

#2187

REPORT NO. MGA-95-N008

NEW CAR ASSESSMENT PROGRAM (NCAP)

FRONTAL BARRIER IMPACT TEST

Hyundai Motor Company
1995 Hyundai Sonata
4 Door
NHTSA NO. MS0501

MGA PROVING GROUNDS
5000 WARREN ROAD
BURLINGTON, WI 53105



Test Date: October 12, 1994

Report Date: December 23, 1994

FINAL REPORT

Prepared For:

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
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400 SEVENTH STREET, S.W.

Room No. 5313 (NRM-22)
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16. Abstract A 56 kph (35 mph) frontal barrier impact using a 30 load cell barrier was conducted on a 1995 Hyundai Sonata 4 Door at the MGA Proving Grounds and Crash Test Center in Burlington, WI. on October 12, 1994. The barrier impact velocity was 56.2 kph (35.0 mph), and the ambient temperature at the time of impact was 21°C. The post-test maximum static crush was 511 mm. The test vehicle appeared to comply with the requirements of the following Federal Motor Vehicle Safety Standards: 1. FMVSS 212, "Windshield Mounting" 2. FMVSS 219 (partial), "Windshield Zone Intrusion" 3. FMVSS 301, "Fuel System Integrity" With regard to FMVSS 208, "Occupant Crash Protection" injury criteria, the driver's HIC was 793 and the 3 msec. Clip (Chest g's) was 57 g's. The left and right femur loads for the driver were -3639 and -6749 Newtons, respectively. The passenger's HIC was 511 and the 3 msec Clip was 57 g's. The left and right femur maximum loads were -5015 and -2415 Newtons respectively.					
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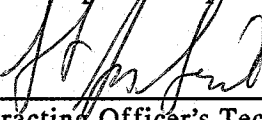
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APPROVED BY: 
John Fleck
MGA Research Corporation

FINAL REPORT ACCEPTED BY:


Manager, New Car Assess. Program (NCAP)

JAN 4 1995
Date of Report Acceptance

 FOR BOB CHAM
Contracting Officer's Tech. Rep. (COTR)

JAN 4 1995
Date of Report Acceptance

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SECTION 1

PURPOSE AND TEST PROCEDURE

This 35 mph frontal barrier impact test is part of the Composite FY'95 Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-90-D-12121. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for an impact speed in excess of the current 48 kph (30 mph) FMVSS 208/212/219/301-75 requirements.

The 56 kph (35 mph) frontal barrier impact test was conducted in accordance with the National Highway Traffic Safety Administration (NHTSA) Indicant Test Procedure for New Car Assessment Program (NCAP) dated January 1, 1990. Data for FMVSS No. 212, "Windshield Mounting", FMVSS No. 219 (Partial), "Windshield Zone Intrusion", FMVSS No. 301-75, "Fuel System Integrity," as well as occupant performance data are provided herein.

SECTION 2

SUMMARY OF FRONTAL BARRIER IMPACT TEST

A load cell barrier consisting of 30 load cells was impacted by a 1995 Hyundai Sonata 4-Door at a velocity of 56.2 kph (34.9 mph). The test was performed at the MGA Proving Grounds and Crash Test Center on October 12, 1994. Pre- and post-test photographs of the vehicle and dummies can be found in Appendix A.

The frontal barrier impact event was documented by one real-time camera and 16 high speed cameras. Camera locations and other pertinent camera information can be found in this report.

Two Part 572E, 50th percentile male anthropomorphic test devices (ATDs) were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

Both ATDs were fully instrumented with head and chest triaxial accelerometers, neck load cell, and right/left femur load cells. The driver was also instrumented with right and left lower leg sensors. Seat belt load cells were also on the driver's and passenger's shoulder and lap belts to measure dummy torso and pelvic section loading. Certification details, along with instrumentation calibration data, are found in Appendix C and D.

The 61 channels of data were recorded on 6 computers. Appendix B contains the vehicle, load cell barrier and dummy response data traces.

The driver's head struck the inflated airbag. The driver HIC was 793. The maximum chest deceleration over 3 milliseconds was 57 g's. The left and right femur loads were -3639 and -6749 Newtons respectively.

The right front passenger's head struck the inflated airbag. The passenger's HIC was 511 and maximum chest deceleration over 3 milliseconds was 57 g's. The left and right femur loads were -5015 and -2415 Newtons respectively.

GENERAL TEST AND VEHICLE PARAMETER DATA

Vehicle Yr/Make/Model/Body Style: 1995/Hyundai/Sonata/4 Door Sedan

NHTSA No.: MS0501 VIN.: KMHCF21F0SU193915

Body color: Blue Date of Manufacture: 6/94

Engine: 4 Cylinders; C.I.D.; 1.9 Liters;

X Gas; Diesel; Turbocharged

 Longitudinal; X Transverse

Transmission: Speed; Manual; X Automatic; X Overdrive

Final Drive: X Front Wheel; Rear Wheel; Four Wheel

Odometer Reading: 140.7 miles

X A/C; X P/S; X P/B; P/wdo;

 P/seats; Tilt Wheel; Cruise Control;

Type of Occupant Restraint: Type II belt with driver & passenger airbags

DATA RECORDED FROM VEHICLE'S TIRE PLACARD:

Tire Pressure (at capacity): Front 210 kpa (30 Psi) Rear 210 kpa (30 Psi)

Recommended Tire Size: P195/70R14

Recommended Cold Tire Pressure: Front 210 kpa (30 Psi) Rear 210 kpa (30 Psi)

Tires on Vehicle: P195/70R14 ; Manufacturer: Michelin

Number of Occupants: 2 Front; 3 Rear; 3rd Seat; 5 TOTAL

Type of Front Seats: X Bucket; Bench; Split Bench

Type of Front Seat Back: Fixed; X Adj. With; Power; X Lever

Vehicle Capacity Weight (VCW) = 390.1 kg. (A)

No. of Occupants x 68.0 kg. = 340.2 kg. (B)

Rated Cargo Weight (RCW) A-B = 49.9 kg.

GVWR 1755 kg. GAWR: Front 995 kg.; Rear 870 kg.

GENERAL TEST AND VEHICLE PARAMETER DATA (Cont'd)

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (WITH MAXIMUM FLUIDS) = UDW:

Right Front = 384.7 kg

Right Rear = 231.3 kg

Left Front = 393.7 kg

Left Rear = 242.7 kg

TOTAL FRONT WEIGHT = 778.4 kg (62 % of Total Vehicle Weight)

TOTAL REAR WEIGHT = 474.0 kg (38 % of Total Vehicle Weight)

TOTAL UNLOADED DELIVERED WEIGHT (UDW) = 1252.4 kg

CALCULATION FOR TARGET TEST WEIGHT:

UDW = Unloaded Delivered Weight 1252.4 kg

VCW = Vehicle Capacity Weight 390.1 kg DSC = Designated Seating Capacity 5

RCW = VCW - 68 (DSC) = 49.9 *kg

Target Test Weight = UDW + RCW + (2 dummies x 75.8 kg/dummy)

Target Test Weight = 1453.8 kg

WEIGHT OF TEST VEHICLE WITH REQUIRED DUMMIES AND CARGO:

Right Front = 415.9 kg

Right Rear = 298.9 kg

Left Front = 429.6 kg

Left Rear = 304.4 kg

TOTAL FRONT WEIGHT = 845.5 kg (58 % of Total Vehicle Weight)

TOTAL REAR WEIGHT = 603.3 kg (42 % of Total Vehicle Weight)

TOTAL TEST WEIGHT = 1448.8 kg

Weight of ballast secured in vehicle trunk area = 0 kg

Vehicle components removed to meet target weight: Muffler, rear seat, seat cushion,
& back, spare tire, jack, tool kit, all interior trim rear of front seats.

VEHICLE ATTITUDE (all dimensions in mm):

Delivered Attitude: RF 722 LF 722 RR 709 LR 704

Test Attitude: RF 695 LF 694 RR 665 LR 659

Wheel Base: 2702 mm; C.G. = 1125 mm rearward of front wheel C/L

Remarks: None

*light trucks and MPVs RCW is 136 kgs or manufacturer's value, whichever is less

GENERAL TEST AND VEHICLE PARAMETER DATA (Cont'd)

POST-IMPACT DATA:

Type of Test: 35 mph Frontal Impact Impact Angle: 90°
Date of Test: October 12, 1994 Time of Test: 5:20 p.m.
Ambient Temperature: 21 °C (Spec. Range = 18.8 to 25.6°C)
Temperature in Occupant Compartment: 21° C
Windshield Molding Temperature: 20° C
Required Impact Velocity Range: 55.5 to 57.1 kph
Impact Velocity: primary = 56.2 kph; secondary = 56.3 kph
Distance From Front Bumper to Barrier Face When
Entering Speed Trap: 1200 mm
Exiting Speed Trap: 200 mm

VEHICLE REBOUND AND CRUSH (mm):

Vehicle Length: Pre-test = R 4504 C_L 4663 L 4515
Post-test = R 3987 C_L 4152 L 3997
Crush = R 517 C_L 511 L 518

Distance from front of test vehicle to point of impact (rebound):

R 672 mm C_L 619 mm L 653 mm

VISIBLE DUMMY CONTACT POINTS:

	<u>Driver</u>	<u>Passenger</u>
Head	<u>To airbag</u>	<u>To airbag</u>
Chest	<u>To airbag</u>	<u>To airbag</u>
Abdomen	<u>No visible contact</u>	<u>No visible contact</u>
Left Knee	<u>To lower dash panel</u>	<u>To lower dash panel</u>
Right Knee	<u>To lower dash panel</u>	<u>To lower dash panel</u>

GENERAL TEST AND VEHICLE PARAMETER DATA (cont'd)

<u>Door Opening</u>	<u>Front</u>		<u>Rear</u>	
	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
(without use of tools)	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>	<u>Yes</u>

<u>Seat Movement</u>	<u>Front</u>		<u>Rear</u>	
	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Seat Back Movement	<u>0</u>	<u>0</u>	<u>N/A</u>	<u>N/A</u>
Seat Shift (mm)	<u>2 mm forward</u>	<u>0</u>	<u>N/A</u>	<u>N/A</u>

Glazing Damage

Backlight/Windshield Cracked windshield

Other Notable Impact Effects: None

SECTION 3

SUMMARY OF RESULTS FOR-----

FMVSS 212, "Windshield Mounting"

FMVSS 219 (Partial), "Windshield Zone Intrusion"

FMVSS 301-75, "Fuel System Integrity"

FMVSS NO. 212, "WINDSHIELD MOUNTING", DATA SHEET

Details of windshield mounting such as retention method, trim type, etc.:

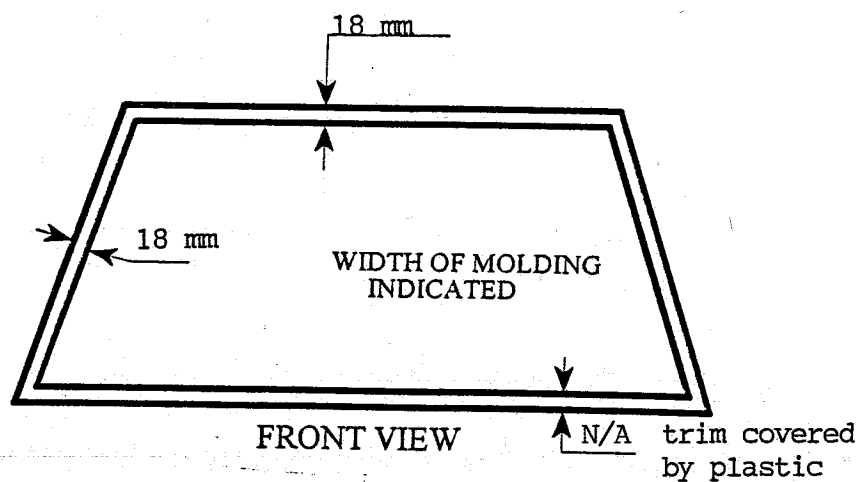
Windshield set in rubber molding within windshield frame

FMVSS 212 Requirements: The Post-Test periphery retention amount must be at least 75% of the Pre-Test periphery measurement for vehicles NOT equipped with automatic restraints, and 50% for each side of windshield for vehicles equipped with automatic restraint systems for front occupants.

FMVSS 212 TEST DATA:

	WINDSHIELD PERIPHERY		
	PRE-TEST (mm)	POST-TEST (mm)	PERCENT RETENTION
RIGHT SIDE	1586	1586	100%
LEFT SIDE	1586	1586	100%
TOTAL	3172	3172	100%

AREA OF RETENTION FAILURE: None



FAILURE DETAILS: None

FMVSS NO. 219, "WINDSHIELD ZONE INTRUSION", DATA SHEET

PROTECTED ZONE LOWER EDGE REQUIREMENT:

The lower edge of the protected zone is determined by placing a 6.5" dia. rigid sphere weighing 15 pounds in a position such that it simultaneously contacts the inner surface of the windshield and the top surface of the instrument panel including padding. Draw the locus of points on the inner surface of the windshield contacted by the sphere across the width of the instrument panel. From the outermost contact points, extend the locus line horizontally to the edges of the windshield, and then draw a line on the inner surface of the windshield below and 1/2" distant from the locus line. The LOWER EDGE OF THE PROTECTED ZONE is the longitudinal projection onto the outer surface of the windshield of this line.

FMVSS 219 TEST DATA:

A= 1167 mm

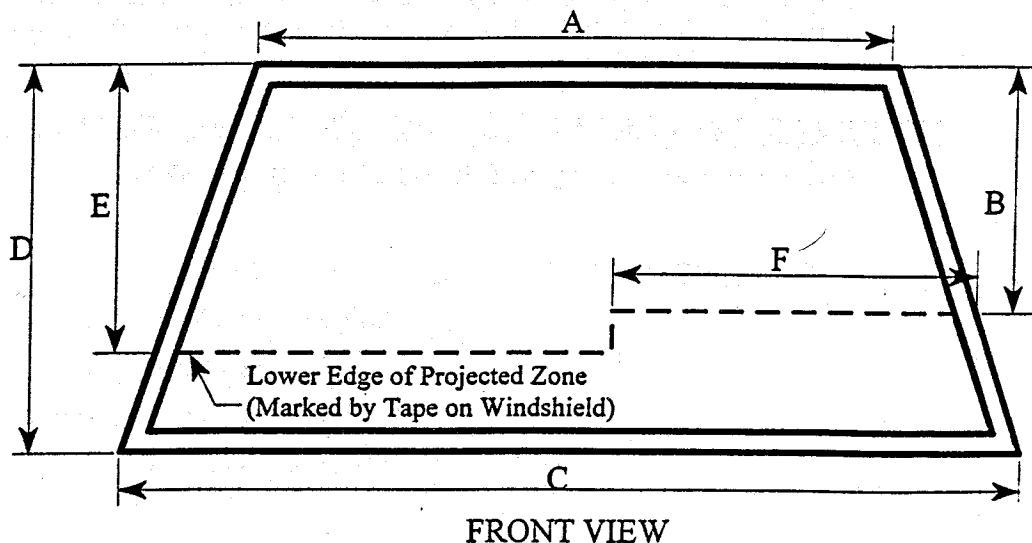
B= 462 mm

C= 1594 mm

D= 703 mm

E= 465 mm

F= 756 mm



DETAILS OF WINDSHIELD GLASS PENETRATION GREATER THAN 1/4":
(Show location of penetration)

NONE

FMVSS NO. 301-75, FUEL SYSTEM INTEGRITY POST IMPACT TEST DATA

FMVSS NO. 301

TEST VEHICLE NHTSA NO.: MS0501 Test Date: October 12, 1994

Vehicle Mfgr./Make/Model: 1995/Hyundai/Sonata/4 Door Sedan

Usable Capacity of Vehicle's Fuel Tank: 64.9 Liters
(figure furnished by vehicle manufacturer)

TEST REQUIREMENTS:

Test vehicle's engine operated to "run dry" condition, and then a small amount of stoddard solvent which has been dyed red shall be added to the vehicle's fuel tank. Operate the fuel pump enough to completely fill the fuel system ahead of the fuel tank, and add 92 to 94% of the stated **USABLE CAPACITY** to the fuel tank.

AMOUNT OF STODDARD SOLVENT ADDED TO VEHICLE'S FUEL TANK:

60.6 Liters which is 93 % of the stated USABLE CAPACITY.

TEST VEHICLE IMPACT TYPE:

X Frontal (35 mph)

___ Oblique (30 mph) with ___° barrier face first
contacting (driver/passenger) side

Rear Moving Barrier (30 mph)

Side Impact MDB (33.2 mph)

FUEL SPILLAGE MEASUREMENT:

1. From impact until vehicle motion ceases
2. For 5 minute period after vehicle motion ceases
3. For next 25 minutes

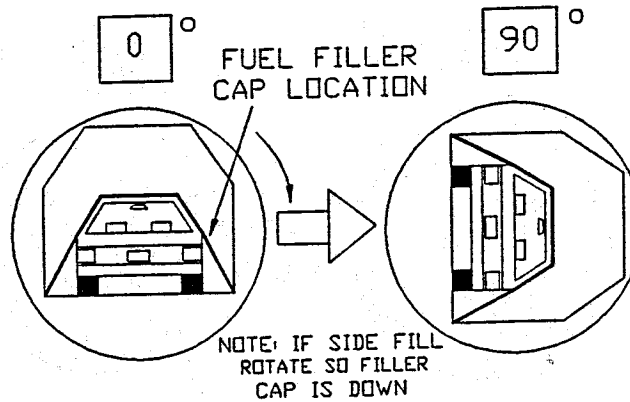
ACTUAL	MAX ALLOWED
Ø	1 OZ
Ø	5 OZ
Ø	1 oz./1 MIN

SOLVENT SPILLAGE DETAILS: None

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 0° - 90°

Vehicle NHTSA ID No.: MS0501



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 2 minutes 37 seconds
(Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + 5 minutes 0 seconds
TOTAL 7 minutes 37 seconds
Next whole minute interval 8 minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	-------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
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III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0	0	0	0
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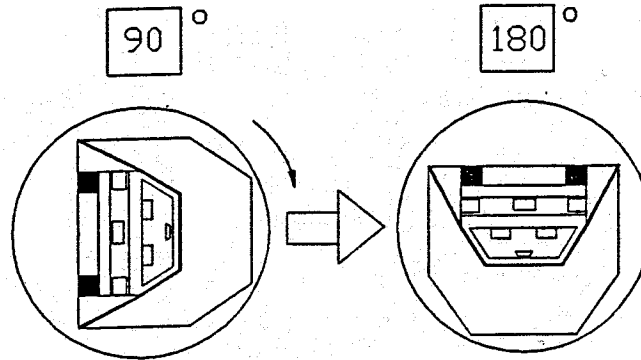
Note: Record Spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATIONS(S): None

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 90° - 180°

Vehicle NHTSA ID No.: MS0501



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 2 minutes 32 seconds
(Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + 5 minutes 0 seconds
TOTAL 7 minutes 32 seconds
 Next whole minute interval 8 minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	-------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
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III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0	0	0	0
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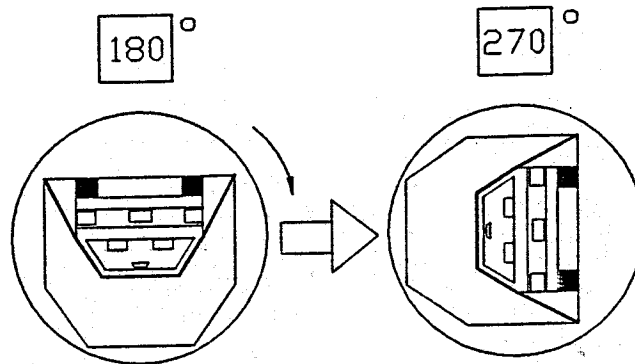
Note: Record Spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATIONS(S): None

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 180° - 270°

Vehicle NHTSA ID No.: MS0501



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 2 minutes 22 seconds
(Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + 5 minutes 0 seconds
TOTAL 7 minutes 22 seconds
Next whole minute interval 8 minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	-------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0	0	0	0
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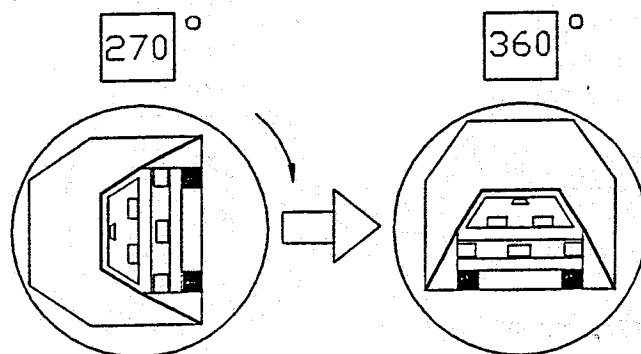
Note: Record Spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATIONS(S): None

FMVSS NO. 301 STATIC ROLLOVER DATA SHEET

TEST PHASE: 270° - 360°

Vehicle NHTSA ID No.: MS0501



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Fixture 90° Rotation Time 2 minutes 17 seconds
(Spec. Range = 1 to 3 minutes)

FMVSS 301 Position Hold Time + 5 minutes 0 seconds
TOTAL 7 minutes 17 seconds
 Next whole minute interval 8 minutes

II. FMVSS 301 REQUIREMENTS:

(1) Time Period

First 5 min FROM onset of rotation	6th min.	7th min.	8th min. if reqd.
------------------------------------	----------	----------	-------------------

(2) Maximum Allowable Solvent Spillage

5 ounces	1 ounce	1 ounce	1 ounce
----------	---------	---------	---------

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

0	0	0	0
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Note: Record Spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATIONS(S): None

SECTION 4
OMI FINAL DATA

Occupant and Vehicle Information

I. OMI DATA

1. **Dummy Injury Criteria Data Summary**
2. **Dummy Positioning Data**
3. **Seat Belt Positioning Data**
4. **Seat Belt Performance Assessment Data**
5. **Camera Locations**
6. **Vehicle Target Locations**

II. OVR DATA

1. **Load Cell Barrier Data**
2. **Vehicle Accelerometer Data**
3. **Test Vehicle Measurements**

III. AID DATA

1. **Accident Investigation Damage Data Summary**

FMVSS NO. 208, "OCCUPANT CRASH PROTECTION", DATA SHEET

VEH. YR./MAKE/MODEL/BODY STYLE: 1995/Hyundai/Sonata/4 Door Sedan

VEH. NHTSA NO.: MS0501 TEST DATE: October 12, 1994

MAX. ACCELERATION VALUES: (g's)	DRIVER # <u>37</u>	PASSENGER # <u>36</u>
Head Channel X	-70.0	-51.4
Head Channel Y	-17.5	-27.6
Head Channel Z	37.9	25.7
HEAD RESULTANT	79.8	59.0
Chest Channel X	-57.5	-59.8
Chest Channel Y	7.5	-6.4
Chest Channel Z	-9.8	12.8
CHEST RESULTANT (CLIP)	57.4	57.3
TIME INTERVAL (msec) [0.003 seconds minimum]	$t_1 = 71.1$ $t_2 = 74.1$	$t_1 = 64.8$ $t_2 = 67.8$

HEAD INJURY CRITERIA (HIC) VALUES:

HIC	792.8	510.5
t_1 = (msec)	63.8	56.0
t_2 = (msec)	94.4	92.0
Avg. Accel. t_1 to t_2 (g's)	58.3	45.8

[The maximum time interval from t_1 to t_2 is 36 milliseconds.]

MAX. COMPRESSIVE FEMUR FORCES:

Left Side (N)	-3639	-5015
Right Side (N)	-6749	-2415

MAXIMUM SEAT BELT FORCES:

Lap Belt (N)	6836	7538
Shoulder Belt (N)	6031	5815

NOTE: All values listed must occur during primary impact event.
(Head X,Y,Z and R listed must be during t_1 to t_2 HIC interval)

HYBRID III NECK AND CHEST DATA SHEET

VEHICLE YR./MAKE/MODEL/BODY STYLE: 1995/Hyundai/Sonata/4 Door Sedan

VEHICLE NHTSA NO.: MS0501 TEST DATE: October 12, 1994

MAXIMUM VALUES	DRIVER DUMMY #37	PASSENGER DUMMY #36
Neck Load X (N)	-692	-935.0
Neck Load Y (N)	-214	-267.0
Neck Load Z (N)	-2405	-1878.0
Neck Moment X (N.M)	-12.5	26.9
Neck Moment Y (N.M)	-54.1	-82.9
Neck Moment Z (N.M)	-17.0	-30.8
Chest Deflection X (mm)	-16	-15
Time of Max. Occurrence	82 msec.	73 msec.

PART 572 DUMMY IN-VEHICLE POSITION

Vehicle NHTSA No.: MS0501 Vehicle: 1995 Hyundai Sonata 4 Door

SEAT TYPE:

 Bench
 X Bucket
 Split Bench

ADJUSTER TYPE:

Driver: X Manual
 Power

 Passenger: X Manual
 Power

BUCKET SEAT BACK TYPE:

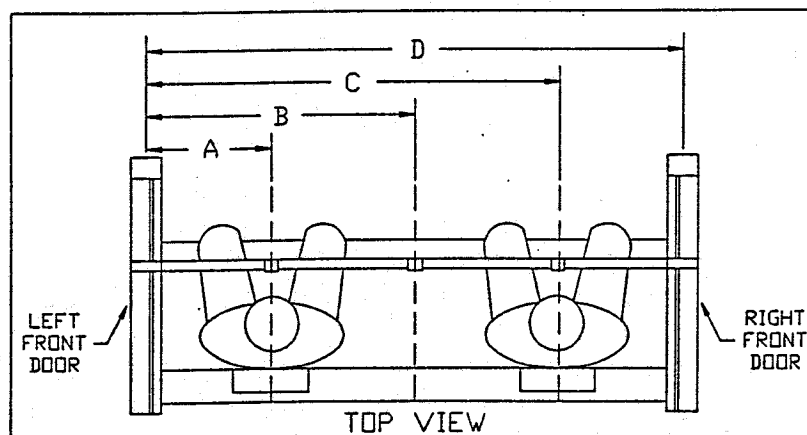
 Fixed
 X Adjustable Reclining

Driver

Adjusted to the 9th position from front

Passenger

Adjusted to 9th position from front



37 DUMMY ID 36

A = Left Door to Driver Centerline	<u>143</u> mm
B = Left Door to Center Passenger Centerline	<u>790</u> mm
C = Left Door to Right Passenger Centerline	<u>1162</u> mm
D = Left Door to Right Door	<u>1580</u> mm

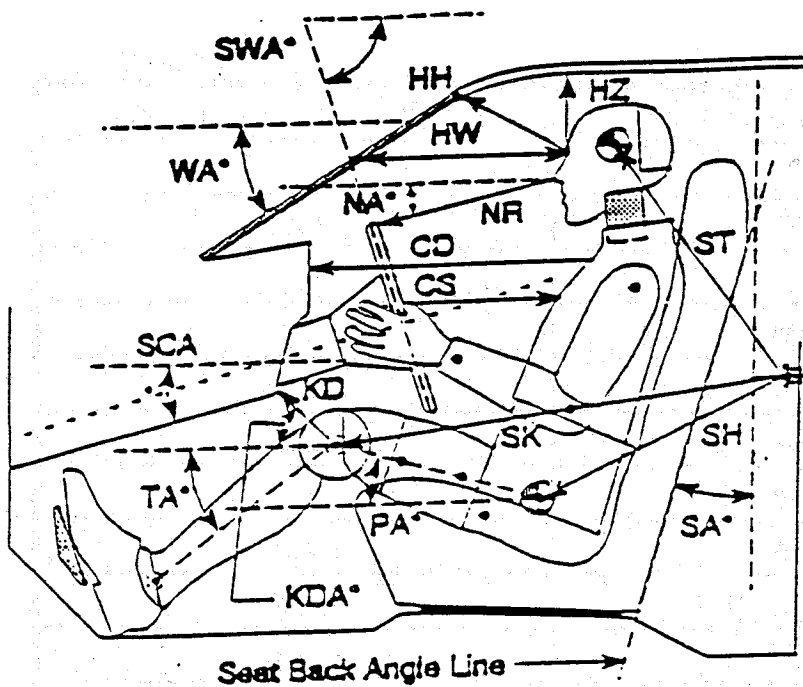
FRONT SEAT MEASUREMENT TABLE

Units (mm)

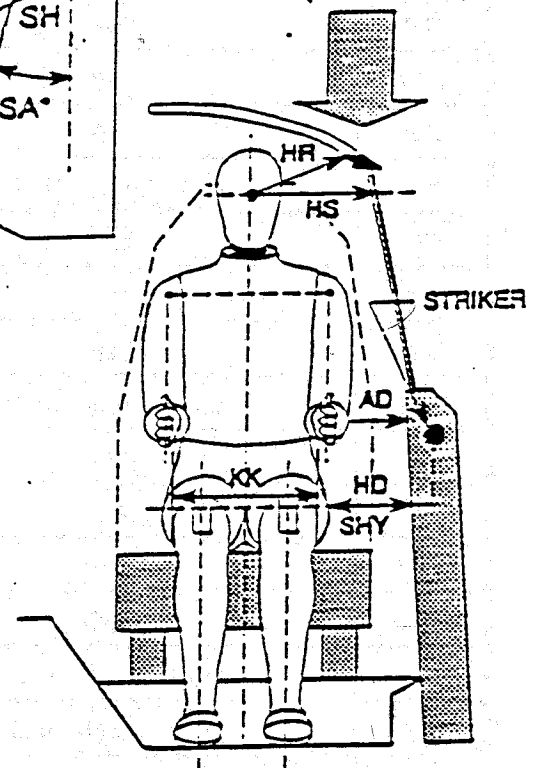
	DRIVER (Serial #37)	PASSENGER (Serial #36)
WA°	28.6°	
SWA°	67°	N/A
SCA°	23°	N/A
SA°	26°	26°
HZ	170	170
HH	334	325
HW	540	541
HR	220	230
NR	458 Angle 14.7°	N/A
CD	566	694
CS	361	N/A
RA	228	N/A
KDL	185 Angle 20.4°	200
KDR	184	175 Angle 23.7°
PA°	24.4°	24.3°
TA°	42.5°	40.0°
KK	320	248
ST	519 Angle 6.6°	496 Angle 123°
SK	602 Angle 90°	631 Angle 1.2°
SH	258 Angle 121.1°	291 Angle 31.7°
SHY	248	245
HS	288	268
HD	170	168
AD	140	140

N/A = Not Applicable

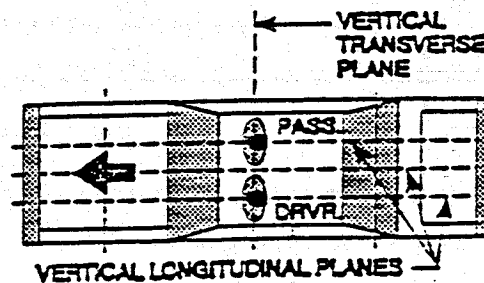
FRONT SEAT MEASUREMENTS



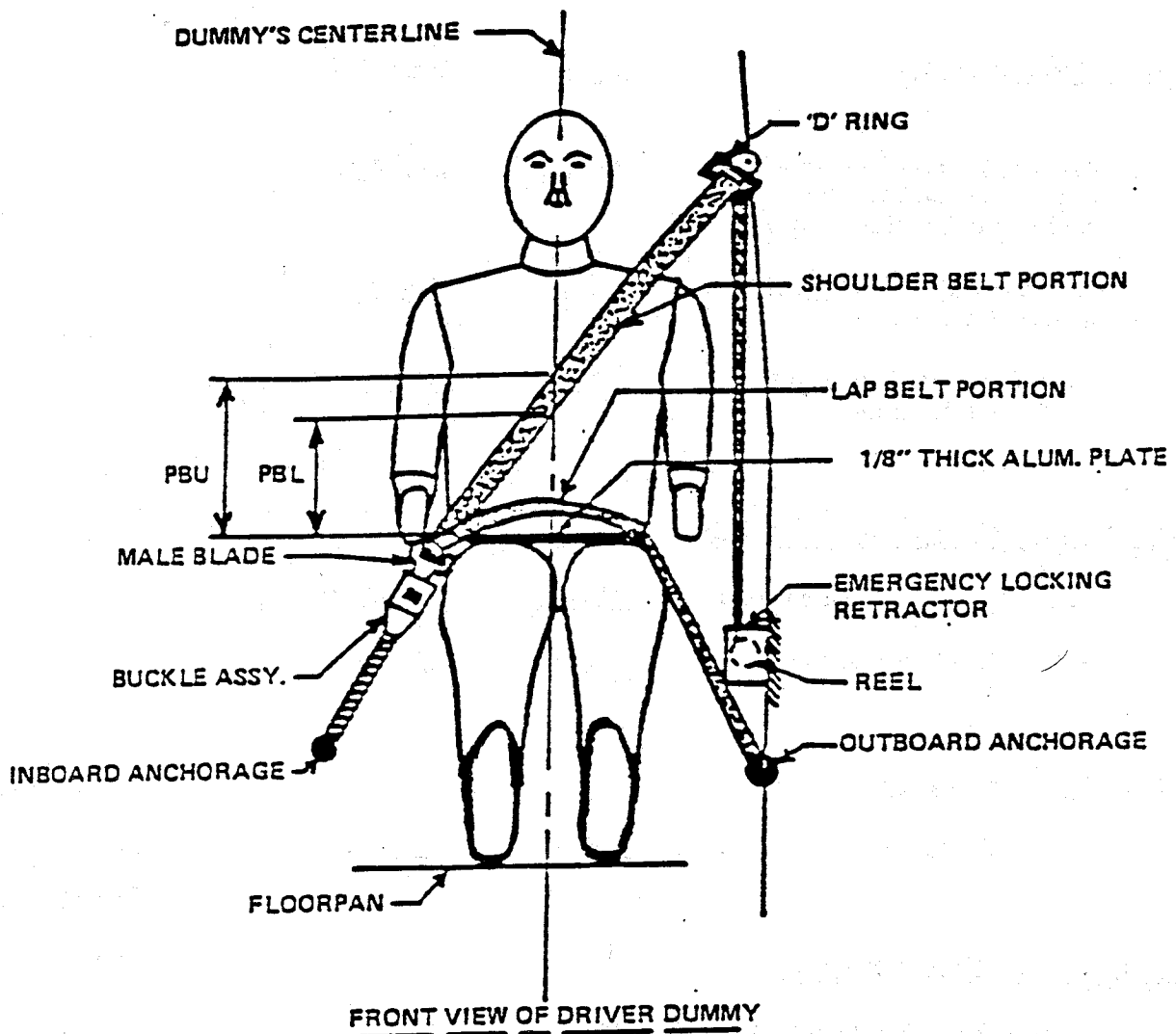
- AD - Arm to Door
- HD - H-Point to Door
- HR - Head to Side Header
- HS - Head to Side Window
- KK - Knee to Knee
- SHY- Striker to H-Point (Y Direction)



- CD - Chest to Dash
- CS - Steering Wheel to Chest
- HH - Head to Header
- HW - Head to Windshield
- HZ - Head to Roof
- KDA - Knee to Dash Angle
- KDL - Left Knee to Dash
- KDR - Right Knee to Dash
- NA - Nose to Rim Angle
- NR - Nose to Rim
- PA - Pelvic Angle
- RA - Rim to Abdomen
- SA - Seat Back Angle
- SCA - Steering Column Angle
- SH - Striker to H-Point
- SK - Striker to Knee
- ST - Striker to Head
- SWA - Steering Wheel Angle
- TA - Tibial Angle
- WA - Windshield Angle



SEAT BELT POSITIONING DATA



(illustration)

		Dimension = mm	
		DRIVER DUMMY	PASSENGER DUMMY
<u>PBU</u> --	Top surface of alum. plate to upper edge	357	349
<u>PBL</u> --	Top surface of alum. plate to belt lower edge	272	265

Note: Adjustable "D" ring set in the fourth position for the highest.

SEAT BELT PERFORMANCE ASSESSMENT TEST DATA

BELT LENGTH DATA:

	<u>Driver</u>	<u>Passenger</u>
Belt length from trim panel exit to bolt hole anchor point for continuous webbing systems.	<u>235 mm</u>	<u>240 mm</u>
Shoulder belt length as measured on Part 572 Dummy.	<u>831 mm</u>	<u>840 mm</u>
Lap belt length as measured on Part 572 Dummy.	<u>789 mm</u>	<u>760 mm</u>

SHOULDER BELT SPOOL-OFF DATA:

As determined by film analysis	<u>126 mm</u>	<u>114 mm</u>
As determined mechanically	<u>131 mm</u>	<u>126 mm</u>

BELT STRETCH DATA:

Measured mechanically	<u>0</u>	<u>0</u>
-----------------------	----------	----------

RETRACTOR LOCK-UP TIME:

As determined by shoulder belt spool-off observed in on-board cameras	<u>30 msec</u>	<u>25 msec</u>
---	----------------	----------------

CAMERA LOCATIONS

VEH. NHTSA NO.: MS0501 ; TEST DATE: October 12, 1994; TIME: 5:20 p.m.

VEH. YEAR/MAKE/MODEL/BODY STYLE: 1995/Hyundai/Sonata/4 Door Sedan

CAMERA POSITION NO.	VIEW	CAMERA POSITIONS (mm.)*			ANGLE (deg)	FILM PLANE TO HEAD TARGET (mm)	LENS (mm)	SPEED (fps)
		X	Y	Z				
1	Real-Time Left Side View	-	-	-	-	-	10	24
2	Left Front View	570	7990	1120	90°	7543	25	962
3	Steering Column Top	2040	7160	1560	90°	6713	25	1005
4	Steering Column Bottom	2020	7170	1005	90°	6723	25	1000
5	Left Driver Close-up	1510	5960	1040	90°	5513	35	962
6	Left Angle	5520	4670	2050	50°		50	1053
7	Driver Onboard						35	697
8	Passenger Onboard						35	563
9	Right Overall	2170	-7380	1065	90°	6933	13	1136
10	Right Front	880	-7590	1165	90°	7143	25	1000
11	Right Passenger Close-up	1410	-7080	1090	90°	6633	50	985
12	Right Angle	4090	-5220	2070	50°		35	952
13	Top View Wide	330	0	4350			13	1258
14	Top Driver	-310	350	2400			13	1093
15	Top Passenger	-350	-390	2400			13	1000
16	Pit Engine	1180	0	-3175			13	1010
17	Fuel Tank	2650	0	-3185			13	1020

*** COORDINATES:**

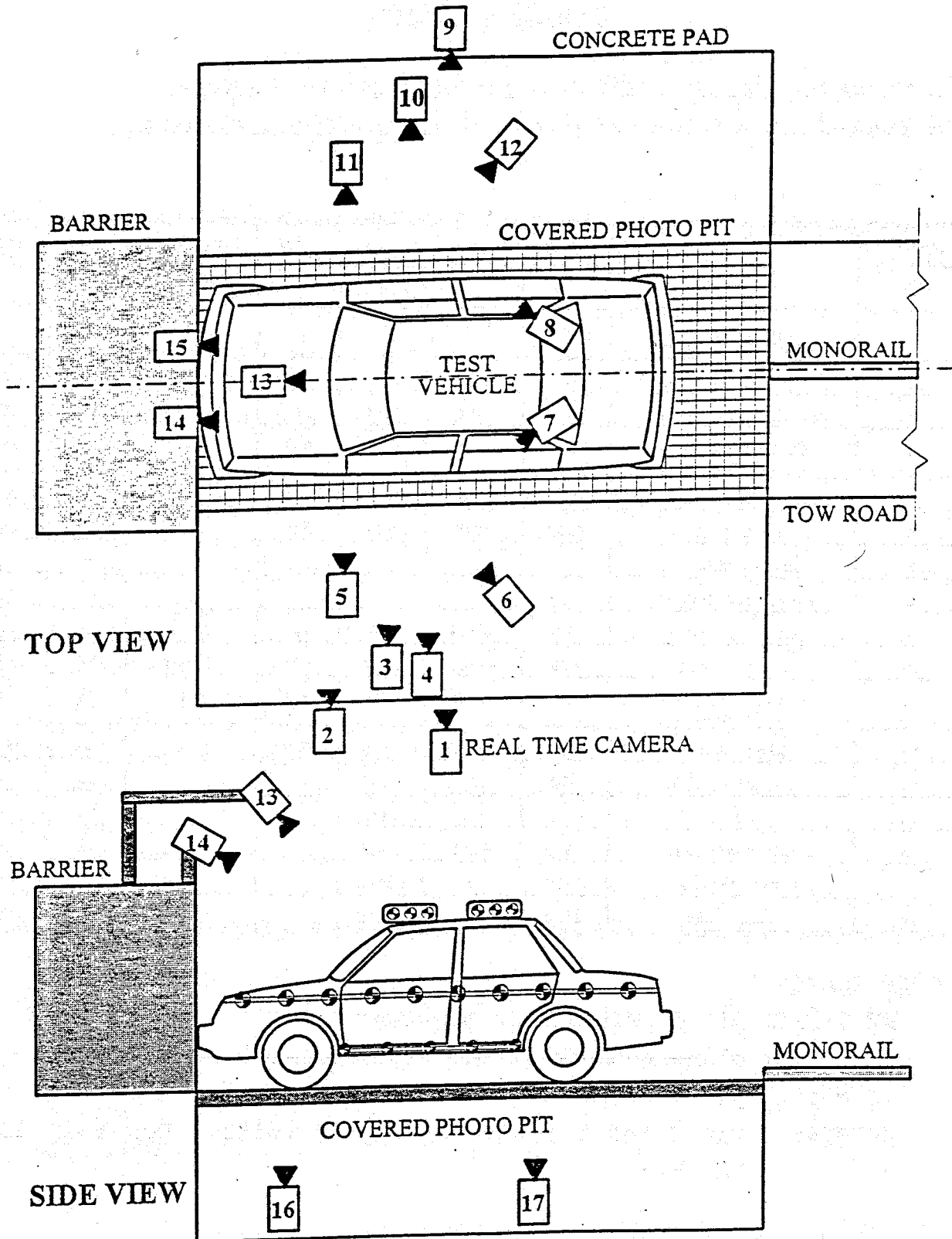
+X = film plane rearward of barrier

+Y = film plane to left of monorail centerline

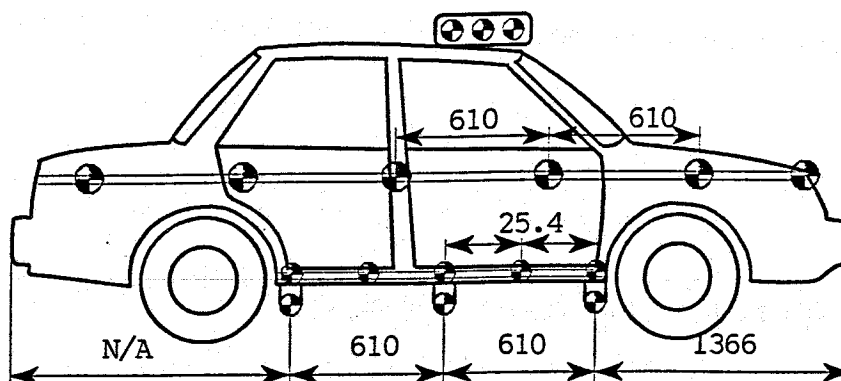
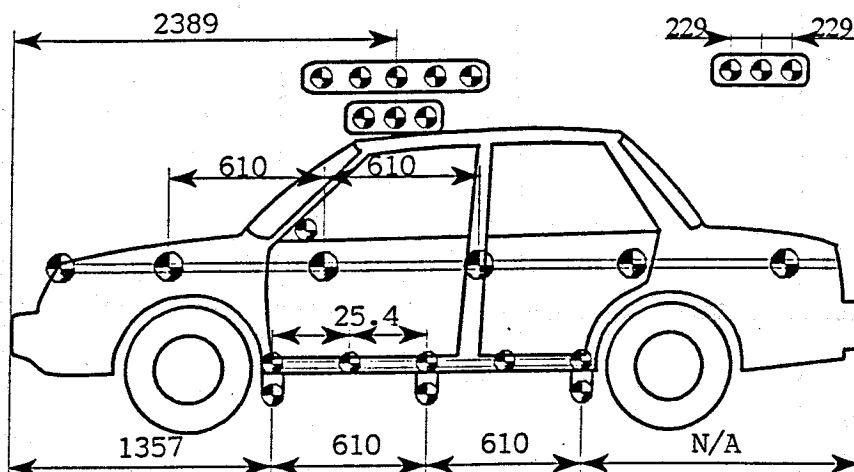
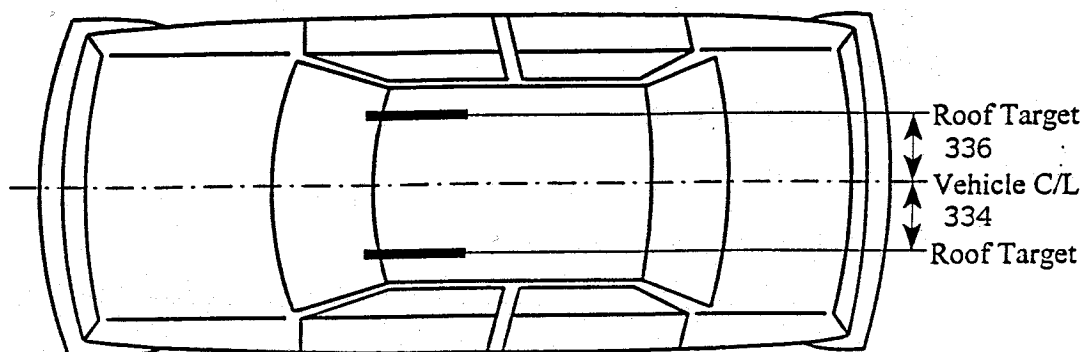
+Z = film plane to above ground level

ORIGIN: For X and Y it is the Impact Point. For Z it is
the Floor.

CAMERA LOCATIONS (Cont'd)



VEHICLE TARGET LOCATIONS



(DIMENSIONS IN MM)

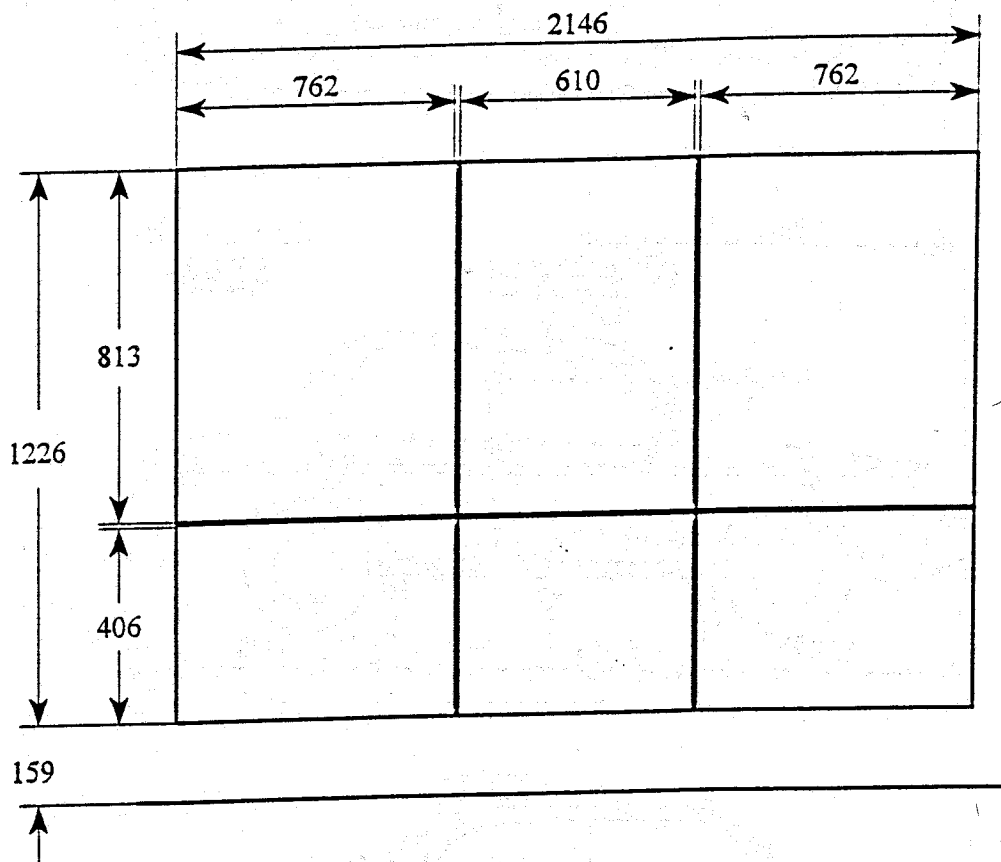
LOAD CELL LOCATIONS ON FIXED BARRIER

30 Load Cells

6 Rows

9 Columns

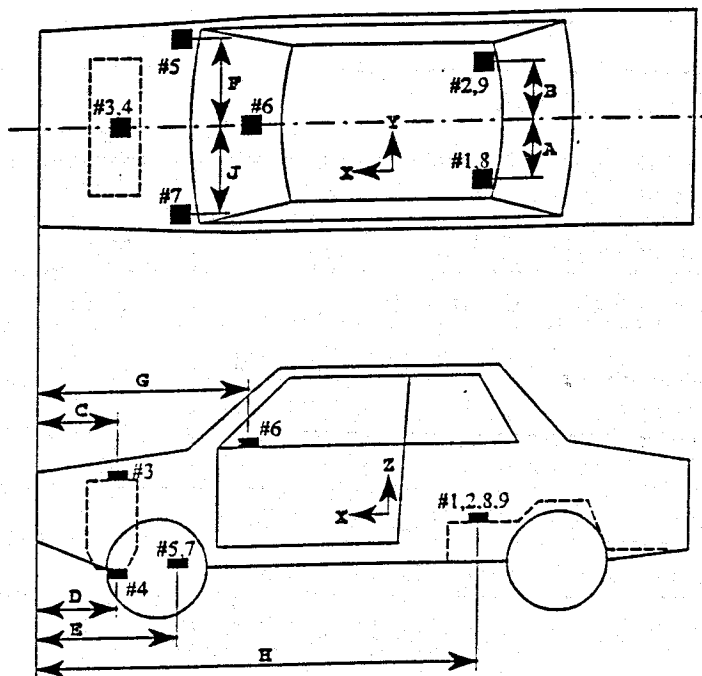
6 Groupings (5 cells/group)



The following data is presented in Appendix B:

- (1) Total or Sum of 30 individual load cells
- (2) Data from 6 Groupings shown above (5 cells/group)

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY



Units: (mm)

Dimension	Length
A	405
B	405
C	759
D	850
E	838
F	660
G	1478
H	2880
J	660

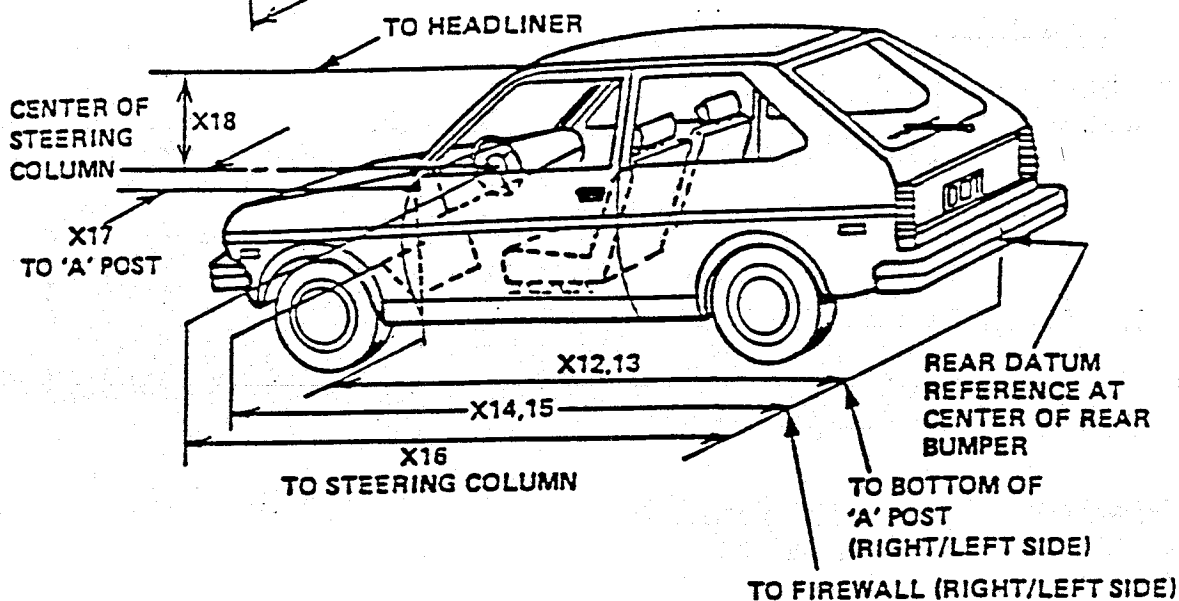
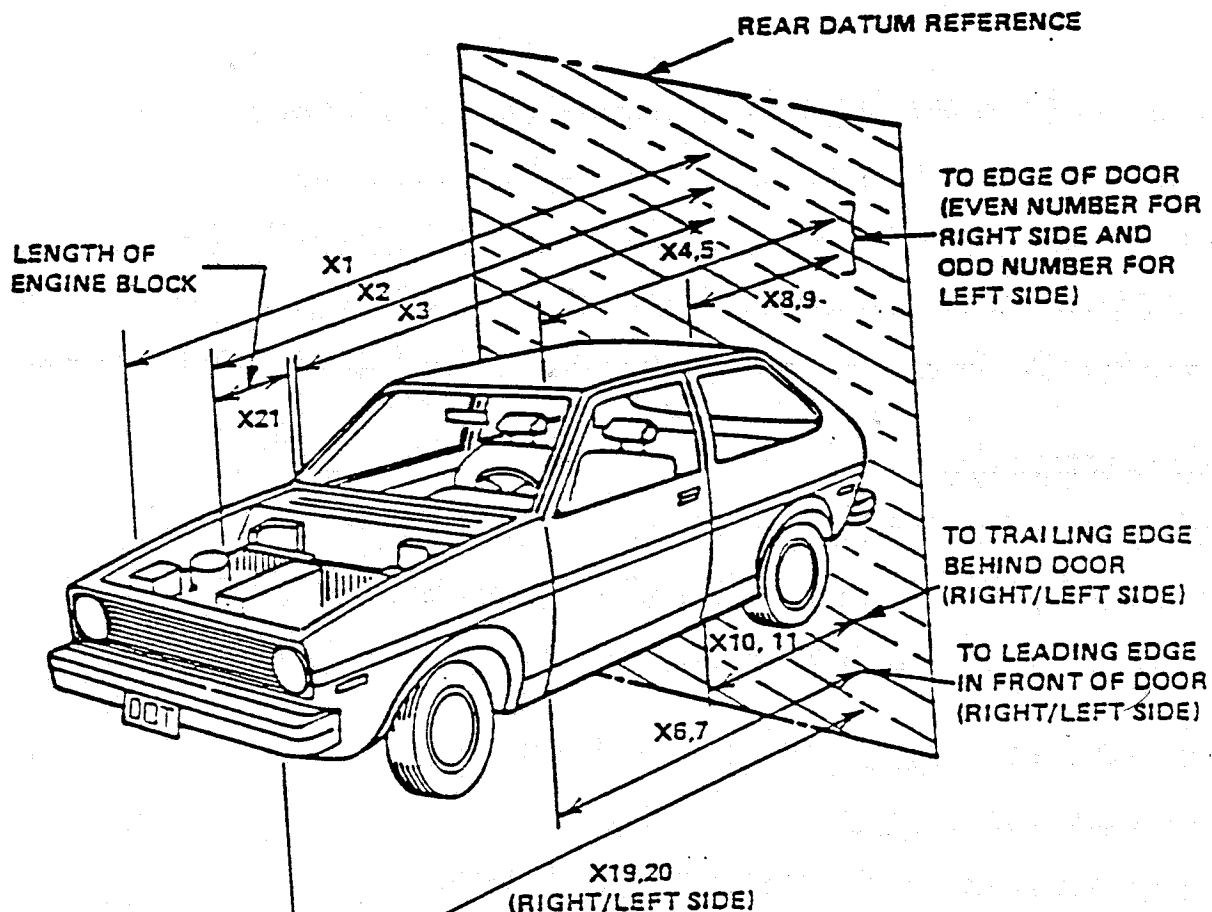
ACCEL. NO.	ACCELEROMETER	DIRECTION
1 and 8	Left Rear Seat Crossmember	X
2 and 9	Right Rear Seat Crossmember	X
3	Top of Engine	X
4	Bottom of Engine	X
5	Right Side Brake Caliper	X
6	Instrument Panel	X
7	Left Disc Brake Caliper	X

* The accelerometer pack number can be correlated with the vehicle response data traces in Appendix B.

TEST VEHICLE MEASUREMENTS

No.	MEASUREMENT DESCRIPTION:	Pre-Test (mm)	Post-Test (mm)	Diff. (mm)
X1	Total Length of Test Vehicle at Centerline	4663	4152	511
X2	Rear Surface of Vehicle to Front of Engine	4043	3877	166
X3	Rear Surface of Vehicle to Firewall	3454	3358	96
X4	Rear Surface to Upr. Leading Edge of Rt. Door	3139	3136	3
X5	Rear Surface to Upr. Leading Edge of Left Door	3147	3139	8
X6	Rear Surface to Lwr. Leading Edge of Rt. Door	3144	3134	10
X7	Rear Surface to Lwr. Leading Edge of Left Door	3151	3145	6
X8	Rear Surface to Upr. Trailing Edge of Rt. Door	2114	2106	8
X9	Rear Surface to Upr. Trailing Edge of Left Door	2113	2108	5
X10	Rear Surface to Lwr. Trailing Edge of Rt. Door	2125	2116	9
X11	Rear Surface to Lwr. Trailing Edge of Left Door	2129	2120	9
X12	Rear Surface to Bottom of 'A' Post on Rt. Side	3147	3144	3
X13	Rear Surface to Bottom of 'A' Post on Left Side	3163	3156	7
X14	Rear Surface to Firewall on Right Side	3488	3387	101
X15	Rear Surface to Firewall on Left Side	3498	3421	77
X16	Rear Surface to Steering Column	2766	2754	12
X17	Center of Steering Column to 'A' Post	390	375	15
X18	Center of Steering Column to Headlining	458	430	28
X19	Rear Surface to Right Side of Front Bumper	4504	3987	517
X20	Rear Surface to Left Side of Front Bumper	4515	3997	518
X21	Length of Engine Block	444	444	0

TEST VEHICLE MEASUREMENTS



ACCIDENT INVESTIGATION DIVISION DATA
FOR 35 MPH FRONTAL BARRIER IMPACT

VEHICLE MAKE/MODEL/BODY STYLE: 1995/Hyundai/Sonata/4 Door Sedan

VEH. NHTSA NO.: MS0501 ; VIN: KMHCF21F0ZU193915

MODEL YEAR: 1995 ; BUILD DATE: 6/94 ; TEST DATE: October 12, 1994

VEH. SIZE CATEGORY: Mid Size ; TEST WEIGHT: 1448.8 kg

VEH. WHEELBASE: 2702 mm ; FRONT OVERHANG: 963 mm ; OVERALL WIDTH: 1768 mm

ACCELEROMETER DATA:

LOCATION: As per measurements on pages 4-12

CALIBRATION PROCEDURE: As per MGA Calibration Procedure

LINEARITY: >99.9% ; INTEGRATION ALGORITHM: Trapezoidal

VEH. IMPACT SPEED: 56.2 kph ; TIME OF SEPARATION: 77 msec

VELOCITY CHANGE: 66.0 kph

COLLISION DEFORMATION CLASSIFICATION (CDC) CODE:

F (Frontal)

CRUSH DEPTH
DIMENSIONS:

C1 = 518 mm

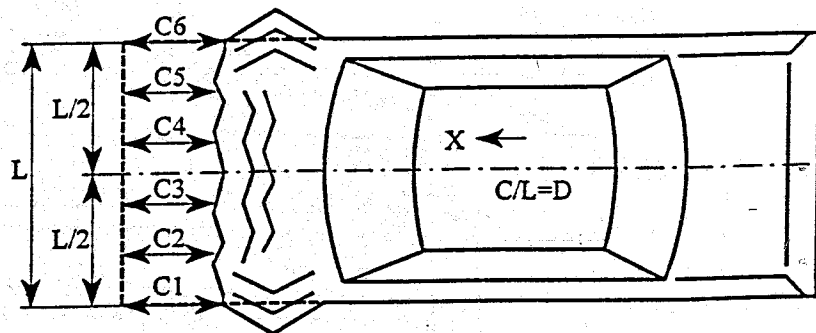
C2 = 506 mm

C3 = 498 mm

C4 = 506 mm

C5 = 510 mm

C6 = 517 mm



MIDPOINT OF
DAMAGE: D = Vehicle Centerline
(Longitude)

LENGTH OF
DAMAGED REGION: L = 1520 mm

APPENDIX A
PHOTOGRAPHS

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Photo No. A-4 - Post-Test Rear View of Test Vehicle	A-4
Photo No. A-5 - Pre-Test Left Side View of Test Vehicle	A-5
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Photo No. A-7 - Pre-Test Left Rear Three-Quarter View of Test Vehicle	A-7
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Photo No. A-11 - Pre-Test Right Front Three-Quarter View of Test Vehicle	A-11
Photo No. A-12 - Post-Test Right Front Three-Quarter View of Test Vehicle	A-12
Photo No. A-13 - Pre-Test Fuel Filler Cap View	A-13
Photo No. A-14 - Pre-Test Engine Compartment View	A-14
Photo No. A-15 - Post-Test Engine Compartment View	A-15
Photo No. A-16 - Pre-Test Front Underbody View	A-16
Photo No. A-17 - Post-Test Front Underbody View	A-17
Photo No. A-18 - Pre-Test Rear Underbody View	A-18
Photo No. A-19 - Post-Test Rear Underbody View	A-19
Photo No. A-20 - Pre-Test Windshield View	A-20
Photo No. A-21 - Post-Test Windshield View	A-21
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Photo No. A-28 - Post-Test Driver Dummy Knee Position	A-28
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Photo No. A-31 - Post-Test Passenger Dummy Position Right Side View	A-31
Photo No. A-32 - Pre-Test Passenger Dummy Position Right Side View (Door Open)	A-32
Photo No. A-33 - Post-Test Passenger Dummy Position Right Side View (Door Open)	A-33
Photo No. A-34 - Pre-Test Passenger Seat Position View	A-34
Photo No. A-35 - Post-Test Passenger Seat Position View	A-35
Photo No. A-36 - Post-Test Passenger Dummy Knee Position	A-36
Photo No. A-37 - Post-Test Passenger Airbag Contact	A-37
Photo No. A-38 - Vehicle Certification Label	A-38
Photo No. A-39 - Tire Placard	A-39
Photo No. A-40 - Impact	A-40
Photo No. A-41 - Rollover 90°	A-41
Photo No. A-42 - Rollover 180°	A-42
Photo No. A-43 - Rollover 270°	A-43
Photo No. A-44 - Rollover 360°	A-44

