Report No. (to be assigned by NHTSA) DOT-382

DYNAMIC CRASH TESTING OF MODIFIED FORD VANS

VAN-TO-NHTSA 36 MODULE LOAD CELL FIXED BARRIER HEAD-ON IMPACT TESTS

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Contract No. DTNH22-81-C-07113

NOVEMBER 1981

TEST REPORT

Prepared for:

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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
WASHINGTON, D.C. 20590

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Tests 1 and 2 of the modified Ford Vans. Calcomp plots in Appendix A & B.

16. Abstract

Two full-scale van crash tests were conducted as required under Task Order #1 of Contract No. DTNH22-81-C-07113, "Dynamic Crash Testing of Modified Ford Vans." This report presents the results of Tests 3118-1 and 3118-2, Symmetric Head-on Van-to-NHTSA 36 Module Load Cell Fixed Barrier Crash Tests. Two different modifications to 1979 Ford E-150 Econoline Vans were tested. Test 3118-1 was conducted on the van with a stiffened frame, modified steering column and master cylinder placement. Test 3118-2 was conducted on the van with the extended, stiffened frame, modified steering column and master cylinder placement.

The objective of these tests was to study the aggressivity of vans, to provide baseline test data to support extension of FMVSS 208 to vans, and to provide initial information for the future FMVSS 400 series standards upgrading.

This report contains all test results which include still photographs, dimensions, accelerometer location identification summaries of electronic data, and summaries of simulated occupant data. This report contains all Calcomp plots of vehicle and NHTSA Load Cell Fixed Barrier electronic data for each test in the Appendix.

17. Key Words	18. Distribution Statement
36 Module Load Cell Fixed Barrier, Ford E-150 Econoline Van, Aggressivity, Crashworthiness	Available through National Technical Information Service, Springfield, Virginia 22161

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Unclassified	Unclassified	130	

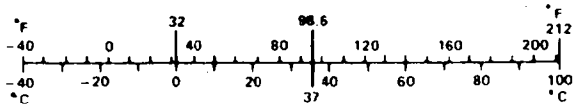
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

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

Approximate Conversions from Metric Measures

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



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1.0 INTRODUCTION

A series of 2 full-scale van crash tests was conducted as required under Task Order #1 of Contract No. DTN22-81-C-07113, "Dynamic Crash Testing of Modified Ford Vans," sponsored by the National Highway Traffic Safety Administration. This report presents the results of Tests 3118-1 and 3118-2, symmetric head-on Van-to-NHTSA 36 Load Cell Fixed Barrier crash tests. Calcomp plots for all vehicle and Load Cell Fixed Barrier electronic data gathered during the conduct of these tests are contained in the Appendix.

1.1 TEST OBJECTIVE

The objective of these tests was to:

- Study the crashworthiness and aggressivity of vans
- Provide baseline van collision data to support FMVSS 208, Occupant Crash Protection
- Support current vehicle standards and provide initial information for future FMVSS 400 series standards upgrading.

1.2 TEST SCOPE

The test matrix and summary of the test conditions for conducting the van crash tests are shown in Table 1-1. A target test speed of 30 mph was chosen for the two different modifications of the 1979 Ford E-150 Econoline Vans which impacted the 36 Load Cell Fixed Barrier. Test 3118-1 was conducted on the van with the standard length, while test 3118-2 was conducted on the van with the extended frame. The load cell barrier face is pictured in Figure 1-1. The barrier consists of a 9 x 4 array of 50 klb load

TABLE 1-1. PROJECT 3118 TEST MATRIX

Test Number	Test Date	Test Configuration	Vehicle Model/ Dynamic Science No.	Vehicle Weight (±10 lb)	Closing Speed (mph)
3118-1	10/27/81	Van-to-Load Cell Barrier Head-On	A - 1979 Ford Econoline 150 Modified Van/#1213 (Cream)	5,000	30.34
			B - 36-Module Load Cell Fixed Barrier	>100,000	
3118-2	10/29/81	Van-to-Load Cell Barrier Head-On	A - 1979 Ford Econoline 150 Modified Van/#1214 (Blue)	5,000	30.29
			B - 36-Module Load Cell Fixed Barrier	>100,000	

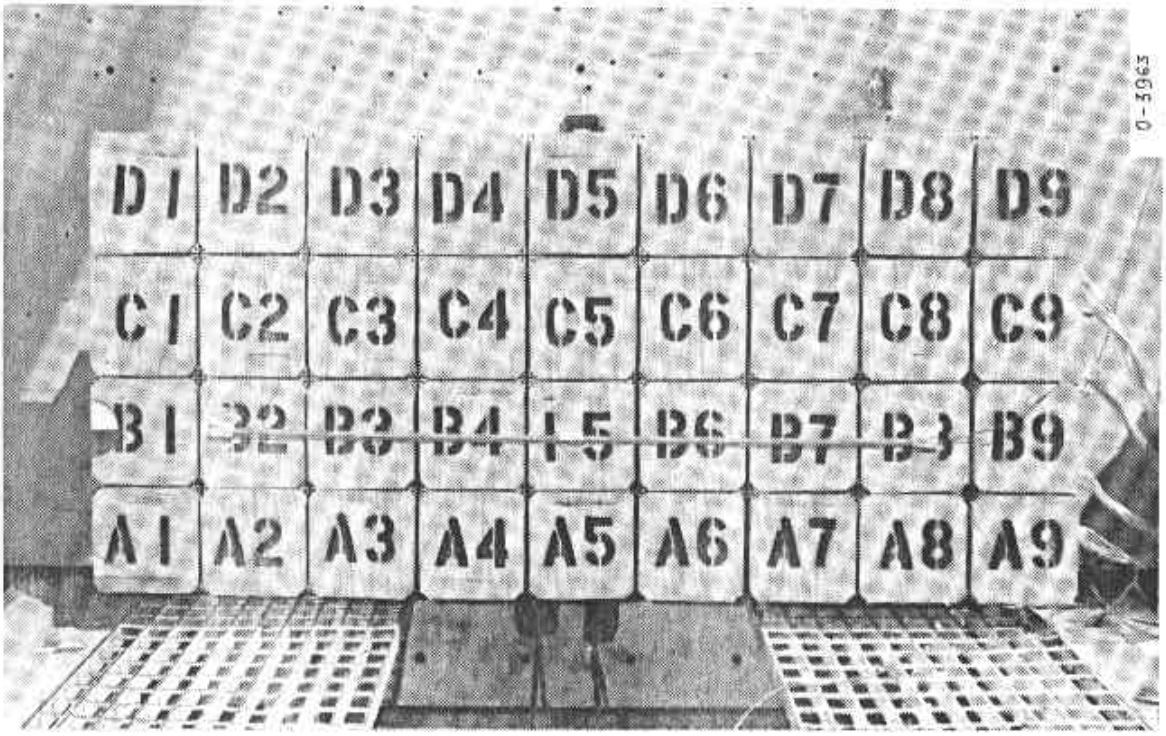


FIGURE 1-1. THIRTY-SIX MODULE LOAD CELL FIXED BARRIER.

cells each faced with a section of 1-3/4-inch thick plywood. Plywood sections for Rows C and D (upper two rows) each measure 10 inches high and 9 inches wide. Plywood sections for Rows A and B (lower two rows) each measure 9 inches high and 9 inches wide. Overall width of the barrier is 83 inches and overall height is 38-3/4 inches. The lower edge of the barrier is 2-5/8 inches above the surface of the ground.

In each test, the van contained two instrumented Alderson Part 572, 50th percentile male anthropomorphic dummies (GFE) located in the two front outboard seating positions. Each occupant was restrained with the vehicle's production restraint system. The seat tracks were put at midposition, but not welded in place. Fuel was removed from the vans and replaced with water.

1.3 VEHICLE INSTRUMENTATION

See Table 1-2 for a summary of vehicle and Fixed Test Device instrumentation. A total of 74 data channels were used in conducting these tests. Van instrumentation consisted of 38 data channels requiring the use of three Remote Signal Conditioning Modules (RSCM's). The Load Cell Fixed Barrier contained a total of 36 data channels requiring the use of 3 RSCM's.

1.3.1 Test Vehicle Instrumentation

In addition to having two full-instrumented anthropomorphic dummies, the test vehicle was instrumented with 16 accelerometers

TABLE 1-2. VEHICLE AND FIXED TEST DEVICE INSTRUMENTATION SUMMARY

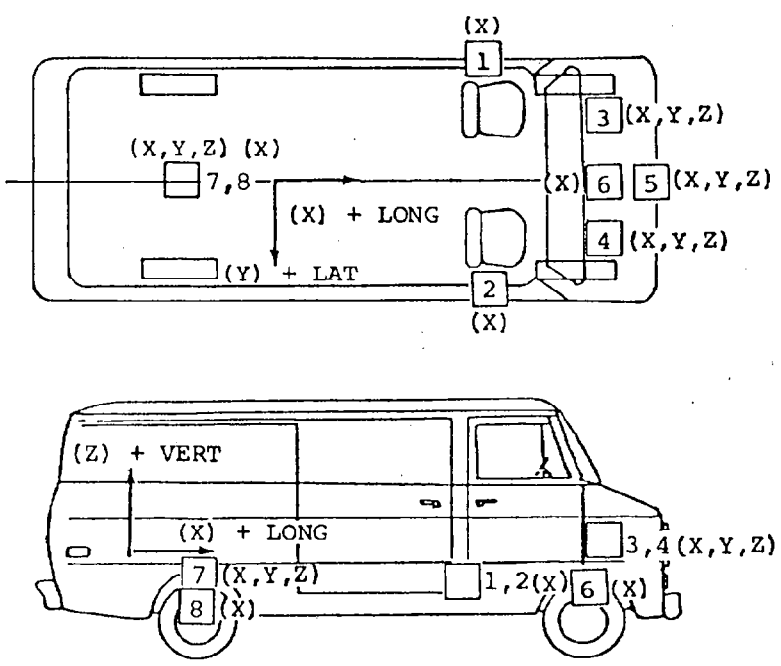
Van Instrumentation	Locations		Data Channels
Vehicle Accelerometers*	8		16
Dummy Instrumentation: Head (3), Chest (3), Femur (2)	2		16
Seat Belt Load Cells: Lap (2), Shoulder (1)	2		6**
		Total	38 - 3 RSCM's
Load Cell Fixed Barrier			
Load Cells	36		36
		Total	36 - 3 RSCM's

*See Figures 1-2 and 1-3 for locations.
**No seat belt load cells were installed for Test 3118-1.

mounted in 8 locations. Figures 1-2 and 1-3 show the vehicle accelerometer locations for the Ford Vans utilized in Tests 3118-1 and 3118-2, respectively. Dummy instrumentation and seat belt load cells required an additional 22 (16 for 3118-1) data channels, making a total of 38 (32 for 3118-1) data channels required for van instrumentation.

1.4 PHOTOGRAPHIC INSTRUMENTATION

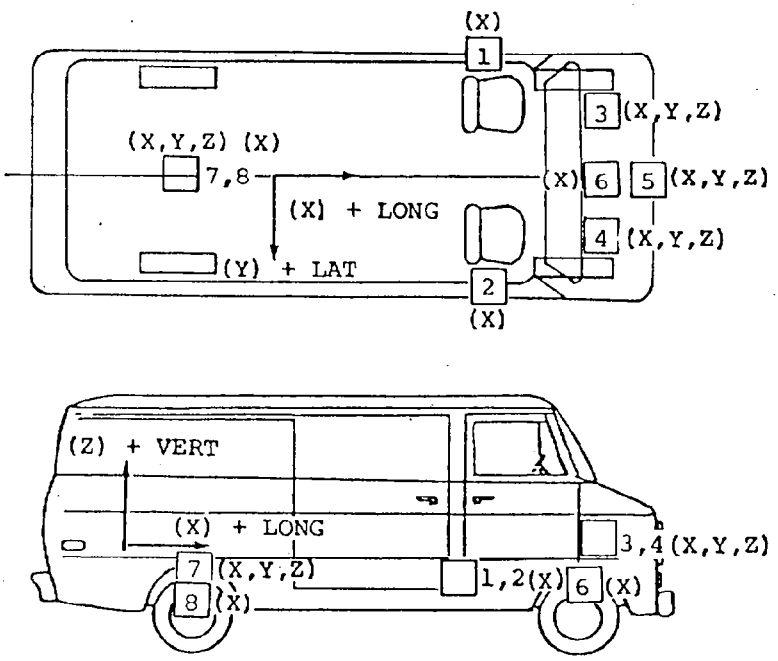
In both tests, seven high-speed cameras (five 1000 fps and two 500 fps) and one panning camera (24 fps) were used to cover the crash event (see Table 1-3). Two of the cameras used were mounted on board the vans to observe occupant kinematics. In addition to high-speed cameras, black-and-white and color slides were taken to record pre-test and post-test vehicle and dummy positions.



Vehicle Accelerometer Locations					Maximum Expected Reading		
No.	Description of Location	X*	Y*	Z*	Long. (G)	Lat. (G)	Vert. (G)
1	Left B-pillar near floor	108.0	28.8	25.5	50		
2	Right B-pillar near floor	108.0	29.5	25.5	50		
3	Left firewall inside compartment	159.5	18.0	35.0	100	100	100
4	Right firewall inside compartment	159.0	18.0	36.0	100	100	100
5	Top engine block	152.0	0	34.0	200	200	200
6	Front axle	161.5	0	12.0	200		
7	Cargo area over rear axle	38.0	0	22.0	50	50	50
8	Rear axle	38.0	0	7.5	100		

*X coordinate - centerline of rear bumper; Y coordinate - vehicle centerline; Z coordinate - ground level.

FIGURE 1-2. TEST VEHICLE ACCELEROMETER INSTRUMENTATION - FORD E-150 VAN (TEST 3118-1).



Vehicle Accelerometer Locations					Maximum Expected Reading		
No.	Description of Location	X*	Y*	Z*	Long. (G)	Lat. (G)	Vert. (G)
1	Left B-pillar near floor	108.5	27.5	25.0	50		
2	Right B-pillar near floor	108.8	27.0	25.0	50		
3	Left firewall inside compartment	152.0	23.0	34.0	100	100	100
4	Right firewall inside compartment	152.0	17.5	34.0	100	100	100
5	Top engine block	146.0	0	36.0	200	200	200
6	Front axle	163.0	0	12.0	200		
7	Cargo area over rear axle	37.3	0	25.0	50	50	50
8	Rear axle	37.3	0	7.3	100		

*X coordinate - centerline of rear bumper; Y coordinate - vehicle centerline; Z coordinate - ground level.

FIGURE 1-3. TEST VEHICLE ACCELEROMETER INSTRUMENTATION - FORD E-150 VAN (TEST 3118-2).

TABLE 1-3. CAMERA LOCATIONS FOR VAN-TO-LOAD CELL FIXED BARRIER IMPACT TESTS 3118-1 AND 2.

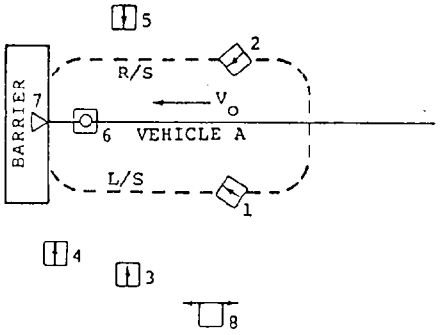
Test No: 3118-1 & 2 Test Date: See Table 1-1

Test Type: 36 Module Load Cell Fixed Barrier

Vehicle A: 1979 Ford E-150 Van

Vehicle B: Load Cell Fixed Barrier

Comments:



CAMERA	YES
STILLS	x
SLIDES	x
MOVIE	x
POLAROID	
VIDEO	

CAMERA SYMBOLS

- PIT
- GROUND
- BARRIER
- OVERHEAD
- ON-BOARD
- PANNING

FRAME RATE

1. 1000 fr/sec
2. 200 fr/sec
3. Other 24 fr/sec
4. 400 fr/sec
5. 500 fr/sec

Loc. No.	Location	Field of View	Lens Size	Frm Rate	Ser No	Impact Dist-X	C.L. Dist-Y	CAM Hght-Z
1	Onboard (R/S)	Right front seat and occupant	8mm	1	5	-	-25"	-
2	Onboard (L/S)	Left front seat and occupant	8mm	1	10	-	+25"	-
3	Left Side	Left side overall	13mm	1	6	+7'	+30'	51"
4	Left Side	Closeup of barrier and occupant compartment	25mm	1	4	+2'	+30'	51"
5	Right Side	Right side overall	13mm	1	12	+6'	-30'	51-1/2"
6	Pit	Under structure of vehicle including fuel tank	10mm	5	11	+3'	0	-8'
7	Barrier	Occupants through front windshield	ZOOM	5	7	-5'	0	+119"
8	Left Side	Panning test and overall results		3				

DSI FORM NO. TSO 125

2.0 PRESENTATION OF RESULTS (TEST 3118-1)

This section of the report presents the results of Test No. 3118-1, a head-on symmetric crash test between a 1979 Ford E-150 Econoline Van and the 36-Load Cell Fixed Barrier (V_O = 30.34 mph).

This report presents all test results without analysis or discussion. Included in this document are: still photographs, film chronologies, vehicle damage sketches and tabulated pre- and post-test dimensions, accelerometer location identification, summaries of the simulated occupant data, including injury criteria values. High-speed motion pictures were also obtained for this test and have been submitted to NHTSA. Appendix A contains Calcomp plots for all electronic data for this test. This includes all vehicle accelerometer data, occupant response data, load cell data, force-deflection curves, and string potentiometer data.

TABLE 2-1. CRASH TEST SUMMARY (TEST 3118-1)

TEST NO.: 3118-1 CONTRACT: DTNH22-81-C-07113

TEST DATE: October 27, 1981 TIME: 1440 TEMPERATURE: 78 °F

TEST CONFIGURATION: Van-to-36 Load Cell Fixed Barrier Symmetric Head-on

VEHICLE NO. 1: 1979 Ford Econoline E-150 Van (Modified)

VEHICLE NO. 2: 36 Load Cell Fixed Barrier

VEHICLE DATA	VEHICLE NO. 1	VEHICLE NO. 2
Overall Length/Width (in.)	185.5/79.4	
Test Weight by Wheel (lb)	LF 1288 RF 1357 LR 1147 RR 1204	
Total Weight (lb)	4996	>100,000
Wheelbase (in.)	123.8	
Longitudinal C.G. (From Center of Front Axle) (in.)	58.25	
Impact Angle (deg)*	0	0
Offset Distance (in.)	0	0
Car Speed (mph)	30.34	0
Final Speed (mph @ msec)	-2.56 @ 93	
Velocity Change (mph)	32.90	
Maximum Averaged Compartment Acceleration (G @ msec)	-34.77 @ 41	
Maximum Engine Acceleration (G @ msec)	-79.00 @ 42	
Maximum Mutual Dynamic Crush (Film Data) (in.)	18.6	
Maximum Static Crush		
• Bottom of Windshield (in.)	2.2	
• Hood Level (in.)	19.0	
• Between Bumper/Hood (in.)	16.6	
• Bumper Level (in.)	17.6	
Maximum Post-test Intrusion (in.)	1.2	
OCCUPANTS		
Type	Alderson Part 572	
Location	LF - #A08 RF - #A09	
Restraints	Standard Lap and Shoulder Belt	
INSTRUMENTATION		
Number of Data Channels	32	36
Number of Cameras	8	

*With respect to tow truck centerline.

TABLE 2-2. RECEIVING INSPECTION OF VEHICLES

Contractor: Dynamic Science, Inc. Contract No.: DTNH22-81-C-07113

VIN No.: E14HHEF4397 Make: Ford Van (Modified)

NHTSA No.: R & D

Year: 1979 Color: White Model: Econoline E-150

Auto Trans:	yes x	no	Pwr Steering:	yes	no x	Seats: (front)	Bench:	
Pwr Brakes:	yes x	no	Auto Speed Cont:	yes	no x		Bucket: x	
Pwr Seats:	yes	no x	Anti Skid Brake:	yes	no x		Split Bench:	
Pwr Windows:	yes	no x	Air Conditioning:	yes	no x			
Tinted Glass:	yes	no x	Rear Window Def.:	yes	no x		Split Back Bench:	
Radio:	yes	no x	Brakes: drum: R	disc: F				
Clock:	yes	no x						

Tire Size: L78-15 Ply Rating: 4 Mfg. & Line: Goodyear

Bias Ply: x Belted: Radial: / Eng. Type: V8 Cylinders: 8 Total Displ: 351

Trans., # Fwd. Speeds: Shipping Weight: Odometer: None

Dealer (name, address, and phone number): The Budd Company via Cooper Mfg. and Equipment Corp.

Remarks (list additional accessories not listed above): Instrument panel missing, seat belts, belt hardware, and right front seat missing when vehicle was received.

Date of Manufacture: 1/20/79 Dynamic Science No.: 1213 Date Received: 9/8/81

Tilting Steering Wheel: yes no x Telescoping Steering Wheel: yes no x

Fuel Capacity: (from owner's manual) "Space Saver" Spare Tire: yes no x

Restraint System: Standard lap & shoulder harness installed by Dynamic Science.

1. Is the vehicle stock throughout? Describe: No, vehicle has modified bumper/frame attachment, steering, and master cylinder placement.

2. Does vehicle show evidence of prior accident history? Describe: Yes, vehicle was low speed tested under Contract Number DOT-HS-8-01942, "Van Crashworthiness and Aggressivity Study".

3. Does vehicle show any significant corrosion? Describe: No

4. Check condition of the front bumper and frame: Satisfactory

TABLE 2-3. SUMMARY OF PRE-TEST ENGINE/BUMPER/FIREWALL CHARACTERISTICS (TEST 3118-1)

Test No.: 3118-1 Type: Van-to-NHTSA Fixed Test Device

Car Model: 1979 Ford E-150 Van Dynamic Science No.: 1213

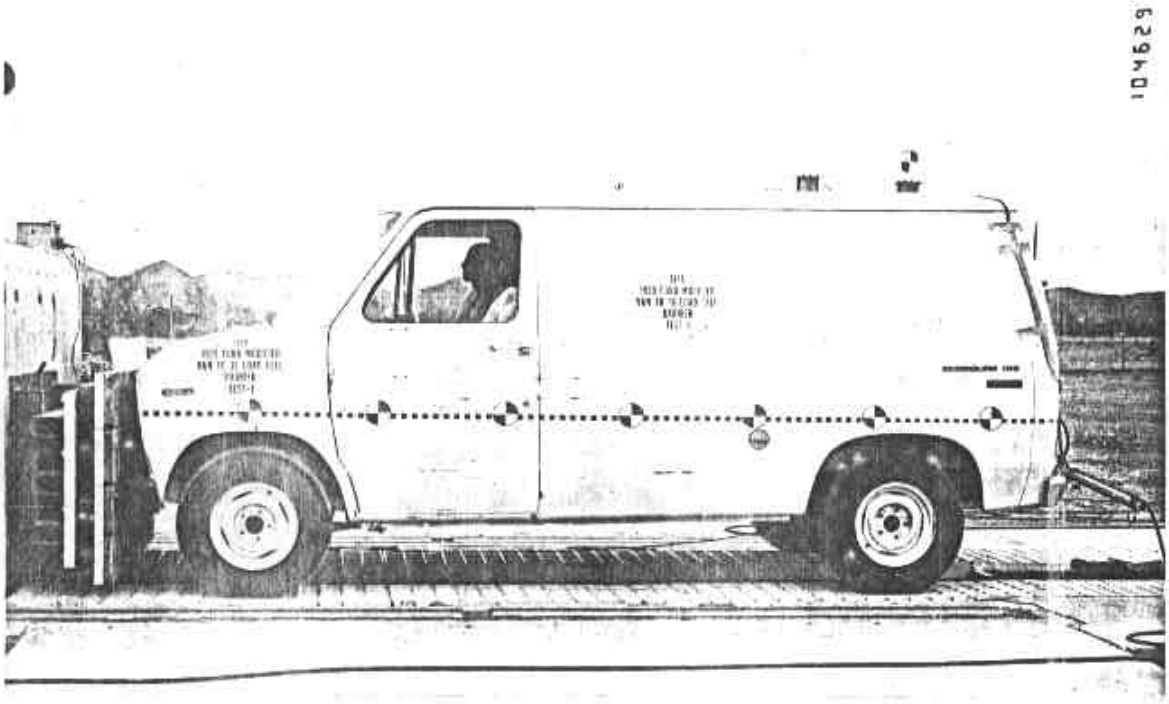
Engine Size	351 CID
Engine Weight* (lb)	768
Engine Height/Width (in.)	32.2/19.2
Bumper to Engine Block (in.)	26.7
Engine Length (in.)	19.8
Engine to Firewall (in.)	Not Applicable
Bumper to Firewall (in.)	28.3
Bumper Height (in.) (Min./Max)	15.2/22.4

*Includes engine and rigid attachments such as transmission and drive train.

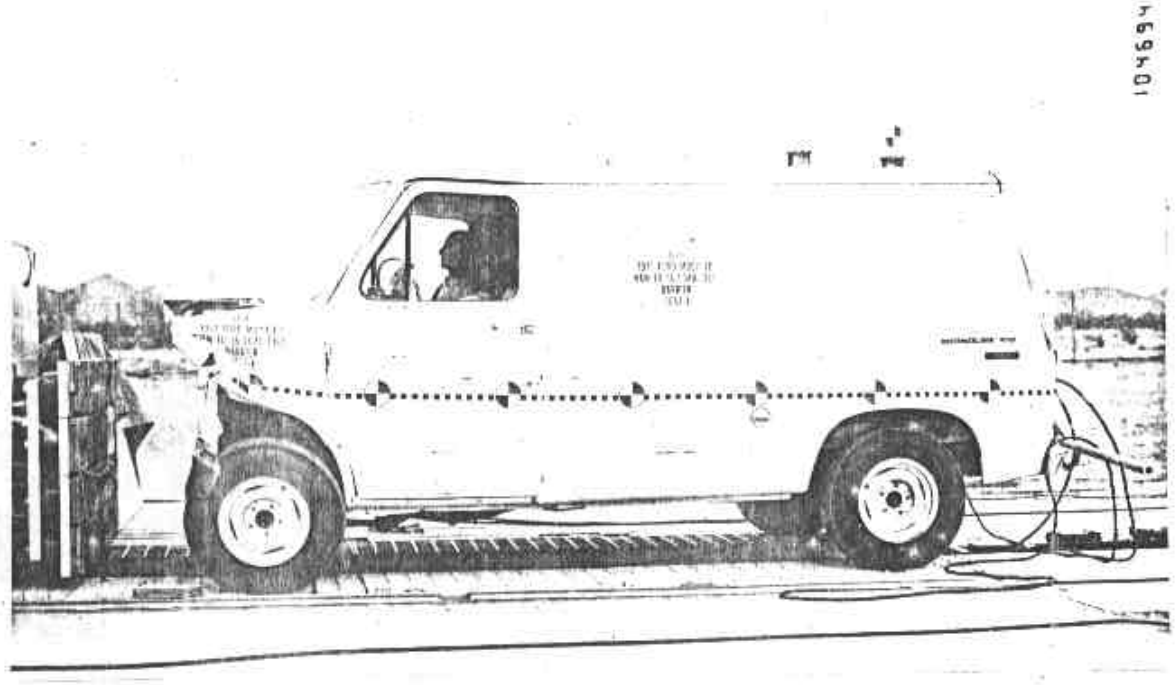
TABLE 2-4. PRE-TEST DUMMY POSITIONS - FORD E-150 VAN (TEST 3118-1)

Distances (in.)	Driver*	Passenger
Chest to Steering Wheel Hub (horizontal)	15.5	
Head to Windshield (horizontal)	28.0	24.0
Knee to Lower Panel (closest point)		
Left	9.0	6.5
Right	9.5	7.5
Chest to Dash (horizontal)	24.5	21.0
Forehead to Header	20.5	17.5

*Tilt steering wheel set at lowermost driving position.



A - PRE-TEST



B - POST-TEST

FIGURE 2-1. VEHICLE CONFIGURATION (TEST 3118-1).

FIGURE 2-2. POST-TEST VEHICLE CONFIGURATION (TEST 3118-1).

A - PRE-TEST DRIVER

C - PRE-TEST PASSENGER

B - POST-TEST DRIVER

D - POST-TEST PASSENGER

FIGURE 2-3. VEHICLE DUMMY CONFIGURATION (TEST 3118-1).

TABLE 2-5. CHRONOLOGY OF EVENTS (TEST 3118-1)

VEHICLE: 1979 Ford Econoline E-150 Van

Time (msec)	Crash Event
0	Impact (visual).
3	Fenders hit barrier.
10	Bumper hits front tires.
22	Tires strike barrier.
29	Passenger starts forward motion.
30	Driver starts forward motion.
37	Fender wells strike back of front tires.
53	Passenger knees strike dash; Passenger left hand strikes engine cowling.
58	Driver knees strike dash; Driver hands and forearms strike dash.
66	Driver head strikes steering wheel hub.
67	Maximum vehicle dynamic crush (18.6)
71	Steering wheel lower rim strikes driver in neck.
99	Maximum driver forward motion.
100	Maximum vehicle declination (4.0°).
106	Right rear tire leaves ground.
109	Maximum passenger forward motion.
110	Passenger head grazes dash.
113	Left rear tire leaves ground.
166	Driver recontacts seat with upper back.
232	Vehicle separates from barrier.
259	Passenger recontacts seat with upper back.
341	Right rear tire recontacts ground.
348	Left rear tire recontacts ground.
551	Maximum vehicle rebound inclination (1.5°).

TABLE 2-6. SUMMARY OF POST-TEST OBSERVATIONS (TEST 3118-1)

VEHICLE: 1979 Ford Econoline E-150 Van

Dummy Contact Points:	Left Front	Right Front
Head----------	Steering wheel hub and lower rim	Top of head grazed front of dash
Chest----------	None	None
Knees----------	Lower dash	Lower dash

Glazing: Cracked on driver's side of vehicle.

Doors: Tools required to open left driver door and right passenger door.

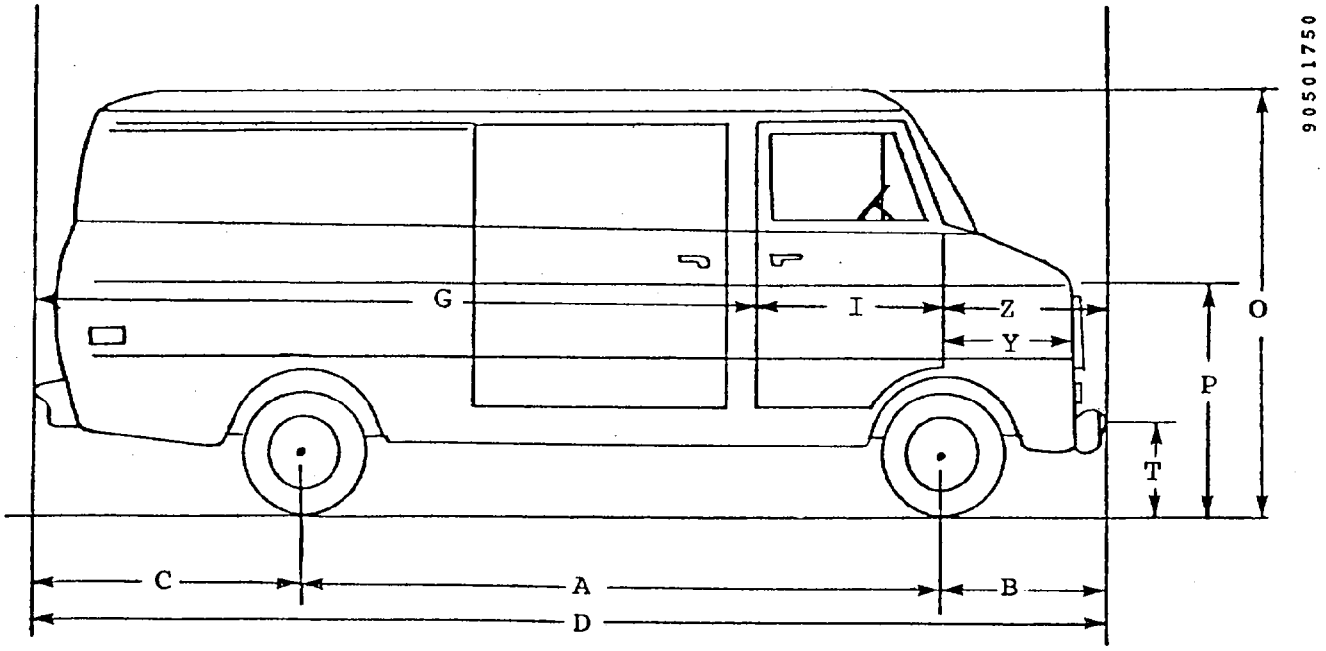
Seat Belt Anchorages and Restraints: Seat belts OK. Left seat moved 2.5 inches rearward. Right seat moved 0.6 inch forward.

Vehicle Center to Barrier Centerline: Rear: 3.4 inches left, Front: 2.3 inches left.

Fuel Leakage: None

General Observations: Radiator leaked. Bumper struck both front tires. 22.4 inches static rebound.

TABLE 2-7. PRE-TEST AND POST-TEST DIMENSION MEASUREMENTS (TEST 3118-1)



VEHICLE: 1979 FORD ECONOLINE E-150 VAN

	Pre-test (in.)		Post-test (in.)		Difference (in.)	
	LS	RS	LS	RS	LS	RS
A	123.7	123.7	121.5	121.0	2.2	2.7
B	24.0	24.5	12.0	11.5	12.0	13.0
C	37.8	38.3	37.5	39.0	0.3	0.7
D	185.5	185.5	171.0	171.5	14.5	14.0
G	108.8	109.0	108.5	109.0	0.3	0.0
I	39.7	39.5	40.0	39.5	0.3	0.0
O	80.5	80.5	80.0	80.0	0.5	0.5
P	42.0	41.5	42.0	42.0	0.0	-0.5
T	23.5	23.0	25.5	24.5	-2.0	-1.5
Y	22.5	22.0	12.0	11.5	10.5	10.5
Z	37.0	37.0	12.0	11.5	25.0	25.5

TABLE 2-8. EXTERIOR PROFILES AND STATIC CRUSH - FORD ECONOLINE E-150 VAN (TEST 3118-1)

Location	Height at ℄	R.P.**	Distance Left of Center (in.)* 36	30	24	18	12	6	0	Distance Right of Center (in.)* 6	12	18	24	30	36
Pre-test Profile - Distance from R.P. (in.)															
Bottom of Windshield	52.5	190	39.8	36.0	33.8	32.3	31.0	30.5	30.4	30.5	31.0	32.0	33.5	36.2	39.8
Hood Level	41.5	190	6.0	4.9	4.8	4.6	4.6	4.4	4.3	4.4	4.7	4.6	4.8	4.9	6.3
Between Bumper/Hood	36.0	190	6.3	5.6	5.0	4.7	4.6	4.4	4.4	4.4	4.5	4.6	4.8	5.5	6.0
Bumper Level	22.8	190	4.0	3.6	3.1	3.0	3.1	3.7	3.7	3.7	3.1	3.0	3.1	3.5	4.0
Post-test Profile - Distance From R.P. (in.)															
Bottom of Windshield	51.6	190	42.0	38.0	36.0	34.0	33.0	32.5	32.5	32.5	32.8	33.8	35.3	38.0	41.5
Hood Level	40.3	190	23.0	19.3	19.8	19.8	19.8	19.5	19.5	20.0	19.8	19.8	19.5	19.8	22.3
Between Bumper/Hood	35.1	190	22.0	-	21.3	21.0	21.0	21.0	20.8	20.8	20.8	20.5	20.5	-	21.5
Bumper Level	22.5	190	19.5	19.8	20.0	20.0	20.3	21.3	21.3	21.3	20.5	20.0	19.5	19.0	18.5
Post-test Static Crush (in.)															
Bottom of Windshield			2.2	2.0	2.2	1.7	2.0	2.0	2.1	2.0	1.8	1.8	1.8	1.8	1.7
Hood Level			17.0	14.4	15.0	15.2	15.2	15.1	15.2	15.6	15.1	15.2	14.7	14.9	19.0
Between Bumper/Hood			15.7	-	16.3	16.3	16.4	16.6	16.4	16.4	16.3	15.9	15.7	-	15.5
Bumper Level			14.5	15.4	16.9	17.0	17.2	17.6	17.6	17.6	17.4	17.0	16.4	15.5	14.4

*As viewed from driver position in van.
**Reference Plane from rear bumper of van.

TABLE 2-9. INTERIOR PROFILES AND STATIC INTRUSION - FORD ECONOLINE E-150 VAN (TEST 3118-1)

Location	Height at ℄	R.P.**	Distance Left of Center (in.)* 36	30	24	18	12	6	0	Distance Right of Center (in.)* 6	12	18	24	30	36
Pre-test Profile - Distance from R.P. (in.)															
Dash level		130	11.0	11.0	11.0	11.0	11.1	11.2	11.2	11.8	13.2	13.1	13.0		
Knee Level		130	12.6	12.6	12.6	12.6	8.0	7.8	8.0	8.9	12.6	12.5	12.6		
Floor Level		130	20.5	25.6	27.1	27.4	5.4	3.8	3.9	5.6	26.8	26.8	23.6		
Post-test Profile - Distance from R.P. (in.)															
Dash Level		130	9.8	10.0	10.8	10.5	10.5	10.8	11.3	11.5	12.5	12.5	13.0		
Knee Level		130	11.5	13.8	12.0	12.0	5.3	5.5	4.8	6.0	13.8	13.5	13.5		
Floor Level		130	19.5	23.0	23.8	17.5	4.8	2.5	2.3	5.3	21.0	20.8	18.0		
Post-test Static Crush (in.)															
Dash Level			1.2	1.0	0.2	0.5	0.6	0.4	-0.1	0.3	0.7	0.6	0.0		
Knee Level			1.1	-1.2	0.6	0.6	2.7	2.3	3.2	2.9	-1.2	-1.0	-0.9		
Floor Level			1.0	2.6	3.3	9.9	0.6	1.3	1.6	0.3	5.8	6.0	5.6		

*As viewed from driver position in van.
**Reference Plane from rear bumper of van.

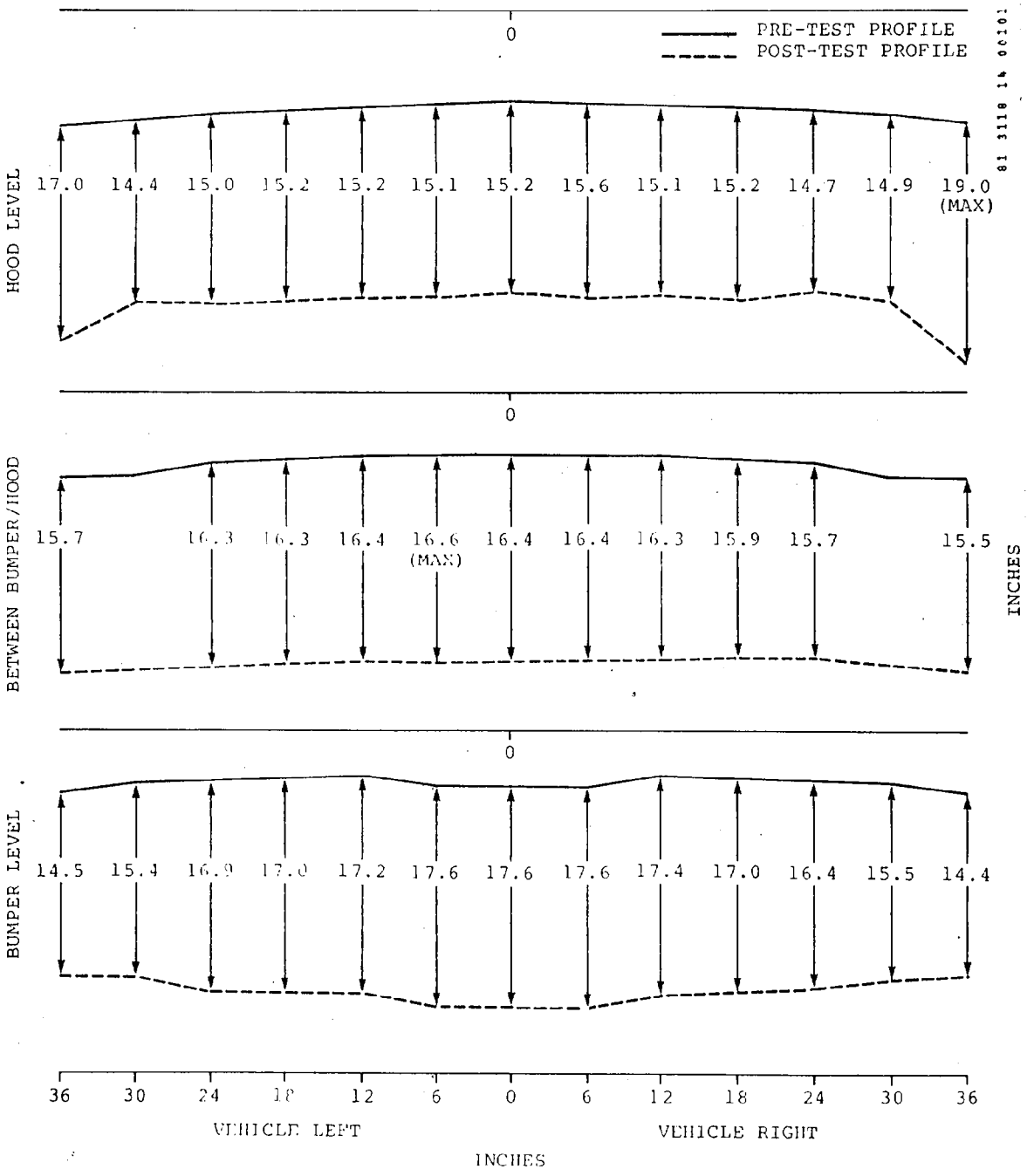


FIGURE 2-4. 1979 FORD E-150 VAN EXTERIOR STATIC CRUSH TEST (3118-1).

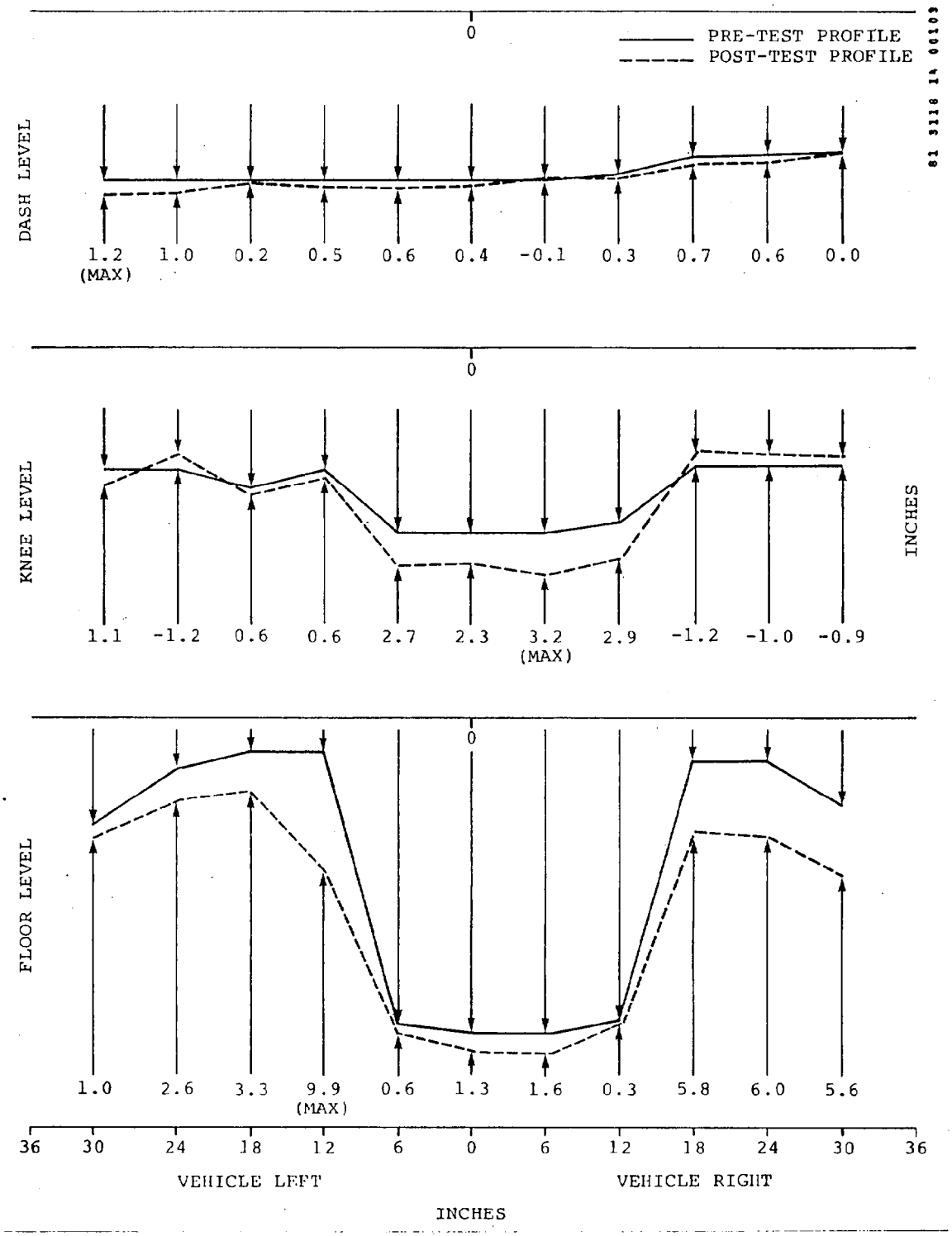


FIGURE 2-5. 1979 FORD E-150 VAN INTERIOR PROFILE AND STATIC INTRUSION (TEST 3118-1).

TABLE 2-10. SUMMARY OF VEHICLE ACCELEROMETER DATA (TEST 3118-1)

Vehicle: 1979 Ford Econoline E-150 Van

Accelerometer		Test 3118-1 (30.34 mph)					
		Maximum Acceleration		Minimum Velocity		Maximum Displacement	
		A	T	V	T	S	T
No.	Location	(G)	(msec)	(mph)	(msec)	(in.)	(msec)
1X	Left Side B-pillar	-32.7	38	-2.6	93	20.8	69
2X	Right Side B-pillar	-37.9	40	-2.5	101	20.2	68
	Average 1X & 2X	-34.8	41	-2.6	93	20.5	69
3X	Left Side Firewall	-60.9	36	-0.1	166	22.6	200
3Y	Left Side Firewall	+21.6	63	-1.1	33	4.2	200
3Z	Left Side Firewall	+30.0	27	-3.8	181	0.2	60
4X	Right Side Firewall	-88.6	40	-2.6	100	17.7	67
4Y	Right Side Firewall	-25.2	22	-2.6	24	8.7	200
4Z	Right Side Firewall	+41.3	27	-3.8	181	0.2	60
5X	Engine	-79.0	42	-4.9	51	18.1	150
5Y	Engine	+6.2	39	-0.9	26	2.7	200
5Z	Engine	+21.1	43	-1.1	30	2.8	111
6X	Front Axle	-96.0	36	2.6	47	36.1	200
7X	Rear Compartment	-34.3	40	-2.1	98	21.0	71
7Y	Rear Compartment	9.0	36	-0.4	22	1.7	200
7Z	Rear Compartment	-40.0	64	-5.4	68	0.2	34
8X	Rear Axle	-71.6	41	-2.5	60	21.2	200

TABLE 2-11. OCCUPANT RESPONSE DATA SUMMARY (TEST 3118-1)

		Test 3118-1 (30.34 mph)			
		Left Front Occupant		Right Front Occupant	
		Maximum Value (G)	T (msec)	Maximum Value (G)	T (msec)
HEAD					
	X	-82.3	74	-34.9	122
	Y	-36.0	56	+21.7	118
	Z	+57.0	74	+53.9	94
	R	101.2	74	+55.2	94
	HIC	517	65-113	709	55-142
CHEST					
	X	-48.0	73	-38.5	71
	Y	-31.4	73	+35.0	75
	Z	+23.8	68	-14.5	82
	R*	49.0	71-74	42.2	69-72
	SI	338	200	319	200
		Maximum Value (lb)	T (msec)	Maximum Value (lb)	T (msec)
FEMURS					
	L	-738	56	-634	57
	R	-3148	58	-297	77

*3-msec clip.

TABLE 2-12. SUMMARY OF MAXIMUM LOAD CELL DATA - FORD ECONOLINE E-150 VAN (TEST 3118-1)

Parameter	Right Half of Car				Left Half of Car				
Load Cell (No.)	D9	D8	D7	D6	D5	D4	D3	D2	D1
Force (klb)	2.63	6.72	8.01	4.22	3.46	2.75	2.59	1.88	5.60
Time (msec)	17	32	16	41	41	43	38	9	38
Load Cell (No.)	C9	C8	C7	C6	C5	C4	C3	C2	C1
Force (klb)	0.36	1.05	15.75	11.55	28.98*	3.18	11.91	7.88	5.08
Time (msec)	46	54	38	39	41	39	37	37	37
Load Cell (No.)	B9	B8	B7	B6	B5	B4	B3	B2	B1
Force (klb)	0.41	9.28	17.89	21.95	3.46	5.77	28.97	15.69	4.13
Time (msec)	15	37	21	36	41	35	31	35	36
Load Cell (No.)	A9	A8	A7	A6	A5	A4	A3	A2	A1
Force (klb)	0.66	2.28	0.55	0.56	0.50	0.48	0.44	0.44	1.70
Time (msec)	47	64	29	29	29	29	29	28	39

*Maximum measured force.

TABLE 2-13. SUMMARY OF GROUPED LOAD CELL DATA BY COLUMNS AND ROWS (TEST 3118-1)

Vehicle: 1979 Ford Econoline E-150 Van

Parameter	Test 3118-2 (30.29 mph) Peak Load (klb)	Time (msec)
Column 1	16.16	38
Column 2	24.44	37
Column 3	38.98	31
Column 4	11.16	39
Column 5	35.91	41
Column 6	37.19	38
Column 7	36.68	38
Column 8	17.55	36
Column 9	3.52	47
Row A	5.36	47
Row B	97.70	39
Row C	78.92	39
Row D	29.35	38

TABLE 2-14. COMPARISON OF TOTAL LOAD CELL FORCE AND INERTIA FORCE (TEST 3118-1)

Vehicle: 1979 Ford Econoline E-150 Van

	Load Cell* Force	Engine/Car** Inertia Force
Force (klb)	210.53	207.45
Time (msec)	39	41

*Sum of 36 load cells.
**Average of van accelerometers 1 and 2 times van weight (4228 lb) plus engine acceleration times engine weight (768 lb).

3.0 PRESENTATION OF RESULTS (TEST 3118-2)

This section of the report presents the results of Test No. 3118-2, a head-on symmetric crash test between a 1979 Ford E-150 Econoline Van and the 36-Load Cell Fixed Barrier (V_o = 30.29 mph).

This report presents all test results without analysis or discussion. Included in this document are: still photographs, film chronologies, vehicle damage sketches and tabulated pre- and post-test dimensions, accelerometer location identification, summaries of vehicle and Load Cell Fixed Barrier electronic data, and summaries of the simulated occupant data, including injury criteria values. High-speed motion pictures were also obtained for this test and have been submitted to NHTSA. Appendix B contains Calcomp plots for all electronic data for this test. This includes all vehicle accelerometer data, occupant response data, seat belt loads, load cell data, force-deflection curves, and string potentiometer data.

TABLE 3-1. CRASH TEST SUMMARY (TEST 3118-2)

TEST NO.: 3118-2 CONTRACT: DTNH22-81-C-07113

TEST DATE: October 29, 1981 TIME: 1440 TEMPERATURE: 79 °F

TEST CONFIGURATION: Van-to-36 Load Cell Fixed Barrier Symmetric Head-on

VEHICLE NO. 1: 1979 Ford Econoline E-150 Van (Modified)

VEHICLE NO. 2: 36 Load Cell Fixed Barrier

VEHICLE DATA	VEHICLE NO. 1	VEHICLE NO. 2
Overall Length/Width (in.)	193.0/79.4	
Test Weight by Wheel (lb)	LF 1321 RF 1321 LR 1189 RR 1173	
Total Weight (lb)	5004	>100,000
Wheelbase (in.)	125.7	
Longitudinal C.G. (From Center of Front Axle) (in.)	59.3	
Impact Angle (deg)*	0	0
Offset Distance (in.)	0	0
Car Speed (mph)	30.29	0
Final Speed (mph @ msec)	-2.20 @ 114	
Velocity Change (mph)	32.49	
Maximum Averaged Compartment Acceleration (G @ msec)	-28.6 @ 50	
Maximum Engine Acceleration (G @ msec)	-69.20 @ 57	
Maximum Mutual Dynamic Crush (Film Data) (in.)	24.1	
Maximum Static Crush		
• Bottom of Windshield (in.)	0.5	
• Hood Level (in.)	13.5	
• Between Bumper/Hood (in.)	13.0	
• Bumper Level (in.)	22.0	
Maximum Post-test Intrusion (in.)	6.4	
OCCUPANTS		
Type	Alderson Part 572	
Location	LF - #A08 RF - #A09	
Restraints	Standard Lap and Shoulder Belt	
INSTRUMENTATION		
Number of Data Channels	38	36
Number of Cameras	8	

*With respect to tow truck centerline.

TABLE 3-2. RECEIVING INSPECTION OF VEHICLES

Contractor: Dynamic Science, Inc. Contract No.: DTNH22-81-C-07113

VIN No.: E14HBEG6651 Make: Ford Van (Modified)

NHTSA No.: R & D

Year: 1979 Color: Lt. Blue Model: E-150 Van

Auto Trans:	yes x	no	Pwr Steering:	yes x	no	Seats: (front)	Bench:
Pwr Brakes:	yes x	no	Auto Speed Cont:	yes	no x		Bucket: x
Pwr Seats:	yes	no x	Anti Skid Brake:	yes	no x		Split Bench:
Pwr Windows:	yes	no x	Air Conditioning:	yes	no x		
Tinted Glass:	yes	no x	Rear Window Def.:	yes	no x		Split Back Bench:
Radio:	yes	no x	Brakes: drum: R	disc: F			
Clock:	yes	no x					

Tire Size: L78-15 Ply Rating: 4 Mfg. & Line: Goodyear

Bias Ply: x Belted: Radial: / Eng. Type: V8 Cylinders: 8 Total Displ: 351 cu in.

Trans., # Fwd. Speeds: 3 Shipping Weight: Odometer: None

Dealer (name, address, and phone number): The Budd Company via Cooper Mfg. and Equipment Corp.

Remarks (list additional accessories not listed above): Instrument panel missing.

Date of Manufacture: 9/12/79 Dynamic Science No.: 1214 Date Received: 9/8/81

Tilting Steering Wheel: yes no x Telescoping Steering Wheel: yes no x

Fuel Capacity: (from owner's manual) "Space Saver" Spare Tire: yes no x

Restraint System: 3-point belt

1. Is the vehicle stock throughout? Describe: No, vehicle contains modified steering column, no instrument panel, and modified front bumper. Front of bumper extends 6 inches forward of van face.

2. Does vehicle show evidence of prior accident history? Describe: No, no evidence of prior accident visible.

3. Does vehicle show any significant corrosion? Describe: No significant corrosion visible.

4. Check condition of the front bumper and frame: Modified front bumper.

TABLE 3-3. SUMMARY OF PRE-TEST ENGINE/BUMPER/FIREWALL CHARACTERISTICS (TEST 3118-2)

Test No.: 3118-2 Type: Van-to-NHTSA Fixed Test Device

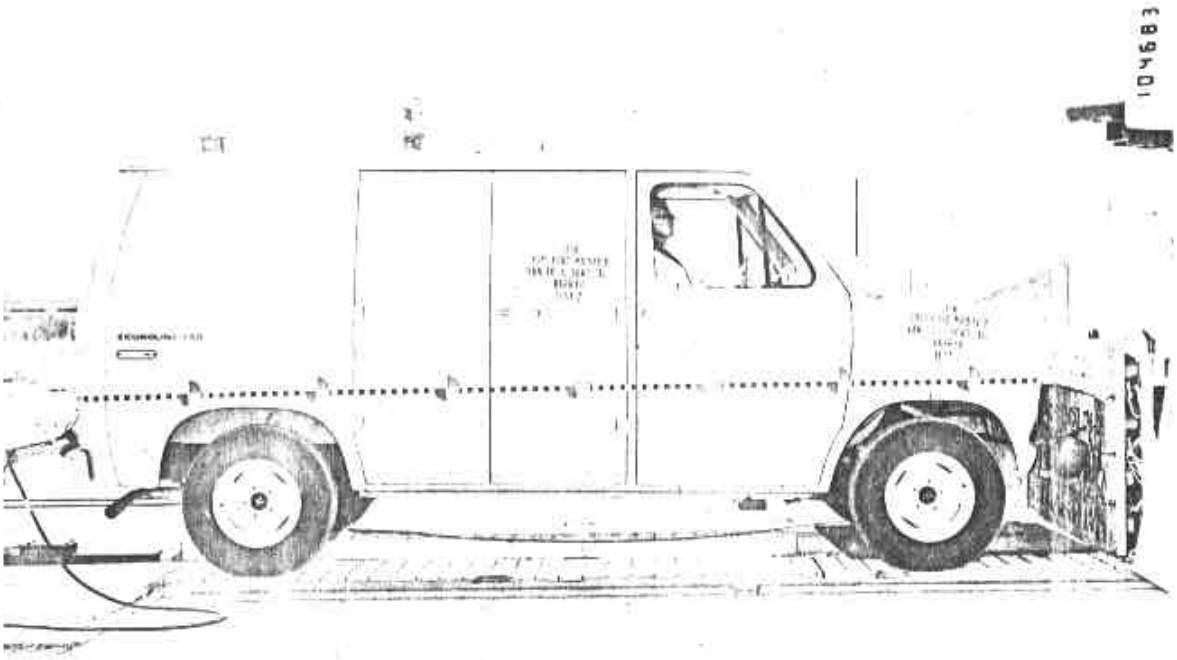
Car Model: 1979 Ford E-150 Van Dynamic Science No.: 1214

Engine Size	351 CID
Engine Weight* (lb)	768
Engine Height/Width (in.)	33.4/19.2
Bumper to Engine Block (in.)	33.3
Engine Length (in.)	19.8
Engine to Firewall (in.)	Not Applicable
Bumper to Firewall (in.)	34.8
Bumper Height (in.) (Min./Max)	16.9/24.0

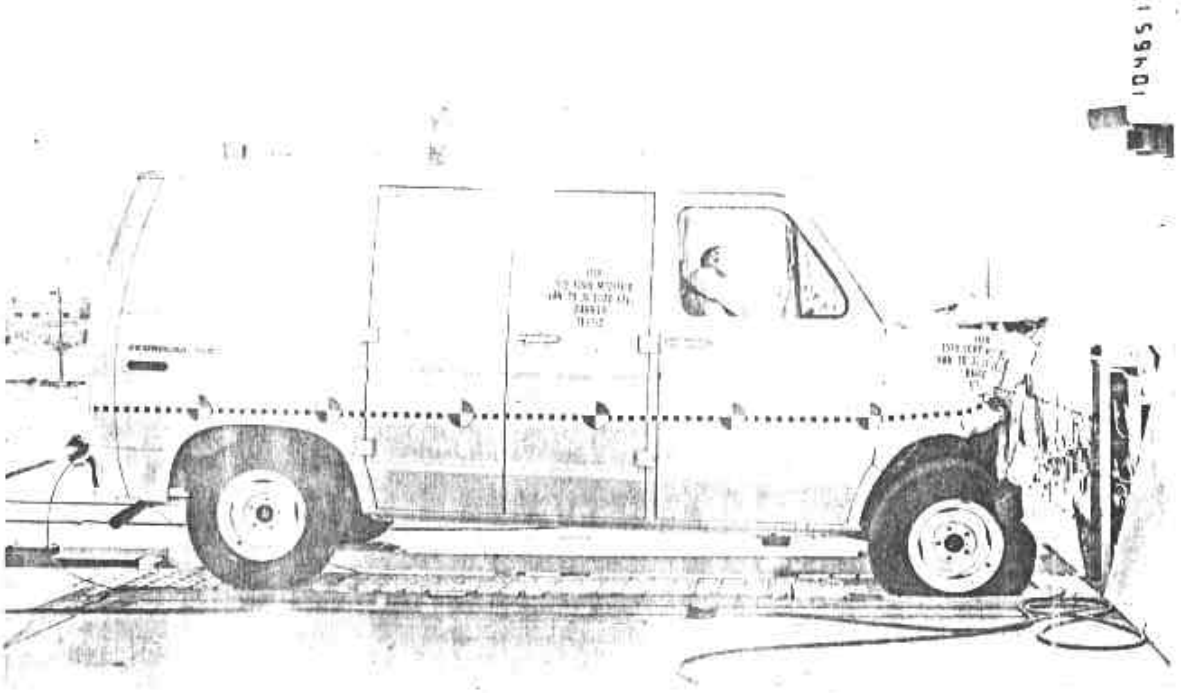
*Includes engine and rigid attachments such as transmission and drive train.

TABLE 3-4. PRE-TEST DUMMY POSITIONS - FORD E-150 VAN (TEST 3118-2)

Distances (in.)	Driver	Passenger
Chest to Steering Wheel Hub (horizontal)	15.5	
Head to Windshield (horizontal)	27.0	26.5
Knee to Lower Panel (closest point)		
Left	9.0	6.5
Right	9.0	7.0
Chest to Dash (horizontal)	25.0	23.0
Forehead to Header	21.3	20.3



A - PRE-TEST



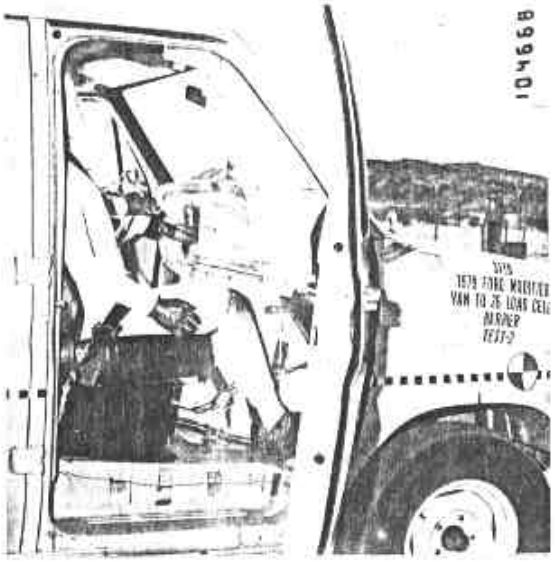
B - POST-TEST

FIGURE 3-1. VEHICLE CONFIGURATION (TEST 3118-2).

FIGURE 3-2. POST-TEST VEHICLE CONFIGURATION (TEST 3118-2).

A - PRE-TEST DRIVER

B - POST-TEST DRIVER



C - PRE-TEST PASSENGER

D - POST-TEST PASSENGER

FIGURE 3-3. VEHICLE DUMMY CONFIGURATION (TEST 3118-2).

TABLE 3-5. CHRONOLOGY OF EVENTS (TEST 3118-2)

VEHICLE: 1979 Ford Econoline E-150 Van

Time (msec)	Crash Event
0	Impact (visual).
15	Fenders hit barrier.
21	Bumper strikes front tires; Dummies start forward motion.
45	Front tires hit barrier; Passenger knees strike dash.
55	Passenger strike engine cowling with left hand.
59	Fender wells strikes back of front tires.
63	Driver knees hit dash.
65	Right rear tire leaves ground.
79	Driver hands strike dash.
83	Maximum vehicle dynamic crush (24.1 in.).
89	Driver head strikes steering wheel hub.
103	Passenger head strikes dash.
105	Maximum driver forward motion.
128	Maximum passenger forward motion.
131	Left rear tire leaves ground.
165	Passenger recontacts seat with upper back.
169	Driver recontacts seat with upper back.
200	Vehicle separates from barrier.
430	Right rear tire recontacts ground.

TABLE 3-6. SUMMARY OF POST-TEST OBSERVATIONS (TEST 3118-2)

VEHICLE: 1979 Ford Econoline E-150 Van

Dummy Contact Points:	Left Front	Right Front
Head----------	Steering wheel hub	Dash
Chest----------	Steering wheel lower rim	None
Knees----------	Lower dash	Lower dash

Glazing: Windshield 100% intact.

Doors: Right side doors open easily; left side door tools required.

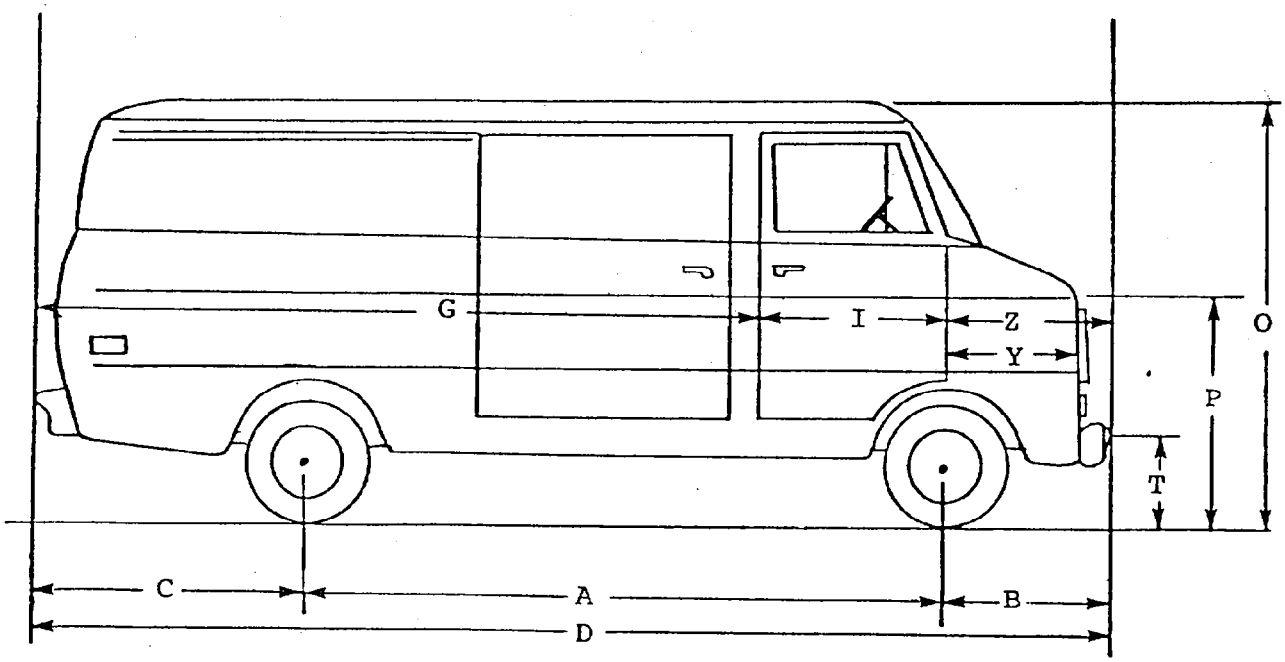
Seat Belt Anchorages and Restraints: Seat belts OK. Right seat moved 2.5 inches forward

Vehicle Center to Barrier Centerline: Rear: 3 inches right, Front: 1 inch right.

