DOT HS-803 594

VEHICLE INTEGRATION AND EVALUATION OF ADVANCED RESTRAINT SYSTEMS Volume III: Phase C

R.W. Carr
O.M. Aboud

Dynamic Science Inc.
A Subsidiary of Talley Industries
1860 West Pinnacle Peak Road
Phoenix, Arizona 85027

Contract No. DOT HS-6-01307
Contract Amt.$427,150

DECEMBER 1977
FINAL REPORT

Prepared For
U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Washington, D.C. 20590

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT-HS-803 594		

4. Title and Subtitle	5. Report Date
The Evaluation of 1975 Torino Type 2 Belt Restraint Systems with Web Locking and Force Limiting Features	December 1977
	6. Performing Orgn Code

7. Author(s)	8. Performing Orgn Rpt No.
R. W. Carr, G. M. Aboud	8300-77-184

9. Performing Organization Name and Address	10. Work Unit No.
Dynamic Science Inc. A Subisdiary of Talley Industries 1850 West Pinnacle Peak Road Phoenix, Arizona 85027	11. Contract or Grant No. DOT-HS-6-01307

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
DOT - National Highway Traffic Safety Administration Washington, D.C. 20590	Test Report Sept. 1976-Sept. 77
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The objective of this program was to evaluate the performance of restraint systems in terms of meeting the FMVSS 208 injury criteria. In this phase of the tests, Ford Torinos were tested using instrumented dummies restrained by both standard and modified belt systems. This report presents the results of these tests.

17. Key Words	18. Distribution Statement
Belt Restraints Crash Tests Occupant Protection	Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. Pages	22. Price
Unclassified	Unclassified	215	

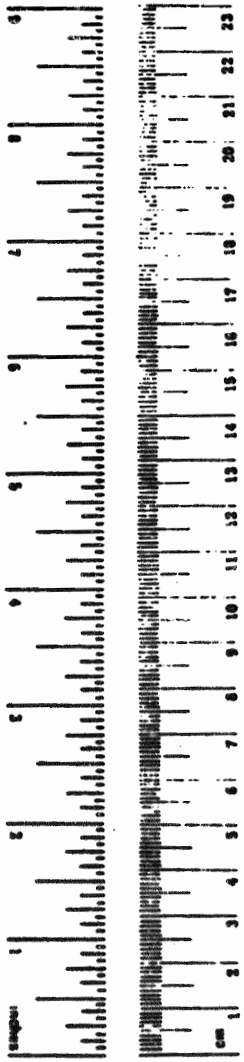
Form DOT F 1700.7 (8-69)

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	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	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	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286



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	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
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	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

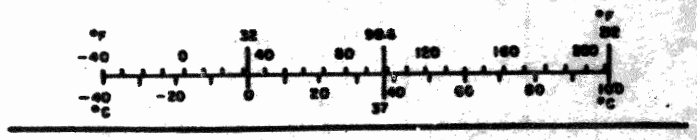


TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (CONTD)

LIST OF ILLUSTRATIONS (CONTD)

LIST OF ILLUSTRATIONS (CONTD)

LIST OF TABLES

LIST OF TABLES (CONTD)

1.0 INTRODUCTION

A series of 18 full-scale car crash tests were conducted primarily to evaluate the performance of four advanced restraint systems that were structurally integrated into the Volvo 244. These tests were split into two phases; Phase A consisted of car-to-car and car-to-barrier impact tests using only the Volvo 244's with the advanced restraints installed while the Phase B impact test configurations were car-to-car using Volvo 244's with Ford Torinos serving as bullet vehicles. As an additional effort, the Ford Torinos were tested with instrumented dummies restrained by standard and slightly modified three-point belt systems. This report presents the data from the Torino tests which were entitled Phase C of the test series.

Three variations of the standard Ford Torino belt systems were tested and the designation applied to each restraint system was:

- Standard 3-point belt system
- Standard 3-point belt system with web lockers
- Standard 3-point belt system with web lockers and force limiters
- Standard 3-point belt system with web lockers and tear webbing.

The standard restraint systems, the web locking mechanisms, and tear webbing were supplied by Allied Chemical, the OEM for the restraint systems in the Ford Torinos used for these tests. Also, each standard 3-point belt system was furnished with polyester webbing instead of the nylon webbing originally supplied.

With the exception of a mounting bracket on the B-pillar for the web locking mechanism, the Ford Torinos were not modified in any manner.

2.0 SUMMARY

The matrix of impact conditions covered by this test report is shown in Table 2-1 and a summary of test results is presented in Table 2-2. The complete data from each test are presented individually in the following section.

TABLE 2-1. TEST MATRIX - PHASE C

Test No.	Configuration	Impact Conditions		Restraint Configuration[1]			
				Vehicle A Occupants		Vehicle B Occupants	
		Speed (mph)	Angle (deg)	Left Front	Right Front	Left Front	Right Front
8	Torino-to-Volvo Head-on	77.0[2]	0	STD	STD	DS	PS
9	Torino-to-Volvo Head-on	78.6[2]	0	SWL	SWL	AB	FLB
10	Torino-to-Volvo Right Oblique	60.5[3]	30	STD	STD	DS	PS
11	Torino-to-Volvo Left Oblique	59.5[3]	30[4]	SWL	SWL	AB	FLB
12	Torino-to-Volvo Right Oblique	63.3[3]	30[4]	SWL	SWL	DS	PS
13	Torino-to-Volvo Left Oblique	65.8[3]	30[4]	STD	STD	DS	PS
14	Torino-to-Volvo Right Oblique	66.6[3]	30[4]	SWFL	SWFL	AB	FLB
15	Torino-to-Torino Head-on	75.0[2]	0	SWTW	SWTW	SWFL	SWFL
16	Torino-to-Volvo Left Oblique	60.3[3]	45	None	None	DS	PS

(1) DS = RSV Driver System, PS = RSV Passenger Airbag System, AB = Force Limited Airbelt, FLB = Force Limited 2-Inch Belt, STD = Standard 3-Point Belt System, SWL = Standard 3-Point Belt System with Web Lockers, SWFL = Standard 3-Point Belt System with Web Lockers and Force Limiters, and SWTW = Standard 3-Point Belt System with Web Lockers and Tear Webbing.
(2) Closing speed; both cars moving at the same speed.
(3) Torino's speed; Volvo stationary.
(4) Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 2-2. DATA SUMMARY - PHASE C

Test No.	Position	Restraint System(1)	Head		Chest		Velocity Change (mph)
			Peak G (G)(2)	HIC	Peak G (G)(2)	CSI	
8	Left Front	STD	111.8	1496	57.1	608	32.8
	Right Front	STD	111.6	1285	38.7	350	32.8
9	Left Front	SWL	75.8	908	44.4	421	35.6
	Right Front	SWL	56.4	814	35.9	321	35.6
10	Left Front	STD	34.7	243	(3)	(3)	25.6
	Right Front	STD	28.9	138	21.5	81	25.6
11	Left Front	SWL	25.2	142	22.8	104	26.7
	Right Front	SWL	32.2	258	22.2	110	26.7
12	Left Front	SWL	47.9	354	29.5	180	29.5
	Right Front	SWL	55.5	488	29.0	198	29.5

(1) STD = Standard 3-Point Belt System, SWL = Standard 3-Point Belt System with Web Lockers, SWFL = Standard 3-Point Belt System with Web Lockers and Force Limiters, and SWTW = Standard 3-Point Belt System with Web Lockers and Tear Webbing.
(2) 3 msec clip.
(3) Transducer failure.

Note: No femur loads measured.

TABLE 2-2. DATA SUMMARY - PHASE C (CONTD)

Test No.	Position	Restraint System(1)	Head		Chest		Velocity Change (mph)
			Peak G (G)(2)	HIC	Peak G (G)(2)	CSI	
13	Left Front	STD	69.3	617	63.7	883	33.4
	Right Front	STD	52.7	609	32.4	211	33.4
14	Left Front	SWFL	48.3	439	29.9	170	31.9
	Right Front	SWFL	54.3	654	39.4	234	31.9
15	Vehicle A						
	Left Front	SWTW	75.5	1011	55.1	520	46.1
	Right Front	SWTW	106.1	1023	55.6	504	46.1
	Vehicle B						
	Left Front	SWFL	128.3	1799	79.0	835	46.1
	Right Front	SWFL	127.0	2154	78.8	952	46.1
16	Left Front	None	54.9	172	37.0	153	25.9
	Right Front	None	76.2	400	34.6	127	25.9

3.0 TEST DATA

3.1 TEST NUMBER 8

The impact conditions for Test 8 were:

Configuration	Closing Speed
Torino-to-Volvo Head-on	77.0 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt	RSV Driver Airbag
Right Front	Standard 3-Point Belt	RSV Passenger Airbag

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 8 are summarized in the following tables:

Table 3-1 - Summary of Vehicle Data (Test 8)

Table 3-2 - Injury Criteria Summary (Test 8)

Table 3-3 - Summary of Restraint System Data (Test 8)

Table 3-4 - Occupant Response Data (Test 8)

which are followed by Figure 3-1 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

TABLE 3-1. SUMMARY OF VEHICLE DATA (TEST 8)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 8/February 10, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		417	439
TEST WEIGHT (lb)		4632	3263
IMPACT VELOCITY (mph)		38.46	38.46
VELOCITY CHANGE (mph)		32.8 (1)	46.5 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	42.9 @ 70	50.6 @ 61
	LOCATION 2	49.3 @ 59	62.2 @ 60
MAXIMUM STATIC CRUSH (in.)			
	LEFT	19.0	35.0
	CENTER	33.0	37.5
	RIGHT	19.0	29.0

(1) Calculated, based on conservation of momentum and a coefficient of restitution of .03.

TABLE 3-2. INJURY CRITERIA SUMMARY (TEST 8)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT		STANDARD 3-POINT BELT	
HIC	1496		1285	
HEAD G(1) @ msec	111.8 @ 108		111.6 @ 107	
CSI	608		350	
CHEST G(1) @ msec	57.1 @ 89		38.7 @ 82	
FEMUR LOAD (lb)(2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

TABLE 3-3. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 8)

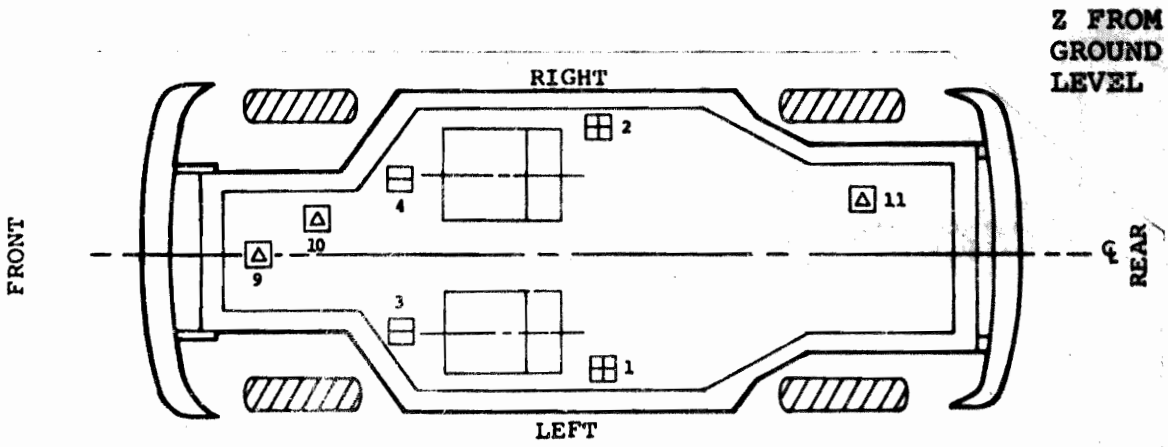
VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1890 @ 92
Peak Lap Belt Load	lb @ msec	1470 @ 79
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	2047 @ 104(1)
Peak Lap Belt Load	lb @ msec	(2)

(1) Transducer Failure > 105 msec.
(2) Transducer Failure > 88 msec.

TABLE 3-4. OCCUPANT RESPONSE DATA SUMMARY (TEST 8)

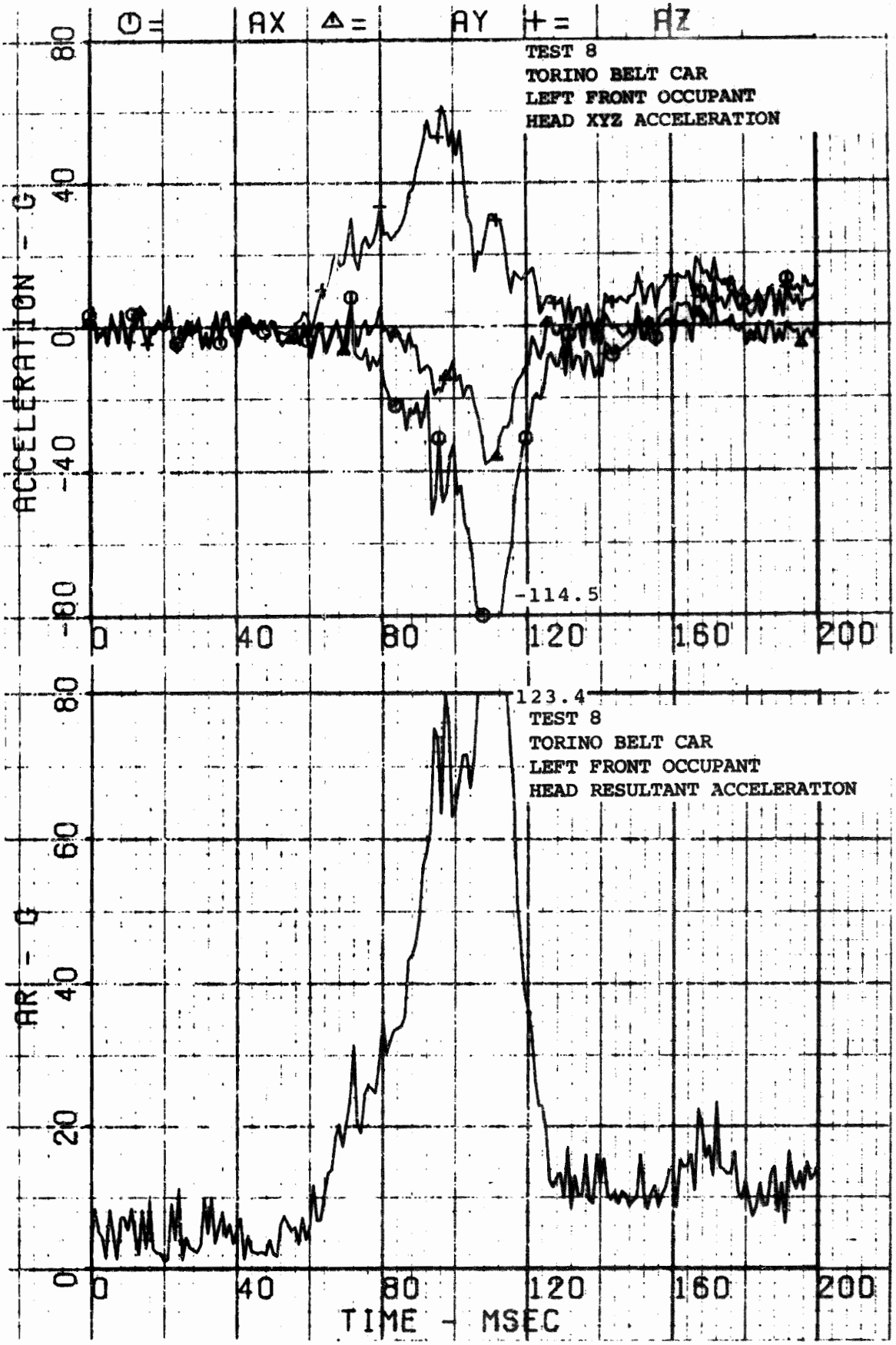
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	114.5	109	211.3	103
	Y	38.4	109	84.0	103
	Z	61.2	97	125.0	103
	R(1)	111.8	108	111.6	107
	HIC	1496 @ 89-118		1285 @ 102-109	
CHEST					
	X	61.0	87	38.4	85
	Y	12.4	92	17.7	121
	Z	23.1	107	24.8	121
	R(1)	57.1	89	38.7	82
	SI	608 @ 200		350 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (2)					
	LF	NA		NA	
	RT	NA		NA	

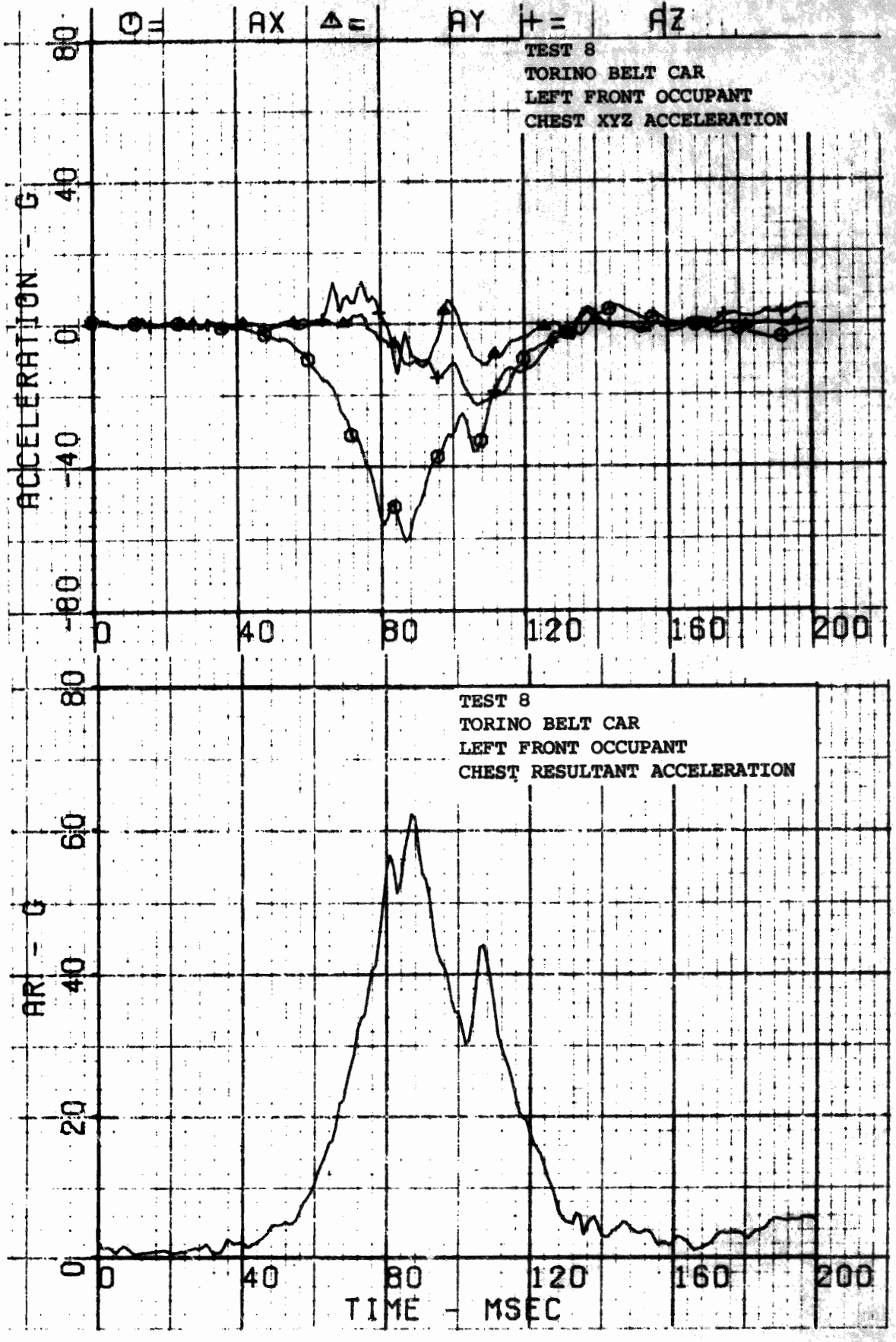
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

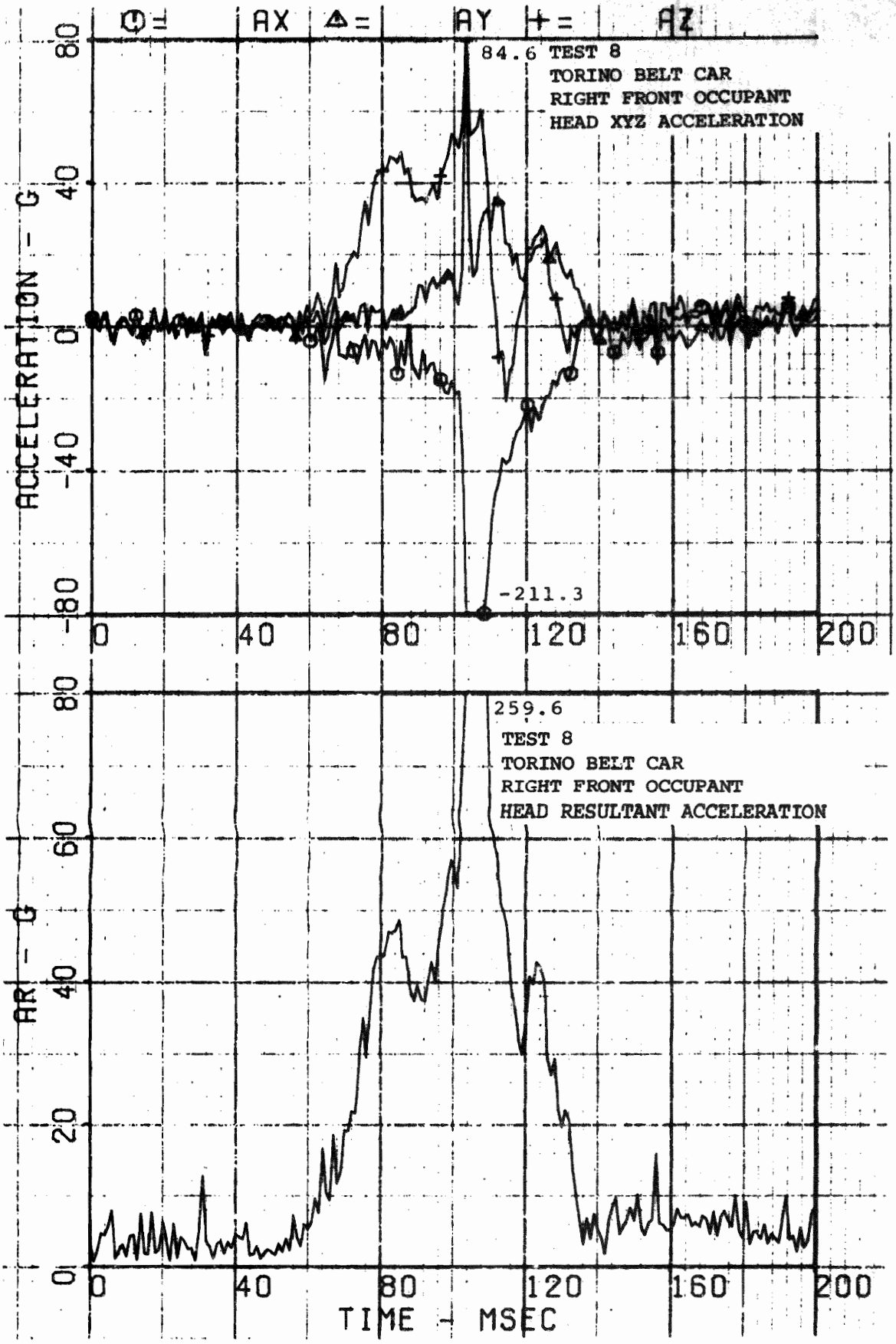


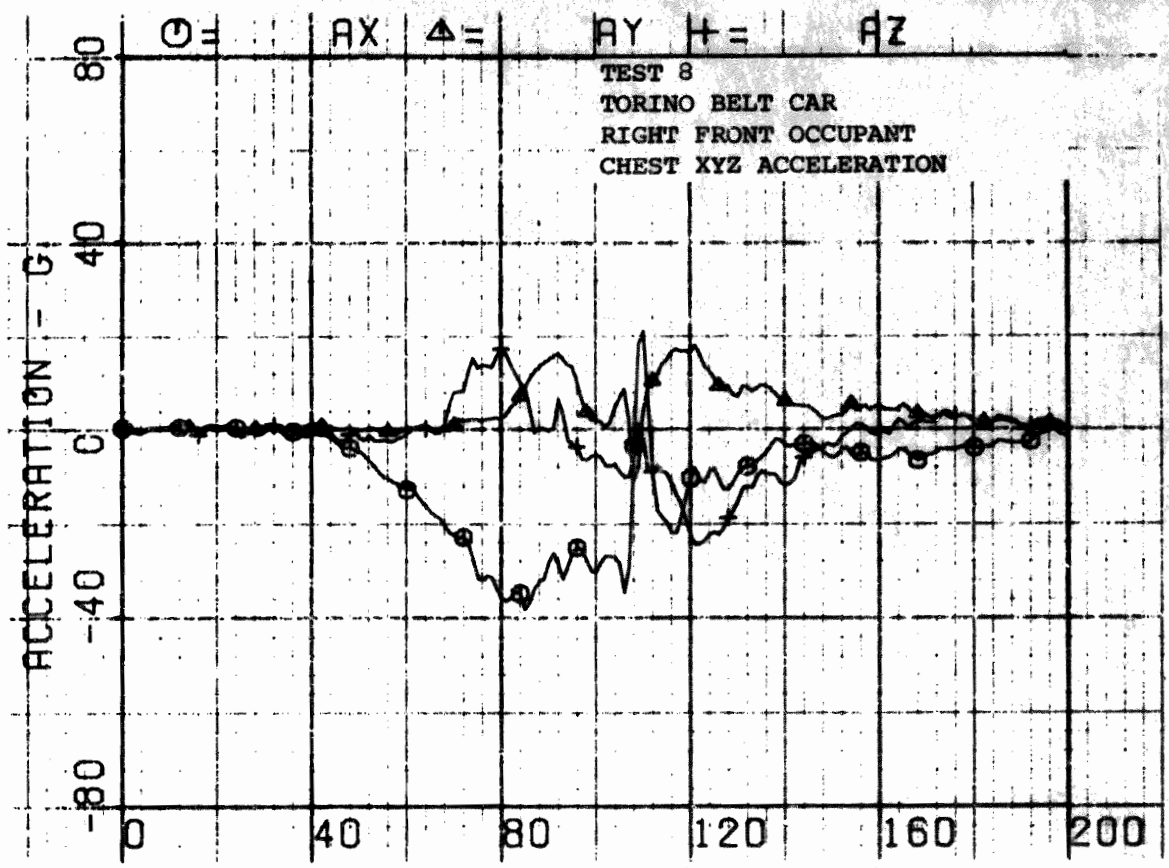
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

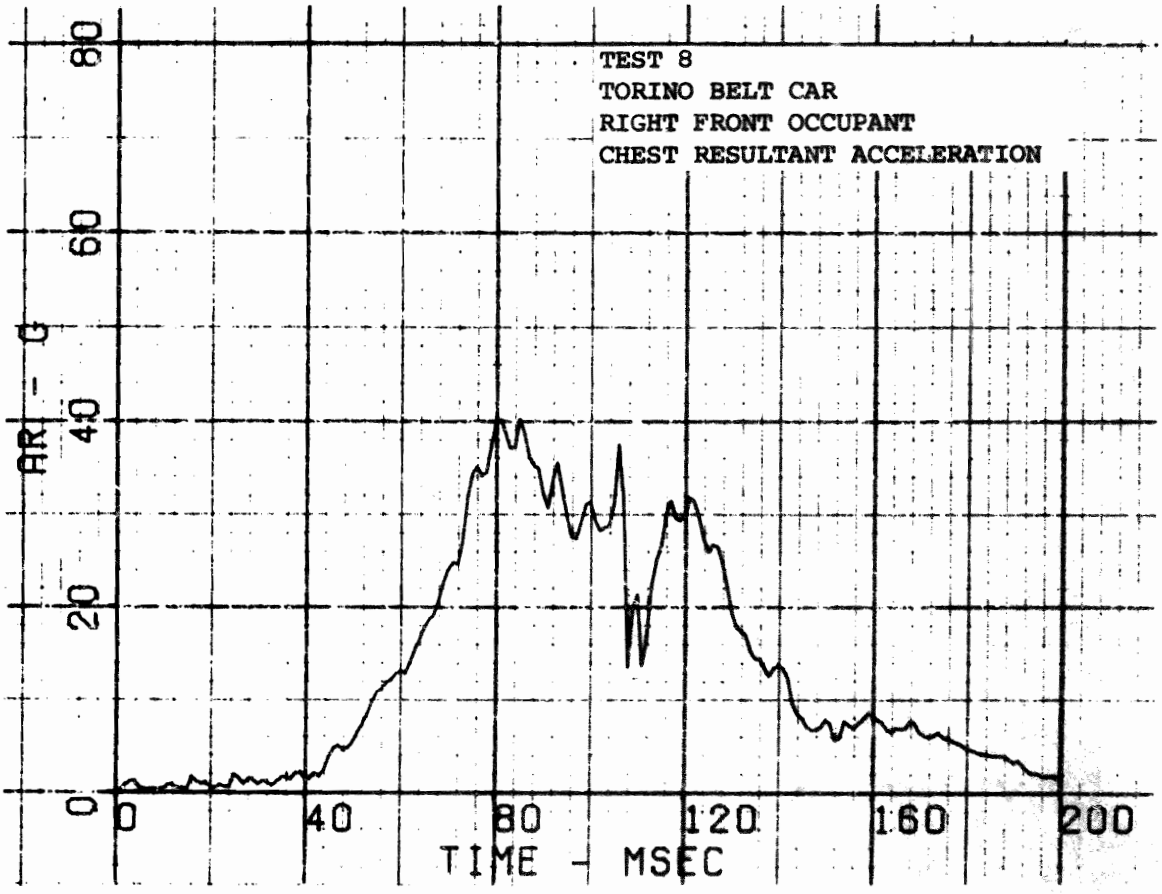
Figure 3-1. Vehicle Accelerometer Locations - Test 8.

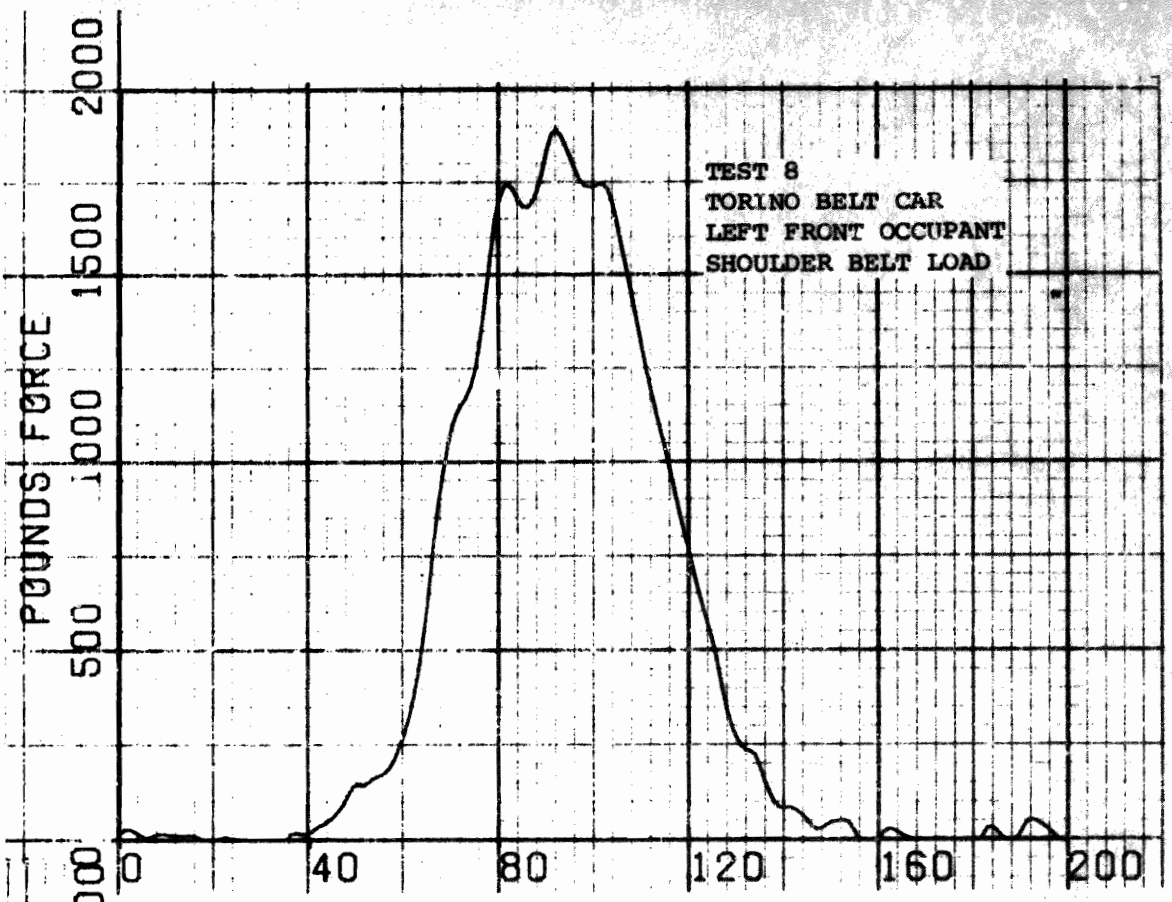

⊙= AX △= AY += AZ
TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-114.5
0
40
80
120
160
200
123.4
TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

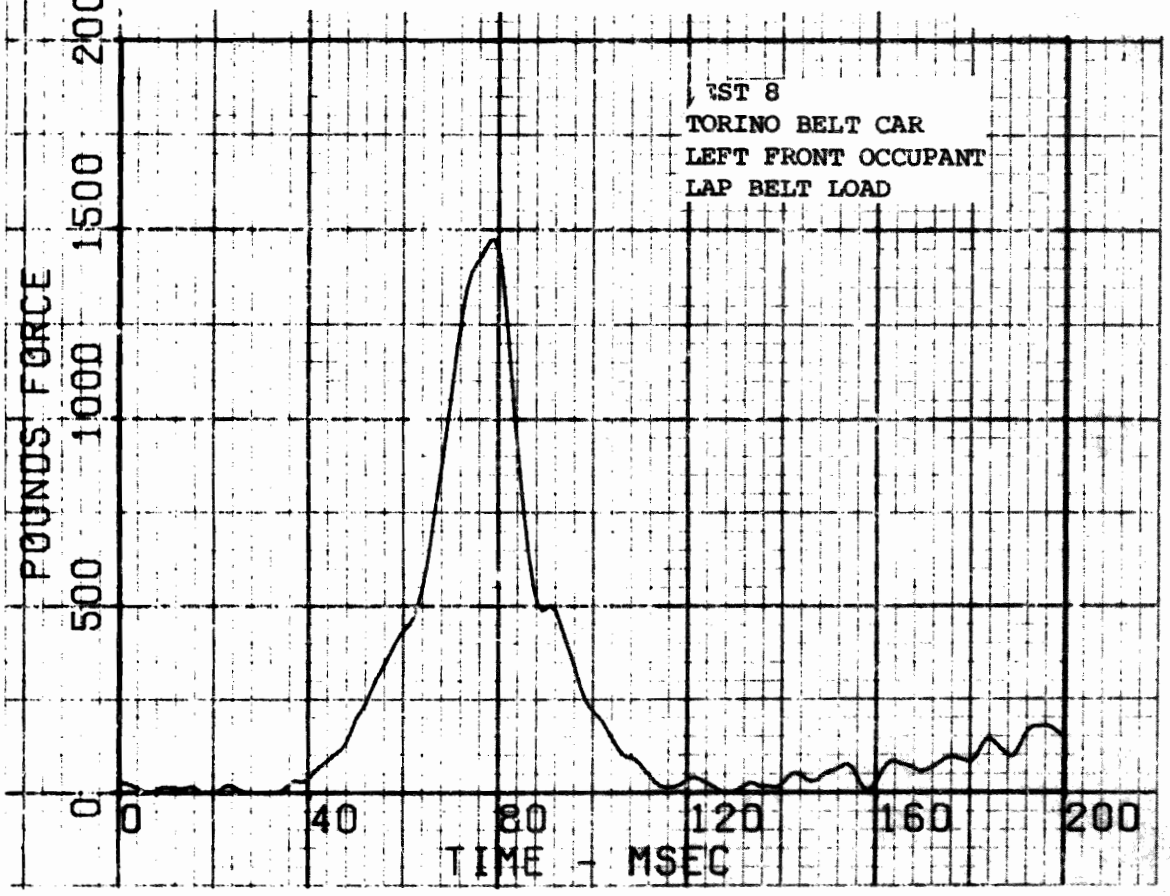

AX
AY
AZ
TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

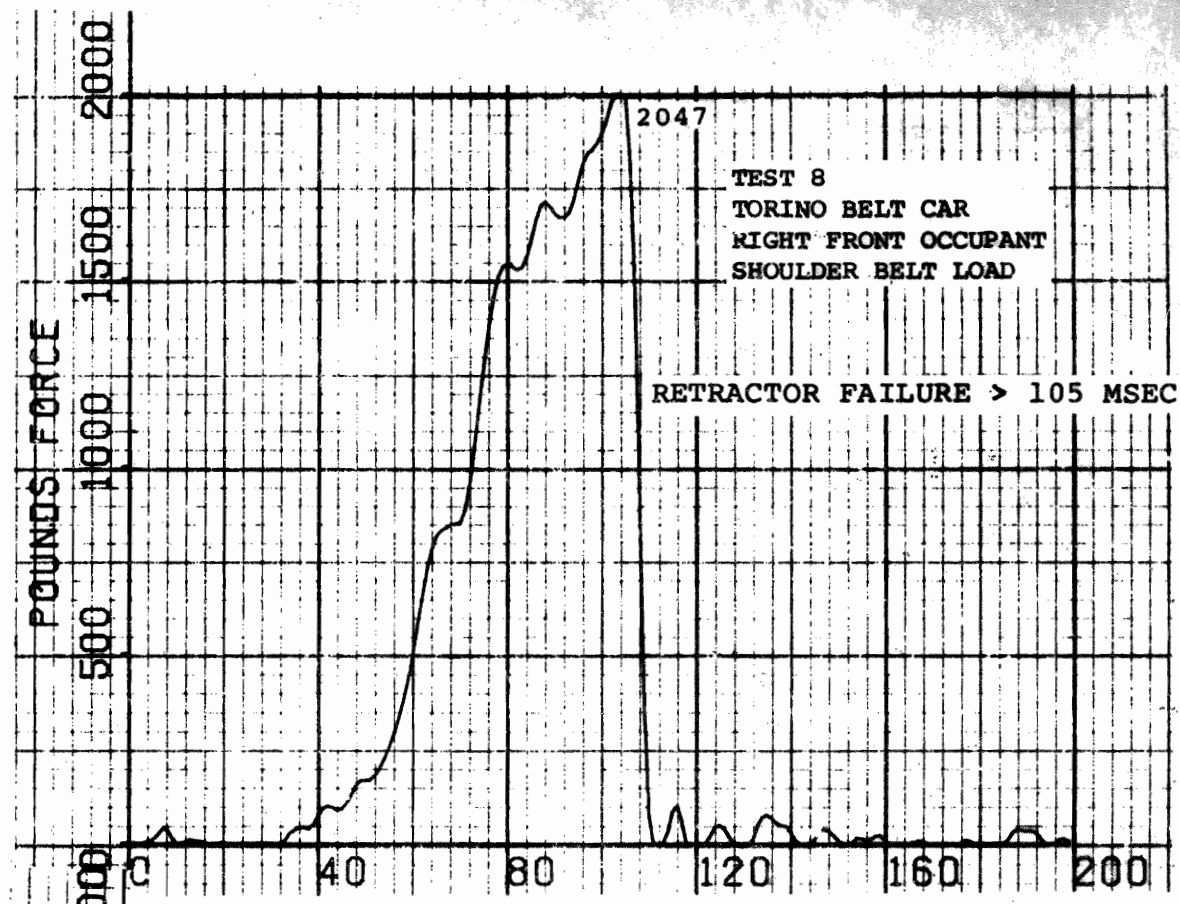

○= AX △= AY += AZ
84.6 TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-211.3
0
40
80
120
160
200
259.6
TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

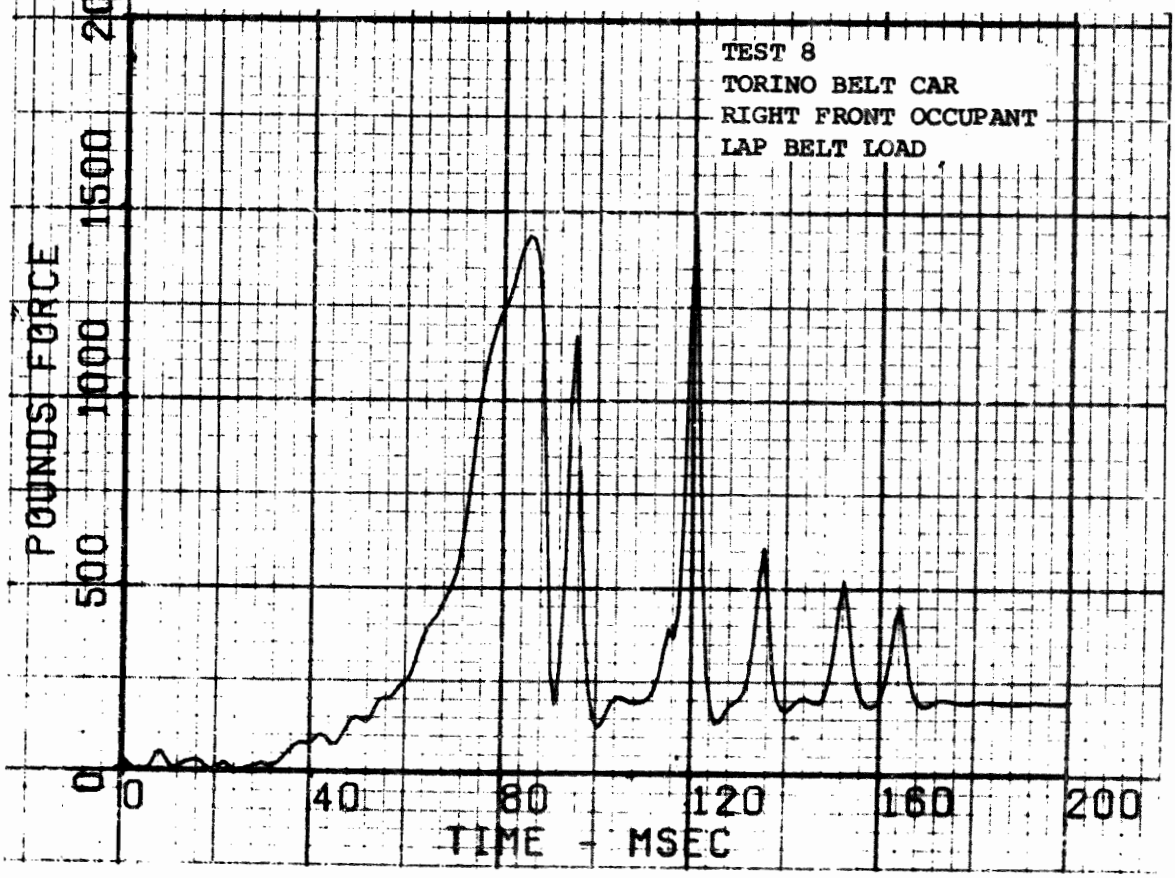

⊙= AX Δ= AY += AZ
TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

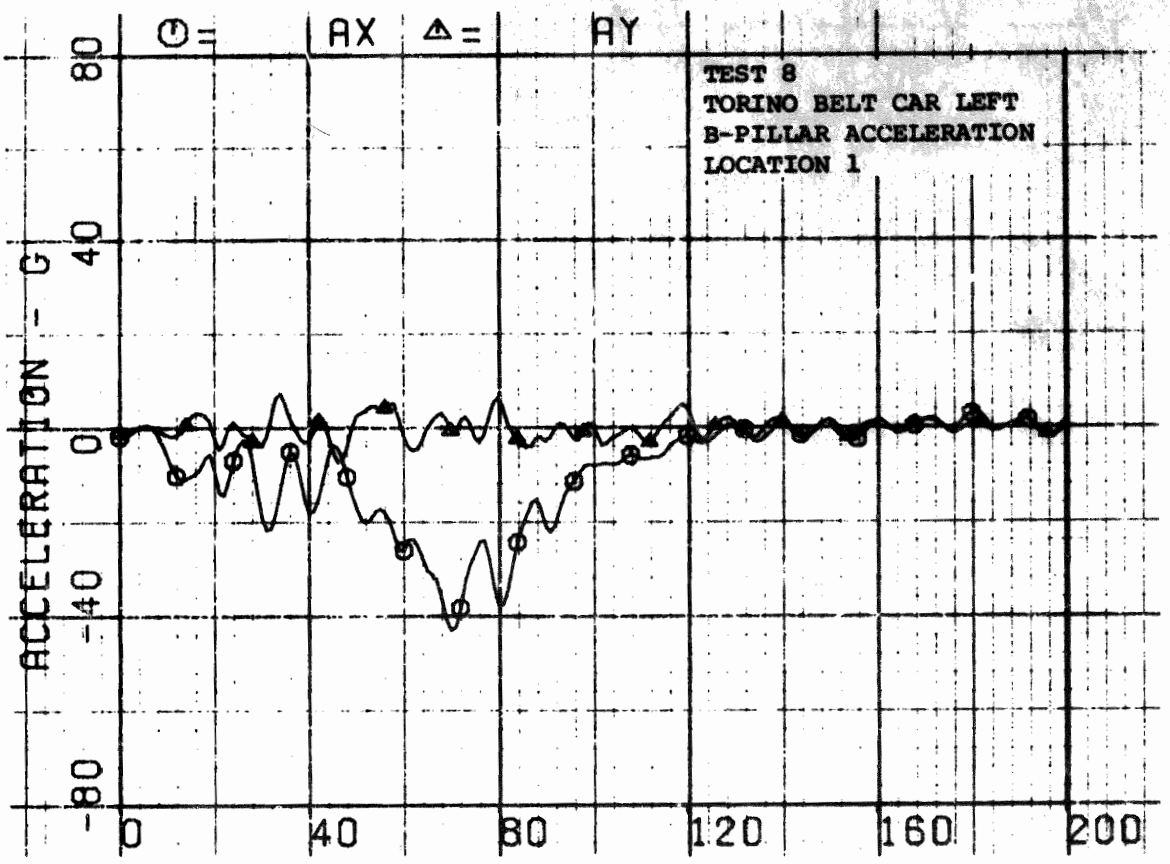

TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

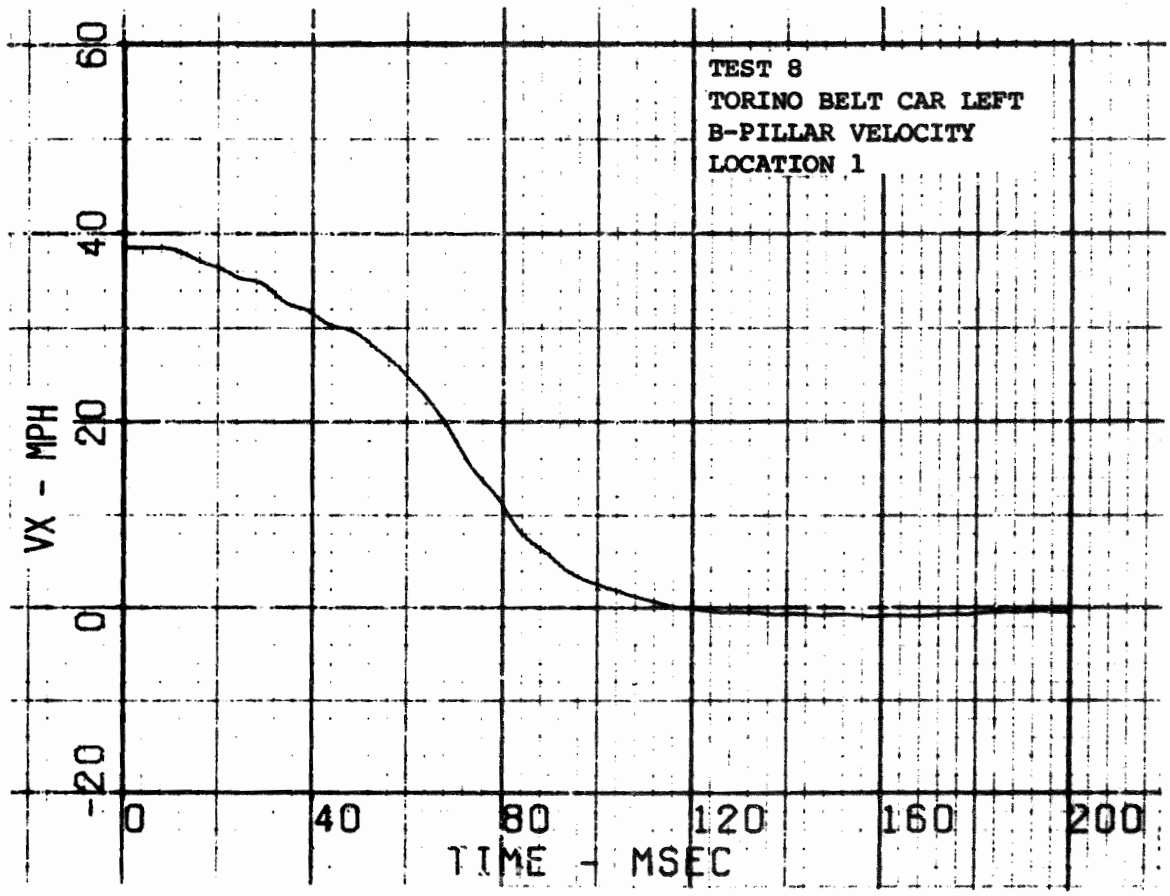

TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

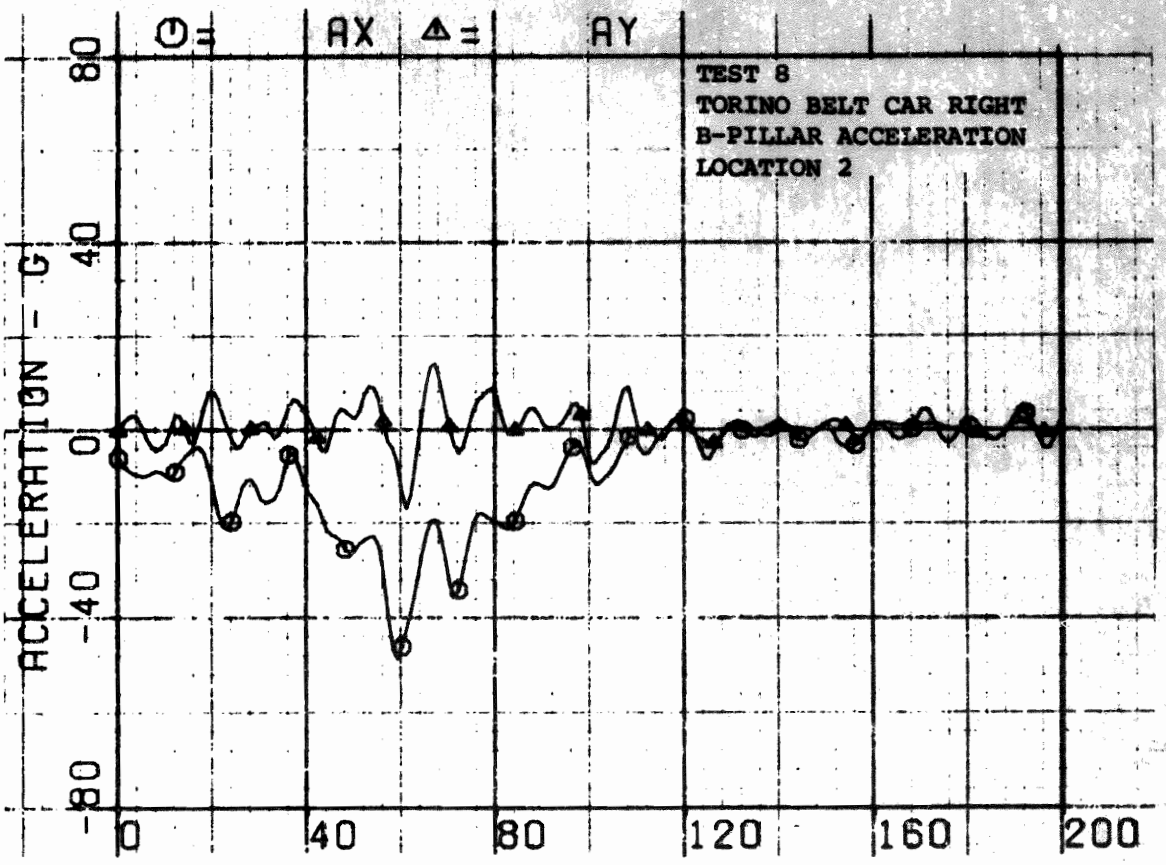

TEST 8
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

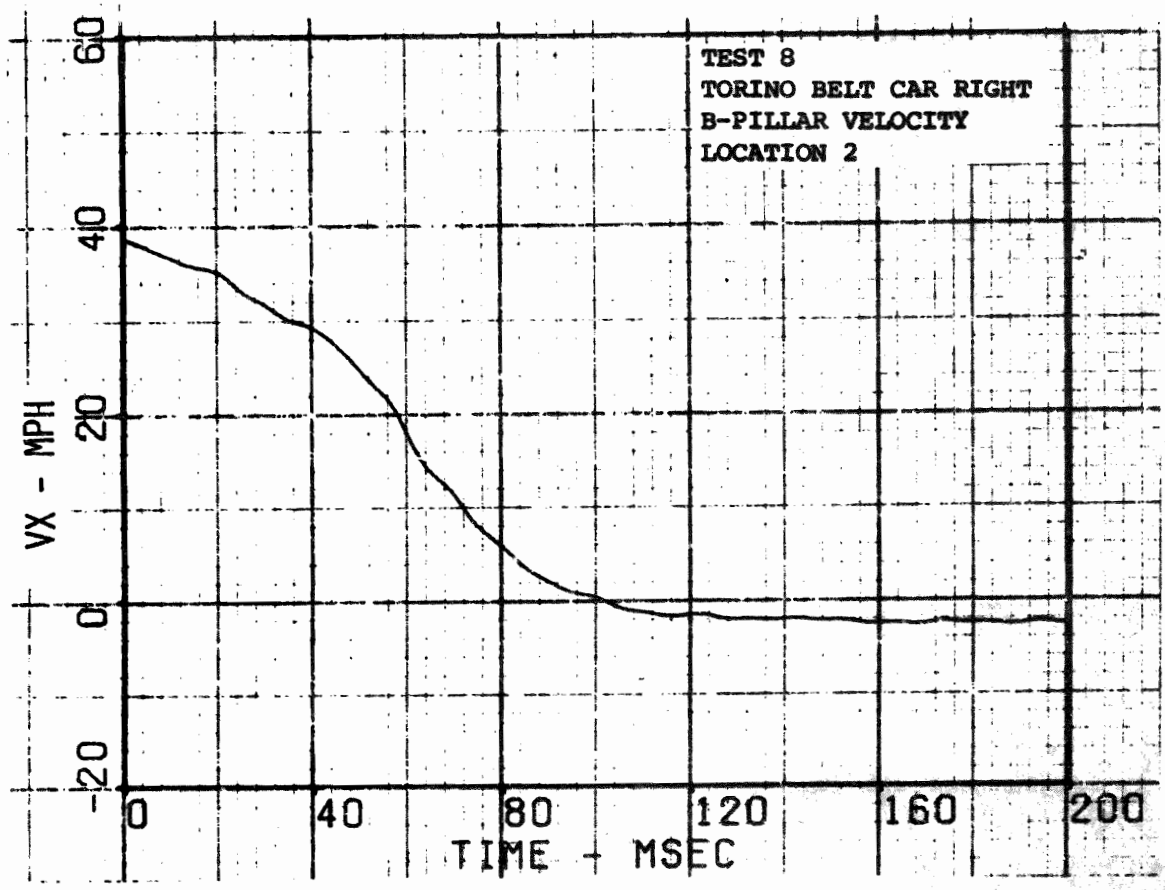

2047
TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
RETRACTOR FAILURE > 105 MSEC
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

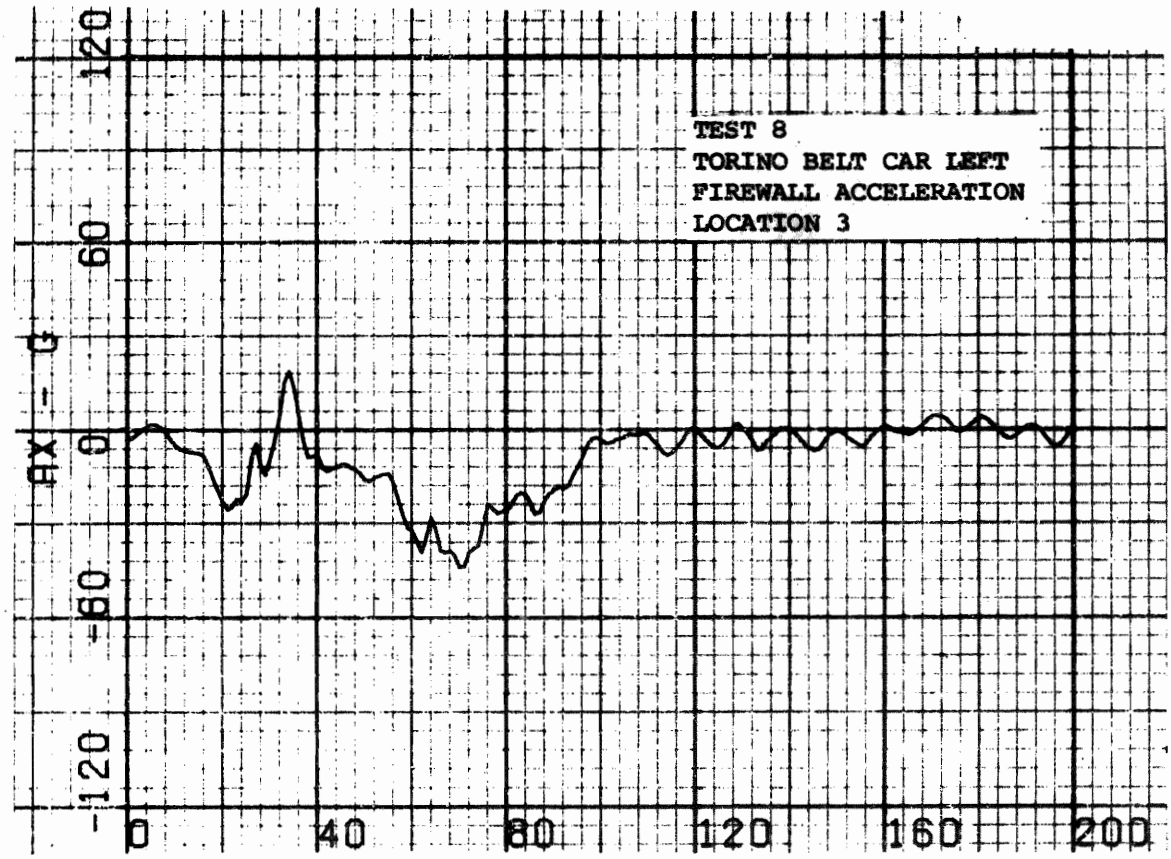

TEST 8
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

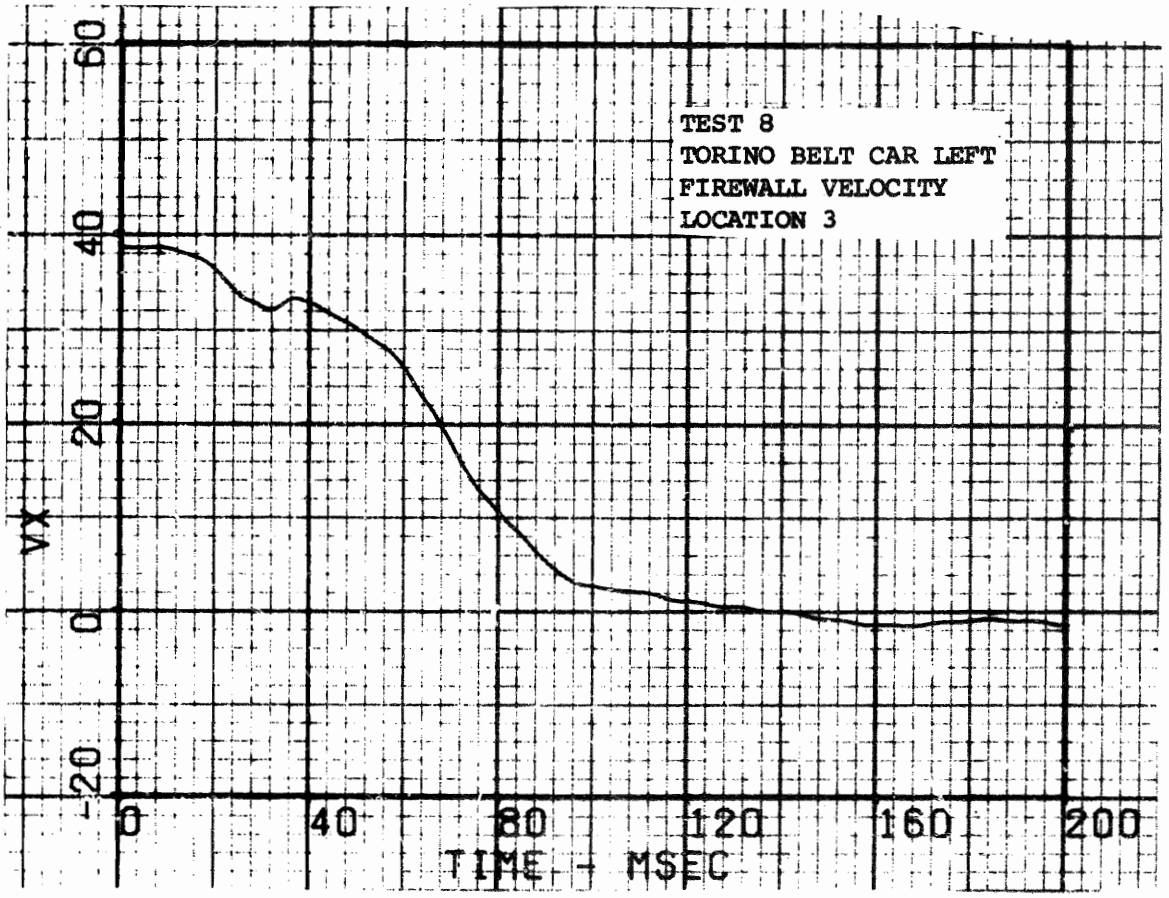

⊙= AX ⚠= AY
TEST 8
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

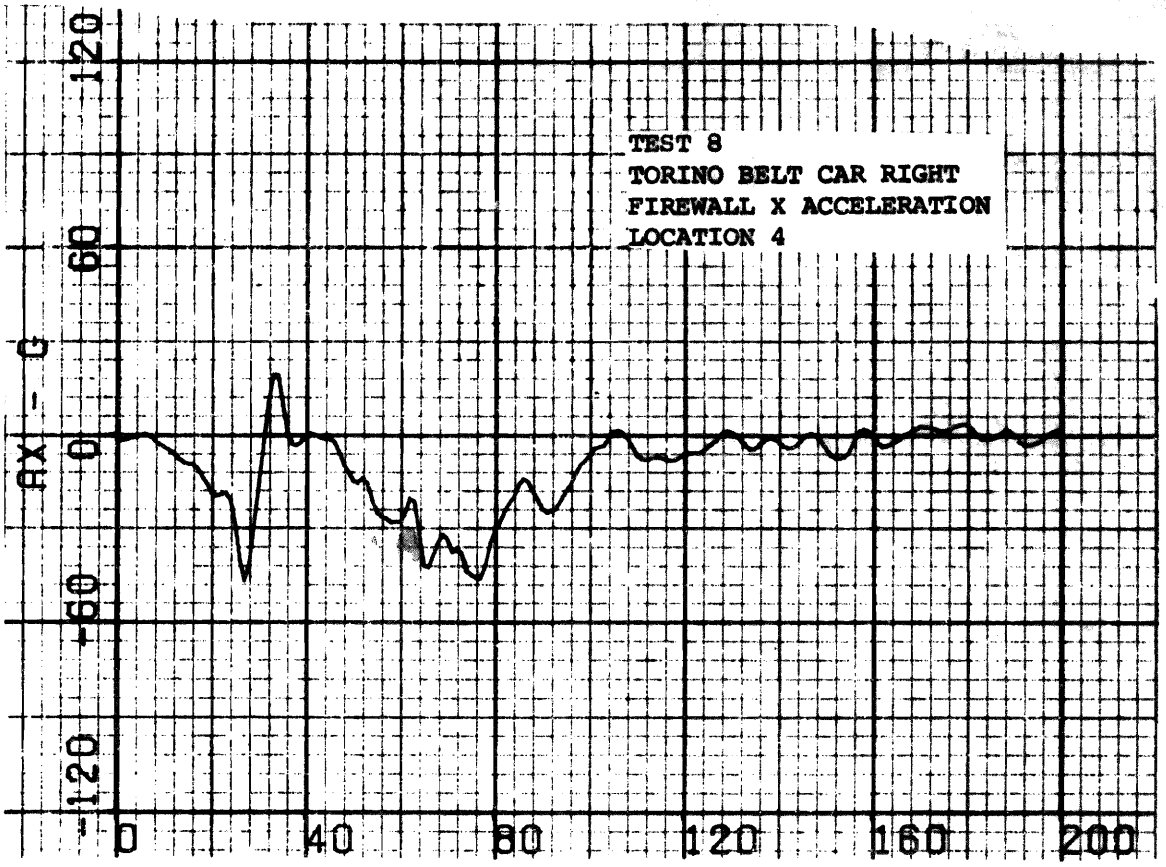

TEST 8
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VX - MPH
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC

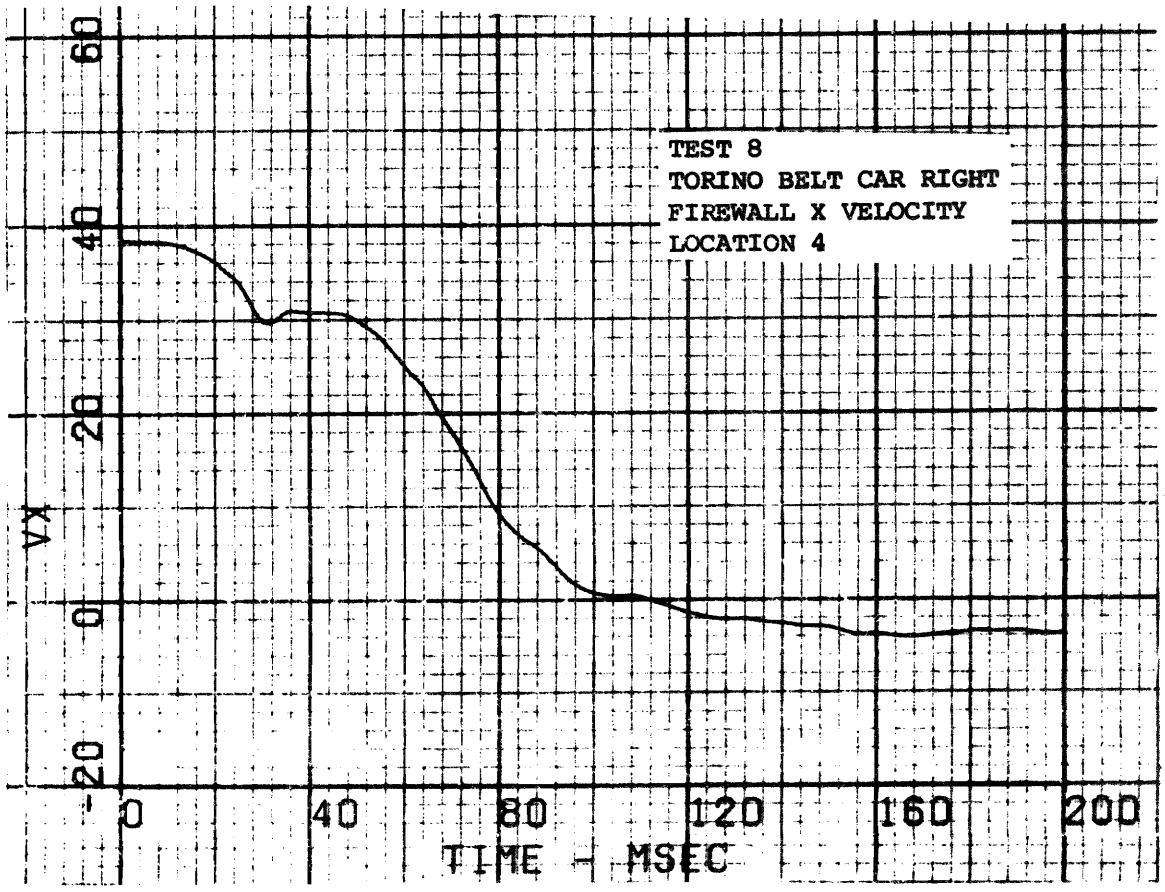

AX
AY
TEST 8
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

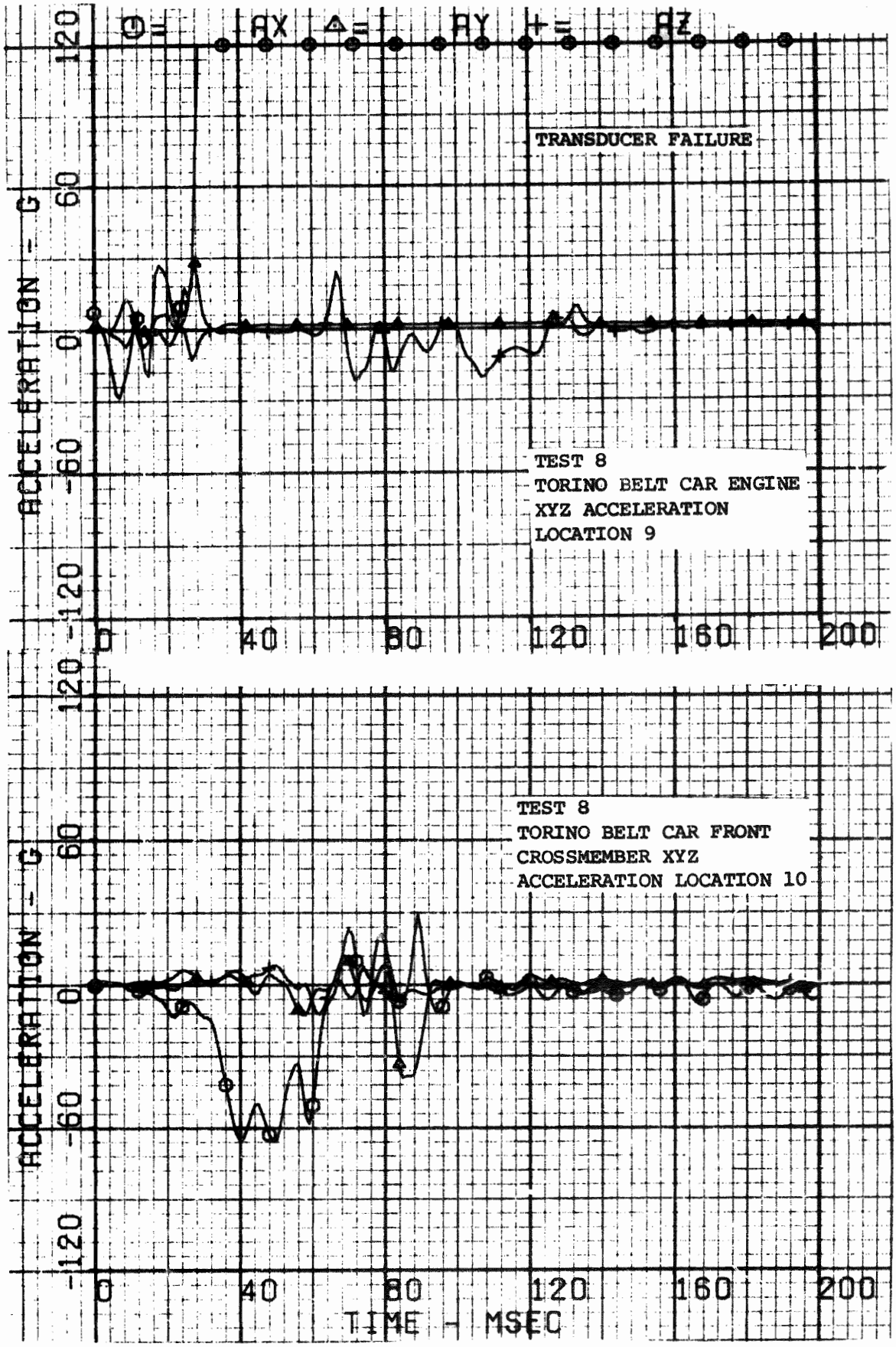

TEST 8
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VX - MPH
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 8
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 8
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 8
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 8
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


⊖ = AX
△ = AY
+ = AZ
TRANSDUCER FAILURE
TEST 8
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 8
TORINO BELT CAR FRONT
CROSSMEMBER XYZ
ACCELERATION LOCATION 10
ACCELERATION - G
TIME - MSEC

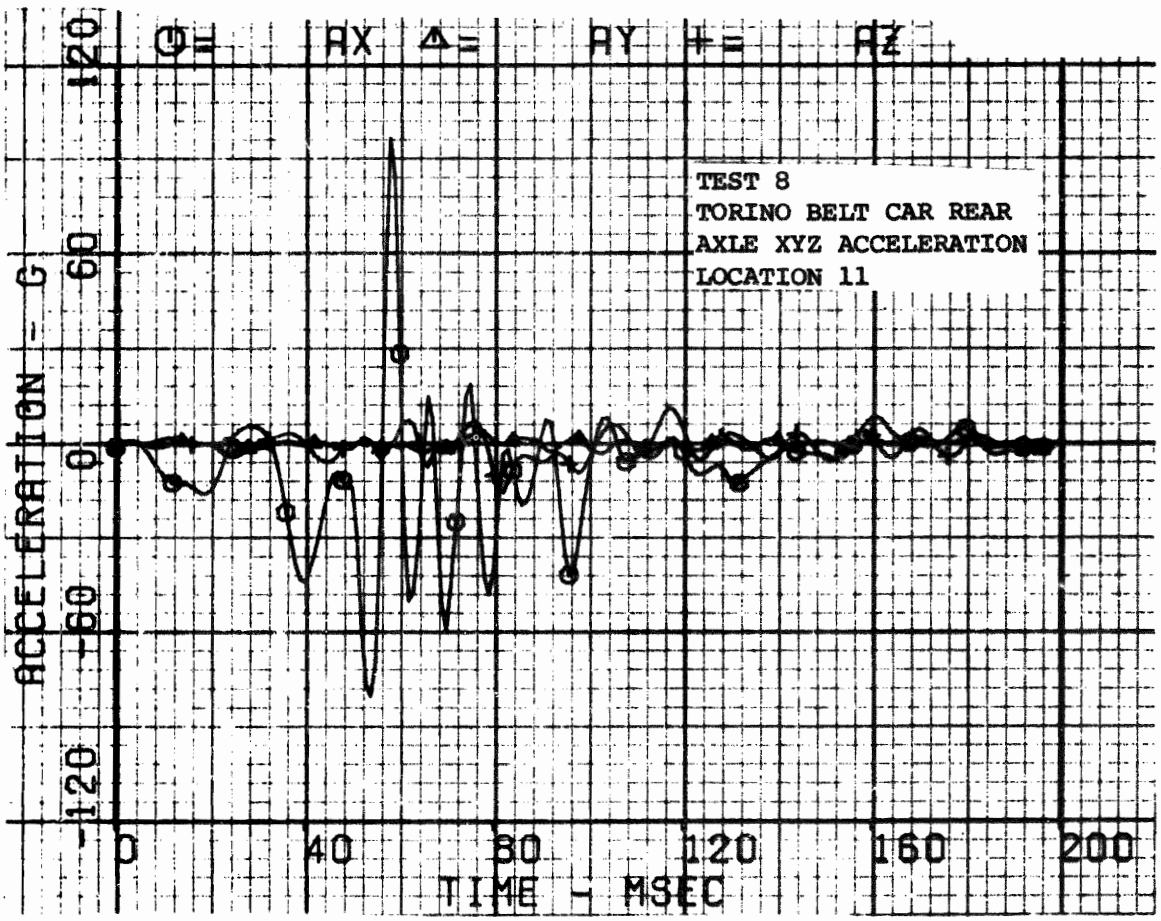

□ =
AX
Δ =
AY
+ =
AZ
TEST 8
TORINO BELT CAR REAR
AXLE XYZ ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

Figure 3-2. Pre-test Vehicle Configuration - Test 8.

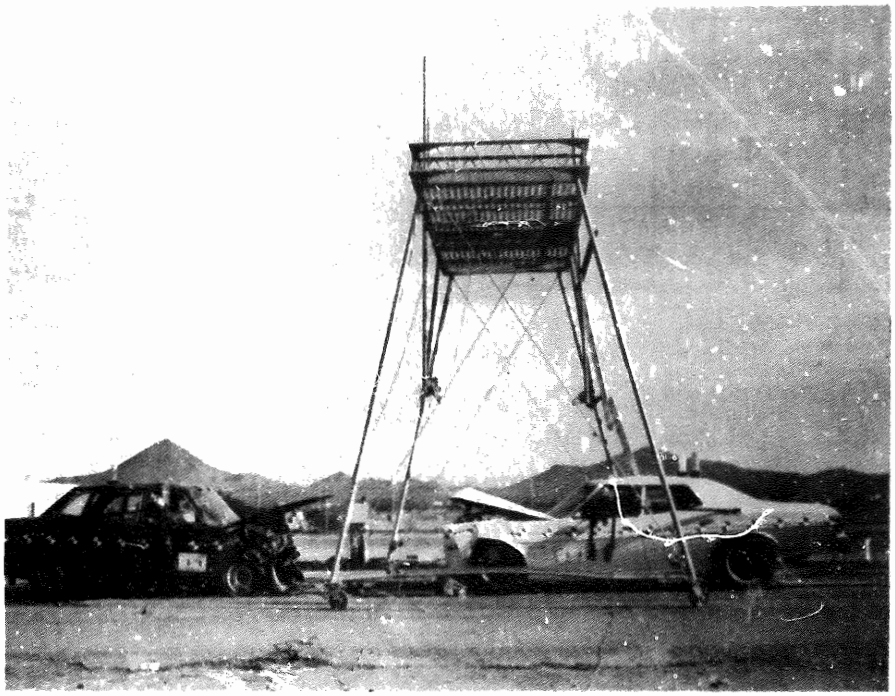


Figure 3-3. Post-test Vehicle Configuration - Test 8.

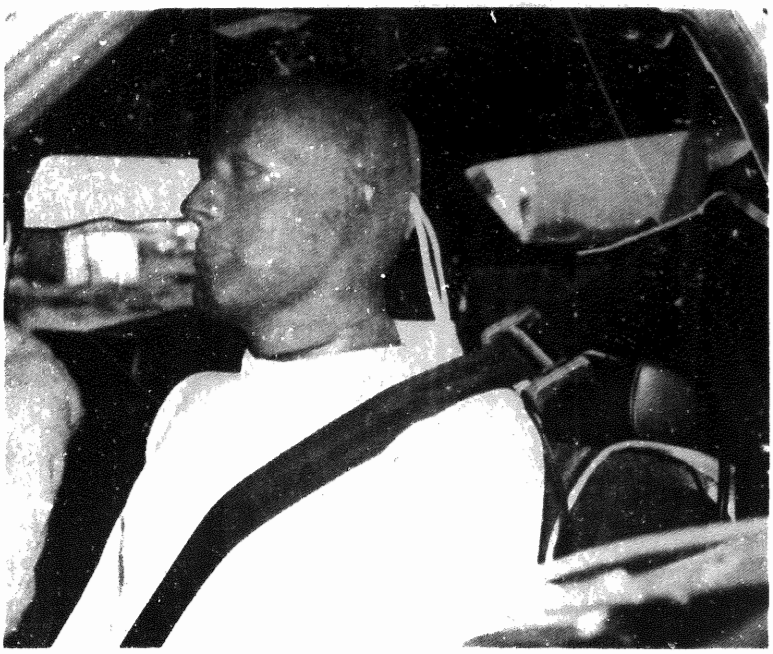


Figure 3-4. Pre-test Standard 3-Point Belt, Left Front - Test 8.

Figure 3-5. Post-test Standard 3-Point Belt, Left Front - Test 8.

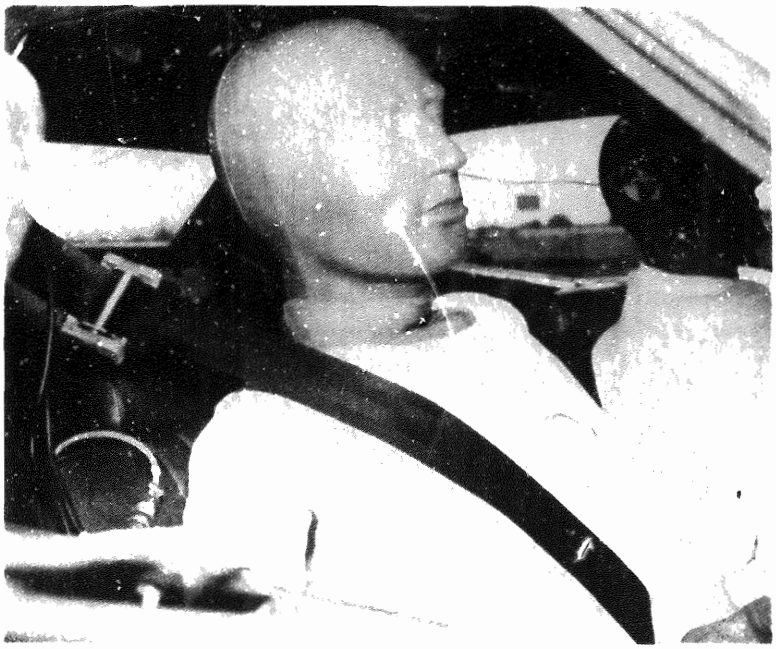


Figure 3-6. Pre-test Standard 3-Point Belt, Right Front - Test 8.

Figure 3-7. Post-test Standard 3-Point Belt, Right Front - Test 8.

3.2 TEST NUMBER 9

The impact conditions for Test 9 were:

Configuration	Closing Speed
Torino-to-Volvo Head-on	78.6 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt with Web Lockers	Force Limited Airbelt
Right Front	Standard 3-Point Belt with Web Lockers	Force Limited 2-Inch Belt

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 9 are summarized in the following tables:

Table 3-5 - Summary of Vehicle Data (Test 9)

Table 3-6 - Injury Criteria Summary (Test 9)

Table 3-7 - Summary of Restraint System Data (Test 9)

Table 3-8 - Occupant Response Data (Test 9)

which are followed by Figure 3-8 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

TABLE 3-5. SUMMARY OF VEHICLE DATA (TEST 9)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 9/February 23, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		418	429
TEST WEIGHT (lb)		4570	3257
IMPACT VELOCITY (mph)		39.3	39.3
VELOCITY CHANGE (mph)		35.6(1)	49.9
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	47.7 @ 73	64.5 @ 57
	LOCATION 2	44.6 @ 65	72.8 @ 58
MAXIMUM STATIC CRUSH (in.)			
	LEFT	23.0	38.0
	CENTER	30.0	35.5
	RIGHT	17.0	35.0

(1) Calculated, based on conservation of momentum and a coefficient of restitution of .087.