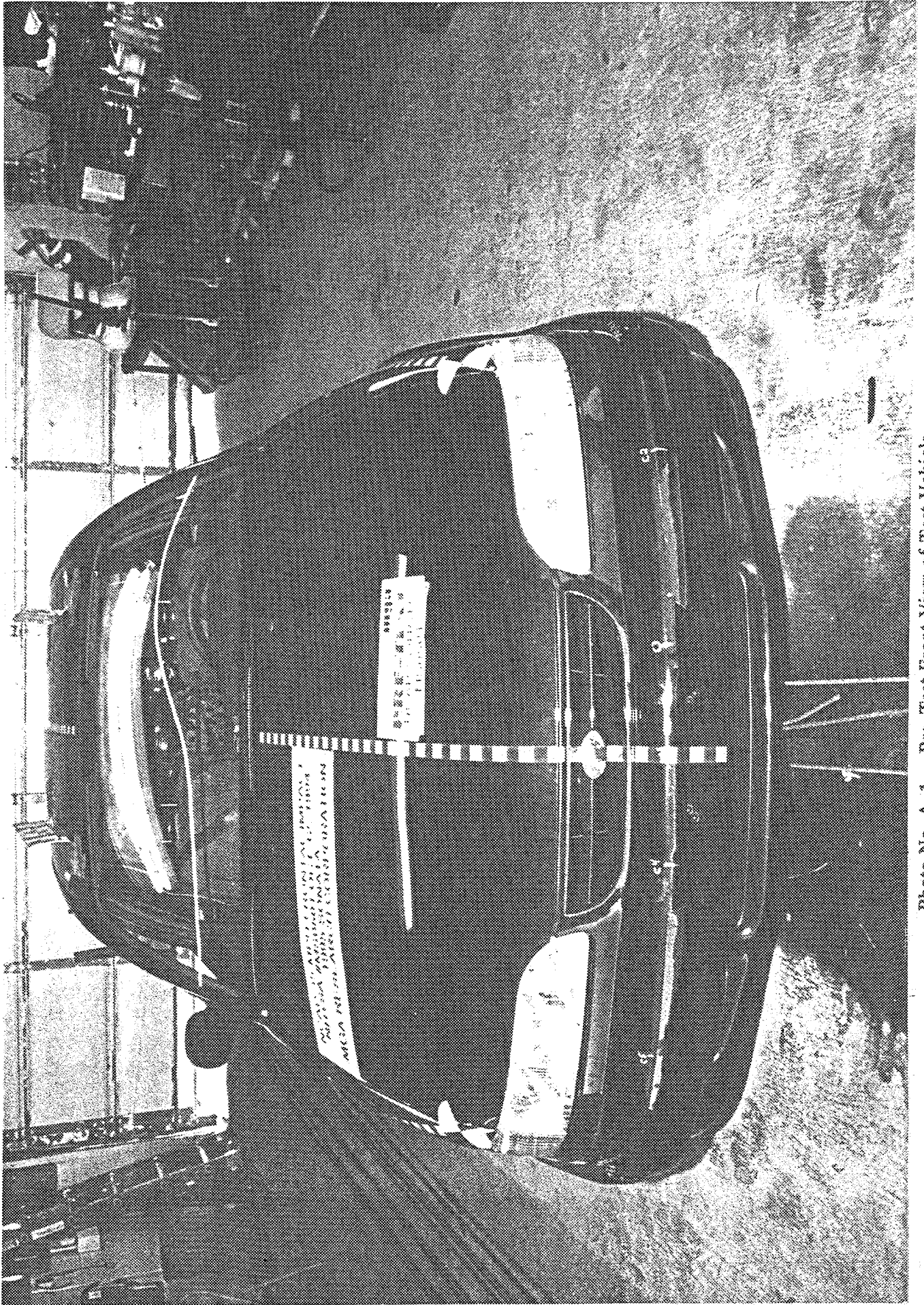


Photo No. A-1 - Pre-Test Front View of Test Vehicle

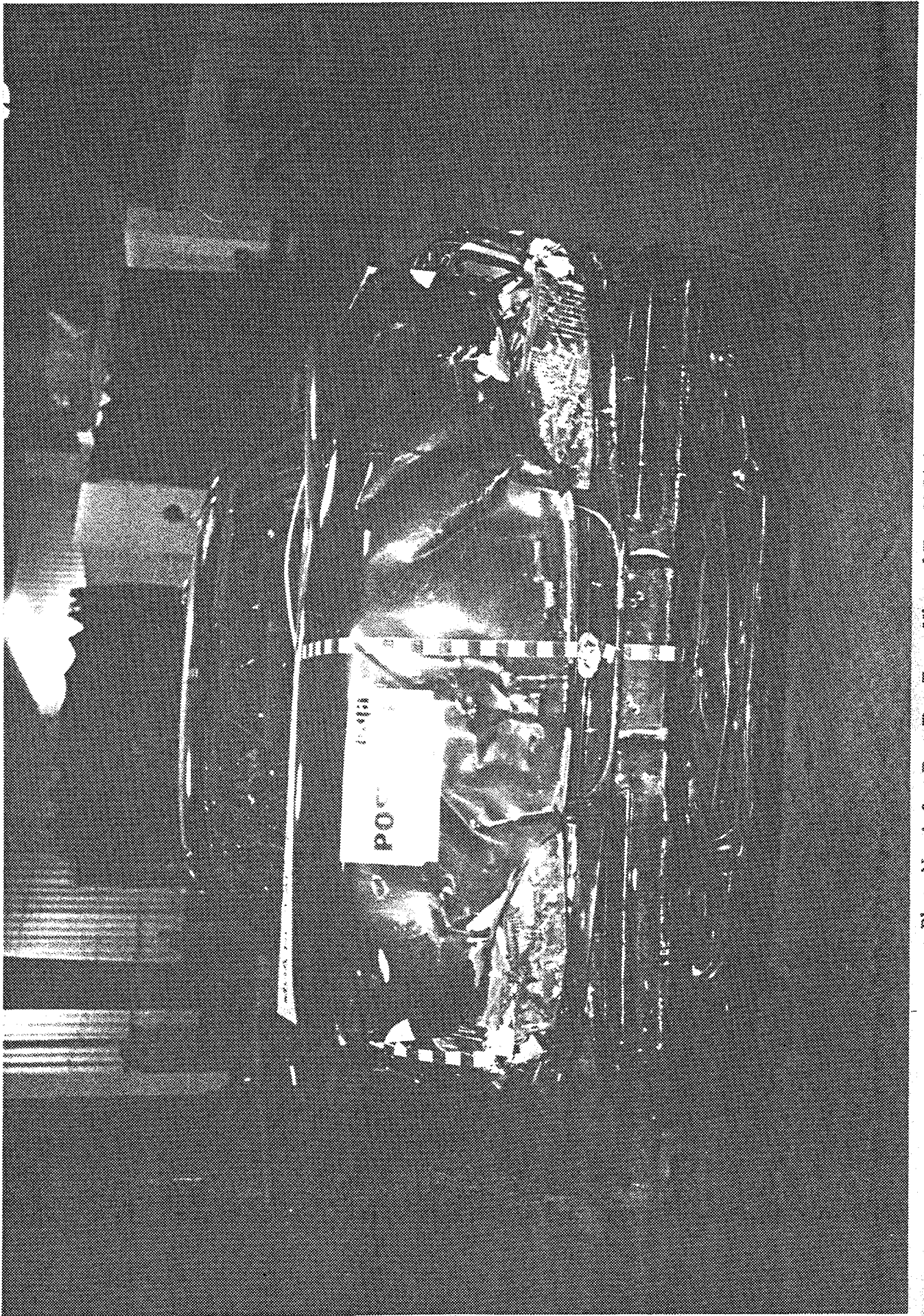


Photo No. A-2 - Post-Test Front View of Test Vehicle

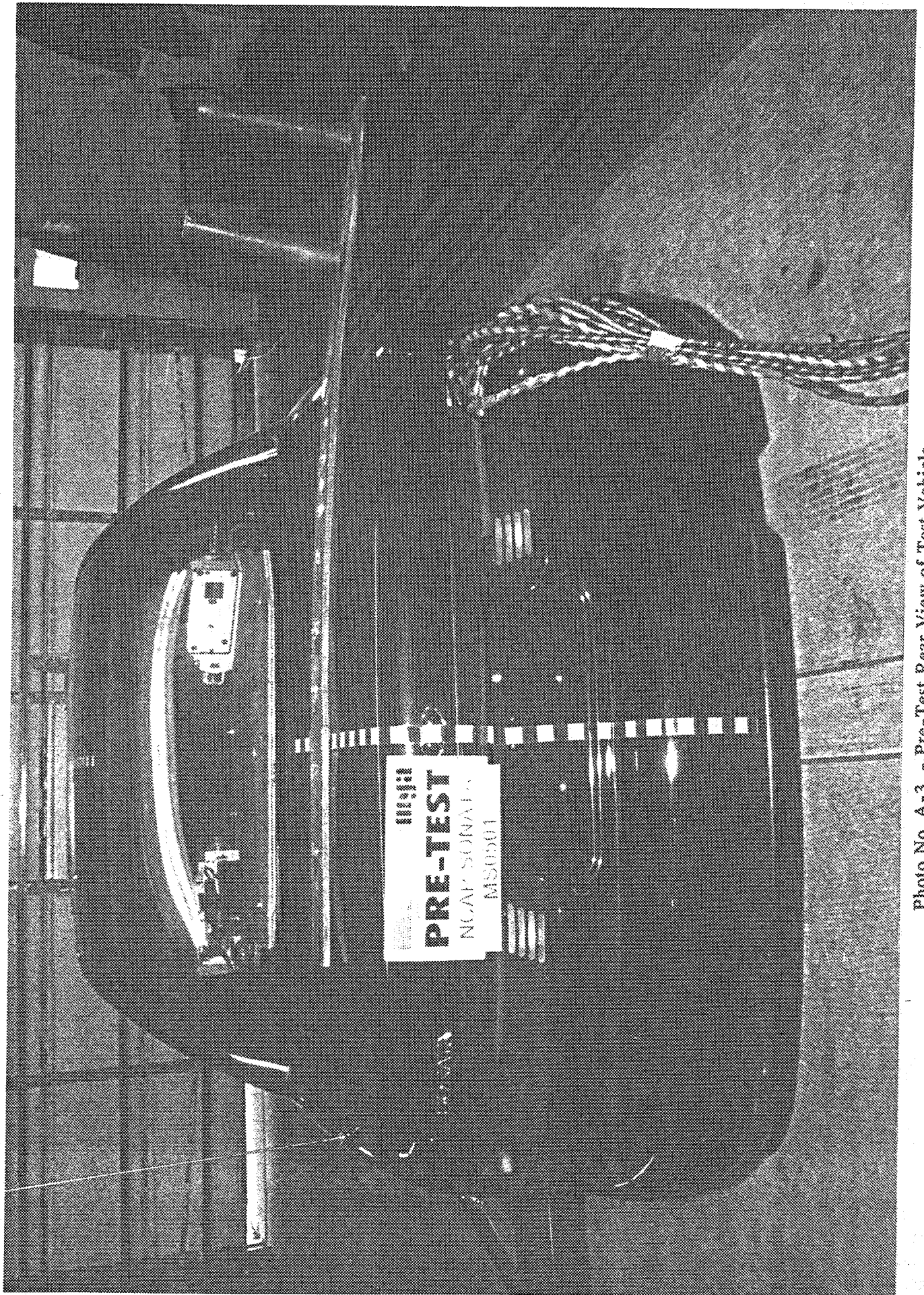


Photo No. A-3 - Pre-Test Rear View of Test Vehicle

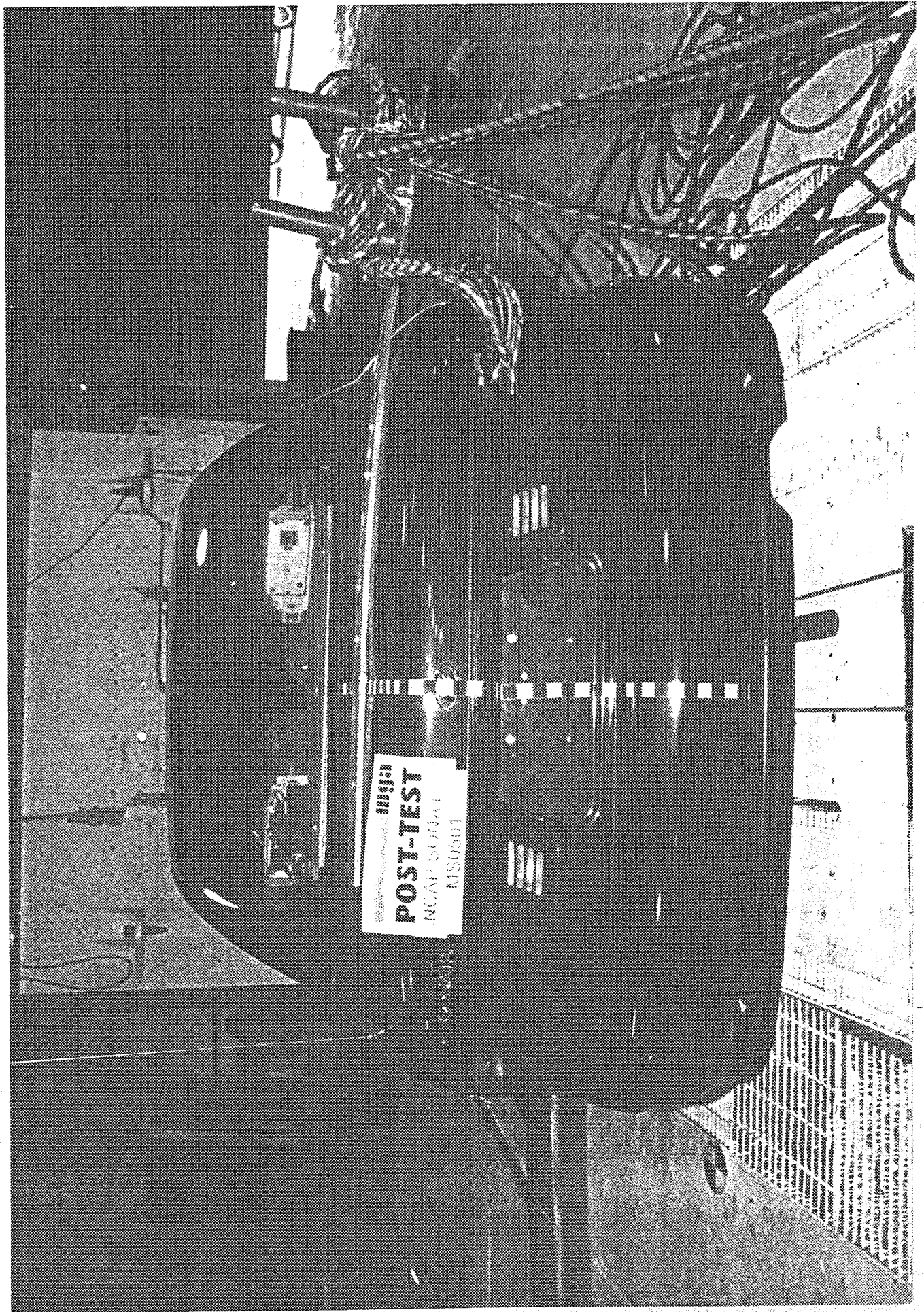


Photo No. A-4 - Post-Test Rear View of Test Vehicle

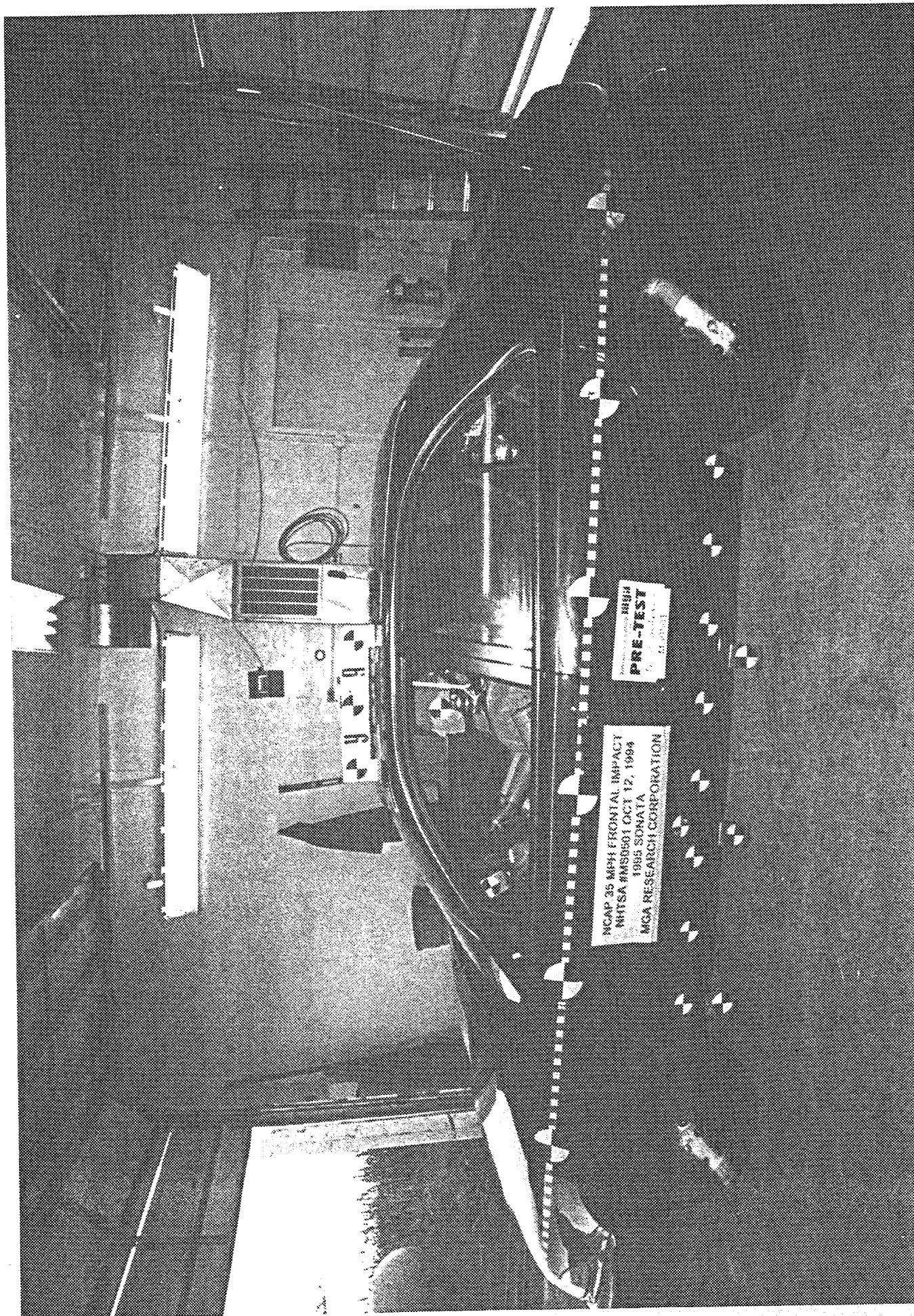


Photo No. A-5 - Pre-Test Left Side View of Test Vehicle

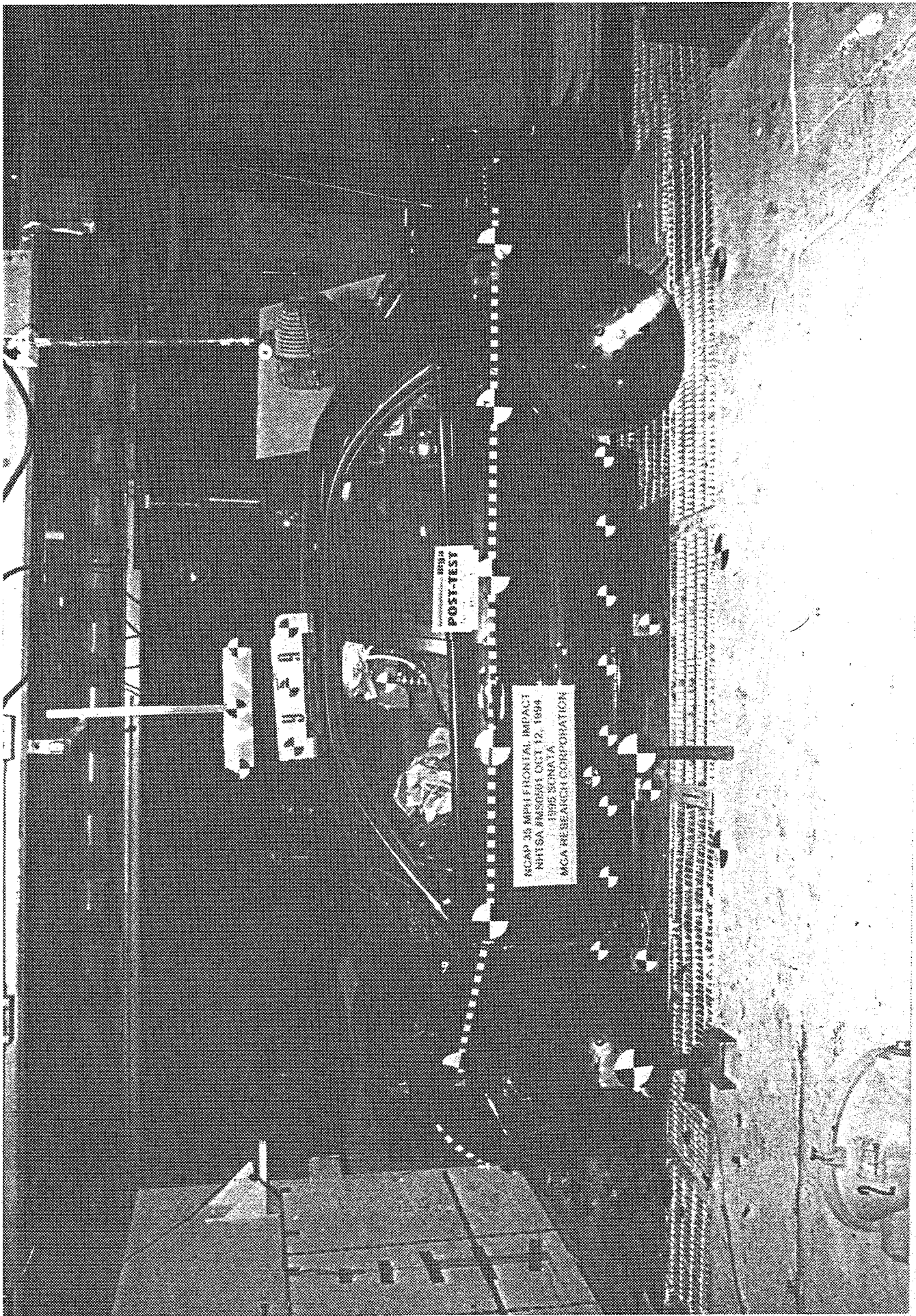


Photo No. A-6 - Post-Test Left Side View of Test Vehicle

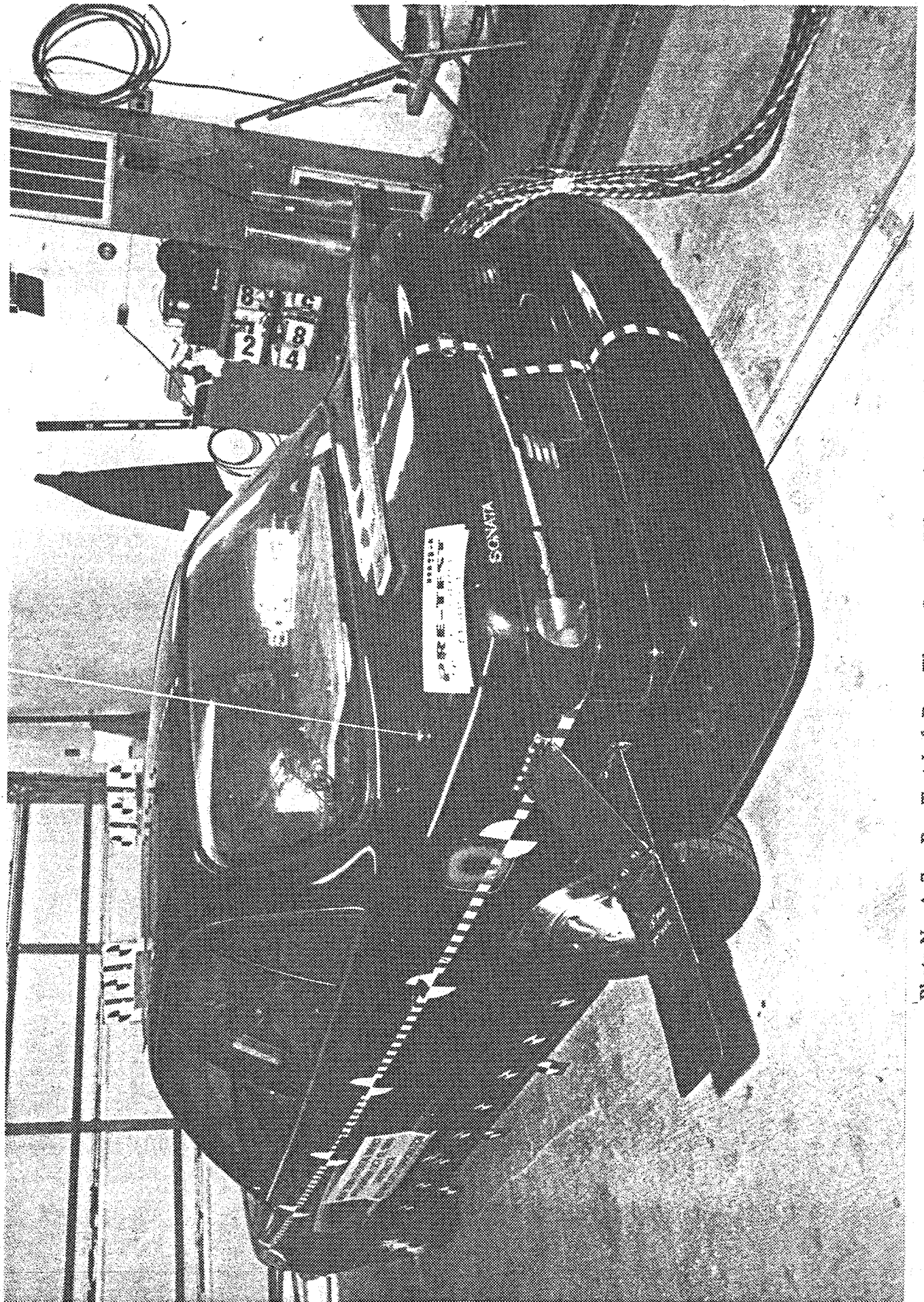


Photo No. A-7 - Pre-Test Left Rear Three-Quarter View of Test Vehicle

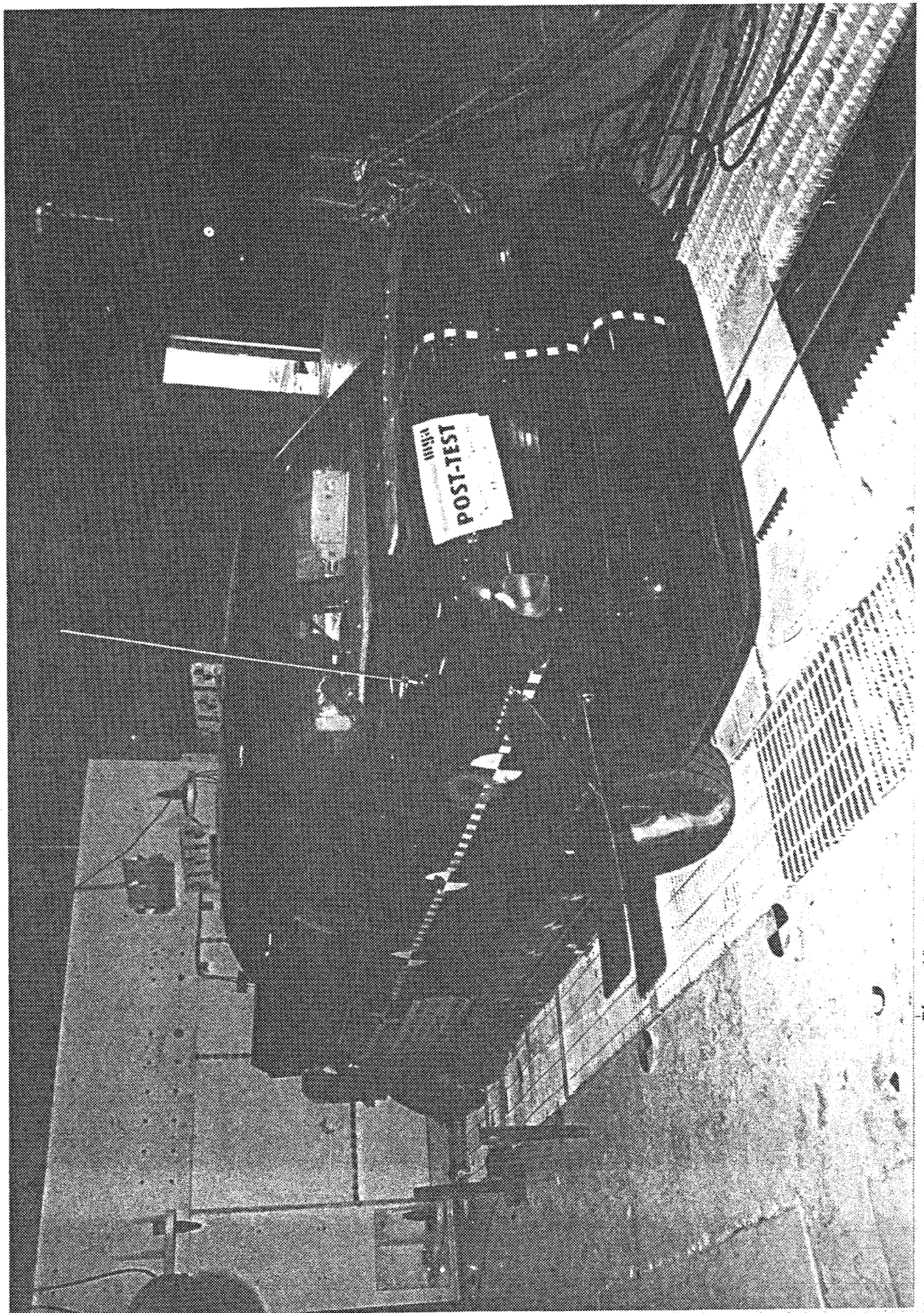


Photo No. A-8 - Post-Test Left Rear Three-Quarter View of Test Vehicle

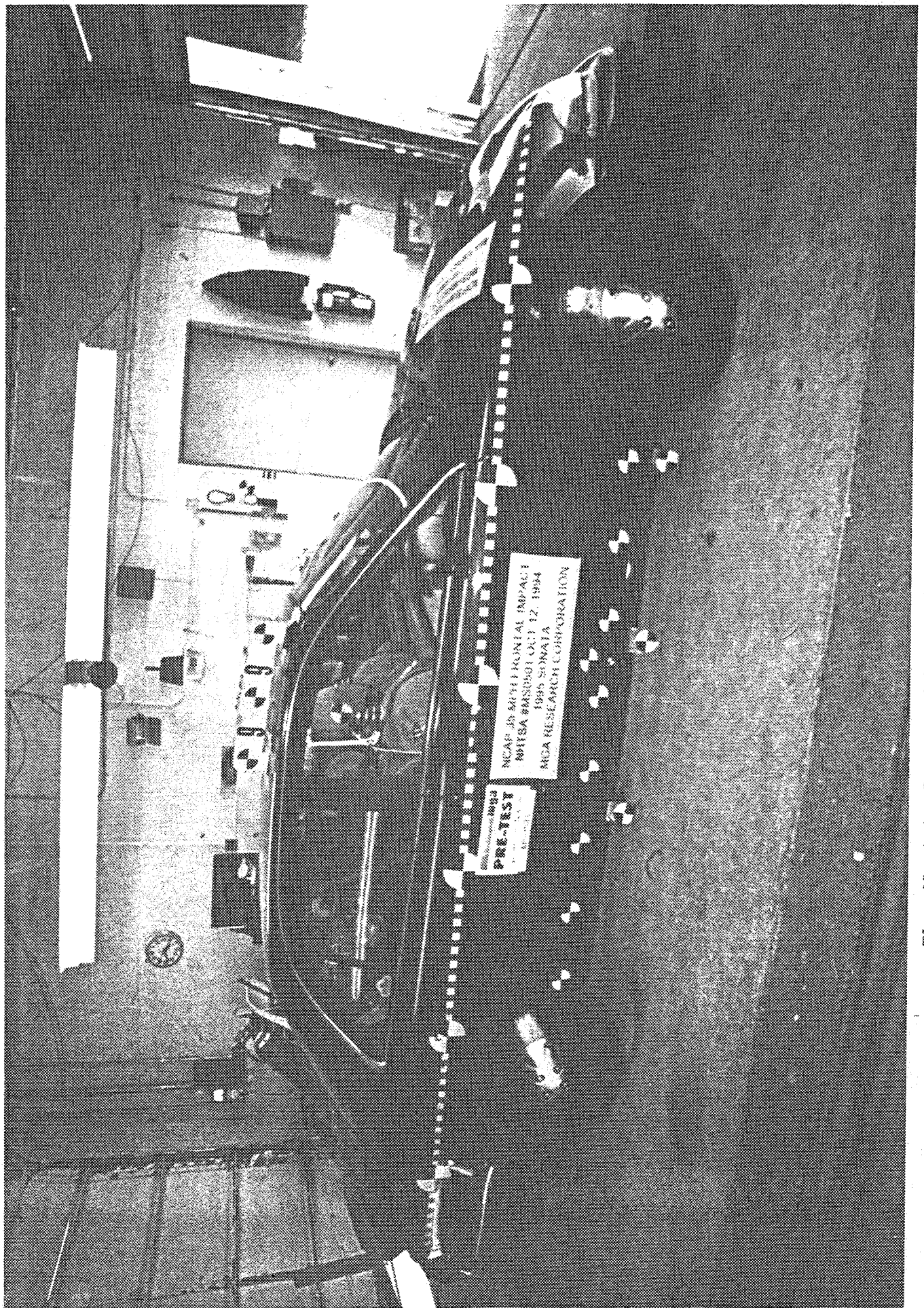


Photo No. A-9 - Pre-Test Right Side View of Test Vehicle

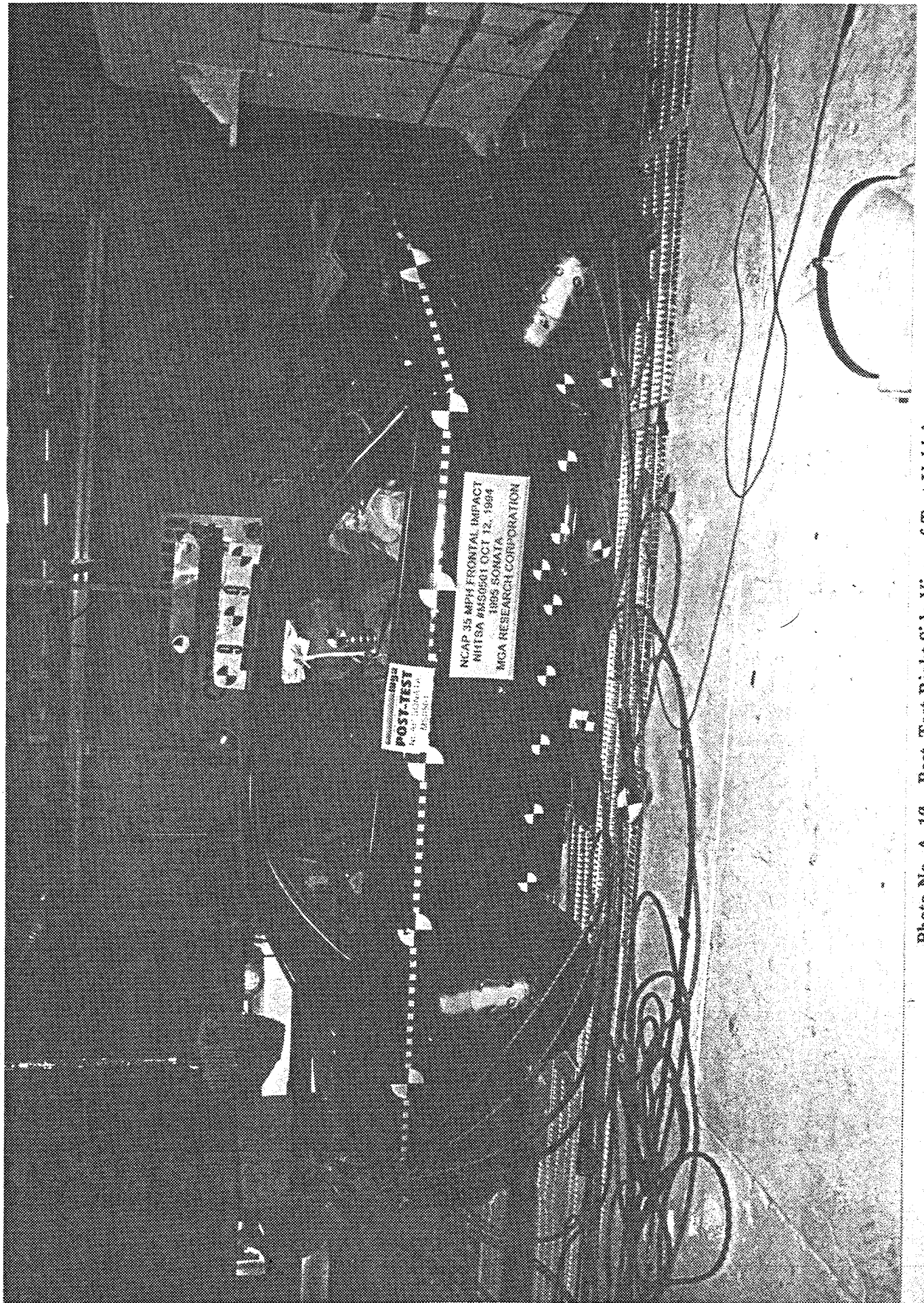


Photo No. A-10 - Post-Test Right Side View of Test Vehicle

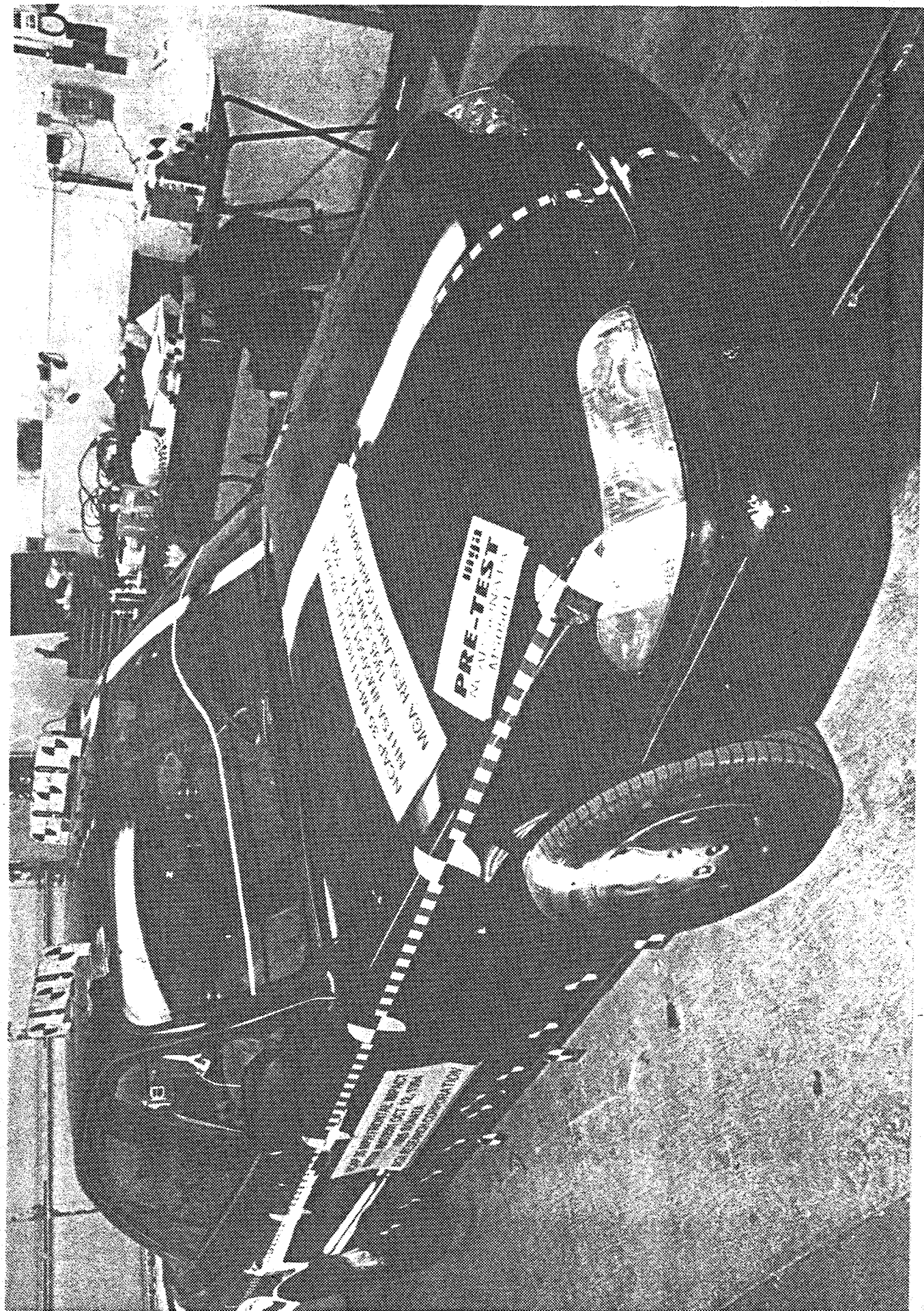


Photo No. A-11 - Pre-Test Right Front Three-Quarter View of Test Vehicle

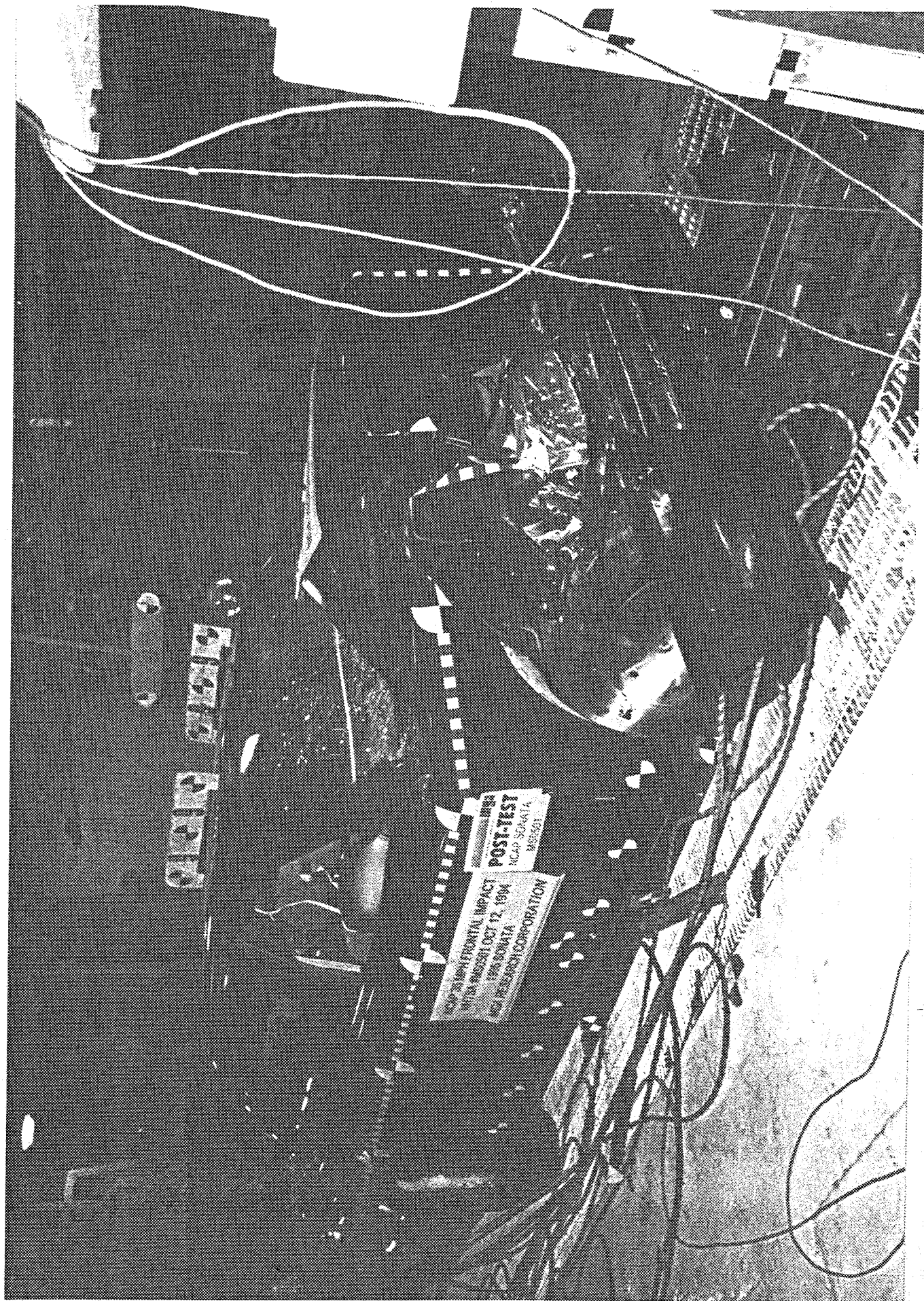


Photo No. A-12 - Post-Test Right Front Three-Quarter View of Test Vehicle

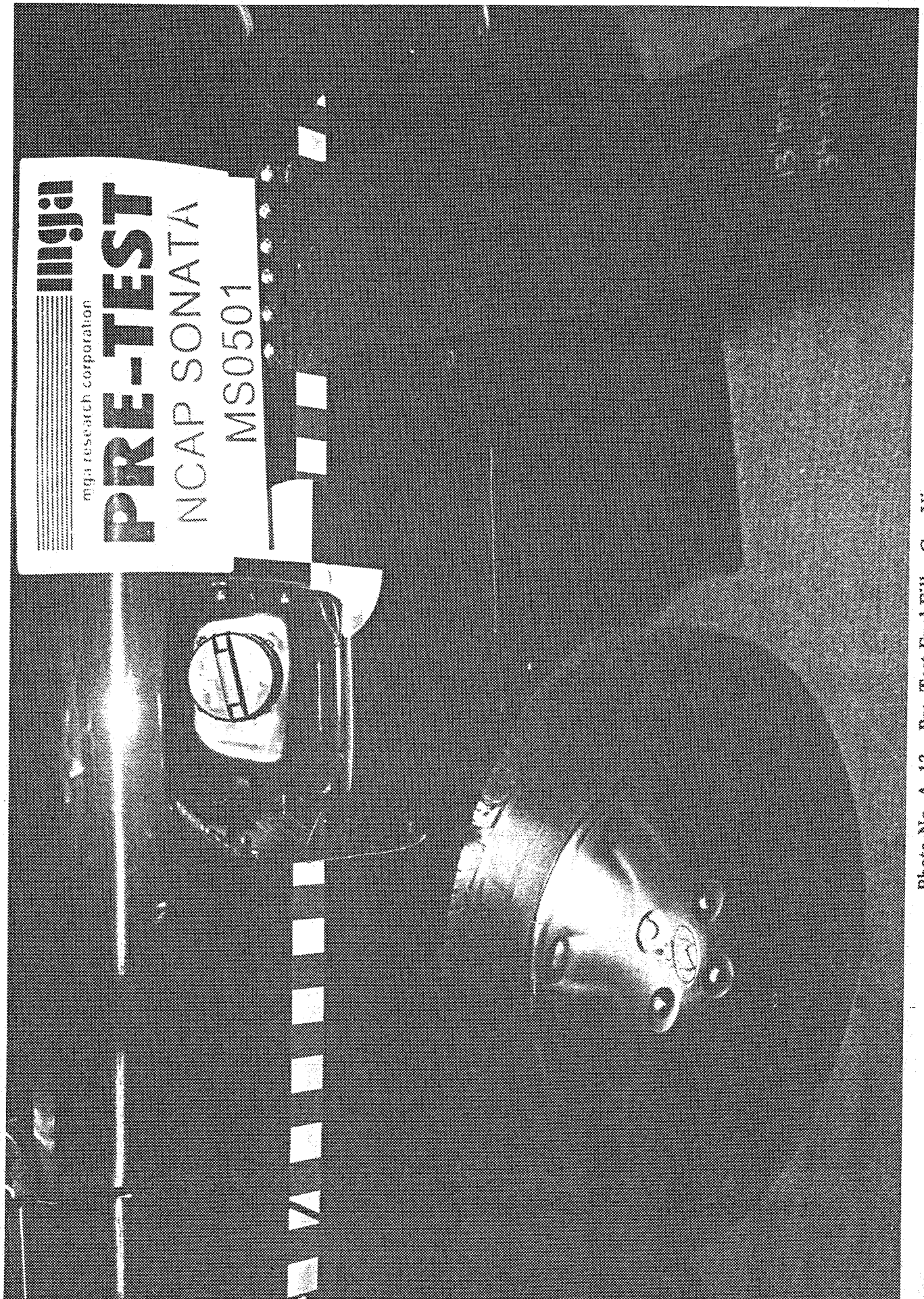


Photo No. A-13 - Pre-Test Fuel Filler Cap View

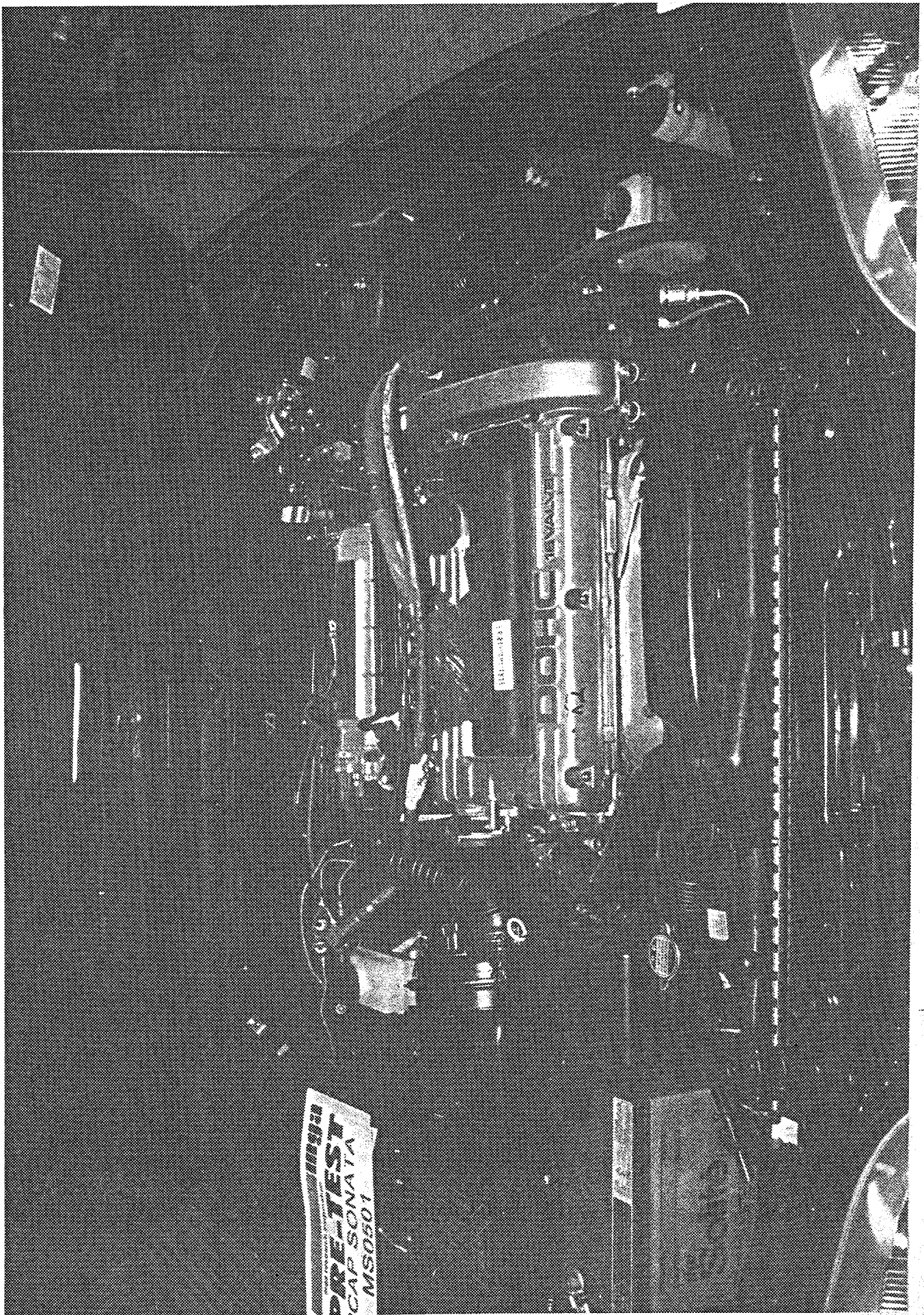


Photo No. A-14 - Pre-Test Engine Compartment View

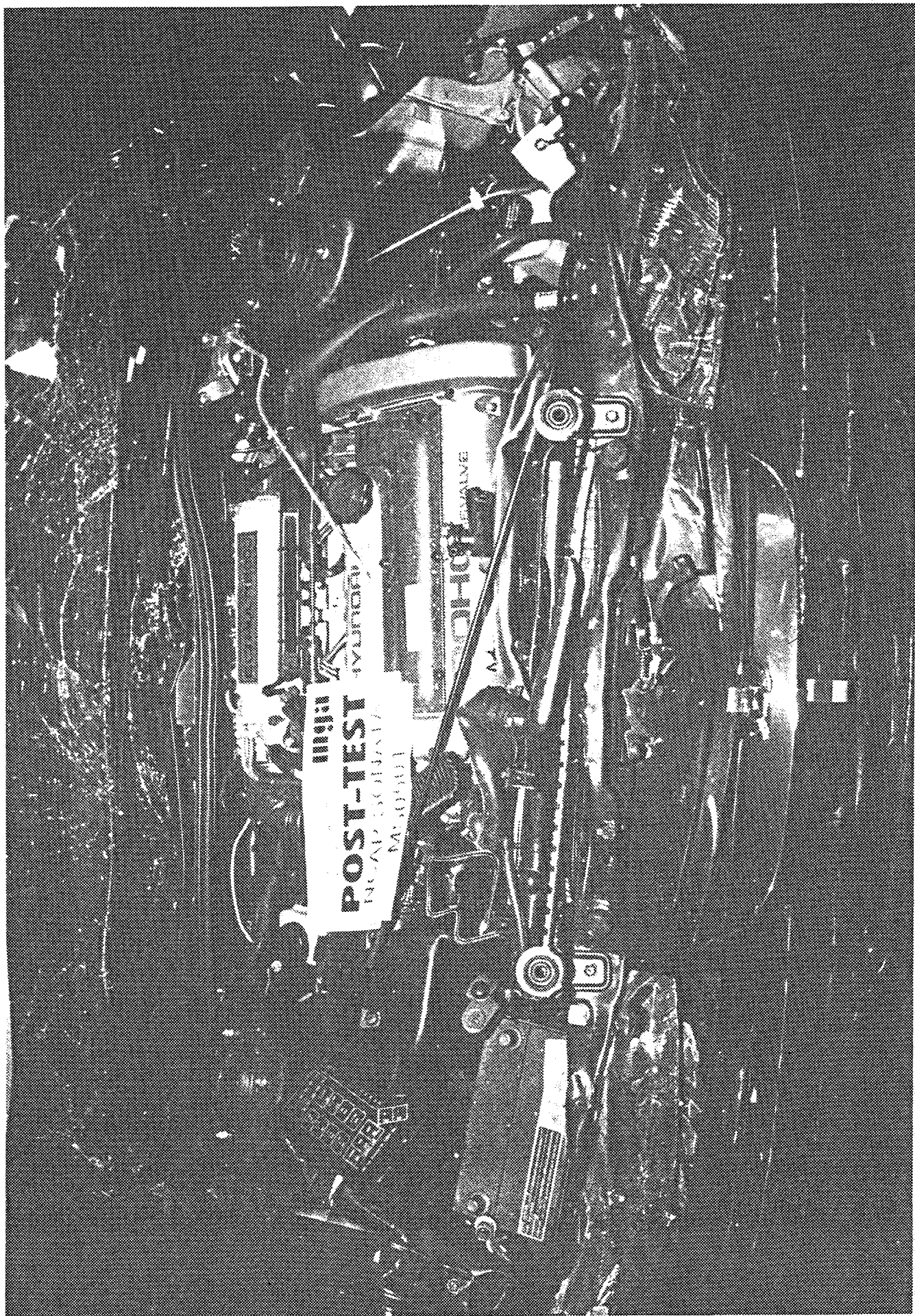


Photo No. A-15 - Post-Test Engine Compartment View

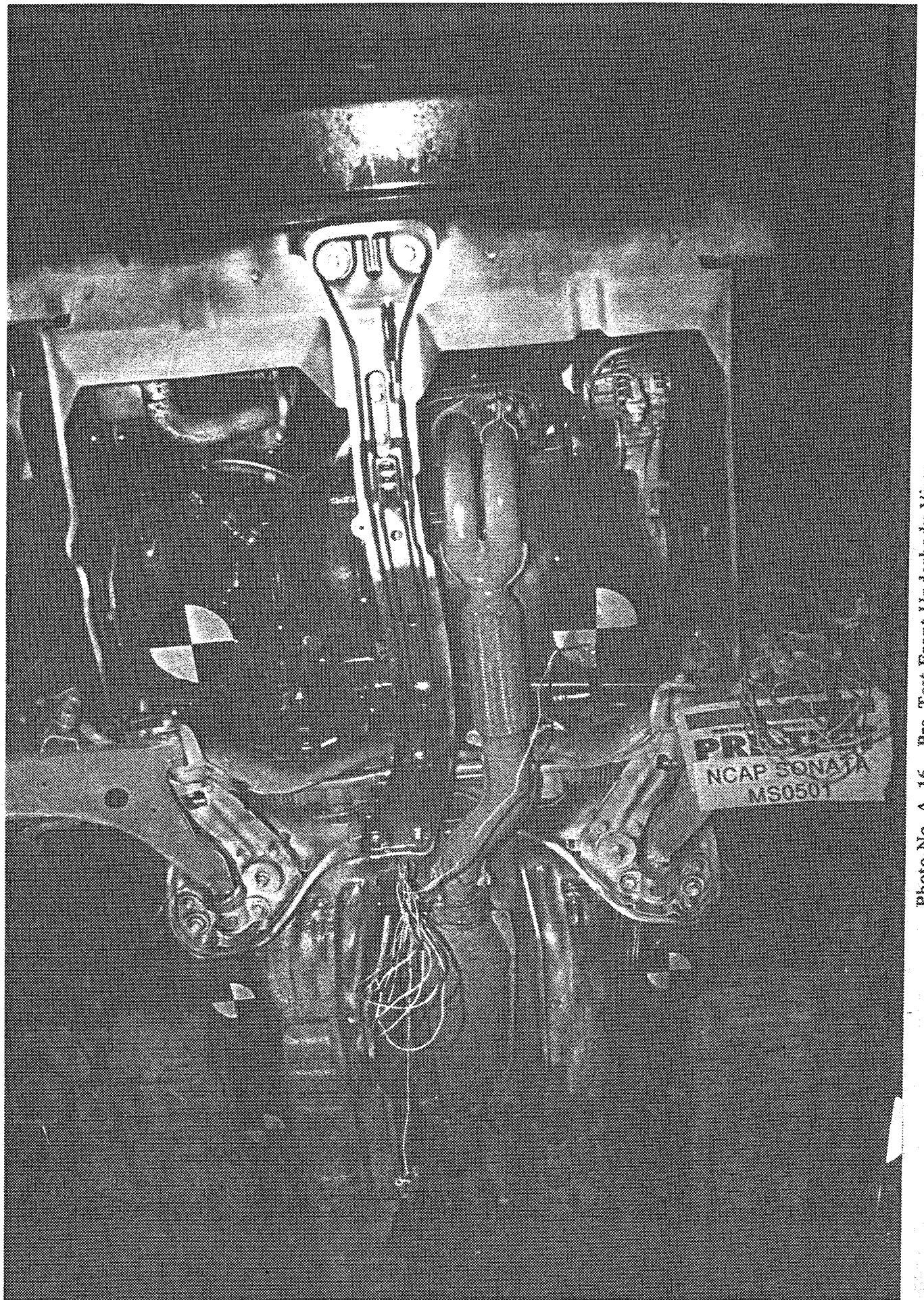


Photo No. A-16 - Pre-Test Front Underbody View

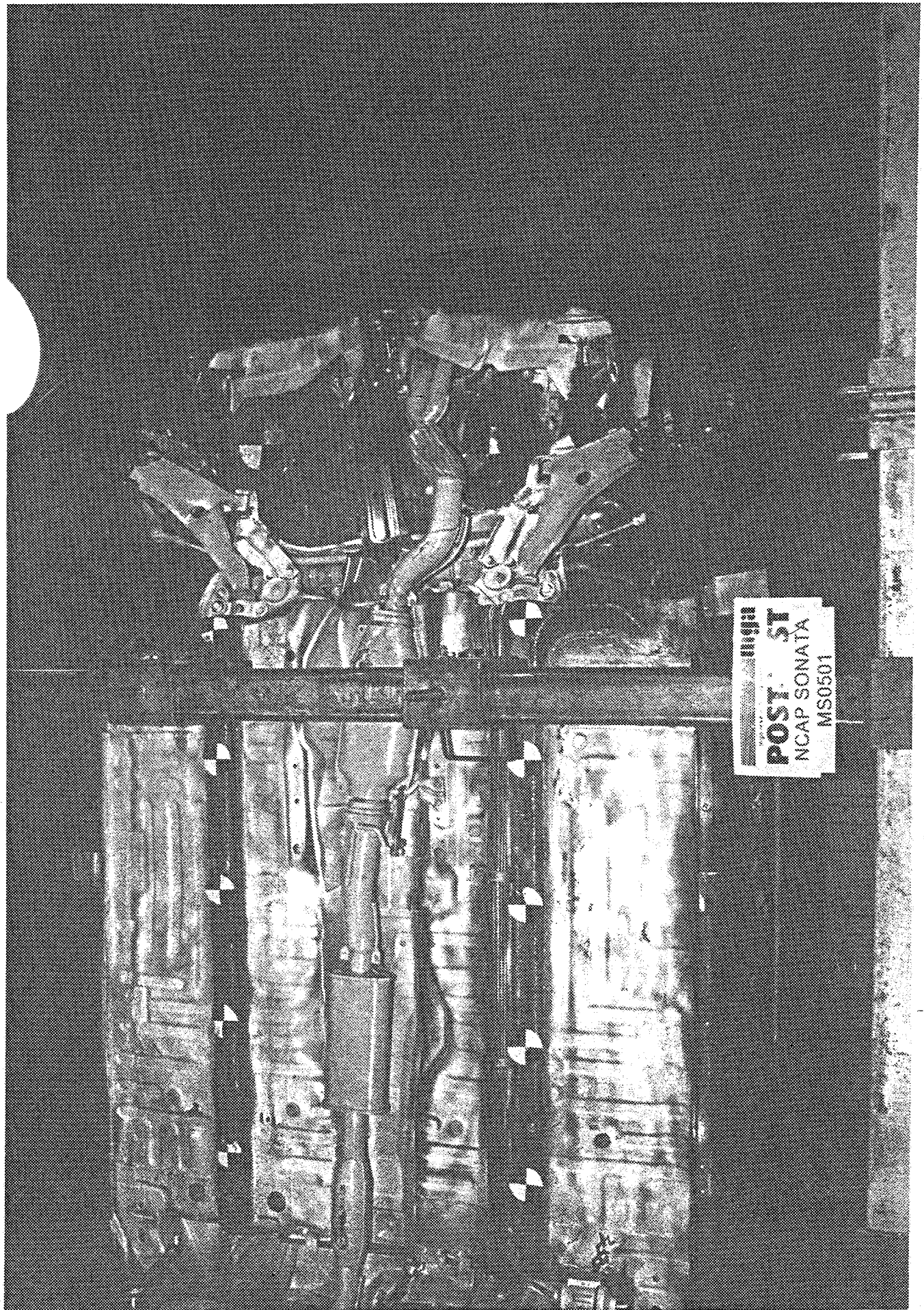


Photo No. A-17 - Post-Test Front Underbody View

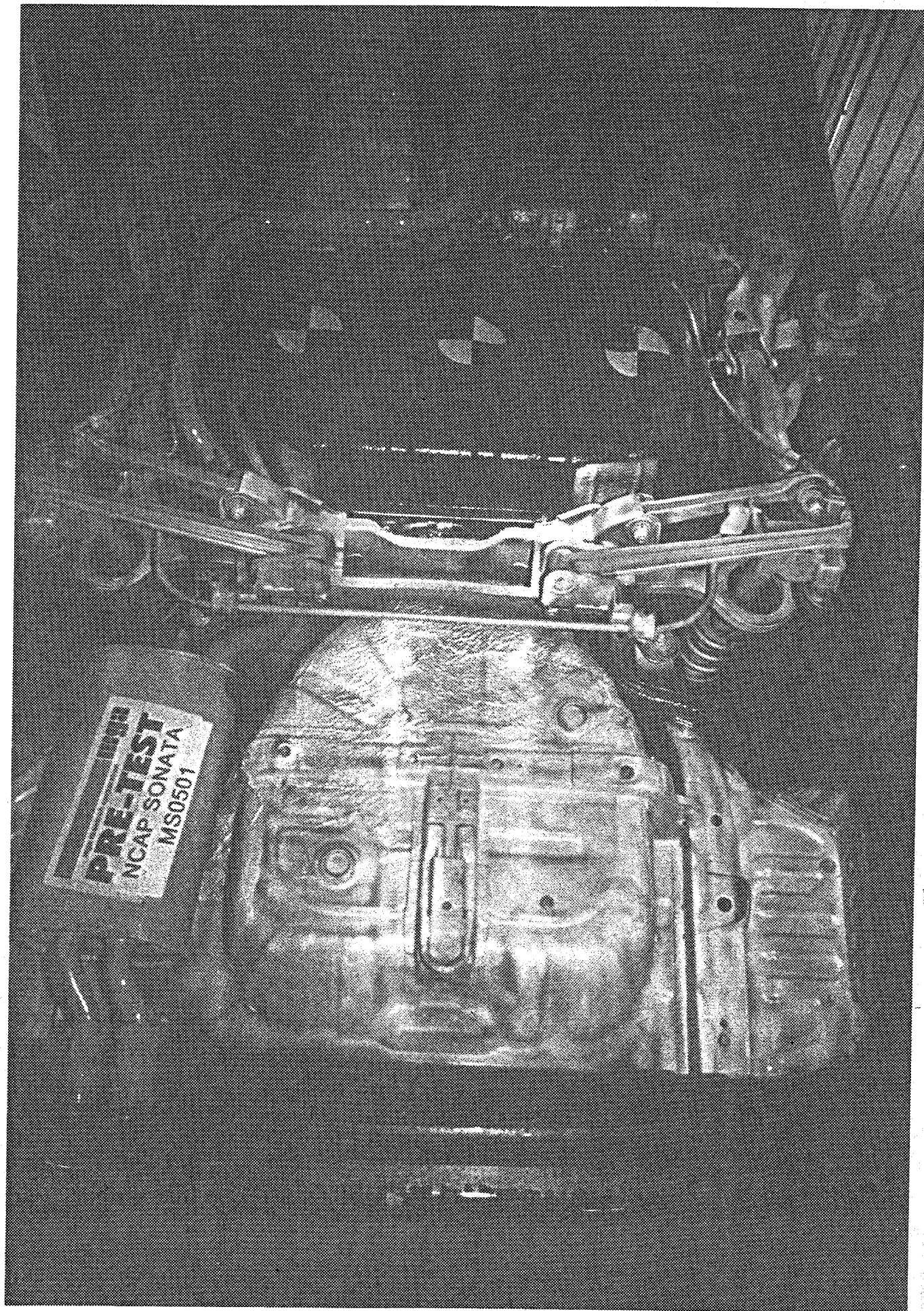


Photo No. A-18 - Pre-Test Rear Underbody View

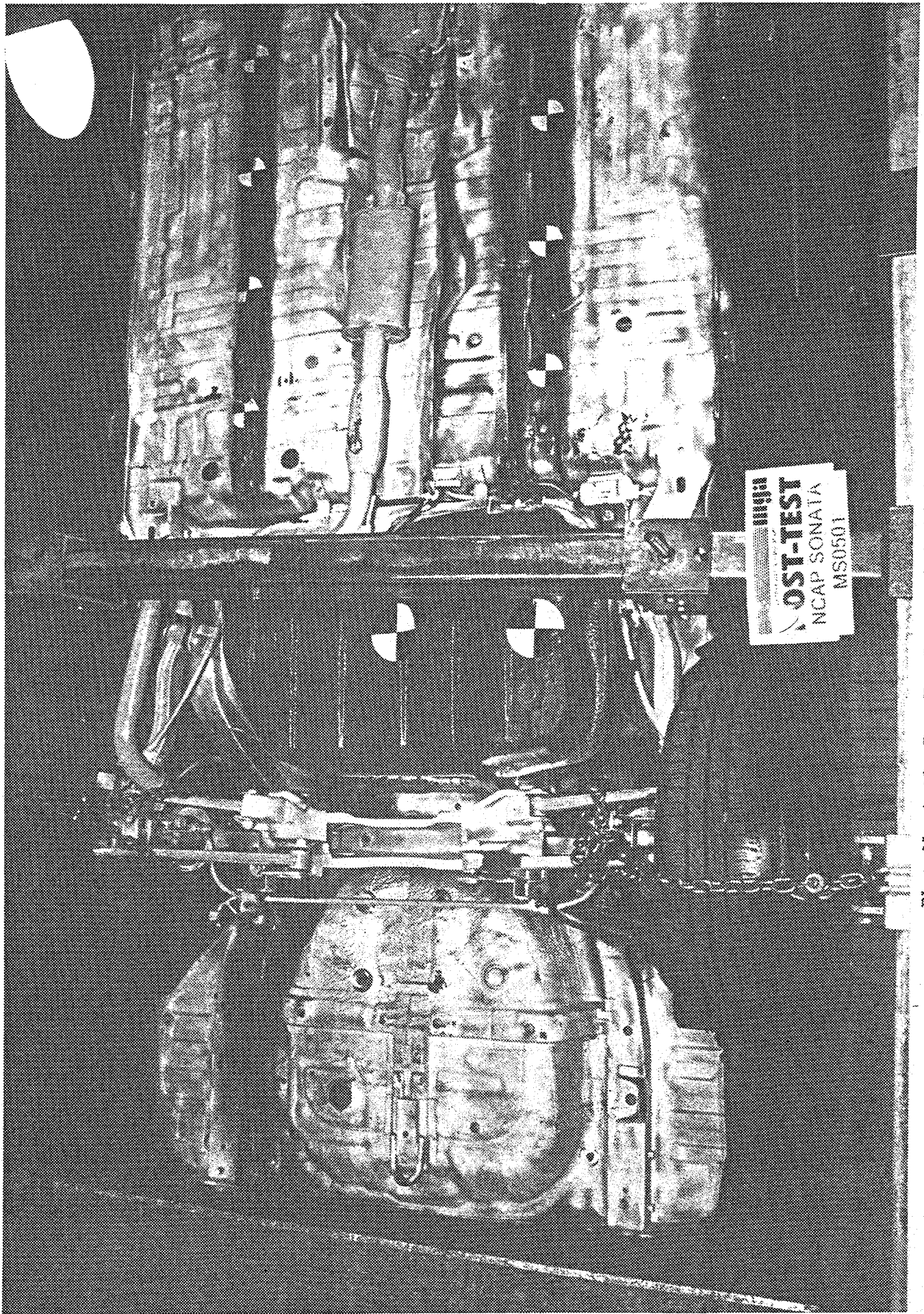


Photo No. A-19 - Post-Test Rear Underbody View

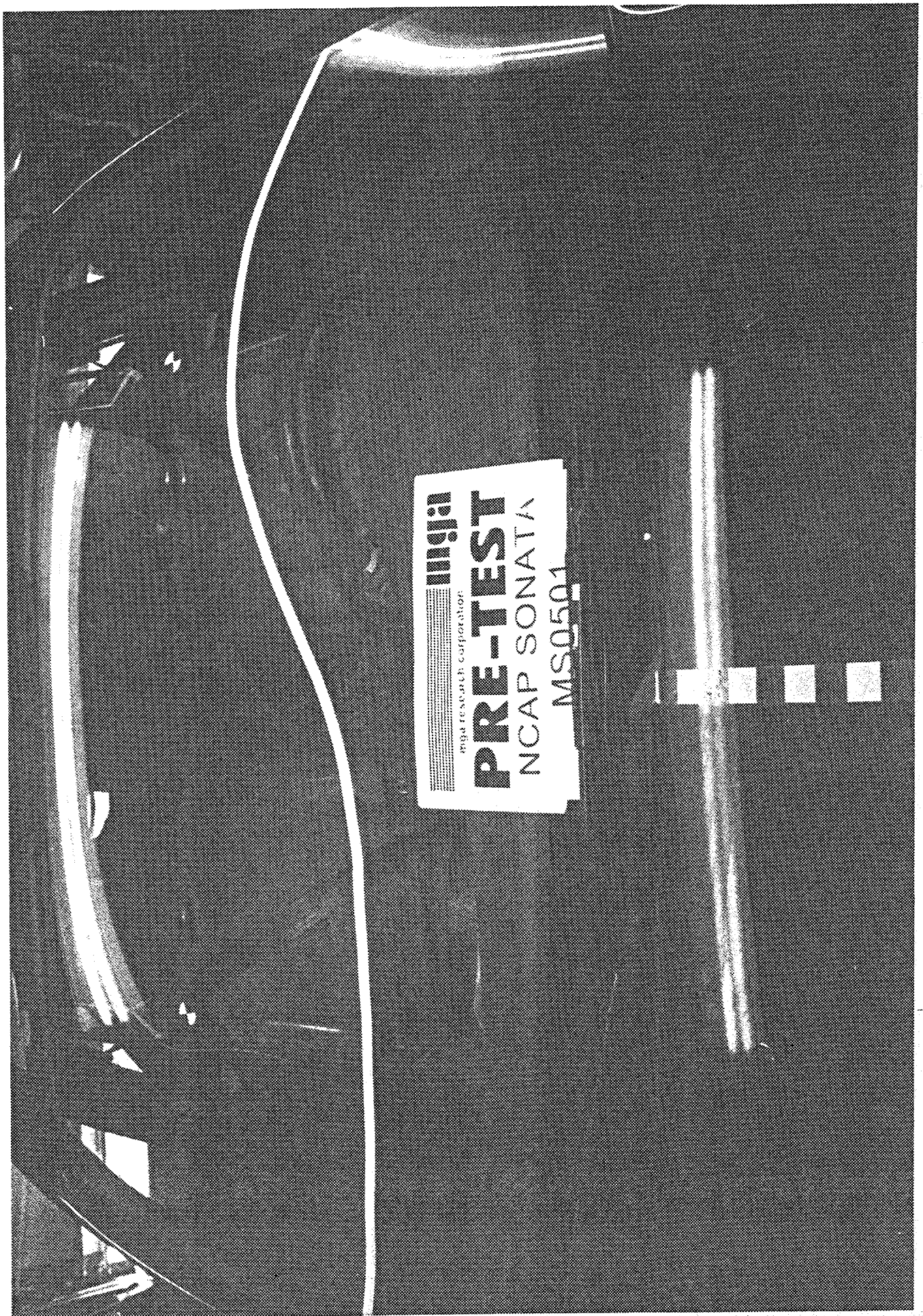


Photo No. A-20 - Pre-Test Windshield View

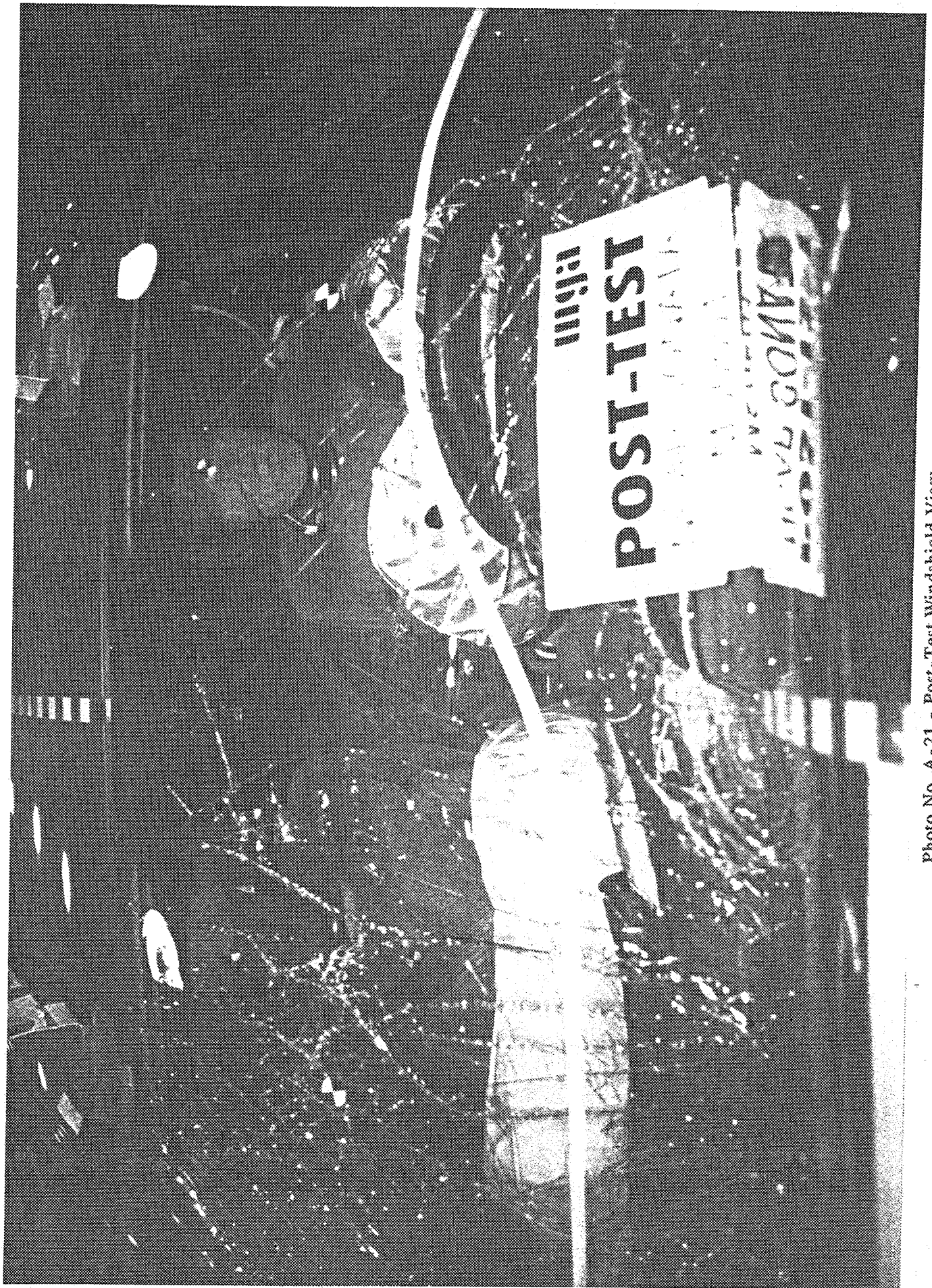


Photo No. A-21 - Post-Test Windshield View

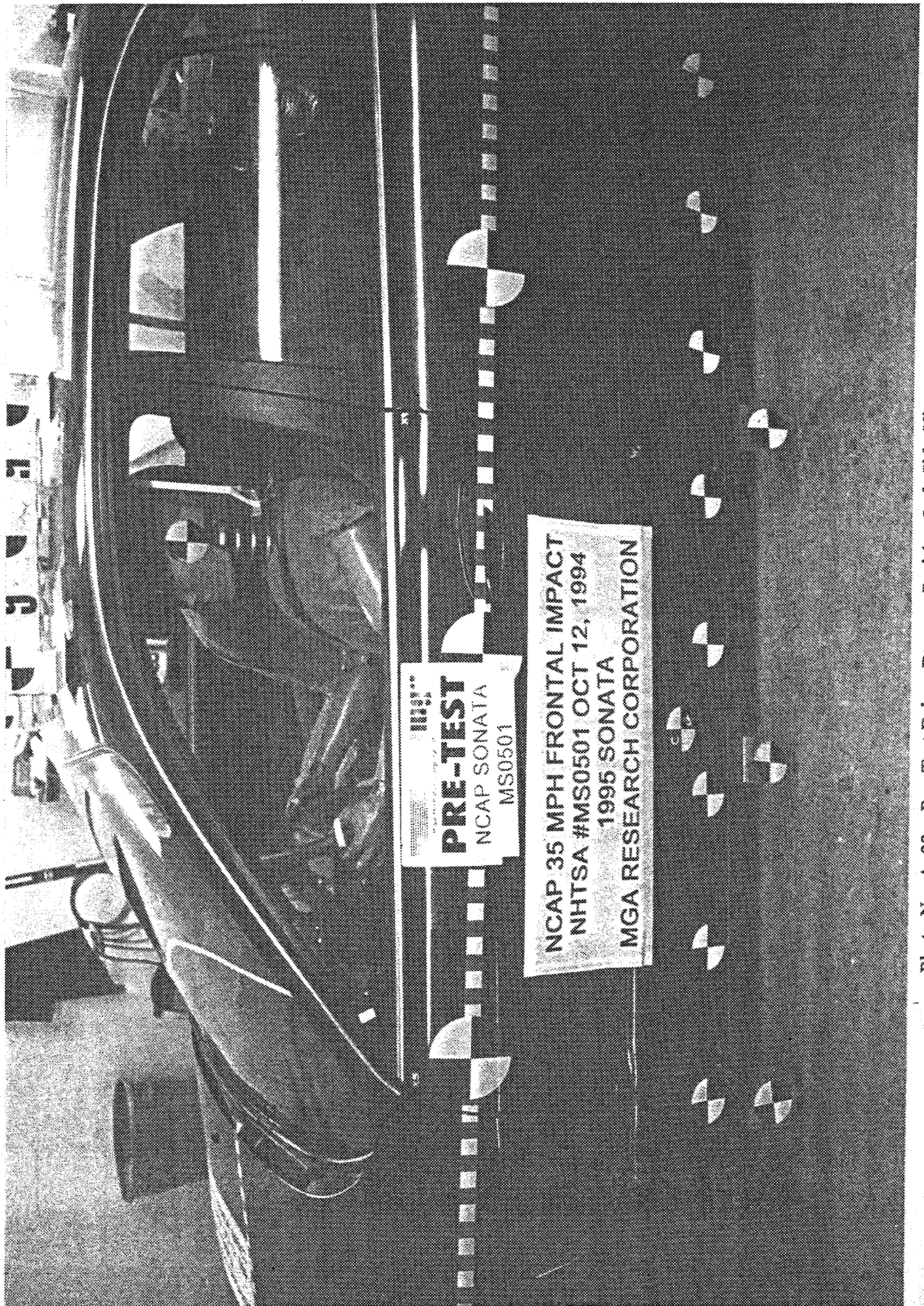


Photo No. A-22 - Pre-Test Driver Dummy Position Left Side View

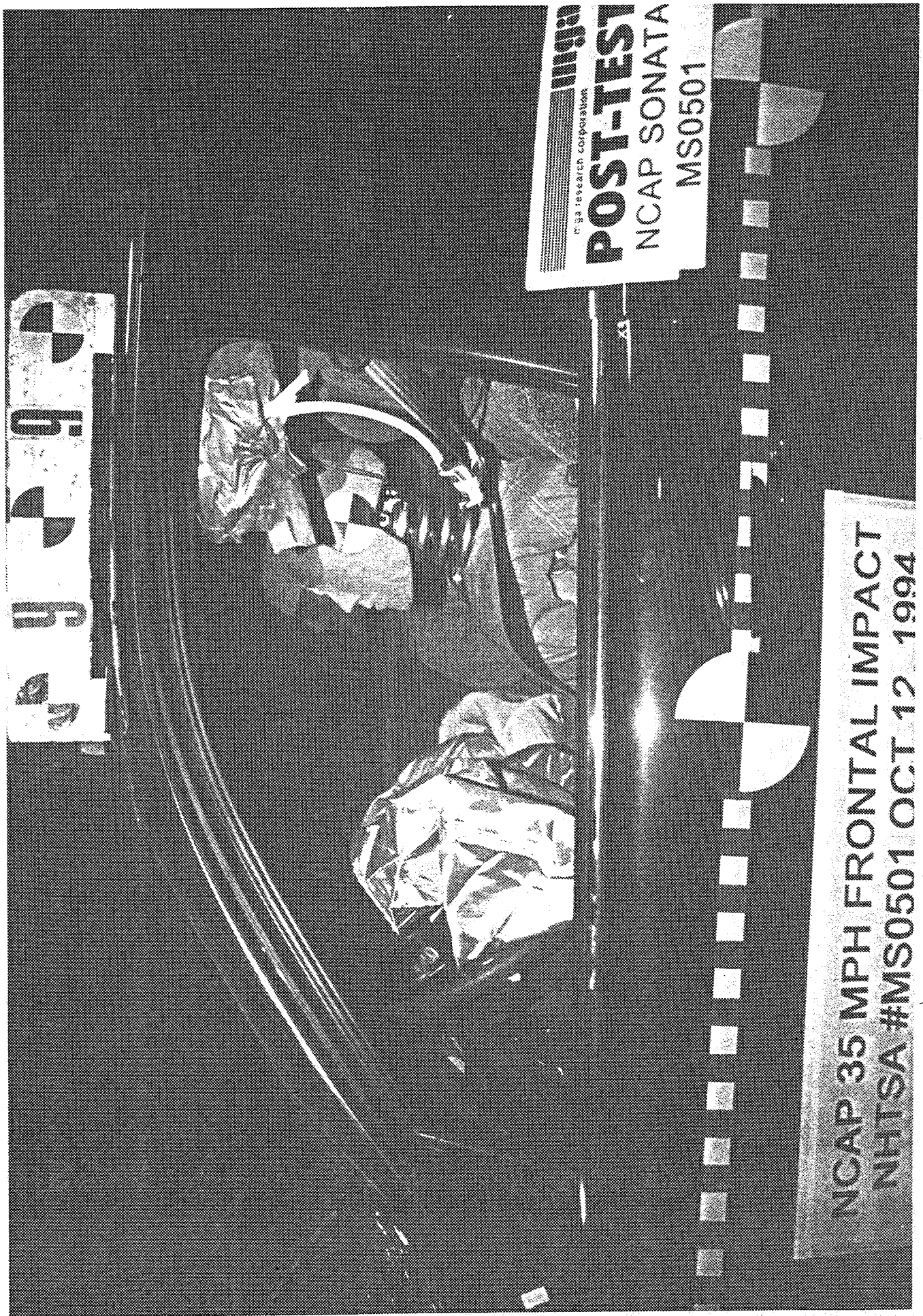


Photo No. A-23 - Post-Test Driver Dummy Position Left Side View

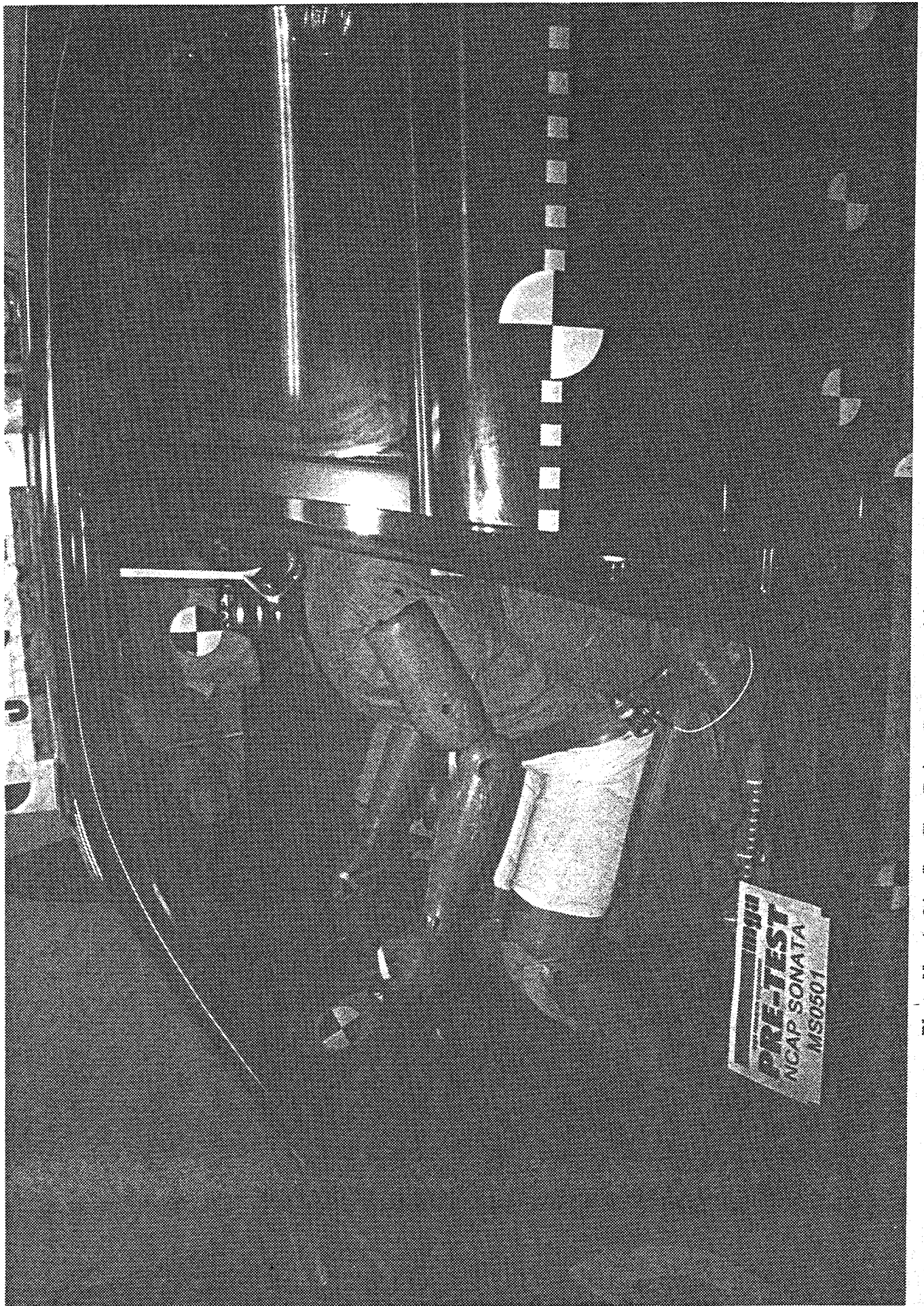


Photo No. A-24 - Pre-Test Driver Dummy Position Left Side View (Door Open)



