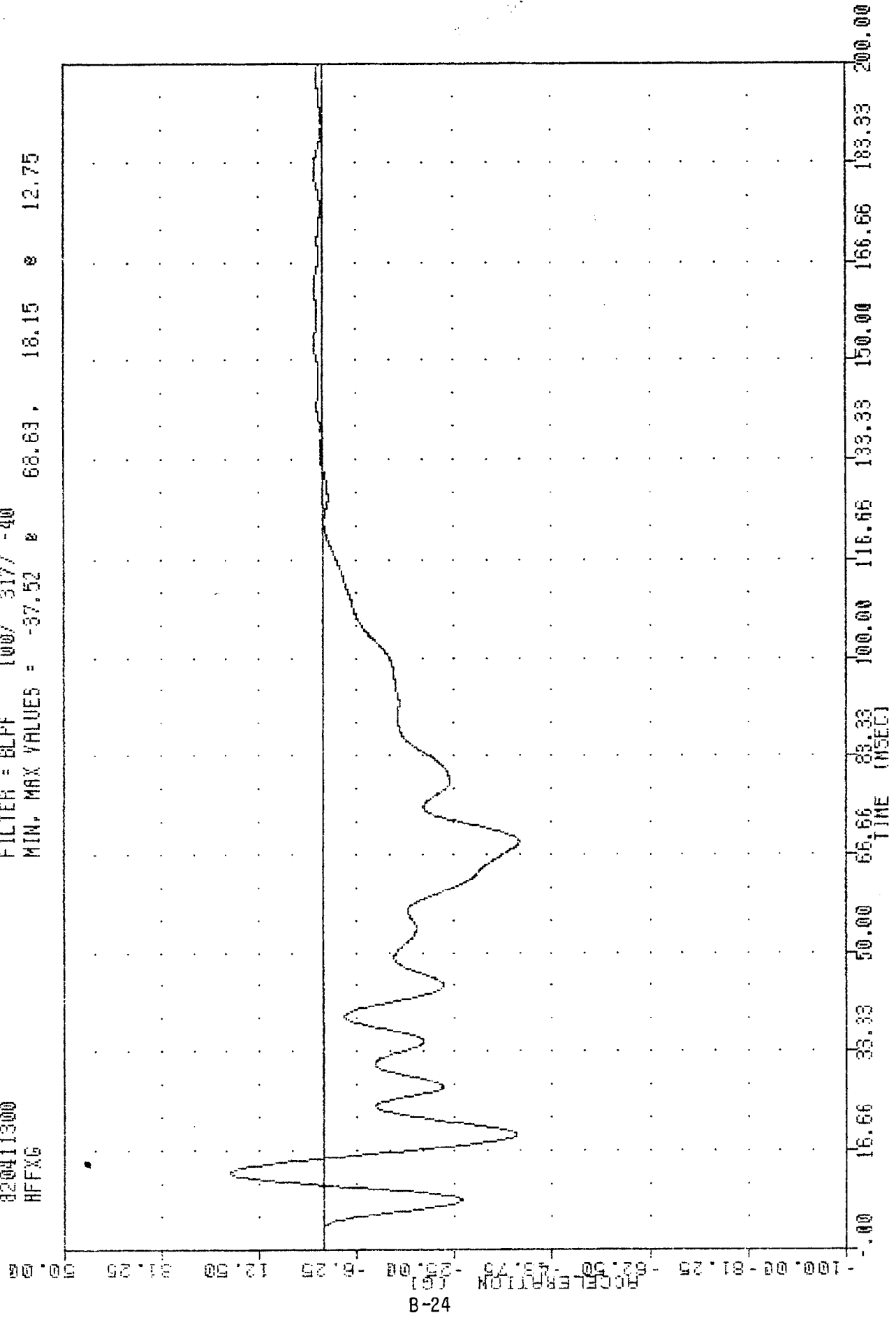
HFFXG

4-MAR-82

14:58:58

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -37.52 68.63, 18.15 12.75

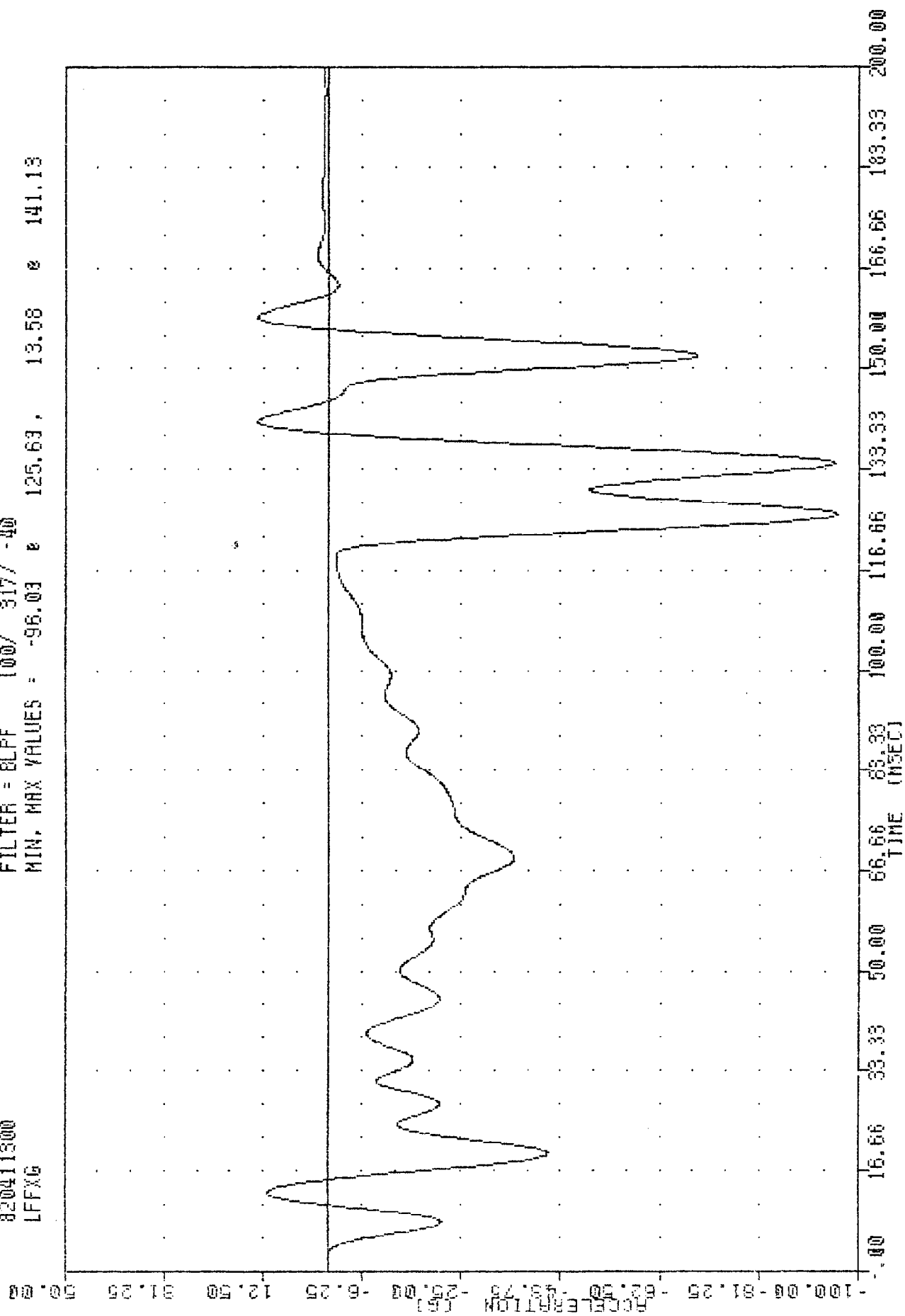


VEHICLE RIGHT FRONT

38L48
1992 VOLVO 20A
820411300
LFFXG

4-MAR-82 14:36:58

FILTER = 8LFF 100/ 317/ -40
MIN. MAX VALUES = -96.03 125.63 13.58 141.13



SRL48

1982 VOLVO 2DR.BAR

820411300

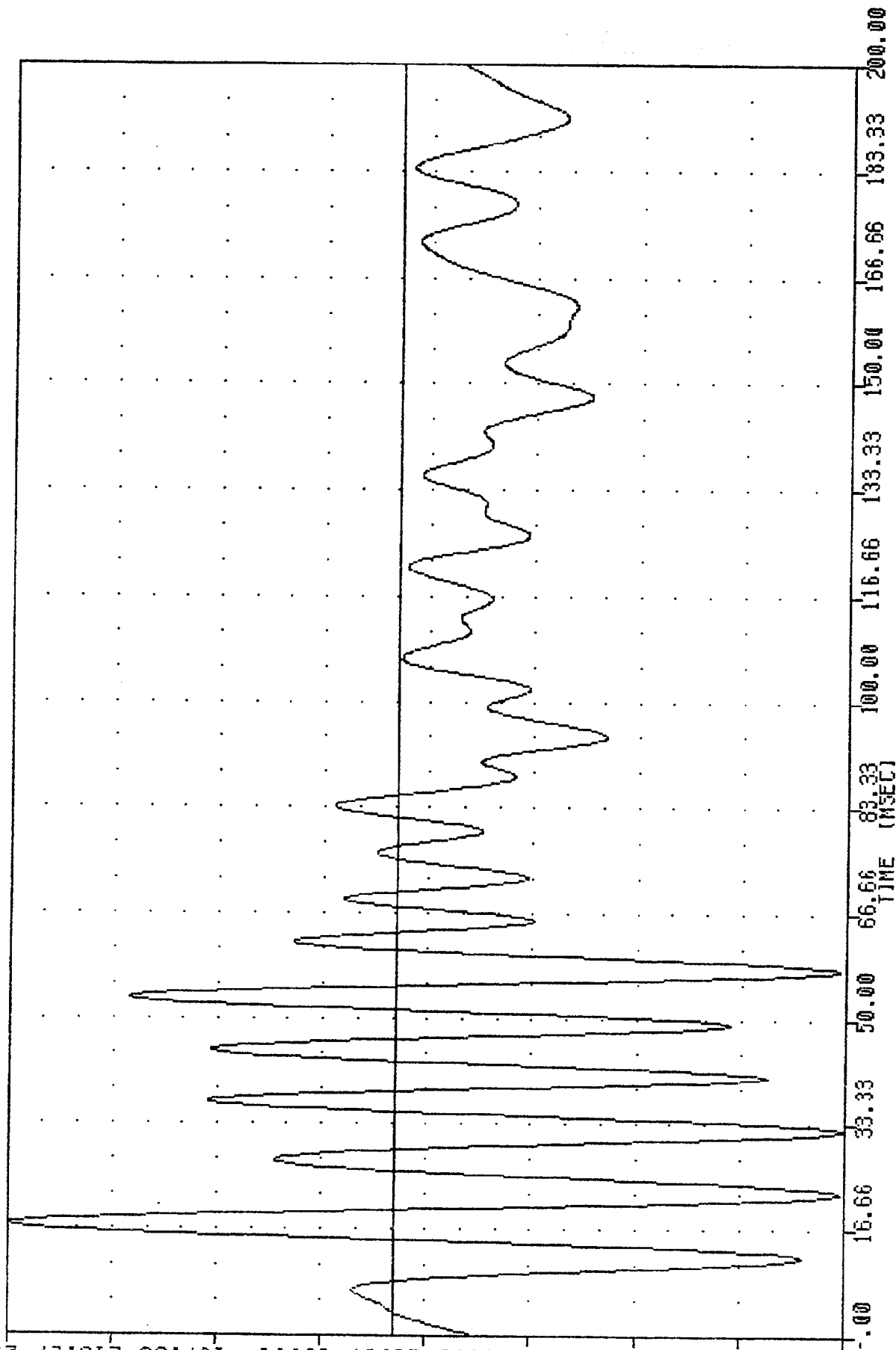
A1

22-FEB-82 12:32:20

FILTER = BLPF 100% 317/ -40

MIN. MAX VALUES = -346.73 32.25, 298.98 17.13

92-B
FORCE (LBS)
-346.72 -266.01 -185.29 -104.58 -23.87 56.84 137.55 218.27 298.98



BARRIER A1

SRL48

1982 VOLVO 200, BAR

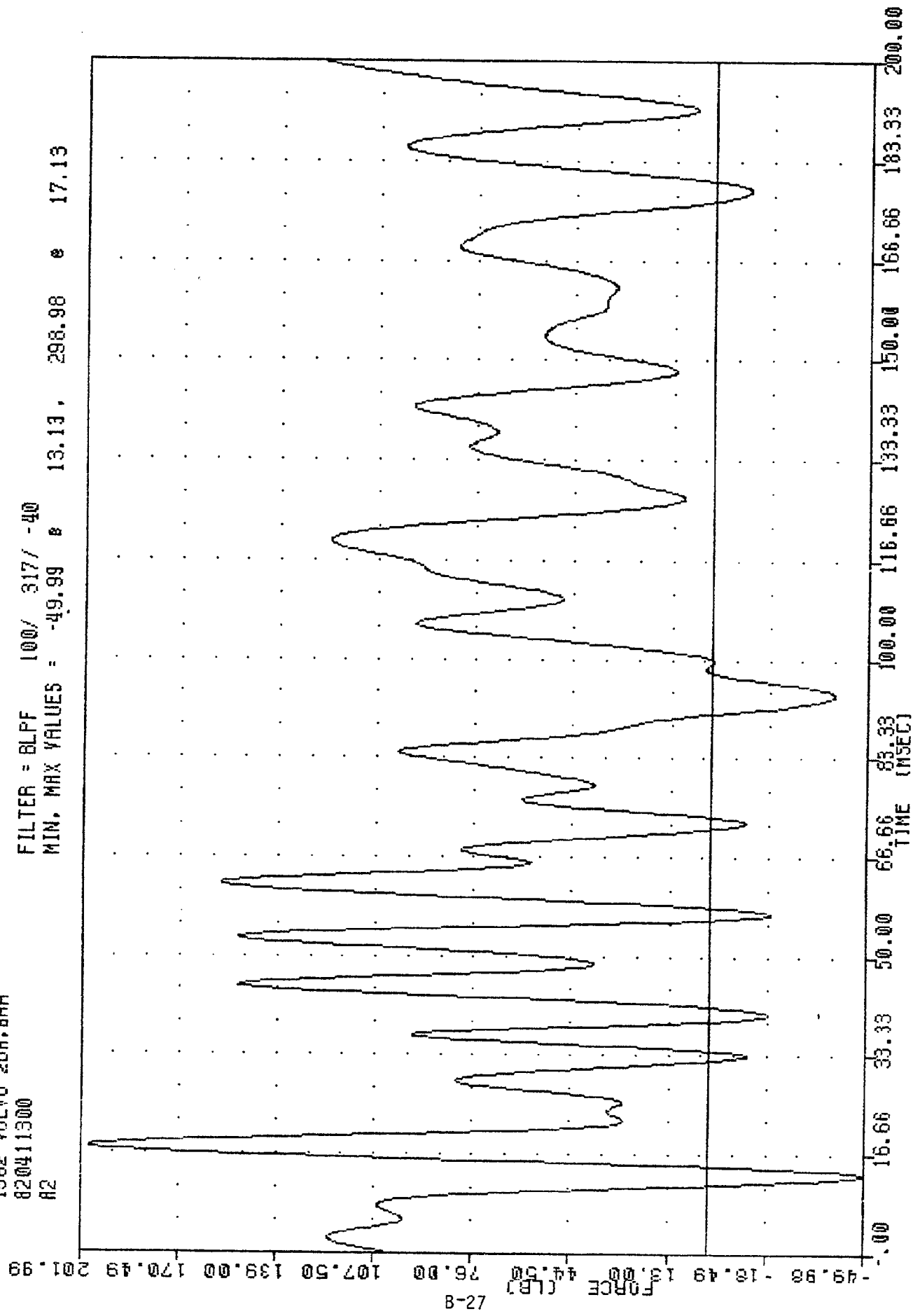
820411300

A2

22-FEB-82 12:32:20

FILTER = BLPF 100/ 317/ -40

MIN, MAX VALUES = -49.99 13.13, 298.98 17.13

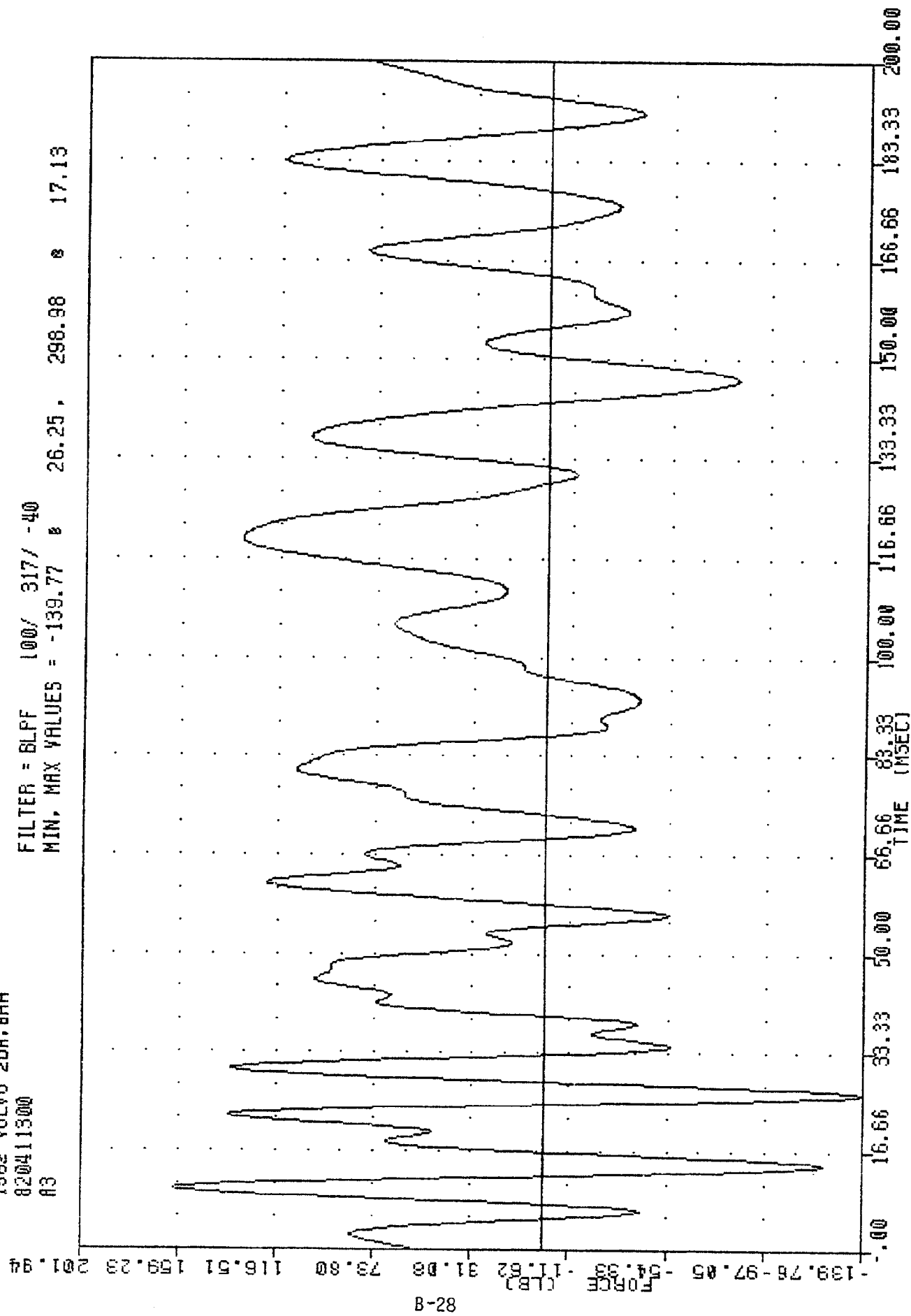


BARRIER A2

SRL48
1982 VOLVO 2DR.8AR
820411300
A3

22-FEB-82 12:32:20

FILTER = BLPF 100/ 317/ -40
MIN. MAX VALUES = -139.77 26.25, 298.98 17.13



BARRIER A3

SRL48

1982 VOLVO 2DR.BAR

820411300

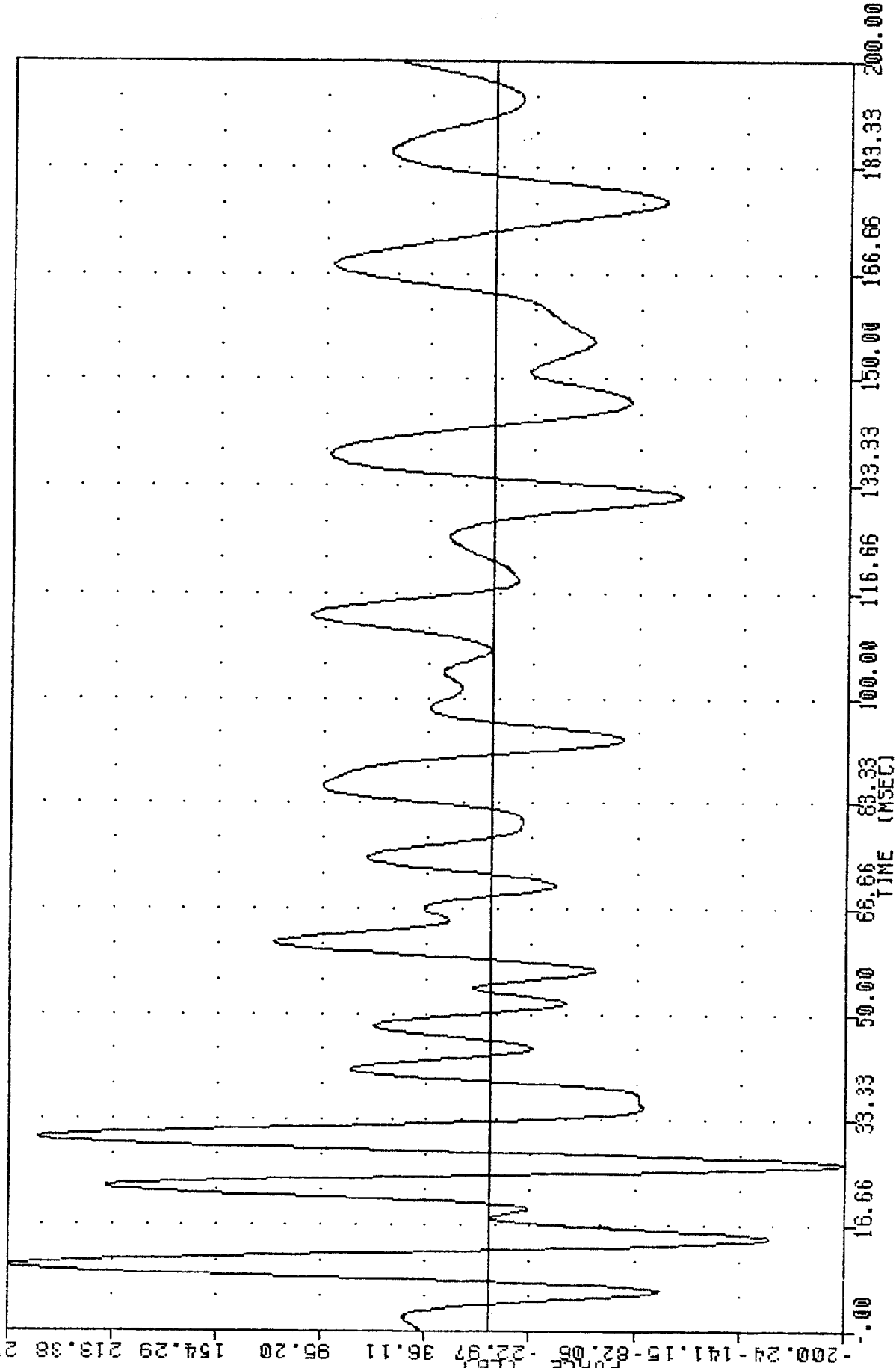
R4

22-FEB-82 12:47:34

FILTER = BLPF 100/ 317/ -40

MIN, MAX VALUES = -200.24 8 26.25, 272.47 8 10.13

62-B
FORCE (LB)
-200.24 -141.15 -82.05 -22.97 36.11 95.20 154.29 213.38 272.46



BARRIER R4

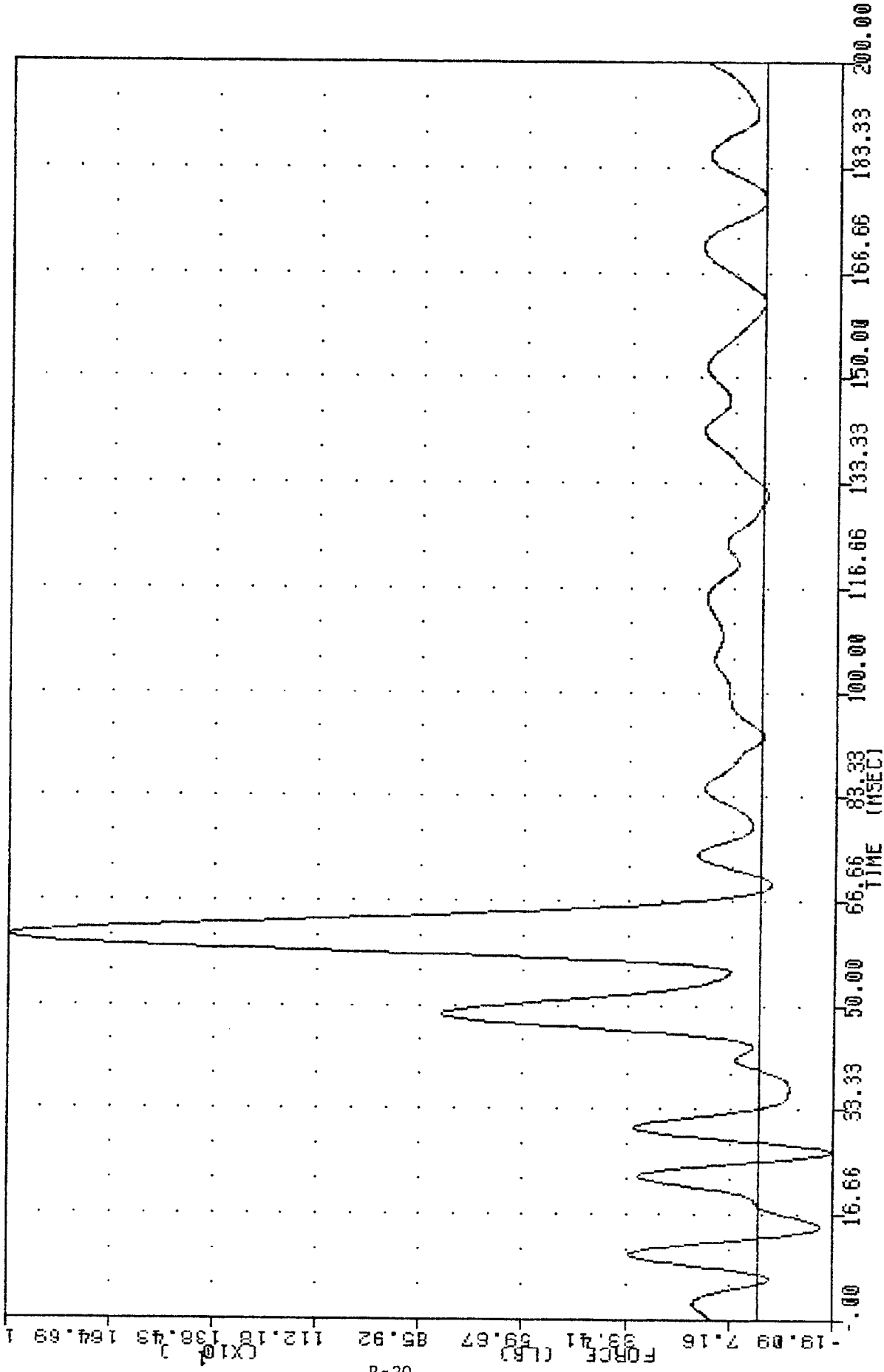
SRL48
1982 VOLVO 2DR.BAR
820411300
R5

22-FEB-82 12:47:34

FILTER = BLPF 100/ 317/ -40

MIN, MAX VALUES = -190.94 8 26.25, 1909.50 8 60.75

03-8
CX10 J
-19.09 7.16
33.41
59.67
85.92
112.18
138.43
164.69
190.95



BARRIER R5

58L48

1982 VOLVO 2DR.BAR

820411300

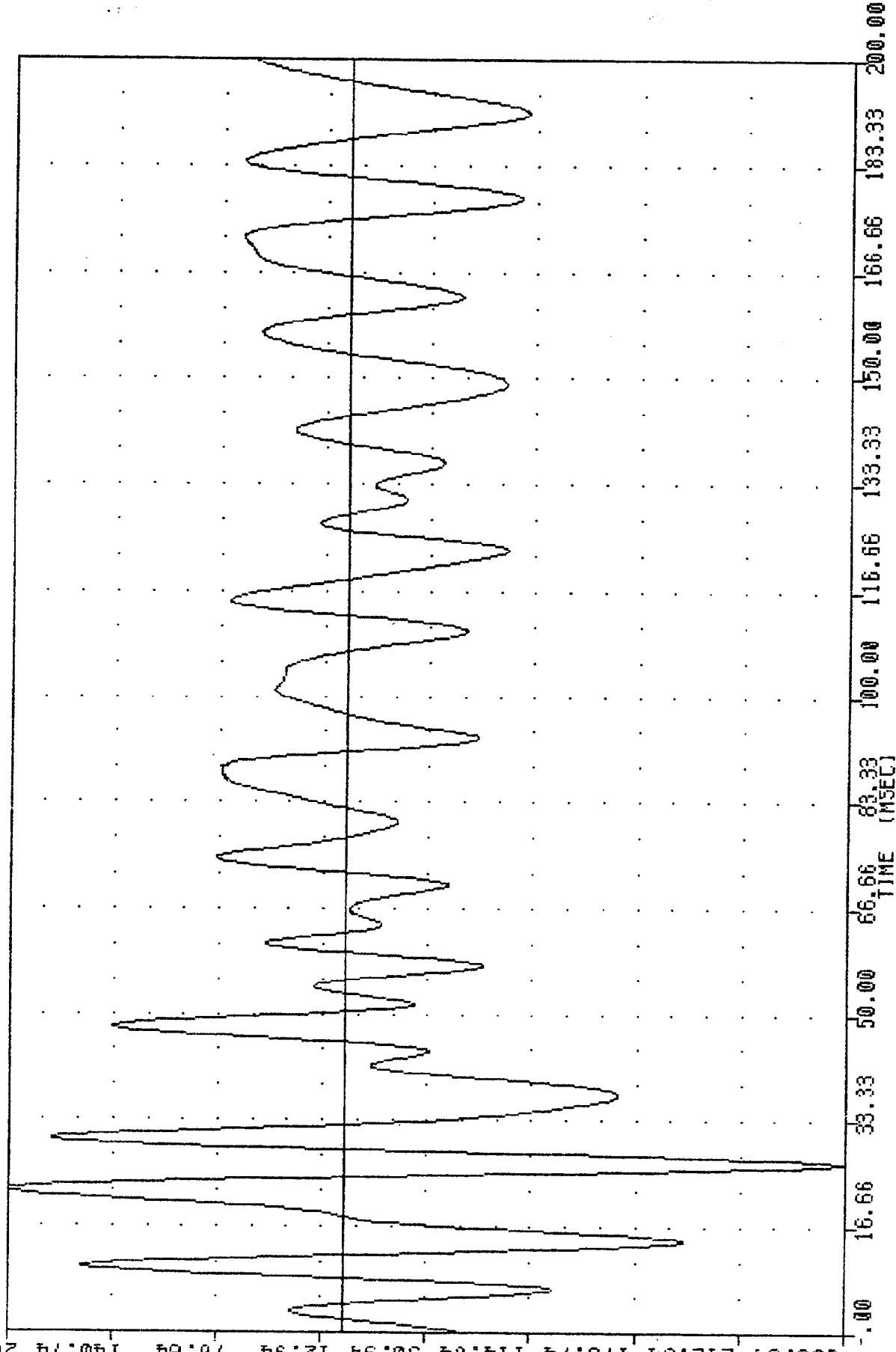
AG

22-FEB-82 12:47:34

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -306.55 26.38, 204.65 22.13

13-B
FORCE (LB)
-306.54 -242.64 -178.74 -114.84 -50.94 12.94 76.84 140.74 204.64



BARRIER AG

3RL48

1982 VOLVO 208, 8AR

820411300

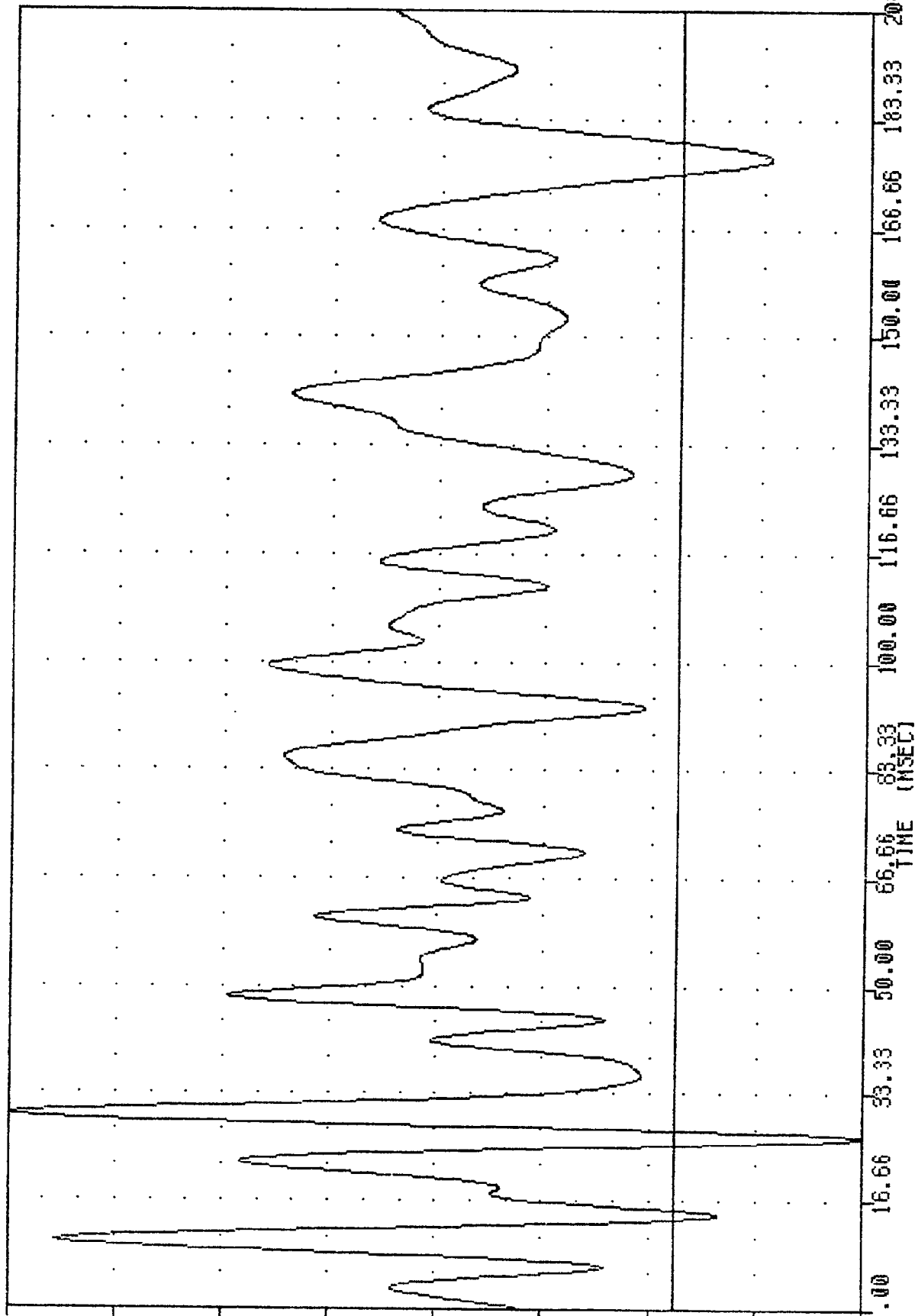
A7

22-FEB-82 12:47:34

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -63.18 26.38, 225.65 29.88

26-B
FORCE (LB)
-63.18 -27.08 9.02 45.12 81.23 117.33 153.44 189.54 225.65



BARRIER A7

SRL46
1992 VOLVO 2DR.BAR
820411300
A8

22-FEB-82 12:47:34

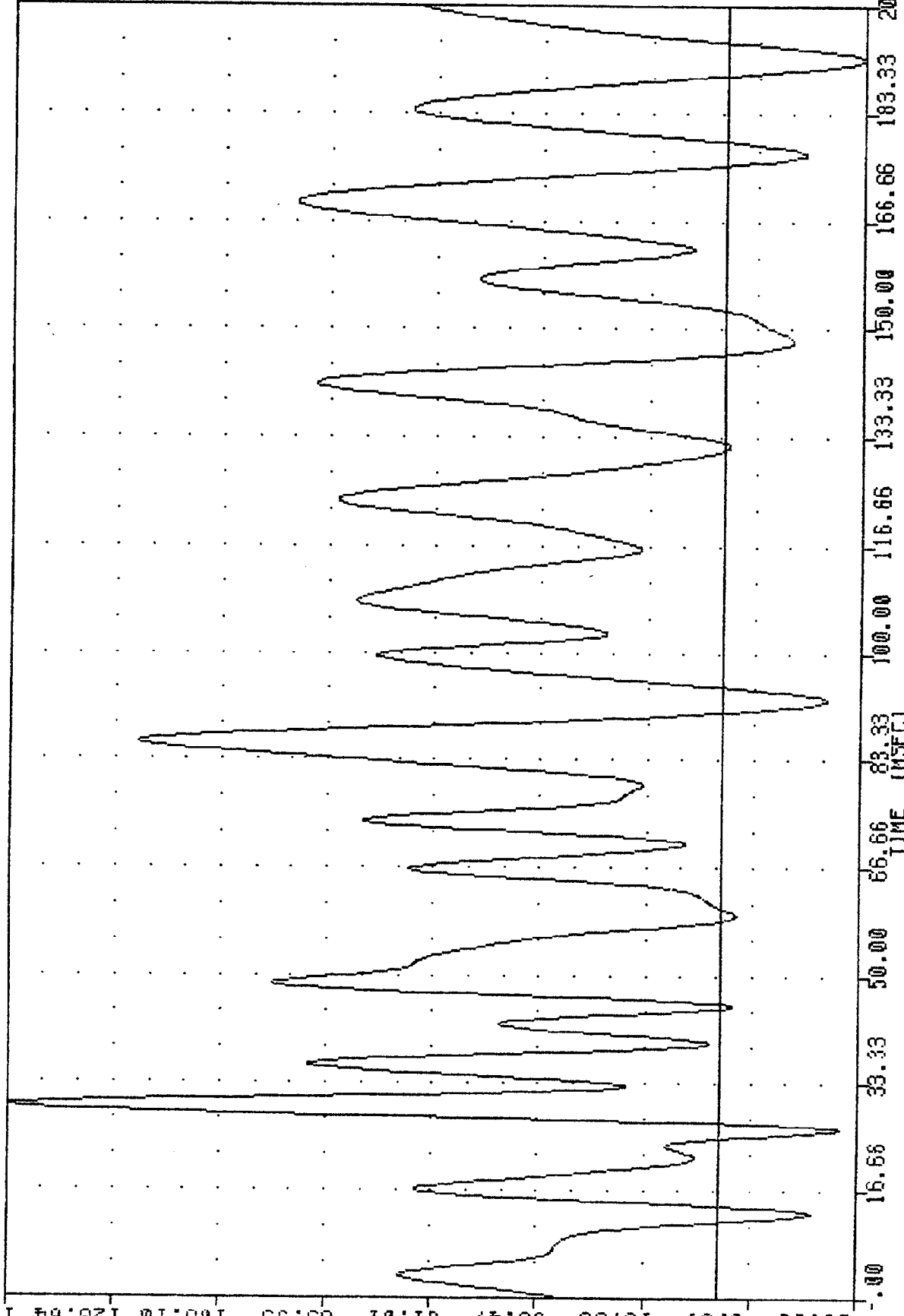
FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -29.15 191.75, 151.19 29.50

151.19 128.64 106.10 83.55 61.01 38.47 15.93 -6.61 -29.15

B-33

FORCE (LB)