TABLE 3-6. INJURY CRITERIA SUMMARY (TEST 9)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT W/WEB LOCKERS		STANDARD 3-POINT BELT W/WEB LOCKERS	
HIC	908		814	
HEAD G(1) @ msec	75.8 @ 109		56.4 @ 113	
CSI	421		321	
CHEST G(1) @ msec	44.4 @ 100		35.9 @ 79	
FEMUR LOAD (lb)(2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

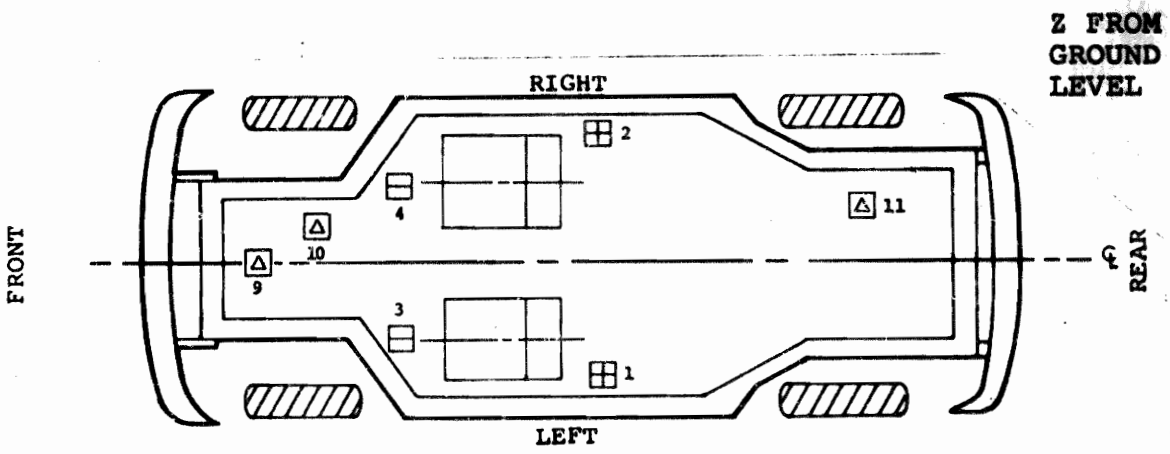
TABLE 3-7. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 9)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	2043 @ 94
Peak Lap Belt Load	lb @ msec	505 @ 72
Peak Vertical Belt Load	lb @ msec	65 @ 83
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	2840 @ 96
Peak Lap Belt Load	lb @ msec	394 @ 78

TABLE 3-8. OCCUPANT RESPONSE DATA SUMMARY (TEST 9)

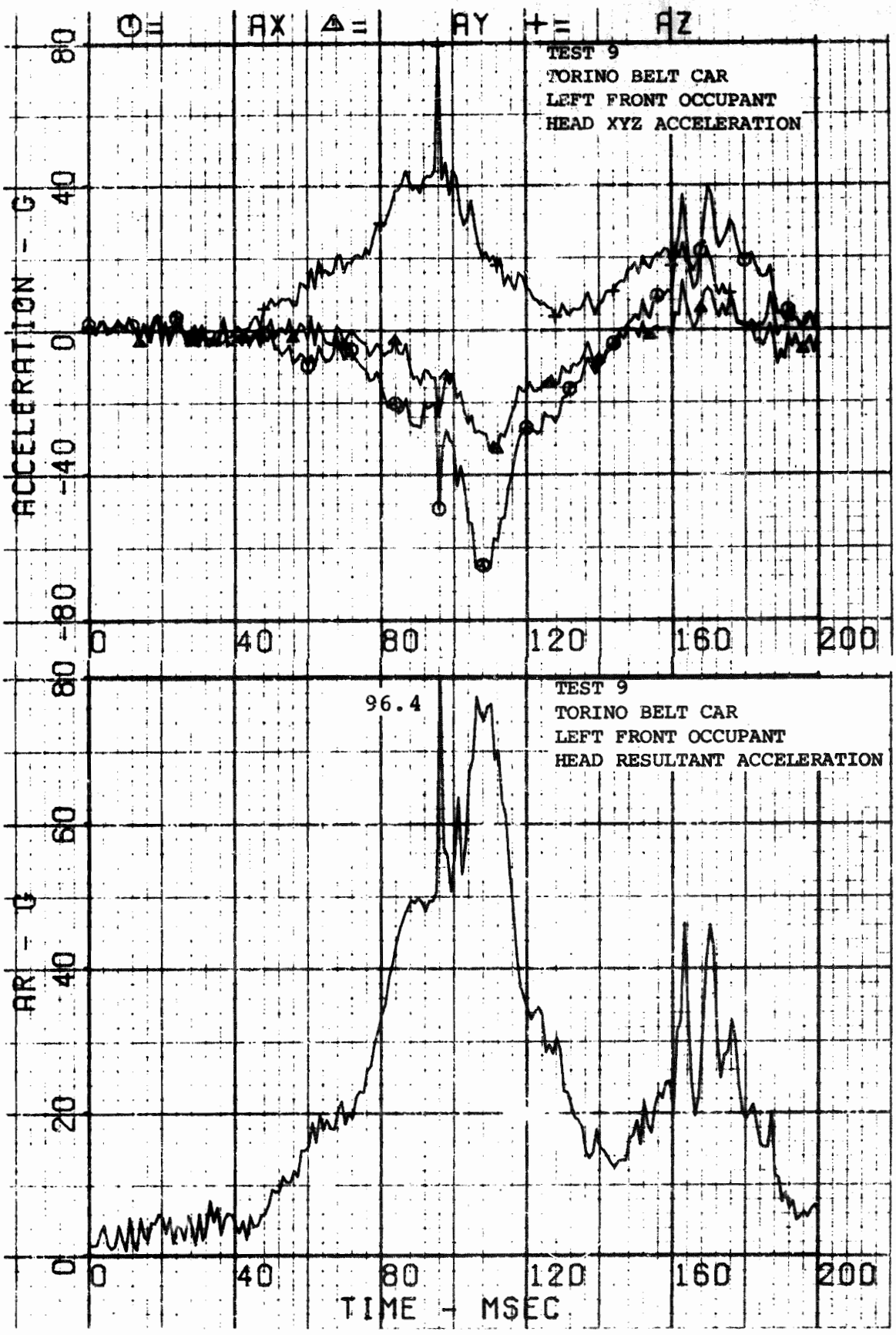
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	66.7	109	28.0	126
	Y	33.5	110	31.8	116
	Z	79.1	96	50.9	94
	R(1)	75.8	109	56.4	113
	HIC	908 @ 79-124		814 @ 79-138	
CHEST					
	X	18.1	92	35.3	80
	Y	40.2	97	28.1	109
	Z	26.7	106	20.1	115
	R(1)	44.4	100	35.9	79
	SI	421 @ 200		321 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (2)					
	LF	NA		NA	
	RT	NA		NA	

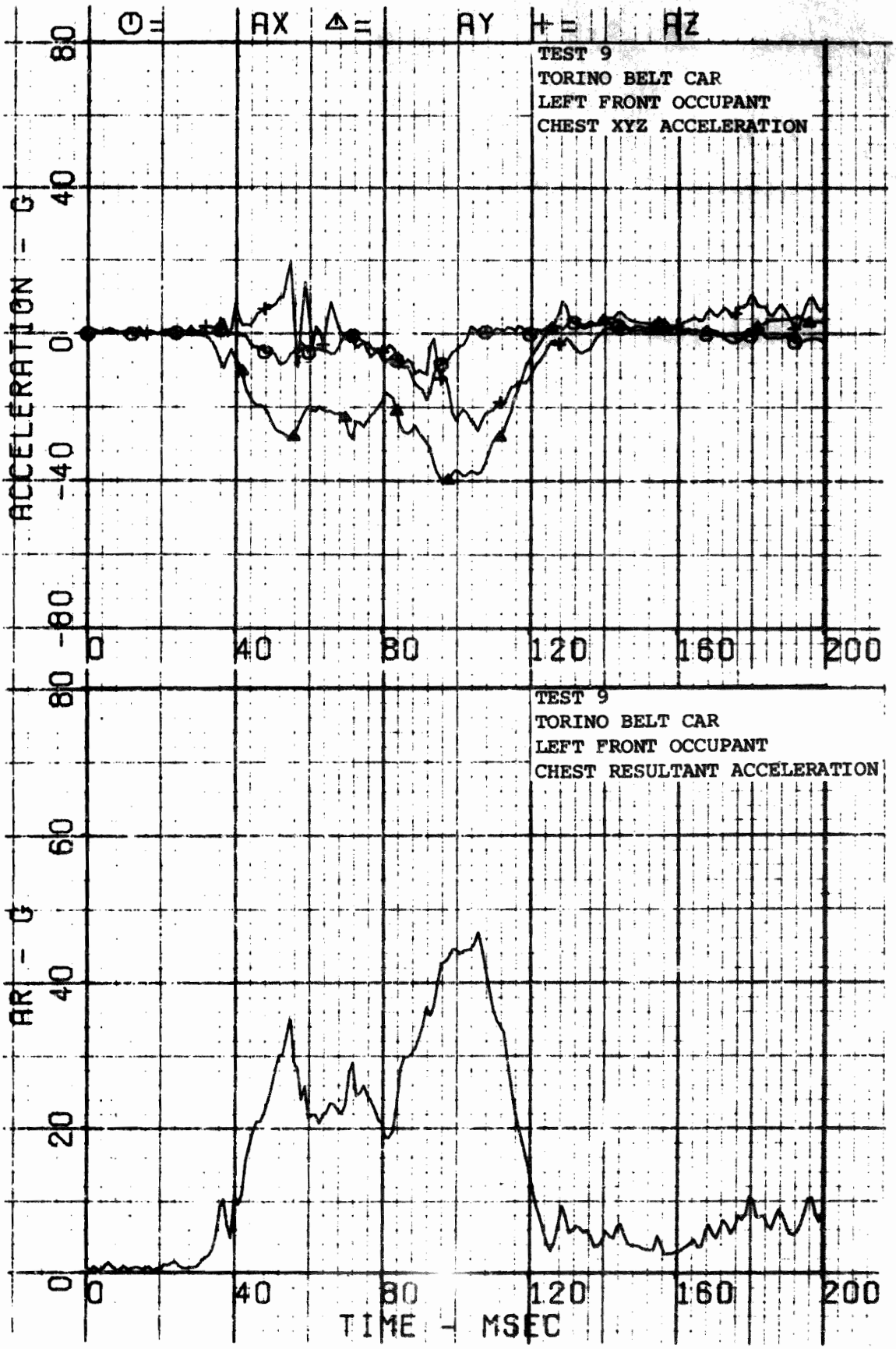
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

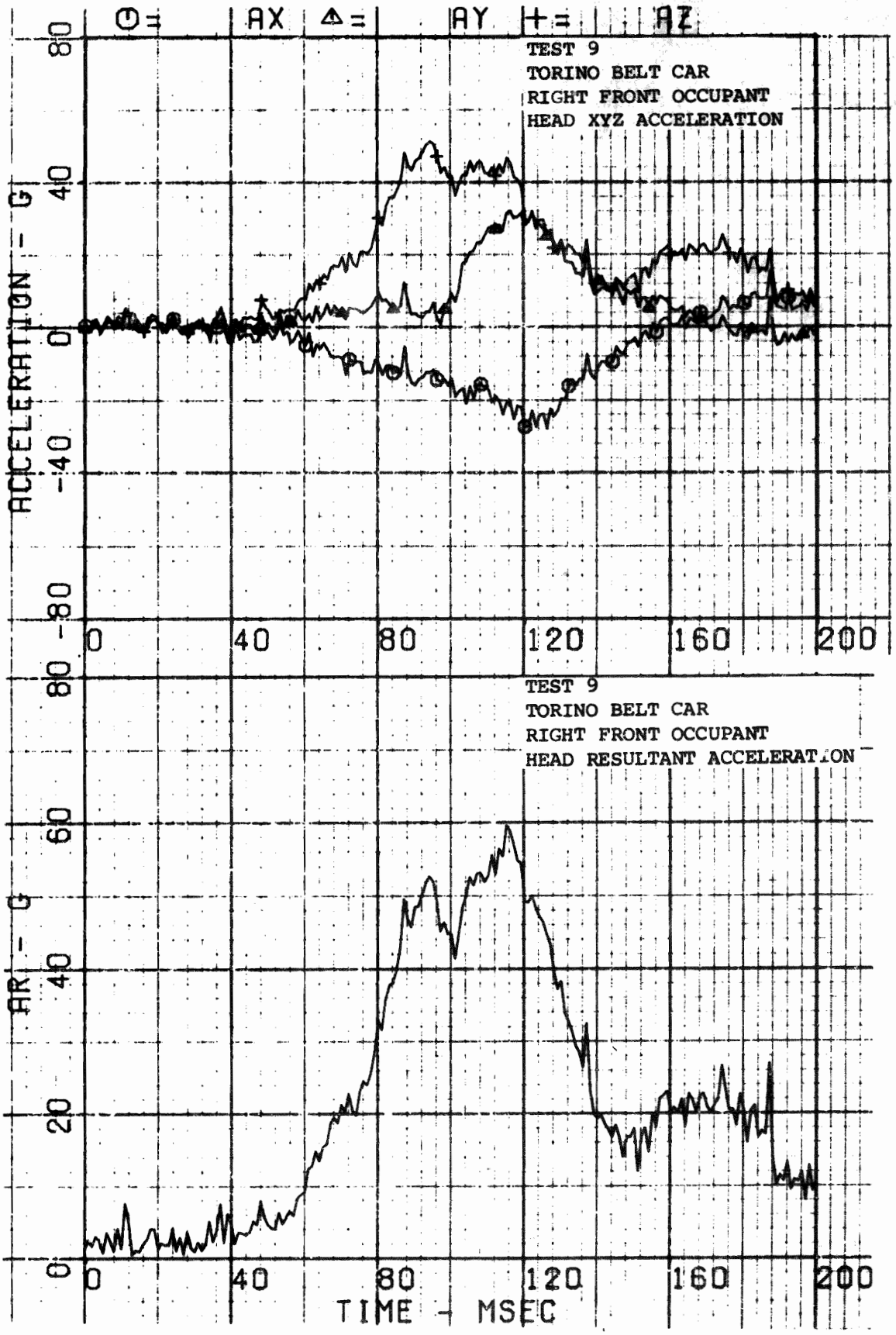


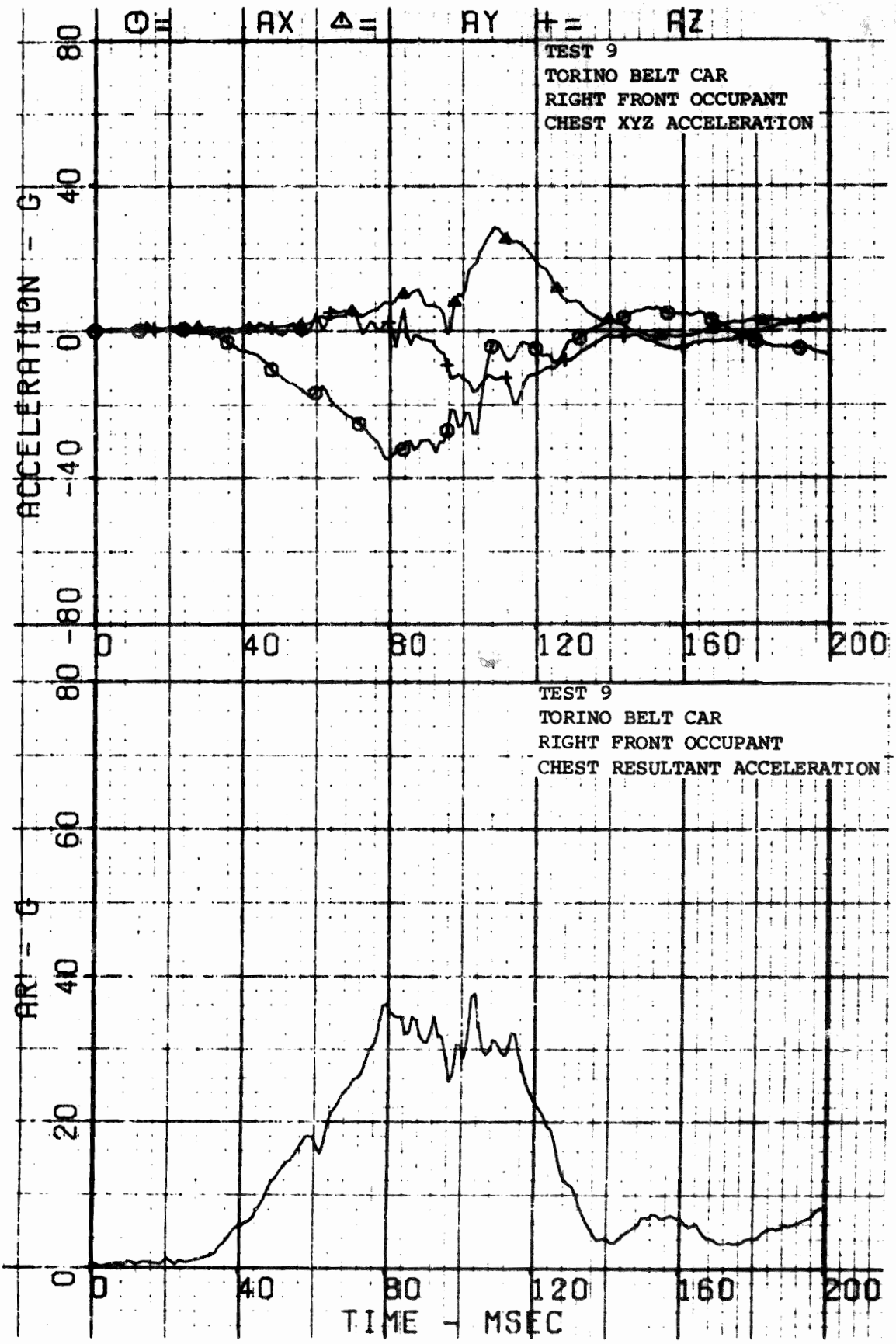
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

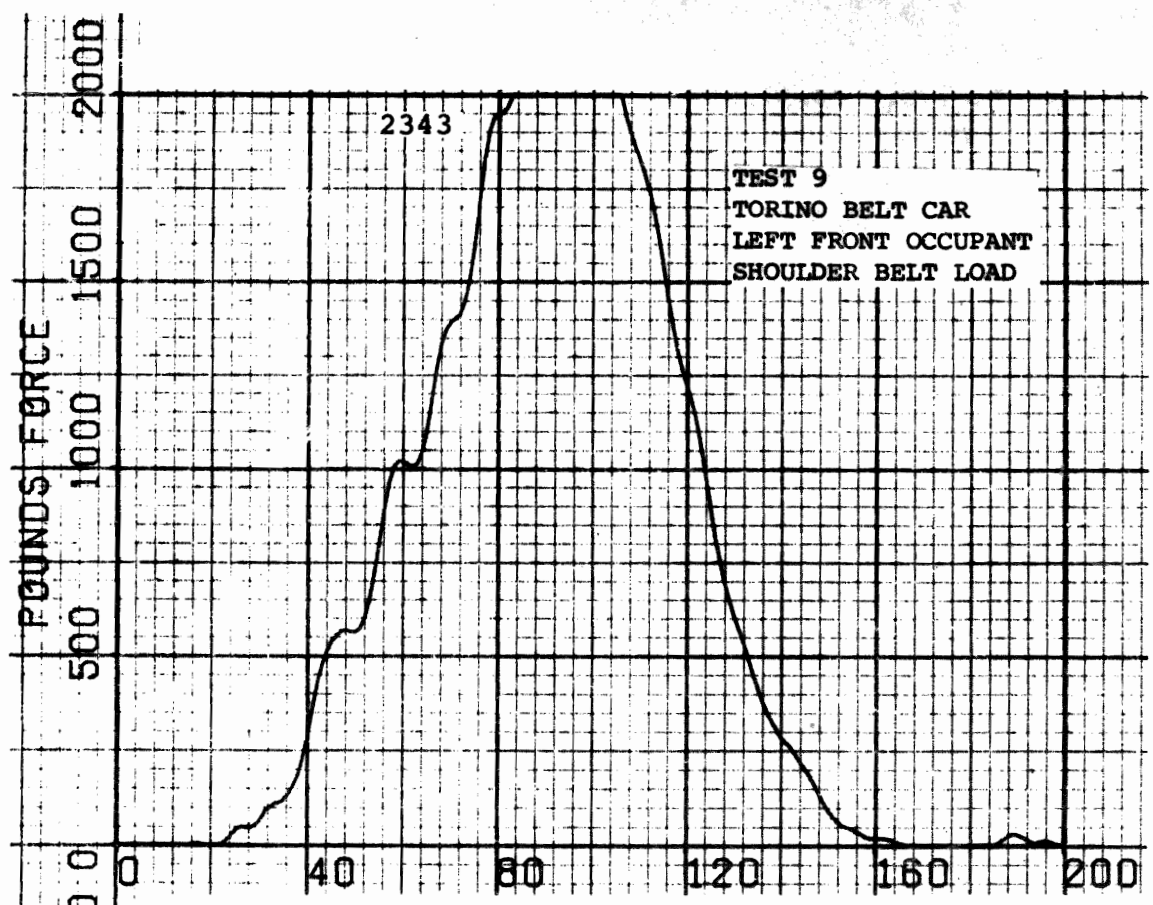
Figure 3-8. Vehicle Accelerometer Locations - Test 9.

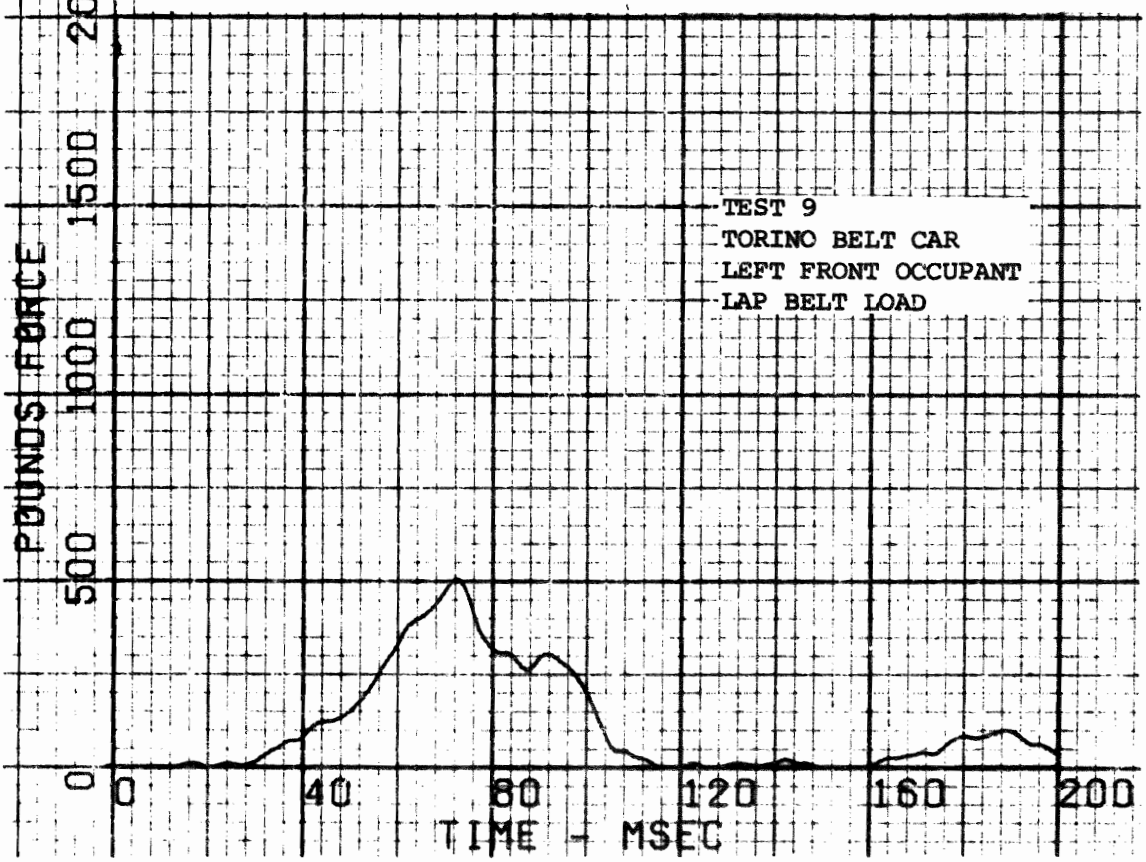

○= AX △= AY +=AZ
TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
96.4
TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

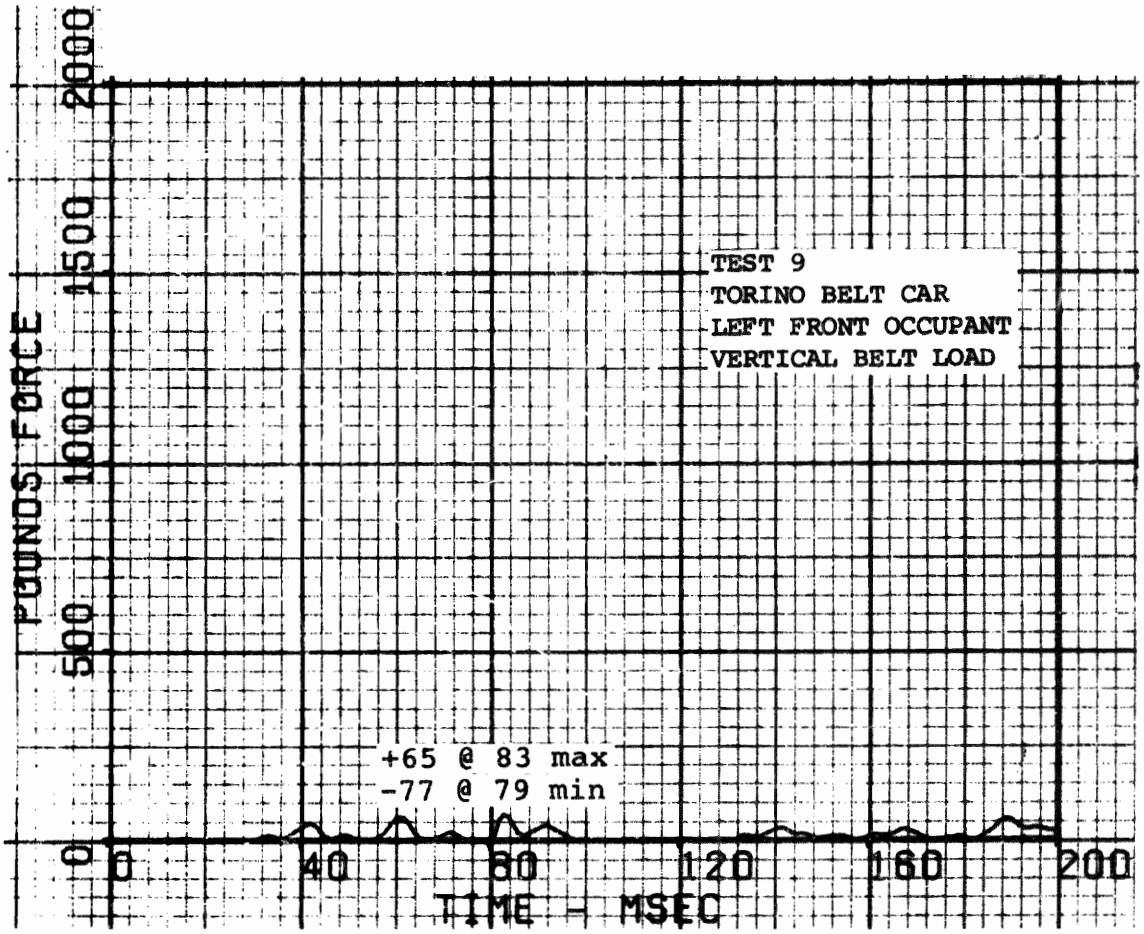

○= AX △= AY += AZ
TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

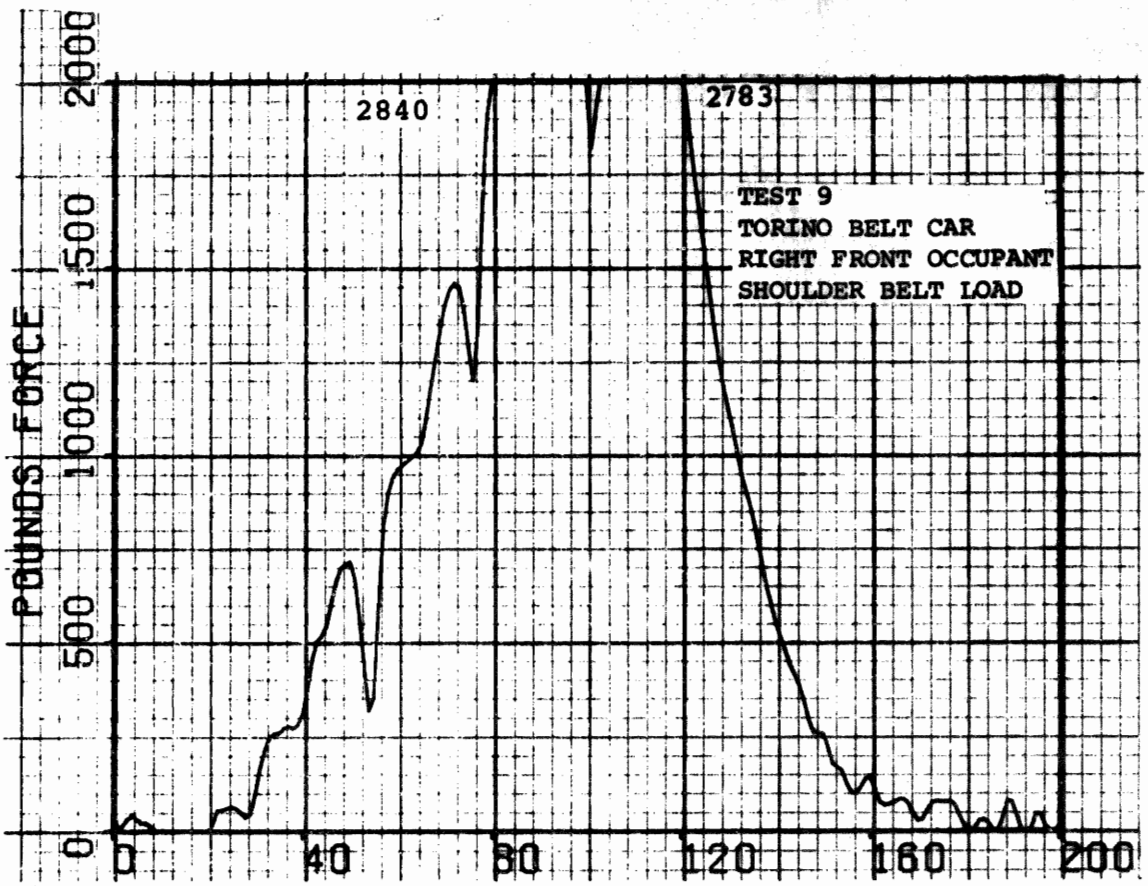

○= AX △= AY += AZ
TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

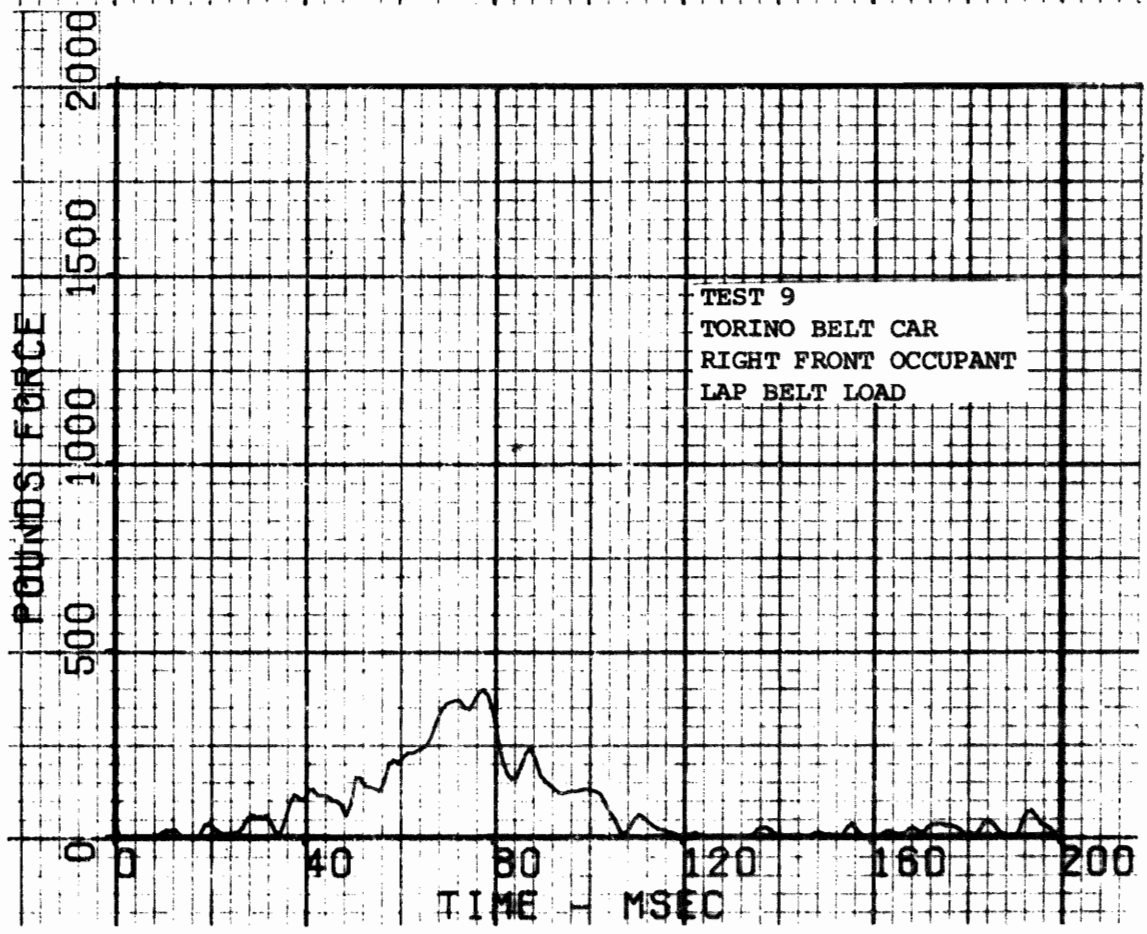

○ = AX
△ = AY
+ = AZ
TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

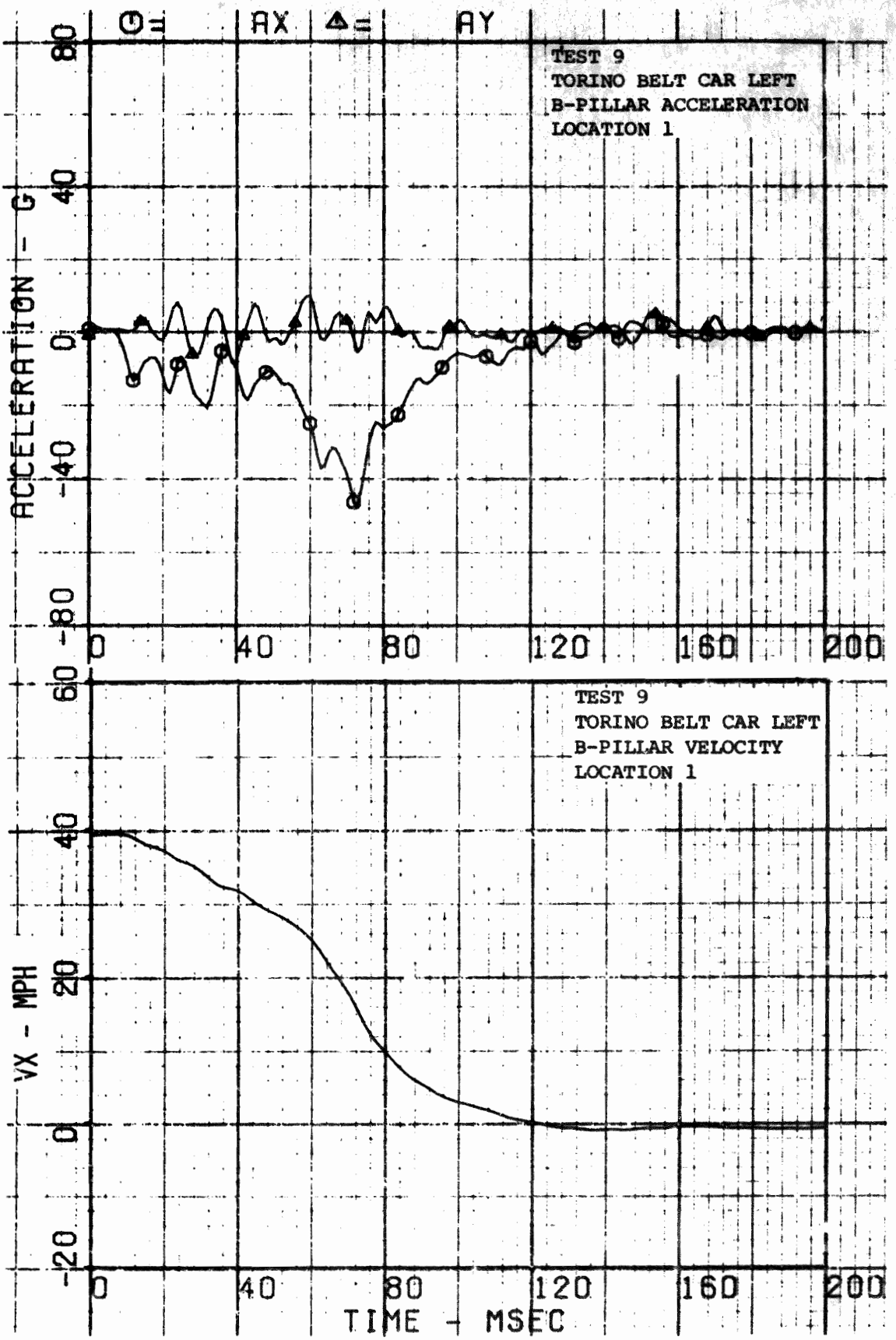

2343
TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

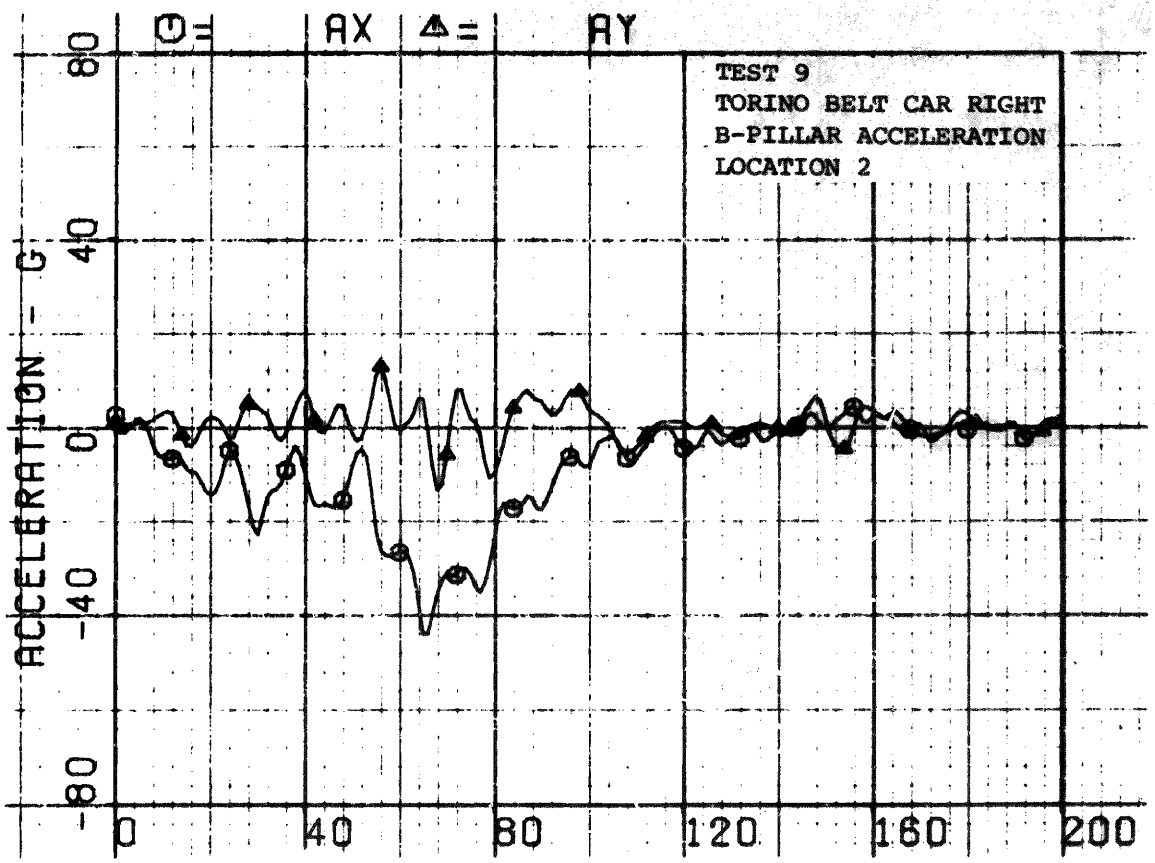

TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

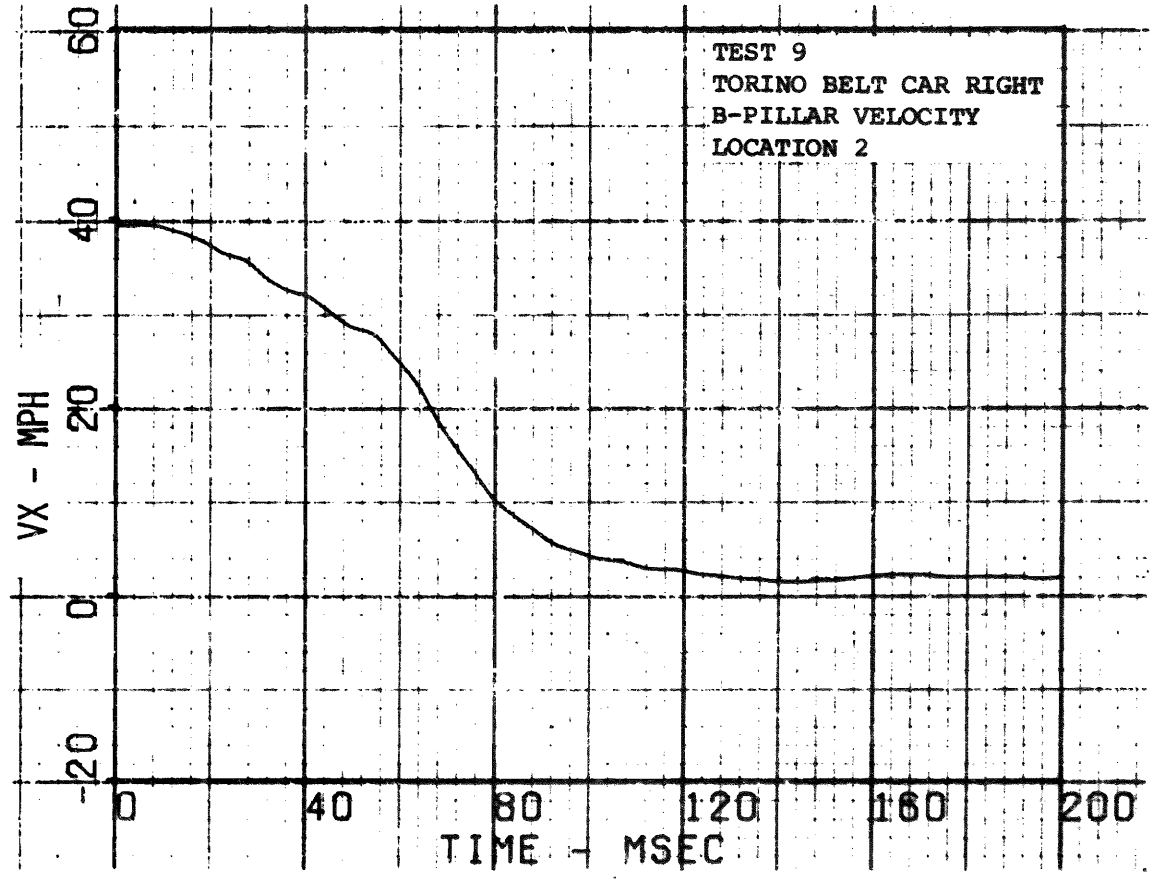

TEST 9
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
+65 @ 83 max
-77 @ 79 min
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

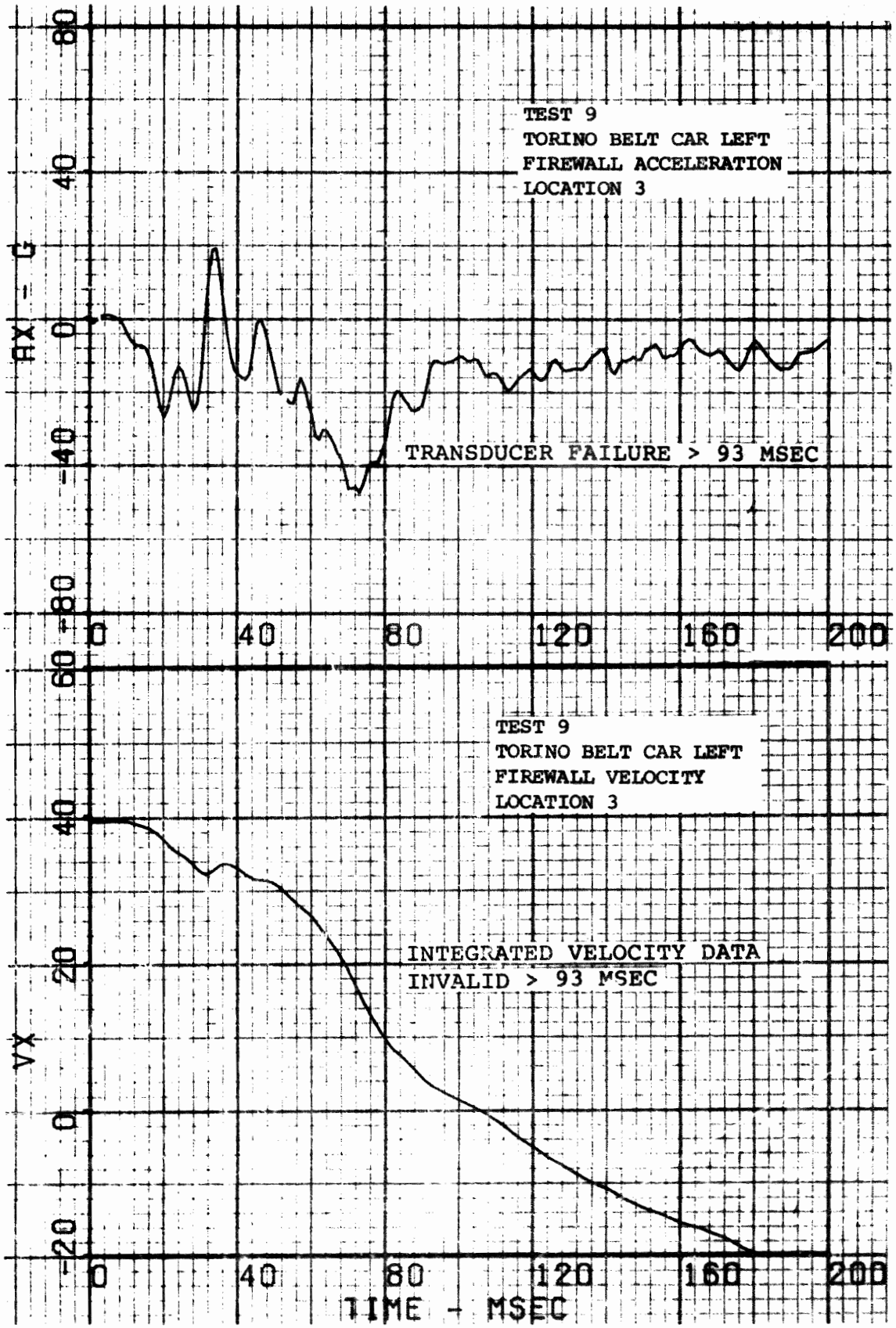

2840
2783
TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

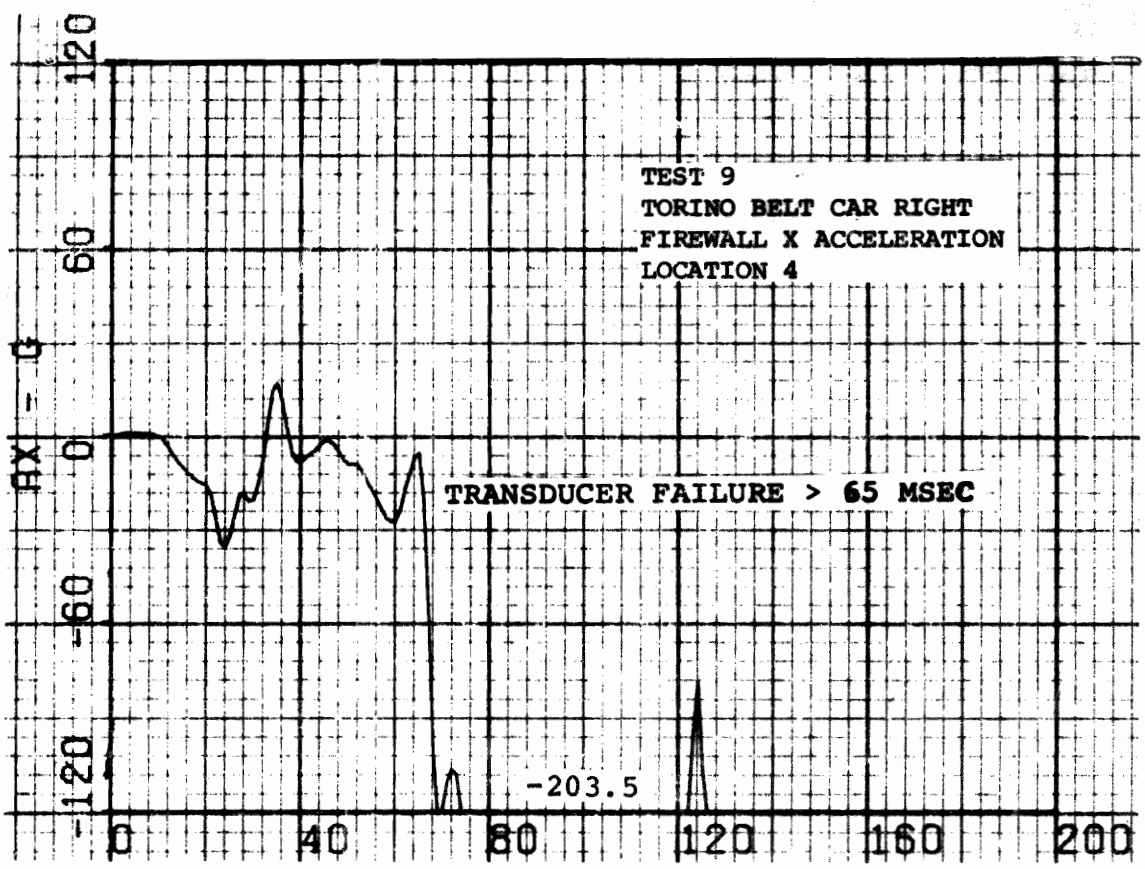

TEST 9
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

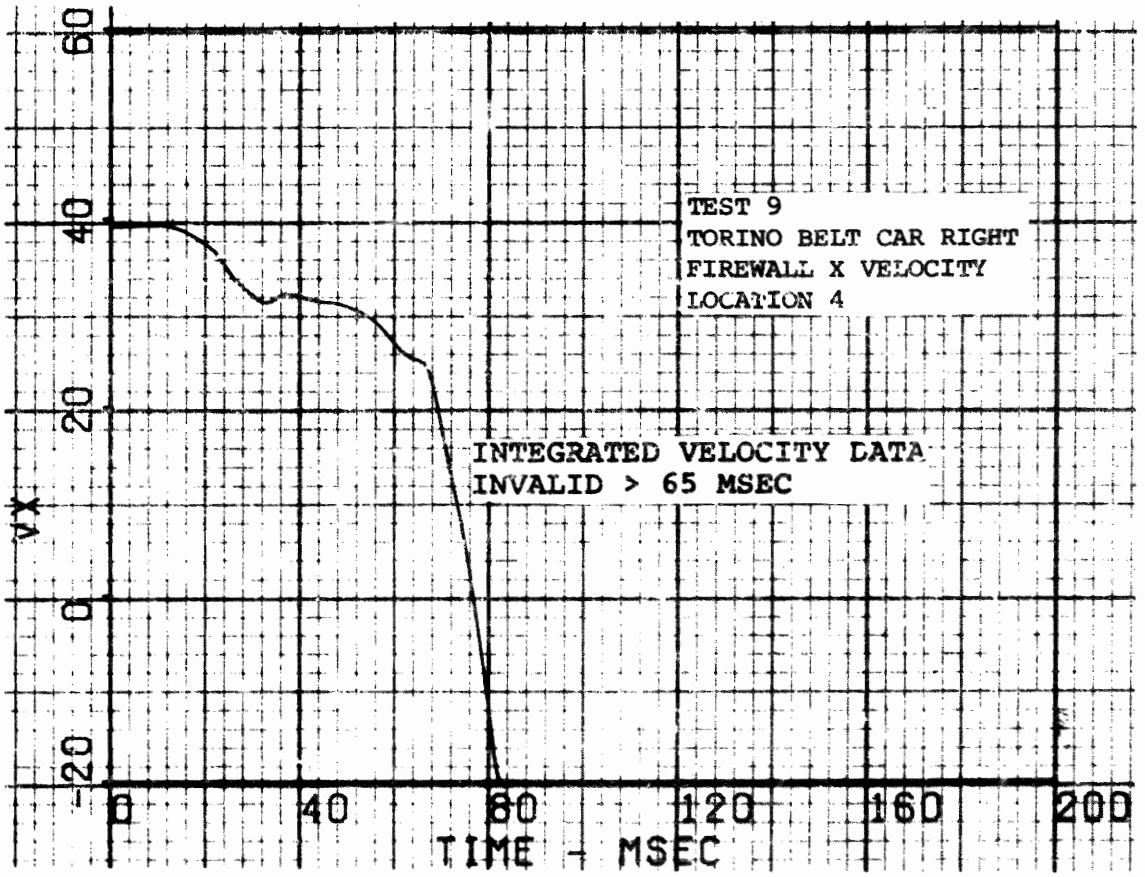

AX
AY
TEST 9
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 9
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VX - MPH
60
40
20
0
-20
TIME - MSEC

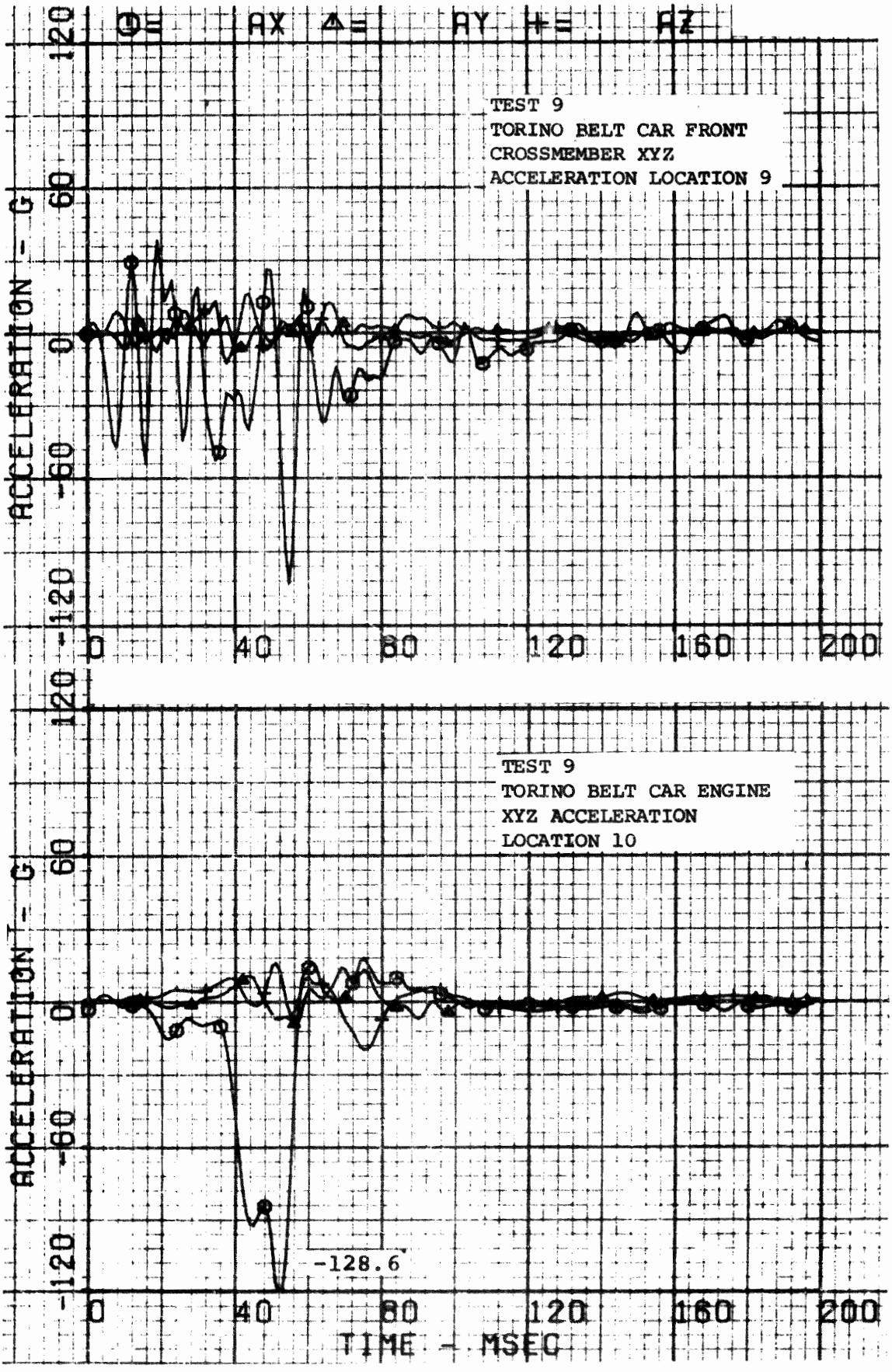

○ = AX
△ = AY
TEST 9
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

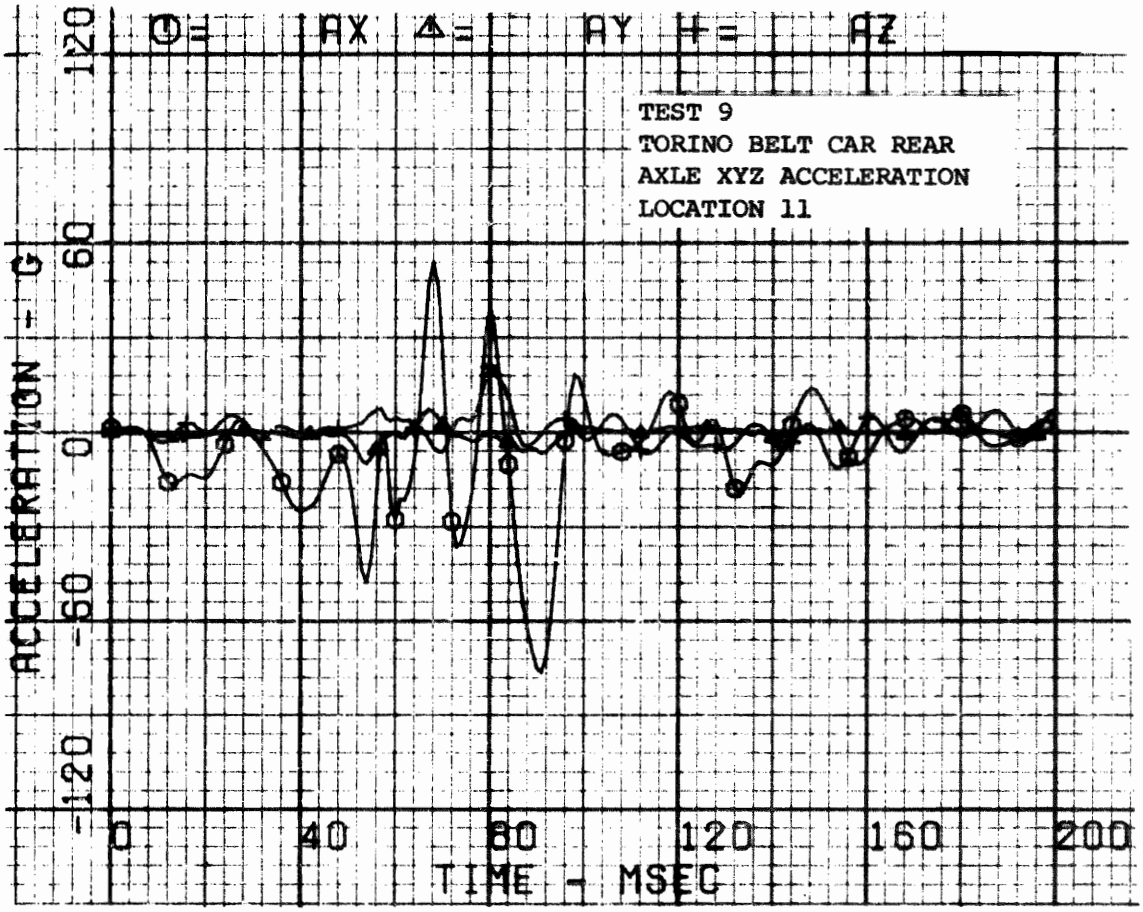

TEST 9
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VX - MPH
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 9
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
TRANSDUCER FAILURE > 93 MSEC
AX - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 9
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
INTEGRATED VELOCITY DATA
INVALID > 93 MSEC
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 9
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
TRANSDUCER FAILURE > 65 MSEC
-203.5
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 9
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
INTEGRATED VELOCITY DATA
INVALID > 65 MSEC
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


AX
AY
AZ
TEST 9
TORINO BELT CAR FRONT
CROSSMEMBER XYZ
ACCELERATION LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 9
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 10
-128.6
TIME - MSEC


AX
AY
AZ
TEST 9
TORINO BELT CAR REAR
AXLE XYZ ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

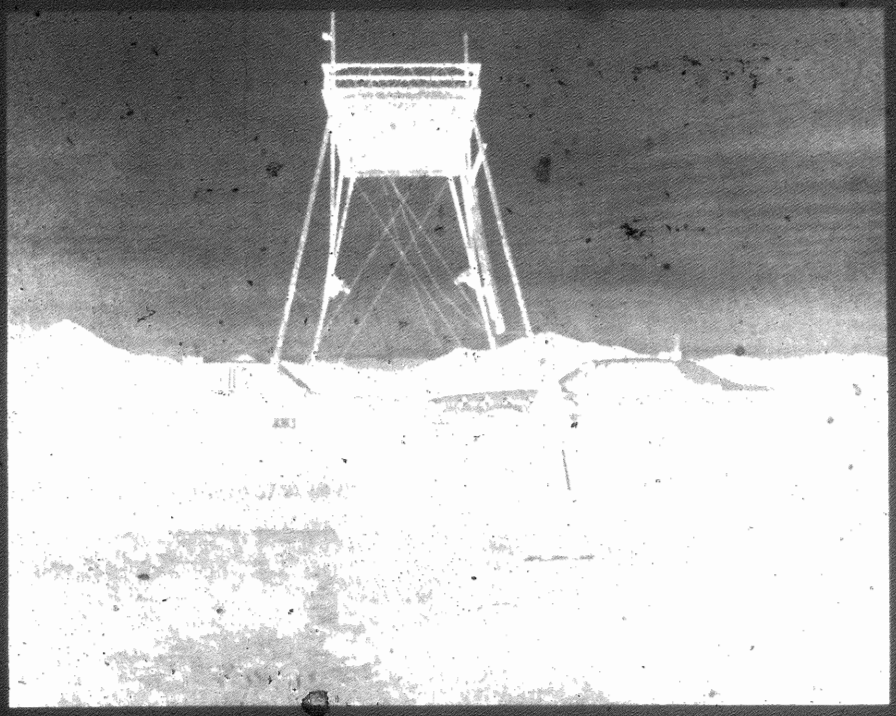


Figure 3-9. Pre-test Vehicle Configuration - Test 9.

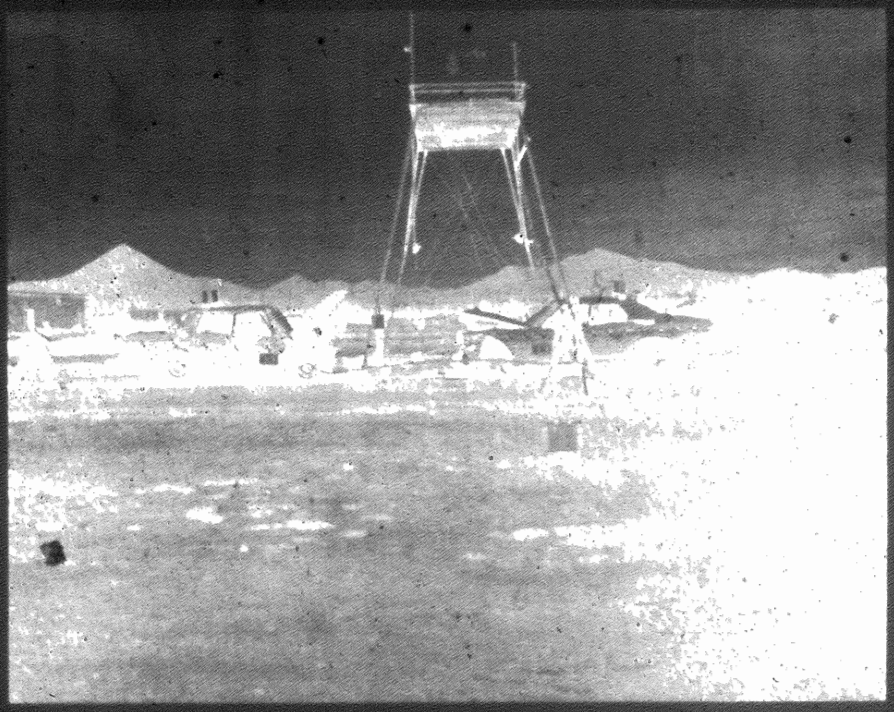


Figure 3-10. Post-test Vehicle Configuration - Test 9.

Figure 3-11. Pre-test Standard 3-Point Belt With Web Lockers, Left Front - Test 9.

Figure 3-12. Post-test Standard 3-Point Belt With Web Lockers, Left Front - Test 9.

Figure 3-13. Pre-test Standard 3-Point Belt With Web Lockers, Right Front - Test 9.

Figure 3-14. Post-test Standard 3-Point Belt With Web Lockers, Right Front - Test 9.

3.3 TEST NUMBER 10

The impact conditions for Test 10 were:

Configuration	Closing Speed
Torino-to-Volvo Right Oblique (30°)*	60.5 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt	RSV Driver Airbag
Right Front	Standard 3-Point Belt	RSV Passenger Airbag

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 10 are summarized in the following tables:

Table 3-9 - Summary of Vehicle Data (Test 10)

Table 3-10 - Injury Criteria Summary (Test 10)

Table 3-11 - Summary of Restraint System Data (Test 10)

Table 3-12 - Occupant Response Data (Test 10)

which are followed by Figure 3-15 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 3-9. SUMMARY OF VEHICLE DATA (TEST 10)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 10/March 3, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		479	438
TEST WEIGHT (lb)		4725	3244
IMPACT VELOCITY (mph)		60.5	0
VELOCITY CHANGE (mph)		25.6	34.9 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	(2)	39.0 @ 74
	LOCATION 2	20.2 @ 43	27.4 @ 20
MAXIMUM STATIC CRUSH (in.)			
	LEFT	18.0	11.0
	CENTER	21.0	12.5
	RIGHT	3.0	13.0

(1) Velocity change calculated using average of resultant velocity vector (V_R) data for compartment accelerometer locations.
(2) Transducer failure, y-axis accelerometer data not valid.

TABLE 3-10. INJURY CRITERIA SUMMARY (TEST 10)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT		STANDARD 3-POINT BELT	
HIC	243		138	
HEAD G(1) @ msec	34.7 @ 119		28.9 @ 97	
CSI	(2)		81	
CHEST G(1) @ msec	(2)		21.5 @ 103	
FEMUR LOAD (lb) (3)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) Transducer failure.
(3) No femur loads measured.

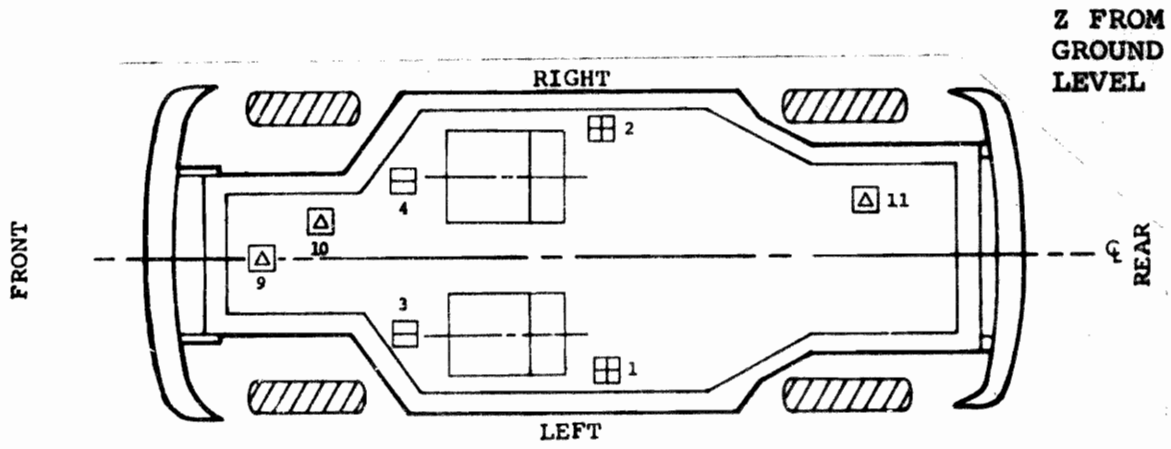
TABLE 3-11. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 10)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1065 @ 110
Peak Lap Belt Load	lb @ msec	428 @ 90
Peak Vertical Belt Load	lb @ msec	783 @ 108
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	2.2 @ 45
Peak Lap Belt Load	lb @ msec	1129 @ 110

TABLE 3-12. OCCUPANT RESPONSE DATA SUMMARY (TEST 10)

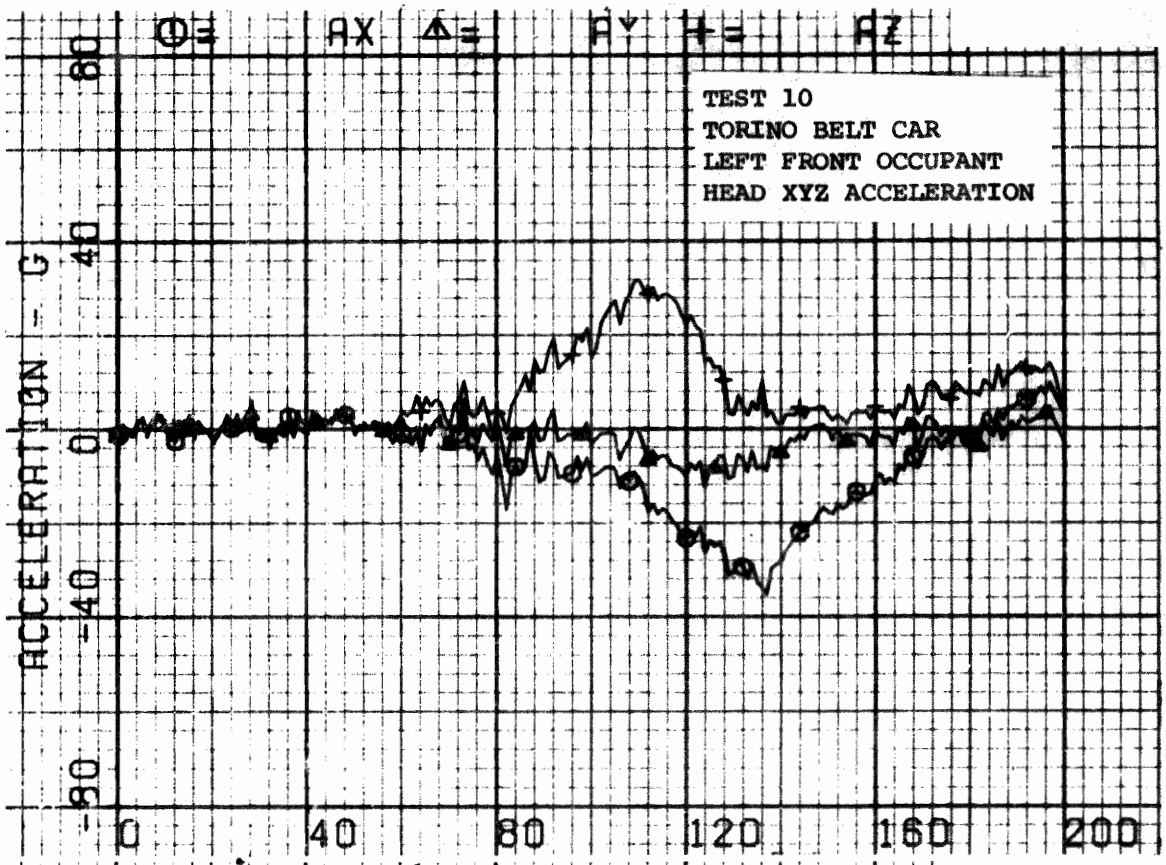
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	35.4	137	15.4	135
	Y	12.4	124	11.7	141
	Z	31.9	110	40.7	87
	R(1)	34.7	119	28.9	97
	HIC	243 @ 88-154		138 @ 76-157	
CHEST					
	X	24.5	112	20.3	105
	Y	5.4	82	7.3	109
	Z	(2)		8.9	94
	R(1)	NA		21.5	103
	SI	NA		81 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (3)					
	LF	NA		NA	
	RT	NA		NA	

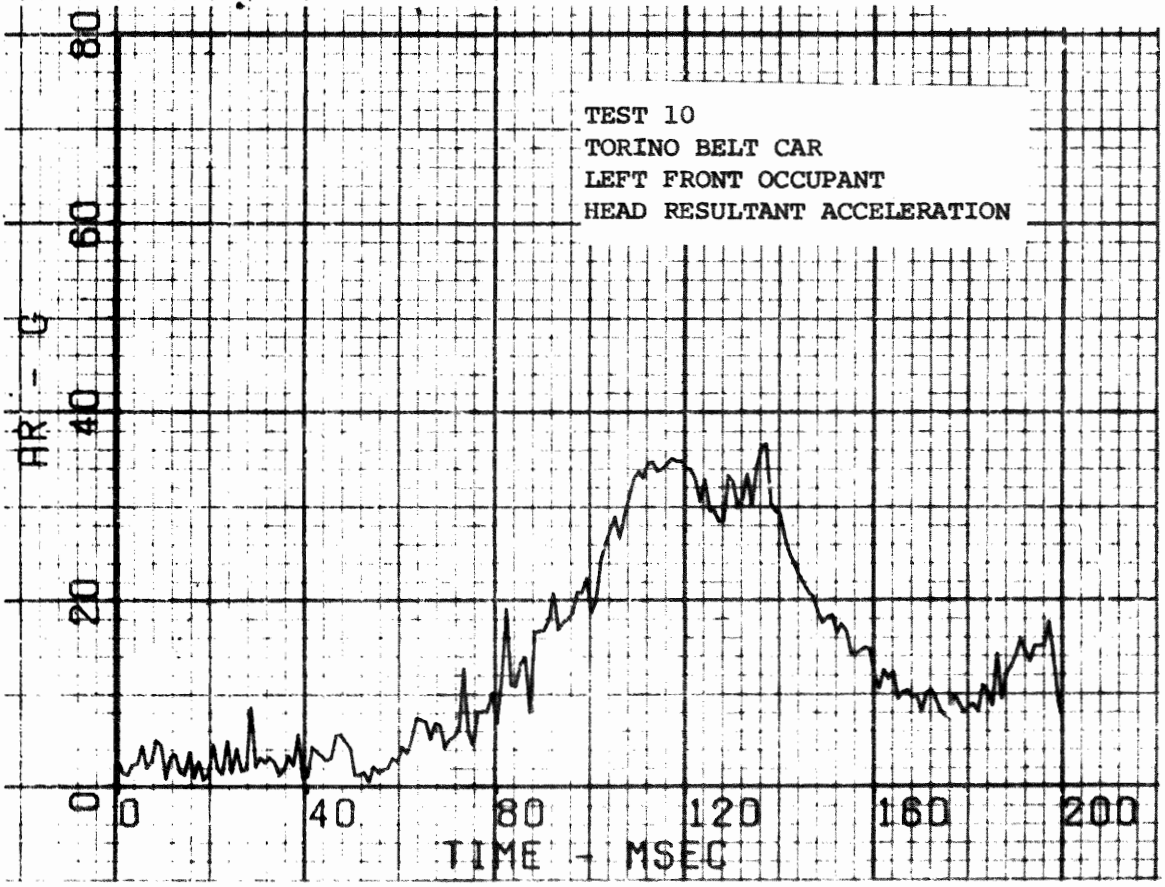
(1) 3 msec clip, components not clipped.
(2) Transducer failure.
(3) No femur loads measured.

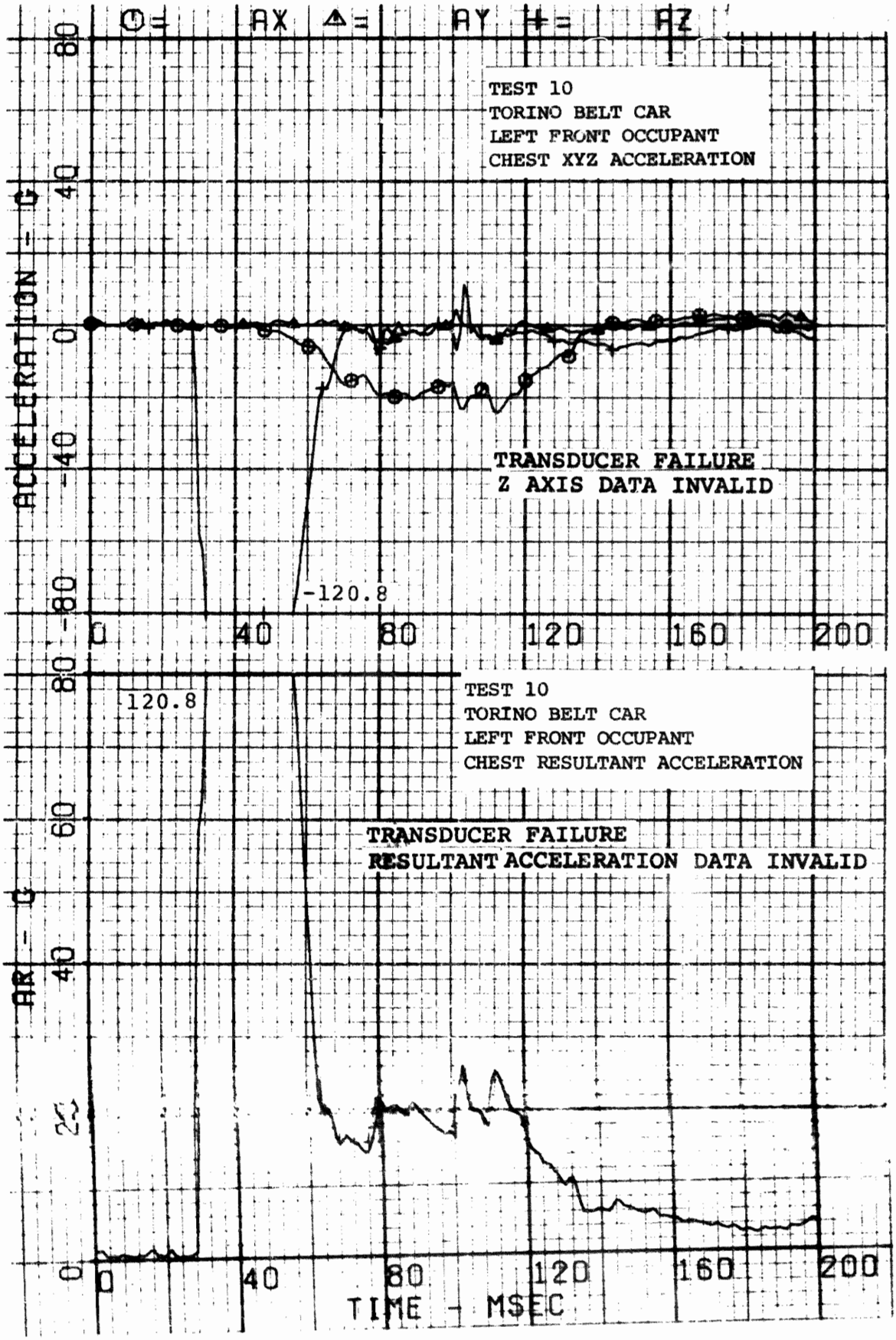


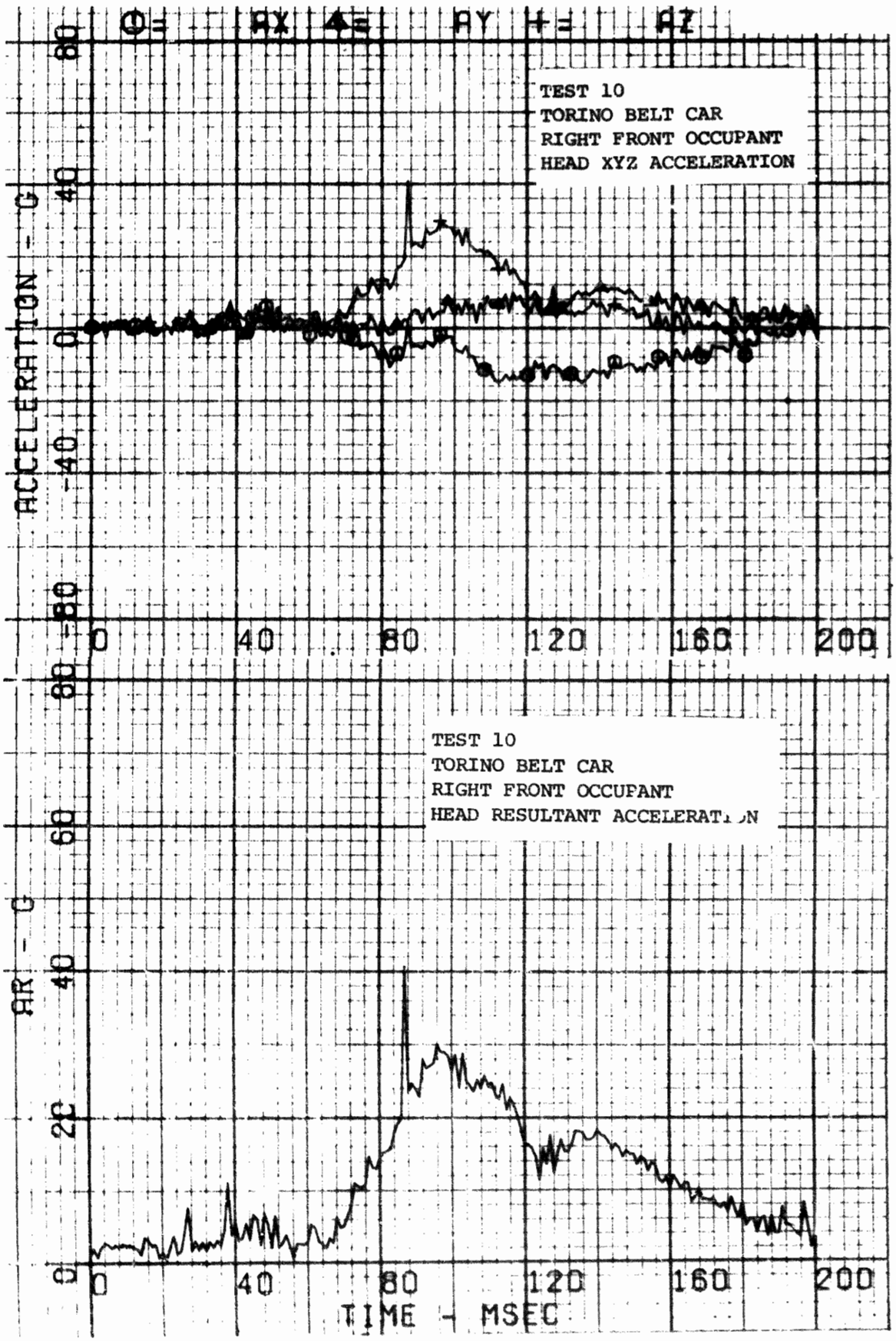
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

Figure 3-15. Vehicle Accelerometer Locations - Test 10.