Photo No. A-25 - Post-Test Driver Dummy Position Left Side View (Door Open)

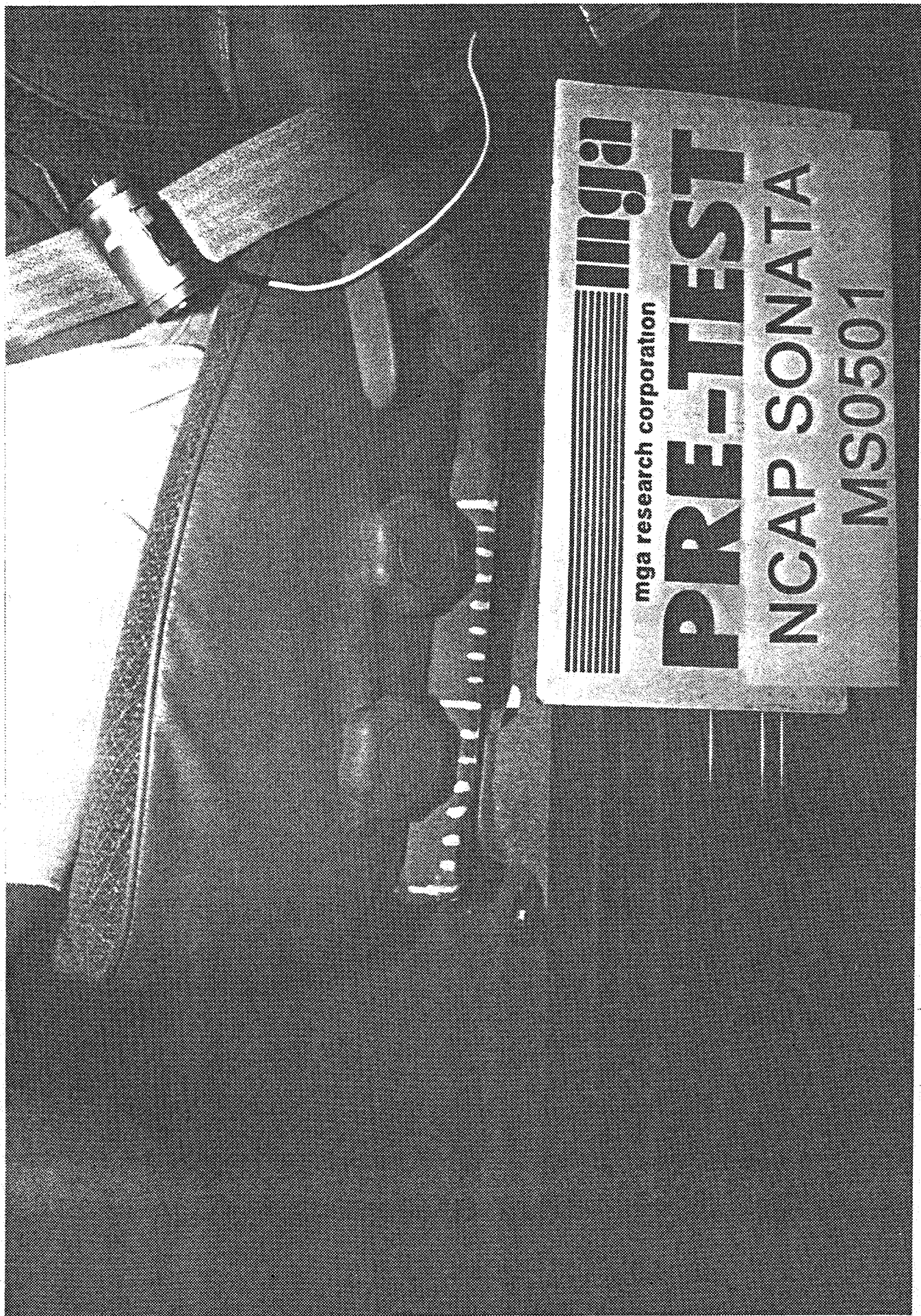


Photo No. A-26 - Pre-Test Driver Seat Position View

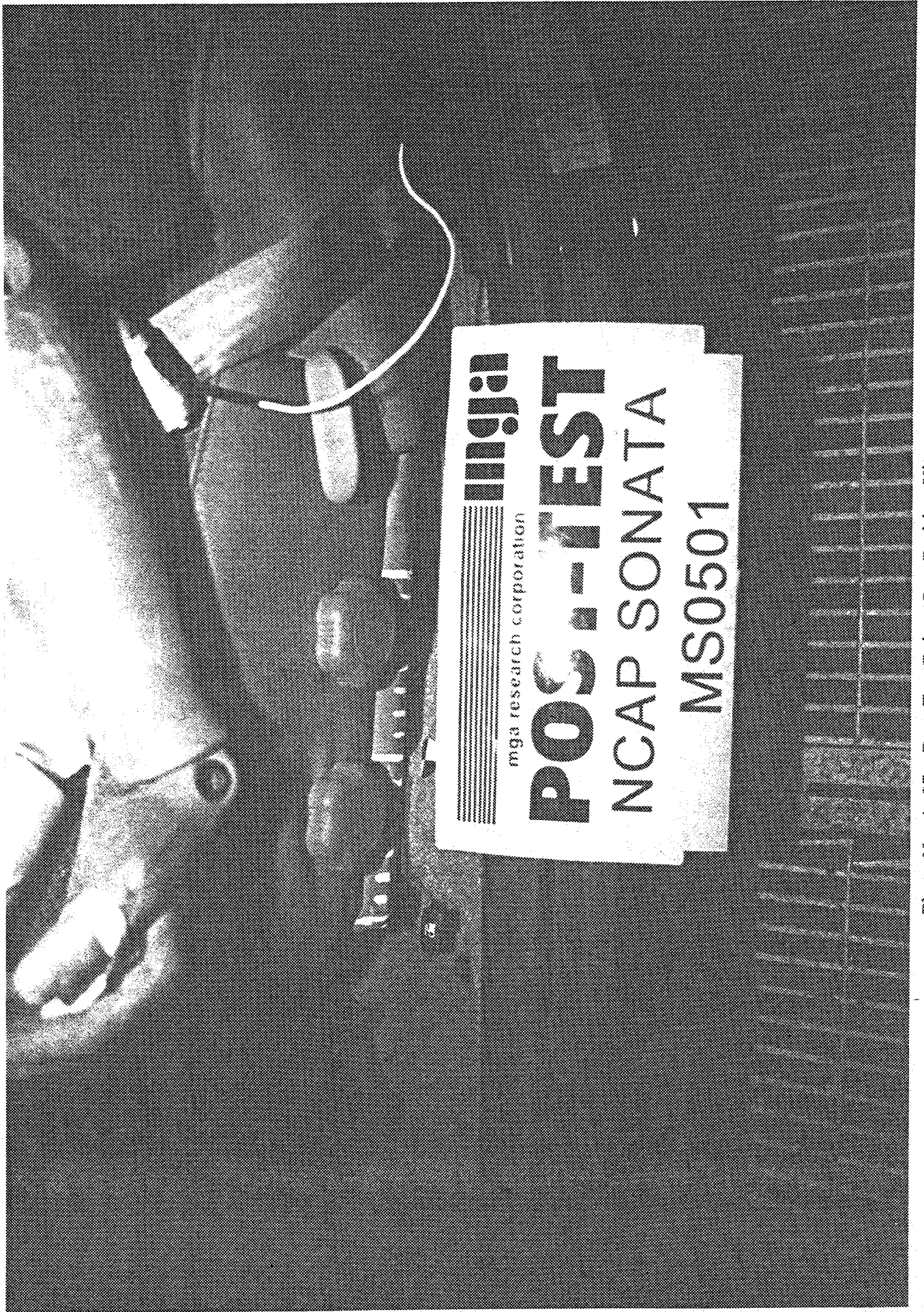


Photo No. A-27 - Post-Test Driver Seat Position View

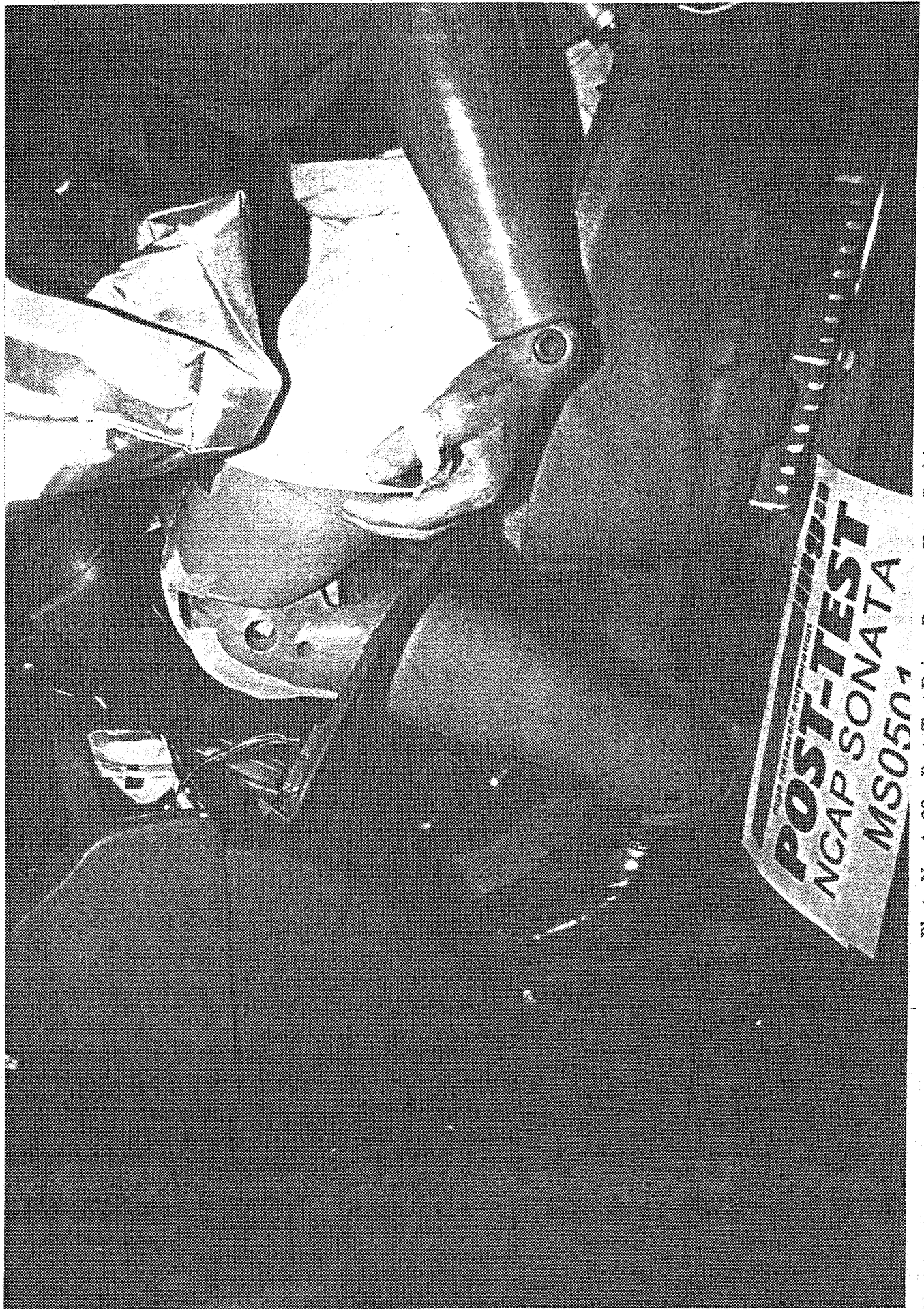


Photo No. A-28 - Post-Test Driver Dummy Knee Position

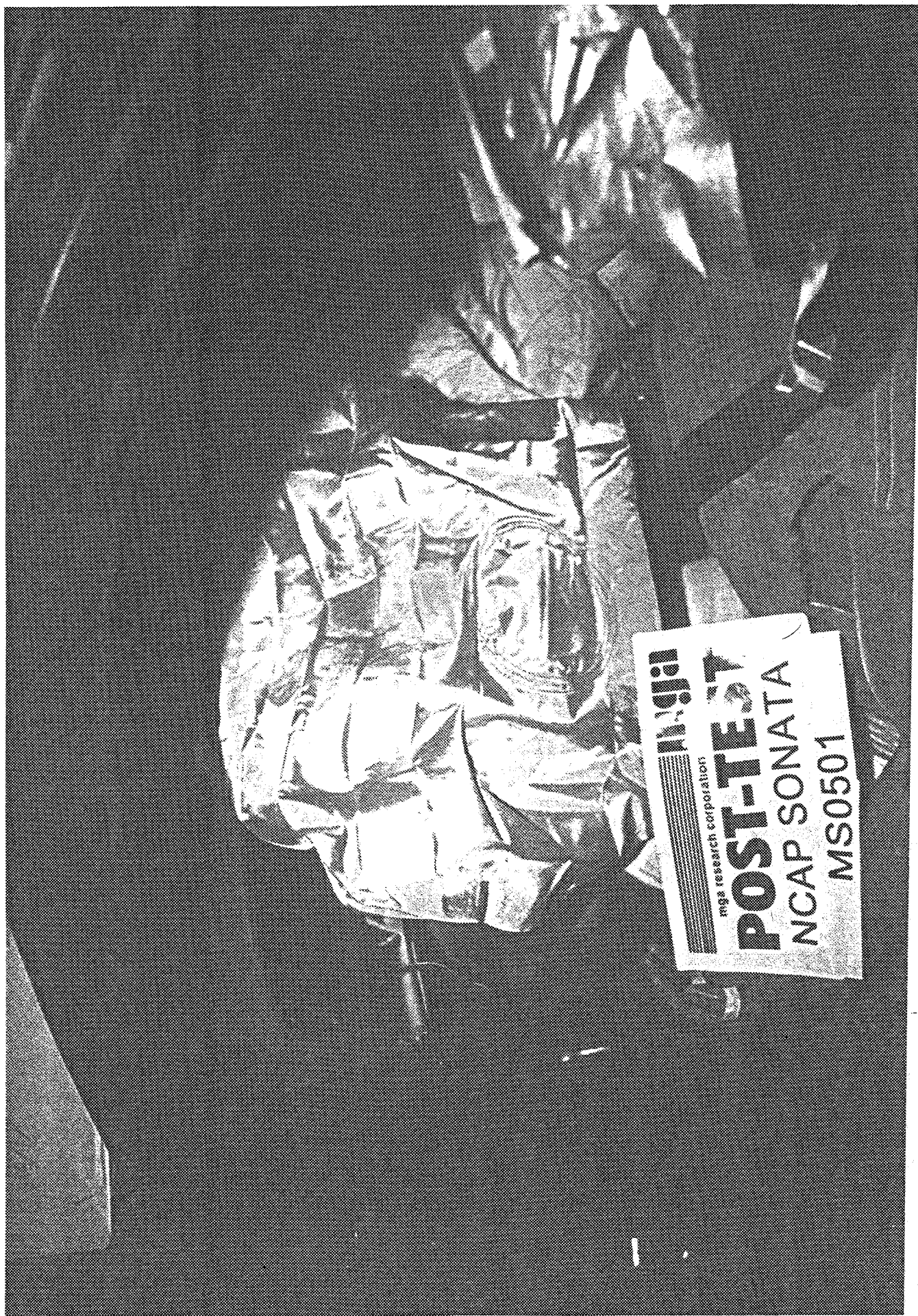


Photo No. A-29 - Post-Test Driver Airbag Contact

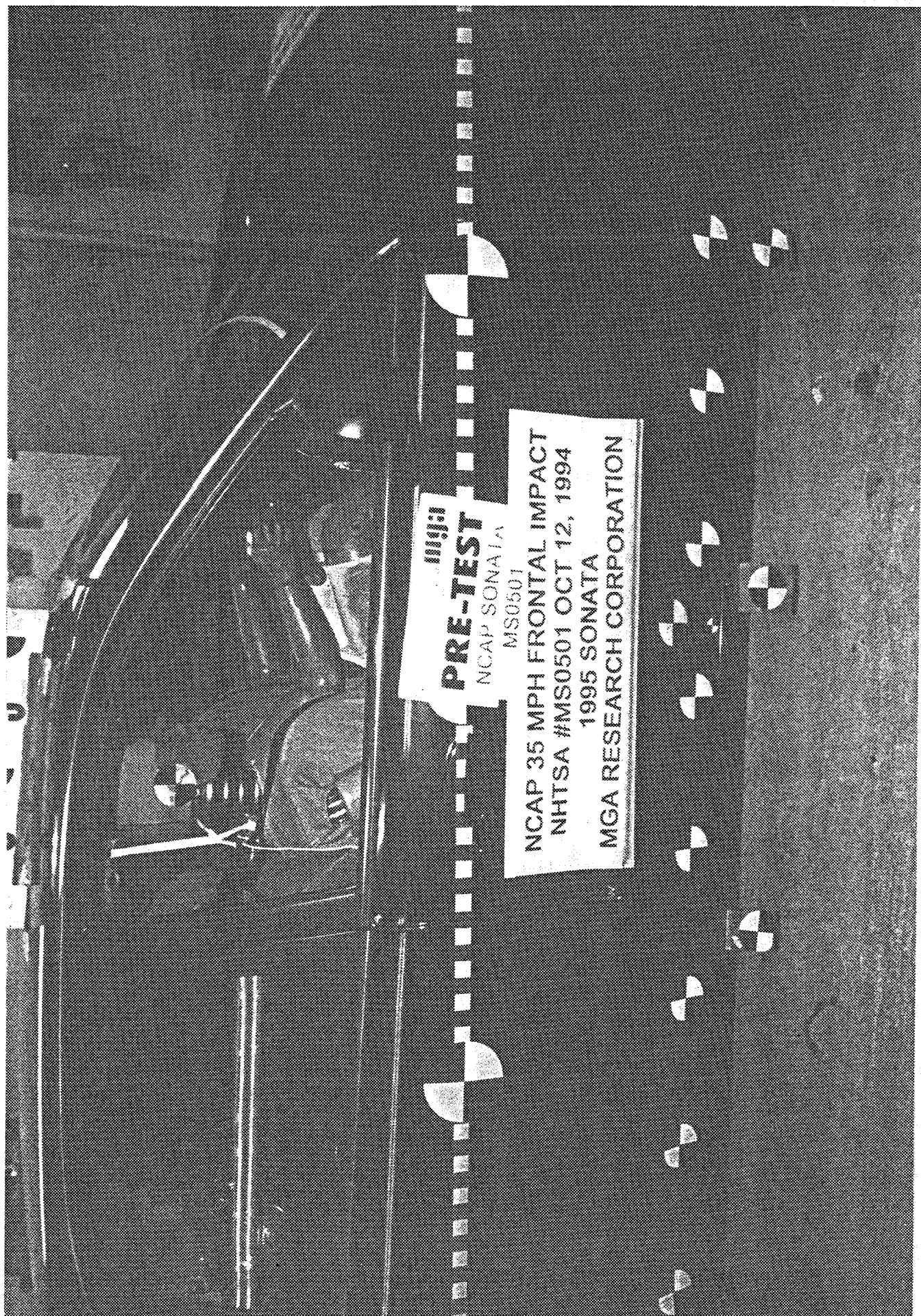


Photo No. A-30 - Pre-Test Passenger Dummy Position Right Side View

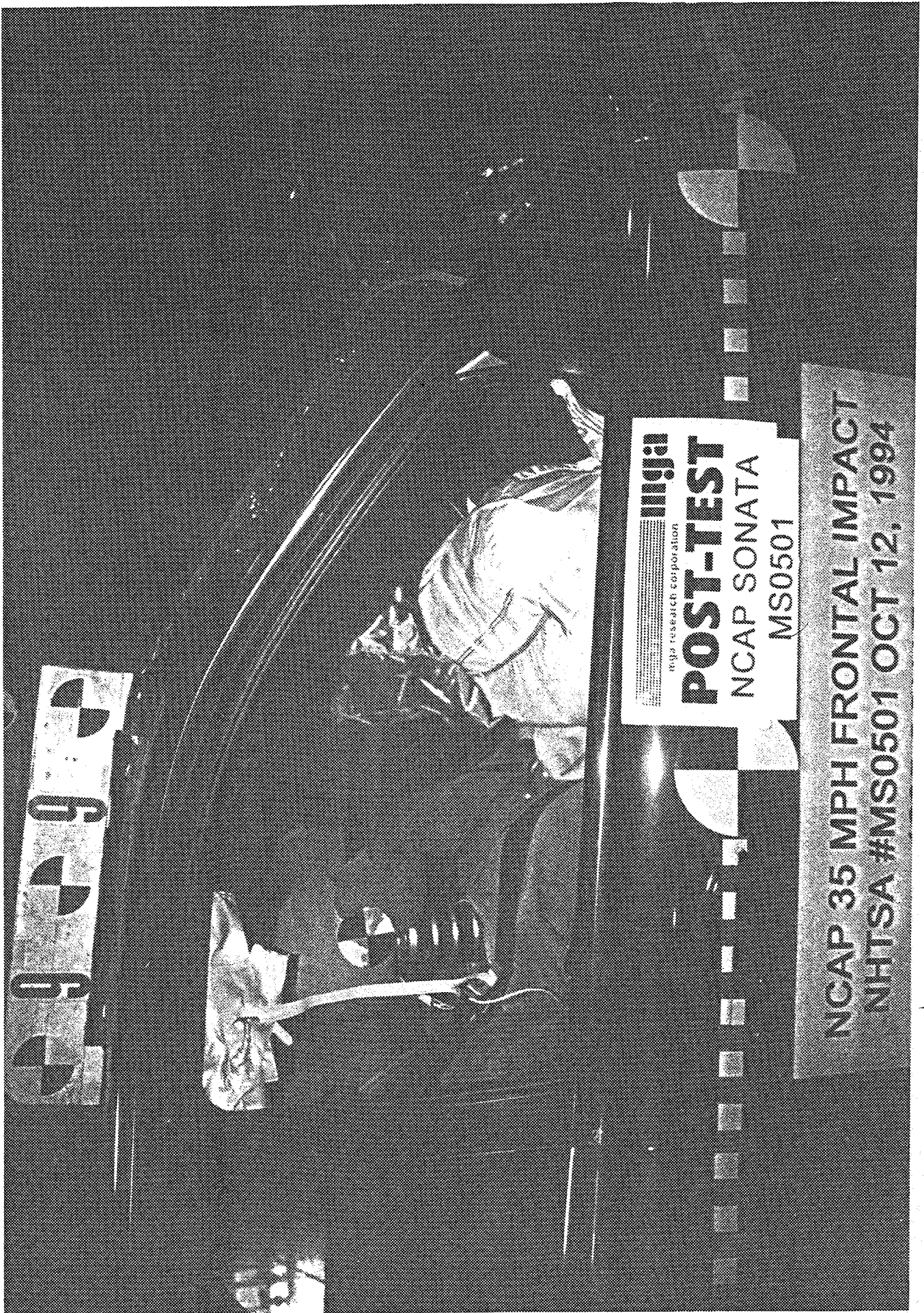


Photo No. A-31 - Post-Test Passenger Dummy Position Right Side View

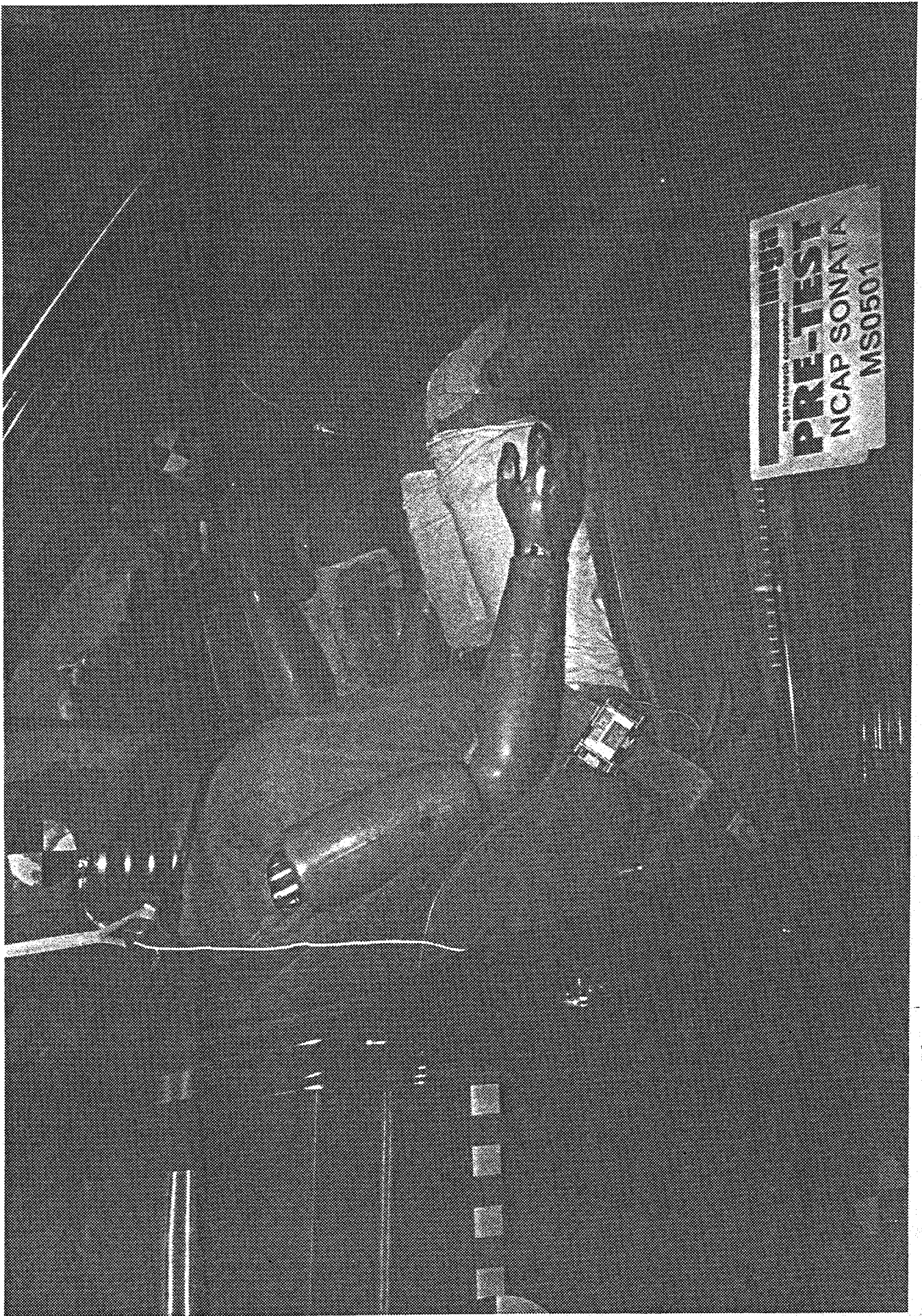


Photo No. A-32 - Pre-Test Passenger Dummy Position Right Side View (Door Open)

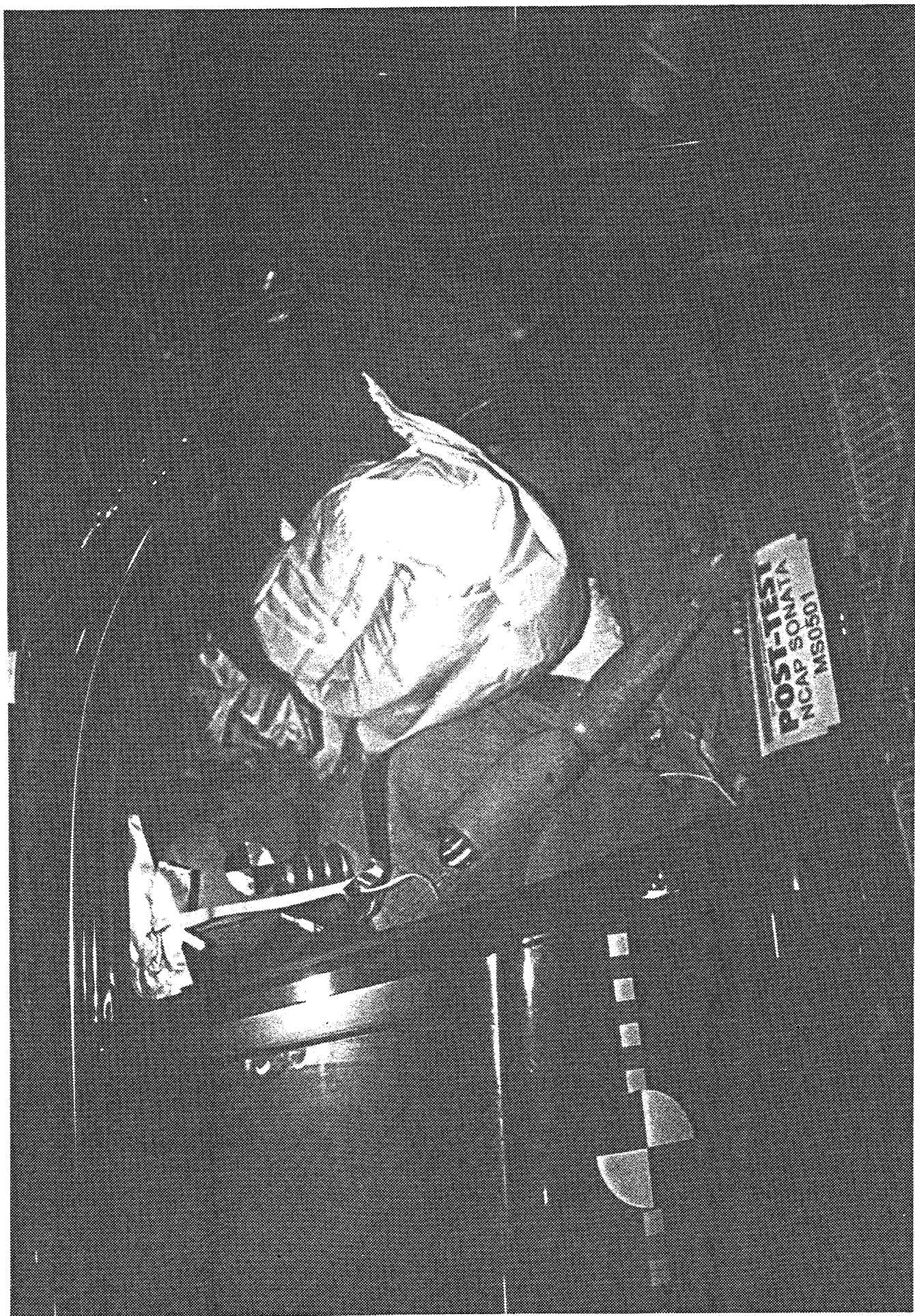


Photo No. A-33 - Post-Test Passenger Dummy Position Right Side View (Door Open)

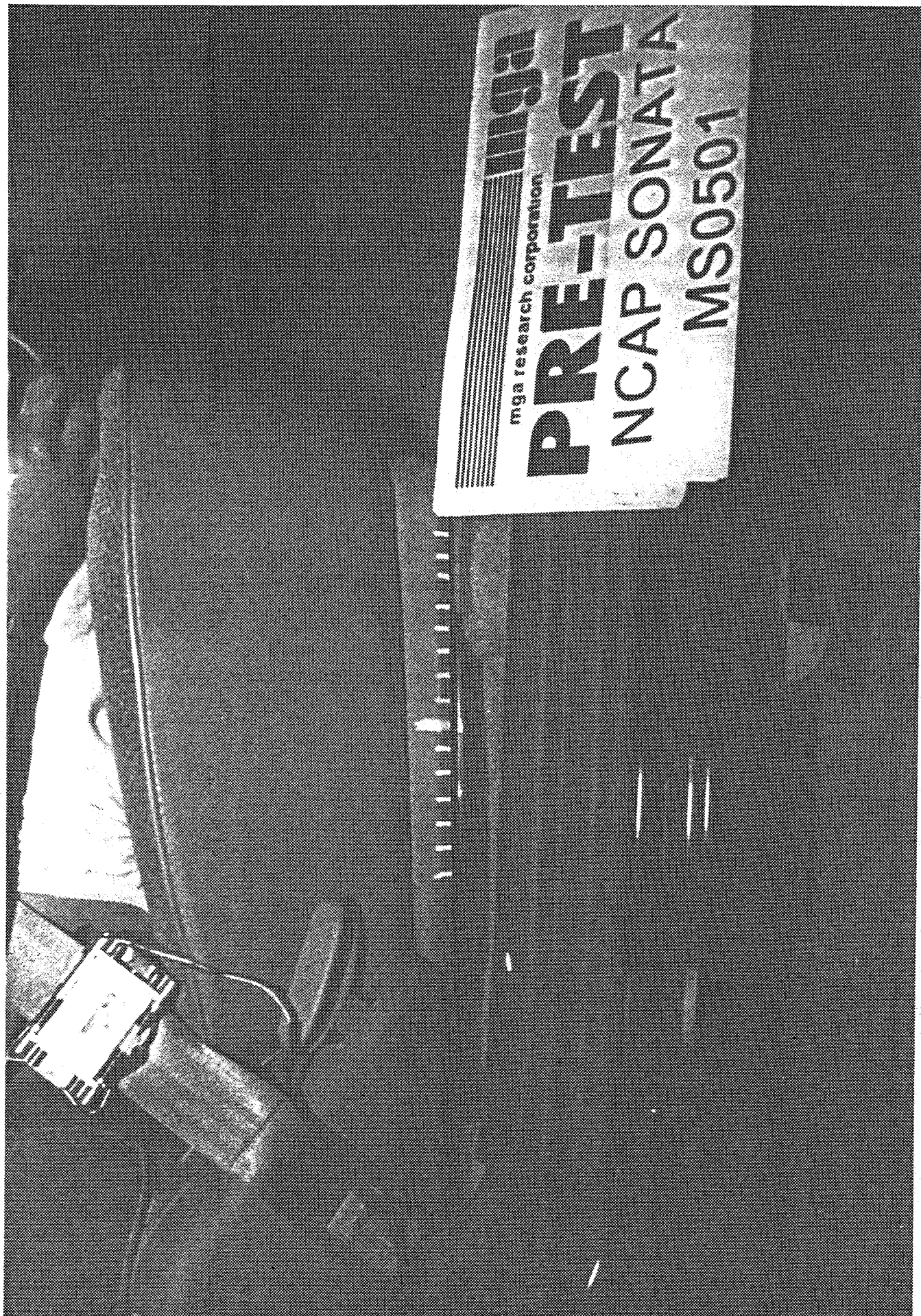


Photo No. A-34 - Pre-Test Passenger Seat Position View

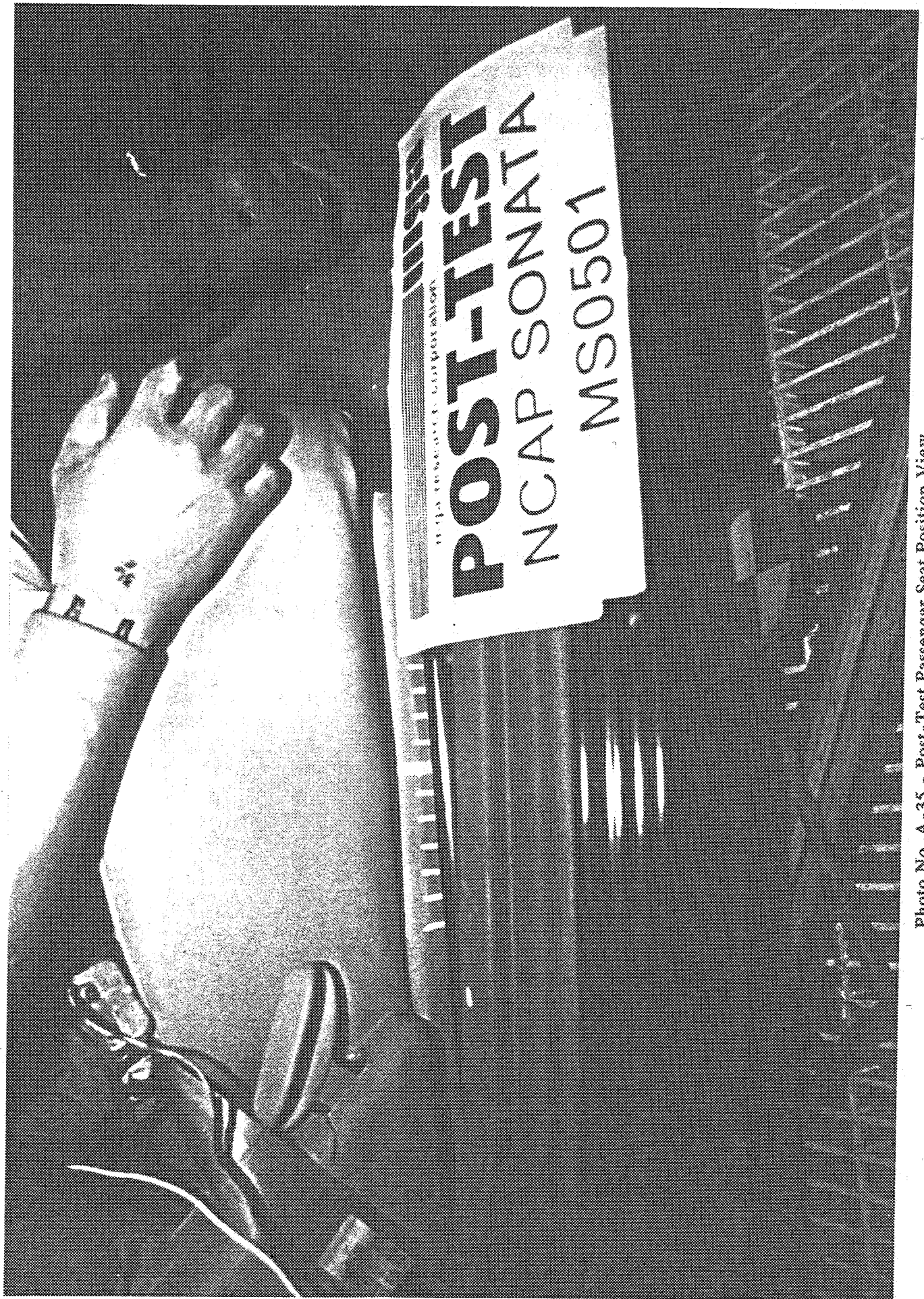


Photo No. A-35 - Post-Test Passenger Seat Position View

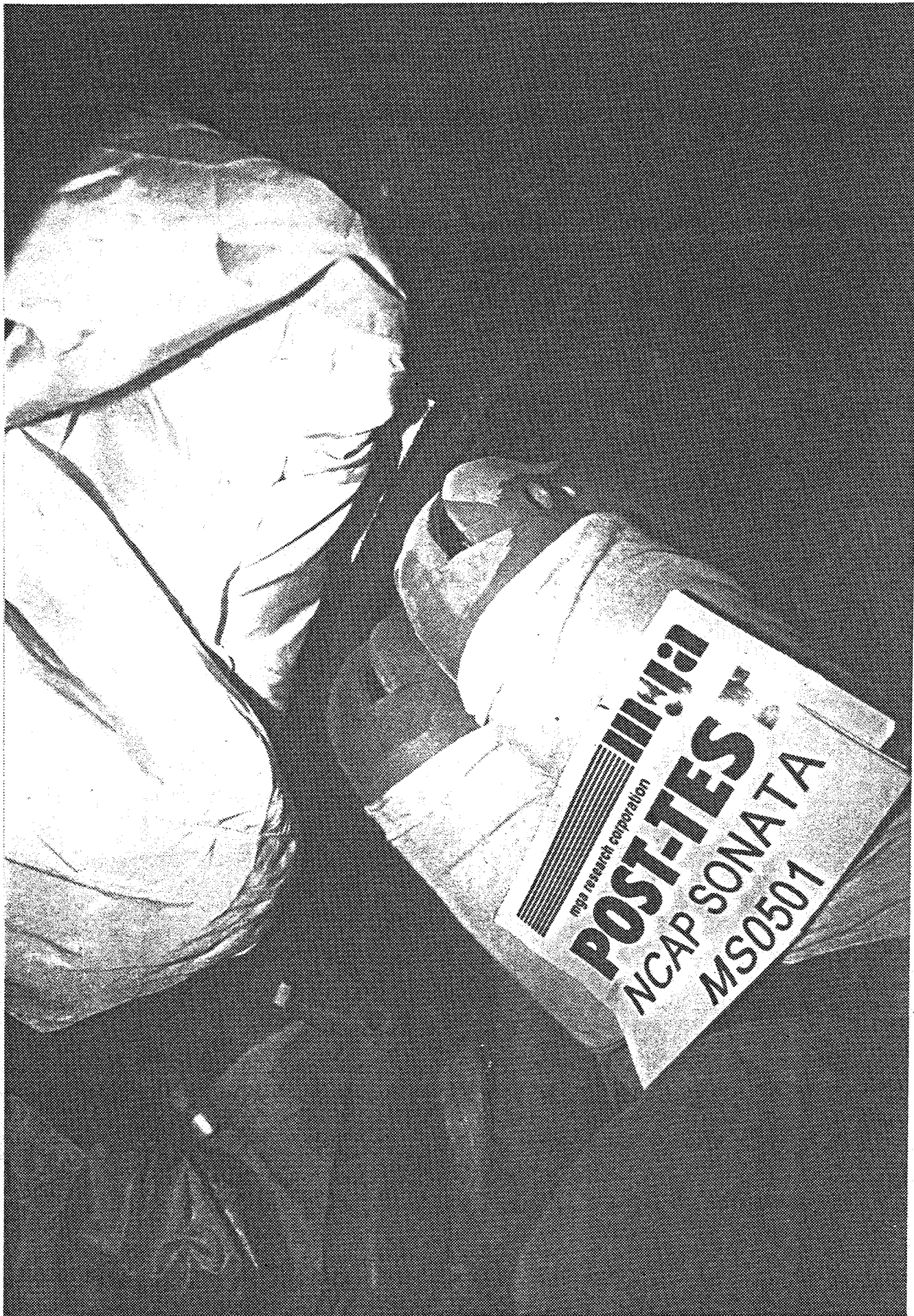


Photo No. A-36 - Post-Test Passenger Dummy Knee Position

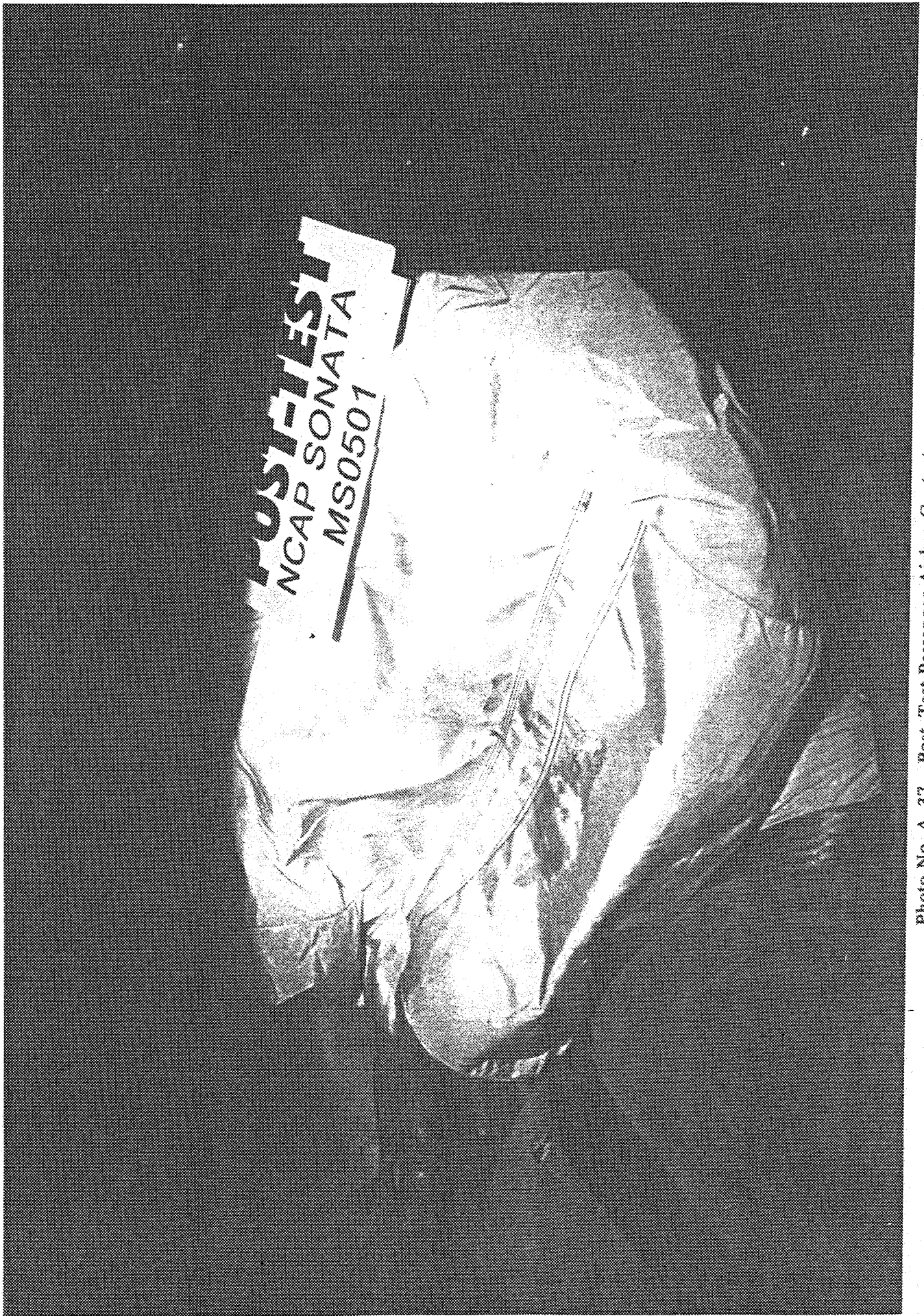


Photo No. A-37 - Post-Test Passenger Airbag Contact

MANUFACTURED IN KOREA BY
HYUNDAI MOTOR COMPANY

PAINT

3870 LBS

GVWR

JUN/16/94

GAWR
FRONT

2194 LBS

GAWR
REAR

1918 LBS

TRIM



THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S.A. FEDERAL
MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

V.I.N.

KMHCF21F0SU193915

PASSENGER CAR

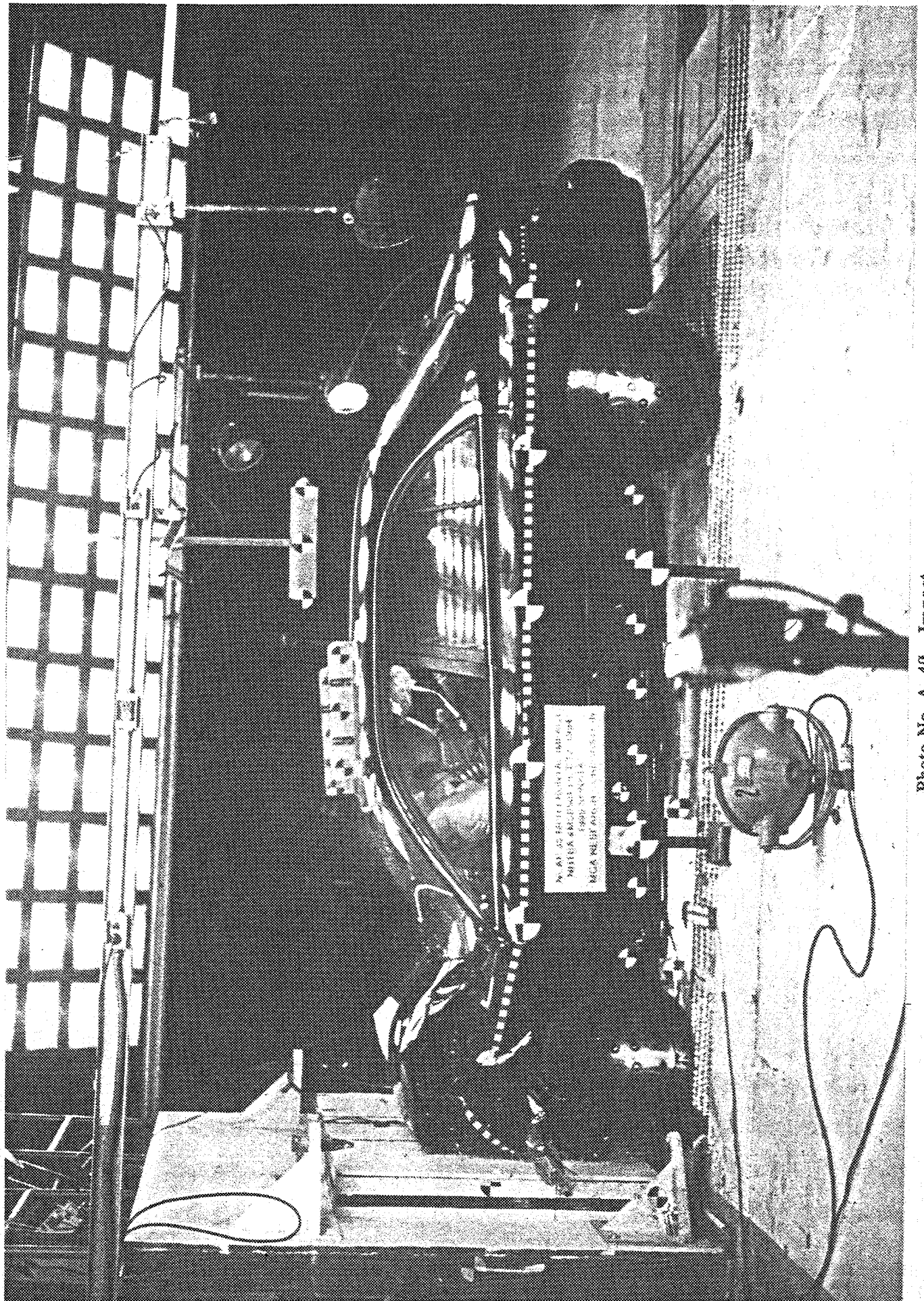


Photo No. A-40 - Impact

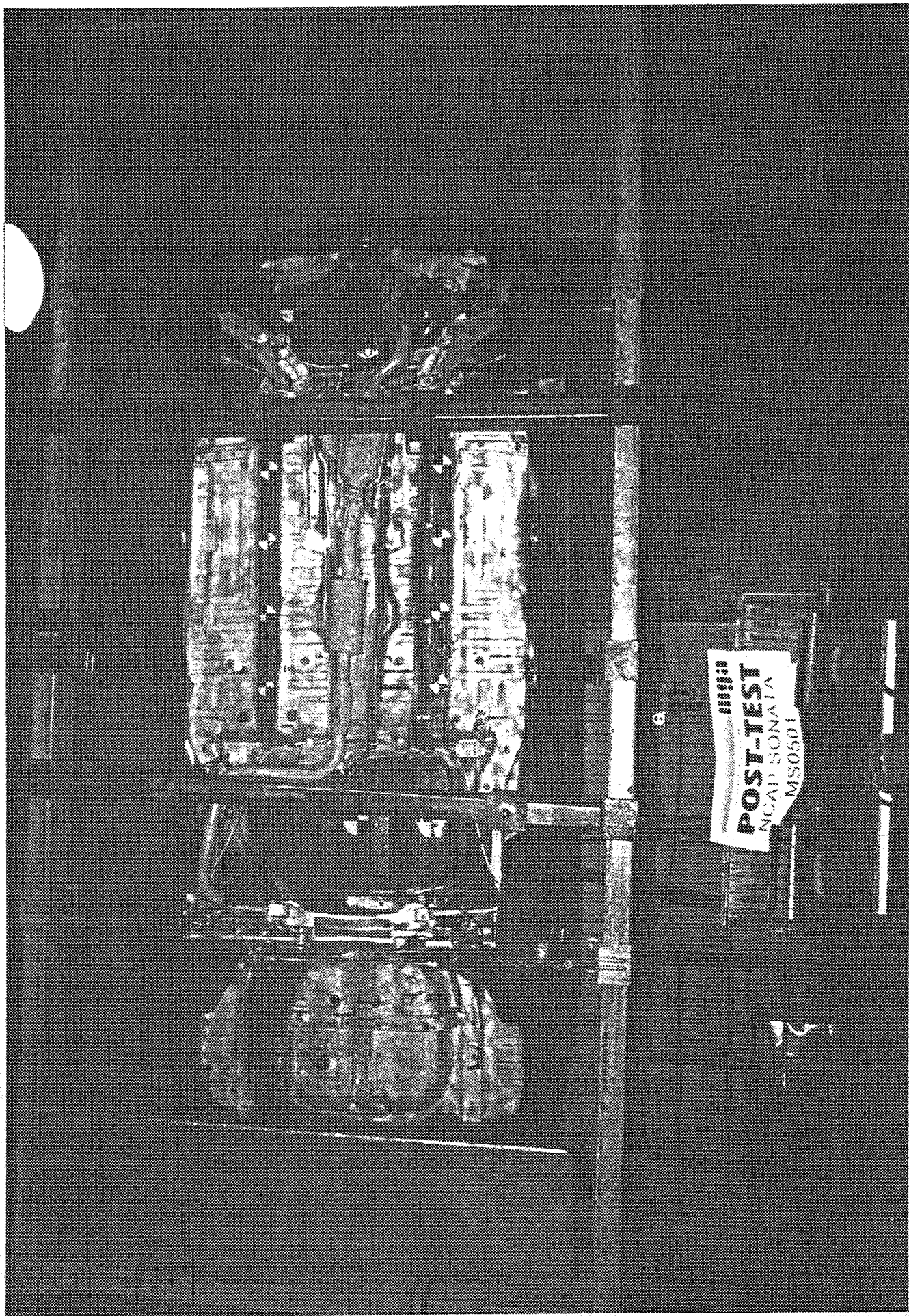


Photo No. A-41 - Rollover 90°

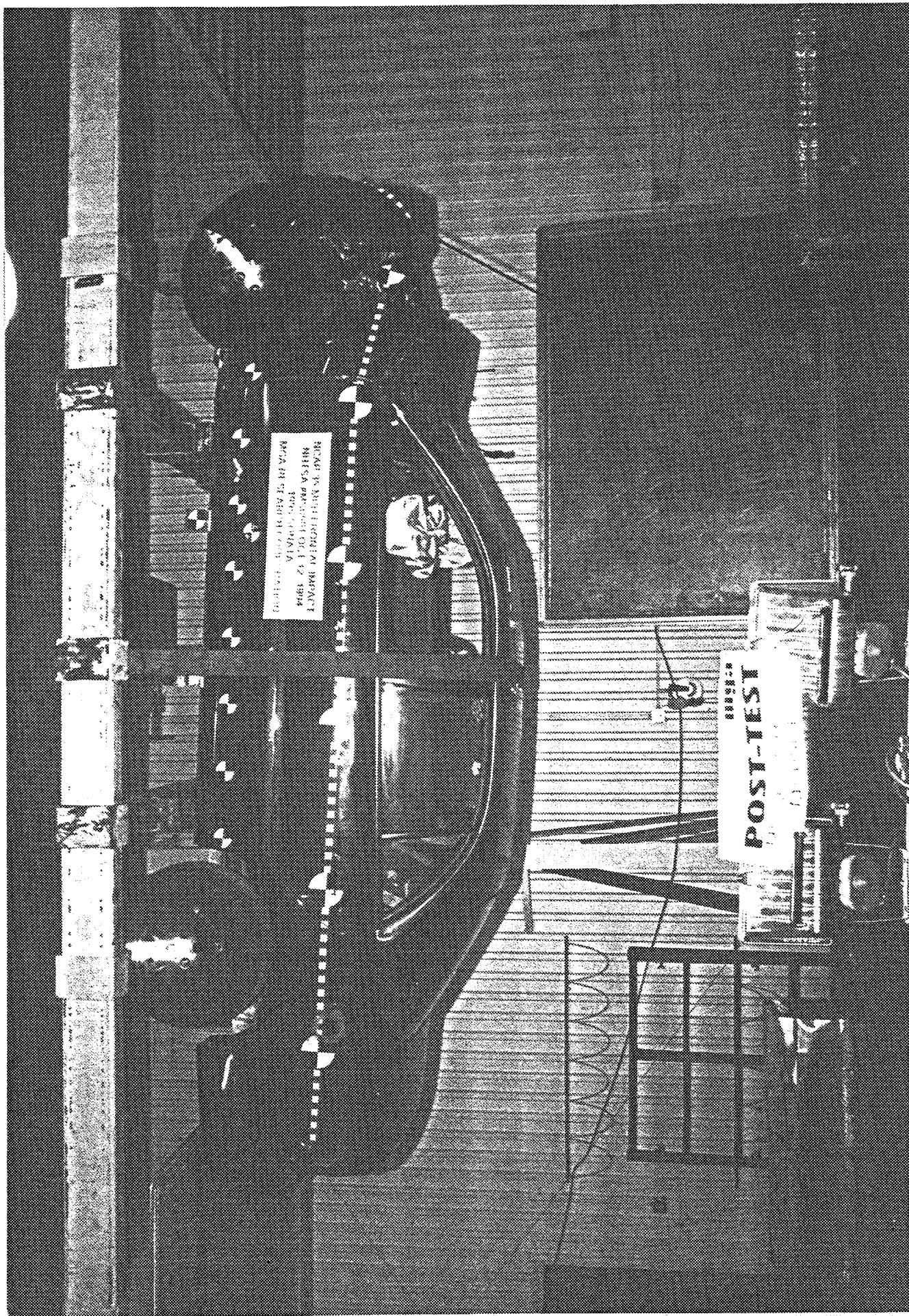


Photo No. A-42 - Rollover 180°

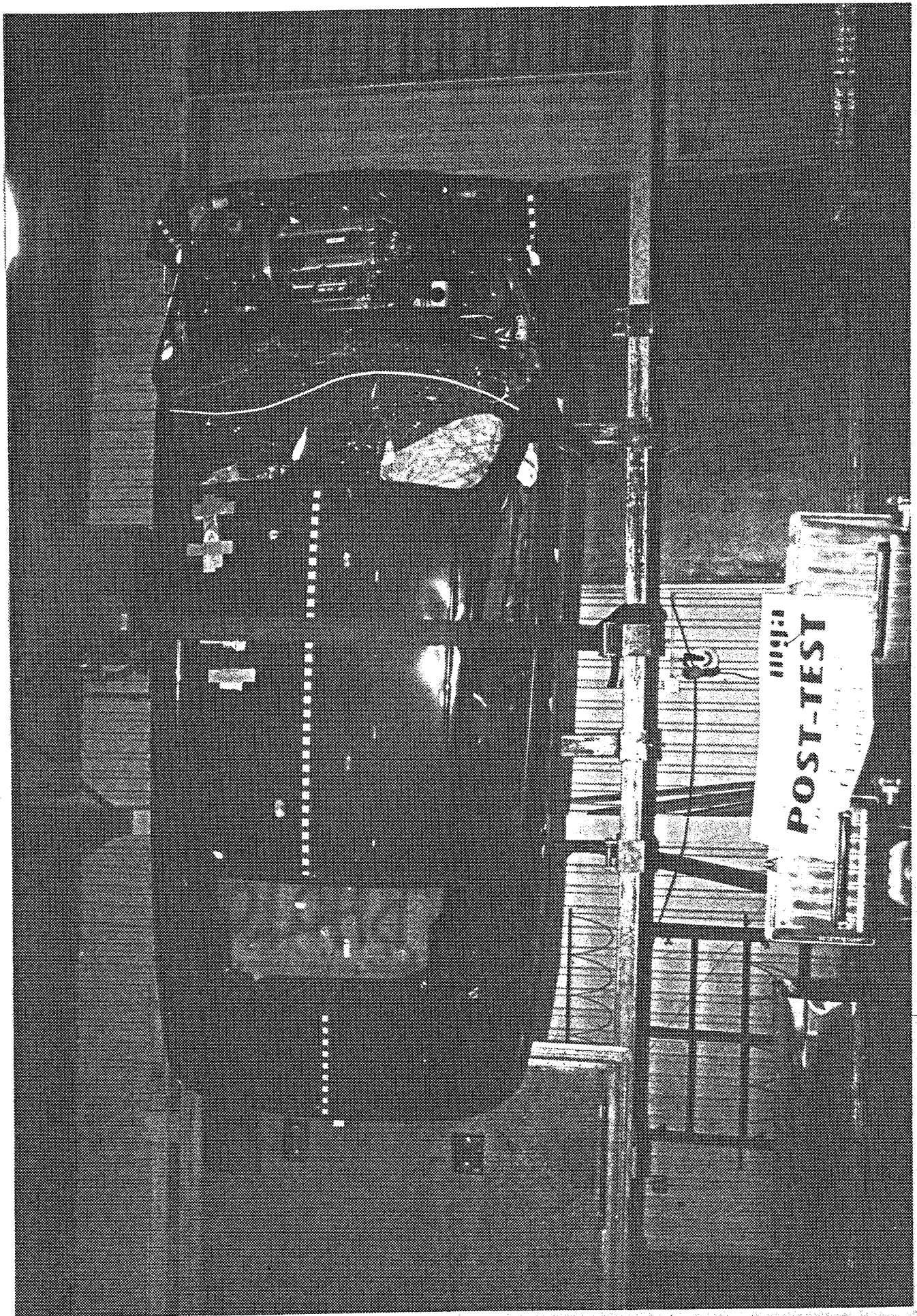


Photo No. A-43 - Rollover 270°

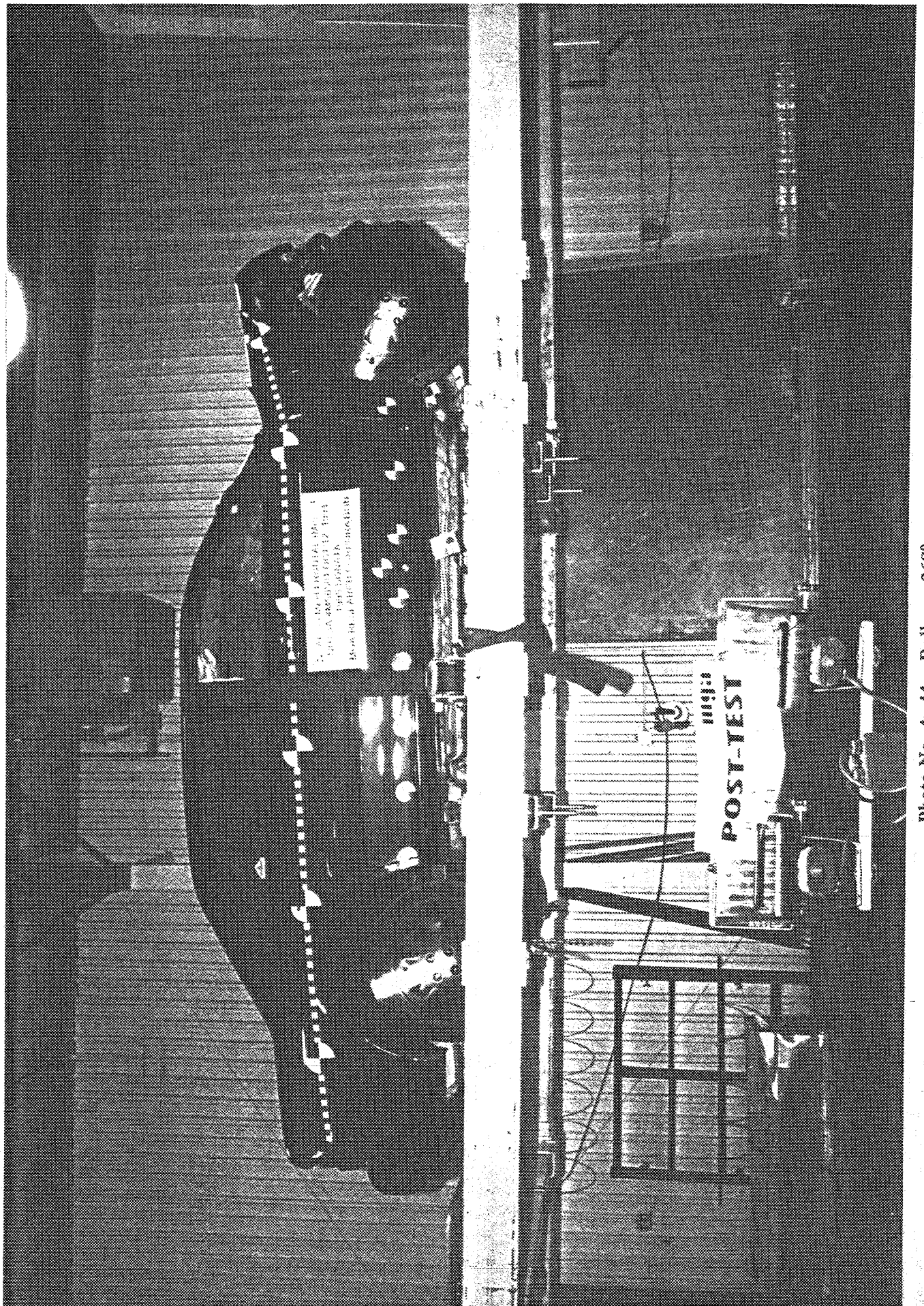


Photo No. A-44 - Rollover 360°

APPENDIX B
Vehicle, Load Cell Barrier and Dummy Response Data

1995 Hyundai Sonata 4-Door
NHTSA NO.: MS0501

<u>VEHICLE DATA</u>	<u>FILTER CHANNEL CLASS</u>
Head Accelerations	1000 (1650 Hz)
Chest Accelerometers	180 (300 Hz)
Vehicle Accelerometers	60 (100 Hz)
Barrier Load Cells	60 (100 Hz)
Femur Load Cells	600 (1000 Hz)
Lap and Torso Belts	60 (100 Hz)

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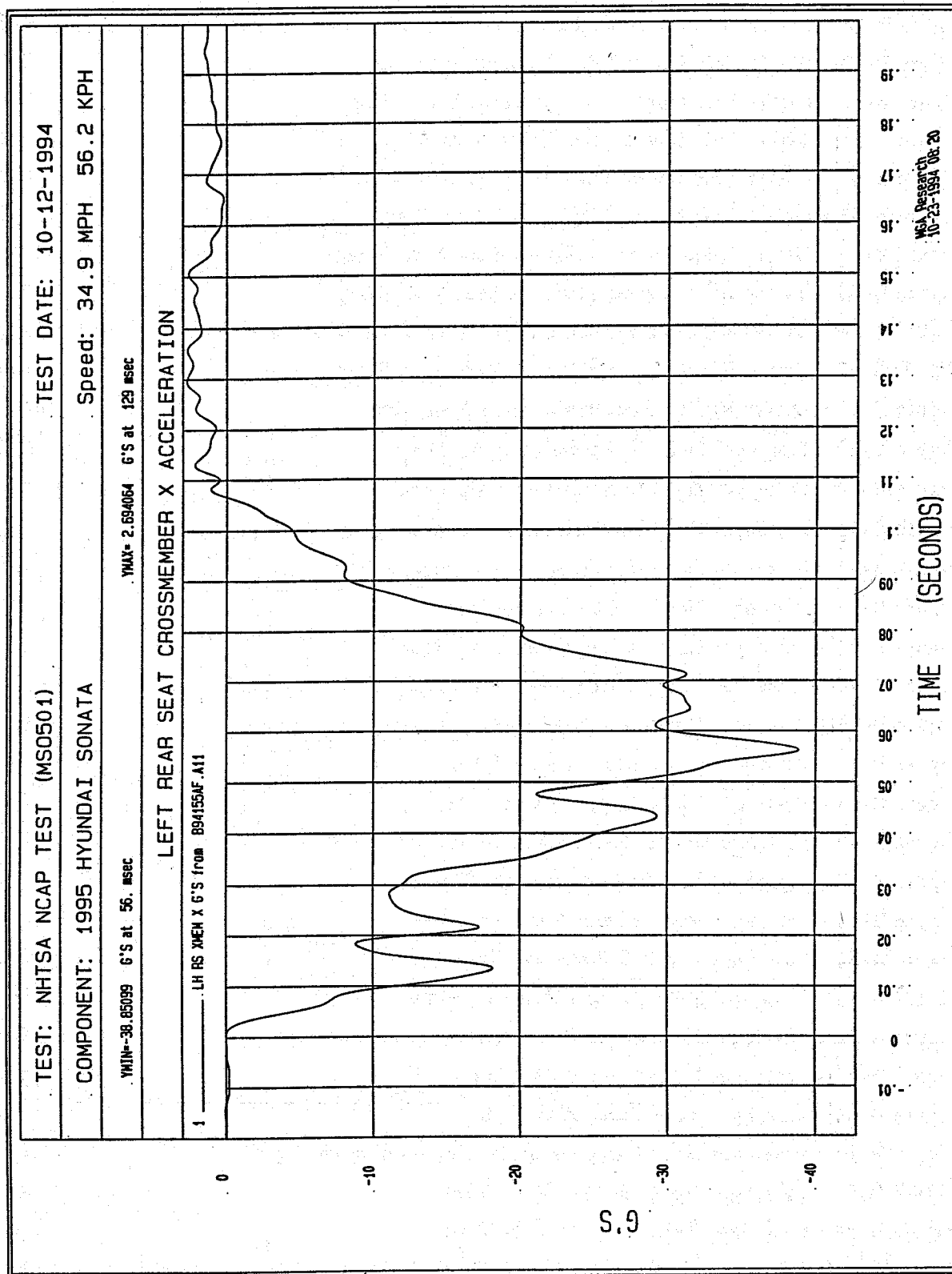