Fuel Leakage: None

General Observations: Radiator leaked. Bumper struck both front tires. Puncturing the right front tire. Eight inches static rebound. Hood struck top row of load cells. Steering wheel made oval and bent back.

TABLE 3-7. PRE-TEST AND POST-TEST DIMENSION MEASUREMENTS (TEST 3118-2)



VEHICLE: 1979 FORD ECONOLINE E-150 VAN

	Pre-test (in.)		Post-test (in.)		Difference (in.)	
	LS	RS	LS	RS	LS	RS
A	125.7	125.7	121.0	123.0	4.7	2.7
B	29.0	29.0	13.3	12.3	15.7	16.7
C	37.8	37.8	38.0	38.0	0.2	0.2
D	192.0	192.0	172.3	173.3	19.7	18.7
G	108.5	108.8	108.0	109.0	0.5	-0.2
I	39.5	39.3	39.3	39.7	0.2	-0.4
O	79.9	79.8	79.9	79.8	0.0	0.0
P	42.0	42.0	42.0	39.0	0.0	3.0
T	22.0	23.0	24.5	19.5	-2.5	3.5
Y	36.0	36.0	13.3	12.3	22.7	23.7
Z	44.0	44.0	13.3	12.3	30.7	31.7

TABLE 3-8. EXTERIOR PROFILES AND STATIC CRUSH - FORD ECONOLINE E-150 VAN (TEST 3118-2)

Location	Height at ℄	R.P.**	Distance Left of Center (in.)* 36	30	24	18	12	6	0	Distance Right of Center (in.)* 6	12	18	24	30	36
Pre-test Profile - Distance from R.P. (in.)															
Bottom of Windshield	52.5	190	39.8	36.0	33.8	32.3	31.0	30.5	30.4	30.5	31.0	32.0	33.5	36.2	39.8
Hood Level	41.5	190	6.0	4.9	4.8	4.6	4.6	4.4	4.3	4.4	4.7	4.6	4.8	4.9	6.3
Between Bumper/Hood	36.0	190	6.3	5.6	5.0	4.7	4.6	4.4	4.4	4.4	4.5	4.6	4.8	5.5	6.0
Bumper Level	22.5	200	8.0	7.3	7.0	6.8	6.5	7.1	7.3	7.1	6.3	6.3	6.5	6.8	7.5
Post-test Profile - Distance From R.P. (in.)															
Bottom of Windshield	53.2	200	49.8	46.0	43.8	42.5	41.5	41.0	40.8	41.0	41.5	42.3	44.0	46.3	49.8
Hood Level	41.9	200	29.5	28.0	28.0	28.0	27.8	27.5	27.5	27.3	26.8	26.5	26.5	26.8	27.5
Between Bumper/Hood	37.8	200	29.0	-	27.0	26.5	26.3	26.3	26.3	26.3	26.3	26.5	27.0	-	29.0
Bumper Level	29.2	200	27.5	27.5	27.5	27.8	28.5	28.5	28.5	28.5	27.8	27.8	27.5	27.5	27.5
Post-test Static Crush (in.)															
Bottom of Windshield			0.0	0.0	0.0	0.2	0.5	0.5	0.4	0.5	0.5	0.3	0.5	0.1	0.0
Hood Level			13.5	13.1	13.2	13.4	13.2	13.1	13.2	12.9	12.1	11.9	11.7	11.9	11.2
Between Bumper/Hood			12.7	-	12.0	11.8	11.7	11.9	11.9	11.9	11.8	11.9	12.2	-	13.0
Bumper Level			19.5	20.2	20.5	21.0	22.0	21.4	21.2	21.4	21.5	21.5	21.0	20.7	20.0

*As viewed from driver position in van.
**Reference Plane from rear bumper of van.

TABLE 3-9. INTERIOR PROFILES AND STATIC INTRUSION - FORD ECONOLINE E-150 VAN (TEST 3118-2)

Location	Height at ℄	R.P.**	Distance Left of Center (in.)* 36	30	24	18	12	6	0	Distance Right of Center (in.)* 6	12	18	24	30	36
Pre-test Profile - Distance from R.P. (in.)															
Dash level		130	11.0	11.0	11.0	11.0	11.1	11.2	11.2	11.8	13.2	13.1	13.0		
Knee Level		130	12.6	12.6	12.6	12.6	8.0	7.8	8.0	8.9	12.6	12.5	12.6		
Floor Level		130	20.5	25.6	27.1	27.4	5.4	3.8	3.9	5.6	26.8	26.8	23.6		
Post-test Profile - Distance from R.P. (in.)															
Dash Level		130	10.2	10.7	10.8	11.7	12.1	11.5	11.7	12.0	12.5	12.8	12.8		
Knee Level		130	10.8	12.4	13.8	13.9	7.4	6.8	7.4	8.8	16.2	18.7	19.0		
Floor Level		130	19.5	23.6	25.3	25.2	4.6	2.0	3.7	7.5	26.0	21.4	20.5		
Post-test Static Crush (in.)															
Dash Level			0.8	0.3	0.2	-0.7	-1.0	-0.3	-0.5	0.2	0.7	0.3	0.2		
Knee Level			1.8	0.2	-1.2	-1.3	0.6	0.1	0.6	0.1	-3.6	-6.2	-6.4		
Floor Level			1.0	2.0	1.8	2.2	0.8	1.8	0.2	-1.9	0.8	5.4	3.1		

*As viewed from driver position in van.
**Reference Plane from rear bumper of van.

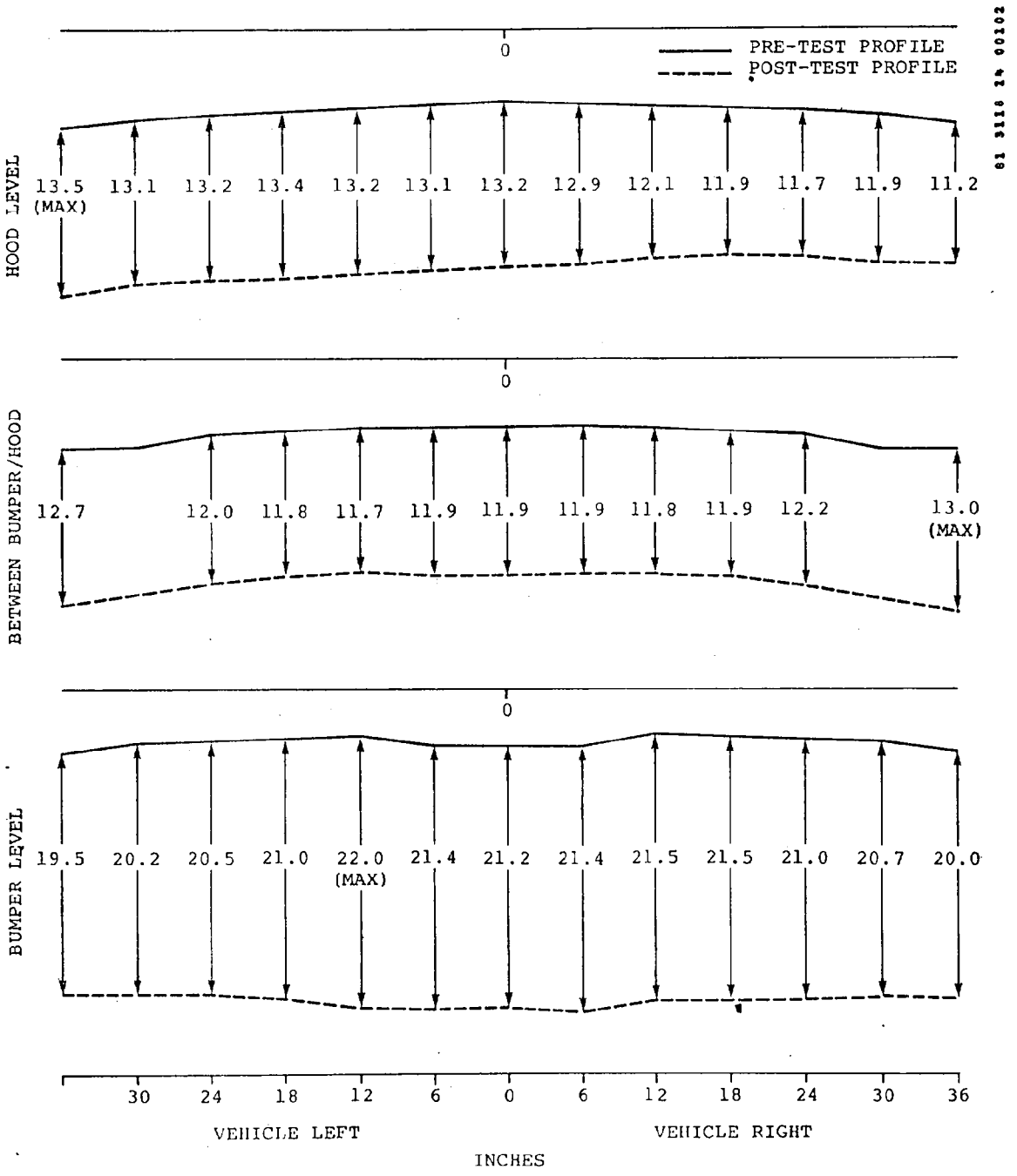


FIGURE 3-4. 1979 FORD E-150 VAN EXTERIOR STATIC CRUSH TEST (3118-2).

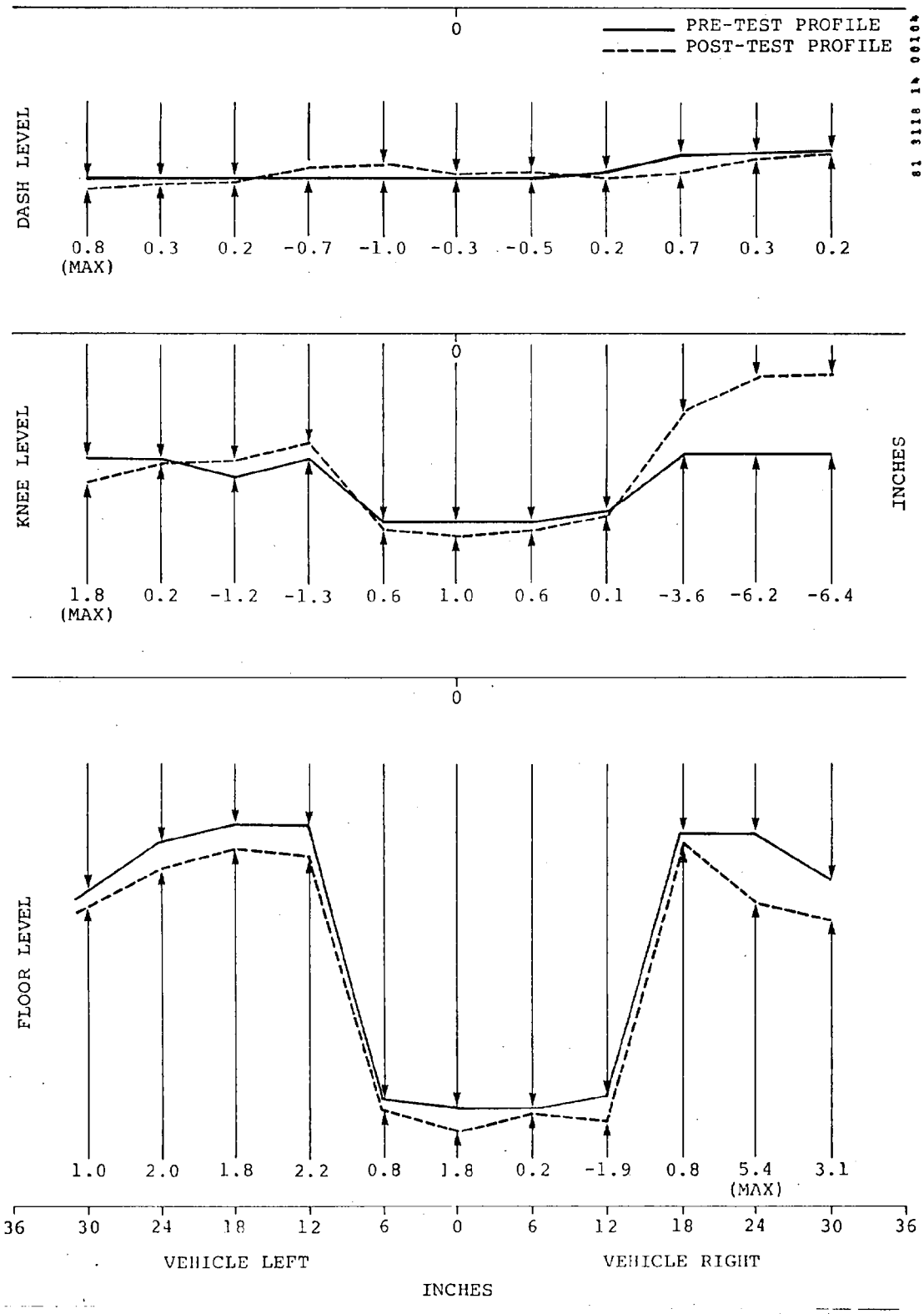


FIGURE 3-5. 1979 FORD E-150 VAN INTERIOR PROFILE AND STATIC INTRUSION (TEST 3118-2).

TABLE 3-10. SUMMARY OF VEHICLE ACCELEROMETER DATA (TEST 3118-2)

Vehicle: 1979 Ford Econoline E-150 Van

Accelerometer		Test 3118-2 (30.29 mph)					
		Maximum Acceleration		Minimum Velocity		Maximum Displacement	
		A	T	V	T	S	T
No.	Location	(G)	(msec)	(mph)	(msec)	(in.)	(msec)
1X	Left Side B-pillar	-29.2	46	-2.3	113	23.5	76
2X	Right Side B-pillar	-30.8	50	-2.1	116	24.3	76
	Average 1X & 2X	-28.6	50	-2.2	114	23.9	76
3X	Left Side Firewall	-57.6	28	-1.0	112	22.9	104
3Y	Left Side Firewall	-16.0	25	-1.7	53	-0.6	66
3Z	Left Side Firewall	+17.6	54	0.0	46	8.8	200
4X	Right Side Firewall	-70.3	42	-1.4	100	23.9	81
4Y	Right Side Firewall	+14.3	47	-1.5	44	4.0	200
4Z	Right Side Firewall	+24.0	29	5.3	71	6.7	200
5X	Engine	-69.2	57	-3.3	68	23.4	148
5Y	Engine	+6.4	61	-1.4	46	1.0	200
5Z	Engine	+11.6	59	+3.9	66	3.6	178
6X	Front Axle	-63.5	36	+0.6	65	23.6	200
7X	Rear Compartment	-28.2	50	+3.3	114	34.6	200
7Y	Rear Compartment	+15.8	73	+1.6	80	2.7	200
7Z	Rear Compartment	+31.1	61	+6.9	199	9.9	200
8X	Rear Axle	-40.1	24	-3.2	80	22.7	72

TABLE 3-11. OCCUPANT RESPONSE DATA SUMMARY (TEST 3118-2)

		Test 3118-2 (30.29 mph)			
		Left Front Occupant		Right Front Occupant	
		Maximum Value (G)	T (msec)	Maximum Value (G)	T (msec)
HEAD					
	X	-87.6	84	-97.9	112
	Y	-21.3	83	+43.1	120
	Z	+38.3	42	+115.5	131
	R	93.3	84	127.7	112
	HIC	441	77-103	1093	107-122
CHEST					
	X	-47.3	86	-34.4	84
	Y	-24.4	81	+33.3	89
	Z	+25.1	79	-10.6	96
	R*	39.2	85	37.7	86
	SI	302	200	239	200
		Maximum Value (lb)	T (msec)	Maximum Value (lb)	T (msec)
FEMURS					
	L	-703	61	-460	67
	R	-939	69	-402	63

*3-msec clip.

TABLE 3-12. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 3118-2)

Vehicle: 1979 Ford Econoline E-150 Van

	Test 3118-2 (30.29 mph)	
	Peak Load (lb)	Time (msec)
LEFT FRONT OCCUPANT		
Left Lap Belt	1288	81
Right Lap Belt	1160	82
Shoulder Belt	1505	84
RIGHT FRONT OCCUPANT		
Left Lap Belt	Sensor Damaged at 70 ms	
Right Lap Belt	1422	84
Shoulder Belt	1423	90

TABLE 3-13. SUMMARY OF MAXIMUM LOAD CELL DATA - FORD ECONOLINE E-150 VAN (TEST 3118-2)

Parameter	Right Half of Car				Left Half of Car				
Load Cell (No.)	D9	D8	D7	D6	D5	D4	D3	D2	D1
Force (klb)	5.82	3.79	3.25	2.64	3.02	1.32	2.85	3.51	3.89
Time (msec)	23	30	25	55	54	19	19	20	49
Load Cell (No.)	C9	C8	C7	C6	C5	C4	C3	C2	C1
Force (klb)	4.54	5.28	10.71	19.98	11.05	5.41	6.35	3.87	0.46
Time (msec)	56	20	19	57	57	51	51	51	39
Load Cell (No.)	B9	B8	B7	B6	B5	B4	B3	B2	B1
Force (klb)	1.51	3.51	24.93	5.48	0.19	9.10	37.79*	3.49	0.37
Time (msec)	55	12	31	57	55	52	38	40	79
Load Cell (No.)	A9	A8	A7	A6	A5	A4	A3	A2	A1
Force (klb)	1.55	0.30	0.24	0.24	0.17	0.22	0.30	0.35	0.41
Time (msec)	55	44	42	42	13	13	27	58	38

*Maximum measured force.

TABLE 3-14. SUMMARY OF GROUPED LOAD CELL DATA BY COLUMNS AND ROWS (TEST 3118-2)

Vehicle: 1979 Ford Econoline E-150 Van

Parameter	Test 3118-2 (30.29 mph) Peak Load (klb)	Time (msec)
Column 1	4.50	49
Column 2	9.31	50
Column 3	42.83	49
Column 4	14.91	52
Column 5	13.83	57
Column 6	28.11	57
Column 7	36.00	30
Column 8	9.43	20
Column 9	11.61	55
Row A	2.71	58
Row B	75.29	52
Row C	59.00	56
Row D	22.25	54

TABLE 3-15. COMPARISON OF TOTAL LOAD CELL FORCE AND INERTIA FORCE (TEST 3118-2)

Vehicle: 1979 Ford Econoline E-15 Van

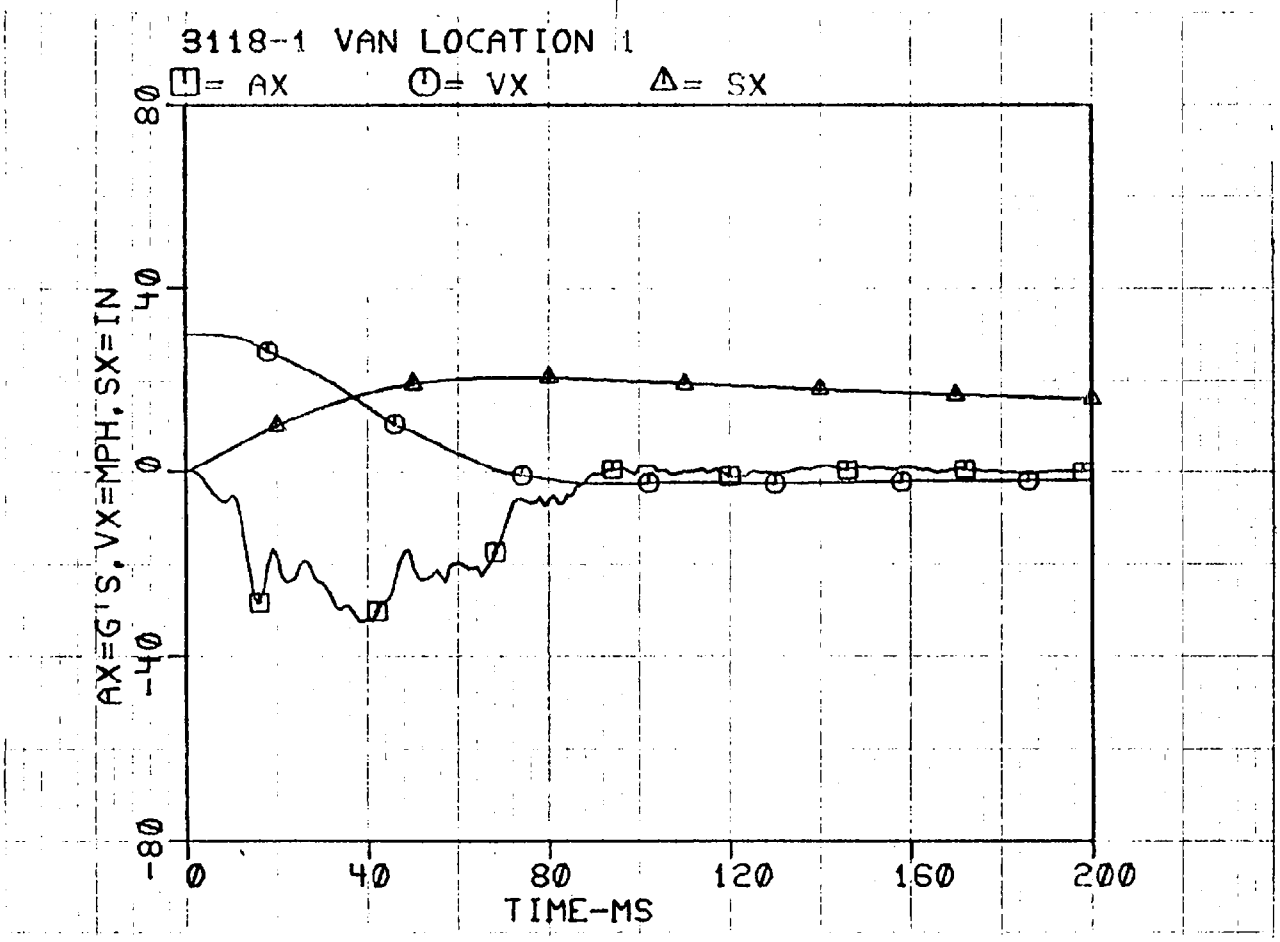
	Load Cell* Force	Engine/Car** Inertia Force
Force (klb)	157.06	161.23
Time (msec)	55	52

*Sum of 36 load cells.
**Average of van accelerometers 1 and 2 times van weight (4236 lb) plus engine acceleration times engine weight (768 lb).