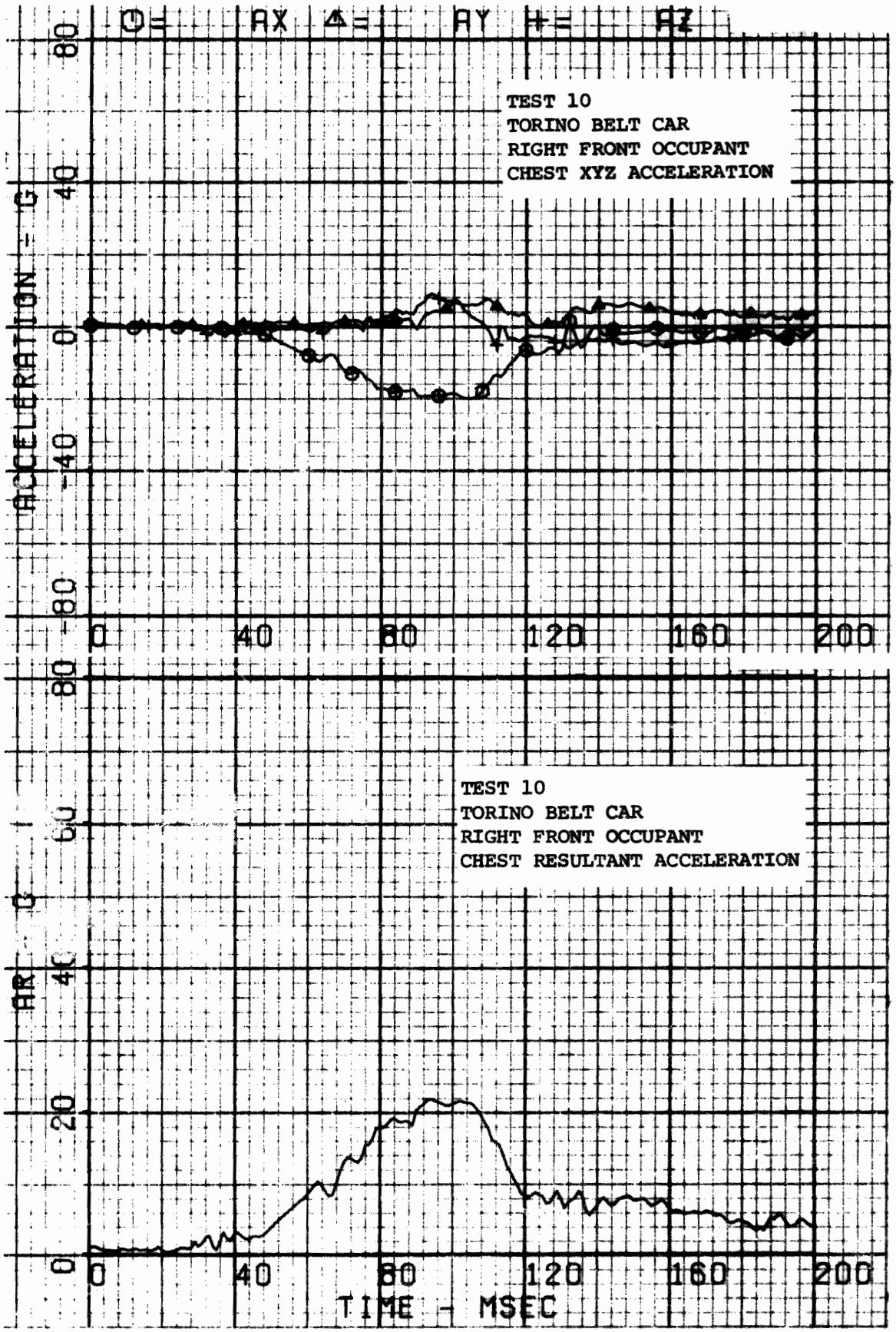

Φ= AX Δ= AY += AZ
TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

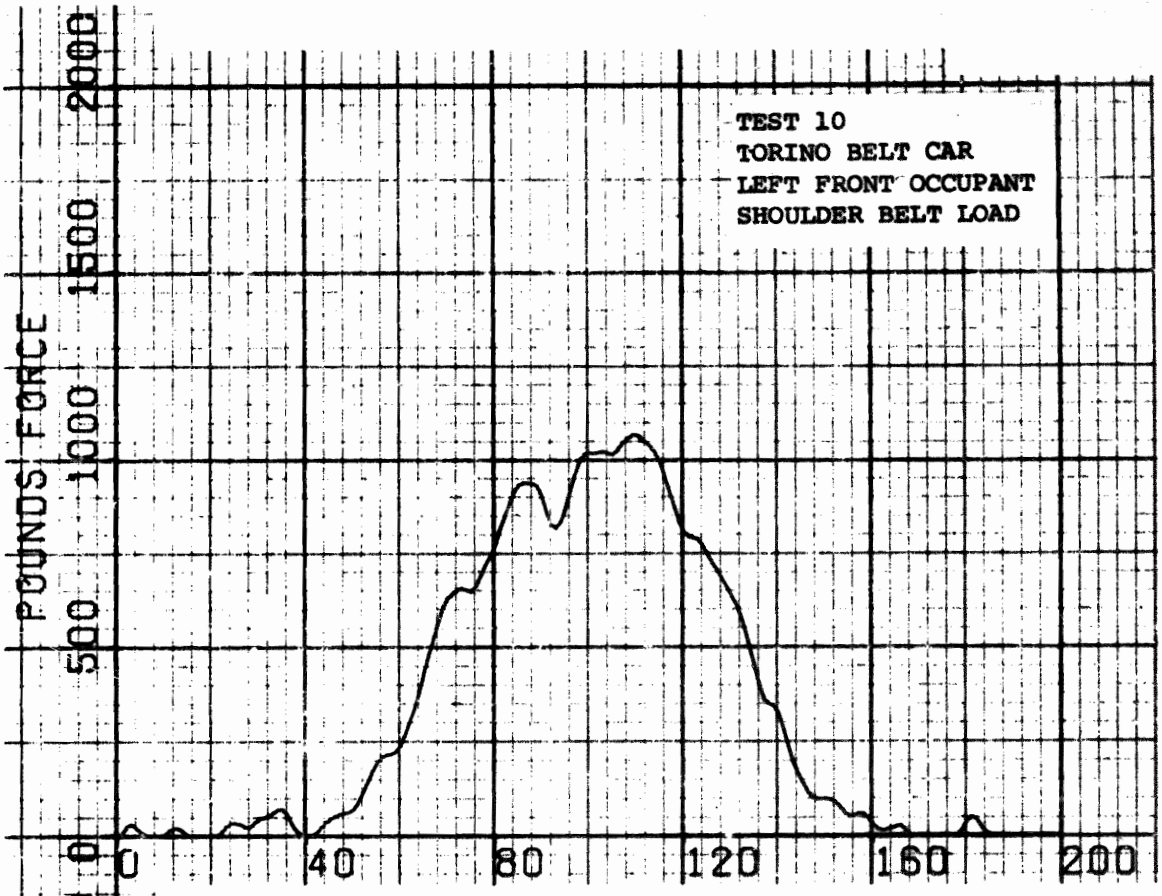

TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

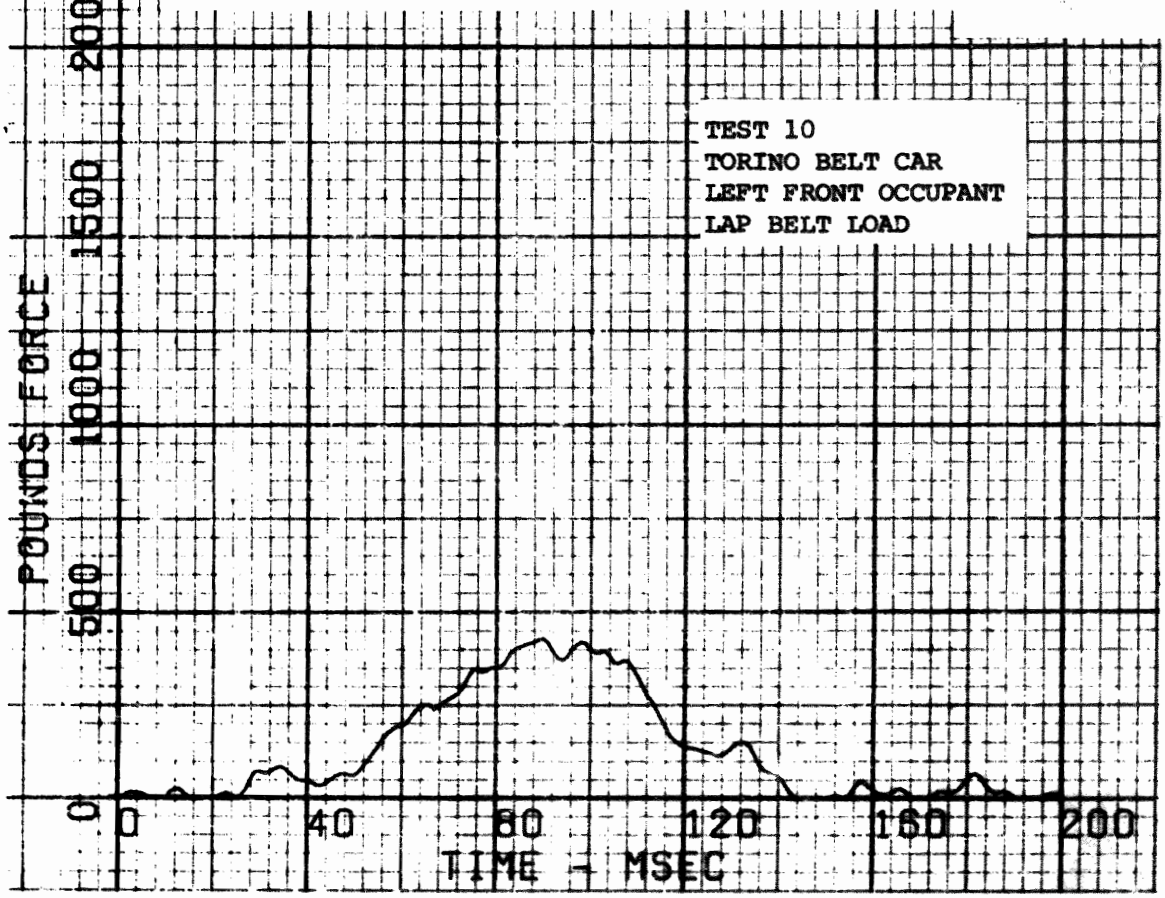

○= AX △= AY += AZ
TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
TRANSDUCER FAILURE
Z AXIS DATA INVALID
-120.8
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
120.8
TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
TRANSDUCER FAILURE
RESULTANT ACCELERATION DATA INVALID
AR - G
80
60
40
20
0
TIME - MSEC

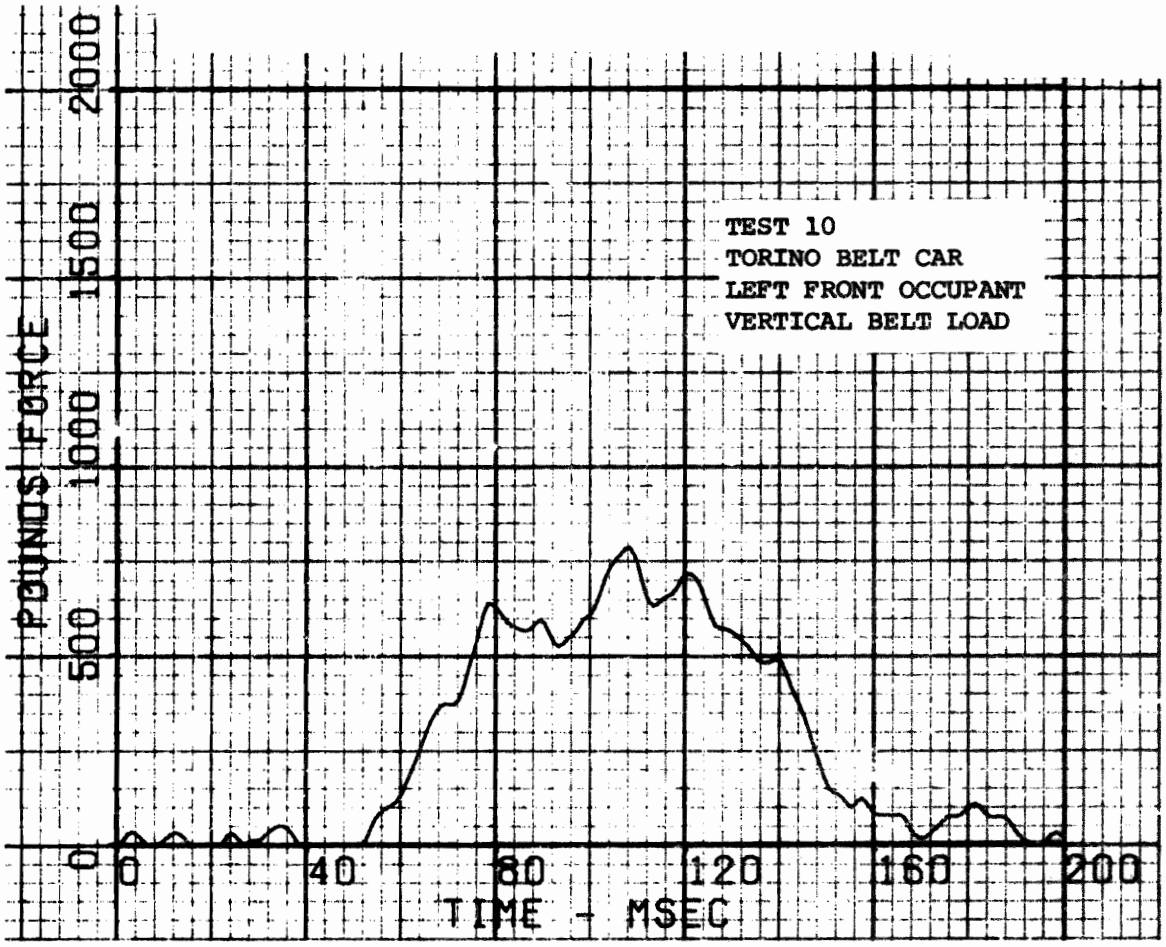

O= AX 4= AY += AZ
TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

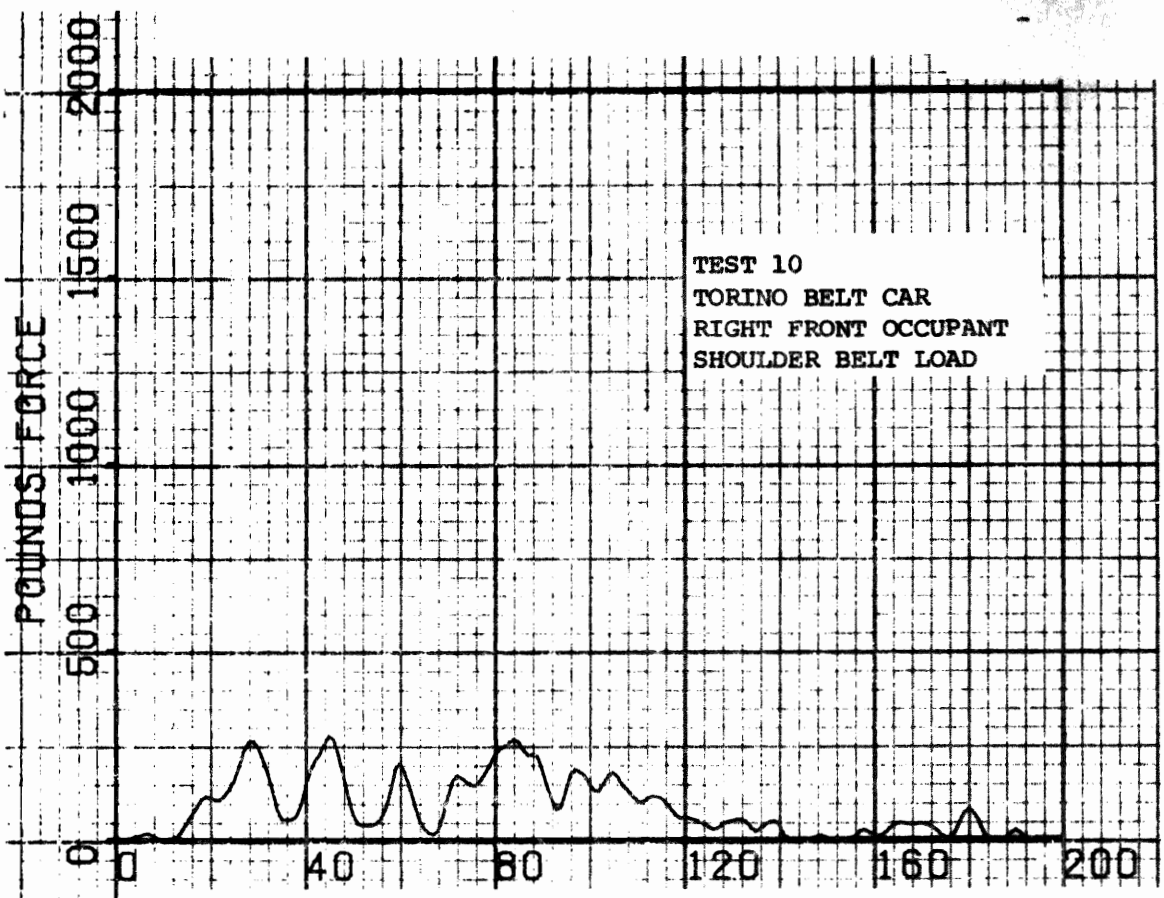
Continued

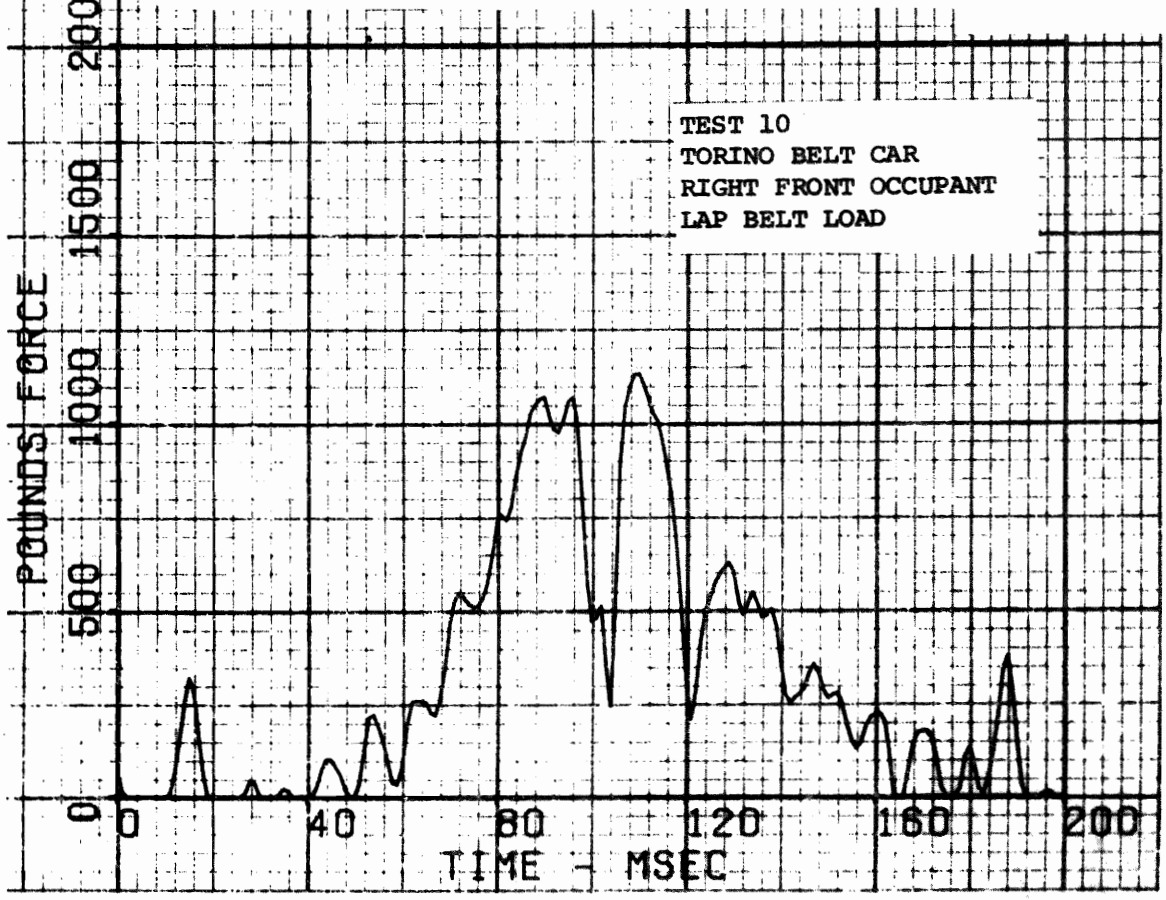

⊙= AX △= AY += AZ
TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR G
60
40
20
0
TIME - MSEC

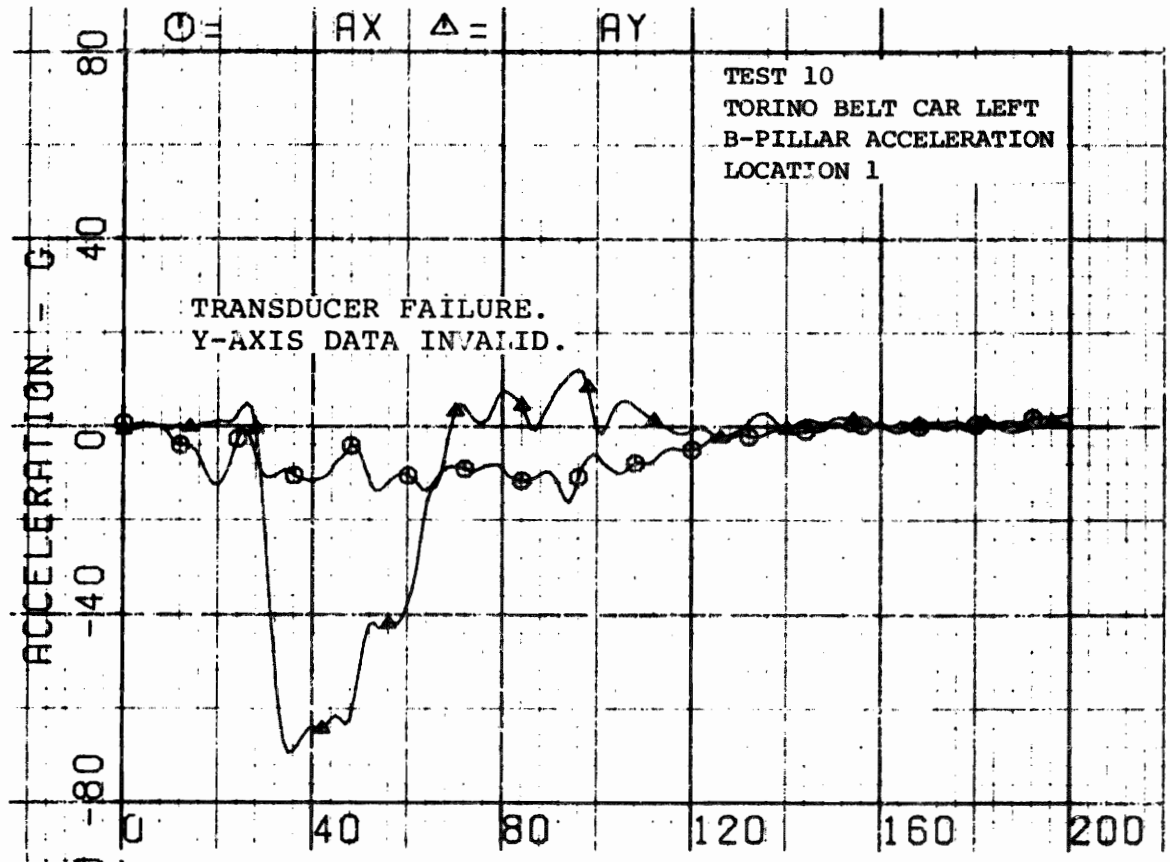

TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

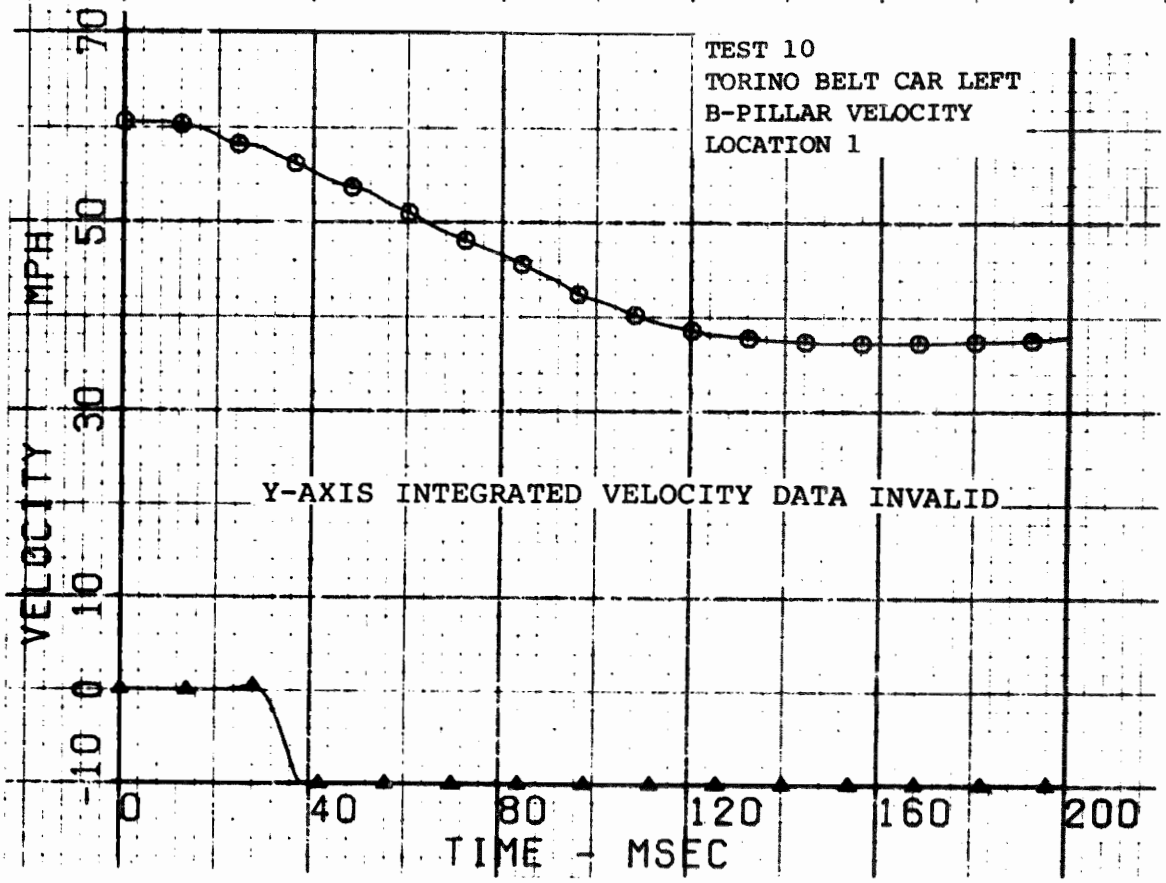

TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

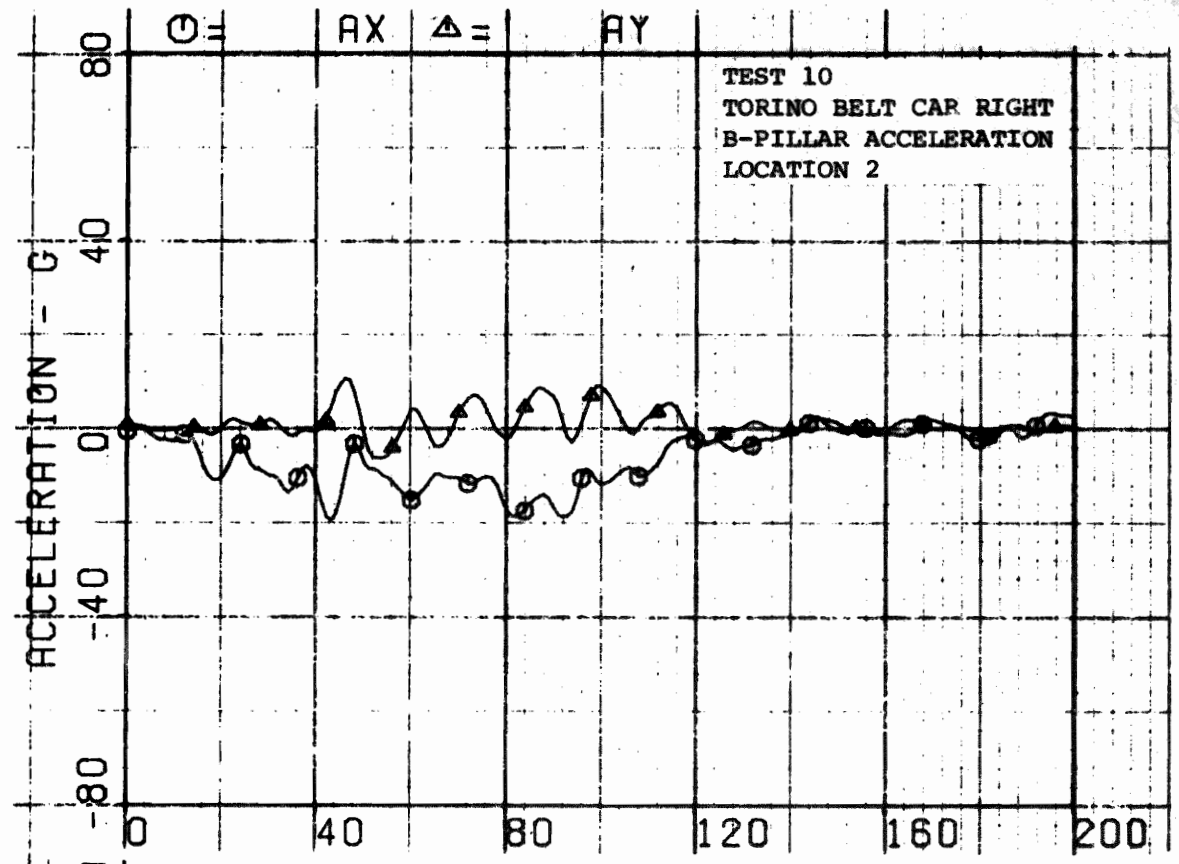

TEST 10
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME - MSEC

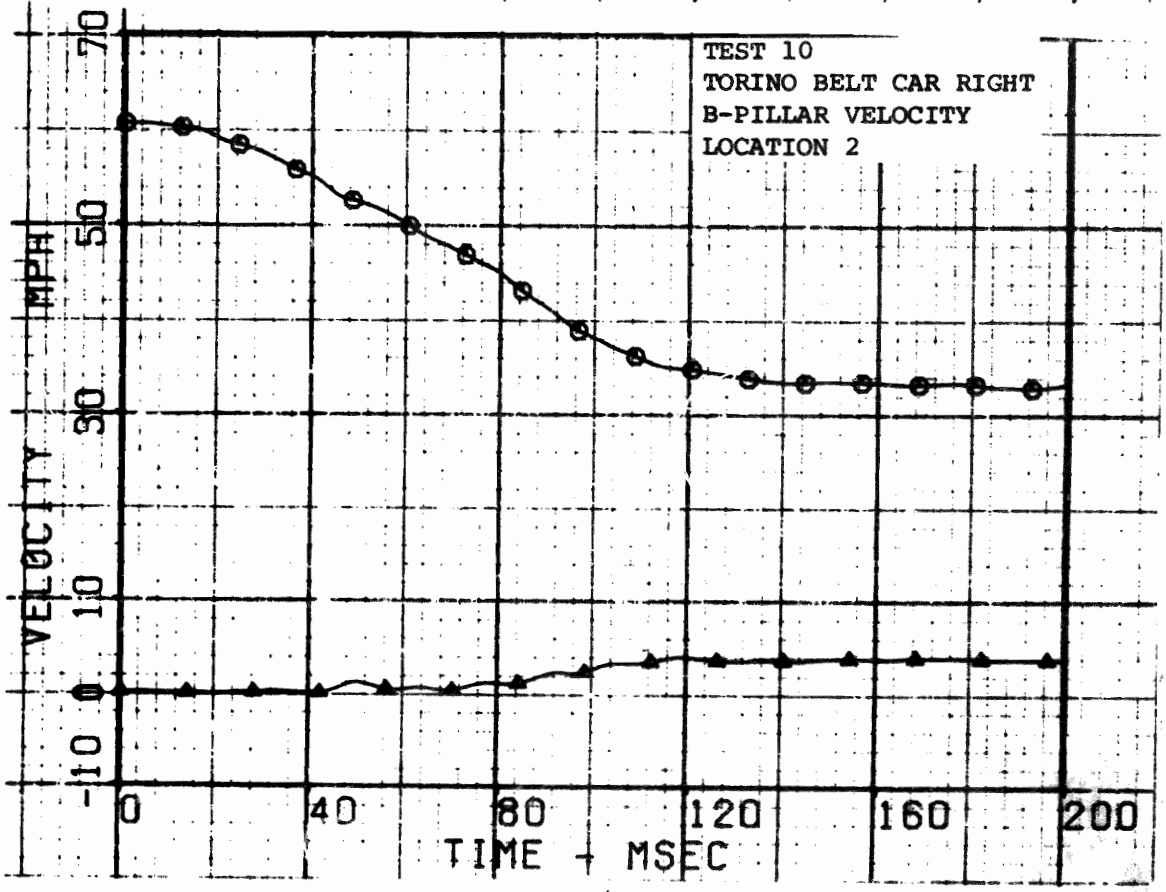

TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

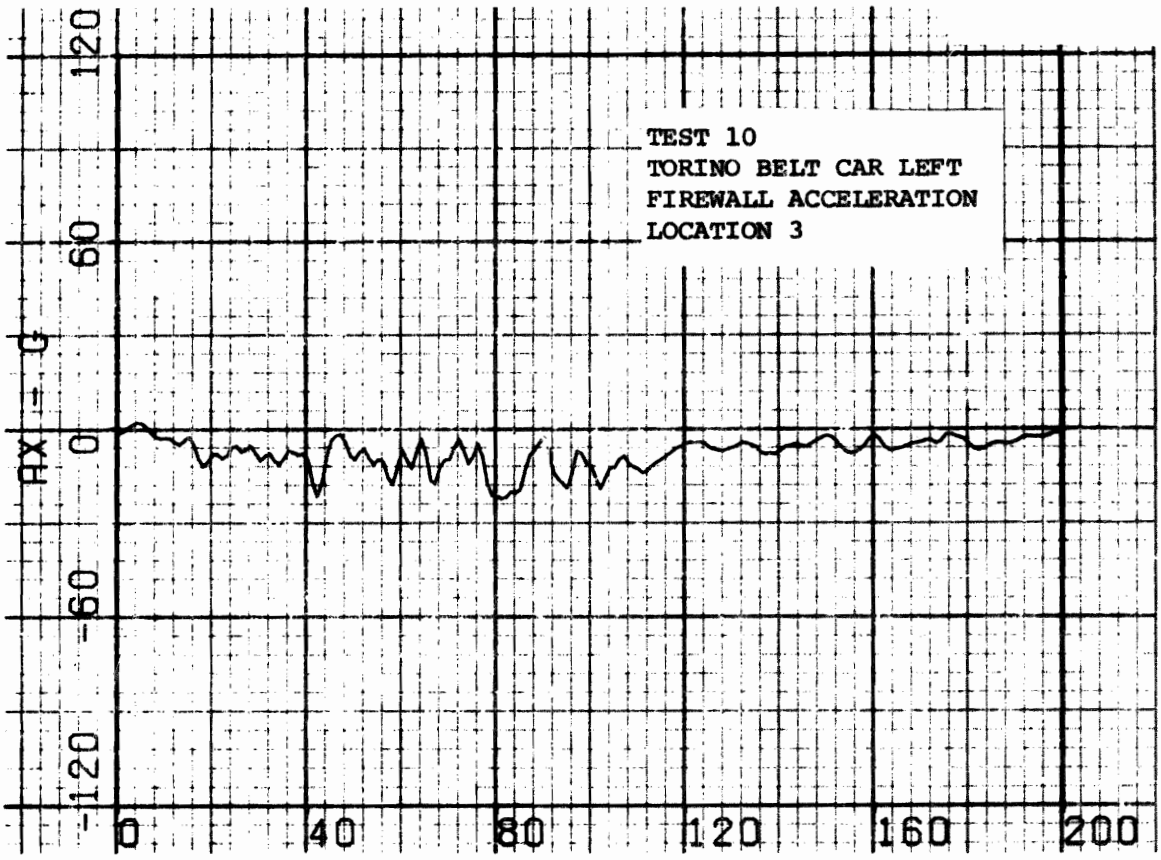

TEST 10
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

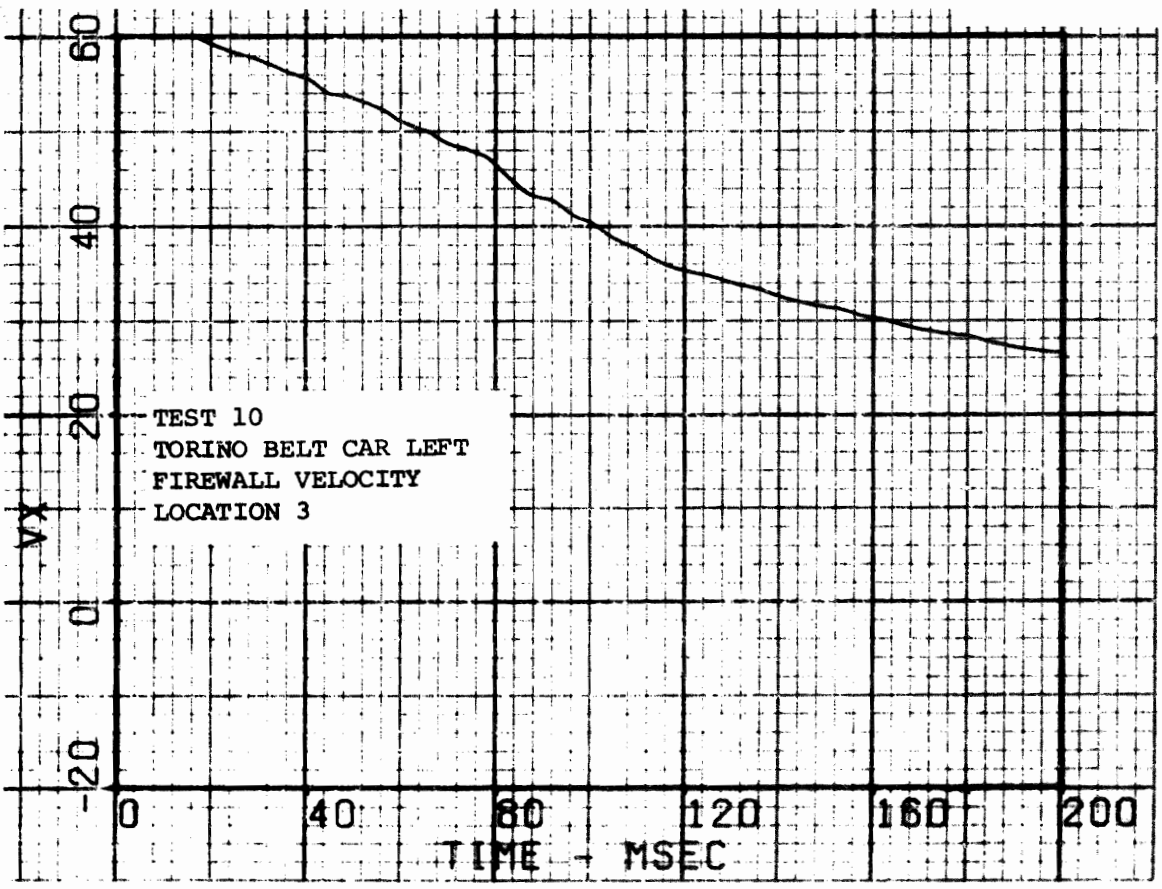

○= AX △= AY
TEST 10
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
TRANSDUCER FAILURE.
Y-AXIS DATA INVALID.
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

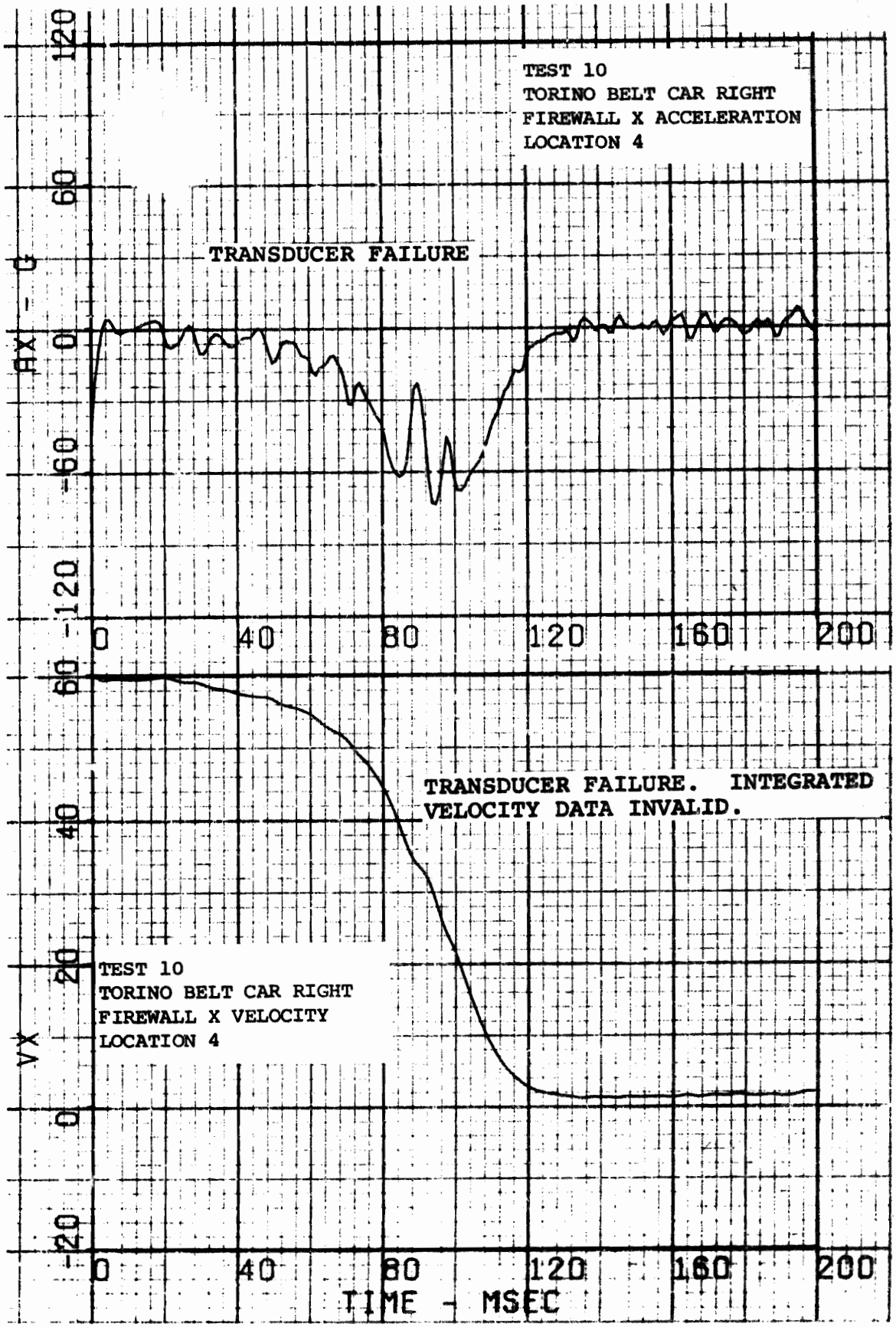

TEST 10
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
Y-AXIS INTEGRATED VELOCITY DATA INVALID
VELOCITY MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

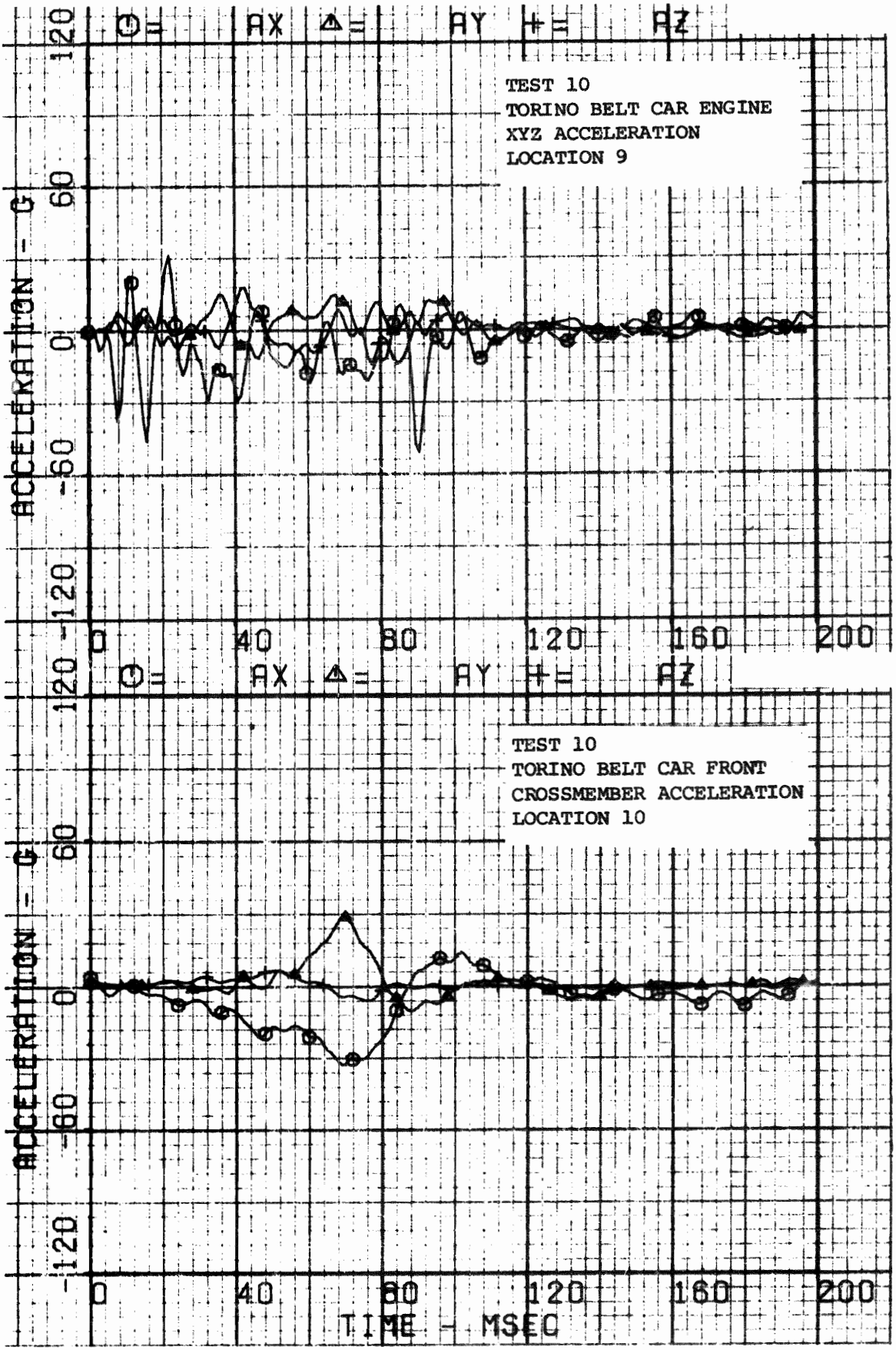

○ = AX △ = AY
TEST 10
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

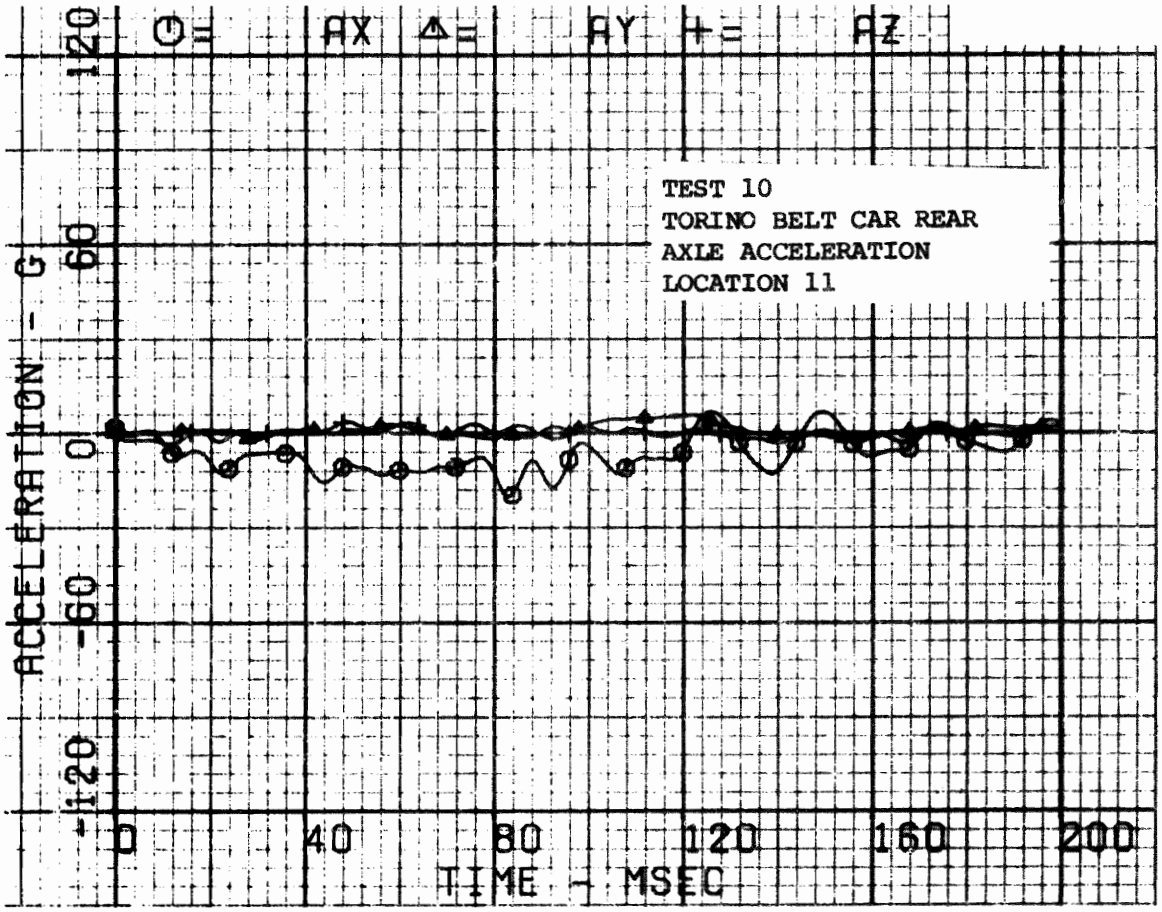

TEST 10
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC


TEST 10
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
RX = G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 10
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME → MSEC


TEST 10
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
TRANSDUCER FAILURE
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TRANSDUCER FAILURE. INTEGRATED VELOCITY DATA INVALID.
TEST 10
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


AX
AY
AZ
TEST 10
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
AX
AY
AZ
TEST 10
TORINO BELT CAR FRONT
CROSSMEMBER ACCELERATION
LOCATION 10
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


○ = AX
△ = AY
+ = AZ
TEST 10
TORINO BELT CAR REAR
AXLE ACCELERATION
LOCATION 11
ACCELERATION - G
+120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

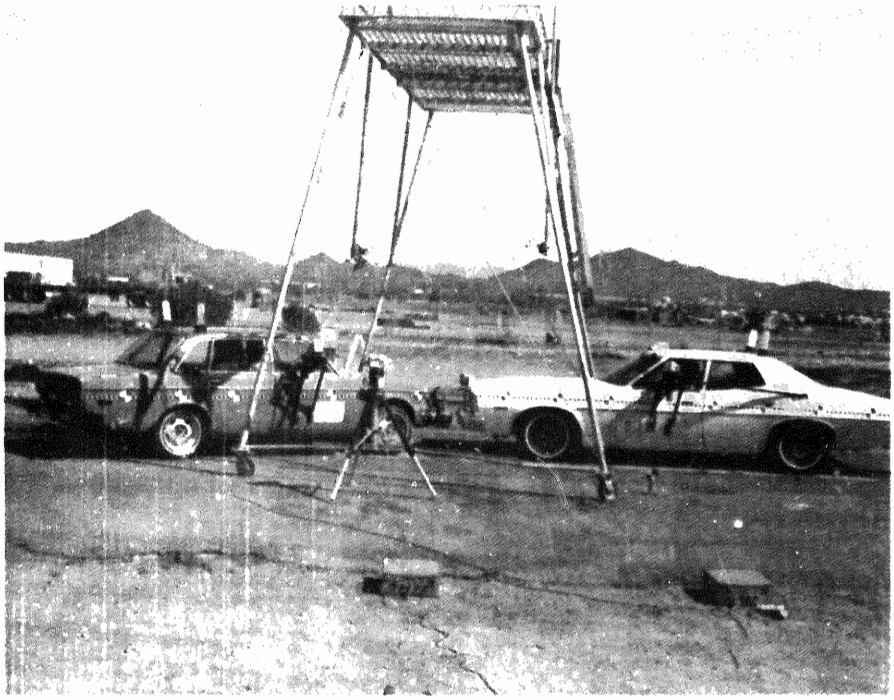


Figure 3-16. Pre-test Vehicle Configuration - Test 10.

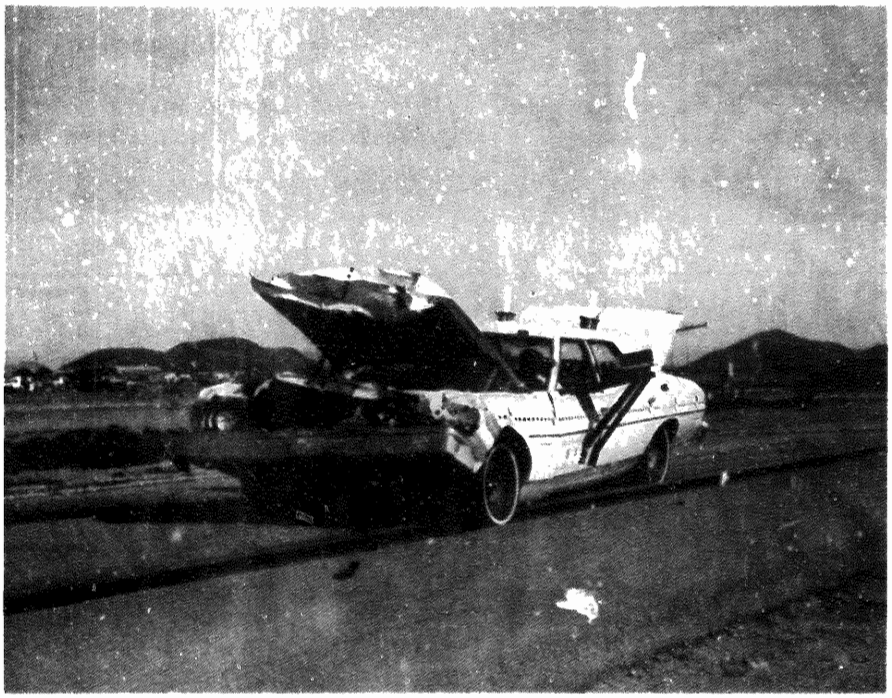


Figure 3-17. Post-test Vehicle Configuration - Test 10.

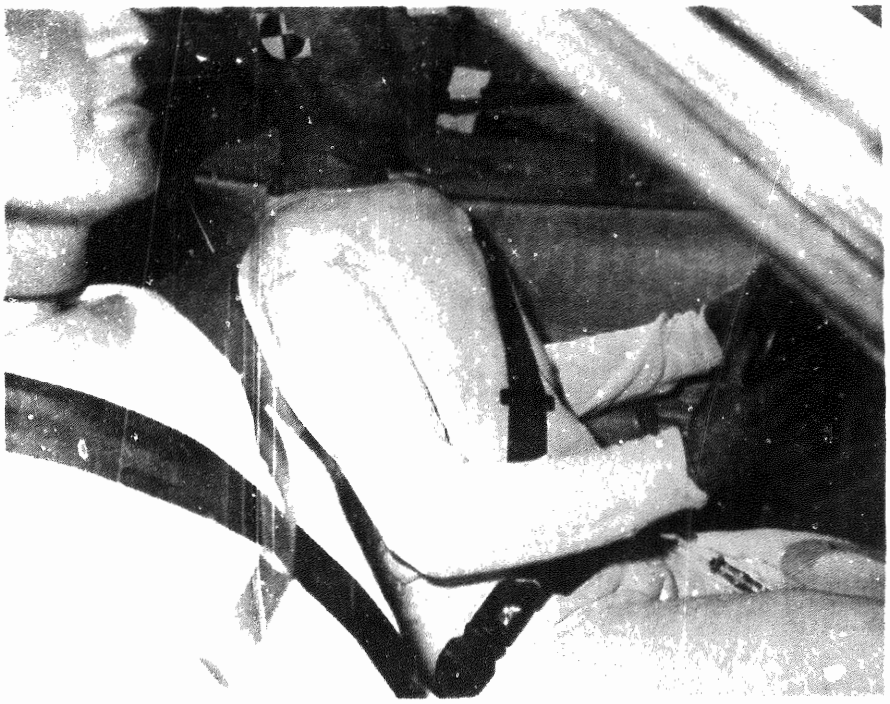


Figure 3-18. Pre-test Standard 3-Point Belt, Left Front - Test 10.

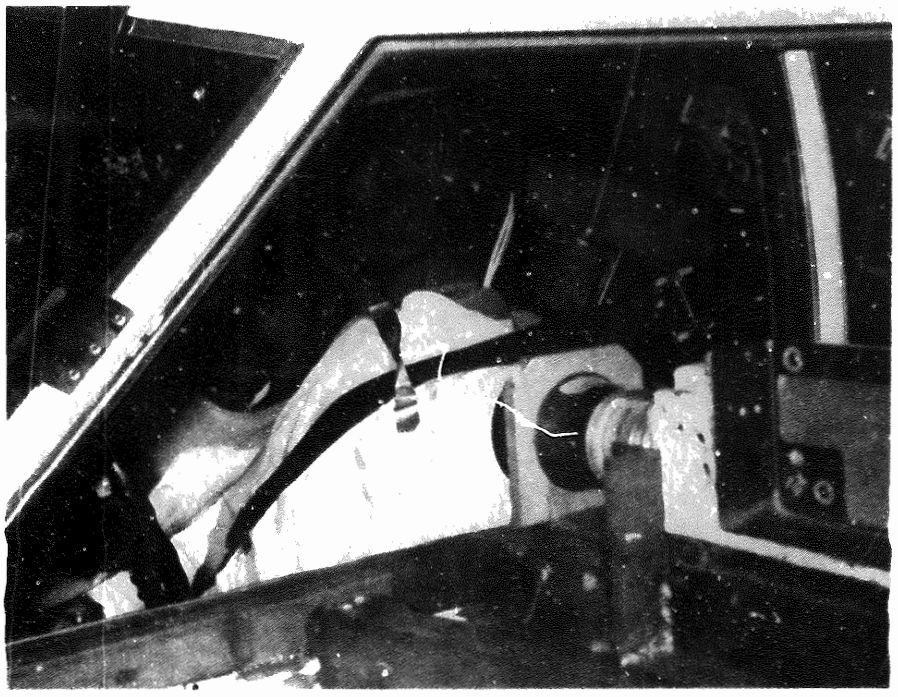


Figure 3-19. Post-test Standard 3-Point Belt, Left Front - Test 10.

Figure 3-20. Pre-test Standard 3-Point Belt, Right Front - Test 10.

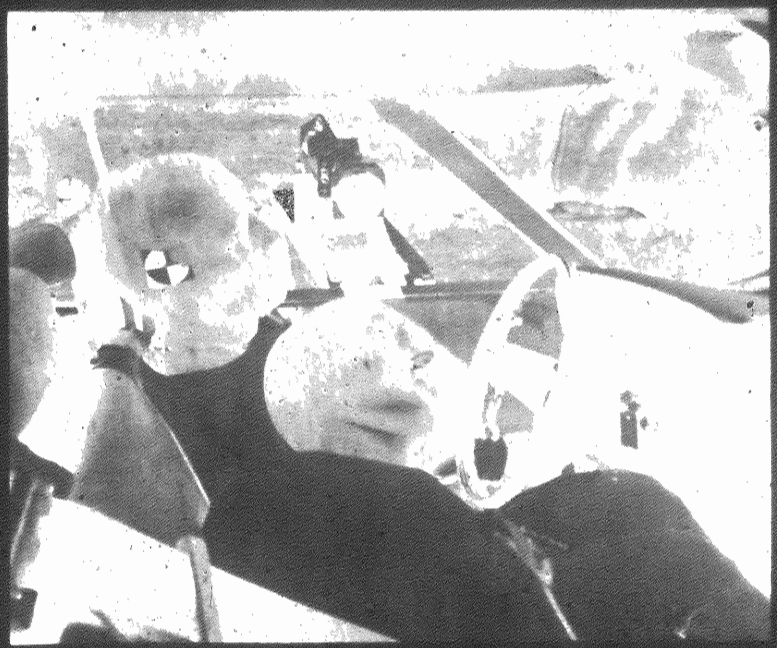


Figure 3-21. Post-test Standard 3-Point Belt, Right Front - Test 10.

3.4 TEST NUMBER 11

The impact conditions for Test 11 were:

Configuration	Closing Speed
Torino-to-Volvo Left Oblique (30°)*	59.5 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt with Web Lockers	Force Limited Airbelt
Right Front	Standard 3-Point Belt with Web Lockers	Force Limited 2-Inch Belt

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 11 are summarized in the following tables:

Table 3-13 - Summary of Vehicle Data (Test 11)

Table 3-14 - Injury Criteria Summary (Test 11)

Table 3-15 - Summary of Restraint System Data (Test 11)

Table 3-16 - Occupant Response Data (Test 11)

which are followed by Figure 3-22 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 3-13. SUMMARY OF VEHICLE DATA (TEST 11)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 11/March 11, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		486	428
TEST WEIGHT (lb)		4698	3214
IMPACT VELOCITY (mph)		59.5	0
VELOCITY CHANGE (mph)		26.7	35.1 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	25.9 @ 103	41.0 @ 65
	LOCATION 2	23.1 @ 194	41.8 @ 76
MAXIMUM STATIC CRUSH (in.)			
	LEFT	11.0	49.0
	CENTER	27.0	21.5
	RIGHT	18.0	9.0

(1) Velocity change found by using average of resultant velocity vector (V_R) data for compartment accelerometer locations.

TABLE 3-14. INJURY CRITERIA SUMMARY (TEST 11)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT W/WEB LOCKERS		STANDARD 3-POINT BELT W/WEB LOCKERS	
HIC	142		258	
HEAD G(1) @ msec	25.2 @ 116		32.2 @ 133	
CSI	104		110	
CHEST G(1) @ msec	22.8 @ 110		22.2 @ 133	
FEMUR LOAD (lb) (2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

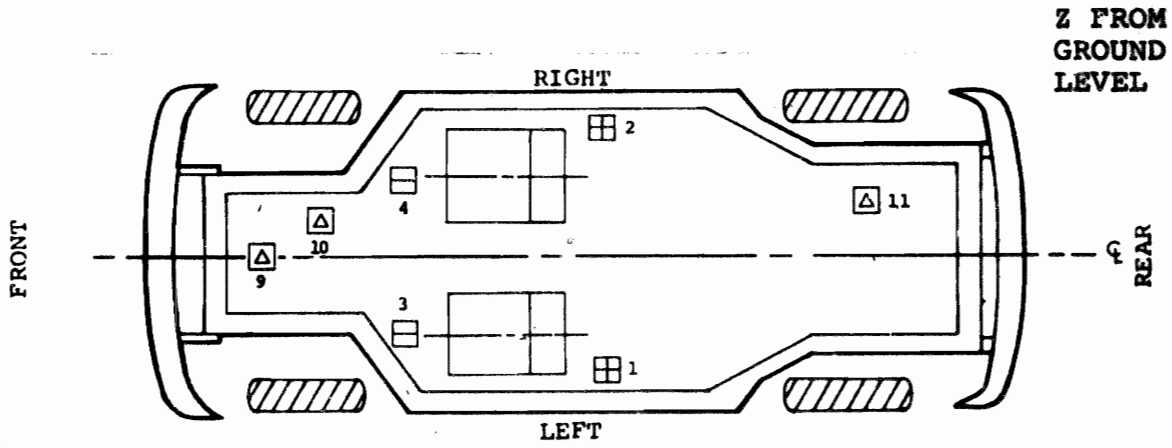
TABLE 3-15. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 11)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1589 @ 110
Peak Lap Belt Load	lb @ msec	594 @ 98
Peak Vertical Belt Load	lb @ msec	165 @ 108
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1522 @ 115
Peak Lap Belt Load	lb @ msec	254 @ 104

TABLE 3-16. OCCUPANT RESPONSE DATA SUMMARY (TEST 11)

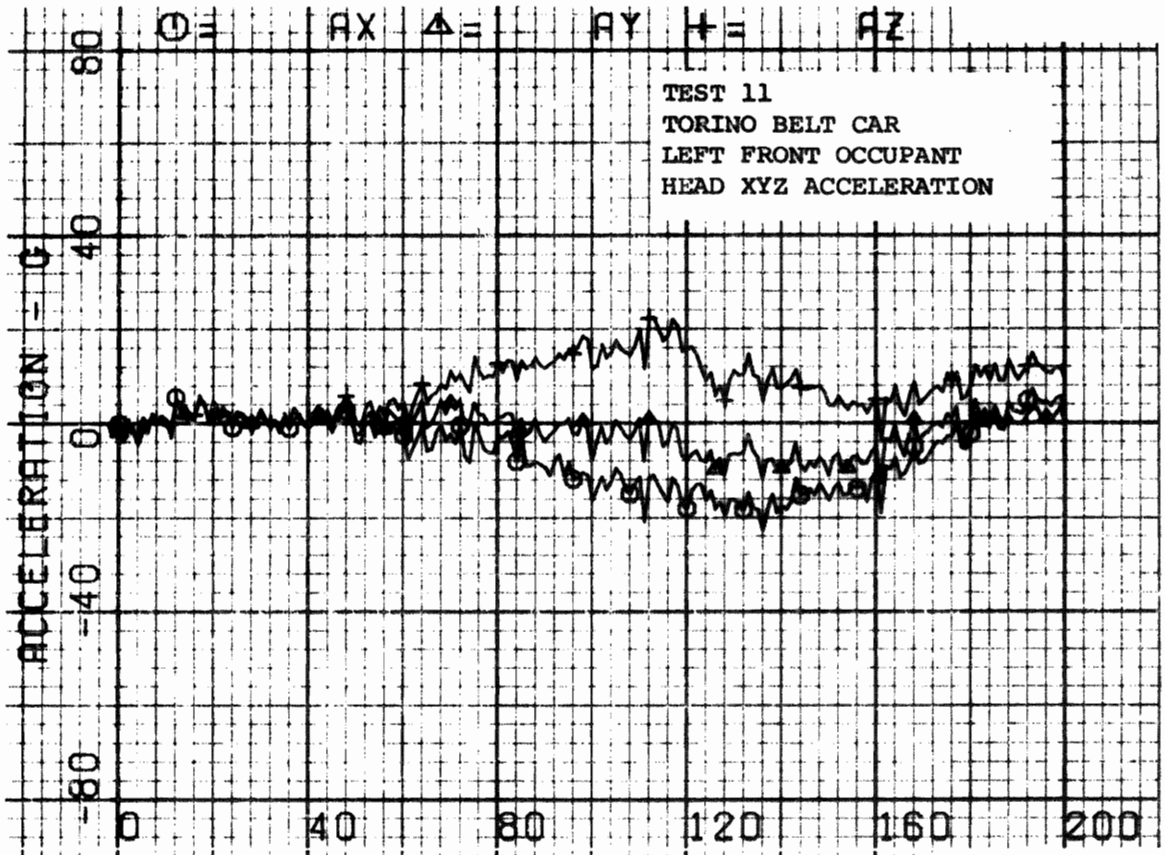
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	22.9	136	29.8	136
	Y	12.7	161	16.9	135
	Z	22.5	113	26.9	117
	R(1)	25.2	116	32.2	133
	HIC	142 @ 69-200		258 @ 88-165	
CHEST					
	X	22.8	108	20.7	104
	Y	9.6	126	17.2	134
	Z	12.2	133	13.9	137
	R(1)	22.8	110	22.2	133
	SI	104 @ 200		110 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (2)					
	LF	NA		NA	
	RT	NA		NA	

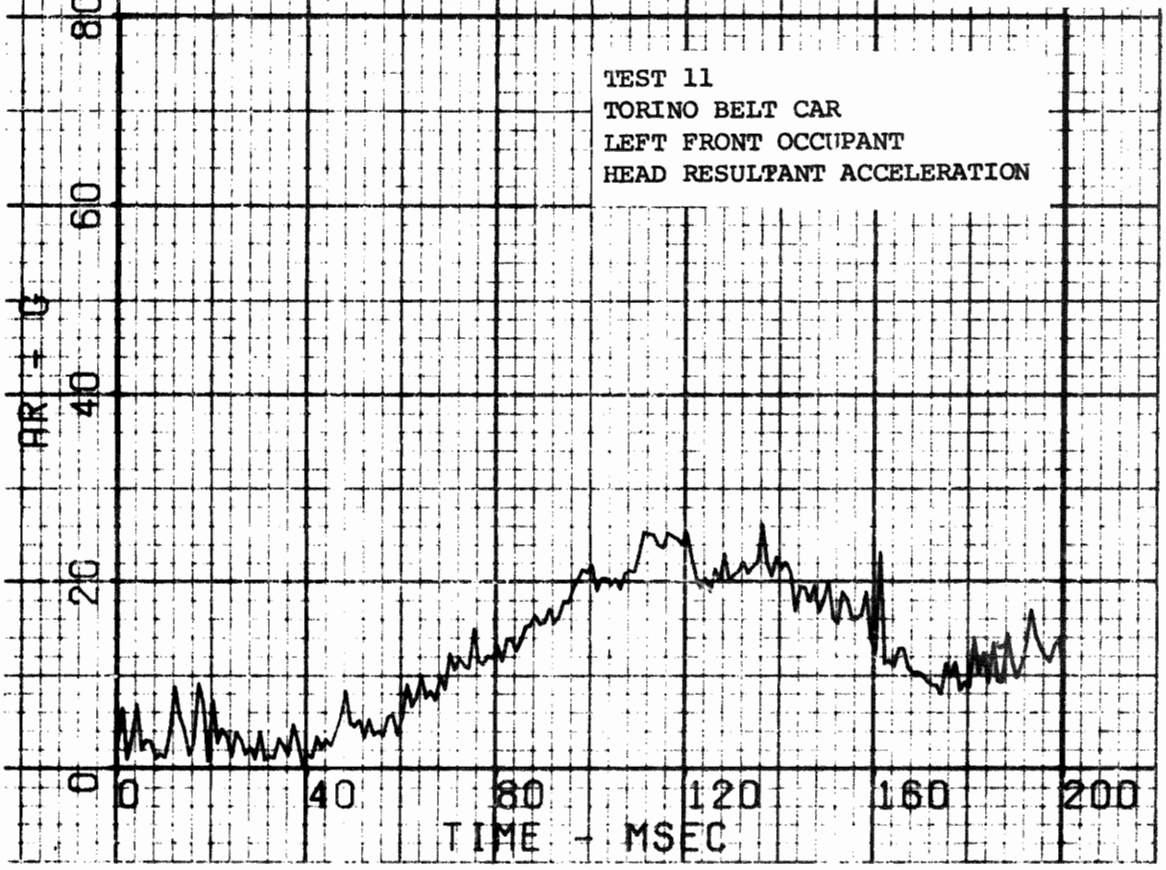
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

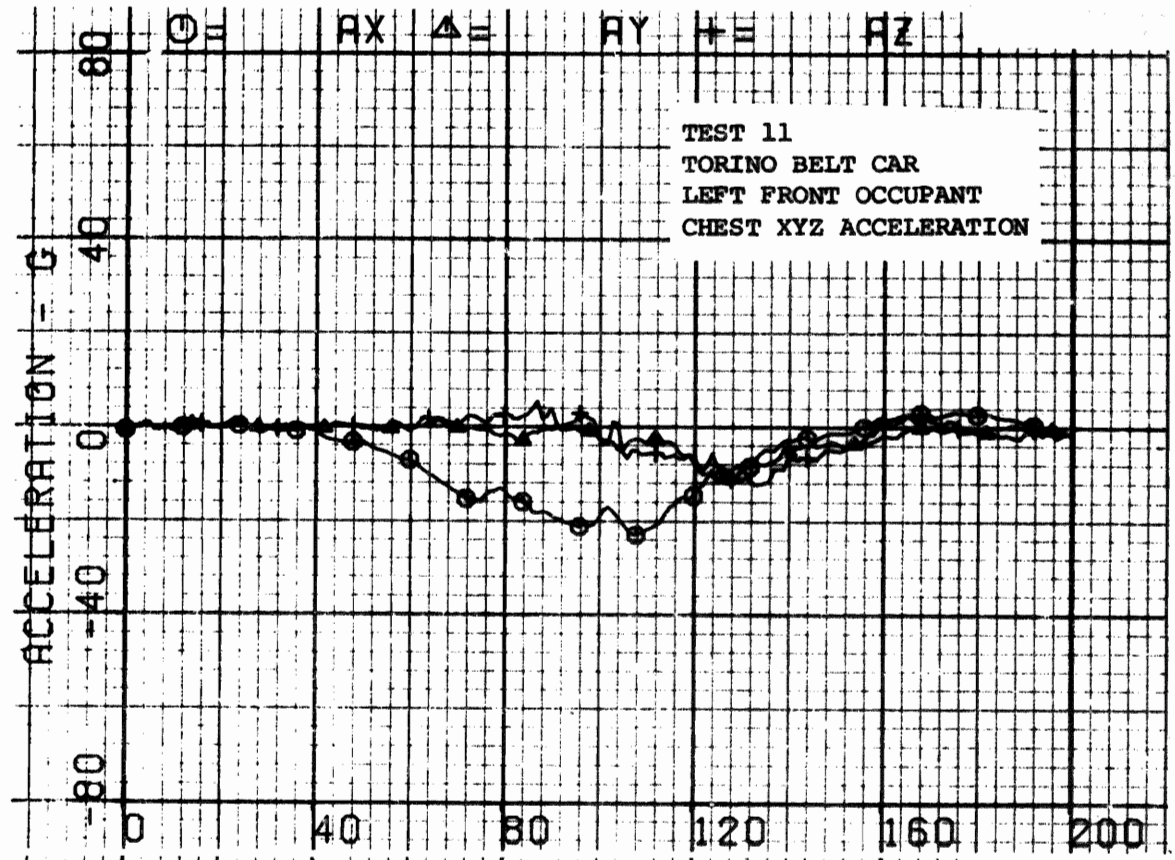


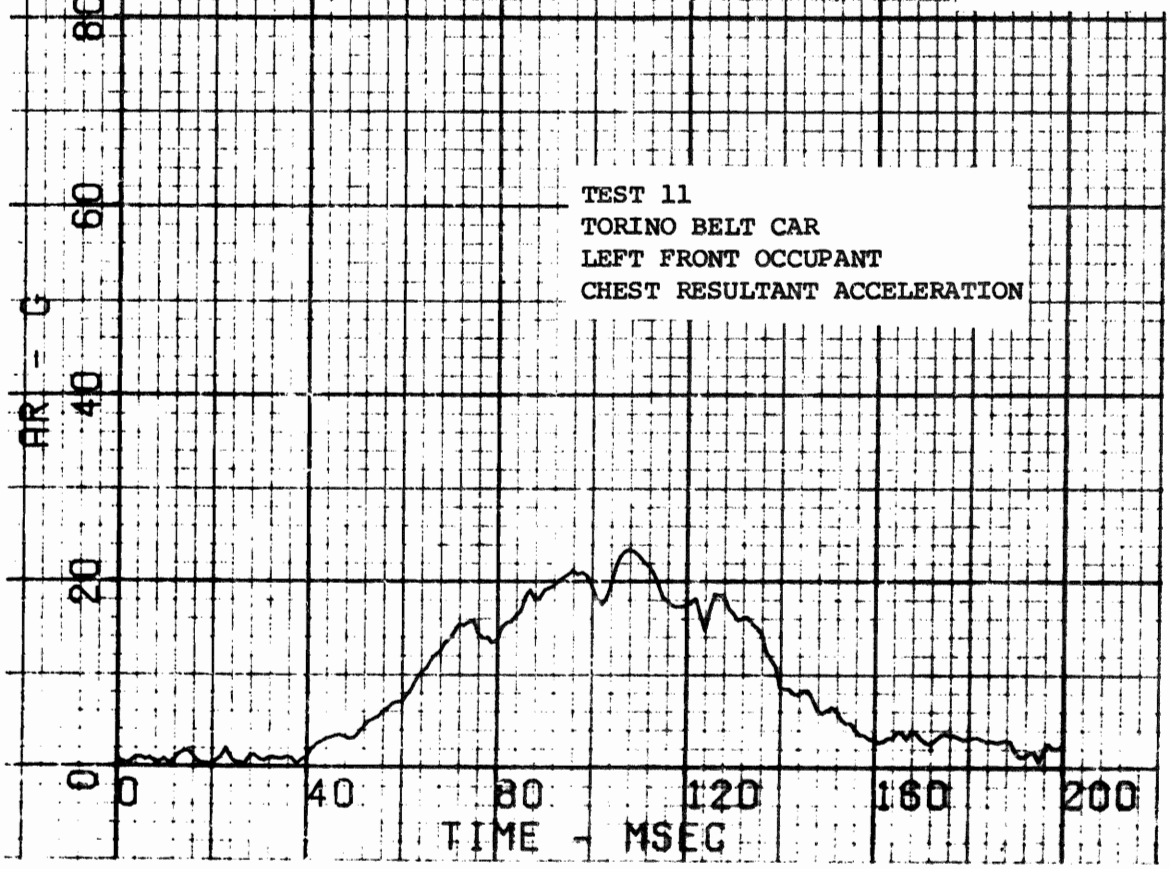
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

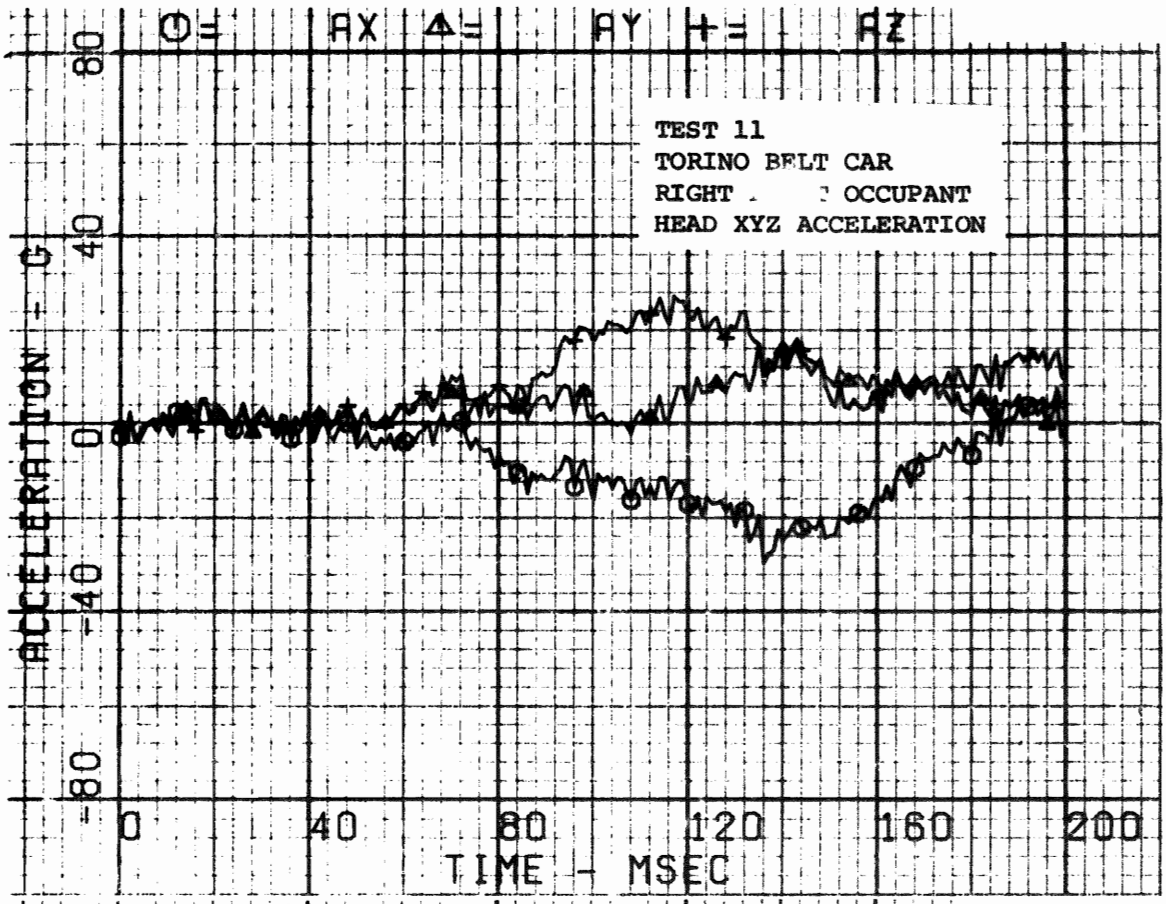
Figure 3-22. Vehicle Accelerometer Locations - Test 11.

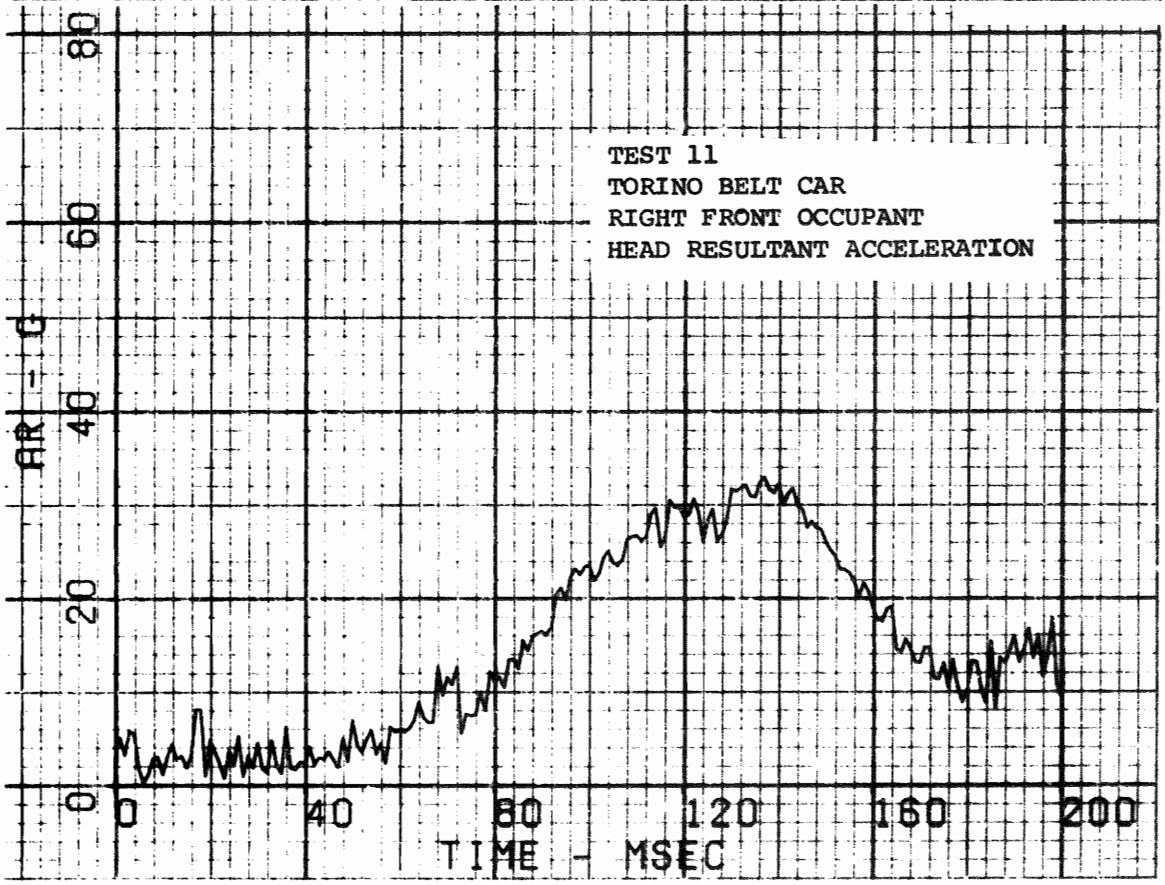

O= AX Δ= AY += AZ
TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

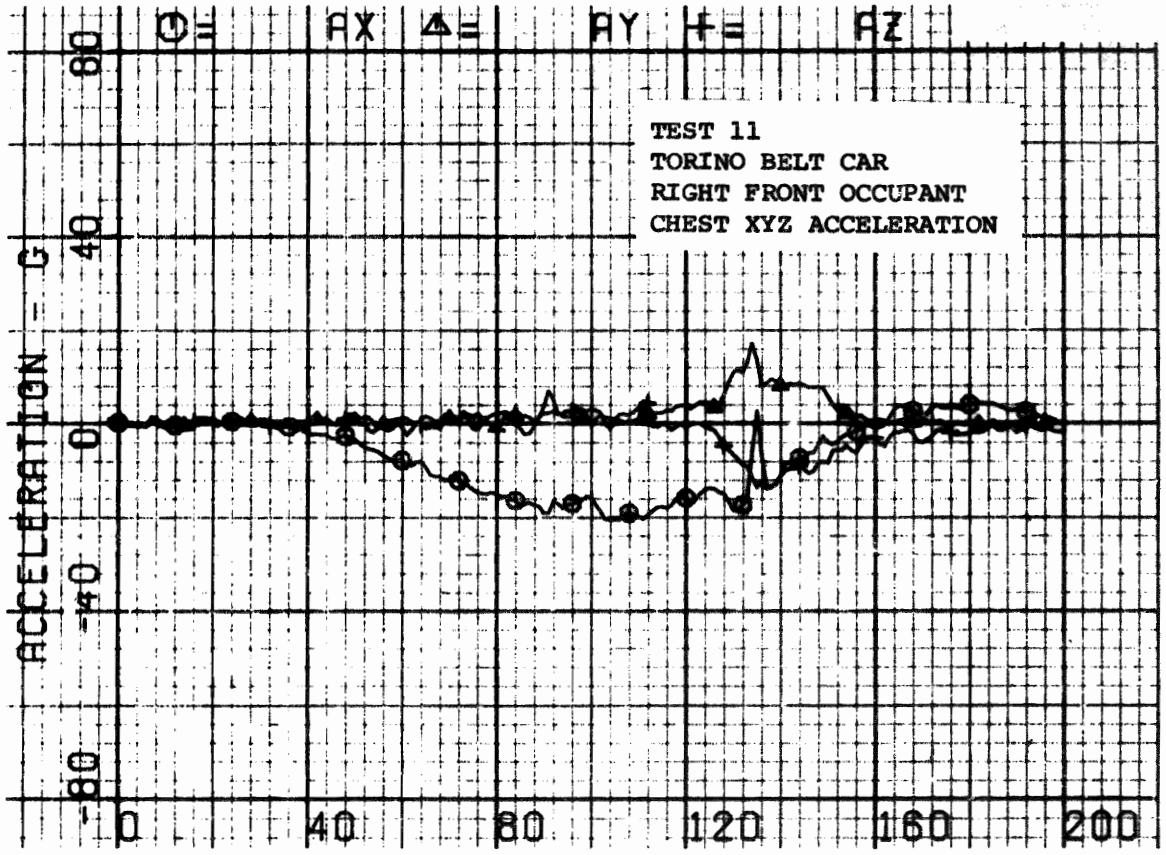

TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

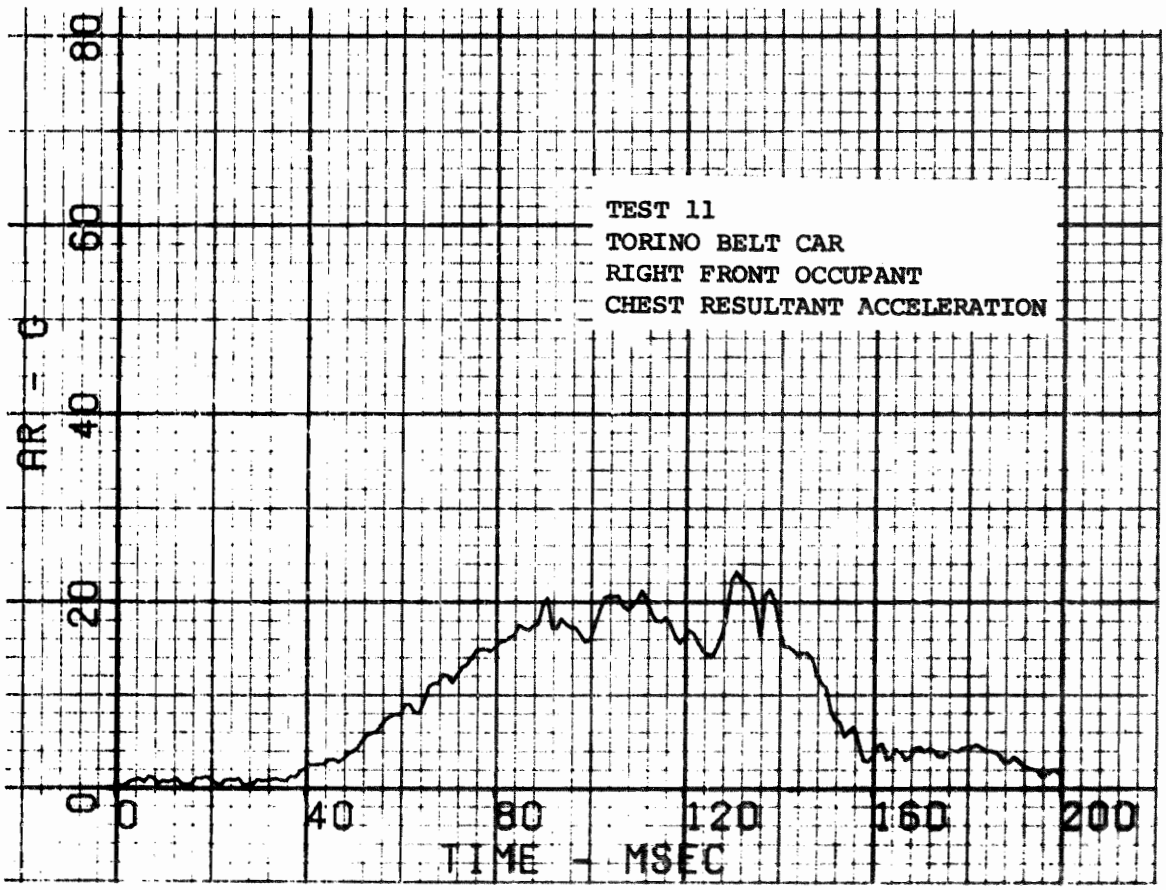

⊙= AX Δ= AY += AZ
TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

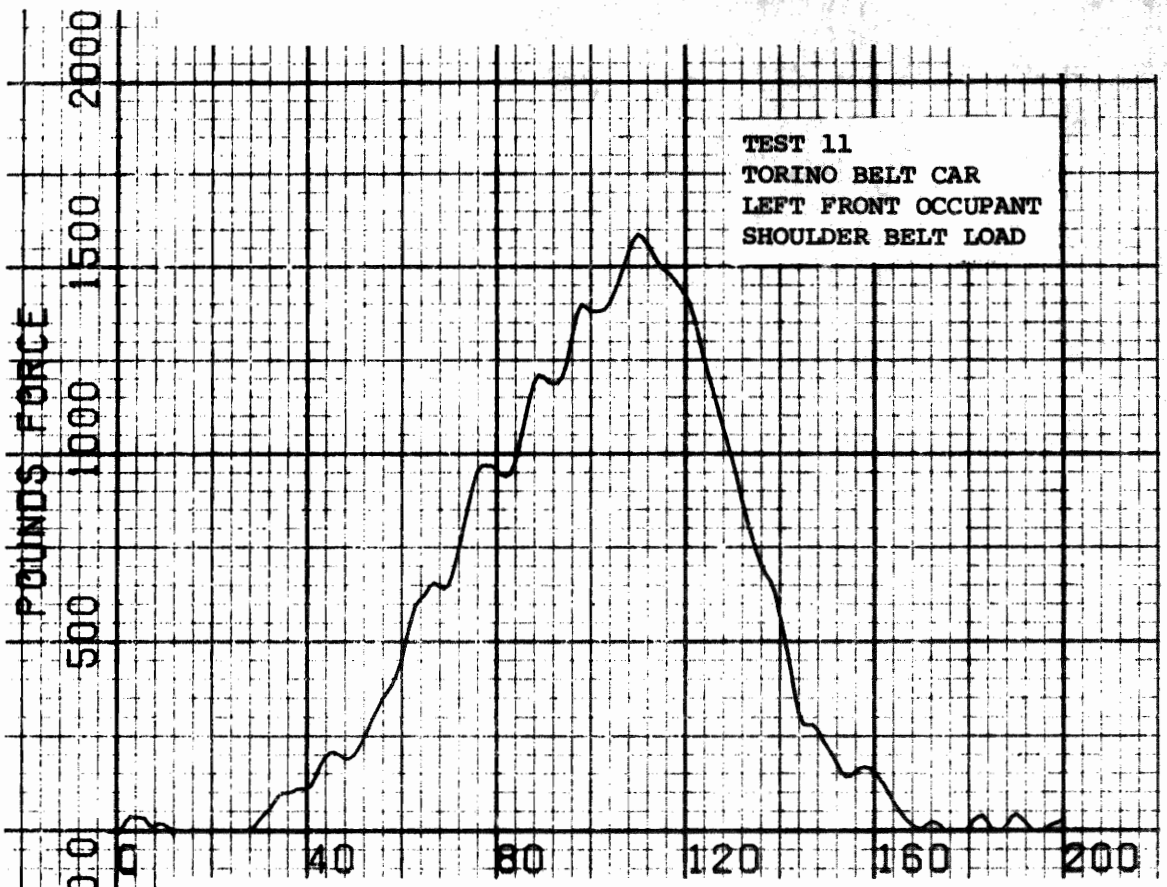

TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

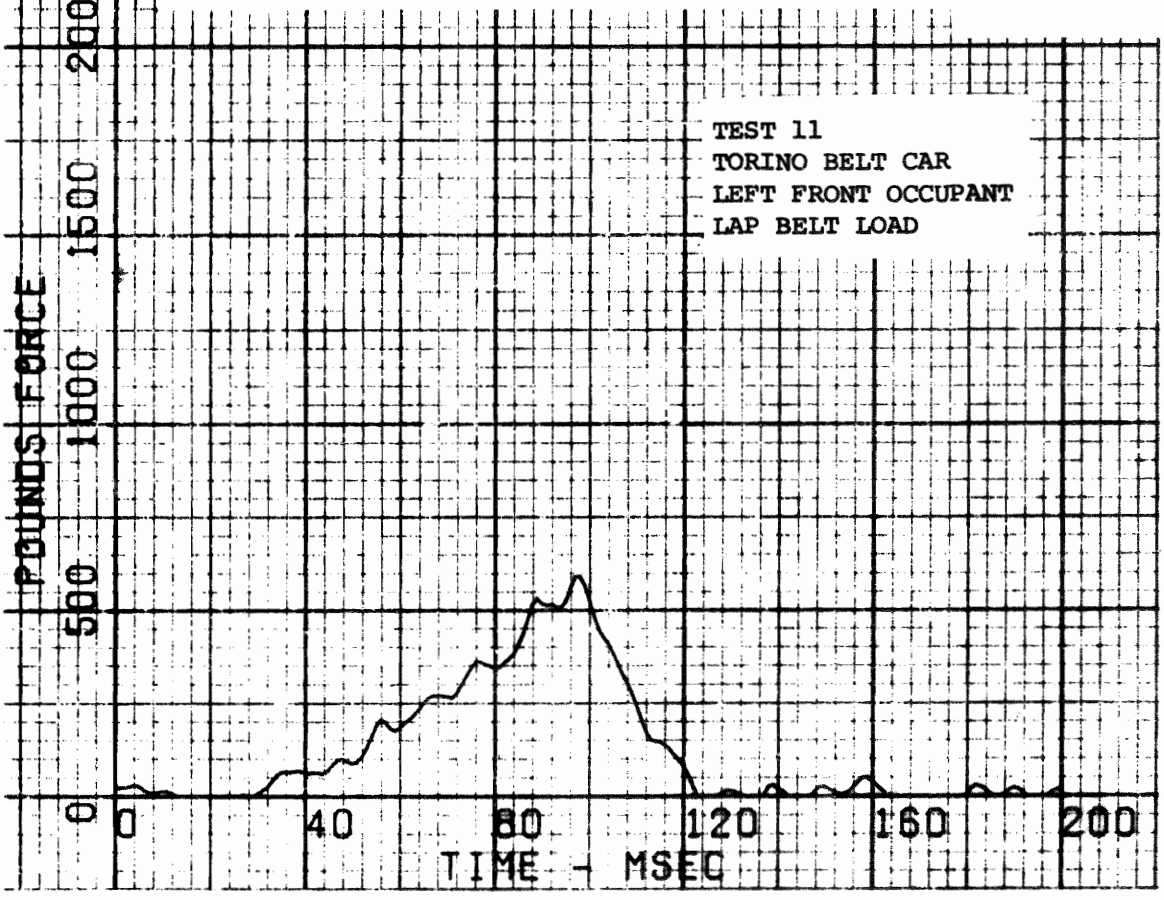

⊙= AX △= AY += AZ
TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TIME - MSEC