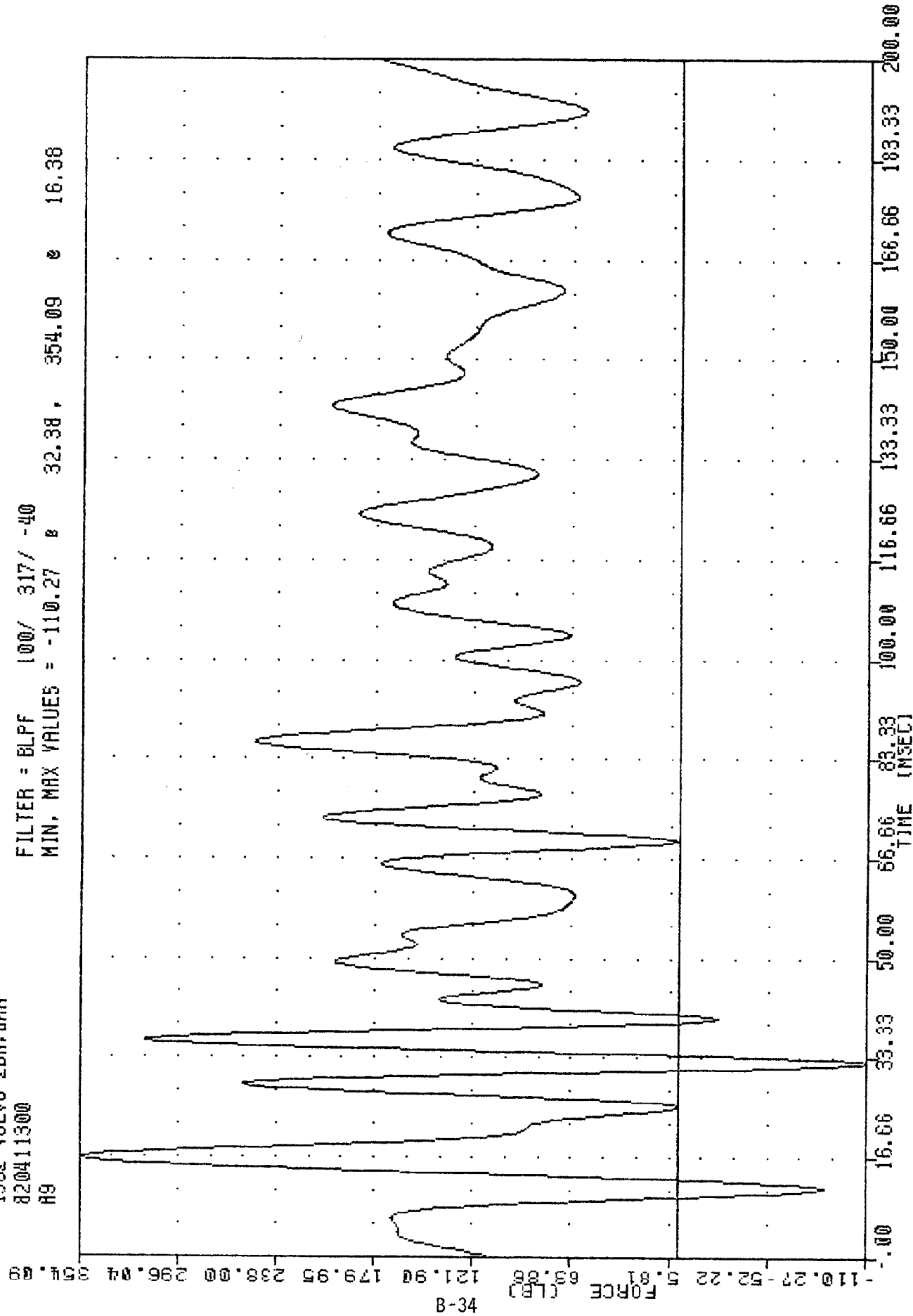
BARRIER A8

SRL48
1982 VOLVO 2DR.BAR
820411300
R9

22-FEB-82 12:47:34

FILTER = BLPF 100/ 317/ -40
MIN. MAX VALUES = -110.27 32.38

354.09 16.38



BARRIER R9

SRL48

1982 VOLVO 200, BAR

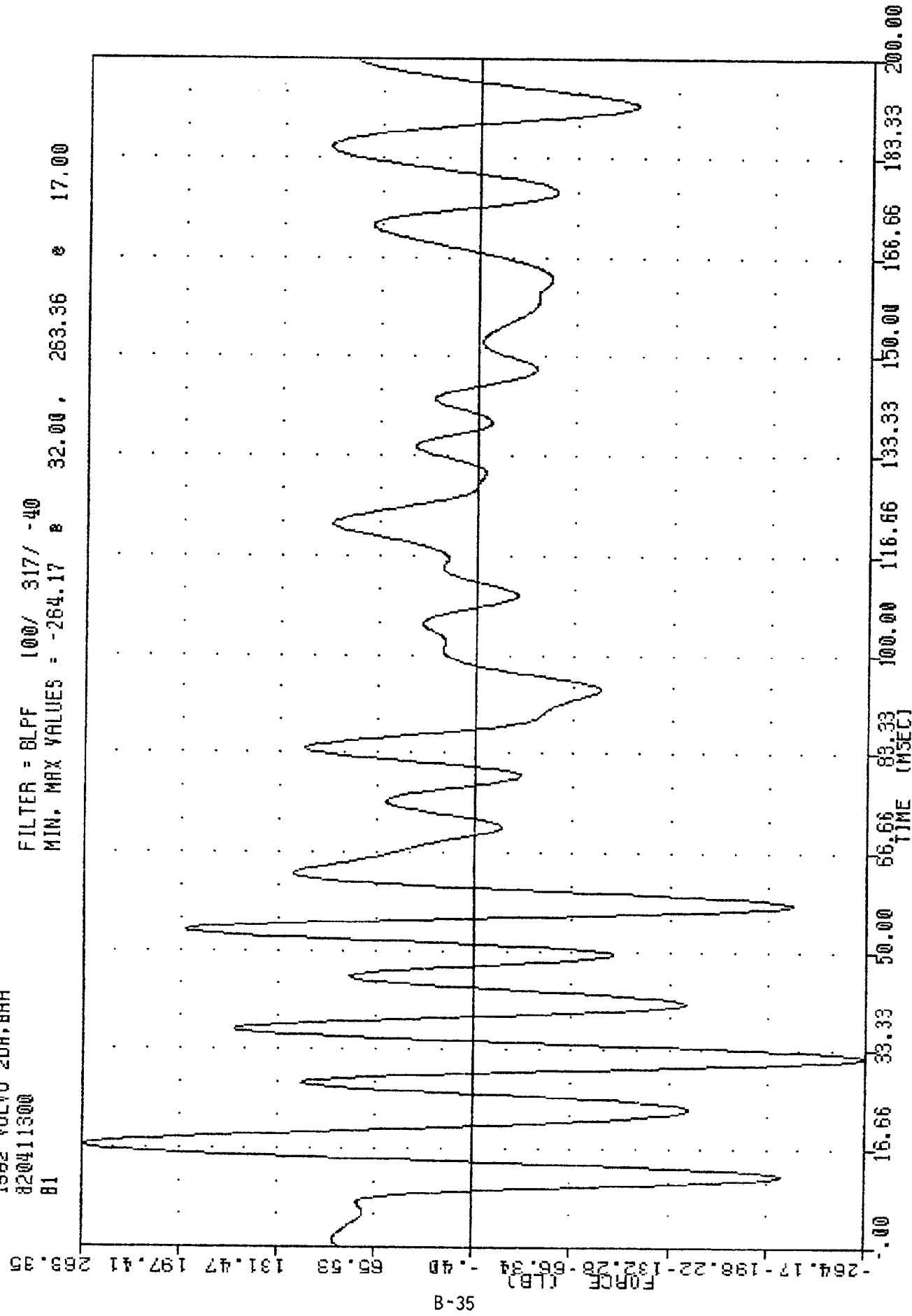
820411300

B1

22-FEB-82 12:47:34

FILTER = 8LPF 100/ 317/ -40

MIN. MAX VALUES = -264.17 32.00, 263.36 17.00



BARRIER B1

SRL48

1962 VOLVO 2DR.BAR

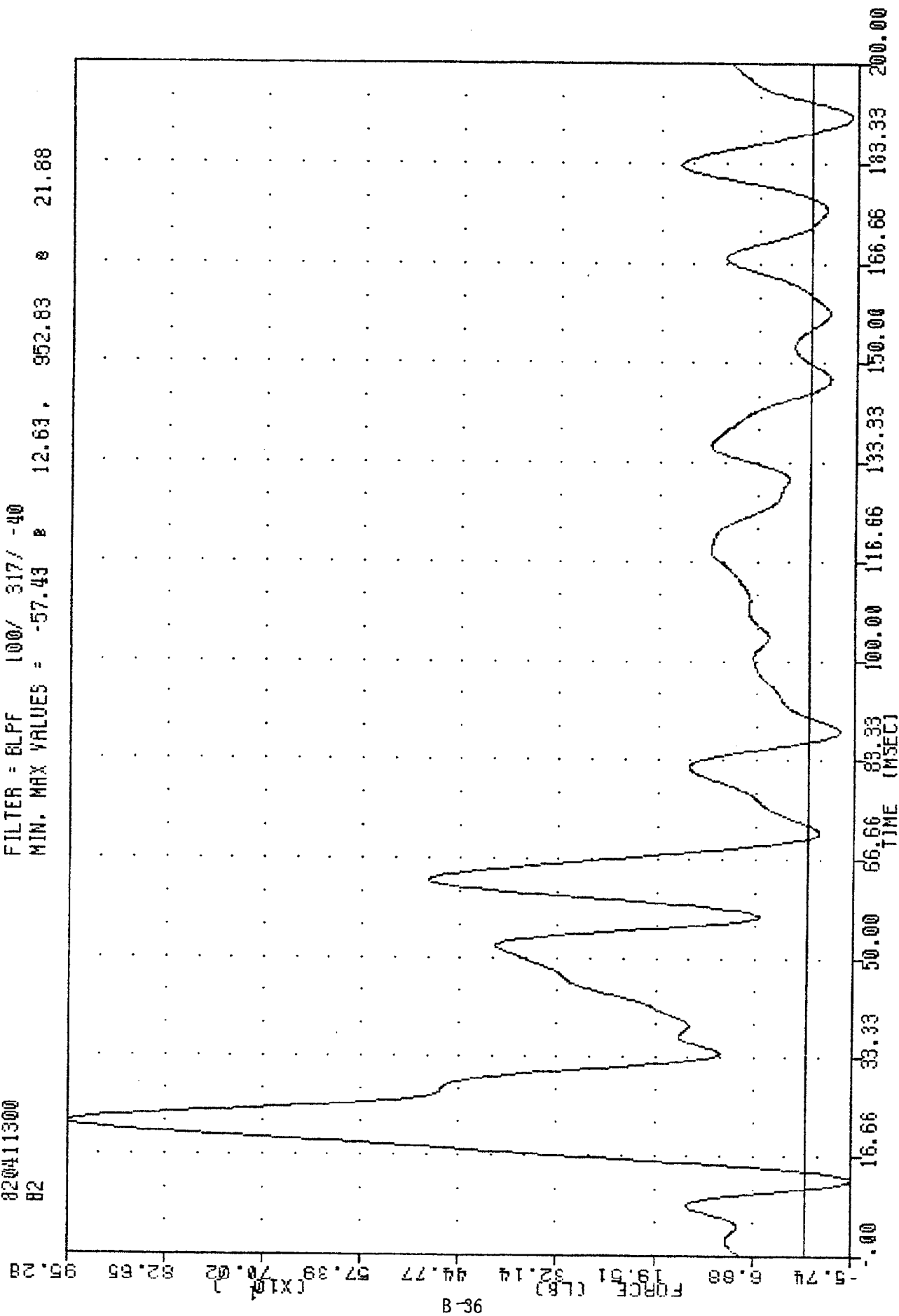
820411300

B2

22-FEB-82 12:47:34

FILTER = 8LPP 100/ 317/ -40

MIN. MAX VALUES = -57.43 12.63 952.83 21.88



BARRIER B2

9RL48

1982 VOLVO 200.BAR

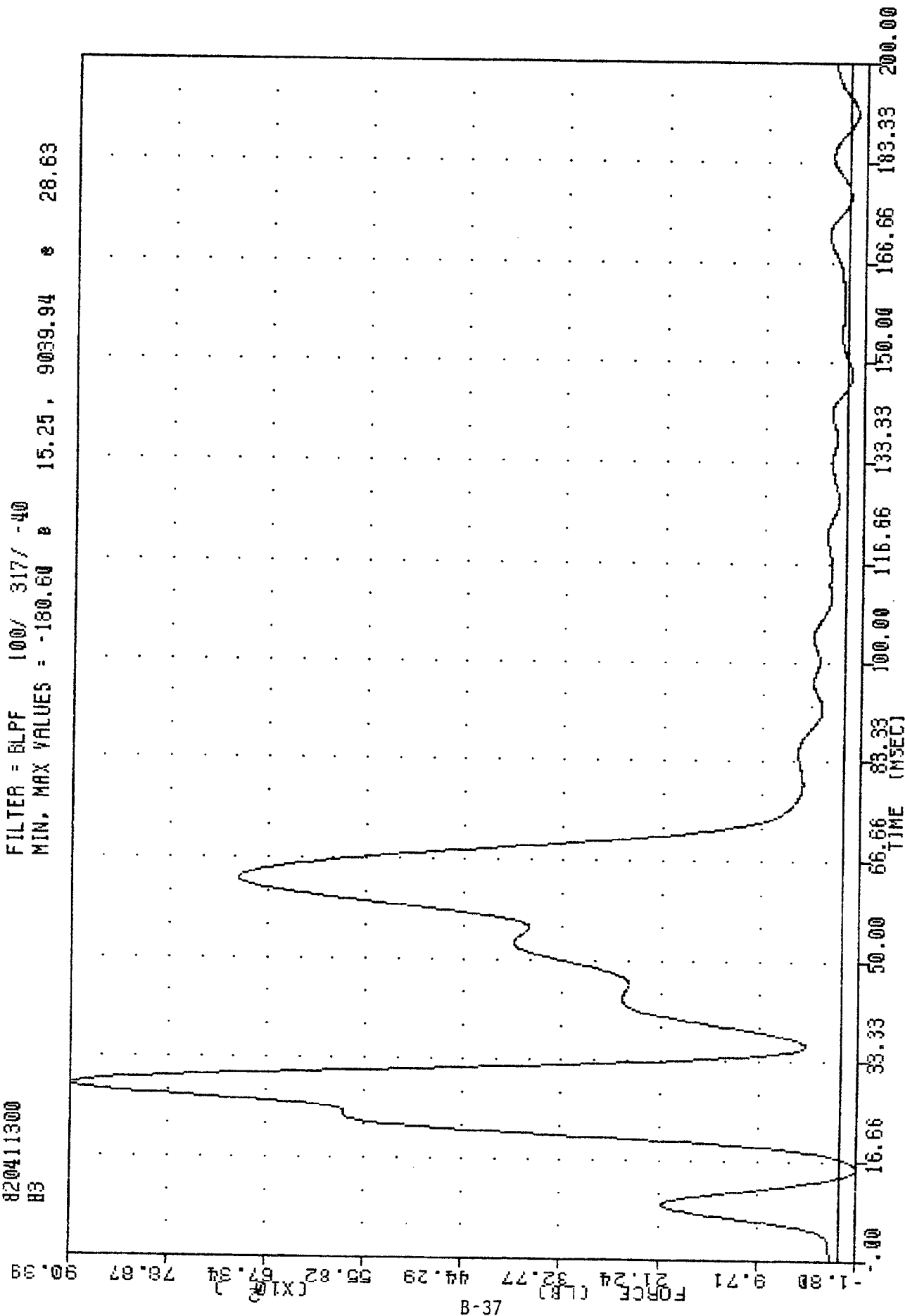
820411300

B3

22-FEB-82 12:47:34

FILTER = 5LPP 100/ 317/ -40

MIN. MAX VALUES = -180.60 15.25, 9039.94 28.63



BARRIER B3

SRL48

1982 VOLVO 2DR.BAR

820411300

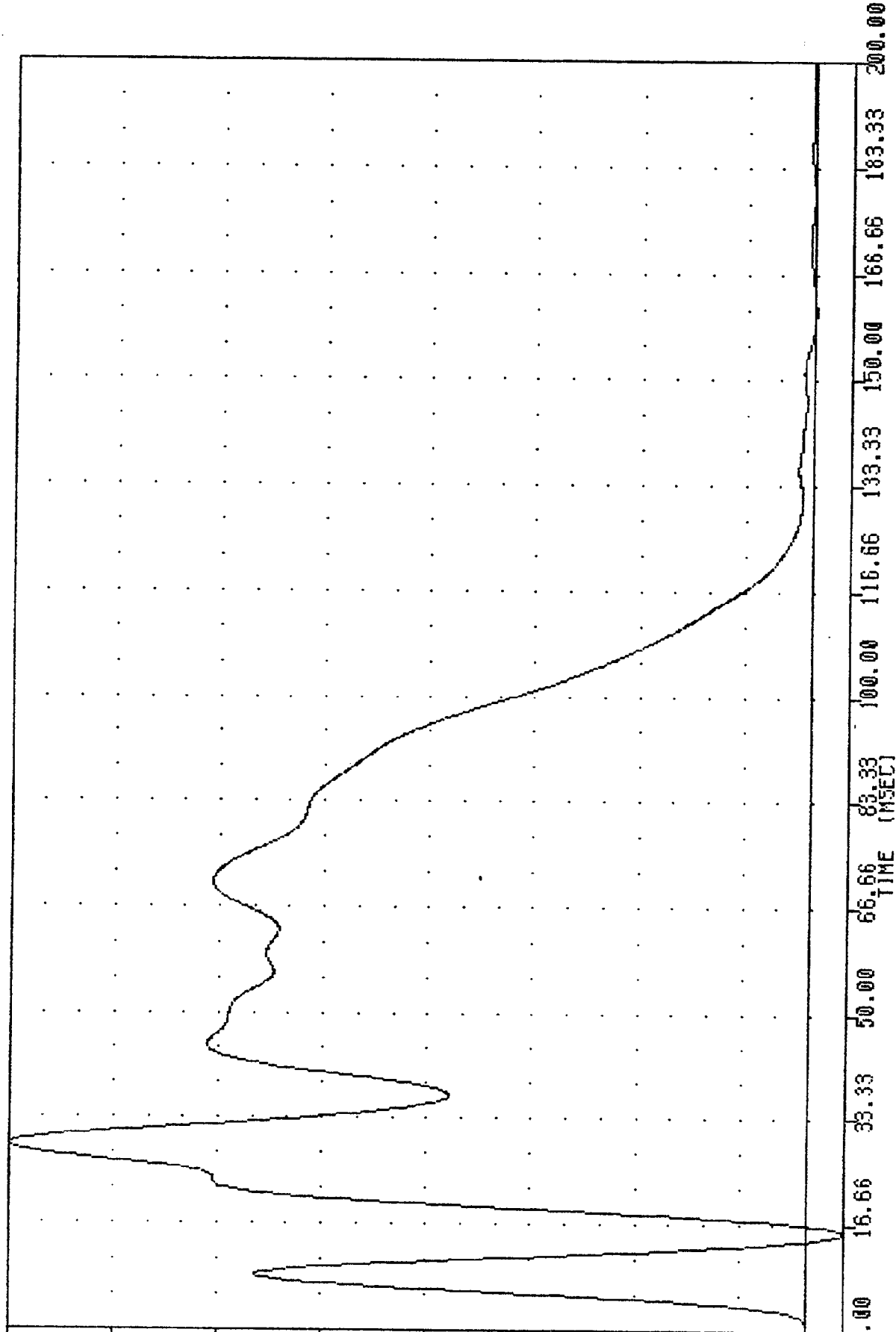
B4

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN, MAX VALUES = -1269.87 8 15.25, 26483.25 8 28.88

83-8
1
195.75
264.83
280.14
21.99
56.68
91.97
126.08
160.75
195.75
264.83



BARRIER B4

SRL48

1982 VOLVO 2DR, BAR

820411300

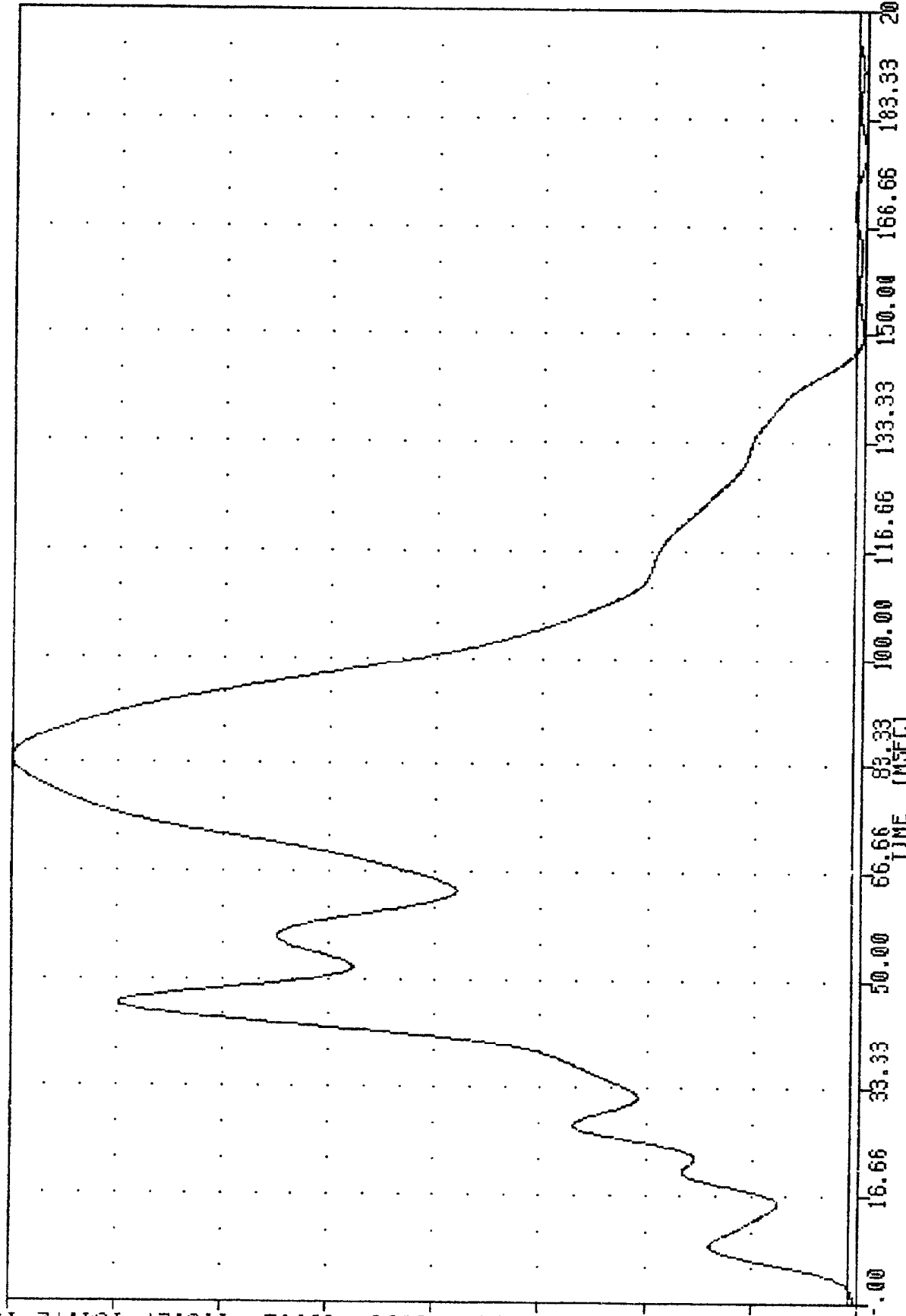
B5

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -143.83 178.25, 15417.76 83.88

66-B
FORCE (LB)
(X10²)
-1.48 18.01 37.46 58.91 76.86 95.82 115.27 134.72 154.17



BARRIER B5

3RL48

1982 VOLVO 2DR. BAR

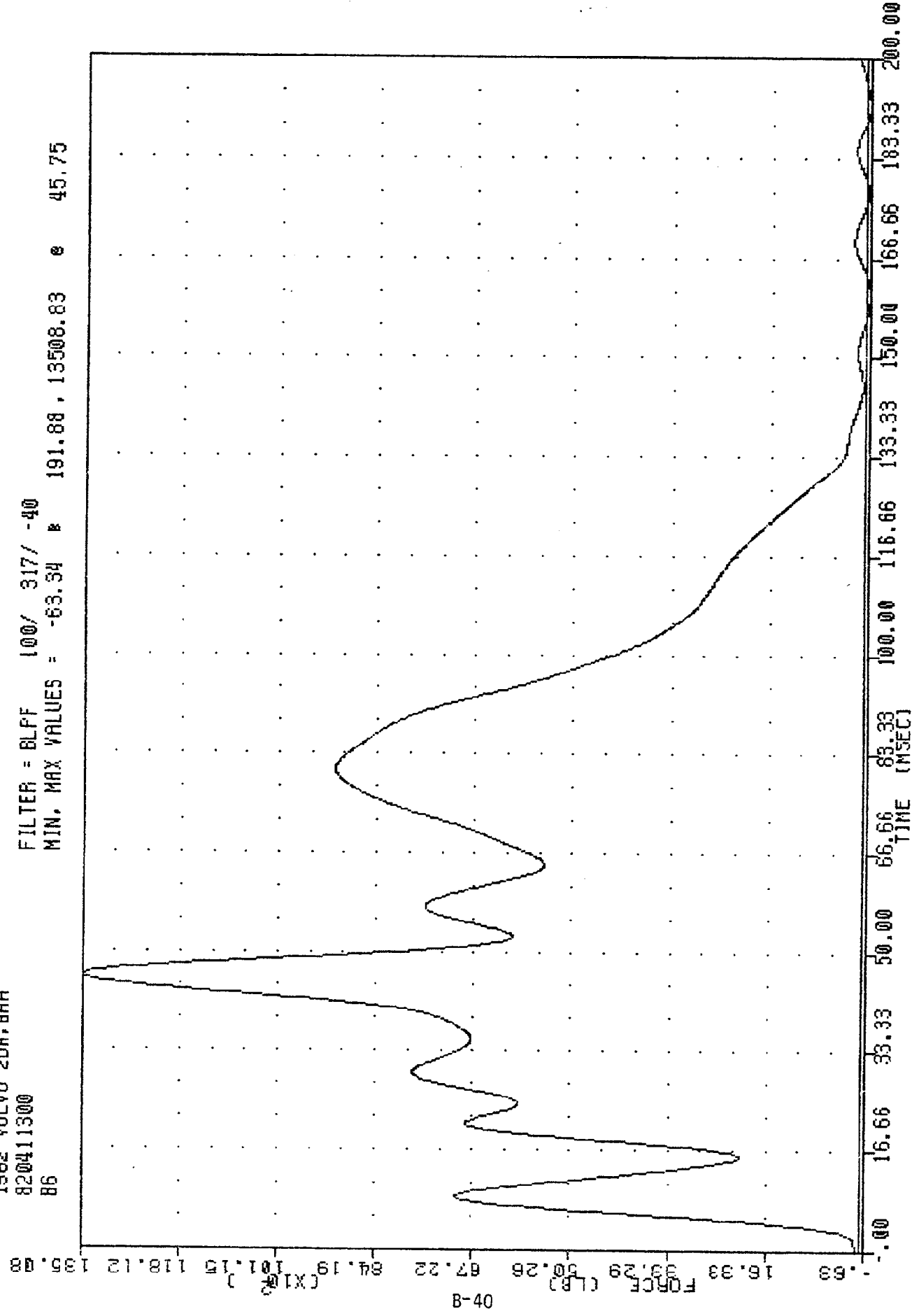
820411500

B6

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -63.34 191.88, 13508.83 @ 45.75



BARRIER B6

3RL48

1982 VOLVO 2DR.BAR

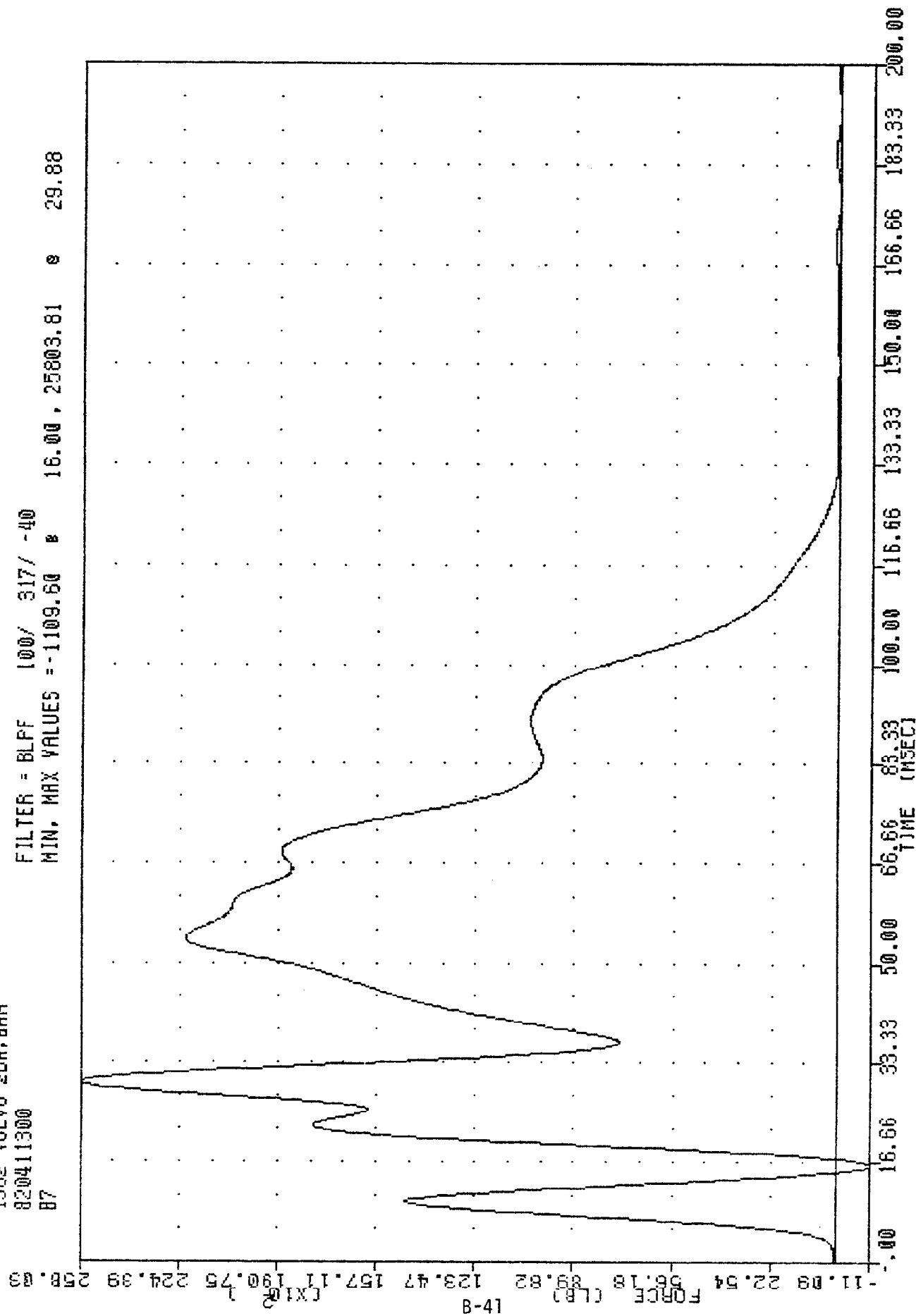
820411300

B7

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -1109.60 16.00, 25803.81 29.88

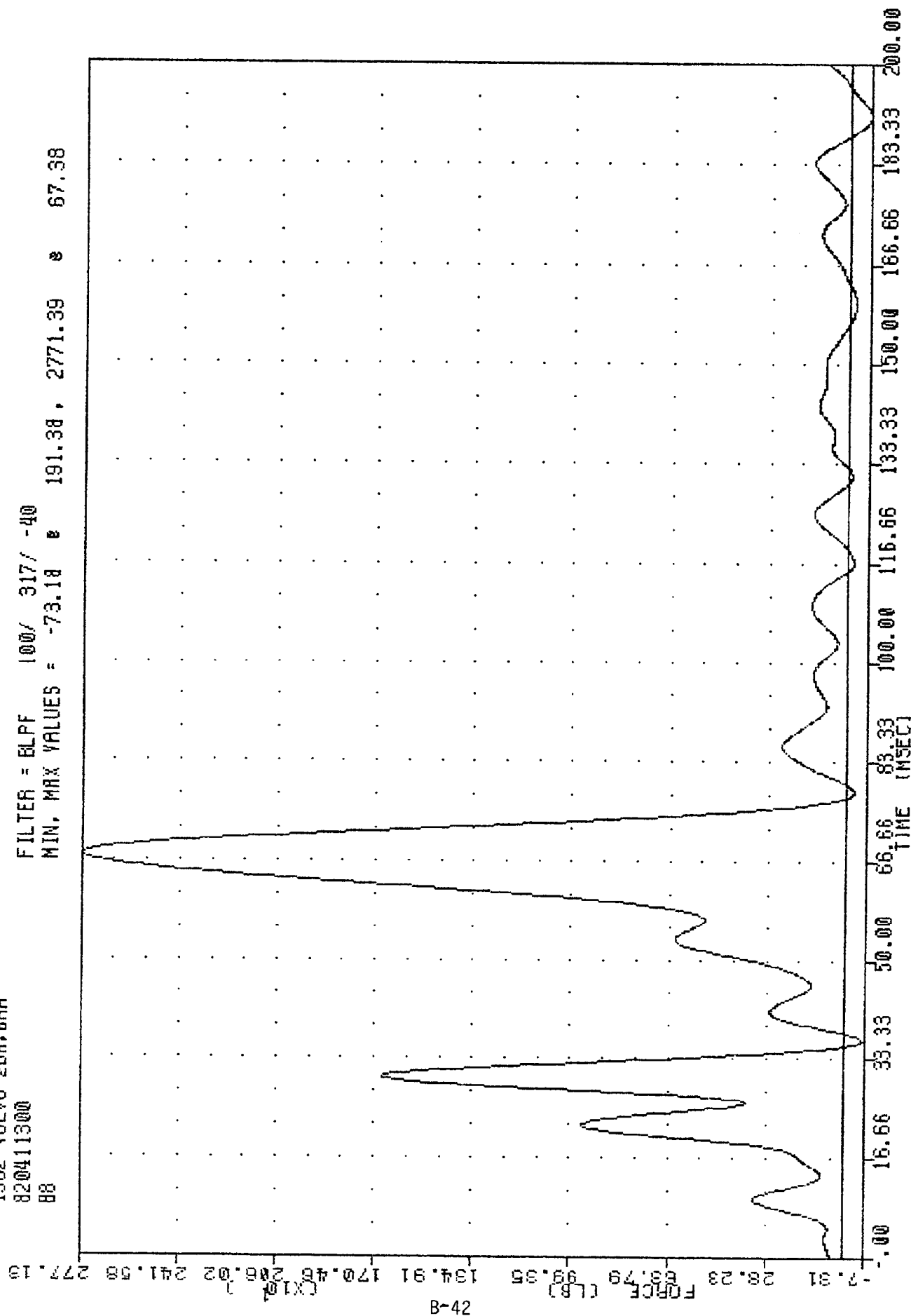


BARRIER B7

SRL48
1982 VOLVO 200, BAR
820411300
B8

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40
MIN, MAX VALUES = -73.18 191.38, 2771.39 67.38



BARRIER B8

SRL48

1982 VOLVO 2DR.BAR

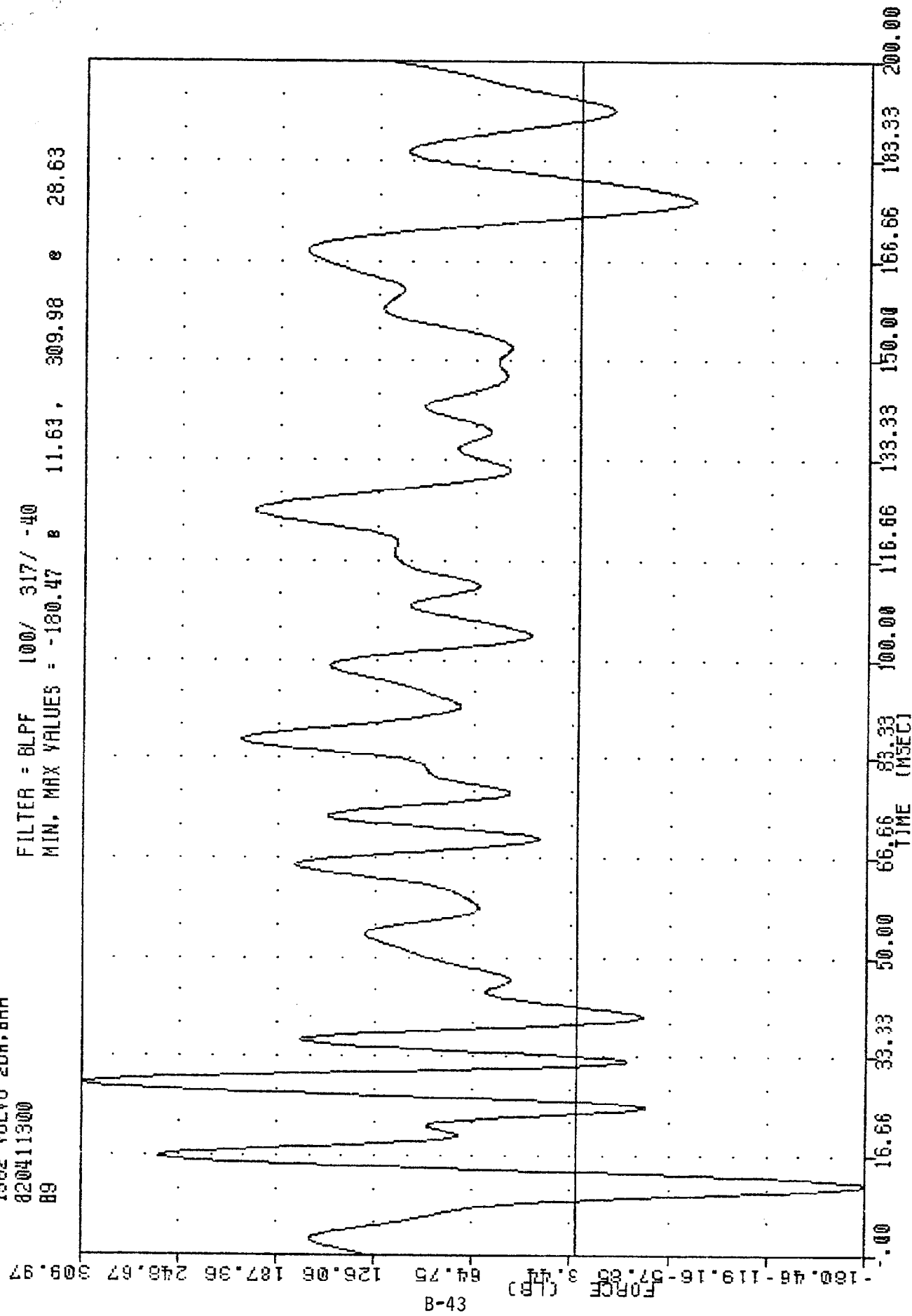
820411300

B9

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = -180.47 8 11.63, 309.98 8 28.63



BARRIER B9

SRL48

1982 VOLVO 200, BAR

820411300

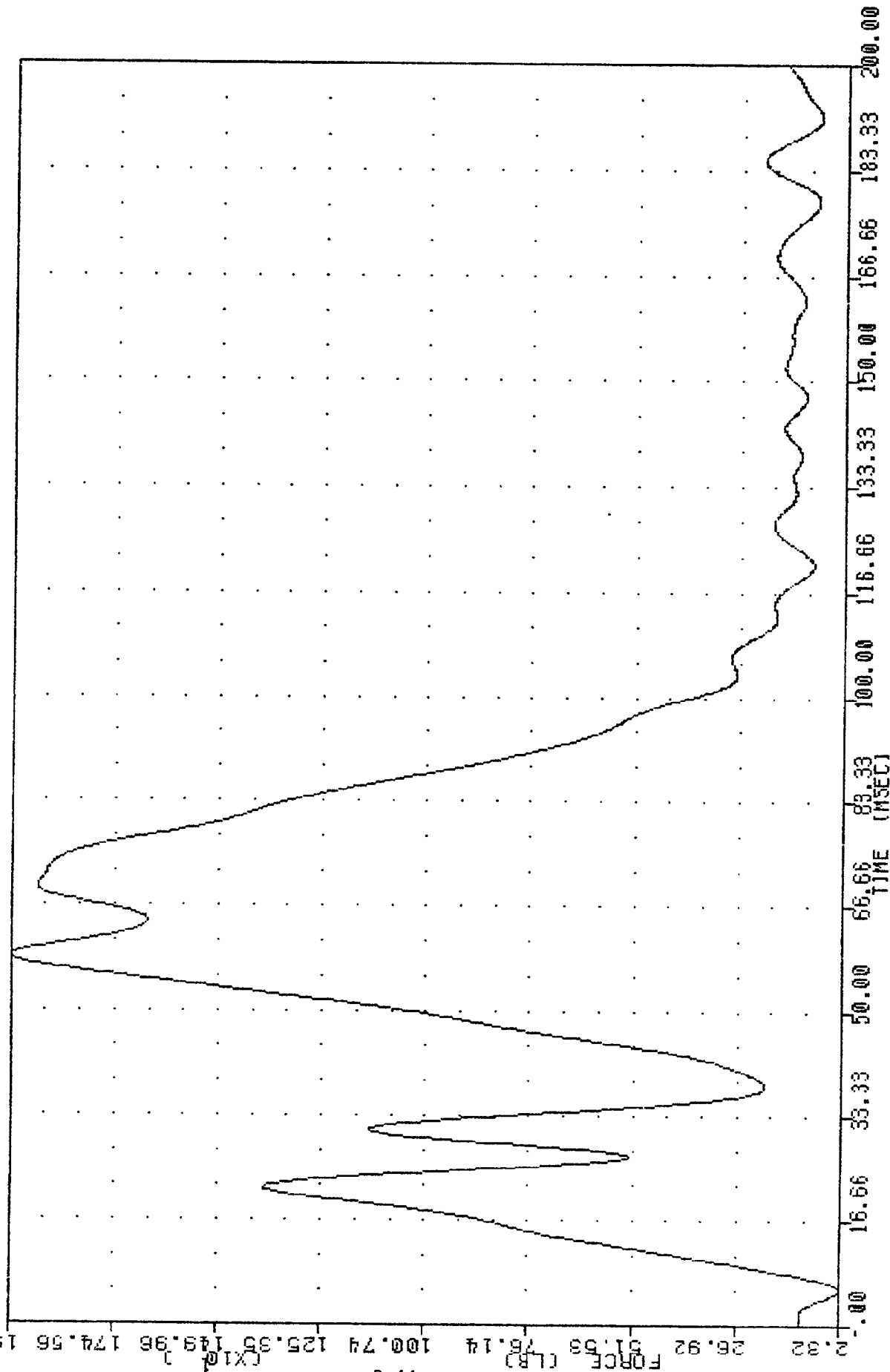
C4

22-FEB-82 12:51:52

FILTER = BLPF 100/ 317/ -40

MIN. MAX VALUES = 23.20 5.50, 1991.75 0 58.38

44-B
FORCE (LB)
2.32 26.92 51.53 76.14 100.74 125.35 149.96 174.56 199.17
C4



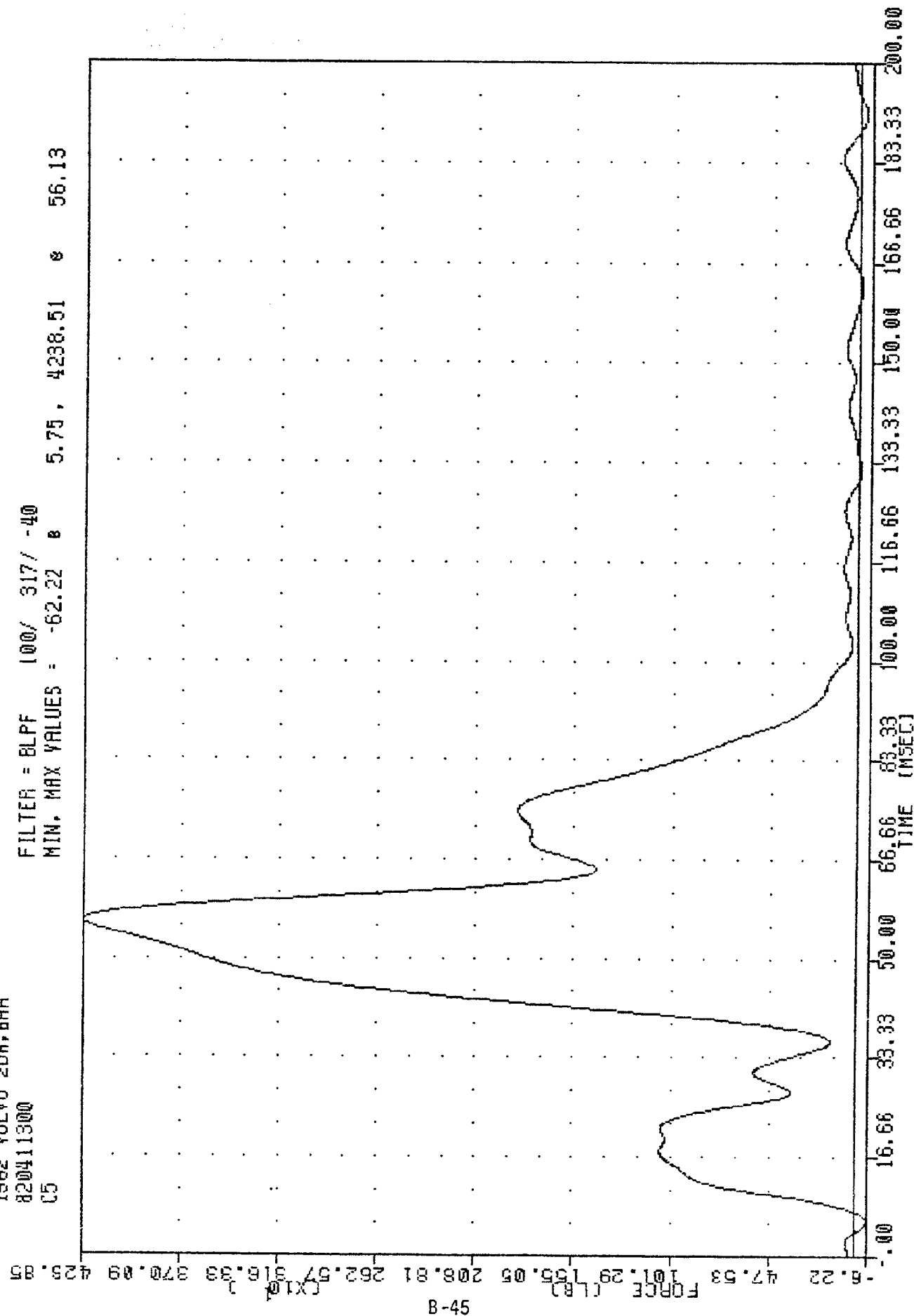
BARRIER C4

SRL48
1982 VOLVO 20A, 8AR
820411300
C5

22-FEB-82 12:51:52

FILTER = 8LPF 100/ 317/ -40

MIN. MAX VALUES = -62.22 5.75, 4238.51 56.13



BARRIER C5

SRL48

1982 VOLVO 20A.BAR

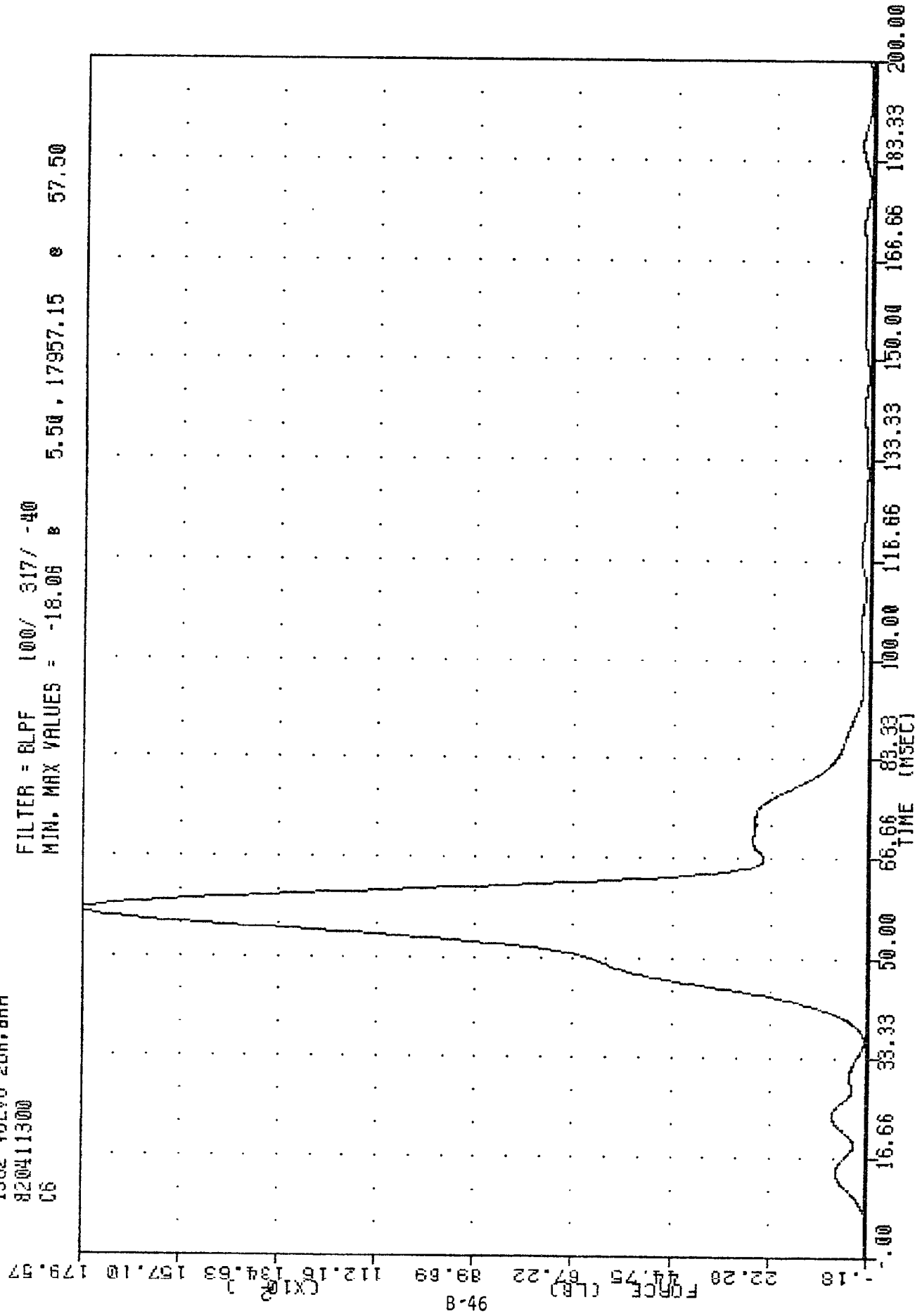
820411300

C6

22-FEB-82 12:51:52

FILTER = 8LPF 100/ 317/ -40

MIN. MAX VALUES = -18.06 5.50 .17957.15 e 57.50



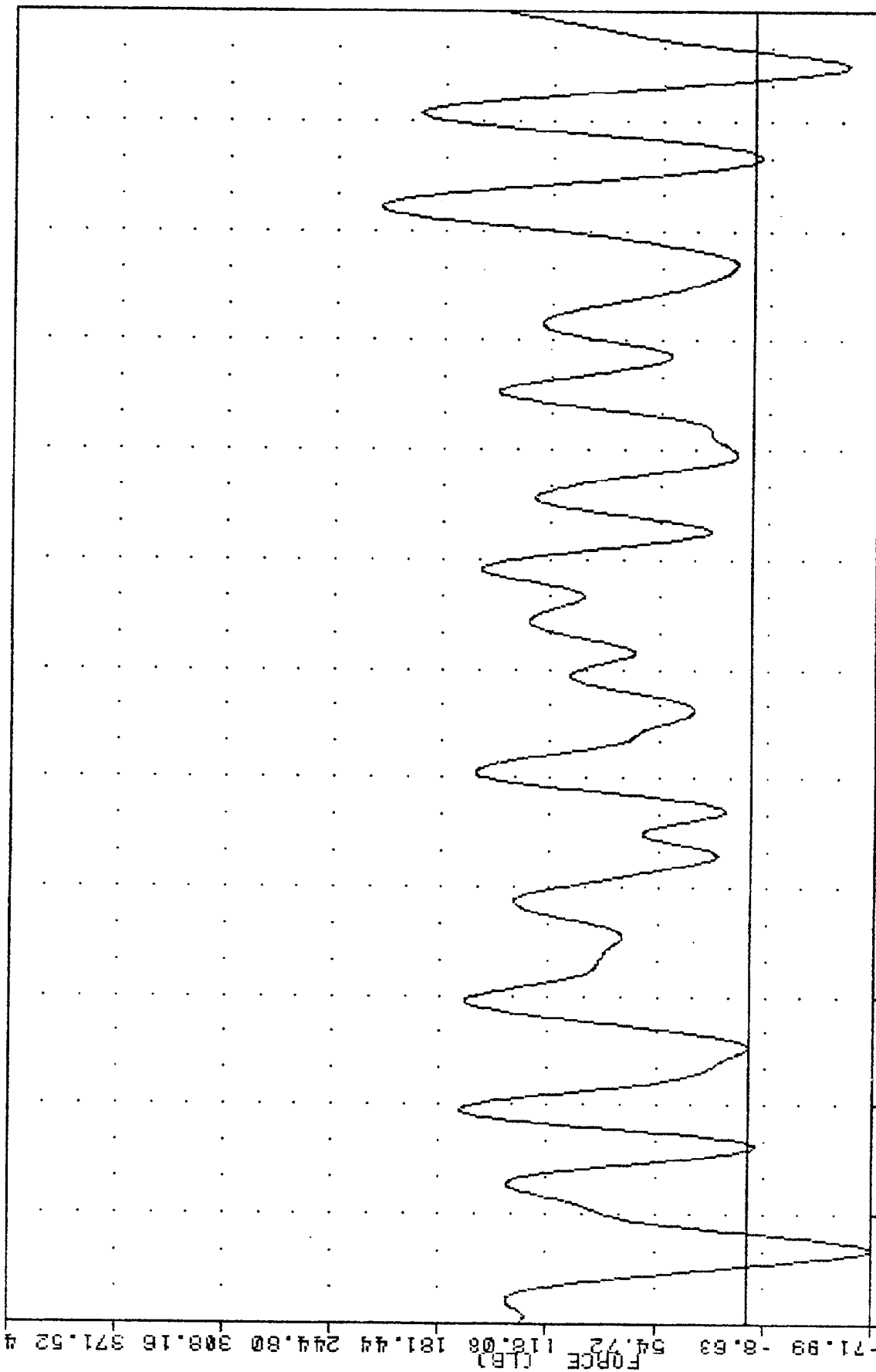
BARRIER C6

SFL48
1982 VOLVO 20R, BAR
820411300
04

22-FEB-82 13:32:08

FILTER = BLPF 100/ 317/ -40
MIN, MAX VALUES = -72.00 8 11.25, 0.00 8 0.00

71.99 -8.63 54.72 118.08 181.44 244.80 308.16 371.52 434.87



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

TIME (MSEC)

BARRIER 04

SRL48

1982 VOLVO 20R.BAR

820411300

05

22-FEB-82 13:32:08

FILTER = 8LPP 100/ 317/ -40

MIN. MAX VALUES = -72.00 11.25, 2089.69 17.75

208.96

162.84

136.72

130.60

104.48

78.36

52.24

26.12

00.00

00.00

00.00

00.00

00.00

00.00

00.00

00.00

00.00

00.00

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00.00

00.00

00.00

00.00

84-B

FORCE (LB)

1000

TIME (MSEC)