APPENDIX A

CALCOMP PLOTS FOR
TEST 3118-1
MODIFIED (STIFFENED) FORD E-150
ECONOLINE VAN-TO-36 MODULE LCFB

TEST SPEED: 30.34 MPH
TEST DATE: OCTOBER 27, 1981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△= SX
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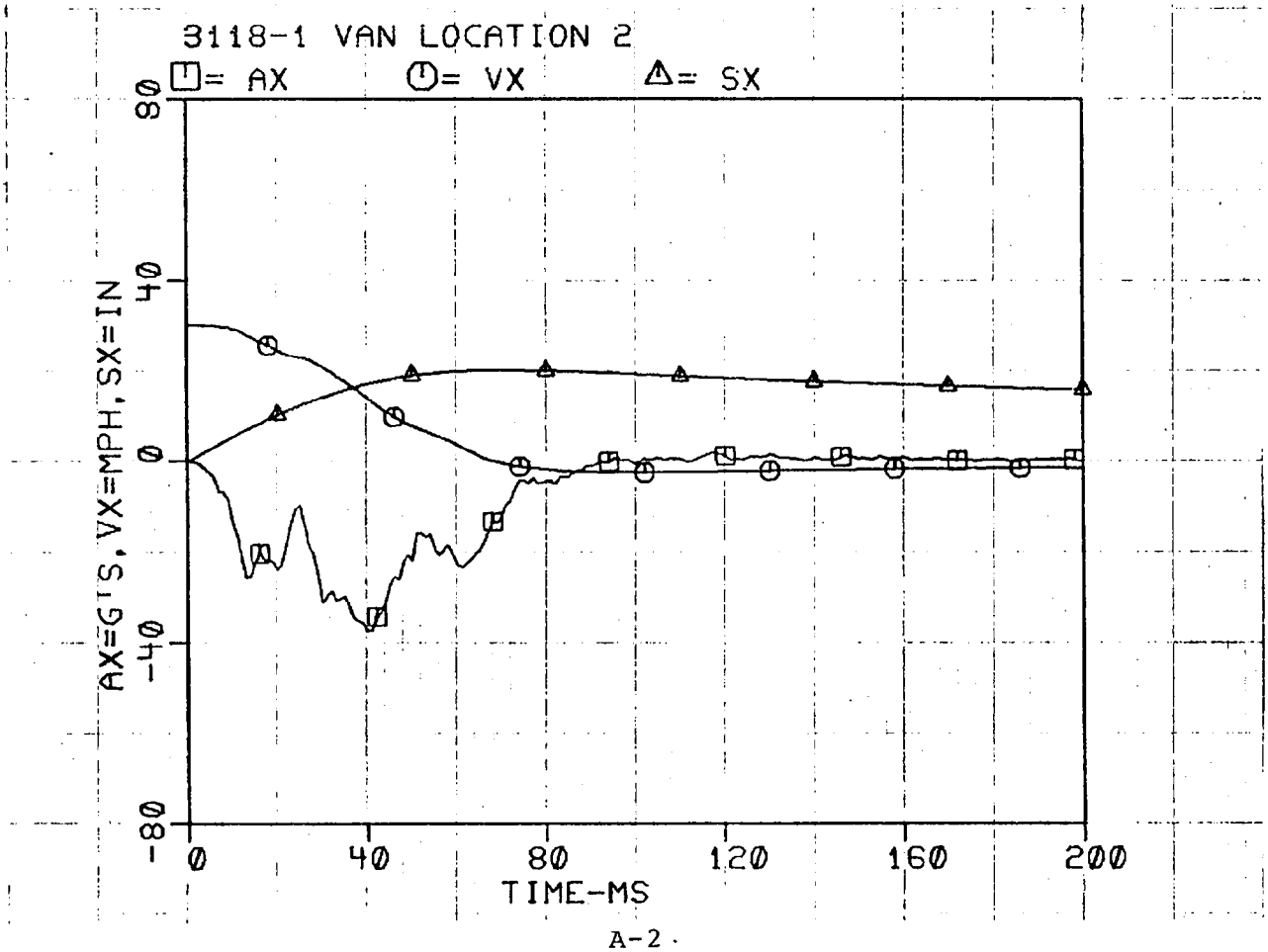
-80
0
40
80
120
160
200
TIME-MS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-80
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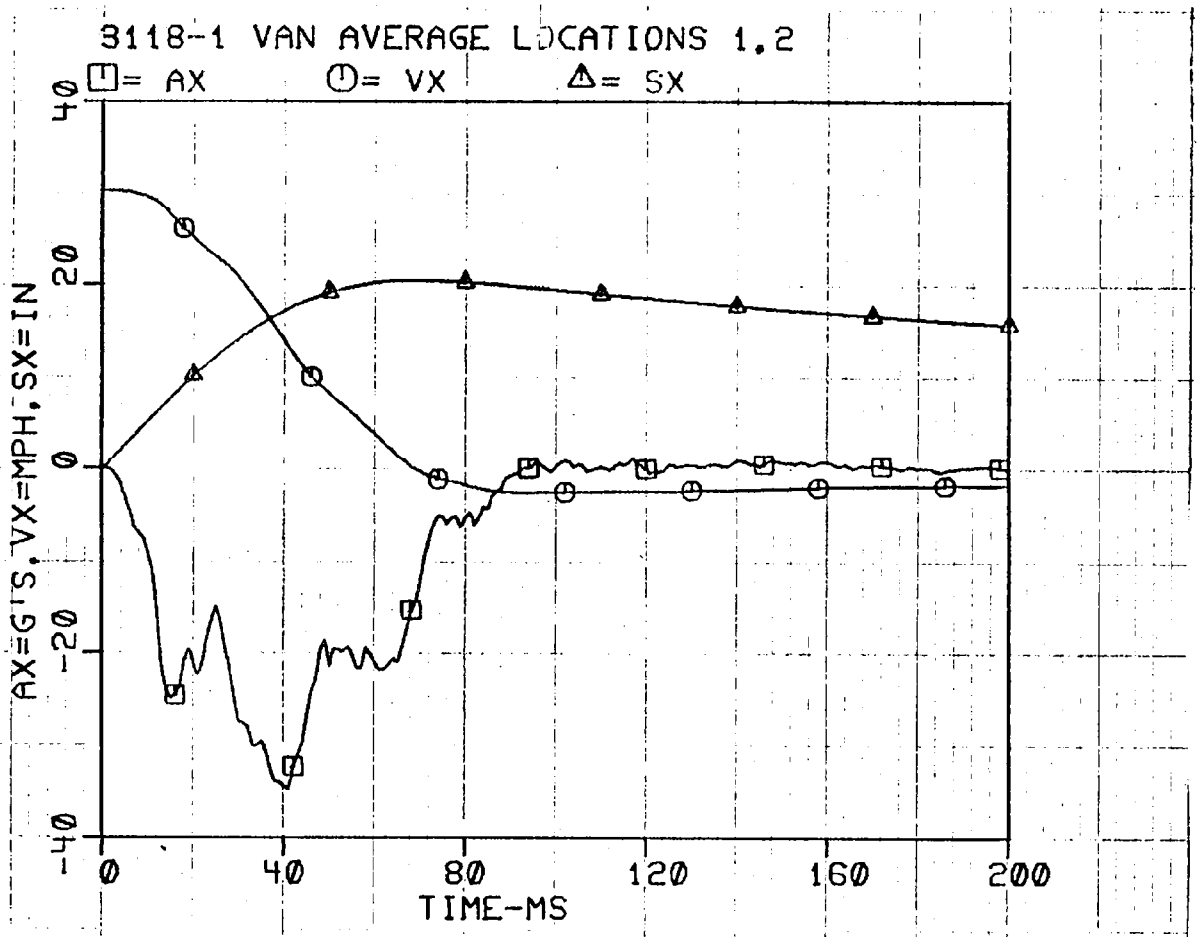
40
80
120
160
200
TIME-MS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-20
-40
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80
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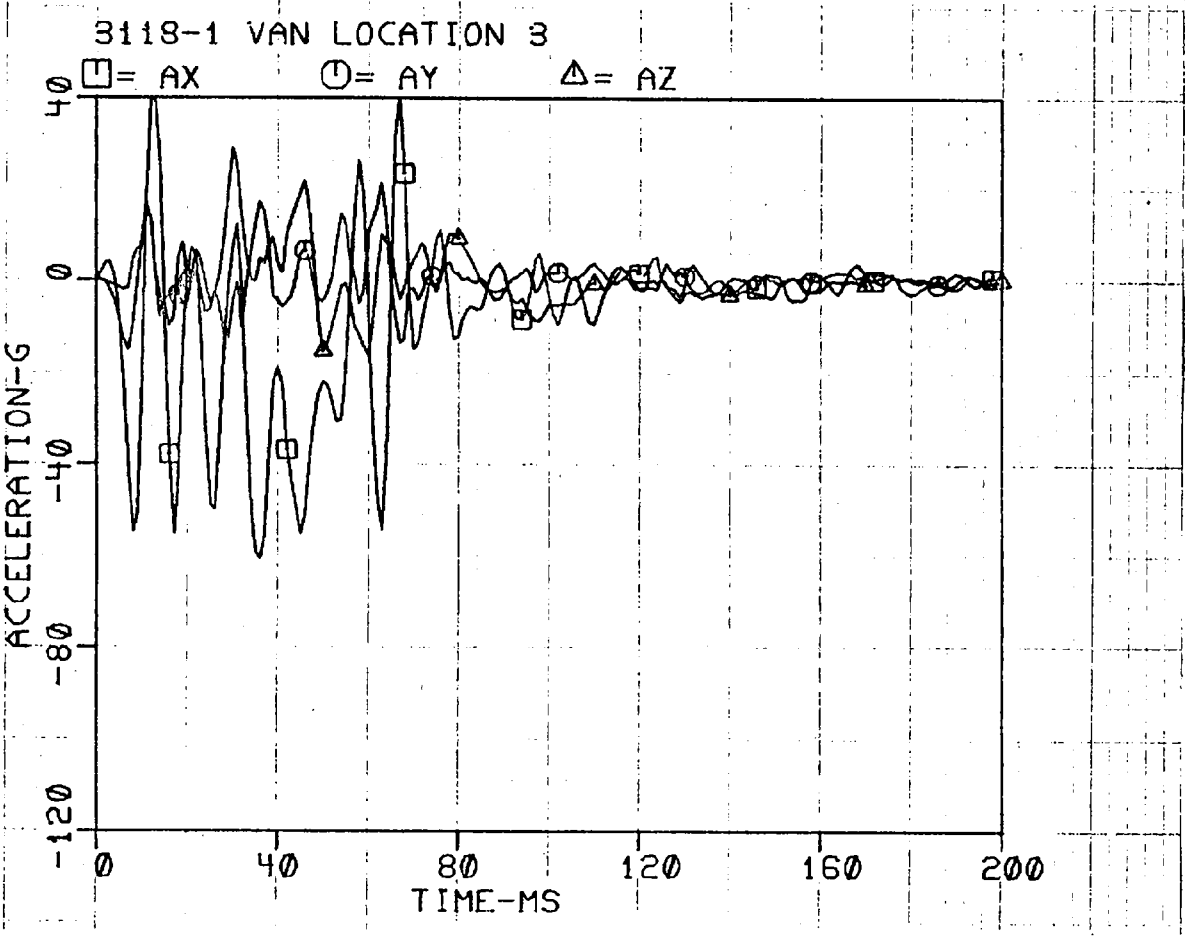
160
200
TIME-MS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△= AZ
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-80
-120
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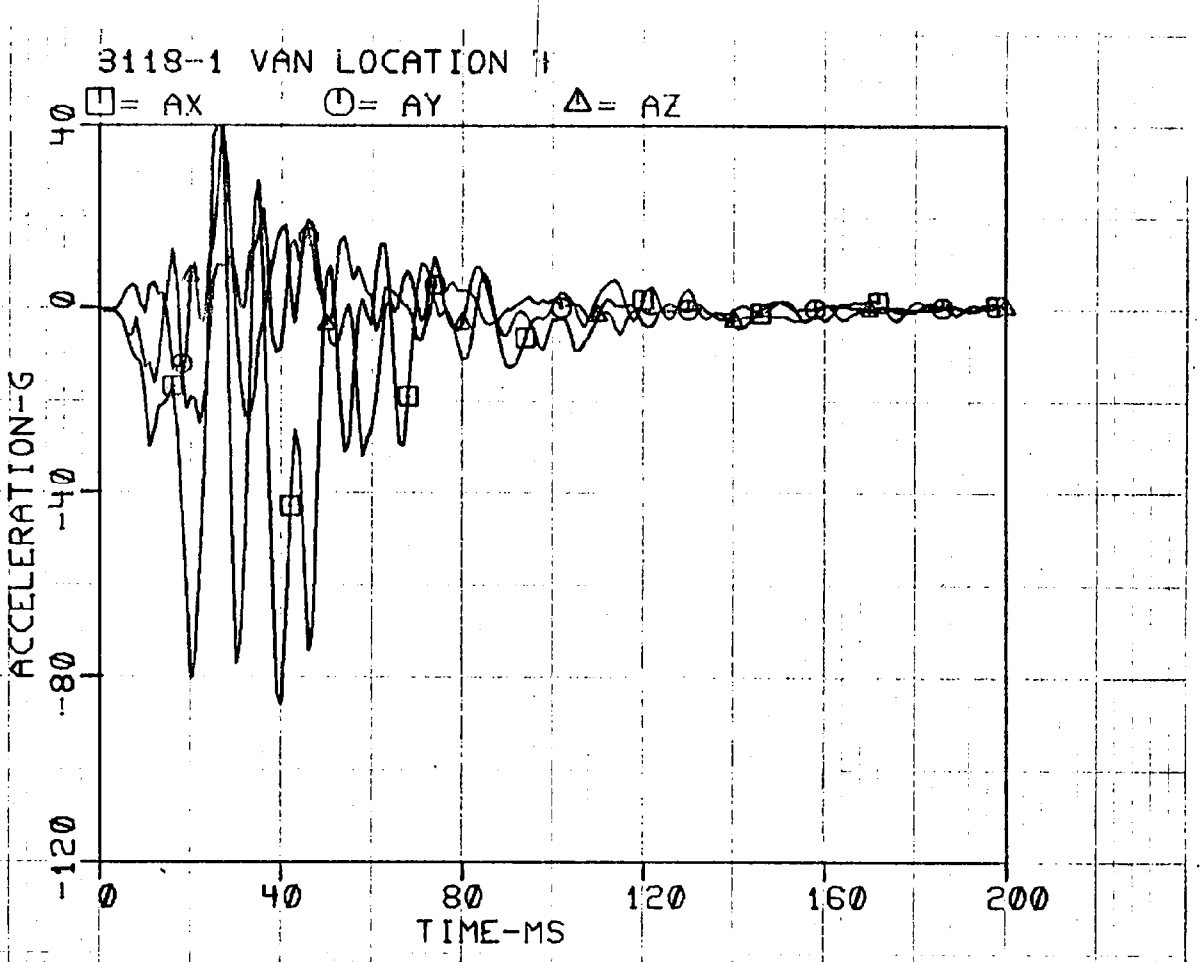
40
80
120
160
200
TIME-MS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-40
-80
-120
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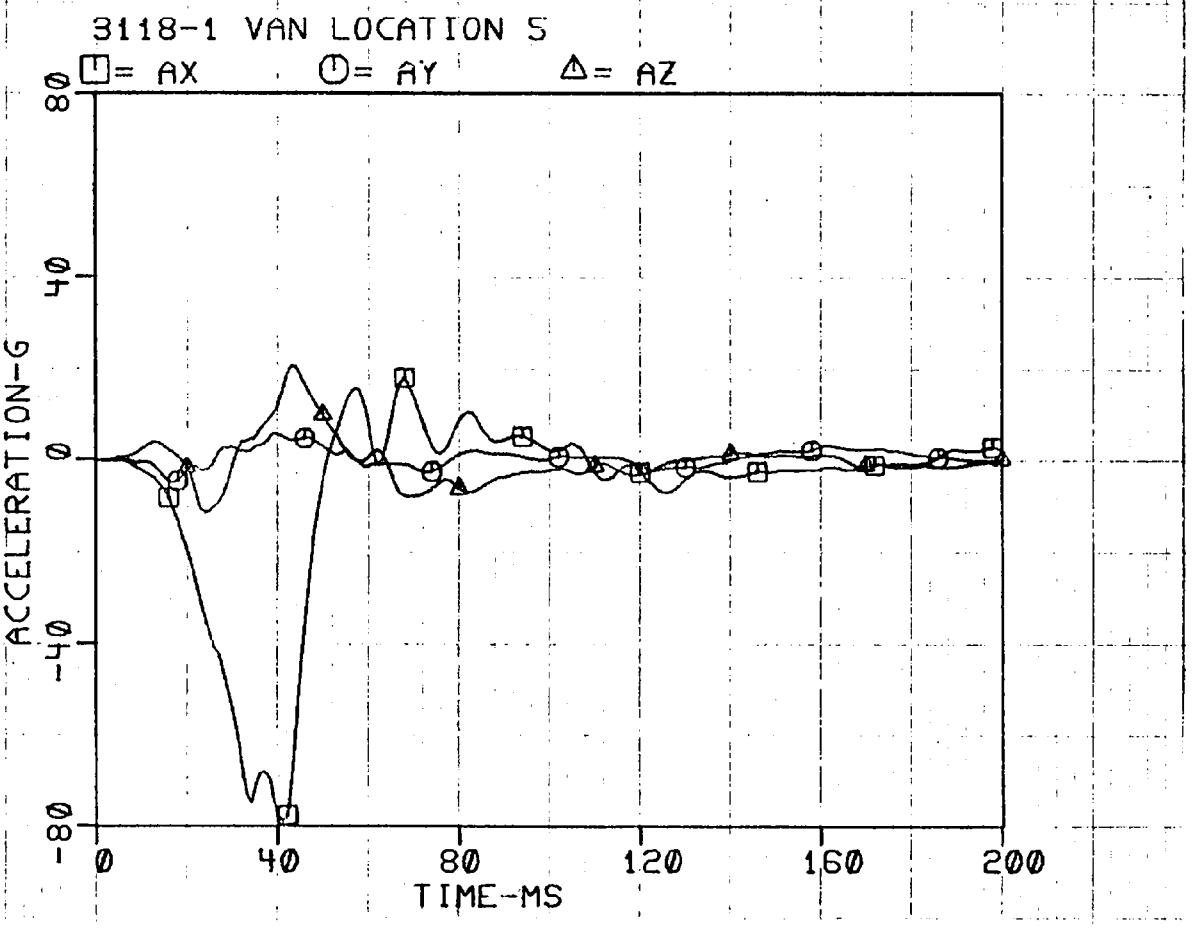
40
80
120
160
200
TIME-MS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-40
-80
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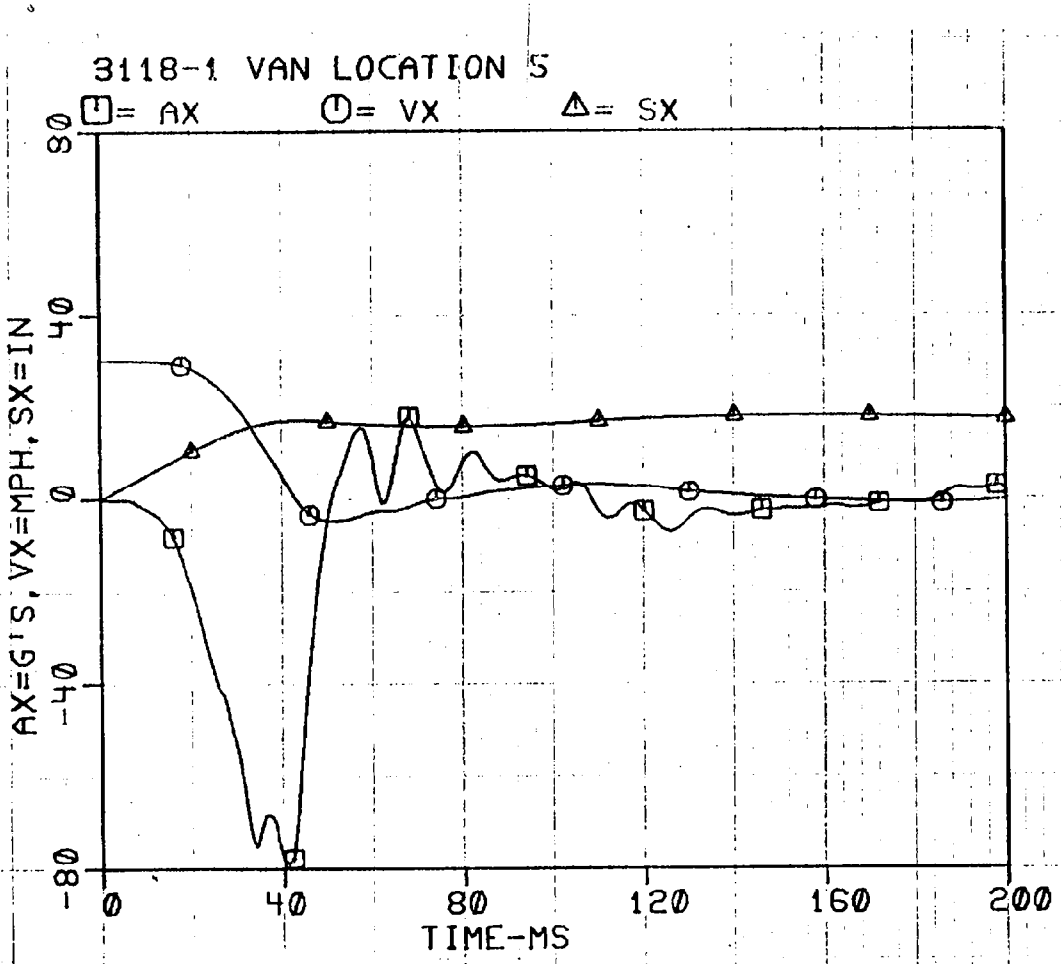
40
80
120
160
200
TIME-MS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△= SX
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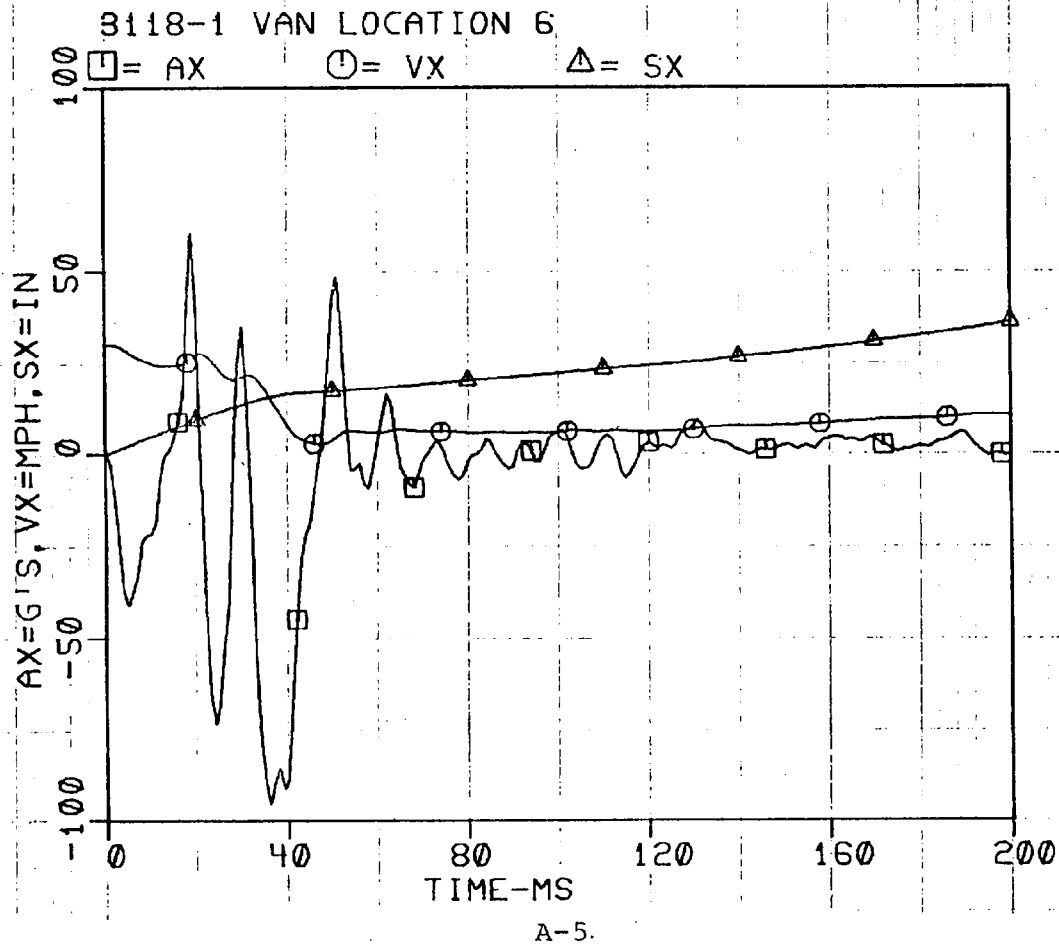
-80
0
40
80
120
160
200
TIME-MS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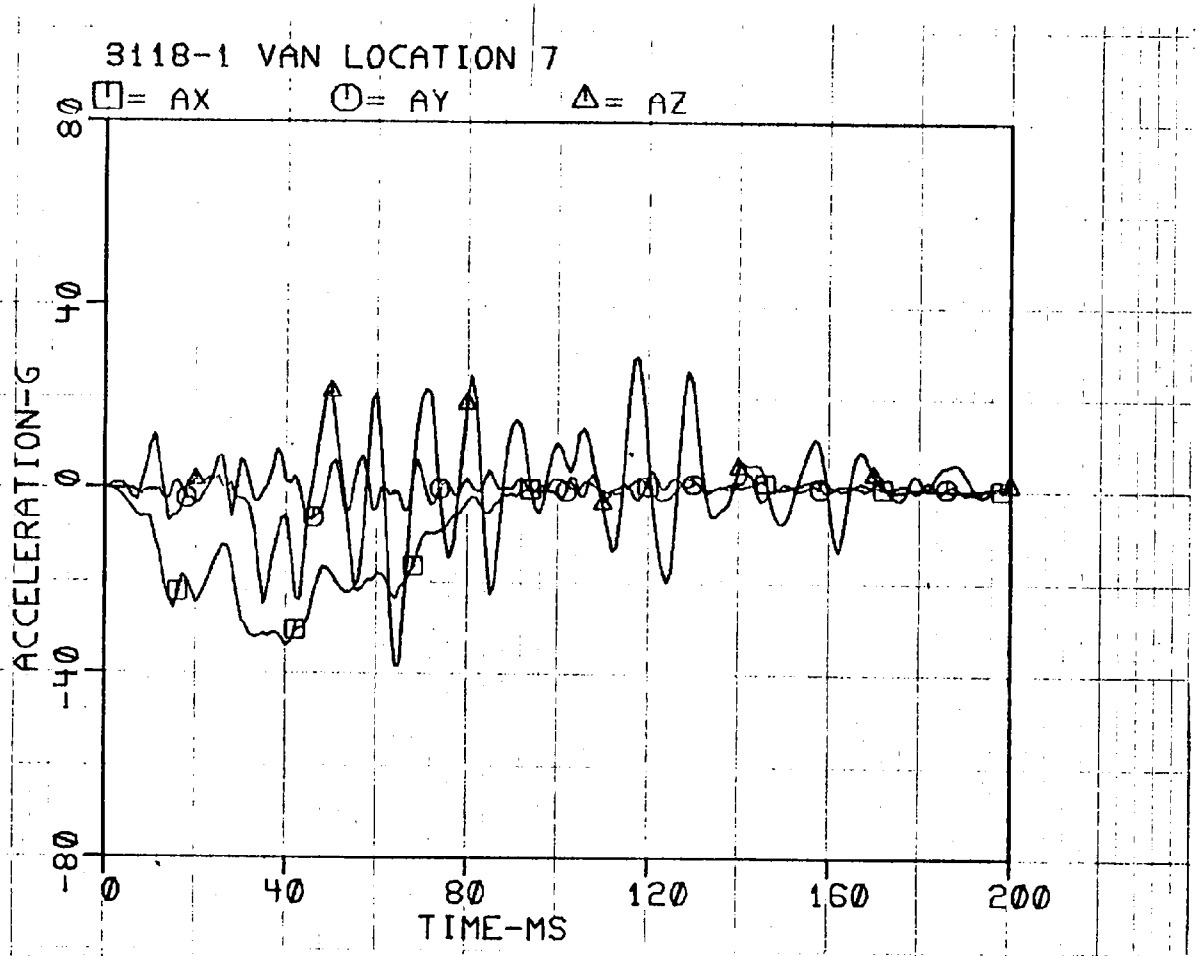
80
120
160
200
TIME-MS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80
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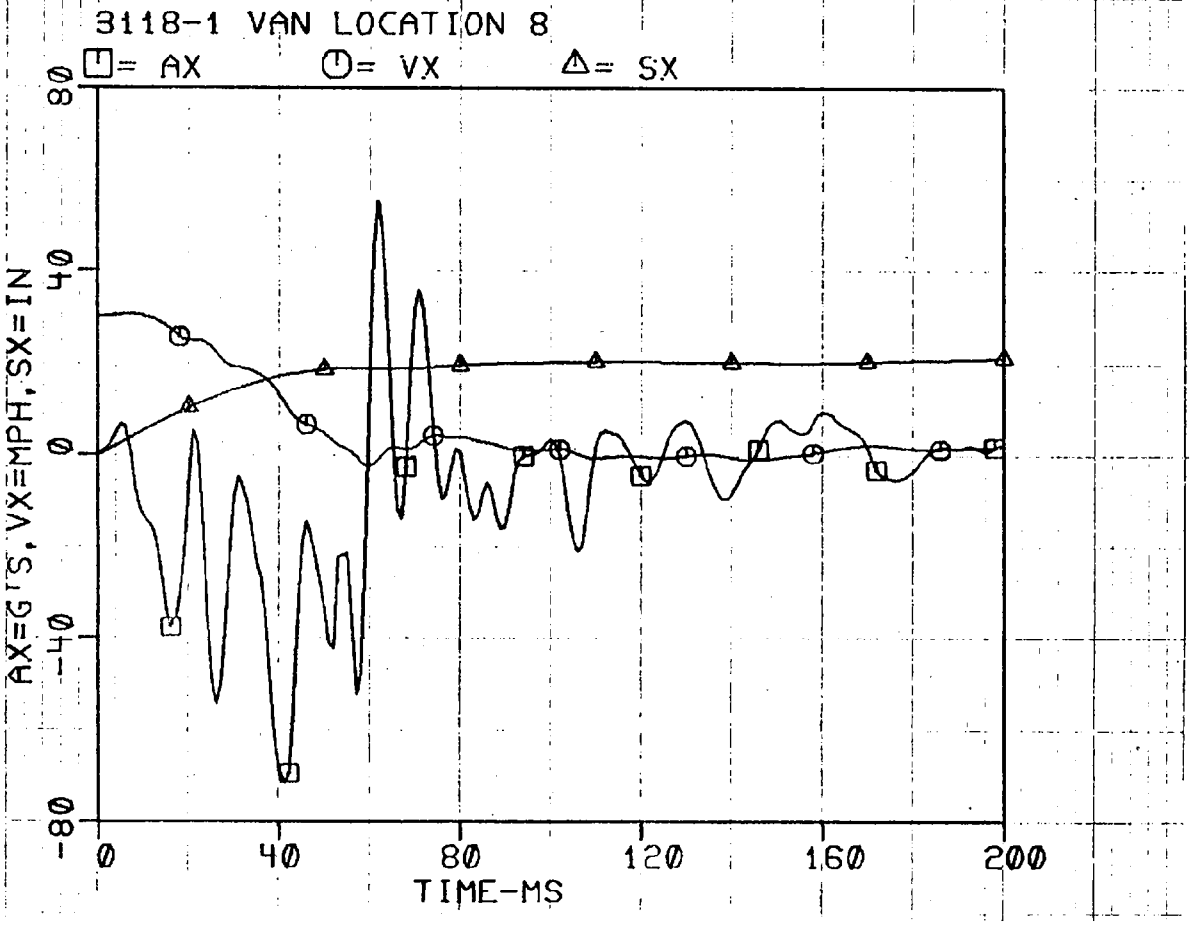
160
200
TIME-MS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△= SX
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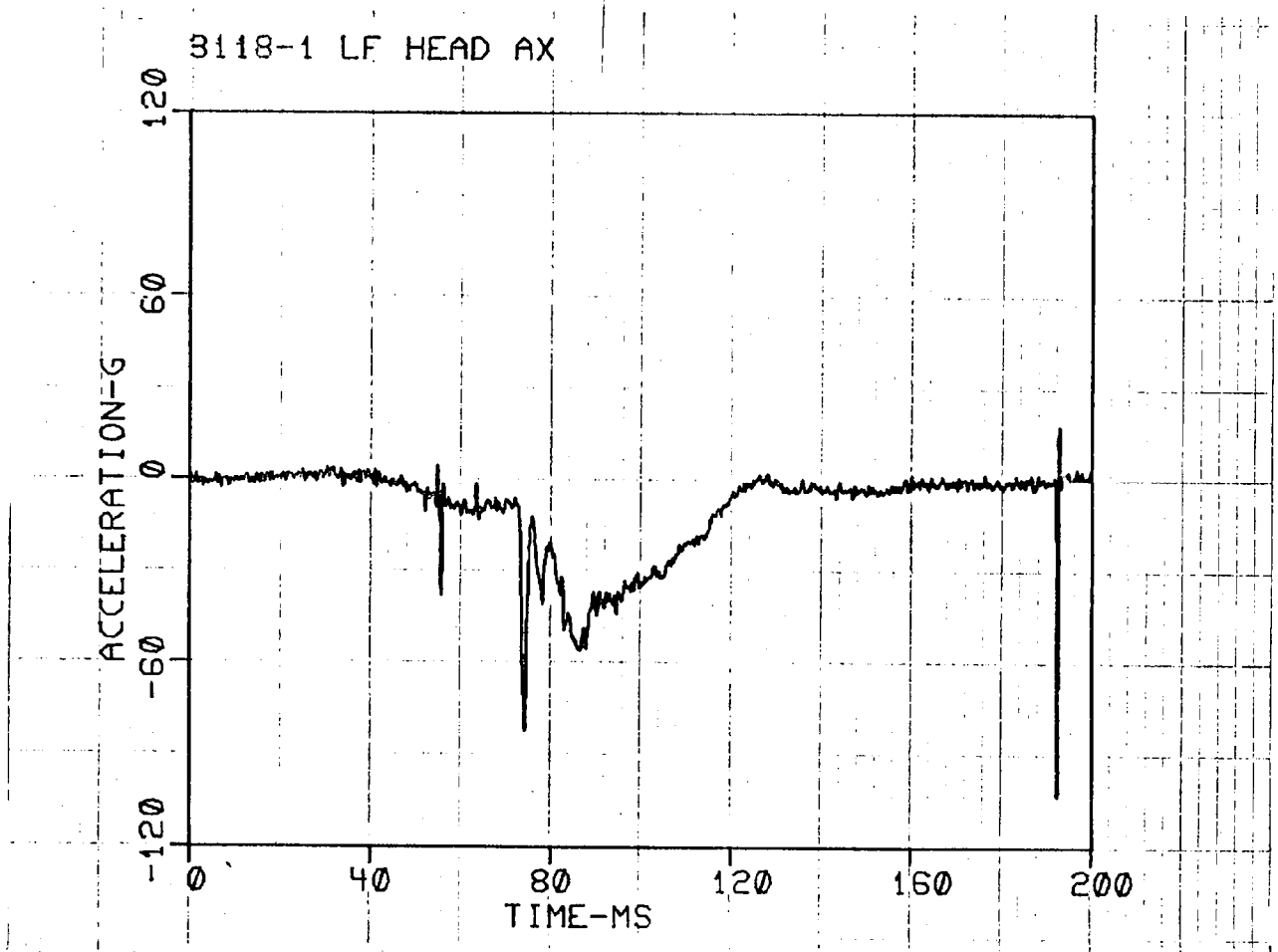
40
80
120
160
200
TIME-MS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ACCELERATION-G
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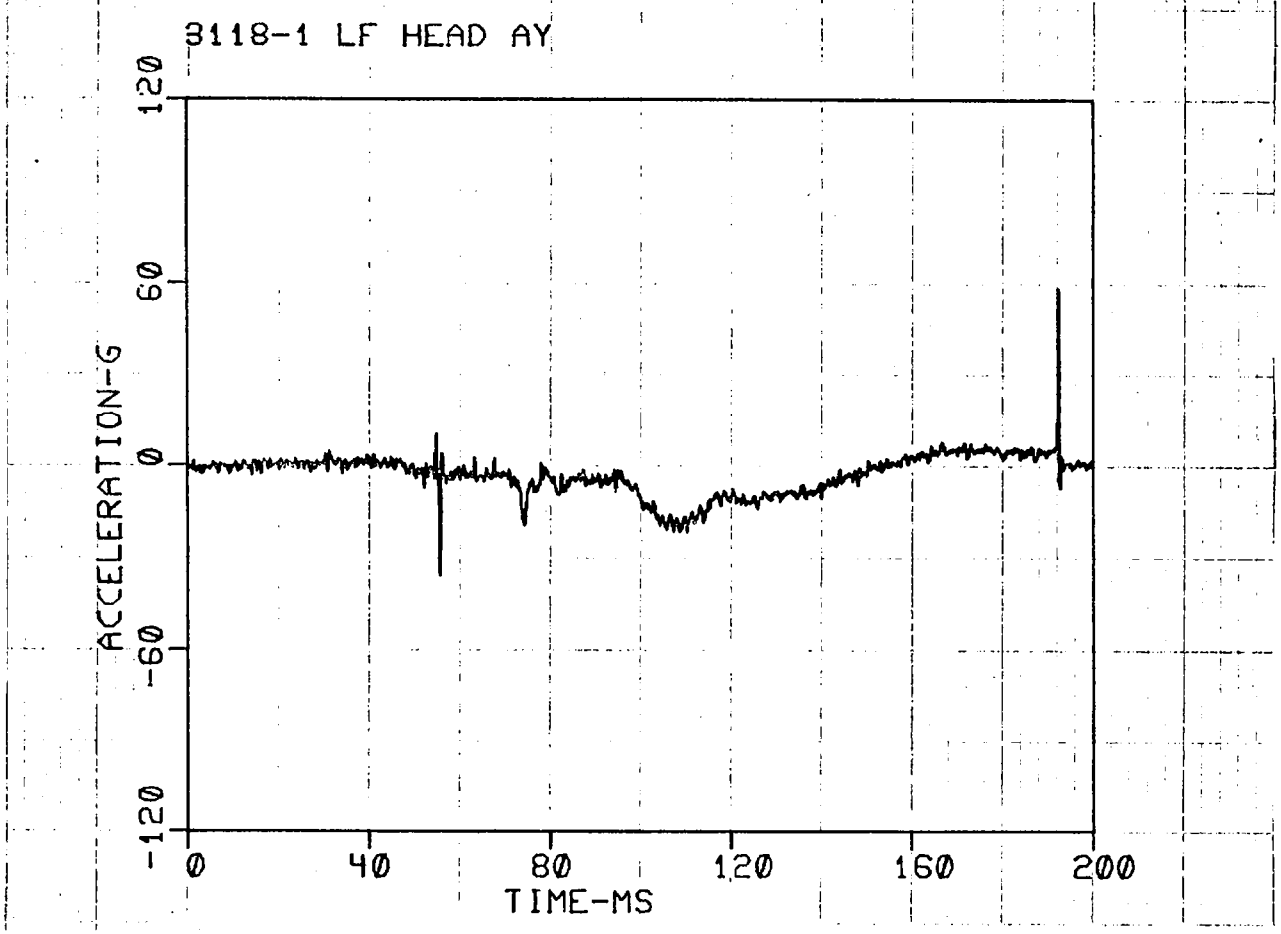
40
80
120
160
200
TIME-MS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ACCELERATION-G
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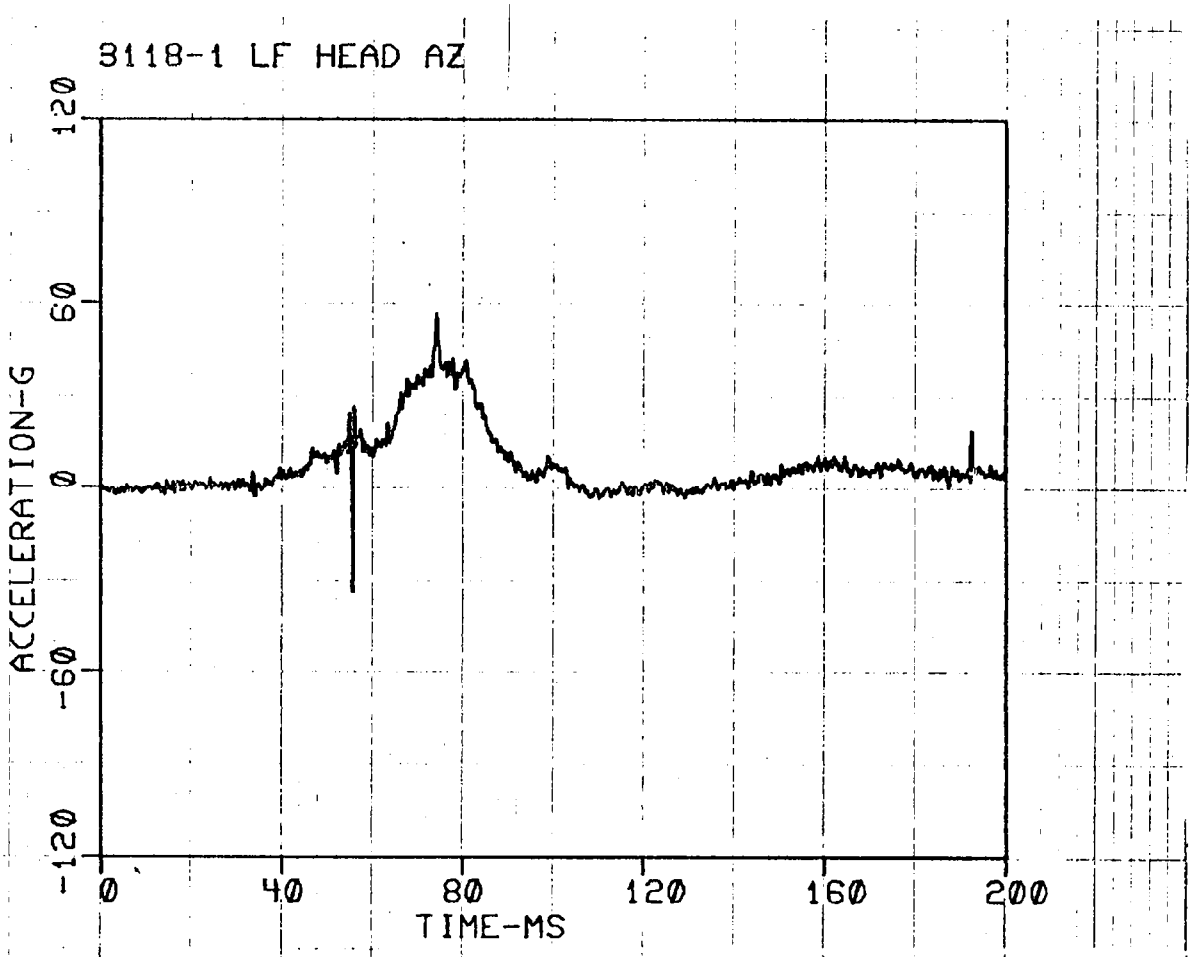
160
200
TIME-MS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-60
-120
0
40
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120
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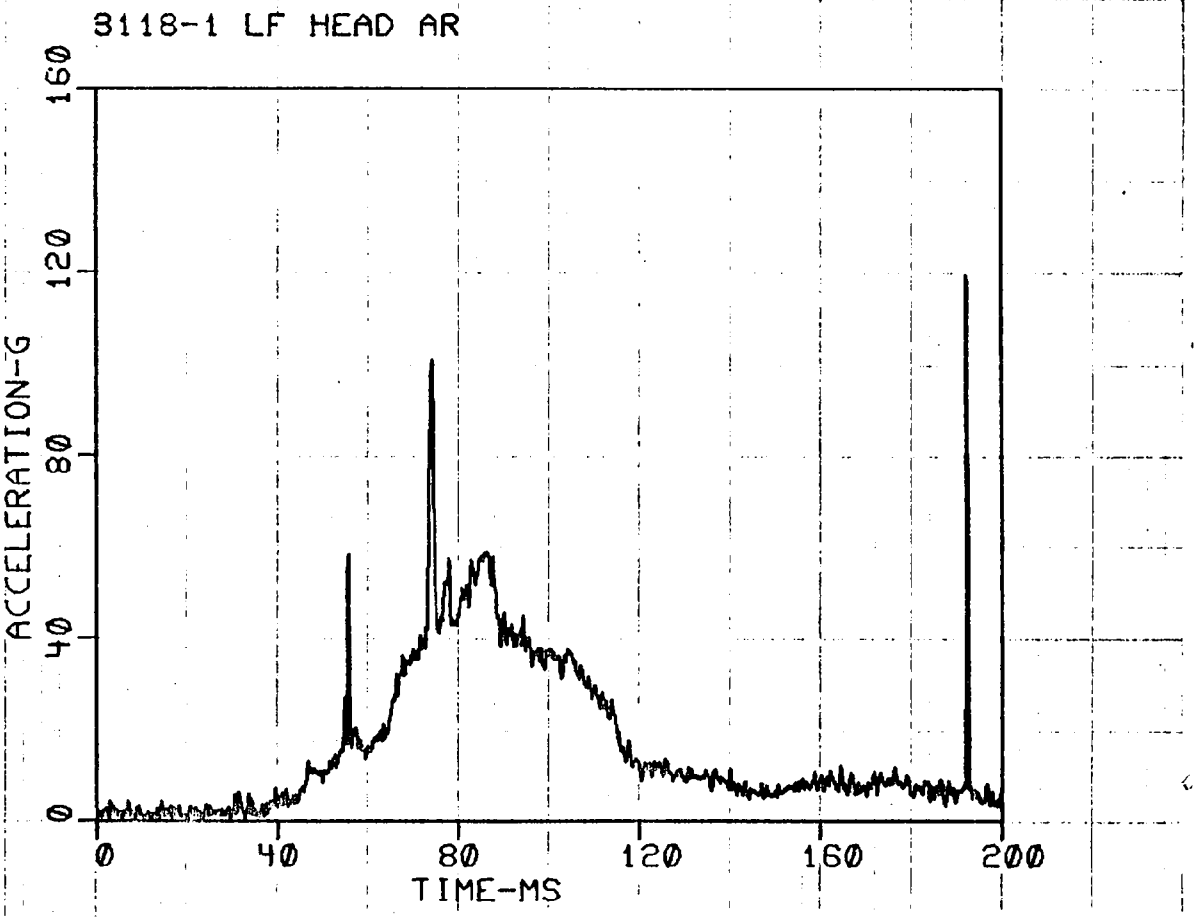
200
TIME-MS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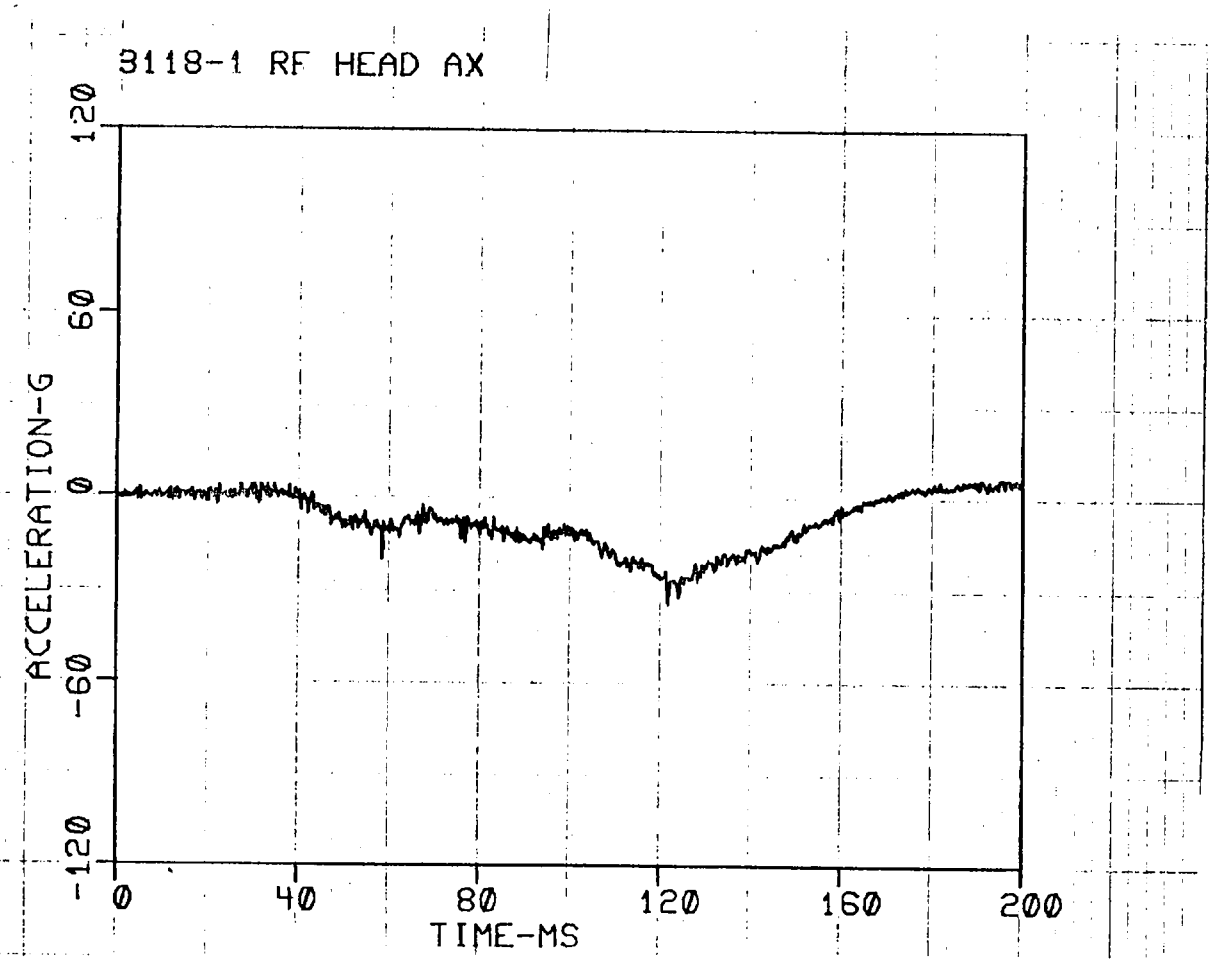
TIME-MS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ACCELERATION-G
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80
120
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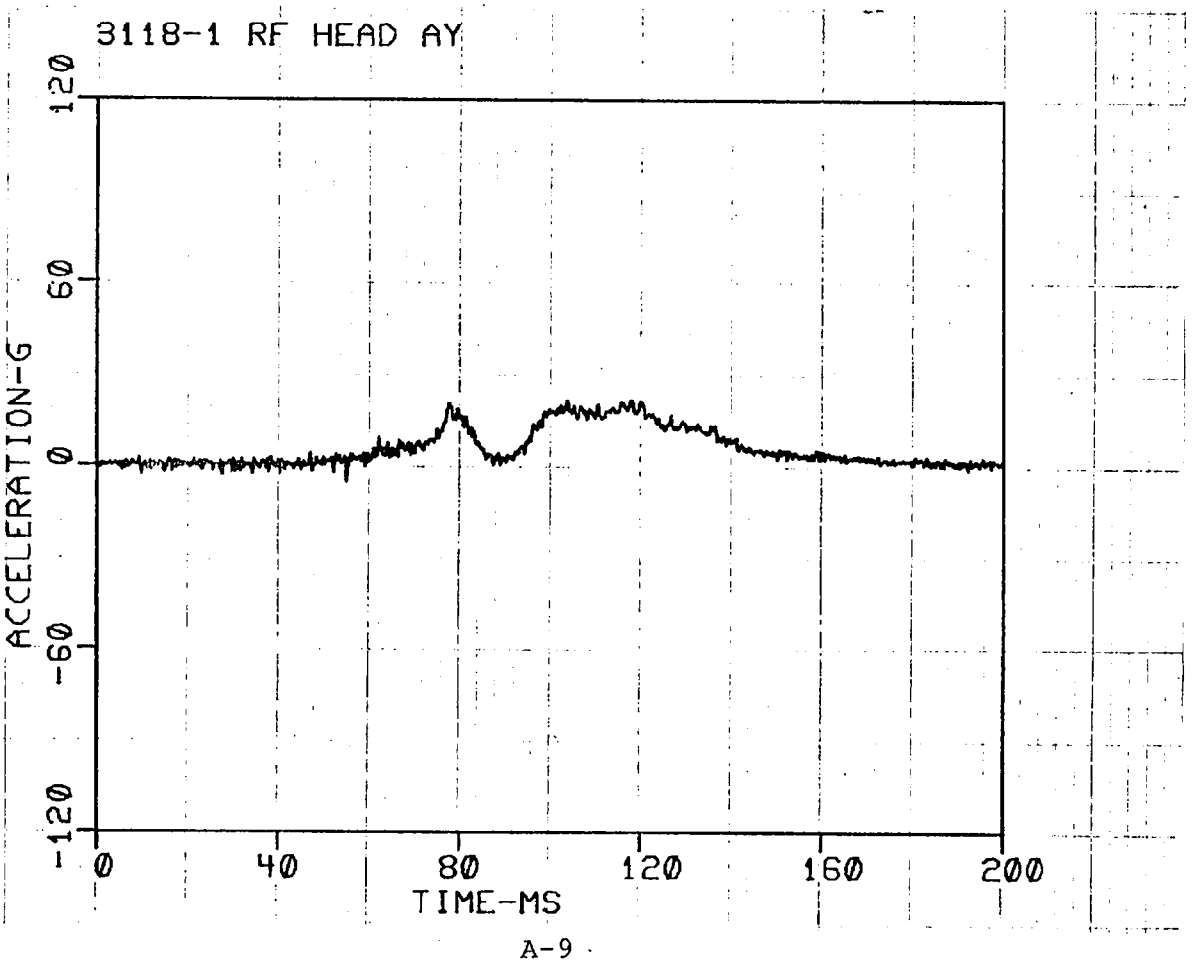
200
TIME-MS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ACCELERATION-G
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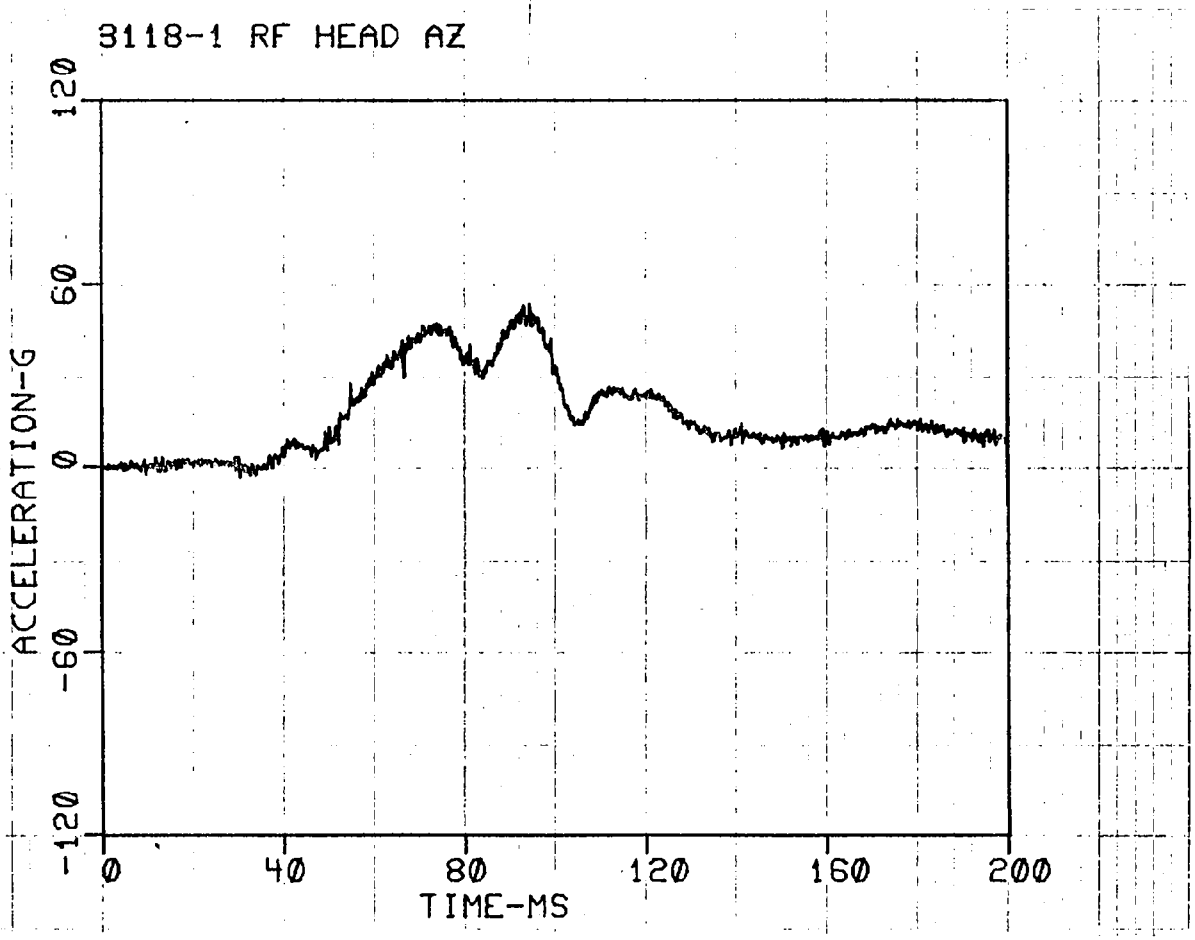
200
TIME-MS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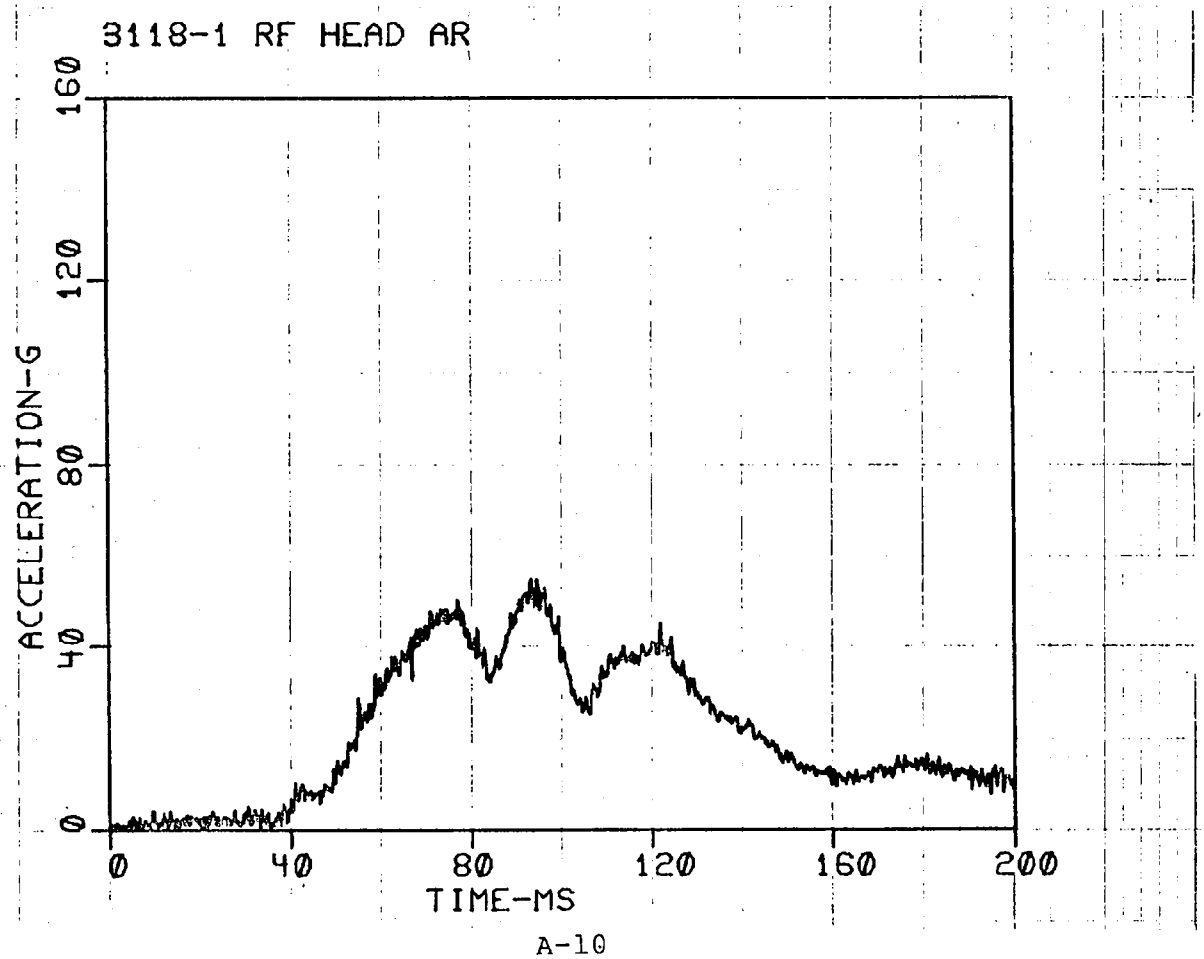
200
TIME-MS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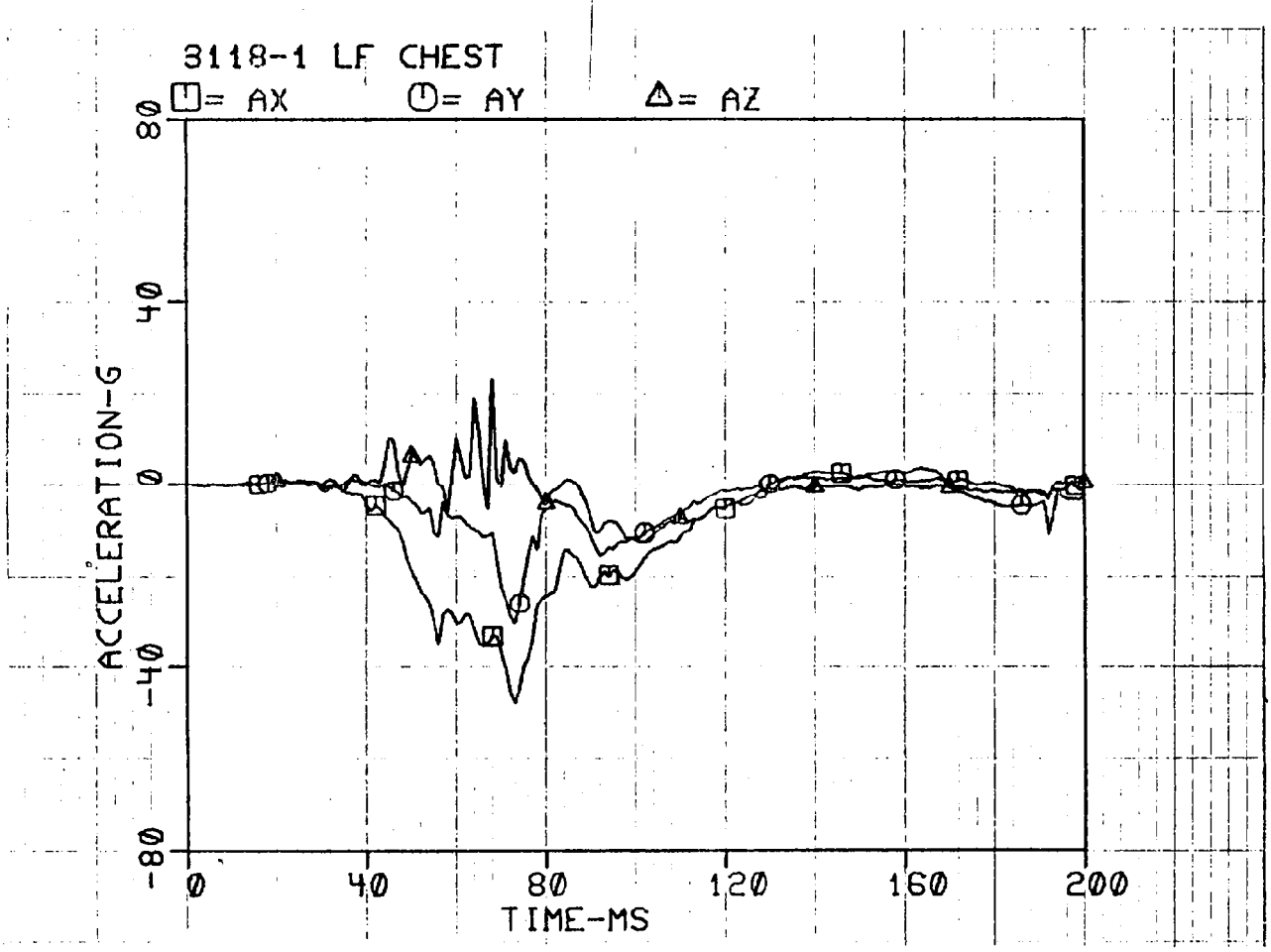
200
TIME-MS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△= AZ
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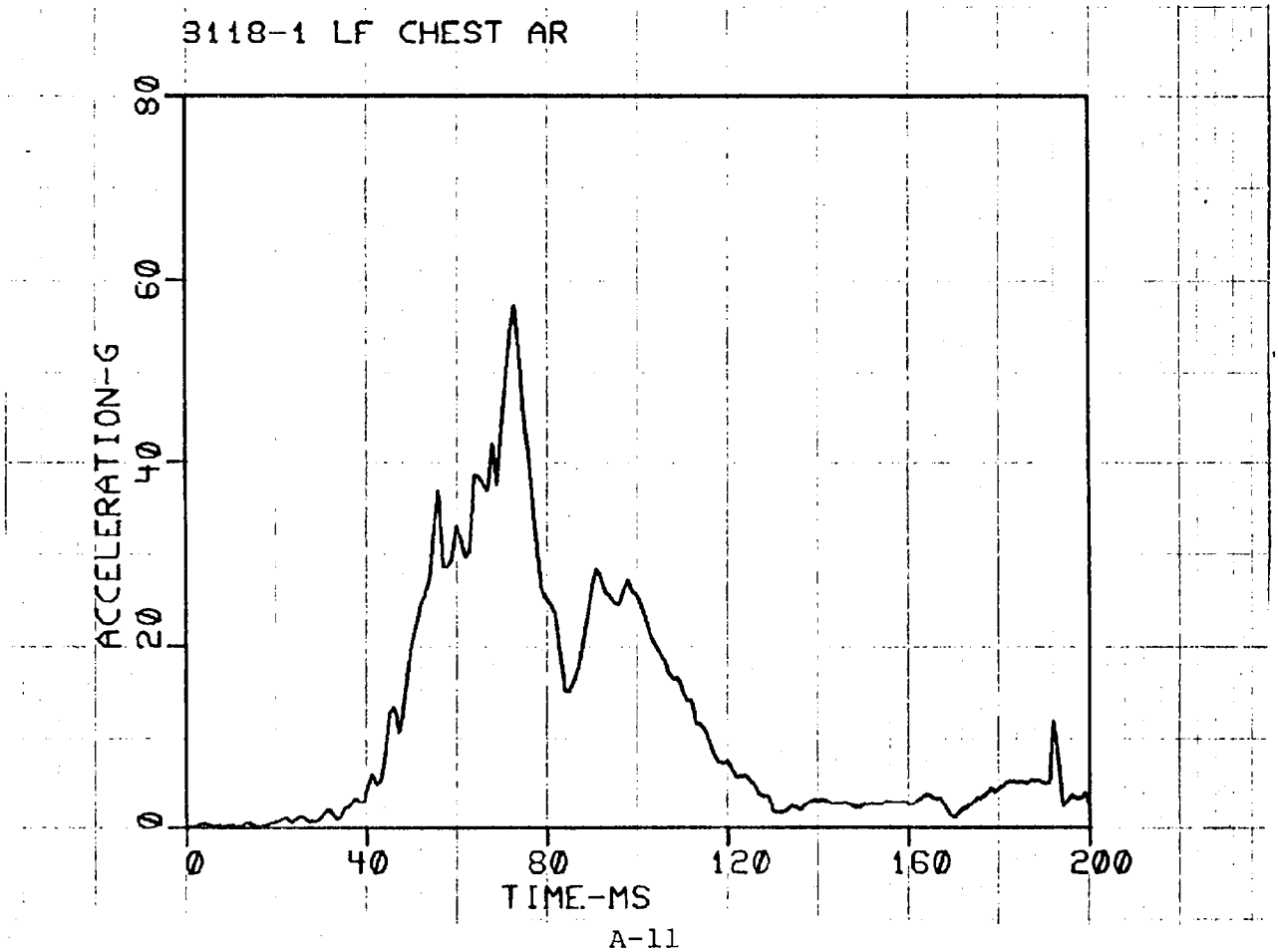
80
120
160
200
TIME-MS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20
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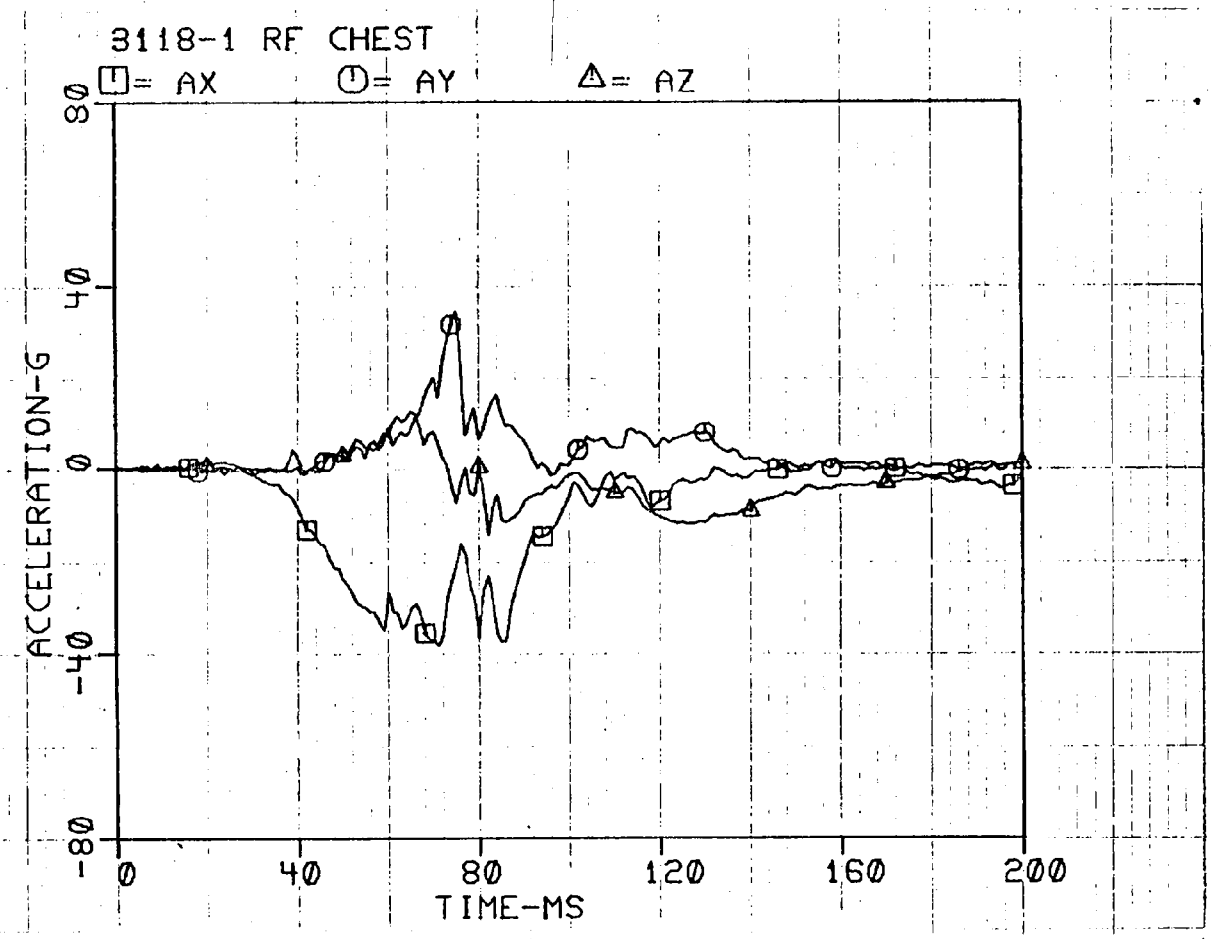
120
160
200
TIME-MS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ACCELERATION-G
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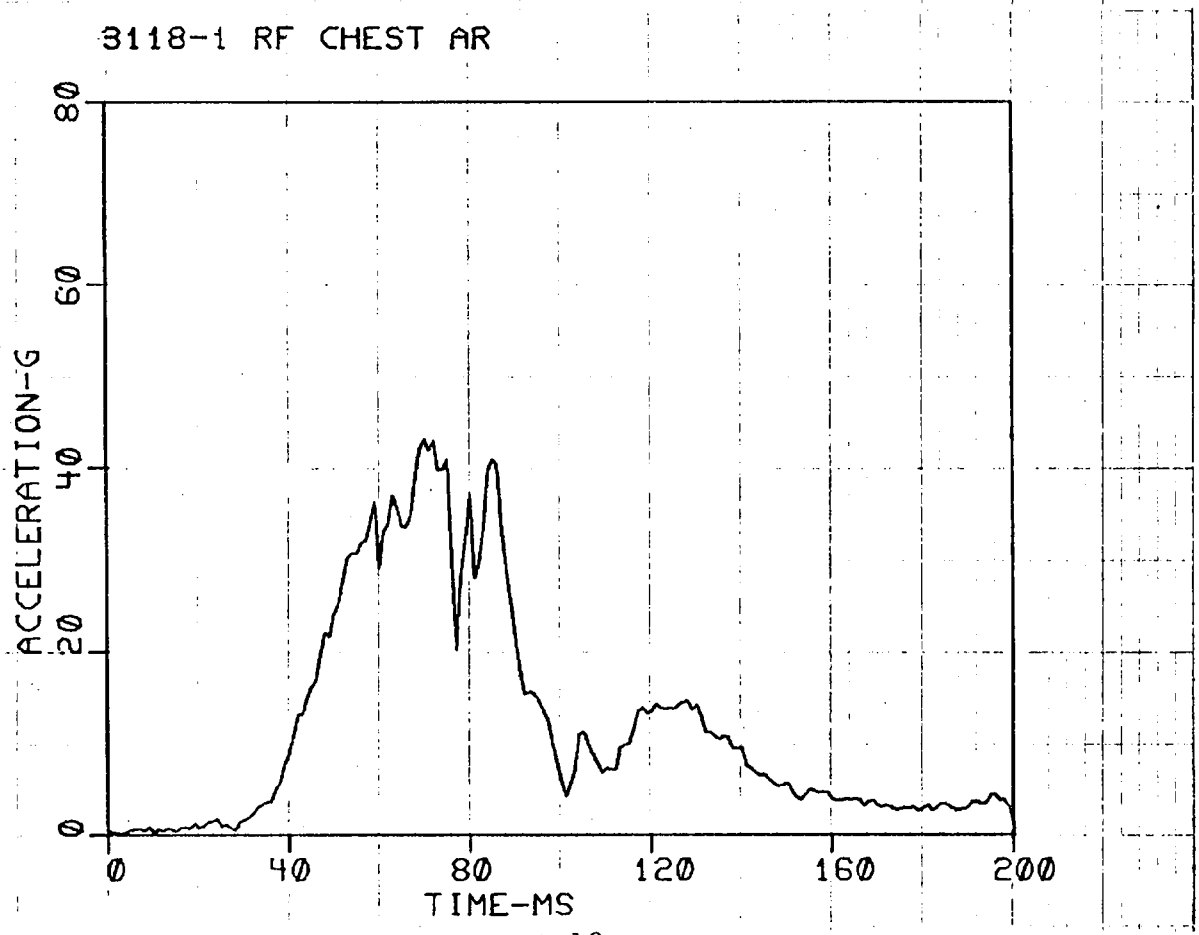
120
160
200
TIME-MS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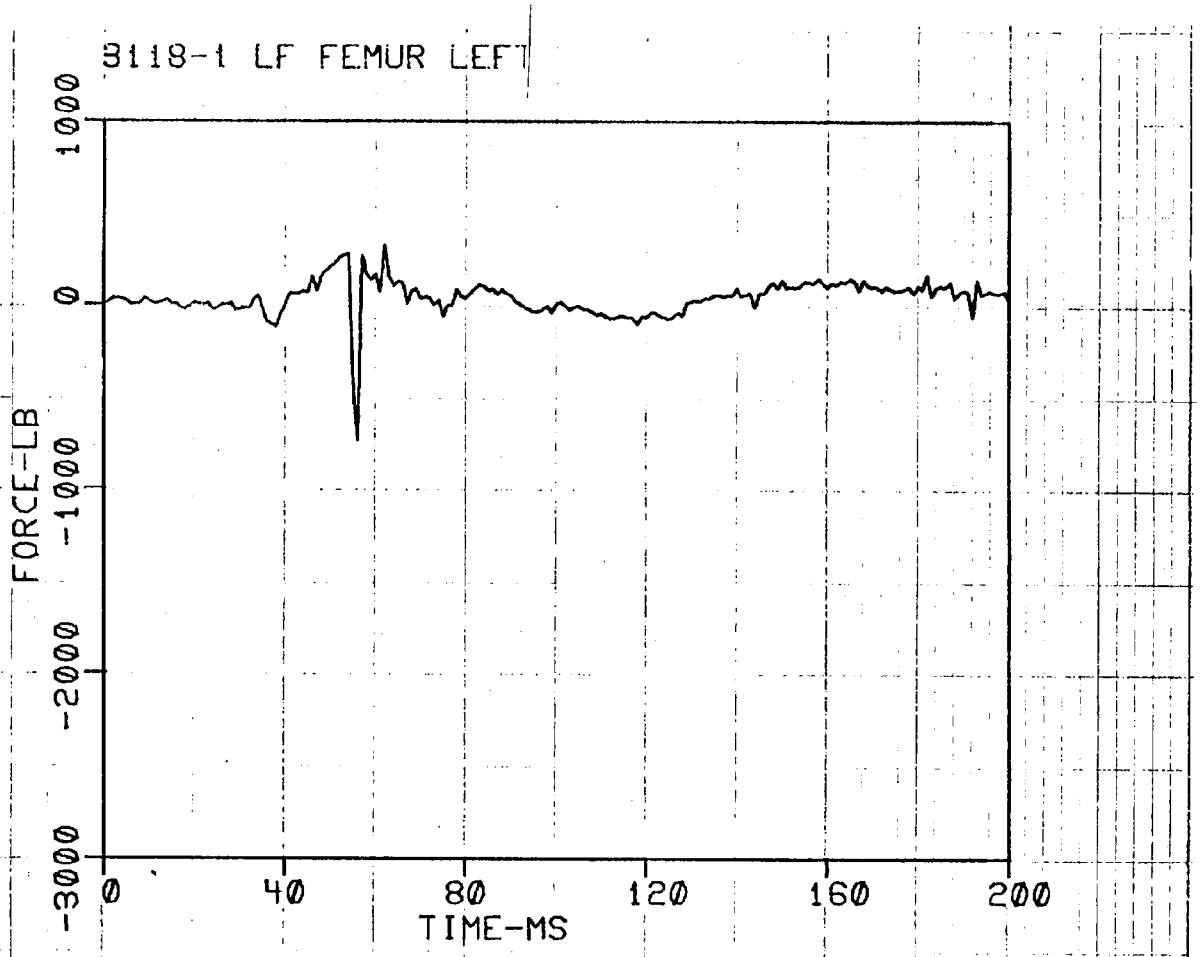
160
200
TIME-MS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-1000
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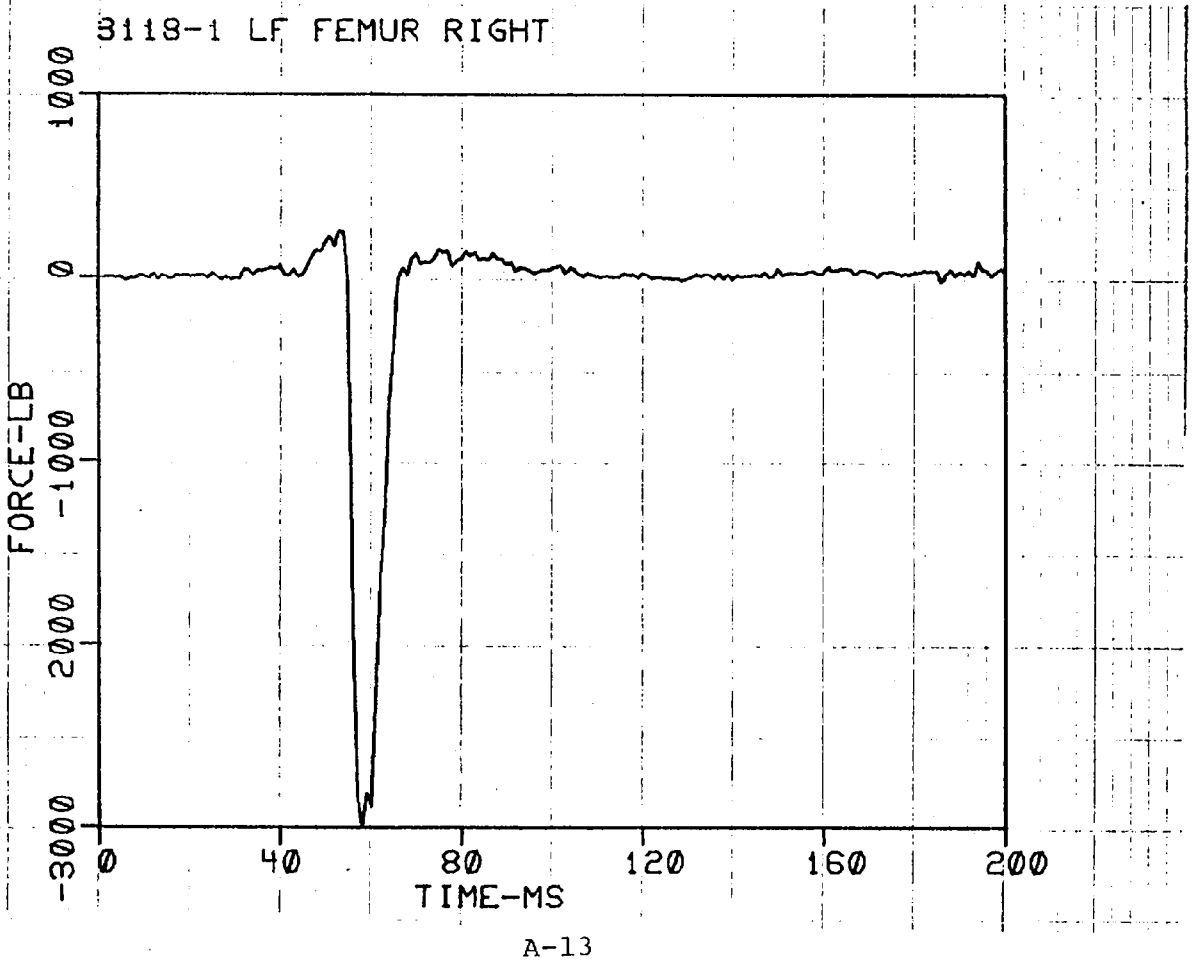
-3000
FORCE-LB
0
40
80
120
160
200
TIME-MS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1000
0
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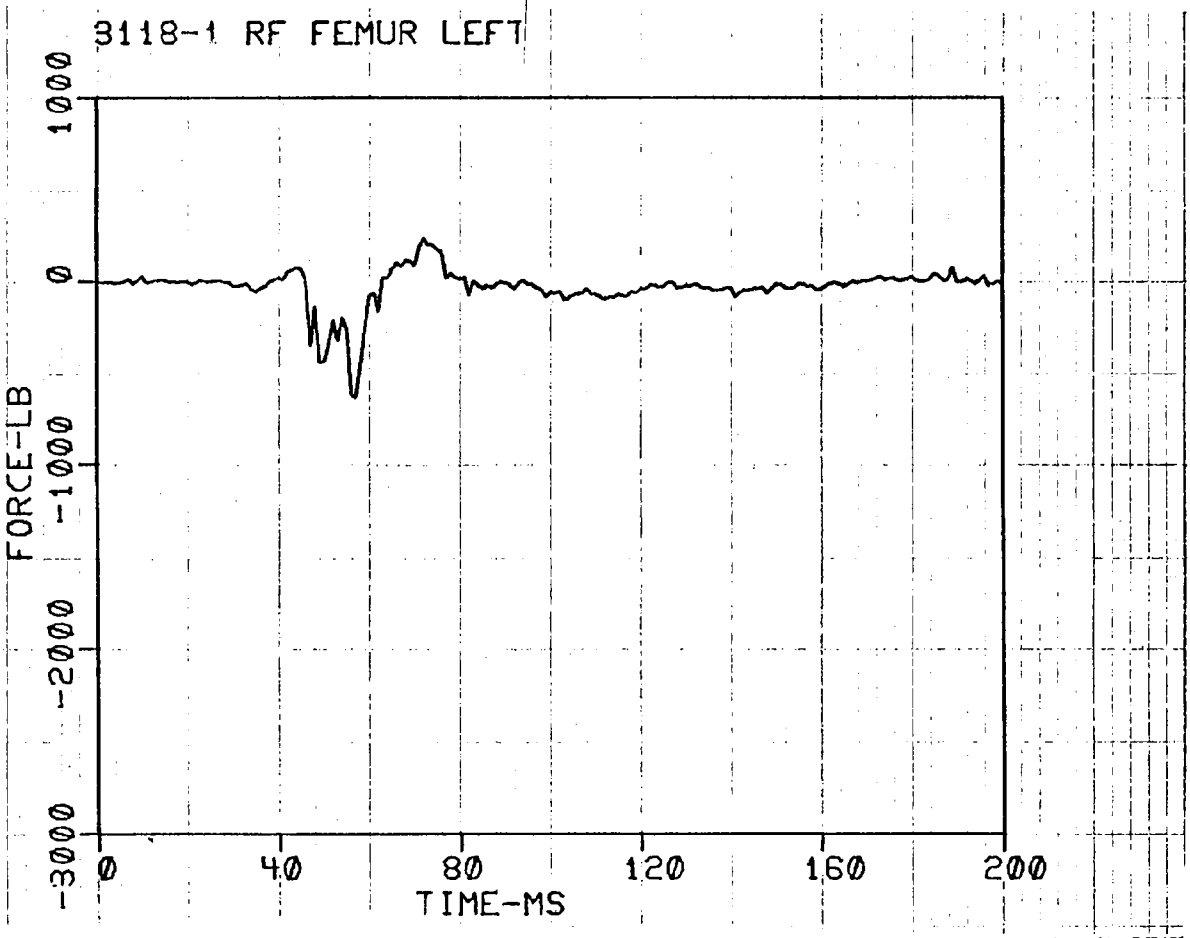
2000
-3000
FORCE-LB
0
40
80
120
160
200
TIME-MS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-1000
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FORCE-LB
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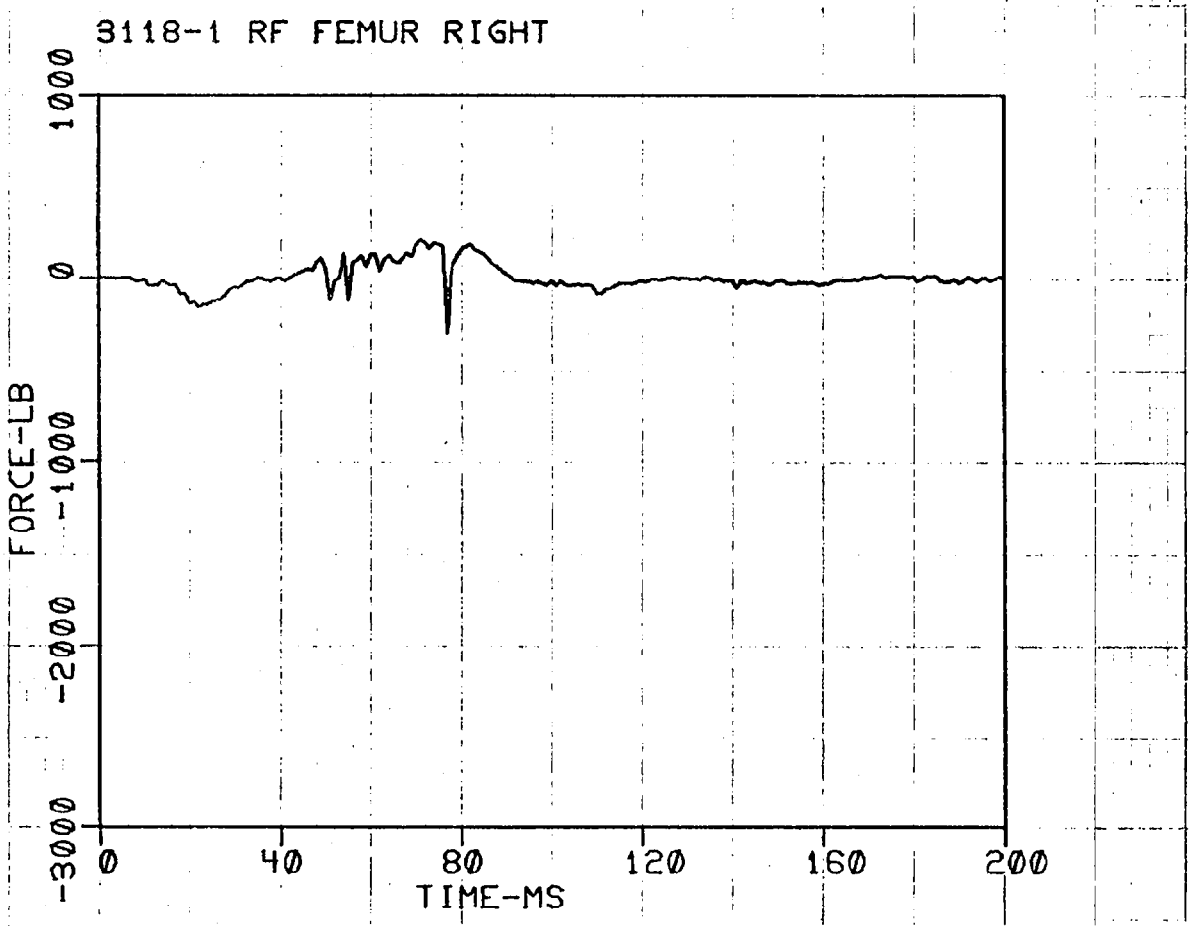
120
160
200
TIME-MS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FORCE-LB
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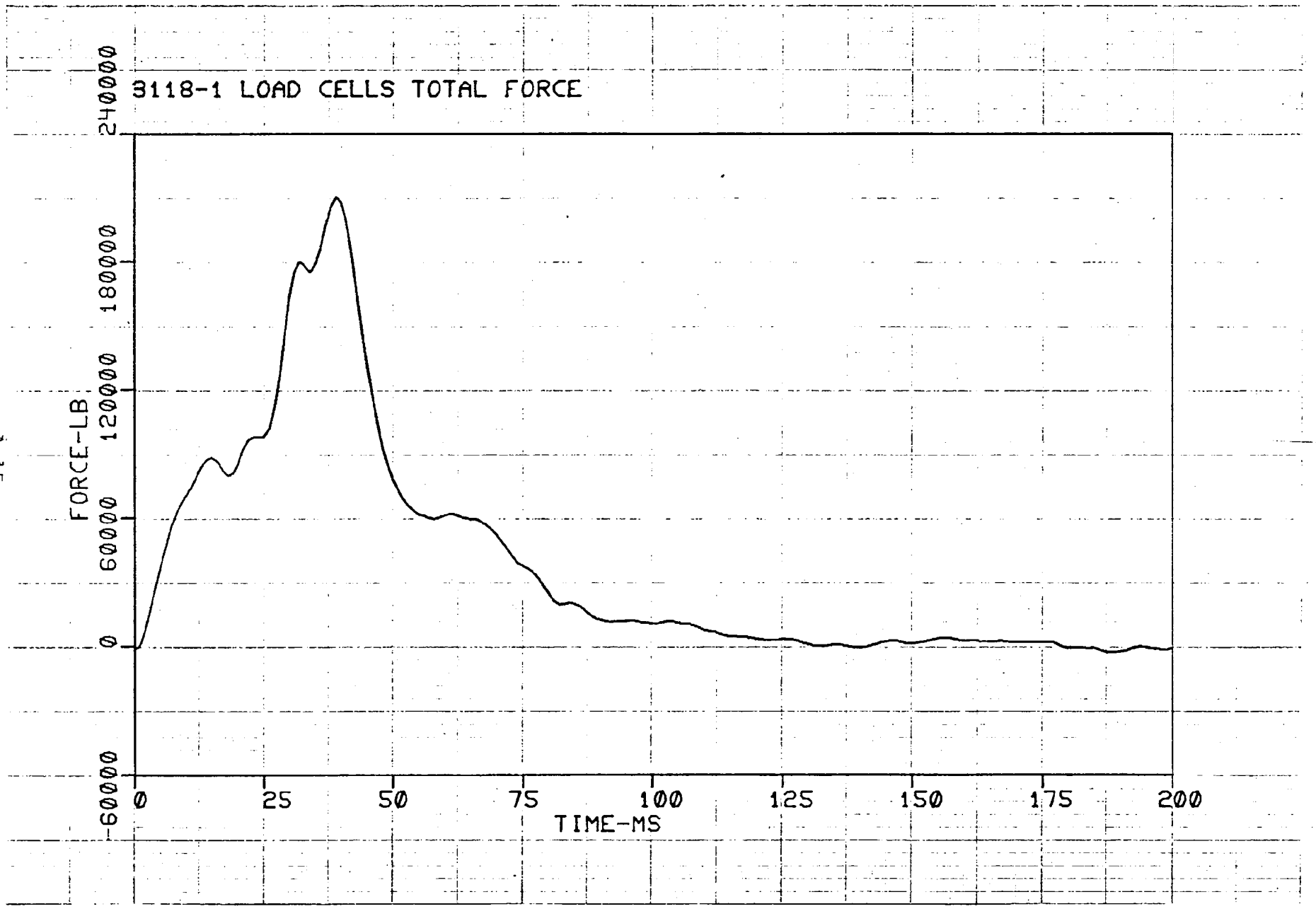
200
TIME-MS


3118-1 LOAD CELLS TOTAL FORCE
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50
75
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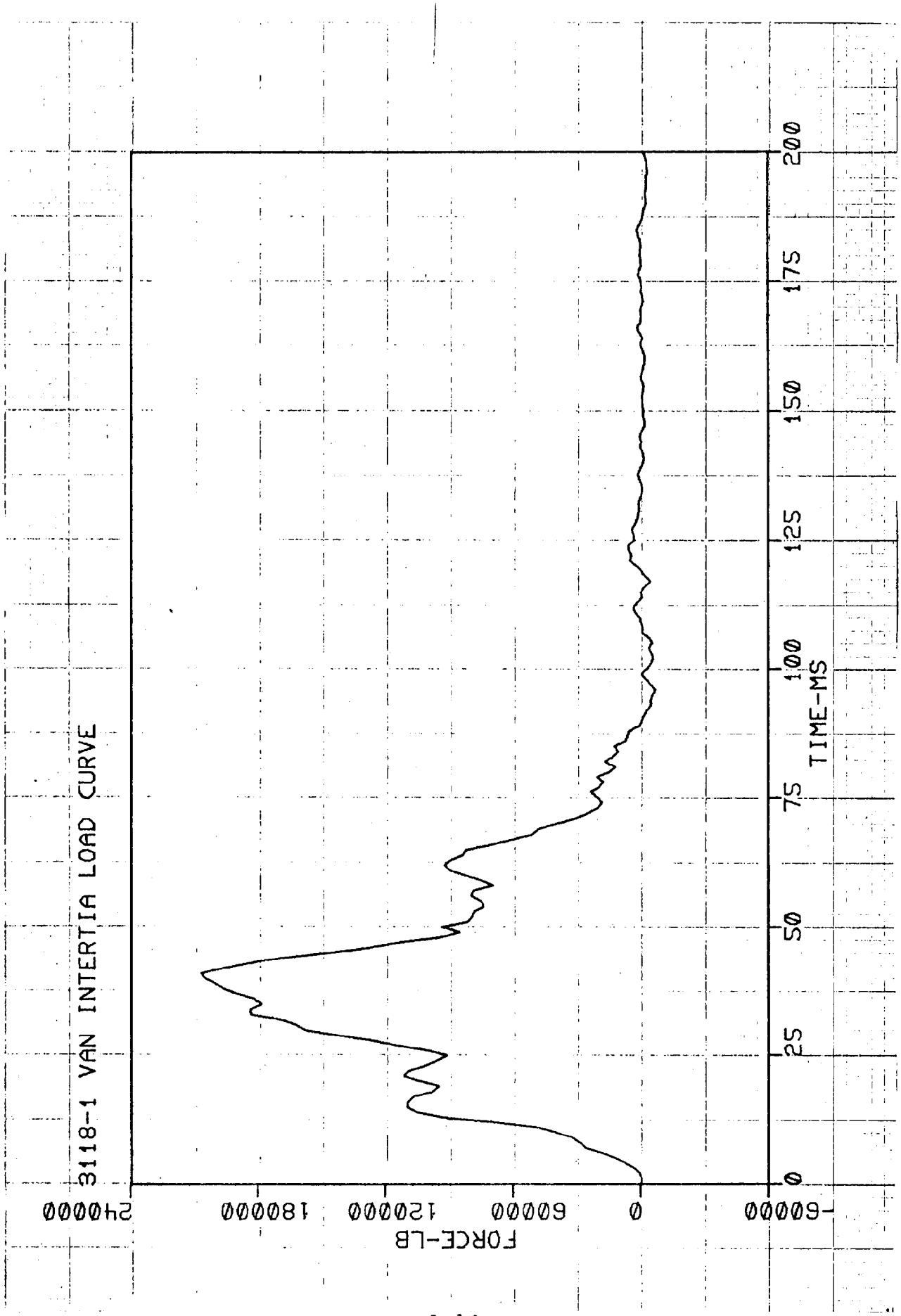
125
150
175
200
TIME-MS


3118-1 VAN INTERTIA LOAD CURVE
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120000
60000
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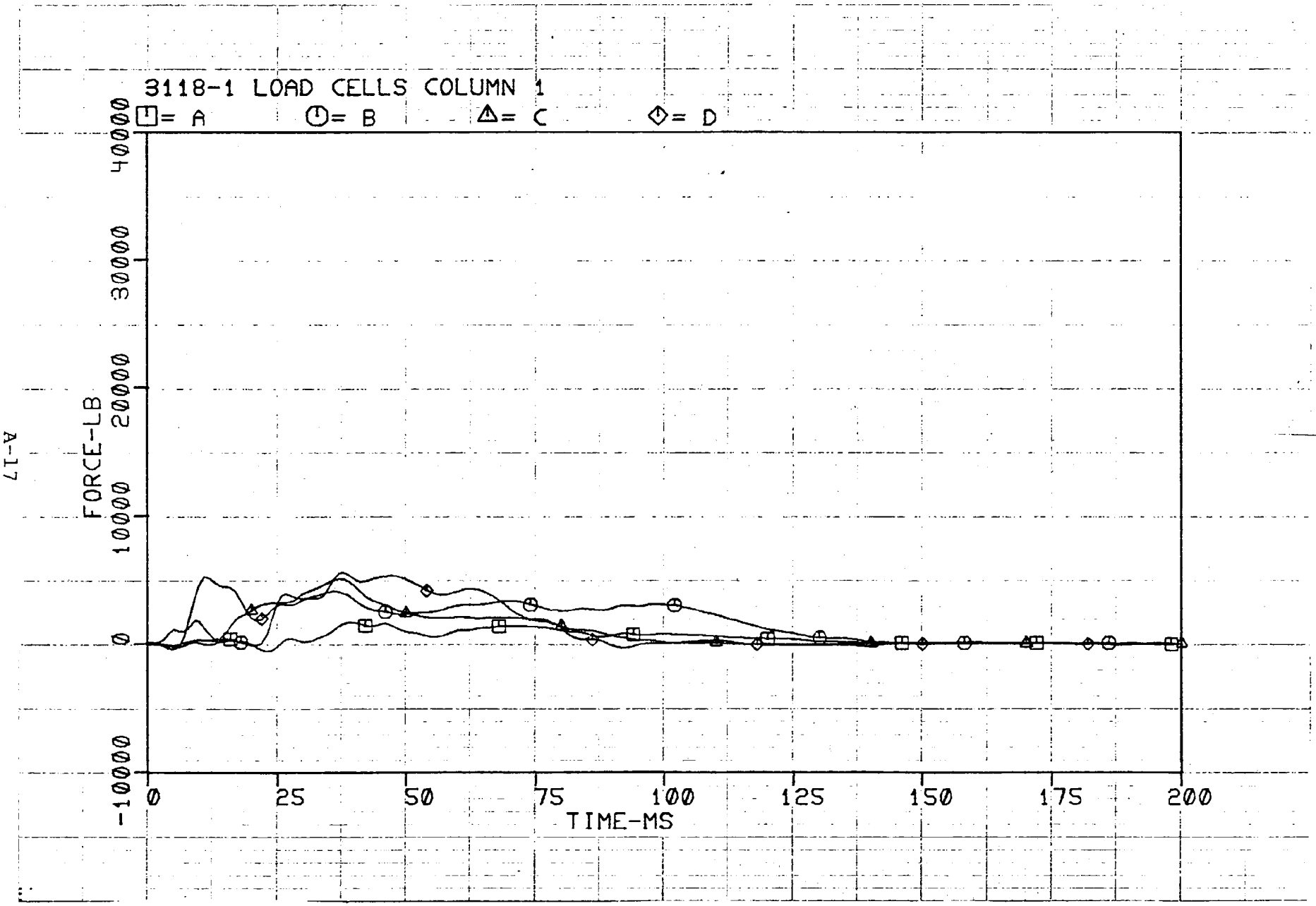
0
25
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 1
= A
= B
= C
= D
FORCE-LB
40000
30000
20000
10000
0
-10000
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75
100
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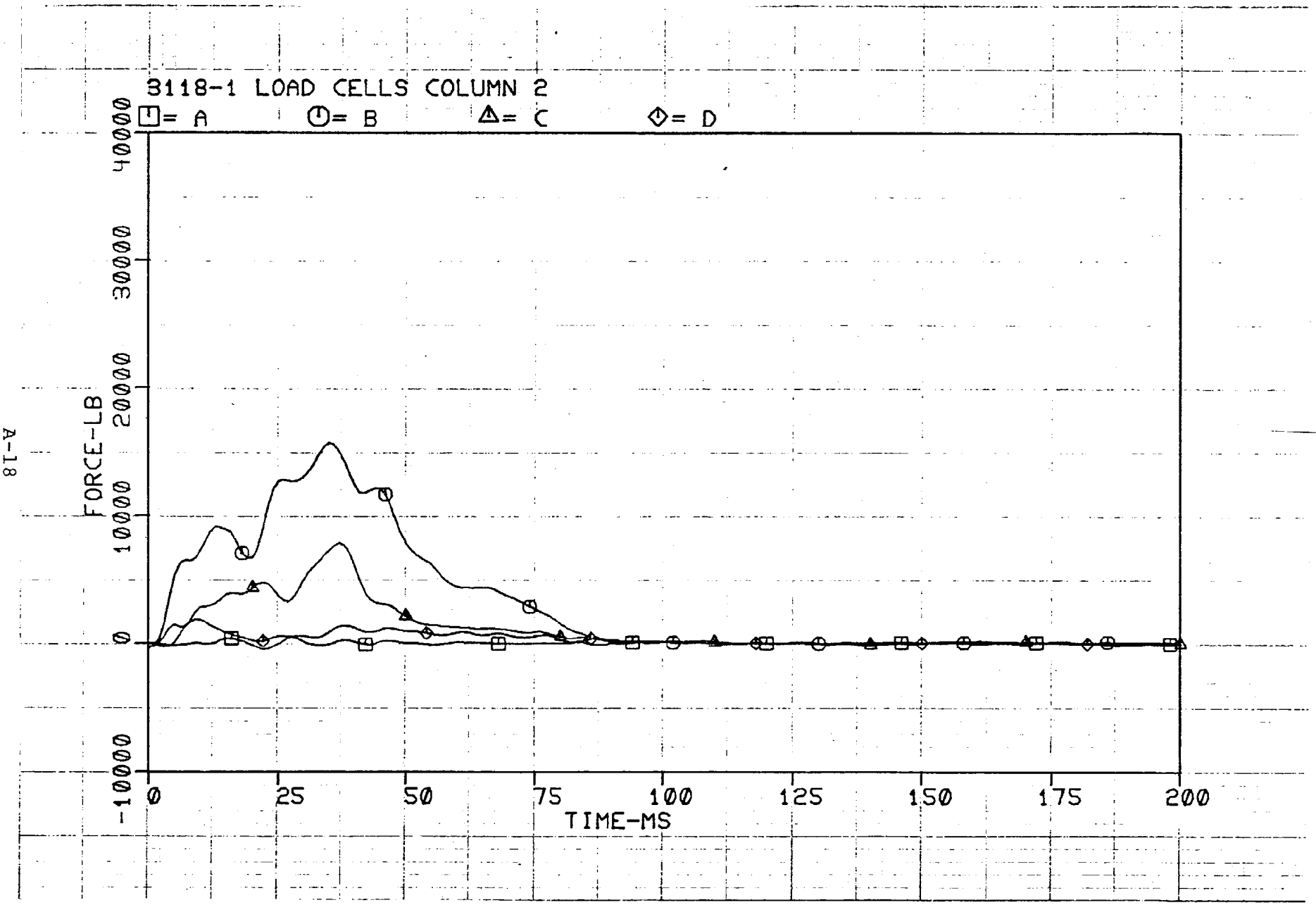
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 2
□= A
○= B
△= C
◇= D
FORCE-LB
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20000
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-10000
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50
75
100
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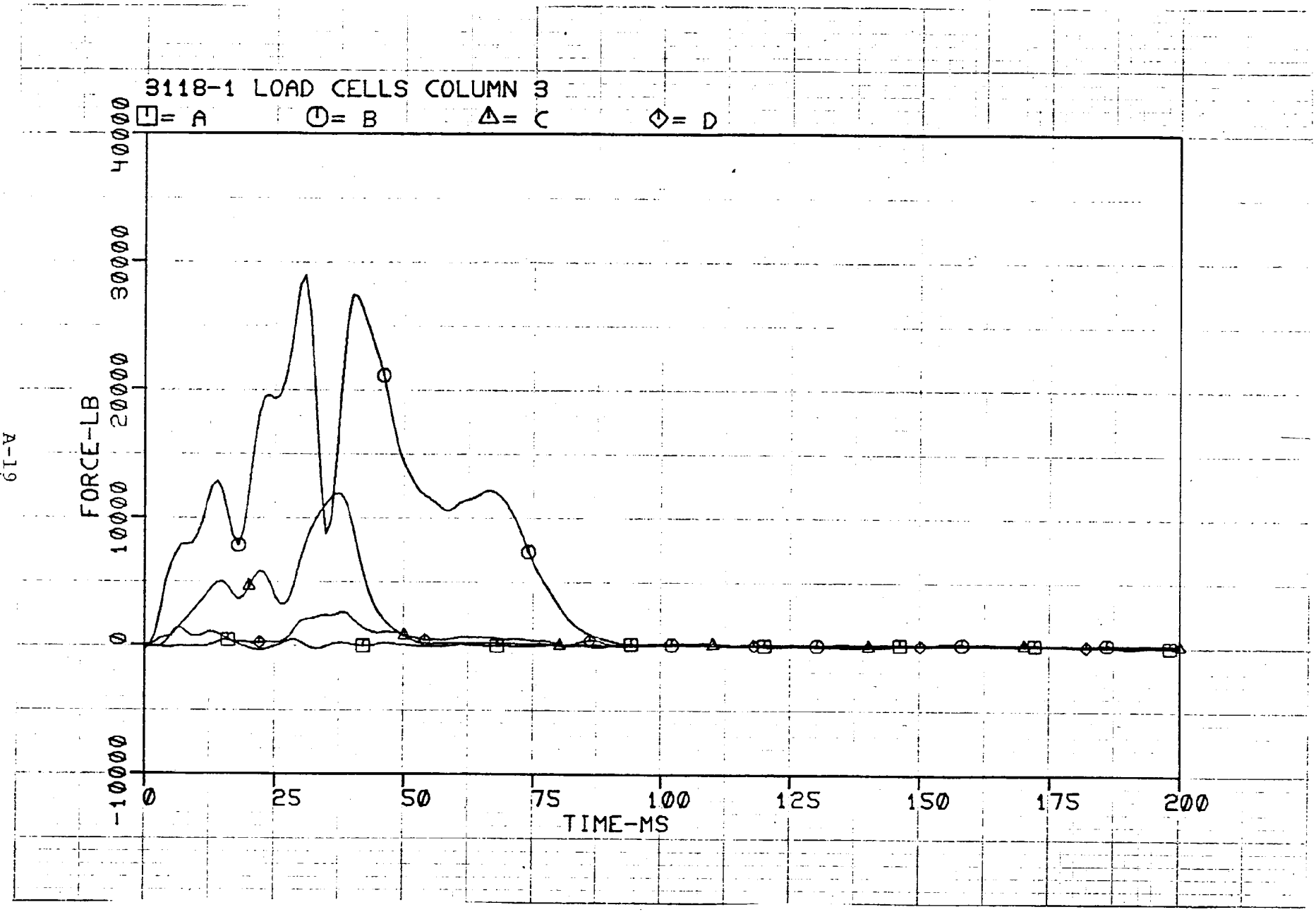
200
TIME-MS