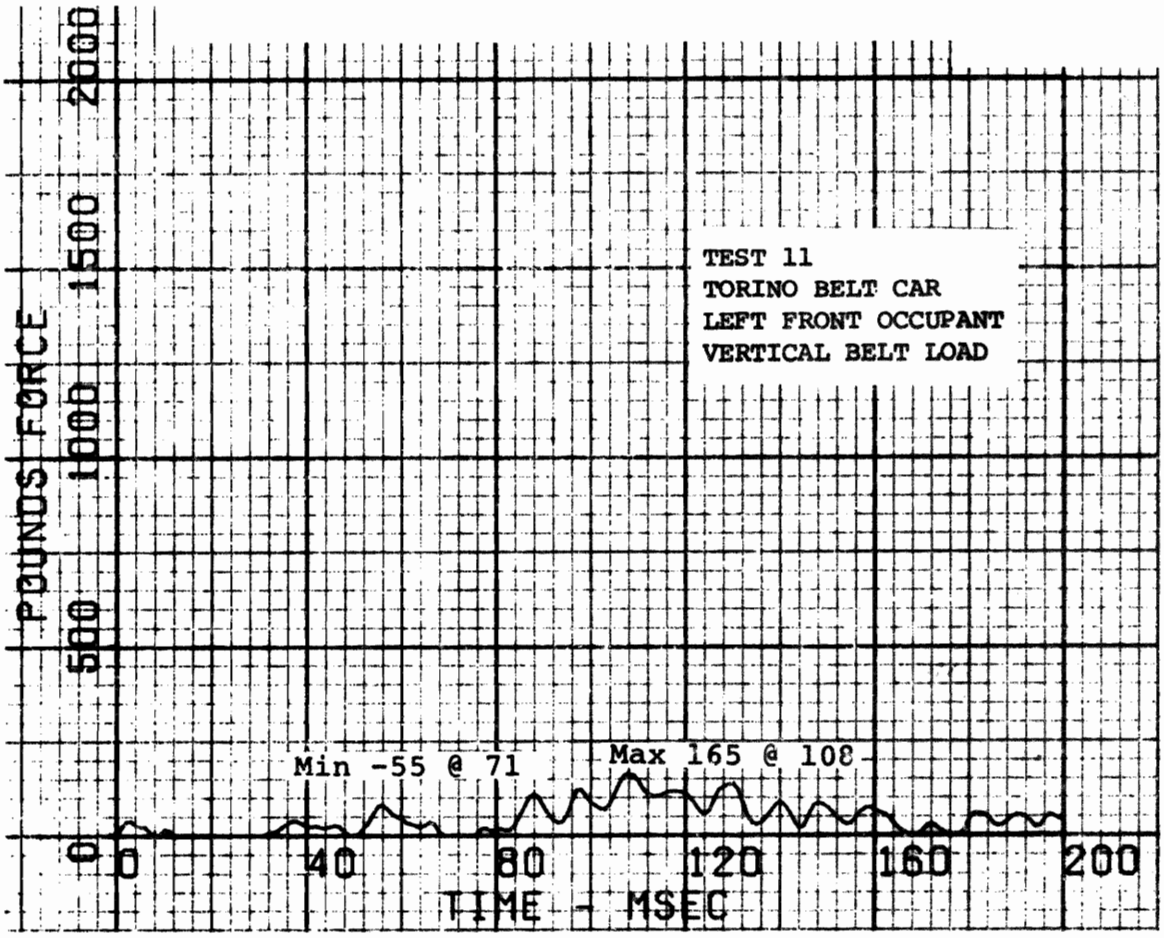

TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

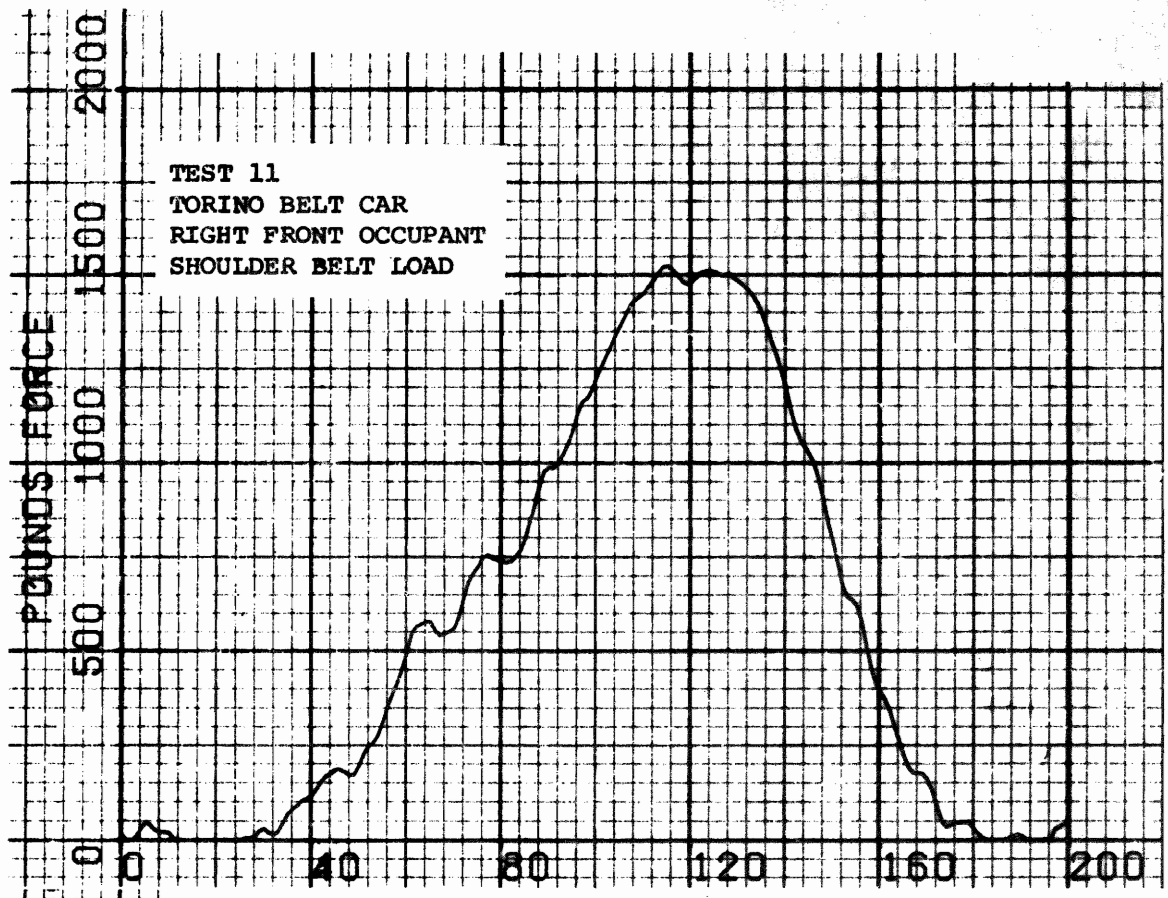

⊖= AX
△= AY
+= AZ
TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

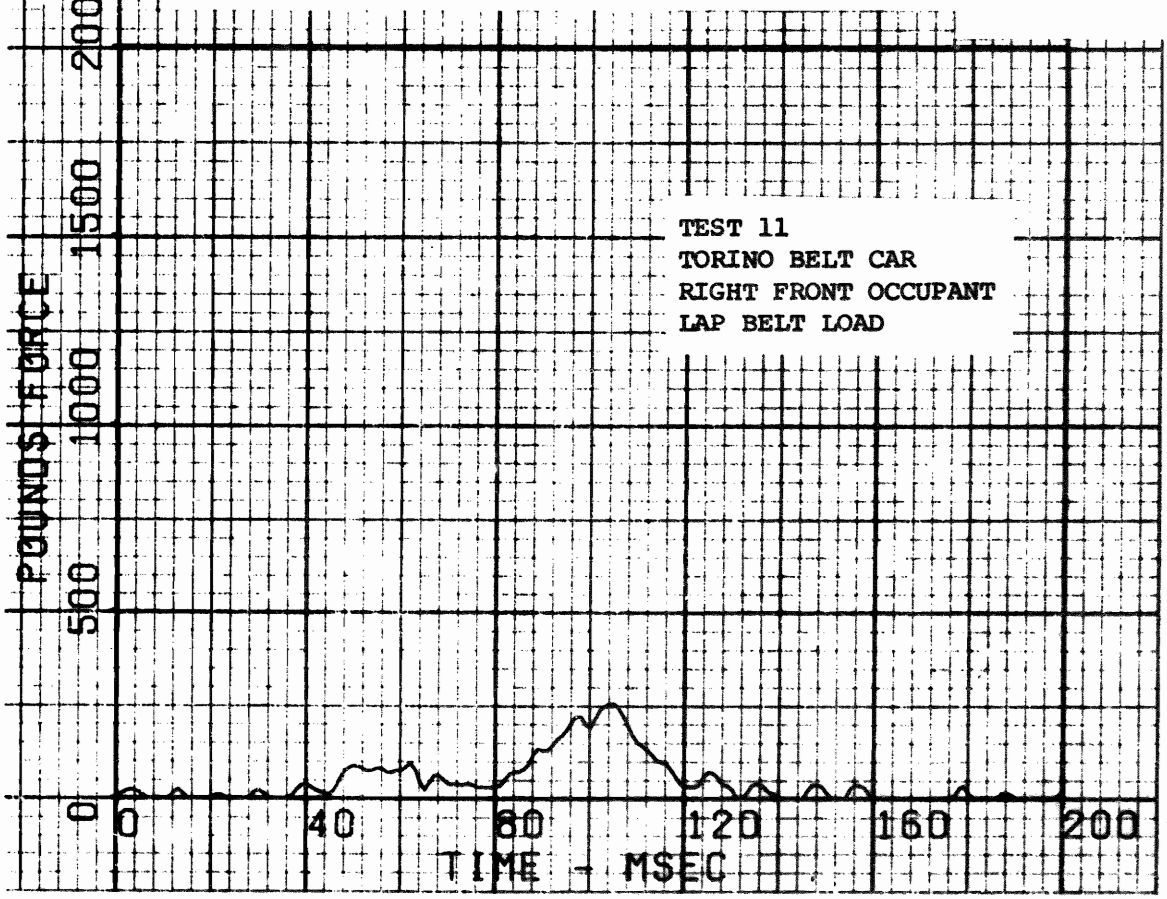

TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

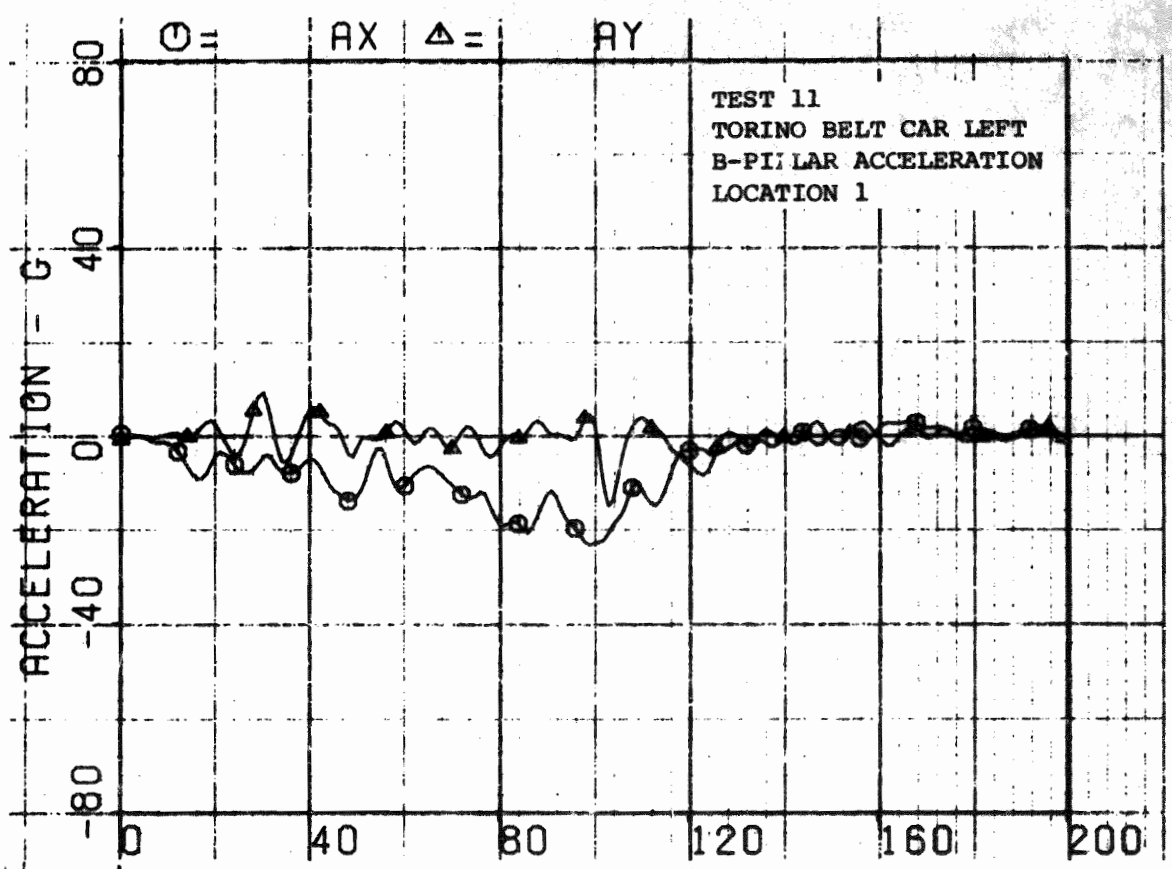

TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

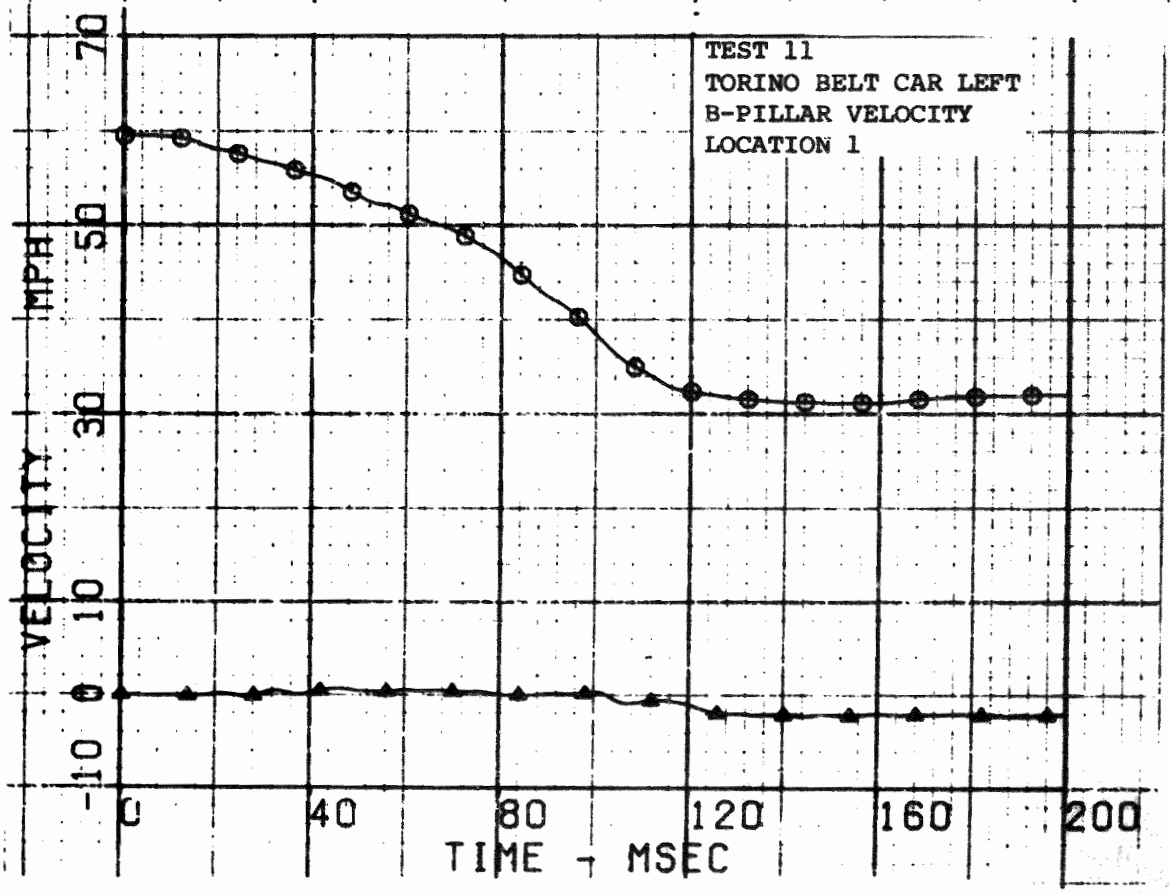

TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

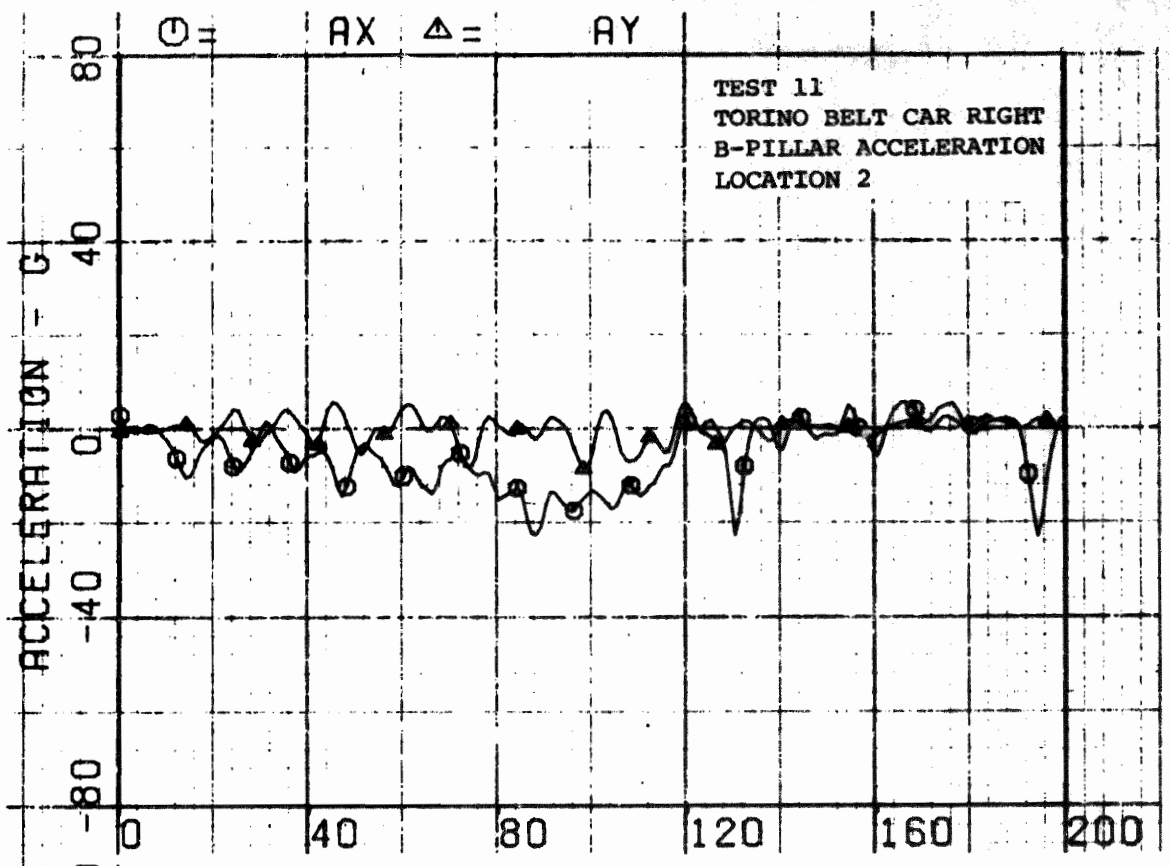

TEST 11
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
Min -55 @ 71
Max 165 @ 108
0
40
80
120
160
200
TIME - MSEC

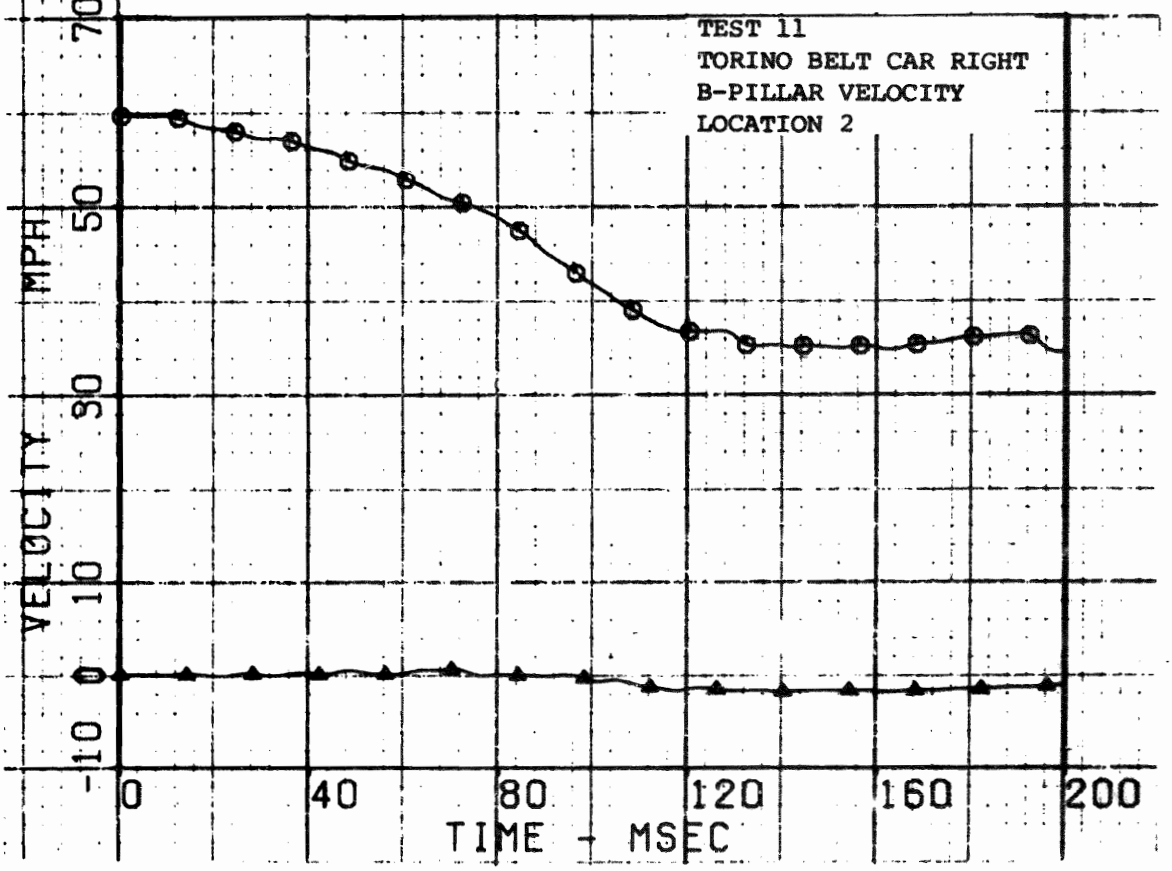

TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

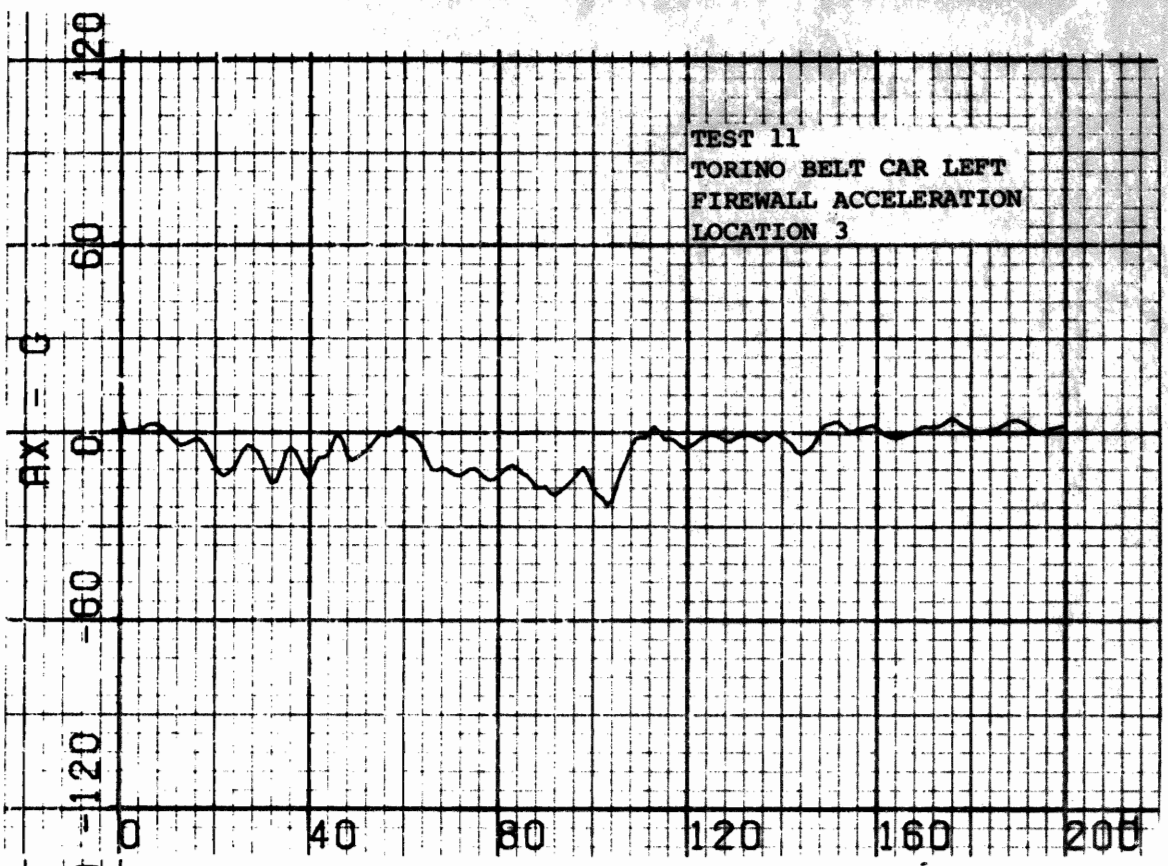

TEST 11
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

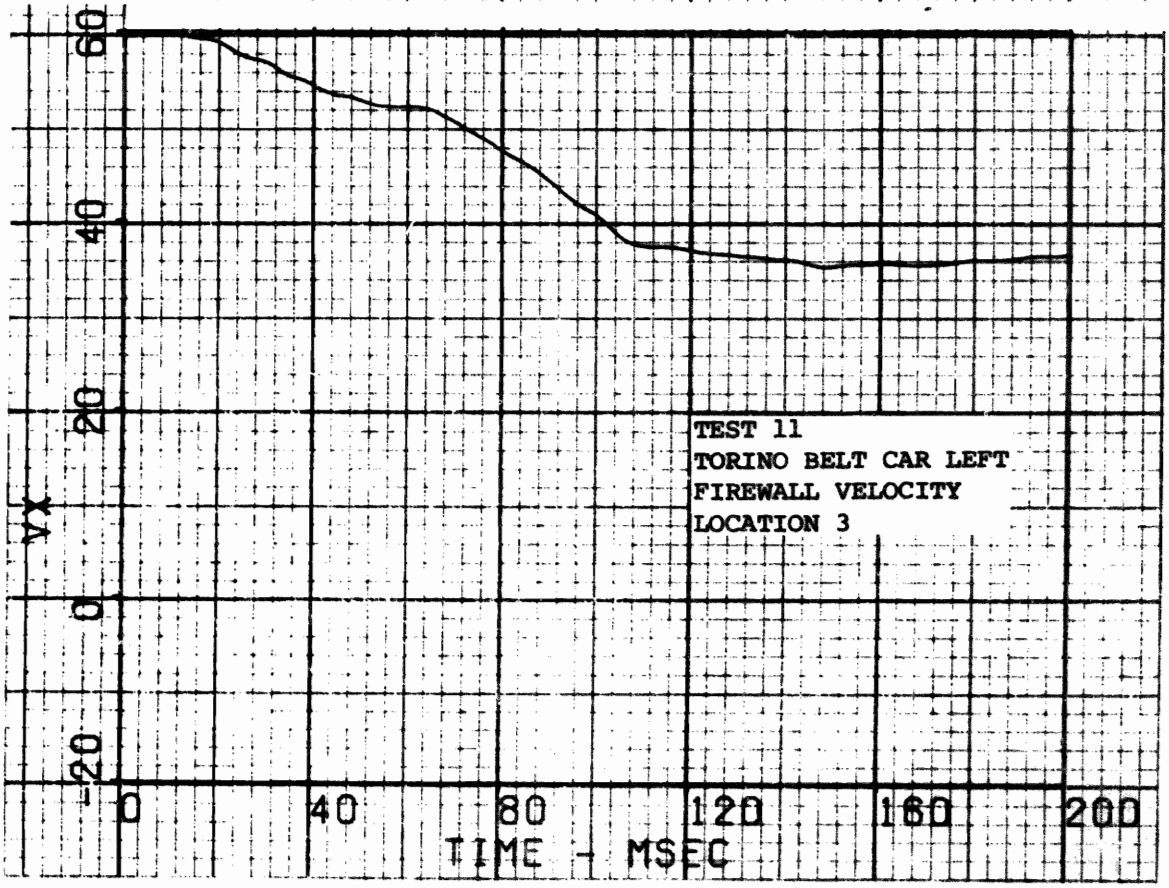

⊖ = AX ⊿ = AY
TEST 11
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

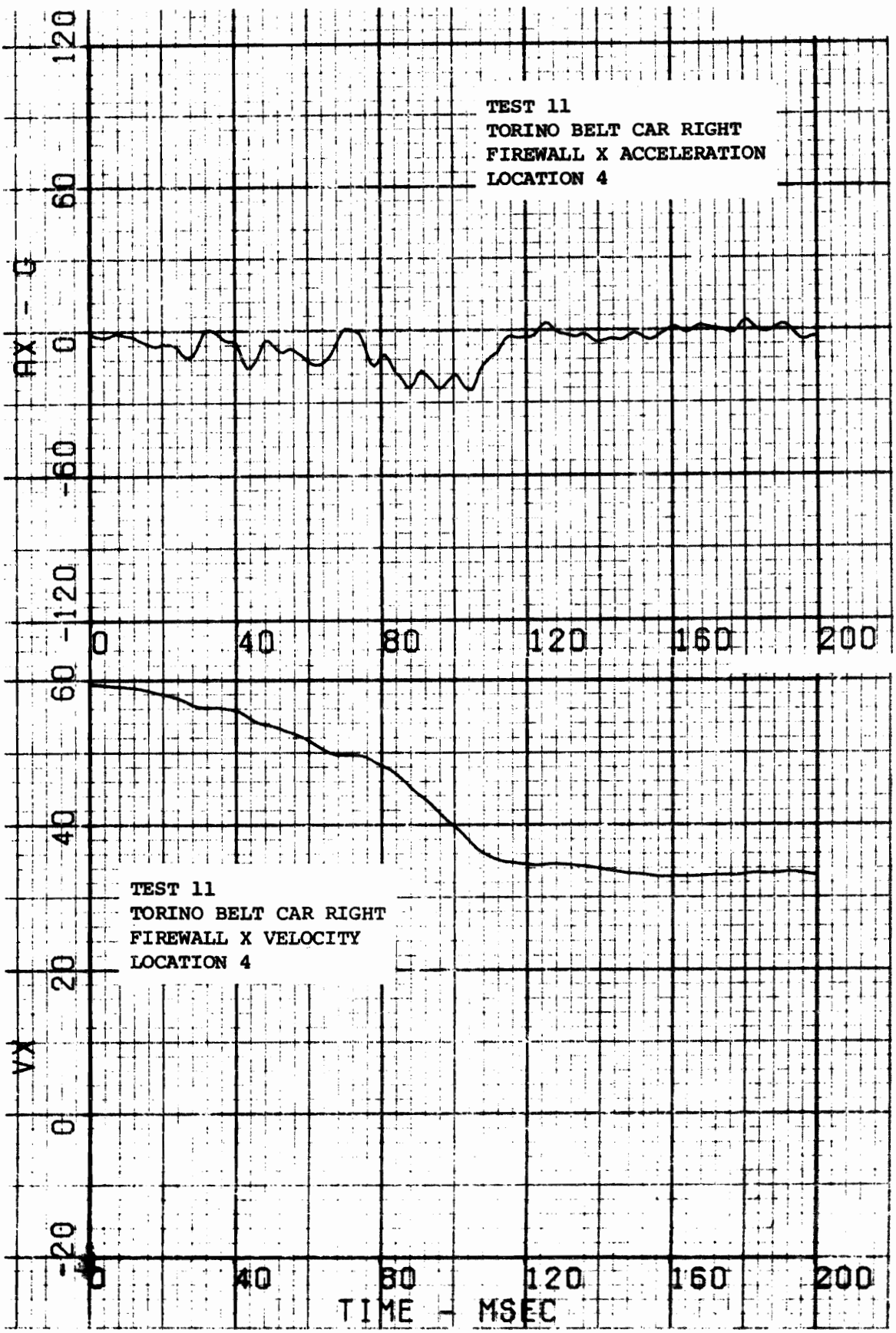

TEST 11
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

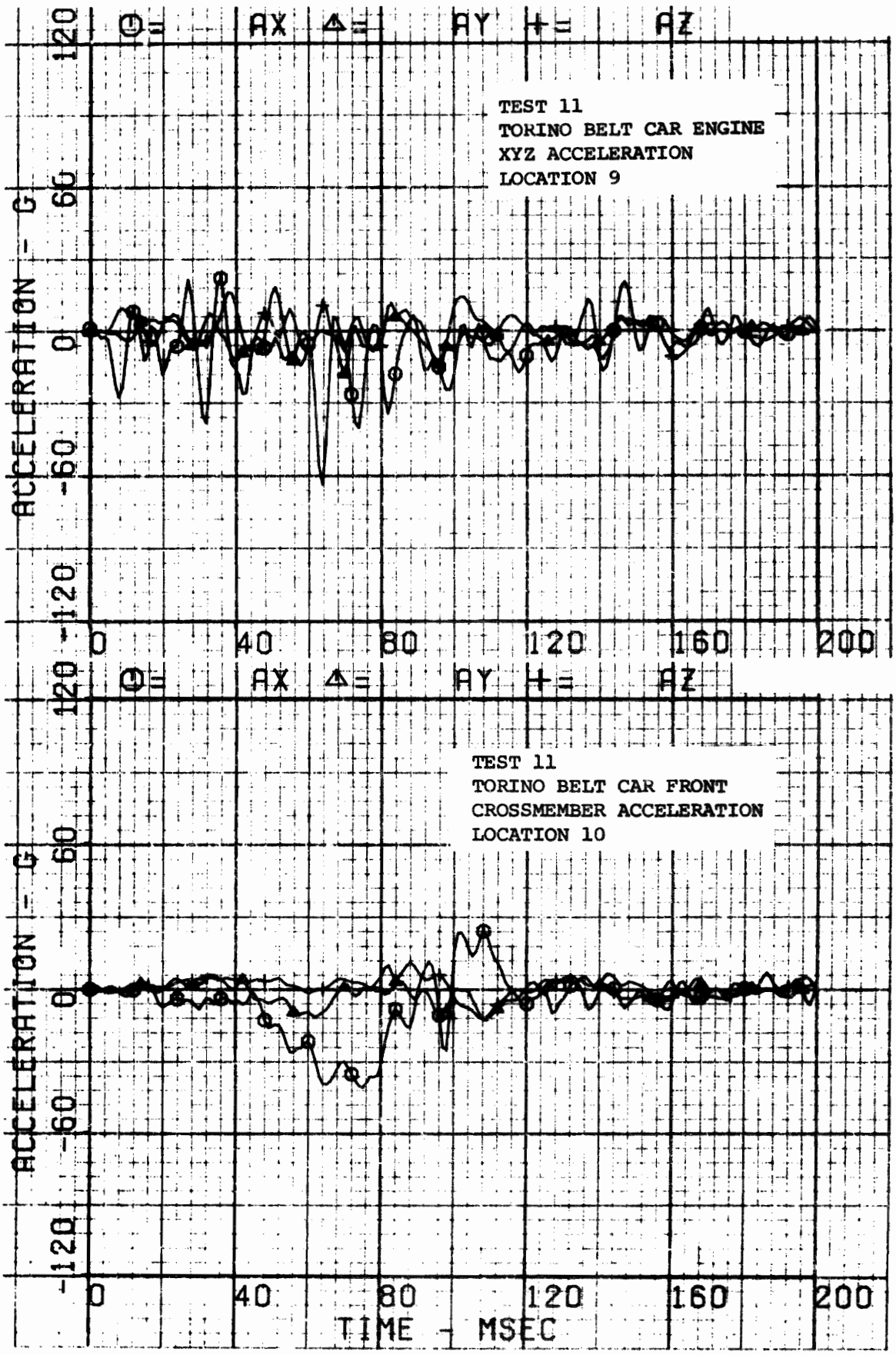

⊙= AX △= AY
TEST 11
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

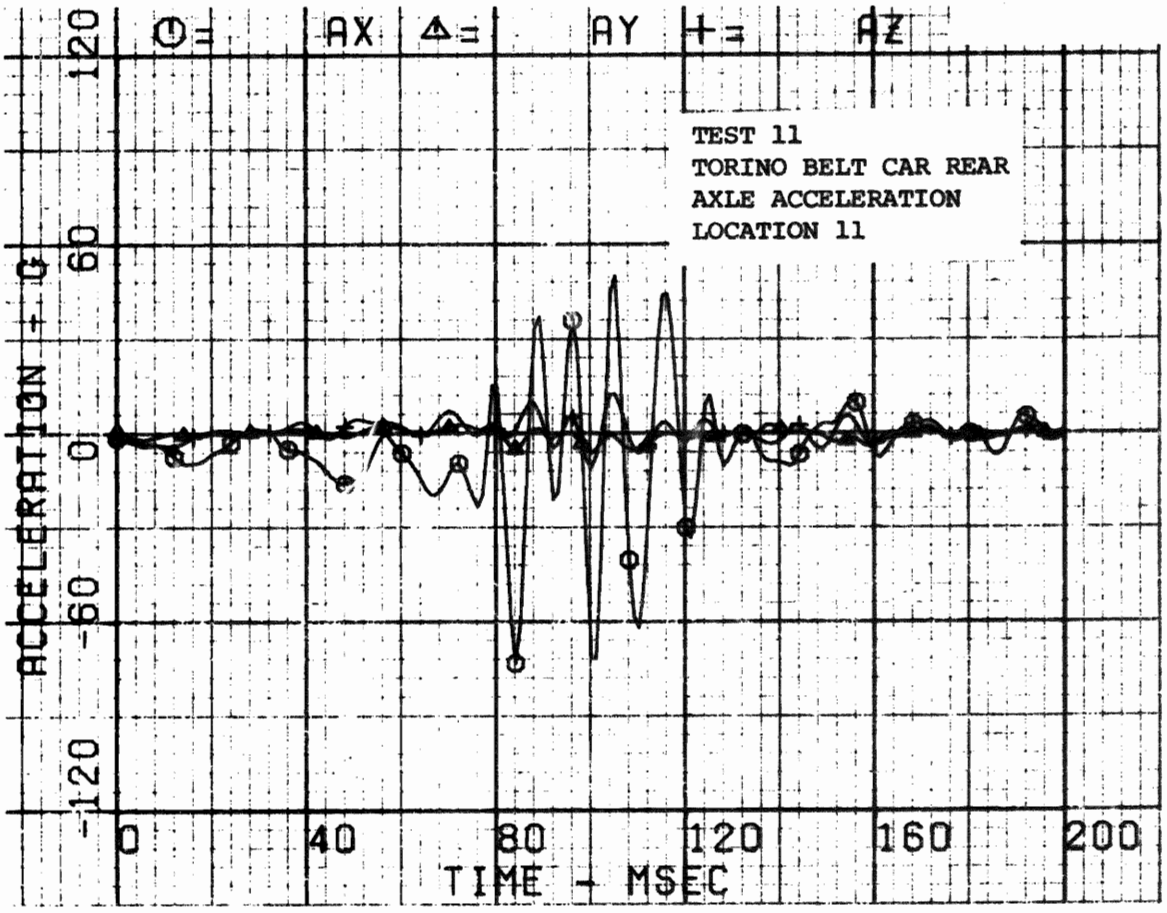

TEST 11
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC


TEST 11
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
AX = G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 11
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME → MSEC


TEST 11
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 11
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


AX
AY
AZ
TEST 11
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
AX
AY
AZ
TEST 11
TORINO BELT CAR FRONT
CROSSMEMBER ACCELERATION
LOCATION 10
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


⊙= AX
△= AY
+= AZ
TEST 11
TORINO BELT CAR REAR
AXLE ACCELERATION
LOCATION 11
ACCELERATION ± G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

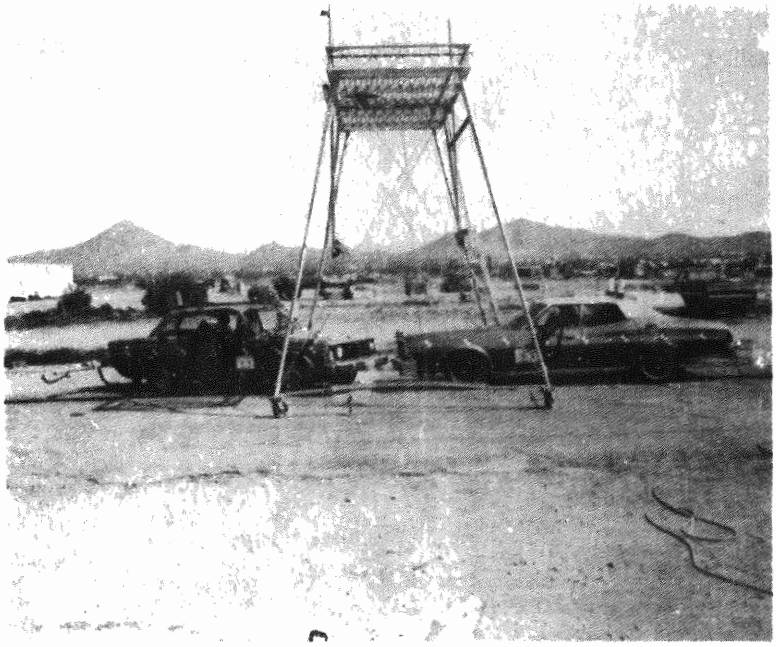


Figure 3-23. Pre-test Vehicle Configuration - Test 11.

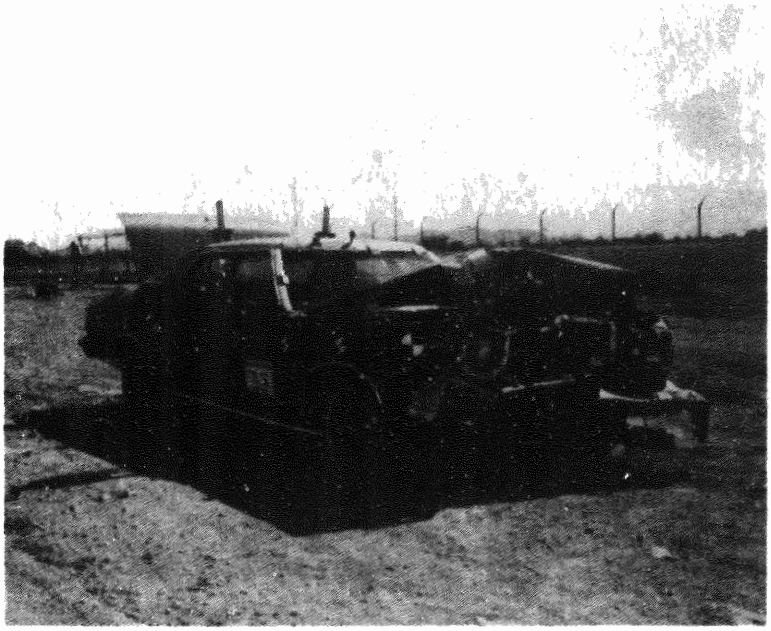


Figure 3-24. Post-test Vehicle Configuration - Test 11.

Figure 3-25. Pre-test Standard 3-Point Belt With Web Lockers, Left Front - Test 11.

Figure 3-26. Post-test Standard 3-Point Belt With Web Lockers, Left Front - Test 11.

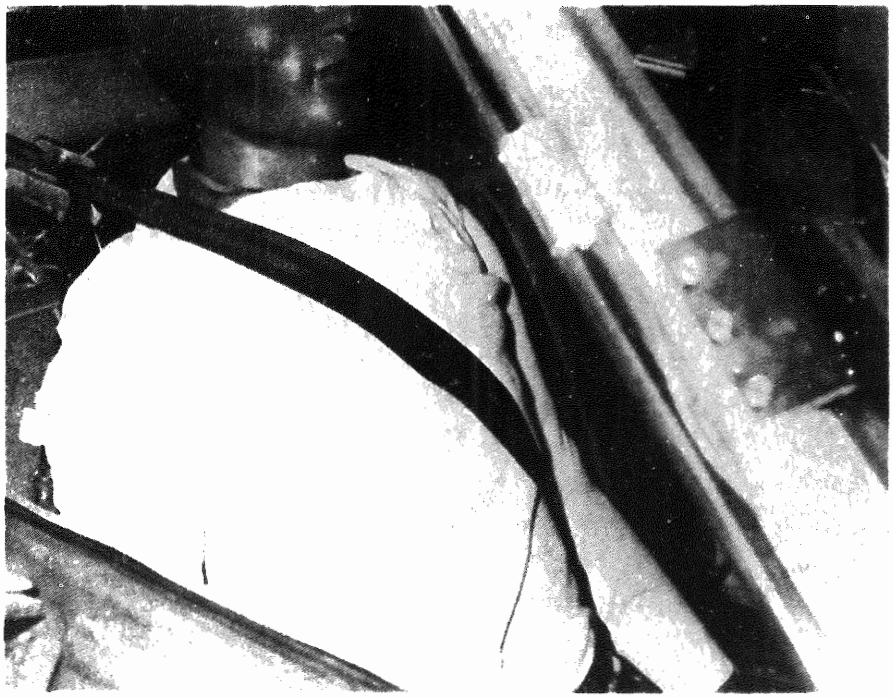


Figure 3-27. Pre-test Standard 3-Point Belt With Web Lockers, Right Front - Test 11.

Figure 3-28. Post-test Standard 3-Point Belt With Web Lockers, Right Front - Test 11.

3.5 TEST NUMBER 12

The impact conditions for Test 12 were:

Configuration	Closing Speed
Torino-to-Volvo Right Oblique (30°)*	63.3 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt with Web Lockers	RSV Driver Airbag
Right Front	Standard 3-Point Belt with Web Lockers	RSV Passenger Airbag

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 12 are summarized in the following tables:

Table 3-17 - Summary of Vehicle Data (Test 12)

Table 3-18 - Injury Criteria Summary (Test 12)

Table 3-19 - Summary of Restraint System Data (Test 12)

Table 3-20 - Occupant Response Data (Test 12)

which are followed by Figure 3-29 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 3-17. SUMMARY OF VEHICLE DATA (TEST 12)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 12/March 17, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		487	436
TEST WEIGHT (lb)		4690	3230
IMPACT VELOCITY (mph)		63.3	0
VELOCITY CHANGE (mph)		29.5	40.2 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	21.3 @ 90	42.1 @ 70
	LOCATION 2	25.3 @ 95	36.4 @ 70
MAXIMUM STATIC CRUSH (in.)			
	LEFT	16.0	8.0
	CENTER	24.0	15.5
	RIGHT	13.0	46.0

(1) Velocity change found by using average of resultant velocity vector (V_R) data for compartment accelerometer locations.

TABLE 3-18. INJURY CRITERIA SUMMARY (TEST 12)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT W/WEB LOCKERS		STANDARD 3-POINT BELT W/WEB LOCKERS	
HIC	354		488	
HEAD G[1] @ msec	47.9 @ 114		55.5 @ 134	
CSI	180		198	
CHEST G[1] @ msec	29.5 @ 100		29.0 @ 93	
FEMUR LOAD (lb)[2]	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

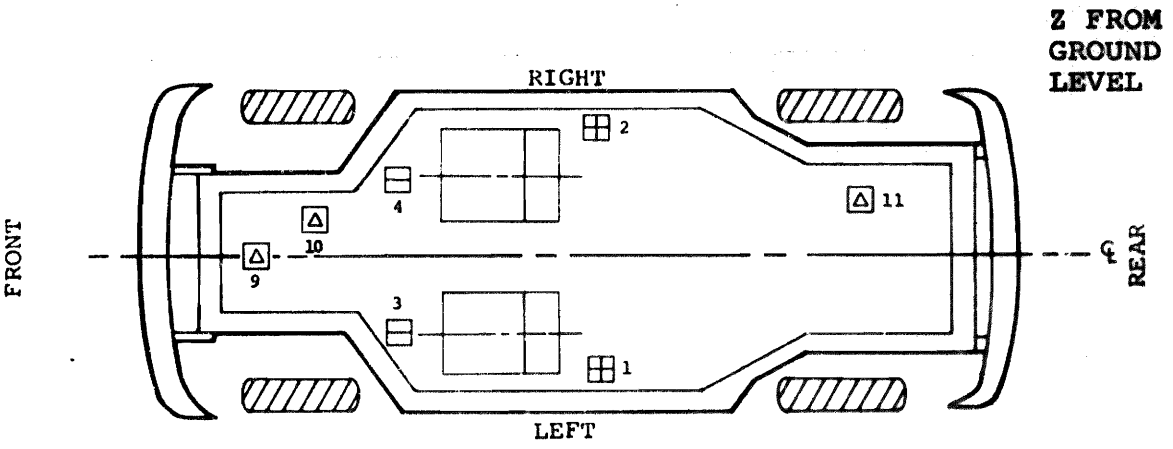
TABLE 3-19. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 12)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1223 @ 92
Peak Lap Belt Load	lb @ msec	684 @ 83
Peak Vertical Belt Load	lb @ msec	152 @ 95
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1435 @ 11[illegible]
Peak Lap Belt Load	lb @ msec	1011 @ 97

TABLE 3-20. OCCUPANT RESPONSE DATA SUMMARY (TEST 12)

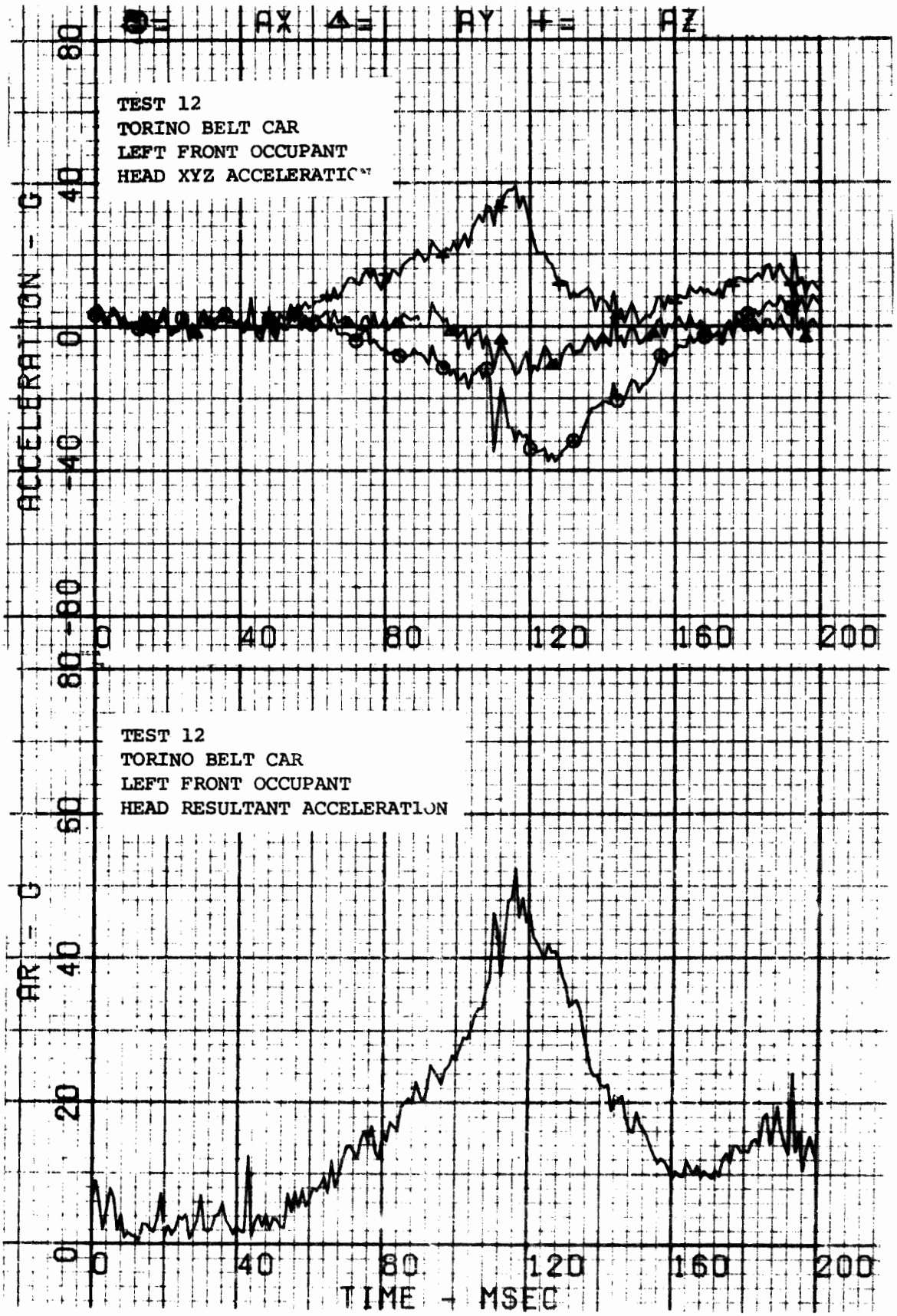
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	37.4	127	36.5	134
	Y	13.9	120	40.8	132
	Z	39.3	116	36.7	115
	R(1)	47.9	114	55.5	134
	HIC	354 @ 85-147		488 @ 83-142	
CHEST					
	X	29.4	96	27.3	87
	Y	9.8	111	14.5	135
	Z	10.9	138	13.3	147
	R(1)	29.5	100	29.0	93
	SI	180 @ 200		198 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS(2)					
	LF	NA		NA	
	RT	NA		NA	

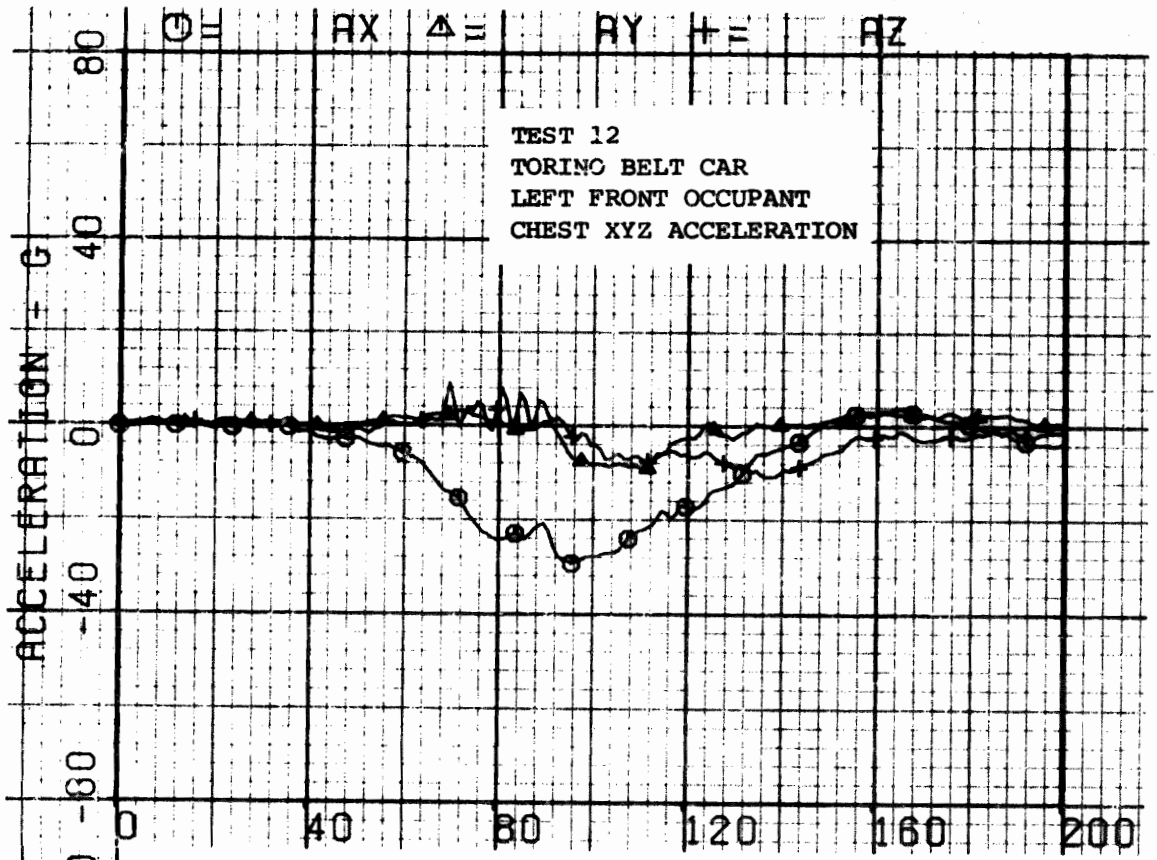
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

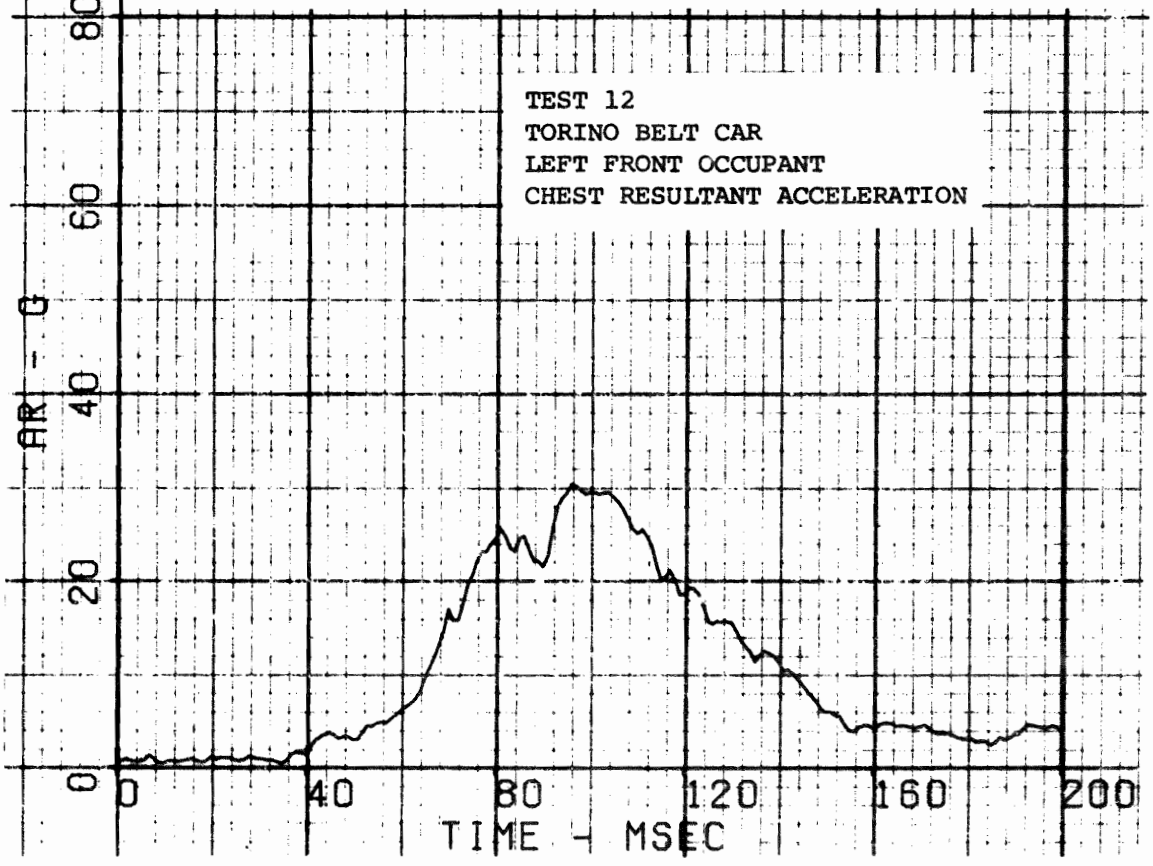


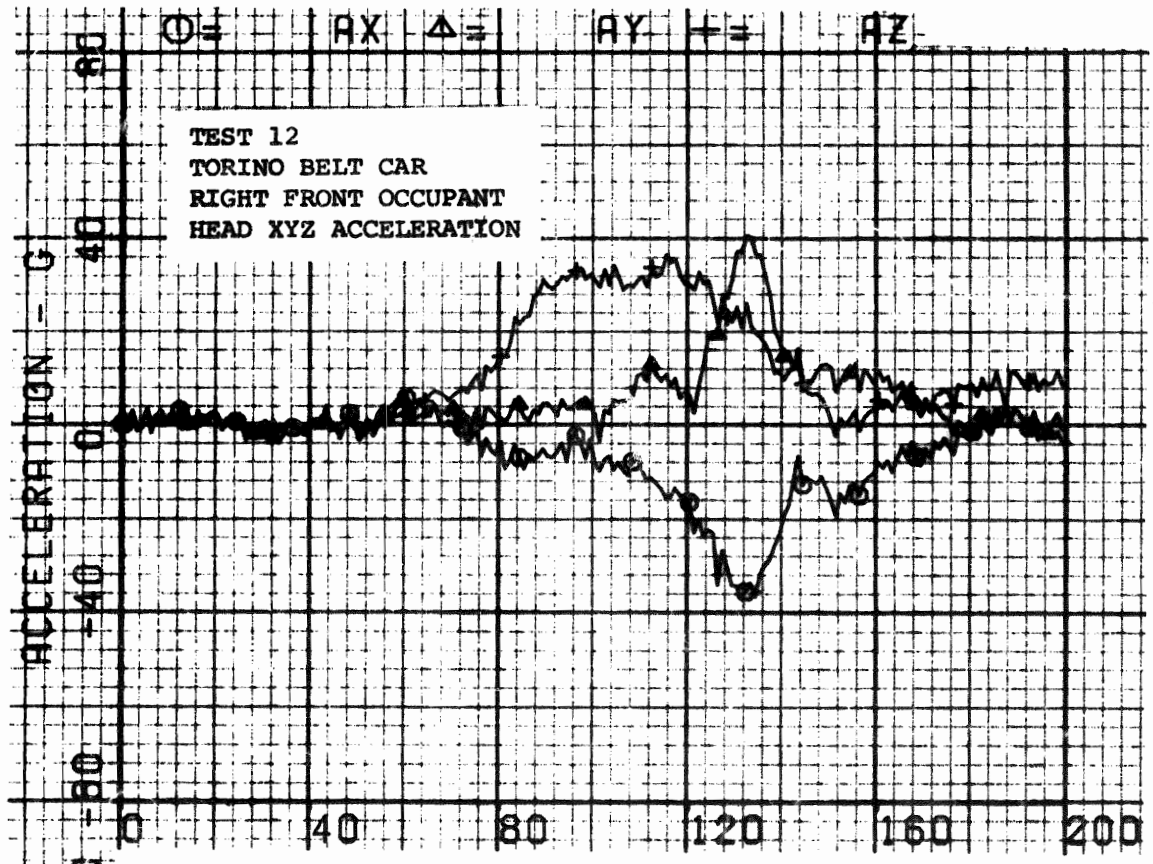
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

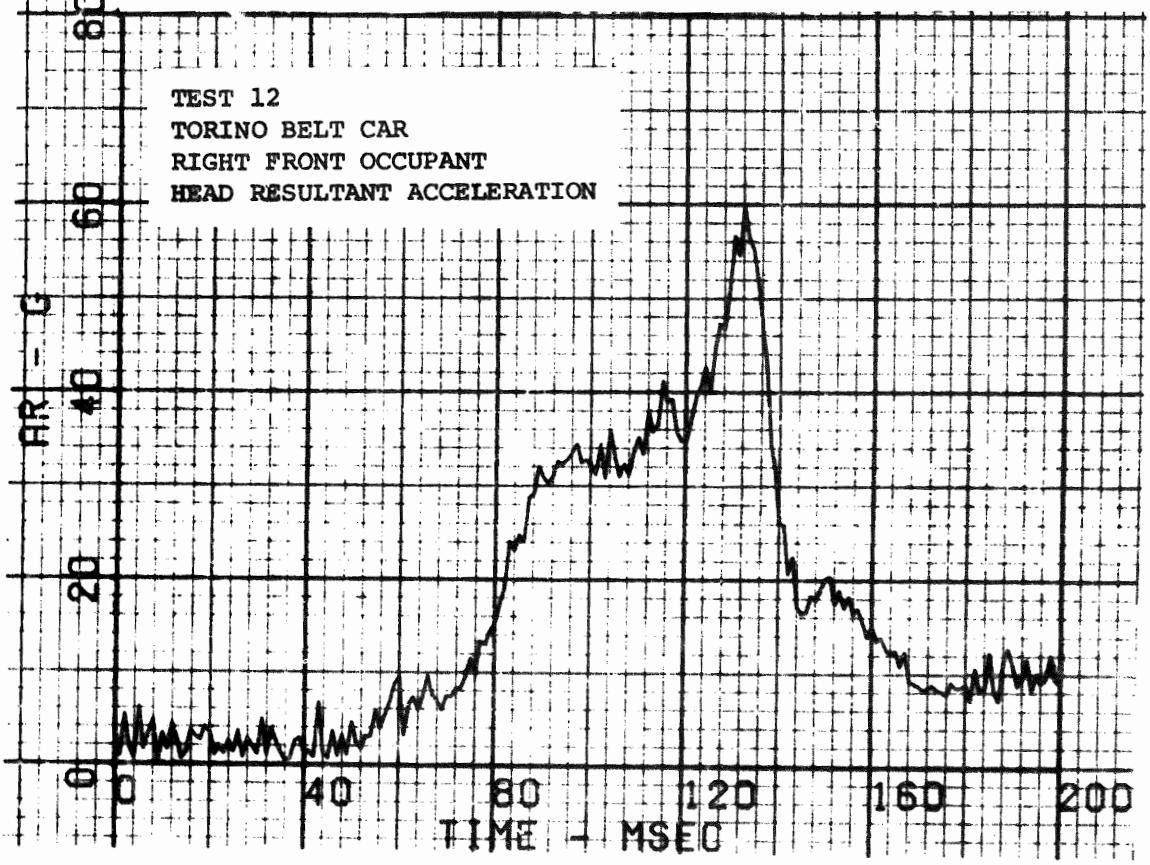
Figure 3-29. Vehicle Accelerometer Locations - Test 12.

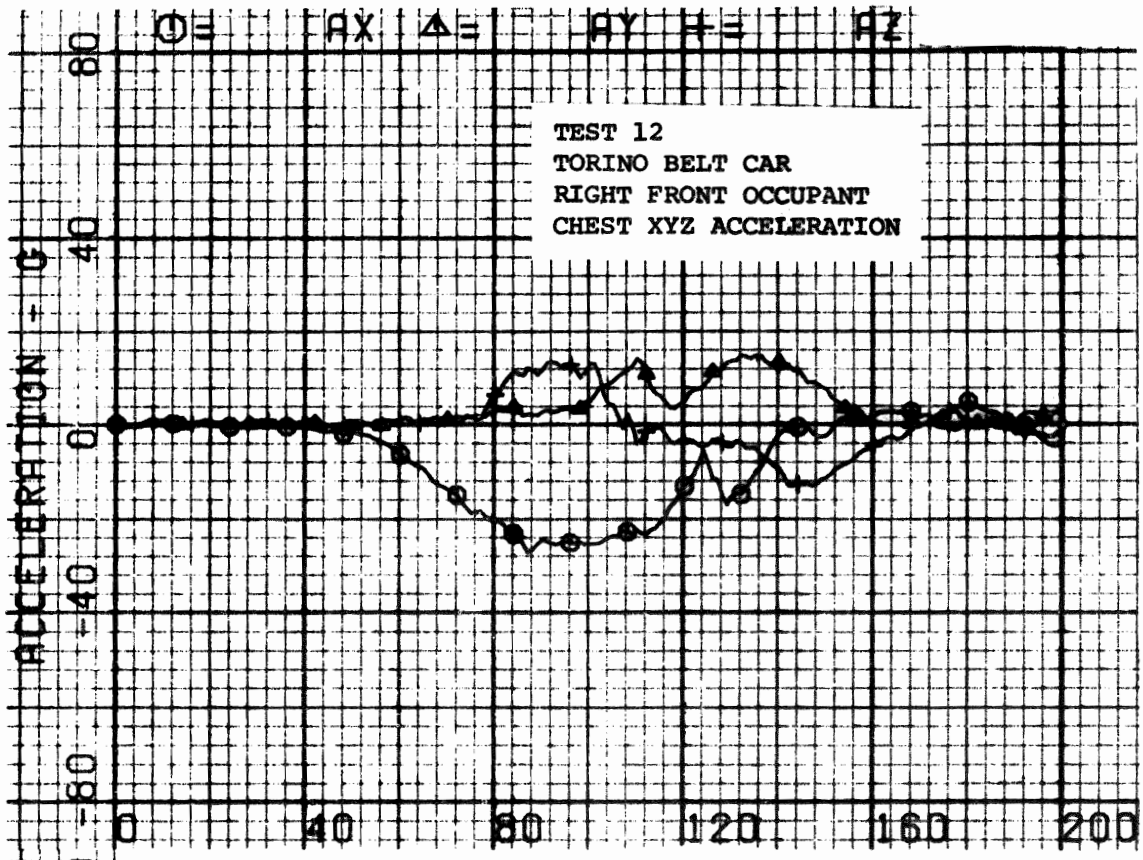

AX
AY
AZ
TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

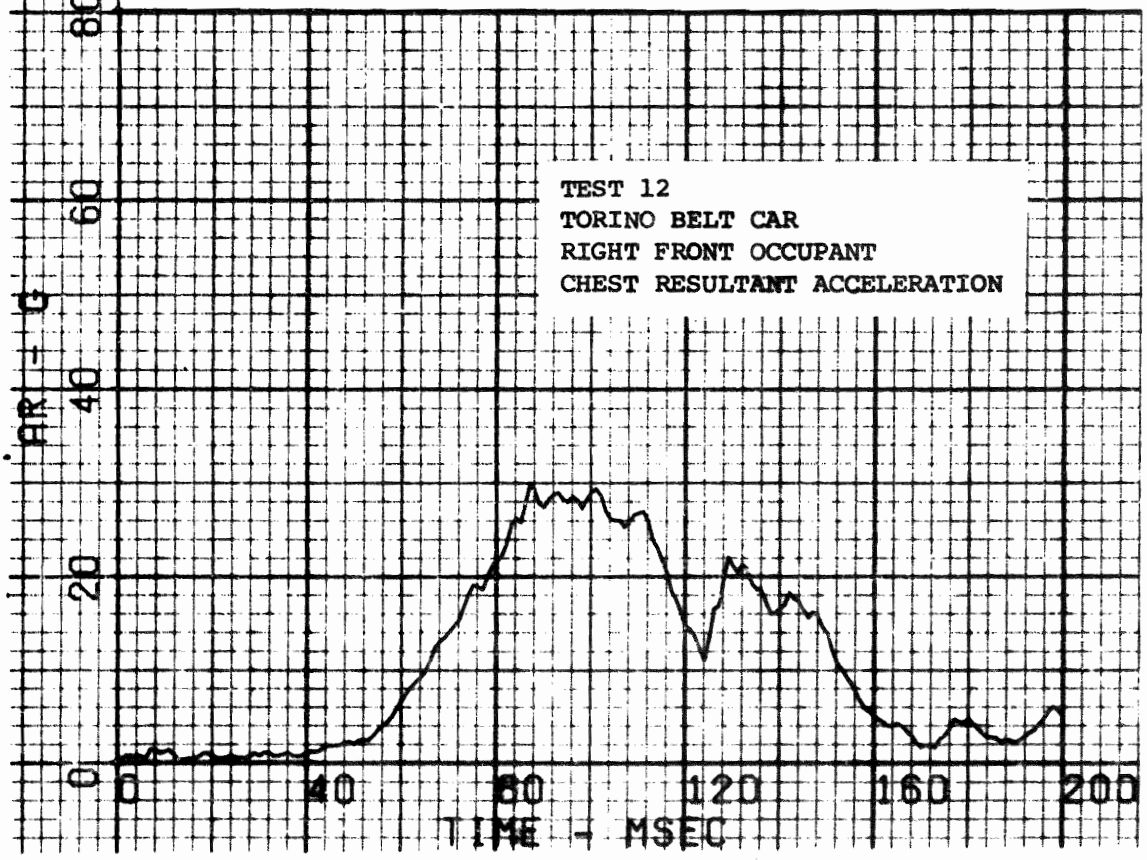

AX
AY
AZ
TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

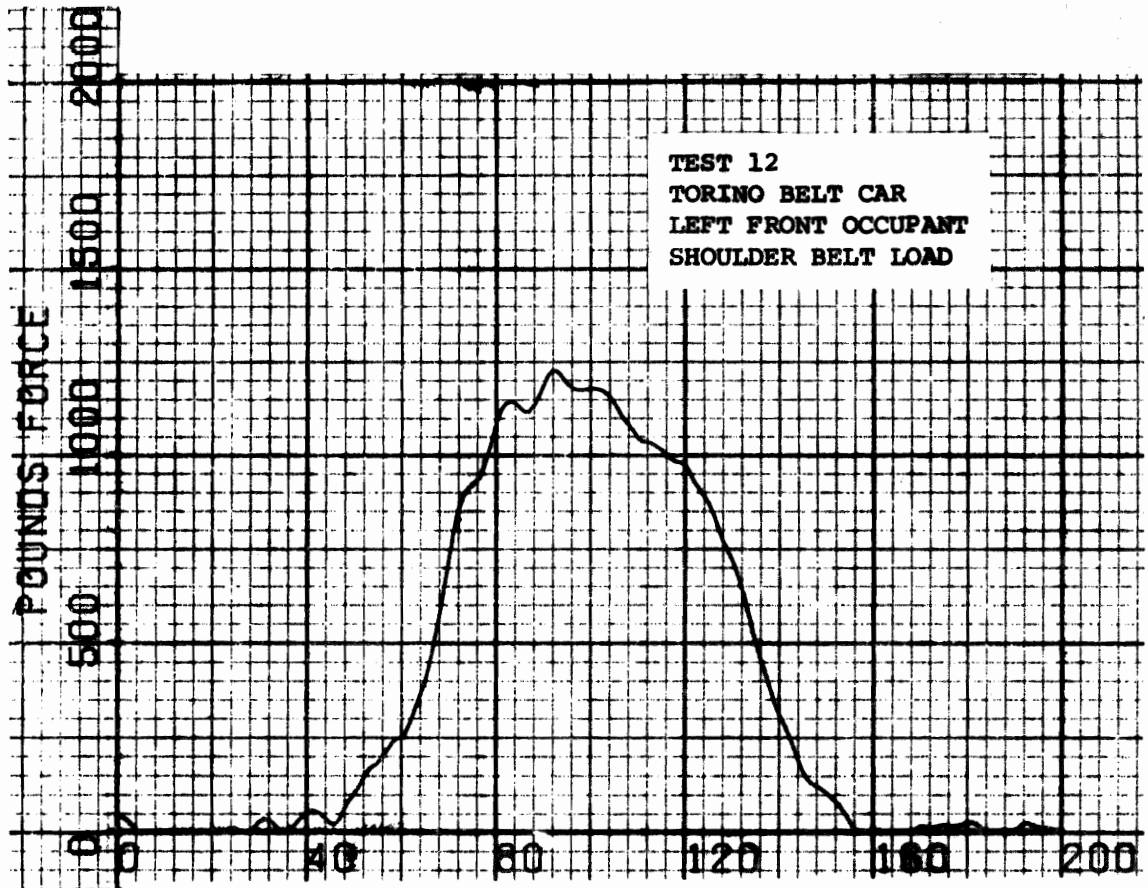

TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

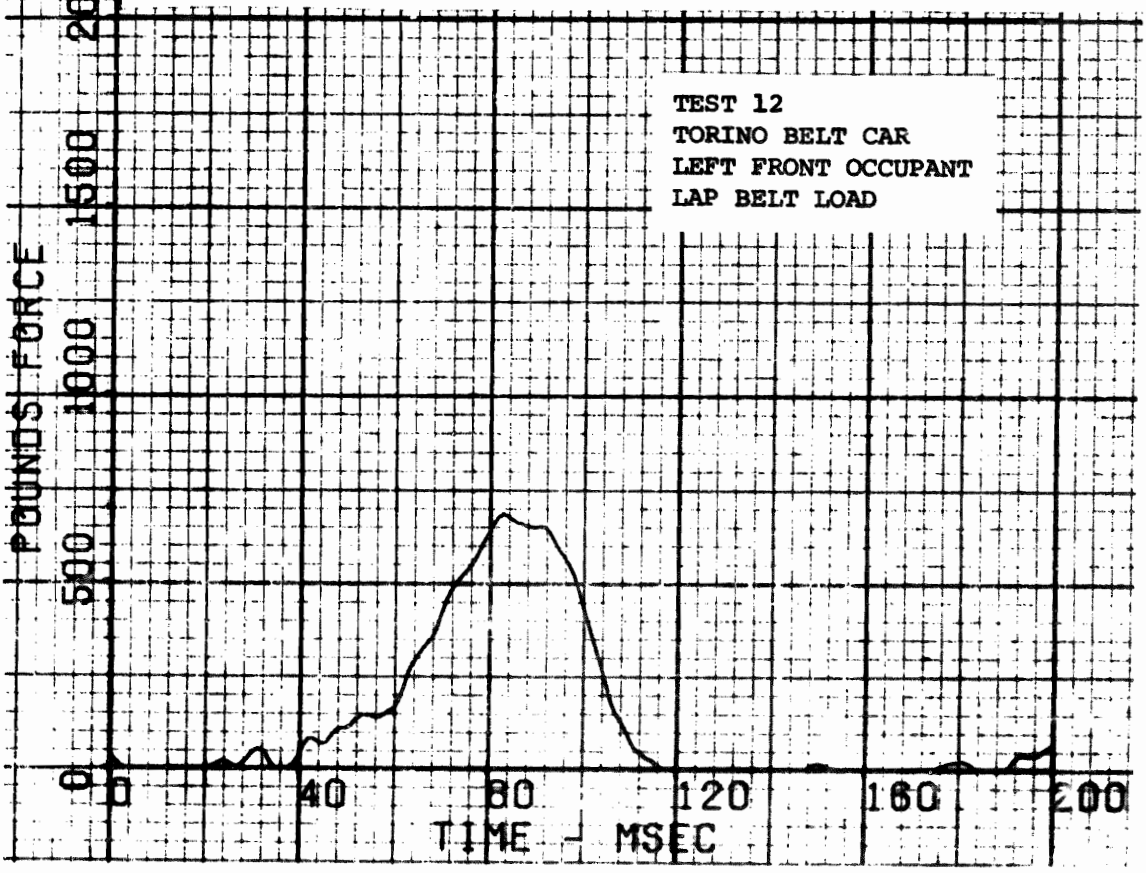

○= AX △= AY += AZ
TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

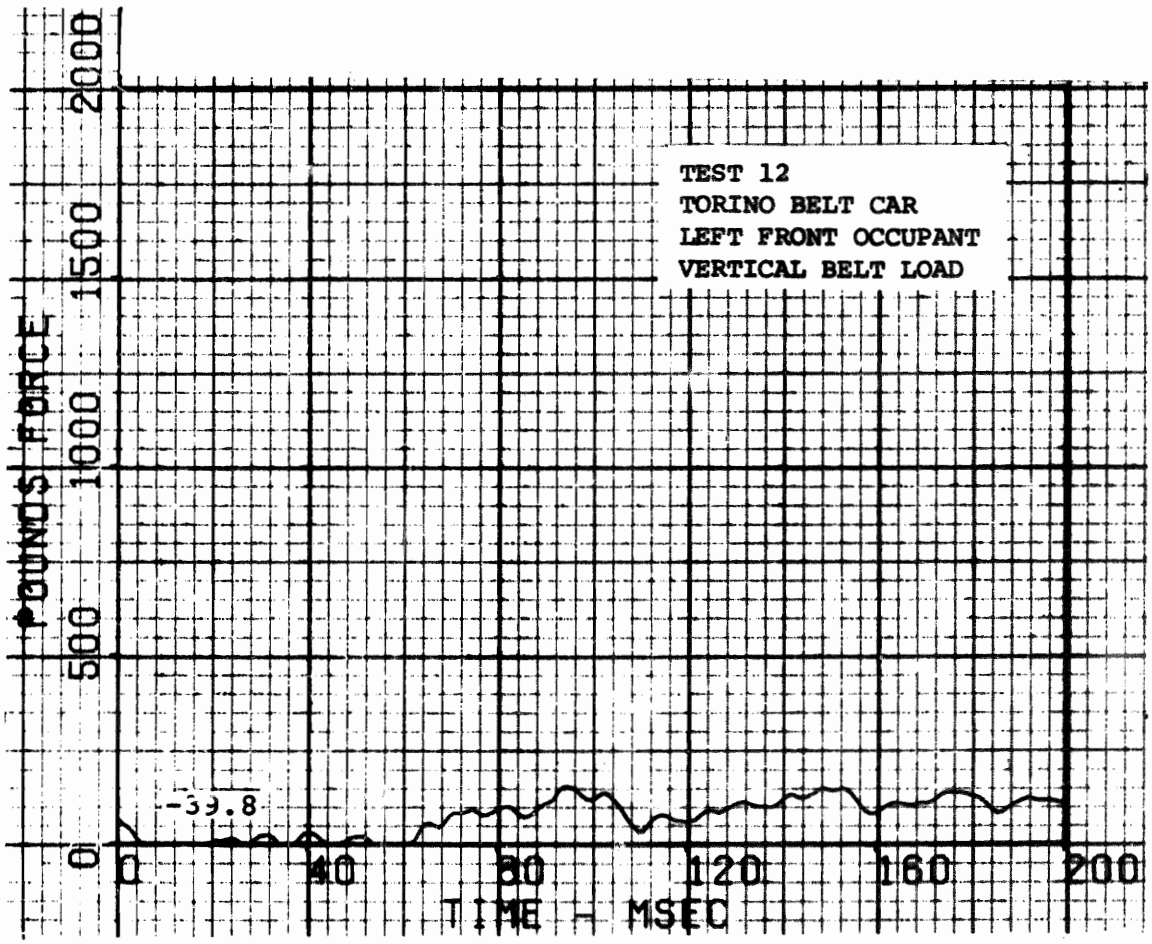

TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME → MSEC

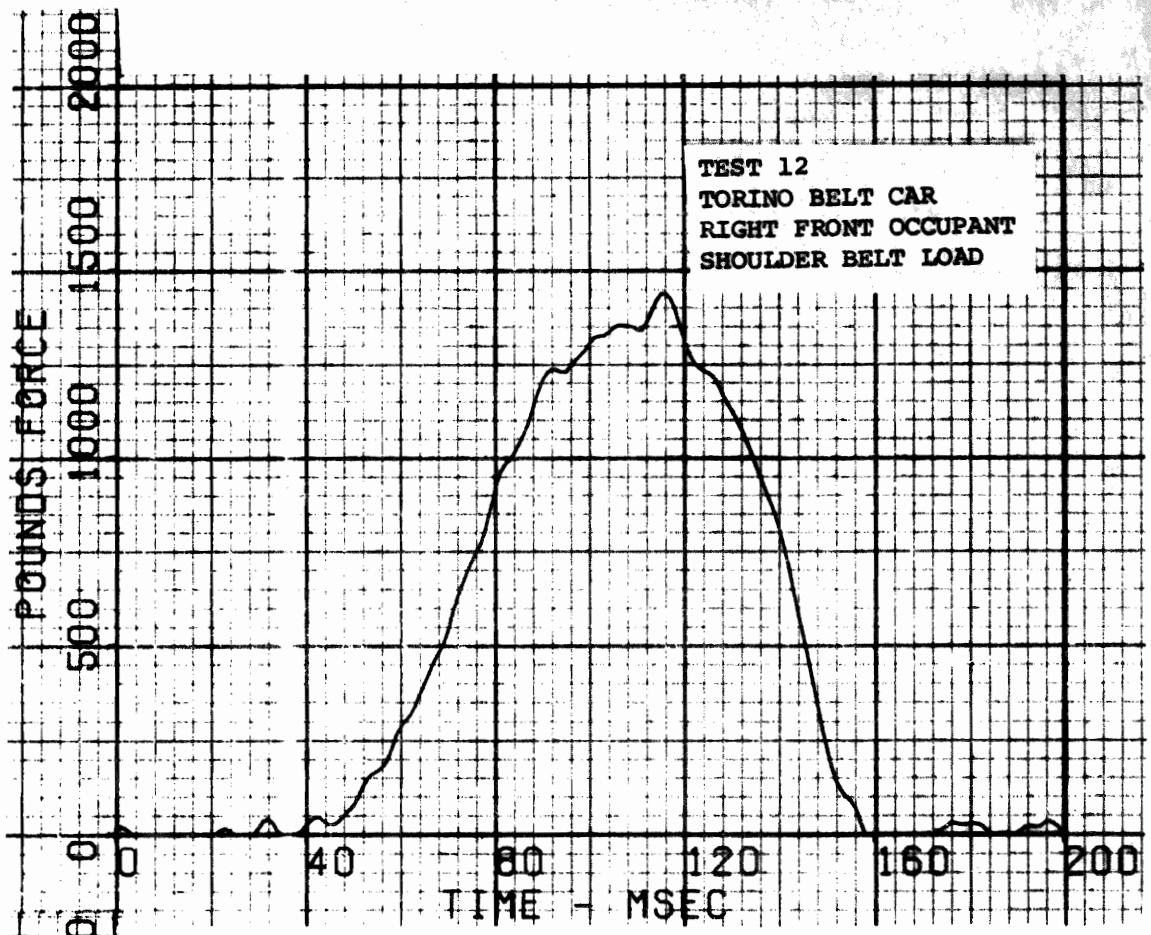

O= AX Δ= AY +=
AZ
TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

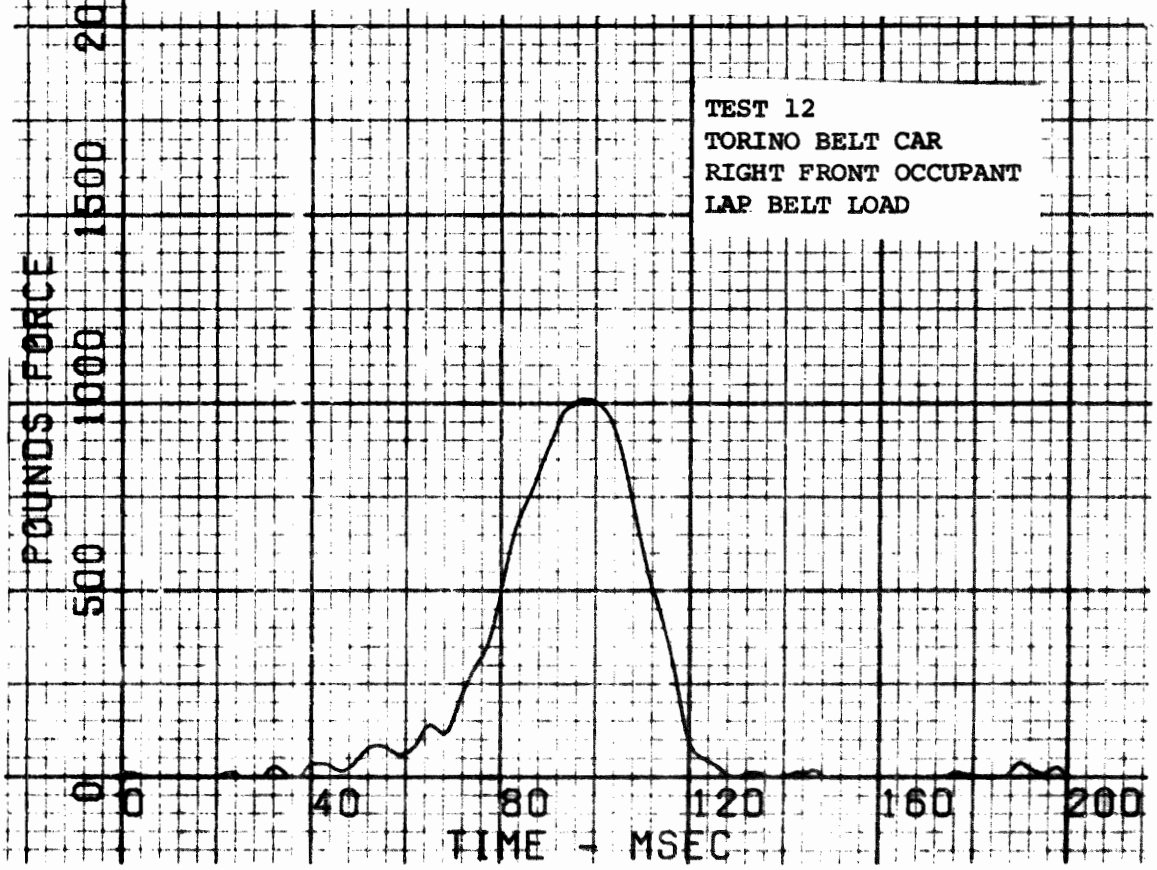

TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

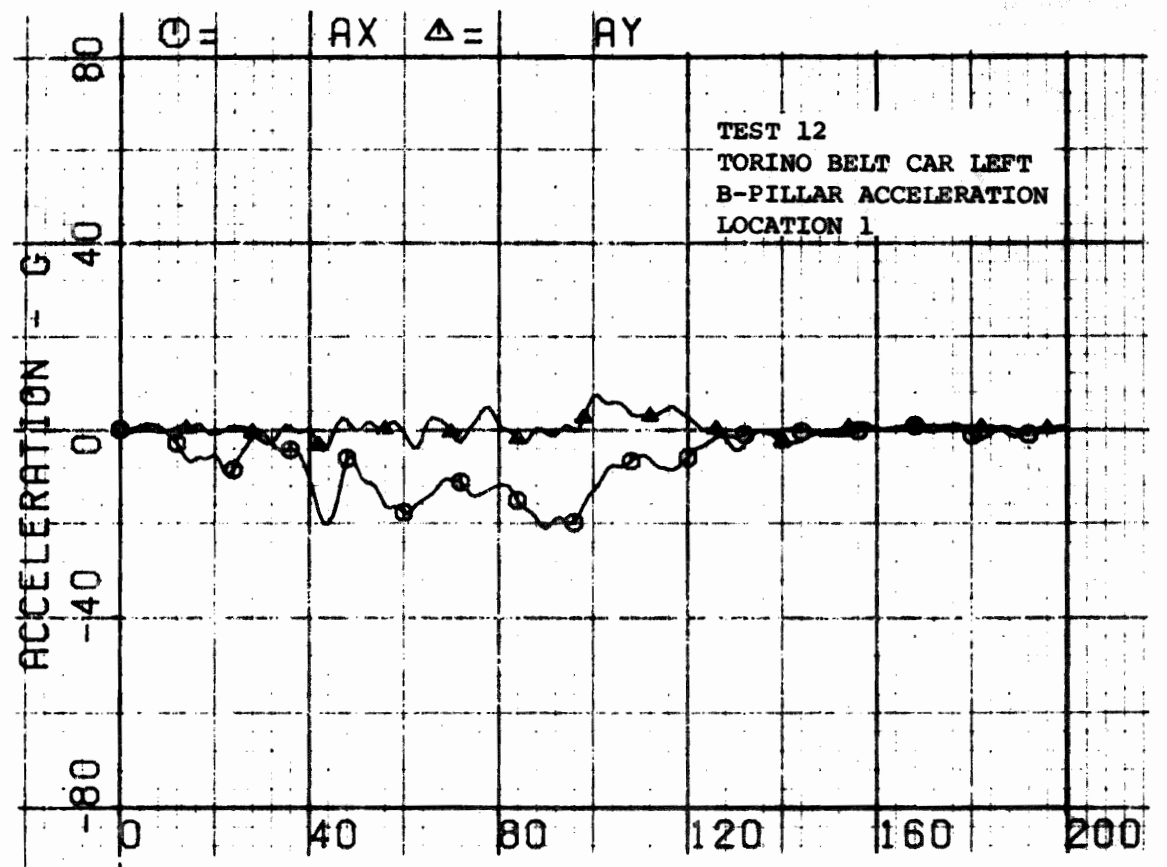

TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

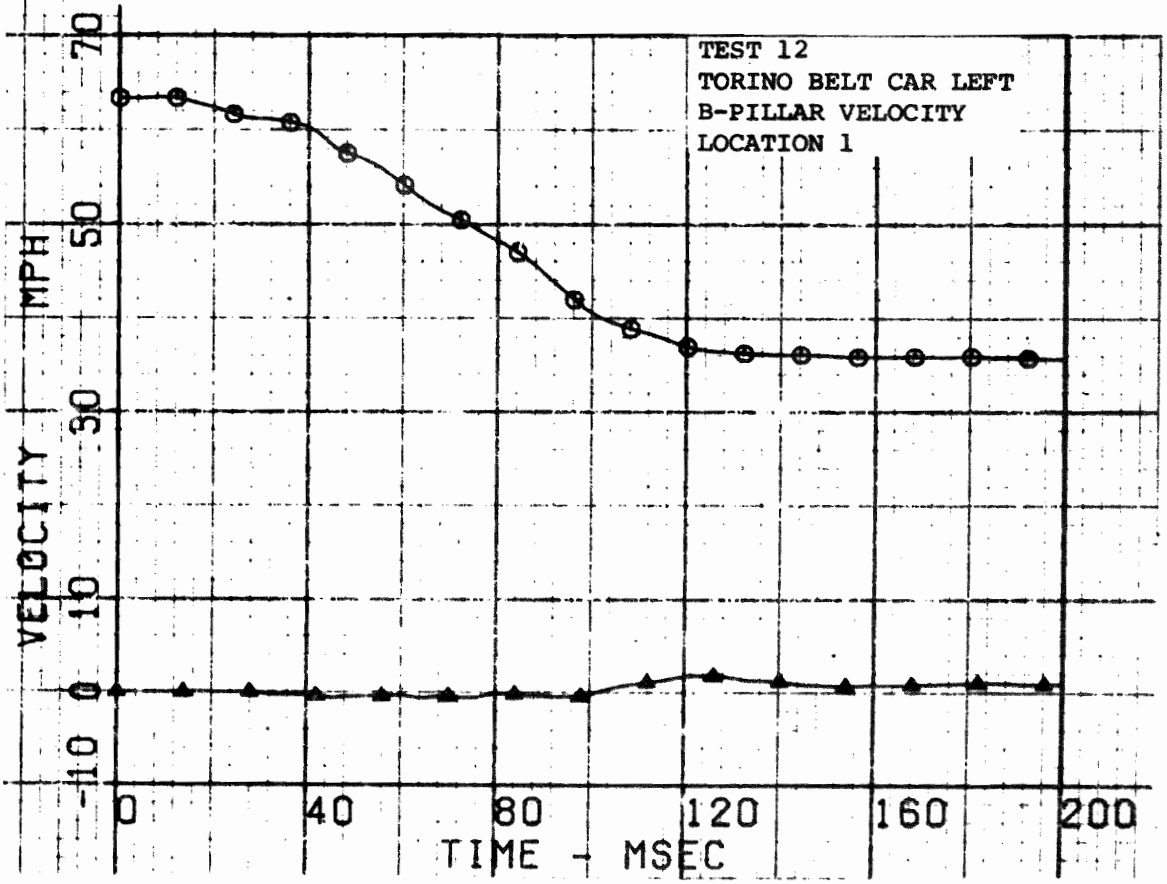

TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

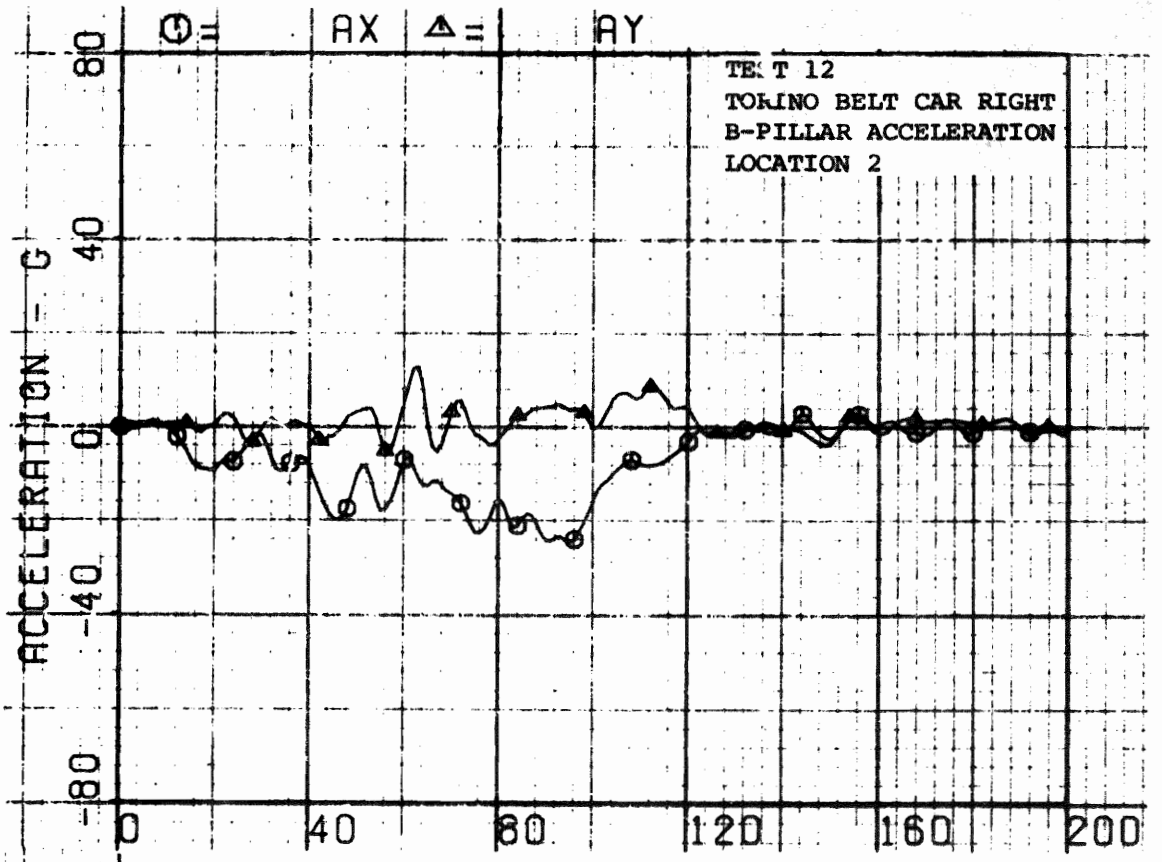

TEST 12
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
-39.8
0
40
80
120
160
200
TIME - MSEC