BARRIER 05

SRL46

1982 VOLVO 2DR, BAR

820411300

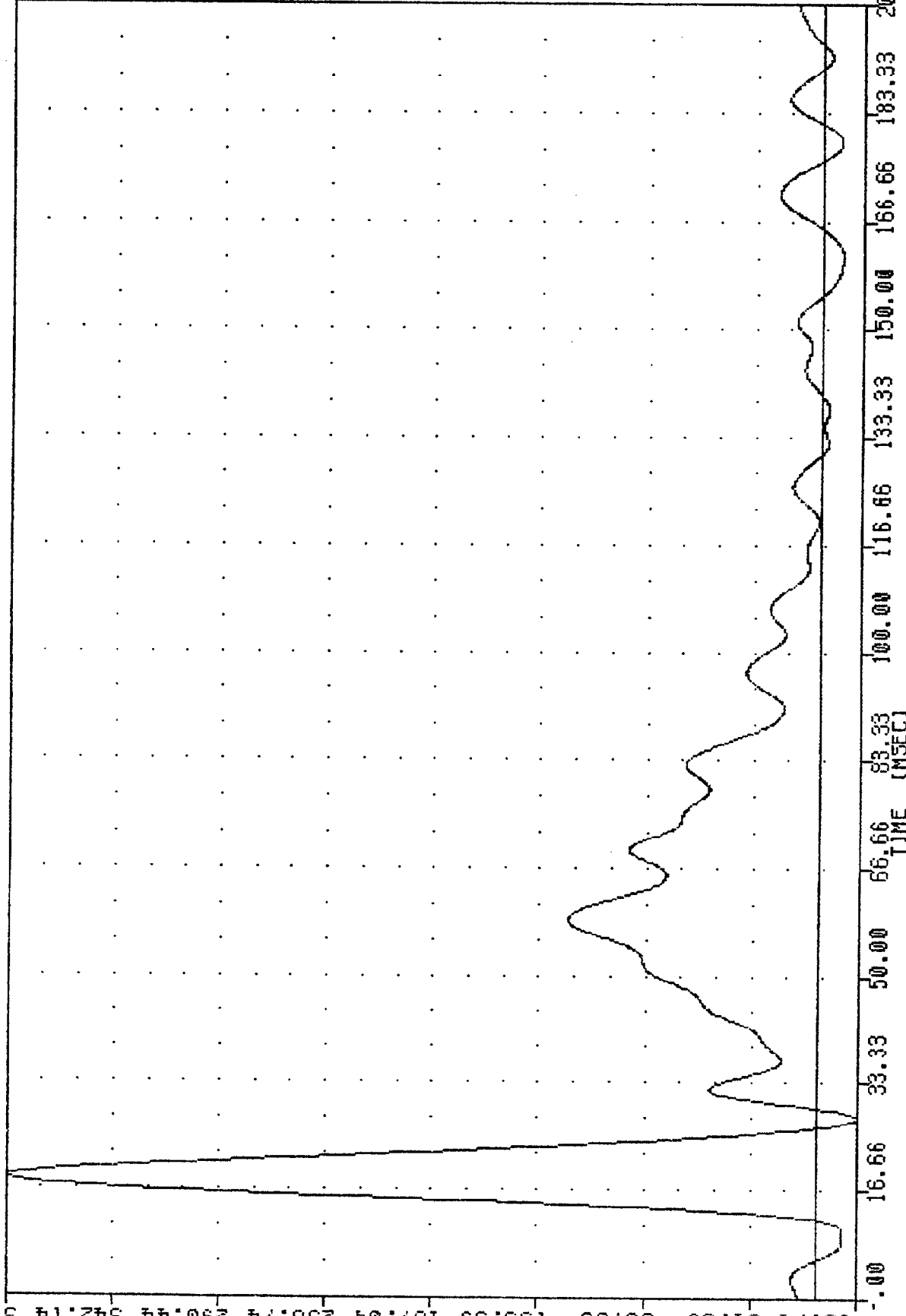
D6

22-FEB-82 13:32:08

FILTER = BLPF 100/ 317/ -40

MIN, MAX VALUES = -197.44 8 27.53, 3938.39 e 18.13

64-8
FORCE (LB)
-19.74 81.95 83.65 85.65 135.35 187.04 238.74 290.44 342.14 393.83
(X10³)



BARRIER D6

DOT0418

NEW CAR ASSESSMENT TESTING

VOLVO CORP.
1982 VOLVO DL

VRTC NO. 444

PREPARED BY:
VEHICLE RESEARCH AND TEST CENTER
St. Rt. 33 Logan County
East Liberty, Ohio 43319



FINAL REPORT

JUNE 1982

Prepared for:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF AUTOMOTIVE RATINGS
400 SEVENTH STREET, S.W.
WASHINGTON, D.C. 20590

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Date: 6/23/82

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B. Peterson
Contract Technical Manager
Vehicle Research & Test Center

Date: 6/23/82

Report Accepted By: V.R. Dwan
Contract Technical Manager
Office of Automotive Ratings

Date: JUL 9 1982

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle NEW VEHICLE ASSESSMENT TEST		5. Report Date June 1982	
		6. Performing Organization Code	
		8. Performing Organization Report No. 820210	
7. Author(s) Jack E. Favors		10. Work Unit No. (TRAIS)	
9. Performing Organization Name and Address Vehicle Research and Test Center St. Rt. 33 Logan County East Liberty, Ohio 43319		11. Contract or Grant No. SRL 48	
		13. Type of Report and Period Covered Final Report June 1982	
12. Sponsoring Agency Name and Address U.S. Department Of Transportation National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington, DC 20590		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract This test report includes a vehicle assessment test according to lab procedure IP-212-02, excluding Federal Motor Vehicle Safety Standards (FMVSS) 301-75, 212 and 219. Testing was conducted on a 1982 Volvo 2-door Sedan, OAR Number C0501, Vin. YV1AX4925C1208444, at the VRTC, TRC East Liberty, Ohio Test Facility. Occupant response was measured in accordance with FMVSS 208. The front of the test vehicle impacted the NHTSA fixed load-measuring barrier at a velocity of 34.9 mph. The test date was February 10, 1982 and the temperature was 70 degrees F.			
17. Key Words Vehicle Assessment Frontal Impact Load Measuring Barrier Occupant Response		18. Distribution Statement Available from: Technical Reference Division, National Highway Traffic Safety Administration Room 5108, Nassif Building 400 Seventh St. S.W. Washington, D.C. 20590	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 110	22. Price

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	acres	0.4	hectares	ha

MASS (weight)

oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons	0.9	metric ton	t
	(2000 lb)			

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	2.5	acres	acres
	(10 000 m ²)			

MASS (weight)

g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric ton	1.1	short tons	
	(1000 kg)			

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
----	-----------------	-------------------	--------------------	----

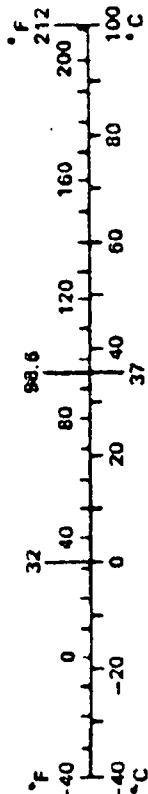


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SECTION 1
PURPOSE AND INTRODUCTION

PURPOSE

The purpose of the test was to subject a 1982 Volvo DL 2-door Sedan to the indicant test requirements of DOT Test Plan IP-212-02, April 4, 1980, except that tests for FMVSS 212, 219 and 301-75 were omitted. Calibrated Part 572 50th-percentile male dummies were utilized to acquire data relative to FMVSS 208, "Occupant Crash Protection." The vehicle was tested using test parameters which are in excess of the current upper limits of the subject FMVSS in order to obtain research and vehicle rating data.

The objectives of this vehicle assessment test were to:

Measure the dynamic responses, acceleration, velocity, and deformation of vehicles and dummies during impact modes that are representative of real world automobile crashes.

Evaluate the performance of late model production or modified automobiles with respect to their crash survivability in this crash mode.

Evaluate the protection performance of the restraint device by full-scale impact tests.

INTRODUCTION

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

SECTION 2
GENERAL TEST AND VEHICLE PARAMETER DATA

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

RECEIVING INSPECTION OF VEHICLES

Contractor: Contract No.: SRL 48
VIN No.: YV1AX4925C1208444 NHTSA No.: OAR No. C0501
Make: Volvo Model: DL
Year: 1982 Color: Yellow
Mfgr. Date: 9-81 Date Received: 12-18-81
Shipping Weight: 2866 Odometer: 000088
Dealer: George Byers, Sons, Inc.

Accessories

Power Steering	Yes	Automatic Transmission	No
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	No	Anti-Skid Brake	No
Clock	Yes	Rear Window Defroster	Yes
Other:			

Seats (front): Bucket

Brakes

Front: Disc - Power Assisted
Rear: Disc - Power Assisted

Tires

Size: 175-SR-14 Mfgr. & Line: Michelin XZX
Ply Rating: Tread: 2 Rayon+2 steel-SW: 2 Bias Ply: No
Radial: Yes
"Space Saver" Spare Tire: Firestone Special Spare - 165-H-14 - 6 P.R.

Engine

Type: In-line Overhead Camshaft Cylinders: 4
Transmission, Frwd Speeds: 4/OD Total Displacement: 130 CID

Fuel Capacity: 15.8 Galons - 60 Liters

Restraint System: Four 3-Point Self-Adjusting Safety Belts

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 bumper and frame: New

SUMMARY OF CRASH TEST CONDITIONS

Test Vehicle Information

Manufacturer: Volvo	Make & Model: Volvo DL
VIN Number: YV1AX4925C1208444	NHTSA Number: OAR No. C0501
Model Year: 1982	Build Date: 9-81
Transmission: 4 Speed Manual /OD	Date Received: 12-18-81
Body Style: 2 Door Sedan	Color: Yellow
Dealer: George Byers, Sons, Inc.	

Engine Data

Type: Overhead Camshaft	Cylinders: 4
Displacement: 130 CID	

Data from Certification Label on Left Door Rear Face or B-Post

Vehicle Mfr: Volvo Gothenburg, Sweden	VIN: YV1AX4925C1208444
Date of mfg: 9-81	
GWR: 4030	GAWR: Front - 1885
	Rear - 2180

Data from "Recommended Tire Pressure" Label on Door, Post Glovebox, Etc.

Vehicle Load Up to Capacity	Recommended Tire Size: 175-R-14
Front: Max. load - 920	Load Range: DWA
Rear:	

Vehicle Capacity	
Type of Seats: F. Bucket No. of Occupants (designated	
Cargo Load: 170	seating capacity): 5

Weight of Test Vehicle as Received from Dealer (with maximum fluids)

Right Front: 735	Right Rear: 677
Left Front: 779	Left Rear: 675
Total Front Weight: 1514	
Total Rear Weight: 1352	
Total Delivered Weight: 2866	

Weight of Test Vehicle with Required Dummies and -0- Pounds of Cargo

Right Front: 762 + 9* = 771	Right Rear: 874
Left Front: 820 + 9* = 829	Left Rear: 870
Total Front Weight: 1600	
Total Rear Weight: 1754**	
Total Test Weight: 3354	

Weight of Ballast Secured in Vehicle Trunk Area: 0

* Guide shoe hardware weight 18 lbs. forward of front wheel center line.

** Plus 10 lbs. for tow system tensioning hardware.

Test Conditions

Date of Test: 2/10/82
Time of Test: 1:00 P.M.
Wind Velocity: DNA

Ambient Temperature
at Impact Area: 70 degrees

Test No.: 820210

Project Title: Vehicle Assessment

Date: Feb. 10, 1982
Temperature: 70 degrees

Time: 1:00 P.M.
Wind Velocity: DNA

Subject Vehicle Data

Description:

	<u>Actual</u>	<u>Intended</u>
Test Weight (lbs.)	3354	3364
Vehicle Orientation (degrees)	0	0
Vehicle Velocity (mph)	34.9	35
Maximum Crush (inches)	Right Side 26 9/16	
Static	Left Side 27 1/8	

Dummies

	<u>Driver</u>	<u>Middle Passenger</u>	<u>Rt. Front Passenger</u>	<u>Left Rear Passenger</u>	<u>Rt. Rear Passenger</u>
Type	572		572		
Serial No.	392		826		
Instrumentation					
Head Accel.	Yes		Yes		
Chest Accel.	Yes		Yes		
Femur L.C.'s	Yes		Yes		
Other					
Restraint System	FMVSS 209 Type 2				

Remarks:

SUMMARY OF TEST CONDITIONS

TEST VEHICLE INFORMATION:

Vehicle Manufacturer: Volvo Gothenburg, Sweden
Make/Model: Volvo DL
Body Style: 2-door Sedan; Model Year: 1982
VIN: YV1AX4925C1208444; Build Date: 9-81
NHTSA No.: OAR No. C0501; Color: Yellow
Engine Data: 4 cylinders; 130 in³/₄ displacement
Transmission Data: 4 speed (X) Manual/ () Automatic
Date Vehicle Received by Laboratory: 12-18-81
Dealer's Name & Address: George Byers N. Hamilton Rd., Columbus, Ohio

DATA FROM CERTIFICATION LABEL ON LEFT DOOR REAR FACE OR 'B' POST:

Vehicle Manufactured By: Volvo Gothenburg, Sweden
Date of Manufacture: 9-81; VIN: YV1AX4925C1208444
GVWR: 4030 lbs.; GAWR: Front = 1885 lbs.; Rear = 2180 lbs.

DATA FROM "RECOMMENDED TIRE PRESSURE" LABEL ON DOOR, POST, GLOVE BOX, ETC.:

Vehicle Load: FRONT REAR
Up to Capacity 3 6 psi 3 6 psi

RECOMMENDED TIRE SIZE:	LOAD RANGE:
175-R-14	B C D

Vehicle Capacity:
Type of Seats - X Bench -rear
X Bucket-front
 Split Bench

Number of Occupants = 2 Front
(Designated Seating 3 Rear
Capacity) 5 Total

CARGO LOAD = 1 7 0 lbs.
TOTAL = 9 2 0 lbs.

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with max. fluids):

Right Front = 7 3 5 lbs. Right Rear = 6 7 7 lbs.
Left Front = 7 7 9 lbs. Left Rear = 6 7 5 lbs.
TOTAL FRONT WEIGHT = 1 5 1 4 lbs. (53 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1 3 5 2 lbs. (47 % of Total Vehicle Weight)
TOTAL DELV. WEIGHT = 2 8 6 6 lbs.

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND 170 lbs. CARGO:

Right Front = 7 7 1 lbs. Right Rear = 8 7 4 lbs.
Left Front = 8 2 9 lbs. Left Rear = 8 7 0 lbs.
TOTAL FRONT WEIGHT = 1 6 0 0 lbs. (48 % of Total Vehicle Weight)
TOTAL REAR WEIGHT = 1 7 5 4 lbs. (52 % of Total Vehicle Weight)
TOTAL TEST WEIGHT = 3 3 5 4 lbs.

Weight of ballast secured in vehicle trunk area = 0 lbs.

TEST CONDITIONS:

Date of Test: February 10, 1982; Time of Test: 1:00 AM/PM
Ambient Temperature: 70 °F at impact area.

VEHICLE ATTITUDE: (all dimensions in inches)

Delivered Attitude: RF 9 3/4; LF 9 3/4; RR 10 3/4; LR 10 3/4

Test Attitude: RF 8 1/4; LF 7 1/2; RR 9 1/8; LR 8 3/8

VEHICLE TIRE DATA:

Recommended Cold Tire Pressure: Front = 36 psi

Rear = 36 psi

Recommended Tire Size: 175-R-14

Load Range: DNA

Tires on Vehicle: Michelin XZX

Is Spare Tire a "Space Saver": Yes (yes/no)

Is Spare Tire standard equipment: Yes (yes/no)

TEST FLUID DATA:

Test Fluid Type: Red Stoddard Solvent #2; Spec. Grav.: 0.764

Kinematic Viscosity: _____

"USEABLE" CAPACITY*: _____ Gallons (Furnished By CTM)

Test Volume: 12.7 Gallons (92-94% of USEABLE)

Fuel System Capacity (data from Owner's Manual): 15.8 gal.

Details of fuel system: This was not an objective on this test

Electric Fuel Pump: X Yes; _____ No; Fuel Injection: X Yes; _____ No

Does electric fuel pump operate with ignition switch "on" and the engine not operating: X Yes; _____ No

VEHICLE REBOUND AND CRUSH:

Overall Length of Test Vehicle: Pre-test=R 189 3/4 L 189 3/4 in.

Post-test=R 163 3/16 L 162 5/8 in.

CRUSH=R 26 9/16/L 27 1/8

FOR FRONTAL IMPACTS, distance from front of test vehicle to the barrier after impact = Center 1 1/4 inches LF - 1 1/8
RF - 3 7/8

*With entire fuel system filled from fuel tank through carburetor bowl.

VEHICLE TEST WEIGHT CALCULATION

UDW - unloaded delivered weight

VCW - vehicle capacity weight

DSC - designated seating capacity

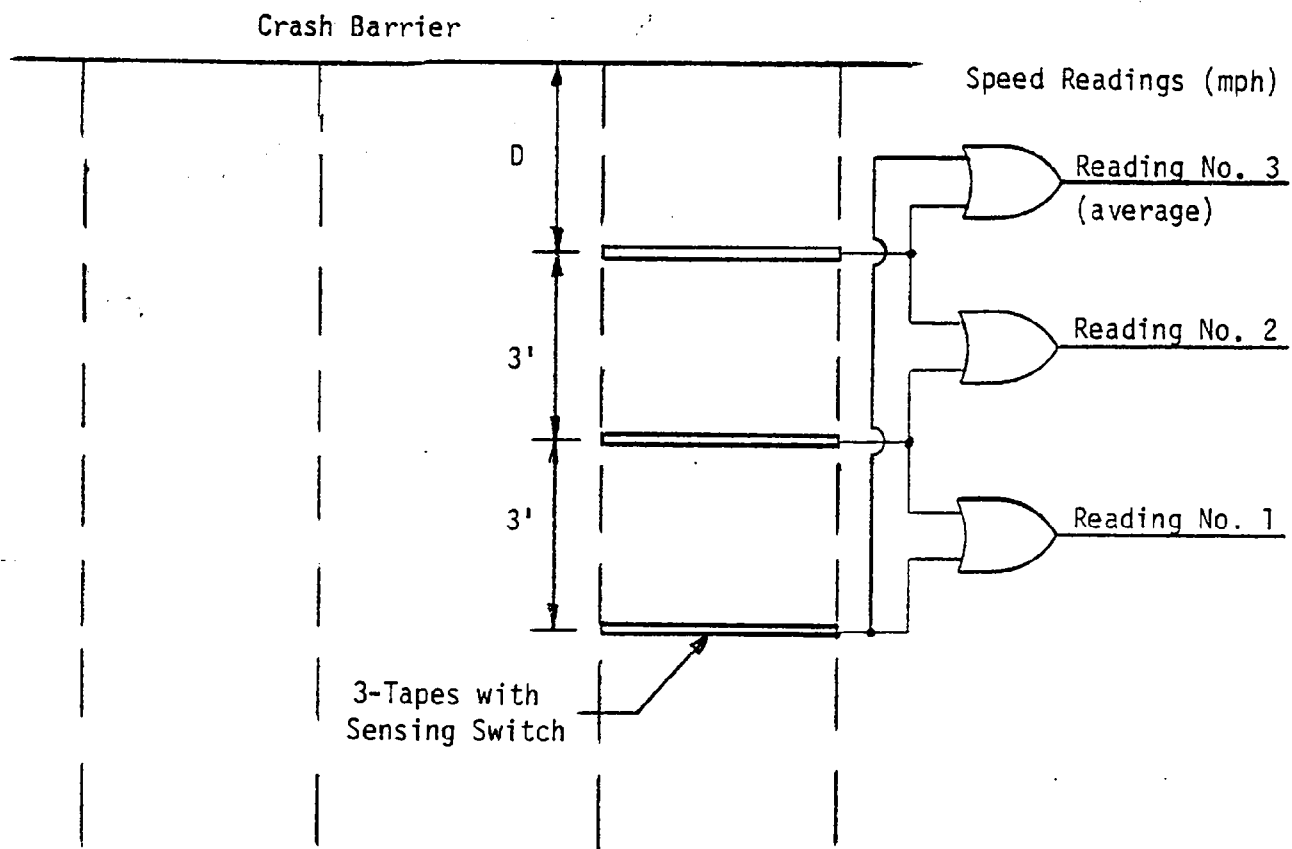
RCLW - rated cargo and luggage weight

$$VCW - 150 \times DSC = RCLW$$

$$2920 - (150 \times 5) = 170$$

$$UDW + RCLW + \text{Number of dummies} \times 164 \text{ lbs.} = \text{Test Weight}$$

$$2866 + 170 + (2 \times 164) = 3364$$



D = Distance from bumper to center of tire - plus 2 inches;

IMPACT VELOCITY MEASURING SYSTEM

TEST EQUIPMENT LIST & FUNCTION

<u>ITEM</u>	<u>MANUFACTURE</u>	<u>MODEL</u>	<u>PURPOSE</u>
Speed Trap	Digitec & Tapeswitch	8211	Determine impact speed in mph by using a programmable computing rate monitor, using a start and stop signal.
10,000 & 1000 Hz Time Code Generator	TRC of Ohio	None	Furnish timing signal for high-speed cameras.

The following are anomalies in the occupant and vehicle data. They are considered anomalies because no correlation was found between them and the high-speed photography.

- 1) Driver Head Acceleration X-Axis: An anomalous pulse occurred after the crash event was effectively over (approximately 166 msec). The pulse had a peak value of 13.64 G's which occurred at 174.88 msec. Deleting this pulse from the data yields a revised maximum G level of 3.21 G's at 14.38 msec.
- 2) Driver Head Acceleration Resultant: Because of the anomalous pulse in the X Axis data, the pulse at 174.88 msec is considered anomalous. It does not effect the peak resultant nor the HIC calculations.
- 3) Passenger Head Acceleration Z Axis: An offset of approximately -6 G's occurred making the value of the peak acceleration suspect.
- 4) Passenger Head Acceleration Resultant: The Z Axis offset affected the peak resultant and the calculated HIC values. The effect should be such that the reported HIC value is greater than what the HIC value would be if no offset occurred.
- 5) Driver Chest Acceleration X Axis: Pulsing occurred after approximately 116 msec due to transducer/cable separation. However, at that point, the acceleration trace had returned to baseline and the event was effectively over. Deleting these anomalies, the peak positive G level was 3.59 G's at 115.88 msec and the peak negative G level was 45.44 G's at 94.50 msec.
- 6) Driver Chest Acceleration Resultant: The X axis pulsing affected the peak resultant. Neglecting these pulses yields a peak resultant of 45.59 G's at 94.50 msec.
- 7) Passenger Chest Acceleration Z Axis: An anomalous pulse occurred after the crash event was effectively over (approximately 166 msec). The pulse had a peak value of -54.77 G's at 181.75 msec. Another anomalous pulse occurred whose peak G level was 24.00 G's at 9 msec. This pulse was uncorrelatable with high-speed photography and is considered anomalous. Neglecting these two pulses, the peak positive G level was 15.23 G's at 52.13 msec and the peak negative G level was 13.42 G's at 137.13 msec.

- 8) Passenger Chest Acceleration Resultant: The Z axis pulses affected the peak resultant. Neglecting these pulses yields a peak resultant of 35.58 G's at 63.38 msec.
- 9) Vehicle L. Front Acceleration X Axis: Anomalous pulses occurred after the event was effectively over (approximately 116 msec for vehicle dynamics). Deleting these pulses from the data yields a maximum positive G level of 12.81 G's at 11.50 msec and a maximum negative G level of 40.98 G's at 18.00 msec.

SECTION 3

DATA REQUIRED BY R&D AND OAR

The following pages are included in this section:

1. Dummy positional data
2. Vehicle crush data
3. Accelerometer location and data summary
4. Load cell barrier face
5. High speed camera information

FRONTAL TESTS ONLY PART 572 DUMMY IN-VEHICLE POSITION

RECORDING SHEET

VEH. NHTSA NO.: 820210; MFR./MAKE/MODEL: Volvo DL 1982

SEAT TYPE: ☐ Bench ☒ Bucket ☐ Split Bench

ADJUSTER TYPE: ☒ Manual ☐ Power

BUCKET SEAT BACK TYPE: ☐ Fixed ☒ Adjustable Reclining

POSITIONING DATE: Feb. 10, 1982; TECHNICIANS: 1. Levan
2. Kokoruda
3. Wills
4. Grumblin

AMBIENT TEMP.: 70 °F. TIME: 10:45

Using the trammel and lateral bar shown in FIGURE 2C or the positioning gage shown in FIGURE 3C, fill in the following information.

DRIVER DUMMY #		PASSENGER DUMMY #	
3	9 2	8	2 6
HEAD TARGET		HEAD TARGET	
24 1/8	55°	25 3/16	58°
KNEE JOINT	KNEE JOINT	KNEE JOINT	
33 3/8	7°	32 5/8	7°
APPROXIMATE "H" POINT		APPROXIMATE "H" POINT	
18 1/8	23°	17 15/16	19°
Fore Midpoint		Fore Midpoint	
Aft		Aft	
Midpoint		Midpoint	
Door Glass Height =		Door Glass Height =	
9 1/8		9 1/8	
Left Frt. Door		Right Frt. Door	
Adjustable Pointer		Adjustable Pointer	
Lat. Bar		Lat. Bar	
Using CTR. or PASS. dummy but not both		Using CTR. or PASS. dummy but not both	
DRIVER DUMMY #		PASSENGER DUMMY #	
3	9 2	8	2 6

TOP VIEW

Overall 51 9/16

39

12 7/16

32 5/8

7°

18 1/8

23°

17 15/16

19°

Fore Midpoint

Aft

Midpoint

Door Glass Height = 9 1/8

Left Frt. Door

Right Frt. Door

Adjustable Pointer

Lat. Bar

Using CTR. or PASS. dummy but not both

DRIVER DUMMY #

CENTER DUMMY # OR

PASSENGER DUMMY #

3 9 2

8 2 6

*Door glass height is equal on the right and left side of vehicle

VISIBLE DUMMY CONTACT POINTS

Head	<u>Driver</u> <u>Steering Wheel</u>	<u>Passenger</u> <u>Top of Dash</u>
Chest	<u>None</u>	<u>None</u>
Abdomen	<u>None</u>	<u>None</u>
Left Knee	<u>Dash</u>	<u>Dash</u>
Right Knee	<u>Center Console</u>	<u>Dash</u>
<u>DOOR OPENING</u>	<u>FRONT</u>	<u>REAR</u>
	<u>Left</u> <u>Right</u>	<u>Left</u> <u>Right</u>
Easy	<u> </u> <u> </u>	<u> </u> <u> </u>
Difficult	<u>Yes</u> <u>Yes</u>	<u> </u> <u> </u>
Tools Required	<u>None</u> <u>None</u>	<u> </u> <u> </u>
<u>SEAT BACK</u>		
Failure	<u>None</u> <u>None</u>	<u>None</u> <u>None</u>
<u>GLAZING DAMAGE</u>		
Windshield	<u>Cracked</u>	
Backlight		<u> </u>
Others	<u>No</u> <u>No</u>	<u>None</u> <u>None</u>

PART 572 DUMMY DATA SUMMARY

	<u>DRIVER DUMMY</u>				<u>PASSENGER DUMMY</u>			
	<u>Positive</u>		<u>Negative</u>		<u>Positive</u>		<u>Negative</u>	
	<u>Direction *</u>		<u>Direction **</u>		<u>Direction *</u>		<u>Direction **</u>	
	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
	<u>(G)</u>	<u>(msec)</u>	<u>(G)</u>	<u>(msec)</u>	<u>(G)</u>	<u>(msec)</u>	<u>(G)</u>	<u>(msec)</u>
Head Acceleration								
Longitudinal	3.21	14.38	81.84	77.25	3.10	13.38	24.01	124.25
Lateral	20.33	122.75	5.08	96.88	7.07	145.00	8.36	70.00
Vertical	6.20	143.50	59.52	88.63	2.61	4.88	44.40	99.88
Resultant		93.56 @	77.25			48.29 @	99.88	
HIC	549.75 from 76.500 to 99.125				381.32 from 45.125 to 150.125			
Chest Acceleration								
Longitudinal	3.59	115.88	45.44	94.50	2.19	178.13	34.66	63.25
Lateral	7.12	73.63	2.24	54.25	7.55	72.00	4.84	149.75
Vertical	14.14	50.25	15.67	79.88	15.23	52.13	13.42	137.13
Resultant		45.59 @	94.50			35.58 @	63.38	
Femur Loads	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>	<u>Peak</u>	<u>Time</u>
	<u>(lb)</u>	<u>(msec)</u>	<u>(lb)</u>	<u>(msec)</u>	<u>(lb)</u>	<u>(msec)</u>	<u>(lb)</u>	<u>(msec)</u>
Left	319.62	64.63	145.92	47.50	276.26	62.63	876.91	78.63
Right	217.41	60.75	1123.33	77.63	177.00	58.63	200.73	50.25

Vehicle Impact Speed (mph): 34.9

*Longitudinal: Forward
 Lateral: Rightward
 Vertical: Downward
 **Longitudinal: Rearward
 Lateral: Leftward
 Vertical: Upward

DUMMY KINEMATIC SUMMARY

DRIVER- After impact, the knees were forced upward; the left knee struck the underside of the dash and the right knee struck the left side of the central console and the underside of the dash. The torso and head rotated forward so that the face struck the upper part of the steering wheel and the steering hub. The torso and head rebounded with no significant lateral rotations and in approximately the original vertical plane.

PASSENGER- After impact, the knees were forced upward and both struck the underside of the dash. The torso rotated forward and laterally toward the passenger door. After torso arrest by the restraint system, the head continued to rotate forward and laterally towards the passenger door; however, there was no head strike. After rebound from the restraint system, the torso rotated rearwards maintaining its laterally rotated orientation to recontact the seat left of center as viewed from the front of the vehicle.

Vehicle Weight

The weight of the test vehicle is determined by placing each wheel on a KG Law Air Bearing Force Plate, certified with test weights scaled to National Bureau of Standards Class B tolerances.

Dummy Temperature Control and Positioning

The vehicle was kept inside the temperature controlled crash test building until approximately 30 minutes prior to the test. Temperature inside the vehicle and ambient temperature within the building were recorded. Vehicle and dummy temperatures while outside the crash test building were maintained portably until approximately 30 seconds prior to the test.

The following table summarizes the steps taken to position the instrumented, calibrated dummies in the test vehicle.

DUMMY PLACEMENT AND POSITIONING

Part 572

<u>Dummy</u>	<u>Driver DSP</u>	<u>Passenger DSP</u>
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 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.

DUMMY PLACEMENT AND POSITIONING (CONTD)

Part 572
DUMMY

	<u>Driver DSP</u>	<u>Passenger DSP</u>
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, longitudinal, 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.
LEFT KNEE	Outer surface of pivot bolt head is 5.9" from midsagittal plane of dummy.	Located as above.
LOWER LEGS (tibias)	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 accelerator 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 toeboard--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.

IMPACTED VEHICLE

VEHICLE MEASUREMENTS		ALL DIMENSIONS IN INCHES	
NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X1	TOTAL LENGTH OF VEHICLE AT CENTERLINE	192 3/8	162 1/2
X2	REAR SURFACE OF VEHICLE TO FIREWALL	140 5/8	DNA
X3	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF RIGHT DOOR	125 5/16	125 1/8
X4	REAR SURFACE OF VEHICLE TO UPPER LEADING EDGE OF LEFT DOOR	125 3/16	125
X5	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF RIGHT DOOR	127 3/4	128 3/8
X6	REAR SURFACE OF VEHICLE TO LOWER LEADING EDGE OF LEFT DOOR	127 5/8	128 1/4
X7	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF RIGHT DOOR	81 7/16	81 3/4
X8	REAR SURFACE OF VEHICLE TO UPPER TRAILING EDGE OF LEFT DOOR	81 3/8	81 7/8
X9	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF RIGHT DOOR	81 3/16	81 1/8
X10	REAR SURFACE OF VEHICLE TO LOWER TRAILING EDGE OF LEFT DOOR	81 3/16	81 1/16
X11	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF RIGHT SIDE	126 1/8	124 15/16
X12	REAR SURFACE OF VEHICLE TO BOTTOM OF "A" POST OF LEFT SIDE	126 1/8	124 3/8
X13	REAR SURFACE OF VEHICLE TO FIREWALL - RIGHT SIDE	140 5/8	DNA
X14	REAR SURFACE OF VEHICLE TO FIREWALL - LEFT SIDE	140 1/4	137
X15	REAR SURFACE OF VEHICLE TO STEERING WHEEL CENTER	113	111 5/8
X16	REAR SURFACE OF VEHICLE TO RIGHT SIDE OF FRONT BUMPER	189 3/4	163 3/16
X17	REAR SURFACE OF VEHICLE TO LEFT SIDE OF FRONT BUMPER	189 5/8	162 5/8
X18	REAR OF WINDOW HEADER TO STEERING WHEEL CENTER	17 1/4	18 1/4

MEASUREMENT TABLE FOR FRONTALLY IMPACTED VEHICLES

IMPACTED VEHICLE

VEHICLE MEASUREMENTS

ALL DIMENSIONS
IN INCHES

NO.	TYPE OF MEASUREMENT	PRE-TEST	POST-TEST
X19	SILL TO GROUND PLANE LEFT FRONT	27 1/2	30 3/4
X20	SILL TO GROUND PLANE RIGHT FRONT	27 1/2	27
X21	SILL TO GROUND PLANE LEFT REAR	25 1/2	26 1/4
X22	SILL TO GROUND PLANE RIGHT REAR	25 1/2	20 1/8

VEHICLE NUMBER TRC444 TEST NUMBER 820210

TEST TECHNICIANS

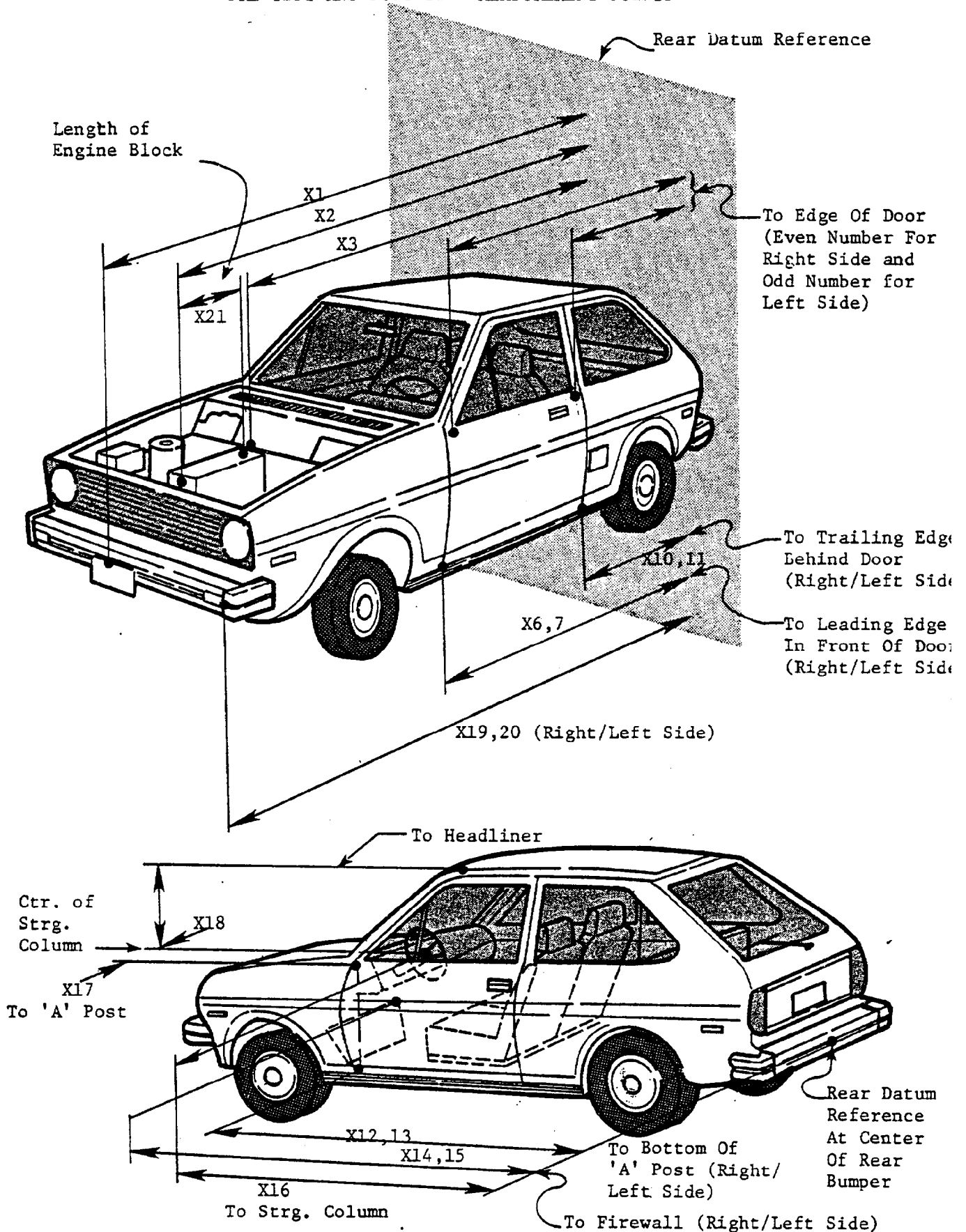
J. M. Sakorunda

J. Clay

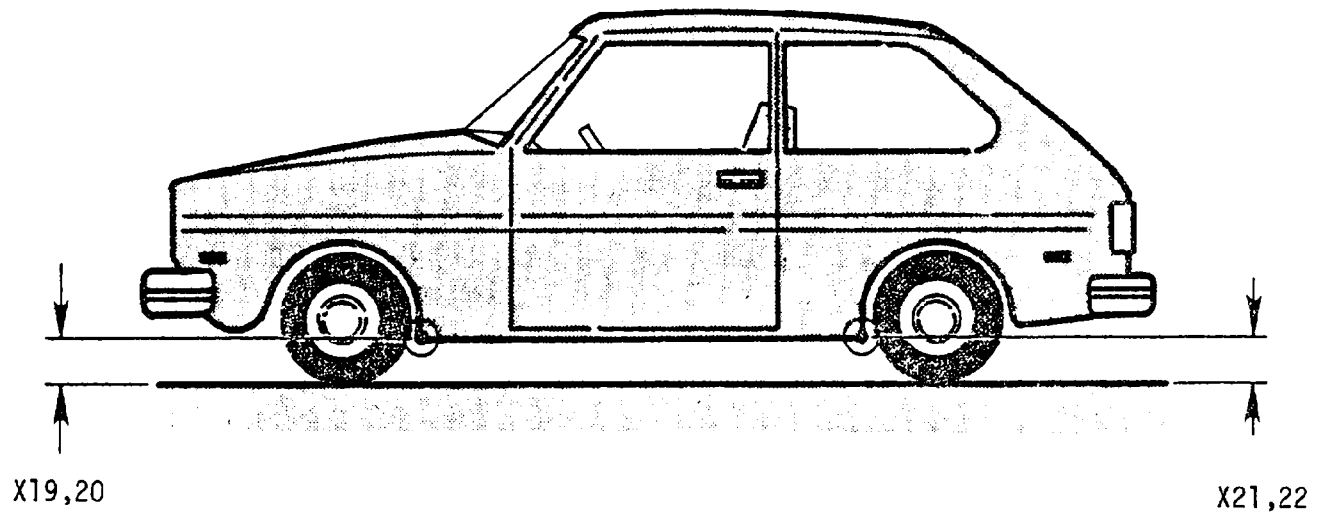
TEST ENGINEER

J. E. Brown

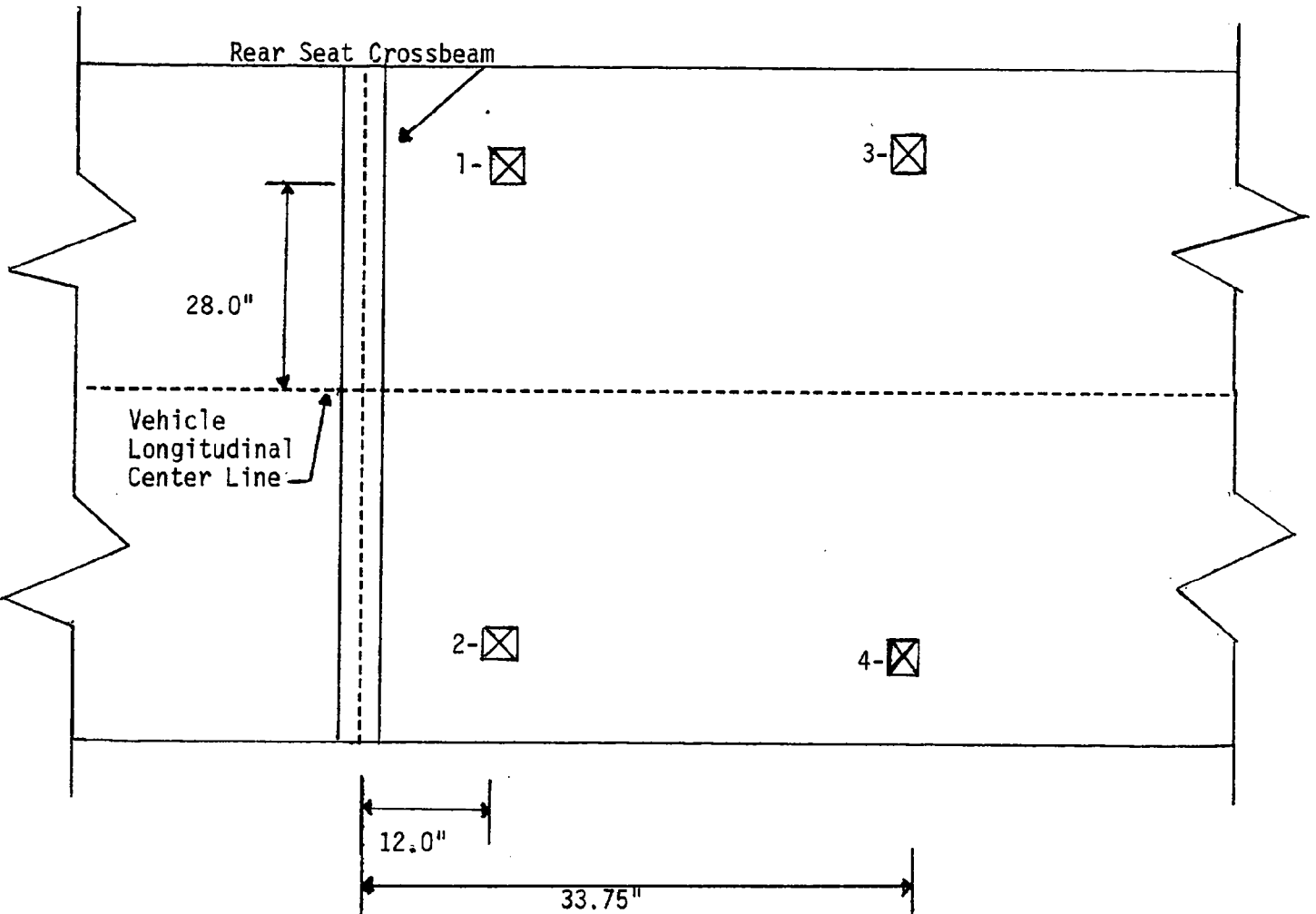
PRE-TEST AND POST-TEST MEASUREMENT POINTS



SILL HEIGHT MEASUREMENT POINT



ACCELEROMETER PLACEMENT



VOLVO
TRANSDUCER INFORMATION

PROJECT NUMBER SRL-48
PROJ. ENGR/TECH Jack Favors
DATE 1/4/82

PARAMETER BEING MEASURED	TYPE OF TRANSDUCER	MODEL NUMBER	SERIAL NO.	MFGR.	DATE OF LAST CALIBRATION	SENSITIVITY	DESIRED FULL SCALE (ENGR. UNITS)
1 X Axis LR Still	S/A Acce1	4-202-0001	18858	Bell Howell	11-18-81	.2366 MV/G	100 G
2 X Axis RR Still	S/A Acce1	4-202-0001	18854	Bell Howell	11-18-81	.2354 MV/G	100 G
3 X Axis LF Still	S/A Acce1	4-202-0001	18856	Bell Howell	11-18-81	.2297 MV/G	100 G
4 X Axis RF Still	S/A Acce1	4-202-0001	18857	Bell Howell	11-18-81	.2382 MV/G	100 G

Linearity and hysteresis shall not exceed $\pm 0.75\%$ of full range output.

Load Cell Barrier Face

The fixed, segmented barrier was instrumented with 36 load cells to provide an axial force-time history mapping during the impact. The load cell configuration employed is depicted on the following page.

Data recorded by these sensors are presented in Appendix B.

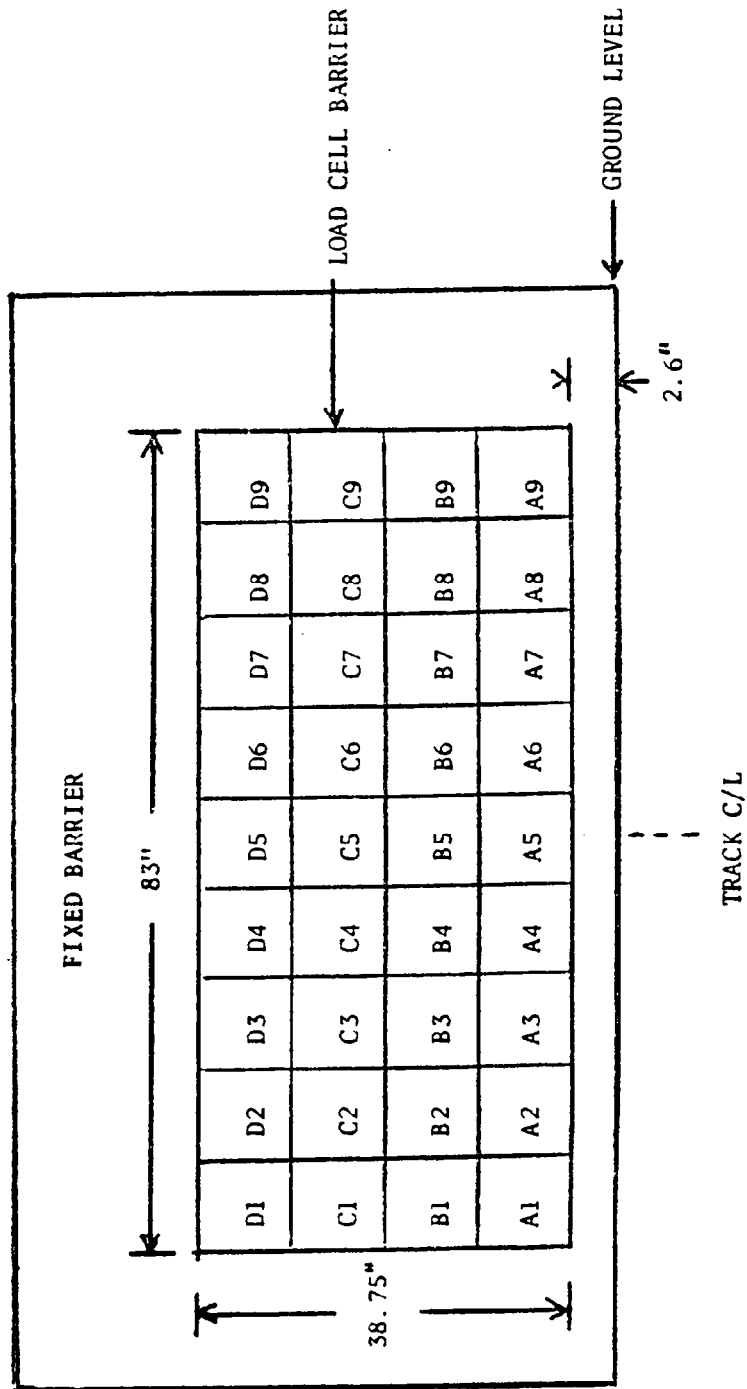
Due to limitations of the data acquisition system, only ~~22~~²⁴ of the 36 load cells, on the load cell barrier face were recorded. The load cells that were not recorded are:

C1 through C3,
C7 through C9,
D1 through D3, and
D7 through D9.