Figure B-1 - Left Rear Seat Crossmember X Acceleration vs. Time

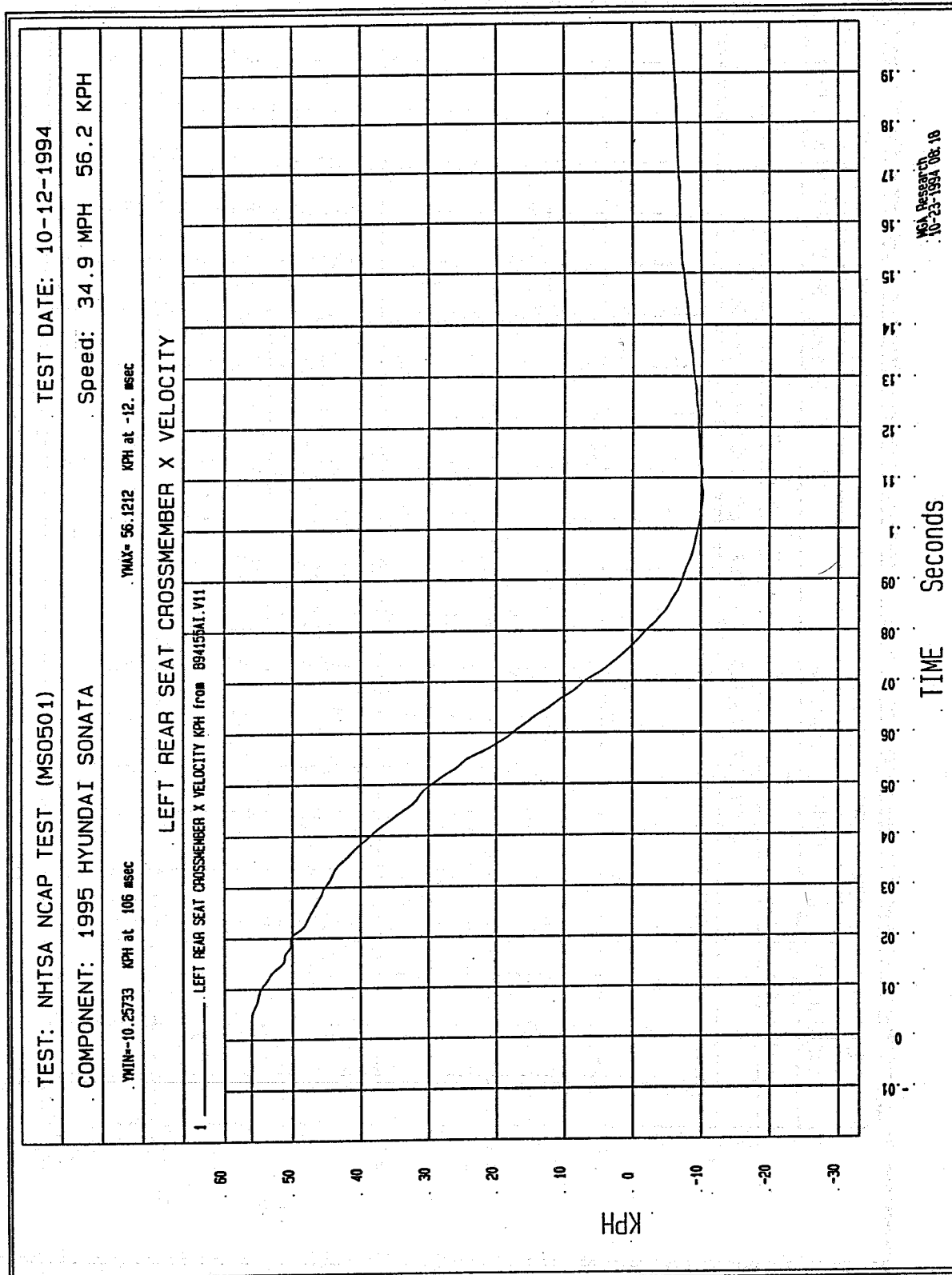


Figure B-2 - Left Rear Seat Crossmember X Velocity vs. Time

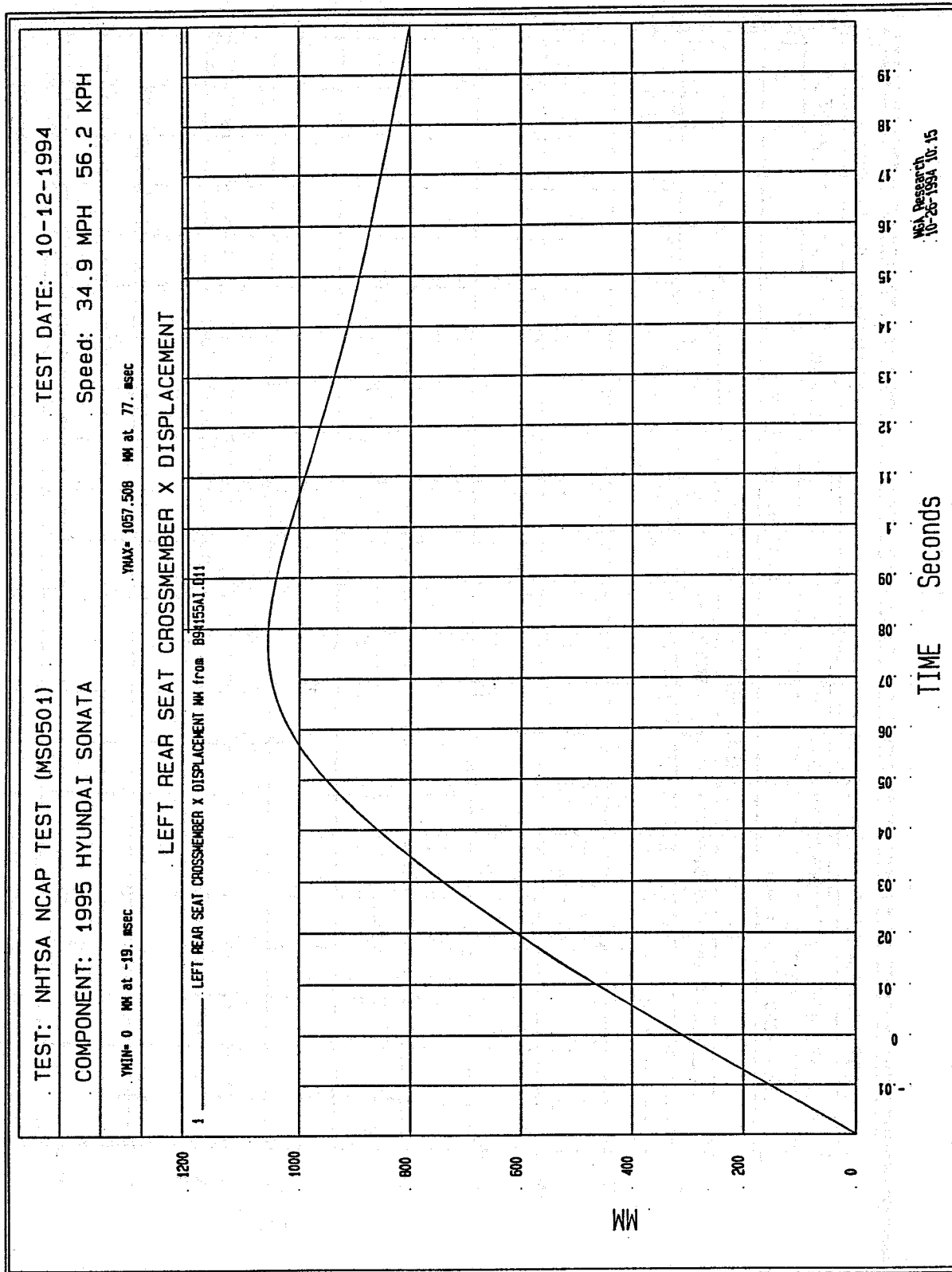


Figure B-3 - Left Rear Seat Crossmember X Displacement vs. Time

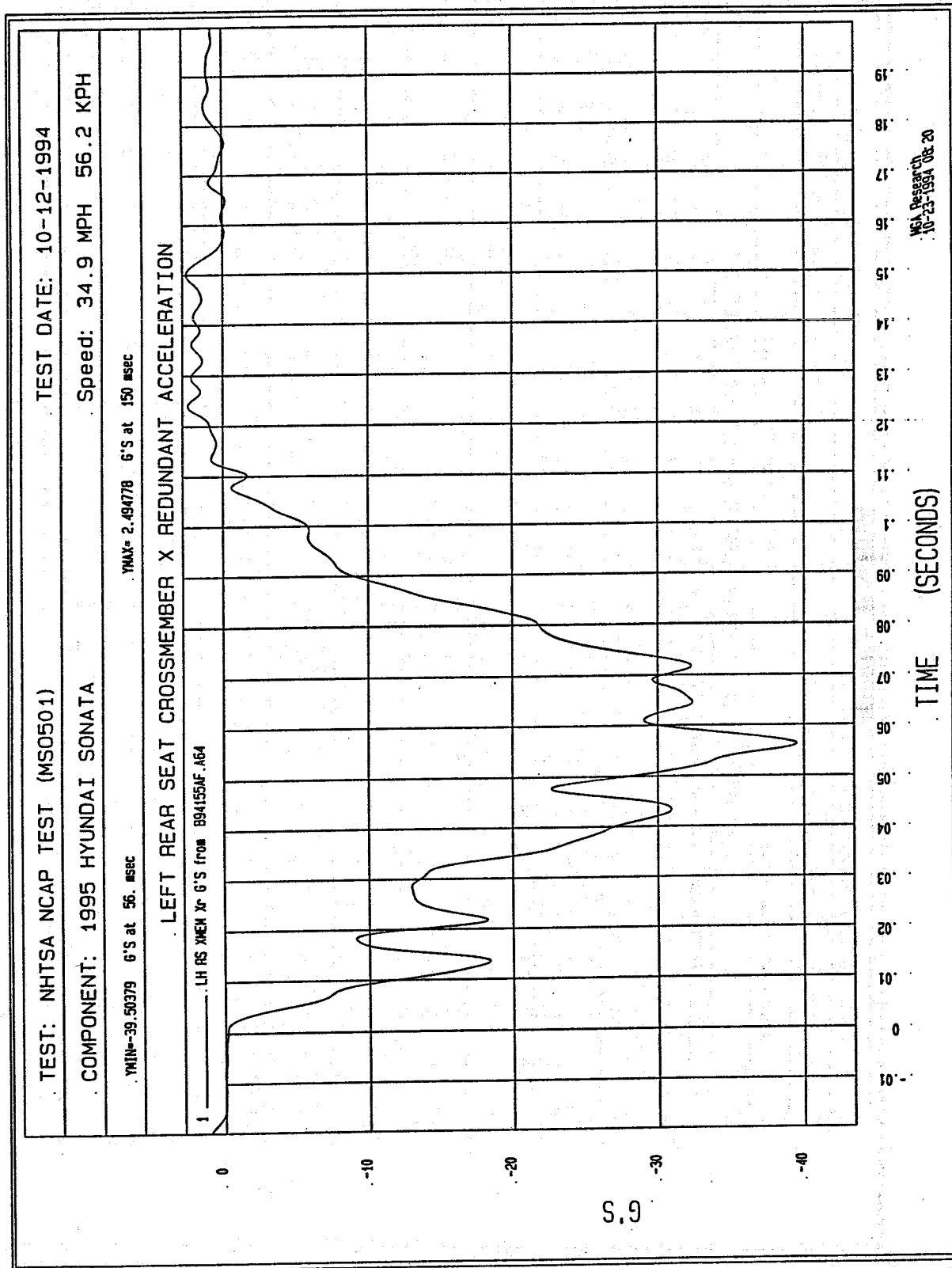


Figure B-4 - Left Rear Seat Crossmember X Redundant Acceleration vs. Time

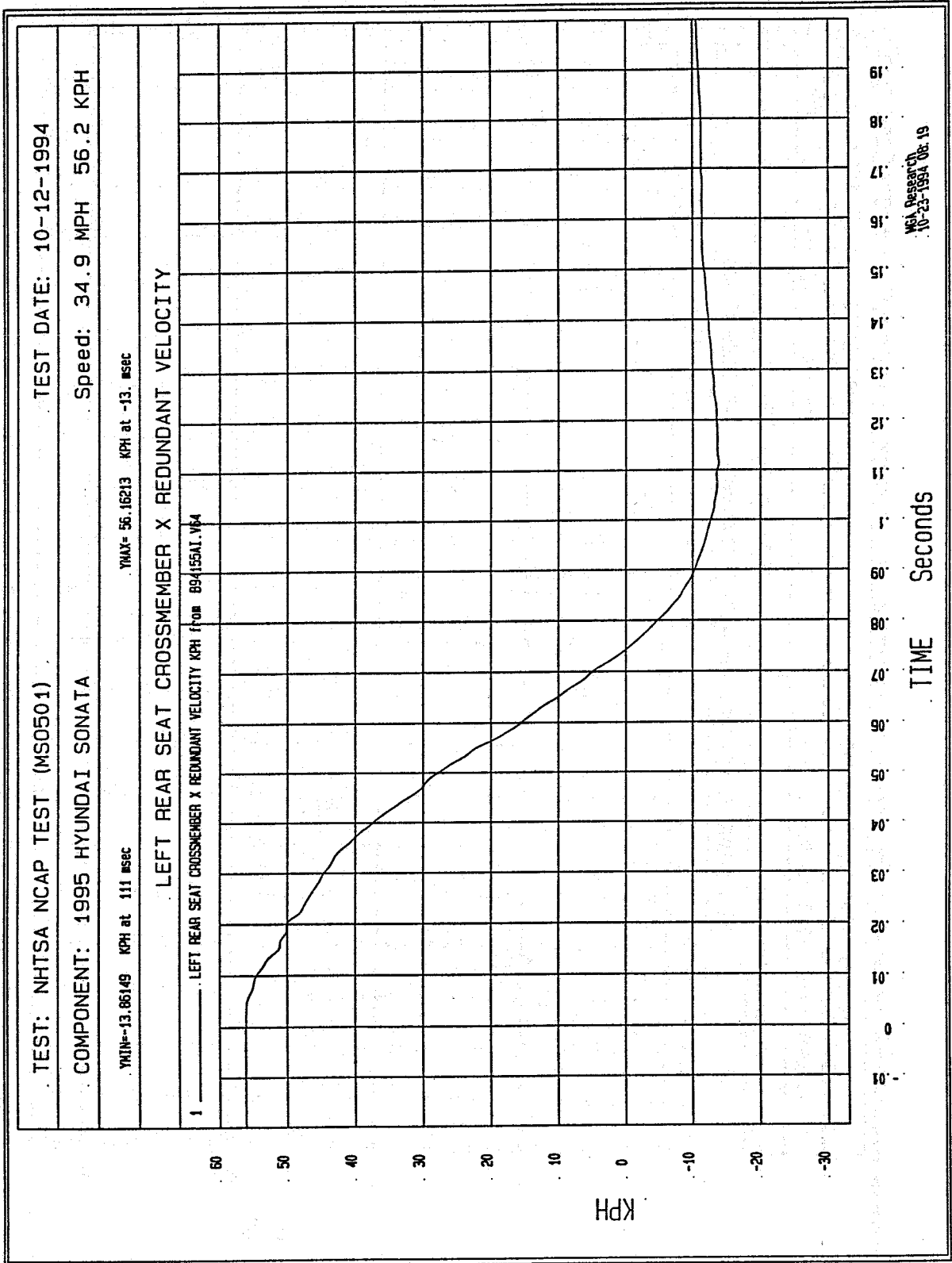


Figure B-5 - Left Rear Seat Crossmember X Redundant Velocity vs. Time

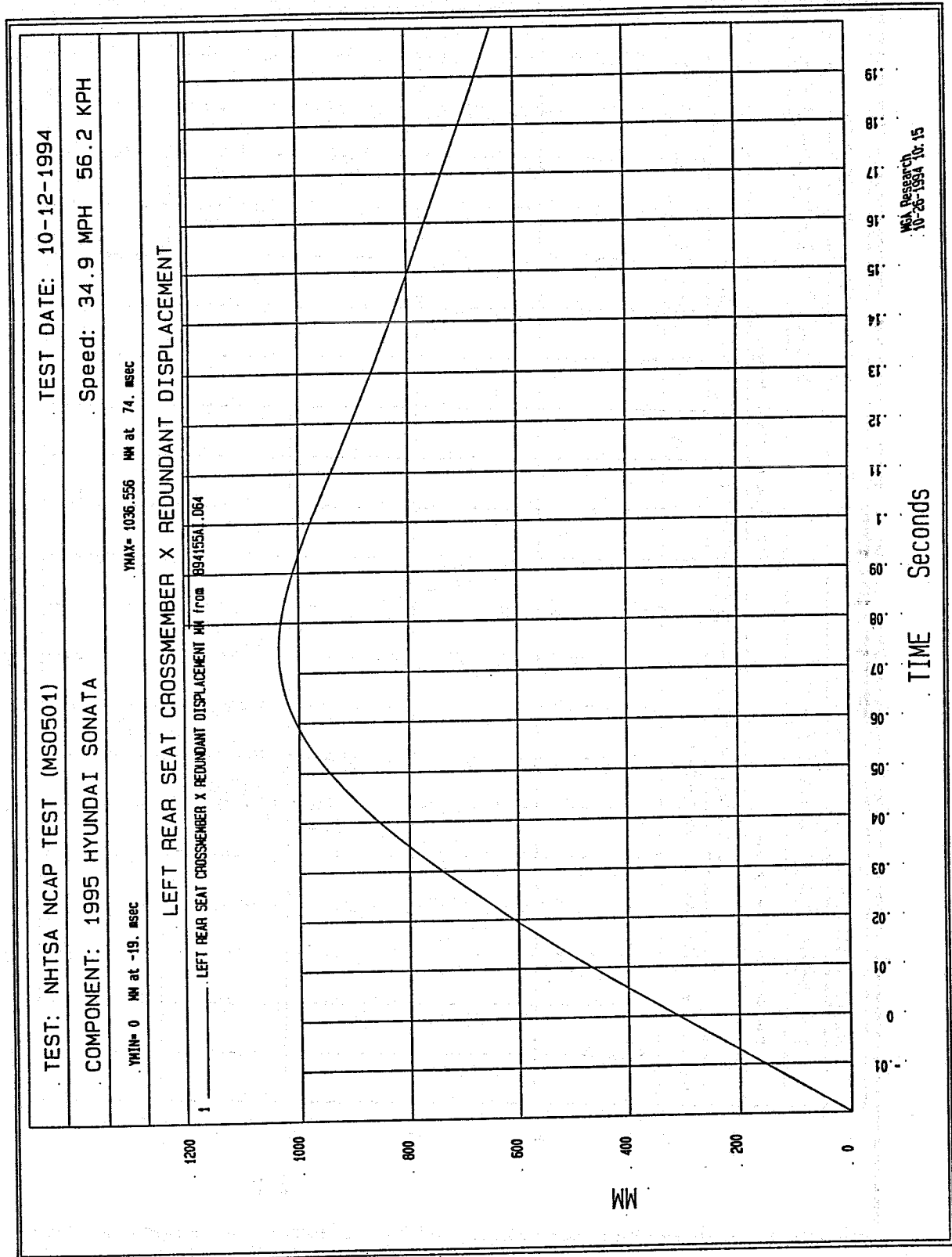


Figure B-6 - Left Rear Seat Crossmember X Redundant Displacement vs. Time

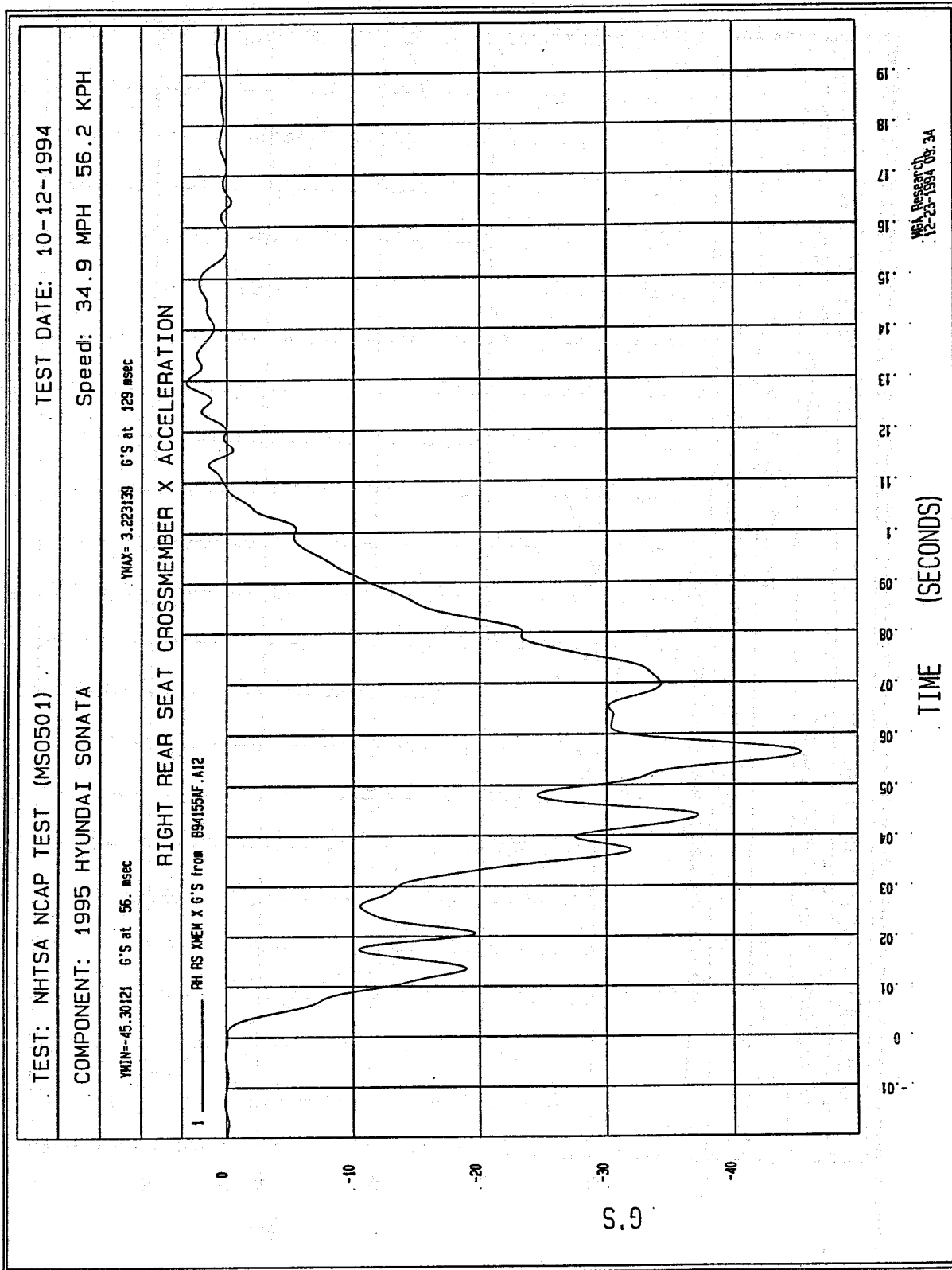


Figure B-7 - Right Rear Seat Crossmember X Acceleration vs. Time

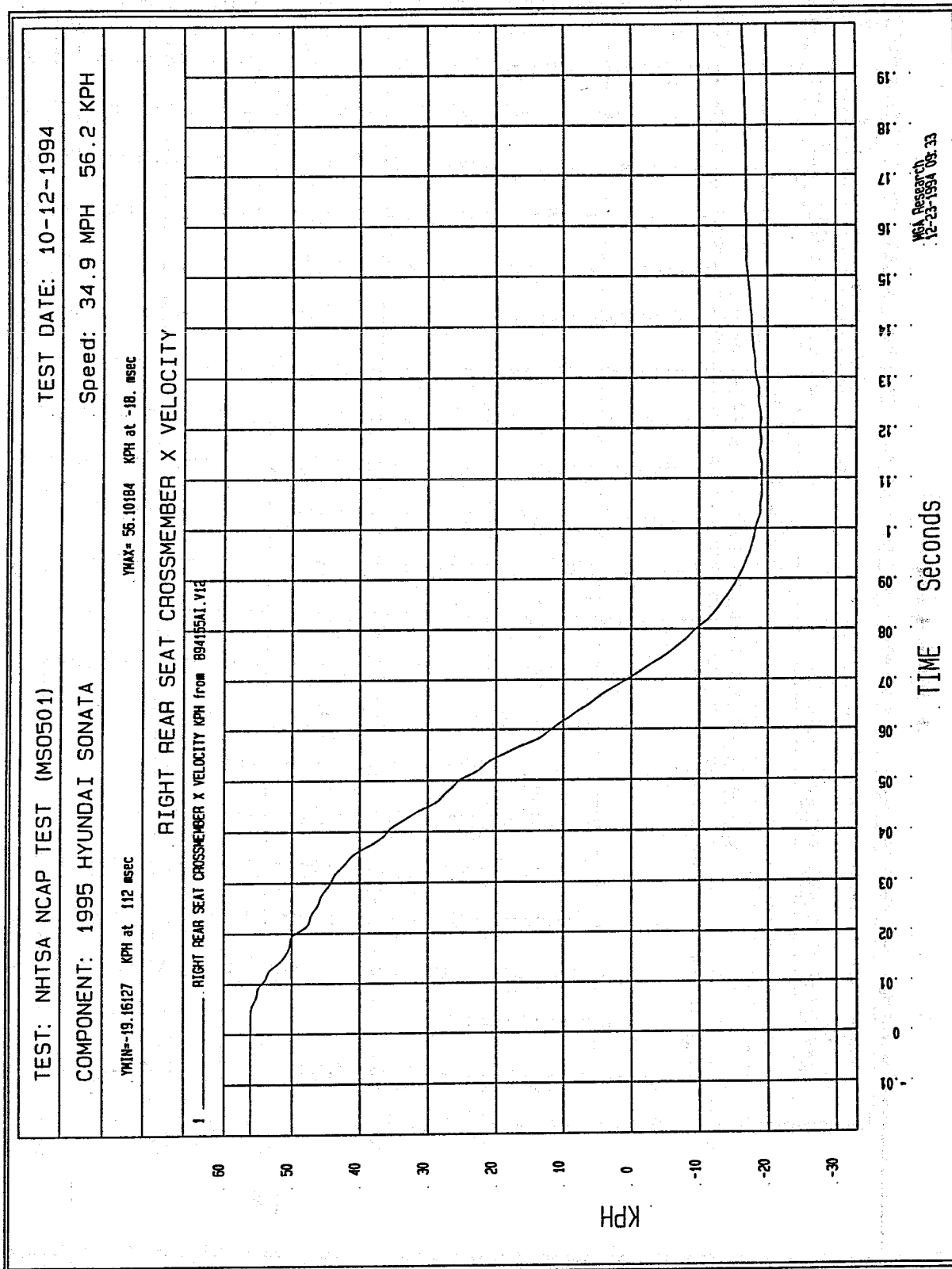

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Figure B-8 - Right Rear Seat Crossmember X Velocity vs. Time

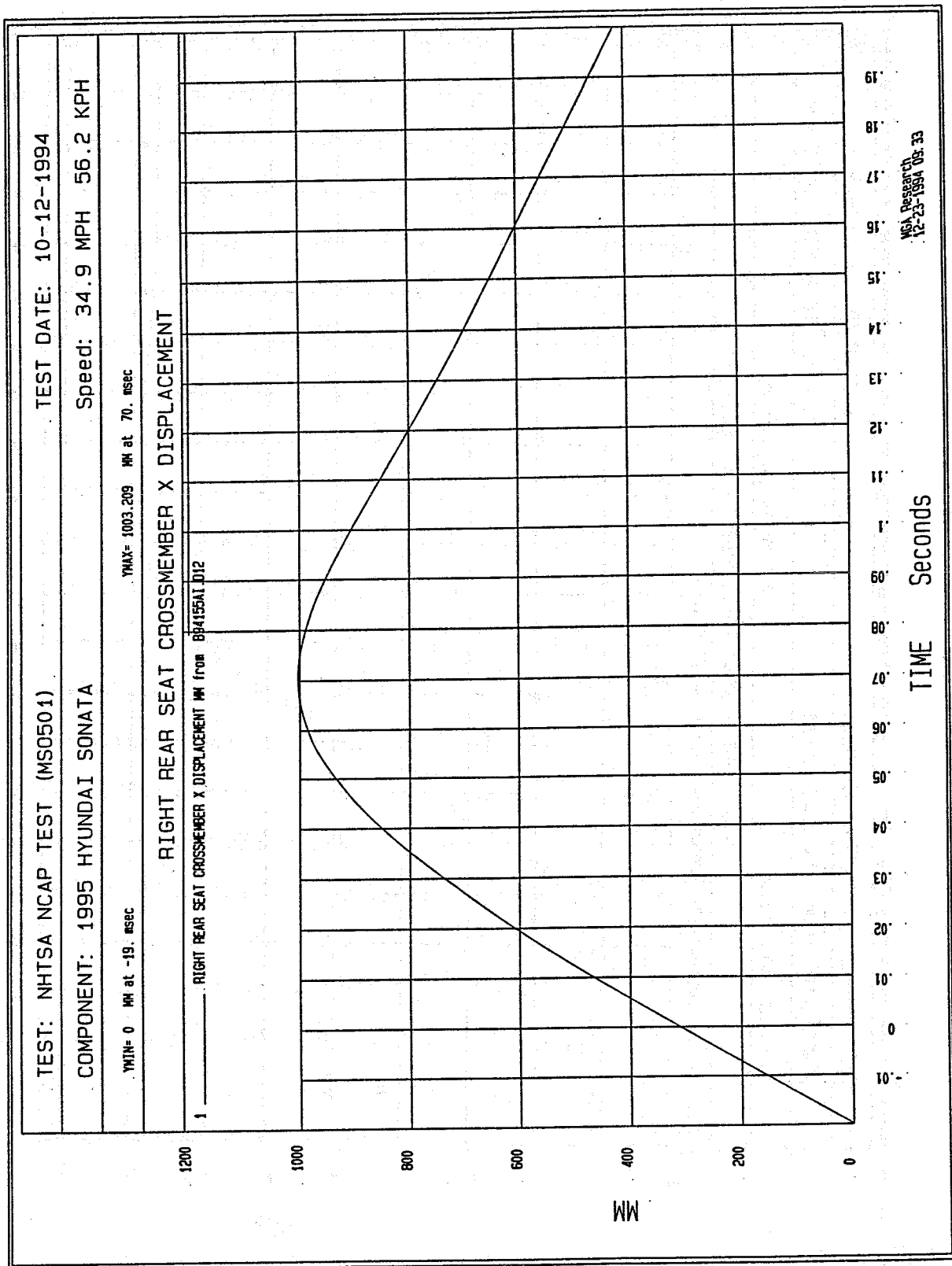


Figure B-9 - Right Rear Seat Crossmember X Displacement vs. Time

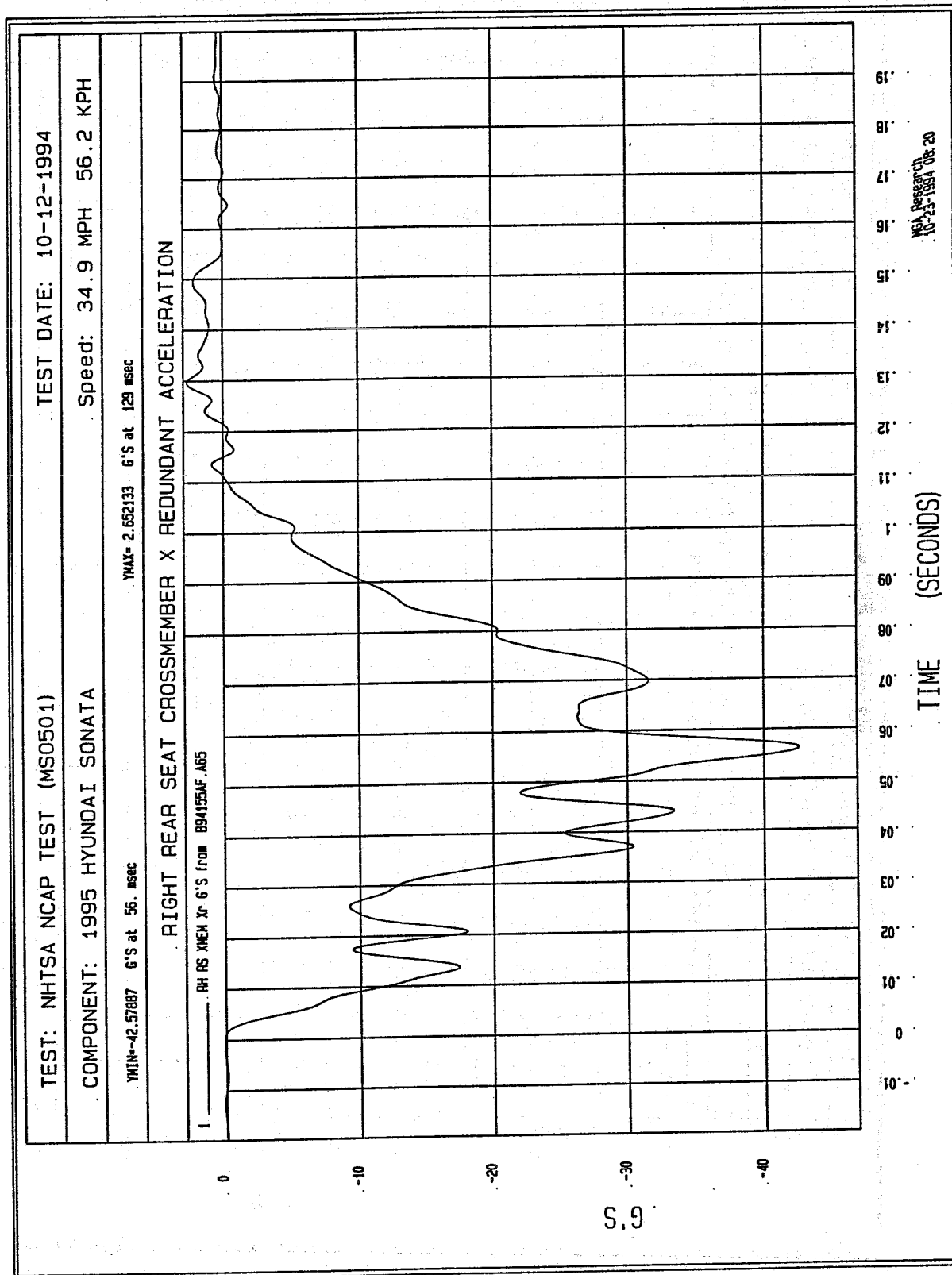


Figure B-10 - Right Rear Seat Crossmember X Redundant Acceleration vs. Time

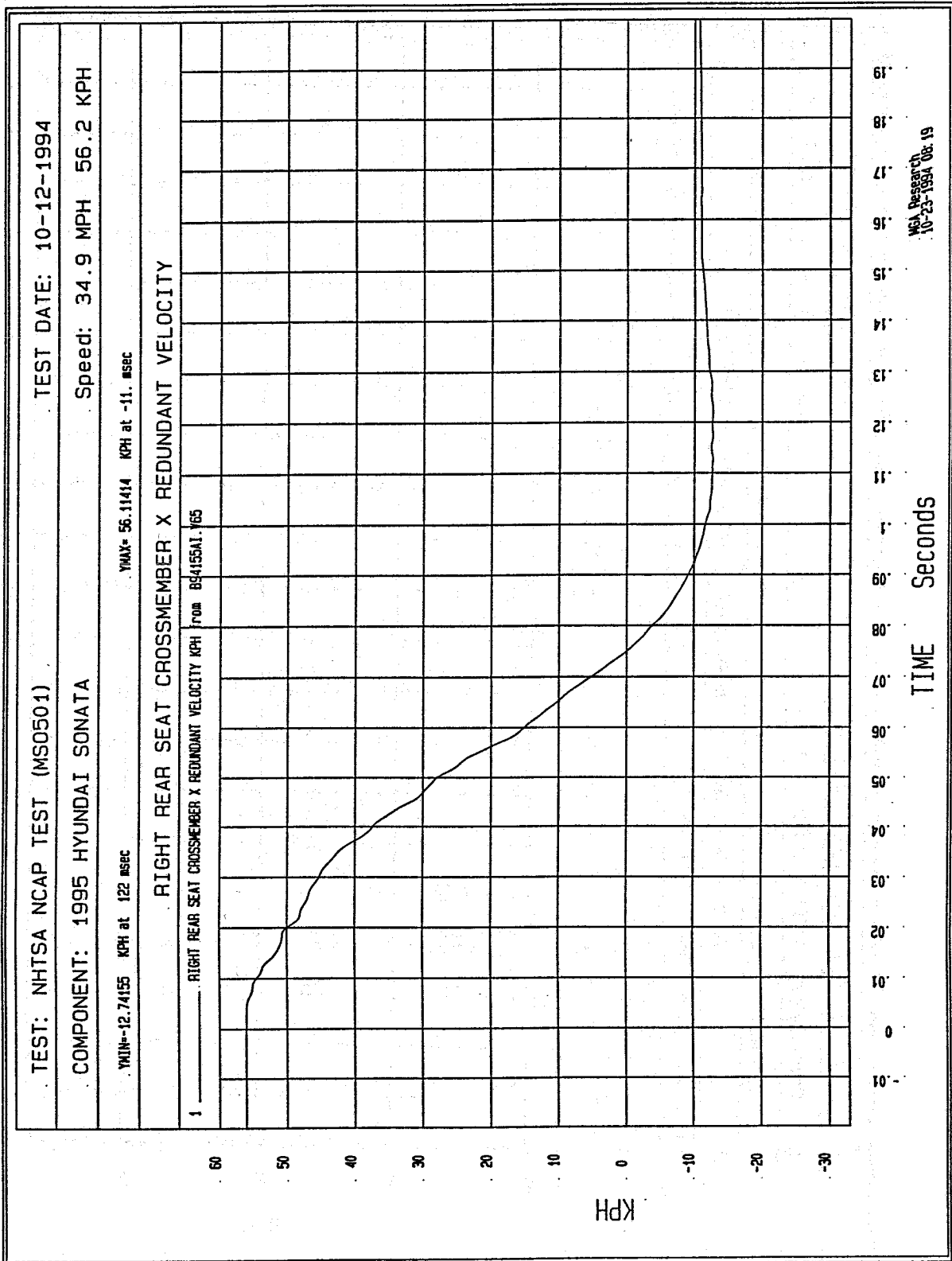


Figure B-11 - Right Rear Seat Crossmember X Redundant Velocity vs. Time

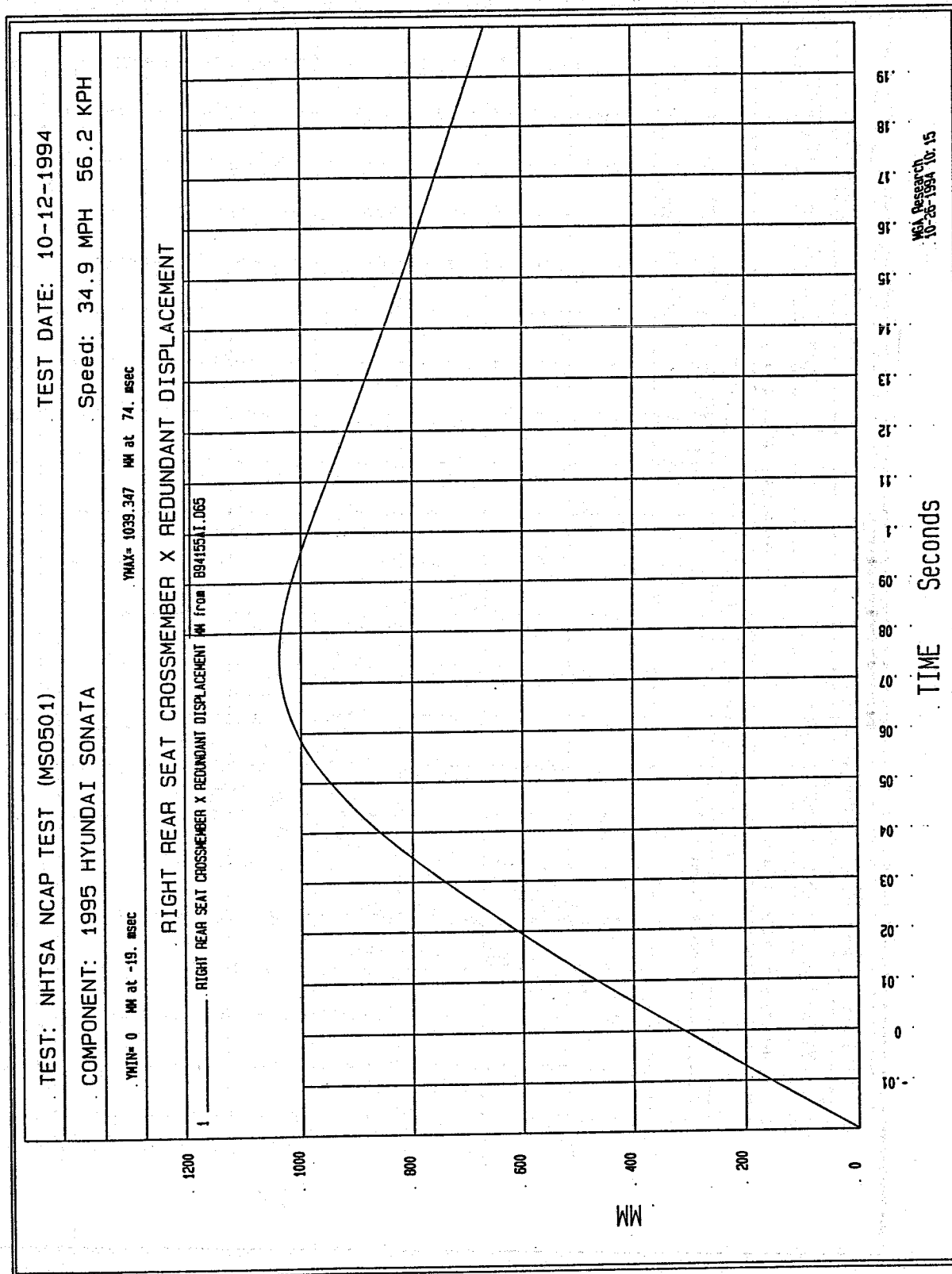


Figure B-12 - Right Rear Seat Crossmember X Redundant Displacement vs. Time

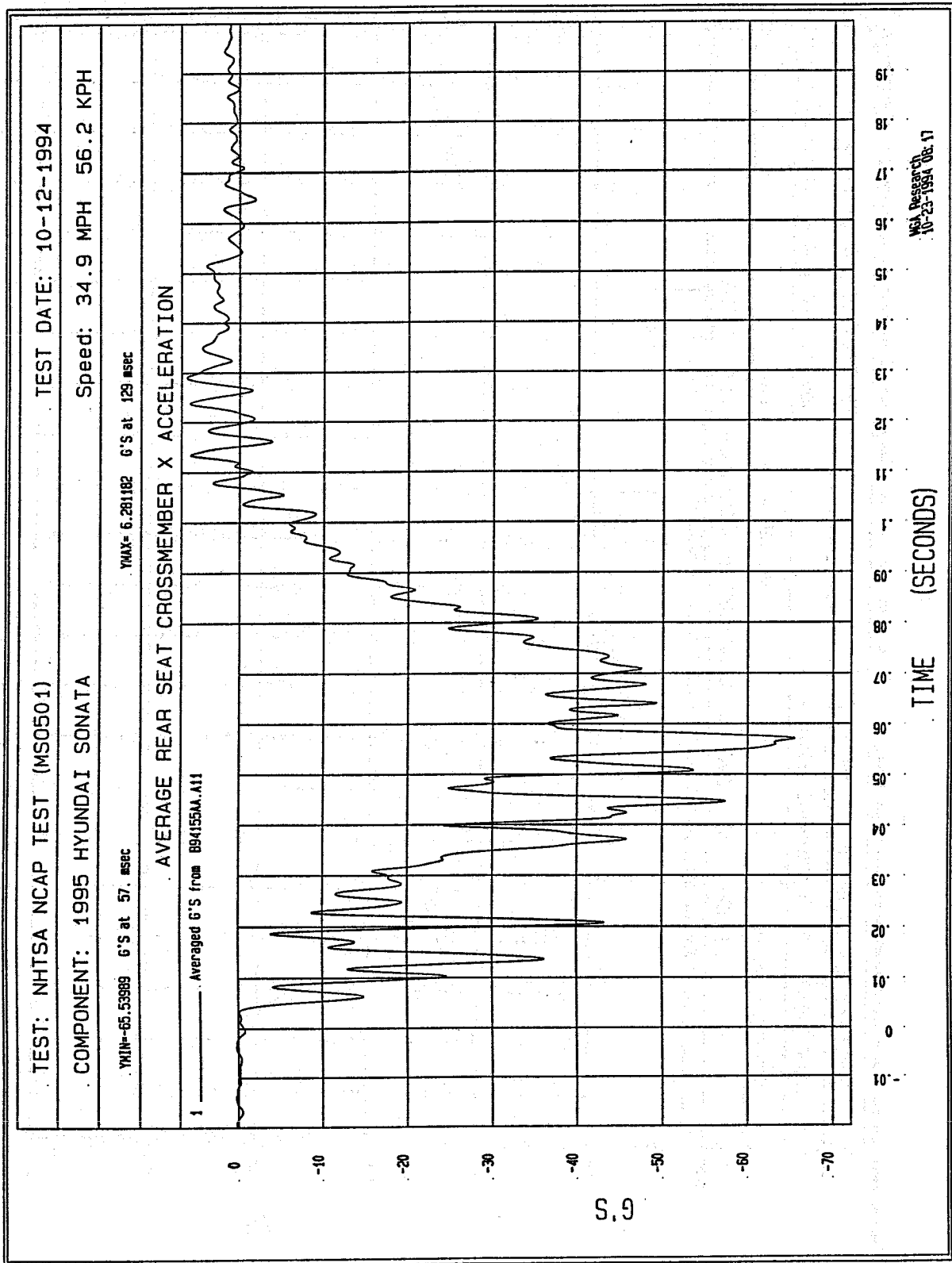


Figure B-13 - Average Rear Seat Crossmember X Acceleration vs. Time

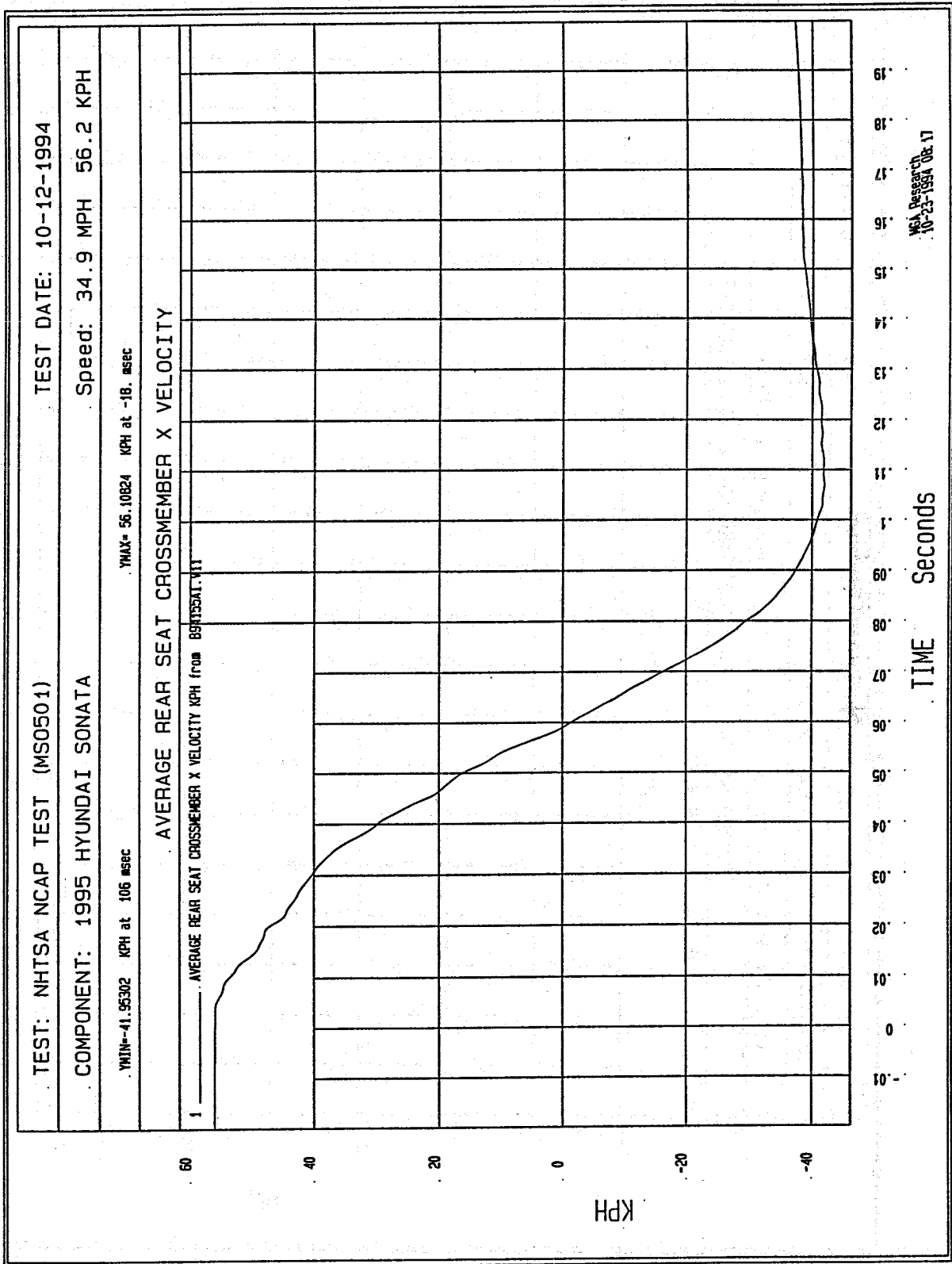


Figure B-14 - Average Rear Seat Crossmember X Velocity vs. Time

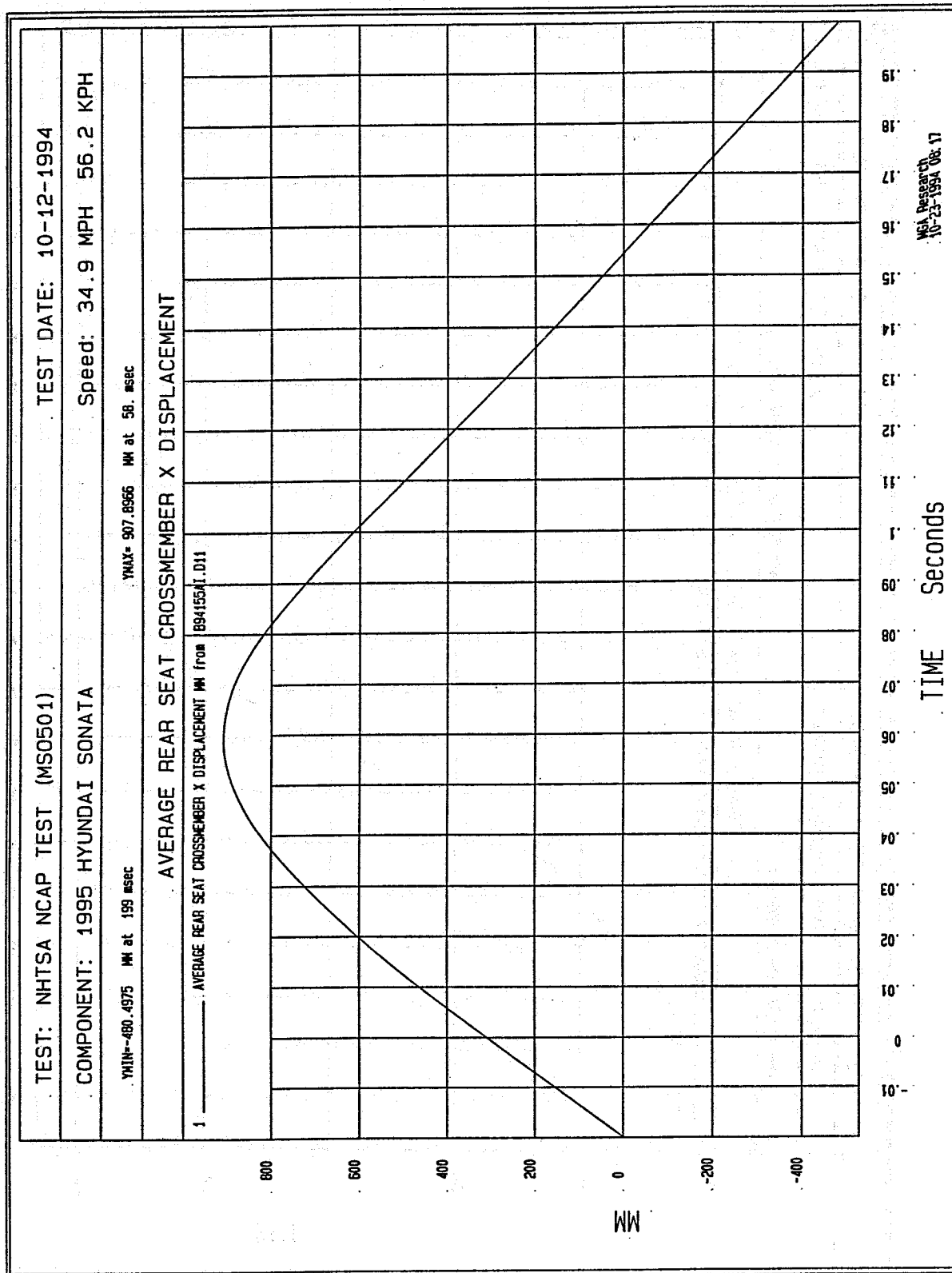


Figure B-15 - Average Rear Seat Crossmember X Displacement vs. Time

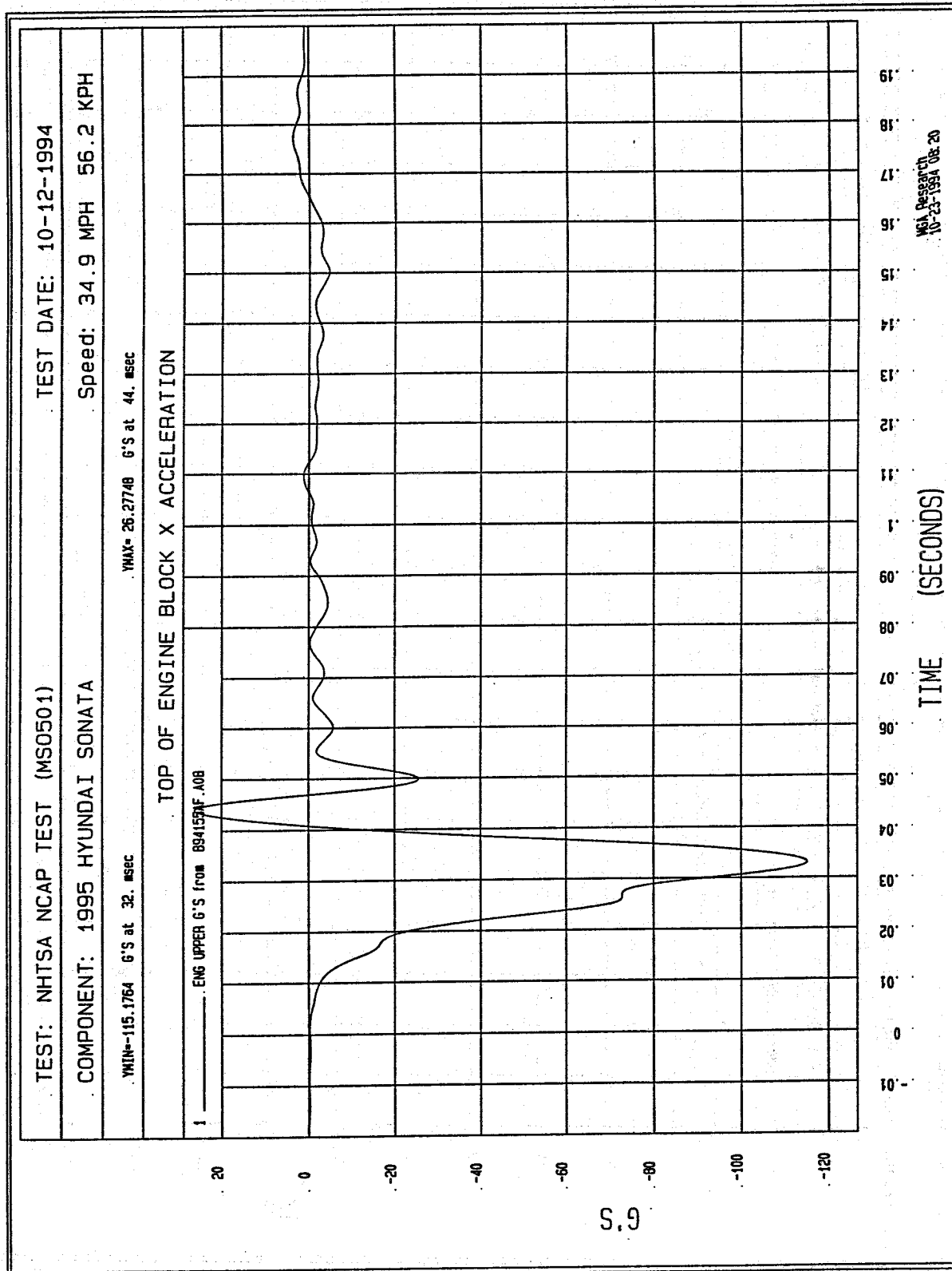


Figure B-16 - Top of Engine Block X Acceleration vs. Time

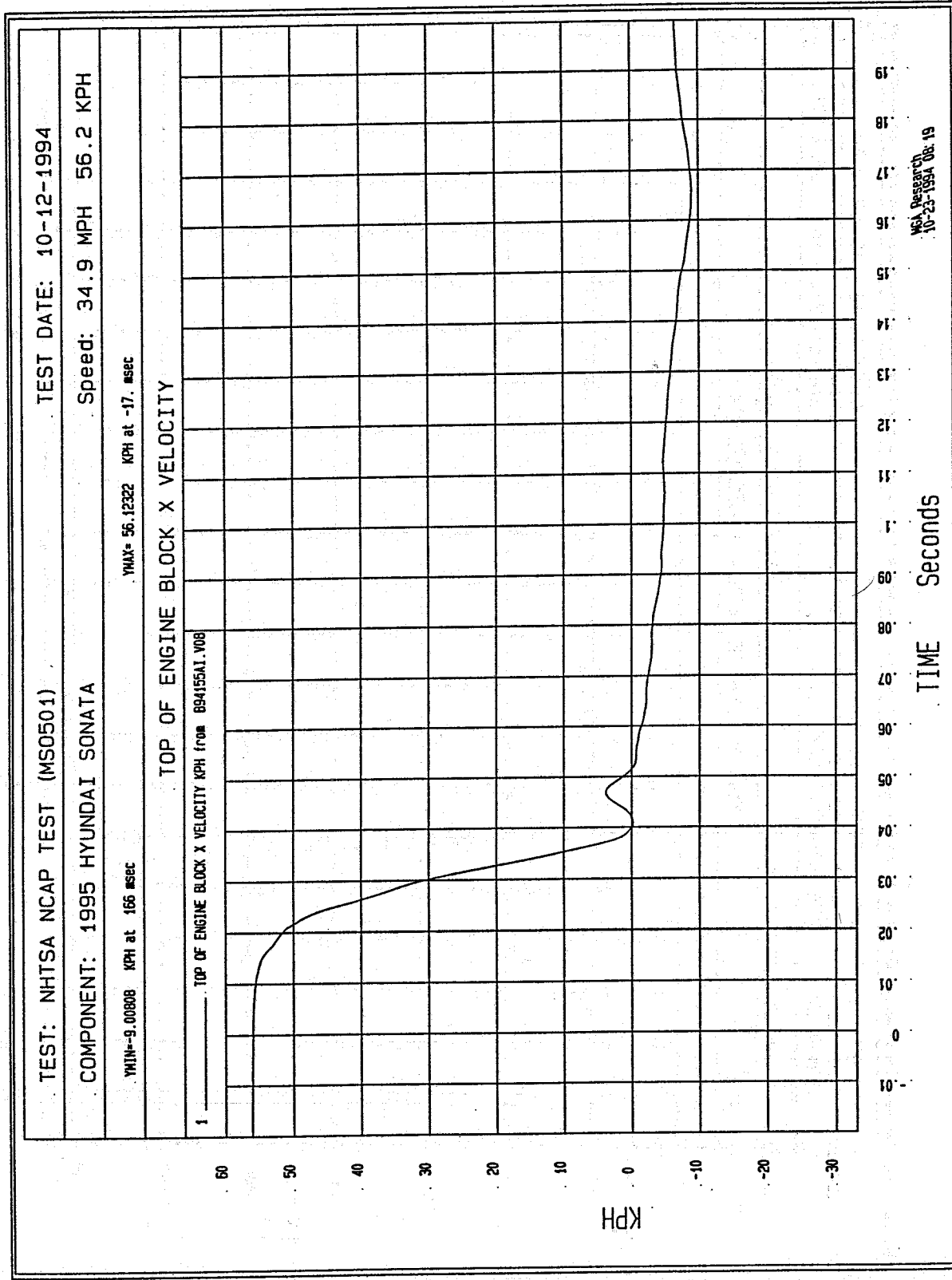


Figure B-17 - Top of Engine Block X Velocity vs. Time

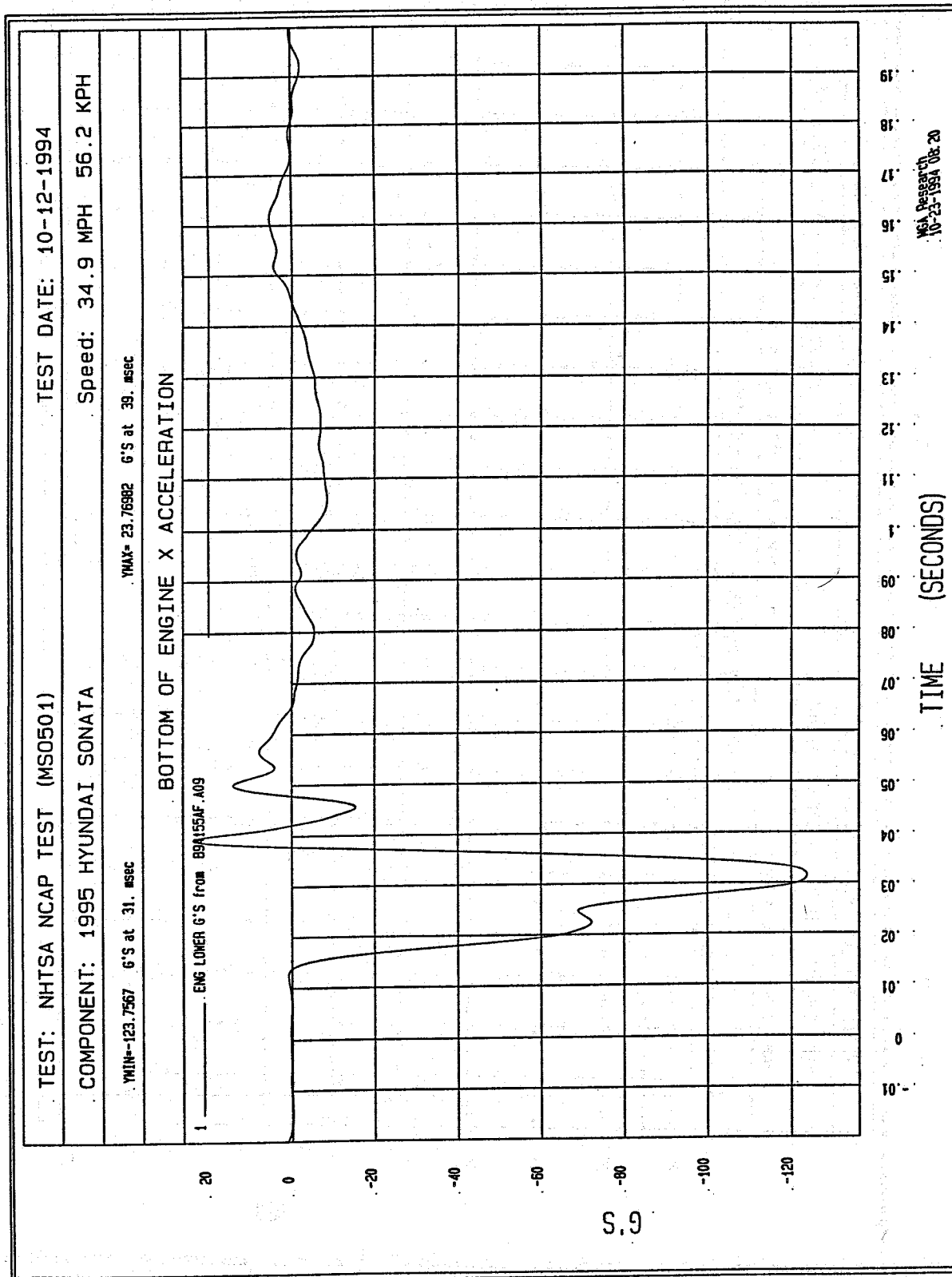


Figure B-18 - Bottom of Engine X Acceleration vs. Time

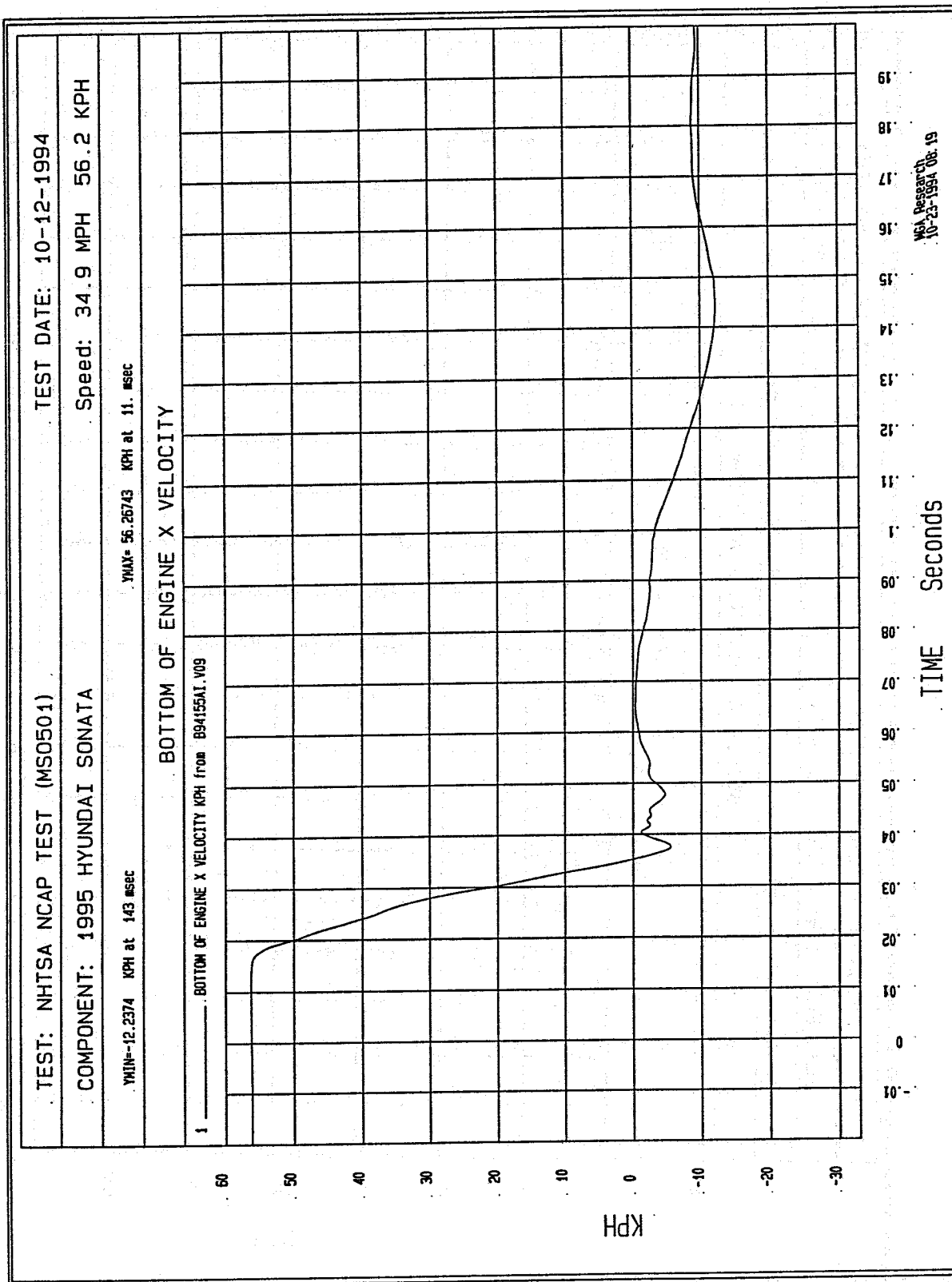
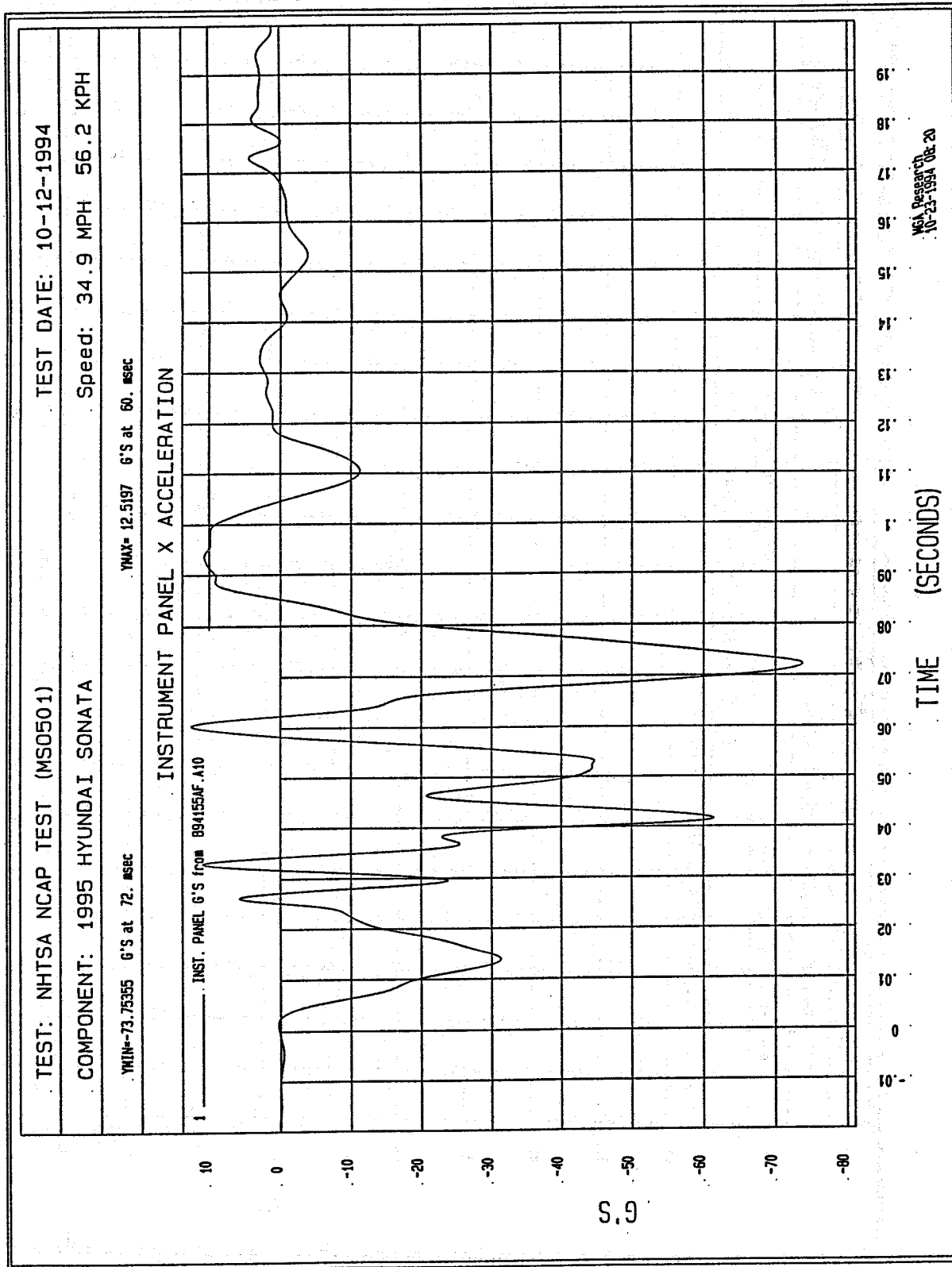