3118-1 LOAD CELLS COLUMN 3
□= A
○= B
△= C
◇= D
FORCE-LB
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20000
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-10000
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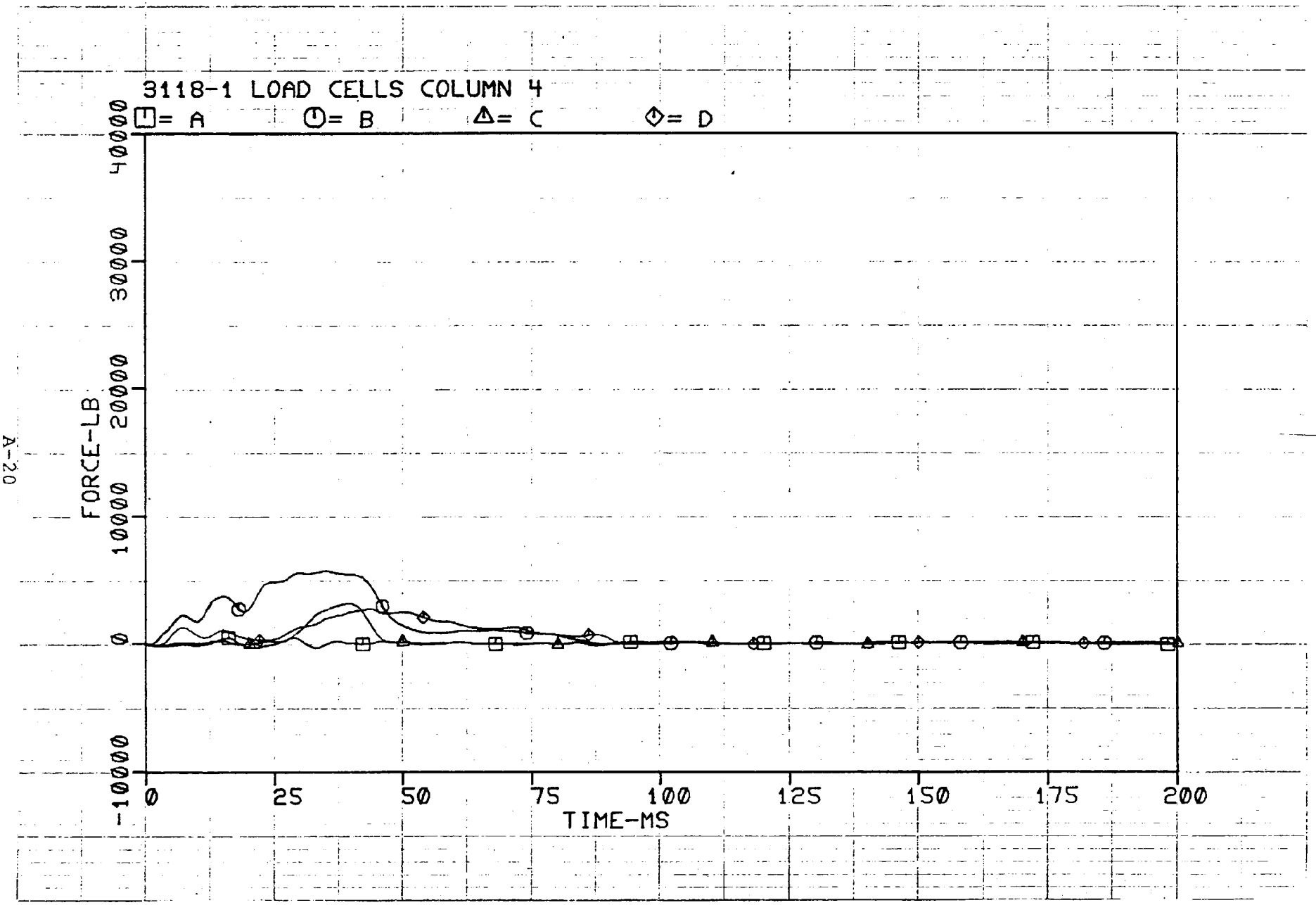
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 4
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○= B
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◇= D
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10000
0
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FORCE-LB
0
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75
100
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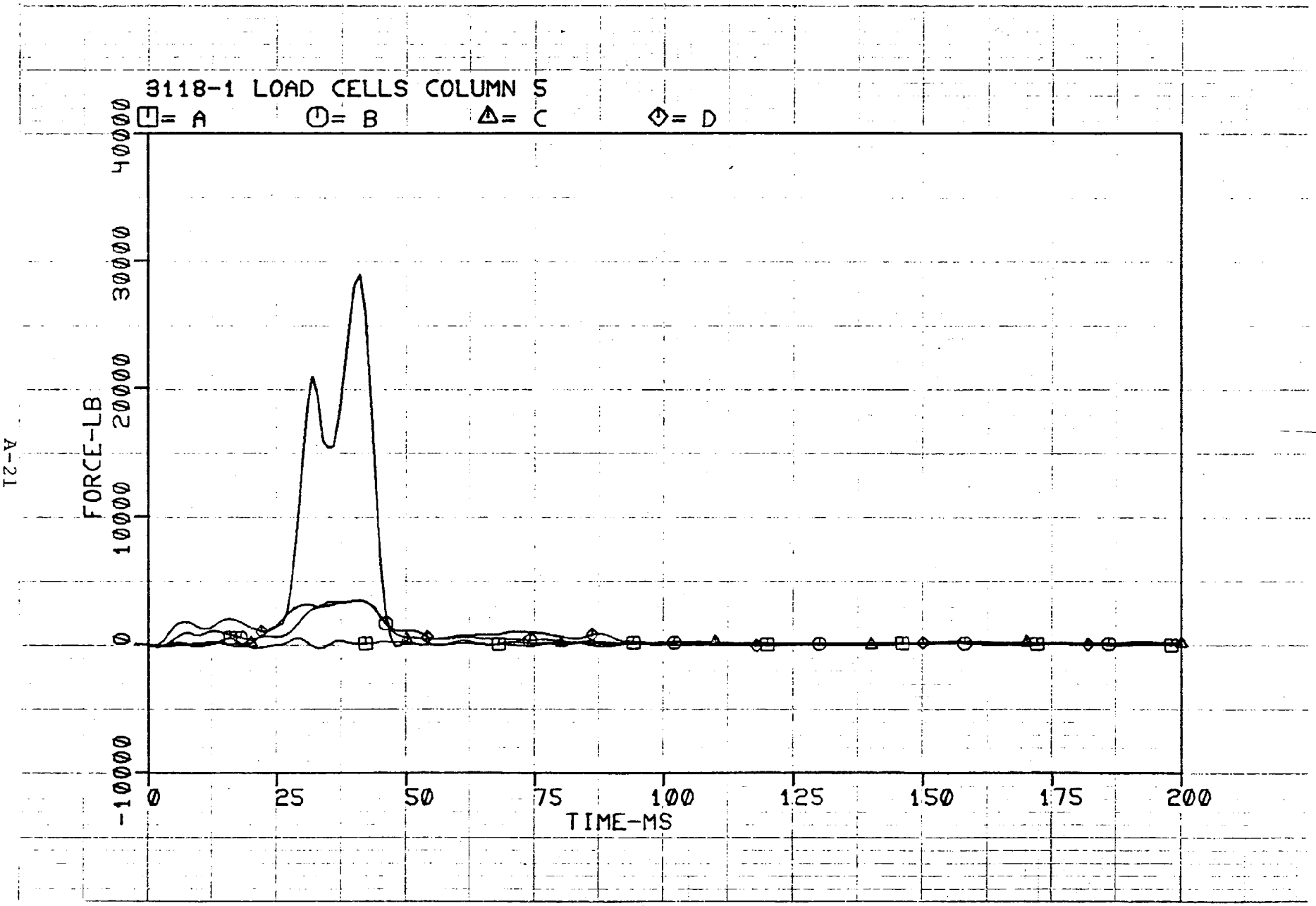
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 5
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= B
= C
= D
FORCE-LB
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30000
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0
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75
100
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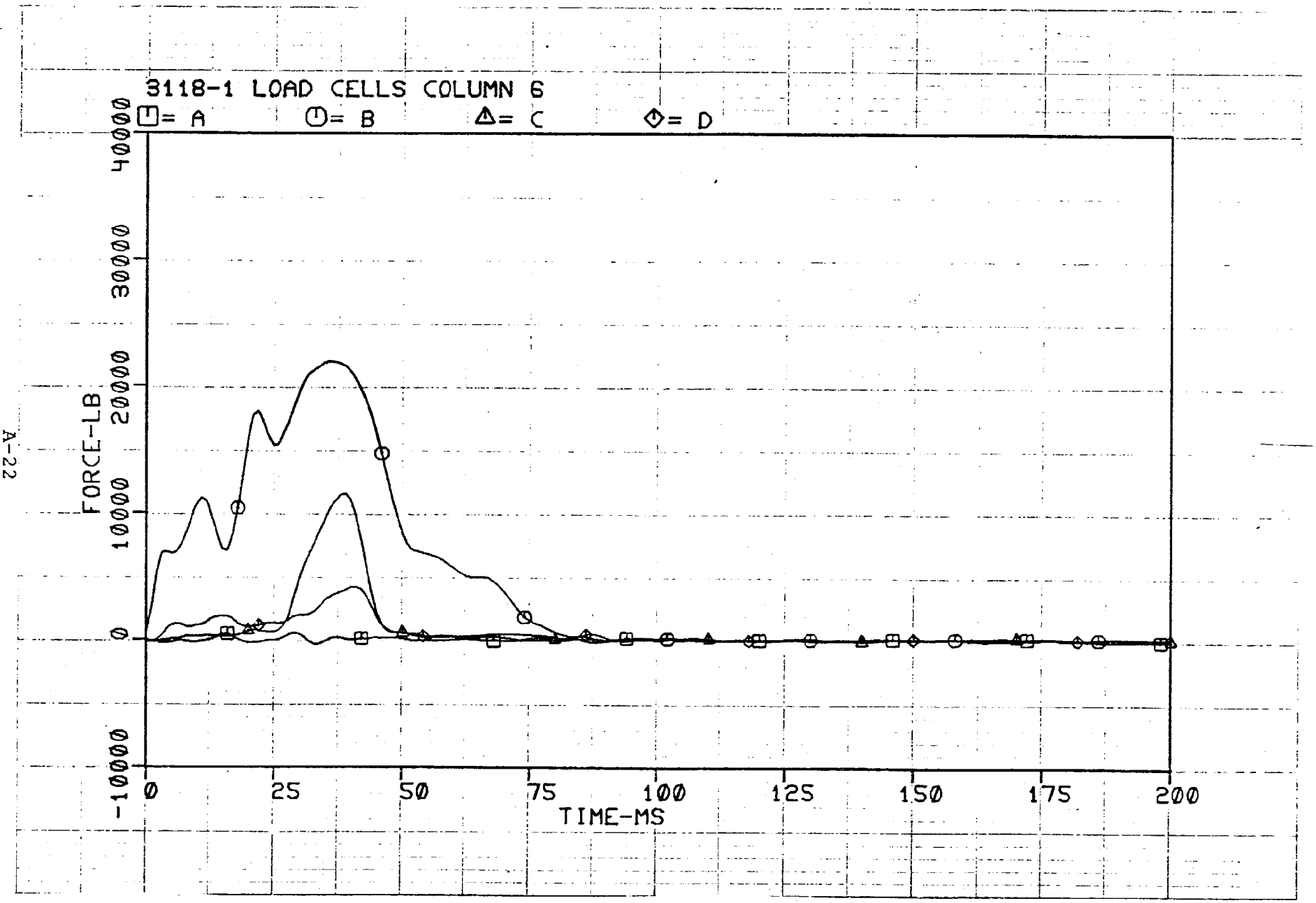
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 6
= A
= B
= C
= D
FORCE-LB
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30000
20000
10000
0
-10000
0
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50
75
100
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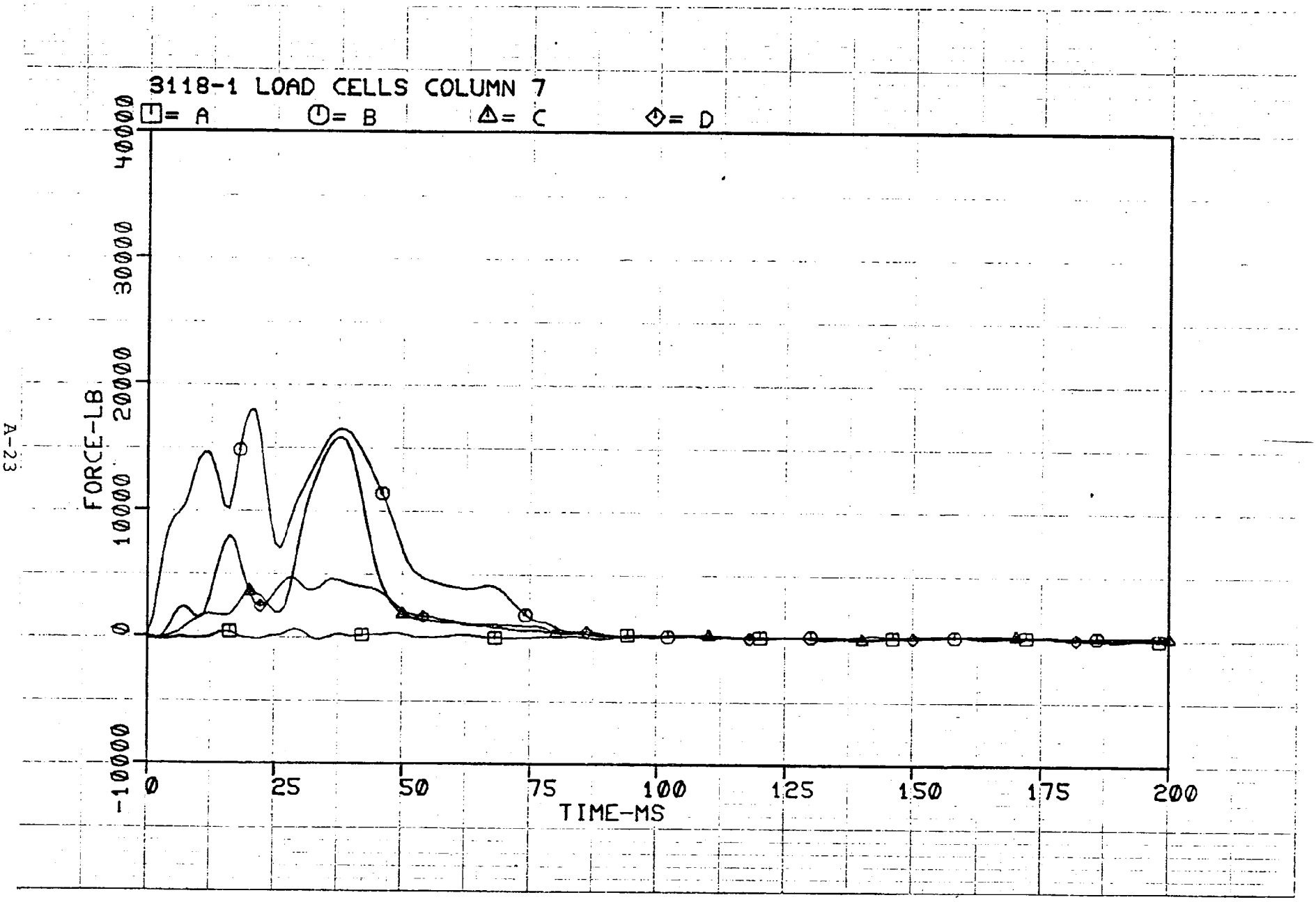
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 7
□= A
○= B
△= C
◇= D
FORCE-LB
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30000
20000
10000
0
-10000
0
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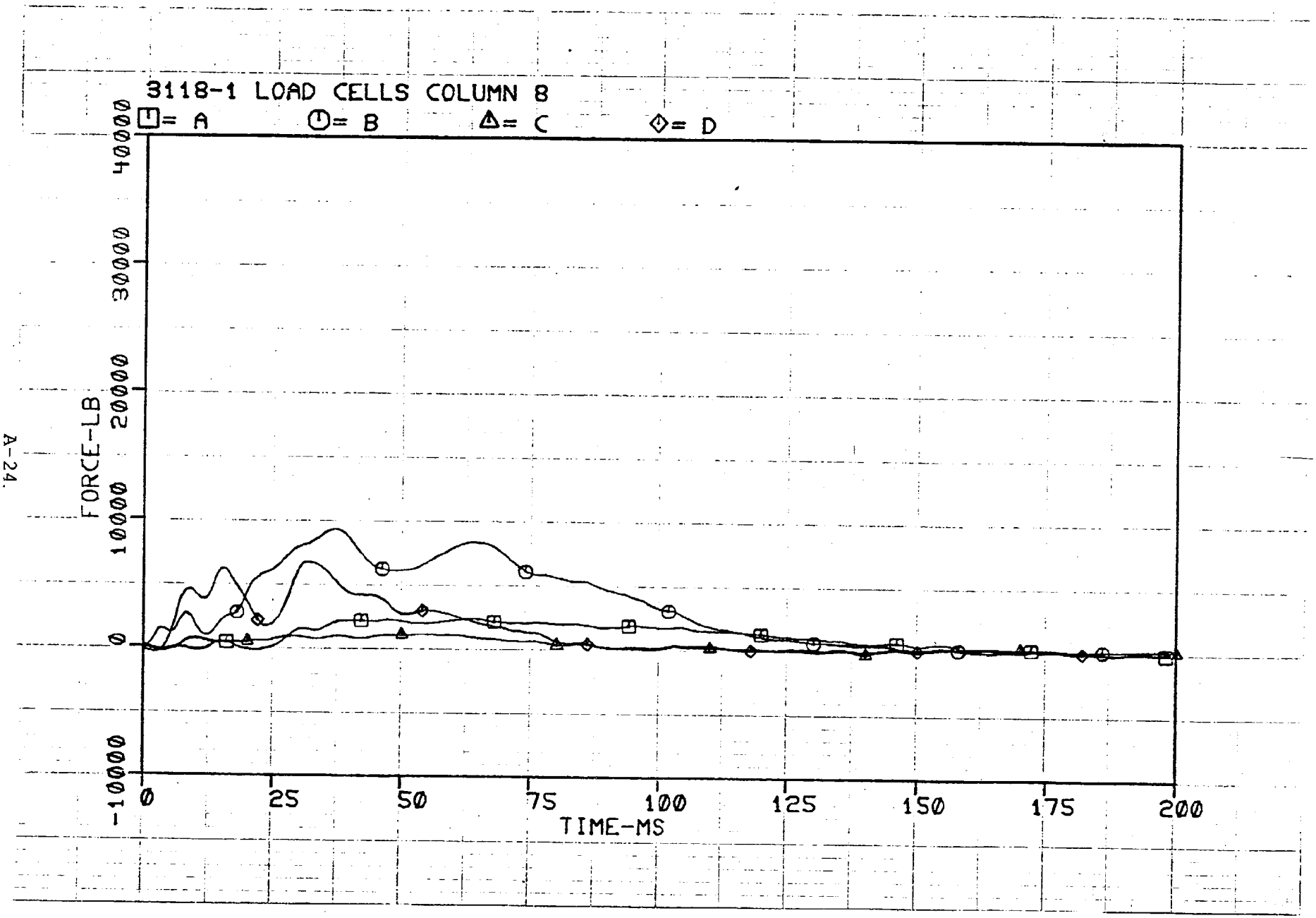
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 8
= A
= B
= C
= D
FORCE-LB
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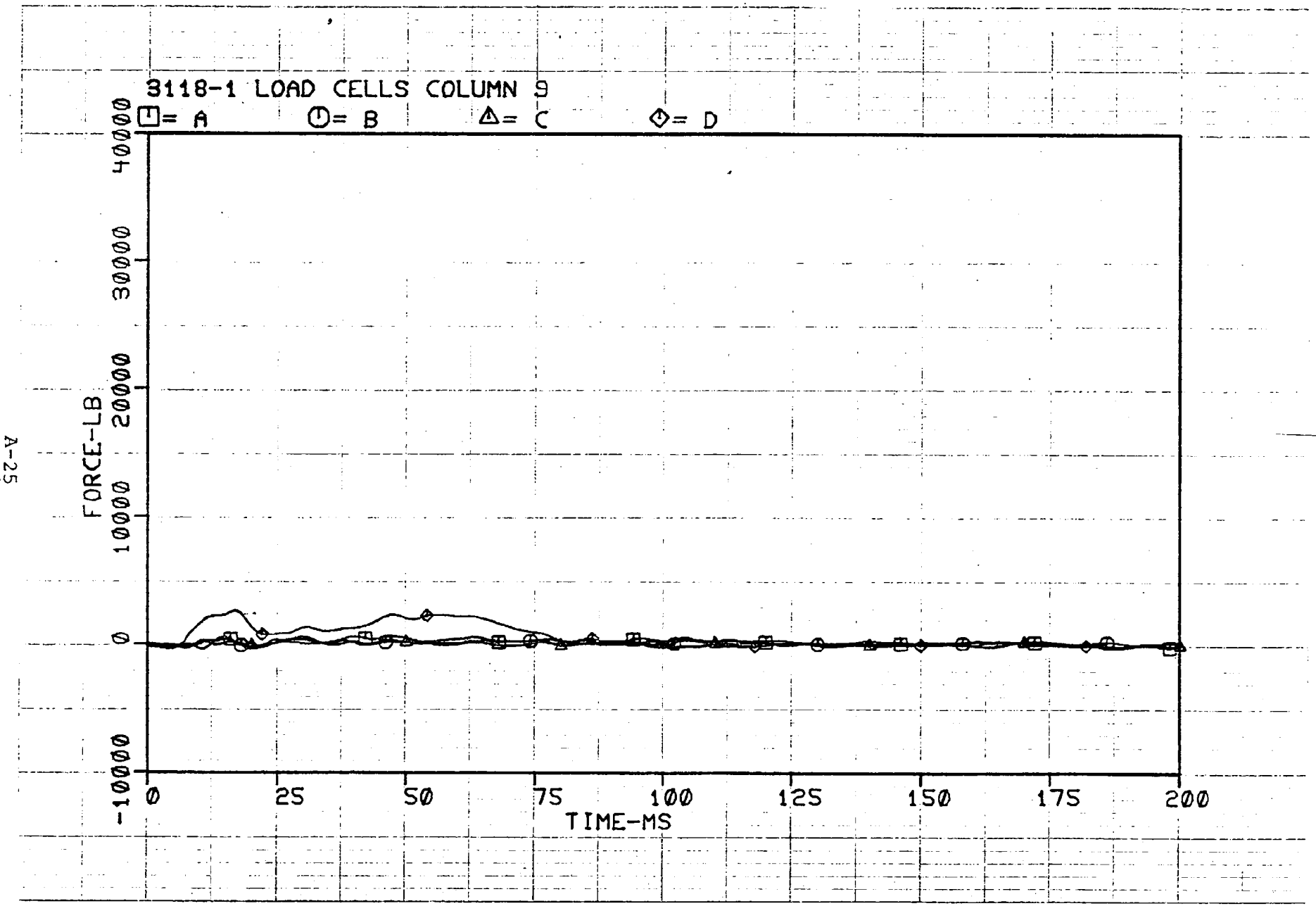
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 9
= A
= B
= C
= D
FORCE-LB
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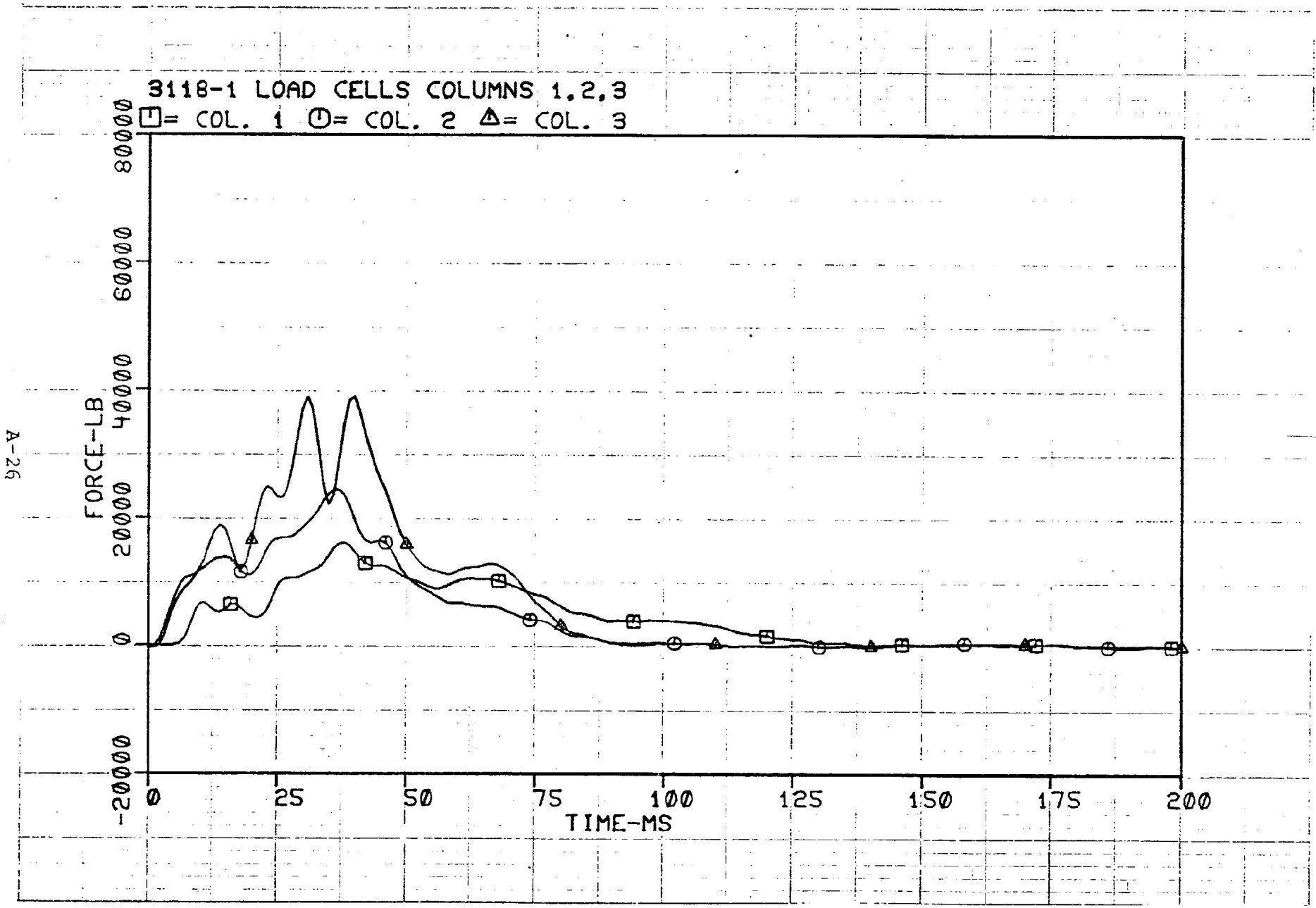
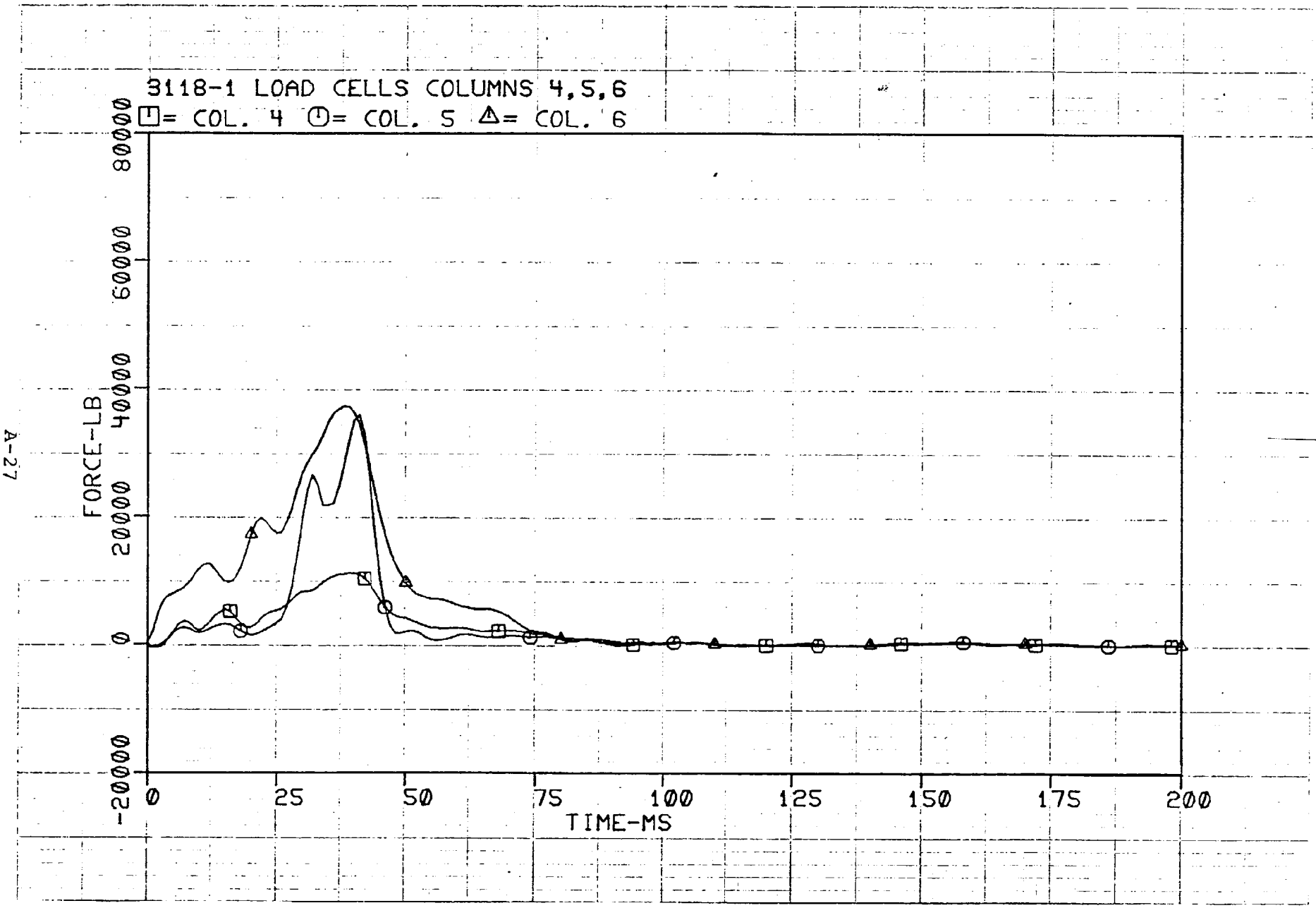
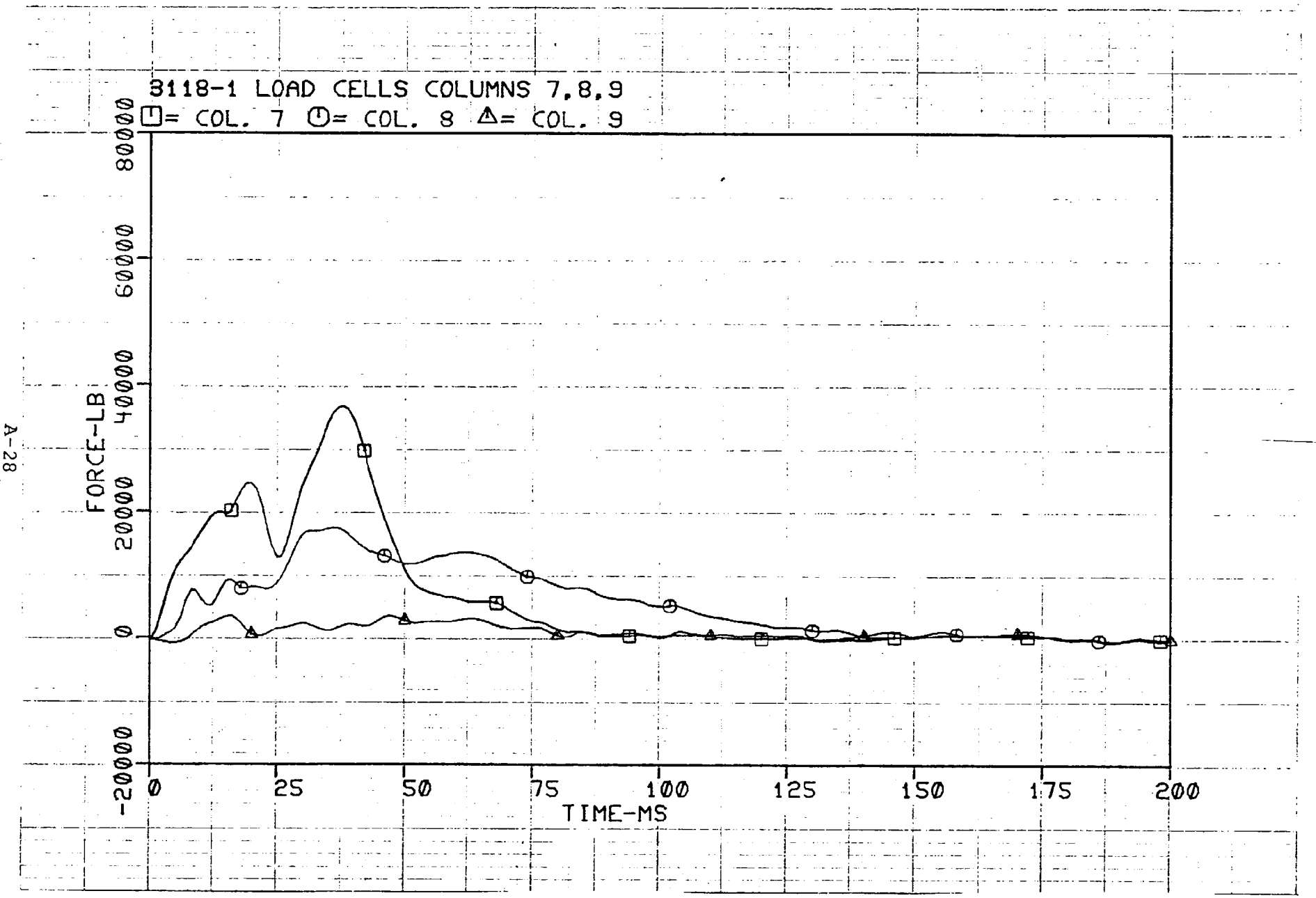
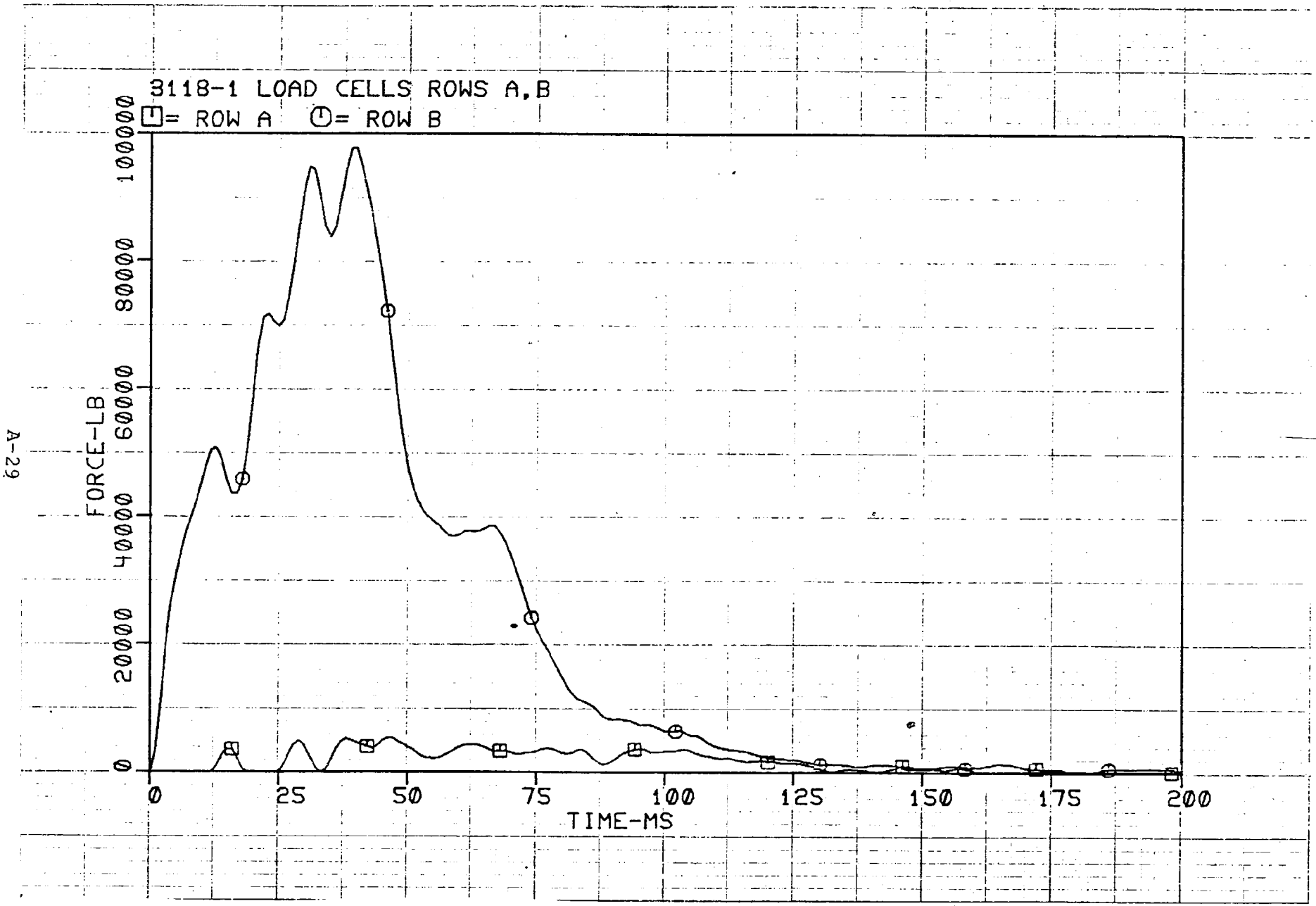
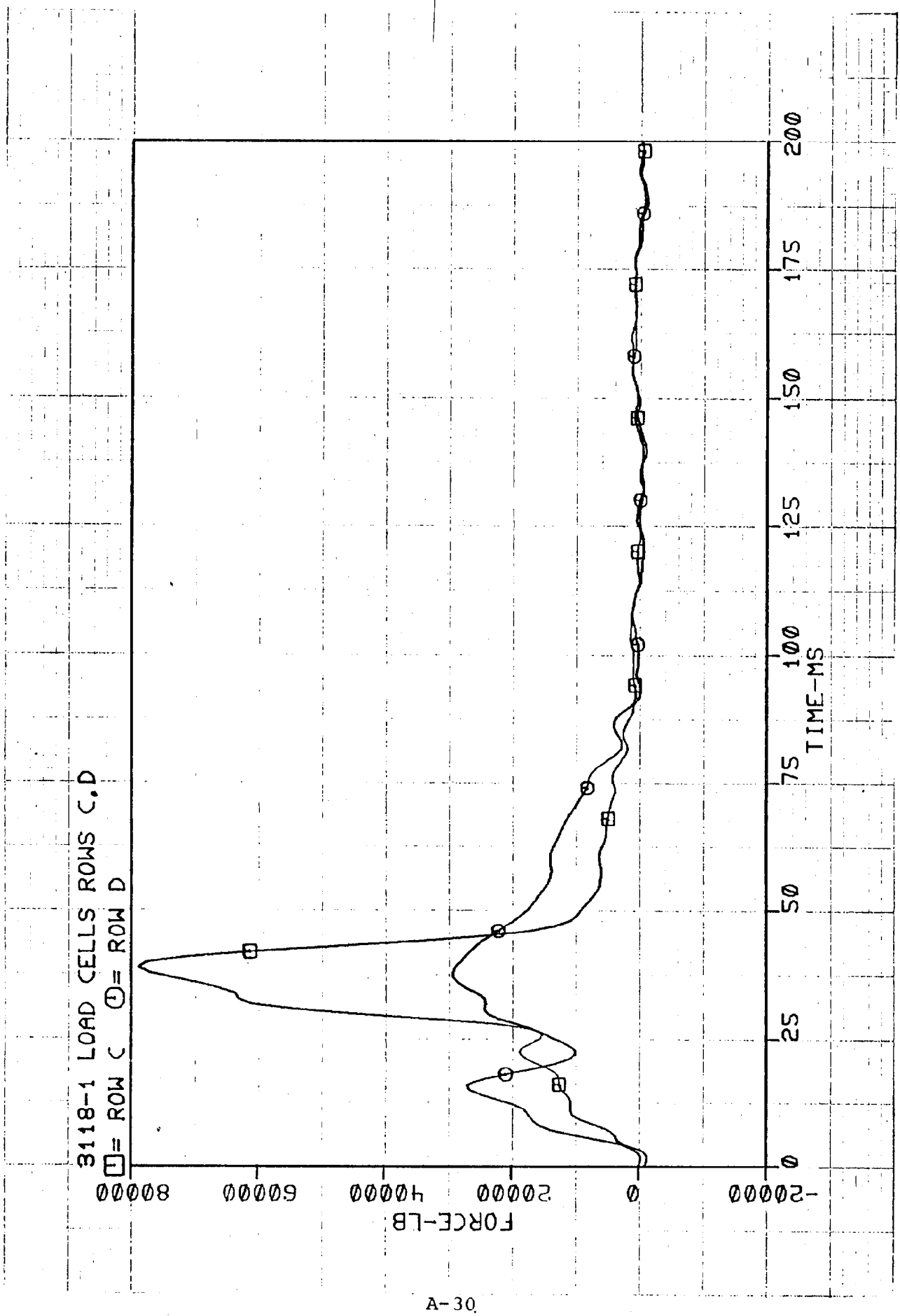
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

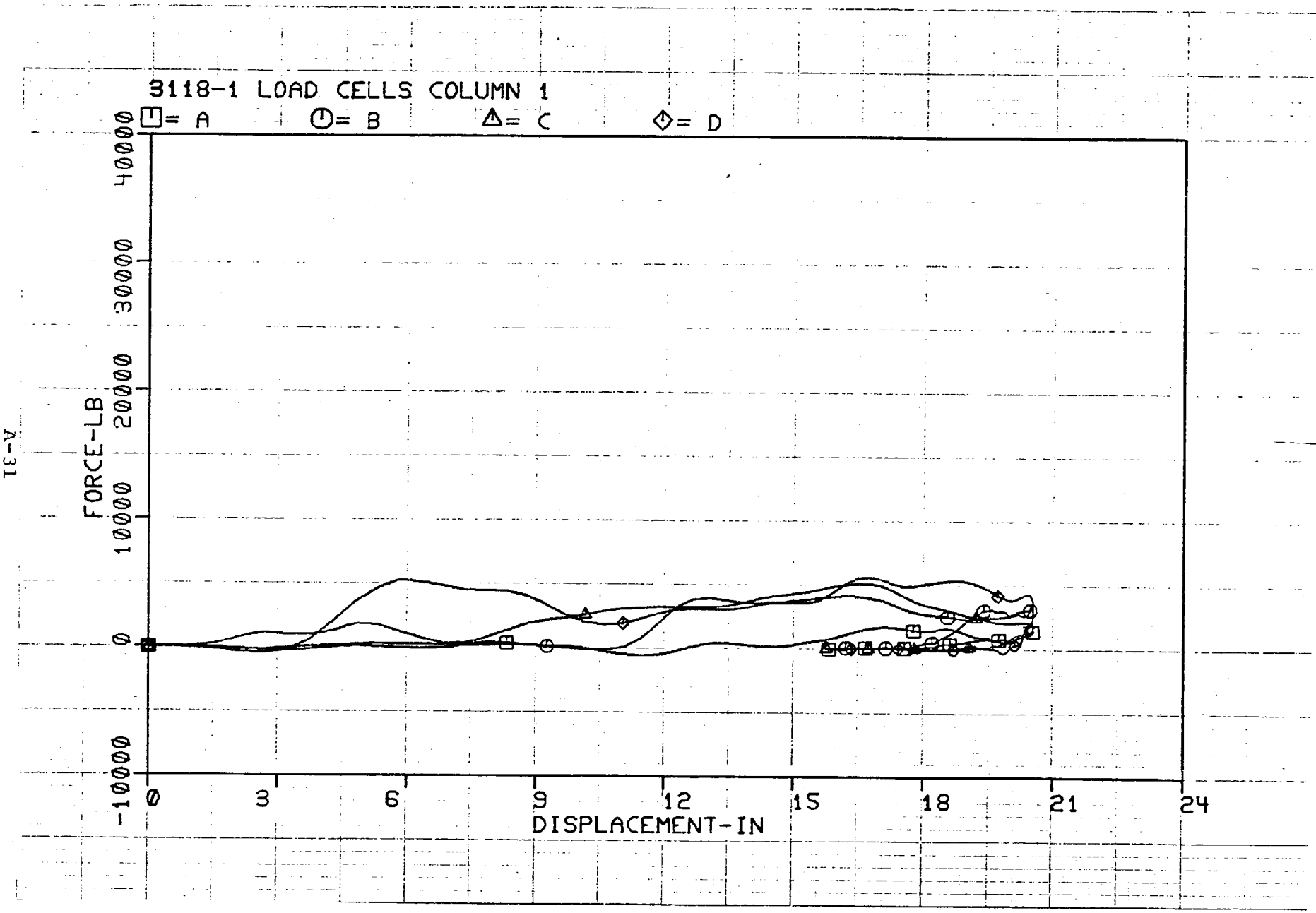

3118-1 LOAD CELLS COLUMNS 1,2,3
□= COL. 1 ○= COL. 2 △= COL. 3
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS

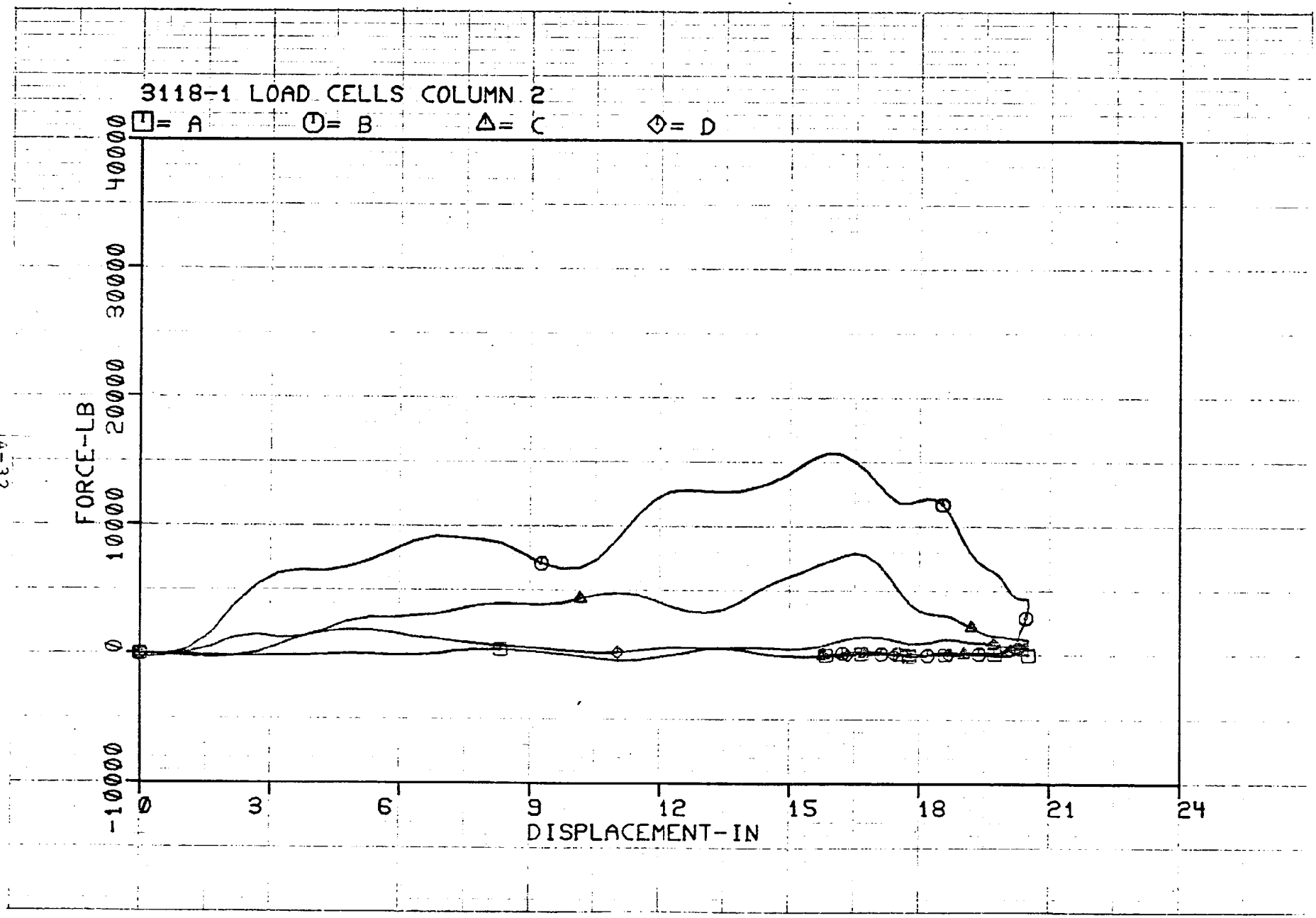

3118-1 LOAD CELLS COLUMNS 4,5,6
□= COL. 4 ⏲= COL. 5 △= COL. 6
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS

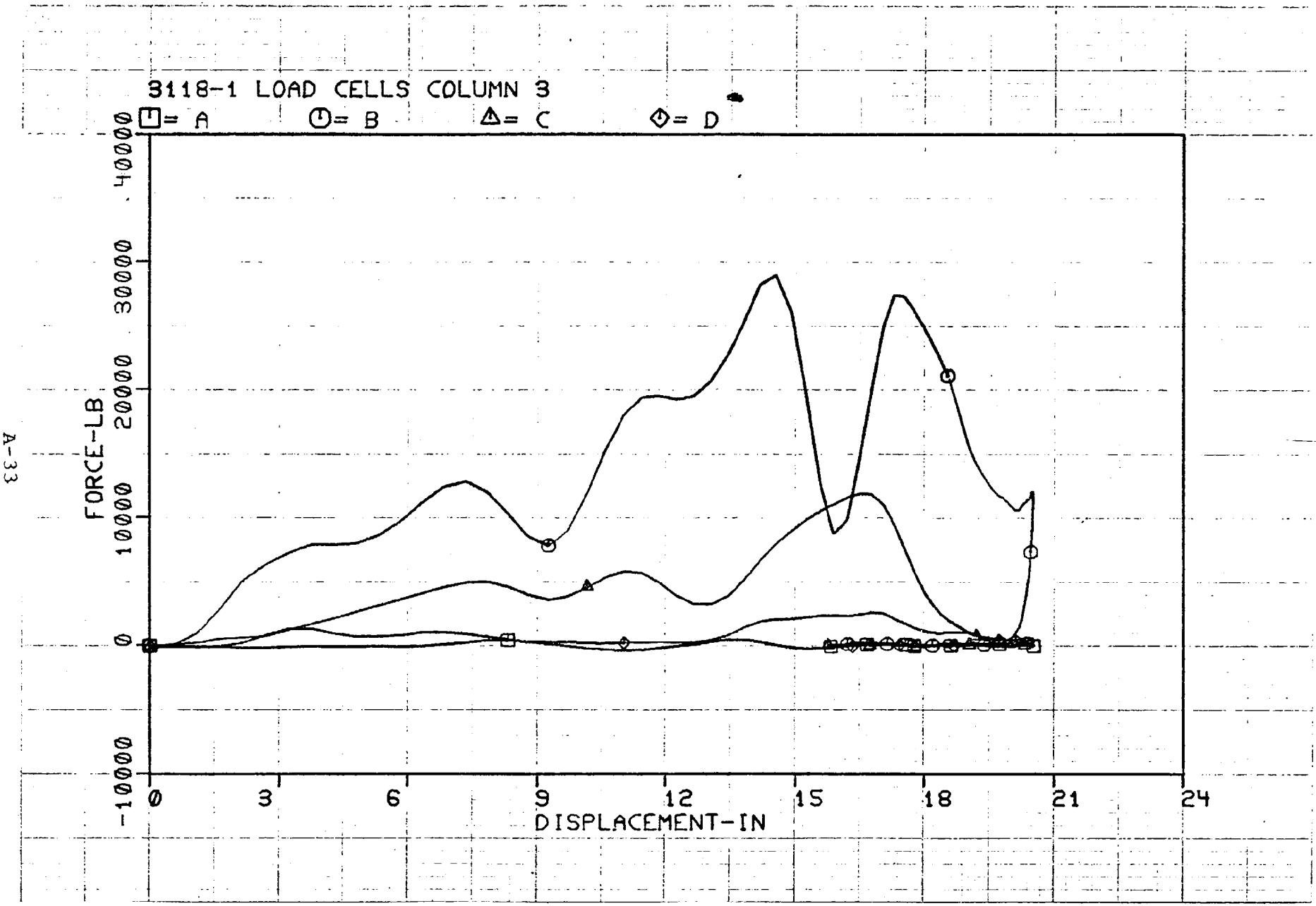

3118-1 LOAD CELLS COLUMNS 7,8,9
□= COL. 7 ○= COL. 8 △= COL. 9
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS ROWS A,B
□= ROW A ⊙= ROW B
FORCE-LB
0
20000
40000
60000
80000
100000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS ROWS C,D
□= ROW C ○= ROW D
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-1 LOAD CELLS COLUMN 1
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN


3118-1 LOAD CELLS COLUMN 2
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN


3118-1 LOAD CELLS COLUMN 3
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
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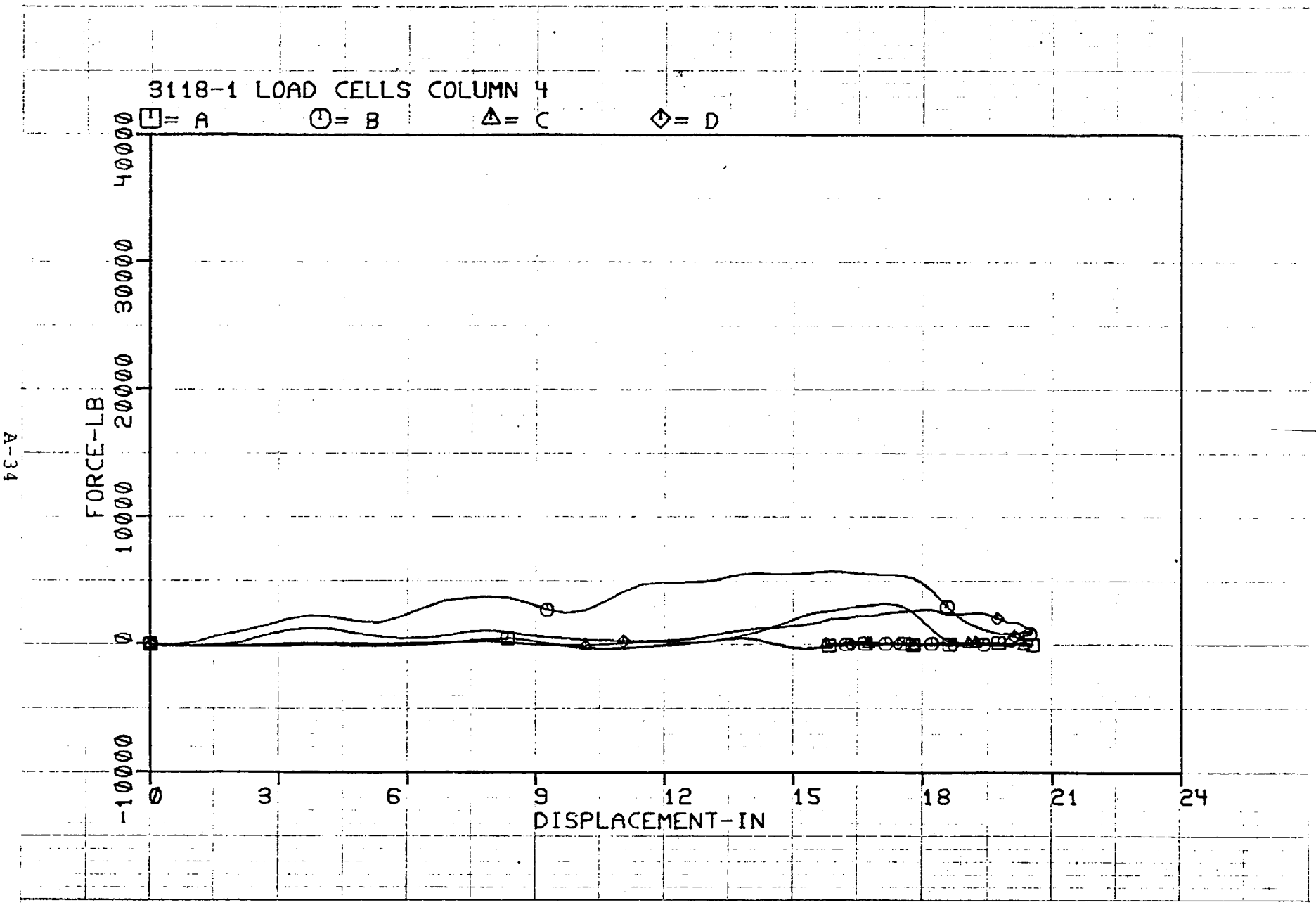
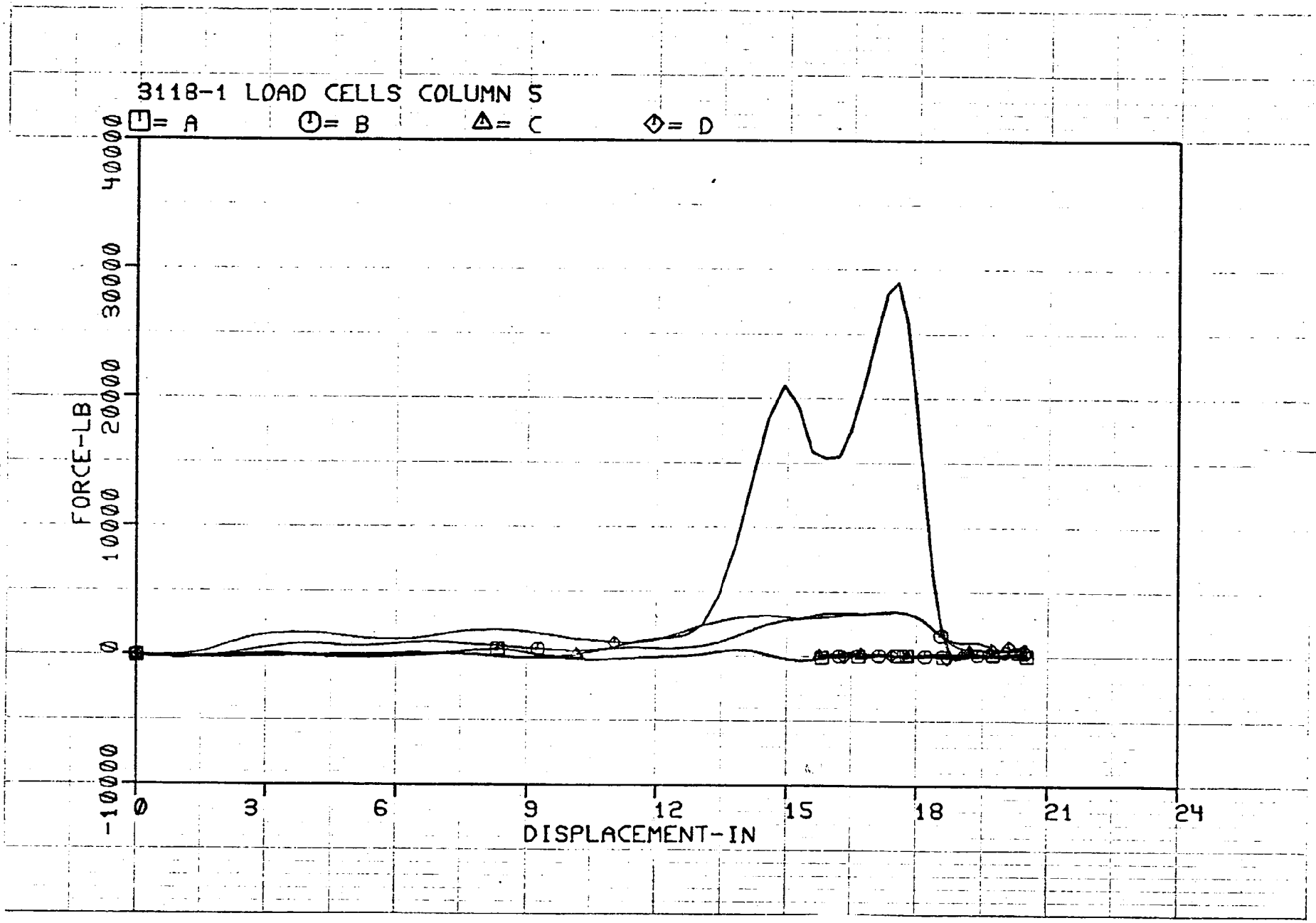
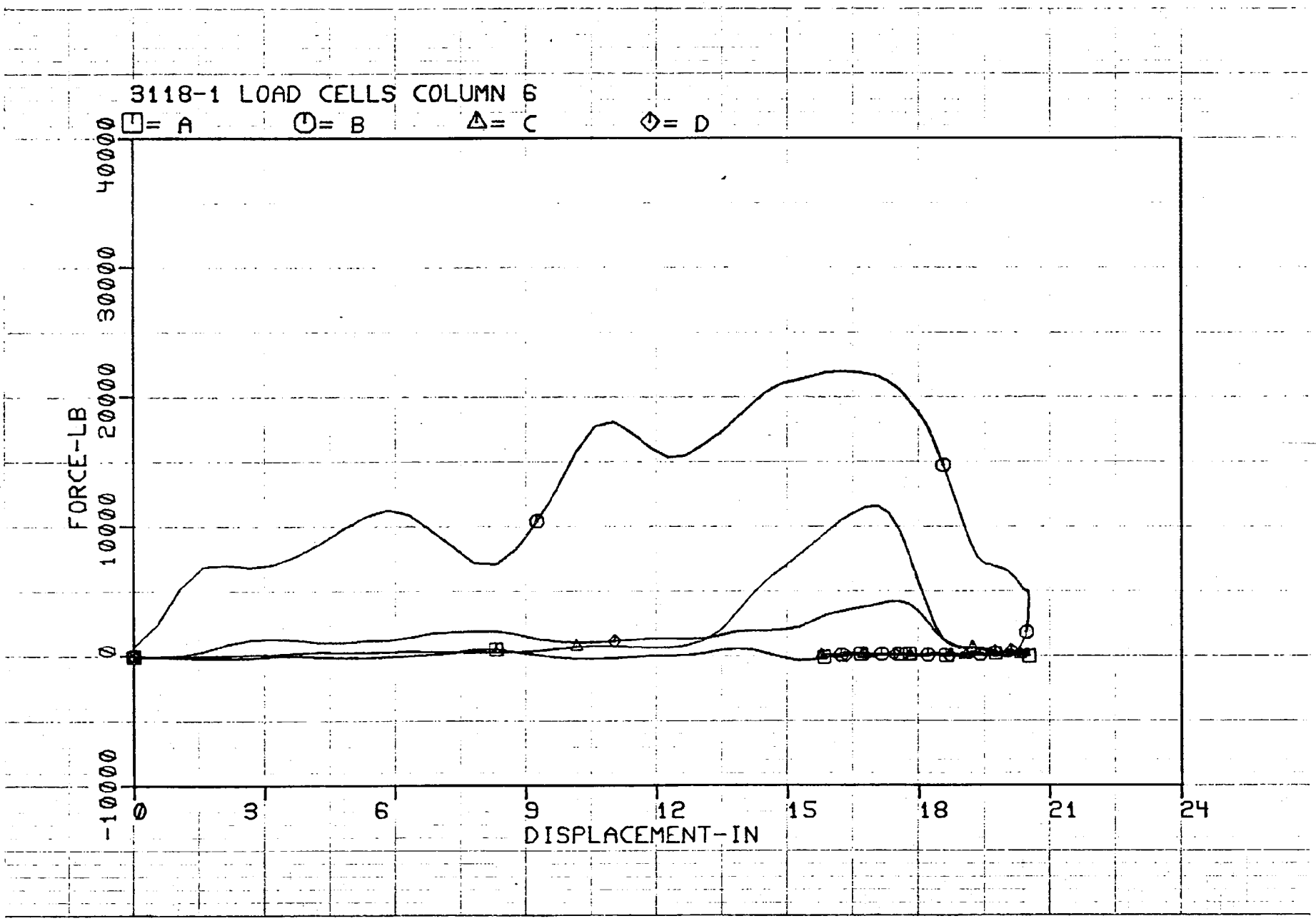
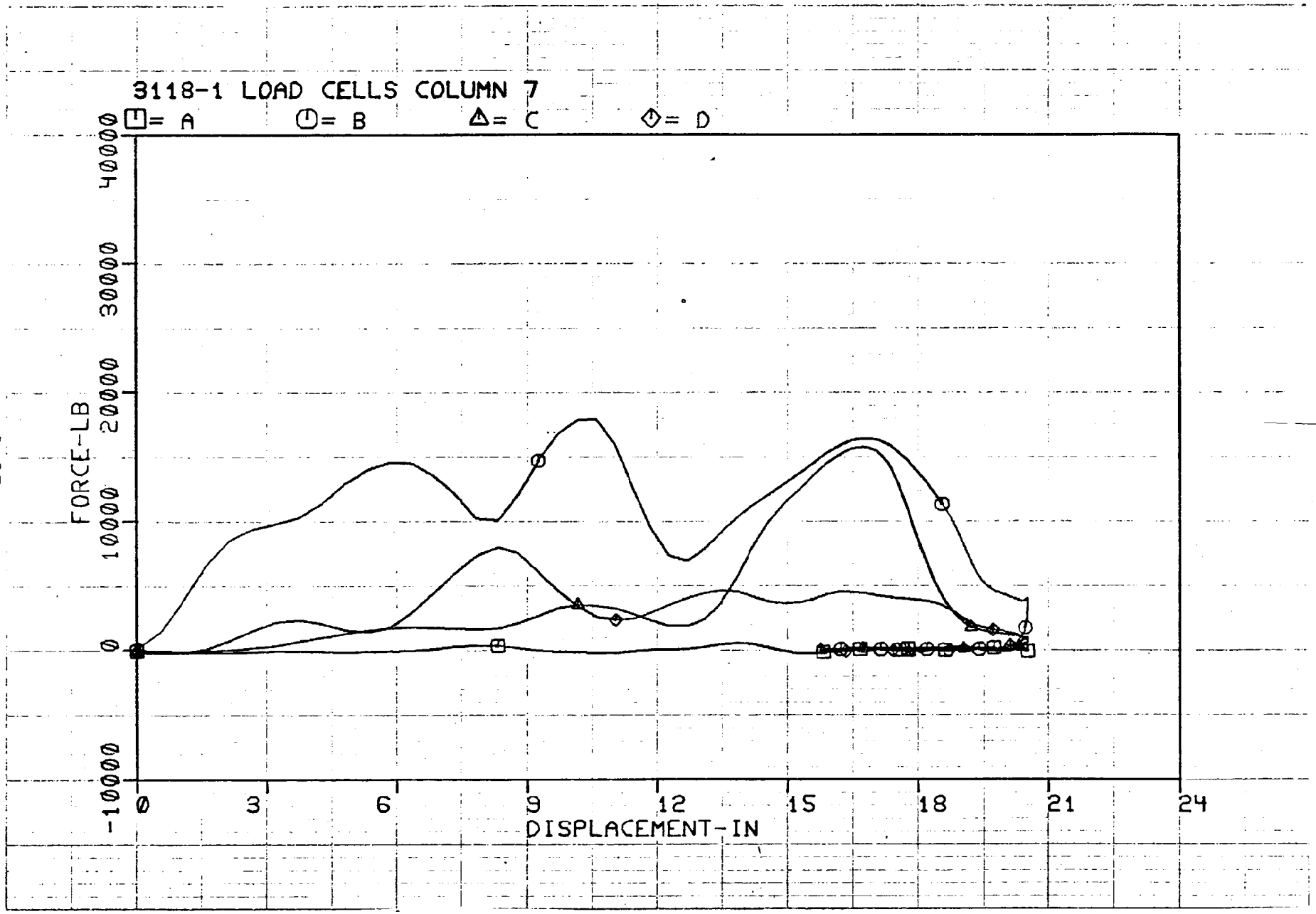
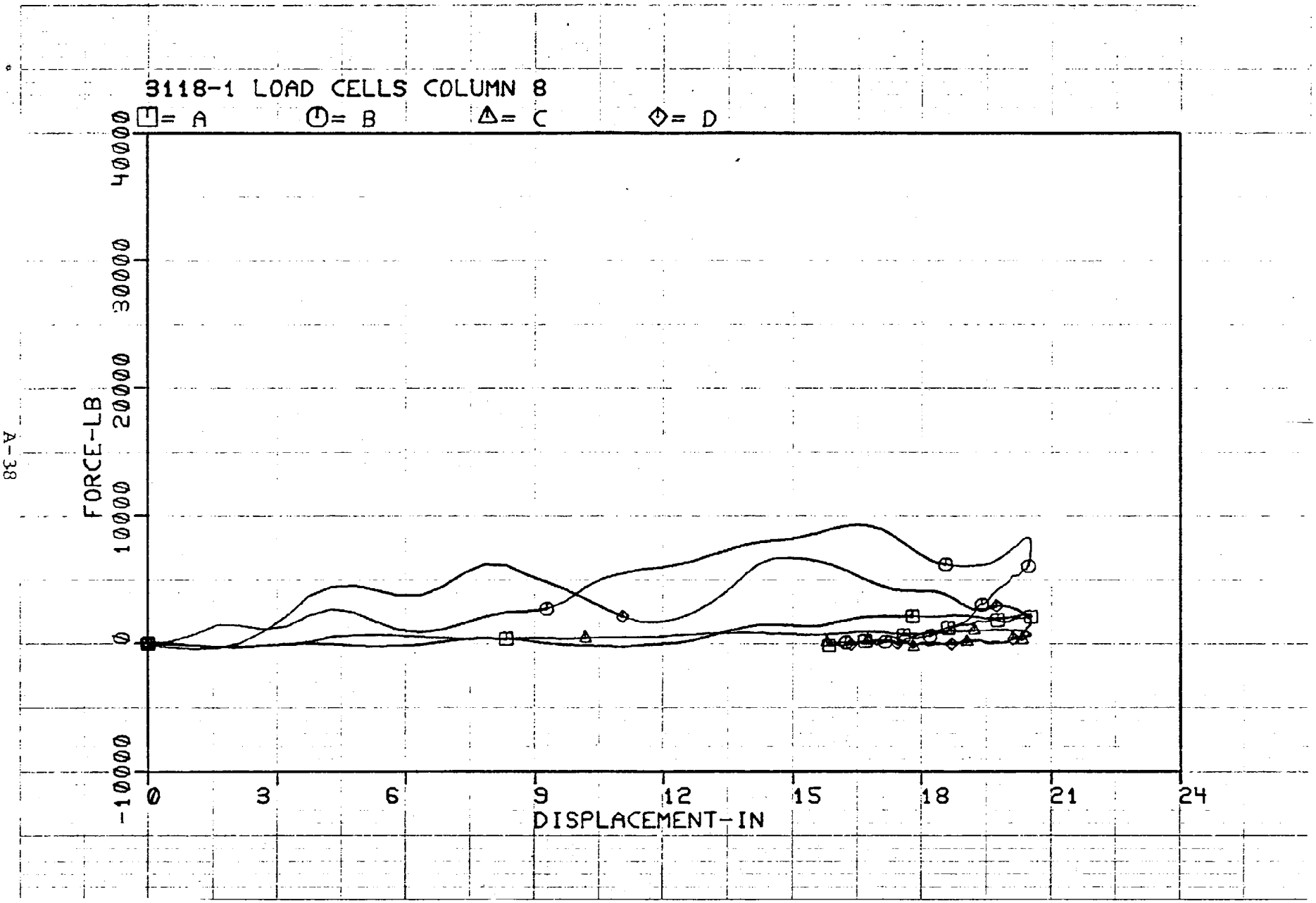
24
DISPLACEMENT-IN