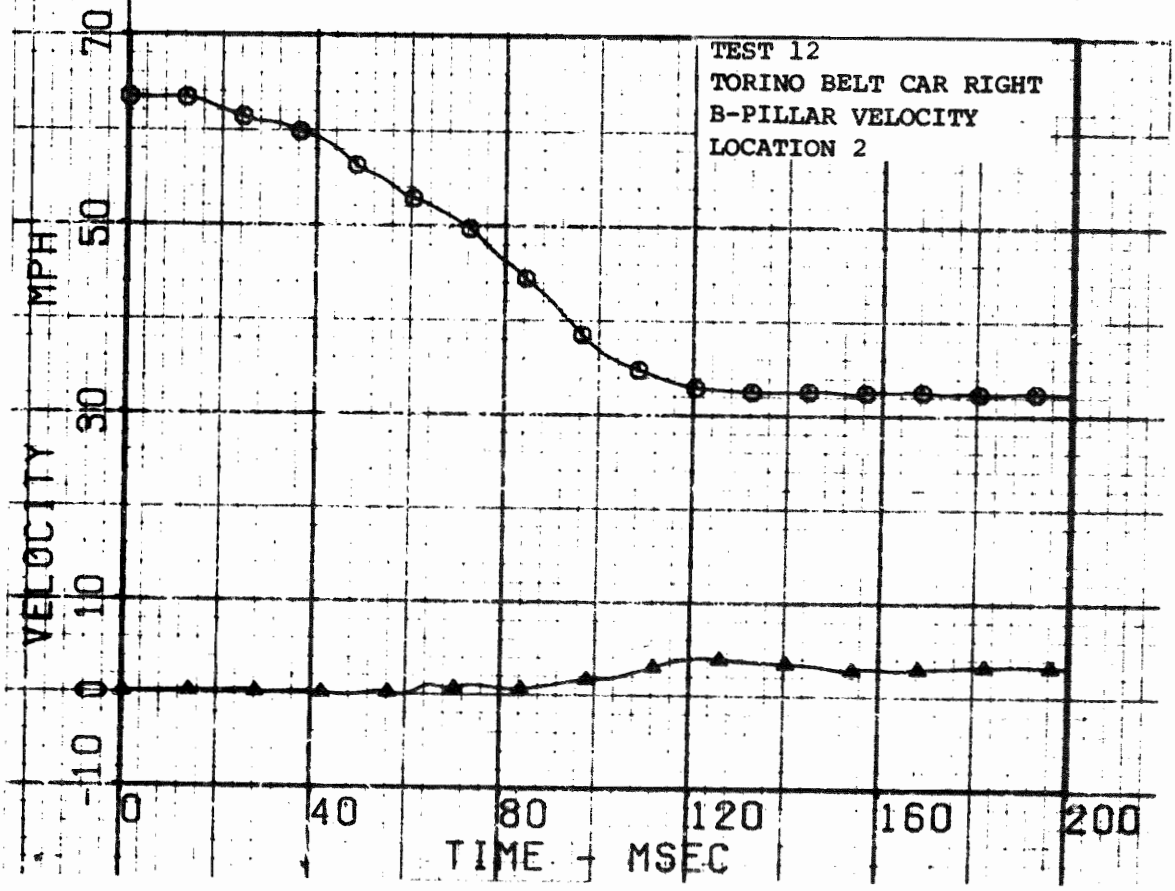

TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

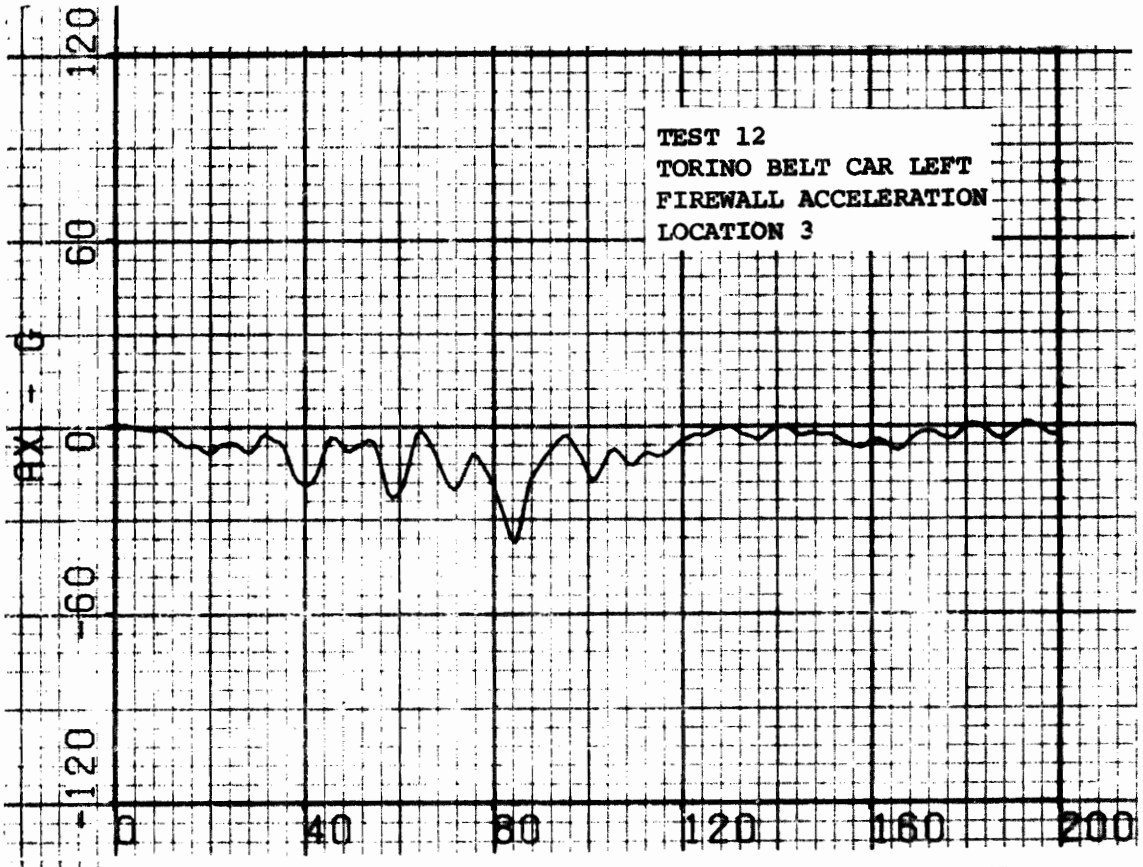

TEST 12
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

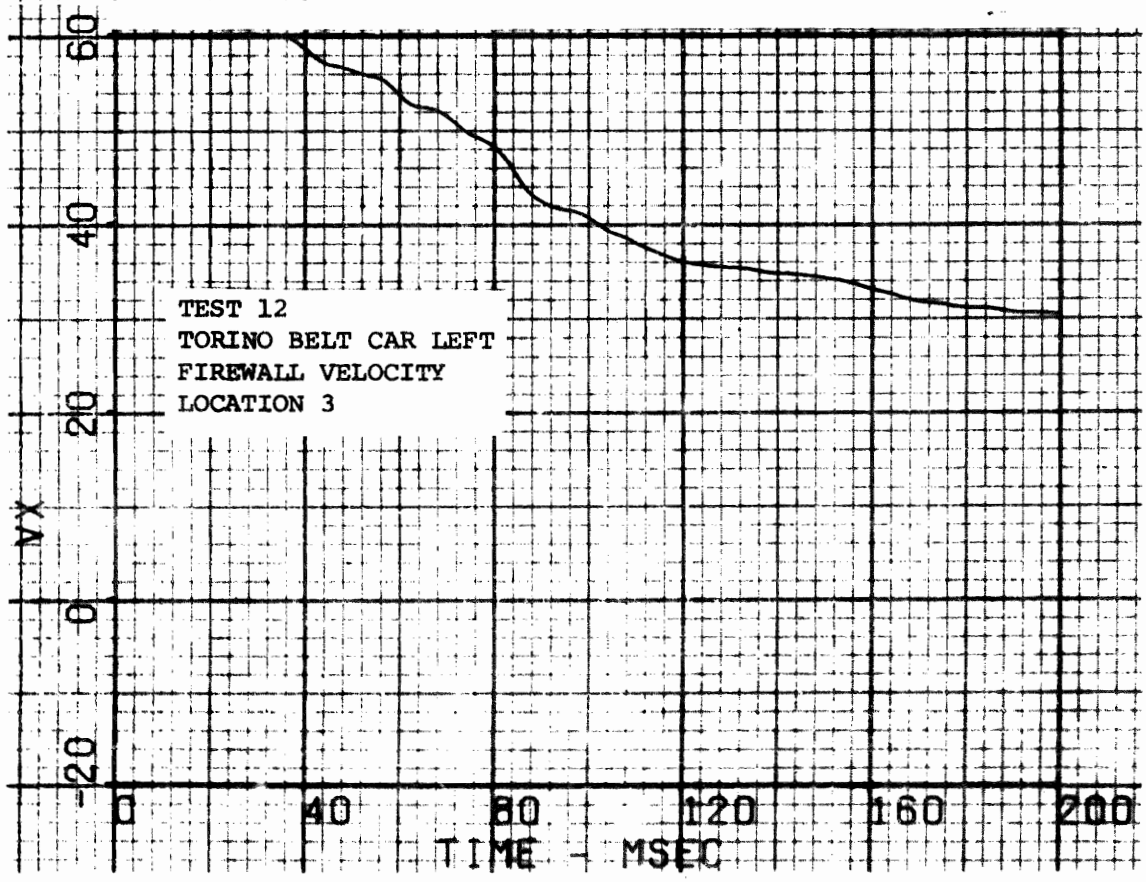

○= AX △= AY
TEST 12
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

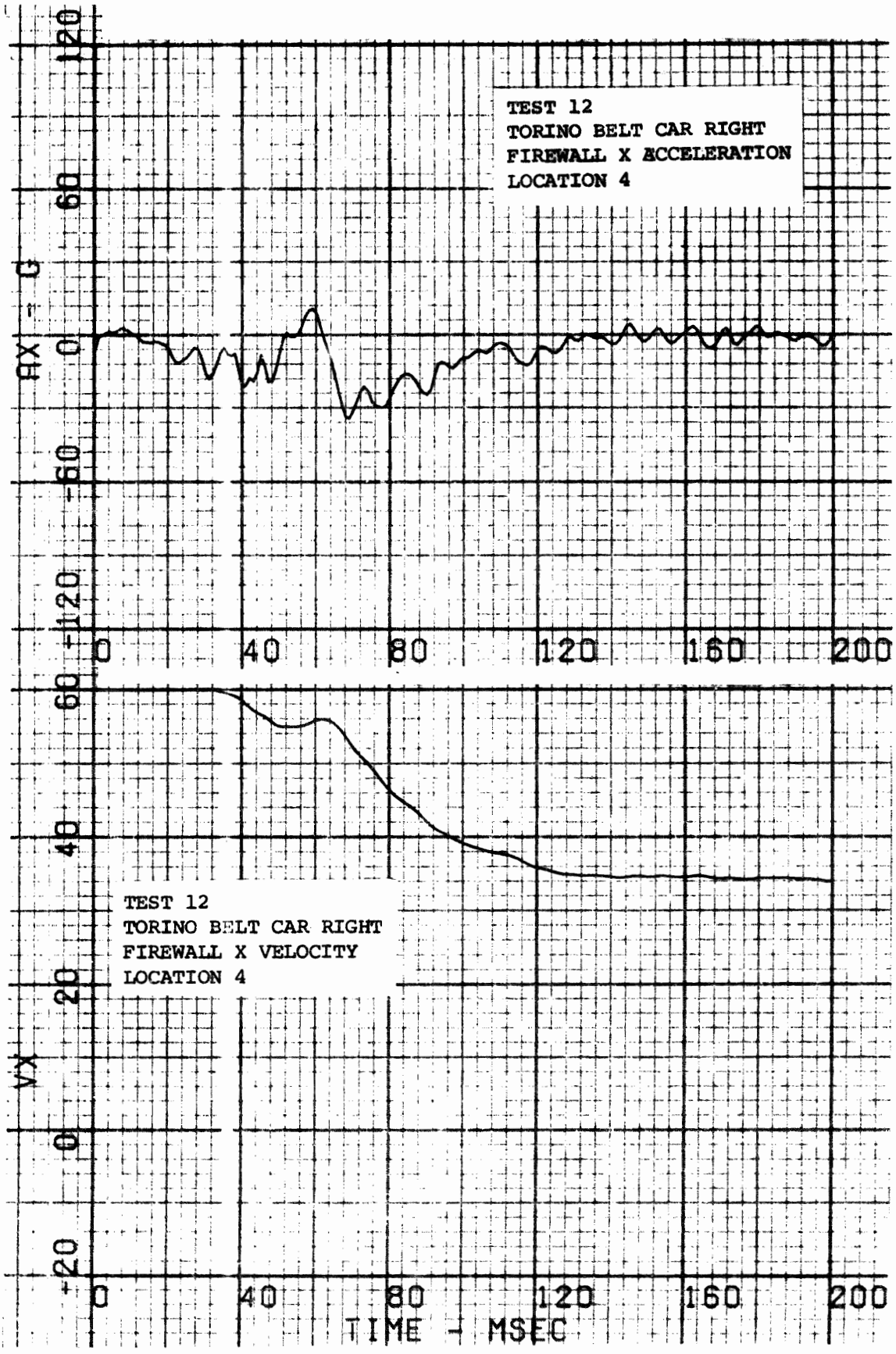

TEST 12
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

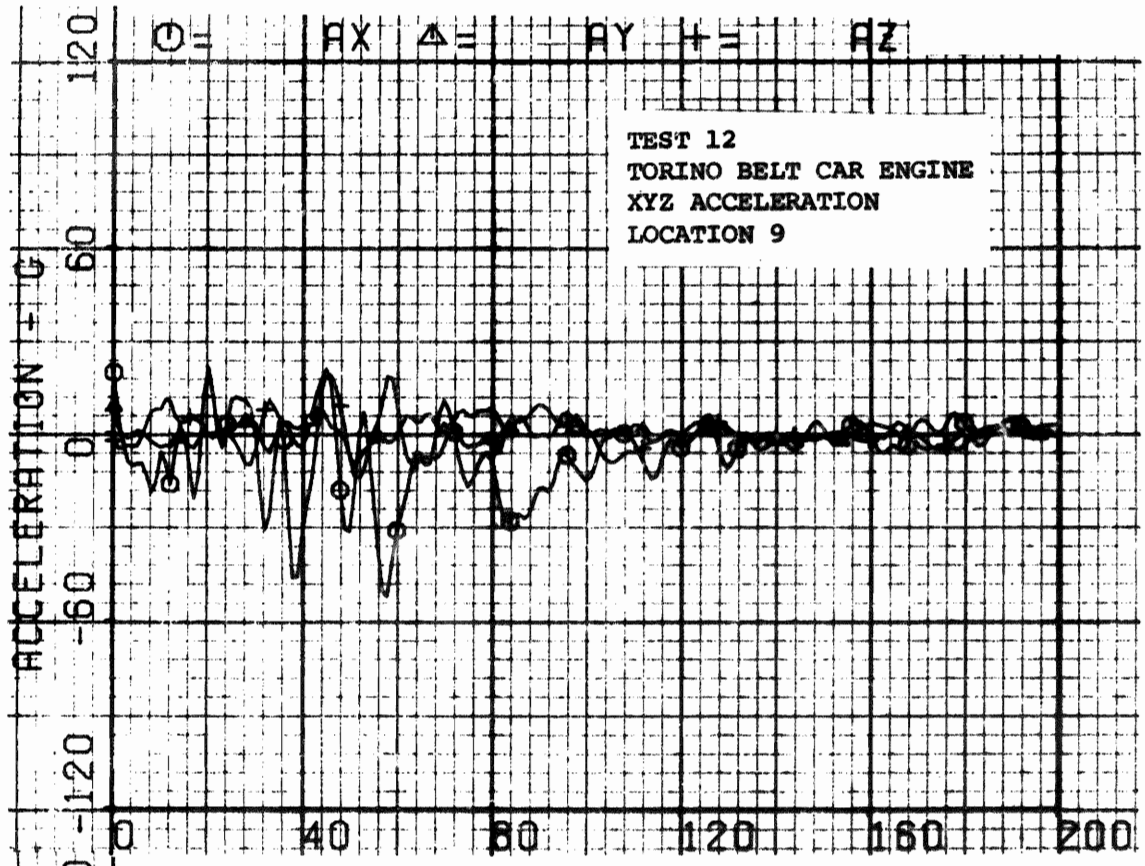

① = AX △ = AY
TEST 12
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

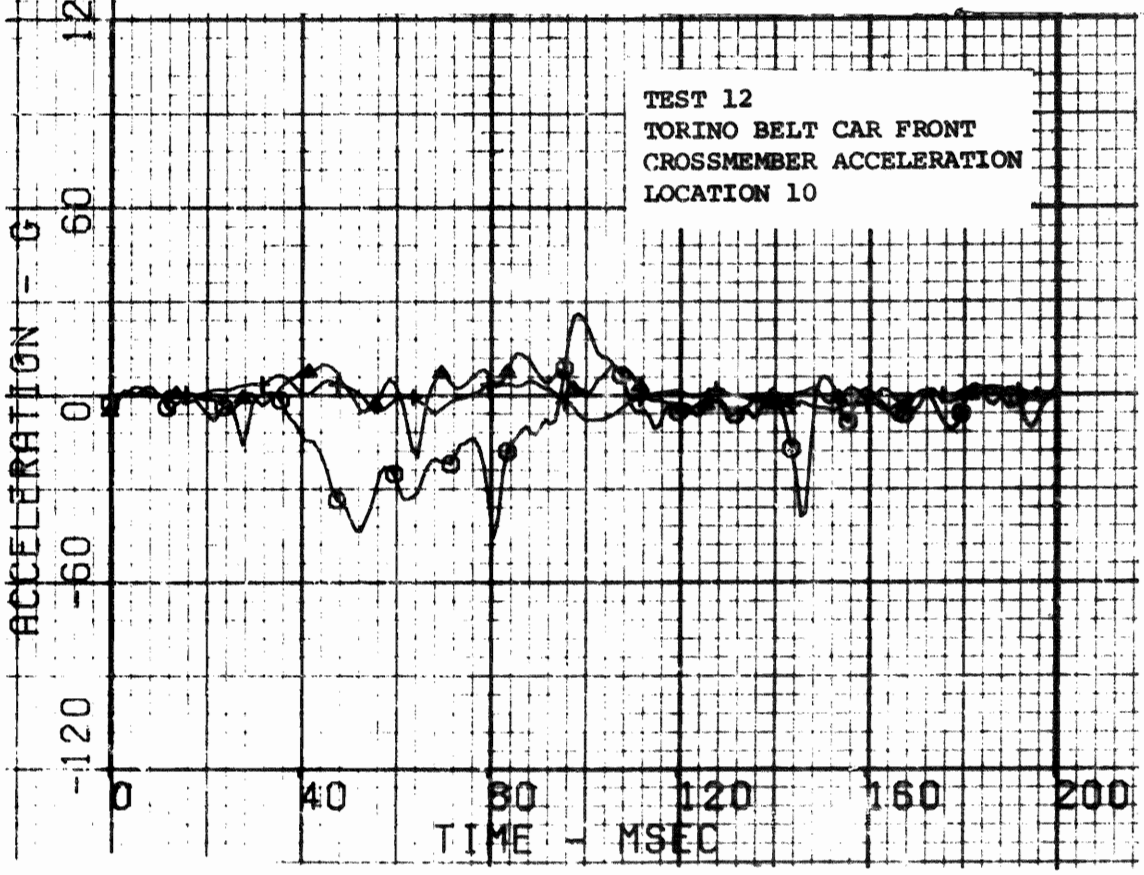

TEST 12
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

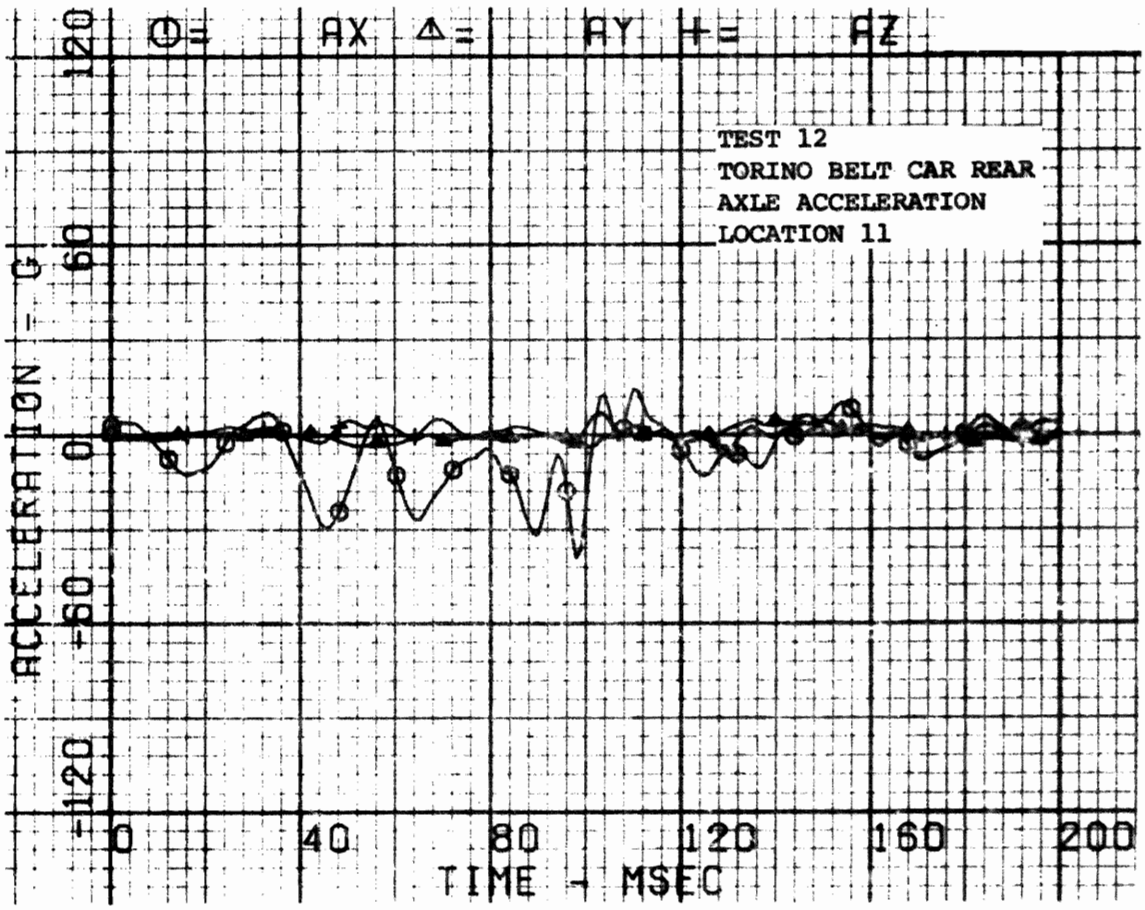

TEST 12
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 12
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 12
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
+120
60
0
-60
-120
0
40
80
120
160
200
TEST 12
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
+20
0
40
80
120
160
200
TIME - MSEC


⊙= AX △= AY += AZ
TEST 12
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION + G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 12
TORINO BELT CAR FRONT
CROSSMEMBER ACCELERATION
LOCATION 10
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


Ⓘ= AX △= AY +=AZ
TEST 12
TORINO BELT CAR REAR
AXLE ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME → MSEC

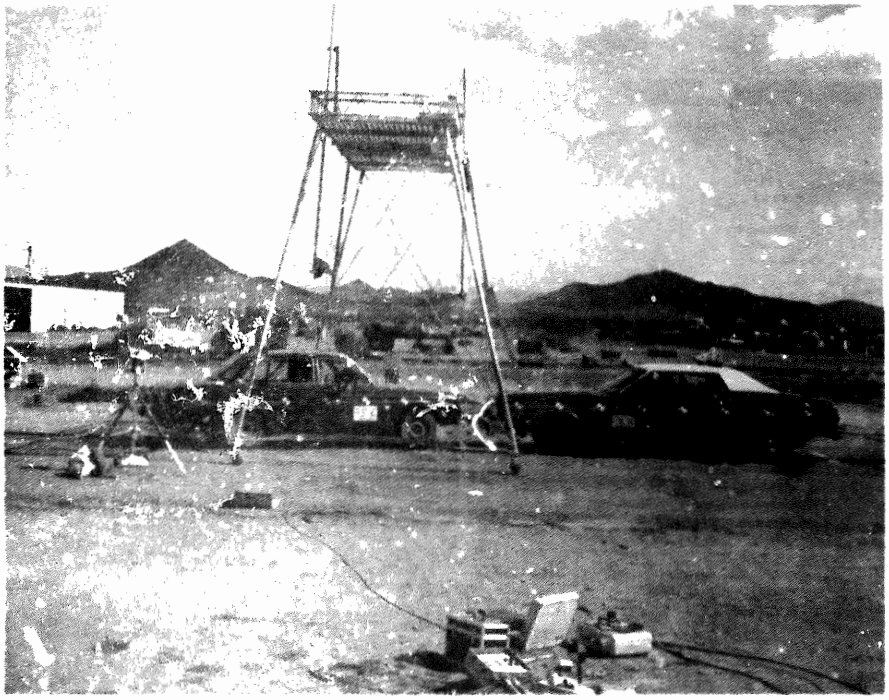


Figure 3-30. Pre-test Vehicle Configuration - Test 12.

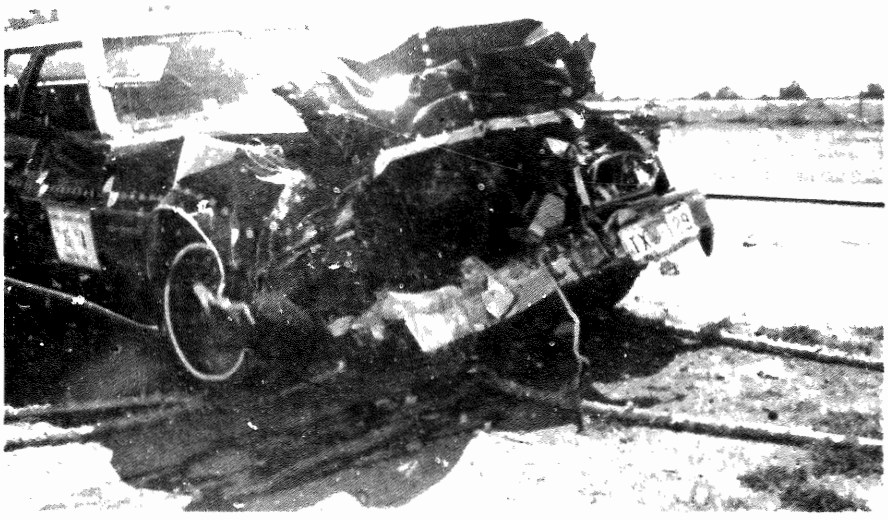


Figure 3-31. Post-test Vehicle Configuration - Test 12.

NO PRE-TEST PHOTO AVAILABLE
SEE FIGURE 3-11 FOR SIMILAR CONDITIONS

Figure 3-32. Pre-test Standard 3-Point Belt With Web Lockers, Left Front - Test 12.

Figure 3-33. Post-test Standard 3-Point Belt With Web Lockers, Left Front - Test 12.

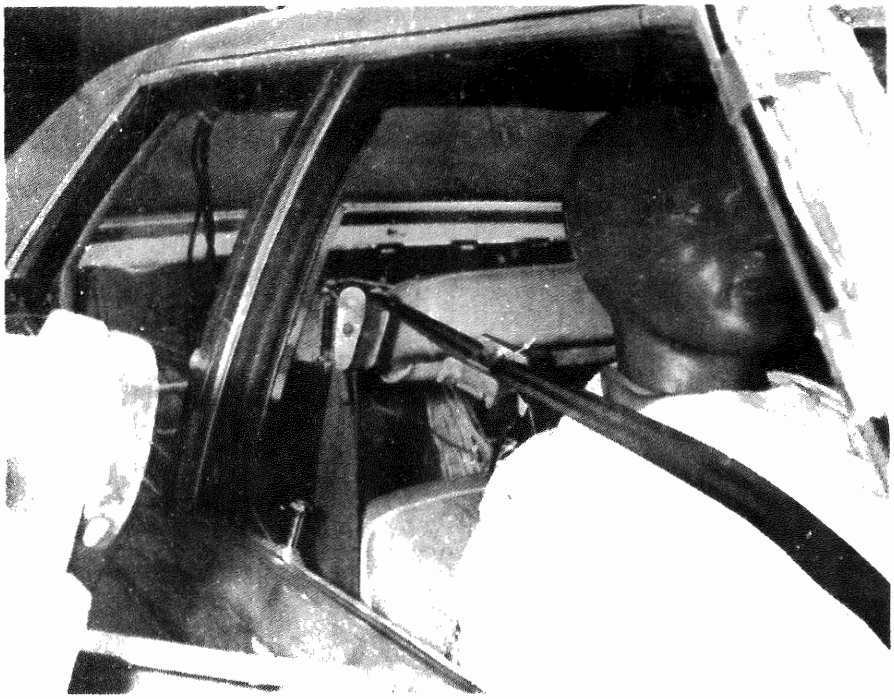


Figure 3-34. Pre-test Standard 3-Point Belt With Web Lockers, Right Front - Test 12.

Figure 3-35. Post-test Standard 3-Point Belt With Web Lockers, Right Front - Test 12.

3.6 TEST NUMBER 13

The impact conditions for Test 13 were:

Configuration	Closing Speed
Torino-to-Volvo Left Oblique (30°)*	65.7 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt	RSV Driver Airbag
Right Front	Standard 3-Point Belt	RSV Passenger Airbag

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to tne Torino.

The results of Test 13 are summarized in the following tables:

Table 3-21 - Summary of Vehicle Data (Test 13)

Table 3-22 - Injury Criteria Summary (Test 13)

Table 3-23 - Summary of Restraint System Data (Test 13)

Table 3-24 - Occupant Response Data (Test 13)

which are followed by Figure 3-36 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 3-21. SUMMARY OF VEHICLE DATA (TEST 13)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 13/April 1, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		494	437
TEST WEIGHT (lb)		4579	3238
IMPACT VELOCITY (mph)		65.7	0
VELOCITY CHANGE (mph)		33.4	42.5(1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	36.9 @ 88	48.3 @ 63
	LOCATION 2	31.6 @ 81	55.5 @ 76
MAXIMUM STATIC CRUSH (in.)			
	LEFT	11.0	29.0
	CENTER	22.0	21.5
	RIGHT	18.0	6.0

(1) Velocity change found by using average of resultant velocity vector (V_R) data for compartment accelerometer locations.

TABLE 3-22. INJURY CRITERIA SUMMARY (TEST 13)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT		STANDARD 3-POINT BELT	
HIC	617		609	
HEAD G(1) @ msec	69.3 @ 117		52.7 @ 141	
CSI	883		211	
CHEST G(1) @ msec	63.7 @ 103		32.4 @ 110	
FEMUR LOAD (lb) (2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

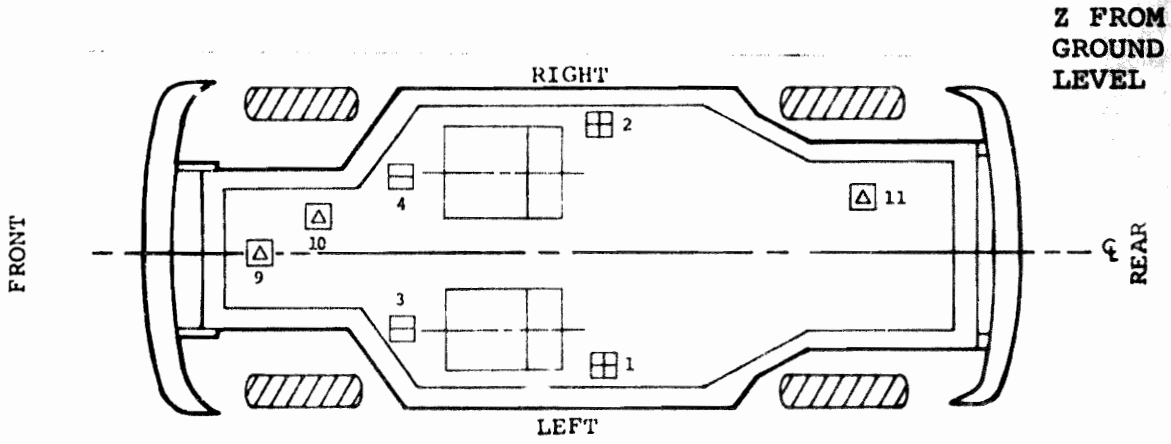
TABLE 3-23. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 13)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1356 @ 104
Peak Lap Belt Load	lb @ msec	1195 @ 97
Peak Vertical Belt Load	lb @ msec	1033 @ 106
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1504 @ 109
Peak Lap Belt Load	lb @ msec	1109 @ 99

TABLE 3-24. OCCUPANT RESPONSE DATA SUMMARY (TEST 13)

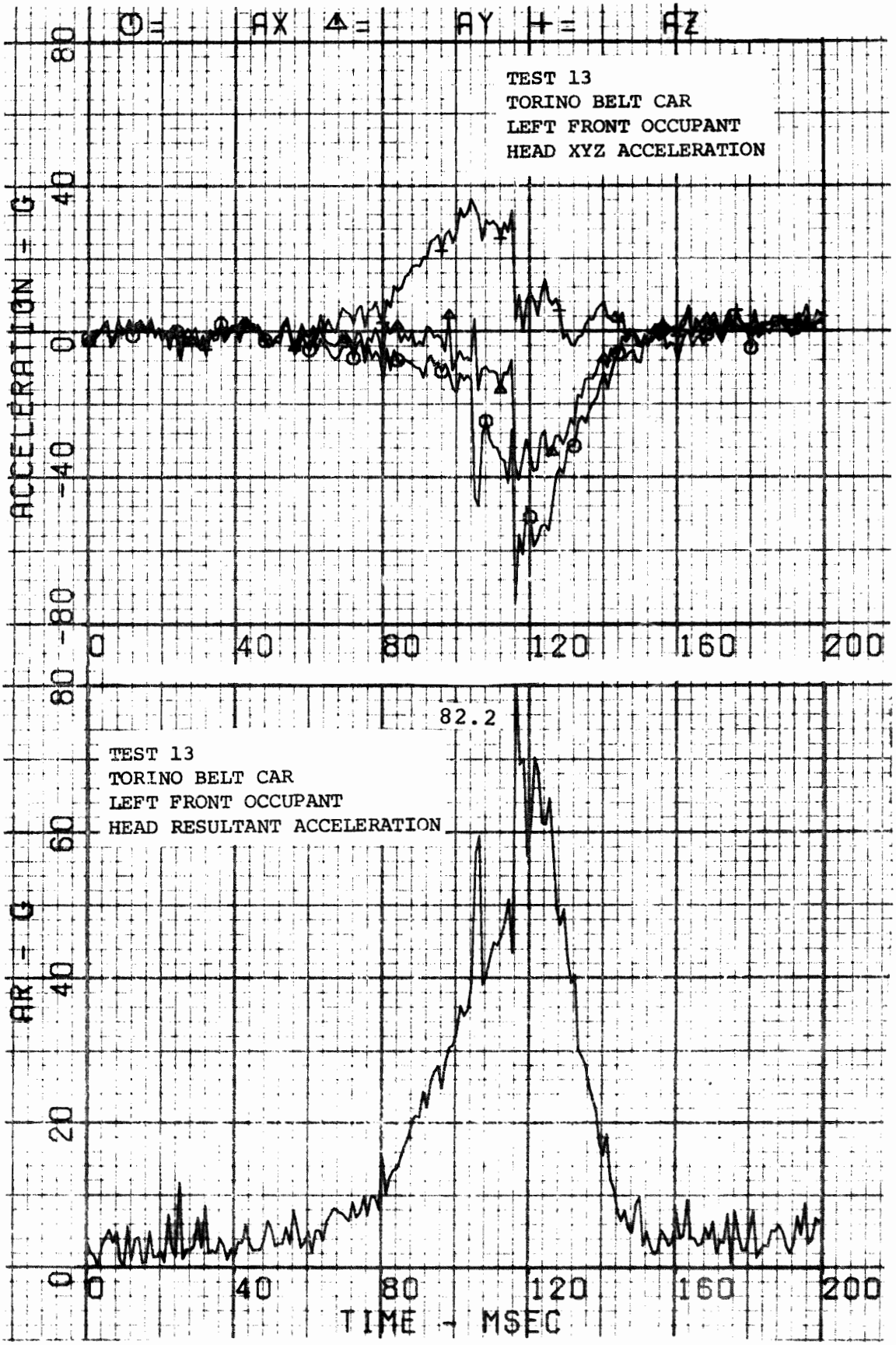
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	74.1	116	55.3	123
	Y	40.5	117	26.6	137
	Z	36.4	104	43.5	118
	R(1)	69.3	117	52.7	141
	HIC	617 @ 98-133		609 @ 86-148	
CHEST					
	X	65.1	99	28.9	104
	Y	18.0	144	19.4	112
	Z	13.0	96	17.5	92
	R(1)	63.7	103	32.4	110
	SI	883 @ 200		211 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (2)					
	LF	NA		NA	
	RT	NA		NA	

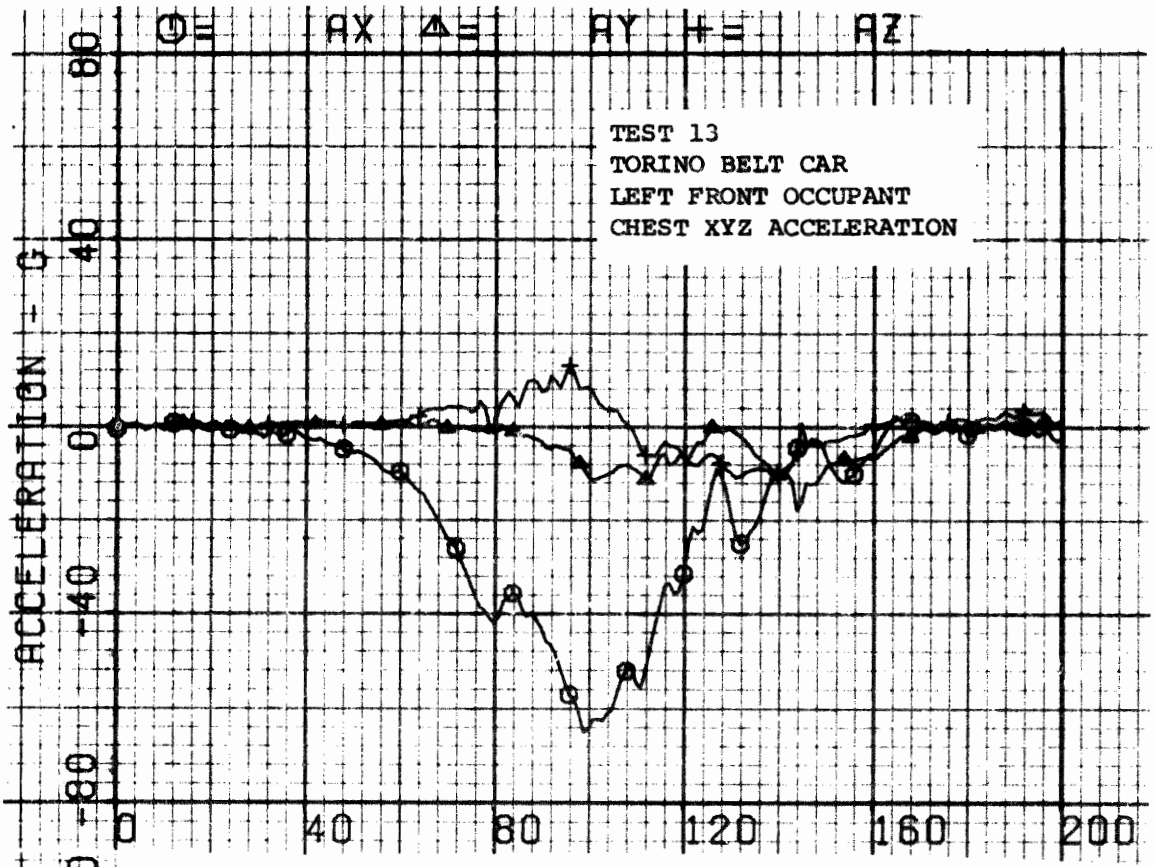
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

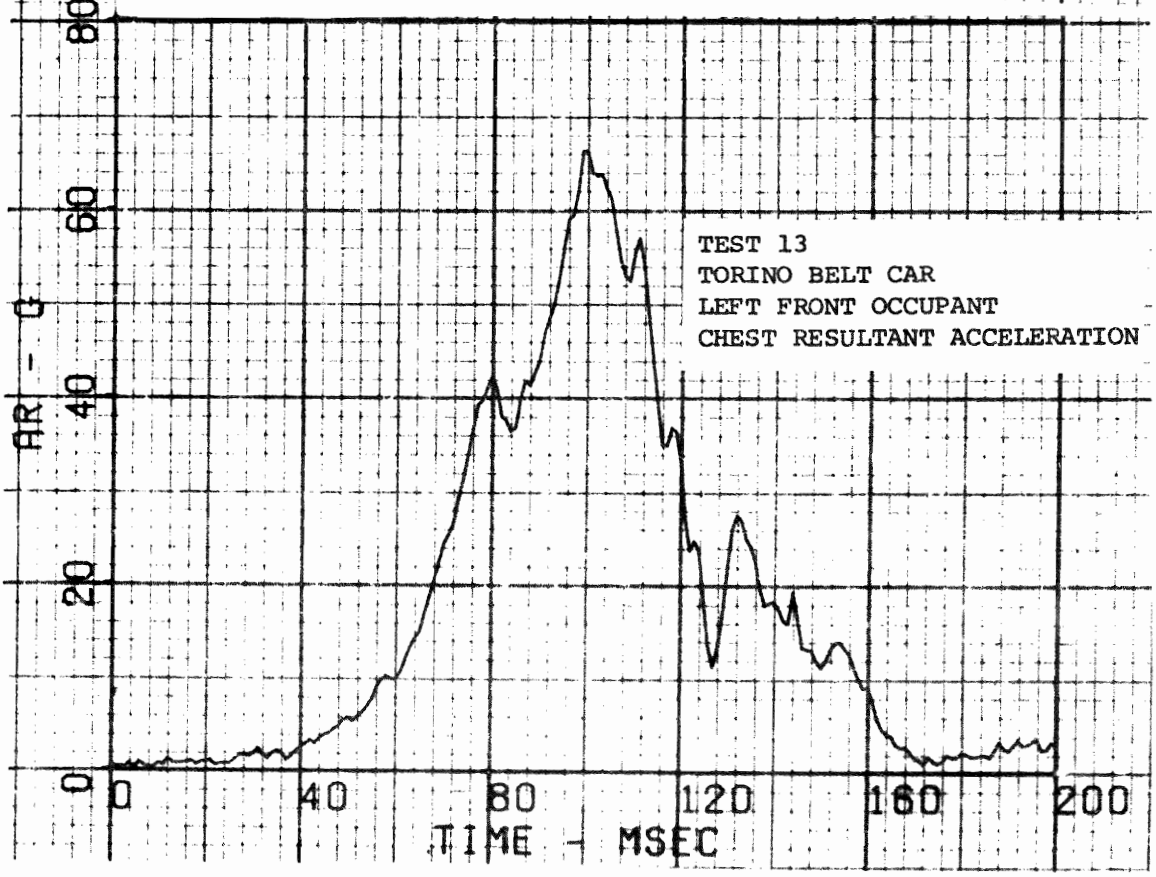


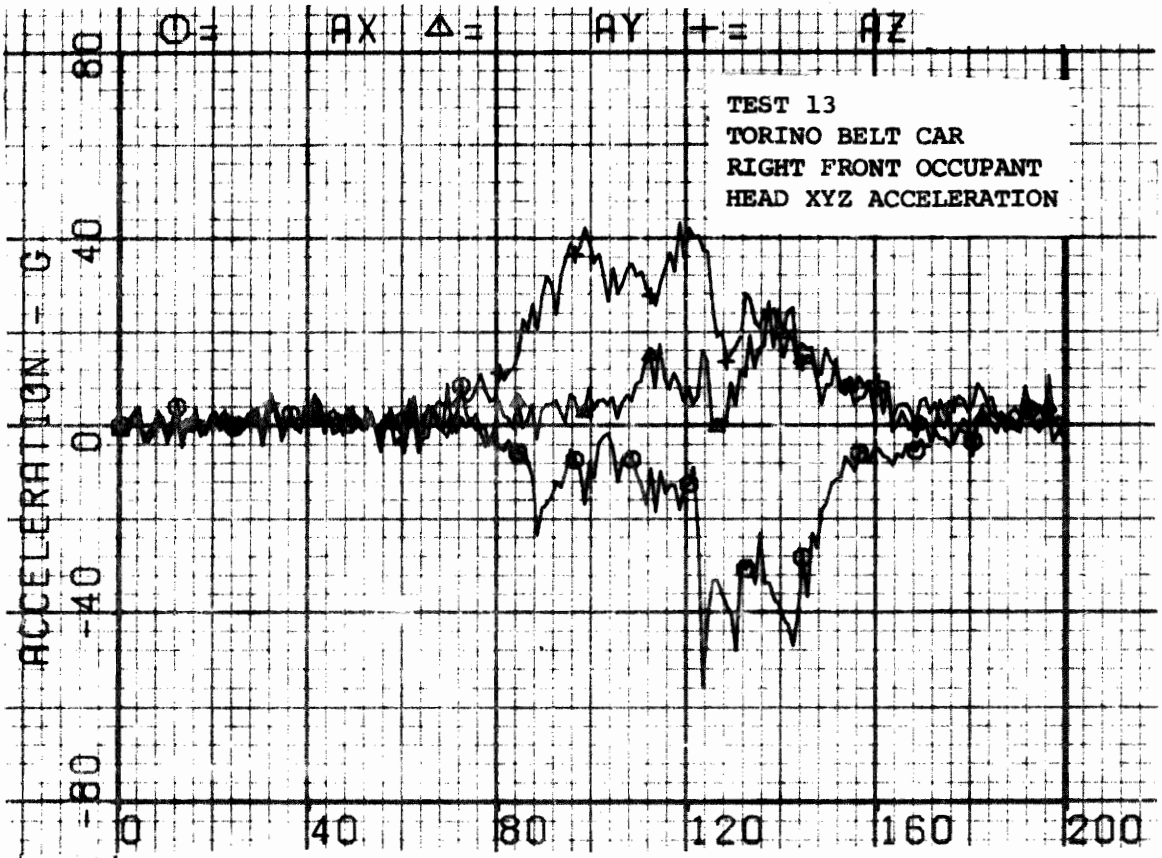
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

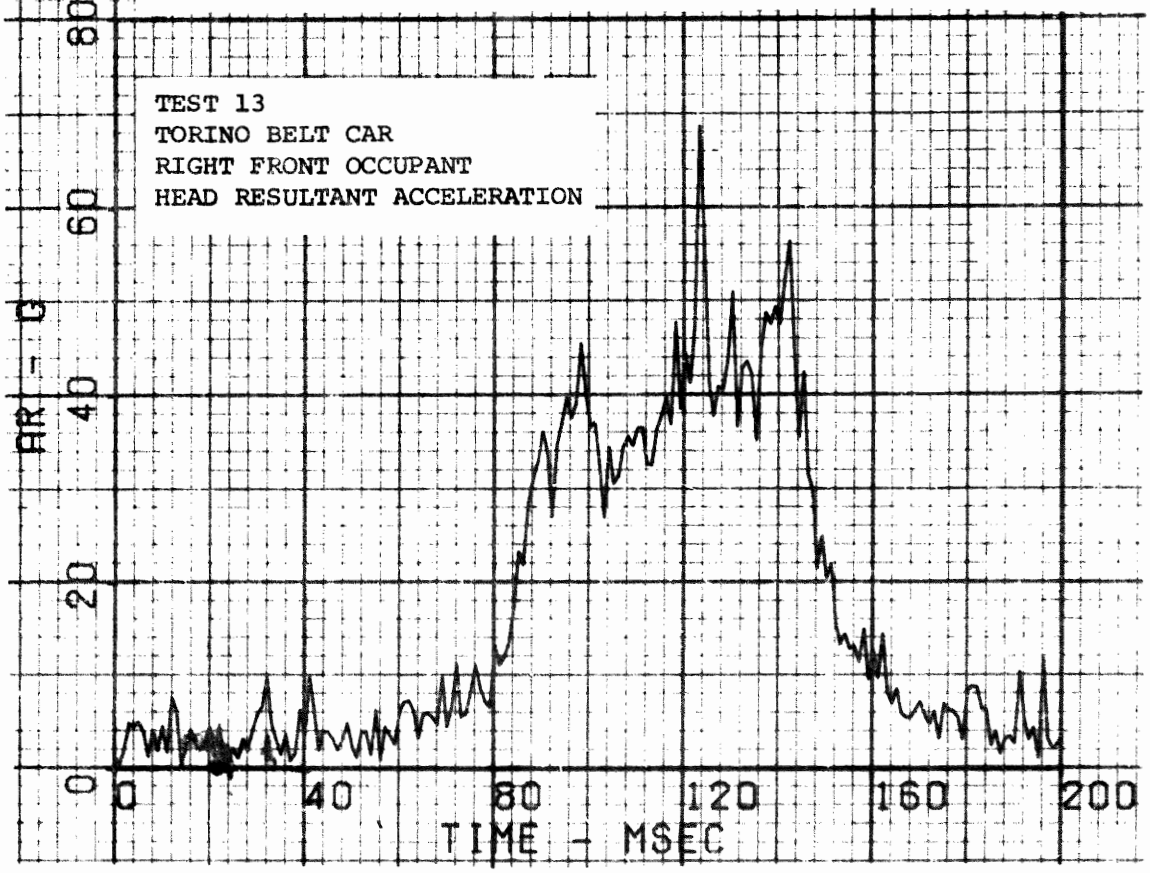
Figure 3-36. Vehicle Accelerometer Locations - Test 13.

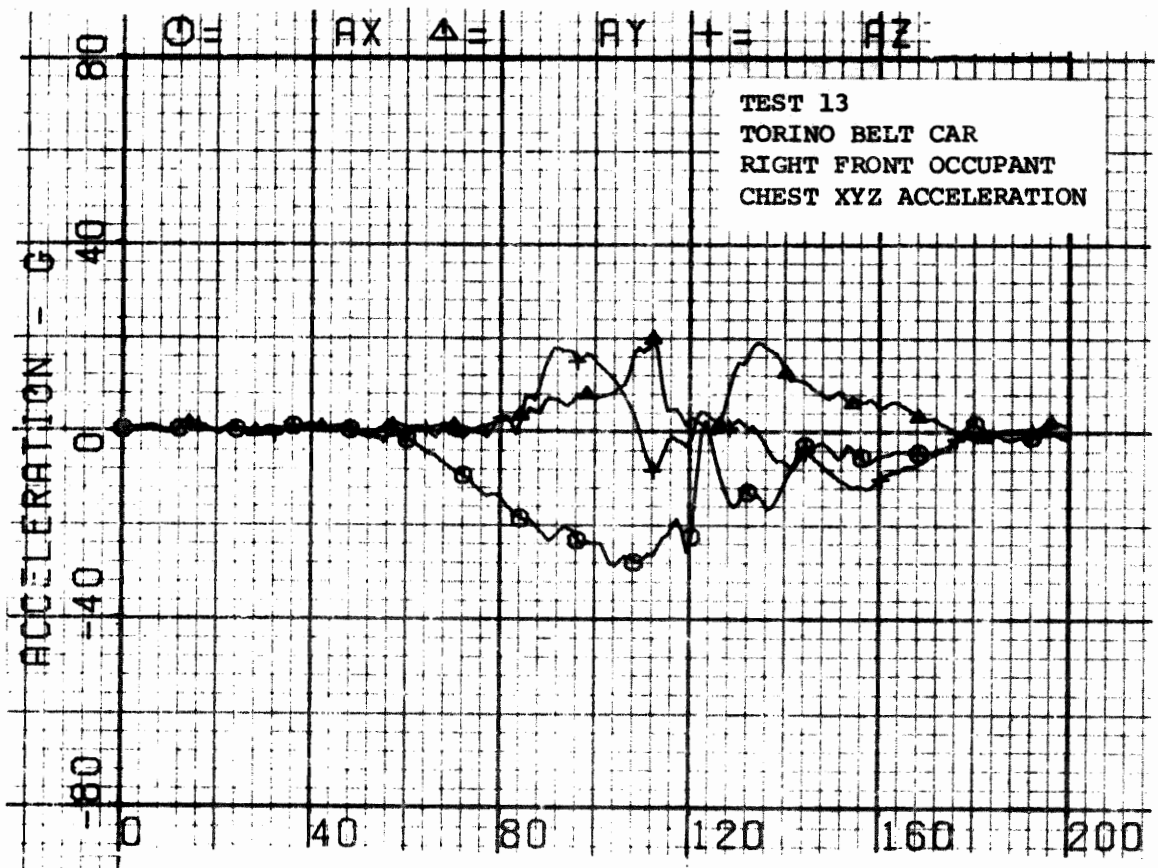

AX
AY
AZ
TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
82.2
TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

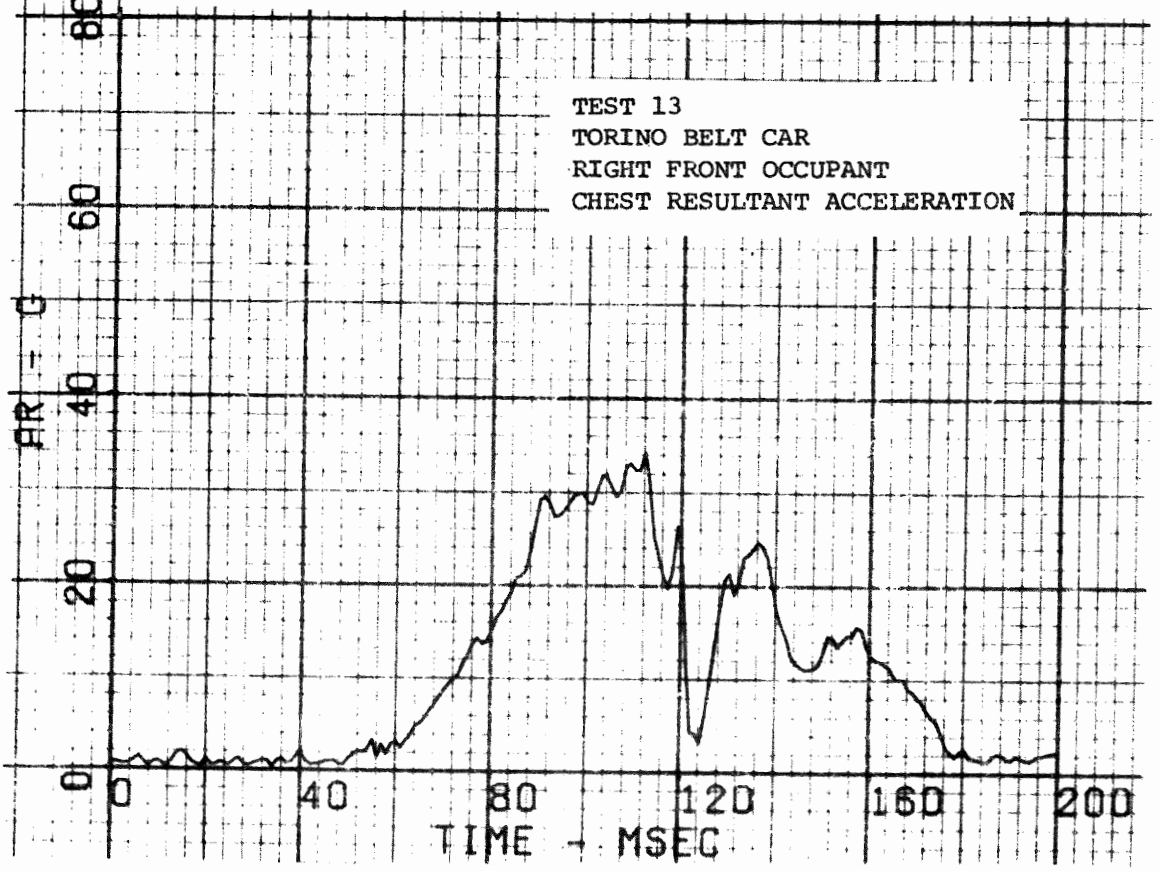

⊖= AX △= AY +=
AZ
TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

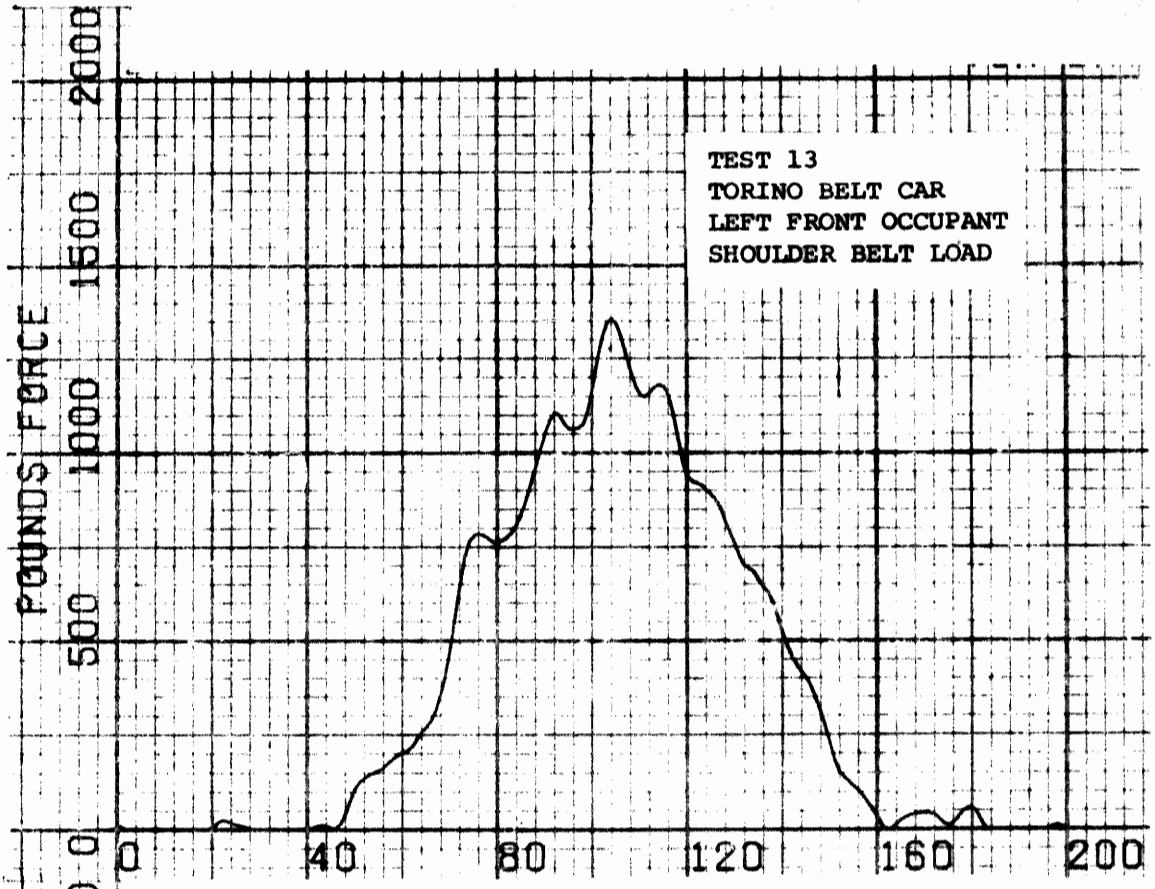

TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

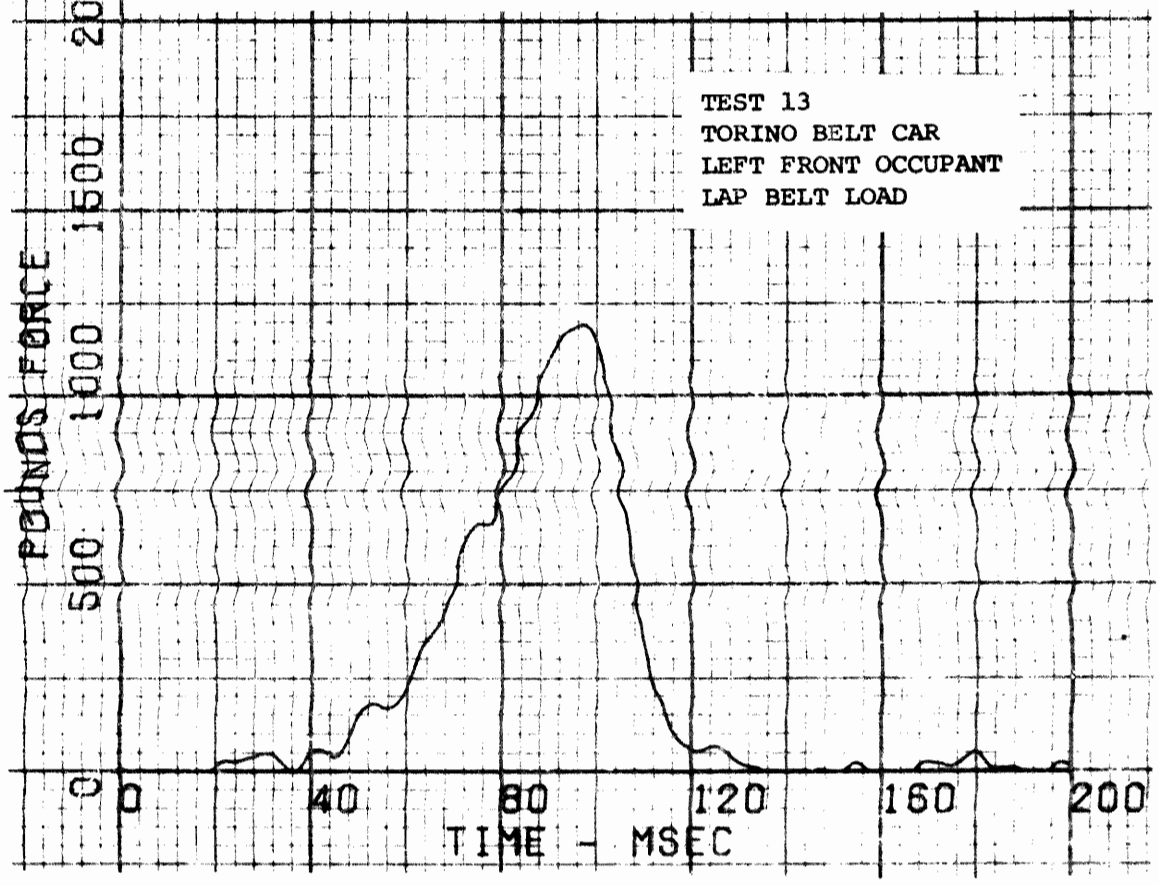

O= AX Δ= AY += AZ
TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

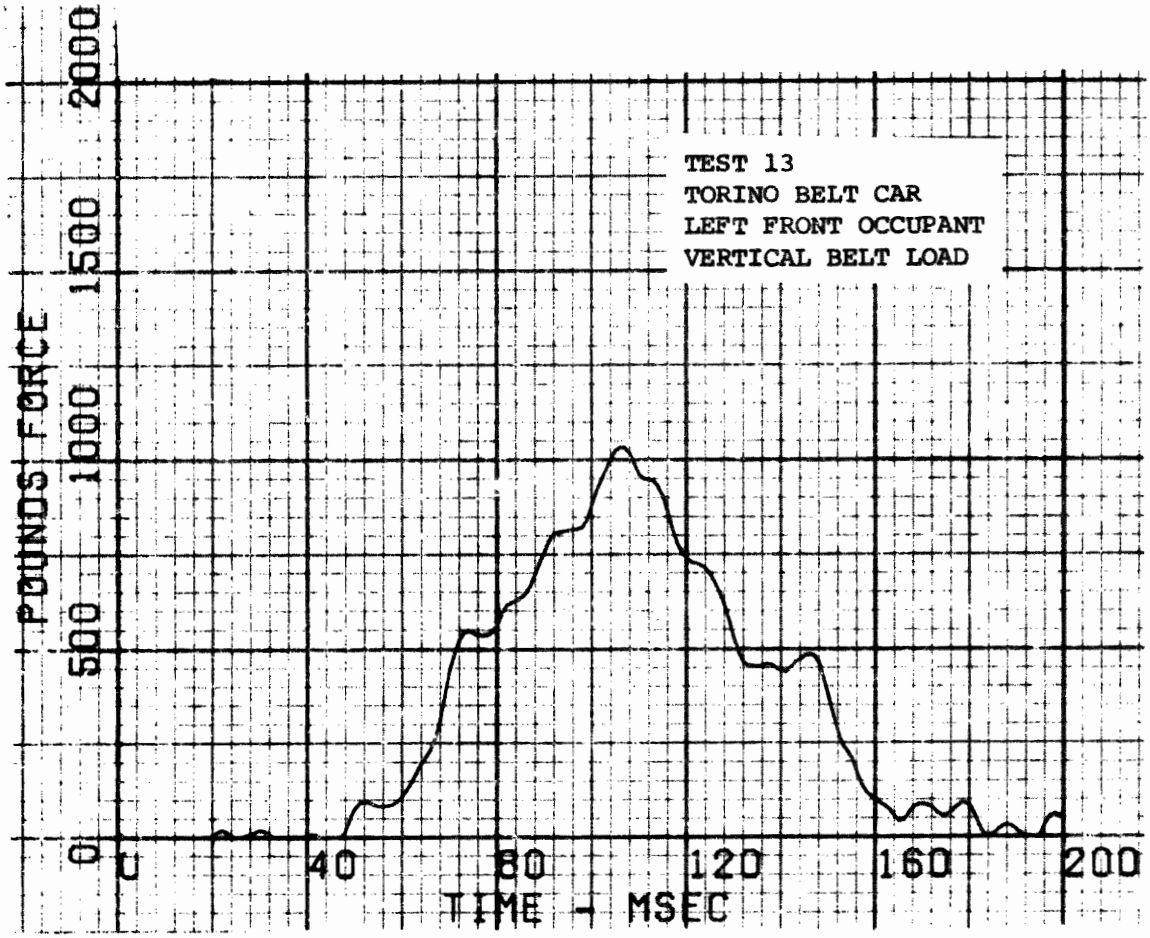

TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

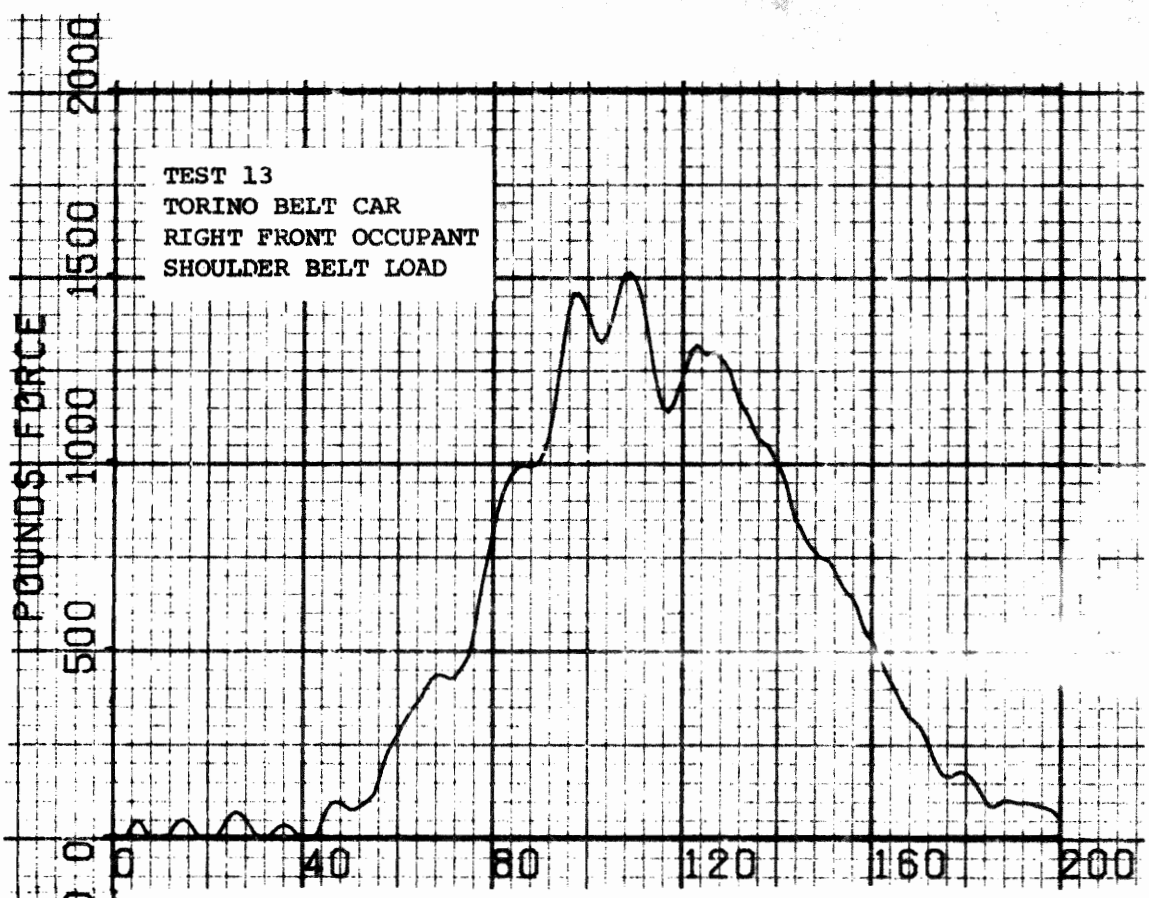

⊖= AX
△= AY
+= AZ
TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

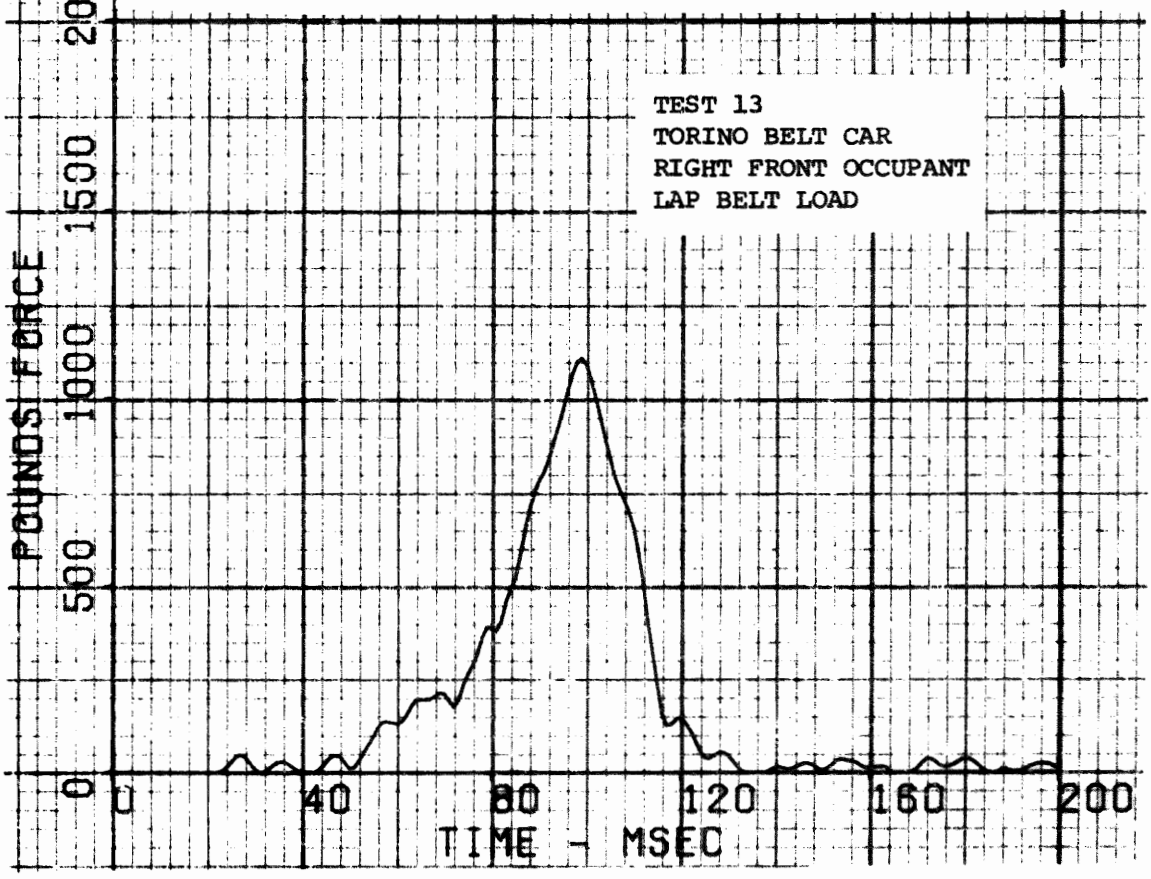

TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

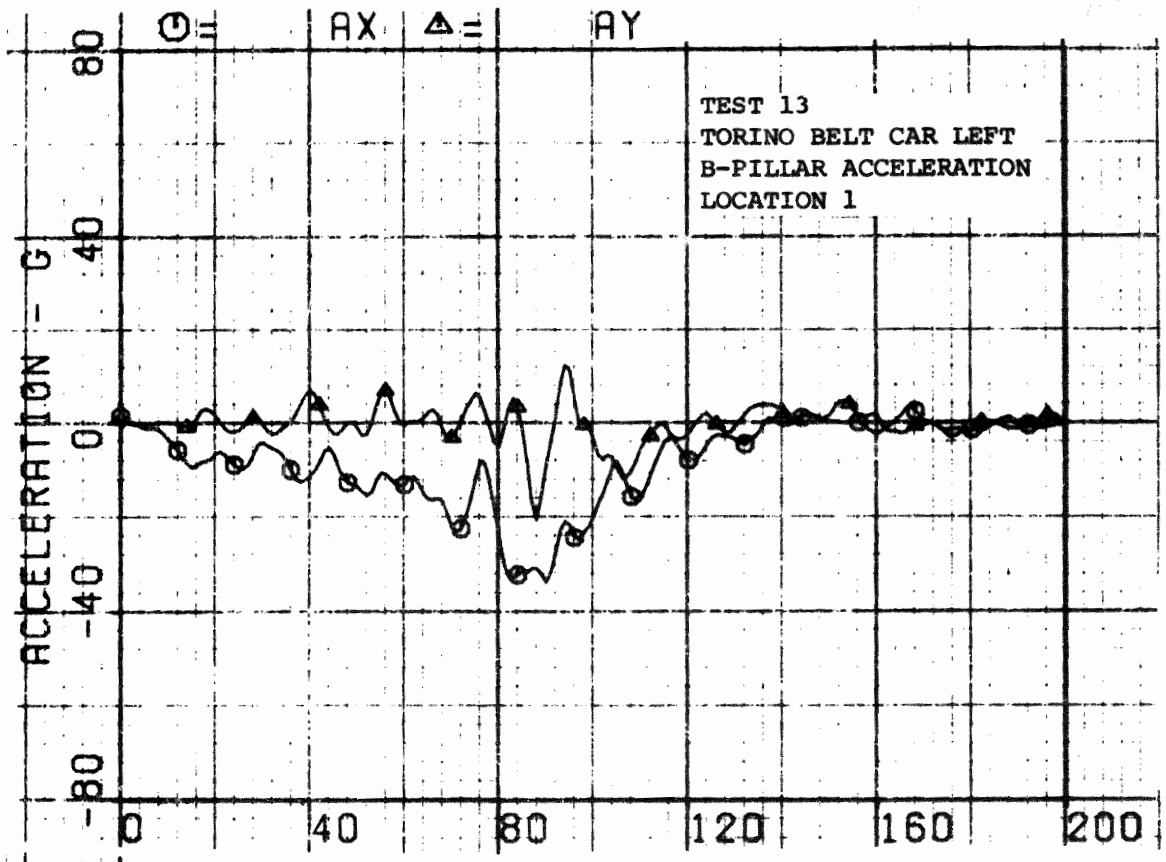

TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

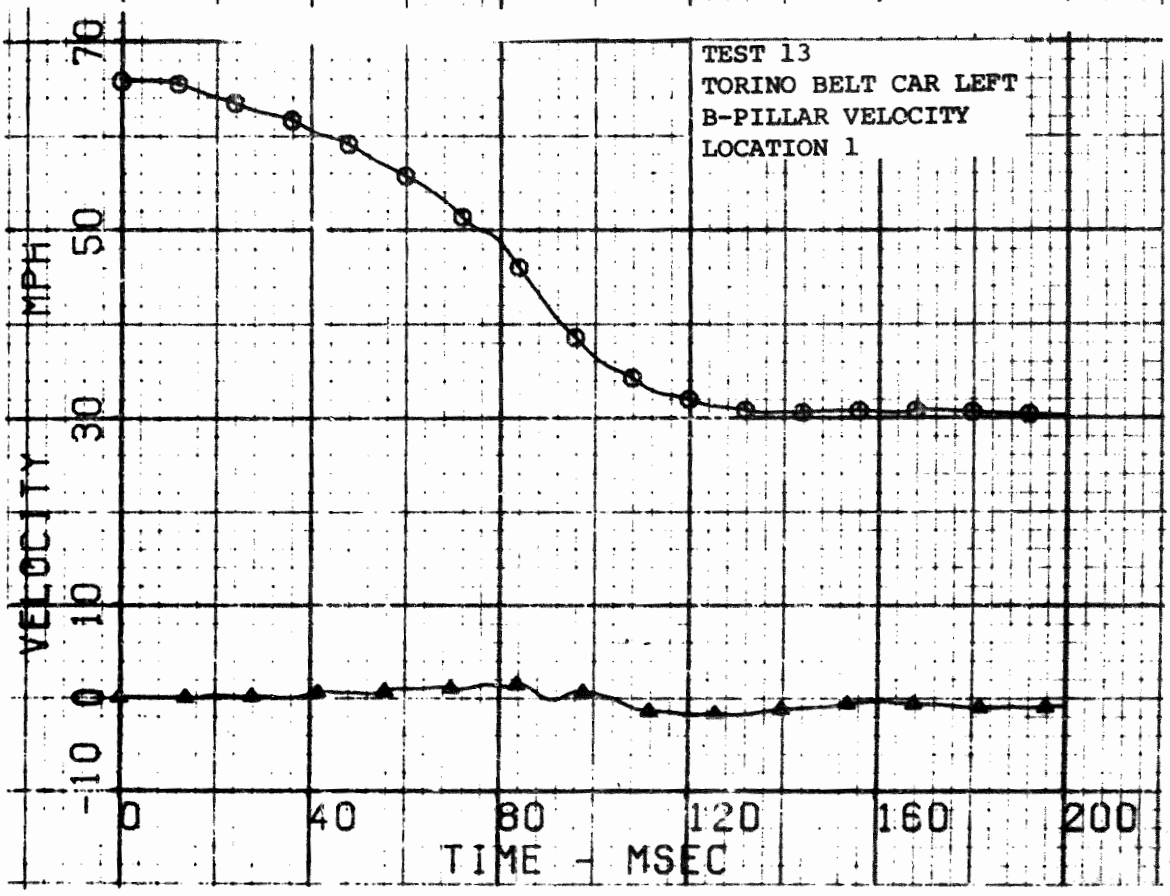

TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

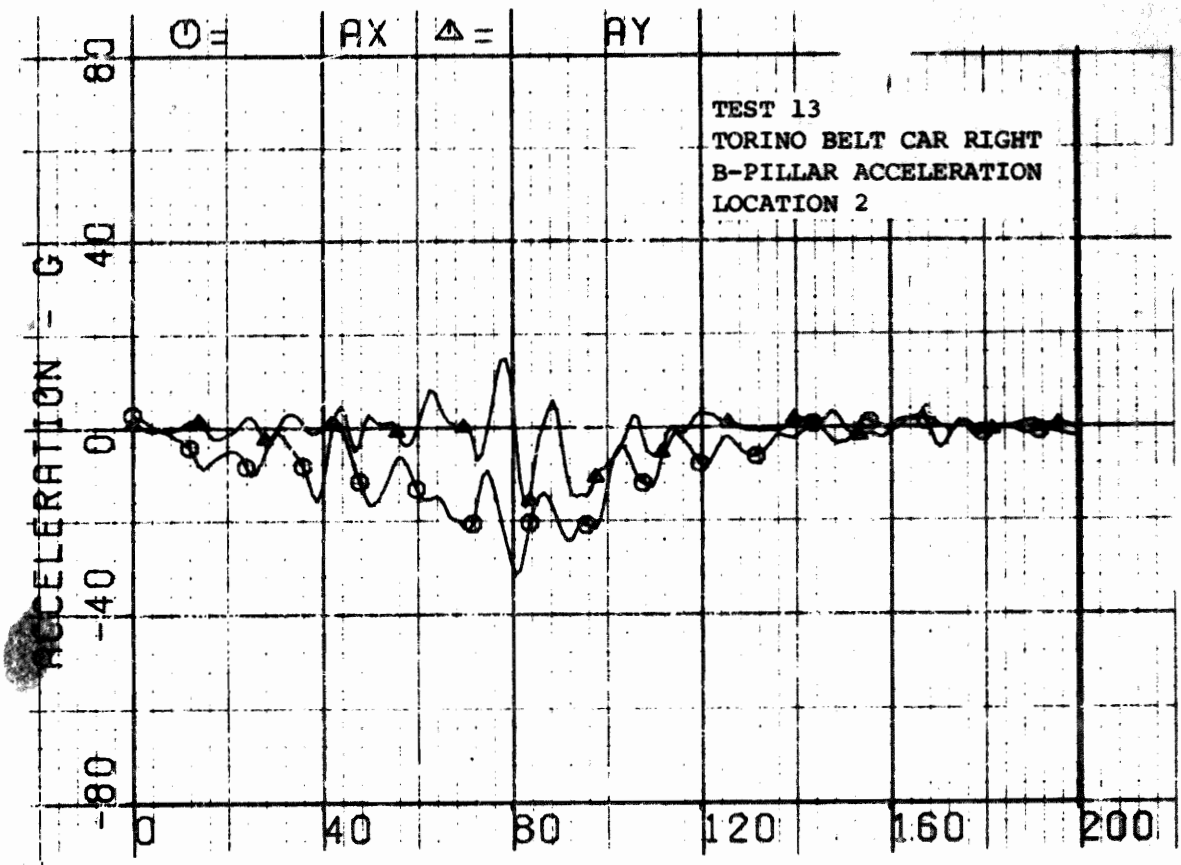

TEST 13
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME → MSEC

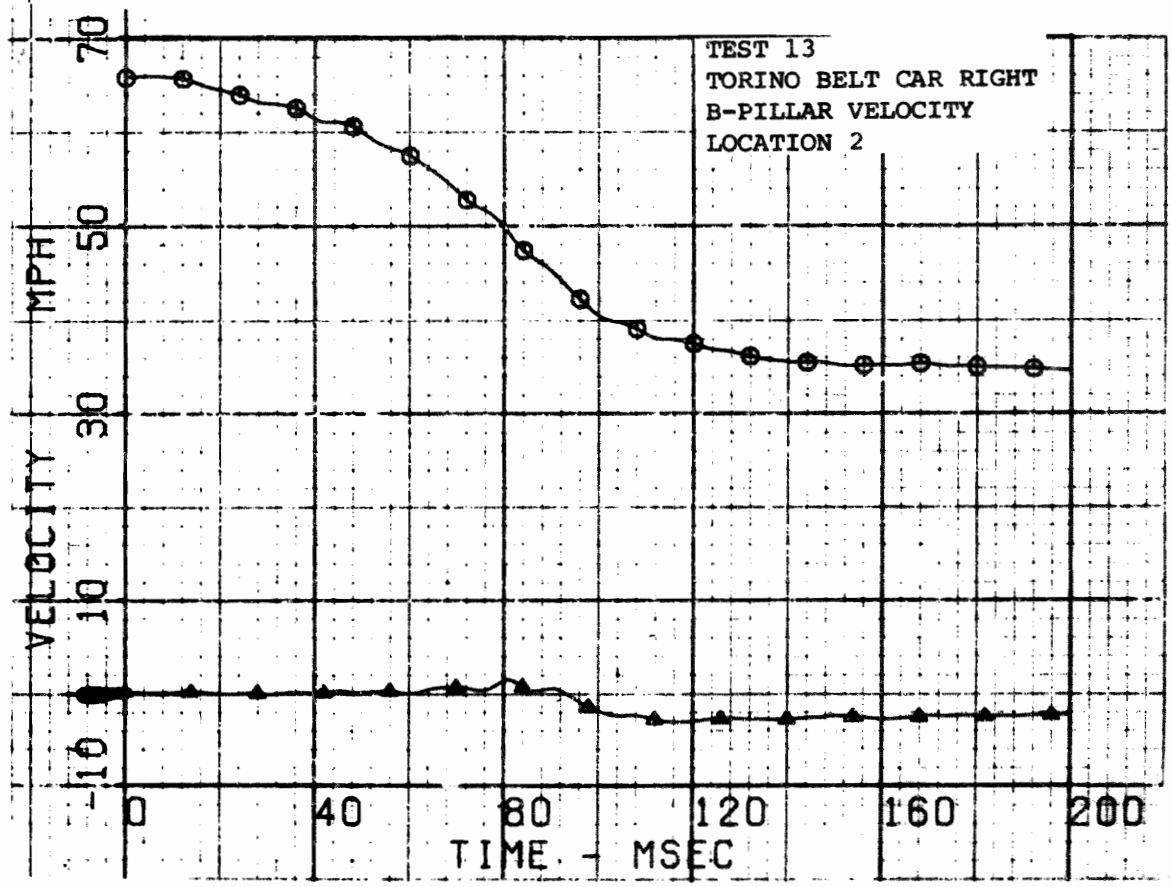

TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

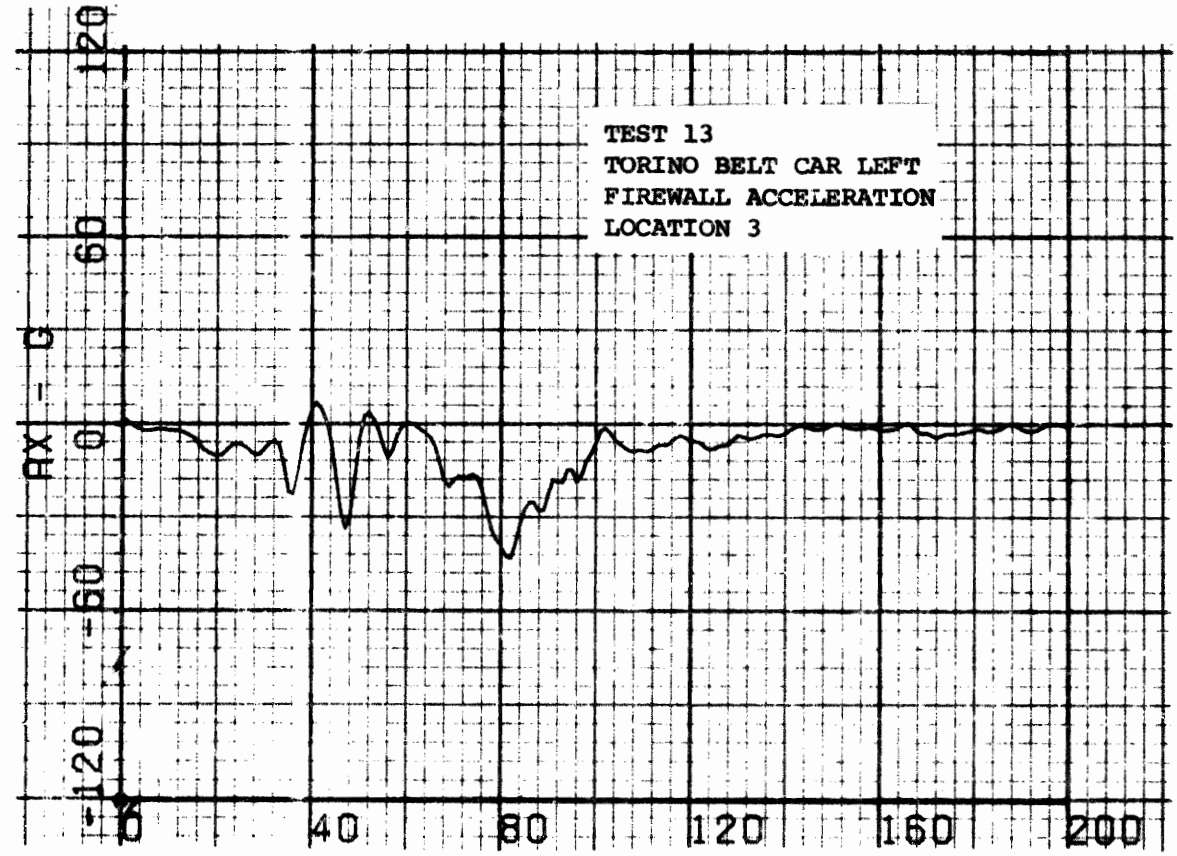

TEST 13
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

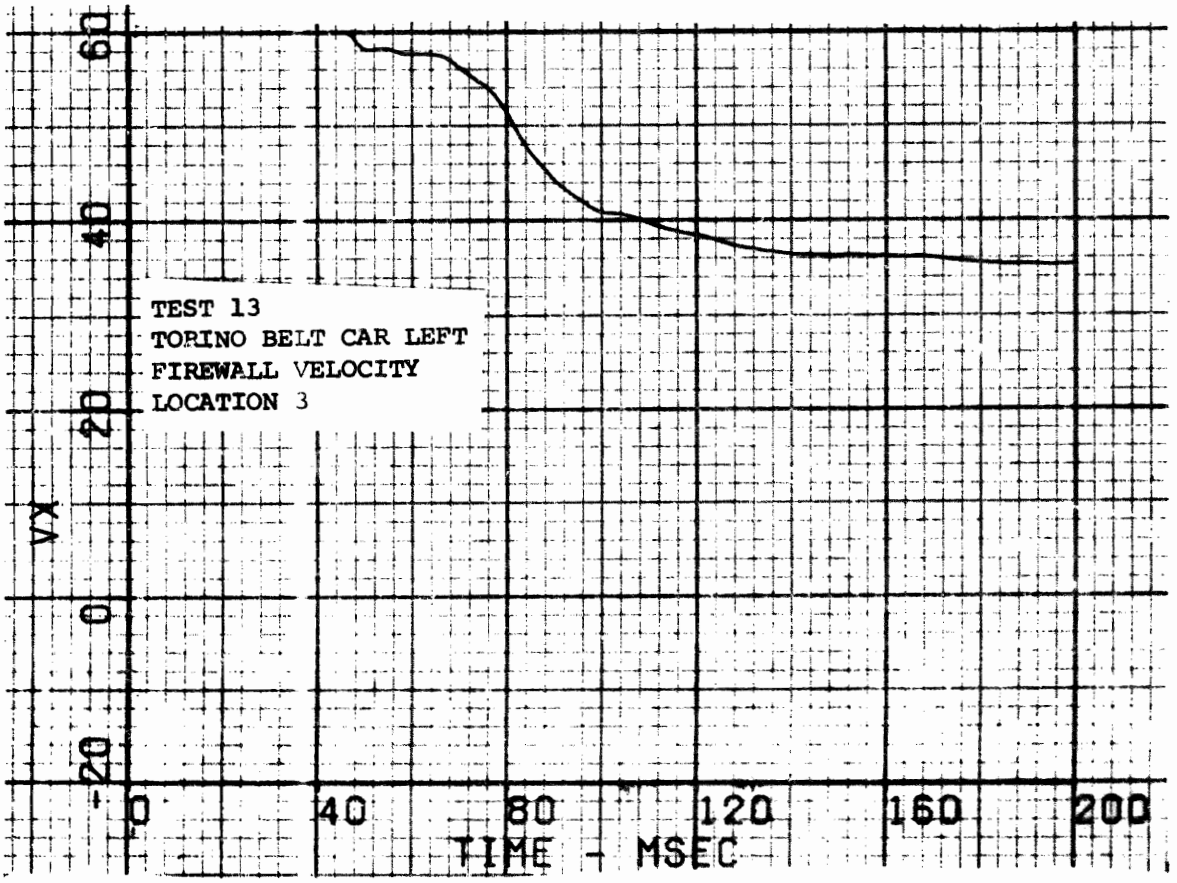

AX
AY
TEST 13
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

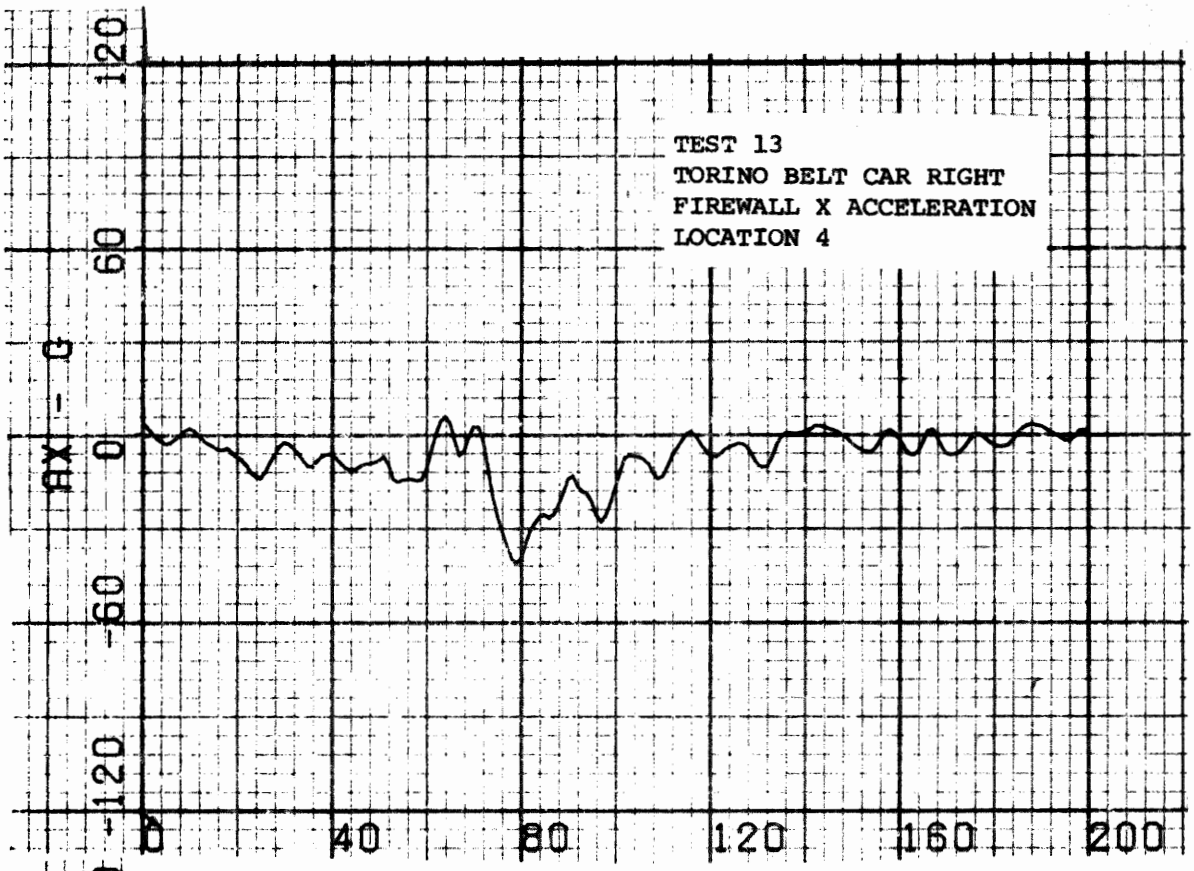

TEST 13
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VELOCITY - MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