Figure B-19 - Bottom of Engine X Velocity vs. Time



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Figure B-20 - Instrument Panel X Acceleration vs. Time

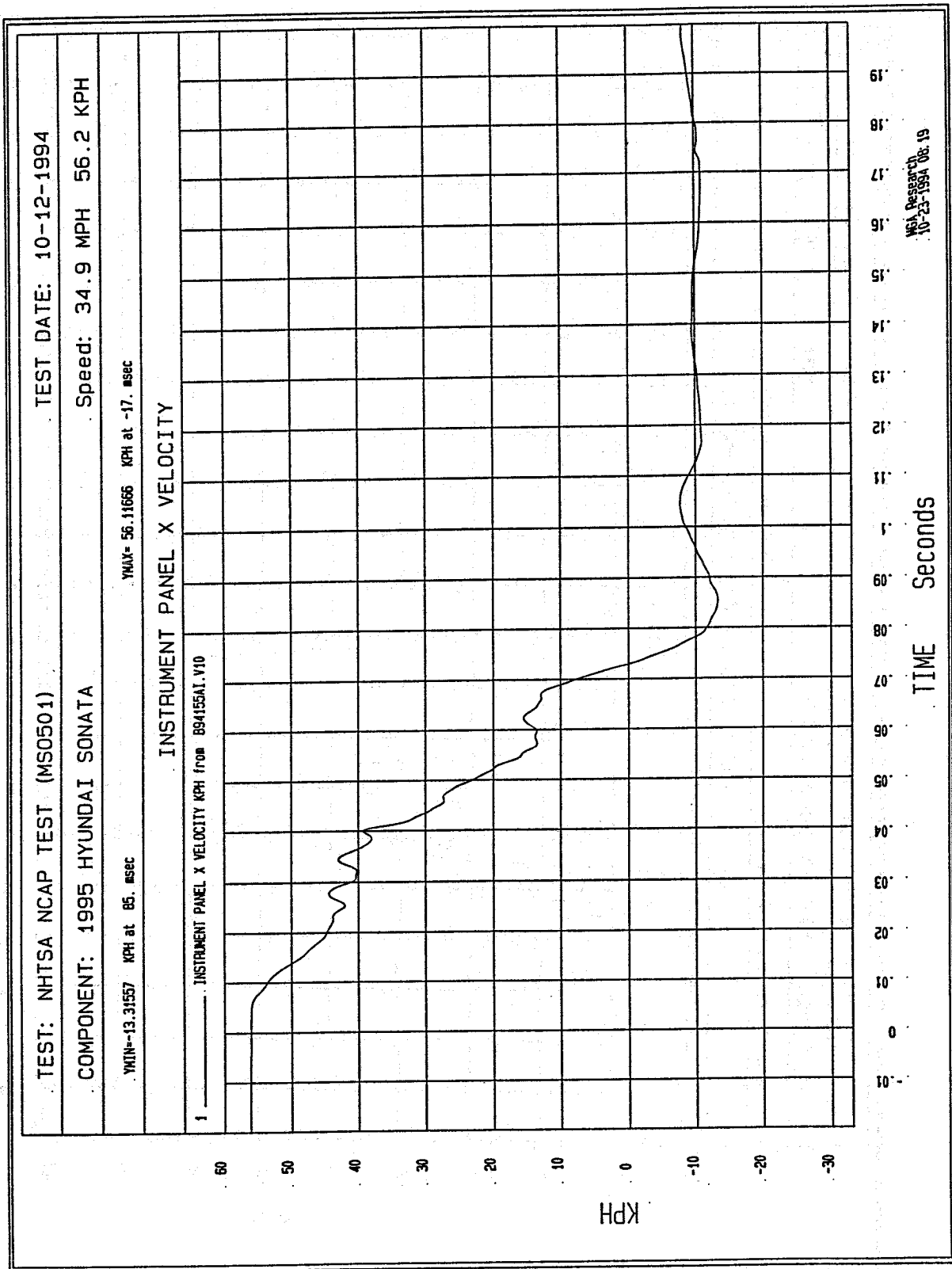


Figure B-21 - Instrument Panel X Velocity vs. Time

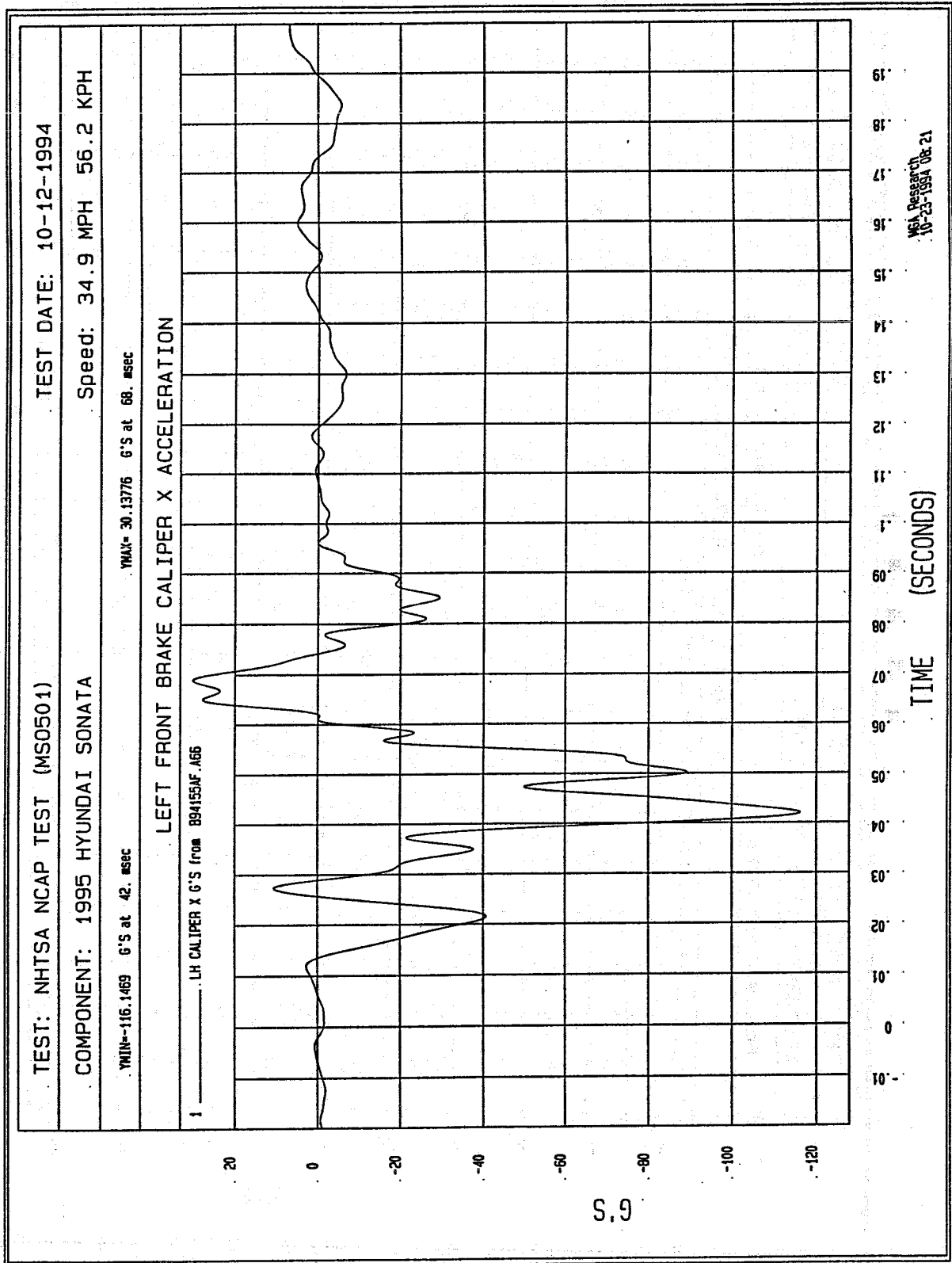


Figure B-22 - Left Brake Caliper X Acceleration vs. Time

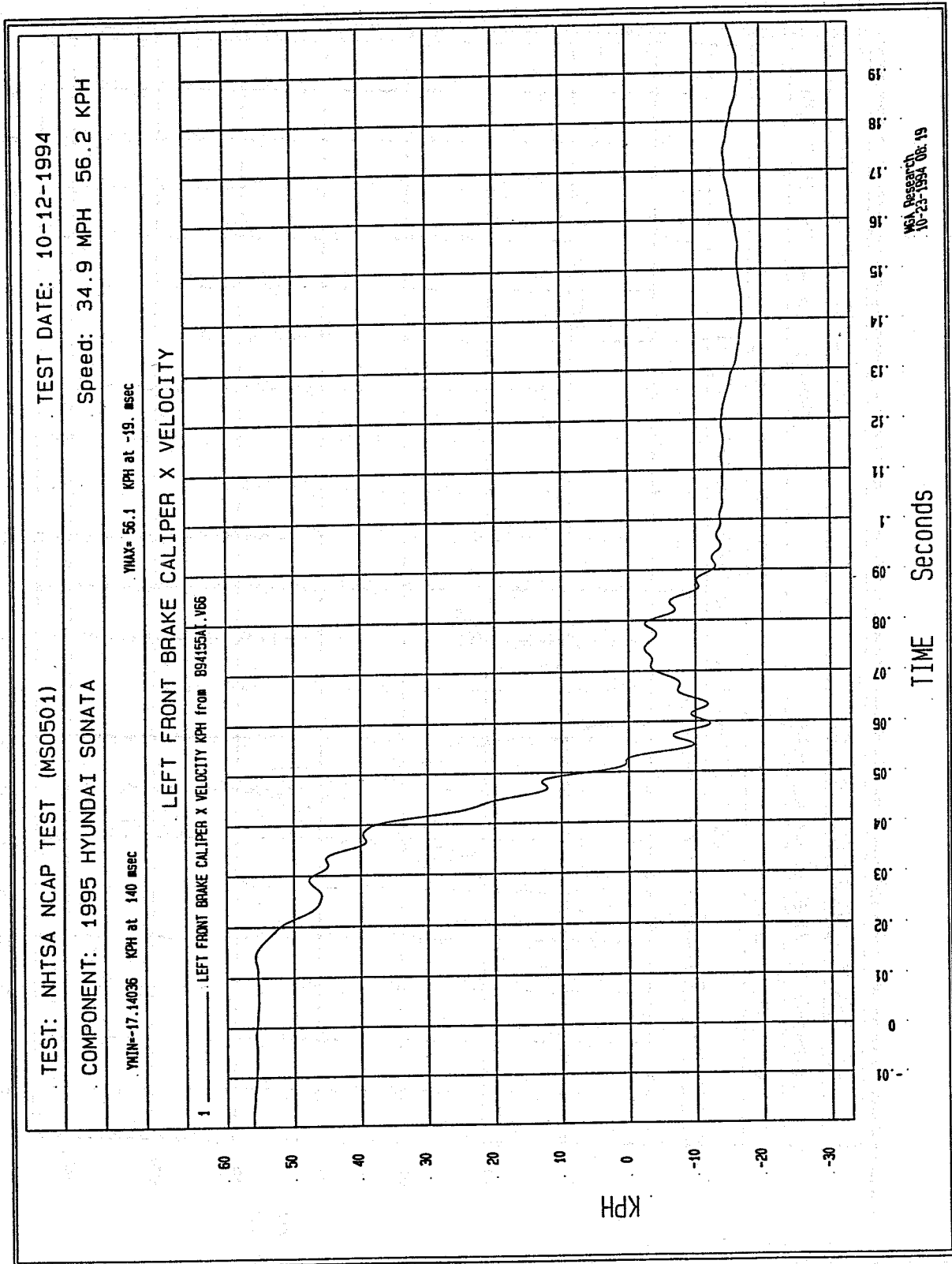


Figure B-23 - Left Brake Caliper X Velocity vs. Time

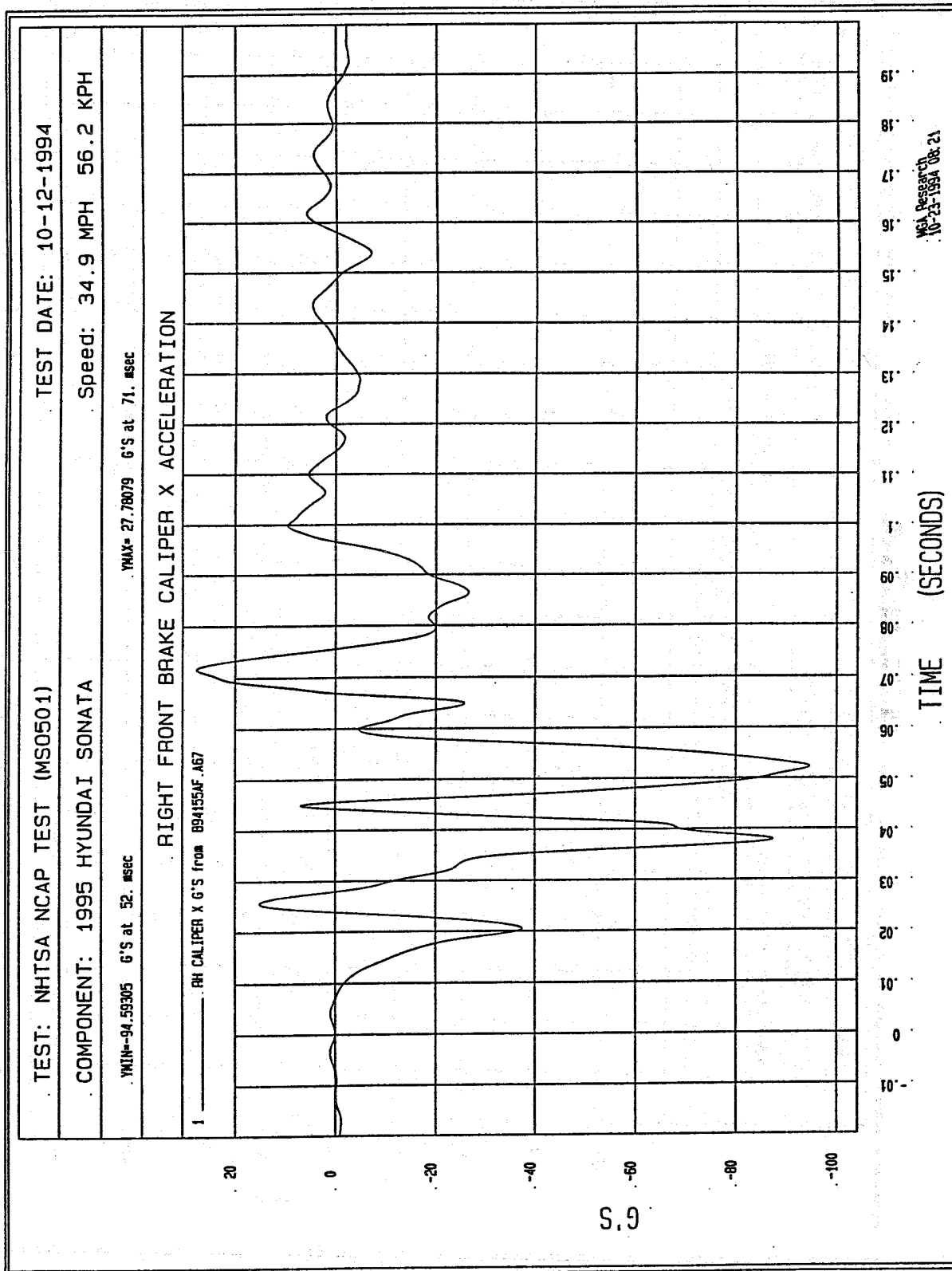


Figure B-24 - Right Brake Caliper X Acceleration vs. Time

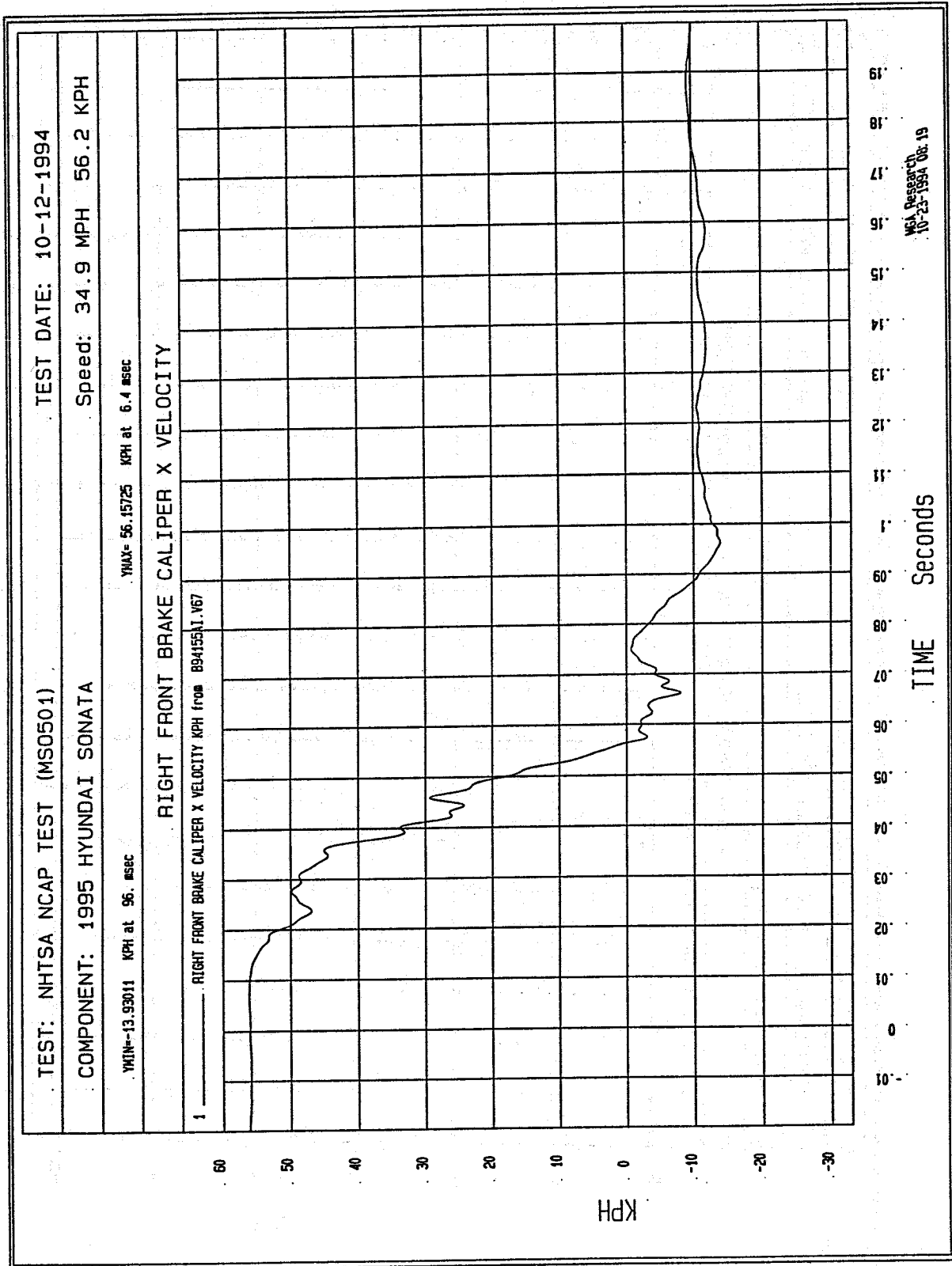


Figure B-25 - Right Brake Caliper X Velocity vs. Time

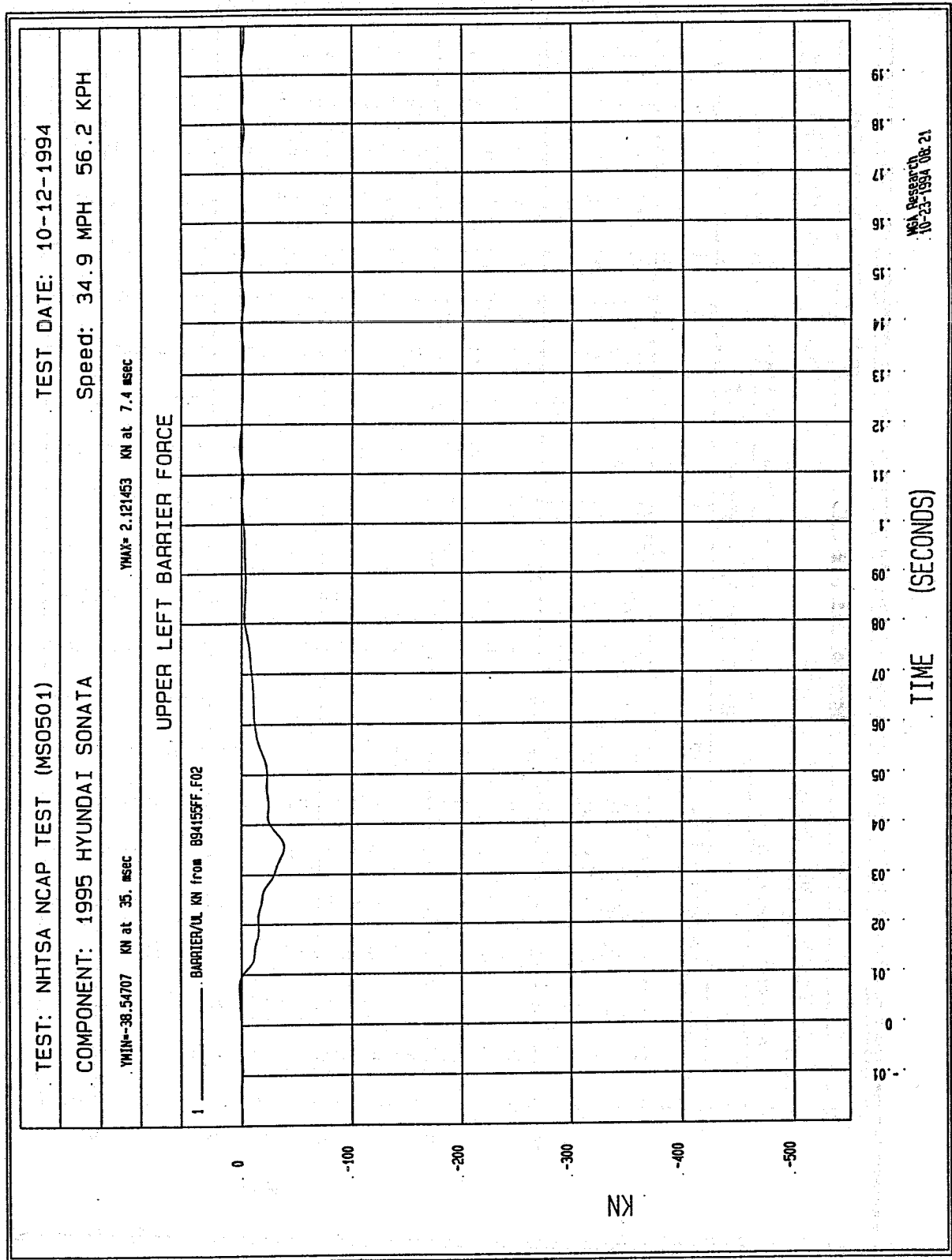


Figure B-26 - Upper Left Barrier Force vs. Time

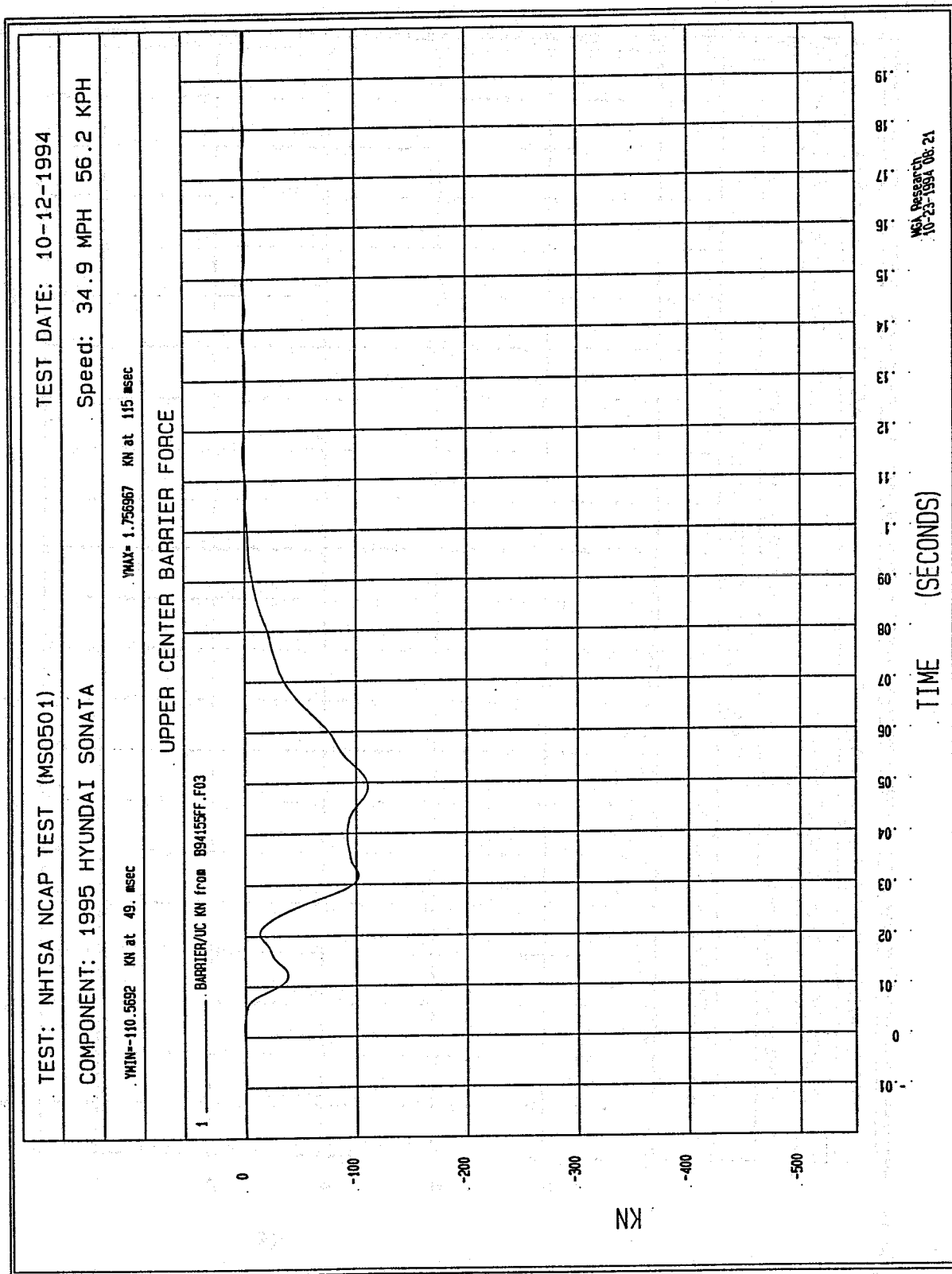


Figure B-27 - Upper Center Barrier Force vs. Time

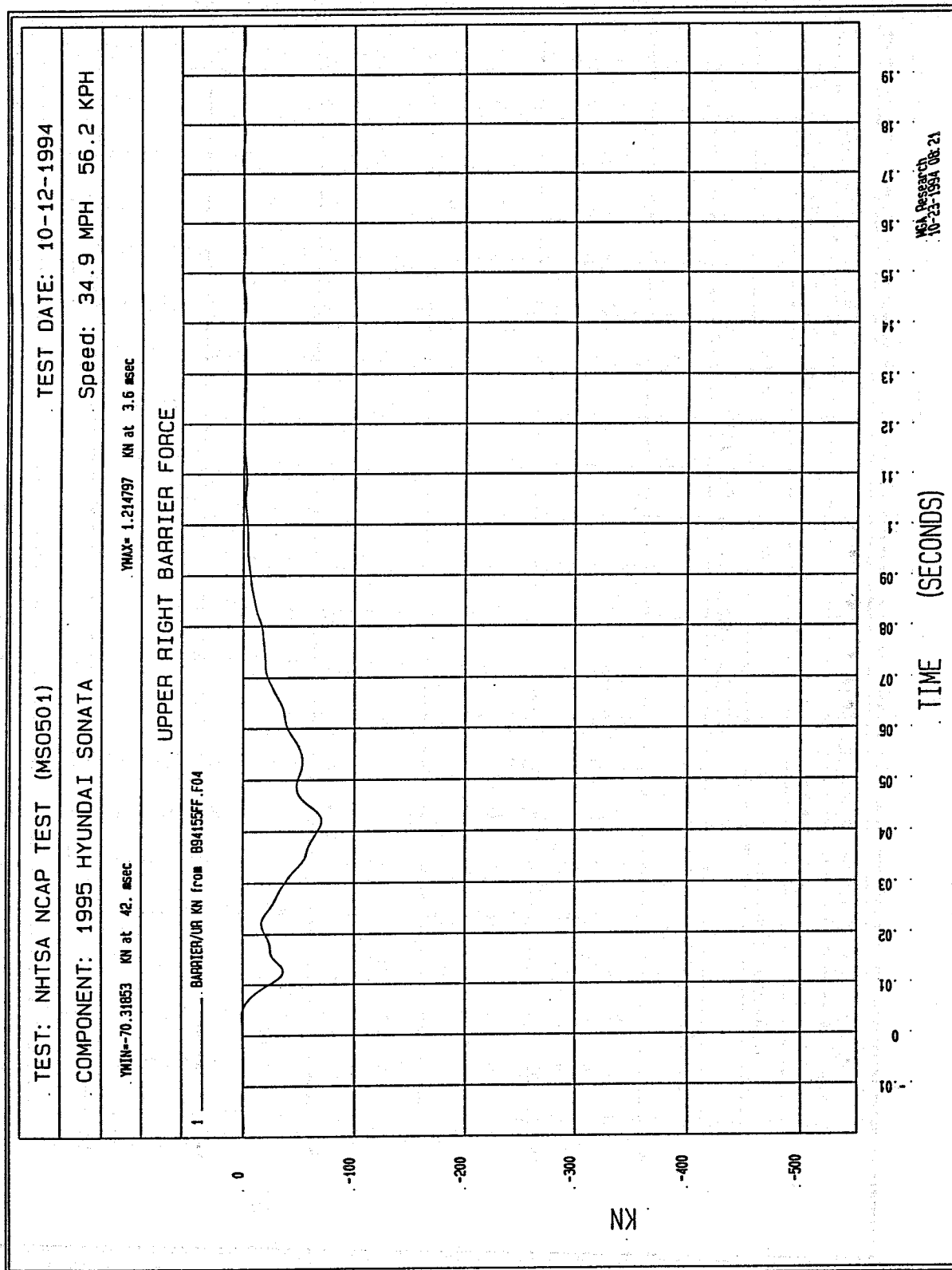


Figure B-28 - Upper Right Barrier Force vs. Time

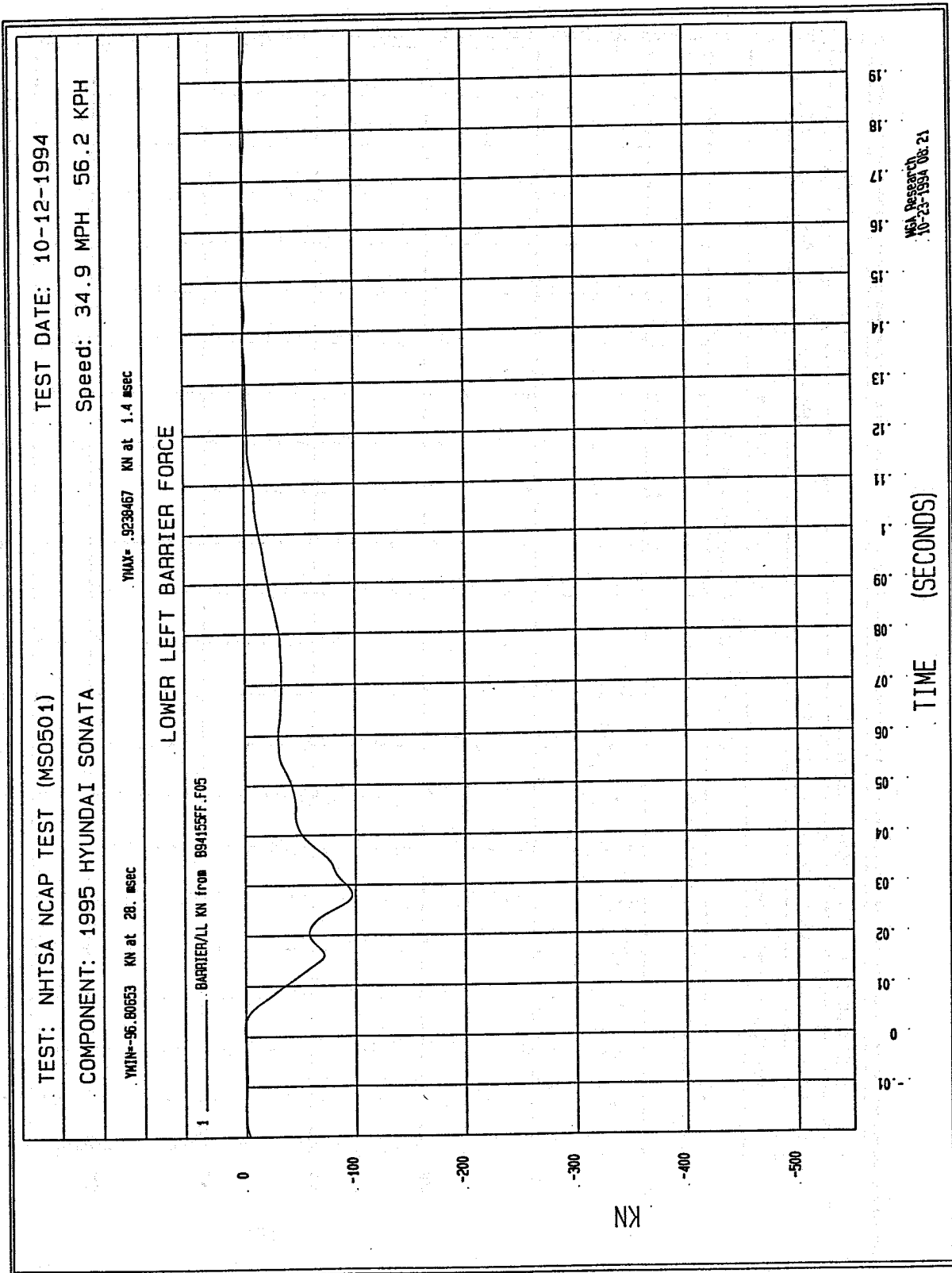


Figure B-29 - Lower Left Barrier Force vs. Time

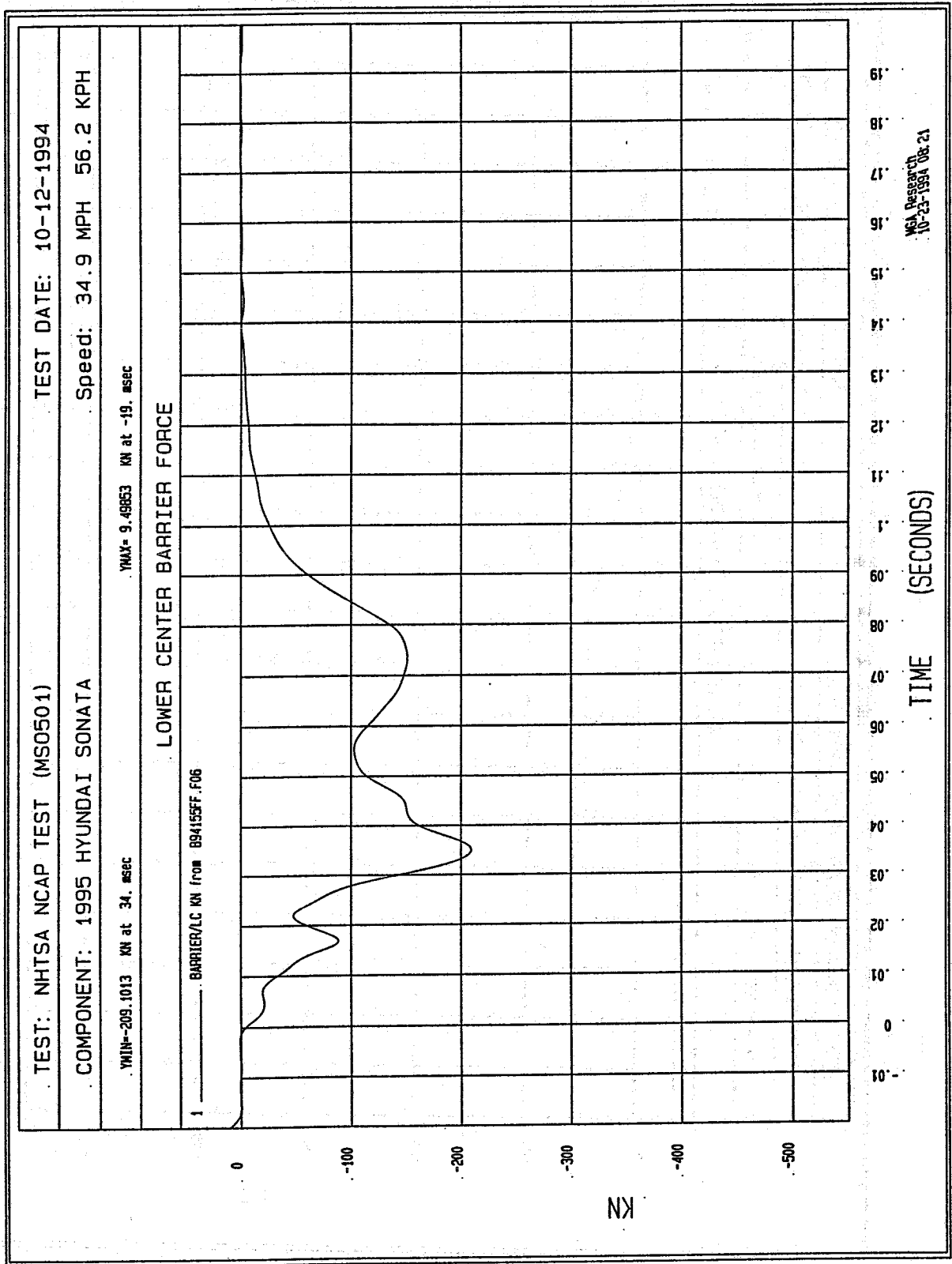


Figure B-30 - Lower Center Barrier Force vs. Time

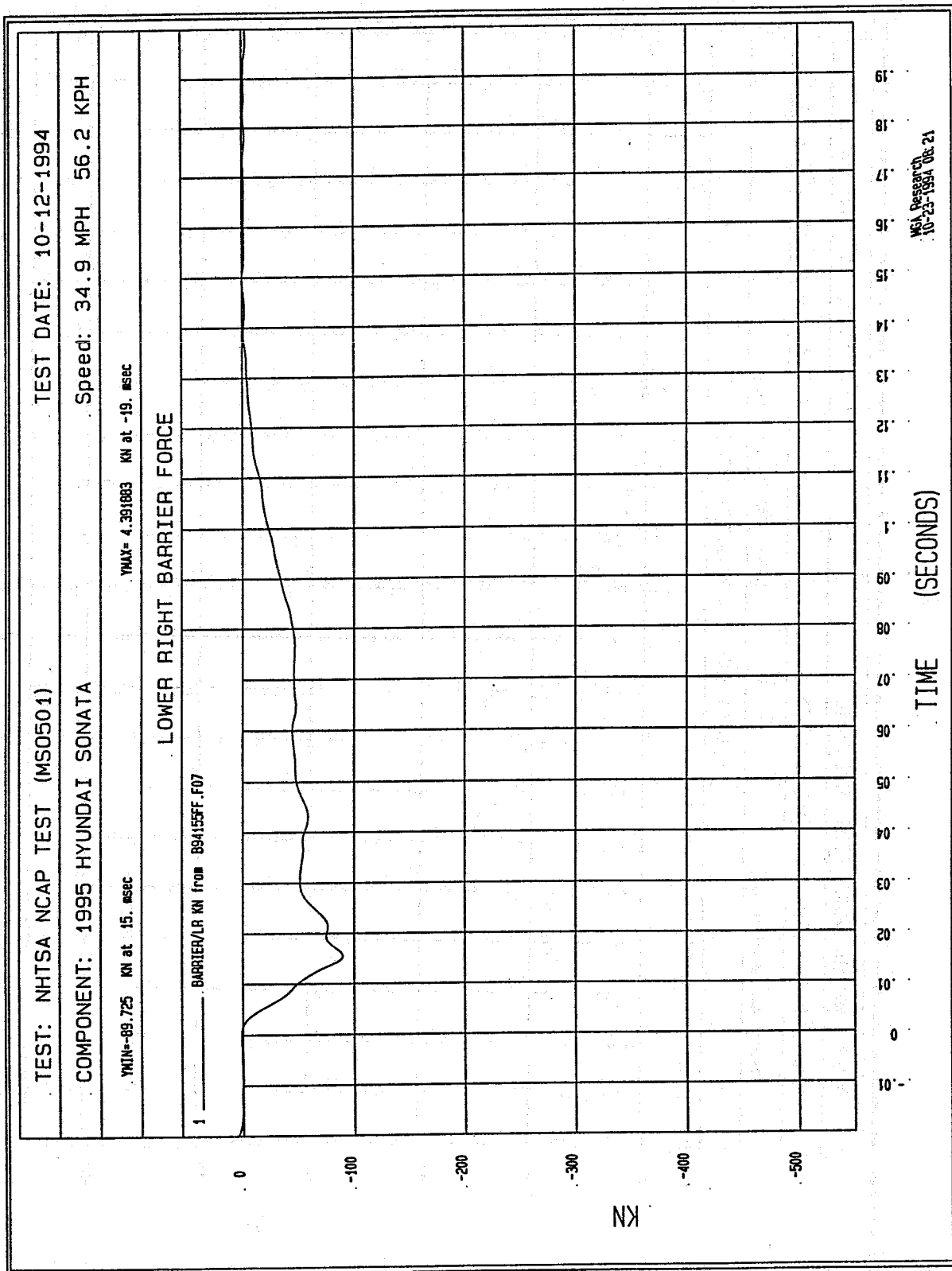


Figure B-31 - Lower Right Barrier Force vs. Time

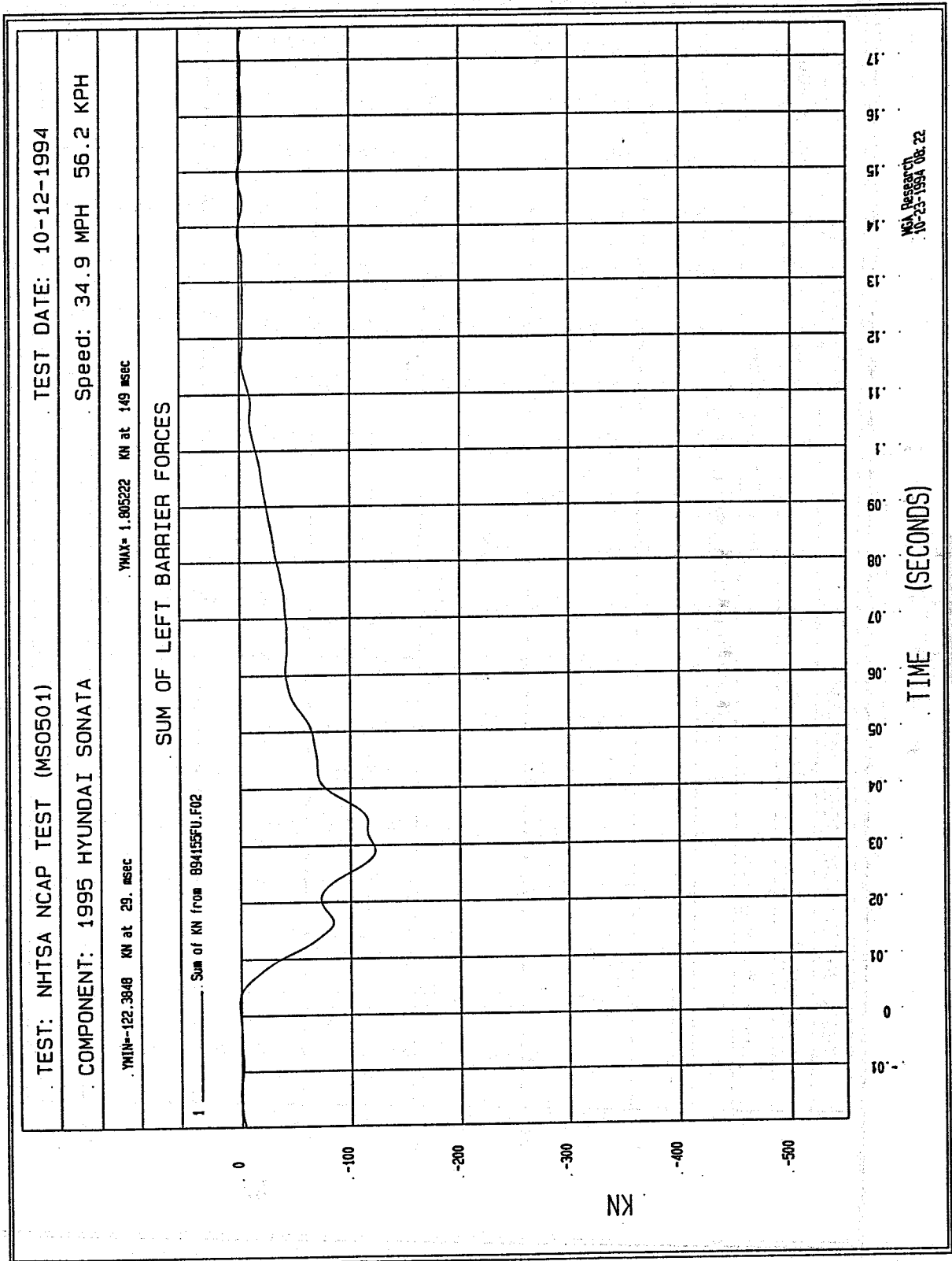


Figure B-32 - Sum of Left Barrier Forces vs. Time

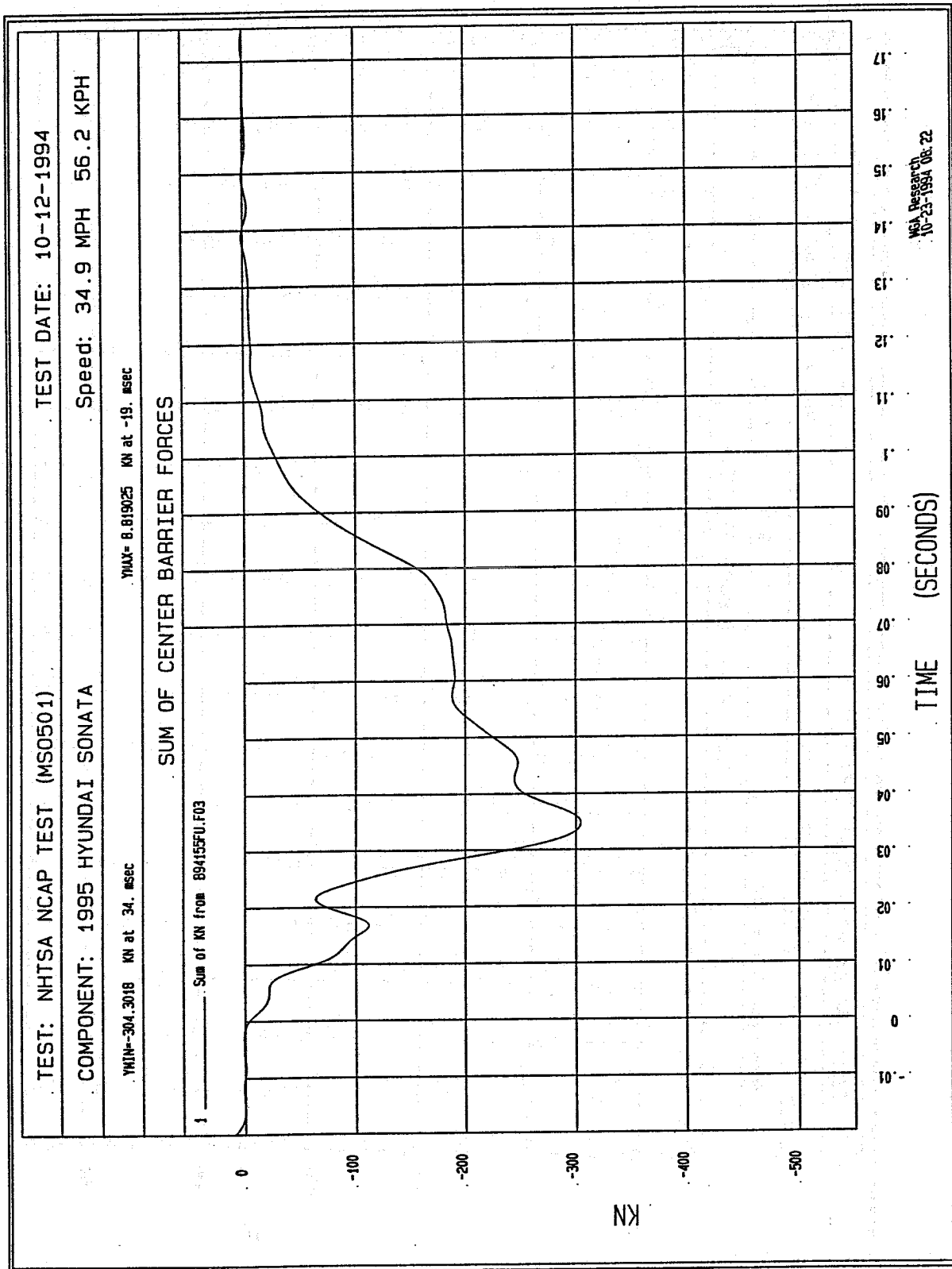


Figure B-33 - Sum of Center Barrier Forces vs. Time

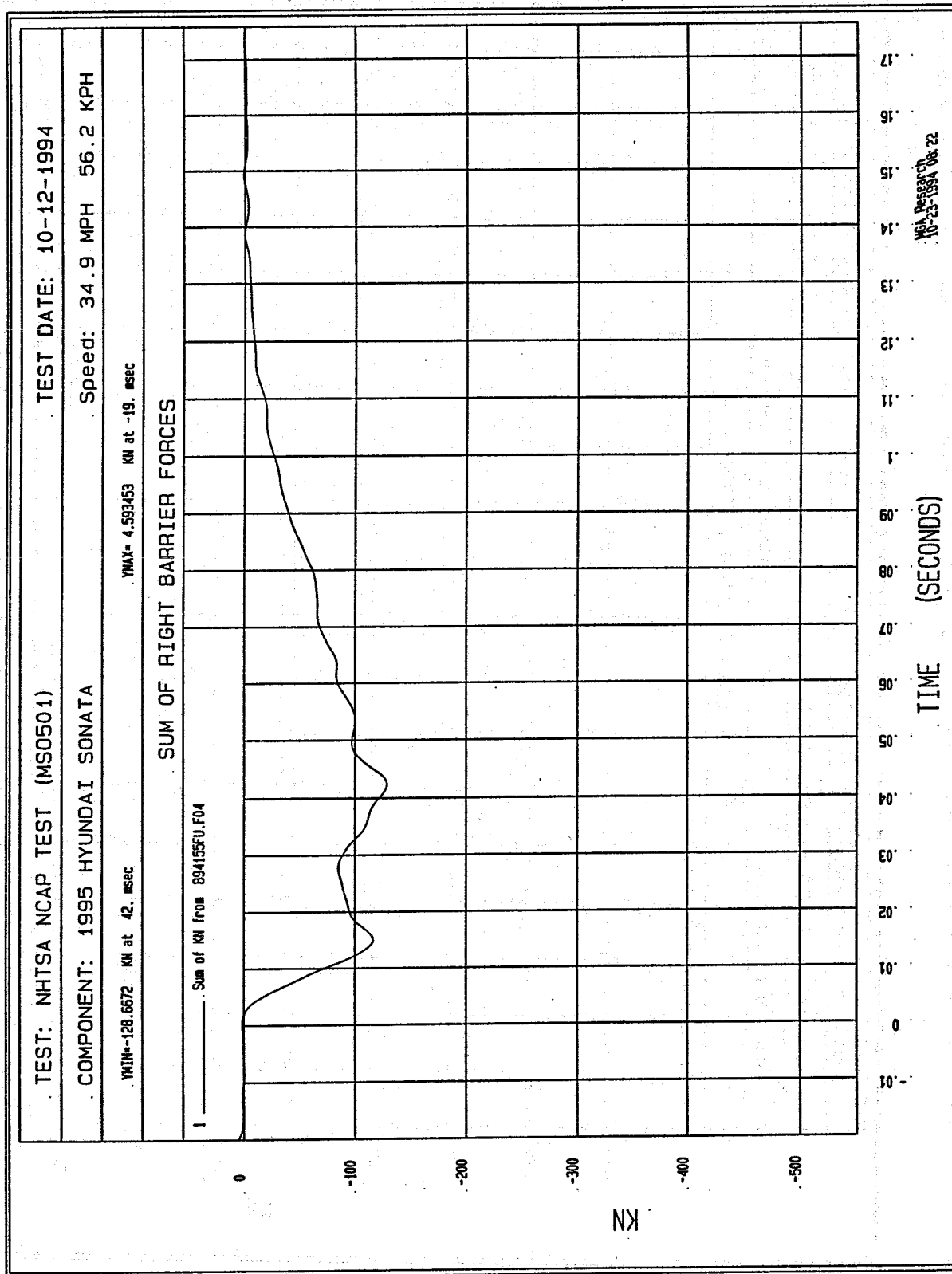


Figure B-34 - Sum of Right Barrier Forces vs. Time

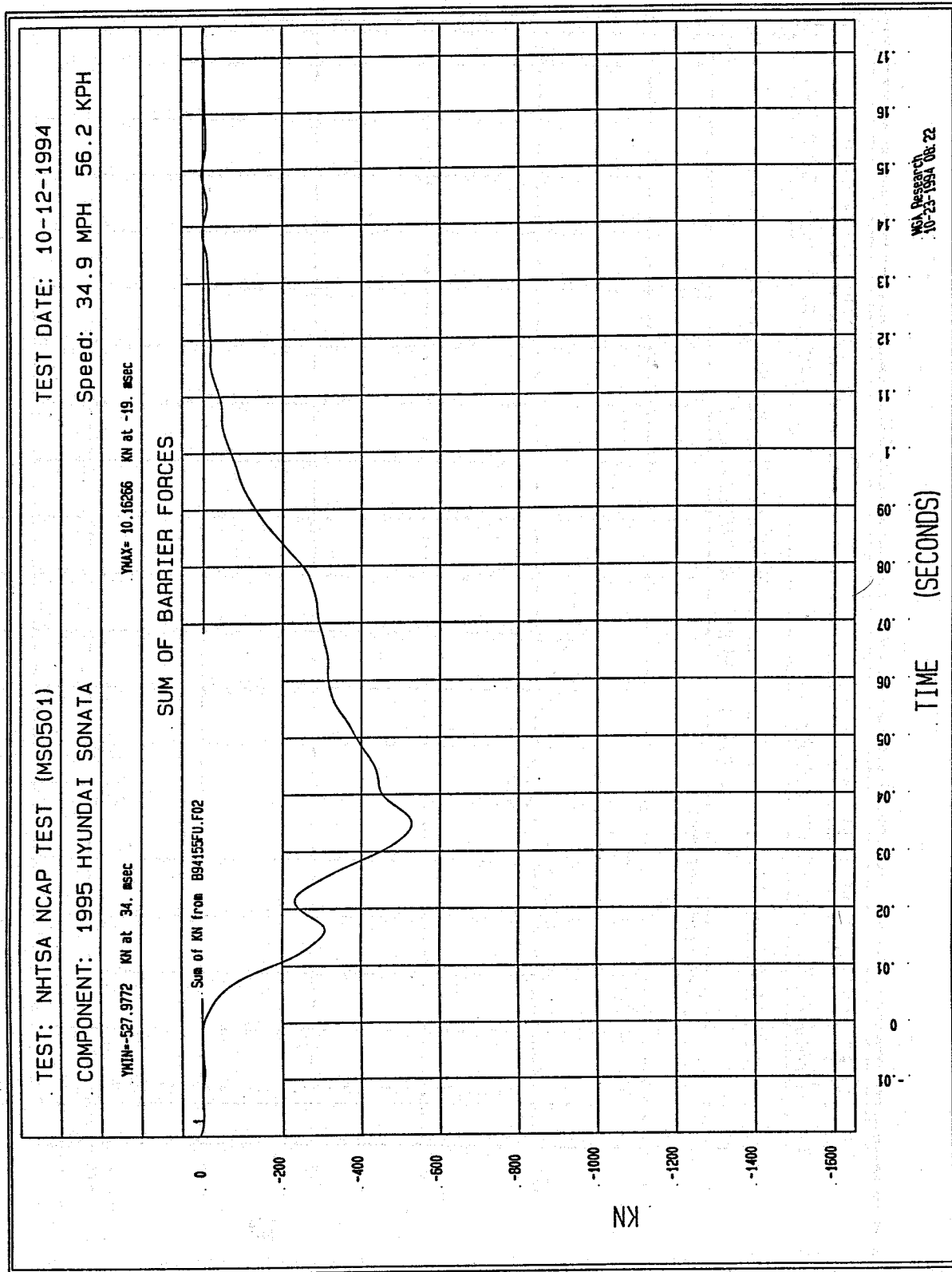


Figure B-35 - Sum of Barrier Forces vs. Time

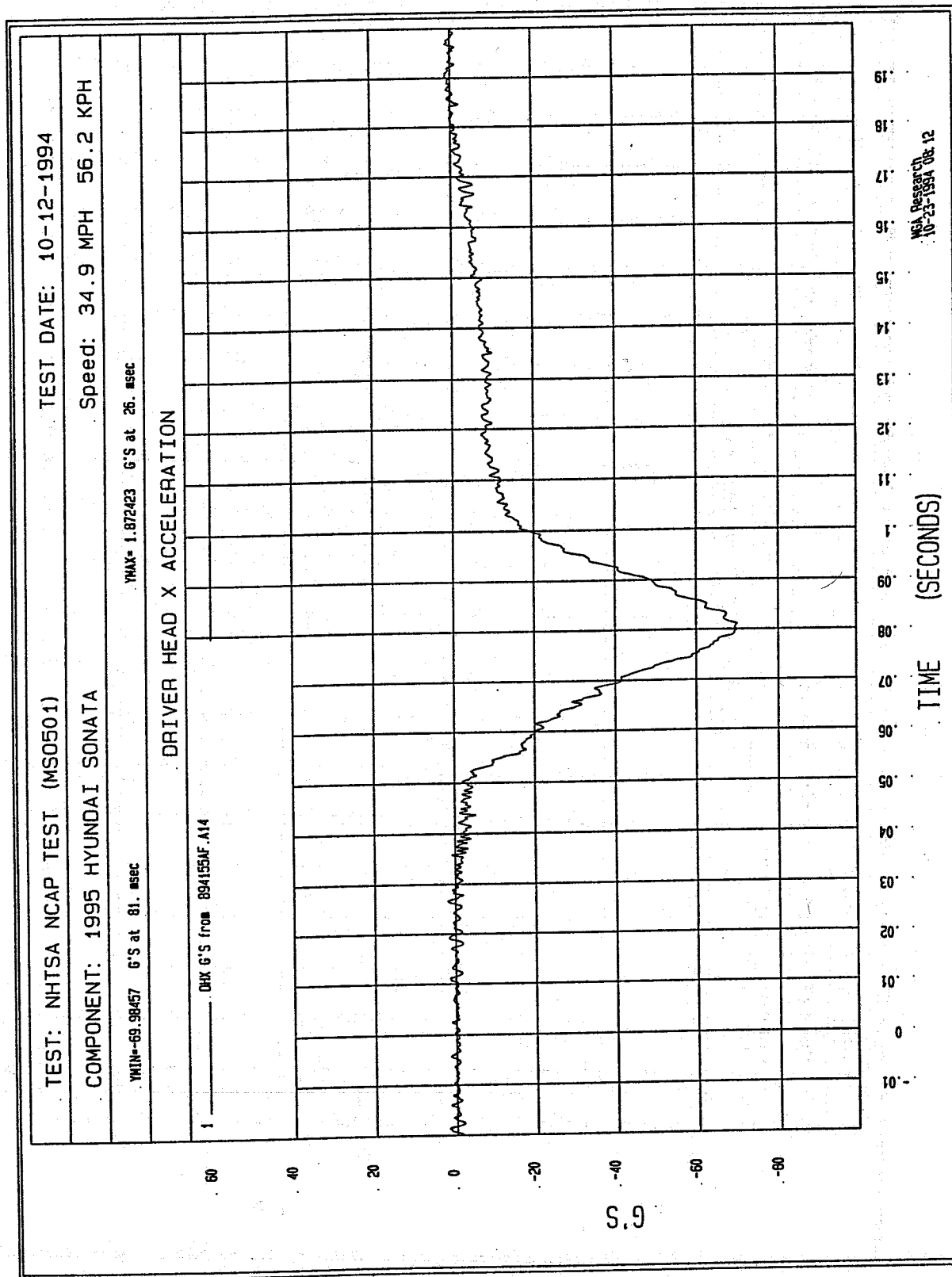


Figure B-36 - Driver Head X Acceleration vs. Time

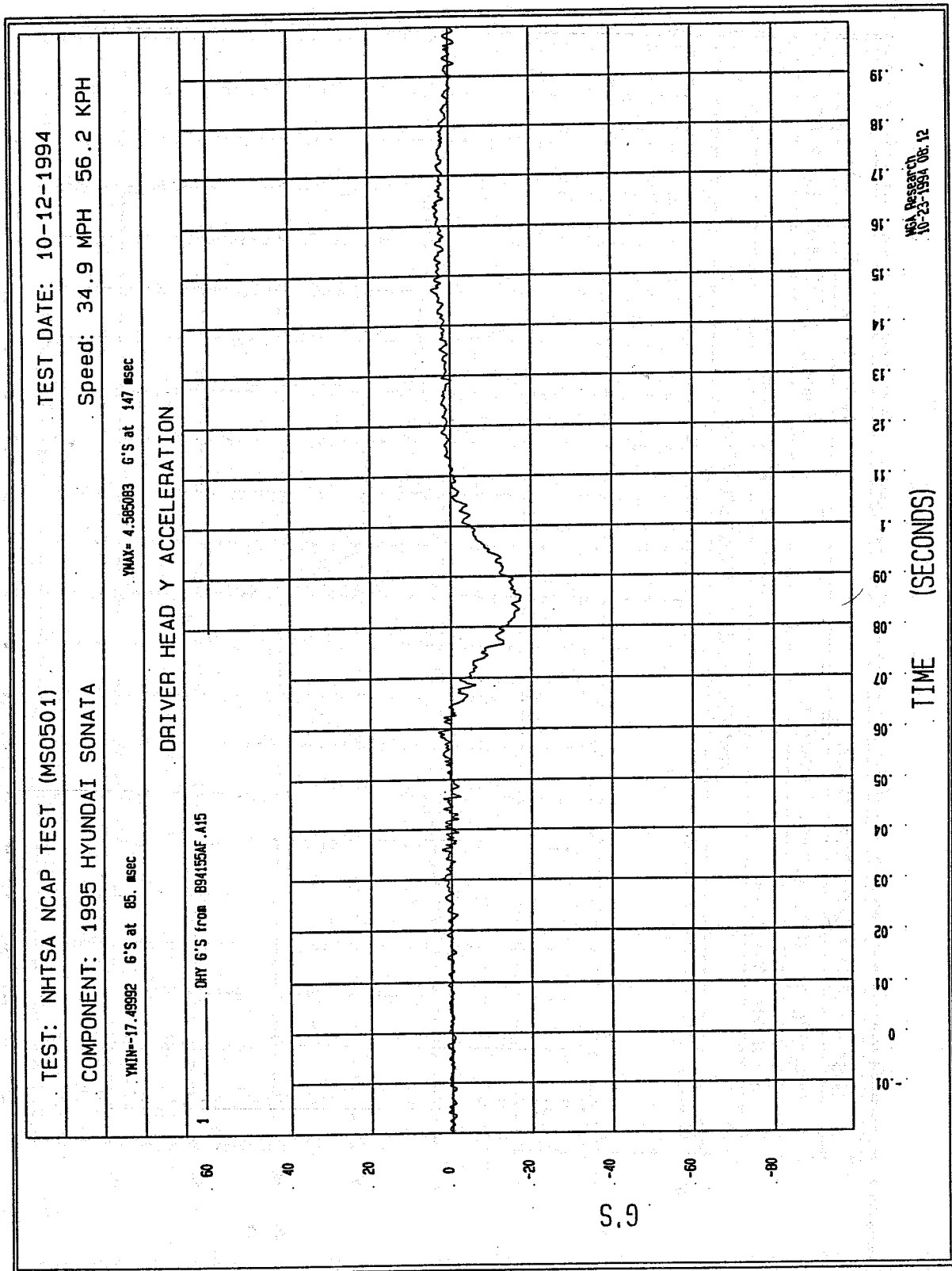


Figure B-37 - Driver Head Y Acceleration vs. Time

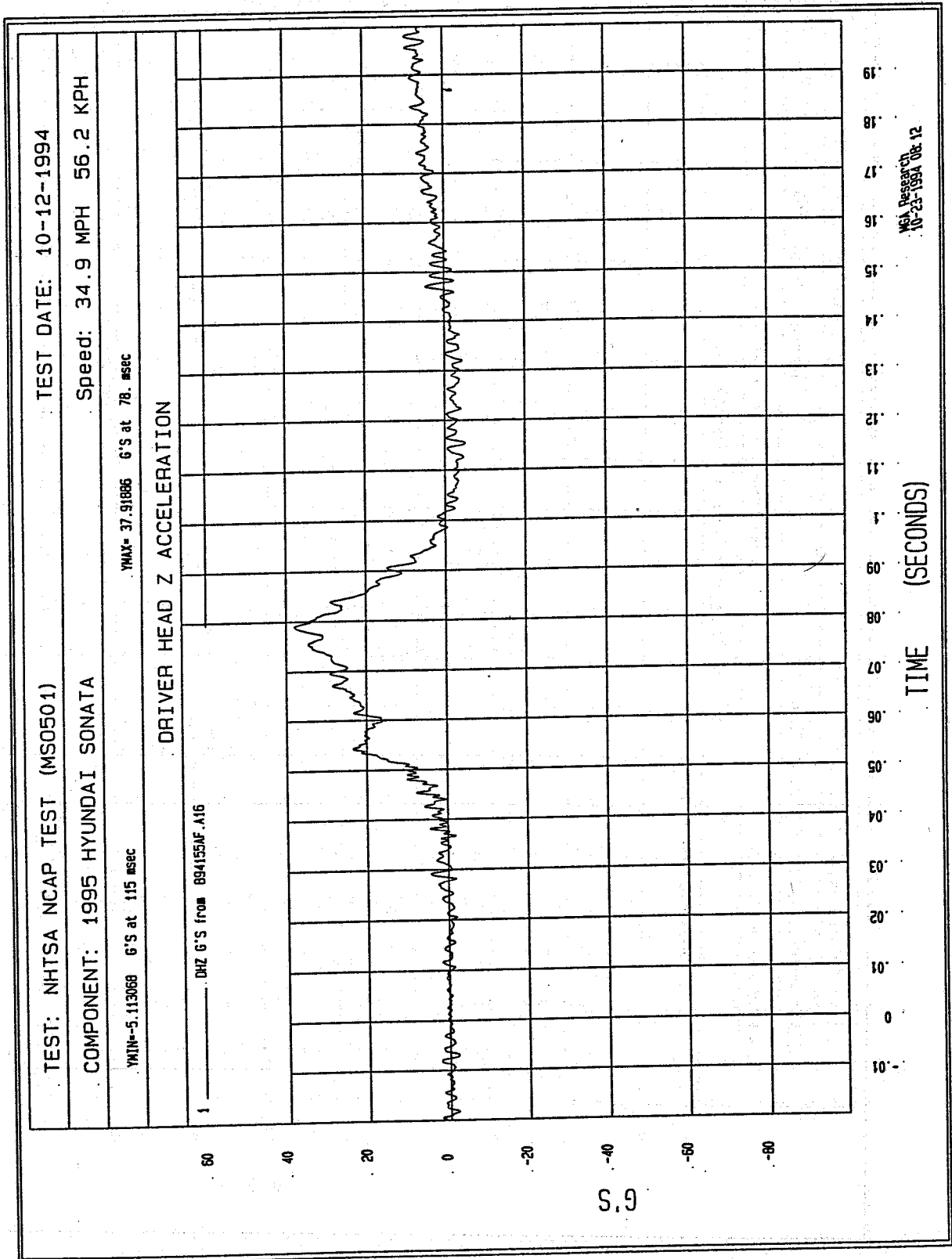


Figure B-38 - Driver Head Z Acceleration vs. Time

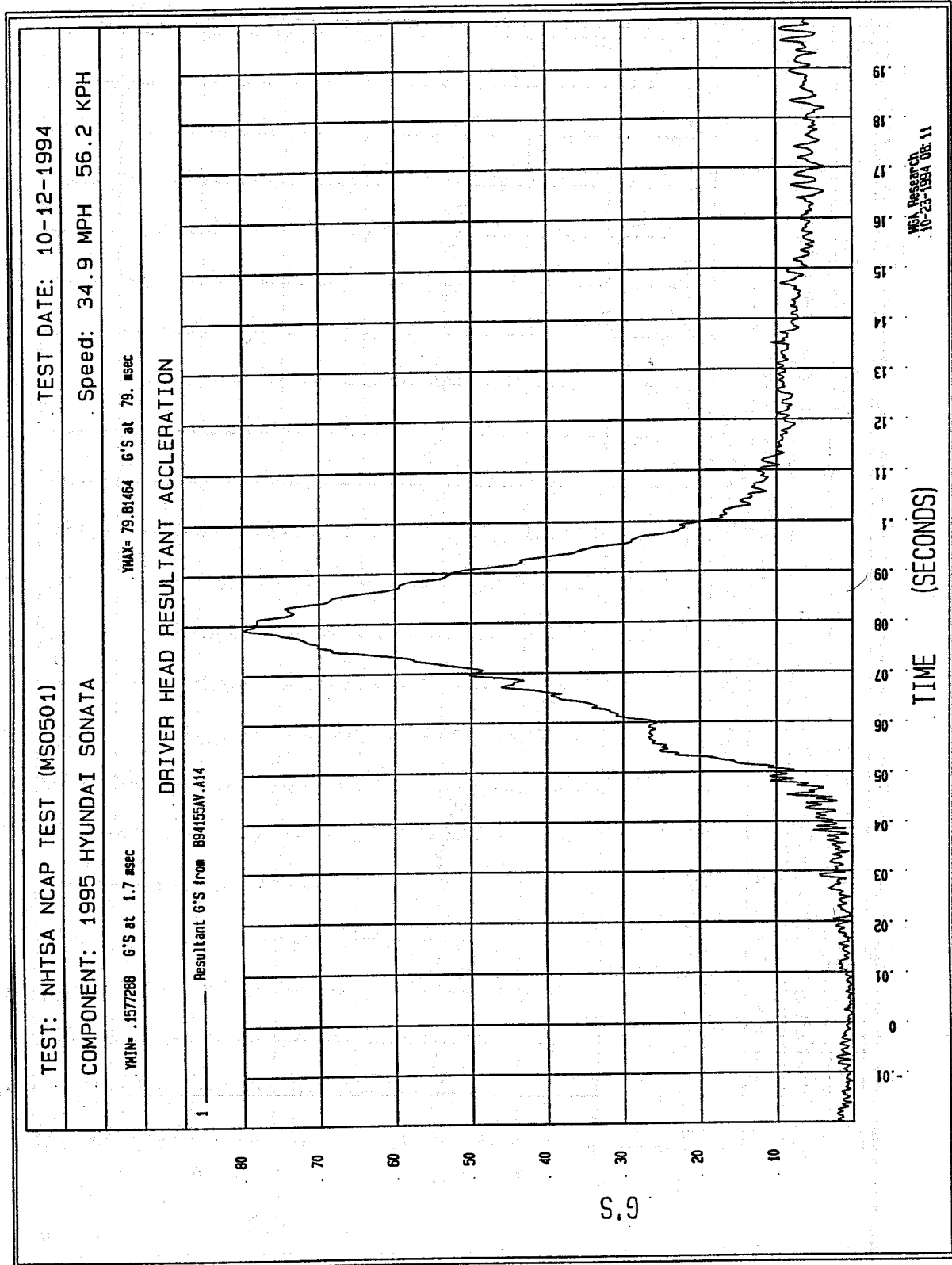


Figure B-39 - Driver Head Resultant Acceleration vs. Time

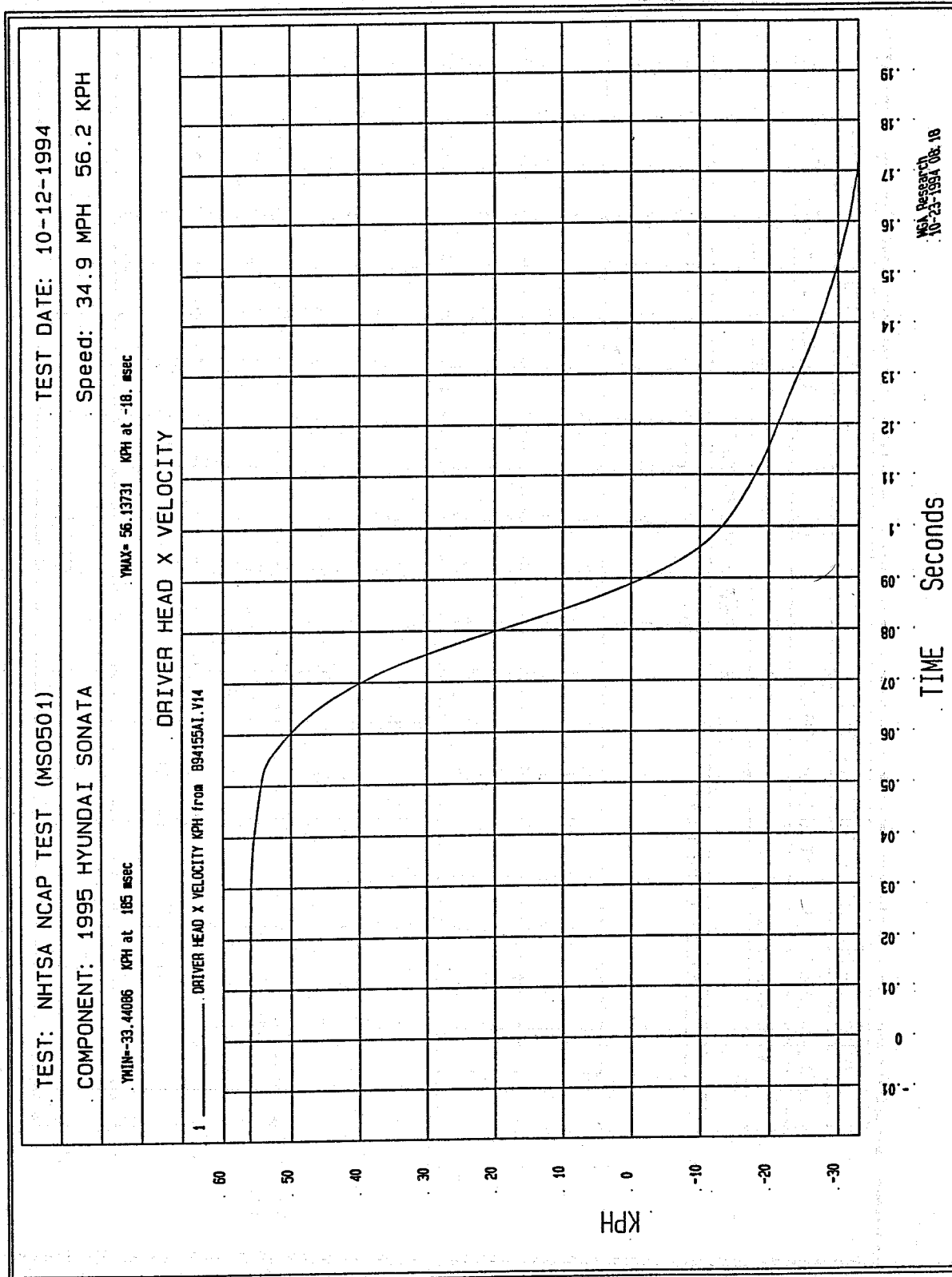


Figure B-40 - Driver Head X Velocity vs. Time

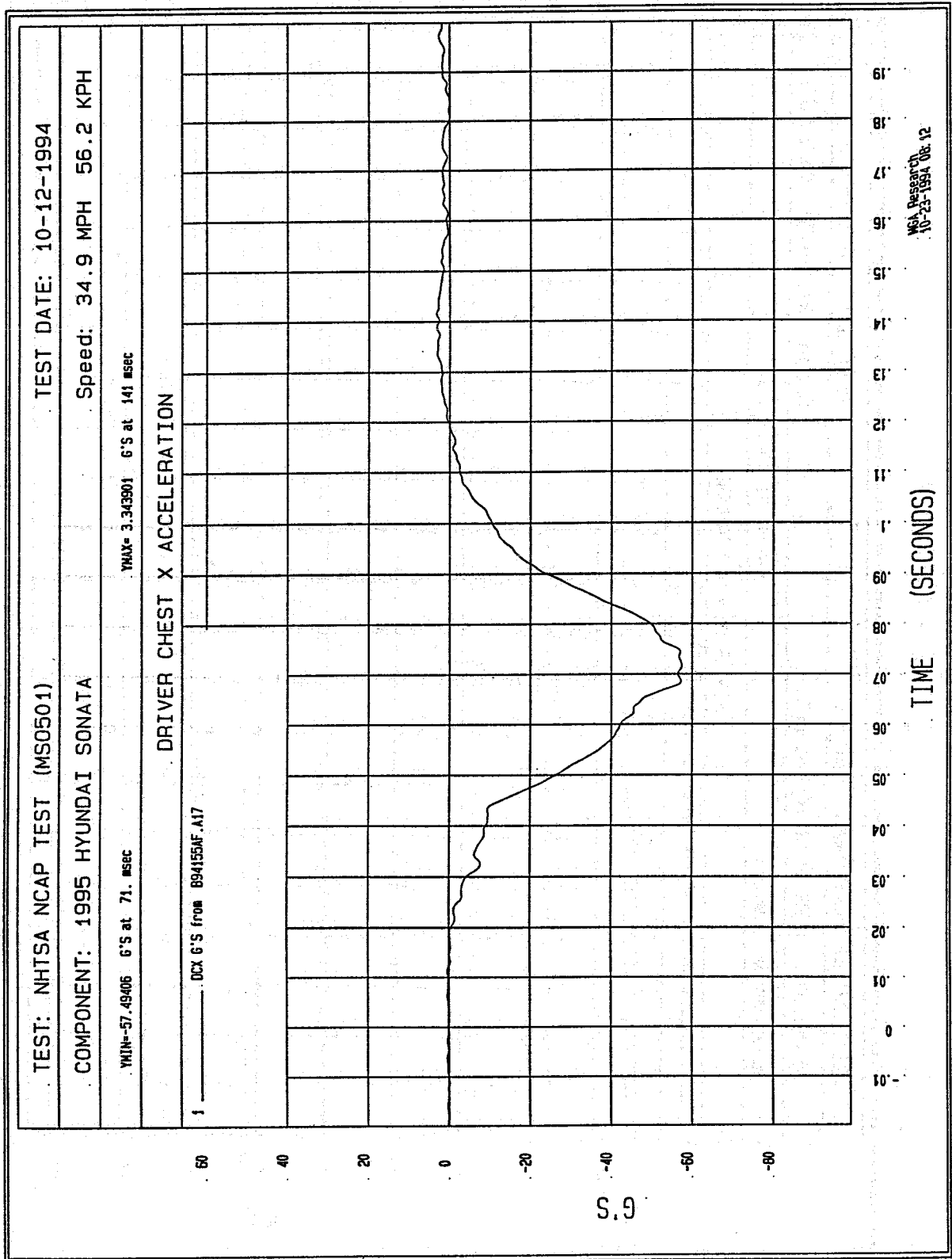


Figure B-41 - Driver Chest X Acceleration vs. Time

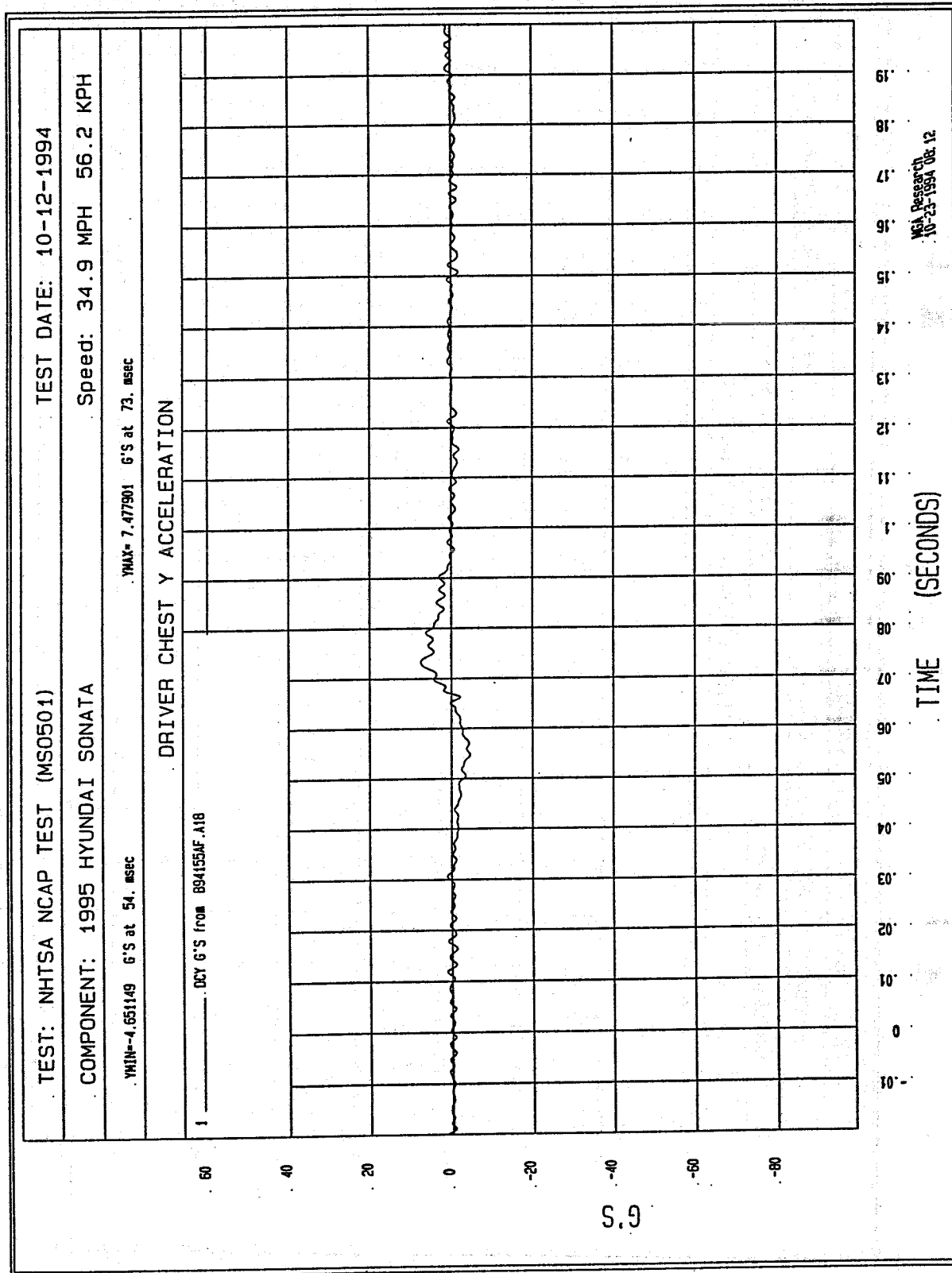


Figure B-42 - Driver Chest Y Acceleration vs. Time

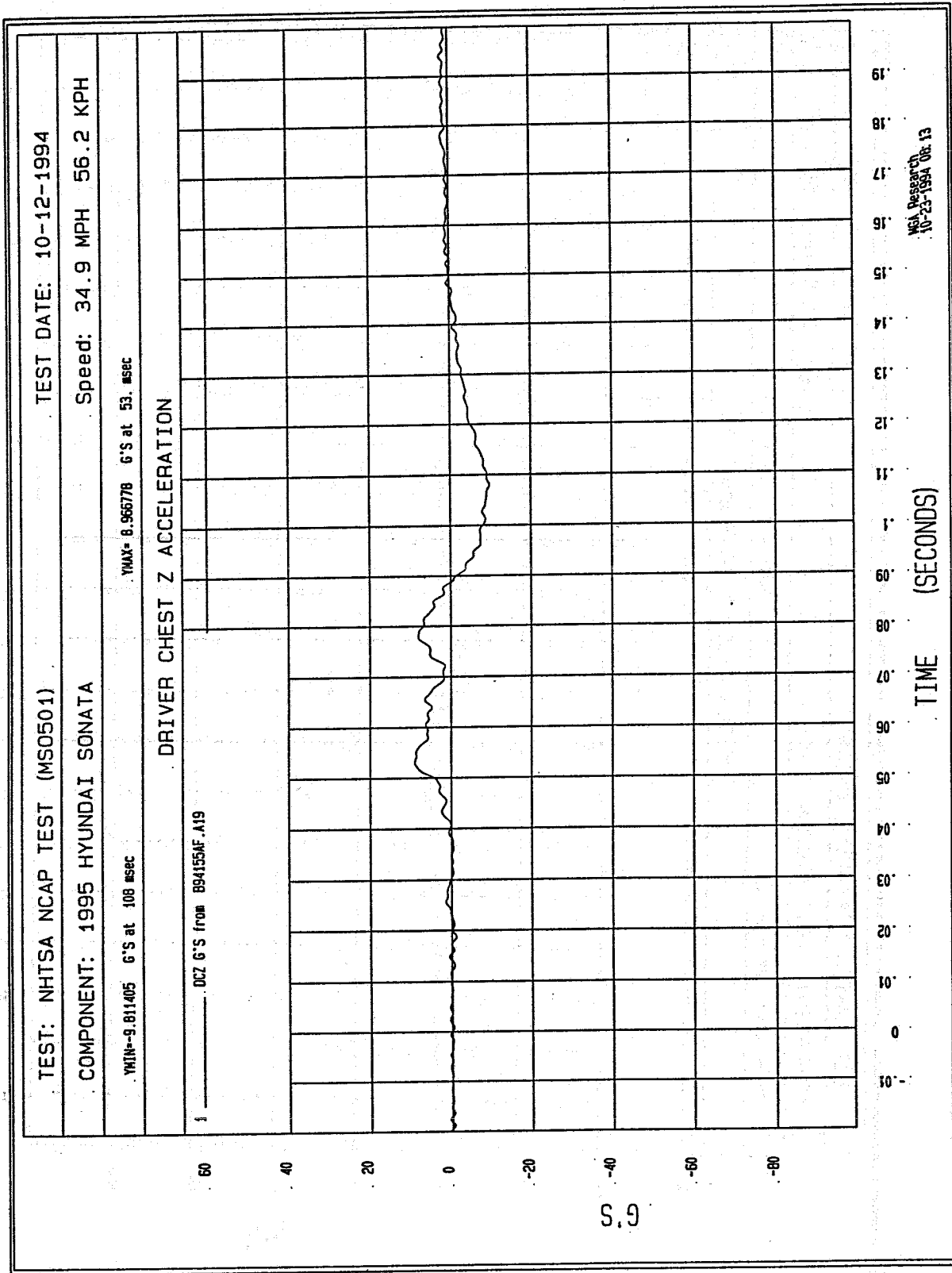


Figure B-43 - Driver Chest Z Acceleration vs. Time

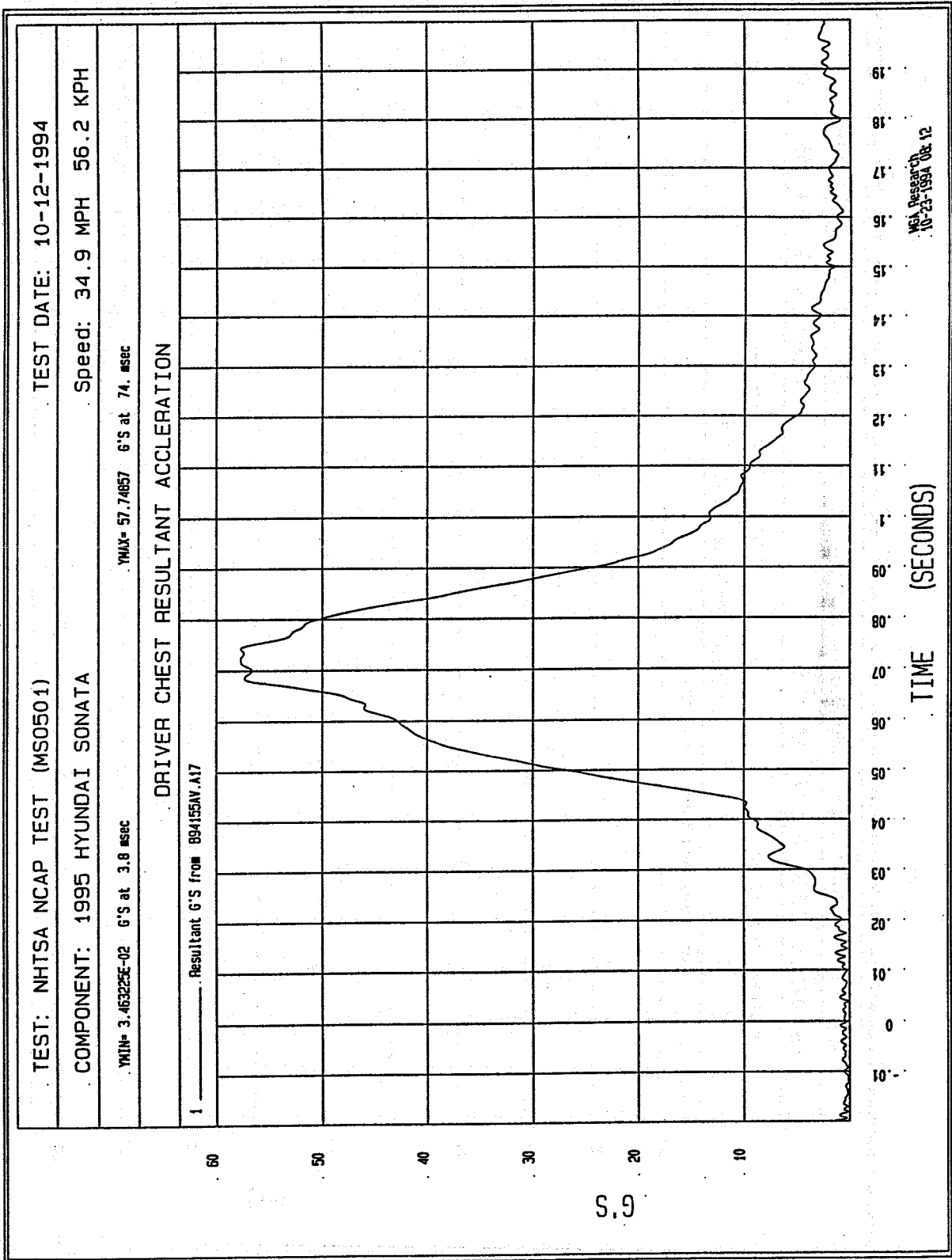


Figure B-44 - Driver Chest Resultant vs. Time

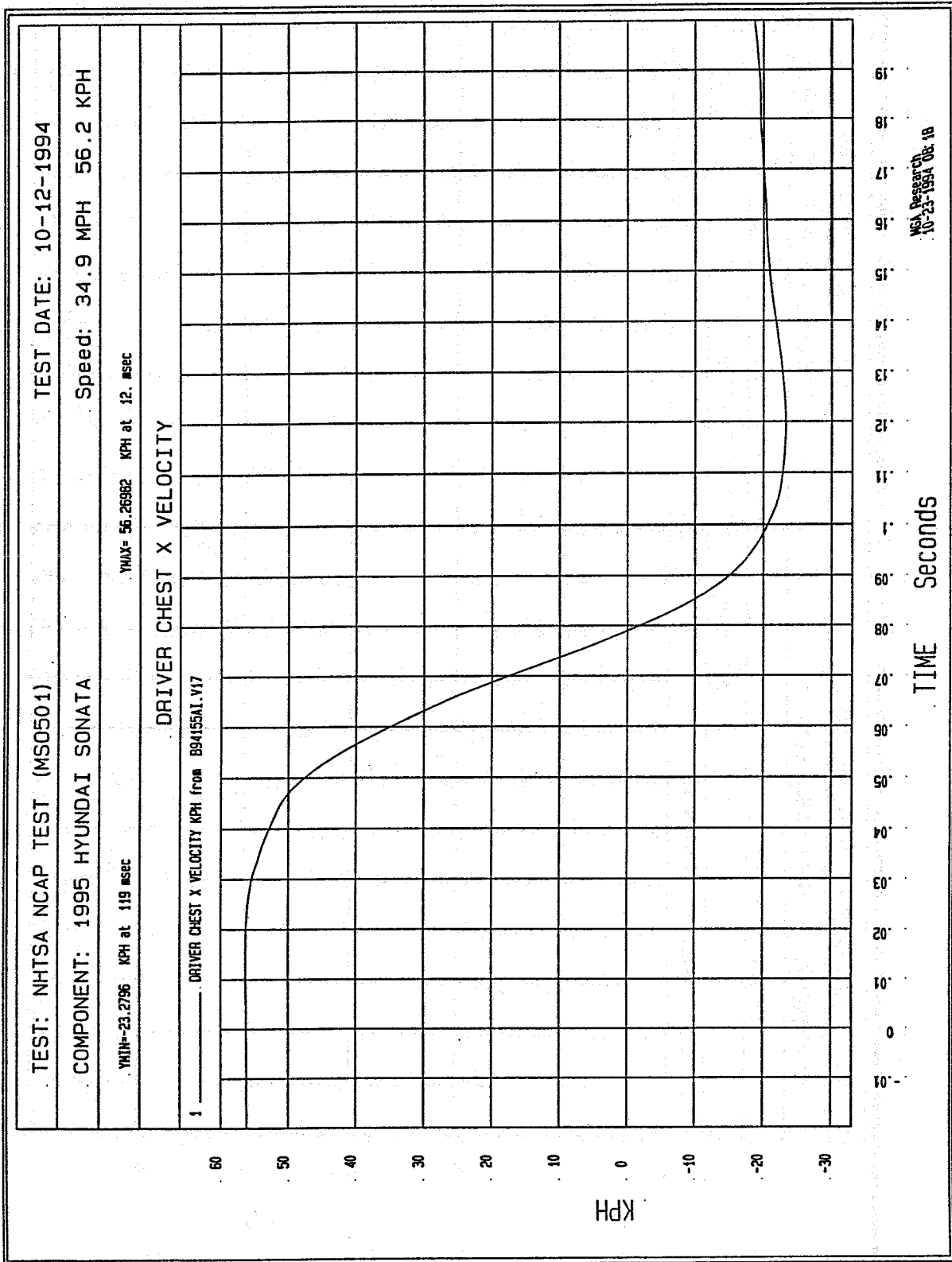


Figure B-45 - Driver Chest X Velocity vs. Time

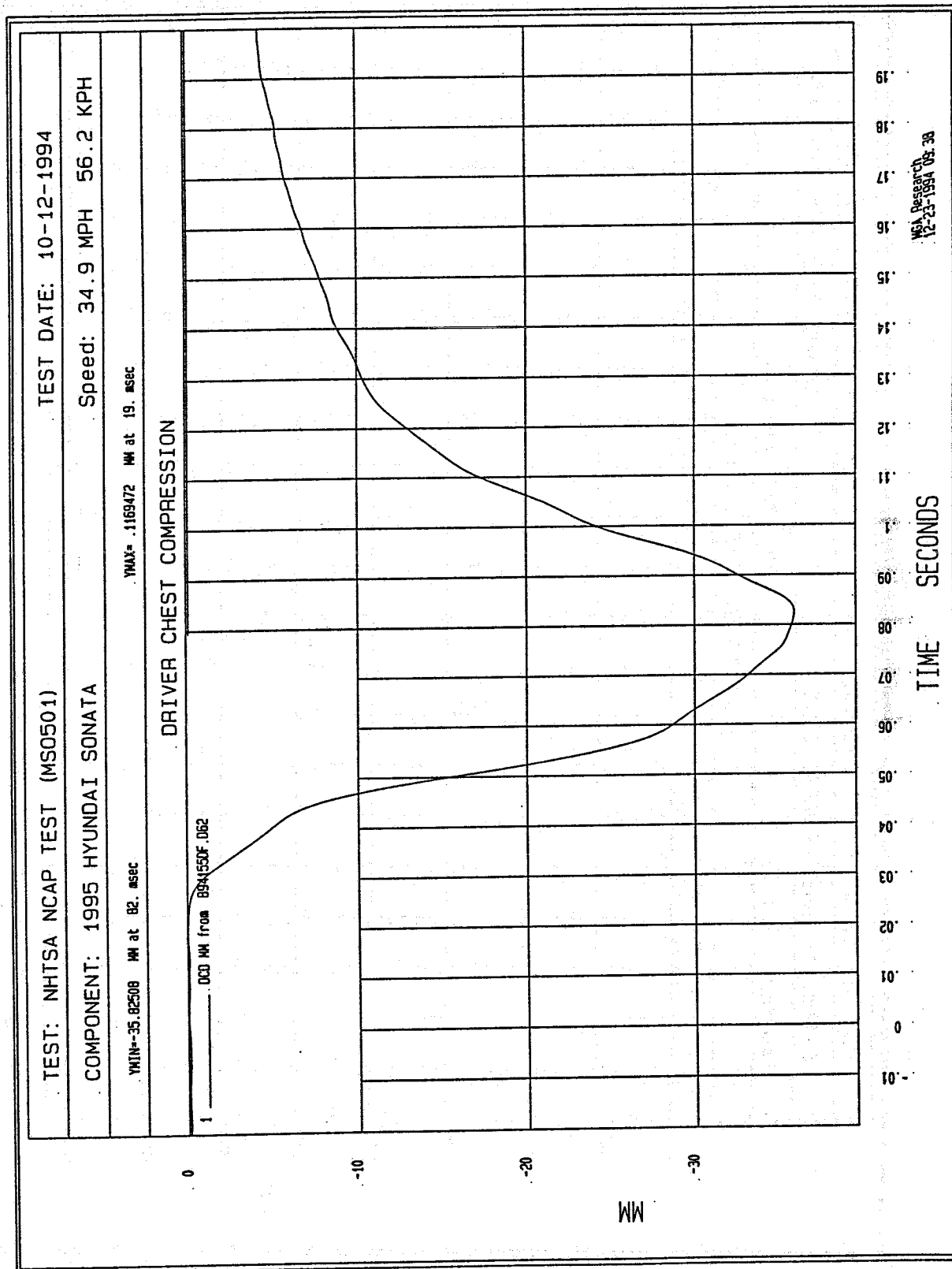


Figure B-46 - Driver Chest Compression vs. Time

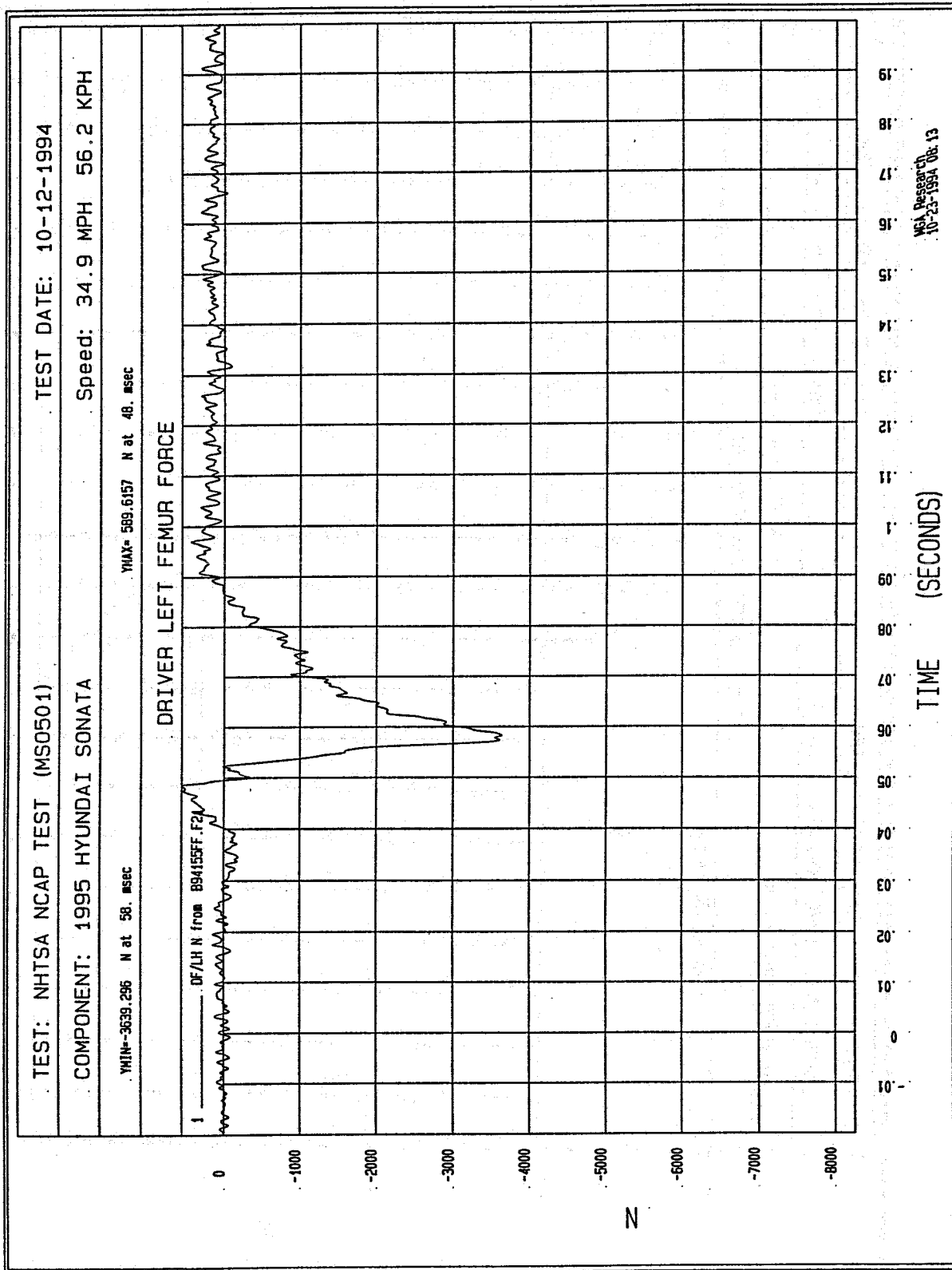


Figure B-47 - Driver Left Femur Force vs. Time

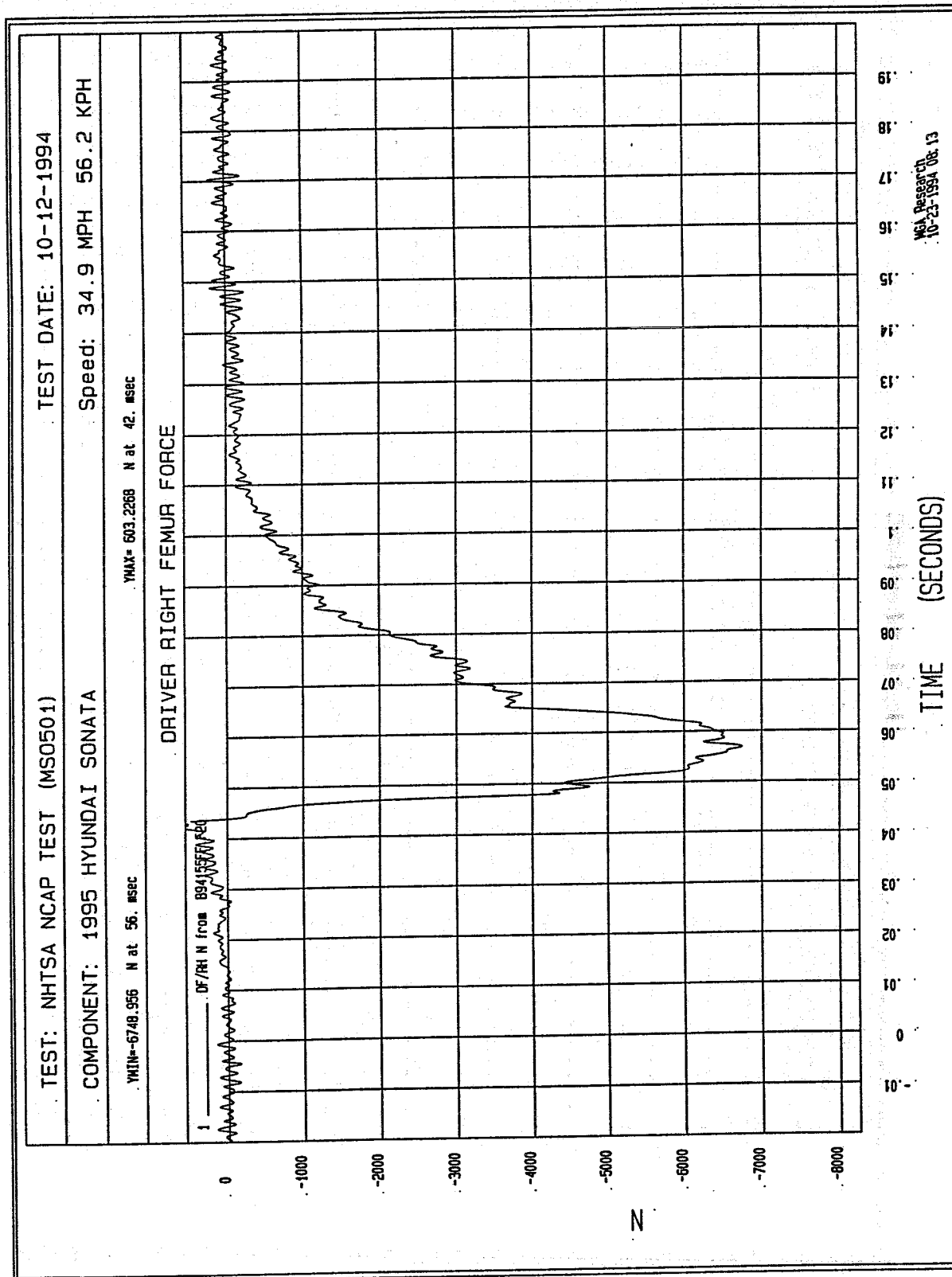


Figure B-48 - Driver Right Femur Force vs. Time

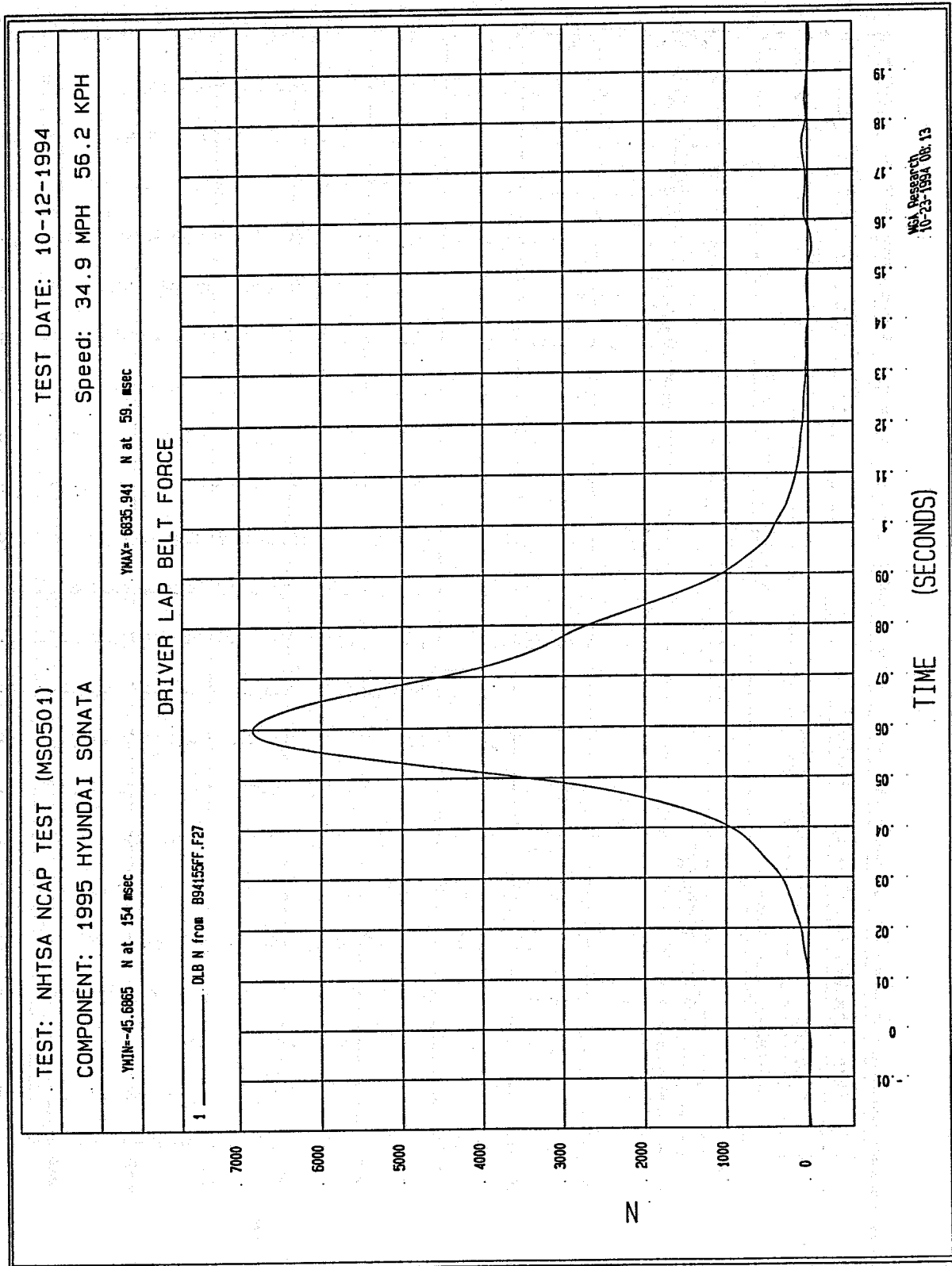


Figure B-49 - Driver Lap Belt Force vs. Time

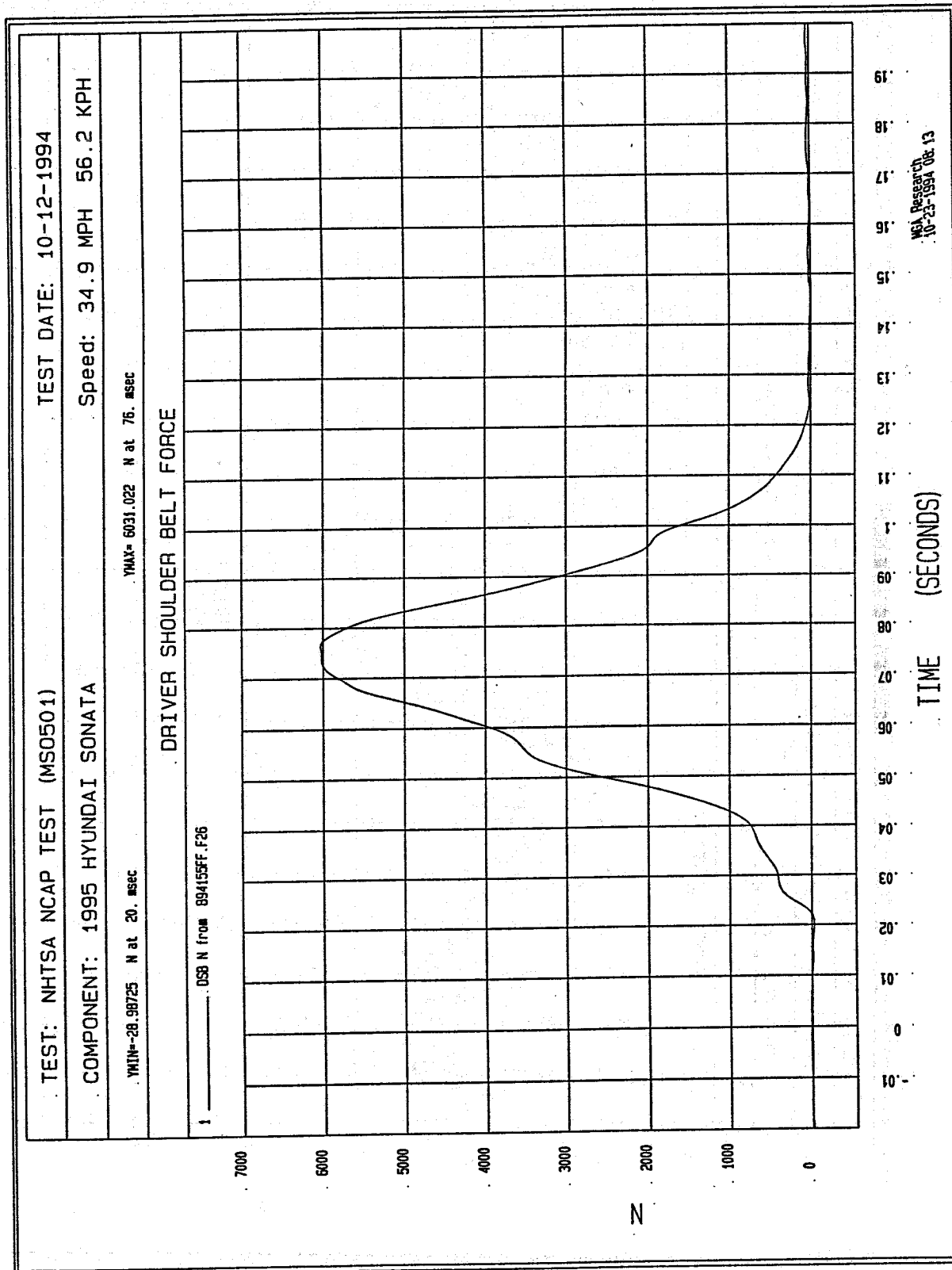


Figure B-50 - Driver Shoulder Belt Force vs. Time

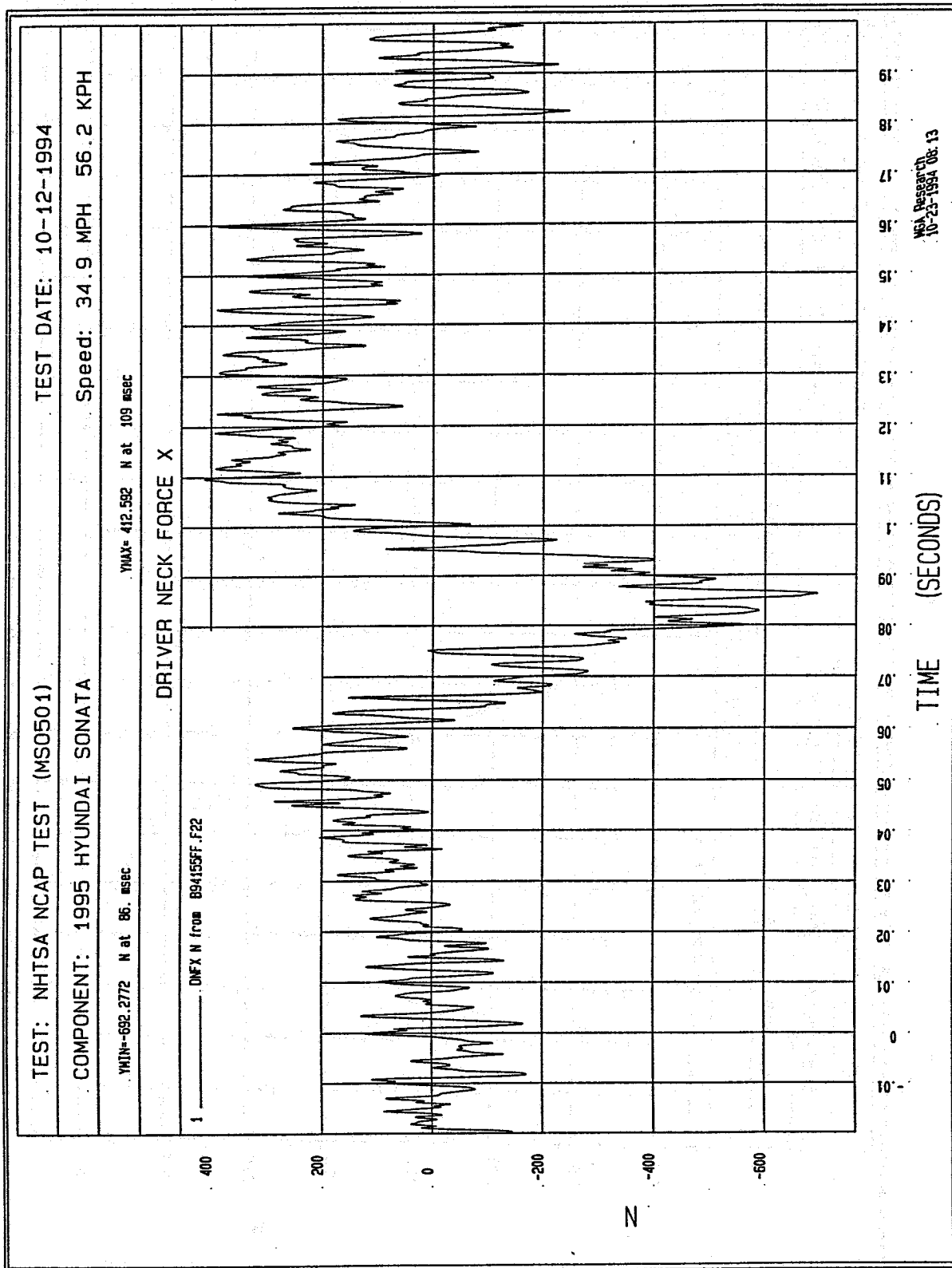


Figure B-51 - Driver Neck Force X vs. Time

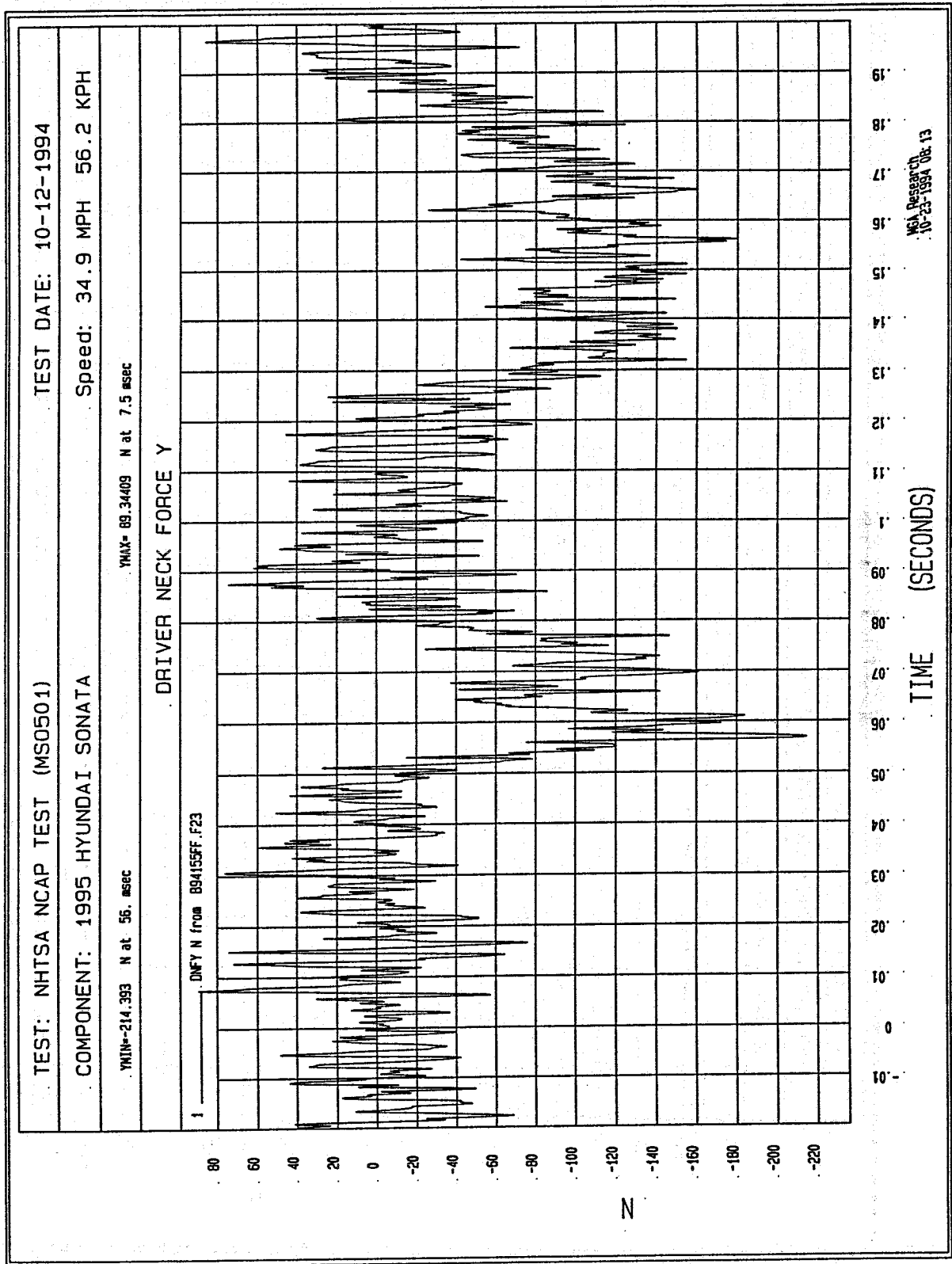


Figure B-52 - Driver Neck Force Y vs. Time

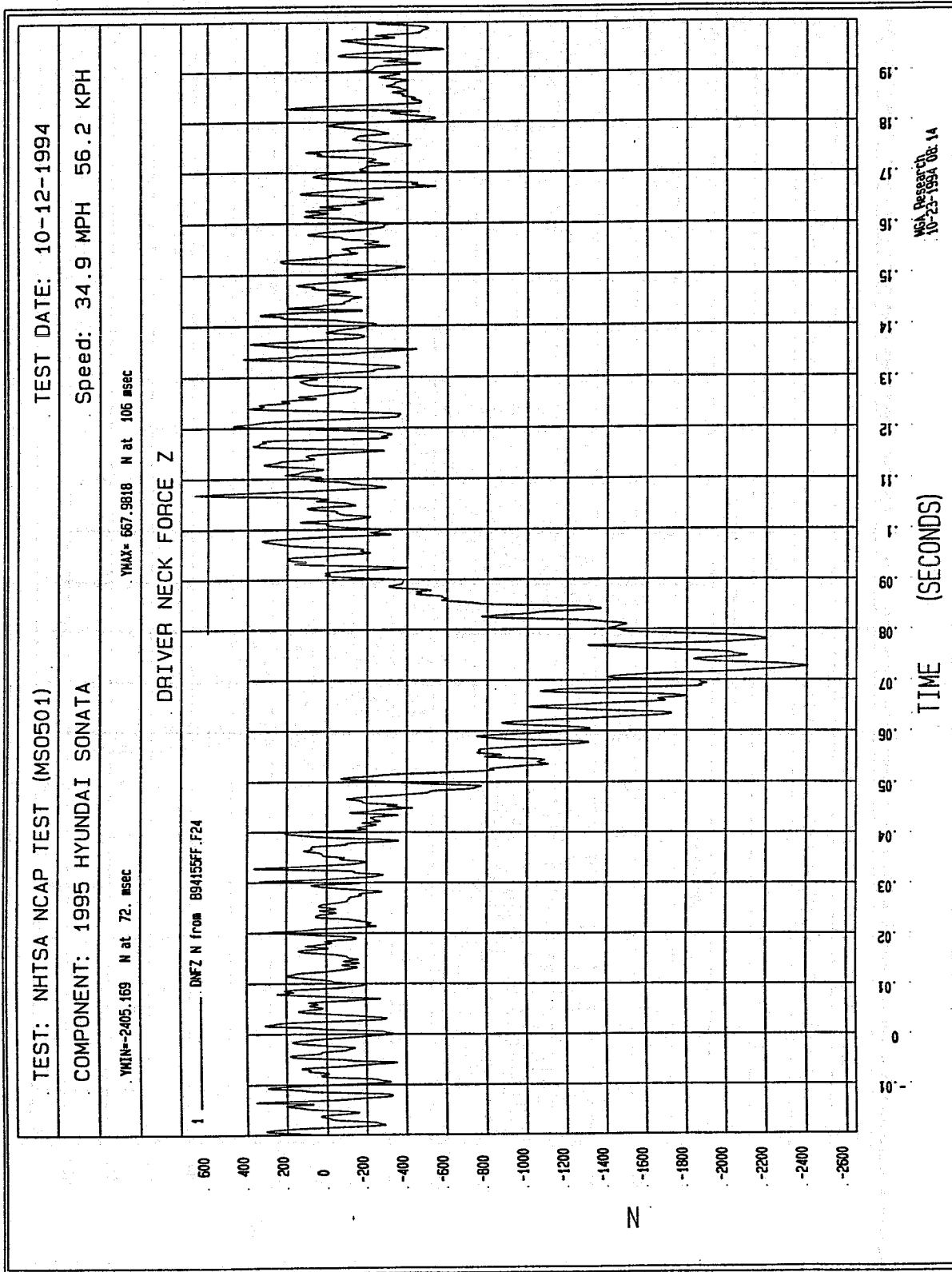


Figure B-53 - Driver Neck Force Z vs. Time

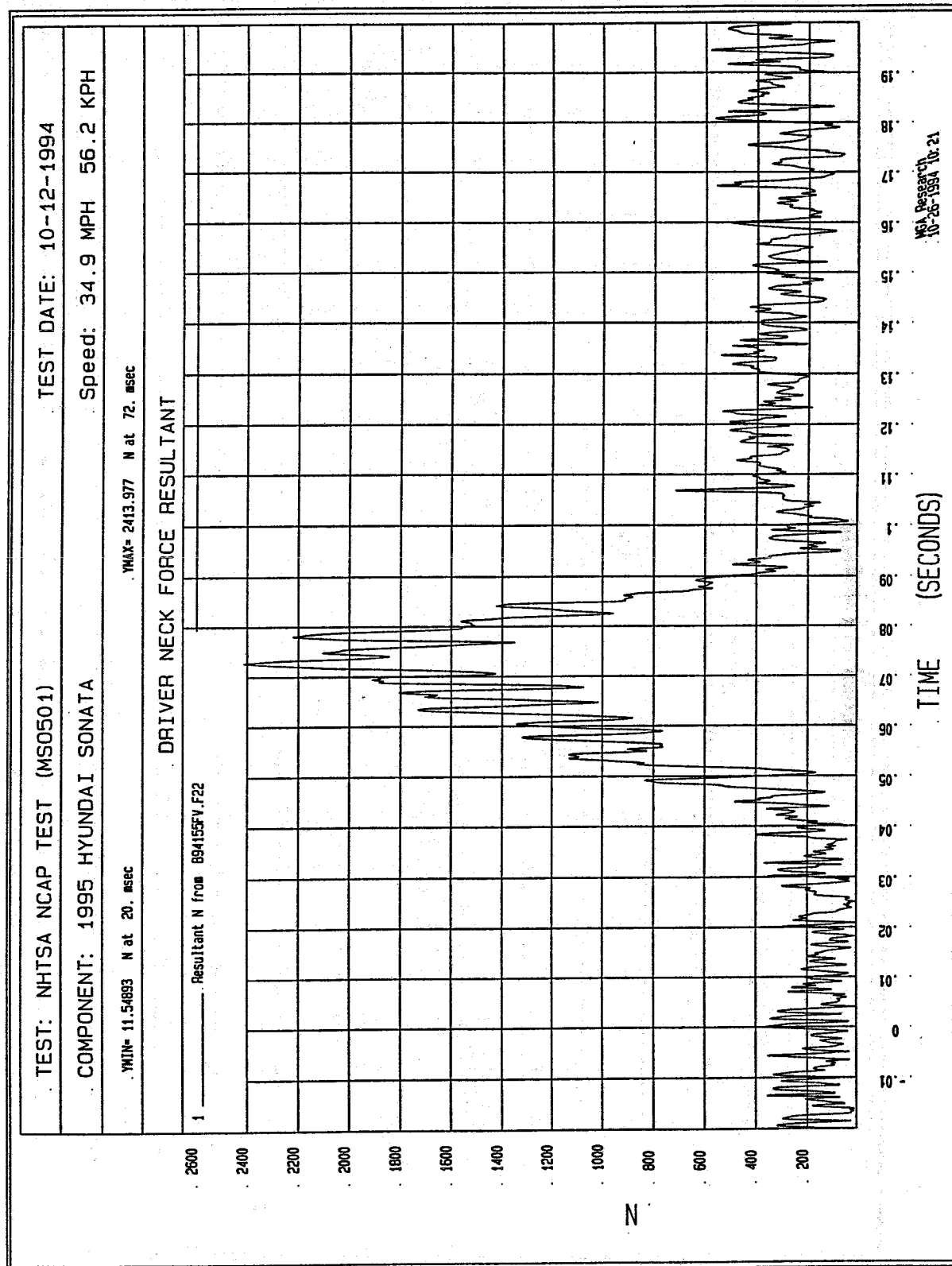


Figure B-54 - Driver Neck Force Resultant vs. Time

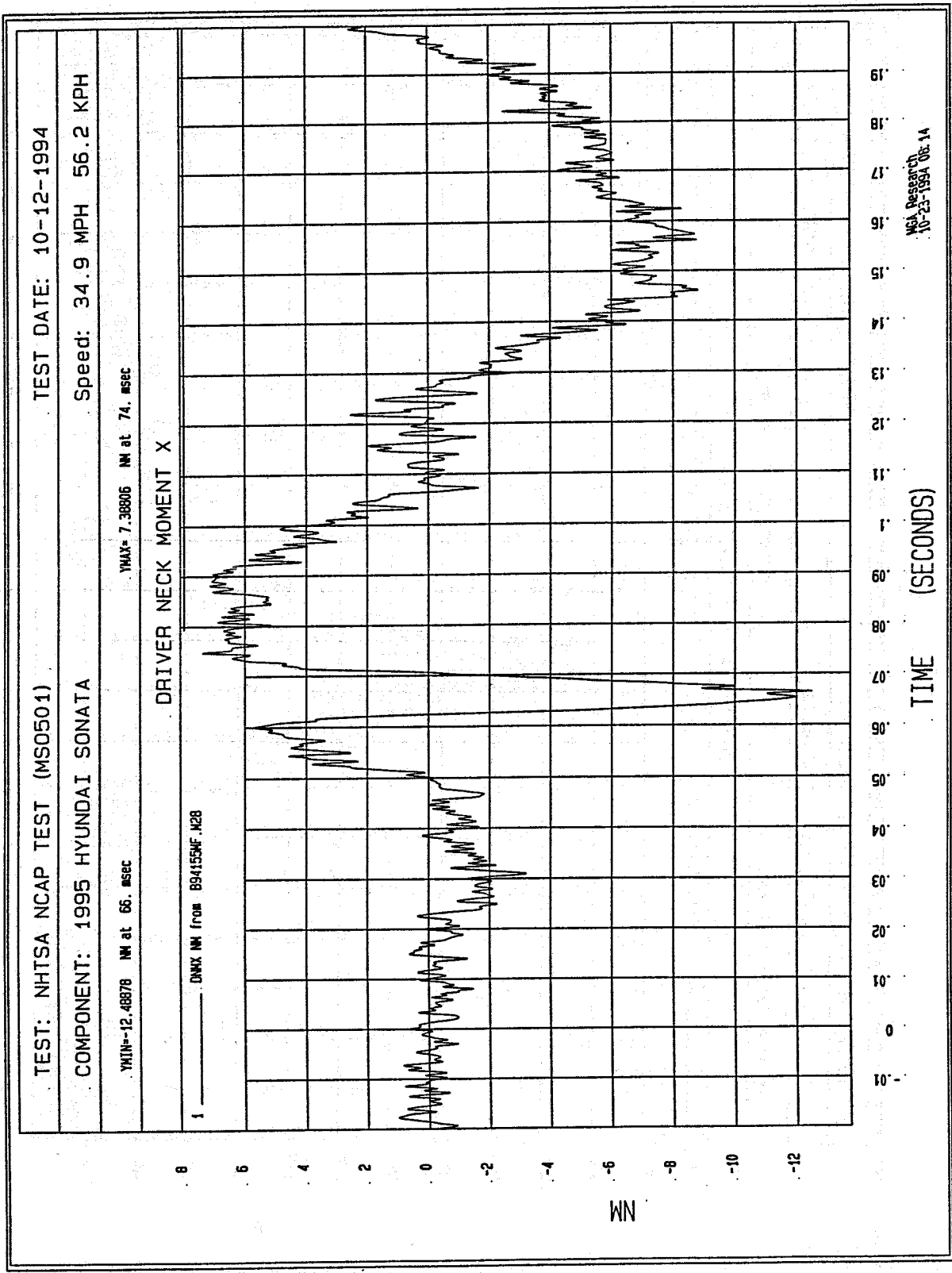


Figure B-55 - Driver Neck Moment X vs. Time

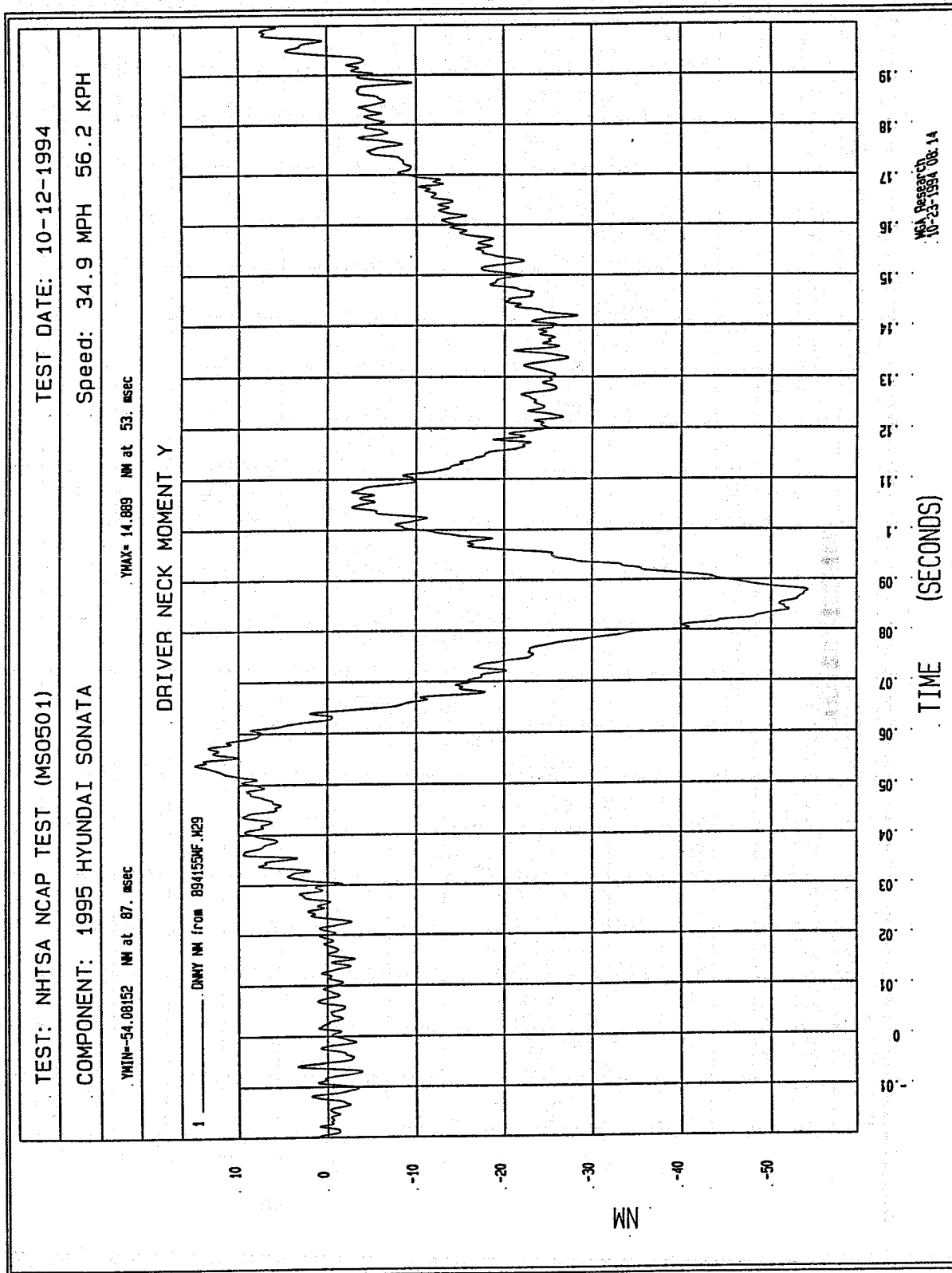


Figure B-56 - Driver Neck Moment Y vs. Time

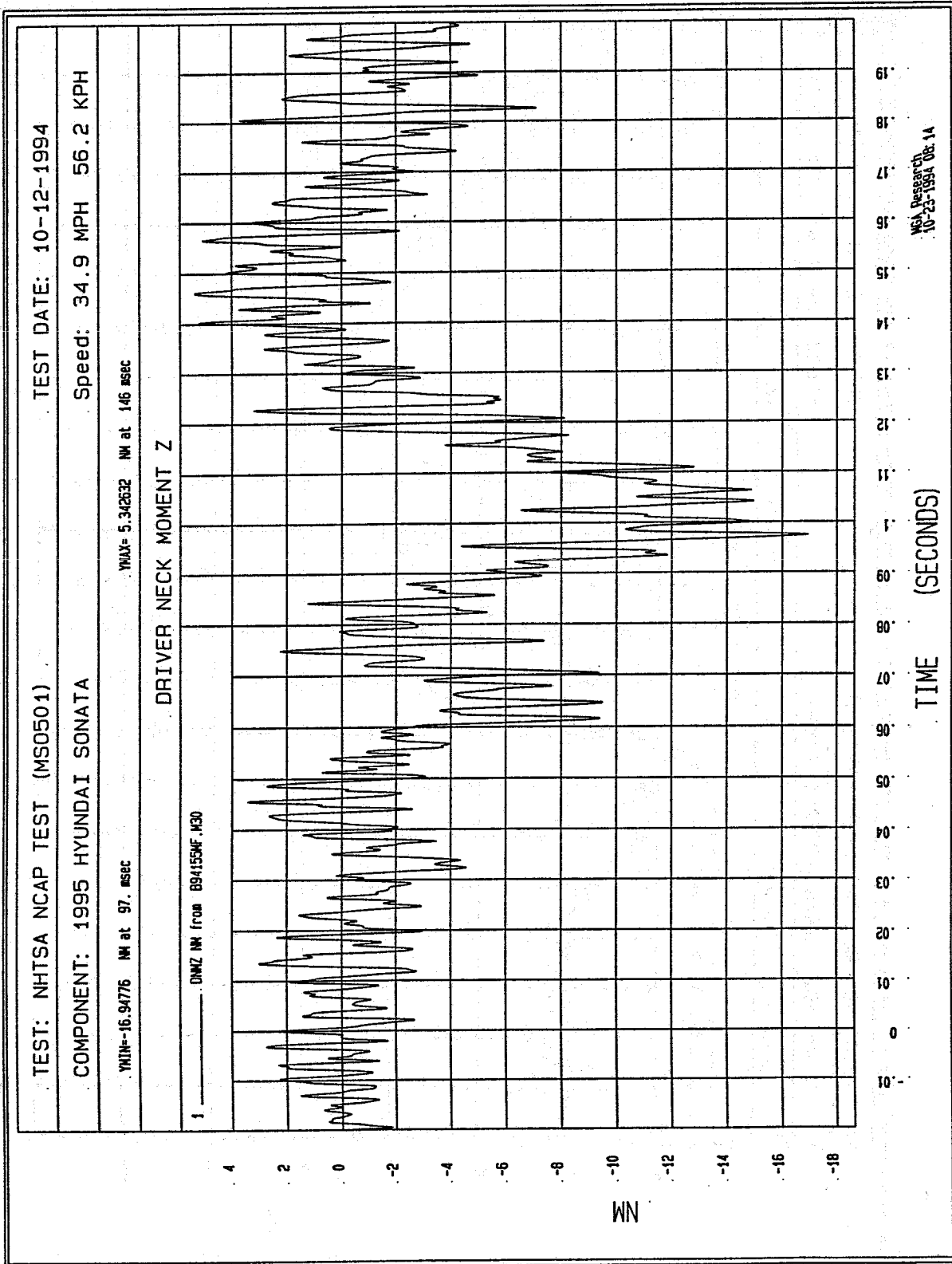


Figure B-57 - Driver Neck Moment Z vs. Time

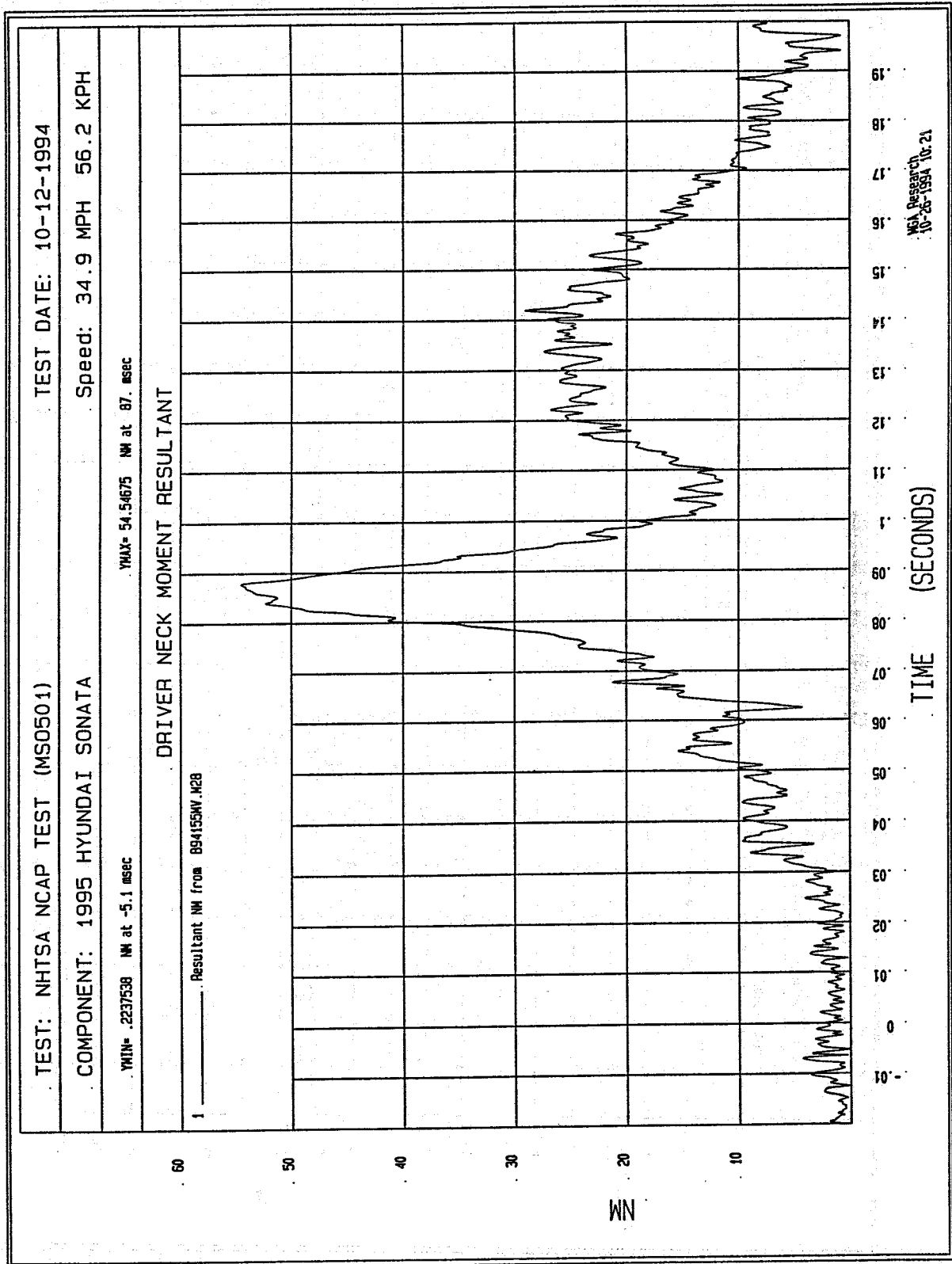


Figure B-58 - Driver Neck Moment Resultant vs. Time

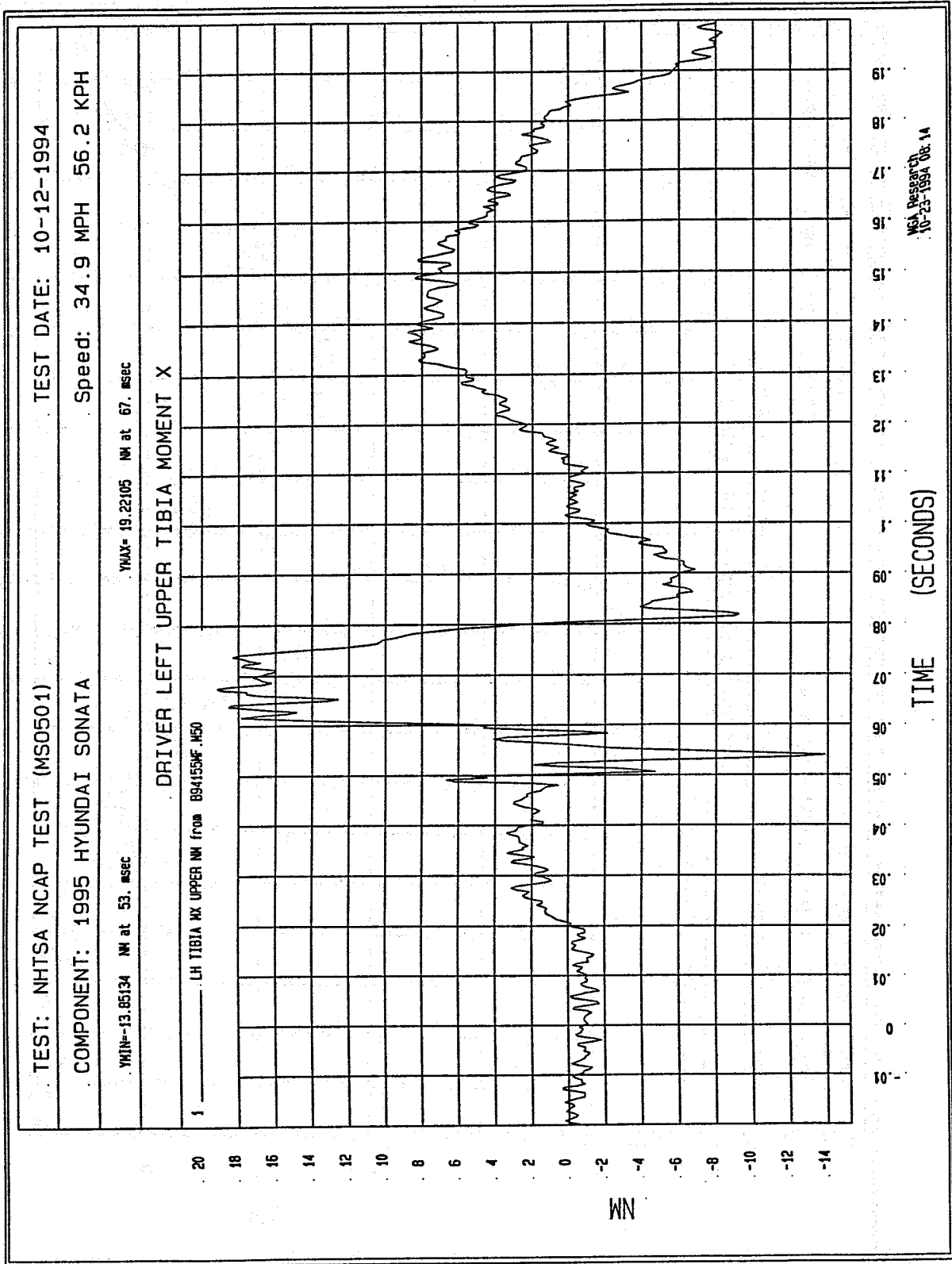


Figure B-59 - Driver Left Upper Tibia Moment X vs. Time

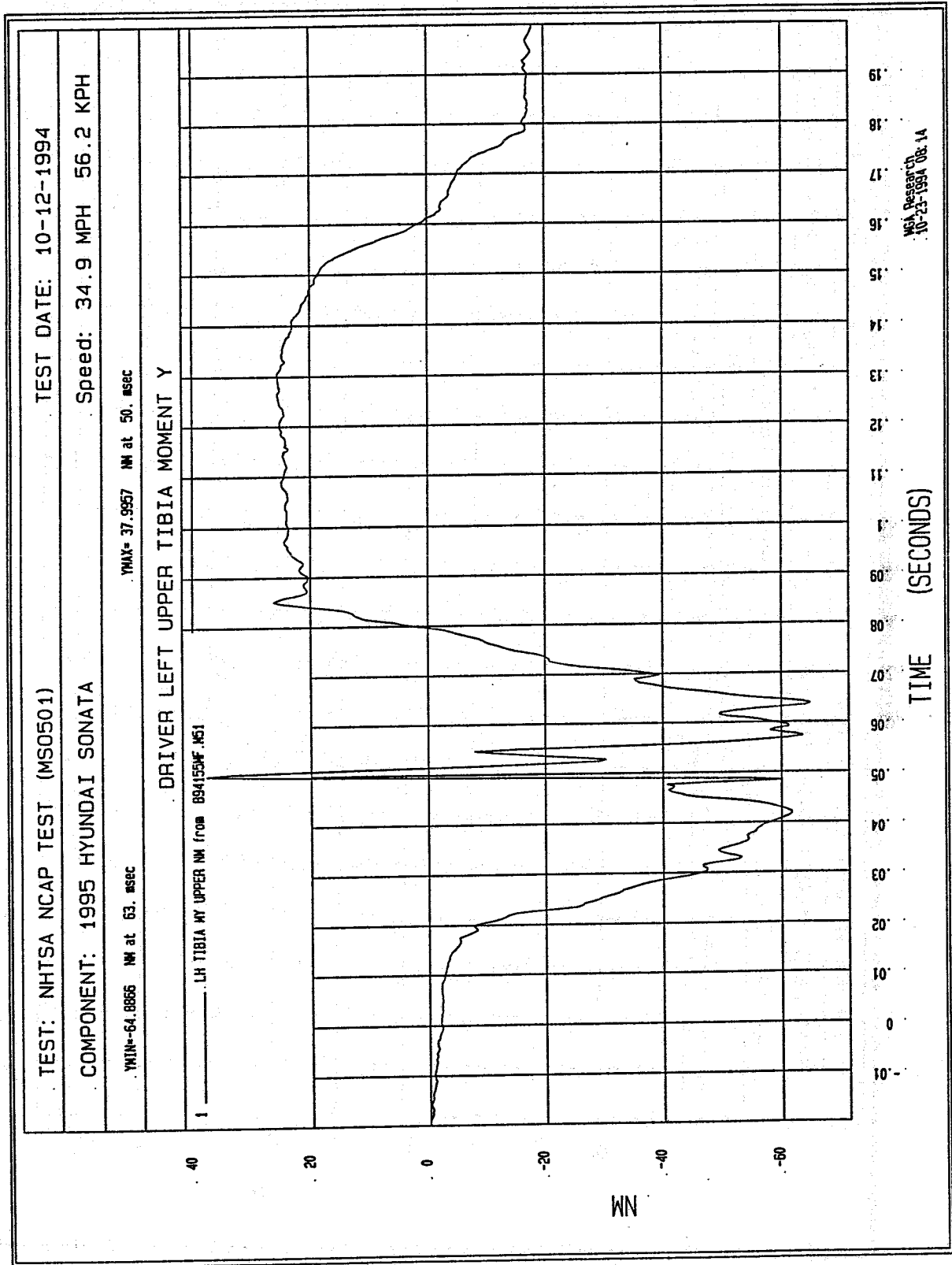


Figure B-60 - Driver Left Upper Tibia Moment Y vs. Time

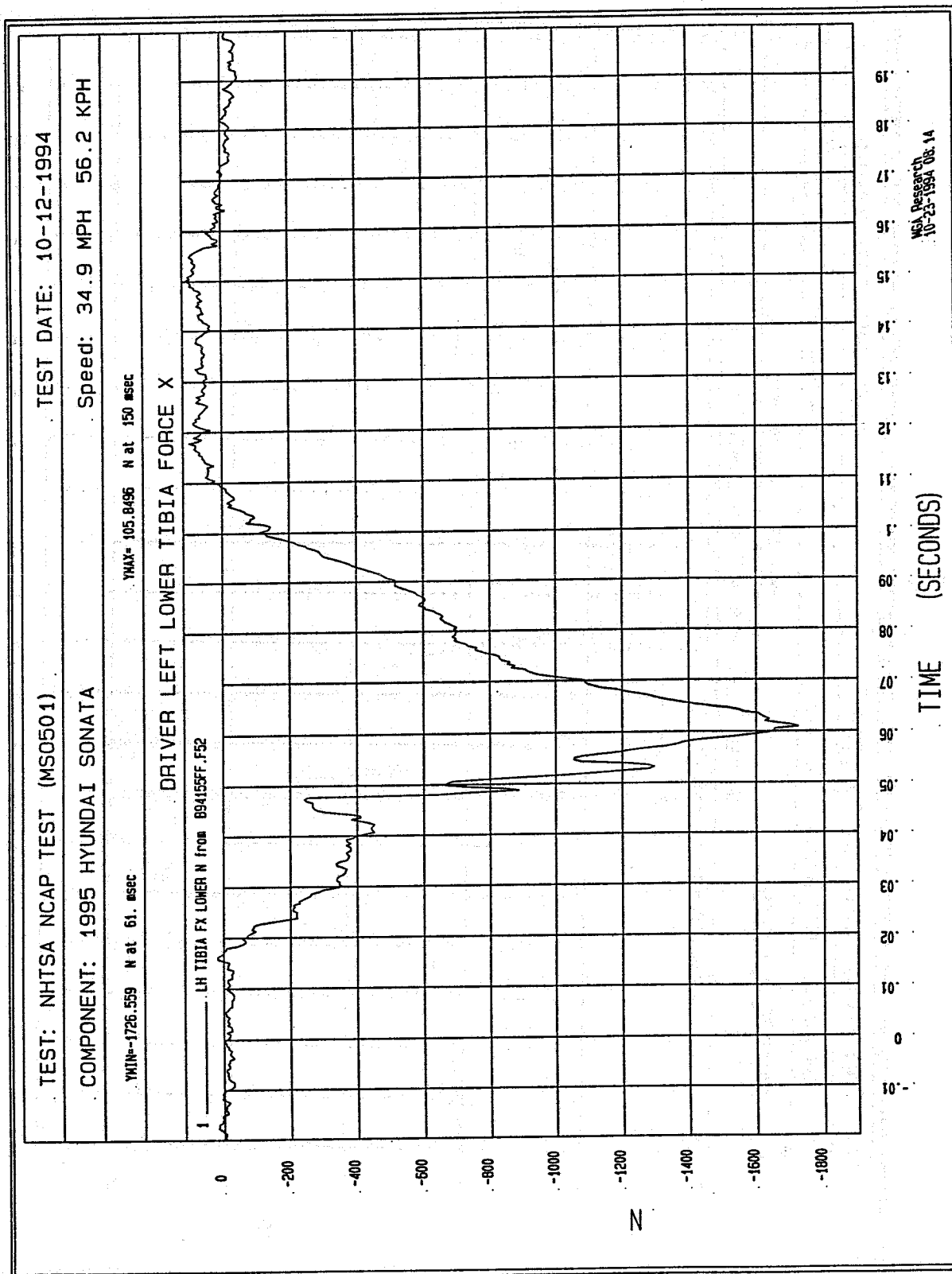


Figure B-61 - Driver Left Lower Tibia Force X vs. Time

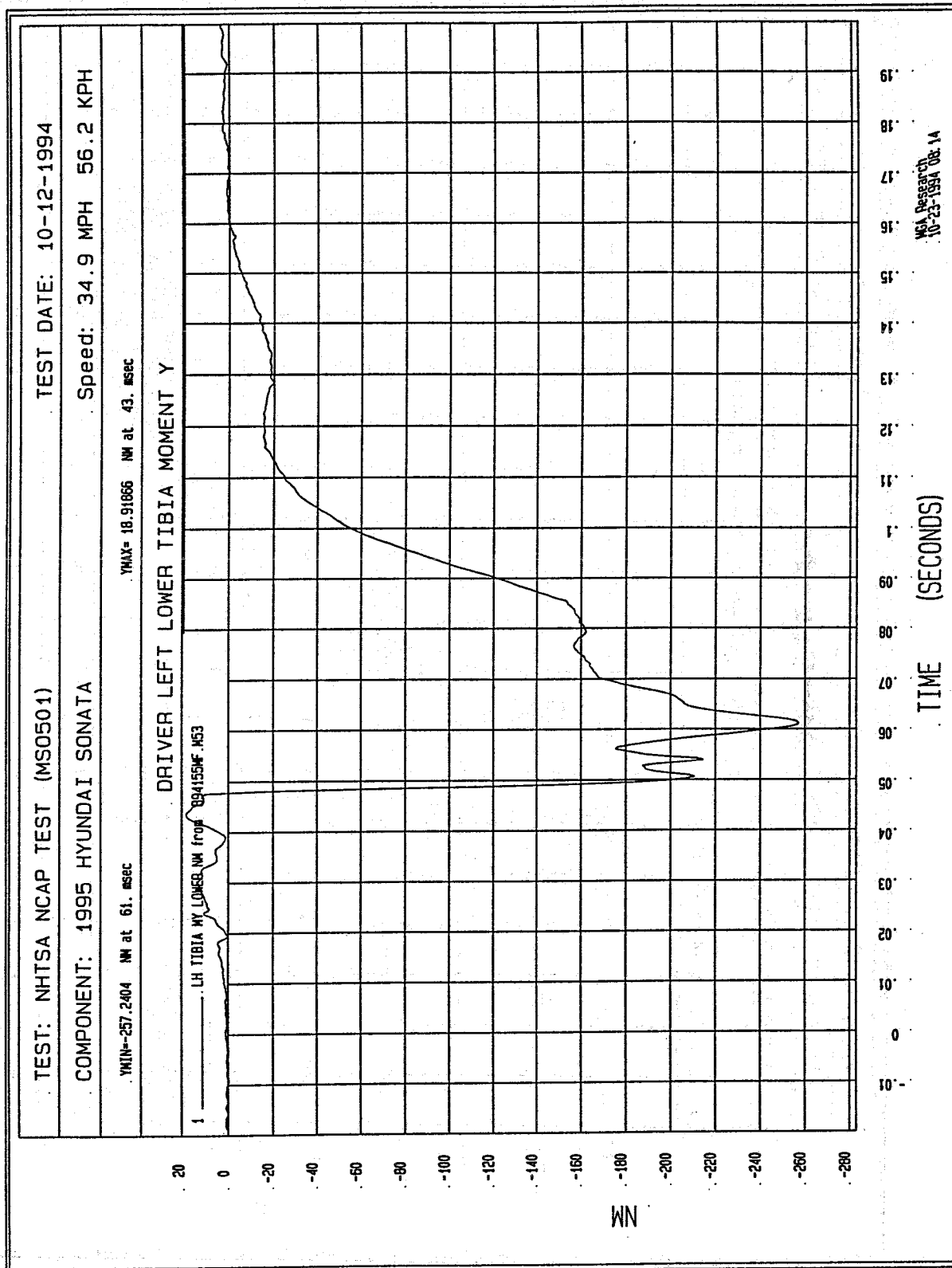


Figure B-62 - Driver Left Lower Tibia Moment Y vs. Time

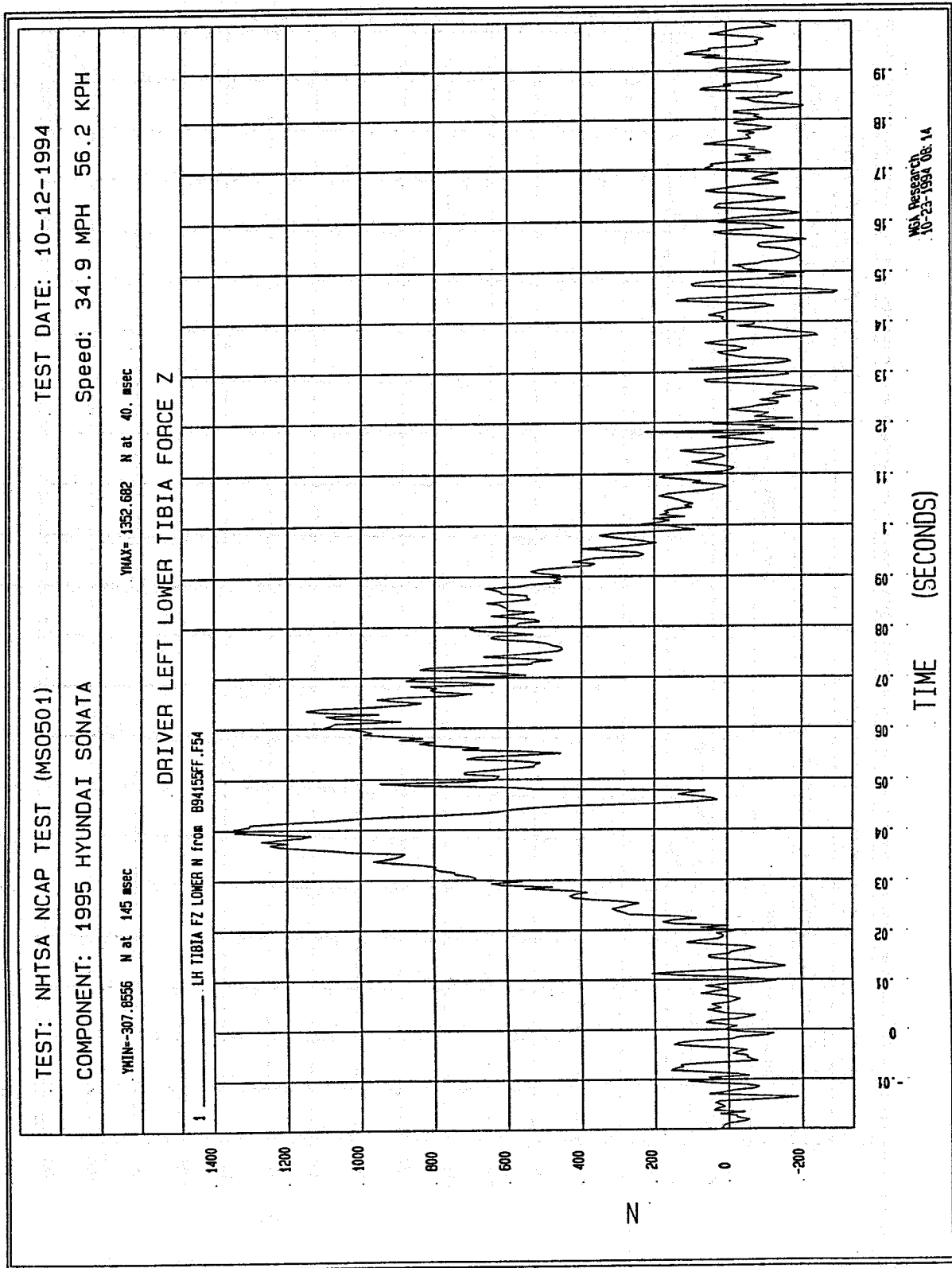