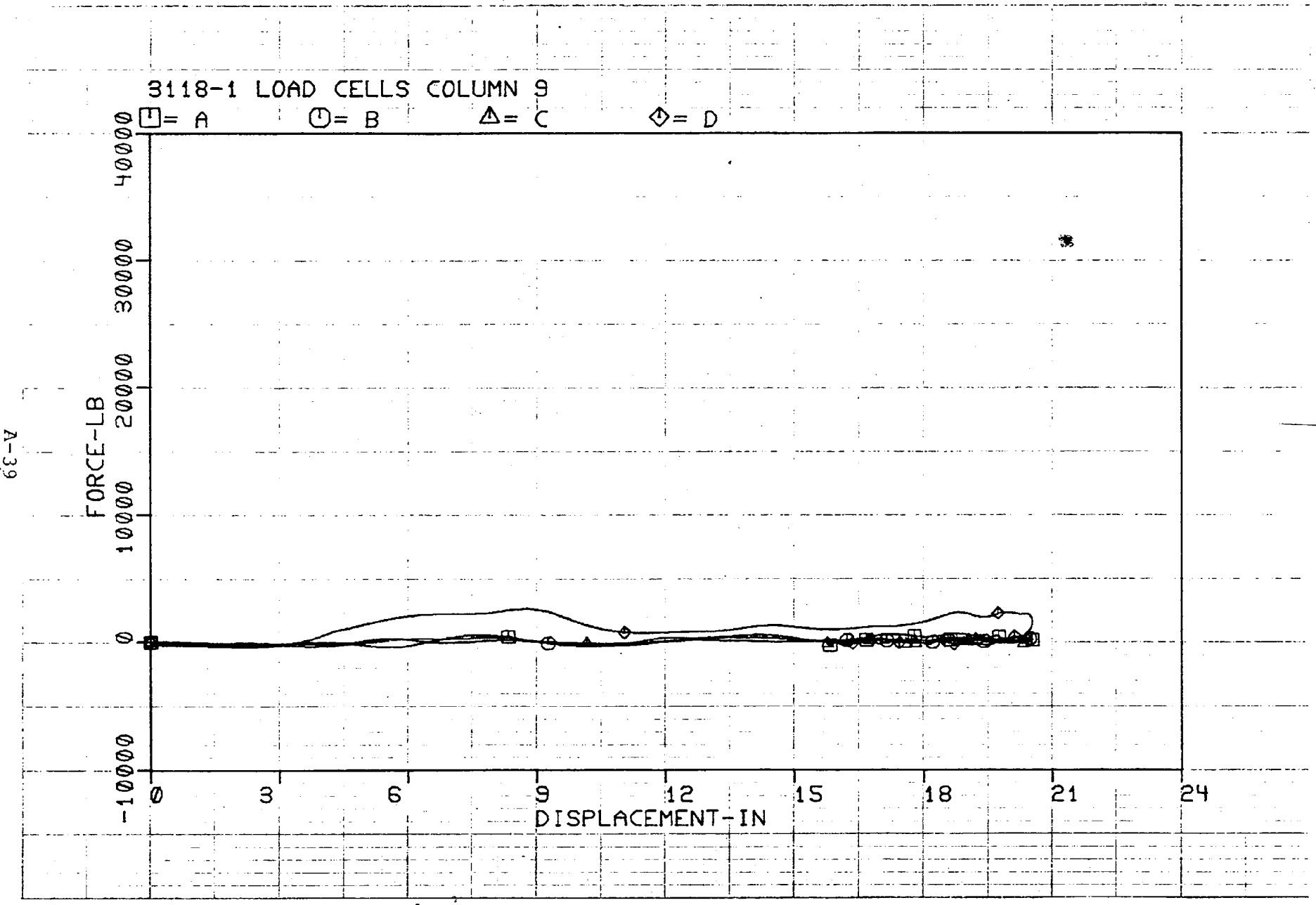

3118-1 LOAD CELLS COLUMN 4
= A
= B
= C
= D
40000
30000
20000
10000
0
-10000
FORCE-LB
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

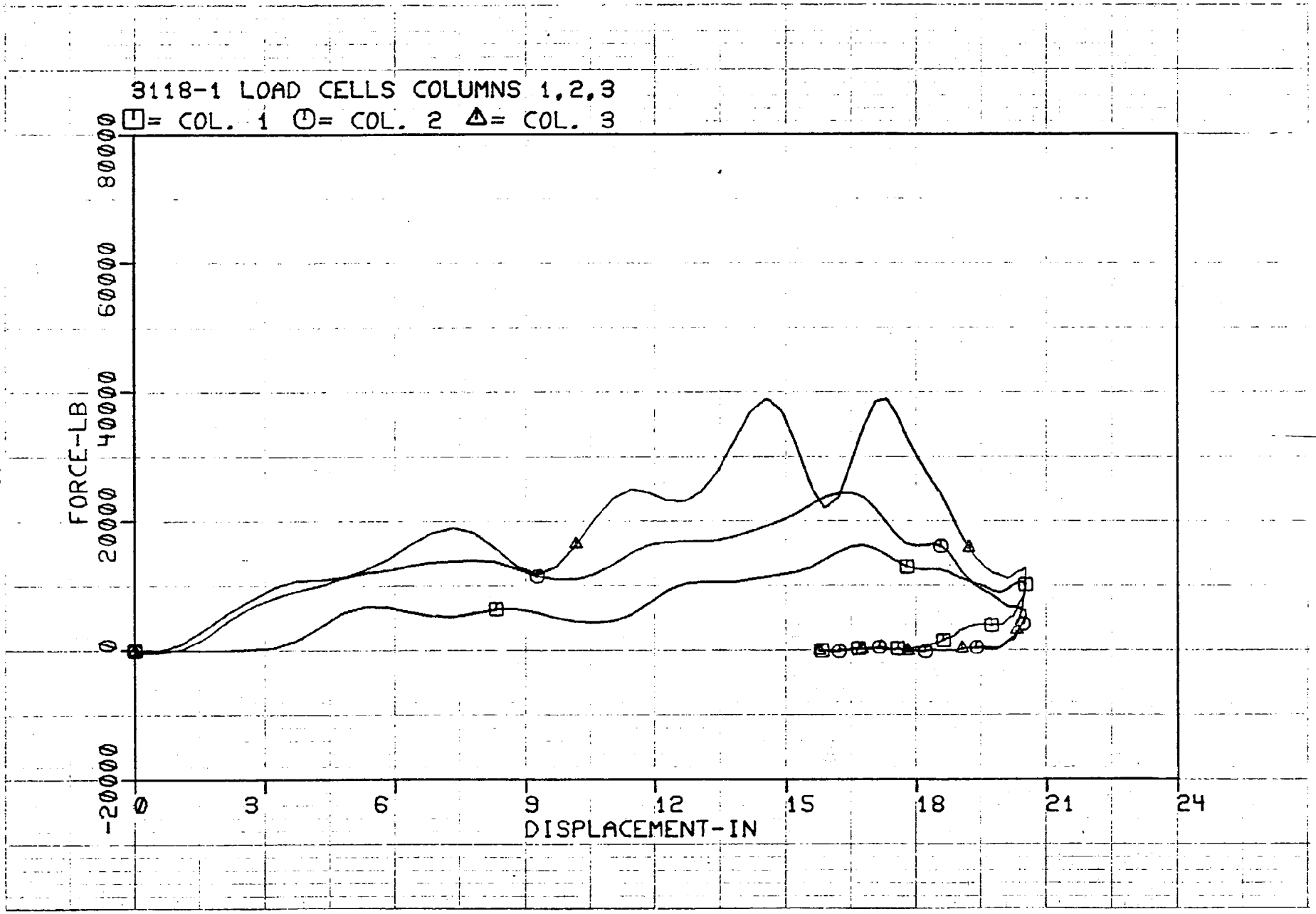

3118-1 LOAD CELLS COLUMN 5
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

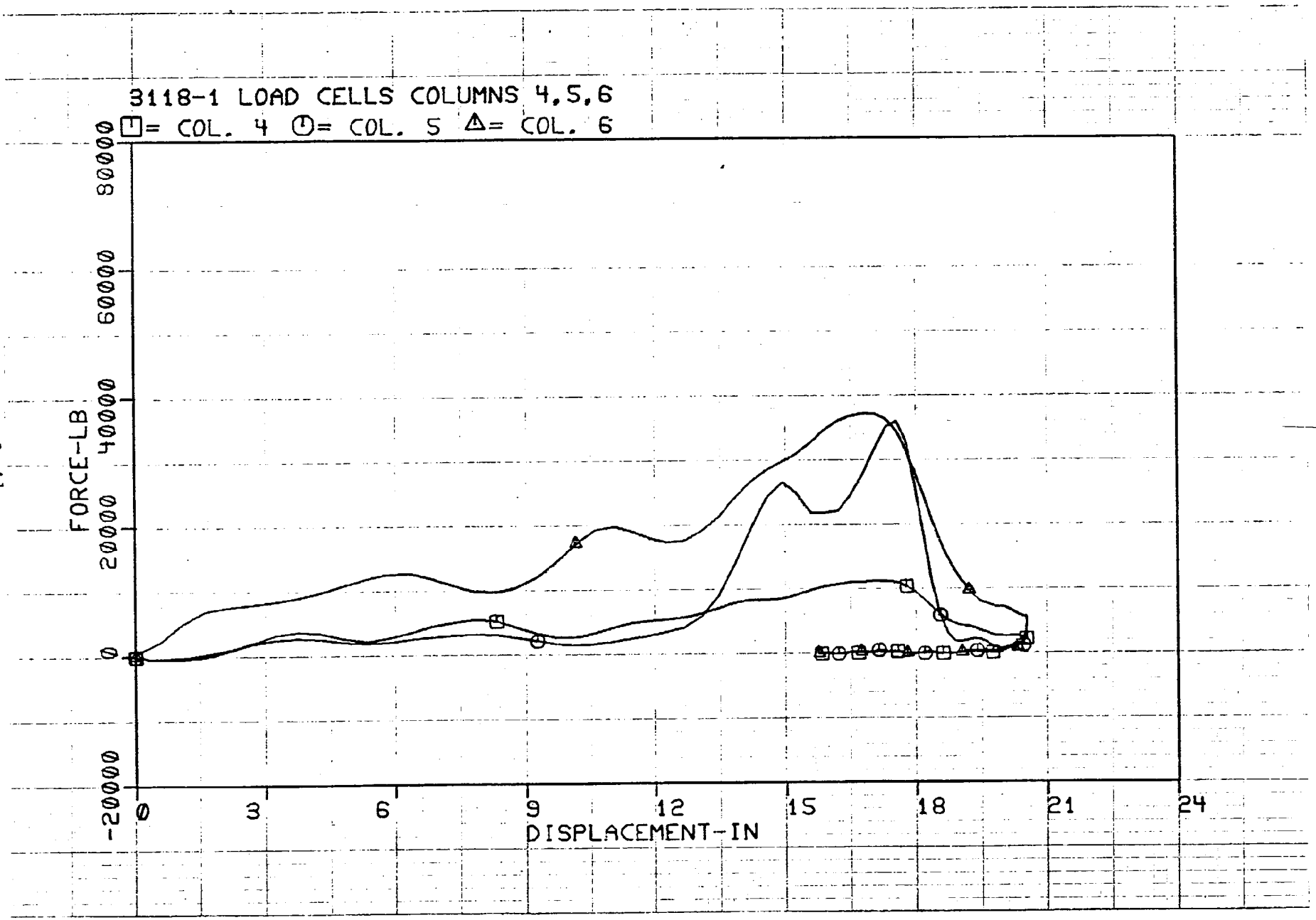

3118-1 LOAD CELLS COLUMN 6
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

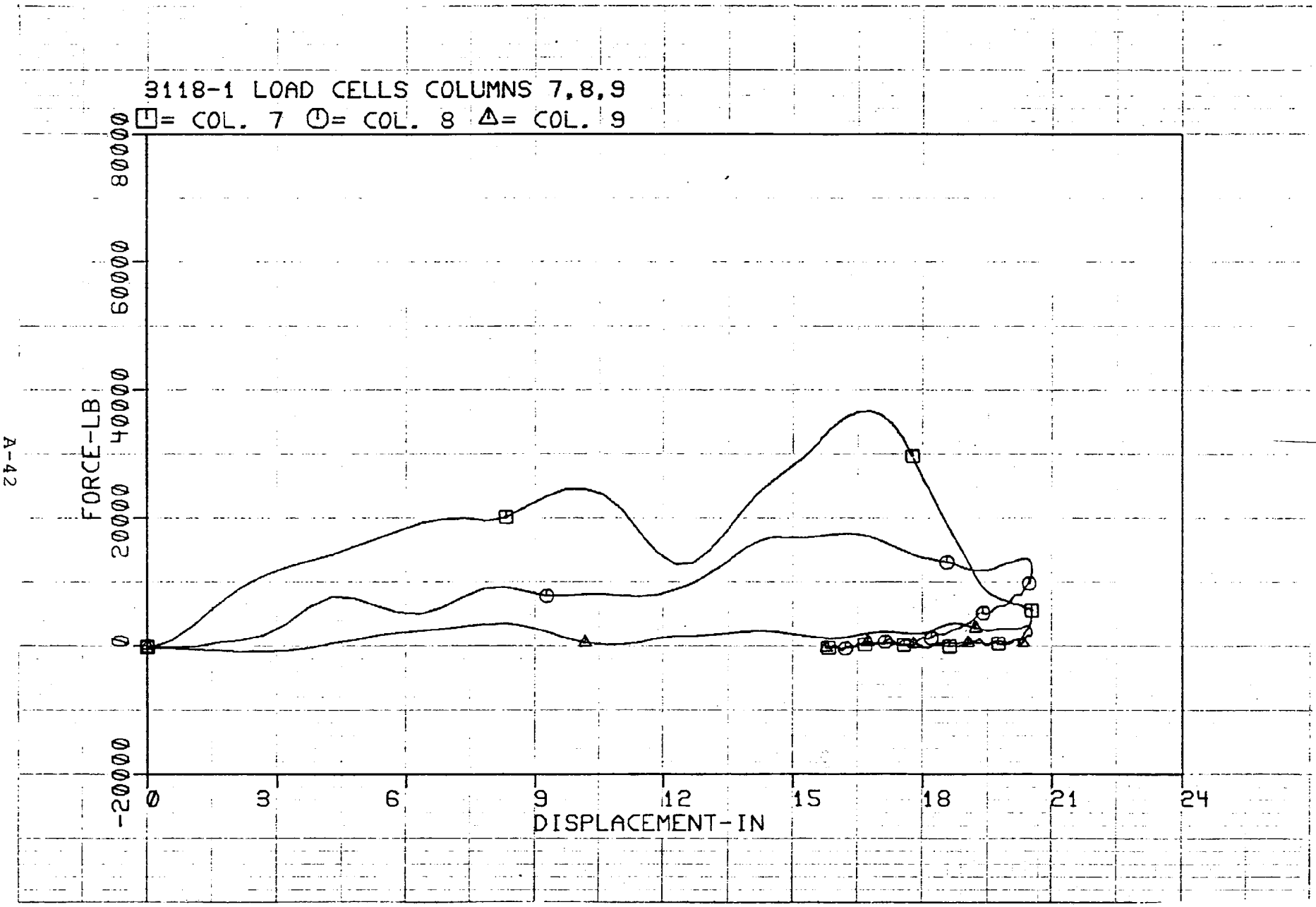

3118-1 LOAD CELLS COLUMN 7
= A
= B
= C
= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

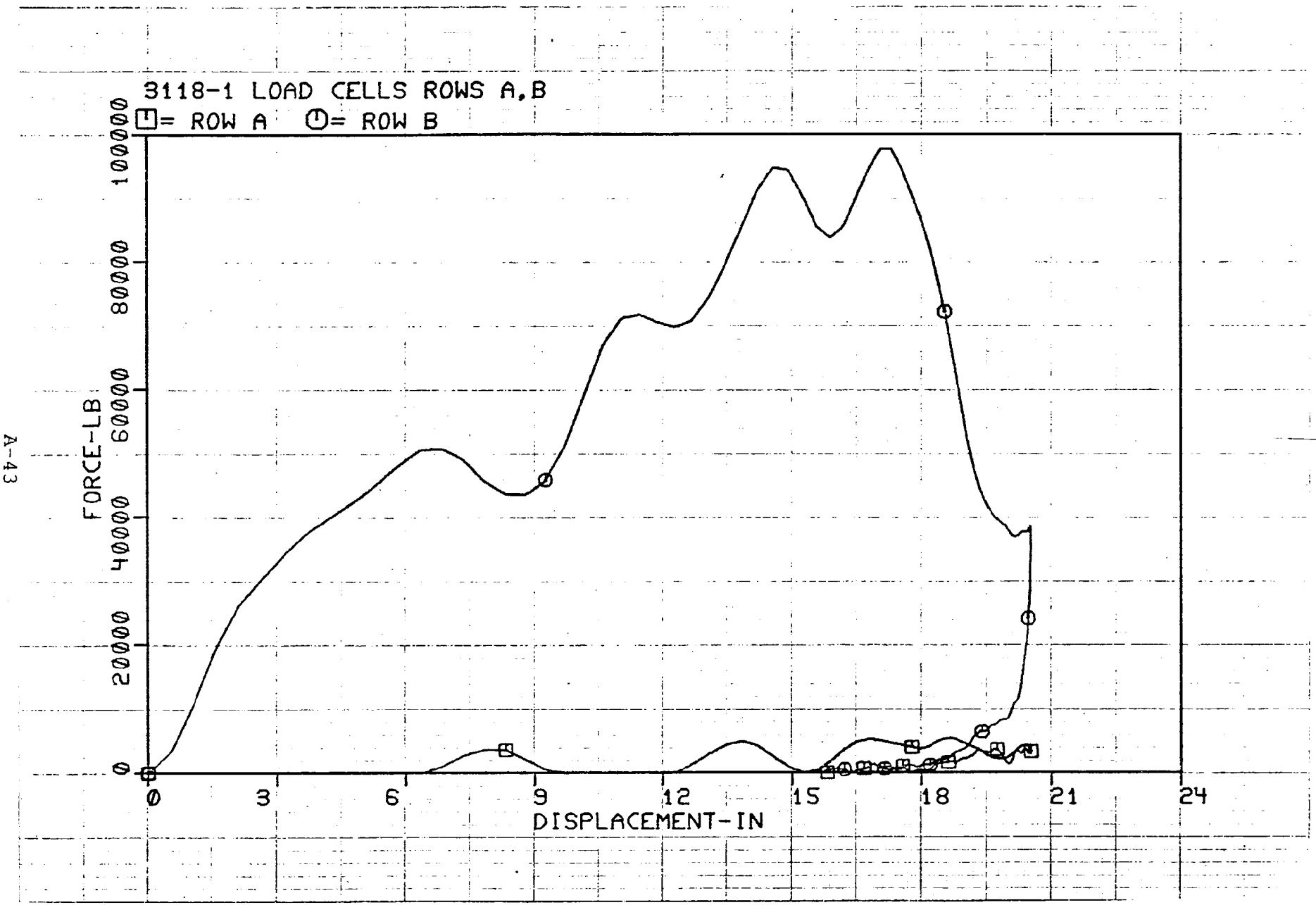

3118-1 LOAD CELLS COLUMN 8
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

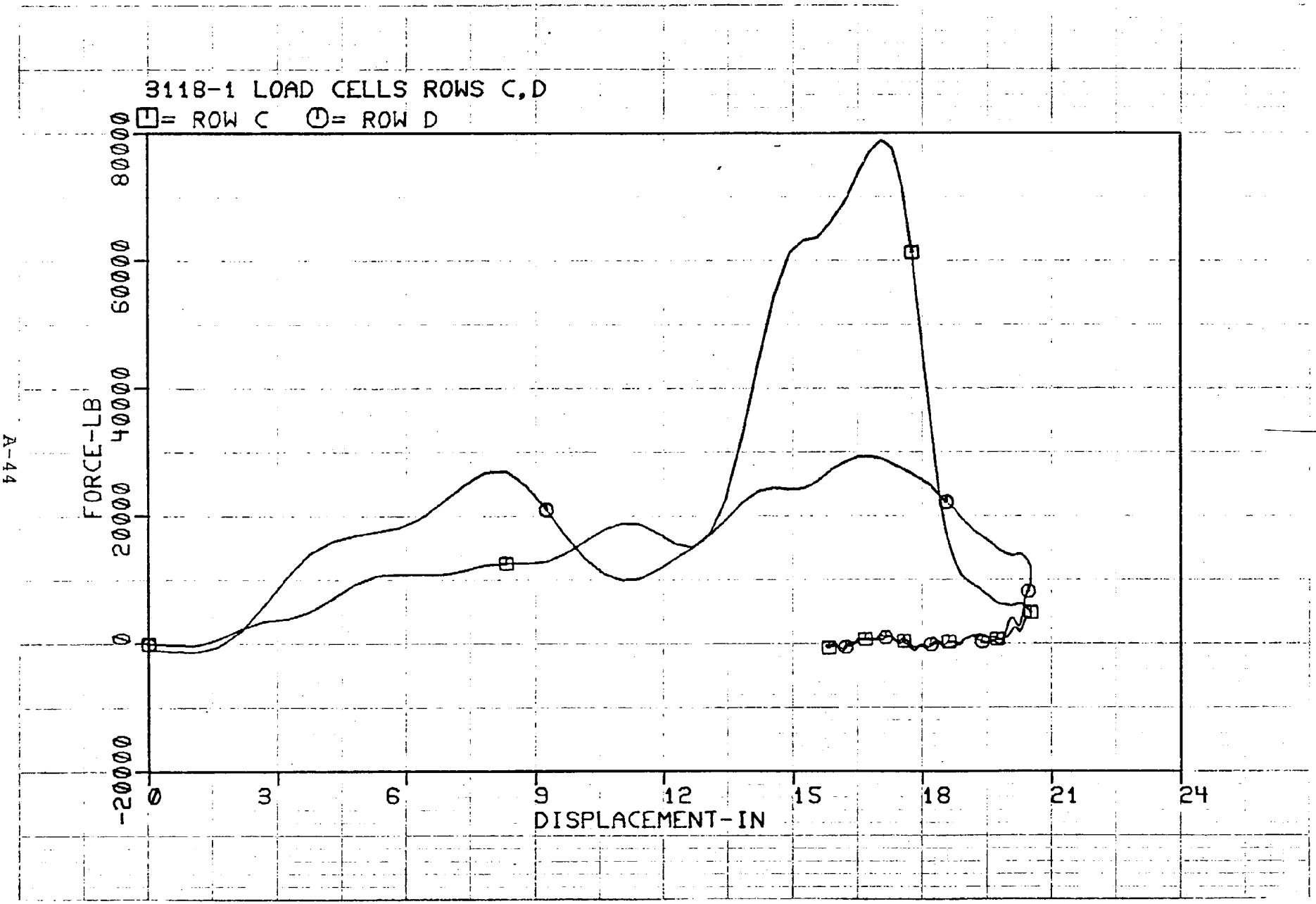

3118-1 LOAD CELLS COLUMN 9
□= A
○= B
△= C
◇= D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

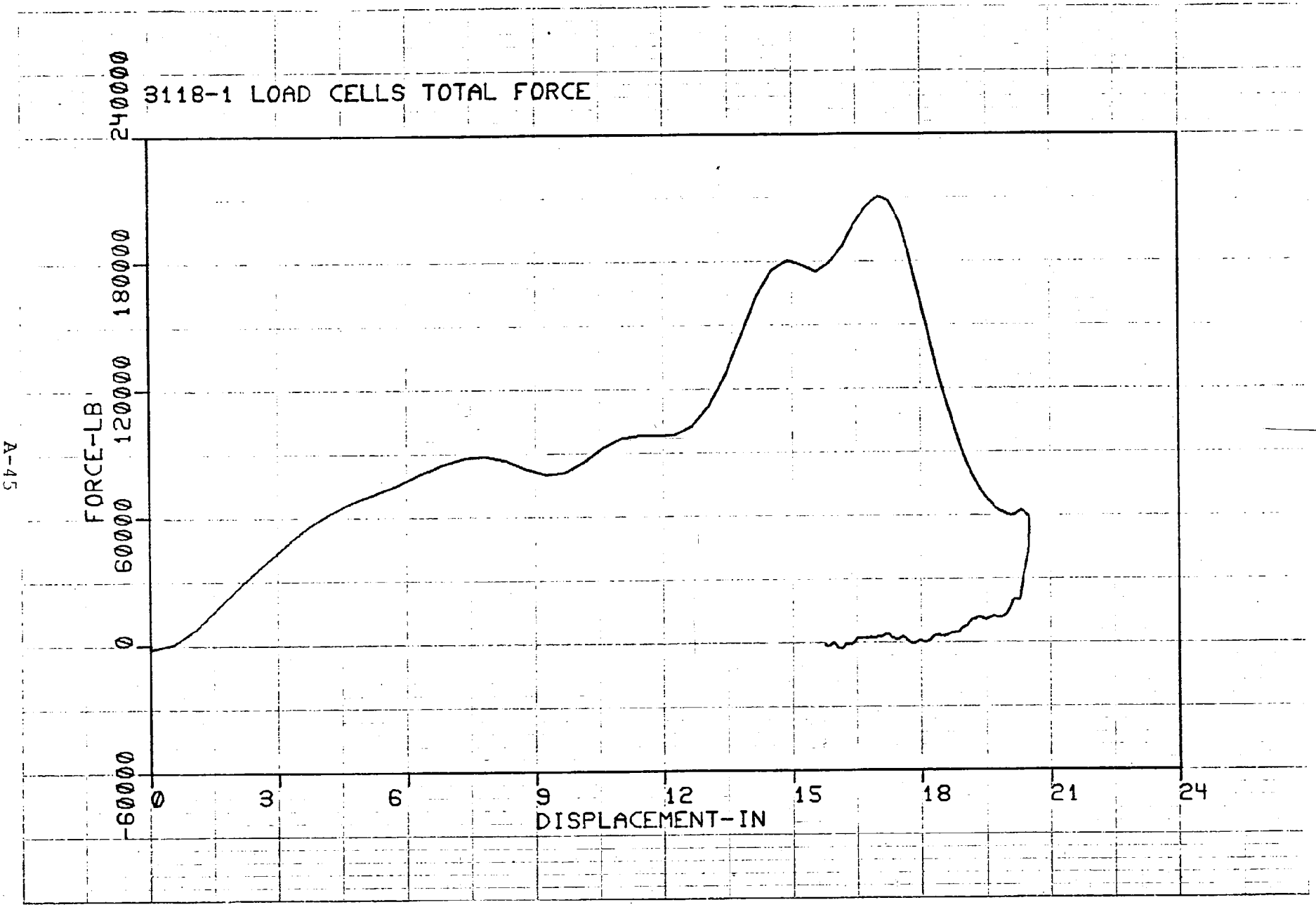

3118-1 LOAD CELLS COLUMNS 1,2,3
□= COL. 1 ⊙= COL. 2 △= COL. 3
FORCE-LB
80000
60000
40000
20000
0
-20000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN


3118-1 LOAD CELLS COLUMNS 4,5,6
□= COL. 4 ○= COL. 5 △= COL. 6
FORCE-LB
80000
60000
40000
20000
0
-20000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN


3118-1 LOAD CELLS COLUMNS 7,8,9
□= COL. 7 ○= COL. 8 △= COL. 9
FORCE-LB
80000
60000
40000
20000
0
-20000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN


3118-1 LOAD CELLS ROWS A,B
□= ROW A ⏱= ROW B
FORCE-LB
0
20000
40000
60000
80000
100000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

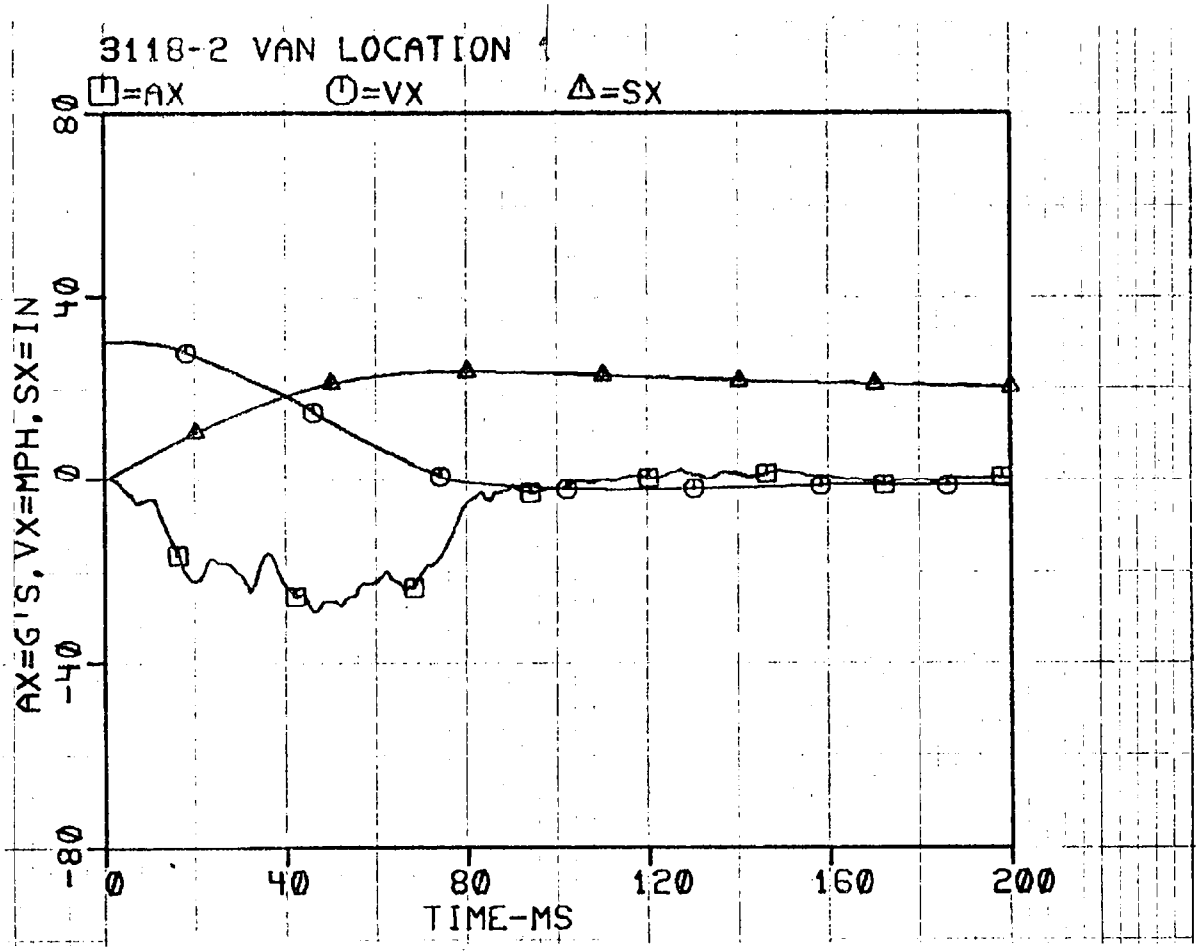

3118-1 LOAD CELLS ROWS C,D
□= ROW C ⓘ= ROW D
FORCE-LB
80000
60000
40000
20000
0
-20000
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

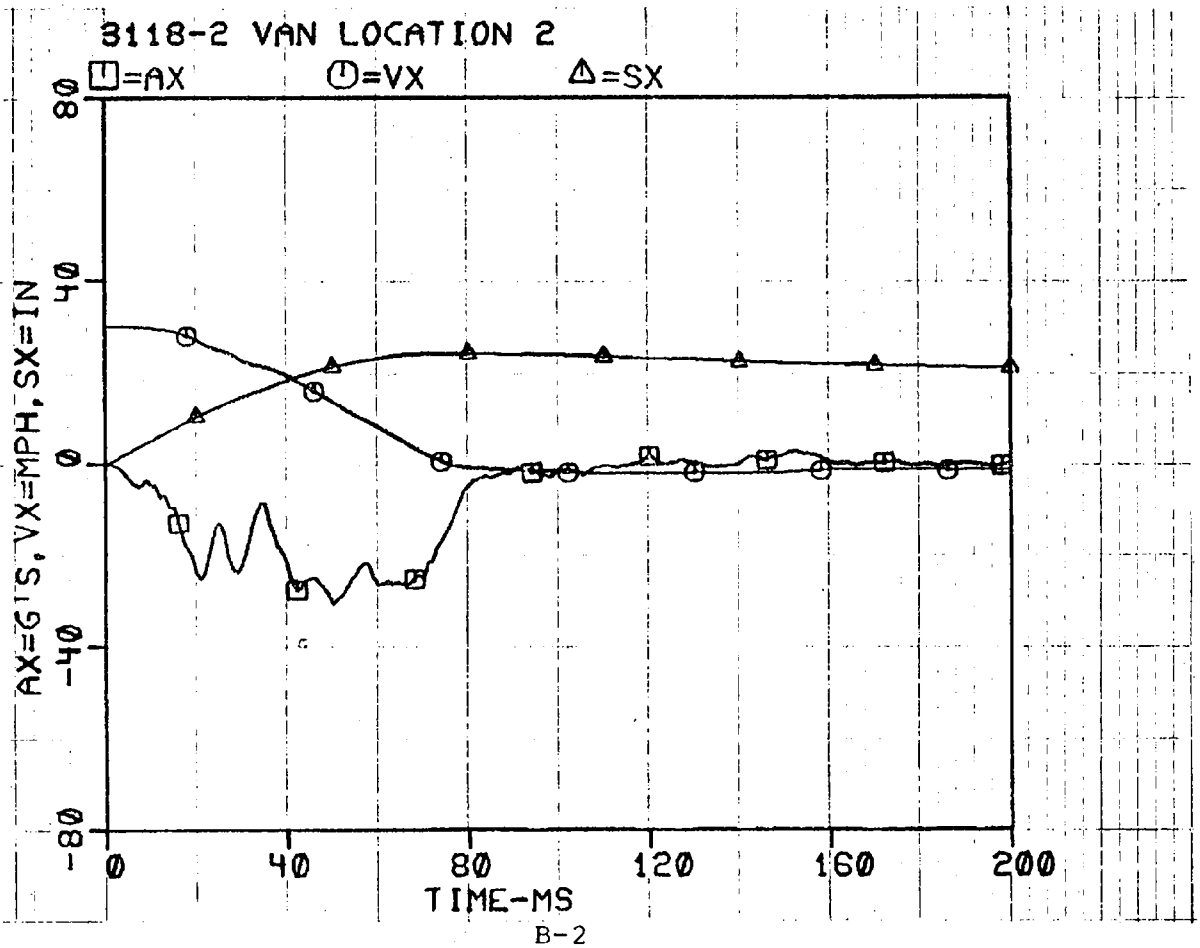

3118-1 LOAD CELLS TOTAL FORCE
240000
180000
120000
60000
0
-60000
FORCE-LB
0
3
6
9
12
15
18
21
24
DISPLACEMENT-IN

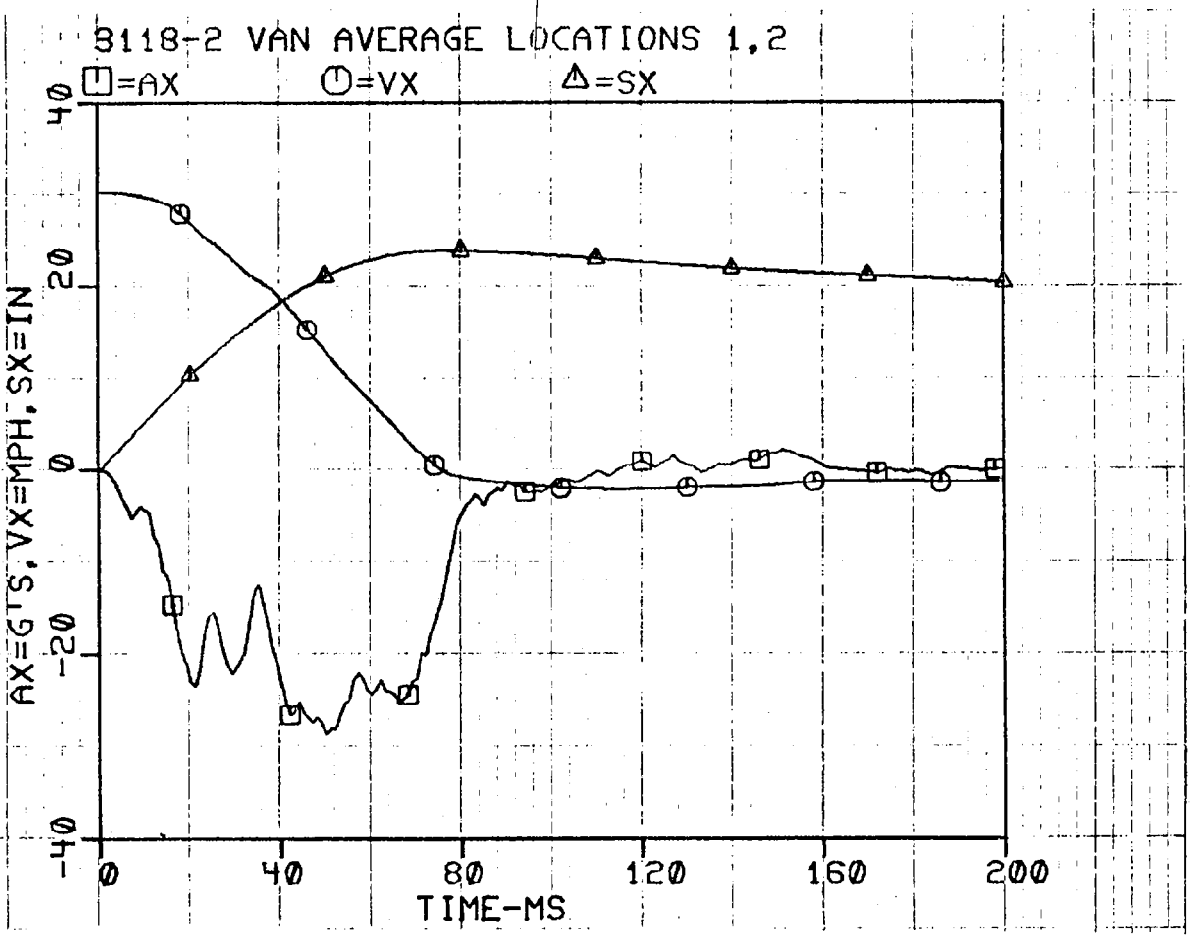
APPENDIX B

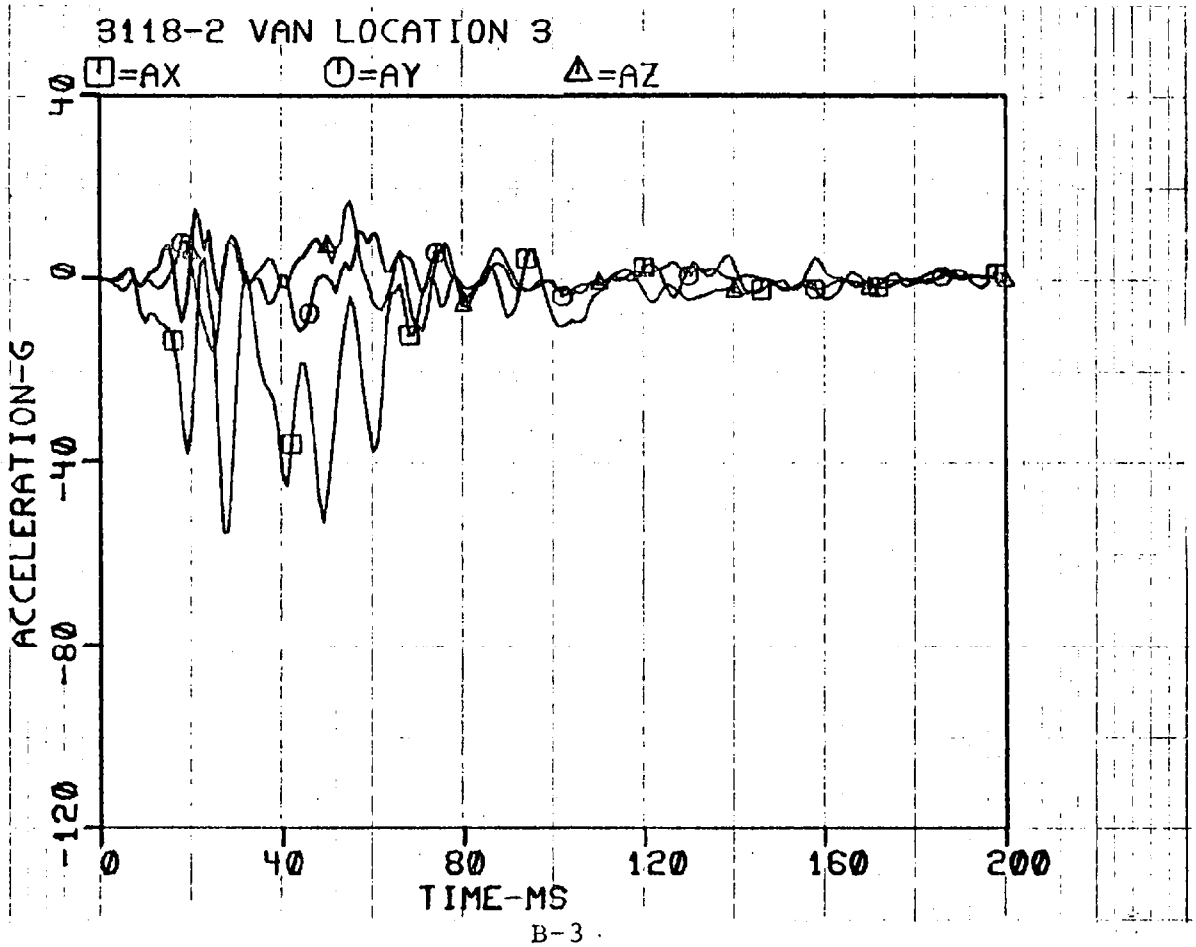
CALCOMP PLOTS FOR
TEST 3118-2
MODIFIED (EXTENDED) FORD E-150
ECONOLINE VAN-TO-36 MODULE LCFB

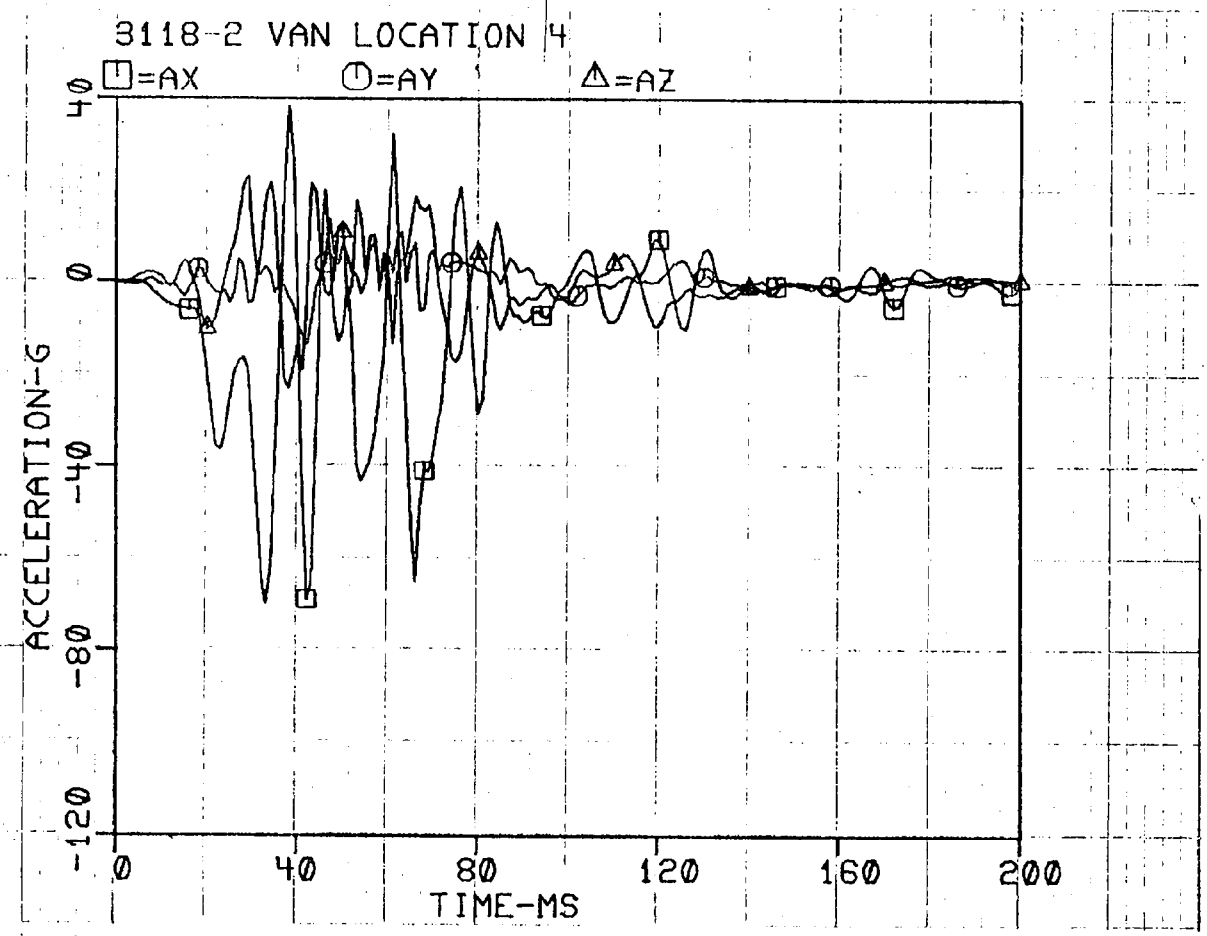
TEST SPEED: 30.29 MPH
TEST DATE: OCTOBER 29, 1981

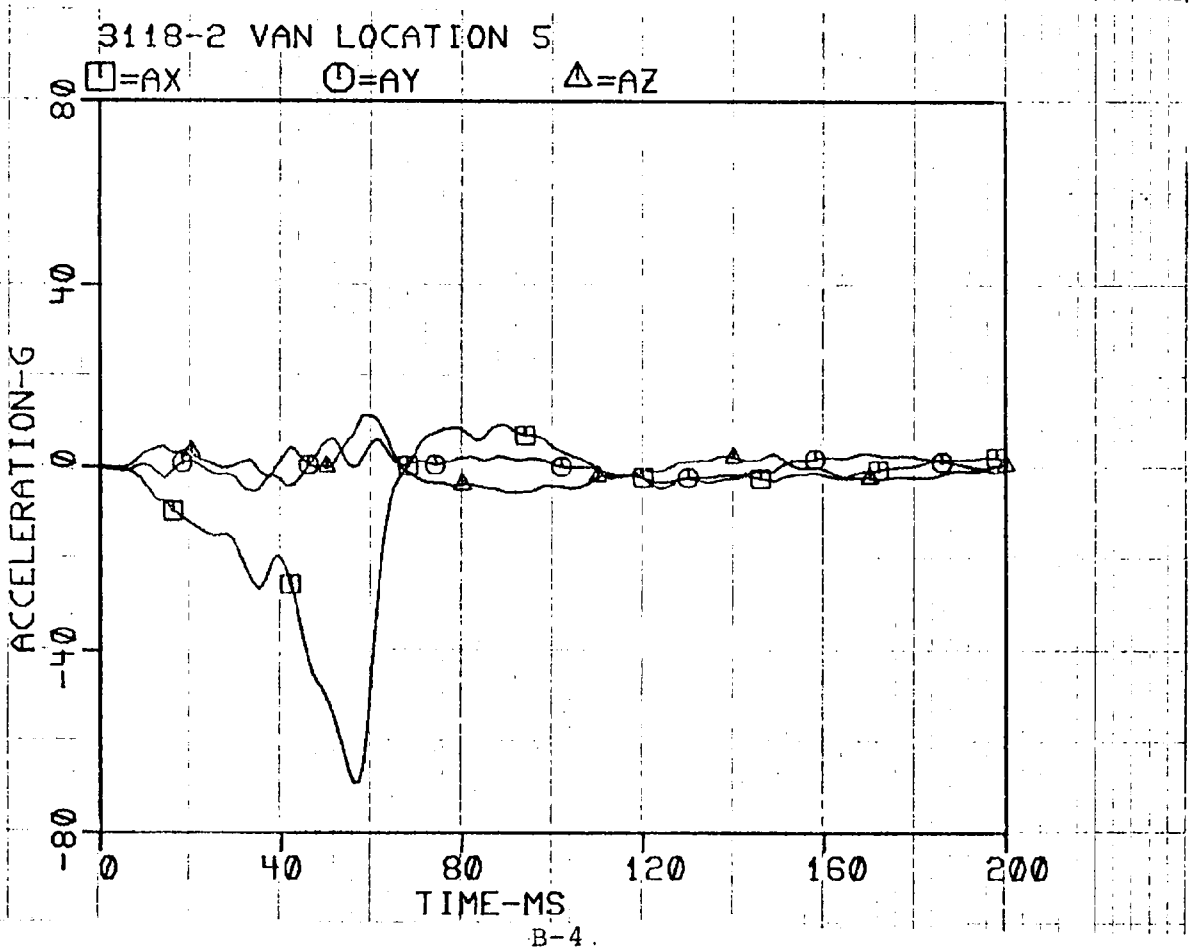

3118-2 VAN LOCATION 1
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS

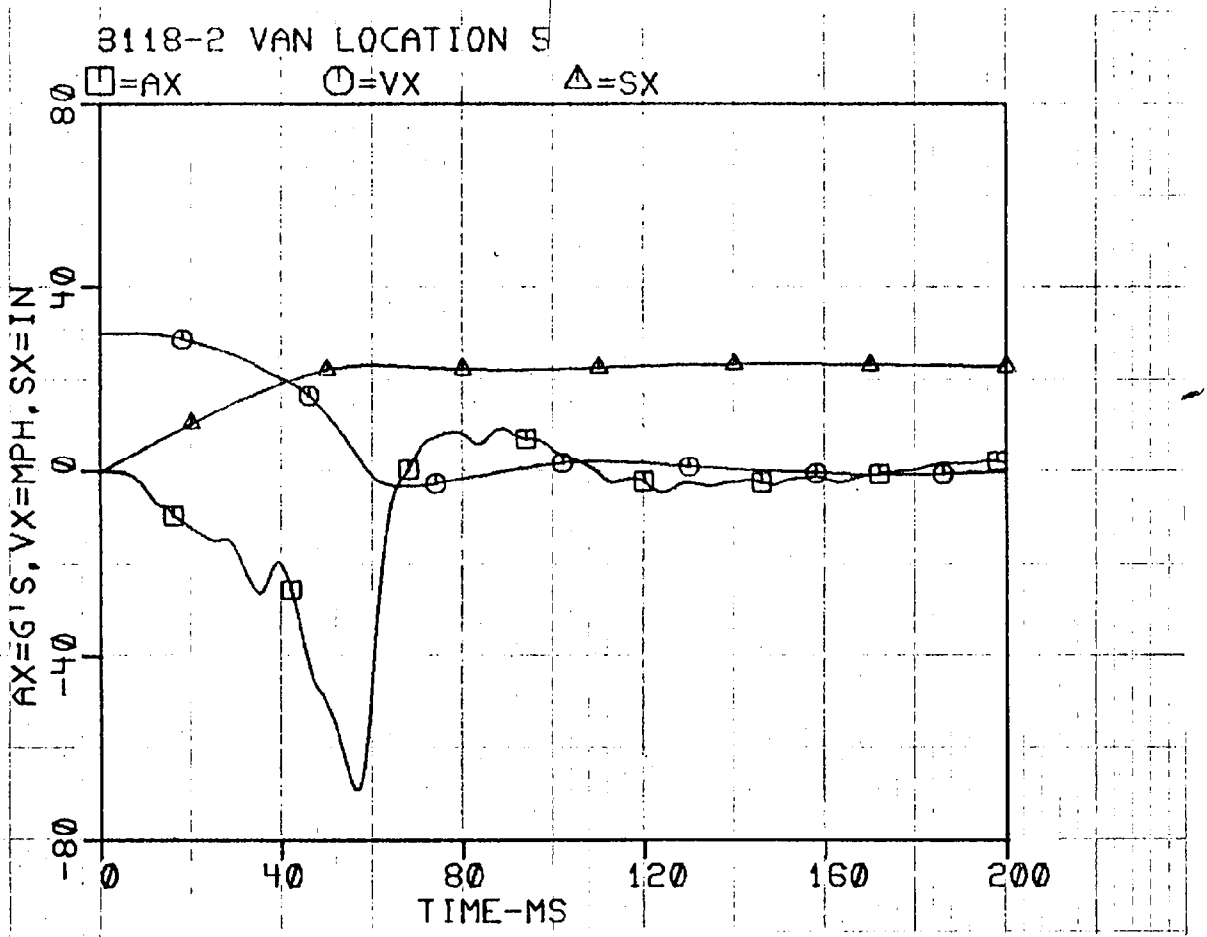

3118-2 VAN LOCATION 2
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS

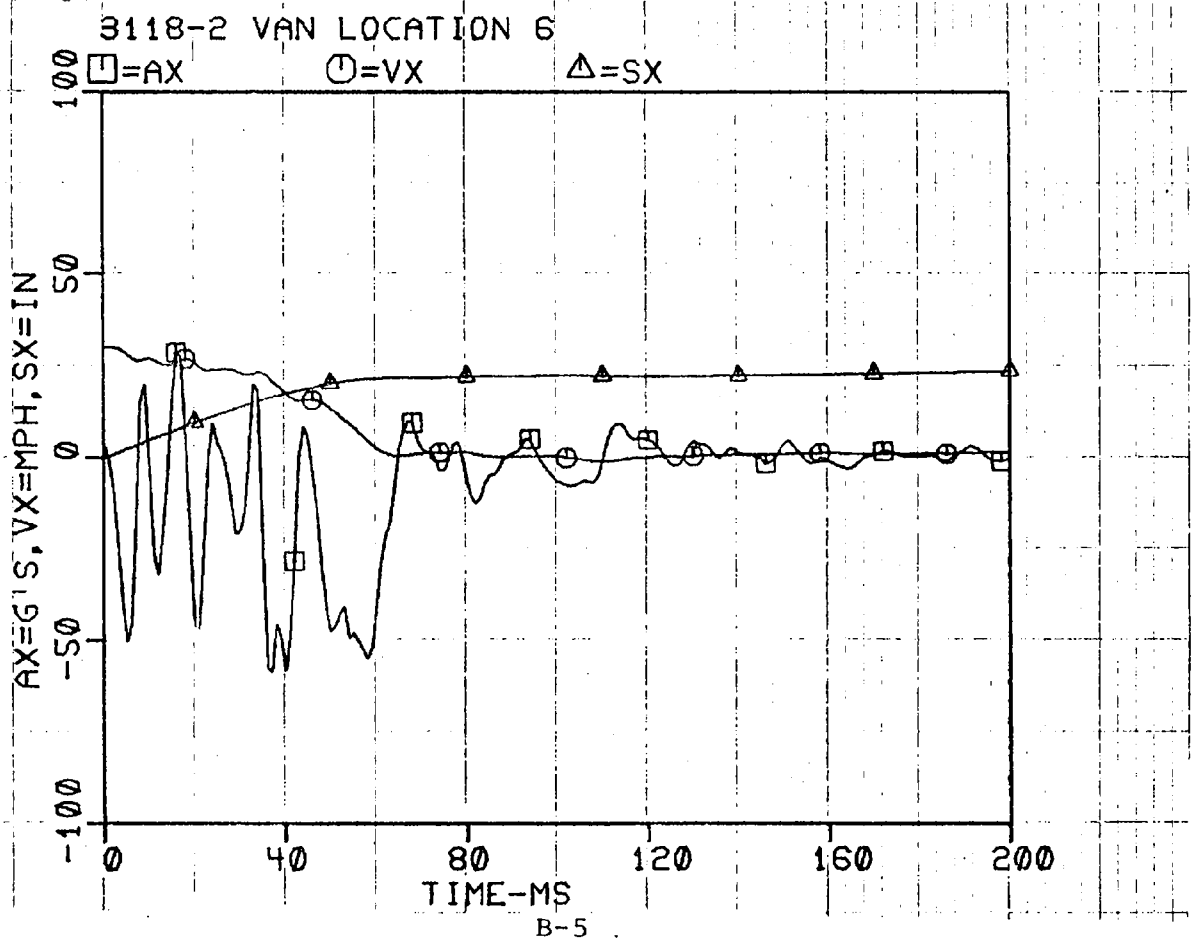

3118-2 VAN AVERAGE LOCATIONS 1,2
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
40
20
0
-20
-40
0
40
80
120
160
200
TIME-MS