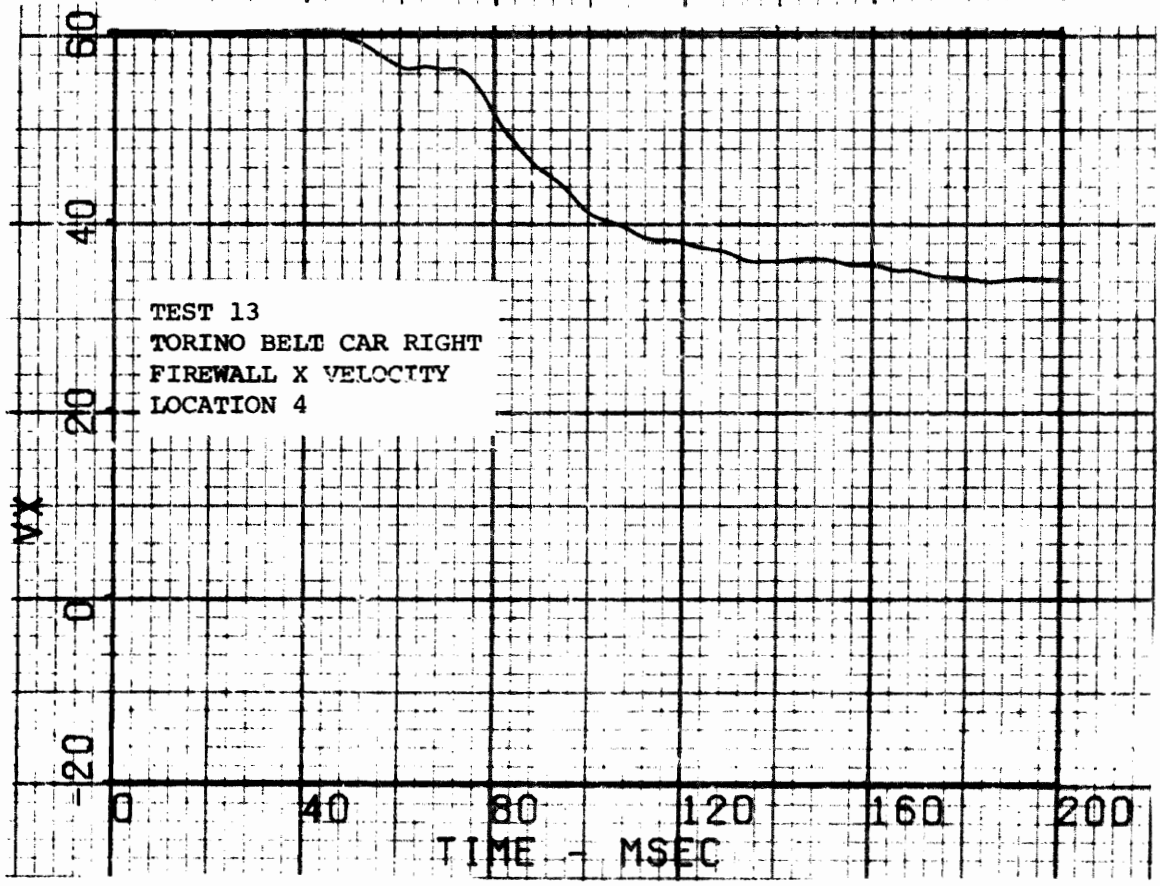

⊙ = AX
△ = AY
TEST 13
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

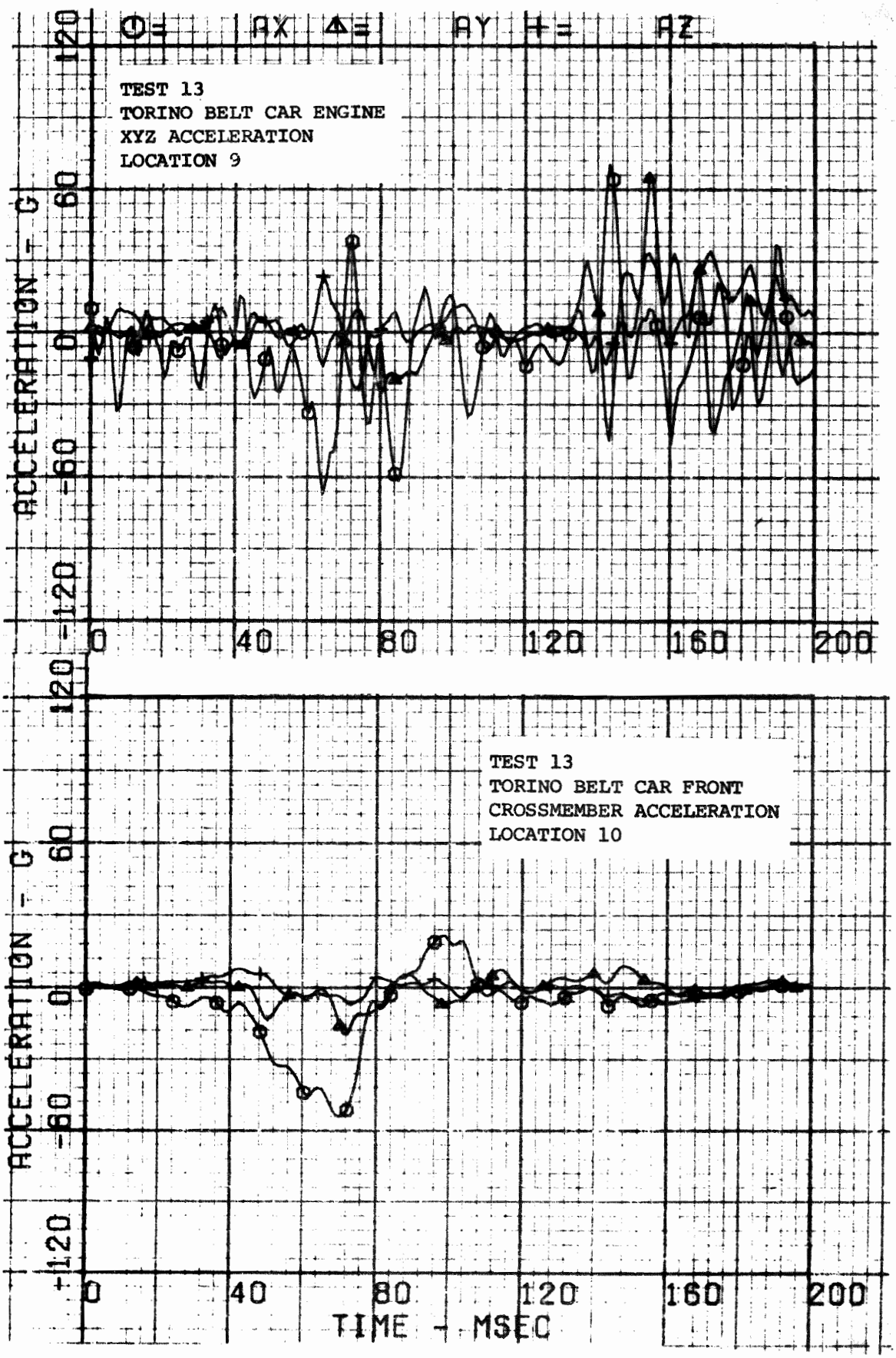

TEST 13
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

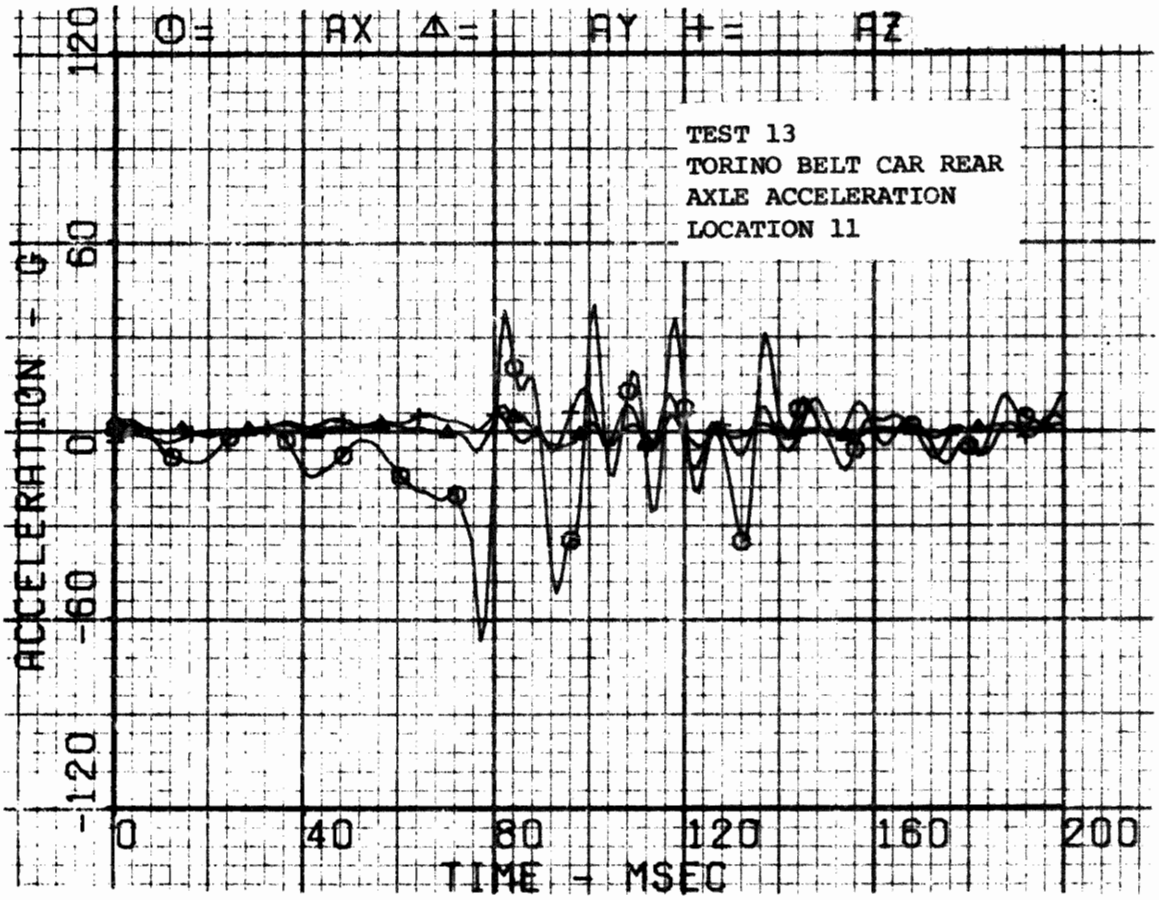

TEST 13
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
RX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 13
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 13
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 13
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


O= AX Δ= AY += AZ
TEST 13
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 13
TORINO BELT CAR FRONT
CROSSMEMBER ACCELERATION
LOCATION 10
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


⊙= AX Δ= AY □= AZ
TEST 13
TORINO BELT CAR REAR
AXLE ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

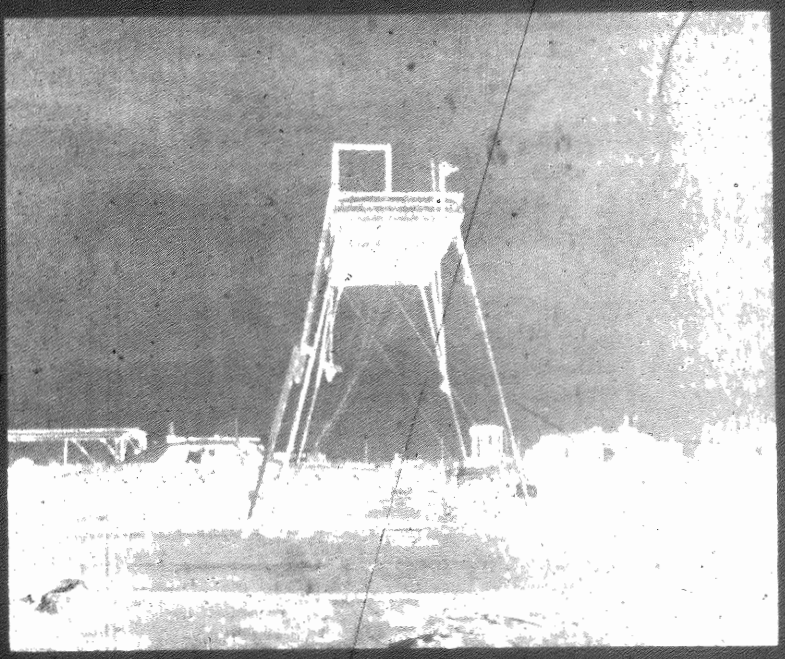


Figure 3-37. Pre-test Vehicle Configuration - Test 13.

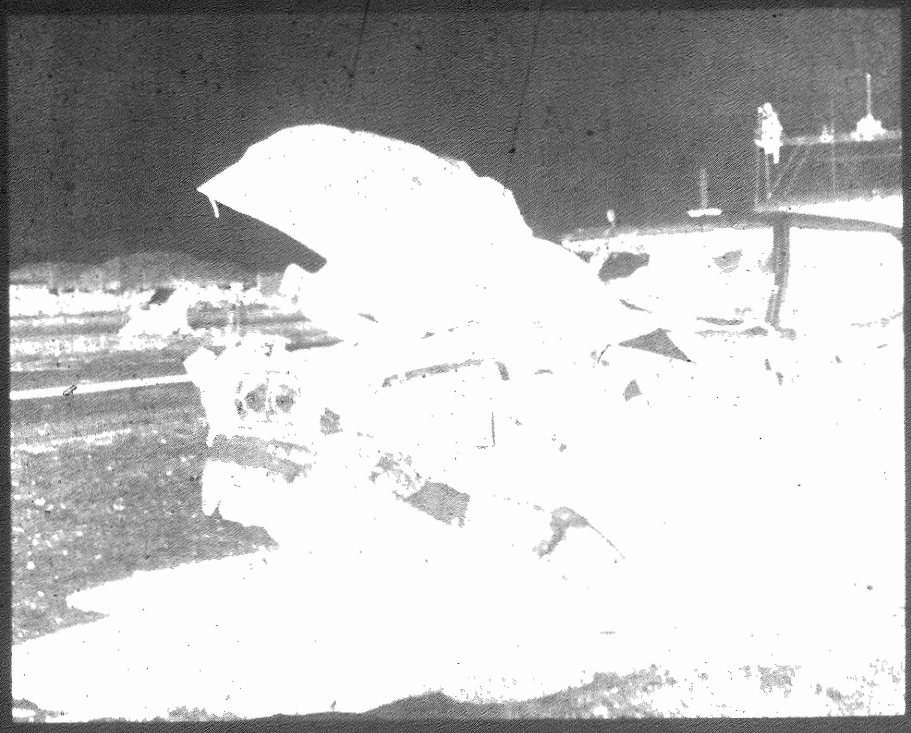


Figure 3-38. Post-test Vehicle Configuration - Test 13.

Figure 3-39. Pre-test Standard 3-Point Belt, Left Front - Test 13.

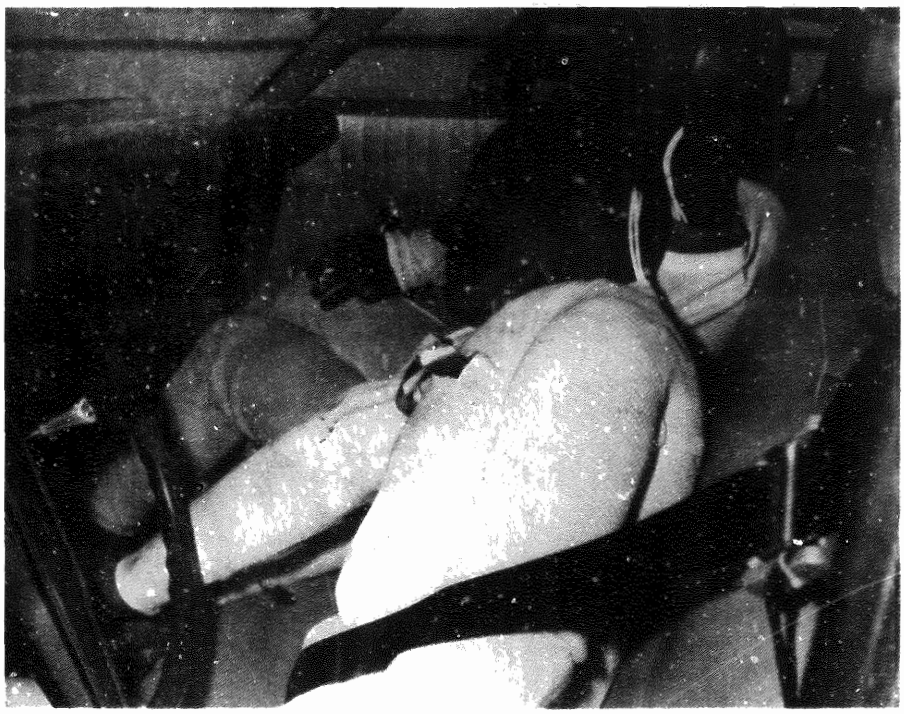


Figure 3-40. Post-test Standard 3-Point Belt, Left Front - Test 13.

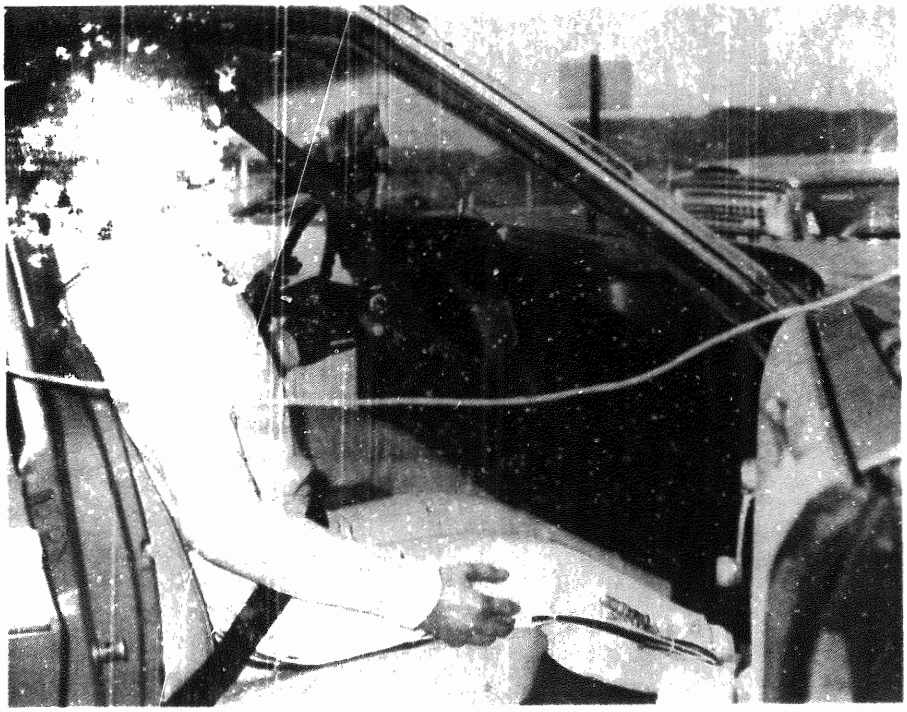


Figure 3-41. Pre-test Standard 3-Point Belt, Right Front - Test 13.

Figure 3-42. Post-test Standard 3-Point Belt, Right Front - Test 13.

3.7 TEST NUMBER 14

The impact conditions for Test 14 were:

Configuration	Closing Speed
Torino-to-Volvo Right Oblique (30°)*	66.6 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt with Web Lockers and Force Limiters	Force Limited Airbelt
Right Front	Standard 3-Point Belt with Web Lockers and Force Limiters	Force Limited 2-Inch Belt

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 14 are summarized in the following tables:

Table 3-25 - Summary of Vehicle Data (Test 14)

Table 3-26 - Injury Criteria Summary (Test 14)

Table 3-27 - Summary of Restraint System Data (Test 14)

Table 3-28 - Occupant Response Data (Test 14)

which are followed by Figure 3-43 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 30° to centerline of target vehicle.

TABLE 3-25. SUMMARY OF VEHICLE DATA (TEST 14)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 14/April 7, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		491	427
TEST WEIGHT (lb)		4675	3216
IMPACT VELOCITY (mph)		66.6	0
VELOCITY CHANGE (mph)		31.9	40.5 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	22.5 @ 87	39.5 @ 85
	LOCATION 2	39.3 @ 87	35.6 @ 63
MAXIMUM STATIC CRUSH (in.)			
	LEFT	17.0	10.0
	CENTER	26.0	30.5
	RIGHT	18.0	53.0

(1) Velocity change found by using average of resultant velocity vector (V_R) data for compartment accelerometer locations.

TABLE 3-26. INJURY CRITERIA SUMMARY (TEST 14)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	STANDARD 3-POINT BELT W/WEB LOCKERS AND FORCE LIMITERS		STANDARD 3-POINT BELT W/WEB LOCKERS AND FORCE LIMITERS	
HIC	439		654	
HEAD G(1) @ msec	48.3 @ 124		54.3 @ 123	
CSI	170		234	
CHEST G(1) @ msec	29.9 @ 89		39.4 @ 107	
FEMUR LOAD (lb) (2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

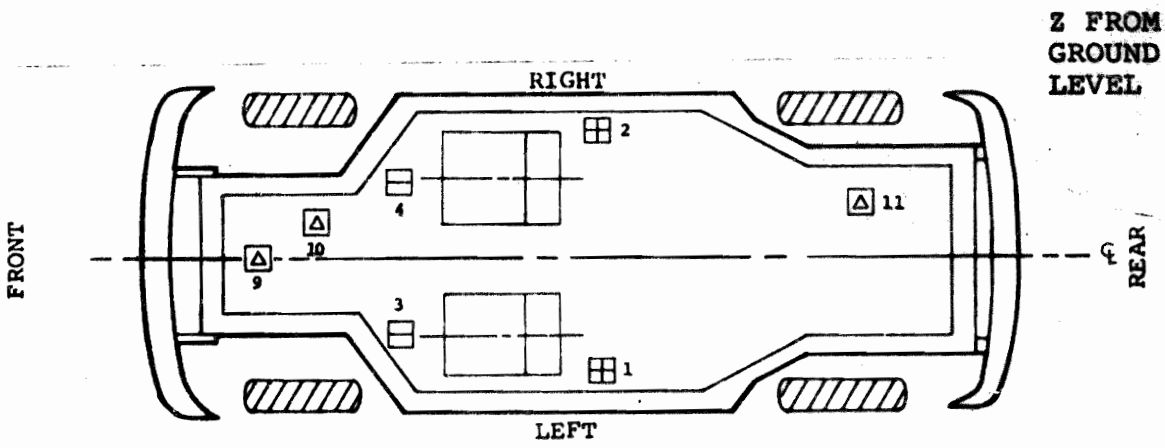
TABLE 3-27. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 14)

VEHICLE A - BELT CAR (TORINO)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1294 @ 109
Peak Lap Belt Load	lb @ msec	686 @ 89
Peak Vertical Belt Load	lb @ msec	51 @ 67
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1305 @ 109
Peak Lap Belt Load	lb @ msec	1244 @ 100

TABLE 3-28. OCCUPANT RESPONSE DATA SUMMARY (TEST 14)

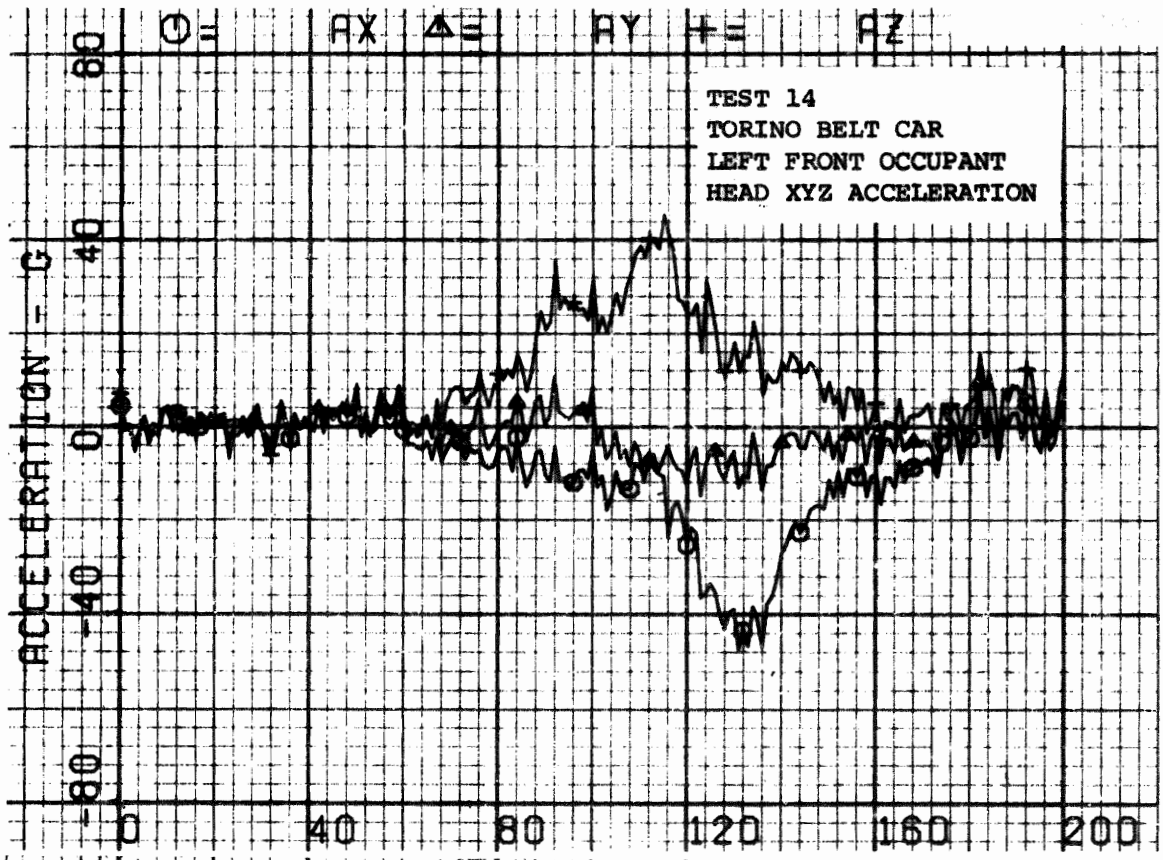
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	47.5	131	68.8	119
	Y	15.0	123	46.1	145
	Z	45.4	115	58.2	117
	R(1)	48.3	124	54.3	123
	HIC	439 @ 88-147		654 @ 89-157	
CHEST					
	X	30.2	100	30.0	107
	Y	11.4	104	44.6	128
	Z	9.6	149	16.4	93
	R(1)	29.9	89	39.4	107
	SI	170 @ 200		234 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS(2)					
	LF	NA		NA	
	RT	NA		NA	

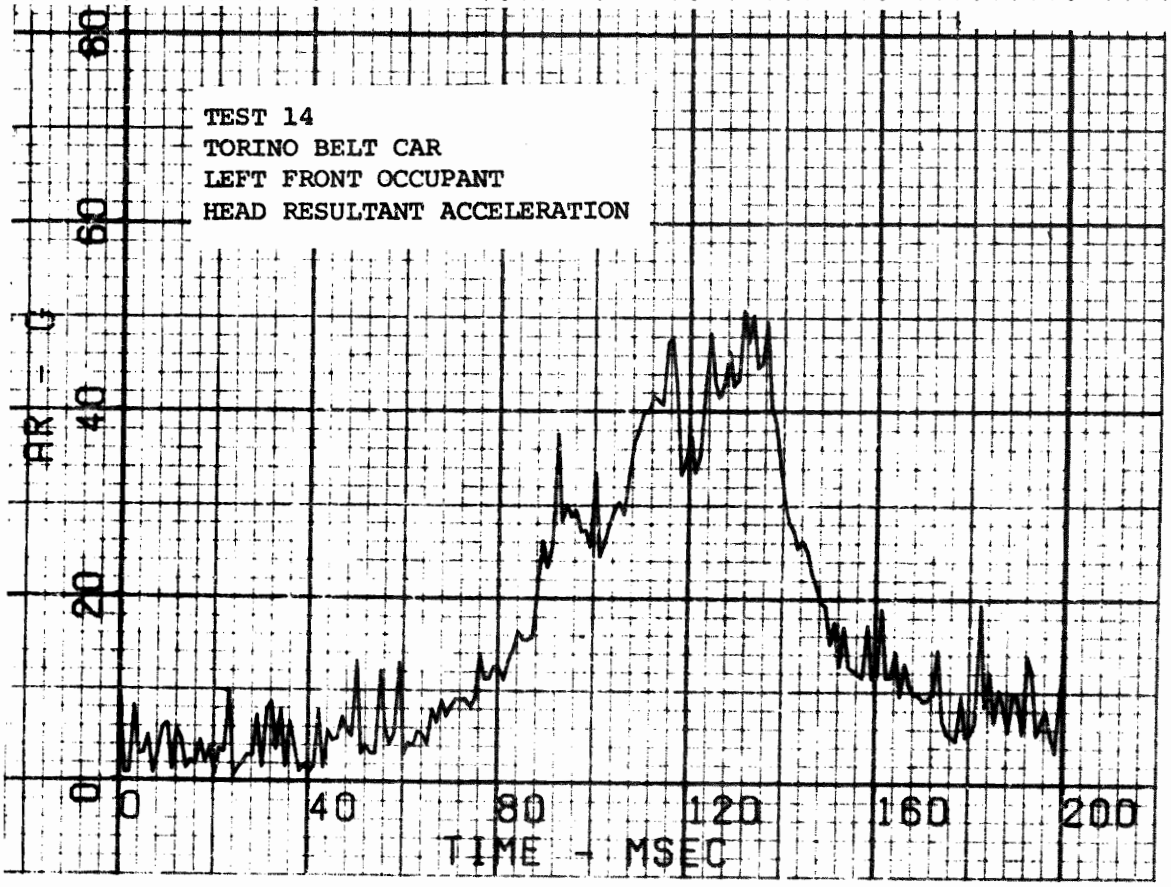
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

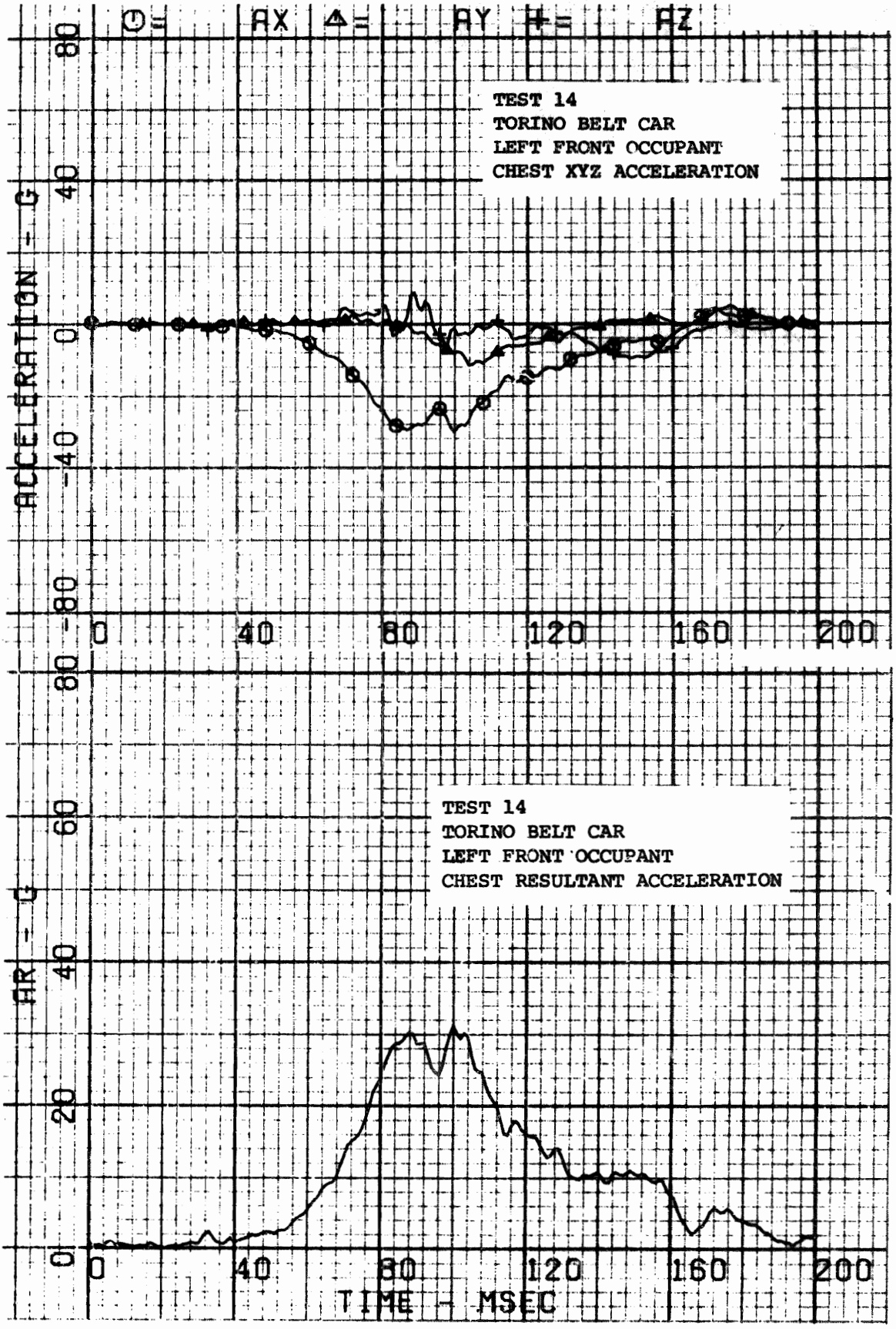


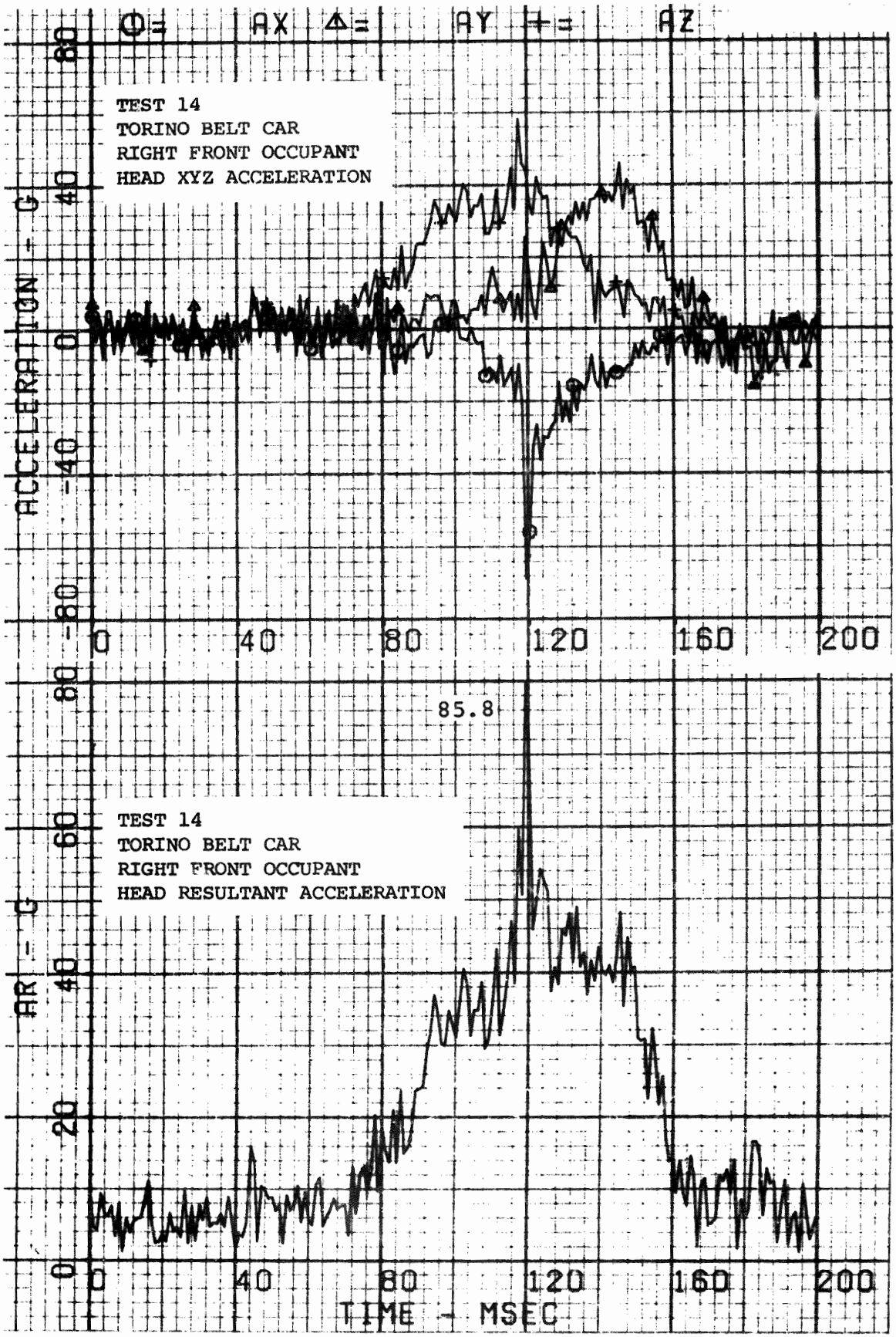
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
9	Engine Block	X	X	X
10	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

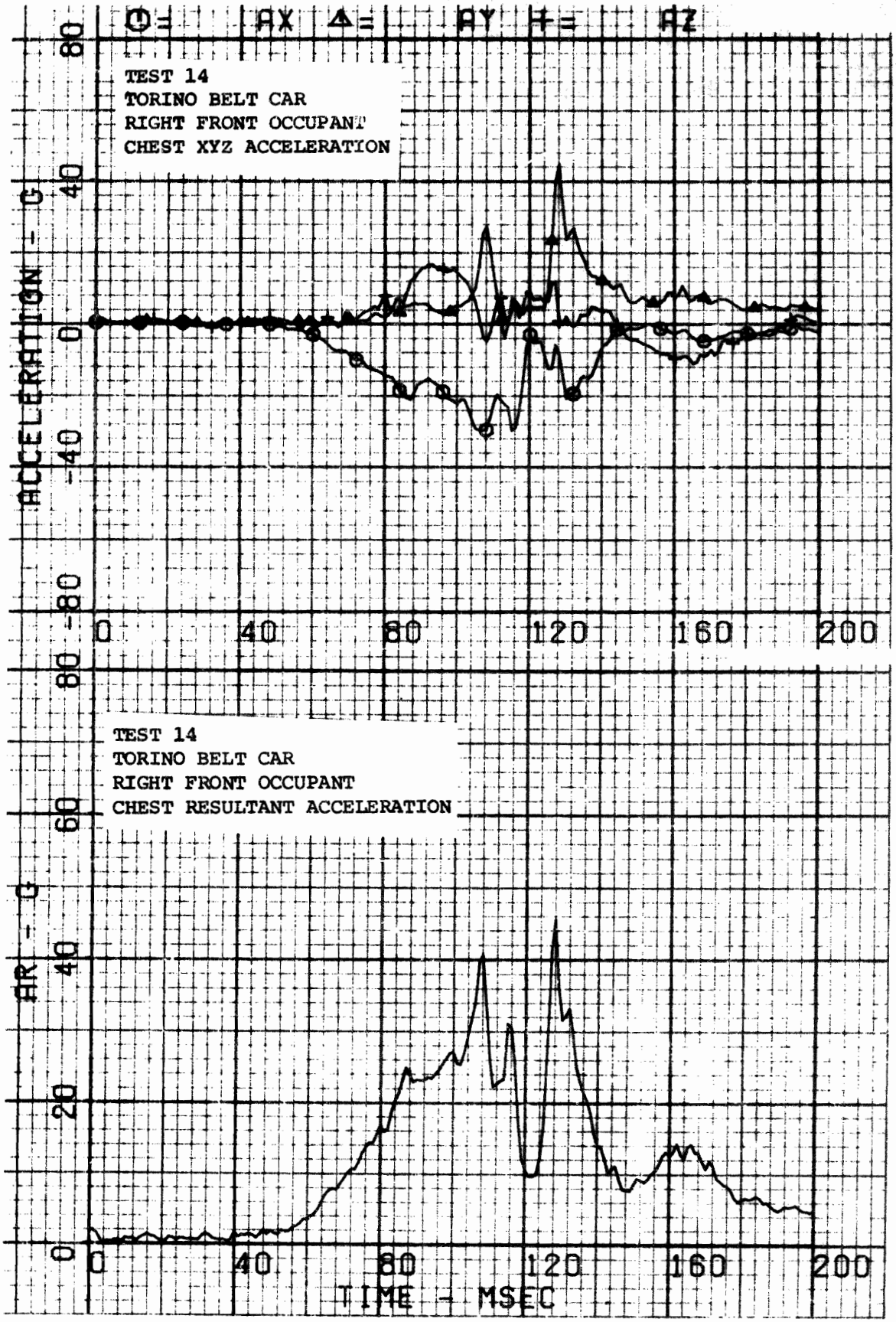
Figure 3-43. Vehicle Accelerometer Locations - Test 14.

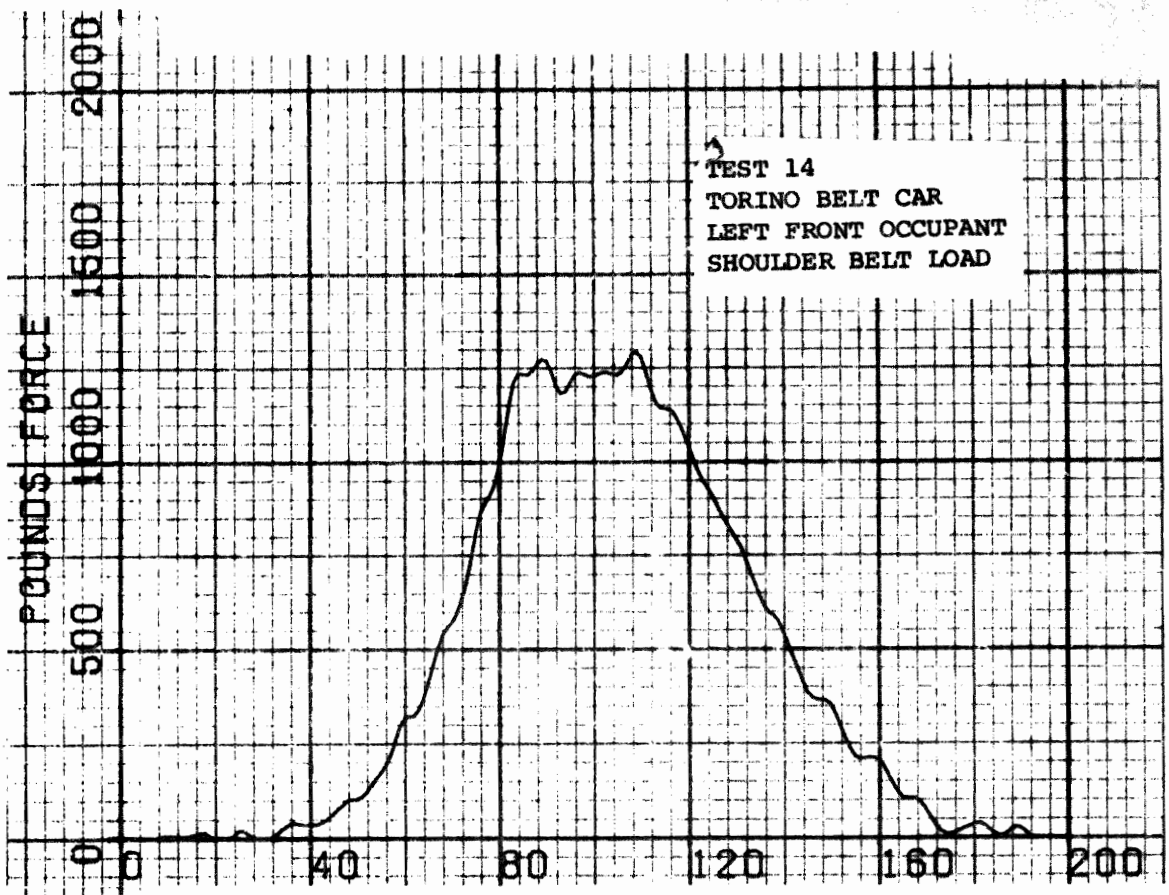

○= AX △= AY += AZ
TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

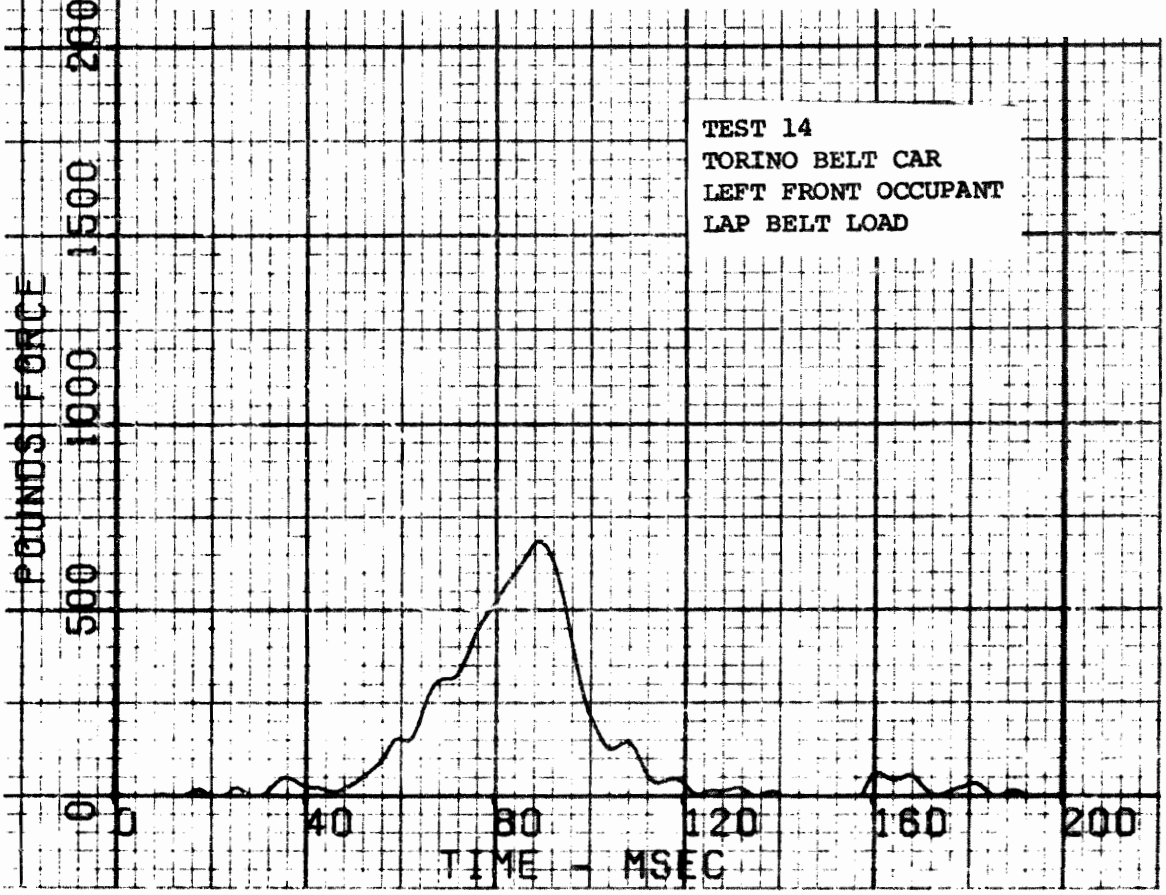

TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

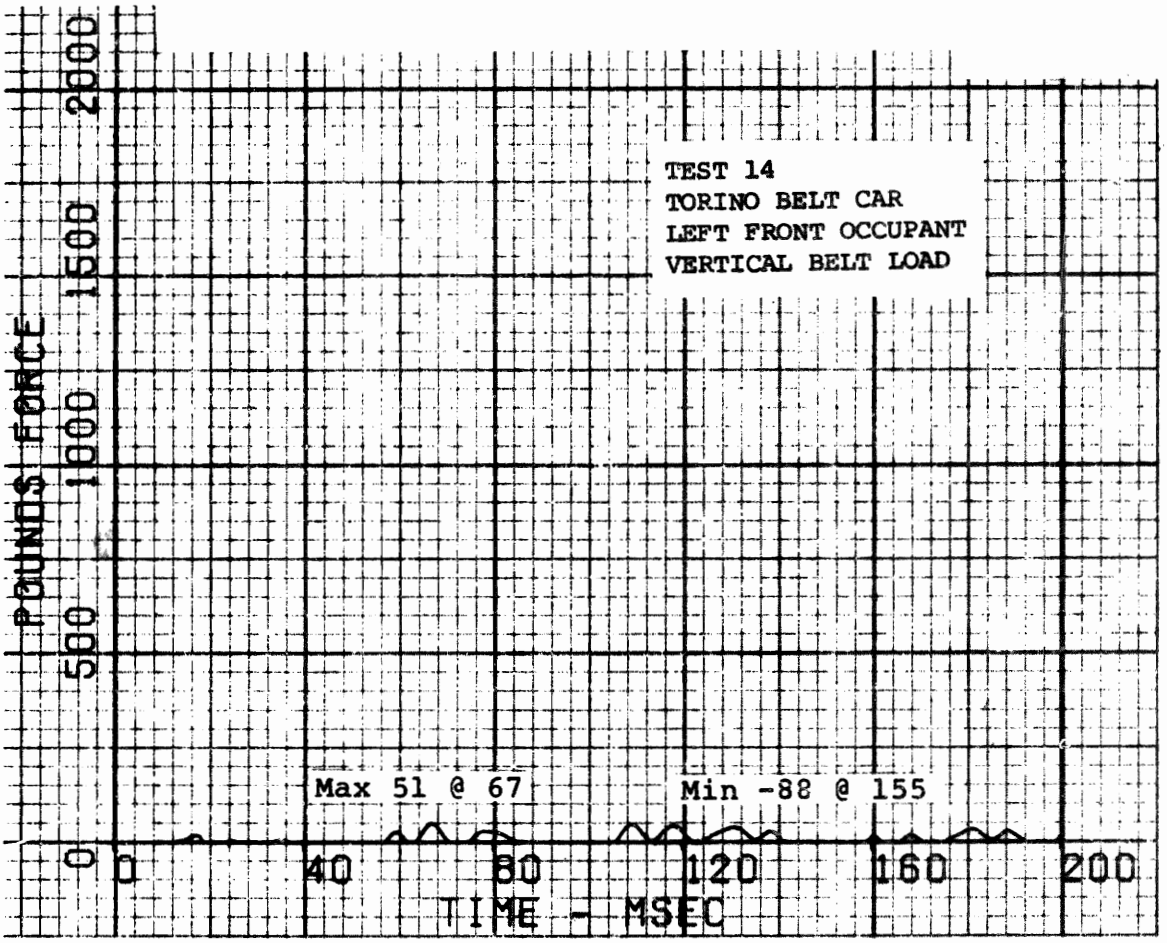

AX
AY
AZ
TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

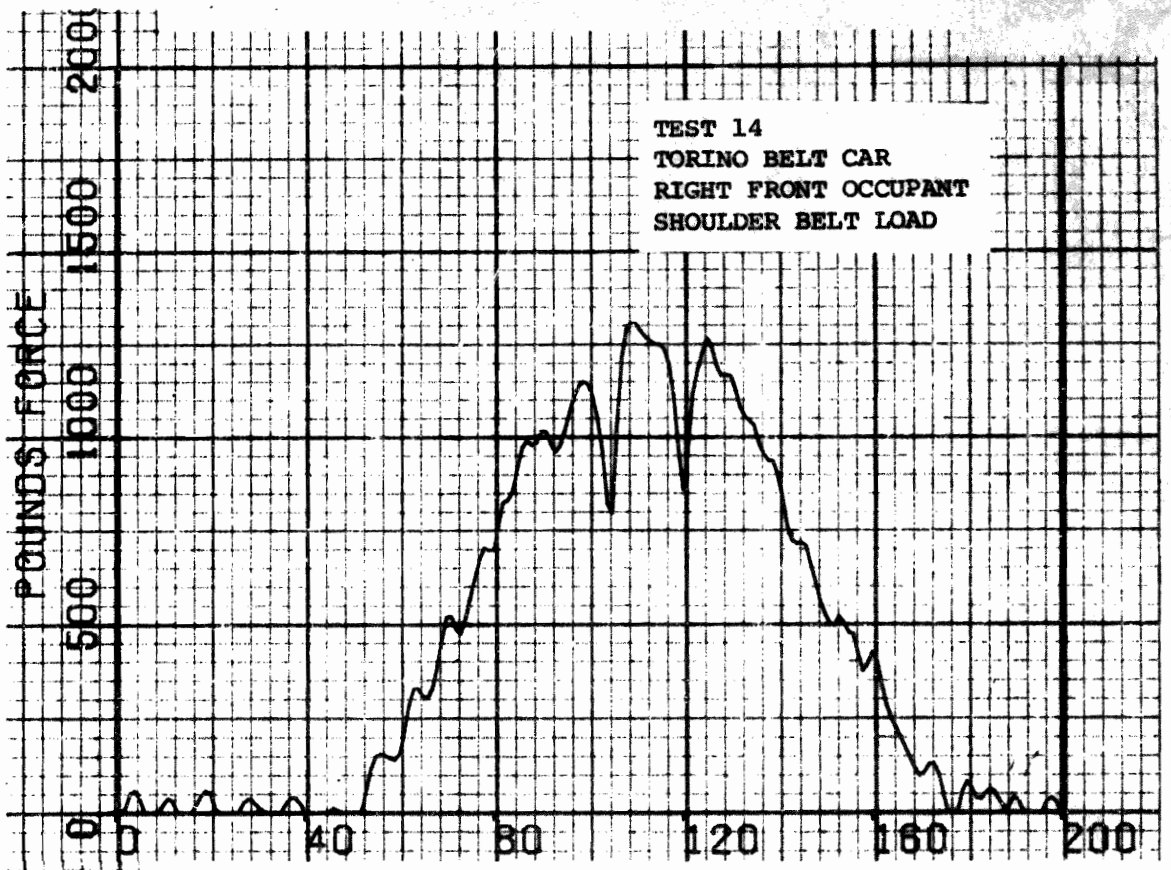

Φ=
AX
Δ=
AY
+=
AZ
TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
85.8
TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

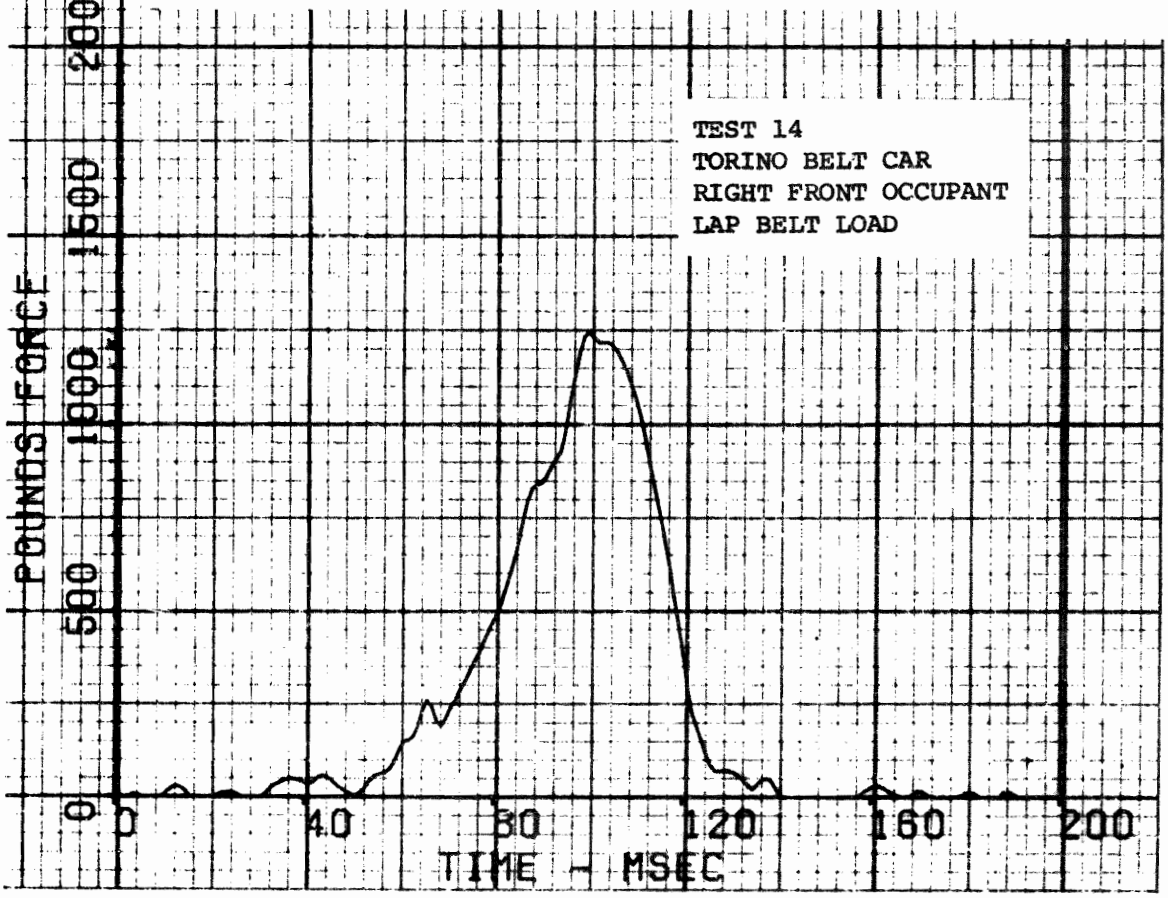

TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
AX
AY
AZ
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

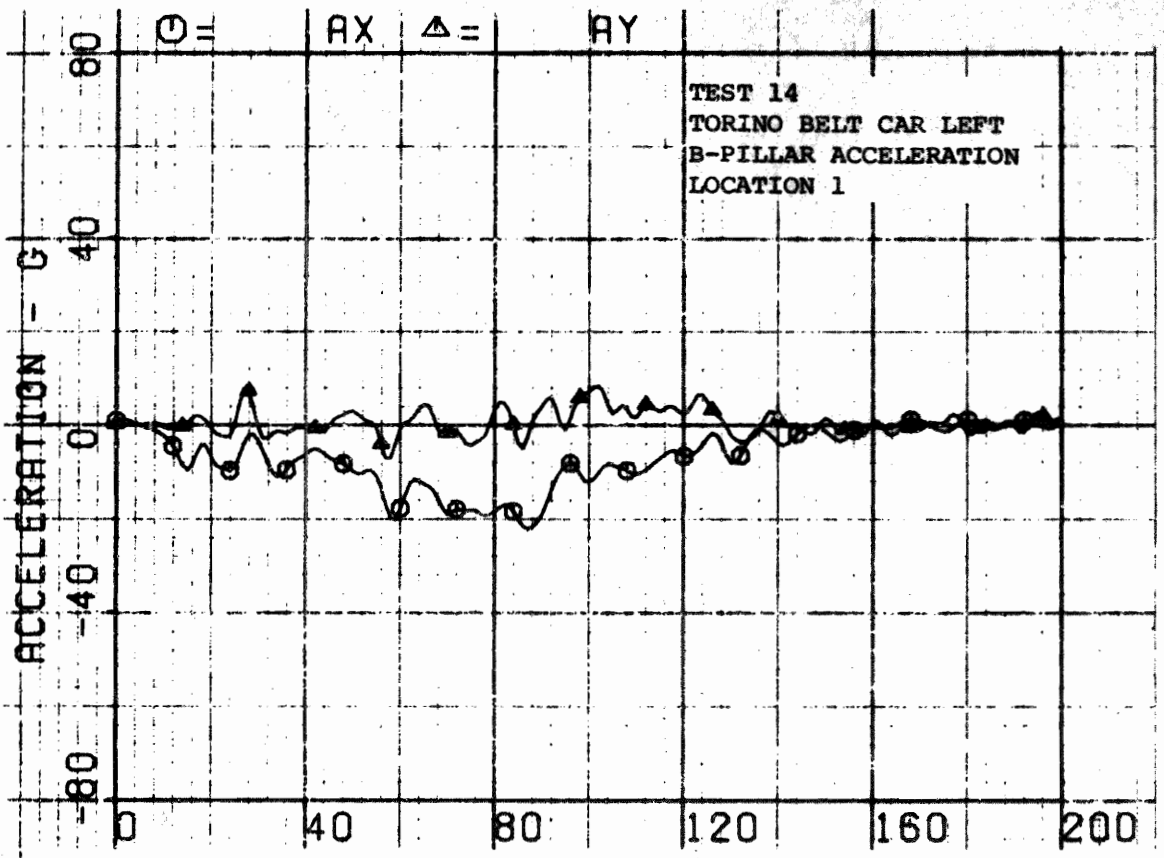

TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

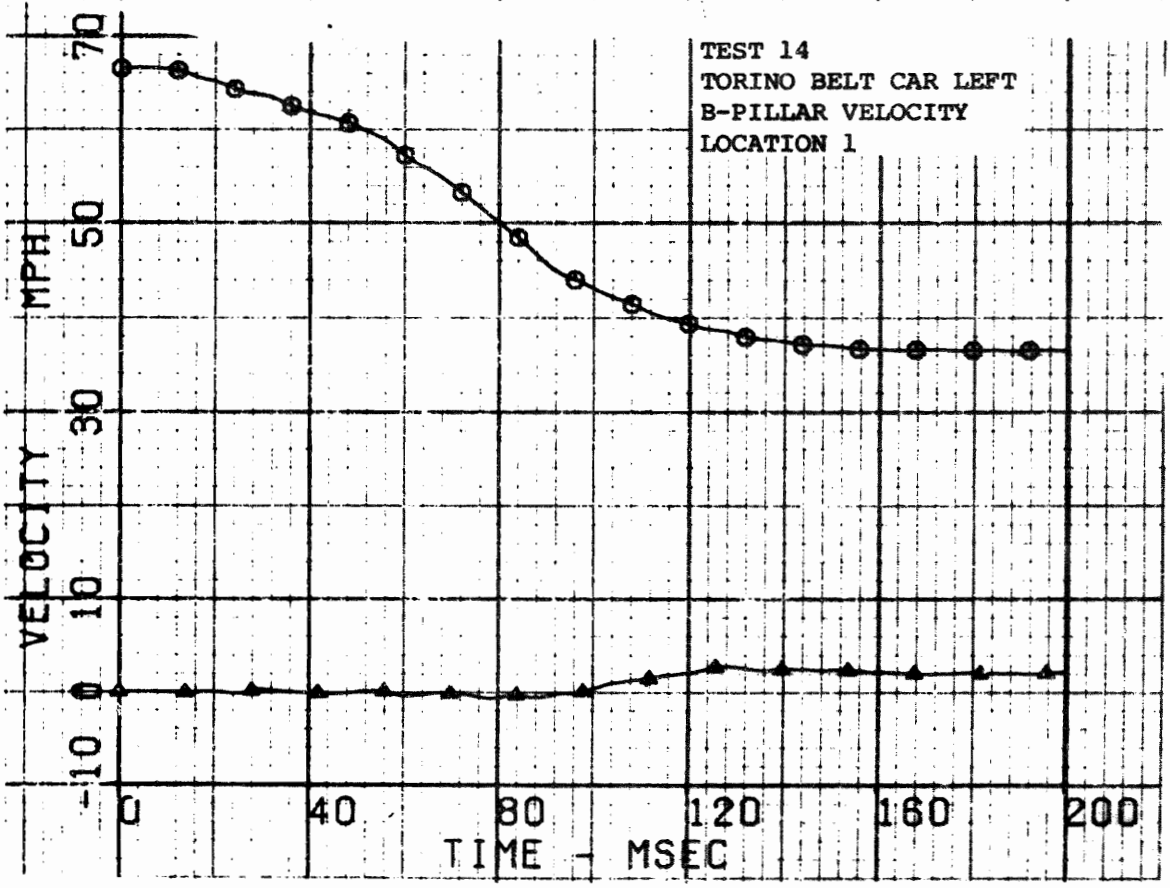

TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

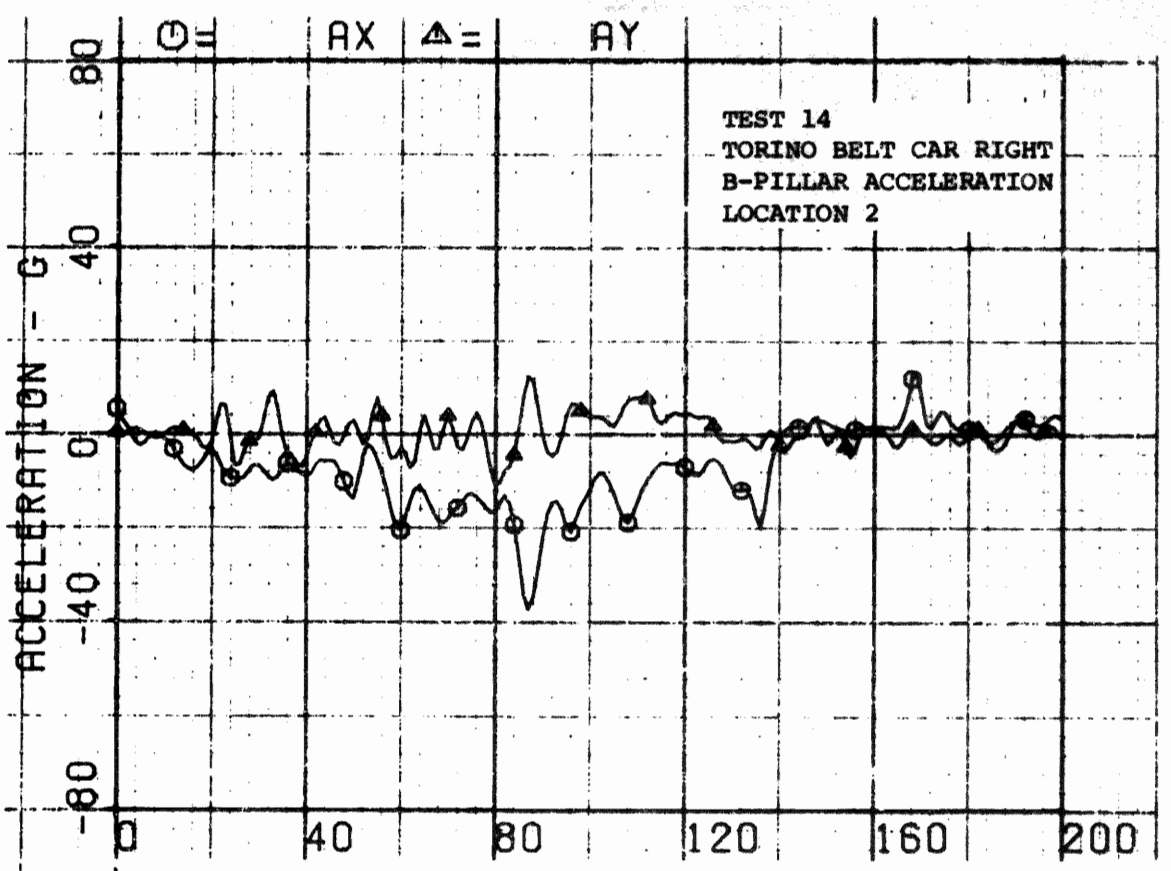

TEST 14
TORINO BELT CAR
LEFT FRONT OCCUPANT
VERTICAL BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
Max 51 @ 67
Min -88 @ 155
0
40
80
120
160
200
TIME - MSEC

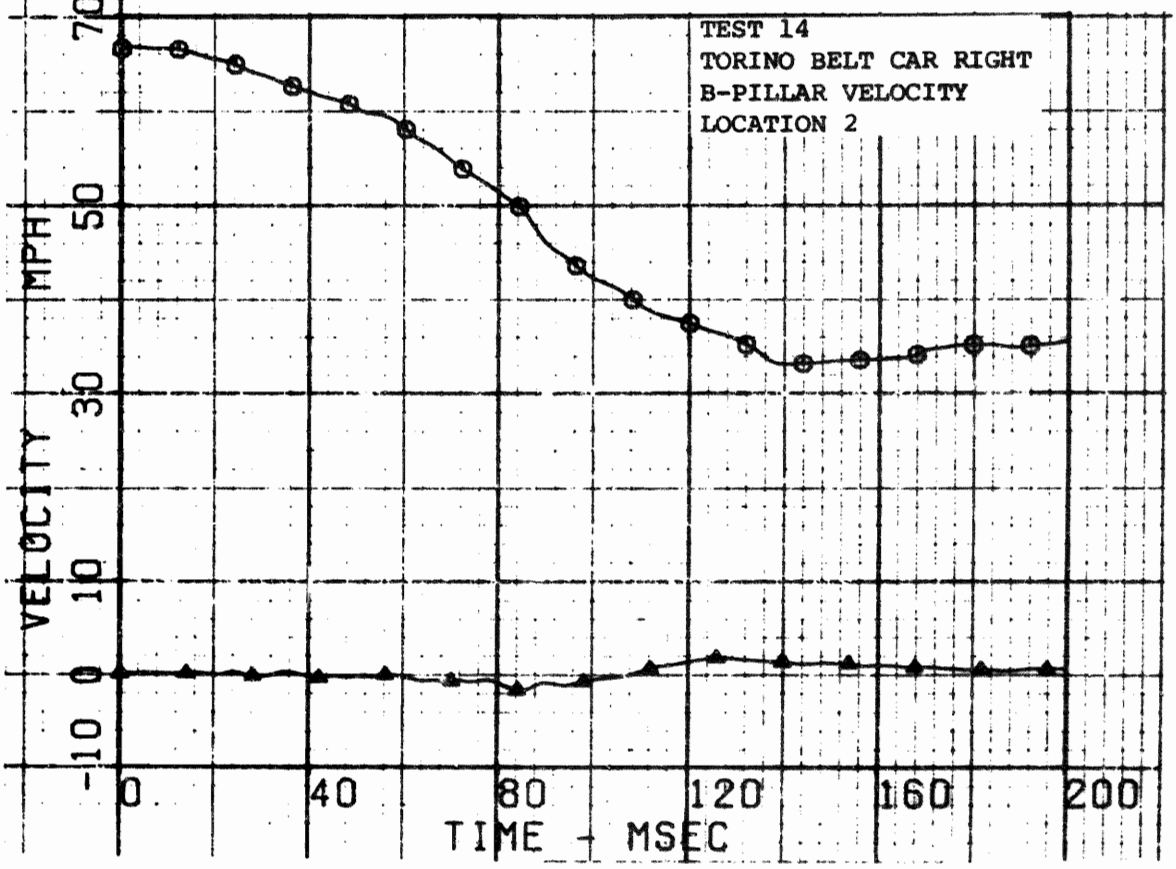

TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200

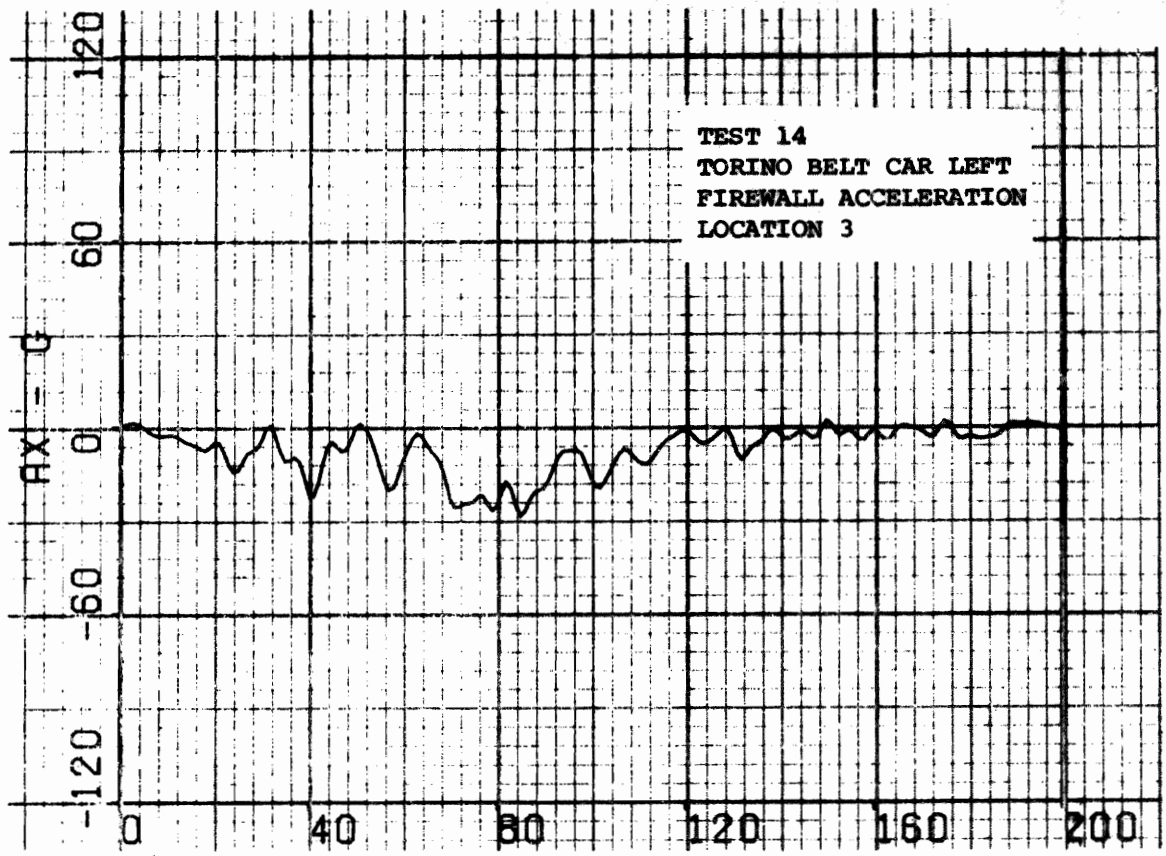

TEST 14
TORINO BELT CAR
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME - MSEC

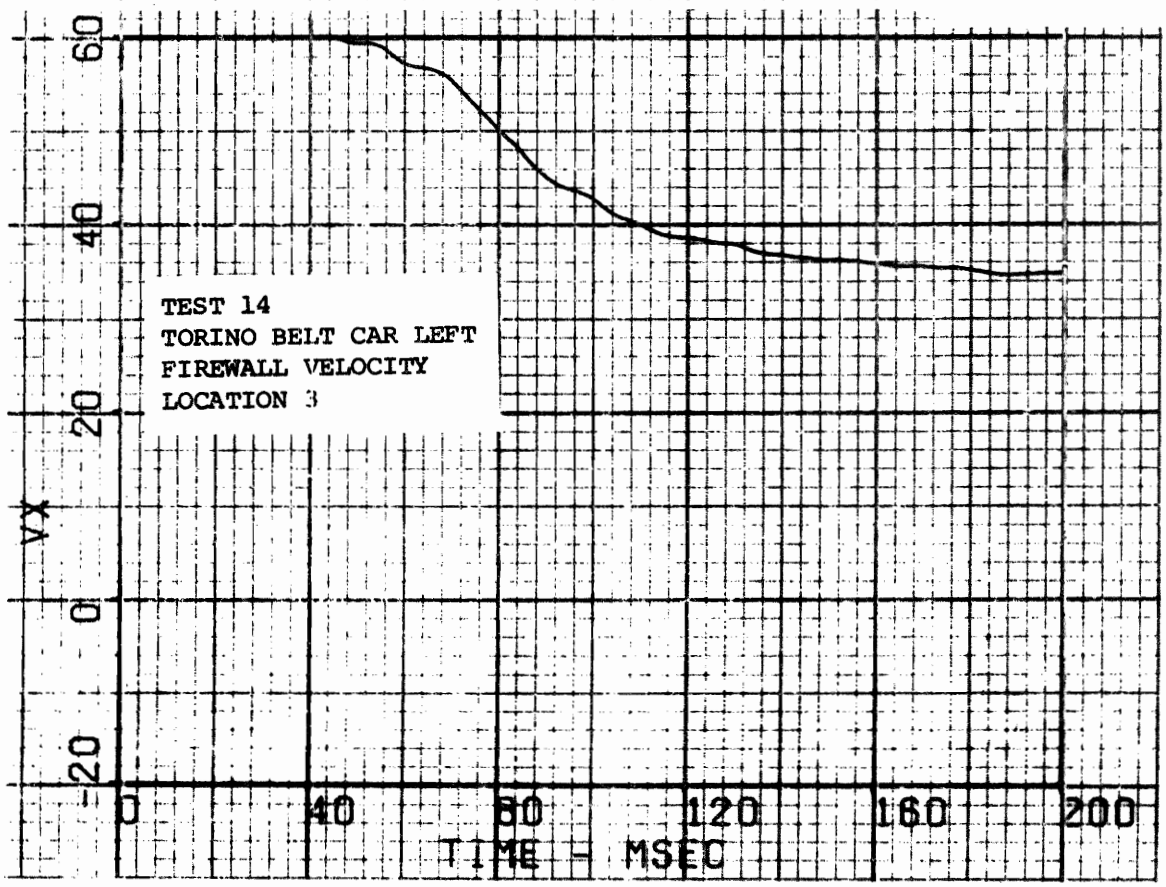

○= AX △= AY
TEST 14
TORINO BELT CAR LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

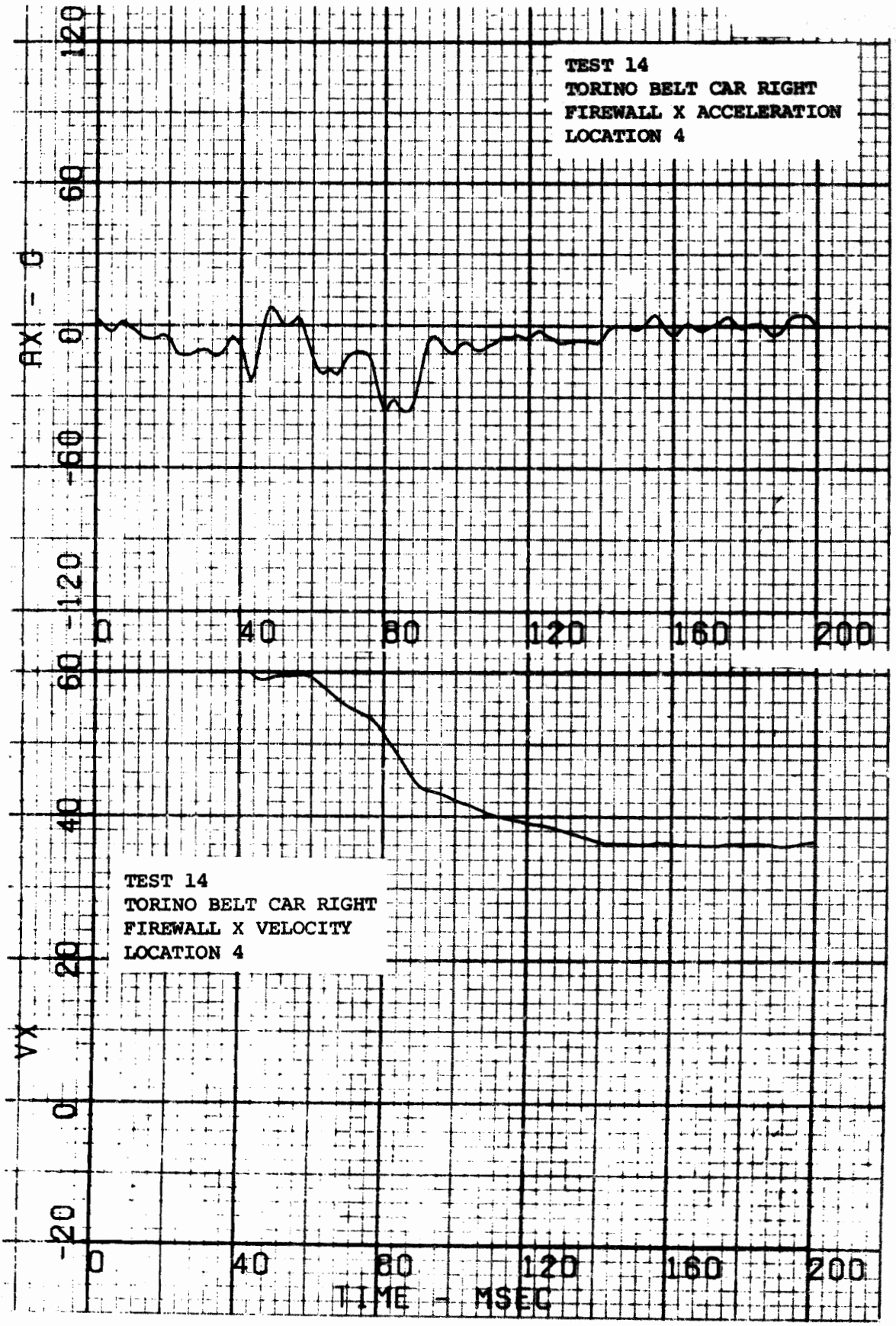

TEST 14
TORINO BELT CAR LEFT
B-PILLAR VELOCITY
LOCATION 1
VELOCITY MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC

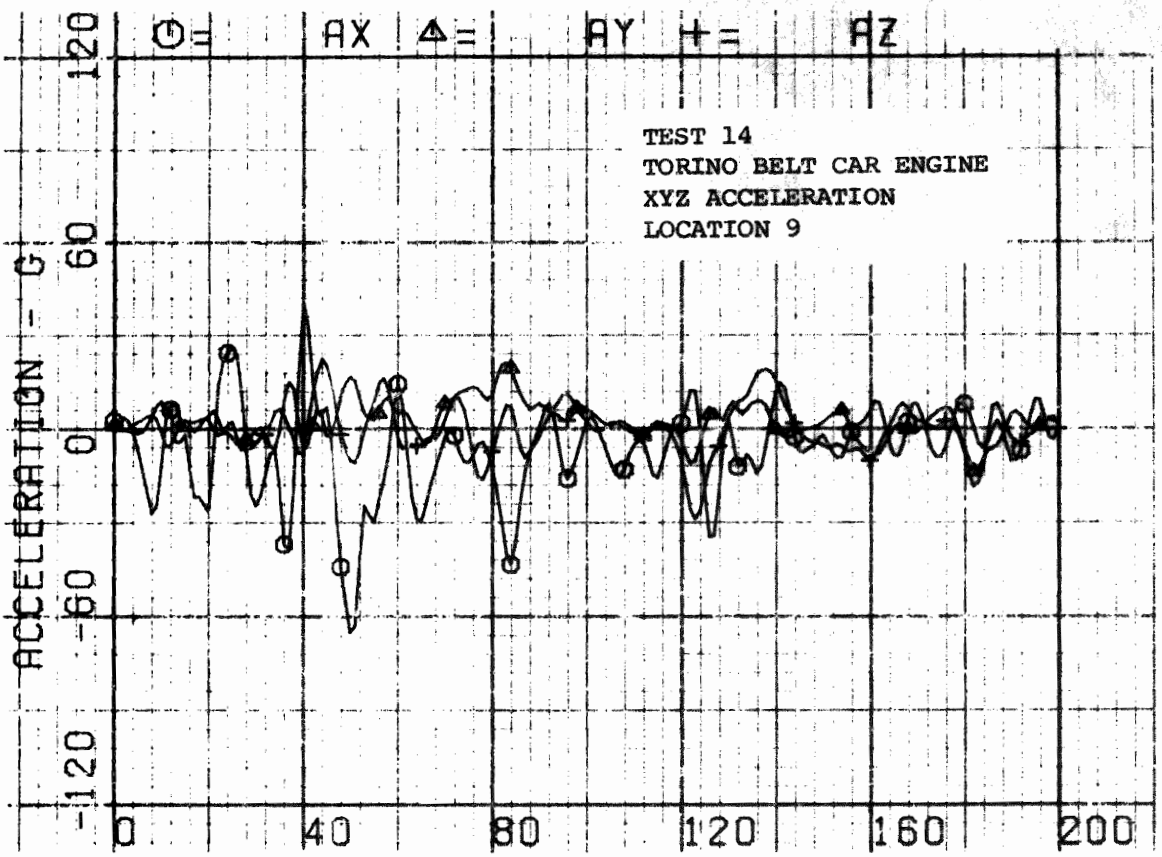

AX
AY
TEST 14
TORINO BELT CAR RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

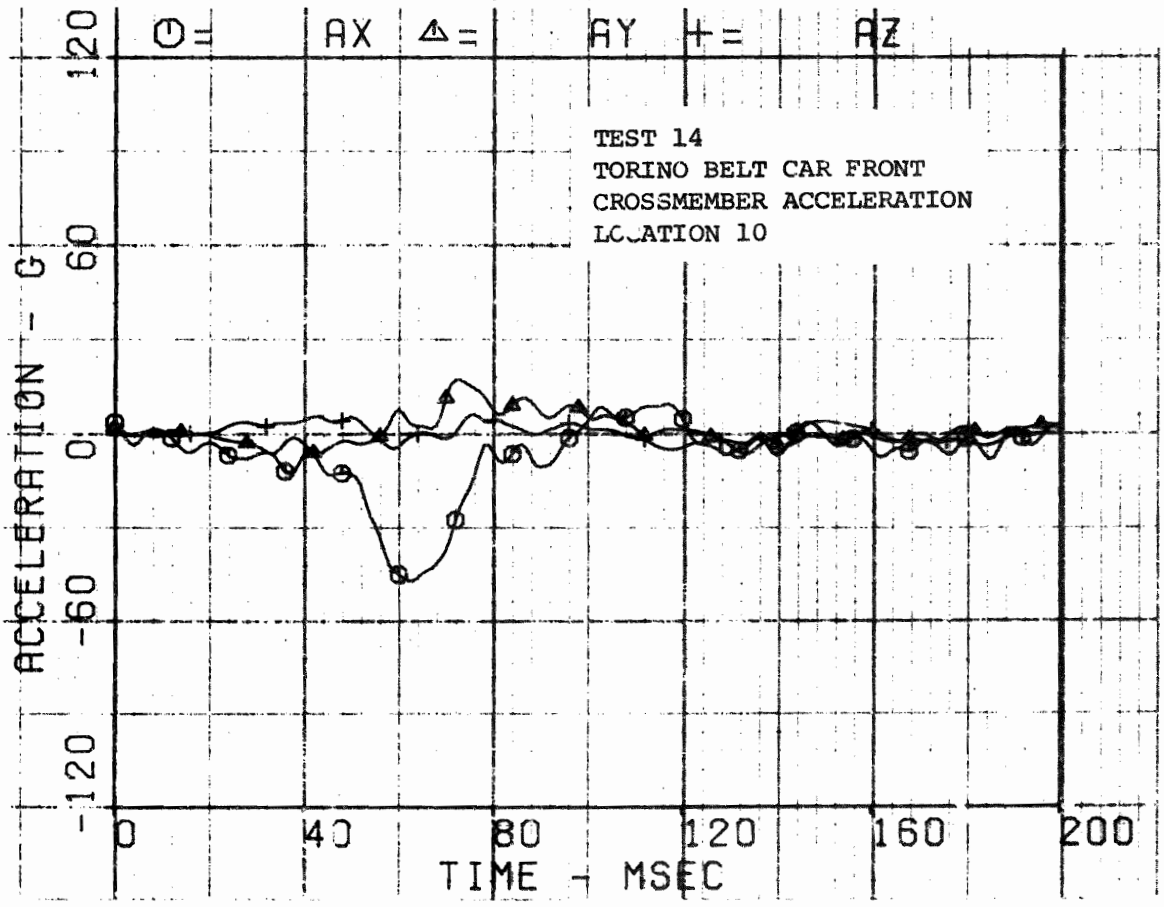

TEST 14
TORINO BELT CAR RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY MPH
70
50
30
10
0
-10
0
40
80
120
160
200
TIME - MSEC

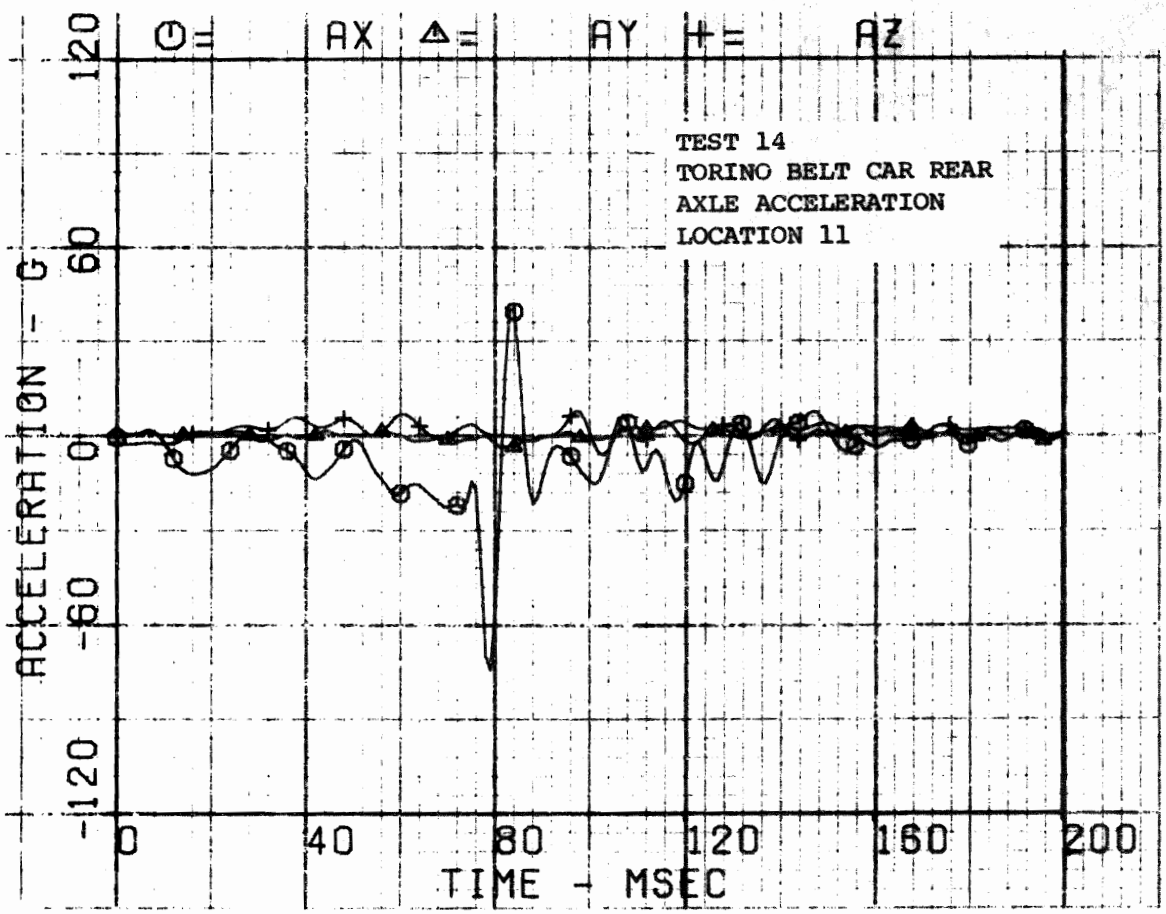

TEST 14
TORINO BELT CAR LEFT
FIREWALL ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200


TEST 14
TORINO BELT CAR LEFT
FIREWALL VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 14
TORINO BELT CAR RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 14
TORINO BELT CAR RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


○ = AX △ = AY + = AZ
TEST 14
TORINO BELT CAR ENGINE
XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200


○ = AX △ = AY + = AZ
TEST 14
TORINO BELT CAR FRONT
CROSSMEMBER ACCELERATION
LOCATION 10
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


⊙= AX △= AY += AZ
TEST 14
TORINO BELT CAR REAR
AXLE ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

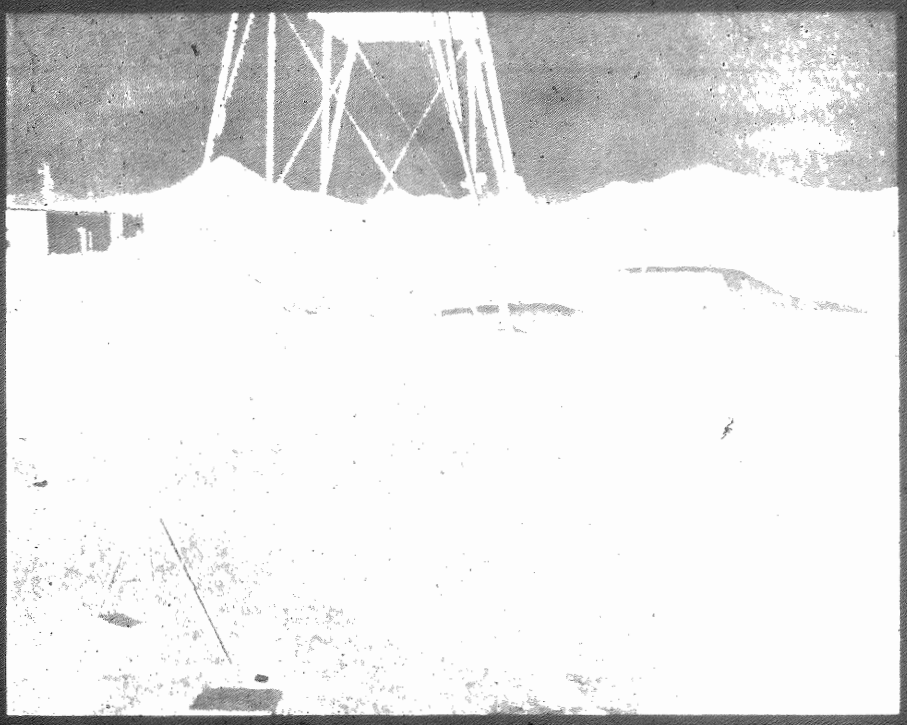


Figure 3-44. Pre-test Vehicle Configuration - Test 14.