Figure B-63 - Driver Left Lower Tibia Force Z vs. Time

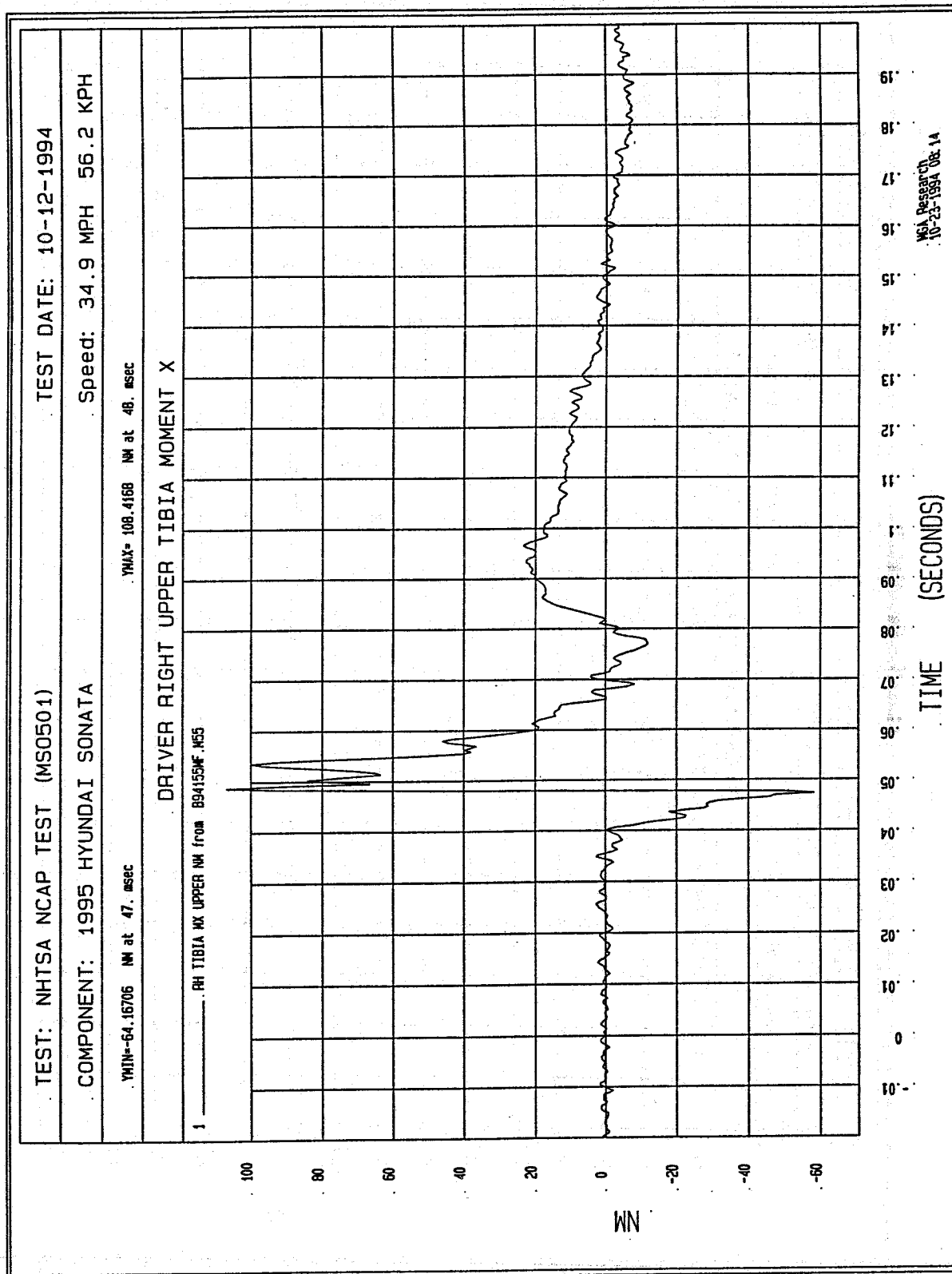


Figure B-64 - Driver Right Upper Tibia Moment X vs. Time

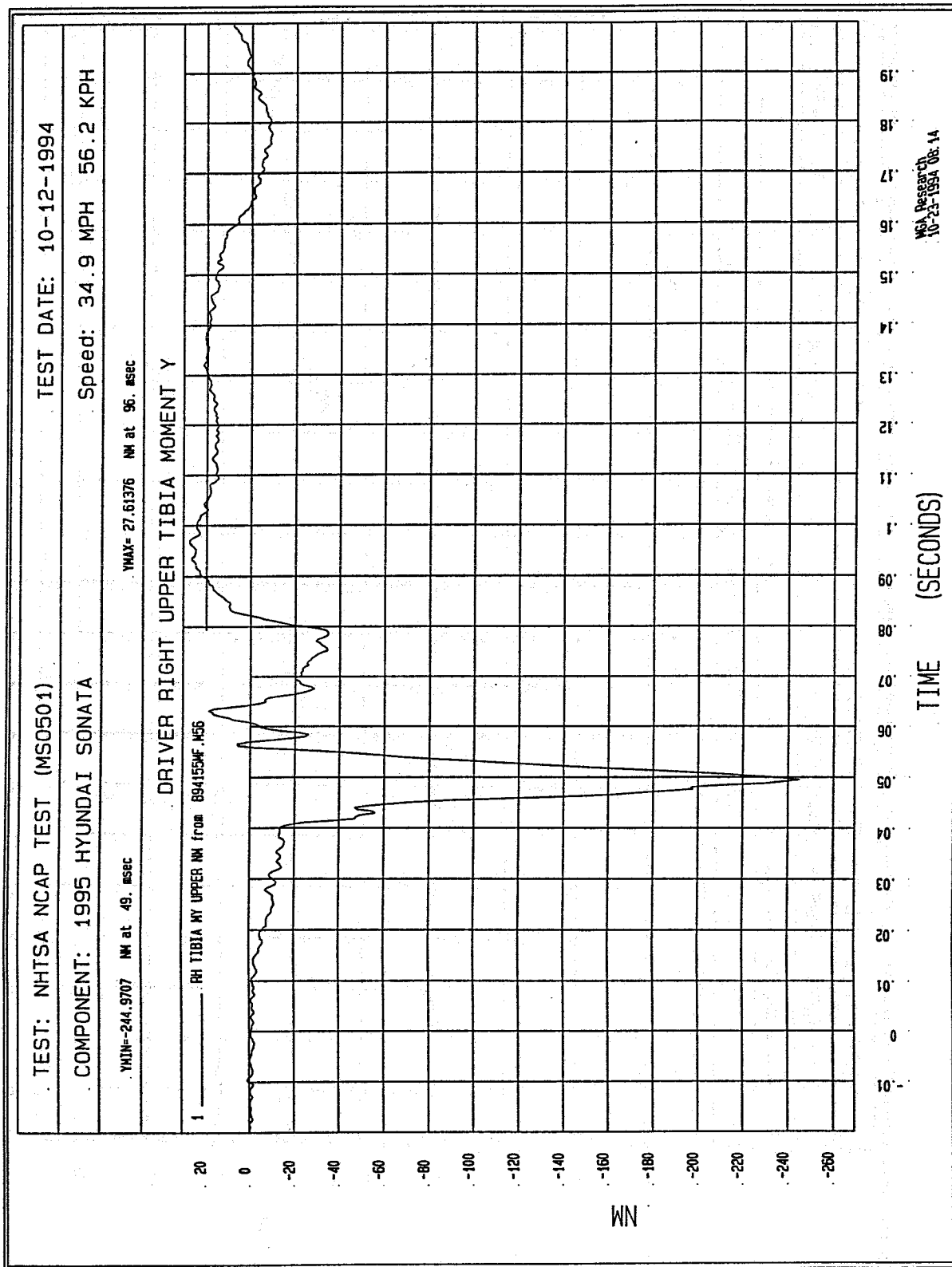


Figure B-65 - Driver Right Upper Tibia Moment Y vs. Time

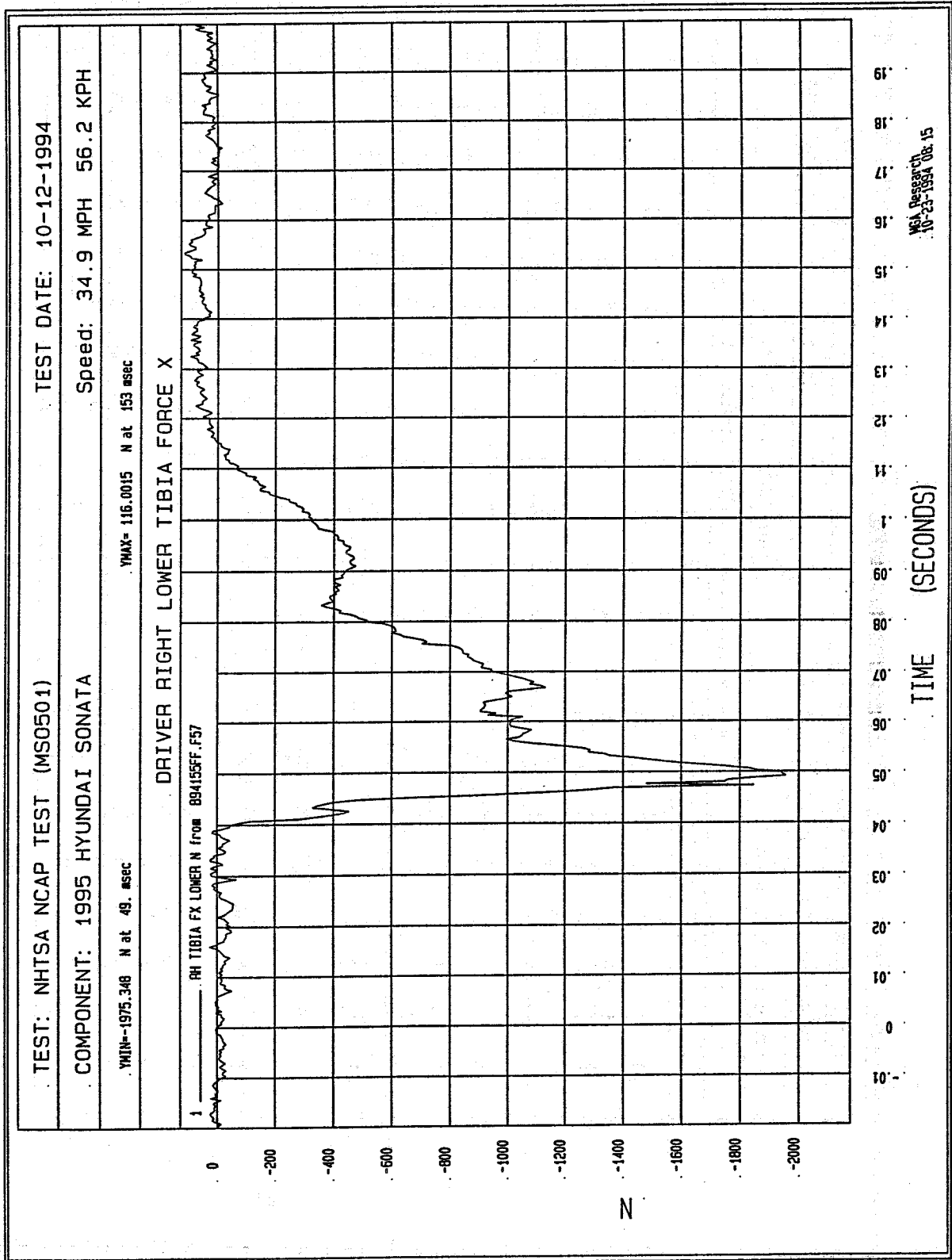


Figure B-66 - Driver Right Lower Tibia Force X vs. Time

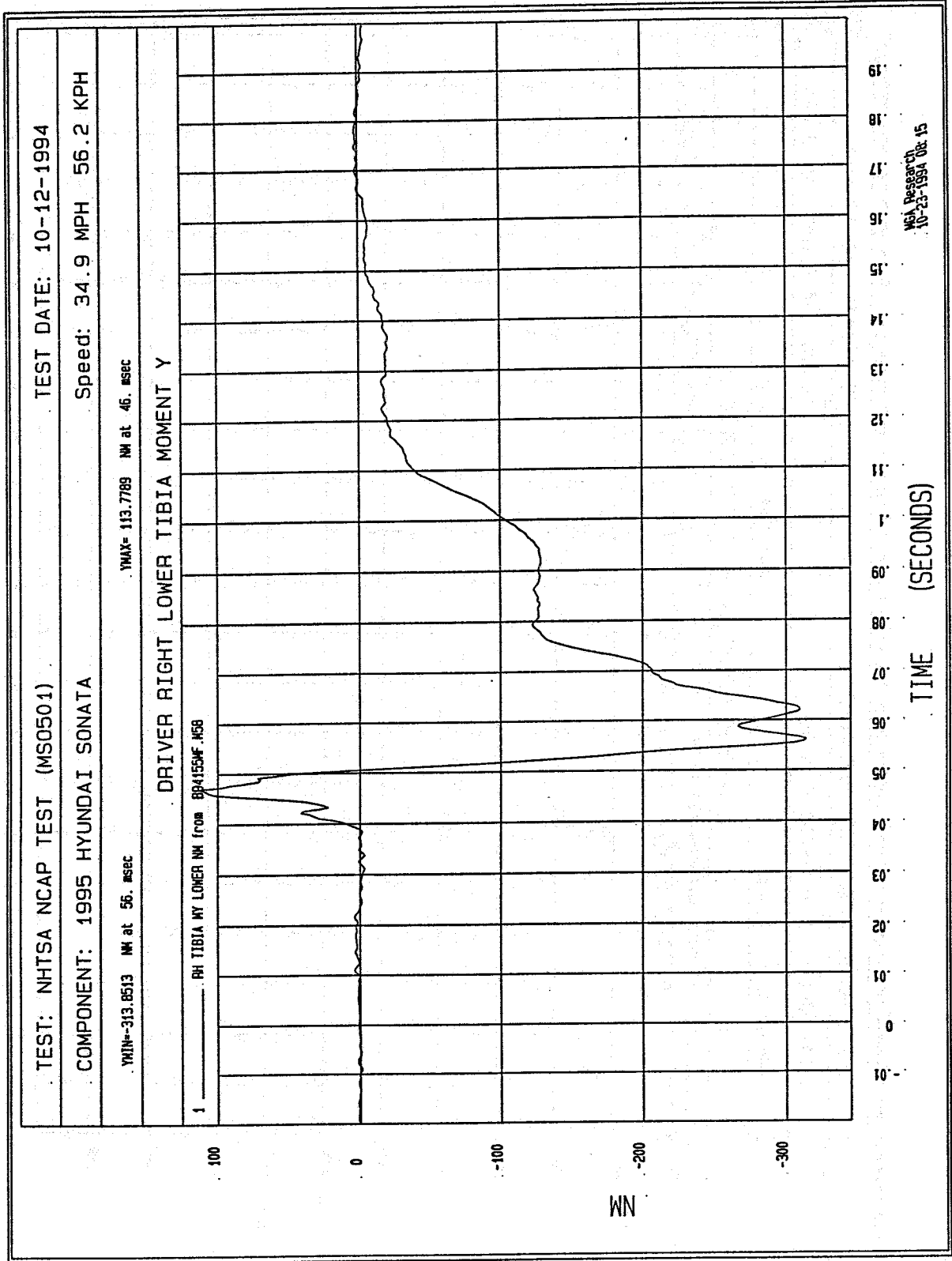


Figure B-67 - Driver Right Lower Tibia Moment Y vs. Time

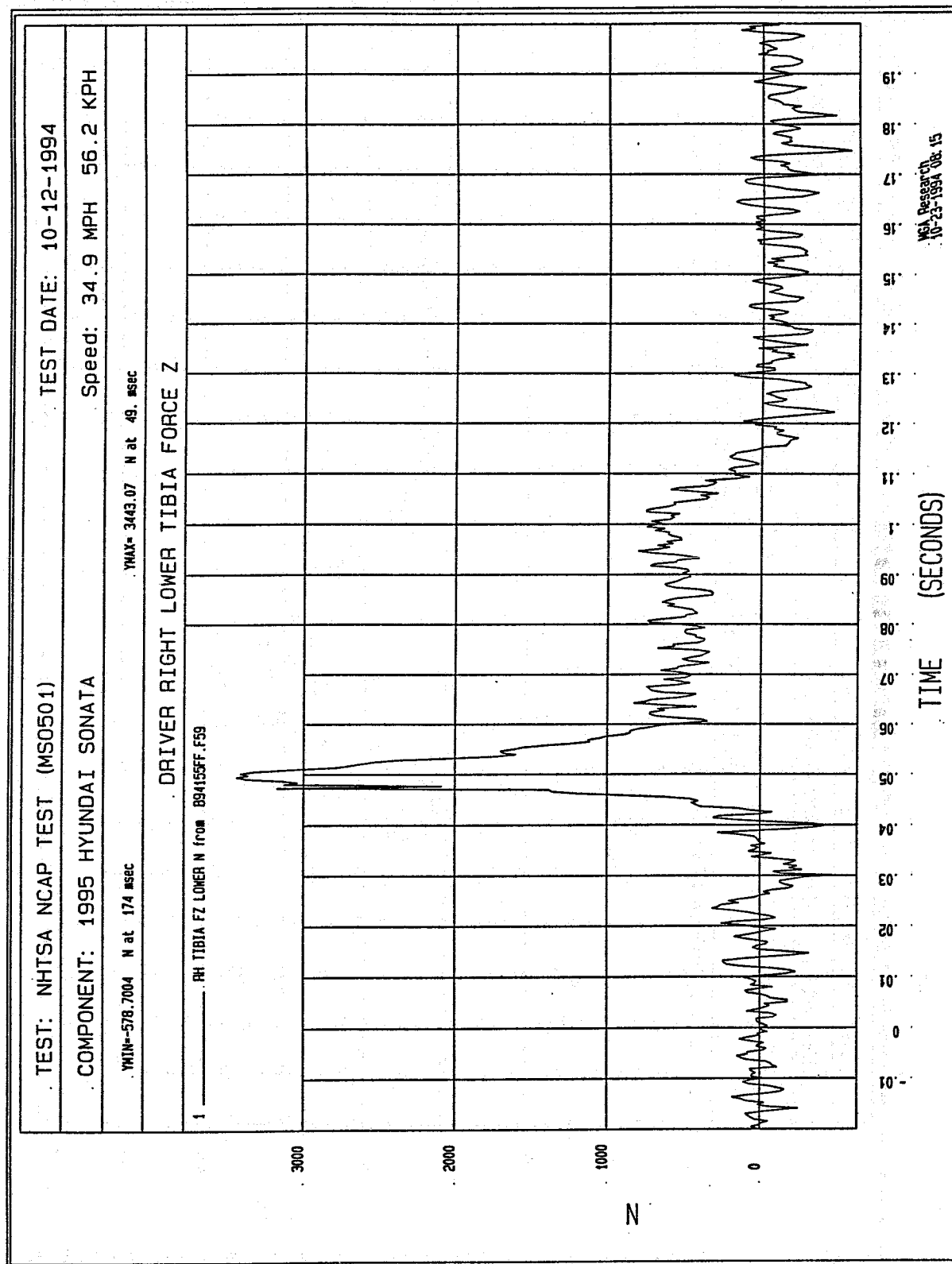


Figure B-68 - Driver Right Lower Tibia Force Z vs. Time

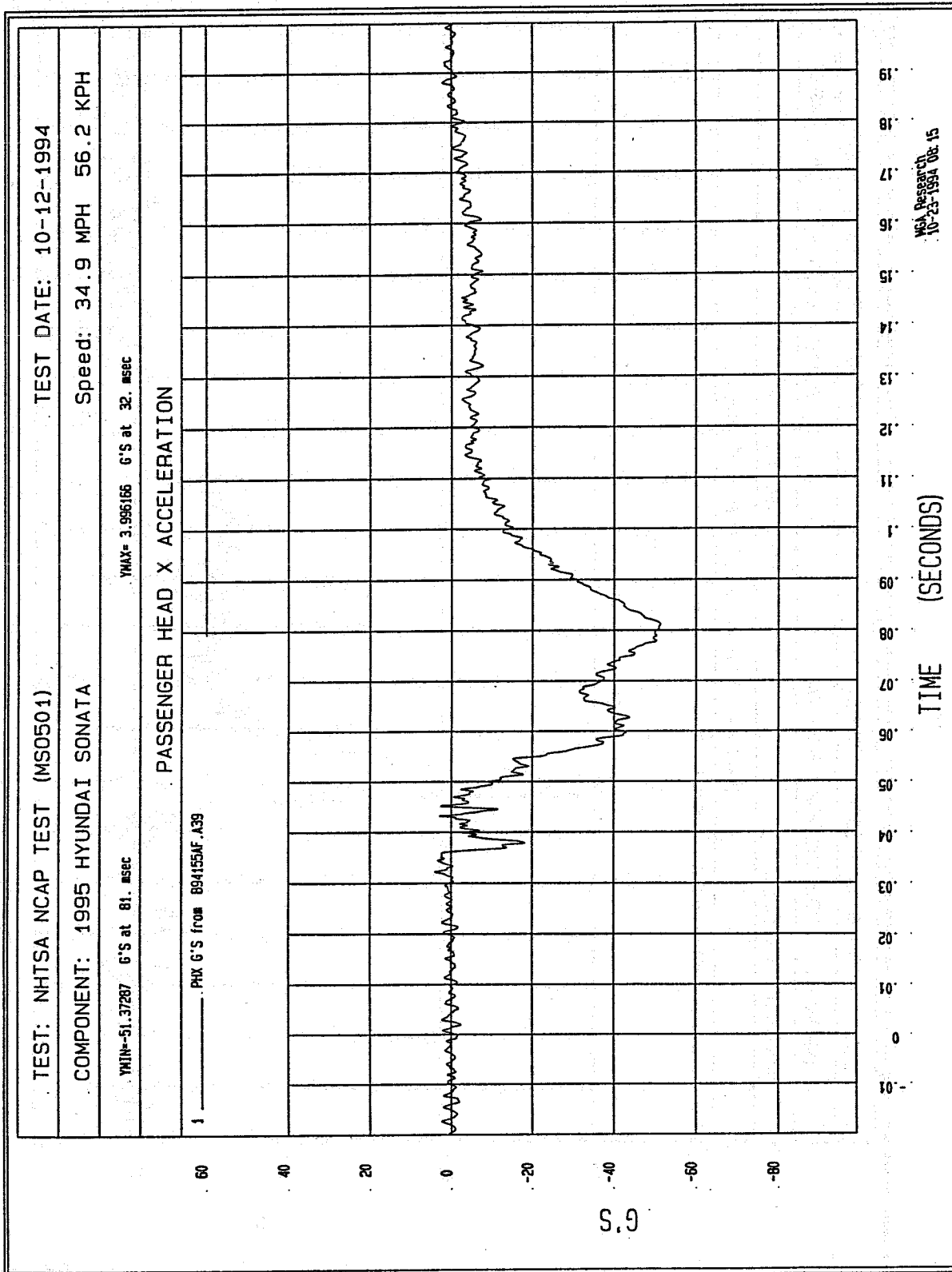


Figure B-69 - Passenger Head X Acceleration vs. Time

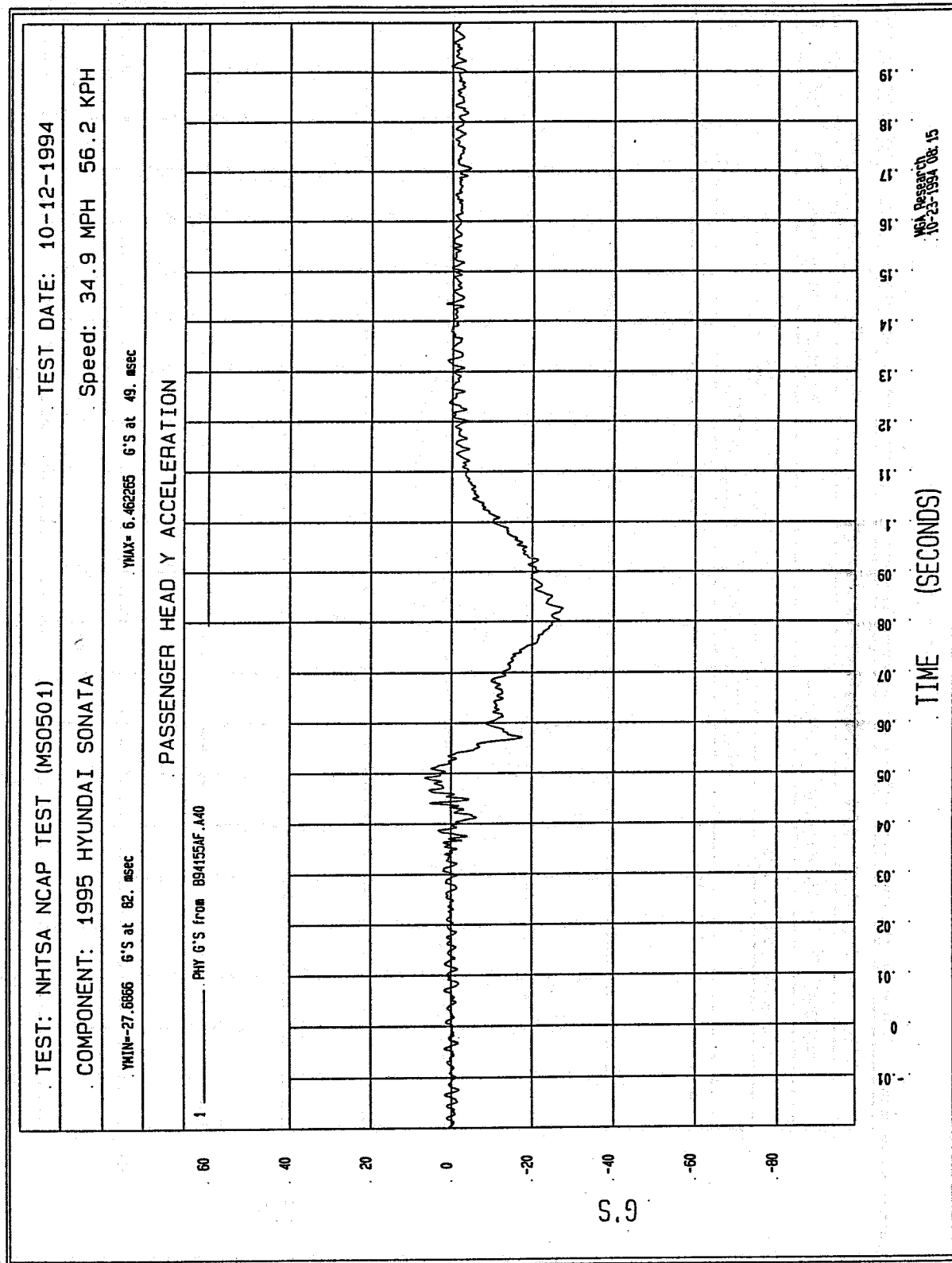


Figure B-70 - Passenger Head Y Acceleration vs. Time

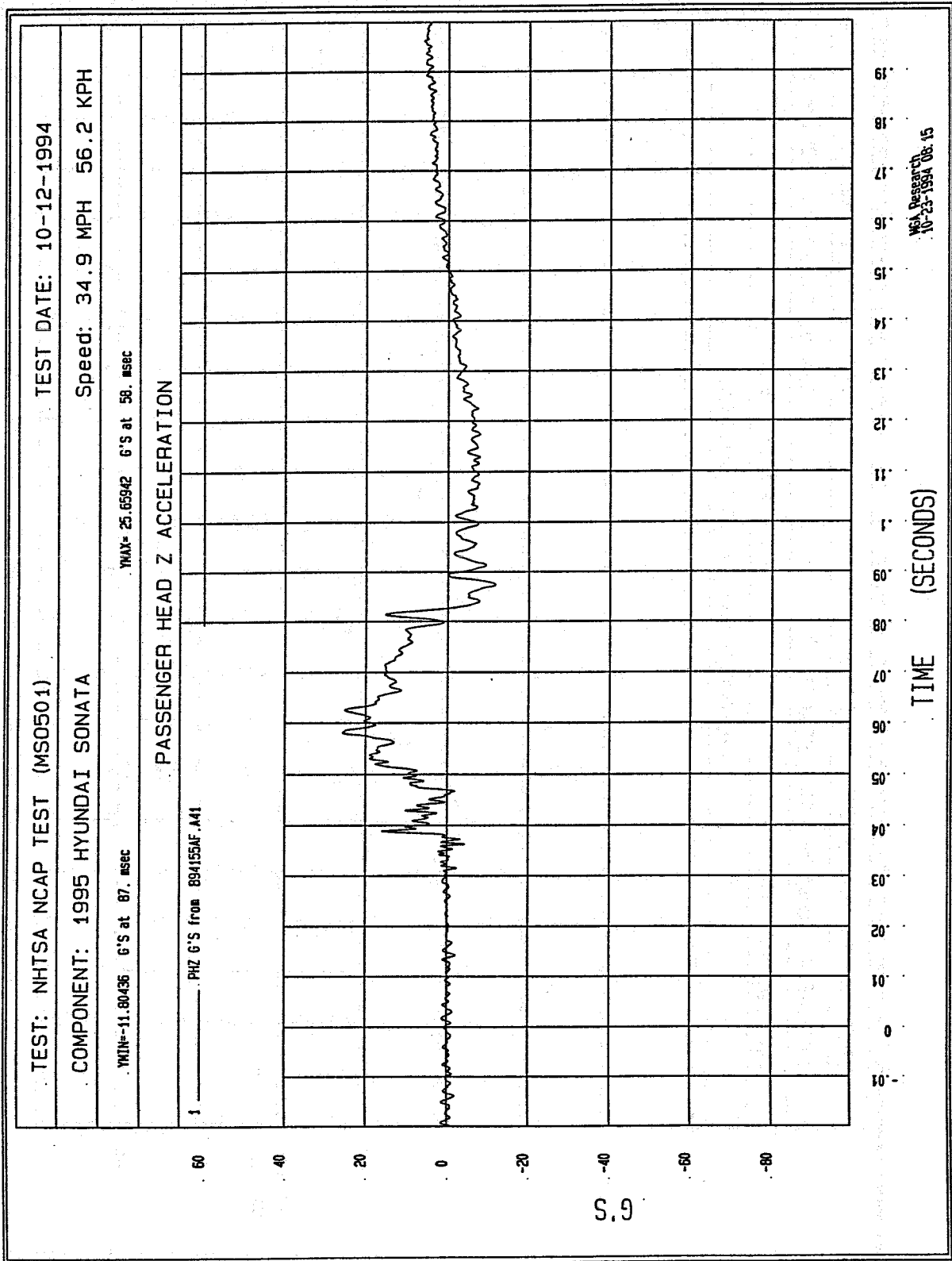


Figure B-71 - Passenger Head Z Acceleration vs. Time

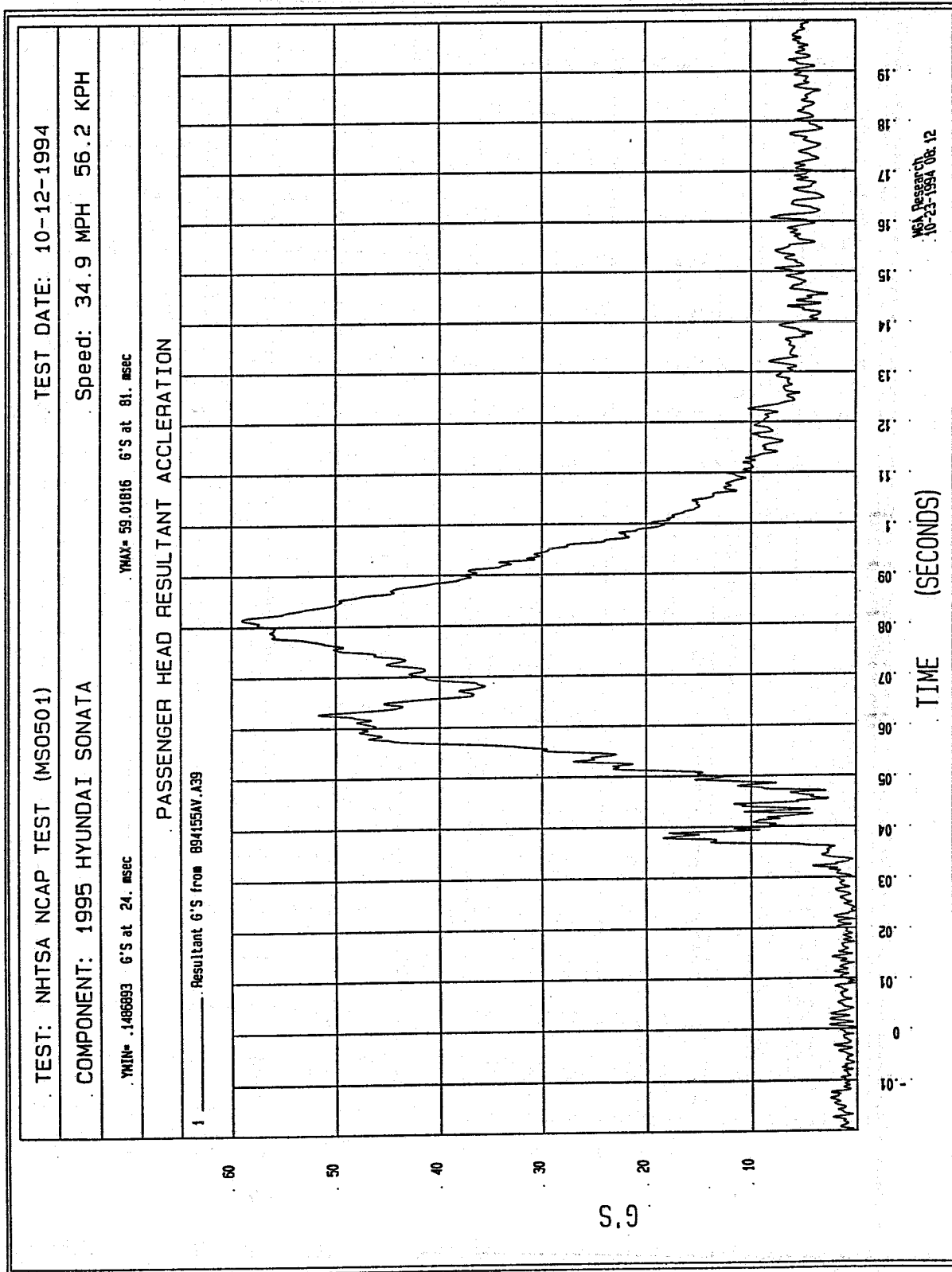


Figure B-72 - Passenger Head Resultant Acceleration vs. Time

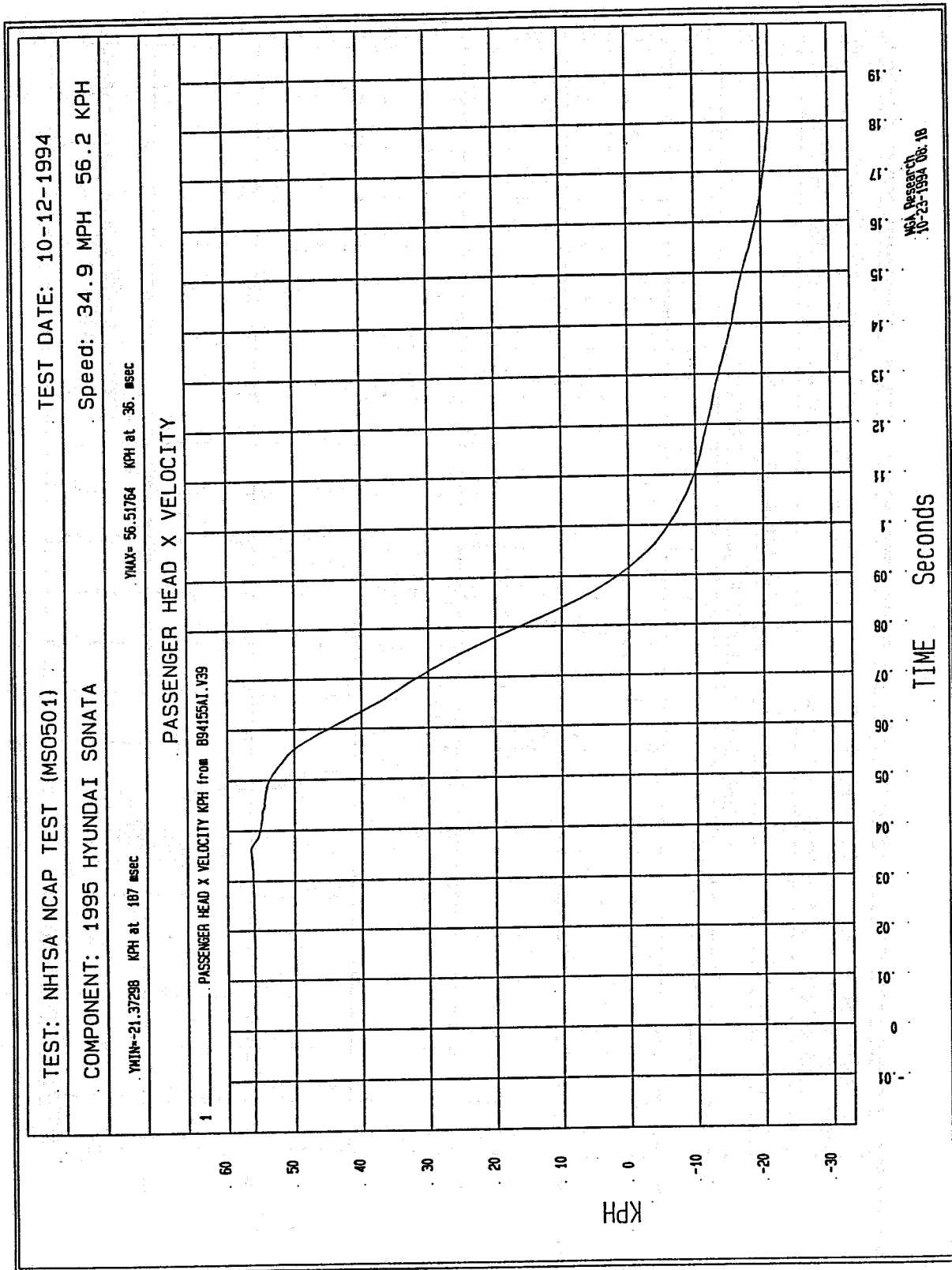


Figure B-73 - Passenger Head X Velocity vs. Time

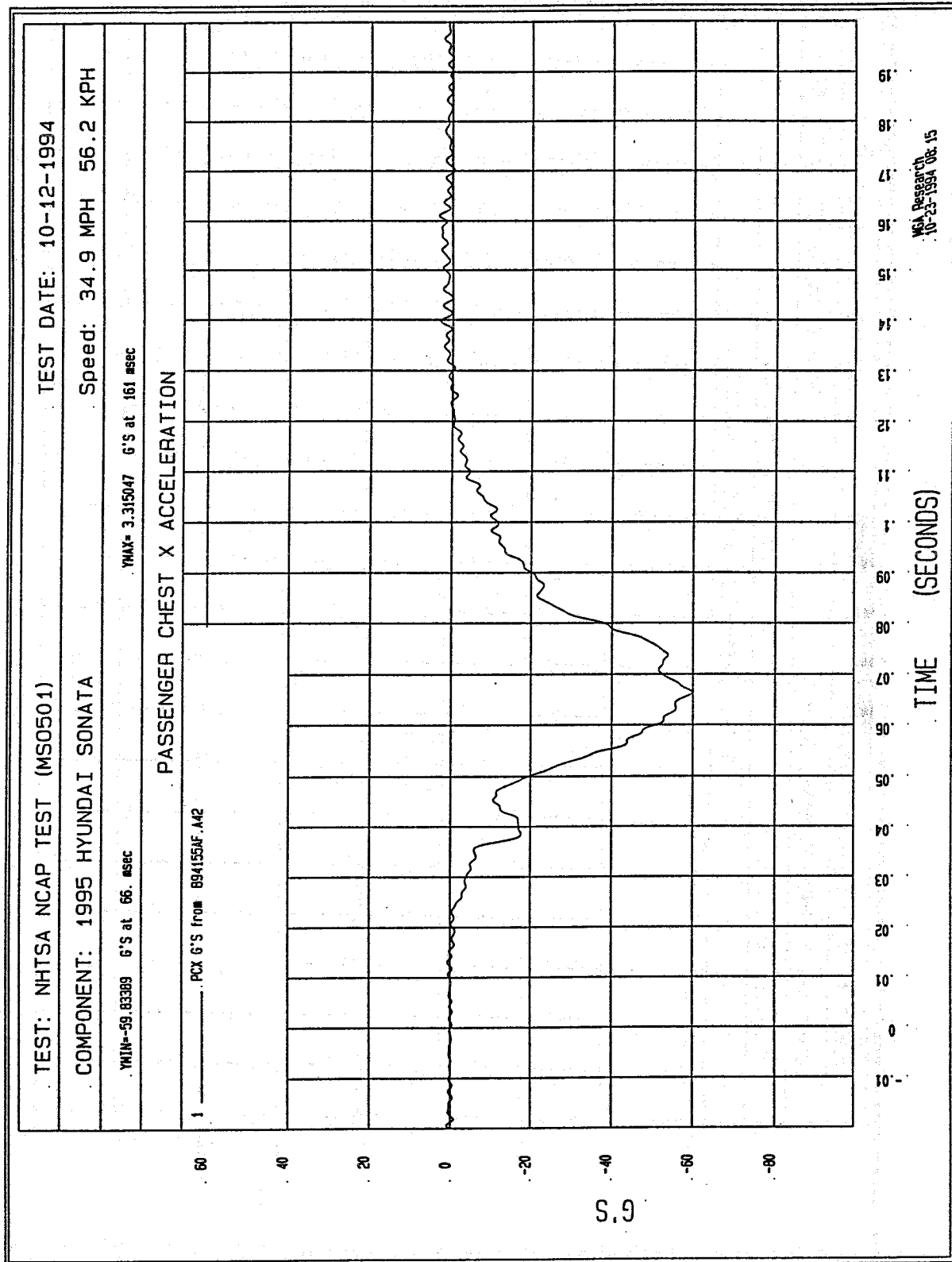


Figure B-74 - Passenger Chest X Acceleration vs. Time

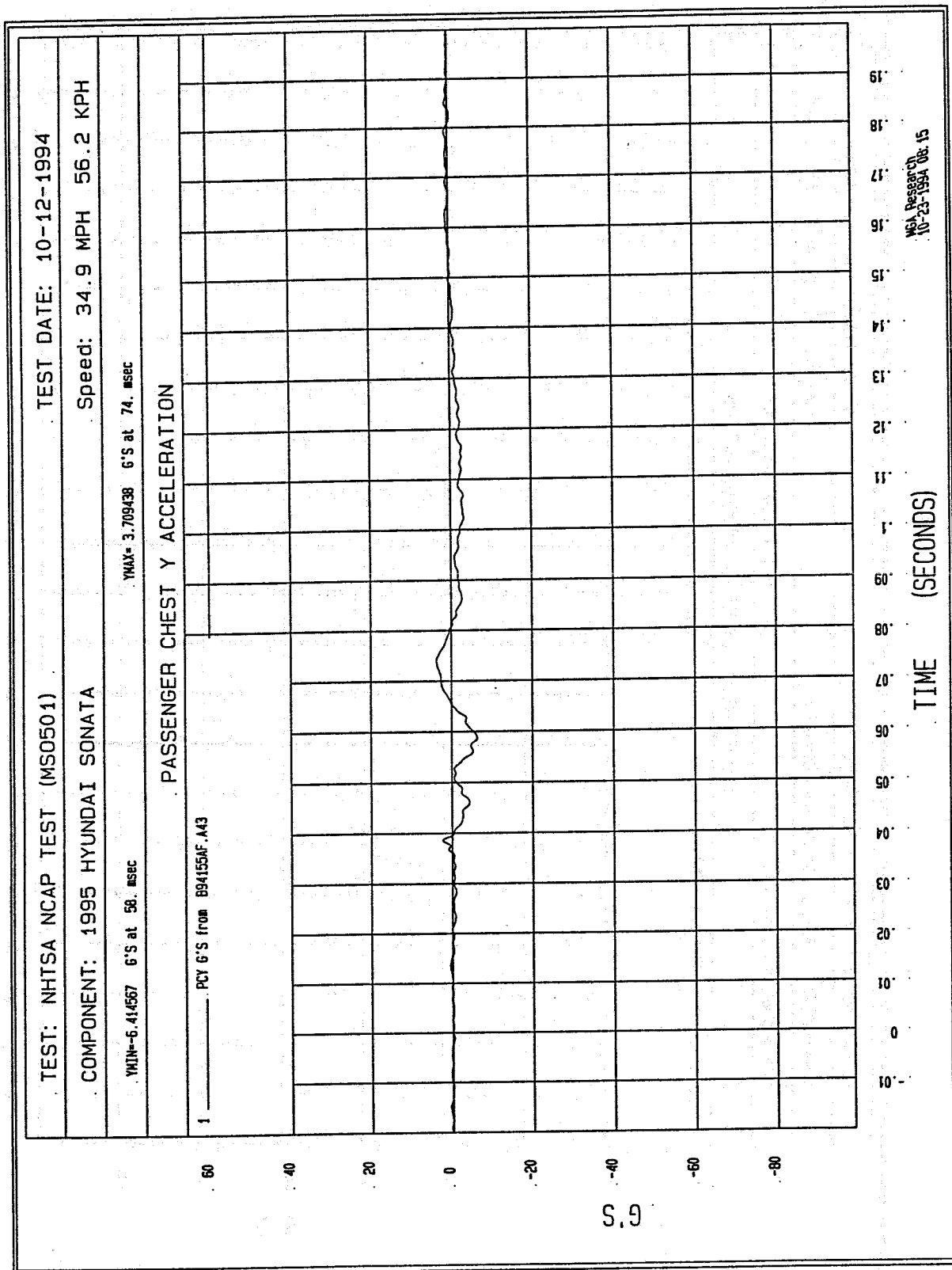


Figure B-75 - Passenger Chest Y Acceleration vs. Time

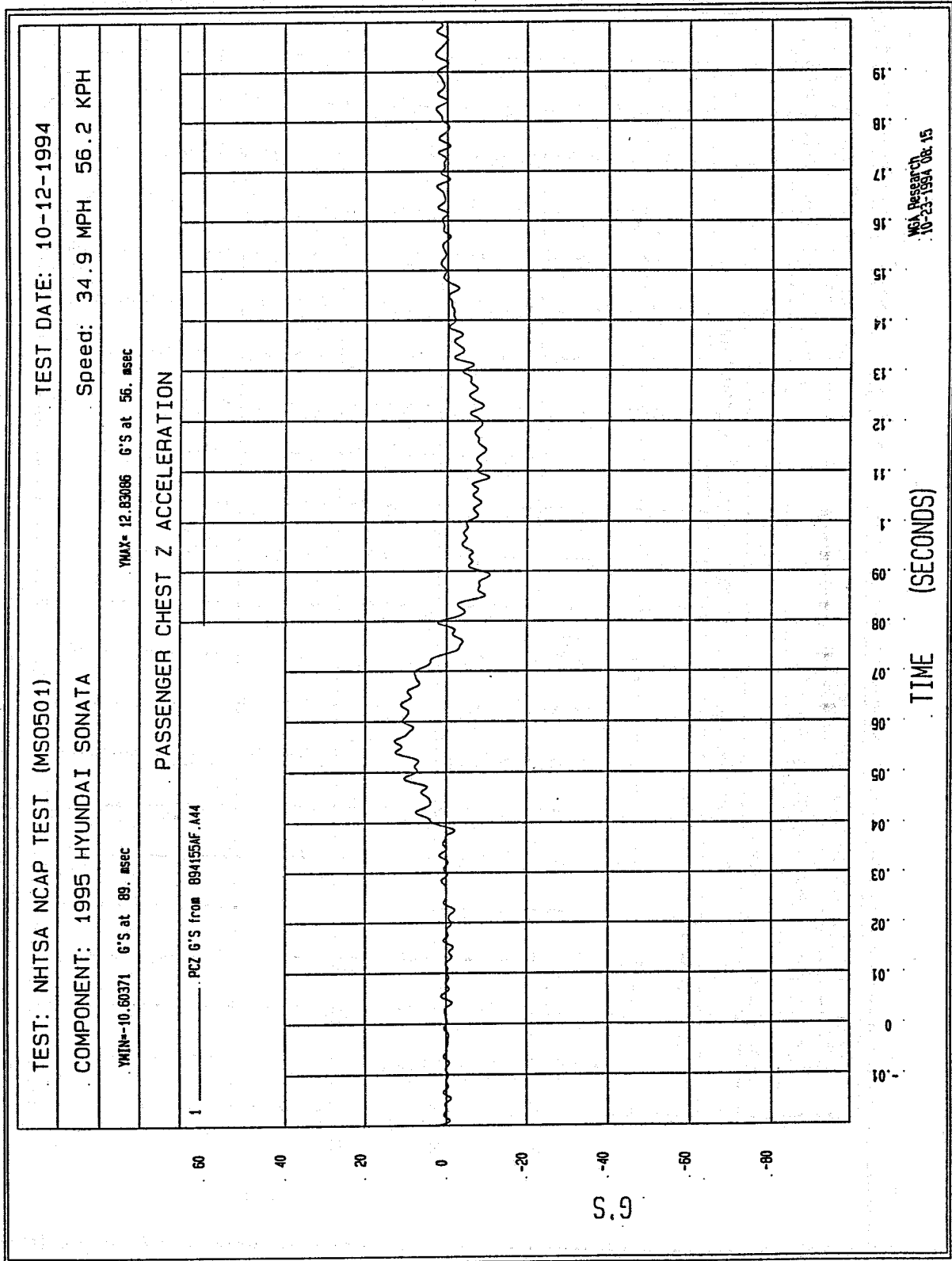


Figure B-76 - Passenger Chest Z Acceleration vs. Time

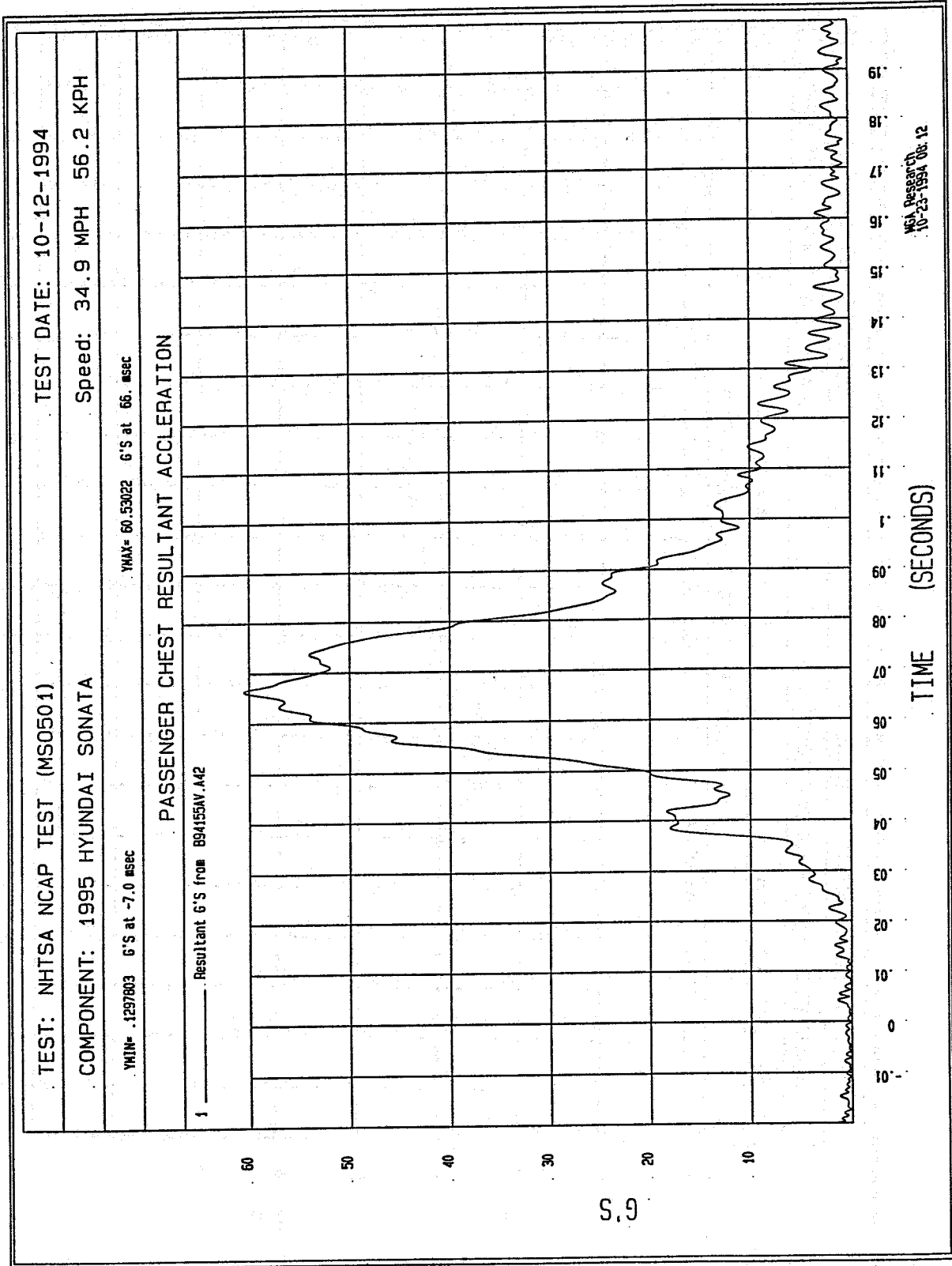


Figure B-77 - Passenger Chest Resultant vs. Time

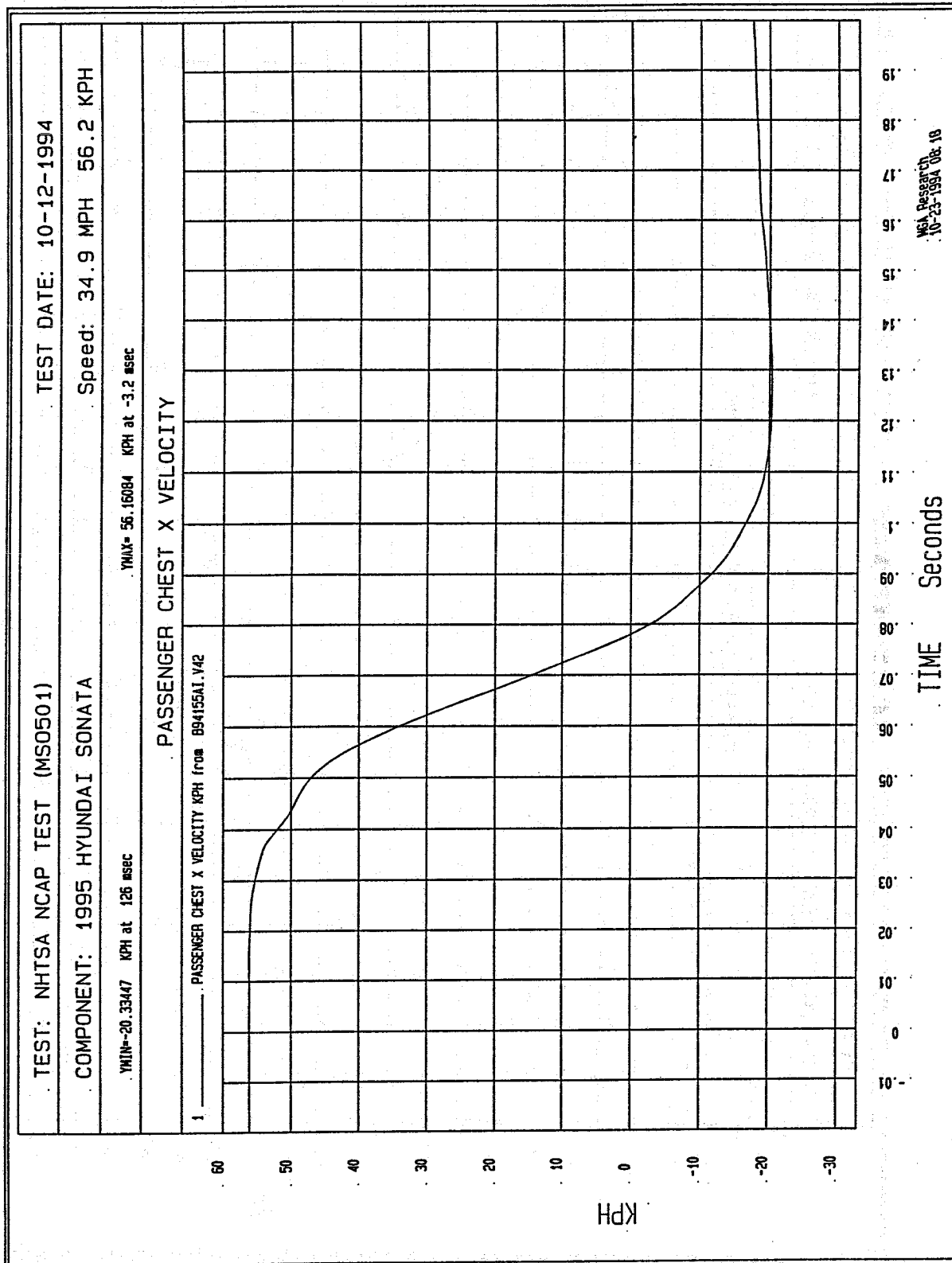


Figure B-78 - Passenger Chest X Velocity vs. Time

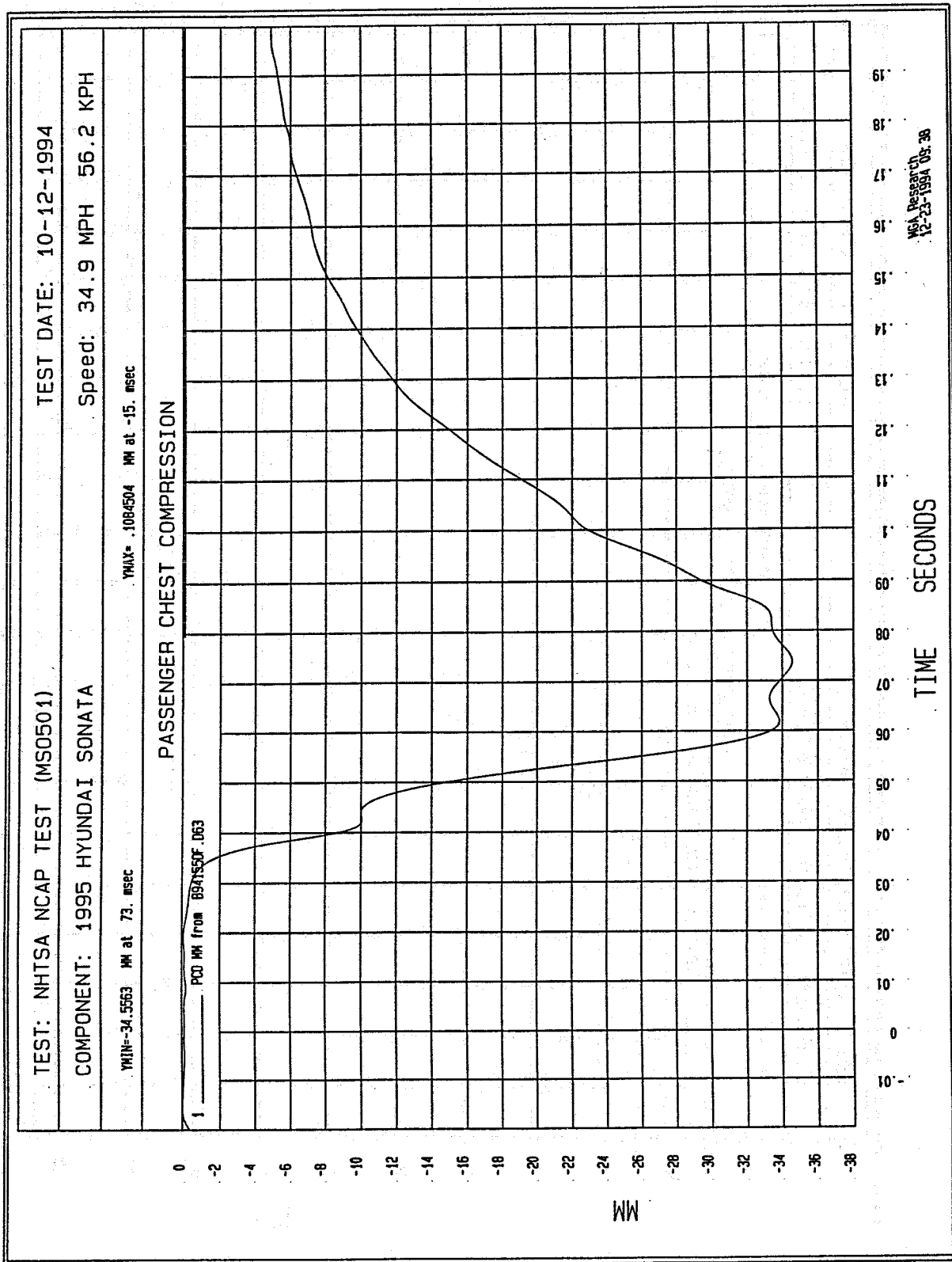


Figure B-79 - Passenger Chest Compression vs. Time

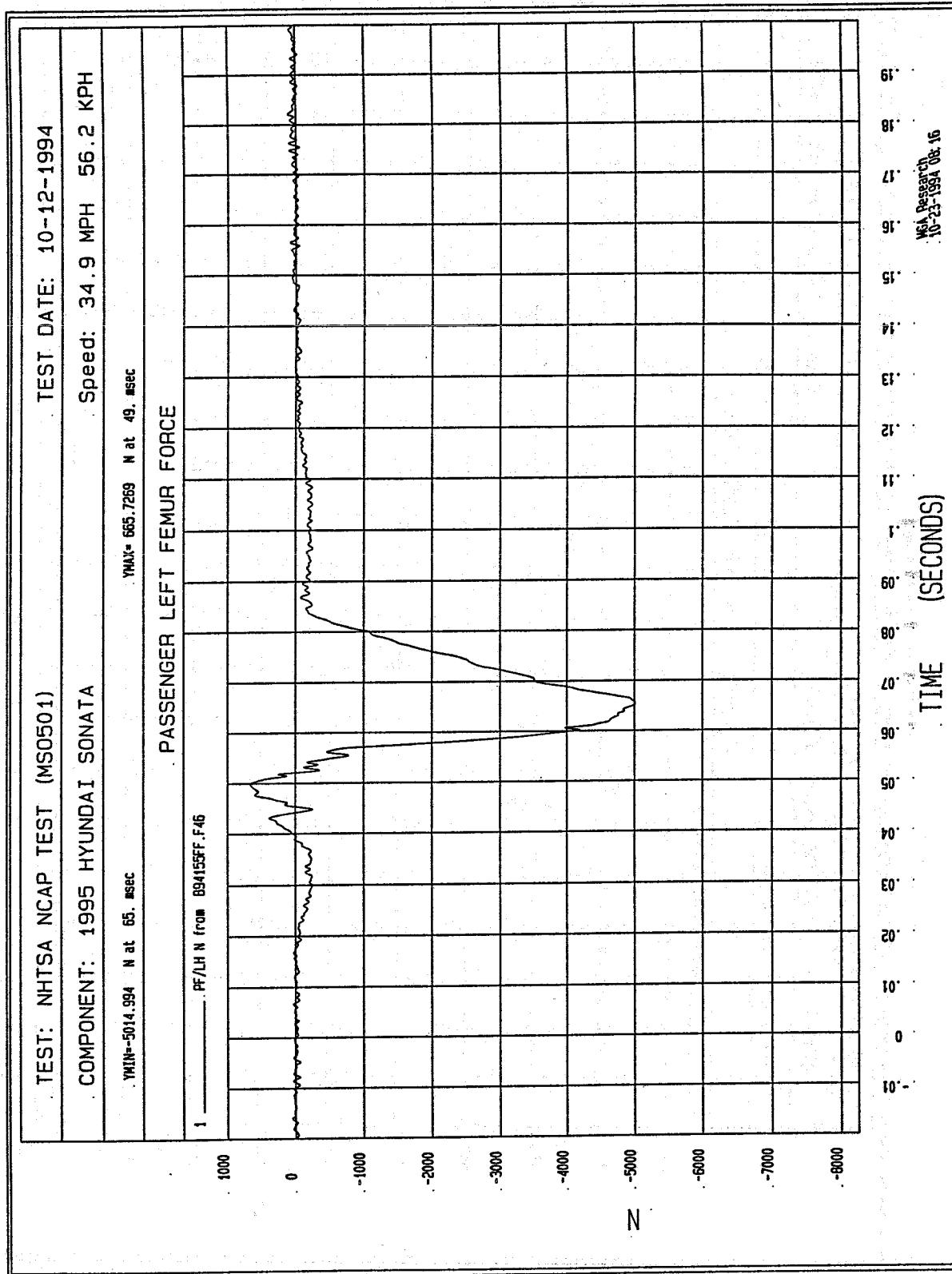


Figure B-80 - Passenger Left Femur Force vs. Time

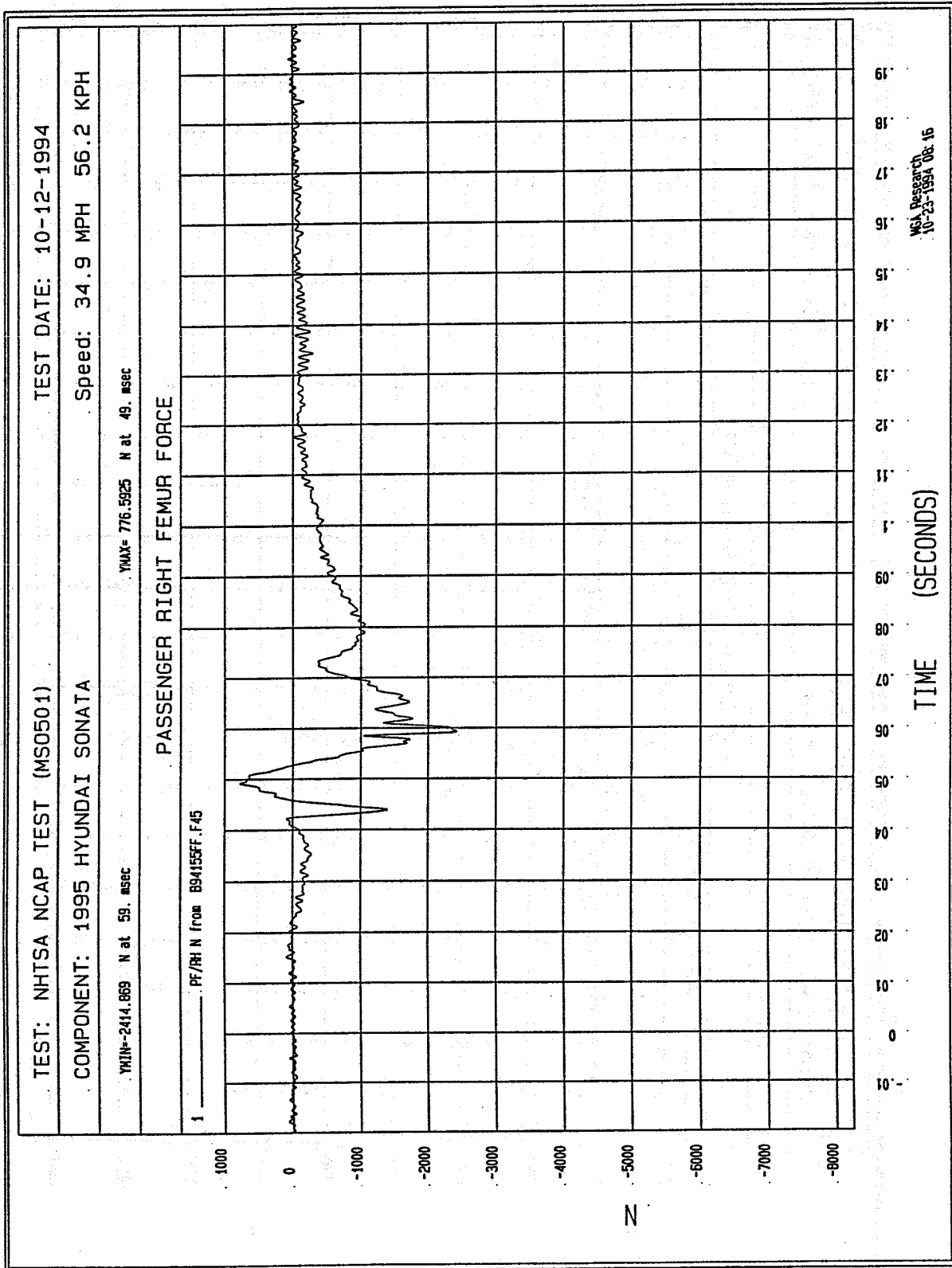


Figure B-81 - Passenger Right Femur Force vs. Time

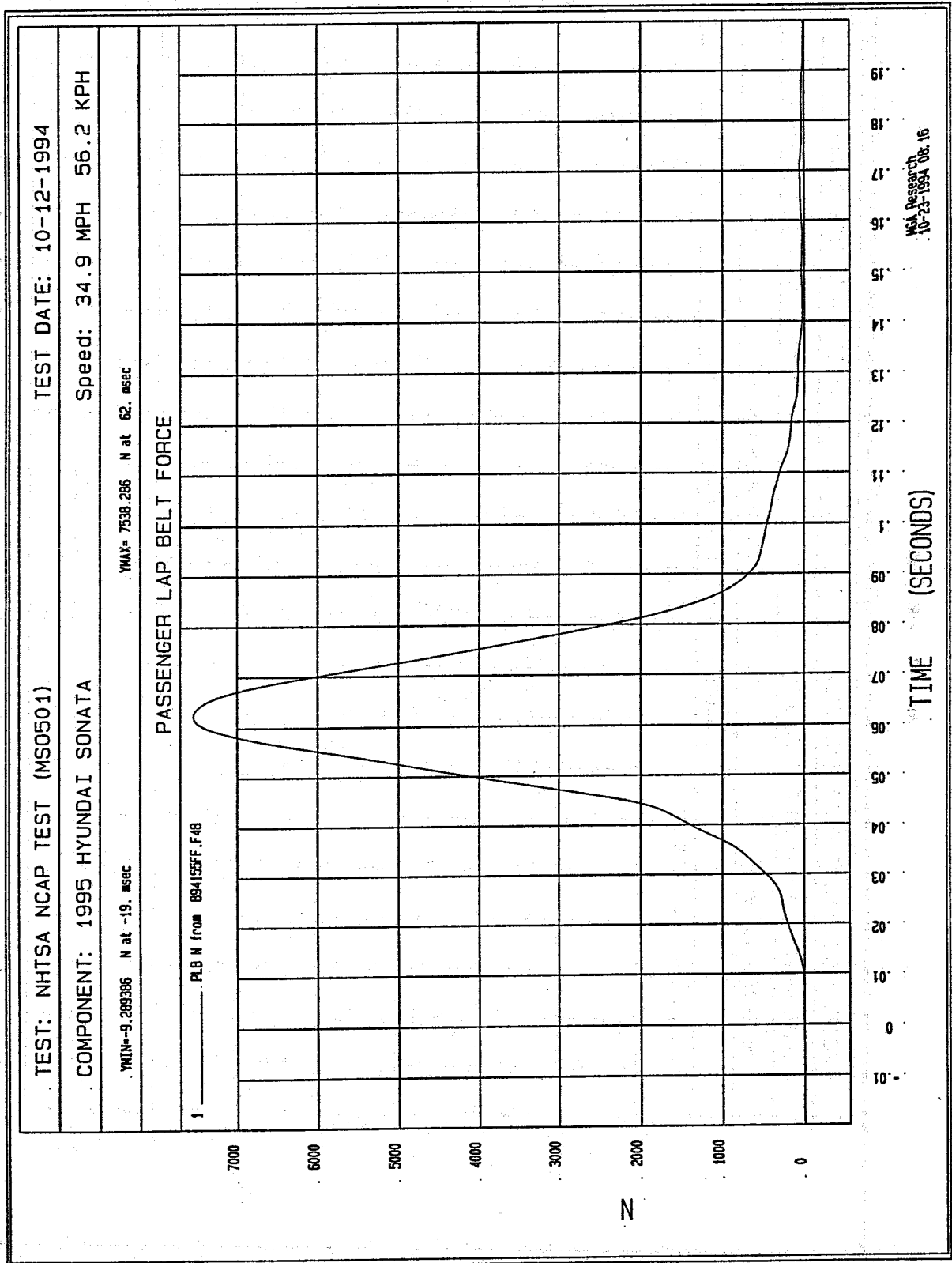


Figure B-82 - Passenger Lap Belt Force vs. Time

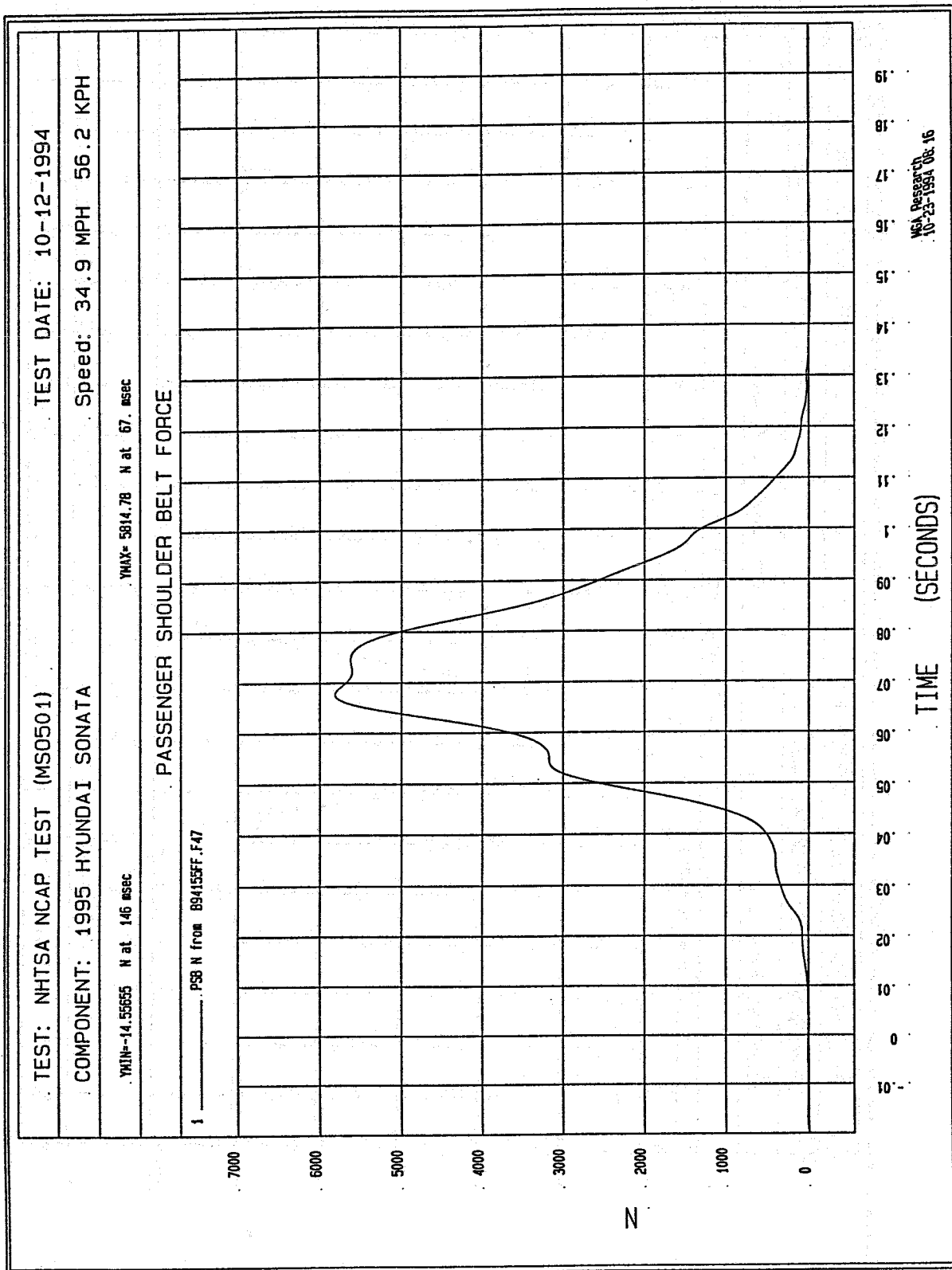


Figure B-83 - Passenger Shoulder Belt Force vs. Time

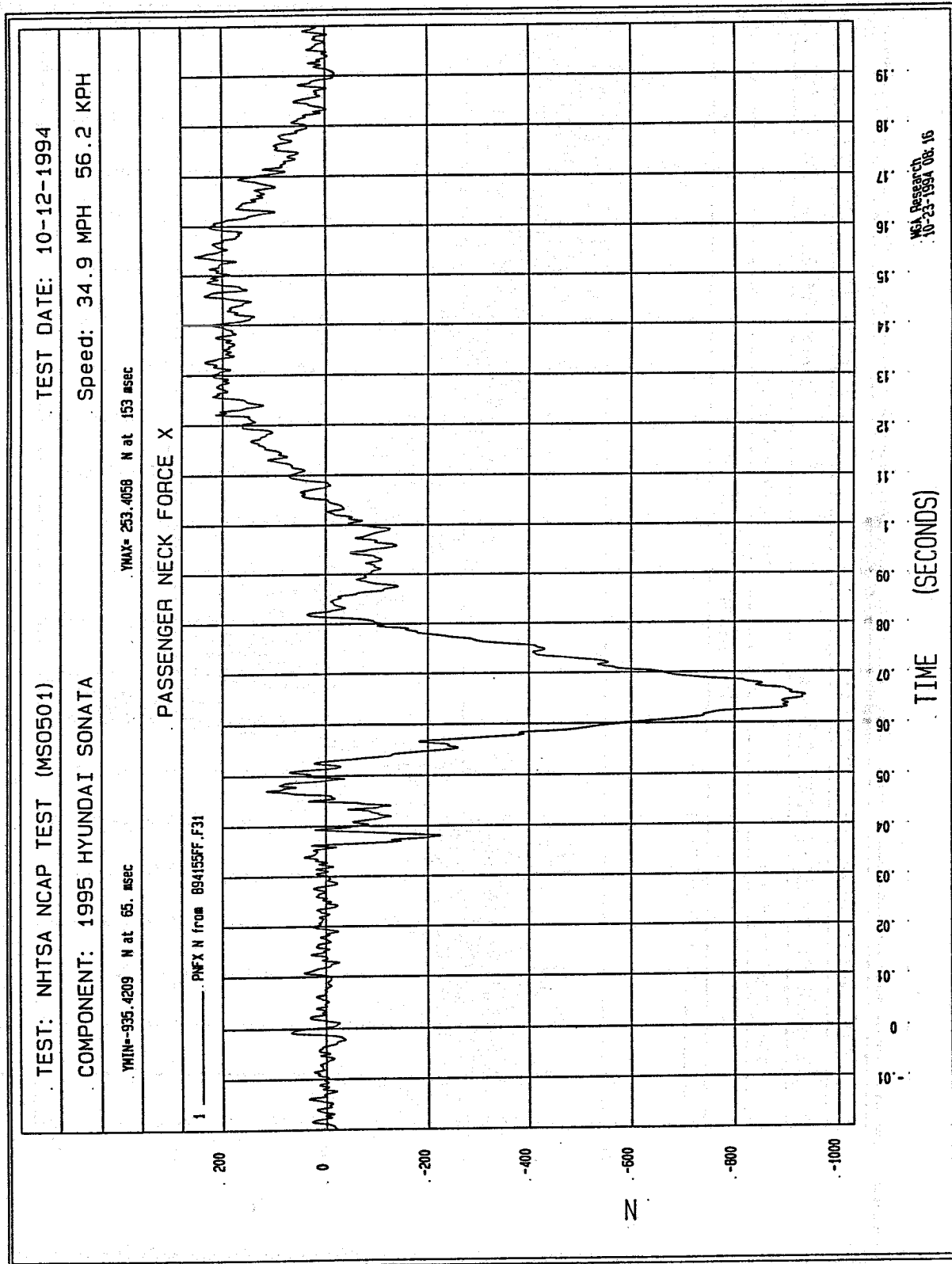


Figure B-84 - Passenger Neck Force X vs. Time

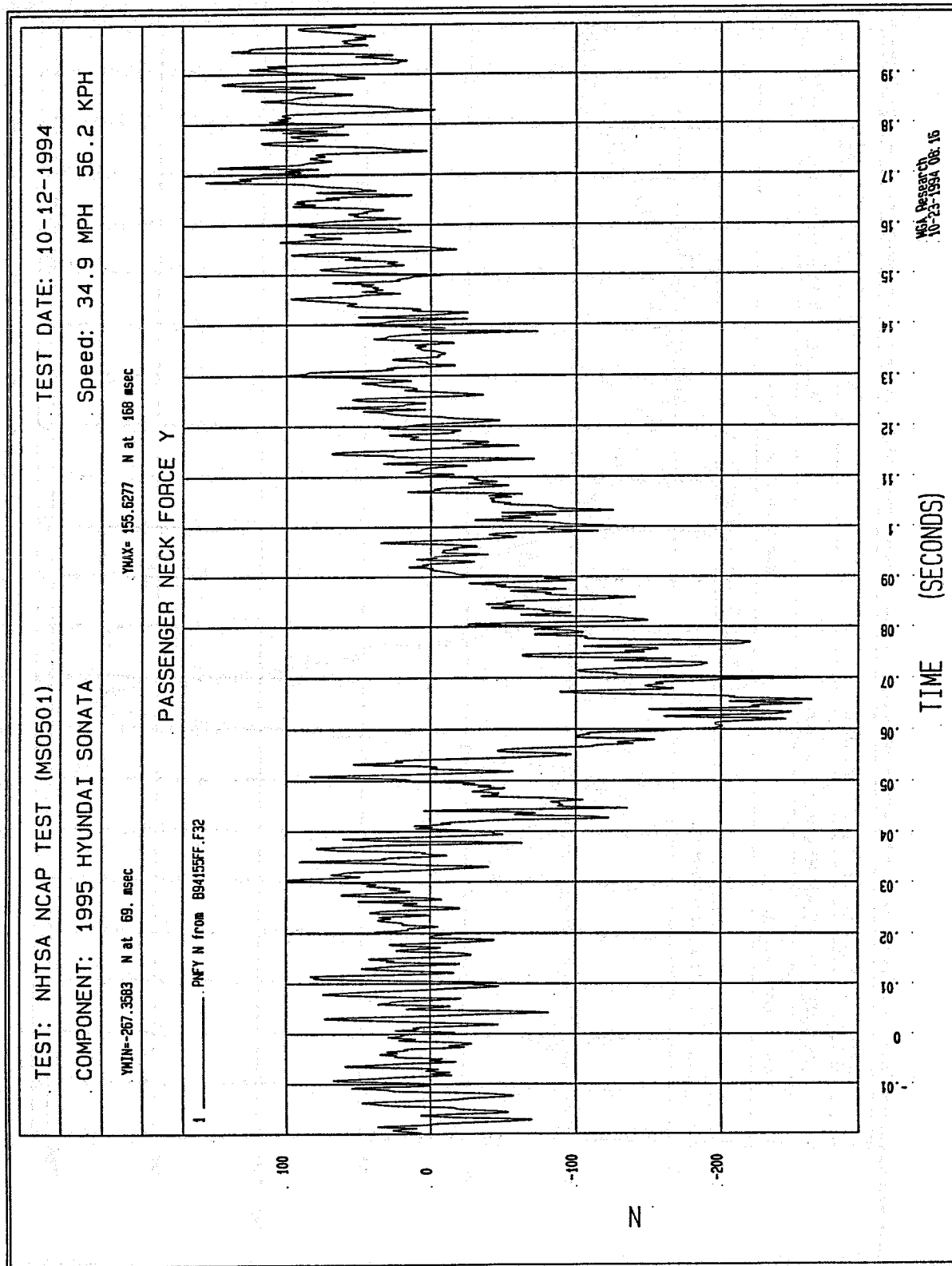


Figure B-85 - Passenger Neck Force Y vs. Time

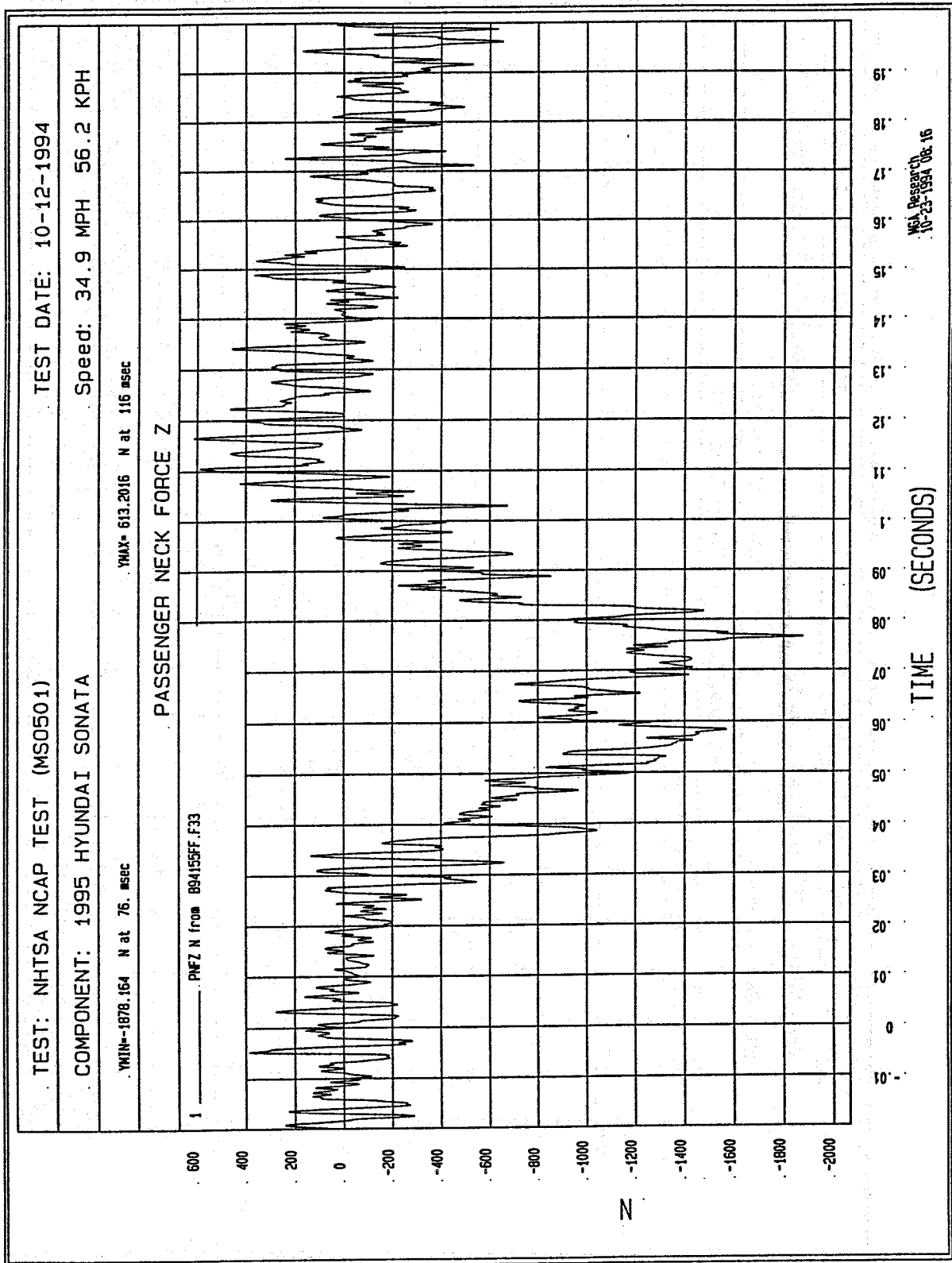


Figure B-86 - Passenger Neck Force Z vs. Time

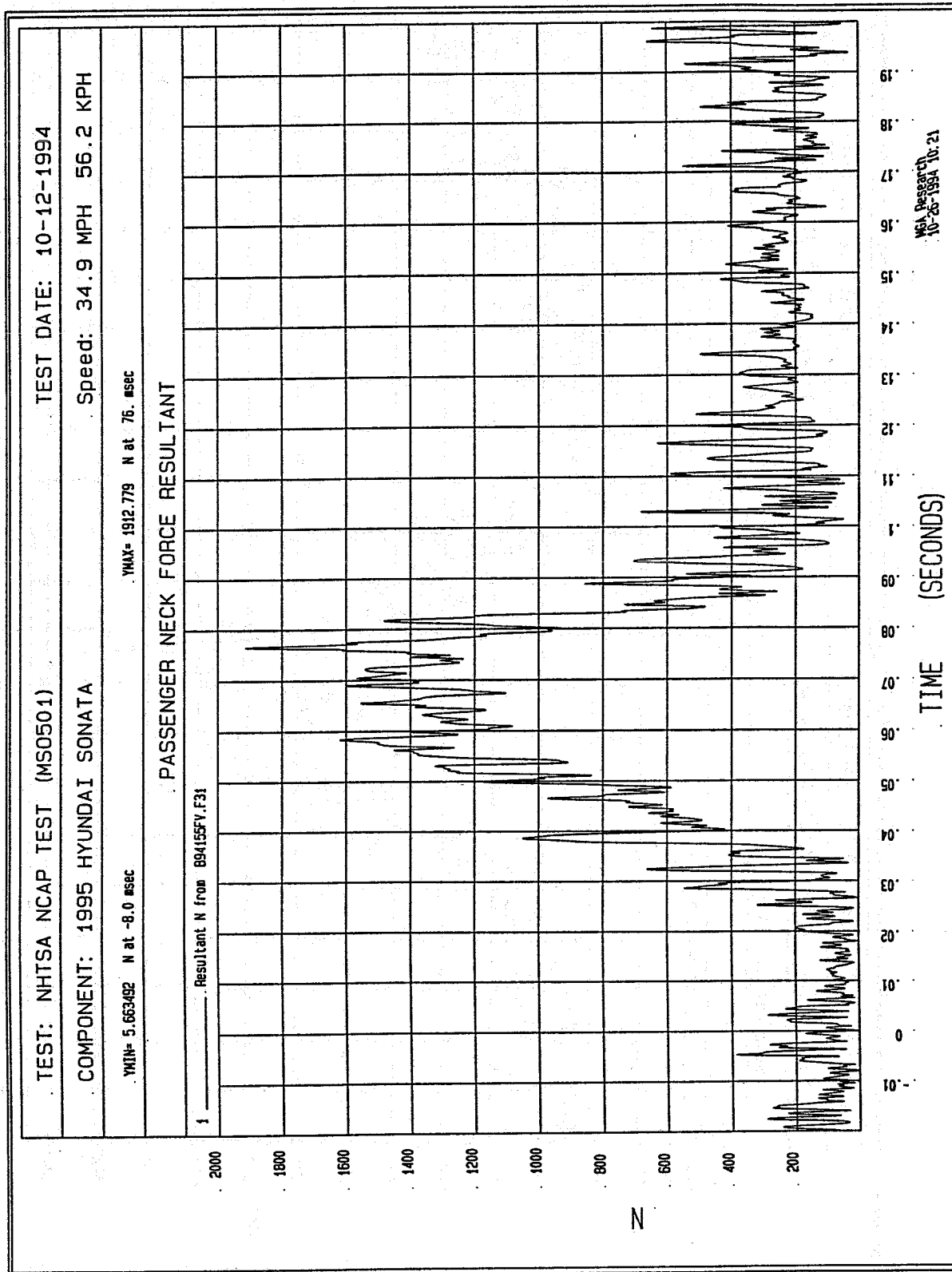


Figure B-87 - Passenger Neck Force Resultant Acceleration vs. Time

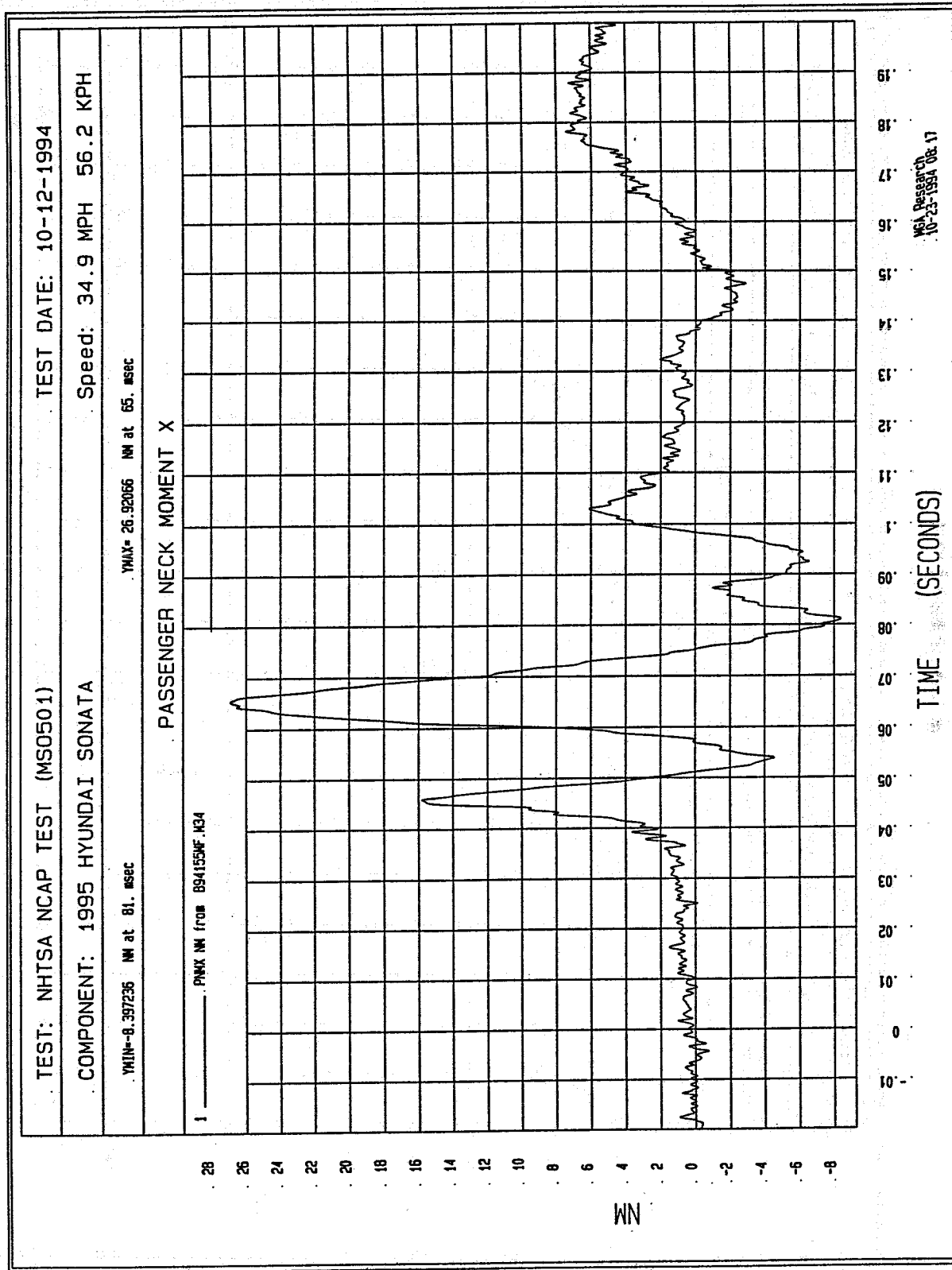


Figure B-88 - Passenger Neck Moment X vs. Time

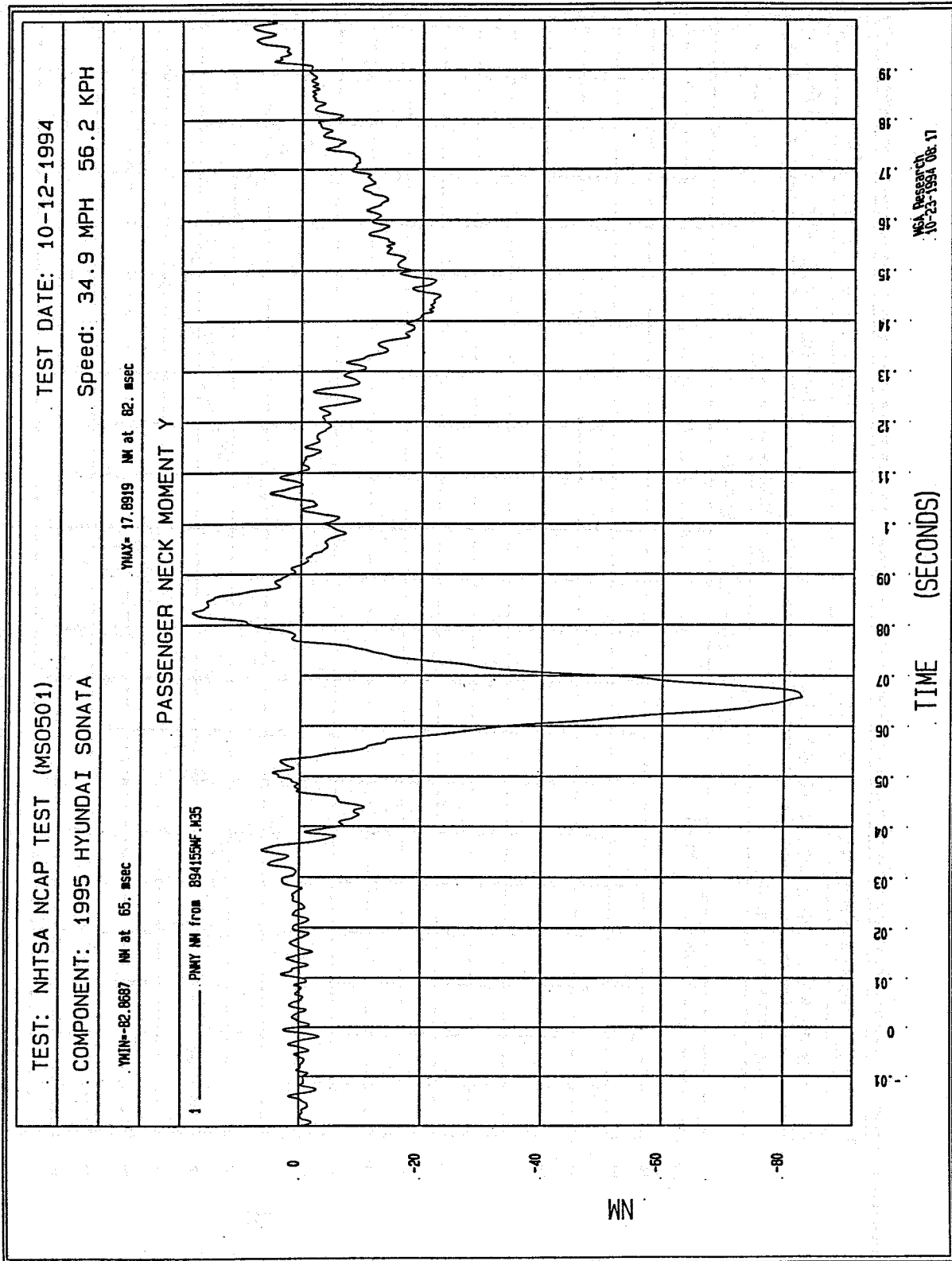


Figure B-89 - Passenger Neck Moment Y vs. Time

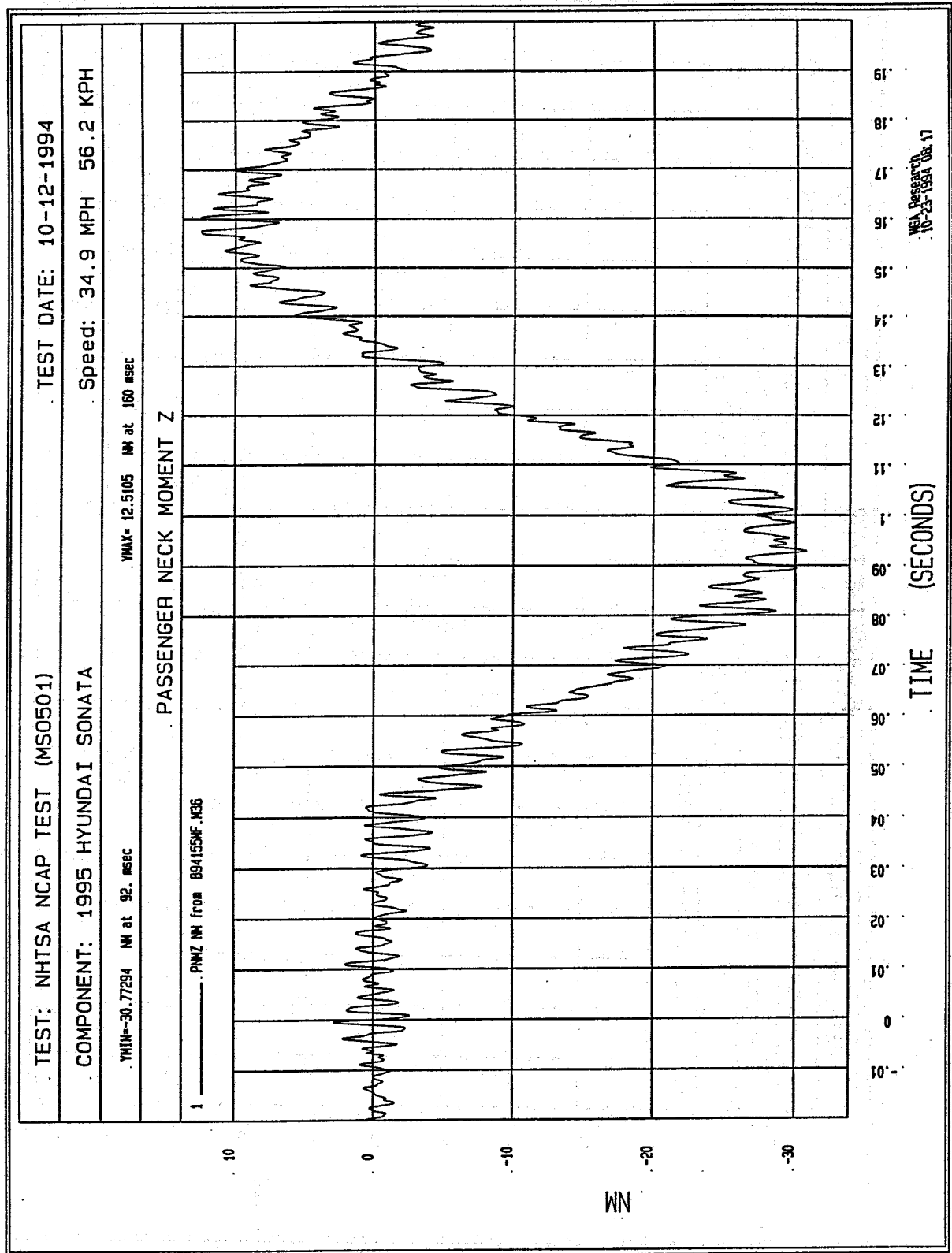


Figure B-90 - Passenger Neck Moment Z vs. Time

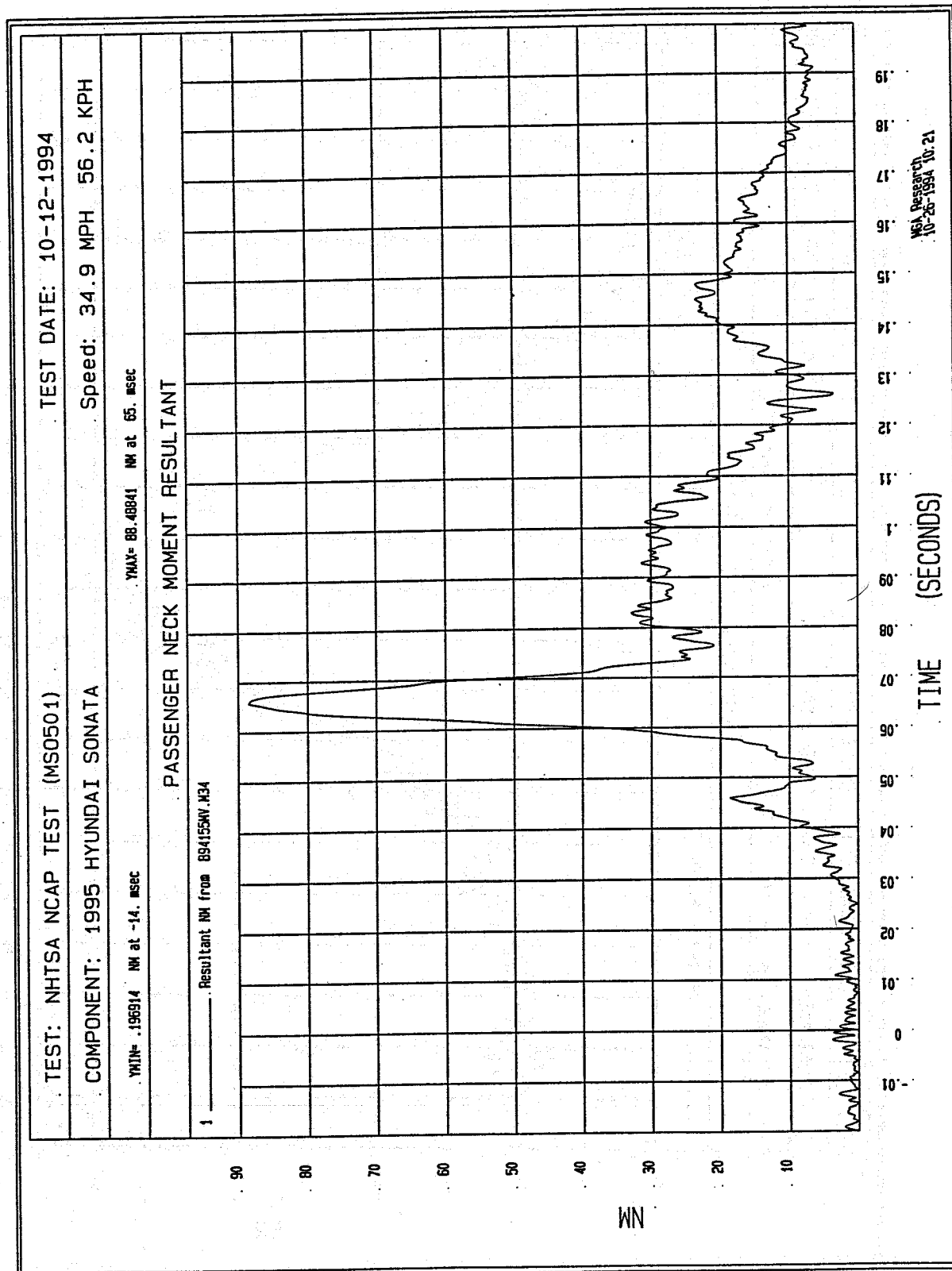


Figure B-91 - Passenger Neck Moment Resultant Acceleration vs. Time

APPENDIX C
Dummy Configuration & Performance Verification Data

HYBRID III DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

DUMMY NO.: 37 DUMMY CALIBRATION BY: Rod McClelland & Al Chalmers

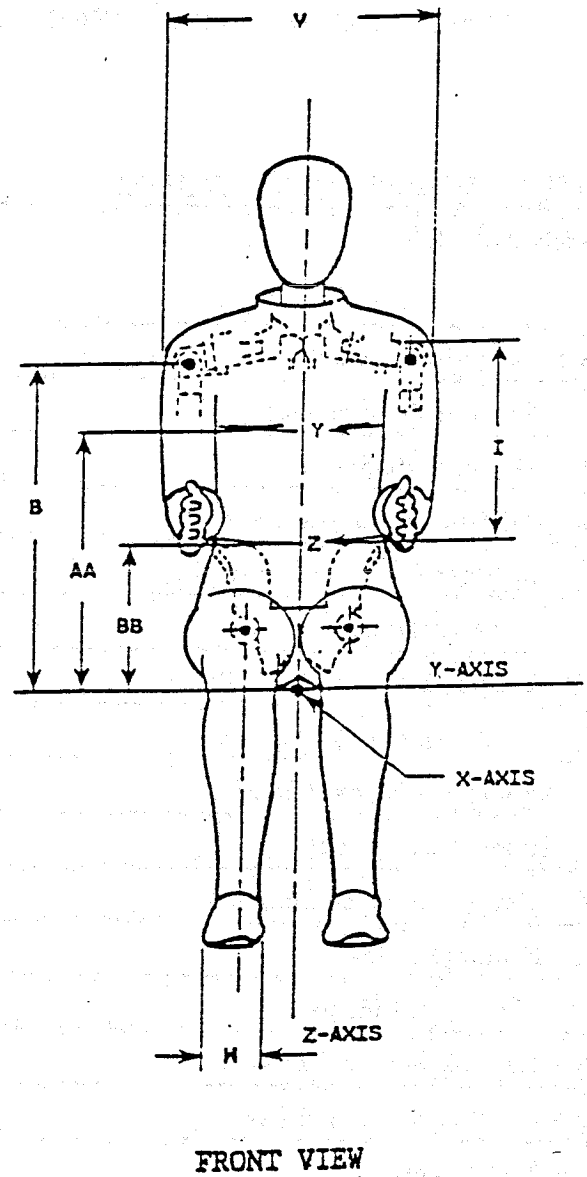
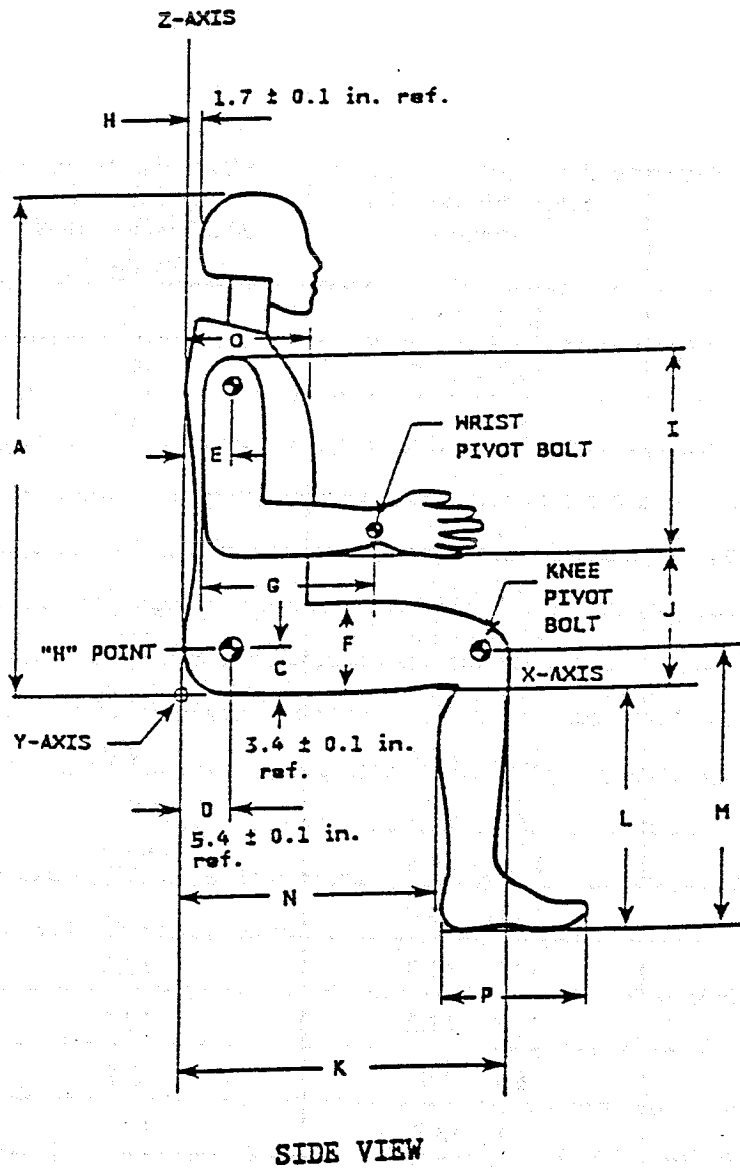
I. CONFIGURATION VERIFICATION DATA

DATE OF VERIFICATION: 10-11-94

DESCRIPTION	SPECIFICATION (inches)	ACTUAL MEASUREMENT (inches)
A - Total Sitting Height	34.6 - 35.0	35.0
B - Shoulder Pivot Height	19.9 - 20.5	20.0
C - "H" Point Height	3.3 - 3.5	3.5
D - "H" Point from Seat Back	5.3 - 5.5	5.5
E - Shoulder Pivot From Backline	3.3 - 3.7	3.5
F - Thigh Clearance	5.5 - 6.1	6.0
G - Back of Elbow to Wrist Pivot	11.4 - 12.0	11.5
H - Skull Cap Skin to Backline	1.6 - 1.8	1.7
I - Shoulder - Elbow Length	13.0 - 13.6	13.0
J - Elbow Rest Height	7.5 - 8.3	8.0
K - Buttock to Knee Length	22.8 - 23.8	23.5
L - Popliteal Height	16.9 - 17.9	17.0
M - Knee Pivot Height	19.1 - 19.9	19.5
N - Buttock Popliteal Length	17.8 - 18.8	18.5
O - Chest Depth at 3rd Rib	8.4 - 9.0	8.5
P - Foot Length	9.9 - 10.5	10.3
V - Shoulder Breadth	16.6 - 17.2	16.8
W - Foot Breadth	3.6 - 4.2	4.0
Y - Chest Circumference	38.2 - 39.4	39.0
Z - Waist Circumference	32.9 - 34.1	33.5

Note: (See next page for external dimensions)

HYBRID III EXTERNAL DIMENSIONS



Note: Figure is referenced to the erect seated position. The curved lumbar does not allow the hybrid III to be positioned in a perfect erect attitude.