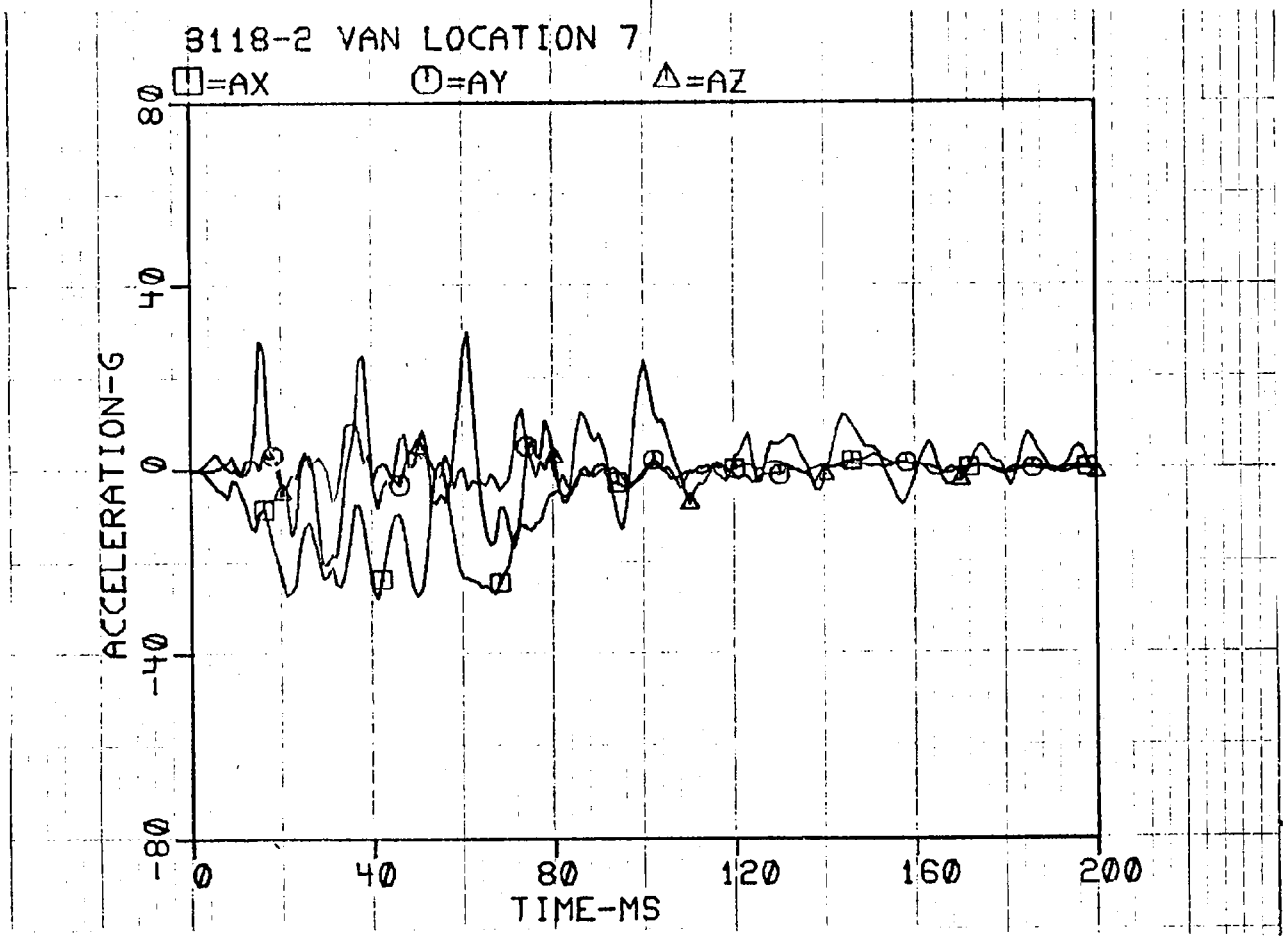

3118-2 VAN LOCATION 3
□=AX
○=AY
△=AZ
ACCELERATION-G
40
0
-40
-80
-120
0
40
80
120
160
200
TIME-MS

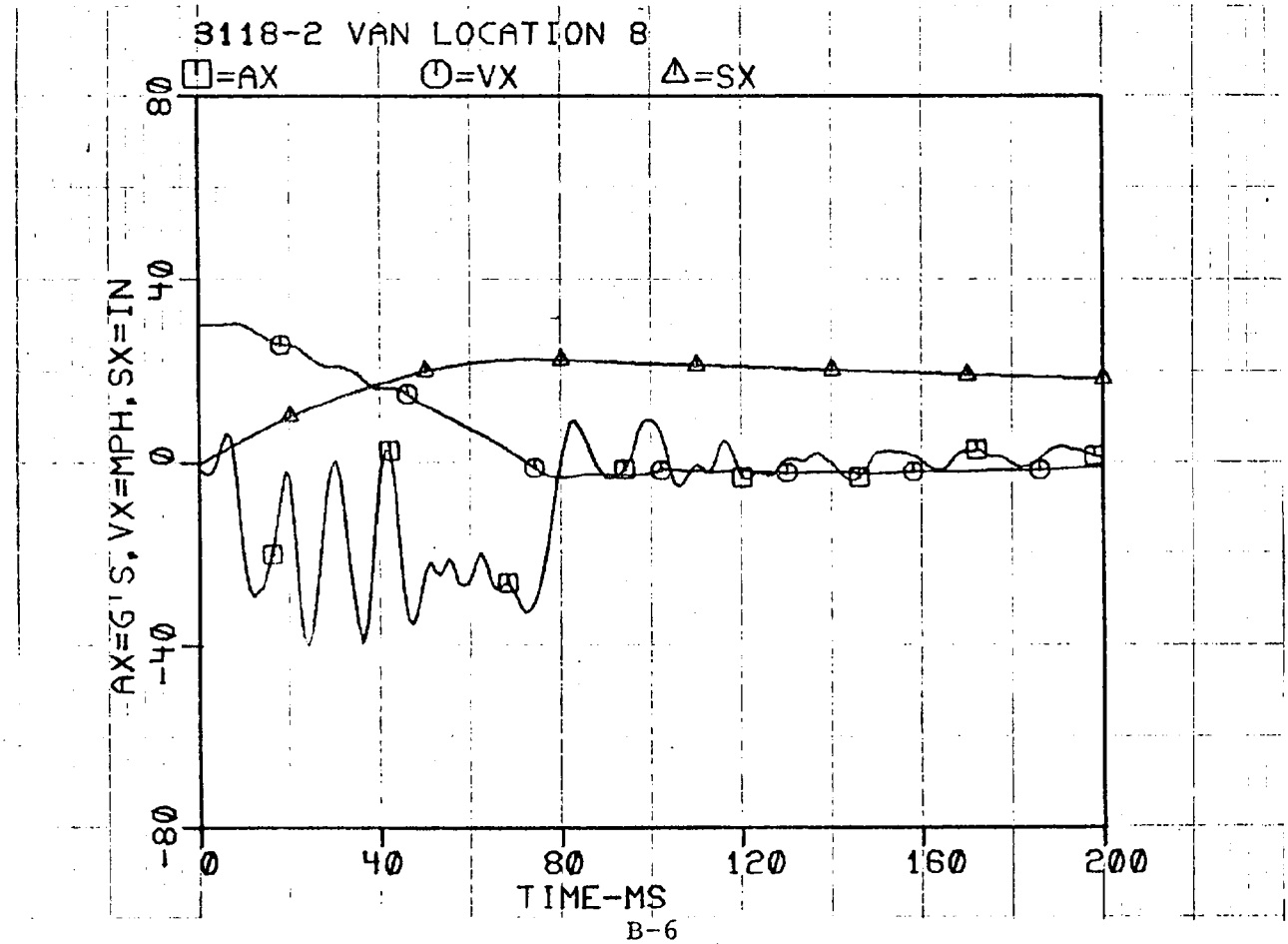

3118-2 VAN LOCATION 4
□=AX
○=AY
△=AZ
ACCELERATION-G
40
0
-40
-80
-120
0
40
80
120
160
200
TIME-MS

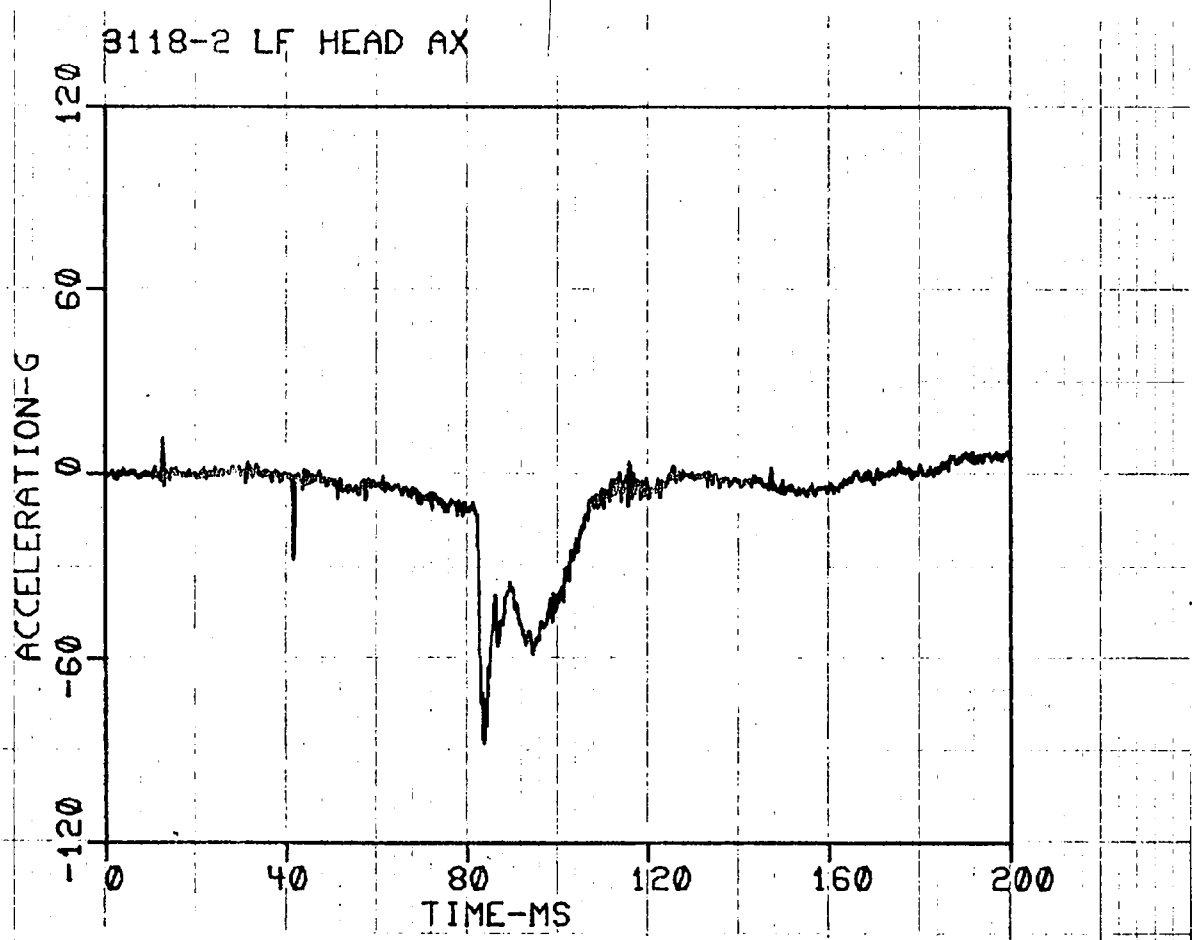

3118-2 VAN LOCATION 5
□=AX
○=AY
△=AZ
ACCELERATION-G
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS

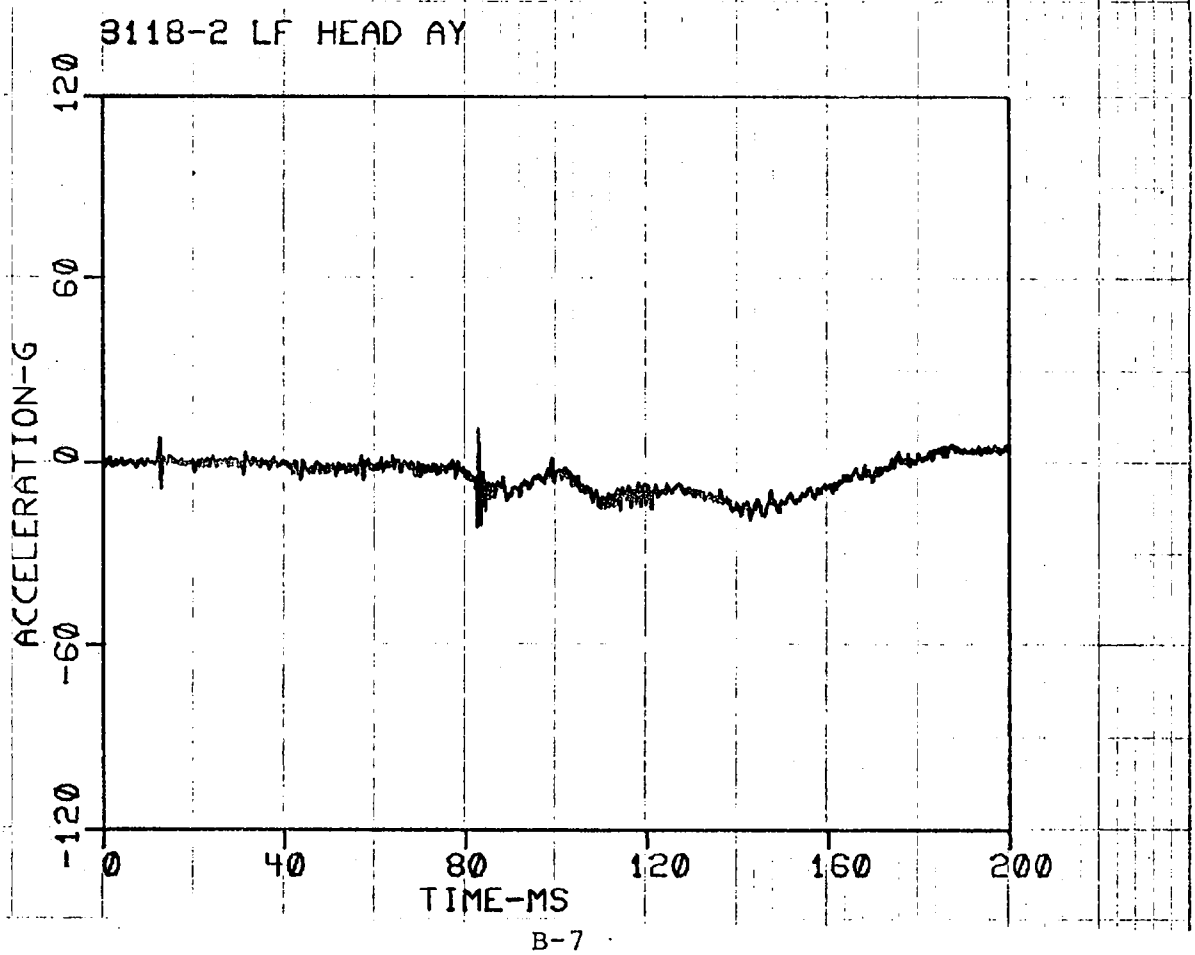

3118-2 VAN LOCATION 5
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS


3118-2 VAN LOCATION 6
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
100
50
0
-50
-100
0
40
80
120
160
200
TIME-MS


3118-2 VAN LOCATION 7
□=AX
○=AY
△=AZ
ACCELERATION-G
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS


3118-2 VAN LOCATION 8
□=AX
○=VX
△=SX
AX=G'S, VX=MPH, SX=IN
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS


3118-2 LF HEAD AX
120
60
0
-60
-120
ACCELERATION-G
0
40
80
120
160
200
TIME-MS


3118-2 LF HEAD AY
120
60
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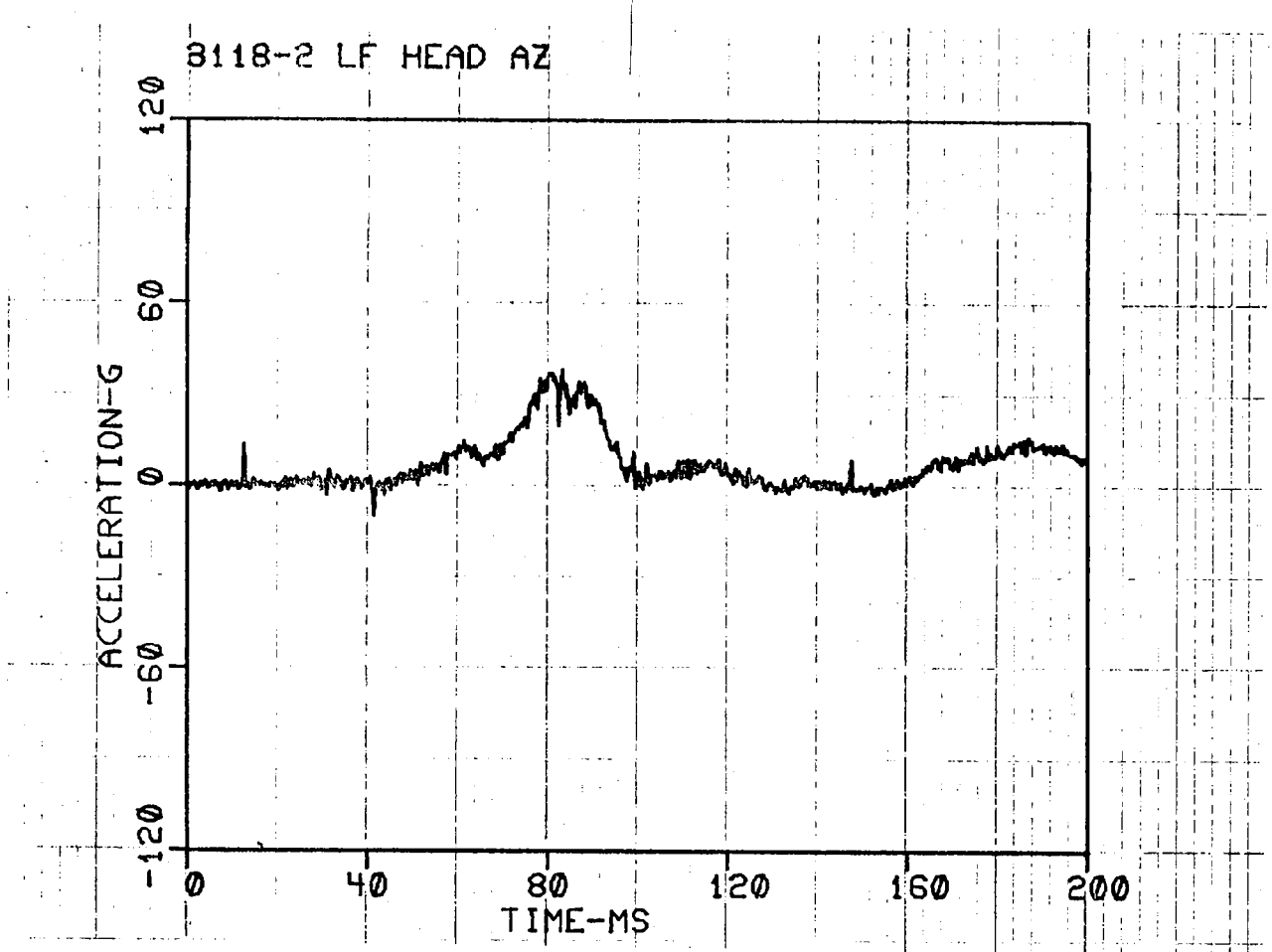
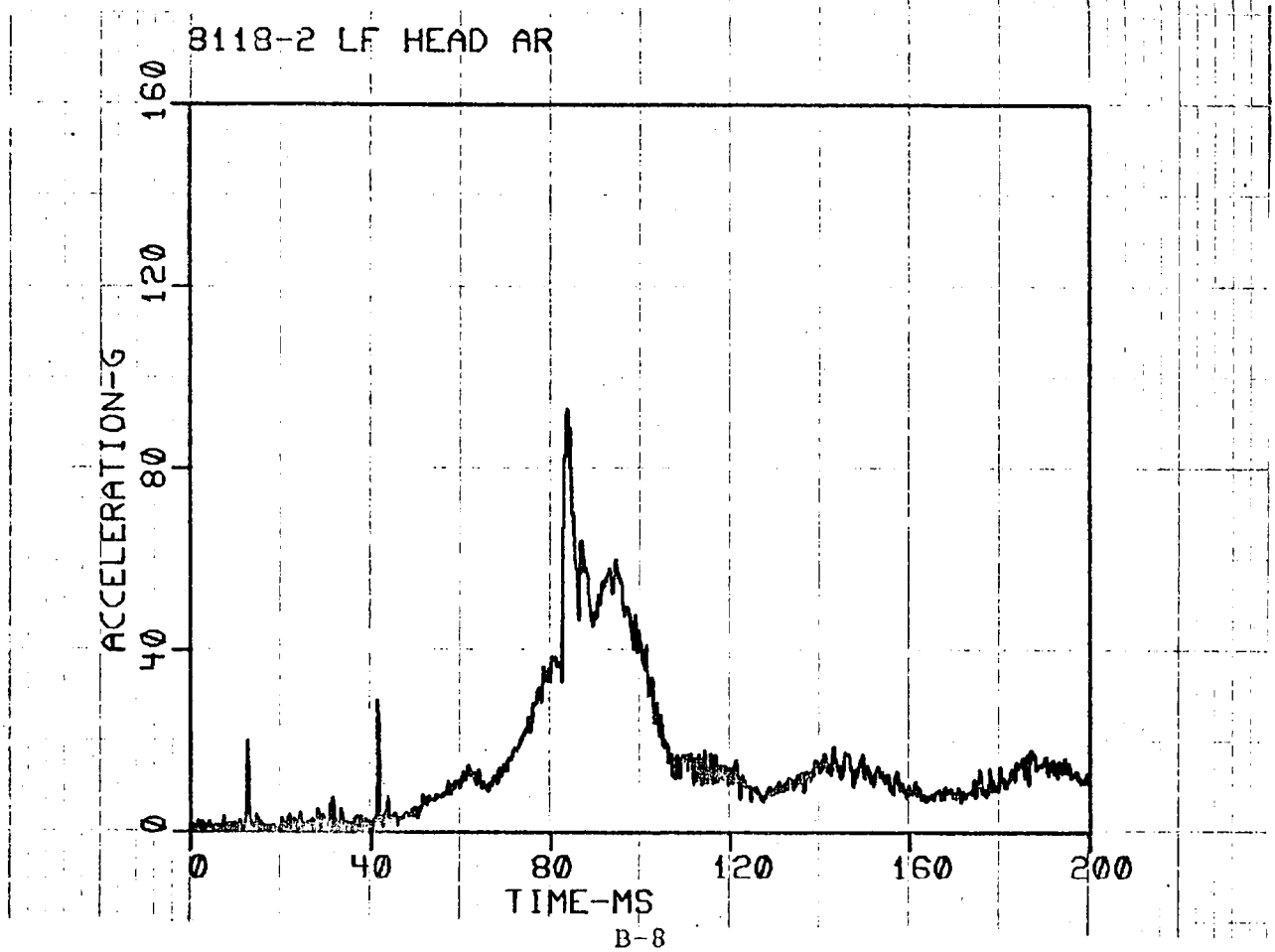
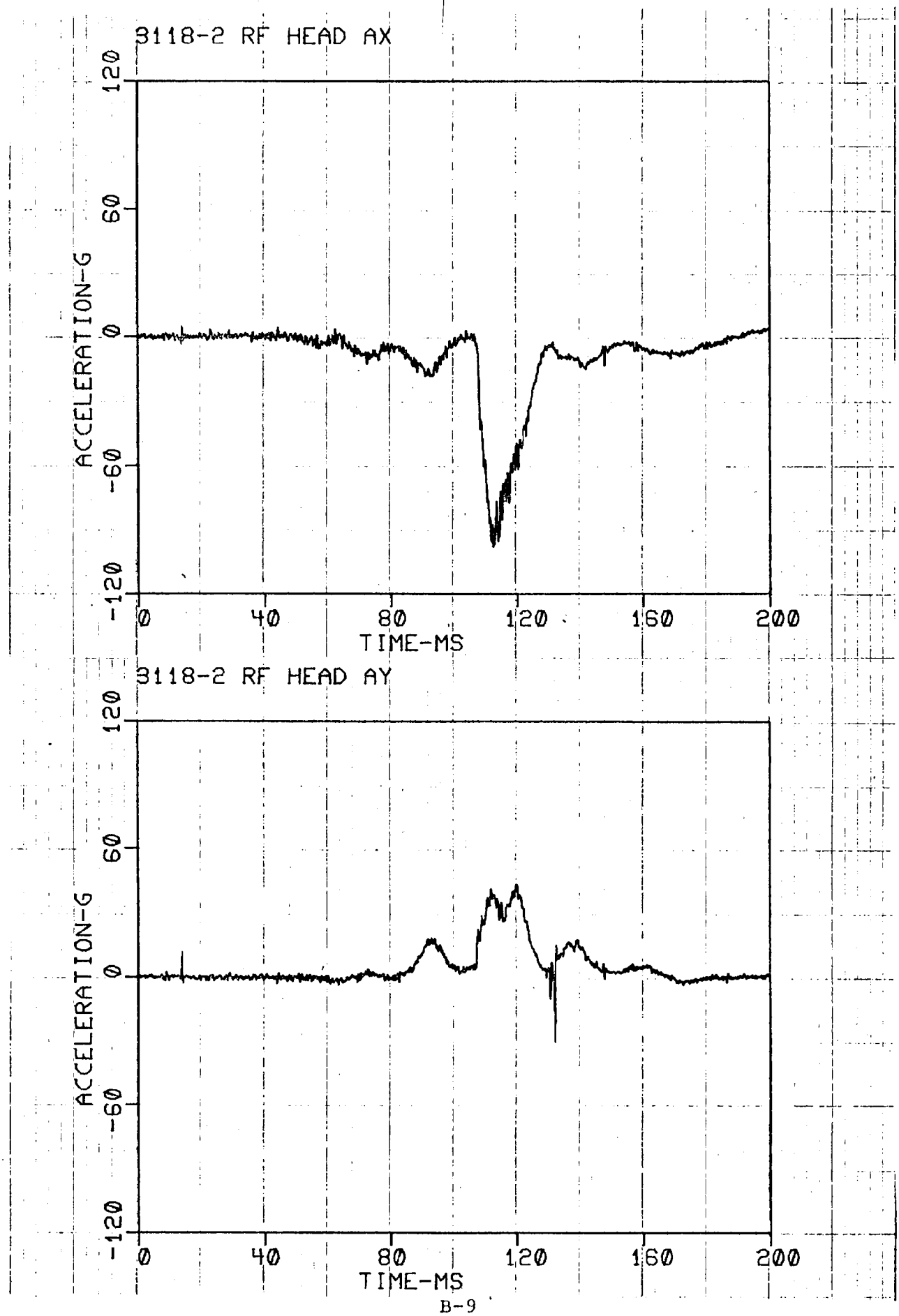
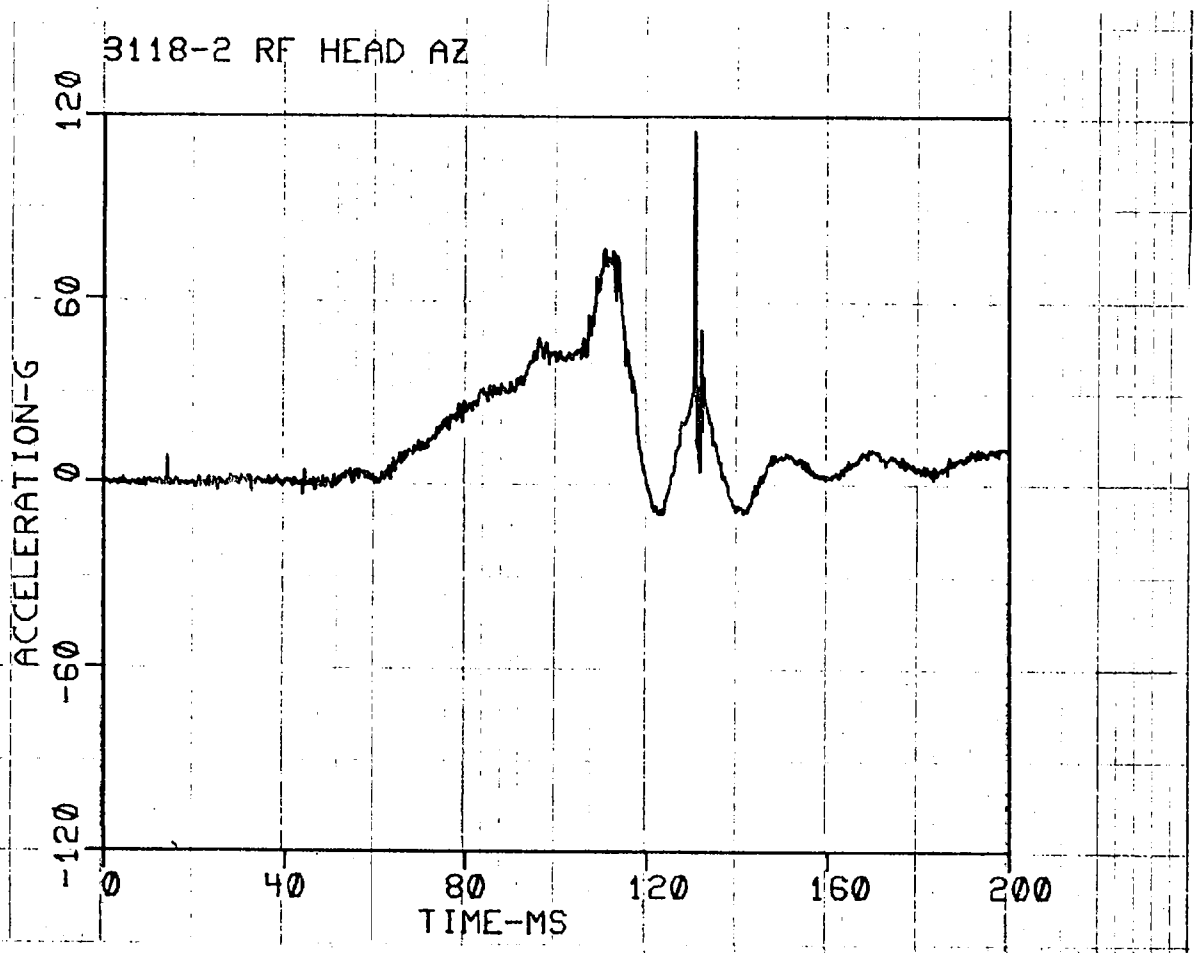
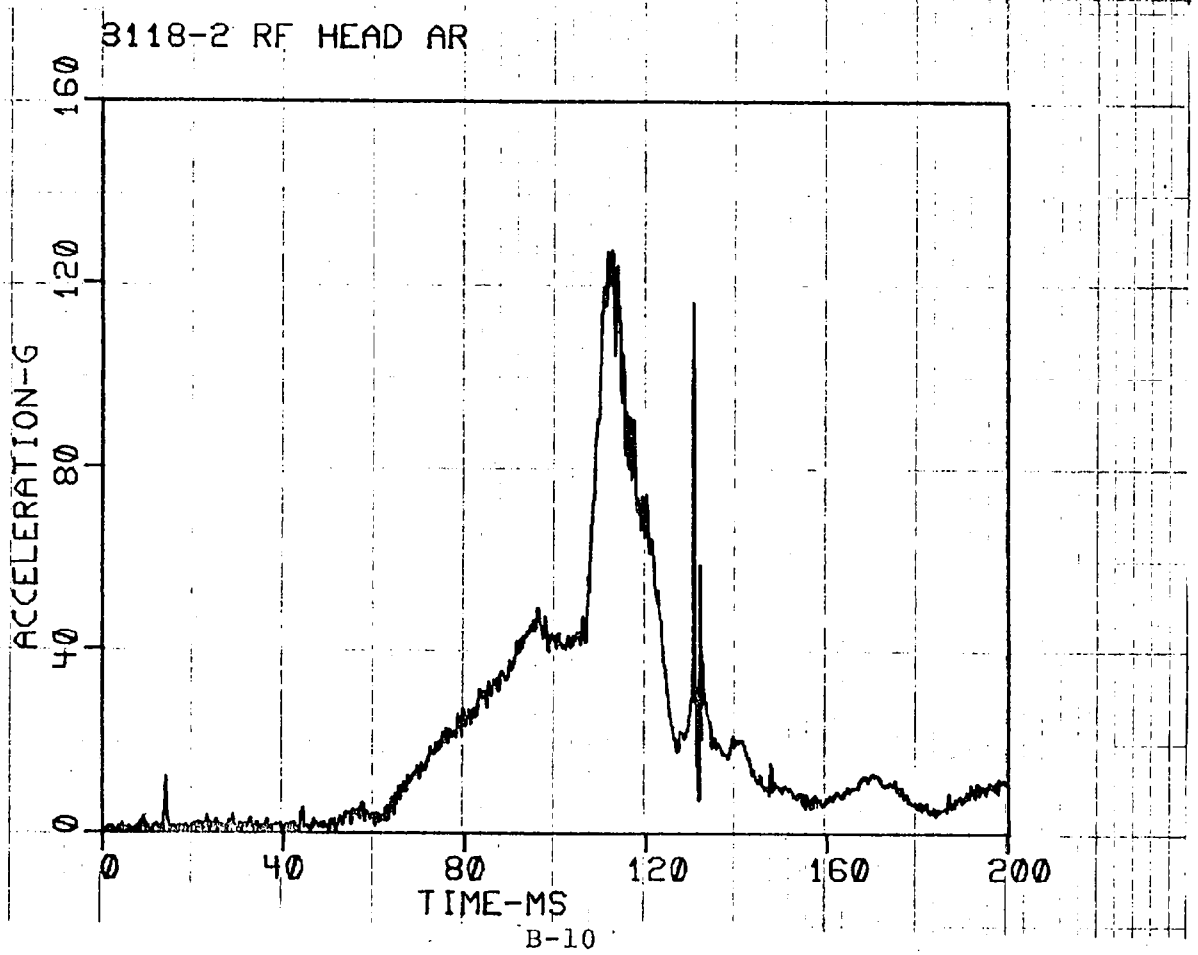
-60
-120
ACCELERATION-G
0
40
80
120
160
200
TIME-MS

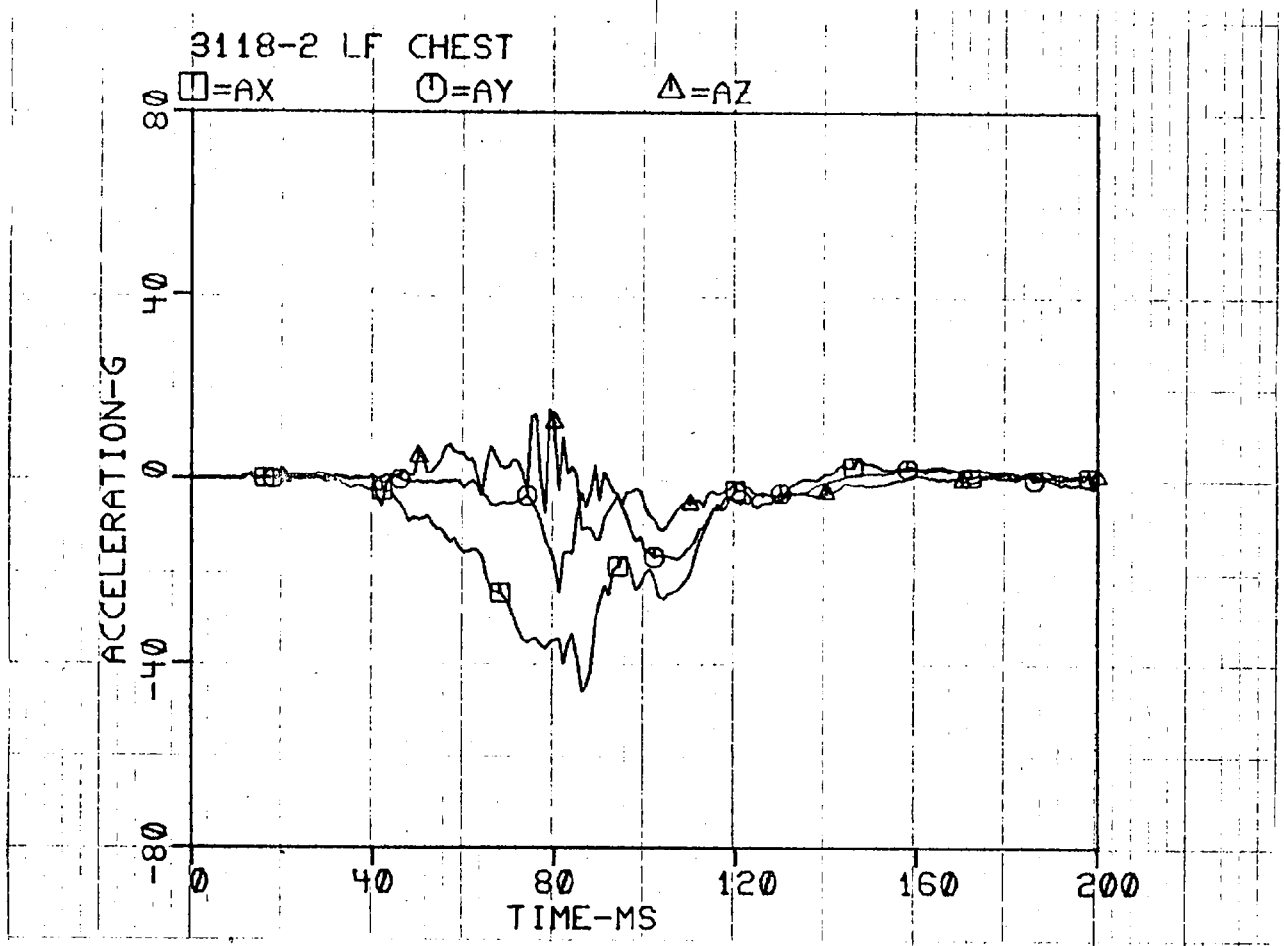

8118-2 LF HEAD AZ
ACCELERATION-G
120
60
0
-60
-120
0
40
80
120
160
200
TIME-MS

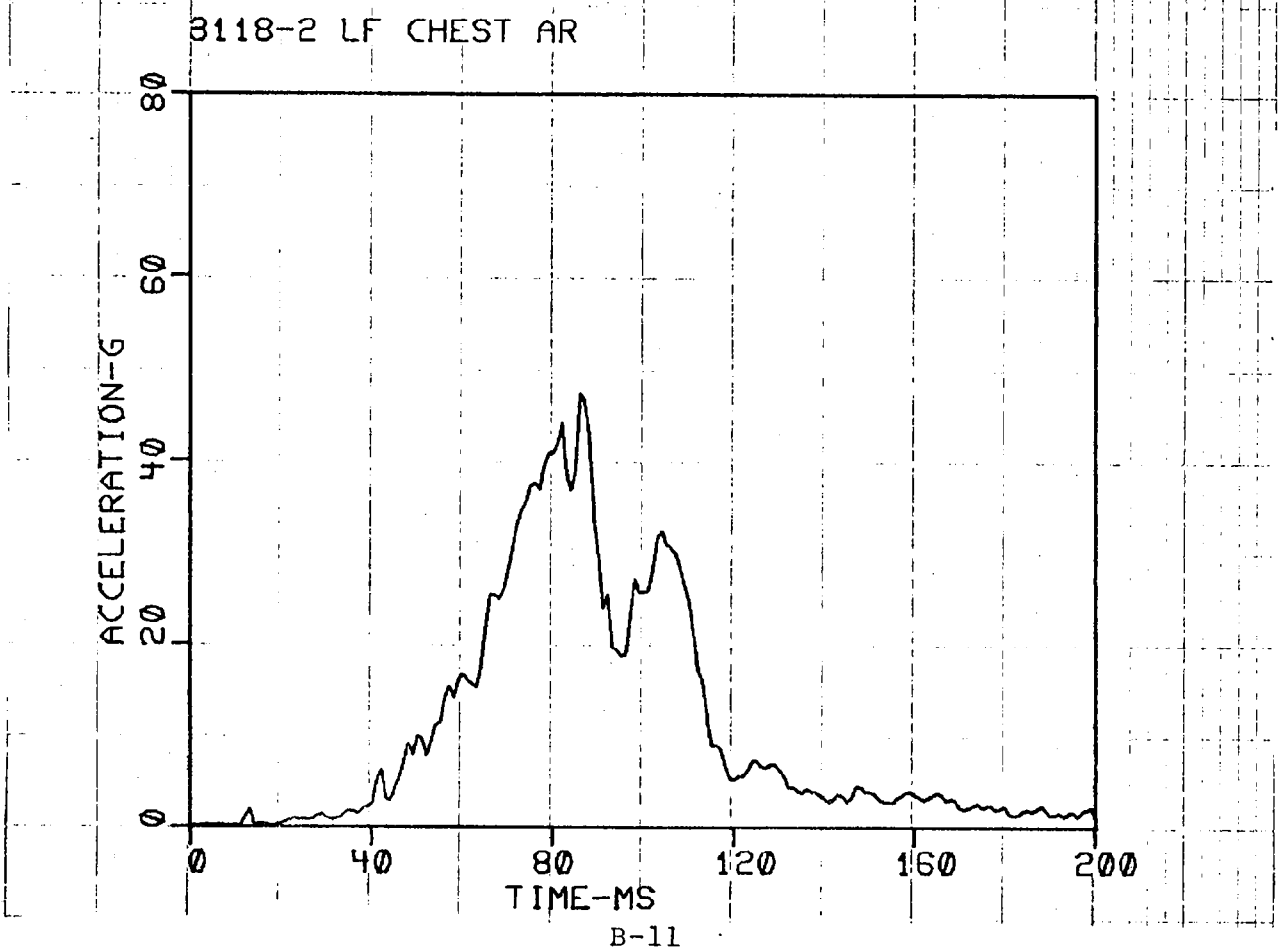

8118-2 LF HEAD AR
ACCELERATION-G
160
120
80
40
0
0
40
80
120
160
200
TIME-MS

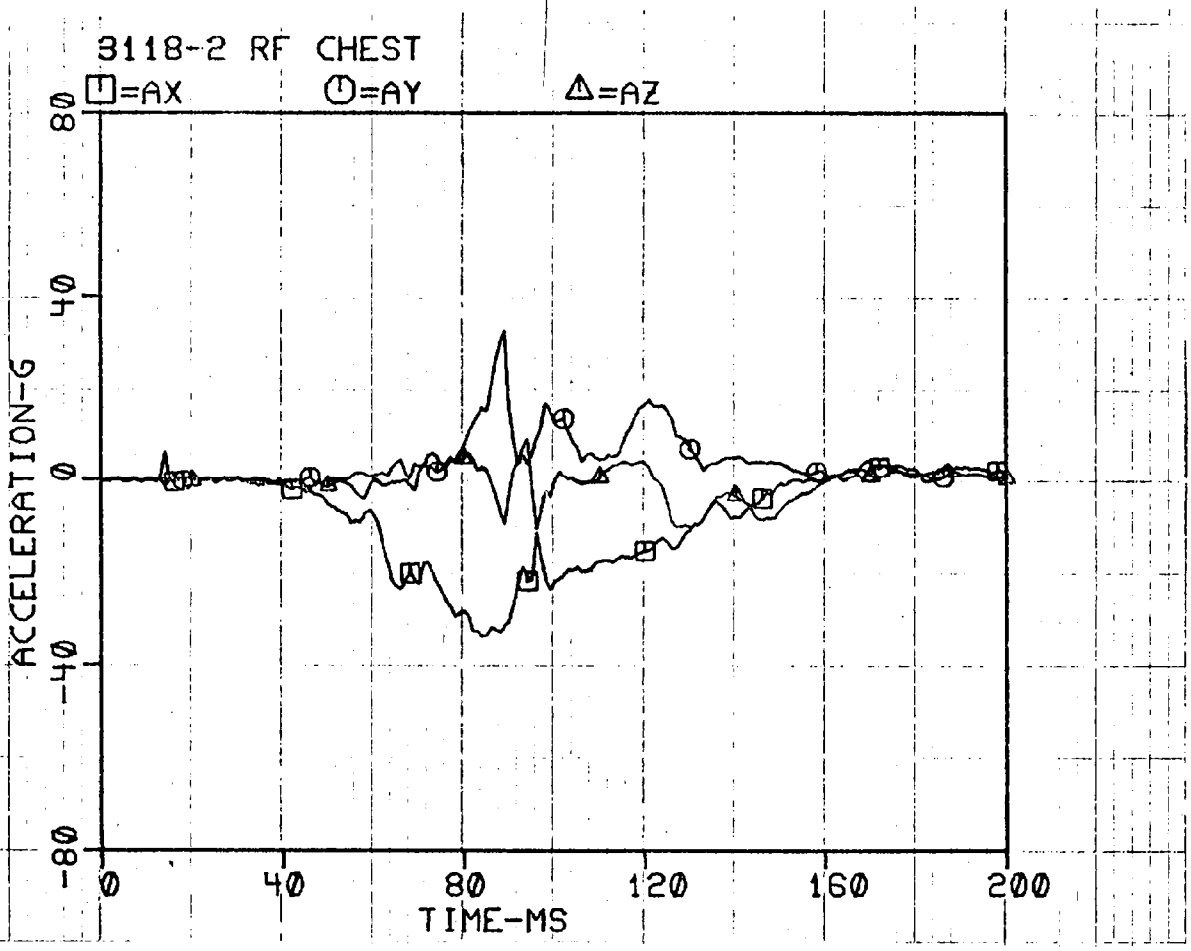

3118-2 RF HEAD AX
120
60
0
-60
-120
ACCELERATION-G
0
40
80
120
160
200
TIME-MS
3118-2 RF HEAD AY
120
60
0
-60
-120
ACCELERATION-G
0
40
80
120
160
200
TIME-MS

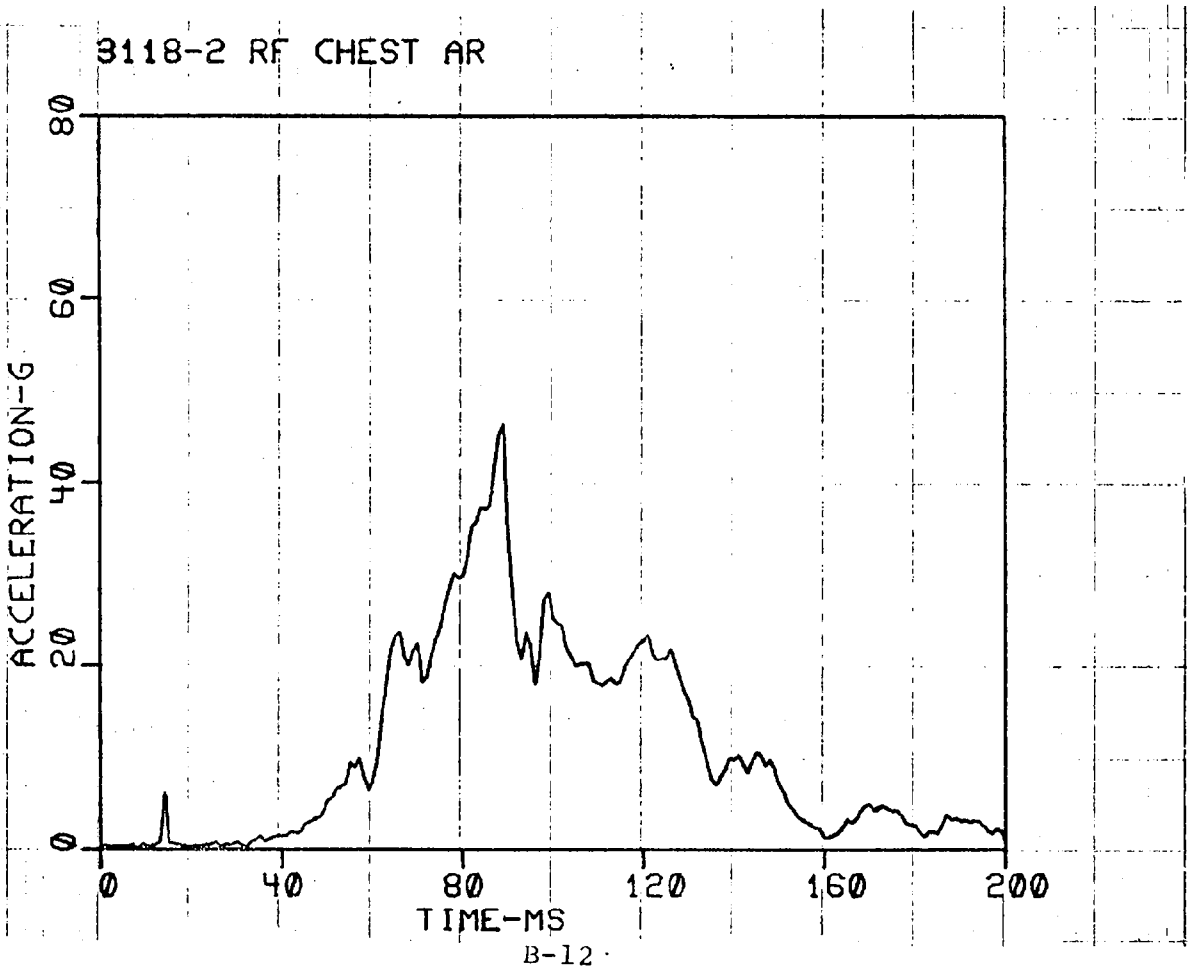

3118-2 RF HEAD AZ
ACCELERATION-G
120
60
0
-60
-120
0
40
80
120
160
200
TIME-MS

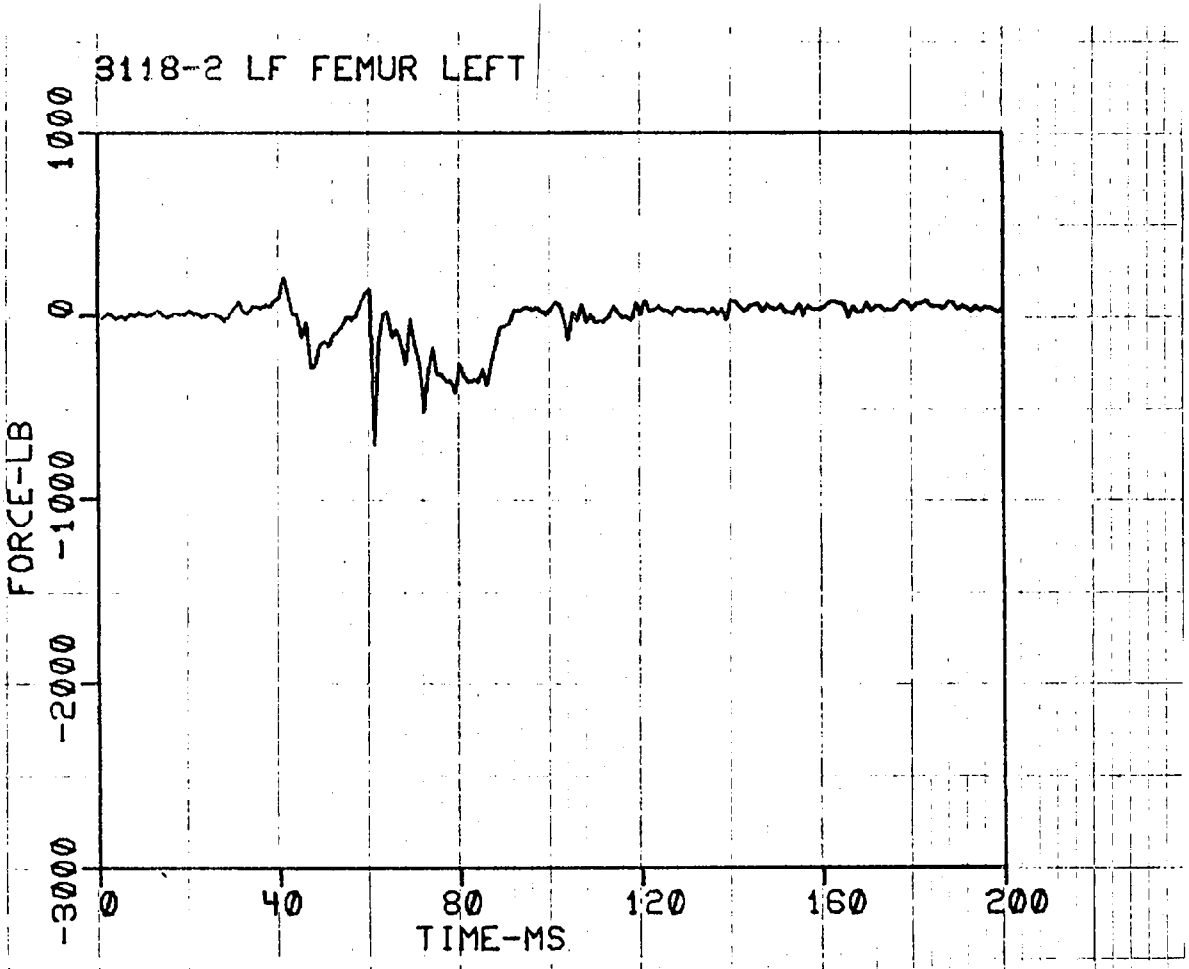

3118-2 RF HEAD AR
ACCELERATION-G
160
120
80
40
0
0
40
80
120
160
200
TIME-MS

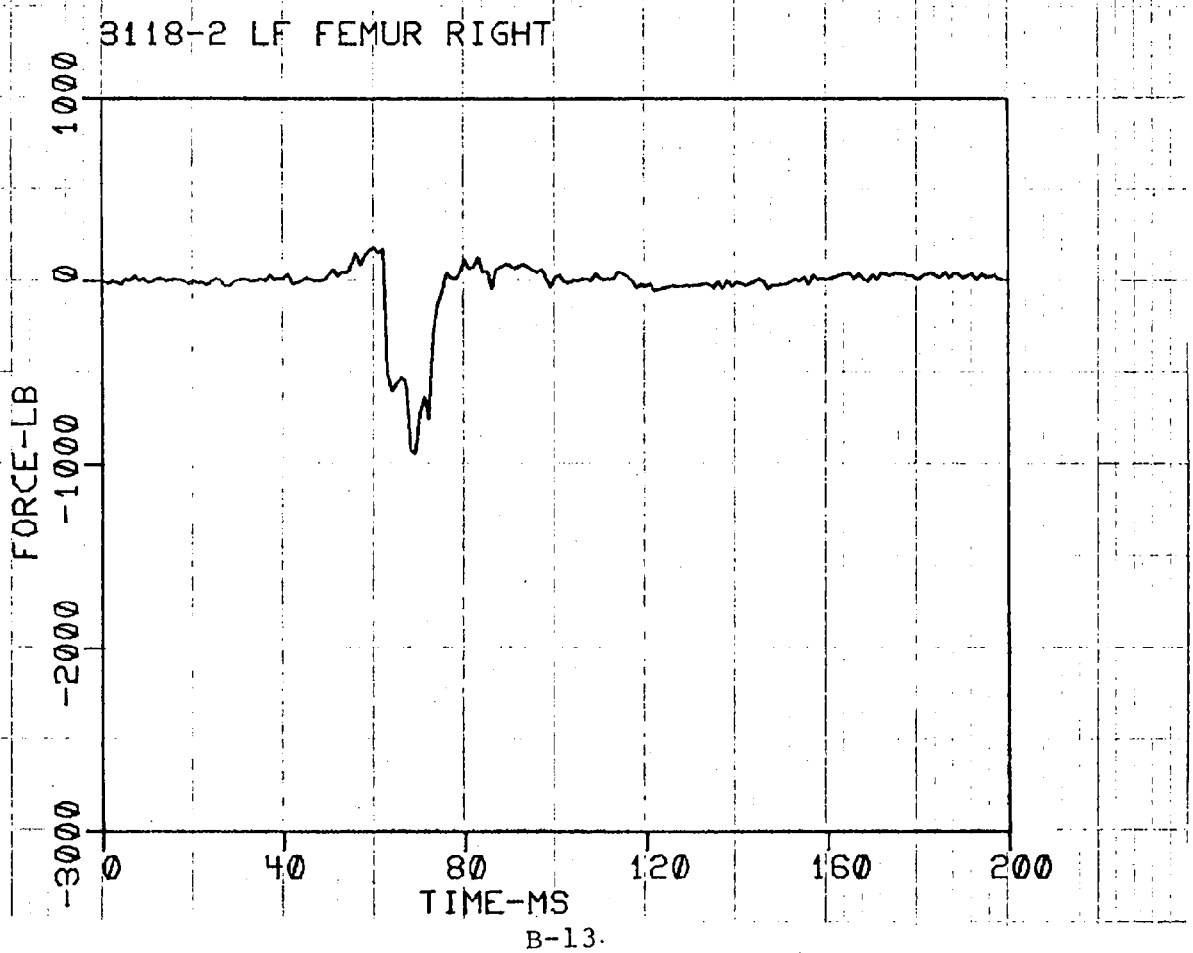

3118-2 LF CHEST
□=AX
○=AY
△=AZ
ACCELERATION-G
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS

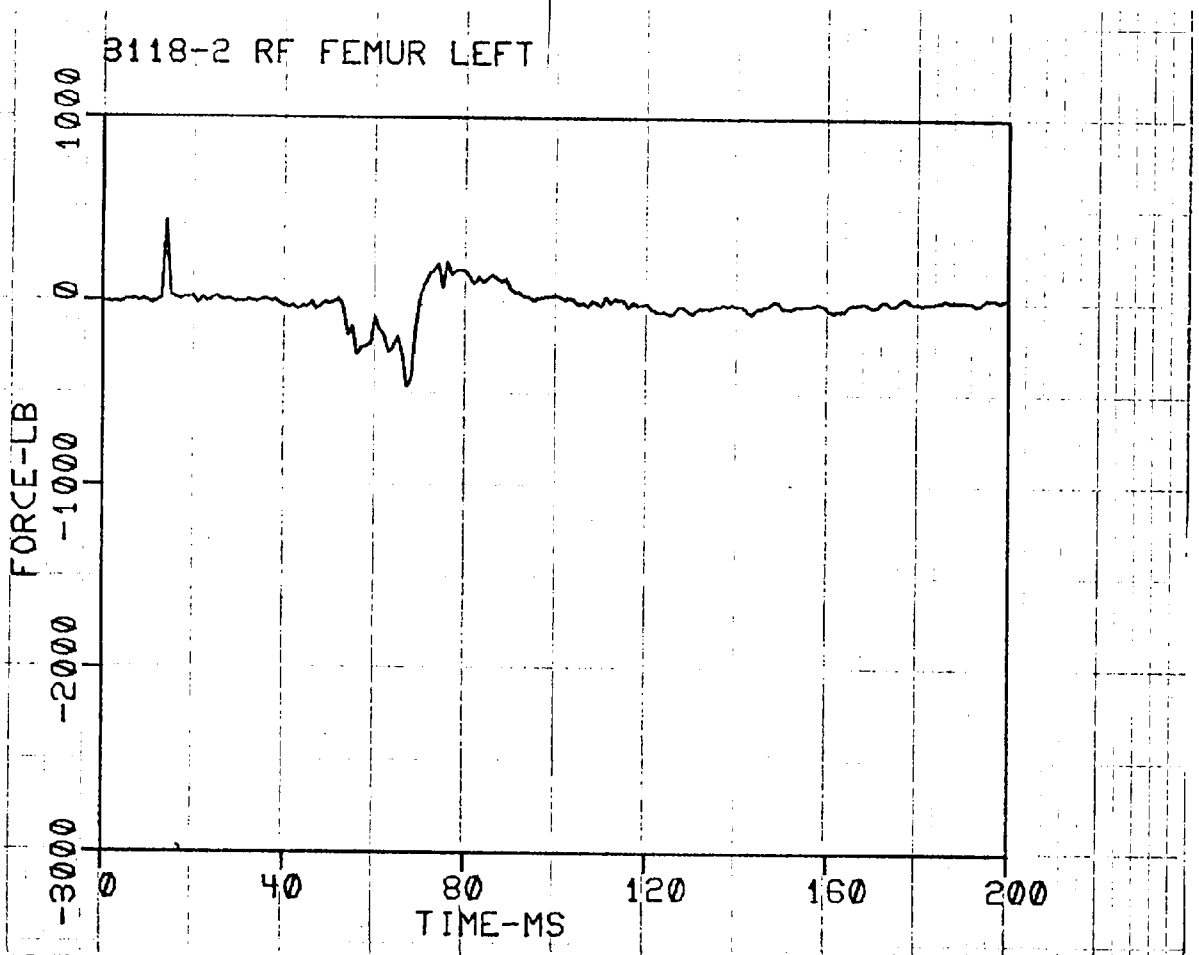

3118-2 LF CHEST AR
ACCELERATION-G
80
60
40
20
0
0
40
80
120
160
200
TIME-MS

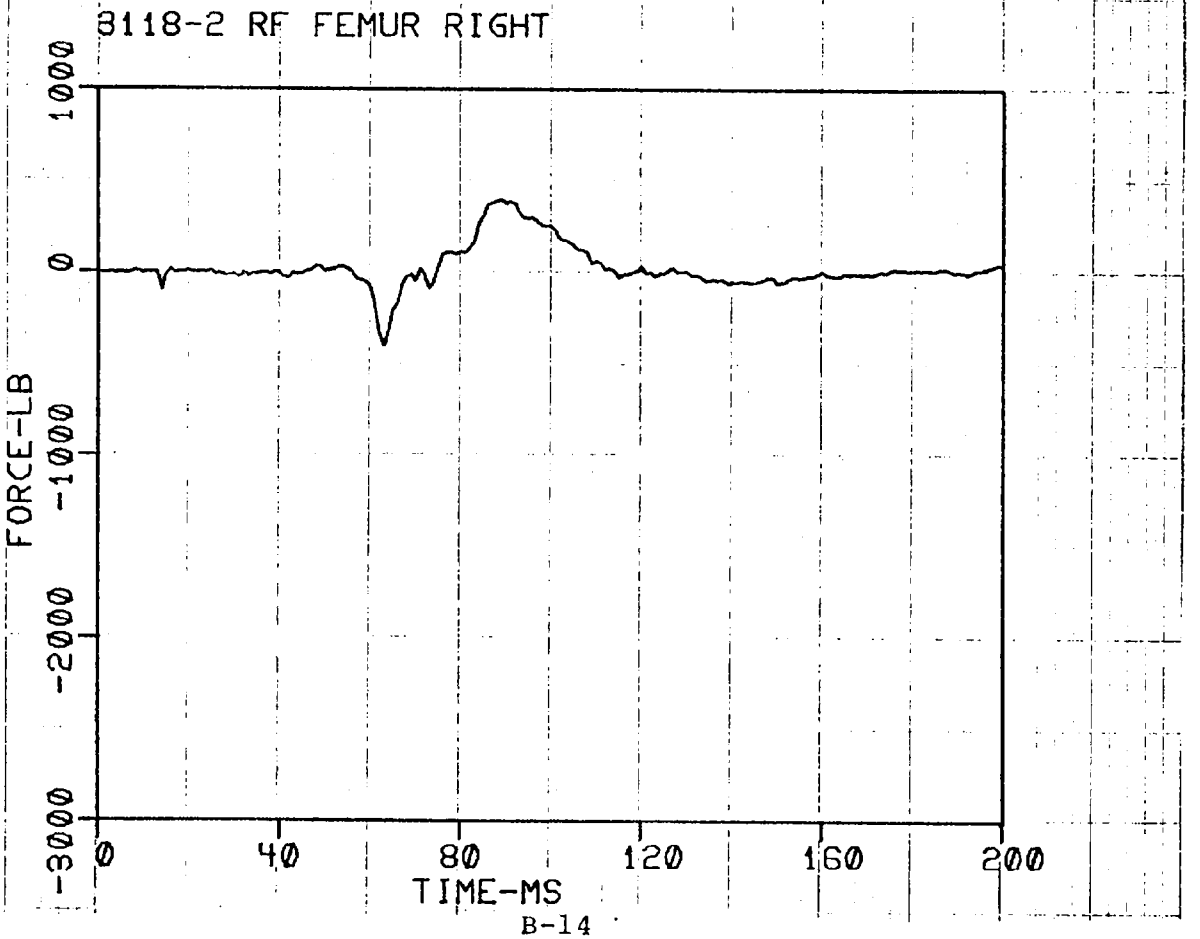

3118-2 RF CHEST
□=AX
○=AY
△=AZ
ACCELERATION-G
80
40
0
-40
-80
0
40
80
120
160
200
TIME-MS

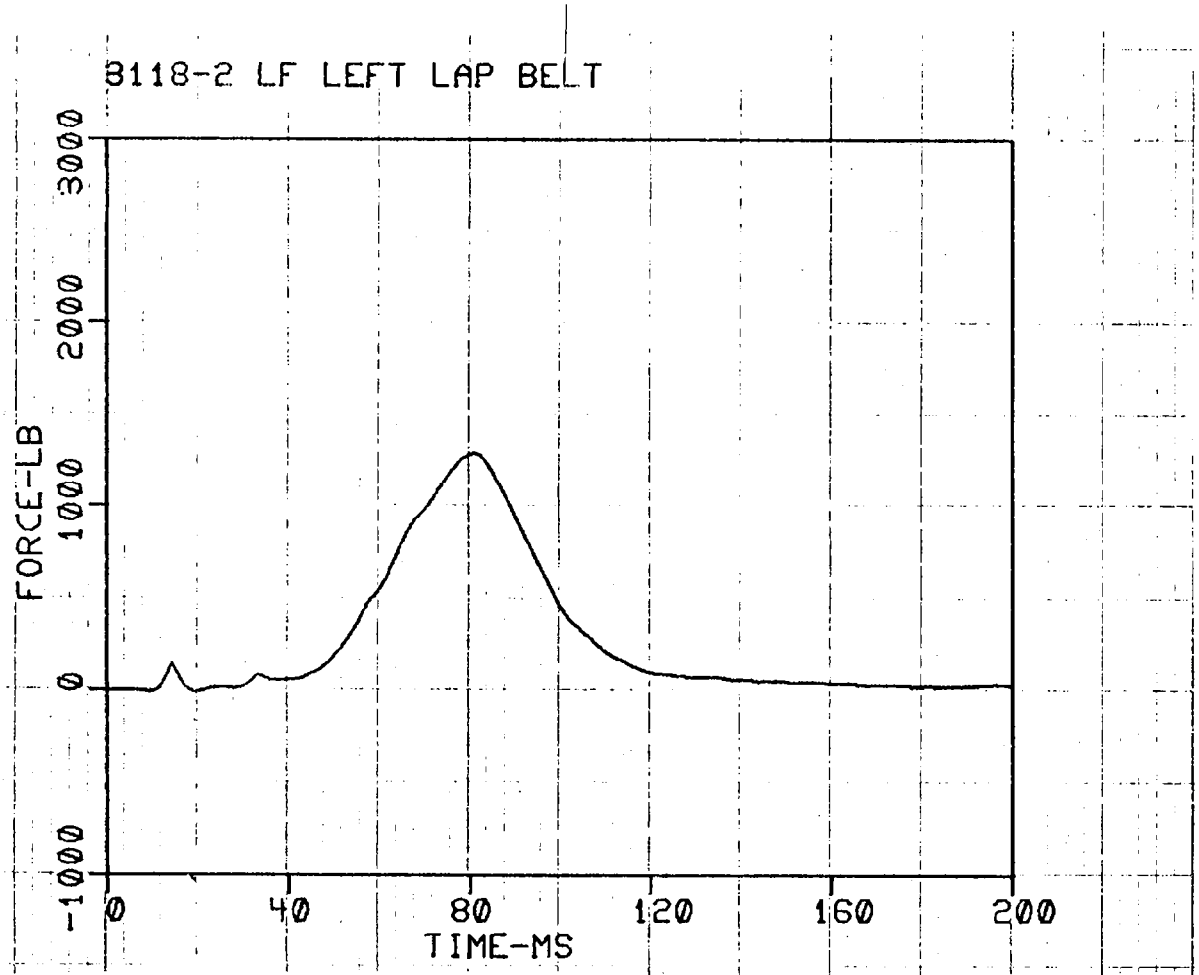

3118-2 RF CHEST AR
ACCELERATION-G
80
60
40
20
0
0
40
80
120
160
200
TIME-MS

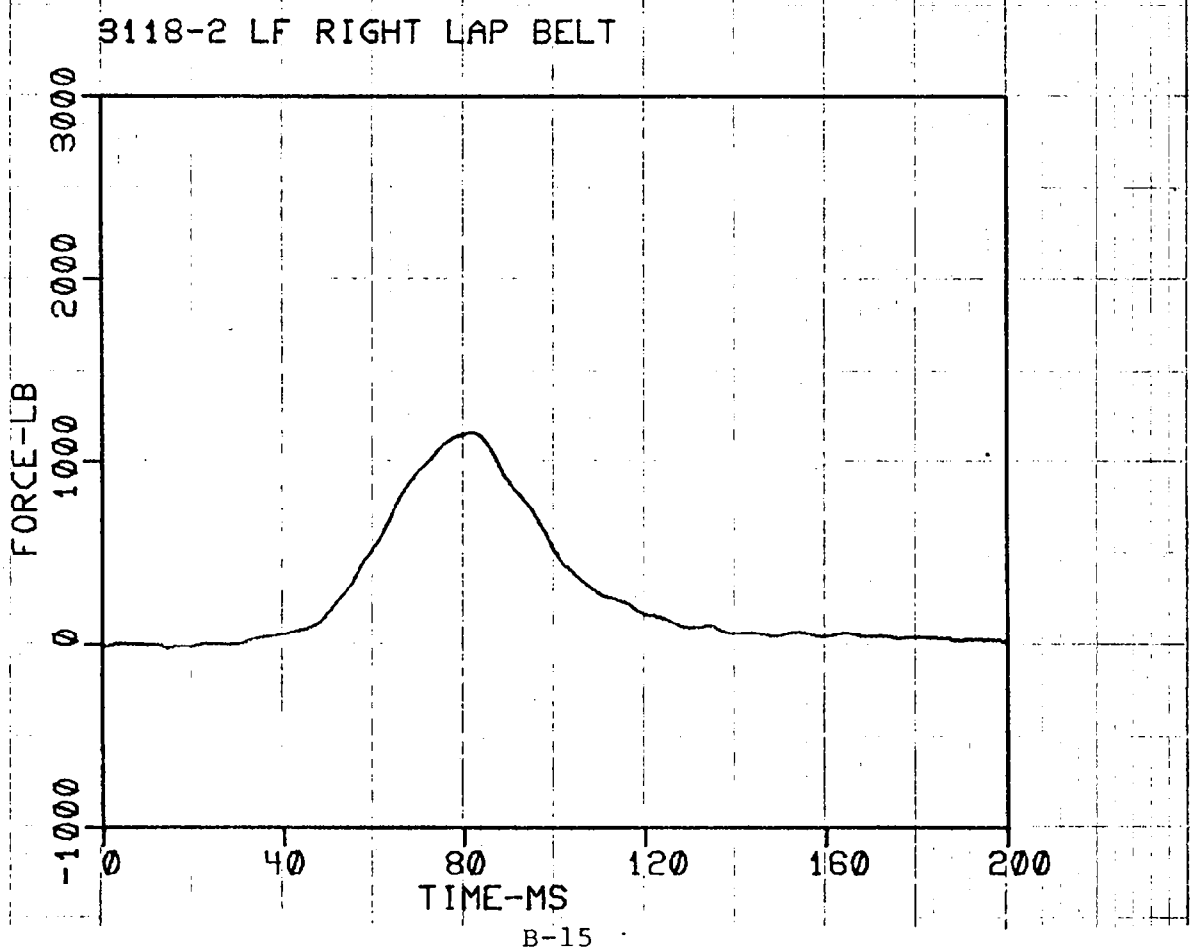

3118-2 LF FEMUR LEFT
FORCE-LB
1000
0
-1000
-2000
-3000
0
40
80
120
160
200
TIME-MS

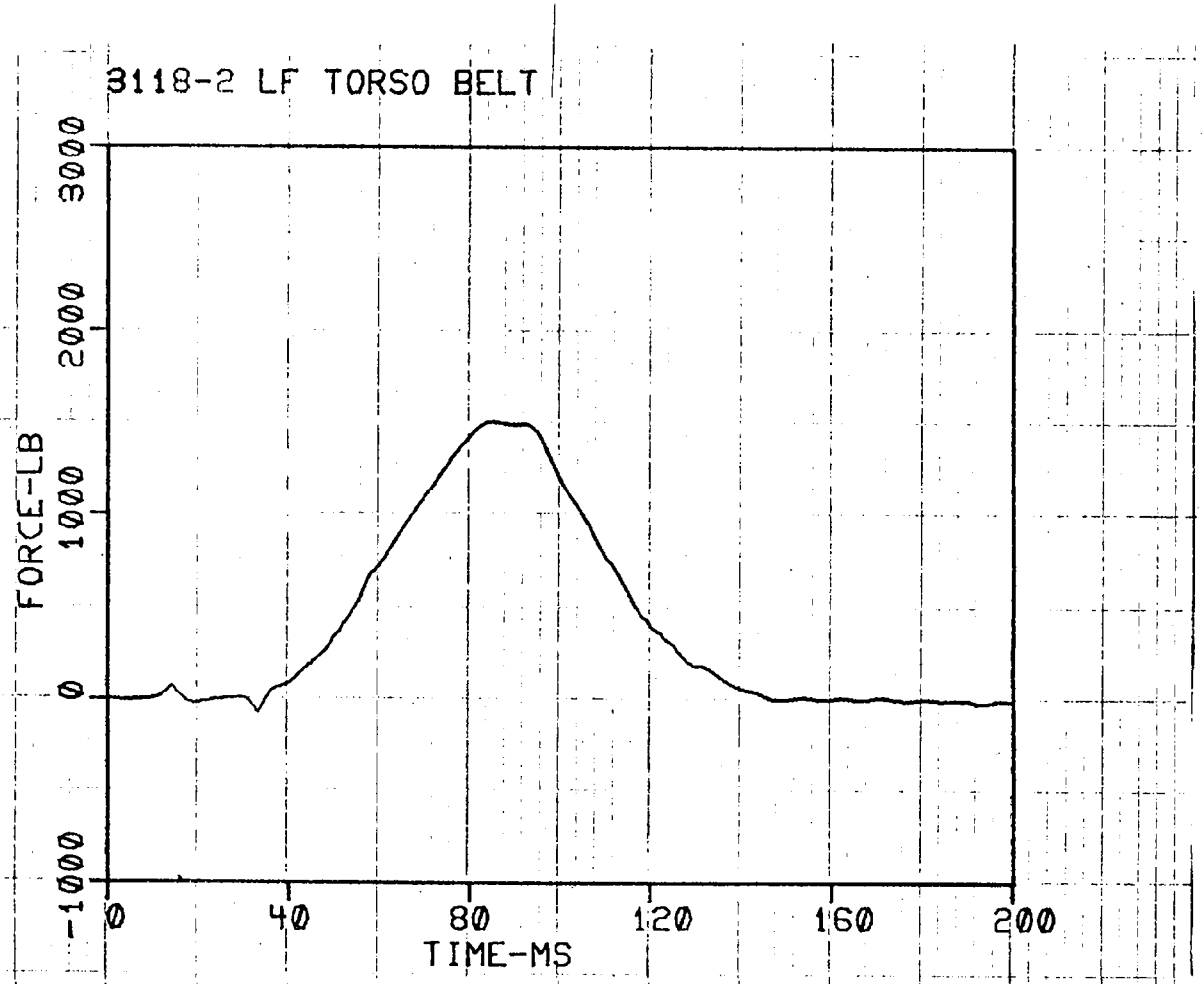

3118-2 LF FEMUR RIGHT
FORCE-LB
1000
0
-1000
-2000
-3000
0
40
80
120
160
200
TIME-MS

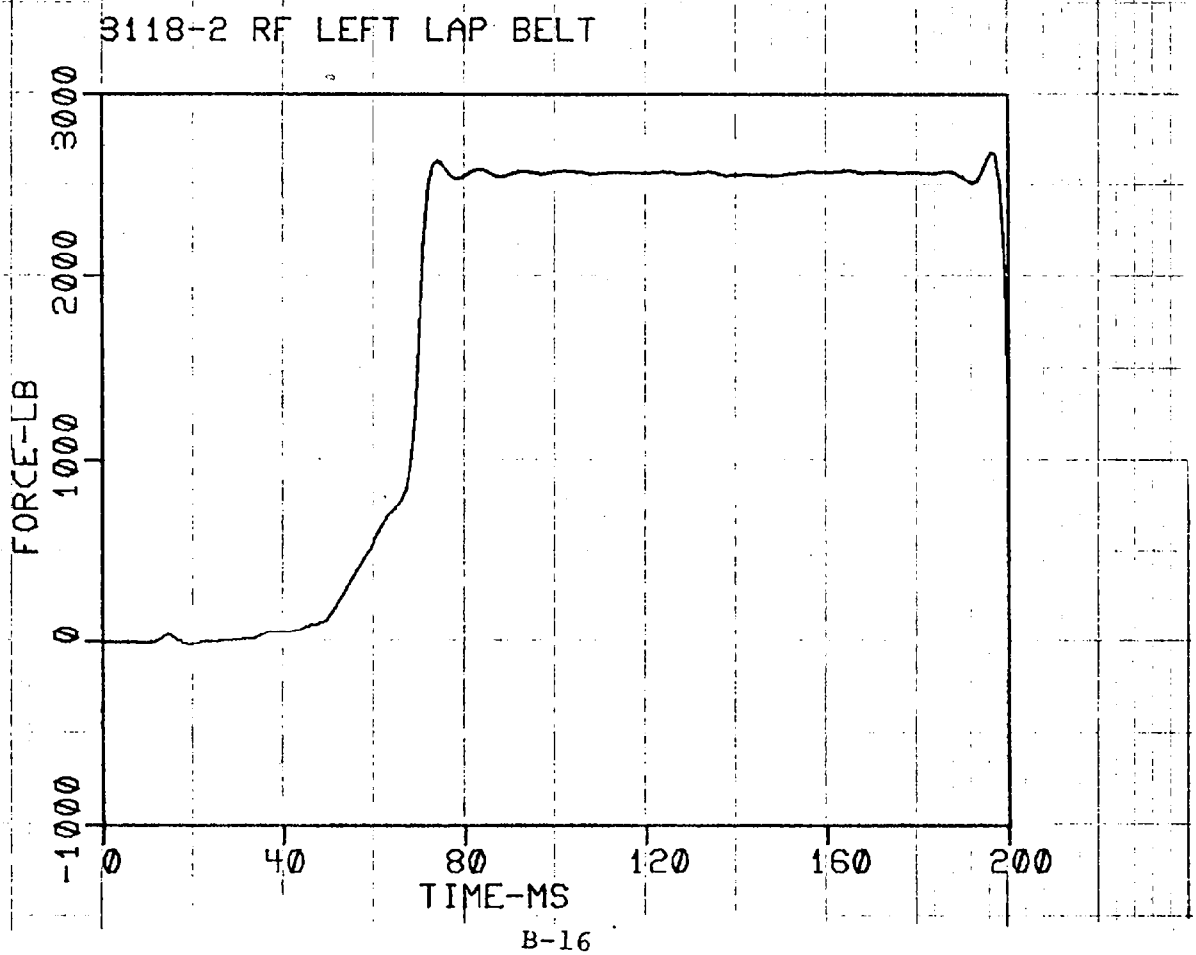

3118-2 RF FEMUR LEFT
1000
0
-1000
-2000
-3000
FORCE-LB
0
40
80
120
160
200
TIME-MS

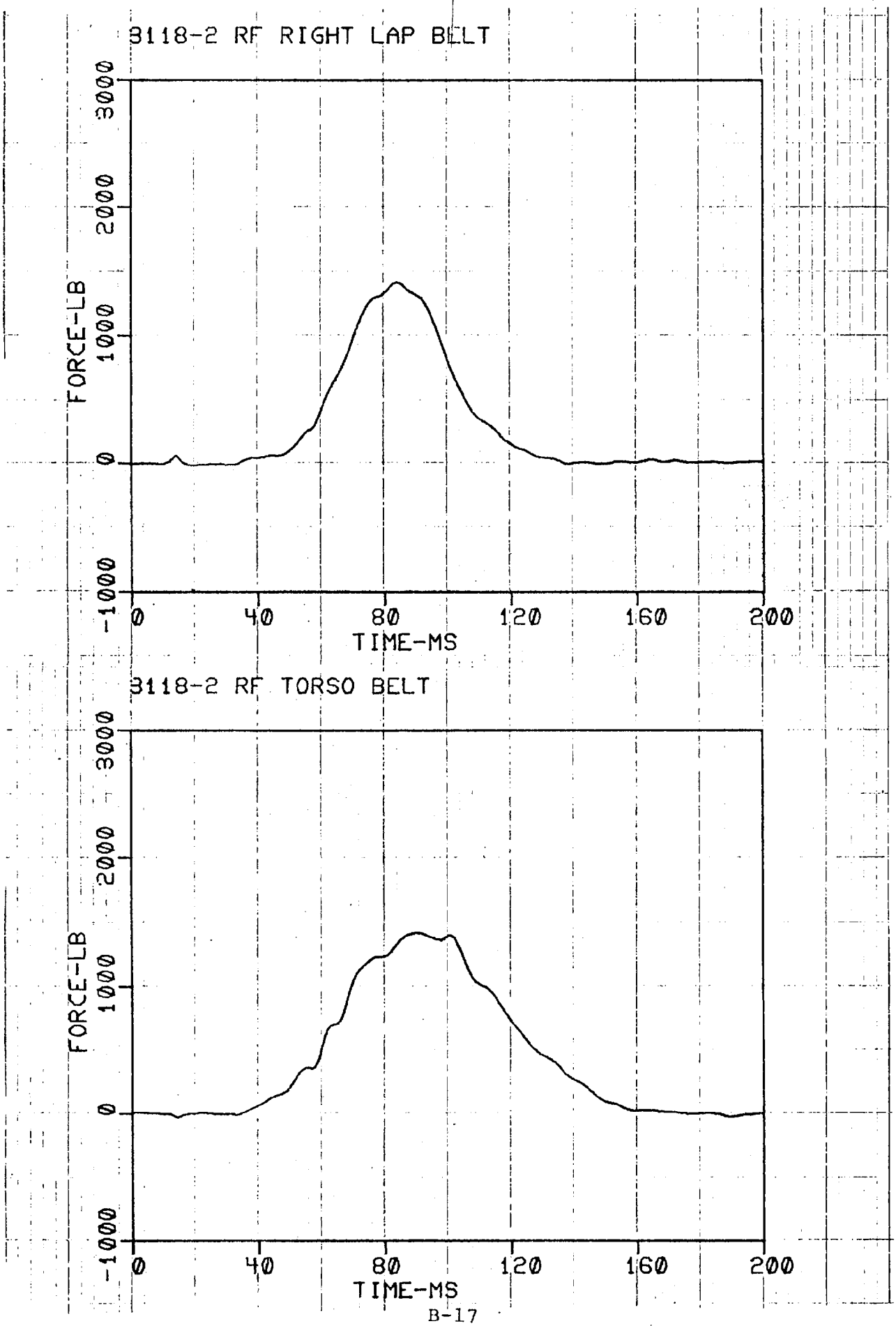

3118-2 RF FEMUR RIGHT
1000
0
-1000
-2000
-3000
FORCE-LB
0
40
80
120
160
200
TIME-MS

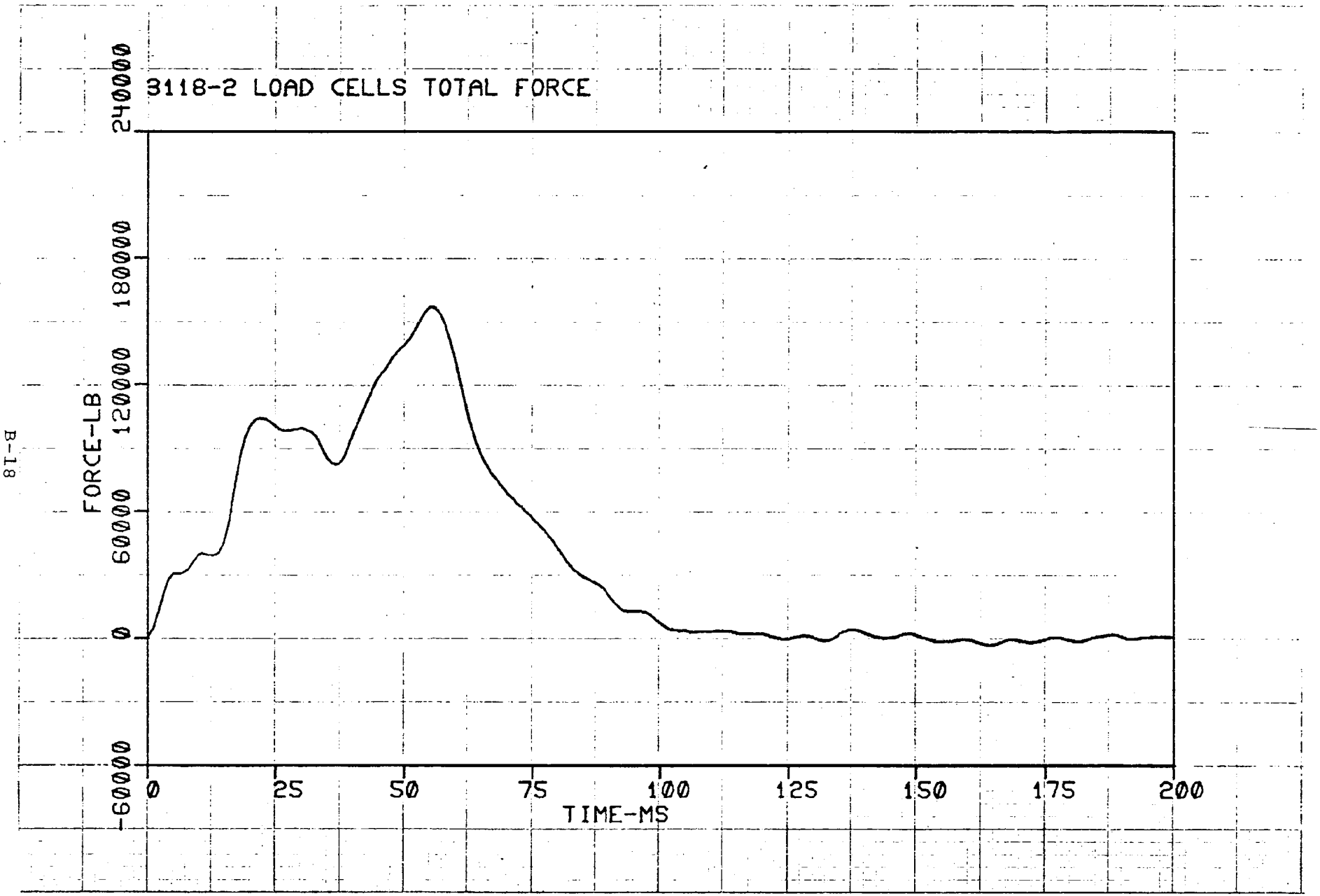

3118-2 LF LEFT LAP BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS

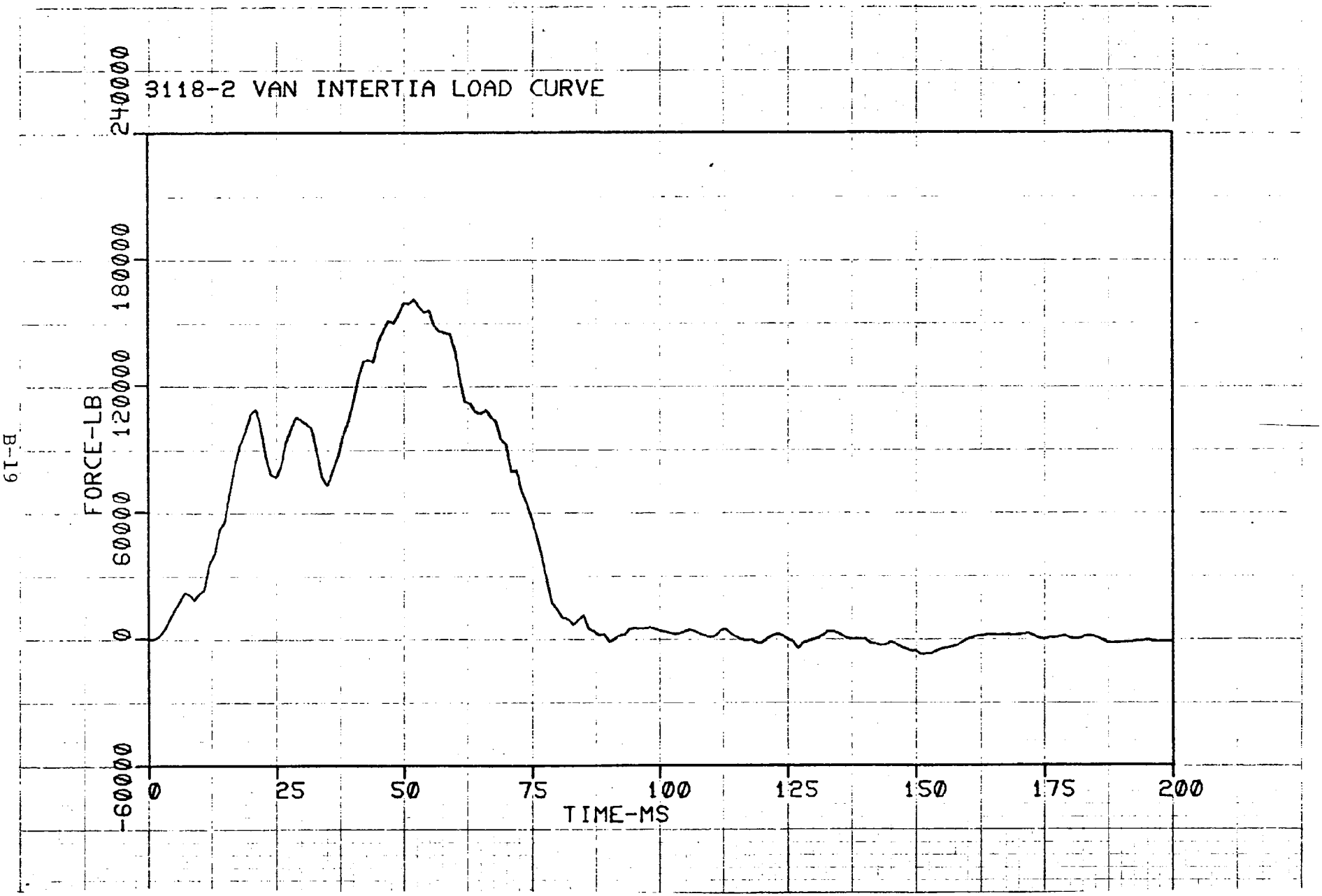

3118-2 LF RIGHT LAP BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS

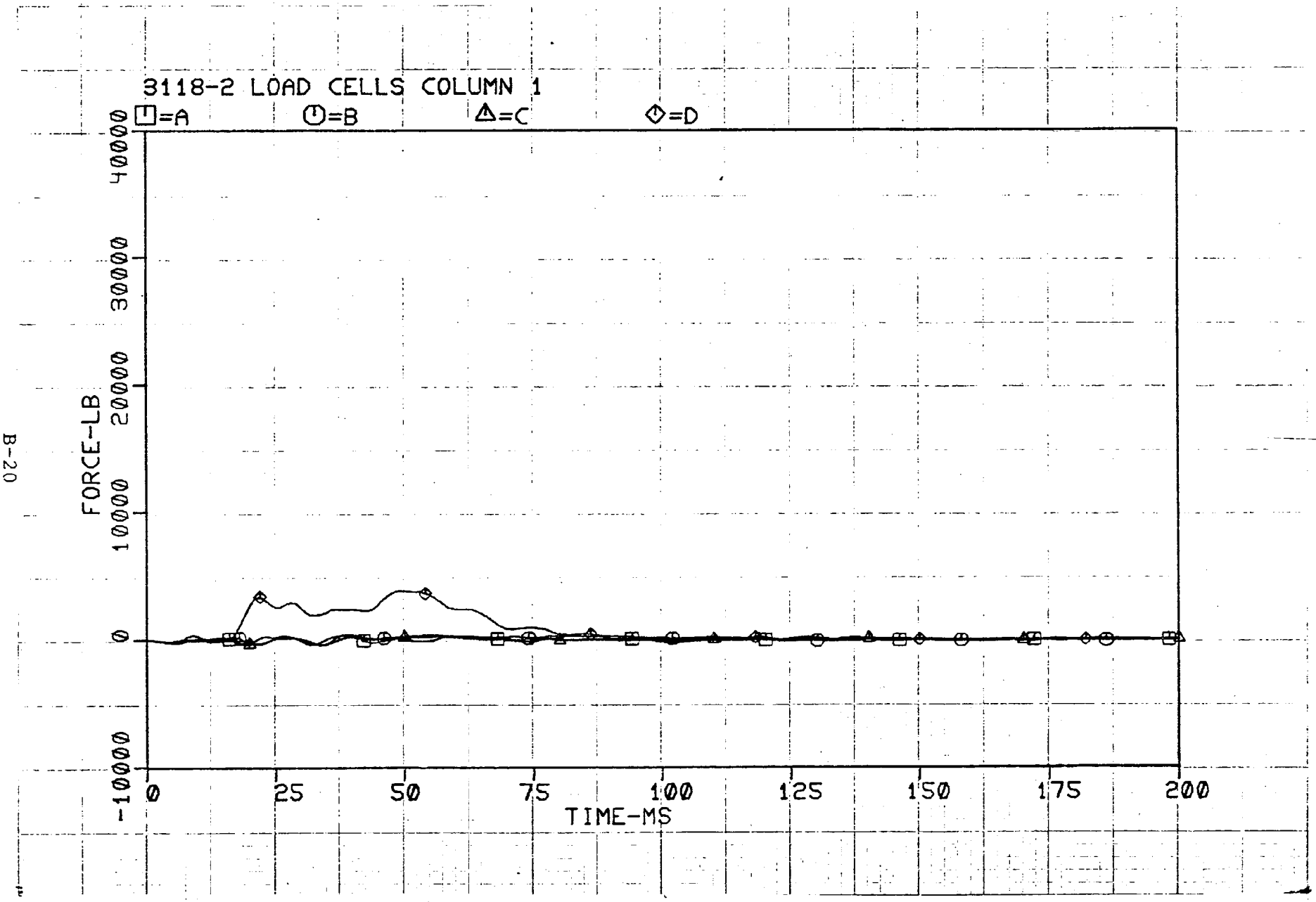

3118-2 LF TORSO BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS

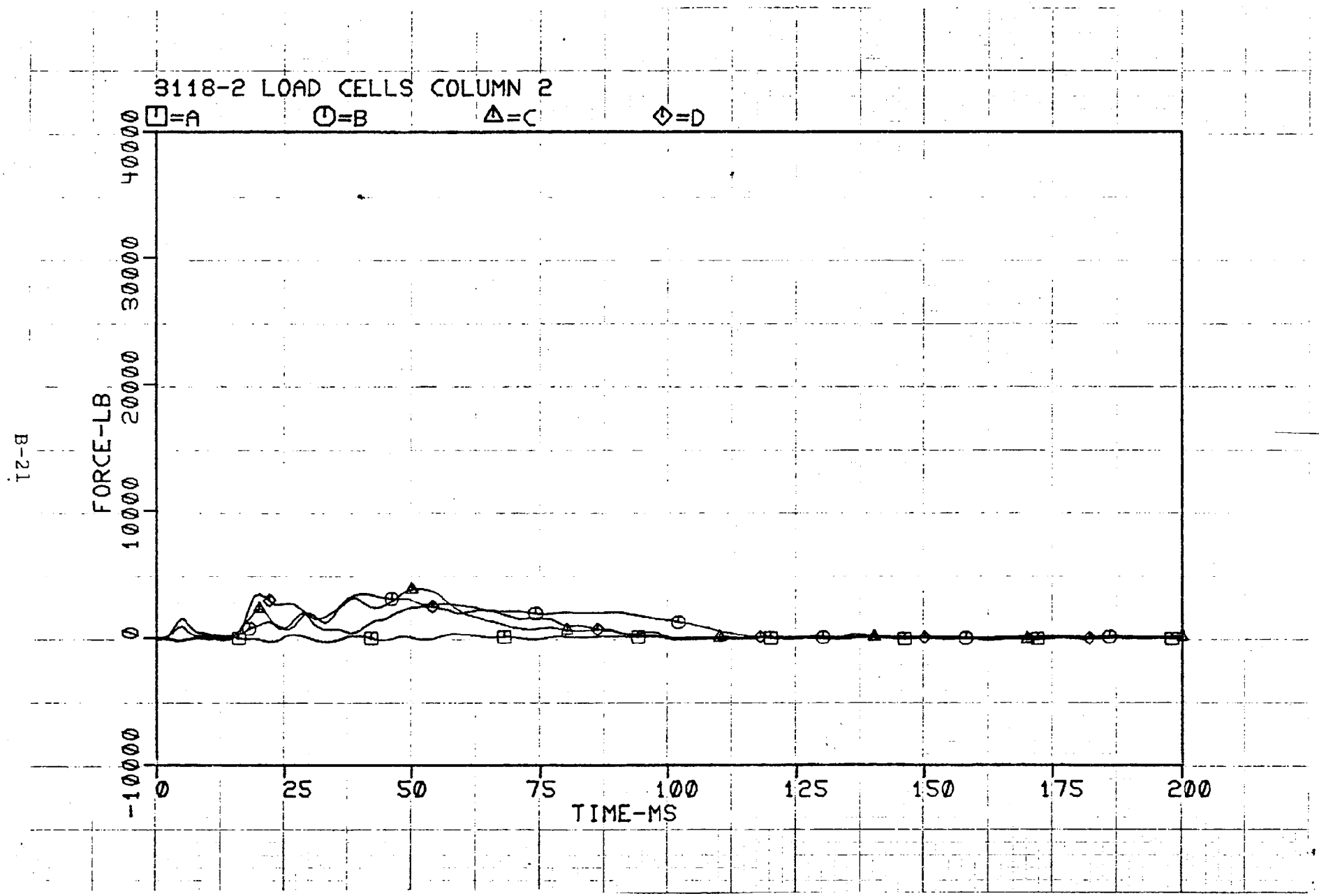

3118-2 RF LEFT LAP BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS

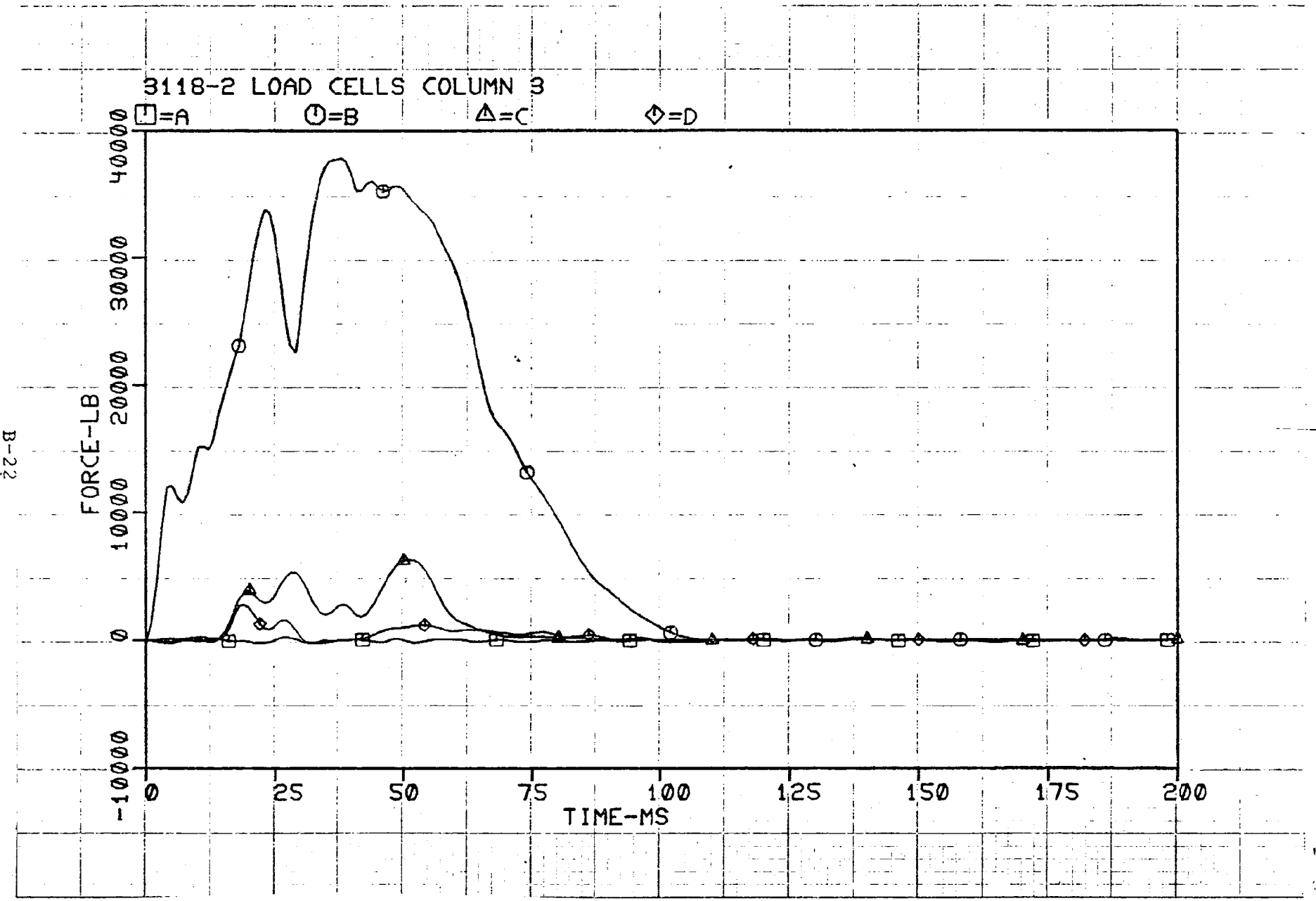

3118-2 RF RIGHT LAP BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS
3118-2 RF TORSO BELT
FORCE-LB
3000
2000
1000
0
-1000
0
40
80
120
160
200
TIME-MS

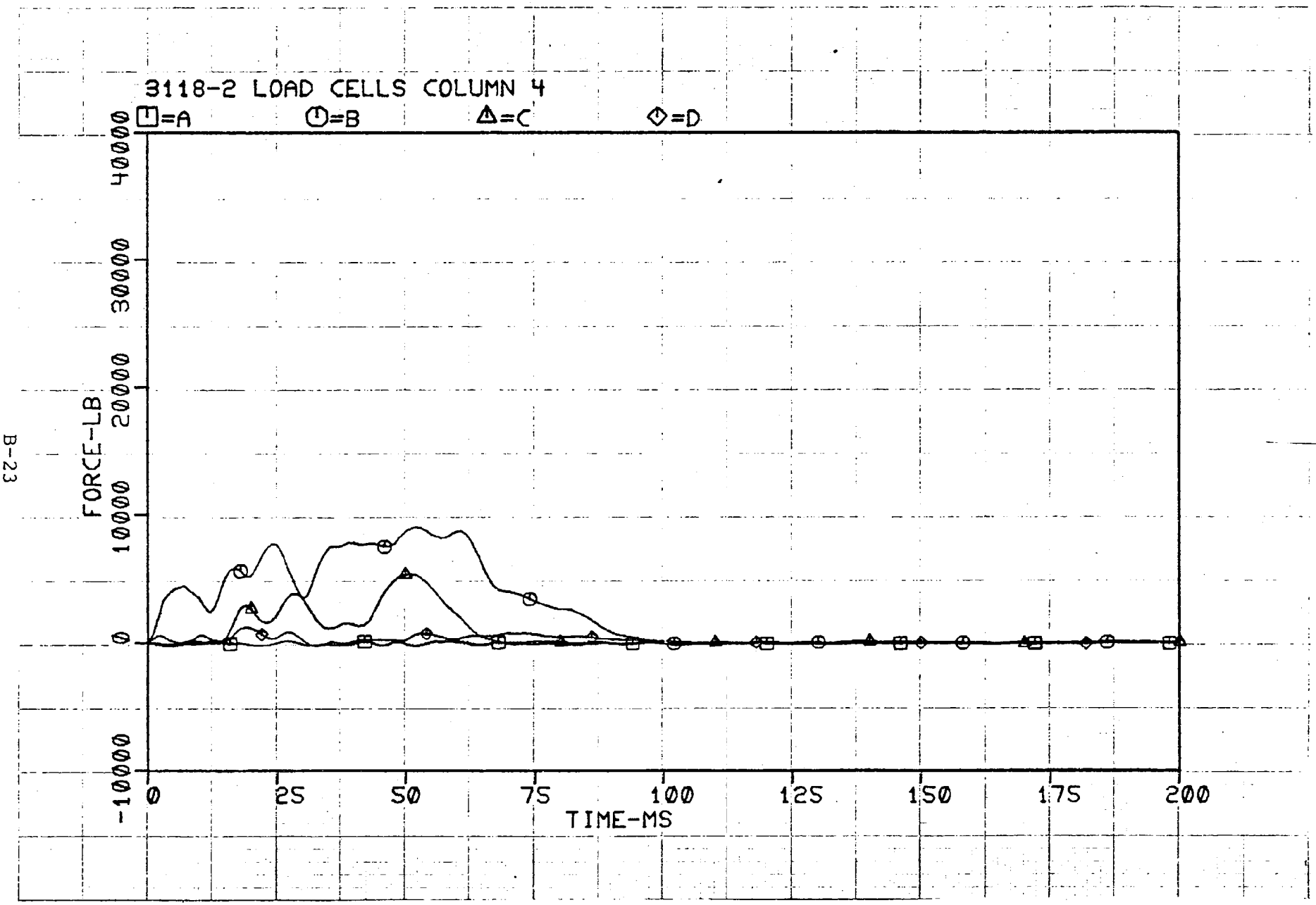

3118-2 LOAD CELLS TOTAL FORCE
240000
180000
120000
60000
0
-60000
FORCE-LB
0
25
50
75
100
125
150
175
200
TIME-MS

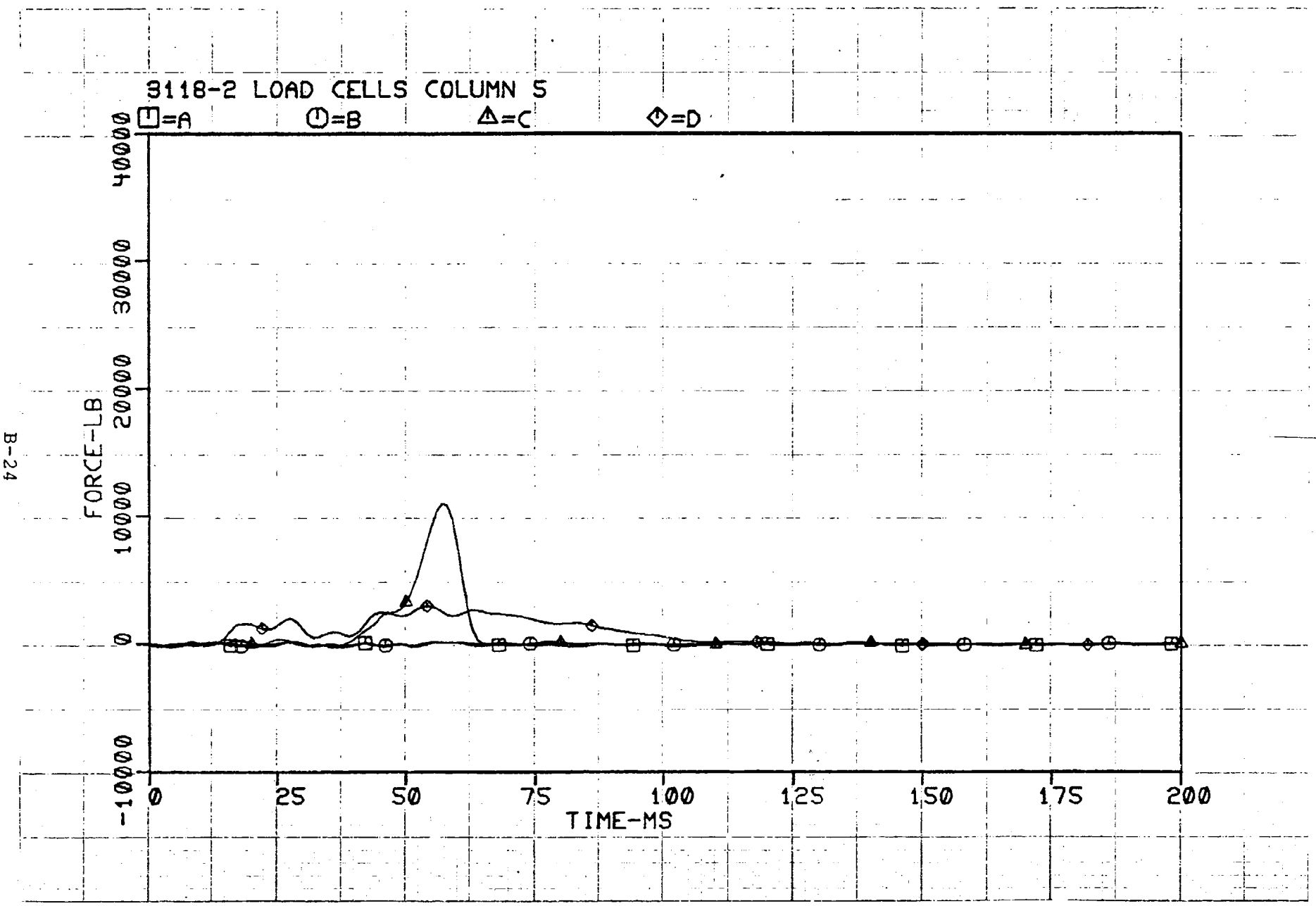

3118-2 VAN INTERTIA LOAD CURVE
FORCE-LB
240000
180000
120000
60000
0
-60000
0
25
50
75
100
125
150
175
200
TIME-MS

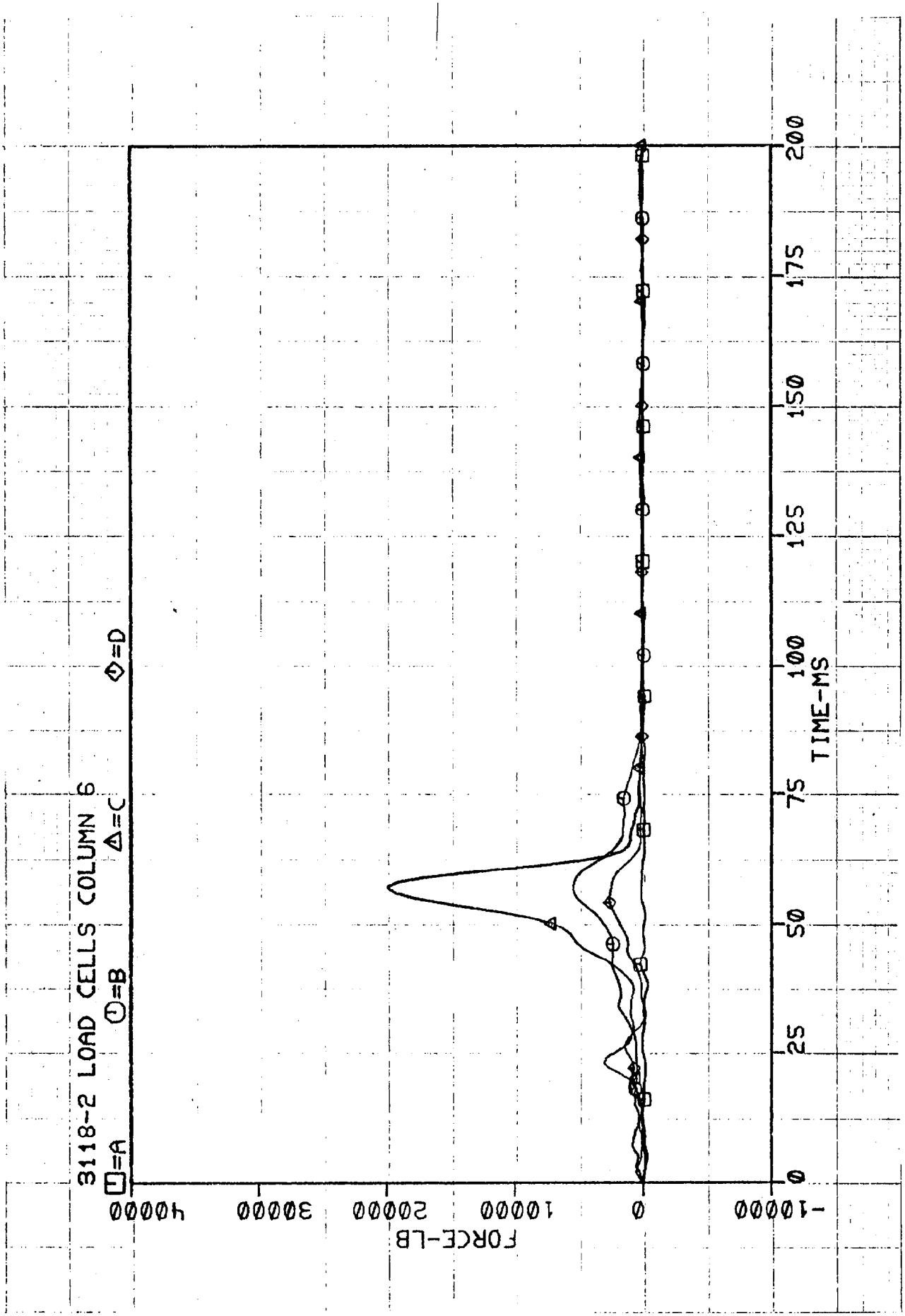

3118-2 LOAD CELLS COLUMN 1
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

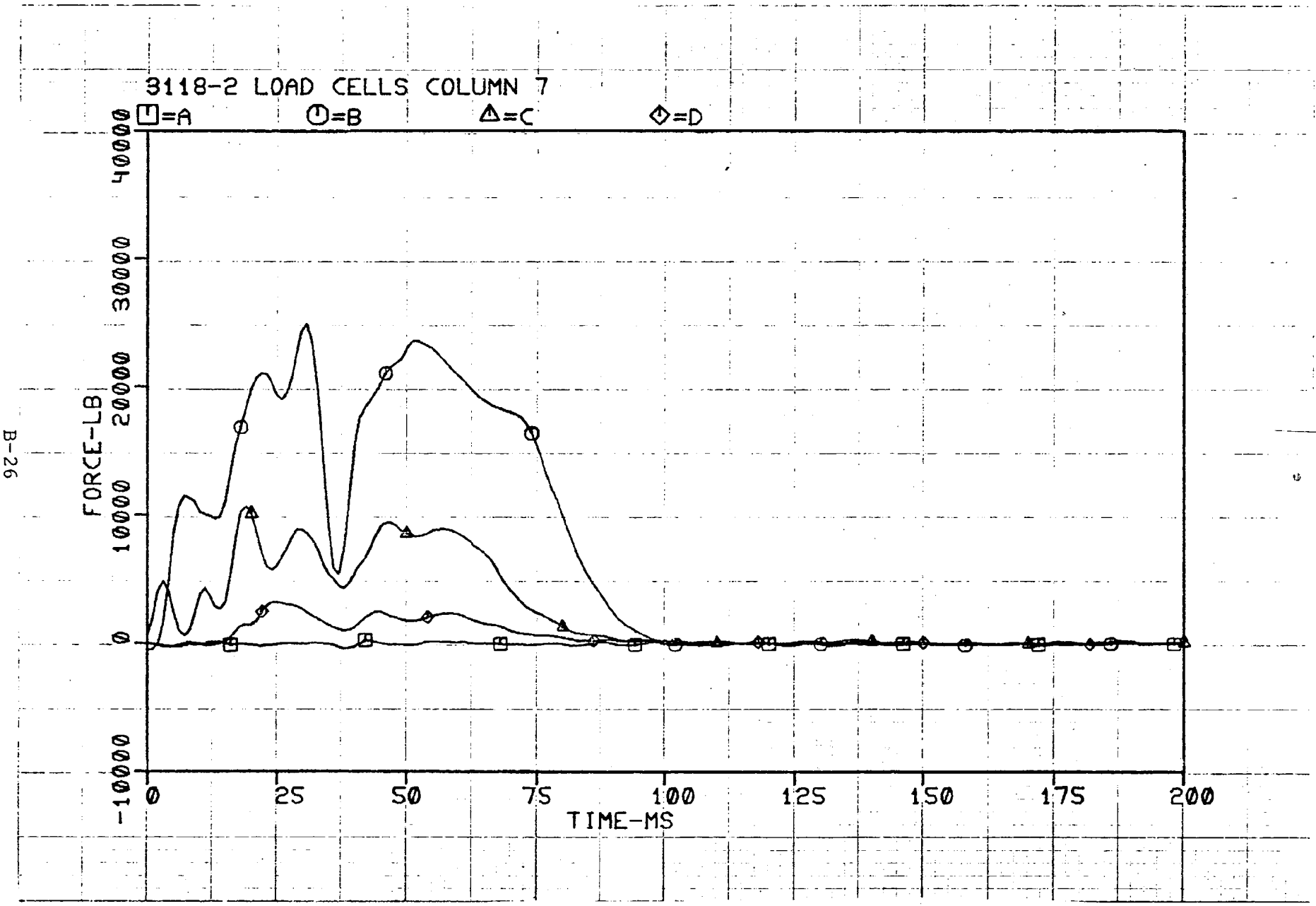

3118-2 LOAD CELLS COLUMN 2
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

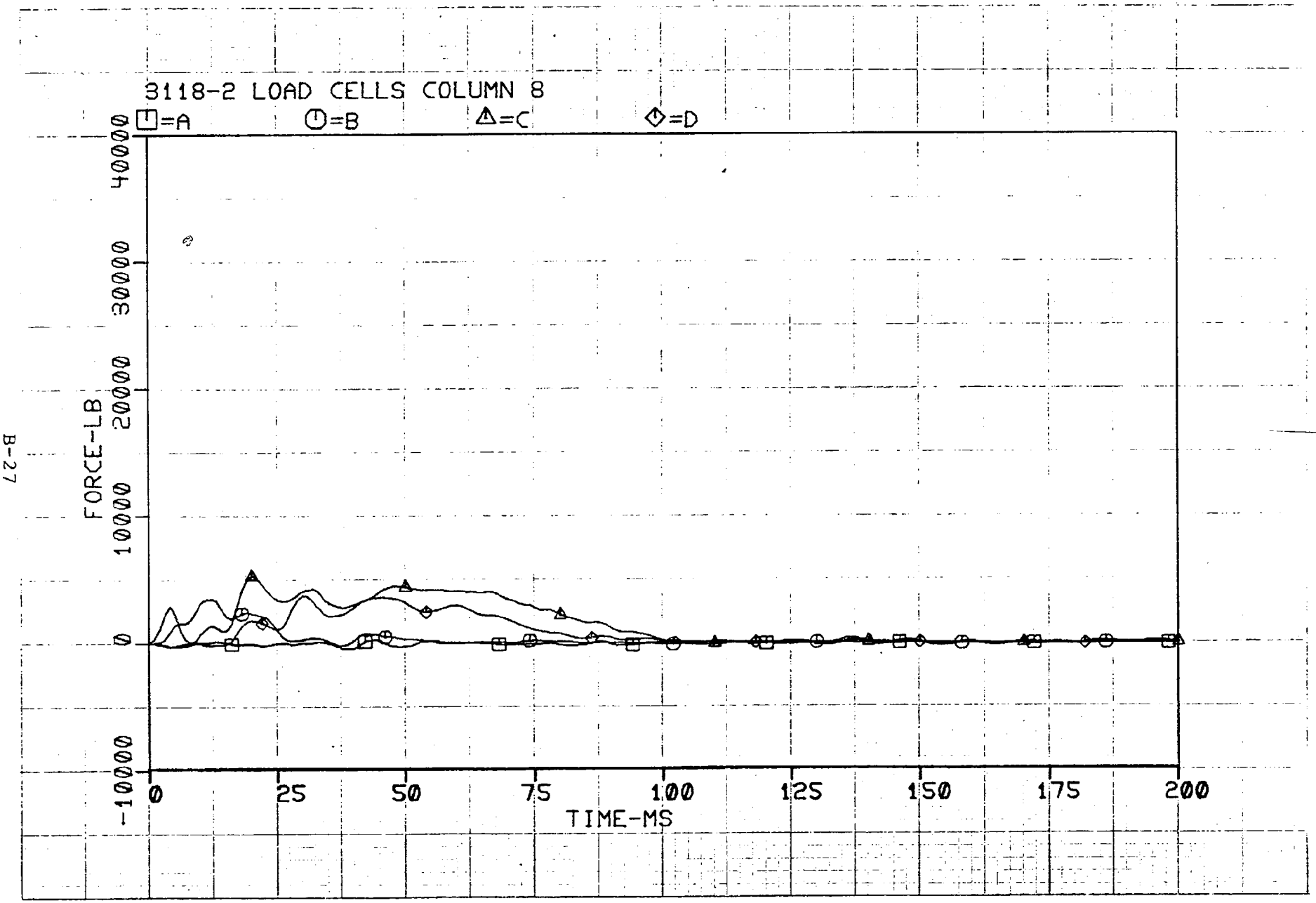

3118-2 LOAD CELLS COLUMN 3
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

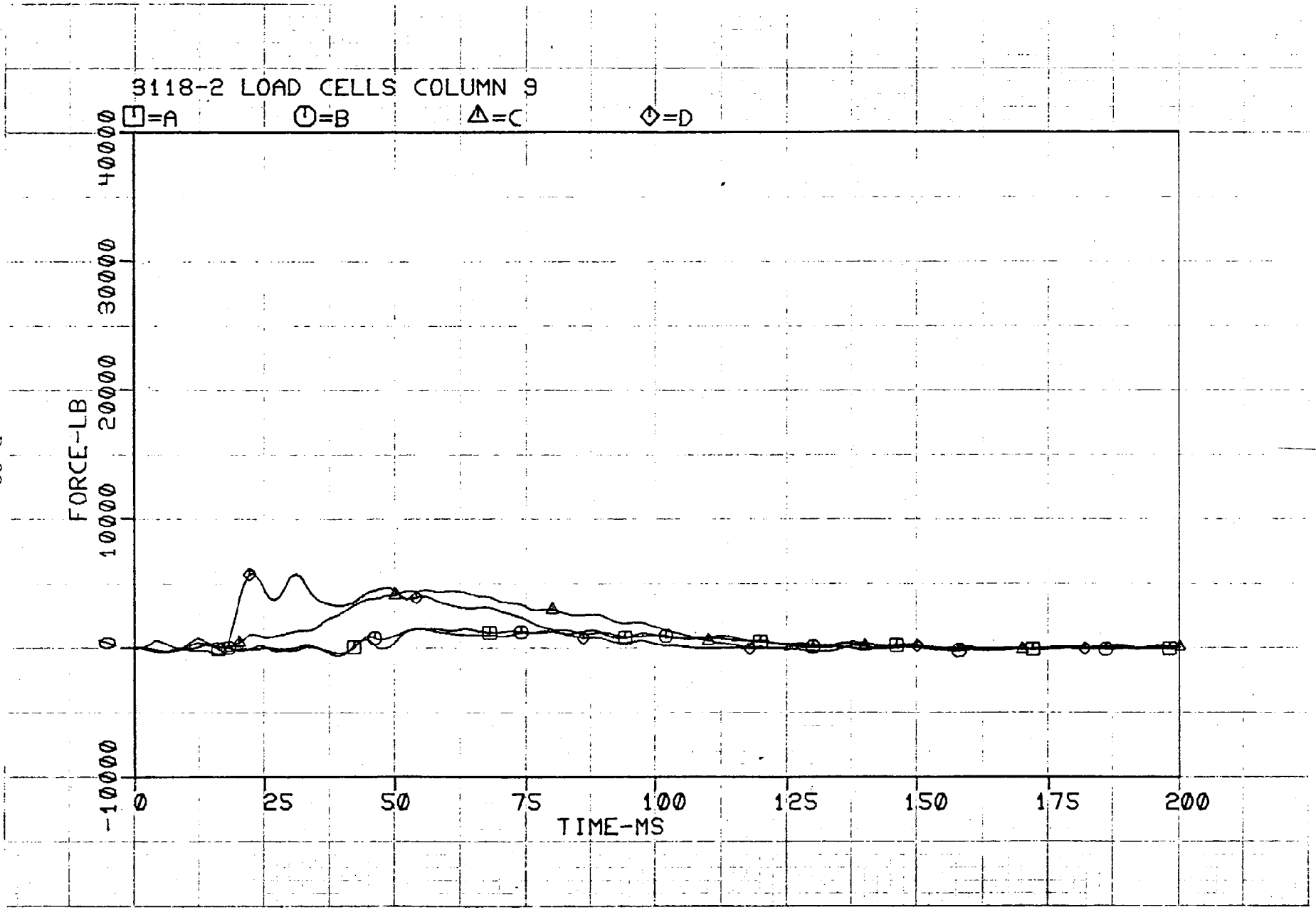

3118-2 LOAD CELLS COLUMN 4
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

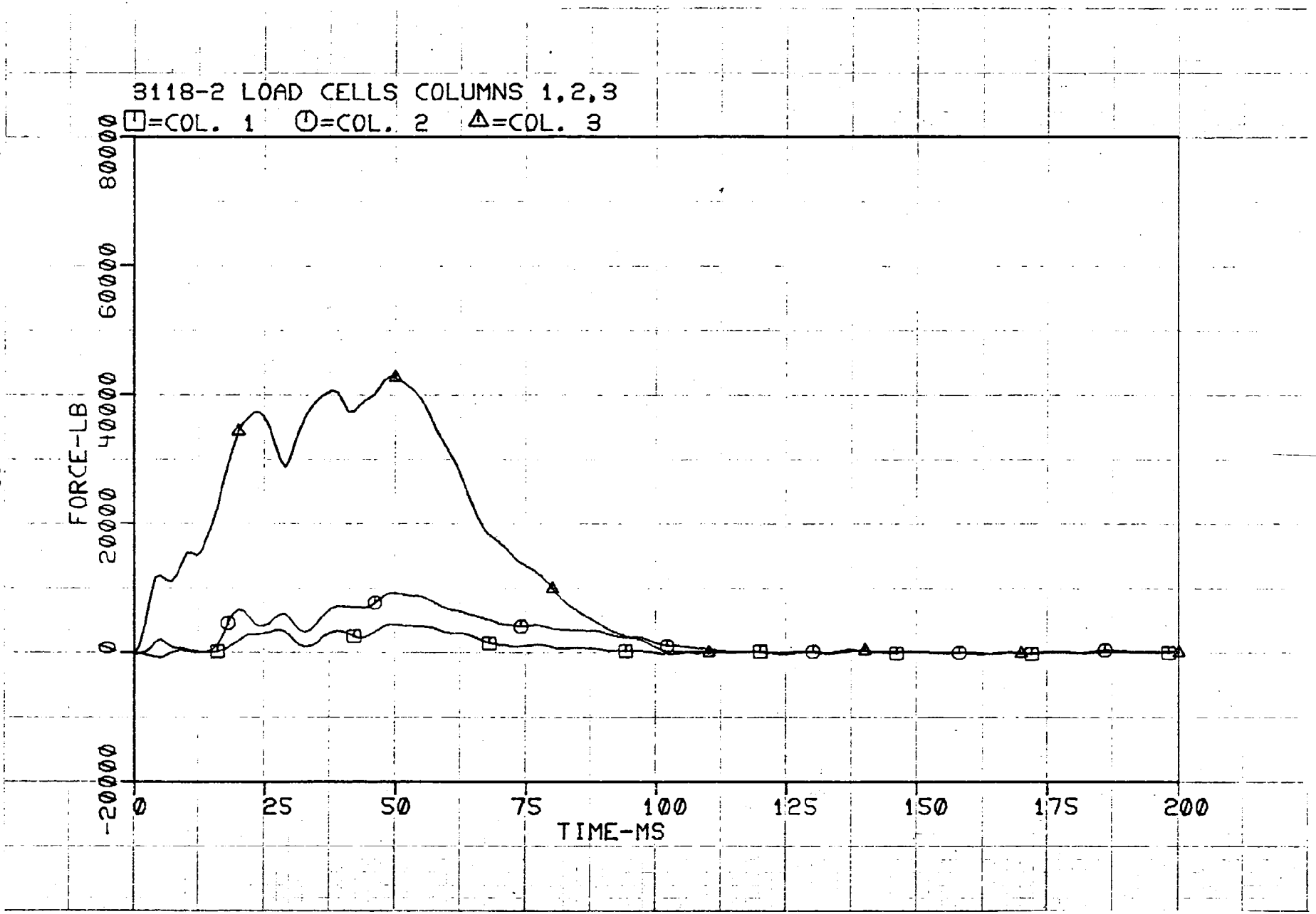

3118-2 LOAD CELLS COLUMN 5
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

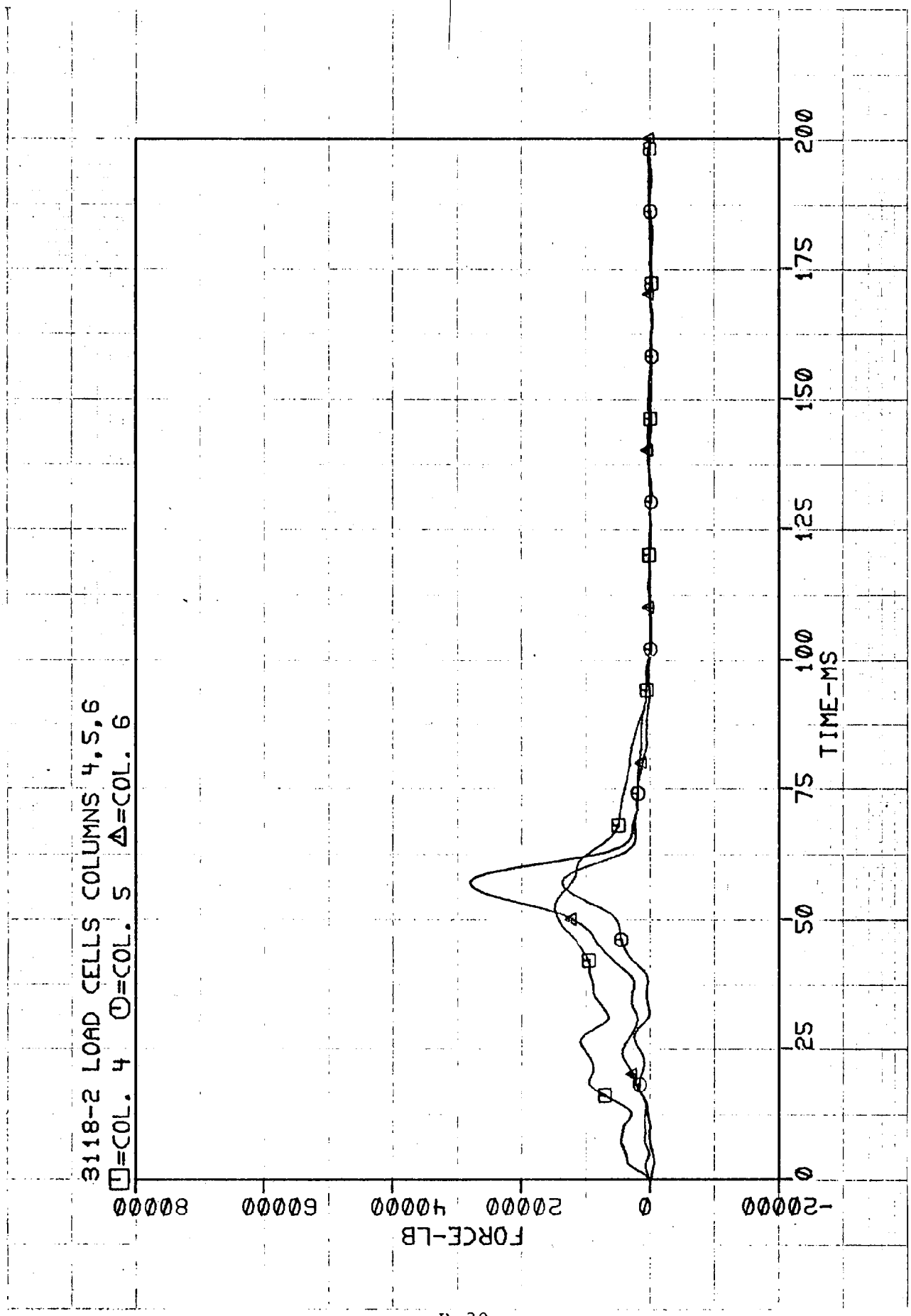

3118-2 LOAD CELLS COLUMN 6
□=A
○=B
△=C
◇=D
FORCE-LB
-10000
0
10000
20000
30000
40000
TIME-MS
0
25
50
75
100
125
150
175
200