*SOMEBODY
DOESN'T KNOW
HOW TO COUNT*

36 LOAD CELLS
4 ROWS
9 COLUMNS

FRONT VIEW



BARRIER LOAD CELL CONFIGURATION

HIGH SPEED CAMERA INFORMATION

CAMERA NO.	LOCATION	TYPE	LENS (mm)	SPEED (fps)	PURPOSE OF CAMERA DATA
1	Overhead	Photosonic	25 mm	1000	Crush analysis
2	Passenger side-front 3/4 view	Photosonic	25 mm	1000	Analysis of dummy movement and windshield crush
3	Drivers side-full sideview	Photosonic	13 mm	1000	Crush analysis
4	Passenger side - overall view	Kodak K-100	16 mm	24 (real-time)	Overall view of crush
5	Drivers side-front 3/4 view	Photosonic	17 mm	1000	Analysis of dummy movement
6	Passenger side - sideview	Photosonic	17 mm	1000	Analysis of dummy movement

NOTE: CAMERAS ARE NUMBERED ACCORDING TO SPLICING SEQUENCE OF FILM.
 (24 fps) REAL TIME MOVIE FILM COVERAGE OF PRE-CRASH, POST-CRASH
 AND CRASH EVENT SPLICED AT START AND END OF FILM.

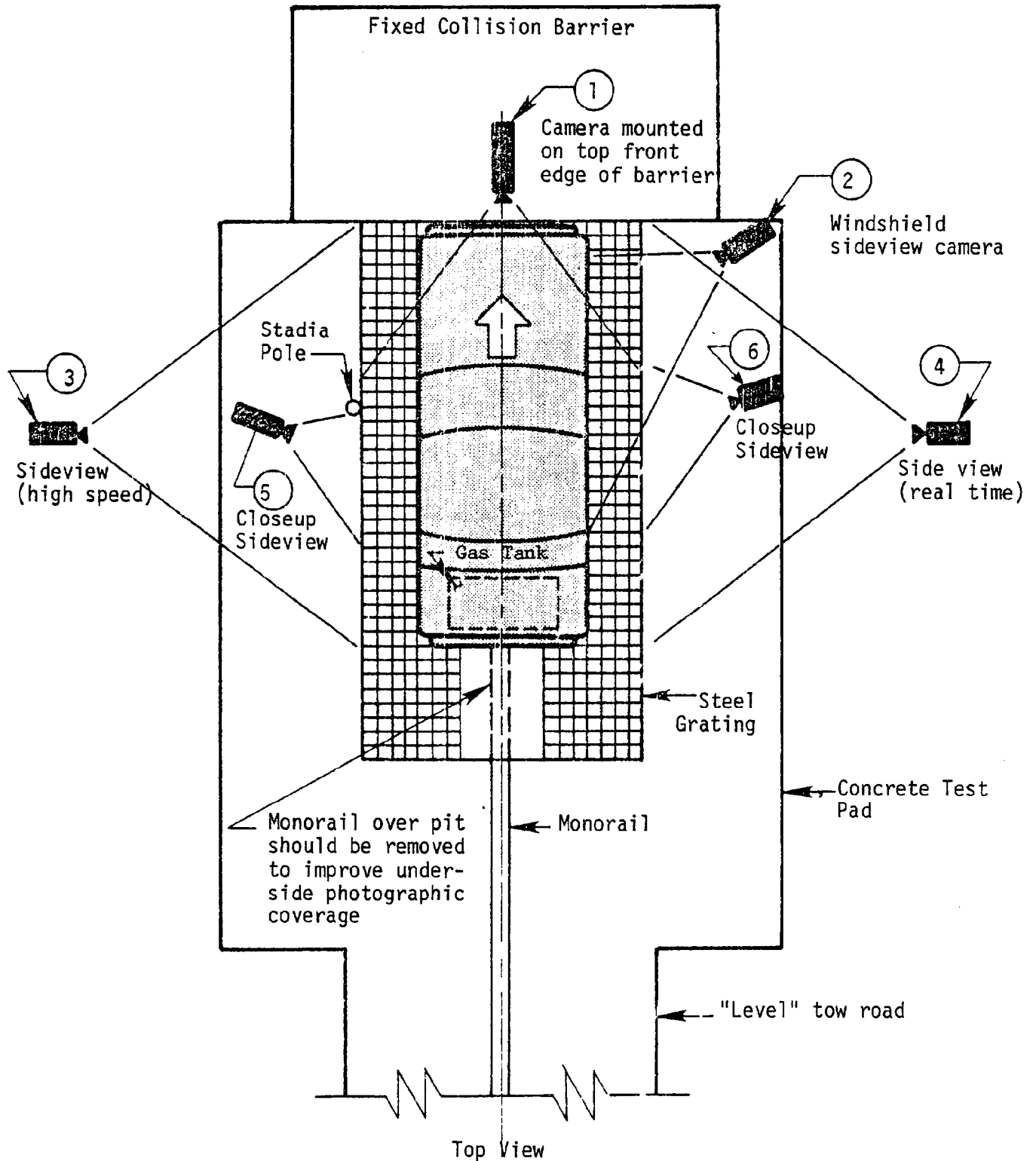
HIGH SPEED CAMERA INFORMATION

CAMERA NO.	CAM/MAG	Lateral *	Longitudinal *	Vertical *
1	1439-1144	0	4'	15'
2	1440-1148	14'9"	-1'	38"
3	1437-1145	24'8"	7'	45"
4**	Kodak K-100	48'	19'	5'
5	1444-1150	36'6"	1'5"	43"
6	1438-1142	13'7"	1'8"	45"

* Lateral distance means the distance horizontally from and perpendicular to the guide rail.
 Longitudinal distance means the distance horizontally from and parallel to the guide rail. The barrier face is the origin with distance measured positively upstream of the barrier.
 Vertical distance is the distance perpendicular to the floor.

** Real-time

CAMERA POSITIONS FOR FRONTAL/OBLIQUE IMPACTS



APPENDIX A
PHOTOGRAPHS

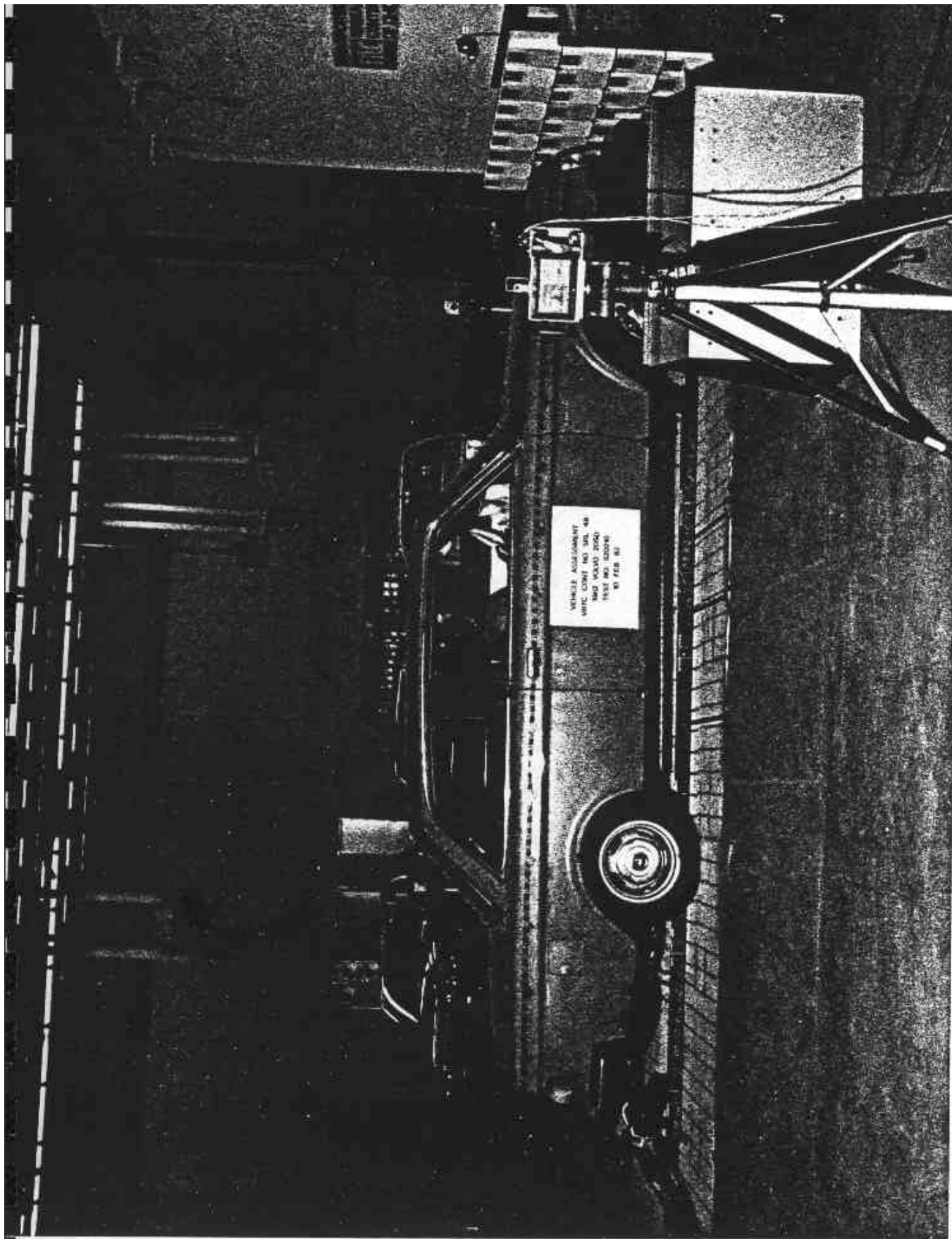


FIGURE A-1. PRE-TEST OF VEHICLE

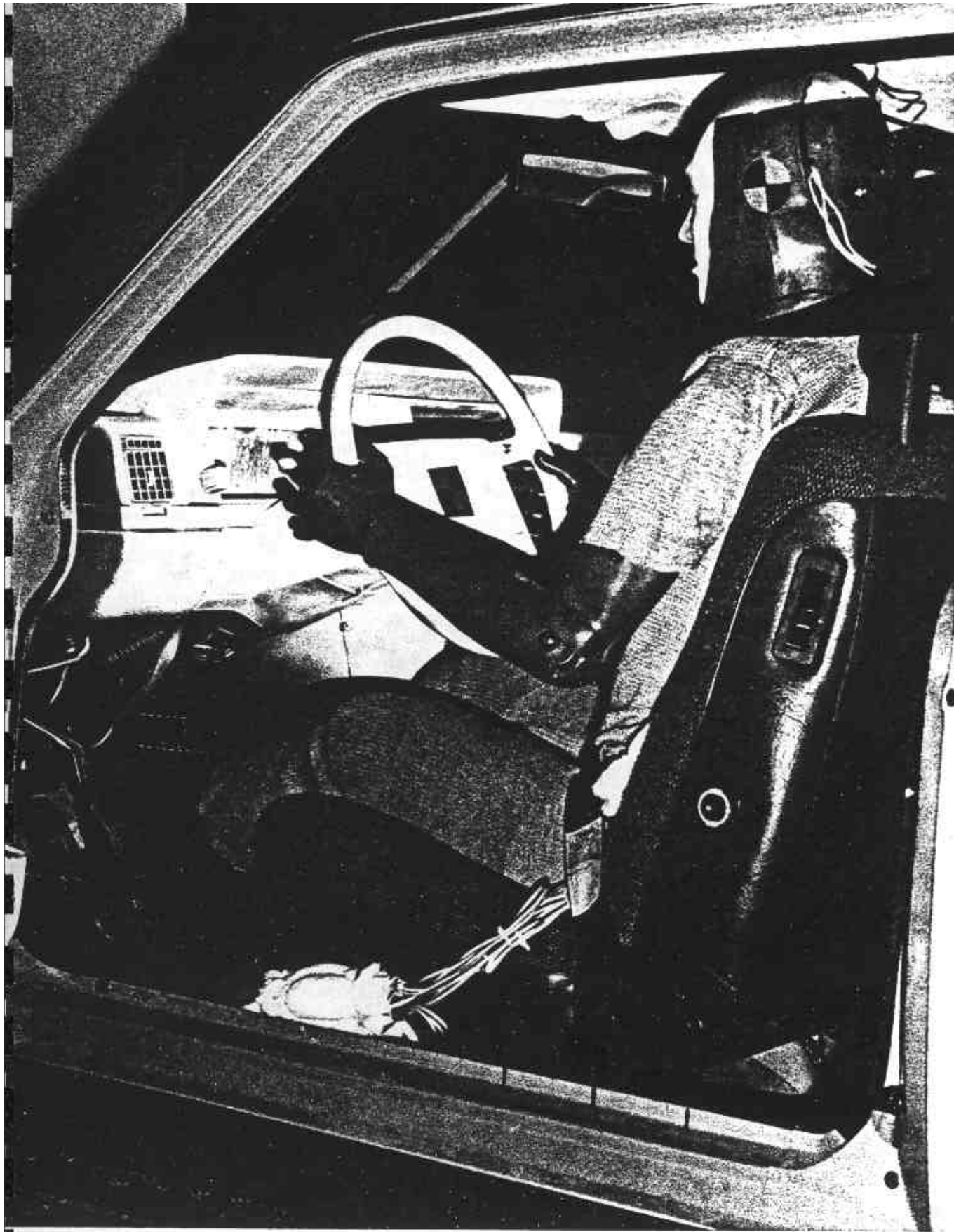


FIGURE A-2. PRE-TEST - DUMMY IN DRIVER POSITION

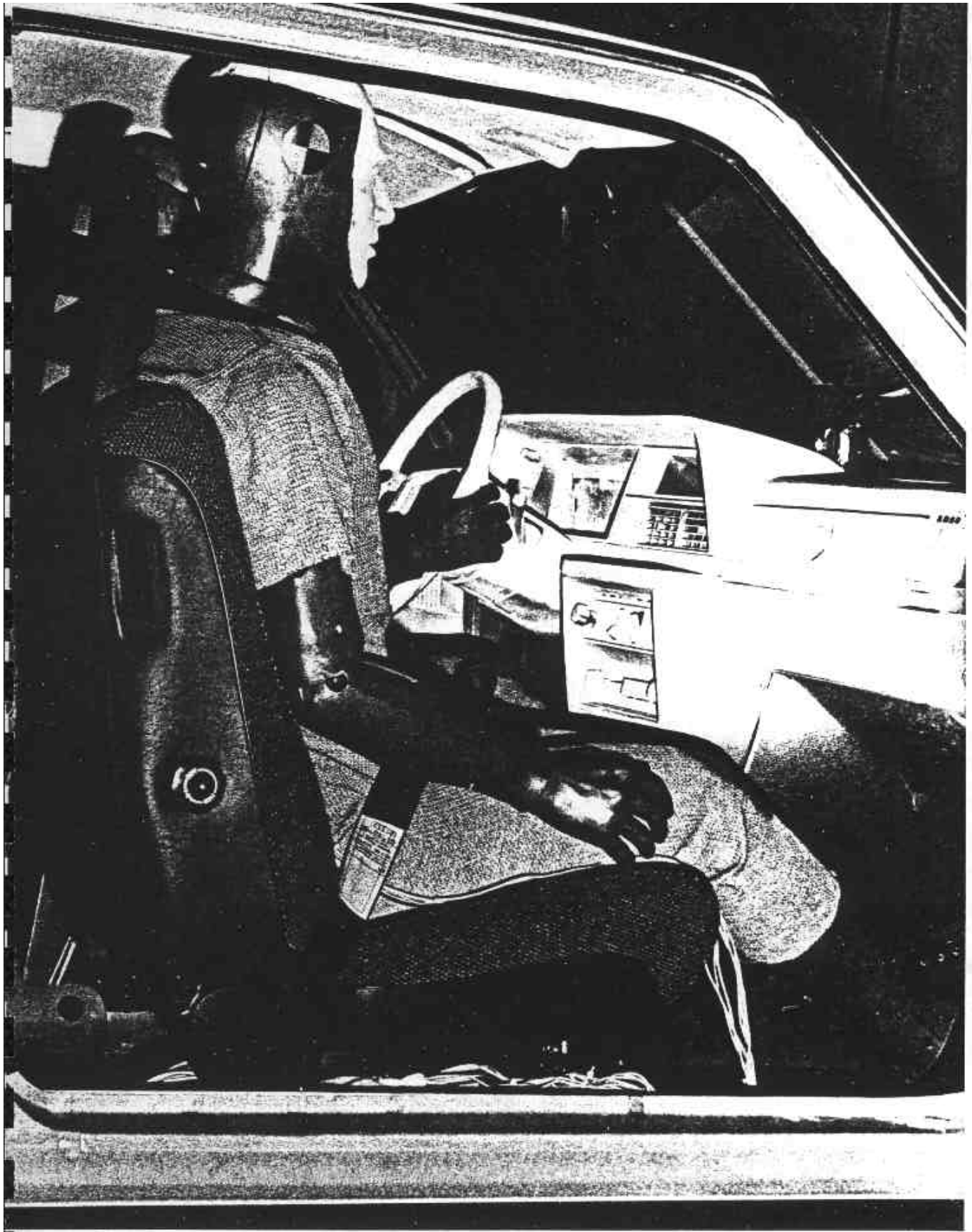


FIGURE A-3. PRE-TEST - DUMMY IN PASSENGER POSITION

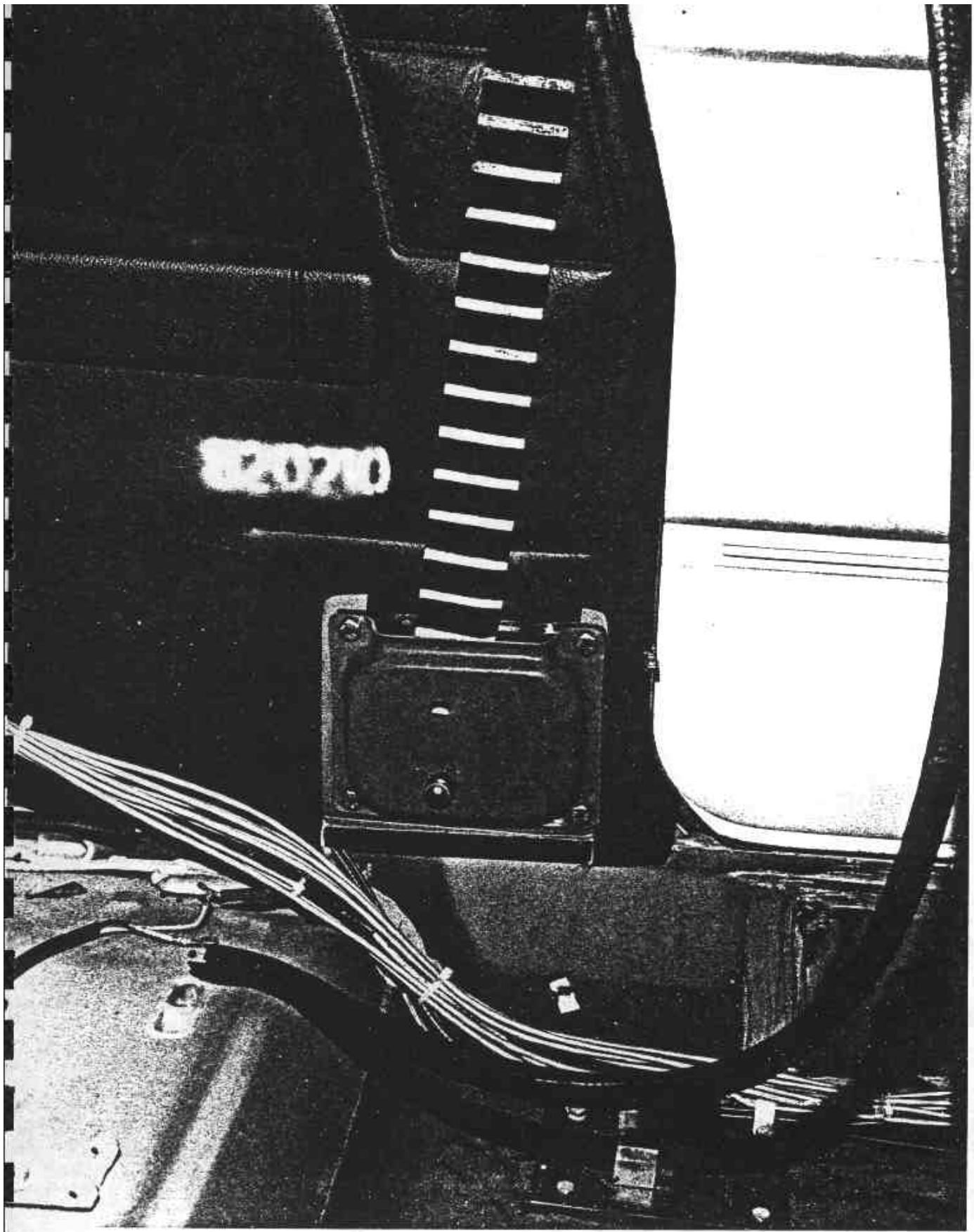


FIGURE A-4. POST-TEST - DRIVER SIDE TORSO RESTRAINT

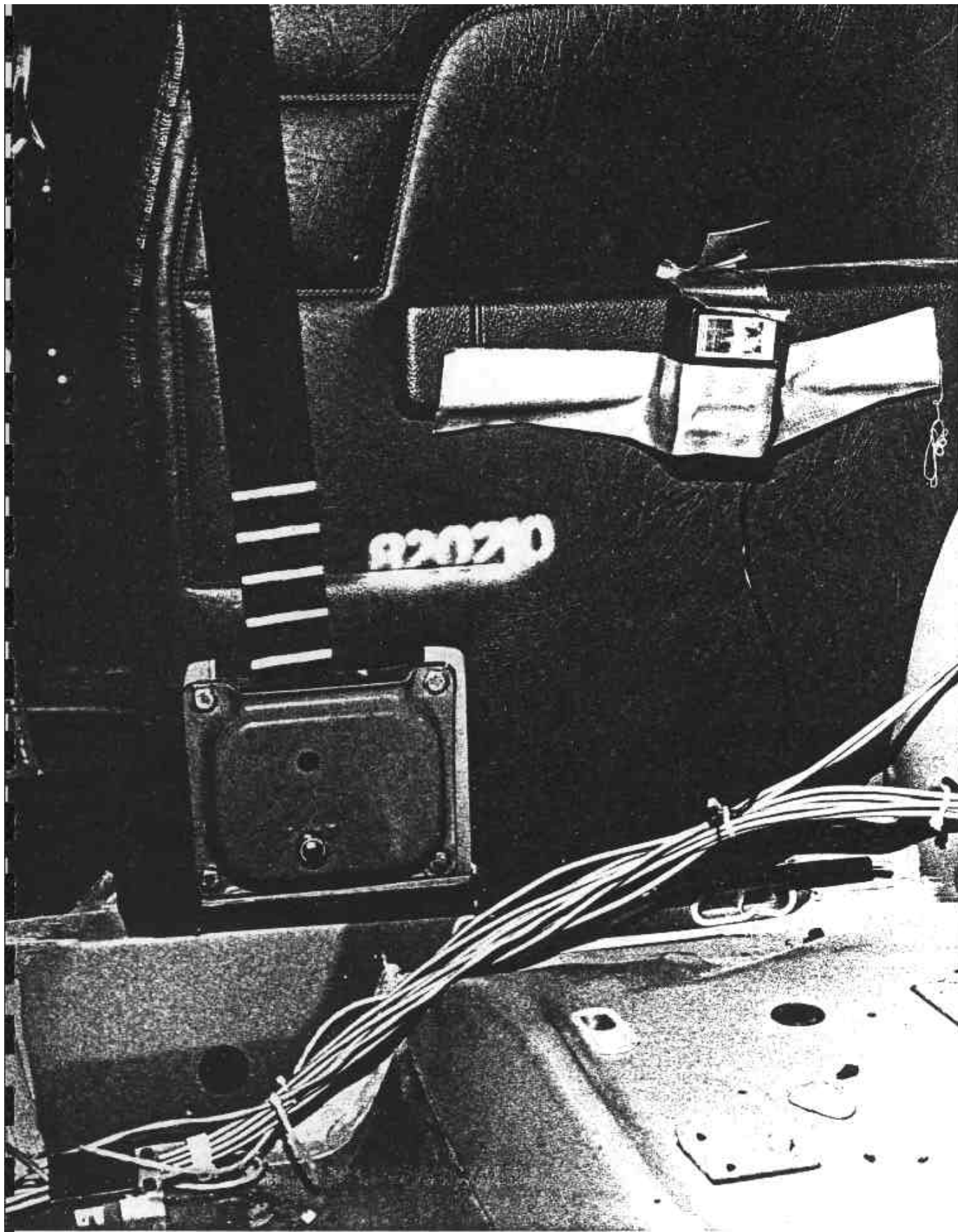


FIGURE A-5. POST-TEST - PASSENGER SIDE TORSO RESTRAINT



FIGURE A-6. POST-TEST - LEFT FRONT DUMMY

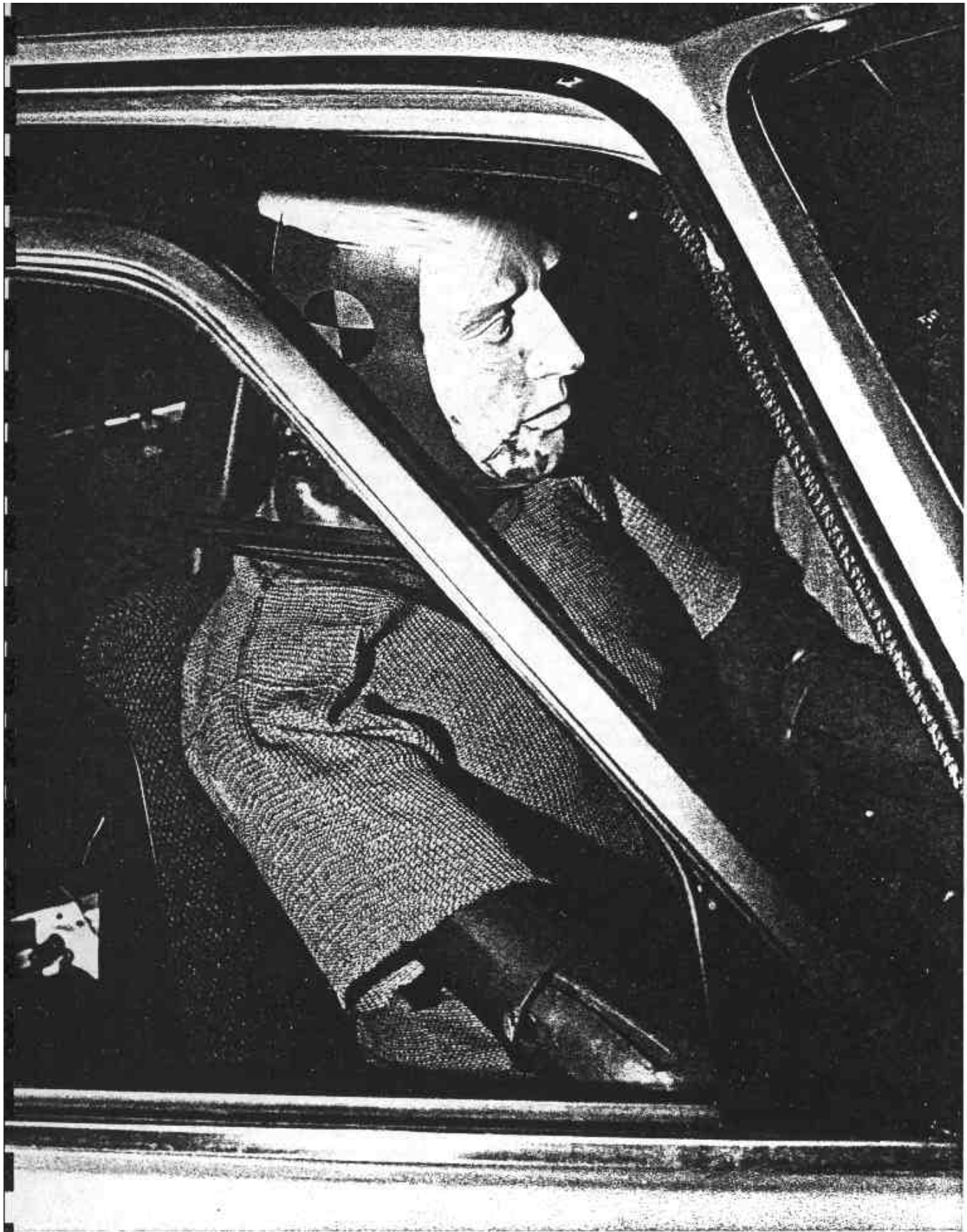


FIGURE A-7. POST-TEST - RIGHT FRONT DUMMY

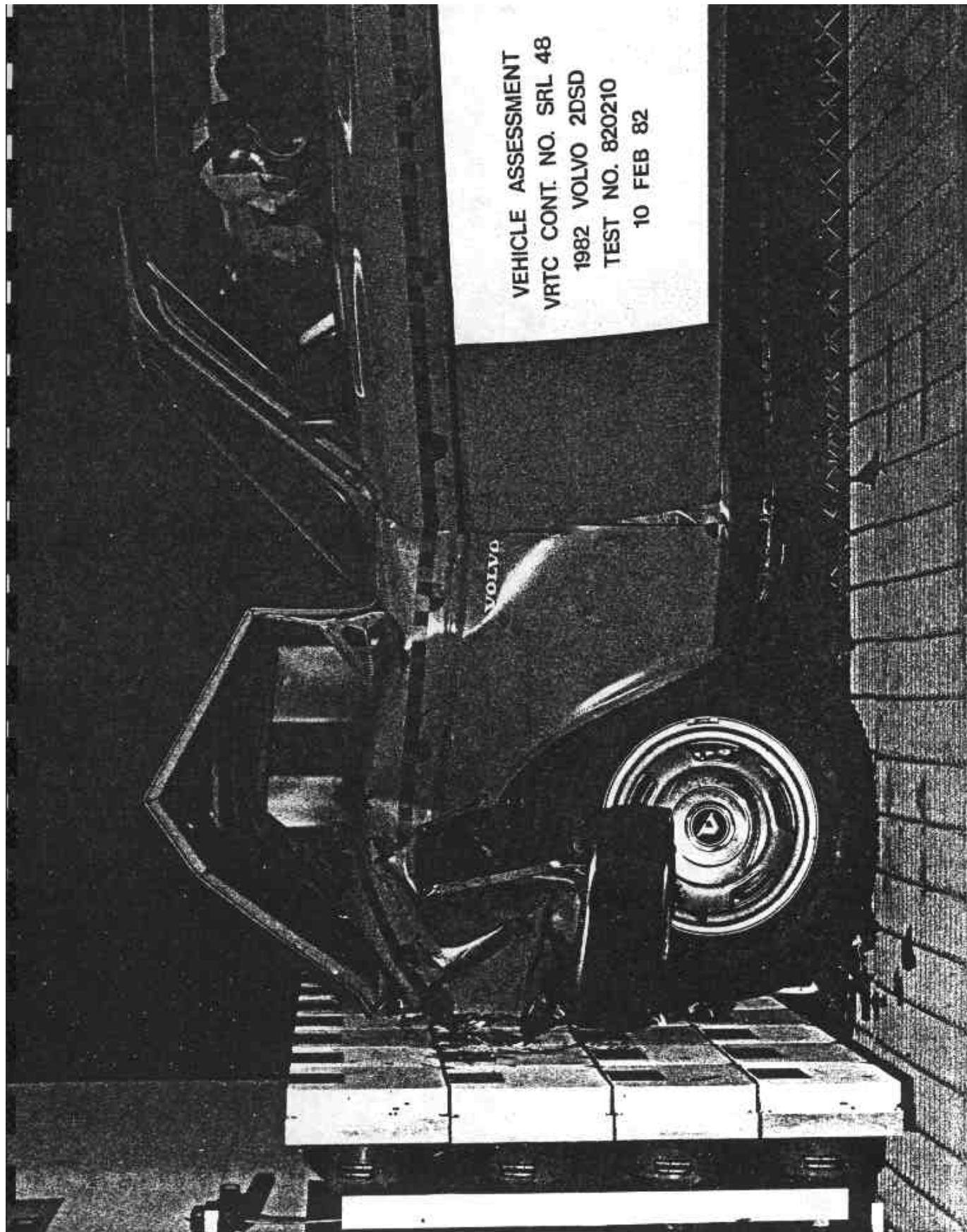


FIGURE A-8. POST-TEST - LEFT FRONT OF VEHICLE

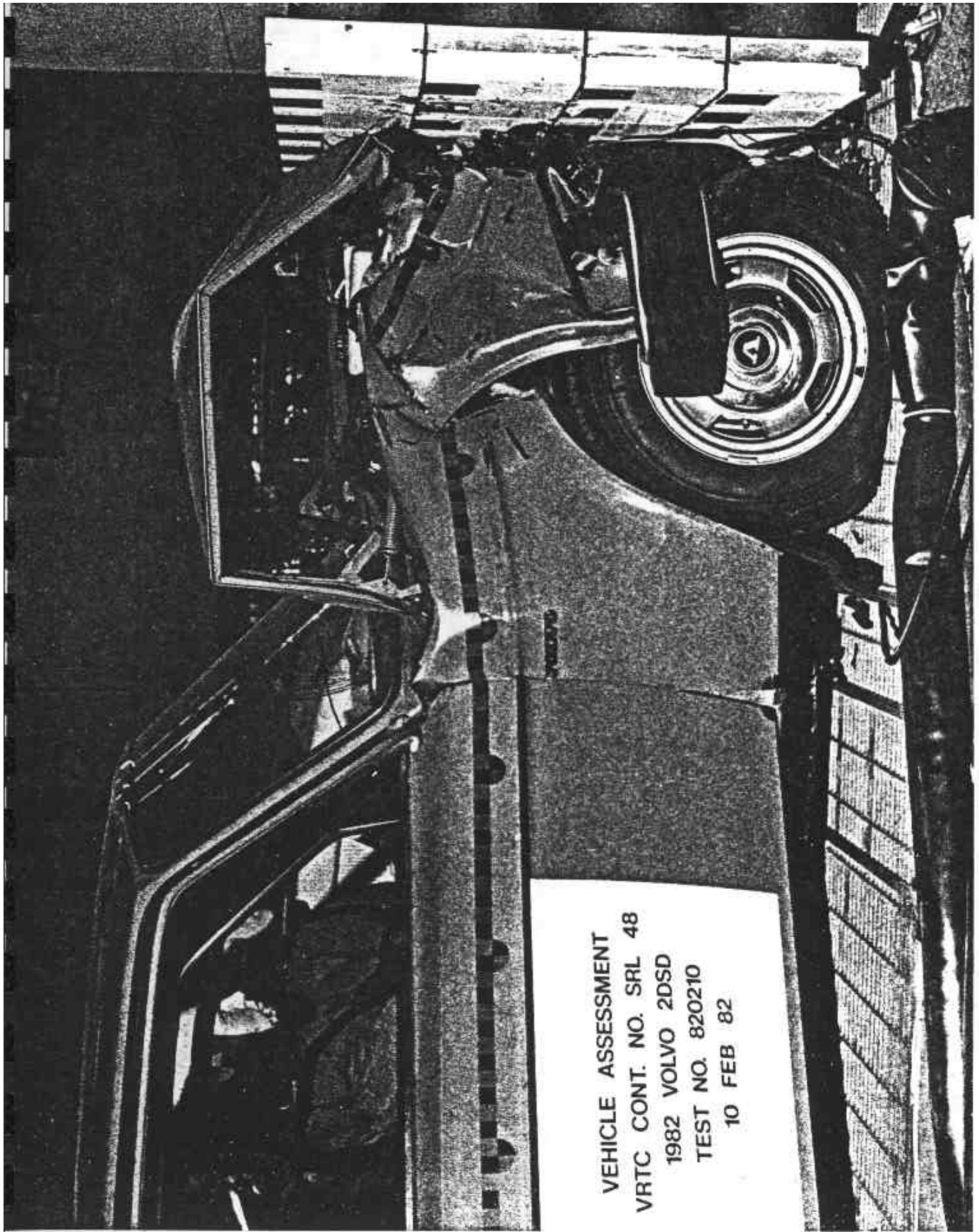


FIGURE A-9. POST-TEST - RIGHT FRONT OF VEHICLE

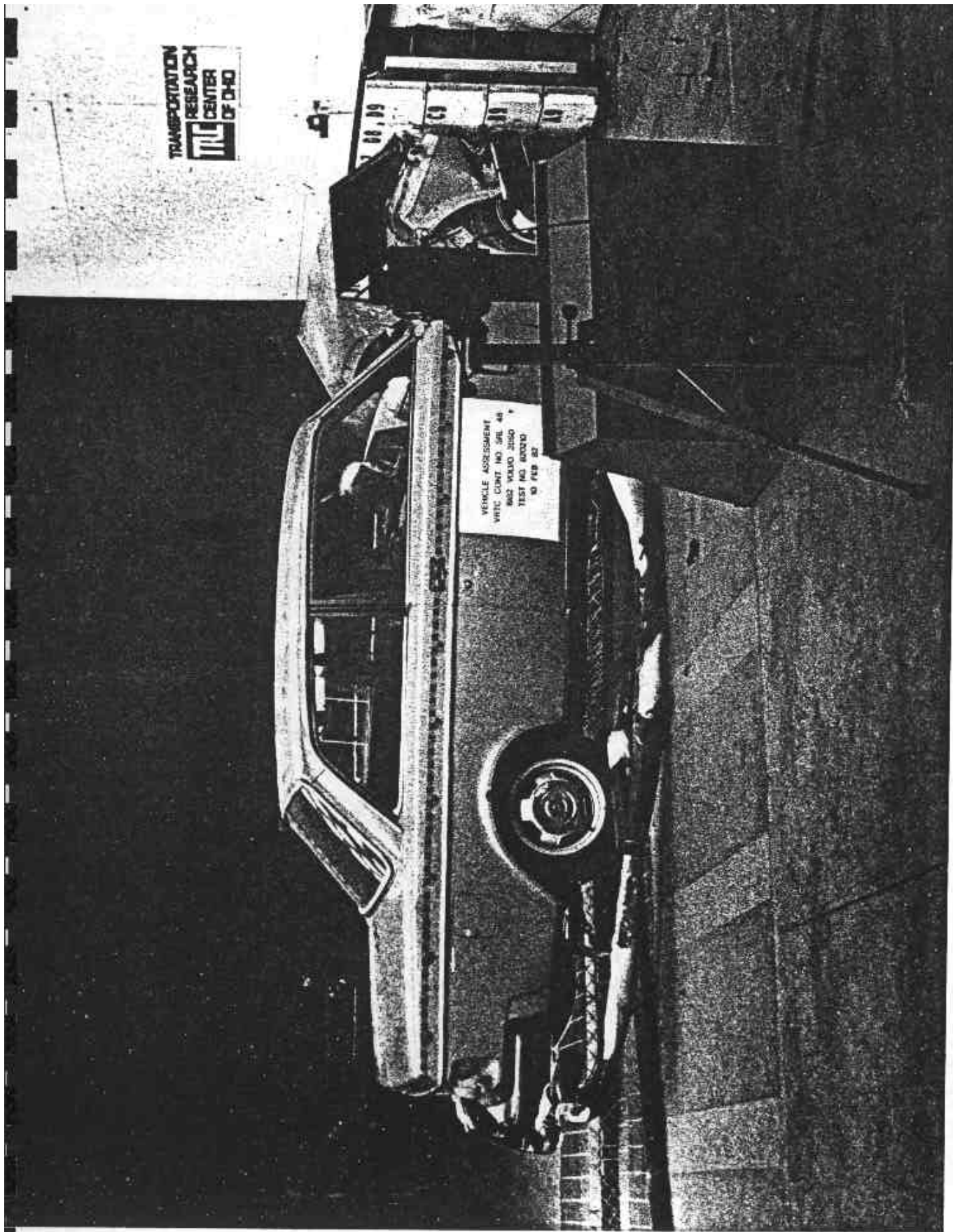


FIGURE A-10. CRASH EVENT PHOTOGRAPH

APPENDIX B
DATA PLOT PRESENTATION

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.

Due to an insufficient number of available data channels, only the responses of the following load cells from the load measuring barrier were recorded:

A1 through A9,
B1 through B9,
C4 through C6, and
D4 through D6.

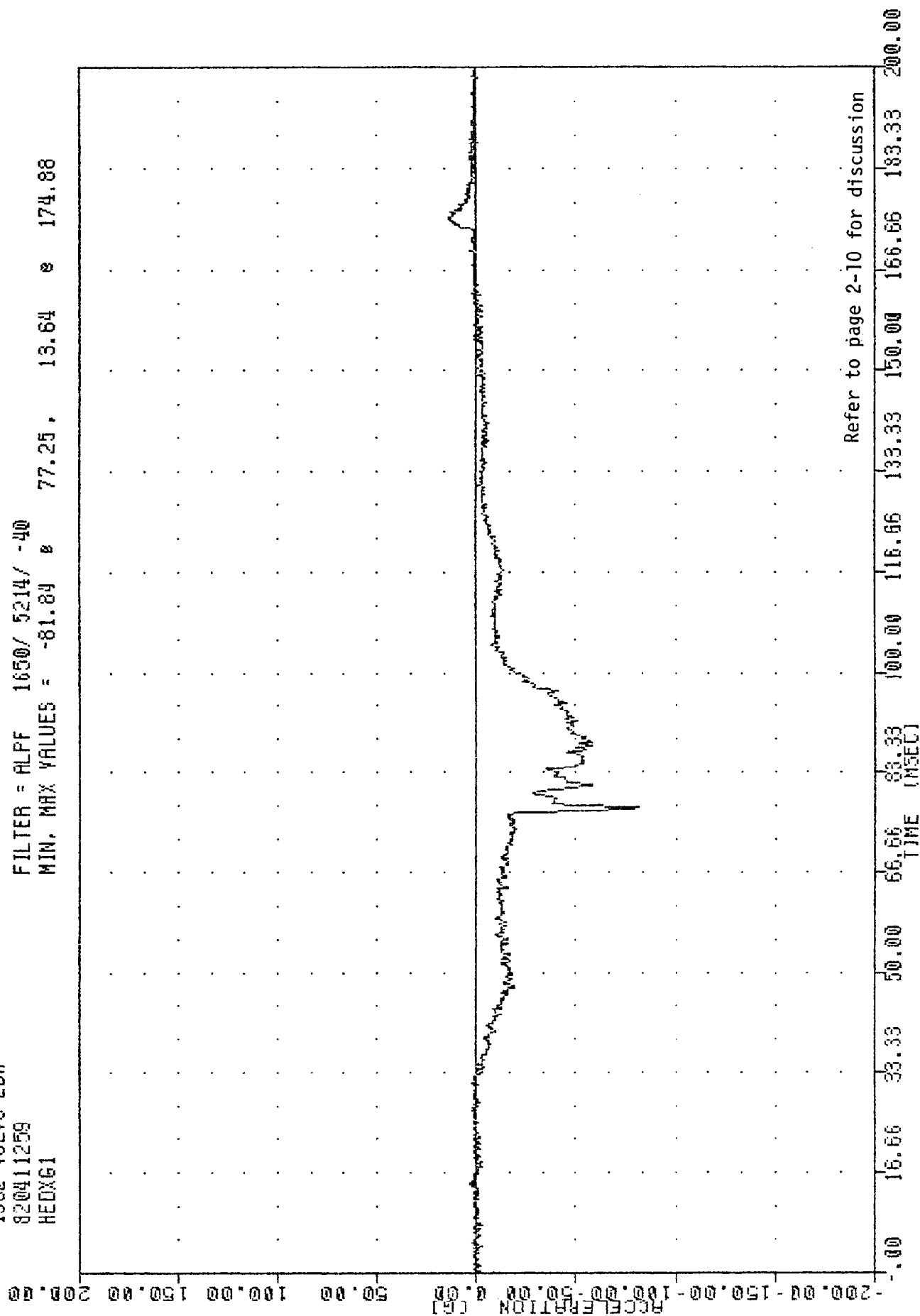
These plots appear on pages B-26 through B-49 inclusive.