HYBRID III DUMMY CALIBRATION DATA SUMMARY SHEET

DUMMY NO.: 37 DUMMY CALIBRATION BY: Rod McClelland & Al Chalmers

VERIFICATION DATE: 10-11-94

VERIFICATION LABORATORY TEMPERATURE (66° - 78°): 69°

1.0 HEAD DROP TEST

	SPECIFICATION	MEASUREMENT
Peak Resultant Acceleration	225 - 275 G	253
Peak Lateral Acceleration	15 G. MAX	4
Is Acceleration Curve Unimodal	within 10% of peak	Yes

2.0 NECK FLEXION TEST

		SPECIFICATION	MEASUREMENT
Pendulum Speed		22.6 - 23.4 FT/SEC	22.9
Pendulum Deceleration	10 MS	22.50 - 27.50 G	23.76
	20 MS	17.60 - 22.60 G	20.37
	30 MS	12.50 - 18.50 G	15.01
Max. Pendulum G Above 30 MS		29.0 G MAX	15.7
Deceleration - Time Curve Decay Time to 5 G		34 - 42 MS	38
D Plane Rotation	MAX	64 - 78 DEG.	74
	TIME	57 - 64 MS	58
Rotation Angle - Time Curve Decay Time to Zero		113 - 128 MS	117
Moment About Occipital Condyle	MIN.	65 - 80 FT.LBS	66
	TIME	47 - 58 MS	51
Positive Moment - Time Curve Decay Time to Zero		97 - 107 MS	103

HYBRID III DUMMY CALIBRATION DATA SUMMARY SHEET (CONT.)

3.0 NECK EXTENSION TEST

		SPECIFICATION	MEASUREMENT
Pendulum Speed		19.50 - 20.30 F/S	19.91
Pendulum Deceleration	10 MS	17.20 - 21.20 G	20.24
	20 MS	14.00 - 19.00 G	18.03
	30 MS	11.00 - 16.00 G	13.39
Max. Pendulum G Above 30 MS		22 G Max	14
Deceleration - Time Curve Decay Time to 5 G		38 - 46 MS	39
D Plane Rotation	MAX	81 - 106 DEG.	100
	TIME	72 - 82 MS	73
Rotation Angle - Time Curve Decay Time to Zero		147 - 174 MS	154
Moment About Occipital Condyle	MIN.	-59.0/-39.0 FT LBS	-53.2
	TIME	65 - 79 MS	68
Positive Moment - Time Curve Decay Time to Zero		120 - 148 MS	142

4.0 CHEST IMPACT TESTS

	SPECIFICATION	MEASUREMENT
Probe Speed	21.6 to 22.4 F/S	21.7
Peak Deflection	2.50 to 2.86 IN.	2.55
Peak Resistive Force	1160 to 1325 LBS.	1287
Internal Hysteresis	69 to 85%	72

5.0 KNEE IMPACT TESTS

LEFT KNEE	SPECIFICATION	MEASUREMENT
Probe Speed	6.8 to 7.0 F/S	6.84
Maximum Force	1060 - 1300 LBS.	1088

RIGHT KNEE	SPECIFICATION	MEASUREMENT
Probe Speed	6.8 to 7.0 F/S	6.84
Maximum Force	1060 - 1300 LBS.	1070

HYBRID III DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

DUMMY NO.: 36 DUMMY CALIBRATION BY: Rod McClelland & Al Chalmers

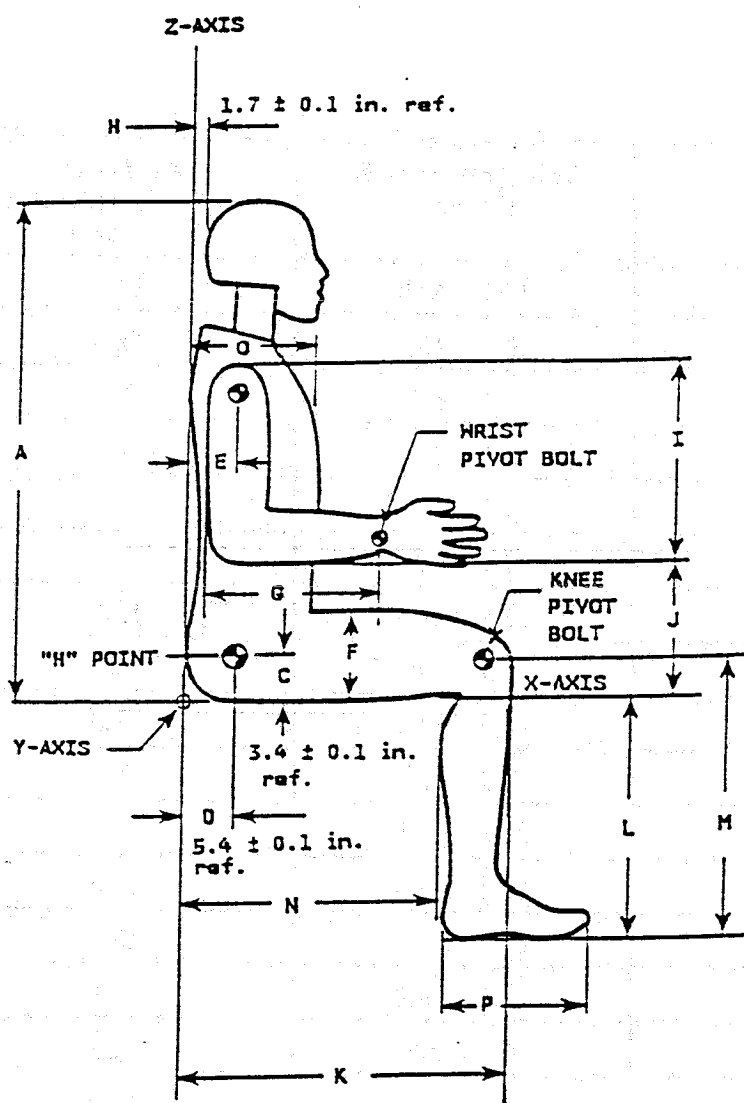
I. CONFIGURATION VERIFICATION DATA

DATE OF VERIFICATION: 10-11-94

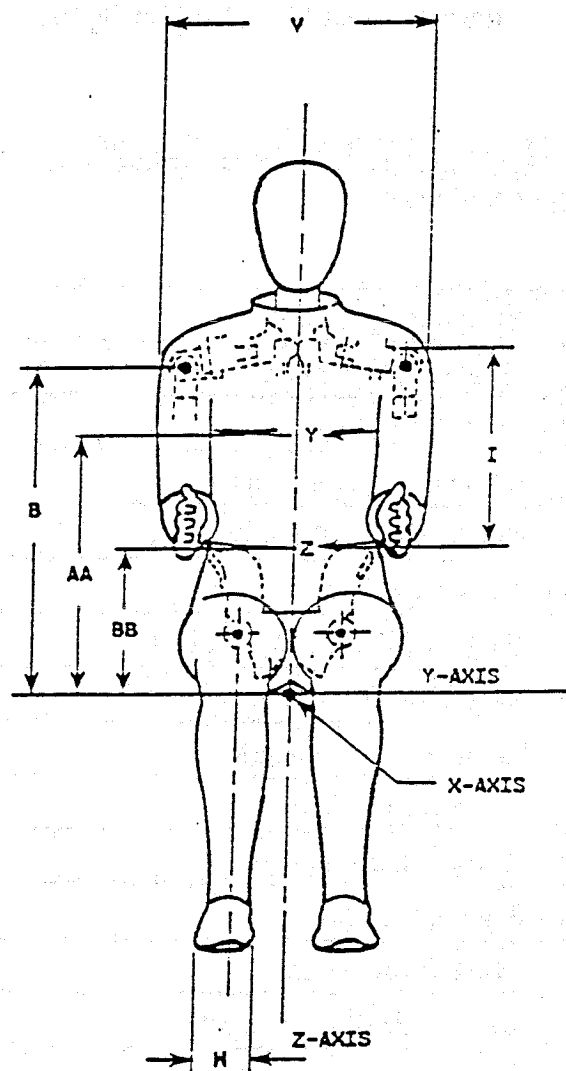
DESCRIPTION	SPECIFICATION (Inches)	ACTUAL MEASUREMENT (inches)
A - Total Sitting Height	34.6 - 35.0	34.8
B - Shoulder Pivot Height	19.9 - 20.5	20.5
C - "H" Point Height	3.3 - 3.5	3.4
D - "H" Point from Seat Back	5.3 - 5.5	5.5
E - Shoulder Pivot From Backline	3.3 - 3.7	3.5
F - Thigh Clearance	5.5 - 6.1	6.0
G - Back of Elbow to Wrist Pivot	11.4 - 12.0	11.5
H - Skull Cap Skin to Backline	1.6 - 1.8	1.7
I - Shoulder Elbow Length	13.0 - 13.6	13.0
J - Elbow Rest Height	7.5 - 8.3	8.0
K - Buttock Knee Length	22.8 - 23.8	23.5
L - Popliteal Height	16.9 - 17.9	17.0
M - Knee Pivot Height	19.1 - 19.9	19.5
N - Buttock Popliteal Length	17.8 - 18.8	18.5
O - Chest Depth at 3rd Rib	8.4 - 9.0	8.5
P - Foot Length	9.9 - 10.5	10.3
V - Shoulder Breadth	16.6 - 17.2	16.8
W - Foot Breadth	3.5 - 4.2	4.0
Y - Chest Circumference	38.2 - 39.4	39.0
Z - Waist Circumference	32.9 - 34.1	33.5

Note: (See next page for external dimensions)

HYBRID III EXTERNAL DIMENSIONS



SIDE VIEW



FRONT VIEW

Note: Figure is referenced to the erect seated position. The curved lumbar does not allow the hybrid III to be positioned in a perfect erect attitude.

HYBRID III DUMMY CALIBRATION DATA SUMMARY SHEET (CONT.)

DUMMY NO.: 36 DUMMY CALIBRATION BY: Rod McClelland & Al Chalmers

VERIFICATION DATE: 10-11-93

VERIFICATION LABORATORY TEMPERATURE (66° - 78°): 69°

1.0 HEAD DROP TEST

	SPECIFICATION	MEASUREMENT
Peak Resultant Acceleration	225 - 275 G	261
Peak Lateral Acceleration	15 G. MAX	12
Is Acceleration Curve Unimodal	within 10% of peak	Yes

2.0 NECK FLEXION TEST

		SPECIFICATION	MEASUREMENT
Pendulum Speed		22.6 - 23.4 FT/SEC	22.8
Pendulum Deceleration	10 MS	22.50 - 27.50 G	23.77
	20 MS	17.60 - 22.60 G	22.23
	30 MS	12.50 - 18.50 G	16.60
Max. Pendulum G Above 30 MS		29.0 G MAX	16.6
Deceleration - Time Curve Decay Time to 5 G		34 - 42 MS	37
D Plane Rotation	MAX	64 - 78 DEG.	76