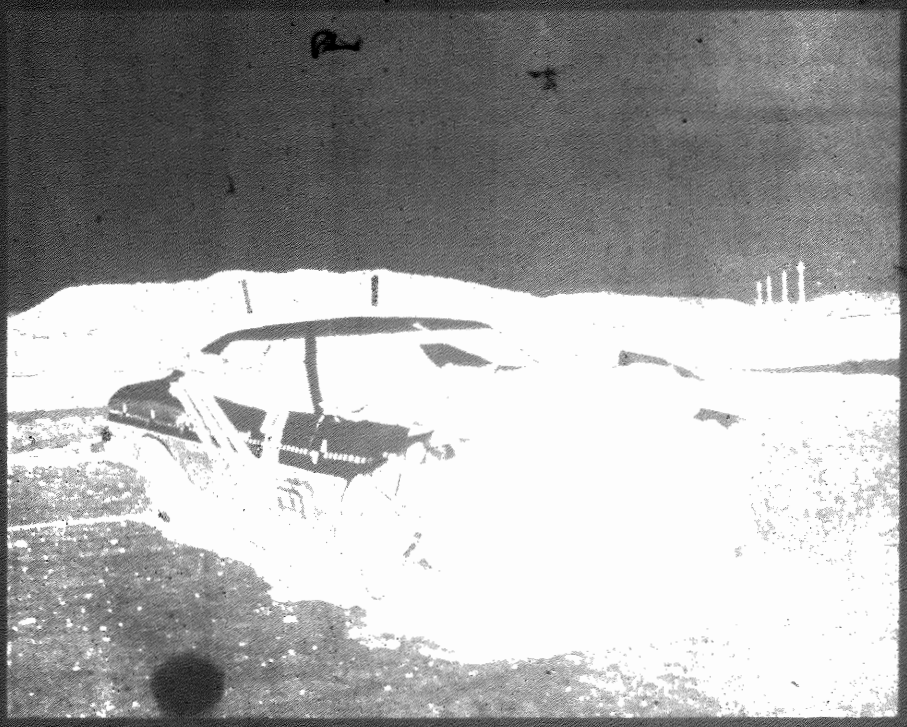


Figure 3-45. Post-test Vehicle Configuration - Test 14.

Figure 3-46. Pre-test Standard 3-Point Belt With Web Lockers and Force Limiters, Left Front - Test 14.

Figure 3-47. Post-test Standard 3-Point Belt With Web Lockers and Force Limiters, Left Front - Test 14.

Figure 3-48. Pre-test Standard 3-Point Belt With Web Lockers and Force Limiters, Right Front - Test 14.

Figure 3-49. Post-test Standard 3-Point Belt With Web Lockers and Force Limiters, Right Front - Test 14.

3.8 TEST NUMBER 15

The impact conditions for Test 15 were:

Configuration	Closing Speed
Torino-to-Torino Head-on	76.2 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Standard 3-Point Belt With Web Lockers and Tear Webbing	Standard 3-Point Belt With Web Lockers and Force Limiters
Right Front	Standard 3-Point Belt With Web Lockers and Tear Webbing	Standard 3-Point Belt With Web Lockers and Force Limiters

The vehicles used for this test were both 4-door model 1975 Ford Torinos. No structural modifications were made to either vehicle.

The results of Test 15 are summarized in the following tables:

Table 3-29 - Summary of Vehicle Data (Test 15)

Table 3-30 - Injury Criteria Summary (Test 15)

Table 3-31 - Summary of Restraint System Data (Test 15)

Table 3-32 - Occupant Response Data (Test 15)

which are followed by Figure 3-50 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

TABLE 3-29. SUMMARY OF VEHICLE DATA (TEST 15)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 15/July 6, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		505	504
TEST WEIGHT (lb)		4544	4591
IMPACT VELOCITY (mph)		38.1	38.1
VELOCITY CHANGE (mph)		46.1 (1)	46.1 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	62.8 @ 66	30.4 @ 62
	LOCATION 2	57.4 @ 62	40.7 @ 61
MAXIMUM STATIC CRUSH (in.)			
	LEFT	27.0	27.0
	CENTER	36.0	37.0
	RIGHT	28.0	30.0

(1) Velocity change using integrated velocity data from location 2 only.

TABLE 3-30. INJURY CRITERIA SUMMARY (TEST 15)

VEHICLE A - TORINO (WEB LOCKER AND TEAR WEBBING)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	-		-	
HIC	1011		1023	
HEAD G(1) @ msec	75.5 @ 109		106.1 @ 110	
CSI	520		504	
CHEST G(1) @ msec	55.1 @ 92		55.6 @ 115	
FEMUR LOAD (lb) (2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

VEHICLE B - TORINO (WEB LOCKERS AND FORCE LIMITERS)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	-		-	
HIC	1799		2154	
HEAD G(1) @ msec	128.3 @ 96		127.0 @ 96	
CSI	835		952	
CHEST G(1) @ msec	79.0 @ 86		78.8 @ 109	
FEMUR LOAD (lb) (2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

TABLE 3-31. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 15)

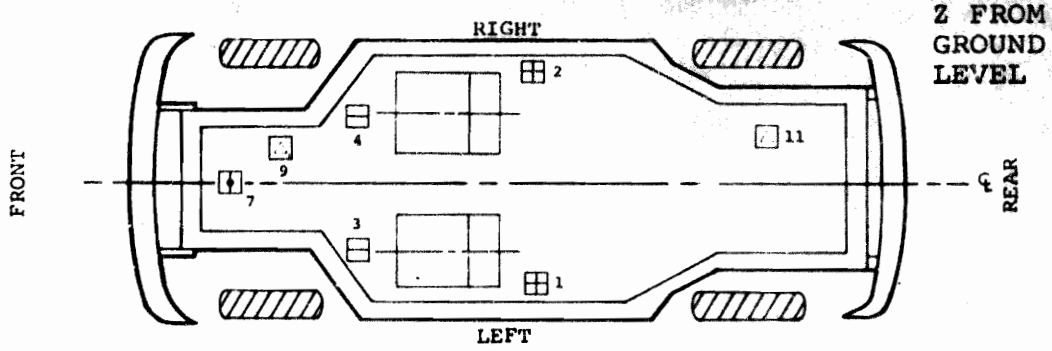
VEHICLE A - (WEB LOCKERS AND TEAR WEBBING)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	(1)
Peak Lap Belt Load	lb @ msec	827 @ 92
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1310 @ 82
Peak Lap Belt Load	lb @ msec	826 @ 77
VEHICLE B - (WEB LOCKERS AND FORCE LIMITERS)		
Left Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1622 @ 81
Peak Lap Belt Load	lb @ msec	(2)
Right Front Occupant		
Peak Shoulder Belt Load	lb @ msec	1816 @ 107
Peak Lap Belt Load	lb @ msec	1588 @ 82

(1) Shoulder Belt Load not measured.
(2) Lap Belt Load not measured.

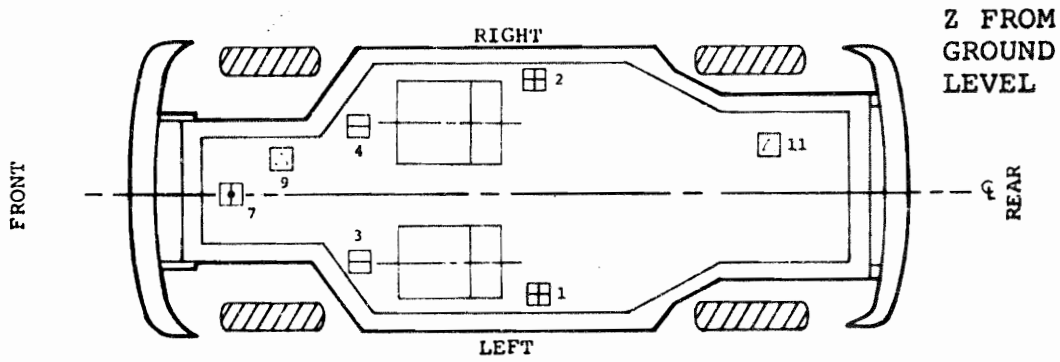
TABLE 3-32. OCCUPANT RESPONSE DATA SUMMARY (TEST 15)

		VEHICLE A				VEHICLE B			
		TORINO (WEB LOCKERS AND TEAR WEBBING)				TORINO (WEB LOCKERS AND FORCE LIMITERS)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD									
	X	105.8	85	119.2	94	216.6	77	72.0	99
	Y	25.5	123	42.6	114	16.2	122	73.3	93
	Z	52.9	106	79.1	109	82.4	95	242.0	94
	R(1)	75.5	109	106.1	110	128.3	96	127.0	96
	HIC	1011 @ 84-124		1023 @ 93-115		1799 @ 76-111		2154 @ 92-96	
CHEST									
	X	59.5	90	42.1	117	75.3	82	66.9	101
	Y	23.2	90	40.4	115	46.4	85	59.1	105
	Z	12.0	94	16.3	127	26.7	73	24.5	83
	R(1)	55.1	92	55.6	115	78.3	83	78.8	109
	SI	520 @ 200		504 @ 200		835 @ 200		952 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS (2)									
	LF	NA		NA		NA		NA	
	RT	NA		NA		NA		NA	

(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

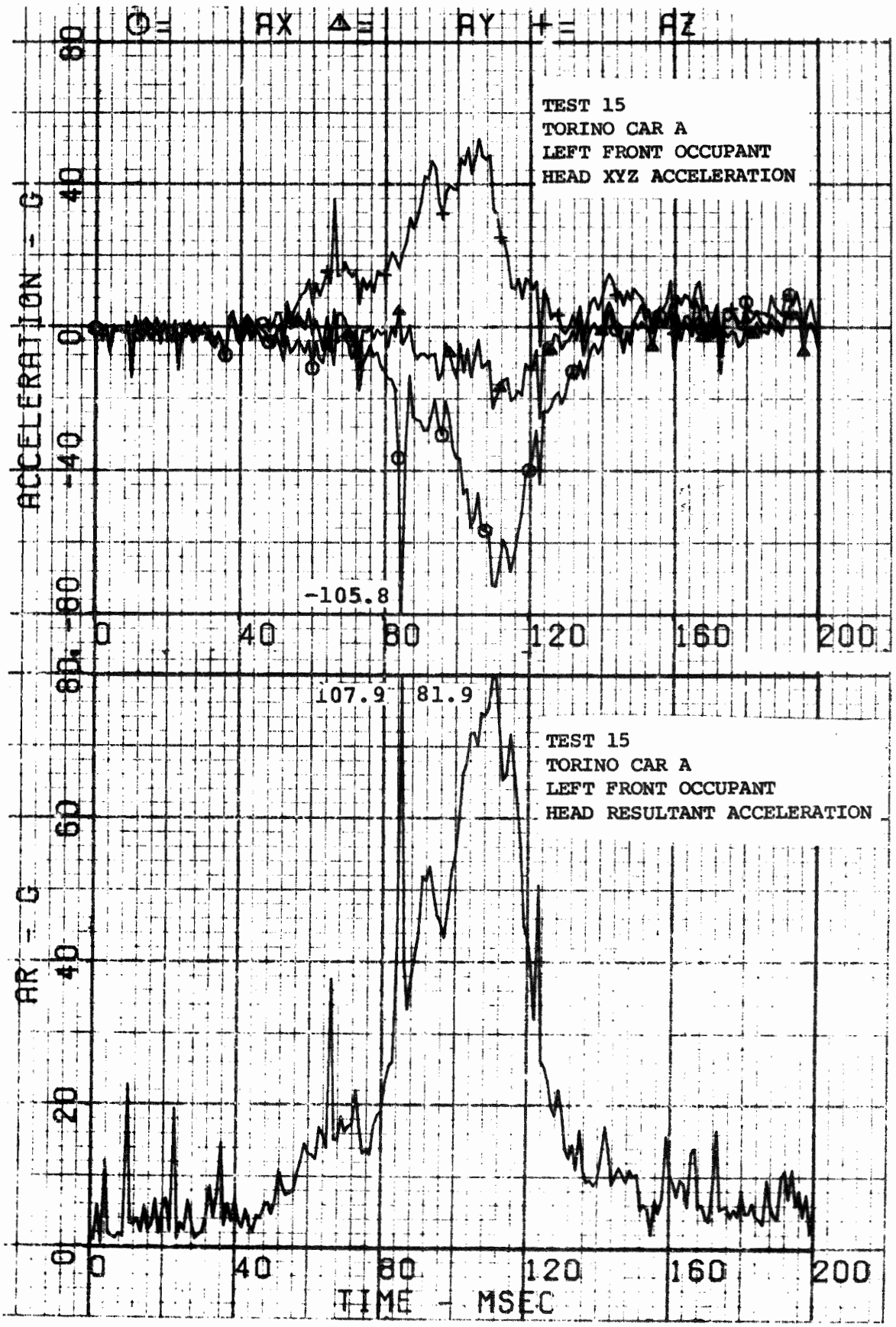


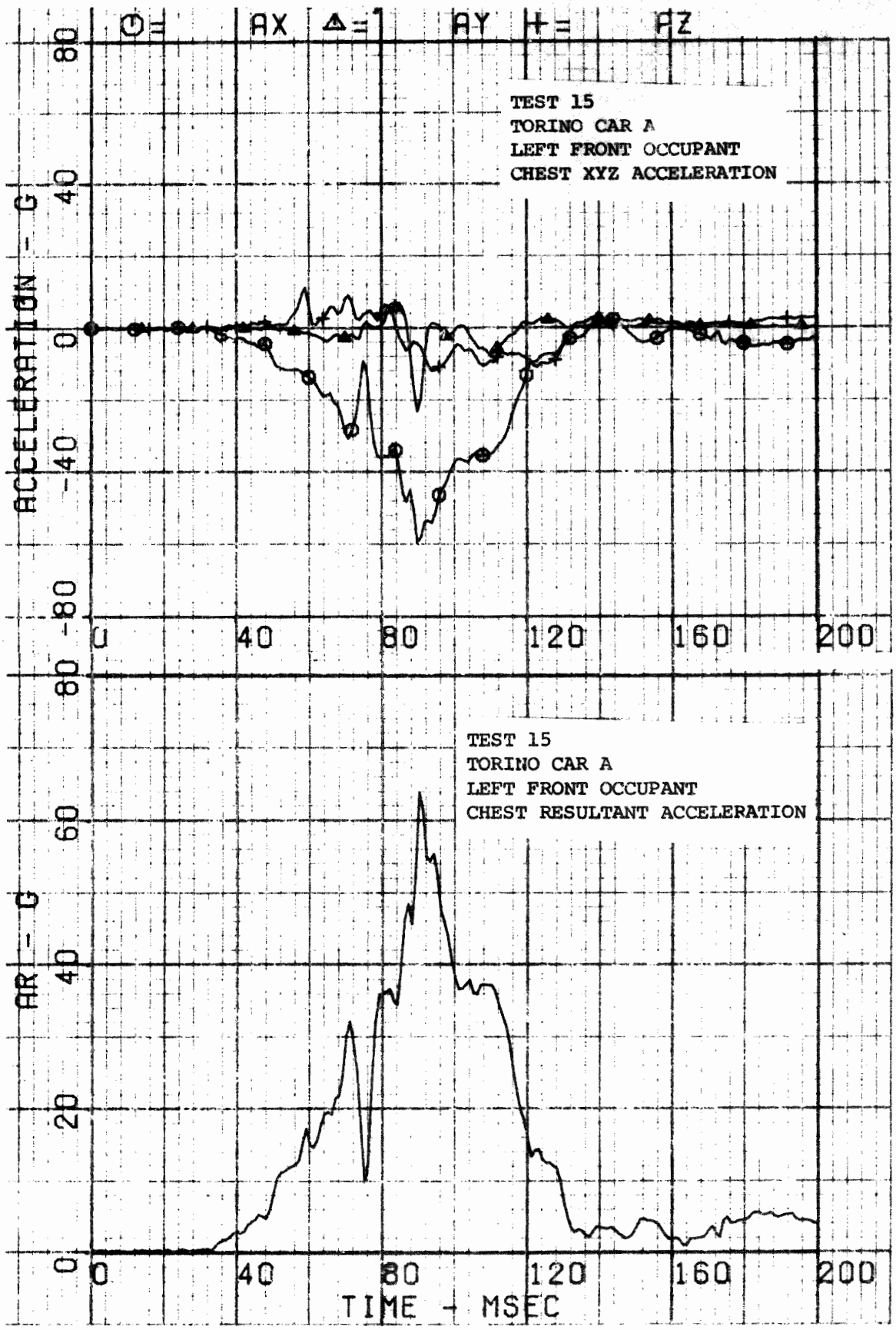
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
7	Engine Block		X	X
9	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

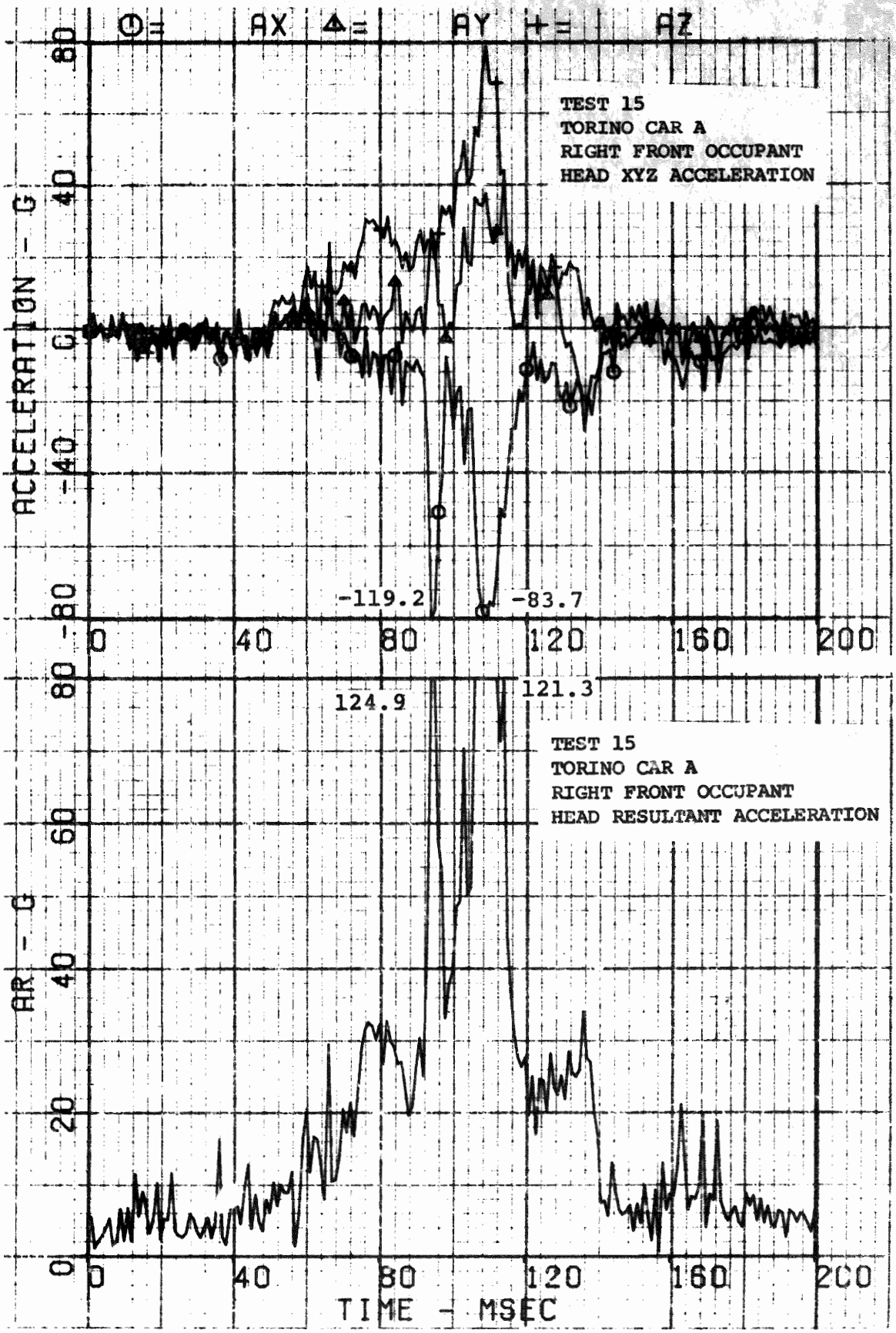


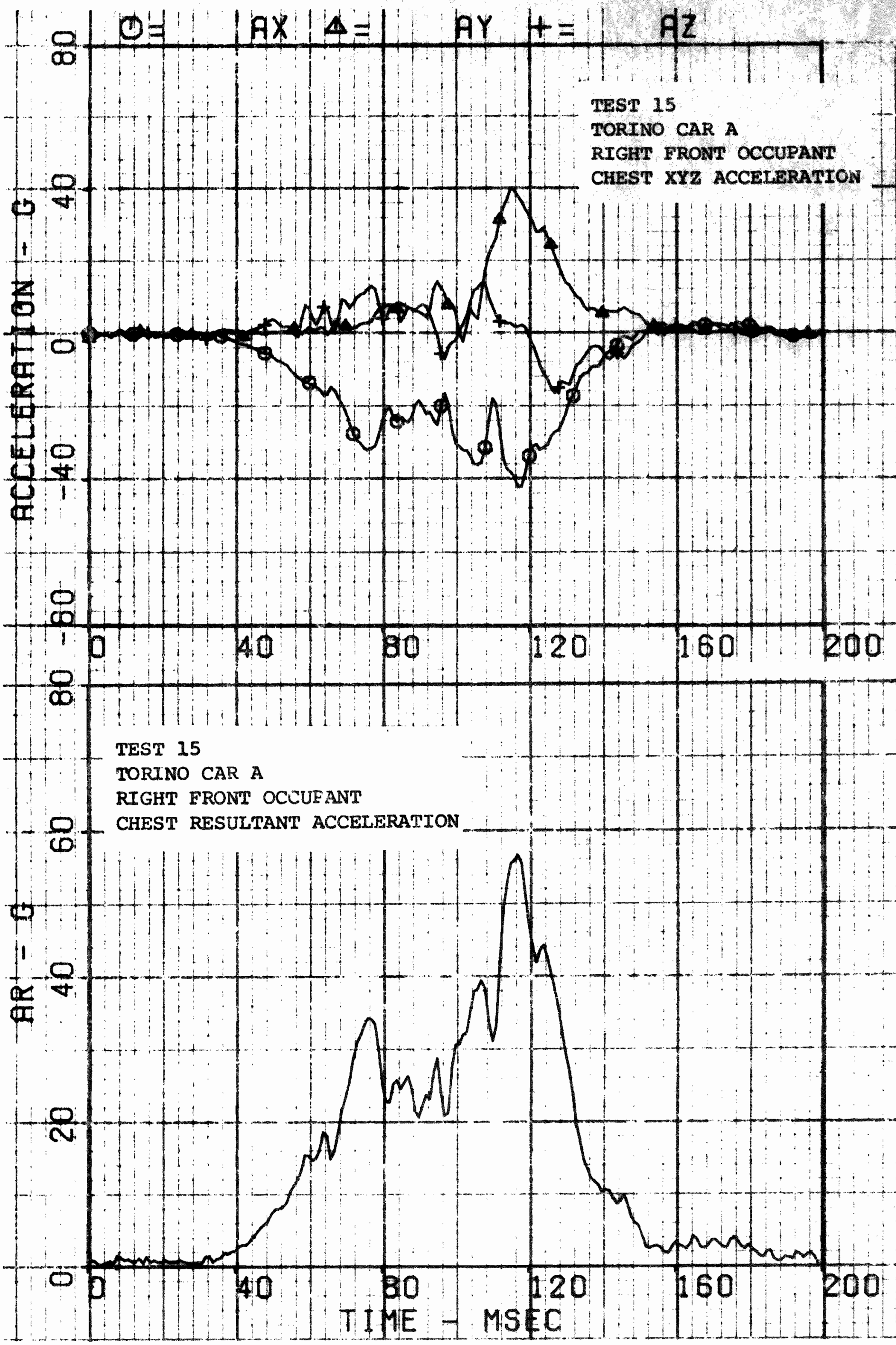
VEHICLE B ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
7	Engine Block		X	X
9	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

Figure 3-50. Vehicle Accelerometer Locations - Test 15.

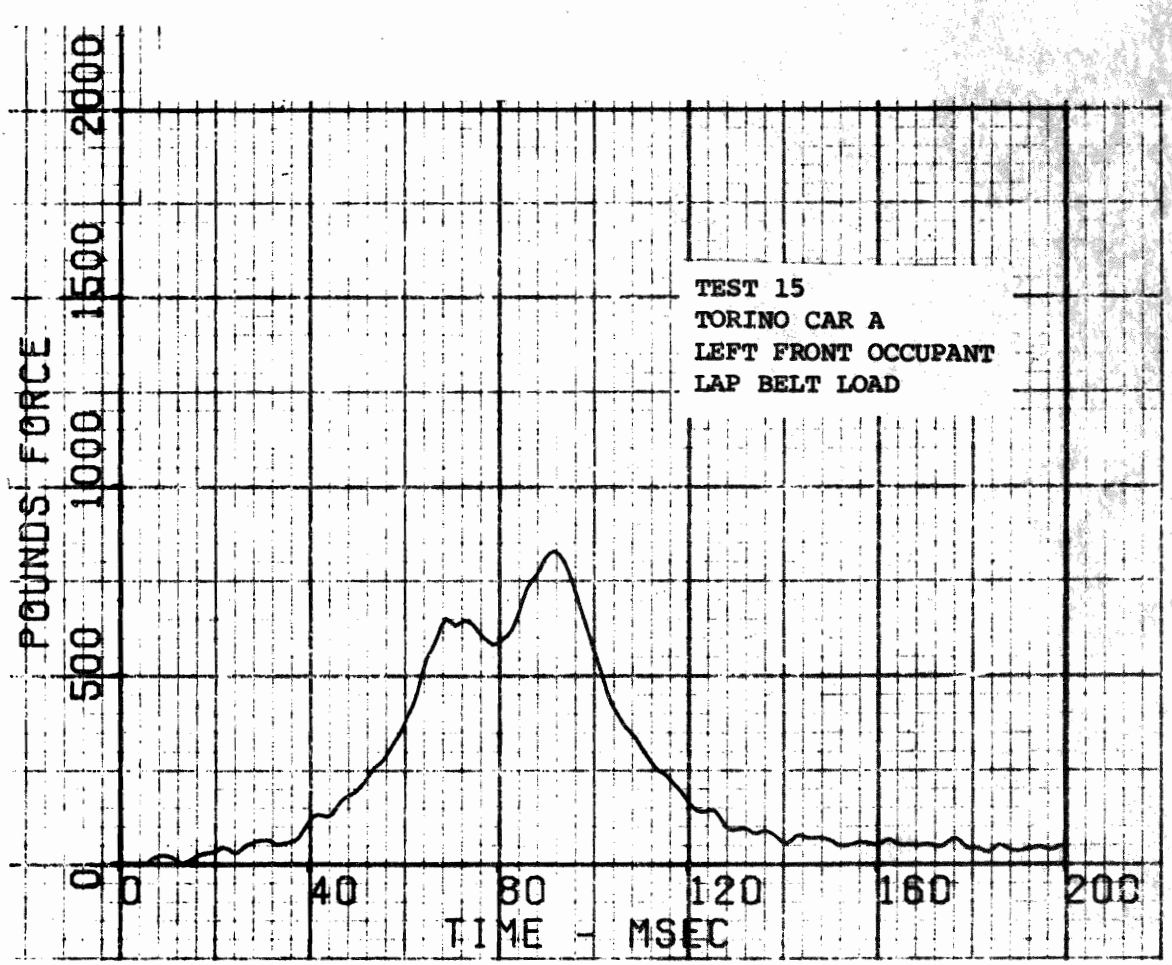

O= AX Δ= AY += AZ
TEST 15
TORINO CAR A
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-105.8
0
40
80
120
160
200
107.9
81.9
TEST 15
TORINO CAR A
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

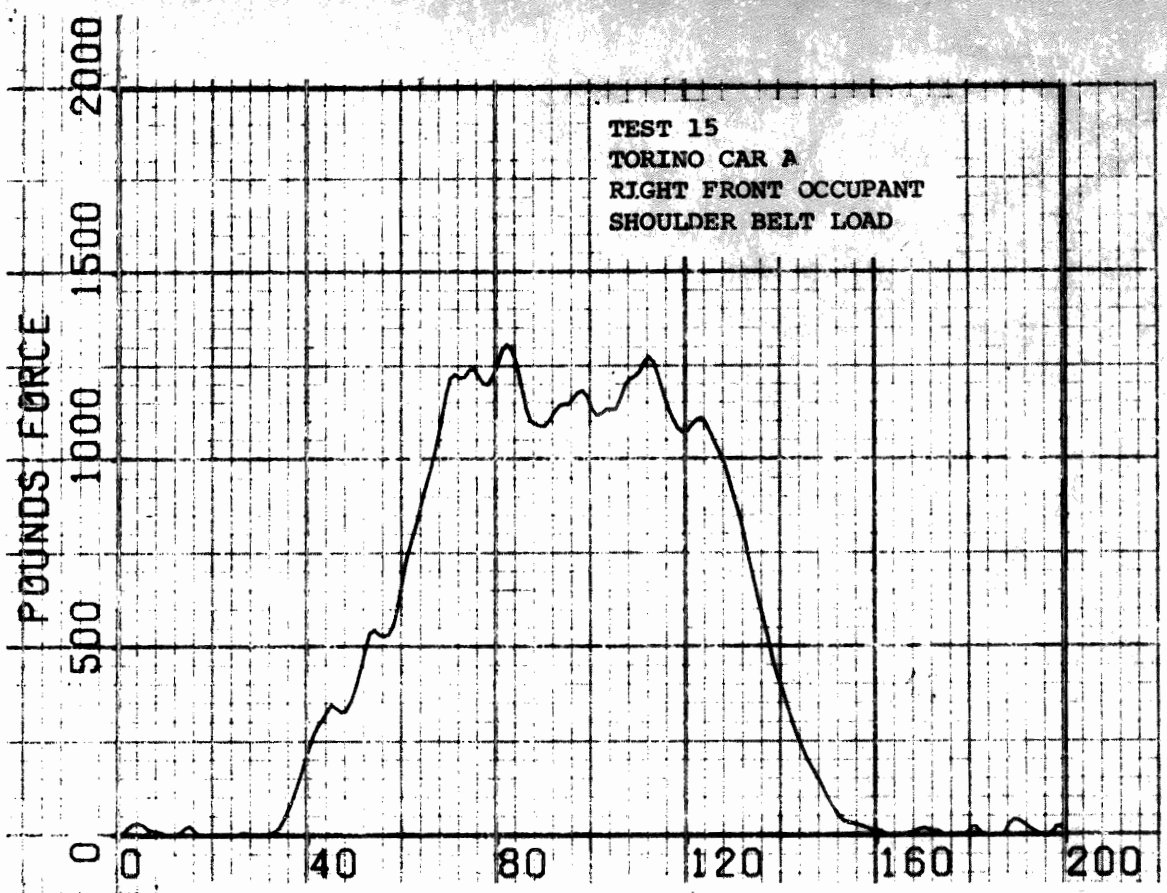

AX
AY
AZ
TEST 15
TORINO CAR A
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR A
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
20
TIME → MSEC

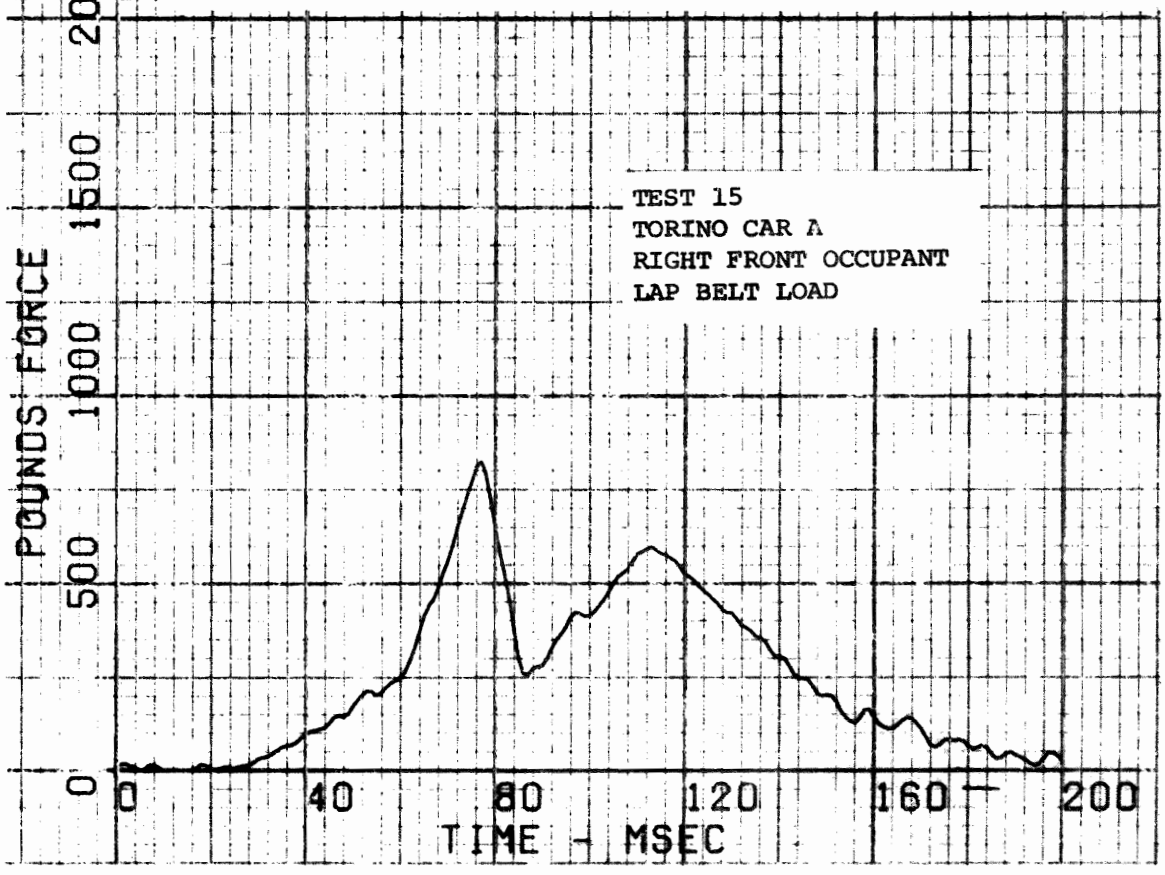

⊖= AX ▲= AY + = AZ
TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-119.2
-83.7
0
40
80
120
160
200
124.9
121.3
TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

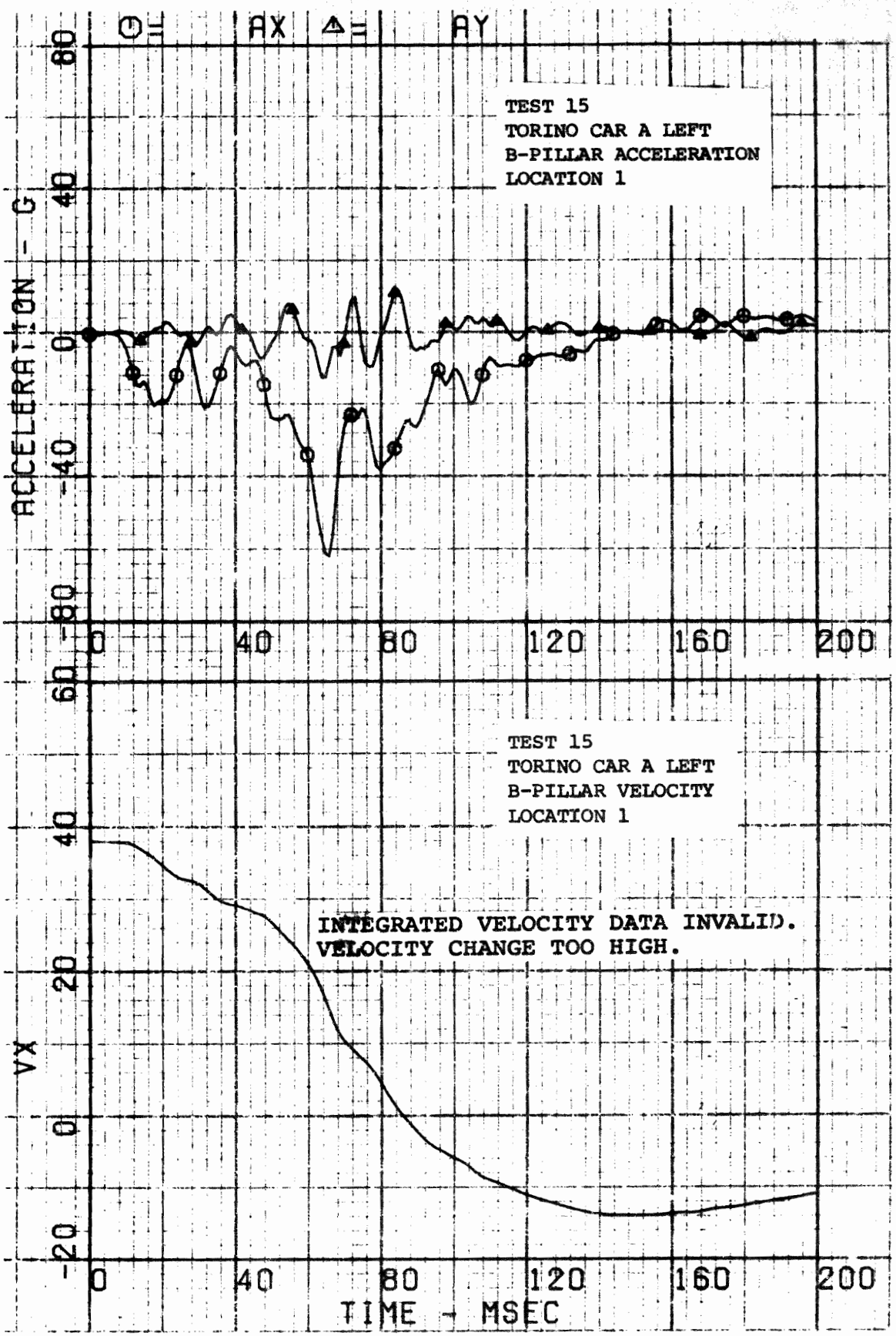


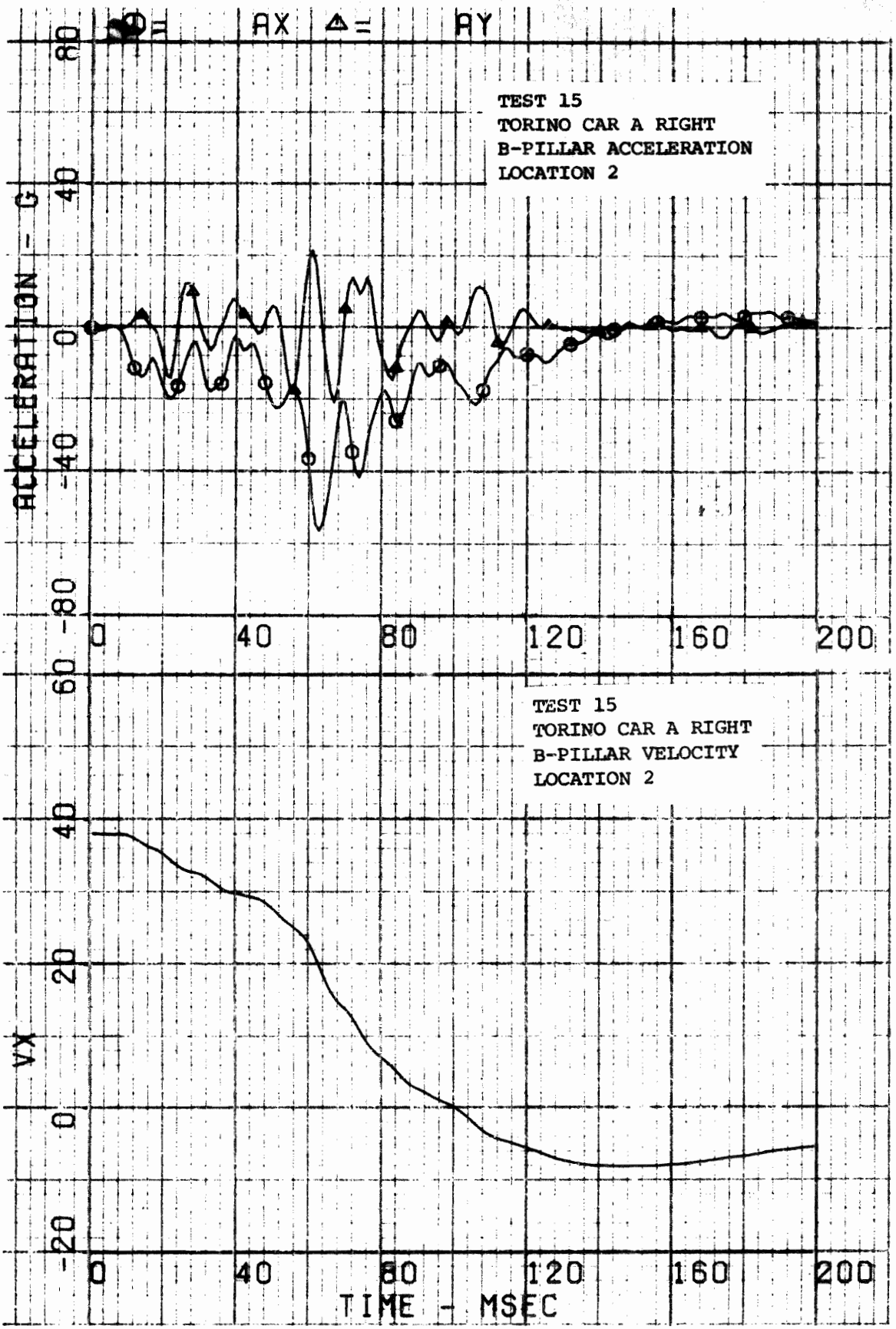
⊙= AX ▵= AY += AZ
TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

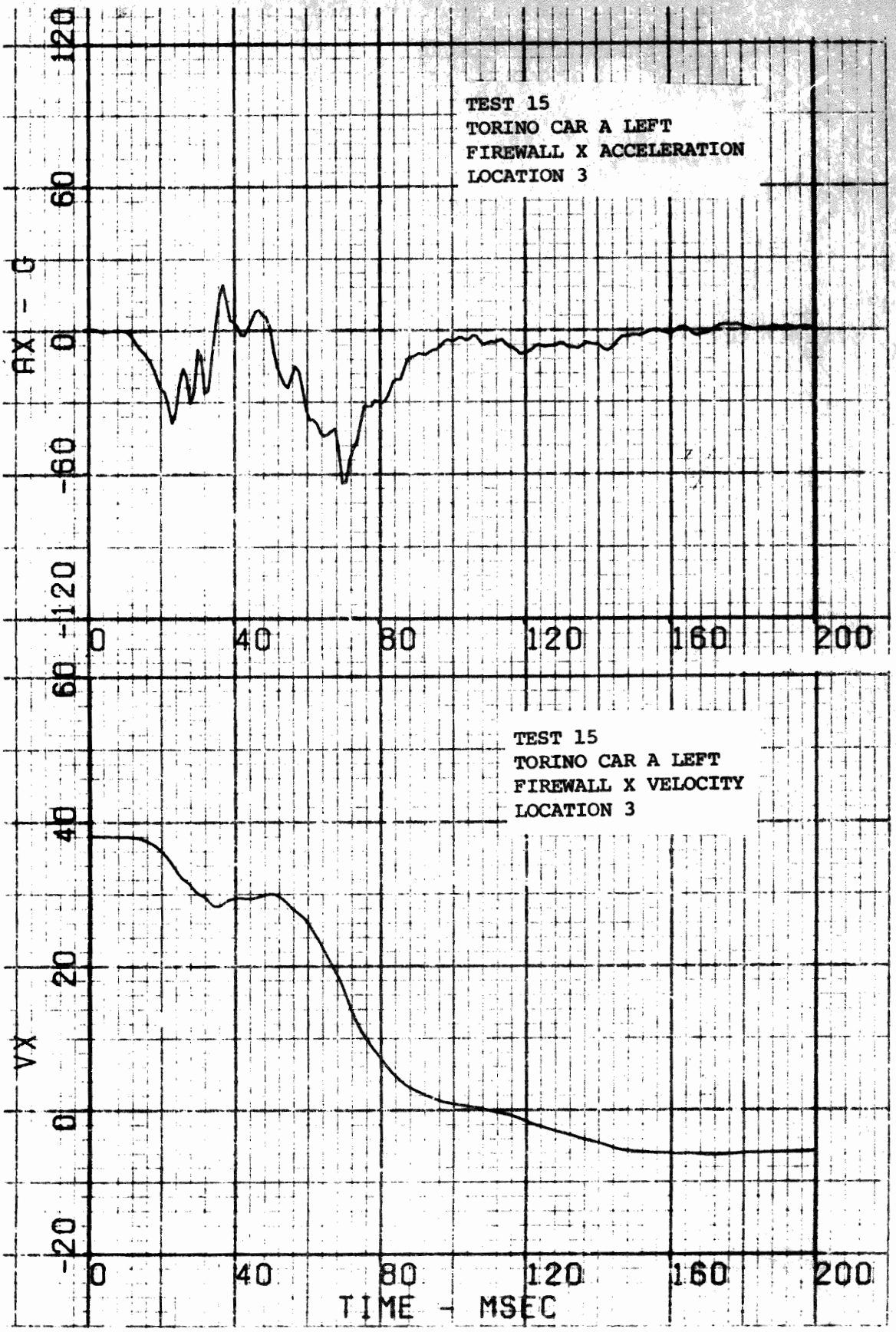

TEST 15
TORINO CAR A
LEFT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME - MSEC

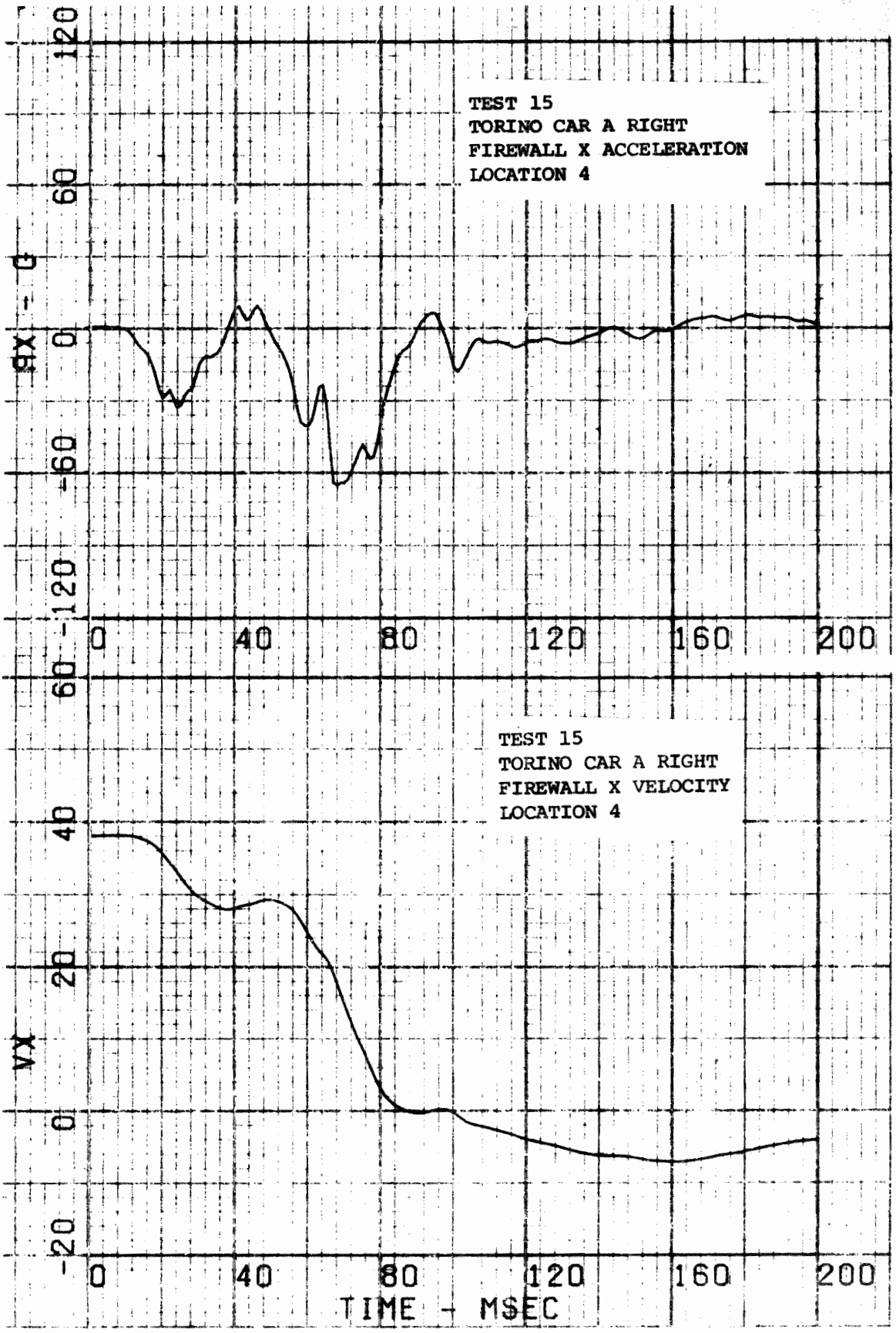

TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200

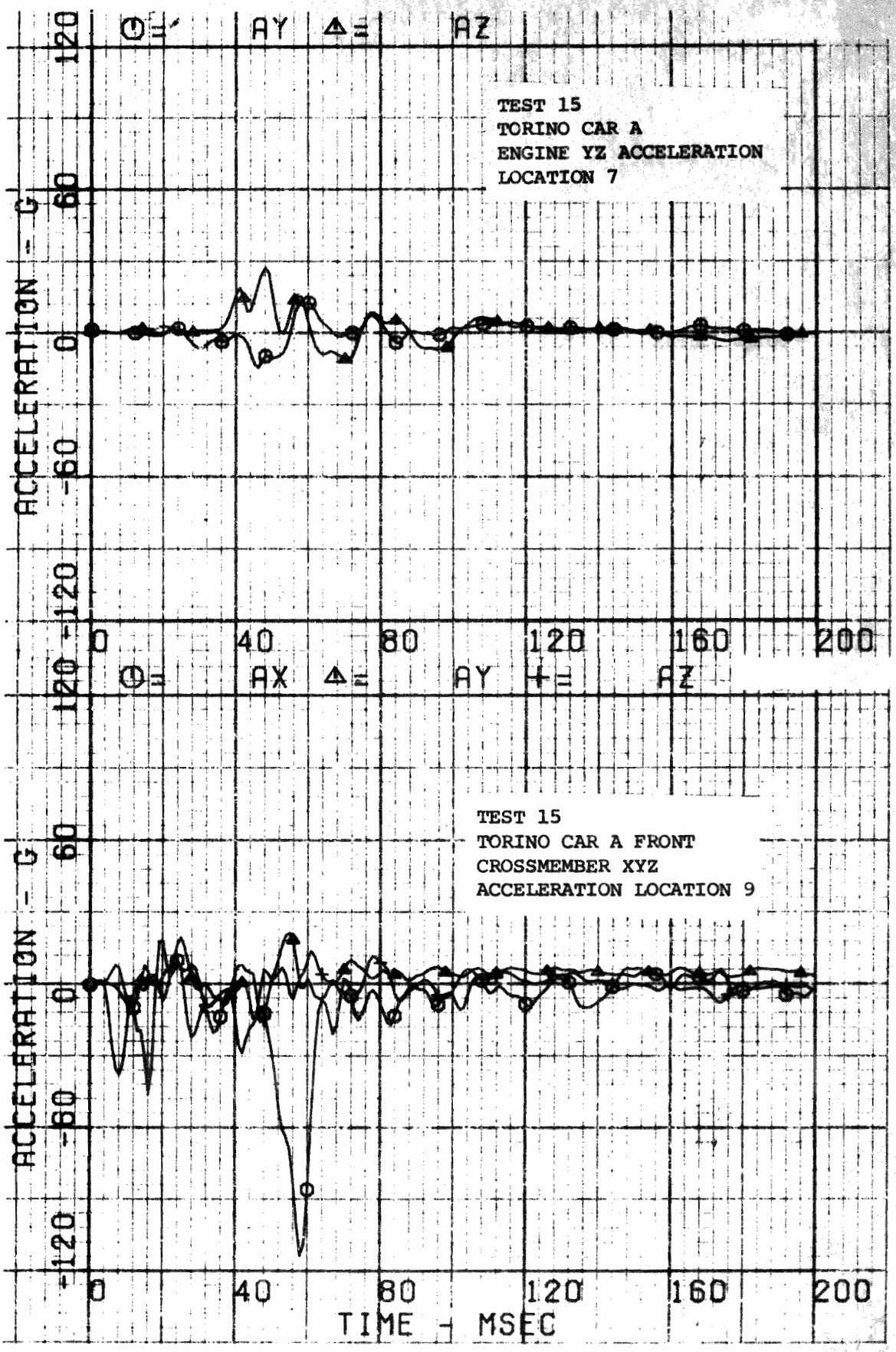

TEST 15
TORINO CAR A
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME - MSEC

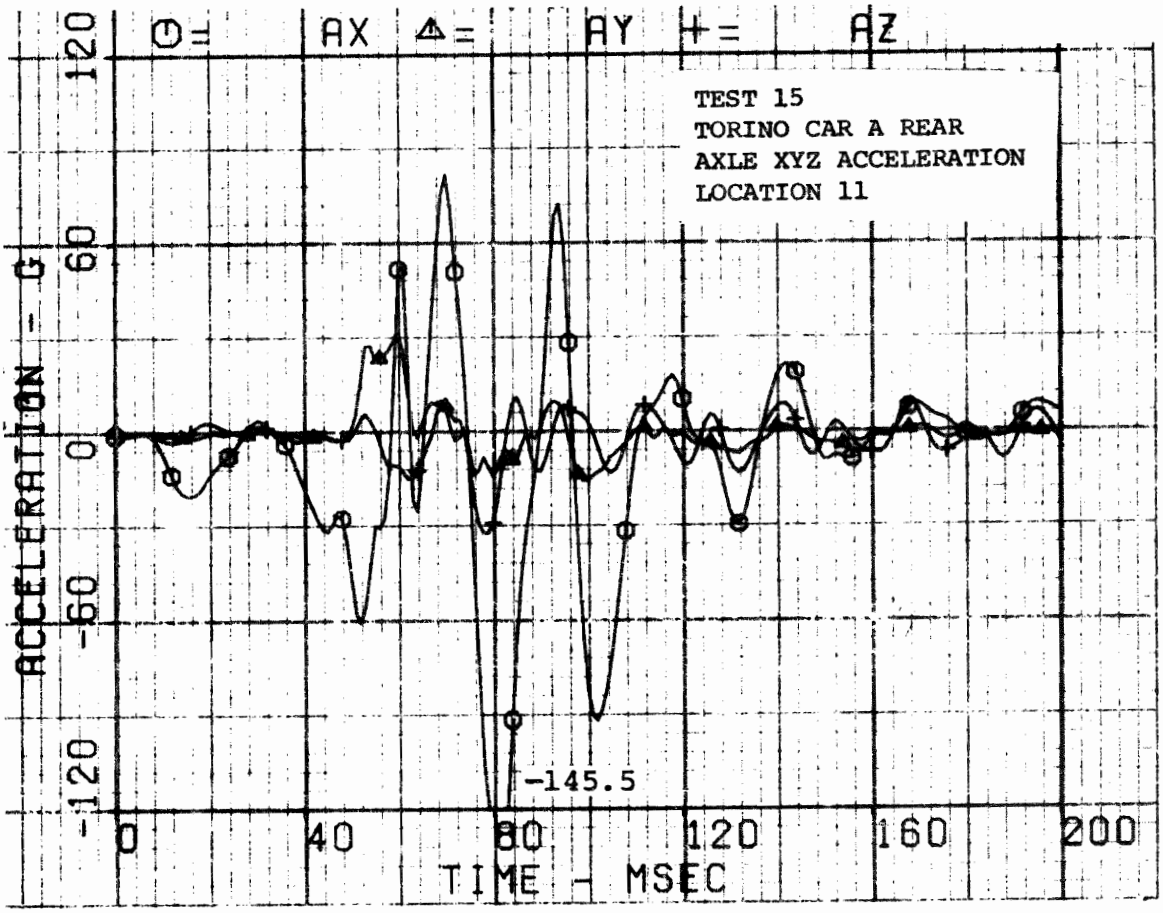

AX
AY
TEST 15
TORINO CAR A LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR A LEFT
B-PILLAR VELOCITY
LOCATION 1
INTEGRATED VELOCITY DATA INVALID.
VELOCITY CHANGE TOO HIGH.
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC

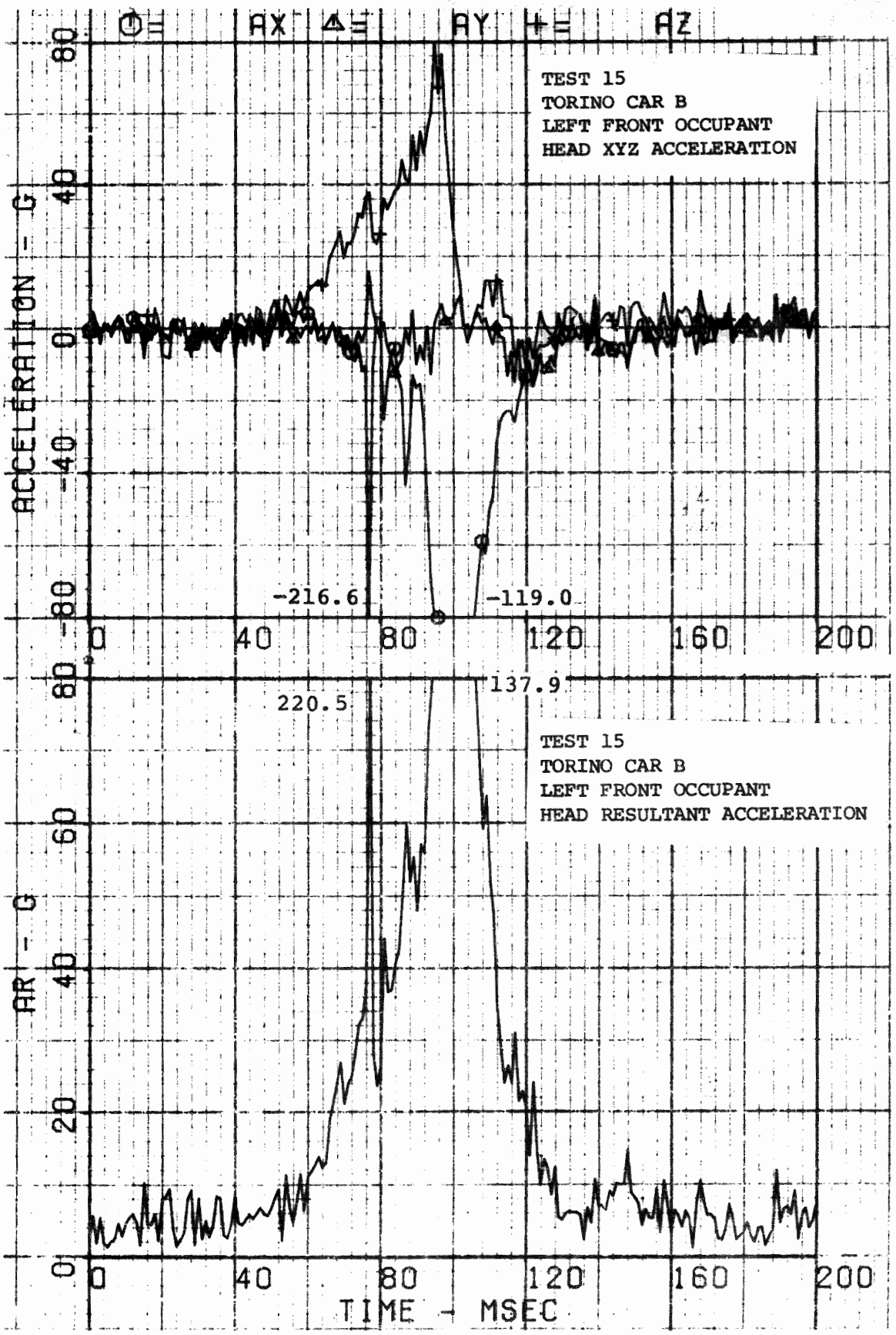

AX
AY
TEST 15
TORINO CAR A RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR A RIGHT
B-PILLAR VELOCITY
LOCATION 2
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC

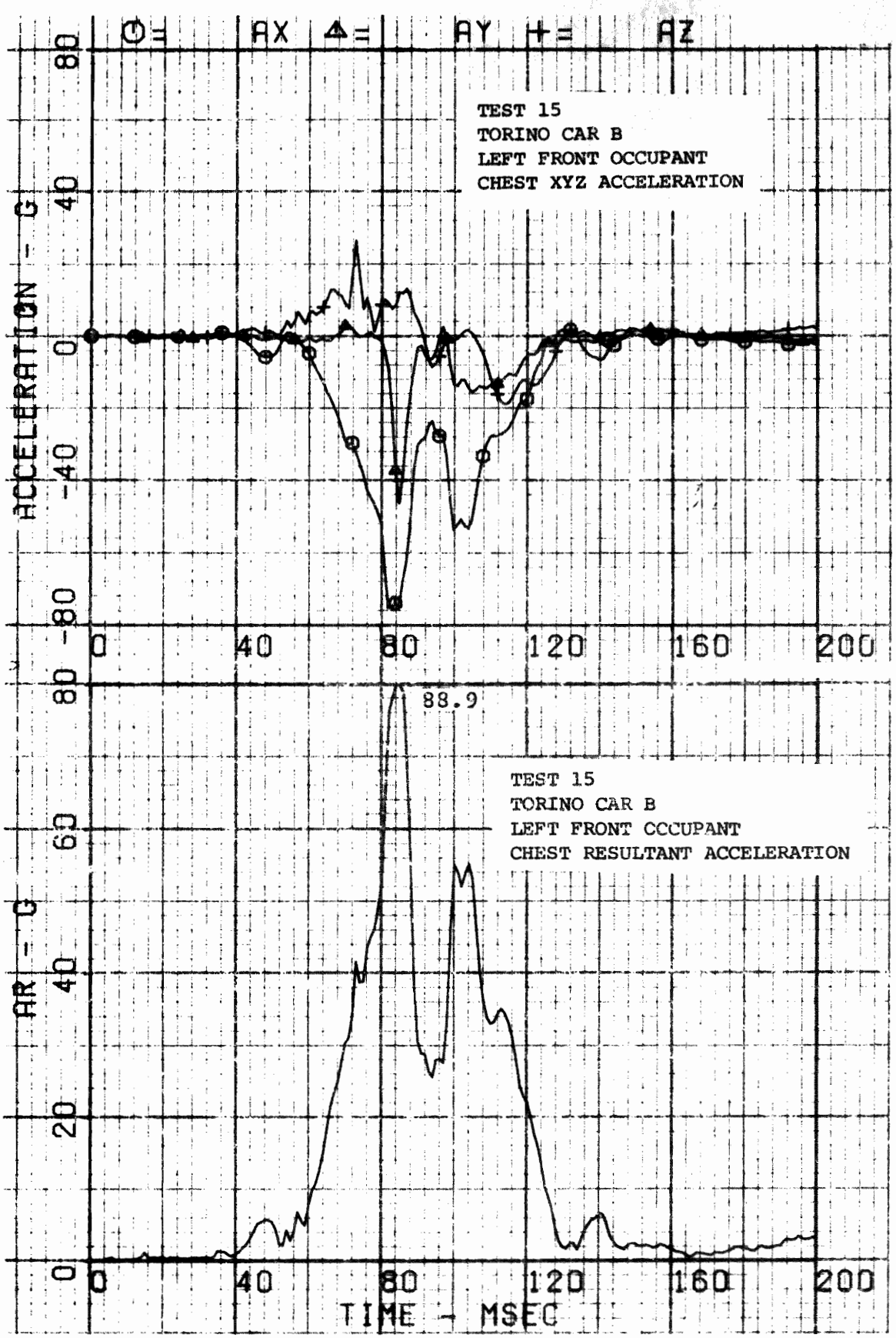

TEST 15
TORINO CAR A LEFT
FIREWALL X ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 15
TORINO CAR A LEFT
FIREWALL X VELOCITY
LOCATION 3
VX
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC

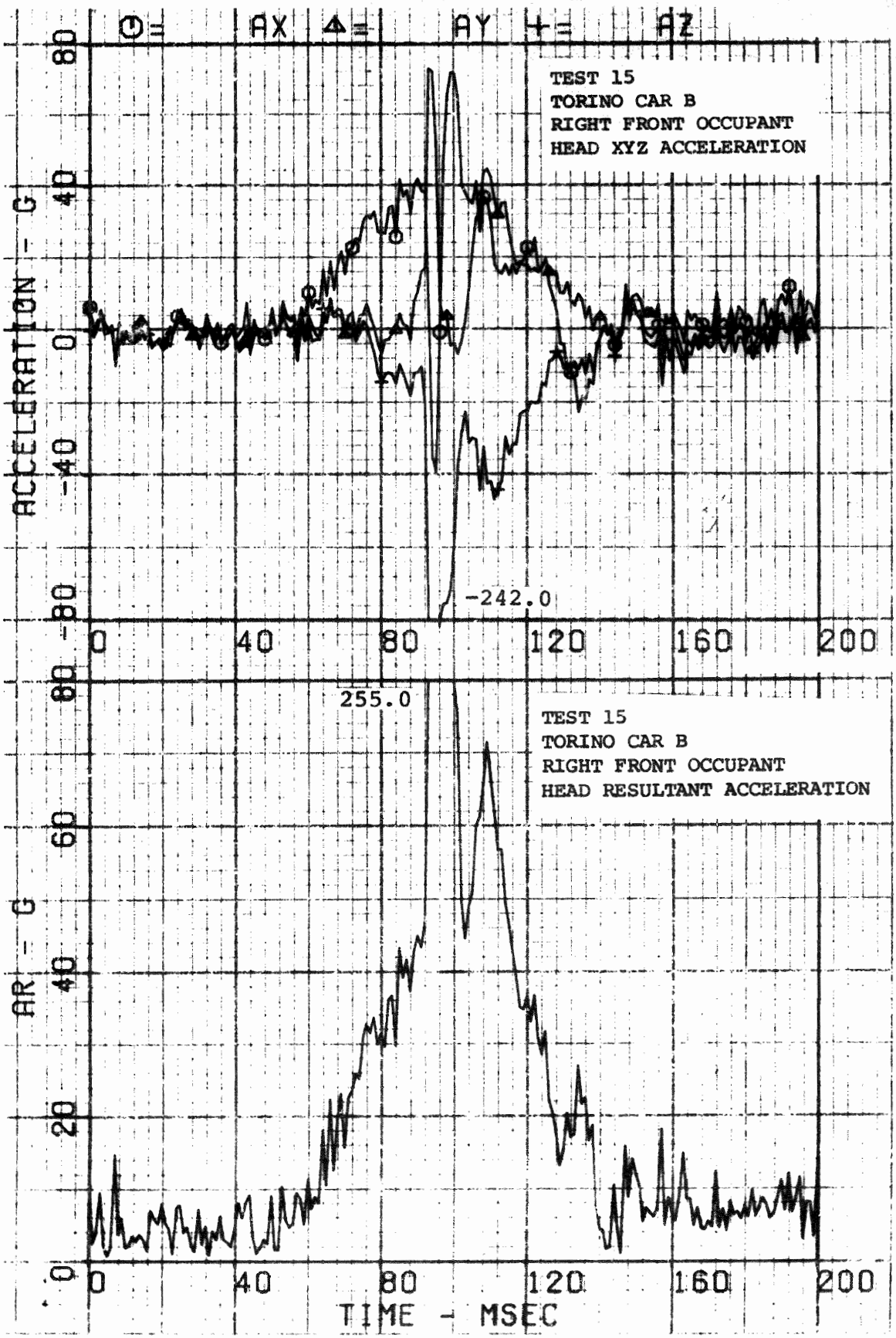

TEST 15
TORINO CAR A RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 15
TORINO CAR A RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC

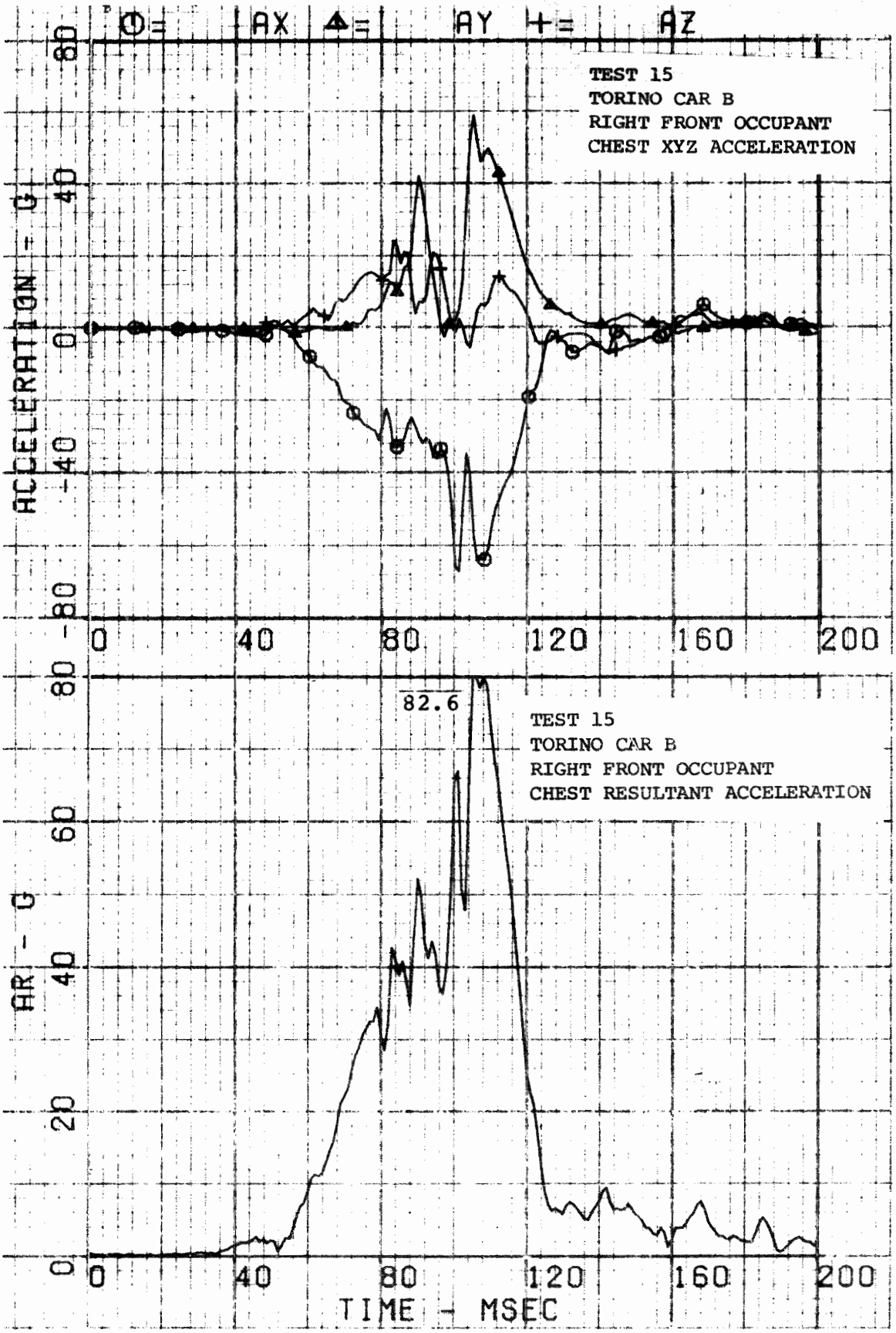

⊙= AY △= AZ
TEST 15
TORINO CAR A
ENGINE YZ ACCELERATION
LOCATION 7
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
⊙= AX △= AY +=
AZ
TEST 15
TORINO CAR A FRONT
CROSSMEMBER XYZ
ACCELERATION LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

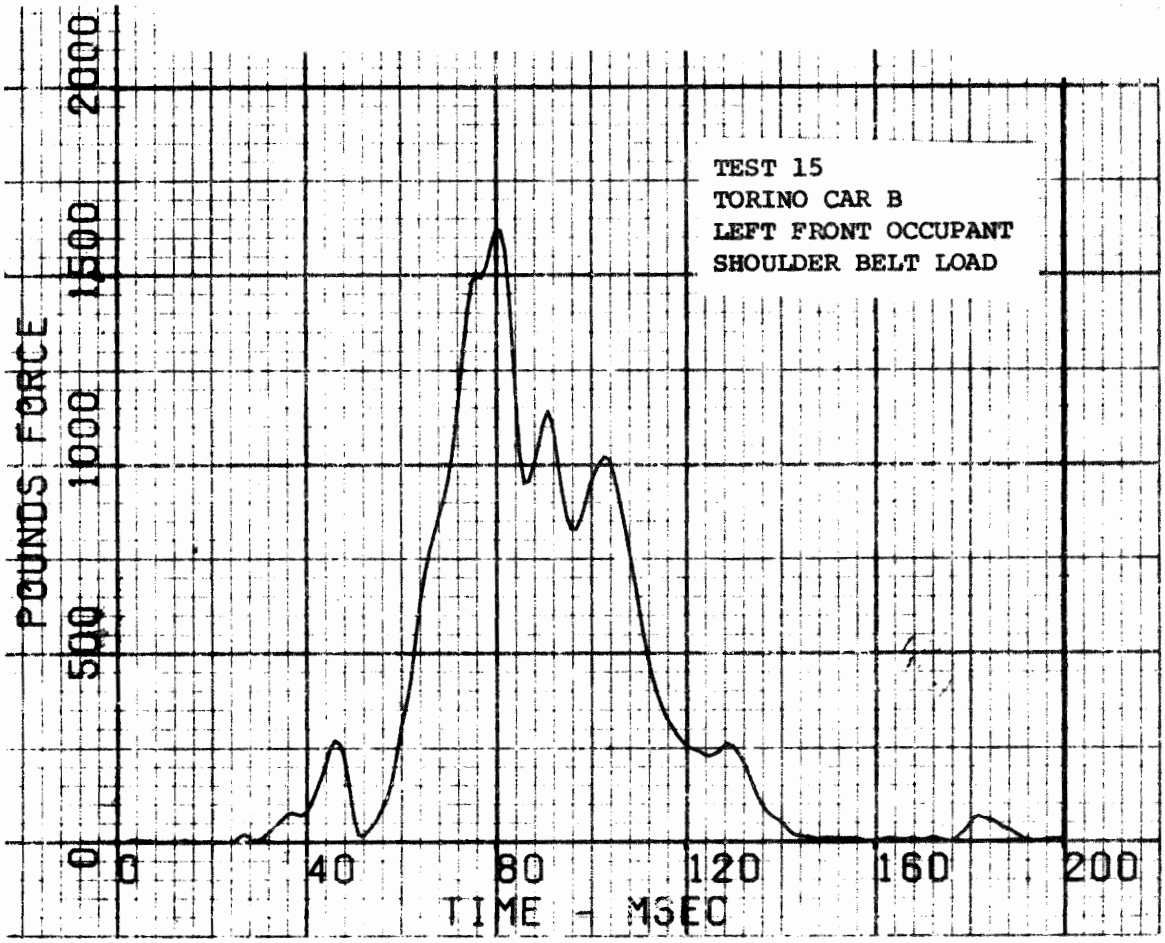

⊖= AX △= AY += AZ
TEST 15
TORINO CAR A REAR
AXLE XYZ ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
-145.5
0
40
80
120
160
200
TIME - MSEC

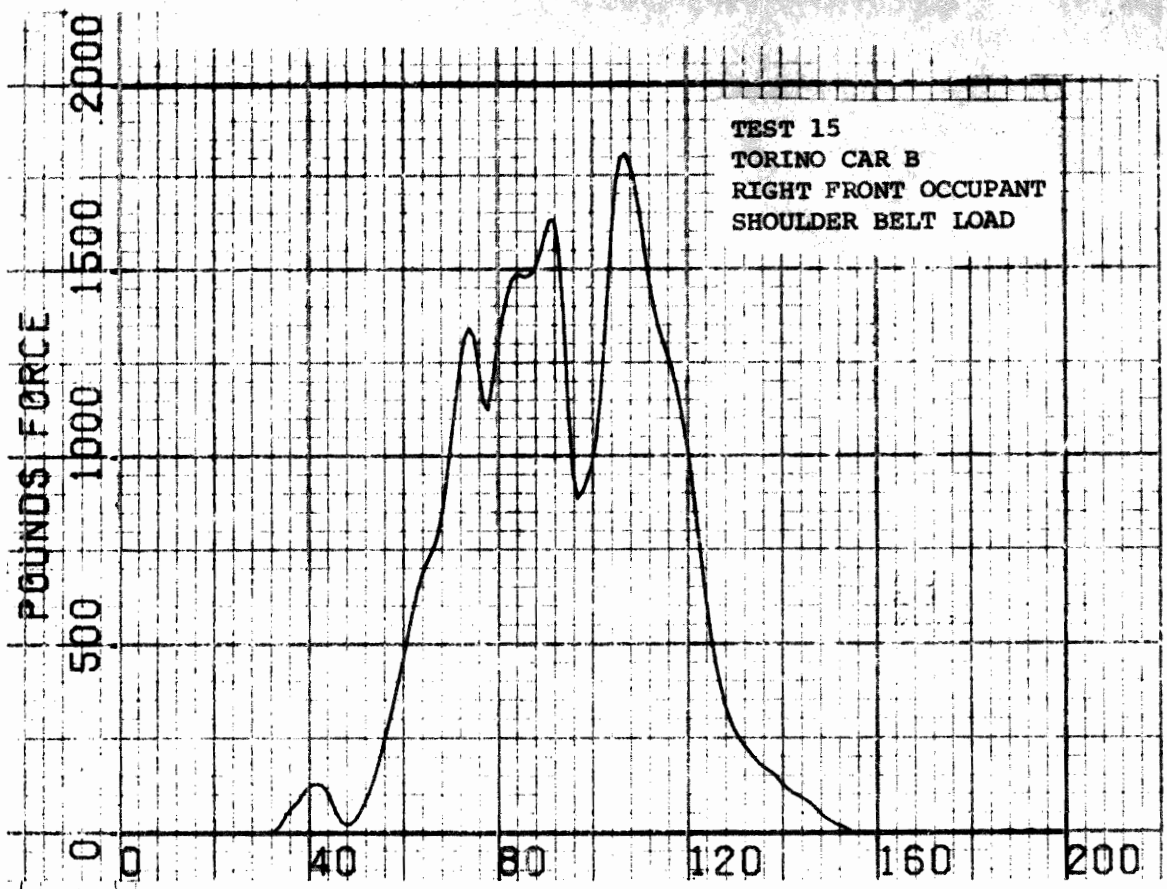

AX
AY
AZ
TEST 15
TORINO CAR B
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-216.6
-119.0
0
40
80
120
160
200
137.9
220.5
TEST 15
TORINO CAR B
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