SRL48
1982 VOLVO 20R
820411259
HEDXG1

PLOT DATE 27-MAY-82 08:52:50

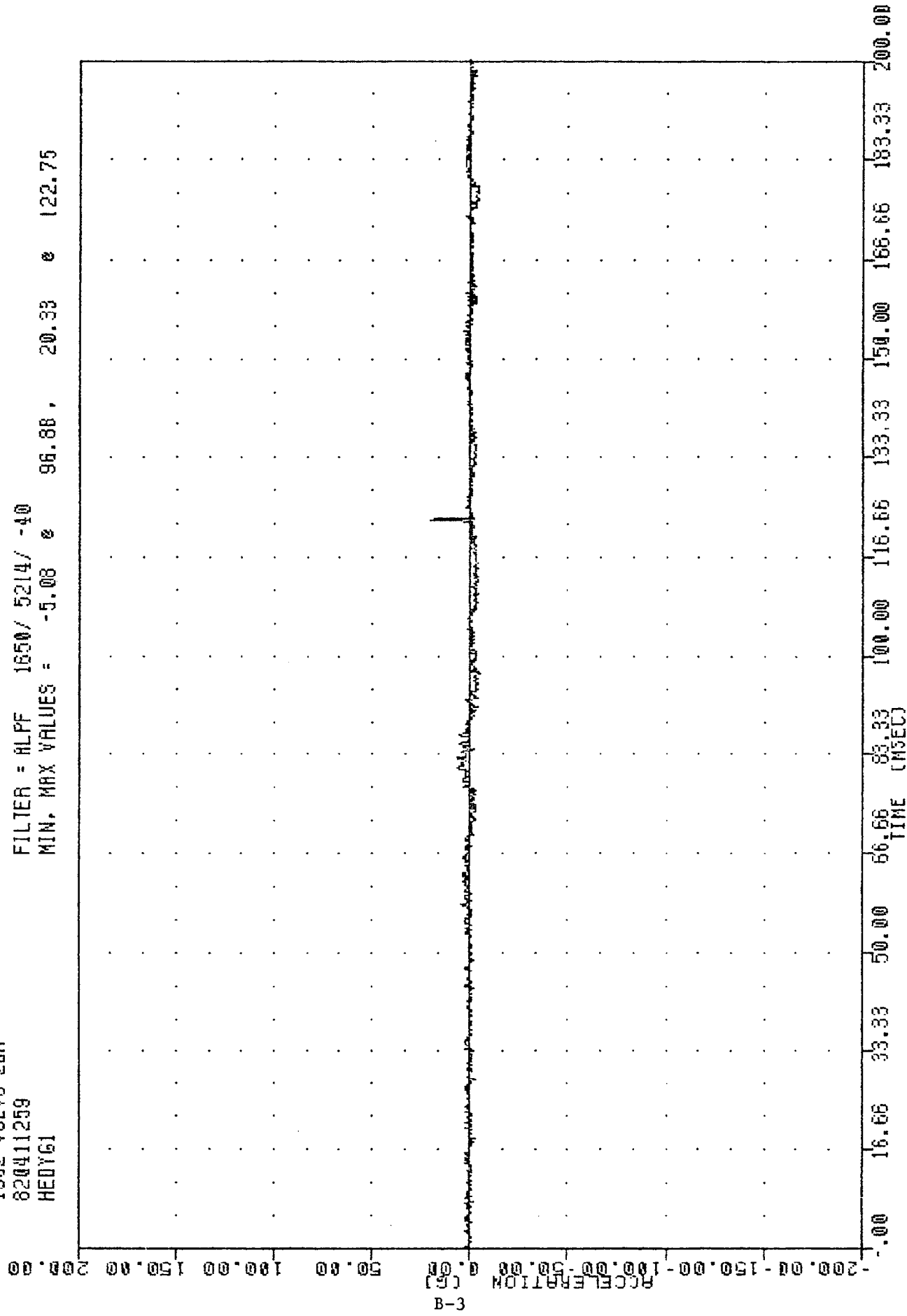
FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -81.84 77.25 13.64 174.88



DRIVER HEAD ACCELERATION X AXIS

SRL48 , SRL48
 1982 VOLVO 20A
 820411259
 HEDY61
 PLOT DATE 27-MAY-82 08:52:50
 FILTER = ALPF 1650/ 5214/ -40
 MIN. MAX VALUES = -5.08 @ 96.88 , 20.33 @ 122.75



DRIVER HEAD ACCELERATION Y AXIS

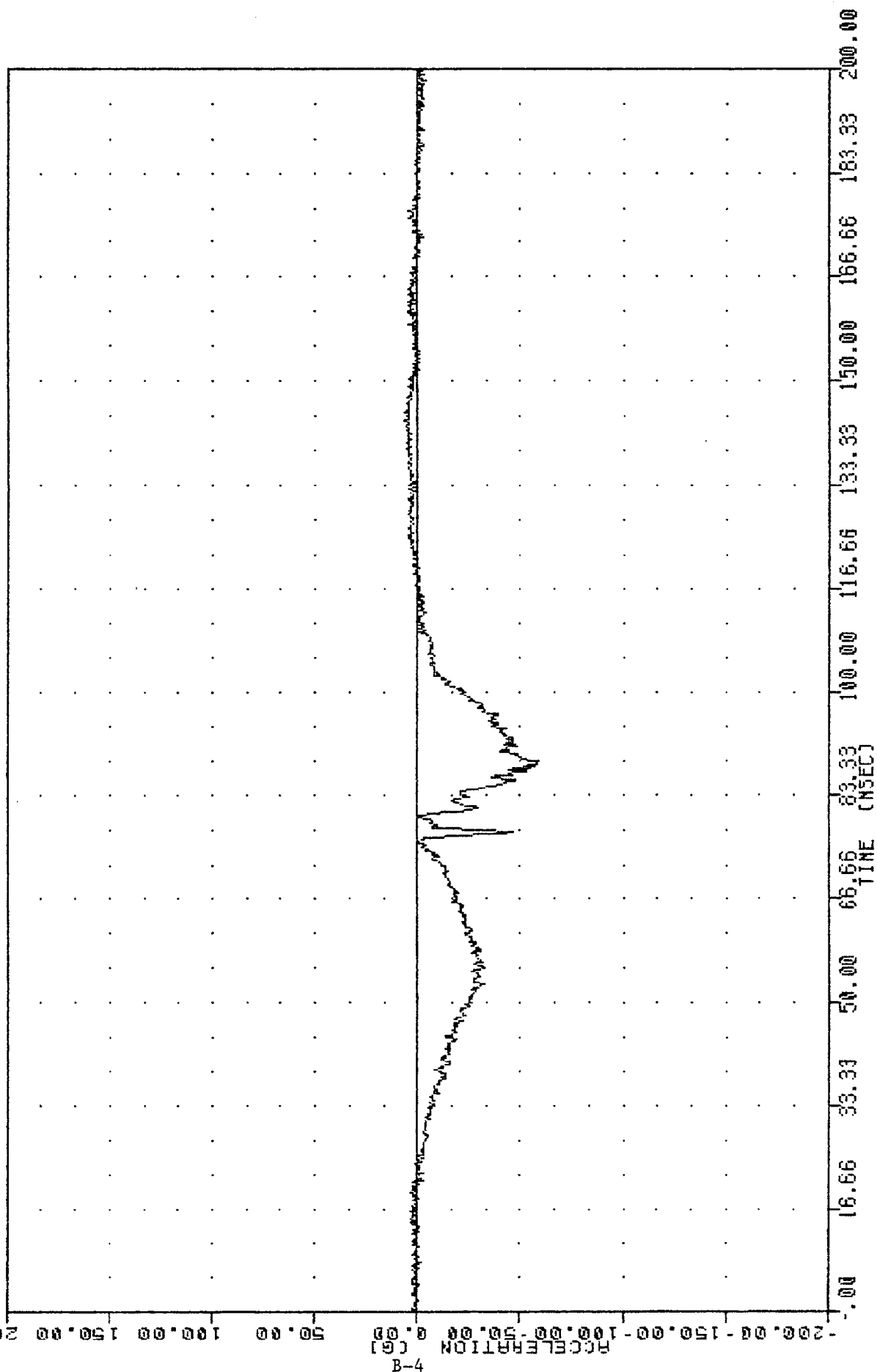
SRL48 , SRL48
1982 VOLVO 20R
820411259
HEDZ61

PLOT DATE 27-MAY-82 08:52:50

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = -59.52 e 88.63, 6.20 e 143.50

B-4



DRIVER HEAD ACCELERATION Z AXIS

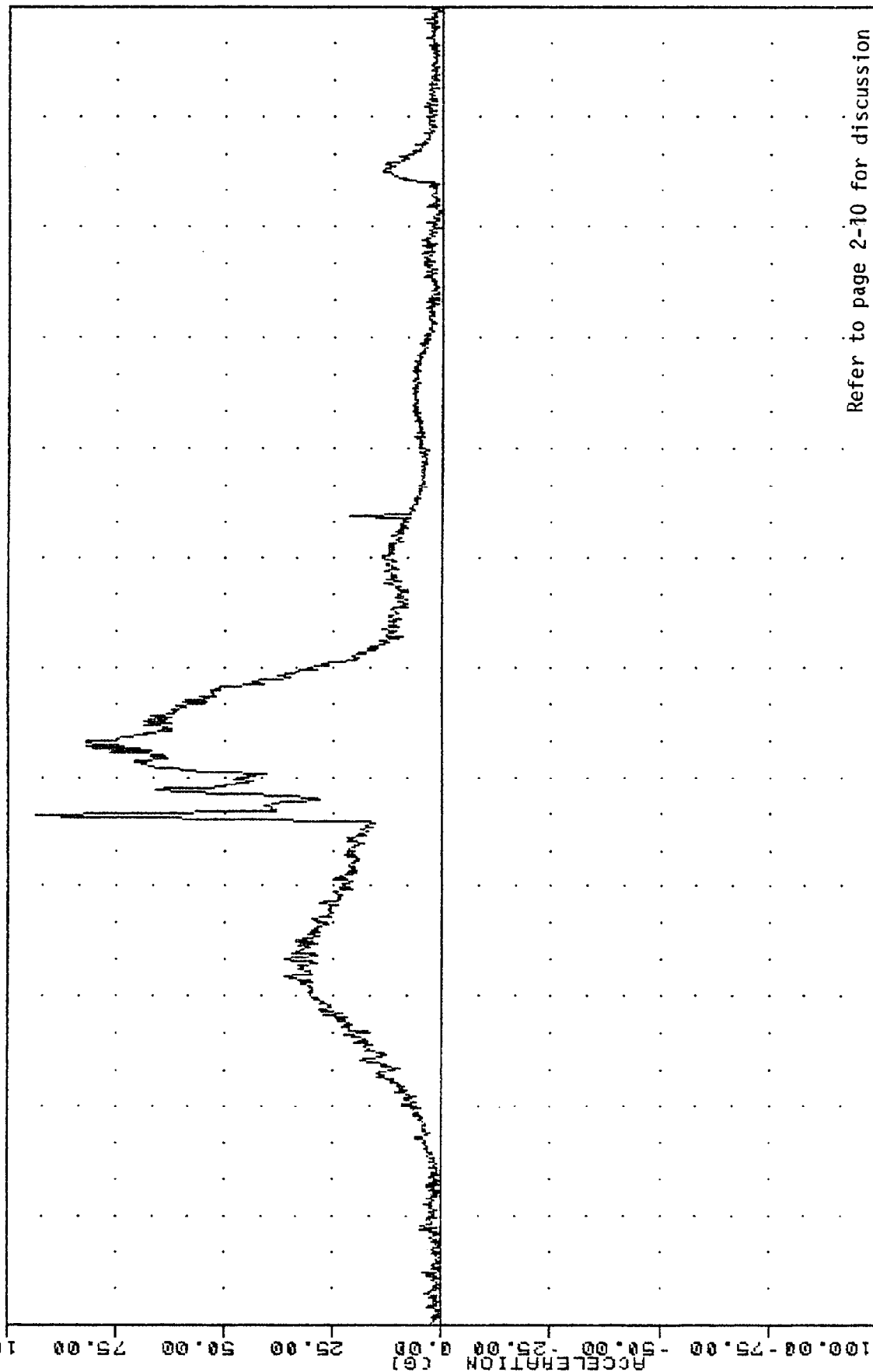
SRL48 , SRL48
1982 VOLVO 2DR
820411259
HEDR61

PLOT DATE 27-MAY-82 08:52:50

FILTER = ALPF 1650/ 5214/ -40

MIN, MAX VALUES = 0.00 e 8.25 , 93.56 e 77.25

ACCELERATION (G)

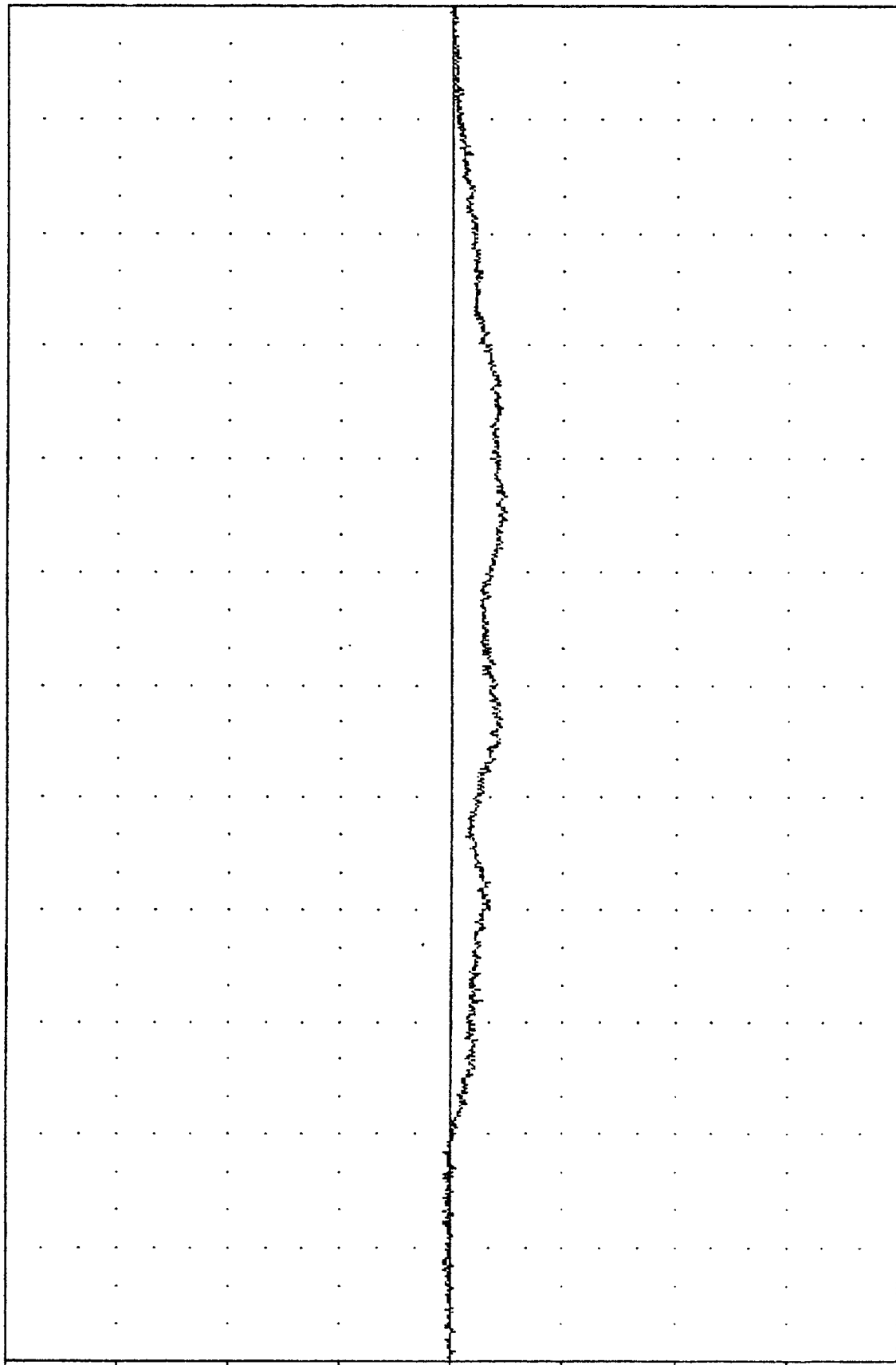


0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

DRIVER HEAD ACCELERATION RESULTANT

SRL48 , SRL48
 1982 VOLVO 20R
 820411259
 HEDX62
 PLOT DATE 27-MAY-82 08:52:50
 FILTER = ALPF 1650/ 5214/ -40
 MIN, MAX VALUES = -24.01 124.25 3.10 13.38

B-6
 ACCELERATION (G)
 -200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00



-200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00
 TIME (MSEC)

PASSENGER HEAD ACCELERATION X AXIS

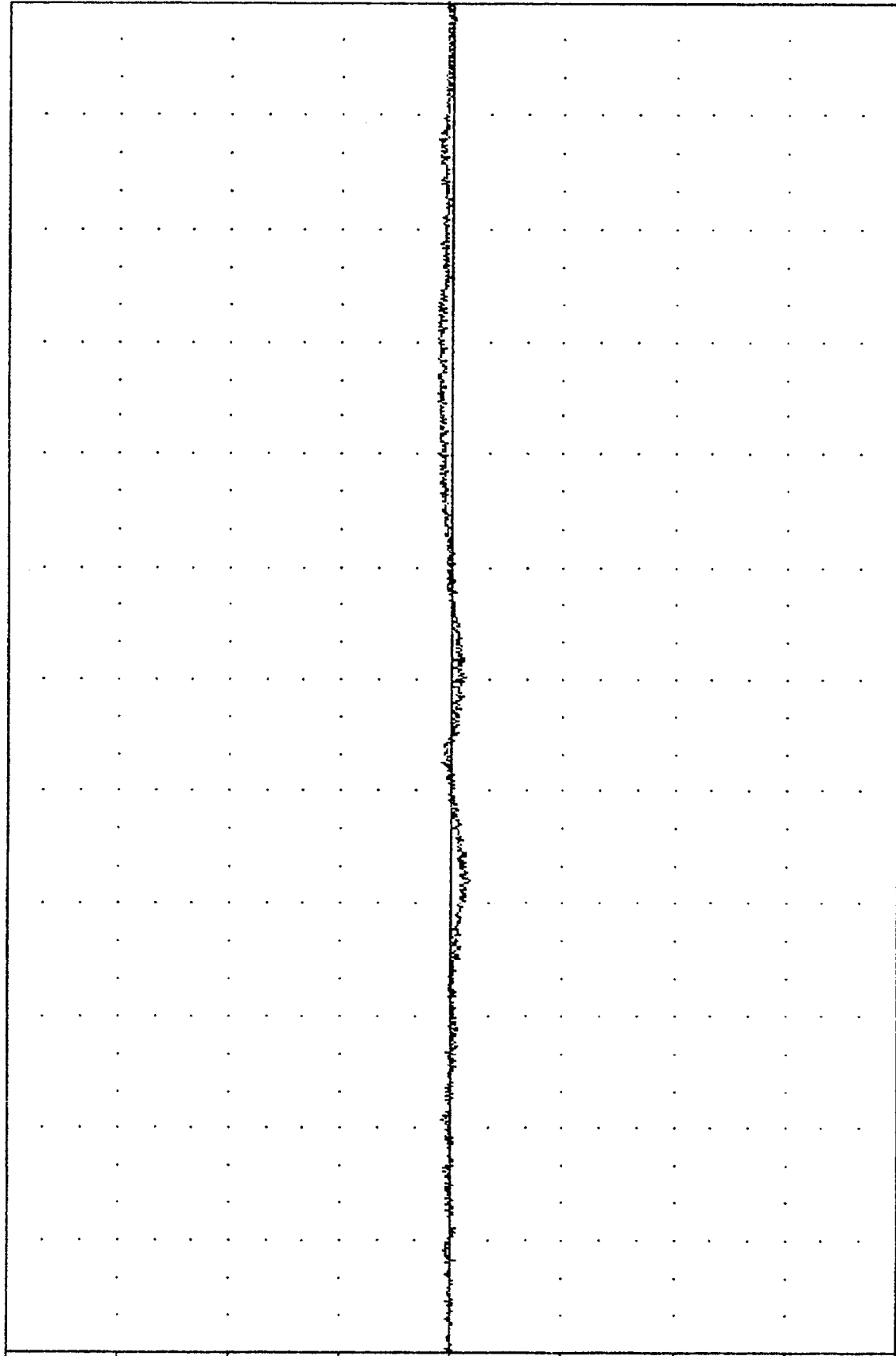
SRL48
1982 VOLVO 20R
820411259
HEDYG2

PLOT DATE 27-MAY-82 08:52:50

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -8.36 70.00 7.07 145.00

B-7
ACCELERATION (G)
-200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

PASSENGER HEAD ACCELERATION Y AXIS

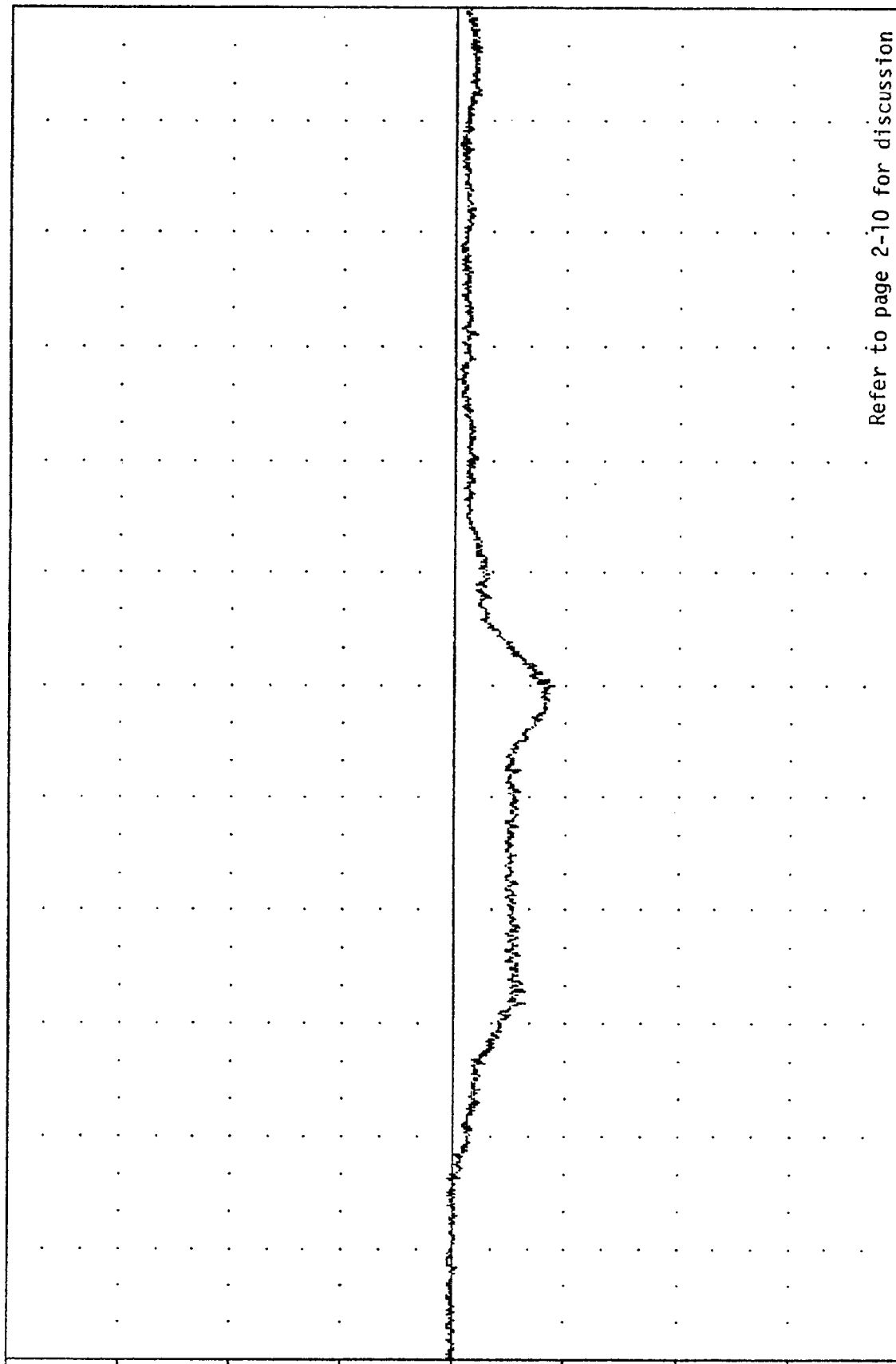
SAL48 , SAL48
 1962 VOLVO 20A
 820411259
 HEDZ62

PLOT DATE 27-MAY-82 08:52:50

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = -44.40 99.68 2.61 4.88

ACCELERATION (G)



Refer to page 2-10 for discussion

0.00 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
 TIME (MSEC)

PASSENGER HEAD ACCELERATION Z AXIS

SRL48
1982 VOLVO 20R
820411259
HEDRG2

PLOT DATE 27-MAY-82 08:52:50

FILTER = ALPF 1650/ 5214/ -40

MIN. MAX VALUES = 0.00 0 10.63, 48.29 0 99.88

100.00

75.00

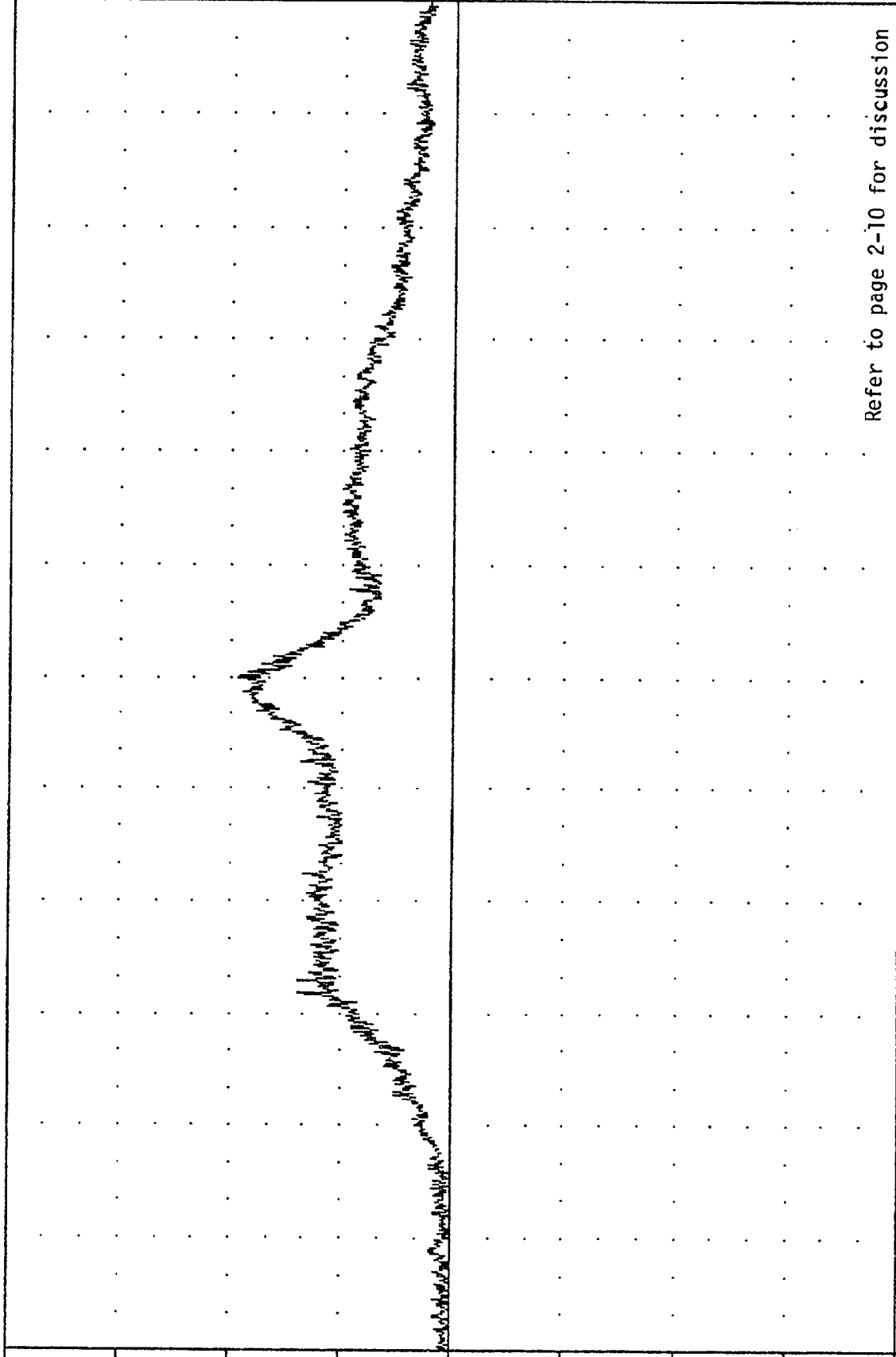
50.00

25.00

0.00

ACCELERATION (G)

B-9



-100.00

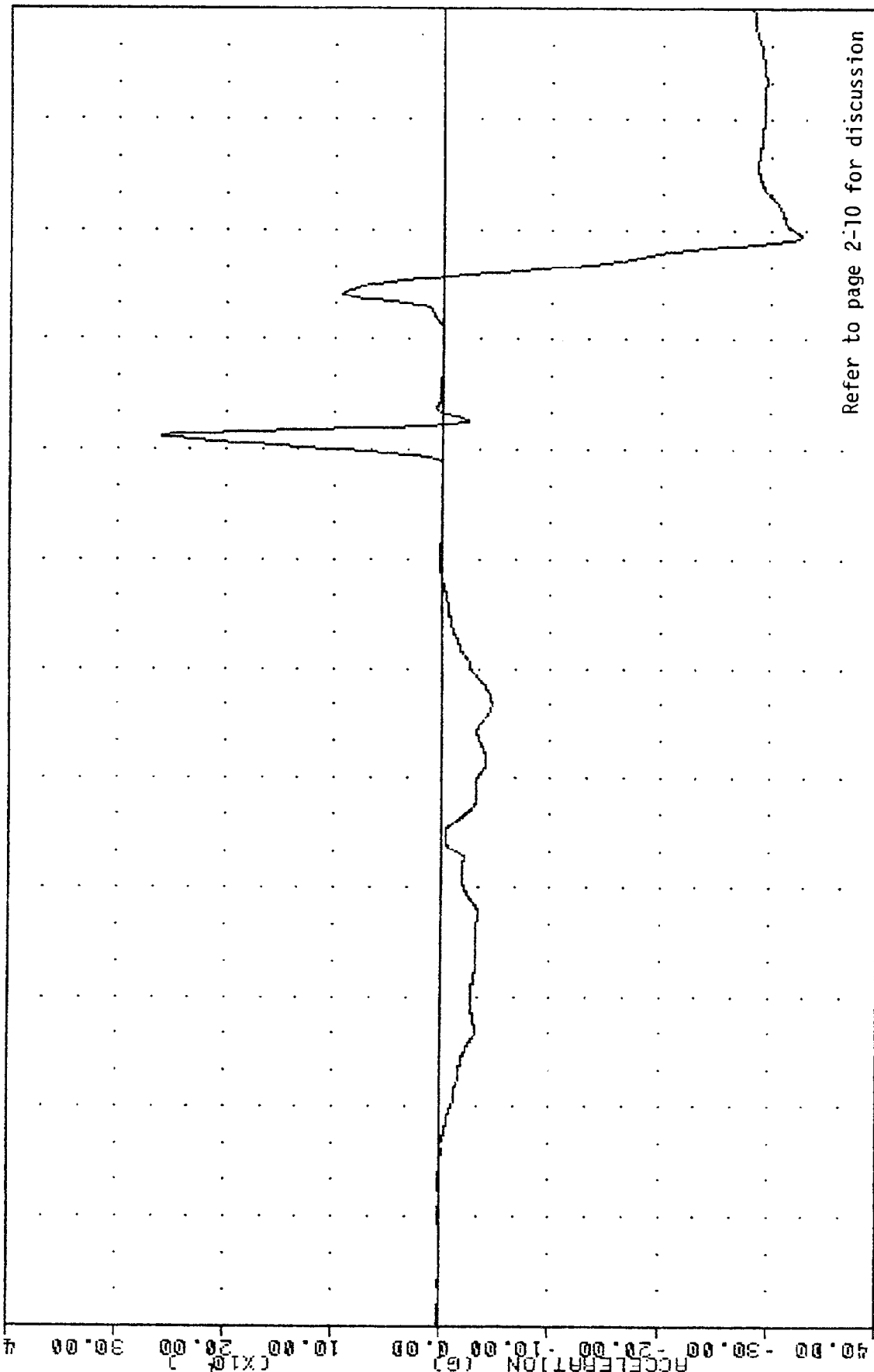
200.00

TIME (MSEC)

PASSENGER HEAD ACCELERATION RESULTANT

SRL48 , SRL48
 1982 VOLVO 20R
 820411259
 CSTXG1
 PLOT DATE 27-MAY-82 08:52:50
 FILTER = BLPF 300/ 950/ -30
 MIN. MAX VALUES = -328.25 @ 165.63 , 260.28 @ 135.25

ACCELERATION (g)
 (x10⁴)



Refer to page 2-10 for discussion

0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
 TIME (MSEC)

DRIVER CHEST ACCELERATION X AXIS

SRL48 , SRL48
1982 VOLVO 20R
820411259
CSTYG1

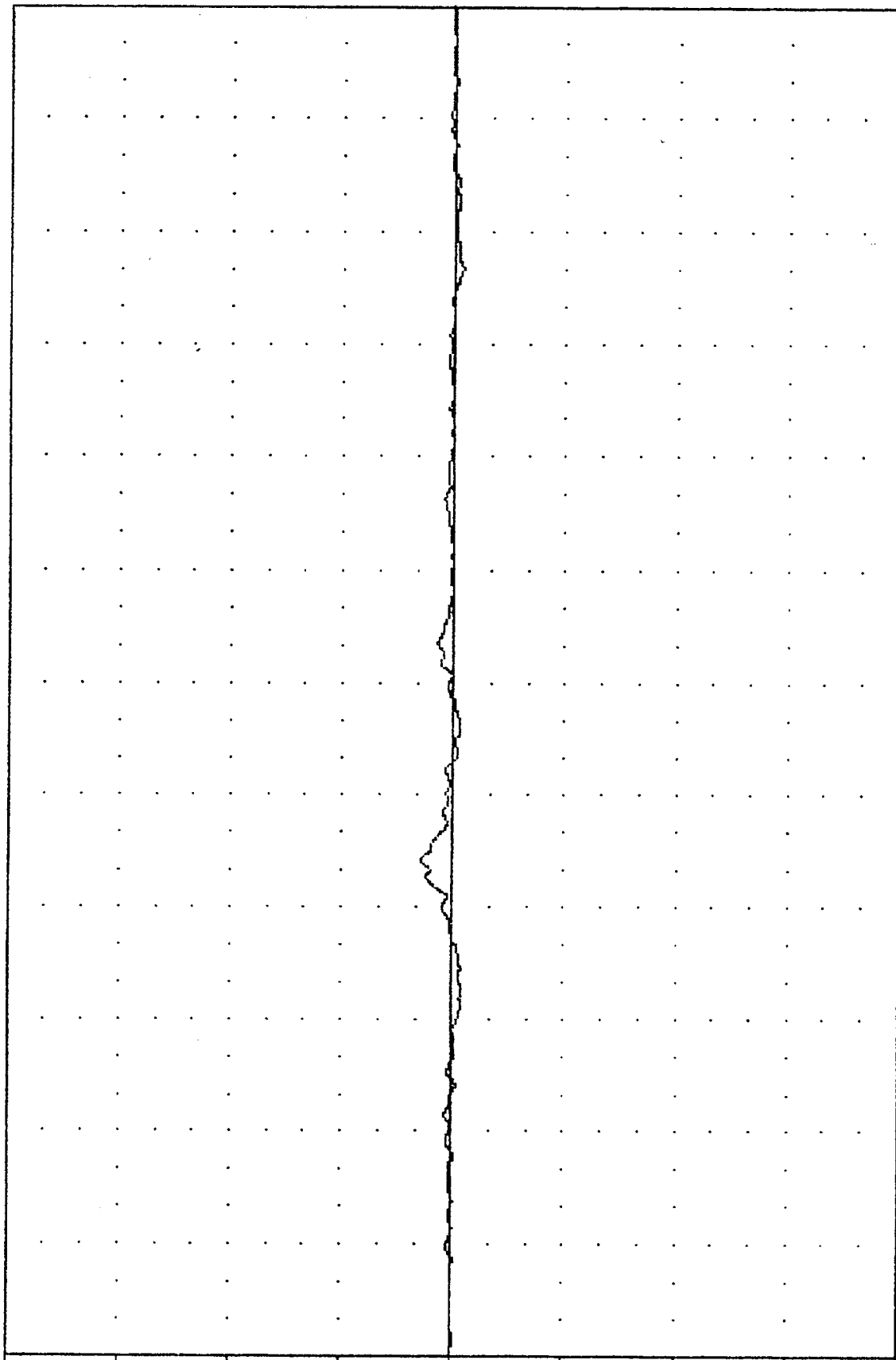
PLOT DATE 27-MAY-82 08:52:50

FILTER = 8LPF 300/ 950/ -30

MIN. MAX VALUES = -2.24 54.25, 7.12 73.63

ACCELERATION (G)

B-11



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

DRIVER CHEST ACCELERATION Y AXIS

PLOT DATE 27-MAY-82 08:52:50

FILTER = BLPF 300/ 950/ -30

MIN, MAX VALUES = -15.67 @ 79.88 , 14.14 @ 50.25

SRL48 , SRL48

1982 VOLVO 20A

820411259

CSTZ61

ACCELERATION (G)

100.00

75.00

50.00

25.00

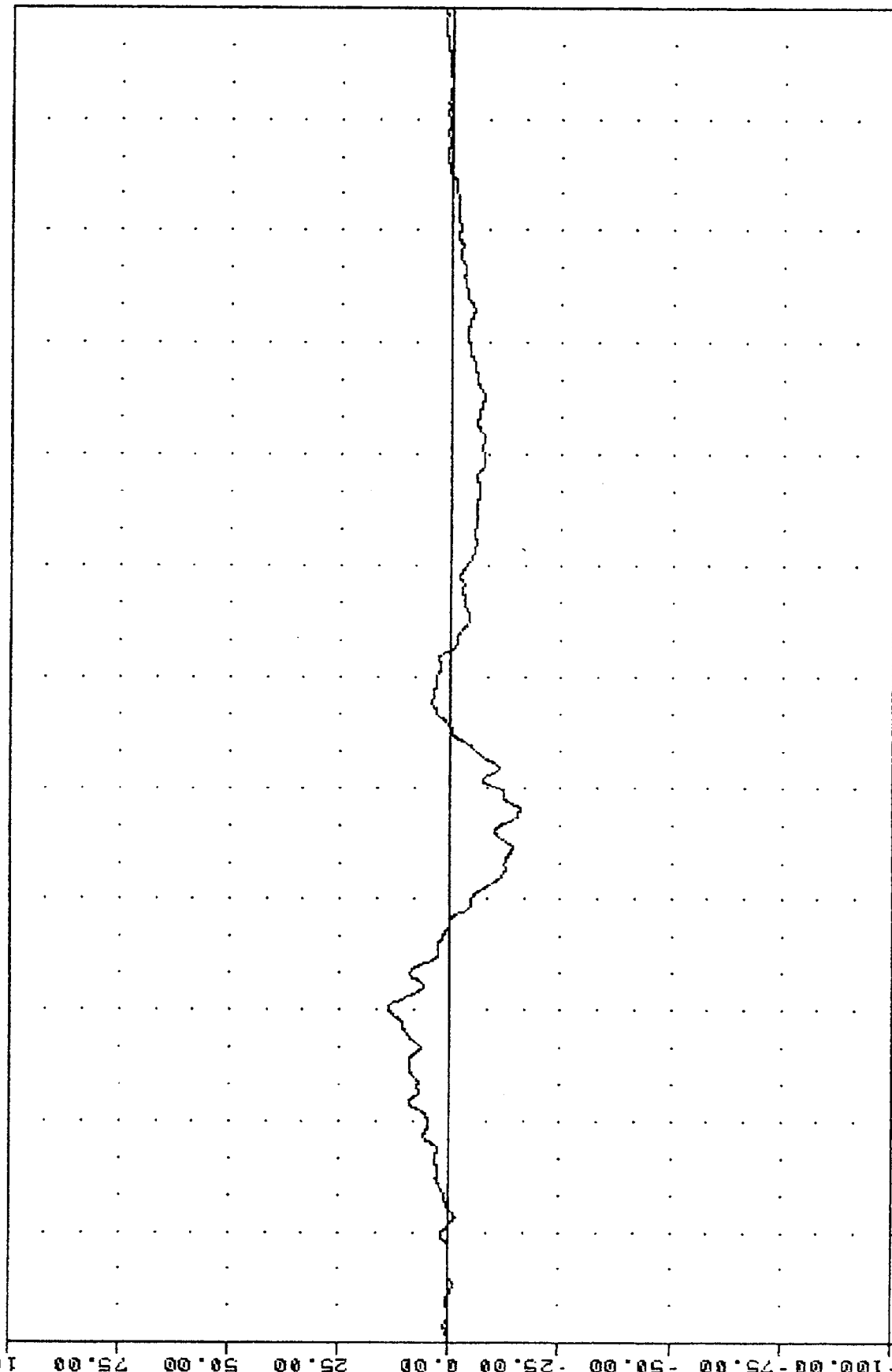
0.00

-25.00

-50.00

-75.00

-100.00



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

DRIVER CHEST ACCELERATION Z AXIS

PLOT DATE 22-JUN-82 09:51:02

SRL48 , SRL48

1982 VOLVO 20R

820411259

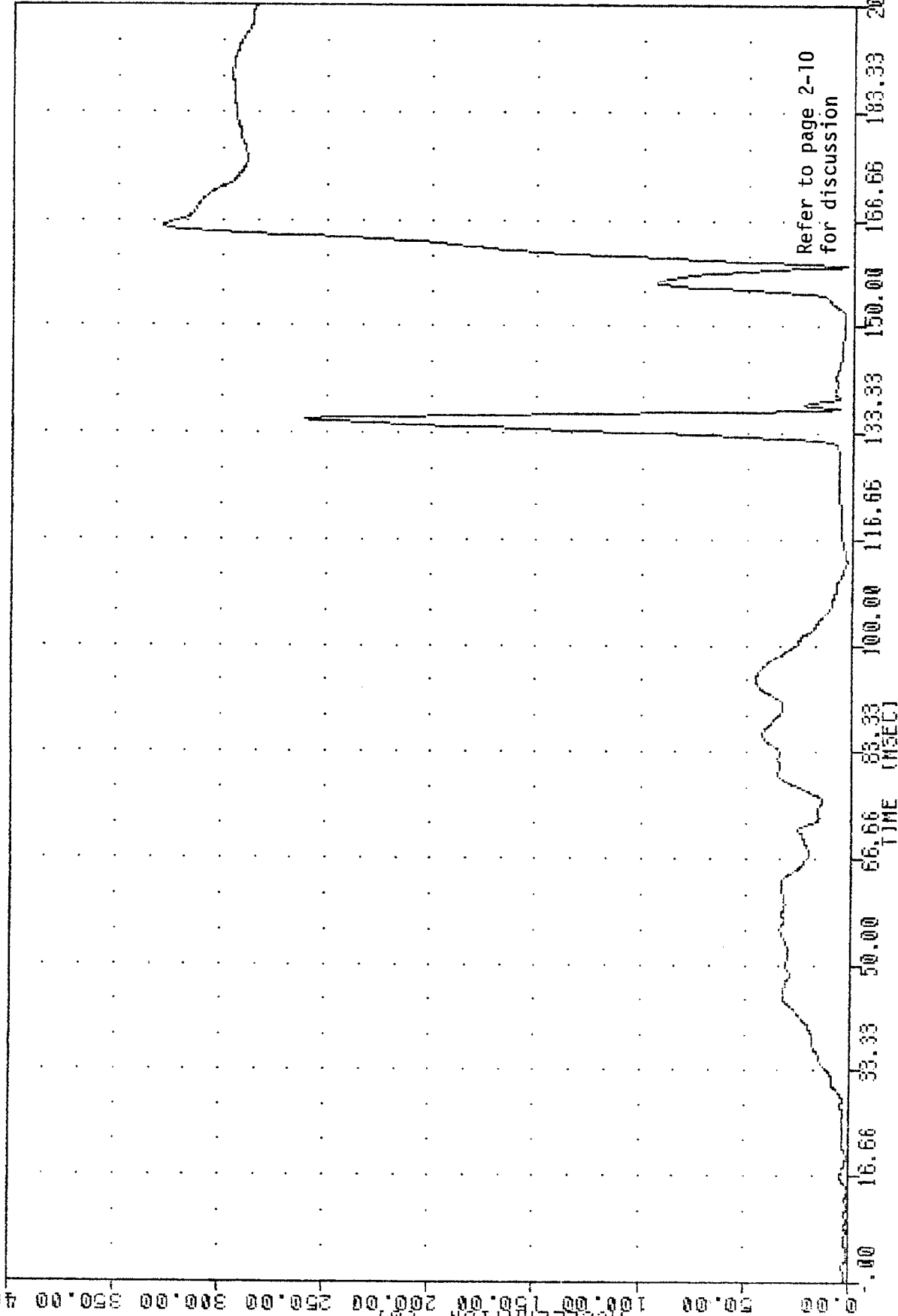
CSTR61

FILTER = BLPF 300/ 950/ -30

MIN. MAX VALUES = 0.458

4.50, 328.25 @ 165.63

ACCELERATION (G)

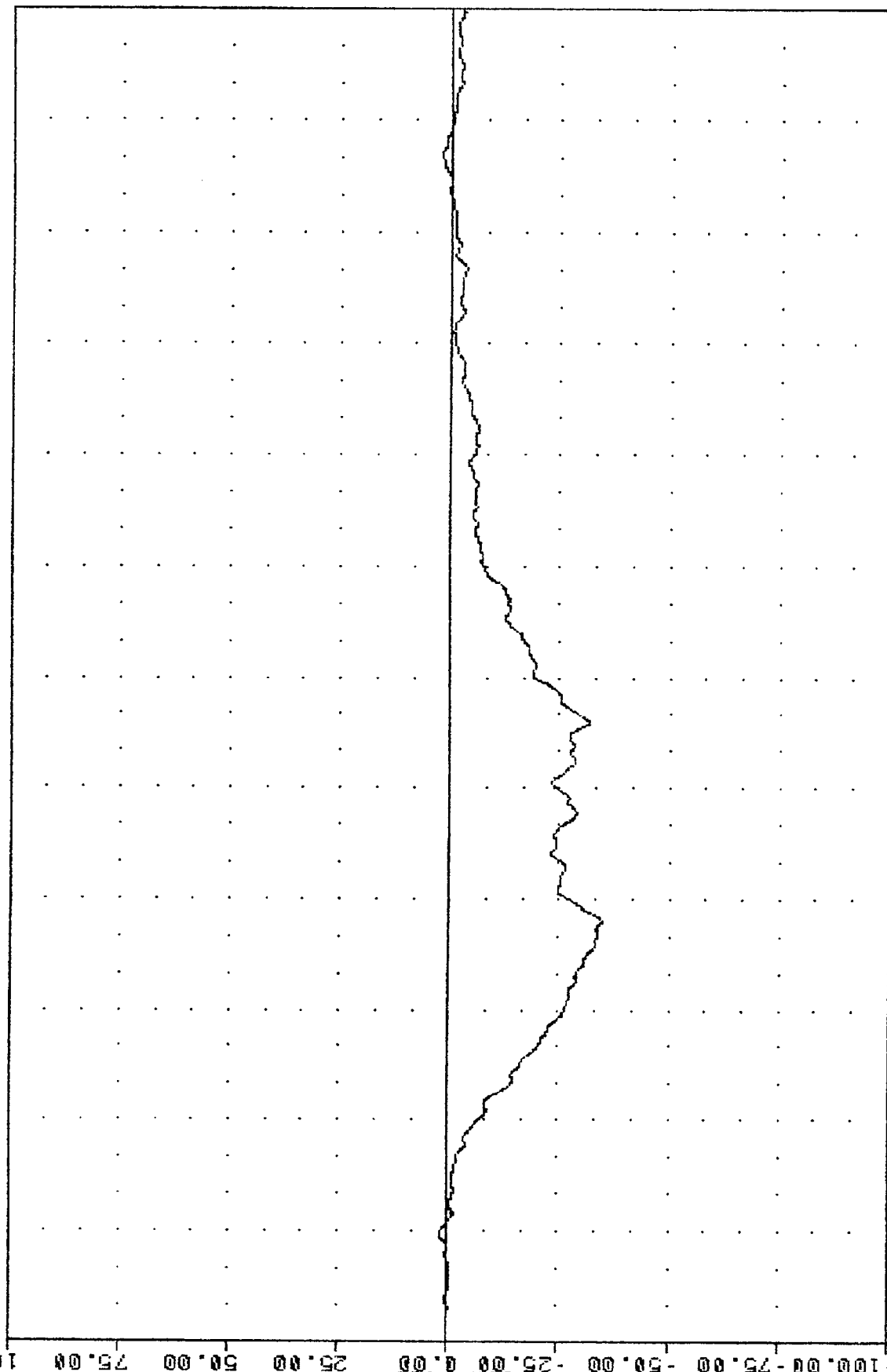


SRL48
1982 VOLVO 20A
820411259
CSTXG2

PLOT DATE 27-MAY-82 08:52:50

FILTER = BLPF 300/ 950/ -30
MIN. MAX VALUES = -34.66 63.25 2.19 178.13

ACCELERATION (G)



B-14

PASSENGER CHEST ACCELERATION X AXIS

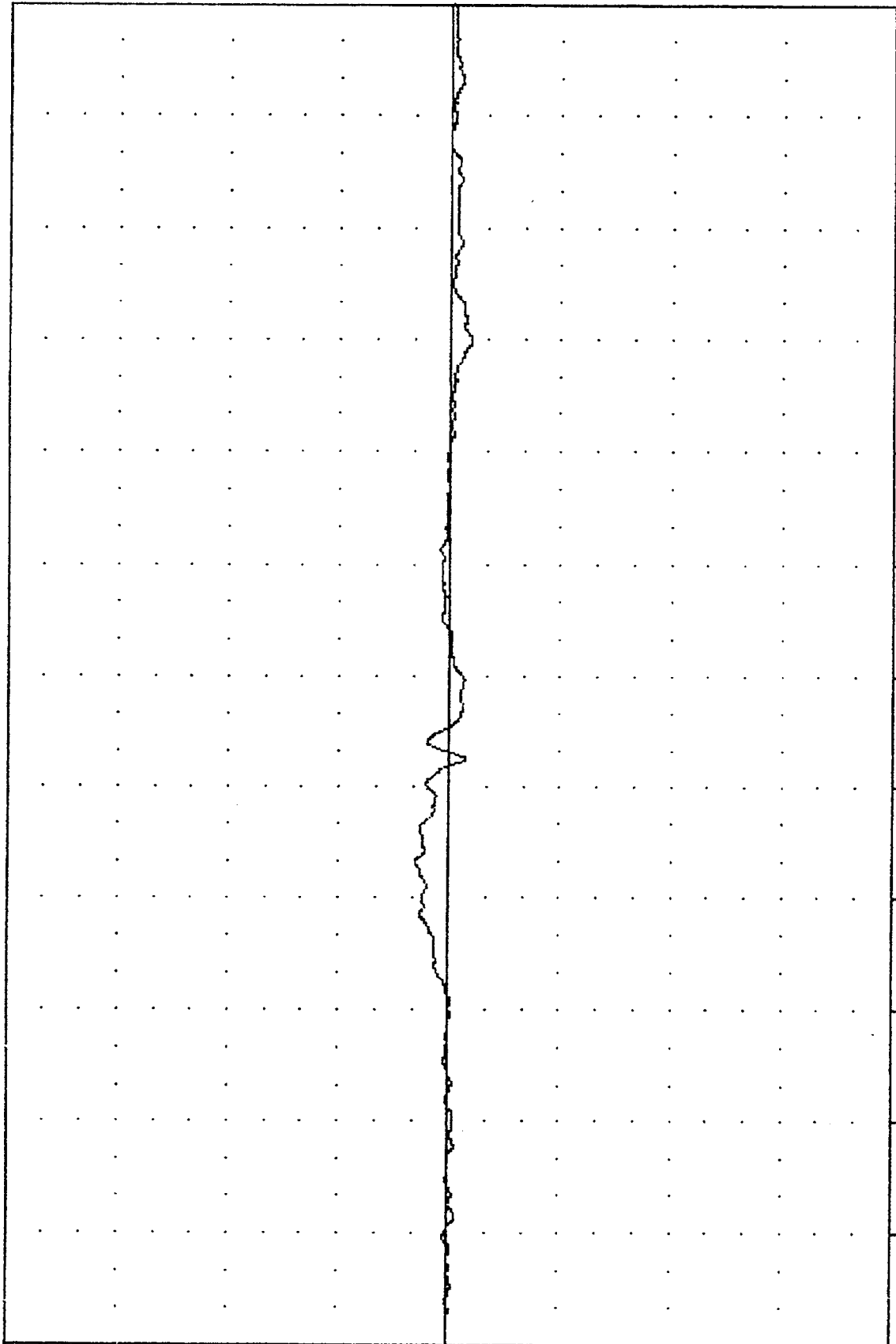
SRL48
1982 VOLVO 20R
820411259
CSTY62

PLOT DATE 27-MAY-82 08:52:50

FILTER = 8LPF 300/ 950/ -30

MIN. MAX VALUES = -4.84 0 149.75, 7.55 0 72.00

ACCELERATION (G)