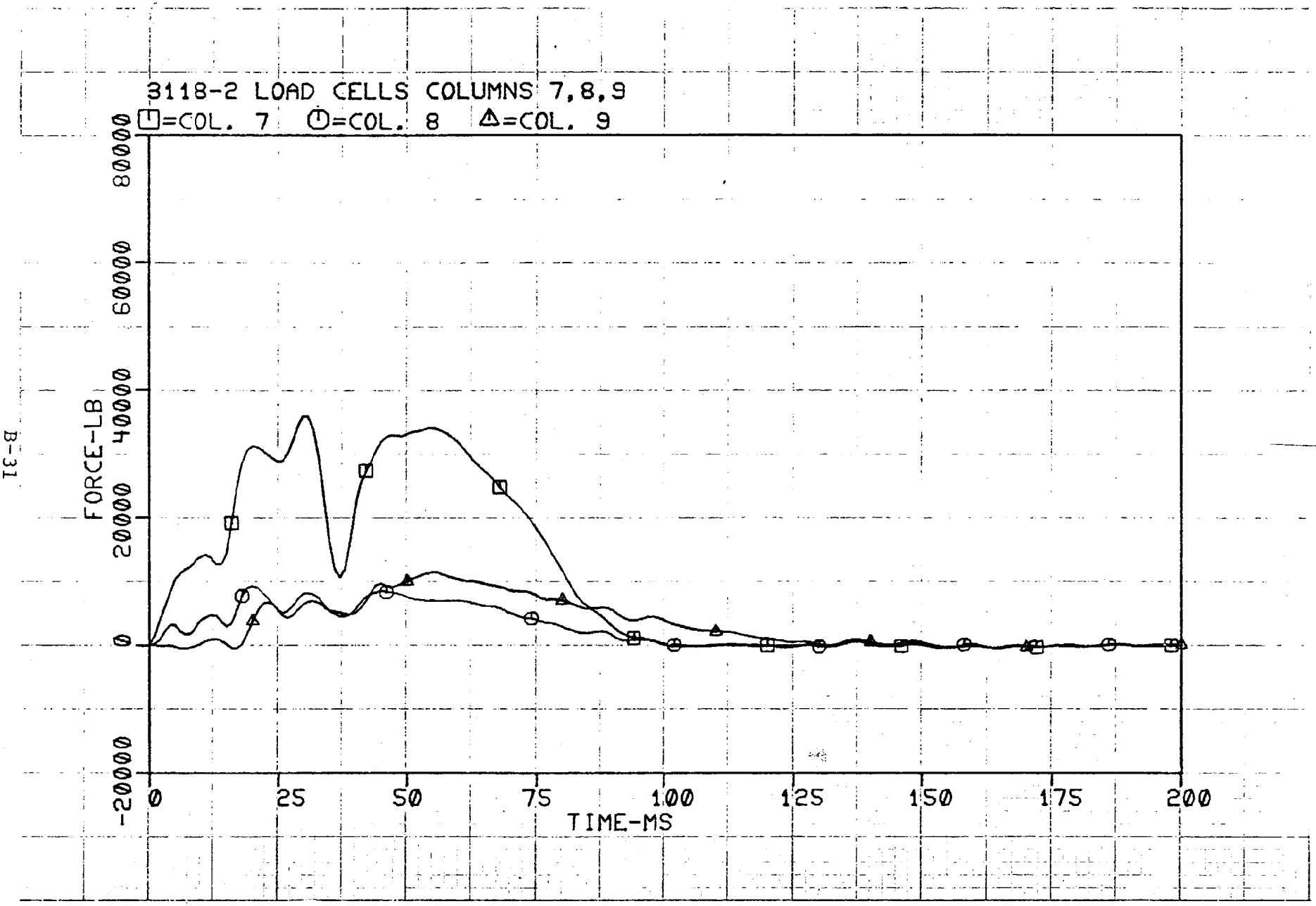

3118-2 LOAD CELLS COLUMN 7
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

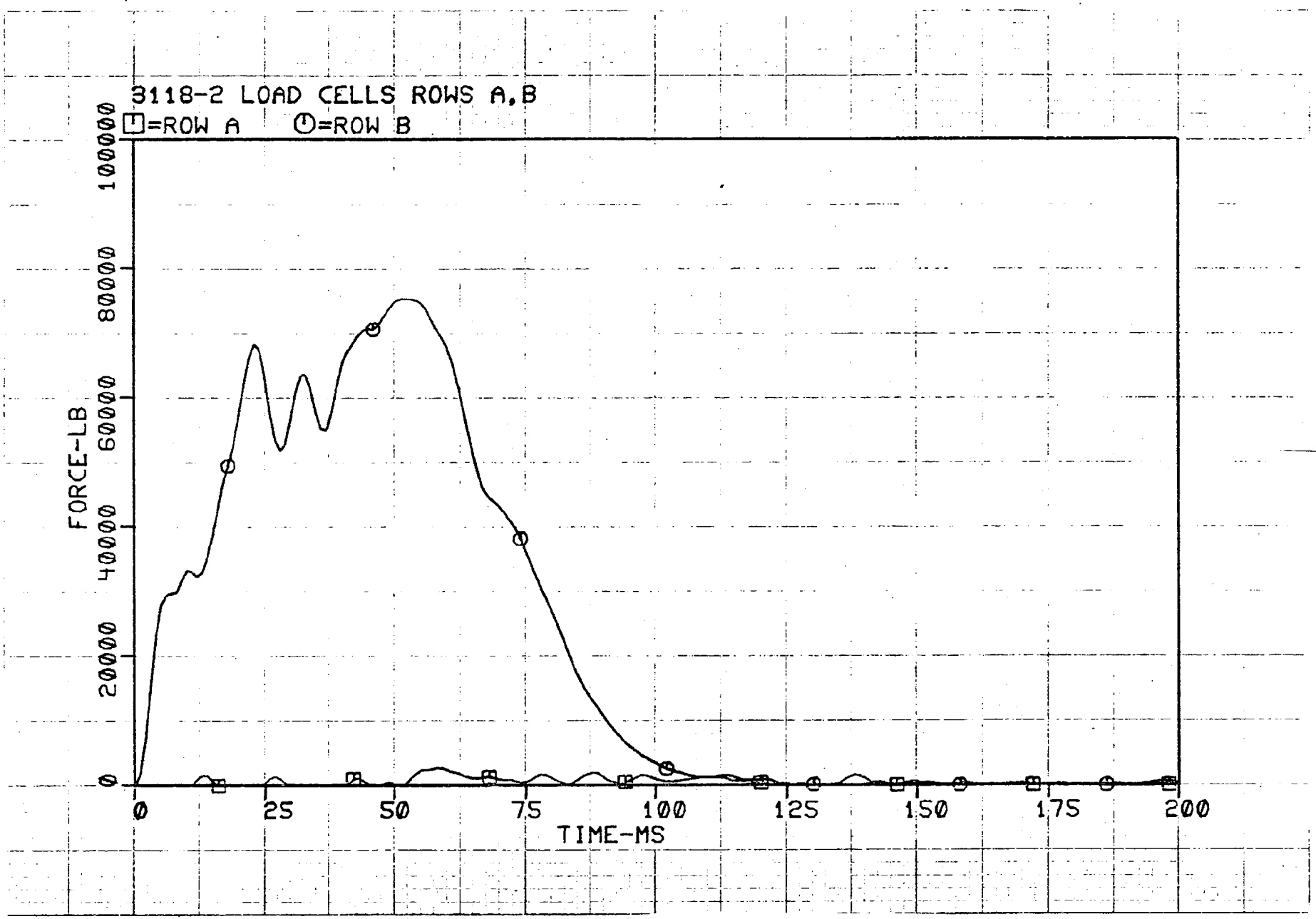

3118-2 LOAD CELLS COLUMN 8
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

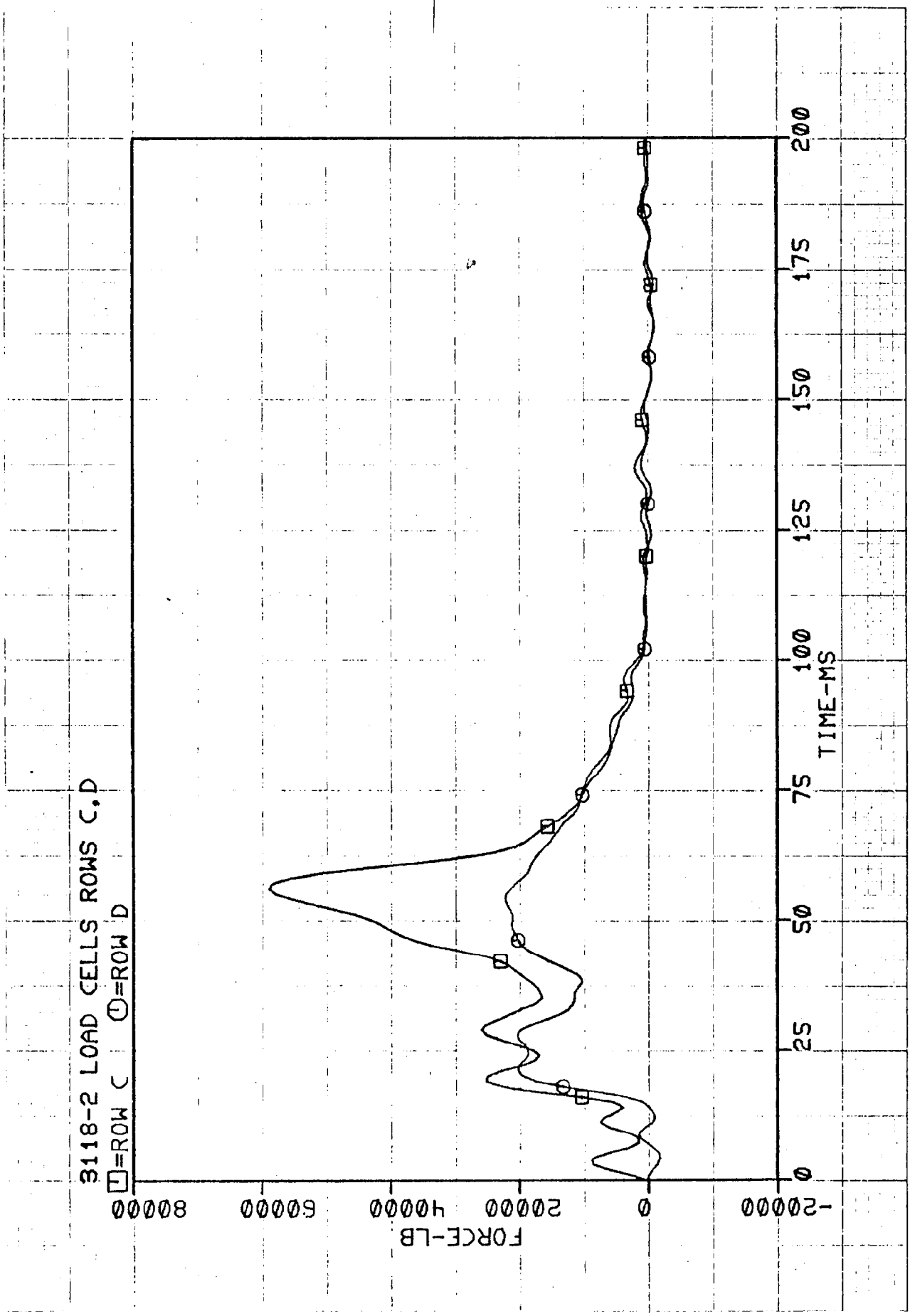

3118-2 LOAD CELLS COLUMN 9
□=A
○=B
△=C
◇=D
FORCE-LB
40000
30000
20000
10000
0
-10000
0
25
50
75
100
125
150
175
200
TIME-MS

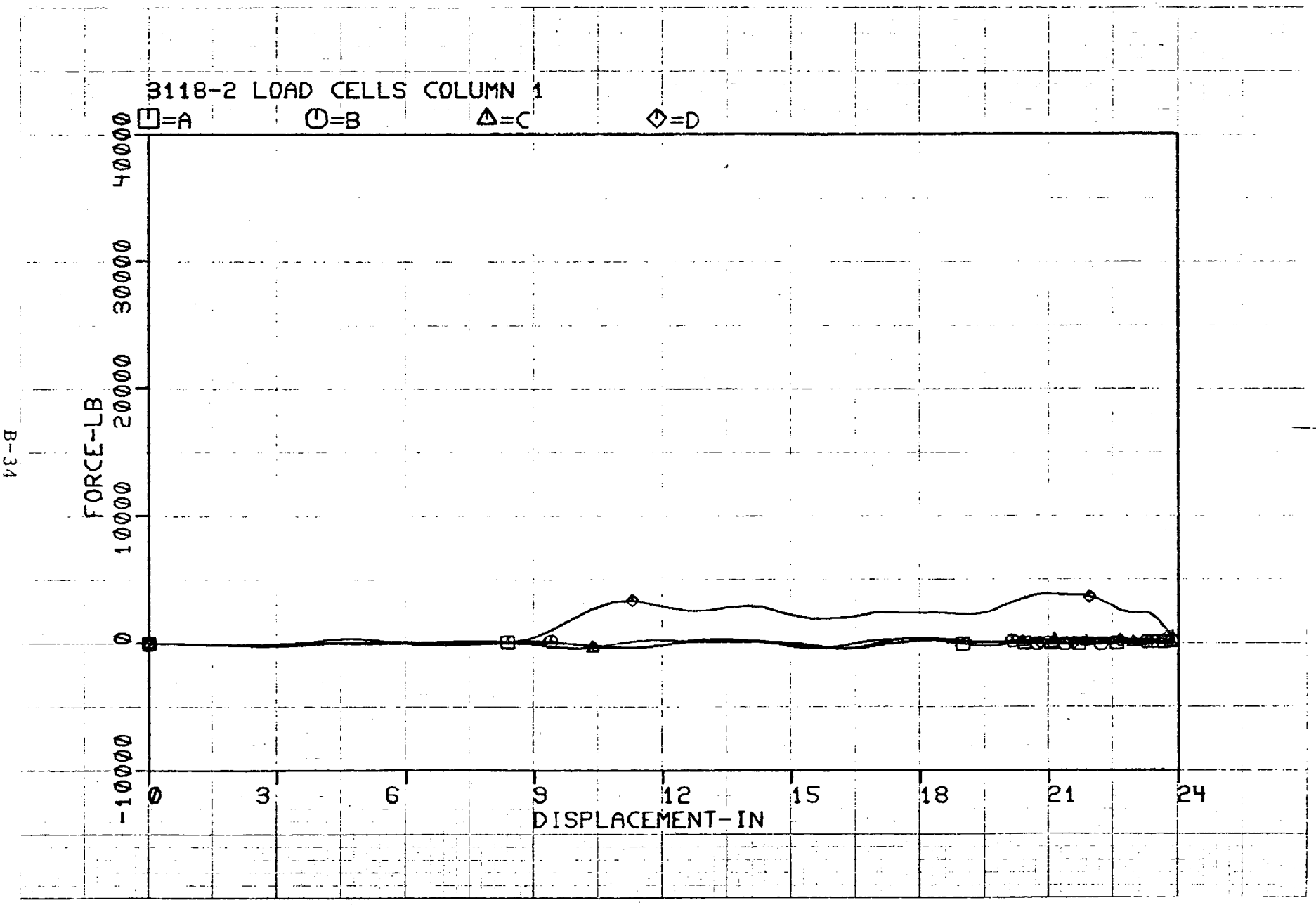

3118-2 LOAD CELLS COLUMNS 1,2,3
□=COL. 1 ○=COL. 2 △=COL. 3
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-2 LOAD CELLS COLUMNS 4,5,6
□=COL. 4 ○=COL. 5 Δ=COL. 6
FORCE-LB
80000
60000
40000
20000
0
-20000
TIME-MS
0
25
50
75
100
125
150
175
200


3118-2 LOAD CELLS COLUMNS 7,8,9
□=COL. 7 ⊙=COL. 8 △=COL. 9
FORCE-LB
80000
60000
40000
20000
0
-20000
0
25
50
75
100
125
150
175
200
TIME-MS


3118-2 LOAD CELLS ROWS A,B
□=ROW A
⏲=ROW B
FORCE-LB
100000
80000
60000
40000
20000
0
0
25
50
75
100
125
150
175
200
TIME-MS


3118-2 LOAD CELLS ROWS C,D
□=ROW C ○=ROW D
FORCE-LB
80000
60000
40000
20000
0
-20000
TIME-MS
0
25
50
75
100
125
150
175
200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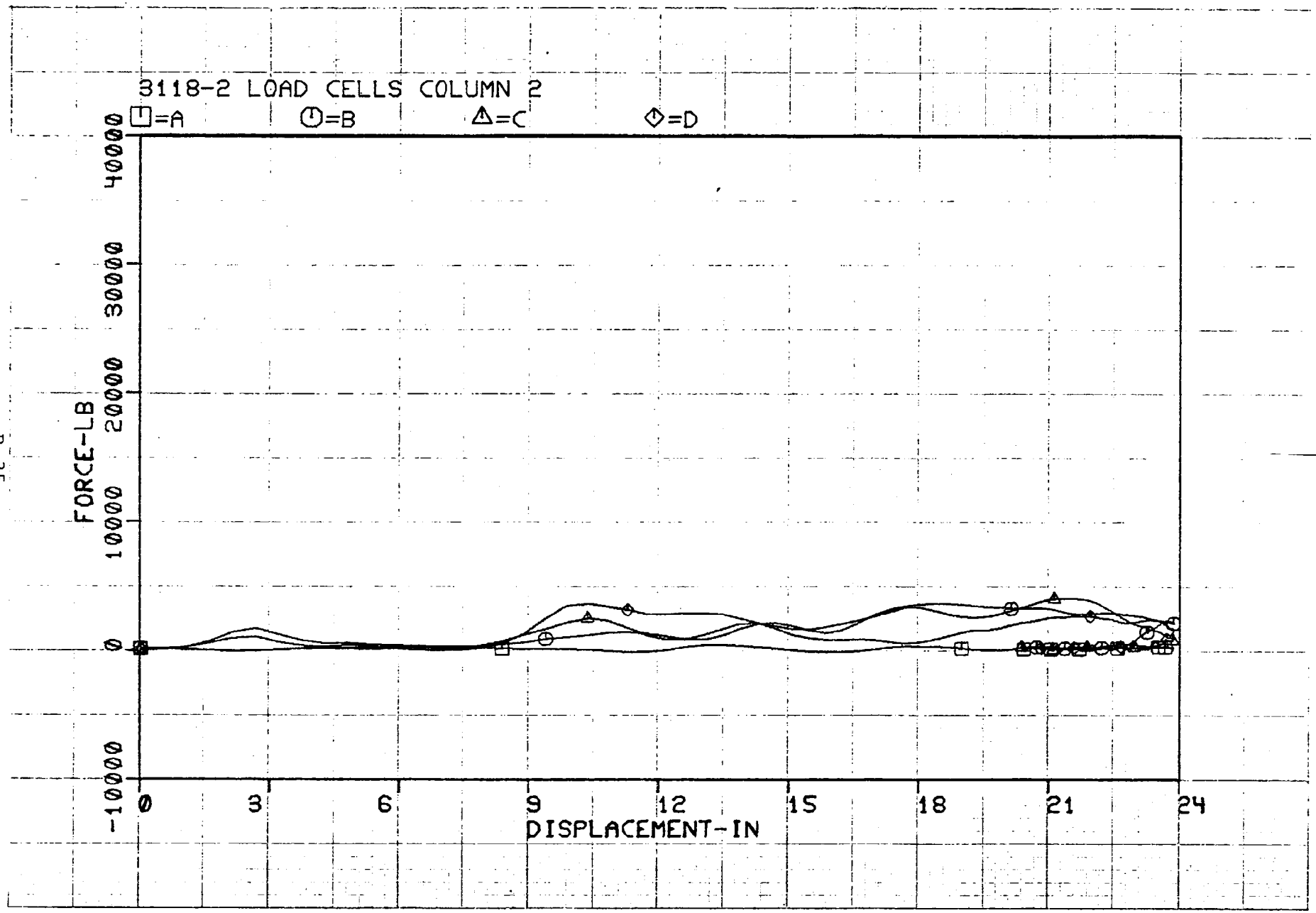
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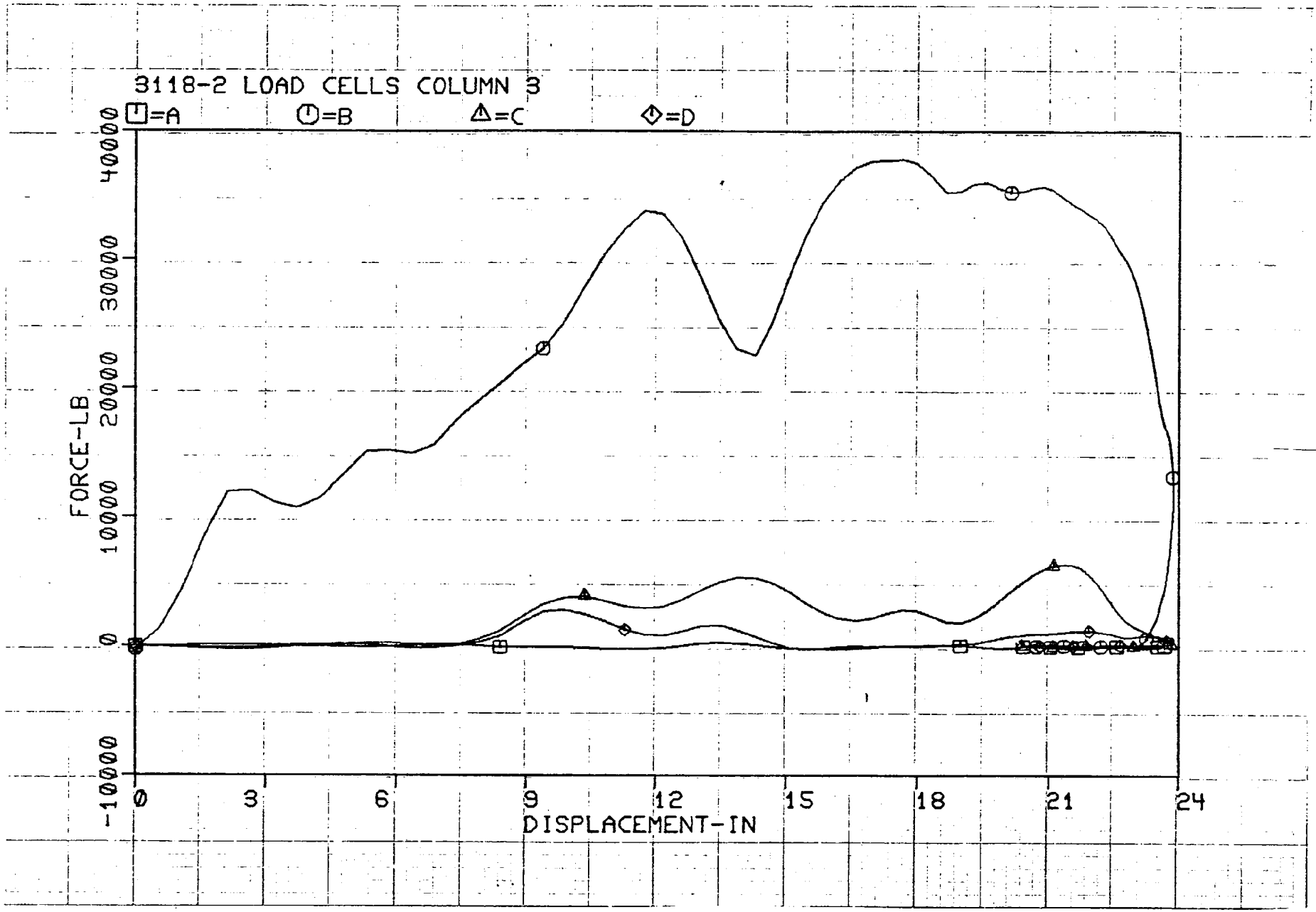
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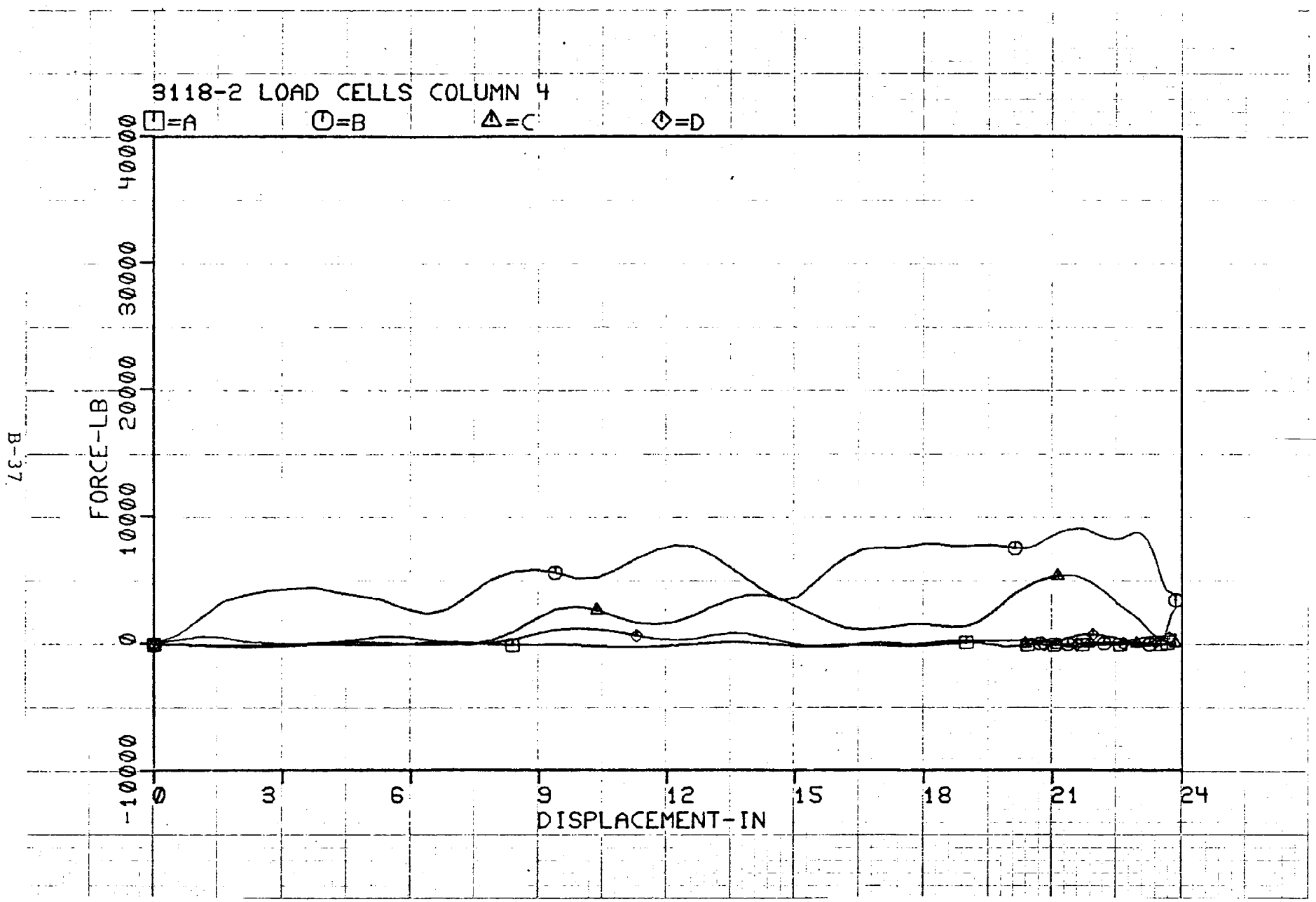
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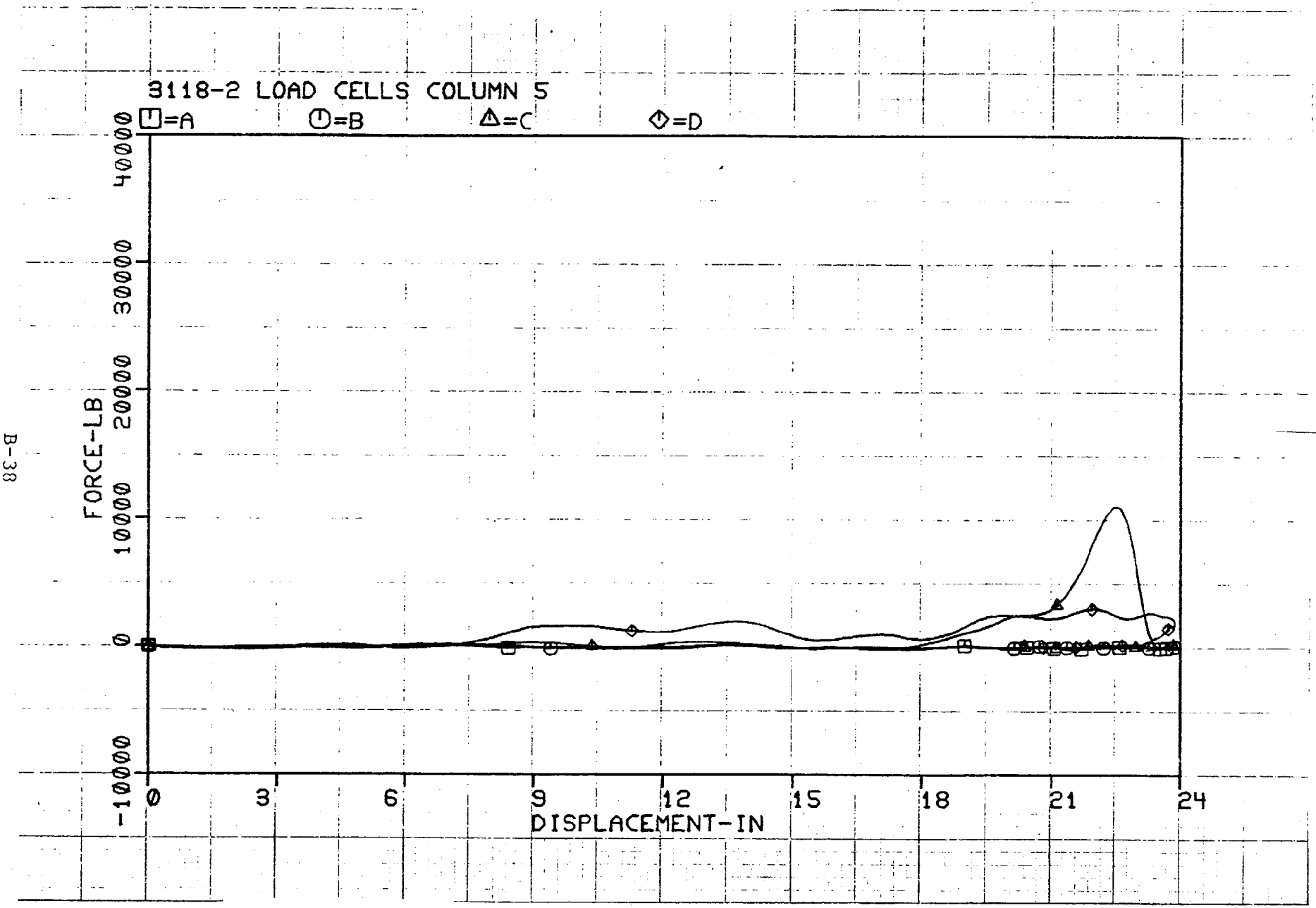
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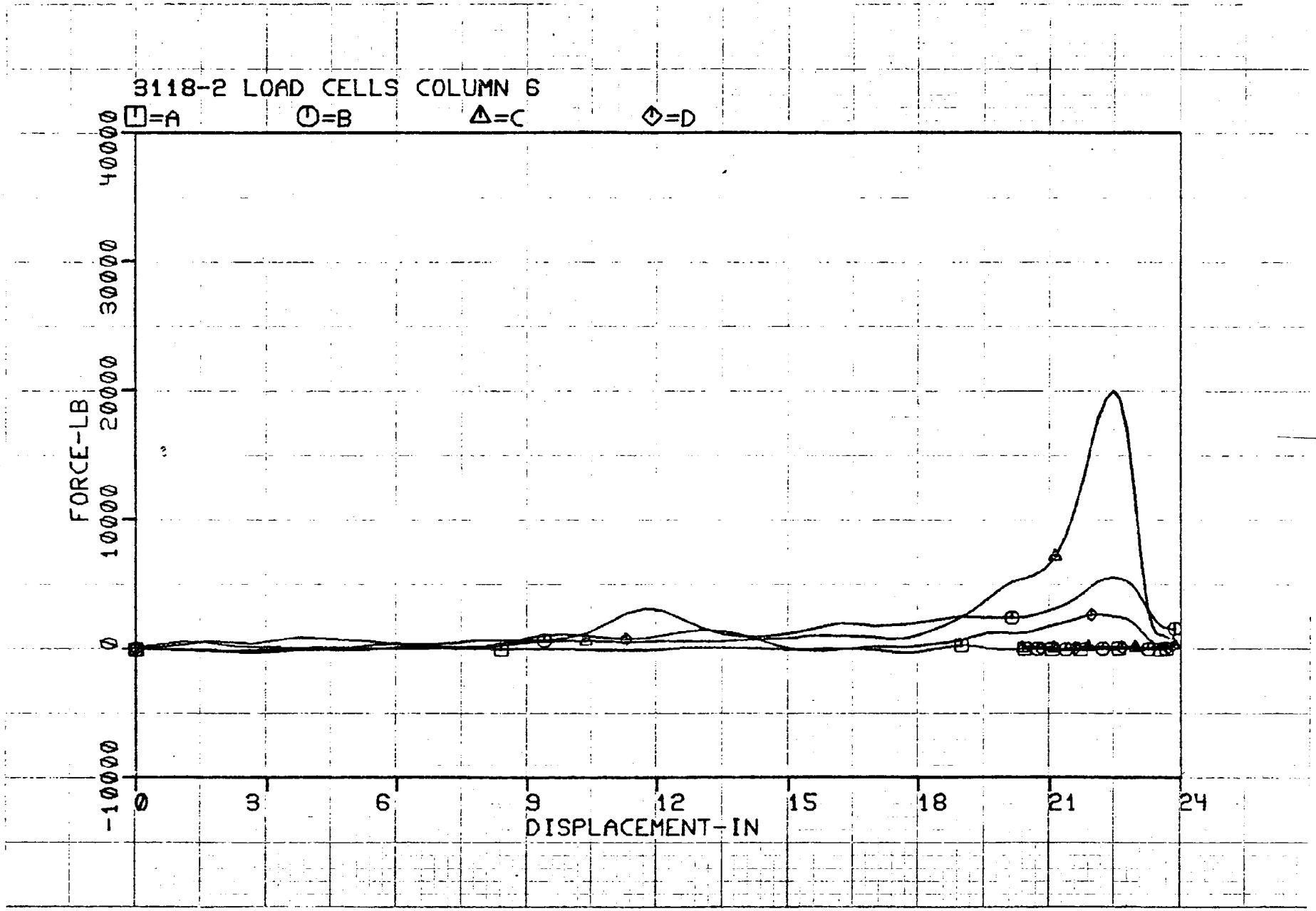
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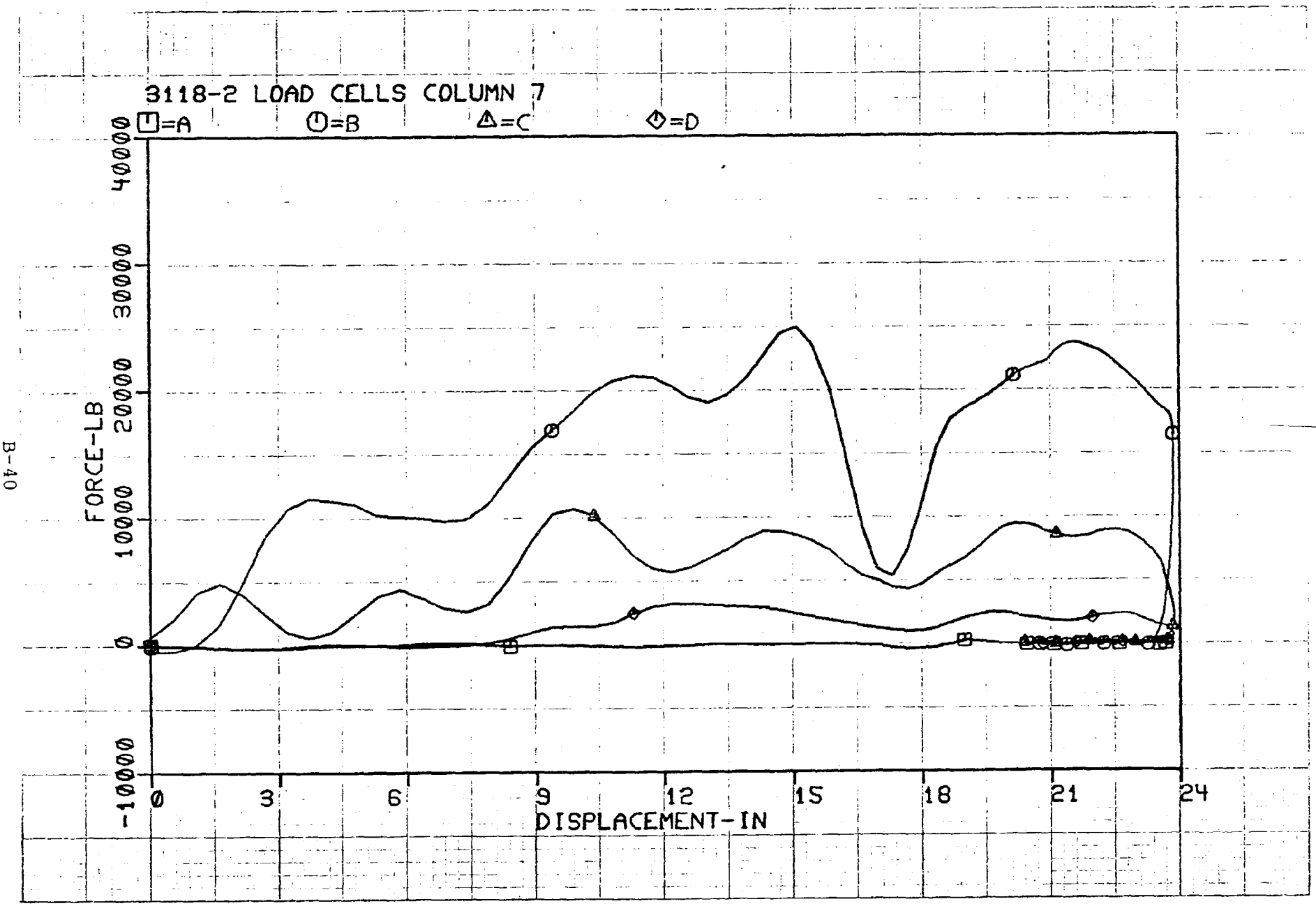
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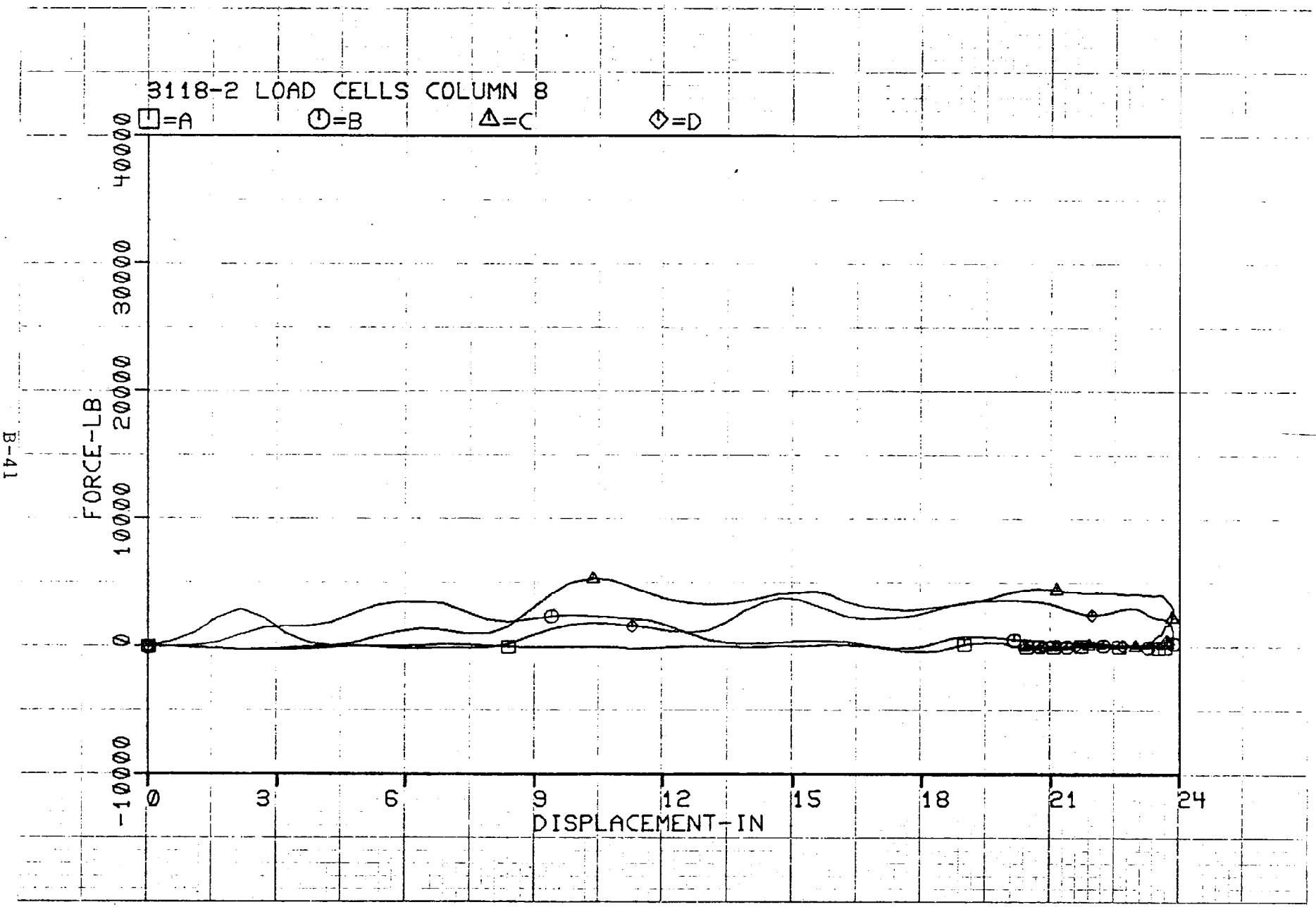
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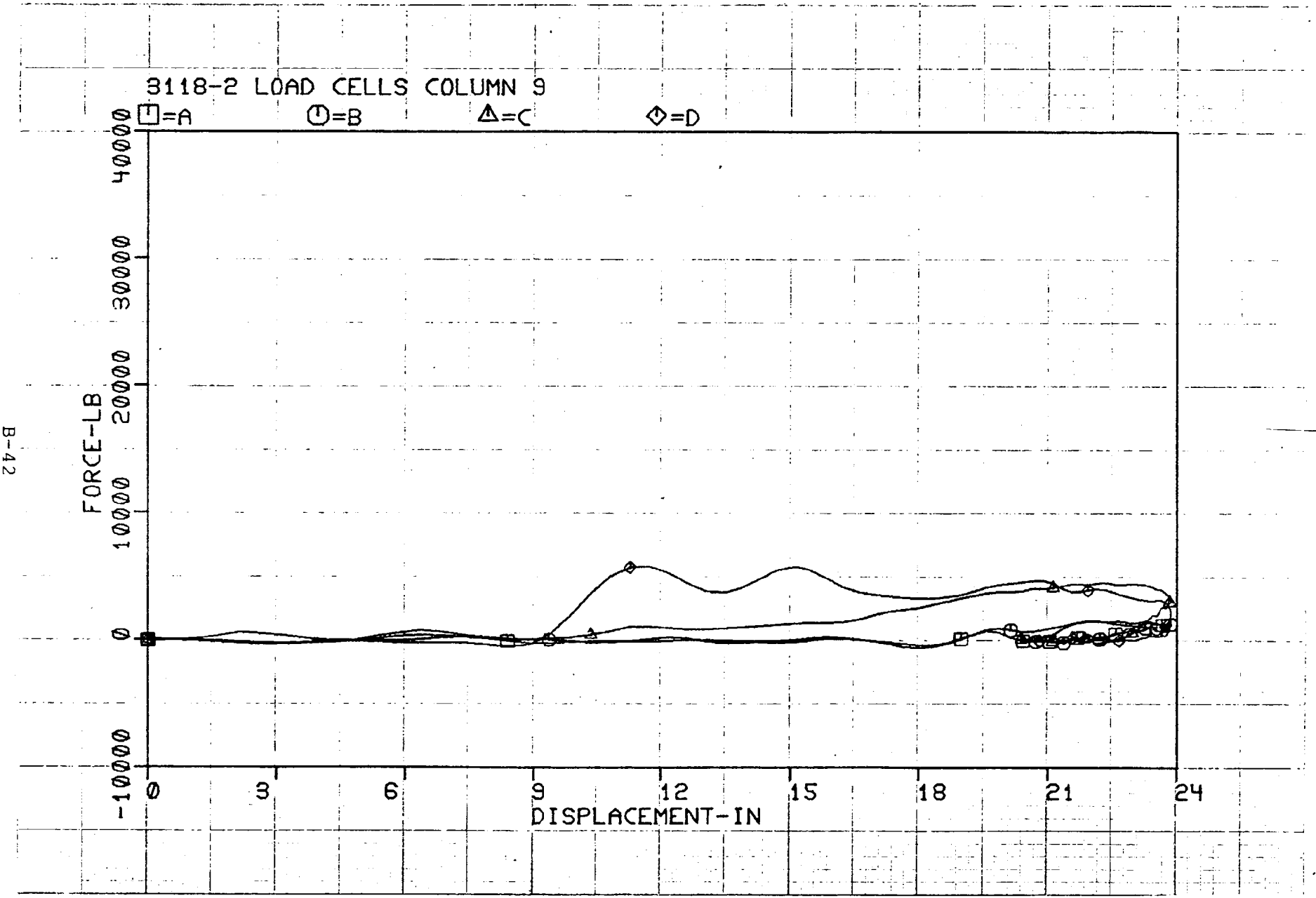
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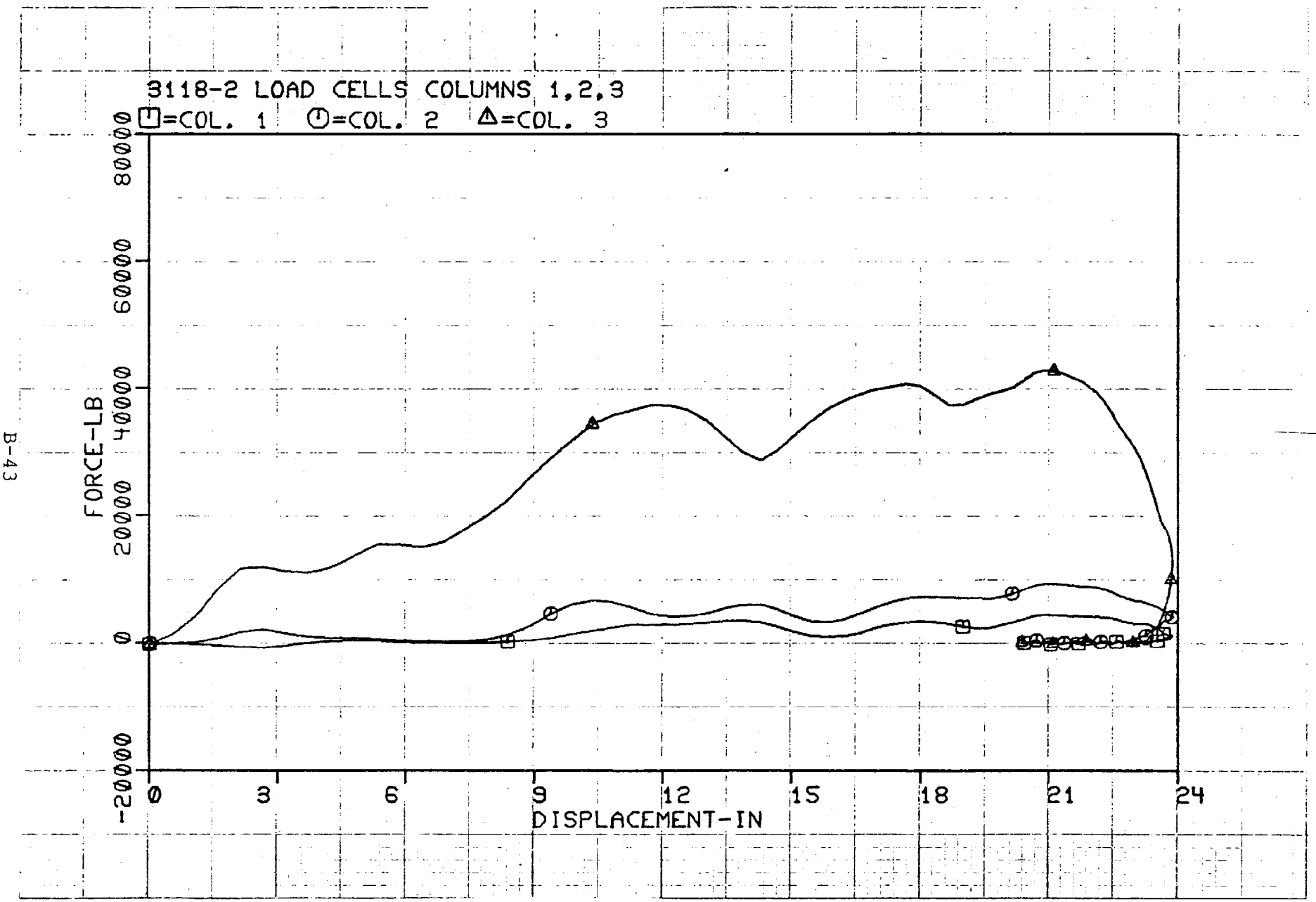
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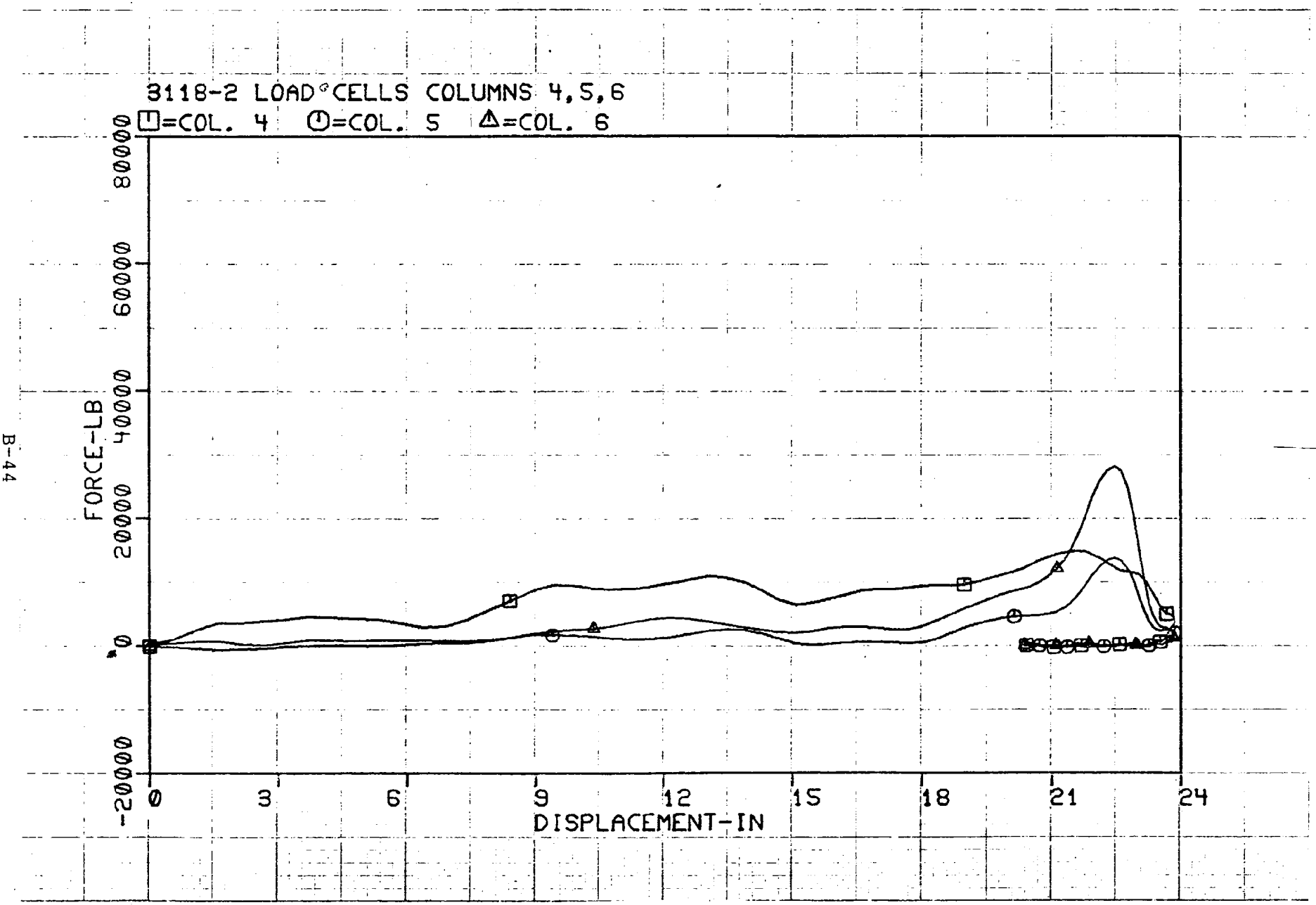
DISPLACEMENT-IN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FORCE-LB
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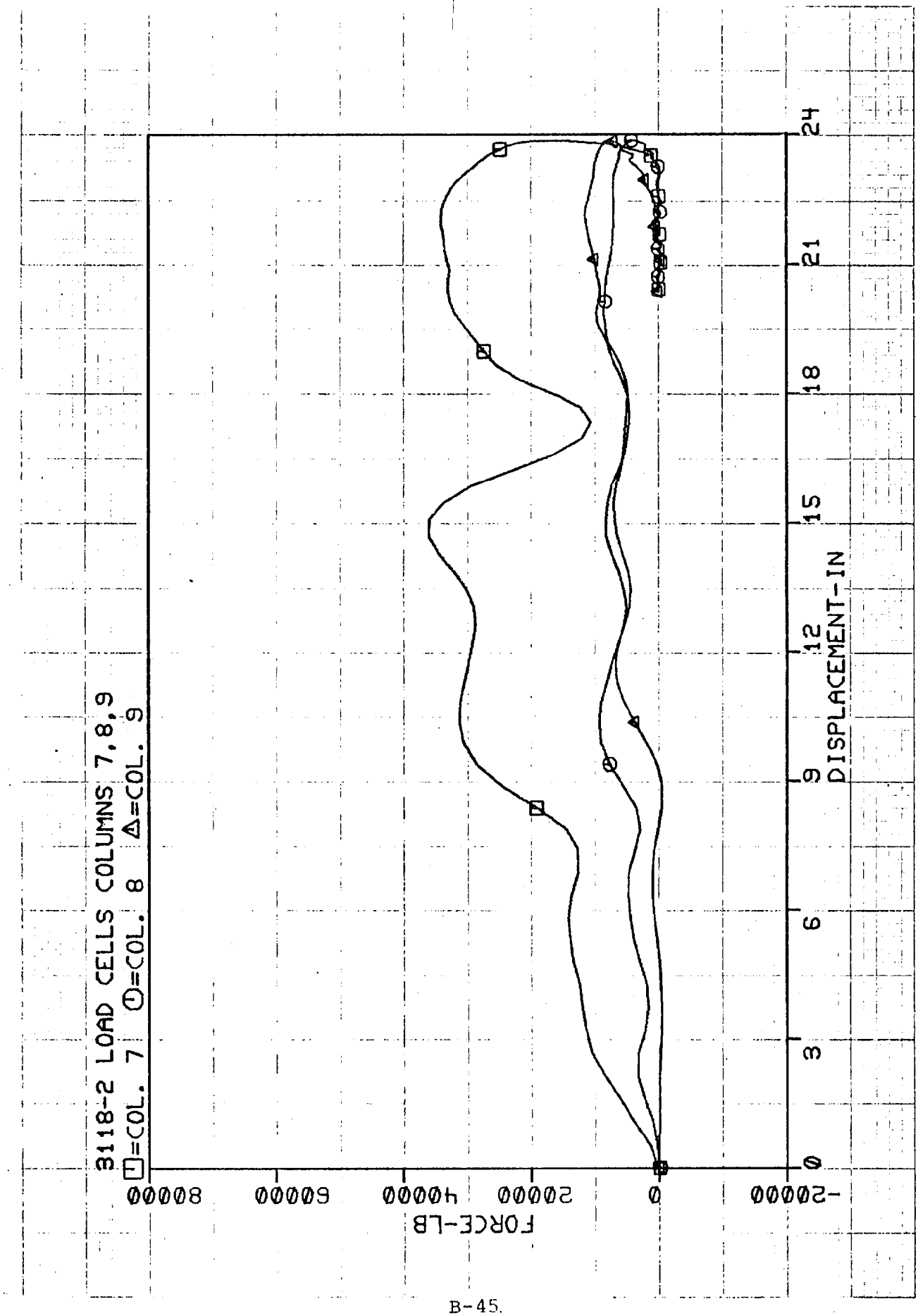
DISPLACEMENT-IN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FORCE-LB
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DISPLACEMENT-IN
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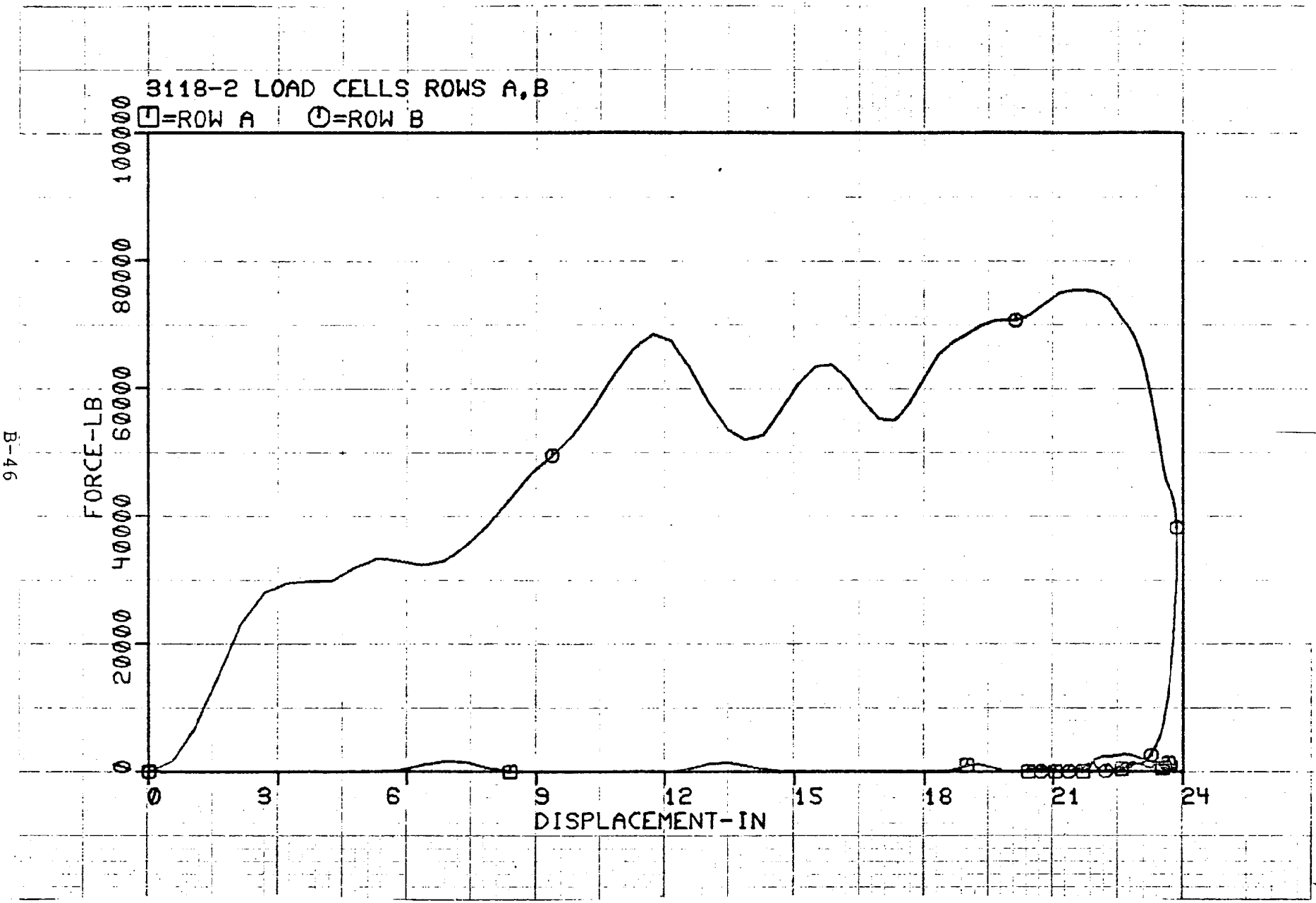
3118-2 LOAD CELLS ROWS A,B
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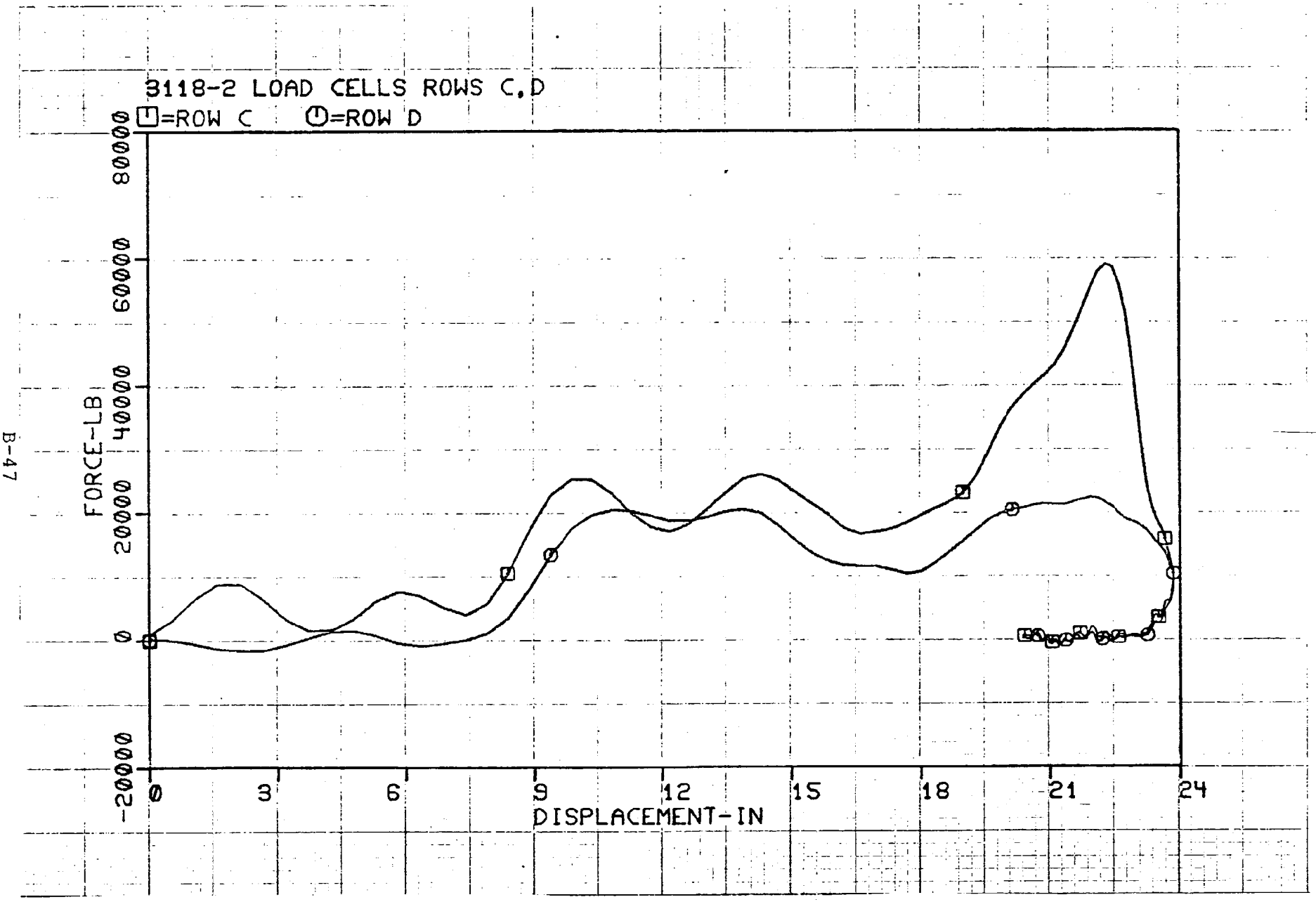
DISPLACEMENT-IN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○=ROW D
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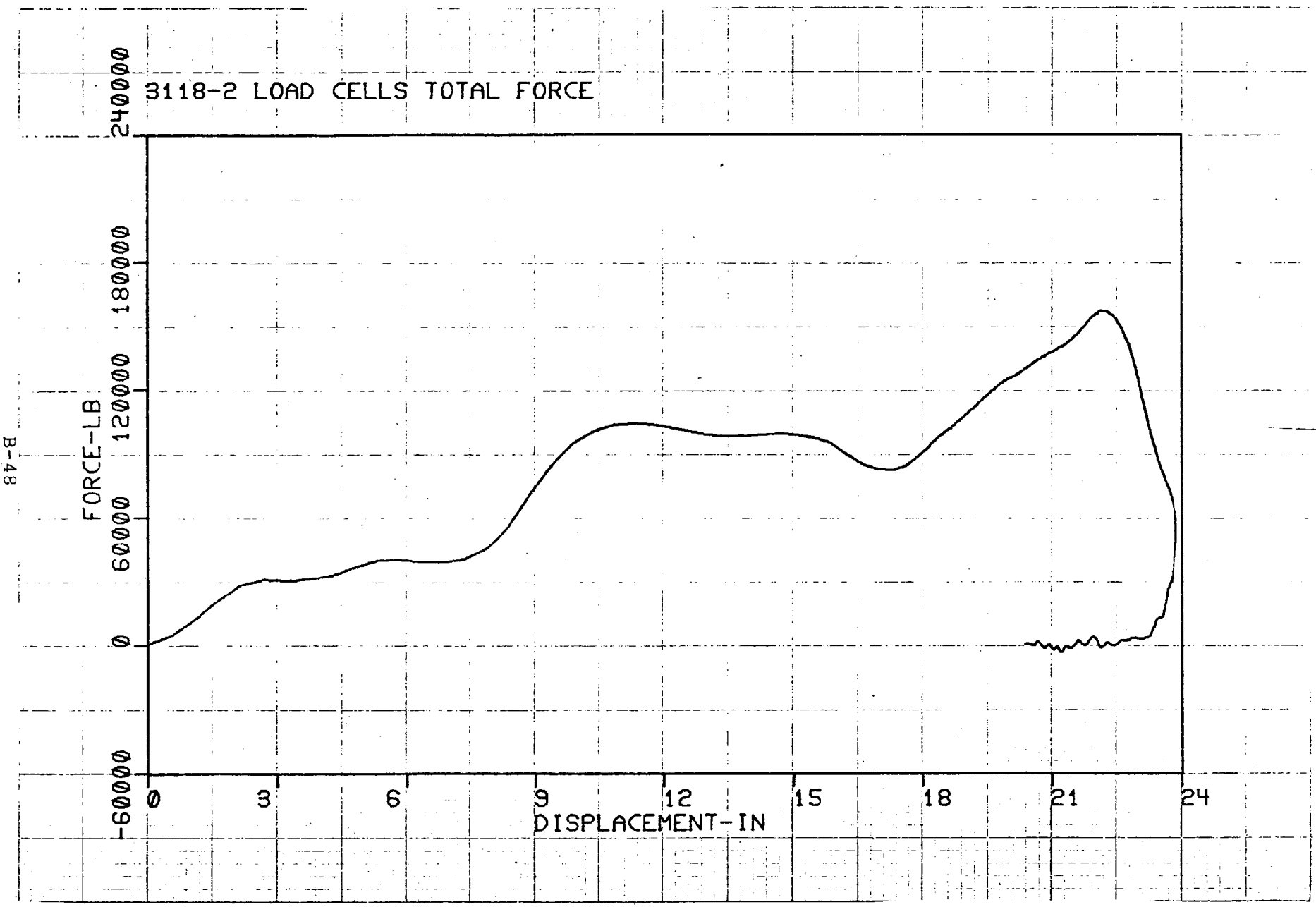
DISPLACEMENT-IN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FORCE-LB
0
3
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21
24
DISPLACEMENT-IN