	TIME	57 - 64 MS	57
Rotation Angle - Time Curve Decay Time to Zero		113 - 128 MS	114
Moment About Occipital Condyle	MIN.	65 - 80 FT.LBS	75
	TIME	47 - 58 MS	49
Positive Moment - Time Curve Decay Time to Zero		97 - 107 MS	100

HYBRID III DUMMY CALIBRATION DATA SUMMARY SHEET (CONT.)

3.0 NECK EXTENSION TEST

		SPECIFICATION	MEASUREMENT
Pendulum Speed		19.50 - 20.30 F/S	19.88
Pendulum Deceleration	10 MS	17.20 - 21.20 G	19.67
	20 MS	14.00 - 19.00 G	16.86
	30 MS	11.00 - 16.00 G	15.57
Max. Pendulum G Above 30 MS		22 G Max	16
Deceleration - Time Curve Decay Time to 5 G		38 - 46 MS	39
D Plane Rotation	MAX	81 - 106 DEG.	96
	TIME	72 - 82 MS	75
Rotation Angle - Time Curve Decay Time to Zero		147 - 174 MS	151
Moment About Occipital Condyle	MIN.	-59.0/-39.0 FT LBS	-51.1
	TIME	65 - 79 MS	70
Positive Moment - Time Curve Decay Time to Zero		120 - 148 MS	137

4.0 CHEST IMPACT TESTS

	SPECIFICATION	MEASUREMENT
Probe Speed	21.6 to 22.4 F/S	22.31
Peak Deflection	2.50 to 2.86 IN.	2.67
Peak Resistive Force	1160 to 1325 LBS.	1286
Internal Hysteresis	69 to 85%	73

5.0 KNEE IMPACT TESTS

LEFT KNEE	SPECIFICATION	MEASUREMENT
Probe Speed	6.8 to 7.0 F/S	6.96
Maximum Force	1060 - 1300 LBS.	1085

RIGHT KNEE	SPECIFICATION	MEASUREMENT
Probe Speed	6.8 to 7.0 F/S	7.0
Maximum Force	1060 - 1300 LBS.	1091

APPENDIX D

Dummy, Vehicle and Laboratory Calibration Data

DUMMY, VEHICLE AND LABORATORY INSTRUMENT CALIBRATION

INSTRUMENTS FOR DUMMY NO. 37

	DRIVER		
	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	ACCY6	Endevco	07/28/94
Head Y	ACCH1	Endevco	07/28/94
Head Z	AAMW5	Endevco	07/28/94
Chest X	ACCY1	Endevco	07/28/94
Chest Y	ACCC8	Endevco	07/28/94
Chest Z	ACCT7	Endevco	07/28/94
Right Femur Load Cell	262	Denton	08/01/94
Left Femur Load Cell	953	GSE	09/02/94
Neck Load Cell X	443	Denton	07/14/94
Neck Load Cell Y	443	Denton	07/14/94
Neck Load Cell Z	443	Denton	07/14/94
Neck Moment X	443	Denton	07/14/94
Neck Moment Y	443	Denton	07/14/94
Neck Moment Z	443	Denton	07/14/94
Chest Deflection Gauge	37G	Servo	08/03/94
Lap Belt Load Cell	212	Lebow	04/26/94
Torso Belt Load Cell	690	Lebow	05/31/94

DUMMY, VEHICLE AND LABORATORY INSTRUMENT CALIBRATION

INSTRUMENTS FOR DUMMY NO. 37

	DRIVER		
	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Upper Right Tibia Moment X	436	Denton	10/08/94
Upper Right Tibia Moment Y	436	Denton	10/08/94
Lower Right Tibia Moment Y	424	Denton	10/07/94
Lower Right Tibia Force X	424	Denton	10/07/94
Lower Right Tibia Force Z	424	Denton	10/07/94
Upper Left Tibia Moment X	438	Denton	10/08/94
Upper Left Tibia Moment Y	438	Denton	10/08/94
Lower Left Tibia Moment Y	426	Denton	10/10/94
Lower Left Tibia Force X	426	Denton	10/10/94
Lower Left Tibia Force Z	426	Denton	10/10/94

DUMMY, VEHICLE AND LABORATORY INSTRUMENT CALIBRATION

INSTRUMENTS FOR DUMMY NO. 36

	PASSENGER		
	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	AGWA4	Endevco	10/10/94
Head Y	ACC70	Endevco	07/28/94
Head Z	ACCW9	Endevco	07/28/94
Chest X	ACC78	Endevco	07/12/94
Chest Y	ACCE6	Endevco	07/12/94
Chest Z	ACCY3	Endevco	07/12/94
Right Femur Load Cell	259	Denton	08/01/94
Left Femur Load Cell	260	Denton	08/01/94
Neck Load Cell X	442	Denton	07/14/94
Neck Load Cell Y	442	Denton	07/14/94
Neck Load Cell Z	442	Denton	07/14/94
Neck Moment X	442	Denton	07/14/94
Neck Moment Y	442	Denton	07/14/94
Neck Moment Z	442	Denton	07/14/94
Chest Deflection Gauge	36G	Servo	08/03/94
Lap Belt Load Cell	690	Lebow	04/26/94
Torso Belt Load Cell	691	Lebow	04/27/94

DUMMY, VEHICLE AND LABORATORY INSTRUMENT CALIBRATION

VEHICLE ACCELEROMETERS		
	SERIAL NO.	CALIBRATION DATE
Left Rear Seat Crossmember X	MGA087	06/14/94
Right Rear Seat Crossmember X	MGA098	06/05/94
Top of Engine Block X	MGA021	05/16/94
Bottom of Engine X	MGA157	05/16/94
Instrument Panel X	MGA155	06/30/94
Redundant Left Rear Seat Crossmember X	MGA084	07/28/94
Redundant Right Rear Seat Crossmember X	MGA133	05/15/94

LABORATORY INSTRUMENTS		
	SERIAL NO.	CALIBRATION DATE
Neck Bending Pendulum Accelerometer	AGH90	09/01/94
Neck Bending Rotary Potentiometer	019	08/29/94
Neck Bending Rotary Potentiometer	018	08/29/94
Femur/Chest/Thorax Probe Accelerometer	403069	10/24/94
Abdomen Compression Force Gauge	N/A	N/A