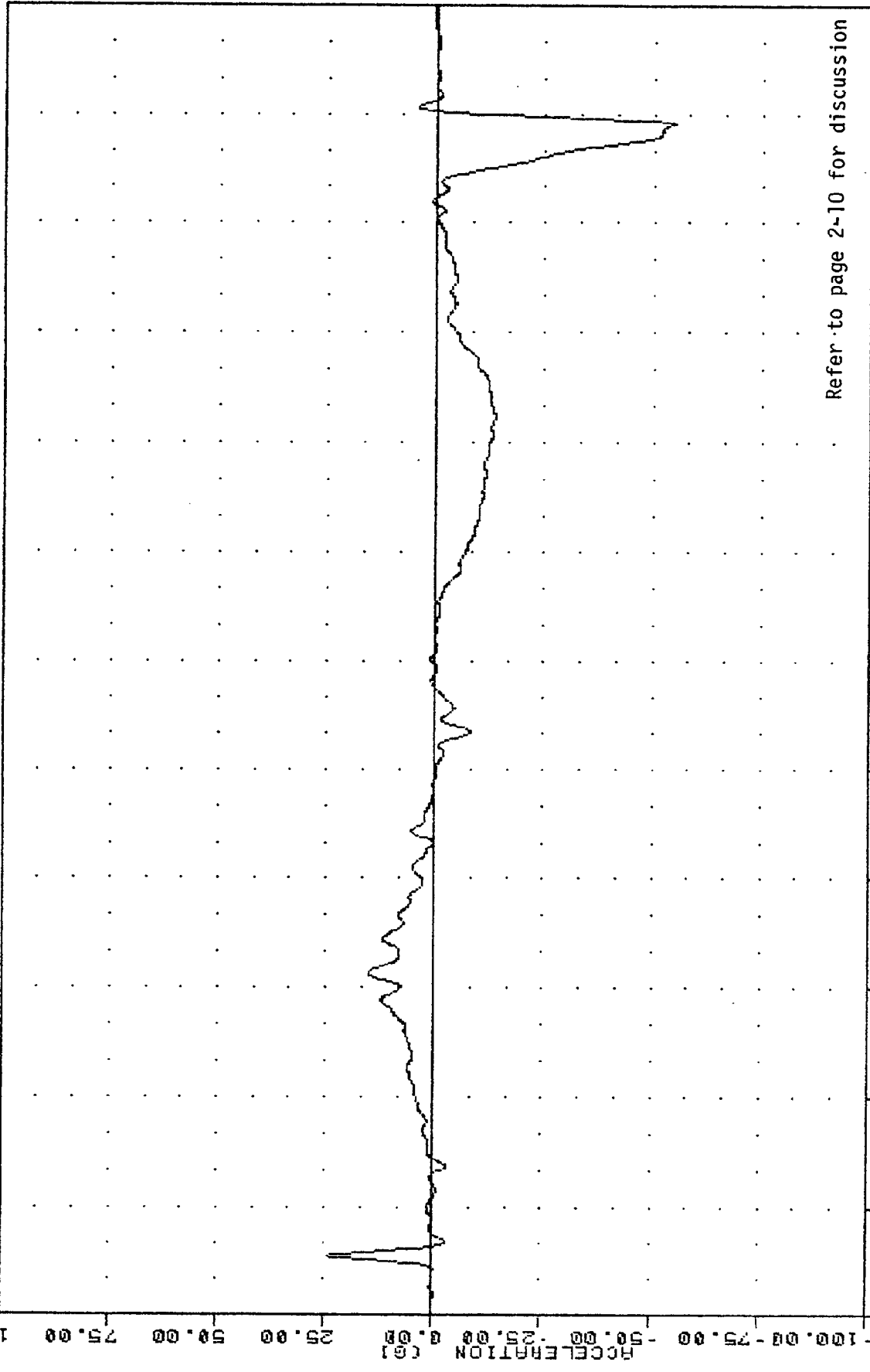


TIME (MSEC)

PASSENGER CHEST ACCELERATION Y AXIS

SRL48
 1982 VOLVO 2DR
 820411259
 C91762
 , SRL48
 PLOT DATE 27-MAY-82 08:52:50
 FILTER = BLPF 300/ 950/ -30
 MIN. MAX VALUES = -54.77 e 181.75. 24.00 e 9.00

100.00



Refer to page 2-10 for discussion

0.00 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
 TIME (MSEC)

PASSENGER CHEST ACCELERATION Z AXIS

PLOT DATE 22-JUN-82 09:51:02

SRL48 , SRL48

1982 VOLVO 20A

820411259

CSTRG2

FILTER = BLPF 300/ 950/ -30

MIN. MAX VALUES = 0.030 5.38, 54.77 @ 181.75

100.00

75.00

50.00

25.00

0.00

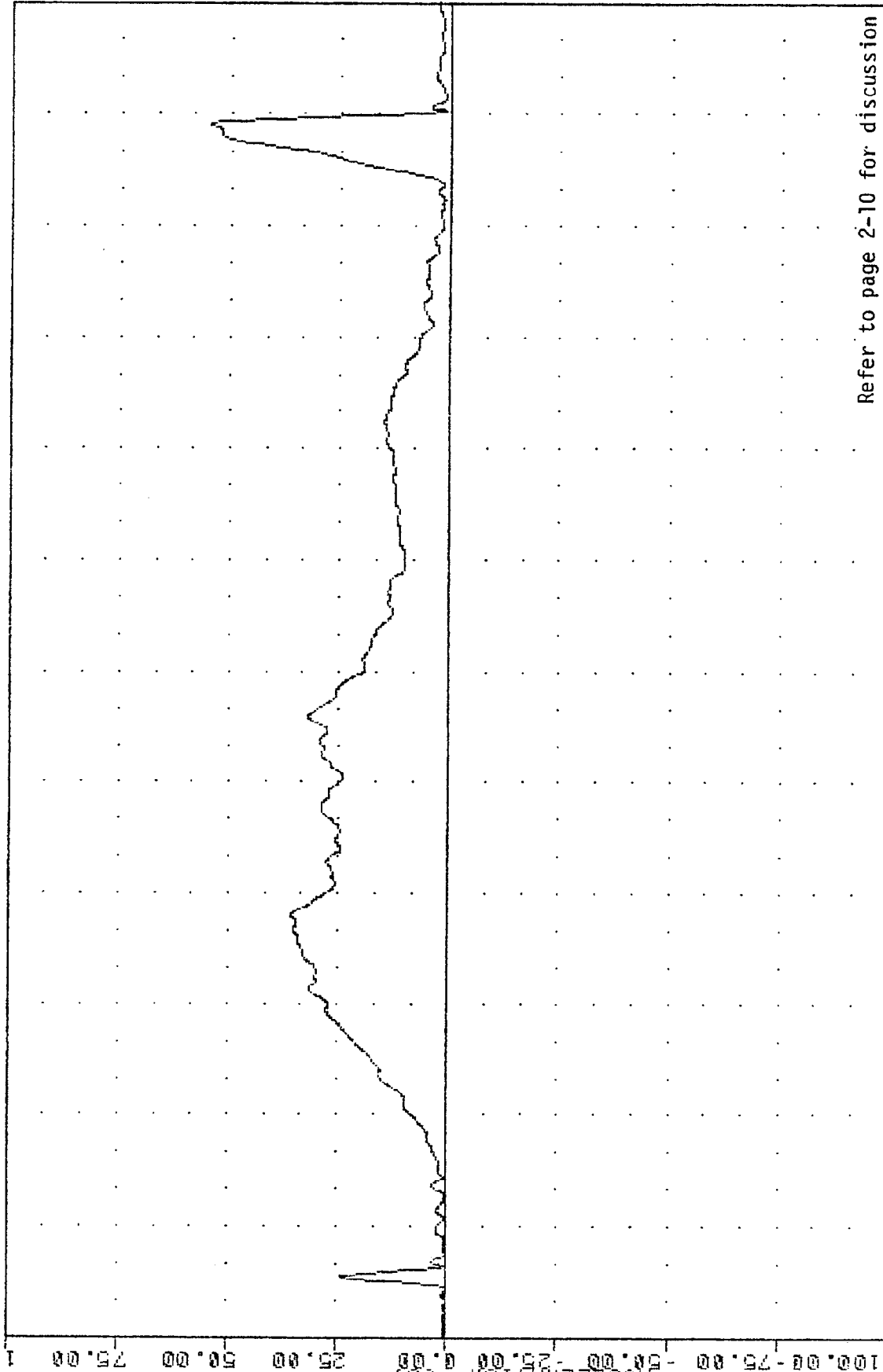
-25.00

-50.00

-75.00

-100.00

B-17



Refer to page 2-10 for discussion

0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

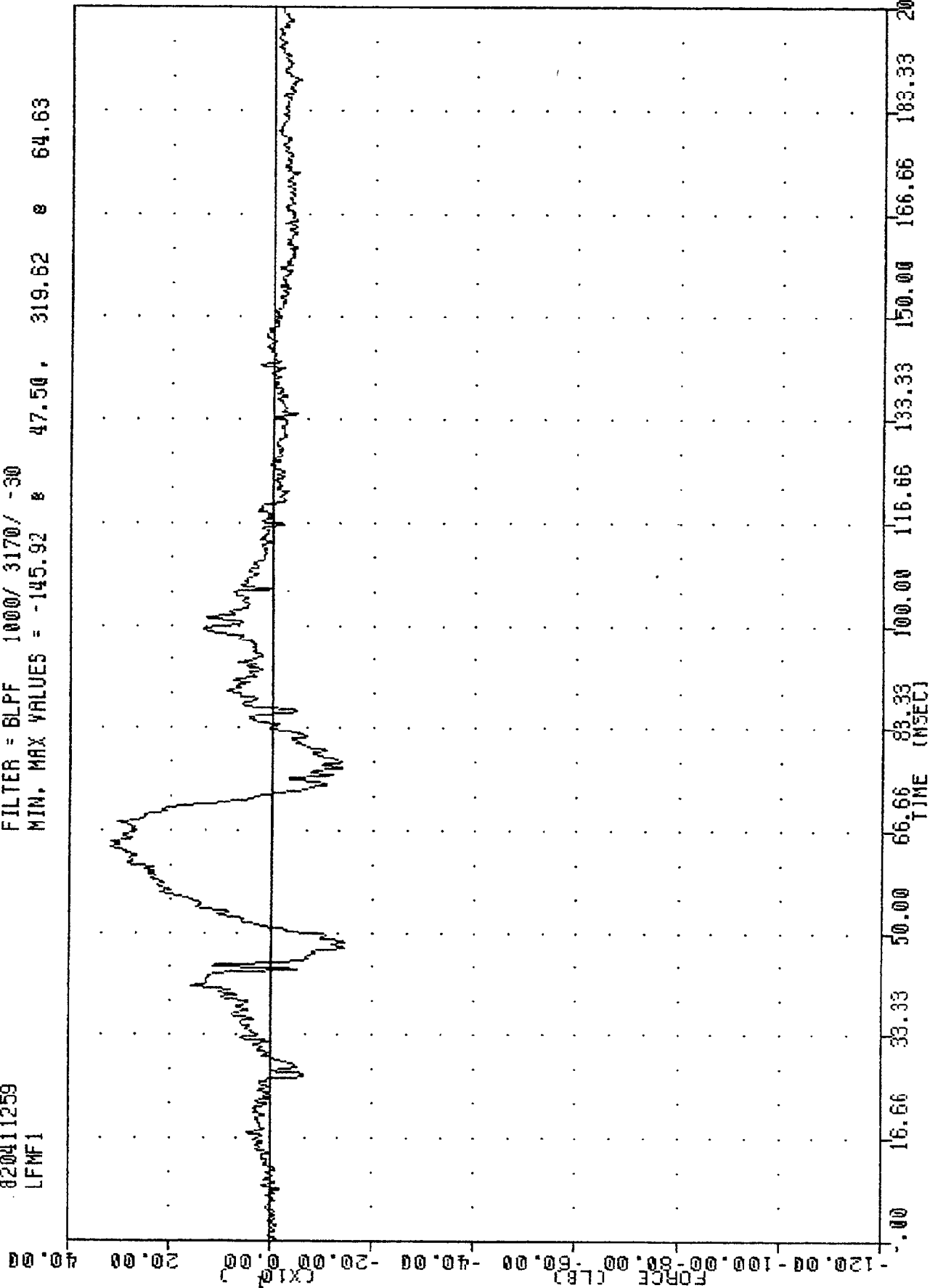
PASSENGER CHEST ACCELERATION RESULTANT

SRL48
1982 VOLVO 2DR
820411259
LFMF1

PLOT DATE 27-MAY-82 08:52:50

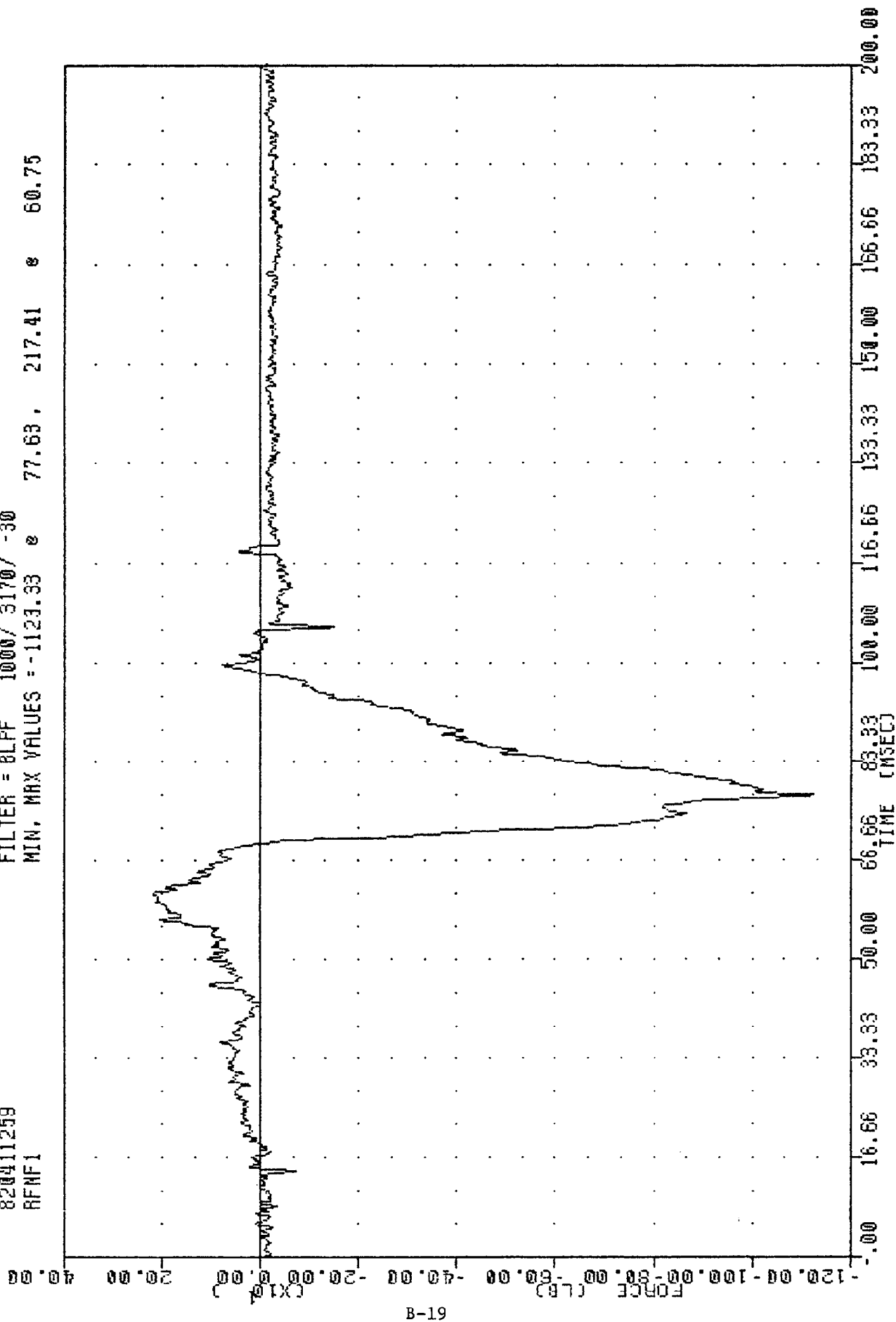
FILTER = BLPF 1000/ 3170/ -30

MIN. MAX VALUES = -145.92 47.50 319.62 64.63



DRIVER FEMUR FORCE LEFT

SRL48 , SRL48
 1982 VOLVO 20R
 820411259
 RNF1
 PLOT DATE 27-MAY-82 08:52:50
 FILTER = 8LFF 1000/ 3170/ -30
 MIN, MAX VALUES = -1123.33 e 77.63 , 217.41 e 60.75



DRIVER FEMUR FORCE RIGHT

57145 , 57148

FILTER = BLPF 1000/ 3170/ -30

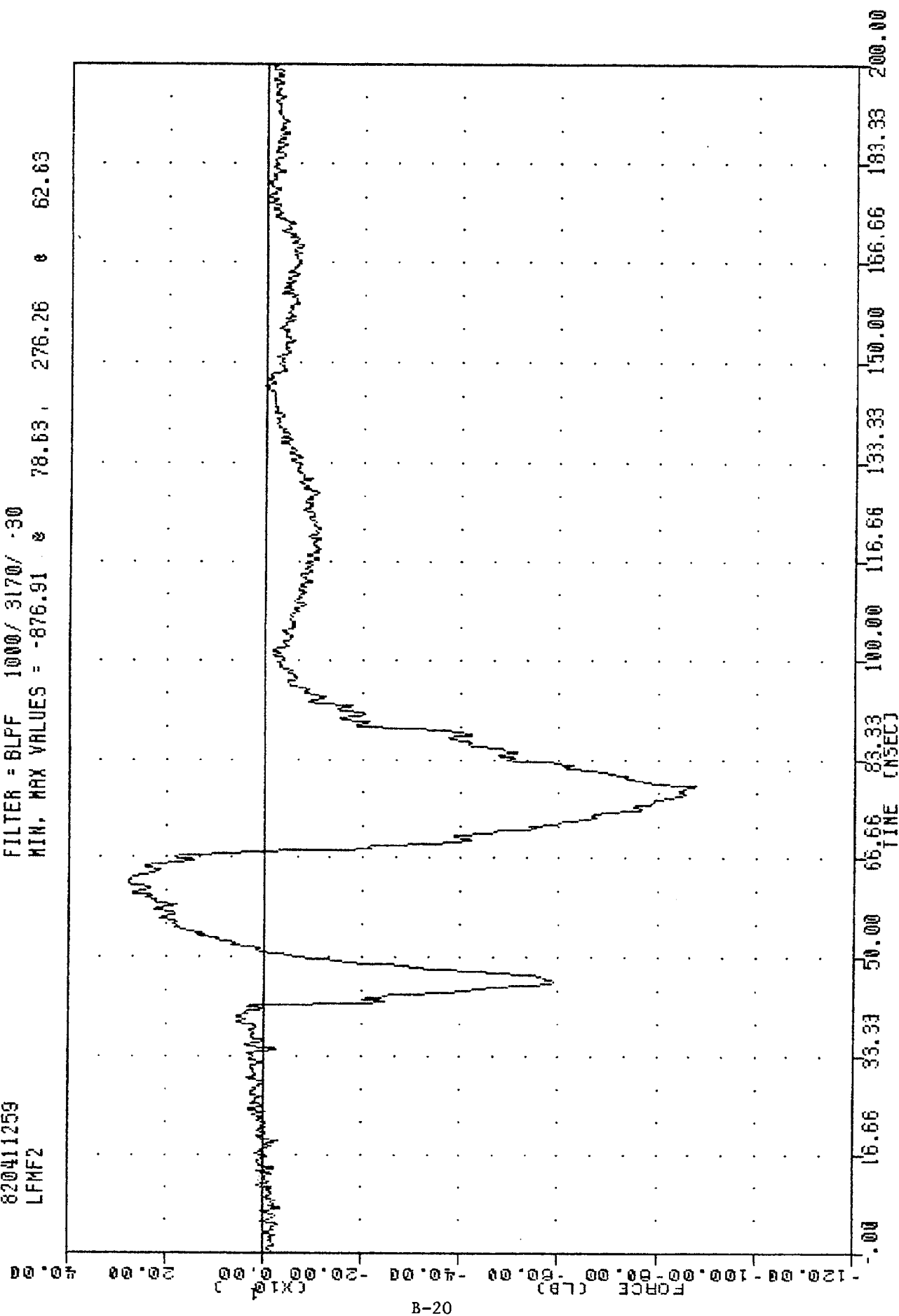
MIN. MAX VALUES =	-876.91	8	78.63	276.26	8	62.63
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5AL48
1982 VOLVO 200

1982 JULY 20A

65714028

LFMF2



PASSENGER FEMUR FORCE LEFT

SRL48
1982 VOLVO 2DR
820411259
RFMF2

PLOT DATE 27-MAY-82 08:52:50

FILTER = BLPF 1000/ 3170/ -30

MIN. MAX VALUES = -200.73 50.25, 177.00 58.63

40.00

20.00

0.00

-20.00

-40.00

-60.00

-80.00

-100.00

-120.00

-140.00

-160.00

-180.00

-200.00

-220.00

-240.00

-260.00

-280.00

-300.00

-320.00

-340.00

-360.00

-380.00

-400.00

-420.00

-440.00

-460.00

-480.00

-500.00

-520.00

-540.00

-560.00

-580.00

-600.00

-620.00

-640.00

-660.00

-680.00

-700.00

-720.00

-740.00

-760.00

-780.00

-800.00

-820.00

-840.00

-860.00

-880.00

-900.00

-920.00

-940.00

-960.00

-980.00

-1000.00

-1020.00

-1040.00

-1060.00

-1080.00

-1100.00

-1120.00

-1140.00

-1160.00

-1180.00

-1200.00

-1220.00

-1240.00

-1260.00

-1280.00

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-1480.00

-1500.00

-1520.00

-1540.00

-1560.00

-1580.00

-1600.00

-1620.00

-1640.00

-1660.00

-1680.00

-1700.00

-1720.00

-1740.00

-1760.00

-1780.00

-1800.00

-1820.00

-1840.00

-1860.00

-1880.00

-1900.00

-1920.00

-1940.00

-1960.00

-1980.00

-2000.00

-2020.00

-2040.00

-2060.00

-2080.00

-2100.00

-2120.00

-2140.00

-2160.00

-2180.00

-2200.00

-2220.00

-2240.00

-2260.00

-2280.00

-2300.00

-2320.00

-2340.00

-2360.00

-2380.00

-2400.00

-2420.00

-2440.00

-2460.00

-2480.00

-2500.00

-2520.00

-2540.00

-2560.00

-2580.00

-2600.00

-2620.00

-2640.00

-2660.00

-2680.00

-2700.00

-2720.00

-2740.00

-2760.00

-2780.00

-2800.00

-2820.00

-2840.00

-2860.00

-2880.00

-2900.00

-2920.00

-2940.00

-2960.00

-2980.00

-3000.00

-3020.00

-3040.00

-3060.00

-3080.00

-3100.00

-3120.00

-3140.00

-3160.00

-3180.00

-3200.00

-3220.00

-3240.00

-3260.00

-3280.00

-3300.00

-3320.00

-3340.00

-3360.00

-3380.00

-3400.00

-3420.00

-3440.00

-3460.00

-3480.00

-3500.00

-3520.00

-3540.00

-3560.00

-3580.00

-3600.00

-3620.00

-3640.00

-3660.00

-3680.00

-3700.00

-3720.00

-3740.00

-3760.00

-3780.00

-3800.00

-3820.00

-3840.00

-3860.00

-3880.00

-3900.00

-3920.00

-3940.00

-3960.00

-3980.00

-4000.00

-4020.00

-4040.00

-4060.00

-4080.00

-4100.00

-4120.00

-4140.00

-4160.00

-4180.00

-4200.00

-4220.00

-4240.00

-4260.00

-4280.00

-4300.00

-4320.00

-4340.00

-4360.00

-4380.00

-4400.00

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-4440.00

-4460.00

-4480.00

-4500.00

-4520.00

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-4560.00

-4580.00

-4600.00

-4620.00

-4640.00

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-4680.00

-4700.00

-4720.00

-4740.00

-4760.00

-4780.00

-4800.00

-4820.00

-4840.00

-4860.00

-4880.00

-4900.00

-4920.00

-4940.00

-4960.00

-4980.00

-5000.00

-5020.00

-5040.00

-5060.00

-5080.00

-5100.00

-5120.00

-5140.00

-5160.00

-5180.00

-5200.00

-5220.00

-5240.00

-5260.00

-5280.00

-5300.00

-5320.00

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-5460.00

-5480.00

-5500.00

-5520.00

-5540.00

-5560.00

-5580.00

-5600.00

-5620.00

-5640.00

-5660.00

-5680.00

-5700.00

-5720.00

-5740.00

-5760.00

-5780.00

-5800.00

-5820.00

-5840.00

-5860.00

-5880.00

-5900.00

-5920.00

-5940.00

-5960.00

-5980.00

-6000.00

-6020.00

-6040.00

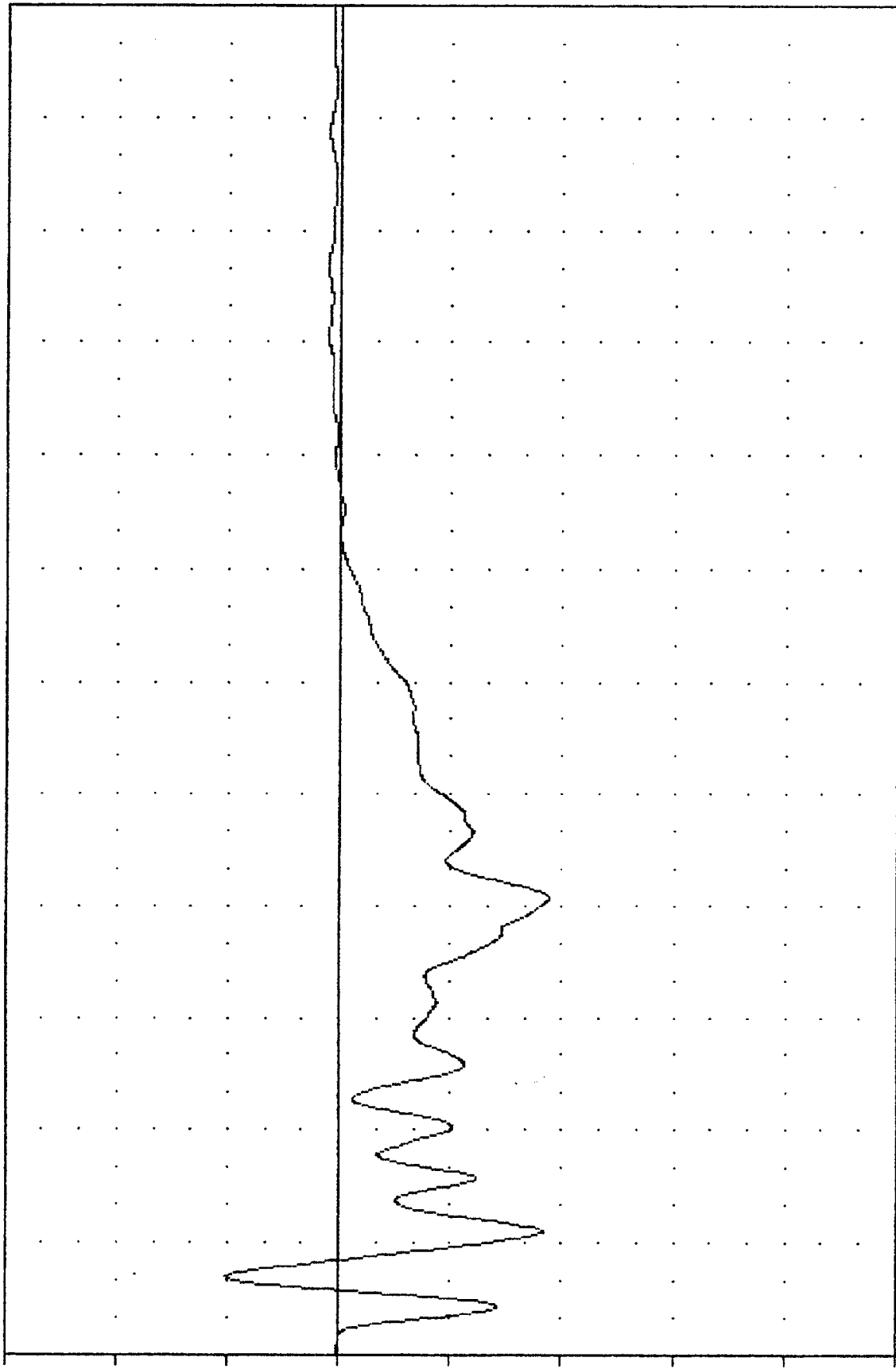
SRL48 , SRL48
1982 VOLVO 2DR
820411259
RFFXG

PLOT DATE 27-MAY-82 10:33:42

FILTER = BLPF 100/ 317/ -30

MIN, MAX VALUES = -37.82 67.75, 20.21 @ 11.50

ACCELERATION (G)



TIME (MSEC)

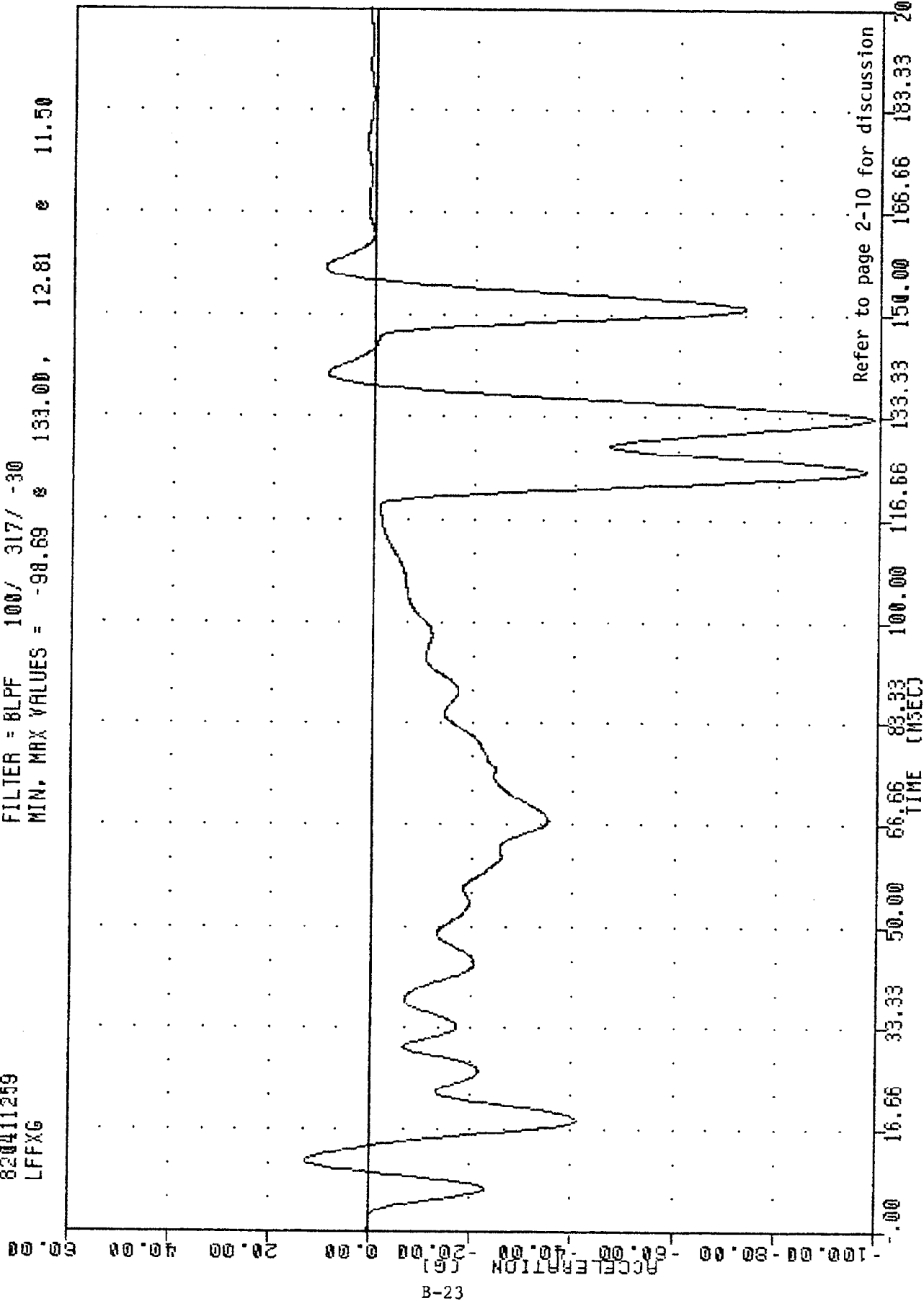
VEHICLE R. FRONT ACCELERATION X AXIS

SRL48 , SRL48
1982 VOLVO 20A
820411259
LFFXG

PLOT DATE 27-MAY-82 08:52:50

FILTER = BLPF 100/ 317/ -30

MIN. MAX VALUES = -98.69 & 133.00, 12.81 & 11.50



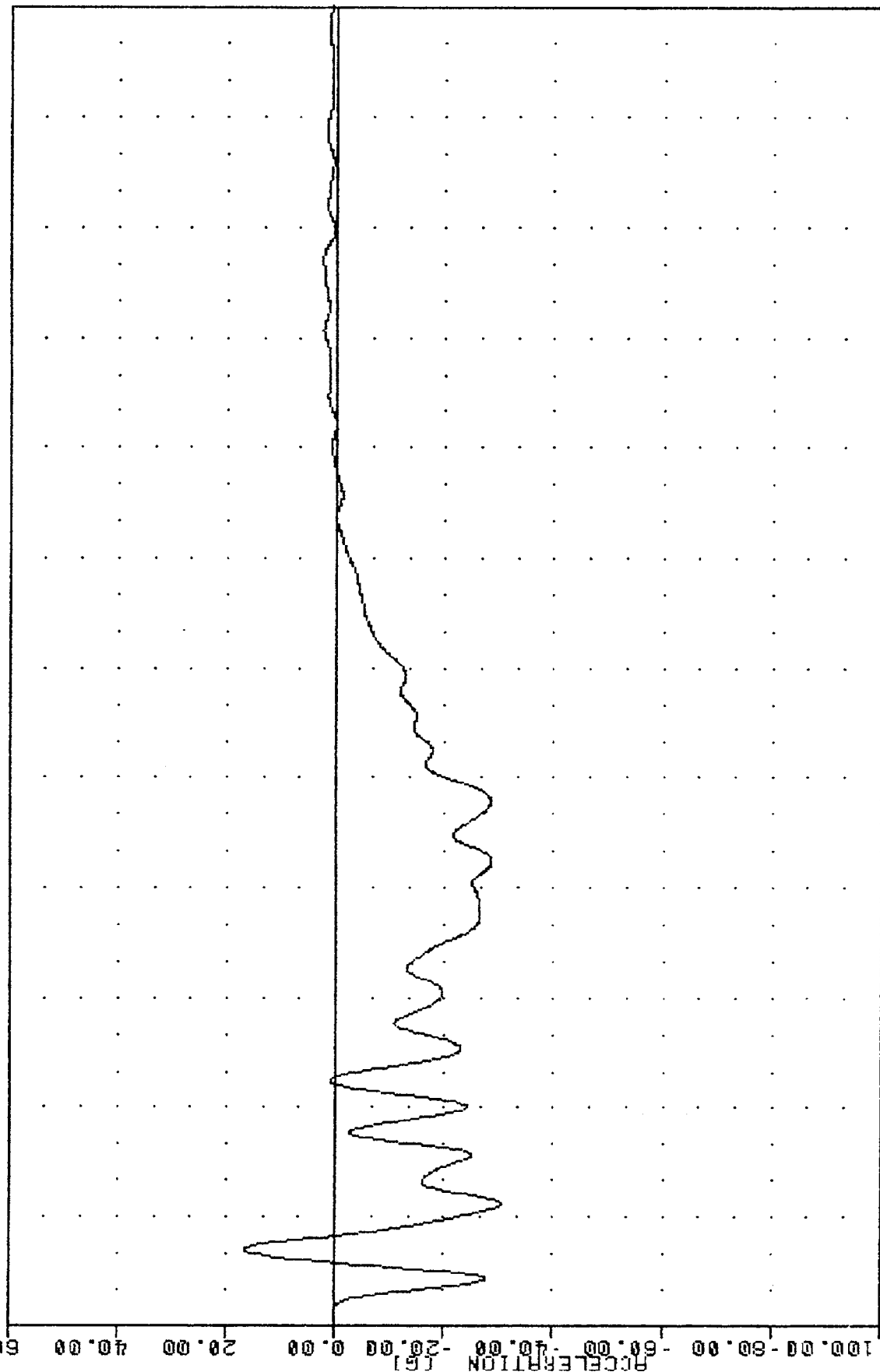
VEHICLE L. FRONT ACCELERATION X AXIS

SRL48 , SRL48
1982 VOLVO 20R
820411259
RRFXG

PLOT DATE 27-MAY-82 00:52:50

FILTER = BLPF 100/ 317/ -30
MIN. MAX VALUES = -30.60 @ 18.50, 16.68 @ 11.63

ACCELERATION [G]



VEHICLE R. REAR ACCELERATION X AXIS

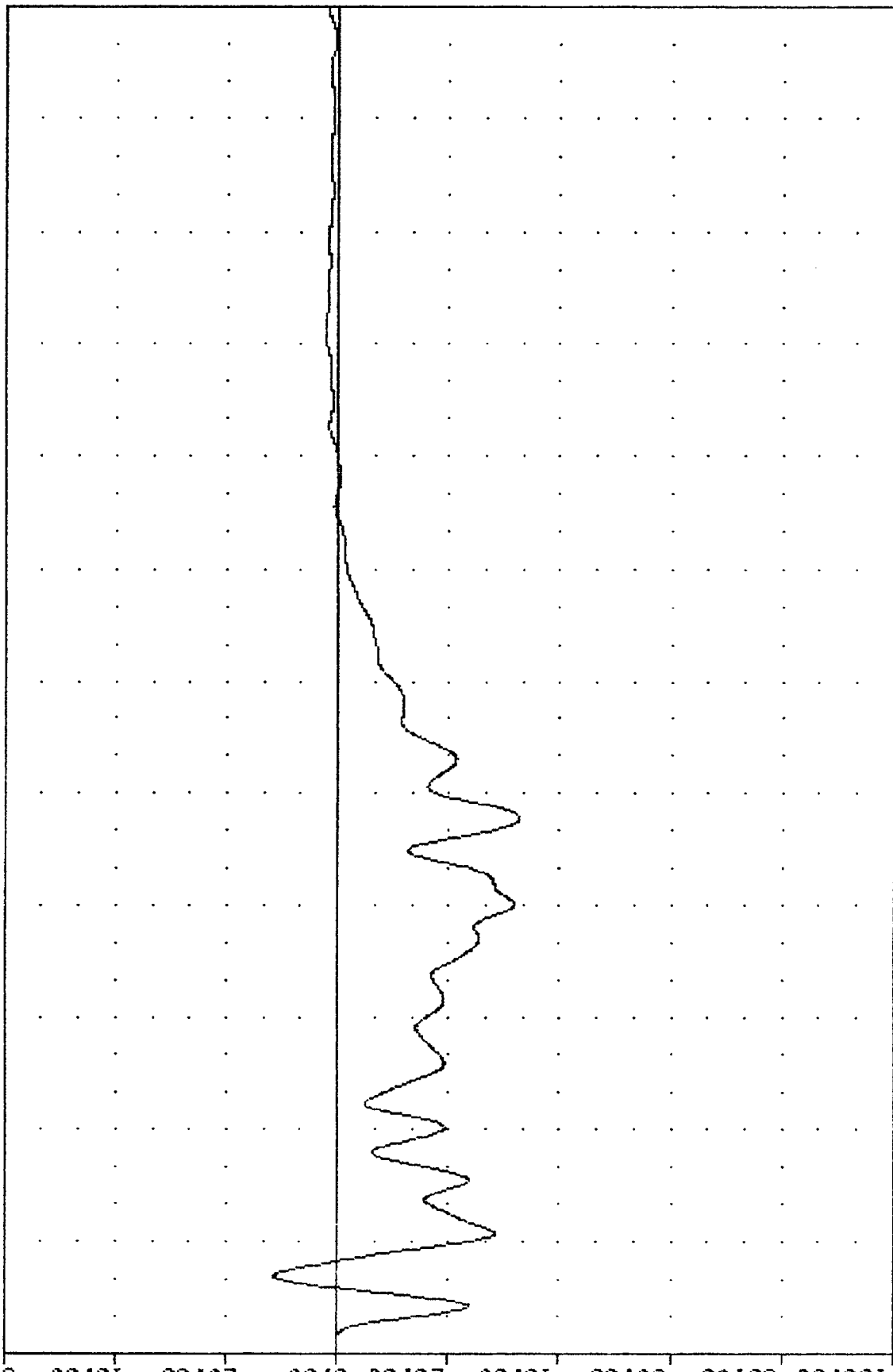
SRL48 , SRL48
1982 VOLVO 20R
820411259
LRFXG

PLOT DATE 27-MAY-82 08:52:50

FILTER = BLPF 100/ 317/ -30

MIN. MAX VALUES = -32.81 79.38 11.35 11.50

B-25
ACCELERATION (G)
-100.00 -80.00 -60.00 -40.00 -20.00 0.00 20.00 40.00 60.00 80.00



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

VEHICLE L. REAR ACCELERATION X AXIS

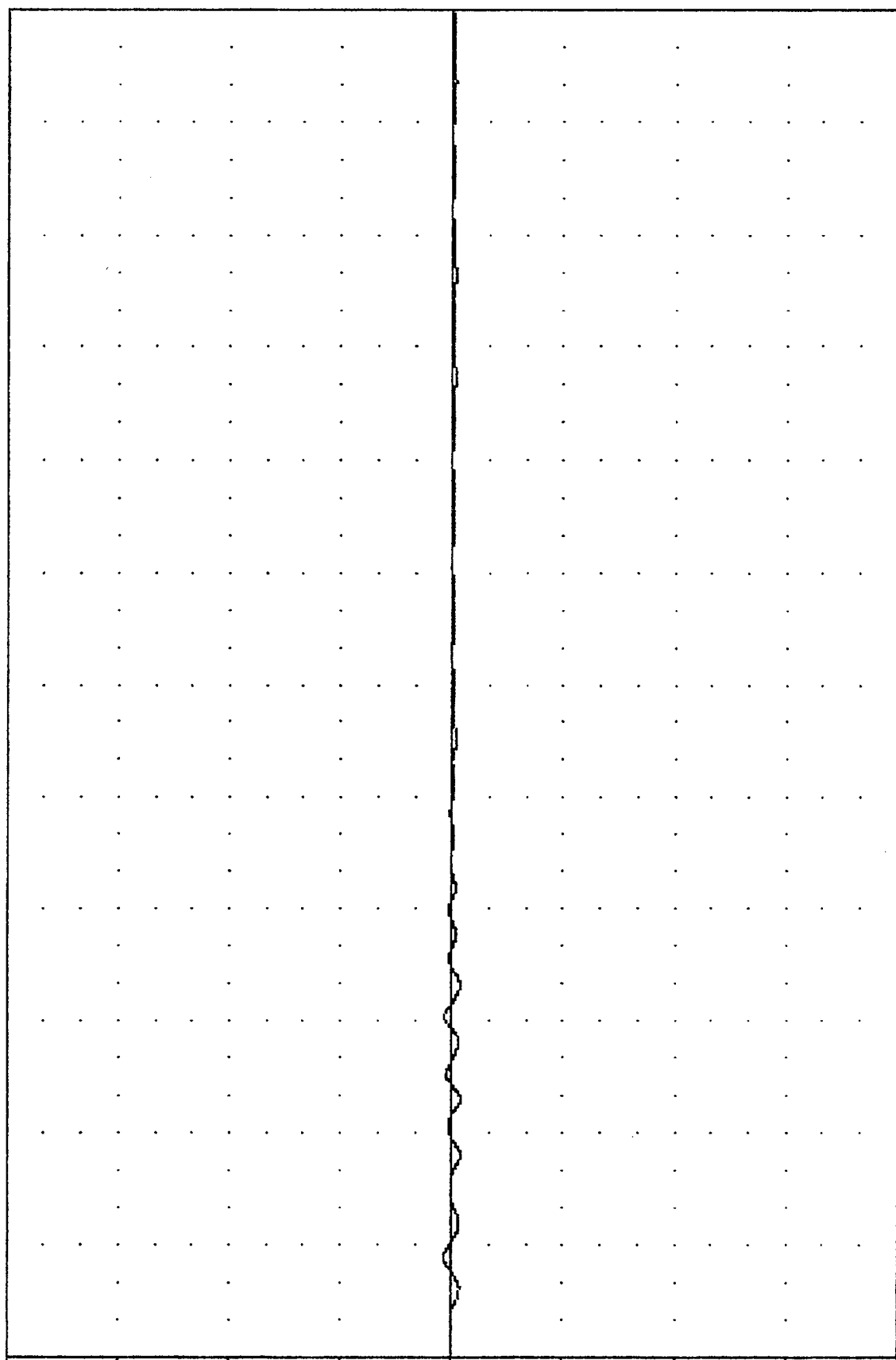
3RL48 , SRL48
 1982 VOLVO 200, BAR
 820411300
 A1

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -396.81 e 30.00 , 336.65 s 14.50

-200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00
 FORCE (LB)
 (X10³)



- .00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
 TIME (MSEC)