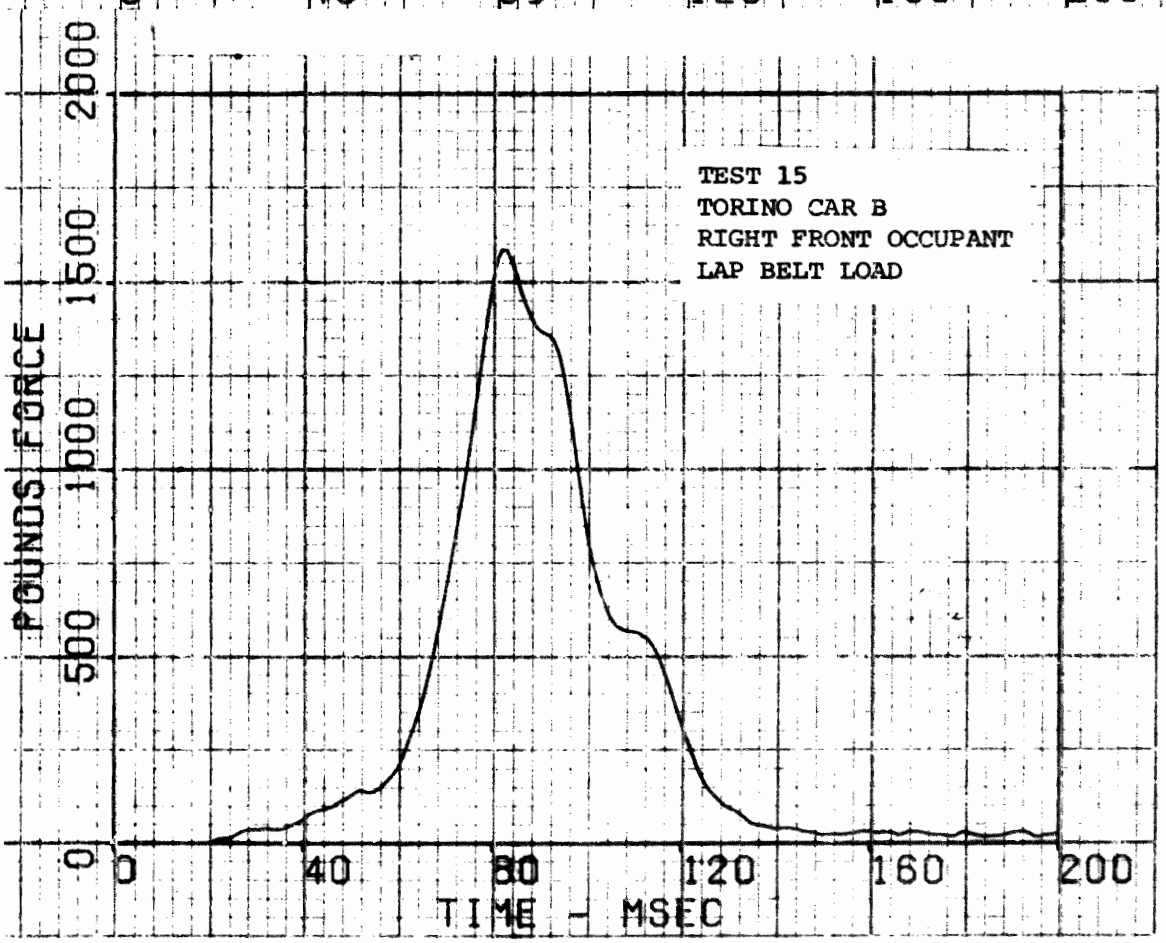

AX
AY
AZ
TEST 15
TORINO CAR B
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
88.9
TEST 15
TORINO CAR B
LEFT FRONT CCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
20
TIME - MSEC

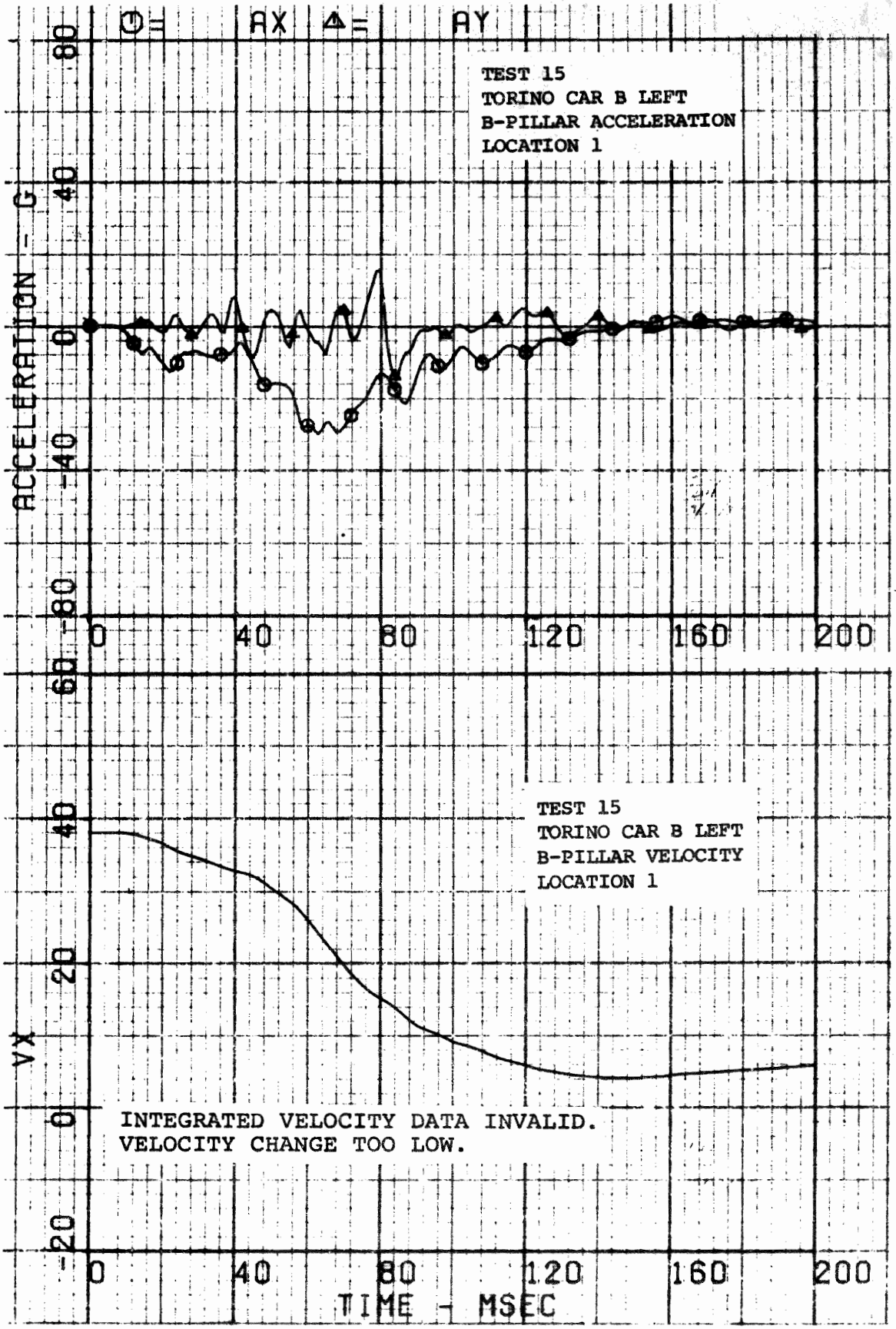

O= AX Δ= AY + = AZ
TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-242.0
0
40
80
120
160
200
255.0
TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

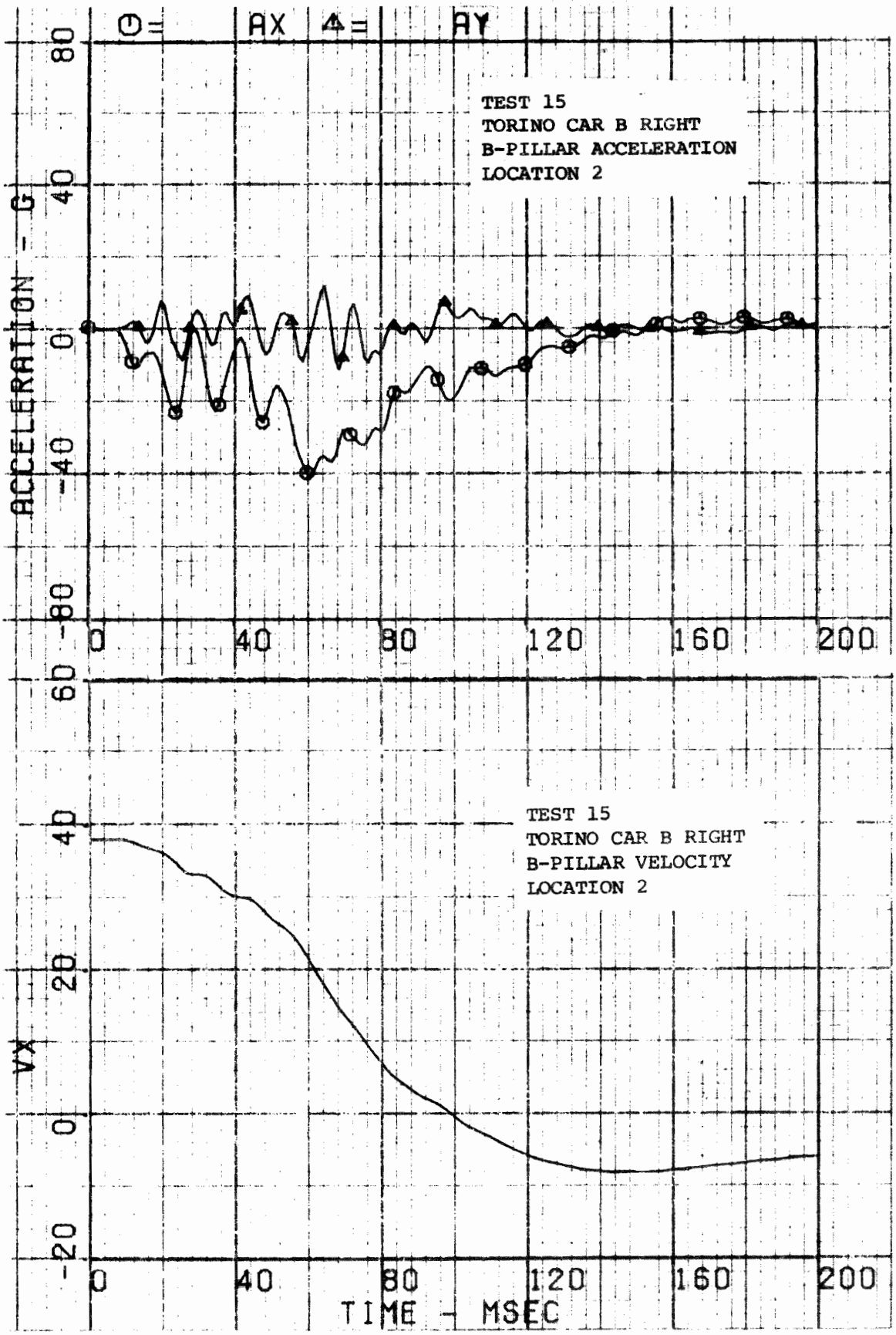

⊙= AX ▲= AY += AZ
TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION = G
80
40
0
-40
-80
0
40
80
120
160
200
82.6
TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
80
60
40
20
0
TIME - MSEC

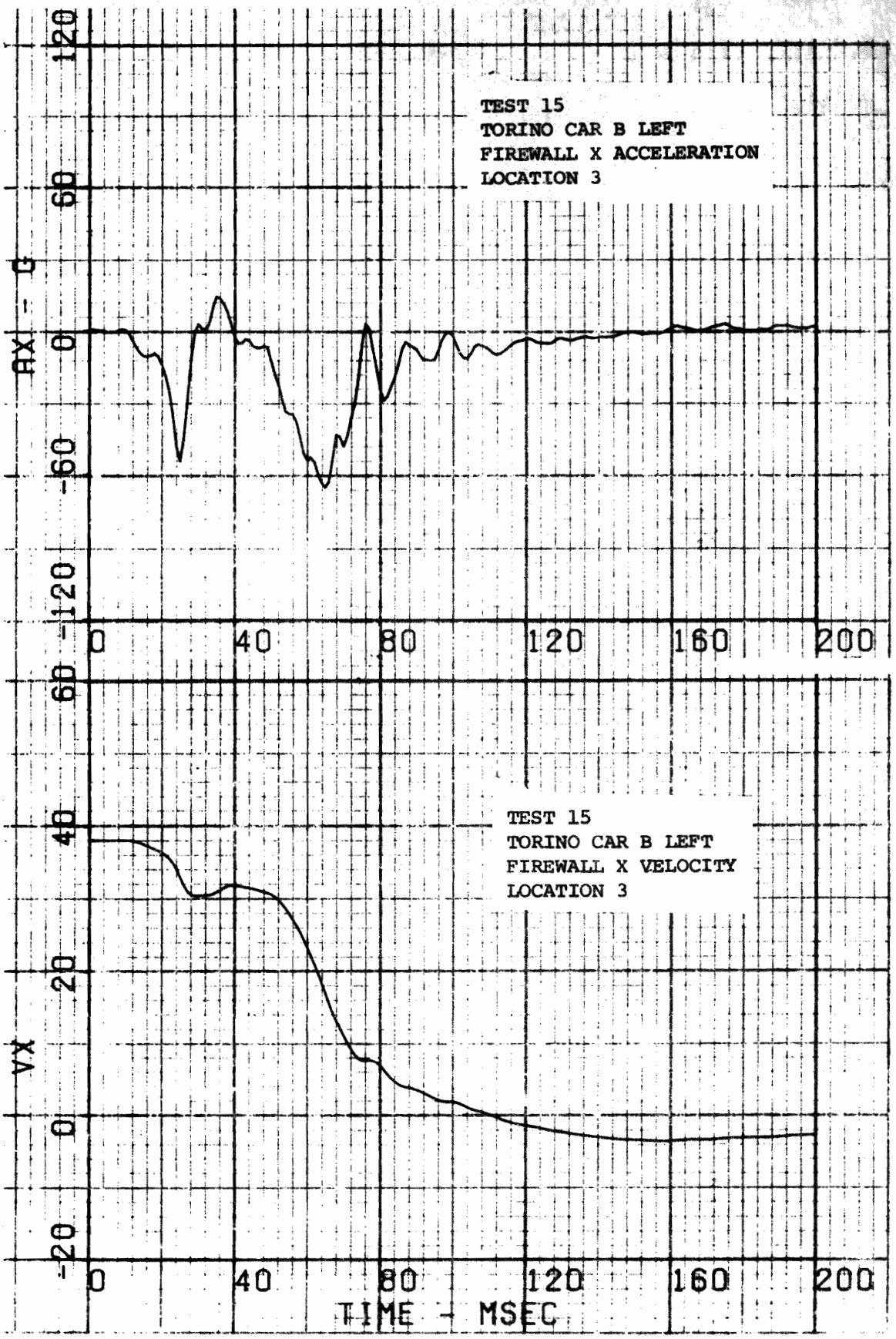

TEST 15
TORINO CAR B
LEFT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
0
500
1000
1500
2000
0
40
80
120
160
200
TIME - MSEC

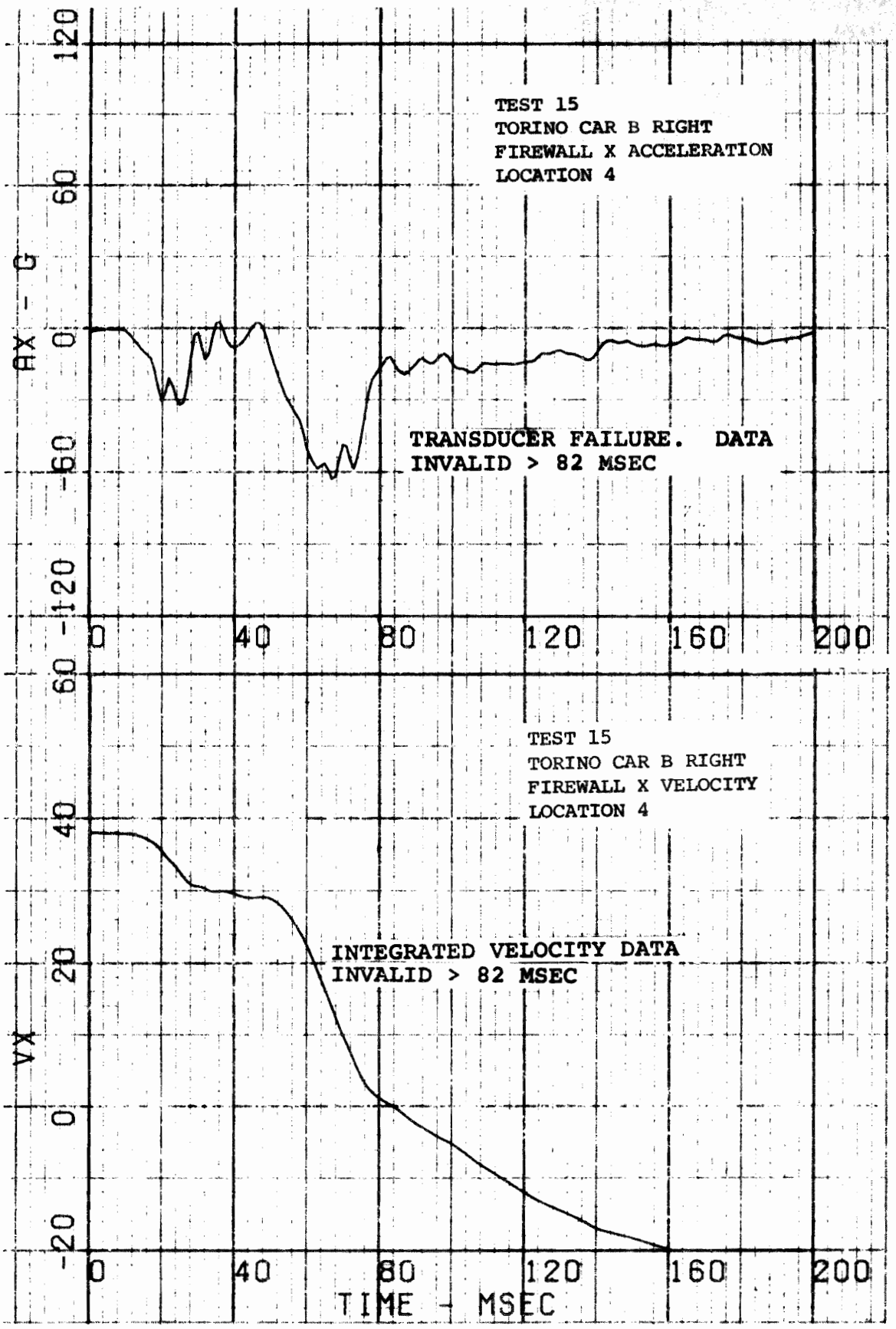

TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
SHOULDER BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200

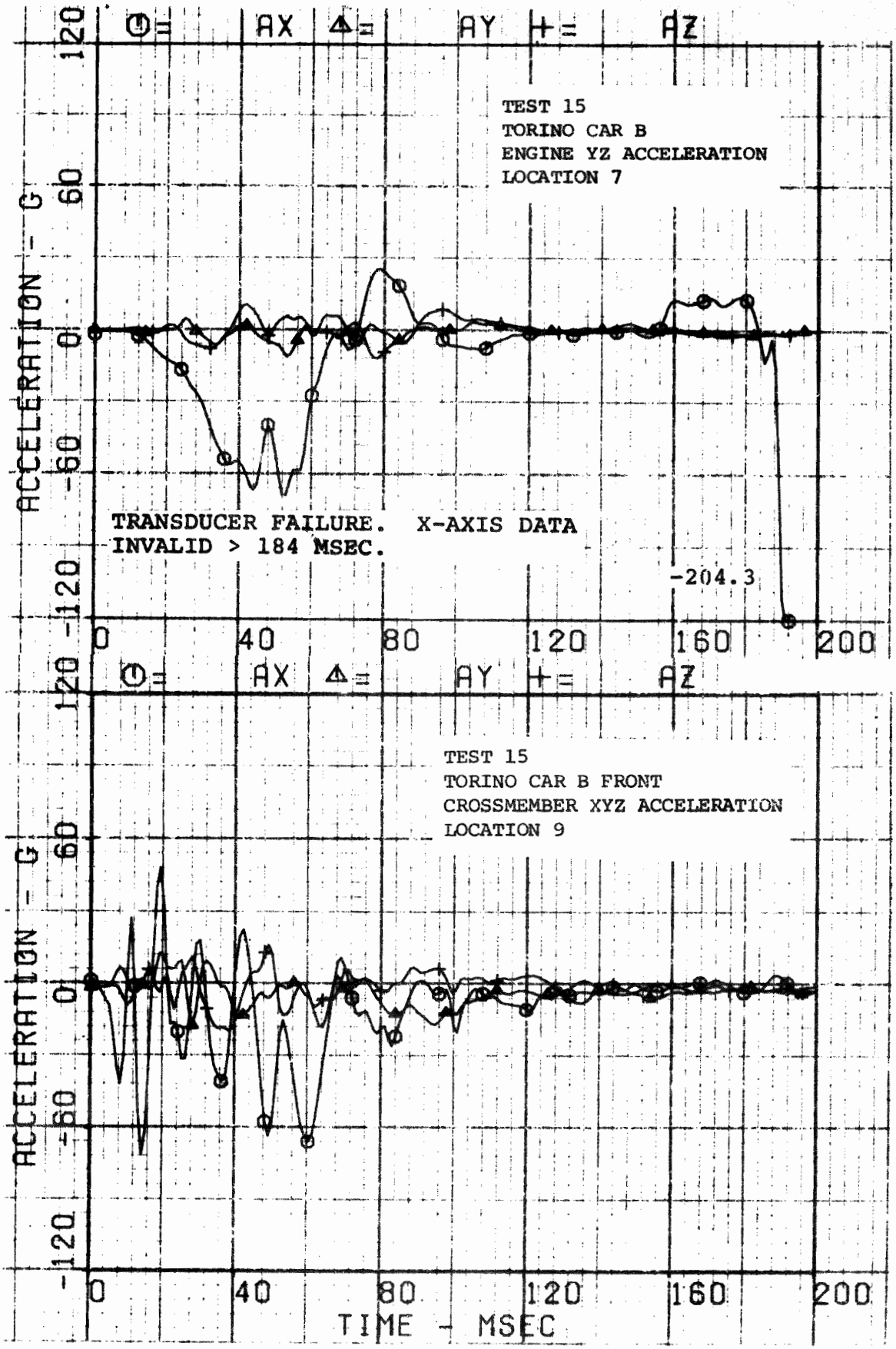

TEST 15
TORINO CAR B
RIGHT FRONT OCCUPANT
LAP BELT LOAD
POUNDS FORCE
2000
1500
1000
500
0
0
40
80
120
160
200
TIME - MSEC

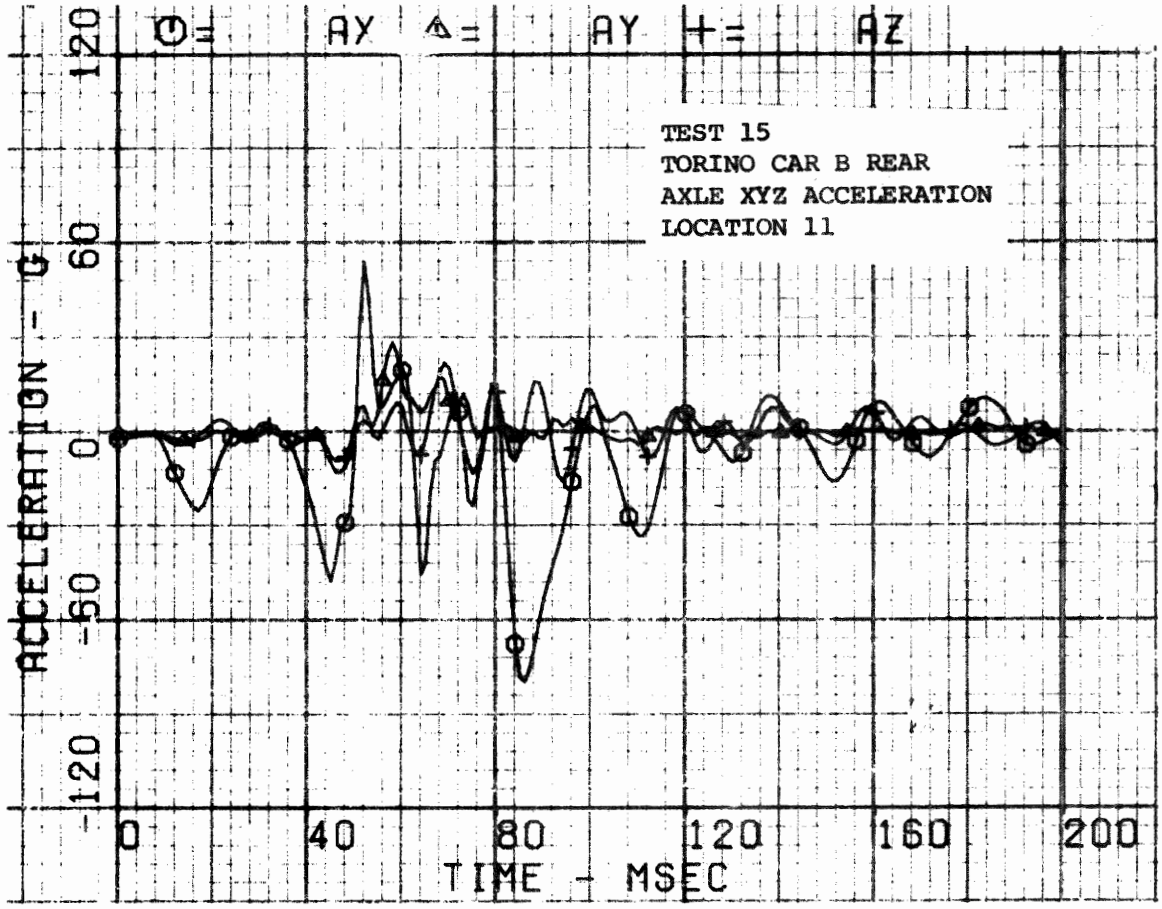

AX
AY
TEST 15
TORINO CAR B LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR B LEFT
B-PILLAR VELOCITY
LOCATION 1
VX
60
40
20
0
-20
INTEGRATED VELOCITY DATA INVALID.
VELOCITY CHANGE TOO LOW.
TIME - MSEC


AX
AY
TEST 15
TORINO CAR B RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 15
TORINO CAR B RIGHT
B-PILLAR VELOCITY
LOCATION 2
VX
60
40
20
0
-20
TIME - MSEC


TEST 15
TORINO CAR B LEFT
FIREWALL X ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 15
TORINO CAR B LEFT
FIREWALL X VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 15
TORINO CAR B RIGHT
FIREWALL X ACCELERATION
LOCATION 4
TRANSDUCER FAILURE. DATA
INVALID > 82 MSEC
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 15
TORINO CAR B RIGHT
FIREWALL X VELOCITY
LOCATION 4
INTEGRATED VELOCITY DATA
INVALID > 82 MSEC
VX
60
40
20
0
-20
TIME - MSEC


⊙= AX △= AY += AZ
TEST 15
TORINO CAR B
ENGINE YZ ACCELERATION
LOCATION 7
TRANSDUCER FAILURE. X-AXIS DATA
INVALID > 184 MSEC.
-204.3
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
⊙= AX △= AY += AZ
TEST 15
TORINO CAR B FRONT
CROSSMEMBER XYZ ACCELERATION
LOCATION 9
ACCELERATION - G
TIME - MSEC


○ = AY △ = AY + = AZ
TEST 15
TORINO CAR B REAR
AXLE XYZ ACCELERATION
LOCATION 11
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

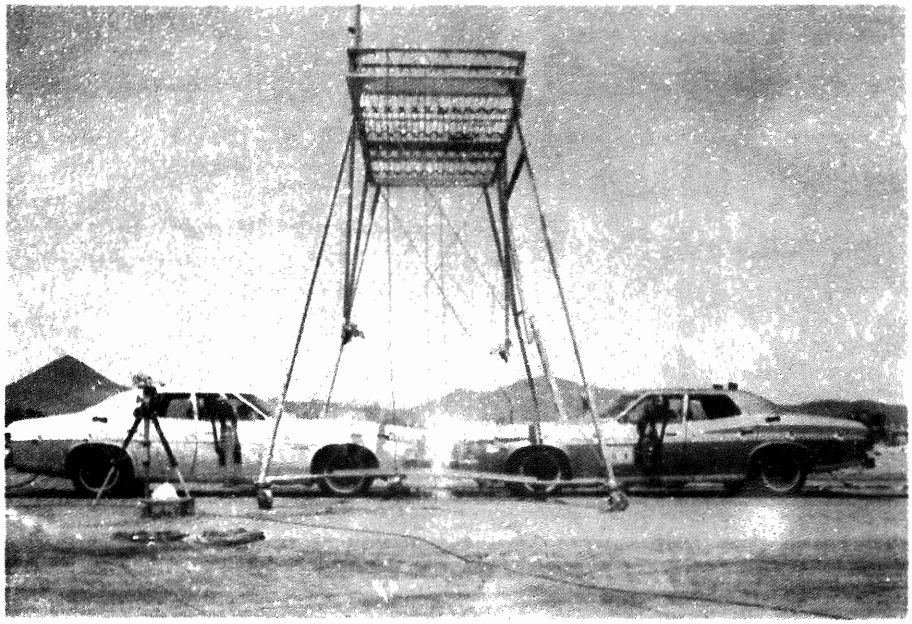


Figure 3-51. Pre-test Vehicle Configuration - Test 15.

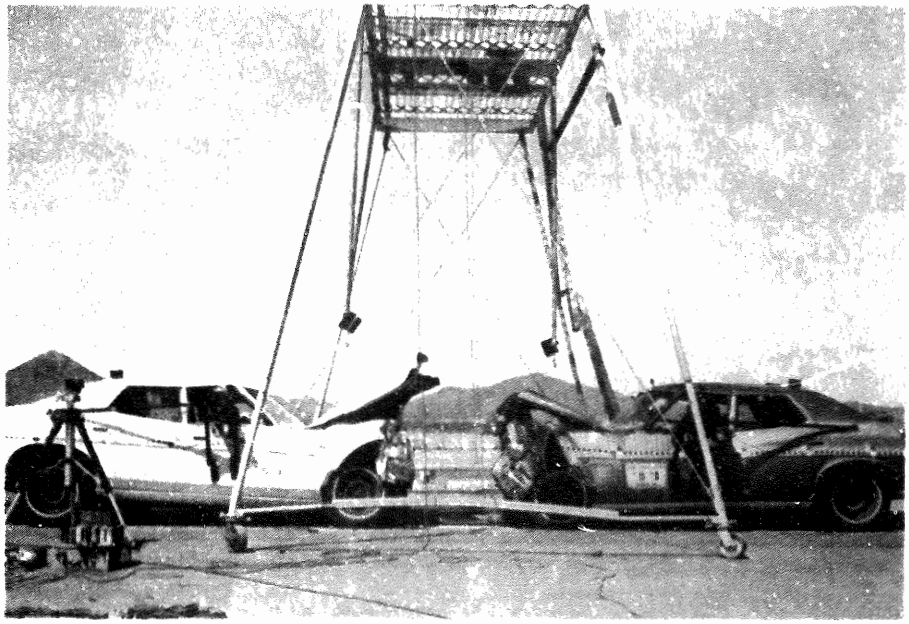


Figure 3-52. Post-test Vehicle Configuration - Test 15.

Figure 3-53. Pre-test Standard 3-Point Belt With Web Lockers and Tear Webbing, Left Front - Test 15.

Figure 3-54. Post-test Standard 3-Point Belt With Web Lockers and Tear Webbing, Left Front - Test 15.

Figure 3-55. Pre-test Standard 3-Point Belt With Web Lockers and Tear Webbing, Right Front - Test 15.

Figure 3-56. Post-test Standard 3-Point Belt With Web Lockers and Tear Webbing, Right Front - Test 15.

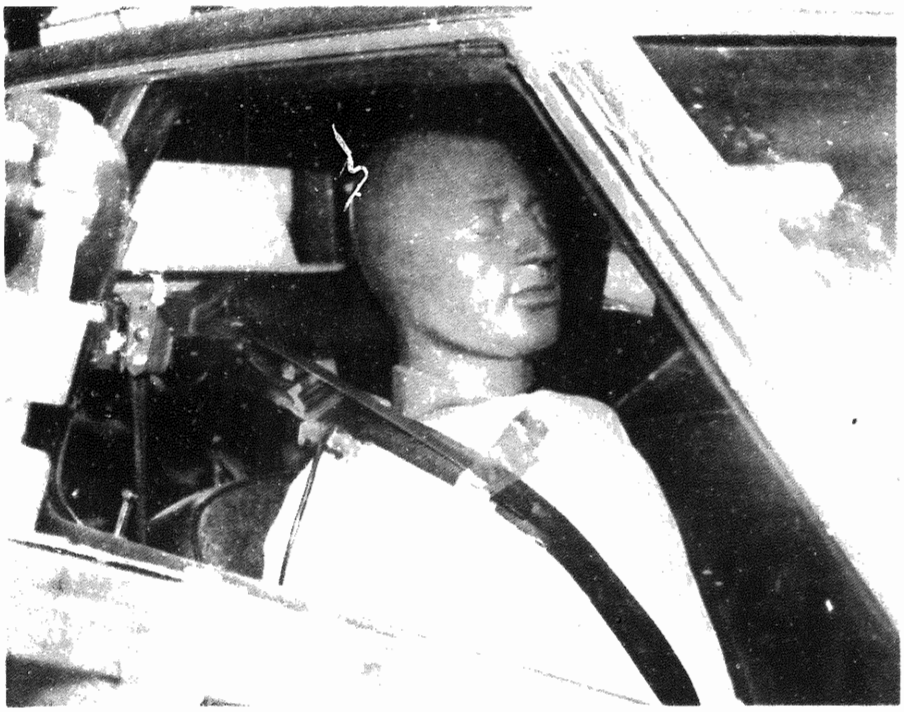


Figure 3-59. Pre-test Standard 3-Point Belt With Web Lockers and Force Limiters, Right Front - Test 15.

Figure 3-60. Post-test Standard 3-Point Belt With Web Lockers and Force Limiters, Right Front - Test 15.

3.9 TEST NUMBER 16

The impact conditions for Test 16 were:

Configuration	Closing Speed
Torino-to-Volvo Left Oblique (45°)*	60.3 mph

and the restraint system configuration was:

Occupant	Vehicle A	Vehicle B
Left Front	Unrestrained	RSV Driver Airbag
Right Front	Unrestrained	RSV Passenger Airbag

For this test, Vehicle A was a 1975 Ford Torino and Vehicle B was a 1976 Volvo 244. No structural modifications were made to the Torino.

The results of Test 16 are summarized in the following tables:

Table 3-33 - Summary of Vehicle Data (Test 16)

Table 3-34 - Injury Criteria Summary (Test 16)

Table 3-35 - Summary of Restraint System Data (Test 16)

Table 3-36 - Occupant Response Data (Test 16)

which are followed by Figure 3-61 defining vehicle accelerometer locations. The plotted data from the test are presented after this figure, and following the data plots are photos showing the before and after conditions of the vehicles and restraint systems.

*Major resultant acceleration vector 45° to centerline of target vehicle.

TABLE 3-33. SUMMARY OF VEHICLE DATA (TEST 16)

PARAMETER		VEHICLE A	VEHICLE B
TEST NUMBER AND DATE		Test 16/July 19, 1977	
TEST VEHICLE		Torino	Volvo
DYNAMIC SCIENCE NUMBER		506	426
TEST WEIGHT (lb)		4634	3263
IMPACT VELOCITY (mph)		60.3	0
VELOCITY CHANGE (mph)		25.9	31.6 (1)
PEAK ACCELERATION (G @ msec)			
	LOCATION 1	26.7 @ 93	29.5 @ 63
	LOCATION 2	19.8 @ 95	31.2 @ 64
MAXIMUM STATIC CRUSH (in.)			
	LEFT	4.0	49.0
	CENTER	25.0	17.5
	RIGHT	25.0	8.0

(1) Velocity change found by using average of resultant velocity vector (V_R) data for compartment accelerometer locations.

TABLE 3-34. INJURY CRITERIA SUMMARY (TEST 16)

VEHICLE A - BELT CAR (TORINO)

OCCUPANT POSITION	LEFT FRONT		RIGHT FRONT	
RESTRAINT SYSTEM	None		None	
HIC	172		400	
HEAD G(1) @ msec	54.9 @ 110		76.2 @ 102	
CSI	153		127	
CHEST G(1) @ msec	37.0 @ 112		34.6 @ 109	
FEMUR LOAD (lb)(2)	LEFT NA	RIGHT NA	LEFT NA	RIGHT NA

(1) 3 msec clip.
(2) No femur loads measured.

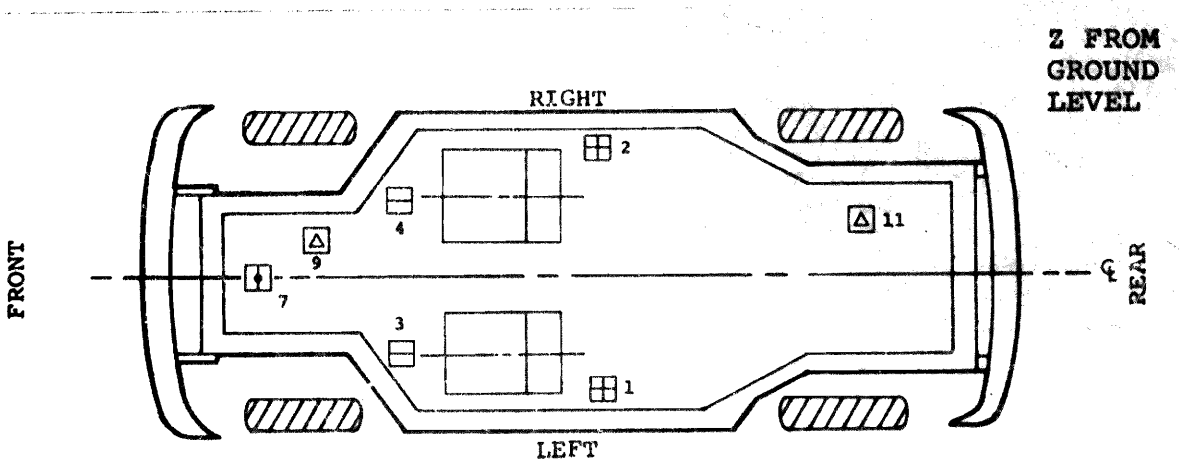
TABLE 3-35. SUMMARY OF RESTRAINT SYSTEM DATA (TEST 16)

VEHICLE A - BELT CAR (TORINO)	
Left Front Occupant No Restraint System	
Right Front Occupant No Restraint System	

TABLE 3-36. OCCUPANT RESPONSE DATA SUMMARY (TEST 16)

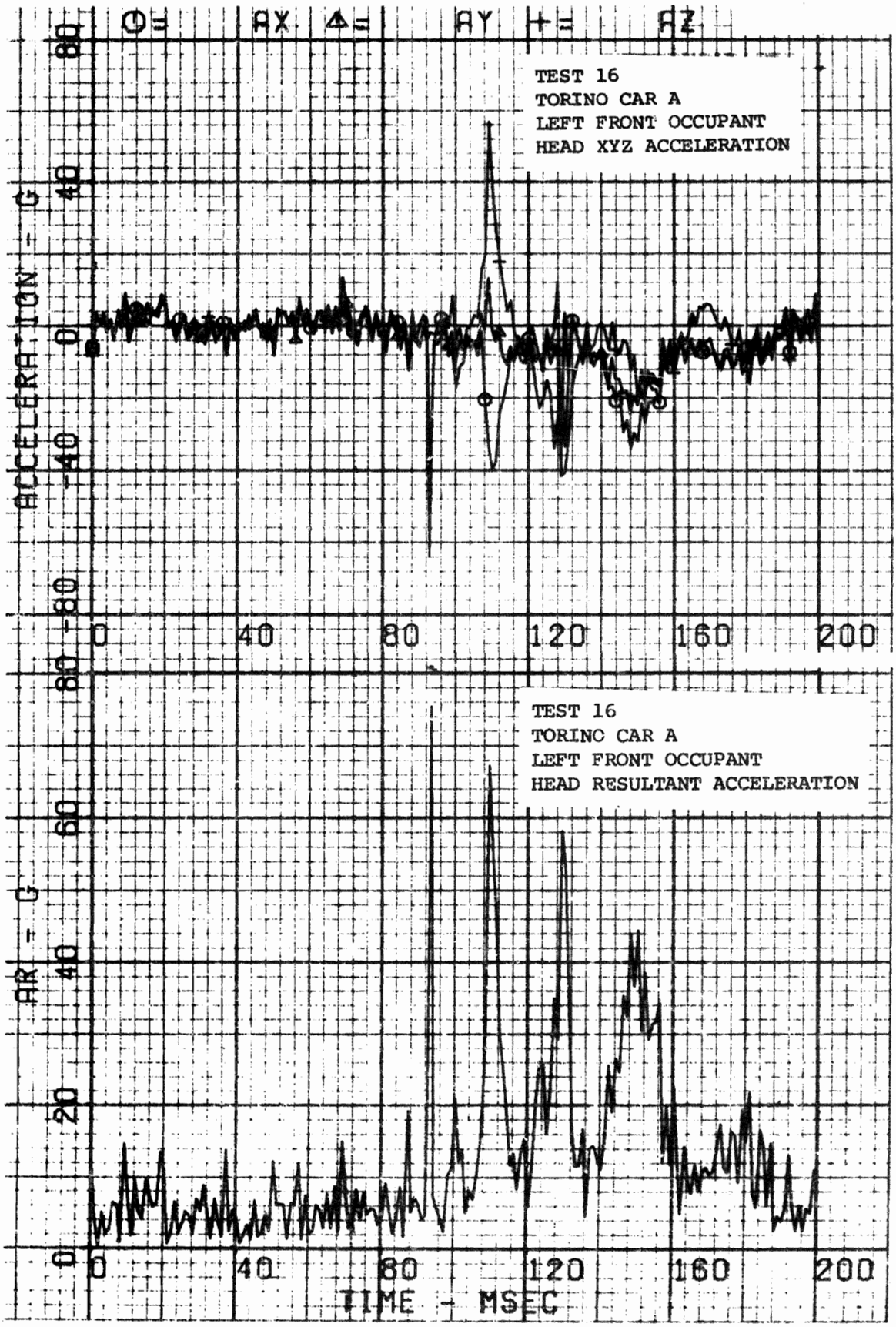
		VEHICLE A - BELT CAR (TORINO)			
		LEFT FRONT OCCUPANT		RIGHT FRONT OCCUPANT	
		MAX VALUE (g)	T MSEC	MAX VALUE (g)	T MSEC
HEAD					
	X	40.1	110	114.1	103
	Y	63.8	93	31.8	134
	Z	56.8	109	69.7	103
	R(1)	54.9	110	76.2	102
	HIC	172 @ 107-161		400 @ 101-106	
CHEST					
	X	39.8	95	35.6	106
	Y	11.5	124	13.2	125
	Z	17.3	93	13.9	87
	R(1)	37.0	112	34.6	109
	SI	153 @ 200		127 @ 200	
		MAX VALUE (lb)	T MSEC	MAX VALUE (lb)	T MSEC
FEMURS(2)					
	LF	NA		NA	
	RT	NA		NA	

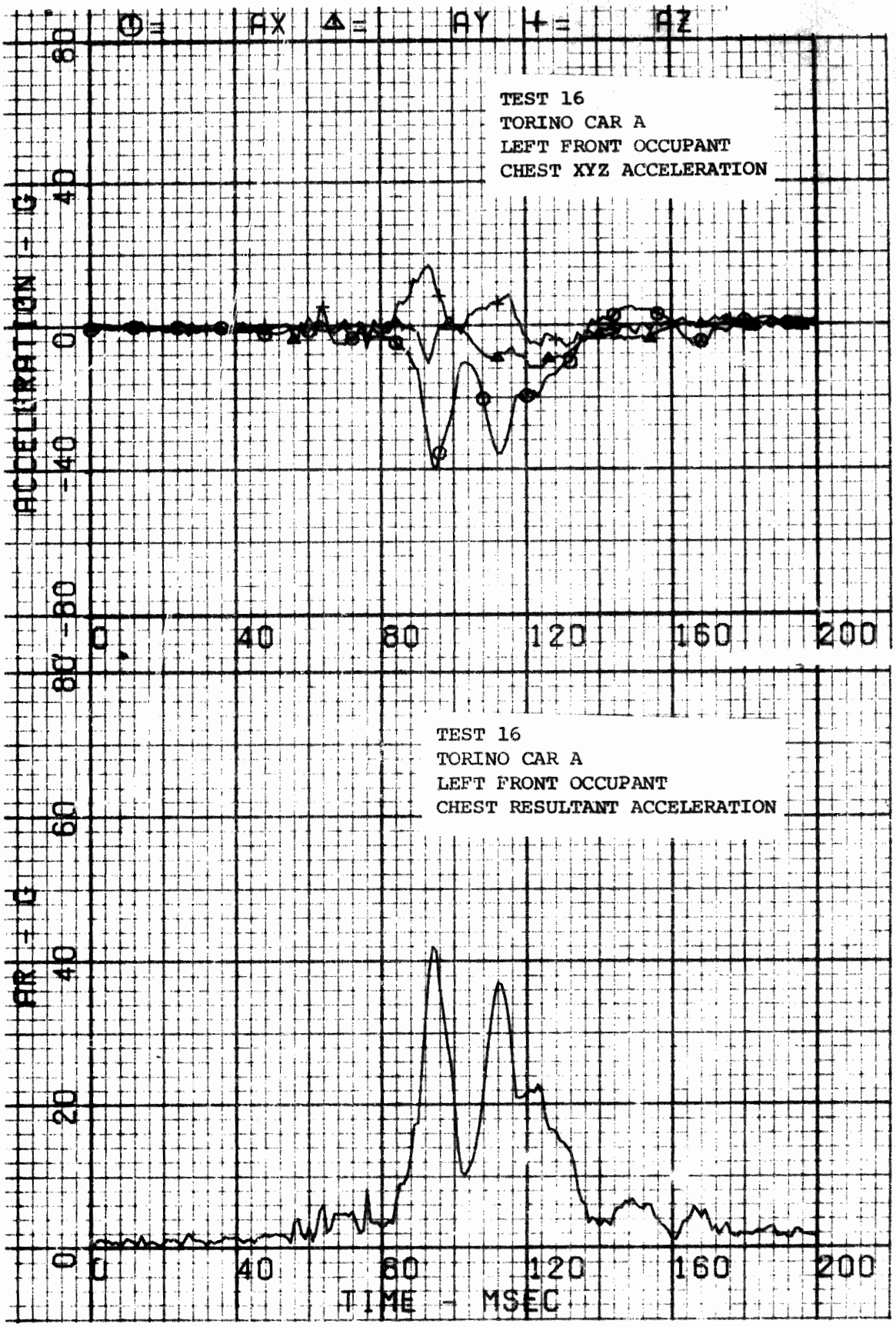
(1) 3 msec clip, components not clipped.
(2) No femur loads measured.

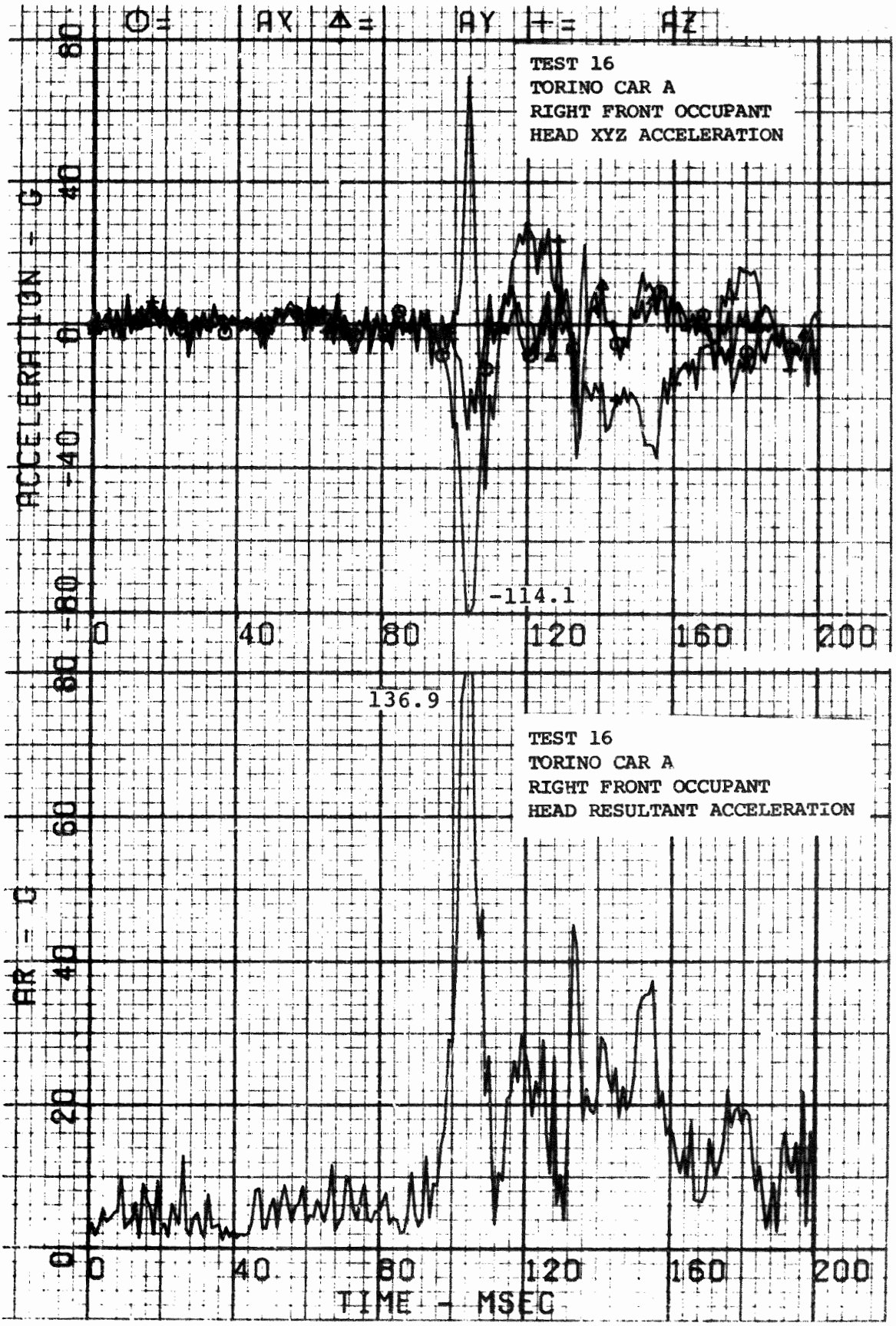


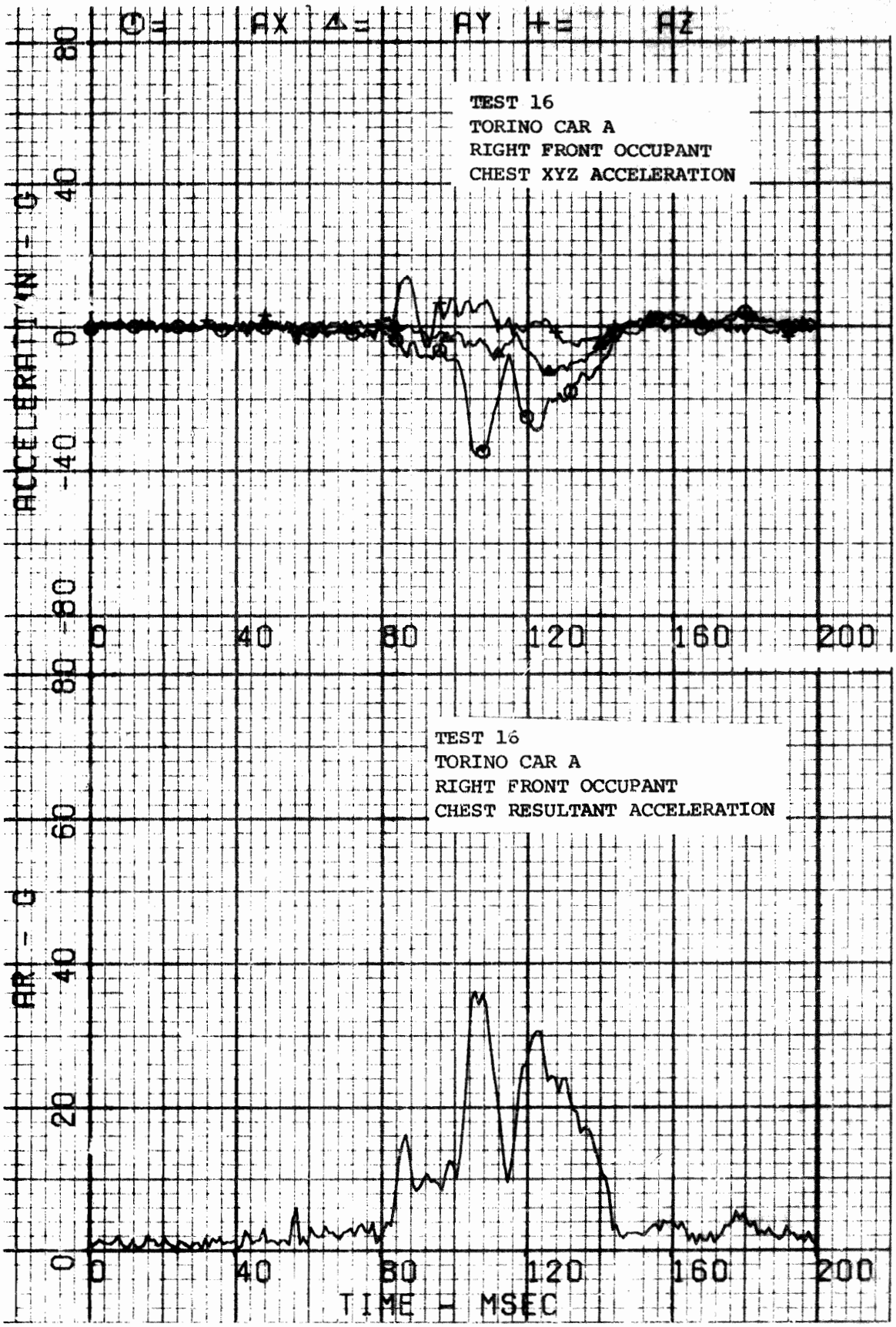
VEHICLE A ACCELEROMETER LOCATIONS AND COORDINATES				
NO.	DESCRIPTION OF LOCATION	X	Y	Z
1	Left Floor Pan near B-Pillar	X	X	
2	Right Floor Pan near B-Pillar	X	X	
3	Left Firewall on CL of Driver's Seat	X		
4	Right Firewall on CL of Passenger's Seat	X		
7	Engine Block		X	X
9	Front Crossmember	X	X	X
11	Rear Axle	X	X	X

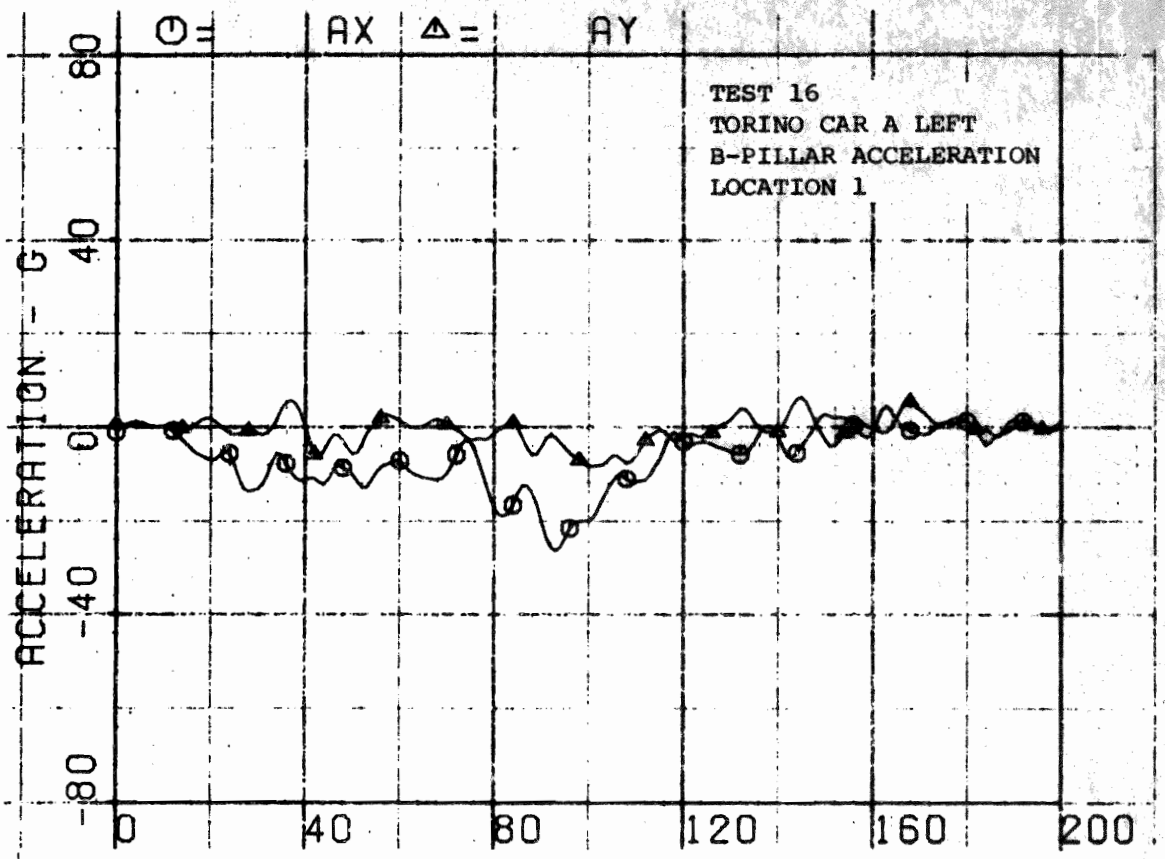
Figure 3-61. Vehicle Accelerometer Locations - Test 16.

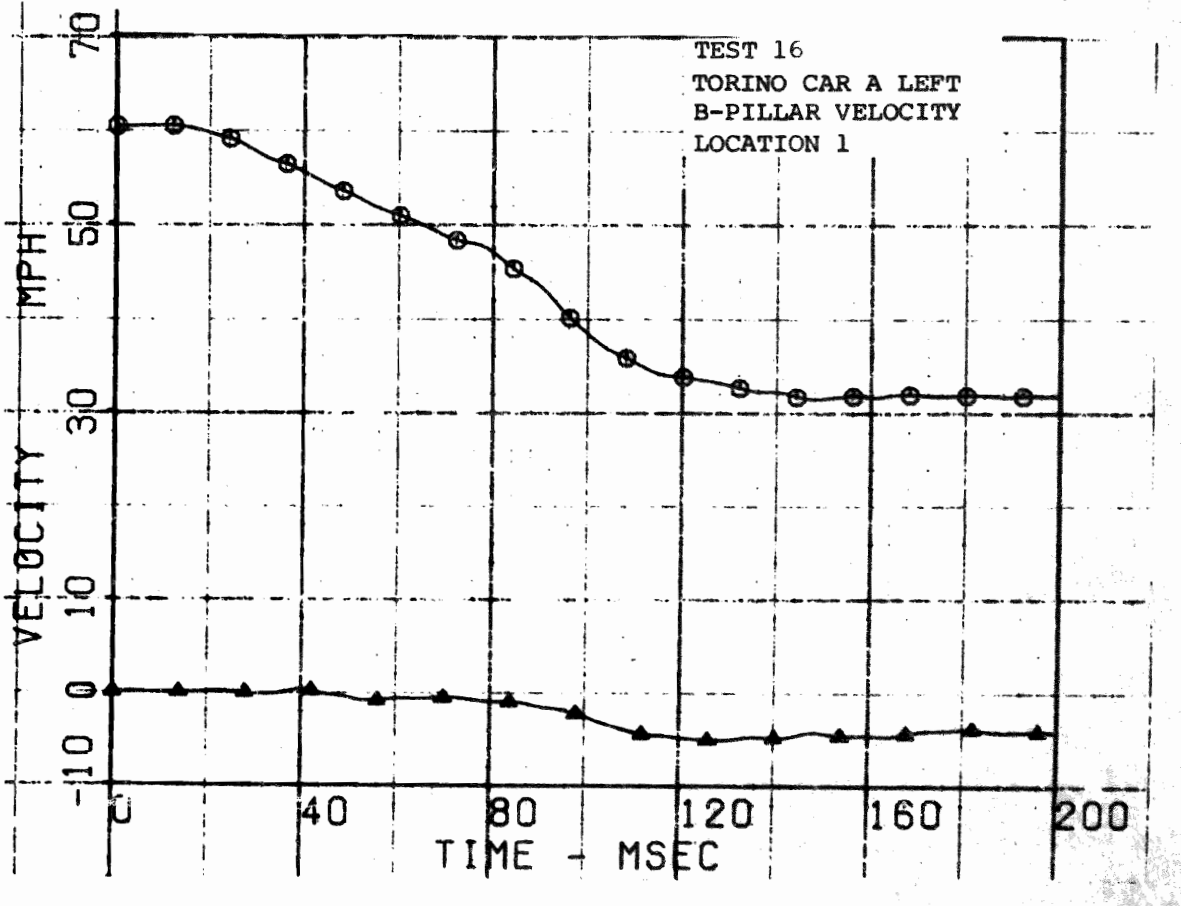

AX
AY
AZ
TEST 16
TORINO CAR A
LEFT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 16
TORINC CAR A
LEFT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
60
20
TIME - MSEC

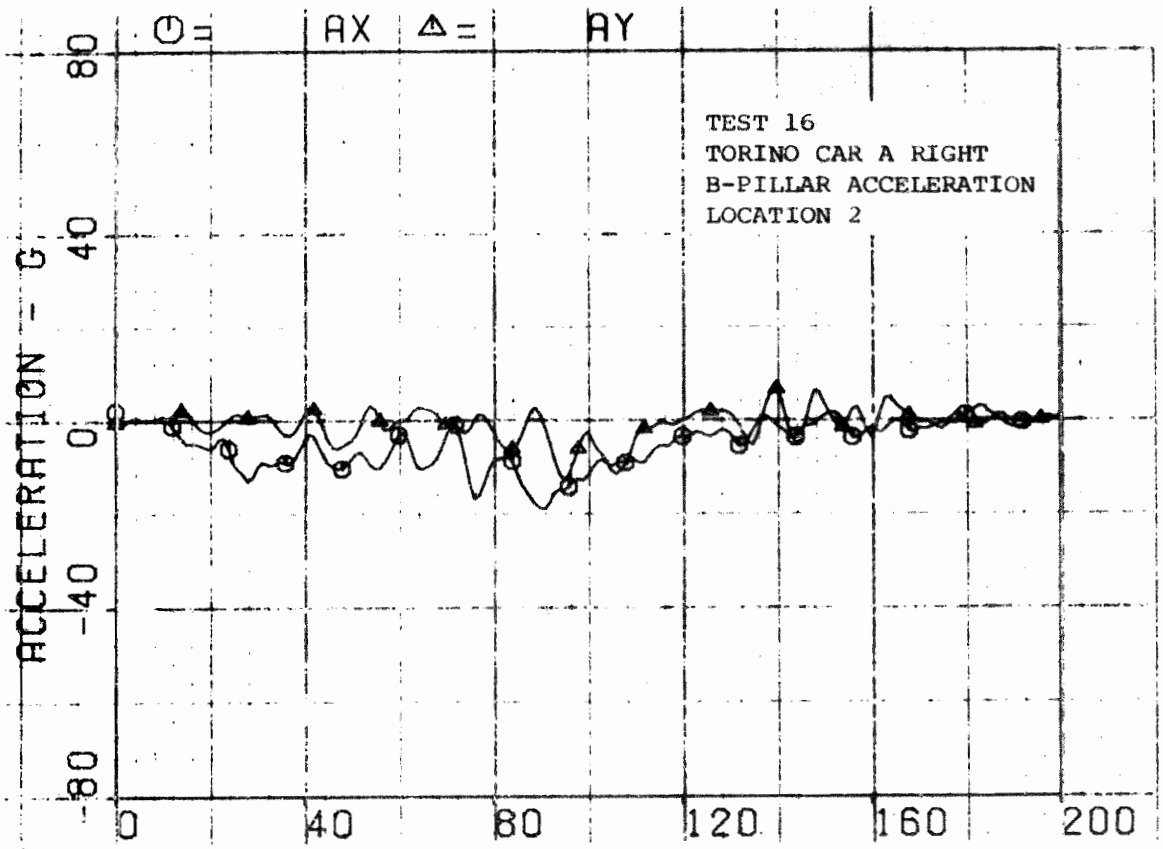

⊙= AX
△= AY
+= AZ
TEST 16
TORINO CAR A
LEFT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 16
TORINO CAR A
LEFT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
20
TIME - MSEC

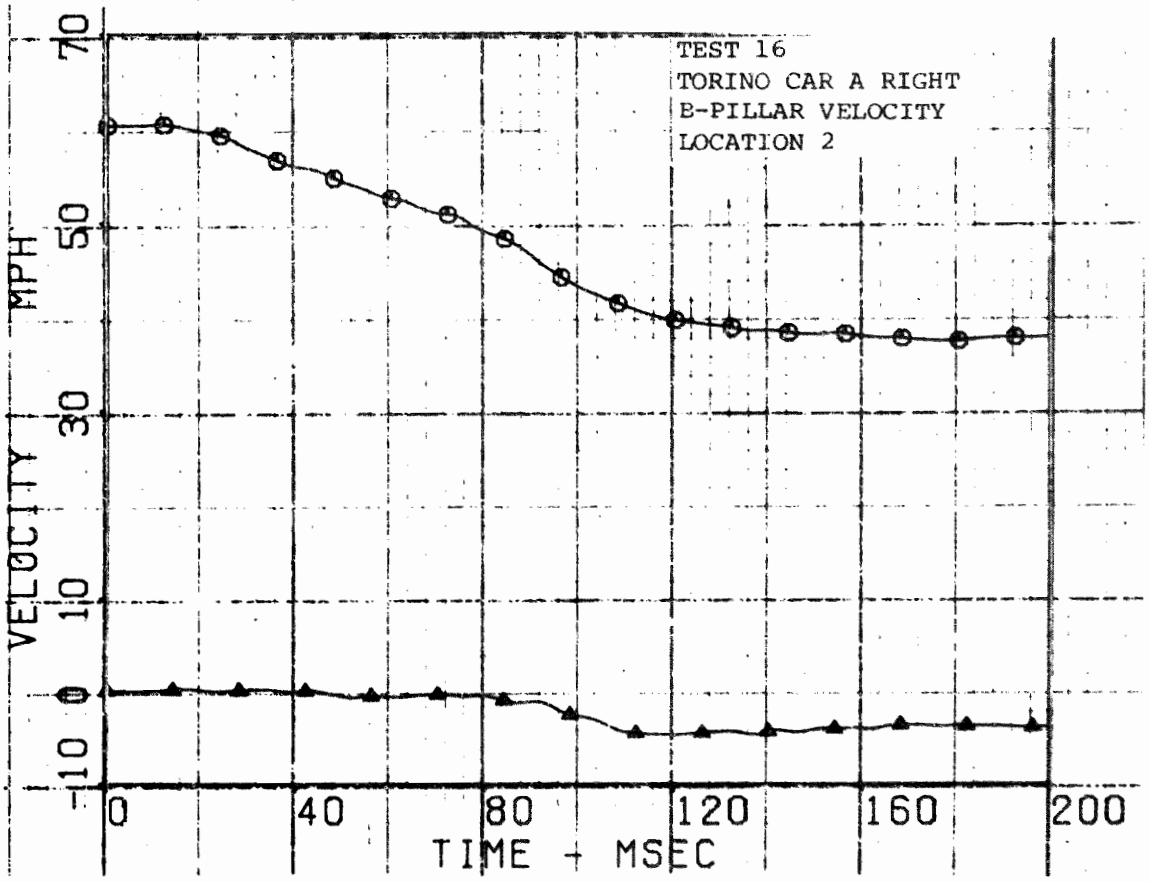

○= AX △= AY +=AZ
TEST 16
TORINO CAR A
RIGHT FRONT OCCUPANT
HEAD XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
-114.1
0
40
80
120
160
200
136.9
TEST 16
TORINO CAR A
RIGHT FRONT OCCUPANT
HEAD RESULTANT ACCELERATION
AR - G
80
60
40
20
0
0
40
80
120
160
200
TIME - MSEC

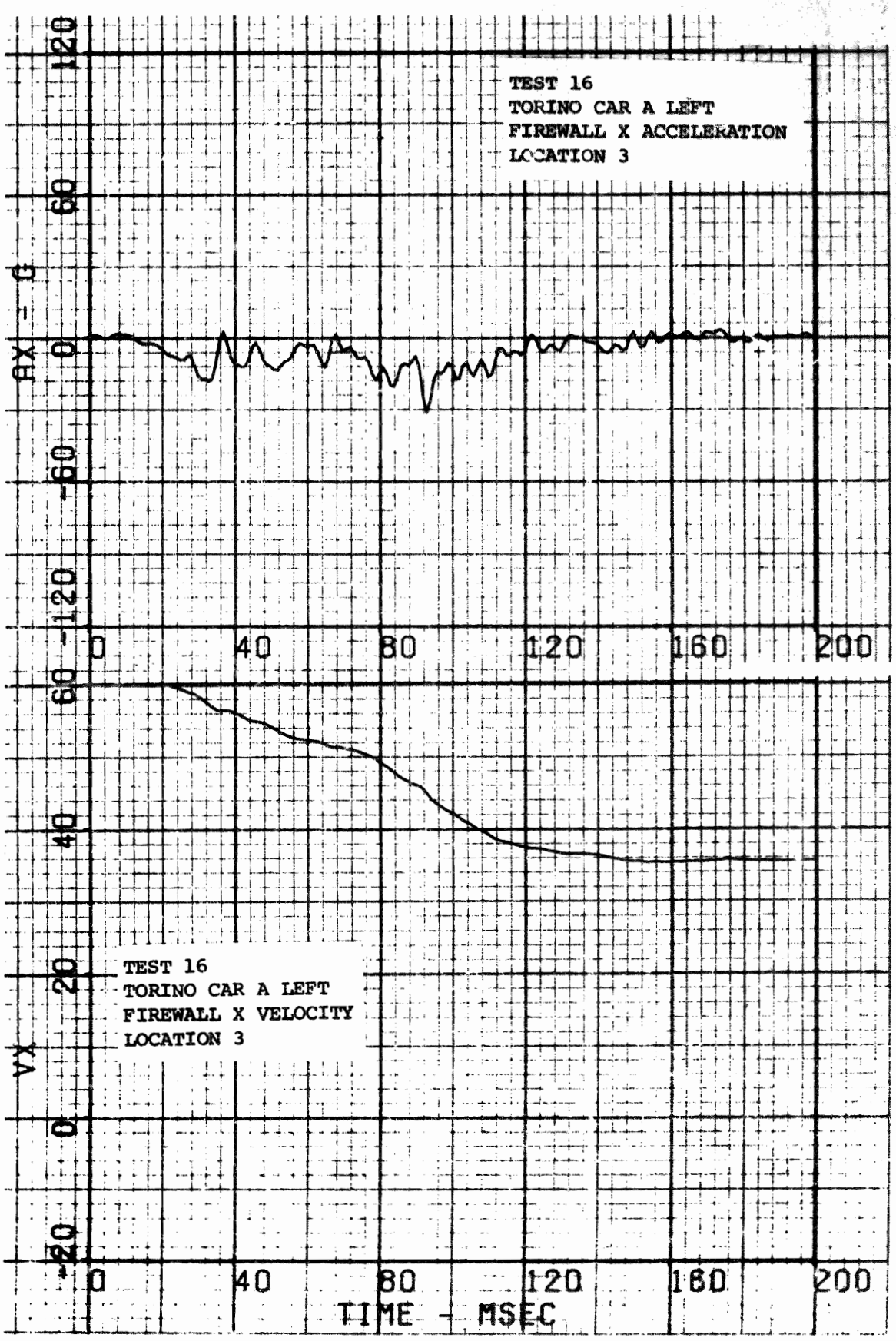

O= AX Δ= AY + = AZ
TEST 16
TORINO CAR A
RIGHT FRONT OCCUPANT
CHEST XYZ ACCELERATION
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200
TEST 16
TORINO CAR A
RIGHT FRONT OCCUPANT
CHEST RESULTANT ACCELERATION
AR - G
60
40
20
0
TIME - MSEC

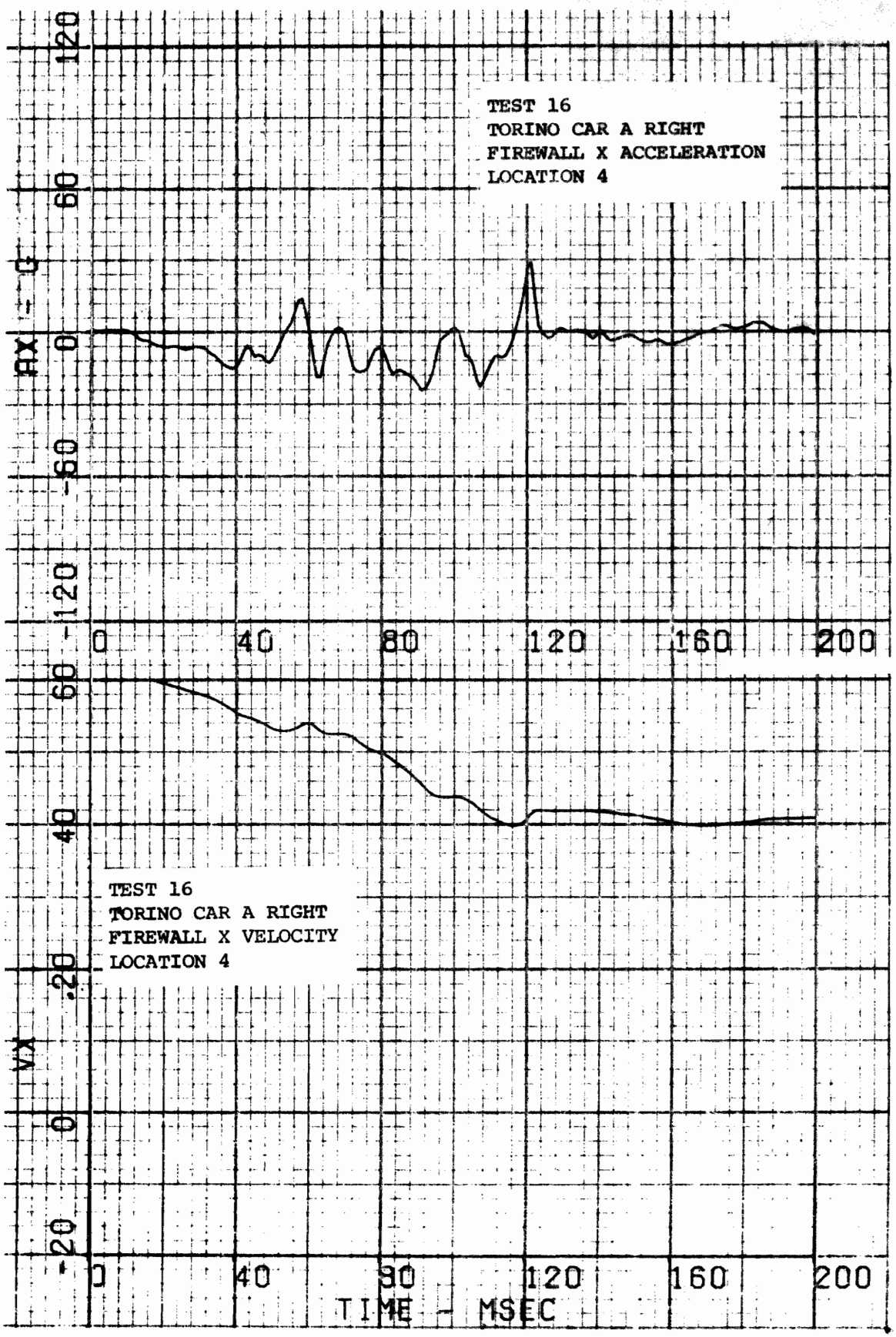

⊖= AX ⊿= AY
TEST 16
TORINO CAR A LEFT
B-PILLAR ACCELERATION
LOCATION 1
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

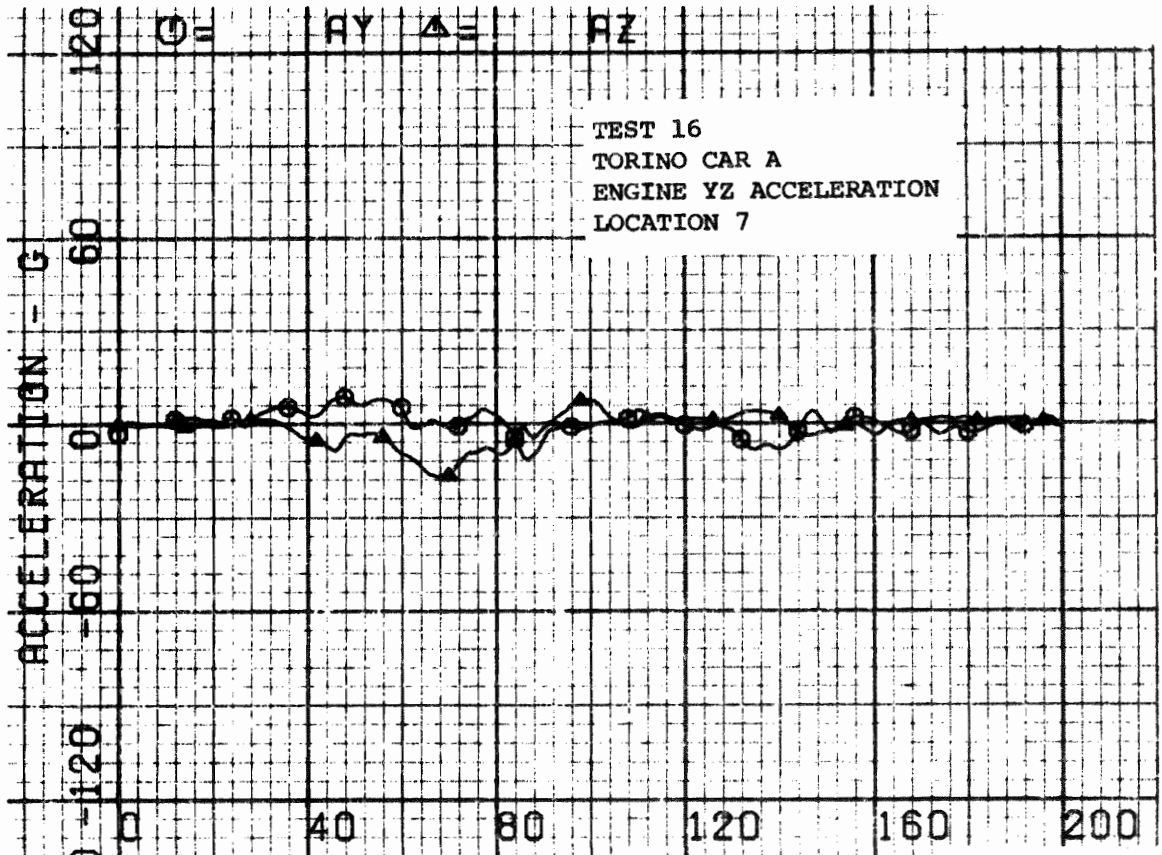

TEST 16
TORINO CAR A LEFT
B-PILLAR VELOCITY
LOCATION 1
VELOCITY - MPH
70
50
30
10
0
-10
0
40
80
120
160
200
TIME - MSEC

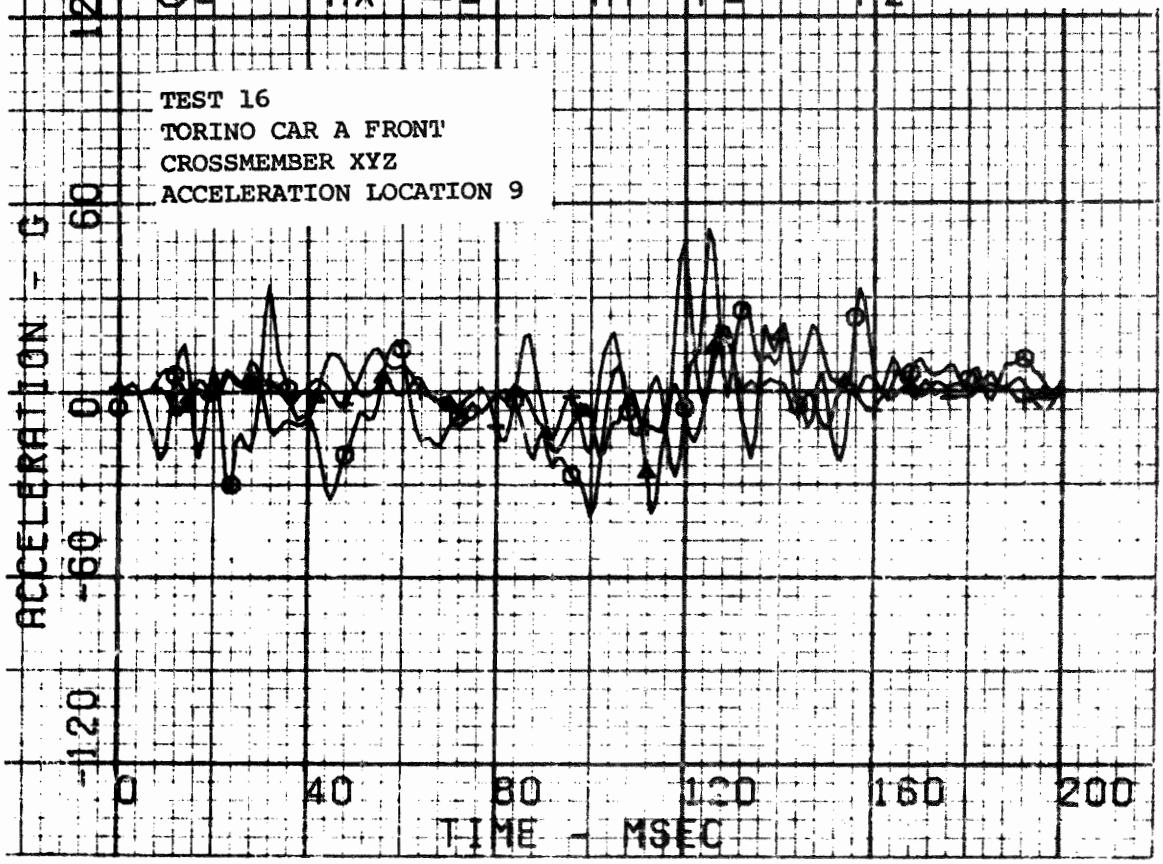

○= AX △= AY
TEST 16
TORINO CAR A RIGHT
B-PILLAR ACCELERATION
LOCATION 2
ACCELERATION - G
80
40
0
-40
-80
0
40
80
120
160
200

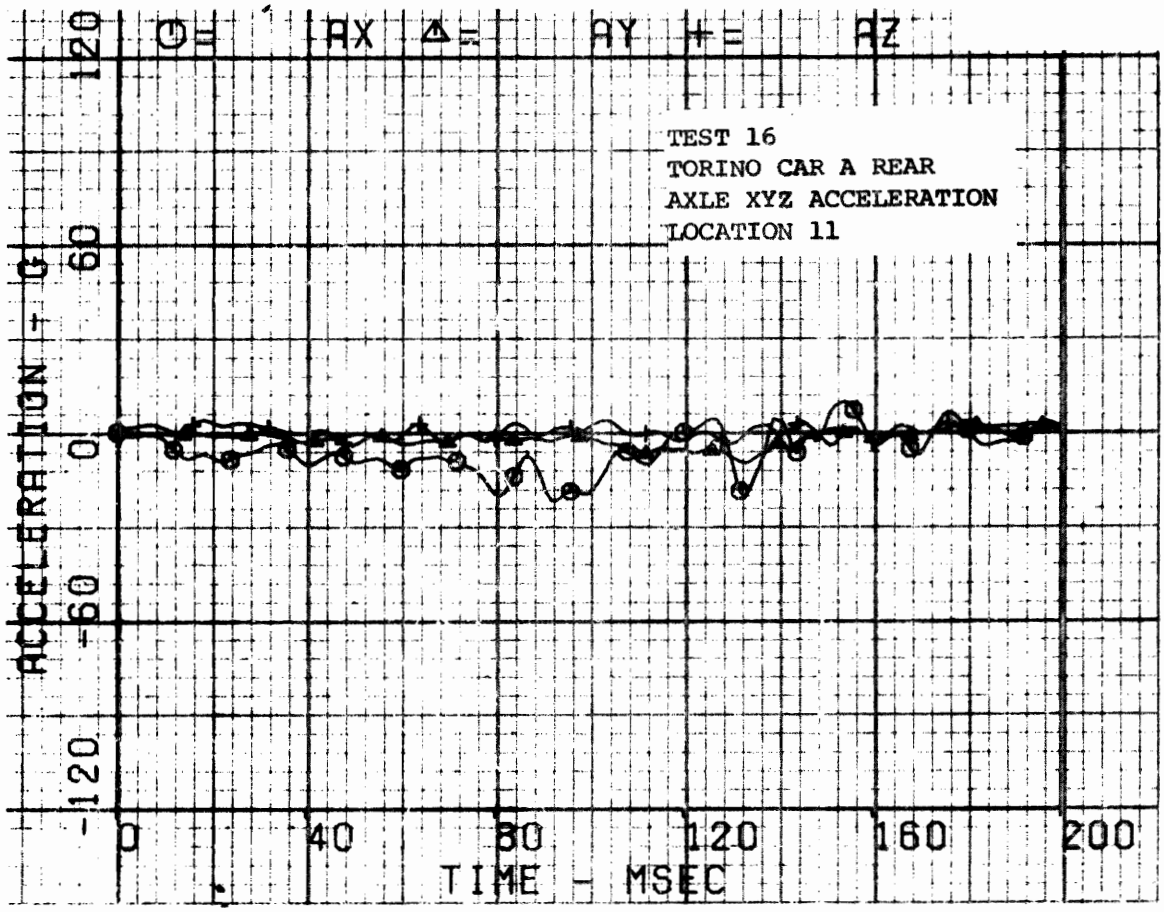

TEST 16
TORINO CAR A RIGHT
B-PILLAR VELOCITY
LOCATION 2
VELOCITY MPH
70
50
30
10
-10
0
40
80
120
160
200
TIME - MSEC


TEST 16
TORINO CAR A LEFT
FIREWALL X ACCELERATION
LOCATION 3
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 16
TORINO CAR A LEFT
FIREWALL X VELOCITY
LOCATION 3
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


TEST 16
TORINO CAR A RIGHT
FIREWALL X ACCELERATION
LOCATION 4
AX - G
120
60
0
-60
-120
0
40
80
120
160
200
TEST 16
TORINO CAR A RIGHT
FIREWALL X VELOCITY
LOCATION 4
VX
60
40
20
0
-20
0
40
80
120
160
200
TIME - MSEC


O= AY Δ= AZ
TEST 16
TORINO CAR A
ENGINE YZ ACCELERATION
LOCATION 7
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200


O= AX Δ= AY + = AZ
TEST 16
TORINO CAR A FRONT
CROSSMEMBER XYZ
ACCELERATION LOCATION 9
ACCELERATION - G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC


AX
AY
AZ
TEST 16
TORINO CAR A REAR
AXLE XYZ ACCELERATION
LOCATION 11
ACCELERATION + G
120
60
0
-60
-120
0
40
80
120
160
200
TIME - MSEC

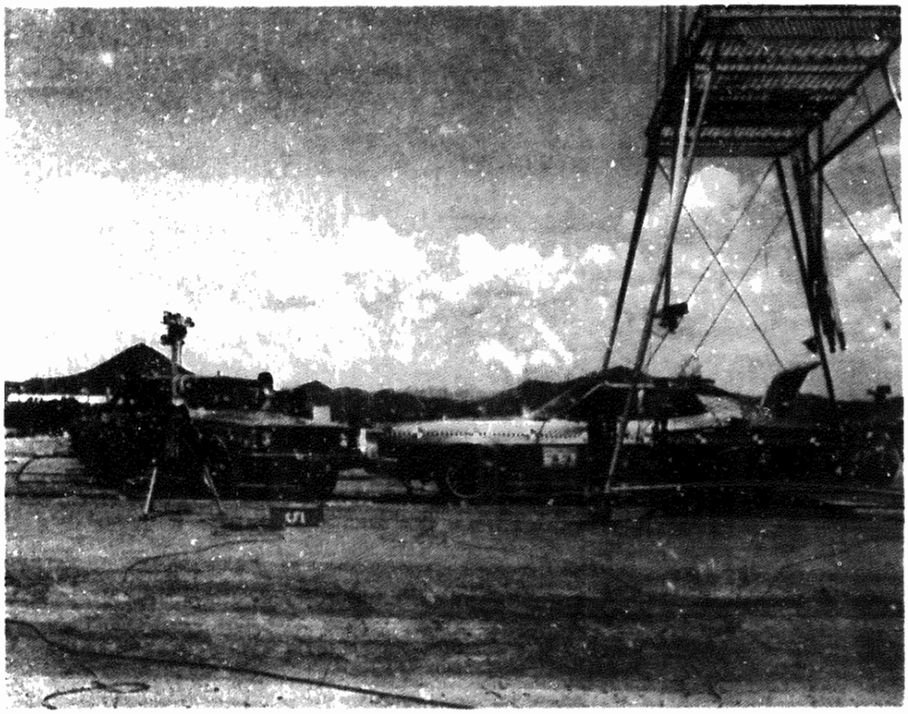


Figure 3-62. Pre-test Vehicle Configuration - Test 16.

Figure 3-63. Post-test Vehicle Configuration - Test 16.

Figure 3-64. Pre-test Unrestrained Driver - Test 16.

Figure 3-65. Post-test Unrestrained Driver - Test 16.

Figure 3-66. Pre-test Unrestrained Passenger - Test 16.

Figure 3-67. Post-test Unrestrained Passenger - Test 16.