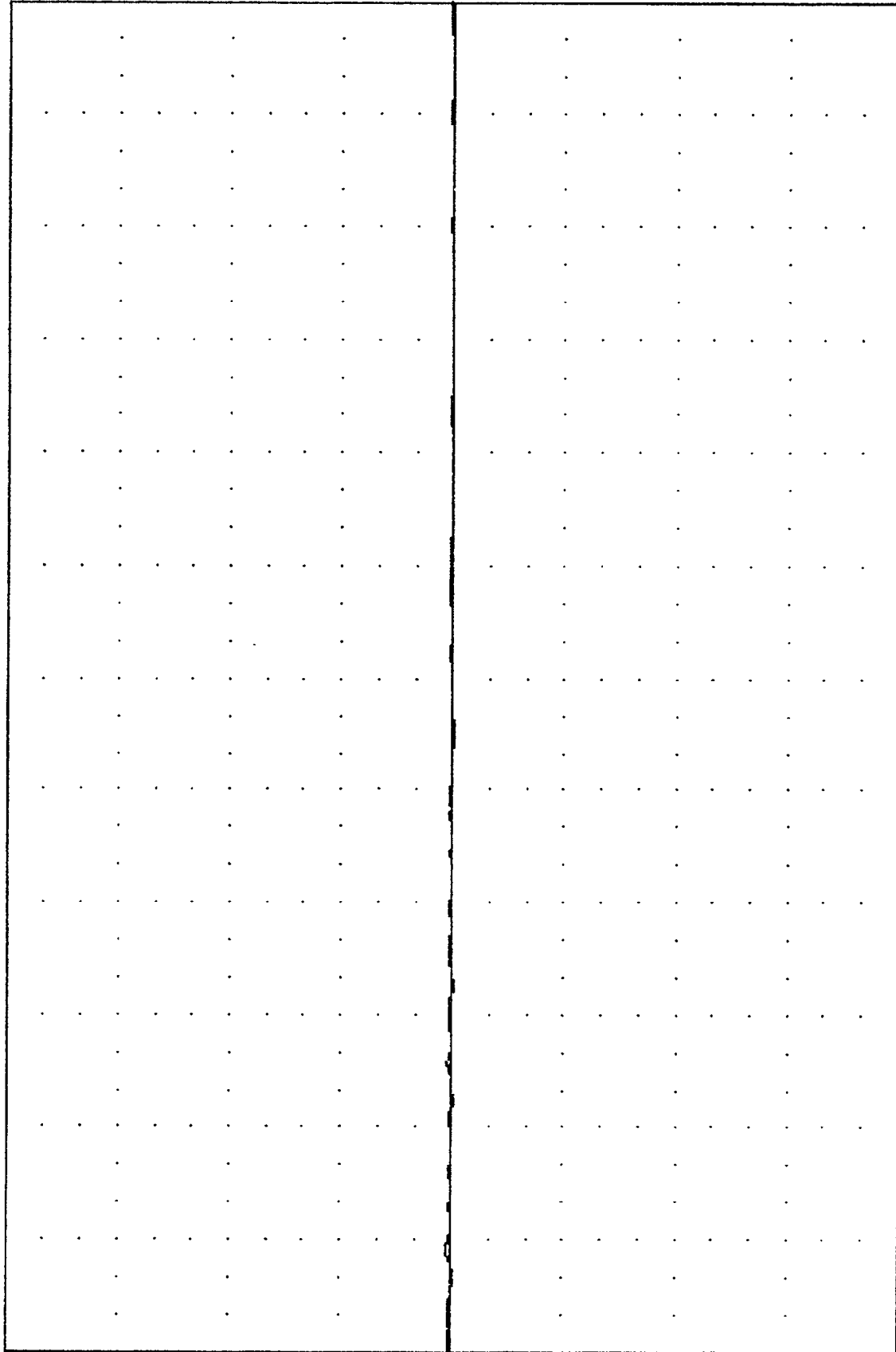
BARRIER FRONT FACING FORCE A1

SRL48
1982 VOLVO 20R.BAR
820411300
A2

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN. MAX VALUES = -96.37 37.13, 234.92 15.13

200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

BARRIER FRONT FACING FORCE A2

SRL4B , SRL4B

1802 VOLVO 20R,BAR

820411300

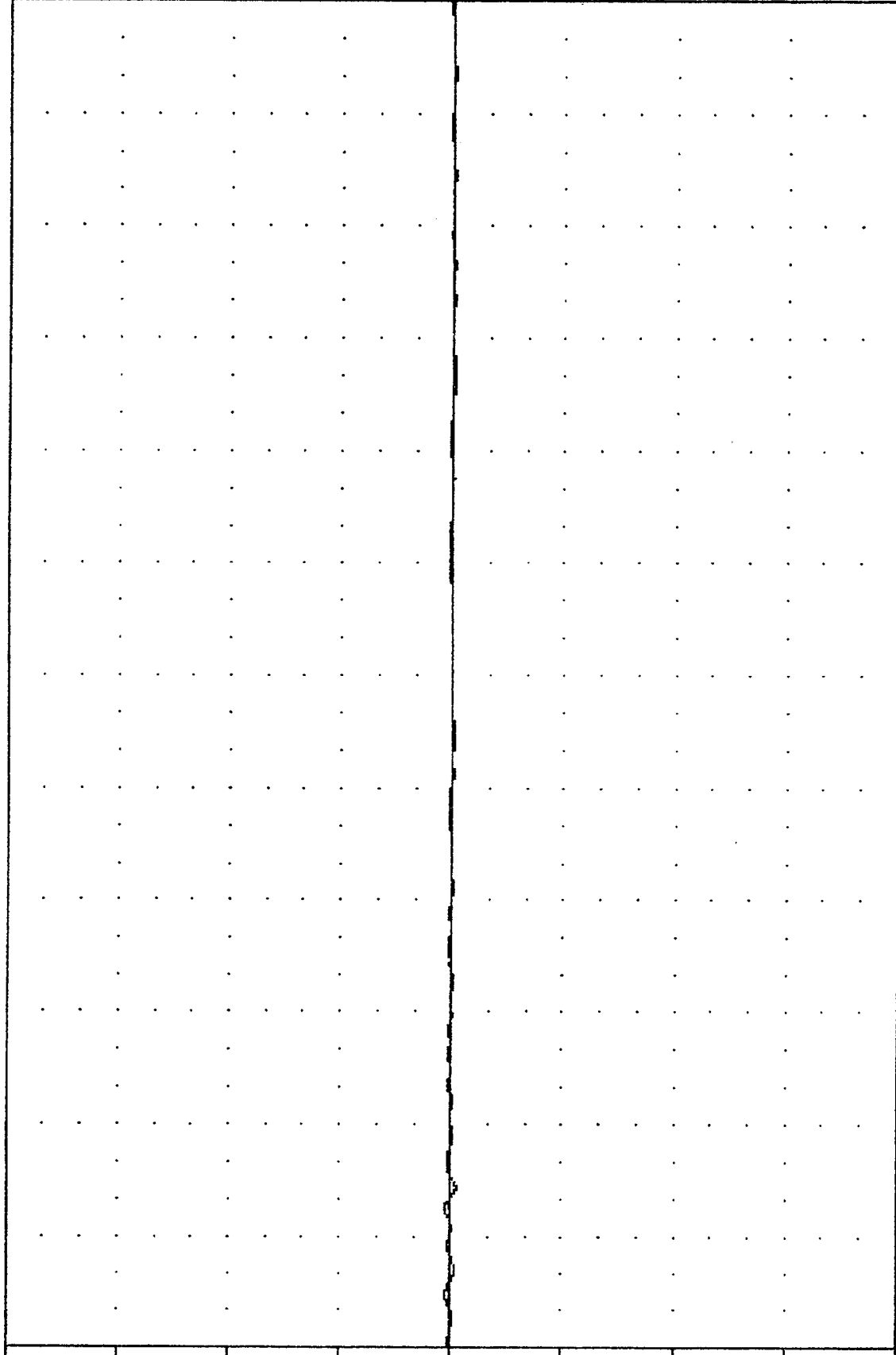
R3

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -258.87 23.75, 237.73 7.63

82-B
FORCE (LBS)
(X10²)
-200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00



0.00 33.33 66.66 100.00 133.33 166.66 200.00
TIME (NSEC)

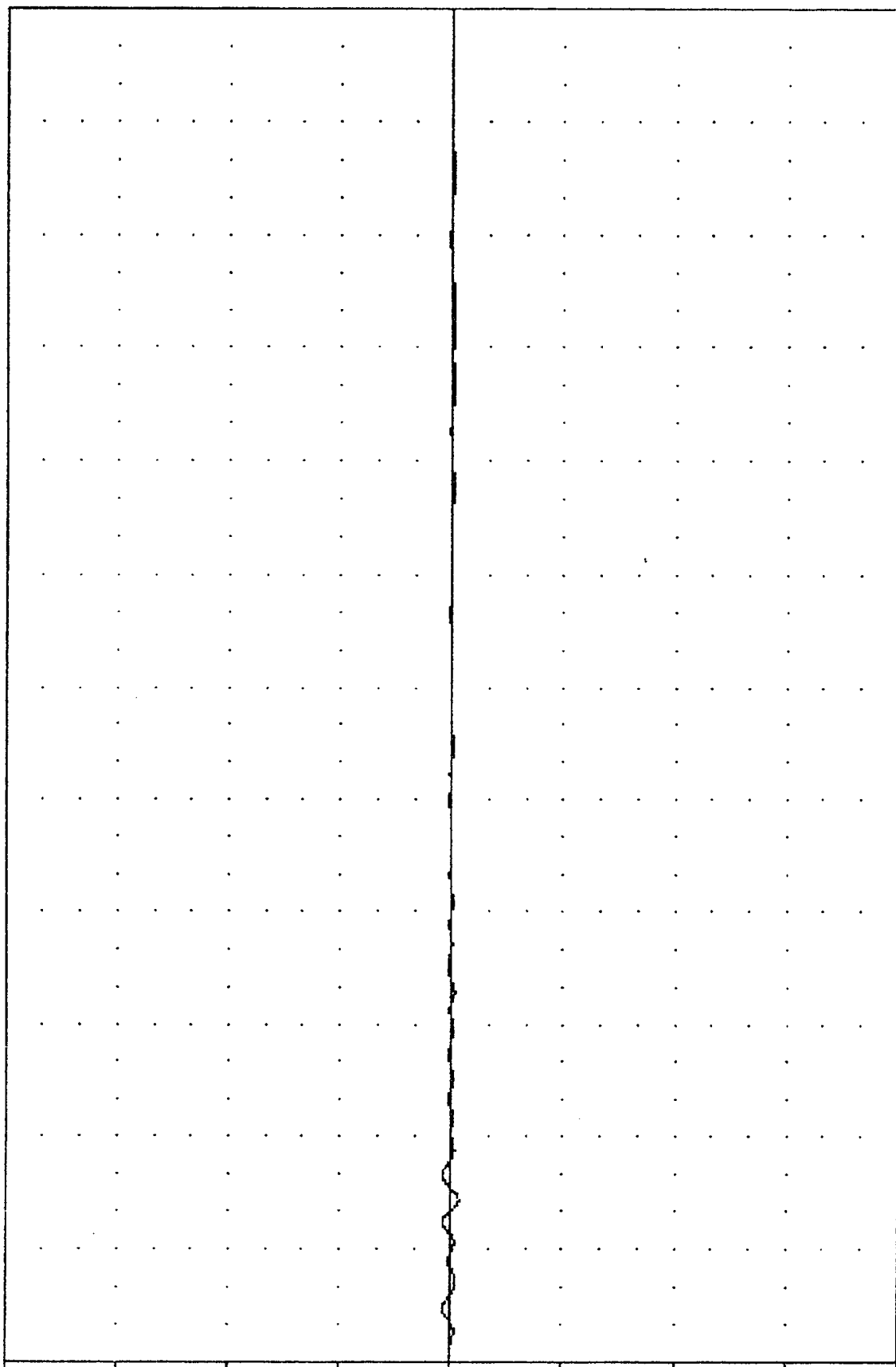
BARRIER FRONT FACING FORCE R3

SRL48
1982 VOLVO 20R.BAR
820411300
R4

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN. MAX VALUES = -353.83 8 23.75, 390.40 8 7.75

FORCE (LB)
(X10²)



TIME (MSEC)

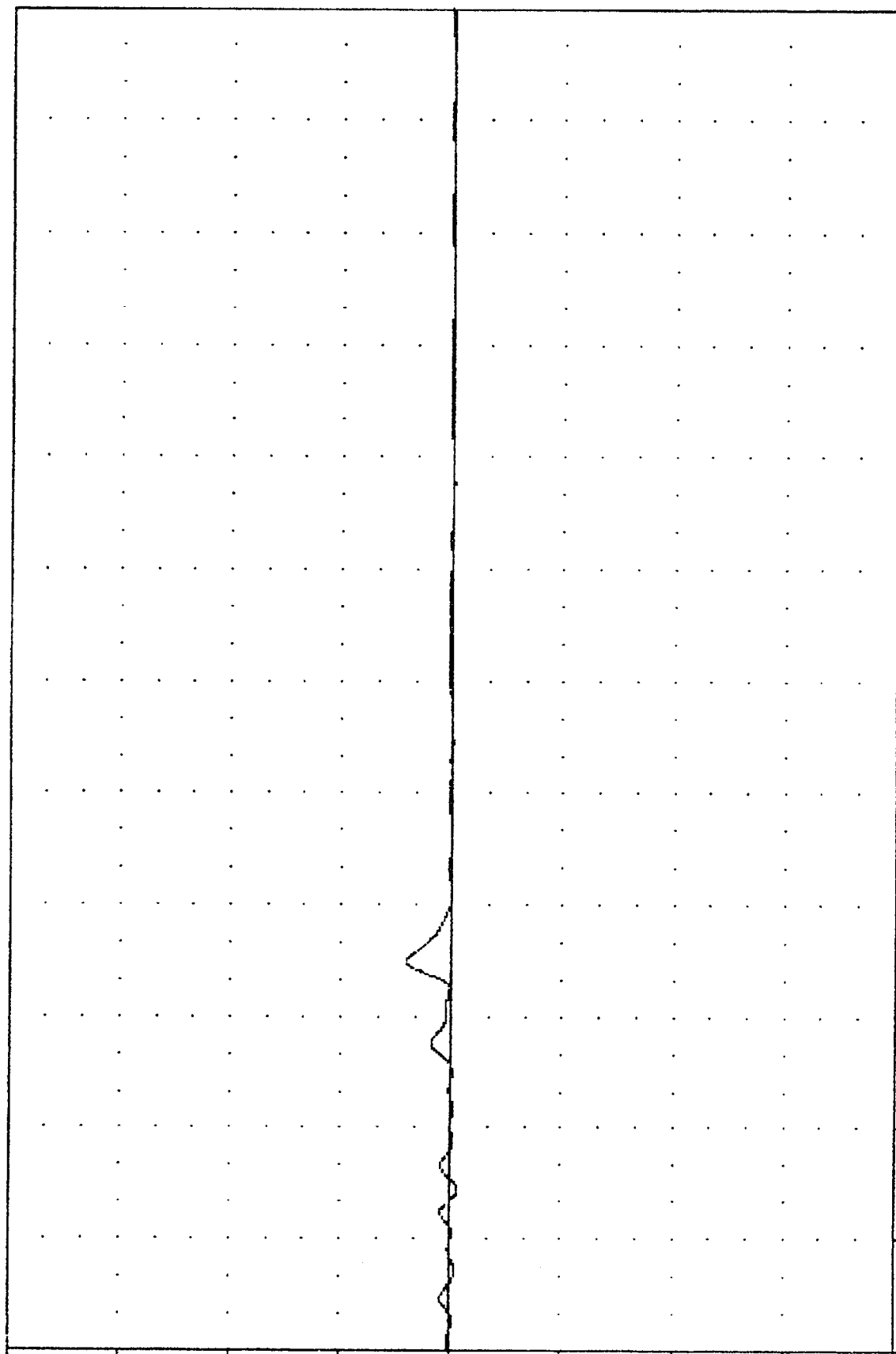
BARRIER FRONT FACING FORCE R4

SRL48
1982 VOLVO 20R, 8AR
820411300
R5

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN. MAX VALUES = -338.30 24.00, 2049.98 58.13

FORCE (LB)
(X10²)



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (msec)

BARRIER FRONT FACING FORCE R5

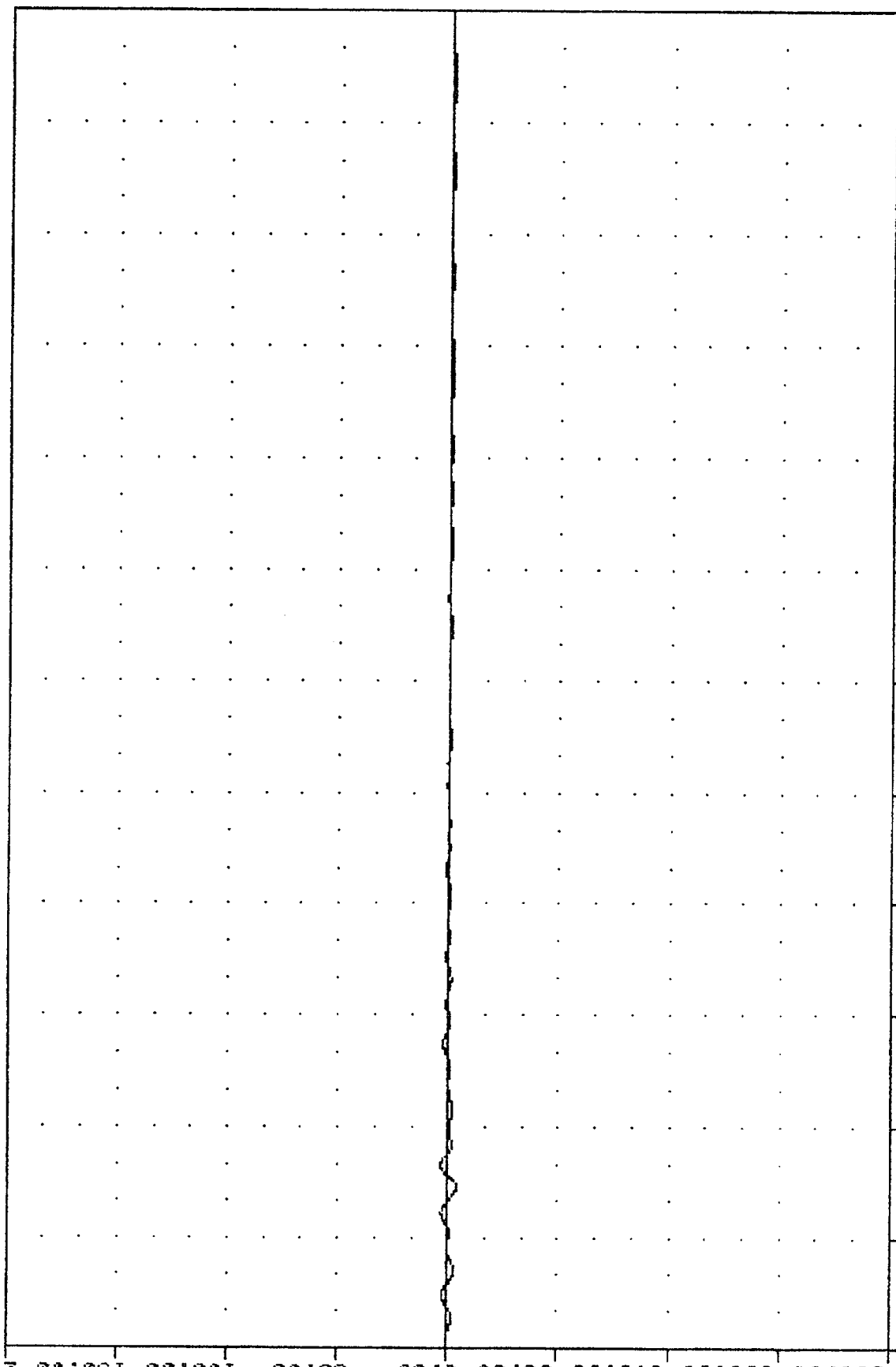
SRL4B
 1882 VOLVD 2DR.BAR
 820411300
 R6

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
 MIN. MAX VALUES = -405.41 e 24.13, 329.42 e 27.50

FORCE (LBS)
 (X10²)

B-31



0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
 TIME (NSEC)

BARRIER FRONT FACING FORCE R6

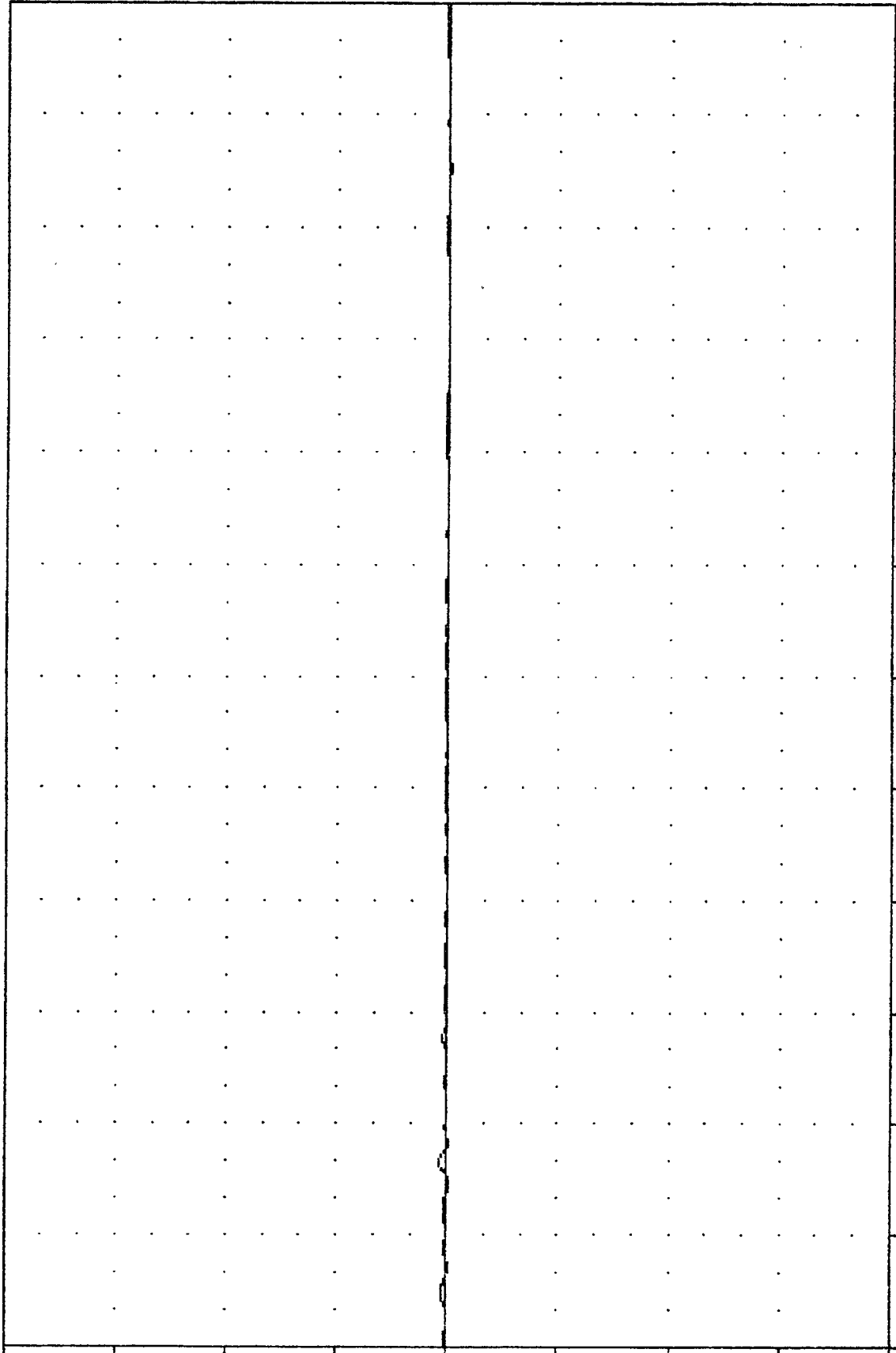
SRL48
1982 VOLVO 2DR.BAR
820411300
A7

PLOT DATE 27-MAY-82 08:51:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -131.98 24.25, 355.13 27.38

FORCE (LB)
(X10³)



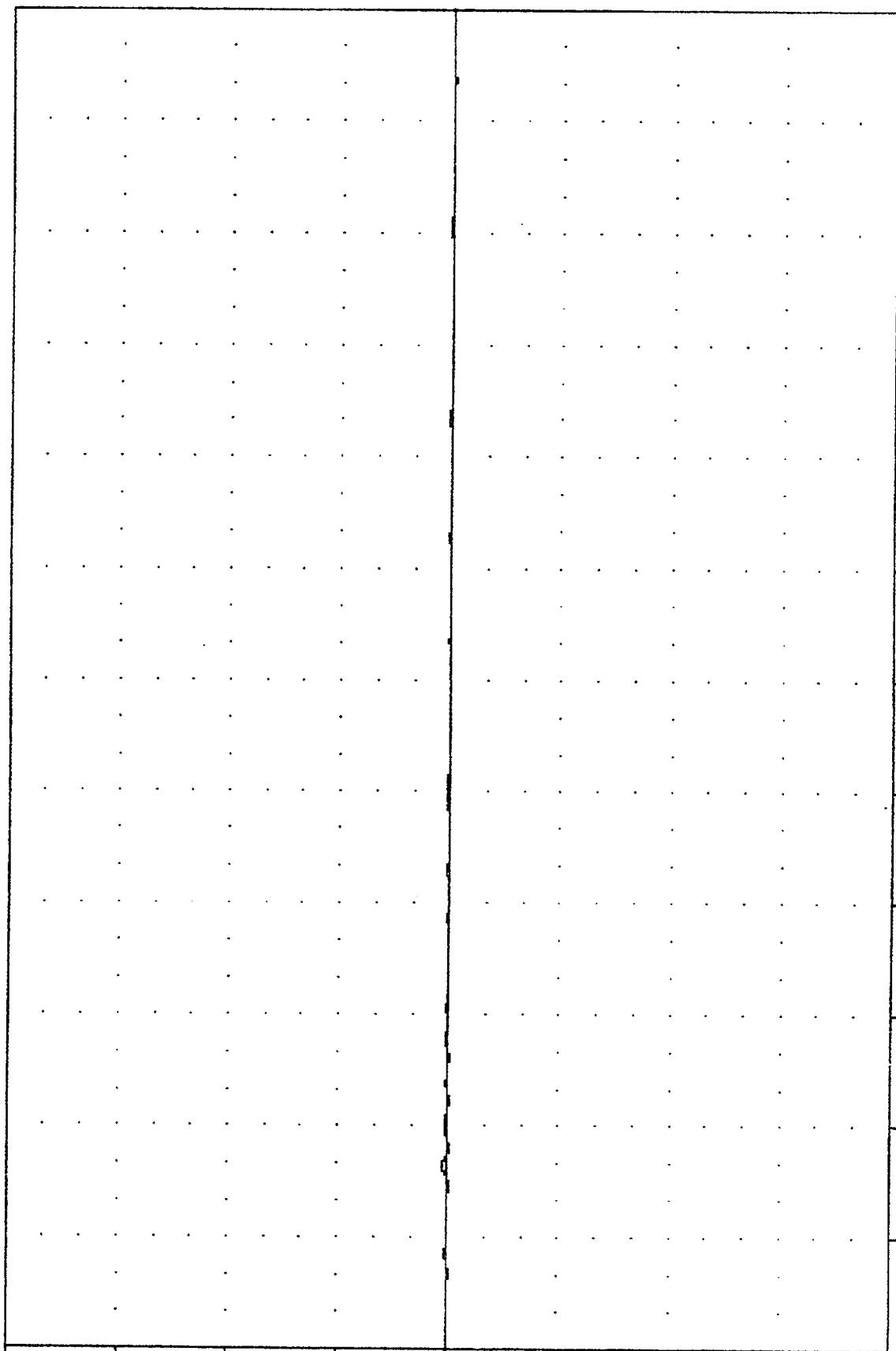
SRL48
 1982 VOLVO 200R.BAR
 820411300
 A8

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -84.61 30.13, 243.53 27.38

FORCE (LB)
 (X10³)



TIME (MSEC)

0.00	16.66	33.33	50.00	66.66	83.33	100.00	116.66	133.33	150.00	166.66	183.33	200.00
------	-------	-------	-------	-------	-------	--------	--------	--------	--------	--------	--------	--------

SRL48
1982 VOLVO 20A.BAA
820411300
A9

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN, MAX VALUES = -229.72 @ 30.13, 486.39 @ 33.50

200.00

150.00

100.00

50.00

0.00

-50.00

-100.00

-150.00

-200.00

FORCE (LB)

(X10²)

0.00

50.00

100.00

150.00

200.00

TIME (MSEC)

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

66.66

83.33

116.66

133.33

150.00

166.66

183.33

200.00

33.50

486.39

30.13

-229.72

100/ 317/ -20

BLPF

FILTER =

MIN, MAX VALUES =

27-MAY-82

08:54:48

PLOT DATE

1982 VOLVO 20A.BAA

820411300

A9

SRL48

0.00

50.00

100.00

150.00

200.00

33.33

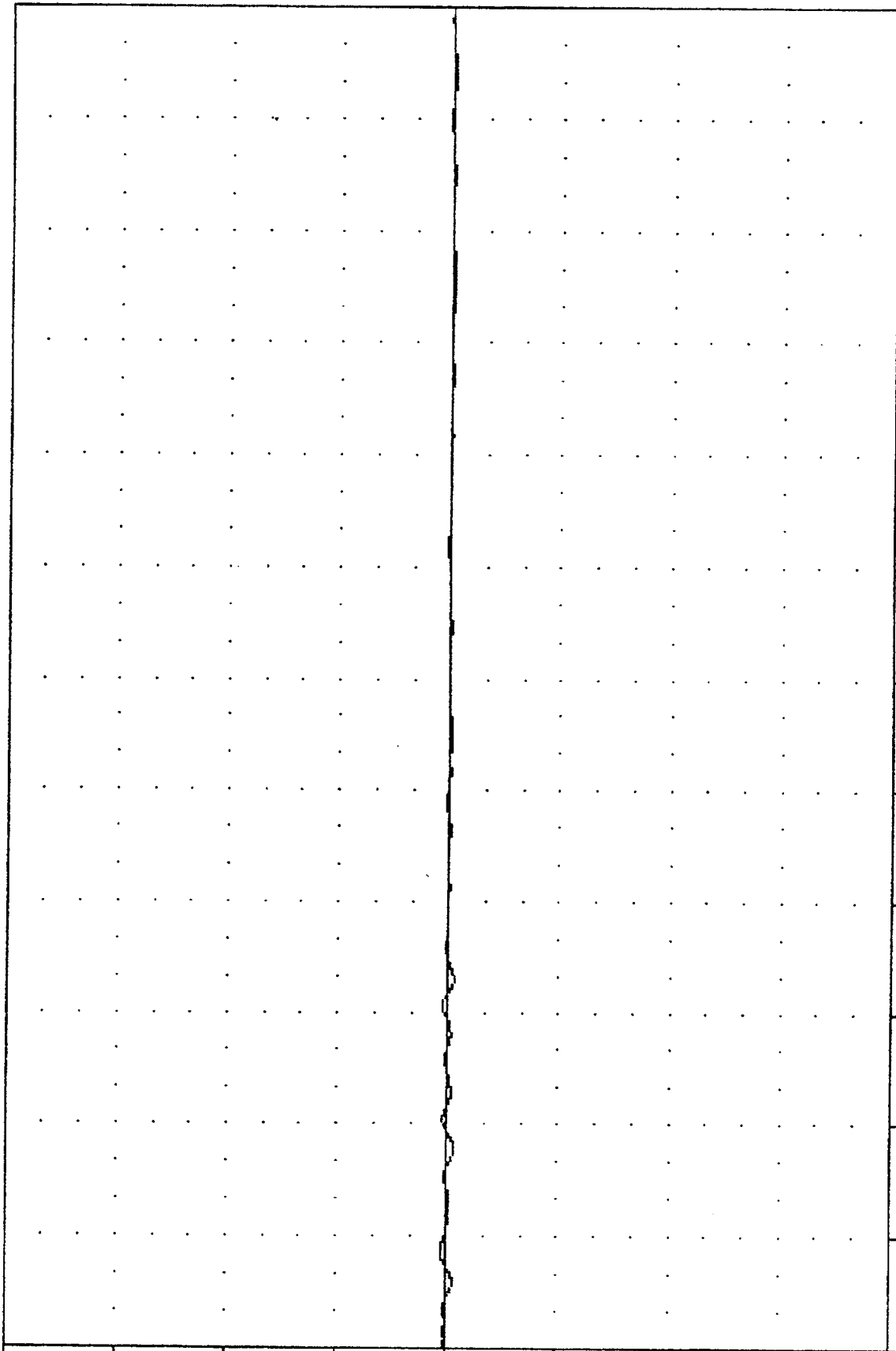
66.66

SRL48
 1982 VOLVO 20R.BAR
 820411300
 B1

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
 MIN. MAX VALUES = -300.76 e 29.38, 285.14 e 50.88

FORCE (LB)
 (X10³)
 200.00
 150.00
 100.00
 50.00
 0.00
 -50.00
 -100.00
 -150.00
 -200.00



B-35

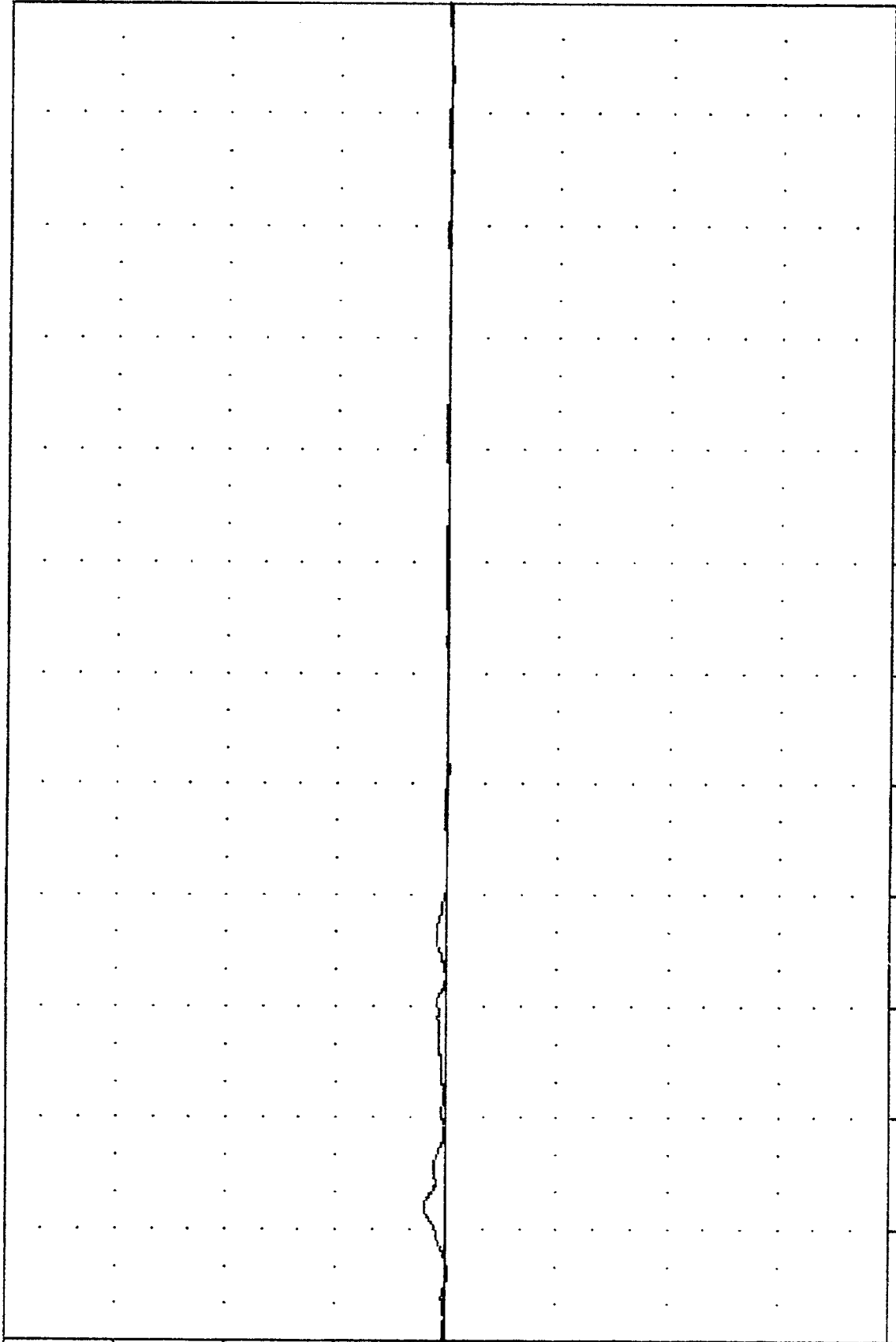
BARRIER FRONT FACING FORCE B1

SRL48
 1982 VOLVO 20A,BAR
 820411300
 B2

PLOT DATE 27-MAY-82 08:54:48

FILTER = 8LPF 100/ 317/ -20
 MIN, MAX VALUES = -92.73 e 10.13, 998.97 e 19.75

FORCE (LB)
 (X10³)



BARRIER FRONT FACING FORCE B2

SRL48
1982 VOLVO 20A,8AA
820411300
B3

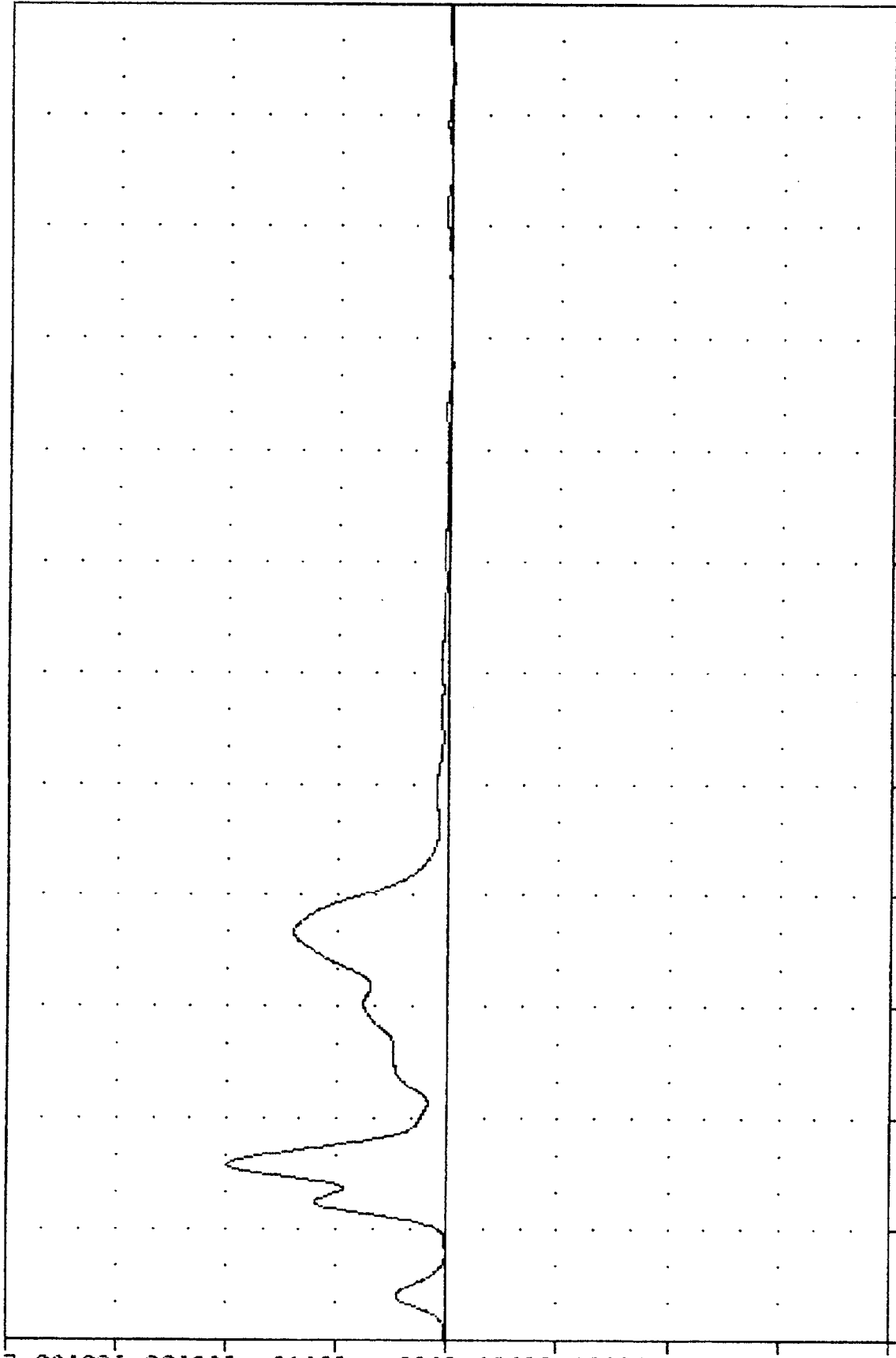
PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -92.10 e 189.25, 9965.13 e 26.13

FORCE (LB)
(X10²)

B-37



BARRIER FRONT FACING FORCE B3

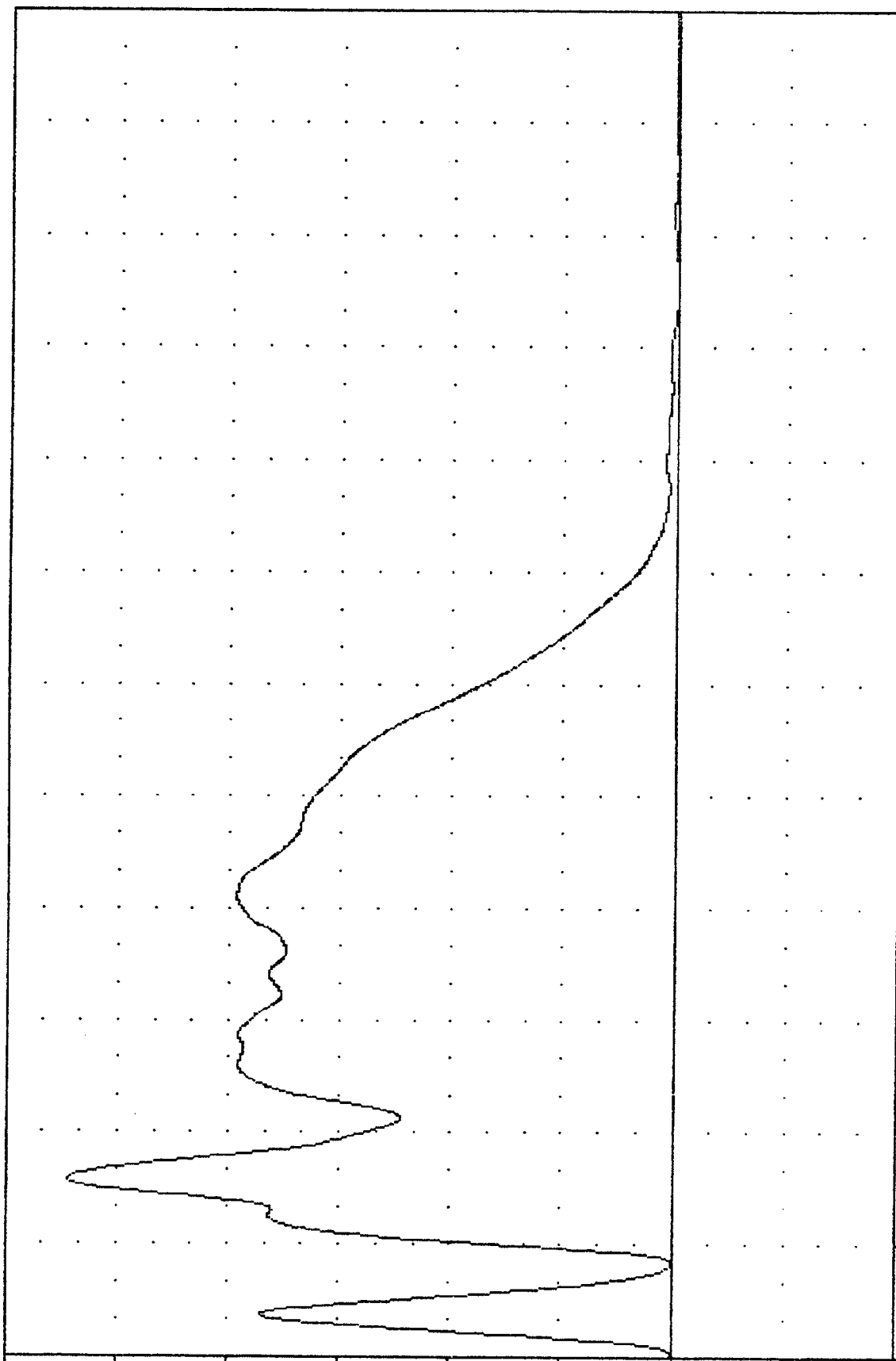
SRL48
1992 VOLVO 20A.BAR
820411300
B4

PLOT DATE 27-MAY-82 10:33:42

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -37.82 67.75, 27231.65 26.13

FORCE (LB)
(X10³)



TIME (MSEC)

BARRIER FRONT FACING FORCE B4

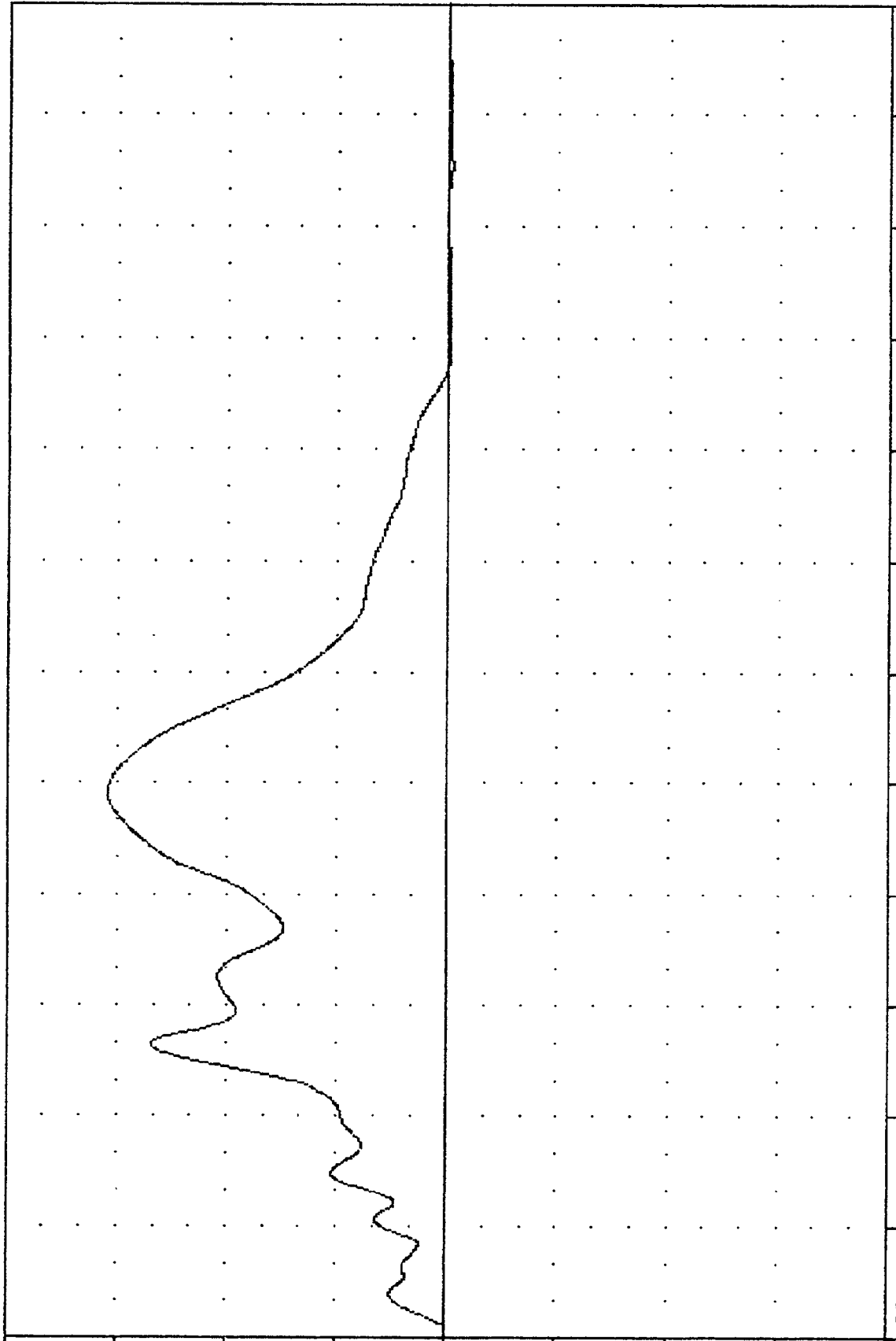
SRL48
1982 VOLVO 20R.BAR
820411300
B5

PLOT DATE 27-MAY-82 06:54:48

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -138.22 176.13, 15425.90 81.38

FORCE (LB) (X10²)



B-39

TIME (MSEC)

BARRIER FRONT FACING FORCE B5

SRL4B , SRL48
 1982 VOLVD 2DR,BAR
 820411300
 B6

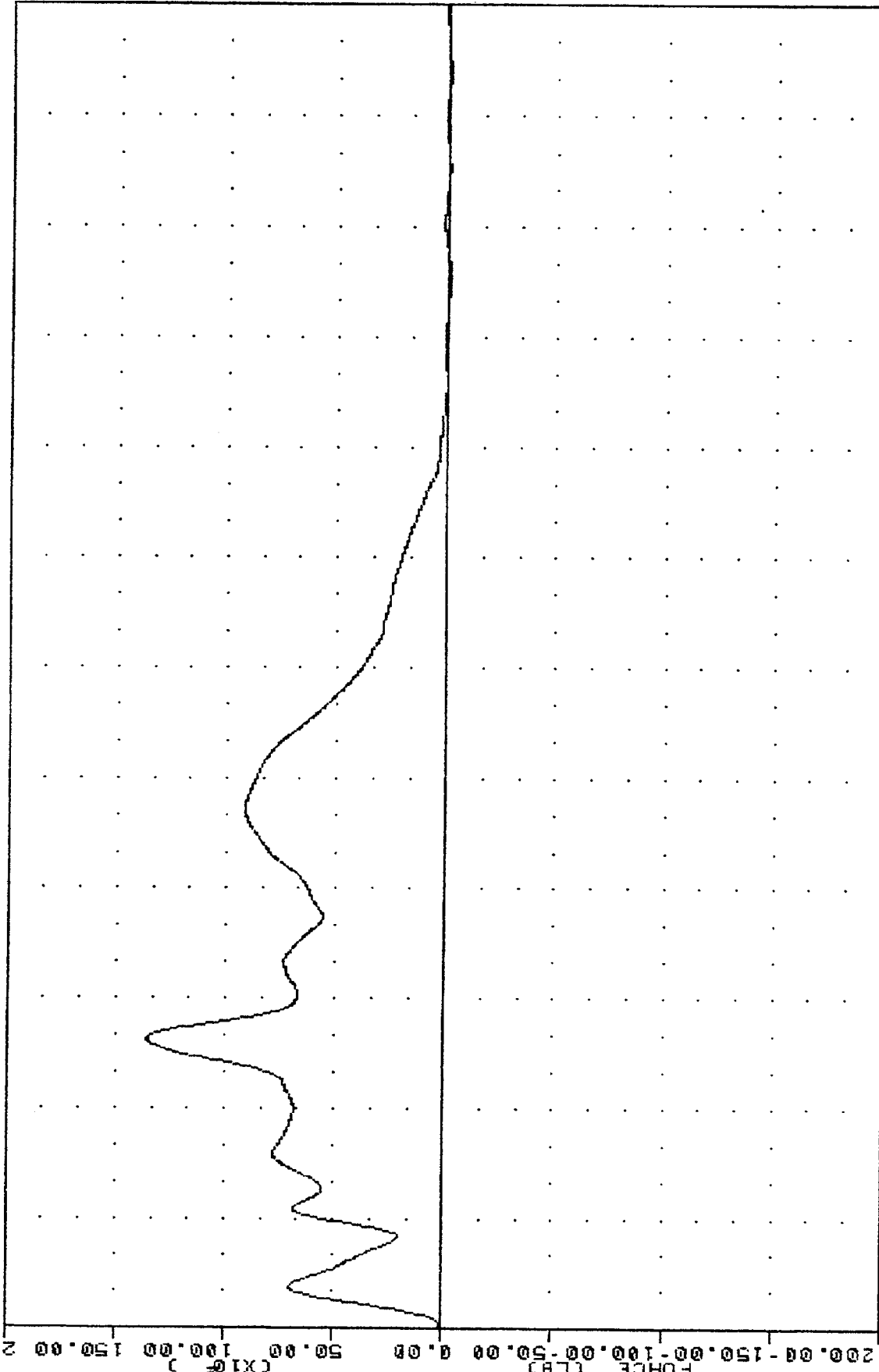
PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -63.65 @ 189.25, 13567.46 @ 43.63

FORCE (LBS)
 (X10³)

B-40



TIME (INSEC)

BARRIER FRONT FACING FORCE B6

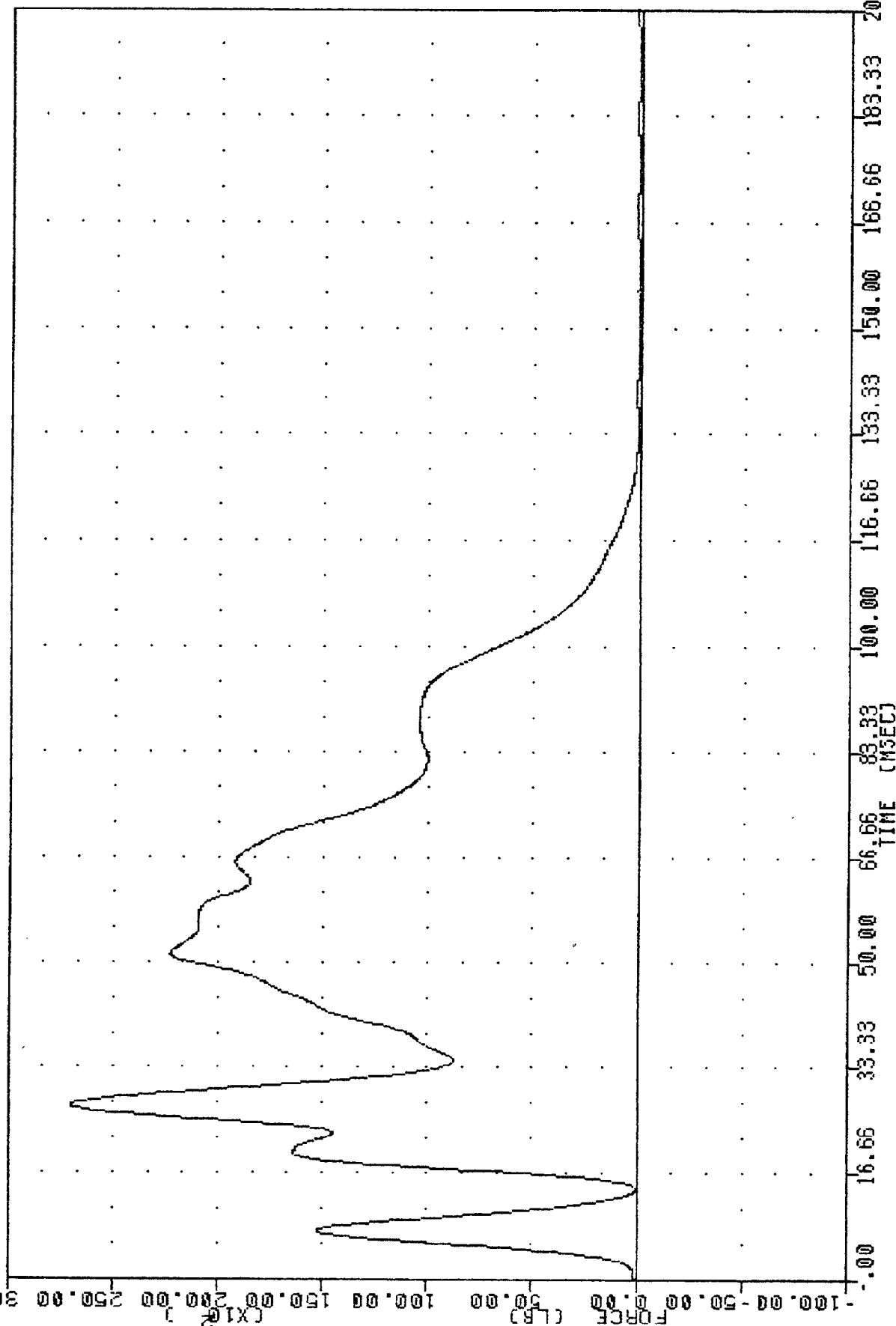
SRL48 , SRL48
 1982 VOLVO 20A.6AA
 820411300
 B7

PLOT DATE 27-MAY-82 10:33:42

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -37.82 e 67.75, 26997.15 e 27.13

FORCE (LB) $\times 10^2$



B-41

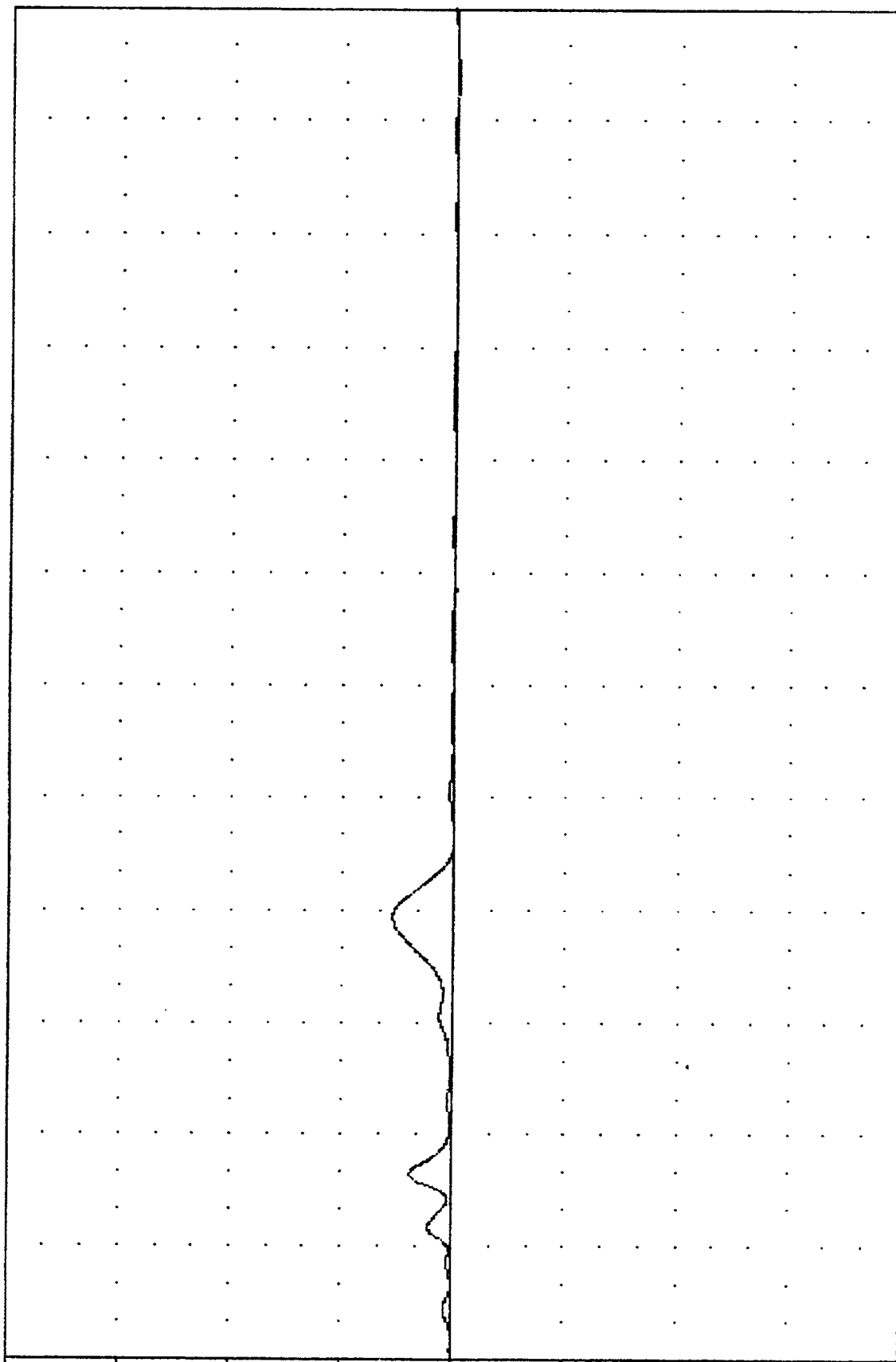
BARRETER FRONT FACING FORCE P7

SRL48
1982 VOLVO 200R.8AR
820411300
B6

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN, MAX VALUES = -75.46 189.25, 2740.40 65.50

FORCE (LB)
(X10²)



B-42

TIME (msec)

BARRIER FRONT FACING FORCE PR

SRL48
 1982 VOLVO 2DR.BAR
 820411300
 B9

PLOT DATE 27-MAY-82 08:54:48

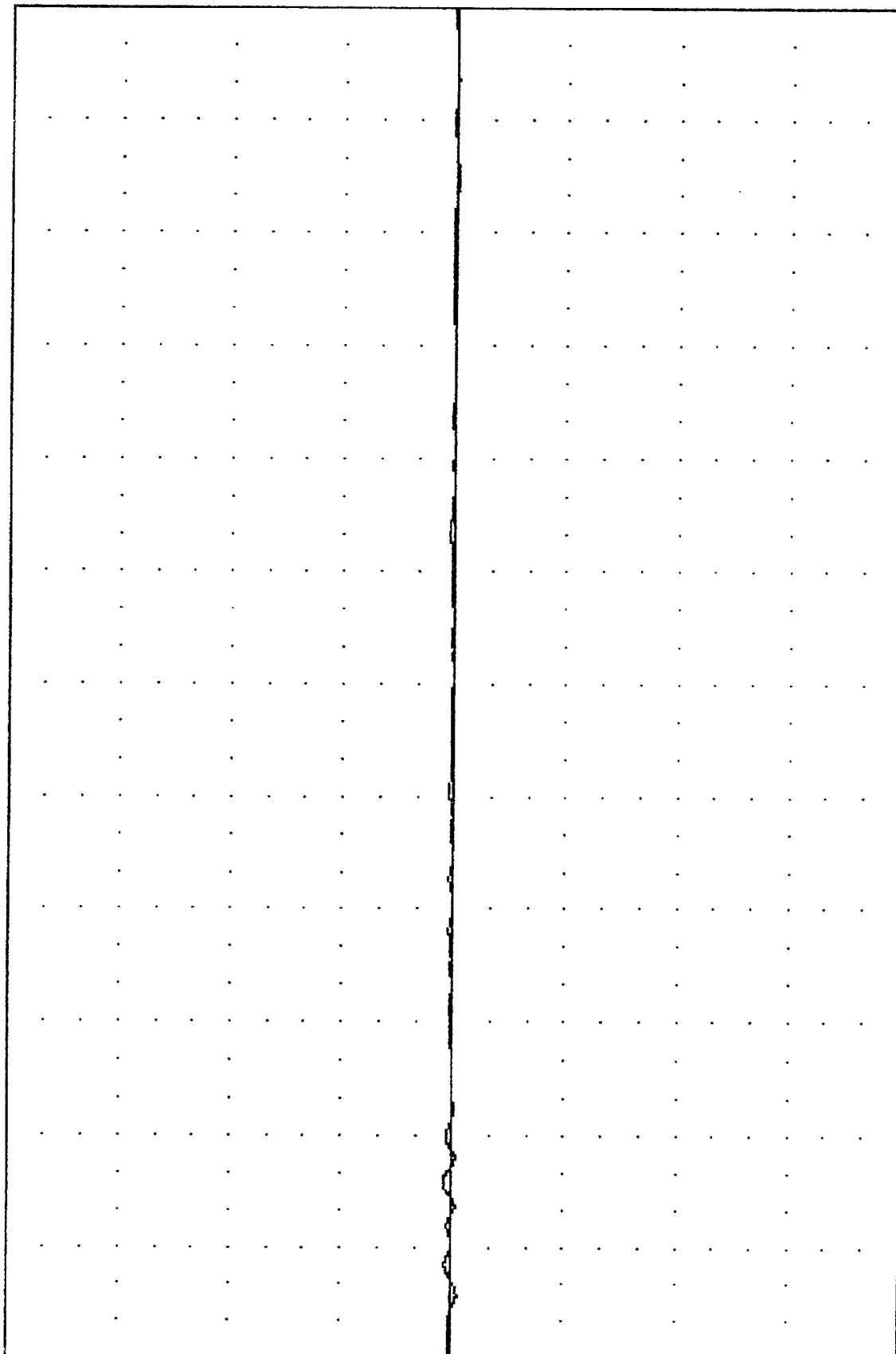
FILTER = BLPF 100/ 317/ .20
 MIN. MAX VALUES = -245.02 0 26.13

200.00 150.00 100.00 50.00 0.00 50.00 100.00 150.00 200.00

(X10²)

B-43

FORCE (LB)



0.00 33.33 66.66 100.00 133.33 166.66 199.99

BARRIER FRONT FACING FORCE B9

SRL48
1982 VOLVO 2DR.BAR
820411300
C4

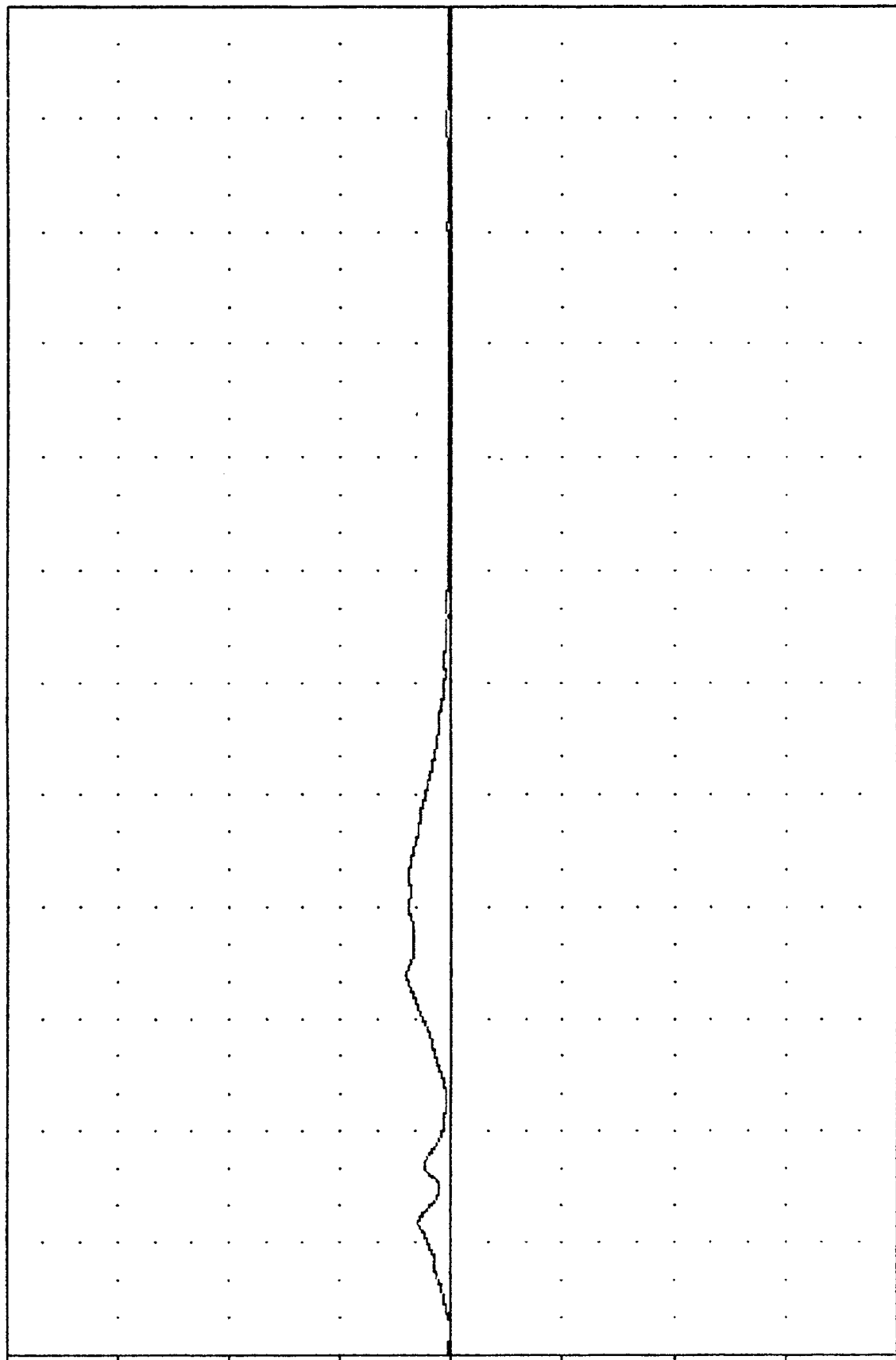
PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -8.47 2.63, 2021.15 56.38

FORCE (LB)
X10²

B-44



BARATER FRONT FACING FORCE FL

SRL48 , SRL48 PLOT DATE 27-MAY-82 08:54:48

1982 VOLVO 20A,8AA

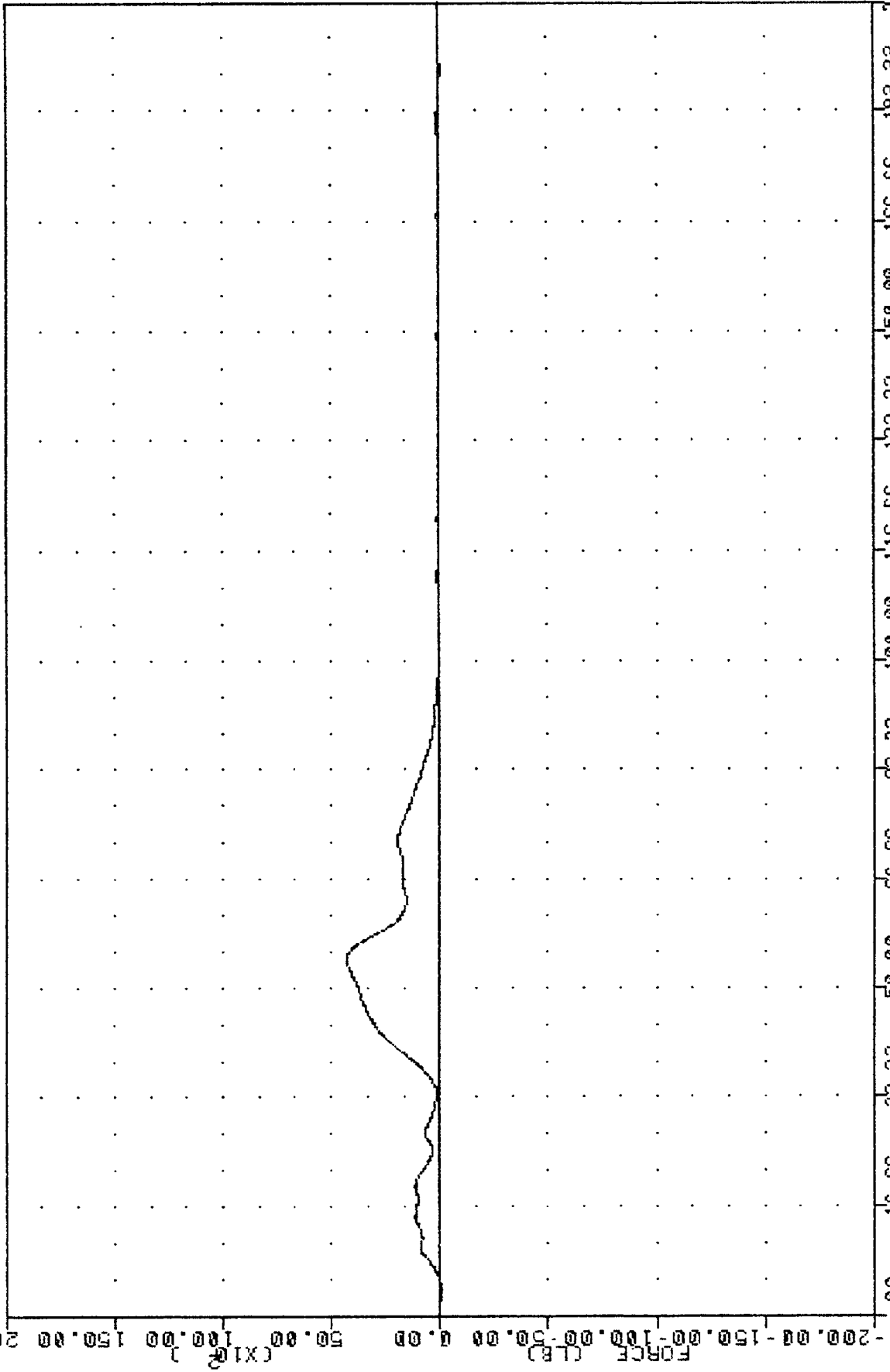
820411300

C5

FILTER = BLPF 100/ 317/ -20

MIN. MAX VALUES = -103.84 3.38, 4283.91 54.25

FORCE (LB)
TIME (MSEC)



B-45

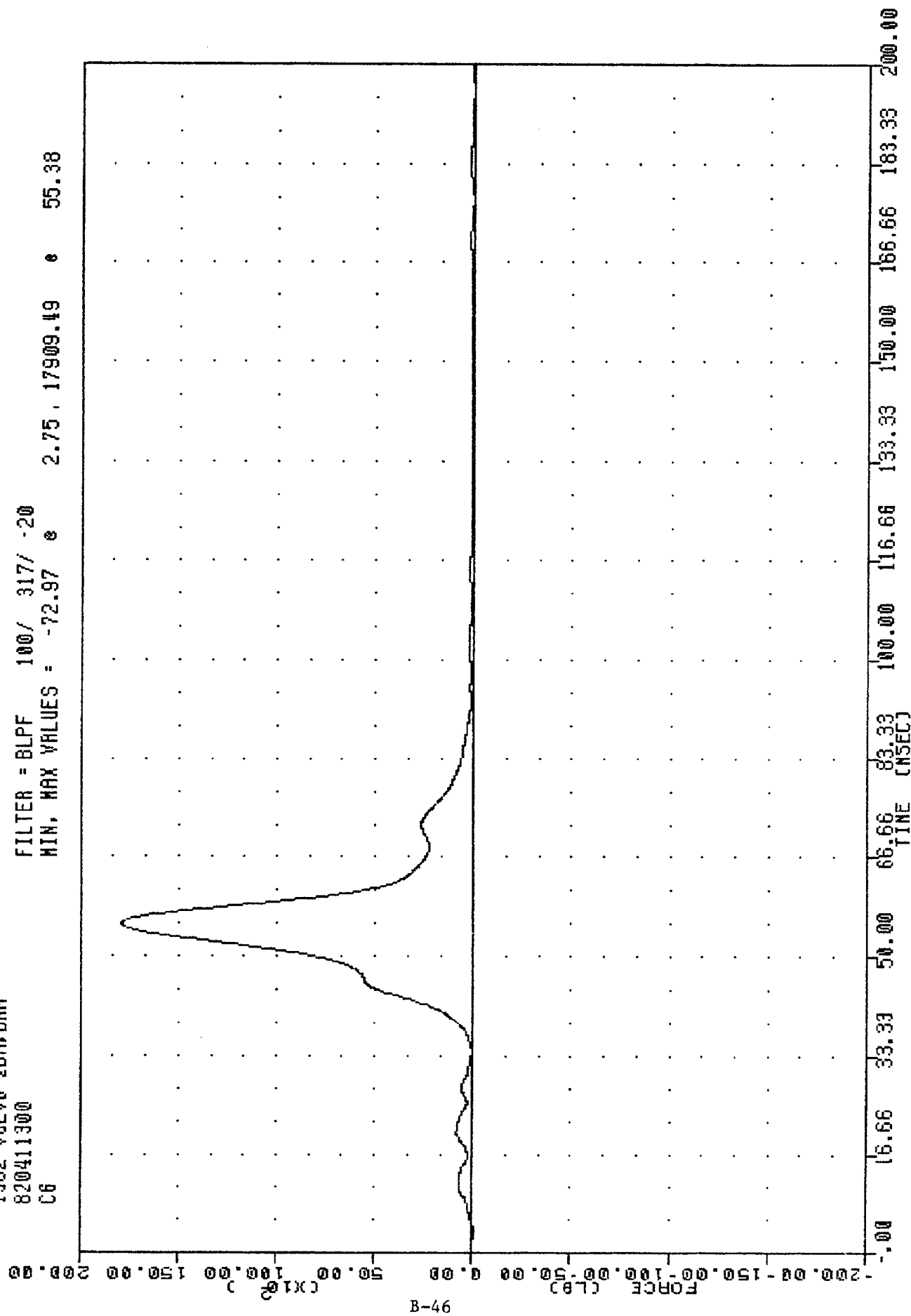
BARRETER FRONT FACING FORCE C5

SRL48
1982 VOLVO 2DR, BRR
820411300
C6

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -72.97 e 2.75, 17909.49 e 55.38



BARRIER FRONT FACING FORCE C6

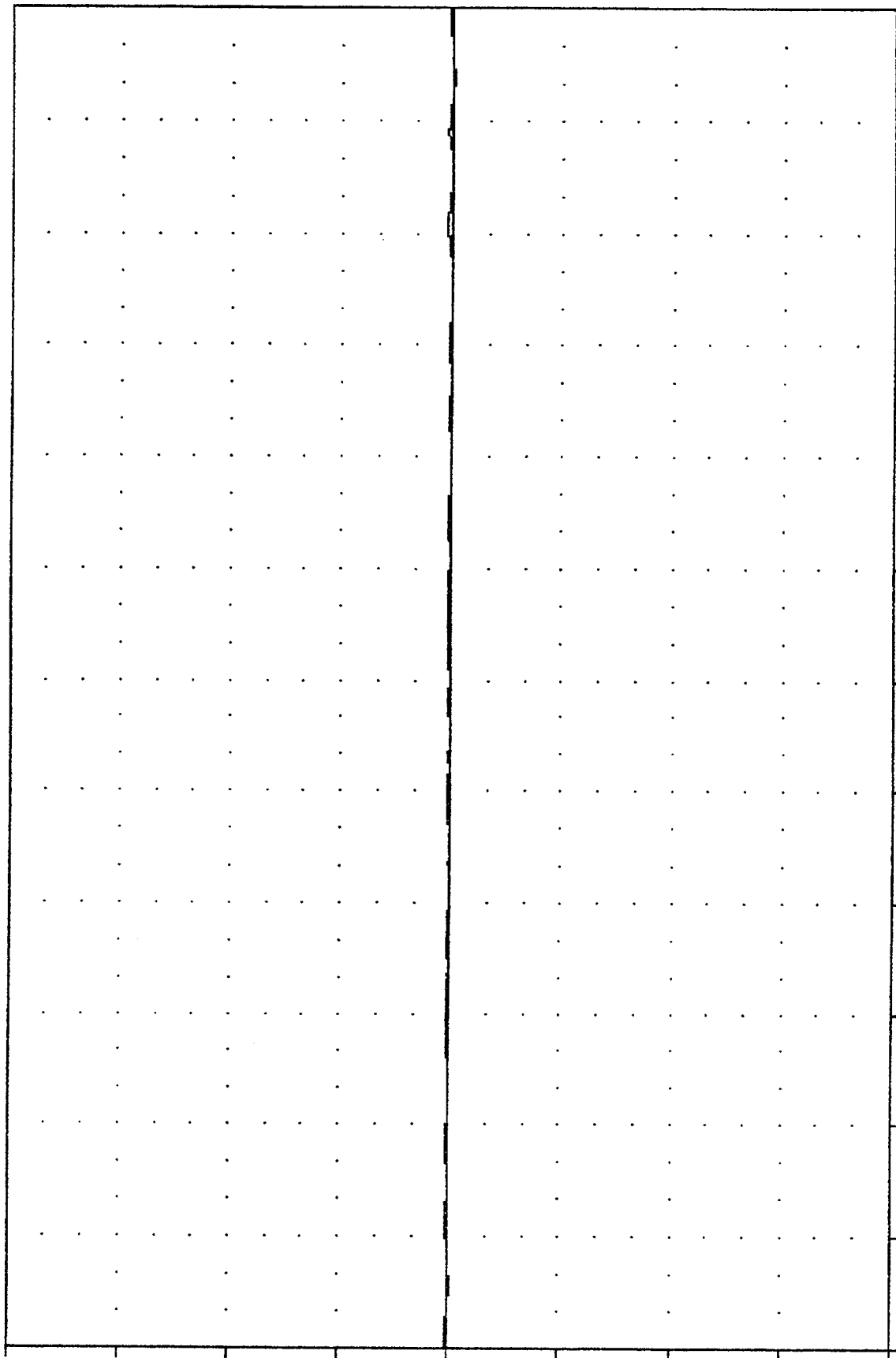
SRL48
1982 VOLVO 2DR.BAR
820411300
04

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20

MIN, MAX VALUES = -82.17 8 9.13, 221.41 8 167.75

FORCE (LB)
(X10³)



TIME (MSEC)

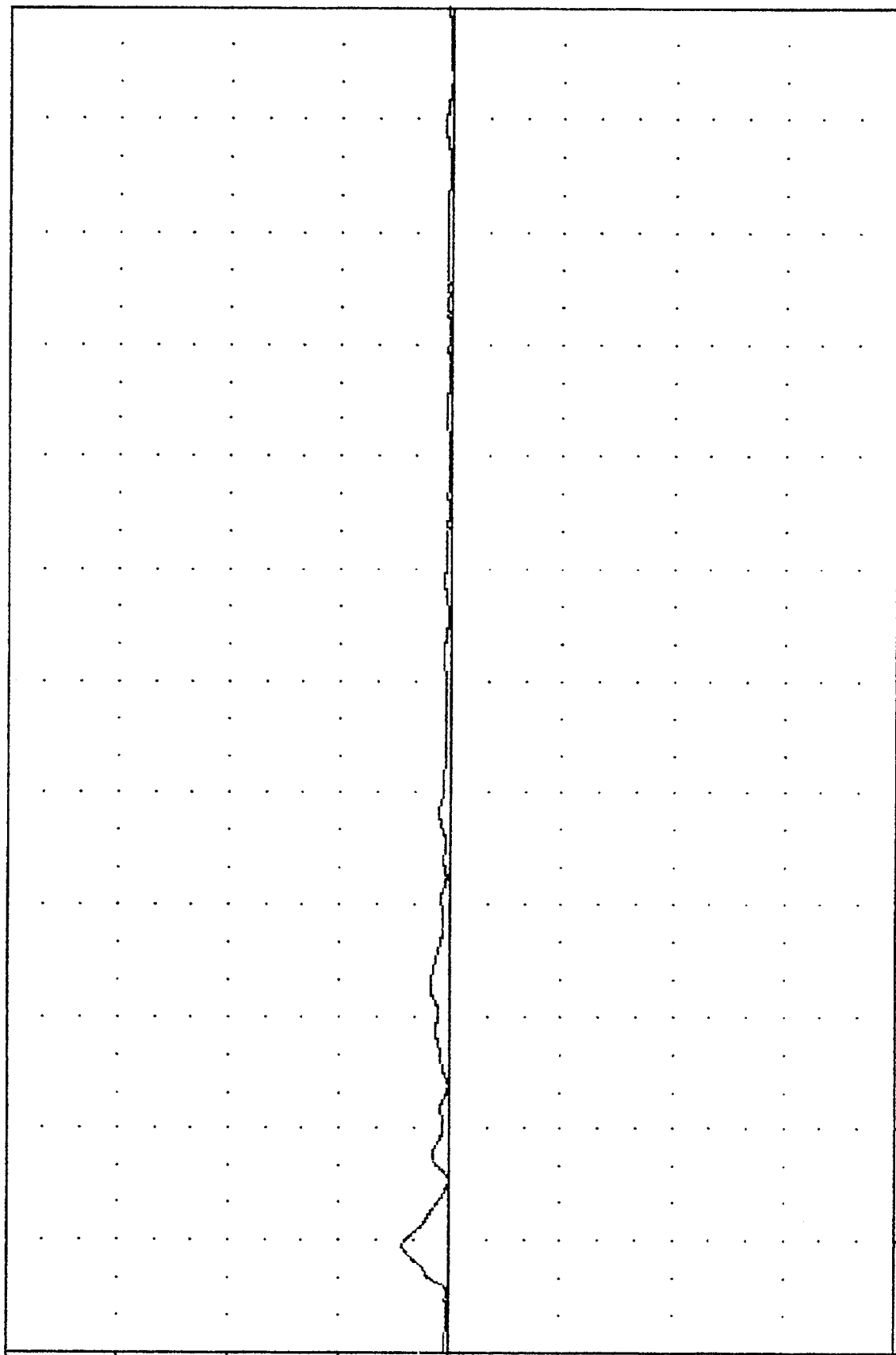
BARRIER FRONT FACING FORCE D4

SRL48
1982 VOLVO 20A.0AR
820411300
D5

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN. MAX VALUES = 52.62 25.50, 2135.58 15.75

FORCE (LBS)
-200.00 -150.00 -100.00 -50.00 0.00 50.00 100.00 150.00 200.00



B-48

0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00
TIME (MSEC)

BARRIER FRONT FACING FORCE D5

SRL48
1982 VOLVD 20R.BAR
820411300
D6

PLOT DATE 27-MAY-82 08:54:48

FILTER = BLPF 100/ 317/ -20
MIN, MAX VALUES = -205.17 @ 25.88, 3864.60 @ 15.50

205.00

150.00

100.00

50.00

0.00

-50.00

-100.00

-150.00

-200.00

(X10²)

64-B

FORCE (LB)

TIME (MSEC)

0.00 16.66 33.33 50.00 66.66 83.33 100.00 116.66 133.33 150.00 166.66 183.33 200.00

BARRIER FRONT FACING FORCE D6

APPENDIX C
DUMMY CERTIFICATION

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

50TH PERCENTILE ADULT MALE (PART 572)

Dummy S/N VRTC
392, SRL 48

Manufacturer Humanoid

Date Jan. 6, 1982

Description	Specification	Actual
Sitting Height	35.7" $\pm$.1"	35.62"
Shoulder Pivot Height	22.1" $\pm$.3"	22.2"
Hip Pivot Height	3.9" (ref.)	3.9"
Hip Pivot From Backline	4.8" (ref.)	4.8"
Knee Pivot From Backline	20.4" $\pm$.3"	20.6"
Rear of Head From Backline	1.7" (ref.)	1.7"
Chest Depth	9.3" $\pm$.2"	9.5"
Shoulder Width	18.1" $\pm$.3"	18.0"
Chest Circumference Over Nipples	37.4" $\pm$.6"	37.6"
Waist Circumference at Min. Girth	32.0" $\pm$.6"	31.9"
Hip Width	14.7" $\pm$.7"	15.1"
Knee Pivot From Floor	19.6" $\pm$.3"	19.5"

Pass/Fail Pass

Weight 161.3 lbs.

COMMENTS: _____

Technician R. E. Loran Date Jan 6, 1982

Test Engineer J. L. Blaker Date Jan 6, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Jan. 7, 1982 Time of Test 1715 hrs.

Ambient Temperature 72° F Relative Humidity 44%

Test No. 01

Deflection Angle	Specification	Test Results
0°	0 lbs.	0
20°	22 - 34 lbs.	25
30°	34 - 46 lbs.	40
40°	46 - 58 lbs.	50

Pass/Fail Pass

Starting Reference Angle 0°

Return Angle 10.5°

Net Return Angle 10.5°

COMMENTS:

Technician R. L. Levan Date Jan. 7, 1982

Test Engineer J. L. Blaker Date Jan. 7, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392

Manufacturer Humanoid

Test Date Jan. 7, 1982

Time of Test 1745 hrs.

Ambient Temperature 71° F

Relative Humidity 42%

Test No. 01

Specification		
Displacement (inches)	Force (lbs.)	Test Results
0	10	10
1.00	50 - 63	58
1.30	73 - 88	81.5

Pass/Fail Pass

COMMENTS:

Technician R.E. LeVan

Date Jan 8, 1982

Test Engineer J. H. Blaker

Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Jan. 8, 1982 Time of Test 1315 hrs.

Ambient Temperature 70° F Relative Humidity 40%

Test No. 01

Test Parameter	Specification	Test Results
Peak Resultant Acceleration	210 - 260 G	220.3
Time Above 100 G Level	0.9 - 1.5 ms.	1.34
Peak Lateral Acceleration	10 G max.	7.7
Is Acceleration Curve Unimodal?		yes

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. Laven Date Jan 8, 1982

Test Engineer J. L. Blaker Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1650 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01 Left or Right Knee Left

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.90
Peak Force	1,850 - 2,500 lbs.	2,279
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.754

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1830 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01 Left or Right Knee Right

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,374
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.755

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 392 Manufacturer Humanoid
 Test Date Feb. 1, 1982 Time of Test 1635 hrs.
 Ambient Temperature 73°F Relative Humidity 50%
 Test No. 01

LOW SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	14.0 fps	13.99
Peak Deflection	1.1 inches max.	1.021
Peak Resistive Force	1,450 pounds max.	1,304
Internal Hysteresis	50% - 70%	57.4%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. C. LeVan Date Feb. 1, 1982
 Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 392 Manufacturer Humanoid

Test Date Feb. 1, 1982 Time of Test 1730 hrs.

Ambient Temperature 72°F Relative Humidity 51%

Test No. 01

HIGH SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	22.0 fps	22.02
Peak Deflection	1.7 inches max.	1.590
Peak Resistive Force	2,250 pounds max.	2,008
Internal Hysteresis	50% - 70%	57.9%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 392 Manufacturer Humanoid
 Test Date Jan. 30, 1982 Time of Test 1400 hrs.
 Ambient Temperature 73° F Relative Humidity 48%
 Test No. 01

Test Parameter	Specification	Test Results
Pendulum Velocity	21.5 - 25.5 fps	22.06 fps
Pendulum Deceleration: $T_1 - T_2$: 5 - 20 G	3 ms. max.	3.0
$T_2 - T_3$: 20 - 20 G	25 - 30 ms.	28.375
$T_3 - T_4$: 20 - 5 G	10 ms. max.	3.625
Avg. G Level $T_2 - T_3$	20 - 24 G	21.84
Rotation Angle	63 - 73 degrees	65.53
Peak Head Resultant Acceleration	26 G max.	24.9

Test Parameter	Specification		Test Results	
Rotation Angle (degrees)	Time (ms.)	Chordal Dis- placement (in.)	Time (ms.)	Chordal Dis- placement (in.)
0	0	-0.5 - +0.5	0	
30	25.6 - 34.4	2.1 - 3.1	31.125	2.73
60	40.3 - 51.7	4.3 - 5.3	49.875	5.14
max.	53.2 - 66.8	5.0 - 6.0	62.375	5.62
60	67.0 - 83.0	4.3 - 5.3	74.625	5.24
30	85.4 - 104.6	2.1 - 3.1	97.75	2.60
0	101.0 - 123.0	-0.5 - +0.5	115.0	0.12

Pass/Fail Pass Neck Base - Head CG = 5.99"

*Indicates failure to meet specifications.

COMMENTS: _____

Technician R. E. Lavan Date Jan. 30, 1982
 Test Engineer J. L. Blaku Date Jan. 30, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

EXTERNAL DIMENSIONS

50TH PERCENTILE ADULT MALE (PART 572)

Dummy S/N VRTC
826, SRL 48

Manufacturer Alderson

Date Jan. 6, 1982

Description	Specification	Actual
Sitting Height	35.7" $\pm$.1"	35.75"
Shoulder Pivot Height	22.1" $\pm$.3"	22.2"
Hip Pivot Height	3.9" (ref.)	3.9"
Hip Pivot From Backline	4.8" (ref.)	4.8"
Knee Pivot From Backline	20.4" $\pm$.3"	20.75"
Rear of Head From Backline	1.7" (ref.)	1.7"
Chest Depth	9.3" $\pm$.2"	9.25"
Shoulder Width	18.1" $\pm$.3"	18.1"
Chest Circumference Over Nipples	37.4" $\pm$.6"	37.9"
Waist Circumference at Min. Girth	32.0" $\pm$.6"	31.9"
Hip Width	14.7" $\pm$.7"	15.37"
Knee Pivot From Floor	19.6" $\pm$.3"	19.65"

Weight 161.3 lbs.

Pass/Fail Pass

COMMENTS: _____

Technician R. E. LeVan Date Jan. 6, 1982

Test Engineer J. L. Blaker Date Jan. 6, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

LUMBAR FLEXION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 7, 1982 Time of Test 1640 hrs.

Ambient Temperature 72° F Relative Humidity 45%

Test No. 01

Deflection Angle	Specification	Test Results
0°	0 lbs.	0
20°	22 - 34 lbs.	30
30°	34 - 46 lbs.	45
40°	46 - 58 lbs.	58

Pass/Fail Pass

Starting Reference Angle 0°

Return Angle 11.1°

Net Return Angle 11.1°

COMMENTS:

Technician R. C. LeVan Date Jan 7, 1982

Test Engineer J. L. Blake Date Jan. 7, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

ABDOMINAL COMPRESSION TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 7, 1982 Time of Test 1855 hrs.

Ambient Temperature 70°F Relative Humidity 42%

Test No. 01

Specification		
Displacement (inches)	Force (lbs.)	Test Results
0	10	10
1.00	50 - 63	60
1.30	73 - 88	80

Pass/Fail Pass

COMMENTS:

Technician R. E. LeVan Date Jan 8, 1982

Test Engineer J. L. Blaker Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

HEAD DROP TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Jan. 8, 1982 Time of Test 1420 hrs.

Ambient Temperature 71°F Relative Humidity 40%

Test No. 01

Test Parameter	Specification	Test Results
Peak Resultant Acceleration	210 - 260 G	235.5
Time Above 100 G Level	0.9 - 1.5 ms.	1.23
Peak Lateral Acceleration	10 G max.	9.4
Is Acceleration Curve Unimodal?		yes

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Jan 8, 1982

Test Engineer J. L. Blaker Date Jan. 8, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 1, 1982 Time of Test 2000 hrs.

Ambient Temperature 72°F Relative Humidity 52%

Test No. 01 Left or Right Knee Left

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,319
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.767

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

KNEE IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 1, 1982 Time of Test 1945 hrs.

Ambient Temperature 72°F Relative Humidity 52%

Test No. 01 Left or Right Knee Right

Test Parameter	Specification	Test Result
Probe Velocity	6.9 ft./sec.	6.9
Peak Force	1,850 - 2,500 lbs.	2,318
Duration Above 1,000 Pounds	≥ 1.7 ms.	1.798

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 1, 1982

Test Engineer J. L. Blaker Date Feb. 01, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 2, 1982 Time of Test 0850 hrs.

Ambient Temperature 71°F Relative Humidity 51%

Test No. 01

LOW SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	14.0 fps	13.99
Peak Deflection	1.1 inches max.	0.923
Peak Resistive Force	1,450 pounds max.	1,360
Internal Hysteresis	50% - 70%	59.4%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 2, 1982

Test Engineer J. L. Blaker Date Feb. 02, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

THORAX IMPACT TEST

PART 572

Customer VRTC, SRL 48

Dummy Serial No. 826 Manufacturer Alderson

Test Date Feb. 2, 1982 Time of Test 1003 hrs.

Ambient Temperature 72°F Relative Humidity 53%

Test No. 01

HIGH SPEED TEST		
Test Parameter	Specification	Test Results
Pendulum Velocity	22.0 fps	22.01
Peak Deflection	1.7 inches max.	1.467
Peak Resistive Force	2,250 pounds max.	2,137
Internal Hysteresis	50% - 70%	60.9%

Pass/Fail Pass

*Indicates failure to meet specifications.

COMMENTS:

Technician R. E. LeVan Date Feb. 2, 1982

Test Engineer J. L. Blaker Date Feb. 02, 1982

TRANSPORTATION RESEARCH CENTER OF OHIO

NECK PENDULUM TEST

PART 572

Customer VRTC, SRL 48
 Dummy Serial No. 826 Manufacturer Alderson
 Test Date Feb. 1, 1982 Time of Test 1130 hrs.
 Ambient Temperature 72°F Relative Humidity 52%
 Test No. _____

Test Parameter	Specification	Test Results
Pendulum Velocity	21.5 - 25.5 fps	21.9
Pendulum Deceleration: $T_1 - T_2$: 5 - 20 G	3 ms. max.	2.259
$T_2 - T_3$: 20 - 20 G	25 - 30 ms.	27.135
$T_3 - T_4$: 20 - 5 G	10 ms. max.	3.08
Avg. G Level $T_2 - T_3$	20 - 24 G	22.9
Rotation Angle	63 - 73 degrees	65.68
Peak Head Resultant Acceleration	26 G max.	26.0

Test Parameter	Specification		Test Results	
Rotation Angle (degrees)	Time (ms.)	Chordal Dis- placement (in.)	Time (ms.)	Chordal Dis- placement (in.)
0	0	-0.5 - +0.5		0.07
30	25.6 - 34.4	2.1 - 3.1	29.625	2.56
60	40.3 - 51.7	4.3 - 5.3	47.25	4.63
max.	53.2 - 66.8	5.0 - 6.0	57.125	5.08
60	67.0 - 83.0	4.3 - 5.3	71.0	4.70
30	85.4 - 104.6	2.1 - 3.1	91.625	2.42
0	101.0 - 123.0	-0.5 - +0.5	107.75	0.078

Pass/Fail Pass

Neck Base to Head CG = 5.93"

*Indicates failure to meet specifications.

COMMENTS: _____

Technician R. E. LeVan Date Feb. 1, 1982
 Test Engineer J. L. Blaker Date Feb. 01, 1982